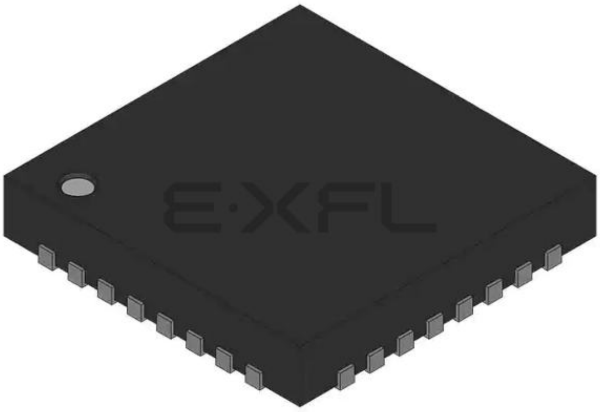
Atmel - ATSAM4LC2BA-MUR Datasheet



Details	
Product Status	Active
Core Processor	ARM® Cortex®-M4
Core Size	32-Bit Single-Core
Speed	48MHz
Connectivity	I²C, IrDA, LINbus, SPI, UART/USART, USB
Peripherals	Brown-out Detect/Reset, DMA, I²S, LCD, POR, PWM, WDT
Number of I/O	43
Program Memory Size	128KB (128K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	32K x 8
Voltage - Supply (Vcc/Vdd)	1.68V ~ 3.6V
Data Converters	A/D 7x12b; D/A 1x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	64-VFQFN Exposed Pad
Supplier Device Package	64-QFN (9x9)
Purchase URL	https://www.e-xfl.com/product-detail/atmel/atsam4lc2ba-mur

Table 2-2. ATSAM4LC Configuration Summary

Feature	ATSAM4LC8/4/2C	ATSAM4LC8/4/2B	ATSAM4LC8/4/2A
Oscillators	Digital Frequency Locked Loop 20-150MHz (DFLL) Phase Locked Loop 48-240MHz (PLL) Crystal Oscillator 0.6-30MHz (OSC0) Crystal Oscillator 32kHz (OSC32K) RC Oscillator 80MHz (RC80M) RC Oscillator 4,8,12MHz (RCFAST) RC Oscillator 115kHz (RCSYS) RC Oscillator 32kHz (RC32K)		
ADC	15-channel	7-channel	3-channel
DAC	1-channel		
Analog Comparators	4	2	1
CATB Sensors	32	32	26
USB	1		
Audio Bitstream DAC	1		
IIS Controller	1		
Packages	TQFP/VFBGA	TQFP/QFN/ WLCSP	TQFP/QFN

.

Table 2-3. ATSAM4LS Configuration Summary

Feature	ATSAM4LS8/4/2C	ATSAM4LS8/4/2B	ATSAM4LS8/4/2A
Number of Pins	100	64	48
Max Frequency	48MHz		
Flash	512/256/128KB		
SRAM	64/32/32KB		
SEGMENT LCD	NA		
GPIO	80	48	32
High-drive pins	6	3	1
External Interrupts	8 + 1 NMI		
TWI	2 Masters + 2 Masters/Slaves		1 Master + 1 Master/Slave
USART	4		3 in LC sub series 4 in LS sub series
PICOUART	1		0
Peripheral DMA Channels	16		
AESA	NA		
Peripheral Event System	1		
SPI	1		
Asynchronous Timers	1		

Figure 3-3. ATSAM4LC WLCSP64 Pinout

	1	2	3	4	5	6	7	8
A	PB04	GNDANA	AD VREFP	VDDANA	PA09	CAPL	CAPH	PA12
B	PB03	XIN32	XOUT32	PA08	PB06	PA10	PA11	VLCD
C	VDDIN	PB01	PA05	PA06	PA07	PB07	PA13	BIASH
D	VDDOUT	PB00	PA04	PB05	PB12	PB08	PA14	BIASL
E	GND	PA03	PB02	RESET_N	PB13	PB09	PA15	GND
F	VDD CORE	TCK	PA02	PB14	PA22	PB10	PA16	VLCDIN
G	GND	PA26	PA24	PA00	PA01	PA19	PA18	PA17
H	VDDIO	PA25	PA23	PB15	PA21	VDDIO	PA20	PB11

3.2 Peripheral Multiplexing on I/O lines

3.2.1 Multiplexed Signals

Each GPIO line can be assigned to one of the peripheral functions. The following tables (Section 3-1 ”100-pin GPIO Controller Function Multiplexing” on page 19 to Section 3-4 ”48-pin GPIO Controller Function Multiplexing” on page 28) describes the peripheral signals multiplexed to the GPIO lines.

Peripheral functions that are not relevant in some parts of the family are grey-shaded.

For description of differents Supply voltage source, refer to the Section 6. ”Power and Startup Considerations” on page 46.

Table 3-1. 100-pin GPIO Controller Function Multiplexing (Sheet 1 of 4)

