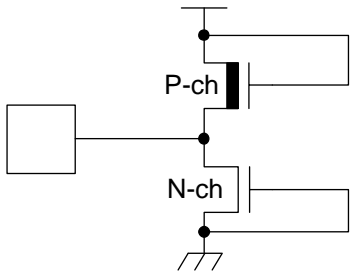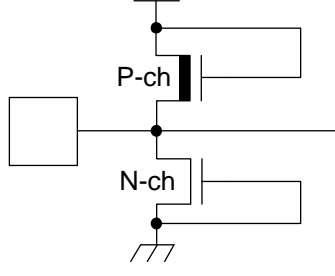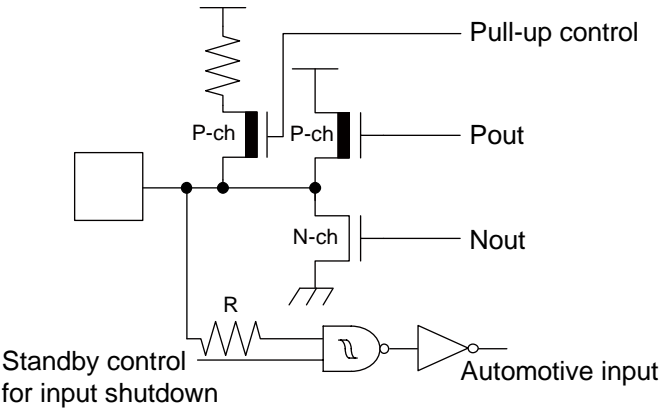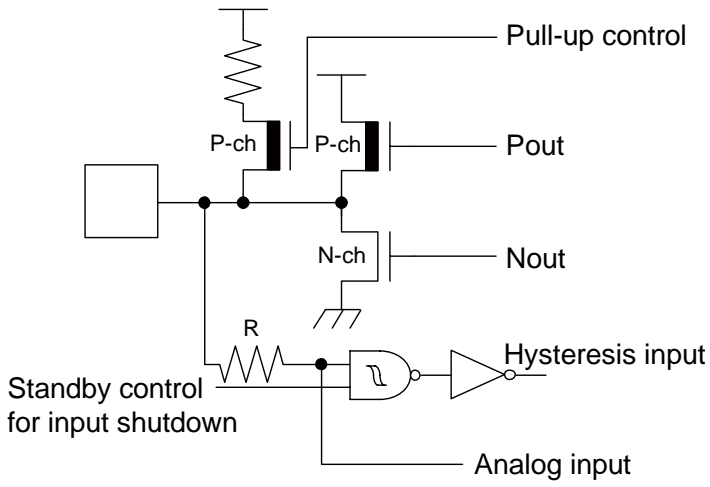**What is "Embedded - Microcontrollers"?**

"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 | 64 |
| Program Memory Size | 160KB (160K x 8) |
| Program Memory Type | FLASH |
| EEPROM Size | - |
| RAM Size | 16K 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 | 80-LQFP |
| Supplier Device Package | 80-LQFP (12x12) |
| Purchase URL | https://www.e-xfl.com/product-detail/infineon-technologies/mb96f635rbpmc-gse2 |

| Pin name | Feature | Description |
|----------|---------|-------------|
| TXn | CAN | CAN interface n TX output pin |
| Vcc | Supply | Power supply pin |
| Vss | Supply | Power supply pin |
| WOT | RTC | Real Time clock output pin |
| WOT_R | RTC | Relocated Real Time clock output pin |
| X0 | Clock | Oscillator input pin |
| X0A | Clock | Subclock Oscillator input pin |
| X1 | Clock | Oscillator output pin |
| X1A | Clock | Subclock Oscillator output pin |
| ZINn | QPRC | Quadrature Position/Revolution Counter Unit n input pin |

| Type | Circuit | Remarks |
|---|---|---|
| F |  | Power supply input protection circuit |
| G |  | • A/D converter ref+ (AVRH) power supply input pin with protection circuit<br>• Without protection circuit against $V_{CC}$ for pins AVRH |
| H |  | • CMOS level output ($I_{OL}$ = 4mA, $I_{OH}$ = -4mA)<br>• Automotive input with input shutdown function<br>• Programmable pull-up resistor |
| I |  | • CMOS level output ($I_{OL}$ = 4mA, $I_{OH}$ = -4mA)<br>• CMOS hysteresis input with input shutdown function<br>• Programmable pull-up resistor<br>• Analog input |

