ARM-based Flash MCU

SAM4E16E SAM4E8E SAM4E16C SAM4E8C

SUMMARY DATASHEET

Description

The Atmel SAM4E series of Flash microcontrollers is based on the high-performance 32-bit ARM® Cortex®-M4 RISC processor and includes a floating point unit (FPU). It operates at a maximum speed of 120 MHz and features up to 1024 Kbytes of Flash, 2 Kbytes of cache memory and up to 128 Kbytes of SRAM.

The SAM4E offers a rich set of advanced connectivity peripherals including 10/100 Mbps Ethernet MAC supporting IEEE 1588 and dual CAN. With a single-precision FPU, advanced analog features, as well as a full set of timing and control functions, the SAM4E is the ideal solution for industrial automation, home and building control, machine-to-machine communications, automotive aftermarket and energy management applications.

The peripheral set includes a full-speed USB device port with embedded transceiver, a 10/100 Mbps Ethernet MAC supporting IEEE 1588, a high-speed MCI for SDIO/SD/MMC, an external bus interface featuring a static memory controller providing connection to SRAM, PSRAM, NOR Flash, LCD Module and NAND Flash, a parallel I/O capture mode for camera interface, hardware acceleration for AES256, two USARTs, two UARTs, two TWIs, three SPIs, as well as a 4-channel PWM, nine general-purpose 16-bit Timers (with stepper motor and quadrature decoder logic support), one RTC, two Analog Front End interfaces (16-bit ADC, DAC, MUX and PGA), one 12-bit DAC (2-ch) and an analog comparator.

Features

- Core
  - ARM® Cortex®-M4 with 2 Kbytes Cache running at up to 120 MHz(1)
  - Memory Protection Unit (MPU)
  - DSP Instruction
  - Floating Point Unit (FPU)
  - Thumb®-2 Instruction Set
- Memories
  - Up to 1024 Kbytes Embedded Flash
  - 128 Kbytes Embedded SRAM
  - 16 Kbytes ROM with Embedded Boot Loader Routines (UART) and IAP Routines
  - Static Memory Controller (SMC): SRAM, NOR, NAND Support.
  - NAND Flash Controller.
- System
  - Embedded Voltage Regulator for Single Supply Operation
  - Power-on-Reset (POR), Brown-out Detector (BOD) and Dual Watchdog for Safe Operation
  - Quartz or Ceramic Resonator Oscillators: 3 to 20 MHz Main Power with Failure Detection and Optional Low-power 32.768 kHz for RTC or Device Clock
  - RTC with Gregorian and Persian Calendar Mode, Waveform Generation in Low-power Modes
  - RTC Clock Calibration Circuitry for 32.768 kHz Crystal Frequency Compensation
  - High Precision 4/8/12 MHz Factory Trimmed Internal RC Oscillator with 4 MHz Default Frequency for Device Startup. In-application Trimming Access for Frequency Adjustment
  - Slow Clock Internal RC Oscillator as Permanent Low-power Mode Device Clock
  - One PLL up to 240 MHz for Device Clock and for USB
  - Temperature Sensor
  - Up to 2 Peripheral DMA Controller with up to 33 Channels (PDC)
  - One 4-channel DMA Controller
- Low-power Modes
  - Sleep and Backup Modes
  - Ultra Low-power RTC
- Peripherals
  - Two USARTs with USART1 (ISO7816, IrDA®, RS-485, SPI, Manchester and Modem Modes)
  - USB 2.0 Device: Full Speed (12 Mbits), 2668 byte FIFO, up to 8 Endpoints. On-chip Transceiver
  - Two 2-wire UARTs
  - Two Two-wire Interfaces (TWI)
  - High-speed Multimedia Card Interface (SDIO/SD Card/MMC)
  - One Master/Slave Serial Peripheral Interface (SPI) with Chip Select Signals
  - Three 3-Channel 32-bit Timer/Counter with Capture, Waveform, Compare and PWM Mode. Quadrature Decoder Logic and 2-bit Gray Up/Down Counter for Stepper Motor
  - 32-bit Real-time Timer and RTC with Calendar and Alarm Features
  - One Ethernet MAC (EMAC) 10/100 Mbps in MII mode only with dedicated DMA and Support for IEEE1588, Wake-on-LAN
  - Two CAN Controllers with eight Mailboxes
  - 4-channel 16-bit PWM with Complementary Output, Fault Input, 12-bit Dead Time Generator Counter for Motor Control

- Real-time Event Management
- Cryptography
  - AES 256-bit Key Algorithm compliant with FIPS Publication 197
- Analog
  - AFE (Analog Front End): 2x16-bit ADC, up to 24-channels, Differential Input Mode, Programmable Gain Stage, Auto Calibration and Automatic Offset Correction
  - One 2-channel 12-bit 1 Msps DAC
  - One Analog Comparator with Flexible Input Selection, Selectable Input Hysteresis
- I/O
  - Up to 117 I/O Lines with External Interrupt Capability (Edge or Level Sensitivity), Debouncing, Glitch Filtering and On-die Series Resistor Termination
  - Bidirectional Pad, Analog I/O, Programmable Pull-up/Pull-down
  - Five 32-bit Parallel Input/Output Controllers, Peripheral DMA Assisted Parallel Capture Mode
- Packages
  - 144-ball LFBGA, 10x10 mm, pitch 0.8 mm
  - 100-ball TFBGA, 9x9 mm, pitch 0.8 mm
  - 144-lead LQFP, 20x20 mm, pitch 0.5 mm
  - 100-lead LQFP, 14x14 mm, pitch 0.5 mm

Note: 1. 120 MHz: -40/+105°C, VDDCORE = 1.2V or using internal voltage regulator

1. Configuration Summary

The SAM4E series devices differ in memory size, package and features. Table 1-1 summarizes the configurations of the device family.

Table 1-1. Configuration Summary

Feature	SAM4E16E	SAM4E8E	SAM4E16C	SAM4E8C
Flash	1024 Kbytes	512 Kbytes	1024 Kbytes	512 Kbytes
SRAM	128 Kbytes		128 Kbytes	
CMCC	2 Kbytes		2 Kbytes	
Package	LFBGA 144 LQFP 144		TFBGA 100 LQFP 100	
Number of PIOs	117		79	
External Bus Interface	8-bit Data, 4 Chip Selects, 24-bit Address		-	
Analog Front End (AFE0 \AFE1)	Up to 16 bits(1) 16 ch.\ 8 ch (2)		Up to 16 bits(1) 6 ch.\ 4ch (3)	
EMAC	YES		YES	
CAN	2		1	
12-bit DAC	2 ch.		2 ch.	
Timer	9(4)		3(5)	
PDC Channels	24 +9		21 +9	
USART/ UART	2/2(6)		2/2(6)	
USB	Full Speed		Full Speed	
HSMCI	1 port 4 bits		1 port 4 bits	
TWI	2		2	

Notes:
1. ADC is 12-bit, up to 16 bits with averaging.
   For details, please refer to the “Electrical Characteristics” section of this datasheet.
2. AFE0 is 16 channels and AFE1 is 8 channels. The total number of AFE channels is 24.
   One channel is reserved for the internal temperature sensor.
3. AFE0 is 6 channels and AFE1 is 4 channels. The total number of AFE channels is 10.
   One channel is reserved for the internal temperature sensor.
4. 9 TC channels are accessible through PIO.
5. 3 TC channels are accessible through PIO.
6. Full Modem support on USART1.

