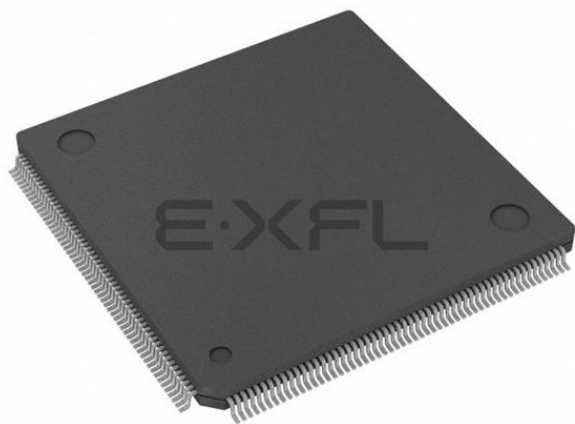




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What is "[Embedded - Microcontrollers](#)"?

"[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	Active
Core Processor	ARM® Cortex®-M4F
Core Size	32-Bit Single-Core
Speed	200MHz
Connectivity	CSIO, EBI/EMI, Ethernet, I ² C, LINbus, SD, SPI, UART/USART, USB
Peripherals	DMA, I ² S, LVD, POR, PWM, WDT
Number of I/O	190
Program Memory Size	1.5MB (1.5M x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	192K x 8
Voltage - Supply (Vcc/Vdd)	2.7V ~ 5.5V
Data Converters	A/D 32x12b; D/A 2x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	216-LQFP
Supplier Device Package	216-LQFP (24x24)
Purchase URL	https://www.e-xfl.com/product-detail/infineon-technologies/s6e2c29l0agl2000a

Multi-function Timer (Max three Units)

The multi-function timer is composed of the following blocks:

Minimum resolution: 5.00 ns

- 16-bit free-run timer × 3 ch/unit
- Input capture × 4 ch/unit
- Output compare × 6 ch/unit
- A/D activation compare × 6 ch/unit
- Waveform generator × 3 ch/unit
- 16-bit PPG timer × 3 ch/unit

The following functions can be used to achieve the motor control:

- PWM signal output function
- DC chopper waveform output function
- Dead time function
- Input capture function
- A/D convertor activate function
- DTIF (motor emergency stop) interrupt function

Real-Time Clock (RTC)

The real-time clock can count year, month, day, hour, minute, second, or day of the week from 00 to 99.

- Interrupt function with specifying date and time (year/month/day/hour/minute) is available. This function is also available by specifying only year, month, day, hour, or minute.
- Timer interrupt function after set time or each set time.
- Capable of rewriting the time with continuing the time count.
- Leap year automatic count is available.

Quadrature Position/Revolution Counter (QPRC; Max four Channels)

The Quadrature Position/Revolution Counter (QPRC) is used to measure the position of the position encoder. It is also possible to use up/down counter.

- The detection edge of the three external event input pins AIN, BIN and ZIN is configurable.
- 16-bit position counter
- 16-bit revolution counter
- Two 16-bit compare registers

Dual Timer (32-/16-bit Down Counter)

The dual timer consists of two programmable 32/16-bit down counters.

Operation mode is selectable from the following for each channel:

- Free-running
- Periodic (= Reload)
- One shot

Watch Counter

The watch counter is used for wake up from low-power consumption mode. It is possible to select the main clock, sub clock, built-in High-speed CR clock, or built-in low-speed CR clock as the clock source.

- Interval timer: up to 64 s (max) with a sub clock of 32.768 kHz

External Interrupt Controller Unit

- External interrupt input pin: Max 32 pins
- Include one non-maskable interrupt (NMI)

Watchdog Timer (2 Channels)

A watchdog timer can generate interrupts or a reset when a time-out value is reached.

This series consists of two different watchdogs: a "hardware" watchdog and a "software" watchdog.

The hardware watchdog timer is clocked by low-speed internal CR oscillator. The hardware watchdog is thus active in any power saving mode except RTC mode and Stop mode.

Cyclic Redundancy Check (CRC) Accelerator

The CRC accelerator helps to verify data transmission or storage integrity.

CCITT CRC16 and IEEE-802.3 CRC32 are supported.

- CCITT CRC16 generator polynomial: 0x1021
- IEEE-802.3 CRC32 generator polynomial: 0x04C11DB7



(Top View)

LQFP - 176

Pin Number				Pin Name	I/O Circuit Type	Pin State Type
LQQ216	LQP176	LQS144	LBE192			
125	101	85	J11	P17	F	L
				AN07		
				SCK11_0 (SCL11_0)		
				TIOB2_2		
				ZIN1_2		
126	102	-	J10	PB0	F	L
				AN16		
				SCK6_1 (SCL6_1)		
				TIOA9_1		
127	103	-	J9	PB1	F	M
				AN17		
				SCS60_1		
				TIOB9_1		
				INT08_1		
128	104	-	H10	PB2	F	M
				AN18		
				SCS61_1		
				TIOA10_1		
				INT09_1		
129	105	-	J14	PB3	F	L
				AN19		
				SCS62_1		
				TIOB10_1		
130	106	86	H9	P18	F	M
				AN08		
				SIN2_0		
				TIOA3_2		
				INT10_0		
131	107	87	H12	P19	F	O
				AN09		
				SOT2_0 (SDA2_0)		
				TIOB3_2		
				INT24_1		
				TRACECLK		
132	108	88	H14	P1A	F	N
				AN10		
				SCK2_0 (SCL2_0)		
				TIOA4_2		
				TRACED0		
133	109	89	G14	P1B	F	O
				AN11		
				SIN12_0		
				TIOB4_2		
				INT11_0		
134	110	90	H13	TRACED1	F	N
				P1C		
				AN12		
				SOT12_0 (SDA12_0)		
				TIOA5_2		
				TRACED2		

