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Applications of "Embedded - Microcontrollers"

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, POR, PWM, WDT
Number of I/O	32
Program Memory Size	256KB (256K 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 3x12b; D/A 1x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	48-TQFP
Supplier Device Package	48-TQFP (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/atsam4ls4aa-aur

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		

Table 2-3. ATSAM4LS Configuration Summary

Feature	ATSAM4LS8/4/2C	ATSAM4LS8/4/2B	ATSAM4LS8/4/2A
Timer/Counter Channels	6	3	
Parallel Capture Inputs	8		
Frequency Meter	1		
Watchdog Timer	1		
Power Manager	1		
Glue Logic LUT	2		1
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

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

Table 3-1. 100-pin GPIO Controller Function Multiplexing (Sheet 2 of 4)

ATSAM4LC		ATSAM4LS		Pin	GPIO	Supply	GPIO Functions						
QFN	VFBGA	QFN	VFBGA				A	B	C	D	E	F	G
66	J7	66	J7	PA16	16	LCDA	USART1 TXD	TC0 CLK2	EIC EXTINT1	PARC PCDATA7		LCDCA SEG8	CATB SENSE11
67	H6	67	H6	PA17	17	LCDA	USART2 RTS	ABDACB DAC0	EIC EXTINT2	PARC PCCK		LCDCA SEG9	CATB SENSE12
76	K10	76	K10	PA18	18	LCDA	USART2 CLK	ABDACB DACN0	EIC EXTINT3	PARC PCEN1		LCDCA SEG18	CATB SENSE13
77	J10	77	J10	PA19	19	LCDA	USART2 RXD	ABDACB DAC1	EIC EXTINT4	PARC PCEN2	SCIF GCLK0	LCDCA SEG19	CATB SENSE14
78	H10	78	H10	PA20	20	LCDA	USART2 TXD	ABDACB DACN1	EIC EXTINT5	GLOC IN0	SCIF GCLK1	LCDCA SEG20	CATB SENSE15
91	E9	91	E9	PA21	21	LCDC	SPI MISO	USART1 CTS	EIC EXTINT6	GLOC IN1	TWIM2 TWD	LCDCA SEG34	CATB SENSE16
92	E10	92	E10	PA22	22	LCDC	SPI MOSI	USART2 CTS	EIC EXTINT7	GLOC IN2	TWIM2 TWCK	LCDCA SEG35	CATB SENSE17
95	D6	95	D6	PA23	23	LCDC	SPI SCK	TWIMS0 TWD	EIC EXTINT8	GLOC IN3	SCIF GCLK IN0	LCDCA SEG38	CATB DIS
96	D10	96	D10	PA24	24	LCDC	SPI NPCS0	TWIMS0 TWCK		GLOC OUT0	SCIF GCLK IN1	LCDCA SEG39	CATB SENSE18
98	D9	98	D9	PA25	25	VDDIO	USBC DM	USART2 RXD					CATB SENSE19
99	C9	99	C9	PA26	26	VDDIO	USBC DP	USART2 TXD					CATB SENSE20
		51	K1	PA27	27	LCDA	SPI MISO	IISC ISCK	ABDACB DAC0	GLOC IN4	USART3 RTS		CATB SENSE0
		52	J1	PA28	28	LCDA	SPI MOSI	IISC ISDI	ABDACB DACN0	GLOC IN5	USART3 CTS		CATB SENSE1
		53	K2	PA29	29	LCDA	SPI SCK	IISC IWS	ABDACB DAC1	GLOC IN6	USART3 CLK		CATB SENSE2
		56	K4	PA30	30	LCDA	SPI NPCS0	IISC ISDO	ABDACB DACN1	GLOC IN7	USART3 RXD		CATB SENSE3
		57	K5	PA31	31	LCDA	SPI NPCS1	IISC IMCK	ABDACB CLK	GLOC OUT1	USART3 TXD		CATB DIS
20	J3	20	J3	PB00	32	VDDIN	TWIMS1 TWD	USART0 RXD					CATB SENSE21
21	D5	21	D5	PB01	33	VDDIN	TWIMS1 TWCK	USART0 TXD	EIC EXTINT0				CATB SENSE22
22	E5	22	E5	PB02	34	VDDANA	ADCIFE AD3	USART1 RTS	ABDACB DAC0	IISC ISCK	ACIFC ACBN0		CATB SENSE23
23	C4	23	C4	PB03	35	VDDANA	ADCIFE AD4	USART1 CLK	ABDACB DACN0	IISC ISDI	ACIFC ACBP0		CATB DIS
28	C1	28	C1	PB04	36	VDDANA	ADCIFE AD5	USART1 RXD	ABDACB DAC1	IISC ISDO	DACC EXT TRIG0		CATB SENSE24
29	B1	29	B1	PB05	37	VDDANA	ADCIFE AD6	USART1 TXD	ABDACB DACN1	IISC IMCK			CATB SENSE25
45	G3	45	G3	PB06	38	LCDA	USART3 RTS		GLOC IN4	IISC IWS		LCDCA SEG22	CATB SENSE26
46	H1	46	H1	PB07	39	LCDA	USART3 CTS		GLOC IN5	TC0 A0		LCDCA SEG21	CATB SENSE27

