

## Features

- 180 MHz ARM926EJ-S™ ARM® Thumb® Processor
  - 8 KBytes Data Cache, 8 KBytes Instruction Cache, MMU
- Memories
  - 32-bit External Bus Interface supporting 4-bank SDRAM/LPSDR, Static Memories, CompactFlash, SLC NAND Flash with ECC
  - Two 4-kbyte internal SRAM, single-cycle access at system speed
  - One 32-kbyte internal ROM, embedding bootstrap routine
- Peripherals
  - ITU-R BT. 601/656 Image Sensor Interface
  - USB Device and USB Host with dedicated On-Chip Transceiver
  - 10/100 Mbps Ethernet MAC Controller
  - One High Speed Memory Card Host
  - Two Master/Slave Serial Peripheral Interfaces
  - Two Three-channel 32-bit Timer/Counters
  - One Synchronous Serial Controller
  - One Two-wire Interface
  - Four USARTs
  - Two UARTs
  - 4-channel 10-bit ADC
- System
  - 90 MHz six 32-bit layer AHB Bus Matrix
  - 22 Peripheral DMA Channels
  - Boot from NAND Flash, SDCard, DataFlash® or serial DataFlash
  - Reset Controller with On-Chip Power-on Reset
  - Selectable 32,768 Hz Low-Power and 3-20 MHz Main Oscillator
  - Internal Low-Power 32 kHz RC Oscillator
  - One PLL for the system and one PLL optimized for USB
  - Two Programmable External Clock Signals
  - Advanced Interrupt Controller and Debug Unit
  - Periodic Interval Timer, Watchdog Timer and Real Time Timer
- I/O
  - Three 32-bit Parallel Input/Output Controllers
  - 96 Programmable I/O Lines Multiplexed with up to Two Peripheral I/Os
- Package
  - 217-ball BGA, 0.8 mm pitch
  - 208-pin QFP, 0.5 mm pitch



## AT91 ARM Thumb Microcontrollers

### AT91SAM9260

## Summary



## 1. Description

The AT91SAM9260 is based on the integration of an ARM926EJ-S processor with fast ROM and RAM memories and a wide range of peripherals.

The AT91SAM9260 embeds an Ethernet MAC, one USB Device Port, and a USB Host controller. It also integrates several standard peripherals, such as the USART, SPI, TWI, Timer Counters, Synchronous Serial Controller, ADC and MultiMedia Card Interface.

The AT91SAM9260 is architected on a 6-layer matrix, allowing a maximum internal bandwidth of six 32-bit buses. It also features an External Bus Interface capable of interfacing with a wide range of memory devices.

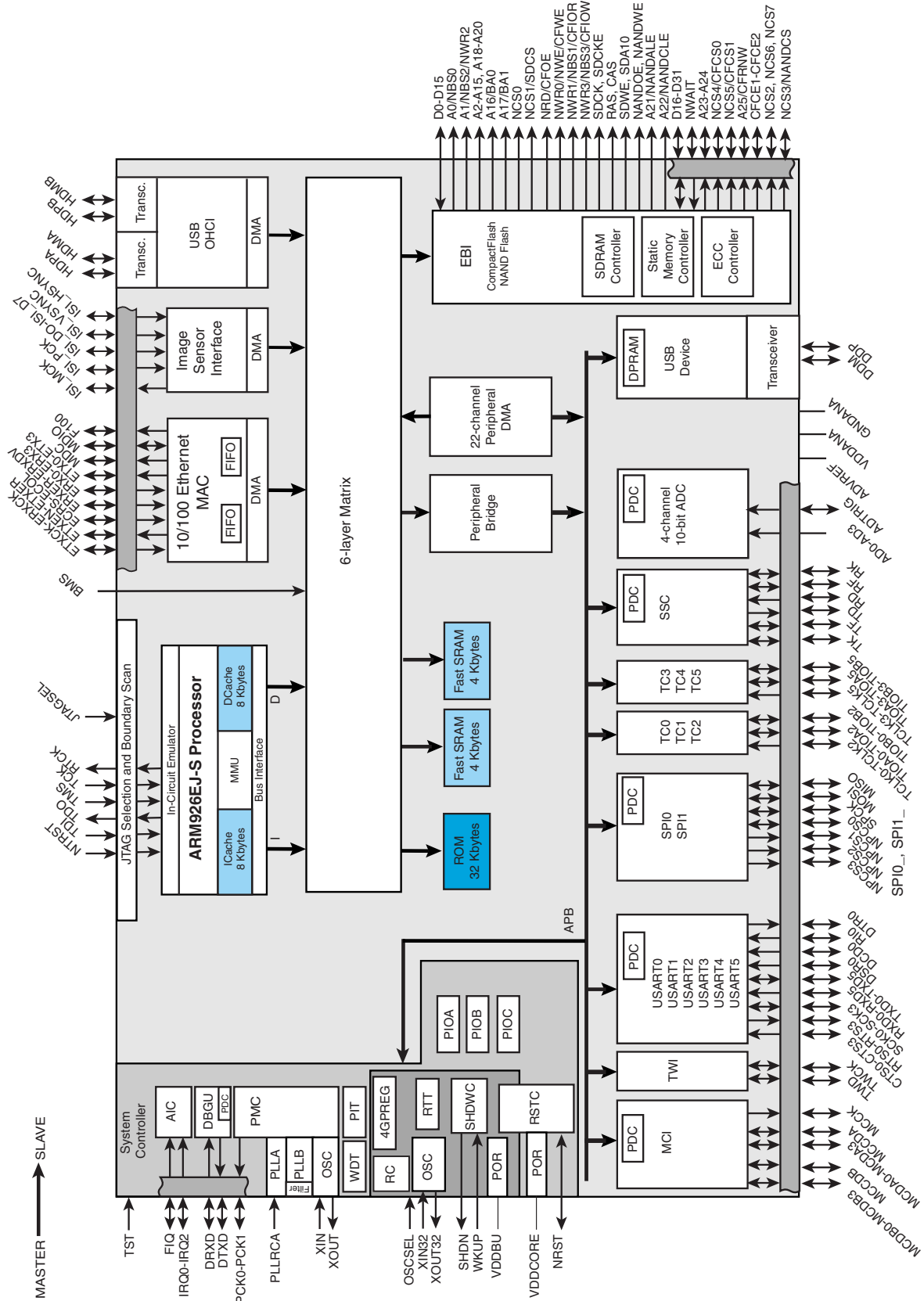
## 2. AT91SAM9260 Block Diagram

The block diagram shows all the features for the 217-LFBGA package. Some functions are not accessible in the 208-pin PQFP package and the unavailable pins are highlighted in [“Multiplexing on PIO Controller A” on page 33](#), [“Multiplexing on PIO Controller B” on page 34](#), [“Multiplexing on PIO Controller C” on page 35](#). The USB Host Port B is not available in the 208-pin package. [Table 2-1 on page 2](#) defines all the multiplexed and not multiplexed pins not available in the 208-PQFP package.

**Table 2-1.** Unavailable Signals in 208-lead PQFP Package

| PIO  | Peripheral A | Peripheral B |
|------|--------------|--------------|
| -    | HDPB         | -            |
| -    | HDMB         | -            |
| PA30 | SCK2         | RXD4         |
| PA31 | SCK0         | TXD4         |
| PB12 | TXD5         | ISI_D10      |
| PB13 | RXD5         | ISI_D11      |
| PC2  | AD2          | PCK1         |
| PC3  | AD3          | SPI1_NPCS3   |
| PC12 | IRQ0         | NCS7         |

Figure 2-1. AT91SAM9260 Block Diagram



### 3. Signal Description

**Table 3-1.** Signal Description List

| Signal Name                         | Function                           | Type   | Active Level | Comments   |
|-------------------------------------|------------------------------------|--------|--------------|--|
| <b>Power Supplies</b>               |                                    |        |              |  |
| VDDIOM                              | EBI I/O Lines Power Supply         | Power  |              | 1.65V to 1.95V or 3.0V to 3.6V                     |
| VDDIOP0                             | Peripherals I/O Lines Power Supply | Power  |              | 3.0V to 3.6V                                       |
| VDDIOP1                             | Peripherals I/O Lines Power Supply | Power  |              | 1.65V to 3.6V                                      |
| VDDDBU                              | Backup I/O Lines Power Supply      | Power  |              | 1.65V to 1.95V                                     |
| VDDANA                              | Analog Power Supply                | Power  |              | 3.0V to 3.6V                                       |
| VDDPLL                              | PLL Power Supply                   | Power  |              | 1.65V to 1.95V                                     |
| VDDCORE                             | Core Chip Power Supply             | Power  |              | 1.65V to 1.95V                                     |
| GND                                 | Ground                             | Ground |              |  |
| GNDPLL                              | PLL and Oscillator Ground          | Ground |              |  |
| GNDANA                              | Analog Ground                      | Ground |              |  |
| GNDDBU                              | Backup Ground                      | Ground |              |  |
| <b>Clocks, Oscillators and PLLs</b> |                                    |        |              |  |
| XIN                                 | Main Oscillator Input              | Input  |              |  |
| XOUT                                | Main Oscillator Output             | Output |              |  |
| XIN32                               | Slow Clock Oscillator Input        | Input  |              |  |
| XOUT32                              | Slow Clock Oscillator Output       | Output |              |  |
| OSCSEL                              | Slow Clock Oscillator Selection    | Input  |              | Accepts between 0V and VDDDBU.                     |
| PLLCA                               | PLL A Filter                       | Input  |              |  |
| PCK0 - PCK1                         | Programmable Clock Output          | Output |              |  |
| <b>Shutdown, Wakeup Logic</b>       |                                    |        |              |  |
| SHDN                                | Shutdown Control                   | Output |              | Driven at 0V only. Do not tie over VDDDBU.         |
| WKUP                                | Wake-up Input                      | Input  |              | Accepts between 0V and VDDDBU.                     |
| <b>ICE and JTAG</b>                 |                                    |        |              |  |
| NTRST                               | Test Reset Signal                  | Input  | Low          | Pull-up resistor                                   |
| TCK                                 | Test Clock                         | Input  |              | No pull-up resistor                                |
| TDI                                 | Test Data In                       | Input  |              | No pull-up resistor                                |
| TDO                                 | Test Data Out                      | Output |              |  |
| TMS                                 | Test Mode Select                   | Input  |              | No pull-up resistor                                |
| JTAGSEL                             | JTAG Selection                     | Input  |              | Pull-down resistor. Accepts between 0V and VDDDBU. |
| RTCK                                | Return Test Clock                  | Output |              |  |

