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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 "<u>Embedded -</u> <u>Microcontrollers</u>"

Details

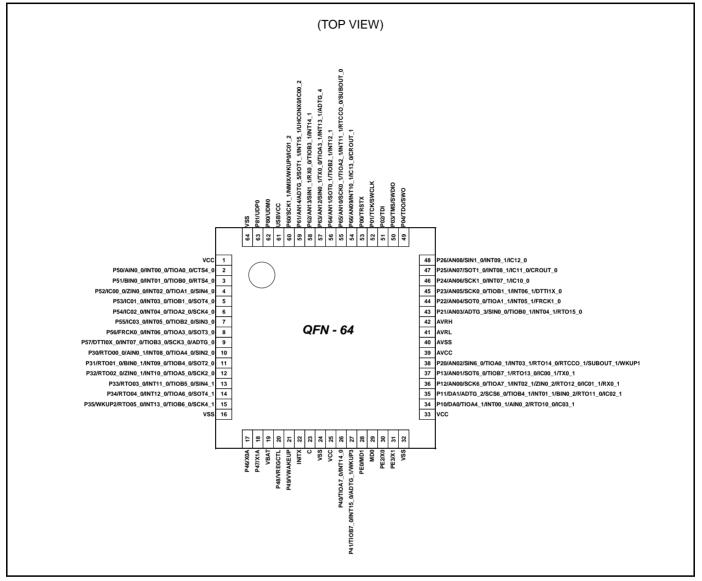
Decails	
Product Status	Active
Core Processor	ARM® Cortex®-M4F
Core Size	32-Bit Single-Core
Speed	160MHz
Connectivity	CSIO, I ² C, LINbus, UART/USART, USB
Peripherals	DMA, LVD, POR, PWM, WDT
Number of I/O	33
Program Memory Size	544KB (544K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	64K x 8
Voltage - Supply (Vcc/Vdd)	2.7V ~ 5.5V
Data Converters	A/D 8x12b; D/A 2x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	48-LQFP
Supplier Device Package	48-LQFP (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/rochester-electronics/mb9bf366kpmc-g-jne2

Email: info@E-XFL.COM

Address: Room A, 16/F, Full Win Commercial Centre, 573 Nathan Road, Mongkok, Hong Kong



LCC-64P-M24



Note:

 The number after the underscore ("_") in pin names such as XXX_1 and XXX_2 indicates the relocated port number. For these pins, there are multiple pins that provide the same function for the same channel. Use the extended port function register (EPFR) to select the pin.



Pin No			I/O circuit	Pin state	
LQFP64 QFN64	LQFP48 QFN48	Pin Name	type	type	
		P12			
		AN00			
		SCK6_0			
36	27	TIOA7_1	М	М	
		INT02_1 ZIN0_2			
		IC01_1			
	- RTO12_0				
	-	P13			
		AN01			
		SOT6_0			
37	28	(SDA6_0)	М	L	
07		TIOB7_1		L	
		IC00_1			
	-				
		P20			
		AN02			
		SIN6_0		0	
		TIOA0_1			
38	29	INT03_1	F		
30		RTCCO_1	F		
		SUBOUT_1			
		WKUP1			
	-	RTO14_0			
39	30	AVCC	-	-	
40	31	AVSS	-	-	
41	32	AVRL	-	-	
42	33	AVRH	-	-	
		P21			
		AN03			
	24	ADTG_3			
43	34	SIN0_0	F	М	
		TIOB0_1			
		 INT04_1			
	-	RTO15_0			
		P22			
		AN04			
		SOT0_0			
44	35	(SDA0_0)	F	М	
		TIOA1_1			
		 INT05_1			
	-	FRCK1_0			
		P23			
		AN05	—		
		SCK0_0	—		
45	36	(SCL0_0)	F	М	
70		TIOB1_1			
		INT06_1			



4.2 List of Pin Functions

The number after the underscore ("_") in pin names such as XXX_1 and XXX_2 indicates the relocated port number. For these pins, there are multiple pins that provide the same function for the same channel. Use the extended port function register (EPFR) to select the pin.

