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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	F ² MC-16FX
Core Size	16-Bit
Speed	32MHz
Connectivity	I ² C, LINbus, SCI, UART/USART
Peripherals	DMA, LCD, LVD, POR, PWM, WDT
Number of I/O	77
Program Memory Size	96KB (96K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	8K x 8
Voltage - Supply (Vcc/Vdd)	2.7V ~ 5.5V
Data Converters	A/D 27x8/10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 105°C (TA)
Mounting Type	Surface Mount
Package / Case	100-LQFP
Supplier Device Package	100-LQFP (14x14)
Purchase URL	https://www.e-xfl.com/product-detail/infineon-technologies/mb96f693abpmc-gse2

- Internal clock divider and prescaler provide exact 1s clock

External Interrupts

- Edge or Level sensitive
- Interrupt mask bit per channel
- Each available CAN channel RX has an external interrupt for wake-up
- Selected USART channels SIN have an external interrupt for wake-up

Non Maskable Interrupt

- Disabled after reset, can be enabled by Boot-ROM depending on ROM configuration block
- Once enabled, cannot be disabled other than by reset
- High or Low level sensitive
- Pin shared with external interrupt 0

I/O Ports

- Most of the external pins can be used as general purpose I/O
- All push-pull outputs(except when used as I²C SDA/SCL line)
- Bit-wise programmable as input/output or peripheral signal
- Bit-wise programmable input enable
- One input level per GPIO-pin (either Automotive or CMOS hysteresis)
- Bit-wise programmable pull-up resistor

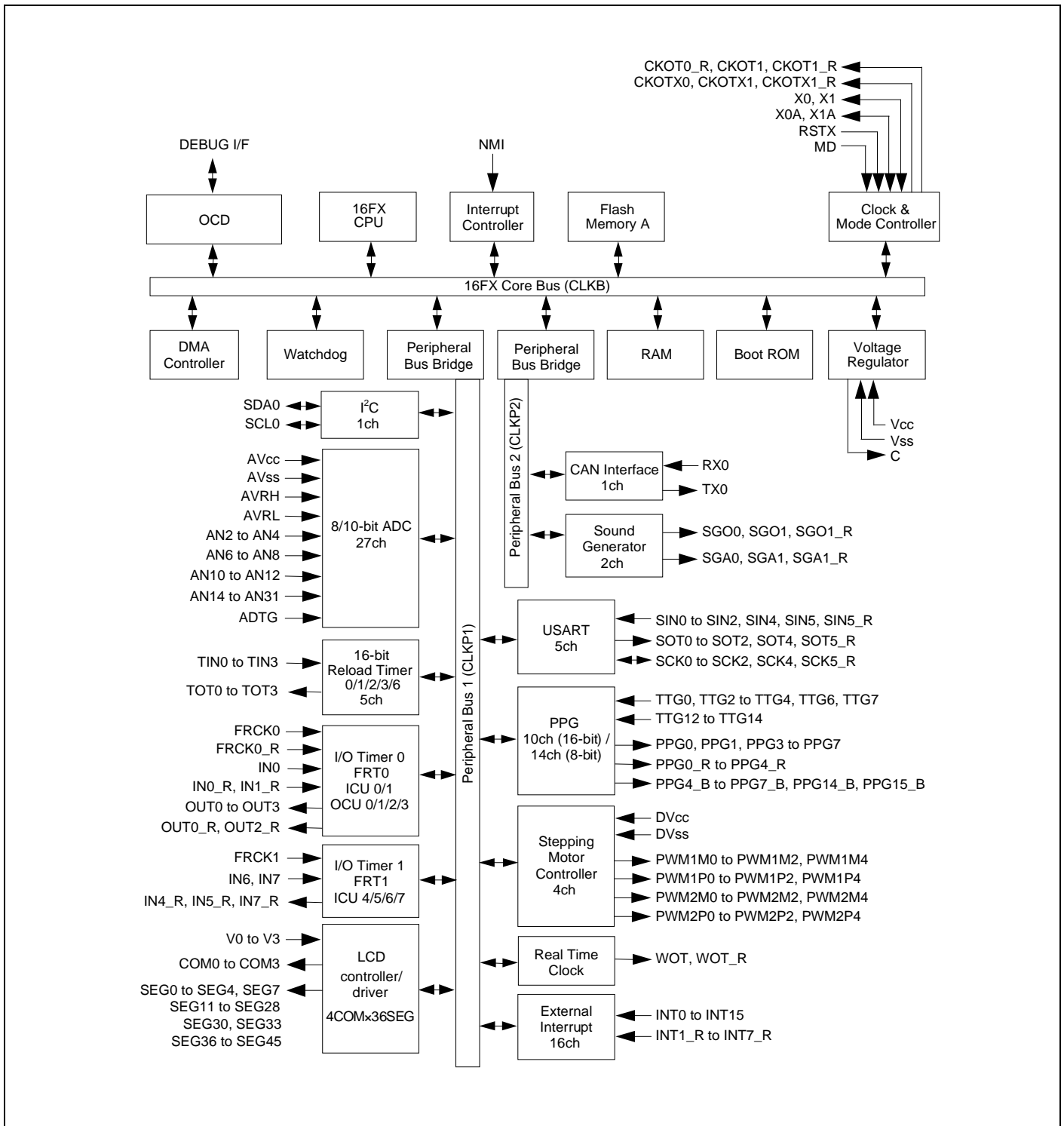
Built-in On Chip Debugger (OCD)