ATSAM4LC		ATSAM4LS		Pin	GPIO	Supply	GPIO Functions						
QFN	VFBGA	QFN	VFBGA				A	B	C	D	E	F	G
5	B9	5	B9	PA00	0	VDDIO							
6	B8	6	B8	PA01	1	VDDIO							
12	A7	12	A7	PA02	2	VDDIN	SCIF GCLK0	SPI NPCS0					CATB DIS
19	B3	19	B3	PA03	3	VDDIN		SPI MISO					
24	A2	24	A2	PA04	4	VDDANA	ADCIFE AD0	USART0 CLK	EIC EXTINT2	GLOC IN1			CATB SENSE0
25	A1	25	A1	PA05	5	VDDANA	ADCIFE AD1	USART0 RXD	EIC EXTINT3	GLOC IN2	ADCIFE TRIGGER		CATB SENSE1
30	C3	30	C3	PA06	6	VDDANA	DACC VOUT	USART0 RTS	EIC EXTINT1	GLOC IN0	ACIFC ACAN0		CATB SENSE2
31	D3	31	D3	PA07	7	VDDANA	ADCIFE AD2	USART0 TXD	EIC EXTINT4	GLOC IN3	ACIFC ACAP0		CATB SENSE3
44	G2	44	G2	PA08	8	LCDA	USART0 RTS	TC0 A0	PEVC PAD EVT0	GLOC OUT0		LCDCA SEG23	CATB SENSE4
47	F5	47	F5	PA09	9	LCDA	USART0 CTS	TC0 B0	PEVC PAD EVT1	PARC PCDATA0		LCDCA COM3	CATB SENSE5
48	H2	48	H2	PA10	10	LCDA	USART0 CLK	TC0 A1	PEVC PAD EVT2	PARC PCDATA1		LCDCA COM2	CATB SENSE6
49	H3	49	H3	PA11	11	LCDA	USART0 RXD	TC0 B1	PEVC PAD EVT3	PARC PCDATA2		LCDCA COM1	CATB SENSE7
50	J2	50	J2	PA12	12	LCDA	USART0 TXD	TC0 A2		PARC PCDATA3		LCDCA COM0	CATB DIS
63	H5	63	H5	PA13	13	LCDA	USART1 RTS	TC0 B2	SPI NPCS1	PARC PCDATA4		LCDCA SEG5	CATB SENSE8
64	K7	64	K7	PA14	14	LCDA	USART1 CLK	TC0 CLK0	SPI NPCS2	PARC PCDATA5		LCDCA SEG6	CATB SENSE9
65	G5	65	G5	PA15	15	LCDA	USART1 RXD	TC0 CLK1	SPI NPCS3	PARC PCDATA6		LCDCA SEG7	CATB SENSE10

Table 3-3. 64-pin GPIO Controller Function Multiplexing for WLCSP package (Sheet 1 of 3)

ATSAM4LC	ATSAM4LS	Pin	GPIO	Supply	GPIO Functions						
WLCSP	WLCSP				A	B	C	D	E	F	G
G4	G4	PA00	0	VDDIO							
G5	G5	PA01	1	VDDIO							
F3	F3	PA02	2	VDDIN	SCIF GCLK0	SPI NPCS0					CATB DIS
E2	E2	PA03	3	VDDIN		SPI MISO					
D3	D3	PA04	4	VDDANA	ADCIFE AD0	USART0 CLK	EIC EXTINT2	GLOC IN1			CATB SENSE0
C3	C3	PA05	5	VDDANA	ADCIFE AD1	USART0 RXD	EIC EXTINT3	GLOC IN2	ADCIFE TRIGGER		CATB SENSE1
C4	C4	PA06	6	VDDANA	DACC VOUT	USART0 RTS	EIC EXTINT1	GLOC IN0	ACIFC ACAN0		CATB SENSE2
C5	C5	PA07	7	VDDANA	ADCIFE AD2	USART0 TXD	EIC EXTINT4	GLOC IN3	ACIFC ACAP0		CATB SENSE3
B4	B4	PA08	8	LCDA	USART0 RTS	TC0 A0	PEVC PAD EVT0	GLOC OUT0		LCDCA SEG23	CATB SENSE4
A5	A5	PA09	9	LCDA	USART0 CTS	TC0 B0	PEVC PAD EVT1	PARC PCDATA0		LCDCA COM3	CATB SENSE5
B6	B6	PA10	10	LCDA	USART0 CLK	TC0 A1	PEVC PAD EVT2	PARC PCDATA1		LCDCA COM2	CATB SENSE6
B7	B7	PA11	11	LCDA	USART0 RXD	TC0 B1	PEVC PAD EVT3	PARC PCDATA2		LCDCA COM1	CATB SENSE7
A8	A8	PA12	12	LCDA	USART0 TXD	TC0 A2		PARC PCDATA3		LCDCA COM0	CATB DIS
C7	C7	PA13	13	LCDA	USART1 RTS	TC0 B2	SPI NPCS1	PARC PCDATA4		LCDCA SEG5	CATB SENSE8
D7	D7	PA14	14	LCDA	USART1 CLK	TC0 CLK0	SPI NPCS2	PARC PCDATA5		LCDCA SEG6	CATB SENSE9
E7	E7	PA15	15	LCDA	USART1 RXD	TC0 CLK1	SPI NPCS3	PARC PCDATA6		LCDCA SEG7	CATB SENSE10
F7	F7	PA16	16	LCDA	USART1 TXD	TC0 CLK2	EIC EXTINT1	PARC PCDATA7		LCDCA SEG8	CATB SENSE11
G8	G8	PA17	17	LCDA	USART2 RTS	ABDACB DAC0	EIC EXTINT2	PARC PCCK		LCDCA SEG9	CATB SENSE12
G7	G7	PA18	18	LCDA	USART2 CLK	ABDACB DACN0	EIC EXTINT3	PARC PCEN1		LCDCA SEG18	CATB SENSE13
G6	G6	PA19	19	LCDA	USART2 RXD	ABDACB DAC1	EIC EXTINT4	PARC PCEN2	SCIF GCLK0	LCDCA SEG19	CATB SENSE14
H7	H7	PA20	20	LCDA	USART2 TXD	ABDACB DACN1	EIC EXTINT5	GLOC IN0	SCIF GCLK1	LCDCA SEG20	CATB SENSE15
H5	H5	PA21	21	LCDC	SPI MISO	USART1 CTS	EIC EXTINT6	GLOC IN1	TWIM2 TWD	LCDCA SEG34	CATB SENSE16
F5	F5	PA22	22	LCDC	SPI MOSI	USART2 CTS	EIC EXTINT7	GLOC IN2	TWIM2 TWCK	LCDCA SEG35	CATB SENSE17

3.3 Signals Description

The following table gives details on signal names classified by peripheral.