Pin -			Pin	Pin No			
function	Pin name	Function description	LQFP64 QFN64	LQFP48 QFN48			
	ADTG_0		9	5			
	ADTG_1		27	-			
	ADTG_2		35	26			
	ADTG_3	A/D converter external trigger input pin	43	34			
	ADTG_4		57	-			
	ADTG_5		59	43			
	AN00		36	27			
	AN01 AN02		37	28			
			38	29			
	AN03		43	34			
ADC	AN04		44	35			
	AN05		45	36			
	AN06	1	46	-			
	AN07	A/D converter analog input pin.	47	-			
	AN08	ANxx describes ADC ch.xx.	48	-			
	AN09		54	42			
	AN10		55	-			
	AN11		56	-			
	AN12		57	-			
	AN13		58	-			
	AN14		59	43			
	TIOA0_0		2	-			
Base Timer	TIOA0_1	Base timer ch.0 TIOA pin	38	29			
0	TIOB0_0		3	-			
	TIOB0_1	Base timer ch.0 TIOB pin	43	34			
	TIOA1_0		4	-			
Base Timer	TIOA1_1	Base timer ch.1 TIOA pin	44	35			
1	TIOB1_0		5	-			
	TIOB1_1	Base timer ch.1 TIOB pin	45	36			
	TIOA2_0		6	2			
Base Timer	TIOA2_1	Base timer ch.2 TIOA pin	55	-			
2	TIOB2_0	Deve times at a TIOD at	7	3			
	TIOB2_1	Base timer ch.2 TIOB pin	56	-			
	TIOA3_0	Deep times of 2 TIOA nin	8	4			
Base Timer	TIOA3_1	Base timer ch.3 TIOA pin	57	-			
3	TIOB3_0	Deep times of 2 TIOD air	9	5			
	TIOB3_1	Base timer ch.3 TIOB pin	58	-			
	TIOA4_0	Deve times at 4 TIOA air	10	6			
Base Timer	TIOA4_1	Base timer ch.4 TIOA pin	34	25			
4	TIOB4_0	Deve times at 4 TIOD at	11	7			
	TIOB4_1	Base timer ch.4 TIOB pin	35	26			
Base Timer	TIOA5_0	Base timer ch.5 TIOA pin	12	8			
5	TIOB5_0	Base timer ch.5 TIOB pin	13	9			





			Pin No			
Pin function	Pin name	Function description	LQFP64 QFN64	LQFP48 QFN48		
	DTTI1X_0	Input signal controlling wave form generator outputs RTO10 to RTO15 of Multi-function timer 1.	45	-		
	FRCK1_0	16-bit free-run timer ch.1 external clock input pin	44	-		
	IC10_0		46	-		
	IC11_0	16-bit input capture ch.1 input pin of Multi-function timer 1.	47	-		
IC12_0	ICxx describes channel number.	48	-			
	IC13_0		54	-		
	RTO10_0 (PPG10_0)	Wave form generator output pin of Multi-function timer 1. This pin operates as PPG10 when it is used in PPG1 output modes.	34	-		
Multi- function Timer	RTO11_0 (PPG10_0)	Wave form generator output pin of Multi-function timer 1. This pin operates as PPG10 when it is used in PPG1 output modes.	35	-		
1		Wave form generator output pin of Multi-function timer 1. This pin operates as PPG12 when it is used in PPG1 output modes.	36	-		
	RTO13_0 (PPG12_0)	Wave form generator output pin of Multi-function timer 1. This pin operates as PPG12 when it is used in PPG1 output modes.	37	-		
	RTO14_0 (PPG14_0)	Wave form generator output pin of Multi-function timer 1. This pin operates as PPG14 when it is used in PPG1 output modes.	38	-		
	RTO15_0 (PPG14_0)	Wave form generator output pin of Multi-function timer 1. This pin operates as PPG14 when it is used in PPG1 output modes.	43	-		
	AIN0_0		2	-		
	AIN0_1	QPRC ch.0 AIN input pin	10	6		
Quadrature	AIN0_2		34	25		
Position/	BIN0_0		3	-		
Revolution	BIN0_1	QPRC ch.0 BIN input pin	11	7		
Counter	BIN0_2		35	26		
0	ZIN0_0	_	4	-		
	ZIN0_1	QPRC ch.0 ZIN input pin	12	8		
	ZIN0_2		36	36		

