

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 M37735M4LXXXHP

SINGLE-CHIP 16-BIT CMOS MICROCOMPUTER

## DESCRIPTION

The M37735M4LXXXHP is a single-chip microcomputer using the 7700 Family core. This single-chip microcomputer has a CPU and a bus interface unit. The CPU is a 16-bit parallel processor that can be an 8-bit parallel processor, and the bus interface unit enhances the memory access efficiency to execute instructions fast. This microcomputer also includes a 32 kHz oscillation circuit, in addition to the ROM, RAM, multiple-function timers, serial I/O, A-D converter, and so on.

Its strong points are the low power dissipation, the low supply voltage and the small package.

## FEATURES

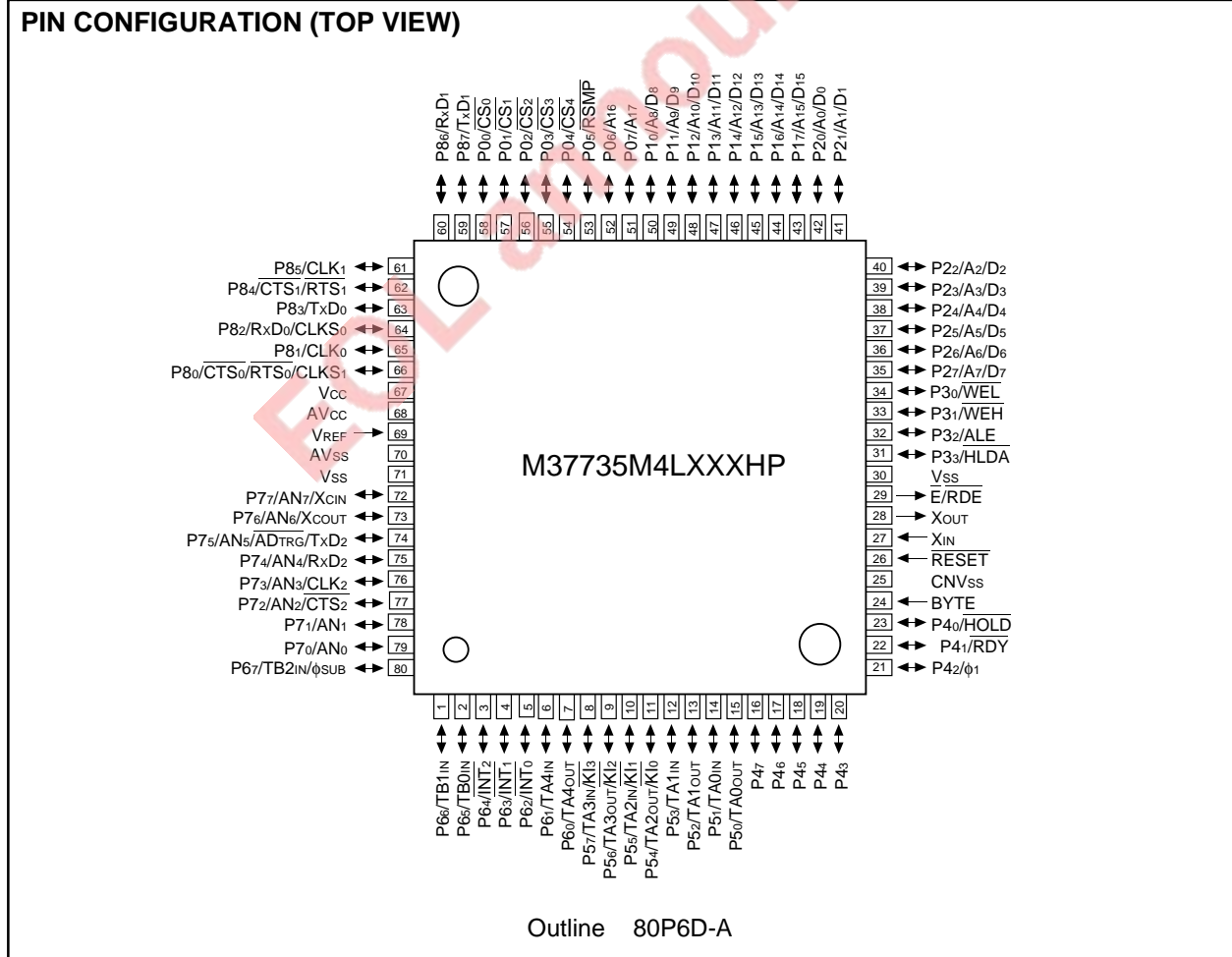
- Number of basic instructions ..... 103
- Memory size ROM ..... 32 Kbytes  
 RAM ..... 2048 bytes
- Instruction execution time  
 The fastest instruction at 12 MHz frequency ..... 333 ns
- Single power supply ..... 2.7–5.5 V
- Low power dissipation (At 3 V supply voltage, 12 MHz frequency)  
 ..... 9 mW (Typ.)

- Interrupts ..... 19 types, 7 levels
- Multiple-function 16-bit timer ..... 5 + 3
- Serial I/O (UART or clock synchronous) ..... 3
- 10-bit A-D converter ..... 8-channel inputs
- 12-bit watchdog timer
- Programmable input/output  
 (ports P0, P1, P2, P3, P4, P5, P6, P7, P8) ..... 68
- Clock generating circuit ..... 2 circuits built-in
- Small package ..... 80-pin plastic molded fine-pitch QFP  
 (80P6D-A; 0.5 mm lead pitch)

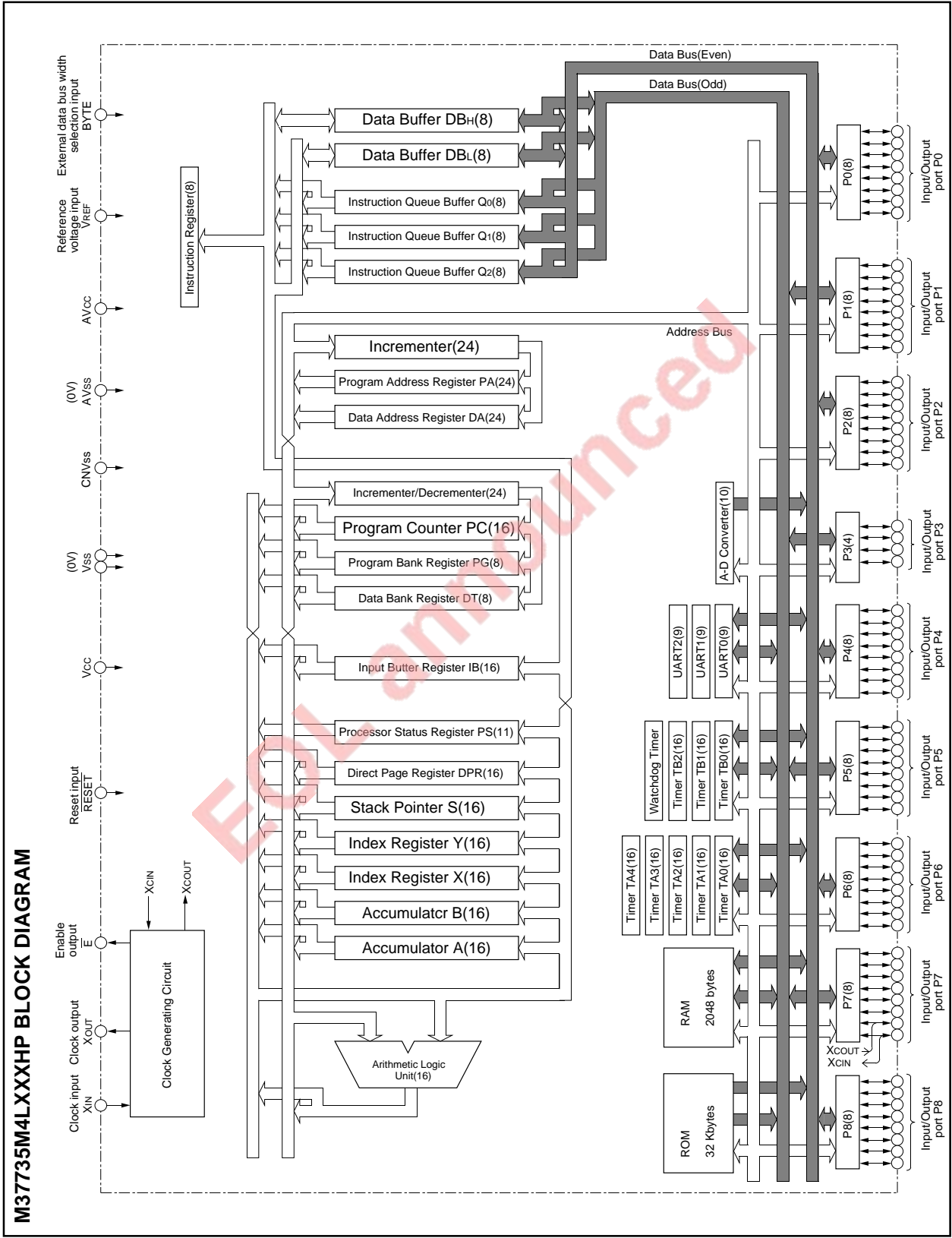
## APPLICATION

Control devices for general commercial equipment such as office automation, office equipment, personal information equipment, and so on.

Control devices for general industrial equipment such as communication equipment, and so on.



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**mitsubishi MICROCOMPUTERS**  
**M37735M4LXXXHP**

SINGLE-CHIP 16-BIT CMOS MICROCOMPUTER

**FUNCTIONS OF M37735M4LXXXHP**

Parameter		Functions
Number of basic instructions		103
Instruction execution time		333 ns (the fastest instruction at external clock 12 MHz frequency)
Memory size	ROM	32 Kbytes
	RAM	2048 bytes
Input/Output ports	P0 – P2, P4 – P8	8-bit X 8
	P3	4-bit X 1
Multi-function timers	TA0, TA1, TA2, TA3, TA4	16-bit X 5
	TB0, TB1, TB2	16-bit X 3
Serial I/O		(UART or clock synchronous serial I/O) X 3
A-D converter		10-bit X 1 (8 channels)
Watchdog timer		12-bit X 1
Interrupts		3 external types, 16 internal types Each interrupt can be set to the priority level (0 – 7.)
Clock generating circuit		2 circuits built-in (externally connected to a ceramic resonator or a quartz-crystal oscillator)
Supply voltage		2.7 – 5.5 V
Power dissipation		9 mW (at 3 V supply voltage, external clock 12 MHz frequency) 22.5 mW (at 5 V supply voltage, external clock 12 MHz frequency)
Input/Output characteristic	Input/Output voltage	5 V
	Output current	5 mA
Memory expansion		Maximum 1 Mbytes
Operating temperature range		–40 to 85 °C
Device structure		CMOS high-performance silicon gate process
Package		80-pin plastic molded fine-pitch QFP (80P6D-A;0.5 mm lead pitch)

