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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	ARM® Cortex®-M0+
Core Size	32-Bit Single-Core
Speed	40MHz
Connectivity	CSIO, I²C, LINbus, SmartCard, UART/USART, USB
Peripherals	I²S, LCD, LVD, POR, PWM, WDT
Number of I/O	65
Program Memory Size	560KB (560K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	64K x 8
Voltage - Supply (Vcc/Vdd)	1.65V ~ 3.6V
Data Converters	A/D 16x12b
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/s6e1b86ehagf20000

1. Product Lineup

Memory Size

Product Name		S6E1B84E/F/G	S6E1B86E/F/G
On-chip Flash memory	Upper Bank	256 Kbytes	512 Kbytes
	Lower Bank	48 Kbytes	48 Kbytes
On-chip SRAM		32 Kbytes	64 Kbytes

Function

Product Name			S6E1B84E0A S6E1B86E0A S6E1B84EHA S6E1B86EHA	S6E1B84F0A S6E1B86F0A S6E1B84FHA S6E1B86FHA	S6E1B84G0A S6E1B86G0A S6E1B84GHA S6E1B86GHA
Pin count			80	100	120
CPU			Cortex-M0+		
	Frequency		40.8 MHz		
Power supply voltage range			1.65 V to 3.6 V		
USB 2.0 (Device/Host)			1 unit		
DSTC			64ch		
Multi-function Serial Interface (UART/CSIO (SPI)/I^{2}C/I^{2}S)			8ch (Max) with 128 bytes FIFO I^{2}S: ch.5, ch.6		
Base Timer (PWC/Reload timer/PWM/PPG)			8ch (Max)		
LCD controller			20SEG x 8COM(Max) / 24SEG x 4COM(Max)	32SEG x 8COM(Max) / 36SEG x 4COM(Max)	40SEG x 8COM(Max) / 44SEG x 4COM(Max)
Multi-function Timer	A/D activation compare	6ch	1 unit		
	Input capture	4ch			
	Free-run timer	3ch			
	Output compare	6ch			
	Waveform generator	3ch			
	PPG	3ch			
Dual Timer			1 unit		
HDMI-CEC/ Remote Control Receiver			2ch (max)		
Smart Card Interface			2ch (max)		
Real-time Clock			1 unit (with battery power)		
Watch Counter			1 unit		
CRC Accelerator			Yes		
Watchdog timer			1ch (SW) + 1ch (HW)		
External Interrupt			24 pins (Max), NMI × 1		
I/O port			65 pins (Max)	82 pins (Max)	102 pins (Max)
12-bit A/D converter			16ch (1 unit)	23ch (1 unit)	24ch (1 unit)
CSV (Clock Supervisor)			Yes		
LVD (Low-voltage Detection)			2ch		
Built-in CR	High-speed		4 MHz		
	Low-speed		100 kHz		
Debug Function			SW-DP		
Unique ID			Yes		
AES Calculator			-	Yes*1	-	Yes*1	-	Yes*1

*1: AES Calculator is built in following products.
S6E1B86GHA, S6E1B84GHA, S6E1B86FHA, S6E1B84FHA, S6E1B86EHA, S6E1B84EHA

Note:

- *All signals of the peripheral function in each product cannot be allocated by limiting the pins of package. It is necessary to use the port relocate function of the I/O port according to your function use.*
  See "11 Electrical Characteristics 11.4 AC Characteristics 11.4.3 Built-in CR Oscillation Characteristics" for accuracy of built-in CR.

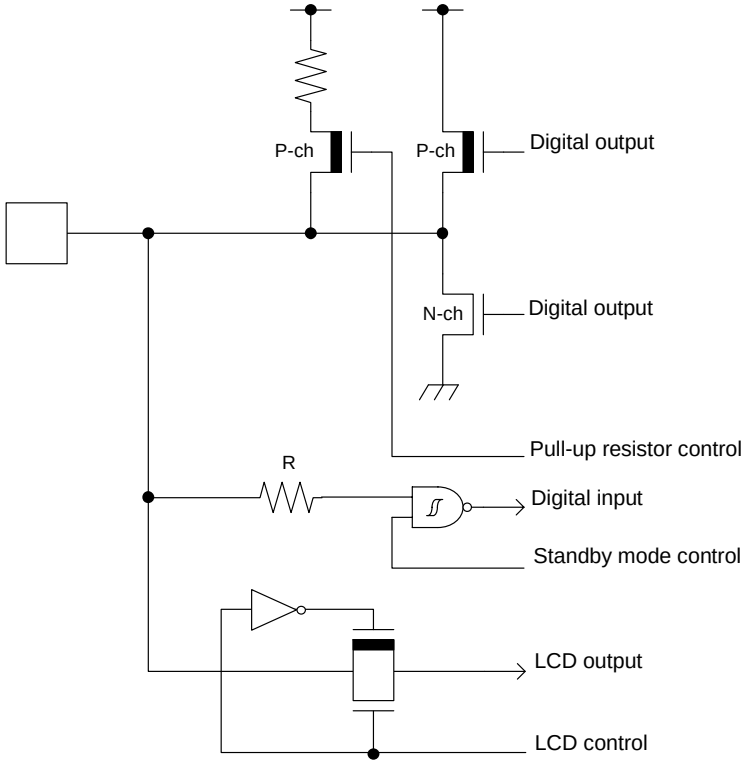
Pin No.			Pin Name	I/O Circuit Type	Pin State Type
LQFP-120	LQFP-100	LQFP-80			
76	66	56	P1A SIN4_1 IC01_1 INT05_1 AN10 SEG17	P	V
77	67	57	P1B SOT4_1 IC02_1 INT20_2 AN11 SEG16	P	V
78	68	-	P1C SCK4_1 IC03_1 INT21_2 AN12 SEG15	P	V
79	69	-	P1D CTS4_1 DTTI0X_1 INT22_2 AN13 SEG14	P	V
80	70	-	P1E RTS4_1 FRCK0_1 ADTG_5 INT23_2 AN14	H	L
81	-	-	P28 RTO05_1 TIOB6_2 ADTG_4	F	I
82	-	-	P27 RTO04_1 TIOA6_2 INT02_2 AN15	G	L
83	-	-	P26 SCK2_1 RTO03_1	F	I
84	-	-	P25 SOT2_1 RTO02_1	F	I
85	-	-	P24 SIN2_1 RTO01_1 INT17_1	F	J
86	71	58	P23 SCK0_0 TIOA7_1 RTO00_1 AN16 SEG13	P	K

