FUJITSU SEMICONDUCTOR
DATA SHEET

DS07-13737-6E

16-bit Microcontroller

CMOS

F²MC-16LX MB90350 Series

MB90F351(S), MB90F352(S),MB90F351A(S), MB90F351TA(S), MB90F352A(S), MB90F352TA(S), MB90F356A(S), MB90F356TA(S), MB90F357A(S), MB90F357TA(S),MB90351A(S), MB90351TA(S), MB90352A(S), MB90352TA(S),MB90356A(S), MB90356TA(S), MB90357A(S), MB90357TA(S), MB90V340A-101/102/103/104

■ DESCRIPTION

The MB90350-series with 1 channel FULL-CAN interface and Flash ROM is especially designed for automotive and industrial applications. Its main feature is the on-board CAN interface, which conforms to V2.0 Part A and Part B, while supporting a very flexible message buffer scheme and so offering more functions than a normal full CAN approach. With the new 0.35 µm CMOS technology, FUJITSU SEMICONDUCTOR now offers on-chip Flash-ROM program memory up to 128 Kbytes.

The power supply (3 V) is supplied to the internal MCU core from an internal regulator circuit. This creates a major advantage in terms of EMI and power consumption.

The internal PLL clock frequency multiplier provides an internal 42 ns instruction execution time from an external 4 MHz clock. Also, the clock monitor function can monitor main clock and sub clock independently.

As the peripheral resources, the unit features a 4-channel Output Compare Unit, 6-channel Input Capture Unit, 2 separate 16-bit freerun timers, 2-channel UART and 15-channel 8/10-bit A/D converter.

Note : F²MC is the abbreviation of FUJITSU Flexible Microcontroller.

For the information for microcontroller supports, see the following web site.
This web site includes the **"Customer Design Review Supplement"** which provides the latest cautions on system development and the minimal requirements to be checked to prevent problems before the system development.

http://edevice.fujitsu.com/micom/en-support/

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■ FEATURES

- **Clock**
  - Built-in PLL clock frequency multiplication circuit
  - Selection of machine clocks (PLL clocks) is allowed among frequency division by two on oscillation clock, and multiplication of 1 to 6 times of oscillation clock (for 4 MHz oscillation clock, 4 MHz to 24 MHz).
  - Operation by sub clock (up to 50 kHz : 100 kHz oscillation clock divided by two) is allowed. (devices without S-suffix only)
  - Minimum execution time of instruction : 42 ns (when operating with 4-MHz oscillation clock, and 6-time multiplied PLL clock).
  - Built-in clock modulation circuit
- **16 Mbytes CPU memory space**
  - 24-bit internal addressing
- **Clock monitor function (MB90x356x and MB90x357x only)**
  - Main clock or sub clock is monitored independently.
  - Internal CR oscillation clock (100 kHz typical) can be used as sub clock.
- **Instruction system best suited to controller**
  - Wide choice of data types (bit, byte, word, and long word)
  - Wide choice of addressing modes (23 types)
  - Enhanced multiply-divide instructions with sign and RETI instructions
  - Enhanced high-precision computing with 32-bit accumulator
- **Instruction system compatible with high-level language (C language) and multitask**
  - Employing system stack pointer
  - Enhanced various pointer indirect instructions
  - Barrel shift instructions
- **Increased processing speed**
  - 4-byte instruction queue
- **Powerful interrupt function**
  - Powerful 8-level, 34-condition interrupt feature
  - Up to 8 channels external interrupts are supported.
- **Automatic data transfer function independent of CPU**
  - Extended intelligent I/O service function (EI^{2}OS) : up to 16 channels
  - DMA : up to 16 channels
- **Low power consumption (standby) mode**
  - Sleep mode (a mode that halts CPU operating clock)
  - Main timer mode (a timebase timer mode switched from the main clock mode)
  - PLL timer mode (a timebase timer mode switched from the PLL clock mode)
  - Watch mode (a mode that operates sub clock and watch timer only)
  - Stop mode (a mode that stops oscillation clock and sub clock)
  - CPU intermittent operation mode
- **Process**
  - CMOS technology

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- **I/O port**
  - General-purpose input/output port (CMOS output)
    - 49 ports (devices without S-suffix : devices that correspond to sub clock)
    - 51 ports (devices with S-suffix : devices that do not correspond to sub clock)
- **Sub clock pin (X0A, X1A)**
  - Yes (using the external oscillation) : devices without S-suffix
  - No (using the sub clock mode at internal CR oscillation) : devices with S-suffix
- **Timer**
  - Timebase timer, watch timer, watchdog timer : 1 channel
  - 8/16-bit PPG timer : 8-bit × 10 channels or 16-bit × 6 channels
  - 16-bit reload timer : 4 channels
  - 16- bit input/output timer
    - 16-bit freerun timer : 2 channels (FRT0 : ICU0/1, FRT1 : ICU 4/5/6/7, OCU 4/5/6/7)
    - 16- bit input capture: (ICU) : 6 channels
    - 16-bit output compare : (OCU) : 4 channels
- **FULL-CAN interface : 1 channel**
  - Compliant with Ver2.0 part A and Ver2.0 part B CAN specifications
  - Flexible message buffering (mailbox and FIFO buffering can be mixed)
  - CAN wake-up function
- **UART (LIN/SCI) : 2 channels**
  - Equipped with full-duplex double buffer
  - Clock-asynchronous or clock-synchronous serial transmission is available.
- **I²C interface : 1 channel**
  - Up to 400 Kbit/s transfer rate
- **DTP/External interrupt : 8 channels, CAN wakeup : 1 channel**
  - Module for activation of extended intelligent I/O service (EI²OS), DMA, and generation of external interrupt by external input.
- **Delay interrupt generator module**
  - Generates interrupt request for task switching.
- **8/10-bit A/D converter : 15 channels**
  - Resolution is selectable between 8-bit and 10-bit.
  - Activation by external trigger input is allowed.
  - Conversion time : 3 μs (at 24-MHz machine clock, including sampling time)
- **Program patch function**
  - Address matching detection for 6 address pointers.
- **Capable of changing input voltage level for port**
  - Automotive/CMOS-Schmitt (initial level is Automotive in single chip mode)
  - TTL level (corresponds to external bus pins only, initial level of these pins is TTL in external bus mode)
- **Low voltage/CPU operation detection reset (devices with T-suffix)**
  - Detects low voltage (4.0 V ± 0.3 V) and resets automatically
  - Resets automatically when program is runaway and counter is not cleared within interval time (approx. 262 ms : external 4 MHz)

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- **Dual operation flash memory (only flash memory devices with A-suffix)**
  - Erase/write and read can be executed in the different bank (Upper Bank/Lower Bank) at the same time.
- **Models that support + 125 °C**
  - Devices without A-suffix (excluding evaluation device) : The maximum operating frequency is 16 MHz (at T_A = +125 °C) .
  - Devices with A-suffix (excluding evaluation device) : The maximum operating frequency is 24 MHz (at T_A = +125 °C) .
- **Flash security function**
  - Protects the content of Flash memory (MB90F352x and MB90F357x only)
- **External bus interface**
  - 4 Mbytes external memory space

■ PRODUCT LINEUP 1

Parameter \ Part Number	MB90F351, MB90F352	MB90F351S, MB90F352S	MB90F351A, MB90F352A	MB90F351TA, MB90F352TA	MB90F351AS, MB90F352AS	MB90F351TAS, MB90F352TAS
CPU	F²MC-16LX CPU					
System clock	On-chip PLL clock multiplier (×1, ×2, ×3, ×4, ×6, 1/2 when PLL stops) Minimum instruction execution time : 42 ns (oscillation clock 4 MHz, PLL × 6)					
ROM	Flash memory 64Kbytes : MB90F351(S) 128Kbytes : MB90F352(S)		Dual operation flash memory 64Kbytes : MB90F351A(S), MB90F351TA(S) 128Kbytes : MB90F352A(S), MB90F352TA(S)			
RAM	4 Kbytes					
Emulator-specific power supply*	—					
Sub clock pin (X0A, X1A) (Max 100 kHz)	Yes	No	Yes		No	
Clock monitor function	No					
Low voltage/CPU operation detection reset	No		No	Yes	No	Yes
Operating voltage range	3.5 V to 5.5 V : at normal operating (not using A/D converter) 4.0 V to 5.5 V : at using A/D converter/Flash programming 4.5 V to 5.5 V : at using external bus					
Operating temperature range	−40 °C to +105 °C (+125 °C up to 16 MHz machine clock)		−40 °C to +125 °C			
Package	LQFP-64					
UART	2 channels					
	Wide range of baud rate settings using a dedicated reload timer Special synchronous options for adapting to different synchronous serial protocols LIN functionality working either as master or slave LIN device					
I²C (400 Kbps)	1 channel					
A/D Converter	15 channels					
	10-bit or 8-bit resolution Conversion time : Min 3 µs includes sample time (per one channel)					
16-bit Reload Timer (4 channels)	Operation clock frequency : fsys/2^1, fsys/2^3, fsys/2^5 (fsys = Machine clock frequency) Supports External Event Count function.					
16-bit I/O Timer (2 channels)	I/O Timer 0 (clock input FRCK0) corresponds to ICU 0/1. I/O Timer 1 (clock input FRCK1) corresponds to ICU 4/5/6/7, OCU 4/5/6/7.					
	Signals an interrupt when overflowing. Supports Timer Clear when a match with Output Compare (Channel 0, 4) . Operation clock frequency : fsys, fsys/2^1, fsys/2^2, fsys/2^3, fsys/2^4, fsys/2^5, fsys/2^6, fsys/2^7 (fsys = Machine clock frequency)					
16-bit Output Compare	4 channels					
	Signals an interrupt when 16-bit I/O Timer matches with output compare registers. A pair of compare registers can be used to generate an output signal.					

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Parameter \ Part Number	MB90F351, MB90F352	MB90F351S, MB90F352S	MB90F351A, MB90F352A	MB90F351TA, MB90F352TA	MB90F351AS, MB90F352AS	MB90F351TAS, MB90F352TAS
16-bit Input Capture	6 channels					
	Retains freerun timer value by (rising edge, falling edge or rising & falling edge), signals an interrupt.					
8/16-bit Programmable Pulse Generator	6 channels (16-bit)/10 channels (8-bit) 8-bit reload counters × 12 8-bit reload registers for L pulse width × 12 8-bit reload registers for H pulse width × 12					
	Supports 8-bit and 16-bit operation modes. A pair of 8-bit reload counters can be configured as one 16-bit reload counter or as 8-bit prescaler + 8-bit reload counter. Operation clock frequency : fsys, fsys/2^1, fsys/2^2, fsys/2^3, fsys/2^4 or 128 µs@fosc = 4 MHz (fsys = Machine clock frequency, fosc = Oscillation clock frequency)					
CAN Interface	1 channel					
	Conforms to CAN Specification Version 2.0 Part A and B. Automatic re-transmission in case of error Automatic transmission responding to Remote Frame Prioritized 16 message buffers for data and ID Supports multiple messages. Flexible configuration of acceptance filtering : Full bit compare/Full bit mask/Two partial bit masks Supports up to 1 Mbps.					
External Interrupt	8 channels					
	Can be used rising edge, falling edge, starting up by H/L level input, external interrupt, extended intelligent I/O services (EI^{2}OS) and DMA.					
D/A converter	—					
I/O Ports	Virtually all external pins can be used as general purpose I/O port. All push-pull outputs Bit-wise settable as input/output or peripheral signal Settable as CMOS schmitt trigger/ automotive inputs TTL input level settable for external bus (only for external bus pin)					
Flash Memory	Supports automatic programming, Embedded Algorithm Write/Erase/Erase-Suspend/Resume commands A flag indicating completion of the algorithm Number of erase cycles : 10,000 times Data retention time : 10 years Boot block configuration Erase can be performed on each block. Block protection with external programming voltage Flash Security Feature for protecting the content of the Flash (MB90F352x only)					
Corresponding EVA name	MB90V340A-102	MB90V340A-101	MB90V340A-102		MB90V340A-101	

* : It is setting of Jumper switch (TOOL VCC) when Emulator (MB2147-01) is used.
Please refer to the Emulator hardware manual about details.

■ PRODUCT LINEUP 2

Part Number / Parameter	MB90351A, MB90352A	MB90351TA, MB90352TA	MB90351AS, MB90352AS	MB90351TAS, MB90352TAS	MB90V340A-101	MB90V340A-102
CPU	F²MC-16LX CPU					
System clock	On-chip PLL clock multiplier (×1, ×2, ×3, ×4, ×6, 1/2 when PLL stops) Minimum instruction execution time : 42 ns (oscillation clock 4 MHz, PLL × 6)					
ROM	MASK ROM 64Kbytes : MB90351A(S), MB90351TA(S) 128Kbytes : MB90352A(S), MB90352TA(S)				External	
RAM	4 Kbytes				30 Kbytes	
Emulator-specific power supply*	—				Yes	
Sub clock pin (X0A, X1A) (Max 100 kHz)	Yes		No		No	Yes
Clock monitor function	No					
Low voltage/CPU operation detection reset	No	Yes	No	Yes	No	
Operating voltage range	3.5 V to 5.5 V : at normal operating (not using A/D converter) 4.0 V to 5.5 V : at using A/D converter 4.5 V to 5.5 V : at using external bus				5 V ± 10%	
Operating temperature range	−40 °C to +125 °C				—	
Package	LQFP-64				PGA-299	
UART	2 channels				5 channels	
	Wide range of baud rate settings using a dedicated reload timer Special synchronous options for adapting to different synchronous serial protocols LIN functionality working either as master or slave LIN device					
I²C (400 Kbps)	1 channel				2 channels	
A/D Converter	15 channels				24 channels	
	10-bit or 8-bit resolution Conversion time : Min 3 µs includes sample time (per one channel)					
16-bit Reload Timer (4 channels)	Operation clock frequency : fsys/2^1, fsys/2^3, fsys/2^5 (fsys = Machine clock frequency) Supports External Event Count function.					
16-bit I/O Timer (2 channels)	I/O Timer 0 (clock input FRCK0) corresponds to ICU 0/1. I/O Timer 1 (clock input FRCK1) corresponds to ICU 4/5/6/7, OCU 4/5/6/7.				I/O Timer 0 corresponds to ICU 0/1/2/3, OCU 0/1/2/3. I/O Timer 1 corresponds to ICU 4/5/6/7, OCU 4/5/6/7.	
	Signals an interrupt when overflowing. Supports Timer Clear when a match with Output Compare (Channel 0, 4) . Operation clock frequency : fsys, fsys/2^1, fsys/2^2, fsys/2^3, fsys/2^4, fsys/2^5, fsys/2^6, fsys/2^7 (fsys = Machine clock frequency)					

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Parameter \ Part Number	MB90351A, MB90352A	MB90351TA, MB90352TA	MB90351AS, MB90352AS	MB90351TAS, MB90352TAS	MB90V340A-101	MB90V340A-102
16-bit Output Compare	4 channels				8 channels	
	Signals an interrupt when 16-bit I/O Timer matches output compare registers. A pair of compare registers can be used to generate an output signal.					
16-bit Input Capture	6 channels				8 channels	
	Retains freerun timer value by (rising edge, falling edge or rising & falling edge), signals an interrupt.					
8/16-bit Programmable Pulse Generator	6 channels (16-bit)/10 channels (8-bit) 8-bit reload counters × 12 8-bit reload registers for L pulse width × 12 8-bit reload registers for H pulse width × 12				8 channels (16-bit)/ 16 channels (8-bit) 8-bit reload counters × 16 8-bit reload registers for L pulse width × 16 8-bit reload registers for H pulse width × 16	
	Supports 8-bit and 16-bit operation modes. A pair of 8-bit reload counters can be configured as one 16-bit reload counter or as 8-bit prescaler + 8-bit reload counter. Operation clock frequency : fsys, fsys/2^1, fsys/2^2, fsys/2^3, fsys/2^4 or 128 µs@fosc = 4 MHz (fsys = Machine clock frequency, fosc = Oscillation clock frequency)					
CAN Interface	1 channel				3 channels	
	Conforms to CAN Specification Version 2.0 Part A and B. Automatic re-transmission in case of error Automatic transmission responding to Remote Frame Prioritized 16 message buffers for data and ID Supports multiple messages. Flexible configuration of acceptance filtering : Full bit compare/Full bit mask/Two partial bit masks Supports up to 1 Mbps.					
External Interrupt	8 channels				16 channels	
	Can be used rising edge, falling edge, starting up by H/L level input, external interrupt, extended intelligent I/O services (EI^{2}OS) and DMA.					
D/A converter	—				2 channels	
I/O Ports	Virtually all external pins can be used as general purpose I/O port. All push-pull outputs Bit-wise settable as input/output or peripheral signal Settable as CMOS schmitt trigger/ automotive inputs TTL input level settable for external bus (only for external bus pin)					
Flash Memory	—					
Corresponding EVA name	MB90V340A-102		MB90V340A-101		—	

* : It is setting of Jumper switch (TOOL VCC) when Emulator (MB2147-01) is used.
Please refer to the Emulator hardware manual about details.

■ PRODUCT LINEUP 3

Part Number / Parameter	MB90F356A, MB90F357A	MB90F356TA, MB90F357TA	MB90F356AS, MB90F357AS	MB90F356TAS, MB90F357TAS
CPU	F²MC-16LX CPU			
System clock	On-chip PLL clock multiplier (×1, ×2, ×3, ×4, ×6, 1/2 when PLL stops) Minimum instruction execution time : 42 ns (oscillation clock 4 MHz, PLL × 6)			
ROM	Dual operation flash memory 64Kbytes : MB90F356A(S), MB90F356TA(S) 128Kbytes : MB90F357A(S), MB90F357TA(S)			
RAM	4 Kbytes			
Emulator-specific power supply*	—			
Sub clock pin (X0A, X1A)	Yes		No (internal CR oscillation can be used as sub clock)	
Clock monitor function	Yes			
Low voltage/CPU operation detection reset	No	Yes	No	Yes
Operating voltage range	3.5 V to 5.5 V : at normal operating (not using A/D converter) 3.5 V to 5.5 V : at using A/D converter/Flash programming 3.5 V to 5.5 V : at using external bus			
Operating temperature range	−40 °C to +125 °C			
Package	LQFP-64			
UART	2 channels			
	Wide range of baud rate settings using a dedicated reload timer Special synchronous options for adapting to different synchronous serial protocols LIN functionality working either as master or slave LIN device			
I²C (400 Kbps)	1 channel			
A/D Converter	15 channels			
	10-bit or 8-bit resolution Conversion time : Min 3 µs includes sample time (per one channel)			
16-bit Reload Timer (4 channels)	Operation clock frequency : fsys/2^1, fsys/2^3, fsys/2^5 (fsys = Machine clock frequency) Supports External Event Count function.			
16-bit I/O Timer (2 channels)	I/O Timer 0 (clock input FRCK0) corresponds to ICU 0/1. I/O Timer 1 (clock input FRCK1) corresponds to ICU 4/5/6/7, OCU 4/5/6/7.			
	Signals an interrupt when overflowing. Supports Timer Clear when a match with Output Compare (Channel 0, 4) . Operation clock frequency : fsys, fsys/2^1, fsys/2^2, fsys/2^3, fsys/2^4, fsys/2^5, fsys/2^6, fsys/2^7 (fsys = Machine clock frequency)			
16-bit Output Compare	4 channels			
	Signals an interrupt when 16-bit I/O Timer matches with output compare registers. A pair of compare registers can be used to generate an output signal.			

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Parameter \ Part Number	MB90F356A, MB90F357A	MB90F356TA, MB90F357TA	MB90F356AS, MB90F357AS	MB90F356TAS, MB90F357TAS
16-bit Input Capture	6 channels			
	Retains freerun timer value by (rising edge, falling edge or rising & falling edge), signals an interrupt.			
8/16-bit Programmable Pulse Generator	6 channels (16-bit)/10 channels (8-bit) 8-bit reload counters × 12 8-bit reload registers for L pulse width × 12 8-bit reload registers for H pulse width × 12			
	Supports 8-bit and 16-bit operation modes. A pair of 8-bit reload counters can be configured as one 16-bit reload counter or as 8-bit prescaler + 8-bit reload counter. Operation clock frequency : fsys, fsys/2^1, fsys/2^2, fsys/2^3, fsys/2^4 or 128 µs@fosc = 4 MHz (fsys = Machine clock frequency, fosc = Oscillation clock frequency)			
CAN Interface	1 channel			
	Conforms to CAN Specification Version 2.0 Part A and B. Automatic re-transmission in case of error Automatic transmission responding to Remote Frame Prioritized 16 message buffers for data and ID Supports multiple messages. Flexible configuration of acceptance filtering : Full bit compare/Full bit mask/Two partial bit masks Supports up to 1 Mbps.			
External Interrupt	8 channels			
	Can be used rising edge, falling edge, starting up by H/L level input, external interrupt, extended intelligent I/O services (EI^{2}OS) and DMA.			
D/A converter	—			
I/O Ports	Virtually all external pins can be used as general purpose I/O port. All push-pull outputs Bit-wise settable as input/output or peripheral module signal Settable as CMOS schmitt trigger/ automotive inputs TTL input level settable for external bus (only for external bus pin)			
Flash Memory	Supports automatic programming, Embedded Algorithm Write/Erase/Erase-Suspend/Resume commands A flag indicating completion of the algorithm Number of erase cycles : 10,000 times Data retention time : 10 years Boot block configuration Erase can be performed on each block. Block protection with external programming voltage Flash Security Feature for protecting the content of the Flash (MB90F357x only)			
Corresponding EVA name	MB90V340A-104		MB90V340A-103	

* : It is setting of Jumper switch (TOOL VCC) when Emulator (MB2147-01) is used.
Please refer to the Emulator hardware manual about details.

■ PRODUCT LINEUP 4

Parameter \ Part Number	MB90356A, MB90357A	MB90356TA, MB90357TA	MB90356AS, MB90357AS	MB90356TAS, MB90357TAS	MB90V340A-103	MB90V340A-104
CPU	F²MC-16LX CPU					
System clock	On-chip PLL clock multiplier (×1, ×2, ×3, ×4, ×6, 1/2 when PLL stops) Minimum instruction execution time : 42 ns (oscillation clock 4 MHz, PLL × 6)					
ROM	MASK ROM 64Kbytes : MB90356A(S), MB90356TA(S) 128Kbytes : MB90357A(S), MB90357TA(S)				External	
RAM	4 Kbytes				30 Kbytes	
Emulator-specific power supply*	—				Yes	
Sub clock pin (X0A, X1A)	Yes		No (internal CR oscillation can be used as sub clock)		No (internal CR oscillation can be used as sub clock)	Yes
Clock monitor function	Yes					
Low voltage/CPU operation detection reset	No	Yes	No	Yes	No	
Operating voltage range	3.5 V to 5.5 V : at normal operating (not using A/D converter) 4.0 V to 5.5 V : at using A/D converter 4.5 V to 5.5 V : at using external bus				5 V ± 10%	
Operating temperature range	−40 °C to +125 °C				—	
Package	LQFP-64				PGA-299	
UART	2 channels				5 channels	
	Wide range of baud rate settings using a dedicated reload timer Special synchronous options for adapting to different synchronous serial protocols LIN functionality working either as master or slave LIN device					
I²C (400 Kbps)	1 channel				2 channels	
A/D Converter	15 channels				24 channels	
	10-bit or 8-bit resolution Conversion time : Min 3 µs includes sample time (per one channel)					
16-bit Reload Timer (4 channels)	Operation clock frequency : fsys/2^1, fsys/2^3, fsys/2^5 (fsys = Machine clock frequency) Supports External Event Count function.					
16-bit I/O Timer (2 channels)	I/O Timer 0 (clock input FRCK0) corresponds to ICU 0/1. I/O Timer 1 (clock input FRCK1) corresponds to ICU 4/5/6/7, OCU 4/5/6/7.				I/O Timer 0 corresponds to ICU 0/1/2/3, OCU 0/1/2/3. I/O Timer 1 corresponds to ICU 4/5/6/7, OCU 4/5/6/7.	
	Signals an interrupt when overflowing. Supports Timer Clear when a match with Output Compare (Channel 0, 4) . Operation clock frequency : fsys, fsys/2^1, fsys/2^2, fsys/2^3, fsys/2^4, fsys/2^5, fsys/2^6, fsys/2^7 (fsys = Machine clock frequency)					

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Parameter \ Part Number	MB90356A, MB90357A	MB90356TA, MB90357TA	MB90356AS, MB90357AS	MB90356TAS, MB90357TAS	MB90V340A-103	MB90V340A-104
16-bit Output Compare	4 channels				8 channels	
	Signals an interrupt when 16-bit I/O Timer matches with output compare registers. A pair of compare registers can be used to generate an output signal.					
16-bit Input Capture	6 channels				8 channels	
	Retains freerun timer value by (rising edge, falling edge or rising & falling edge), signals an interrupt.					
8/16-bit Programmable Pulse Generator	6 channels (16-bit)/10 channels (8-bit) 8-bit reload counters × 12 8-bit reload registers for L pulse width × 12 8-bit reload registers for H pulse width × 12				8 channels (16-bit)/16 channels (8-bit) 8-bit reload counters × 16 8-bit reload registers for L pulse width × 16 8-bit reload registers for H pulse width × 16	
	Supports 8-bit and 16-bit operation modes. A pair of 8-bit reload counters can be configured as one 16-bit reload counter or as 8-bit prescaler + 8-bit reload counter. Operation clock frequency : fsys, fsys/2^1, fsys/2^2, fsys/2^3, fsys/2^4 or 128 µs@fosc = 4 MHz (fsys = Machine clock frequency, fosc = Oscillation clock frequency)					
CAN Interface	1 channel				3 channels	
	Conforms to CAN Specification Version 2.0 Part A and B. Automatic re-transmission in case of error Automatic transmission responding to Remote Frame Prioritized 16 message buffers for data and ID Supports multiple messages. Flexible configuration of acceptance filtering : Full bit compare/Full bit mask/Two partial bit masks Supports up to 1 Mbps.					
External Interrupt	8 channels				16 channels	
	Can be used rising edge, falling edge, starting up by H/L level input, external interrupt, extended intelligent I/O services (EI^{2}OS) and DMA.					
D/A converter	—				2 channels	
I/O Ports	Virtually all external pins can be used as general purpose I/O port. All push-pull outputs Bit-wise settable as input/output or peripheral module signal Settable as CMOS schmitt trigger/ automotive inputs TTL input level settable for external bus (only for external bus pin)					
Flash Memory	—					
Corresponding EVA name	MB90V340A-104		MB90V340A-103		—	

* : It is setting of Jumper switch (TOOL VCC) when Emulator (MB2147-01) is used.
Please refer to the Emulator hardware manual about details.