EOL announcement

**PIN DESCRIPTION**

Pin	Name	Input/Output	Functions
Vcc, Vss	Power source		Apply 2.7 – 5.5 V to Vcc and 0 V to Vss.
CNVss	CNVss input	Input	This pin controls the processor mode. Connect to Vss for the single-chip mode and the memory expansion mode, and to Vcc for the microprocessor mode.
RESET	Reset input	Input	When "L" level is applied to this pin, the microcomputer enters the reset state.
XIN	Clock input	Input	These are pins of main-clock generating circuit. Connect a ceramic resonator or a quartz-crystal oscillator between XIN and XOUT. 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	
E	Enable output	Output	In the single-chip mode, this pin functions as the enable signal output pin which indicates the access status in the internal bus. In the memory expansion mode or the microprocessor mode, this pin functions as the $\overline{RDE}$ signal output pin.
BYTE	External data bus width selection input	Input	In the memory expansion mode or the microprocessor mode, this pin determines whether the external data bus has an 8-bit width or a 16-bit width. The data bus has a 16-bit width when "L" signal is input and an 8-bit width when "H" signal is input.
AVcc, AVss	Analog power source input		Power source input pin for the A-D converter. Externally connect AVcc to Vcc and AVss to Vss.
VREF	Reference voltage input	Input	This is reference voltage input pin for the A-D converter.
P00 – P07	I/O port P0	I/O	In the single-chip mode, port P0 becomes an 8-bit I/O port. An I/O direction register is available so that each pin can be programmed for input or output. These ports are in the input mode when reset. In the memory expansion mode or the microprocessor mode, these pins output $\overline{CS}_0 - \overline{CS}_4$ , RSMP signals, and address (A16, A17).
P10 – P17	I/O port P1	I/O	In the single-chip mode, these pins have the same functions as port P0. When the BYTE pin is set to "L" in the memory expansion mode or the microprocessor mode and external data bus has a 16-bit width, high-order data (D8 – D15) is input/output or an address (A8 – A15) is output. When the BYTE pin is "H" and an external data bus has an 8-bit width, only address (A8 – A15) is output.
P20 – P27	I/O port P2	I/O	In the single-chip mode, these pins have the same functions as port P0. In the memory expansion mode or the microprocessor mode, low-order data (D0 – D7) is input/output or an address (A0 – A7) is output.
P30 – P33	I/O port P3	I/O	In the single-chip mode, these pins have the same function as port P0. In the memory expansion mode or the microprocessor mode, WEL, WEH, ALE, and HLDA signals are output.
P40 – P47	I/O port P4	I/O	In the single-chip mode, these pins have the same functions as port P0. In the memory expansion mode or the microprocessor mode, P40, P41, and P42 become HOLD and RDY input pins, and clock $\phi_1$ output pin, respectively. Functions of the other pins are the same as in the single-chip mode. However, in the memory expansion mode, P42 also functions as an I/O port.
P50 – P57	I/O port P5	I/O	In addition to having the same functions as port P0 in the single-chip mode, these pins also function as I/O pins for timers A0 to A3 and input pins for key input interrupt input ( $\overline{KI}_0 - \overline{KI}_3$ ).
P60 – P67	I/O port P6	I/O	In addition to having the same functions as port P0 in the single-chip mode, these pins also function as I/O pins for timer A4, input pins for external interrupt input ( $\overline{INT}_0 - \overline{INT}_2$ ) and input pins for timers B0 to B2. P67 also functions as sub-clock $\phi_{SUB}$ output pin.
P70 – P77	I/O port P7	I/O	In addition to having the same functions as port P0 in the single-chip mode, these pins function as input pins for A-D converter. P72 to P75 also function as I/O pins for UART2. Additionally, P76 and P77 have the function as the output pin (XCOUT) and the input pin (XCIN) of the sub-clock (32 kHz) oscillation circuit, respectively. When P76 and P77 are used as the XCOUT and XCIN pins, connect a resonator or an oscillator between the both.
P80 – P87	I/O port P8	I/O	In addition to having the same functions as port P0 in the single-chip mode, these pins also function as I/O pins for UART 0 and UART 1.

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**BASIC FUNCTION BLOCKS**

The M37735M4LXXXHP has the same functions as the M37735MHBXXXFP except for the memory allocation, the reset circuit, the ROM area modification function, and the package. Refer to the section on the M37735MHBXXXFP.

**MEMORY**

The memory map is shown in Figure 1. The address space has a capacity of 16 Mbytes and is allocated to addresses from 0<sub>16</sub> to FFFFFFF<sub>16</sub>. The address space is divided by 64-Kbyte unit called bank. The banks are numbered from 0<sub>16</sub> to FF<sub>16</sub>. However, banks 10<sub>16</sub> – FF<sub>16</sub> of the 7735 group cannot be accessed. Built-in ROM, RAM and control registers for internal peripheral devices are assigned to bank 0<sub>16</sub>. The 32-Kbyte area from addresses 8000<sub>16</sub> to FFFF<sub>16</sub> is the built-in ROM. Addresses FFD6<sub>16</sub> to FFFF<sub>16</sub> are the RESET and interrupt vector addresses and contain the interrupt vectors. Refer to the section on interrupts for details. The 2048-byte area allocated to addresses from 80<sub>16</sub> to 87F<sub>16</sub> is the built-in RAM. In addition to storing data, the RAM is used as stack

during a subroutine call or interrupts. Peripheral devices such as I/O ports, A-D converter, serial I/O, timer, and interrupt control registers are allocated to addresses from 0<sub>16</sub> to 7F<sub>16</sub>. Additionally, the internal ROM area can be modified by software. Refer to the section on ROM area modification function for details. A 256-byte direct page area can be allocated anywhere in bank 0<sub>16</sub> by using the direct page register (DPR). In the direct page addressing mode, the memory in the direct page area can be accessed with two words. Hence program steps can be reduced.

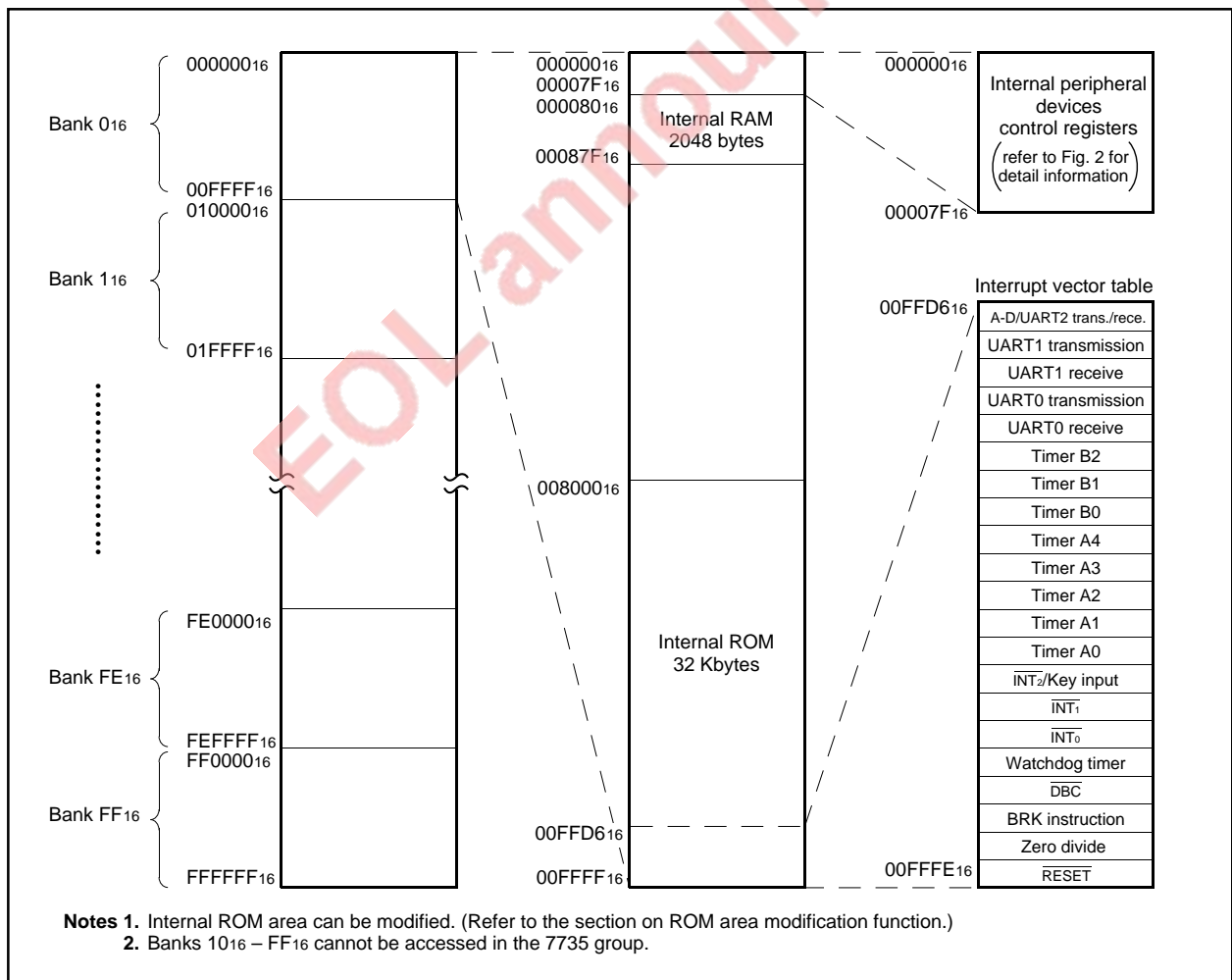


Fig. 1 Memory map

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**M37735M4LXXXHP**

**SINGLE-CHIP 16-BIT CMOS MICROCOMPUTER**

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

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

Fig. 2 Location of internal peripheral devices and interrupt control registers

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### RESET CIRCUIT

The microcomputer is released from the reset state when the  $\overline{\text{RESET}}$  pin is returned to "H" level after holding it at "L" level with the power source voltage at 2.7 – 5.5 V. Program execution starts at the address formed by setting address  $A_{23} - A_{16}$  to  $00_{16}$ ,  $A_{15} - A_8$  to the contents of address  $\text{FFFF}_{16}$ , and  $A_7 - A_0$  to the contents of address  $\text{FFFE}_{16}$ . Figure 3 shows an example of a reset circuit. When the stabilized clock is input from the external to the main-clock oscillation circuit, the reset input voltage must be 0.55 V or less when the power source voltage reaches 2.7 V. When a resonator/oscillator is connected to the main-clock oscillation circuit, change the reset input voltage from "L" to "H" after the main-clock oscillation is fully stabilized. The status of the internal registers during reset is the same as the M37735MHBXXXFP's.

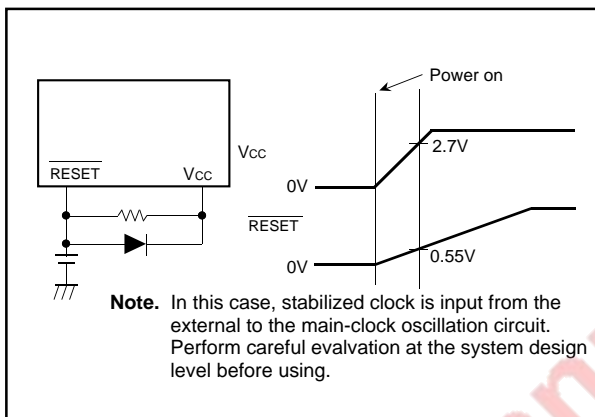


Fig. 3 Example of a reset circuit



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**ROM AREA MODIFICATION FUNCTION**

The internal ROM size and its address area of the M37735M4LXXXHP can be modified by the memory allocation control register's bit 0 shown in Figure 4.

Figure 6 shows the memory allocation in which the internal ROM size and its address area are modified.

Make sure to write data in the memory allocation control register as the flow shown in Figure 5.

This ROM area modification function is valid in memory expansion mode and single-chip mode.

Table 1 shows the relationship between memory allocation selection

bits and address corresponding to chip-select signals  $\overline{CS}_0$  and  $\overline{CS}_1$ . When ordering a mask ROM, Mitsubishi Electric corp. produces the mask ROM using the data within 32 Kbytes (addresses 008000<sub>16</sub> – 00FFFF<sub>16</sub>). It is regardless of the selected ROM size (refer to MASK ROM ORDER CONFIRMATION FORM.) Therefore, program "FF<sub>16</sub>" to the addresses out of the selected ROM area in the EPROM which you tender when ordering a mask ROM. Address 00FFFF<sub>16</sub> of this microcomputer corresponds to the lowest address of the EPROM which you tender.