Module	Pin Name	Function	Pin Number			
			LQQ 216	LQP 176	LQS 144	LBE 192
External bus	MADATA00_0	External bus interface data bus (address/data multiplex bus)	2	2	2	B2
	MADATA01_0		3	3	3	C2
	MADATA02_0		4	4	4	C3
	MADATA03_0		5	5	5	D5
	MADATA04_0		6	6	6	D2
	MADATA05_0		7	7	7	D1
	MADATA06_0		8	8	8	D3
	MADATA07_0		9	9	9	D4
	MADATA08_0		14	13	10	E5
	MADATA09_0		15	14	11	F1
	MADATA10_0		16	15	12	F2
	MADATA11_0		17	16	13	F3
	MADATA12_0		18	17	14	F4
	MADATA13_0		23	18	15	F5
	MADATA14_0		24	19	16	F6
	MADATA15_0		25	20	17	G2
	MADATA16_0		10	-	-	-
	MADATA17_0		11	-	-	-
	MADATA18_0		12	-	-	-
	MADATA19_0		13	-	-	-
	MADATA20_0		19	-	-	-
	MADATA21_0		20	-	-	-
	MADATA22_0		21	-	-	-
	MADATA23_0		22	-	-	-
	MADATA24_0		26	-	-	-
	MADATA25_0		27	-	-	-
	MADATA26_0		28	-	-	-
	MADATA27_0		29	-	-	-
	MADATA28_0		33	-	-	-
	MADATA29_0		51	-	-	-
	MADATA30_0		52	-	-	-
	MADATA31_0		53	-	-	-
	MDQM0_0	External bus interface byte mask signal output pin	30	21	18	G3
	MDQM1_0		31	22	19	G4
	MDQM2_0		34	-	-	-
	MDQM3_0		35	-	-	-
	MALE_0	External bus interface address latch enable output signal for multiplex	211	171	139	C4
	MRDY_0	External bus interface external RDY input signal	80	65	55	L6

Module	Pin Name	Function	Pin Number			
			LQQ 216	LQP 176	LQS 144	LBE 192
Multi-Function Serial 5	SIN5_0	Multi-function serial interface ch 5 input pin	147	121	97	F13
	SIN5_1		170	140	-	D11
	SOT5_0 (SDA5_0)	Multi-function serial interface ch 5 output pin.	146	120	96	F12
	SOT5_1 (SDA5_1)	This pin operates as SOT5 when it is used in a UART/CSIO/LIN (operation modes 0 to 3) and as SDA5 when it is used in an I ² C (operation mode 4).	171	141	-	B10
	SCK5_0 (SCL5_0)	Multi-function serial interface ch 5 clock I/O pin.	145	119	95	F11
	SCK5_1 (SCL5_1)	This pin operates as SCK5 when it is used in a CSIO (operation mode 2) and as SCL5 when it is used in an I ² C (operation mode 4).	172	142	-	C10
	CTS5_0	Multi-function serial interface ch 5 CTS input pin	144	118	94	F10
	CTS5_1		173	143	-	D10
	RTS5_0	Multi-function serial interface ch 5 RTS output pin	143	117	93	G9
	RTS5_1		174	144	-	B9
Multi-Function Serial 6	SIN6_0	Multi-function serial interface ch 6 input pin	96	79	63	L10
	SIN6_1		117	97	81	K14
	SOT6_0 (SDA6_0)	Multi-function serial interface ch 6 output pin.	97	80	64	K10
	SOT6_1 (SDA6_1)	This pin operates as SOT6 when it is used in a UART/CSIO/LIN (operation modes 0 to 3) and as SDA6 when it is used in an I ² C (operation mode 4).	118	98	82	K11
	SCK6_0 (SCL6_0)	Multi-function serial interface ch 6 clock I/O pin.	98	81	65	M10
	SCK6_1 (SCL6_1)	This pin operates as SCK6 when it is used in a CSIO (operation mode 2) and as SCL6 when it is used in an I ² C (operation mode 4).	126	102	-	J10
	SCS60_0	Multi-function serial interface ch 6 chip select 0 input/output pin	99	82	66	N11
	SCS60_1		127	103	-	J9
	SCS61_0	Multi-function serial interface ch 6 chip select1 input/output pin	100	83	67	M11
	SCS61_1		128	104	-	H10
	SCS62_0	Multi-function serial interface ch 6 chip select2 input/output pin	79	64	-	K6
	SCS62_1		129	105	-	J14
	SCS63_0	Multi-function serial interface ch 6 chip select3 input/output pin	78	63	-	K5
	SCS63_1		119	-	-	-

Module	Pin Name	Function	Pin Number			
			LQQ 216	LQP 176	LQS 144	LBE 192
Multi-Function Timer 1	DTT1X_0	Input signal controlling waveform generator outputs RTO10 to RTO15 of Multi-Function Timer 1.	70	55	47	L5
	DTT1X_1		94	-	-	-
	FRCK1_0	16-bit free-run timer ch 1 external clock input pin	71	56	48	M5
	FRCK1_1		78	63	-	K5
	IC10_0	16-bit input capture input pin of Multi-Function Timer 1. ICxx describes channel number.	96	79	63	L10
	IC10_1		95	-	-	-
	IC11_0		97	80	64	K10
	IC11_1		101	-	-	-
	IC12_0		98	81	65	M10
	IC12_1		102	-	-	-
	IC13_0		99	82	66	N11
	IC13_1		103	-	-	-
	RTO10_0 (PPG10_0)	Waveform generator output pin of Multi-Function Timer 1.	56	46	38	N2
	RTO10_1 (PPG10_1)	This pin operates as PPG10 when it is used in PPG1 output modes.	85	70	-	N8
	RTO11_0 (PPG10_0)	Waveform generator output pin of Multi-Function Timer 1.	57	47	39	N3
	RTO11_1 (PPG10_1)	This pin operates as PPG10 when it is used in PPG1 output modes.	86	71	-	M8
	RTO12_0 (PPG12_0)	Waveform generator output pin of Multi-Function Timer 1.	58	48	40	M3
	RTO12_1 (PPG12_1)	This pin operates as PPG12 when it is used in PPG1 output modes.	87	72	-	N9
	RTO13_0 (PPG12_0)	Waveform generator output pin of Multi-Function Timer 1.	59	49	41	L4
	RTO13_1 (PPG12_1)	This pin operates as PPG12 when it is used in PPG1 output modes.	88	73	-	P9
	RTO14_0 (PPG14_0)	Waveform generator output pin of Multi-Function Timer 1.	60	50	42	M4
	RTO14_1 (PPG14_1)	This pin operates as PPG14 when it is used in PPG1 output modes.	89	74	-	M9
	RTO15_0 (PPG14_0)	Waveform generator output pin of Multi-Function Timer 1.	61	51	43	N4
	RTO15_1 (PPG14_1)	This pin operates as PPG14 when it is used in PPG1 output modes.	90	75	-	L9

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 milliamps 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

As previously mentioned, all semiconductor devices have inherent rates 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.