**Table 3-1.** Signal Description List (Continued)

| Signal Name                                | Function                       | Type   | Active Level | Comments   |
|--|--------------------------------|--------|--------------|--|
| <b>Reset/Test</b>                          |                                |        |              |  |
| NRST                                       | Microcontroller Reset          | I/O    | Low          | Pull-up resistor   |
| TST  | Test Mode Select               | Input  |              | Pull-down resistor. Accepts between 0V and VDDBU.                                |
| BMS  | Boot Mode Select               | Input  |              | No pull-up resistor<br>BMS = 0 when tied to GND<br>BMS = 1 when tied to VDDIOP0. |
| <b>Debug Unit - DBGU</b>                   |                                |        |              |  |
| DRXD                                       | Debug Receive Data             | Input  |              |  |
| DTXD                                       | Debug Transmit Data            | Output |              |  |
| <b>Advanced Interrupt Controller - AIC</b> |                                |        |              |  |
| IRQ0 - IRQ2                                | External Interrupt Inputs      | Input  |              |  |
| FIQ  | Fast Interrupt Input           | Input  |              |  |
| <b>PIO Controller - PIOA - PIOB - PIOC</b> |                                |        |              |  |
| PA0 - PA31                                 | Parallel IO Controller A       | I/O    |              | Pulled-up input at reset   |
| PB0 - PB31                                 | Parallel IO Controller B       | I/O    |              | Pulled-up input at reset   |
| PC0 - PC31                                 | Parallel IO Controller C       | I/O    |              | Pulled-up input at reset   |
| <b>External Bus Interface - EBI</b>        |                                |        |              |  |
| D0 - D31                                   | Data Bus                       | I/O    |              | Pulled-up input at reset   |
| A0 - A25                                   | Address Bus                    | Output |              | 0 at reset   |
| NWAIT                                      | External Wait Signal           | Input  | Low          |  |
| <b>Static Memory Controller - SMC</b>      |                                |        |              |  |
| NCS0 - NCS7                                | Chip Select Lines              | Output | Low          |  |
| NWR0 - NWR3                                | Write Signal                   | Output | Low          |  |
| NRD  | Read Signal                    | Output | Low          |  |
| NWE  | Write Enable                   | Output | Low          |  |
| NBS0 - NBS3                                | Byte Mask Signal               | Output | Low          |  |
| <b>CompactFlash Support</b>                |                                |        |              |  |
| CFCE1 - CFCE2                              | CompactFlash Chip Enable       | Output | Low          |  |
| CFOE                                       | CompactFlash Output Enable     | Output | Low          |  |
| CFWE                                       | CompactFlash Write Enable      | Output | Low          |  |
| CFIOR                                      | CompactFlash IO Read           | Output | Low          |  |
| CFIOW                                      | CompactFlash IO Write          | Output | Low          |  |
| CFRNW                                      | CompactFlash Read Not Write    | Output |              |  |
| CFCS0 - CFCS1                              | CompactFlash Chip Select Lines | Output | Low          |  |



**Table 3-1.** Signal Description List (Continued)

| Signal Name   | Function                        | Type   | Active Level | Comments |
|---|---------------------------------|--------|--------------|----------|
| <b>NAND Flash Support</b>   |                                 |        |              |          |
| NANDCS  | NAND Flash Chip Select          | Output | Low          |          |
| NANDOE  | NAND Flash Output Enable        | Output | Low          |          |
| NANDWE  | NAND Flash Write Enable         | Output | Low          |          |
| NANDALE   | NAND Flash Address Latch Enable | Output | Low          |          |
| NANDCLE   | NAND Flash Command Latch Enable | Output | Low          |          |
| <b>SDRAM Controller</b>   |                                 |        |              |          |
| SDCK  | SDRAM Clock                     | Output |              |          |
| SDCKE   | SDRAM Clock Enable              | Output | High         |          |
| SDCS  | SDRAM Controller Chip Select    | Output | Low          |          |
| BA0 - BA1   | Bank Select                     | Output |              |          |
| SDWE  | SDRAM Write Enable              | Output | Low          |          |
| RAS - CAS   | Row and Column Signal           | Output | Low          |          |
| SDA10   | SDRAM Address 10 Line           | Output |              |          |
| <b>Multimedia Card Interface MCI</b>                                  |                                 |        |              |          |
| MCKK  | Multimedia Card Clock           | Output |              |          |
| MCCDA   | Multimedia Card Slot A Command  | I/O    |              |          |
| MCDA0 - MCDA3   | Multimedia Card Slot A Data     | I/O    |              |          |
| MCCDB   | Multimedia Card Slot B Command  | I/O    |              |          |
| MCDB0 - MCDB3   | Multimedia Card Slot B Data     | I/O    |              |          |
| <b>Universal Synchronous Asynchronous Receiver Transmitter USARTx</b> |                                 |        |              |          |
| 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  |              |          |
| DTR0  | USART0 Data Terminal Ready      | Output |              |          |
| DSR0  | USART0 Data Set Ready           | Input  |              |          |
| DCD0  | USART0 Data Carrier Detect      | Input  |              |          |
| RI0   | USART0 Ring Indicator           | Input  |              |          |
| <b>Synchronous Serial Controller - SSC</b>                            |                                 |        |              |          |
| TD  | SSC Transmit Data               | Output |              |          |
| RD  | SSC Receive Data                | Input  |              |          |
| TK  | SSC Transmit Clock              | I/O    |              |          |
| RK  | SSC Receive Clock               | I/O    |              |          |
| TF  | SSC Transmit Frame Sync         | I/O    |              |          |
| RF  | SSC Receive Frame Sync          | I/O    |              |          |

**Table 3-1.** Signal Description List (Continued)

| Signal Name                                | Function                          | Type   | Active Level | Comments                    |
|--|-----------------------------------|--------|--------------|-----------------------------|
| <b>Timer/Counter - TCx</b>                 |                                   |        |              |                             |
| 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    |              |                             |
| <b>Serial Peripheral Interface - SPIx_</b> |                                   |        |              |                             |
| SPIx_MISO                                  | Master In Slave Out               | I/O    |              |                             |
| SPIx_MOSI                                  | Master Out Slave In               | I/O    |              |                             |
| SPIx_SPCK                                  | SPI Serial Clock                  | I/O    |              |                             |
| SPIx_NPCS0                                 | SPI Peripheral Chip Select 0      | I/O    | Low          |                             |
| SPIx_NPCS1-SPIx_NPCS3                      | SPI Peripheral Chip Select        | Output | Low          |                             |
| <b>Two-Wire Interface</b>                  |                                   |        |              |                             |
| TWD  | Two-wire Serial Data              | I/O    |              |                             |
| TWCK                                       | Two-wire Serial Clock             | I/O    |              |                             |
| <b>USB Host Port</b>                       |                                   |        |              |                             |
| HDPA                                       | USB Host Port A Data +            | Analog |              |                             |
| HDMA                                       | USB Host Port A Data -            | Analog |              |                             |
| HDPB                                       | USB Host Port B Data +            | Analog |              |                             |
| HDMB                                       | USB Host Port B Data +            | Analog |              |                             |
| <b>USB Device Port</b>                     |                                   |        |              |                             |
| DDM  | USB Device Port Data -            | Analog |              |                             |
| DDP  | USB Device Port Data +            | Analog |              |                             |
| <b>Ethernet 10/100</b>                     |                                   |        |              |                             |
| ETXCK                                      | Transmit Clock or Reference Clock | Input  |              | MII only, REFCK in RMII     |
| ERXCK                                      | Receive Clock                     | Input  |              | MII only                    |
| ETXEN                                      | Transmit Enable                   | Output |              |                             |
| ETX0-ETX3                                  | Transmit Data                     | Output |              | ETX0-ETX1 only in RMII      |
| ETXER                                      | Transmit Coding Error             | Output |              | MII only                    |
| ERXDV                                      | Receive Data Valid                | Input  |              | RXDV in MII , CRSDV in RMII |
| ERX0-ERX3                                  | Receive Data                      | Input  |              | ERX0-ERX1 only in RMII      |
| ERXER                                      | Receive Error                     | Input  |              |                             |
| ECRS                                       | Carrier Sense and Data Valid      | Input  |              | MII only                    |
| ECOL                                       | Collision Detect                  | Input  |              | MII only                    |
| EMDC                                       | Management Data Clock             | Output |              |                             |
| EMDIO                                      | Management Data Input/Output      | I/O    |              |                             |
| EF100                                      | Force 100Mbit/sec.                | Output | High         |                             |

**Table 3-1.** Signal Description List (Continued)

| Signal Name                        | Function                        | Type   | Active Level | Comments                          |
|------------------------------------|---------------------------------|--------|--------------|-----------------------------------|
| <b>Image Sensor Interface</b>      |                                 |        |              |                                   |
| ISI_D0-ISI_D11                     | Image Sensor Data               | Input  |              |                                   |
| ISI_MCK                            | Image Sensor Reference Clock    | Output |              | Provided by PCK1.                 |
| ISI_HSYNC                          | Image Sensor Horizontal Synchro | Input  |              |                                   |
| ISI_VSYNC                          | Image Sensor Vertical Synchro   | Input  |              |                                   |
| ISI_PCK                            | Image Sensor Data clock         | Input  |              |                                   |
| <b>Analog to Digital Converter</b> |                                 |        |              |                                   |
| AD0-AD3                            | Analog Inputs                   | Analog |              | Digital pulled-up inputs at reset |
| ADVREF                             | Analog Positive Reference       | Analog |              |                                   |
| ADTRG                              | ADC Trigger                     | Input  |              |                                   |



## 4. Package and Pinout

The AT91SAM9260 is available in two packages:

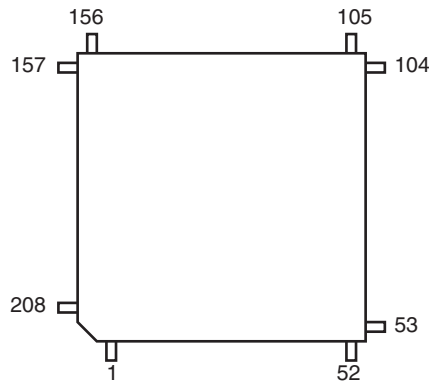
- 208-pin PQFP Green package (0.5mm pitch) ([Figure 4-1](#))
- 217-ball LFBGA Green package (0.8 mm ball pitch) ([Figure 4-2](#)).

### 4.1 208-pin PQFP Package Outline

[Figure 4-1](#) shows the orientation of the 208-pin PQFP package.

A detailed mechanical description is given in the section “AT91SAM9260 Mechanical Characteristics” of the product datasheet.

