# Infineon Technologies - MB96F625RBPMC1-GTE1 Datasheet

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## What is "Embedded - Microcontrollers"?

"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

## Applications of "Embedded - Microcontrollers"

| Details | |
|---|---|
| Product Status | Obsolete |
| Core Processor | F²MC-16FX |
| Core Size | 16-Bit |
| Speed | 32MHz |
| Connectivity | CANbus, I²C, LINbus, SCI, UART/USART |
| Peripherals | DMA, LVD, POR, PWM, WDT |
| Number of I/O | 52 |
| Program Memory Size | 160KB (160K x 8) |
| Program Memory Type | FLASH |
| EEPROM Size | - |
| RAM Size | 10K x 8 |
| Voltage - Supply (Vcc/Vdd) | 2.7V ~ 5.5V |
| Data Converters | A/D 21x8/10b |
| Oscillator Type | Internal |
| Operating Temperature | -40°C ~ 125°C (TA) |
| Mounting Type | Surface Mount |
| Package / Case | 64-LQFP |
| Supplier Device Package | 64-LQFP (10x10) |
| Purchase URL | https://www.e-xfl.com/product-detail/infineon-technologies/mb96f625rbpmc1-gte1 |

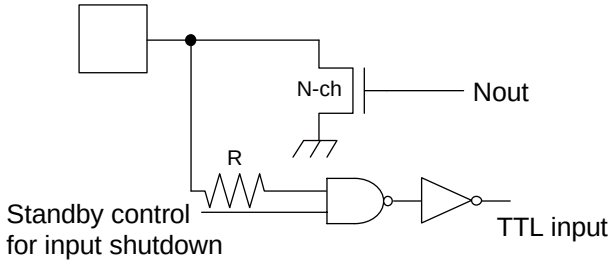
# 1. Product Lineup

| Features | | | MB96620 | Remark |
|---|---|---|---|---|
| Product Type | | | Flash Memory Product | |
| Subclock | | | Subclock can be set by software | |
| Dual Operation Flash Memory | | RAM | - | |
| 32.5KB + 32KB | | 4KB | MB96F622R, MB96F622A | Product Options<br>R: MCU with CAN<br>A: MCU without CAN |
| 64.5KB + 32KB | | 10KB | MB96F623R, MB96F623A | |
| 128.5KB + 32KB | | 10KB | MB96F625R, MB96F625A | |
| Package | | | LQFP-64<br>FPT-64P-M23/M24 | |
| DMA | | | 2ch | |
| USART | | | 3ch | LIN-USART 2/7/8 |
| | with automatic LIN-Header transmission/reception | | Yes (only 1ch) | LIN-USART 2 |
| | with 16 byte RX- and TX-FIFO | | No | |
| $I^2C$ | | | 1ch | $I^2C$ 0 |
| 8/10-bit A/D Converter | | | 21ch | AN 0 to 14/24/25/28 to 31 |
| | with Data Buffer | | No | |
| | with Range Comparator | | Yes | |
| | with Scan Disable | | No | |
| | with ADC Pulse Detection | | No | |
| 16-bit Reload Timer (RLT) | | | 3ch | RLT 1/3/6 |
| 16-bit Free-Running Timer (FRT) | | | 4ch | FRT 0 to 3<br>FRT 2/3 does not have external clock input pin |
| 16-bit Input Capture Unit (ICU) | | | 8ch<br>(2 channels for LIN-USART) | ICU 0/1/4 to 7/9/10<br>(ICU 9/10 for LIN-USART) |
| 16-bit Output Compare Unit (OCU) | | | 6ch | OCU 0/1/4 to 7 |
| 8/16-bit Programmable Pulse Generator (PPG) | | | 8ch (16-bit) / 16ch (8-bit) | PPG 0/1/3/4/6/7/12/14 |
| | with Timing point capture | | Yes | |
| | with Start delay | | No | |
| | with Ramp | | No | |
| Quadrature Position/Revolution Counter (QPRC) | | | 2ch | QPRC 0/1 |
| CAN Interface | | | 1ch | CAN 2<br>32 Message Buffers |
| External Interrupts (INT) | | | 13ch | INT 0/2/3/4/7 to 15 |
| Non-Maskable Interrupt (NMI) | | | 1ch | |
| Real Time Clock (RTC) | | | 1ch | |
| I/O Ports | | | 50 (Dual clock mode)<br>52 (Single clock mode) | |
| Clock Calibration Unit (CAL) | | | 1ch | |
| Clock Output Function | | | 2ch | |
| Low Voltage Detection Function | | | Yes | Low voltage detection function can be disabled by software |
| Hardware Watchdog Timer | | | Yes | |
| On-chip RC-oscillator | | | Yes | |
| On-chip Debugger | | | Yes | |

**Note:**

All signals of the peripheral function in each product cannot be allocated by limiting the pins of package.

It is necessary to use the port relocate function of the general I/O port according to your function use.

| Type | Circuit | Remarks |
|---|---|---|
| O |  | • Open-drain I/O<br>• Output 25mA, Vcc = 2.7V<br>• TTL input |

## 11. Interrupt Vector Table

| Vector number | Offset in vector table | Vector name | Cleared by DMA | Index in ICR to program | Description |
|---|---|---|---|---|---|
| 0 | $3FC_H$ | CALLV0 | No | - | CALLV instruction |
| 1 | $3F8_H$ | CALLV1 | No | - | CALLV instruction |
| 2 | $3F4_H$ | CALLV2 | No | - | CALLV instruction |
| 3 | $3F0_H$ | CALLV3 | No | - | CALLV instruction |
| 4 | $3EC_H$ | CALLV4 | No | - | CALLV instruction |
| 5 | $3E8_H$ | CALLV5 | No | - | CALLV instruction |
| 6 | $3E4_H$ | CALLV6 | No | - | CALLV instruction |
| 7 | $3E0_H$ | CALLV7 | No | - | CALLV instruction |
| 8 | $3DC_H$ | RESET | No | - | Reset vector |
| 9 | $3D8_H$ | INT9 | No | - | INT9 instruction |
| 10 | $3D4_H$ | EXCEPTION | No | - | Undefined instruction execution |
| 11 | $3D0_H$ | NMI | No | - | Non-Maskable Interrupt |
| 12 | $3CC_H$ | DLY | No | 12 | Delayed Interrupt |
| 13 | $3C8_H$ | RC_TIMER | No | 13 | RC Clock Timer |
| 14 | $3C4_H$ | MC_TIMER | No | 14 | Main Clock Timer |
| 15 | $3C0_H$ | SC_TIMER | No | 15 | Sub Clock Timer |
| 16 | $3BC_H$ | LVDI | No | 16 | Low Voltage Detector |
| 17 | $3B8_H$ | EXTINT0 | Yes | 17 | External Interrupt 0 |
| 18 | $3B4_H$ | - | - | 18 | Reserved |
| 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 | $3A4_H$ | - | - | 22 | Reserved |
| 23 | $3A0_H$ | - | - | 23 | Reserved |
| 24 | $39C_H$ | EXTINT7 | Yes | 24 | External Interrupt 7 |
| 25 | $398_H$ | EXTINT8 | Yes | 25 | External Interrupt 8 |
| 26 | $394_H$ | EXTINT9 | Yes | 26 | External Interrupt 9 |
| 27 | $390_H$ | EXTINT10 | Yes | 27 | External Interrupt 10 |
| 28 | $38C_H$ | EXTINT11 | Yes | 28 | External Interrupt 11 |
| 29 | $388_H$ | EXTINT12 | Yes | 29 | External Interrupt 12 |
| 30 | $384_H$ | EXTINT13 | Yes | 30 | External Interrupt 13 |
| 31 | $380_H$ | EXTINT14 | Yes | 31 | External Interrupt 14 |
| 32 | $37C_H$ | EXTINT15 | Yes | 32 | External Interrupt 15 |
| 33 | $378_H$ | - | - | 33 | Reserved |
| 34 | $374_H$ | - | - | 34 | Reserved |
| 35 | $370_H$ | CAN2 | No | 35 | CAN Controller 2 |
| 36 | $36C_H$ | - | - | 36 | Reserved |
| 37 | $368_H$ | - | - | 37 | Reserved |
| 38 | $364_H$ | PPG0 | Yes | 38 | Programmable Pulse Generator 0 |
| 39 | $360_H$ | PPG1 | Yes | 39 | Programmable Pulse Generator 1 |

