Infineon Technologies - MB96F685RBPMC-GSE1 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.

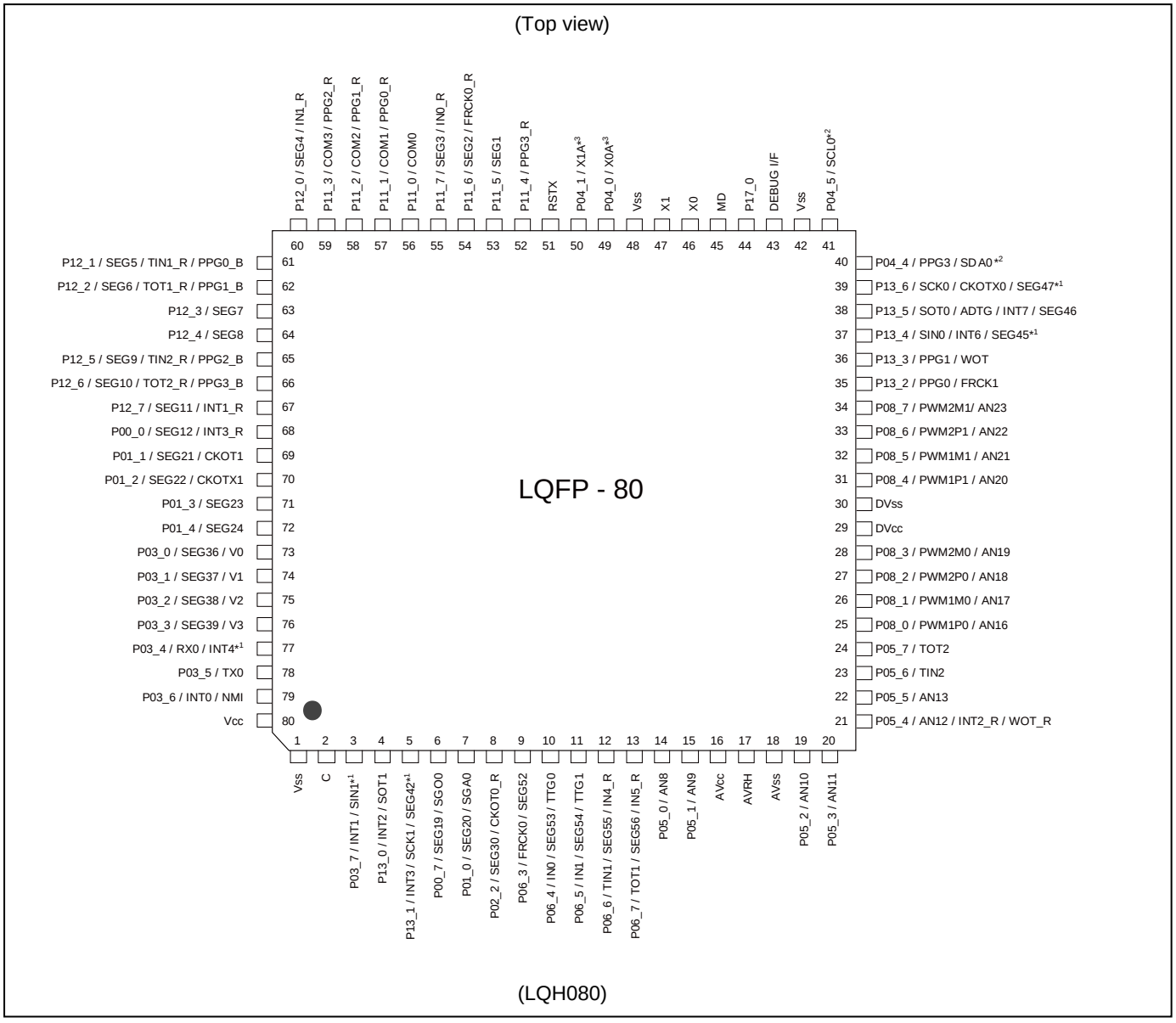
Applications of "Embedded - Microcontrollers"

Details	
Product Status	Obsolete
Core Processor	F²MC-16FX
Core Size	16-Bit
Speed	32MHz
Connectivity	CANbus, I²C, LINbus, SCI, UART/USART
Peripherals	DMA, LCD, LVD, POR, PWM, WDT
Number of I/O	65
Program Memory Size	160KB (160K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	4K x 8
Voltage - Supply (Vcc/Vdd)	2.7V ~ 5.5V
Data Converters	A/D 14x8/10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 105°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/mb96f685rbpmc-gse1

- Built-in On Chip Debugger (OCD)
  - One-wire debug tool interface
  - Break function:
    - Hardware break: 6 points (shared with code event)
    - Software break: 4096 points
  - Event function
    - Code event: 6 points (shared with hardware break)
    - Data event: 6 points
    - Event sequencer: 2 levels + reset
  - Execution time measurement function
  - Trace function: 42 branches
  - Security function
- Flash Memory
  - Dual operation flash allowing reading of one Flash bank while programming or erasing the other bank
  - Command sequencer for automatic execution of programming algorithm and for supporting DMA for programming of the Flash Memory
  - Supports automatic programming, Embedded Algorithm
  - Write/Erase/Erase-Suspend/Resume commands
  - A flag indicating completion of the automatic algorithm
  - Erase can be performed on each sector individually
  - Sector protection
  - Flash Security feature to protect the content of the Flash
  - Low voltage detection during Flash erases or writes