Table 3-8. Signal Descriptions List (Sheet 1 of 4)

Signal Name	Function	Type	Active Level	Comments
Audio Bitstream DAC - ABDACB				
CLK	D/A clock output	Output		
DAC1 - DAC0	D/A bitstream outputs	Output		
DACN1 - DACN0	D/A inverted bitstream outputs	Output		
Analog Comparator Interface - ACIFC				
ACAN1 - ACAN0	Analog Comparator A negative references	Analog		
ACAP1 - ACAP0	Analog Comparator A positive references	Analog		
ACBN1 - ACBN0	Analog Comparator B negative references	Analog		
ACBP1 - ACBP0	Analog Comparator B positive references	Analog		
ADC controller interface - ADCIFE				
AD14 - AD0	Analog inputs	Analog		
ADVREFP	Positive voltage reference	Analog		
TRIGGER	External trigger	Input		
Backup System Control Interface - BSCIF				
XIN32	32 kHz Crystal Oscillator Input	Analog/ Digital		
XOUT32	32 kHz Crystal Oscillator Output	Analog		
Capacitive Touch Module B - CATB				
DIS	Capacitive discharge line	Output		
SENSE31 - SENSE0	Capacitive sense lines	I/O		
DAC Controller - DACC				
DAC external trigger	DAC external trigger	Input		
DAC voltage output	DAC voltage output	Analog		
Enhanced Debug Port For ARM Products - EDP				
TCK/SWCLK	JTAG / SW Debug Clock	Input		
TDI	JTAG Debug Data In	Input		
TDO/TRACESWO	JTAG Debug Data Out / SW Trace Out	Output		
TMS/SWDIO	JTAG Debug Mode Select / SW Data	I/O		
External Interrupt Controller - EIC				
EXTINT8 - EXTINT0	External interrupts	Input		
Glue Logic Controller - GLOC				
IN7 - IN0	Lookup Tables Inputs	Input		
OUT1 - OUT0	Lookup Tables Outputs	Output		

6.2 Power Supplies

The ATSAM4L8/L4/L2 has several types of power supply pins:

- VDDIO: Powers I/O lines, the general purpose oscillator (OSC), the 80MHz integrated RC oscillator (RC80M) . Voltage is 1.68V to 3.6V.
- VLCDIN: (ATSAM4LC only) Powers the LCD voltage pump. Voltage is 1.68V to 3.6V.
- VDDIN: Powers the internal voltage regulator. Voltage is 1.68V to 3.6V.
- VDDANA: Powers the ADC, the DAC, the Analog Comparators, the 32kHz oscillator (OSC32K), the 32kHz integrated RC oscillator (RC32K)and the Brown-out detectors (BOD18 and BOD33). Voltage is 1.68V to 3.6V nominal.
- VDDCORE: Powers the core, memories, peripherals, the PLL, the DFLL, the 4MHz integrated RC oscillator (RCFAST) and the 115kHz integrated RC oscillator (RCSYS).
  - VDDOUT is the output voltage of the regulator and must be connected with or without an inductor to VDDCORE.

The ground pins GND are common to VDDCORE, VDDIO, and VDDIN. The ground pin for VDDANA is GNDANA.

For decoupling recommendations for the different power supplies, refer to the schematic document.

6.2.1 Voltage Regulator

An embedded voltage regulator supplies all the digital logic in the Core and the Backup power domains.

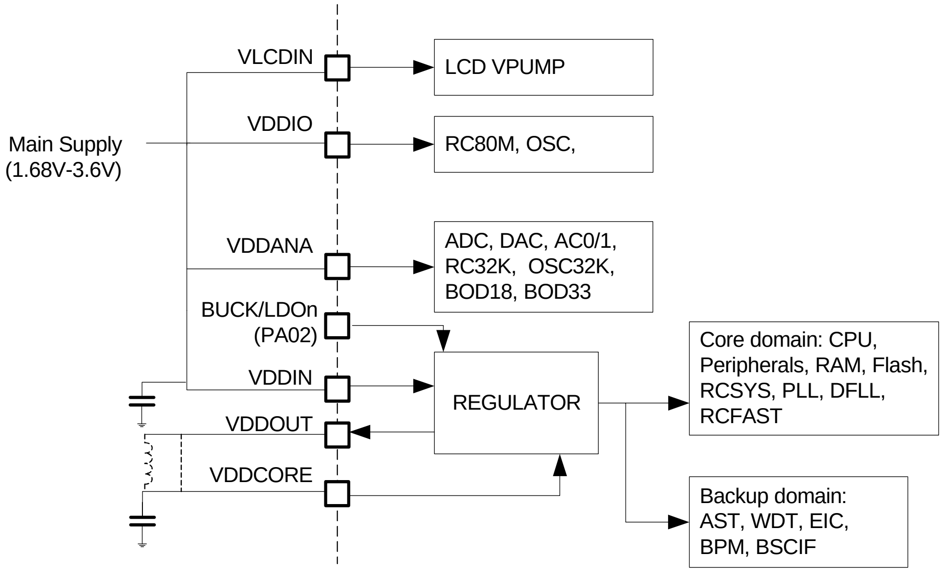
The regulator has two functionnal mode depending of BUCK/LDOn (PA02) pin value. When this pin is low, the regulator is in linear mode and VDDOUT must be connected to VDDCORE externally. When this pin is high, it behaves as a switching regulator and an inductor must be placed between VDDOUT and VDDCORE. The value of this pin is sampled during the power-up phase when the Power On Reset 33 reaches V_{POT+} (Section 9.9 "Analog Characteristics" on page 129)

Its output voltages in the Core domain (V_{CORE}) and in the Backup domain (V_{BKUP}) are always equal except in Backup mode where the Core domain is not powered ($V_{CORE}=0$). The Backup domain is always powered. The voltage regulator features three different modes:

- Normal mode: the regulator is configured as linear or switching regulator. It can support all different Run and Sleep modes.
- Low Power (LP) mode: the regulator consumes little static current. It can be used in Wait modes.
- Ultra Low Power (ULP) mode: the regulator consumes very little static current . It is dedicated to Retention and Backup modes. In Backup mode, the regulator only supplies the backup domain.