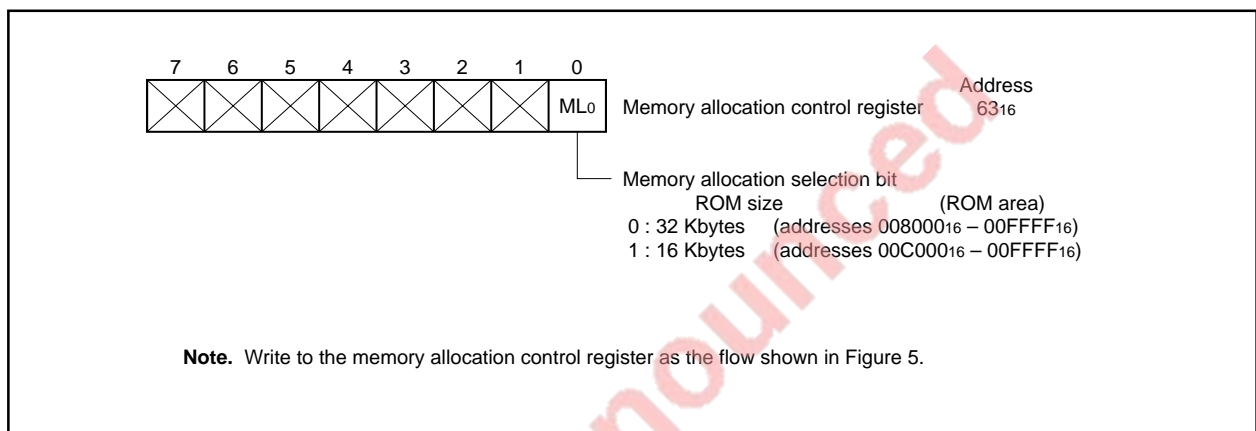


Fig. 4 Bit configuration of memory allocation control register

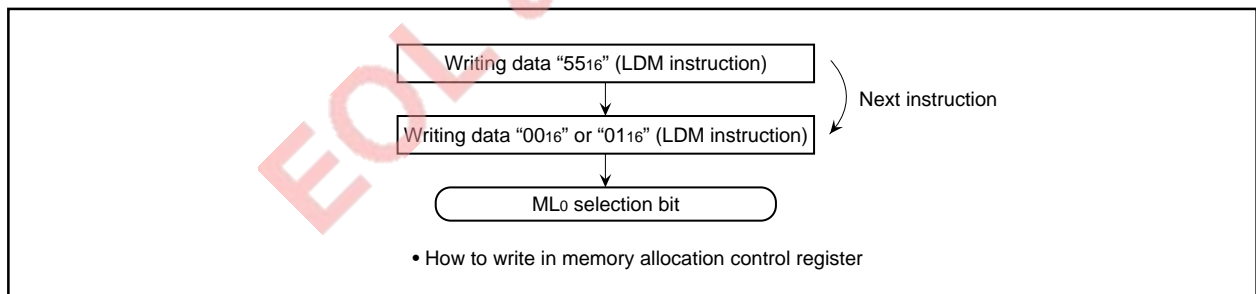


Fig. 5 How to write data in memory allocation control register

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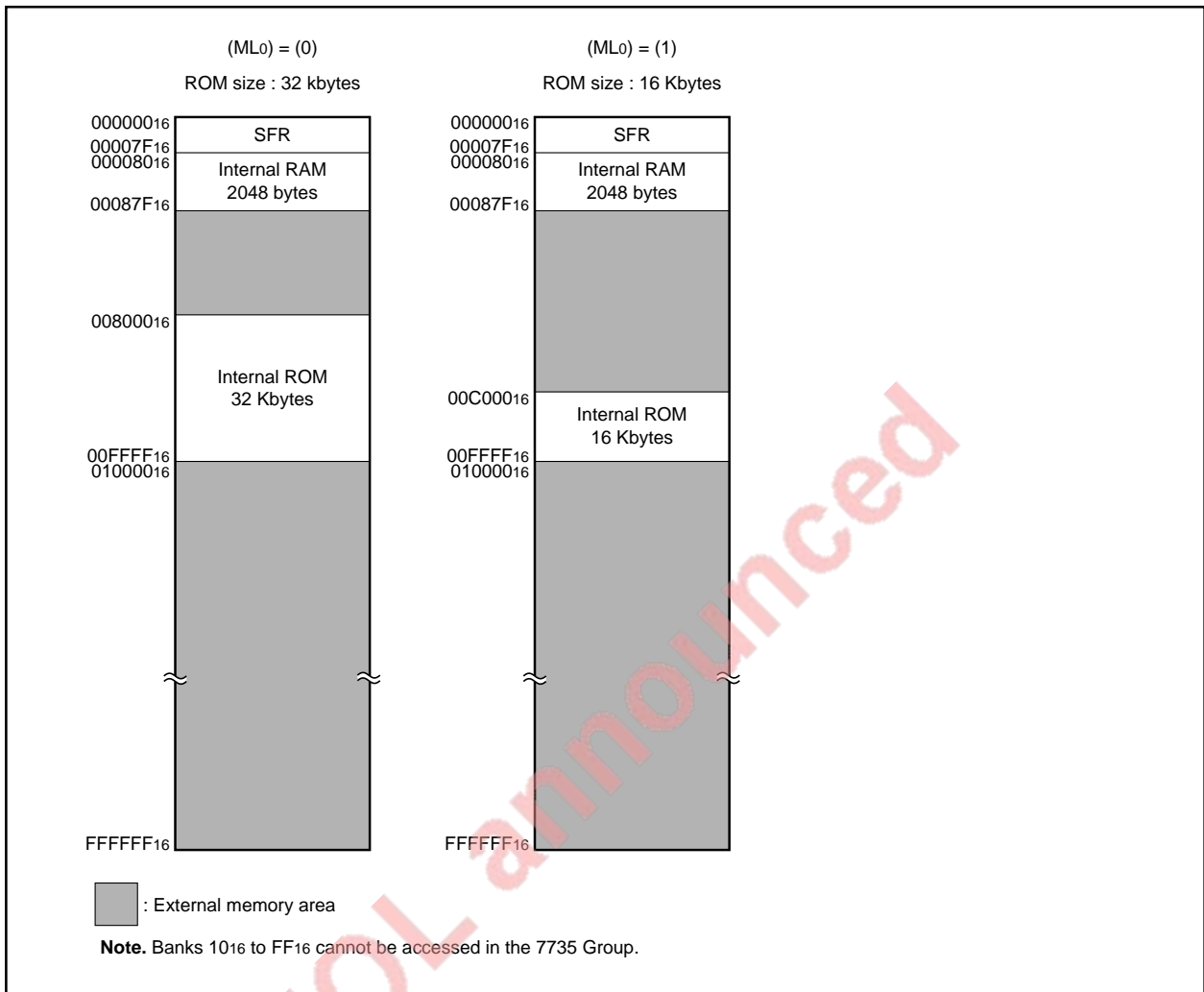


Fig. 6 Memory allocation (modification of internal ROM area by memory allocation selection bit)

Table 1. Relationship between memory allocation selection bits and addresses corresponding to chip-select signals  $\overline{CS}_0$  and  $\overline{CS}_1$

Memory allocation select bit ML <sub>0</sub>	Internal ROM area	Access address	
		$\overline{CS}_0$	$\overline{CS}_1$
0	008000 <sub>16</sub> – 00FFFF <sub>16</sub>	000880 <sub>16</sub> – 007FFF <sub>16</sub>	010000 <sub>16</sub> – 03FFFF <sub>16</sub>
1	00C000 <sub>16</sub> – 00FFFF <sub>16</sub>	000880 <sub>16</sub> – 007FFF <sub>16</sub>	008000 <sub>16</sub> – 00BFFF <sub>16</sub> 010000 <sub>16</sub> – 03FFFF <sub>16</sub>

**ADDRESSING MODES**

The M37735M4LXXXHP has 28 powerful addressing modes. Refer to the MITSUBISHI SEMICONDUCTORS DATA BOOK SINGLE-CHIP 16-BIT MICROCOMPUTERS for the details of each addressing mode.

**MACHINE INSTRUCTION LIST**

The M37735M4LXXXHP has 103 machine instructions. Refer to the

MITSUBISHI SEMICONDUCTORS DATA BOOK SINGLE-CHIP 16-BIT MICROCOMPUTERS for details.

**DATA REQUIRED FOR MASK ROM ORDERING**

Please send the following data for mask orders.

- (1) M37735M4LXXXHP mask ROM order confirmation form
- (2) 80P6D mark specification form
- (3) ROM data (EPROM 3 sets)

**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Conditions	Ratings	Unit
V <sub>cc</sub>	Power source voltage		-0.3 to +7	V
AV <sub>cc</sub>	Analog power source voltage		-0.3 to +7	V
V <sub>I</sub>	Input voltage $\overline{\text{RESET}}$ , CNV <sub>ss</sub> , BYTE		-0.3 to +12	V
V <sub>I</sub>	Input voltage P00 – P07, P10 – P17, P20 – P27, P30 – P33, P40 – P47, P50 – P57, P60 – P67, P70 – P77, P80 – P87, V <sub>REF</sub> , X <sub>IN</sub>		-0.3 to V <sub>cc</sub> + 0.3	V
V <sub>O</sub>	Output voltage P00 – P07, P10 – P17, P20 – P27, P30 – P33, P40 – P47, P50 – P57, P60 – P67, P70 – P77, P80 – P87, X <sub>OUT</sub> , $\overline{\text{E}}$		-0.3 to V <sub>cc</sub> + 0.3	V
P <sub>d</sub>	Power dissipation	T <sub>a</sub> = 25 °C	200	mW
T <sub>opr</sub>	Operating temperature		-40 to +85	°C
T <sub>stg</sub>	Storage temperature		-65 to +150	°C

**RECOMMENDED OPERATING CONDITIONS** (V<sub>cc</sub> = 2.7 – 5.5 V, T<sub>a</sub> = -40 to +85 °C, unless otherwise noted)

Symbol	Parameter	Limits			Unit
		Min.	Typ.	Max.	
V <sub>cc</sub>	Power source voltage	f(X <sub>IN</sub> ) : Operating 2.7		5.5	V
		f(X <sub>IN</sub> ) : Stopped, f(X <sub>CIN</sub> ) = 32.768 kHz 2.7		5.5	
AV <sub>cc</sub>	Analog power source voltage		V <sub>cc</sub>		V
V <sub>ss</sub>	Power source voltage		0		V
AV <sub>ss</sub>	Analog power source voltage		0		V
V <sub>IH</sub>	High-level input voltage P00 – P07, P30 – P33, P40 – P47, P50 – P57, P60 – P67, P70 – P77, P80 – P87, X <sub>IN</sub> , $\overline{\text{RESET}}$ , CNV <sub>ss</sub> , BYTE, X <sub>CIN</sub> (Note 3)	0.8 V <sub>cc</sub>		V <sub>cc</sub>	V
V <sub>IH</sub>	High-level input voltage P10 – P17, P20 – P27 (in single-chip mode)	0.8 V <sub>cc</sub>		V <sub>cc</sub>	V
V <sub>IH</sub>	High-level input voltage P10 – P17, P20 – P27 (in memory expansion mode and microprocessor mode)	0.5 V <sub>cc</sub>		V <sub>cc</sub>	V
V <sub>IL</sub>	Low-level input voltage P00 – P07, P30 – P33, P40 – P47, P50 – P57, P60 – P67, P70 – P77, P80 – P87, X <sub>IN</sub> , $\overline{\text{RESET}}$ , CNV <sub>ss</sub> , BYTE, X <sub>CIN</sub> (Note 3)	0		0.2V <sub>cc</sub>	V
V <sub>IL</sub>	Low-level input voltage P10 – P17, P20 – P27 (in single-chip mode)	0		0.2V <sub>cc</sub>	V
V <sub>IL</sub>	Low-level input voltage P10 – P17, P20 – P27 (in memory expansion mode and microprocessor mode)	0		0.16V <sub>cc</sub>	V
I <sub>OH(peak)</sub>	High-level peak output current P00 – P07, P10 – P17, P20 – P27, P30 – P33, P40 – P47, P50 – P57, P60 – P67, P70 – P77, P80 – P87			-10	mA
I <sub>OH(avg)</sub>	High-level average output current P00 – P07, P10 – P17, P20 – P27, P30 – P33, P40 – P47, P50 – P57, P60 – P67, P70 – P77, P80 – P87			-5	mA
I <sub>OL(peak)</sub>	Low-level peak output current P00 – P07, P10 – P17, P20 – P27, P30 – P33, P40 – P43, P54 – P57, P60 – P67, P70 – P77, P80 – P87			10	mA
I <sub>OL(peak)</sub>	Low-level peak output current P44 – P47, P50 – P53			16	mA
I <sub>OL(avg)</sub>	Low-level average output current P00 – P07, P10 – P17, P20 – P27, P30 – P33, P40 – P43, P54 – P57, P60 – P67, P70 – P77, P80 – P87			5	mA
I <sub>OL(avg)</sub>	Low-level average output current P44 – P47, P50 – P53			12	mA
f(X <sub>IN</sub> )	Main-clock oscillation frequency (Note 4)			12	MHz
f(X <sub>CIN</sub> )	Sub-clock oscillation frequency		32.768	50	kHz

- Notes**
1. Average output current is the average value of a 100 ms interval.
  2. The sum of I<sub>OL(peak)</sub> for ports P0, P1, P2, P3, and P8 must be 80 mA or less, the sum of I<sub>OH(peak)</sub> for ports P0, P1, P2, P3, and P8 must be 80 mA or less, the sum of I<sub>OL(peak)</sub> for ports P4, P5, P6, and P7 must be 100 mA or less, and the sum of I<sub>OH(peak)</sub> for ports P4, P5, P6, and P7 must be 80 mA or less.
  3. Limits V<sub>IH</sub> and V<sub>IL</sub> for X<sub>CIN</sub> are applied when the sub clock external input selection bit = "1".
  4. The maximum value of f(X<sub>IN</sub>) = 6 MHz when the main clock division selection bit = "1".