# 9. User ROM Memory Map For Flash Devices

| CPU mode address | Flash memory mode address | MB96F633 Flash size 64.5KB + 32KB | | MB96F635 Flash size 128.5KB + 32KB | | MB96F636 Flash size 256.5KB + 32KB | | MB96F637 Flash size 384.5KB + 32KB | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FF:FFFF$_H$ FF:0000$_H$ | 3F:FFFF$_H$ 3F:0000$_H$ | SA39 - 64KB | | SA39 - 64KB | | SA39 - 64KB | | SA39 - 64KB | | |
| FE:FFFF$_H$ FE:0000$_H$ | 3E:FFFF$_H$ 3E:0000$_H$ | | | SA38 - 64KB | | SA38 - 64KB | | SA38 - 64KB | | |
| FD:FFFF$_H$ FD:0000$_H$ | 3D:FFFF$_H$ 3D:0000$_H$ | | | | | SA37 - 64KB | | SA37 - 64KB | | |
| FC:FFFF$_H$ FC:0000$_H$ | 3C:FFFF$_H$ 3C:0000$_H$ | | | | | SA36 - 64KB | | SA36 - 64KB | | |
| FB:FFFF$_H$ FB:0000$_H$ | 3B:FFFF$_H$ 3B:0000$_H$ | | | | | | | SA35 - 64KB | | Bank A of Flash A |
| FA:FFFF$_H$ FA:0000$_H$ | 3A:FFFF$_H$ 3A:0000$_H$ | | | | | | | SA34 - 64KB | | |
| F9:FFFF$_H$ | | Reserved | | Reserved | | Reserved | | Reserved | | |
| DF:A000$_H$ | | | | | | | | | | |
| DF:9FFF$_H$ DF:8000$_H$ | 1F:9FFF$_H$ 1F:8000$_H$ | SA4 - 8KB | | SA4 - 8KB | | SA4 - 8KB | | SA4 - 8KB | | |
| DF:7FFF$_H$ DF:6000$_H$ | 1F:7FFF$_H$ 1F:6000$_H$ | SA3 - 8KB | | SA3 - 8KB | | SA3 - 8KB | | SA3 - 8KB | | Bank B of Flash A |
| DF:5FFF$_H$ DF:4000$_H$ | 1F:5FFF$_H$ 1F:4000$_H$ | SA2 - 8KB | | SA2 - 8KB | | SA2 - 8KB | | SA2 - 8KB | | |
| DF:3FFF$_H$ DF:2000$_H$ | 1F:3FFF$_H$ 1F:2000$_H$ | SA1 - 8KB | | SA1 - 8KB | | SA1 - 8KB | | SA1 - 8KB | | |
| DF:1FFF$_H$ DF:0000$_H$ | 1F:1FFF$_H$ 1F:0000$_H$ | SAS - 512B* | | SAS - 512B* | | SAS - 512B* | | SAS - 512B* | | Bank A of Flash A |
| DE:FFFF$_H$ DE:0000$_H$ | | Reserved | | Reserved | | Reserved | | Reserved | | |

*: Physical address area of SAS-512B is from DF:0000$_H$ to DF:01FF$_H$.
  Others (from DF:0200$_H$ to DF:1FFF$_H$) is mirror area of SAS-512B.
  Sector SAS contains the ROM configuration block RCBA at CPU address DF:0000$_H$ -DF:01FF$_H$.
  SAS can not be used for E$^2$PROM emulation.

# 10. Serial Programming Communication Interface

USART pins for Flash serial programming (MD = 0, DEBUG I/F = 0, Serial Communication mode)

| MB96630 | | |
|---|---|---|
| **Pin Number** | **USART Number** | **Normal Function** |
| 5 | USART0 | SIN0 |
| 6 | | SOT0 |
| 7 | | SCK0 |
| 37 | USART2 | SIN2 |
| 38 | | SOT2 |
| 39 | | SCK2 |
| 68 | USART4 | SIN4 |
| 69 | | SOT4 |
| 70 | | SCK4 |

| Vector number | Offset in vector table | Vector name | Cleared by DMA | Index in ICR to program | Description |
|---|---|---|---|---|---|
| 40 | 35C$_H$ | PPG2 | Yes | 40 | Programmable Pulse Generator 2 |
| 41 | 358H | PPG3 | Yes | 41 | Programmable Pulse Generator 3 |
| 42 | 354H | PPG4 | Yes | 42 | Programmable Pulse Generator 4 |
| 43 | 350H | - | - | 43 | Reserved |
| 44 | 34CH | PPG6 | Yes | 44 | Programmable Pulse Generator 6 |
| 45 | 348H | PPG7 | Yes | 45 | Programmable Pulse Generator 7 |
| 46 | 344H | PPG8 | Yes | 46 | Programmable Pulse Generator 8 |
| 47 | 340H | PPG9 | Yes | 47 | Programmable Pulse Generator 9 |
| 48 | 33CH | PPG10 | Yes | 48 | Programmable Pulse Generator 10 |
| 49 | 338H | PPG11 | Yes | 49 | Programmable Pulse Generator 11 |
| 50 | 334H | PPG12 | Yes | 50 | Programmable Pulse Generator 12 |
| 51 | 330H | PPG13 | Yes | 51 | Programmable Pulse Generator 13 |
| 52 | 32CH | PPG14 | Yes | 52 | Programmable Pulse Generator 14 |
| 53 | 328H | PPG15 | Yes | 53 | Programmable Pulse Generator 15 |
| 54 | 324H | - | - | 54 | Reserved |
| 55 | 320H | - | - | 55 | Reserved |
| 56 | 31CH | - | - | 56 | Reserved |
| 57 | 318H | - | - | 57 | Reserved |
| 58 | 314H | RLT0 | Yes | 58 | Reload Timer 0 |
| 59 | 310H | RLT1 | Yes | 59 | Reload Timer 1 |
| 60 | 30CH | - | - | 60 | Reserved |
| 61 | 308H | - | - | 61 | Reserved |
| 62 | 304H | - | - | 62 | Reserved |
| 63 | 300H | - | - | 63 | Reserved |
| 64 | 2FCH | RLT6 | Yes | 64 | Reload Timer 6 |
| 65 | 2F8H | ICU0 | Yes | 65 | Input Capture Unit 0 |
| 66 | 2F4H | ICU1 | Yes | 66 | Input Capture Unit 1 |
| 67 | 2F0H | - | - | 67 | Reserved |
| 68 | 2ECH | - | - | 68 | Reserved |
| 69 | 2E8H | ICU4 | Yes | 69 | Input Capture Unit 4 |
| 70 | 2E4H | ICU5 | Yes | 70 | Input Capture Unit 5 |
| 71 | 2E0H | ICU6 | Yes | 71 | Input Capture Unit 6 |
| 72 | 2DCH | ICU7 | Yes | 72 | Input Capture Unit 7 |
| 73 | 2D8H | - | - | 73 | Reserved |
| 74 | 2D4H | ICU9 | Yes | 74 | Input Capture Unit 9 |
| 75 | 2D0H | - | - | 75 | Reserved |
| 76 | 2CCH | - | - | 76 | Reserved |
| 77 | 2C8H | OCU0 | Yes | 77 | Output Compare Unit 0 |
| 78 | 2C4H | OCU1 | Yes | 78 | Output Compare Unit 1 |
| 79 | 2C0H | OCU2 | Yes | 79 | Output Compare Unit 2 |
| 80 | 2BCH | OCU3 | Yes | 80 | Output Compare Unit 3 |
| 81 | 2B8H | OCU4 | Yes | 81 | Output Compare Unit 4 |