6.2 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.

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.

Pin Status Type	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		Deep Standby RTC mode or Deep Standby Stop mode State		Return From Deep Standby mode State
		Power Supply Unstable	Power Supply Stable		Power Supply Stable	Power Supply Stable		Power Supply Stable		Power Supply Stable
		-	INITX=0	INITX=1	INITX=1	INITX=1		INITX=1		INITX=1
		-	-	-	-	SPL=0	SPL=1	SPL=0	SPL=1	-
M	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
	External interrupt enable selected	Setting disabled	Setting disabled	Setting disabled	Maintain previous state	Maintain previous state	Maintain previous state	GPIO selected, internal input fixed at 0	Hi-Z/internal input fixed at 0	GPIO selected
	Resource other than above selected						Hi-Z/internal input fixed at 0			
	GPIO selected									
N	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
	Trace selected	Setting disabled	Setting disabled	Setting disabled	Maintain previous state	Maintain previous state	Trace output	GPIO selected, internal input fixed at 0	Hi-Z/internal input fixed at 0	GPIO selected
	Resource other than above selected						Hi-Z/internal input fixed at 0			
	GPIO selected									

12.2 Recommended Operating Conditions

Parameter		Symbol	Conditions	Value		Unit	Remarks
				Min	Max		
Power supply voltage		V _{CC}	-	2.7 ^{*9}	5.5	V	
Power supply voltage (for USB ch 0)		USBV _{CC0}	-	3.0	3.6 (≤V _{CC})	V	*1
				2.7	5.5 (≤V _{CC})		*2
Power supply voltage (for USB ch 1)		USBV _{CC1}	-	3.0	3.6 (≤V _{CC})	V	*3
				2.7	5.5 (≤V _{CC})		*4
Power supply voltage (for Ethernet-MAC)		ETHV _{CC}	-	3.0	3.6 (≤V _{CC})	V	*5
				4.5	5.5 (≤V _{CC})		*5
				2.7	5.5 (≤V _{CC})		*6
Power supply voltage (VBAT)		V _{BAT}	-	1.65	5.5	V	
Analog power supply voltage		AV _{CC}	-	2.7	5.5	V	AV _{CC} = V _{CC}
Analog reference voltage		AVRH	-	*8	AV _{CC}	V	
		AVRL	-	AV _{SS}	AV _{SS}	V	
Operating temperature	Junction temperature	T _J	-	- 40	+ 125	°C	
	Ambient temperature	T _A	-	- 40	*7	°C	

*1: When P81/UDP0 and P80/UDM0 pins are used as USB (UDP0, UDM0)

*2: When P81/UDP0 and P80/UDM0 pins are used as GPIO (P81, P80)

*3: When P83/UDP1 and P82/UDM1 pins are used as USB (UDP1, UDM1)

*4: When P83/UDP1 and P82/UDM1 pins are used as GPIO (P83, P82)

*5: When the pins in "Ethernet-MAC Pins," except P6E/ADTG_5/SCK4_1/IC23_1/INT29_0/E_PPS pin, are used as Ethernet-MAC pin

*6: When the pins in "Ethernet-MAC Pins," except P6E/ADTG_5/SCK4_1/IC23_1/INT29_0/E_PPS pin, are used as Ethernet-MAC pin

*7: The maximum temperature of the ambient temperature (T_A) can guarantee a range that does not exceed the junction temperature (T_J).

The calculation formula of the ambient temperature (T_A) is:

$$T_A (\text{Max}) = T_J (\text{Max}) - P_d (\text{Max}) \times \theta_{JA}$$

P_d: Power dissipation (W)

θ_{JA}: Package thermal resistance (°C/W)

$$P_d (\text{Max}) = V_{CC} \times I_{CC} (\text{Max}) + \sum (I_{OL} \times V_{OL}) + \sum ((V_{CC} - V_{OH}) \times (-I_{OH}))$$

I_{OL}: L level output current

I_{OH}: H level output current

V_{OL}: L level output voltage

V_{OH}: H level output voltage

*8: The minimum value of analog reference voltage depends on the value of compare clock cycle (T_{ck}). See 12.5. 12-bit A/D Converter for the details.

*9: For the voltage range between V_{CC}(min) and the low voltage detection reset (VDH), the MCU must be clocked from either the High-speed CR or the low-speed CR."

12.3 DC Characteristics

12.3.1 Current Rating

Table 12-1 Typical and Maximum Current Consumption in Normal Operation (PLL), Code Running from Flash Memory (Flash Accelerator Mode and Trace Buffer Function Enabled)

Parameter	Symbol	Pin Name	Conditions		Frequency* ⁴	Value		Unit	Remarks
						Typ* ¹	Max* ²		
Power supply current	I _{CC}	VCC	Normal operation * ⁷ ,* ⁸ (PLL)	*5	200 MHz	117	224	mA	* ³ When all peripheral clocks are on
					192 MHz	113	219	mA	
					180 MHz	106	211	mA	
				*6	160 MHz	95	197	mA	
					144 MHz	86	186	mA	
					120 MHz	73	169	mA	
					100 MHz	61	155	mA	
					80 MHz	50	140	mA	
					60 MHz	39	126	mA	
					40 MHz	27	112	mA	
					20 MHz	16	97	mA	
					8 MHz	8.7	88.9	mA	
					4 MHz	6.4	86.1	mA	
				*5	200 MHz	71	168	mA	
					192 MHz	68	165	mA	
					180 MHz	64	159	mA	
				*6	160 MHz	58	151	mA	
					144 MHz	52	144	mA	
					120 MHz	44	134	mA	
					100 MHz	38	126	mA	
					80 MHz	31	117	mA	
					60 MHz	24	109	mA	
					40 MHz	17	100	mA	
					20 MHz	10	91	mA	
					8 MHz	6.3	86.1	mA	
				4 MHz	5.0	84.5	mA		