2. Block Diagram

Figure 2-1. SAM4E 100-pin Block Diagram

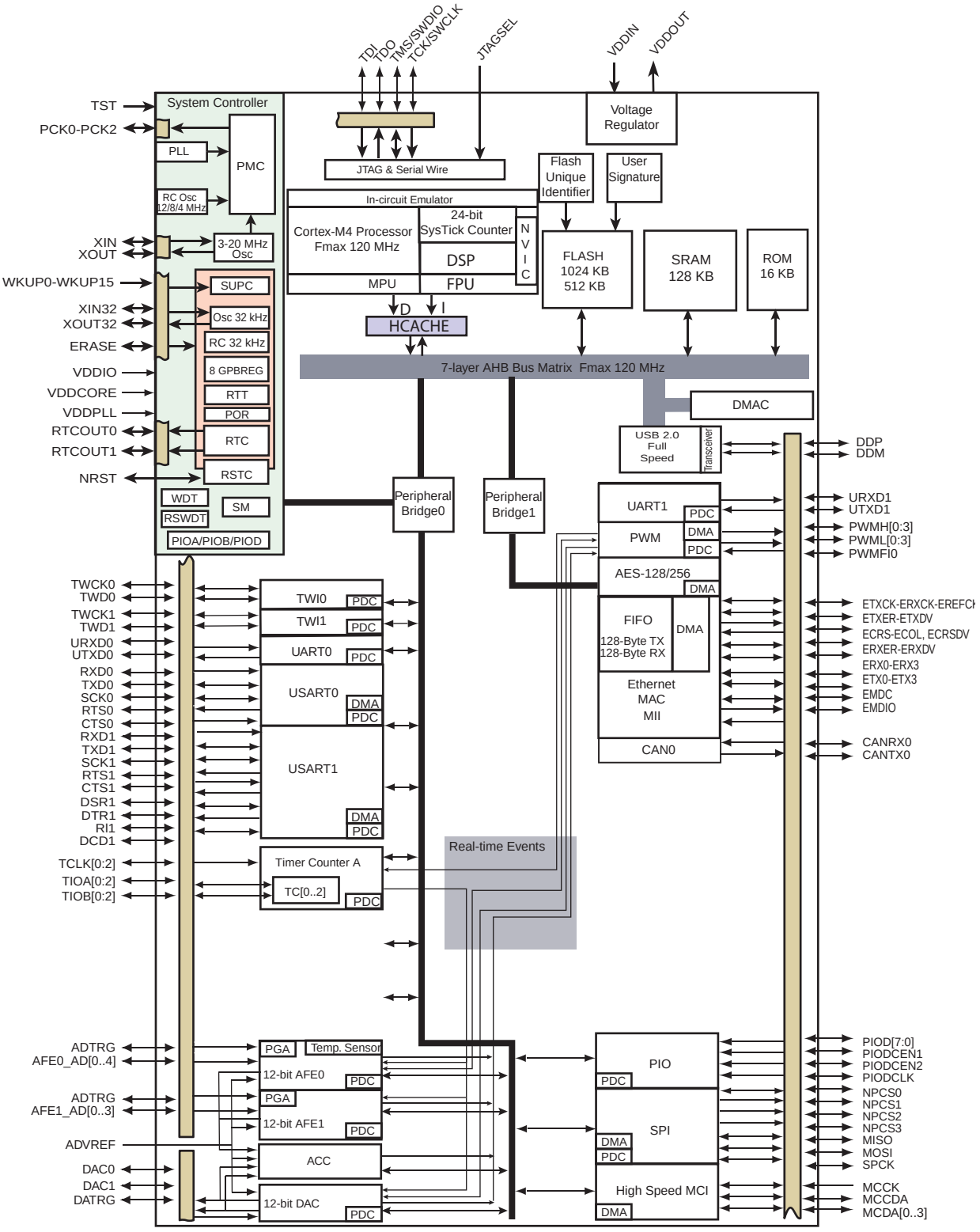
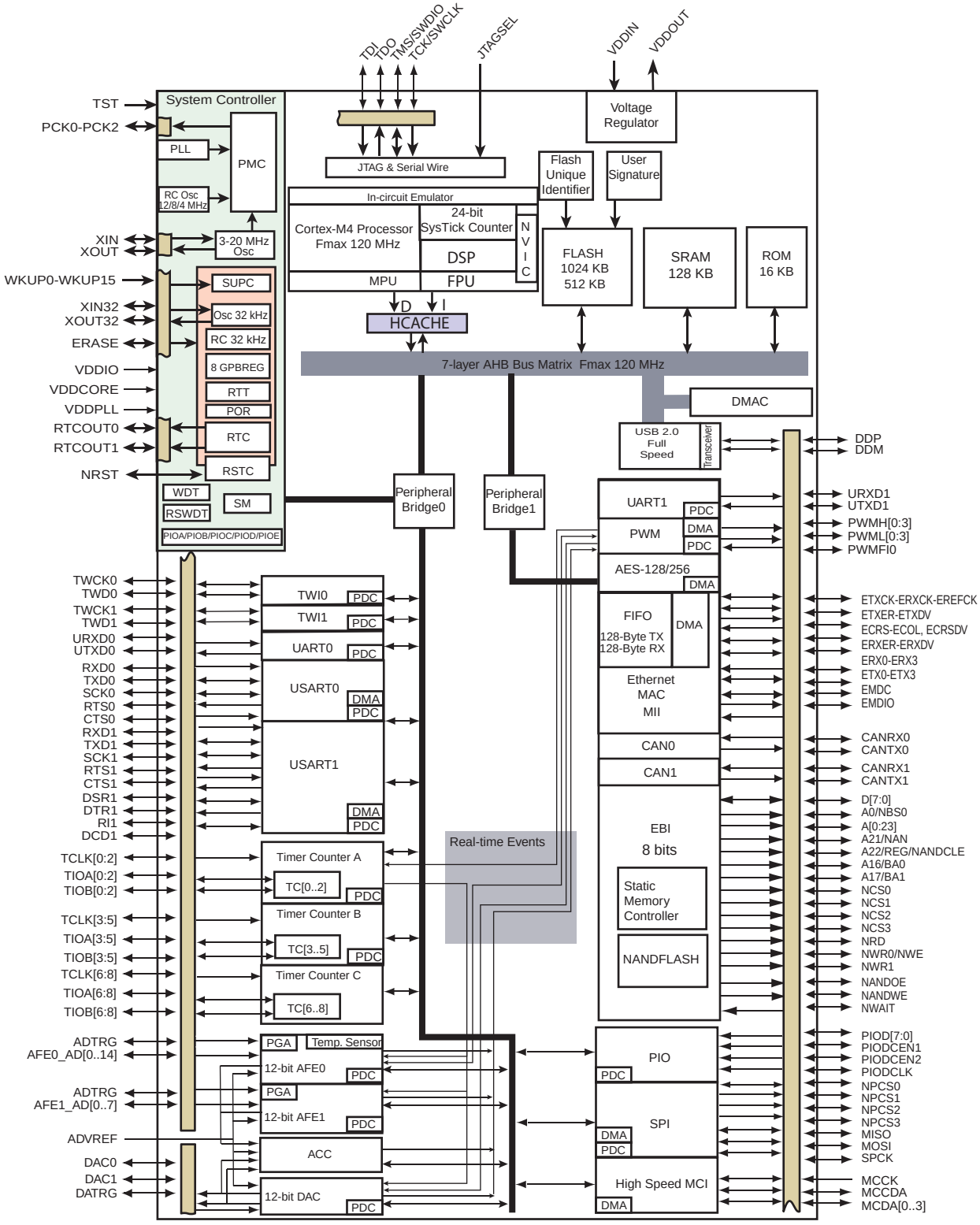


Figure 2-2. SAM4E 144-pin Block Diagram



3. Signal Description

Table 3-1 gives details on signal names classified by peripheral.