| Vector number | Offset in vector table | Vector name | Cleared by DMA | Index in ICR to program | Description |
|---|---|---|---|---|---|
| 124 | 20CH | - | - | 124 | Reserved |
| 125 | 208H | - | - | 125 | Reserved |
| 126 | 204H | - | - | 126 | Reserved |
| 127 | 200H | - | - | 127 | Reserved |
| 128 | 1FCH | - | - | 128 | Reserved |
| 129 | 1F8H | - | - | 129 | Reserved |
| 130 | 1F4H | - | - | 130 | Reserved |
| 131 | 1F0H | - | - | 131 | Reserved |
| 132 | 1ECH | - | - | 132 | Reserved |
| 133 | 1E8H | FLASHA | Yes | 133 | Flash memory A interrupt |
| 134 | 1E4H | - | - | 134 | Reserved |
| 135 | 1E0H | - | - | 135 | Reserved |
| 136 | 1DCH | - | - | 136 | Reserved |
| 137 | 1D8H | QPRC0 | Yes | 137 | Quadrature Position/Revolution counter 0 |
| 138 | 1D4H | QPRC1 | Yes | 138 | Quadrature Position/Revolution counter 1 |
| 139 | 1D0H | ADCRC0 | No | 139 | A/D Converter 0 - Range Comparator |
| 140 | 1CCH | - | - | 140 | Reserved |
| 141 | 1C8H | - | - | 141 | Reserved |
| 142 | 1C4H | - | - | 142 | Reserved |
| 143 | 1C0H | - | - | 143 | Reserved |

■Precautions Related to Usage of Devices

Cypress semiconductor devices are intended for use in standard applications (computers, office automation and other office equipment, industrial, communications, and measurement equipment, personal or household devices, etc.).

CAUTION: Customers considering the use of our products in special applications where failure or abnormal operation may directly affect human lives or cause physical injury or property damage, or where extremely high levels of reliability are demanded (such as aerospace systems, atomic energy controls, sea floor repeaters, vehicle operating controls, medical devices for life support, etc.) are requested to consult with sales representatives before such use. The company will not be responsible for damages arising from such use without prior approval.

## 12.2  Precautions for Package Mounting

Package mounting may be either lead insertion type or surface mount type. In either case, for heat resistance during soldering, you should only mount under Cypress's recommended conditions. For detailed information about mount conditions, contact your sales representative.

■Lead Insertion Type

Mounting of lead insertion type packages onto printed circuit boards may be done by two methods: direct soldering on the board, or mounting by using a socket.

Direct mounting onto boards normally involves processes for inserting leads into through-holes on the board and using the flow soldering (wave soldering) method of applying liquid solder. In this case, the soldering process usually causes leads to be subjected to thermal stress in excess of the absolute ratings for storage temperature. Mounting processes should conform to Cypress recommended mounting conditions.

If socket mounting is used, differences in surface treatment of the socket contacts and IC lead surfaces can lead to contact deterioration after long periods. For this reason it is recommended that the surface treatment of socket contacts and IC leads be verified before mounting.

■Surface Mount Type

Surface mount packaging has longer and thinner leads than lead-insertion packaging, and therefore leads are more easily deformed or bent. The use of packages with higher pin counts and narrower pin pitch results in increased susceptibility to open connections caused by deformed pins, or shorting due to solder bridges.

You must use appropriate mounting techniques. Cypress recommends the solder reflow method, and has established a ranking of mounting conditions for each product. Users are advised to mount packages in accordance with Cypress ranking of recommended conditions.

■Lead-Free Packaging

CAUTION: When ball grid array (BGA) packages with Sn-Ag-Cu balls are mounted using Sn-Pb eutectic soldering, junction strength may be reduced under some conditions of use.

■Storage of Semiconductor Devices

Because plastic chip packages are formed from plastic resins, exposure to natural environmental conditions will cause absorption of moisture. During mounting, the application of heat to a package that has absorbed moisture can cause surfaces to peel, reducing moisture resistance and causing packages to crack. To prevent, do the following:

1. Avoid exposure to rapid temperature changes, which cause moisture to condense inside the product. Store products in locations where temperature changes are slight.

2. Use dry boxes for product storage. Products should be stored below 70% relative humidity, and at temperatures between 5°C and 30°C.
   When you open Dry Package that recommends humidity 40% to 70% relative humidity.

3. When necessary, Cypress packages semiconductor devices in highly moisture-resistant aluminum laminate bags, with a silica gel desiccant. Devices should be sealed in their aluminum laminate bags for storage.

4. Avoid storing packages where they are exposed to corrosive gases or high levels of dust.

■Baking

Packages that have absorbed moisture may be de-moisturized by baking (heat drying). Follow the Cypress recommended conditions for baking.

Condition: 125°C/24 h

■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.

## 14.2 Recommended Operating Conditions

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

| Parameter | Symbol | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| Power supply voltage | $V_{CC}$, $AV_{CC}$ | 2.7 | - | 5.5 | V | |
| | | 2.0 | - | 5.5 | V | Maintains RAM data in stop mode |
| Smoothing capacitor at C pin | $C_S$ | 0.5 | 1.0 to 3.9 | 4.7 | $\mu$F | 1.0$\mu$F (Allowance within ± 50%)<br>3.9$\mu$F (Allowance within ± 20%)<br>Please use the ceramic capacitor or the capacitor of the frequency response of this level.<br>The smoothing capacitor at $V_{CC}$ must use the one of a capacity value that is larger than $C_S$. |

**WARNING**

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

Always use semiconductor devices within their recommended operating condition ranges. Operation outside these ranges may adversely affect reliability and could result in device failure. No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their representatives beforehand.