Table 3-4. 48-pin GPIO Controller Function Multiplexing (Sheet 1 of 2)

ATSAM4LC	ATSAM4LS	Pin	GPIO	Supply	GPIO Functions						
					A	B	C	D	E	F	G
1	1	PA00	0	VDDIO							
2	2	PA01	1	VDDIO							
3	3	PA02	2	VDDIN	SCIF GCLK0	SPI NPCS0					CATB DIS
10	10	PA03	3	VDDIN		SPI MISO					
11	11	PA04	4	VDDANA	ADCIFE AD0	USART0 CLK	EIC EXTINT2	GLOC IN1			CATB SENSE0
12	12	PA05	5	VDDANA	ADCIFE AD1	USART0 RXD	EIC EXTINT3	GLOC IN2	ADCIFE TRIGGER		CATB SENSE1
15	15	PA06	6	VDDANA	DACC VOUT	USART0 RTS	EIC EXTINT1	GLOC IN0	ACIFC ACAN0		CATB SENSE2
16	16	PA07	7	VDDANA	ADCIFE AD2	USART0 TXD	EIC EXTINT4	GLOC IN3	ACIFC ACAP0		CATB SENSE3
20	20	PA08	8	LCDA	USART0 RTS	TC0 A0	PEVC PAD EVT0	GLOC OUT0		LCDCA SEG23	CATB SENSE4
21	21	PA09	9	LCDA	USART0 CTS	TC0 B0	PEVC PAD EVT1	PARC PCDATA0		LCDCA COM3	CATB SENSE5
22	22	PA10	10	LCDA	USART0 CLK	TC0 A1	PEVC PAD EVT2	PARC PCDATA1		LCDCA COM2	CATB SENSE6
23	23	PA11	11	LCDA	USART0 RXD	TC0 B1	PEVC PAD EVT3	PARC PCDATA2		LCDCA COM1	CATB SENSE7
24	24	PA12	12	LCDA	USART0 TXD	TC0 A2		PARC PCDATA3		LCDCA COM0	CATB DIS
32	32	PA13	13	LCDA	USART1 RTS	TC0 B2	SPI NPCS1	PARC PCDATA4		LCDCA SEG5	CATB SENSE8
33	33	PA14	14	LCDA	USART1 CLK	TC0 CLK0	SPI NPCS2	PARC PCDATA5		LCDCA SEG6	CATB SENSE9
34	34	PA15	15	LCDA	USART1 RXD	TC0 CLK1	SPI NPCS3	PARC PCDATA6		LCDCA SEG7	CATB SENSE10
35	35	PA16	16	LCDA	USART1 TXD	TC0 CLK2	EIC EXTINT1	PARC PCDATA7		LCDCA SEG8	CATB SENSE11
36	36	PA17	17	LCDA	USART2 RTS	ABDACB DAC0	EIC EXTINT2	PARC PCCK		LCDCA SEG9	CATB SENSE12
37	37	PA18	18	LCDA	USART2 CLK	ABDACB DACN0	EIC EXTINT3	PARC PCEN1		LCDCA SEG18	CATB SENSE13
38	38	PA19	19	LCDA	USART2 RXD	ABDACB DAC1	EIC EXTINT4	PARC PCEN2	SCIF GCLK0	LCDCA SEG19	CATB SENSE14
39	39	PA20	20	LCDA	USART2 TXD	ABDACB DACN1	EIC EXTINT5	GLOC IN0	SCIF GCLK1	LCDCA SEG20	CATB SENSE15
41	41	PA21	21	LCDC	SPI MISO	USART1 CTS	EIC EXTINT6	GLOC IN1	TWIM2 TWD	LCDCA SEG34	CATB SENSE16
42	42	PA22	22	LCDC	SPI MOSI	USART2 CTS	EIC EXTINT7	GLOC IN2	TWIM2 TWCK	LCDCA SEG35	CATB SENSE17
43	43	PA23	23	LCDC	SPI SCK	TWIMS0 TWD	EIC EXTINT8	GLOC IN3	SCIF GCLK IN0	LCDCA SEG38	CATB DIS