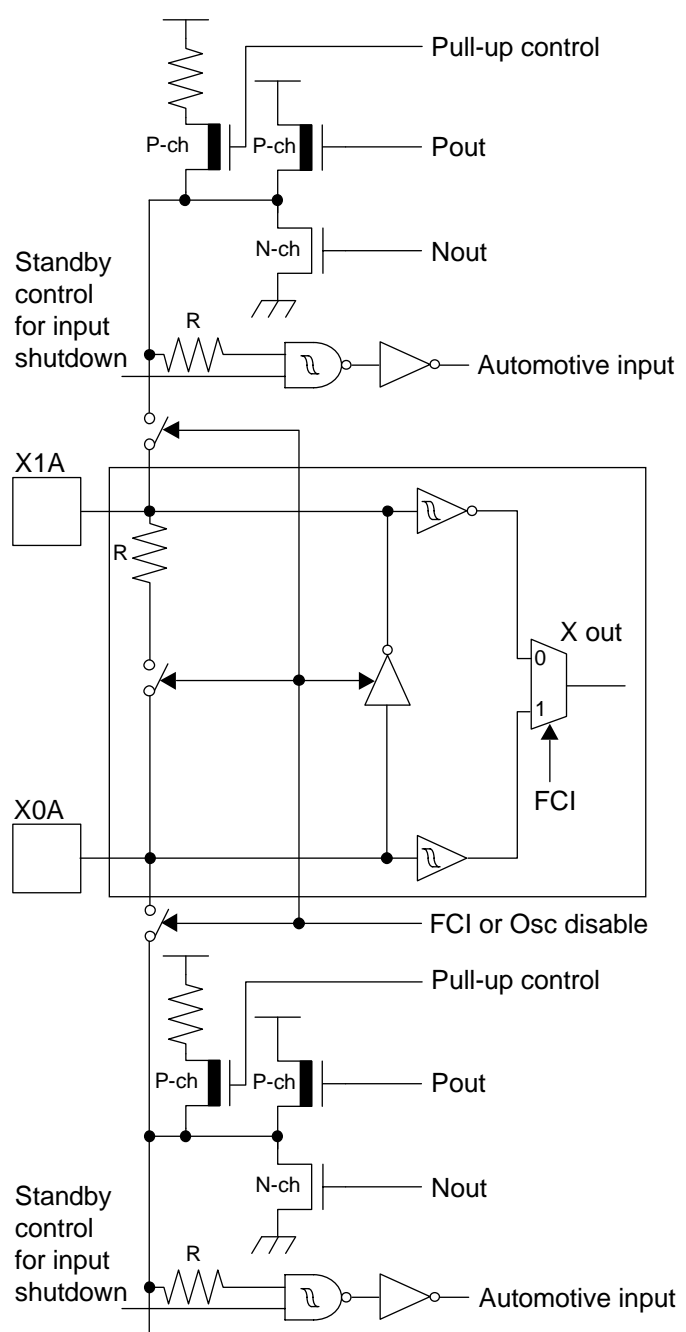
- One-wire debug tool interface
- Break function:
 - Hardware break: 6 points (shared with code event)
 - Software break: 4096 points
- Event function
 - Code event: 6 points (shared with hardware break)
 - Data event: 6 points
 - Event sequencer: 2 levels + reset
- Execution time measurement function
- Trace function: 42 branches
- Security function

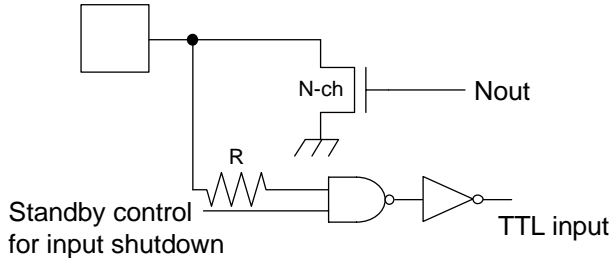
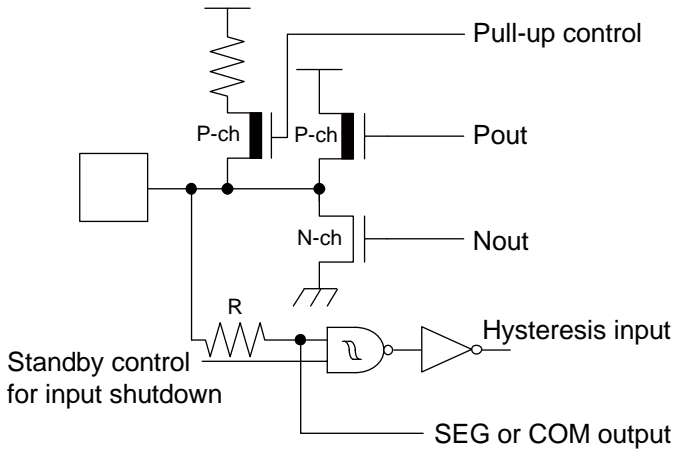
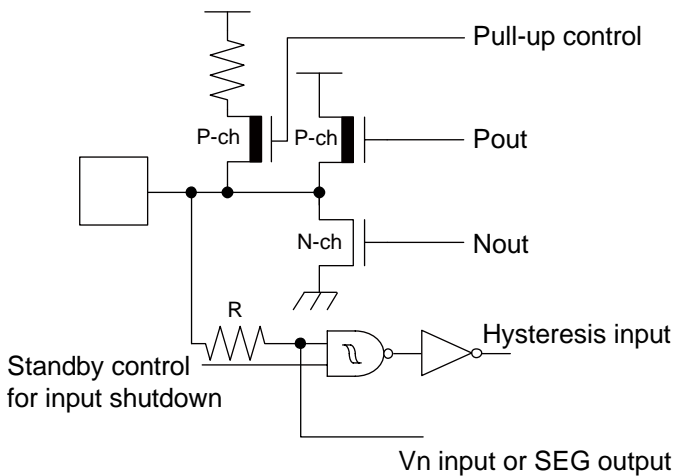
Flash Memory