**Figure 4-1.** 208-pin PQFP Package



## 4.2 208-pin PQFP Pinout

**Table 4-1.** Pinout for 208-pin PQFP Package

| Pin | Signal Name | Pin | Signal Name   | Pin | Signal Name | Pin | Signal Name |
|-----|-------------|-----|---------------|-----|-------------|-----|-------------|
| 1   | PA24        | 53  | GND           | 105 | RAS         | 157 | ADVREF      |
| 2   | PA25        | 54  | DDM           | 106 | D0          | 158 | PC0         |
| 3   | PA26        | 55  | DDP           | 107 | D1          | 159 | PC1         |
| 4   | PA27        | 56  | PC13          | 108 | D2          | 160 | VDDANA      |
| 5   | VDDIOP0     | 57  | PC11          | 109 | D3          | 161 | PB10        |
| 6   | GND         | 58  | PC10          | 110 | D4          | 162 | PB11        |
| 7   | PA28        | 59  | PC14          | 111 | D5          | 163 | PB20        |
| 8   | PA29        | 60  | PC9           | 112 | D6          | 164 | PB21        |
| 9   | PB0         | 61  | PC8           | 113 | GND         | 165 | PB22        |
| 10  | PB1         | 62  | PC4           | 114 | VDDIOM      | 166 | PB23        |
| 11  | PB2         | 63  | PC6           | 115 | SDCK        | 167 | PB24        |
| 12  | PB3         | 64  | PC7           | 116 | SDWE        | 168 | PB25        |
| 13  | VDDIOP0     | 65  | VDDIOM        | 117 | SDCKE       | 169 | VDDIOP1     |
| 14  | GND         | 66  | GND           | 118 | D7          | 170 | GND         |
| 15  | PB4         | 67  | PC5           | 119 | D8          | 171 | PB26        |
| 16  | PB5         | 68  | NCS0          | 120 | D9          | 172 | PB27        |
| 17  | PB6         | 69  | CFOE/NRD      | 121 | D10         | 173 | GND         |
| 18  | PB7         | 70  | CFWE/NWE/NWR0 | 122 | D11         | 174 | VDDCORE     |
| 19  | PB8         | 71  | NANDOE        | 123 | D12         | 175 | PB28        |
| 20  | PB9         | 72  | NANDWE        | 124 | D13         | 176 | PB29        |
| 21  | PB14        | 73  | A22           | 125 | D14         | 177 | PB30        |
| 22  | PB15        | 74  | A21           | 126 | D15         | 178 | PB31        |
| 23  | PB16        | 75  | A20           | 127 | PC15        | 179 | PA0         |
| 24  | VDDIOP0     | 76  | A19           | 128 | PC16        | 180 | PA1         |
| 25  | GND         | 77  | VDDCORE       | 129 | PC17        | 181 | PA2         |
| 26  | PB17        | 78  | GND           | 130 | PC18        | 182 | PA3         |
| 27  | PB18        | 79  | A18           | 131 | PC19        | 183 | PA4         |
| 28  | PB19        | 80  | BA1/A17       | 132 | VDDIOM      | 184 | PA5         |
| 29  | TDO         | 81  | BA0/A16       | 133 | GND         | 185 | PA6         |
| 30  | TDI         | 82  | A15           | 134 | PC20        | 186 | PA7         |
| 31  | TMS         | 83  | A14           | 135 | PC21        | 187 | VDDIOP0     |
| 32  | VDDIOP0     | 84  | A13           | 136 | PC22        | 188 | GND         |
| 33  | GND         | 85  | A12           | 137 | PC23        | 189 | PA8         |
| 34  | TCK         | 86  | A11           | 138 | PC24        | 190 | PA9         |
| 35  | NTRST       | 87  | A10           | 139 | PC25        | 191 | PA10        |
| 36  | NRST        | 88  | A9            | 140 | PC26        | 192 | PA11        |
| 37  | RTCK        | 89  | A8            | 141 | PC27        | 193 | PA12        |
| 38  | VDDCORE     | 90  | VDDIOM        | 142 | PC28        | 194 | PA13        |
| 39  | GND         | 91  | GND           | 143 | PC29        | 195 | PA14        |
| 40  | BMS         | 92  | A7            | 144 | PC30        | 196 | PA15        |
| 41  | OSCSEL      | 93  | A6            | 145 | PC31        | 197 | PA16        |
| 42  | TST         | 94  | A5            | 146 | GND         | 198 | PA17        |
| 43  | JTAGSEL     | 95  | A4            | 147 | VDDCORE     | 199 | VDDIOP0     |
| 44  | GNDBU       | 96  | A3            | 148 | VDDPLL      | 200 | GND         |
| 45  | XOUT32      | 97  | A2            | 149 | XIN         | 201 | PA18        |
| 46  | XIN32       | 98  | NWR2/NBS2/A1  | 150 | XOUT        | 202 | PA19        |
| 47  | VDDBU       | 99  | NBS0/A0       | 151 | GNDPLL      | 203 | VDDCORE     |
| 48  | WKUP        | 100 | SDA10         | 152 | NC          | 204 | GND         |

**Table 4-1.** Pinout for 208-pin PQFP Package (Continued)

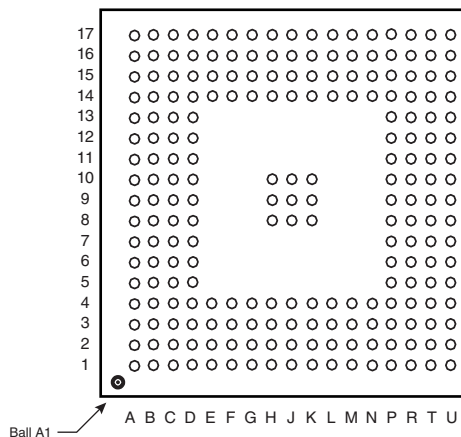
| Pin | Signal Name | Pin | Signal Name     | Pin | Signal Name | Pin | Signal Name |
|-----|-------------|-----|-----------------|-----|-------------|-----|-------------|
| 49  | SHDN        | 101 | CFIOW/NBS3/NWR3 | 153 | GNDPLL      | 205 | PA20        |
| 50  | HDMA        | 102 | CFIOR/NBS1/NWR1 | 154 | PLLRC       | 206 | PA21        |
| 51  | HDP         | 103 | SDCS/NCS1       | 155 | VDDPLL      | 207 | PA22        |
| 52  | VDDIOP0     | 104 | CAS             | 156 | GNDANA      | 208 | PA23        |

### 4.3 217-ball LFBGA Package Outline

Figure 4-2 shows the orientation of the 217-ball LFBGA package.

A detailed mechanical description is given in the section “AT91SAM9260 Mechanical Characteristics” of the product datasheet.

**Figure 4-2.** 217-ball LFBGA Package (Top View)



## 4.4 217-ball LFBGA Pinout

Table 4-2. Pinout for 217-ball LFBGA Package

| Pin | Signal Name     | Pin | Signal Name | Pin | Signal Name | Pin | Signal Name |
|-----|-----------------|-----|-------------|-----|-------------|-----|-------------|
| A1  | CFIOW/NBS3/NWR3 | D5  | A5          | J14 | TDO         | P17 | PB5         |
| A2  | NBS0/A0         | D6  | GND         | J15 | PB19        | R1  | NC          |
| A3  | NWR2/NBS2/A1    | D7  | A10         | J16 | TDI         | R2  | GNDANA      |
| A4  | A6              | D8  | GND         | J17 | PB16        | R3  | PC29        |
| A5  | A8              | D9  | VDDCORE     | K1  | PC24        | R4  | VDDANA      |
| A6  | A11             | D10 | GND         | K2  | PC20        | R5  | PB12        |
| A7  | A13             | D11 | VDDIOM      | K3  | D15         | R6  | PB23        |
| A8  | BA0/A16         | D12 | GND         | K4  | PC21        | R7  | GND         |
| A9  | A18             | D13 | DDM         | K8  | GND         | R8  | PB26        |
| A10 | A21             | D14 | HDPB        | K9  | GND         | R9  | PB28        |
| A11 | A22             | D15 | NC          | K10 | GND         | R10 | PA0         |
| A12 | CFWE/NWE/NWR0   | D16 | VDDBU       | K14 | PB4         | R11 | PA4         |
| A13 | CFOE/NRD        | D17 | XIN32       | K15 | PB17        | R12 | PA5         |
| A14 | NCS0            | E1  | D10         | K16 | GND         | R13 | PA10        |
| A15 | PC5             | E2  | D5          | K17 | PB15        | R14 | PA21        |
| A16 | PC6             | E3  | D3          | L1  | GND         | R15 | PA23        |
| A17 | PC4             | E4  | D4          | L2  | PC26        | R16 | PA24        |
| B1  | SDCK            | E14 | HDPA        | L3  | PC25        | R17 | PA29        |
| B2  | CFIOR/NBS1/NWR1 | E15 | HDMA        | L4  | VDDIOP0     | T1  | PLLRCA      |
| B3  | SDCS/NCS1       | E16 | GNDBU       | L14 | PA28        | T2  | GNDPLL      |
| B4  | SDA10           | E17 | XOUT32      | L15 | PB9         | T3  | PC0         |
| B5  | A3              | F1  | D13         | L16 | PB8         | T4  | PC1         |
| B6  | A7              | F2  | SDWE        | L17 | PB14        | T5  | PB10        |
| B7  | A12             | F3  | D6          | M1  | VDDCORE     | T6  | PB22        |
| B8  | A15             | F4  | GND         | M2  | PC31        | T7  | GND         |
| B9  | A20             | F14 | OSCSEL      | M3  | GND         | T8  | PB29        |
| B10 | NANDWE          | F15 | BMS         | M4  | PC22        | T9  | PA2         |
| B11 | PC7             | F16 | JTAGSEL     | M14 | PB1         | T10 | PA6         |
| B12 | PC10            | F17 | TST         | M15 | PB2         | T11 | PA8         |
| B13 | PC13            | G1  | PC15        | M16 | PB3         | T12 | PA11        |
| B14 | PC11            | G2  | D7          | M17 | PB7         | T13 | VDDCORE     |
| B15 | PC14            | G3  | SDCKE       | N1  | XIN         | T14 | PA20        |
| B16 | PC8             | G4  | VDDIOM      | N2  | VDDPLL      | T15 | GND         |
| B17 | WKUP            | G14 | GND         | N3  | PC23        | T16 | PA22        |
| C1  | D8              | G15 | NRST        | N4  | PC27        | T17 | PA27        |
| C2  | D1              | G16 | RTCK        | N14 | PA31        | U1  | GNDPLL      |
| C3  | CAS             | G17 | TMS         | N15 | PA30        | U2  | ADVREF      |
| C4  | A2              | H1  | PC18        | N16 | PB0         | U3  | PC2         |
| C5  | A4              | H2  | D14         | N17 | PB6         | U4  | PC3         |
| C6  | A9              | H3  | D12         | P1  | XOUT        | U5  | PB20        |
| C7  | A14             | H4  | D11         | P2  | VDDPLL      | U6  | PB21        |
| C8  | BA1/A17         | H8  | GND         | P3  | PC30        | U7  | PB25        |
| C9  | A19             | H9  | GND         | P4  | PC28        | U8  | PB27        |
| C10 | NANDOE          | H10 | GND         | P5  | PB11        | U9  | PA12        |
| C11 | PC9             | H14 | VDDCORE     | P6  | PB13        | U10 | PA13        |
| C12 | PC12            | H15 | TCK         | P7  | PB24        | U11 | PA14        |
| C13 | DDP             | H16 | NTRST       | P8  | VDDIOP1     | U12 | PA15        |
| C14 | HDMB            | H17 | PB18        | P9  | PB30        | U13 | PA19        |
| C15 | NC              | J1  | PC19        | P10 | PB31        | U14 | PA17        |

**Table 4-2.** Pinout for 217-ball LFBGA Package (Continued)

| Pin | Signal Name | Pin | Signal Name | Pin | Signal Name | Pin | Signal Name |
|-----|-------------|-----|-------------|-----|-------------|-----|-------------|
| C16 | VDDIOP0     | J2  | PC17        | P11 | PA1         | U15 | PA16        |
| C17 | SHDN        | J3  | VDDIOM      | P12 | PA3         | U16 | PA18        |
| D1  | D9          | J4  | PC16        | P13 | PA7         | U17 | VDDIOP0     |
| D2  | D2          | J8  | GND         | P14 | PA9         |     |             |
| D3  | RAS         | J9  | GND         | P15 | PA26        |     |             |
| D4  | D0          | J10 | GND         | P16 | PA25        |     |             |

## 5. Power Considerations

### 5.1 Power Supplies

The AT91SAM9260 has several types of power supply pins:

- **VDDCORE** pins: Power the core, including the processor, the embedded memories and the peripherals; voltage ranges from 1.65V and 1.95V, 1.8V nominal.
- **VDDIOM** pins: Power the External Bus Interface I/O lines; voltage ranges between 1.65V and 1.95V (1.8V typical) or between 3.0V and 3.6V (3.3V nominal). The expected voltage range is selectable by software.
- **VDDIOP0** pins: Power the Peripheral I/O lines and the USB transceivers; voltage ranges from 3.0V and 3.6V, 3V or 3.3V nominal.
- **VDDIOP1** pins: Power the Peripherals I/O lines involving the Image Sensor Interface; voltage ranges from 1.65V and 3.6V, 1.8V, 2.5V, 3V or 3.3V nominal.
- **VDDBU** pin: Powers the Slow Clock oscillator and a part of the System Controller; voltage ranges from 1.65V to 1.95V, 1.8V nominal.
- **VDDPLL** pin: Powers the Main Oscillator and PLL cells; voltage ranges from 1.65V and 1.95V, 1.8V nominal.
- **VDDANA** pin: Powers the Analog to Digital Converter; voltage ranges from 3.0V and 3.6V, 3.3V nominal.