■ PACKAGES AND PRODUCT CORRESPONDENCE

Package	MB90V340A -101 -102 -103 -104	MB90F351 MB90F351S MB90F352 MB90F352S	MB90F351A (S) , MB90F351TA (S) MB90F352A (S) , MB90F352TA (S) MB90F356A (S) , MB90F356TA (S) MB90F357A (S) , MB90F357TA (S) MB90351A (S) , MB90351TA (S) MB90352A (S) , MB90352TA (S) MB90356A (S) , MB90356TA (S) MB90357A (S) , MB90357TA (S)
PGA-299C-A01	○	×	×
FPT-64P-M23 (12 mm □, 0.65 mm pitch)	×	○	○
FPT-64P-M24 (10 mm □, 0.50 mm pitch)	×	×	○*

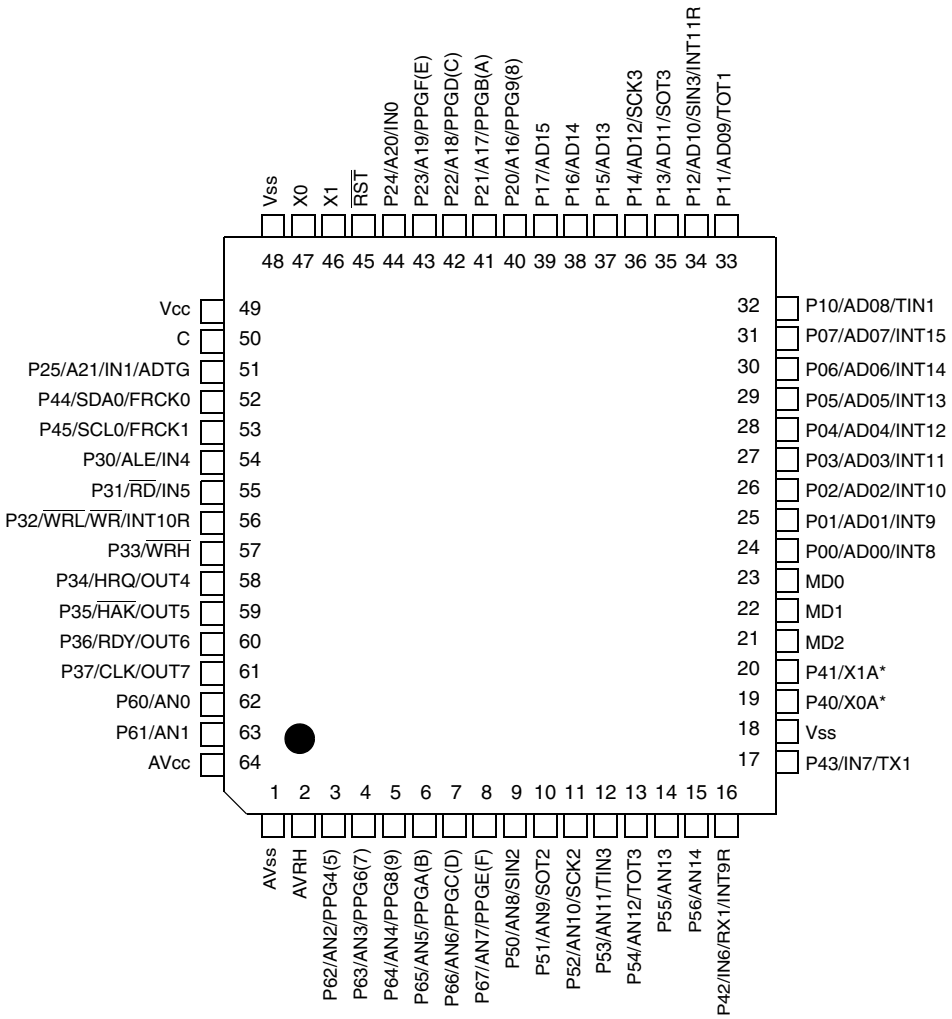
* : This device is under development.
○ : Yes, × : No

Note : Refer to “■ PACKAGE DIMENSIONS” for detail of each package.

■ PIN ASSIGNMENTS

- MB90F351(S), MB90F352(S),MB90F351A(S), MB90F351TA(S), MB90F352A(S), MB90F352TA(S), MB90F356A(S), MB90F356TA(S), MB90F357A(S), MB90F357TA(S),MB90351A(S), MB90351TA(S), MB90352A(S), MB90352TA(S),MB90356A(S), MB90356TA(S), MB90357A(S), MB90357TA(S),

(TOP VIEW)
(LQFP-64P)



(FPT-64P-M23, FPT-64P-M24)

* : Devices without S-suffix : X0A, X1A
Devices with S-suffix : P40, P41

■ PIN DESCRIPTION

Pin No. LQFP64*	Pin name	Circuit type	Function
46	X1	A	Oscillation output pin
47	X0		Oscillation input pin
45	$\overline{RST}$	E	Reset input pin
3 to 8	P62 to P67	I	General purpose I/O ports
	AN2 to AN7		Analog input pins for A/D converter
	PPG4 (5) , 6 (7) , 8 (9) , A (B) , C (D) , E (F)		Output pins for PPGs
9	P50	O	General purpose I/O port
	AN8		Analog input pin for A/D converter
	SIN2		Serial data input pin for UART2
10	P51	I	General purpose I/O port
	AN9		Analog input pin for A/D converter
	SOT2		Serial data output pin for UART2
11	P52	I	General purpose I/O port
	AN10		Analog input pin for A/D converter
	SCK2		Serial clock I/O pin for UART2
12	P53	I	General purpose I/O port
	AN11		Analog input pin for A/D converter
	TIN3		Event input pin for reload timer3
13	P54	I	General purpose I/O port
	AN12		Analog input pin for A/D converter
	TOT3		Output pin for reload timer3
14, 15	P55, P56	I	General purpose I/O ports
	AN13, AN14		Analog input pins for A/D converter
16	P42	F	General purpose I/O port
	IN6		Data sample input pin for input capture ICU6
	RX1		RX input pin for CAN1
	INT9R		External interrupt request input pin for INT9
17	P43	F	General purpose I/O port
	IN7		Data sample input pin for input capture ICU7
	TX1		TX output pin for CAN1
19, 20	P40, P41	F	General purpose I/O ports (devices with S-suffix and MB90V340A-101/103)
	X0A, X1A	B	X0A : Oscillation input pins for sub clock X1A : Oscillation output pins for sub clock (devices without S-suffix and MB90V340A-102/104)

(Continued)

Pin No. LQFP64*	Pin name	Circuit type	Function
24 to 31	P00 to P07	G	General purpose I/O ports. The register can be set to select whether to use a pull-up resistor. This function is enabled in single-chip mode.
	AD00 to AD07		Input/output pins of external address data bus lower 8 bits. This function is enabled when the external bus is enabled.
	INT8 to INT15		External interrupt request input pins for INT8 to INT15
32	P10	G	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled in single-chip mode.
	AD08		Input/output pin for external bus address data bus bit 8. This function is enabled when external bus is enabled.
	TIN1		Event input pin for reload timer1
33	P11	G	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled in single-chip mode.
	AD09		Input/output pin for external bus address data bus bit 9. This function is enabled when external bus is enabled.
	TOT1		Output pin for reload timer1
34	P12	N	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled in single-chip mode.
	AD10		Input/output pin for external bus address data bus bit 10. This function is enabled when external bus is enabled.
	SIN3		Serial data input pin for UART3
	INT11R		External interrupt request input pin for INT11
35	P13	G	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled in single-chip mode.
	AD11		Input/output pin for external bus address data bus bit 11. This function is enabled when external bus is enabled.
	SOT3		Serial data output pin for UART3
36	P14	G	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled in single-chip mode.
	AD12		Input/output pin for external bus address data bus bit 12. This function is enabled when external bus is enabled.
	SCK3		Clock input/output pin for UART3
37	P15	N	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled in single-chip mode.
	AD13		Input/output pin for external bus address data bus bit 13. This function is enabled when external bus is enabled.
38	P16	G	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled in single-chip mode.
	AD14		Input/output pin for external bus address data bus bit 14. This function is enabled when external bus is enabled.

(Continued)

Pin No. LQFP64*	Pin name	Circuit type	Function
39	P17	G	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled in single-chip mode.
	AD15		Input/output pin for external bus address data bus bit 15. This function is enabled when external bus is enabled.
40 to 43	P20 to P23	G	General purpose I/O ports. The register can be set to select whether to use a pull-up resistor. In external bus mode, the pins are enabled as a general-purpose I/O port when the corresponding bit in the external address output control register (HACR) is 1.
	A16 to A19		Output pins for A16 to A19 of the external address data bus. When the corresponding bit in the external address output control register (HACR) is 0, the pins are enabled as high address output pins A16 to A19.
	PPG9 (8) , PPGB (A) , PPGD (C) , PPGF (E)		Output pins for PPGs
44	P24	G	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. In external bus mode, the pin is enabled as a general-purpose I/O port when the corresponding bit in the external address output control register (HACR) is 1.
	A20		Output pin for A20 of the external address data bus. When the corresponding bit in the external address output control register (HACR) is 0, the pin is enabled as high address output pin A20.
	IN0		Data sample input pin for input capture ICU0
51	P25	G	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. In external bus mode, the pin is enabled as a general-purpose I/O port when the corresponding bit in the external address output control register (HACR) is 1.
	A21		Output pin for A21 of the external address data bus. When the corresponding bit in the external address output control register (HACR) is 0, the pin is enabled as high address output pin A21.
	IN1		Data sample input pin for input capture ICU1
	ADTG		Trigger input pin for A/D converter
52	P44	H	General purpose I/O port
	SDA0		Serial data I/O pin for I^2C 0
	FRCK0		Input pin for the 16-bit I/O Timer 0
53	P45	H	General purpose I/O port
	SCL0		Serial clock I/O pin for I^2C 0
	FRCK1		Input pin for the 16-bit I/O Timer 1

(Continued)

Pin No. LQFP64*	Pin name	Circuit type	Function
54	P30	G	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled in single-chip mode.
	ALE		Address latch enable output pin. This function is enabled when external bus is enabled.
	IN4		Data sample input pin for input capture ICU4
55	P31	G	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled in single-chip mode.
	$\overline{RD}$		Read strobe output pin for data bus. This function is enabled when external bus is enabled.
	IN5		Data sample input pin for input capture ICU5
56	P32	G	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled either in single-chip mode or with the $\overline{WR}$/$\overline{WRL}$ pin output disabled.
	$\overline{WR}$/$\overline{WRL}$		Write strobe output pin for the data bus. This function is enabled when both the external bus and the $\overline{WR}$/$\overline{WRL}$ pin output are enabled. $\overline{WRL}$ is used to write-strobe 8 lower bits of the data bus in 16-bit access. $\overline{WR}$ is used to write-strobe 8 bits of the data bus in 8-bit access.
	INT10R		External interrupt request input pin for INT10
57	P33	G	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled either in single-chip mode, in external bus 8-bit mode or with the $\overline{WRH}$ pin output disabled.
	$\overline{WRH}$		Write strobe output pin for the 8 higher bits of the data bus. This function is enabled when the external bus is enabled, when the external bus 16-bit mode is selected, and when the $\overline{WRH}$ output pin is enabled.
58	P34	G	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled either in single-chip mode or with the hold function disabled.
	HRQ		Hold request input pin. This function is enabled when both the external bus and the hold function are enabled.
	OUT4		Waveform output pin for output compare OCU4
59	P35	G	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled either in single-chip mode or with the hold function disabled.
	$\overline{HAK}$		Hold acknowledge output pin. This function is enabled when both the external bus and the hold function are enabled.
	OUT5		Waveform output pin for output compare OCU5
60	P36	G	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled either in single-chip mode or with the external ready function disabled.
	RDY		Ready input pin. This function is enabled when both the external bus and the external ready function are enabled.
	OUT6		Waveform output pin for output compare OCU6

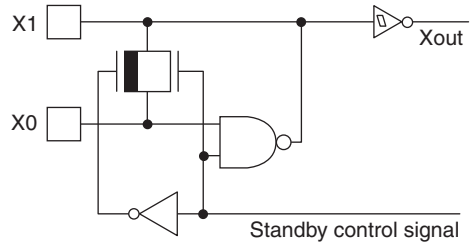
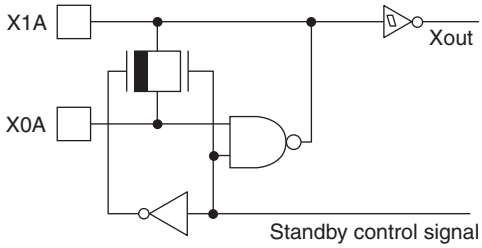
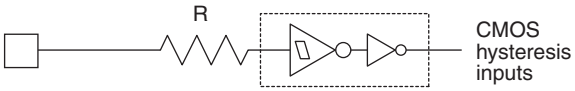
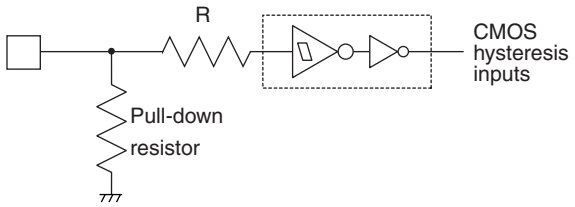
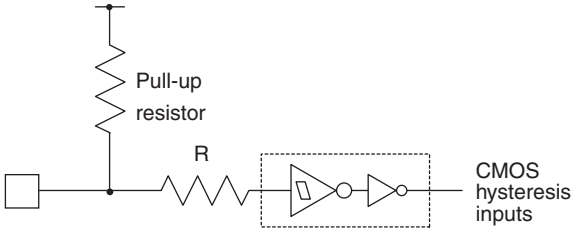
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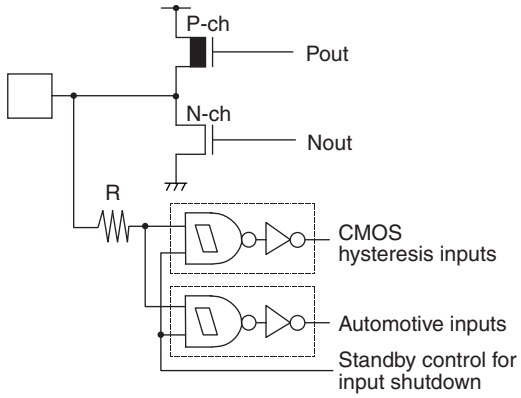
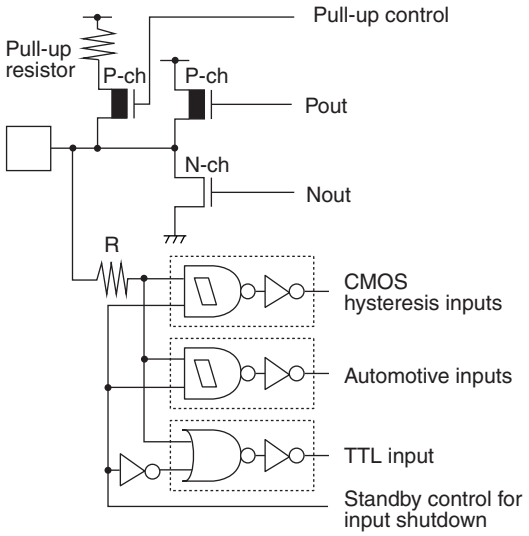
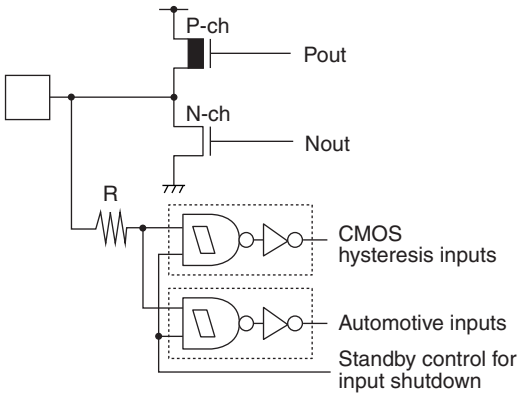
Pin No. LQFP64*	Pin name	Circuit type	Function
61	P37	G	General purpose I/O port. The register can be set to select whether to use a pull-up resistor. This function is enabled either in single-chip mode or with the CLK output disabled.
	CLK		CLK output pin. This function is enabled when both the external bus and CLK output are enabled.
	OUT7		Waveform output pin for output compare OCU7
62, 63	P60, P61	I	General purpose I/O ports
	AN0, AN1		Analog input pins for A/D converter
64	AV_{CC}	K	V_{CC} power input pin for analog circuits
2	AVRH	L	Reference voltage input for the A/D converter. This power supply must be turned on or off while a voltage higher than or equal to AVRH is applied to AV_{CC}.
1	AV_{SS}	K	V_{SS} power input pin for analog circuits
22, 23	MD1, MD0	C	Input pins for specifying the operating mode
21	MD2	D	Input pin for specifying the operating mode
49	V_{CC}	—	Power (3.5 V to 5.5 V) input pin
18, 48	V_{SS}	—	Power (0 V) input pins
50	C	K	This is the power supply stabilization capacitor pin. It should be connected to a higher than or equal to 0.1 μF ceramic capacitor.

* : FPT-64P-M23, FPT-64P-M24

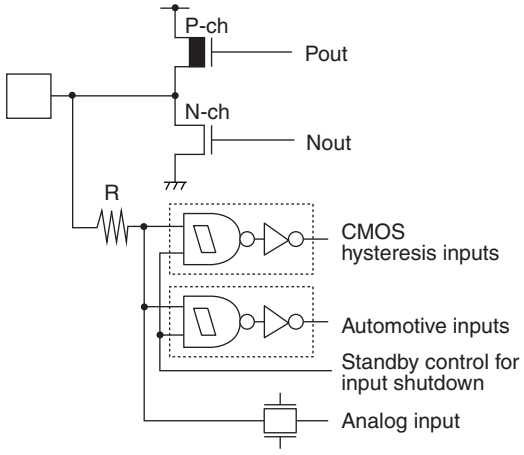
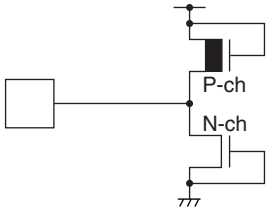
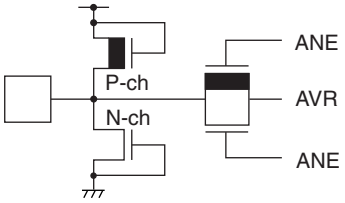
■ I/O CIRCUIT TYPE

Type	Circuit	Remarks
A		Oscillation circuit • High-speed oscillation feedback resistor = approx. 1 MΩ
B		Oscillation circuit • Low-speed oscillation feedback resistor = approx. 10 MΩ
C		Mask ROM device: • CMOS hysteresis input pin Flash memory device: • CMOS input pin
D		Mask ROM device: • CMOS hysteresis input pin • Pull-down resistor value: approx. 50 kΩ Flash memory device: • CMOS input pin • No Pull-down
E		CMOS hysteresis input pin • Pull-up resistor value: approx. 50 kΩ

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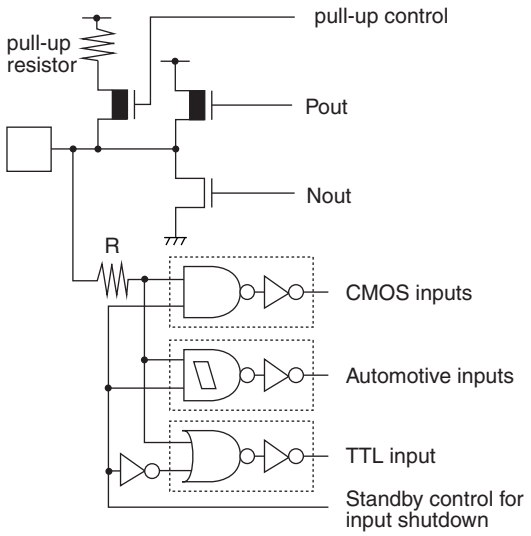
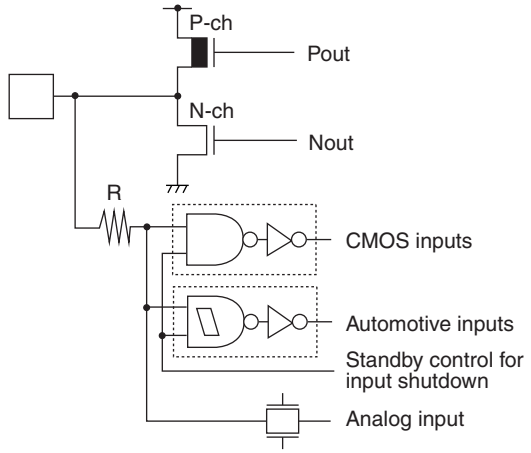
Type	Circuit	Remarks
F		• CMOS level output (I_{OL} = 4 mA, I_{OH} = –4 mA) • CMOS hysteresis inputs (With the stand-by-time input shutdown function) • Automotive input (With the standby-time input shutdown function)
G		• CMOS level output (I_{OL} = 4 mA, I_{OH} = –4 mA) • CMOS hysteresis inputs (With the stand-by-time input shutdown function) • Automotive input (With the standby-time input shutdown function) • TTL input (With the standby-time input shutdown function) • Programmable pull-up resistor: approx. 50 kΩ
H		• CMOS level output (I_{OL} = 3 mA, I_{OH} = –3 mA) • CMOS hysteresis inputs (With the stand-by-time input shutdown function) • Automotive input (With the standby-time input shutdown function)

(Continued)

Type	Circuit	Remarks
I		• CMOS level output (I_{OL} = 4 mA, I_{OH} = –4 mA) • CMOS hysteresis inputs (With the stand-by-time input shutdown function) • Automotive input (With the standby-time input shutdown function) • A/D analog input
K		• Power supply input protection circuit
L		• A/D converter reference voltage power supply input pin, with the protection circuit • Flash memory devices do not have a protection circuit against V_{CC} for pin AVRH.

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Type	Circuit	Remarks
N		• CMOS level output (I_{OL} = 4 mA, I_{OH} = –4 mA) • CMOS inputs (With the standby-time input shutdown function) • Automotive input (With the standby-time input shutdown function) • TTL input (With the standby-time input shutdown function) • Programmable pull-up resistor: approx. 50 kΩ
O		• CMOS level output (I_{OL} = 4 mA, I_{OH} = –4 mA) • CMOS inputs (With the standby-time input shutdown function) • Automotive input (With the standby-time input shutdown function) • A/D analog input

■ HANDLING DEVICES

Special care is required for the following when handling the device :

- Preventing latch-up
- Treatment of unused pins
- Using external clock
- Precautions for when not using a sub clock signal
- Notes on during operation of PLL clock mode
- Power supply pins (V_{CC}/V_{SS})
- Pull-up/down resistors
- Crystal Oscillator Circuit
- Turning-on Sequence of Power Supply to A/D Converter and Analog Inputs
- Connection of Unused Pins of A/D Converter
- Notes on Energization
- Stabilization of power supply voltage
- Initialization
- Port0 to port3 output during Power-on (External-bus mode)
- Notes on using CAN Function
- Flash security Function
- Correspondence with $T_A = +105$ °C or more
- Low voltage/CPU operation detection reset circuit
- Internal CR oscillation circuit

1. Preventing latch-up

CMOS IC chips may suffer latch-up under the following conditions :

- A voltage higher than V_{CC} or lower than V_{SS} is applied to an input or output pin.
- A voltage higher than the rated voltage is applied between V_{CC} pin and V_{SS} pin.
- The AV_{CC} power supply is applied before the V_{CC} voltage.

Latch-up may increase the power supply current drastically, causing thermal damage to the device.

In using the devices, take sufficient care to avoid exceeding maximum ratings.

For the same reason, also be careful not to let the analog power-supply voltage (AV_{CC}, AVRH) exceed the digital power-supply voltage.

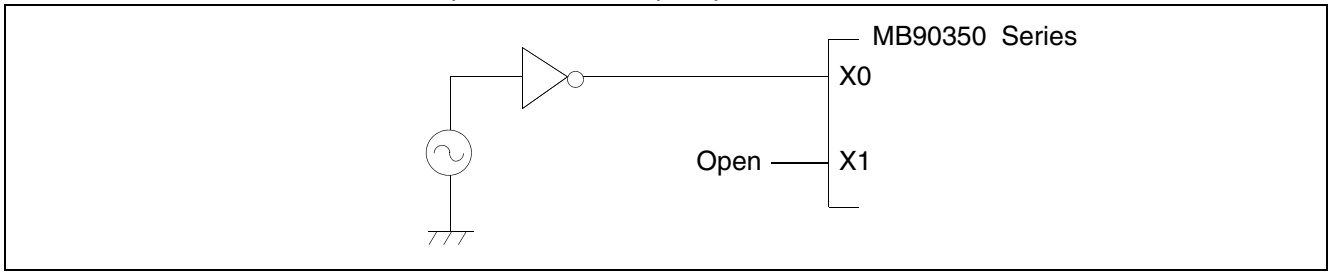
2. Handling unused pins

Leaving unused input pins open may result in misbehavior or latch up and possible permanent damage of the device. Therefore they must be pulled up or pulled down through resistors. In this case those resistors should be more than 2 kΩ.

Unused I/O pins should be set to the output state and can be left open, or the input state with the above described connection.

3. Using external clock

To use external clock, drive the X0 pin and leave X1 pin open.



4. Precautions for when not using a sub clock signal

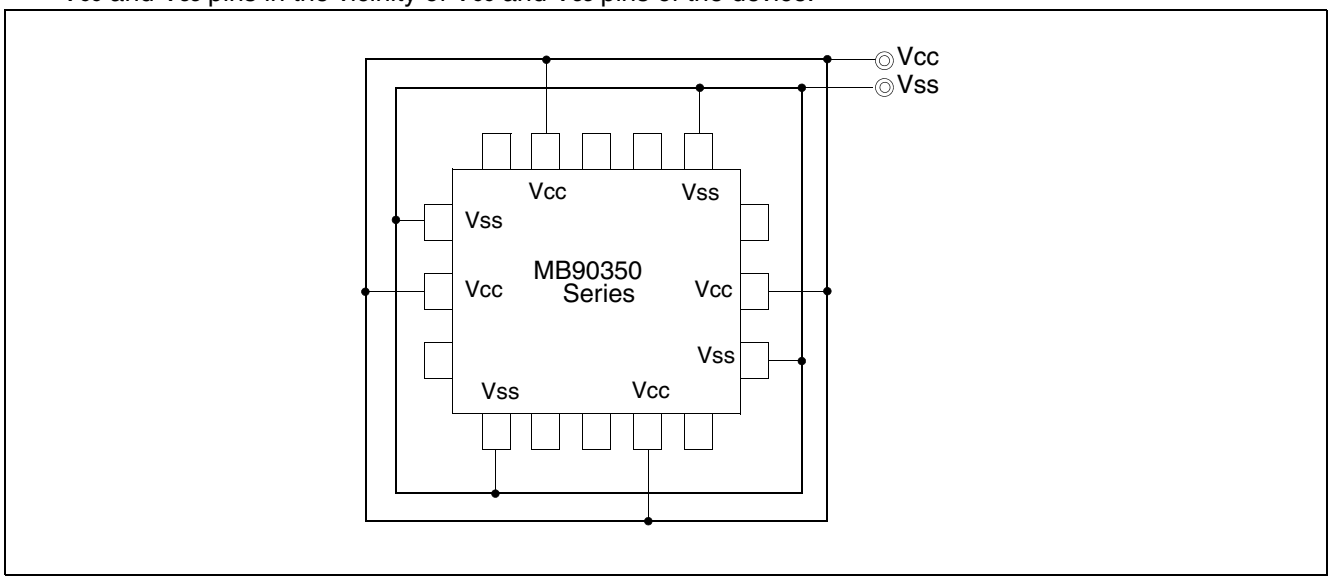
If you do not connect pins X0A and X1A to an oscillator, use pull-down handling on the X0A pin, and leave the X1A pin open.