| Vector number | Offset in vector table | Vector name | Cleared by DMA | Index in ICR to program | Description |
|---|---|---|---|---|---|
| 81 | $2B8_H$ | OCU4 | Yes | 81 | Output Compare Unit 4 |
| 82 | $2B4_H$ | OCU5 | Yes | 82 | Output Compare Unit 5 |
| 83 | $2B0_H$ | OCU6 | Yes | 83 | Output Compare Unit 6 |
| 84 | $2AC_H$ | OCU7 | Yes | 84 | Output Compare Unit 7 |
| 85 | $2A8_H$ | - | - | 85 | Reserved |
| 86 | $2A4_H$ | - | - | 86 | Reserved |
| 87 | $2A0_H$ | - | - | 87 | Reserved |
| 88 | $29C_H$ | - | - | 88 | Reserved |
| 89 | $298_H$ | FRT0 | Yes | 89 | Free-Running Timer 0 |
| 90 | $294_H$ | FRT1 | Yes | 90 | Free-Running Timer 1 |
| 91 | $290_H$ | FRT2 | Yes | 91 | Free-Running Timer 2 |
| 92 | $28C_H$ | FRT3 | Yes | 92 | Free-Running Timer 3 |
| 93 | $288_H$ | RTC0 | No | 93 | Real Time Clock |
| 94 | $284_H$ | CAL0 | No | 94 | Clock Calibration Unit |
| 95 | $280_H$ | - | - | 95 | Reserved |
| 96 | $27C_H$ | IIC0 | Yes | 96 | $I^2C$ interface 0 |
| 97 | $278_H$ | - | - | 97 | Reserved |
| 98 | $274_H$ | ADC0 | Yes | 98 | A/D Converter 0 |
| 99 | $270_H$ | - | - | 99 | Reserved |
| 100 | $26C_H$ | - | - | 100 | Reserved |
| 101 | $268_H$ | - | - | 101 | Reserved |
| 102 | $264_H$ | - | - | 102 | Reserved |
| 103 | $260_H$ | - | - | 103 | Reserved |
| 104 | $25C_H$ | - | - | 104 | Reserved |
| 105 | $258_H$ | LINR2 | Yes | 105 | LIN USART 2 RX |
| 106 | $254_H$ | LINT2 | Yes | 106 | LIN USART 2 TX |
| 107 | $250_H$ | - | - | 107 | Reserved |
| 108 | $24C_H$ | - | - | 108 | Reserved |
| 109 | $248_H$ | - | - | 109 | Reserved |
| 110 | $244_H$ | - | - | 110 | Reserved |
| 111 | $240_H$ | - | - | 111 | Reserved |
| 112 | $23C_H$ | - | - | 112 | Reserved |
| 113 | $238_H$ | - | - | 113 | Reserved |
| 114 | $234_H$ | - | - | 114 | Reserved |
| 115 | $230_H$ | LINR7 | Yes | 115 | LIN USART 7 RX |
| 116 | $22C_H$ | LINT7 | Yes | 116 | LIN USART 7 TX |
| 117 | $228_H$ | LINR8 | Yes | 117 | LIN USART 8 RX |
| 118 | $224_H$ | LINT8 | Yes | 118 | LIN USART 8 TX |
| 119 | $220_H$ | - | - | 119 | Reserved |
| 120 | $21C_H$ | - | - | 120 | Reserved |
| 121 | $218_H$ | - | - | 121 | Reserved |
| 122 | $214_H$ | - | - | 122 | Reserved |

| Vector number | Offset in vector table | Vector name | Cleared by DMA | Index in ICR to program | Description |
|---|---|---|---|---|---|
| 123 | $210_H$ | - | - | 123 | Reserved |
| 124 | $20C_H$ | - | - | 124 | Reserved |
| 125 | $208_H$ | - | - | 125 | Reserved |
| 126 | $204_H$ | - | - | 126 | Reserved |
| 127 | $200_H$ | - | - | 127 | Reserved |
| 128 | $1FC_H$ | - | - | 128 | Reserved |
| 129 | $1F8_H$ | - | - | 129 | Reserved |
| 130 | $1F4_H$ | - | - | 130 | Reserved |
| 131 | $1F0_H$ | - | - | 131 | Reserved |
| 132 | $1EC_H$ | - | - | 132 | Reserved |
| 133 | $1E8_H$ | FLASHA | Yes | 133 | Flash memory A interrupt |
| 134 | $1E4_H$ | - | - | 134 | Reserved |
| 135 | $1E0_H$ | - | - | 135 | Reserved |
| 136 | $1DC_H$ | - | - | 136 | Reserved |
| 137 | $1D8_H$ | QPRC0 | Yes | 137 | Quad Position/Revolution counter 0 |
| 138 | $1D4_H$ | QPRC1 | Yes | 138 | Quad Position/Revolution counter 1 |
| 139 | $1D0_H$ | ADCRC0 | No | 139 | A/D Converter 0 - Range Comparator |
| 140 | $1CC_H$ | - | - | 140 | Reserved |
| 141 | $1C8_H$ | - | - | 141 | Reserved |
| 142 | $1C4_H$ | - | - | 142 | Reserved |
| 143 | $1C0_H$ | - | - | 143 | Reserved |

# 12. Handling Precautions

Any semiconductor devices have inherently a certain rate of failure. The possibility of failure is greatly affected by the conditions in which they are used (circuit conditions, environmental conditions, etc.). This page describes precautions that must be observed to minimize the chance of failure and to obtain higher reliability from your Cypress semiconductor devices.