The power supplies VDDIOM, VDDIOP0 and VDDIOP1 are identified in the pinout table and the multiplexing tables. These supplies enable the user to power the device differently for interfacing with memories and for interfacing with peripherals.

Ground pins GND are common to VDDCORE, VDDIOM, VDDIOP0 and VDDIOP1 pins power supplies. Separated ground pins are provided for VDDBU, VDDPLL and VDDANA. These ground pins are respectively GNDBU, GNDPLL and GNDANA.

### 5.2 Power Consumption

The AT91SAM9260 consumes about 500  $\mu$ A of static current on VDDCORE at 25°C. This static current rises up to 5 mA if the temperature increases to 85°C.

On VDDBU, the current does not exceed 10  $\mu$ A in worst case conditions.

For dynamic power consumption, the AT91SAM9260 consumes a maximum of 100 mA on VDDCORE at maximum conditions (1.8V, 25°C, processor running full-performance algorithm out of high speed memories).

### 5.3 Programmable I/O Lines Power Supplies

The power supplies pins VDDIOM accept two voltage ranges. This allows the device to reach its maximum speed either out of 1.8V or 3.3V external memories.

The target maximum speed is 100 MHz on the pin SDCK (SDRAM Clock) loaded with 30 pF for power supply at 1.8V and 50 pF for power supply at 3.3V. The other signals (control, address and data signals) do not exceed 50 MHz.

The voltage ranges are determined by programming registers in the Chip Configuration registers located in the Matrix User Interface.

At reset, the selected voltage defaults to 3.3V nominal, and power supply pins can accept either 1.8V or 3.3V. Obviously, the device cannot reach its maximum speed if the voltage supplied to the pins is 1.8V only. The user must program the EBI voltage range before getting the device out of its Slow Clock Mode.

## 6. I/O Line Considerations

### 6.1 JTAG Port Pins

TMS, TDI and TCK are Schmitt trigger inputs and have no pull-up resistors.

TDO and RTCK are outputs, driven at up to VDDIOP0, and have no pull-up resistors.

The JTAGSEL pin is used to select the JTAG boundary scan when asserted at a high level (tied to VDDBU). It integrates a permanent pull-down resistor of about **15 k $\Omega$**  to GNDBU, so that it can be left unconnected for normal operations.

The NTRST signal is described in [Section 6.3](#).

All the JTAG signals are supplied with VDDIOP0.

### 6.2 Test Pin

The TST pin is used for manufacturing test purposes when asserted high. It integrates a permanent pull-down resistor of about 15 k $\Omega$  to GNDBU, so that it can be left unconnected for normal operations. Driving this line at a high level leads to unpredictable results.

This pin is supplied with VDDBU.

### 6.3 Reset Pins

NRST is a bidirectional with an open-drain output integrating a non-programmable pull-up resistor. It can be driven with voltage at up to VDDIOP0.

NTRST is an input which allows reset of the JTAG Test Access port. It has no action on the processor.

As the product integrates power-on reset cells, which manages the processor and the JTAG reset, the NRST and NTRST pins can be left unconnected.

The NRST and NTRST pins both integrate a permanent pull-up resistor to VDDIOP0. Its value can be found in the table “DC Characteristics” in the section “AT91SAM9260 Electrical Characteristics” in the product datasheet.

The NRST signal is inserted in the Boundary Scan.

## 6.4 PIO Controllers

All the I/O lines managed by the PIO Controllers integrate a programmable pull-up resistor. Refer to the section on DC Characteristics in “AT91SAM9260 Electrical Characteristics” for more information. Programming of this pull-up resistor is performed independently for each I/O line through the PIO Controllers.

After reset, all the I/O lines default as inputs with pull-up resistors enabled, except those which are multiplexed with the External Bus Interface signals and that must be enabled as Peripheral at reset. This is explicitly indicated in the column “Reset State” of the PIO Controller multiplexing tables.

## 6.5 I/O Line Drive Levels

The PIO lines are high-drive current capable. Each of these I/O lines can drive up to 16 mA permanently except PC4 to PC31 that are VDDIOM powered.

## 6.6 Shutdown Logic Pins

The SHDN pin is a tri-state output pin, which is driven by the Shutdown Controller. There is no internal pull-up. An external pull-up tied to VDDDBU is needed and its value must be higher than 1 MΩ. The resistor value is calculated according to the regulator enable implementation and the SHDN level.

The pin WKUP is an input-only. It can accept voltages only between 0V and VDDDBU.

## 6.7 Slow Clock Selection

The AT91SAM9260 slow clock can be generated either by an external 32,768 Hz crystal or the on-chip RC oscillator.

[Table 6-1](#) defines the states for OSCSEL signal.

**Table 6-1.** Slow Clock Selection

| OSCSEL | Slow Clock        | Startup Time |
|--------|-------------------|--------------|
| 0      | Internal RC       | 240 μs       |
| 1      | External 32768 Hz | 1200 ms      |

The startup counter delay for the slow clock oscillator depends on the OSCSEL signal. The 32,768 Hz startup delay is 1200 ms whereas it is 240 μs for the internal RC oscillator (refer to [Table 6-1](#)). The pin OSCSEL must be tied either to GND or VDDDBU for correct operation of the device.

## 7. Processor and Architecture

### 7.1 ARM926EJ-S Processor

- RISC Processor Based on ARM v5TEJ Architecture with Jazelle technology for Java acceleration
- Two Instruction Sets
  - ARM High-performance 32-bit Instruction Set
  - Thumb High Code Density 16-bit Instruction Set

- DSP Instruction Extensions
- 5-Stage Pipeline Architecture:
  - Instruction Fetch (F)
  - Instruction Decode (D)
  - Execute (E)
  - Data Memory (M)
  - Register Write (W)
- 8-Kbyte Data Cache, 8-Kbyte Instruction Cache
  - Virtually-addressed 4-way Associative Cache
  - Eight words per line
  - Write-through and Write-back Operation
  - Pseudo-random or Round-robin Replacement
- Write Buffer
  - Main Write Buffer with 16-word Data Buffer and 4-address Buffer
  - DCache Write-back Buffer with 8-word Entries and a Single Address Entry
  - Software Control Drain
- Standard ARM v4 and v5 Memory Management Unit (MMU)
  - Access Permission for Sections
  - Access Permission for large pages and small pages can be specified separately for each quarter of the page
  - 16 embedded domains
- Bus Interface Unit (BIU)
  - Arbitrates and Schedules AHB Requests
  - Separate Masters for both instruction and data access providing complete Matrix system flexibility
  - Separate Address and Data Buses for both the 32-bit instruction interface and the 32-bit data interface
  - On Address and Data Buses, data can be 8-bit (Bytes), 16-bit (Half-words) or 32-bit (Words)

## 7.2 Bus Matrix

- 6-layer Matrix, handling requests from 6 masters
- Programmable Arbitration strategy
  - Fixed-priority Arbitration
  - Round-Robin Arbitration, either with no default master, last accessed default master or fixed default master
- Burst Management
  - Breaking with Slot Cycle Limit Support
  - Undefined Burst Length Support
- One Address Decoder provided per Master
  - Three different slaves may be assigned to each decoded memory area: one for internal boot, one for external boot, one after remap



- Boot Mode Select
  - Non-volatile Boot Memory can be internal or external
  - Selection is made by BMS pin sampled at reset
- Remap Command
  - Allows Remapping of an Internal SRAM in Place of the Boot Non-Volatile Memory
  - Allows Handling of Dynamic Exception Vectors

## 7.2.1 Matrix Masters

The Bus Matrix of the AT91SAM9260 manages six Masters, which means that each master can perform an access concurrently with others, according the slave it accesses is available.

Each Master has its own decoder that can be defined specifically for each master. In order to simplify the addressing, all the masters have the same decodings.

**Table 7-1.** List of Bus Matrix Masters

|          |                     |
|----------|---------------------|
| Master 0 | ARM926™ Instruction |
| Master 1 | ARM926 Data         |
| Master 2 | PDC                 |
| Master 3 | USB Host DMA        |
| Master 4 | ISI Controller      |
| Master 5 | Ethernet MAC        |

## 7.2.2 Matrix Slaves

Each Slave has its own arbiter, thus allowing a different arbitration per Slave to be programmed.

**Table 7-2.** List of Bus Matrix Slaves

|         |                         |
|---------|-------------------------|
| Slave 0 | Internal SRAM0 4 KBytes |
| Slave 1 | Internal SRAM1 4 KBytes |
| Slave 2 | Internal ROM            |
|         | USB Host User Interface |
| Slave 3 | External Bus Interface  |
| Slave 4 | Internal Peripherals    |

## 7.2.3 Master to Slave Access

All the Masters can normally access all the Slaves. However, some paths do not make sense, such as allowing access from the Ethernet MAC to the Internal Peripherals. Thus, these paths are forbidden or simply not wired, and shown “-” in the following table.