Table 3-1. Signal Description List

Signal Name	Function	Type	Active Level	Voltage Reference	Comments
Power Supplies					
VDDIO	Peripherals I/O Lines Power Supply	Power			1.62V to 3.6V
VDDIN	Voltage Regulator Input, DAC and Analog Comparator Power Supply	Power			1.62V to 3.6V(1)
VDDOUT	Voltage Regulator Output	Power			1.2V Output
VDDPLL	Oscillator and PLL Power Supply	Power			1.08 V to 1.32V
VDDCORE	Power the core, the embedded memories and the peripherals	Power			1.08V to 1.32V
GND	Ground	Ground			
Clocks, Oscillators and PLLs					
XIN	Main Oscillator Input	Input		VDDIO	Reset State: - PIO Input - Internal Pull-up disabled - Schmitt Trigger enabled(2)
XOUT	Main Oscillator Output	Output			
XIN32	Slow Clock Oscillator Input	Input			
XOUT32	Slow Clock Oscillator Output	Output			
PCK0 - PCK2	Programmable Clock Output	Output			Reset State: - PIO Input - Internal Pull-up enabled - Schmitt Trigger enabled(2)
Real-time Clock					
RTCOUT0	Programmable RTC waveform output	Output		VDDIO	Reset State: - PIO Input - Internal Pull-up enabled - Schmitt Trigger enabled(2)
RTCOUT1	Programmable RTC waveform output	Output			
Serial Wire/JTAG Debug Port - SWJ-DP					
TCK/SWCLK	Test Clock/Serial Wire Clock	Input		VDDIO	Reset State: - SWJ-DP Mode - Internal Pull-up disabled(3) - Schmitt Trigger enabled(2)
TDI	Test Data In	Input			
TDO/TRACESWO	Test Data Out / Trace Asynchronous Data Out	Output			
TMS/SWDIO	Test Mode Select /Serial Wire Input/Output	Input / I/O			
JTAGSEL	JTAG Selection	Input	High		Permanent Internal Pull-down
Flash Memory					
ERASE	Flash and NVM Configuration Bits Erase Command	Input	High	VDDIO	Reset State: - Erase Input - Internal Pull-down enabled - Schmitt Trigger enabled(2)

Table 3-1. Signal Description List

Signal Name	Function	Type	Active Level	Voltage Reference	Comments
Reset/Test					
NRST	Synchronous Microcontroller Reset	I/O	Low	VDDIO	Permanent Internal Pull-up
TST	Test Select	Input			Permanent Internal Pull-down
Universal Asynchronous Receiver Transceiver - UARTx					
URXDx	UART Receive Data	Input			
UTXDx	UART Transmit Data	Output			
PIO Controller - PIOA - PIOB - PIOC- PIOD - PIOE					
PA0 - PA31	Parallel IO Controller A	I/O		VDDIO	Reset State: - PIO or System IOs(4) - Internal Pull-up enabled - Schmitt Trigger enabled(2)
PB0 - PB14	Parallel IO Controller B	I/O			
PC0 - PC31	Parallel IO Controller C	I/O			
PD0 - PD31	Parallel IO Controller D	I/O			Reset State: - PIO or System IOs(4) - Internal Pull-up enabled - Schmitt Trigger enabled(2)
PE0 - PE5	Parallel IO Controller E	I/O			
PIO Controller - Parallel Capture Mode					
PIODC0-PIODC7	Parallel Capture Mode Data	Input		VDDIO	
PIODCCLK	Parallel Capture Mode Clock	Input			
PIODCEN1-2	Parallel Capture Mode Enable	Input			
High Speed Multimedia Card Interface - HSMCI					
MCCK	Multimedia Card Clock	I/O			
MCCDA	Multimedia Card Slot A Command	I/O			
MCDA0 - MCDA3	Multimedia Card Slot A Data	I/O			
Universal Synchronous Asynchronous Receiver Transmitter USARTx					
SCKx	USARTx Serial Clock	I/O			
TXDx	USARTx Transmit Data	I/O			
RXDx	USARTx Receive Data	Input			
RTSx	USARTx Request To Send	Output			
CTSx	USARTx Clear To Send	Input			
DTR1	USART1 Data Terminal Ready	I/O			
DSR1	USART1 Data Set Ready	Input			
DCD1	USART1 Data Carrier Detect	Output			
RI1	USART1 Ring Indicator	Input			
Timer/Counter - TC					
TCLKx	TC Channel x External Clock Input	Input			
TIOAx	TC Channel x I/O Line A	I/O			
TIOBx	TC Channel x I/O Line B	I/O			

Table 3-1. Signal Description List

Signal Name	Function	Type	Active Level	Voltage Reference	Comments
Serial Peripheral Interface - SPI					
MISO	Master In Slave Out	I/O			
MOSI	Master Out Slave In	I/O			
SPCK	SPI Serial Clock	I/O			
SPI_NPCS0	SPI Peripheral Chip Select 0	I/O	Low		
SPI_NPCS1 - SPI_NPCS3	SPI Peripheral Chip Select	Output	Low		
Two-Wire Interface - TWIx					
TWDx	TWIx Two-wire Serial Data	I/O			
TWCKx	TWIx Two-wire Serial Clock	I/O			
Analog					
ADVREF	ADC, DAC and Analog Comparator Reference	Analog			
12-bit Analog-Front-End - AFEx					
AFE0_AD0-AFE0_AD14	Analog Inputs	Analog, Digital			
AFE1_AD0-AFE1_AD7	Analog Inputs	Analog, Digital			
ADTRG	Trigger	Input		VDDIO	
12-bit Digital-to-Analog Converter - DAC					
DAC0 - DAC1	Analog output	Analog, Digital			
DACTRG	DAC Trigger	Input		VDDIO	
Fast Flash Programming Interface - FFPI					
PGMEN0-PGMEN2	Programming Enabling	Input		VDDIO	
PGMM0-PGMM3	Programming Mode	Input		VDDIO	
PGMD0-PGMD15	Programming Data	I/O			
PGMRDY	Programming Ready	Output	High		
PGMNVALID	Data Direction	Output	Low		
PGMNOE	Programming Read	Input	Low		
PGMCK	Programming Clock	Input			
PGMNCMD	Programming Command	Input	Low		
External Bus Interface					
D0 - D7	Data Bus	I/O			
A0 - A23	Address Bus	Output			
NWAIT	External Wait Signal	Input	Low		
Static Memory Controller - SMC					
NCS0 - NCS3	Chip Select Lines	Output	Low		
NRD	Read Signal	Output	Low		