Contents

3. Pin Assignment

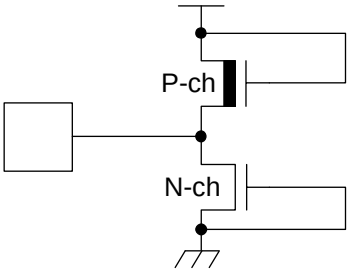
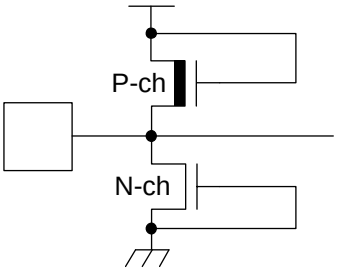
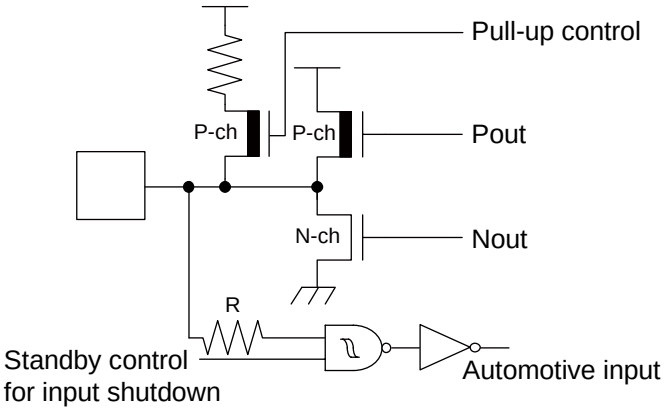
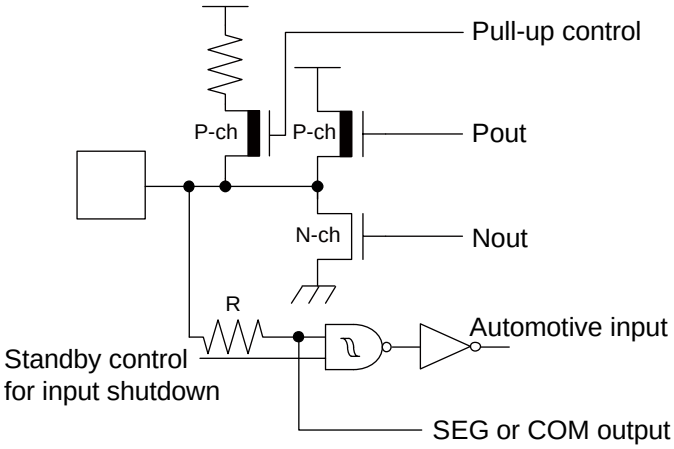


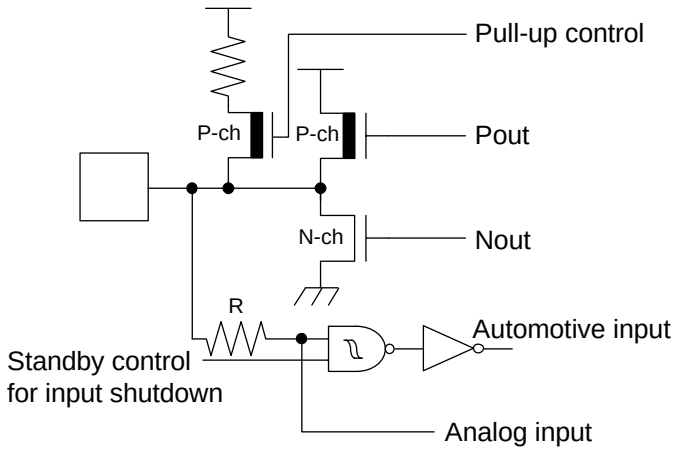
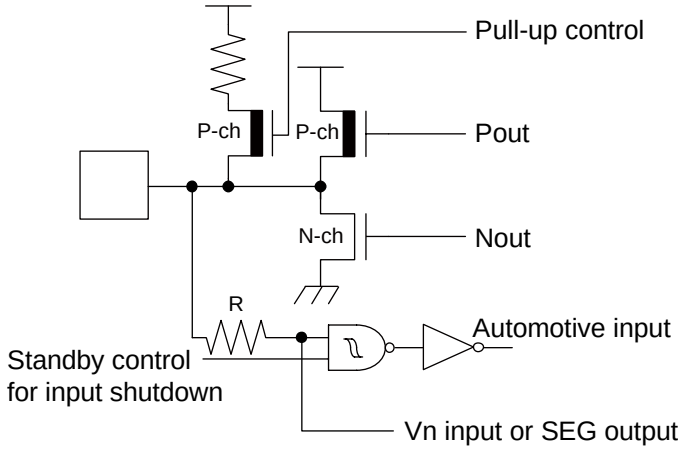
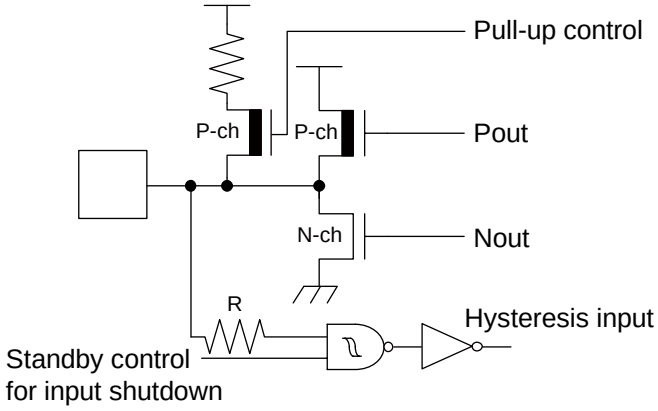
*1: CMOS input level only