5. Notes on during operation of PLL clock mode

If the PLL clock mode is selected, the microcontroller attempts to be working with the self-oscillating circuit even when there is no external oscillator or external clock input is stopped. Performance of this operation, however, cannot be guaranteed.

6. Power supply pins (V_{CC}/V_{SS})

- If there are multiple V_{CC} and V_{SS} pins, from the point of view of device design, pins to be of the same potential are connected inside of the device to prevent such malfunctioning as latch up.
  To reduce unnecessary radiation, prevent malfunctioning of the strobe signal due to the rise of ground level, and observe the standard for total output current, be sure to connect the V_{CC} and V_{SS} pins to the power supply and ground externally.
  Connect V_{CC} and V_{SS} pins to the device from the current supply source at a low impedance.
- As a measure against power supply noise, connect a capacitor of about 0.1 μF as a bypass capacitor between V_{CC} and V_{SS} pins in the vicinity of V_{CC} and V_{SS} pins of the device.



7. Pull-up/down resistors

The MB90350 series does not support internal pull-up/down resistors (Port 0 to Port 3: built-in pull-up resistors). Use external components where needed.

8. Crystal Oscillator Circuit

Noises around X0 or X1 pins may be possible causes of abnormal operations. Make sure to provide bypass capacitors via shortest distance from X0, X1 pins, crystal oscillator (or ceramic resonator) and ground lines, and make sure, to the utmost effort, that lines of oscillation circuit do not cross the lines of other circuits.

It is highly recommended to provide a printed circuit board artwork surrounding X0 and X1 pins with a ground area for stabilizing the operation.

Please ask the crystal maker to evaluate the oscillational characteristics of the crystal and this device.

9. Turning-on Sequence of Power Supply to A/D Converter and Analog Inputs

Make sure to turn on the A/D converter power supply (AV_{CC}, AVRH) and analog inputs (AN0 to AN14) after turning-on the digital power supply (V_{CC}) .

Turn-off the digital power after turning off the A/D converter power supply and analog inputs. In this case, make sure that the voltage does not exceed AVRH or AV_{CC} (turning on/off the analog and digital power supplies simultaneously is acceptable).

10. Connection of Unused Pins of A/D Converter if A/D Converter is not used

Connect unused pins of A/D converter to $AV_{CC} = V_{CC}$, $AV_{SS} = AVRH = V_{SS}$.

11. Notes on Energization

To prevent the internal regulator circuit from malfunctioning, set the voltage rise time during energization at 50 µs or more (0.2 V to 2.7 V) .

12. Stabilization of power supply voltage

A sudden change in the power supply voltage may cause the device to malfunction even within the specified V_{CC} power supply voltage operating range. Therefore, the V_{CC} power supply voltage should be stabilized.

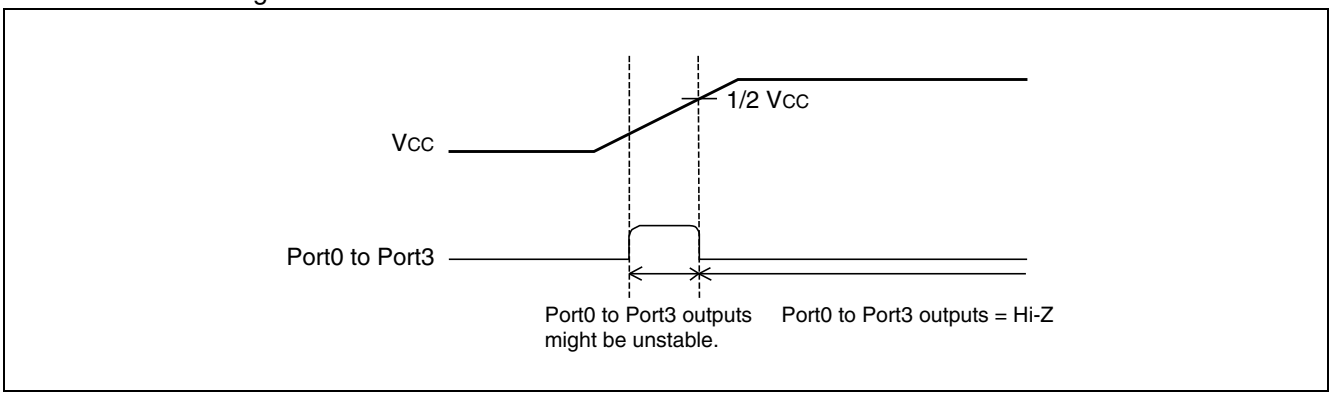
For reference, the power supply voltage should be controlled so that V_{CC} ripple variations (peak-to-peak value) at commercial frequencies (50 Hz to 60 Hz) fall below 10% of the standard V_{CC} power supply voltage and the coefficient of fluctuation does not exceed 0.1 V/ms at instantaneous power switching.

13. Initialization

In the device, there are internal registers which are initialized only by a power-on reset. To initialize these registers, turn on the power again.

14. Port 0 to port 3 output during Power-on (External-bus mode)

As shown below, when power is turned on in external-bus mode, there is a possibility that output signal of Port 0 to Port 3 might be unstable.



15. Notes on using CAN Function

To use CAN function, please set “1” to DIRECT bit of CAN direct mode register (CDMR).
If DIRECT bit is set to “0” (initial value), wait states will be performed when accessing CAN registers.

Note : Please refer to section “22.15 CAN Direct Mode Register” in Hardware Manual of MB90350 series for detail of CAN direct mode register.

16. Flash security Function

The security byte is located in the area of the flash memory.
If protection code 01_H is written in the security byte, the flash memory is in the protected state by security.
Therefore please do not write 01_H in this address if you do not use the security function.
Please refer to following table for the address of the security byte.

	Flash memory size	Address for security bit
MB90F352(S) MB90F352A(S) MB90F352TA(S) MB90F357A(S) MB90F357TA(S)	Embedded 1 Mbit Flash Memory	FE0001$_H$

17. Correspondence with T_A = +105 °C or more

If used exceeding T_A = +105 °C, please contact sales representatives for reliability limitations.

18. Low voltage/CPU operation reset circuit

The low voltage detection reset circuit is a function that monitors power supply voltage in order to detect when a voltage drops below a given voltage level. When a low voltage condition is detected, an internal reset signal is generated.
The CPU operation detection reset circuit is a 20-bit counter that uses oscillation as a count clock and generates an internal reset signal if not cleared within a given time after startup.

(1) Low voltage detection reset circuit

Detection voltage
4.0 V ± 0.3 V

When a low voltage condition is detected, the low voltage detection flag (LVRC: LVRF) is set to “1” and an internal reset signal is output.
Because the low voltage detection reset circuit continues to operate even in stop mode, detection of a low voltage condition generates an internal reset and releases stop mode.
During an internal RAM write cycle, low voltage reset is generated after the completion of writing. During the output of this internal reset, the reset output from the low voltage detection reset circuit is suppressed.

(2) CPU operation detection reset circuit

The CPU operation detection reset circuit is a counter that prevents program runaway. The counter starts automatically after a power-on reset, and must be continually cleared within a given time. If the given time interval elapses and the counter has not been cleared, a cause such as infinite program looping is assumed and an internal reset signal is generated. The internal reset generated from the CPU operation detection circuit has a width of 5 machine cycles.

Interval time
$2^{20}/F_C$ (approx. 262 ms*)

* : This value assumes the interval time at an oscillation clock frequency of 4 MHz.
During recovery from standby mode, the detection period is the maximum interval plus 20 µs.

This circuit does not operate in modes where CPU operation is stopped.
The CPU operation detection reset circuit counter is cleared under any of the following conditions.

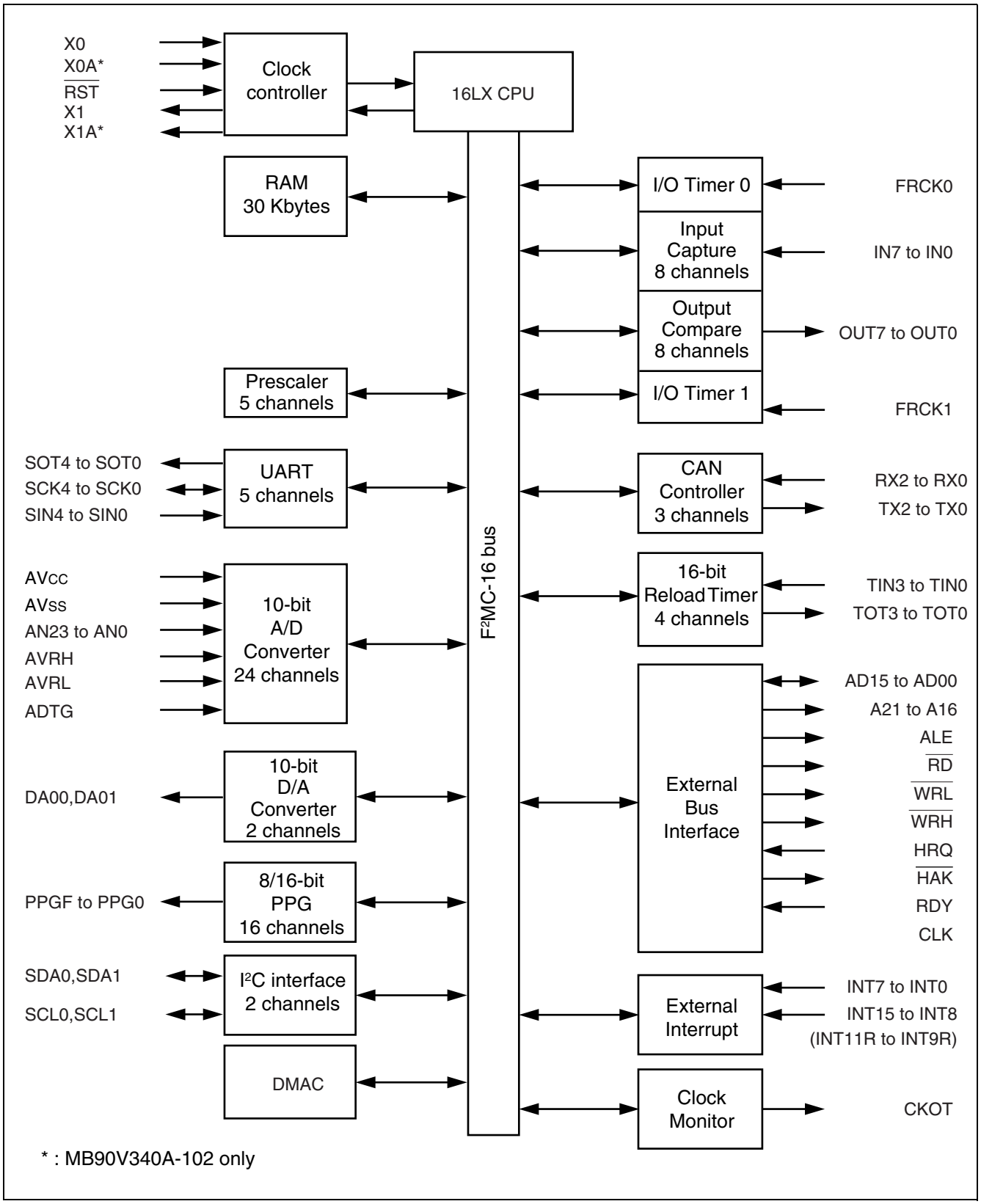
- “0” writing to CL bit of LVRC register
- Internal reset
- Main oscillation clock stop
- Transit to sleep mode
- Transit to timebase timer mode and watch mode

19. Internal CR oscillation circuit

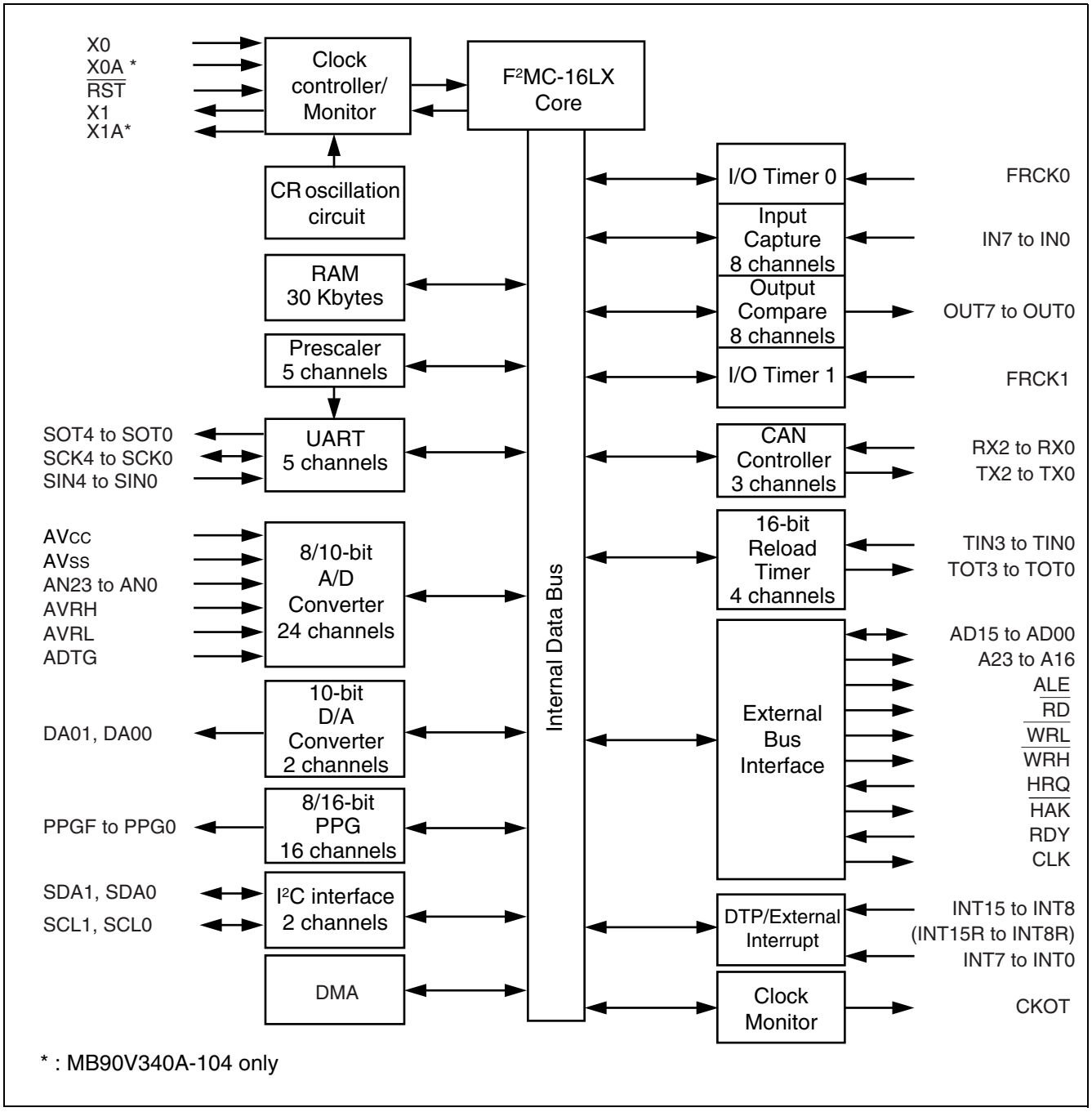
Parameter	Symbol	Value			Unit
		Min	Typ	Max	
Oscillation frequency	f_{RC}	50	100	200	kHz
Oscillation stabilization wait time	tstab	—	—	100	µs

■ BLOCK DIAGRAMS

• MB90V340A-101/102

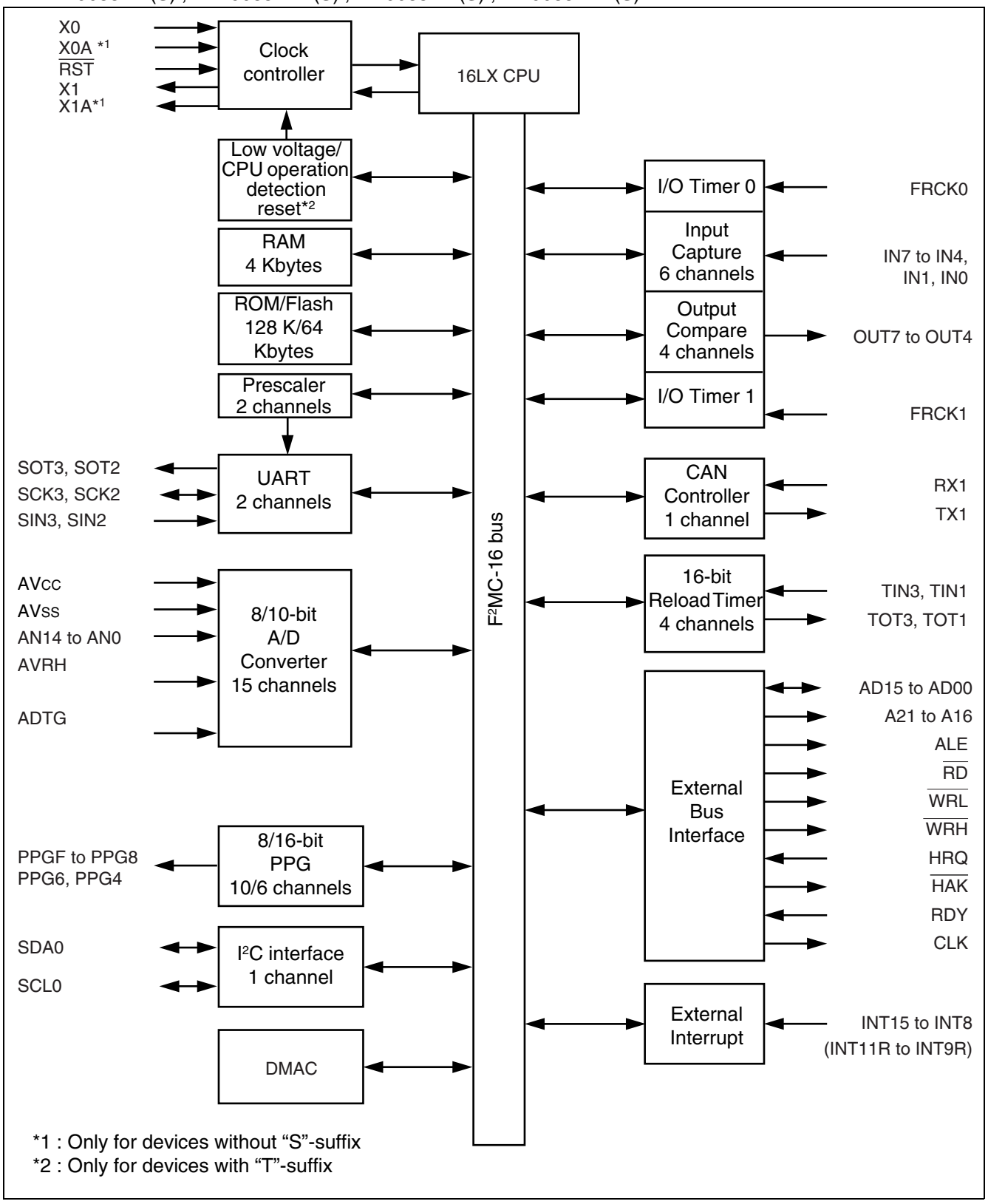


• MB90V340A-103/104



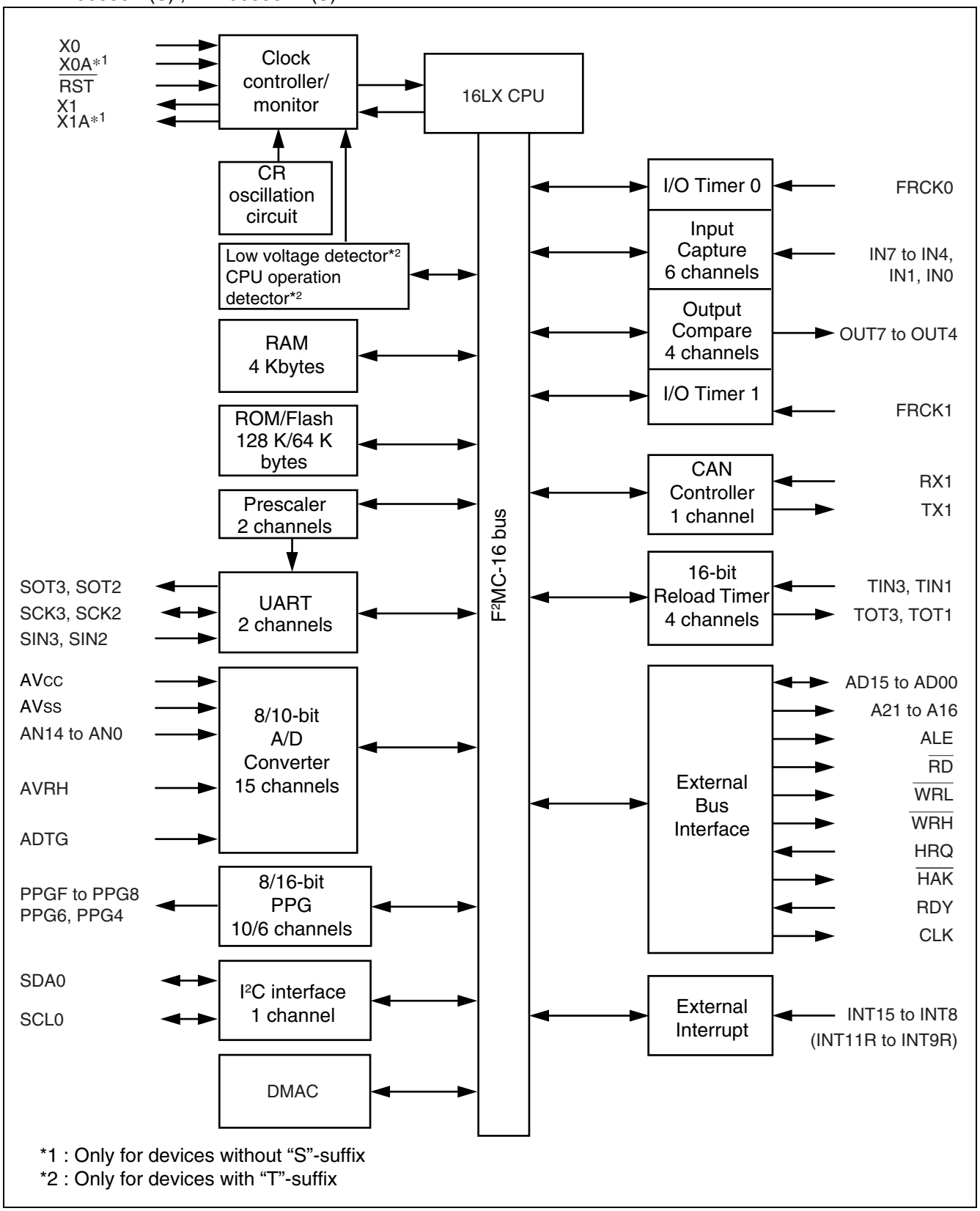
* : MB90V340A-104 only

- MB90F352 (S) , MB90F351 (S) , MB90F352A (S) , MB90F352TA (S) , MB90F351A (S) , MB90F351TA (S) , MB90352A (S) , MB90352TA (S) , MB90351A (S) , MB90351TA (S)



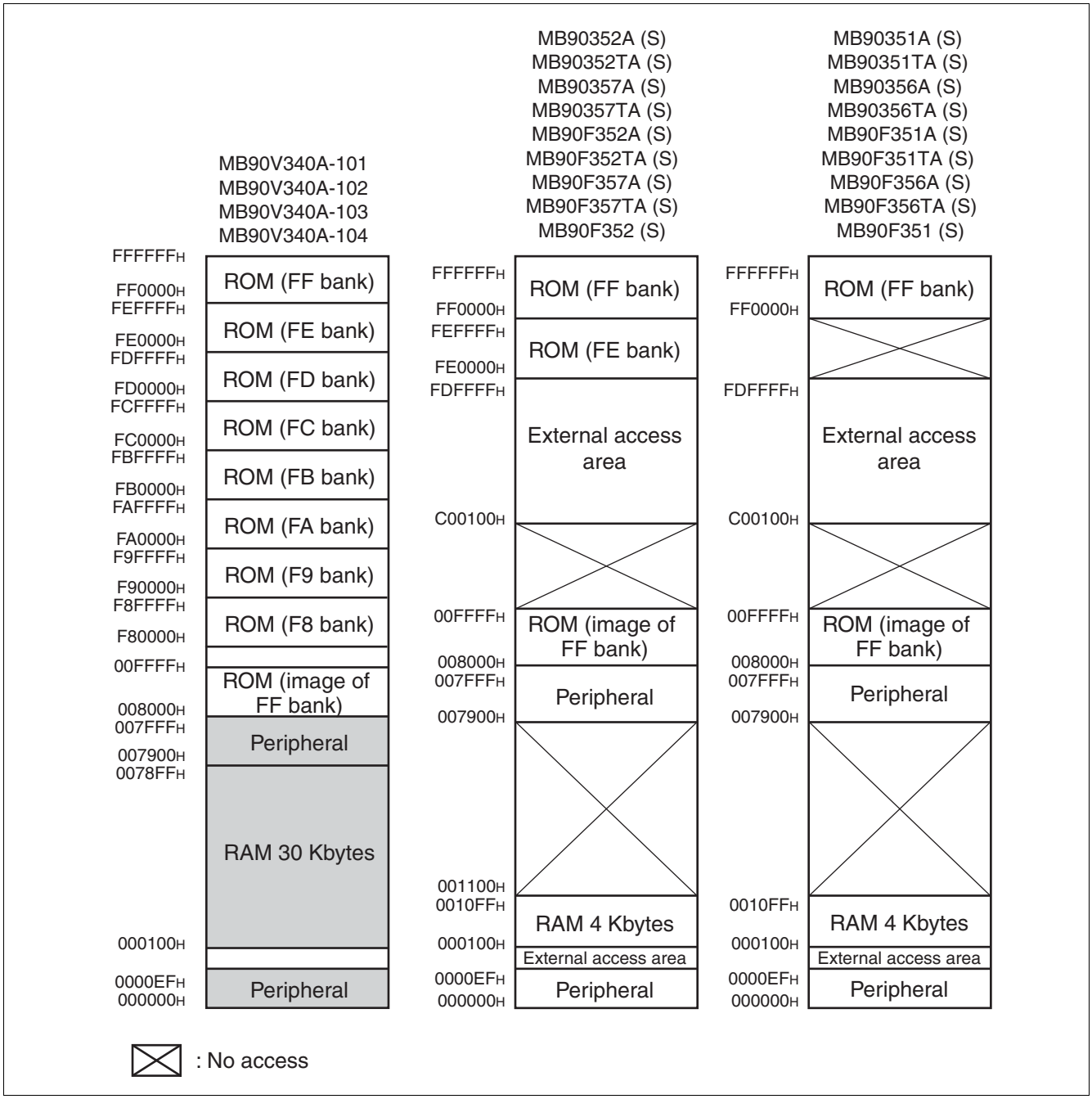
*1 : Only for devices without “S”-suffix
*2 : Only for devices with “T”-suffix

- MB90F357A (S) , MB90F357TA (S) , MB90F356A (S) , MB90F356TA (S) , MB90357A (S) , MB90357TA (S) , MB90356A (S) , MB90356TA (S)



*1 : Only for devices without “S”-suffix
*2 : Only for devices with “T”-suffix

■ MEMORY MAP



Note : The high-order portion of bank 00 gives the image of the FF bank ROM to make the small model of the C compiler effective. Since the low-order 16 bits are the same, the table in ROM can be referenced without using the far specification in the pointer declaration.
For example, an attempt to access 00C000H accesses the value at FFC000H in ROM.
The ROM area in bank FF exceeds 32 Kbytes, and its entire image cannot be shown in bank 00.
The image between FF8000H and FFFFFFH is visible in bank 00, while the image between FF0000H and FF7FFFH is visible only in bank FF.