Table 3-1. Signal Description List

Signal Name	Function	Type	Active Level	Voltage Reference	Comments
NWE	Write Enable	Output	Low		
NAND Flash Logic					
NANDOE	NAND Flash Output Enable	Output	Low		
NANDWE	NAND Flash Write Enable	Output	Low		
Pulse Width Modulation Controller- PWMC					
PWMH	PWM Waveform Output High for channel x	Output			
PWML	PWM Waveform Output Low for channel x	Output			Only output in complementary mode when dead time insertion is enabled.
PWMFI0	PWM Fault Input	Input			
Ethernet MAC 10/100 -EMAC					
GREFCK	Reference Clock	Input			
GTXCK	Transmit Clock	Input			
GRXCK	Receive Clock	Input			
GTXEN	Transmit Enable	Output			
GTX0 - GTX3	Transmit Data	Output			
GTXER	Transmit Coding Error	Output			
GRXDV	Receive Data Valid	Input			
GRX0 - GRX3	Receive Data	Input			
GRXER	Receive Error	Input			
GCRS	Carrier Sense	Input			
GCOL	Collision Detected	Input			
GMDC	Management Data Clock	Output			
GMDIO	Management Data Input/Output	I/O			
Controller Area Network-CAN (x=[0:1])					
CANRXx	CAN Receive	Input			
CANTXx	CAN Transmit	Output			
USB Full Speed Device					
DDM	DDM USB Full Speed Data -	Analog, Digital			Reset State: - USB Mode - Internal Pull-down(1)
DDP	DDP USB Full Speed Data +				Reset State: - USB Mode - Internal Pull-down(1)

Notes:
1. See “Typical Powering Schematics” section of this datasheet for restrictions on voltage range of Analog Cells.
2. Schmitt Triggers can be disabled through PIO registers.
3. TDO pin is set in input mode when the Cortex-M4 Core is not in debug mode. Thus the internal pull-up corresponding to this PIO line must be enabled to avoid current consumption due to floating input.
4. Some PIO lines are shared with System I/Os.

4. Package and Pinout

The SAM4E is available in TFBGA100, LFBGA144, LQFP100, and LQFP144 and packages. These packages respects the recommendations of the NEMI User Group.

4.1 100-ball TFBGA Package and Pinout

4.1.1 100-ball TFBGA Package Drawing

The 100-ball TFBGA package has a 0.8 mm ball pitch and respects Green Standards.

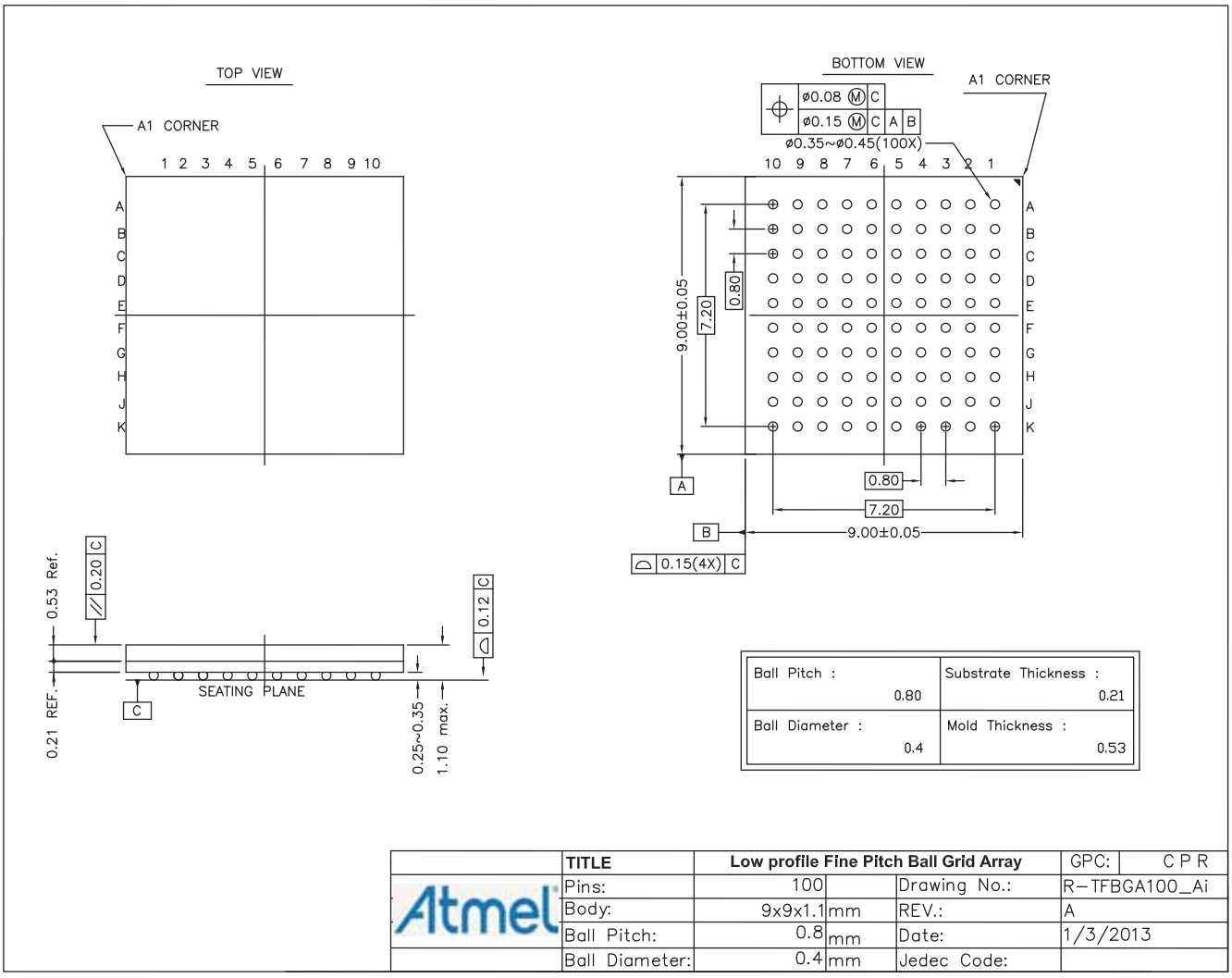


Table 4-1. Device and TFBGA Package Maximum Weight (Preliminary)