| 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) | - | 8.5 | - | mA | $T_A$ = +25°C |
| | | | | - | - | 14 | mA | $T_A$ = +105°C |
| | | | | - | - | 15.5 | mA | $T_A$ = +125°C |
| | $I_{CCSMAIN}$ | | Main Sleep mode with CLKS1/2 = CLKP1/2 = 4MHz, SMCR:LPMSS = 0 (CLKPLL, CLKRC and CLKSC stopped) | - | 1 | - | mA | $T_A$ = +25°C |
| | | | | - | - | 4.5 | mA | $T_A$ = +105°C |
| | | | | - | - | 6 | 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) | - | 0.6 | - | mA | $T_A$ = +25°C |
| | | | | - | - | 3.8 | mA | $T_A$ = +105°C |
| | | | | - | - | 5.3 | mA | $T_A$ = +125°C |
| | $I_{CCSRCL}$ | | RC Sleep mode with CLKS1/2 = CLKP1/2 = CLKRC = 100kHz (CLKMC, CLKPLL and CLKSC stopped) | - | 0.07 | - | mA | $T_A$ = +25°C |
| | | | | - | - | 2.8 | mA | $T_A$ = +105°C |
| | | | | - | - | 4.3 | 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 |
| | | | | - | - | 4 | mA | $T_A$ = +125°C |

### 14.3.2 Pin 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 Min | Value Typ | Value Max | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| "H" level input voltage | $V_{IH}$ | Port inputs Pnn_m | - | $V_{CC} \times 0.7$ | - | $V_{CC} + 0.3$ | V | CMOS Hysteresis input |
| | | | - | $V_{CC} \times 0.8$ | - | $V_{CC} + 0.3$ | V | AUTOMOTIVE Hysteresis input |
| | $V_{IHX0S}$ | X0 | External clock in "Fast Clock Input mode" | $VD \times 0.8$ | - | $VD$ | V | VD=1.8V±0.15V |
| | $V_{IHX0AS}$ | X0A | External clock in "Oscillation mode" | $V_{CC} \times 0.8$ | - | $V_{CC} + 0.3$ | V | |
| | $V_{IHR}$ | RSTX | - | $V_{CC} \times 0.8$ | - | $V_{CC} + 0.3$ | V | CMOS Hysteresis input |
| | $V_{IHM}$ | MD | - | $V_{CC} - 0.3$ | - | $V_{CC} + 0.3$ | V | CMOS Hysteresis input |
| | $V_{IHD}$ | DEBUG I/F | - | 2.0 | - | $V_{CC} + 0.3$ | V | TTL Input |
| "L" level input voltage | $V_{IL}$ | Port inputs Pnn_m | - | $V_{SS} - 0.3$ | - | $V_{CC} \times 0.3$ | V | CMOS Hysteresis input |
| | | | - | $V_{SS} - 0.3$ | - | $V_{CC} \times 0.5$ | V | AUTOMOTIVE Hysteresis input |
| | $V_{ILX0S}$ | X0 | External clock in "Fast Clock Input mode" | $V_{SS}$ | - | $VD \times 0.2$ | V | VD=1.8V±0.15V |
| | $V_{ILX0AS}$ | X0A | External clock in "Oscillation mode" | $V_{SS} - 0.3$ | - | $V_{CC} \times 0.2$ | V | |
| | $V_{ILR}$ | RSTX | - | $V_{SS} - 0.3$ | - | $V_{CC} \times 0.2$ | V | CMOS Hysteresis input |
| | $V_{ILM}$ | MD | - | $V_{SS} - 0.3$ | - | $V_{SS} + 0.3$ | V | CMOS Hysteresis input |
| | $V_{ILD}$ | DEBUG I/F | - | $V_{SS} - 0.3$ | - | 0.8 | V | TTL Input |
| "H" level output voltage | $V_{OH4}$ | 4mA type | $4.5V \leq V_{CC} \leq 5.5V$ $I_{OH} = -4mA$ | $V_{CC} - 0.5$ | - | $V_{CC}$ | V | |
| | | | $2.7V \leq V_{CC} < 4.5V$ $I_{OH} = -1.5mA$ | | | | | |
| | $V_{OH3}$ | 3mA type | $4.5V \leq V_{CC} \leq 5.5V$ $I_{OH} = -3mA$ | $V_{CC} - 0.5$ | - | $V_{CC}$ | V | |
| | | | $2.7V \leq V_{CC} < 4.5V$ $I_{OH} = -1.5mA$ | | | | | |
| "L" level output voltage | $V_{OL4}$ | 4mA type | $4.5V \leq V_{CC} \leq 5.5V$ $I_{OL} = +4mA$ | - | - | 0.4 | V | |
| | | | $2.7V \leq V_{CC} < 4.5V$ $I_{OL} = +1.7mA$ | | | | | |
| | $V_{OL3}$ | 3mA type | $2.7V \leq V_{CC} < 5.5V$ $I_{OL} = +3mA$ | - | - | 0.4 | V | |
| | $V_{OLD}$ | DEBUG I/F | $V_{CC} = 2.7V$ $I_{OL} = +25mA$ | 0 | - | 0.25 | V | |

| Parameter | Symbol | Pin name | Conditions | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | | |
| Input leak current | $I_{IL}$ | Pnn_m | $V_{SS} < V_I < V_{CC}$ $AV_{SS} < V_I < AV_{CC}$, AVRH | - 1 | - | + 1 | μA | |
| Pull-up resistance value | $R_{PU}$ | Pnn_m | $V_{CC} = 5.0V \pm 10\%$ | 25 | 50 | 100 | kΩ | |
| Input capacitance | $C_{IN}$ | Other than C, Vcc, Vss, AVcc, AVss, AVRH | - | - | 5 | 15 | pF | |