- 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 erase or write

2. Block Diagram



Type	Circuit	Remarks
B	 <p>The diagram illustrates the internal circuitry of the CY96690 Series, specifically the feedback and input control sections. It features two identical blocks, each containing a pull-up control circuit with P-ch and N-ch MOSFETs, a standby control for input shutdown with a resistor R, and an automotive input with an AND gate and inverter. The central part of the diagram shows a feedback loop with two comparators (X1A and X0A) and a multiplexer (X out) controlled by FCI. The FCI or Osc disable signal is also shown.</p>	<p>Low-speed oscillation circuit shared with GPIO functionality:</p> <ul style="list-style-type: none"> ■ Feedback resistor = approx. 5.0MΩ ■ GPIO functionality selectable (CMOS level output ($I_{OL} = 4\text{mA}$, $I_{OH} = -4\text{mA}$), Automotive input with input shutdown function and programmable pull-up resistor)

Type	Circuit	Remarks
O	 <p>Standby control for input shutdown</p> <p>Nout</p> <p>TTL input</p>	<ul style="list-style-type: none"> ■ Open-drain I/O ■ Output 25mA, $V_{CC} = 2.7V$ ■ TTL input
P	 <p>Pull-up control</p> <p>Pout</p> <p>Nout</p> <p>Hysteresis input</p> <p>SEG or COM output</p> <p>Standby control for input shutdown</p>	<ul style="list-style-type: none"> ■ CMOS level output ($I_{OL} = 4mA$, $I_{OH} = -4mA$) ■ CMOS hysteresis inputs with input shutdown function ■ Programmable pull-up resistor ■ SEG or COM output
Q	 <p>Pull-up control</p> <p>Pout</p> <p>Nout</p> <p>Hysteresis input</p> <p>Vn input or SEG output</p> <p>Standby control for input shutdown</p>	<ul style="list-style-type: none"> ■ CMOS level output ($I_{OL} = 4mA$, $I_{OH} = -4mA$) ■ CMOS hysteresis inputs with input shutdown function ■ Programmable pull-up resistor ■ Vn input or SEG output

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	EXTINT14	Yes	31	External Interrupt 14
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

Vector Number	Offset in Vector Table	Vector Name	Cleared by DMA	Index in ICR to Program	Description
82	2B4 _H	-	-	82	Reserved
83	2B0 _H	-	-	83	Reserved
84	2AC _H	-	-	84	Reserved
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	-	-	91	Reserved
92	28C _H	-	-	92	Reserved
93	288 _H	RTC0	No	93	Real Time Clock
94	284 _H	CAL0	No	94	Clock Calibration Unit
95	280 _H	SG0	No	95	Sound Generator 0
96	27C _H	IIC0	Yes	96	I ² C 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	LINR0	Yes	101	LIN USART 0 RX
102	264 _H	LINT0	Yes	102	LIN USART 0 TX
103	260 _H	LINR1	Yes	103	LIN USART 1 RX
104	25C _H	LINT1	Yes	104	LIN USART 1 TX
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	LINR4	Yes	109	LIN USART 4 RX
110	244 _H	LINT4	Yes	110	LIN USART 4 TX
111	240 _H	LINR5	Yes	111	LIN USART 5 RX
112	23C _H	LINT5	Yes	112	LIN USART 5 TX
113	238 _H	-	-	113	Reserved
114	234 _H	-	-	114	Reserved
115	230 _H	-	-	115	Reserved
116	22C _H	-	-	116	Reserved
117	228 _H	-	-	117	Reserved
118	224 _H	-	-	118	Reserved
119	220 _H	-	-	119	Reserved
120	21C _H	-	-	120	Reserved
121	218 _H	SG1	No	121	Sound Generator 1
122	214 _H	-	-	122	Reserved
123	210 _H	-	-	123	Reserved