*1: T_A = +25°C, V_{CC} = 3.3 V

*2: T_J = +125°C, V_{CC} = 5.5 V

*3: When all ports are fixed

*4: Frequency is a value of HCLK when PCLK0 = PCLK1 = PCLK2 = HCLK

*5: When stopping flash accelerator mode and trace buffer function (FRWTR.RWT = 11, FBFCR.BE = 1)

*6: When stopping flash accelerator mode and trace buffer function (FRWTR.RWT = 10, FBFCR.BE = 1)

*7: Firmware being executed during data collection for this table is not being accessed from the MainFlash memory."

*8: When using the crystal oscillator of 4 MHz (including the current consumption of the oscillation circuit)

Table 12-10 Typical and Maximum Current Consumption in Low-voltage Detection Circuit, Main Flash Memory Write/erase

Parameter	Symbol	Pin Name	Conditions	Value			Unit	Remarks
				Min	Typ	Max		
Low-voltage detection circuit (LVD) power supply current	I _{CCLVD}	VCC	At operation	-	4	7	μA	For occurrence of interrupt
MainFlash memory write/erase current	I _{CCFLASH}		At write/erase	-	13.4	15.9	mA	*1

*1: When programming or erase in flash memory, Flash Memory Write/Erase current (I_{CCFLASH}) is added to the Power supply current (I_{CC}).

Peripheral Current Dissipation

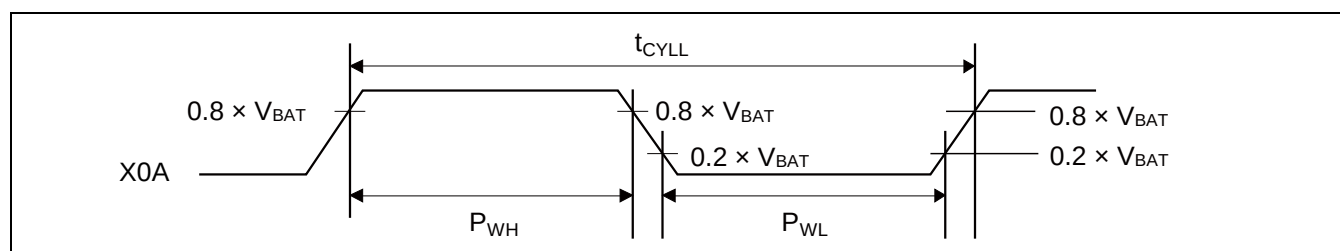
Clock system	Peripheral	Unit	Frequency (MHz)			Unit	Remarks
			50	100	200		
HCLK	GPIO	All ports	0.39	0.81	1.56	mA	
	DMAC	-	0.99	1.97	3.82		
	DSTC	-	0.73	1.49	2.86		
	External bus I/F	-	0.25	0.48	0.97		
	SD card I/F	-	0.74	1.47	2.90		
	USB	1 ch	0.48	0.95	1.89		
	Ethernet-MAC	-	1.85	3.63	7.20		
	I ² S	-	0.51	1.02	1.99		
	High-Speed Quad SPI	-	0.48	0.97	1.49		
	Programmable CRC	-	0.05	0.10	0.22		
PCLK1	Base timer	4 ch	0.21	0.42	0.83	mA	
	Multi-functional timer/PPG	1 unit/4 ch	0.83	1.65	3.25		
	Quadrature position/revolution counter	1 unit	0.07	0.13	0.27		
	A/D converter	1 unit	0.31	0.60	1.17		
PCLK2	Multi-function serial	1 ch	0.41	0.81	-	mA	

12.4.2 Sub Clock Input Characteristics

($V_{BAT} = 1.65V$ to $5.5V$, $V_{SS} = 0V$)

Parameter	Symbol	Pin Name	Conditions	Value			Unit	Remarks
				Min	Typ	Max		
Input frequency	$1/t_{CYLL}$	X0A, X1A	-	-	32.768	-	kHz	When crystal oscillator is connected *
			-	32	-	100	kHz	When using external clock
Input clock cycle	t_{CYLL}		-	10	-	31.25	μs	When using external clock
Input clock pulse width	-		P_{WH}/t_{CYLL} , P_{WL}/t_{CYLL}	45	-	55	%	When using external clock

*: For more information about crystal oscillator, see Sub crystal oscillator in 7. Handling Devices.



12.4.3 Built-In CR Oscillation Characteristics

Built-In High-speed CR

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

Parameter	Symbol	Conditions	Value			Unit	Remarks
			Min	Typ	Max		
Clock frequency	f_{CRH}	$T_J = -20^{\circ}C$ to $+105^{\circ}C$	3.92	4	4.08	MHz	When trimming *1
		$T_J = -40^{\circ}C$ to $+125^{\circ}C$	3.88	4	4.12		
		$T_J = -40^{\circ}C$ to $+125^{\circ}C$	3	4	5		When not trimming
Frequency stabilization time	t_{CRWT}	-	-	-	30	μs	*2

*1: In the case of using the values in CR trimming area of flash memory at shipment for frequency/temperature trimming

*2: This is the time to stabilize the frequency of the High-speed CR clock after setting trimming value. During this period, it is able to use the High-speed CR clock as a source clock.