3.2.4 ITM Trace Connections

If the ITM trace is enabled, the ITM will take control over the pin PA23, irrespectively of the I/O Controller configuration. The Serial Wire Trace signal is available on pin PA23

3.2.5 Oscillator Pinout

The oscillators are not mapped to the normal GPIO functions and their muxings are controlled by registers in the System Control Interface (SCIF) or Backup System Control Interface (BSCIF). Refer to the Section 15. "System Control Interface (SCIF)" on page 308 and Section 15. "Backup System Control Interface (BSCIF)" on page 308 for more information about this.

Table 3-7. Oscillator Pinout

48-pin Packages	64-pin QFN/QFP	64-pin WLCSP	100-pin Packages	100-ball VFBGA	Pin Name	Oscillator Pin
1	1	G4	5	B9	PA00	XIN0
13	17	B2	26	B2	XIN32	XIN32
2	2	G5	6	B8	PA01	XOUT0
14	18	B3	27	C2	XOUT32	XOUT32

4.6 Cortex-M4 implementations options

This table provides the specific configuration options implemented in the SAM4L series

Option	Implementation
Inclusion of MPU	yes
Inclusion of FPU	No
Number of interrupts	80
Number of priority bits	4
Inclusion of the WIC	No
Embedded Trace Macrocell	No
Sleep mode instruction	Only WFI supported
Endianness	Little Endian
Bit-banding	No
SysTick timer	Yes
Register reset values	No

Table 4-1. Cortex-M4 implementation options

4.7 Cortex-M4 Interrupts map

The table below shows how the interrupt request signals are connected to the NVIC.

Table 4-2. Interrupt Request Signal Map (Sheet 1 of 3)

Line	Module	Signal
0	Flash Controller	HFLASHC
1	Peripheral DMA Controller	PDCA 0
2	Peripheral DMA Controller	PDCA 1
3	Peripheral DMA Controller	PDCA 2
4	Peripheral DMA Controller	PDCA 3
5	Peripheral DMA Controller	PDCA 4
6	Peripheral DMA Controller	PDCA 5
7	Peripheral DMA Controller	PDCA 6
8	Peripheral DMA Controller	PDCA 7
9	Peripheral DMA Controller	PDCA 8
10	Peripheral DMA Controller	PDCA 9
11	Peripheral DMA Controller	PDCA 10

The FPB unit contains:

- Two literal comparators for matching against literal loads from Code space, and remapping to a corresponding area in System space.
- Six instruction comparators for matching against instruction fetches from Code space and remapping to a corresponding area in System space.
- Alternatively, comparators can also be configured to generate a Breakpoint instruction to the processor core on a match.