**Table 7-3.** AT91SAM9260 Masters to Slaves Access

| Master |                        | 0 & 1                     | 2                         | 3                   | 4              | 5            |
|--------|------------------------|---------------------------|---------------------------|---------------------|----------------|--------------|
| Slave  |                        | ARM926 Instruction & Data | Peripheral DMA Controller | USB Host Controller | ISI Controller | Ethernet MAC |
| 0      | Internal SRAM 4 KBytes | X                         | X                         | X                   | X              | X            |

**Table 7-3.** AT91SAM9260 Masters to Slaves Access

|   |                           |   |   |   |   |   |
|---|---------------------------|---|---|---|---|---|
| 1 | Internal SRAM<br>4 KBytes | X | X | X | X | X |
| 2 | Internal ROM              | X | X | X | - | - |
|   | UHP User Interface        | X | - | - | - | - |
| 3 | External Bus Interface    | X | X | X | X | X |
| 4 | Internal Peripherals      | X | X | X | - | - |

### 7.3 Peripheral DMA Controller

- Acting as one Matrix Master
- Allows data transfers from/to peripheral to/from any memory space without any intervention of the processor.
- Next Pointer Support, forbids strong real-time constraints on buffer management.
- Twenty-two channels
  - Two for each USART
  - Two for the Debug Unit
  - Two for each Serial Synchronous Controller
  - Two for each Serial Peripheral Interface
  - One for Multimedia Card Interface
  - One for Analog-to-Digital Converter

The Peripheral DMA Controller handles transfer requests from the channel according to the following priorities (Low to High priorities):

- DBGU Transmit Channel
- USART5 Transmit Channel
- USART4 Transmit Channel
- USART3 Transmit Channel
- USART2 Transmit Channel
- USART1 Transmit Channel
- USART0 Transmit Channel
- SPI1 Transmit Channel
- SPI0 Transmit Channel
- SSC Transmit Channel
- DBGU Receive Channel
- USART5 Receive Channel
- USART4 Receive Channel
- USART3 Receive Channel
- USART2 Receive Channel
- USART1 Receive Channel
- USART0 Receive Channel
- ADC Receive Channel
- SPI1 Receive Channel

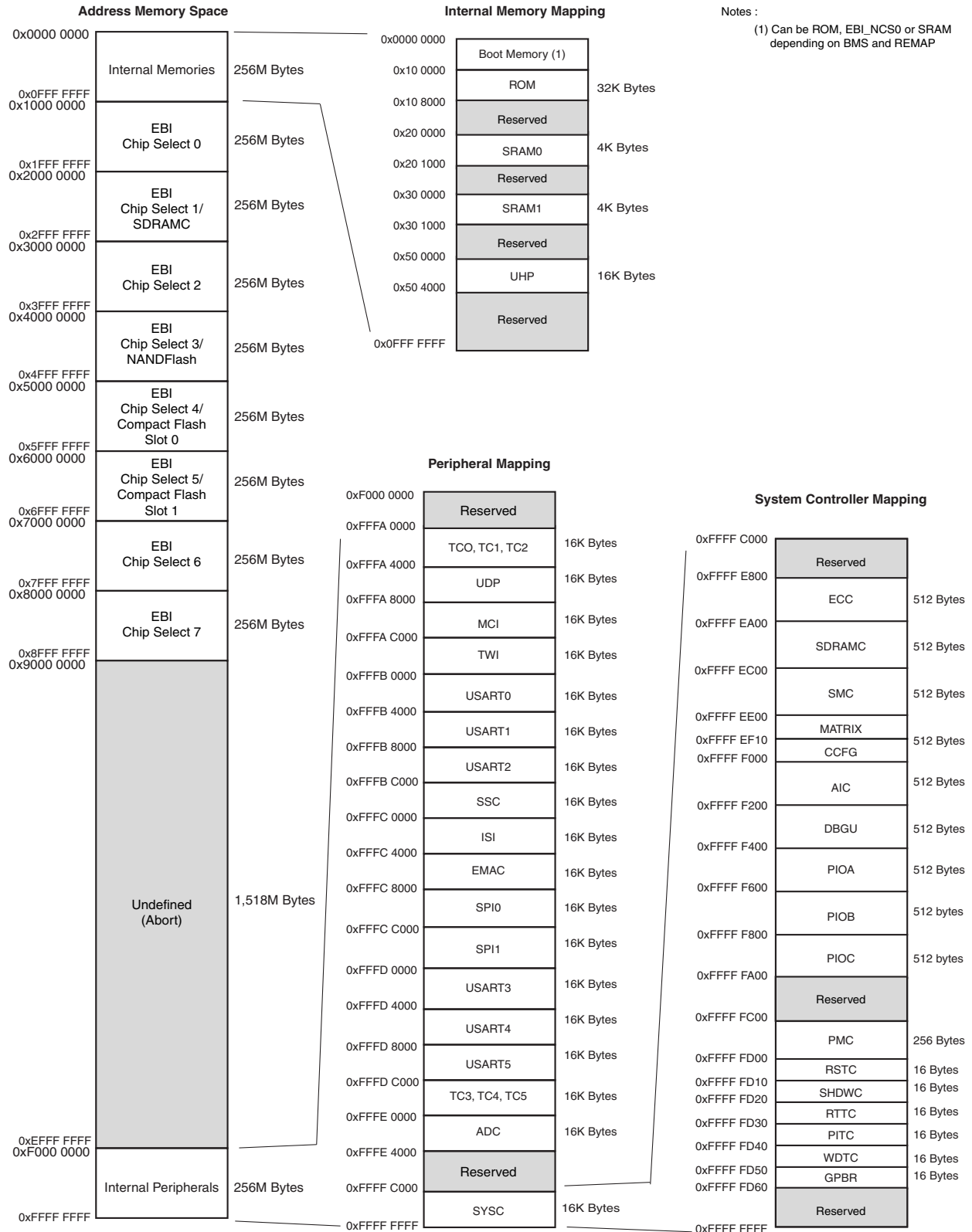
- SPI0 Receive Channel
- SSC Receive Channel
- MCI Transmit/Receive Channel

## **7.4 Debug and Test Features**

- ARM926 Real-time In-circuit Emulator
  - Two real-time Watchpoint Units
  - Two Independent Registers: Debug Control Register and Debug Status Register
  - Test Access Port Accessible through JTAG Protocol
  - Debug Communications Channel
- Debug Unit
  - Two-pin UART
  - Debug Communication Channel Interrupt Handling
  - Chip ID Register
- IEEE1149.1 JTAG Boundary-scan on All Digital Pins

## 8. Memories

Figure 8-1. AT91SAM9260 Memory Mapping



A first level of address decoding is performed by the Bus Matrix, i.e., the implementation of the Advanced High Performance Bus (AHB) for its Master and Slave interfaces with additional features.

Decoding breaks up the 4G bytes of address space into 16 banks of 256 Mbytes. The banks 1 to 7 are directed to the EBI that associates these banks to the external chip selects EBI\_NCS0 to EBI\_NCS7. Bank 0 is reserved for the addressing of the internal memories, and a second level of decoding provides 1 Mbyte of internal memory area. Bank 15 is reserved for the peripherals and provides access to the Advanced Peripheral Bus (APB).

Other areas are unused and performing an access within them provides an abort to the master requesting such an access.

Each Master has its own bus and its own decoder, thus allowing a different memory mapping per Master. However, in order to simplify the mappings, all the masters have a similar address decoding.

Regarding Master 0 and Master 1 (ARM926 Instruction and Data), three different Slaves are assigned to the memory space decoded at address 0x0: one for internal boot, one for external boot, one after remap. Refer to [Table 8-1, “Internal Memory Mapping,” on page 21](#) for details.

A complete memory map is presented in [Figure 8-1 on page 20](#).

## 8.1 Embedded Memories

- 32 KB ROM
  - Single Cycle Access at full matrix speed
- Two 4 KB Fast SRAM
  - Single Cycle Access at full matrix speed

### 8.1.1 Boot Strategies

[Table 8-1](#) summarizes the Internal Memory Mapping for each Master, depending on the Remap status and the BMS state at reset.

**Table 8-1.** Internal Memory Mapping

| Address     | REMAP = 0 |          | REMAP = 1 |
|-------------|-----------|----------|-----------|
|             | BMS = 1   | BMS = 0  |           |
| 0x0000 0000 | ROM       | EBI_NCS0 | SRAM0 4K  |

The system always boots at address 0x0. To ensure a maximum number of possibilities for boot, the memory layout can be configured with two parameters.

REMAP allows the user to lay out the first internal SRAM bank to 0x0 to ease development. This is done by software once the system has booted. Refer to the Bus Matrix Section for more details.

When REMAP = 0, BMS allows the user to lay out to 0x0, at his convenience, the ROM or an external memory. This is done via hardware at reset.

Note: Memory blocks not affected by these parameters can always be seen at their specified base addresses. See the complete memory map presented in [Figure 8-1 on page 20](#).

The AT91SAM9260 matrix manages a boot memory that depends on the level on the BMS pin at reset. The internal memory area mapped between address 0x0 and 0x000F FFFF is reserved for this purpose.

If BMS is detected at 1, the boot memory is the embedded ROM.

If BMS is detected at 0, the boot memory is the memory connected on the Chip Select 0 of the External Bus Interface.

#### 8.1.1.1 *BMS = 1, Boot on Embedded ROM*

The system boots using the Boot Program.

- Boot on slow clock (On-chip RC or 32,768 Hz)
- Auto baudrate detection
- Downloads and runs an application from external storage media into internal SRAM
- Downloaded code size depends on embedded SRAM size
- Automatic detection of valid application
- Bootloader on a non-volatile memory
  - SPI DataFlash<sup>®</sup> connected on NPCS0 and NPCS1 of the SPI0
  - 8-bit and/or 16-bit NAND Flash
- SAM-BA<sup>®</sup> Monitor in case no valid program is detected in external NVM, supporting
  - Serial communication on a DBGU
  - USB Device Port

#### 8.1.1.2 *BMS = 0, Boot on External Memory*

- Boot on slow clock (On-chip RC or 32,768 Hz)
- Boot with the default configuration for the Static Memory Controller, byte select mode, 16-bit data bus, Read/Write controlled by Chip Select, allows boot on 16-bit non-volatile memory.

The customer-programmed software must perform a complete configuration.

To speed up the boot sequence when booting at 32 kHz EBI CS0 (BMS=0), the user must take the following steps:

1. Program the PMC (main oscillator enable or bypass mode).
2. Program and start the PLL.
3. Reprogram the SMC setup, cycle, hold, mode timings registers for CS0 to adapt them to the new clock.
4. Switch the main clock to the new value.

## 8.2 External Memories

The external memories are accessed through the External Bus Interface. Each Chip Select line has a 256-Mbyte memory area assigned.

Refer to the memory map in [Figure 8-1 on page 20](#).

### 8.2.1 External Bus Interface

- Integrates three External Memory Controllers
  - Static Memory Controller
  - SDRAM Controller

- ECC Controller
- Additional logic for NAND Flash
- Full 32-bit External Data Bus
- Up to 26-bit Address Bus (up to 64MBytes linear)
- Up to 8 chip selects, Configurable Assignment:
  - Static Memory Controller on NCS0
  - SDRAM Controller or Static Memory Controller on NCS1
  - Static Memory Controller on NCS2
  - Static Memory Controller on NCS3, Optional NAND Flash support
  - Static Memory Controller on NCS4 - NCS5, Optional CompactFlash support
  - Static Memory Controller on NCS6-NCS7

## 8.2.2 Static Memory Controller

- 8-, 16- or 32-bit Data Bus
- Multiple Access Modes supported
  - Byte Write or Byte Select Lines
  - Asynchronous read in Page Mode supported (4- up to 32-byte page size)
- Multiple device adaptability
  - Compliant with LCD Module
  - Control signals programmable setup, pulse and hold time for each Memory Bank
- Multiple Wait State Management
  - Programmable Wait State Generation
  - External Wait Request
  - Programmable Data Float Time
- Slow Clock mode supported

## 8.2.3 SDRAM Controller

- Supported devices
  - Standard and Low-power SDRAM (Mobile SDRAM)
- Numerous configurations supported
  - 2K, 4K, 8K Row Address Memory Parts
  - SDRAM with two or four Internal Banks
  - SDRAM with 16- or 32-bit Datapath
- Programming facilities
  - Word, half-word, byte access
  - Automatic page break when Memory Boundary has been reached
  - Multibank Ping-pong Access
  - Timing parameters specified by software
  - Automatic refresh operation, refresh rate is programmable
- Energy-saving capabilities
  - Self-refresh, power down and deep power down modes supported

- Error detection
  - Refresh Error Interrupt
- SDRAM Power-up Initialization by software
- CAS Latency of 1, 2 and 3 supported
- Auto Precharge Command not used

#### **8.2.4 Error Corrected Code Controller**

- Tracking the accesses to a NAND Flash device by triggering on the corresponding chip select
- Single bit error correction and 2-bit Random detection
- Automatic Hamming Code Calculation while writing
  - ECC value available in a register
- Automatic Hamming Code Calculation while reading
  - Error Report, including error flag, correctable error flag and word address being detected erroneous
  - Support 8- or 16-bit NAND Flash devices with 512-, 1024-, 2048- or 4096-bytes pages



## 9. System Controller

The System Controller is a set of peripherals that allows handling of key elements of the system, such as power, resets, clocks, time, interrupts, watchdog, etc.