Built-In Low-speed CR

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

Parameter	Symbol	Condition	Value			Unit	Remarks
			Min	Typ	Max		
Clock frequency	f_{CRL}	-	50	100	150	kHz	

12.4.8 Power-On Reset Timing

(V_{SS} = 0V)

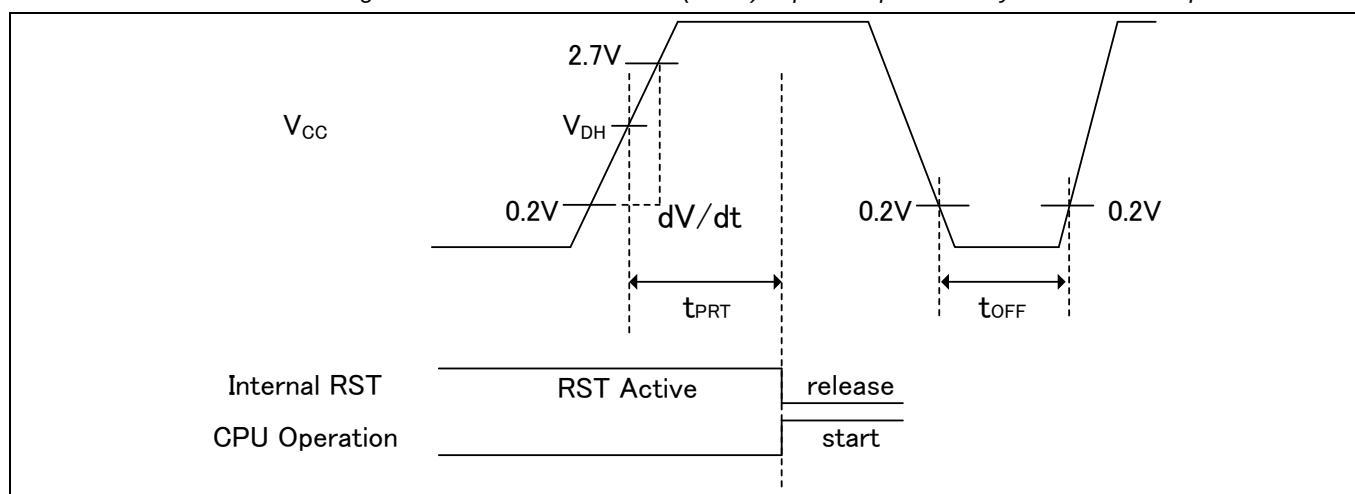
Parameter	Symbol	Pin Name	Conditions	Value			Unit	Remarks
				Min	Typ	Max		
Power supply shut down time	t _{OFF}	VCC	-	1	-	-	ms	*1
Power ramp rate	dV/dt		V _{CC} : 0.2V to 2.70V	0.6	-	1000	mV/μs	*2
Time until releasing Power-on reset	t _{PRT}		-	0.33	-	0.60	ms	

*1: V_{CC} must be held below 0.2V for a minimum period of t_{OFF}. Improper initialization may occur if this condition is not met.

*2: This dV/dt characteristic is applied at the power-on of cold start (t_{OFF}>1ms).

Note:

- If t_{OFF} cannot be satisfied designs must assert external reset(INITX) at power-up and at any brownout event per 12. 4. 7.



Glossary

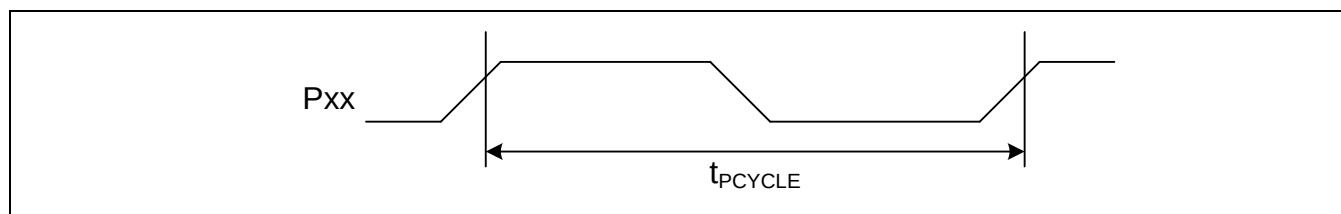
- V_{DH}: detection voltage of Low Voltage detection reset. See “12.8. Low-Voltage Detection Characteristics”.

12.4.9 GPIO Output Characteristics

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

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Typ		
Output frequency	t _{PCYCLE}	Pxx*	V _{CC} ≥ 4.5 V	-	50	MHz	
			V _{CC} < 4.5 V	-	32	MHz	

*: GPIO is a target.



12.4.10 External Bus Timing

External Bus Clock Output Characteristics

Separate Bus Access Asynchronous SRAM Mode

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

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Max		
MOEX Minimum pulse width	t _{OE}	MOEX	-	MCLK×n-3	-	ns	
MCSX ↓ → Address output delay time	t _{CSL - AV}	MCSX[7: 0], MAD[24: 0]	-	-9	+9	ns	
MOEX ↑ → Address hold time	t _{OE} - AX	MOEX, MAD[24: 0]	-	0	MCLK×m+9	ns	
MCSX ↓ → MOEX ↓ delay time	t _{CSL - OEL}	MOEX, MCSX[7: 0]	-	MCLK×m-9	MCLK×m+9	ns	
MOEX ↑ → MCSX ↑ time	t _{OE} - CSH		-	0	MCLK×m+9	ns	
MCSX ↓ → MDQM ↓ delay time	t _{CSL - RDQML}	MCSX, MDQM[3: 0]	-	MCLK×m-9	MCLK×m+9	ns	
Data set up → MOEX ↑ time	t _{DS - OE}	MOEX, MADATA[31: 0]	-	20	-	ns	
MOEX ↑ → Data hold time	t _{DH - OE}	MOEX, MADATA[31: 0]	-	0	-	ns	
MWEX Minimum pulse width	t _{WE}	MWEX	-	MCLK×n-3	-	ns	
MWEX ↑ → Address output delay time	t _{WE} - AX	MWEX, MAD[24: 0]	-	0	MCLK×m+9	ns	
MCSX ↓ → MWEX ↓ delay time	t _{CSL - WEL}	MWEX, MCSX[7: 0]	-	MCLK×n-9	MCLK×n+9	ns	
MWEX ↑ → MCSX ↑ delay time	t _{WE} - CSH		-	0	MCLK×m+9	ns	
MCSX ↓ → MDQM ↓ delay time	t _{CSL - WDQML}	MCSX, MDQM[3: 0]	-	MCLK×n-9	MCLK×n+9	ns	
MCSX ↓ → Data output time	t _{CSL - DX}	MCSX, MADATA[31: 0]	-	MCLK-9	MCLK+9	ns	
MWEX ↑ → Data hold time	t _{WE} - DX	MWEX, MADATA[31: 0]	-	0	MCLK×m+9	ns	