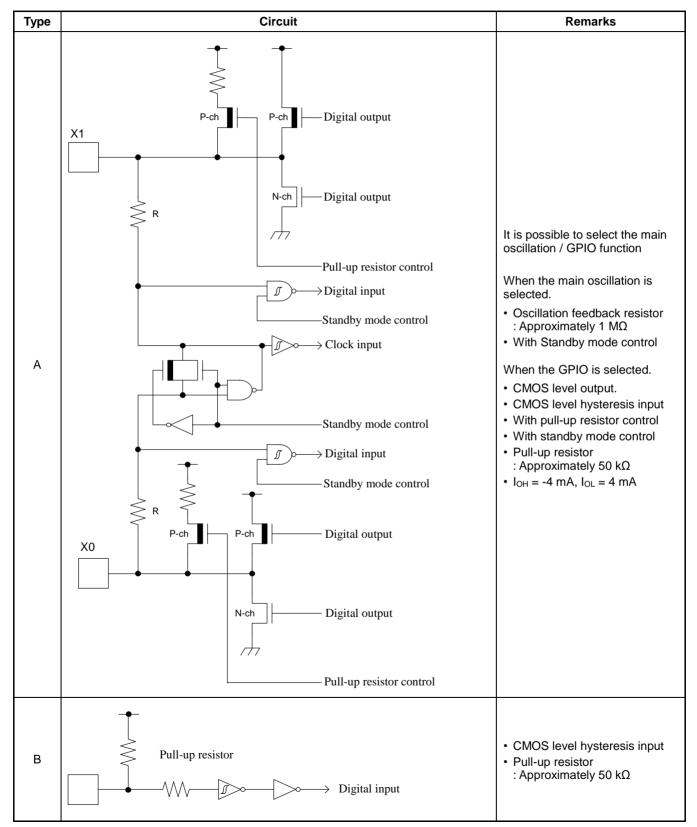




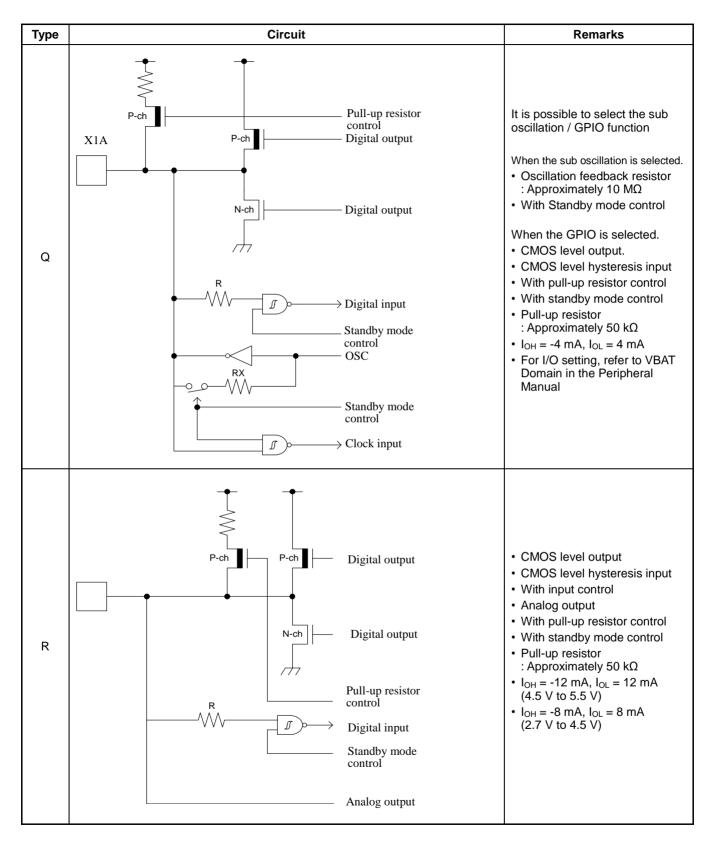
			Pin No			
Pin function	Pin name	Function description	LQFP64 QFN64	LQFP48 QFN48		
	RTCCO_0	0.5 seconds pulse output pin of Real-time clock	55	-		
Real-time	RTCCO_1	Sub clock output pin	38	29		
clock	SUBOUT_0	Out-start start size	55	-		
	SUBOUT_1 Sub clock output pin					
	UDM0	USB function/host D – pin	62	46		
USB						
	UHCONX0	USB external pull-up control pin	59	43		
Low-Power	WKUP0	Deep standby mode return signal input pin 0	60	44		
Consumpti	WKUP1	Deep standby mode return signal input pin 1	38	29		
on	WKUP2	Deep standby mode return signal input pin 2	15	11		
Mode	WKUP3	Deep standby mode return signal input pin 3	27	-		
	DA0	D/A converter ch.0 analog output pin	34	25		
DAC	DA1	D/A converter ch.1 analog output pin	35	26		
	VREGCTL	On-board regulator control pin	20	-		
VBAT	VWAKEUP	The return signal input pin from a hibernation state	21	-		
Reset	INITX	External Reset Input pin. A reset is valid when INITX="L".	22	16		
	MD1	Mode 1 pin. During serial programming to Flash memory, MD1="L" must be input.	28	20		
Mode	MD0	Mode 0 pin. During normal operation, MD0="L" must be input. During serial programming to Flash memory, MD0="H" must be input.	29	21		
			1	1		
Power	VCC	Power supply Pin	25	19		
Fower			33	-		
	USBVCC	3.3V Power supply port for USB I/O	61	45		
			16	12		
	VCC		24	18		
GND	VSS	GND Pin	32	24		
			64	48		
	X0	Main clock (oscillation) input pin	30	22		
	X1	Main clock (oscillation) I/O pin	31	23		
	X0A	Sub clock (oscillation) input pin	17	13		
Clock	X1A	Sub clock (oscillation) I/O pin	18	14		
F	CROUT_0		47	-		
F	CROUT 1	Built-in high-speed CR-osc clock output port	54	42		
Analog	AVCC	A/D converter and D/A converter analog power supply pin	39	30		
Power	AVRH	A/D converter analog reference voltage input pin	42	33		
VBAT Power	VBAT	VBAT power supply pin. Backup power supply (battery etc.) and system power supply.	19	15		
Analog	AVSS	A/D converter and D/A converter GND pin	40	31		
GND -	AVRL	A/D converter analog reference voltage input pin	41	32		
C pin	С	Power supply stabilization capacity pin	23	17		



5. I/O Circuit Type









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 $1 \text{ M}\Omega$).