## 12.1 Precautions for Product Design

This section describes precautions when designing electronic equipment using semiconductor devices.

■Absolute Maximum Ratings

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

■Recommended Operating Conditions

Recommended operating conditions are normal operating ranges for the semiconductor device. All the device's electrical characteristics are warranted when operated within these ranges.

Always use semiconductor devices within the recommended operating conditions. 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 sales representative beforehand.

■Processing and Protection of Pins

These precautions must be followed when handling the pins which connect semiconductor devices to power supply and input/output functions.

1. Preventing Over-Voltage and Over-Current Conditions

   Exposure to voltage or current levels in excess of maximum ratings at any pin is likely to cause deterioration within the device, and in extreme cases leads to permanent damage of the device. Try to prevent such overvoltage or over-current conditions at the design stage.
2. Protection of Output Pins

   Shorting of output pins to supply pins or other output pins, or connection to large capacitance can cause large current flows. Such conditions if present for extended periods of time can damage the device.
   Therefore, avoid this type of connection.
3. Handling of Unused Input Pins

   Unconnected input pins with very high impedance levels can adversely affect stability of operation. Such pins should be connected through an appropriate resistance to a power supply pin or ground pin.

■Latch-up

Semiconductor devices are constructed by the formation of P-type and N-type areas on a substrate. When subjected to abnormally high voltages, internal parasitic PNPN junctions (called thyristor structures) may be formed, causing large current levels in excess of several hundred mA to flow continuously at the power supply pin. This condition is called latch-up.

CAUTION: The occurrence of latch-up not only causes loss of reliability in the semiconductor device, but can cause injury or damage from high heat, smoke or flame. To prevent this from happening, do the following:

1. Be sure that voltages applied to pins do not exceed the absolute maximum ratings. This should include attention to abnormal noise, surge levels, etc.
2. Be sure that abnormal current flows do not occur during the power-on sequence.

■Observance of Safety Regulations and Standards

Most countries in the world have established standards and regulations regarding safety, protection from electromagnetic interference, etc. Customers are requested to observe applicable regulations and standards in the design of products.

■Fail-Safe Design

Any semiconductor devices have inherently a certain rate of failure. You must protect against injury, damage or loss from such failures by incorporating safety design measures into your facility and equipment such as redundancy, fire protection, and prevention of over-current levels and other abnormal operating conditions.

■Static Electricity

Because semiconductor devices are particularly susceptible to damage by static electricity, you must take the following precautions:

1. Maintain relative humidity in the working environment between 40% and 70%. Use of an apparatus for ion generation may be needed to remove electricity.
2. Electrically ground all conveyors, solder vessels, soldering irons and peripheral equipment.
3. Eliminate static body electricity by the use of rings or bracelets connected to ground through high resistance (on the level of 1 MΩ).
   Wearing of conductive clothing and shoes, use of conductive floor mats and other measures to minimize shock loads is recommended.
4. Ground all fixtures and instruments, or protect with anti-static measures.
5. Avoid the use of styrofoam or other highly static-prone materials for storage of completed board assemblies.

### 12.3 Precautions for Use Environment

Reliability of semiconductor devices depends on ambient temperature and other conditions as described above.

For reliable performance, do the following:

1. Humidity

   Prolonged use in high humidity can lead to leakage in devices as well as printed circuit boards. If high humidity levels are anticipated, consider anti-humidity processing.
2. Discharge of Static Electricity

   When high-voltage charges exist close to semiconductor devices, discharges can cause abnormal operation. In such cases, use anti-static measures or processing to prevent discharges.
3. Corrosive Gases, Dust, or Oil

   Exposure to corrosive gases or contact with dust or oil may lead to chemical reactions that will adversely affect the device. If you use devices in such conditions, consider ways to prevent such exposure or to protect the devices.
4. Radiation, Including Cosmic Radiation

   Most devices are not designed for environments involving exposure to radiation or cosmic radiation. Users should provide shielding as appropriate.
5. Smoke, Flame

CAUTION: Plastic molded devices are flammable, and therefore should not be used near combustible substances. If devices begin to smoke or burn, there is danger of the release of toxic gases.

Customers considering the use of Cypress products in other special environmental conditions should consult with sales representatives.

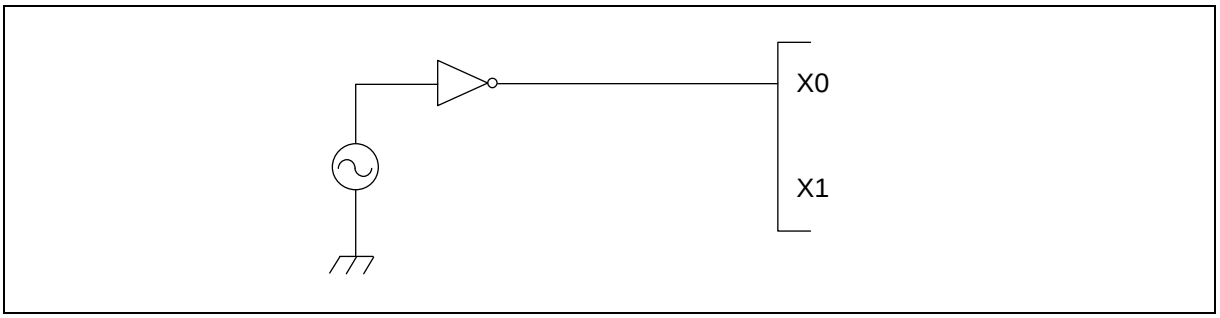
## 13.3 External clock usage

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:

### *13.3.1 Single phase external clock for Main oscillator*

When using a single phase external clock for the Main oscillator, X0 pin must be driven and X1 pin left open.
And supply 1.8V power to the external clock.




### *13.3.2 Single phase external clock for Sub oscillator*

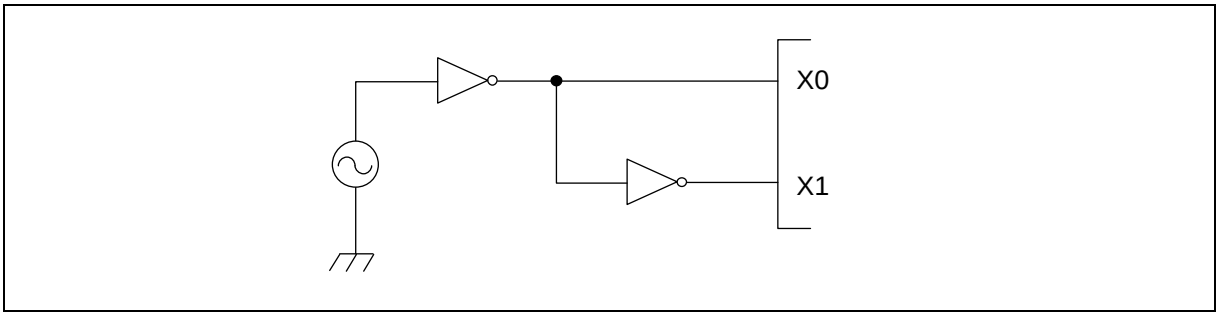
When using a single phase external clock for the Sub oscillator, “External clock mode” must be selected and

X0A/P04_0 pin must be driven. X1A/P04_1 pin can be configured as GPIO.

