■ FEATURES

Feature	Description
Technology	• 0.18µm CMOS
CPU	• F²MC-16FX CPU • Up to 56 MHz internal, 17.8 ns instruction cycle time • Optimized instruction set for controller applications (bit, byte, word and long-word data types; 23 different addressing modes; barrel shift; variety of pointers) • 8-byte instruction execution queue • Signed multiply (16-bit × 16-bit) and divide (32-bit/16-bit) instructions available
System clock	• On-chip PLL clock multiplier (x1 - x25, x1 when PLL stop) • 3 MHz - 16 MHz external crystal oscillator clock (maximum frequency when using ceramic resonator depends on Q-factor). • Up to 56 MHz external clock for devices with fast clock input feature • 32-100 kHz subsystem quartz clock • 100kHz/2MHz internal RC clock for quick and safe startup, oscillator stop detection, watchdog • Clock source selectable from main- and subclock oscillator (part number suffix “W”) and on-chip RC oscillator, independently for CPU and 2 clock domains of peripherals. • Low Power Consumption - 13 operating modes : (different Run, Sleep, Timer modes, Stop mode) • Clock modulator
On-chip voltage regulator	• Internal voltage regulator supports reduced internal MCU voltage, offering low EMI and low power consumption figures
Low voltage reset	• Reset is generated when supply voltage is below minimum.
Code Security	• Protects ROM content from unintended read-out
Memory Patch Function	• Replaces ROM content • Can also be used to implement embedded debug support
DMA	• Automatic transfer function independent of CPU, can be assigned freely to resources
Interrupts	• Fast Interrupt processing • 8 programmable priority levels • Non-Maskable Interrupt (NMI)
Timers	• Three independent clock timers (23-bit RC clock timer, 23-bit Main clock timer, 17-bit Sub clock timer) • Watchdog Timer

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Feature	Description
CAN	• Supports CAN protocol version 2.0 part A and B • ISO16845 certified • Bit rates up to 1 Mbit/s • 32 message objects • Each message object has its own identifier mask • Programmable FIFO mode (concatenation of message objects) • Maskable interrupt • Disabled Automatic Retransmission mode for Time Triggered CAN applications • Programmable loop-back mode for self-test operation
USART	• Full duplex USARTs (SCI/LIN) • 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
I^2C	• Up to 400 kbps • Master and Slave functionality, 7-bit and 10-bit addressing
A/D converter	• SAR-type • 10-bit resolution • Signals interrupt on conversion end, single conversion mode, continuous conversion mode, stop conversion mode, activation by software, external trigger or reload timer
A/D Converter Reference Voltage switch	• 2 independent positive A/D converter reference voltages available
Reload Timers	• 16-bit wide • Prescaler with $1/2^1$, $1/2^2$, $1/2^3$, $1/2^4$, $1/2^5$, $1/2^6$ of peripheral clock frequency • Event count function
Free Running Timers	• Signals an interrupt on overflow, supports timer clear upon match with Output Compare (0, 4), Prescaler with 1, $1/2^1$, $1/2^2$, $1/2^3$, $1/2^4$, $1/2^5$, $1/2^6$, $1/2^7$,$1/2^8$ of peripheral clock frequency
Input Capture Units	• 16-bit wide • Signals an interrupt upon external event • Rising edge, falling edge or rising & falling edge sensitive
Output Compare Units	• 16-bit wide • Signals an interrupt when a match with 16-bit I/O Timer occurs • A pair of compare registers can be used to generate an output signal.

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Feature	Description
Programmable Pulse Generator	• 16-bit down counter, cycle and duty setting registers • Interrupt at trigger, counter borrow and/or duty match • PWM operation and one-shot operation • Internal prescaler allows 1, 1/4, 1/16, 1/64 of peripheral clock as counter clock and Reload timer underflow as clock input • Can be triggered by software or reload timer
Stepper Motor Controller	• Stepper Motor Controller with integrated high current output drivers • Four high current outputs for each channel • Two synchronized 8/10-bit PWMs per channel • Internal prescaling for PWM clock: 1, 1/4, 1/5, 1/6, 1/8, 1/10, 1/12, 1/16 of peripheral clock • Separate power supply for high current output drivers
LCD Controller	• LCD controller with up to 4 COM × 65 SEG • Internal or external voltage generation • Duty cycle: Selectable from options: 1/2, 1/3 and 1/4 • Fixed 1/3 bias • Programmable frame period • Clock source selectable from three options (peripheral clock, subclock or RC oscillator clock) • On-chip drivers for internal divider resistors or external divider resistors • On-chip data memory for display • LCD display can be operated in Timer Mode • Blank display: selectable • All SEG, COM and V pins can be switched between general and specialized purposes • External divided resistors can be also used to shut off the current when LCD is deactivated
Sound Generator	• 8-bit PWM signal is mixed with tone frequency from 16-bit reload counter • PWM clock by internal prescaler: 1, 1/2, 1/4, 1/8 of peripheral clock
Real Time Clock	• Can be clocked either from sub oscillator (devices with part number suffix “W”), main oscillator or from the RC oscillator • Facility to correct oscillation deviation of Sub clock or RC oscillator clock (clock calibration) • Read/write accessible second/minute/hour registers • Can signal interrupts every half second/second/minute/hour/day • Internal clock divider and prescaler provide exact 1s clock

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Feature	Description
External Interrupts	• Edge sensitive or level sensitive • Interrupt mask and pending bit per channel • Each available CAN channel RX has an external interrupt for wake-up • Selected USART channels SIN have an external interrupt for wake-up
Non Maskable Interrupt	• Disabled after reset • Once enabled, can not be disabled other than by reset. • Level high or level low sensitive • Pin shared with external interrupt 0.
External bus interface	• 8-bit or 16-bit bidirectional data • Up to 24-bit addresses • 6 chip select signals • Multiplexed address/data lines • Non-multiplexed address/data lines • Wait state request • External bus master possible • Timing programmable
Alarm comparator	• Monitors an external voltage and generates an interrupt in case of a voltage lower or higher than the defined thresholds • Threshold voltages defined externally or generated internally • Status is readable, interrupts can be masked separately
I/O Ports	• Virtually all external pins can be used as general purpose I/O • All push-pull outputs (except when used as I2C SDA/SCL line) • Bit-wise programmable as input/output or peripheral signal • Bit-wise programmable input enable • Bit-wise programmable input levels: Automotive / CMOS-Schmitt trigger / TTL • Bit-wise programmable pull-up resistor • Bit-wise programmable output driving strength for EMI optimization
Package	• 120-pin plastic LQFP
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: 20 years • Erase can be performed on each sector individually • Sector protection • Flash Security feature to protect the content of the Flash • Low voltage detection during Flash erase

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■ PRODUCT LINEUP

Features		MB96V300B	MB96(F)38x
Product type		Evaluation sample	Flash product: MB96F38x Mask ROM product: MB9638x
Product options			
YS		NA	Low voltage reset persistently on / Single clock
RS			Low voltage reset can be disabled / Single clock
YW			Low voltage reset persistently on / Dual clock
RW			Low voltage reset can be disabled / Dual clock
TS			indep. 32KB Flash / Low voltage reset persistently on / Single clock
HS			indep. 32KB Flash / Low voltage reset can be disabled / Single clock
TW			indep. 32KB Flash / Low voltage reset persistently on / Dual clock
HW			indep. 32KB Flash / Low voltage reset can be disabled / Dual clock
Flash/ROM	RAM		
128KB	6KB	ROM/Flash memory emulation by external RAM, 92KB internal RAM	MB96384Y[*1], MB96384R[*1]
160KB	8KB		MB96385Y[*1], MB96385R[*1], MB96F385Y[*1], MB96F385R[*1]
288KB	16KB		MB96F386Y, MB96F386R
416KB	16KB		MB96F387Y, MB96F387R
576KB [Flash A: 544KB, Flash B: 32KB]	28KB		MB96F388T[*1], MB96F388H[*1]
832KB [Flash A: 544KB, Flash B: 288KB]	32KB		MB96F389Y[*1], MB96F389R[*1],
Package		BGA416	FPT-120P-M21
DMA		16 channels	7 channels
USART		10 channels	5 channels
I2C		2 channels	1 channel
A/D Converter		40 channels	16 channels
A/D Converter Reference Voltage switch		yes	Only for MB96F386Y, MB96F386R, MB96F387Y, MB96F387R
16-bit Reload Timer		6 channels + 1 channel (for PPG)	4 channels + 1 channel (for PPG)
16-bit Free-Running Timer		4 channels	2 channels
16-bit Output Compare		12 channels	4 channels

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Features	MB96V300B	MB96(F)38x
16-bit Input Capture	12 channels	8 channels
16-bit Programmable Pulse Generator	20 channels	8 channels
CAN Interface	5 channels	Other than below: 2 channels MB96384Y*1, MB96384R*1, MB96(F)385Y*1, MB96(F)385R*1,: 1 channel
Stepping Motor Controller	6 channels	5 channels
External Interrupts	16 channels	8 channels
Non-Maskable Interrupt	1 channel	
Sound generator	2 channels	2 channels
LCD Controller	4 COM x 72 SEG	4 COM x 65 SEG
Real Time Clock	1	
I/O Ports	136	94 for part number with suffix "W", 96 for part number with suffix "S"
Alarm comparator	2 channels	Other than below: 2 channels MB96384Y*1, MB96384R*1, MB96(F)385Y*1, MB96(F)385R*1,: 1 channel
External bus interface	Yes	
Chip select	6 signals	
Clock output function	2 channels	
Low voltage reset	Yes	
On-chip RC-oscillator	Yes	

*1: These devices are under development and specification is preliminary. These products under development may change its specification without notice.

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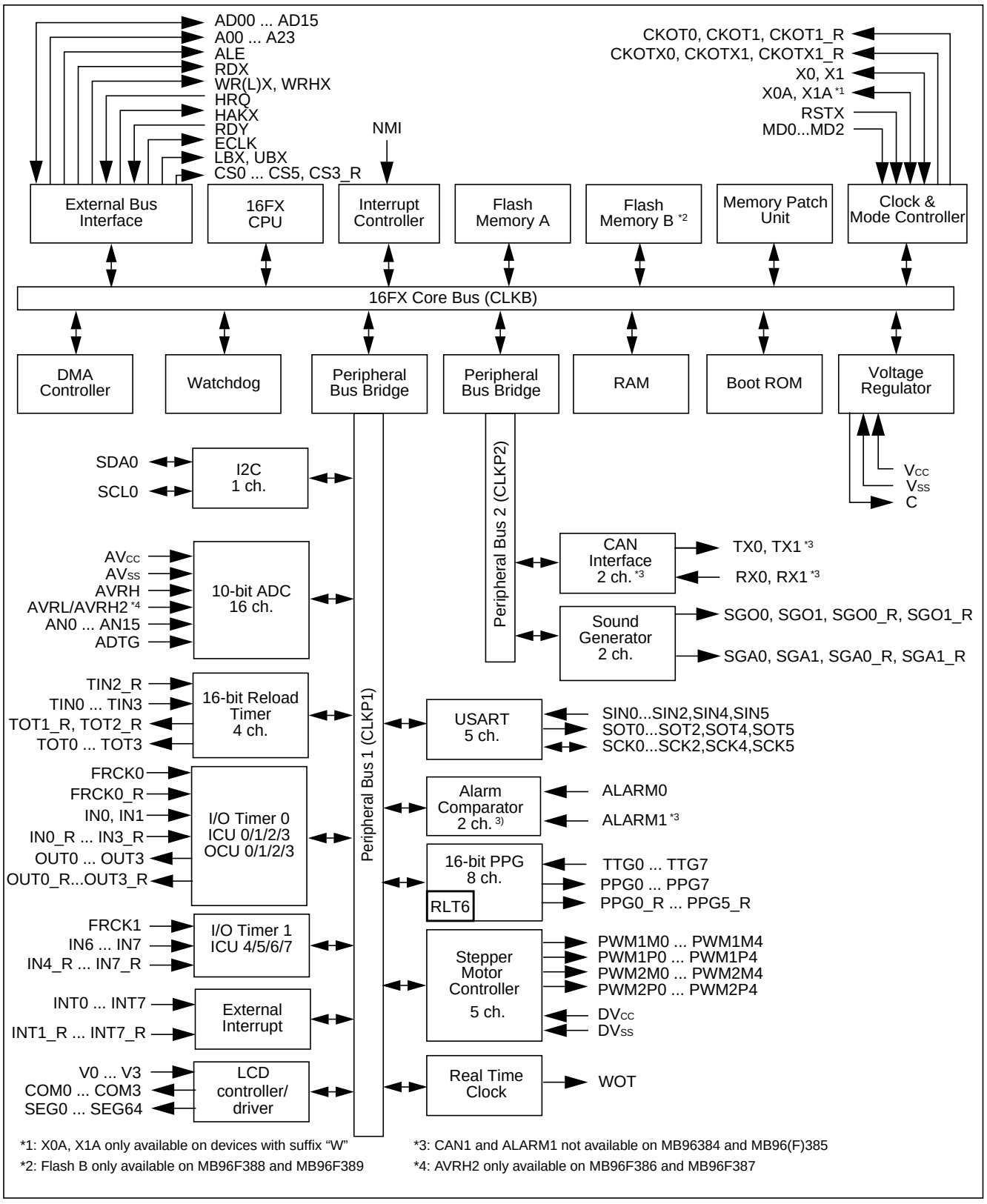
■ BLOCK DIAGRAM

Block diagram of MB96(F)38x



*1: X0A, X1A only available on devices with suffix “W”

*2: Flash B only available on MB96F388 and MB96F389

*3: CAN1 and ALARM1 not available on MB96384 and MB96(F)385

*4: AVRH2 only available on MB96F386 and MB96F387

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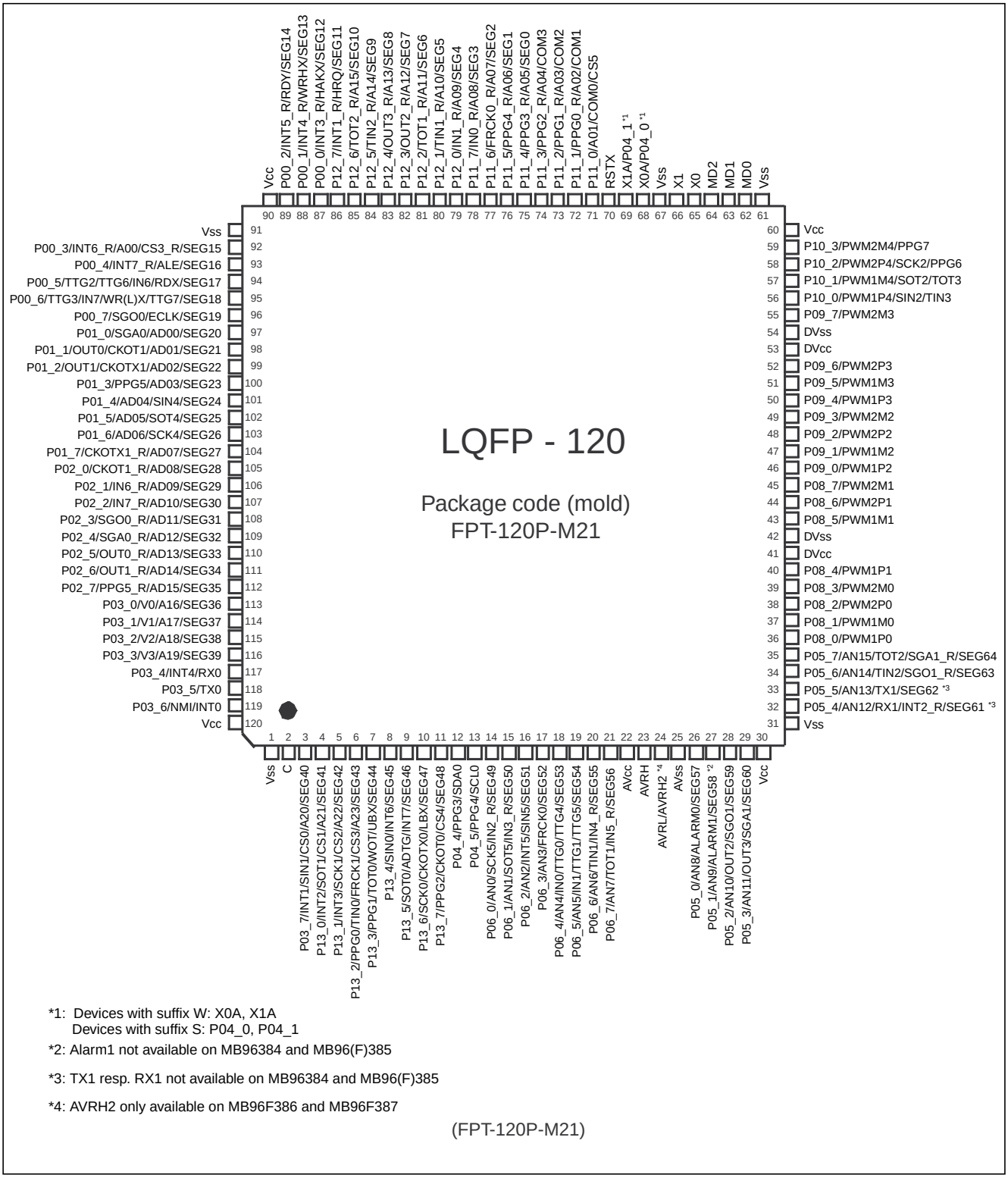
■ PIN ASSIGNMENT

Pin assignment of MB96(F)38x



*1: Devices with suffix W: X0A, X1A
Devices with suffix S: P04_0, P04_1

*2: Alarm1 not available on MB96384 and MB96(F)385

*3: TX1 resp. RX1 not available on MB96384 and MB96(F)385

*4: AVRH2 only available on MB96F386 and MB96F387

(FPT-120P-M21)

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■ PIN FUNCTION DESCRIPTION

Pin Function description (1 of 3)

Pin name	Feature	Description
ADn	External bus	External bus interface (non multiplexed mode) data input/ output. External bus interface (multiplexed mode) address output and data input/output
ADTG	ADC	A/D converter trigger input
ALARMn	Alarm comparator	Alarm Comparator n input
ALE	External bus	External bus Address Latch Enable output
An	External bus	External bus non-multiplexed address output
ANn	ADC	A/D converter channel n input
AV_{CC}	Supply	Analog circuits power supply
AVRH	ADC	A/D converter high reference voltage input
AVRH2	ADC	Alternative A/D converter high reference voltage input
AVRL	ADC	A/D converter low reference voltage input
AV_{SS}	Supply	Analog circuits power supply
C	Voltage regulator	Internally regulated power supply stabilization capacitor pin
CKOTn	Clock output function	Clock Output function n output
CKOTn_R	Clock output function	Relocated Clock Output function n output
CKOTXn	Clock output function	Clock Output function n inverted output
CKOTXn_R	Clock output function	Relocated Clock Output function n inverted output
COMn	LCD	LCD COM pins
ECLK	External bus	External bus clock output
CSn	External bus	External bus chip select n output
CSn_R	External bus	Relocated External bus chip select n output
DV_{CC}	Supply	SMC pins power supply
FRCKn	Free Running Timer	Free Running Timer n input
FRCKn_R	Free Running Timer	Relocated Free Running Timer n input
HAKX	External bus	External bus Hold Acknowledge
HRQ	External bus	External bus Hold Request
INn	ICU	Input Capture Unit n input
INn_R	ICU	Relocated Input Capture Unit n input
INTn	External Interrupt	External Interrupt n input

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Pin Function description (2 of 3)

Pin name	Feature	Description
INTn_R	External Interrupt	Relocated External Interrupt n input
LBX	External bus	External Bus Interface Lower Byte select strobe output
MDn	Core	Input pins for specifying the operating mode.
NMI	External Interrupt	Non-Maskable Interrupt input
OUTn	OCU	Output Compare Unit n waveform output
OUTn_R	OCU	Relocated Output Compare Unit n waveform output
Pxx_n	GPIO	General purpose IO
PPGn	PPG	Programmable Pulse Generator n output
PPGn_R	PPG	Relocated Programmable Pulse Generator n output
PWMn	SMC	SMC PWM high current
RDX	External bus	External bus interface read strobe output
RDY	External bus	External bus interface external wait state request input
RSTX	Core	Reset input
RXn	CAN	CAN interface n RX input
SCKn	USART	USART n serial clock input/output
SCLn	I2C	I2C interface n clock I/O input/output
SDAn	I2C	I2C interface n serial data I/O input/output
SEGn	LCD	LCD segment n
SGA	Sound Generator	SG amplitude output
SGO	Sound Generator	SG sound/tone output
SGA_R	Sound Generator	Relocated SG amplitude output
SGO_R	Sound Generator	Relocated SG sound/tone output
SINn	USART	USART n serial data input
SOTn	USART	USART n serial data output
TINn	Reload Timer	Reload Timer n event input
TINn_R	Reload Timer	Relocated Reload Timer n event input
TOTn	Reload Timer	Reload Timer n output
TOTn_R	Reload Timer	Relocated Reload Timer n output
TTGn	PPG	Programmable Pulse Generator n trigger input
TXn	CAN	CAN interface n TX output

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Pin Function description (3 of 3)

Pin name	Feature	Description
UBX	External bus	External Bus Interface Upper Byte select strobe output
Vn	LCD	LCD voltage references
V_{CC}	Supply	Power supply
V_{SS}	Supply	Power supply
WOT	RTC	Real Timer clock output
WRHX	External bus	External bus High byte write strobe output
WRLX/WRX	External bus	External bus Low byte / Word write strobe output
X0	Clock	Oscillator input
X0A	Clock	Subclock Oscillator input (only for devices with suffix "W")
X1	Clock	Oscillator output
X1A	Clock	Subclock Oscillator output (only for devices with suffix "W")

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■ PIN CIRCUIT TYPE

Pin circuit types (1 of 2)

FPT-120P-M21	
Pin no.	Circuit type *1
1	Supply
2	F
3 to 11	J
12,13	N
14 to 21	K
22	Supply
23 to 24	G
25	Supply
26 to 29	K
30,31	Supply
32 to 35	K
36 to 40	M
41,42	Supply
43 to 52	M
53,54	Supply
55 to 59	M
60, 61	Supply
62 to 64	C
65, 66	A
67	Supply
68,69	B *2
68,69	H *3
70	E
71 to 89	J
90 to 91	Supply
92 to 112	J
113 to 116	L

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Pin circuit types (2 of 2)

FPT-120P-M21	
Pin no.	Circuit type *1
117 to 119	H
120	Supply

*1: Please refer to “■ I/O CIRCUIT TYPE” for details on the I/O circuit types
*2: Devices with suffix ”W”
*3: Devices without suffix ”W”

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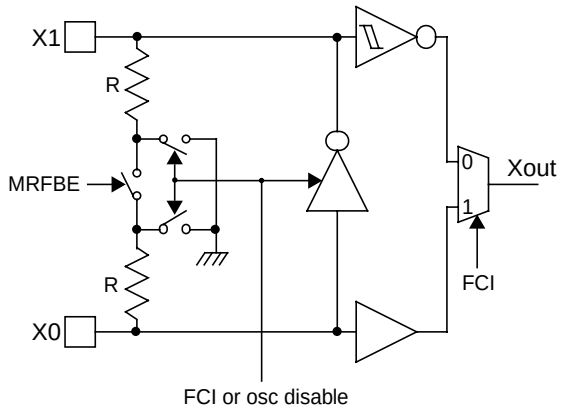
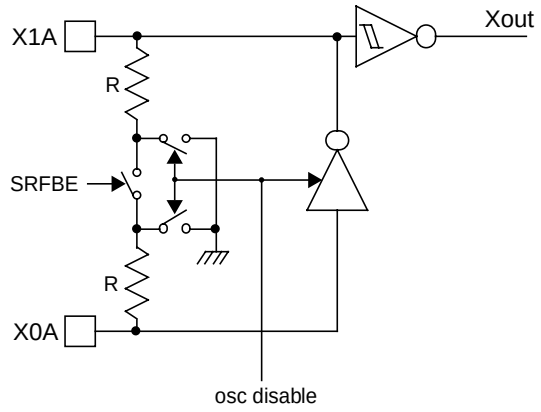
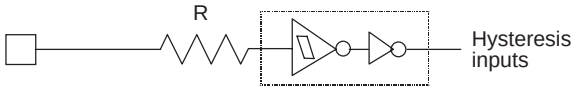
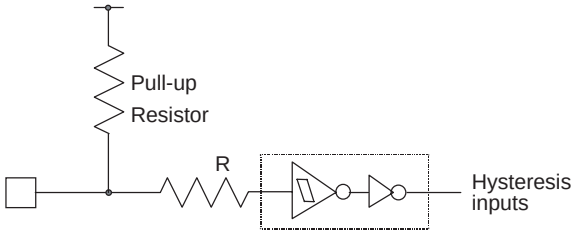
■ I/O CIRCUIT TYPE

Type	Circuit	Remarks
A		High-speed oscillation circuit: • Programmable between oscillation mode (external crystal or resonator connected to X0/X1 pins) and Fast external Clock Input (FCI) mode (external clock connected to X0 pin) • Programmable feedback resistor = approx. 2 * 0.5 MΩ. Feedback resistor is grounded in the center when the oscillator is disabled or in FCI mode
B		Low-speed oscillation circuit: • Programmable feedback resistor = approx. 2 * 5 MΩ. Feedback resistor is grounded in the center when the oscillator is disabled
C		• Mask ROM and EVA device: CMOS Hysteresis input pin • Flash device: CMOS input pin
E		• CMOS Hysteresis input pin • Pull-up resistor value: approx. 50 kΩ

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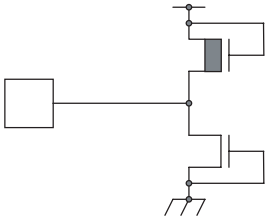
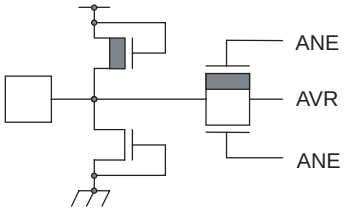
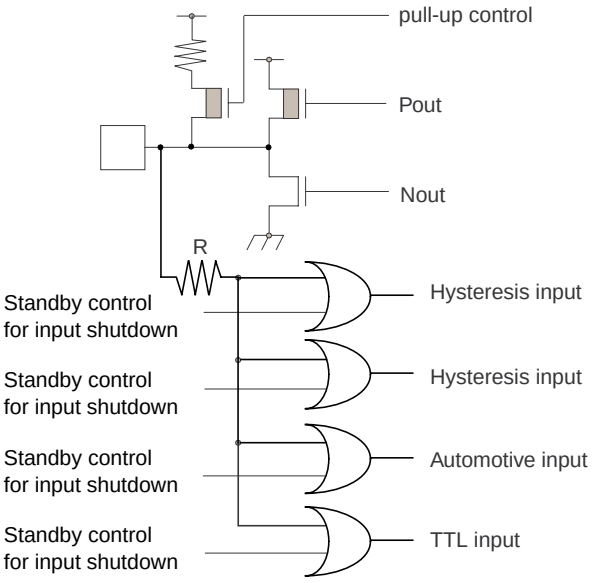
Type	Circuit	Remarks
F		• Power supply input protection circuit
G		• A/D converter ref+ (AVRH/AVRH2) power supply input pin with protection circuit • Flash devices do not have a protection circuit against VCC for pins AVRH/AVRH2 • Devices without AVRH reference switch do not have an analog switch for the AVRL pin
H		• CMOS level output (programmable I_{OL} = 5mA, I_{OH} = -5mA and I_{OL} = 2mA, I_{OH} = -2mA) • 2 different CMOS hysteresis inputs with input shutdown function • Automotive input with input shutdown function • TTL input with input shutdown function • Programmable pull-up resistor: 50kΩ approx.

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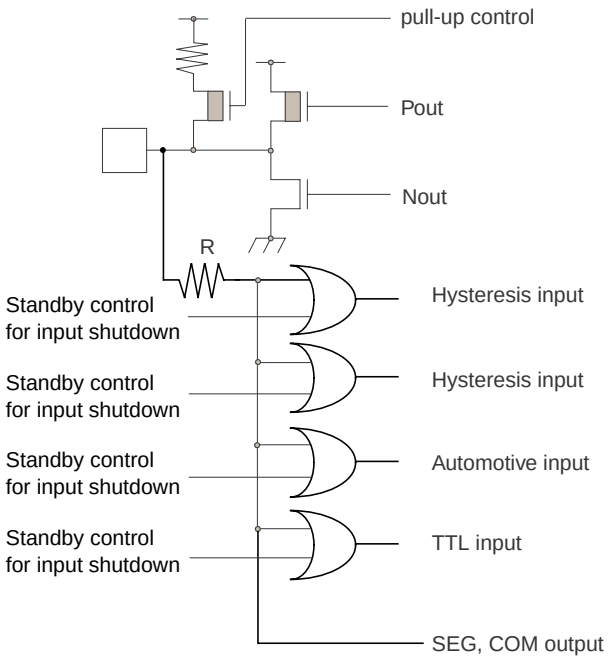
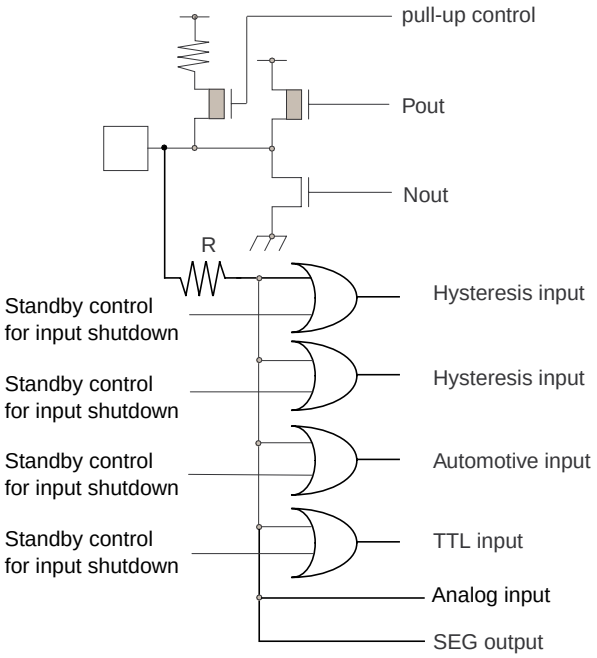
Type	Circuit	Remarks
J		• CMOS level output (programmable I_{OL} = 5mA, I_{OH} = -5mA and I_{OL} = 2mA, I_{OH} = -2mA) • 2 different CMOS hysteresis inputs with input shutdown function • Automotive input with input shutdown function • TTL input with input shutdown function • Programmable pull-up resistor: 50kΩ approx. • SEG or COM output
K		• CMOS level output (programmable I_{OL} = 5mA, I_{OH} = -5mA and I_{OL} = 2mA, I_{OH} = -2mA) • 2 different CMOS hysteresis inputs with input shutdown function • Automotive input with input shutdown function • TTL input with input shutdown function. • Programmable pull-up resistor: 50kΩ approx. • Analog input • SEG output

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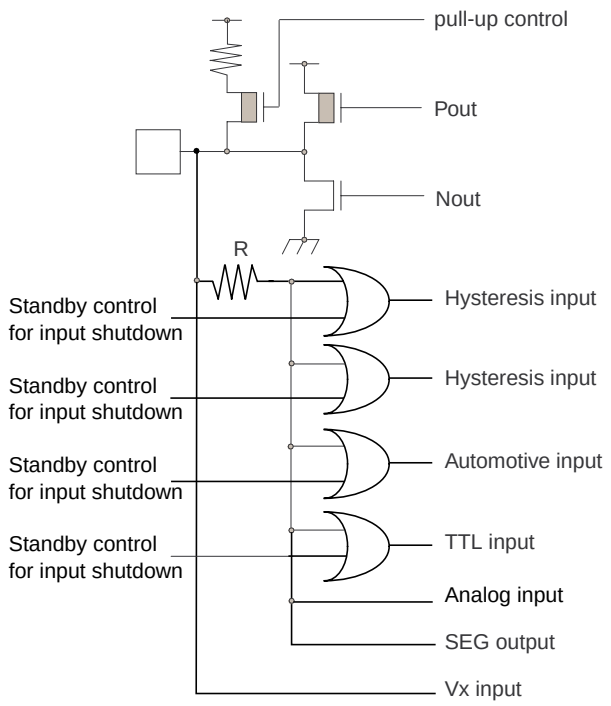
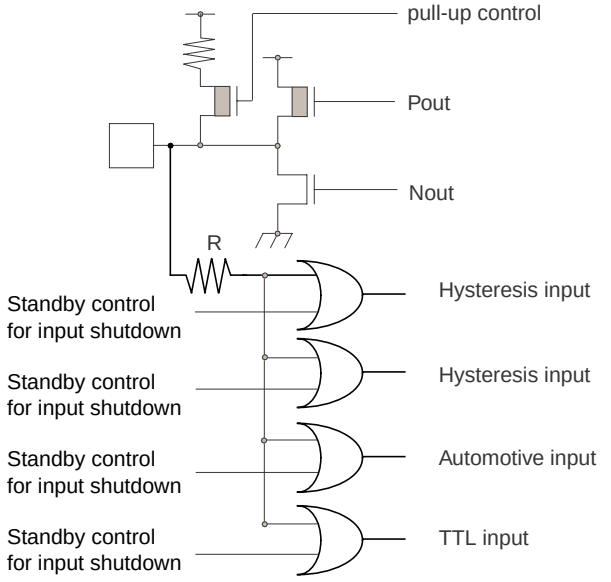
Type	Circuit	Remarks
L		• CMOS level output (programmable I_{OL} = 5mA, I_{OH} = -5mA and I_{OL} = 2mA, I_{OH} = -2mA) • 2 different CMOS hysteresis inputs with input shutdown function • Automotive input with input shutdown function • TTL input with input shutdown function • Programmable pull-up resistor: 50kΩ approx. • Analog input • Vx input • SEG output
M		• CMOS level output (programmable I_{OL} = 5mA, I_{OH} = -5mA and I_{OL} = 2mA, I_{OH} = -2mA, I_{OL} = 30mA, I_{OH} = -30mA) • 2 different CMOS hysteresis inputs with input shutdown function • Automotive input with input shutdown function • TTL input with input shutdown function • Programmable pull-up resistor: 50kΩ approx.

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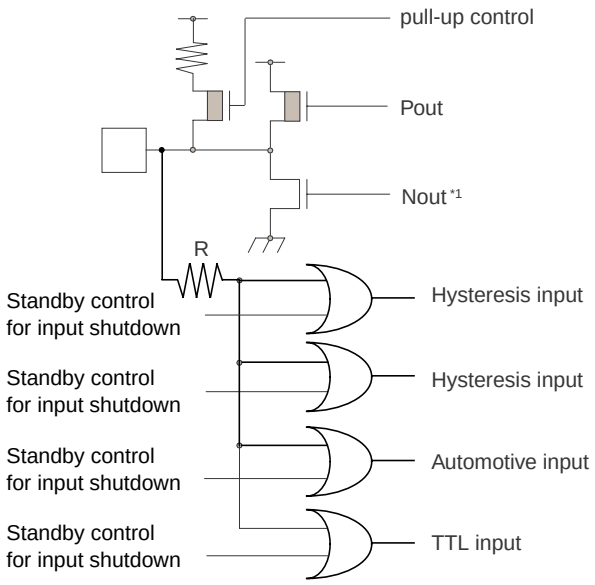
Type	Circuit	Remarks
N		• CMOS level output (I_{OL} = 3mA, I_{OH} = -3mA) • 2 different CMOS hysteresis inputs with input shutdown function • Automotive input with input shutdown function • TTL input with input shutdown function • Programmable pull-up resistor: 50kΩ approx. *1: N-channel transistor has slew rate control according to I^2C spec, irrespective of usage

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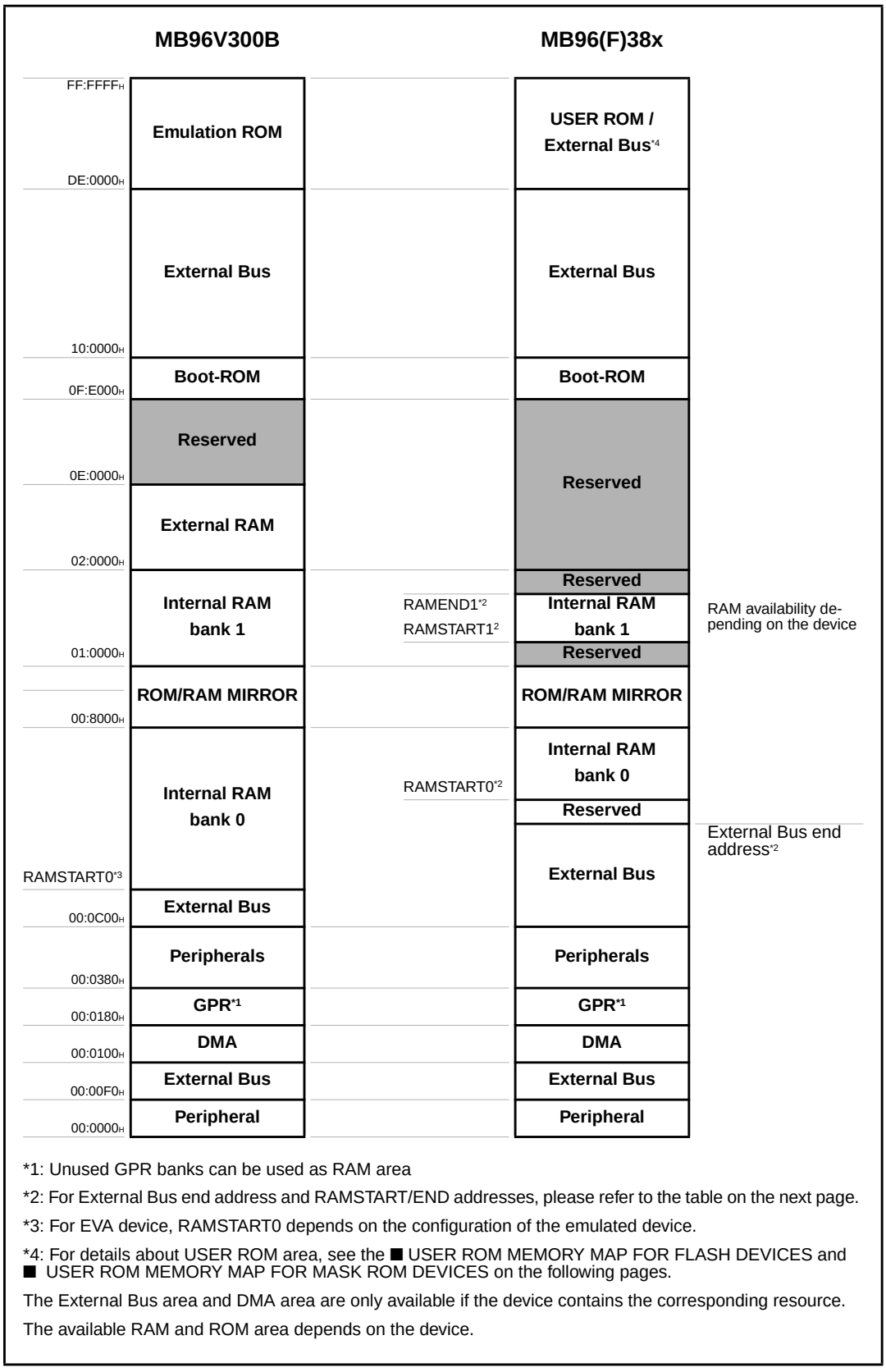
■ MEMORY MAP



*1: Unused GPR banks can be used as RAM area

*2: For External Bus end address and RAMSTART/END addresses, please refer to the table on the next page.