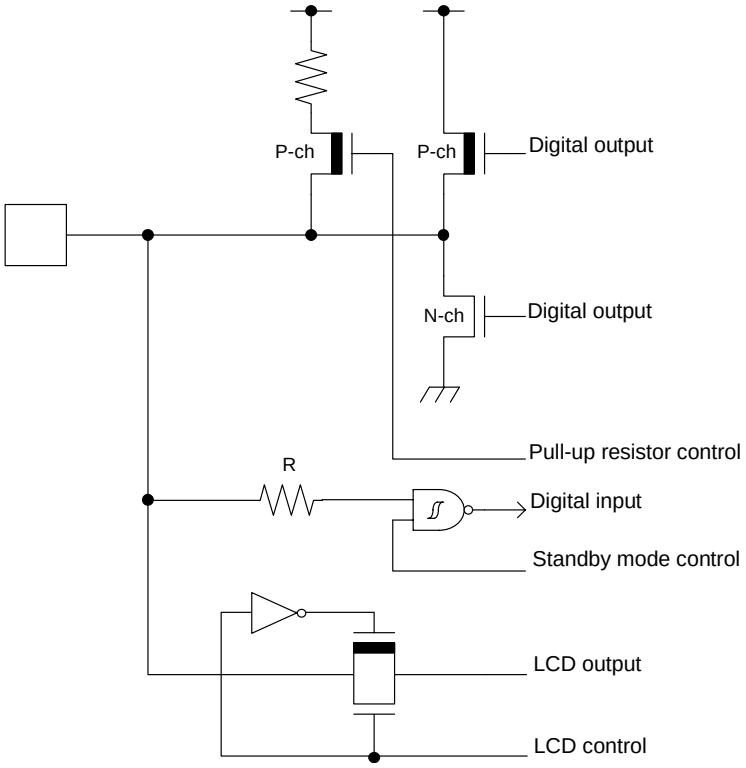
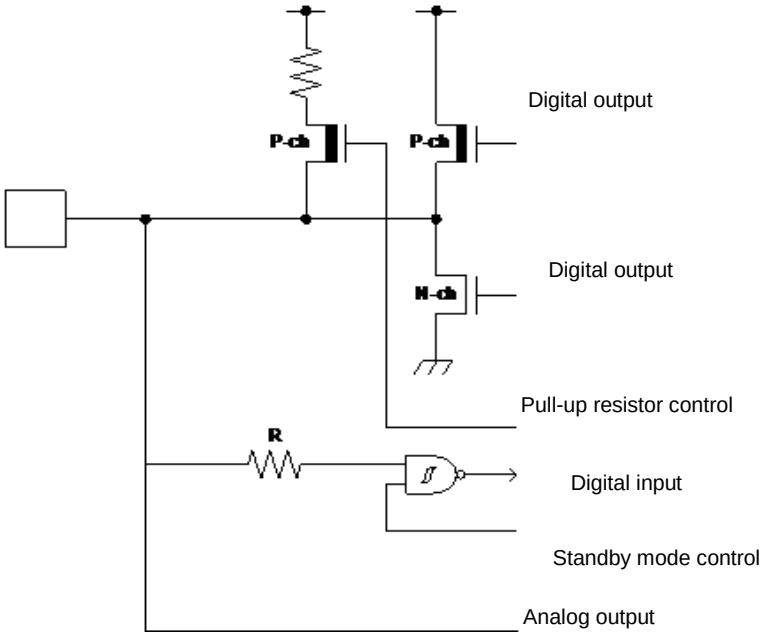
Pin No.			Pin Name	I/O Circuit Type	Pin State Type
LQFP-120	LQFP-100	LQFP-80			
100	85	-	P08 TIOA0_2 CTS4_2 INT16_0 AN23 SEG06	P	V
101	86	-	P09 TIOB0_2 RTS4_2 INT17_0 SEG05	L	S
102	87	67	P0A SIN4_0 INT00_2 WKUP5 IC0_CIN_0 UHCONX0 CEC0_1	I	O
103	88	68	P0B INT18_0 UDM0	K	Q
104	89	69	P0C INT19_0 UDP0	K	Q
105	90	70	P0D RTS4_0 TIOA3_2 INT20_0 SEG04 IC0_VPEN_0	L	S
106	91	71	P0E CTS4_0 TIOB3_2 INT21_0 SEG03 IC0_VCC_0	L	S
107	92	72	P0F CROUT_1 RTCCO_0 SUBOUT_0 MI2SMCK5_0 NMIX WKUP0 IC0_CLK_0 SCK4_0	I	G
108	-	-	P68 SCK3_0 TIOB7_2 INT12_2	F	J
109	-	-	P67 SOT3_0 TIOA7_2 INT22_0	F	J
110	-	-	P66 SIN3_0 INT11_2	F	J