SAM4E	150	mg

Table 4-2. TFBGA Package Reference

JEDEC Drawing Reference	MO-275-DDAC-2
JESD97 Classification	e8

Table 4-3. TFBGA Package Characteristics

Moisture Sensitivity Level	3

4.1.2 100-ball TFBGA Pinout

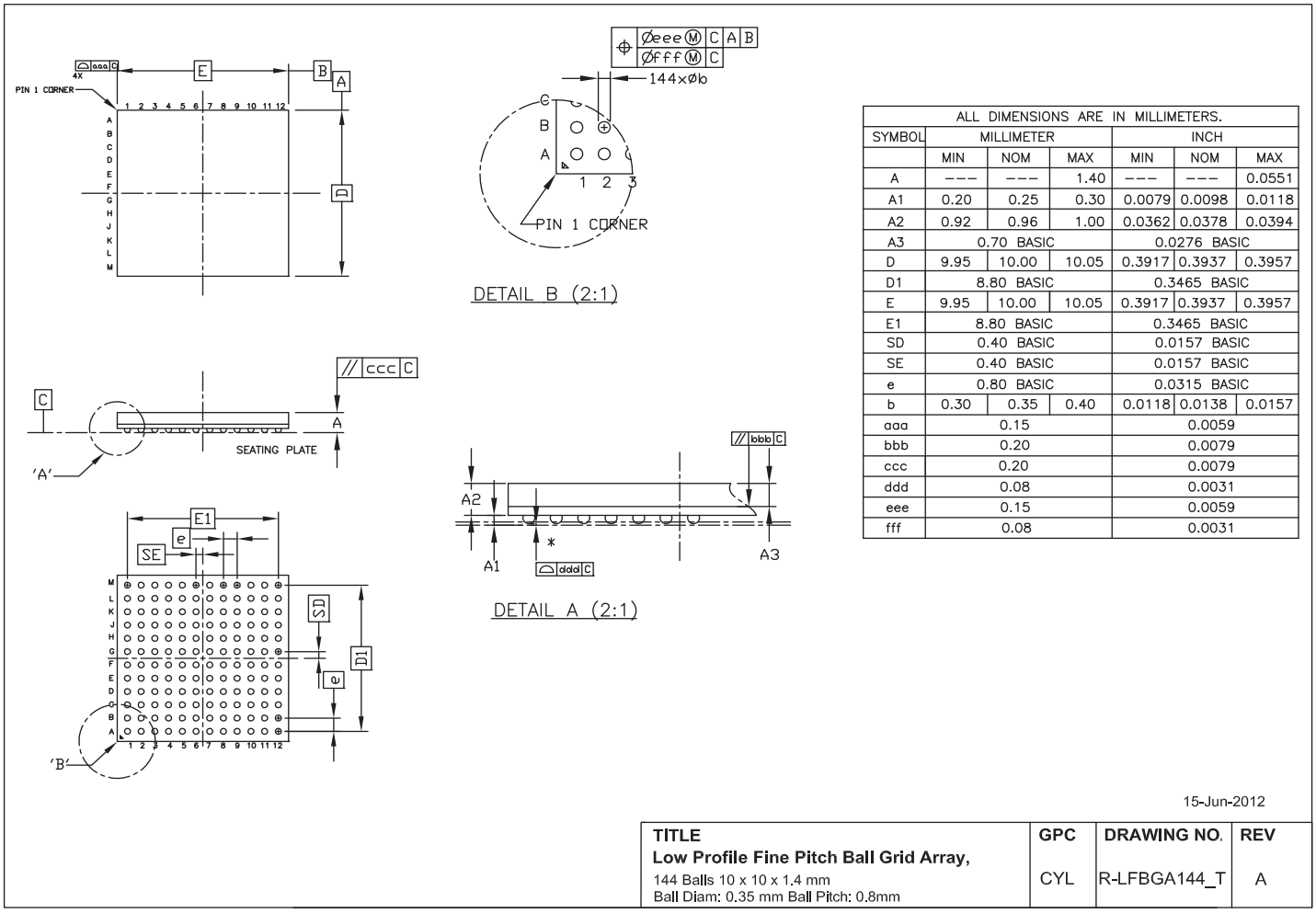
Table 4-4. SAM4E 100-ball TFBGA Pinout

A1	PB9	C6	PD29	F1	PA19/PGMD11	H6	PA14/PGMD6
A2	PB8	C7	PA30	F2	PA20/PGMD12	H7	PA25
A3	PB14	C8	PB5	F3	PD23	H8	PA27
A4	PB10	C9	PD10	F4	GNDIO	H9	PA5/PGMN1
A5	PD4	C10	PA1/PGMRDY	F5	GNDCORE	H10	PA4/PGMN0
A6	PD7	D1	ADVREF	F6	GNDIO	J1	PA21/PGMD13
A7	PA31	D2	PD1	F7	TST	J2	PA7/PGMN3
A8	PA6/PGMN2	D3	GNDCORE	F8	PB12	J3	PA22/PGMD14
A9	PA28	D4	GNDCORE	F9	PA3/PGMNVALID	J4	PD22
A10	JTAGSEL	D5	PD5	F10	PD14	J5	PA16/PGMD8
B1	PD31	D6	VDDCORE	G1	PA17/PGMD9	J6	PA15/PGMD7
B2	PB13	D7	VDDCORE	G2	PA18/PGMD10	J7	PD28
B3	VDDPLL	D8	PA0/PGMNCMD	G3	PD26	J8	PA11/PGMD3
B4	PB11	D9	PD11	G4	PD24	J9	PA9/PGMD1
B5	PD3	D10	PA2/PGMNOE	G5	PA13/PGMD5	J10	PD17
B6	PD6	E1	PB0	G6	VDDCORE	K1	PD30
B7	PD8	E2	PB1	G7	VDDIO	K2	PA8/PGMD0
B8	PD9	E3	PD2	G8	PB6	K3	PD20
B9	PB4	E4	GNDANA	G9	PD16	K4	PD19
B10	PD15	E5	VDDIO	G10	NRST	K5	PA23/PGMD15
C1	PD0	E6	VDDIO	H1	PB2	K6	PD18
C2	VDDIN	E7	GNDIO	H2	PB3	K7	PA24
C3	VDDOUT	E8	PD13	H3	PD25	K8	PA26
C4	GNDPLL	E9	PB7	H4	PD27	K9	PA10/PGMD2
C5	PA29	E10	PD12	H5	PD21	K10	PA12/PGMD4

4.2 144-ball LFBGA Package and Pinout

4.2.1 144-ball LFBGA Package Outline

The 144-ball LFBGA package has a 0.8 mm ball pitch and respects Green Standards.



ALL DIMENSIONS ARE IN MILLIMETERS.						
SYMBOL	MILLIMETER			INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	---	---	1.40	---	---	0.0551
A1	0.20	0.25	0.30	0.0079	0.0098	0.0118
A2	0.92	0.96	1.00	0.0362	0.0378	0.0394
A3	0.70 BASIC			0.0276 BASIC		
D	9.95	10.00	10.05	0.3917	0.3937	0.3957
D1	8.80 BASIC			0.3465 BASIC		
E	9.95	10.00	10.05	0.3917	0.3937	0.3957
E1	8.80 BASIC			0.3465 BASIC		
SD	0.40 BASIC			0.0157 BASIC		
SE	0.40 BASIC			0.0157 BASIC		
e	0.80 BASIC			0.0315 BASIC		
b	0.30	0.35	0.40	0.0118	0.0138	0.0157
aaa	0.15			0.0059		
bbb	0.20			0.0079		
ccc	0.20			0.0079		
ddd	0.08			0.0031		
eee	0.15			0.0059		
fff	0.08			0.0031		

Table 4-5. Device and LFBGA Package Maximum Weight (Preliminary)