*3: For EVA device, RAMSTART0 depends on the configuration of the emulated device.

*4: For details about USER ROM area, see the ■ USER ROM MEMORY MAP FOR FLASH DEVICES and ■ USER ROM MEMORY MAP FOR MASK ROM DEVICES on the following pages.

The External Bus area and DMA area are only available if the device contains the corresponding resource.

The available RAM and ROM area depends on the device.

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■ RAMSTART/END AND EXTERNAL BUS END ADDRESSES

Devices	Bank 0 RAM size	Bank 1 RAM size	External Bus end address	RAMSTART0	RAMSTART1	RAMEND1
MB96384	6KByte	-	00:61FF$_H$	00:6A40$_H$	-	-
MB96385/F385	8KByte	-	00:61FF$_H$	00:6240$_H$	-	-
MB96F386, MB96F387	16KByte	-	00:41FF$_H$	00:4240$_H$	-	-
MB96F388	28KByte	-	00:11FF$_H$	00:1240$_H$	-	-
MB96F389	28KByte	4KByte	00:11FF$_H$	00:1240$_H$	01:8000$_H$	01:8FFF$_H$

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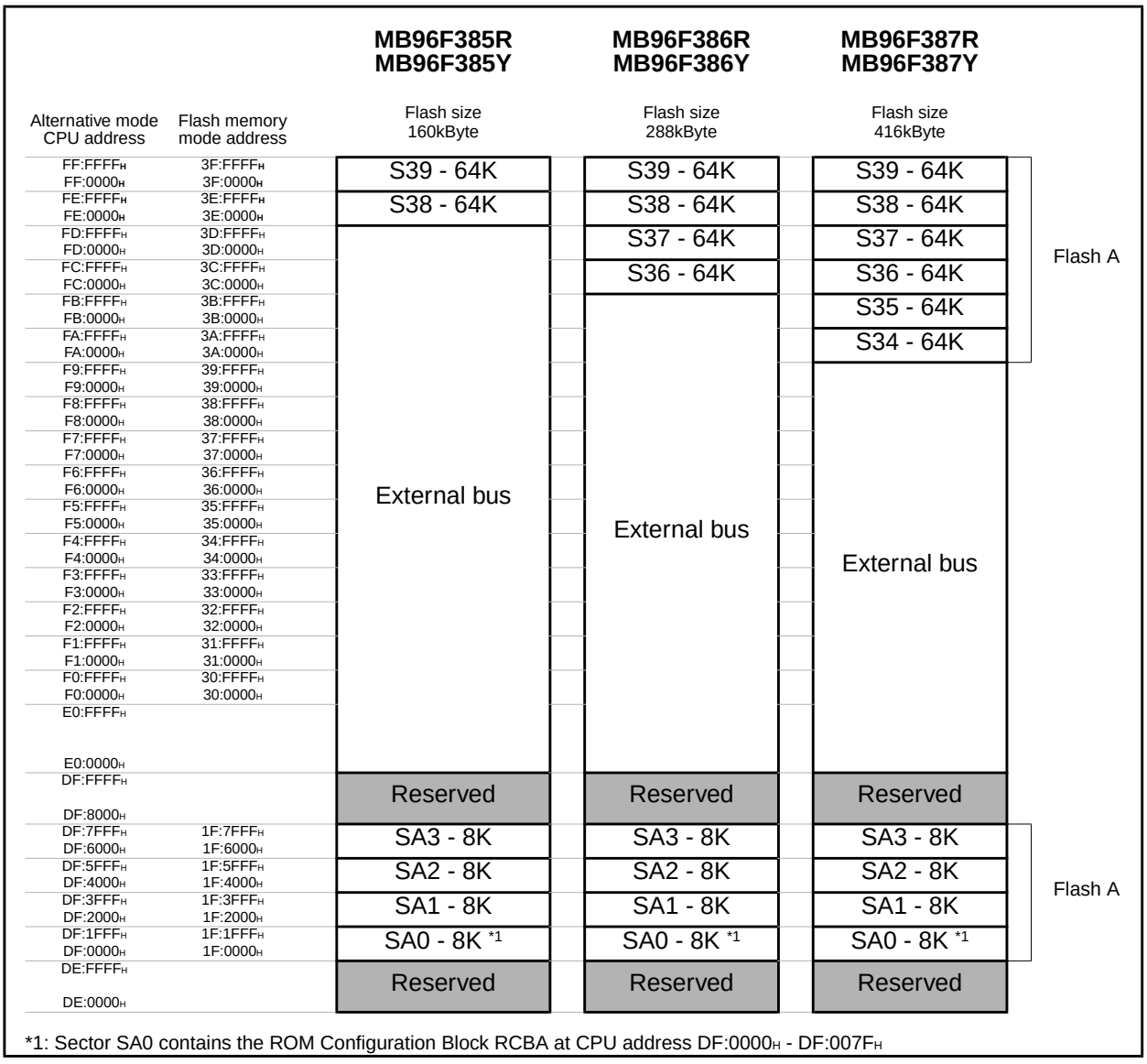
■ USER ROM MEMORY MAP FOR FLASH DEVICES



*1: Sector SA0 contains the ROM Configuration Block RCBA at CPU address DF:0000H - DF:007FH

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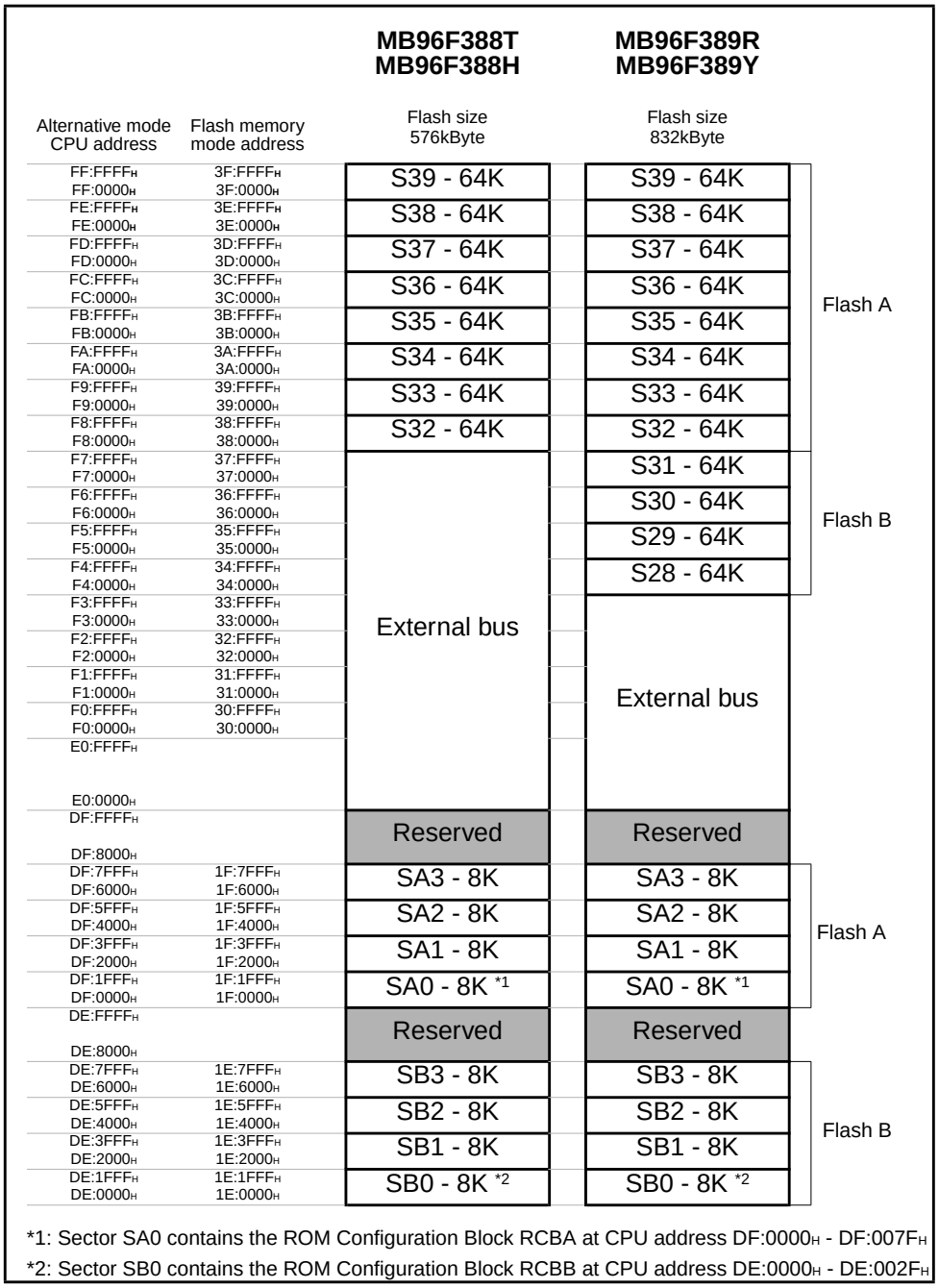

*1: Sector SA0 contains the ROM Configuration Block RCBA at CPU address DF:0000H - DF:007FH

*2: Sector SB0 contains the ROM Configuration Block RCBB at CPU address DE:0000H - DE:002FH

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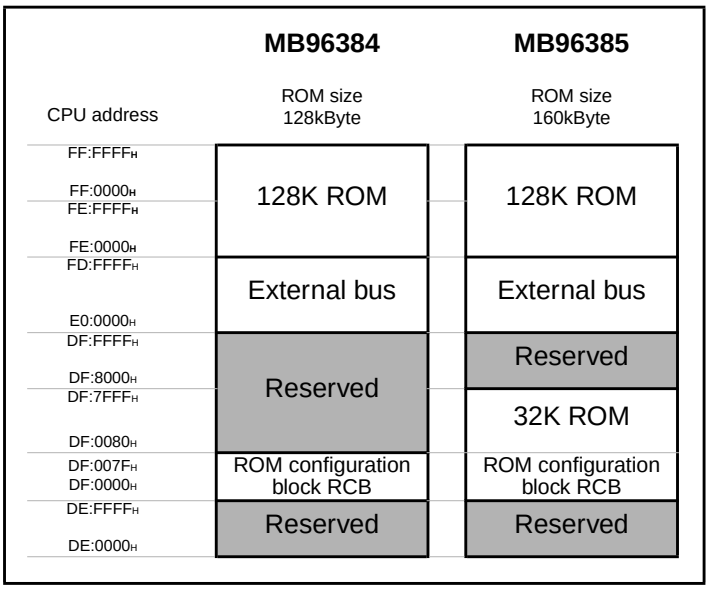
■ USER ROM MEMORY MAP FOR MASK ROM DEVICES



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■ SERIAL PROGRAMMING COMMUNICATION INTERFACE

USART pins for Flash serial programming (MD[2:0] = 010, Serial Communication mode)

MB96F38x		
Pin number	USART Number	Normal function
LQFP-120		
8	USART0	SIN0
9		SOT0
10		SCK0
3	USART1	SIN1
4		SOT1
5		SCK1
56	USART2	SIN2
57		SOT2
58		SCK2

Note: If a Flash programmer and its software needs to use a handshaking pin, Fujitsu suggests to the tool vendor to support at least port P00_1 on pin 88.
If handshaking is used by the tool but P00_1 is not available in customer's application, Fujitsu suggests to the customer to check the tool manual or to contact the tool vendor for alternative handshaking pins.

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■ I/O MAP

I/O map MB96(F)38x (1 of 31)

Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
000000H	I/O Port P00 - Port Data Register	PDR00	-	R/W
000001H	I/O Port P01 - Port Data Register	PDR01	-	R/W
000002H	I/O Port P02 - Port Data Register	PDR02	-	R/W
000003H	I/O Port P03 - Port Data Register	PDR03	-	R/W
000004H	I/O Port P04 - Port Data Register	PDR04	-	R/W
000005H	I/O Port P05 - Port Data Register	PDR05	-	R/W
000006H	I/O Port P06 - Port Data Register	PDR06	-	R/W
000007H	Reserved	-	-	-
000008H	I/O Port P08 - Port Data Register	PDR08	-	R/W
000009H	I/O Port P09 - Port Data Register	PDR09	-	R/W
00000AH	I/O Port P10 - Port Data Register	PDR10	-	R/W
00000BH	I/O Port P11 - Port Data Register	PDR11	-	R/W
00000CH	I/O Port P12 - Port Data Register	PDR12	-	R/W
00000DH	I/O Port P13 - Port Data Register	PDR13	-	R/W
00000EH-000017H	Reserved	-	-	-
000018H	ADC0 - Control Status register Low	ADCSL	ADCS	R/W
000019H	ADC0 - Control Status register High	ADCSH	-	R/W
00001AH	ADC0 - Data Register Low	ADCRL	ADCR	R
00001BH	ADC0 - Data Register High	ADCRH	-	R
00001CH	ADC0 - Setting Register	-	ADSR	R/W
00001DH	ADC0 - Setting Register	-	-	R/W
00001EH	ADC0 - Extended Configuration Register	ADECR	-	R/W
00001FH	Reserved	-	-	-
000020H	FRT0 - Data register of free-running timer	-	TCDT0	R/W
000021H	FRT0 - Data register of free-running timer	-	-	R/W
000022H	FRT0 - Control status register of free-running timer Low	TCCSL0	TCCS0	R/W
000023H	FRT0 - Control status register of free-running timer High	TCCSH0	-	R/W

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I/O map MB96(F)38x (2 of 31)

Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
000024H	FRT1 - Data register of free-running timer	-	TCDT1	R/W
000025H	FRT1 - Data register of free-running timer	-	-	R/W
000026H	FRT1 - Control status register of free-running timer Low	TCCSL1	TCCS1	R/W
000027H	FRT1 - Control status register of free-running timer High	TCCSH1	-	R/W
000028H	OCU0 - Output Compare Control Status	OCS0	-	R/W
000029H	OCU1 - Output Compare Control Status	OCS1	-	R/W
00002AH	OCU0 - Compare Register	-	OCCP0	R/W
00002BH	OCU0 - Compare Register	-	-	R/W
00002CH	OCU1 - Compare Register	-	OCCP1	R/W
00002DH	OCU1 - Compare Register	-	-	R/W
00002EH	OCU2 - Output Compare Control Status	OCS2	-	R/W
00002FH	OCU3 - Output Compare Control Status	OCS3	-	R/W
000030H	OCU2 - Compare Register	-	OCCP2	R/W
000031H	OCU2 - Compare Register	-		R/W
000032H	OCU3 - Compare Register	-	OCCP3	R/W
000033H	OCU3 - Compare Register	-	-	R/W
000034H-00003FH	Reserved	-	-	-
000040H	ICU0/ICU1 - Control Status Register	ICS01	-	R/W
000041H	ICU0/ICU1 - Edge register	ICE01	-	R/W
000042H	ICU0 - Capture Register Low	IPCPL0	IPCP0	R
000043H	ICU0 - Capture Register High	IPCPH0	-	R
000044H	ICU1 - Capture Register Low	IPCPL1	IPCP1	R
000045H	ICU1 - Capture Register High	IPCPH1	-	R
000046H	ICU2/ICU3 - Control Status Register	ICS23	-	R/W
000047H	ICU2/ICU3 - Edge register	ICE23	-	R/W
000048H	ICU2 - Capture Register Low	IPCPL2	IPCP2	R
000049H	ICU2 - Capture Register High	IPCPH2	-	R
00004AH	ICU3 - Capture Register Low	IPCPL3	IPCP3	R

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I/O map MB96(F)38x (3 of 31)

Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
00004B$_H$	ICU3 - Capture Register High	IPCPH3	-	R
00004C$_H$	ICU4/ICU5 - Control Status Register	ICS45	-	R/W
00004D$_H$	ICU4/ICU5 - Edge register	ICE45	-	R/W
00004E$_H$	ICU4 - Capture Register Low	IPCPL4	IPCP4	R
00004F$_H$	ICU4 - Capture Register High	IPCPH4	-	R
000050$_H$	ICU5 - Capture Register Low	IPCPL5	IPCP5	R
000051$_H$	ICU5 - Capture Register High	IPCPH5	-	R
000052$_H$	ICU6/ICU7 - Control Status Register	ICS67	-	R/W
000053$_H$	ICU6/ICU7 - Edge register	ICE67	-	R/W
000054$_H$	ICU6 - Capture Register Low	IPCPL6	IPCP6	R
000055$_H$	ICU6 - Capture Register High	IPCPH6	-	R
000056$_H$	ICU7 - Capture Register Low	IPCPL7	IPCP7	R
000057$_H$	ICU7 - Capture Register High	IPCPH7	-	R
000058$_H$	EXTINT0 - External Interrupt Enable Register	ENIR0	-	R/W
000059$_H$	EXTINT0 - External Interrupt Interrupt request Register	EIRR0	-	R/W
00005A$_H$	EXTINT0 - External Interrupt Level Select Low	ELVRL0	ELVR0	R/W
00005B$_H$	EXTINT0 - External Interrupt Level Select High	ELVRH0	-	R/W
00005C$_H$-00005F$_H$	Reserved	-	-	-
000060$_H$	RLT0 - Timer Control Status Register Low	TMCSRL0	TMCSR0	R/W
000061$_H$	RLT0 - Timer Control Status Register High	TMCSRH0	-	R/W
000062$_H$	RLT0 - Reload Register - for writing	-	TMRLR0	W
000062$_H$	RLT0 - Reload Register - for reading	-	TMR0	R
000063$_H$	RLT0 - Reload Register - for writing	-	-	W
000063$_H$	RLT0 - Reload Register - for reading	-	-	R
000064$_H$	RLT1 - Timer Control Status Register Low	TMCSRL1	TMCSR1	R/W
000065$_H$	RLT1 - Timer Control Status Register High	TMCSRH1	-	R/W
000066$_H$	RLT1 - Reload Register - for writing	-	TMRLR1	W
000066$_H$	RLT1 - Reload Register - for reading	-	TMR1	R
000067$_H$	RLT1 - Reload Register - for writing	-	-	W

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I/O map MB96(F)38x (4 of 31)

Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
000067H	RLT1 - Reload Register - for reading	-	-	R
000068H	RLT2 - Timer Control Status Register Low	TMCSRL2	TMCSR2	R/W
000069H	RLT2 - Timer Control Status Register High	TMCSRH2	-	R/W
00006AH	RLT2 - Reload Register - for writing	-	TMRLR2	W
00006AH	RLT2 - Reload Register - for reading	-	TMR2	R
00006BH	RLT2 - Reload Register - for writing	-	-	W
00006BH	RLT2 - Reload Register - for reading			R
00006CH	RLT3 - Timer Control Status Register Low	TMCSRL3	TMCSR3	R/W
00006DH	RLT3 - Timer Control Status Register High	TMCSRH3	-	R/W
00006EH	RLT3 - Reload Register - for writing	-	TMRLR3	W
00006EH	RLT3 - Reload Register - for reading	-	TMR3	R
00006FH	RLT3 - Reload Register - for writing	-	-	W
00006FH	RLT3 - Reload Register - for reading		-	R
000070H	RLT6 - Timer Control Status Register Low (dedic. RLT for PPG)	TMCSRL6	TMCSR6	R/W
000071H	RLT6 - Timer Control Status Register High (dedic. RLT for PPG)	TMCSRH6	-	R/W
000072H	RLT6 - Reload Register (dedic. RLT for PPG) - for writing	-	TMRLR6	W
000072H	RLT6 - Reload Register (dedic. RLT for PPG) - for reading	-	TMR6	R
000073H	RLT6 - Reload Register (dedic. RLT for PPG) - for writing	-	-	W
000073H	RLT6 - Reload Register (dedic. RLT for PPG) - for reading	-	-	R
000074H	PPG3-PPG0 - General Control register 1 Low	GCN1L0	GCN10	R/W
000075H	PPG3-PPG0 - General Control register 1 High	GCN1H0	-	R/W
000076H	PPG3-PPG0 - General Control register 2 Low	GCN2L0	GCN20	R/W
000077H	PPG3-PPG0 - General Control register 2 High	GCN2H0	-	R/W
000078H	PPG0 - Timer register	-	PTMR0	R
000079H	PPG0 - Timer register	-	-	R
00007AH	PPG0 - Period setting register	-	PCSR0	W

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I/O map MB96(F)38x (5 of 31)

Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
00007B$_H$	PPG0 - Period setting register	-	-	W
00007C$_H$	PPG0 - Duty cycle register	-	PDUT0	W
00007D$_H$	PPG0 - Duty cycle register	-	-	W
00007E$_H$	PPG0 - Control status register Low	PCNL0	PCN0	R/W
00007F$_H$	PPG0 - Control status register High	PCNH0	-	R/W
000080$_H$	PPG1 - Timer register	-	PTMR1	R
000081$_H$	PPG1 - Timer register	-	-	R
000082$_H$	PPG1 - Period setting register	-	PCSR1	W
000083$_H$	PPG1 - Period setting register	-	-	W
000084$_H$	PPG1 - Duty cycle register	-	PDUT1	W
000085$_H$	PPG1 - Duty cycle register	-	-	W
000086$_H$	PPG1 - Control status register Low	PCNL1	PCN1	R/W
000087$_H$	PPG1 - Control status register High	PCNH1	-	R/W
000088$_H$	PPG2 - Timer register	-	PTMR2	R
000089$_H$	PPG2 - Timer register	-	-	R
00008A$_H$	PPG2 - Period setting register	-	PCSR2	W
00008B$_H$	PPG2 - Period setting register	-	-	W
00008C$_H$	PPG2 - Duty cycle register	-	PDUT2	W
00008D$_H$	PPG2 - Duty cycle register	-	-	W
00008E$_H$	PPG2 - Control status register Low	PCNL2	PCN2	R/W
00008F$_H$	PPG2 - Control status register High	PCNH2	-	R/W
000090$_H$	PPG3 - Timer register	-	PTMR3	R
000091$_H$	PPG3 - Timer register	-	-	R
000092$_H$	PPG3 - Period setting register	-	PCSR3	W
000093$_H$	PPG3 - Period setting register	-	-	W
000094$_H$	PPG3 - Duty cycle register	-	PDUT3	W
000095$_H$	PPG3 - Duty cycle register	-	-	W
000096$_H$	PPG3 - Control status register Low	PCNL3	PCN3	R/W
000097$_H$	PPG3 - Control status register High	PCNH3	-	R/W
000098$_H$	PPG7-PPG4 - General Control register 1 Low	GCN1L1	GCN11	R/W

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I/O map MB96(F)38x (6 of 31)

Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
000099H	PPG7-PPG4 - General Control register 1 High	GCN1H1	-	R/W
00009AH	PPG7-PPG4 - General Control register 2 Low	GCN2L1	GCN21	R/W
00009BH	PPG7-PPG4 - General Control register 2 High	GCN2H1	-	R/W
00009CH	PPG4 - Timer register	-	PTMR4	R
00009DH	PPG4 - Timer register	-	-	R
00009EH	PPG4 - Period setting register	-	PCSR4	W
00009FH	PPG4 - Period setting register	-	-	W
0000A0H	PPG4 - Duty cycle register	-	PDUT4	W
0000A1H	PPG4 - Duty cycle register	-	-	W
0000A2H	PPG4 - Control status register Low	PCNL4	PCN4	R/W
0000A3H	PPG4 - Control status register High	PCNH4	-	R/W
0000A4H	PPG5 - Timer register	-	PTMR5	R
0000A5H	PPG5 - Timer register	-	-	R
0000A6H	PPG5 - Period setting register	-	PCSR5	W
0000A7H	PPG5 - Period setting register	-	-	W
0000A8H	PPG5 - Duty cycle register	-	PDUT5	W
0000A9H	PPG5 - Duty cycle register	-	-	W
0000AAH	PPG5 - Control status register Low	PCNL5	PCN5	R/W
0000ABH	PPG5 - Control status register High	PCNH5	-	R/W
0000ACH	I2C0 - Bus Status Register	IBSR0	-	R
0000ADH	I2C0 - Bus Control Register	IBCR0	-	R/W
0000AEH	I2C0 - Ten bit Slave address Register Low	ITBAL0	ITBA0	R/W
0000AFH	I2C0 - Ten bit Slave address Register High	ITBAH0	-	R/W
0000B0H	I2C0 - Ten bit Address mask Register Low	ITMKL0	ITMK0	R/W
0000B1H	I2C0 - Ten bit Address mask Register High	ITMKH0	-	R/W
0000B2H	I2C0 - Seven bit Slave address Register	ISBA0	-	R/W
0000B3H	I2C0 - Seven bit Address mask Register	ISMK0	-	R/W
0000B4H	I2C0 - Data Register	IDAR0	-	R/W
0000B5H	I2C0 - Clock Control Register	ICCR0	-	R/W

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I/O map MB96(F)38x (7 of 31)

Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
0000B6H-0000BFH	Reserved	-	-	-
0000C0H	USART0 - Serial Mode Register	SMR0	-	R/W
0000C1H	USART0 - Serial Control Register	SCR0	-	R/W
0000C2H	USART0 - TX Register	TDR0	-	W
0000C2H	USART0 - RX Register	RDR0	-	R
0000C3H	USART0 - Serial Status	SSR0	-	R/W
0000C4H	USART0 - Control/Com. Register	ECCR0	-	R/W
0000C5H	USART0 - Ext. Status Register	ESCR0	-	R/W
0000C6H	USART0 - Baud Rate Generator Register Low	BGRL0	BGR0	R/W
0000C7H	USART0 - Baud Rate Generator Register High	BGRH0	-	R/W
0000C8H	USART0 - Extended Serial Interrupt Register	ESIR0	-	R/W
0000C9H	Reserved	-	-	-
0000CAH	USART1 - Serial Mode Register	SMR1	-	R/W
0000CBH	USART1 - Serial Control Register	SCR1	-	R/W
0000CCH	USART1 - TX Register	TDR1	-	W
0000CCH	USART1 - RX Register	RDR1	-	R
0000CDH	USART1 - Serial Status	SSR1	-	R/W
0000CEH	USART1 - Control/Com. Register	ECCR1	-	R/W
0000CFH	USART1 - Ext. Status Register	ESCR1	-	R/W
0000D0H	USART1 - Baud Rate Generator Register Low	BGRL1	BGR1	R/W
0000D1H	USART1 - Baud Rate Generator Register High	BGRH1	-	R/W
0000D2H	USART1 - Extended Serial Interrupt Register	ESIR1	-	R/W
0000D3H	Reserved	-	-	-
0000D4H	USART2 - Serial Mode Register	SMR2	-	R/W
0000D5H	USART2 - Serial Control Register	SCR2	-	R/W
0000D6H	USART2 - TX Register	TDR2	-	W
0000D6H	USART2 - RX Register	RDR2	-	R
0000D7H	USART2 - Serial Status	SSR2	-	R/W
0000D8H	USART2 - Control/Com. Register	ECCR2	-	R/W

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I/O map MB96(F)38x (8 of 31)

Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
0000D9H	USART2 - Ext. Status Register	ESCR2	-	R/W
0000DAH	USART2 - Baud Rate Generator Register Low	BGRL2	BGR2	R/W
0000DBH	USART2 - Baud Rate Generator Register High	BGRH2	-	R/W
0000DCH	USART2 - Extended Serial Interrupt Register	ESIR2	-	R/W
0000DDH-0000EFH	Reserved	-	-	-
0000F0H-0000FFH	External Bus area	EXTBUS0	-	R/W
000100H	DMA0 - Buffer address pointer low byte	BAPL0	-	R/W
000101H	DMA0 - Buffer address pointer middle byte	BAPM0	-	R/W
000102H	DMA0 - Buffer address pointer high byte	BAPH0	-	R/W
000103H	DMA0 - DMA control register	DMACS0	-	R/W
000104H	DMA0 - I/O register address pointer low byte	IOAL0	IOA0	R/W
000105H	DMA0 - I/O register address pointer high byte	IOAH0	-	R/W
000106H	DMA0 - Data counter low byte	DCTL0	DCT0	R/W
000107H	DMA0 - Data counter high byte	DCTH0	-	R/W
000108H	DMA1 - Buffer address pointer low byte	BAPL1	-	R/W
000109H	DMA1 - Buffer address pointer middle byte	BAPM1	-	R/W
00010AH	DMA1 - Buffer address pointer high byte	BAPH1	-	R/W
00010BH	DMA1 - DMA control register	DMACS1	-	R/W
00010CH	DMA1 - I/O register address pointer low byte	IOAL1	IOA1	R/W
00010DH	DMA1 - I/O register address pointer high byte	IOAH1	-	R/W
00010EH	DMA1 - Data counter low byte	DCTL1	DCT1	R/W
00010FH	DMA1 - Data counter high byte	DCTH1	-	R/W
000110H	DMA2 - Buffer address pointer low byte	BAPL2	-	R/W
000111H	DMA2 - Buffer address pointer middle byte	BAPM2	-	R/W
000112H	DMA2 - Buffer address pointer high byte	BAPH2	-	R/W
000113H	DMA2 - DMA control register	DMACS2	-	R/W
000114H	DMA2 - I/O register address pointer low byte	IOAL2	IOA2	R/W
000115H	DMA2 - I/O register address pointer high byte	IOAH2	-	R/W
000116H	DMA2 - Data counter low byte	DCTL2	DCT2	R/W

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I/O map MB96(F)38x (9 of 31)

Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
000117H	DMA2 - Data counter high byte	DCTH2	-	R/W
000118H	DMA3 - Buffer address pointer low byte	BAPL3	-	R/W
000119H	DMA3 - Buffer address pointer middle byte	BAPM3	-	R/W
00011AH	DMA3 - Buffer address pointer high byte	BAPH3	-	R/W
00011BH	DMA3 - DMA control register	DMACS3	-	R/W
00011CH	DMA3 - I/O register address pointer low byte	IOAL3	IOA3	R/W
00011DH	DMA3 - I/O register address pointer high byte	IOAH3	-	R/W
00011EH	DMA3 - Data counter low byte	DCTL3	DCT3	R/W
00011FH	DMA3 - Data counter high byte	DCTH3	-	R/W
000120H	DMA4 - Buffer address pointer low byte	BAPL4	-	R/W
000121H	DMA4 - Buffer address pointer middle byte	BAPM4	-	R/W
000122H	DMA4 - Buffer address pointer high byte	BAPH4	-	R/W
000123H	DMA4 - DMA control register	DMACS4	-	R/W
000124H	DMA4 - I/O register address pointer low byte	IOAL4	IOA4	R/W
000125H	DMA4 - I/O register address pointer high byte	IOAH4	-	R/W
000126H	DMA4 - Data counter low byte	DCTL4	DCT4	R/W
000127H	DMA4 - Data counter high byte	DCTH4	-	R/W
000128H	DMA5 - Buffer address pointer low byte	BAPL5	-	R/W
000129H	DMA5 - Buffer address pointer middle byte	BAPM5	-	R/W
00012AH	DMA5 - Buffer address pointer high byte	BAPH5	-	R/W
00012BH	DMA5 - DMA control register	DMACS5	-	R/W
00012CH	DMA5 - I/O register address pointer low byte	IOAL5	IOA5	R/W
00012DH	DMA5 - I/O register address pointer high byte	IOAH5	-	R/W
00012EH	DMA5 - Data counter low byte	DCTL5	DCT5	R/W
00012FH	DMA5 - Data counter high byte	DCTH5	-	R/W
000130H	DMA6 - Buffer address pointer low byte	BAPL6	-	R/W
000131H	DMA6 - Buffer address pointer middle byte	BAPM6	-	R/W
000132H	DMA6 - Buffer address pointer high byte	BAPH6	-	R/W
000133H	DMA6 - DMA control register	DMACS6	-	R/W
000134H	DMA6 - I/O register address pointer low byte	IOAL6	IOA6	R/W

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I/O map MB96(F)38x (10 of 31)

Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
000135H	DMA6 - I/O register address pointer high byte	IOAH6	-	R/W
000136H	DMA6 - Data counter low byte	DCTL6	DCT6	R/W
000137H	DMA6 - Data counter high byte	DCTH6	-	R/W
000138H-00017FH	Reserved	-	-	-
000180H-00037FH	CPU - General Purpose registers (RAM access)	GPR_RAM	-	R/W
000380H	DMA0 - Interrupt select	DISEL0	-	R/W
000381H	DMA1 - Interrupt select	DISEL1	-	R/W
000382H	DMA2 - Interrupt select	DISEL2	-	R/W
000383H	DMA3 - Interrupt select	DISEL3	-	R/W
000384H	DMA4 - Interrupt select	DISEL4	-	R/W
000385H	DMA5 - Interrupt select	DISEL5	-	R/W
000386H	DMA6 - Interrupt select	DISEL6	-	R/W
000387H-00038FH	Reserved	-	-	-
000390H	DMA - Status register low byte	DSRL	DSR	R/W
000391H	DMA - Status register high byte	DSRH	-	R/W
000392H	DMA - Stop status register low byte	DSSRL	DSSR	R/W
000393H	DMA - Stop status register high byte	DSSRH	-	R/W
000394H	DMA - Enable register low byte	DERL	DER	R/W
000395H	DMA - Enable register high byte	DERH	-	R/W
000396H-00039FH	Reserved	-	-	-
0003A0H	Interrupt level register	ILR	ICR	R/W
0003A1H	Interrupt index register	IDX	-	R/W
0003A2H	Interrupt vector table base register Low	TBRL	TBR	R/W
0003A3H	Interrupt vector table base register High	TBRH	-	R/W
0003A4H	Delayed Interrupt register	DIRR	-	R/W
0003A5H	Non Maskable Interrupt register	NMI	-	R/W
0003A6H-0003ABH	Reserved	-	-	-

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I/O map MB96(F)38x (11 of 31)

Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
0003AC$_H$	EDSU communication interrupt selection Low	EDSU2L	EDSU2	R/W
0003AD$_H$	EDSU communication interrupt selection High	EDSU2H	-	R/W
0003AE$_H$	ROM mirror control register	ROMM	-	R/W
0003AF$_H$	EDSU configuration register	EDSU	-	R/W
0003B0$_H$	Memory patch control/status register ch 0/1	-	PFCS0	R/W
0003B1$_H$	Memory patch control/status register ch 0/1	-	-	R/W
0003B2$_H$	Memory patch control/status register ch 2/3	-	PFCS1	R/W
0003B3$_H$	Memory patch control/status register ch 2/3	-	-	R/W
0003B4$_H$	Memory patch control/status register ch 4/5	-	PFCS2	R/W
0003B5$_H$	Memory patch control/status register ch 4/5	-	-	R/W
0003B6$_H$	Memory patch control/status register ch 6/7	-	PFCS3	R/W
0003B7$_H$	Memory patch control/status register ch 6/7	-	-	R/W
0003B8$_H$	Memory Patch function - Patch address 0 low	PFAL0	-	R/W
0003B9$_H$	Memory Patch function - Patch address 0 middle	PFAM0	-	R/W
0003BA$_H$	Memory Patch function - Patch address 0 high	PFAH0	-	R/W
0003BB$_H$	Memory Patch function - Patch address 1 low	PFAL1	-	R/W
0003BC$_H$	Memory Patch function - Patch address 1 middle	PFAM1	-	R/W
0003BD$_H$	Memory Patch function - Patch address 1 high	PFAH1	-	R/W
0003BE$_H$	Memory Patch function - Patch address 2 low	PFAL2	-	R/W
0003BF$_H$	Memory Patch function - Patch address 2 middle	PFAM2	-	R/W
0003C0$_H$	Memory Patch function - Patch address 2 high	PFAH2	-	R/W
0003C1$_H$	Memory Patch function - Patch address 3 low	PFAL3	-	R/W
0003C2$_H$	Memory Patch function - Patch address 3 middle	PFAM3	-	R/W
0003C3$_H$	Memory Patch function - Patch address 3 high	PFAH3	-	R/W
0003C4$_H$	Memory Patch function - Patch address 4 low	PFAL4	-	R/W
0003C5$_H$	Memory Patch function - Patch address 4 middle	PFAM4	-	R/W
0003C6$_H$	Memory Patch function - Patch address 4 high	PFAH4	-	R/W
0003C7$_H$	Memory Patch function - Patch address 5 low	PFAL5	-	R/W
0003C8$_H$	Memory Patch function - Patch address 5 middle	PFAM5	-	R/W
0003C9$_H$	Memory Patch function - Patch address 5 high	PFAH5	-	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
0003CA$_H$	Memory Patch function - Patch address 6 low	PFAL6	-	R/W
0003CB$_H$	Memory Patch function - Patch address 6 middle	PFAM6	-	R/W
0003CC$_H$	Memory Patch function - Patch address 6 high	PFAH6	-	R/W
0003CD$_H$	Memory Patch function - Patch address 7 low	PFAL7	-	R/W
0003CE$_H$	Memory Patch function - Patch address 7 middle	PFAM7	-	R/W
0003CF$_H$	Memory Patch function - Patch address 7 high	PFAH7	-	R/W
0003D0$_H$	Memory Patch function - Patch data 0 Low	PFDL0	PFD0	R/W
0003D1$_H$	Memory Patch function - Patch data 0 High	PFDH0	-	R/W
0003D2$_H$	Memory Patch function - Patch data 1 Low	PFDL1	PFD1	R/W
0003D3$_H$	Memory Patch function - Patch data 1 High	PFDH1	-	R/W
0003D4$_H$	Memory Patch function - Patch data 2 Low	PFDL2	PFD2	R/W
0003D5$_H$	Memory Patch function - Patch data 2 High	PFDH2	-	R/W
0003D6$_H$	Memory Patch function - Patch data 3 Low	PFDL3	PFD3	R/W
0003D7$_H$	Memory Patch function - Patch data 3 High	PFDH3	-	R/W
0003D8$_H$	Memory Patch function - Patch data 4 Low	PFDL4	PFD4	R/W
0003D9$_H$	Memory Patch function - Patch data 4 High	PFDH4	-	R/W
0003DA$_H$	Memory Patch function - Patch data 5 Low	PFDL5	PFD5	R/W
0003DB$_H$	Memory Patch function - Patch data 5 High	PFDH5	-	R/W
0003DC$_H$	Memory Patch function - Patch data 6 Low	PFDL6	PFD6	R/W
0003DD$_H$	Memory Patch function - Patch data 6 High	PFDH6	-	R/W
0003DE$_H$	Memory Patch function - Patch data 7 Low	PFDL7	PFD7	R/W
0003DF$_H$	Memory Patch function - Patch data 7 High	PFDH7	-	R/W
0003E0$_H$-0003F0$_H$	Reserved	-	-	-
0003F1$_H$	Memory Control Status Register A	MCSRA	-	R/W
0003F2$_H$	Memory Timing Configuration Register A Low	MTCRAL	MTCRA	R/W
0003F3$_H$	Memory Timing Configuration Register A High	MTCRAH	-	R/W
0003F4$_H$	Reserved	-	-	-
0003F5$_H$	Memory Control Status Register B	MCSRB	-	R/W
0003F6$_H$	Memory Timing Configuration Register B Low	MTCRBL	MTCRB	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
0003F7H	Memory Timing Configuration Register B High	MTCRBH	-	R/W
0003F8H	Flash Memory Write Control register 0	FMWC0	-	R/W
0003F9H	Flash Memory Write Control register 1	FMWC1	-	R/W
0003FAH	Flash Memory Write Control register 2	FMWC2	-	R/W
0003FBH	Flash Memory Write Control register 3	FMWC3	-	R/W
0003FCH	Flash Memory Write Control register 4	FMWC4	-	R/W
0003FDH	Flash Memory Write Control register 5	FMWC5	-	R/W
0003FEH-0003FFH	Reserved	-	-	-
000400H	Standby Mode control register	SMCR	-	R/W
000401H	Clock select register	CKSR	-	R/W
000402H	Clock Stabilization select register	CKSSR	-	R/W
000403H	Clock monitor register	CKMR	-	R
000404H	Clock Frequency control register Low	CKFCRL	CKFCR	R/W
000405H	Clock Frequency control register High	CKFCRH	-	R/W
000406H	PLL Control register Low	PLLCRL	PLLCR	R/W
000407H	PLL Control register High	PLLCRH	-	R/W
000408H	RC clock timer control register	RCTCR	-	R/W
000409H	Main clock timer control register	MCTCR	-	R/W
00040AH	Sub clock timer control register	SCTCR	-	R/W
00040BH	Reset cause and clock status register with clear function	RCCSRC	-	R
00040CH	Reset configuration register	RCR	-	R/W
00040DH	Reset cause and clock status register	RCCSR	-	R
00040EH	Watch dog timer configuration register	WDTC	-	R/W
00040FH	Watch dog timer clear pattern register	WDTCP	-	W
000410H-000414H	Reserved	-	-	-
000415H	Clock output activation register	COAR	-	R/W
000416H	Clock output configuration register 0	COCR0	-	R/W
000417H	Clock output configuration register 1	COCR1	-	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
000418H	Clock Modulator control register	CMCR	-	R/W
000419H	Reserved	-	-	-
00041AH	Clock Modulator Parameter register Low	CMPRL	CMPR	R/W
00041BH	Clock Modulator Parameter register High	CMPRH	-	R/W
00041CH-00042BH	Reserved	-	-	-
00042CH	Voltage Regulator Control register	VRCR	-	R/W
00042DH	Clock Input and LVD Control Register	CILCR	-	R/W
00042EH-00042FH	Reserved	-	-	-
000430H	I/O Port P00 - Data Direction Register	DDR00	-	R/W
000431H	I/O Port P01 - Data Direction Register	DDR01	-	R/W
000432H	I/O Port P02 - Data Direction Register	DDR02	-	R/W
000433H	I/O Port P03 - Data Direction Register	DDR03	-	R/W
000434H	I/O Port P04 - Data Direction Register	DDR04	-	R/W
000435H	I/O Port P05 - Data Direction Register	DDR05	-	R/W
000436H	I/O Port P06 - Data Direction Register	DDR06	-	R/W
000437H	Reserved	-	-	-
000438H	I/O Port P08 - Data Direction Register	DDR08	-	R/W
000439H	I/O Port P09 - Data Direction Register	DDR09	-	R/W
00043AH	I/O Port P10 - Data Direction Register	DDR10	-	R/W
00043BH	I/O Port P11 - Data Direction Register	DDR11	-	R/W
00043CH	I/O Port P12 - Data Direction Register	DDR12	-	R/W
00043DH	I/O Port P13 - Data Direction Register	DDR13	-	R/W
00043EH-000443H	Reserved	-	-	-
000444H	I/O Port P00 - Port Input Enable Register	PIER00	-	R/W
000445H	I/O Port P01 - Port Input Enable Register	PIER01	-	R/W
000446H	I/O Port P02 - Port Input Enable Register	PIER02	-	R/W
000447H	I/O Port P03 - Port Input Enable Register	PIER03	-	R/W
000448H	I/O Port P04 - Port Input Enable Register	PIER04	-	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
000449H	I/O Port P05 - Port Input Enable Register	PIER05	-	R/W
00044AH	I/O Port P06 - Port Input Enable Register	PIER06	-	R/W
00044BH	Reserved	-	-	-
00044CH	I/O Port P08 - Port Input Enable Register	PIER08	-	R/W
00044DH	I/O Port P09 - Port Input Enable Register	PIER09	-	R/W
00044EH	I/O Port P10 - Port Input Enable Register	PIER10	-	R/W
00044FH	I/O Port P11 - Port Input Enable Register	PIER11	-	R/W
000450H	I/O Port P12 - Port Input Enable Register	PIER12	-	R/W
000451H	I/O Port P13 - Port Input Enable Register	PIER13	-	R/W
000452H-000457H	Reserved	-	-	-
000458H	I/O Port P00 - Port Input Level Register	PILR00	-	R/W
000459H	I/O Port P01 - Port Input Level Register	PILR01	-	R/W
00045AH	I/O Port P02 - Port Input Level Register	PILR02	-	R/W
00045BH	I/O Port P03 - Port Input Level Register	PILR03	-	R/W
00045CH	I/O Port P04 - Port Input Level Register	PILR04	-	R/W
00045DH	I/O Port P05 - Port Input Level Register	PILR05	-	R/W
00045EH	I/O Port P06 - Port Input Level Register	PILR06	-	R/W
00045FH	Reserved	-	-	-
000460H	I/O Port P08 - Port Input Level Register	PILR08	-	R/W
000461H	I/O Port P09 - Port Input Level Register	PILR09	-	R/W
000462H	I/O Port P10 - Port Input Level Register	PILR10	-	R/W
000463H	I/O Port P11 - Port Input Level Register	PILR11	-	R/W
000464H	I/O Port P12 - Port Input Level Register	PILR12	-	R/W
000465H	I/O Port P13 - Port Input Level Register	PILR13	-	R/W
000466H-00046BH	Reserved	-	-	-
00046CH	I/O Port P00 - Extended Port Input Level Register	EPILR00	-	R/W
00046DH	I/O Port P01 - Extended Port Input Level Register	EPILR01	-	R/W
00046EH	I/O Port P02 - Extended Port Input Level Register	EPILR02	-	R/W
00046FH	I/O Port P03 - Extended Port Input Level Register	EPILR03	-	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
000470H	I/O Port P04 - Extended Port Input Level Register	EPILR04	-	R/W
000471H	I/O Port P05 - Extended Port Input Level Register	EPILR05	-	R/W
000472H	I/O Port P06 - Extended Port Input Level Register	EPILR06	-	R/W
000473H	Reserved	-	-	-
000474H	I/O Port P08 - Extended Port Input Level Register	EPILR08	-	R/W
000475H	I/O Port P09 - Extended Port Input Level Register	EPILR09	-	R/W
000476H	I/O Port P10 - Extended Port Input Level Register	EPILR10	-	R/W
000477H	I/O Port P11 - Extended Port Input Level Register	EPILR11	-	R/W
000478H	I/O Port P12 - Extended Port Input Level Register	EPILR12	-	R/W
000479H	I/O Port P13 - Extended Port Input Level Register	EPILR13	-	R/W
00047AH-00047FH	Reserved	-	-	-
000480H	I/O Port P00 - Port Output Drive Register	PODR00	-	R/W
000481H	I/O Port P01 - Port Output Drive Register	PODR01	-	R/W
000482H	I/O Port P02 - Port Output Drive Register	PODR02	-	R/W
000483H	I/O Port P03 - Port Output Drive Register	PODR03	-	R/W
000484H	I/O Port P04 - Port Output Drive Register	PODR04	-	R/W
000485H	I/O Port P05 - Port Output Drive Register	PODR05	-	R/W
000486H	I/O Port P06 - Port Output Drive Register	PODR06	-	R/W
000487H	Reserved	-	-	-
000488H	I/O Port P08 - Port Output Drive Register	PODR08	-	R/W
000489H	I/O Port P09 - Port Output Drive Register	PODR09	-	R/W
00048AH	I/O Port P10 - Port Output Drive Register	PODR10	-	R/W
00048BH	I/O Port P11 - Port Output Drive Register	PODR11	-	R/W
00048CH	I/O Port P12 - Port Output Drive Register	PODR12	-	R/W
00048DH	I/O Port P13 - Port Output Drive Register	PODR13	-	R/W
00048EH-00049BH	Reserved	-	-	-
00049CH	I/O Port P08 - Port High Drive Register	PHDR08	-	R/W
00049DH	I/O Port P09 - Port High Drive Register	PHDR09	-	R/W
00049EH	I/O Port P10 - Port High Drive Register	PHDR10	-	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
00049F$_H$-0004A7$_H$	Reserved	-	-	-
0004A8$_H$	I/O Port P00 - Pull-Up resistor Control Register	PUCR00	-	R/W
0004A9$_H$	I/O Port P01 - Pull-Up resistor Control Register	PUCR01	-	R/W
0004AA$_H$	I/O Port P02 - Pull-Up resistor Control Register	PUCR02	-	R/W
0004AB$_H$	I/O Port P03 - Pull-Up resistor Control Register	PUCR03	-	R/W
0004AC$_H$	I/O Port P04 - Pull-Up resistor Control Register	PUCR04	-	R/W
0004AD$_H$	I/O Port P05 - Pull-Up resistor Control Register	PUCR05	-	R/W
0004AE$_H$	I/O Port P06 - Pull-Up resistor Control Register	PUCR06	-	R/W
0004AF$_H$	Reserved	-	-	-
0004B0$_H$	I/O Port P08 - Pull-Up resistor Control Register	PUCR08	-	R/W
0004B1$_H$	I/O Port P09 - Pull-Up resistor Control Register	PUCR09	-	R/W
0004B2$_H$	I/O Port P10 - Pull-Up resistor Control Register	PUCR10	-	R/W
0004B3$_H$	I/O Port P11 - Pull-Up resistor Control Register	PUCR11	-	R/W
0004B4$_H$	I/O Port P12 - Pull-Up resistor Control Register	PUCR12	-	R/W
0004B5$_H$	I/O Port P13 - Pull-Up resistor Control Register	PUCR13	-	R/W
0004B6$_H$-0004BB$_H$	Reserved	-	-	-
0004BC$_H$	I/O Port P00 - External Pin State Register	EPSR00	-	R
0004BD$_H$	I/O Port P01 - External Pin State Register	EPSR01	-	R
0004BE$_H$	I/O Port P02 - External Pin State Register	EPSR02	-	R
0004BF$_H$	I/O Port P03 - External Pin State Register	EPSR03	-	R
0004C0$_H$	I/O Port P04 - External Pin State Register	EPSR04	-	R
0004C1$_H$	I/O Port P05 - External Pin State Register	EPSR05	-	R
0004C2$_H$	I/O Port P06 - External Pin State Register	EPSR06	-	R
0004C3$_H$	Reserved	-	-	-
0004C4$_H$	I/O Port P08 - External Pin State Register	EPSR08	-	R
0004C5$_H$	I/O Port P09 - External Pin State Register	EPSR09	-	R
0004C6$_H$	I/O Port P10 - External Pin State Register	EPSR10	-	R
0004C7$_H$	I/O Port P11 - External Pin State Register	EPSR11	-	R
0004C8$_H$	I/O Port P12 - External Pin State Register	EPSR12	-	R

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
0004C9H	I/O Port P13 - External Pin State Register	EPSR13	-	R
0004CAH-0004CFH	Reserved	-	-	-
0004D0H	ADC analog input enable register 0	ADER0	-	R/W
0004D1H	ADC analog input enable register 1	ADER1	-	R/W
0004D2H	ADC analog input enable register 2	ADER2	-	R/W
0004D3H	ADC analog input enable register 3	ADER3	-	R/W
0004D4H	ADC analog input enable register 4	ADER4	-	R/W
0004D5H	Reserved	-	-	-
0004D6H	Peripheral Resource Relocation Register 0	PRRR0	-	R/W
0004D7H	Peripheral Resource Relocation Register 1	PRRR1	-	R/W
0004D8H	Peripheral Resource Relocation Register 2	PRRR2	-	R/W
0004D9H	Peripheral Resource Relocation Register 3	PRRR3	-	R/W
0004DAH	Peripheral Resource Relocation Register 4	PRRR4	-	R/W
0004DBH	Peripheral Resource Relocation Register 5	PRRR5	-	R/W
0004DCH	Peripheral Resource Relocation Register 6	PRRR6	-	R/W
0004DDH	Peripheral Resource Relocation Register 7	PRRR7	-	R/W
0004DEH	Peripheral Resource Relocation Register 8	PRRR8	-	R/W
0004DFH	Peripheral Resource Relocation Register 9	PRRR9	-	R/W
0004E0H	RTC - Sub Second Register L	WTBRL0	WTBR0	R/W
0004E1H	RTC - Sub Second Register M	WTBRH0	-	R/W
0004E2H	RTC - Sub-Second Register H	WTBR1	-	R/W
0004E3H	RTC - Second Register	WTSR	-	R/W
0004E4H	RTC - Minutes	WTMR	-	R/W
0004E5H	RTC - Hour	WTHR	-	R/W
0004E6H	RTC - Timer Control Extended Register	WTCER	-	R/W
0004E7H	RTC - Clock select register	WTCKSR	-	R/W
0004E8H	RTC - Timer Control Register Low	WTCRL	WTCR	R/W
0004E9H	RTC - Timer Control Register High	WTCRH	-	R/W
0004EAH	CAL - Calibration unit Control register	CUCR	-	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
0004EB$_H$	Reserved	-	-	-
0004EC$_H$	CAL - Duration Timer Data Register Low	CUTDL	CUTD	R/W
0004ED$_H$	CAL - Duration Timer Data Register High	CUTDH	-	R/W
0004EE$_H$	CAL - Calibration Timer Register 2 Low	CUTR2L	CUTR2	R
0004EF$_H$	CAL - Calibration Timer Register 2 High	CUTR2H	-	R
0004F0$_H$	CAL - Calibration Timer Register 1 Low	CUTR1L	CUTR1	R
0004F1$_H$	CAL - Calibration Timer Register 1 High	CUTR1H	-	R
0004F2$_H$-0004F9$_H$	Reserved	-	-	-
0004FA$_H$	RLT - Timer input select (for Cascading)	TMISR	-	R/W
0004FB$_H$-00051F$_H$	Reserved	-	-	-
000520$_H$	USART4 - Serial Mode Register	SMR4	-	R/W
000521$_H$	USART4 - Serial Control Register	SCR4	-	R/W
000522$_H$	USART4 - TX Register	TDR4	-	W
000522$_H$	USART4 - RX Register	RDR4	-	R
000523$_H$	USART4 - Serial Status	SSR4	-	R/W
000524$_H$	USART4 - Control/Com. Register (internal)	ECCR4	-	R/W
000525$_H$	USART4 - Ext. Status Register	ESCR4	-	R/W
000526$_H$	USART4 - Baud Rate Generator Register Low	BGRL4	BGR4	R/W
000527$_H$	USART4 - Baud Rate Generator Register High	BGRH4	-	R/W
000528$_H$	USART4 - Extended Serial Interrupt Register	ESIR4	-	R/W
000529$_H$	Reserved	-	-	-
00052A$_H$	USART5 - Serial Mode Register	SMR5	-	R/W
00052B$_H$	USART5 - Serial Control Register	SCR5	-	R/W
00052C$_H$	USART5 - RX Register	TDR5	-	W
00052C$_H$	USART5 - TX Register	RDR5	-	R
00052D$_H$	USART5 - Serial Status	SSR5	-	R/W
00052E$_H$	USART5 - Control/Com. Register	ECCR5	-	R/W
00052F$_H$	USART5 - Ext. Status Register	ESCR5	-	R/W
000530$_H$	USART5 - Baud Rate Generator Register Low	BGRL5	BGR5	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
000531H	USART5 - Baud Rate Generator Register High	BGRH5	-	R/W
000532H	USART5 - Extended Serial Interrupt Register	ESIR5	-	R/W
000533H-00055FH	Reserved	-	-	-
000560H	ALARM0 - Control Status Register	ACSR0	-	R/W
000561H	ALARM0 - Extended Control Status Register	AECSR0	-	R/W
000562H	ALARM1 - Control Status Register	ACSR1	-	R/W
000563H	ALARM1 - Extended Control Status Register	AECSR1	-	R/W
000564H	PPG6 - Timer register	-	PTMR6	R
000565H	PPG6 - Timer register	-	-	R
000566H	PPG6 - Period setting register	-	PCSR6	W
000567H	PPG6 - Period setting register	-	-	W
000568H	PPG6 - Duty cycle register	-	PDUT6	W
000569H	PPG6 - Duty cycle register	-	-	W
00056AH	PPG6 - Control status register Low	PCNL6	PCN6	R/W
00056BH	PPG6 - Control status register High	PCNH6	-	R/W
00056CH	PPG7 - Timer register	-	PTMR7	R
00056DH	PPG7 - Timer register	-	-	R
00056EH	PPG7 - Period setting register	-	PCSR7	W
00056FH	PPG7 - Period setting register	-		W
000570H	PPG7 - Duty cycle register	-	PDUT7	W
000571H	PPG7 - Duty cycle register	-	-	W
000572H	PPG7 - Control status register Low	PCNL7	PCN7	R/W
000573H	PPG7 - Control status register High	PCNH7	-	R/W
000574H-0005DFH	Reserved	-	-	-
0005E0H	SMC0 - PWM control register	PWC0	-	R/W
0005E1H	SMC0 - Extended control register (Output enable)	PWEC0	-	R/W
0005E2H	SMC0 - PWM compare register PWM 1	-	PWC10	R/W
0005E3H	SMC0 - PWM compare register PWM 1	-	-	R/W
0005E4H	SMC0 - PWM compare register PWM 2	-	PWC20	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
0005E5H	SMC0 - PWM compare register PWM 2	-	-	R/W
0005E6H	SMC0 - PWM Select register	PWS10	-	R/W
0005E7H	SMC0 - PWM Select register	PWS20	-	R/W
0005E8H-0005E9H	Reserved	-	-	-
0005EAH	SMC1 - PWM control register	PWC1	-	R/W
0005EBH	SMC1 - Extended control register (Output enable)	PWEC1	-	R/W
0005ECH	SMC1 - PWM compare register PWM 1	-	PWC11	R/W
0005EDH	SMC1 - PWM compare register PWM 1	-	-	R/W
0005EEH	SMC1 - PWM compare register PWM 2	-	PWC21	R/W
0005EFH	SMC1 - PWM compare register PWM 2	-	-	R/W
0005F0H	SMC1 - PWM Select register	PWS11	-	R/W
0005F1H	SMC1 - PWM Select register	PWS21	-	R/W
0005F2H-0005F3H	Reserved	-	-	-
0005F4H	SMC2 - PWM control register	PWC2	-	R/W
0005F5H	SMC2 - Extended control register (Output enable)	PWEC2	-	R/W
0005F6H	SMC2 - PWM compare register PWM 1	-	PWC12	R/W
0005F7H	SMC2 - PWM compare register PWM 1	-	-	R/W
0005F8H	SMC2 - PWM compare register PWM 2	-	PWC22	R/W
0005F9H	SMC2 - PWM compare register PWM 2	-	-	R/W
0005FAH	SMC2 - PWM Select register	PWS12	-	R/W
0005FBH	SMC2 - PWM Select register	PWS22	-	R/W
0005FCH-0005FDH	Reserved	-	-	-
0005FEH	SMC3 - PWM control register	PWC3	-	R/W
0005FFH	SMC3 - Extended control register (Output enable)	PWEC3	-	R/W
000600H	SMC3 - PWM compare register PWM 1	-	PWC13	R/W
000601H	SMC3 - PWM compare register PWM 1	-	-	R/W
000602H	SMC3 - PWM compare register PWM 2	-	PWC23	R/W
000603H	SMC3 - PWM compare register PWM 2	-	-	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
000604H	SMC3 - PWM Select register	PWS13	-	R/W
000605H	SMC3 - PWM Select register	PWS23	-	R/W
000606H-000607H	Reserved	-	-	-
000608H	SMC4 - PWM control register	PWC4	-	R/W
000609H	SMC4 - Extended control register (Output enable)	PWEC4	-	R/W
00060AH	SMC4 - PWM compare register PWM 1	-	PWC14	R/W
00060BH	SMC4 - PWM compare register PWM 1	-	-	R/W
00060CH	SMC4 - PWM compare register PWM 2	-	PWC24	R/W
00060DH	SMC4 - PWM compare register PWM 2	-	-	R/W
00060EH	SMC4 - PWM Select register	PWS14	-	R/W
00060FH	SMC4 - PWM Select register	PWS24	-	R/W
000610H-00061BH	Reserved	-	-	-
00061CH	LCD - Output Enable Register 0 (Seg 7-0)	LCDER0	-	R/W
00061DH	LCD - Output Enable Register 1 (Seg 15-8)	LCDER1	-	R/W
00061EH	LCD - Output Enable Register 2 (Seg 23-16)	LCDER2	-	R/W
00061FH	LCD - Output Enable Register 3 (Seg 31-24)	LCDER3	-	R/W
000620H	LCD - Output Enable Register 4 (Seg 39-32)	LCDER4	-	R/W
000621H	LCD - Output Enable Register 5 (Seg 47-40)	LCDER5	-	R/W
000622H	LCD - Output Enable Register 6 (Seg 55-48)	LCDER6	-	R/W
000623H	LCD - Output Enable Register 7 (Seg 63-56)	LCDER7	-	R/W
000624H	LCD - Output Enable Register 8 (Seg 71-64)	LCDER8	-	R/W
000625H	Reserved	-	-	-
000626H	LCD - Output Enable Register V (Vx)	LCDVER	-	R/W
000627H	LCD - Extended Control Register	LECR	-	R/W
000628H	LCD - Common pin switching register	LCDCMR	-	R/W
000629H	LCD - Control Register	LCR	-	R/W
00062AH	LCD - Data register for Segment 1-0	VRAM0	-	R/W
00062BH	LCD - Data register for Segment 3-2	VRAM1	-	R/W
00062CH	LCD - Data register for Segment 5-4	VRAM2	-	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
00062D$_H$	LCD - Data register for Segment 7-6	VRAM3	-	R/W
00062E$_H$	LCD - Data register for Segment 9-8	VRAM4	-	R/W
00062F$_H$	LCD - Data register for Segment 11-10	VRAM5	-	R/W
000630$_H$	LCD - Data register for Segment 13-12	VRAM6	-	R/W
000631$_H$	LCD - Data register for Segment 15-14	VRAM7	-	R/W
000632$_H$	LCD - Data register for Segment 17-16	VRAM8	-	R/W
000633$_H$	LCD - Data register for Segment 19-18	VRAM9	-	R/W
000634$_H$	LCD - Data register for Segment 21-20	VRAM10	-	R/W
000635$_H$	LCD - Data register for Segment 23-22	VRAM11	-	R/W
000636$_H$	LCD - Data register for Segment 25-24	VRAM12	-	R/W
000637$_H$	LCD - Data register for Segment 27-26	VRAM13	-	R/W
000638$_H$	LCD - Data register for Segment 29-28	VRAM14	-	R/W
000639$_H$	LCD - Data register for Segment 31-30	VRAM15	-	R/W
00063A$_H$	LCD - Data register for Segment 33-32	VRAM16	-	R/W
00063B$_H$	LCD - Data register for Segment 35-34	VRAM17	-	R/W
00063C$_H$	LCD - Data register for Segment 37-36	VRAM18	-	R/W
00063D$_H$	LCD - Data register for Segment 39-38	VRAM19	-	R/W
00063E$_H$	LCD - Data register for Segment 41-40	VRAM20	-	R/W
00063F$_H$	LCD - Data register for Segment 43-42	VRAM21	-	R/W
000640$_H$	LCD - Data register for Segment 45-44	VRAM22	-	R/W
000641$_H$	LCD - Data register for Segment 47-46	VRAM23	-	R/W
000642$_H$	LCD - Data register for Segment 49-48	VRAM24	-	R/W
000643$_H$	LCD - Data register for Segment 51-50	VRAM25	-	R/W
000644$_H$	LCD - Data register for Segment 53-52	VRAM26	-	R/W
000645$_H$	LCD - Data register for Segment 55-54	VRAM27	-	R/W
000646$_H$	LCD - Data register for Segment 57-56	VRAM28	-	R/W
000647$_H$	LCD - Data register for Segment 59-58	VRAM29	-	R/W
000648$_H$	LCD - Data register for Segment 61-60	VRAM30	-	R/W
000649$_H$	LCD - Data register for Segment 63-62	VRAM31	-	R/W
00064A$_H$	LCD - Data register for Segment 65-64	VRAM32	-	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
00064B$_H$-00065F$_H$	Reserved	-	-	-
000660$_H$	Peripheral Resource Relocation Register 10	PRRR10	-	R/W
000661$_H$	Peripheral Resource Relocation Register 11	PRRR11	-	R/W
000662$_H$	Peripheral Resource Relocation Register 12	PRRR12	-	R/W
000663$_H$	Peripheral Resource Relocation Register 13	PRRR13	-	W
000664$_H$-0006DF$_H$	Reserved	-	-	-
0006E0$_H$	External Bus - Area configuration register 0 Low	EACL0	EAC0	R/W
0006E1$_H$	External Bus - Area configuration register 0 High	EACH0	-	R/W
0006E2$_H$	External Bus - Area configuration register 1 Low	EACL1	EAC1	R/W
0006E3$_H$	External Bus - Area configuration register 1 High	EACH1	-	R/W
0006E4$_H$	External Bus - Area configuration register 2 Low	EACL2	EAC2	R/W
0006E5$_H$	External Bus - Area configuration register 2 High	EACH2	-	R/W
0006E6$_H$	External Bus - Area configuration register 3 Low	EACL3	EAC3	R/W
0006E7$_H$	External Bus - Area configuration register 3 High	EACH3	-	R/W
0006E8$_H$	External Bus - Area configuration register 4 Low	EACL4	EAC4	R/W
0006E9$_H$	External Bus - Area configuration register 4 High	EACH4	-	R/W
0006EA$_H$	External Bus - Area configuration register 5 Low	EACL5	EAC5	R/W
0006EB$_H$	External Bus - Area configuration register 5 High	EACH5	-	R/W
0006EC$_H$	External Bus - Area select register 2	EAS2	-	R/W
0006ED$_H$	External Bus - Area select register 3	EAS3	-	R/W
0006EE$_H$	External Bus - Area select register 4	EAS4	-	R/W
0006EF$_H$	External Bus - Area select register 5	EAS5	-	R/W
0006F0$_H$	External Bus - Mode register	EBM	-	R/W
0006F1$_H$	External Bus - Clock and Function register	EBCF	-	R/W
0006F2$_H$	External Bus - Address output enable register 0	EBAE0	-	R/W
0006F3$_H$	External Bus - Address output enable register 1	EBAE1	-	R/W
0006F4$_H$	External Bus - Address output enable register 2	EBAE2	-	R/W
0006F5$_H$	External Bus - Control signal register	EBCS	-	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
0006F6H-0006FFH	Reserved	-	-	-
000700H	CAN0 - Control register Low	CTRLRL0	CTRLR0	R/W
000701H	CAN0 - Control register High (reserved)	CTRLRH0	-	R
000702H	CAN0 - Status register Low	STATRL0	STATR0	R/W
000703H	CAN0 - Status register High (reserved)	STATRH0	-	R
000704H	CAN0 - Error Counter Low (Transmit)	ERRCNTL0	ERRCNT0	R
000705H	CAN0 - Error Counter High (Receive)	ERRCNTH0	-	R
000706H	CAN0 - Bit Timing Register Low	BTRL0	BTR0	R/W
000707H	CAN0 - Bit Timing Register High	BTRH0	-	R/W
000708H	CAN0 - Interrupt Register Low	INTRL0	INTR0	R
000709H	CAN0 - Interrupt Register High	INTRH0	-	R
00070AH	CAN0 - Test Register Low	TESTRL0	TESTR0	R/W
00070BH	CAN0 - Test Register High (reserved)	TESTRH0	-	R
00070CH	CAN0 - BRP Extension register Low	BRPERL0	BRPER0	R/W
00070DH	CAN0 - BRP Extension register High (reserved)	BRPERH0	-	R
00070EH-00070FH	Reserved	-	-	-
000710H	CAN0 - IF1 Command request register Low	IF1CREQL0	IF1CREQ0	R/W
000711H	CAN0 - IF1 Command request register High	IF1CREQH0	-	R/W
000712H	CAN0 - IF1 Command Mask register Low	IF1CMSKL0	IF1CMSK0	R/W
000713H	CAN0 - IF1 Command Mask register High (reserved)	IF1CMSKH0	-	R
000714H	CAN0 - IF1 Mask 1 Register Low	IF1MSK1L0	IF1MSK10	R/W
000715H	CAN0 - IF1 Mask 1 Register High	IF1MSK1H0	-	R/W
000716H	CAN0 - IF1 Mask 2 Register Low	IF1MSK2L0	IF1MSK20	R/W
000717H	CAN0 - IF1 Mask 2 Register High	IF1MSK2H0	-	R/W
000718H	CAN0 - IF1 Arbitration 1 Register Low	IF1ARB1L0	IF1ARB10	R/W
000719H	CAN0 - IF1 Arbitration 1 Register High	IF1ARB1H0	-	R/W
00071AH	CAN0 - IF1 Arbitration 2 Register Low	IF1ARB2L0	IF1ARB20	R/W
00071BH	CAN0 - IF1 Arbitration 2 Register High	IF1ARB2H0	-	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
00071C$_H$	CAN0 - IF1 Message Control Register Low	IF1MCTRL0	IF1MCTR0	R/W
00071D$_H$	CAN0 - IF1 Message Control Register High	IF1MCTRH0	-	R/W
00071E$_H$	CAN0 - IF1 Data A1 Low	IF1DTA1L0	IF1DTA10	R/W
00071F$_H$	CAN0 - IF1 Data A1 High	IF1DTA1H0	-	R/W
000720$_H$	CAN0 - IF1 Data A2 Low	IF1DTA2L0	IF1DTA20	R/W
000721$_H$	CAN0 - IF1 Data A2 High	IF1DTA2H0	-	R/W
000722$_H$	CAN0 - IF1 Data B1 Low	IF1DTB1L0	IF1DTB10	R/W
000723$_H$	CAN0 - IF1 Data B1 High	IF1DTB1H0	-	R/W
000724$_H$	CAN0 - IF1 Data B2 Low	IF1DTB2L0	IF1DTB20	R/W
000725$_H$	CAN0 - IF1 Data B2 High	IF1DTB2H0	-	R/W
000726$_H$-00073F$_H$	Reserved	-	-	-
000740$_H$	CAN0 - IF2 Command request register Low	IF2CREQL0	IF2CREQ0	R/W
000741$_H$	CAN0 - IF2 Command request register High	IF2CREQH0	-	R/W
000742$_H$	CAN0 - IF2 Command Mask register Low	IF2CMSKL0	IF2CMSK0	R/W
000743$_H$	CAN0 - IF2 Command Mask register High (reserved)	IF2CMSKH0	-	R
000744$_H$	CAN0 - IF2 Mask 1 Register Low	IF2MSK1L0	IF2MSK10	R/W
000745$_H$	CAN0 - IF2 Mask 1 Register High	IF2MSK1H0	-	R/W
000746$_H$	CAN0 - IF2 Mask 2 Register Low	IF2MSK2L0	IF2MSK20	R/W
000747$_H$	CAN0 - IF2 Mask 2 Register High	IF2MSK2H0	-	R/W
000748$_H$	CAN0 - IF2 Arbitration 1 Register Low	IF2ARB1L0	IF2ARB10	R/W
000749$_H$	CAN0 - IF2 Arbitration 1 Register High	IF2ARB1H0	-	R/W
00074A$_H$	CAN0 - IF2 Arbitration 2 Register Low	IF2ARB2L0	IF2ARB20	R/W
00074B$_H$	CAN0 - IF2 Arbitration 2 Register High	IF2ARB2H0	-	R/W
00074C$_H$	CAN0 - IF2 Message Control Register Low	IF2MCTRL0	IF2MCTR0	R/W
00074D$_H$	CAN0 - IF2 Message Control Register High	IF2MCTRH0	-	R/W
00074E$_H$	CAN0 - IF2 Data A1 Low	IF2DTA1L0	IF2DTA10	R/W
00074F$_H$	CAN0 - IF2 Data A1 High	IF2DTA1H0	-	R/W
000750$_H$	CAN0 - IF2 Data A2 Low	IF2DTA2L0	IF2DTA20	R/W
000751$_H$	CAN0 - IF2 Data A2 High	IF2DTA2H0	-	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
000752H	CAN0 - IF2 Data B1 Low	IF2DTB1L0	IF2DTB10	R/W
000753H	CAN0 - IF2 Data B1 High	IF2DTB1H0	-	R/W
000754H	CAN0 - IF2 Data B2 Low	IF2DTB2L0	IF2DTB20	R/W
000755H	CAN0 - IF2 Data B2 High	IF2DTB2H0	-	R/W
000756H-00077FH	Reserved	-	-	-
000780H	CAN0 - Transmission Request 1 Register Low	TREQR1L0	TREQR10	R
000781H	CAN0 - Transmission Request 1 Register High	TREQR1H0	-	R
000782H	CAN0 - Transmission Request 2 Register Low	TREQR2L0	TREQR20	R
000783H	CAN0 - Transmission Request 2 Register High	TREQR2H0	-	R
000784H-00078FH	Reserved	-	-	-
000790H	CAN0 - New Data 1 Register Low	NEWDT1L0	NEWDT10	R
000791H	CAN0 - New Data 1 Register High	NEWDT1H0	-	R
000792H	CAN0 - New Data 2 Register Low	NEWDT2L0	NEWDT20	R
000793H	CAN0 - New Data 2 Register High	NEWDT2H0	-	R
000794H-00079FH	Reserved	-	-	-
0007A0H	CAN0 - Interrupt Pending 1 Register Low	INTPND1L0	INTPND10	R
0007A1H	CAN0 - Interrupt Pending 1 Register High	INTPND1H0	-	R
0007A2H	CAN0 - Interrupt Pending 2 Register Low	INTPND2L0	INTPND20	R
0007A3H	CAN0 - Interrupt Pending 2 Register High	INTPND2H0	-	R
0007A4H-0007AFH	Reserved	-	-	-
0007B0H	CAN0 - Message Valid 1 Register Low	MSGVAL1L0	MSGVAL10	R
0007B1H	CAN0 - Message Valid 1 Register High	MSGVAL1H0	-	R
0007B2H	CAN0 - Message Valid 2 Register Low	MSGVAL2L0	MSGVAL20	R
0007B3H	CAN0 - Message Valid 2 Register High	MSGVAL2H0	-	R
0007B4H-0007CDH	Reserved	-	-	-
0007CEH	CAN0 - Output enable register	COER0	-	R/W
0007CFH	Reserved	-	-	-

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
0007D0H	SG0 - Sound Generator Control Register Low	SGCRL0	SGCR0	R/W
0007D1H	SG0 - Sound Generator Control Register High	SGCRH0	-	R/W
0007D2H	SG0 - Sound Generator Frequency Register	SGFR0	-	R/W
0007D3H	SG0 - Sound Generator Amplitude Register	SGAR0	-	R/W
0007D4H	SG0 - Sound Generator Decrement Register	SGDR0	-	R/W
0007D5H	SG0 - Sound Generator Tone Register	SGTR0	-	R/W
0007D6H	SG1 - Sound Generator Control Register Low	SGCRL1	SGCR1	R/W
0007D7H	SG1 - Sound Generator Control Register High	SGCRH1	-	R/W
0007D8H	SG1 - Sound Generator Frequency Register	SGFR1	-	R/W
0007D9H	SG1 - Sound Generator Amplitude Register	SGAR1	-	R/W
0007DAH	SG1 - Sound Generator Decrement Register	SGDR1	-	R/W
0007DBH	SG1 - Sound Generator Tone Register	SGTR1	-	R/W
0007DCH-0007FFH	Reserved	-	-	-
000800H	CAN1 - Control register Low	CTRLRL1	CTRLR1	R/W
000801H	CAN1 - Control register High (reserved)	CTRLRH1	-	R
000802H	CAN1 - Status register Low	STATRL1	STATR1	R/W
000803H	CAN1 - Status register High (reserved)	STATRH1	-	R
000804H	CAN1 - Error Counter Low (Transmit)	ERRCNTL1	ERRCNT1	R
000805H	CAN1 - Error Counter High (Receive)	ERRCNTH1	-	R
000806H	CAN1 - Bit Timing Register Low	BTRL1	BTR1	R/W
000807H	CAN1 - Bit Timing Register High	BTRH1	-	R/W
000808H	CAN1 - Interrupt Register Low	INTRL1	INTR1	R
000809H	CAN1 - Interrupt Register High	INTRH1	-	R
00080AH	CAN1 - Test Register Low	TESTRL1	TESTR1	R/W
00080BH	CAN1 - Test Register High (reserved)	TESTRH1	-	R
00080CH	CAN1 - BRP Extension register Low	BRPERL1	BRPER1	R/W
00080DH	CAN1 - BRP Extension register High (reserved)	BRPERH1	-	R
00080EH-00080FH	Reserved	-	-	-
000810H	CAN1 - IF1 Command request register Low	IF1CREQL1	IF1CREQ1	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
000811H	CAN1 - IF1 Command request register High	IF1CREQH1	-	R/W
000812H	CAN1 - IF1 Command Mask register Low	IF1CMSKL1	IF1CMSK1	R/W
000813H	CAN1 - IF1 Command Mask register High (reserved)	IF1CMSKH1	-	R
000814H	CAN1 - IF1 Mask 1 Register Low	IF1MSK1L1	IF1MSK11	R/W
000815H	CAN1 - IF1 Mask 1 Register High	IF1MSK1H1	-	R/W
000816H	CAN1 - IF1 Mask 2 Register Low	IF1MSK2L1	IF1MSK21	R/W
000817H	CAN1 - IF1 Mask 2 Register High	IF1MSK2H1	-	R/W
000818H	CAN1 - IF1 Arbitration 1 Register Low	IF1ARB1L1	IF1ARB11	R/W
000819H	CAN1 - IF1 Arbitration 1 Register High	IF1ARB1H1	-	R/W
00081AH	CAN1 - IF1 Arbitration 2 Register Low	IF1ARB2L1	IF1ARB21	R/W
00081BH	CAN1 - IF1 Arbitration 2 Register High	IF1ARB2H1	-	R/W
00081CH	CAN1 - IF1 Message Control Register Low	IF1MCTRL1	IF1MCTR1	R/W
00081DH	CAN1 - IF1 Message Control Register High	IF1MCTRH1	-	R/W
00081EH	CAN1 - IF1 Data A1 Low	IF1DTA1L1	IF1DTA11	R/W
00081FH	CAN1 - IF1 Data A1 High	IF1DTA1H1	-	R/W
000820H	CAN1 - IF1 Data A2 Low	IF1DTA2L1	IF1DTA21	R/W
000821H	CAN1 - IF1 Data A2 High	IF1DTA2H1	-	R/W
000822H	CAN1 - IF1 Data B1 Low	IF1DTB1L1	IF1DTB11	R/W
000823H	CAN1 - IF1 Data B1 High	IF1DTB1H1	-	R/W
000824H	CAN1 - IF1 Data B2 Low	IF1DTB2L1	IF1DTB21	R/W
000825H	CAN1 - IF1 Data B2 High	IF1DTB2H1	-	R/W
000826H-00083FH	Reserved	-	-	-
000840H	CAN1 - IF2 Command request register Low	IF2CREQL1	IF2CREQ1	R/W
000841H	CAN1 - IF2 Command request register High	IF2CREQH1	-	R/W
000842H	CAN1 - IF2 Command Mask register Low	IF2CMSKL1	IF2CMSK1	R/W
000843H	CAN1 - IF2 Command Mask register High (reserved)	IF2CMSKH1	-	R
000844H	CAN1 - IF2 Mask 1 Register Low	IF2MSK1L1	IF2MSK11	R/W
000845H	CAN1 - IF2 Mask 1 Register High	IF2MSK1H1	-	R/W

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
000846H	CAN1 - IF2 Mask 2 Register Low	IF2MSK2L1	IF2MSK21	R/W
000847H	CAN1 - IF2 Mask 2 Register High	IF2MSK2H1	-	R/W
000848H	CAN1 - IF2 Arbitration 1 Register Low	IF2ARB1L1	IF2ARB11	R/W
000849H	CAN1 - IF2 Arbitration 1 Register High	IF2ARB1H1	-	R/W
00084AH	CAN1 - IF2 Arbitration 2 Register Low	IF2ARB2L1	IF2ARB21	R/W
00084BH	CAN1 - IF2 Arbitration 2 Register High	IF2ARB2H1	-	R/W
00084CH	CAN1 - IF2 Message Control Register Low	IF2MCTRL1	IF2MCTR1	R/W
00084DH	CAN1 - IF2 Message Control Register High	IF2MCTRH1	-	R/W
00084EH	CAN1 - IF2 Data A1 Low	IF2DTA1L1	IF2DTA11	R/W
00084FH	CAN1 - IF2 Data A1 High	IF2DTA1H1	-	R/W
000850H	CAN1 - IF2 Data A2 Low	IF2DTA2L1	IF2DTA21	R/W
000851H	CAN1 - IF2 Data A2 High	IF2DTA2H1	-	R/W
000852H	CAN1 - IF2 Data B1 Low	IF2DTB1L1	IF2DTB11	R/W
000853H	CAN1 - IF2 Data B1 High	IF2DTB1H1	-	R/W
000854H	CAN1 - IF2 Data B2 Low	IF2DTB2L1	IF2DTB21	R/W
000855H	CAN1 - IF2 Data B2 High	IF2DTB2H1	-	R/W
000856H-00087FH	Reserved	-	-	-
000880H	CAN1 - Transmission Request 1 Register Low	TREQR1L1	TREQR11	R
000881H	CAN1 - Transmission Request 1 Register High	TREQR1H1	-	R
000882H	CAN1 - Transmission Request 2 Register Low	TREQR2L1	TREQR21	R
000883H	CAN1 - Transmission Request 2 Register High	TREQR2H1	-	R
000884H-00088FH	Reserved	-	-	-
000890H	CAN1 - New Data 1 Register Low	NEWDT1L1	NEWDT11	R
000891H	CAN1 - New Data 1 Register High	NEWDT1H1	-	R
000892H	CAN1 - New Data 2 Register Low	NEWDT2L1	NEWDT21	R
000893H	CAN1 - New Data 2 Register High	NEWDT2H1	-	R
000894H-00089FH	Reserved	-	-	-
0008A0H	CAN1 - Interrupt Pending 1 Register Low	INTPND1L1	INTPND11	R

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Address	Register	Abbreviation 8-bit access	Abbreviation 16-bit access	Access
0008A1H	CAN1 - Interrupt Pending 1 Register High	INTPND1H1	-	R
0008A2H	CAN1 - Interrupt Pending 2 Register Low	INTPND2L1	INTPND21	R
0008A3H	CAN1 - Interrupt Pending 2 Register High	INTPND2H1	-	R
0008A4H-0008AFH	Reserved	-	-	-
0008B0H	CAN1 - Message Valid 1 Register Low	MSGVAL1L1	MSGVAL11	R
0008B1H	CAN1 - Message Valid 1 Register High	MSGVAL1H1	-	R
0008B2H	CAN1 - Message Valid 2 Register Low	MSGVAL2L1	MSGVAL21	R
0008B3H	CAN1 - Message Valid 2 Register High	MSGVAL2H1	-	R
0008B4H-0008CDH	Reserved	-	-	-
0008CEH	CAN1 - Output enable register	COER1	-	R/W
0008CFH-000BFFH	Reserved	-	-	-

Note: Any write access to reserved addresses in the I/O map should not be performed. A read access to a reserved address results in reading ‘X’.
Registers of resources which are described in this table, but which are not supported by the device, should also be handled as “Reserved”.