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.

6.3 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.

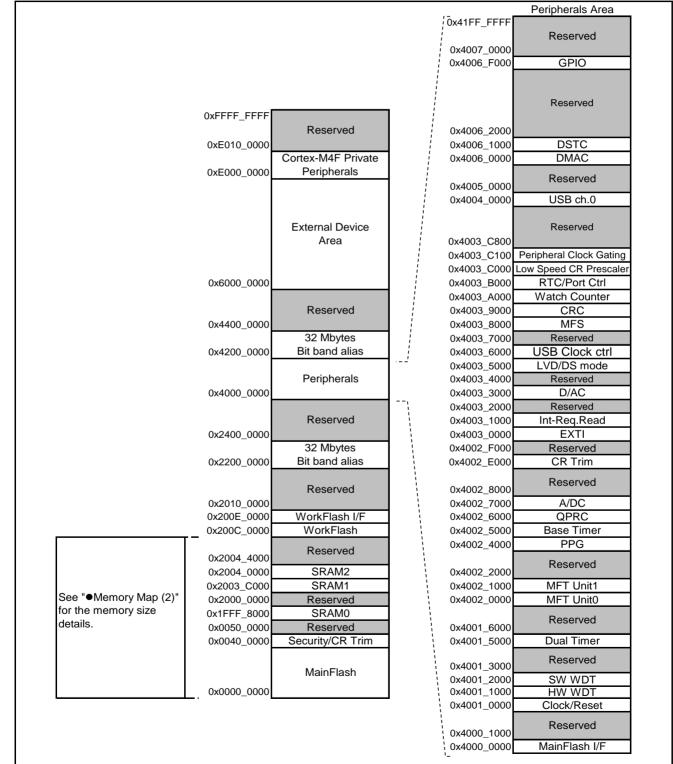


9. Memory Size

See Memory size in 1. Product Lineup to confirm the memory size.

10. Memory Map

Memory Map (1)





11. Pin Status in Each CPU State

The terms used for pin status have the following meanings.

■INITX=0

This is the period when the INITX pin is the L level.

■INITX=1

This is the period when the INITX pin is the H level.

■SPL=0

This is the status that the standby pin level setting bit (SPL) in the standby mode control register (STB_CTL) is set to 0.

■SPL=1

This is the status that the standby pin level setting bit (SPL) in the standby mode control register (STB_CTL) is set to 1.

■Input enabled Indicates that the input function can be used.

Internal input fixed at 0 This is the status that the input function cannot be used. Internal input is fixed at L.

■Hi-Z

Indicates that the pin drive transistor is disabled and the pin is put in the Hi-Z state.

Setting disabled Indicates that the setting is disabled.

Maintain previous state

Maintains the state that was immediately prior to entering the current mode. If a built-in peripheral function is operating, the output follows the peripheral function. If the pin is being used as a port, that output is maintained.

Analog input is enabled

Indicates that the analog input is enabled.

■Trace output

Indicates that the trace function can be used.

■GPIO selected

In Deep standby mode, pins switch to the general-purpose I/O port.

Setting prohibition

Prohibition of a setting by specification limitation.



