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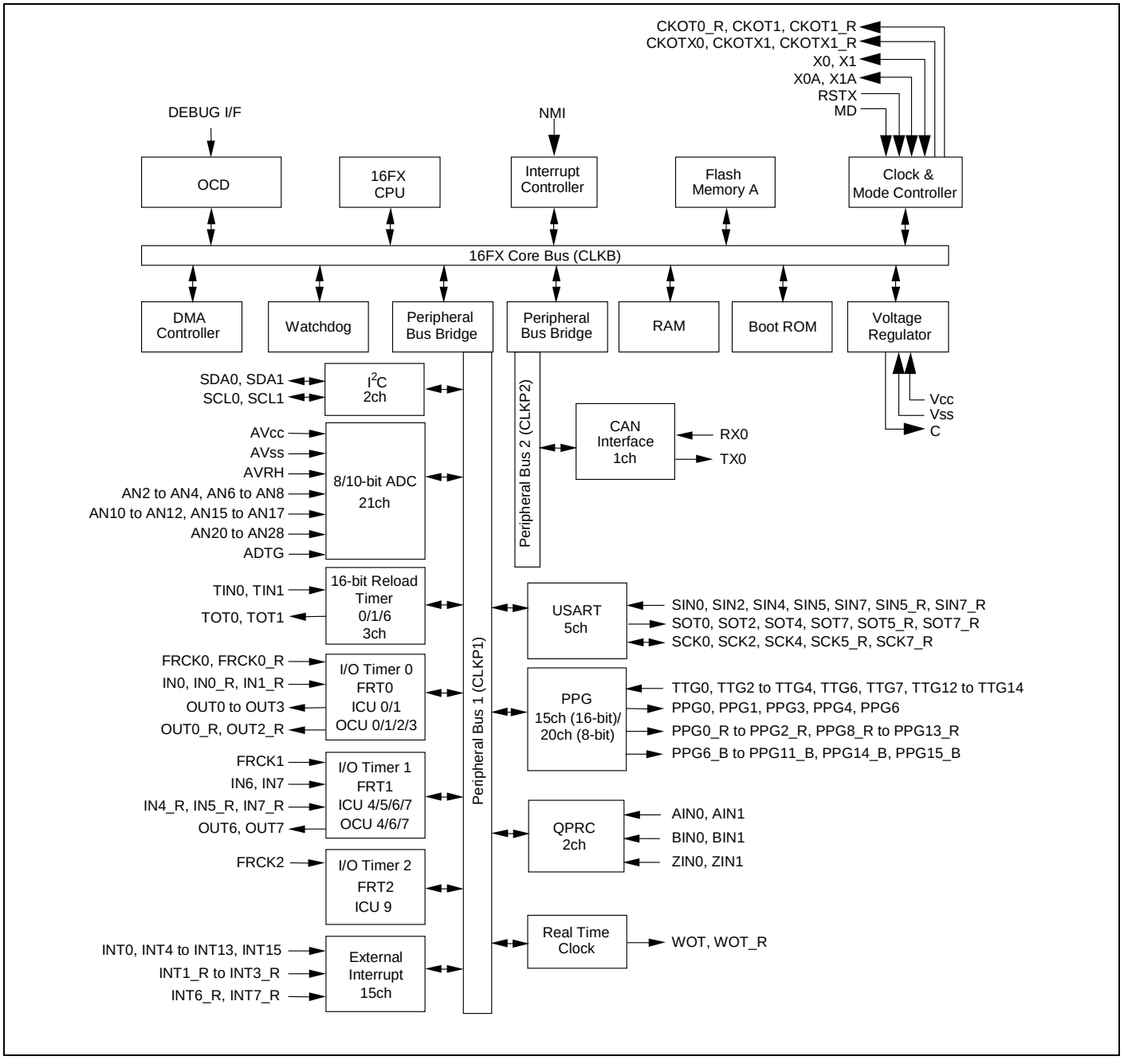
What is "Embedded - Microcontrollers"?