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■ INTERRUPT VECTOR TABLE

Interrupt vector table MB96(F)38x (1 of 3)

Vector number	Offset in vector table	Vector name	Cleared by DMA	Index in ICR to program	Description
0	3FC$_H$	CALLV0	No	-	
1	3F8$_H$	CALLV1	No	-	
2	3F4$_H$	CALLV2	No	-	
3	3F0$_H$	CALLV3	No	-	
4	3EC$_H$	CALLV4	No	-	
5	3E8$_H$	CALLV5	No	-	
6	3E4$_H$	CALLV6	No	-	
7	3E0$_H$	CALLV7	No	-	
8	3DC$_H$	RESET	No	-	
9	3D8$_H$	INT9	No	-	
10	3D4$_H$	EXCEPTION	No	-	
11	3D0$_H$	NMI	No	-	Non-Maskable Interrupt
12	3CC$_H$	DLY	No	12	Delayed Interrupt
13	3C8$_H$	RC_TIMER	No	13	RC Timer
14	3C4$_H$	MC_TIMER	No	14	Main Clock Timer
15	3C0$_H$	SC_TIMER	No	15	Sub Clock Timer
16	3BC$_H$	RESERVED	No	16	Reserved
17	3B8$_H$	EXTINT0	Yes	17	External Interrupt 0
18	3B4$_H$	EXTINT1	Yes	18	External Interrupt 1
19	3B0$_H$	EXTINT2	Yes	19	External Interrupt 2
20	3AC$_H$	EXTINT3	Yes	20	External Interrupt 3
21	3A8$_H$	EXTINT4	Yes	21	External Interrupt 4
22	3A4$_H$	EXTINT5	Yes	22	External Interrupt 5
23	3A0$_H$	EXTINT6	Yes	23	External Interrupt 6
24	39C$_H$	EXTINT7	Yes	24	External Interrupt 7
25	398$_H$	CAN0	No	25	CAN Controller 0
26	394$_H$	CAN1*	No	26	CAN Controller 1
27	390$_H$	PPG0	Yes	27	Programmable Pulse Generator 0
28	38C$_H$	PPG1	Yes	28	Programmable Pulse Generator 1
29	388$_H$	PPG2	Yes	29	Programmable Pulse Generator 2
30	384$_H$	PPG3	Yes	30	Programmable Pulse Generator 3
31	380$_H$	PPG4	Yes	31	Programmable Pulse Generator 4
32	37C$_H$	PPG5	Yes	32	Programmable Pulse Generator 5

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Interrupt vector table MB96(F)38x (2 of 3)

Vector number	Offset in vector table	Vector name	Cleared by DMA	Index in ICR to program	Description
33	378H	PPG6	Yes	33	Programmable Pulse Generator 6
34	374H	PPG7	Yes	34	Programmable Pulse Generator 7
35	370H	RLT0	Yes	35	Reload Timer 0
36	36CH	RLT1	Yes	36	Reload Timer 1
37	368H	RLT2	Yes	37	Reload Timer 2
38	364H	RLT3	Yes	38	Reload Timer 3
39	360H	PPGRLT	Yes	39	Reload Timer 6 - dedicated for PPG
40	35CH	ICU0	Yes	40	Input Capture Unit 0
41	358H	ICU1	Yes	41	Input Capture Unit 1
42	354H	ICU2	Yes	42	Input Capture Unit 2
43	350H	ICU3	Yes	43	Input Capture Unit 3
44	34CH	ICU4	Yes	44	Input Capture Unit 4
45	348H	ICU5	Yes	45	Input Capture Unit 5
46	344H	ICU6	Yes	46	Input Capture Unit 6
47	340H	ICU7	Yes	47	Input Capture Unit 7
48	33CH	OCU0	Yes	48	Output Compare Unit 0
49	338H	OCU1	Yes	49	Output Compare Unit 1
50	334H	OCU2	Yes	50	Output Compare Unit 2
51	330H	OCU3	Yes	51	Output Compare Unit 3
52	32CH	FRT0	Yes	52	Free Running Timer 0
53	328H	FRT1	Yes	53	Free Running Timer 1
54	324H	RTC0	No	54	Real Timer Clock
55	320H	CAL0	No	55	Clock Calibration Unit
56	31CH	SG0	No	56	Sound Generator 0
57	318H	SG1	No	57	Sound Generator 1
58	314H	IIC0	Yes	58	I2C interface
59	310H	ADC0	Yes	59	A/D Converter
60	30CH	ALARM0	No	60	Alarm Comparator 0
61	308H	ALARM1*	No	61	Alarm Comparator 1
62	304H	LINR0	Yes	62	LIN USART 0 RX
63	300H	LINT0	Yes	63	LIN USART 0 TX
64	2FCH	LINR1	Yes	64	LIN USART 1 RX
65	2F8H	LINT1	Yes	65	LIN USART 1 TX
66	2F4H	LINR2	Yes	66	LIN USART 2 RX
67	2F0H	LINT2	Yes	67	LIN USART 2 TX

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Interrupt vector table MB96(F)38x (3 of 3)

Vector number	Offset in vector table	Vector name	Cleared by DMA	Index in ICR to program	Description
68	2EC$_H$	LINR4	Yes	68	LIN USART 4 RX
69	2E8$_H$	LINT4	Yes	69	LIN USART 4 TX
70	2E4$_H$	LINR5	Yes	70	LIN USART 5 RX
71	2E0$_H$	LINT5	Yes	71	LIN USART 5 TX
72	2DC$_H$	FLASH_A	No	72	Flash memory A (only Flash devices)
73	2D8$_H$	FLASH_B	No	73	Flash memory B (only MB96F388/F389)

*: ALARM1 and CAN1 are not included on MB96384 and MB96(F)385 devices

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■ HANDLING DEVICES

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

- Latch-up prevention
- Unused pins handling
- External clock usage
- Unused sub clock signal
- Notes on PLL clock mode operation
- Power supply pins (V_{CC}/V_{SS})
- Crystal oscillator circuit
- Turn on sequence of power supply to A/D converter and analog inputs
- Pin handling when not using the A/D converter
- Notes on energization
- Stabilization of power supply voltage
- SMC power supply pins
- Serial communication

1. Latch-up prevention

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} pins and V_{SS} pins.
- The AV_{CC} power supply is applied before the V_{CC} voltage.

Latch-up may increase the power supply current dramatically, causing thermal damages to the device.

For the same reason, extra care is required to not let the analog power-supply voltage (AV_{CC}, AVRH) exceed the digital power-supply voltage.

2. Unused pins handling

Unused input pins can be left open when the input is disabled (corresponding bit of Port Input Enable register PIER = 0).

Leaving unused input pins open when the input is enabled may result in misbehavior and possible permanent damage of the device. They must therefore be pulled up or pulled down through resistors. To prevent latch-up, those resistors should be more than 2 kΩ.

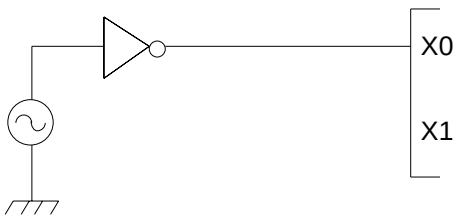
Unused bidirectional pins can be set either to the output state and be then left open, or to the input state with either input disabled or external pull-up/pull-down resistor as described above.

3. External clock usage

The permitted frequency range of an external clock depends on the oscillator type and configuration. See AC Characteristics for detailed modes and frequency limits. Single and opposite phase external clocks must be connected as follows:

1. Single phase external clock

- When using a single phase external clock, X0 (X0A) pin must be driven and X1 (X1A) pin left open.



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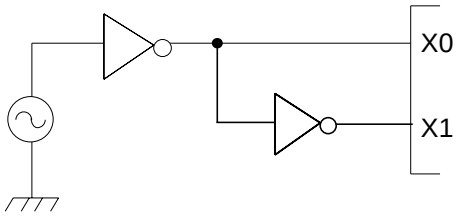
2. Opposite phase external clock

- When using an opposite phase external clock, X1 (X1A) must be supplied with a clock signal which has the opposite phase to the X0 (X0A) pins.



4. Unused sub clock signal

If the pins X0A and X1A are not connected to an oscillator, a pull-down resistor must be connected on the X0A pin and the X1A pin must be left open.

5. Notes on PLL clock mode operation

If the PLL clock mode is selected and no external oscillator is operating or no external clock is supplied, the microcontroller attempts to work with the free oscillating PLL. Performance of this operation, however, cannot be guaranteed.

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

It is required that all V_{CC}-level as well as all V_{SS}-level power supply pins are at the same potential. If there is more than one V_{CC} or V_{SS} level, the device may operate incorrectly or be damaged even within the guaranteed operating range.

V_{CC} and V_{SS} must be connected to the device from the power supply with lowest possible impedance.

As a measure against power supply noise, it is required to connect a bypass capacitor of about 0.1 µF between V_{CC} and V_{SS} as close as possible to V_{CC} and V_{SS} pins.

7. Crystal oscillator and ceramic resonator circuit

Noise at X0, X1 pins or X0A, X1A pins might cause abnormal operation. It is required to provide bypass capacitors with shortest possible distance to X0, X1 pins and X0A, X1A pins, crystal oscillator (or ceramic resonator) and ground lines, and, to the utmost effort, that the lines of oscillation circuit do not cross the lines of other circuits.

It is highly recommended to provide a printed circuit board art work surrounding X0, X1 pins and X0A, X1A pins with a ground area for stabilizing the operation.

It is highly recommended to evaluate the quartz/MCU or resonator/MCU system at the quartz or resonator manufacturer, especially when using low-Q resonators at higher frequencies.

8. Turn on sequence of power supply to A/D converter and analog inputs

It is required to turn the A/D converter power supply (AV_{CC}, AVRH, AVRL) and analog inputs (ANn) on after turning the digital power supply (V_{CC}) on.

It is also required to turn the digital power off after turning the A/D converter supply and analog inputs off. In this case, the voltage must not exceed AVRH or AV_{CC} (turning the analog and digital power supplies simultaneously on or off is acceptable).

9. Pin handling when not using the A/D converter

It is required to connect the unused pins of the A/D converter as $AV_{CC} = V_{CC}$, AV_{SS} = AVRH = AVRL = V_{SS}.

10. Notes on Power-on

To prevent malfunction of the internal voltage regulator, supply voltage profile while turning the power supply on should be slower than 50µs from 0.2 V to 2.7 V.

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11. Stabilization of power supply voltage

If the power supply voltage varies acutely even within the operation safety range of the Vcc power supply voltage, a malfunction may occur. The Vcc power supply voltage must therefore be stabilized. As stabilization guidelines, the power supply voltage must be stabilized in such a way that Vcc ripple fluctuations (peak to peak value) in the commercial frequencies (50 to 60 Hz) fall within 10% of the standard Vcc power supply voltage and the transient fluctuation rate becomes 0.1V/µs or less in instantaneous fluctuation for power supply switching.

12. SMC power supply pins

All DV_{SS} pins must be set to the same level as the V_{SS} pins.

The DV_{CC} power supply level can be set independently of the V_{CC} power supply level. However note that the SMC I/O pin state is undefined if DV_{CC} is powered on and V_{CC} is below 3V. To avoid this, we recommend to always power V_{CC} before DV_{CC}.

13. Serial communication

There is a possibility to receive wrong data due to noise or other causes on the serial communication.
Therefore, design a printed circuit board so as to avoid noise.
Consider receiving of wrong data when designing the system. For example apply a checksum and retransmit the data if an error occurs.

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■ ELECTRICAL CHARACTERISTICS

1. Absolute Maximum Ratings

Parameter	Symbol	Rating		Unit	Remarks
		Min	Max		
Power supply voltage	V_{CC}	V_{SS} - 0.3	V_{SS} + 6.0	V	
	AV_{CC}	V_{SS} - 0.3	V_{SS} + 6.0	V	$V_{CC} = AV_{CC}$ *1
AD Converter voltage references	AVRH, AVRL	V_{SS} - 0.3	V_{SS} + 6.0	V	$AV_{CC} \geq AVRH$, $AV_{CC} \geq AVRL$, $AVRH > AVRL$, $AVRL \geq AV_{SS}$
SMC Power supply	DV_{CC}	V_{SS} - 0.3	V_{SS} + 6.0	V	See *7
LCD power supply voltage	V0 to V3	V_{SS} - 0.3	V_{SS} + 6.0	V	V0 to V3 must not exceed V_{CC}
Input voltage	V_I	V_{SS} - 0.3	V_{SS} + 6.0	V	$V_I \leq (D)V_{CC}$ + 0.3V *2
Output voltage	V_O	V_{SS} - 0.3	V_{SS} + 6.0	V	$V_O \leq (D)V_{CC}$ + 0.3V *2
Maximum Clamp Current	I_{CLAMP}	-4.0	+4.0	mA	Applicable to general purpose I/O pins *3
Total Maximum Clamp Current	$\Sigma\|I_{CLAMP}\|$	-	40	mA	Applicable to general purpose I/O pins *3
“L” level maximum output current	I_{OL1}	-	15	mA	Normal outputs with driving strength set to 5mA
	I_{OLSMC}	-	40	mA	High current outputs with driving strength set to 30mA
“L” level average output current	I_{OLAV1}	-	5	mA	Normal outputs with driving strength set to 5mA
	$I_{OLAVSMC}$	-	30	mA	High current outputs with driving strength set to 30mA
“L” level maximum overall output current	ΣI_{OL1}	-	100	mA	Normal outputs
	ΣI_{OLSMC}	-	330	mA	High current outputs
“L” level average overall output current	ΣI_{OLAV1}	-	50	mA	Normal outputs
	$\Sigma I_{OLAVSMC}$	-	250	mA	High current outputs
”H” level maximum output current	I_{OH1}	-	-15	mA	Normal outputs with driving strength set to 5mA
	I_{OHSMC}	-	-40	mA	High current outputs with driving strength set to 30mA
”H” level average output current	I_{OHAV1}	-	-5	mA	Normal outputs with driving strength set to 5mA
	$I_{OHAVSMC}$	-	-30	mA	High current outputs with driving strength set to 30mA
”H” level maximum overall output current	ΣI_{OH1}	-	-100	mA	Normal outputs
	ΣI_{OHSMC}	-	-330	mA	High current outputs
”H” level average overall output current	ΣI_{OHAV1}	-	-50	mA	Normal outputs
	ΣI_{OHASMC}	-	-250	mA	High current outputs

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Parameter	Symbol	Rating		Unit	Remarks
		Min	Max		
Permitted Power dissipation (MB96F385) *4	P_D	-	295*5	mW	T_A=105°C
		-	595*5	mW	T_A=85°C
		-	820*5	mW	T_A=70°C
		-	370*5	mW	T_A=125°C, no Flash program/ erase *6
		-	670*5	mW	T_A=105°C, no Flash program/ erase *6
Permitted Power dissipation (MB96F386/F387/F388/F389) *4	P_D	-	370*5	mW	T_A=105°C
		-	740*5	mW	T_A=85°C
		-	1000*5	mW	T_A=70°C
		-	460*5	mW	T_A=125°C, no Flash program/ erase *6
		-	800*5	mW	T_A=105°C, no Flash program/ erase *6
Permitted Power dissipation (MB96384/ 385) *4	P_D	-	310*5	mW	T_A=105°C
		-	625*5	mW	T_A=85°C
		-	800*5	mW	T_A=70°C
		-	390*5	mW	T_A=125°C *6
		-	700*5	mW	T_A=105°C*6
Operating ambient temperature	T_A	0	+70	°C	MB96V300B
		-40	+105		
		-40	+125		*6
Storage temperature	T_{STG}	-55	+150	°C	

*1: AV_{CC} and V_{CC} must be set to the same voltage. It is required that AV_{CC} does not exceed V_{CC} and that the voltage at the analog inputs does not exceed AV_{CC} neither when the power is switched on.

*2: V_I and V_O should not exceed (D)V_{CC} + 0.3 V. V_I should also not exceed the specified ratings. However if the maximum current to/from a input is limited by some means with external components, the I_{CLAMP} rating supersedes the V_I rating. Input/output voltages of high current ports depend on DV_{CC}. Input/output voltages of standard ports depend on V_{CC}.

*3: • Applicable to all general purpose I/O pins (Pnn_m) except I/O pins with SEG or COM functionality.
• Use within recommended operating conditions.
• Use at DC voltage (current)
• The +B signal should always be applied a limiting resistance placed between the +B signal and the microcontroller.
• The value of the limiting resistance should be set so that when the +B signal is applied the input current to the microcontroller pin does not exceed rated values, either instantaneously or for prolonged periods.
• Note that when the microcontroller drive current is low, such as in the power saving modes, the +B input potential may pass through the protective diode and increase the potential at the VCC pin, and this may affect other devices.
• Note that if a +B signal is input when the microcontroller power supply is off (not fixed at 0 V), the power

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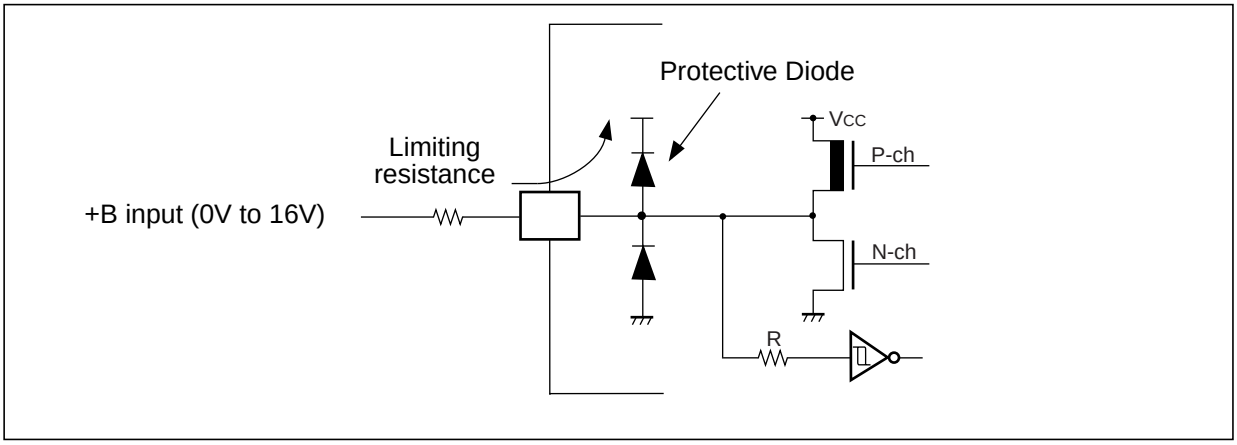
supply is provided from the pins, so that incomplete operation may result.

- Note that if the +B input is applied during power-on, the power supply is provided from the pins and the resulting supply voltage may not be sufficient to operate the Power reset (except devices with persistent low voltage reset in internal vector mode).
- No +B signal must be applied to any LCD I/O pin (including unused SEG/COM pins).

- Sample recommended circuits:



*4: The maximum permitted power dissipation depends on the ambient temperature, the air flow velocity and the thermal conductance of the package on the PCB.
The actual power dissipation depends on the customer application and can be calculated as follows:
$P_D = P_{IO} + P_{INT}$
$P_{IO} = \sum (V_{OL} * I_{OL} + V_{OH} * I_{OH})$ (IO load power dissipation, sum is performed on all IO ports)
$P_{INT} = V_{CC} * (I_{CC} + I_A)$ (internal power dissipation)
I_{CC} is the total core current consumption into V_{CC} as described in the “DC characteristics” and depends on the selected operation mode and clock frequency and the usage of functions like Flash programming or the clock modulator.
I_A is the analog current consumption into AV_{CC}.

*5: Worst case value for a package mounted on single layer PCB at specified T_A without air flow.

*6: Please contact Fujitsu for reliability limitations when using under these conditions.

*7: If DV_{CC} is powered before V_{CC}, then SMC I/O pins state is undefined. To avoid this, we recommend to always power V_{CC} before DV_{CC}. It is not necessary to set V_{CC} and DV_{CC} to the same value.

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.

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2. Recommended Operating Conditions

Parameter	Symbol	Value			Unit	Remarks
		Min	Typ	Max		
Power supply voltage	V_{CC}, DV_{CC}	3.0	-	5.5	V	
Smoothing capacitor at C pin	C_S	3.5	4.7	15	µF	Use a X7R ceramic capacitor or a capacitor that has similar frequency characteristics

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

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

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

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3. DC characteristics

(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Pin	Condition	Value			Unit	Remarks
				Min	Typ	Max		
Input H voltage	V_{IH}	Port inputs Pnn_m	CMOS Hysteresis 0.8/0.2 input selected	0.8 V_{CC}	-	(D)V_{CC} + 0.3	V	
			CMOS Hysteresis 0.7/0.3 input selected	0.7 V_{CC}	-	(D)V_{CC} + 0.3	V	(D)V_{CC} ≥ 4.5V
				0.74 V_{CC}	-	(D)V_{CC} + 0.3	V	(D)V_{CC} < 4.5V
			AUTOMOTIVE Hysteresis input selected	0.8 V_{CC}	-	(D)V_{CC} + 0.3	V	
			TTL input selected	2.0	-	(D)V_{CC} + 0.3	V	
	V_{IHX0F}	X0	External clock in “Fast Clock Input mode”	0.8 V_{CC}	-	V_{CC} + 0.3	V	Not available in MB96F386xxA/ F387xxA
	V_{IHX0S}	X0,X1, X0A,X1A	External clock in “oscillation mode”	2.5	-	V_{CC} + 0.3	V	
	V_{IHR}	RSTX	-	0.8 V_{CC}	-	V_{CC} + 0.3	V	CMOS Hysteresis input
	V_{IHM}	MD2-MD0	-	V_{CC} - 0.3	-	V_{CC} + 0.3	V	
Input L voltage	V_{IL}	Port inputs Pnn_m	CMOS Hysteresis 0.8/0.2 input selected	V_{SS} - 0.3	-	0.2 (D)V_{CC}	V	
			CMOS Hysteresis 0.7/0.3 input selected	V_{SS} - 0.3	-	0.3 (D)V_{CC}	V	
			AUTOMOTIVE Hysteresis input selected	V_{SS} - 0.3	-	0.5 (D)V_{CC}	V	(D)V_{CC} ≥ 4.5V
				V_{SS} - 0.3	-	0.46 (D)V_{CC}		(D)V_{CC} < 4.5V
			TTL input selected	V_{SS} - 0.3	-	0.8	V	
	V_{ILX0F}	X0	External clock in “Fast Clock Input mode”	V_{SS} - 0.3	-	0.2 V_{CC}	V	Not available in MB96F386xxA/ F387xxA
	V_{ILX0S}	X0,X1, X0A,X1A	External clock in “oscillation mode”	V_{SS} - 0.3	-	0.4	V	
	V_{ILR}	RSTX	-	V_{SS} - 0.3	-	0.2 V_{CC}	V	CMOS Hysteresis input
	V_{ILM}	MD2-MD0	-	V_{SS} - 0.3	-	V_{SS} + 0.3	V	

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(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Pin	Condition	Value			Unit	Remarks
				Min	Typ	Max		
Output H voltage	V_{OH2}	Normal and High Current outputs	4.5V ≤ (D)V_{CC} ≤ 5.5V I_{OH} = -2mA 3.0V ≤ (D)V_{CC} < 4.5V I_{OH} = -1.6mA	(D)V_{CC} - 0.5	-	-	V	Driving strength set to 2mA (PODR:OD=1, PHDR:HD=0)
	V_{OH5}	Normal and High Current outputs	4.5V ≤ (D)V_{CC} ≤ 5.5V I_{OH} = -5mA 3.0V ≤ (D)V_{CC} < 4.5V I_{OH} = -3mA	(D)V_{CC} - 0.5	-	-	V	Driving strength set to 5mA (PODR:OD=0, PHDR:HD=0)
	V_{OH30}	High current outputs	4.5V ≤ DV_{CC} ≤ 5.5V I_{OH} = -30mA 3.0V ≤ DV_{CC} < 4.5V I_{OH} = -20mA	DV_{CC} - 0.5	-	-	V	Driving strength set to 30mA (PHDR:HD=1)
	V_{OH3}	3mA outputs	4.5V ≤ V_{CC} ≤ 5.5V I_{OH} = -3mA 3.0V ≤ V_{CC} < 4.5V I_{OH} = -2mA	V_{CC} - 0.5	-	-	V	I/O circuit type “N”
Output L voltage	V_{OL2}	Normal and High Current outputs	4.5V ≤ (D)V_{CC} ≤ 5.5V I_{OL} = +2mA 3.0V ≤ (D)V_{CC} < 4.5V I_{OL} = +1.6mA	-	-	0.4	V	Driving strength set to 2mA (PODR:OD=1, PHDR:HD=0)
	V_{OL5}	Normal and High Current outputs	4.5V ≤ (D)V_{CC} ≤ 5.5V I_{OL} = +5mA 3.0V ≤ (D)V_{CC} < 4.5V I_{OL} = +3mA	-	-	0.4	V	Driving strength set to 5mA (PODR:OD=0, PHDR:HD=0)
	V_{OL30}	High current outputs	4.5V ≤ DV_{CC} ≤ 5.5V I_{OL} = +30mA 3.0V ≤ DV_{CC} < 4.5V I_{OL} = +20mA	-	-	0.5	V	Driving strength set to 30mA (PHDR:HD=1)
	V_{OL3}	3mA outputs	3.0V ≤ V_{CC} ≤ 5.5V I_{OL} = +3mA	-	-	0.4	V	I/O circuit type “N”
Input leak current	I_{IL}	Pnn_m	V_{SS} < V_I < V_{CC} AV_{SS}, AVRL < V_I < AV_{CC}, AVRH	-1	-	+1	µA	Single port pin

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(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Pin	Condition	Value			Unit	Remarks
				Min	Typ	Max		
Total LCD leak current	$\Sigma\lvert I_{ILCD}\rvert$	all SEG/ COM pins	V_{CC} = 5.0V	-	0.5	10	µA	Maximum leakage current of all LCD pins
Internal LCD divide resistance	R_{LCD}	Between V3 and V_{SS}	V_{CC} = 5.0V	25	40	65	kΩ	
Pull-up resistance	R_{UP}	Pnn_m, RSTX	V_{CC} = 3.3V ± 10%	40	100	160	kΩ	
			V_{CC} = 5.0V ± 10%	25	50	100	kΩ	

Note: Input/output voltages of high current ports depend on DV_{CC}, of other ports on V_{CC}.

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(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Condition (at T_A)		Value			Remarks
				Typ	Max	Unit	
Power supply current in Run modes*	I_{CCPLL}	PLL Run mode with CLKS1/2 = CLKB = CLKP1 = 16MHz, CLKP2 = 8MHz 1 Flash/ROM wait state (CLKRC and CLKSC stopped)	+25˚C	8	11	mA	MB96384/385
			+125˚C	8.5	13		
			+25˚C	15	20	mA	MB96F385
			+125˚C	16	22.5		
			+25˚C	16	21	mA	MB96F386/F387
			+125˚C	17.5	24.5		
			+25˚C	17.5	23	mA	MB96F388/F389
			+125˚C	19	26		
		PLL Run mode with CLKS1/2 = CLKB = CLKP1 = 32MHz, CLKP2 = 16MHz 2 Flash/ROM wait states (CLKRC and CLKSC stopped)	+25˚C	14	18	mA	MB96384/385
			+125˚C	14.5	20		
			+25˚C	23	29	mA	MB96F385
			+125˚C	24.5	31.5		
			+25˚C	25	31	mA	MB96F386/F387
			+125˚C	27	35		
			+25˚C	28	34	mA	MB96F388/F389
			+125˚C	30	37.5		
		PLL Run mode with CLKS1/2 = 48MHz, CLKB = CLKP1/2 = 24MHz 0 Flash/ROM wait states (CLKRC and CLKSC stopped)	+25˚C	13	17	mA	MB96384/385
			+125˚C	13.5	19		
			+25˚C	28	40	mA	MB96F385
			+125˚C	29.5	42.5		
			+25˚C	30	42	mA	MB96F386/F387
			+125˚C	32	46		
			+25˚C	32	44	mA	MB96F388/F389
			+125˚C	34	47.5		

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(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Condition (at T_A)		Value			Remarks
				Typ	Max	Unit	
Power supply current in Run modes*	I_{CCPLL}	PLL Run mode with CLKS1/2 = CLKB = CLKP1= 56MHz, CLKP2 = 28MHz 2 Flash/ROM wait states (CLKRC and CLKSC stopped. Core voltage at 1.9V)	+25˚C	23	28	mA	MB96384/385
			+125˚C	23.5	30		
			+25˚C	44	55	mA	MB96F386/F387
			+125˚C	46	59		
		PLL Run mode with CLKS1/2 = 72MHz, CLKB = CLKP1 = 36MHz, CLKP2 = 18MHz 1 Flash wait state (CLKRC and CLKSC stopped. Core voltage at 1.9V)	+25˚C	37	50	mA	MB96F386/F387
			+125˚C	39	54		
		PLL Run mode with CLKS1/2 = 80MHz, CLKB = CLKP1 = 40MHz, CLKP2 = 20MHz 1 Flash wait state (CLKRC and CLKSC stopped. Core voltage at 1.9V)	+25˚C	38	51	mA	MB96F385
			+125˚C	39.5	53.5		
			+25˚C	44	58	mA	MB96F388/F389
			+125˚C	46	61.5		
		PLL Run mode with CLKS1/2 = 96MHz, CLKB = CLKP1= 48MHz, CLKP2 = 24MHz 1 ROM wait state (CLKRC and CLKSC stopped. Core voltage at 1.9V)	+25˚C	23	27.5	mA	MB96384/385
			+125˚C	23.5	29.5		
	I_{CCMAIN}	Main Run mode with CLKS1/2 = CLKB = CLKP1/2 = 4MHz 1 Flash/ROM wait state (CLKPLL, CLKSC and CLKRC stopped)	+25˚C	2.3	3.5	mA	MB96384/385
			+125˚C	2.8	5		
			+25˚C	4.2	5.2	mA	MB96F385
			+125˚C	4.7	7		
			+25˚C	4.5	5.5	mA	MB96F386/F387
			+125˚C	5.2	8.5		
			+25˚C	4.8	5.8	mA	MB96F388/F389
			+125˚C	5.5	8.2		

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(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Condition (at T_A)		Value			Remarks
				Typ	Max	Unit	
Power supply current in Run modes*	I_{CCRCH}	RC Run mode with CLKS1/2 = CLKB = CLKP1/2 = 2MHz 1 Flash/ROM wait state (CLKMC, CLKPLL and CLKSC stopped)	+25˚C	1.5	2.5	mA	MB96384/385
			+125˚C	2	4.1		
			+25˚C	2.7	3.7	mA	MB96F385
			+125˚C	3.2	5.4		
			+25˚C	2.9	4	mA	MB96F386/F387
			+125˚C	3.6	7		
			+25˚C	3	4.1	mA	MB96F388/F389
			+125˚C	3.7	6.5		
	I_{CCRCL}	RC Run mode with CLKS1/2 = CLKB = CLKP1/2 = 100kHz, SMCR:LPMS = 0 1 Flash/ROM wait state (CLKMC, CLKPLL and CLKSC stopped. Voltage regulator in high power mode)	+25˚C	0.35	0.55	mA	MB96384/385
			+125˚C	0.75	1.95		
			+25˚C	0.4	0.6	mA	MB96F385
			+125˚C	0.9	2.1		
			+25˚C	0.4	0.6	mA	MB96F386/F387
			+125˚C	0.95	3.4		
			+25˚C	0.4	0.6	mA	MB96F388/F389
			+125˚C	0.95	2.8		
		RC Run mode with CLKS1/2 = CLKB = CLKP1/2 = 100kHz, SMCR:LPMS = 1 1 Flash/ROM wait state (CLKMC, CLKPLL and CLKSC stopped. Voltage regulator in low power mode, no Flash programming/erasing allowed)	+25˚C	0.08	0.17	mA	MB96384/385
			+125˚C	0.47	1.6		
			+25˚C	0.15	0.25	mA	MB96F385
			+125˚C	0.55	1.75		
			+25˚C	0.15	0.25	mA	MB96F386/F387
			+125˚C	0.7	3.05		
			+25˚C	0.15	0.25	mA	MB96F388/F389
			+125˚C	0.7	2.45		

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(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Condition (at T_A)		Value			Remarks
				Typ	Max	Unit	
Power supply current in Run modes*	I_{CCSUB}	Sub Run mode with CLKS1/2 = CLKB = CLKP1/2 = 32kHz 1 Flash/ROM wait state (CLKMC, CLKPLL and CLKRC stopped, no Flash programming/erasing allowed)	+25˚C	0.04	0.12	mA	MB96384/385
			+125˚C	0.43	1.55		
			+25˚C	0.1	0.2	mA	MB96F385
			+125˚C	0.5	1.7		
			+25˚C	0.1	0.2	mA	MB96F386/F387
			+125˚C	0.65	3		
			+25˚C	0.1	0.2	mA	MB96F388/F389
			+125˚C	0.65	2.4		
Power supply current in Sleep modes*	I_{CCSPLL}	PLL Sleep mode with CLKS1/2 = CLKP1 = 16MHz, CLKP2 = 8MHz (CLKRC and CLKSC stopped)	+25˚C	4	6	mA	MB96384/385
			+125˚C	4.5	8		
			+25˚C	4	6	mA	MB96F385
			+125˚C	4.6	8		
			+25˚C	4	6	mA	MB96F386/F387
			+125˚C	4.7	9		
			+25˚C	5	7	mA	MB96F388/F389
			+125˚C	5.7	9.5		
		PLL Sleep mode with CLKS1/2 = CLKP1 = 32MHz, CLKP2 = 16MHz (CLKRC and CLKSC stopped)	+25˚C	6.5	9	mA	MB96384/385
			+125˚C	7	11		
			+25˚C	7	9.5	mA	MB96F385
			+125˚C	7.6	11.5		
			+25˚C	7	9.5	mA	MB96F386/F387
			+125˚C	8	12.5		
			+25˚C	9	11.5	mA	MB96F388/F389
			+125˚C	10	14		