Vector Number	Offset in Vector Table	Vector Name	Cleared by DMA	Index in ICR to Program	Description
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	-	-	137	Reserved
138	1D4 _H	-	-	138	Reserved
139	1D0 _H	ADCRC0	No	139	A/D Converter 0 - Range Comparator
140	1CC _H	ADCPD0	No	140	A/D Converter 0 - Pulse detection
141	1C8 _H	-	-	141	Reserved
142	1C4 _H	-	-	142	Reserved
143	1C0 _H	-	-	143	Reserved

13. Handling Devices

Special Care is Required for the following when Handling the Device:

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

13.1 Latch-Up Prevention

CMOS IC chips may suffer latch-up under the following conditions:

- A voltage higher than V_{CC} or lower than V_{SS} is applied to an input or output pin.
 - A voltage higher than the rated voltage is applied between V_{CC} pins and V_{SS} pins.
 - The AV_{CC} power supply is applied before the V_{CC} voltage.
- Latch-up may increase the power supply current dramatically, causing thermal damages to the device.

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

13.2 Unused Pins Handling

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

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

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

13.3 External Clock Usage

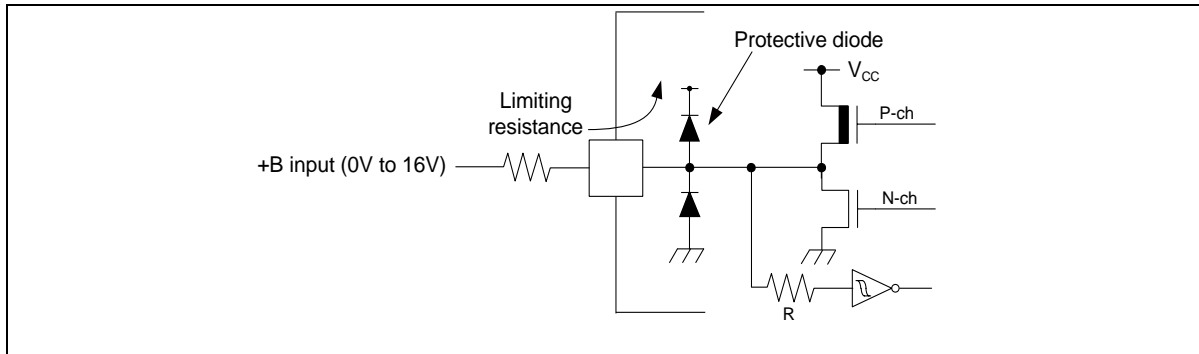
The permitted frequency range of an external clock depends on the oscillator type and configuration.

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.

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:

$$P_D = P_{IO} + P_{INT}$$

$$P_{IO} = \sum (V_{OL} \times I_{OL} + V_{OH} \times I_{OH}) \text{ (I/O load power dissipation, sum is performed on all I/O ports)}$$

$$P_{INT} = V_{CC} \times (I_{CC} + I_A) \text{ (internal power dissipation)}$$

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.

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.

14.2 Recommended Operating Conditions

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

Parameter	Symbol	Value			Unit	Remarks
		Min	Typ	Max		
Power supply voltage	V_{CC} ,	2.7	-	5.5	V	
	AV_{CC} , DV_{CC}	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	μF	1.0 μF (Allowance within $\pm 50\%$) 3.9 μF (Allowance within $\pm 20\%$) Please use the ceramic capacitor or the capacitor of the frequency response of this level. 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.

14.3 DC Characteristics

14.3.1 Current Rating

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

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)	-	28	-	mA	T _A = +25°C
				-	-	38	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
				-	-	8	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)	-	1.8	-	mA	T _A = +25°C
				-	-	6	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)	-	0.16	-	mA	T _A = +25°C
				-	-	3.5	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
				-	-	3.3	mA	T _A = +105°C

Parameter	Symbol	Pin Name	Conditions	Value			Unit	Remarks
				Min	Typ	Max		
Power supply current in Stop mode ^[3]	I _{CCH}	V _{CC}	-	-	20	60	μA	T _A = +25°C
				-	-	880	μA	T _A = +105°C
Flash Power Down current	I _{CCFLASHPD}		-	-	36	70	μA	
Power supply current for active Low Voltage detector ^[4]	I _{CCLVD}		Low voltage detector enabled	-	5	-	μA	T _A = +25°C
				-	-	12.5	μA	T _A = +105°C
Flash Write/ Erase current ^[5]	I _{CCFLASH}		-	-	12.5	-	mA	T _A = +25°C
				-	-	20	mA	T _A = +105°C

[1]: The power supply current is measured with a 4MHz external clock connected to the Main oscillator and a 32kHz external clock connected to the Sub oscillator. See chapter “Standby mode and voltage regulator control circuit” of the Hardware Manual for further details about voltage regulator control. Current for “On Chip Debugger” part is not included. Power supply current in Run mode does not include Flash Write / Erase current.

[2]: The power supply current in Timer mode is the value when Flash is in Power-down / reset mode.

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 32 kHz external clock connected to the Sub oscillator. The current for “On Chip Debugger” part is not included.

[3]: The power supply current in Stop mode is the value when Flash is in Power-down / reset mode.