### *13.3.3 Opposite phase external clock*

When using an opposite phase external clock, X1 (X1A) pins must be supplied with a clock signal which has

the opposite phase to the X0 (X0A) pins. Supply level on X0 and X1 pins must be 1.8V.




## 13.4 Notes on PLL clock mode operation

If the microcontroller is operated with PLL clock mode 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.

## 13.5 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 $V_{ss}$ pins must be connected to the device from the power supply with lowest possible impedance.

The smoothing capacitor at $V_{cc}$ pin must use the one of a capacity value that is larger than Cs.

Besides this, as a measure against power supply noise, it is required to connect a bypass capacitor of about 0.1μF between $V_{cc}$ and $V_{ss}$ pins as close as possible to $V_{cc}$ and $V_{ss}$ pins.

# 14. Electrical Characteristics

## 14.1 Absolute Maximum Ratings

| Parameter | Symbol | Condition | Rating | | Unit | Remarks |
|---|---|---|---|---|---|---|
| | | | Min | Max | | |
| Power supply voltage*1 | $V_{CC}$ | - | $V_{SS}$ - 0.3 | $V_{SS}$ + 6.0 | V | |
| Analog power supply voltage*1 | $AV_{CC}$ | - | $V_{SS}$ - 0.3 | $V_{SS}$ + 6.0 | V | $V_{CC} = AV_{CC}$*2 |
| Analog reference voltage*1 | AVRH | - | $V_{SS}$ - 0.3 | $V_{SS}$ + 6.0 | V | $AV_{CC} \geq AVRH$, $AVRH \geq AV_{SS}$ |
| Input voltage*1 | $V_I$ | - | $V_{SS}$ - 0.3 | $V_{SS}$ + 6.0 | V | $V_I \leq V_{CC}$ + 0.3V*3 |
| Output voltage*1 | $V_O$ | - | $V_{SS}$ - 0.3 | $V_{SS}$ + 6.0 | V | $V_O \leq V_{CC}$ + 0.3V*3 |
| Maximum Clamp Current | $I_{CLAMP}$ | - | -4.0 | +4.0 | mA | Applicable to general purpose I/O pins *4 |
| Total Maximum Clamp Current | $\Sigma\lvert I_{CLAMP}\rvert$ | - | - | 17 | mA | Applicable to general purpose I/O pins *4 |
| "L" level maximum output current | $I_{OL}$ | - | - | 15 | mA | |
| "L" level average output current | $I_{OLAV}$ | - | - | 4 | mA | |
| "L" level maximum overall output current | $\Sigma I_{OL}$ | - | - | 42 | mA | |
| "L" level average overall output current | $\Sigma I_{OLAV}$ | - | - | 21 | mA | |
| "H" level maximum output current | $I_{OH}$ | - | - | -15 | mA | |
| "H" level average output current | $I_{OHAV}$ | - | - | -4 | mA | |
| "H" level maximum overall output current | $\Sigma I_{OH}$ | - | - | -42 | mA | |
| "H" level average overall output current | $\Sigma I_{OHAV}$ | - | - | -21 | mA | |
| Power consumption*5 | $P_D$ | $T_A$= +125°C | - | 352*6 | mW | |
| Operating ambient temperature | $T_A$ | - | -40 | +125*7 | °C | |
| Storage temperature | $T_{STG}$ | - | -55 | +150 | °C | |

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

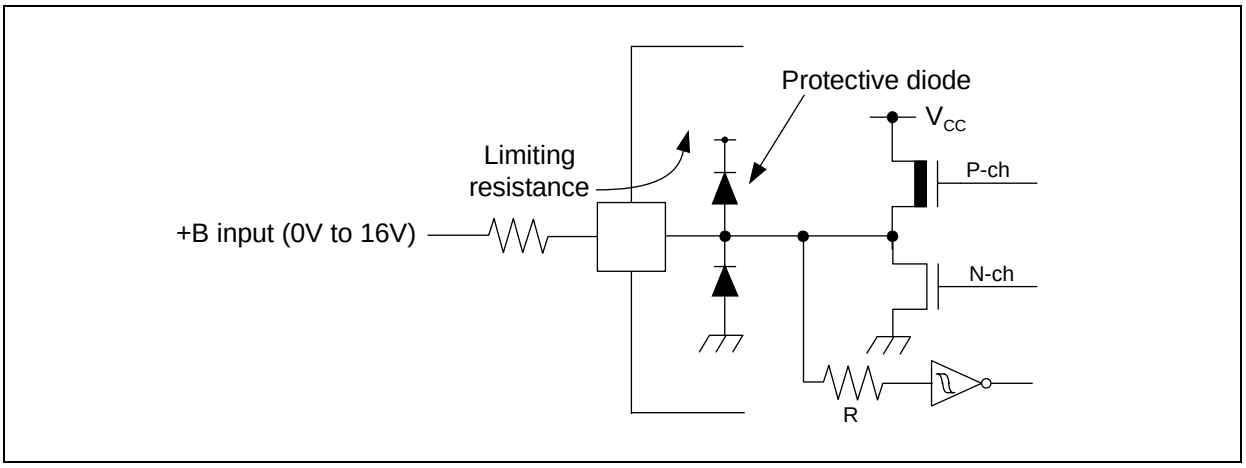
*2: $AV_{CC}$ and $V_{CC}$ must be set to the same voltage. It is required that $AV_{CC}$ does not exceed $V_{CC}$ and that the voltage at the analog inputs does not exceed $AV_{CC}$ when the power is switched on.

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

*4: Applicable to all general purpose I/O pins (Pnn_m).

- Use within recommended operating conditions.
- Use at DC voltage (current).
- The +B signal should always be applied a limiting resistance placed between the +B signal and the microcontroller.
- The value of the limiting resistance should be set so that when the +B signal is applied the input current to the microcontroller pin does not exceed rated values, either instantaneously or for prolonged periods.
- Note that when the microcontroller drive current is low, such as in the power saving modes, the +B input potential may pass through the protective diode and increase the potential at the $V_{CC}$ pin, and this may affect other devices.
- Note that if a +B signal is input when the microcontroller power supply is off (not fixed at 0V), the power supply is provided from the pins, so that incomplete operation may result.
- Note that if the +B input is applied during power-on, the power supply is provided from the pins and the resulting supply voltage may not be sufficient to operate the Power reset.

- The DEBUG I/F pin has only a protective diode against $V_{SS}$. Hence it is only permitted to input a negative clamping current (4mA). For protection against positive input voltages, use an external clamping diode which limits the input voltage to maximum 6.0V.
- Sample recommended circuits:




*5: 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:
$P_D = P_{IO} + P_{INT}$
$P_{IO} = \Sigma (V_{OL} \times I_{OL} + V_{OH} \times I_{OH})$ (I/O load power dissipation, sum is performed on all I/O ports)
$P_{INT} = V_{CC} \times (I_{CC} + I_A)$ (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.
$I_A$ is the analog current consumption into $AV_{CC}$.