The System Controller User Interface also embeds the registers that configure the Matrix and a set of registers for the chip configuration. The chip configuration registers configure EBI chip select assignment and voltage range for external memories

The System Controller's peripherals are all mapped within the highest 16 Kbytes of address space, between addresses 0xFFFF E800 and 0xFFFF FFFF.

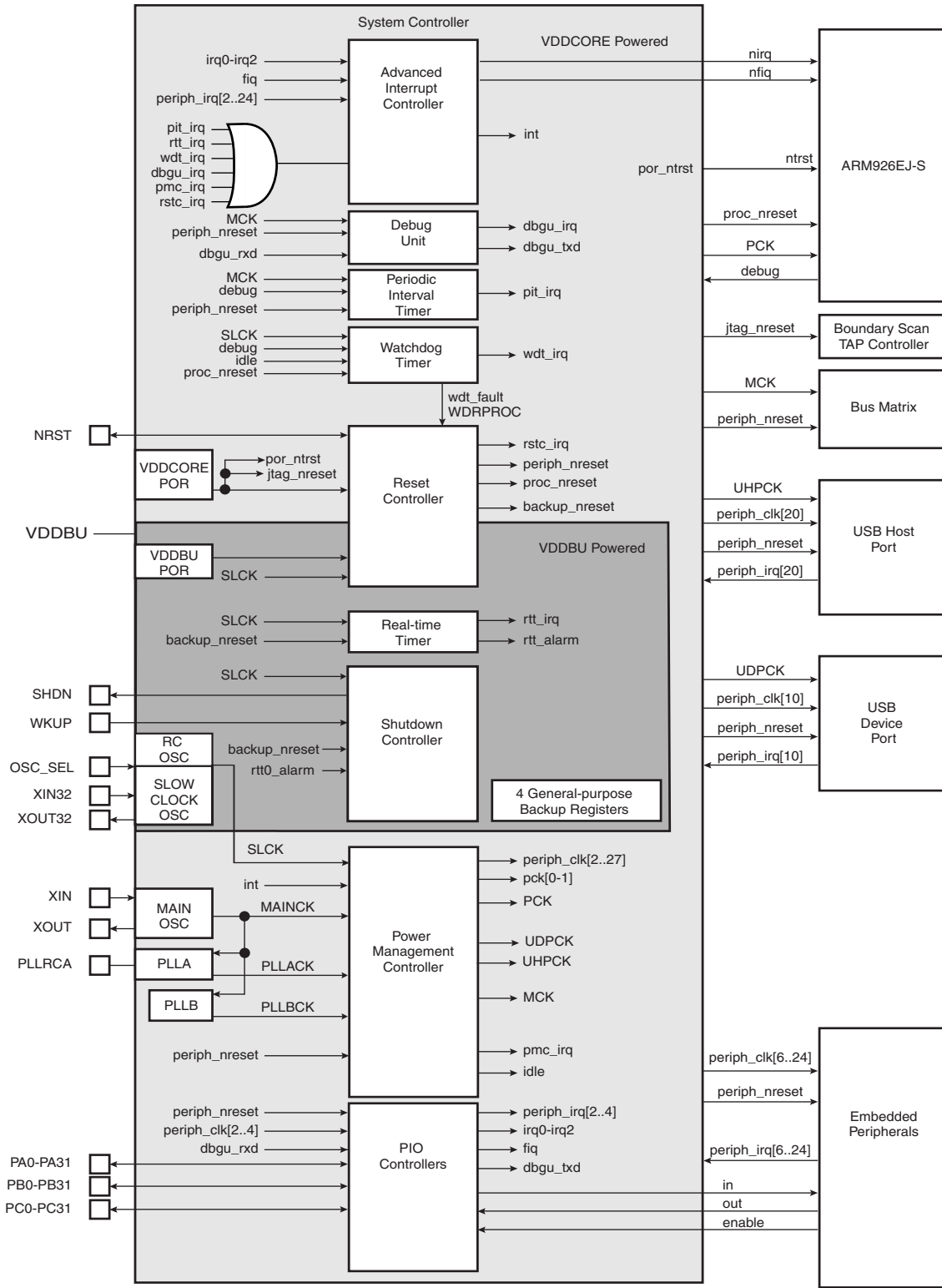
However, all the registers of System Controller are mapped on the top of the address space. All the registers of the System Controller can be addressed from a single pointer by using the standard ARM instruction set, as the Load/Store instruction has an indexing mode of  $\pm 4$  Kbytes.

[Figure 9-1 on page 26](#) shows the System Controller block diagram.

[Figure 8-1 on page 20](#) shows the mapping of the User Interfaces of the System Controller peripherals.

## 9.1 Block Diagram

Figure 9-1. AT91SAM9260 System Controller Block Diagram



## 9.2 Reset Controller

- Based on two Power-on-reset cells
  - One on VDDDBU and one on VDDCORE
- Status of the last reset
  - Either general reset (VDDDBU rising), wake-up reset (VDDCORE rising), software reset, user reset or watchdog reset
- Controls the internal resets and the NRST pin output
  - Allows shaping a reset signal for the external devices

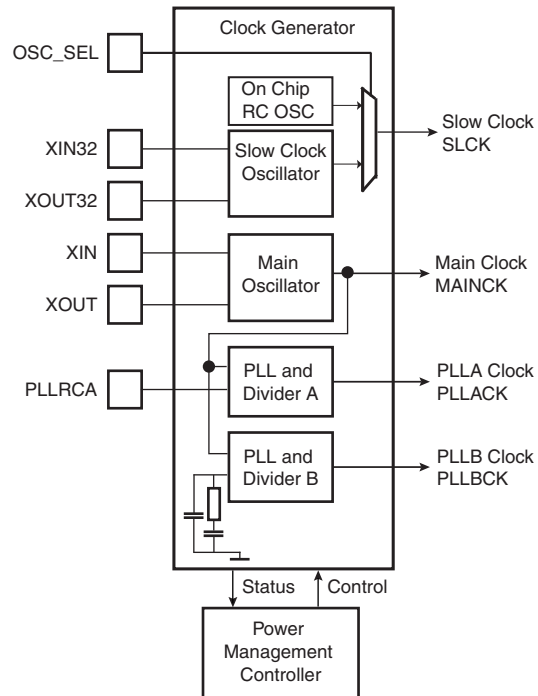
## 9.3 Shutdown Controller

- Shutdown and Wake-up logic
  - Software programmable assertion of the SHDN pin
  - Deassertion Programmable on a WKUP pin level change or on alarm

## 9.4 Clock Generator

- Embeds a Low-power 32,768 Hz Slow Clock Oscillator and a Low-power RC oscillator selectable with OSCSEL signal
  - Provides the permanent Slow Clock SLCK to the system
- Embeds the Main Oscillator
  - Oscillator bypass feature
  - Supports 3 to 20 MHz crystals
- Embeds 2 PLLs
  - PLLA outputs 80 to 240 MHz clock
  - PLLB outputs 70 to 130 MHz clock
  - Both integrate an input divider to increase output accuracy
  - PLLB embeds its own filter

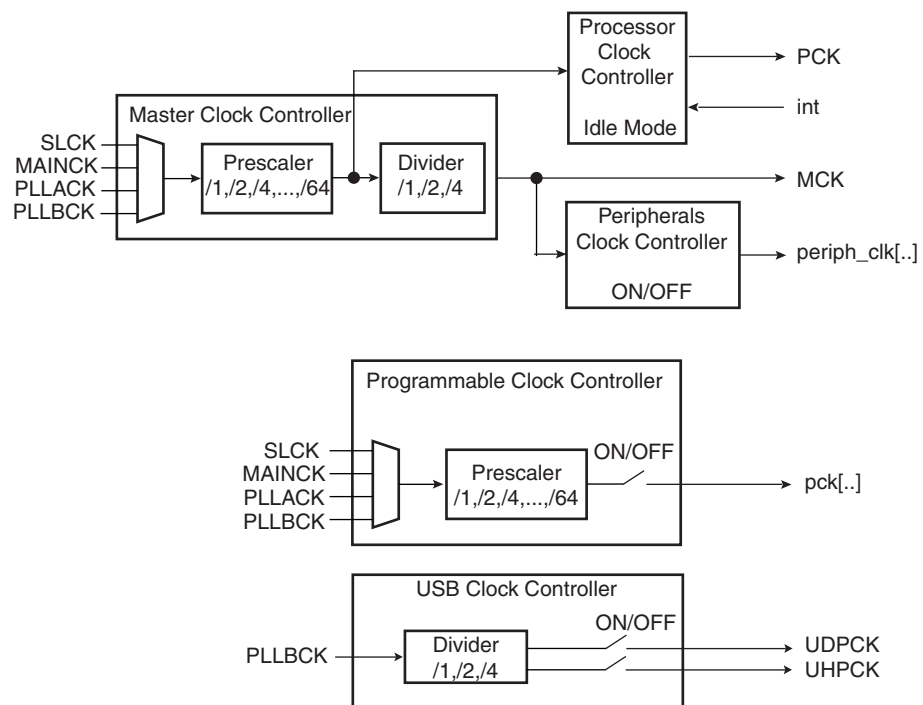
**Figure 9-2.** Clock Generator Block Diagram



## 9.5 Power Management Controller

- Provides:
  - the Processor Clock PCK
  - the Master Clock MCK, in particular to the Matrix and the memory interfaces
  - the USB Device Clock UDPCK
  - independent peripheral clocks, typically at the frequency of MCK
  - 2 programmable clock outputs: PCK0, PCK1
- Five flexible operating modes:
  - Normal Mode, processor and peripherals running at a programmable frequency
  - Idle Mode, processor stopped waiting for an interrupt
  - Slow Clock Mode, processor and peripherals running at low frequency
  - Standby Mode, mix of Idle and Backup Mode, peripheral running at low frequency, processor stopped waiting for an interrupt
  - Backup Mode, Main Power Supplies off, VDDBU powered by a battery

**Figure 9-3.** AT91SAM9260 Power Management Controller Block Diagram



## 9.6 Periodic Interval Timer

- Includes a 20-bit Periodic Counter, with less than 1  $\mu$ s accuracy
- Includes a 12-bit Interval Overlay Counter
- Real Time OS or Linux<sup>®</sup>/Windows CE<sup>®</sup> compliant tick generator

## 9.7 Watchdog Timer

- 16-bit key-protected only-once-Programmable Counter
- Windowed, prevents the processor being in a dead-lock on the watchdog access

## 9.8 Real-time Timer

- Real-time Timer 32-bit free-running back-up Counter
- Integrates a 16-bit programmable prescaler running on slow clock
- Alarm Register capable of generating a wake-up of the system through the Shutdown Controller

## 9.9 General-purpose Back-up Registers

- Four 32-bit backup general-purpose registers

## 9.10 Advanced Interrupt Controller

- Controls the interrupt lines (nIRQ and nFIQ) of the ARM Processor
- Thirty-two individually maskable and vectored interrupt sources
  - Source 0 is reserved for the Fast Interrupt Input (FIQ)
  - Source 1 is reserved for system peripherals (PIT, RTT, PMC, DBGU, etc.)