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(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Condition (at T_A)		Value			Remarks
				Typ	Max	Unit	
Power supply current in Sleep modes*	I_{CCSPLL}	PLL Sleep mode with CLKS1/2 = 48MHz, CLKP1/2 = 24MHz (CLKRC and CLKSC stopped)	+25˚C	6.5	8.5	mA	MB96384/385
			+125˚C	7	10.5		
			+25˚C	7	9	mA	MB96F385
			+125˚C	7.6	11		
			+25˚C	7	9	mA	MB96F386/F387
			+125˚C	8	12		
			+25˚C	9	11	mA	MB96F388/F389
			+125˚C	10	13.5		
		PLL Sleep mode with CLKS1/2 = CLKP1= 56MHz, CLKP2 = 28MHz (CLKRC and CLKSC stopped. Core voltage at 1.9V)	+25˚C	11	13.5	mA	MB96384/385
			+125˚C	11.5	15.5		
			+25˚C	11.5	14	mA	MB96F386/F387
			+125˚C	12.5	17		
		PLL Sleep mode with CLKS1/2 = 72MHz, CLKP1 = 36MHz, CLKP2 = 18MHz (CLKRC and CLKSC stopped. Core voltage at 1.9V)	+25˚C	9.5	11.5	mA	MB96F386/F387
			+125˚C	10.5	14.5		
		PLL Sleep mode with CLKS1/2 = 80MHz, CLKP1 = 40MHz, CLKP2 = 20MHz (CLKRC and CLKSC stopped. Core voltage at 1.9V)	+25˚C	11	13	mA	MB96F385
			+125˚C	11.6	15		
			+25˚C	13	15.5	mA	MB96F388/F389
			+125˚C	14	18		
		PLL Sleep mode with CLKS1/2 = 96MHz, CLKP1= 48MHz, CLKP2 = 24MHz (CLKRC and CLKSC stopped. Core voltage at 1.9V)	+25˚C	12	14	mA	MB96384/385
			+125˚C	12.5	16		

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(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Condition (at T_A)		Value			Remarks
				Typ	Max	Unit	
Power supply current in Sleep modes*	$I_{CCSMAIN}$	Main Sleep mode with CLKS1/2 = CLKP1/2 = 4MHz (CLKPLL, CLKSC and CLKRC stopped)	+25˚C	1.3	1.8	mA	MB96384/385
			+125˚C	1.8	3.3		
			+25˚C	1.3	1.8	mA	MB96F385
			+125˚C	1.8	3.3		
			+25˚C	1.3	1.8	mA	MB96F386/F387
			+125˚C	1.9	4.6		
			+25˚C	1.5	2	mA	MB96F388/F389
			+125˚C	2.1	4.2		
	I_{CCSRCH}	RC Sleep mode with CLKS1/2 = CLKP1/2 = 2MHz (CLKMC, CLKPLL and CLKSC stopped)	+25˚C	0.8	1.4	mA	MB96384/385
			+125˚C	1.3	2.9		
			+25˚C	0.8	1.4	mA	MB96F385
			+125˚C	1.3	2.9		
			+25˚C	0.8	1.4	mA	MB96F386/F387
			+125˚C	1.4	4.2		
			+25˚C	0.9	1.5	mA	MB96F388/F389
			+125˚C	1.5	3.7		

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(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Condition (at T_A)		Value			Remarks
				Typ	Max	Unit	
Power supply current in Sleep modes*	I_{CCSRCL}	RC Sleep mode with CLKS1/2 = CLKP1/2 = 100kHz, SMCR:LPMSS = 0 (CLKMC, CLKPLL and CLKSC stopped. Voltage regulator in high power mode)	+25˚C	0.3	0.5	mA	MB96384/385
			+125˚C	0.7	1.9		
			+25˚C	0.3	0.5	mA	MB96F385
			+125˚C	0.7	2		
			+25˚C	0.3	0.5	mA	MB96F386/F387
			+125˚C	0.8	3.3		
			+25˚C	0.3	0.5	mA	MB96F388/F389
			+125˚C	0.8	2.7		
		RC Sleep mode with CLKS1/2 = CLKP1/2 = 100kHz, SMCR:LPMSS = 1 (CLKMC, CLKPLL and CLKSC stopped. Voltage regulator in low power mode)	+25˚C	0.04	0.13	mA	MB96384/385
			+125˚C	0.43	1.55		
			+25˚C	0.05	0.15	mA	MB96F385
			+125˚C	0.44	1.6		
			+25˚C	0.05	0.15	mA	MB96F386/F387
			+125˚C	0.56	2.9		
			+25˚C	0.05	0.15	mA	MB96F388/F389
			+125˚C	0.56	2.3		
	I_{CCSSUB}	Sub Sleep mode with CLKS1/2 = CLKP1/2 = 32kHz (CLKMC, CLKPLL and CLKRC stopped)	+25˚C	0.035	0.11	mA	MB96384/385
			+125˚C	0.42	1.55		
			+25˚C	0.04	0.12	mA	MB96F385
			+125˚C	0.43	1.55		
			+25˚C	0.04	0.12	mA	MB96F386/F387
			+125˚C	0.54	2.9		
			+25˚C	0.04	0.12	mA	MB96F388/F389
			+125˚C	0.54	2.3		

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(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Condition (at T_A)		Value			Remarks
				Typ	Max	Unit	
Power supply current in Timer modes*	I_{CCTPLL}	PLL Timer mode with CLKMC = 4MHz, CLKPLL = 48MHz (CLKRC and CLKSC stopped. Core voltage at 1.9V)	+25˚C	1.4	1.9	mA	MB96384/385
			+125˚C	1.9	3.5		
			+25˚C	1.5	2	mA	MB96F385
			+125˚C	2	3.6		
			+25˚C	1.5	2	mA	MB96F386/F387
			+125˚C	2.1	5		
			+25˚C	1.5	2	mA	MB96F388/F389
			+125˚C	2.1	4.4		
	$I_{CCTMAIN}$	Main Timer mode with CLKMC = 4MHz, SMCR:LPMSS = 0 (CLKPLL, CLKRC and CLKSC stopped. Voltage regulator in high power mode)	+25˚C	0.35	0.5	mA	MB96384/385
			+125˚C	0.75	2		
			+25˚C	0.35	0.55	mA	MB96F385
			+125˚C	0.75	2		
			+25˚C	0.35	0.5	mA	MB96F386/F387
			+125˚C	0.85	3.3		
			+25˚C	0.35	0.5	mA	MB96F388/F389
			+125˚C	0.85	2.7		
		Main Timer mode with CLKMC = 4MHz, SMCR:LPMSS = 1 (CLKPLL, CLKRC and CLKSC stopped. Voltage regulator in low power mode)	+25˚C	0.08	0.15	mA	MB96384/385
			+125˚C	0.47	1.6		
			+25˚C	0.1	0.18	mA	MB96F385
			+125˚C	0.5	1.6		
			+25˚C	0.08	0.15	mA	MB96F386/F387
			+125˚C	0.6	2.9		
			+25˚C	0.08	0.15	mA	MB96F388/F389
			+125˚C	0.6	2.3		

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(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Condition (at T_A)		Value			Remarks
				Typ	Max	Unit	
Power supply current in Timer modes*	I_{CCTRCH}	RC Timer mode with CLKRC = 2MHz, SMCR:LPMSS = 0 (CLKMC, CLKPLL and CLKSC stopped. Voltage regulator in high power mode)	+25˚C	0.35	0.5	mA	MB96384/385
			+125˚C	0.75	2		
			+25˚C	0.35	0.5	mA	MB96F385
			+125˚C	0.75	2		
			+25˚C	0.35	0.5	mA	MB96F386/F387
			+125˚C	0.85	3.3		
			+25˚C	0.35	0.5	mA	MB96F388/F389
			+125˚C	0.85	2.7		
		RC Timer mode with CLKRC = 2MHz, SMCR:LPMSS = 1 (CLKMC, CLKPLL and CLKSC stopped. Voltage regulator in low power mode)	+25˚C	0.07	0.15	mA	MB96384/385
			+125˚C	0.46	1.6		
			+25˚C	0.07	0.15	mA	MB96F385
			+125˚C	0.46	1.6		
			+25˚C	0.07	0.15	mA	MB96F386/F387
			+125˚C	0.6	2.9		
			+25˚C	0.07	0.15	mA	MB96F388/F389
			+125˚C	0.6	2.3		

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(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Condition (at T_A)		Value			Remarks
				Typ	Max	Unit	
Power supply current in Timer modes*	I_{CCTRCL}	RC Timer mode with CLKRC = 100kHz, SMCR:LPMSS = 0 (CLKMC, CLKPLL and CLKSC stopped. Voltage regulator in high power mode)	+25˚C	0.3	0.45	mA	MB96384/385
			+125˚C	0.65	1.9		
			+25˚C	0.3	0.45	mA	MB96F385
			+125˚C	0.65	1.9		
			+25˚C	0.3	0.45	mA	MB96F386/F387
			+125˚C	0.8	3.2		
			+25˚C	0.3	0.45	mA	MB96F388/F389
			+125˚C	0.8	2.6		
		RC Timer mode with CLKRC = 100kHz, SMCR:LPMSS = 1 (CLKMC, CLKPLL and CLKSC stopped. Voltage regulator in low power mode)	+25˚C	0.03	0.1	mA	MB96384/385
			+125˚C	0.41	1.55		
			+25˚C	0.03	0.1	mA	MB96F385
			+125˚C	0.41	1.55		
			+25˚C	0.03	0.1	mA	MB96F386/F387
			+125˚C	0.53	2.85		
			+25˚C	0.03	0.1	mA	MB96F388/F389
			+125˚C	0.53	2.25		
	I_{CCTSUB}	Sub Timer mode with CLKSC = 32kHz (CLKMC, CLKPLL and CLKRC stopped)	+25˚C	0.03	0.1	mA	MB96384/385
			+125˚C	0.41	1.55		
			+25˚C	0.035	0.1	mA	MB96F385
			+125˚C	0.42	1.55		
			+25˚C	0.035	0.1	mA	MB96F386/F387
			+125˚C	0.53	2.85		
			+25˚C	0.035	0.1	mA	MB96F388/F389
			+125˚C	0.53	2.25		

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(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Condition (at T_A)		Value			Remarks
				Typ	Max	Unit	
Power supply current in Stop Mode	I_{CCH}	VRCR:LPMB[2:0] = 110_B (Core voltage at 1.8V)	+25˚C	0.02	0.08	mA	MB96384/385
			+125˚C	0.4	1.5		
			+25˚C	0.02	0.08	mA	MB96F385
			+125˚C	0.4	1.5		
			+25˚C	0.02	0.08	mA	MB96F386/F387
			+125˚C	0.52	2.8		
			+25˚C	0.02	0.08	mA	MB96F388/F389
			+125˚C	0.52	2.2		
		VRCR:LPMB[2:0] = 000_B (Core voltage at 1.2V)	+25˚C	0.015	0.06	mA	MB96384/385
			+125˚C	0.3	1.2		
			+25˚C	0.015	0.06	mA	MB96F385
			+125˚C	0.3	1.2		
			+25˚C	0.015	0.06	mA	MB96F386/F387
			+125˚C	0.4	2.3		
			+25˚C	0.015	0.06	mA	MB96F388/F389
			+125˚C	0.4	1.65		
Power supply current for active Low Voltage detector	I_{CCLVD}	Low voltage detector enabled (RCR:LVDE = 1)	+25˚C	90	140	µA	This current must be added to all Power supply currents above
			+125˚C	100	150		
Power supply current for active Clock modulator	$I_{CCCLOMO}$	Clock modulator enabled (CMCR:PDX = 1)	-	3	4.5	mA	Must be added to all current above
Flash Write/Erase current	$I_{CCFLASH}$	Current for one Flash module	-	15	40	mA	Must be added to all current above
Input capacitance	C_{IN}	-		15	30	pF	High current outputs
Input capacitance	C_{IN}	-	-	5	15	pF	Other than C, AV_{CC}, AV_{SS}, AVRH, AVRL, V_{CC}, V_{SS}, DV_{CC}, DV_{SS}, High current outputs

* The power supply current is measured with a 4MHz external clock connected to the Main oscillator and a 32kHz external clock connected to the Sub oscillator. See chapter “Standby mode and voltage regulator control circuit” of the Hardware Manual for further details about voltage regulator control.

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4. AC Characteristics

Source Clock timing

(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Pin	Value			Unit	Remarks
			Min	Typ	Max		
Clock frequency	f_C	X0, X1	3	-	16	MHz	When using a crystal oscillator, PLL off
			0	-	16	MHz	When using an opposite phase external clock, PLL off
			3.5	-	16	MHz	When using a crystal oscillator or opposite phase external clock, PLL on
Clock frequency	f_{FCI}	X0	0	-	56	MHz	When using a single phase external clock in “Fast Clock Input mode” (not available in MB96F386xxA and MB96F387xxA), PLL off
			3.5	-	56	MHz	When using a single phase external clock in “Fast Clock Input mode” (not available in MB96F386xxA and MB96F387xxA), PLL on
Clock frequency	f_{CL}	X0A, X1A	32	32.768	100	kHz	When using an oscillation circuit
			0	-	100	kHz	When using an opposite phase external clock
		X0A	0	-	50	kHz	When using a single phase external clock
Clock frequency	f_{CR}	-	50	100	200	kHz	When using slow frequency of RC oscillator
			1	2	4	MHz	When using fast frequency of RC oscillator
RC clock stabilization time	t_{RCSTAB}	-	64 RC clock cycles				Applied after any reset and when activating the RC oscillator.
PLL Clock frequency	f_{CLKVCO}	-	64	-	200	MHz	Permitted VCO output frequency of PLL (CLKVCO)
PLL Phase Jitter	T_{PSKEW}	-	-	-	± 5	ns	For CLKMC (PLL input clock) ≥ 4MHz, jitter coming from external oscillator, crystal or resonator is not covered
Input clock pulse width	P_{WH}, P_{WL}	X0,X1	8	-	-	ns	Duty ratio is about 30% to 70%
Input clock pulse width	P_{WHL}, P_{WLL}	X0A,X1A	5	-	-	µs	

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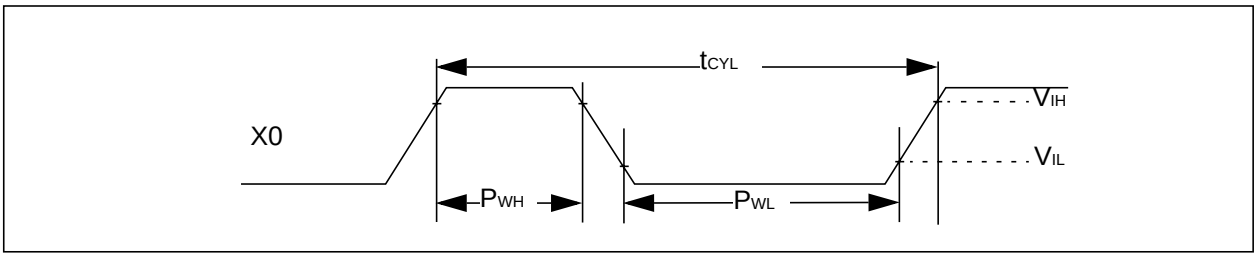

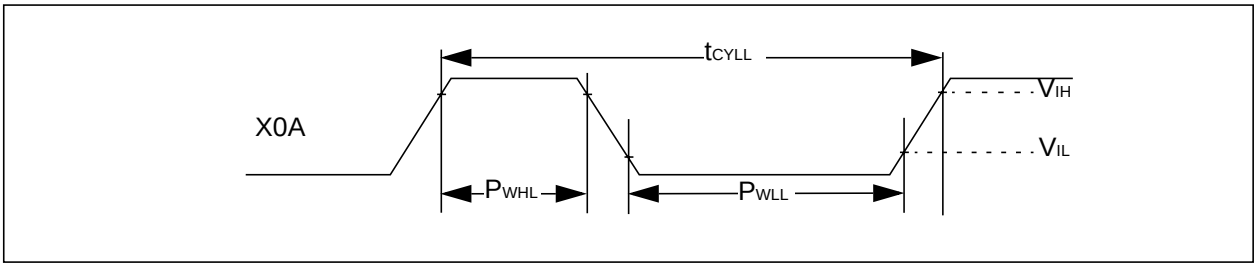

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Internal Clock timing

(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Core Voltage Settings				Unit	Remarks
		1.8V		1.9V			
		Min	Max	Min	Max		
Internal System clock frequency (CLKS1 and CLKS2)	f_{CLKS1}, f_{CLKS2}	0	92	0	96	MHz	Others than below
		0	72	0	80	MHz	MB96F385/F388/F389
		0	68	0	74	MHz	MB96F386/F387
Internal CPU clock frequency (CLKB), internal peripheral clock frequency (CLKP1)	f_{CLKB}, f_{CLKP1}	0	52	0	56	MHz	Others than below
		0	36	0	40	MHz	MB96F385/F388/F389
Internal peripheral clock frequency (CLKP2)	f_{CLKP2}	0	28	0	32	MHz	Others than below
		0	26	0	28	MHz	MB96F386/F387

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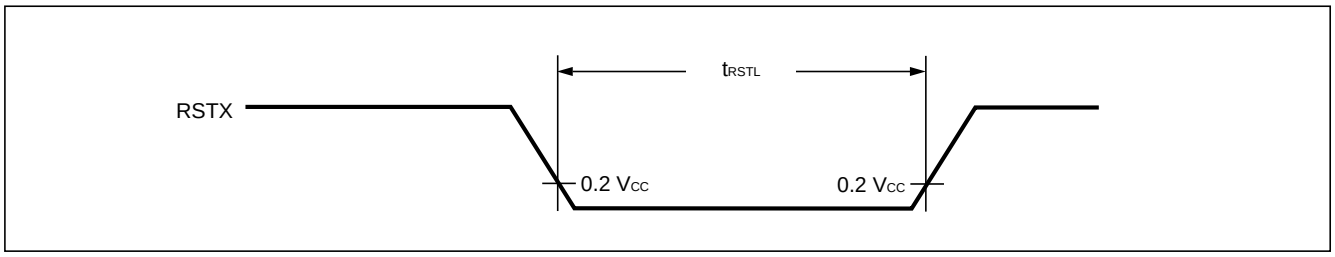
External Reset timing

(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Pin	Value			Unit	Remarks
			Min	Typ	Max		
Reset input time	t_{RSTL}	RSTX	500	-	-	ns	



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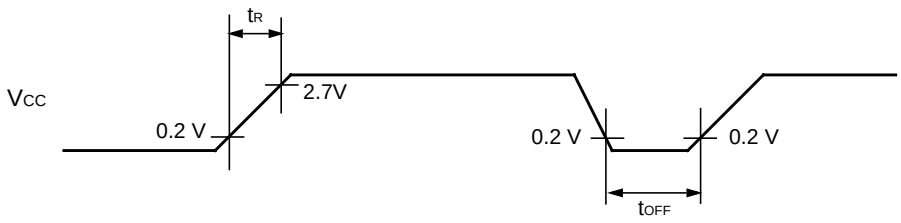
Power On Reset timing

(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Pin	Value			Unit	Remarks
			Min	Typ	Max		
Power on rise time	t_R	Vcc	0.05	-	30	ms	
Power off time	t_{OFF}	Vcc	1	-	-	ms	



If the power supply is changed too rapidly, a power-on reset may occur.
We recommend a smooth startup by restraining voltages when changing the power supply voltage during operation, as shown in the figure below.

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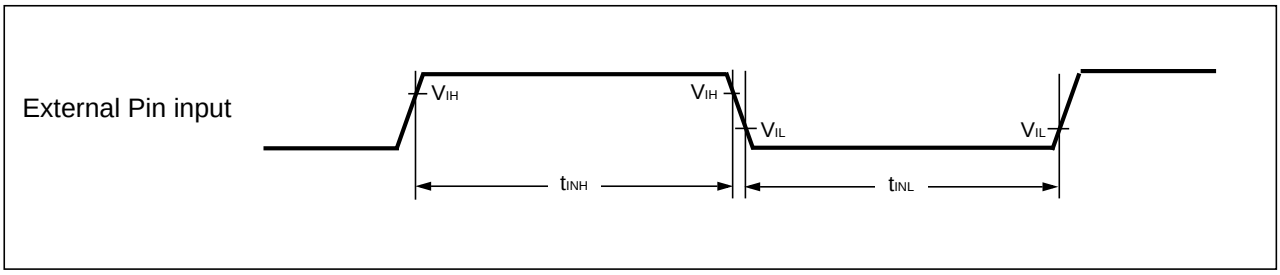
External Input timing

(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Pin	Condition	Value		Unit	Used Pin input function
				Min	Max		
Input pulse width	t_{INH} t_{INL}	INTn(_R)	—	200	—	ns	External Interrupt
		NMI(_R)					NMI
		Pnn_m		$2*t_{CLKP1}$ + 200 (t_{CLKP1}=1/ f_{CLKP1})	—	ns	General Purpose IO
		TINn(_R)					Reload Timer
		TTGn(_R)					PPG Trigger input
		ADTG(_R)					AD Converter Trigger
		FRCKn(_R)					Free Running Timer external clock
		INn(_R)					Input Capture

Note : Relocated Resource Inputs have same characteristics



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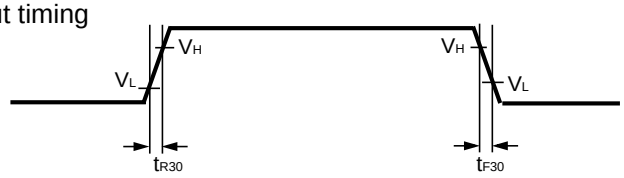
Slew Rate High Current Outputs

(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Symbol	Pin	Condition	Value		Unit	Remarks
				Min	Max		
Output rise/fall time	t_{R30} t_{F30}	I/O circuit type M	Output driving strength set to “30mA”	15	—	ns	

Note : Relocated Resource Inputs have same characteristics

- Slew rate output timing



$V_H = V_{OL30} + 0.9 \times (V_{OH30} - V_{OL30})$
$V_L = V_{OL30} + 0.1 \times (V_{OH30} - V_{OL30})$

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External Bus timing

Note: The values given below are for an I/O driving strength IO_{drive} = 5mA. If IO_{drive} is 2mA, all the maximum output timing described in the different tables must then be increased by 10ns.

Basic Timing

(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, V_{SS} = 0.0 V, IO_{drive} = 5mA, C_L = 50pF)

Parameter	Symbol	Pin	Condition	Value		Unit	Remarks
				Min	Max		
ECLK	t_{CYC}	ECLK	—	25	—	ns	
	t_{CHCL}			t_{CYC}/2-5	t_{CYC}/2+5		
	t_{CLCH}			t_{CYC}/2-5	t_{CYC}/2+5		
ECLK → UBX/ LBX / CSn time	t_{CHCBH}	CSn, UBX, LBX, ECLK	—	-20	20	ns	
	t_{CHCBL}			-20	20		
	t_{CLCBH}			-20	20		
	t_{CLCBL}			-20	20		
ECLK → ALE time	t_{CHLH}	ALE, ECLK	—	-10	10	ns	
	t_{CHLL}			-10	10		
	t_{CLLH}			-10	10		
	t_{CLLL}			-10	10		
ECLK → address valid time (non-multiplexed)	t_{CHAV}	A[23:0], ECLK	EBM:NMS=1	-15	15	ns	
	t_{CLAV}			-15	15		
ECLK → address valid time (multiplexed)	t_{CHAV}	A[23:16], ECLK	EBM:NMS=0	-15	15	ns	
	t_{CLAV}			-15	15		
	t_{CLADV}	AD[15:0], ECLK	EBM:NMS=0	-15	15	ns	
	t_{CHADV}			-15	15		
ECLK → RDX /WRX time	t_{CHRWH}	RDX, WRX, WRLX,WRHX, ECLK	—	-10	10	ns	
	t_{CHRWL}			-10	10		
	t_{CLRWH}			-10	10		
	t_{CLRWL}			-10	10		

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(T_A = –40 °C to +125 °C, V_{CC} = 3.0 to 4.5V, V_{SS} = 0.0 V, IO_{drive} = 5mA, C_L = 50pF)

Parameter	Symbol	Pin	Condition	Value		Unit	Remarks
				Min	Max		
ECLK	t_{CYC}	ECLK	—	30	—	ns	
	t_{CHCL}			t_{CYC}/2-8	t_{CYC}/2+8		
	t_{CLCH}			t_{CYC}/2-8	t_{CYC}/2+8		
ECLK → UBX/ LBX / CSn time	t_{CHCBH}	CSn, UBX, LBX, ECLK	—	-25	25	ns	
	t_{CHCBL}			-25	25		
	t_{CLCBH}			-25	25		
	t_{CLCBL}			-25	25		
ECLK → ALE time	t_{CHLH}	ALE, ECLK	—	-15	15	ns	
	t_{CHLL}			-15	15		
	t_{CLLH}			-15	15		
	t_{CLLL}			-15	15		
ECLK → address valid time (non-multiplexed)	t_{CHAV}	A[23:0], ECLK	EBM:NMS=1	-20	20	ns	
	t_{CLAV}			-20	20		
ECLK → address valid time (multiplexed)	t_{CHAV}	A[23:16], ECLK	EBM:NMS=0	-20	20	ns	
	t_{CLAV}			-20	20		
	t_{CLADV}	AD[15:0], ECLK	EBM:NMS=0	-20	20	ns	
	t_{CHADV}			-20	20		
ECLK → RDX /WRX time	t_{CHRWH}	RDX, WRX, WRLX, WRHX, ECLK	—	-15	15	ns	
	t_{CHRWL}			-15	15		
	t_{CLRWH}			-15	15		
	t_{CLRWL}			-15	15		

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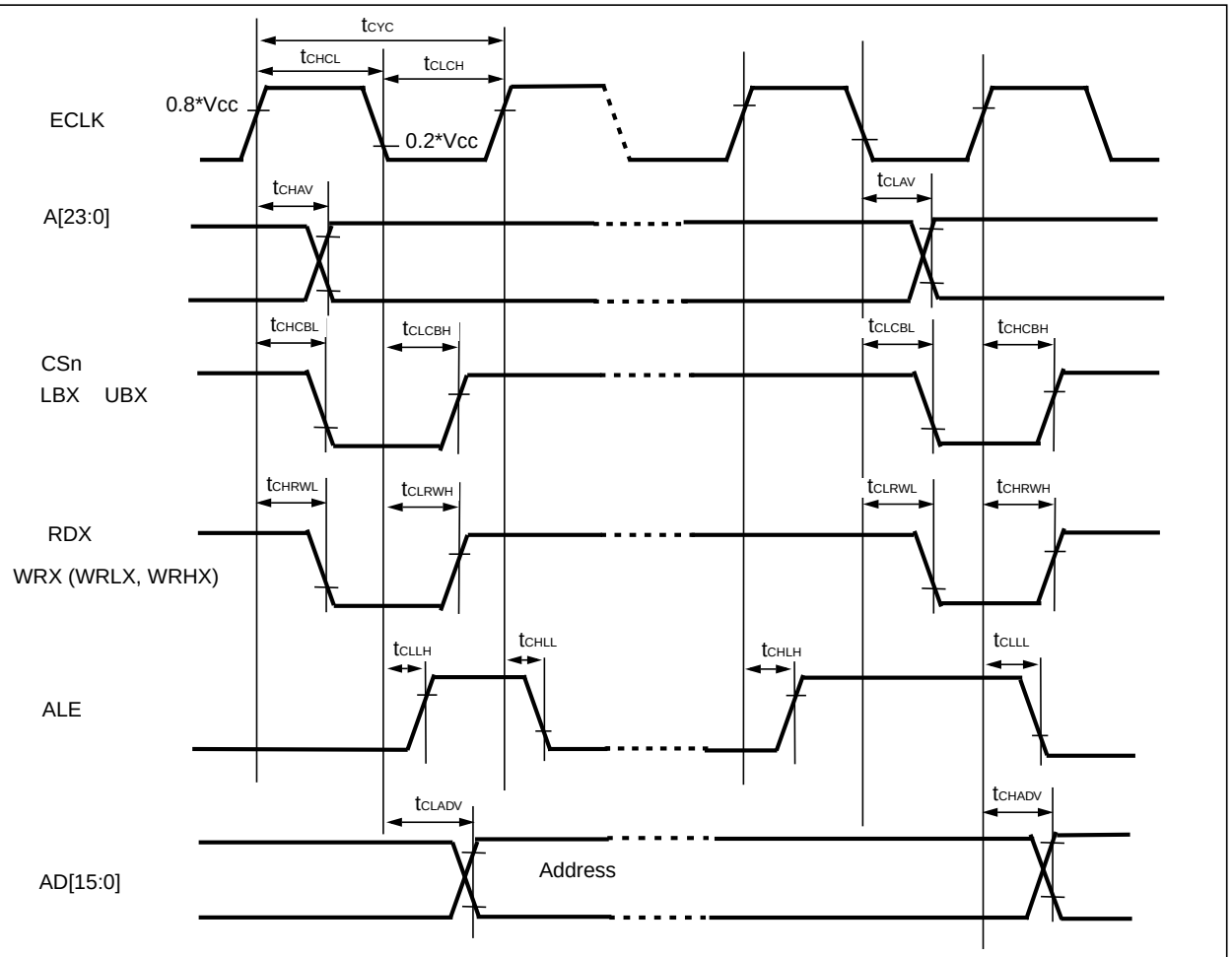

Refer to the Hardware Manual for detailed Timing Charts

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Bus Timing (Read)

(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, V_{SS} = 0.0 V, IO_{drive} = 5mA, C_L = 50pF)

Parameter	Sym-bol	Pin	Conditions	Value		Unit	Remarks
				Min	Max		
ALE pulse width (multiplexed)	t_{LHLL}	ALE	EACL:STS=0 and EACL:ACE=0	$t_{CYC}/2 - 5$	—	ns	EBM:NMS = 0
			EACL:STS=1	$t_{CYC} - 5$	—		
			EACL:STS=0 and EACL:ACE=1	$3t_{CYC}/2 - 5$	—		
Valid address ⇒ ALE ↓ time (multiplexed)	t_{AVLL}	ALE, A[23:16],	EACL:STS=0 and EACL:ACE=0	$t_{CYC} - 15$	—	ns	
			EACL:STS=1 and EACL:ACE=0	$3t_{CYC}/2 - 15$	—		
			EACL:STS=0 and EACL:ACE=1	$2t_{CYC} - 15$	—		
			EACL:STS=1 and EACL:ACE=1	$5t_{CYC}/2 - 15$	—		
	t_{ADVLL}	ALE,AD[15:0]	EACL:STS=0 and EACL:ACE=0	$t_{CYC}/2 - 15$	—	ns	
			EACL:STS=1 and EACL:ACE=0	$t_{CYC} - 15$	—		
			EACL:STS=0 and EACL:ACE=1	$3t_{CYC}/2 - 15$	—		
			EACL:STS=1 and EACL:ACE=1	$2t_{CYC} - 15$	—		
ALE ↓ ⇒ Address valid time (multiplexed)	t_{LLAX}	ALE, AD[15:0]	EACL:STS=0	$t_{CYC}/2 - 15$	—	ns	
			EACL:STS=1	-15	—		
Valid address ⇒ RDX ↓ time (non-multiplexed)	t_{AVRL}	RDX, A[23:0]	EBM:NMS= 1	$t_{CYC}/2 - 15$	—	ns	
Valid address ⇒ RDX ↓ time (multiplexed)	t_{AVRL}	RDX, A[23:16]	EACL:ACE=0 EBM:NMS=0	$3t_{CYC}/2 - 15$	—	ns	
			EACL:ACE=1 EBM:NMS=0	$5t_{CYC}/2 - 15$	—		
	t_{ADVRL}	RDX, AD[15:0]	EACL:ACE=0 EBM:NMS=0	$t_{CYC} - 15$	—	ns	
			EACL:ACE=1 EBM:NMS=0	$2t_{CYC} - 15$	—		
Valid address ⇒ Valid data input (non-multiplexed)	t_{AVDV}	A[23:0], AD[15:0]	EBM:NMS= 1	—	$2t_{CYC} - 55$	ns	w/o cycle extension

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(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, V_{SS} = 0.0 V, IO_{drive} = 5mA, C_L = 50pF)

Parameter	Sym-bol	Pin	Conditions	Value		Unit	Remarks
				Min	Max		
Valid address ⇒ Valid data input (multiplexed)	t_{AVDV}	A[23:16], AD[15:0]	EACL:ACE=0 EBM:NMS=0	—	$3t_{CYC}$ – 55	ns	w/o cycle extension
			EACL:ACE=1 EBM:NMS=0	—	$4t_{CYC}$ – 55		
	t_{ADVDV}	AD[15:0]	EACL:ACE=0 EBM:NMS=0	—	$5t_{CYC}/2$ – 55	ns	w/o cycle extension
			EACL:ACE=1 EBM:NMS=0	—	$7t_{CYC}/2$ – 55		
RDX pulse width	t_{RLRH}	RDX	—	$3\ t_{CYC}/2$ – 5	—	ns	w/o cycle extension
RDX ↓ ⇒ Valid data input	t_{RLDV}	RDX, AD[15:0]	—	—	$3\ t_{CYC}/2$ – 50	ns	w/o cycle extension
RDX ↑ ⇒ Data hold time	t_{RHDX}	RDX, AD[15:0]	—	0	—	ns	
Address valid ⇒ Data hold time	t_{AXDX}	A[23:0], AD[15:0]	—	0	—	ns	
RDX ↑ ⇒ ALE ↑ time	t_{RHLH}	RDX, ALE	EACL:STS=1 and EACL:ACE=1	$3t_{CYC}/2$ – 10	—	ns	
			other ECL:STS, EACL:ACE setting	$t_{CYC}/2$ – 10	—		
Valid address ⇒ ECLK ↑ time	t_{AVCH}	A[23:0], ECLK	—	t_{CYC} – 15	—	ns	
	t_{ADVCH}	AD[15:0], ECLK		$t_{CYC}/2$ – 15	—		
RDX ↓ ⇒ ECLK ↑ time	t_{RLCH}	RDX, ECLK	—	$t_{CYC}/2$ – 10	—	ns	
ALE ↓ ⇒ RDX ↓ time	t_{LLRL}	ALE, RDX	EACL:STS=0	$t_{CYC}/2$ – 10	—	ns	
			EACL:STS=1	– 10	—		
ECLK↑ ⇒ Valid data input	t_{CHDV}	AD[15:0], ECLK	—	—	t_{CYC} – 50	ns	

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(T_A = –40 °C to +125 °C, V_{CC} = 3.0 to 4.5V, V_{SS} = 0.0 V, IO_{drive} = 5mA, C_L = 50pF)

Parameter	Sym-bol	Pin	Conditions	Value		Unit	Remarks
				Min	Max		
ALE pulse width (multiplexed)	t_{LHLL}	ALE	EACL:STS=0 and EACL:ACE=0	$t_{CYC}/2 - 8$	—	ns	EBM:NMS = 0
			EACL:STS=1	$t_{CYC} - 8$	—		
			EACL:STS=0 and EACL:ACE=1	$3t_{CYC}/2 - 8$	—		
Valid address ⇒ ALE ↓ time (multiplexed)	t_{AVLL}	ALE, A[23:16],	EACL:STS=0 and EACL:ACE=0	$t_{CYC} - 20$	—	ns	
			EACL:STS=1 and EACL:ACE=0	$3t_{CYC}/2 - 20$	—		
			EACL:STS=0 and EACL:ACE=1	$2t_{CYC} - 20$	—		
			EACL:STS=1 and EACL:ACE=1	$5t_{CYC}/2 - 20$	—		
	t_{ADVLL}	ALE, AD[15:0]	EACL:STS=0 and EACL:ACE=0	$t_{CYC}/2 - 20$	—	ns	
			EACL:STS=1 and EACL:ACE=0	$t_{CYC} - 20$	—		
			EACL:STS=0 and EACL:ACE=1	$3t_{CYC}/2 - 20$	—		
			EACL:STS=1 and EACL:ACE=1	$2t_{CYC} - 20$	—		
ALE ↓ ⇒ Address valid time (multiplexed)	t_{LLAX}	ALE, AD[15:0]	EACL:STS=0	$t_{CYC}/2 - 20$	—	ns	
			EACL:STS=1	-20	—		
Valid address ⇒ RDX ↓ time (non-multiplexed)	t_{AVRL}	RDX, A[23:0]	EBM:NMS= 1	$t_{CYC}/2 - 20$	—	ns	
Valid address ⇒ RDX ↓ time (multiplexed)	t_{AVRL}	RDX, A[23:16]	EACL:ACE=0 EBM:NMS=0	$3t_{CYC}/2 - 20$	—	ns	
			EACL:ACE=1 EBM:NMS=0	$5t_{CYC}/2 - 20$	—		
	t_{ADVRL}	RDX, AD[15:0]	EACL:ACE=0 EBM:NMS=0	$t_{CYC} - 20$	—	ns	
			EACL:ACE=1 EBM:NMS=0	$2t_{CYC} - 20$	—		
Valid address ⇒ Valid data input (non-multiplexed)	t_{AVDV}	A[23:0], AD[15:0]	EBM:NMS= 1	—	$2t_{CYC} - 60$	ns	w/o cycle extension

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(T_A = –40 °C to +125 °C, V_{CC} = 3.0 to 4.5V, V_{SS} = 0.0 V, IO_{drive} = 5mA, C_L = 50pF)

Parameter	Sym-bol	Pin	Conditions	Value		Unit	Remarks
				Min	Max		
Valid address ⇒ Valid data input (multiplexed)	t_{AVDV}	A[23:16], AD[15:0]	EACL:ACE=0 EBM:NMS=0	—	$3t_{CYC}$ – 60	ns	w/o cycle extension
			EACL:ACE=1 EBM:NMS=0	—	$4t_{CYC}$ – 60		
	t_{ADVDV}	AD[15:0]	EACL:ACE=0 EBM:NMS=0	—	$5t_{CYC}/2$ – 60	ns	w/o cycle extension
			EACL:ACE=1 EBM:NMS=0	—	$7t_{CYC}/2$ – 60		
RDX pulse width	t_{RLRH}	RDX	—	$3t_{CYC}/2$ – 8	—	ns	w/o cycle extension
RDX ↓ ⇒ Valid data input	t_{RLDV}	RDX, AD[15:0]	—	—	$3t_{CYC}/2$ – 55	ns	w/o cycle extension
RDX ↑ ⇒ Data hold time	t_{RHDX}	RDX, AD[15:0]	—	0	—	ns	
Address valid ⇒ Data hold time	t_{AXDX}	A[23:0]	—	0	—	ns	
RDX ↑ ⇒ ALE ↑ time	t_{RHLH}	RDX, ALE	EACL:STS=1 and EACL:ACE=1	$3t_{CYC}/2$ – 15	—	ns	
			other ECL:STS, EACL:ACE setting	$t_{CYC}/2$ – 15	—		
Valid address ⇒ ECLK ↑ time	t_{AVCH}	A[23:0], ECLK	—	t_{CYC} – 20	—	ns	
	t_{ADVCH}	AD[15:0], ECLK		$t_{CYC}/2$ – 20	—		
RDX ↓ ⇒ ECLK ↑ time	t_{RLCH}	RDX, ECLK	—	$t_{CYC}/2$ – 15	—	ns	
ALE ↓ ⇒ RDX ↓ time	t_{LLRL}	ALE, RDX	EACL:STS=0	$t_{CYC}/2$ – 15	—	ns	
			EACL:STS=1	– 15	—		
ECLK↑ ⇒ Valid data input	t_{CHDV}	AD[15:0], ECLK	—	—	t_{CYC} – 55	ns	