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**SINGLE-CHIP 16-BIT CMOS MICROCOMPUTER**

**ELECTRICAL CHARACTERISTICS** ( $V_{CC} = 5\text{ V}$ ,  $V_{SS} = 0\text{ V}$ ,  $T_a = -40$  to  $+85\text{ }^\circ\text{C}$ ,  $f(X_{IN}) = 12\text{ MHz}$ , unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit	
			Min.	Typ.	Max.		
V <sub>OH</sub>	High-level output voltage P00 – P07, P10 – P17, P20 – P27, P33, P40 – P47, P50 – P57, P60 – P67, P70 – P77, P80 – P87	V <sub>CC</sub> = 5 V, I <sub>OH</sub> = –10 mA	3			V	
		V <sub>CC</sub> = 3 V, I <sub>OH</sub> = –1 mA	2.5				
V <sub>OH</sub>	High-level output voltage P00 – P07, P10 – P17, P20 – P27, P33	V <sub>CC</sub> = 5 V, I <sub>OH</sub> = –400 $\mu$ A	4.7			V	
V <sub>OH</sub>	High-level output voltage P30 – P32	V <sub>CC</sub> = 5 V, I <sub>OH</sub> = –10 mA	3.1			V	
		V <sub>CC</sub> = 5 V, I <sub>OH</sub> = –400 $\mu$ A	4.8				
		V <sub>CC</sub> = 3 V, I <sub>OH</sub> = –1 mA	2.6				
V <sub>OH</sub>	High-level output voltage $\bar{E}$	V <sub>CC</sub> = 5 V, I <sub>OH</sub> = –10 mA	3.4			V	
		V <sub>CC</sub> = 5 V, I <sub>OH</sub> = –400 $\mu$ A	4.8				
		V <sub>CC</sub> = 3 V, I <sub>OH</sub> = –1 mA	2.6				
V <sub>OL</sub>	Low-level output voltage P00 – P07, P10 – P17, P20 – P27, P33, P40 – P43, P54 – P57, P60 – P67, P70 – P77, P80 – P87	V <sub>CC</sub> = 5 V, I <sub>OL</sub> = 10 mA			2	V	
		V <sub>CC</sub> = 3 V, I <sub>OL</sub> = 1 mA			0.5		
V <sub>OL</sub>	Low-level output voltage P44 – P47, P50 – P53	V <sub>CC</sub> = 5 V, I <sub>OL</sub> = 16 mA			1.8	V	
		V <sub>CC</sub> = 3 V, I <sub>OL</sub> = 10 mA			1.5		
V <sub>OL</sub>	Low-level output voltage P00 – P07, P10 – P17, P20 – P27, P33	V <sub>CC</sub> = 5 V, I <sub>OL</sub> = 2 mA			0.45	V	
V <sub>OL</sub>	Low-level output voltage P30 – P32	V <sub>CC</sub> = 5 V, I <sub>OL</sub> = 10 mA			1.9	V	
		V <sub>CC</sub> = 5 V, I <sub>OL</sub> = 2 mA			0.43		
		V <sub>CC</sub> = 3 V, I <sub>OL</sub> = 1 mA			0.4		
V <sub>OL</sub>	Low-level output voltage $\bar{E}$	V <sub>CC</sub> = 5 V, I <sub>OL</sub> = 10 mA			1.6	V	
		V <sub>CC</sub> = 5 V, I <sub>OL</sub> = 2 mA			0.4		
		V <sub>CC</sub> = 3 V, I <sub>OL</sub> = 1 mA			0.4		
V <sub>T+</sub> – V <sub>T–</sub>	Hysteresis HOLD, RDY, TA0IN – TA4IN, TB0IN – TB2IN, INT0 – INT2, ADTRG, CTS0, CTS1, CTS2, CLK0, CLK1, CLK2, KI0 – KI3	V <sub>CC</sub> = 5 V	0.4		1	V	
		V <sub>CC</sub> = 3 V	0.1		0.7		
V <sub>T+</sub> – V <sub>T–</sub>	Hysteresis RESET	V <sub>CC</sub> = 5 V	0.2		0.5	V	
		V <sub>CC</sub> = 3 V	0.1		0.4		
V <sub>T+</sub> – V <sub>T–</sub>	Hysteresis X <sub>IN</sub>	V <sub>CC</sub> = 5 V	0.1		0.4	V	
		V <sub>CC</sub> = 3 V	0.06		0.26		
V <sub>T+</sub> – V <sub>T–</sub>	Hysteresis X <sub>CIN</sub> (When external clock is input)	V <sub>CC</sub> = 5 V	0.1		0.4	V	
		V <sub>CC</sub> = 3 V	0.06		0.26		
I <sub>IH</sub>	High-level input current P00 – P07, P10 – P17, P20 – P27, P30 – P33, P40 – P47, P50 – P57, P60 – P67, P70 – P77, P80 – P87, X <sub>IN</sub> , RESET, CNV <sub>SS</sub> , BYTE	V <sub>CC</sub> = 5 V, V <sub>I</sub> = 5 V			5	$\mu$ A	
		V <sub>CC</sub> = 3 V, V <sub>I</sub> = 3 V			4		
I <sub>IL</sub>	Low-level input current P00 – P07, P10 – P17, P20 – P27, P30 – P33, P40 – P47, P50 – P53, P60, P61, P65 – P67, P70 – P77, P80 – P87, X <sub>IN</sub> , RESET, CNV <sub>SS</sub> , BYTE	V <sub>CC</sub> = 5 V, V <sub>I</sub> = 0 V			–5	$\mu$ A	
		V <sub>CC</sub> = 3 V, V <sub>I</sub> = 0 V			–4		
I <sub>IL</sub>	Low-level input current P54 – P57, P62 – P64	V <sub>I</sub> = 0 V, without a pull-up transistor	V <sub>CC</sub> = 5 V			–5	$\mu$ A
			V <sub>CC</sub> = 3 V			–4	
		V <sub>I</sub> = 0 V, with a pull-up transistor	V <sub>CC</sub> = 5 V	–0.25	–0.5	–1.0	mA
			V <sub>CC</sub> = 3 V	–0.08	–0.18	–0.35	
V <sub>RAM</sub>	RAM hold voltage	When clock is stopped.	2			V	

**ELECTRICAL CHARACTERISTICS** ( $V_{CC} = 5\text{ V}$ ,  $V_{SS} = 0\text{ V}$ ,  $T_a = -40\text{ to }+85\text{ }^\circ\text{C}$ , unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit		
			Min.	Typ.	Max.			
I <sub>CC</sub>	Power source current	When single-chip mode, output pins are open, and other pins are V <sub>SS</sub> .	V <sub>CC</sub> = 5 V, f(X <sub>IN</sub> ) = 12 MHz (square waveform), f(f <sub>2</sub> ) = 6 MHz, f(X <sub>CIN</sub> ) = 32.768 kHz, in operating (Note 1)		4.5	9	mA	
			V <sub>CC</sub> = 3 V, f(X <sub>IN</sub> ) = 12 MHz (square waveform), f(f <sub>2</sub> ) = 6 MHz, f(X <sub>CIN</sub> ) = 32.768 kHz, in operating (Note 1)		3	6	mA	
			V <sub>CC</sub> = 3 V, f(X <sub>IN</sub> ) = 12 MHz (square waveform), f(f <sub>2</sub> ) = 0.75 MHz, f(X <sub>CIN</sub> ) : Stopped, in operating		0.4	0.8	mA	
			V <sub>CC</sub> = 3 V, f(X <sub>IN</sub> ) = 12 MHz (square waveform), f(X <sub>CIN</sub> ) = 32.768 kHz, when a WIT instruction is executed (Note 2)		6	12	μA	
			V <sub>CC</sub> = 3 V, f(X <sub>IN</sub> ) : Stopped, f(X <sub>CIN</sub> ) = 32.768 kHz, in operating (Note 3)		30	60	μA	
			V <sub>CC</sub> = 3 V, f(X <sub>IN</sub> ) : Stopped, f(X <sub>CIN</sub> ) = 32.768 kHz, when a WIT instruction is executed (Note 4)		3	6	μA	
			T <sub>a</sub> = 25 °C, when clock is stopped				1	μA
			T <sub>a</sub> = 85 °C, when clock is stopped				20	μA

- Notes 1.** This applies when the main clock external input selection bit = "1", the main clock division selection bit = "0", and the signal output stop bit = "1".
- 2.** This applies when the main clock external input selection bit = "1" and the system clock stop bit at wait state = "1".
- 3.** This applies when CPU and the clock timer are operating with the sub clock (32.768 kHz) selected as the system clock.
- 4.** This applies when the X<sub>COUT</sub> drivability selection bit = "0" and the system clock stop bit at wait state = "1".

**A-D CONVERTER CHARACTERISTICS**

( $V_{CC} = AV_{CC} = 5\text{ V}$ ,  $V_{SS} = AV_{SS} = 0\text{ V}$ ,  $T_a = -40\text{ to }+85\text{ }^\circ\text{C}$ ,  $f(X_{IN}) = 12\text{ MHz}$ , unless otherwise noted (Note))

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
—	Resolution	V <sub>REF</sub> = V <sub>CC</sub>			10	Bits
—	Absolute accuracy	V <sub>REF</sub> = V <sub>CC</sub>			± 3	LSB
RLADDER	Ladder resistance	V <sub>REF</sub> = V <sub>CC</sub>	10		25	kΩ
t <sub>CONV</sub>	Conversion time		19.6			μs
V <sub>REF</sub>	Reference voltage		2.7		V <sub>CC</sub>	V
V <sub>IA</sub>	Analog input voltage		0		V <sub>REF</sub>	V

**Note.** This applies when the main clock division selection bit = "0" and f(f<sub>2</sub>) = 6 MHz.

**TIMING REQUIREMENTS** ( $V_{CC} = 2.7 - 5.5 \text{ V}$ ,  $V_{SS} = 0 \text{ V}$ ,  $T_a = -40 \text{ to } +85 \text{ }^\circ\text{C}$ ,  $f(X_{IN}) = 12 \text{ MHz}$ , unless otherwise noted (Note 1))

**Notes 1.** This applies when the main clock division selection bit = "0" and  $f(f_2) = 6 \text{ MHz}$ .

**2.** Input signal's rise/fall time must be 100 ns or less, unless otherwise noted.

**External clock input**

Symbol	Parameter	Limits		Unit
		Min.	Max.	
$t_c$	External clock input cycle time (Note 1)	83		ns
$t_{w(H)}$	External clock input high-level pulse width (Note 2)	33		ns
$t_{w(L)}$	External clock input low-level pulse width (Note 2)	33		ns
$t_r$	External clock rise time		15	ns
$t_f$	External clock fall time		15	ns

**Notes 1.** When the main clock division selection bit = "1", the minimum value of  $t_c = 166 \text{ ns}$ .

**2.** When the main clock division selection bit = "1", values of  $t_{w(H)} / t_c$  and  $t_{w(L)} / t_c$  must be set to values from 0.45 through 0.55.

**Single-chip mode**

Symbol	Parameter	Limits		Unit
		Min.	Max.	
$t_{su}(P0D-E)$	Port P0 input setup time	200		ns
$t_{su}(P1D-E)$	Port P1 input setup time	200		ns
$t_{su}(P2D-E)$	Port P2 input setup time	200		ns
$t_{su}(P3D-E)$	Port P3 input setup time	200		ns
$t_{su}(P4D-E)$	Port P4 input setup time	200		ns
$t_{su}(P5D-E)$	Port P5 input setup time	200		ns
$t_{su}(P6D-E)$	Port P6 input setup time	200		ns
$t_{su}(P7D-E)$	Port P7 input setup time	200		ns
$t_{su}(P8D-E)$	Port P8 input setup time	200		ns
$t_h(E-P0D)$	Port P0 input hold time	0		ns
$t_h(E-P1D)$	Port P1 input hold time	0		ns
$t_h(E-P2D)$	Port P2 input hold time	0		ns
$t_h(E-P3D)$	Port P3 input hold time	0		ns
$t_h(E-P4D)$	Port P4 input hold time	0		ns
$t_h(E-P5D)$	Port P5 input hold time	0		ns
$t_h(E-P6D)$	Port P6 input hold time	0		ns
$t_h(E-P7D)$	Port P7 input hold time	0		ns
$t_h(E-P8D)$	Port P8 input hold time	0		ns

**Memory expansion mode and microprocessor mode**

Symbol	Parameter	Limits		Unit
		Min.	Max.	
$t_{su}(D-RDE)$	Data input setup time	80		ns
$t_{su}(RDY-\phi_1)$	$\overline{RDY}$ input setup time	80		ns
$t_{su}(HOLD-\phi_1)$	HOLD input setup time	80		ns
$t_h(RDE-D)$	Data input hold time	0		ns
$t_h(\phi_1-RDY)$	$\overline{RDY}$ input hold time	0		ns
$t_h(\phi_1-HOLD)$	HOLD input hold time	0		ns

**Timer A input** (Count input in event counter mode)

Symbol	Parameter	Limits		Unit
		Min.	Max.	
t <sub>c</sub> (TA)	TAiIN input cycle time	250		ns
t <sub>w</sub> (TAH)	TAiIN input high-level pulse width	125		ns
t <sub>w</sub> (TAL)	TAiIN input low-level pulse width	125		ns