■ I/O MAP

Address	Register	Abbreviation	Access	Resource name	Initial value
00H	Port 0 Data Register	PDR0	R/W	Port 0	XXXXXXXXB
01H	Port 1 Data Register	PDR1	R/W	Port 1	XXXXXXXXB
02H	Port 2 Data Register	PDR2	R/W	Port 2	XXXXXXXXB
03H	Port 3 Data Register	PDR3	R/W	Port 3	XXXXXXXXB
04H	Port 4 Data Register	PDR4	R/W	Port 4	XXXXXXXXB
05H	Port 5 Data Register	PDR5	R/W	Port 5	XXXXXXXXB
06H	Port 6 Data Register	PDR6	R/W	Port 6	XXXXXXXXB
07H to 0AH	Reserved				
0BH	Port 5 Analog Input Enable Register	ADER5	R/W	Port 5, A/D	11111111B
0CH	Port 6 Analog Input Enable Register	ADER6	R/W	Port 6, A/D	11111111B
0DH	Reserved				
0EH	Input Level Select Register 0	ILSR0	R/W	Ports	00000000B
0FH	Input Level Select Register 1	ILSR1	R/W	Ports	00000000B
10H	Port 0 Direction Register	DDR0	R/W	Port 0	00000000B
11H	Port 1 Direction Register	DDR1	R/W	Port 1	00000000B
12H	Port 2 Direction Register	DDR2	R/W	Port 2	XX000000B
13H	Port 3 Direction Register	DDR3	R/W	Port 3	00000000B
14H	Port 4 Direction Register	DDR4	R/W	Port 4	XX000000B
15H	Port 5 Direction Register	DDR5	R/W	Port 5	X0000000B
16H	Port 6 Direction Register	DDR6	R/W	Port 6	00000000B
17H to 19H	Reserved				
1AH	SIN input Level Setting Register	DDRA	W	UART2, UART3	X00XXXXXB
1BH	Reserved				
1CH	Port 0 Pull-up Control Register	PUCR0	R/W	Port 0	00000000B
1DH	Port 1 Pull-up Control Register	PUCR1	R/W	Port 1	00000000B
1EH	Port 2 Pull-up Control Register	PUCR2	R/W	Port 2	00000000B
1FH	Port 3 Pull-up Control Register	PUCR3	R/W	Port 3	00000000B
20H to 37H	Reserved				
38H	PPG 4 Operation Mode Control Register	PPGC4	W, R/W	16-bit Programmable Pulse Generator 4/5	0X000XX1B
39H	PPG 5 Operation Mode Control Register	PPGC5	W, R/W		0X000001B
3AH	PPG 4/5 Count Clock Select Register	PPG45	R/W		000000X0B
3BH	Address Detect Control Register 1	PACSR1	R/W	Address Match Detection 1	00000000B

(Continued)

Address	Register	Abbreviation	Access	Resource name	Initial value
3C$_H$	PPG 6 Operation Mode Control Register	PPGC6	W, R/W	16-bit Programmable Pulse Generator 6/7	0X000XX1$_B$
3D$_H$	PPG 7 Operation Mode Control Register	PPGC7	W, R/W		0X000001$_B$
3E$_H$	PPG 6/7 Count Clock Select Register	PPG67	R/W		000000X0$_B$
3F$_H$	Reserved				
40$_H$	PPG 8 Operation Mode Control Register	PPGC8	W, R/W	16-bit Programmable Pulse Generator 8/9	0X000XX1$_B$
41$_H$	PPG 9 Operation Mode Control Register	PPGC9	W, R/W		0X000001$_B$
42$_H$	PPG 8/9 Count Clock Select Register	PPG89	R/W		000000X0$_B$
43$_H$	Reserved				
44$_H$	PPG A Operation Mode Control Register	PPGCA	W, R/W	16-bit Programmable Pulse Generator A/B	0X000XX1$_B$
45$_H$	PPG B Operation Mode Control Register	PPGCB	W, R/W		0X000001$_B$
46$_H$	PPG A/B Count Clock Select Register	PPGAB	R/W		000000X0$_B$
47$_H$	Reserved				
48$_H$	PPG C Operation Mode Control Register	PPGCC	W,R/W	16-bit Programmable Pulse Generator C/D	0X000XX1$_B$
49$_H$	PPG D Operation Mode Control Register	PPGCD	W,R/W		0X000001$_B$
4A$_H$	PPG C/D Count Clock Select Register	PPGCD	R/W		000000X0$_B$
4B$_H$	Reserved				
4C$_H$	PPG E Operation Mode Control Register	PPGCE	W,R/W	16-bit Programmable Pulse Generator E/F	0X000XX1$_B$
4D$_H$	PPG F Operation Mode Control Register	PPGCF	W,R/W		0X000001$_B$
4E$_H$	PPG E/F Count Clock Select Register	PPGEF	R/W		000000X0$_B$
4F$_H$	Reserved				
50$_H$	Input Capture Control Status Register 0/1	ICS01	R/W	Input Capture 0/1	00000000$_B$
51$_H$	Input Capture Edge Register 0/1	ICE01	R/W, R		XXX0X0XX$_B$
52$_H$, 53$_H$	Reserved				
54$_H$	Input Capture Control Status Register 4/5	ICS45	R/W	Input Capture 4/5	00000000$_B$
55$_H$	Input Capture Edge Register 4/5	ICE45	R		XXXXXXXX$_B$
56$_H$	Input Capture Control Status Register 6/7	ICS67	R/W	Input Capture 6/7	00000000$_B$
57$_H$	Input Capture Edge Register 6/7	ICE67	R/W, R		XXX000XX$_B$
58$_H$ to 5B$_H$	Reserved				
5C$_H$	Output Compare Control Status Register 4	OCS4	R/W	Output Compare 4/5	0000XX00$_B$
5D$_H$	Output Compare Control Status Register 5	OCS5	R/W		0XX00000$_B$

(Continued)

Address	Register	Abbreviation	Access	Resource name	Initial value
5E$_H$	Output Compare Control Status Register 6	OCS6	R/W	Output Compare 6/7	0000XX00$_B$
5F$_H$	Output Compare Control Status Register 7	OCS7	R/W		0XX00000$_B$
60$_H$	Timer Control Status Register 0	TMCSR0	R/W	16-bit Reload Timer 0	00000000$_B$
61$_H$	Timer Control Status Register 0	TMCSR0	R/W		XXXX0000$_B$
62$_H$	Timer Control Status Register 1	TMCSR1	R/W	16-bit Reload Timer 1	00000000$_B$
63$_H$	Timer Control Status Register 1	TMCSR1	R/W		XXXX0000$_B$
64$_H$	Timer Control Status Register 2	TMCSR2	R/W	16-bit Reload Timer 2	00000000$_B$
65$_H$	Timer Control Status Register 2	TMCSR2	R/W		XXXX0000$_B$
66$_H$	Timer Control Status Register 3	TMCSR3	R/W	16-bit Reload Timer 3	00000000$_B$
67$_H$	Timer Control Status Register 3	TMCSR3	R/W		XXXX0000$_B$
68$_H$	A/D Control Status Register 0	ADCS0	R/W	A/D Converter	000XXXX0$_B$
69$_H$	A/D Control Status Register 1	ADCS1	R/W		0000000X$_B$
6A$_H$	A/D Data Register 0	ADCR0	R		00000000$_B$
6B$_H$	A/D Data Register 1	ADCR1	R		XXXXXX00$_B$
6C$_H$	ADC Setting Register 0	ADSR0	R/W		00000000$_B$
6D$_H$	ADC Setting Register 1	ADSR1	R/W		00000000$_B$
6E$_H$	Low Voltage/CPU Operation Detection Reset Control Register	LVRC	R/W, W	Low Voltage/CPU Operation Detection Reset	00111000$_B$
6F$_H$	ROM Mirror Function Select Register	ROMM	W	ROM Mirror	XXXXXXX1$_B$
70$_H$ to 7F$_H$	Reserved				
80$_H$ to 8F$_H$	Reserved for CAN Interface 1. Refer to “■ CAN CONTROLLERS”				
90$_H$ to 9A$_H$	Reserved				
9B$_H$	DMA Descriptor Channel Specification Register	DCSR	R/W	DMA	00000000$_B$
9C$_H$	DMA Status Register L	DSRL	R/W		00000000$_B$
9D$_H$	DMA Status Register H	DSRH	R/W		00000000$_B$
9E$_H$	Address Detect Control Register 0	PACSR0	R/W	Address Match Detection 0	00000000$_B$
9F$_H$	Delayed Interrupt/Release Register	DIRR	R/W	Delayed Interrupt	XXXXXXX0$_B$
A0$_H$	Low-power Consumption Mode Control Register	LPMCR	W,R/W	Low Power Consumption Control Circuit	00011000$_B$
A1$_H$	Clock Selection Register	CKSCR	R,R/W	Low Power Consumption Control Circuit	11111100$_B$
A2$_H$, A3$_H$	Reserved				

(Continued)

Address	Register	Abbreviation	Access	Resource name	Initial value
A4H	DMA Stop Status Register	DSSR	R/W	DMA	00000000B
A5H	Automatic Ready Function Selection Register	ARSR	W	External Memory Access	0011XX00B
A6H	External Address Output Control Register	HACR	W		00000000B
A7H	Bus Control Signal Selection Register	ECSR	W		0000000XB
A8H	Watchdog Control Register	WDTC	R,W	Watchdog Timer	XXXXX111B
A9H	Timebase Timer Control Register	TBTC	W,R/W	Timebase timer	1XX00100B
AAH	Watch Timer Control Register	WTC	R,R/W	Watch Timer	1X001000B
ABH	Reserved				
ACH	DMA Enable Register L	DERL	R/W	DMA	00000000B
ADH	DMA Enable Register H	DERH	R/W		00000000B
AEH	Flash Control Status Register (Flash Devices only. Otherwise reserved)	FMCS	R,R/W	Flash Memory	000X0000B
AFH	Reserved				
B0H	Interrupt Control Register 00	ICR00	W,R/W	Interrupt Control	00000111B
B1H	Interrupt Control Register 01	ICR01	W,R/W		00000111B
B2H	Interrupt Control Register 02	ICR02	W,R/W		00000111B
B3H	Interrupt Control Register 03	ICR03	W,R/W		00000111B
B4H	Interrupt Control Register 04	ICR04	W,R/W		00000111B
B5H	Interrupt Control Register 05	ICR05	W,R/W		00000111B
B6H	Interrupt Control Register 06	ICR06	W,R/W		00000111B
B7H	Interrupt Control Register 07	ICR07	W,R/W		00000111B
B8H	Interrupt Control Register 08	ICR08	W,R/W		00000111B
B9H	Interrupt Control Register 09	ICR09	W,R/W		00000111B
BAH	Interrupt Control Register 10	ICR10	W,R/W		00000111B
BBH	Interrupt Control Register 11	ICR11	W,R/W		00000111B
BCH	Interrupt Control Register 12	ICR12	W,R/W		00000111B
BDH	Interrupt Control Register 13	ICR13	W,R/W		00000111B
BEH	Interrupt Control Register 14	ICR14	W,R/W		00000111B
BFH	Interrupt Control Register 15	ICR15	W,R/W		00000111B
C0H to C9H	Reserved				

(Continued)

Address	Register	Abbreviation	Access	Resource name	Initial value
CA$_H$	External Interrupt Enable Register 1	ENIR1	R/W	External Interrupt 1	00000000$_B$
CB$_H$	External Interrupt Source Register 1	EIRR1	R/W		XXXXXXXX$_B$
CC$_H$	External Interrupt Level Register 1	ELVR1	R/W		00000000$_B$
CD$_H$	External Interrupt Level Register 1	ELVR1	R/W		00000000$_B$
CE$_H$	External Interrupt Source Select Register	EISSR	R/W		00000000$_B$
CF$_H$	PLL/Sub clock Control register	PSCCR	W	PLL	XXXX0000$_B$
D0$_H$	DMA Buffer Address Pointer L	BAPL	R/W	DMA	XXXXXXXX$_B$
D1$_H$	DMA Buffer Address Pointer M	BAPM	R/W		XXXXXXXX$_B$
D2$_H$	DMA Buffer Address Pointer H	BAPH	R/W		XXXXXXXX$_B$
D3$_H$	DMA Control Register	DMACS	R/W		XXXXXXXX$_B$
D4$_H$	I/O Register Address Pointer L	IOAL	R/W		XXXXXXXX$_B$
D5$_H$	I/O Register Address Pointer H	IOAH	R/W		XXXXXXXX$_B$
D6$_H$	Data Counter L	DCTL	R/W		XXXXXXXX$_B$
D7$_H$	Data Counter H	DCTH	R/W		XXXXXXXX$_B$
D8$_H$	Serial Mode Register 2	SMR2	W,R/W	UART2	00000000$_B$
D9$_H$	Serial Control Register 2	SCR2	W,R/W		00000000$_B$
DA$_H$	Reception/Transmission Data Register 2	RDR2/ TDR2	R/W		00000000$_B$
DB$_H$	Serial Status Register 2	SSR2	R,R/W		00001000$_B$
DC$_H$	Extended Communication Control Register 2	ECCR2	R,W, R/W		000000XX$_B$
DD$_H$	Extended Status/Control Register 2	ESCR2	R/W		00000100$_B$
DE$_H$	Baud Rate Generator Register 20	BGR20	R/W		00000000$_B$
DF$_H$	Baud Rate Generator Register 21	BGR21	R/W		00000000$_B$
E0$_H$ to EF$_H$	Reserved				
F0$_H$ to FF$_H$	External area				
7900$_H$ to 7907$_H$	Reserved				

(Continued)

Address	Register	Abbreviation	Access	Resource name	Initial value
7908H	Reload Register L4	PRLL4	R/W	16-bit Programmable Pulse Generator 4/5	XXXXXXXXB
7909H	Reload Register H4	PRLH4	R/W		XXXXXXXXB
790AH	Reload Register L5	PRLL5	R/W		XXXXXXXXB
790BH	Reload Register H5	PRLH5	R/W		XXXXXXXXB
790CH	Reload Register L6	PRLL6	R/W	16-bit Programmable Pulse Generator 6/7	XXXXXXXXB
790DH	Reload Register H6	PRLH6	R/W		XXXXXXXXB
790EH	Reload Register L7	PRLL7	R/W		XXXXXXXXB
790FH	Reload Register H7	PRLH7	R/W		XXXXXXXXB
7910H	Reload Register L8	PRLL8	R/W	16-bit Programmable Pulse Generator 8/9	XXXXXXXXB
7911H	Reload Register H8	PRLH8	R/W		XXXXXXXXB
7912H	Reload Register L9	PRLL9	R/W		XXXXXXXXB
7913H	Reload Register H9	PRLH9	R/W		XXXXXXXXB
7914H	Reload Register LA	PRLLA	R/W	16-bit Programmable Pulse Generator A/B	XXXXXXXXB
7915H	Reload Register HA	PRLHA	R/W		XXXXXXXXB
7916H	Reload Register LB	PRLLB	R/W		XXXXXXXXB
7917H	Reload Register HB	PRLHB	R/W		XXXXXXXXB
7918H	Reload Register LC	PRLLC	R/W	16-bit Programmable Pulse Generator C/D	XXXXXXXXB
7919H	Reload Register HC	PRLHC	R/W		XXXXXXXXB
791AH	Reload Register LD	PRLLD	R/W		XXXXXXXXB
791BH	Reload Register HD	PRLHD	R/W		XXXXXXXXB
791CH	Reload Register LE	PRLLE	R/W	16-bit Programmable Pulse Generator E/F	XXXXXXXXB
791DH	Reload Register HE	PRLHE	R/W		XXXXXXXXB
791EH	Reload Register LF	PRLLF	R/W		XXXXXXXXB
791FH	Reload Register HF	PRLHF	R/W		XXXXXXXXB
7920H	Input Capture Register 0	IPCP0	R	Input Capture 0/1	XXXXXXXXB
7921H	Input Capture Register 0	IPCP0	R		XXXXXXXXB
7922H	Input Capture Register 1	IPCP1	R		XXXXXXXXB
7923H	Input Capture Register 1	IPCP1	R		XXXXXXXXB
7924H to 7927H	Reserved				
7928H	Input Capture Register 4	IPCP4	R	Input Capture 4/5	XXXXXXXXB
7929H	Input Capture Register 4	IPCP4	R		XXXXXXXXB
792AH	Input Capture Register 5	IPCP5	R		XXXXXXXXB
792BH	Input Capture Register 5	IPCP5	R		XXXXXXXXB

(Continued)

Address	Register	Abbreviation	Access	Resource name	Initial value
792C$_H$	Input Capture Register 6	IPCP6	R	Input Capture 6/7	XXXXXXXX$_B$
792D$_H$	Input Capture Register 6	IPCP6	R		XXXXXXXX$_B$
792E$_H$	Input Capture Register 7	IPCP7	R		XXXXXXXX$_B$
792F$_H$	Input Capture Register 7	IPCP7	R		XXXXXXXX$_B$
7930$_H$ to 7937$_H$	Reserved				
7938$_H$	Output Compare Register 4	OCCP4	R/W	Output Compare 4/5	XXXXXXXX$_B$
7939$_H$	Output Compare Register 4	OCCP4	R/W		XXXXXXXX$_B$
793A$_H$	Output Compare Register 5	OCCP5	R/W		XXXXXXXX$_B$
793B$_H$	Output Compare Register 5	OCCP5	R/W		XXXXXXXX$_B$
793C$_H$	Output Compare Register 6	OCCP6	R/W	Output Compare 6/7	XXXXXXXX$_B$
793D$_H$	Output Compare Register 6	OCCP6	R/W		XXXXXXXX$_B$
793E$_H$	Output Compare Register 7	OCCP7	R/W		XXXXXXXX$_B$
793F$_H$	Output Compare Register 7	OCCP7	R/W		XXXXXXXX$_B$
7940$_H$	Timer Data Register 0	TCDT0	R/W	I/O Timer 0	00000000$_B$
7941$_H$	Timer Data Register 0	TCDT0	R/W		00000000$_B$
7942$_H$	Timer Control Status Register 0	TCCSL0	R/W		00000000$_B$
7943$_H$	Timer Control Status Register 0	TCCSH0	R/W		0XXXXXXX$_B$
7944$_H$	Timer Data Register 1	TCDT1	R/W	I/O Timer 1	00000000$_B$
7945$_H$	Timer Data Register 1	TCDT1	R/W		00000000$_B$
7946$_H$	Timer Control Status Register 1	TCCSL1	R/W		00000000$_B$
7947$_H$	Timer Control Status Register 1	TCCSH1	R/W		0XXXXXXX$_B$
7948$_H$	Timer Register 0/Reload Register 0	TMR0/ TMRLR0	R/W	16-bit Reload Timer 0	XXXXXXXX$_B$
7949$_H$			R/W		XXXXXXXX$_B$
794A$_H$	Timer Register 1/Reload Register 1	TMR1/ TMRLR1	R/W	16-bit Reload Timer 1	XXXXXXXX$_B$
794B$_H$			R/W		XXXXXXXX$_B$
794C$_H$	Timer Register 2/Reload Register 2	TMR2/ TMRLR2	R/W	16-bit Reload Timer 2	XXXXXXXX$_B$
794D$_H$			R/W		XXXXXXXX$_B$
794E$_H$	Timer Register 3/Reload Register 3	TMR3/ TMRLR3	R/W	16-bit Reload Timer 3	XXXXXXXX$_B$
794F$_H$			R/W		XXXXXXXX$_B$

(Continued)

Address	Register	Abbreviation	Access	Resource name	Initial value
7950H	Serial Mode Register 3	SMR3	W, R/W	UART3	00000000B
7951H	Serial Control Register 3	SCR3	W, R/W		00000000B
7952H	Reception/Transmission Data Register 3	RDR3/ TDR3	R/W		00000000B
7953H	Serial Status Register 3	SSR3	R,R/W		00001000B
7954H	Extended Communication Control Register 3	ECCR3	R,W, R/W		000000XXB
7955H	Extended Status/Control Register 3	ESCR3	R/W		00000100B
7956H	Baud Rate Generator Register 30	BGR30	R/W		00000000B
7957H	Baud Rate Generator Register 31	BGR31	R/W		00000000B
7958H, 7959H	Reserved				
7960H	Clock Monitor Function Control Register	CSVCR	R, R/W	Clock Monitor	00011100B
7961H to 796DH	Reserved				
796EH	CAN Direct Mode Register	CDMR	R/W	CAN Clock Sync	XXXXXXX0B
796FH	Reserved				
7970H	I²C Bus Status Register 0	IBSR0	R	I²C Interface 0	00000000B
7971H	I²C Bus Control Register 0	IBCR0	W,R/W		00000000B
7972H	I²C 10-bit Slave Address Register 0	ITBAL0	R/W		00000000B
7973H		ITBAH0	R/W		00000000B
7974H	I²C 10-bit Slave Address Mask Register 0	ITMKL0	R/W		11111111B
7975H		ITMKH0	R/W		00111111B
7976H	I²C 7-bit Slave Address Register 0	ISBA0	R/W		00000000B
7977H	I²C 7-bit Slave Address Mask Register 0	ISMK0	R/W		01111111B
7978H	I²C data register 0	IDAR0	R/W		00000000B
7979H, 797AH	Reserved				
797BH	I²C Clock Control Register 0	ICCR0	R/W	I²C Interface 0	00011111B
797CH to 79A1H	Reserved				
79A2H	Flash Write Control Register 0	FWR0	R/W	Dual Operation Flash	00000000B
79A3H	Flash Write Control Register 1	FWR1	R/W		00000000B
79A4H	Sector Change Setting Register	SSR0	R/W		00XXXXX0B
79A5H to 79C1H	Reserved				

(Continued)

(Continued)

Address	Register	Abbreviation	Access	Resource name	Initial value
79C2H	Setting Prohibited				
79C3H to 79DFH	Reserved				
79E0H	Detect Address Setting Register 0	PADR0	R/W	Address Match Detection 0	XXXXXXXXB
79E1H	Detect Address Setting Register 0	PADR0	R/W		XXXXXXXXB
79E2H	Detect Address Setting Register 0	PADR0	R/W		XXXXXXXXB
79E3H	Detect Address Setting Register 1	PADR1	R/W		XXXXXXXXB
79E4H	Detect Address Setting Register 1	PADR1	R/W		XXXXXXXXB
79E5H	Detect Address Setting Register 1	PADR1	R/W		XXXXXXXXB
79E6H	Detect Address Setting Register 2	PADR2	R/W		XXXXXXXXB
79E7H	Detect Address Setting Register 2	PADR2	R/W		XXXXXXXXB
79E8H	Detect Address Setting Register 2	PADR2	R/W		XXXXXXXXB
79E9H to 79EFH	Reserved				
79F0H	Detect Address Setting Register 3	PADR3	R/W	Address Match Detection 1	XXXXXXXXB
79F1H	Detect Address Setting Register 3	PADR3	R/W		XXXXXXXXB
79F2H	Detect Address Setting Register 3	PADR3	R/W		XXXXXXXXB
79F3H	Detect Address Setting Register 4	PADR4	R/W		XXXXXXXXB
79F4H	Detect Address Setting Register 4	PADR4	R/W		XXXXXXXXB
79F5H	Detect Address Setting Register 4	PADR4	R/W		XXXXXXXXB
79F6H	Detect Address Setting Register 5	PADR5	R/W		XXXXXXXXB
79F7H	Detect Address Setting Register 5	PADR5	R/W		XXXXXXXXB
79F8H	Detect Address Setting Register 5	PADR5	R/W		XXXXXXXXB
79F9H to 7BFFH	Reserved				
7C00H to 7CFFH	Reserved for CAN Interface 1. Refer to “■ CAN CONTROLLERS”				
7D00H to 7DFFH	Reserved for CAN Interface 1. Refer to “■ CAN CONTROLLERS”				
7E00H to 7FFFH	Reserved				

Notes : • Initial value of “X” represents unknown value.
• Any write access to reserved addresses in I/O map should not be performed. A read access to reserved addresses results reading “X”.