Pin Function	Pin Name	Function Description	Pin No.		
			LQFP-120	LQFP-100	LQFP-80
Multi-function Serial 7	SIN7_0	Multi-function serial interface ch.7 input pin	11	-	-
	SIN7_1		48	43	33
	SIN7_2		117	97	77
	SOT7_0 (SDA7_0)	Multi-function serial interface ch.7 output pin. This pin operates as SOT7 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA7 when used as an I^2C pin (operation mode 4).	12	-	-
	SOT7_1 (SDA7_1)		49	44	34
	SOT7_2 (SDA7_2)		118	98	78
	SCK7_0 (SCL7_0)	Multi-function serial interface ch.7 clock I/O pin. This pin operates as SCK7 when used as a CSIO (operation mode 2) and as SCL7 when used as an I^2C pin (operation mode 4).	13	-	-
	SCK7_1 (SCL7_1)		50	45	35
	SCK7_2 (SCL7_2)		119	99	79
	SCS70_1	Multi-function serial interface ch.7 serial chip select 0 input/output pin.	47	42	32
	SCS71_1	Multi-function serial interface ch.7 serial chip select 1 input/output pin.	51	-	-
	SCS72_1	Multi-function serial interface ch.7 serial chip select 2 input/output pin.	52	-	-
Smart Card Interface 0	IC0_VCC_0	Smart card ch.0 power enable output pin	106	91	71
	IC0_VCC_1		33	28	-
	IC0_VPEN_0	Smart card ch.0 programming output pin	105	90	70
	IC0_VPEN_1		34	29	-
	IC0_RST_0	Smart card ch.0 reset output pin	114	94	74
	IC0_RST_1		35	30	-
	IC0_CIN_0	Smart card ch.0 insert detection input pin	102	87	67
	IC0_CIN_1		37	32	22
	IC0_CLK_0	Smart card ch.0 serial interface clock output pin	107	92	72
	IC0_CLK_1		32	27	-
	IC0_DATA_0	Smart card ch.0 serial interface data input/output pin	113	93	73
	IC0_DATA_1		36	31	21
Smart Card Interface 1	IC1_VCC_0	Smart card ch.1 power enable output pin	28	23	18
	IC1_VCC_1		63	53	43
	IC1_VPEN_0	Smart card ch.1 programming output pin	27	22	17
	IC1_VPEN_1		64	54	44
	IC1_RST_0	Smart card ch.1 reset output pin	26	21	16
	IC1_RST_1		65	55	45
	IC1_CIN_0	Smart card ch.1 insert detection input pin	24	19	14
	IC1_CIN_1		67	57	47
	IC1_CLK_0	Smart card ch.1 serial interface clock output pin	29	24	19
	IC1_CLK_1		62	52	42
	IC1_DATA_0	Smart card ch.1 serial interface data input/output pin	25	20	15
	IC1_DATA_1		66	56	46
USB	UDM0	USB device/host D – pin	103	88	68
	UDP0	USB device/host D + pin	104	89	69
	UHCONX0	USB external pull-up control pin	102	87	67

Pin Function	Pin Name	Function Description	Pin No.		
			LQFP-120	LQFP-100	LQFP-80
VBAT	LVDI	Input pin to monitor the external voltage.	37	32	22
	VWAKEUP	The return signal input pin from a hibernation state	45	40	30
	REGCTL	On-board regulator control pin	44	39	29
Reset	INITX	External Reset Input pin. A reset is valid when INITX="L".	41	36	26
Mode	MD0	Mode 0 pin. During normal operation, input MD0="L". During serial programming to Flash memory, input MD0="H".	57	47	37
	MD1	Mode 1 pin. During normal operation, input is not needed. During serial programming to Flash memory, MD1 = "L" must be input.	56	46	36
Power	VCC	Power supply pin	1	1	1
			31	26	-
			40	35	25
			61	51	41
			91	76	-
VBAT power	VBAT	VBAT power supply pin Backup power supply (battery etc.) and system power supply	46	41	31
GND	VSS	GND pin	30	25	20
			39	34	24
			60	50	40
			90	75	-
			120	100	80
Clock	X0	Main clock (oscillation) input pin	58	48	38
	X0A	Sub clock (oscillation) input pin	42	37	27
	X1	Main clock (oscillation) I/O pin	59	49	39
	X1A	Sub clock (oscillation) I/O pin	43	38	28
	CROUT_0	Built-in high-speed CR oscillation clock output port	89	74	-
	CROUT_1	Built-in high-speed CR oscillation clock output port	107	92	72
Analog Power	AVCC	A/D converter analog power supply pin	70	60	50
	AVRH	A/D converter analog reference voltage input pin	73	63	53
Analog GND	AVSS	A/D converter analog reference voltage input pin	71	61	51
C pin	C	Power supply stabilization capacitance pin	38	33	23

*: PE0 is an open drain pin, cannot output high.