**Timer A input** (Gating input in timer mode)

Symbol	Parameter	Limits		Unit
		Min.	Max.	
t <sub>c</sub> (TA)	TAiIN input cycle time (Note)	666		ns
t <sub>w</sub> (TAH)	TAiIN input high-level pulse width (Note)	333		ns
t <sub>w</sub> (TAL)	TAiIN input low-level pulse width (Note)	333		ns

**Note.** Limits change depending on f(X<sub>IN</sub>). Refer to "DATA FORMULAS".

**Timer A input** (External trigger input in one-shot pulse mode)

Symbol	Parameter	Limits		Unit
		Min.	Max.	
t <sub>c</sub> (TA)	TAiIN input cycle time (Note)	666		ns
t <sub>w</sub> (TAH)	TAiIN input high-level pulse width	166		ns
t <sub>w</sub> (TAL)	TAiIN input low-level pulse width	166		ns

**Note.** Limits change depending on f(X<sub>IN</sub>). Refer to "DATA FORMULAS".

**Timer A input** (External trigger input in pulse width modulation mode)

Symbol	Parameter	Limits		Unit
		Min.	Max.	
t <sub>w</sub> (TAH)	TAiIN input high-level pulse width	166		ns
t <sub>w</sub> (TAL)	TAiIN input low-level pulse width	166		ns

**Timer A input** (Up-down input in event counter mode)

Symbol	Parameter	Limits		Unit
		Min.	Max.	
t <sub>c</sub> (UP)	TAiOUT input cycle time	3333		ns
t <sub>w</sub> (UPH)	TAiOUT input high-level pulse width	1666		ns
t <sub>w</sub> (UPL)	TAiOUT input low-level pulse width	1666		ns
t <sub>su</sub> (UP-T <sub>IN</sub> )	TAiOUT input setup time	666		ns
t <sub>h</sub> (T <sub>IN</sub> -UP)	TAiOUT input hold time	666		ns

**Timer A input** (Two-phase pulse input in event counter mode)

Symbol	Parameter	Limits		Unit
		Min.	Max.	
t <sub>c</sub> (TA)	TAjIN input cycle time	2000		ns
t <sub>su</sub> (TAjIN-TAjOUT)	TAjIN input setup time	500		ns
t <sub>su</sub> (TAjOUT-TAjIN)	TAjOUT input setup time	500		ns

**Timer B input** (Count input in event counter mode)

Symbol	Parameter	Limits		Unit
		Min.	Max.	
$t_{c(TB)}$	TBiN input cycle time (one edge count)	250		ns
$t_{w(TBH)}$	TBiN input high-level pulse width (one edge count)	125		ns
$t_{w(TBL)}$	TBiN input low-level pulse width (one edge count)	125		ns
$t_{c(TB)}$	TBiN input cycle time (both edges count)	500		ns
$t_{w(TBH)}$	TBiN input high-level pulse width (both edges count)	250		ns
$t_{w(TBL)}$	TBiN input low-level pulse width (both edges count)	250		ns

**Timer B input** (Pulse period measurement mode)

Symbol	Parameter	Limits		Unit
		Min.	Max.	
$t_{c(TB)}$	TBiN input cycle time (Note)	666		ns
$t_{w(TBH)}$	TBiN input high-level pulse width (Note)	333		ns
$t_{w(TBL)}$	TBiN input low-level pulse width (Note)	333		ns

**Note.** Limits change depending on  $f(XIN)$ . Refer to "DATA FORMULAS".

**Timer B input** (Pulse width measurement mode)

Symbol	Parameter	Limits		Unit
		Min.	Max.	
$t_{c(TB)}$	TBiN input cycle time (Note)	666		ns
$t_{w(TBH)}$	TBiN input high-level pulse width (Note)	333		ns
$t_{w(TBL)}$	TBiN input low-level pulse width (Note)	333		ns

**Note.** Limits change depending on  $f(XIN)$ . Refer to "DATA FORMULAS".

**A-D trigger input**

Symbol	Parameter	Limits		Unit
		Min.	Max.	
$t_{c(AD)}$	$\overline{ADTRG}$ input cycle time (minimum allowable trigger)	1333		ns
$t_{w(ADL)}$	$\overline{ADTRG}$ input low-level pulse width	166		ns

**Serial I/O**

Symbol	Parameter	Limits		Unit
		Min.	Max.	
$t_{c(CK)}$	CLKi input cycle time	333		ns
$t_{w(CKH)}$	CLKi input high-level pulse width	166		ns
$t_{w(CKL)}$	CLKi input low-level pulse width	166		ns
$t_{d(C-Q)}$	TxDi output delay time		100	ns
$t_{h(C-Q)}$	TxDi hold time	0		ns
$t_{su(D-C)}$	RxDi input setup time	65		ns
$t_{h(C-D)}$	RxDi input hold time	75		ns

**External interrupt  $\overline{INTi}$  input, key input interrupt  $\overline{KIi}$  input**

Symbol	Parameter	Limits		Unit
		Min.	Max.	
$t_{w(INH)}$	$\overline{INTi}$ input high-level pulse width	250		ns
$t_{w(INL)}$	$\overline{INTi}$ input low-level pulse width	250		ns
$t_{w(KIL)}$	$\overline{KIi}$ input low-level pulse width	250		ns



**DATA FORMULAS**

**Timer A input** (Gating input in timer mode)

Symbol	Parameter	Limits		Unit
		Min.	Max.	
$t_{c(TA)}$	TAiIn input cycle time	$\frac{8 \times 10^9}{2 \cdot f(f_2)}$		ns
$t_{w(TAH)}$	TAiIn input high-level pulse width	$\frac{4 \times 10^9}{2 \cdot f(f_2)}$		ns
$t_{w(TAL)}$	TAiIn input low-level pulse width	$\frac{4 \times 10^9}{2 \cdot f(f_2)}$		ns

**Timer A input** (External trigger input in one-shot pulse mode)

Symbol	Parameter	Limits		Unit
		Min.	Max.	
$t_{c(TA)}$	TAiIn input cycle time	$\frac{8 \times 10^9}{2 \cdot f(f_2)}$		ns

**Timer B input** (In pulse period measurement mode or pulse width measurement mode)

Symbol	Parameter	Limits		Unit
		Min.	Max.	
$t_{c(TB)}$	TBiIn input cycle time	$\frac{8 \times 10^9}{2 \cdot f(f_2)}$		ns
$t_{w(TBH)}$	TBiIn input high-level pulse width	$\frac{4 \times 10^9}{2 \cdot f(f_2)}$		ns
$t_{w(TBL)}$	TBiIn input low-level pulse width	$\frac{4 \times 10^9}{2 \cdot f(f_2)}$		ns

**Note.**  $f(f_2)$  represents the clock  $f_2$  frequency.

For the relation to the main clock and sub clock, refer to Table 10 in data sheet "M37735MHBXXXFP".

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

**SWITCHING CHARACTERISTICS**

( $V_{CC} = 2.7 - 5.5$  V,  $V_{SS} = 0$  V,  $T_a = -40$  to  $+85^\circ\text{C}$ ,  $f(X_{IN}) = 12$  MHz, unless otherwise noted (Note))

**Single-chip mode**

Symbol	Parameter	Test conditions	Limits		Unit
			Min.	Max.	
$t_{d(E-P0Q)}$	Port P0 data output delay time	Fig. 7		300	ns
$t_{d(E-P1Q)}$	Port P1 data output delay time			300	ns
$t_{d(E-P2Q)}$	Port P2 data output delay time			300	ns
$t_{d(E-P3Q)}$	Port P3 data output delay time			300	ns
$t_{d(E-P4Q)}$	Port P4 data output delay time			300	ns
$t_{d(E-P5Q)}$	Port P5 data output delay time			300	ns
$t_{d(E-P6Q)}$	Port P6 data output delay time			300	ns
$t_{d(E-P7Q)}$	Port P7 data output delay time			300	ns
$t_{d(E-P8Q)}$	Port P8 data output delay time			300	ns

**Note.** This applies when the main clock division selection bit = "0" and  $f(f_2) = 6$  MHz.

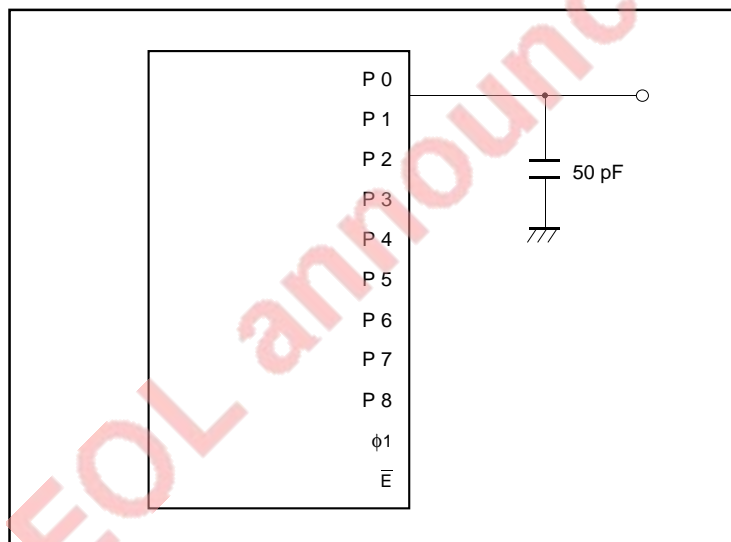


Fig. 7 Measuring circuit for ports P0 – P8 and  $\phi 1$

**Memory expansion mode and microprocessor mode**

(V<sub>CC</sub> = 2.7 – 5.5 V, V<sub>SS</sub> = 0 V, T<sub>a</sub> = –40 to +85 °C, f(X<sub>IN</sub>) = 12 MHz (Note 1), unless otherwise noted)

Symbol	Parameter	(Note 2) Wait mode	Test conditions	Limits		Unit
				Min.	Max.	
t <sub>d</sub> (CS–WE) t <sub>d</sub> (CS–RDE)	Chip-select output delay time	No wait	Fig. 7	20		ns
		Wait 1		182		ns
		Wait 0				ns
t <sub>h</sub> (WE–CS) t <sub>h</sub> (RDE–CS)	Chip-select hold time			4		ns
t <sub>d</sub> (An–WE) t <sub>d</sub> (An–RDE)	Address output delay time	No wait	Fig. 7	20		ns
		Wait 1		182		ns
		Wait 0				ns
t <sub>d</sub> (A–WE) t <sub>d</sub> (A–RDE)	Address output delay time	No wait	Fig. 7	20		ns
		Wait 1		162		ns
		Wait 0				ns
t <sub>h</sub> (WE–An) t <sub>h</sub> (RDE–An)	Address hold time		Fig. 7	40		ns
t <sub>w</sub> (ALE)	ALE pulse width	No wait	Fig. 7	40		ns
		Wait 1		123		ns
		Wait 0				ns
t <sub>su</sub> (A–ALE)	Address output setup time	No wait	Fig. 7	10		ns
		Wait 1		93		ns
		Wait 0				ns
t <sub>h</sub> (ALE–A)	Address hold time	No wait	Fig. 7	9		ns
		Wait 1		40		ns
		Wait 0				ns
t <sub>d</sub> (ALE–WE) t <sub>d</sub> (ALE–RDE)	ALE output delay time	No wait	Fig. 7	4		ns
		Wait 1		40		ns
		Wait 0				ns
t <sub>d</sub> (WE–DQ)	Data output delay time				90	ns
t <sub>h</sub> (WE–DQ)	Data hold time			40		ns
t <sub>w</sub> (WE)	WEL/WEH pulse width	No wait	Fig. 7	131		ns
		Wait 1		298		ns
		Wait 0				ns
t <sub>pxz</sub> (RDE–DZ)	Floating start delay time				10	ns
t <sub>pzx</sub> (RDE–DZ)	Floating release delay time			53		ns
t <sub>w</sub> (RDE)	RDE pulse width	No wait	Fig. 7	128		ns
		Wait 1		295		ns
		Wait 0				ns
t <sub>d</sub> (RSMP–WE) t <sub>d</sub> (RSMP–RDE)	RSMP output delay time			25		ns
t <sub>h</sub> (φ <sub>1</sub> –RSMP)	RSMP hold time			0		ns
t <sub>d</sub> (WE–φ <sub>1</sub> ) t <sub>d</sub> (RDE–φ <sub>1</sub> )	φ <sub>1</sub> output delay time			0	30	ns
t <sub>d</sub> (φ <sub>1</sub> –HLDA)	HLDA output delay time				120	ns

**Notes 1.** This applies when the main clock division selection bit = "0" and f(f<sub>2</sub>) = 6 MHz.

**2.** No wait : Wait bit = "1".

Wait 1 : The external memory area is accessed with wait bit = "0" and wait selection bit = "1".