■ CAN CONTROLLERS

The CAN controller has the following features :

- Conforms to CAN Specification Version 2.0 Part A and B
  - Supports transmission/reception in standard frame and extended frame formats
- Supports transmitting of data frames by receiving remote frames
- 16 transmitting/receiving message buffers
  - 29-bit ID and 8-byte data
  - Multi-level message buffer configuration
- Provides full-bit comparison, full-bit mask, acceptance register 0/acceptance register 1 for each message buffer as ID acceptance mask
  - Two acceptance mask registers in either standard frame format or extended frame formats
- Bit rate programmable from 10 Kbps to 2 Mbps (when input clock is at 16 MHz)

List of Control Registers

Address CAN1	Register	Abbreviation	Access	Initial Value
000080_H	Message buffer enable register	BVALR	R/W	00000000_B
000081_H				00000000_B
000082_H	Transmit request register	TREQR	R/W	00000000_B
000083_H				00000000_B
000084_H	Transmit cancel register	TCANR	W	00000000_B
000085_H				00000000_B
000086_H	Transmission complete register	TCR	R/W	00000000_B
000087_H				00000000_B
000088_H	Receive complete register	RCR	R/W	00000000_B
000089_H				00000000_B
$00008A_H$	Remote request receiving register	RRTRR	R/W	00000000_B
$00008B_H$				00000000_B
$00008C_H$	Receive overrun register	ROVRR	R/W	00000000_B
$00008D_H$				00000000_B
$00008E_H$	Reception interrupt enable register	RIER	R/W	00000000_B
$00008F_H$				00000000_B

(Continued)

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Address CAN1	Register	Abbreviation	Access	Initial Value
007D00H	Control status register	CSR	R/W, W R/W, R	0XXXX0X1B 00XXX000B
007D01H				
007D02H	Last event indicator register	LEIR	R/W	000X0000B XXXXXXXXB
007D03H				
007D04H	Receive/transmit error counter	RTEC	R	00000000B 00000000B
007D05H				
007D06H	Bit timing register	BTR	R/W	11111111B X1111111B
007D07H				
007D08H	IDE register	IDER	R/W	XXXXXXXXB XXXXXXXXB
007D09H				
007D0AH	Transmit RTR register	TRTRR	R/W	00000000B 00000000B
007D0BH				
007D0CH	Remote frame receive waiting register	RFWTR	R/W	XXXXXXXXB XXXXXXXXB
007D0DH				
007D0EH	Transmit interrupt enable register	TIER	R/W	00000000B 00000000B
007D0FH				
007D10H	Acceptance mask select register	AMSR	R/W	XXXXXXXXB XXXXXXXXB
007D11H				
007D12H				XXXXXXXXB XXXXXXXXB
007D13H				
007D14H	Acceptance mask register 0	AMR0	R/W	XXXXXXXXB XXXXXXXXB
007D15H				
007D16H				XXXXXXXXB XXXXXXXXB
007D17H				
007D18H	Acceptance mask register 1	AMR1	R/W	XXXXXXXXB XXXXXXXXB
007D19H				
007D1AH				XXXXXXXXB XXXXXXXXB
007D1BH				

List of Message Buffers (ID Registers)

Address CAN1	Register	Abbreviation	Access	Initial Value
007C00H to 007C1FH	General-purpose RAM	—	R/W	XXXXXXXXB to XXXXXXXXB
007C20H	ID register 0	IDR0	R/W	XXXXXXXXB XXXXXXXXB
007C21H				
007C22H				XXXXXXXXB XXXXXXXXB
007C23H				
007C24H	ID register 1	IDR1	R/W	XXXXXXXXB XXXXXXXXB
007C25H				
007C26H				XXXXXXXXB XXXXXXXXB
007C27H				
007C28H	ID register 2	IDR2	R/W	XXXXXXXXB XXXXXXXXB
007C29H				
007C2AH				XXXXXXXXB XXXXXXXXB
007C2BH				
007C2CH	ID register 3	IDR3	R/W	XXXXXXXXB XXXXXXXXB
007C2DH				
007C2EH				XXXXXXXXB XXXXXXXXB
007C2FH				
007C30H	ID register 4	IDR4	R/W	XXXXXXXXB XXXXXXXXB
007C31H				
007C32H				XXXXXXXXB XXXXXXXXB
007C33H				
007C34H	ID register 5	IDR5	R/W	XXXXXXXXB XXXXXXXXB
007C35H				
007C36H				XXXXXXXXB XXXXXXXXB
007C37H				
007C38H	ID register 6	IDR6	R/W	XXXXXXXXB XXXXXXXXB
007C39H				
007C3AH				XXXXXXXXB XXXXXXXXB
007C3BH				
007C3CH	ID register 7	IDR7	R/W	XXXXXXXXB XXXXXXXXB
007C3DH				
007C3EH				XXXXXXXXB XXXXXXXXB
007C3FH				

(Continued)

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Address CAN1	Register	Abbreviation	Access	Initial Value
007C40H	ID register 8	IDR8	R/W	XXXXXXXXB XXXXXXXXB
007C41H				
007C42H				XXXXXXXXB XXXXXXXXB
007C43H				
007C44H	ID register 9	IDR9	R/W	XXXXXXXXB XXXXXXXXB
007C45H				
007C46H				XXXXXXXXB XXXXXXXXB
007C47H				
007C48H	ID register 10	IDR10	R/W	XXXXXXXXB XXXXXXXXB
007C49H				
007C4AH				XXXXXXXXB XXXXXXXXB
007C4BH				
007C4CH	ID register 11	IDR11	R/W	XXXXXXXXB XXXXXXXXB
007C4DH				
007C4EH				XXXXXXXXB XXXXXXXXB
007C4FH				
007C50H	ID register 12	IDR12	R/W	XXXXXXXXB XXXXXXXXB
007C51H				
007C52H				XXXXXXXXB XXXXXXXXB
007C53H				
007C54H	ID register 13	IDR13	R/W	XXXXXXXXB XXXXXXXXB
007C55H				
007C56H				XXXXXXXXB XXXXXXXXB
007C57H				
007C58H	ID register 14	IDR14	R/W	XXXXXXXXB XXXXXXXXB
007C59H				
007C5AH				XXXXXXXXB XXXXXXXXB
007C5BH				
007C5CH	ID register 15	IDR15	R/W	XXXXXXXXB XXXXXXXXB
007C5DH				
007C5EH				XXXXXXXXB XXXXXXXXB
007C5FH				

List of Message Buffers (DLC Registers and Data Registers)

Address	Register	Abbreviation	Access	Initial Value
CAN1				
007C60H	DLC register 0	DLCR0	R/W	XXXXXXXXB
007C61H				
007C62H	DLC register 1	DLCR1	R/W	XXXXXXXXB
007C63H				
007C64H	DLC register 2	DLCR2	R/W	XXXXXXXXB
007C65H				
007C66H	DLC register 3	DLCR3	R/W	XXXXXXXXB
007C67H				
007C68H	DLC register 4	DLCR4	R/W	XXXXXXXXB
007C69H				
007C6AH	DLC register 5	DLCR5	R/W	XXXXXXXXB
007C6BH				
007C6CH	DLC register 6	DLCR6	R/W	XXXXXXXXB
007C6DH				
007C6EH	DLC register 7	DLCR7	R/W	XXXXXXXXB
007C6FH				
007C70H	DLC register 8	DLCR8	R/W	XXXXXXXXB
007C71H				
007C72H	DLC register 9	DLCR9	R/W	XXXXXXXXB
007C73H				
007C74H	DLC register 10	DLCR10	R/W	XXXXXXXXB
007C75H				
007C76H	DLC register 11	DLCR11	R/W	XXXXXXXXB
007C77H				
007C78H	DLC register 12	DLCR12	R/W	XXXXXXXXB
007C79H				
007C7AH	DLC register 13	DLCR13	R/W	XXXXXXXXB
007C7BH				
007C7CH	DLC register 14	DLCR14	R/W	XXXXXXXXB
007C7DH				
007C7EH	DLC register 15	DLCR15	R/W	XXXXXXXXB
007C7FH				

(Continued)

Address CAN1	Register	Abbreviation	Access	Initial Value
007C80H to 007C87H	Data register 0 (8 bytes)	DTR0	R/W	XXXXXXXXB to XXXXXXXXB
007C88H to 007C8FH	Data register 1 (8 bytes)	DTR1	R/W	XXXXXXXXB to XXXXXXXXB
007C90H to 007C97H	Data register 2 (8 bytes)	DTR2	R/W	XXXXXXXXB to XXXXXXXXB
007C98H to 007C9FH	Data register 3 (8 bytes)	DTR3	R/W	XXXXXXXXB to XXXXXXXXB
007CA0H to 007CA7H	Data register 4 (8 bytes)	DTR4	R/W	XXXXXXXXB to XXXXXXXXB
007CA8H to 007CAFH	Data register 5 (8 bytes)	DTR5	R/W	XXXXXXXXB to XXXXXXXXB
007CB0H to 007CB7H	Data register 6 (8 bytes)	DTR6	R/W	XXXXXXXXB to XXXXXXXXB
007CB8H to 007CBFH	Data register 7 (8 bytes)	DTR7	R/W	XXXXXXXXB to XXXXXXXXB
007CC0H to 007CC7H	Data register 8 (8 bytes)	DTR8	R/W	XXXXXXXXB to XXXXXXXXB
007CC8H to 007CCFH	Data register 9 (8 bytes)	DTR9	R/W	XXXXXXXXB to XXXXXXXXB
007CD0H to 007CD7H	Data register 10 (8 bytes)	DTR10	R/W	XXXXXXXXB to XXXXXXXXB
007CD8H to 007CDFH	Data register 11 (8 bytes)	DTR11	R/W	XXXXXXXXB to XXXXXXXXB
007CE0H to 007CE7H	Data register 12 (8 bytes)	DTR12	R/W	XXXXXXXXB to XXXXXXXXB
007CE8H to 007CEFH	Data register 13 (8 bytes)	DTR13	R/W	XXXXXXXXB to XXXXXXXXB

(Continued)

(Continued)

Address CAN1	Register	Abbreviation	Access	Initial Value
007CF0H to 007CF7H	Data register 14 (8 bytes)	DTR14	R/W	XXXXXXXXB to XXXXXXXXB
007CF8H to 007CFFH	Data register 15 (8 bytes)	DTR15	R/W	XXXXXXXXB to XXXXXXXXB

■ INTERRUPT FACTORS, INTERRUPT VECTORS, INTERRUPT CONTROL REGISTER

Interrupt cause	EI²OS corre-sponding	DMA ch number	Interrupt vector		Interrupt control register	
			Number	Address	Number	Address
Reset	N	—	#08	FFFFDC$_H$	—	—
INT9 instruction	N	—	#09	FFFFD8$_H$	—	—
Exception	N	—	#10	FFFFD4$_H$	—	—
Reserved	N	—	#11	FFFFD0$_H$	ICR00	0000B0$_H$
Reserved	N	—	#12	FFFFCC$_H$		
CAN 1 RX / Input Capture 6	Y1	—	#13	FFFFC8$_H$	ICR01	0000B1$_H$
CAN 1 TX/NS / Input Capture 7	Y1	—	#14	FFFFC4$_H$		
I²C	N	—	#15	FFFFC0$_H$	ICR02	0000B2$_H$
Reserved	N	—	#16	FFFFBC$_H$		
16-bit Reload Timer 0	Y1	0	#17	FFFFB8$_H$	ICR03	0000B3$_H$
16-bit Reload Timer 1	Y1	1	#18	FFFFB4$_H$		
16-bit Reload Timer 2	Y1	2	#19	FFFFB0$_H$	ICR04	0000B4$_H$
16-bit Reload Timer 3	Y1	—	#20	FFFFAC$_H$		
PPG 4/5	N	—	#21	FFFFA8$_H$	ICR05	0000B5$_H$
PPG 6/7	N	—	#22	FFFFA4$_H$		
PPG 8/9/C/D	N	—	#23	FFFFA0$_H$	ICR06	0000B6$_H$
PPG A/B/E/F	N	—	#24	FFFF9C$_H$		
Timebase Timer	N	—	#25	FFFF98$_H$	ICR07	0000B7$_H$
External Interrupt 8 to 11	Y1	3	#26	FFFF94$_H$		
Watch Timer	N	—	#27	FFFF90$_H$	ICR08	0000B8$_H$
External Interrupt 12 to 15	Y1	4	#28	FFFF8C$_H$		
A/D Converter	Y1	5	#29	FFFF88$_H$	ICR09	0000B9$_H$
I/O Timer 0 / I/O Timer 1	N	—	#30	FFFF84$_H$		
Input Capture 4/5	Y1	6	#31	FFFF80$_H$	ICR10	0000BA$_H$
Output Compare 4/5	Y1	7	#32	FFFF7C$_H$		
Input Capture 0/1	Y1	8	#33	FFFF78$_H$	ICR11	0000BB$_H$
Output Compare 6/7	Y1	9	#34	FFFF74$_H$		
Reserved	N	10	#35	FFFF70$_H$	ICR12	0000BC$_H$
Reserved	N	11	#36	FFFF6C$_H$		
UART 3 RX	Y2	12	#37	FFFF68$_H$	ICR13	0000BD$_H$
UART 3 TX	Y1	13	#38	FFFF64$_H$		

(Continued)

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Interrupt cause	EI²OS corre-sponding	DMA ch number	Interrupt vector		Interrupt control register	
			Number	Address	Number	Address
UART 2 RX	Y2	14	#39	FFFF60H	ICR14	0000BEH
UART 2 TX	Y1	15	#40	FFFF5CH		
Flash Memory	N	—	#41	FFFF58H	ICR15	0000BFH
Delayed interrupt	N	—	#42	FFFF54H		

Y1 : Usable

Y2 : Usable, with EI²OS stop function

N : Unusable

Notes :
- The peripheral resources sharing the ICR register have the same interrupt level.
- When two peripheral resources share the ICR register, only one can use EI²OSat a time.
- When either of the two peripheral resources sharing the ICR register specifies EI²OS, the other one cannot use interrupts.

■ ELECTRICAL CHARACTERISTICS

1. Absolute Maximum Ratings

Parameter	Symbol	Rating		Unit	Remarks
		Min	Max		
Power supply voltage*1	V_{CC}	V_{SS} – 0.3	V_{SS} + 6.0	V	
	AV_{CC}	V_{SS} – 0.3	V_{SS} + 6.0	V	$V_{CC} = AV_{CC}$*2
	AVRH	V_{SS} – 0.3	V_{SS} + 6.0	V	$AV_{CC} \geq$ AVRH*2
Input voltage*1	V_I	V_{SS} – 0.3	V_{SS} + 6.0	V	*3
Output voltage*1	V_O	V_{SS} – 0.3	V_{SS} + 6.0	V	*3
Maximum Clamp Current	I_{CLAMP}	–4.0	+4.0	mA	*5
Total Maximum Clamp Current	$\Sigma\lvert I_{CLAMP}\rvert$	—	40	mA	*5
“L” level maximum output current	I_{OL}	—	15	mA	*4
“L” level average output current	I_{OLAV}	—	4	mA	*4
“L” level maximum overall output current	ΣI_{OL}	—	100	mA	*4
“L” level average overall output current	ΣI_{OLAV}	—	50	mA	*4
“H” level maximum output current	I_{OH}	—	–15	mA	*4
“H” level average output current	I_{OHAV}	—	–4	mA	*4
“H” level maximum overall output current	ΣI_{OH}	—	–100	mA	*4
“H” level average overall output current	ΣI_{OHAV}	—	–50	mA	*4
Power consumption	P_D	—	240	mW	MB90F351(S), MB90F352(S) +105 °C < $T_A \leq$ +125 °C, Normal operation : maximum frequency 16 MHz
		—	320	mW	MB90F351(S), MB90F352(S) –40 °C < $T_A \leq$ +105 °C, Normal operation : maximum frequency 24 MHz
		—	320	mW	Device other than above
Operating temperature	T_A	–40	+105	°C	
		–40	+125	°C	*6
Storage temperature	T_{STG}	–55	+150	°C	

(Continued)

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*1: This parameter is based on V_{SS} = AV_{SS} = 0 V

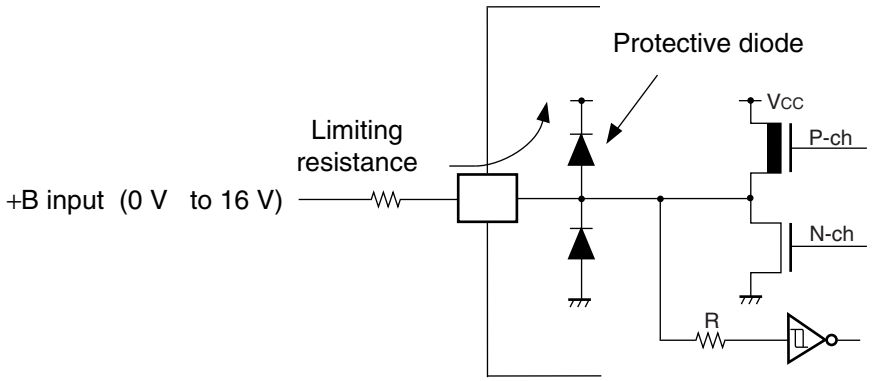
*2: Set AV_{CC} and V_{CC} to the same voltage. Make sure that AV_{CC} does not exceed V_{CC} and that the voltage at the analog inputs does not exceed AV_{CC} when the power is switched on.

*3: V_I and V_O should not exceed V_{CC} + 0.3 V. V_I should not exceed the specified ratings. However if the maximum current to/from an input is limited by some means with external components, the I_{CLAMP} rating supersedes the V_I rating.

*4: Applicable to pins: P00 to P07, P10 to P17, P20 to P25, P30 to P37, P40 to P45, P50 to P56, P60 to P67

*5: • Applicable to pins: P00 to P07, P10 to P17, P20 to P25, P30 to P37, P40 to P45, P50 to P56 (for evaluation device : P50 to P55) , P60 to P67
- Use within recommended operating conditions.
- Use at DC voltage (current)
- The +B signal should always be applied a limiting resistance placed between the +B signal and the microcontroller.
- The value of the limiting resistance should be set so that when the +B signal is applied the input current to the microcontroller pin does not exceed rated values, either instantaneously or for prolonged periods.
- Note that when the microcontroller drive current is low, such as in the power saving modes, the +B input potential may pass through the protective diode and increase the potential at the V_{CC} pin, and this may affect other devices.
- Note that if a +B signal is input when the microcontroller power supply is off (not fixed at 0 V) , the power supply is provided from the pins, so that incomplete operation may result.
- Note that if the +B input is applied during power-on, the power supply is provided from the pins and the resulting power supply voltage may not be sufficient to operate the power-on reset.
- Care must be taken not to leave the +B input pin open.
- Sample recommended circuits:

• Input/output equivalent circuits



*6 : If used exceeding T_A = +105 °C, be sure to contact sales for reliability limitations.

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

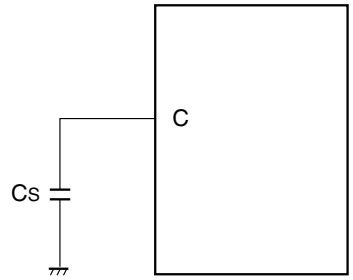
2. Recommended Operating Conditions

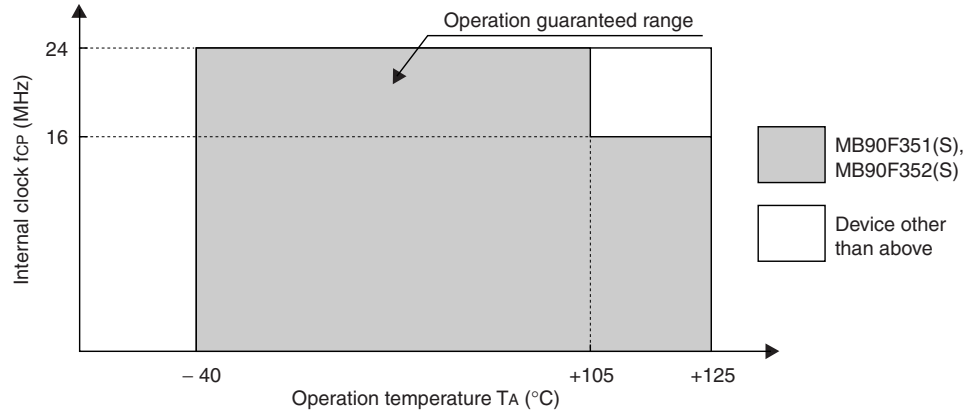
(V_{SS} = AV_{SS} = 0 V)

Parameter	Symbol	Value			Unit	Remarks
		Min	Typ	Max		
Power supply voltage	V_{CC}, AV_{CC}	4.0	5.0	5.5	V	Under normal operation
		3.5	5.0	5.5	V	Under normal operation, when not using the A/D converter and not Flash programming.
		4.5	5.0	5.5	V	When External bus is used.
		3.0	—	5.5	V	Maintains RAM data in stop mode
Smooth capacitor	C_S	0.1	—	1.0	µF	Use a ceramic capacitor or capacitor of better AC characteristics. Bypass capacitor at the V_{CC} pin should be greater than this capacitor.
Operating temperature	T_A	–40	—	+105	°C	MB90F352(S) $f_{CP} \leq$ 24MHz
		–40	—	+125	°C	*, MB90F352(S) $f_{CP} \leq$ 16MHz, Devices with A-suffix

* : If used exceeding T_A = +105 °C, be sure to contact sales for reliability limitations.

• C Pin Connection Diagram





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

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

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

3. DC Characteristics

(MB90F352(S)/MB90F351(S): T_A = –40 °C to +105 °C, V_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 24 MHz, $V_{SS} = AV_{SS}$ = 0 V)
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 16 MHz, $V_{SS} = AV_{SS}$ = 0 V)
(Device other than above: T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 24 MHz, $V_{SS} = AV_{SS}$ = 0 V)

Parameter	Symbol	Pin	Condition	Value			Unit	Remarks
				Min	Typ	Max		
Input H voltage (At V_{CC} = 5 V ± 10%)	V_{IHS}	—	—	0.8 V_{CC}	—	V_{CC} + 0.3	V	Pin inputs if CMOS hysteresis input levels are selected (except P12, P15, P44, P45, P50)
	V_{IHA}	—	—	0.8 V_{CC}	—	V_{CC} + 0.3	V	Pin inputs if AUTOMOTIVE input levels are selected
	V_{IHT}	—	—	2.0	—	V_{CC} + 0.3	V	Pin inputs if TTL input levels are selected
	V_{IHS}	—	—	0.7 V_{CC}	—	V_{CC} + 0.3	V	P12, P15, P50 inputs if CMOS input levels are selected
	V_{IHI}	—	—	0.7 V_{CC}	—	V_{CC} + 0.3	V	P44, P45 inputs if CMOS hysteresis input levels are selected
	V_{IHR}	—	—	0.8 V_{CC}	—	V_{CC} + 0.3	V	$\overline{RST}$ input pin (CMOS hysteresis)
	V_{IHM}	—	—	V_{CC} – 0.3	—	V_{CC} + 0.3	V	MD input pin
Input L voltage (At V_{CC} = 5 V ± 10%)	V_{ILS}	—	—	V_{SS} – 0.3	—	0.2 V_{CC}	V	Pin inputs if CMOS hysteresis input levels are selected (except P12, P15, P44, P45, P50)
	V_{ILA}	—	—	V_{SS} – 0.3	—	0.5 V_{CC}	V	Pin inputs if AUTOMOTIVE input levels are selected
	V_{ILT}	—	—	V_{SS} – 0.3	—	0.8	V	Pin inputs if TTL input levels are selected
	V_{ILS}	—	—	V_{SS} – 0.3	—	0.3 V_{CC}	V	P12, P15, P50 inputs if CMOS input levels are selected
	V_{ILI}	—	—	V_{SS} – 0.3	—	0.3 V_{CC}	V	P44, P45 inputs if CMOS hysteresis input levels are selected
	V_{ILR}	—	—	V_{SS} – 0.3	—	0.2 V_{CC}	V	$\overline{RST}$ input pin (CMOS hysteresis)
	V_{ILM}	—	—	V_{SS} – 0.3	—	V_{SS} + 0.3	V	MD input pin
Output H voltage	V_{OH}	Normal outputs	V_{CC} = 4.5 V, I_{OH} = –4.0 mA	V_{CC} – 0.5	—	—	V	
Output H voltage	V_{OHI}	I^2C current outputs	V_{CC} = 4.5 V, I_{OH} = –3.0 mA	V_{CC} – 0.5	—	—	V	

(Continued)

(MB90F352(S)/MB90F351(S): T_A = –40 °C to +105 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 16 MHz, V_{SS} = AV_{SS} = 0 V)
(Device other than above: T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

Parameter	Symbol	Pin	Condition	Value			Unit	Remarks
				Min	Typ	Max		
Output L voltage	V_{OL}	Normal outputs	V_{CC} = 4.5 V, I_{OL} = 4.0 mA	—	—	0.4	V	
Output L voltage	V_{OLI}	I^2C current outputs	V_{CC} = 4.5 V, I_{OL} = 3.0 mA	—	—	0.4	V	
Input leak current	I_{IL}	—	V_{CC} = 5.5 V, V_{SS}<V_I<V_{CC}	– 1	—	1	µA	
Pull-up resistance	R_{UP}	P00 to P07, P10 to P17, P20 to P25, P30 to P37, $\overline{RST}$	—	25	50	100	kΩ	
Pull-down resistance	R_{DOWN}	MD2	—	25	50	100	kΩ	Except Flash memory devices
Power supply current	I_{CC}	V_{CC}	V_{CC} = 5.0 V, Internal frequency : 24 MHz, At normal operation.	—	48	60	mA	
			V_{CC} = 5.0 V, Internal frequency : 24 MHz, At writing FLASH memory.	—	53	65	mA	Flash memory devices
			V_{CC} = 5.0 V, Internal frequency : 24 MHz, At erasing FLASH memory.	—	58	70	mA	Flash memory devices
	I_{CCS}		V_{CC} = 5.0 V, Internal frequency : 24 MHz, At Sleep mode.	—	25	35	mA	
	I_{CTS}		V_{CC} = 5.0 V, Internal frequency : 2 MHz, At Main Timer mode	—	0.3	0.8	mA	Devices without “T”-suffix
				—	0.4	1.0	mA	Devices with “T”-suffix
	$I_{CTSPLL6}$		V_{CC} = 5.0 V, Internal frequency : 24 MHz, At PLL Timer mode, external frequency = 4 MHz	—	4	7	mA	
	I_{CCL}		V_{CC} = 5.0 V, Internal frequency: 8 kHz, During stopping clock monitor function, At sub clock operation T_A = +25°C	—	70	140	µA	MB90F351 MB90F352 MB90F351A MB90F352A MB90F356A MB90F357A MB90351A MB90352A MB90356A MB90357A

(Continued)

(MB90F352(S)/MB90F351(S): T_A = –40 °C to +105 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 16 MHz, V_{SS} = AV_{SS} = 0 V)
(Device other than above: T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