*2: CMOS input level only for I^2C

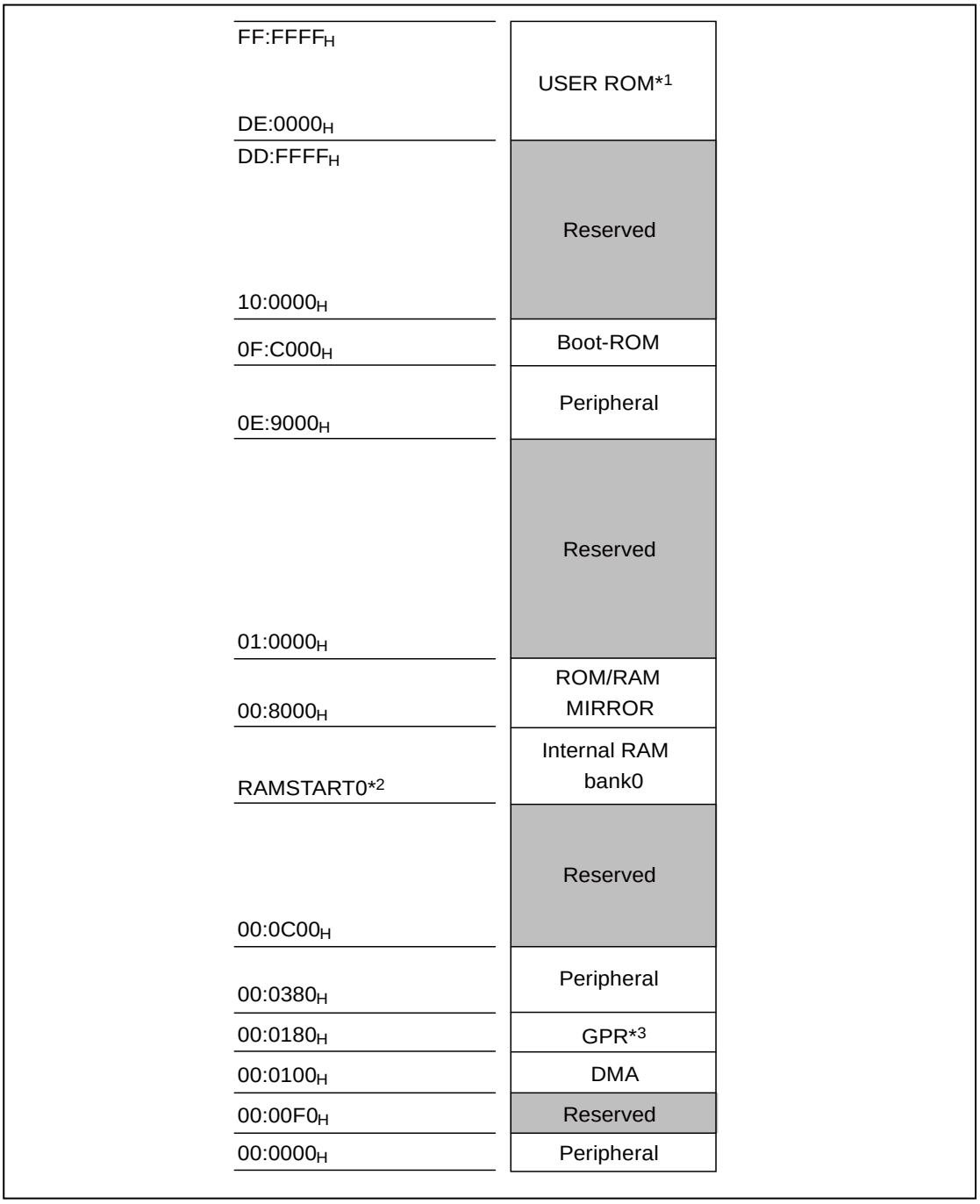
*3: Please set ROM Configuration Block (RCB) to use the sub clock.

Other than those above, general-purpose pins have only automotive input level.

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

Type	Circuit	Remarks
K		• CMOS level output (I_{OL} = 4mA, I_{OH} = -4mA) • Automotive input with input shutdown function • Programmable pull-up resistor • Analog input
L		• CMOS level output (I_{OL} = 4mA, I_{OH} = -4mA) • Automotive input with input shutdown function • Programmable pull-up resistor • Vn input or SEG output
M		• CMOS level output (I_{OL} = 4mA, I_{OH} = -4mA) • CMOS hysteresis input with input shutdown function • Programmable pull-up resistor

7. Memory Map



*1: For details about USER ROM area, see “User ROM Memory Map For Flash Devices” on the following pages.

*2: For RAMSTART addresses see the table on the next page.

*3: Unused GPR banks can be used as RAM area.

GPR: General-Purpose Register

The DMA area is only available if the device contains the corresponding resource.

The available RAM and ROM area depends on the device.

8. RAMSTART Addresses

Devices	Bank 0 RAM Size	RAMSTART0
CY96F683 CY96F685	4KB	00:7200$_H$

■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

13.8 Pin Handling when not using the A/D Converter

If the A/D converter is not used, the power supply pins for A/D converter should be connected such as $AV_{CC} = V_{CC}$, AV_{SS} = AVRH = V_{SS}.

13.9 Notes on Power-on

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

13.10 Stabilization of Power Supply Voltage

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

13.11 SMC Power Supply Pins

All DVcc /DVss pins must be set to the same level as the Vcc /Vss pins.

Note that the SMC I/O pin state is undefined if DV_{CC} is powered on and V_{CC} is below 3V. To avoid this, V_{CC} must always be powered on before DV_{CC}.

DV_{cc}/DV_{ss} must be applied when using SMC I/O pin as GPIO.

13.12 Serial Communication

There is a possibility to receive wrong data due to noise or other causes on the serial communication.

Therefore, design a printed circuit board so as to avoid noise.

Consider receiving of wrong data when designing the system. For example apply a checksum and retransmit the data if an error occurs.

13.13 Mode Pin (MD)

Connect the mode pin directly to Vcc or Vss pin. To prevent the device unintentionally entering test mode due to noise, lay out the printed circuit board so as to minimize the distance from the mode pin to Vcc or Vss pin and provide a low-impedance connection.

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	$AV_{CC} \geq AVRH$, $AVRH \geq AV_{SS}$
SMC Power supply*1	DV_{CC}	-	V_{SS} - 0.3	V_{SS} + 6.0	V	$V_{CC} = AV_{CC} = DV_{CC}$*2
LCD power supply voltage*1	V0 to V3	-	V_{SS} - 0.3	V_{SS} + 6.0	V	V0 to V3 must not exceed V_{CC}
Input voltage*1	V_I	-	V_{SS} - 0.3	V_{SS} + 6.0	V	$V_I \leq (D)V_{CC} + 0.3V$*3
Output voltage*1	V_O	-	V_{SS} - 0.3	V_{SS} + 6.0	V	$V_O \leq (D)V_{CC} + 0.3V$*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	Normal port
	I_{OLSMC}	T_A= -40°C	-	52	mA	High current port
		T_A= +25°C	-	39	mA	
		T_A= +85°C	-	32	mA	
		T_A= +105°C	-	30	mA	
"L" level average output current	I_{OLAV}	-	-	4	mA	Normal port
	$I_{OLAVSMC}$	T_A= -40°C	-	40	mA	High current port
		T_A= +25°C	-	30	mA	
		T_A= +85°C	-	25	mA	
		T_A= +105°C	-	23	mA	
"L" level maximum overall output current	ΣI_{OL}	-	-	46	mA	Normal port
	ΣI_{OLSMC}	-	-	180	mA	High current port
"L" level average overall output current	ΣI_{OLAV}	-	-	23	mA	Normal port
	$\Sigma I_{OLAVSMC}$	-	-	90	mA	High current port
"H" level maximum output current	I_{OH}	-	-	-15	mA	Normal port
	I_{OHSMC}	T_A= -40°C	-	-52	mA	High current port
		T_A= +25°C	-	-39	mA	
		T_A= +85°C	-	-32	mA	
		T_A= +105°C	-	-30	mA	
"H" level average output current	I_{OHAV}	-	-	-4	mA	Normal port
	$I_{OHAVSMC}$	T_A= -40°C	-	-40	mA	High current port
		T_A= +25°C	-	-30	mA	
		T_A= +85°C	-	-25	mA	
		T_A= +105°C	-	-23	mA	
"H" level maximum overall output current	ΣI_{OH}	-	-	-46	mA	Normal port
	ΣI_{OHSMC}	-	-	-180	mA	High current port
"H" level average overall output current	ΣI_{OHAV}	-	-	-23	mA	Normal port
	$\Sigma I_{OHAVSMC}$	-	-	-90	mA	High current port
Power consumption*5	P_D	T_A= +105°C	-	317*6	mW	
Operating ambient temperature	T_A	-	-40	+105	°C	
Storage temperature	T_{STG}	-	-55	+150	°C	