Function Group	Power-on Reset or Low-voltage Detection State	INITX Input State	Device Internal Reset State	Run Mode or Sleep Mode State	Timer Mode, RTC Mode, or Stop Mode State		Mode or De	ep Standby	Return from Deep Standby Mode State Power
Group	Power Supply Unstable	Sta	able	Supply Stable	Sta	able	Sta	Power Supply Stable	
		INITX=0	INITX=1	INITX=1					INITX=1
	-	-	-	-		-		-	- Hi-Z /
Analog input selected	Hi-Z	Internal input fixed at 0 / Analog input enabled	Internal input fixed at 0 / Analog input enabled	Internal input fixed at 0 / Analog input enabled	Internal input fixed at 0 / Analog input enabled	Internal input fixed at 0 / Analog input enabled	Internal input fixed at 0 / Analog input enabled	Internal input fixed at 0 / Analog input enabled	Internal input fixed at 0 / Analog input enabled
WKUP enabled	Cotting	Cotting	Cotting			Maintain	WKUP input enabled	WKUP input enabled	
External interrupt enabled selected	disabled	disabled	disabled	Maintain	Maintain previous	previous state	GPIO	Internal	GPIO
Resource other than above selected GPIO selected	Hi-Z	Hi-Z Input enabled	Hi-Z Input enabled	state	state	Hi-Z / Internal input fixed at 0	selected Internal input fixed at 0		selected
Analog input selected	Hi-Z	Hi-Z / Internal input fixed at 0 / Analog input enabled	Hi-Z / Internal input fixed at 0 / Analog input enabled	Hi-Z / Internal input fixed at 0 / Analog input enabled	Hi-Z / Internal input fixed at 0 / Analog input enabled	Hi-Z / Internal input fixed at 0 / Analog input enabled	Hi-Z / Internal input fixed at 0 / Analog input enabled	Hi-Z / Internal input fixed at 0 / Analog input enabled	Hi-Z / Internal input fixed at 0 / Analog input enabled
WKUP enabled						Maintain previous state	WKUP input enabled	Hi-Z / WKUP input enabled	
Resource other than above selected GPIO	Setting disabled	Setting disabled	Setting disabled	Maintain previous state	Maintain previous state	Hi-Z / Internal input fixed at 0	GPIO selected Internal input fixed at 0	Hi-Z / Internal input fixed at 0	GPIO selected
	Group Analog input selected WKUP enabled External interrupt enabled selected Resource other than above selected GPIO selected Analog input selected WKUP enabled Resource other than above selected	Function GroupReset or Low-voltage Detection StatePower Supply Unstable-Analog input selectedHi-ZWKUP enabledSetting disabledExternal interrupt enabled selectedHi-ZResource other than above selectedHi-ZAnalog input selectedHi-ZWKUP enabledHi-ZWKUP enabledSetting disabledResource other than above selectedHi-ZMalog input selectedHi-ZVKUP enabledSetting disabledAnalog input selectedHi-ZWKUP enabledHi-Z	Function GroupReset or Low-voltage Detection StateINITX Input StatePower Supply UnstablePower StateAnalog input selectedHi-ZHi-ZHi-Z / Internal input fixed at 0 / Analog input enabledWKUP enabledSetting disabledExternal interrupt enabledSetting disabledKesource other than above selectedHi-ZHi-ZHi-ZHi-ZHi-ZResource other than above selectedHi-ZAnalog input selectedHi-ZAnalog input selectedHi-ZAnalog input selectedHi-ZAnalog input selectedSetting disabledKUP enabledHi-ZSetting disabledSetting disabledKUP enabledSetting disabledKUP enabledSetting disabledKUP enabledSetting disabledKUP enabledSetting disabledKUP enabledSetting disabledKUP enabledSetting disabledKUP enabledSetting disabled	Function GroupReset or Low-voltage Detection StateINITX Input StateDevice Internal Reset StatePower Supply UnstablePower Supply StateINITX=0INITX=1Analog input selectedHi-ZHi-Z / Internal input fixed at 0 / Analog input enabledHi-ZHi-Z / Internal input fixed at 0 / Analog input enabledHi-ZExternal interrupt enabled selectedSetting disabledSetting disabledSetting disabledHi-ZHi-ZHi-ZHi-ZResource other than above selectedHi-ZHi-ZAnalog input selectedHi-ZHi-Z / Input enabledHi-ZHi-ZHi-ZMalog input selectedHi-ZHi-Z / Input enabledMalog input selectedHi-ZSetting disabledMalog input selectedHi-ZSetting disabledMalog input selectedHi-ZSetting disabledMalog input selectedHi-ZSetting disabledMKUP enabledSetting disabledSetting disabledResource other than above selectedSetting disabledSetting disabledResource other than above selectedSetting disabledSetting disabledResource other than above selectedSetting disabledSetting disabledResource other than above selectedSetting disabled	Function GroupReset or Low-voltage Detection StateINITX Input StateDevice Internal Reset StateRun Mode Step Mode StatePower Supply UnstablePower Supply UnstablePower Supply StablePower Supply StablePower Supply StableAnalog input selected-INITX=0INITX=1INITX=1Analog input selectedHi-ZHi-Z/ Internal input fixed at 0 / Analog input enabledHi-ZHi-Z / Internal input fixed 	Function GroupReset or Low-voltage Detection 	Function GroupReset or Low-voltage Detection StateINITX internal stateDever stateSupply stableTimer Mode, RTC Mode, or Stop Mode StatePower Supply UnstablePower Supply UnstablePower Supply StablePower Supply StablePower Supply StablePower Supply StablePower Supply StableSPL=0SPL=1SPL=0SPL=1SPL=0SPL=1SPL=0SPL=1SPL=0SPL=1 <td>Function GroupReset or Low-voltage Detection StateINITX Input StateDevice Internal Reset StateWin Mode or Step Mode StateTimer Mode, RTC Mode, or Stop Mode StateDeep State Mode or De Stop Mode StatePower Supply UnstablePower StableSupply StablePower Supply St</td> <td>Function Group Reset or Istate INITX Input State Deck Internal State Deck State Deck State</td>	Function GroupReset or Low-voltage Detection StateINITX Input StateDevice Internal Reset StateWin Mode or Step Mode StateTimer Mode, RTC Mode, or Stop Mode StateDeep State Mode or De Stop Mode StatePower Supply UnstablePower StableSupply StablePower Supply St	Function Group Reset or Istate INITX Input State Deck Internal State Deck State Deck State