When Flash is not in Power-down / reset mode, $I_{CCFLASHPD}$ must be added to the Power supply current.

[4]: When low voltage detector is enabled, I_{CCLVD} must be added to Power supply current.

[5]: When Flash Write / Erase program is executed, $I_{CCFLASH}$ must be added to Power supply current.

14.3.2 Pin Characteristics

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

Parameter	Symbol	Pin Name	Conditions	Value			Unit	Remarks
				Min	Typ	Max		
"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	$VD = 1.8V \pm 0.15V$
	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	$VD = 1.8V \pm 0.15V$
	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

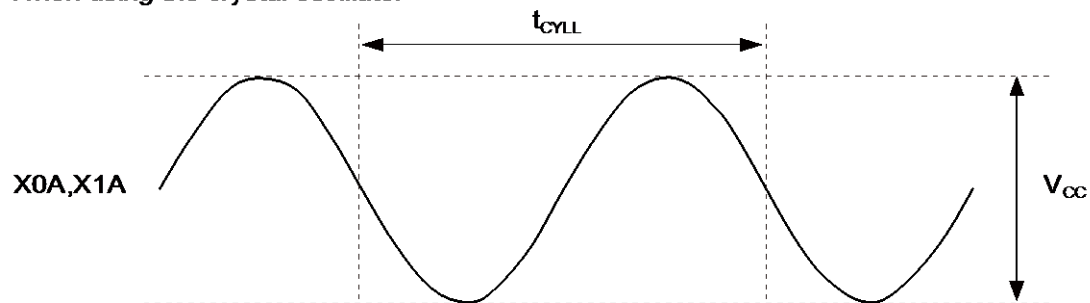
Parameters	Symbol	Pin Name	Conditions	Value			Unit	Remarks
				Min	Typ	Max		
"L" level output voltage	V _{OL4}	4mA type	4.5V ≤ (D)V _{CC} ≤ 5.5V I _{OL} = +4mA	-	-	0.4	V	
			2.7V ≤ (D)V _{CC} < 4.5V I _{OL} = +1.7mA					
	V _{OL30}	High Drive type	4.5V ≤ DV _{CC} ≤ 5.5V I _{OL} = +52mA	-	-	0.5	V	T _A = -40°C
			2.7V ≤ DV _{CC} < 4.5V I _{OL} = +22mA					
			4.5V ≤ DV _{CC} ≤ 5.5V I _{OL} = +39mA					T _A = +25°C
			2.7V ≤ DV _{CC} < 4.5V I _{OL} = +18mA					
			4.5V ≤ DV _{CC} ≤ 5.5V I _{OL} = +32mA					T _A = +85°C
			2.7V ≤ DV _{CC} < 4.5V I _{OL} = +14mA					
			4.5V ≤ DV _{CC} ≤ 5.5V I _{OL} = +30mA					T _A = +105°C
			2.7V ≤ DV _{CC} < 4.5V I _{OL} = +13.5mA					
	V _{OL3}	3mA type	2.7V ≤ 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	
Input leak current	I _{IL}	Pnn_m	V _{SS} < V _I < V _{CC} AV _{SS} , AV _{RL} < V _I < AV _{CC} , AV _{RH}	- 1	-	+ 1	μA	Single port pin except high current output I/O for SMC
		P08_m, P09_m, P10_m	DV _{SS} < V _I < DV _{CC} AV _{SS} , AV _{RL} < V _I < AV _{CC} , AV _{RH}	- 3	-	+ 3	μA	
Total LCD leak current	Σ I _{ILCD}	All SEG/ COM pin	V _{CC} = 5.0V	-	0.5	10	μA	Maximum leakage current of all LCD pins
Internal LCD divide resistance	R _{LCD}	Between V3 and V2, V2 and V1, V1 and V0	V _{CC} = 5.0V	6.25	12.5	25	kΩ	

14.4.2 Sub Clock Input Characteristics

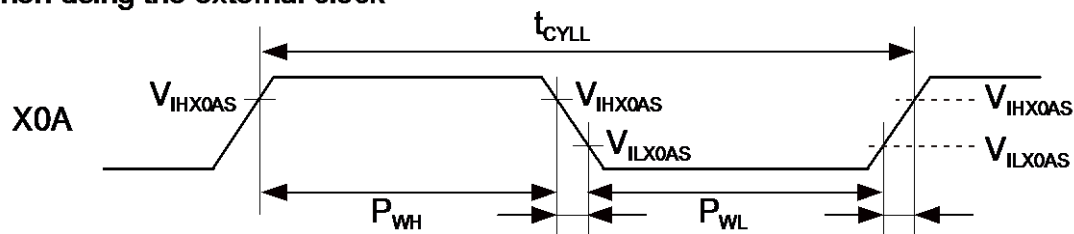
($V_{CC} = AV_{CC} = DV_{CC} = 2.7V$ to $5.5V$, $V_{SS} = AV_{SS} = DV_{SS} = 0V$, $T_A = -40^{\circ}C$ to $+105^{\circ}C$)