14.3 DC Characteristics

14.3.1 Current Rating

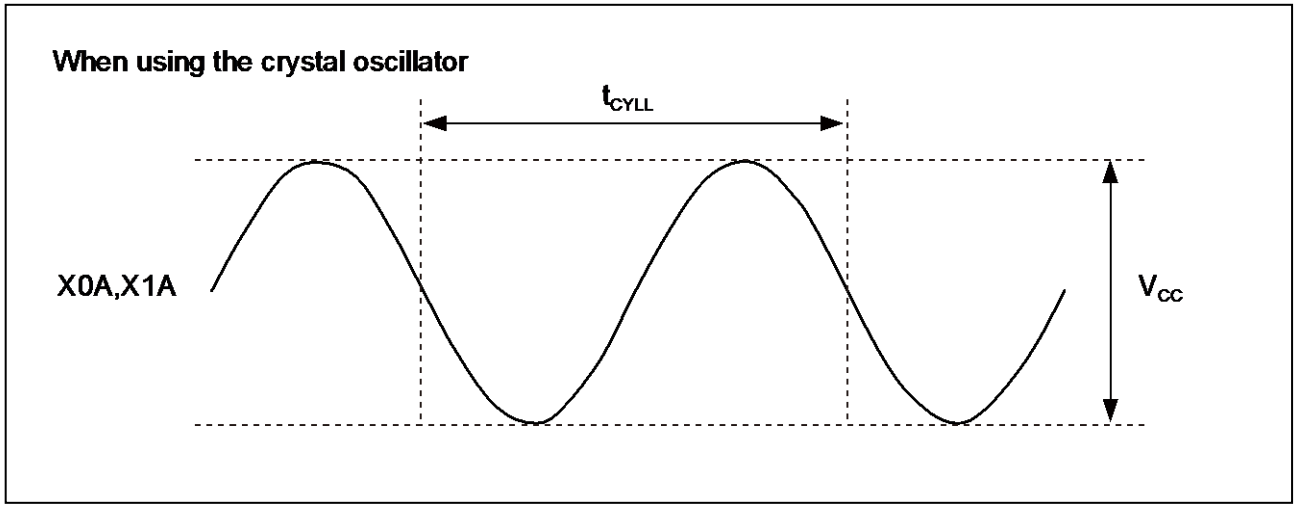
(V_{CC} = AV_{CC} = DV_{CC} = 2.7V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V, T_A = - 40°C to + 105°C)

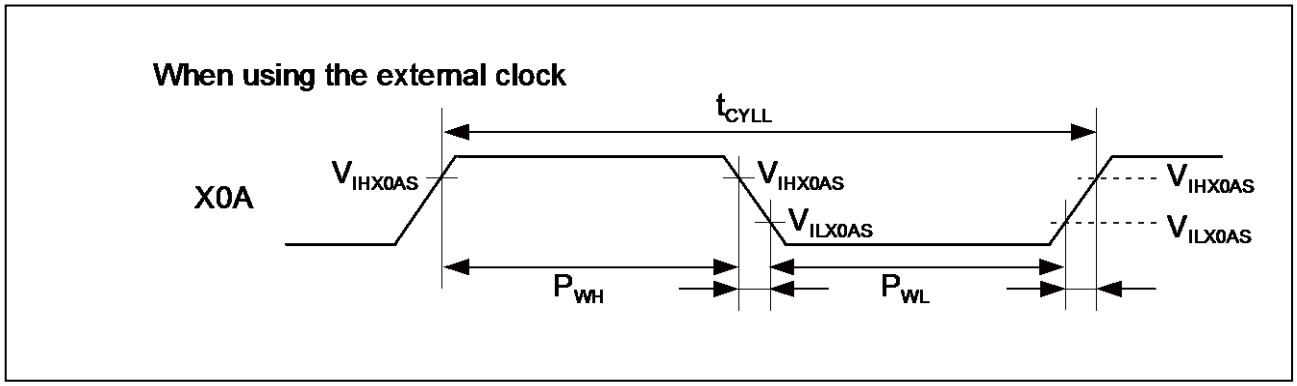
Parameter	Symbol	Pin Name	Conditions	Value			Unit	Remarks
				Min	Typ	Max		
Power supply current in Run modes*1	I_{CCPLL}	V_{cc}	PLL Run mode with CLKS1/2 = CLKB = CLKP1/2 = 32MHz Flash 0 wait (CLKRC and CLKSC stopped)	-	25	-	mA	T_A = +25°C
				-	-	34	mA	T_A = +105°C
	I_{CCMAIN}		Main Run mode with CLKS1/2 = CLKB = CLKP1/2 = 4MHz Flash 0 wait (CLKPLL, CLKSC and CLKRC stopped)	-	3.5	-	mA	T_A = +25°C
				-	-	7.5	mA	T_A = +105°C
	I_{CCRCH}		RC Run mode with CLKS1/2 = CLKB = CLKP1/2 = CLKRC = 2MHz Flash 0 wait (CLKMC, CLKPLL and CLKSC stopped)	-	1.7	-	mA	T_A = +25°C
				-	-	5.5	mA	T_A = +105°C
	I_{CCRCL}		RC Run mode with CLKS1/2 = CLKB = CLKP1/2 = CLKRC = 100kHz Flash 0 wait (CLKMC, CLKPLL and CLKSC stopped)	-	0.15	-	mA	T_A = +25°C
				-	-	3.2	mA	T_A = +105°C
	I_{CCSUB}		Sub Run mode with CLKS1/2 = CLKB = CLKP1/2 = 32kHz Flash 0 wait (CLKMC, CLKPLL and CLKRC stopped)	-	0.1	-	mA	T_A = +25°C
				-	-	3	mA	T_A = +105°C