SAM4E	200	mg

Table 4-6. LFBGA Package Reference

JEDEC Drawing Reference	MS-275-EEAD-1
JESD97 Classification	e8

Table 4-7. LFBGA Package Characteristics

Moisture Sensitivity Level	3

4.2.2 144-ball LFBGA Pinout

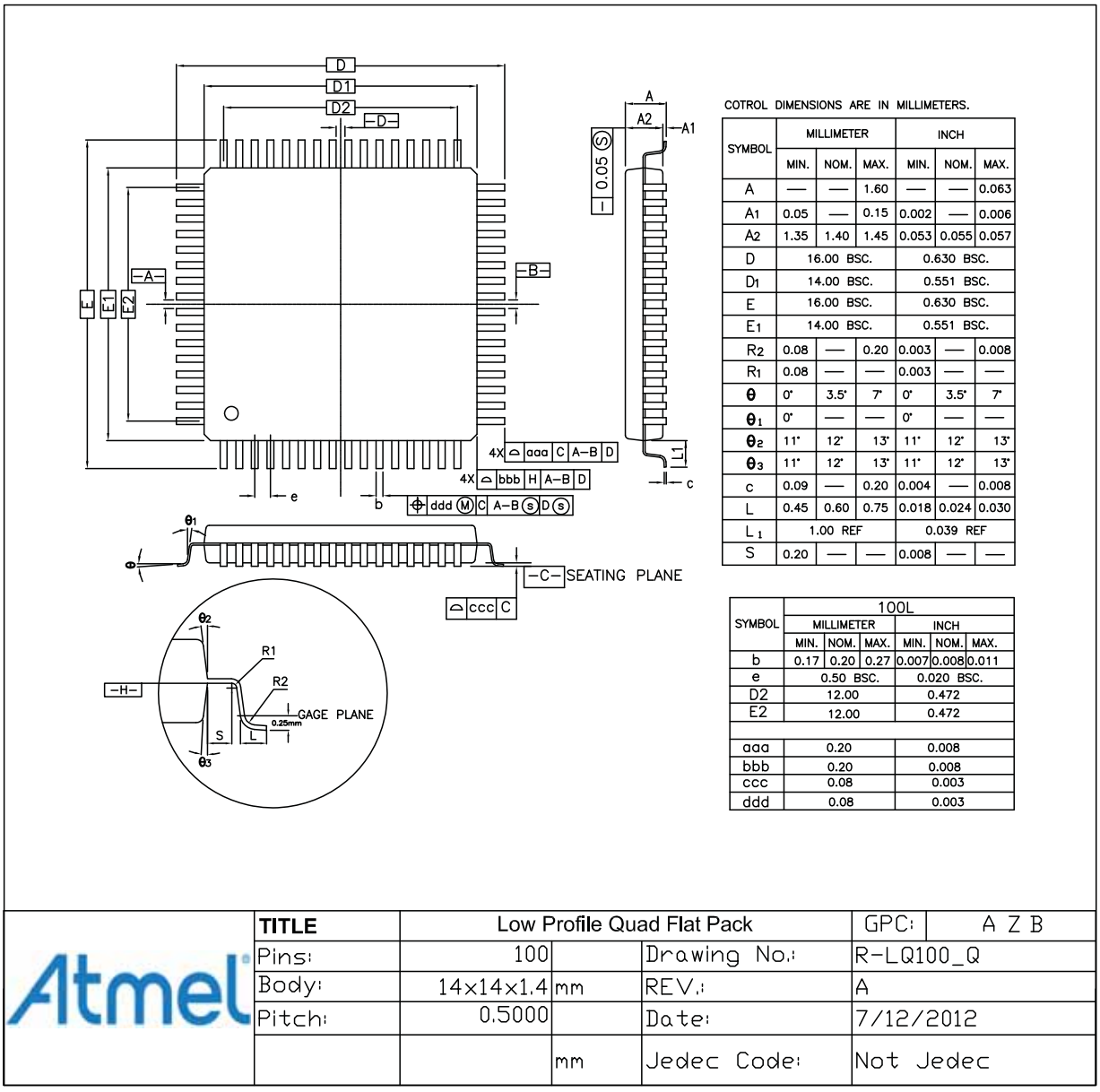
Table 4-8. SAM4E 144-ball LFBGA Pinout

A1	PE1	D1	ADVREF	G1	PC15	K1	PE4
A2	PB9	D2	GNDANA	G2	PC13	K2	PA21/PGMD13
A3	PB8	D3	PD31	G3	PB1	K3	PA22/PGMD14
A4	PB11	D4	PD0	G4	GNDIO	K4	PC2
A5	PD2	D5	GNDPLL	G5	GNDIO	K5	PA16/PGMD8
A6	PA29	D6	PD4	G6	GNDIO6	K6	PA14/PGMD6
A7	PC21	D7	PD5	G7	GNDCORE	K7	PC6
A8	PD6	D8	PC19	G8	VDDIO	K8	PA25
A9	PC20	D9	PD9	G9	PD13	K9	PD20
A10	PA30	D10	PD29	G10	PD12	K10	PD28
A11	PD15	D11	PC16	G11	PC9	K11	PD16
A12	PB4	D12	PA1/PGMRDY	G12	PB12	K12	PA4/PGMN0
B1	PE2	E1	PC31	H1	PA19/PGMD11	L1	PE5
B2	PB13	E2	PC27	H2	PA18/PGMD10	L2	PA7/PGMN3
B3	VDDPLL	E3	PE3	H3	PA20/PGMD12	L3	PC3
B4	PB10	E4	PC0	H4	PB0	L4	PA23/PGMD15
B5	PD1	E5	GNDCORE	H5	VDDCORE	L5	PA15/PGMD7
B6	PC24	E6	GNDCORE	H6	VDDIO	L6	PD26
B7	PD3	E7	VDDIO	H7	VDDIO	L7	PA24
B8	PD7	E8	VDDCORE	H8	VDDCORE	L8	PC5
B9	PA6/PGMN2	E9	PD8	H9	PD21	L9	PA10/PGMD2
B10	PC18	E10	PC14	H10	PD14	L10	PA12/PGMD4
B11	JTAGSEL	E11	PD11	H11	TEST	L11	PD17
B12	PC17	E12	PA2/PGMNOE	H12	NRST	L12	PC28
C1	VDDIN	F1	PC30	J1	PA17/PGMD9	M1	PD30
C2	PE0	F2	PC26	J2	PB2	M1	PA8/PGMD0
C3	VDDOUT	F3	PC29	J3	PB3	M3	PA13/PGMD5
C4	PB14	F4	PC12	J4	PC1	M4	PC7
C5	PC25	F5	GNDIO	J5	PC4	M5	PD25
C6	PC23	F6	GNDIO	J6	PD27	M6	PD24
C7	PC22	F7	GNDCORE	J7	VDDCORE	M7	PD23
C8	PA31	F8	VDDIO	J8	PA26	M8	PD22
C9	PA28	F9	PB7	J9	PA11/PGMD3	M9	PD19
C10	PB5	F10	PC10	J10	PA27	M10	PD18
C11	PA0/PGMNCMD	F11	PC11	J11	PB6	M11	PA5/PGMN1
C12	PD10	F12	PA3/PGMNVALID	J12	PC8	M12	PA9/PGMD1

4.3 100-lead LQFP Package and Pinout

4.3.1 100-lead LQFP Package Outline

The 100-lead LQFP package has a 0.5 mm ball pitch and respects Green Standards.



COTROL DIMENSIONS ARE IN MILLIMETERS.