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

*7: Write/erase to a large sector in flash memory is warranted with TA ≤ + 105°C.

**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.

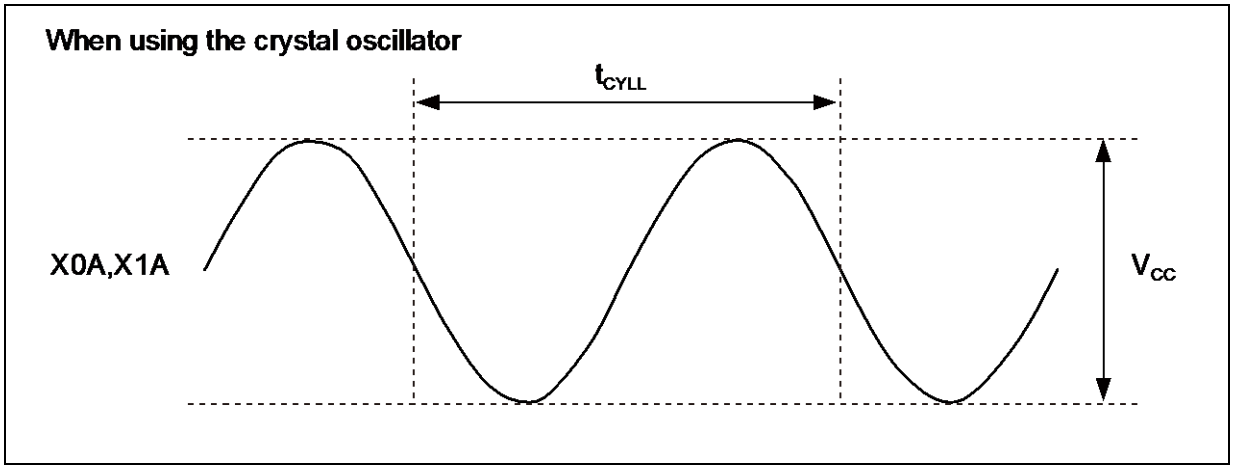
| Parameter | Symbol | Pin name | Conditions | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | | |
| Power supply current in Sleep modes[*1] | $I_{CCSPLL}$ | Vcc | PLL Sleep mode with CLKS1/2 = CLKP1/2 = 32MHz (CLKRC and CLKSC stopped) | - | 6.5 | - | mA | $T_A$ = +25°C |
| | | | | - | - | 13 | mA | $T_A$ = +105°C |
| | | | | - | - | 14 | mA | $T_A$ = +125°C |
| | $I_{CCSMAIN}$ | | Main Sleep mode with CLKS1/2 = CLKP1/2 = 4MHz, SMCR:LPMSS = 0 (CLKPLL, CLKRC and CLKSC stopped) | - | 0.9 | - | mA | $T_A$ = +25°C |
| | | | | - | - | 4 | mA | $T_A$ = +105°C |
| | | | | - | - | 5 | mA | $T_A$ = +125°C |
| | $I_{CCSRCH}$ | | RC Sleep mode with CLKS1/2 = CLKP1/2 = CLKRC = 2MHz, SMCR:LPMSS = 0 (CLKMC, CLKPLL and CLKSC stopped) | - | 0.5 | - | mA | $T_A$ = +25°C |
| | | | | - | - | 3.5 | mA | $T_A$ = +105°C |
| | | | | - | - | 4.5 | mA | $T_A$ = +125°C |
| | $I_{CCSRCL}$ | | RC Sleep mode with CLKS1/2 = CLKP1/2 = CLKRC = 100kHz (CLKMC, CLKPLL and CLKSC stopped) | - | 0.06 | - | mA | $T_A$ = +25°C |
| | | | | - | - | 2.7 | mA | $T_A$ = +105°C |
| | | | | - | - | 3.7 | mA | $T_A$ = +125°C |
| | $I_{CCSSUB}$ | | Sub Sleep mode with CLKS1/2 = CLKP1/2 = 32kHz, (CLKMC, CLKPLL and CLKRC stopped) | - | 0.04 | - | mA | $T_A$ = +25°C |
| | | | | - | - | 2.5 | mA | $T_A$ = +105°C |
| | | | | - | - | 3.5 | mA | $T_A$ = +125°C |

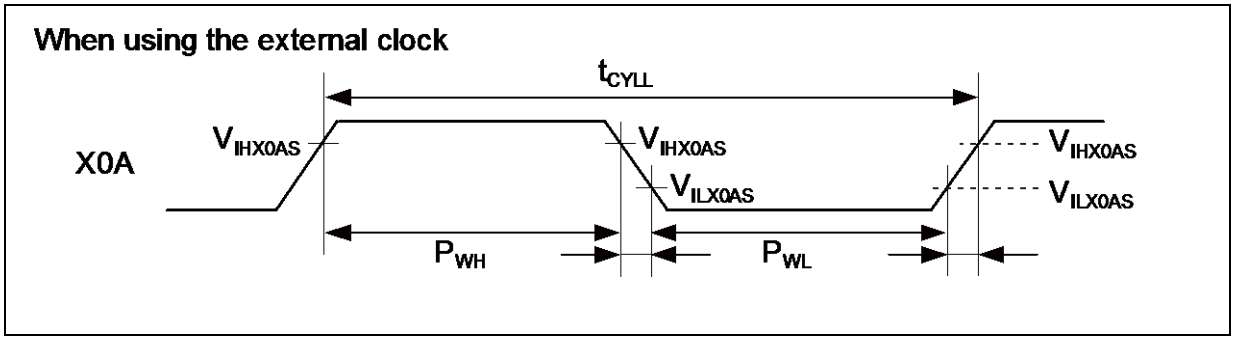
| Parameter | Symbol | Pin name | Conditions | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | | |
| Power supply current in Timer modes[*2] | $I_{CCTPLL}$ | Vcc | PLL Timer mode with CLKPLL = 32MHz (CLKRC and CLKSC stopped) | - | 1800 | 2245 | µA | $T_A$ = +25°C |
| | | | | - | - | 3165 | µA | $T_A$ = +105°C |
| | | | | - | - | 3975 | µA | $T_A$ = +125°C |
| | $I_{CCTMAIN}$ | | Main Timer mode with CLKMC = 4MHz, SMCR:LPMSS = 0 (CLKPLL, CLKRC and CLKSC stopped) | - | 285 | 325 | µA | $T_A$ = +25°C |
| | | | | - | - | 1085 | µA | $T_A$ = +105°C |
| | | | | - | - | 1930 | µA | $T_A$ = +125°C |
| | $I_{CCTRCH}$ | | RC Timer mode with CLKRC = 2MHz, SMCR:LPMSS = 0 (CLKPLL, CLKMC and CLKSC stopped) | - | 160 | 210 | µA | $T_A$ = +25°C |
| | | | | - | - | 1025 | µA | $T_A$ = +105°C |
| | | | | - | - | 1840 | µA | $T_A$ = +125°C |
| | $I_{CCTRCL}$ | | RC Timer mode with CLKRC = 100kHz (CLKPLL, CLKMC and CLKSC stopped) | - | 35 | 75 | µA | $T_A$ = +25°C |
| | | | | - | - | 855 | µA | $T_A$ = +105°C |
| | | | | - | - | 1640 | µA | $T_A$ = +125°C |
| | $I_{CCTSUB}$ | | Sub Timer mode with CLKSC = 32kHz (CLKMC, CLKPLL and CLKRC stopped) | - | 25 | 65 | µA | $T_A$ = +25°C |
| | | | | - | - | 830 | µA | $T_A$ = +105°C |
| | | | | - | - | 1620 | µA | $T_A$ = +125°C |