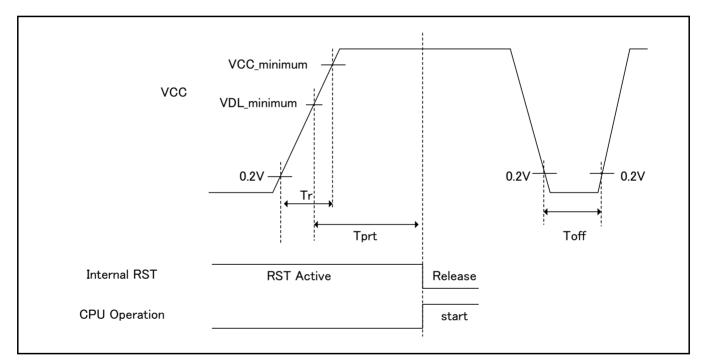
12.4.7 Reset Input Characteristics

							(V _{CC} = 2.7V to 5.5V, V _{SS} =	= 0V)
Parameter	Symbol	Pin	Condition	Va	lue	Unit	Remarks	
Farameter	Symbol	Name	Condition	Min	Max	Onit	Nemarks	
Reset input time	t _{INITX}	INITX	-	500	-	ns		

12.4.8 Power-on Reset Timing

 $(V_{CC} = 2.7V \text{ to } 5.5V, V_{SS} = 0V)$

Parameter	Symbol	Pin Name	V	/alue	Unit	Demorko
Parameter	Symbol	Pin Name	Min	Max	Unit	Remarks
Power supply rising time	Tr		0	-	ms	
Power supply shut down time	Toff	VCC	1	-	ms	
Time until releasing Power-on reset	Tprt		0.33	0.60	ms	



Glossary

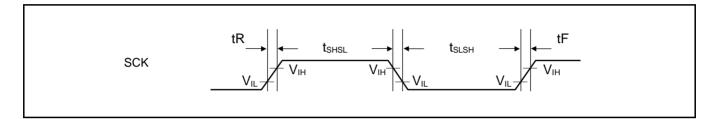
- + VCC_minimum: Minimum V_{CC} of recommended operating conditions.
- VDL_minimum: Minimum detection voltage of Low-Voltage detection reset.
 - See 12.8. Low-Voltage Detection Characteristics.



External Clock (EXT = 1): when in Asynchronous Mode Only

 $(V_{CC} = 2.7V \text{ to } 5.5V, V_{SS} = 0V)$

		A 11/1	V	alue		
Parameter	Symbol	Condition	Min	Max	– Unit	Remarks
Serial clock "L" pulse width	t _{SLSH}		t _{CYCP} + 10	-	ns	
Serial clock "H" pulse width	t _{SHSL}	0 20 5	t _{CYCP} + 10	-	ns	
SCK falling time	tF	$C_L = 30 \text{ pF}$	-	5	ns	
SCK rising time	tR		-	5	ns	