The internal regulator is connected to the VDDIN pin and its output VDDOUT feeds VDDCORE in linear mode or through an inductor in switching mode. Figure 6-4 shows the power schematics to be used. All I/O lines will be powered by the same power (V_{VDDIN}=V_{VDDIO}=V_{VDDANA}).

Figure 6-4. Single Supply Mode



6.2.3 LCD Power Modes

6.2.3.1 Principle

LCD lines is powered using the device internal voltage sources provided by the LCDPWR block. When enabled, the LCDPWR blocks will generate the VLCD, BIASL, BIASH voltages.

LCD pads are splitted into three clusters that can be powered independently namely clusters A, B and C. A cluster can either be in GPIO mode or in LCD mode.

When a cluster is in GPIO mode, its VDDIO pin must be powered externally. None of its GPIO pin can be used as a LCD line

When a cluster is in LCD mode, each clusters VDDIO pin can be either forced externally (1.8-3.6V) or unconnected (nc). GPIOs in a cluster are not available when it is in LCD mode. A cluster is set in LCD mode by the LCDCA controller when it is enabled depending on the number of segments configured. The LCDPWR block is powered by the VLCDIN pin inside cluster A

When LCD feature is not used, VLCDIN must be always powered (1.8-3.6V). VLCD, CAPH, CAPL, BIASH, BIASL can be left unconnected in this case mechanism can be useful for applications that only require the processor to run when an interrupt occurs.

Before entering the SLEEP mode, the user must configure:

- the SLEEP mode configuration field (BPM.PMCON.SLEEP), Refer to Table 7-1.
- the SCR.SLEEPDEEP bit to 0. (See the Power Management section in the ARM Cortex-M4 Processor chapter).
- the BPM.PMCON.RET bit to 0.
- the BPM.PMCON.BKUP bit to 0.

7.1.1.2 Exiting SLEEP mode

The NVIC wakes the system up when it detects any non-masked interrupt with sufficient priority to cause exception entry. The system goes back to the RUN mode from which the SLEEP mode was entered. The CPU and affected modules are restarted. Note that even if an interrupt is enabled in SLEEP mode, it will not trigger if the source module is not clocked.

7.1.2 WAIT Mode and RETENTION Mode

The WAIT and RETENTION modes allow achieving very low power consumption while maintaining the Core domain powered-on. Internal SRAM and registers contents of the Core domain are preserved.

In these modes, all clocks are stopped except the 32kHz clocks (OSC32K, RC32K) which are kept running if enabled.

In RETENTION mode, the SleepWalking feature is not supported and must not be used.

7.1.2.1 Entering WAIT or RETENTION Mode

The WAIT or RETENTION modes are entered by executing the WFI instruction with the following settings:

- set the SCR.SLEEPDEEP bit to 1. (See the Power Management section in the ARM Cortex-M4 Processor chapter).
- set the BPM.PSAVE.BKUP bit to 0.
- set the BPM.PMCON.RET bit to RETENTION or WAIT mode.

SLEEPONEXIT feature is also available. See ”Entering SLEEP mode” on page 56.

7.1.2.2 Exiting WAIT or RETENTION Mode

In WAIT or RETENTION modes, synchronous clocks are stopped preventing interrupt sources from triggering. To wakeup the system, asynchronous wake up sources (AST, EIC, USBC ...) should be enabled in the peripheral (refer to the documentation of the peripheral). The PM.AWEN (Asynchronous Wake Up Enable) register should also be enabled for all peripheral except for EIC and AST.

When the enabled asynchronous wake up event occurs and the system is waken-up, it will generate either:

- an interrupt on the PM WAKE interrupt line if enabled (Refer to Section 9. ”Power Manager (PM)” on page 677). In that case, the PM.WCAUSE register indicates the wakeup source.
- or an interrupt directly from the peripheral if enabled (Refer to the section of the peripheral).

When waking up, the system goes back to the RUN mode mode from which the WAIT or RETENTION mode was entered.

8.7.12 JTAG Instructions Summary

The implemented JTAG instructions are shown in the table below.

Table 8-2. Implemented JTAG instructions list

IR instruction value	Instruction	Description	availability when protected	Component
b0000	EXTEST	Select boundary-scan chain as data register for testing circuitry external to the device.	yes	BSCAN-TAP
b0001	SAMPLE_PRELOAD	Take a snapshot of external pin values without affecting system operation.	yes	
b0100	INTEST	Select boundary-scan chain for internal testing of the device.	yes	
b0101	CLAMP	Bypass device through Bypass register, while driving outputs from boundary-scan register.	yes	
b1000	ABORT	ARM JTAG-DP Instruction	yes	SWJ-DP (in JTAG mode)
b1010	DPACC	ARM JTAG-DP Instruction	yes	
b1011	APACC	ARM JTAG-DP Instruction	yes	
b1100	-	Reserved	yes	
b1101	-	Reserved	yes	
b1110	IDCODE	ARM JTAG-DP Instruction	yes	
b1111	BYPASS	Bypass this device through the bypass register.	yes	

8.9.6 Security Considerations

In protected state this module may access sensible information located in the device memories. To avoid any risk of sensible data extraction from the module registers, all operations are non interruptible except by a disable command triggered by writing a one to CR.DIS. Issuing this command clears all the interface and internal registers.