### 14.4.5 Operating Conditions of PLL

$(V_{CC} = AV_{CC} = 2.7V$ to $5.5V$, $V_{SS} = AV_{SS} = 0V$, $T_A = -40°C$ to $+125°C)$
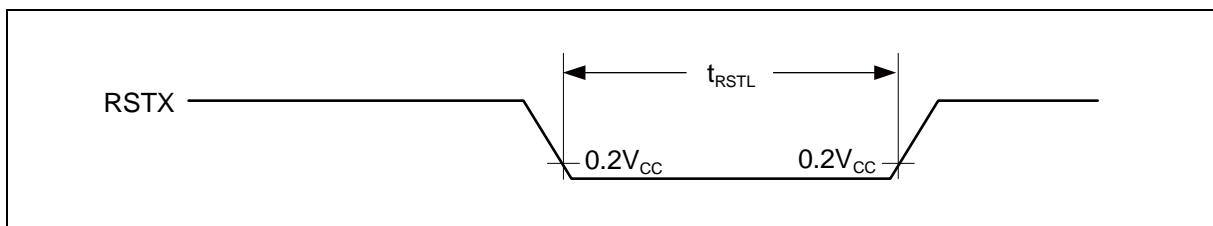
| Parameter | Symbol | Value | | | Unit | Remarks |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| PLL oscillation stabilization wait time | $t_{LOCK}$ | 1 | - | 4 | ms | For CLKMC = 4MHz |
| PLL input clock frequency | $f_{PLLI}$ | 4 | - | 8 | MHz | |
| PLL oscillation clock frequency | $f_{CLKVCO}$ | 56 | - | 108 | MHz | Permitted VCO output frequency of PLL (CLKVCO) |
| PLL phase jitter | $t_{PSKEW}$ | -5 | - | +5 | ns | For CLKMC (PLL input clock) ≥ 4MHz |
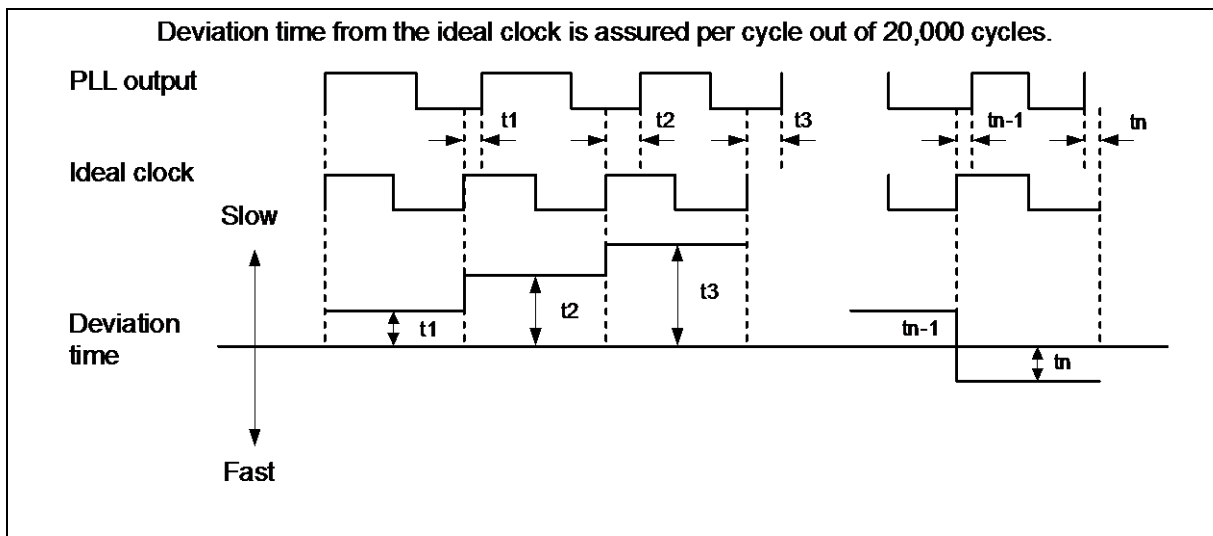


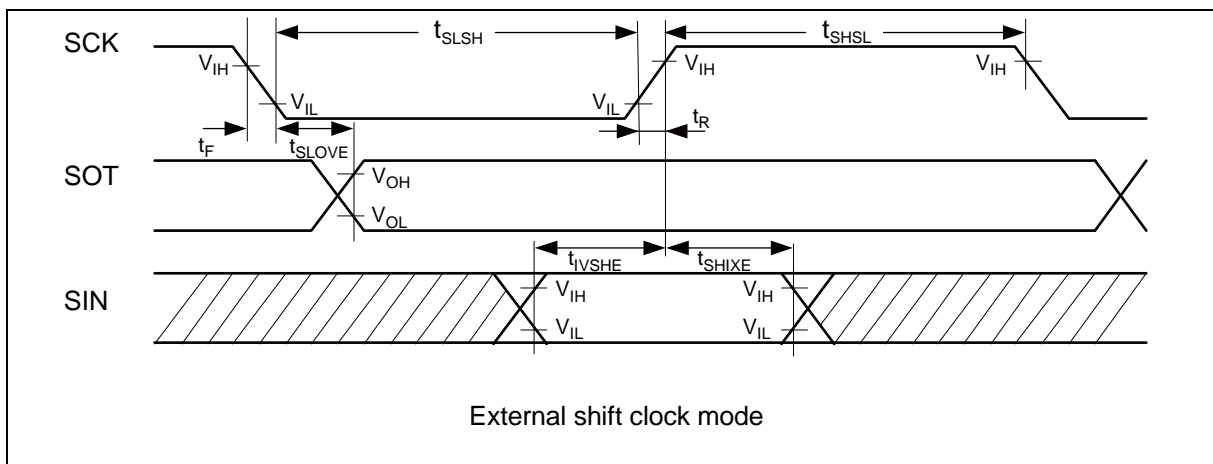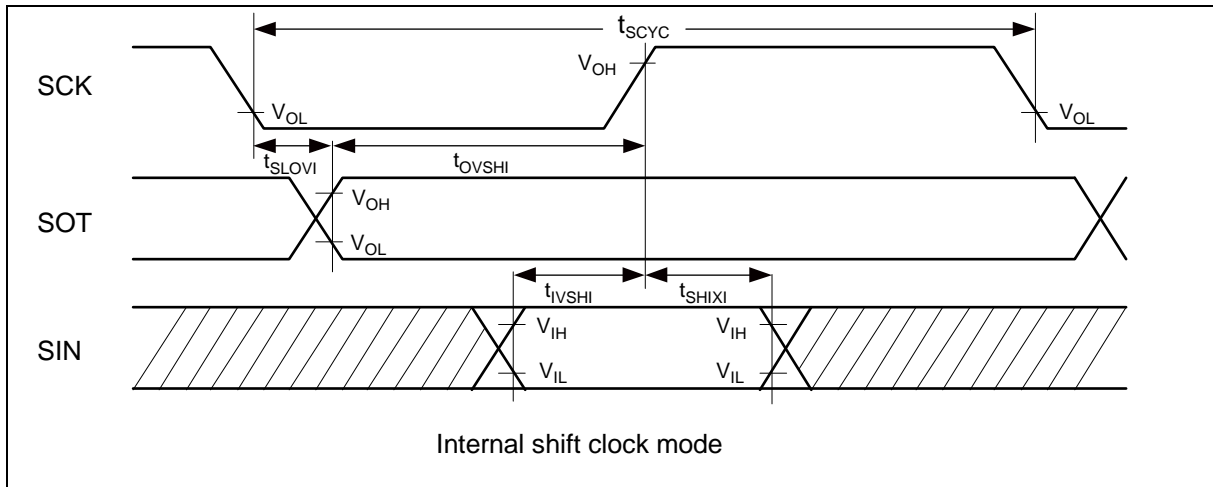### 14.4.6 Reset Input