8.6.2 DWT (Data Watchpoint and Trace)

The DWT contains four comparators which can be configured to generate the following:

- PC sampling packets at set intervals
- PC or Data watchpoint packets
- Watchpoint event to halt core

The DWT contains counters for the items that follow:

- Clock cycle (CYCCNT)
- Folded instructions
- Load Store Unit (LSU) operations
- Sleep Cycles
- CPI (all instruction cycles except for the first cycle)
- Interrupt overhead

8.6.3 ITM (Instrumentation Trace Macrocell)

The ITM is an application driven trace source that supports printf style debugging to trace Operating System (OS) and application events, and emits diagnostic system information. The ITM emits trace information as packets which can be generated by three different sources with several priority levels:

- **Software trace**: This can be done thanks to the printf style debugging. For more information, refer to Section "How to Configure the ITM:".
- **Hardware trace**: The ITM emits packets generated by the DWT.
- **Time stamping**: Timestamps are emitted relative to packets. The ITM contains a 21-bit counter to generate the timestamp.

How to Configure the ITM:

The following example describes how to output trace data in asynchronous trace mode.

- Configure the TPIU for asynchronous trace mode (refer to Section "5.4.3. How to Configure the TPIU")
- Enable the write accesses into the ITM registers by writing "0xC5ACCE55" into the Lock Access Register (Address: 0xE0000FB0)
- Write 0x00010015 into the Trace Control Register:
  - Enable ITM
  - Enable Synchronization packets
  - Enable SWO behavior

  – Fix the ATB ID to 1
- Write 0x1 into the Trace Enable Register:
  – Enable the Stimulus port 0
- Write 0x1 into the Trace Privilege Register:
  – Stimulus port 0 only accessed in privileged mode (Clearing a bit in this register will result in the corresponding stimulus port being accessible in user mode.)
- Write into the Stimulus port 0 register: TPIU (Trace Port Interface Unit)

  The TPIU acts as a bridge between the on-chip trace data and the Instruction Trace Macrocell (ITM).

  The TPIU formats and transmits trace data off-chip at frequencies asynchronous to the core.

Asynchronous Mode:

The TPIU is configured in asynchronous mode, trace data are output using the single TRACESWO pin. The TRACESWO signal is multiplexed with the TDO signal of the JTAG Debug Port. As a consequence, asynchronous trace mode is only available when the Serial Wire Debug mode is selected since TDO signal is used in JTAG debug mode.

Two encoding formats are available for the single pin output:

- Manchester encoded stream. This is the reset value.
- NRZ_based UART byte structure

5.4.3. How to Configure the TPIU

This example only concerns the asynchronous trace mode.

- Set the TRCENA bit to 1 into the Debug Exception and Monitor Register (0xE000EDFC) to enable the use of trace and debug blocks.
- Write 0x2 into the Selected Pin Protocol Register
  – Select the Serial Wire Output – NRZ
- Write 0x100 into the Formatter and Flush Control Register
- Set the suitable clock prescaler value into the Async Clock Prescaler Register to scale the baud rate of the asynchronous output (this can be done automatically by the debugging tool).

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	

Table 8-4. Instruction Description (Continued)

Instruction	Description
DR Size	Shows the number of bits in the data register chain when this instruction is active. Example: 32 bits
DR input value	Shows which bit pattern to shift into the data register in the Shift-DR state when this instruction is active.
DR output value	Shows the bit pattern shifted out of the data register in the Shift-DR state when this instruction is active.

8.7.14 JTAG Instructions

Refer to the ARM Debug Interface v5.1 Architecture Specification for more details on ABORT, DPACC, APACC and IDCODE instructions.

8.7.14.1 EXTEST

This instruction selects the boundary-scan chain as Data Register for testing circuitry external to the chip package. The contents of the latched outputs of the boundary-scan chain is driven out as soon as the JTAG IR-register is loaded with the EXTEST instruction.