Wait 0 : The external memory area is accessed with wait bit = "0" and wait selection bit = "0".

**Bus timing data formulas** ( $V_{CC} = 2.7 - 5.5V$ ,  $V_{SS} = 0V$ ,  $T_a = -40$  to  $+85^\circ C$ ,  $f(X_{IN}) = 12$  MHz (Max. Note1), unless otherwise noted)

Symbol	Parameter	Wait mode	Limits		Unit
			Min.	Max.	
td(CS-WE) td(CS-RDE)	Chip-select output delay time	No wait	$\frac{1 \times 10^9}{2 \cdot f(f_2)}$	- 63	ns
		Wait 1	$\frac{3 \times 10^9}{2 \cdot f(f_2)}$	- 68	
th(WE-CS) th(RDE-CS)	Chip-select hold time	Wait 0	$\frac{1 \times 10^9}{2 \cdot f(f_2)}$	- 68	ns
		Wait 0	4		
td(An-WE) td(An-RDE)	Address output delay time	No wait	$\frac{1 \times 10^9}{2 \cdot f(f_2)}$	- 63	ns
		Wait 1	$\frac{3 \times 10^9}{2 \cdot f(f_2)}$	- 68	
td(A-WE) td(A-RDE)	Address output delay time	Wait 0	$\frac{1 \times 10^9}{2 \cdot f(f_2)}$	- 63	ns
		Wait 0	$\frac{3 \times 10^9}{2 \cdot f(f_2)}$	- 88	
th(WE-An) th(RDE-An)	Address hold time	No wait	$\frac{1 \times 10^9}{2 \cdot f(f_2)}$	- 43	ns
		Wait 1	$\frac{1 \times 10^9}{2 \cdot f(f_2)}$	- 43	
tw(ALE)	ALE pulse width	No wait	$\frac{1 \times 10^9}{2 \cdot f(f_2)}$	- 43	ns
		Wait 1	$\frac{2 \times 10^9}{2 \cdot f(f_2)}$	- 43	
tsu(A-ALE)	Address output setup time	Wait 0	$\frac{1 \times 10^9}{2 \cdot f(f_2)}$	- 73	ns
		Wait 0	$\frac{2 \times 10^9}{2 \cdot f(f_2)}$	- 73	
th(ALE-A)	Address hold time	No wait	9		ns
		Wait 1	$\frac{1 \times 10^9}{2 \cdot f(f_2)}$	- 43	
td(ALE-WE) td(ALE-RDE)	ALE output delay time	Wait 0	4		ns
		Wait 0	$\frac{1 \times 10^9}{2 \cdot f(f_2)}$	- 43	
td(WE-DQ)	Data output delay time			90	ns
th(WE-DQ)	Data hold time		$\frac{1 \times 10^9}{2 \cdot f(f_2)}$	- 43	ns
tw(WE)	WEL/WEH pulse width	No wait	$\frac{2 \times 10^9}{2 \cdot f(f_2)}$	- 35	ns
		Wait 1	$\frac{4 \times 10^9}{2 \cdot f(f_2)}$	- 35	
tpxz(RDE-DZ)	Floating start delay time	Wait 0		10	ns
tpzx(RDE-DZ)	Floating release delay time		$\frac{1 \times 10^9}{2 \cdot f(f_2)}$	- 30	ns
tw(RDE)	RDE pulse width	No wait	$\frac{2 \times 10^9}{2 \cdot f(f_2)}$	- 38	ns
		Wait 1	$\frac{4 \times 10^9}{2 \cdot f(f_2)}$	- 38	
td(RSMP-WE) td(RSMP-RDE)	RSMP output delay time	Wait 0	$\frac{1 \times 10^9}{2 \cdot f(f_2)}$	- 58	ns
th( $\phi_1$ -RSMP)	RSMP hold time		0		ns
td(WE- $\phi_1$ ) td(RDE- $\phi_1$ )	$\phi_1$ output delay time		0	30	ns

**Notes 1.** This applies when the main clock division selection bit = "0".

**2.**  $f(f_2)$  represents the clock  $f_2$  frequency.

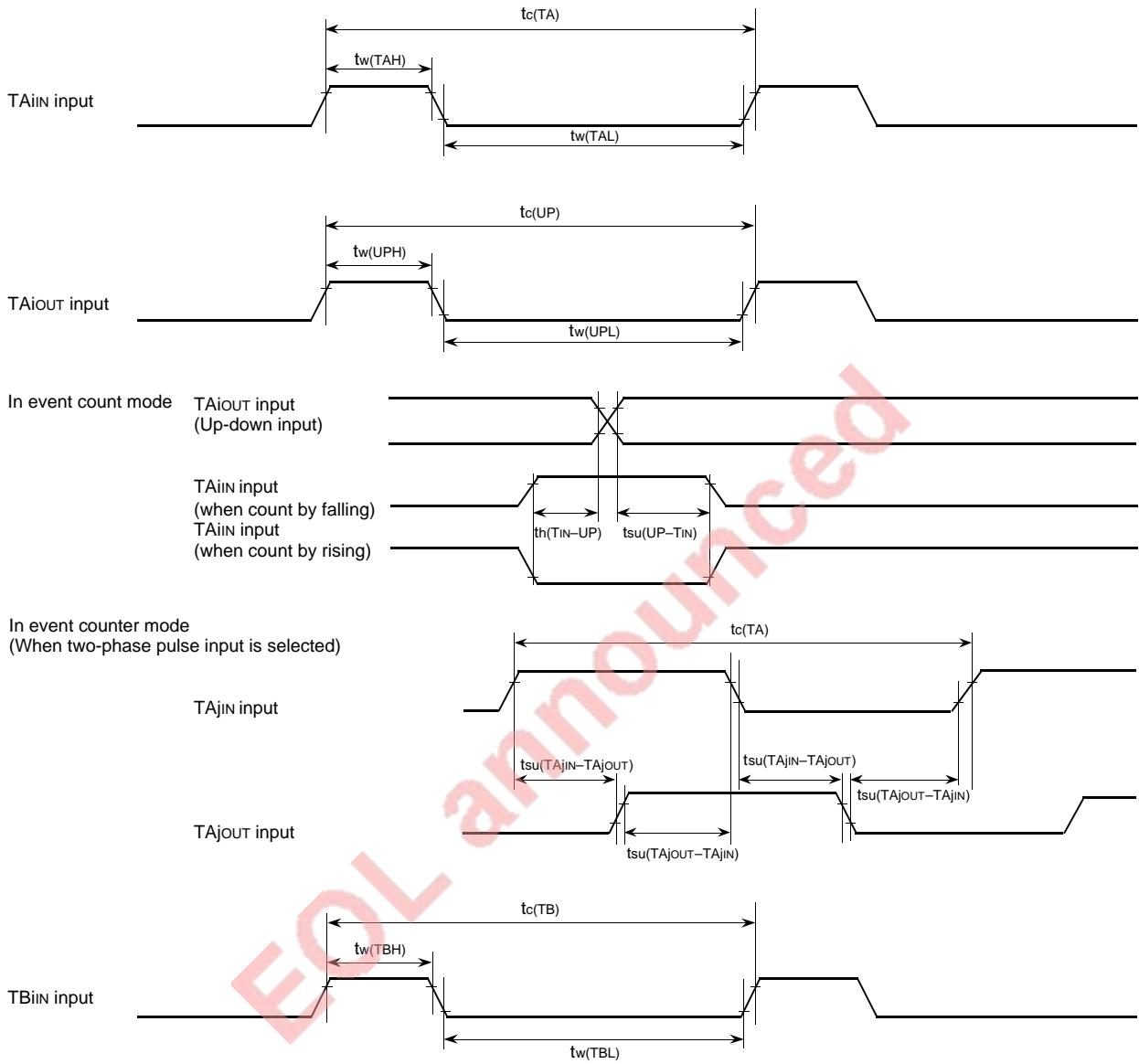
For the relation to the main clock and sub clock, refer to Table 10 in data sheet "M37735MHBXXXFP".

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

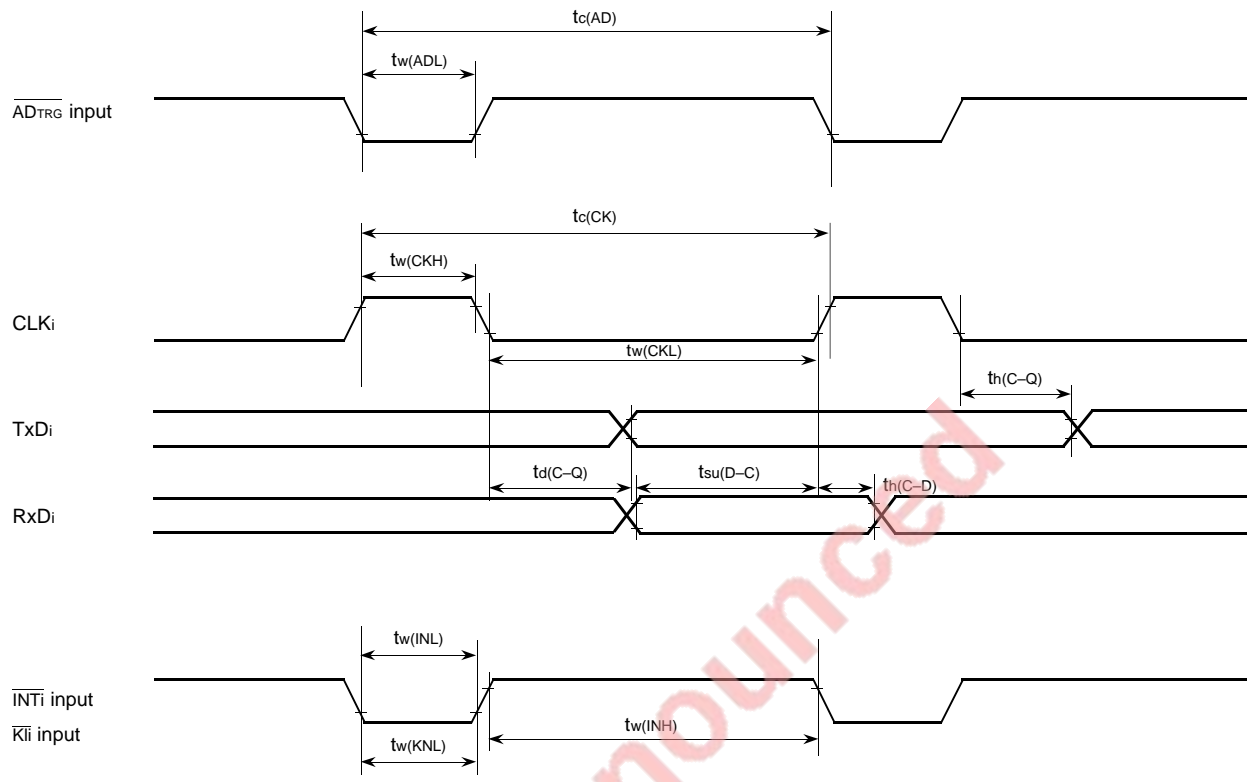
**TIMING DIAGRAM**



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



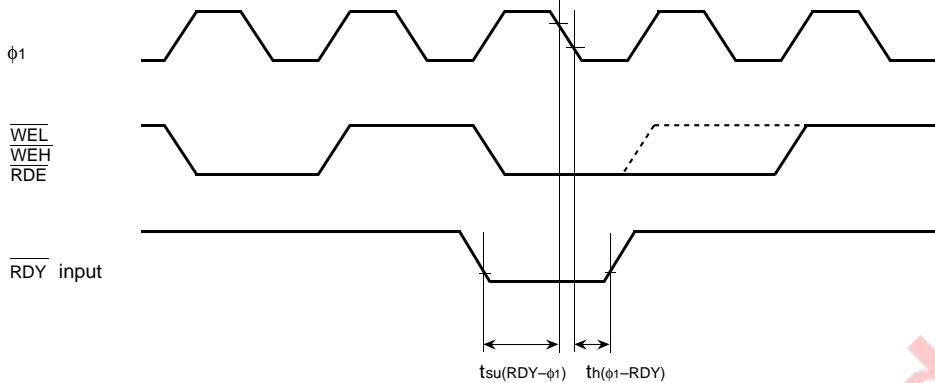
**PRELIMINARY**  
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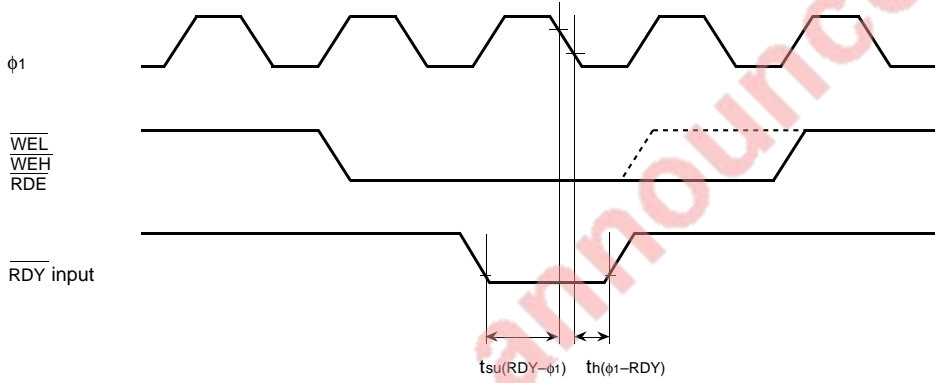
EOL announced