14.4.2 Sub Clock Input Characteristics

(V_{CC} = AV_{CC} = DV_{CC} = 2.7V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V, T_A = - 40°C to + 105°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	%	





14.4.3 Built-in RC Oscillation Characteristics

(V_{CC} = AV_{CC} = DV_{CC} = 2.7V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V, T_A = - 40°C to + 105°C)

Parameter	Symbol	Value			Unit	Remarks
		Min	Typ	Max		
Clock frequency	f_{RC}	50	100	200	kHz	When using slow frequency of RC oscillator
		1	2	4	MHz	When using fast frequency of RC oscillator
RC clock stabilization time	t_{RCSTAB}	80	160	320	µs	When using slow frequency of RC oscillator (16 RC clock cycles)
		64	128	256	µs	When using fast frequency of RC oscillator (256 RC clock cycles)

14.4.4 Internal Clock Timing

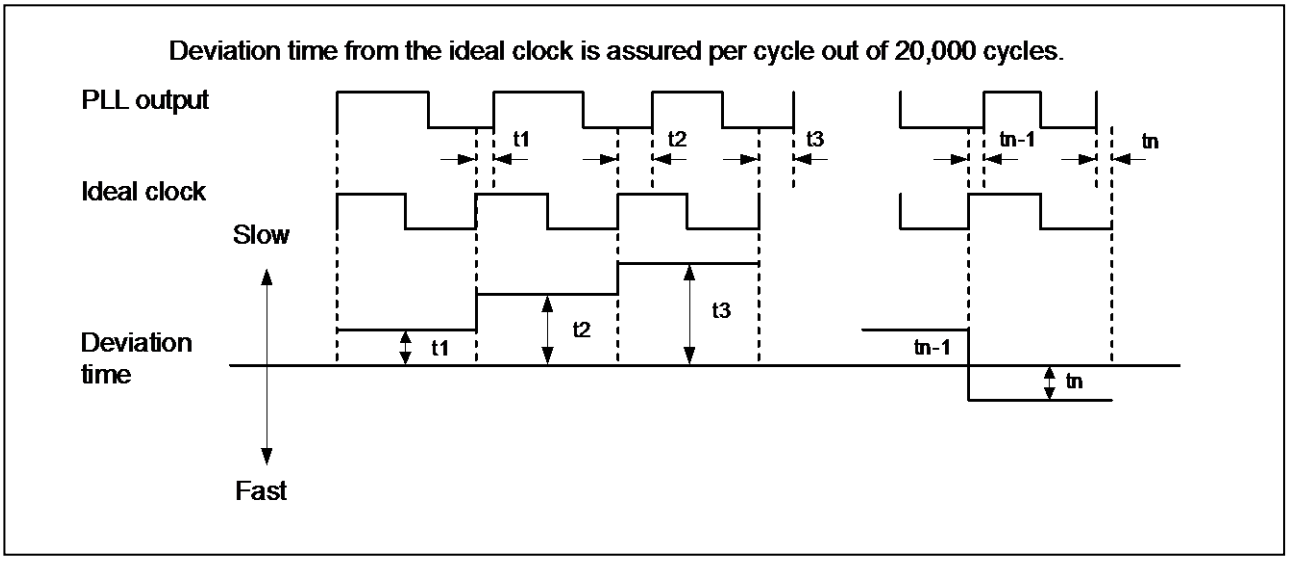
(V_{CC} = AV_{CC} = DV_{CC} = 2.7V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V, T_A = - 40°C to + 105°C)

Parameter	Symbol	Value		Unit
		Min	Max	
Internal System clock frequency (CLKS1 and CLKS2)	f_{CLKS1}, f_{CLKS2}	-	54	MHz
Internal CPU clock frequency (CLKB), Internal peripheral clock frequency (CLKP1)	f_{CLKB}, f_{CLKP1}	-	32	MHz
Internal peripheral clock frequency (CLKP2)	f_{CLKP2}	-	32	MHz

14.4.5 Operating Conditions of PLL

(V_{CC} = AV_{CC} = DV_{CC} = 2.7V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V, T_A = - 40°C to + 105°C)

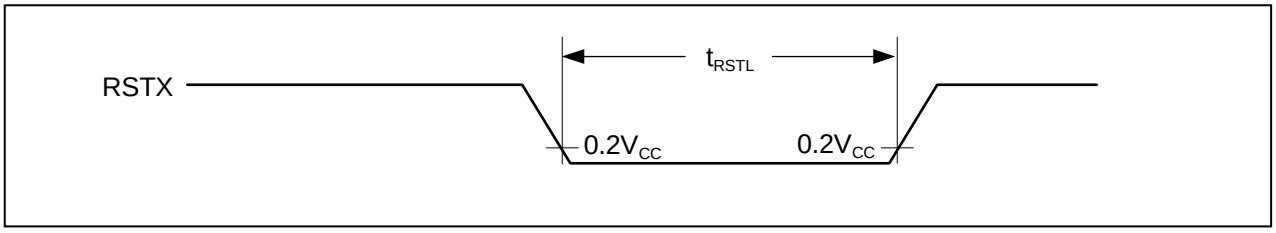
Parameter	Symbol	Value			Unit	Remarks
		Min	Typ	Max		
PLL oscillation stabilization wait time	t_{LOCK}	1	-	4	ms	For CLKMC = 4MHz
PLL input clock frequency	f_{PLLI}	4	-	8	MHz	
PLL oscillation clock frequency	f_{CLKVCO}	56	-	108	MHz	Permitted VCO output frequency of PLL (CLKVCO)
PLL phase jitter	t_{PSKEW}	-5	-	+5	ns	For CLKMC (PLL input clock) ≥ 4MHz