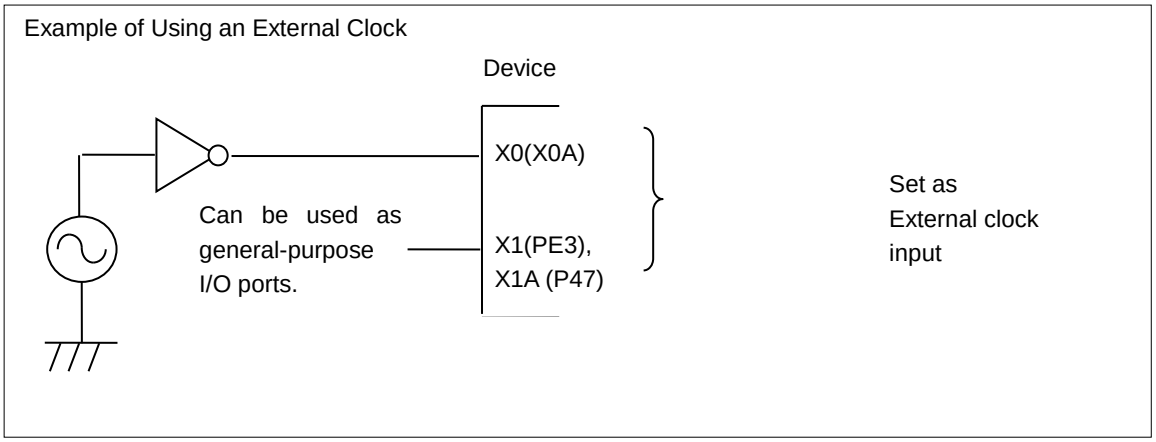
Type	Circuit	Remarks
L		・CMOS level output ・CMOS level hysteresis input ・With input control ・5 V tolerant ・LCD segment output ・With pull-up resistor control ・With standby mode control ・Pull-up resistor : Approximately 33 kΩ ・I_{OH}= -4 mA, I_{OL}= 4 mA ・Available to control of PZR registers. ・When this pin is used as an I^2C pin, the digital output P-ch transistor is always off

Type	Circuit	Remarks
N		・CMOS level output ・CMOS level hysteresis input ・With input control ・5 V tolerant ・LCD common output ・With pull-up resistor control ・With standby mode control ・Pull-up resistor : Approximately 33 kΩ ・I_{OH}=-4 mA, I_{OL}= 4 mA ・Available to control of PZR registers.
O		・CMOS level output ・CMOS level hysteresis input ・With input control ・Analog output ・5 V tolerant ・With pull-up resistor control ・With standby mode control ・Pull-up resistor : Approximately 33 kΩ ・I_{OH}= -4 mA, I_{OL}= 4 mA ・Available to control of PZR registers. ・When this pin is used as an I^2C pin, the digital output P-ch transistor is always off

Using an External Clock

When using an external clock as an input of the main clock, set X0/X1 to the external clock input, and input the clock to X0. X1(PE3) can be used as a general-purpose I/O port.
Similarly, when using an external clock as an input of the sub clock, set X0A/X1A to the external clock input, and input the clock to X0A. X1A (P47) can be used as a general-purpose I/O port.

Example of Using an External Clock

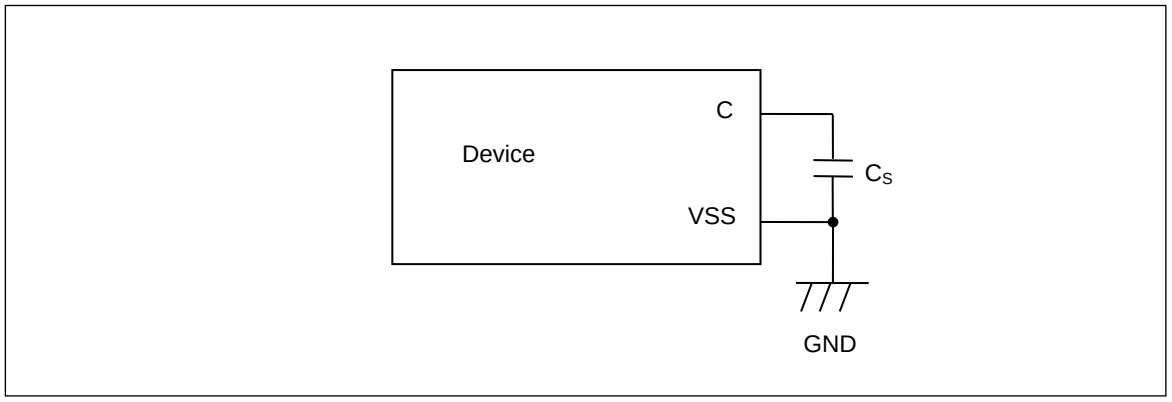


Handling when Using Multi-Function Serial Pin as I²C Pin

If it is using the multi-function serial pin as I²C pins, P-ch transistor of digital output is always disabled. However, I²C pins need to keep the electrical characteristic like other pins and not to connect to the external I²C bus system with power OFF.