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	%	

When using the crystal oscillator



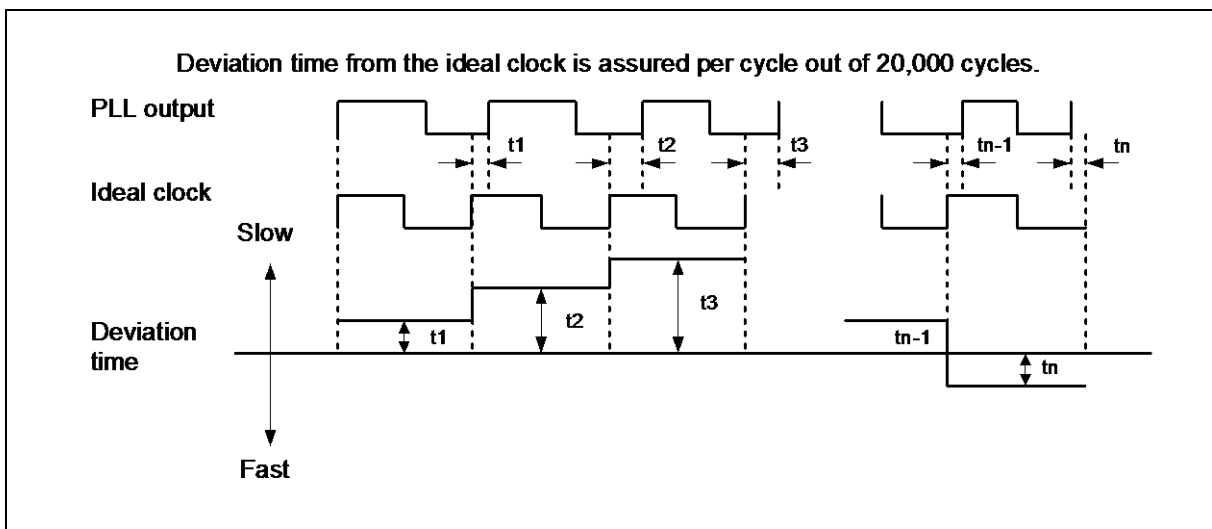
When using the external clock



14.4.5 Operating Conditions of PLL

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

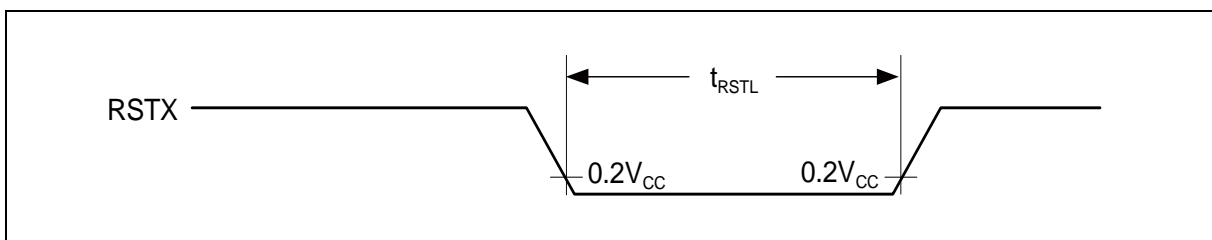
Parameter	Symbol	Value			Unit	Remarks
		Min	Typ	Max		
PLL oscillation stabilization wait time	t_{LOCK}	1	-	4	ms	For CLKMC = 4MHz
PLL input clock frequency	f_{PLLI}	4	-	8	MHz	
PLL oscillation clock frequency	f_{CLKVCO}	56	-	108	MHz	Permitted VCO output frequency of PLL (CLKVCO)
PLL phase jitter	t_{PSKEW}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



14.4.6 Reset Input

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

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



14.4.10 I²C 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	Conditions	Typical Mode		High-Speed Mode ^[4]		Unit
			Min	Max	Min	Max	
SCL clock frequency	f _{SCL}	C _L = 50pF, R = (V _p /I _{OL}) ^[1]	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}		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) × t _{CLKP1} ^[5]	0	(1-1.5) × t _{CLKP1} ^[5]	ns

[1]: R and C_L represent the pull-up resistance and load capacitance of the SCL and SDA lines, respectively.