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

| Parameter | Symbol | Pin name | Value | | Unit |
|---|---|---|---|---|---|
| | | | Min | Max | |
| Reset input time | $t_{RSTL}$ | RSTX | 10 | - | µs |
| Rejection of reset input time | | | 1 | - | µs |

Internal shift clock mode



External shift clock mode

### 14.4.10 $I^2C$ Timing

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

| Parameter | Symbol | Conditions | Typical mode | | High-speed mode[4] | | Unit |
|---|---|---|---|---|---|---|---|
| | | | Min | Max | Min | Max | |
| SCL clock frequency | $f_{SCL}$ | | 0 | 100 | 0 | 400 | kHz |
| (Repeated) START condition hold time SDA↓ → SCL↓ | $t_{HDSTA}$ | | 4.0 | - | 0.6 | - | μs |
| SCL clock "L" width | $t_{LOW}$ | | 4.7 | - | 1.3 | - | μs |
| SCL clock "H" width | $t_{HIGH}$ | | 4.0 | - | 0.6 | - | μs |
| (Repeated) START condition setup time SCL↑ → SDA↓ | $t_{SUSTA}$ | $C_L = 50pF$, $R = (Vp/I_{OL})$[1] | 4.7 | - | 0.6 | - | μs |
| Data hold time SCL↓ → SDA↓↑ | $t_{HDDAT}$ | | 0 | 3.45[2] | 0 | 0.9[3] | μs |
| Data setup time SDA↓↑ → SCL↑ | $t_{SUDAT}$ | | 250 | - | 100 | - | ns |
| STOP condition setup time SCL↑ → SDA↑ | $t_{SUSTO}$ | | 4.0 | - | 0.6 | - | μs |
| Bus free time between "STOP condition" and "START condition" | $t_{BUS}$ | | 4.7 | - | 1.3 | - | μs |
| Pulse width of spikes which will be suppressed by input noise filter | $t_{SP}$ | - | 0 | $(1-1.5) \times t_{CLKP1}$[5] | 0 | $(1-1.5) \times t_{CLKP1}$[5] | ns |

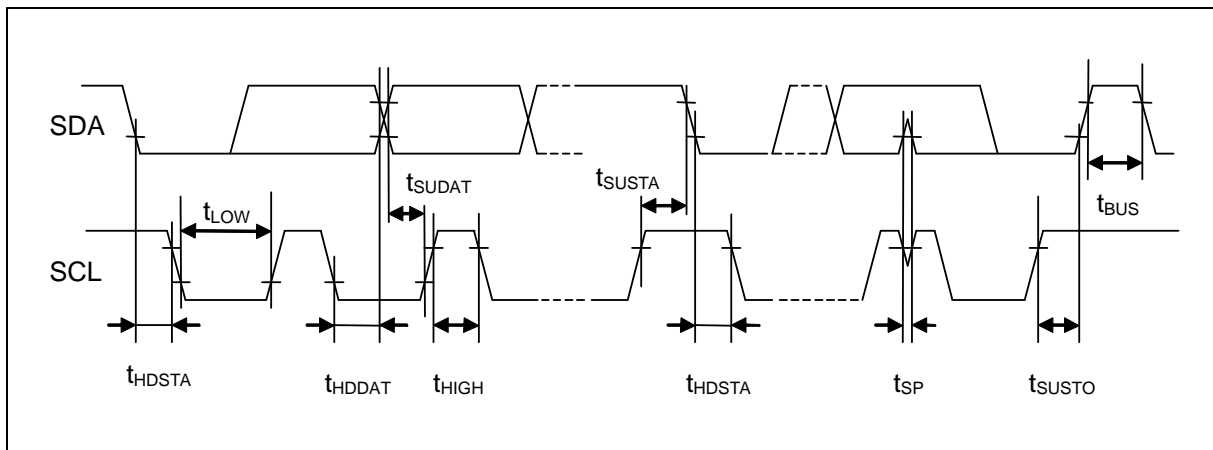[1]: R and $C_L$ represent the pull-up resistance and load capacitance of the SCL and SDA lines, respectively. Vp indicates the power supply voltage of the pull-up resistance and $I_{OL}$ indicates $V_{OL}$ guaranteed current.
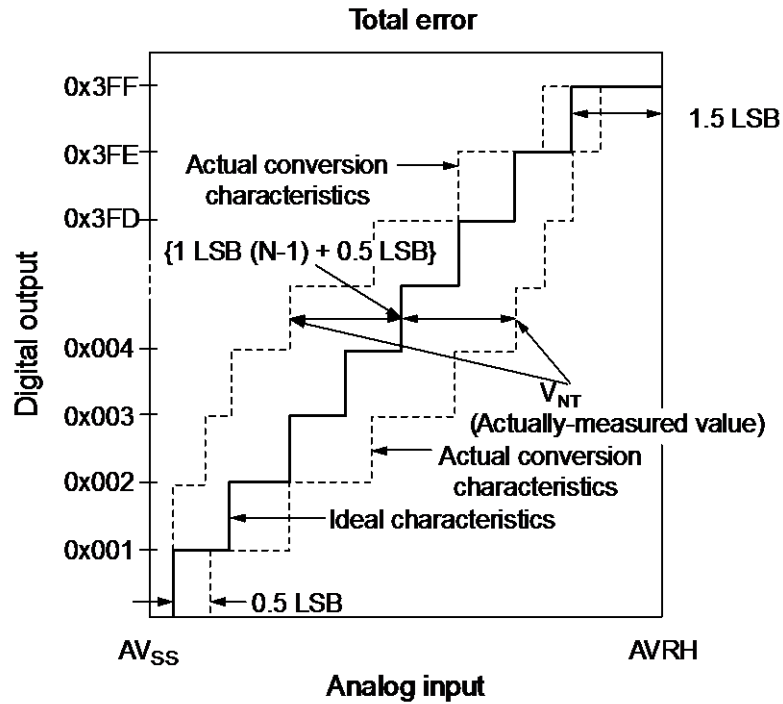
[2]: The maximum $t_{HDDAT}$ only has to be met if the device does not extend the "L" width ($t_{LOW}$) of the SCL signal.