Note:

- When the external load capacitance C_L = 30 pF (m = 0 to 15, n = 1 to 16)

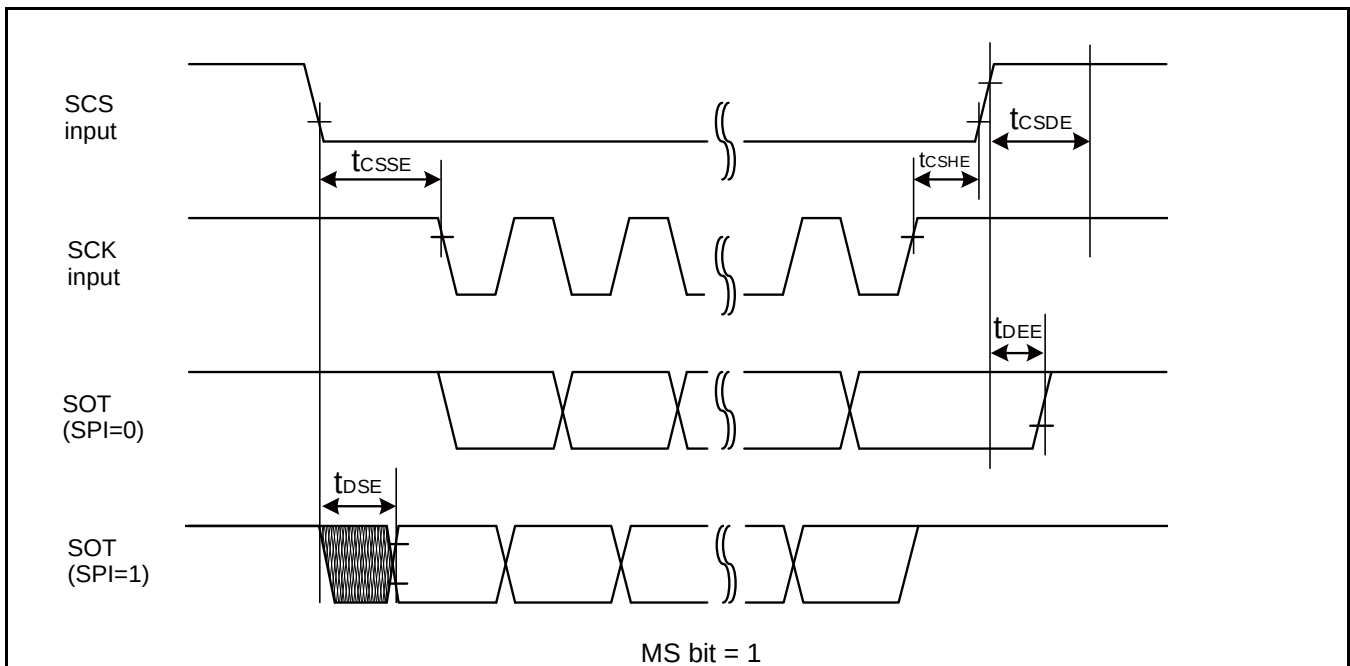
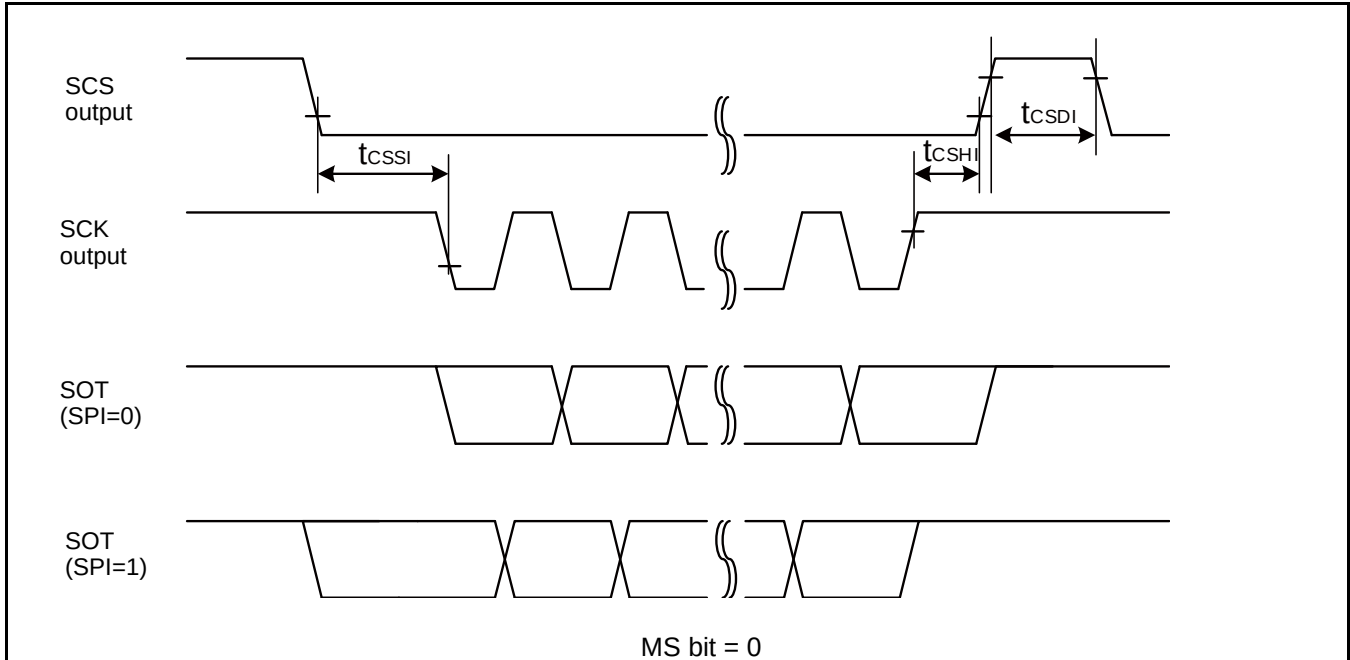
Synchronous Serial (SPI = 1, SCINV = 0)