Some registers have some special protection:

- It is not possible to read or write the LENGTH register when the part is protected.
- In addition, when the part is protected and an operation is ongoing, it is not possible to read the ADDR and DATA registers. Once an operation has started, the user has to wait until it has terminated by polling the DONE field in the Status Register (SR.DONE).

8.9.7 Chip Erase

The Chip erase operation consists in:

1. clearing all the volatile memories in the system
2. clearing the whole flash array
3. clearing the protected state

No proprietary or sensitive information is left in volatile memories once the protected state is disabled.

This feature is operated by writing a one to the CE bit of the Control Register (CR.CE). When the operation completes, SR.DONE is asserted.

8.9.8 Cortex-M4 Core Reset Source

The SMAP processes the EDP Core hold reset requests (Refer to Section 1.1.8 ”SMAP Core Reset Request Source” on page 6). When requested, it instructs the Power Manager to hold the Cortex-M4 core under reset.

The SMAP can de-assert the core reset request if a one is written to the Hold Core Reset bit in the Status Clear Register (SCR.HCR). This has the effect of releasing the CPU from its reset state. To assert again this signal, a new reset sequence with TCK tied low must be issued.

Note that clearing HCR with this module is only possible when it is enabled, for more information refer to Section 8.9.4 ”Initializing the Module” on page 78. Also note that asserting RESET_N automatically clears HCR.

8.9.11.6 Data Register

Name: DATA

Access Type: Read/Write

Offset: 0x14

Reset Value: 0x00000000

31	30	29	28	27	26	25	24
DATA							

23	22	21	20	19	18	17	16
DATA							

15	14	13	12	11	10	9	8
DATA							

7	6	5	4	3	2	1	0
DATA							

- **DATA: Generic data register**

8.10 Available Features in Protected State

Table 8-10. Features availablility when in protected state

Feature	Provider	Availability when protected
Hot plugging	EDP	yes
System bus R/W Access	AHB-AP	no
Flash User Page read access	SMAP	yes
Core Hold Reset clear from the SMAP interface	SMAP	no
CRC32 of any memory accessible through the bus matrix	SMAP	restricted (limited to the entire flash array)
Chip Erase	SMAP	yes
IDCODE	SMAP	yes

Table 9-11. Typical Current Consumption by Peripheral in Power Scaling Mode 0 and 2 (1)

Peripheral	Typ Consumption Active	Unit
IISC	1.0	µA/MHz
SPI	1.9	
TC	6.3	
TWIM	1.5	
TWIS	1.2	
USART	8.5	
ADCIFE(2)	3.1	
DACC	1.3	
ACIFC (2)	3.1	
GLOC	0.4	
ABDACB	0.7	
TRNG	0.9	
PARC	0.7	
CATB	3.0	
LCDCA	4.4	
PDCA	1.0	
CRCCU	0.3	
USBC	1.5	
PEVC	5.6	
CHIPID	0.1	
SCIF	6.4	
FREQM	0.5	
GPIO	7.1	
BPM	0.9	
BSCIF	4.6	
AST	1.5	
WDT	1.4	
EIC	0.6	
PICOUART	0.3	

1. These numbers are valid for the measured condition only and must not be extrapolated to other frequencies
2. Includes the current consumption on VDDANA and ADVREFP.

9.5.4 .Peripheral Power Consumption in Power Scaling mode 1

The values in Table 9-13 are measured values of power consumption under the following conditions:

1. These values are based on simulation. These values are not covered by test limits in production or characterization.

The values in Table 9-43 describe the values of the BOD33.LEVEL in the flash User Page fuses.

Table 9-43. BOD33.LEVEL Values

BOD33.LEVEL Value	Min	Typ	Max	Units
16		2.08		V
20		2.18		
24		2.33		
28		2.48		
32		2.62		
36		2.77		
40		2.92		
44		3.06		
48		3.21		

Table 9-44. BOD33 Characteristics (1)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
	Step size, between adjacent values in BSCIF.BOD33LEVEL(1)			34.4		mV
V_{HYST}	Hysteresis(1)		45		170	
t_{DET}	Detection time(1)	Time with VDDIN < V_{TH} necessary to generate a reset signal				µs
I_{BOD33}	Current consumption(1)	Normal mode			36	µA
$t_{STARTUP}$	Startup time(1)	Normal mode			6	µs

1. These values are based on simulation. These values are not covered by test limits in production or characterization.

Table 9-46. DC Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Units
VDDANA	Supply voltage (1)		1.6		3.6	V
	Reference range (2)	Differential mode	1.0		VDDANA -0.6	V
		Unipolar and Window modes	1.0		1.0	
		Using divide by two function (differential)	2.0		VDDANA	
	Absolute min, max input voltage(2)		-0,1		VDDANA +0.1	V
	Start up time(2)	ADC with reference already enabled		12	24	Cycles
		No gain compensation Reference buffer			5	µs
		Gain compensation Reference buffer			60	Cycles
R_{SAMPLE}	Input channel source resistance(2)				0.5	kΩ
C_{SAMPLE}	Sampling capacitance(2)		2.9	3.6	4.3	pF
	Reference input source resistance(2)	Gain compensation			2	kΩ
		No gain compensation			1	MΩ
	ADC reference settling time(2)	After changing reference/mode (3)		5	60	Cycles