Starting in Run-Test/Idle, the EXTEST instruction is accessed the following way:

1. Select the IR Scan path.
2. In Capture-IR: The IR output value is latched into the shift register.
3. In Shift-IR: The instruction register is shifted by the TCK input.
4. In Update-IR: The data from the boundary-scan chain is applied to the output pins.
5. Return to Run-Test/Idle.
6. Select the DR Scan path.
7. In Capture-DR: The data on the external pins is sampled into the boundary-scan chain.
8. In Shift-DR: The boundary-scan chain is shifted by the TCK input.
9. In Update-DR: The data from the scan chain is applied to the output pins.
10. Return to Run-Test/Idle.

Table 8-5. EXTEST Details

Instructions	Details
IR input value	**0000** (0x0)
IR output value	p00s
DR Size	Depending on boundary-scan chain, see BSDL-file.
DR input value	Depending on boundary-scan chain, see BSDL-file.
DR output value	Depending on boundary-scan chain, see BSDL-file.

8.7.14.2 SAMPLE_PRELOAD

This instruction takes a snap-shot of the input/output pins without affecting the system operation, and pre-loading the scan chain without updating the DR-latch. The boundary-scan chain is selected as Data Register.

Starting in Run-Test/Idle, the Device Identification register is accessed in the following way:

8.9 System Manager Access Port (SMAP)

Rev.: 1.0.0.0

8.9.1 Features

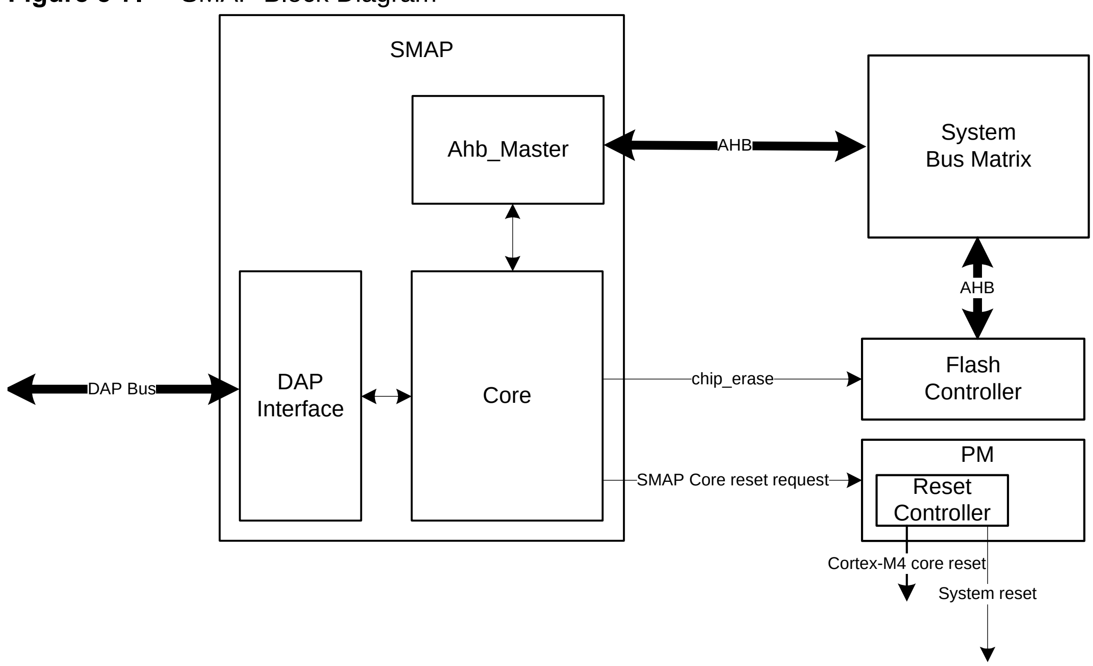
- **Chip Erase command and status**
- **Cortex-M4 core reset source**
- **32-bit Cyclic Redundancy check of any memory accessible through the bus matrix**
- **Unlimited Flash User page read access**
- **Chip identification register**

8.9.2 Overview

The SMAP provides memory-related services and also Cortex-M4 core reset control to a debugger through the Debug Port. This makes possible to halt the CPU and program the device after reset.