"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"

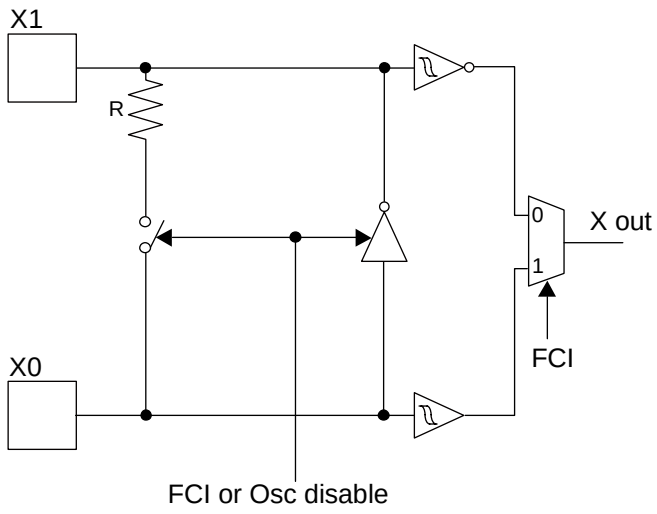
Details	
Product Status	Obsolete
Core Processor	F²MC-16FX
Core Size	16-Bit
Speed	32MHz
Connectivity	CANbus, I²C, LINbus, SCI, UART/USART
Peripherals	DMA, LVD, POR, PWM, WDT
Number of I/O	64
Program Memory Size	288KB (288K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	24K x 8
Voltage - Supply (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/mb96f636rbpmc-gse2

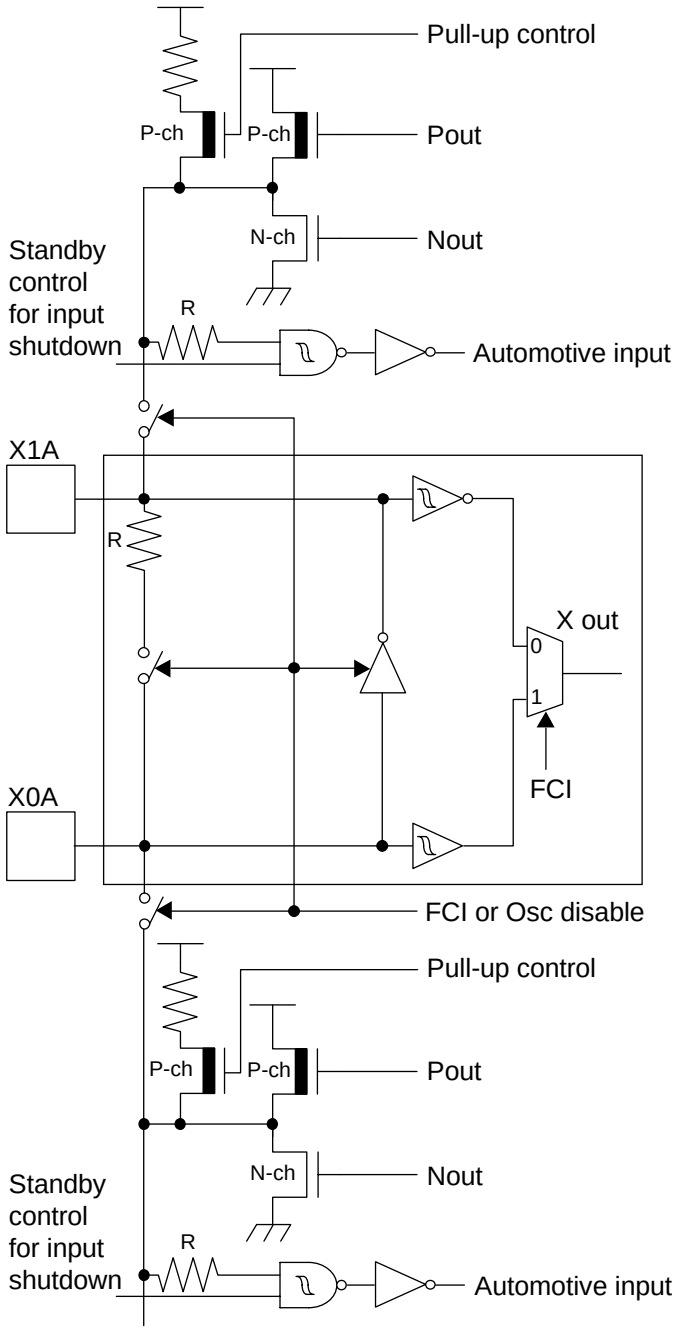
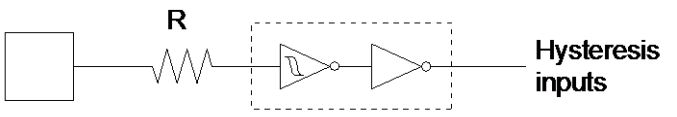
2. Block Diagram