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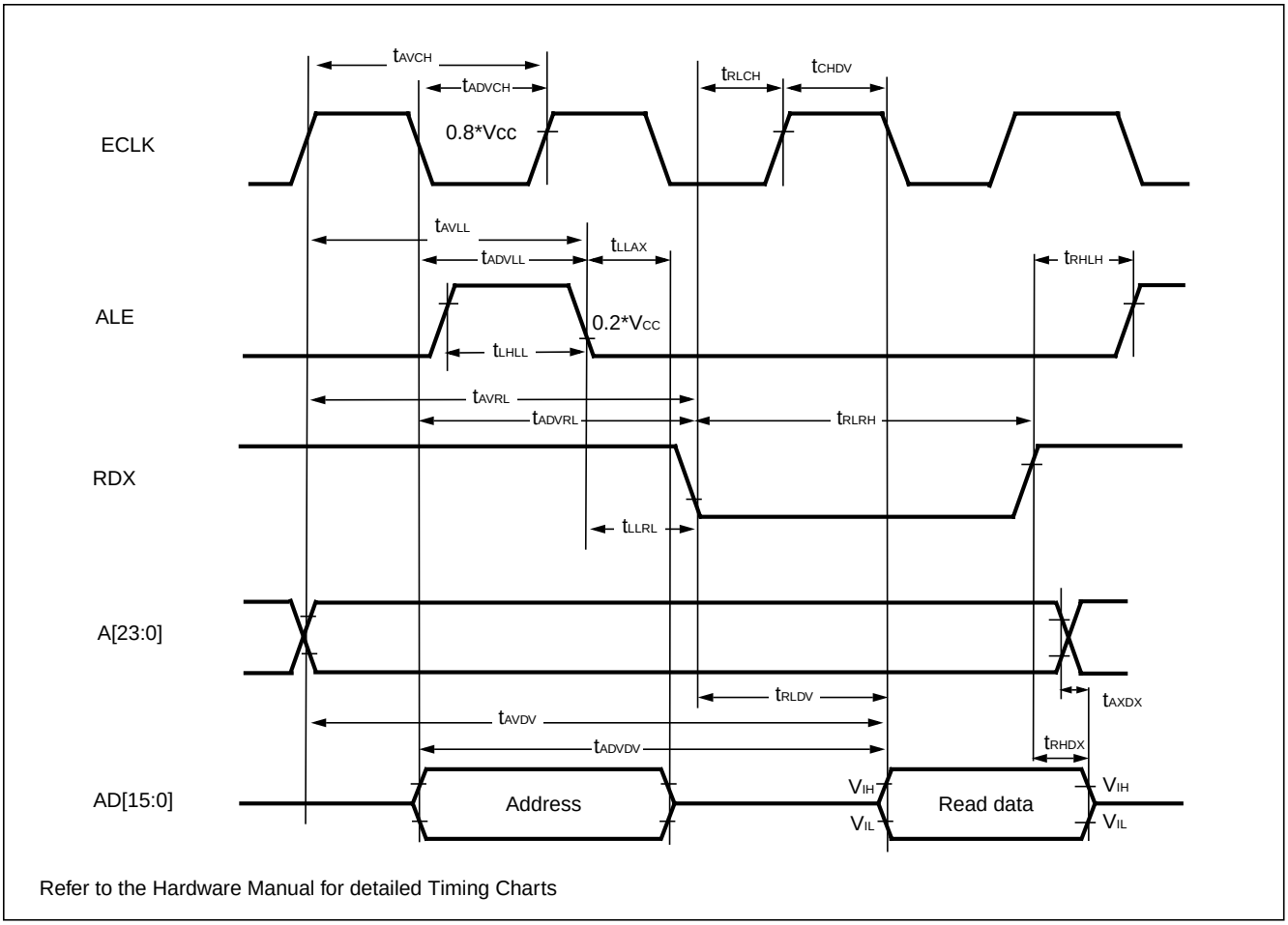

Refer to the Hardware Manual for detailed Timing Charts

Bus Timing (Write)

(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, V_{SS} = 0.0 V, IO_{drive} = 5mA, C_L = 50pF)

Parameter	Symbol	Pin	Condition	Value		Unit	Remarks
				Min	Max		
Valid address ⇒ WRX ↓ time (non-multiplexed)	t_{AVWL}	WRX, WRLX, WRHX, A[23:0]	EACL:STS=0 EBM:NMS=1	$t_{CYC}/2 - 15$	—	ns	
			EACL:STS=1 EBM:NMS=1	$t_{CYC} - 15$	—		
Valid address ⇒ WRX ↓ time (multiplexed)	t_{AVWL}	WRX, WRLX, WRHX, A[23:16]	EACL:ACE=0 EBM:NMS=0	$3t_{CYC}/2 - 15$	—	ns	
			EACL:ACE=1 EBM:NMS=0	$5t_{CYC}/2 - 15$	—		
	t_{ADVWL}	WRX, WRLX, WRHX, AD[15:0]	EACL:ACE=0 EBM:NMS=0	$t_{CYC} - 15$	—	ns	
			EACL:ACE=1 EBM:NMS=0	$2t_{CYC} - 15$	—		
WRX pulse width	t_{WLWH}	WRX, WRXL, WRHX	—	$t_{CYC} - 5$	—	ns	w/o cycle extension

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(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, V_{SS} = 0.0 V, IO_{drive} = 5mA, C_L = 50pF)

Parameter	Symbol	Pin	Condition	Value		Unit	Remarks
				Min	Max		
Valid data output ⇒ WRX ↑ time	t_{DVWH}	WRX, WRLX, WRHX, AD[15:0]	—	t_{CYC} – 20	—	ns	w/o cycle extension
WRX ↑ ⇒ Data hold time	t_{WHDX}	WRX, WRLX, WRHX, AD[15:0]	—	$t_{CYC}/2$ – 15	—	ns	
WRX ↑ ⇒ Address valid time (non-multiplexed)	t_{WHAX}	WRX, WRLX, WRHX, A[23:0]	EACL:STS=1 EBM:NMS=1	– 15	—	ns	
			EACL:STS=0 EBM:NMS=1	$t_{CYC}/2$ – 15	—	ns	
WRX ↑ ⇒ Address valid time (multiplexed)	t_{WHAX}	WRX, WRLX, WRHX, A[23:16]	EBM:NMS=0	$t_{CYC}/2$ – 15	—	ns	
WRX ↑ ⇒ ALE ↑ time (multiplexed)	t_{WHLH}	WRX, WRLX, WRHX, ALE	EBM:ACE=1 and EACL:STS=1	$2t_{CYC}$ – 10	—	ns	EBM:NMS=0
			other EBM:ACE and EACL:STS setting	t_{CYC} – 10	—		
WRX ↓ ⇒ ECLK ↑ time	t_{WLCH}	WRX, WRLX, WRHX, ECLK	—	$t_{CYC}/2$ – 10	—	ns	
CSn ⇒ WRX time (non-multiplexed)	t_{CSLWL}	WRX, WRLX, WRHX, CSn	EACL:STS=0 EBM:NMS=1	—	$t_{CYC}/2$ – 15	ns	
			EACL:STS=1 EBM:NMS=1	—	t_{CYC} – 15		
CSn ⇒ WRX time (multiplexed)	t_{CSLWL}	WRX, WRLX, WRHX, CSn	EACL:ACE=0 EBM:NMS=0	—	$3t_{CYC}/2$ – 15	ns	
			EACL:ACE=1 EBM:NMS=0	—	$5t_{CYC}/2$ – 15		
WRX ⇒ CSn time (non-multiplexed)	t_{WHCSH}	WRX, WRLX, WRHX, CSn	EACL:STS=1 EBM:NMS=1	– 15	—	ns	
			EACL:STS=0 EBM:NMS=1	$t_{CYC}/2$ – 15	—	ns	
WRX ⇒ CSn time (multiplexed)	t_{WHCSH}	WRX, WRLX, WRHX, CSn	EBM:NMS=0	$t_{CYC}/2$ – 15	—	ns	

(T_A = –40 °C to +125 °C, V_{CC} = 3.0 to 4.5V, V_{SS} = 0.0 V, IO_{drive} = 5mA, C_L = 50pF)

Parameter	Symbol	Pin	Condition	Value		Unit	Remarks
				Min	Max		
Valid address ⇒ WRX ↓ time (non-multiplexed)	t_{AVWL}	WRX, WRLX, WRHX, A[23:0]	EACL:STS=0 EBM:NMS=1	$t_{CYC}/2$ – 20	—	ns	
			EACL:STS=1 EBM:NMS=1	t_{CYC} – 20	—		

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(T_A = –40 °C to +125 °C, V_{CC} = 3.0 to 4.5V, V_{SS} = 0.0 V, IO_{drive} = 5mA, C_L = 50pF)

Parameter	Symbol	Pin	Condition	Value		Unit	Remarks
				Min	Max		
Valid address ⇒ WRX ↓ time (multiplexed)	t_{AVWL}	WRX, WRLX, WRHX, A[23:16]	EACL:ACE=0 EBM:NMS=0	$3t_{CYC}/2$ – 20	—	ns	
			EACL:ACE=1 EBM:NMS=0	$5t_{CYC}/2$ – 20	—		
	t_{ADVWL}	WRX, WRLX, WRHX, AD[15:0]	EACL:ACE=0 EBM:NMS=0	t_{CYC} – 20	—	ns	
			EACL:ACE=1 EBM:NMS=0	$2t_{CYC}$ – 20	—		
WRX pulse width	t_{WLWH}	WRX, WRXL, WRHX	—	t_{CYC} – 8	—	ns	w/o cycle extension
Valid data output ⇒ WRX ↑ time	t_{DVWH}	WRX, WRLX, WRHX, AD[15:0]	—	t_{CYC} – 25	—	ns	w/o cycle extension
WRX ↑ ⇒ Data hold time	t_{WHDX}	WRX, WRLX, WRHX, AD[15:0]	—	$t_{CYC}/2$ – 20	—	ns	
WRX ↑ ⇒ Address valid time (non-multiplexed)	t_{WHAX}	WRX, WRLX, WRHX, A[23:0]	EACL:STS=1 EBM:NMS=1	– 20	—	ns	
			EACL:STS=0 EBM:NMS=1	$t_{CYC}/2$ – 20	—	ns	
WRX ↑ ⇒ Address valid time (multiplexed)	t_{WHAX}	WRX, WRLX, WRHX, A[23:16]	EBM:NMS=0	$t_{CYC}/2$ – 20	—	ns	
WRX ↑ ⇒ ALE ↑ time (multiplexed)	t_{WHLH}	WRX, WRLX, WRHX, ALE	EBM:ACE=1 and EACL:STS=1	$2t_{CYC}$ – 15	—	ns	EBM:NMS=0
			other EBM:ACE and EACL:STS setting	t_{CYC} – 15	—		
WRX ↓ ⇒ ECLK ↑ time	t_{WLCH}	WRX, WRLX, WRHX, ECLK	—	$t_{CYC}/2$ – 15	—	ns	
CSn ⇒ WRX time (non-multiplexed)	t_{CSLWL}	WRX, WRLX, WRHX, CSn	EACL:STS=0 EBM:NMS=1	—	$t_{CYC}/2$ – 20	ns	
			EACL:STS=1 EBM:NMS=1	—	t_{CYC} – 20		
CSn ⇒ WRX time (multiplexed)	t_{CSLWL}	WRX, WRLX, WRHX, CSn	EACL:ACE=0 EBM:NMS=0	—	$3t_{CYC}/2$ – 20	ns	
			EACL:ACE=1 EBM:NMS=0	—	$5t_{CYC}/2$ – 20		
WRX ⇒ CSn time (non-multiplexed)	t_{WHCSH}	WRX, WRLX, WRHX, CSn	EACL:STS=1 EBM:NMS=1	– 20	—	ns	
			EACL:STS=0 EBM:NMS=1	$t_{CYC}/2$ – 20	—	ns	
WRX ⇒ CSn time (multiplexed)	t_{WHCSH}	WRX, WRLX, WRHX, CSn	EBM:NMS=0	$t_{CYC}/2$ – 20	—	ns	

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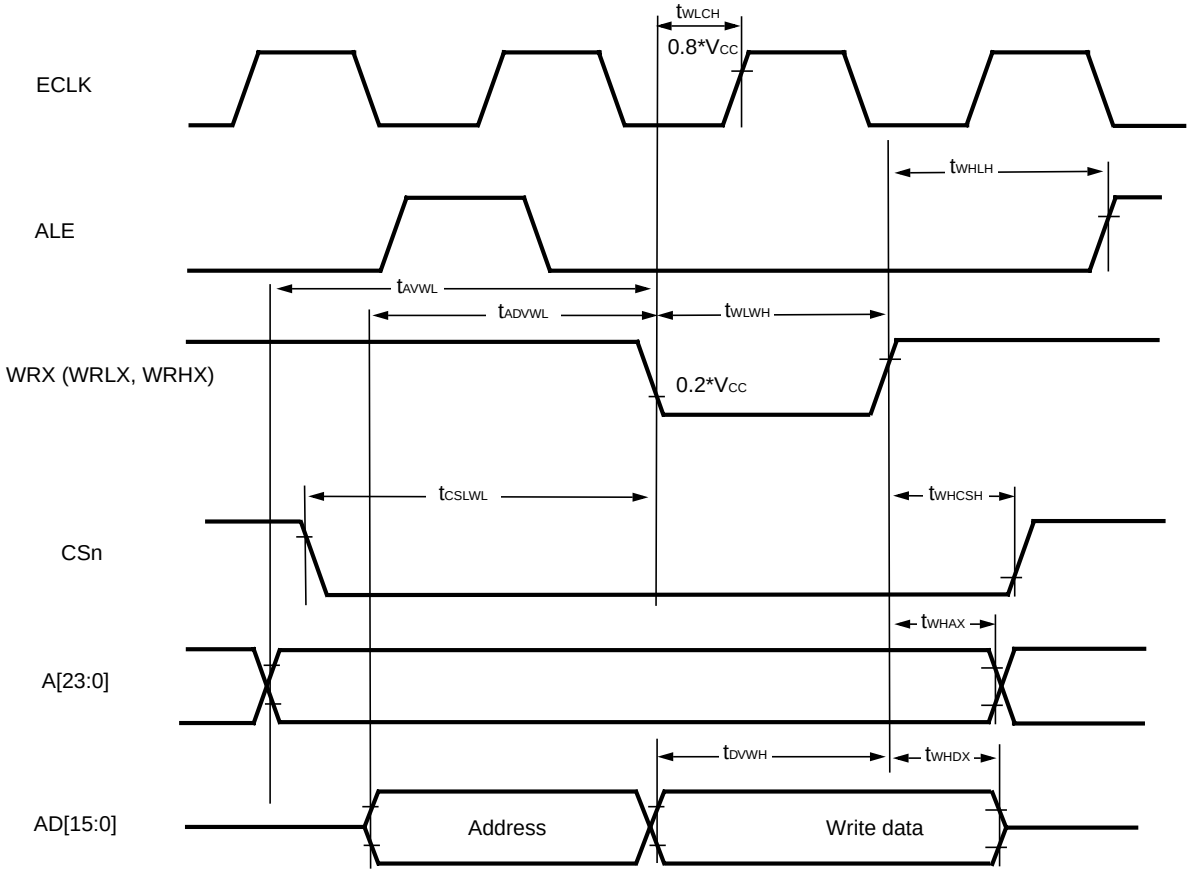

Refer to the Hardware Manual for detailed Timing Charts

Ready Input Timing

(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, V_{SS} = 0.0 V, IO_{drive} = 5mA, C_L = 50pF)

Parameter	Symbol	Pin	Test Condition	Rated Value		Units	Remarks
				Min	Max		
RDY setup time	t_{RYHS}	RDY	—	35	—	ns	
RDY hold time	t_{RYHH}	RDY		0	—	ns	

(T_A = –40 °C to +125 °C, V_{CC} = 3.0 to 4.5V, V_{SS} = 0.0 V, IO_{drive} = 5mA, C_L = 50pF)

Parameter	Symbol	Pin	Test Condition	Rated Value		Units	Remarks
				Min	Max		
RDY setup time	t_{RYHS}	RDY	—	45	—	ns	
RDY hold time	t_{RYHH}	RDY		0	—	ns	

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

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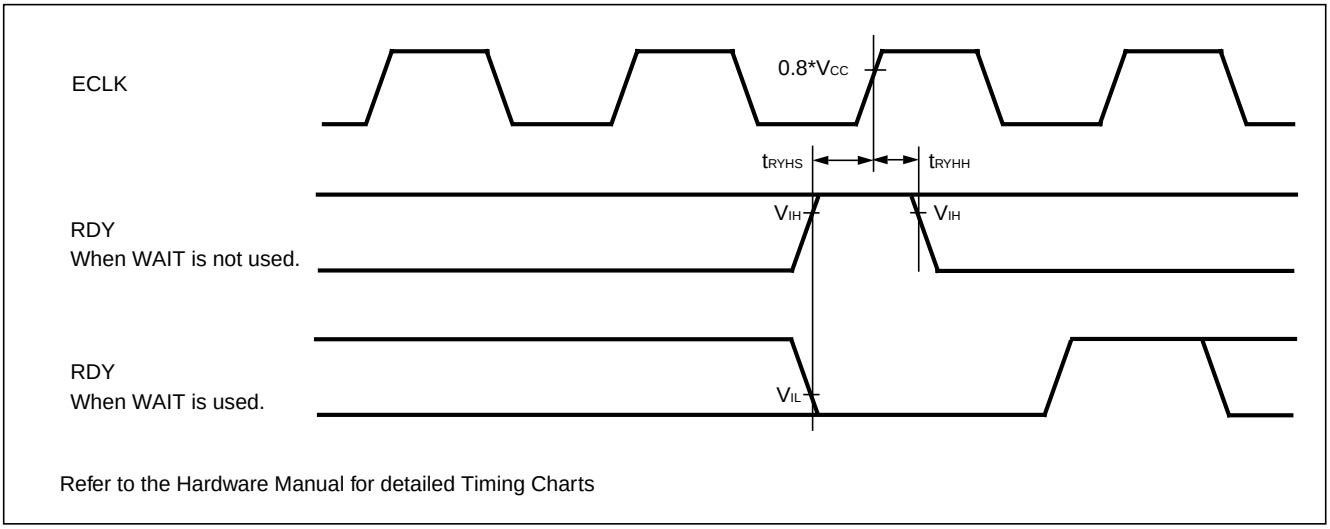


Refer to the Hardware Manual for detailed Timing Charts

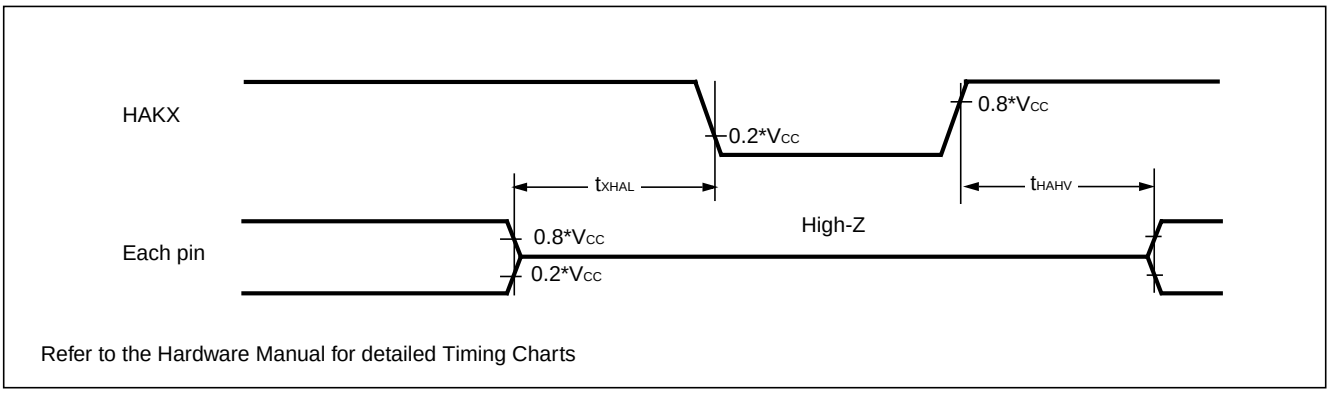
Hold Timing

(T_A = –40 °C to +125 °C, V_{CC} = 5.0 V ± 10%, V_{SS} = 0.0 V, IO_{drive} = 5mA, C_L = 50pF)

Parameter	Symbol	Pin	Condition	Value		Units	Remarks
				Min	Max		
Pin floating ⇒ HAKX ↓ time	t_{XHAL}	HAKX	—	t_{CYC} – 20	t_{CYC} + 20	ns	
HAKX ↑ time ⇒ Pin valid time	t_{HAHV}	HAKX		t_{CYC} – 20	t_{CYC} + 20	ns	

(T_A = –40 °C to +125 °C, V_{CC} = 3.0 to 4.5V, V_{SS} = 0.0 V, IO_{drive} = 5mA, C_L = 50pF)

Parameter	Symbol	Pin	Condition	Value		Units	Remarks
				Min	Max		
Pin floating ⇒ HAKX ↓ time	t_{XHAL}	HAKX	—	t_{CYC} – 25	t_{CYC} + 25	ns	
HAKX ↑ time ⇒ Pin valid time	t_{HAHV}	HAKX		t_{CYC} – 25	t_{CYC} + 25	ns	



Refer to the Hardware Manual for detailed Timing Charts

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USART timing

WARNING: The values given below are for an I/O driving strength IO_{drive} = 5mA. If IO_{drive} is 2mA, all the maximum output timing described in the different tables must then be increased by 10ns.

(T_A = -40˚C to 125˚C, V_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = 0V, IO_{drive} = 5mA, C_L = 50pF)

Parameter	Symbol	Pin	Condition	V_{CC} = AV_{CC}= 4.5V to 5.5V		V_{CC} = AV_{CC}= 3.0V to 4.5V		Unit
				Min	Max	Min	Max	
Serial clock cycle time	t_{SCYCI}	SCKn	Internal Shift Clock Mode	4 t_{CLKP1}	—	4 t_{CLKP1}	—	ns
SCK ↓ → SOT delay time	t_{SLOVI}	SCKn, SOTn		-20	+20	-30	+30	ns
SOT → SCK ↑ delay time	t_{OVSHI}	SCKn, SOTn		$N*t_{CLKP1}$ - 20 *1	—	$N*t_{CLKP1}$ - 30 *1	—	ns
Valid SIN → SCK ↑	t_{IVSHI}	SCKn, SINn		t_{CLKP1} + 45	—	t_{CLKP1} + 55	—	ns
SCK ↑ → Valid SIN hold time	t_{SHIXI}	SCKn, SINn		0	—	0	—	ns
Serial clock “L” pulse width	t_{SLSHE}	SCKn	External Shift Clock Mode	t_{CLKP1} + 10	—	t_{CLKP1} + 10	—	ns
Serial clock “H” pulse width	t_{SHSLE}	SCKn		t_{CLKP1} + 10	—	t_{CLKP1} + 10	—	ns
SCK ↓ → SOT delay time	t_{SLOVE}	SCKn, SOTn		—	2 t_{CLKP1} + 45	—	2 t_{CLKP1} + 55	ns
Valid SIN → SCK ↑	t_{IVSHE}	SCKn, SINn		t_{CLKP1}/2 + 10	—	t_{CLKP1}/2 + 10	—	ns
SCK ↑ → Valid SIN hold time	t_{SHIXE}	SCKn, SINn		t_{CLKP1} + 10	—	t_{CLKP1} + 10	—	ns
SCK fall time	t_{FE}	SCKn		—	20	—	20	ns
SCK rise time	t_{RE}	SCKn		—	20	—	20	ns

Notes:
- AC characteristic in CLK synchronized mode.
- C_L is the load capacity value of pins when testing.
- Depending on the used machine clock frequency, the maximum possible baud rate can be limited by some parameters. These parameters are shown in “MB96300 Super series HARDWARE MANUAL”
- t_{CLKP1} is the cycle time of the peripheral clock 1 (CLKP1), Unit : ns

*1: Parameter N depends on t_{SCYCI} and can be calculated as follows:
- if t_{SCYCI} = 2*k*t_{CLKP1}, then N = k, where k is an integer > 2
- if t_{SCYCI} = (2*k+1)*t_{CLKP1}, then N = k+1, where k is an integer > 1

Examples:

t_{SCYCI}	N
4*t_{CLKP1}	2
5*t_{CLKP1}, 6*t_{CLKP1}	3
7*t_{CLKP1}, 8*t_{CLKP1}	4
...	...

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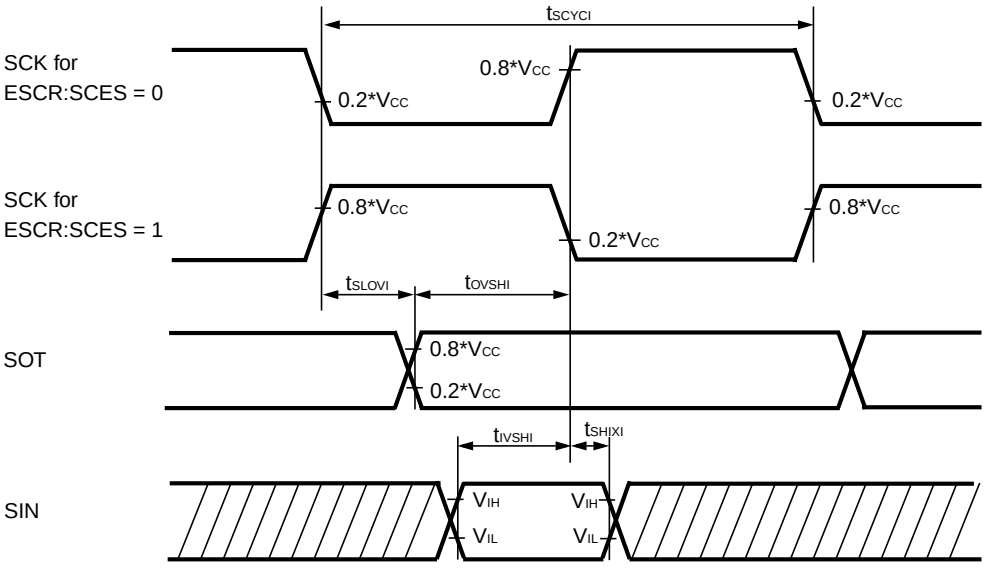
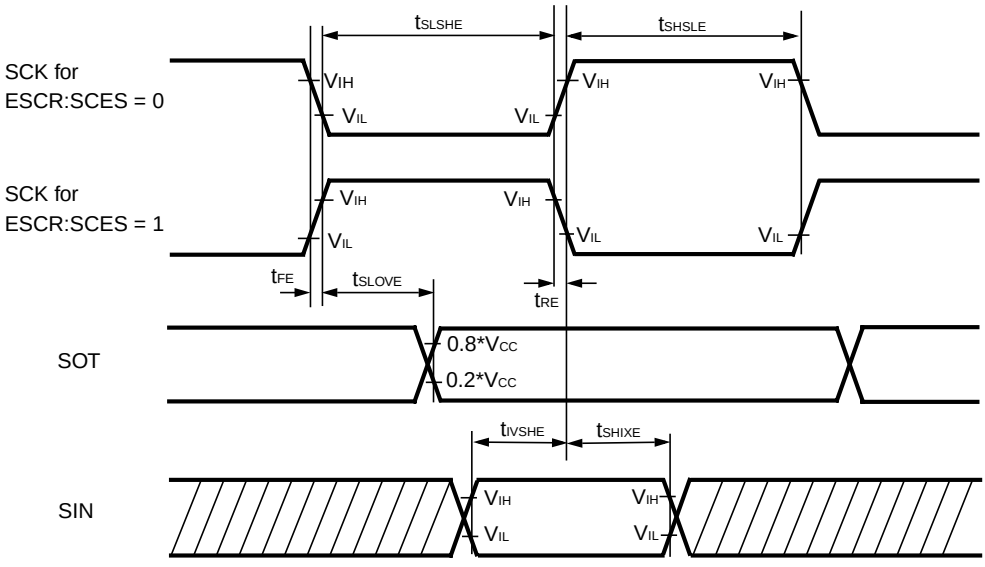


Internal Shift Clock Mode



External Shift Clock Mode

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I²C Timing

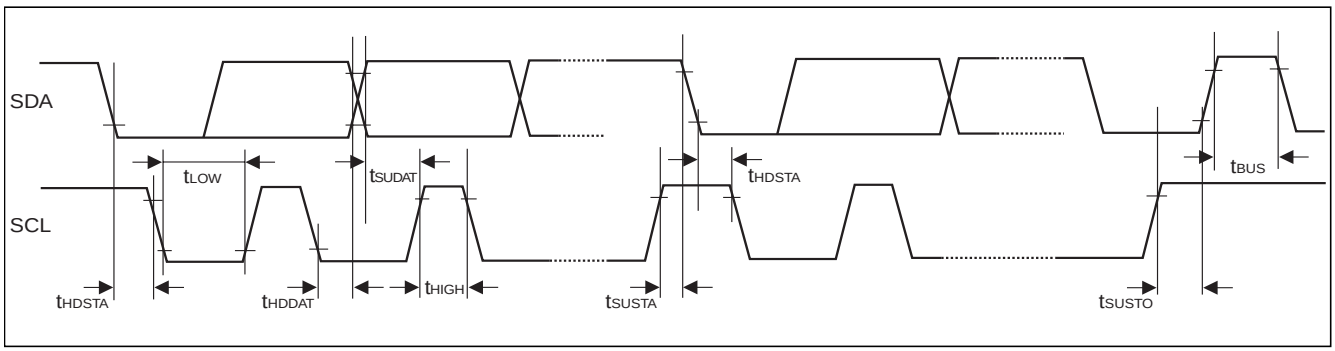
(T_A = -40˚C to 125˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = 0V)

Parameter	Symbol	Standard-mode		Fast-mode*1		Unit
		Min	Max	Min	Max	
SCL clock frequency	f_{SCL}	0	100	0	400	kHz
Hold time (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	0	0.9	µs
Data set-up time SDA↓↑→SCL↑	t_{SUDAT}	250	—	100	—	ns
Set-up time for STOP condition SCL↑→SDA↑	t_{SUSTO}	4.0	—	0.6	—	µs
Bus free time between a STOP and START condition	t_{BUS}	4.7	—	1.3	—	µs
Output fall time from 0.7*Vcc to 0.3*Vcc with a bus capacitance from 10 pF to 400 pF	t_{of}	20 + 0.1*C_b *2	250	20 + 0.1*C_b *2	250	ns
Capacitive load for each bus line	C_b	—	400	—	400	pF
Pulse width of spikes which will be suppressed by input noise filter	t_{SP}	n/a	n/a	0	1*t_{CLKP1}*3	ns

*1 : For use at over 100 kHz, set the peripheral clock 1 to at least 6 MHz.

*2 : C_b = capacitance of one bus line in pF.

*3 : t_{CLKP1} is the cycle time of the peripheral clock CLKP1.



- V_{OH} = 0.7 * V_{CC}
- V_{OL} = 0.3 * V_{CC}
- CMOS Hysteresis 0.7/0.3 input selected

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5. Analog Digital Converter

(T_A = -40 ˚C to +125 ˚C, 3.0 V ≤ AVRH - AVRL, V_{CC} = AV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = 0V)

Parameter	Symbol	Pin	Value			Unit	Remarks
			Min	Typ	Max		
Resolution	-	-	-	-	10	bit	
Total error	-	-	-	-	± 3	LSB	
Nonlinearity error	-	-	-	-	± 2.5	LSB	
Differential nonlinearity error	-	-	-	-	± 1.9	LSB	
Zero transition voltage	V_{OT}	ANn	AVRL - 1.5 LSB	AVRL+ 0.5 LSB	AVRL + 2.5 LSB	V	
Full scale transition voltage	V_{FST}	ANn	AVRH - 3.5 LSB	AVRH - 1.5 LSB	AVRH + 0.5 LSB	V	
Compare time	-	-	1.0	-	16,500	µs	4.5V ≤ AV_{CC} ≤ 5.5V
			2.0	-	-	µs	3.0V ≤ AV_{CC} < 4.5V
Sampling time	-	-	0.5	-	-	µs	4.5V ≤ AV_{CC} ≤ 5.5V
			1.2	-	-	µs	3.0V ≤ AV_{CC} < 4.5V
Analog input leakage current (during conversion)	I_{AIN}	ANn	-1	-	+1	µA	T_A ≤ 105 ˚C, AV_{SS}, AVRL < V_I < AV_{CC}, AVRH
			-1.2	-	+1.2	µA	105 ˚C < T_A ≤ 125 ˚C, AV_{SS}, AVRL < V_I < AV_{CC}, AVRH
Analog input voltage range	V_{AIN}	ANn	AVRL	-	AVRH	V	
Reference voltage range	AVRH	AVRH/ AVRH2	0.75 AVcc	-	AVcc	V	
	AVRL	AVRL	AV_{SS}	-	0.25 AV_{CC}	V	
Power supply current	I_A	AVcc	-	2.5	5	mA	A/D Converter active
	I_{AH}	AVcc	-	-	5	µA	A/D Converter not operated
Reference voltage current	I_R	AVRH/ AVRL	-	0.7	1	mA	A/D Converter active
	I_{RH}	AVRH/ AVRL	-	-	5	µA	A/D Converter not operated
Offset between input channels	-	ANn	-	-	4	LSB	

Note: The accuracy gets worse as |AVRH - AVRL| becomes smaller.

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Definition of A/D Converter Terms

Resolution: Analog variation that is recognized by an A/D converter.

Total error: Difference between the actual value and the ideal value. The total error includes zero transition error, full-scale transition error and nonlinearity error.

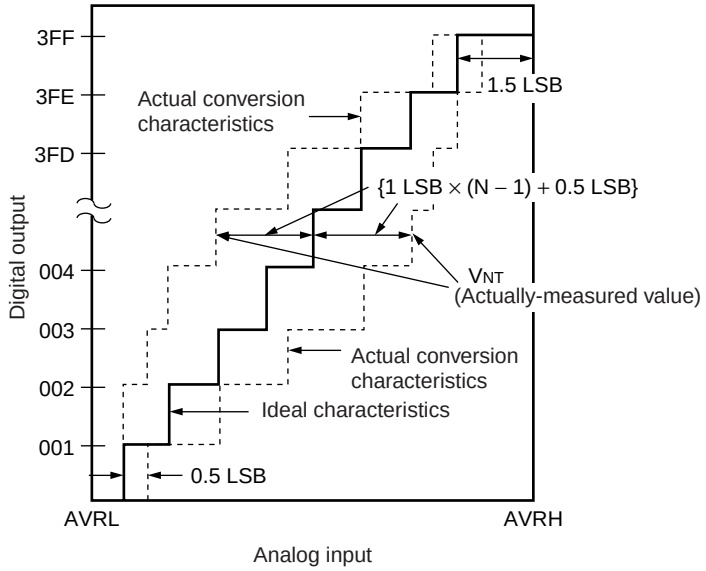
Nonlinearity error: Deviation between a line across zero-transition line (“00 0000 0000” <--> “00 0000 0001”) and full-scale transition line (“11 1111 1110” <--> “11 1111 1111”) and actual conversion characteristics.

Differential nonlinearity error: Deviation of input voltage, which is required for changing output code by 1 LSB, from an ideal value.

Zero reading voltage: Input voltage which results in the minimum conversion value.

Full scale reading voltage: Input voltage which results in the maximum conversion value.

Total error



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

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

N: A/D converter digital output value

V_{OT} (Ideal value) = AVRL + 0.5 LSB [V]

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

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

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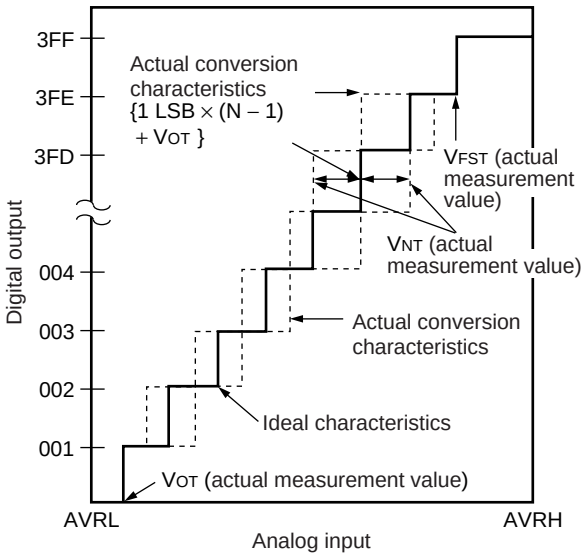
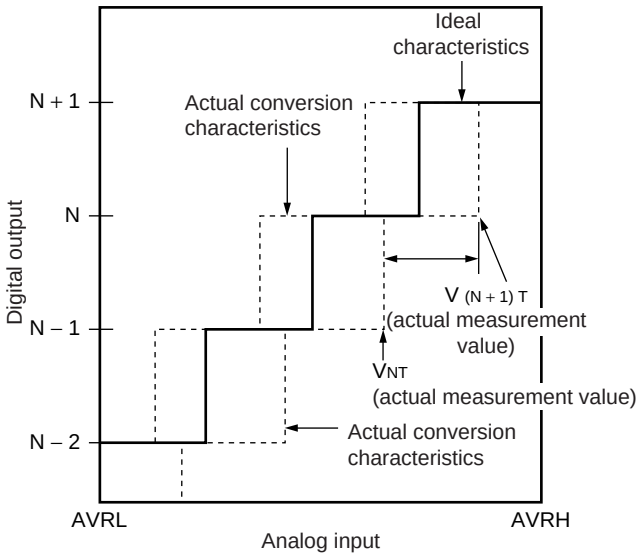
Nonlinearity error



Differential nonlinearity error



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

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

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

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 “$3FF_H$.”