- Programmable Edge-triggered or Level-sensitive Internal Sources
- Programmable Positive/Negative Edge-triggered or High/Low Level-sensitive
- Three External Sources plus the Fast Interrupt signal
- 8-level Priority Controller
  - Drives the Normal Interrupt of the processor
  - Handles priority of the interrupt sources 1 to 31
  - Higher priority interrupts can be served during service of lower priority interrupt
- Vectoring
  - Optimizes Interrupt Service Routine Branch and Execution
  - One 32-bit Vector Register per interrupt source
  - Interrupt Vector Register reads the corresponding current Interrupt Vector
- Protect Mode
  - Easy debugging by preventing automatic operations when protect models are enabled
- Fast Forcing
  - Permits redirecting any normal interrupt source on the Fast Interrupt of the processor

## 9.11 Debug Unit

- Composed of two functions:
  - Two-pin UART
  - Debug Communication Channel (DCC) support
- Two-pin UART
  - Implemented features are 100% compatible with the standard Atmel<sup>®</sup> USART
  - Independent receiver and transmitter with a common programmable Baud Rate Generator
  - Even, Odd, Mark or Space Parity Generation
  - Parity, Framing and Overrun Error Detection
  - Automatic Echo, Local Loopback and Remote Loopback Channel Modes
  - Support for two PDC channels with connection to receiver and transmitter
- Debug Communication Channel Support
  - Offers visibility of and interrupt trigger from COMMRX and COMMTX signals from the ARM Processor's ICE Interface

## 9.12 Chip Identification

- Chip ID: 0x019803A2
- JTAG ID: 0x05B1303F
- ARM926 TAP ID: 0x0792603F

## 10. Peripherals

### 10.1 User Interface

The peripherals are mapped in the upper 256 Mbytes of the address space between the addresses 0xFFFA 0000 and 0xFFFC FFFF. Each User Peripheral is allocated 16 Kbytes of address space. A complete memory map is presented in [Figure 8-1 on page 20](#).

### 10.2 Identifiers

[Table 10-1](#) defines the Peripheral Identifiers of the AT91SAM9260. A peripheral identifier is required for the control of the peripheral interrupt with the Advanced Interrupt Controller and for the control of the peripheral clock with the Power Management Controller.

**Table 10-1.** AT91SAM9260 Peripheral Identifiers

| Peripheral ID | Peripheral Mnemonic | Peripheral Name               | External Interrupt |
|---------------|---------------------|-------------------------------|--------------------|
| 0             | AIC                 | Advanced Interrupt Controller | FIQ                |
| 1             | SYSC                | System Controller Interrupt   |                    |
| 2             | PIOA                | Parallel I/O Controller A     |                    |
| 3             | PIOB                | Parallel I/O Controller B     |                    |
| 4             | PIOC                | Parallel I/O Controller C     |                    |
| 5             | ADC                 | Analog to Digital Converter   |                    |
| 6             | US0                 | USART 0                       |                    |
| 7             | US1                 | USART 1                       |                    |
| 8             | US2                 | USART 2                       |                    |
| 9             | MCI                 | Multimedia Card Interface     |                    |
| 10            | UDP                 | USB Device Port               |                    |
| 11            | TWI                 | Two-wire Interface            |                    |
| 12            | SPI0                | Serial Peripheral Interface 0 |                    |
| 13            | SPI1                | Serial Peripheral Interface 1 |                    |
| 14            | SSC                 | Synchronous Serial Controller |                    |
| 15            | -                   | Reserved                      |                    |
| 16            | -                   | Reserved                      |                    |
| 17            | TC0                 | Timer/Counter 0               |                    |
| 18            | TC1                 | Timer/Counter 1               |                    |
| 19            | TC2                 | Timer/Counter 2               |                    |
| 20            | UHP                 | USB Host Port                 |                    |
| 21            | EMAC                | Ethernet MAC                  |                    |
| 22            | ISI                 | Image Sensor Interface        |                    |
| 23            | US3                 | USART 3                       |                    |
| 24            | US4                 | USART 4                       |                    |
| 25            | US5                 | USART 5                       |                    |
| 26            | TC3                 | Timer/Counter 3               |                    |
| 27            | TC4                 | Timer/Counter 4               |                    |
| 28            | TC5                 | Timer/Counter 5               |                    |

**Table 10-1.** AT91SAM9260 Peripheral Identifiers (Continued)

| Peripheral ID | Peripheral Mnemonic | Peripheral Name               | External Interrupt |
|---------------|---------------------|-------------------------------|--------------------|
| 29            | AIC                 | Advanced Interrupt Controller | IRQ0               |
| 30            | AIC                 | Advanced Interrupt Controller | IRQ1               |
| 31            | AIC                 | Advanced Interrupt Controller | IRQ2               |

Note: Setting AIC, SYSC, UHP and IRQ0-2 bits in the clock set/clear registers of the PMC has no effect.

## 10.2.1 Peripheral Interrupts and Clock Control

### 10.2.1.1 System Interrupt

The System Interrupt in Source 1 is the wired-OR of the interrupt signals coming from:

- the SDRAM Controller
- the Debug Unit
- the Periodic Interval Timer
- the Real-time Timer
- the Watchdog Timer
- the Reset Controller
- the Power Management Controller

The clock of these peripherals cannot be deactivated and Peripheral ID 1 can only be used within the Advanced Interrupt Controller.

### 10.2.1.2 External Interrupts

All external interrupt signals, i.e., the Fast Interrupt signal FIQ or the Interrupt signals IRQ0 to IRQ2, use a dedicated Peripheral ID. However, there is no clock control associated with these peripheral IDs.

## 10.3 Peripheral Signal Multiplexing on I/O Lines

The AT91SAM9260 features 3 PIO controllers (PIOA, PIOB, PIOC) that multiplex the I/O lines of the peripheral set.

Each PIO Controller controls up to 32 lines. Each line can be assigned to one of two peripheral functions, A or B. [Table 10-2 on page 33](#), [Table 10-3 on page 34](#) and [Table 10-4 on page 35](#) define how the I/O lines of the peripherals A and B are multiplexed on the PIO Controllers. The two columns “Function” and “Comments” have been inserted in this table for the user’s own comments; they may be used to track how pins are defined in an application.

Note that some peripheral functions which are output only might be duplicated within both tables.

The column “Reset State” indicates whether the PIO Line resets in I/O mode or in peripheral mode. If I/O appears, the PIO Line resets in input with the pull-up enabled, so that the device is maintained in a static state as soon as the reset is released. As a result, the bit corresponding to the PIO Line in the register PIO\_PSR (Peripheral Status Register) resets low.

If a signal name appears in the “Reset State” column, the PIO Line is assigned to this function and the corresponding bit in PIO\_PSR resets high. This is the case of pins controlling memories, in particular the address lines, which require the pin to be driven as soon as the reset is released. Note that the pull-up resistor is also enabled in this case.



## 10.3.1 PIO Controller A Multiplexing

**Table 10-2.** Multiplexing on PIO Controller A

| PIO Controller A    |              |              |          |             | Application Usage |          |          |
|---------------------|--------------|--------------|----------|-------------|-------------------|----------|----------|
| I/O Line            | Peripheral A | Peripheral B | Comments | Reset State | Power Supply      | Function | Comments |
| PA0                 | SPI0_MISO    | MCDB0        |          | I/O         | VDDIOP0           |          |          |
| PA1                 | SPI0_MOSI    | MCCDB        |          | I/O         | VDDIOP0           |          |          |
| PA2                 | SPI0_SPCK    |              |          | I/O         | VDDIOP0           |          |          |
| PA3                 | SPI0_NPCS0   | MCDB3        |          | I/O         | VDDIOP0           |          |          |
| PA4                 | RTS2         | MCDB2        |          | I/O         | VDDIOP0           |          |          |
| PA5                 | CTS2         | MCDB1        |          | I/O         | VDDIOP0           |          |          |
| PA6                 | MCDA0        |              |          | I/O         | VDDIOP0           |          |          |
| PA7                 | MCCDA        |              |          | I/O         | VDDIOP0           |          |          |
| PA8                 | MCCK         |              |          | I/O         | VDDIOP0           |          |          |
| PA9                 | MCDA1        |              |          | I/O         | VDDIOP0           |          |          |
| PA10                | MCDA2        | ETX2         |          | I/O         | VDDIOP0           |          |          |
| PA11                | MCDA3        | ETX3         |          | I/O         | VDDIOP0           |          |          |
| PA12                | ETX0         |              |          | I/O         | VDDIOP0           |          |          |
| PA13                | ETX1         |              |          | I/O         | VDDIOP0           |          |          |
| PA14                | ERX0         |              |          | I/O         | VDDIOP0           |          |          |
| PA15                | ERX1         |              |          | I/O         | VDDIOP0           |          |          |
| PA16                | ETXEN        |              |          | I/O         | VDDIOP0           |          |          |
| PA17                | ERXDV        |              |          | I/O         | VDDIOP0           |          |          |
| PA18                | ERXER        |              |          | I/O         | VDDIOP0           |          |          |
| PA19                | ETXCK        |              |          | I/O         | VDDIOP0           |          |          |
| PA20                | EMDC         |              |          | I/O         | VDDIOP0           |          |          |
| PA21                | EMDIO        |              |          | I/O         | VDDIOP0           |          |          |
| PA22                | ADTRG        | ETXER        |          | I/O         | VDDIOP0           |          |          |
| PA23                | TWD          | ETX2         |          | I/O         | VDDIOP0           |          |          |
| PA24                | TWCK         | ETX3         |          | I/O         | VDDIOP0           |          |          |
| PA25                | TCLK0        | ERX2         |          | I/O         | VDDIOP0           |          |          |
| PA26                | TIOA0        | ERX3         |          | I/O         | VDDIOP0           |          |          |
| PA27                | TIOA1        | ERXCK        |          | I/O         | VDDIOP0           |          |          |
| PA28                | TIOA2        | ECRS         |          | I/O         | VDDIOP0           |          |          |
| PA29                | SCK1         | ECOL         |          | I/O         | VDDIOP0           |          |          |
| PA30 <sup>(1)</sup> | SCK2         | RXD4         |          | I/O         | VDDIOP0           |          |          |
| PA31 <sup>(1)</sup> | SCK0         | TXD4         |          | I/O         | VDDIOP0           |          |          |

Note: 1. Not available in the 208-lead PQFP package.