Pin no.	I/O circuit type*	Pin name
39	M	P10_2 / SCK2 / PPG6
40	Supply	Vcc
41	Supply	Vss
42	O	DEBUG I/F
43	H	P17_0
44	C	MD
45	A	X0
46	A	X1
47	Supply	Vss
48	B	P04_0 / X0A
49	B	P04_1 / X1A
50	C	RSTX
51	H	P11_1 / PPG0_R
52	H	P11_2 / PPG1_R
53	H	P11_3 / PPG2_R
54	H	P11_6 / FRCK0_R / ZIN1
55	H	P11_7 / IN0_R / AIN1
56	H	P12_0 / IN1_R / BIN1
57	H	P12_3 / OUT2_R
58	H	P12_7 / INT1_R
59	H	P00_0 / INT3_R / FRCK2
60	Supply	Vcc
61	Supply	Vss
62	H	P00_3 / INT6_R / PPG8_B
63	H	P00_4 / INT7_R / PPG9_B
64	H	P00_5 / IN6 / TTG2 / TTG6 / PPG10_B
65	H	P00_6 / IN7 / TTG3 / TTG7 / PPG11_B
66	H	P01_1 / CKOT1 / OUT0 / SOT7
67	M	P01_2 / CKOTX1 / OUT1 / INT15 / SIN7
68	M	P01_4 / SIN4 / INT8
69	H	P01_5 / SOT4
70	M	P01_6 / SCK4 / TTG12
71	M	P01_7 / CKOTX1_R / INT9 / TTG13 / ZIN0 / SCK7_R
72	H	P02_0 / CKOT1_R / INT10 / TTG14 / AIN0 / SOT7_R
73	M	P02_2 / IN7_R / CKOT0_R / INT12 / BIN0 / SIN7_R
74	M	P02_5 / OUT0_R / INT13 / SIN5_R
75	H	P03_2 / PPG14_B / SOT5_R
76	M	P03_3 / PPG15_B / SCK5_R
77	M	P03_4 / RX0 / INT4

6. 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) • Feedback resistor = approx. 1.0MΩ • The amplitude: 1.8V±0.15V to operate by the internal supply voltage

Type	Circuit	Remarks
B		Low-speed oscillation circuit shared with GPIO functionality: • Feedback resistor = approx. 5.0MΩ • GPIO functionality selectable (CMOS level output (I_{OL} = 4mA, I_{OH} = -4mA), Automotive input with input shutdown function and programmable pull-up resistor)
C		CMOS hysteresis input pin

8. RAMSTART Addresses

Devices	Bank 0 RAM size	RAMSTART0
MB96F633	10KB	$00:5A00_H$
MB96F635	16KB	$00:4200_H$
MB96F636	24KB	$00:2200_H$
MB96F637	28KB	$00:1200_H$

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	$3B4_H$	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	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	-	-	31	Reserved
32	$37C_H$	EXTINT15	Yes	32	External Interrupt 15
33	378_H	CAN0	No	33	CAN Controller 0
34	374_H	-	-	34	Reserved
35	370_H	-	-	35	Reserved
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

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.

■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. 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	$\Sigma\|I_{CLAMP}\|$	-	-	21	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	ΣI_{OL}	-	-	52	mA	
"L" level average overall output current	ΣI_{OLAV}	-	-	26	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	ΣI_{OH}	-	-	-52	mA	
"H" level average overall output current	ΣI_{OHAV}	-	-	-26	mA	
Power consumption*[5]	P_D	T_A= +125°C	-	396*[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.