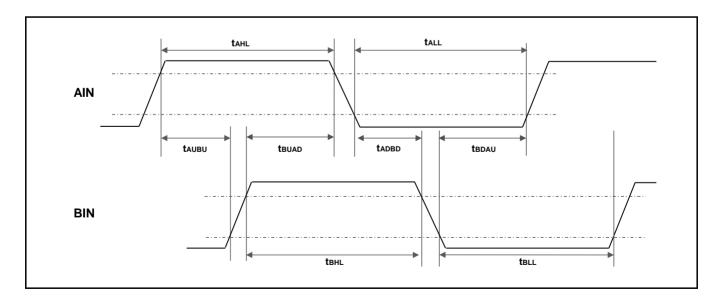


12.4.13 Quadrature Position/Revolution Counter Timing

 $(V_{CC} = 2.7V \text{ to } 5.5V, V_{SS} = 0V)$

Devemeter	Symbol	Conditions	Va	alue	Unit
Parameter	Symbol Conditions		Min	Max	Unit
AIN pin H width	t _{AHL}	-			
AIN pin L width	t _{ALL}	-			
BIN pin H width	t _{BHL}	-			
BIN pin L width	t _{BLL}	-			
BIN rising time from AIN pin H level	t _{AUBU}	PC_Mode2 or PC_Mode3			
AIN falling time from BIN pin H level	t _{BUAD}	PC_Mode2 or PC_Mode3			
BIN falling time from AIN pin L level	t _{ADBD}	PC_Mode2 or PC_Mode3			
AIN rising time from BIN pin L level	t _{BDAU}	PC_Mode2 or PC_Mode3		-	
AIN rising time from BIN pin H level	t _{BUAU}	PC_Mode2 or PC_Mode3	2t _{CYCP} *		ns
BIN falling time from AIN pin H level	t _{AUBD}	PC_Mode2 or PC_Mode3			
AIN falling time from BIN pin L level	t _{BDAD}	PC_Mode2 or PC_Mode3			
BIN rising time from AIN pin L level	t _{ADBU}	PC_Mode2 or PC_Mode3			
ZIN pin H width	t _{ZHL}	QCR:CGSC = 0			
ZIN pin L width	t _{ZLL}	QCR:CGSC = 0			
AIN/BIN rising and falling time from determined ZIN level	t _{ZABE}	QCR:CGSC = 1			
Determined ZIN level from AIN/BIN rising and falling time	t _{ABEZ}	QCR:CGSC = 1			

*: t_{CYCP} indicates the APB bus clock cycle time except stop when in Stop mode, in timer mode. About the APB bus number which Quadrature Position/Revolution Counter is connected to, see 8. Block Diagram in this data sheet.





12.5 12-bit A/D Converter

Electrical Characteristics for the A/D Converter

$(V_{CC} = AV_{CC} =$	2 7\/ to 5 5	$V V_{ee} = AV_{ee}$	= AV/RI = 0V/
	2.7 1 10 0.0	· •, • 33 – / • 33 ·	-7.010 ± 0.07

Parameter	Symbol	Symbol Pin Name		Value	Unit	Remarks	
Farameter	Symbol	r in Name	Min Typ Max		Max		Nemarks
Resolution	-	-	-	-	12	bit	
Integral Nonlinearity	-	-	-4.5	-	+4.5	LSB	
Differential Nonlinearity	-	-	-2.5	-	+2.5	LSB	AVRH =
Zero transition voltage	V _{ZT}	AN00 to AN14	-15	-	+15	mV	2.7 V to 5.5 V
Full-scale transition voltage	V _{FST}	AN00 to AN14	AVRH - 15	-	AVRH + 15	mV	
Conversion time	-	-	0.5* ¹	-	-	μs	$AV_{CC} \ge 4.5V$
O	T -		*2	-	40		$AV_{CC} \ge 4.5V$
Sampling time	Ts	-	*2	-	- 10	μs	$AV_{CC} < 4.5V$
0	- .		25	-	1000		$AV_{CC} \ge 4.5V$
Compare clock cycle*3	Tcck	-	50	-	1000	ns	$AV_{CC} < 4.5V$
State transition time to operation permission	Tstt	-	1.0	-	-	μs	
Power supply current (analog	_	AVCC	-	0.69	0.92	mA	A/D 1 unit operation
+ digital)	-	AVCC	-	0.3	12	μA	When A/D stop
Reference power supply current	-	AVRH	-	1.1	1.97	mA	A/D 1unit operation AVRH=5.5 V
(between AVRH and AVSS)				0.2	4.2	μA	When A/D stop
Analog input capacity	C _{AIN}	-	-	-	10	pF	
Analog input resistance	RAIN	-	_	-	1.2	kΩ	AV _{CC} ≥ 4.5 V
Analog input resistance	NAIN	-	-	-	1.8	K12	$AV_{CC} < 4.5 V$
Interchannel disparity	-	-	-	-	4	LSB	
Analog port input current	-	AN00 to AN14	-	-	5	μA	
Analog input voltage	-	AN00 to AN14	AV _{SS}	-	AVRH	V	
			4.5	-	AV _{CC}	v	Tcck < 50 ns
Reference voltage	-	AVRH	2.7	-	AV _{CC}	v	Tcck ≥ 50 ns

*1: The conversion time is the value of sampling time (Ts) + compare time (Tc).

The condition of the minimum conversion time is when the value of sampling time: 150 ns, the value of compare time: 350 ns $(AV_{CC} \ge 4.5 \text{ V})$. Ensure that it satisfies the value of sampling time (Ts) and compare clock cycle (Tcck). For setting^{*4} of sampling time and compare clock cycle, see CHAPTER 1-1: A/D Converter in FM4 Family Peripheral Manual Analog macro part (002-04860). The register setting of the A/D Converter is reflected by the peripheral clock timing. The sampling and compare clock are set at Base clock (HCLK).

*2: A necessary sampling time changes by external impedance. Ensure that it set the sampling time to satisfy (Equation 1).

*3: The compare time (Tc) is the value of (Equation 2).