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

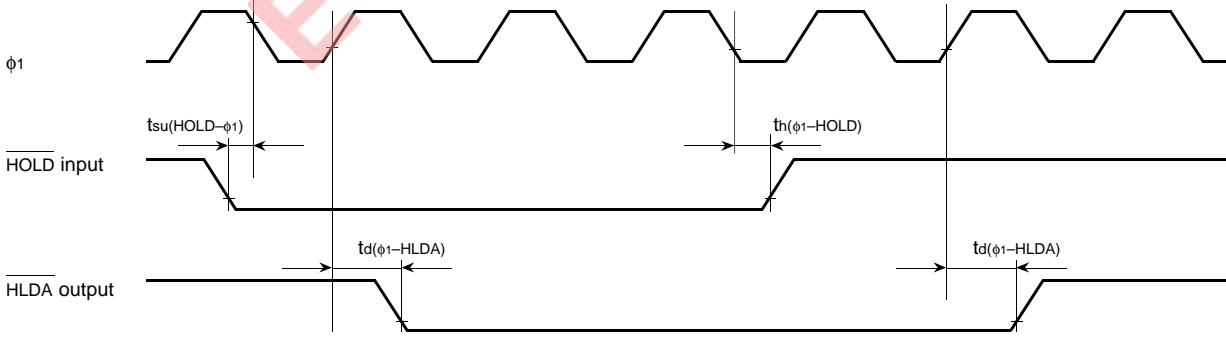
Memory expansion and microprocessor mode  
 (When wait bit = "1")



(When wait bit = "0")



(When wait bit = "1" or "0" in common)



- Test conditions
- $V_{CC} = 2.7 - 5.5 \text{ V}$
  - Input timing voltage :  $V_{IL} = 0.2V_{CC}$ ,  $V_{IH} = 0.8V_{CC}$
  - Output timing voltage :  $V_{OL} = 0.8 \text{ V}$ ,  $V_{OH} = 2.0 \text{ V}$

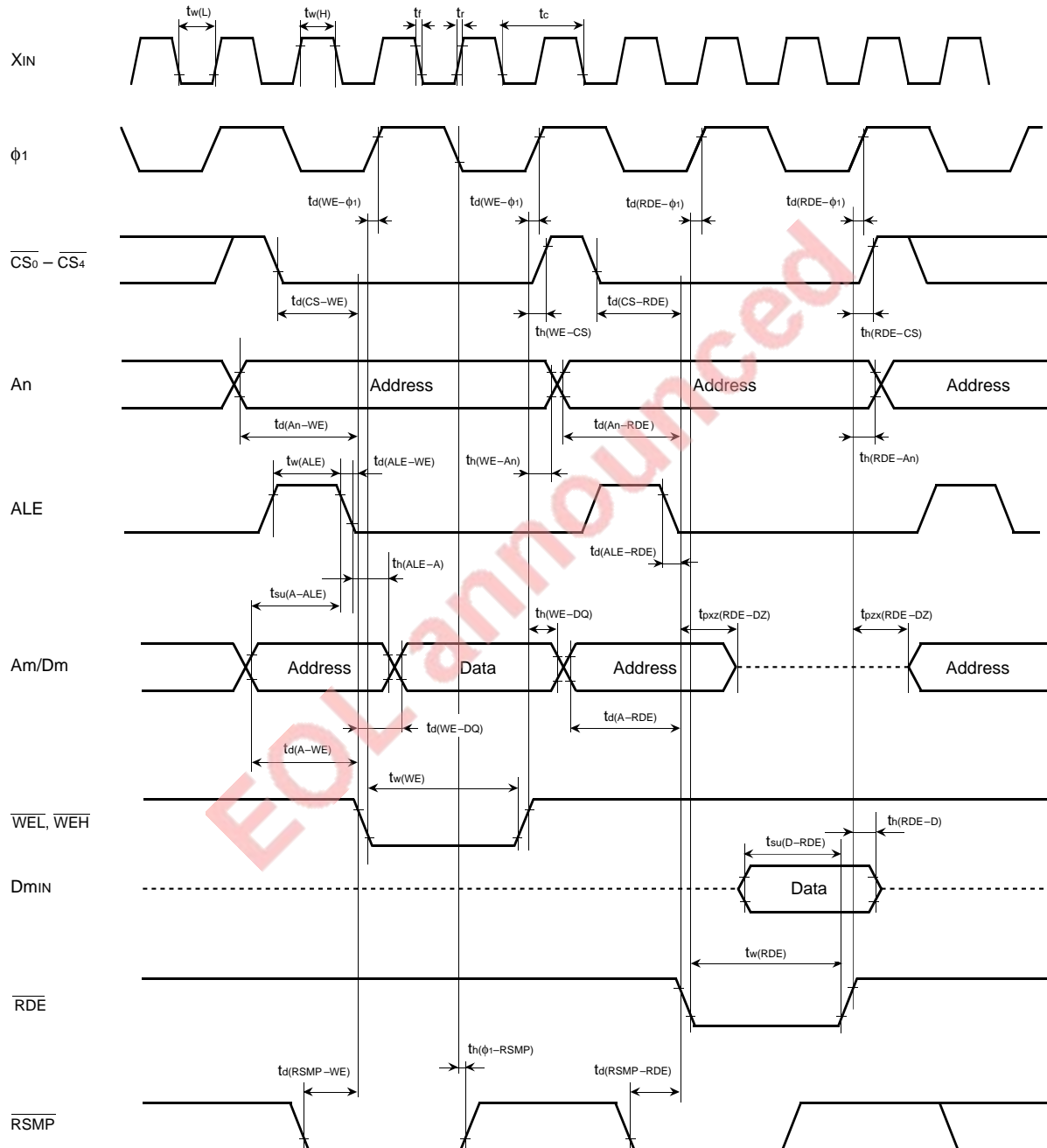


**PRELIMINARY**  
 Notice: This is not a final specification.  
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SINGLE-CHIP 16-BIT CMOS MICROCOMPUTER

Memory expansion and microprocessor mode  
 (No wait : When wait bit = "1")



Test conditions

- $V_{CC} = 2.7 - 5.5 V$
- Output timing voltage :  $V_{OL} = 0.8 V, V_{OH} = 2.0 V$
- Data input  $D_{MIN}$  :  $V_{IL} = 0.16 V_{CC}, V_{IH} = 0.5 V_{CC}$

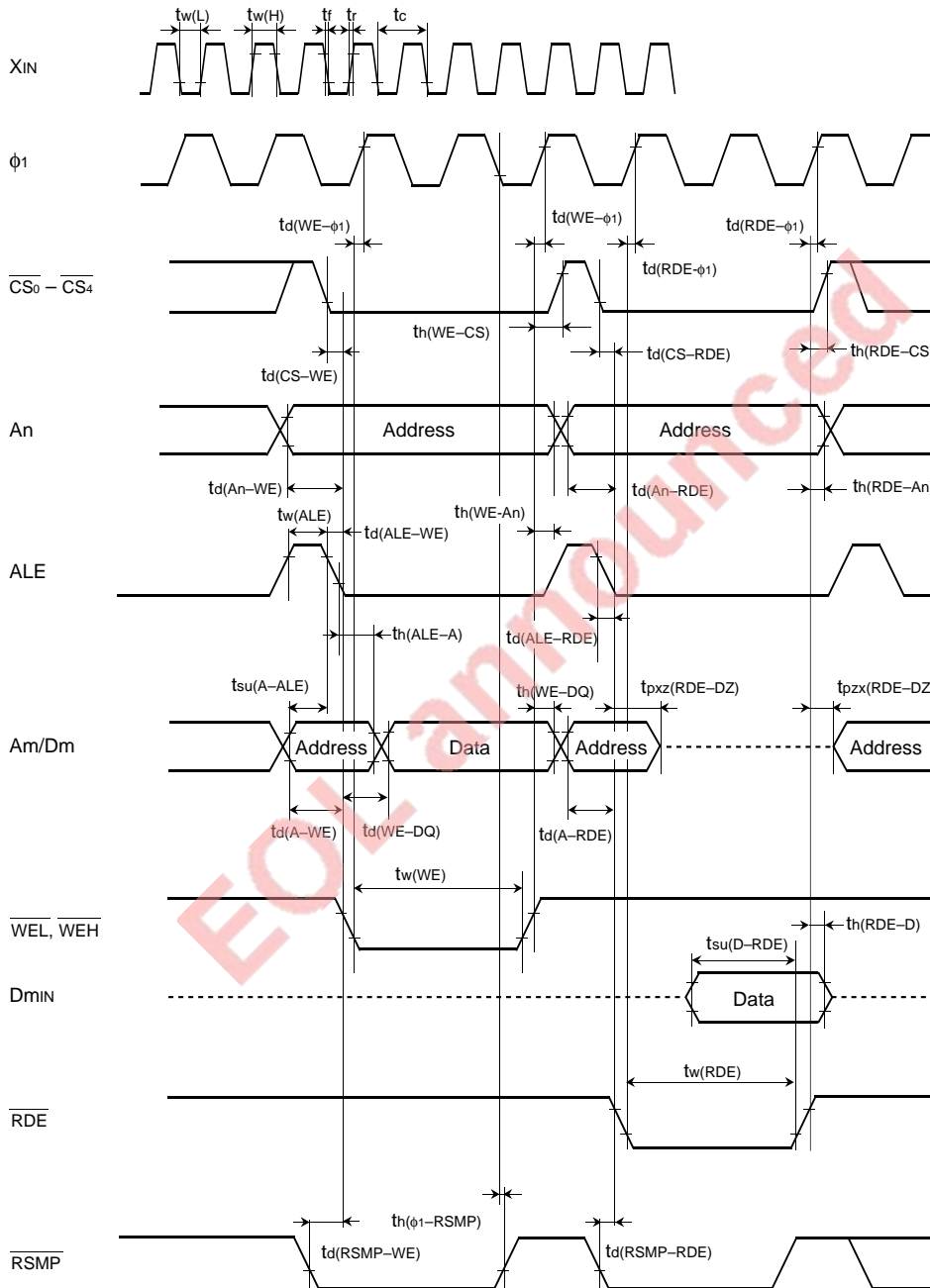
**PRELIMINARY**  
 Notice: This is not a final specification.  
 Some parametric limits are subject to change.

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**SINGLE-CHIP 16-BIT CMOS MICROCOMPUTER**

**Memory expansion and microprocessor mode**

(Wait 1 : The external area is accessed when wait bit = "0" and wait selection bit = "1".)