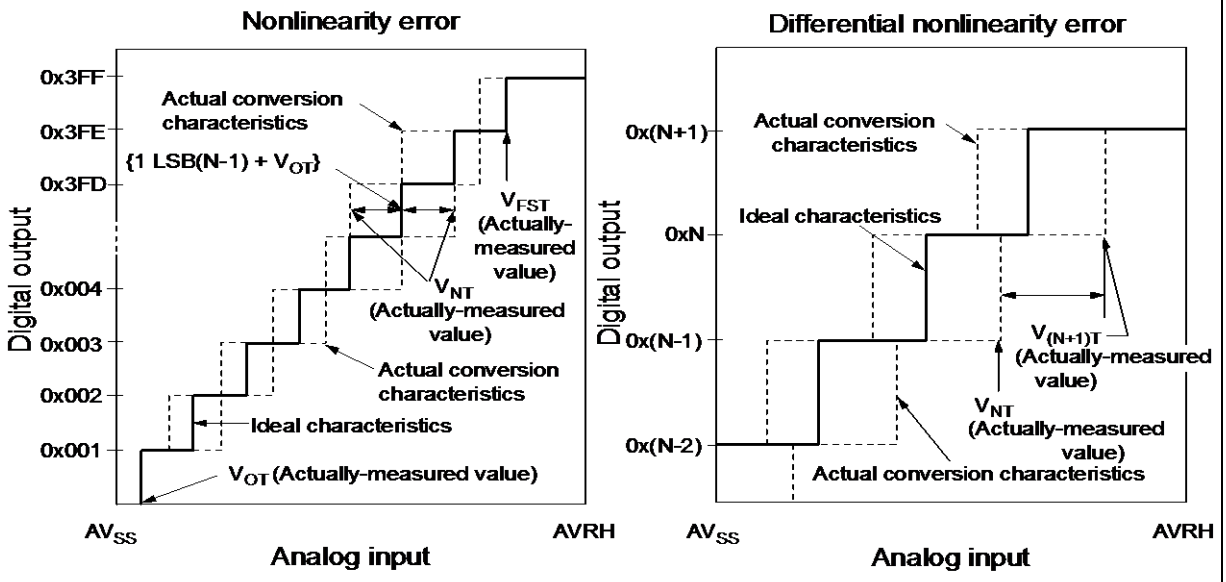
*[3]: V_I and V_O should not exceed V_{CC} + 0.3V. V_I should also not exceed the specified ratings. However if the maximum current to/from an input is limited by some means with external components, the I_{CLAMP} rating supersedes the V_I rating. Input/Output voltages of standard ports depend on V_{CC}.

*[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.

14.5.3 Definition of A/D Converter Terms

- Resolution : Analog variation that is recognized by an A/D converter.
- Nonlinearity error : Deviation of the actual conversion characteristics from a straight line that connects the zero transition point (0b0000000000 ⟷ 0b0000000001) to the full-scale transition point (0b1111111110 ⟷ 0b1111111111).
- Differential nonlinearity error : Deviation from the ideal value of the input voltage that is required to change the output code by 1LSB.
- Total error : Difference between the actual value and the theoretical value. The total error includes zero transition error, full-scale transition error and nonlinearity error.
- Zero transition voltage : Input voltage which results in the minimum conversion value.
- Full scale transition voltage: Input voltage which results in the maximum conversion value.



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

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

$$1LSB = \frac{V_{FST} - V_{OT}}{1022}$$

N : A/D converter digital output value.
V_{OT} : Voltage at which the digital output changes from 0x000 to 0x001.
V_{FST} : Voltage at which the digital output changes from 0x3FE to 0x3FF.
V_{NT} : Voltage at which the digital output changes from 0x(N − 1) to 0xN.

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	$T_A \leq$ + 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	$T_A \leq$ + 105°C	-	25	400	µs	Not including system-level overhead time.
	Small Sector	-	-	25	400	µs	
Chip erase time		$T_A \leq$ + 105°C	-	11.51	55.05	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].