Parameter	Symbol	Pin	Condition	Value			Unit	Remarks
				Min	Typ	Max		
Power supply current	I_{CCL}	V_{CC}	V_{CC} = 5.0 V, Internal frequency: 8 kHz, During operating clock monitor function, At sub clock operation T_A = +25°C	—	100	200	µA	MB90F356A MB90F357A MB90356A MB90357A
			V_{CC} = 5.0 V, Internal CR oscillation/ 4 division, At sub clock operation T_A = +25°C	—	100	200	µA	MB90F356AS MB90F357AS MB90356AS MB90357AS
			V_{CC} = 5.0 V, Internal frequency: 8 kHz, During stopping clock monitor function, At sub clock operation T_A = +25°C	—	120	240	µA	MB90F351TA MB90F352TA MB90F356TA MB90F357TA MB90351TA MB90352TA MB90356TA MB90357TA
			V_{CC} = 5.0 V, Internal frequency: 8 kHz, During operating clock monitor function, At sub clock operation T_A = +25°C	—	150	300	µA	MB90F356TA MB90F357TA MB90356TA MB90357TA
			V_{CC} = 5.0 V, Internal CR oscillation/ 4 division, At sub clock operation T_A = +25°C	—	150	300	µA	MB90F356TAS MB90F357TAS MB90356TAS MB90357TAS
	I_{CCLS}		V_{CC} = 5.0 V, Internal frequency: 8 kHz, During stopping clock monitor function, At sub sleep T_A = +25°C	—	20	50	µA	MB90F351 MB90F352 MB90F351A MB90F352A MB90F356A MB90F357A MB90351A MB90352A MB90356A MB90357A

(Continued)

(MB90F352(S)/MB90F351(S): T_A = –40 °C to +105 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 16 MHz, V_{SS} = AV_{SS} = 0 V)
(Device other than above: T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

Parameter	Symbol	Pin	Condition	Value			Unit	Remarks
				Min	Typ	Max		
Power supply current	I_{CCLS}	V_{CC}	V_{CC} = 5.0 V, Internal frequency: 8 kHz, During operating clock monitor function, At sub sleep T_A = +25°C	—	60	200	µA	MB90F356A MB90F357A MB90356A MB90357A
			V_{CC} = 5.0 V, Internal CR oscillation/ 4 division, At sub sleep T_A = +25°C	—	60	200	µA	MB90F356AS MB90F357AS MB90356AS MB90357AS
			V_{CC} = 5.0 V, Internal frequency: 8 kHz, During stopping clock monitor function, At sub sleep T_A = +25°C	—	70	150	µA	MB90F351TA MB90F352TA MB90F356TA MB90F357TA MB90351TA MB90352TA MB90356TA MB90357TA
			V_{CC} = 5.0 V, Internal frequency: 8 kHz, During operating clock monitor function, At sub sleep T_A = +25°C	—	110	300	µA	MB90F356TA MB90F357TA MB90356TA MB90357TA
			V_{CC} = 5.0 V, Internal CR oscillation/ 4 division, At sub sleep T_A = +25°C	—	110	300	µA	MB90F356TAS MB90F357TAS MB90356TAS MB90357TAS
	I_{CCT}		V_{CC} = 5.0 V, Internal frequency: 8 kHz, During stopping clock monitor function, At watch mode T_A = +25°C	—	10	35	µA	MB90F351 MB90F352 MB90F351A MB90F352A MB90F356A MB90F357A MB90351A MB90352A MB90356A MB90357A

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(Continued)

(MB90F352(S)/MB90F351(S): T_A = –40 °C to +105 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 16 MHz, V_{SS} = AV_{SS} = 0 V)
(Device other than above: T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

Parameter	Symbol	Pin	Condition	Value			Unit	Remarks
				Min	Typ	Max		
Power supply current	I_{CCT}	V_{CC}	V_{CC} = 5.0 V, Internal frequency: 8 kHz, During operating clock monitor function, At watch mode T_A = +25°C	—	25	150	µA	MB90F356A MB90F357A MB90356A MB90357A
			V_{CC} = 5.0 V, Internal CR oscillation/ 4 division, At watch mode T_A = +25°C	—	25	150	µA	MB90F356AS MB90F357AS MB90356AS MB90357AS
			V_{CC} = 5.0 V, Internal frequency: 8 kHz, During stopping clock monitor function, At watch mode T_A = +25°C	—	60	140	µA	MB90F351TA MB90F352TA MB90F356TA MB90F357TA MB90351TA MB90352TA MB90356TA MB90357TA
			V_{CC} = 5.0 V, Internal frequency: 8 kHz, During operating clock monitor function, At watch mode T_A = +25°C	—	80	250	µA	MB90F356TA MB90F357TA MB90356TA MB90357TA
			V_{CC} = 5.0 V, Internal CR oscillation/ 4 division, At watch mode T_A = +25°C	—	80	250	µA	MB90F356TAS MB90F357TAS MB90356TAS MB90357TAS
	I_{CCH}		V_{CC} = 5.0 V, At Stop mode, T_A = +25°C	—	7	25	µA	Devices without “T”-suffix
				—	60	130	µA	Devices with “T”-suffix
Input capacity	C_{IN}	Other than C, AV_{CC}, AV_{SS}, AVRH, V_{CC}, V_{SS},	—	—	5	15	pF	

4. AC Characteristics

(1) Clock Timing

(MB90F352(S)/MB90F351(S): T_A = –40 °C to +105 °C, V_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 24 MHz, $V_{SS} = AV_{SS}$ = 0 V)
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 16 MHz, $V_{SS} = AV_{SS}$ = 0 V)
(Device other than above: T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 24 MHz, $V_{SS} = AV_{SS}$ = 0 V)

Parameter	Symbol	Pin	Value			Unit	Remarks
			Min	Typ	Max		
Clock frequency	f_C	X0, X1	3	—	16	MHz	1/2 (at PLL stop) When using an oscillation circuit
			4	—	16	MHz	1 multiplied PLL When using an oscillation circuit
			4	—	12	MHz	2 multiplied PLL When using an oscillation circuit
			4	—	8	MHz	3 multiplied PLL When using an oscillation circuit
			4	—	6	MHz	4 multiplied PLL When using an oscillation circuit
			—	—	4	MHz	6 multiplied PLL When using an oscillation circuit
		X0	3	—	24	MHz	1/2 (at PLL stop), When using an external clock
			4	—	24	MHz	1 multiplied PLL When using an external clock
			4	—	12	MHz	2 multiplied PLL When using an external clock
			4	—	8	MHz	3 multiplied PLL When using an external clock
			4	—	6	MHz	4 multiplied PLL When using an external clock
			—	—	4	MHz	6 multiplied PLL When using an external clock
	f_{CL}	X0A, X1A	—	32.768	100	kHz	
Clock cycle time	t_{CYL}	X0, X1	62.5	—	333	ns	When using an oscillation circuit
		X0	41.67	—	333	ns	When using an external clock
	t_{CYLL}	X0A, X1A	10	30.5	—	µs	
Input clock pulse width	P_{WH}, P_{WL}	X0	10	—	—	ns	Duty ratio is about 30% to 70%.
	P_{WHL}, P_{WLL}	X0A	5	15.2	—	µs	
Input clock rise and fall time	t_{CR}, t_{CF}	X0	—	—	5	ns	When using an external clock

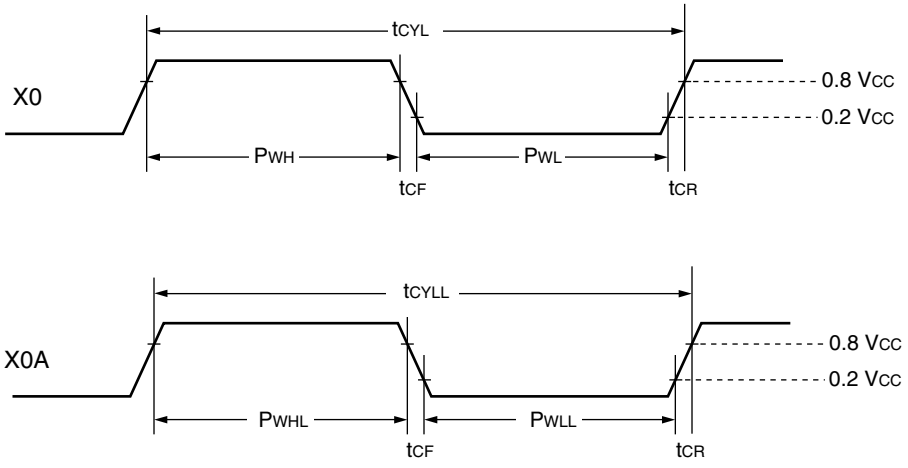
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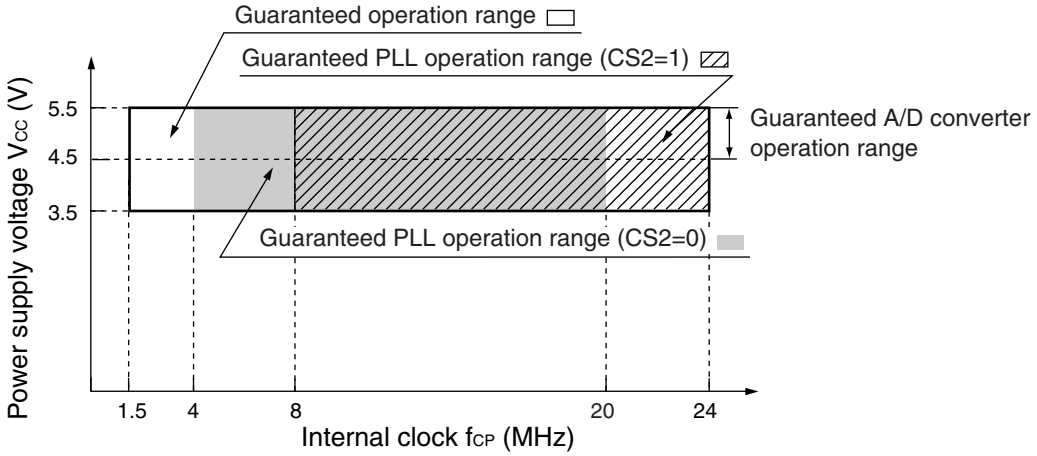
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +105 °C, V_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 24 MHz, $V_{SS} = AV_{SS}$ = 0 V)
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 16 MHz, $V_{SS} = AV_{SS}$ = 0 V)
(Device other than above: T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 24 MHz, $V_{SS} = AV_{SS}$ = 0 V)

Parameter	Symbol	Pin	Value			Unit	Remarks
			Min	Typ	Max		
Internal operating clock frequency (machine clock)	f_{CP}	—	1.5	—	24	MHz	MB90F352/(S), MB90F351/(S) When using main clock ($T_A \leq$ +105 °C)
					16		MB90F352/(S), MB90F351/(S) When using main clock ($T_A \leq$ +125 °C)
			1.5	—	24	MHz	Device other than above, When using main clock
	f_{CPL}	—	—	8.192	50	kHz	When using sub clock
Internal operating clock cycle time (machine clock)	t_{CP}	—	41.67	—	666	ns	MB90F352/(S), MB90F351/(S) When using main clock ($T_A \leq$ +105 °C)
			62.5				MB90F352/(S), MB90F351/(S) When using main clock ($T_A \leq$ +125 °C)
			41.67	—	666	ns	Device other than above, When using main clock
	t_{CPL}	—	20	122.1	—	µs	When using sub clock

• Clock Timing

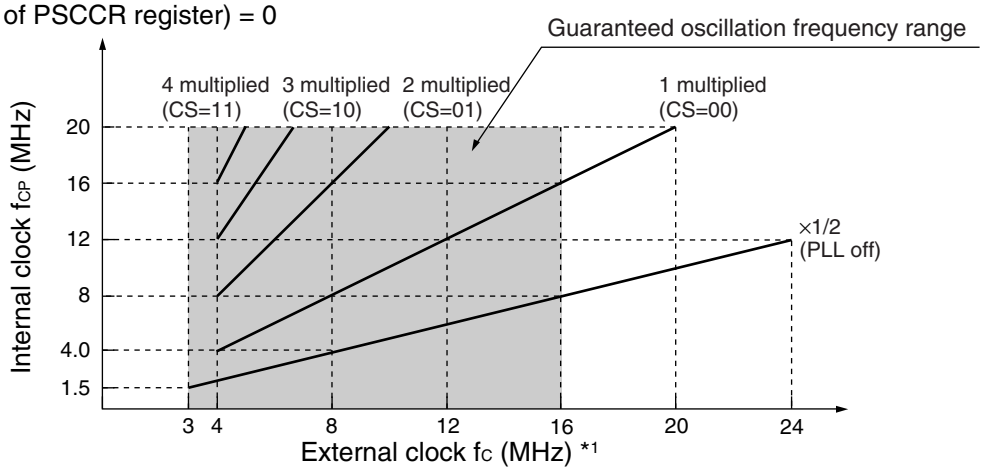


• PLL guaranteed operation range

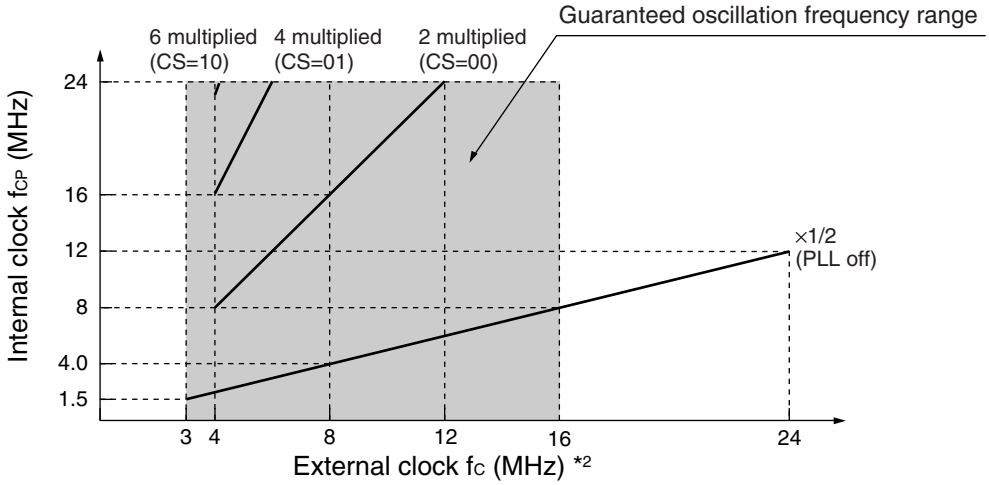


Guaranteed operation range of MB90350 series

CS2(bit0 of PSCCR register) = 0



CS2(bit0 of PSCCR register) = 1



*1 : Guaranteed 1 multiplied PLL operation range is 4.0 MHz to 20 MHz.

*2 : When using crystal oscillator or ceramic oscillator, the maximum clock frequency is 16 MHz.

External clock frequency and internal operation clock frequency

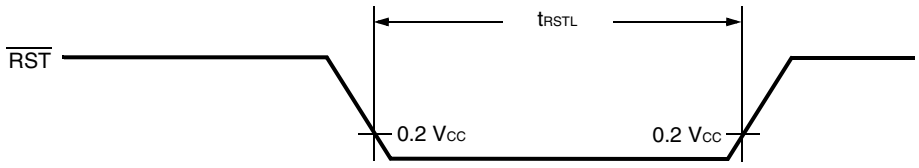
(2) Reset Standby Input

(MB90F352(S)/MB90F351(S): T_A = –40 °C to +105 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 16 MHz, V_{SS} = AV_{SS} = 0 V)
(Device other than above: T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

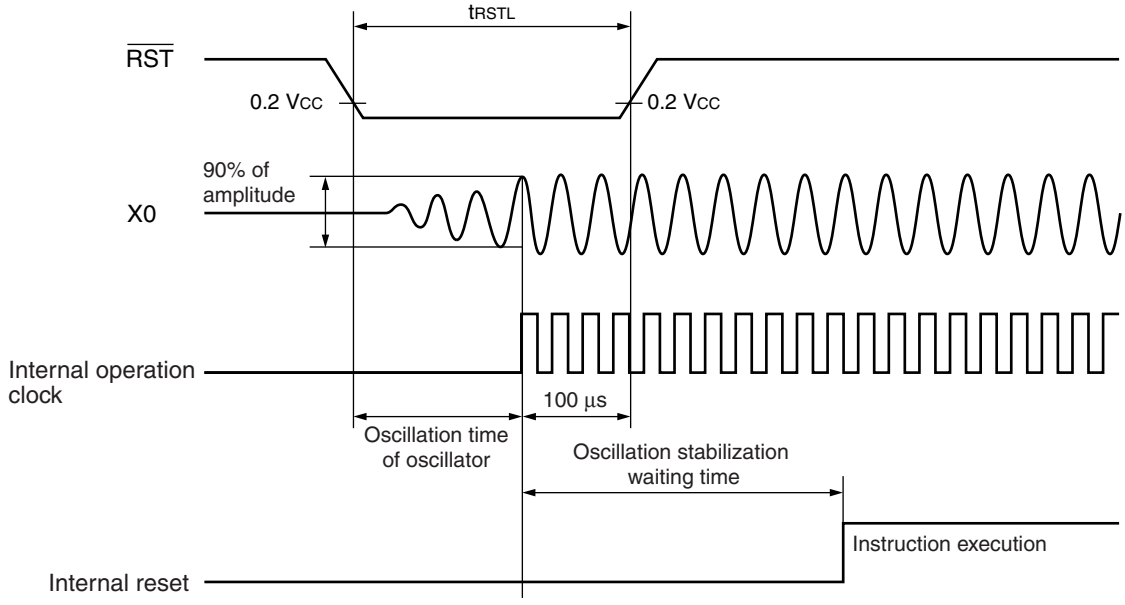
Parameter	Symbol	Pin	Value		Unit	Remarks
			Min	Max		
Reset input time	t_{RSTL}	$\overline{RST}$	500	—	ns	Under normal operation
			Oscillation time of oscillator* + 100 µs	—	µs	In Stop mode, Sub Clock mode, Sub Sleep mode and Watch mode
			100	—	µs	In Main timer mode and PLL timer mode

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

Under normal operation:



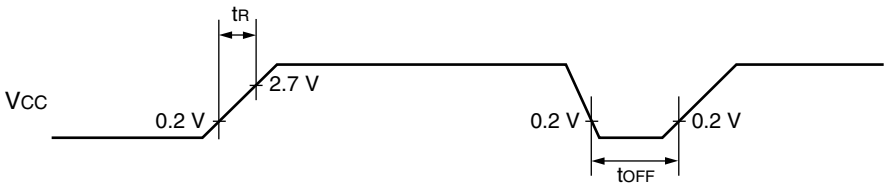
In Stop mode, Sub Clock mode, Sub Sleep mode, Watch mode:



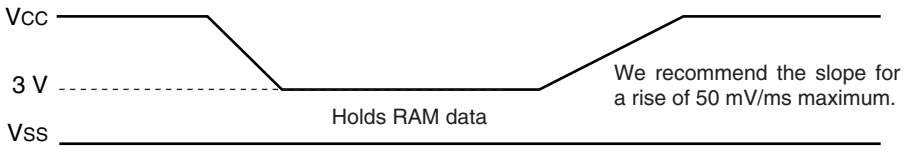
(3) Power On Reset

(MB90F352(S)/MB90F351(S): T_A = –40 °C to +105 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 16 MHz, V_{SS} = AV_{SS} = 0 V)
(Device other than above: T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

Parameter	Symbol	Pin	Condition	Value		Unit	Remarks
				Min	Max		
Power on rise time	t_R	V_{CC}	—	0.05	30	ms	
Power off time	t_{OFF}	V_{CC}		1	—	ms	Due to repetitive operation



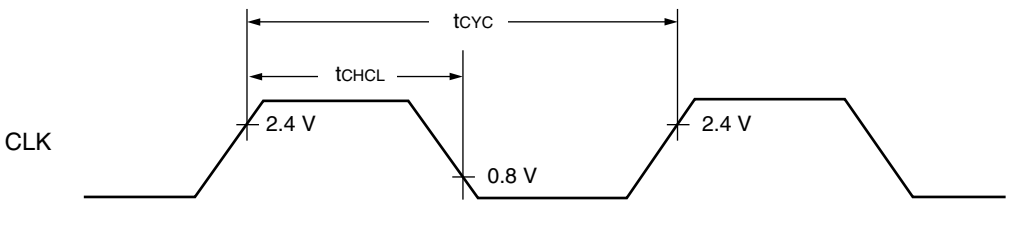
If you change the power supply voltage too rapidly, a power on reset may occur. We recommend that you start up smoothly by restraining voltages when changing the power supply voltage during operation, as shown in the figure below. Perform while not using the PLL clock. However, if voltage drops are within 1 V/s, you can operate while using the PLL clock.



(4) Clock Output Timing

(T_A = –40 °C to +105 °C, V_{CC} = 5.0 V ± 10%, V_{SS} = 0.0 V, f_{CP} ≤ 24 MHz)

Parameter	Symbol	Pin	Condition	Value		Unit	Remarks
				Min	Max		
Cycle time	t_{CYC}	CLK	—	62.5	—	ns	f_{CP} = 16 MHz
				41.67	—	ns	f_{CP} = 24 MHz
CLK ↑ → CLK ↓	t_{CHCL}	CLK	—	20	—	ns	f_{CP} = 16 MHz
				13	—	ns	f_{CP} = 24 MHz

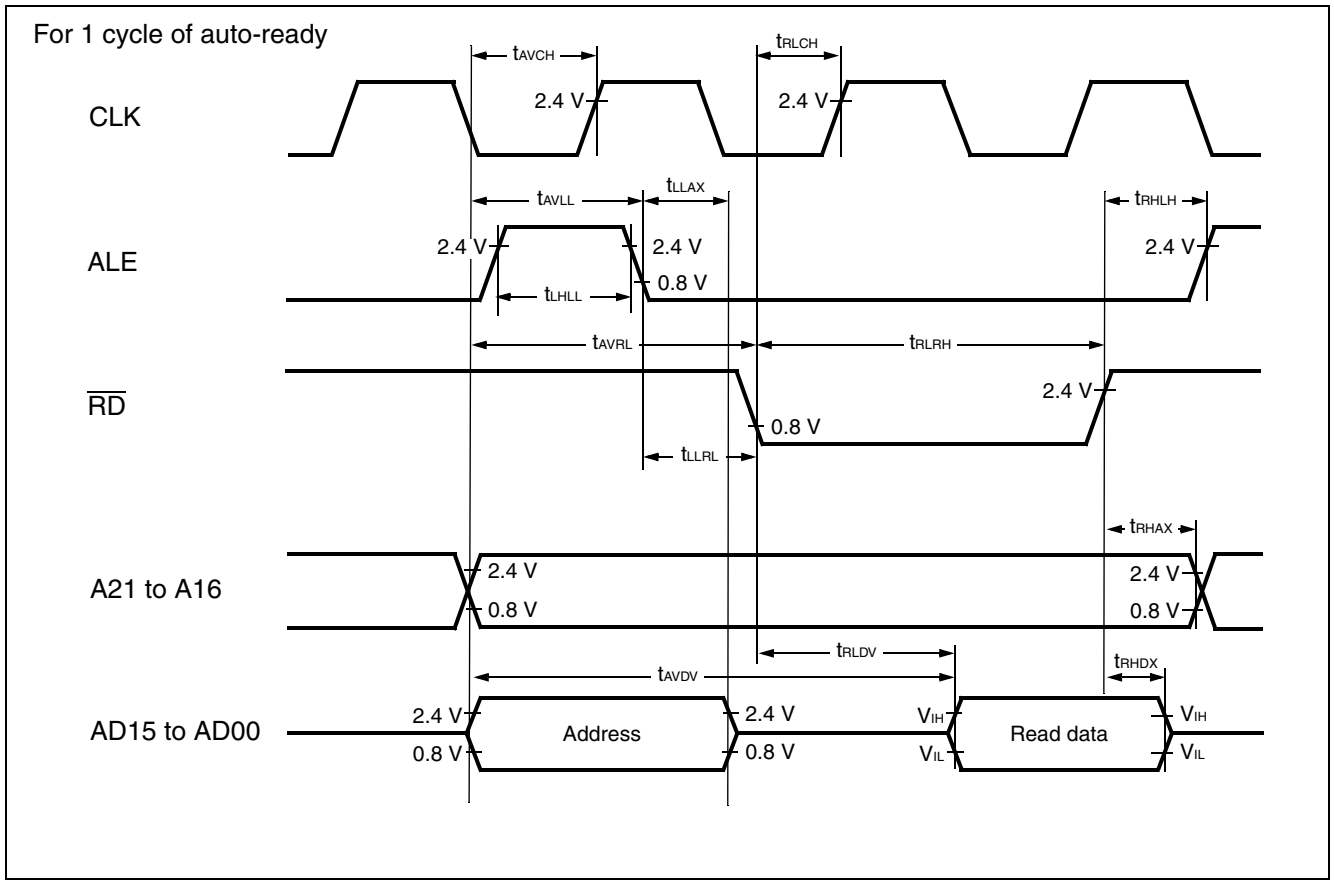


(5) Bus Timing (Read)

(T_A = –40°C to +105°C, V_{CC} = 5.0 V ± 10 %, V_{SS} = 0.0 V, f_{CP} ≤ 24 MHz)

Parameter	Symbol	Pin	Condition	Value		Unit	Remarks
				Min	Max		
ALE pulse width	t_{LHLL}	ALE	—	$t_{CP}/2 - 10$	—	ns	
Valid address → ALE ↓ time	t_{AVLL}	ALE, A21 to A16, AD15 to AD00		$t_{CP}/2 - 20$	—	ns	
ALE ↓ → Address valid time	t_{LLAX}	ALE, AD15 to AD00		$t_{CP}/2 - 15$	—	ns	
Valid address → $\overline{RD}$ ↓ time	t_{AVRL}	A21 toA16, AD15 to AD00, $\overline{RD}$		$t_{CP} - 15$	—	ns	
Valid address → Valid data input	t_{AVDV}	A21 to A16, AD15 to AD00		—	$5\ t_{CP}/2 - 60$	ns	
$\overline{RD}$ pulse width	t_{RLRH}	$\overline{RD}$		$(n^*+3/2)\ t_{CP} - 20$	—	ns	
$\overline{RD}$ ↓ → Valid data input	t_{RLDV}	$\overline{RD}$, AD15 to AD00		—	$(n^*+3/2)\ t_{CP} - 50$	ns	
$\overline{RD}$ ↑ → Data hold time	t_{RHDX}	$\overline{RD}$, AD15 to AD00		0	—	ns	
$\overline{RD}$ ↑ → ALE ↑ time	t_{RHLH}	$\overline{RD}$, ALE		$t_{CP}/2 - 15$	—	ns	
$\overline{RD}$ ↑ → Address valid time	t_{RHAX}	$\overline{RD}$, A21 to A16		$t_{CP}/2 - 10$	—	ns	
Valid address → CLK ↑ time	t_{AVCH}	A21 to A16, AD15 to AD00, CLK		$t_{CP}/2 - 16$	—	ns	
$\overline{RD}$ ↓ → CLK ↑ time	t_{RLCH}	$\overline{RD}$, CLK		$t_{CP}/2 - 15$	—	ns	
ALE ↓ → $\overline{RD}$ ↓ time	t_{LLRL}	ALE, $\overline{RD}$		$t_{CP}/2 - 15$	—	ns	