*4: The register setting of the A/D Converter is reflected by the timing of the APB bus clock. The sampling clock and compare clock are set in base clock (HCLK). About the APB bus number which the A/D Converter is connected to, see 8. Block Diagram in this data sheet.



12.7 USB Characteristics

Parameter					Value			_ .
		Symbol	Pin Name	Conditions	Min	Max	Unit	Remarks
Input character -istics	Input H level voltage	V _{IH}	UDP0,UDM0	-	2.0	USBV _{CC} + 0.3	V	*1
	Input L level voltage	VIL		-	V _{SS} - 0.3	0.8	V	*1
	Differential input sensitivity	V _{DI}		-	0.2	-	V	*2
	Different common mode range	V _{CM}		-	0.8	2.5	V	*2
Output character -istics	Output "H" level voltage	V _{OH}		External pull-down resistance = $15 \text{ k}\Omega$	2.8	3.6	V	*3
	Output "L" level voltage	V _{OL}		External pull-up resistance = $1.5 \text{ k}\Omega$	0.0	0.3	V	*3
	Crossover voltage	V _{CRS}		-	1.3	2.0	V	*4
	Rising time	t _{FR}		Full-Speed	4	20	ns	*5
	Falling time	t _{FF}		Full-Speed	4	20	ns	*5
	Rising/falling time matching	t _{FRFM}		Full-Speed	90	111.11	%	*5
	Output impedance	Z _{DRV}		Full-Speed	28	44	Ω	*6
	Rising time	t _{LR}		Low-Speed	75	300	ns	*7
	Falling time	t _{LF}		Low-Speed	75	300	ns	*7
	Rising/falling time matching	t _{LRFM}		Low-Speed	80	125	%	*7

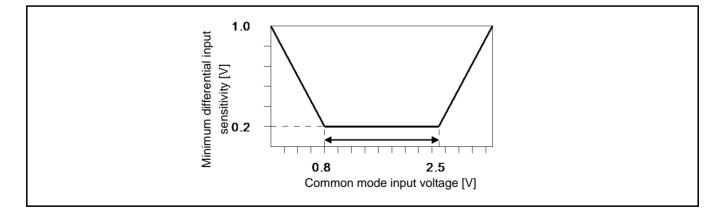
 $(V_{CC} = 2.7V \text{ to } 5.5V, \text{USBV}_{CC} = 3.0V \text{ to } 3.6V, \text{V}_{SS} = 0V)$

*1: The switching threshold voltage of Single-End-Receiver of USB I/O buffer is set as within V_{IL} (Max) = 0.8 V, V_{IH} (Min) = 2.0 V (TTL input standard).

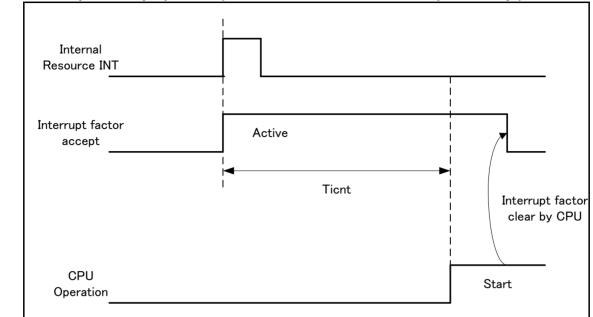
There are some hysteresises to lower noise sensitivity.

*2: Use differential-Receiver to receive USB differential data signal. Differential-Receiver has 200 mV of differential input sensitivity when the differential data input is within 0.8 V to 2.5 V to the local ground reference level.

Above voltage range is the common mode input voltage range.







Example of Standby Recovery Operation (when in Internal Resource Interrupt Recovery*)

*: Depending on the standby mode, interrupt from the internal resource is not included in the recovery cause.

Notes:

- The return factor is different in each Low-Power consumption modes.
 See CHAPTER 6: Low Power Consumption Mode and Operations of Standby Modes in FM4 Family Peripheral Manual Main part (002-04856).
- When interrupt recoveries, the operation mode that CPU recoveries depend on the state before the Low-Power consumption mode transition. See CHAPTER 6: Low Power Consumption Mode in FM4 Family Peripheral Manual Main part (002-04856).



Page	Section	Change Results		
116	 ELECTRICAL CHARACTERISTICS 11. Standby Recovery Time (1) Recovery cause: Interrupt/WKUP 	 Revised the value of TBD Revised the table of Recovery count time 		
118	 ELECTRICAL CHARACTERISTICS 11. Standby Recovery Time (2) Recovery cause:Reset 	 Revised the value of TBD Revised the table of Recovery count time 		

NOTE: Please see "Document History" about later revised information.



Document History

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Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	_	AKIH	12/25/2013	Migrated to Cypress and assigned document number 002-04930. No change to document contents or format.
*A	5273878	AKIH	05/12/2016	Updated to Cypress format.



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