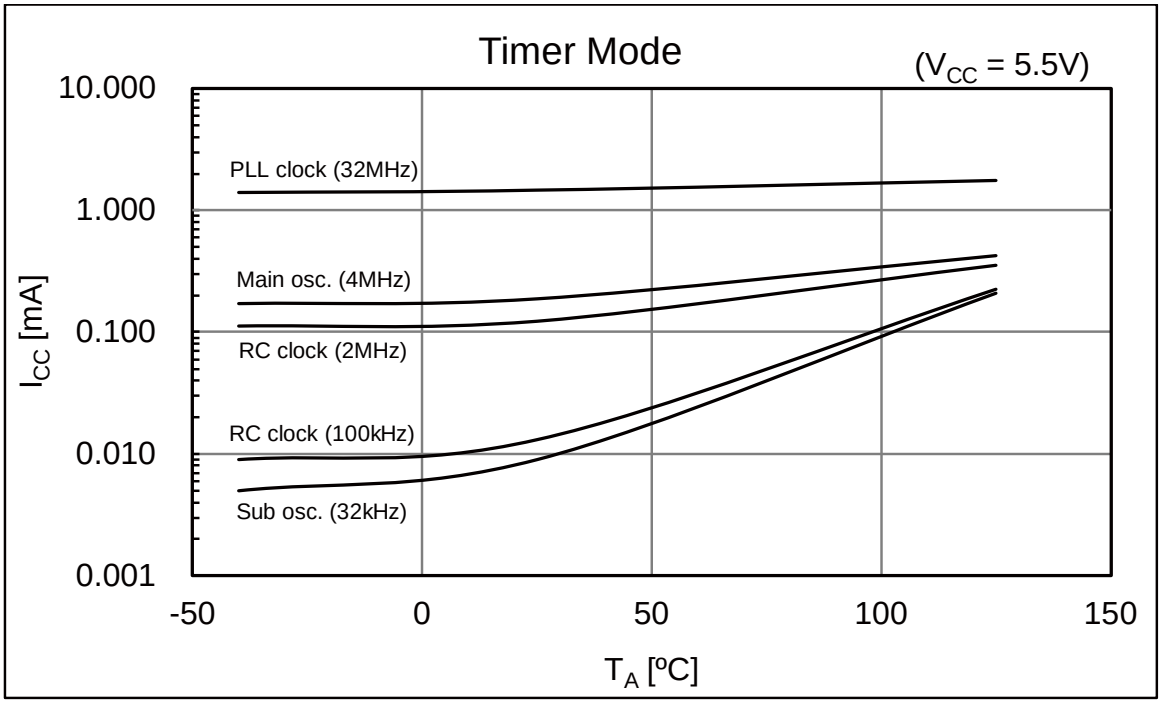
Write/Erase cycles and data hold time

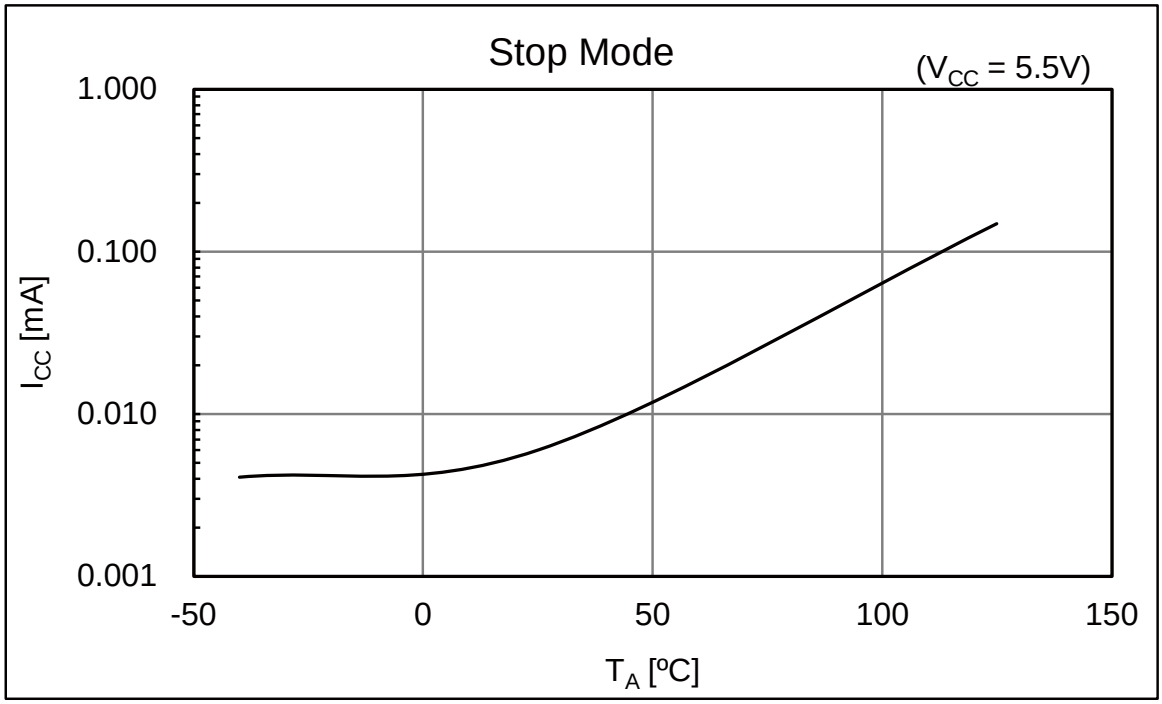
Write/Erase cycles (cycle)	Data hold time (year)
1,000	20 [*2]
10,000	10 [*2]
100,000	5 [*2]

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

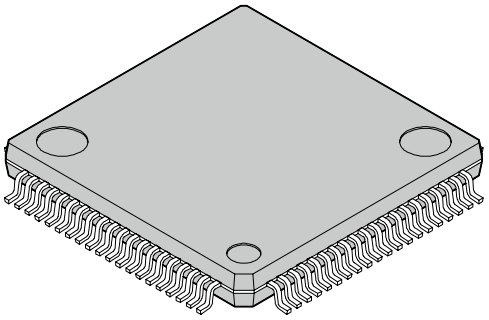
[*2]: This value comes from the technology qualification (using Arrhenius equation to translate high temperature measurements into normalized value at + 85°C).