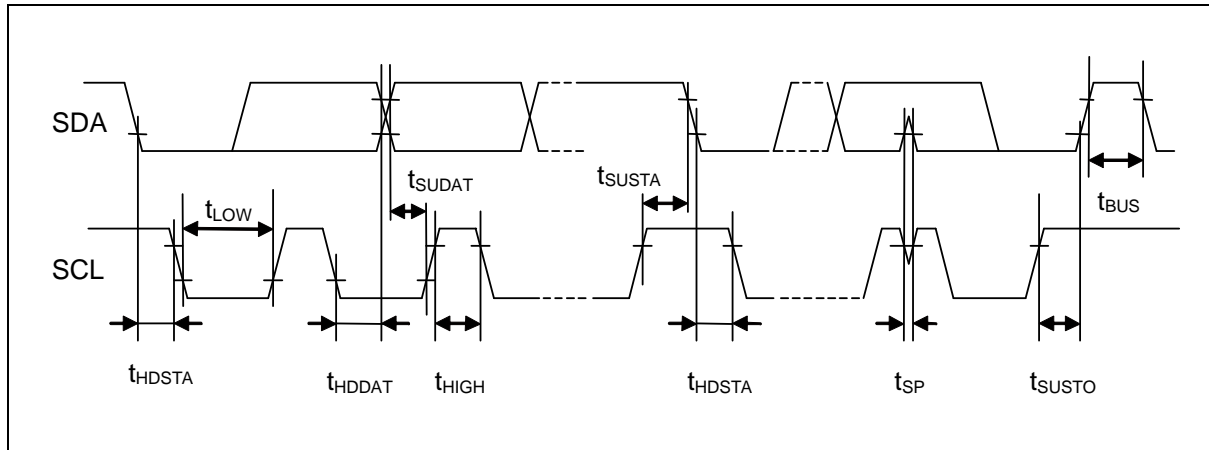
V_p indicates the power supply voltage of the pull-up resistance and I_{OL} indicates V_{OL} guaranteed current.

[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 I²C bus device can be used on a standard mode I²C bus system as long as the device satisfies the requirement of "t_{SUDAT} ≥ 250ns".

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

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



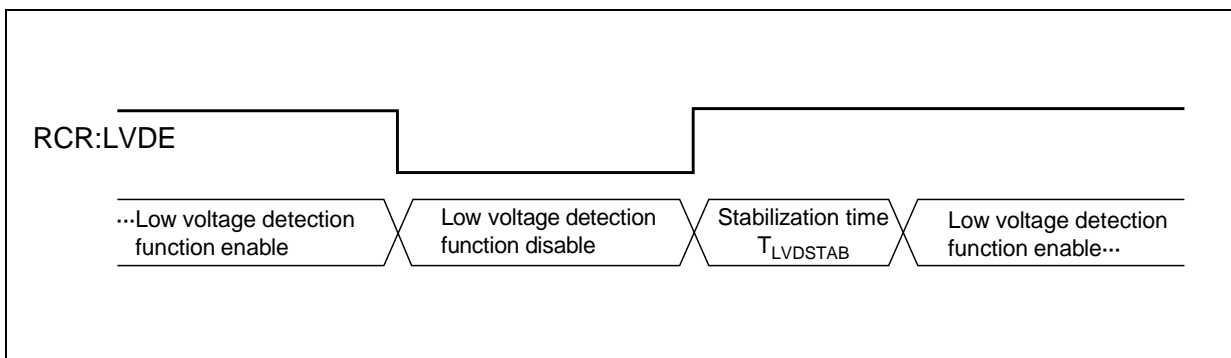
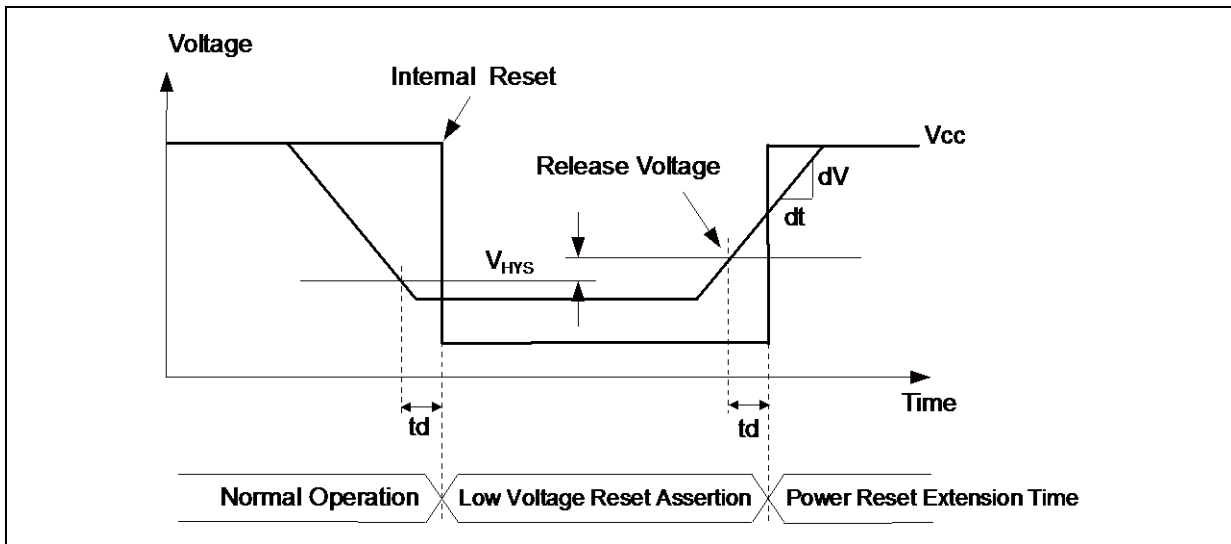
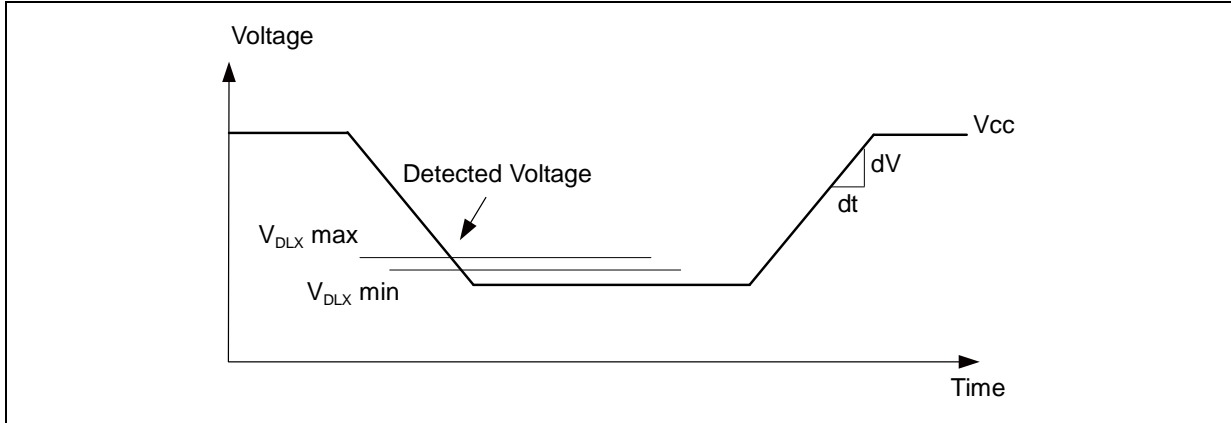
14.5 A/D Converter