1. These values are based on characterization. These values are not covered by test limits in production
2. These values are based on simulation. These values are not covered by test limits in production
3. Requires refresh/flush otherwise conversion time (latency) + 1

Table 9-47. Differential mode, gain=1

Symbol	Parameter	Conditions	Min	Typ	Max	Units
	Accuracy without compensation (1)			7		ENOB
	Accuracy after compensation(1)	(INL, gain and offset)			11	ENOB
INL	Integral Non Linearity (2)	After calibration, Gain compensation		1.2	1.7	LSBs
DNL	Differential Non Linearity(2)	After calibration		0.7	1.0	LSBs
	Gain error (2)	External reference	-5.0	-1.0	5.0	mV
		VDDANA/1.6	-40		40	
		VDDANA/2.0	-40		40	
		Bandgap After calibration	-30		30	
	Gain error drift vs voltage(1)	External reference	-2		2	mV/V
	Gain error drift vs temperature(1)	After calibration + bandgap drift If using onchip bandgap			0.08	mV/°K
	Offset error (2)	External reference	-5.0		5.0	mV
		VDDANA/1.6	-10		10	
		VDDANA/2.0	-10		10	
		Bandgap After calibration	-10		10	
	Offset error drift vs voltage(1)		-4		4	mV/V

Table 9-54. USART0 in SPI Mode Timing, Master Mode(1)

Symbol	Parameter	Conditions	Min	Max	Units
USPI0	MISO setup time before SPCK rises	V_{VDDIO} from 3.0V to 3.6V, maximum external capacitor = 40pF	$123.2 + t_{SAMPLE}$(2)		ns
USPI1	MISO hold time after SPCK rises		$24.74 - t_{SAMPLE}$(2)		
USPI2	SPCK rising to MOSI delay			513.56	
USPI3	MISO setup time before SPCK falls		$125.99 + t_{SAMPLE}$(2)		
USPI4	MISO hold time after SPCK falls		$24.74 - t_{SAMPLE}$(2)		
USPI5	SPCK falling to MOSI delay			516.55	

Table 9-55. USART1 in SPI Mode Timing, Master Mode(1)

Symbol	Parameter	Conditions	Min	Max	Units
USPI0	MISO setup time before SPCK rises	V_{VDDIO} from 3.0V to 3.6V, maximum external capacitor = 40pF	$69.28 + t_{SAMPLE}$(2)		ns
USPI1	MISO hold time after SPCK rises		$25.75 - t_{SAMPLE}$(2)		
USPI2	SPCK rising to MOSI delay			99.66	
USPI3	MISO setup time before SPCK falls		$73.12 + t_{SAMPLE}$(2)		
USPI4	MISO hold time after SPCK falls		$28.10 - t_{SAMPLE}$(2)		
USPI5	SPCK falling to MOSI delay			102.01	

Table 9-56. USART2 in SPI Mode Timing, Master Mode(1)

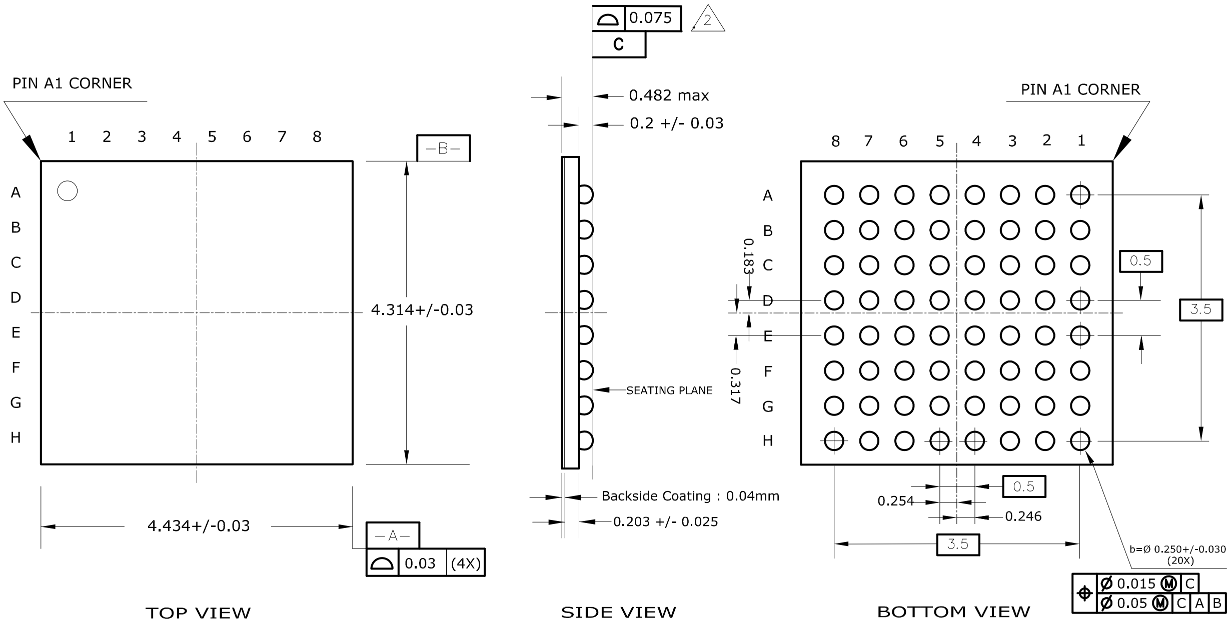
Symbol	Parameter	Conditions	Min	Max	Units
USPI0	MISO setup time before SPCK rises	V_{VDDIO} from 3.0V to 3.6V, maximum external capacitor = 40pF	$69.09 + t_{SAMPLE}$(2)		ns
USPI1	MISO hold time after SPCK rises		$26.52 - t_{SAMPLE}$(2)		
USPI2	SPCK rising to MOSI delay			542.96	
USPI3	MISO setup time before SPCK falls		$72.55 + t_{SAMPLE}$(2)		
USPI4	MISO hold time after SPCK falls		$28.37 - t_{SAMPLE}$(2)		
USPI5	SPCK falling to MOSI delay			544.80	