**Test conditions**

- $V_{CC} = 2.7 - 5.5 V$
- Output timing voltage :  $V_{OL} = 0.8 V, V_{OH} = 2.0 V$
- Data input  $D_{min}$  :  $V_{IL} = 0.16 V_{CC}, V_{IH} = 0.5 V_{CC}$

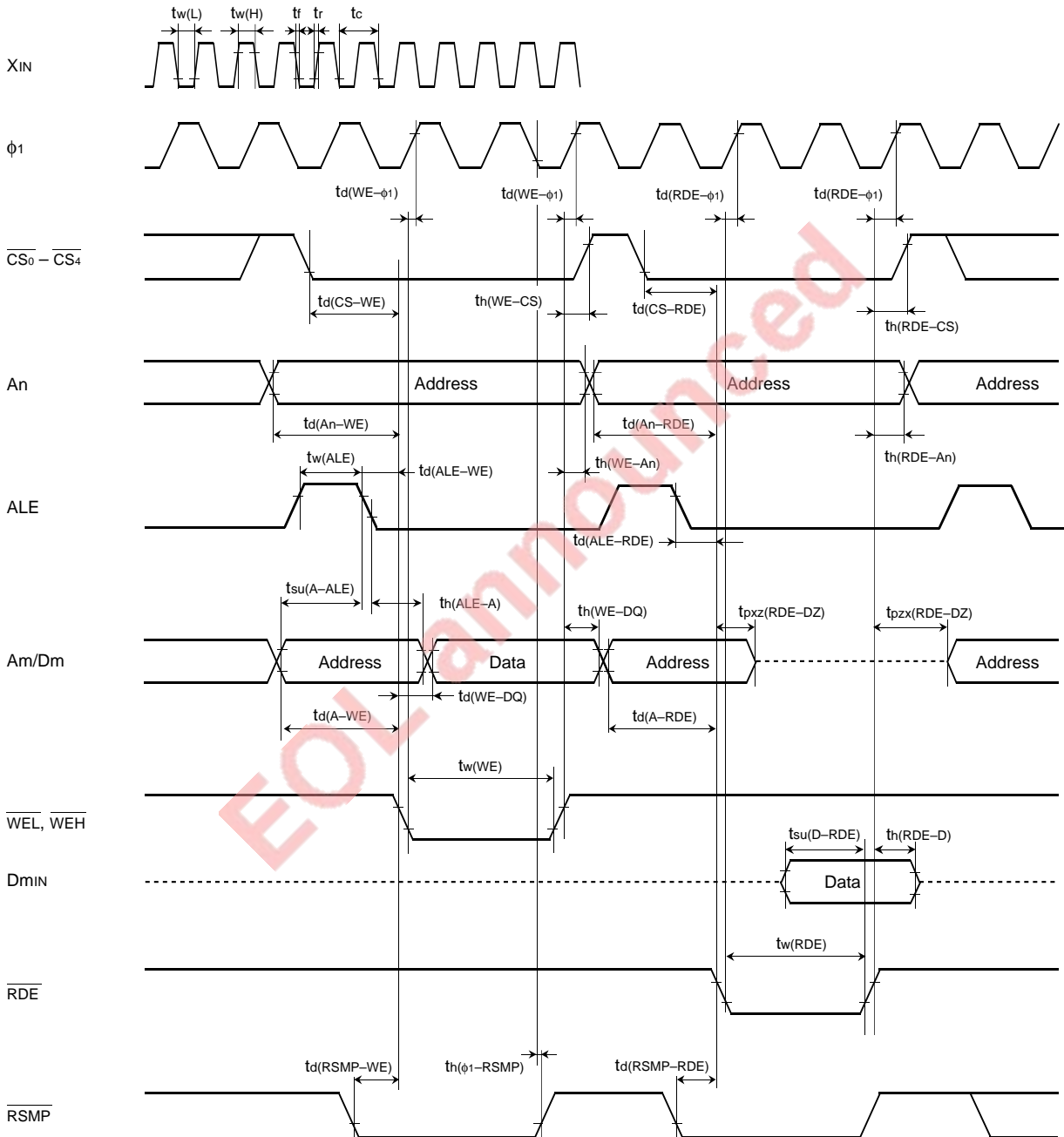
**PRELIMINARY**  
 Notice: This is not a final specification.  
 Some parametric limits are subject to change.

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**SINGLE-CHIP 16-BIT CMOS MICROCOMPUTER**

**Memory expansion and microprocessor mode**

(Wait 0 : The external memory are is accessed when wait bit = "0" and wait selection bit = "0".)



**Test conditions**

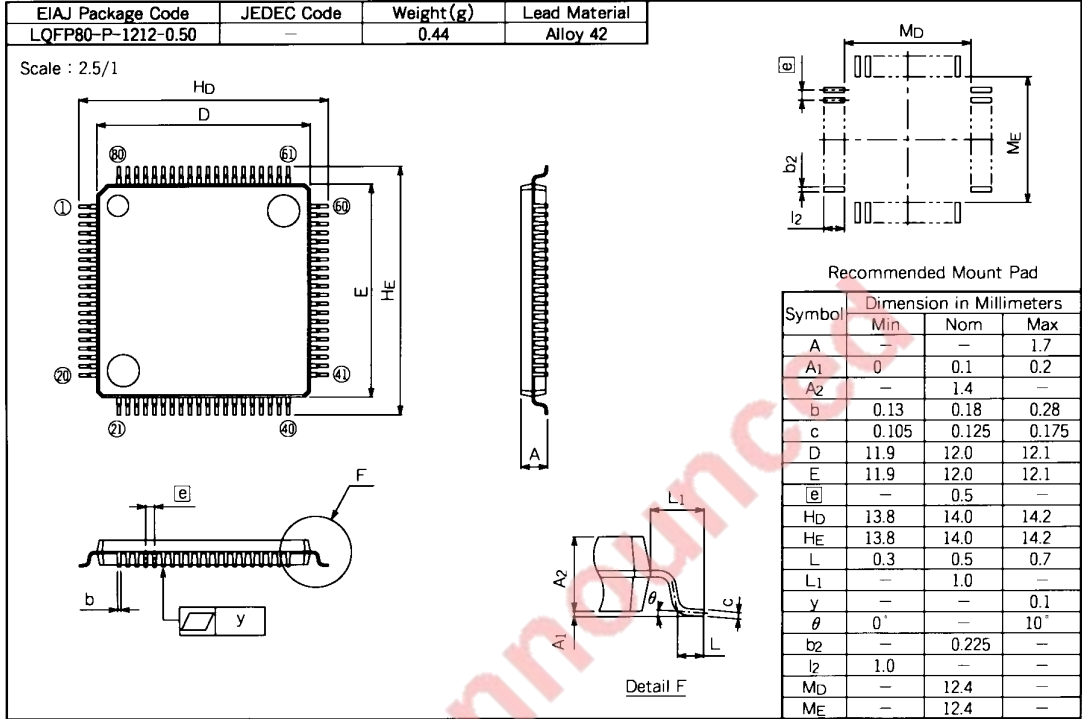
- $V_{CC} = 2.7 - 5.5 \text{ V}$
- Output timing voltage :  $V_{OL} = 0.8 \text{ V}$ ,  $V_{OH} = 2.0 \text{ V}$
- Data input  $D_{min}$  :  $V_{IL} = 0.16 V_{CC}$ ,  $V_{IH} = 0.5 V_{CC}$

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

**PACKAGE OUTLINE**

**80P6D-A**

Plastic 80pin 12X 12mm body LQFP



**7700 FAMILY MASK ROM ORDER CONFIRMATION FORM  
SINGLE-CHIP 16-BIT MICROCOMPUTER  
M37735M4LXXXHP  
MITSUBISHI ELECTRIC**

Mask ROM number	
-----------------	--

Receipt	Date:	
	Section head signature	Supervisor signature

Note : Please fill in all items marked ※

※ Customer	Company name	TEL ( )	Issuance signatures	Responsible officer	Supervisor
	Date issued	Date:			

※1. Confirmation

Specify the name of the product being ordered.

Three sets of EPROMs are required for each pattern (Check @ in the appropriate box).

If at least two of the three sets of EPROMs submitted contain the identical data, we will produce masks based on this data.

We shall assume the responsibility for errors only if the mask ROM data on the products we produce differ from this data.

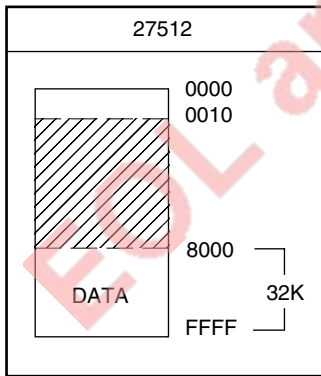
Thus, the customer must be especially careful in verifying the data contained in the EPROMs submitted.

Checksum code for entire EPROM areas 

--	--	--	--	--

 (hexadecimal notation)

EPROM Type :



- (1) Set "FF<sub>16</sub>" in the shaded area.
  - (2) Address 0<sub>16</sub> to 10<sub>16</sub> are the area for storing the data on model designation and options. This area must be written with the data shown below.
- Details for option data are given next in the section describing the STP instruction option.
- Address and data are written in hexadecimal notation.

Address	Address	Address
4D	0	4C
33	1	FF
37	2	FF
37	3	FF
33	4	FF
35	5	FF
4D	6	FF
34	7	FF
	8	Option data
	9	
	A	
	B	
	C	
	D	
	E	
	F	
		10

※2. STP instruction option

One of the following sets of data should be written to the option data address (10<sub>16</sub>) of the EPROM you have ordered.

Check @ in the appropriate box.

- STP instruction enable      

01 <sub>16</sub>
------------------

 Address 10<sub>16</sub>
- STP instruction disable      

00 <sub>16</sub>
------------------

 Address 10<sub>16</sub>

※3. Mark specification

Mark specification must be submitted using the correct form for the type of package being ordered fill out the appropriate 80P6D Mark Specification Form (for M37735M4LXXXHP) and attach to the Mask ROM Order Confirmation Form.

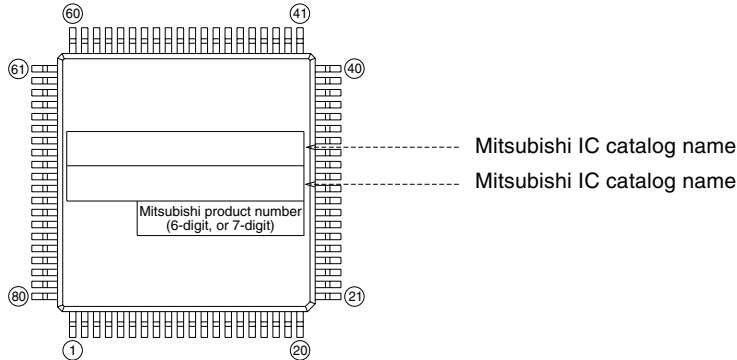
※4. Comments

## 80P6S (80-PIN QFP) MARK SPECIFICATION FORM 80P6D, 80P6Q (80-PIN Fine-pitch QFP)

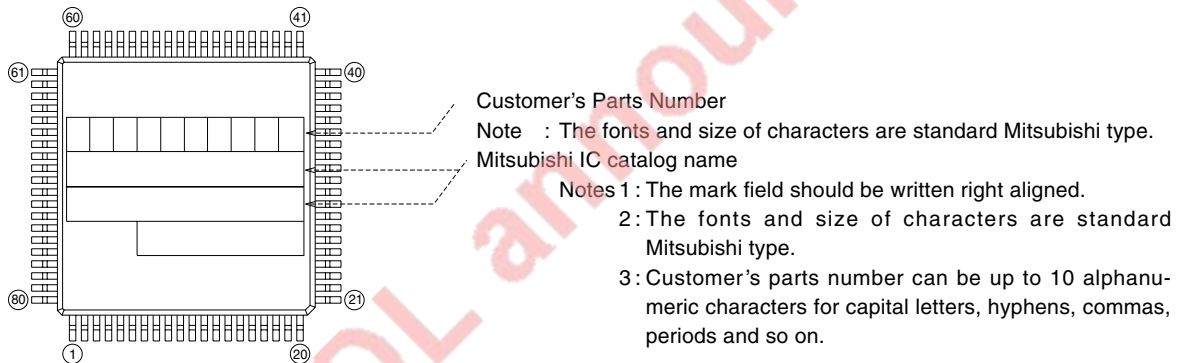
Mitsubishi IC catalog name

Please choose one of the marking types below (A, B, C), and enter the Mitsubishi IC catalog name and the special mark (if needed).

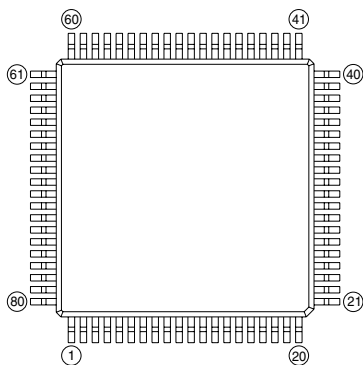
### A. Standard Mitsubishi Mark



### B. Customer's Parts Number + Mitsubishi IC Catalog Name



### C. Special Mark Required



- Notes 1:** If Special mark is to be printed, indicate the desired layout of the mark in the left figure. The layout will be duplicated technically as close as possible. Mitsubishi product number (6-digit, or 7-digit) and Mask ROM number (3-digit) are always marked for sorting the products.
- 2:** If special character fonts (e.g., customer's trade mark logo) must be used in Special Mark, check the box below.  
For the new special character fonts, a clean font original (ideally logo drawing) must be submitted.

Special character fonts required

**PRELIMINARY**

Notice: This is not a final specification.  
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**M37735M4LXXXHP**

SINGLE-CHIP 16-BIT CMOS MICROCOMPUTER

**EOL announced**

## Renesas Technology Corp.

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

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- Mitsubishi Electric Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of non-flammable material or (iii) prevention against any malfunction or mishap.

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REVISION DESCRIPTION LIST

M37735M4LXXXHP DATA SHEET

Rev. No.	Revision Description	Rev. date
1.0	First Edition	970604
1.01	The following are added: •MASK ROM ORDER CONFIRMATION FORM •MARK SPECIFICATION FORM	980526

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