### *14.4.2 Sub Clock Input Characteristics*

($V_{CC}$ = $AV_{CC}$ = 2.7V to 5.5V, $V_{SS}$ = $AV_{SS}$ = 0V, $T_A$ = - 40°C to + 125°C)

| Parameter | Symbol | Pin name | Conditions | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | | |
| Input frequency | $f_{CL}$ | X0A, X1A | - | - | 32.768 | - | kHz | When using an oscillation circuit |
| | | | - | - | - | 100 | kHz | When using an opposite phase external clock |
| | | X0A | - | - | - | 50 | kHz | When using a single phase external clock |
| Input clock cycle | $t_{CYLL}$ | - | - | 10 | - | - | µs | |
| Input clock pulse width | - | - | $P_{WH}/t_{CYLL}$, $P_{WL}/t_{CYLL}$ | 30 | - | 70 | % | |

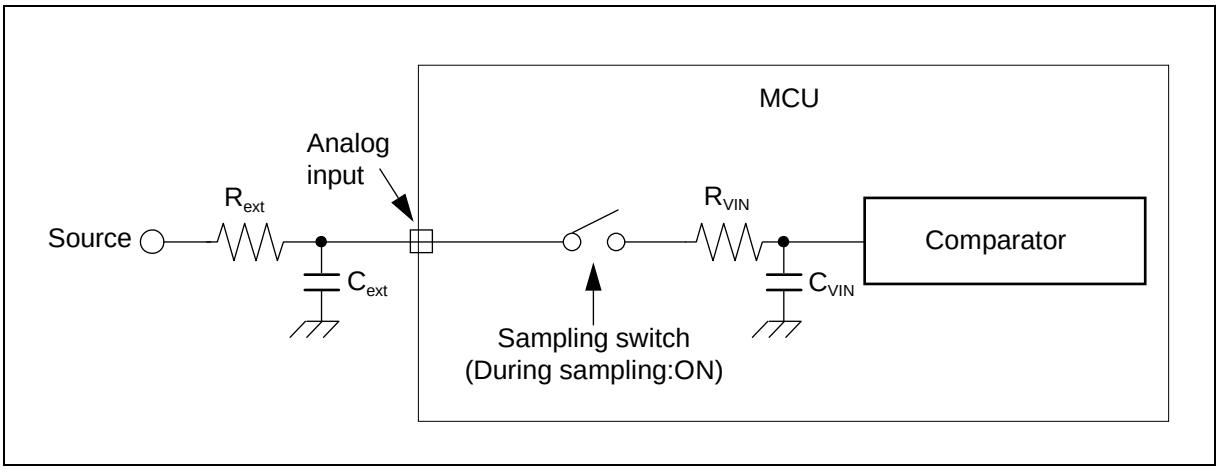


### *14.5.2 Accuracy and Setting of the A/D Converter Sampling Time*

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 (Tsamp) 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

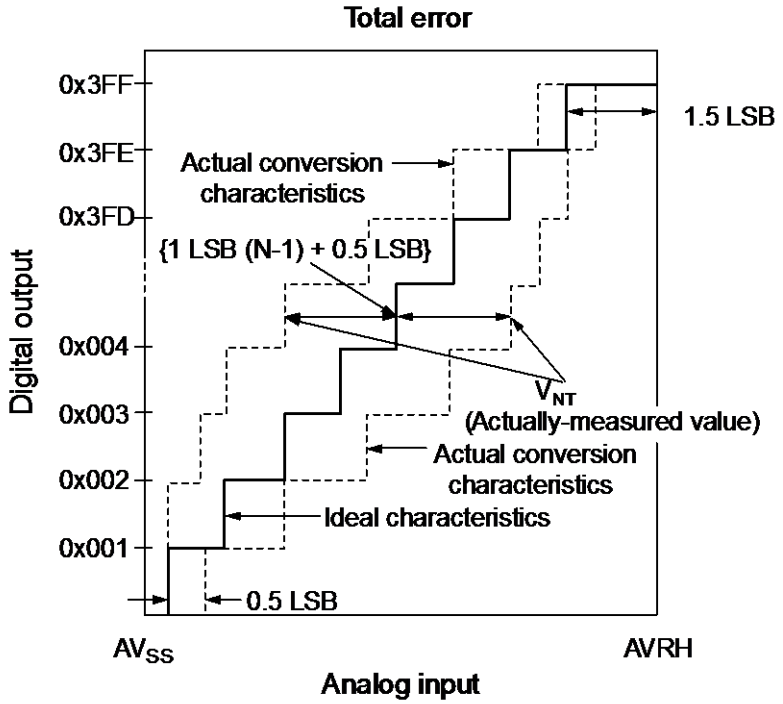
$C_{VIN}$: Analog input capacity (I/O, analog switch and ADC are contained)

$R_{VIN}$: Analog input impedance (I/O, analog switch and ADC are contained)

The following approximation formula for the replacement model above can be used:

$Tsamp = 7.62 \times (Rext \times Cext + (Rext + R_{VIN}) \times C_{VIN})$

- Do not select a sampling time below the absolute minimum permitted value.
  ($0.5\mu s$ for $4.5V \le AV_{CC} \le 5.5V$, $1.2\mu s$ for $2.7V \le AV_{CC} < 4.5V$)
- If the sampling time cannot be sufficient, connect a capacitor of about $0.1\mu F$ to the analog input pin.
- A big external driving impedance also adversely affects the A/D conversion precision due to the pin input leakage current IIL (static current before the sampling switch) or the analog input leakage current IAIN (total leakage current of pin input and comparator during sampling). The effect of the pin input leakage current IIL cannot be compensated by an external capacitor.
- The accuracy gets worse as $|AVRH - AV_{SS}|$ becomes smaller.