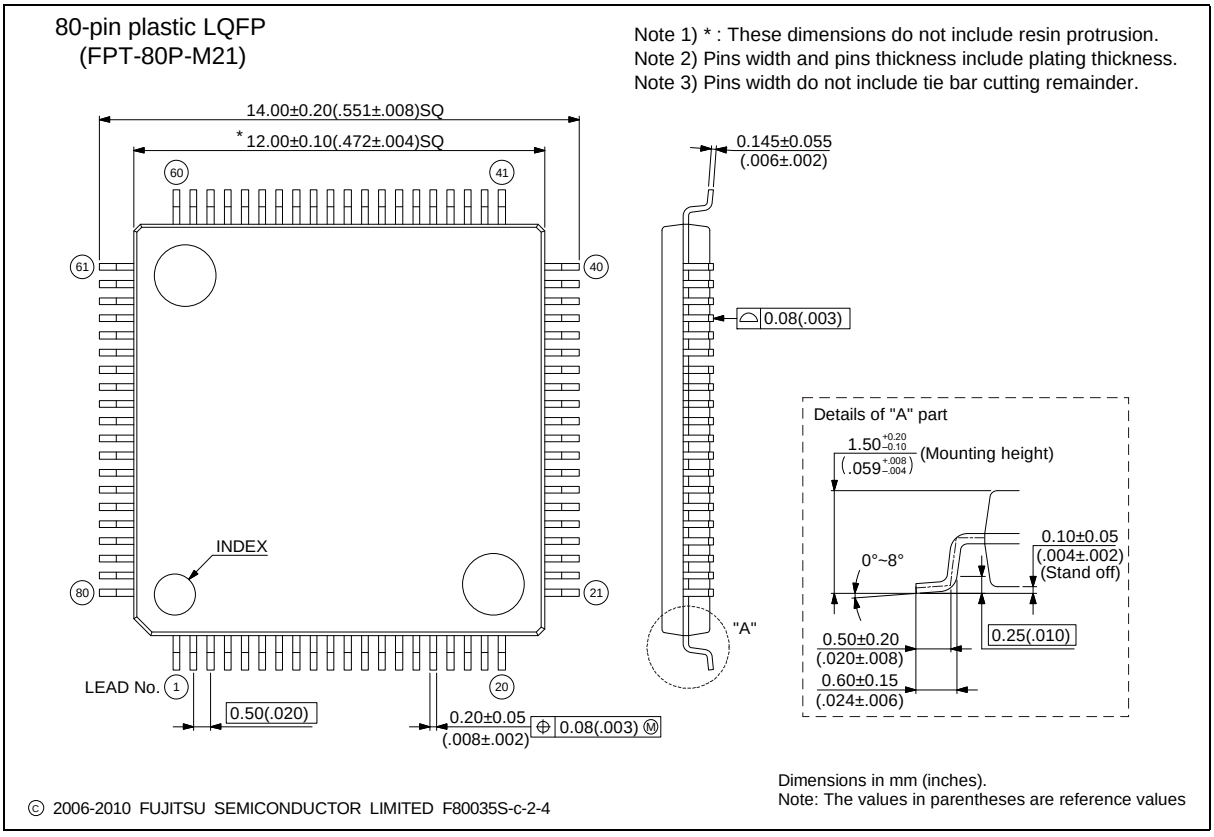
■MB96F637


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]

17. Package Dimension

80-pin plastic LQFP		
	Lead pitch	0.50 mm
	Package width × package length	12 mm × 12 mm
	Lead shape	Gullwing
	Sealing method	Plastic mold
	Mounting height	1.70 mm Max
	Weight	0.47 g
(FPT-80P-M21)	Code (Reference)	P-LFQFP80-12×12-0.50