14.4.6 Reset Input

(V_{CC} = AV_{CC} = DV_{CC} = 2.7V to 5.5V, V_{SS} = AV_{SS} = DV_{SS} = 0V, T_A = - 40°C to + 105°C)

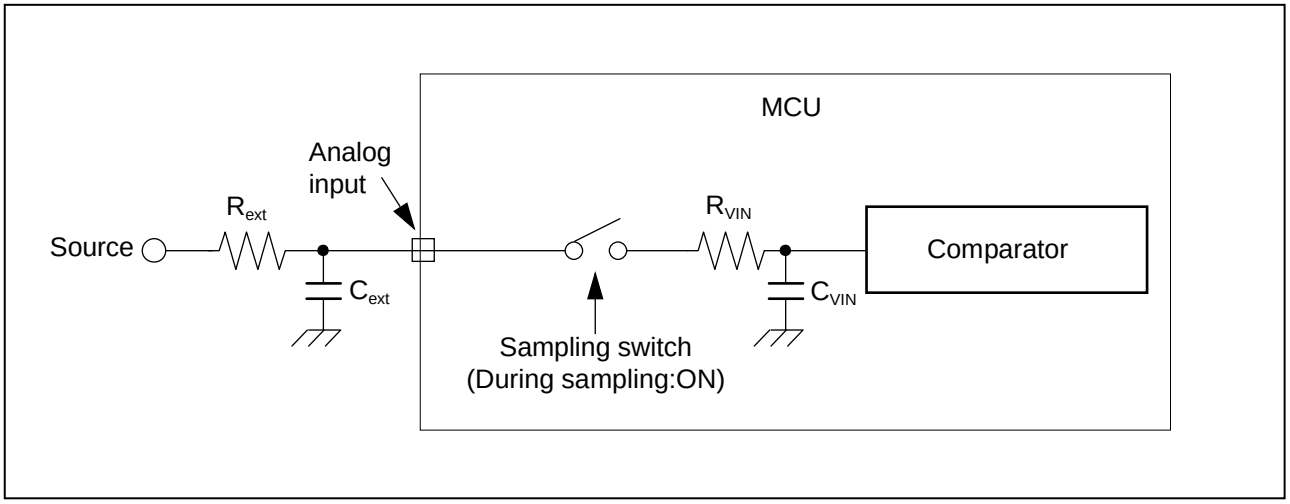
Parameter	Symbol	Pin Name	Value		Unit
			Min	Max	
Reset input time	t_{RSTL}	RSTX	10	-	µs
Rejection of reset input time			1	-	µs



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 (T_{samp}) 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:



Rext: External driving impedance

Cext: Capacitance of PCB at A/D converter input

CVIN: Analog input capacity (I/O, analog switch and ADC are contained)

RVIN: Analog input impedance (I/O, analog switch and ADC are contained)

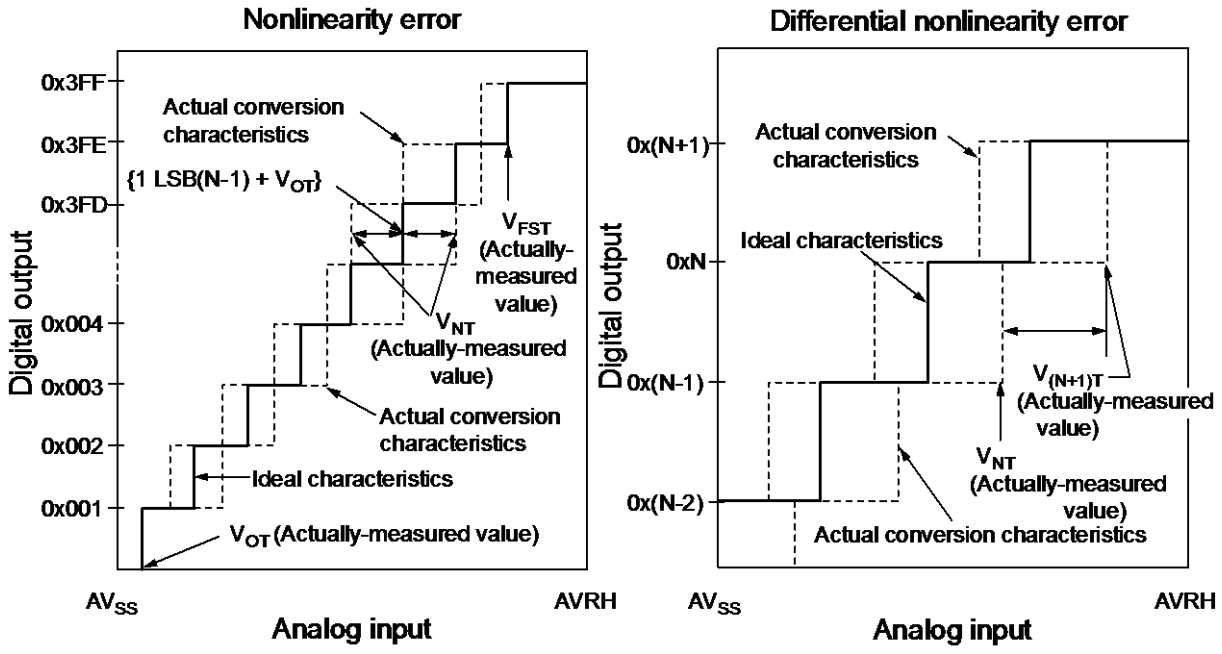
The following approximation formula for the replacement model above can be used:

$T_{samp} = 7.62 \times (R_{ext} \times C_{ext} + (R_{ext} + R_{VIN}) \times C_{VIN})$

- 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.

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.