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

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

N : A/D converter digital output value.
$V_{NT}$ : Voltage at which the digital output changes from 0x(N + 1) to 0xN.
$V_{OT}$ (Ideal value) = $AV_{SS}$ + 0.5LSB[V]
$V_{FST}$ (Ideal value) = AVRH - 1.5LSB[V]

## 14.6 Low Voltage Detection Function Characteristics

($V_{CC}$ = $AV_{CC}$ = 2.7V to 5.5V, $V_{SS}$ = $AV_{SS}$ = 0V, $T_A$ = - 40°C to + 125°C)

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| Detected voltage[*1] | $V_{DL0}$ | CILCR:LVL = $0000_B$ | 2.70 | 2.90 | 3.10 | V |
| | $V_{DL1}$ | CILCR:LVL = $0001_B$ | 2.79 | 3.00 | 3.21 | V |
| | $V_{DL2}$ | CILCR:LVL = $0010_B$ | 2.98 | 3.20 | 3.42 | V |
| | $V_{DL3}$ | CILCR:LVL = $0011_B$ | 3.26 | 3.50 | 3.74 | V |
| | $V_{DL4}$ | CILCR:LVL = $0100_B$ | 3.45 | 3.70 | 3.95 | V |
| | $V_{DL5}$ | CILCR:LVL = $0111_B$ | 3.73 | 4.00 | 4.27 | V |
| | $V_{DL6}$ | CILCR:LVL = $1001_B$ | 3.91 | 4.20 | 4.49 | V |
| Power supply voltage change rate[*2] | dV/dt | - | - 0.004 | - | + 0.004 | V/µs |
| Hysteresis width | $V_{HYS}$ | CILCR:LVHYS=0 | - | - | 50 | mV |
| | | CILCR:LVHYS=1 | 80 | 100 | 120 | mV |
| Stabilization time | $T_{LVDSTAB}$ | - | - | - | 75 | µs |
| Detection delay time | $t_d$ | - | - | - | 30 | µs |

[*1]: If the power supply voltage fluctuates within the time less than the detection delay time ($t_d$), there is a possibility that the low voltage detection will occur or stop after the power supply voltage passes the detection range.

[*2]: In order to perform the low voltage detection at the detection voltage ($V_{DLX}$), be sure to suppress fluctuation of the power supply voltage within the limits of the change ration of power supply voltage.

## 14.7 Flash Memory Write/Erase Characteristics

($V_{CC}$ = $AV_{CC}$ = 2.7V to 5.5V, $V_{SS}$ = $AV_{SS}$ = 0V, $T_A$ = - 40°C to + 125°C)

| Parameter | | Conditions | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | |
| Sector erase time | Large Sector | $T_A$ ≤ + 105°C | - | 1.6 | 7.5 | s | Includes write time prior to internal erase. |
| | Small Sector | - | - | 0.4 | 2.1 | s | |
| | Security Sector | - | - | 0.31 | 1.65 | s | |
| Word (16-bit) write time | Large Sector | $T_A$ ≤ + 105°C | - | 25 | 400 | µs | Not including system-level overhead time. |
| | Small Sector | - | - | 25 | 400 | µs | |
| Chip erase time | | $T_A$ ≤ + 105°C | - | 5.11 | 25.05 | s | Includes write time prior to internal erase. |

**Note**:

While the Flash memory is written or erased, shutdown of the external power ($V_{CC}$) is prohibited. In the application system where the external power ($V_{CC}$) might be shut down while writing or erasing, be sure to turn the power off by using a low voltage detection function.

To put it concrete, change the external power in the range of change ration of power supply voltage (-0.004V/µs to +0.004V/µs) after the external power falls below the detection voltage ($V_{DLX}$)[*1].