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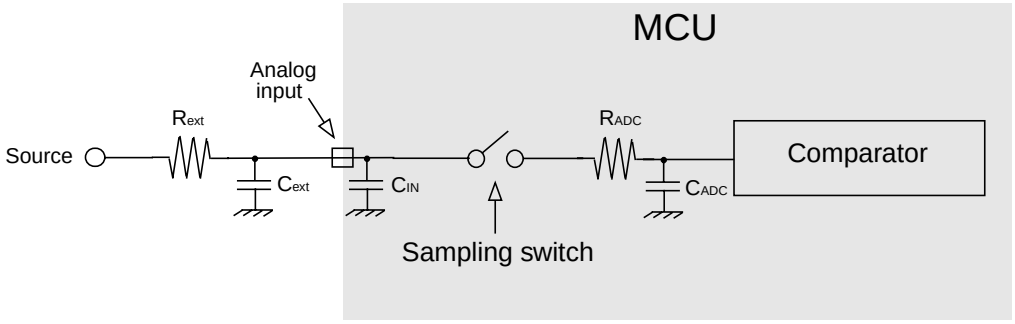
Accuracy and setting of the A/D Converter sampling time

If the external impedance is too high or the sampling time too short, the analog voltage charged to the internal sample and hold capacitor is insufficient, adversely affecting the A/D conversion precision.

To satisfy the A/D conversion precision, a sufficient sampling time must be selected. The required sampling time depends on the external driving impedance R_{ext}, the board capacitance of the A/D converter input pin C_{ext} and the AV_{cc} voltage level. The following replacement model can be used for the calculation:



R_{ext}: external driving impedance
C_{ext}: capacitance of PCB at A/D converter input
C_{IN}: capacitance of MCU input pin: 15pF (max)
R_{ADC}: resistance within MCU: 2.6kΩ (max) for $4.5V \le AV_{cc} \le 5.5V$
12kΩ (max) for $3.0V \le AV_{cc} < 4.5V$
C_{ADC}: sampling capacitance within MCU: 10pF (max)

The sampling time should be set to minimum “7τ“. The following approximation formula for the replacement model above can be used:

$$T_{samp}\ [min] = 7 \times (R_{ext} \times (C_{ext} + C_{IN}) + (R_{ext} + R_{ADC}) \times C_{ADC})$$

- Do not select a sampling time below the absolute minimum permitted value (0.5µs for $4.5V \le AV_{cc} \le 5.5V$; 1.2 µs for $3.0V \le AV_{cc} < 4.5V$).
- If the sampling time cannot be sufficient, connect a capacitor of about 0.1 µF to the analog input pin. In this case the internal sampling capacitance C_{ADC} will be charged out of this external capacitance.
- A big external driving impedance also adversely affects the A/D conversion precision due to the pin input leakage current I_{IL} (static current before the sampling switch) or the analog input leakage current I_{AIN} (total leakage current of pin input and comparator during sampling). The effect of the pin input leakage current I_{IL} cannot be compensated by an external capacitor.
- The accuracy gets worse as |AVRH - AVRL| becomes smaller.

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6. Alarm Comparator

(T_A = -40 ˚C to +125 ˚C, V_{CC} = AV_{CC} = 3.0V - 5.5V, V_{SS} = AV_{SS} = 0V)

Parameter	Symbol	Pin	Value			Unit	Remarks
			Min	Typ	Max		
Power supply current	I_{A5ALMF}	AV_{CC}	-	25	45	µA	Alarm comparator enabled in fast mode (one channel)
	I_{A5ALMS}		-	7	13	µA	Alarm comparator enabled in slow mode (one channel)
	I_{A5ALMH}		-	-	5	µA	Alarm comparator disabled
ALARM pin input current	I_{ALIN}	ALARM0, ALARM1	-1	-	+1	µA	T_A = 25 ˚C
			-3	-	+3	µA	T_A = 125 ˚C
ALARM pin input voltage range	V_{ALIN}		0	-	AV_{CC}	V	
External low threshold high->low transition	$V_{EVTL(H->L)}$		0.36 * AV_{CC} -0.25	0.36 * AV_{CC} -0.1	-	V	INTREF = 0
External low threshold low->high transition	$V_{EVTL(L->H)}$		-	0.36 * AV_{CC} +0.1	0.36 * AV_{CC} +0.25	V	
External high threshold high->low transition	$V_{EVTH(H->L)}$		0.78 * AV_{CC} -0.25	0.78 * AV_{CC} -0.1	-	V	
External high threshold low->high transition	$V_{EVTH(L->H)}$			0.78 * AV_{CC} +0.1	0.78 * AV_{CC} +0.25	V	
Internal low threshold high->low transition	$V_{IVTL(H->L)}$		0.9	1.1	-	V	INTREF = 1
Internal low threshold low->high transition	$V_{IVTL(L->H)}$		-	1.3	1.55	V	
Internal high threshold high->low transition	$V_{IVTH(H->L)}$		2.2	2.4	-	V	
Internal high threshold low->high transition	$V_{IVTH(L->H)}$		-	2.6	2.85	V	
Switching hysteresis	V_{HYS}		50	-	300	mV	
Comparison time	t_{COMPF}		-	0.1	1	µs	CMD = 1 (fast)
	t_{COMPS}		-	1	10	µs	CMD = 0 (slow)
Power-up stabilization time after enabling alarm comparator	t_{PD}		-	1	10	ms	Threshold levels specified above are not guaranteed within this time
Slow/Fast mode transition time	t_{CMD}		-	100	500	µs	

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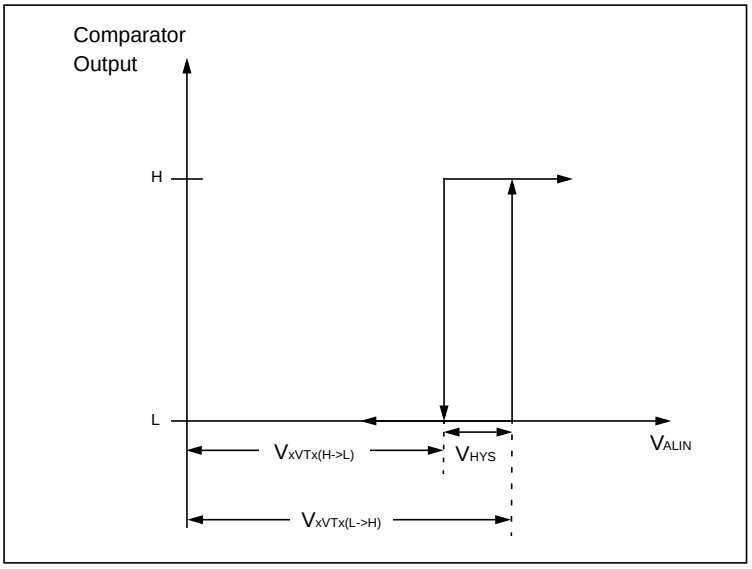

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7. Low Voltage Detector characteristics

(T_A = -40 ˚C to +125 ˚C, V_{cc} = AV_{cc} = 3.0V - 5.5V, V_{ss} = AV_{ss} = 0V)

Parameter	Symbol	Value		Unit	Remarks
		Min	Max		
Stabilization time	$T_{LVDSTAB}$	-	75	µs	After power-up or change of detection level
Level 0	V_{DL0}	2.7	2.9	V	CILCR:LVL[3:0]="0000"
Level 1	V_{DL1}	2.9	3.1	V	CILCR:LVL[3:0]="0001"
Level 2	V_{DL2}	3.1	3.3	V	CILCR:LVL[3:0]="0010"
Level 3	V_{DL3}	3.5	3.75	V	CILCR:LVL[3:0]="0011"
Level 4	V_{DL4}	3.6	3.85	V	CILCR:LVL[3:0]="0100"
Level 5	V_{DL5}	3.7	3.95	V	CILCR:LVL[3:0]="0101"
Level 6	V_{DL6}	3.8	4.05	V	CILCR:LVL[3:0]="0110"
Level 7	V_{DL7}	3.9	4.15	V	CILCR:LVL[3:0]="0111"
Level 8	V_{DL8}	4.0	4.25	V	CILCR:LVL[3:0]="1000"
Level 9	V_{DL9}	4.1	4.35	V	CILCR:LVL[3:0]="1001"
Level 10	V_{DL10}	not used			
Level 11	V_{DL11}	not used			
Level 12	V_{DL12}	not used			
Level 13	V_{DL13}	not used			
Level 14	V_{DL14}	not used			
Level 15	V_{DL15}	not used			

CILCR:LVL[3:0] are the low voltage detector level select bits of the CILCR register.

For correct detection, the slope of the voltage level must satisfy $\left|\frac{dV}{dt}\right| \leq 0.004\frac{V}{\mu s}$.

Faster variations are regarded as noise and may not be detected.

The functional operation of the MCU is guaranteed down to the minimum low voltage detection level of "Level 0" (V_{DL0_MIN}). The electrical characteristics however are only valid in the specified range (usually down to 3.0V).

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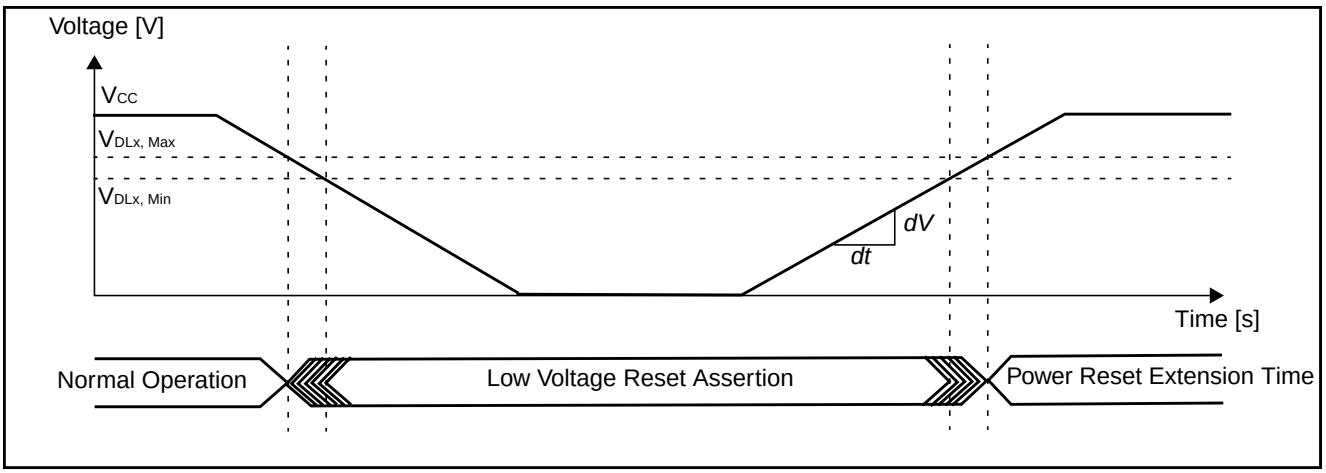
Low Voltage Detector Operation

In the following figure, the occurrence of a low voltage condition is illustrated. For a detailed description of the reset and startup behavior, please refer to the corresponding hardware manual chapter.



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8. FLASH memory program/erase characteristics

(T_A = -40˚C to 105˚C, V_{CC} = AV_{CC} = 3.0V to 5.5V, DV_{CC} = 3.0V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V)

Parameter	Value			Unit	Remarks
	Min	Typ	Max		
Sector erase time	-	0.9	3.6	s	Without erasure pre-programming time
Chip erase time	-	n*0.9	n*3.6	s	Without erasure pre-programming time (n is the number of Flash sector of the device)
Word (16-bit width) programming time	-	23	370	us	Without overhead time for submitting write command
Program/Erase cycle	10 000	-	-	cycle	
Flash data retention time	20	-	-	year	*1

*1: This value was converted from the results of evaluating the reliability of the technology (using Arrhenius equation to convert high temperature measurements into normalized value at 85ºC)

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■ EXAMPLE CHARACTERISTICS

1. Temperature dependency of power supply currents

The following diagrams show the current consumption of samples with typical wafer process parameters in different operation modes.

Common condition for all operation modes:
- V_{CC} = AV_{CC} = 5.0V
- Main clock = 4MHz external clock
- Sub clock = 32kHz external clock

Operation mode details:

Mode name	Details
PLL Run 56	PLL Run mode current I_{CCPLL} with the following settings: • f_{CLKS1} = f_{CLKS2} = f_{CLKB} = f_{CLKP1} = 56MHz • f_{CLKP2} = 28MHz • Regulator in High Power Mode • Core voltage at 1.9V (VRCR:HPM[1:0] = 11_B) • 2 Flash/ROM wait states (MTCRA=$233A_H$) • RC oscillator and Sub oscillator stopped
PLL Run 48	PLL Run mode current I_{CCPLL} with the following settings: • f_{CLKS1} = f_{CLKS2} = 96MHz • f_{CLKB} = f_{CLKP1} = 48MHz • f_{CLKP2} = 24MHz • Regulator in High Power Mode • Core voltage at 1.9V (VRCR:HPM[1:0] = 11_B) • 1 Flash/ROM wait states (MTCRA=$6B09_H$) • RC oscillator and Sub oscillator stopped
PLL Run 40	PLL Run mode current I_{CCPLL} with the following settings: • f_{CLKS1} = f_{CLKS2} = 80MHz • f_{CLKB} = f_{CLKP1} = 40MHz • f_{CLKP2} = 20MHz • Regulator in High Power Mode • Core voltage at 1.9V (VRCR:HPM[1:0] = 11_B) • 1 Flash/ROM wait states (MTCRA=$6B09_H$) • RC oscillator and Sub oscillator stopped
PLL Run 36	PLL Run mode current I_{CCPLL} with the following settings: • f_{CLKS1} = f_{CLKS2} = 72MHz • f_{CLKB} = f_{CLKP1} = 36MHz • f_{CLKP2} = 18MHz • Regulator in High Power Mode • Core voltage at 1.9V (VRCR:HPM[1:0] = 11_B) • 1 Flash/ROM wait states (MTCRA=$6B09_H$) • RC oscillator and Sub oscillator stopped

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Mode name	Details
PLL Run 24	PLL Run mode current I_{CCPLL} with the following settings: • $f_{CLKS1} = f_{CLKS2} = 48MHz$ • $f_{CLKB} = f_{CLKP1} = f_{CLKP2} = 24MHz$ • Regulator in High Power Mode • Core voltage at 1.8V (VRCR:HPM[1:0] = 10_B) • 0 Flash/ROM wait states (MTCRA=2208_H) • RC oscillator and Sub oscillator stopped
Main Run	Main Run mode current I_{CCMAIN} with the following settings: • $f_{CLKS1} = f_{CLKS2} = f_{CLKB} = f_{CLKP1} = f_{CLKP2} = 4MHz$ • Regulator in High Power Mode • Core voltage at 1.8V (VRCR:HPM[1:0] = 10_B) • 1 Flash/ROM wait states (MTCRA=0239_H) • PLL, RC oscillator and Sub oscillator stopped
RC Run 2M	RC Run mode current I_{CCRCH} with the following settings: • RC oscillator set to 2MHz (CKFCR:RCFS = 1) • $f_{CLKS1} = f_{CLKS2} = f_{CLKB} = f_{CLKP1} = f_{CLKP2} = 2MHz$ • Regulator in High Power Mode • Core voltage at 1.8V (VRCR:HPM[1:0] = 10_B) • 1 Flash/ROM wait states (MTCRA=0239_H) • PLL, Main oscillator and Sub oscillator stopped
RC Run 100k	RC Run mode current I_{CCRCL} with the following settings: • RC oscillator set to 100kHz (CKFCR:RCFS = 0) • $f_{CLKS1} = f_{CLKS2} = f_{CLKB} = f_{CLKP1} = f_{CLKP2} = 100kHz$ • Regulator in Low Power Mode A (SMCR:LPMS = 1) • Core voltage at 1.8V (VRCR:LPMA[2:0] = 110_B) • 1 Flash/ROM wait states (MTCRA=0239_H) • PLL, Main oscillator and Sub oscillator stopped
Sub Run	Sub Run mode current I_{CCSUB} with the following settings: • $f_{CLKS1} = f_{CLKS2} = f_{CLKB} = f_{CLKP1} = f_{CLKP2} = 32kHz$ • Regulator in Low Power Mode A (by hardware) • Core voltage at 1.8V (VRCR:LPMA[2:0] = 110_B) • 1 Flash/ROM wait states (MTCRA=0239_H) • PLL, RC oscillator and Main oscillator stopped
PLL Sleep 56	PLL Sleep mode current I_{CCSPLL} with the following settings: • $f_{CLKS1} = f_{CLKS2} = f_{CLKP1} = 56MHz$ • $f_{CLKP2} = 28MHz$ • Regulator in High Power Mode • Core voltage at 1.9V (VRCR:HPM[1:0] = 11_B) • RC oscillator and Sub oscillator stopped

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Mode name	Details
PLL Sleep 48	PLL Sleep mode current I_{CCSPLL} with the following settings: • $f_{CLKS1} = f_{CLKS2} = 96MHz$ • $f_{CLKP1} = 48MHz$ • $f_{CLKP2} = 24MHz$ • Regulator in High Power Mode • Core voltage at 1.9V (VRCR:HPM[1:0] = 11_B) • RC oscillator and Sub oscillator stopped
PLL Sleep 40	PLL Sleep mode current I_{CCSPLL} with the following settings: • $f_{CLKS1} = f_{CLKS2} = 80MHz$ • $f_{CLKP1} = 40MHz$ • $f_{CLKP2} = 20MHz$ • Regulator in High Power Mode • Core voltage at 1.9V (VRCR:HPM[1:0] = 11_B) • RC oscillator and Sub oscillator stopped
PLL Sleep 36	PLL Sleep mode current I_{CCSPLL} with the following settings: • $f_{CLKS1} = f_{CLKS2} = 72MHz$ • $f_{CLKP1} = 36MHz$ • $f_{CLKP2} = 18MHz$ • Regulator in High Power Mode • Core voltage at 1.9V (VRCR:HPM[1:0] = 11_B) • RC oscillator and Sub oscillator stopped
PLL Sleep 24	PLL Sleep mode current I_{CCSPLL} with the following settings: • $f_{CLKS1} = f_{CLKS2} = 48MHz$ • $f_{CLKP1} = f_{CLKP2} = 24MHz$ • Regulator in High Power Mode • Core voltage at 1.8V (VRCR:HPM[1:0] = 10_B) • RC oscillator and Sub oscillator stopped
Main Sleep	Main Sleep mode current $I_{CCSMAIN}$ with the following settings: • $f_{CLKS1} = f_{CLKS2} = f_{CLKP1} = f_{CLKP2} = 4MHz$ • Regulator in High Power Mode • Core voltage at 1.8V (VRCR:HPM[1:0] = 10_B) • PLL, RC oscillator and Sub oscillator stopped
RC Sleep 2M	RC Sleep mode current I_{CCSRCH} with the following settings: • RC oscillator set to 2MHz (CKFCR:RCFS = 1) • $f_{CLKS1} = f_{CLKS2} = f_{CLKP1} = f_{CLKP2} = 2MHz$ • Regulator in High Power Mode • Core voltage at 1.8V (VRCR:HPM[1:0] = 10_B) • PLL, Main oscillator and Sub oscillator stopped
RC Sleep 100k	RC Sleep mode current I_{CCSRCL} with the following settings: • RC oscillator set to 100kHz (CKFCR:RCFS = 0) • $f_{CLKS1} = f_{CLKS2} = f_{CLKP1} = f_{CLKP2} = 100kHz$ • Regulator in Low Power Mode A (SMCR:LPMSS = 1) • Core voltage at 1.8V (VRCR:LPMA[2:0] = 110_B) • PLL, Main oscillator and Sub oscillator stopped

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Mode name	Details
Sub Sleep	Sub Sleep mode current I_{CCSUB} with the following settings: • $f_{CLKS1} = f_{CLKS2} = f_{CLKP1} = f_{CLKP2}$ = 32kHz • Regulator in Low Power Mode A (by hardware) • Core voltage at 1.8V (VRCR:LPMA[2:0] = 110_B) • PLL, RC oscillator and Main oscillator stopped
PLL Timer 48	PLL Timer mode current I_{CCTPLL} with the following settings: • $f_{CLKS1} = f_{CLKS2}$ = 48MHz • Regulator in High Power Mode • Core voltage at 1.8V (VRCR:HPM[1:0] = 10_B) • RC oscillator and Sub oscillator stopped
Main Timer	Main Timer mode current $I_{CCTMAIN}$ with the following settings: • $f_{CLKS1} = f_{CLKS2}$ = 4MHz • Regulator in Low Power Mode A (SMCR:LPMSS = 1) • Core voltage at 1.8V (VRCR:LPMA[2:0] = 110_B) • PLL, RC oscillator and Sub oscillator stopped
RC Timer 2M	RC Timer mode current I_{CCTRCH} with the following settings: • RC oscillator set to 2MHz (CKFCR:RCFS = 1) • $f_{CLKS1} = f_{CLKS2}$ = 2MHz • Regulator in Low Power Mode A (SMCR:LPMSS = 1) • Core voltage at 1.8V (VRCR:LPMA[2:0] = 110_B) • PLL, Main oscillator and Sub oscillator stopped
RC Timer 100k	RC Timer mode current I_{CCTRCL} with the following settings: • RC oscillator set to 100kHz (CKFCR:RCFS = 0) • $f_{CLKS1} = f_{CLKS2}$ = 100kHz • Regulator in Low Power Mode A (SMCR:LPMSS = 1) • Core voltage at 1.8V (VRCR:LPMA[2:0] = 110_B) • PLL, Main oscillator and Sub oscillator stopped
Sub Timer	Sub Timer mode current I_{CCTSUB} with the following settings: • $f_{CLKS1} = f_{CLKS2}$ = 32kHz • Regulator in Low Power Mode A (by hardware) • Core voltage at 1.8V (VRCR:LPMA[2:0] = 110_B) • PLL, RC oscillator and Main oscillator stopped
Stop 1.8V	Stop mode current I_{CCH} with the following settings: • Regulator in Low Power Mode B (by hardware) • Core voltage at 1.8V (VRCR:LPMB[2:0] = 110_B)
Stop 1.2V	Stop mode current I_{CCH} with the following settings: • Regulator in Low Power Mode B (by hardware) • Core voltage at 1.2V (VRCR:LPMB[2:0] = 000_B)

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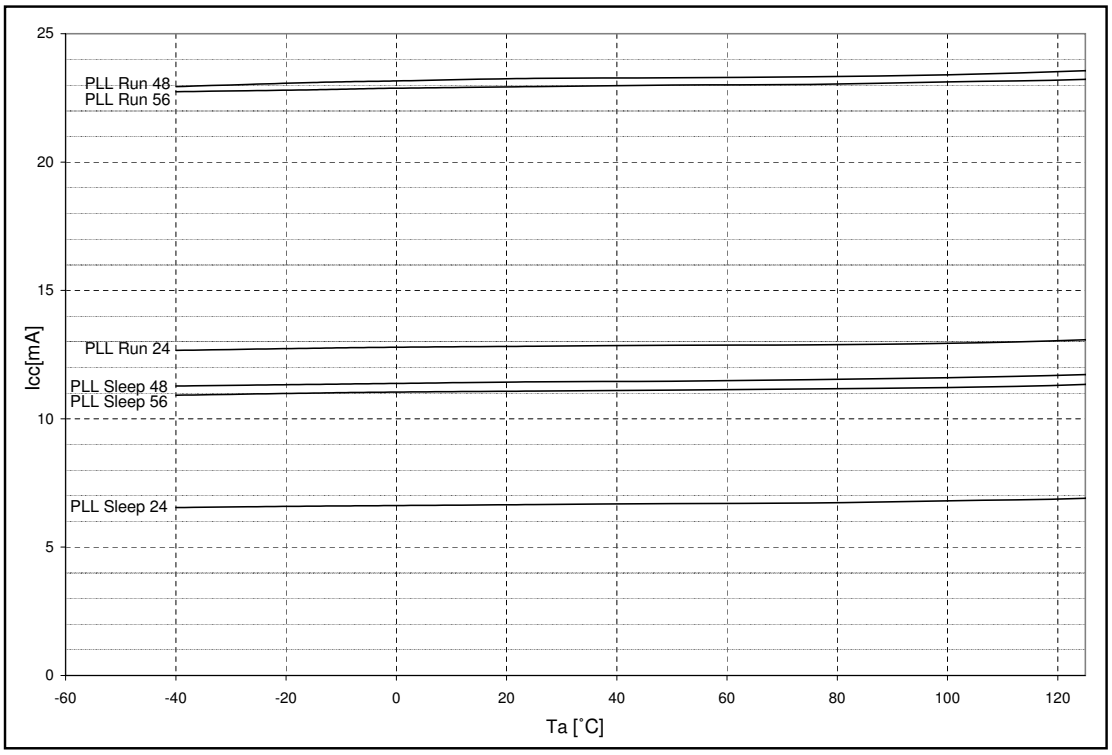
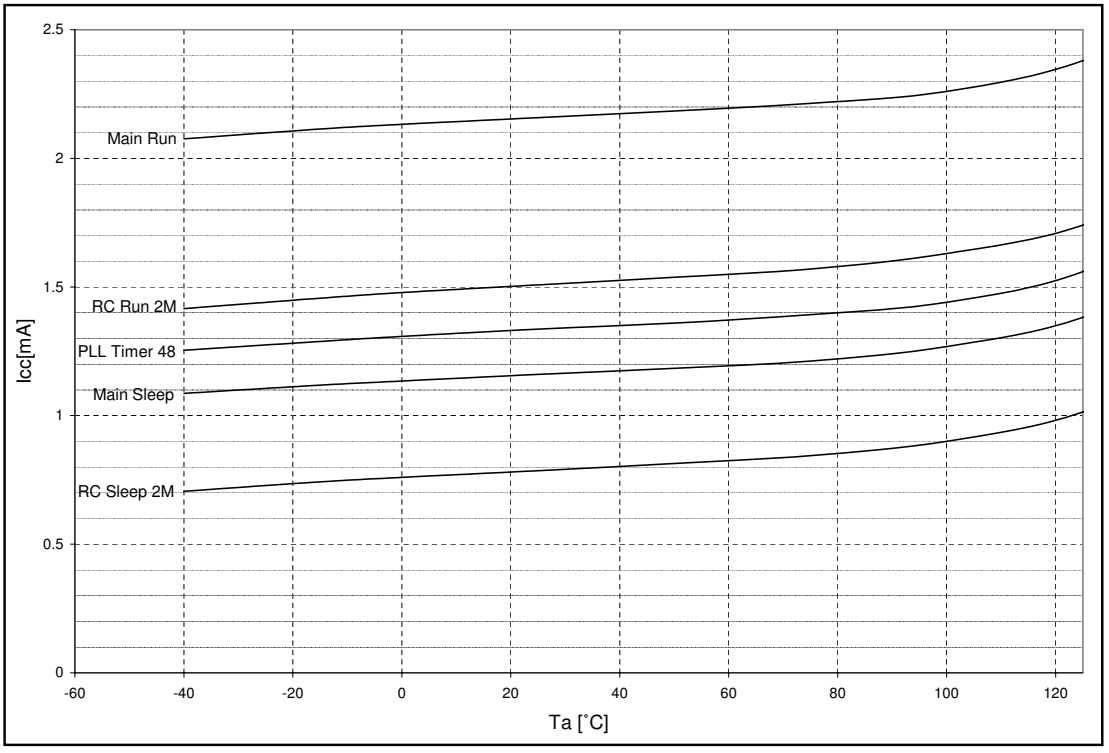
MB96384/385 PLL Run and Sleep mode currents



MB96384/385 operation modes with medium currents



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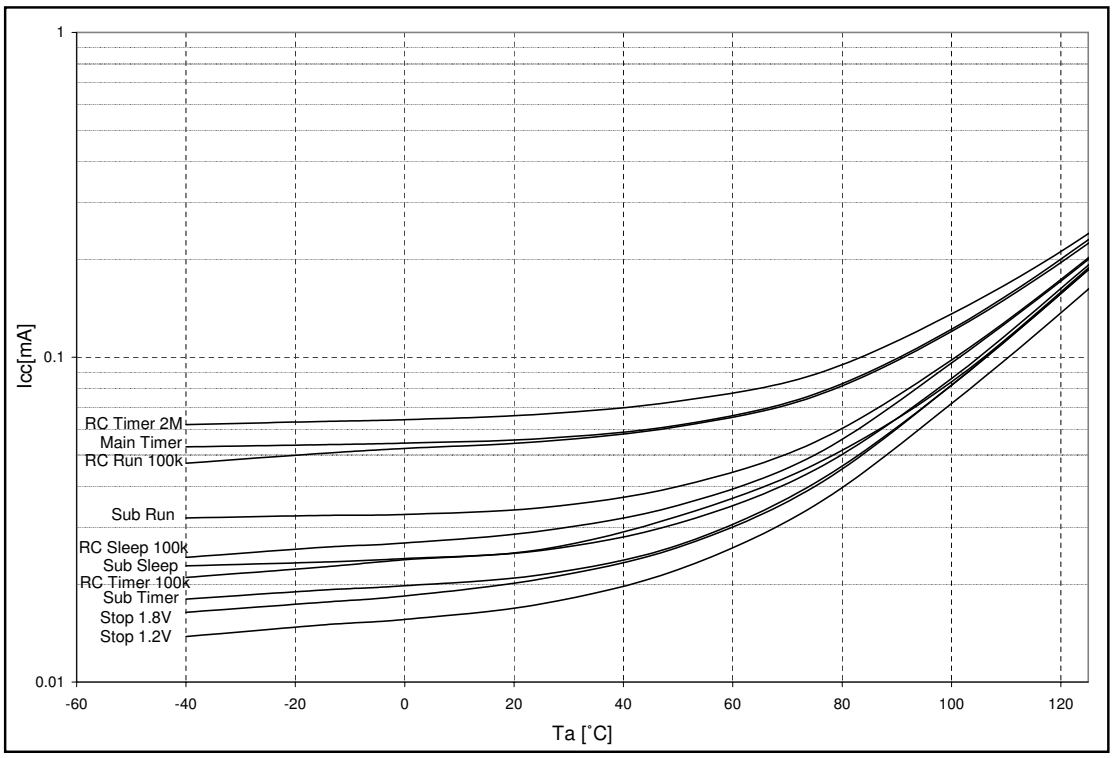
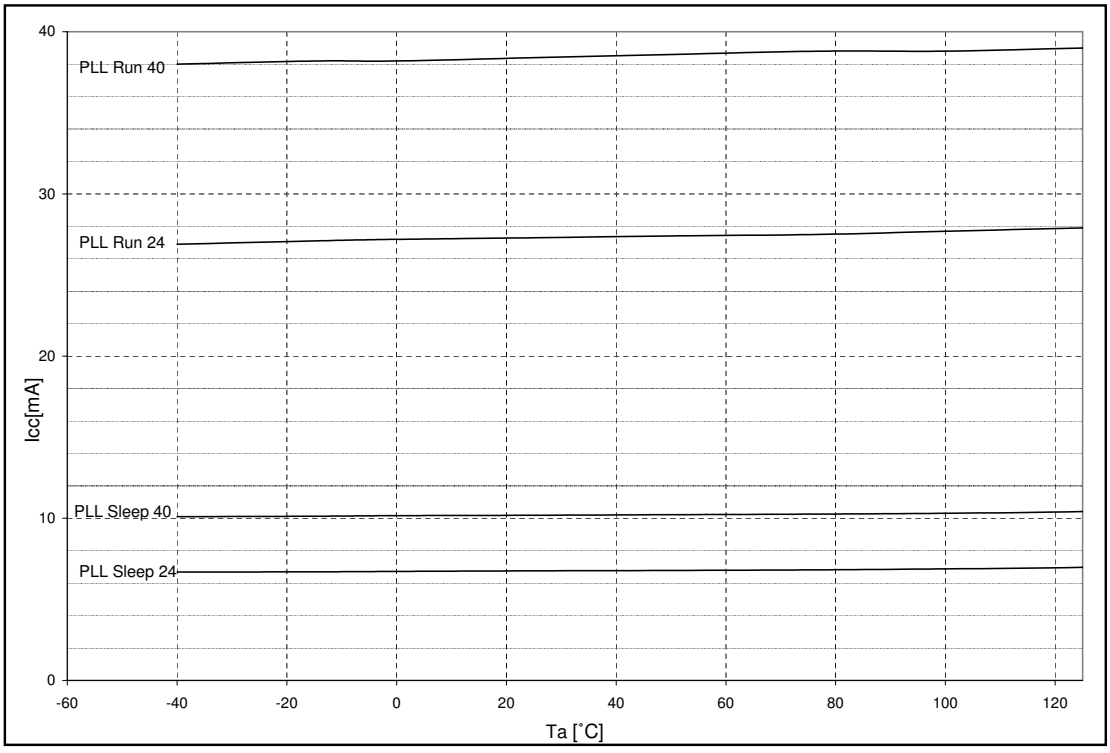
MB96384/385 Low power mode currents



MB96F385 PLL Run and Sleep mode currents



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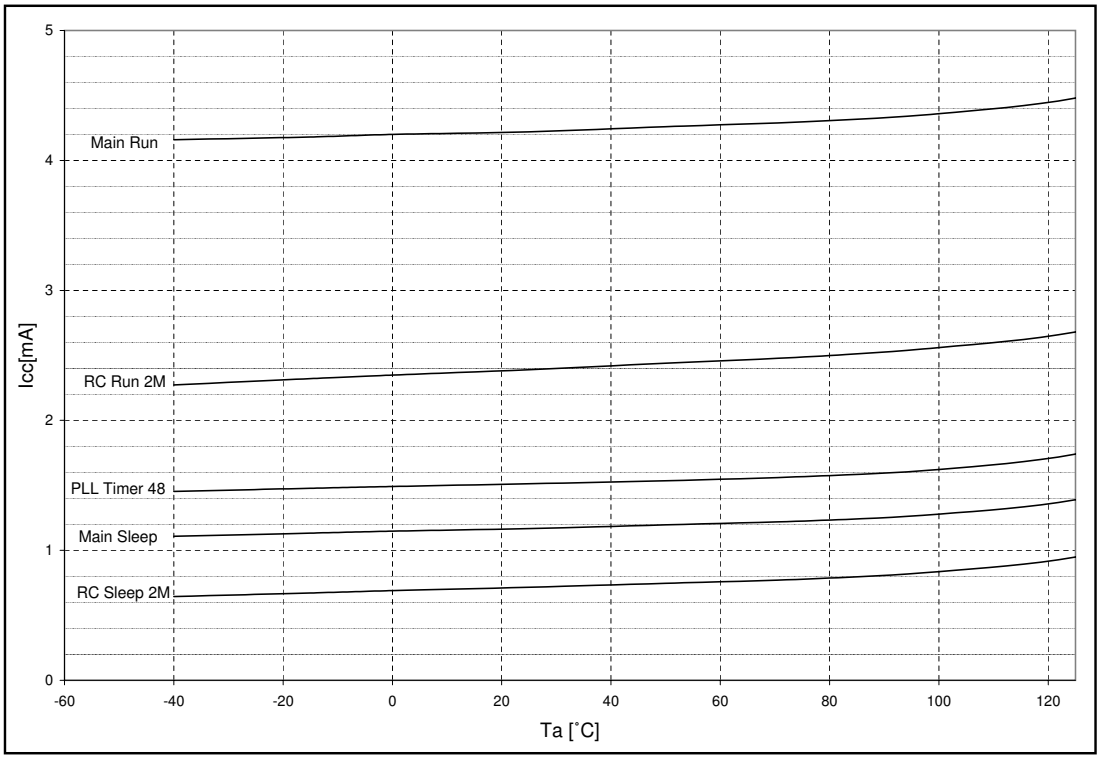
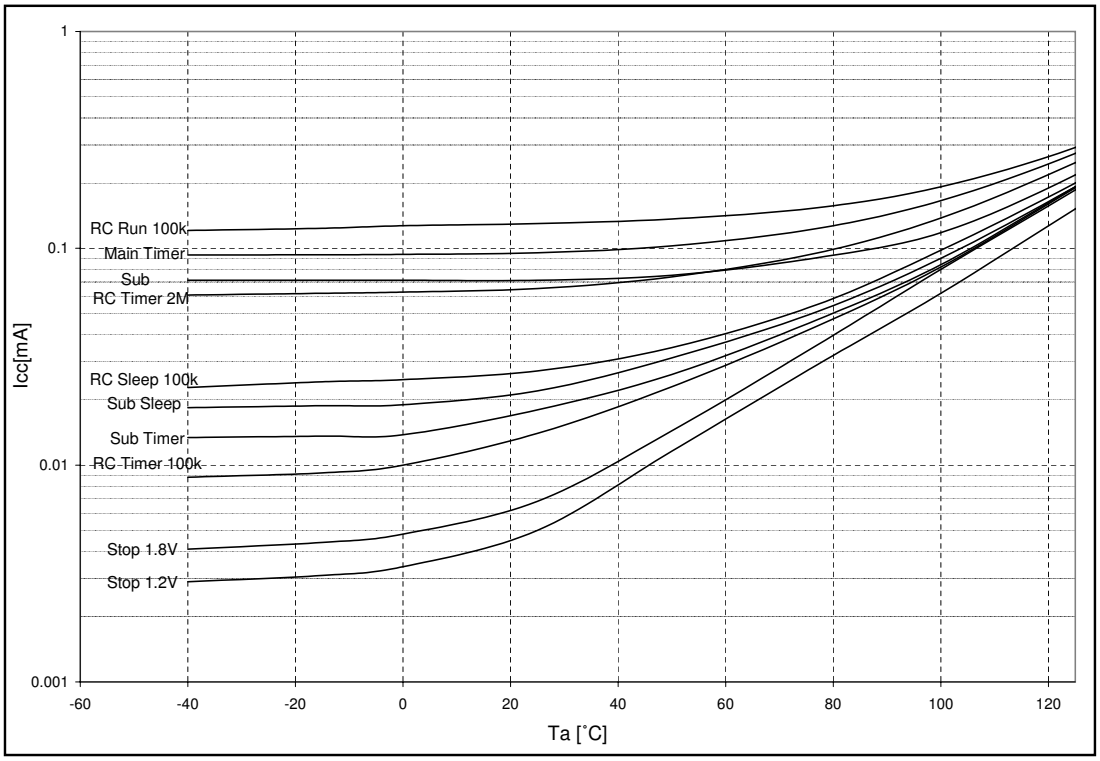
MB96F385 operation modes with medium currents