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

Page	Section	Change Results
36	3. DC Characteristics (1) Current Rating	Deleted “(Target value)” from Remarks
		Added the Symbol to “Power supply current in Run modes” I_{CCRCH}, I_{CCRCL}
		Changed the Conditions of I_{CCPLL}, I_{CCMAIN}, I_{CCSUB} in “Power supply current in Run modes” “Flash 0 wait” is added
		Changed the Value of “Power supply current in Run modes” I_{CCPLL} Max: 37.5mA → 37mA (T_A = +105°C) Max: 39mA → 38.5mA (T_A = +125°C) I_{CCMAIN} Max: 9mA → 8mA (T_A = +105°C) Max: 10.5mA → 9.5mA (T_A = +125°C) I_{CCSUB} Max: 6mA → 3.3mA (T_A = +105°C) Max: 7.5mA → 4.8mA (T_A = +125°C)
37		Added the Symbol to “Power supply current in Sleep modes” I_{CCSRCH}, I_{CCSRCL}
		Changed the Conditions of $I_{CCSMAIN}$ in “Power supply current in Sleep modes” “SMCR:LPMSS=0” is added
		Changed the Value of “Power supply current in Sleep modes” I_{CCSPLL} Typ: 10mA → 8.5mA (T_A = +25°C) Max : 15mA → 14mA (T_A = +105°C) Max : 16.5mA → 15.5mA (T_A = +125°C) $I_{CCSMAIN}$ Max: 7mA → 4.5m A (T_A = +105°C) Max : 8.5mA → 6mA (T_A = +125°C) I_{CCSSUB} Typ: 0.08mA → 0.04m A (T_A = +25°C) Max: 4mA → 2.5m A (T_A = +105°C) Max : 5.5mA → 4mA (T_A = +125°C)
38		Added the Symbol to “Power supply current in Timer modes” I_{CCTPLL}
		Changed the Conditions of $I_{CCTMAIN}$, I_{CCTRCH} in “Power supply current in Timer modes” “SMCR:LPMSS=0” is added
		Changed the Value of “Power supply current in Timer modes” $I_{CCTMAIN}$ Max: 355µA → 330µA (T_A = +25°C) Max: 1300µA → 1195µA (T_A = +105°C) Max: 2310µA → 2165µA (T_A = +125°C) I_{CCTRCH} Max: 245µA → 215µA (T_A = +25°C) Max: 1215µA → 1095µA (T_A = +105°C) Max: 2215µA → 2075µA (T_A = +125°C) I_{CCTRCL} Max: 105µA → 75µA (T_A = +25°C) Max: 1010µA → 905µA (T_A = +105°C) Max: 2015µA → 1880µA (T_A = +125°C) I_{CCTSUB} Max: 90µA → 65µA (T_A = +25°C) Max: 985µA → 885µA (T_A = +105°C) Max: 1990µA → 1850µA (T_A = +125°C)

Page	Section	Change Results
39	3. DC Characteristics (1) Current Rating	Changed the Value of “Power supply current in Stop modes” I_{CCH} Max: 90µA → 60µA (T_A = +25°C) Max: 985µA → 880µA (T_A = +105°C) Max: 1985µA → 1845µA (T_A = +125°C)
		Added the Symbol $I_{CCFLASHPD}$
		Changed the Value and condition of “Power supply current for active Low Voltage detector” I_{CCLVD} Typ: 5µA, Max: 15µA, Remarks: nothing → Typ: 5µA, Max: -, Remarks: T_A = +25°C Typ: -, Max: 12.5µA, Remarks: T_A = +125°C
		Changed the condition of “Flash Write/Erase current” $I_{CCFLASH}$ Typ: 12.5mA, Max: 20mA, Remarks: nothing → Typ: 12.5mA, Max: -, Remarks: T_A = +25°C Typ: -, Max: 20mA, Remarks: T_A = +125°C
		Changed the annotation *2 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. → When Flash is not in Power-down / reset mode, $I_{CCFLASHPD}$ must be added to the Power supply current. 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. The current for "On Chip Debugger" part is not included.
40	3. DC Characteristics (2) Pin Characteristics	Added the Symbol for DEBUG I/F pin V_{OLD}
41		Changed the Pin name of “Input capacitance” Other than Vcc, Vss, AVcc, AVss, AVRH → Other than C, Vcc, Vss, AVcc, AVss, AVRH
		Deleted the annotation “I_{OH} and I_{OL} are target value.”
42	4. AC Characteristics (1) Main Clock Input Characteristics	Changed MAX frequency for f_{FCI} in all conditions 16→8 Changed MIN frequency for t_{CYLH} 62.5→125 Changed MIN, MAX and Unit for P_{WH} , P_{WL} MIN: 30→55 MAX: 70→- Unit: %→ns
		Added the figure (t_{CYLH}) when using the external clock
43	4. AC Characteristics (2) Sub Clock Input Characteristics	Added the figure (t_{CYLL}) when using the crystal oscillator clock