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

Parameter	Symbol	Pin Name	Conditions	V _{CC} < 4.5 V		V _{CC} ≥ 4.5 V		Unit
				Min	Max	Min	Max	
Baud rate	-	-	-	-	8	-	8	Mbps
Serial clock cycle time	t _{SCYC}	SCKx	Internal shift clock operation	4t _{CYCP}	-	4t _{CYCP}	-	ns
SCK↑→SOT delay time	t _{SHOVI}	SCKx, SOTx		- 30	+ 30	- 20	+ 20	ns
SIN→SCK↓ setup time	t _{IVSLI}	SCKx, SINx		50	-	30	-	ns
SCK↓→SIN hold time	t _{SLIXI}	SCKx, SINx		0	-	0	-	ns
SOT→SCK↓ delay time	t _{SOVLI}	SCKx, SOTx		2t _{CYCP} - 30	-	2t _{CYCP} - 30	-	ns
Serial clock L pulse width	t _{LSLH}	SCKx		2t _{CYCP} - 10	-	2t _{CYCP} - 10	-	ns
Serial clock H pulse width	t _{SHSL}	SCKx	External shift clock operation	t _{CYCP} + 10	-	t _{CYCP} + 10	-	ns
SCK↑→SOT delay time	t _{SHOVE}	SCKx, SOTx		-	50	-	30	ns
SIN→SCK↓ setup time	t _{IVSLE}	SCKx, SINx		10	-	10	-	ns
SCK↓→SIN hold time	t _{SLIXE}	SCKx, SINx		20	-	20	-	ns
SCK fall time	t _F	SCKx		-	5	-	5	ns
SCK rise time	t _R	SCKx		-	5	-	5	ns

Notes:

- The above characteristics apply to CLK synchronous mode.
- t_{CYCP} indicates the APB bus clock cycle time. For more information about the APB bus number to which the multi-function serial is connected, see 8. Block Diagram in this data sheet.
- These characteristics only guarantee the same relocate port number; for example, the combination of SCKx_0 and SOTx_1 is not guaranteed.
- When the external load capacitance C_L = 30 pF.



When Using High-Speed Synchronous Serial Chip Select (SCINV = 1, CSLVL = 0)

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

Parameter	Symbol	Conditions	V _{CC} < 4.5 V		V _{CC} ≥ 4.5 V		Unit
			Min	Max	Min	Max	
SCS↓→SCK↓ setup time	t _{CSSI}	Internal shift clock operation	(*1)-20	(*1)+0	(*1)-20	(*1)+0	ns
SCK↑→SCS↓ hold time	t _{CSHI}		(*2)+0	(*2)+20	(*2)+0	(*2)+20	ns
SCS deselect time	t _{CSDI}		(*3)-20 +5t _{CYCP}	(*3)+20 +5t _{CYCP}	(*3)-20 +5t _{CYCP}	(*3)+20 +5t _{CYCP}	ns
SCS↑→SCK↑ setup time	t _{CSSE}	External shift clock operation	3t _{CYCP} +15	-	3t _{CYCP} +15	-	ns
SCK↓→SCS↓ hold time	t _{CSHE}		0	-	0	-	ns
SCS deselect time	t _{CSDE}		3t _{CYCP} +15	-	3t _{CYCP} +15	-	ns
SCS↑→SOT delay time	t _{DSE}		-	40	-	40	ns
SCS↓→SOT delay time	t _{DEE}		0	-	0	-	ns

(*1): CSSU bit value×serial chip select timing operating clock cycle [ns]

(*2): CSHD bit value×serial chip select timing operating clock cycle [ns]

(*3): CSDS bit value×serial chip select timing operating clock cycle [ns]

Notes:

- t_{CYCP} indicates the APB bus clock cycle time. For more information about the APB bus number to which the multi-function serial is connected, see 8. Block Diagram in this data sheet.
- For more information about CSSU, CSHD, CSDS, and the serial chip select timing operating clock, see FM4 Family Peripheral Manual Main Part (002-04856).
- When the external load capacitance C_L = 30 pF.

High-Speed Mode

■ Clock CLK (All values are referred to V_{IH} and V_{IL})

($V_{CC} = 2.7V$ to $3.6V$, $V_{SS} = 0V$)

Parameter	Symbol	Pin Name	Conditions	Value		Remarks
				Min	Max	
Clock frequency Data Transfer Mode	f_{PP}	S_CLK	$C_{CARD} \leq 10$ pF (1 card)	0	50	MHz
Clock low time	t_{WL}	S_CLK		7	-	ns
Clock high time	t_{WH}	S_CLK		7	-	ns
Clock rise time	t_{TLH}	S_CLK		-	3	ns
Clock fall time	t_{THL}	S_CLK		-	3	ns