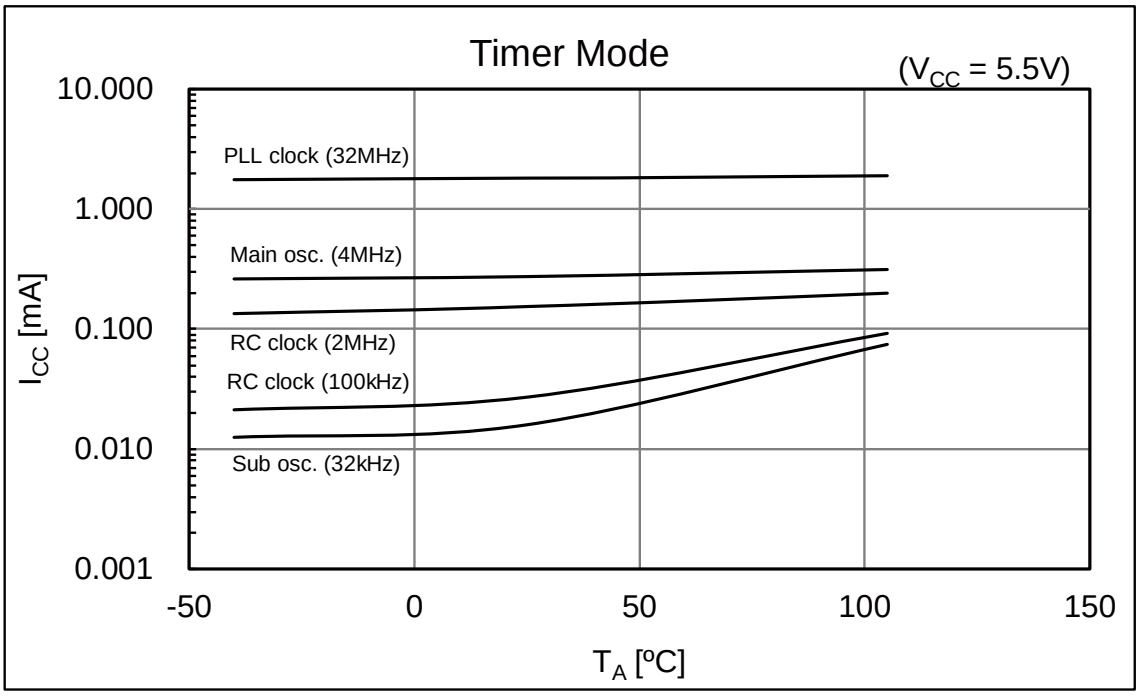
Write/Erase cycles and data hold time

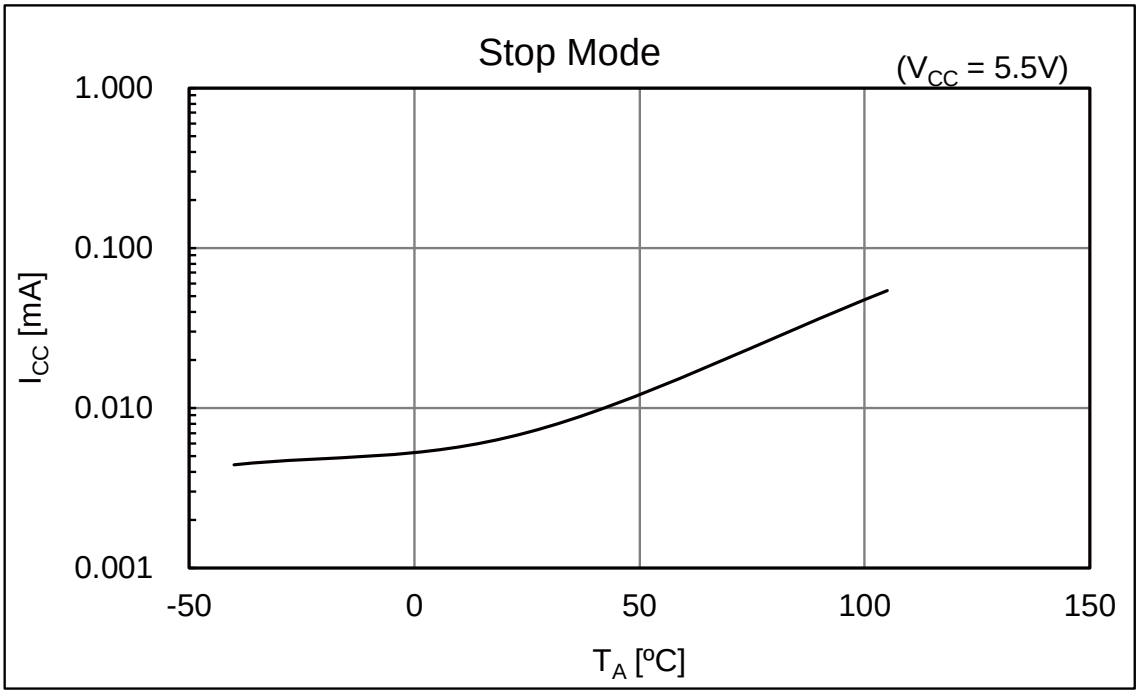
| Write/Erase cycles (cycle) | Data hold time (year) |
|---|---|
| 1,000 | 20 [*2] |
| 10,000 | 10 [*2] |
| 100,000 | 5 [*2] |

[*1]: See "Low Voltage Detection Function Characteristics".

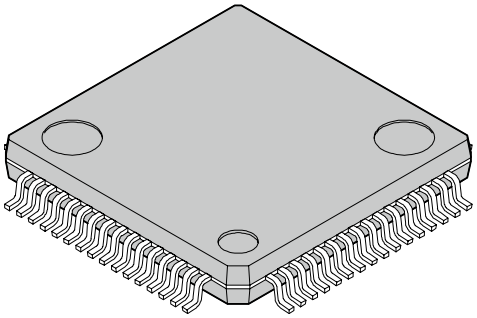
[*2]: This value comes from the technology qualification (using Arrhenius equation to translate high temperature measurements into normalized value at + 85°C).

■MB96F625


Timer Mode
($V_{CC}$ = 5.5V)
10.000
1.000
0.100
0.010
0.001
$I_{CC}$ [mA]
PLL clock (32MHz)
Main osc. (4MHz)
RC clock (2MHz)
RC clock (100kHz)
Sub osc. (32kHz)
-50
0
50
100
150
$T_A$ [ºC]


Stop Mode
($V_{CC}$ = 5.5V)
1.000
0.100
0.010
0.001
$I_{CC}$ [mA]
-50
0
50
100
150
$T_A$ [ºC]

64-pin plastic LQFP

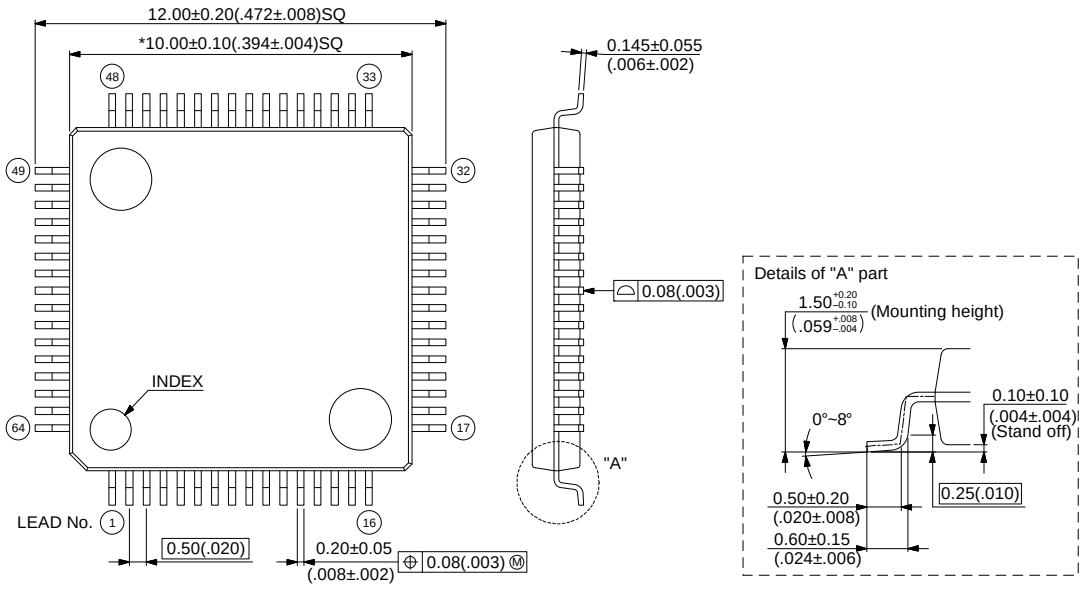


(FPT-64P-M24)

| | |
|---|---|
| Lead pitch | 0.50 mm |
| Package width × package length | 10.0 × 10.0 mm |
| Lead shape | Gullwing |
| Sealing method | Plastic mold |
| Mounting height | 1.70 mm MAX |
| Weight | 0.32 g |
| Code (Reference) | P-LFQFP64-10×10-0.50 |

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

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






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

| Page | Section | Change Results |
|---|---|---|
| 56 | Electrical Characteristics<br>7. Flash Memory Write/Erase Characteristics | Changed the Note<br>While the Flash memory is written or erased, shutdown of the external power ($V_{CC}$) is prohibited. In the application system where the external power ($V_{CC}$) might be shut down while writing, be sure to turn the power off by using an external voltage detector.<br>→<br>While the Flash memory is written or erased, shutdown of the external power ($V_{CC}$) is prohibited. In the application system where the external power ($V_{CC}$) might be shut down while writing or erasing, be sure to turn the power off by using a low voltage detection function. |
| 60 | Ordering Information | Deleted the Part number<br>MCU with CAN controller<br>MB96F622RBPMC-GTE2<br>MB96F622RBPMC1-GTE2<br>MB96F623RBPMC-GTE2<br>MB96F623RBPMC1-GTE2<br>MB96F625RBPMC-GTE2<br>MB96F625RBPMC1-GTE2<br>MCU without CAN controller<br>MB96F622ABPMC-GTE2<br>MB96F622ABPMC1-GTE2<br>MB96F623ABPMC-GTE2<br>MB96F623ABPMC1-GTE2<br>MB96F625ABPMC-GTE2<br>MB96F625ABPMC1-GTE2 |
| Revision 2.1 | | |
| - | - | Company name and layout design change |

**NOTE: Please see “Document History” about later revised information.**