Page	Section	Change Results
44	4. AC Characteristics (3) Built-In RC Oscillation Characteristics	Added “RC clock stabilization time”
45	4. AC Characteristics (5) Operating Conditions Of PLL	Changed the Value of “PLL input clock frequency” Max: 16MHz → 8MHz
		Changed the Symbol of “PLL oscillation clock frequency” f_{PLLO} → f_{CLKVCO}
		Added Remarks to “PLL oscillation clock frequency”
		Added “ PLL phase jitter” and the figure
	4. Ac Characteristics (6) Reset Input	Added the figure for reset input time (t_{RSTL})
47	4. Ac Characteristics (8) Usart Timing	Changed the condition (VCC = AVCC = 2.7V to 5.5V, VSS = AVSS = 0V, TA = - 40°C to + 105°C) → (V_{CC} = AV_{CC} = 2.7V to 5.5V, V_{SS} = AV_{SS} = 0V, T_A = - 40°C to + 125°C, C_L=50pF)
		Changed the HARDWARE MANUAL “MB96630 series HARDWARE MANUAL” → “MB96600 series HARDWARE MANUAL”
48		Changed the figure for “Internal shift clock mode”
50	4. AC Characteristics (10) I^2C Timing	Added parameter, “Noise filter” and an annotation *5 for it
		Added t_{SP} to the figure
51	5. A/D Converter (1) Electrical Characteristics For The A/D Converter	Added “Analog impedance”
		Added “Variation between channels”
		Added the annotation
52	5. A/D Converter (2) Accuracy And Setting Of The A/D Converter Sampling Time	Deleted the unit “[Min]” from approximation formula of Sampling time
53	5. A/D Converter (3) Definition Of A/D Converter Terms	Changed the Description and the figure “Linearity” → “Nonlinearity” “Differential linearity error” → “Differential nonlinearity error”
		Changed the Description Linearity error: Deviation of the line between the zero-transition point (0b0000000000←→0b0000000001) and the full-scale transition point (0b1111111110←→0b1111111111) from the actual conversion characteristics. → Nonlinearity error: Deviation of the actual conversion characteristics from a straight line that connects the zero transition point (0b0000000000 ←→ 0b0000000001) to the full-scale transition point (0b1111111110 ←→ 0b1111111111).
		Added the Description “Zero transition voltage” “Full scale transition voltage”
55	6. Low Voltage Detection Function Characteristics	Added the Value of “ Power supply voltage change rate” Max: +0.004 V/µs
		Added “Hysteresis width” (V_{HYS})
		Added “Stabilization time” ($T_{LVDSTAB}$)
		Added “Detection delay time” (t_d)
		Deleted the Remarks
		Added the annotation *1, *2
56		Added the figure for “Hysteresis width”
		Added the figure for “Stabilization time”

Page	Section	Change Results
57	7. Flash Memory Write/Erase Characteristics	Changed the Value of “Sector erase time”
		Added “Security Sector” to “Sector erase time”
		Changed the Parameter “Half word (16 bit) write time” → “Word (16-bit) write time”
		Changed the Value of “Chip erase time”
		Changed the Remarks of “Sector erase time” Excludes write time prior to internal erase → Includes write time prior to internal erase
		Added the Note and annotation *1
		Deleted “(targeted value)” from title “ Write/Erase cycles and data hold time”
58 to 60	Example Characteristics	Added a section
61	Ordering Information	Changed part number MCU with CAN controller MB96F636RAPMC-GSE1* → MB96F636RBPMC-GSE1 MB96F636RAPMC-GSE2* → MB96F636RBPMC-GSE2 MB96F637RAPMC-GSE1* → MB96F637RBPMC-GSE1 MB96F637RAPMC-GSE2* → MB96F637RBPMC-GSE2
61	Ordering Information	Added part number MCU with CAN controller MB96F633RBPMC-GSE1 MB96F633RBPMC-GSE2 MB96F635RBPMC-GSE1 MB96F635RBPMC-GSE2 MCU without CAN controller MB96F633ABPMC-GSE1 MB96F633ABPMC-GSE2 MB96F635ABPMC-GSE1 MB96F635ABPMC-GSE2
Revision 1.1		
-	-	Company name and layout design change

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