SYMBOL	MILLIMETER			INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	—	—	1.60	—	—	0.063
A1	0.05	—	0.15	0.002	—	0.006
A2	1.35	1.40	1.45	0.053	0.055	0.057
D	16.00 BSC.			0.630 BSC.		
D1	14.00 BSC.			0.551 BSC.		
E	16.00 BSC.			0.630 BSC.		
E1	14.00 BSC.			0.551 BSC.		
R2	0.08	—	0.20	0.003	—	0.008
R1	0.08	—	—	0.003	—	—
θ	0°	3.5°	7°	0°	3.5°	7°
θ1	0°	—	—	0°	—	—
θ2	11°	12°	13°	11°	12°	13°
θ3	11°	12°	13°	11°	12°	13°
c	0.09	—	0.20	0.004	—	0.008
L	0.45	0.60	0.75	0.018	0.024	0.030
L1	1.00 REF			0.039 REF		
S	0.20	—	—	0.008	—	—

SYMBOL	100L					
	MILLIMETER			INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
b	0.17	0.20	0.27	0.007	0.008	0.011
e	0.50 BSC.			0.020 BSC.		
D2	12.00			0.472		
E2	12.00			0.472		
aaa	0.20			0.008		
bbb	0.20			0.008		
ccc	0.08			0.003		
ddd	0.08			0.003		

Atmel	TITLE	Low Profile Quad Flat Pack		GPC:	A Z B
	Pins:	100		Drawing No.:	R-LQ100_Q
	Body:	14x14x1.4	mm	REV.:	A
	Pitch:	0.5000		Date:	7/12/2012
			mm	Jedec Code:	Not Jedec

Table 4-9. Device and LQFP Package Maximum Weight (Preliminary)

SAM4E	740	mg

Table 4-10. LQFP Package Reference

JEDEC Drawing Reference	MS-026
JESD97 Classification	e3

Table 4-11. LQFP Package Characteristics

Moisture Sensitivity Level	3

4.3.2 100-lead LQFP Pinout

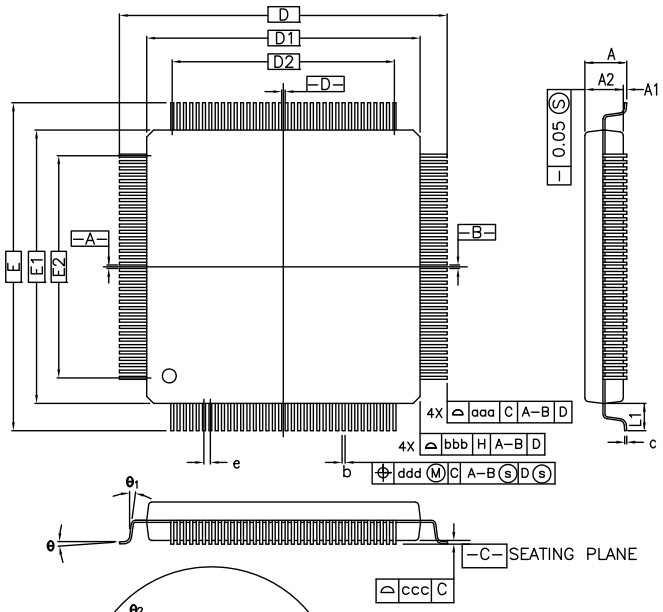
Table 4-12. SAM4E 100-lead LQFP Pinout

1	PD0	26	PA22/PGMD14	51	PD28	76	PD29
2	PD31	27	PA13/PGMD5	52	PA5/PGMN1	77	PB5
3	GND	28	VDDIO	53	PD17	78	PD9
4	VDDOUT	29	GND	54	PA9/PGMD1	79	PA28
5	VDDIN	30	PA16/PGMD8	55	PA4/PGMN0	80	PD8
6	GND	31	PA23/PGMD15	56	PD16	81	PA6/PGMN2
7	GND	32	PD27	57	PB6	82	PA30
8	GND	33	PA15/PGMD7	58	NRST	83	PA31
9	ADVREF	34	PA14/PGMD6	59	PD14	84	PD7
10	GND	35	PD25	60	TST	85	PD6
11	PB1	36	PD26	61	PB12	86	VDDCORE
12	PB0	37	PD24	62	PD13	87	PD5
13	PA20/PGMD12	38	PA24	63	PB7	88	PD4
14	PA19/PGMD11	39	PD23	64	PA3/PGMNVALID	89	PD3
15	PA18/PGMD10	40	PA25	65	PD12	90	PA29
16	PA17/PGMD9	41	PD22	66	PA2/PGMNOE	91	PD2
17	PB2	42	PA26	67	GND	92	PD1
18	VDDCORE	43	PD21	68	VDDIO	93	VDDIO
19	VDDIO	44	PA11/PGMD3	69	PD11	94	PB10
20	PB3	45	PD20	70	PA1/PGMRDY	95	PB11
21	PA21/PGMD13	46	PA10/PGMD2	71	PD10	96	VDDPLL
22	VDDCORE	47	PD19	72	PA0	97	PB14
23	PD30	48	PA12/PGMD4	73	JTAGSEL	98	PB8
24	PA7/PGMN3	49	PD18	74	PB4	99	PB9
25	PA8/PGMD0	50	PA27	75	PD15	100	PB13

4.4 144-lead LQFP Package and Pinout

4.4.1 144-lead LQFP Package Outline

The 144-lead LQFP package has a 0.5 mm ball pitch and respects Green Standards.



COTROL DIMENSIONS ARE IN MILLIMETERS.

SYMBOL	MILLIMETER			INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	—	—	1.60	—	—	0.063
A1	0.05	—	0.15	0.002	—	0.006
A2	1.35	1.40	1.45	0.053	0.055	0.057
D	22.00 BSC.			0.866 BSC.		
D1	20.00 BSC.			0.787 BSC.		
E	22.00 BSC.			0.866 BSC.		
E1	20.00 BSC.			0.787 BSC.		
R2	0.08	—	0.20	0.003	—	0.008
R1	0.08	—	—	0.003	—	—
θ	0°	3.5°	7°	0°	3.5°	7°
θ1	0°	—	—	0°	—	—
θ2	11°	12°	13°	11°	12°	13°
θ3	11°	12°	13°	11°	12°	13°
c	0.09	—	0.20	0.004	—	0.008
L	0.45	0.60	0.75	0.018	0.024	0.030
L1	1.00 REF			0.039 REF		
S	0.20	—	—	0.008	—	—

SYMBOL	144L					
	MILLIMETER			INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
b	0.17	0.20	0.27	0.007	0.008	0.011
e	0.50 BSC.			0.020 BSC.		
D2	17.50			0.689		
E2	17.50			0.689		
aaa	0.20			0.008		
bbb	0.20			0.008		
ccc	0.08			0.003		
ddd	0.08			0.003		

NOTES :

1. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PER SIDE. D1 AND E1 ARE MAXIMUN PLASTIC BODY SIZE DIMENSIONS INCLUDING MOLD MISMATCH.
2. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED THE MAXIMUM b DIMENSION BY MORE THAN 0.08mm. DAMBAR CAN NOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSION AND AN ADJACENT LEAD IS 0.07mm FOR 0.4mm and 0.5mm PITCH PACKAGES.
3. ALL DIMENSION OF 160L WERE BASE ON THOSE OF 176L SINCE THEY ARE NOT MENTIONED IN JEDEC SPEC MS-026.