[3]: A high-speed mode $I^2C$ bus device can be used on a standard mode $I^2C$ bus system as long as the device satisfies the requirement of "$t_{SUDAT} ≥ 250ns$".

[4]: For use at over 100kHz, set the peripheral clock1 (CLKP1) to at least 6MHz.

[5]: $t_{CLKP1}$ indicates the peripheral clock1 (CLKP1) cycle time.

**Total error**

Digital output

0x3FF

0x3FE

0x3FD

Actual conversion characteristics

{1 LSB (N-1) + 0.5 LSB}

0x004

0x003

0x002

0x001

$V_{NT}$
(Actually-measured value)

Actual conversion characteristics

Ideal characteristics

0.5 LSB

1.5 LSB

$AV_{SS}$          AVRH

**Analog input**

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

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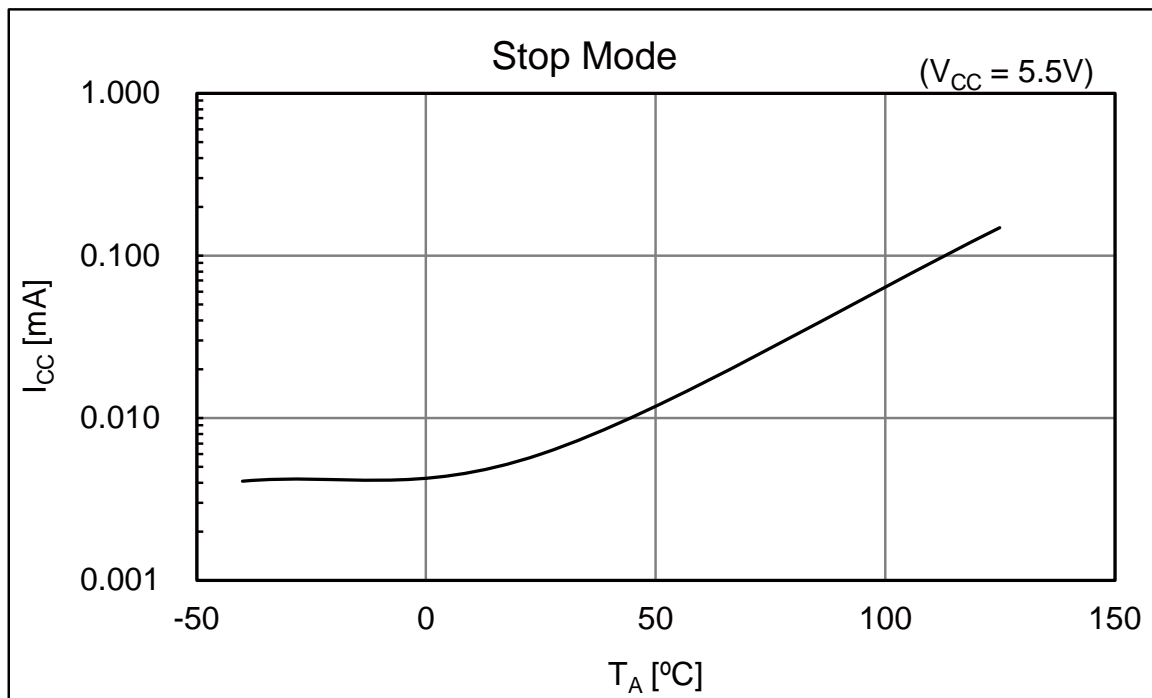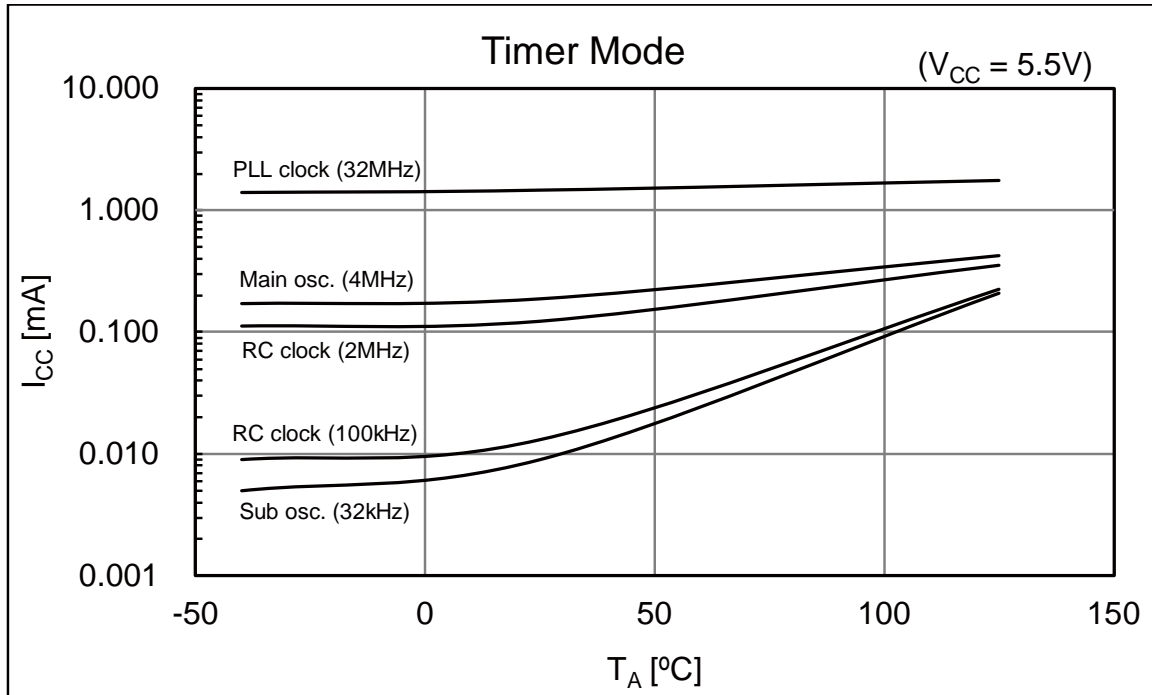
N : A/D converter digital output value.
$V_{NT}$ : Voltage at which the digital output changes from 0x(N + 1) to 0xN.
$V_{OT}$ (Ideal value) = $AV_{SS}$ + 0.5LSB[V]
$V_{FST}$ (Ideal value) = AVRH - 1.5LSB[V]