C Pin

This series contains the regulator. Be sure to connect a smoothing capacitor (C_S) for the regulator between the C pin and the GND pin. Please use a ceramic capacitor or a capacitor of equivalent frequency characteristics as a smoothing capacitor.
However, some laminated ceramic capacitors have the characteristics of capacitance variation due to thermal fluctuation (F characteristics and Y5V characteristics). Please select the capacitor that meets the specifications in the operating conditions to use by evaluating the temperature characteristics of a capacitor.
A smoothing capacitor of about 4.7 µF would be recommended for this series.



Mode Pins (MD0)

Connect the MD pin (MD0) directly to VCC or VSS pins. Design the printed circuit board such that the pull-up/down resistance stays low, as well as the distance between the mode pins and VCC pins or VSS pins is as short as possible and the connection impedance is low, when the pins are pulled-up/down such as for switching the pin level and rewriting the Flash memory data. It is because of preventing the device erroneously switching to test mode due to noise.

Pin Status Type	Function Group	State Upon Power-on Reset or Low-Voltage Detection	State at INITX Input	State Upon Device Internal Reset	State in Run Mode or Sleep Mode	State in Timer Mode, RTC Mode, or Stop Mode		State in Deep Standby RTC Mode or Deep Standby Stop Mode State		State when Return from Deep Standby Mode State
		Power Supply Unstable	Power Supply Stable	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	-
R	WKUP enabled	Setting disabled	Setting disabled	Setting disabled	Maintain previous state	Maintain previous state	Hi-Z / Internal input fixed at 0	WKUP input enabled	Hi-Z / WKUP input enabled	GPIO selected / Internal input fixed at 0
	External interrupt enabled selected						Maintain previous state	GPIO selected / Internal input fixed at 0	Hi-Z / Internal input fixed at 0	
	Resource other than above selected	Hi-Z	Hi-Z / Internal input fixed at 0	Hi-Z / Internal input fixed at 0			Hi-Z / Internal input fixed at 0			
	GPIO selected							Output maintains previous state / Internal input fixed at 0		Output maintains previous state / Internal input fixed at 0
S	External interrupt enabled 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	Hi-Z / Internal input fixed at 0
	Resource other than above selected	Hi-Z	Hi-Z / Internal input fixed at 0	Hi-Z / Internal input fixed at 0			Hi-Z / Internal input fixed at 0			
	GPIO selected							Output Maintain previous state / Internal input fixed at 0		Output Maintain previous state / Internal input fixed at 0

Pin Status Type	Function Group	State Upon Power-on Reset or Low-Voltage Detection	State at INITX Input	State Upon Device Internal Reset	State in Run Mode or Sleep Mode	State in Timer Mode, RTC Mode, or Stop Mode		State in Deep Standby RTC Mode or Deep Standby Stop Mode State		State when Return from Deep Standby Mode State
		Power Supply Unstable	Power Supply Stable	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	-
W	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	Setting disabled	Setting disabled	Setting disabled	Maintain previous state	Maintain previous state	Hi-Z / Internal input fixed at 0	WKUP input enabled	Hi-Z / WKUP input enabled	GPIO selected / Internal input fixed at 0
	External interrupt enabled selected						Maintain previous state	GPIO selected / Internal input fixed at 0	Hi-Z / Internal input fixed at 0	
	Resource other than above selected						Hi-Z / Internal input fixed at 0			
	GPIO selected									
X	External interrupt enabled 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	Hi-Z / Internal input fixed at 0
	Resource other than above selected	Hi-Z	Hi-Z / Internal input fixed at 0	Hi-Z / Internal input fixed at 0			Hi-Z / Internal input fixed at 0			
	GPIO selected							Output Maintain previous state / Internal input fixed at 0		

*1: Oscillation stops in Sub timer mode, Low-speed CR timer mode, Stop mode, RTC mode.

*2: Oscillation stops in Stop mode.

11.2 Recommended Operating Conditions

(V_{SS}=AV_{SS}=0.0 V)

Parameter	Symbol	Conditions	Value		Unit	Remarks
			Min	Max		
Power supply voltage	V_{CC}	-	1.65 *5	3.6	V	*1
			2.2	3.6	V	*2
			3.0	3.6	V	*3
LCD input voltage	V_{VV4}	-	2.2	V_{CC}	V	No booster used
		-	2.2	4.7	V	Booster is used
LCD External Capacitor *6	C_f,C_{VV1}, C_{VV2},C_{VV3}, C_{VV4}	-	0.5	1.3	µF	Booster is used
Sub Oscillation frequency *7	Fin	-	-	-	kHz	Typical is 32.768 kHz
Analog power supply voltage	AV_{CC}	-	1.65	3.6	V	AV_{CC}=V_{CC}
Analog reference voltage	AVRH	-	2.7	AV_{CC}	V	AV_{CC} ≥ 2.7 V
			AV_{CC}	AV_{CC}	V	AV_{CC} < 2.7 V
	AVRL	-	AV_{SS}	AV_{SS}	V	
Smoothing capacitor	C_S	-	1	10	µF	For regulator*4
Operating temperature	T_A	-	- 40	+ 105	°C	

*1: When LCD Controller is not used.

*2: When LCD Controller is used.

*3: When P0C/UDP0 and P0B/UDM0 pins are used as USB (UDP0, UDM0).

*4: See "C Pin" in "7. Handling Devices" for the connection of the smoothing capacitor.