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

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

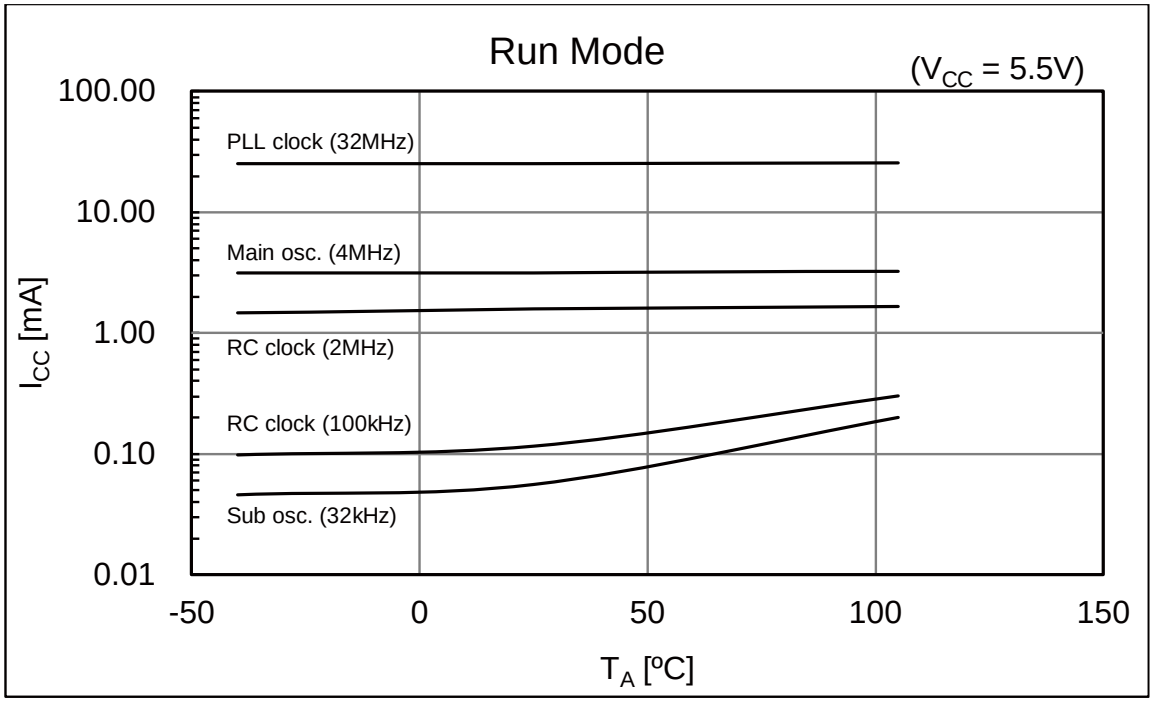
$$1LSB = \frac{V_{FST} - V_{OT}}{1022}$$

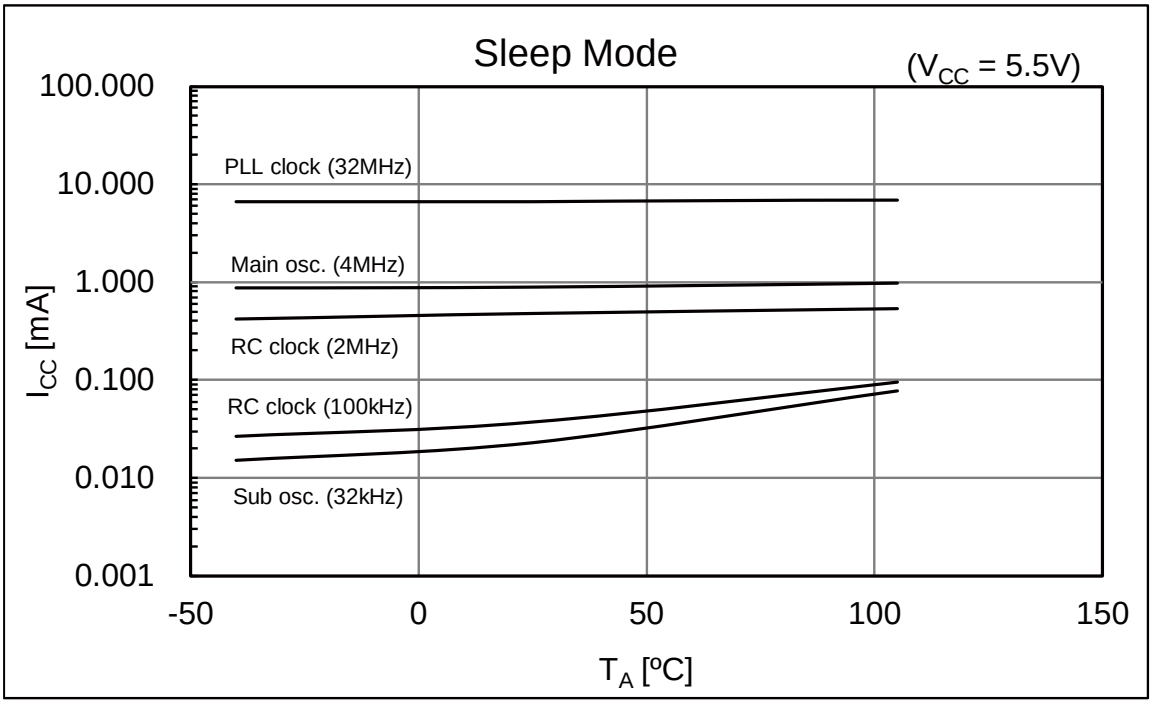
N : A/D converter digital output value.
V_{OT} : Voltage at which the digital output changes from 0x000 to 0x001.
V_{FST} : Voltage at which the digital output changes from 0x3FE to 0x3FF.
V_{NT} : Voltage at which the digital output changes from 0x(N − 1) to 0xN.