■MB96F637



Timer Mode graph (V_CC = 5.5V): I_CC [mA] versus T_A [°C] showing curves for PLL clock (32MHz), Main osc. (4MHz), RC clock (2MHz), RC clock (100kHz), and Sub osc. (32kHz).



Stop Mode graph (V_CC = 5.5V): I_CC [mA] versus T_A [°C].

## 16. Ordering Information

MCU with CAN controller

| Part number | Flash memory | Package* |
|---|---|---|
| MB96F633RBPMC-GSE1 | Flash A (96.5KB) | 80-pin plastic LQFP (FPT-80P-M21) |
| MB96F633RBPMC-GSE2 | | |
| MB96F635RBPMC-GSE1 | Flash A (160.5KB) | 80-pin plastic LQFP (FPT-80P-M21) |
| MB96F635RBPMC-GSE2 | | |
| MB96F636RBPMC-GSE1 | Flash A (288.5KB) | 80-pin plastic LQFP (FPT-80P-M21) |
| MB96F636RBPMC-GSE2 | | |
| MB96F637RBPMC-GSE1 | Flash A (416.5KB) | 80-pin plastic LQFP (FPT-80P-M21) |
| MB96F637RBPMC-GSE2 | | |

*: For details about package, see "Package Dimension".

MCU without CAN controller

| Part number | Flash memory | Package* |
|---|---|---|
| MB96F633ABPMC-GSE1 | Flash A (96.5KB) | 80-pin plastic LQFP (FPT-80P-M21) |
| MB96F633ABPMC-GSE2 | | |
| MB96F635ABPMC-GSE1 | Flash A (160.5KB) | 80-pin plastic LQFP (FPT-80P-M21) |
| MB96F635ABPMC-GSE2 | | |

*: For details about package, see "Package Dimension".

| Page | Section | Change Results |
|------|---------|----------------|
| 21 | Interrupt Vector Table | Changed the Description of CALLV0 to CALLV7<br>Reserved<br>→<br>CALLV instruction |
| | | Changed the Description of RESET<br>Reserved<br>→<br>Reset vector |
| | | Changed the Description of INT9<br>Reserved<br>→<br>INT9 instruction |
| | | Changed the Description of EXCEPTION<br>Reserved<br>→<br>Undefined instruction execution |
| 22 | | Changed the Vector name of Vector number 64<br>PPGRLT<br>→<br>RLT6 |
| | | Changed the Description of Vector number 64<br>Reload Timer 6 can be used as PPG clock source<br>→<br>Reload Timer 6 |
| 25 to 28 | Handling Precautions | Added a section |
| 30 | Handling Devices | Added the description to "3. External clock usage"<br>(3) Opposite phase external clock |
| | | Changed the description in "7. Turn on sequence of power supply to A/D converter and analog inputs"<br><br>In this case, the voltage must not exceed AVRH or AV$_{CC}$<br>→<br>In this case, AVRH must not exceed AV$_{CC}$. Input voltage for ports shared with analog input ports also must not exceed AV$_{CC}$ |
| 31 | | Added the description "12. Mode Pin (MD)" |
| 33 | Electrical Characteristics<br>1. Absolute Maximum Ratings | Changed the annotation *4<br>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).<br>→<br>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. |
| 33 | 1. Absolute Maximum Ratings | Added the annotation *4<br>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. |
| 35 | 2. Recommended Operating Conditions | Added the Value and Remarks to "Power supply voltage"<br>Min: 2.0V<br>Typ: -<br>Max: 5.5V<br>Remarks: Maintains RAM data in stop mode |
| | | Changed the Value of "Smoothing capacitor at C pin"<br>Typ: 1.0μF → 1.0μF to 3.9μF<br>Max: 1.5μF → 4.7μF |
| | | Changed the Remarks of "Smoothing capacitor at C pin"<br>Deleted "(Target value)"<br>Added "3.9μF (Allowance within ± 20%)" |