8.9.3 Block Diagram

Figure 8-7. SMAP Block Diagram



8.9.4 Initializing the Module

The SMAP can be accessed only if the CPU clock is running and the SWJ-DP has been activated by issuing a CDBGPWRUP request. For more details, refer to the ARM Debug Interface v5.1 Architecture Specification.

Then it must be enabled by writing a one to the EN bit of the CR register (CR.EN) before writing or reading other registers. If the SMAP is not enabled it will discard any read or write operation.

8.9.5 Stopping the Module

To stop the module, the user must write a one to the DIS bit of the CR register (CR.DIS). All the user interface and internal registers will be cleared and the internal clock will be stopped.

8.9.11.3 Status Clear Register

Name: SCR

Access Type: Write-Only

Offset: 0x08

Reset Value: 0x00000000

31	30	29	28	27	26	25	24
-	-	-	-	-	-	-	-

23	22	21	20	19	18	17	16
-	-	-	-	-	-	-	-

15	14	13	12	11	10	9	8
-	-	-	-	-	-	-	-

7	6	5	4	3	2	1	0
-	-	-	LCK	FAIL	BERR	HCR	DONE

Writing a zero to a bit in this register has no effect.
Writing a one to a bit clears the corresponding SR bit

Note: *Writing a one to bit HCR while the chip is in protected state has no effect*

8.9.11.4 Address Register

Name: ADDR

Access Type: Read/Write

Offset: 0x0C

Reset Value: 0x00000000

31	30	29	28	27	26	25	24
ADDR							

23	22	21	20	19	18	17	16
ADDR							

15	14	13	12	11	10	9	8
ADDR							

7	6	5	4	3	2	1	0
ADDR						-	-

- **ADDR: Address Value**

  Addess values are always world aligned

9.5 Power Consumption

9.5.1 Power Scaling 0 and 2

The values in Table 9-6 are measured values of power consumption under the following conditions, except where noted:

- Operating conditions for power scaling mode 0 and 2
  - V_{VDDIN} = 3.3V
  - Power Scaling mode 0 is used for CPU frequencies under 36MHz
  - Power Scaling mode 2 is used for CPU frequencies above 36MHz
- Wake up time from low power modes is measured from the edge of the wakeup signal to the first instruction fetched in flash.
- Oscillators
  - OSC0 (crystal oscillator) stopped
  - OSC32K (32kHz crystal oscillator) running with external 32kHz crystal
  - DFLL using OSC32K as reference and running at 48MHz
- Clocks
  - DFLL used as main clock source
  - CPU, AHB clocks undivided
  - APBC and APBD clocks divided by 4
  - APBA and APBB bridges off
  - The following peripheral clocks running
    - PM, SCIF, AST, FLASHCALW, APBC and APBD bridges
  - All other peripheral clocks stopped
- I/Os are inactive with internal pull-up
- CPU is running on flash with 1 wait state
- Low power cache enabled
- BOD18 and BOD33 disabled

Table 9-6. ATSAM4L4/2 Current consumption and Wakeup time for power scaling mode 0 and 2

Mode	Conditions	T_A	Typical Wakeup Time	Typ	Max [(1)]	Unit
RUN	CPU running a Fibonacci algorithm Linear mode	25°C	N/A	296	326	µA/MHz
		85°C		300	332	
	CPU running a CoreMark algorithm Linear mode	25°C	N/A	320	377	
		85°C		326	380	
	CPU running a Fibonacci algorithm Switching mode	25°C	N/A	177	198	
		85°C		179	200	
	CPU running a CoreMark algorithm Switching mode	25°C	N/A	186	232	
		85°C		195	239	