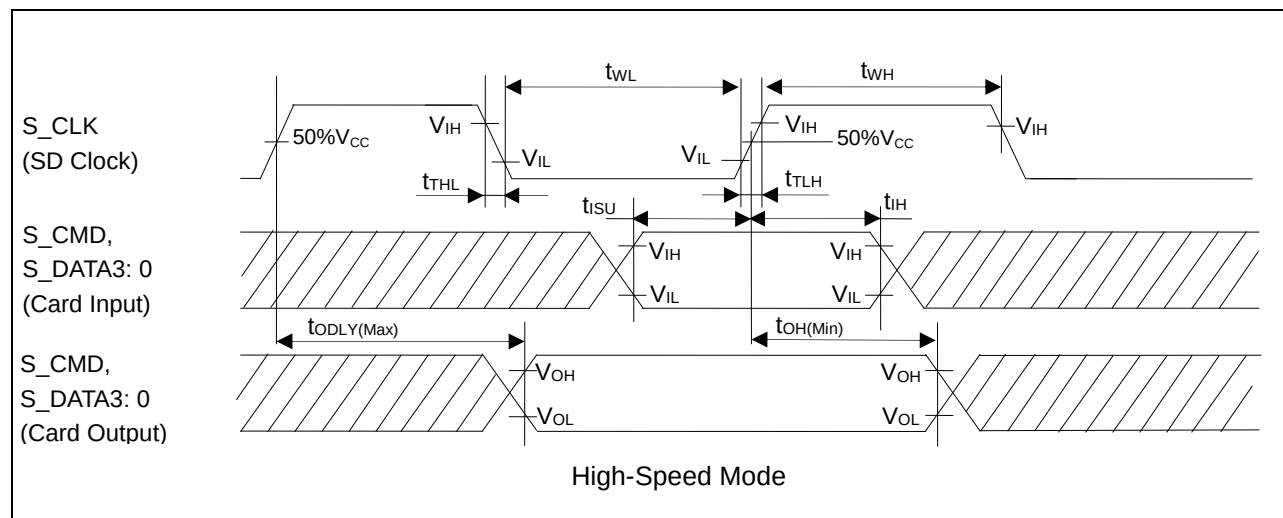
■ Card Inputs CMD, DAT (referenced to Clock CLK)

Parameter	Symbol	Pin Name	Conditions	Value		Remarks
				Min	Max	
Input set-up time	t_{ISU}	S_CMD, S_DATA3: 0	$C_{CARD} \leq 10$ pF (1 card)	6	-	ns
Input hold time	t_{IH}	S_CMD, S_DATA3: 0		2	-	ns

■ Card Outputs CMD, DAT (referenced to Clock CLK)

Parameter	Symbol	Pin Name	Conditions	Value		Remarks
				Min	Max	
Output delay time during data transfer mode	t_{ODLY}	S_CMD, S_DATA3: 0	$C_L \leq 40$ pF (1 card)	0	14	ns
Output hold time	t_{OH}	S_CMD, S_DATA3: 0	$C_L \geq 15$ pF (1 card)	2.5	-	ns
Total system capacitance for each line*	C_L	-	1 card	-	40	pF

*: In order to satisfy severe timing, host shall drive only one card.



Notes:

- The Card Input corresponds to the Host Output and the Card Output corresponds to the Host Input because this model is the Host.
- For more information about clock frequency (f_{PP}), see Chapter 15: SD card Interface in FM4 Family Peripheral Manual Main Part (002-04856).

Document History

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Document Number: 002-05030

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	-	AKIH	04/22/2015	New Spec.
*A	5126421	HITK	02/05/2016	Company name and layout design change. Added the note of TAP pin. Updated Package Code and Dimensions (LQFP-144, LQFP-176, LQFP-216).
*B	5634625	YSKA	02/20/2017	Deleted CAN in communications interfaces. (Page 1) Deleted CAN(RX0_2, TX0_2) in LQFP216 pin assignments (Page 12) Deleted RX2_0 in P7D in "4. Pin Descriptions" (Page 20) Updated 12.4.8 Power-On Reset Timing. Changed parameter from "Power Supply rise time (t_{VCCR})[ms]" to "Power ramp rate(dV/dt)[mV/us]" and add some comments. (Page 117) Modified CSIO timing typo (12.4.12 CSIO(SPI) Timing) Deleted "SPI=1, MS=0" in the titles and added MS=0,1 in the schematic (Page 138-145, 154-161) Modified RTC description (Features, Real-Time Clock (RTC)) Deleted "second, or day of the week" in the Interrupt function. (Page.3) Modifications related to the VBAT in the following chapter. "7. Handling Devices" Notes on Power-on (Page 77) "11. Pin Status in Each CPU State" List of VBAT Domain Pin Status (Page 93) "12.3.1 Current Rating" Table12-9. Typical and Maximum Current Consumption in Deep Standby STOP Mode, Deep Standby RTC Mode and VBAT (Page 109) Deleted MPNs below from "3. Ordering Information" (Page 199) S6E2C28H0AGV20000, S6E2C29H0AGV20000, S6E2C2AH0AGV20000, S6E2C28HHAGV20000, S6E2C29HHAGV20000, S6E2C2AHHAGV20000, S6E2C28J0AGV20000, S6E2C29J0AGV20000, S6E2C2AJ0AGV20000, S6E2C28JHAGV20000, S6E2C29JHAGV20000, S6E2C2AJHAGV20000, S6E2C28J0AGB10000, S6E2C29J0AGB10000, S6E2C2AJ0AGB10000, S6E2C28JHAGB10000, S6E2C29JHAGB10000, S6E2C2AJHAGB10000, S6E2C28L0AGL20000, S6E2C29L0AGL20000, S6E2C2AL0AGL20000, S6E2C28LHAGL20000, S6E2C29LHAGL20000, S6E2C2ALHAGL20000 Added MPNs below to "3. Ordering Information" (Page 199) S6E2C28H0AGV2000A, S6E2C29H0AGV2000A, S6E2C2AH0AGV2000A, S6E2C28HHAGV2000A, S6E2C29HHAGV2000A, S6E2C2AHHAGV2000A, S6E2C28J0AGV2000A, S6E2C29J0AGV2000A, S6E2C2AJ0AGV2000A, S6E2C28JHAGV2000A, S6E2C29JHAGV2000A, S6E2C2AJHAGV2000A, S6E2C28J0AGB1000A, S6E2C29J0AGB1000A, S6E2C2AJ0AGB1000A, S6E2C28JHAGB1000A, S6E2C29JHAGB1000A, S6E2C2AJHAGB1000A, S6E2C28L0AGL2000A, S6E2C29L0AGL2000A, S6E2C2AL0AGL2000A,