14.5.1 Electrical Characteristics for the A/D Converter

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

Parameter	Symbol	Pin Name	Value			Unit	Remarks
			Min	Typ	Max		
Resolution	-	-	-	-	10	bit	
Total error	-	-	- 3.0	-	+ 3.0	LSB	
Nonlinearity error	-	-	- 2.5	-	+ 2.5	LSB	
Differential Nonlinearity error	-	-	- 1.9	-	+ 1.9	LSB	
Zero transition voltage	V_{OT}	ANn	Typ - 20	AVRL+ 0.5LSB	Typ + 20	mV	
Full scale transition voltage	V_{FST}	ANn	Typ - 20	AVRH- 1.5LSB	Typ + 20	mV	
Compare time*	-	-	1.0	-	5.0	μs	$4.5V \leq AV_{CC} \leq 5.5V$
			2.2	-	8.0	μs	$2.7V \leq AV_{CC} < 4.5V$
Sampling time*	-	-	0.5	-	-	μs	$4.5V \leq AV_{CC} \leq 5.5V$
			1.2	-	-	μs	$2.7V \leq AV_{CC} < 4.5V$
Power supply current	I_A	AV_{CC}	-	2.0	3.1	mA	A/D Converter active
	I_{AH}		-	-	3.3	μA	A/D Converter not operated
Reference power supply current (between AVRH and AVRL)	I_R	AVRH	-	520	810	μA	A/D Converter active
	I_{RH}		-	-	1.0	μA	A/D Converter not operated
Analog input capacity	C_{VIN}	AN2 to 4, 6 to 8, 10 to 12, 14, 15	-	-	16.0	pF	Normal outputs
		AN16 to 31	-	-	17.8	pF	High current outputs
Analog impedance	R_{VIN}	ANn	-	-	2050	Ω	$4.5V \leq AV_{CC} \leq 5.5V$
			-	-	3600	Ω	$2.7V \leq AV_{CC} < 4.5V$
Analog port input current (during conversion)	I_{AIN}	AN2 to 4, 6 to 8, 10 to 12, 14, 15	- 0.3	-	+ 0.3	μA	$AV_{SS}, AVRL < V_{AIN} < AV_{CC}, AVRH$
		AN16 to 31	- 3.0	-	+ 3.0	μA	
Analog input voltage	V_{AIN}	ANn	AVRL	-	AVRH	V	
Reference voltage range	-	AVRH	$AV_{CC} - 0.1$	-	AV_{CC}	V	
	-	AVRL	AV_{SS}	-	$AV_{SS} + 0.1$	V	
Variation between channels	-	ANn	-	-	4.0	LSB	

*: Time for each channel.



Page	Section	Change Results
66	16. Ordering Information	<p>Revised Marketing Part Numbers as follows:</p> <p>Before)</p> <p>MCU with CAN controller</p> <p>MB96F693RBPMC-GSE1 MB96F693RBPMC-GSE2 MB96F695RBPMC-GSE1 MB96F695RBPMC-GSE2 MB96F696RBPMC-GSE1 MB96F696RBPMC-GSE2</p> <p>MCU without CAN controller</p> <p>MB96F693ABPMC-GSE1 MB96F693ABPMC-GSE2 MB96F695ABPMC-GSE1 MB96F695ABPMC-GSE2</p> <p>After)</p> <p>MCU with CAN controller</p> <p>CY96F693RBPMC-GS-UJE1 CY96F696RBPMC-GS-UJE1 CY96F696RBPMC-GS-UJE2</p> <p>MCU without CAN controller</p> <p>CY96F693ABPMC-GS-UJE1 CY96F693ABPMC-GS-UJE2</p>

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