9.5.3 Peripheral Power Consumption in Power Scaling mode 0 and 2

The values in Table 9-11 are measured values of power consumption under the following conditions:

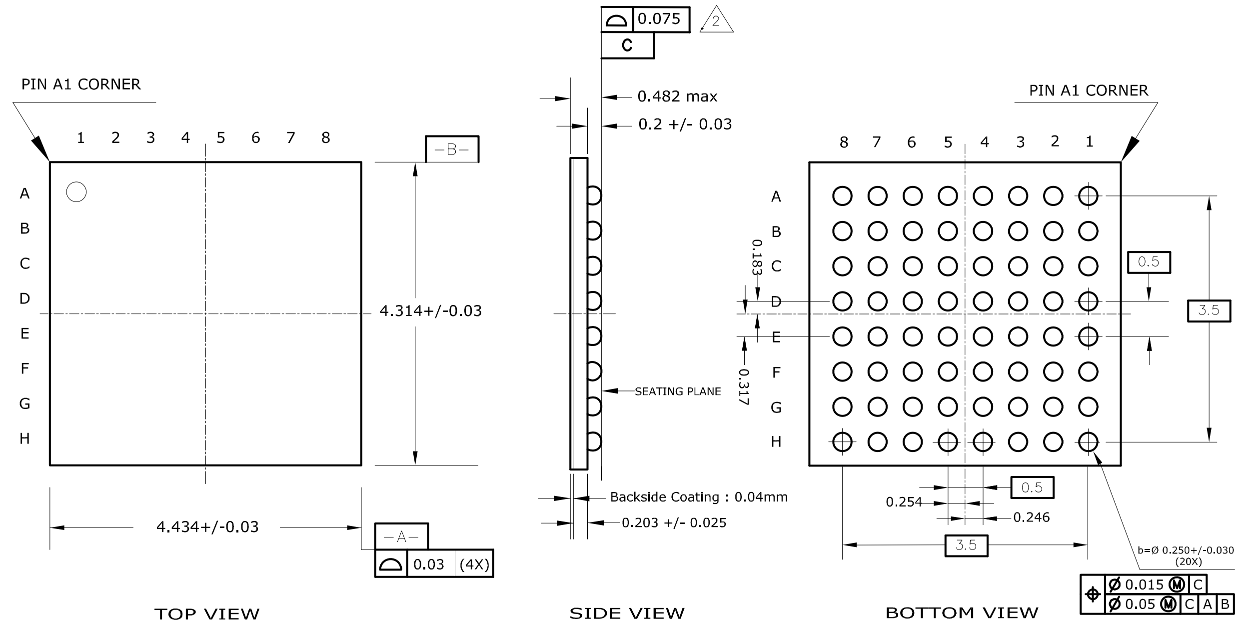
- Operating conditions, internal core supply (Figure 9-2)
  - V_{VDDIN} = 3.3V
  - $V_{VDDCORE}$ supplied by the internal regulator in switching mode
- T_A = 25°C
- Oscillators
  - OSC0 (crystal oscillator) stopped
  - OSC32K (32KHz crystal oscillator) running with external 32KHz crystal
  - DFLL running at 48MHz with OSC32K as reference clock
- Clocks
  - DFLL used as main clock source
  - CPU, AHB, and PB clocks undivided
- I/Os are inactive with internal pull-up
- Flash enabled in high speed mode
- CPU in SLEEP0 mode
- BOD18 and BOD33 disabled

Consumption active is the added current consumption when the module clock is turned on.