* : n: number of ready cycles

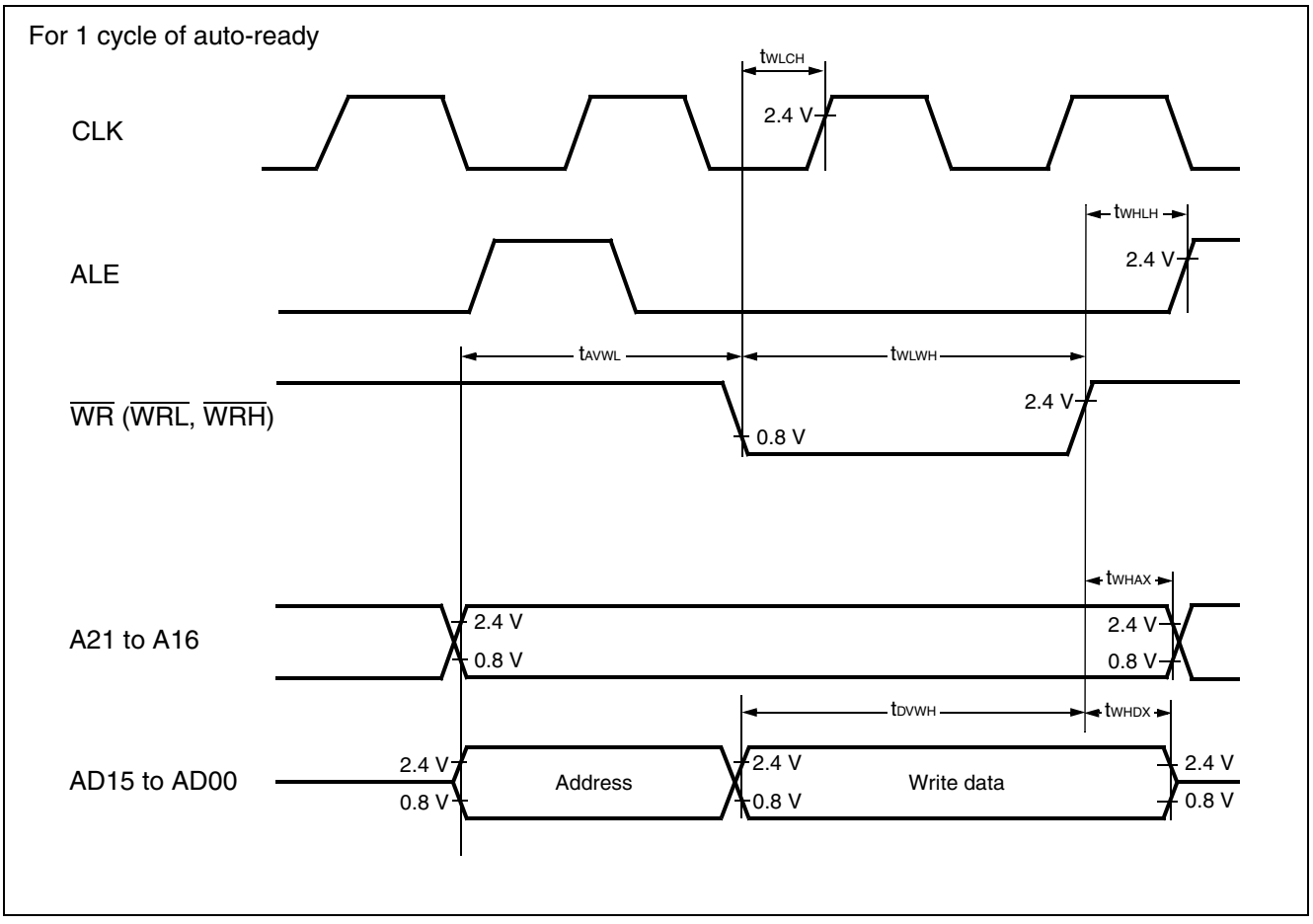

For 1 cycle of auto-ready
CLK
ALE
RD
A21 to A16
AD15 to AD00
tAVCH
tRLCH
2.4 V
tAVLL
tLLAX
tRHLH
0.8 V
tLHLL
tAVRL
tRLRH
tLLRL
tRHAX
tRLDV
tRHDX
tAVDV
Address
Read data
VIH
VIL

(6) Bus Timing (Write)

(T_A = –40°C to +105°C, V_{CC} = 5.0 V ± 10 %, V_{SS} = 0.0 V, f_{CP} ≤ 24 MHz)

Parameter	Symbol	Pin	Condition	Value		Unit	Remarks
				Min	Max		
Valid address → $\overline{WR}$ ↓ time	t_{AVWL}	A21 to A16, AD15 to AD00, $\overline{WR}$	—	t_{CP}–15	—	ns	
$\overline{WR}$ pulse width	t_{WLWH}	$\overline{WR}$		(n*+3/2)t_{CP} – 20	—	ns	
Valid data output → $\overline{WR}$ ↑ time	t_{DVWH}	AD15 to AD00, $\overline{WR}$		(n*+3/2)t_{CP} – 20	—	ns	
$\overline{WR}$ ↑ → Data hold time	t_{WHDX}	AD15 to AD00, $\overline{WR}$		15	—	ns	
$\overline{WR}$ ↑ → Address valid time	t_{WHAX}	A21 to A16, $\overline{WR}$		t_{CP}/2 – 10	—	ns	
$\overline{WR}$ ↑ → ALE ↑ time	t_{WHLH}	$\overline{WR}$, ALE		t_{CP}/2 – 15	—	ns	
$\overline{WR}$ ↓ → CLK ↑ time	t_{WLCH}	$\overline{WR}$, CLK		t_{CP}/2 – 15	—	ns	

* : n: Number of ready cycles

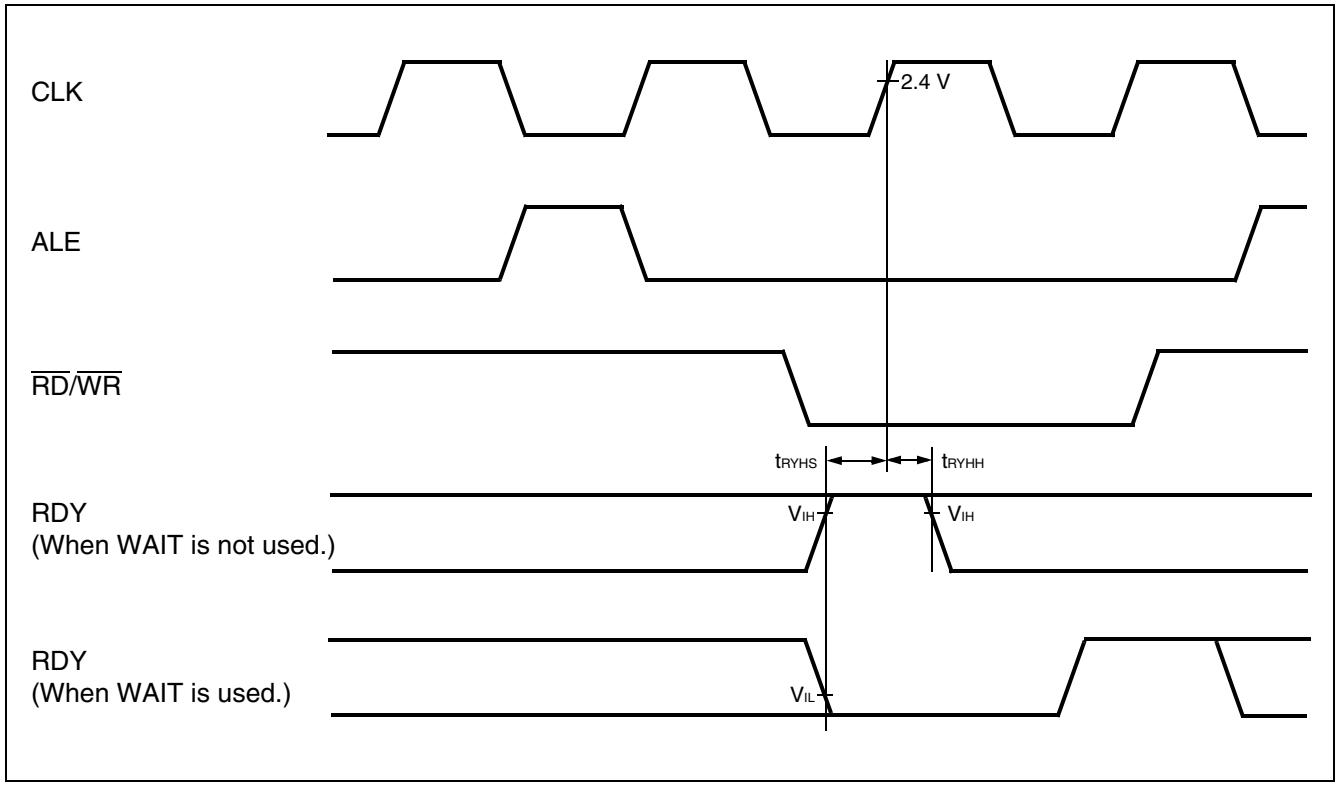


(7) Ready Input Timing

(T_A = –40°C to +105°C, V_{CC} = 5.0 V ± 10 %, V_{SS} = 0.0 V, f_{CP} ≤ 24 MHz)

Parameter	Symbol	Pin	Condition	Value		Units	Remarks
				Min	Max		
RDY set-up time	t_{RYHS}	RDY	—	45	—	ns	f_{CP} = 16 MHz
				32	—	ns	f_{CP} = 24 MHz
RDY hold time	t_{RYHH}	RDY		0	—	ns	

Note : If the RDY set-up time is insufficient, use the auto-ready function.

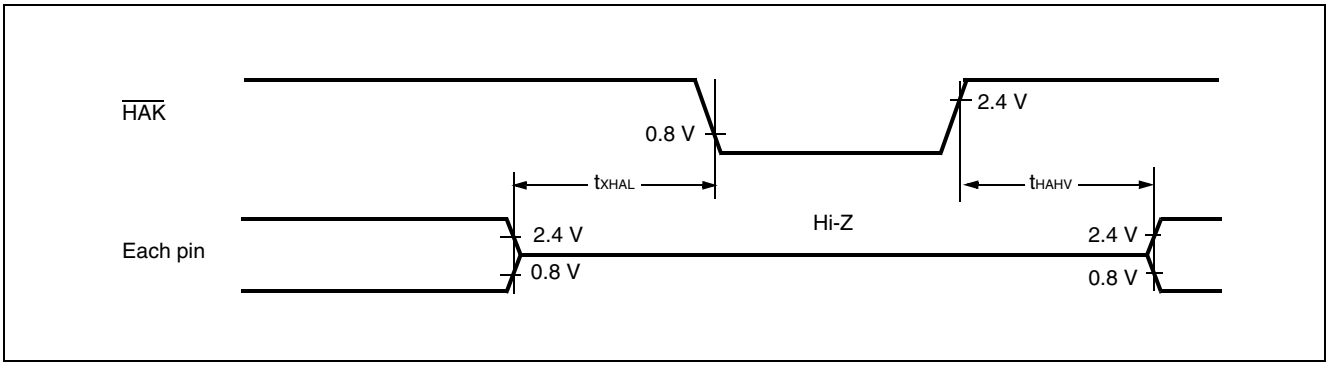


(8) Hold Timing

(T_A = –40°C to +105°C, V_{CC} = 5.0 V ± 10 %, V_{SS} = 0.0 V, $f_{CP} \leq$ 24 MHz)

Parameter	Symbol	Pin	Condition	Value		Units	Remarks
				Min	Max		
Pin floating → $\overline{HAK}$ ↓ time	t_{XHAL}	$\overline{HAK}$	—	30	t_{CP}	ns	
$\overline{HAK}$ ↑ time → Pin valid time	t_{HAHV}	$\overline{HAK}$		t_{CP}	2 t_{CP}	ns	

Note : There is more than 1 machine cycle from when HRQ pin reads in until the $\overline{HAK}$ is changed.



(9) UART 2/3

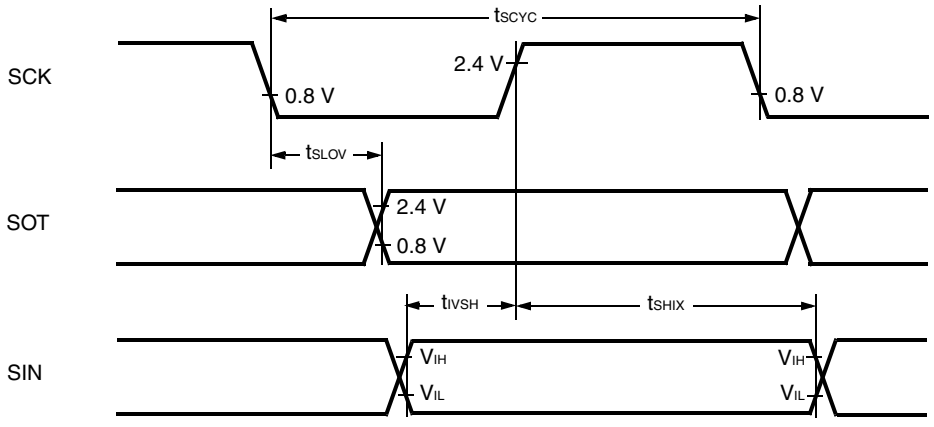
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +105 °C, V_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 24 MHz, $V_{SS} = AV_{SS}$ = 0 V)
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 16 MHz, $V_{SS} = AV_{SS}$ = 0 V)
(Device other than above: T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 24 MHz, $V_{SS} = AV_{SS}$ = 0 V)

Parameter	Symbol	Pin	Condition	Value		Unit	Remarks
				Min	Max		
Serial clock cycle time	t_{SCYC}	SCK2, SCK3	Internal shift clock mode output pins are C_L = 80 pF + 1 TTL	8 t_{CP}*	—	ns	
SCK ↓ → SOT delay time	t_{SLOV}	SCK2, SCK3, SOT2, SOT3		–80	+80	ns	
Valid SIN → SCK ↑	t_{IVSH}	SCK2, SCK3, SIN2, SIN3		100	—	ns	
SCK ↑ → Valid SIN hold time	t_{SHIX}	SCK2, SCK3, SIN2, SIN3		60	—	ns	
Serial clock “H” pulse width	t_{SHSL}	SCK2, SCK3	External shift clock mode output pins are C_L = 80 pF + 1 TTL	4 t_{CP}	—	ns	
Serial clock “L” pulse width	t_{SLSH}	SCK2, SCK3		4 t_{CP}	—	ns	
SCK ↓ → SOT delay time	t_{SLOV}	SCK2, SCK3, SOT2, SOT3		—	150	ns	
Valid SIN → SCK ↑	t_{IVSH}	SCK2, SCK3, SIN2, SIN3		60	—	ns	
SCK ↑ → Valid SIN hold time	t_{SHIX}	SCK2, SCK3, SIN2, SIN3		60	—	ns	

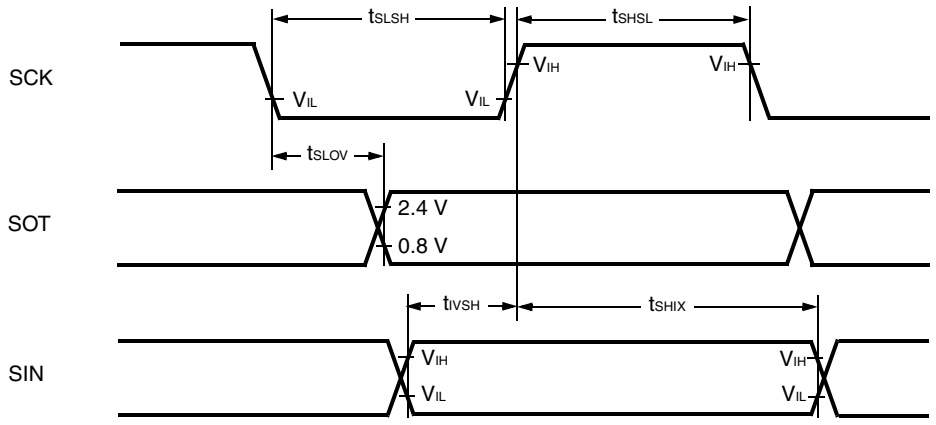
* : Refer to “ (1) Clock timing” rating for t_{CP} (internal operating clock cycle time).

Notes : • AC characteristic in CLK synchronized mode.
• C_L is load capacity value of pins when testing.

• Internal Shift Clock Mode



• External Shift Clock Mode



(10) Trigger Input Timing

(MB90F352(S)/MB90F351(S): T_A = –40 °C to +105 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 16 MHz, V_{SS} = AV_{SS} = 0 V)
(Device other than above: T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

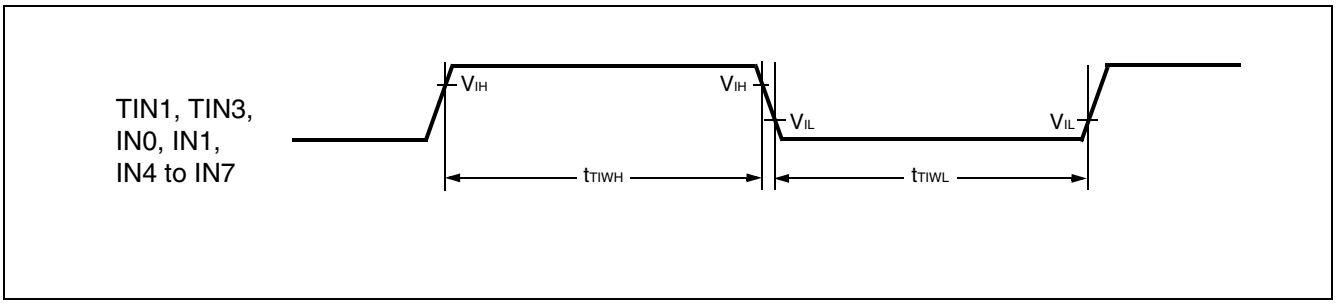
Parameter	Symbol	Pin	Condition	Value		Unit	Remarks
				Min	Max		
Input pulse width	t_{TRGH} t_{TRGL}	INT8 to INT15, INT9R to INT11R, ADTG	—	5 t_{CP}	—	ns	



(11) Timer Related Resource Input Timing

(MB90F352(S)/MB90F351(S): T_A = –40 °C to +105 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 16 MHz, V_{SS} = AV_{SS} = 0 V)
(Device other than above: T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

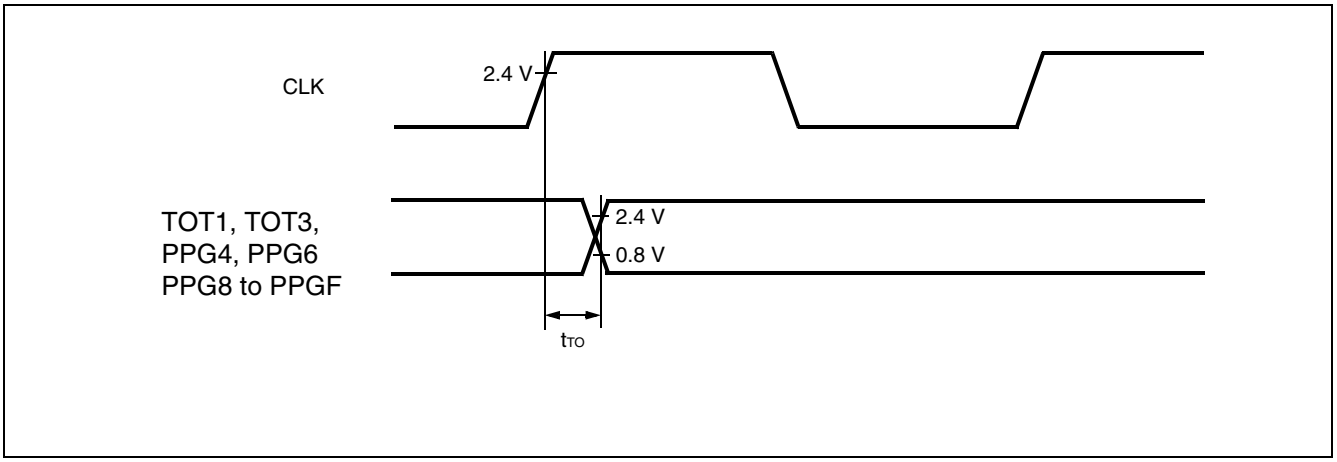
Parameter	Symbol	Pin	Condition	Value		Unit	Remarks
				Min	Max		
Input pulse width	t_{TIWH} t_{TIWL}	TIN1, TIN3, IN0, IN1, IN4 to IN7	—	4 t_{CP}	—	ns	



(12) Timer Related Resource Output Timing

(MB90F352(S)/MB90F351(S): T_A = –40 °C to +105 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 16 MHz, V_{SS} = AV_{SS} = 0 V)
(Device other than above: T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

Parameter	Symbol	Pin	Condition	Value		Unit	Remarks
				Min	Max		
CLK ↑ → T_{OUT} change time	t_{TO}	TOT1, TOT3, PPG4, PPG6, PPG8 to PPGF	—	30	—	ns	



(13) I²C Timing

(MB90F352(S)/MB90F351(S): T_A = –40 °C to +105 °C, V_{CC} = AV_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 24 MHz, V_{SS} = AV_{SS} = 0 V)
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +125 °C, V_{CC} = AV_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 16 MHz, V_{SS} = AV_{SS} = 0 V)
(Device other than above: T_A = –40 °C to +125 °C, V_{CC} = AV_{CC} = 5.0 V ± 10%, $f_{CP} \leq$ 24 MHz, V_{SS} = AV_{SS} = 0 V)

Parameter	Symbol	Condition	Standard-mode		Fast-mode*4		Unit
			Min	Max	Min	Max	
SCL clock frequency	f_{SCL}	R = 1.7 kΩ, C = 50 pF*1	0	100	0	400	kHz
Hold time for (repeated) START condition SDA↓→SCL↓	t_{HDSTA}		4.0	—	0.6	—	µs
"L" width of the SCL clock	t_{LOW}		4.7	—	1.3	—	µs
"H" width of the SCL clock	t_{HIGH}		4.0	—	0.6	—	µs
Set-up time for a repeated START condition SCL↑→SDA↓	t_{SUSTA}		4.7	—	0.6	—	µs
Data hold time SCL↓→SDA↓↑	t_{HDDAT}		0	3.45*2	0	0.9*3	µs
Data set-up time SDA↓↑→SCL↑	t_{SUDAT}		250*5	—	100*5	—	ns
Set-up time for STOP condition SCL↑→SDA↑	t_{SUSTO}		4.0	—	0.6	—	µs
Bus free time between STOP condition and START condition	t_{BUS}		4.7	—	1.3	—	µs

*1 : R,C : Pull-up resistor and load capacitor of the SCL and SDA lines.

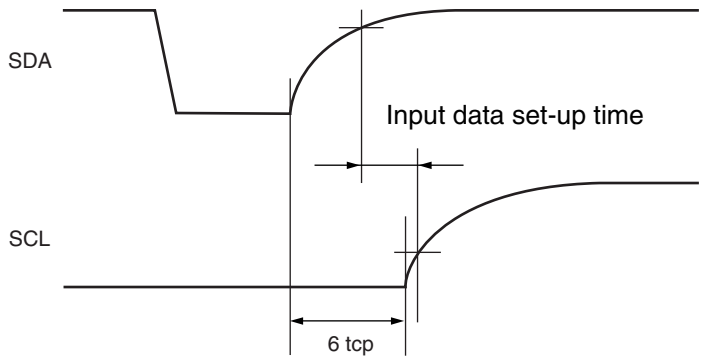
*2 : The maximum t_{HDDAT} has only to be met if the device does not stretch the "L" width (t_{LOW}) of the SCL signal.

*3 : A Fast-mode I²C -bus device can be used in a Standard-mode I²C-bus system, but the requirement $t_{SUDAT} \geq$ 250 ns must then be met.

*4 : For use at over 100 kHz, set the machine clock to at least 6 MHz.

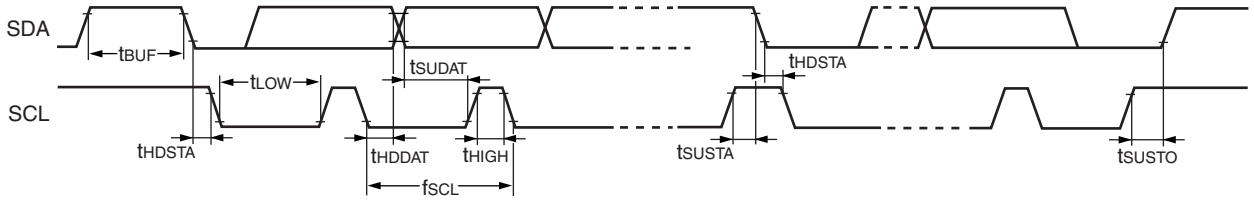
*5 : Refer to "• Note of SDA, SCL set-up time".

• Note of SDA, SCL set-up time



Note : The rating of the input data set-up time in the device connected to the bus cannot be satisfied depending on the load capacitance or pull-up resistor.
Be sure to adjust the pull-up resistor of SDA and SCL if the rating of the input data set-up time cannot be satisfied.