15. Example Characteristics

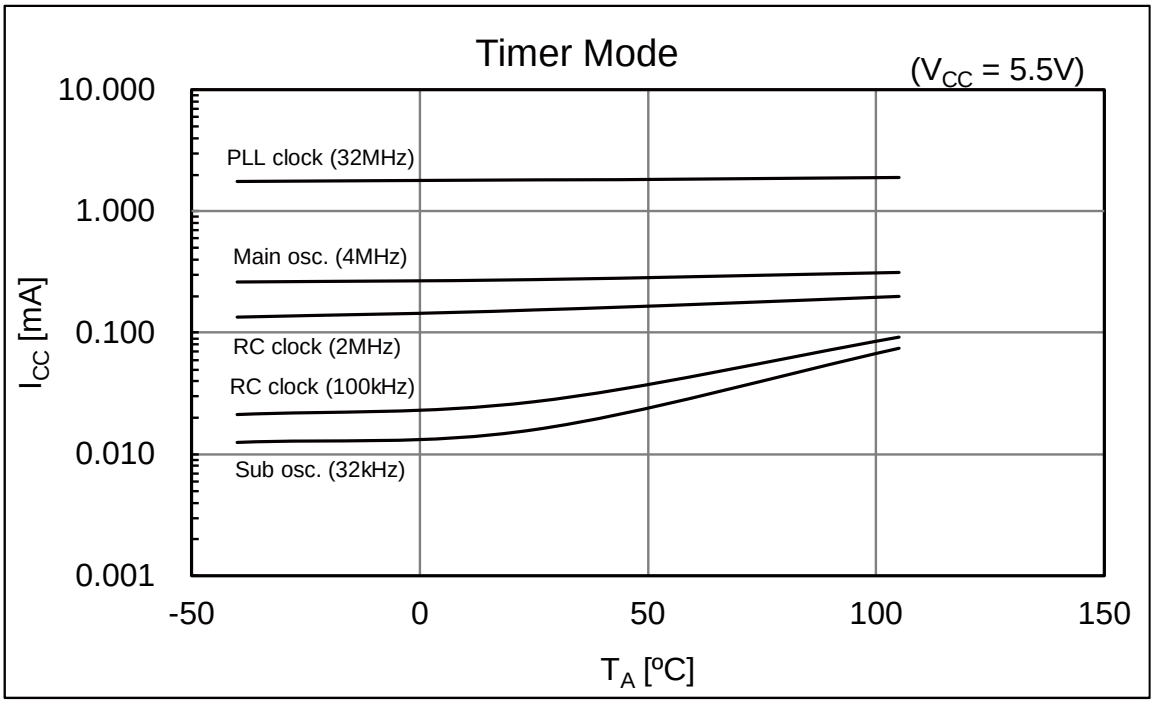
This characteristic is an actual value of the arbitrary sample. It is not the guaranteed value.

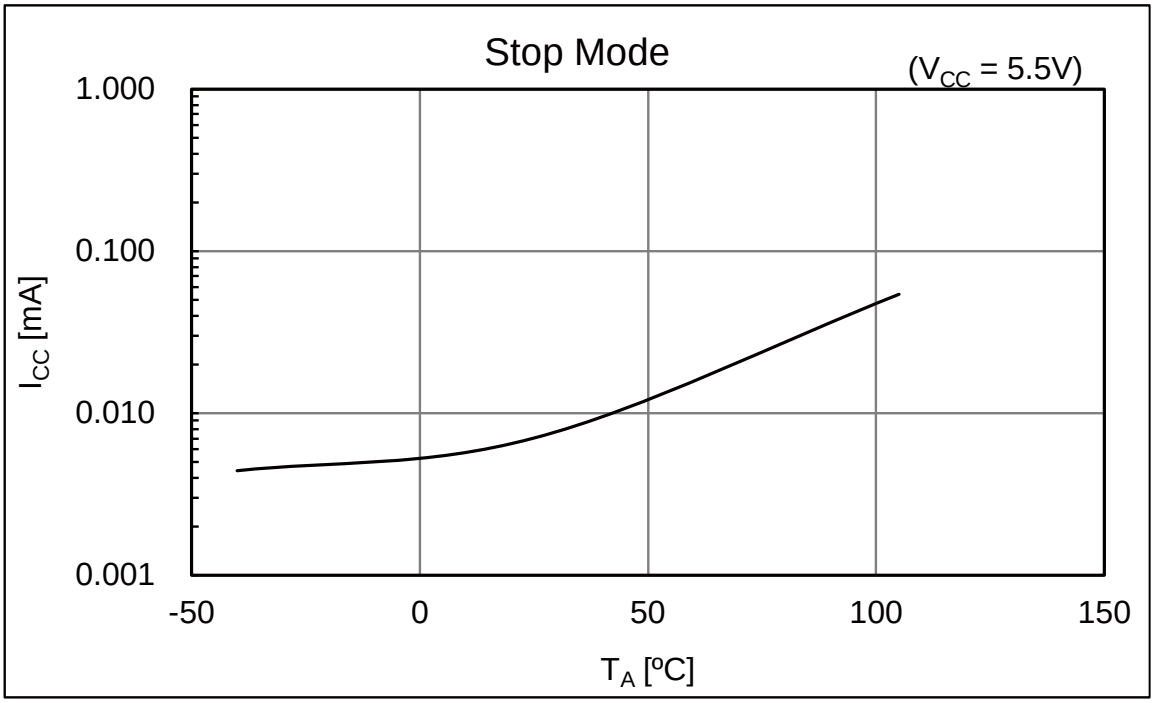
■CY96F685





■CY96F685


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]

18. Major Changes

Spansion Publication Number: MB96680_DS704-00002

Page	Section	Change Results
Revision 2.0		
40	Electrical Characteristics 3. DC Characteristics (1) Current Rating	Changed the Value of “Power supply current in Timer modes” I_{CCTPLL} Typ: 1880µA → 1800µA (T_A = +25°C)
Revision 2.1		
-	-	Company name and layout design change
Rev.*B		
-	Marketing Part Numbers changed from an MB prefix to a CY prefix.	
6, 8, 64, 65	1. Product Lineup 3. Pin Assignment 16. Ordering Information 17. Package Dimension	Package description modified to JEDEC description. FPT-80P-M21 → LQH080
64	16. Ordering Information	Revised Marketing Part Numbers as follows: Before) **MCU with CAN controller** MB96F683RBPMC-GSE1 MB96F683RBPMC-GSE2 MB96F685RBPMC-GSE1 MB96F685RBPMC-GSE2 **MCU without CAN controller** MB96F683ABPMC-GSE1 MB96F683ABPMC-GSE2 MB96F685ABPMC-GSE1 MB96F685ABPMC-GSE2 After) **MCU with CAN controller** MB96F683RBPMC-GS-UJE1 MB96F685RBPMC-GS-UJE1 **MCU without CAN controller** MB96F683ABPMC-GS-UJE1

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

Document History

Document Title: CY96680 Series F²MC-16FX 16-Bit Microcontroller
Document Number: 002-04705

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	-	TORS	01/31/2014	Migrated to Cypress and assigned document number 002-04705 No change to document contents or format.
*A	5147098	TORS	08/22/2016	Updated to Cypress format.
*B	6003420	MIYH	12/25/2017	Revised the following items: Marketing Part Numbers changed from an MB prefix to a CY prefix. 1. Product Lineup 3. Pin Assignment 16. Ordering Information 17. Package Dimension For details, please see 18. Major Changes.