*5: In between less than the minimum power supply voltage reset / interrupt detection voltage or more, instruction execution and low voltage detection function by built-in High-speed CR (including Main PLL is used) or built-in Low-speed CR is possible to operate only.

*6: LCD external capacitor between VVx to VSS, and between C0 and C1.

*7: If a Booster is used, Sub OSC should provide operation clock at typically 32.768 kHz.

<WARNING>

1. *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.*
2. *Always use semiconductor devices within their recommended operating condition ranges. Operation outside these ranges may adversely affect reliability and could result in device failure.*
3. *No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet.*
4. *Users considering application outside the listed conditions are advised to contact their representatives beforehand.*

Parameter	Symbol (Pin Name)	Conditions		Value		Unit	Remarks
				Typ	Max		
Power supply current	I_{CCVBAT} (VBAT)	RTC operation	T_A=25°C V_{CC}=3.0V 32 kHz Crystal oscillation	0.9	TBD	µA	*1
			T_A=25°C V_{CC}=1.65 V 32 kHz Crystal oscillation	0.8	TBD	µA	*1
			T_A=105°C V_{CC}=3.6V 32 kHz Crystal oscillation	-	TBD	µA	*1
		RTC stop	T_A=25°C V_{CC}=3.0V	0.05	TBD	µA	*1
			T_A=25°C V_{CC}=1.65 V	0.02	TBD	µA	*1
			T_A=105°C V_{CC}=3.6V	-	TBD	µA	*1

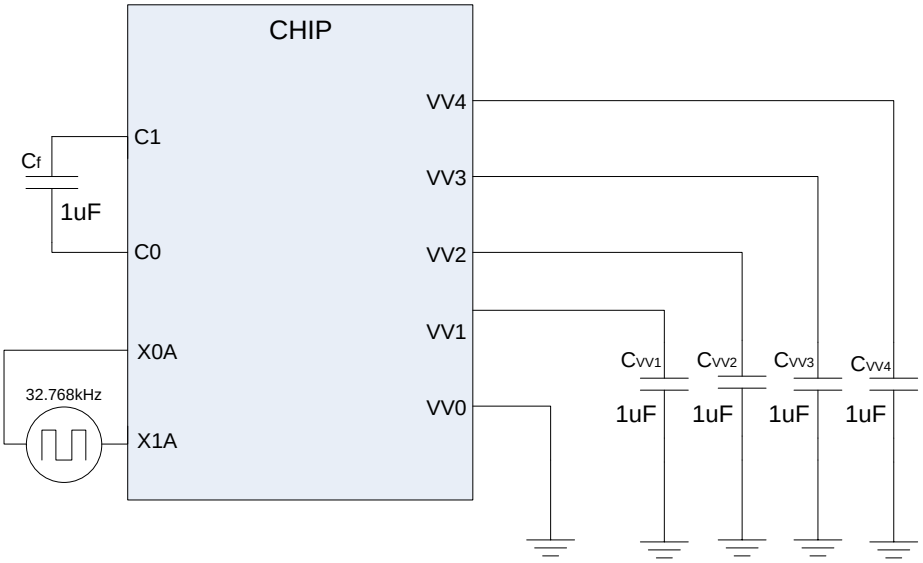
*1: All ports are fixed.

11.3.3.2 LCD Characteristic With Booster

Recommended LCD Operation Conditions With Booster

(V_{CC} =AV_{CC}=1.65 V to 3.6 V, V_{SS}=AV_{SS}=0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Value			Unit	Remarks
			Min	Typ	Max		
Voltage correlation	VCC-VV1	VCC,VV1	0.35	-	-	V	VCC-VV1 must be larger than 0.35 V
External input tolerant voltage	V_{tole}	VV1,VV2,VV3,VV4,C0,C1	0	-	5.5	V	
Operating frequency	f_{IN}	-	-	32.768	-	kHz	Crystal oscillator
External Capacitor	C_f,C_{VV1}, C_{VV2},C_{VV3}, C_{VV4}	VV1,VV2,VV3,VV4,C0,C1	0.5	1	1.3	µF	
LCD capacitor	$C_{LCD/1COM}$	-	-	1.25	8	µF	
Frame period	t_{FRAME}	-	1/150	-	1/30	s	



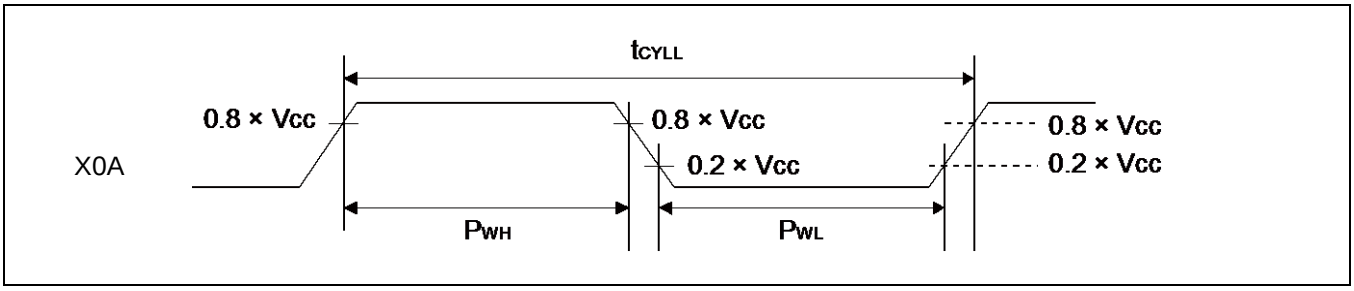
LCD Booster 1/4 mode （BIAS[1:0]=2'b10)