	TITLE	Thin Quad Flat Pack (LQFP)		GPC:	A E
Atmel	Pins:	144		Drawing No.:	R-LQ144_N
	Body:	20x20x1.4	mm	REV.:	A
	Foot Print:	0.2	mm	Date:	11/6/2012
	Pitch:	0.5	mm	Jedec Code:	MS-026

Table 4-13. Device and LQFP Package Maximum Weight (Preliminary)

SAM4E	900	mg

Table 4-14. LQFP Package Reference

JEDEC Drawing Reference	MS-026-C
JESD97 Classification	e3

Table 4-15. LQFP Package Characteristics

Moisture Sensitivity Level	3

4.4.2 144-lead LQFP Pinout

Table 4-16. SAM4E 144-lead LQFP Pinout

1	PD0	37	PA22/PGMD14	73	PA5/PGMN1	109	PB5
2	PD31	38	PC1	74	PD17	110	PD9
3	VDDOUT	39	PC2	75	PA9/PGMD1	111	PC18
4	PE0	40	PC3	76	PC28	112	PA28
5	VDDIN	41	PC4	77	PA4/PGMN0	113	PD8
6	PE1	42	PA13/PGMD5	78	PD16	114	PA6/PGMN2
7	PE2	43	VDDIO	79	PB6	115	GND
8	GND	44	GND	80	VDDIO	116	PA30
9	ADVREFP	45	PA16/PGMD8	81	VDDCORE	117	PC19
10	PE3	46	PA23/PGMD15	82	PC8	118	PA31
11	PC0	47	PD27	83	NRST	119	PD7
12	PC27	48	PC7	84	PD14	120	PC20
13	PC26	49	PA15/PGMD7	85	TEST	121	PD6
14	PC31	50	VDDCORE	86	PC9	122	PC21
15	PC30	51	PA14/PGMD6	87	PB12	123	VDDCORE
16	PC29	52	PD25	88	PD13	124	PC22
17	PC12	53	PD26	89	PB7	125	PD5
18	PC15	54	PC6	90	PC10	126	PD4
19	PC13	55	PD24	91	PA3	127	PC23
20	PB1	56	PA24	92	PD12	128	PD3
21	PB0	57	PD23	93	PA2	129	PA29
22	PA20/PGMD12	58	PC5	94	PC11	130	PC24
23	PA19/PGMD11	59	PA25	95	GND	131	PD2
24	PA18/PGMD10	60	PD22	96	VDDIO	132	PD1
25	PA17/PGMD9	61	GND	97	PC14	133	PC25
26	PB2	62	PA26	98	PD11	134	VDDIO
27	PE4	63	PD21	99	PA1	135	GND
28	PE5	64	PA11/PGMD3	100	PC16	136	PB10
29	VDDCORE	65	PD20	101	PD10	137	PB11
30	VDDIO	66	PA10/PGMD2	102	PA0	138	GND
31	PB3	67	PD19	103	PC17	139	VDDPLL
32	PA21/PGMD13	68	PA12/PGMD4	104	JTAGSEL	140	PB14
33	VDDCORE	69	PD18	105	PB4	141	PB8
34	PD30	70	PA27	106	PD15	142	PB9
35	PA7/PGMN3	71	PD28	107	VDDCORE	143	VDDIO
36	PA8/PGMD0	72	VDDIO	108	PD29	144	PB13

5. Ordering Information

Table 5-1. Ordering Codes for SAM4E Devices

Ordering Code	MRL	Flash (Kbytes)	RAM (Kbytes)	Package	Conditioning	Package Type	Temperature Operating Range
ATSAM4E16EA-CU	A	1024	128	LFBGA144	Tray	Green	Industrial (-40°C to 85°C)
ATSAM4E16EA-CUR	A				Reel		
ATSAM4E16EA-AU	A			LQFP144	Tray		Industrial (-40°C to 85°C)
ATSAM4E16EA-AUR	A				Reel		
ATSAM4E16EA-AN	A			LQFP144	Tray		Industrial (-40°C to 105°C)
ATSAM4E16EA-ANR	A				Reel		
ATSAM4E16CA-CU	A			TFBGA100	Tray		Industrial (-40°C to 85°C)
ATSAM4E16CA-CUR	A				Reel		
ATSAM4E16CA-AU	A			LQFP100	Tray		Industrial (-40°C to 85°C)
ATSAM4E16CA-AUR	A				Reel		
ATSAM4E16CA-AN	A			LQFP100	Tray		Industrial (-40°C to 105°C)
ATSAM4E16CA-ANR	A				Reel		
ATSAM4E8EA-CU	A	512		LFBGA144	Tray		Industrial (-40°C to 85°C)
ATSAM4E8EA-CUR	A				Reel		
ATSAM4E8EA-AU	A			LQFP144	Tray		Industrial (-40°C to 85°C)
ATSAM4E8EA-AUR	A				Reel		
ATSAM4E8EA-AN	A			LQFP144	Tray		Industrial (-40°C to 105°C)
ATSAM4E8EA-ANR	A				Reel		
ATSAM4E8CA-CU	A			TFBGA100	Tray		Industrial (-40°C to 85°C)
ATSAM4E8CA-CUR	A				Reel		
ATSAM4E8CA-AU	A			LQFP100	Tray		Industrial (-40°C to 85°C)
ATSAM4E8CA-AUR	A				Reel		
ATSAM4E8CA-AN	A			LQFP100	Tray		Industrial (-40°C to 105°C)
ATSAM4E8CA-ANR	A				Reel		

Revision History

In the tables that follow, the most recent version of the document is referenced first.

"rfo" indicates changes requested during the document review and approval loop.

Doc. Rev	Comments	Change Request Ref.
11157CS	**Introduction** In "Features" : - added information on Two-wire Interface in Peripherals section and Wake-on-LAN for EMAC - changed operating temperature range to 105°C Updated Table 1-1 "Configuration Summary" with TWI informationIn Section 4. "Package and Pinout", added the FFPI signals to Table 4-1 "SAM4E 100-ball TFBGA Pinout", Table 4-2 "SAM4E 144-ball LFBGA Pinout", Table 4-3 "SAM4E 100-lead LQFP Pinout" and Table 4-4 "SAM4E 144-lead LQFP Pinout". Removed Section 7. "Processor and Architecture". Renumbered sections. Removed Sections 11-4 to 11-16. Table 5-1, "Ordering Codes for SAM4E Devices" updated with new ordering codes for parts at 105°C and for tape & reel	 rfo 8992 9045 rfo rfo rfo

Doc. Rev	Comments	Change Request Ref.
11157BS	Updated the document structure and added references to 100-ball TFBGA and 100-lead LQFP packages in: - Section 1. "Features" - Table 1-1 "Configuration Summary" - Figure 2-1 "SAM4E 100-pin Block Diagram" - Section 4.1 "100-ball TFBGA Package and Pinout" - Section 4.3 "100-lead LQFP Package and Pinout" - Section 5.1 "100-ball TFBGA Package Drawing" - Section 5.3 "100-lead LQFP Package Drawing" - Table 5-1 "Ordering Codes for SAM4E Devices" Updated the figure title and added Analog Comparator (ACC) and Reinforced Safety Watchdog Timer (RSWDT) blocks in Figure 2-2 "SAM4E 144-pin Block Diagram". Removed "AT91SAM" from the document title. Replaced "Cortex™" references with "Cortex®" in "Description" and further on in the entire document. Removed package dimension references in Section 4. "Package and Pinout".	8580 8605/rfo rfo rfo

Doc. Rev	Comments	Change Request Ref.
11157AS	Initial release.	

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