Table 9-57. USART3 in SPI Mode Timing, Master Mode(1)

Symbol	Parameter	Conditions	Min	Max	Units
USPI0	MISO setup time before SPCK rises	V_{VDDIO} from 3.0V to 3.6V, maximum external capacitor = 40pF	$147.24 + t_{SAMPLE}$(2)		ns
USPI1	MISO hold time after SPCK rises		$25.80 - t_{SAMPLE}$(2)		
USPI2	SPCK rising to MOSI delay			88.23	
USPI3	MISO setup time before SPCK falls		$154.9 + t_{SAMPLE}$(2)		
USPI4	MISO hold time after SPCK falls		$26.89 - t_{SAMPLE}$(2)		
USPI5	SPCK falling to MOSI delay			89.32	

Notes:
1. These values are based on simulation. These values are not covered by test limits in production.
2. Where: $t_{SAMPLE} = t_{SPCK} - \left(\left\lfloor \frac{t_{SPCK}}{2 \times t_{CLKUSART}} \right\rfloor \frac{1}{2}\right) \times t_{CLKUSART}$

Figure 10-4. WLCSP64 SAM4LS4/2 Package Drawing



COMMON DIMENSIONS
(Unit of Measure = mm)

BALL	SIGNAL	X COORD	Y COORD
A1	PB04	1.746	1.683
A2	GNDANA	1.246	1.683
A3	ADVREFP	0.746	1.683
A4	VDDANA	0.246	1.683
A5	PA09	-0.254	1.683
A6	PA28	-0.754	1.683
A7	PA27	-1.254	1.683
A8	PA12	-1.754	1.683
B1	PB03	1.746	1.183
B2	XIN32	1.246	1.183
B3	XOUT32	0.746	1.183
B4	PA08	0.246	1.183
B5	PB06	-0.254	1.183
B6	PA10	-0.754	1.183
B7	PA11	-1.254	1.183
B8	PA29	-1.754	1.183
C1	VDDIN	1.746	0.683
C2	PB01	1.246	0.683
C3	PA05	0.746	0.683
C4	PA06	0.246	0.683
C5	PA07	-0.254	0.683
C6	PB07	-0.754	0.683
C7	PA13	-1.254	0.683
C8	GNDIO0	-1.754	0.683
D1	VDDOUT	1.746	0.183
D2	PB00	1.246	0.183
D3	PA04	0.746	0.183
D4	PB05	0.246	0.183
D5	PB12	-0.254	0.183
D6	PB08	-0.754	0.183
D7	PA14	-1.254	0.183
D8	VLCDIN	-1.754	0.183
E1	GNDIN	1.746	-0.317
E2	PA03	1.246	-0.317
E3	PB02	0.746	-0.317
E4	RESET_N	0.246	-0.317
E5	PB13	-0.254	-0.317
E6	PB09	-0.754	-0.317
E7	PA15	-1.254	-0.317
E8	PA30	-1.754	-0.317
F1	VDDCORE	1.746	-0.817
F2	TCK	1.246	-0.817
F3	PA02	0.746	-0.817
F4	PB14	0.246	-0.817
F5	PA22	-0.254	-0.817
F6	PB10	-0.754	-0.817
F7	PA16	-1.254	-0.817
F8	PA31	-1.754	-0.817
G1	GNDIO1	1.746	-1.317
G2	PA26	1.246	-1.317
G3	PA24	0.746	-1.317
G4	PA00	0.246	-1.317
G5	PA01	-0.254	-1.317
G6	PA19	-0.754	-1.317
G7	PA18	-1.254	-1.317
G8	PA17	-1.754	-1.317
H1	VDDIO1	1.746	-1.817
H2	PA25	1.246	-1.817
H3	PA23	0.746	-1.817
H4	PB15	0.246	-1.817
H5	PA21	-0.254	-1.817
H6	VDDIO0	-0.754	-1.817
H7	PA20	-1.254	-1.817
H8	PB11	-1.754	-1.817

Notes : 1. Dimension "b" is measured at the maximum ball diameter in a plane to the seating plane.