MB96F385 Low power mode currents



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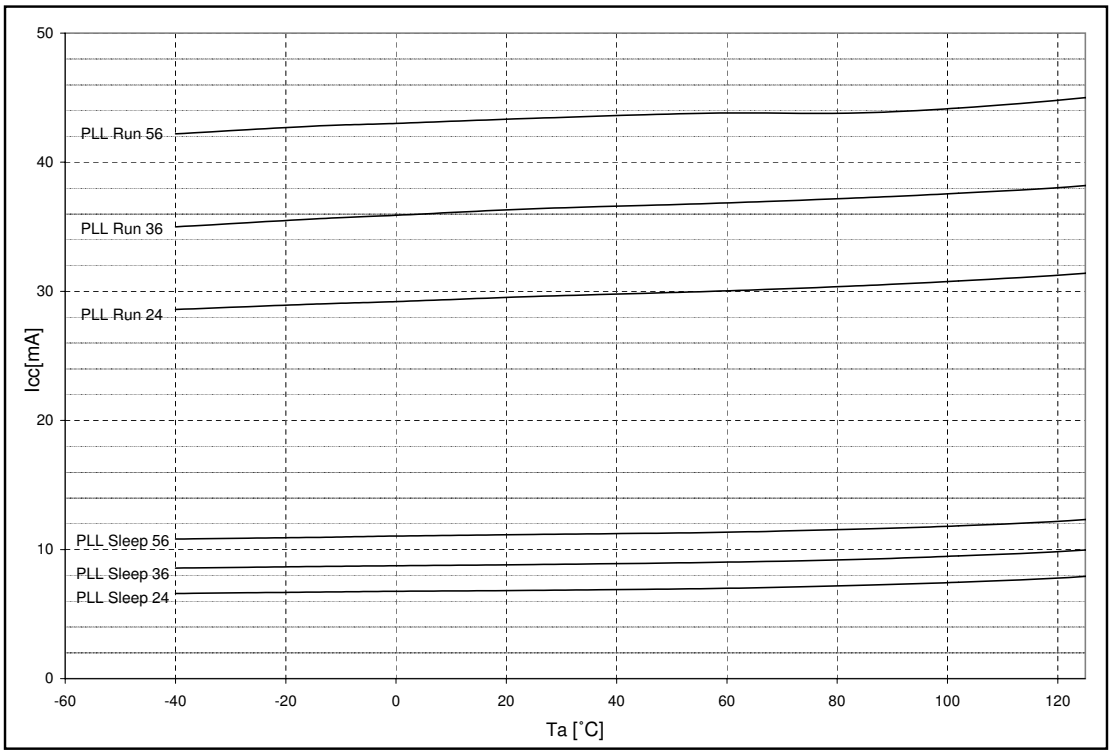
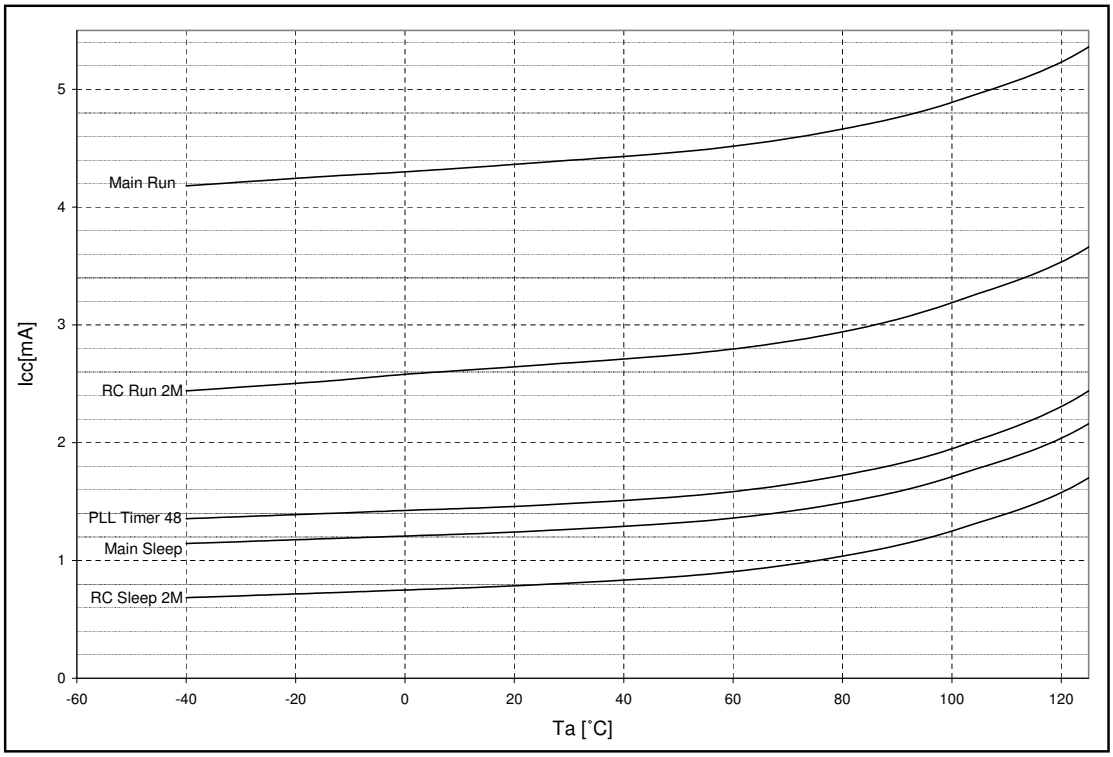
MB96F386/F387 PLL Run and Sleep mode currents



MB96F386/F387 operation modes with medium currents



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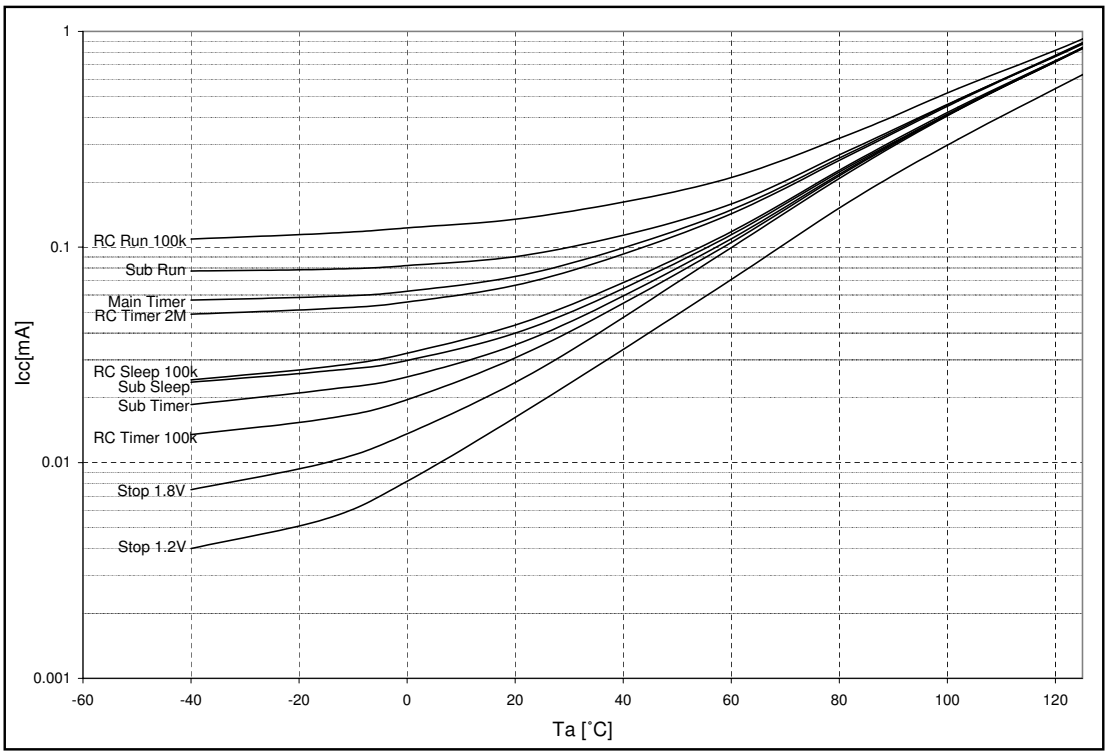
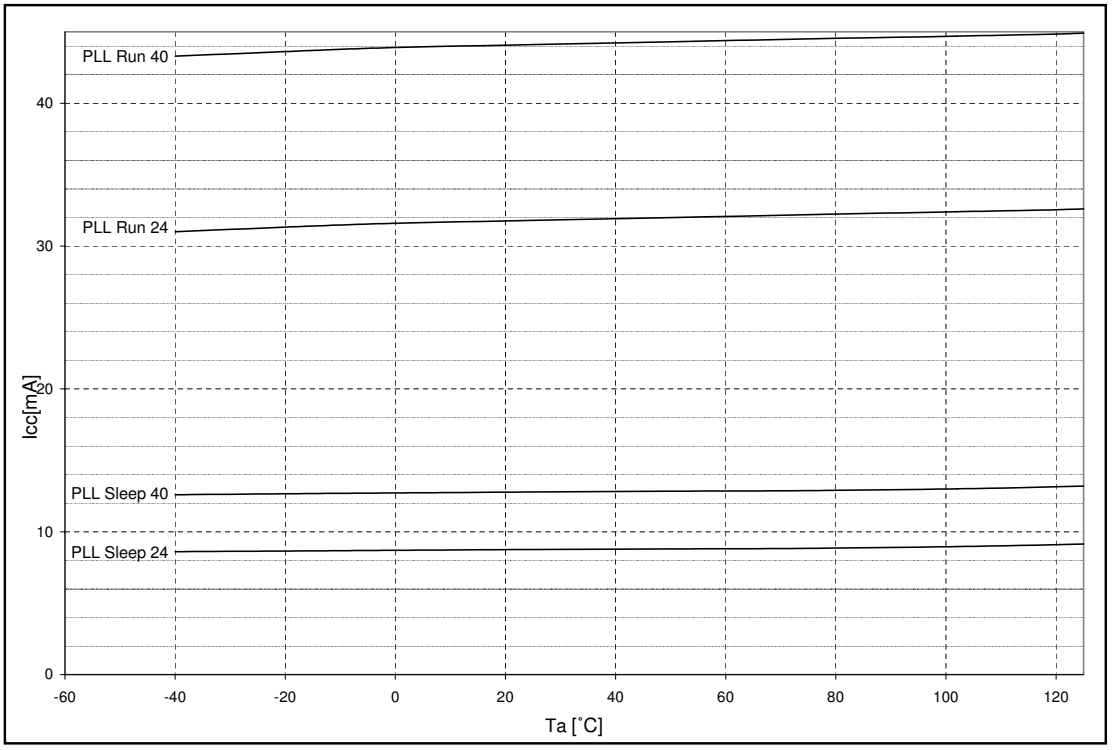
MB96F386/F387 Low power mode currents



MB96F388/F389 PLL Run and Sleep mode currents



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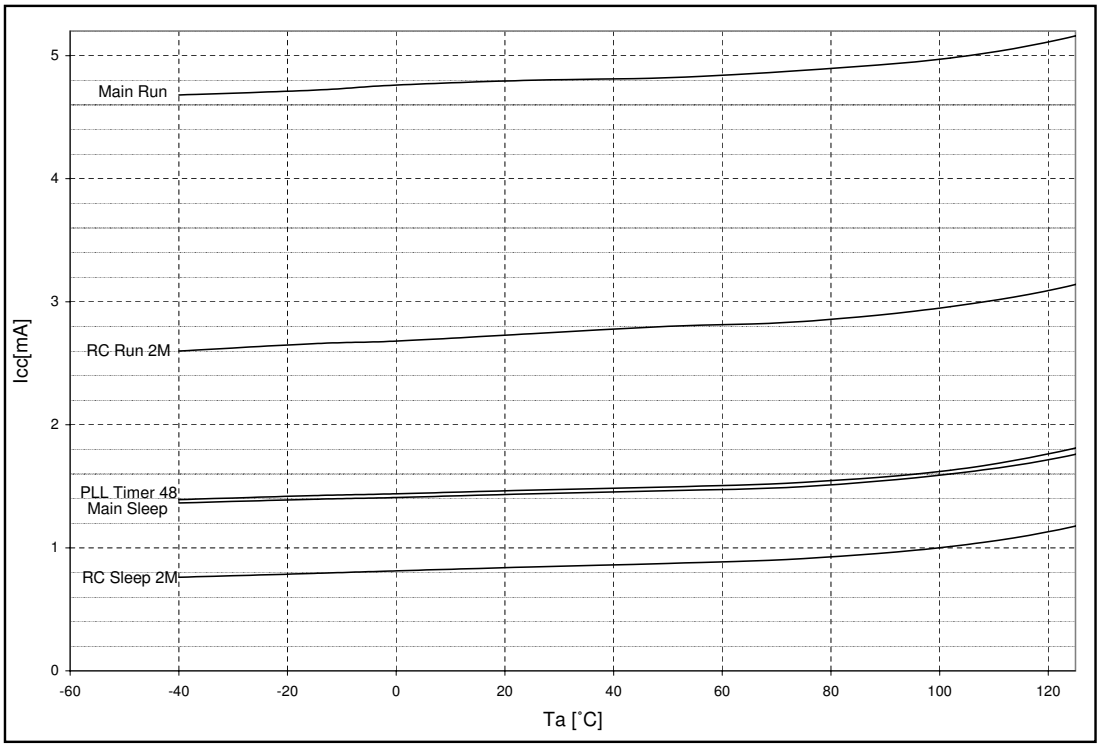
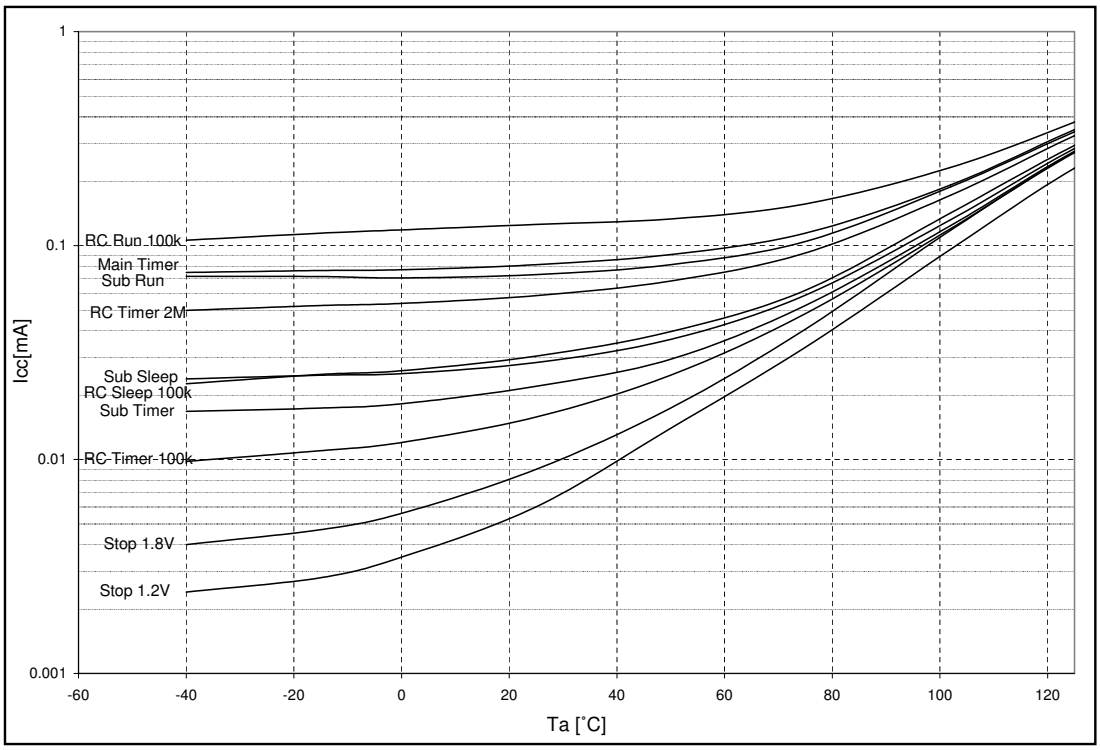
MB96F388/F389 operation modes with medium currents



MB96F388/F389 Low power mode currents



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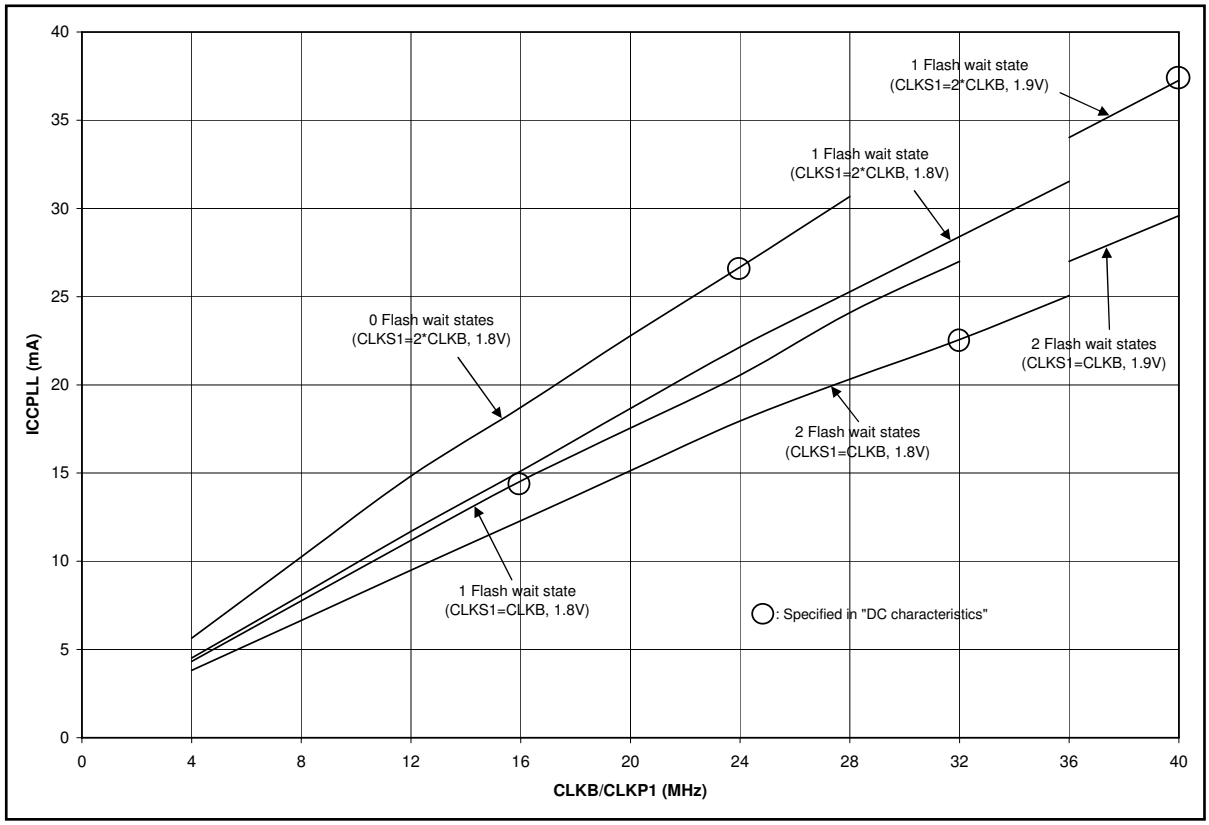
2. Frequency dependency of power supply currents in PLL Run mode

The following diagrams show the current consumption of samples with typical wafer process parameters in PLL Run mode at different frequencies and Flash timing settings.

Measurement conditions:

- V_{CC} = AV_{CC} = 5.0V
- Ta = 25˚C
- f_{CLKS1} = f_{CLKB} or f_{CLKS1} = 2*f_{CLKB} as described in diagram
- f_{CLKS2} = f_{CLKS1}
- f_{CLKP1} = f_{CLKB}
- f_{CLKP2} = f_{CLKB}/2
- Core voltage at 1.8V (VRCR:HPM[1:0] = 10_B) or 1.9V (VRCR:HPM[1:0] = 11_B) as described in diagram
- Main clock = 4MHz external clock
- Flash memory timing settings:
  - MTCRA=2128_H/2208_H (0 Flash wait states, f_{CLKS1} = 2*f_{CLKB})
  - MTCRA=0239_H/2129_H (1 Flash wait state, f_{CLKS1} = f_{CLKB})
  - MTCRA=$4C09_H$/$6B09_H$ (1 Flash wait state, f_{CLKS1} = 2*f_{CLKB})
  - MTCRA=$233A_H$ (2 Flash wait states, f_{CLKS1} = f_{CLKB})
- Average Flash access rate (number of read accesses to the Flash per CLKB clock cycle, no buffer hit):
  - 0 Flash wait states: 0.5
  - 1 Flash wait states: 0.33
  - 2 Flash wait states: 0.25

MB96F385 PLL Run mode currents



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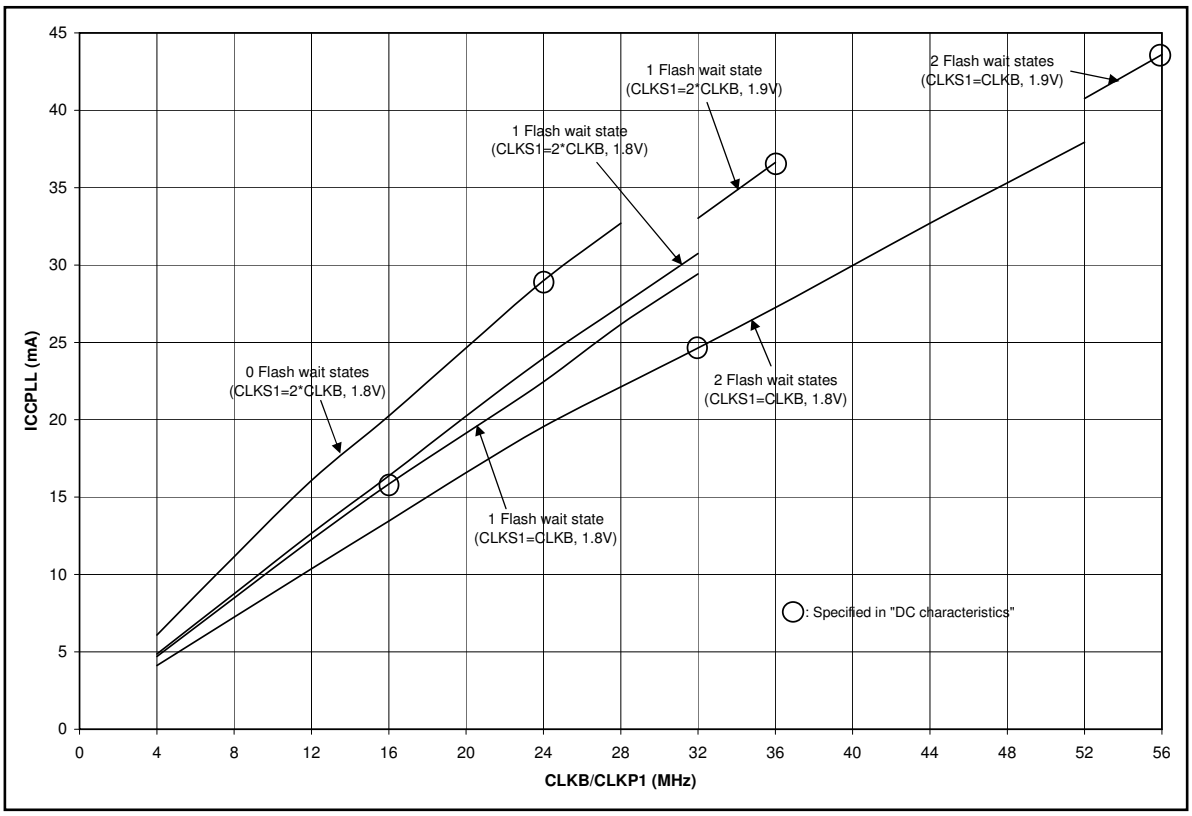
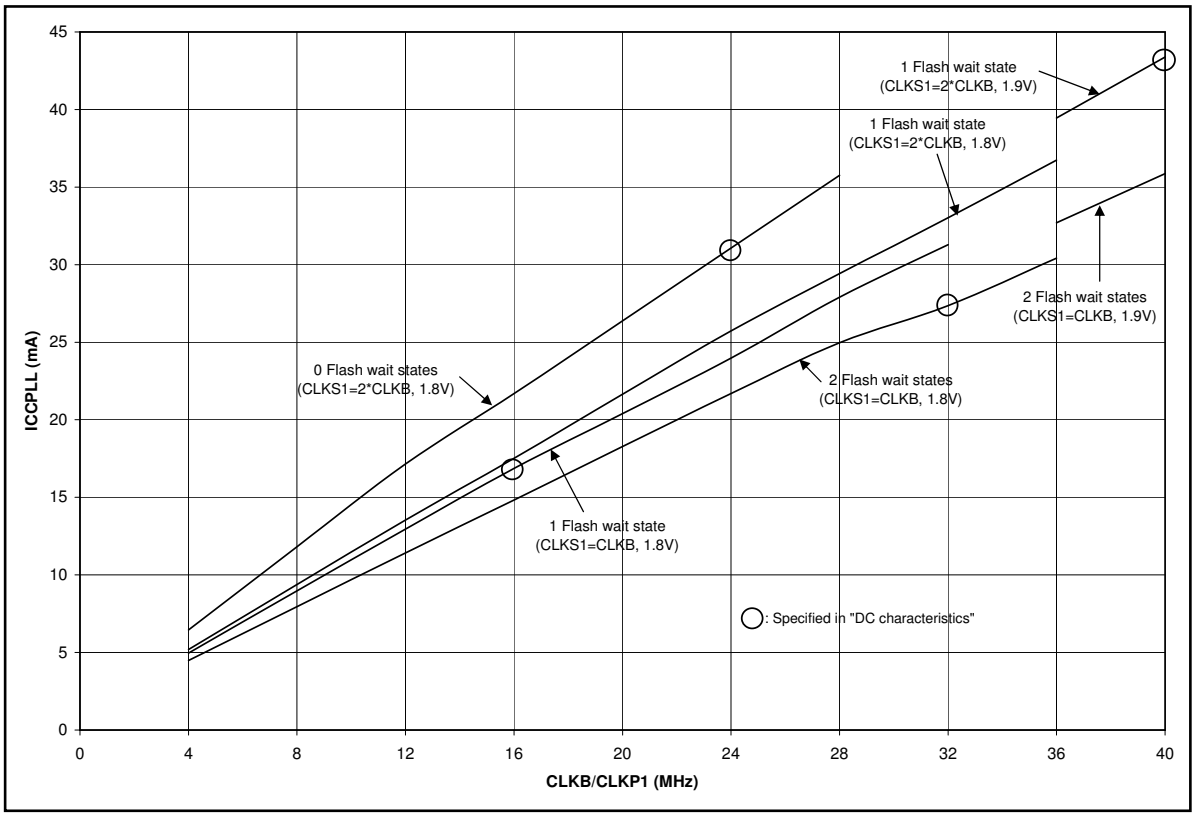
MB96F386/F387 PLL Run mode currents



MB96F388/F389 PLL Run mode currents



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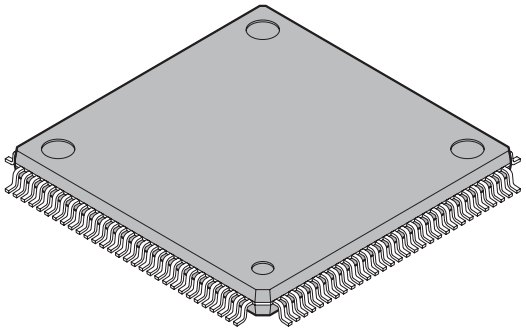
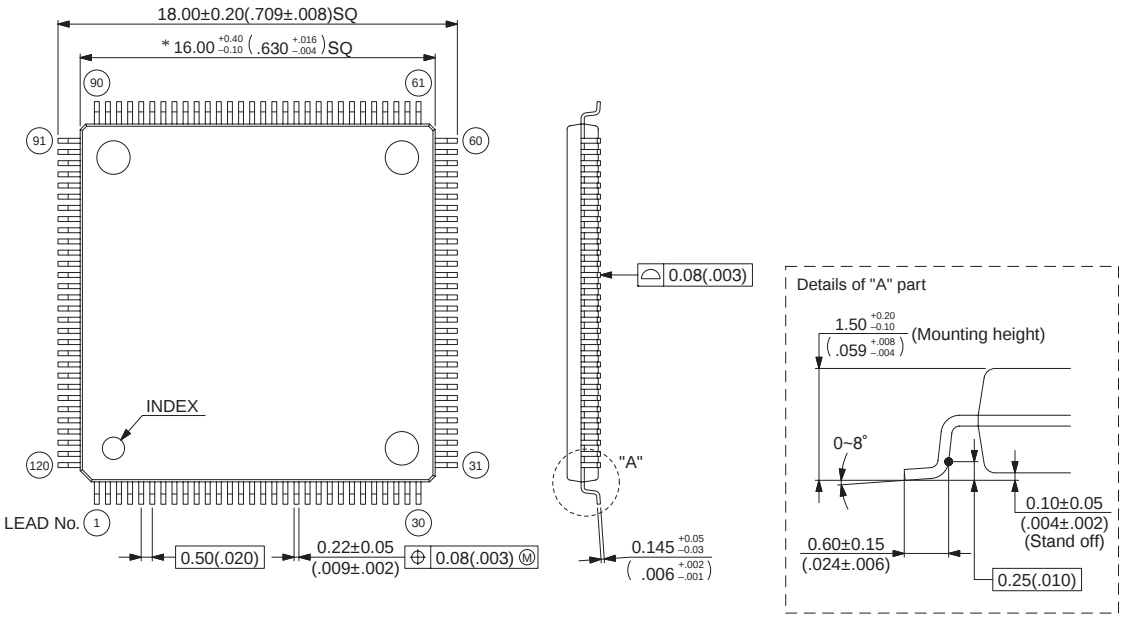
■ PACKAGE DIMENSION MB96(F)38x LQFP 120P

120-pin plastic LQFP		
	Lead pitch	0.50 mm
	Package width × package length	16.0 × 16.0 mm
	Lead shape	Gullwing
	Sealing method	Plastic mold
	Mounting height	1.70 mm MAX
	Weight	0.88 g
(FPT-120P-M21)	Code (Reference)	P-LFQFP120-16×16-0.50

120-pin plastic LQFP
(FPT-120P-M21)

Note 1) * : These dimensions do not include resin protrusion.
Resin protrusion is +0.25(.010) MAX(each side).
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.
http://edevice.fujitsu.com/package/en-search/

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■ ORDERING INFORMATION

Part number	Flash/ROM	Subclock	Persistent Low Voltage Reset	Package
MB96384YSC PMC-GSE2 *1	ROM (128KB)	No	Yes	120 pin Plastic LQFP (FPT-120P-M21)
MB96384RSC PMC-GSE2 *1			No	
MB96384YWC PMC-GSE2 *1		Yes	Yes	
MB96384RWC PMC-GSE2 *1			No	
MB96385YSC PMC-GSE2 *1	ROM (160KB)	No	Yes	120 pin Plastic LQFP (FPT-120P-M21)
MB96385RSC PMC-GSE2 *1			No	
MB96385YWC PMC-GSE2 *1		Yes	Yes	
MB96385RWC PMC-GSE2 *1			No	
MB96F385YSB PMC-GSE2 *1	Flash A (160KB)	No	Yes	120 pin Plastic LQFP (FPT-120P-M21)
MB96F385RSB PMC-GSE2 *1			No	
MB96F385YWB PMC-GSE2 *1		Yes	Yes	
MB96F385RWB PMC-GSE2 *1			No	
MB96F386YSB PMC-GSE2	Flash A (288KB)	No	Yes	120 pin Plastic LQFP (FPT-120P-M21)
MB96F386RSB PMC-GSE2			No	
MB96F386YWB PMC-GSE2		Yes	Yes	
MB96F386RWB PMC-GSE2			No	
MB96F387YSB PMC-GSE2	Flash A (416KB)	No	Yes	120 pin Plastic LQFP (FPT-120P-M21)
MB96F387RSB PMC-GSE2			No	
MB96F387YWB PMC-GSE2		Yes	Yes	
MB96F387RWB PMC-GSE2			No	
MB96F386YSC PMC-GSE2 *1	Flash A (288KB)	No	Yes	20 pin Plastic LQFP (FPT-120P-M21)
MB96F386RSC PMC-GSE2 *1			No	
MB96F386YWC PMC-GSE2 *1		Yes	Yes	
MB96F386RWC PMC-GSE2 *1			No	
MB96F387YSC PMC-GSE2 *1	Flash A (416KB)	No	Yes	120 pin Plastic LQFP (FPT-120P-M21)
MB96F387RSC PMC-GSE2 *1			No	
MB96F387YWC PMC-GSE2 *1		Yes	Yes	
MB96F387RWC PMC-GSE2 *1			No	
MB96F388TSB PMC-GSE2 *1	Flash A (544KB) Flash B (32KB)	No	Yes	120 pin Plastic LQFP (FPT-120P-M21)
MB96F388HSB PMC-GSE2 *1			No	
MB96F388TWB PMC-GSE2 *1		Yes	Yes	
MB96F388HWB PMC-GSE2 *1			No	

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Part number	Flash/ROM	Subclock	Persistent Low Voltage Reset	Package
MB96F389YSB PMC-GSE2 *1	Flash A (544KB) Flash B (288kB)	No	Yes	120 pin Plastic LQFP (FPT-120P-M21)
MB96F389RSB PMC-GSE2 *1			No	
MB96F389YWB PMC-GSE2 *1		Yes	Yes	
MB96F389RWB PMC-GSE2 *1			No	
MB96V300BRB-ES (for evaluation)	Emulated by ext. RAM	Yes	No	416 pin Plastic BGA (BGA-416P-M02)

*1: These devices are under development and specification is preliminary. These products under development may change its specification without notice.

This datasheet is also valid for the following outdated devices:

MB96384YSB, MB96384RSB, MB96384YWB, MB96384RWB,
MB96385YSB, MB96385RSB, MB96385YWB, MB96385RWB,
MB96F385YSA, MB96F385RSA, MB96F385YWA, MB96F385RWA,
MB96F386YSA, MB96F386RSA, MB96F386YWA, MB96F386RWA,
MB96F387YSA, MB96F387RSA, MB96F387YWA, MB96F387RWA,
MB96F388TSA, MB96F388HSA, MB96F388TWA, MB96F388HWA,
MB96F389YSA, MB96F389RSA, MB96F389YWA, MB96F389RWA.

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■ REVISION HISTORY

Revision	Date	Modification
Prelim 1	2007-05-2	Creation
Prelim 2	2007-05-24	Electrical characteristics and memory description updates
Prelim 3	2007-08-09	Typo errors corrections, Flash memory programming interface update
Prelim 4	2007-08-31	Update of DC characteristics. new MB96F388 and MB96F389 added. LVD chapter added as well as an example characteristics chapter
Prelim 5	2007-09-06	Updates of the DC characteristics, interrupt vector table update, update of the LVD characteristics
Prelim 6	2007-11-14	Memory map for external bus modified. Modifications of the drawing of the pin circuits. Electrical characteristics updates. Rephrasing and typos corrections. Add Slew rate high current outputs chapter. Modification of the block diagram. Memory map modified for Flash. RAM memory map added. Pin circuit type corrected. Type L IO is now included.
Prelim 7	2007-12-12	Memory IO map modified New Flash/ROM configuration presentation Ordering information: MB96300B used as reference. Block diagram modified to included relocated pins. Main Flash becomes Flash memory A and Satellite flash becomes Flash memory B

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Revision	Date	Modification
Prelim 8	2008-02-04	• Devices under development added: MB96384/385/F385/F388/F389 • Block diagram corrected (existing resource pins) • Pin assignment: TTG8 -> TTG7 • Pin function table corrected • I/O circuit type diagrams corrected • Memory map cleaned up • "Flash sector configuration" replaced by corrected "User ROM Memory map for Flash devices", “ROM configuration” replaced by “User ROM Memory map for Mask ROM devices” • IO map table regenerated: - Port register: Naming style corrected - Memory control registers renamed (Main/Sat -> A/B) - addresses after 000BFFh removed • Absolute maximum ratings: Pd and Ta specified more precisely • Run and Sleep mode currents: more conditions added (1WS settings) • Run mode current spec in 48/24MHz mode corrected • Maximum CLKP2 frequency for MB96F386/F387 corrected • High current port input capacitance added • External bus timings: missing conditions added and readability improved • Alarm comparator spec updated (transition voltages defined) • MB96V300A removed • Ordering information updated • Typos and formatting corrected

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Revision	Date	Modification
9	2009-01-09	• Format adjusted to official Fujitsu Microelectronics datasheet standard (mainly style changes and official notes and disclaimer added) • Numbering of Electrical Characteristics subchapters automated • Note about devices under development modified • I/O map: Note added about reserved addresses • Serial programming interface: Note about handshaking pins improved • ICCPLL for CLKS1/2=80MHz, CLKB=40MHz (F388/F389) increased by 5mA • ICCSPLL for CLKS1/2=80MHz, CLKB=40MHz (F388/F389) increased by 0.8mA (typ) and 1.3mA (max) • Updated ordering information: MB96384/385**A -> MB96384/385**B • Package code of MB96V300 corrected in ordering information • Internal LCD divider resistance value corrected: Typ 35kOhm -> 40kOhm, Max 50kOhm -> 65kOhm • Run and Sleep mode currents of ROM devices (MB96384/385) reduced • Added voltage condition to pull-up resistance and LCD divide resistance spec • Lineup: Term “Data Flash” replaced by “independent 32KB Flash” • Ordering information: column “Independent 32KB Data Flash” replaced by new column “Flash/ROM”, column “Remarks” removed • Official package dimension drawing with additional notes added • Empty pages removed • MB96384/385 and MB96F385/F388/F389 separated in DC spec and currents of these devices adjusted according to first evaluation results • Alarm comparator: Power supply current max values increased, comparison time reduced, mode transition time and power-up stabilization time newly added • Handling devices: Notes added about Serial communication and about using ceramic resonators. • Feature list and AC Characteristics: 16MHz maximum frequency is valid for crystal oscillators. For resonators, maximum frequency depends on Q-factor • AC characteristics: PLL phase skew spec added, CLKVCO min=64MHz • VOL3 spec improved: spec valid for 3mA load for full Vcc range • C-Pin cap spec updated: 4.7uF-10uF capacitor with tolerance permitted • “Preliminary” watermark removed

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Revision	Date	Modification
10	2010-06-25	• AD converter I_{AIN} spec improved: 1uA valid up to 105deg, 1.2uA above 105deg • Note added that PLL phase jitter spec does not include jitter coming from Main clock • Alarm comparator: Maximum power-up stabilization time increased to 10ms • Note added in DC characteristics how to select driving strength of ports • I2C AC spec updated: tof, Cb and tSP spec added, wrong footnotes and Condition removed • I/O Circuit type: Note added for type “N” (slew rate control according to I2C spec) • Example characteristics updated, new figures added showing dependency of PLL Run mode current on frequency • Updated Power Supply current spec in Run/Sleep/Timer/Stop modes (new spec items in PLL Run/Sleep mode, small adjustment of most other values) • Package dimension: Added the following sentence under the figure: “Please confirm the latest Package dimension by following URL. http://edevice.fujitsu.com/package/en-search/” • AD converter: Impact of input pin capacitance and external capacitance added to formula for calculation of the sampling time • Added specification of RC clock stabilization time • Feature description I2C: ‘8-bit addressing’ corrected to ‘7-bit addressing’ • Feature description PPG: ‘Reload timer overflow as clock input’ corrected to ‘Reload timer underflow as clock input’ • Company name updated on the cover page: Fujitsu Microelectronics Limited -> Fujitsu Semiconductor Limited • Ordering information: MB96384/385**B -> MB96384/385**C, MB96F385/F388/F389**A -> MB96F385/F388/F389**B, added devices under development MB96F386**C and MB96F387**C

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