11.4.2 Sub Clock Input Characteristics

(V_{CC}=AV_{CC}=1.65 V to 3.6 V, V_{SS}=AV_{SS}=0 V, 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 the crystal oscillator is connected*
			-	32	-	100	kHz	When the external clock is used
Input clock cycle	t_{CYLL}		-	10	-	31.25	µs	When the external clock is used
Input clock pulse width	-		P_{WH}/t_{CYLL}, P_{WL}/t_{CYLL}	45	-	55	%	When the external clock is used

*: See "Sub crystal oscillator" in "7. Handling Devices" for the crystal oscillator used.



SPI (SPI=1, SCINV=1)

(V_{CC}=AV_{CC}=1.65 V to 3.6 V, V_{SS}=AV_{SS}=0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
				Min	Max	Min	Max	
Serial clock cycle time	t_{SCYC}	SCKx	Master mode	4 t_{CYCP}	-	4 t_{CYCP}	-	ns
SCK ↓ → SOT delay time	t_{SLOVI}	SCKx, SOTx		-30	+30	-20	+20	ns
SIN → SCK ↑ setup time	t_{IVSHI}	SCKx, SINx		60	-	50	-	ns
SCK ↑ → SIN hold time	t_{SHIXI}	SCKx, SINx		0	-	0	-	ns
SOT → SCK ↑ delay time	t_{SOVHI}	SCKx, SOTx		2 t_{CYCP} - 30	-	2 t_{CYCP} - 30	-	ns
Serial clock L pulse width	t_{SLSH}	SCKx	Slave mode	2 t_{CYCP} - 10	-	2 t_{CYCP} - 10	-	ns
Serial clock H pulse width	t_{SHSL}	SCKx		t_{CYCP} +10	-	t_{CYCP} +10	-	ns
SCK ↓ → SOT delay time	t_{SLOVE}	SCKx, SOTx		-	65	-	52	ns
SIN → SCK ↑ setup time	t_{IVSHE}	SCKx, SINx		10	-	10	-	ns
SCK ↑ → SIN hold time	t_{SHIXE}	SCKx, SINx		20	-	20	-	ns
SCK falling time	t_F	SCKx		-	5	-	5	ns
SCK rising time	t_R	SCKx		-	5	-	5	ns

Notes:

- *The above AC characteristics are for clock synchronous mode.*
- *t_{CYCP} represents the APB bus clock cycle time.*
  For the number of the APB bus to which Multi-function Serial has been connected, see "8. Block Diagram ".
- *The characteristics are only applicable when the relocate port numbers are the same.*
  For instance, they are not applicable for the combination of SCKx_0 and SOTx_1.
- *External load capacitance C_L=30 pF*

When Using CSIO/SPI Chip Select (SCINV=1, CSLVL=1)

(V_{CC}=AV_{CC}=1.65 V to 3.6 V, V_{SS}=AV_{SS}=0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
			Min	Max	Min	Max	
SCS↓→SCK↑ setup time	t_{CSSI}	Master mode	(*1)-50	(*1)+0	(*1)-50	(*1)+0	ns
SCK↓→SCS↑ hold time	t_{CSHI}		(*2)+0	(*2)+50	(*2)+0	(*2)+50	ns
SCS deselect time	t_{CSDI}		(*3)-50	(*3)+50	(*3)-50	(*3)+50	ns
SCS↓→SCK↑ setup time	t_{CSSE}	Slave mode	$3t_{CYCP}$+30	-	$3t_{CYCP}$+30	-	ns
SCK↓→SCS↑ hold time	t_{CSHE}		0	-	0	-	ns
SCS deselect time	t_{CSDE}		$3t_{CYCP}$+30	-	$3t_{CYCP}$+30	-	ns
SCS↓→SOT delay time	t_{DSE}		-	55	-	43	ns
SCS↑→SOT delay time	t_{DEE}		0	-	0	-	ns

*1: CSSU bit value × serial chip select timing operating clock cycle.

*2: CSHD bit value × serial chip select timing operating clock cycle.

*3: CSDS bit value × serial chip select timing operating clock cycle.
Irrespective of CSDS bit setting, $5t_{CYCP}$ or more are required for the period the time when the serial chip select pin becomes inactive to the time when the serial chip select pin becomes active again.

Notes:

- *t_{CYCP} indicates the APB bus clock cycle time.*
  For information about the APB bus number which Multi-function Serial is connected to, see "8. Block Diagram ".
- *For information about CSSU, CSHD, CSDS, serial chip select timing operating clock, see "FM0+ Family Peripheral Manual".*
- *These characteristics only guarantee the same relocate port number.*
  For example, the combination of SCKx_0 and SCSIx_1 is not guaranteed.
- *When the external load capacitance C_L=30 pF.*

11.7 Low-Voltage Detection Characteristics

11.7.1 Low-Voltage Detection Reset

(T_A=-40°C to +105°C)

Parameter	Symbol	Conditions	Value			Unit	Remarks
			Min	Typ	Max		
Detected voltage	VDL	Fixed*1	1.38	1.50	1.60	V	When voltage drops
Released voltage	VDH		1.43	1.55	1.65	V	When voltage rises
LVD stabilization wait time	t_{LVDW}	-	-	-	8160× t_{CYCP}*2	µs	
LVD detection delay time	t_{LVDDL}	-	-	-	200	µs	

*1: The value of low voltage detection reset is always fixed.