2. Applied to whole wafer.

Table 10-11. Device and Package Maximum Weight

14.8	mg

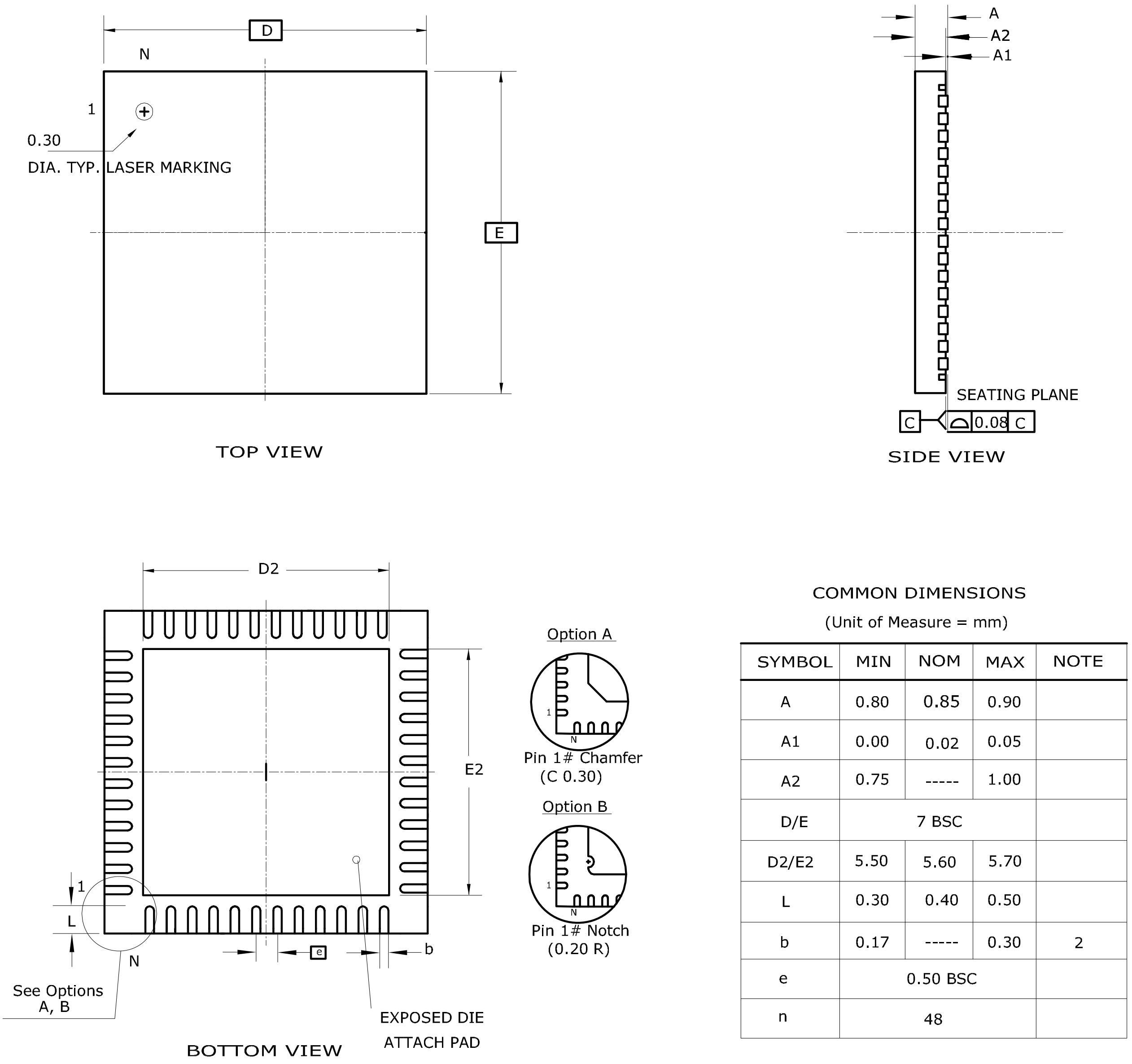
Table 10-12. Package Characteristics

Moisture Sensitivity Level	MSL3

Table 10-13. Package Reference

JEDEC Drawing Reference	MS-026
JESD97 Classification	E1

Figure 10-11. QFN-48 Package Drawing for ATSAM4LC8 and ATSAM4LS8



SYMBOL	MIN	NOM	MAX	NOTE
A	0.80	0.85	0.90	
A1	0.00	0.02	0.05	
A2	0.75	-----	1.00	
D/E	7 BSC			
D2/E2	5.50	5.60	5.70	
L	0.30	0.40	0.50	
b	0.17	-----	0.30	2
e	0.50 BSC			
n	48			

Note: The exposed pad is not connected to anything internally, but should be soldered to ground to increase board level reliability.

Table 10-32. Device and Package Maximum Weight

140	mg

Table 10-33. Package Characteristics

Moisture Sensitivity Level	MSL3

Table 10-34. Package Reference

JEDEC Drawing Reference	MO-220
JESD97 Classification	E3

12. Errata

12.1 ATSAM4L4 /2 Rev. B & ATSAM4L8 Rev. A

12.1.1 General

PS2 mode is not supported by Engineering Samples
PS2 mode support is supported only by parts with calibration version higher than 0.
Fix/Workaround
The calibration version can be checked by reading a 32-bit word at address 0x0080020C.
The calibration version bitfield is 4-bit wide and located from bit 4 to bit 7 in this word. Any value higher than 0 ensures that the part supports the PS2 mode

12.1.2 SCIF

PLLCOUNT value larger than zero can cause PLLEN glitch
Initializing the PLLCOUNT with a value greater than zero creates a glitch on the PLLEN signal during asynchronous wake up.
Fix/Workaround
The lock-masking mechanism for the PLL should not be used.
The PLLCOUNT field of the PLL Control Register should always be written to zero.

12.1.3 WDT

WDT Control Register does not have synchronization feedback
When writing to the Timeout Prescale Select (PSEL), Time Ban Prescale Select (TBAN), Enable (EN), or WDT Mode (MODE) fieldss of the WDT Control Register (CTRL), a synchronizer is started to propagate the values to the WDT clcok domain. This synchronization takes a finite amount of time, but only the status of the synchronization of the EN bit is reflected back to the user. Writing to the synchronized fields during synchronization can lead to undefined behavior.
Fix/Workaround
-When writing to the affected fields, the user must ensure a wait corresponding to 2 clock cycles of both the WDT peripheral bus clock and the selected WDT clock source.
-When doing writes that changes the EN bit, the EN bit can be read back until it reflects the written value.

12.1.4 SPI

SPI data transfer hangs with CSR0.CSAAT==1 and MR.MODFDIS==0
When CSR0.CSAAT==1 and mode fault detection is enabled (MR.MODFDIS==0), the SPI module will not start a data transfer.
Fix/Workaround
Disable mode fault detection by writing a one to MR.MODFDIS.

SPI disable does not work in SLAVE mode
SPI disable does not work in SLAVE mode.