- Operating conditions, internal core supply (Figure 9-2)
  - V_{VDDIN} = 3.3V
  - $V_{VDDCORE}$ = 1.2 V, supplied by the internal regulator in switching mode
- T_A = 25°C
- Oscillators
  - OSC0 (crystal oscillator) stopped
  - OSC32K (32KHz crystal oscillator) running with external 32KHz crystal
  - RCFAST running @ 12MHz
- Clocks
  - RCFAST used as main clock source
  - CPU, AHB, and PB clocks undivided
- I/Os are inactive with internal pull-up
- Flash enabled in normal mode
- CPU in SLEEP0 mode
- BOD18 and BOD33 disabled

Consumption active is the added current consumption when the module clock is turned on

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

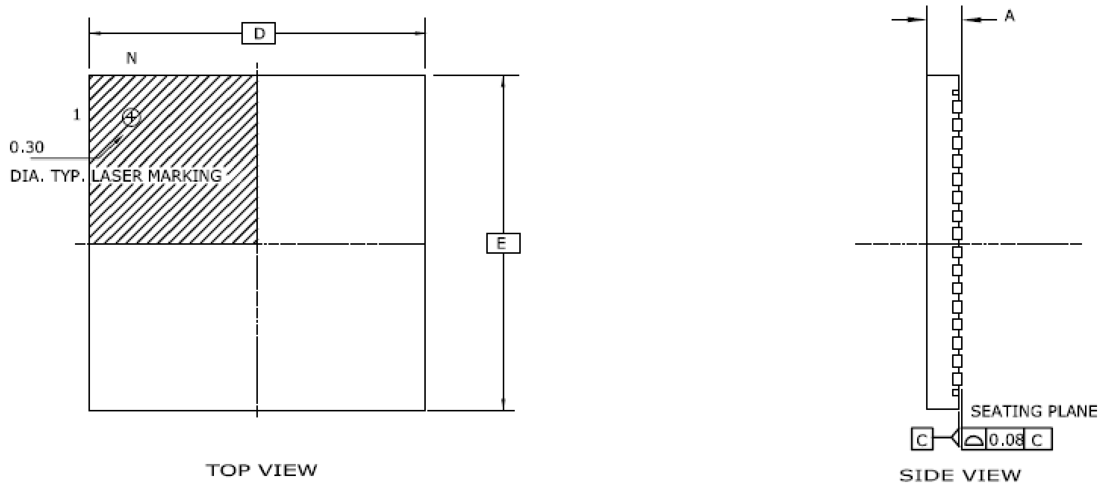
Table 10-12. Package Characteristics

Moisture Sensitivity Level	MSL3

Table 10-13. Package Reference

JEDEC Drawing Reference	MS-026
JESD97 Classification	E1

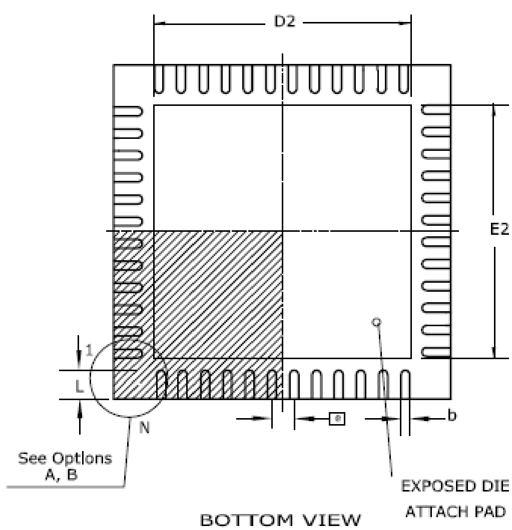
Figure 10-10. QFN-48 Package Drawing for ATSAM4LC4/2 and ATSAM4LS4/2

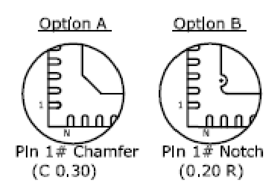


COMMON DIMENSIONS

(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	0.80	0.85	0.90	
D/E		7.00 BSC		
D2/E2	5.05	5.15	5.25	
b	0.18	0.25	0.30	
e		0.50 BSC		
L	0.30	0.40	0.50	
N		48		





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

Table 10-29. Device and Package Maximum Weight

140	mg

Table 10-30. Package Characteristics

Moisture Sensitivity Level	MSL3

Table 10-31. Package Reference

JEDEC Drawing Reference	MO-220
JESD97 Classification	E3

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