*2: t_{CYCP} indicates the APB1 bus clock cycle time.

11.8 Flash Memory Write/Erase Characteristics

(V_{CC}=1.65 V to 3.6 V, T_A=- 40°C to +105°C)

Parameter		Value			Unit	Remarks
		Min	Typ*	Max*		
Sector erase time	Large sector	-	1.1	2.7	s	The sector erase time includes the time of writing prior to internal erase.
	Small sector	-	0.3	0.9		
Halfword (16-bit) write time		-	30	528	µs	The halfword (16-bit) write time excludes the system-level overhead.
Chip erase time		-	11.2	28.8	s	The chip erase time includes the time of writing prior to internal erase.

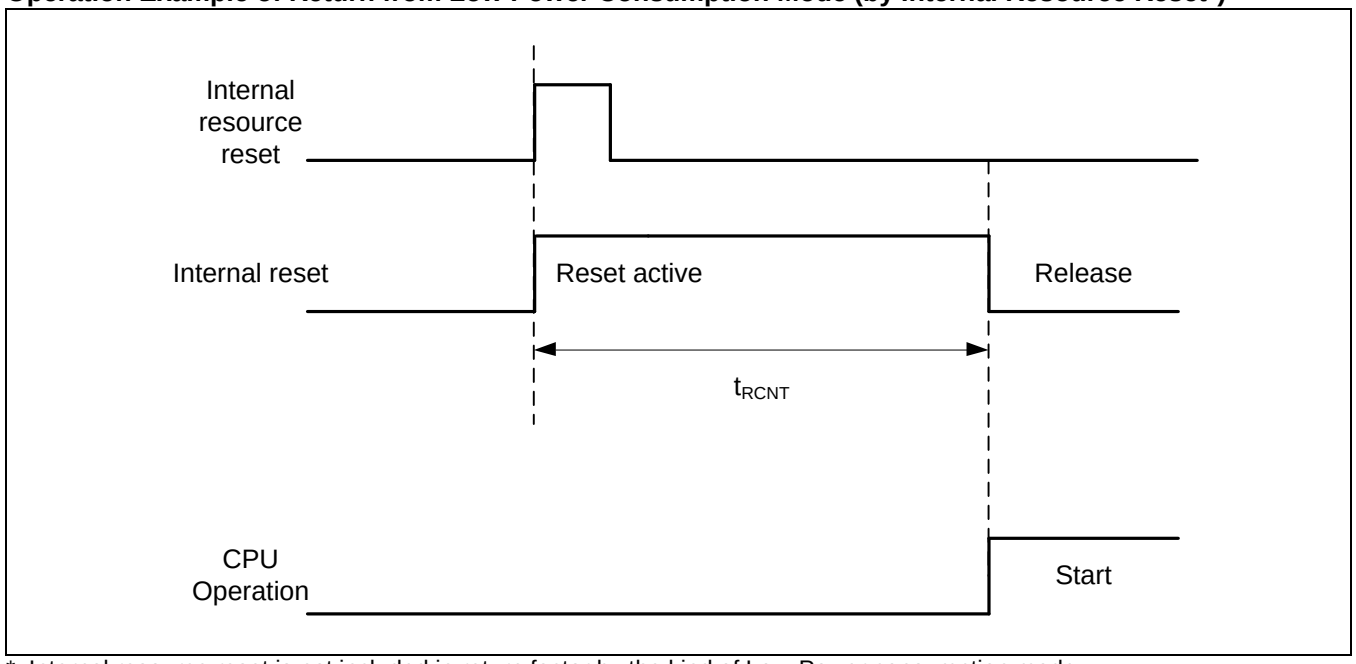
*: The typical value is immediately after shipment, the maximum value is guarantee value under 10,000 cycle of erase/write.

Write/Erase Cycle and Data Hold Time (Target Value)

Write/Erase Cycle	Data Hold Time (Year)	Remarks
1,000	20*	
10,000	10*	

*: At average + 85°C

Operation Example of Return from Low Power Consumption Mode (by Internal Resource Reset*)



*: Internal resource reset is not included in return factor by the kind of Low-Power consumption mode.

Notes:

- *The return factor is different in each Low-Power consumption modes.*
  See "Chapter: Low Power Consumption Mode" and "Operations of Standby Modes" in FM0+ Family Peripheral Manual.
- *When interrupt recoveries, the operation mode that CPU recoveries depends on the state before the Low-Power consumption mode transition. See "Chapter: Low Power Consumption Mode" in "FM0+ Family Peripheral Manual".*
- *The time during the power-on reset/low-voltage detection reset is excluded. See "11.4.7 Power-on Reset Timing in 11.4 AC Characteristics in 11. Electrical Characteristics" for the detail on the time during the power-on reset/low -voltage detection reset.*
- *When in recovery from reset, CPU changes to the high-speed CR run mode. When using the main clock or the PLL clock, it is necessary to add the main clock oscillation stabilization wait time or the main PLL clock stabilization wait time.*
- *The internal resource reset means the watchdog reset and the CSV reset.*

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