- Timing definition



5. A/D Converter

(MB90F352(S)/MB90F351(S): T_A = –40 °C to +105 °C, 3.0 V ≤ AVRH, V_{CC} = AV_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)
(MB90F352(S)/MB90F351(S): T_A = –40 °C to +125 °C, 3.0 V ≤ AVRH, V_{CC} = AV_{CC} = 5.0 V ± 10%, f_{CP} ≤ 16 MHz, V_{SS} = AV_{SS} = 0 V)
(Device other than above: T_A = –40 °C to +125 °C, 3.0 V ≤ AVRH, V_{CC} = AV_{CC} = 5.0 V ± 10%, f_{CP} ≤ 24 MHz, V_{SS} = AV_{SS} = 0 V)

Parameter	Symbol	Pin	Value			Unit	Remarks
			Min	Typ	Max		
Resolution	—	—	—	—	10	bit	
Total error	—	—	—	—	±3.0	LSB	
Nonlinearity error	—	—	—	—	±2.5	LSB	
Differential nonlinearity error	—	—	—	—	±1.9	LSB	
Zero reading voltage	V_{OT}	AN0 to AN14	AV_{SS} – 1.5 LSB	AV_{SS} + 0.5 LSB	AV_{SS} + 2.5 LSB	V	
Full scale reading voltage	V_{FST}	AN0 to AN14	AVRH – 3.5 LSB	AVRH – 1.5 LSB	AVRH + 0.5 LSB	V	
Compare time	—	—	1.0	—	16,500	µs	4.5 V ≤ AV_{CC} ≤ 5.5 V
			2.0				4.0 V ≤ AV_{CC} < 4.5 V
Sampling time	—	—	0.5	—	∞	µs	4.5 V ≤ AV_{CC} ≤ 5.5 V
			1.2				4.0 V ≤ AV_{CC} < 4.5 V
Analog port input current	I_{AIN}	AN0 to AN14	–0.3	—	+0.3	µA	
Analog input voltage range	V_{AIN}	AN0 to AN14	AV_{SS}	—	AVRH	V	
Reference voltage range	—	AVRH	AV_{SS} + 2.7	—	AV_{CC}	V	
Power supply current	I_A	AV_{CC}	—	3.5	7.5	mA	
	I_{AH}	AV_{CC}	—	—	5	µA	*
Reference voltage supply current	I_R	AVRH	—	600	900	µA	
	I_{RH}	AVRH	—	—	5	µA	*
Offset between input channels	—	AN0 to AN14	—	—	4	LSB	

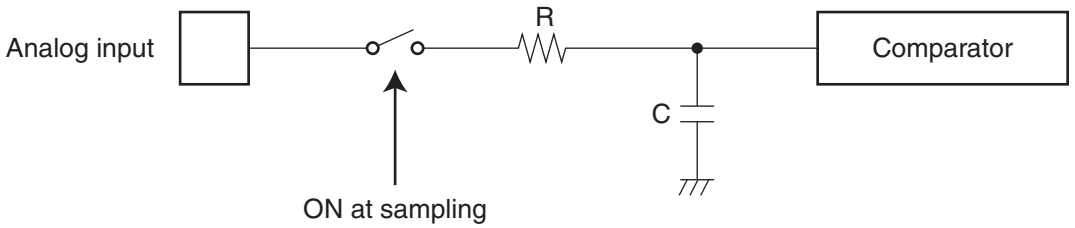
* : If A/D converter is not operating, a current when CPU is stopped is applicable (V_{CC} = AV_{CC} = AVRH = 5.0 V) .

Notes on A/D Converter Section

- **About the external impedance of the analog input and its sampling time**

  A/D converter with sample and hold circuit. If the external impedance is too high to keep sufficient sampling time, the analog voltage charged to the internal sample and hold capacitor is insufficient, adversely affecting A/D conversion precision. Therefore to satisfy the A/D conversion precision standard, consider the relationship between the external impedance and minimum sampling time and either adjust the register value and operating frequency or decrease the external impedance so that the sampling time is longer than the minimum value. Also if the sampling time cannot be sufficient, connect a capacitor of about 0.1 µF to the analog input pin.

· Analog input equivalence circuit



MB90F352(S), MB90F351A(S), MB90F352A(S), MB90F351TA(S), MB90F352TA(S), MB90F356A(S), MB90F357A(S), MB90F356TA(S), MB90F357TA(S),

	R	C
4.5 V ≦ AV_{CC} ≦ 5.5 V	2.0 kΩ (Max)	16.0 pF (Max)
4.0 V ≦ AV_{CC} ≦ 4.5 V	8.2 kΩ (Max)	16.0 pF (Max)

MB90V340A-101/102/103/104, MB90351A(S), MB90352A(S), MB90351TA(S), MB90352TA(S), MB90356A(S), MB90357A(S), MB90356TA(S), MB90357TA(S),

	R	C
4.5 V ≦ AV_{CC} ≦ 5.5 V	2.0 kΩ (Max)	14.4 pF (Max)
4.0 V ≦ AV_{CC} ≦ 4.5 V	8.2 kΩ (Max)	14.4 pF (Max)

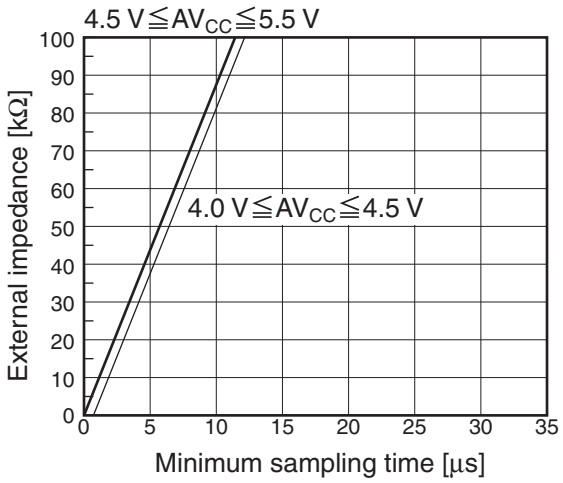
Note : The value is reference value.

• Flash memory device

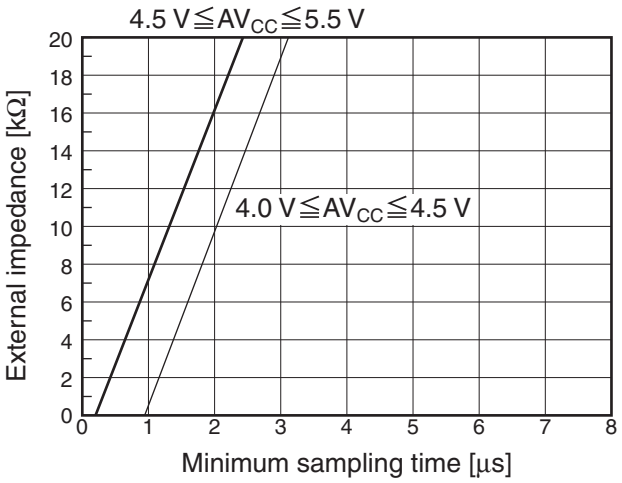
· Relation between External impedance and minimum sampling time

(MB90F352(S), MB90F351A(S), MB90F352A(S), MB90F351TA(S), MB90F352TA(S), MB90F356A(S), MB90F357A(S), MB90F356TA(S), MB90F357TA(S))

[External impedance = 0 kΩ to 100 kΩ]



[External impedance = 0 kΩ to 20 kΩ]

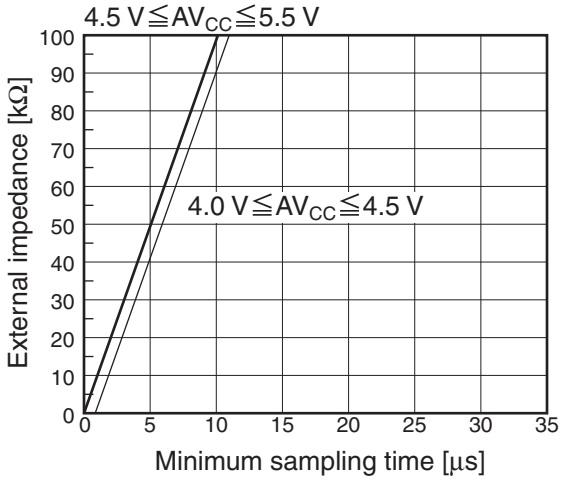


• MASK ROM device

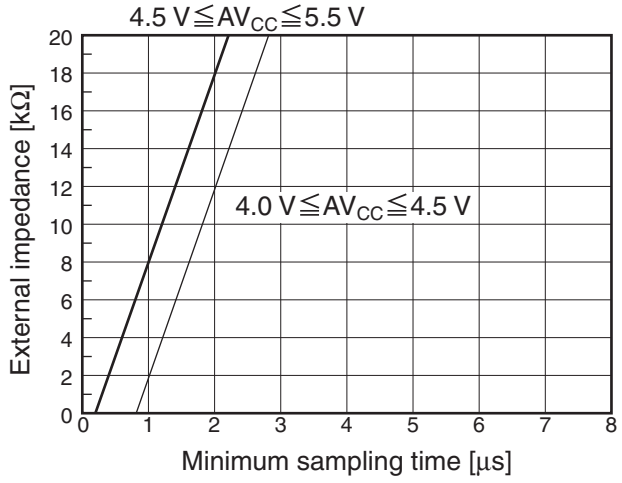
· Relation between External impedance and minimum sampling time

(MB90V340A-101/102/103/104, MB90351A(S), MB90352A(S), MB90351TA(S), MB90352TA(S), MB90356A(S), MB90357A(S), MB90356TA(S), MB90357TA(S))

[External impedance = 0 kΩ to 100 kΩ]



[External impedance = 0 kΩ to 20kΩ]



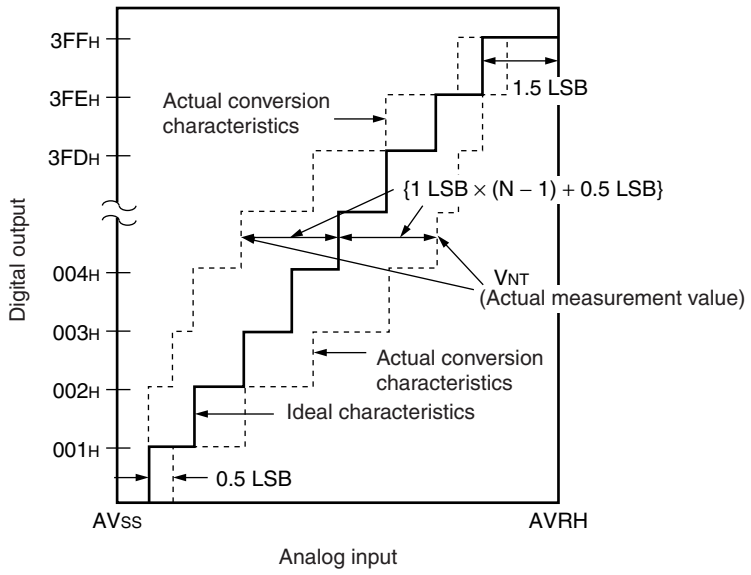
• **About the error**

Values of relative errors grow larger, as |AVRH − AVSS| becomes smaller.

6. Definition of A/D Converter Terms

Resolution	:	Analog variation that is recognized by an A/D converter.
Non linearity error	:	Deviation between a line across zero-transition line (“00 0000 0000” ← → “00 0000 0001”) and full-scale transition line (“11 1111 1110” ← → “11 1111 1111”) and actual conversion characteristics.
Differential linearity error	:	Deviation of input voltage, which is required for changing output code by 1 LSB, from an ideal value.
Total error	:	Difference between an actual value and a theoretical value. A total error includes zero transition error, full-scale transition error, and linear error.

Total error



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

$$1\ \text{LSB} = (\text{Ideal value})\ \frac{AVRH - AV_{SS}}{1024}\ [\text{V}]$$

N : A/D converter digital output value

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

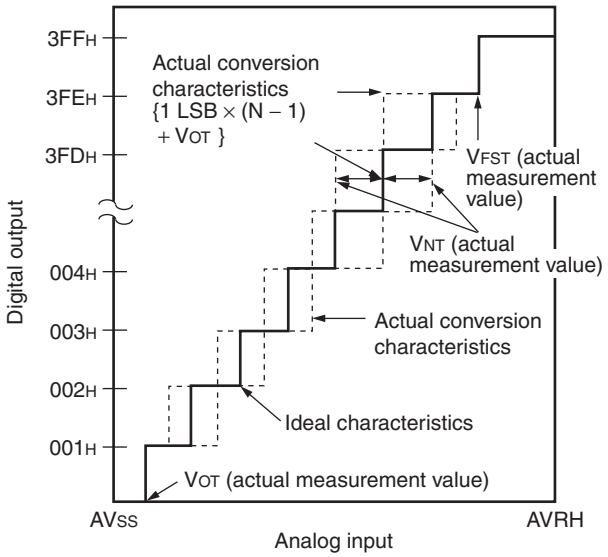
V_{FST} (Ideal value) $= AVRH - 1.5$ LSB [V]

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

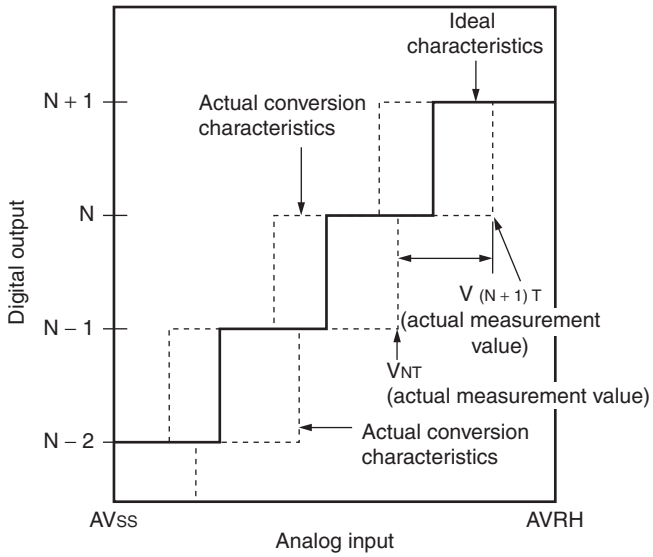
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Non linearity error



Differential linearity error



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

$$\text{Differential linearity error of digital output N} = \frac{V_{(N+1)T} - V_{NT}}{1\ \text{LSB}} - 1\ \text{LSB}\ [\text{LSB}]$$

$$1\ \text{LSB} = \frac{V_{FST} - V_{OT}}{1022}\ [\text{V}]$$

N : A/D converter digital output value
V_{OT} : Voltage at which digital output transits from “000_H” to “001_H.”
V_{FST} : Voltage at which digital output transits from “$3FE_H$” to “$3FF_H$.”

7. Flash Memory Program/Erase Characteristics

Flash Memory

Parameter	Conditions	Value			Unit	Remarks
		Min	Typ	Max		
Sector erase time	T_A = +25 °C V_{CC} = 5.0 V	—	1	15	s	Excludes programming prior to erasure
Chip erase time		—	9	—	s	Excludes programming prior to erasure
Word (16-bit width) programming time		—	16	3,600	µs	Except for the overhead time of the system level
Program/Erase cycle	—	10,000	—	—	cycle	
Flash Memory Data Retention Time	Average T_A = +85 °C	20	—	—	year	*

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

Dual Operation Flash Memory

Parameter	Conditions	Value			Unit	Remarks
		Min	Typ	Max		
Sector erase time (4 Kbytes sector)	T_A = +25 °C V_{CC} = 5.0 V	—	0.2	0.5	s	Excludes programming prior to erasure
Sector erase time (16 Kbytes sector)		—	0.5	7.5	s	Excludes programming prior to erasure
Chip erase time		—	4.6	—	s	Excludes programming prior to erasure
Word (16-bit width) programming time		—	64	3,600	µs	Except for the overhead time of the system level
Program/Erase cycle	—	10,000	—	—	cycle	
Flash Memory Data Retention Time	Average T_A = +85 °C	20	—	—	year	*

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

■ ORDERING INFORMATION

Part number	Package	Remarks
MB90F351PMC	64-pin plastic LQFP FPT-64P-M23 12mm □, 0.65mm pitch	Flash memory products (64 Kbytes)
MB90F351SPMC		
MB90F352PMC		Flash memory products (128 Kbytes)
MB90F352SPMC		
MB90F351APMC	64-pin plastic LQFP FPT-64P-M23 12mm □, 0.65mm pitch	Dual operation Flash memory products (64 Kbytes)
MB90F351ASPMC		
MB90F351TAPMC		
MB90F351TASPMC		
MB90F356APMC		
MB90F356ASPMC		
MB90F356TAPMC		
MB90F356TASPMC		
MB90F352APMC	64-pin plastic LQFP FPT-64P-M23 12mm □, 0.65mm pitch	Dual operation Flash memory products (128 Kbytes)
MB90F352ASPMC		
MB90F352TAPMC		
MB90F352TASPMC		
MB90F357APMC		
MB90F357ASPMC		
MB90F357TAPMC		
MB90F357TASPMC		
MB90351APMC	64-pin plastic LQFP FPT-64P-M23 12mm □, 0.65mm pitch	MASK ROM products (64 Kbytes)
MB90351ASPMC		
MB90351TAPMC		
MB90351TASPMC		
MB90356APMC		
MB90356ASPMC		
MB90356TAPMC		
MB90356TASPMC		
MB90352APMC	64-pin plastic LQFP FPT-64P-M23 12mm □, 0.65mm pitch	MASK ROM products (128 Kbytes)
MB90352ASPMC		
MB90352TAPMC		
MB90352TASPMC		
MB90357APMC		
MB90357ASPMC		
MB90357TAPMC		
MB90357TASPMC		

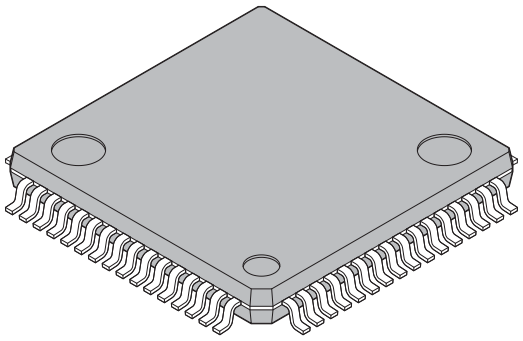
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Part number	Package	Remarks
MB90F351APMC1	64-pin plastic LQFP FPT-64P-M24 10 mm □, 0.50 mm pitch	Dual operation Flash memory products* (64 Kbytes)
MB90F351ASPMC1		
MB90F351TAPMC1		
MB90F351TASPMC1		
MB90F356APMC1		
MB90F356ASPMC1		
MB90F356TAPMC1		
MB90F356TASPMC1		
MB90F352APMC1	64-pin plastic LQFP FPT-64P-M24 10 mm □, 0.50 mm pitch	Dual operation Flash memory products* (128 Kbytes)
MB90F352ASPMC1		
MB90F352TAPMC1		
MB90F352TASPMC1		
MB90F357APMC1		
MB90F357ASPMC1		
MB90F357TAPMC1		
MB90F357TASPMC1		
MB90351APMC1	64-pin plastic LQFP FPT-64P-M24 10 mm □, 0.50 mm pitch	MASK ROM products* (64 Kbytes)
MB90351ASPMC1		
MB90351TAPMC1		
MB90351TASPMC1		
MB90356APMC1		
MB90356ASPMC1		
MB90356TAPMC1		
MB90356TASPMC1		
MB90352APMC1	64-pin plastic LQFP FPT-64P-M24 10 mm □, 0.50 mm pitch	MASK ROM products* (128 Kbytes)
MB90352ASPMC1		
MB90352TAPMC1		
MB90352TASPMC1		
MB90357APMC1		
MB90357ASPMC1		
MB90357TAPMC1		
MB90357TASPMC1		
MB90V340A-101	299-pin ceramic PGA PGA-299C-A01	Device for evaluation
MB90V340A-102		
MB90V340A-103		
MB90V340A-104		

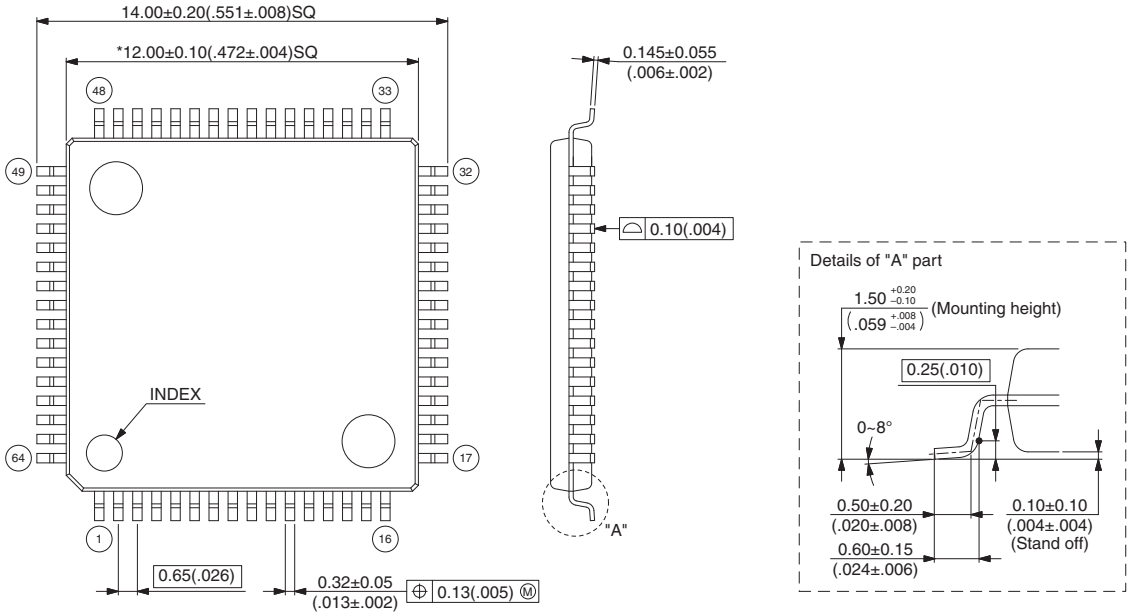
* : These devices are under development.

■ PACKAGE DIMENSIONS

64-pin plastic LQFP		
	Lead pitch	0.65 mm
	Package width × package length	12.0 × 12.0 mm
	Lead shape	Gullwing
	Sealing method	Plastic mold
	Mounting height	1.70 mm MAX
	Weight	0.47 g
(FPT-64P-M23)	Code (Reference)	P-LQFP64-12×12-0.65

64-pin plastic LQFP
(FPT-64P-M23)

Note 1) * : These dimensions do not include resin protrusion.
Note 2) Pins width and pins thickness include plating thickness.
Note 3) Pins width do not include tie bar cutting remainder.



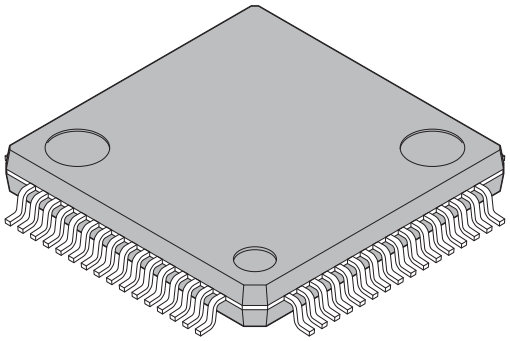
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Dimensions in mm (inches).
Note: The values in parentheses are reference values

Please check the latest package dimension at the following URL.
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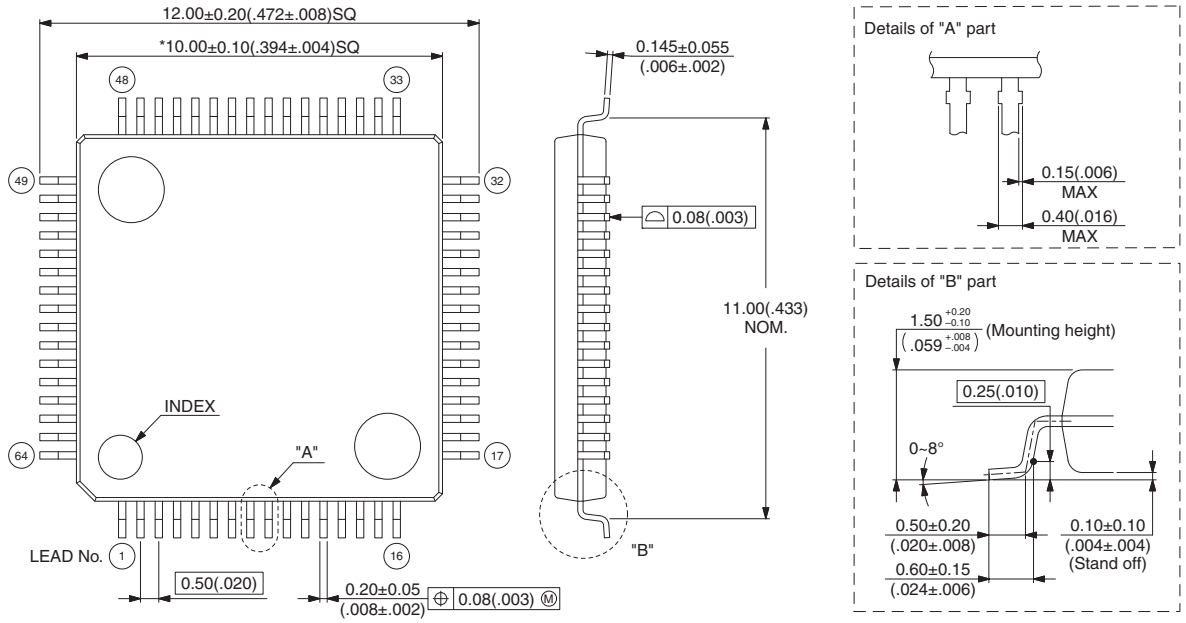
(Continued)

(Continued)

64-pin plastic LQFP		
 (FPT-64P-M24)	Lead pitch	0.50 mm
	Package width × package length	10.0 mm × 10.0 mm
	Lead shape	Gullwing
	Sealing method	Plastic mold
	Code (Reference)	P-LFQFP64-10×10-0.50

64-pin plastic LQFP
(FPT-64P-M24)

Note 1) * : These dimensions do not include resin protrusion.
Note 2) Pins width and pins thickness include plating thickness.
Note 3) Pins width do not include tie bar cutting remainder.



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

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■ MAJOR CHANGES IN THIS EDITION

Page	Section	Change Results
—	—	Deleted the following package. FPT-64P-M09
13	■ PACKAGES AND PRODUCT CORRESPONDENCE	Changed the correspondence package for MB90F351, MB90F351S, MB90F352 and MB90F352S. FPT-64P-M09 → FPT-64P-M23
26	■ HANDLING DEVICES	Corrected a typo in number 10. “is used”→ “is not used”
64	■ ELECTRICAL CHARACTER-ISTICS 4. AC Characteristics (4) Clock Output Timing	Changed the Minimum value of cycle time. 41.76 → 41.67
75	5. A/D Converter	Changed the notation of “Zero reading voltage” and “Full scale reading voltage”.
81	■ ORDERING INFORMATION	Changed the part numbers and the package. MB90F351PFM → MB90F351PMC MB90F351SPFM → MB90F351SPMC MB90F352PFM → MB90F352PMC MB90F352SPFM → MB90F352SPMC FPT-64P-M09 → FPT-64P-M23

The vertical lines marked in the left side of the page show the changes.

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