### 10.3.2 PIO Controller B Multiplexing

**Table 10-3.** Multiplexing on PIO Controller B

| PIO Controller B    |              |              |          |             | Application Usage |          |          |
|---------------------|--------------|--------------|----------|-------------|-------------------|----------|----------|
| I/O Line            | Peripheral A | Peripheral B | Comments | Reset State | Power Supply      | Function | Comments |
| PB0                 | SPI1_MISO    | TIOA3        |          | I/O         | VDDIOP0           |          |          |
| PB1                 | SPI1_MOSI    | TIOB3        |          | I/O         | VDDIOP0           |          |          |
| PB2                 | SPI1_SPCK    | TIOA4        |          | I/O         | VDDIOP0           |          |          |
| PB3                 | SPI1_NPCS0   | TIOA5        |          | I/O         | VDDIOP0           |          |          |
| PB4                 | TXD0         |              |          | I/O         | VDDIOP0           |          |          |
| PB5                 | RXD0         |              |          | I/O         | VDDIOP0           |          |          |
| PB6                 | TXD1         | TCLK1        |          | I/O         | VDDIOP0           |          |          |
| PB7                 | RXD1         | TCLK2        |          | I/O         | VDDIOP0           |          |          |
| PB8                 | TXD2         |              |          | I/O         | VDDIOP0           |          |          |
| PB9                 | RXD2         |              |          | I/O         | VDDIOP0           |          |          |
| PB10                | TXD3         | ISI_D8       |          | I/O         | VDDIOP1           |          |          |
| PB11                | RXD3         | ISI_D9       |          | I/O         | VDDIOP1           |          |          |
| PB12 <sup>(1)</sup> | TXD5         | ISI_D10      |          | I/O         | VDDIOP1           |          |          |
| PB13 <sup>(1)</sup> | RXD5         | ISI_D11      |          | I/O         | VDDIOP1           |          |          |
| PB14                | DRXD         |              |          | I/O         | VDDIOP0           |          |          |
| PB15                | DTXD         |              |          | I/O         | VDDIOP0           |          |          |
| PB16                | TK0          | TCLK3        |          | I/O         | VDDIOP0           |          |          |
| PB17                | TF0          | TCLK4        |          | I/O         | VDDIOP0           |          |          |
| PB18                | TD0          | TIOB4        |          | I/O         | VDDIOP0           |          |          |
| PB19                | RD0          | TIOB5        |          | I/O         | VDDIOP0           |          |          |
| PB20                | RK0          | ISI_D0       |          | I/O         | VDDIOP1           |          |          |
| PB21                | RF0          | ISI_D1       |          | I/O         | VDDIOP1           |          |          |
| PB22                | DSR0         | ISI_D2       |          | I/O         | VDDIOP1           |          |          |
| PB23                | DCD0         | ISI_D3       |          | I/O         | VDDIOP1           |          |          |
| PB24                | DTR0         | ISI_D4       |          | I/O         | VDDIOP1           |          |          |
| PB25                | RI0          | ISI_D5       |          | I/O         | VDDIOP1           |          |          |
| PB26                | RTS0         | ISI_D6       |          | I/O         | VDDIOP1           |          |          |
| PB27                | CTS0         | ISI_D7       |          | I/O         | VDDIOP1           |          |          |
| PB28                | RTS1         | ISI_PCK      |          | I/O         | VDDIOP1           |          |          |
| PB29                | CTS1         | ISI_VSYNC    |          | I/O         | VDDIOP1           |          |          |
| PB30                | PCK0         | ISI_HSYNC    |          | I/O         | VDDIOP1           |          |          |
| PB31                | PCK1         |              |          | I/O         | VDDIOP1           |          |          |

Note: 1. Not available in the 208-lead PQFP package.

## 10.3.3 PIO Controller C Multiplexing

**Table 10-4.** Multiplexing on PIO Controller C

| PIO Controller C    |              |              |          |             | Application Usage |          |          |
|---------------------|--------------|--------------|----------|-------------|-------------------|----------|----------|
| I/O Line            | Peripheral A | Peripheral B | Comments | Reset State | Power Supply      | Function | Comments |
| PC0                 |              | SCK3         | AD0      | I/O         | VDDANA            |          |          |
| PC1                 |              | PCK0         | AD1      | I/O         | VDDANA            |          |          |
| PC2 <sup>(1)</sup>  |              | PCK1         | AD2      | I/O         | VDDANA            |          |          |
| PC3 <sup>(1)</sup>  |              | SPI1_NPCS3   | AD3      | I/O         | VDDANA            |          |          |
| PC4                 | A23          | SPI1_NPCS2   |          | A23         | VDDIOM            |          |          |
| PC5                 | A24          | SPI1_NPCS1   |          | A24         | VDDIOM            |          |          |
| PC6                 | TIOB2        | CFCE1        |          | I/O         | VDDIOM            |          |          |
| PC7                 | TIOB1        | CFCE2        |          | I/O         | VDDIOM            |          |          |
| PC8                 | NCS4/CFCS0   | RTS3         |          | I/O         | VDDIOM            |          |          |
| PC9                 | NCS5/CFCS1   | TIOB0        |          | I/O         | VDDIOM            |          |          |
| PC10                | A25/CFRNW    | CTS3         |          | A25         | VDDIOM            |          |          |
| PC11                | NCS2         | SPI0_NPCS1   |          | I/O         | VDDIOM            |          |          |
| PC12 <sup>(1)</sup> | IRQ0         | NCS7         |          | I/O         | VDDIOM            |          |          |
| PC13                | FIQ          | NCS6         |          | I/O         | VDDIOM            |          |          |
| PC14                | NCS3/NANDCS  | IRQ2         |          | I/O         | VDDIOM            |          |          |
| PC15                | NWAIT        | IRQ1         |          | I/O         | VDDIOM            |          |          |
| PC16                | D16          | SPI0_NPCS2   |          | I/O         | VDDIOM            |          |          |
| PC17                | D17          | SPI0_NPCS3   |          | I/O         | VDDIOM            |          |          |
| PC18                | D18          | SPI1_NPCS1   |          | I/O         | VDDIOM            |          |          |
| PC19                | D19          | SPI1_NPCS2   |          | I/O         | VDDIOM            |          |          |
| PC20                | D20          | SPI1_NPCS3   |          | I/O         | VDDIOM            |          |          |
| PC21                | D21          | EF100        |          | I/O         | VDDIOM            |          |          |
| PC22                | D22          | TCLK5        |          | I/O         | VDDIOM            |          |          |
| PC23                | D23          |              |          | I/O         | VDDIOM            |          |          |
| PC24                | D24          |              |          | I/O         | VDDIOM            |          |          |
| PC25                | D25          |              |          | I/O         | VDDIOM            |          |          |
| PC26                | D26          |              |          | I/O         | VDDIOM            |          |          |
| PC27                | D27          |              |          | I/O         | VDDIOM            |          |          |
| PC28                | D28          |              |          | I/O         | VDDIOM            |          |          |
| PC29                | D29          |              |          | I/O         | VDDIOM            |          |          |
| PC30                | D30          |              |          | I/O         | VDDIOM            |          |          |
| PC31                | D31          |              |          | I/O         | VDDIOM            |          |          |

Note: 1. Not available in the 208-lead PQFP package.

## 10.4 Embedded Peripherals

### 10.4.1 Serial Peripheral Interface

- Supports communication with serial external devices
  - Four chip selects with external decoder support allow communication with up to 15 peripherals
  - Serial memories, such as DataFlash and 3-wire EEPROMs
  - Serial peripherals, such as ADCs, DACs, LCD Controllers, CAN Controllers and Sensors
  - External co-processors
- Master or slave serial peripheral bus interface
  - 8- to 16-bit programmable data length per chip select
  - Programmable phase and polarity per chip select
  - Programmable transfer delays between consecutive transfers and between clock and data per chip select
  - Programmable delay between consecutive transfers
  - Selectable mode fault detection
- Very fast transfers supported
  - Transfers with baud rates up to MCK
  - The chip select line may be left active to speed up transfers on the same device

### 10.4.2 Two-wire Interface

- Master, MultiMaster and Slave modes supported
- General Call supported in Slave mode

### 10.4.3 USART

- Programmable Baud Rate Generator
- 5- to 9-bit full-duplex synchronous or asynchronous serial communications
  - 1, 1.5 or 2 stop bits in Asynchronous Mode or 1 or 2 stop bits in Synchronous Mode
  - Parity generation and error detection
  - Framing error detection, overrun error detection
  - MSB- or LSB-first
  - Optional break generation and detection
  - By 8 or by-16 over-sampling receiver frequency
  - Hardware handshaking RTS-CTS
  - Optional modem signal management DTR-DSR-DCD-RI
  - Receiver time-out and transmitter timeguard
  - Optional Multi-drop Mode with address generation and detection
- RS485 with driver control signal
- ISO7816, T = 0 or T = 1 Protocols for interfacing with smart cards
  - NACK handling, error counter with repetition and iteration limit
- IrDA modulation and demodulation

- Communication at up to 115.2 Kbps
- Test Modes
  - Remote Loopback, Local Loopback, Automatic Echo

The USART contains features allowing management of the Modem Signals DTR, DSR, DCD and RI. In the AT91SAM9260, only the USART0 implements these signals, named DTR0, DSR0, DCD0 and RI0.

The USART1 and USART2 do not implement all the modem signals. Only RTS and CTS (RTS1 and CTS1, RTS2 and CTS2, respectively) are implemented in these USARTs for other features.

Thus, programming the USART1, USART2 or the USART3 in Modem Mode may lead to unpredictable results. In these USARTs, the commands relating to the Modem Mode have no effect and the status bits relating the status of the modem signals are never activated.

#### 10.4.4 Serial Synchronous Controller

- Provides serial synchronous communication links used in audio and telecom applications (with CODECs in Master or Slave Modes, I<sup>2</sup>S, TDM Buses, Magnetic Card Reader, etc.)
- Contains an independent receiver and transmitter and a common clock divider
- Offers a configurable frame sync and data length
- Receiver and transmitter can be programmed to start automatically or on detection of different event on the frame sync signal
- Receiver and transmitter include a data signal, a clock signal and a frame synchronization signal

#### 10.4.5 Timer Counter

- Two blocks of three 16-bit Timer Counter channels
- Each channel can be individually programmed to perform a wide range of functions including:
  - Frequency Measurement
  - Event Counting
  - Interval Measurement
  - Pulse Generation
  - Delay Timing
  - Pulse Width Modulation
  - Up/down Capabilities
- Each channel is user-configurable and contains:
  - Three external clock inputs
  - Five internal clock inputs
  - Two multi-purpose input/output signals
- Each block contains two global registers that act on all three TC Channels

Note: TC Block 0 (TC0, TC1, TC2) and TC Block 1 (TC3, TC4, TC5) have identical user interfaces. See [Figure 8-1, “AT91SAM9260 Memory Mapping,” on page 20](#) for TC Block 0 and TC Block 1 base addresses.

#### 10.4.6 Multimedia Card Interface

- One double-channel MultiMedia Card Interface
- Compatibility with MultiMedia Card Specification Version 3.11

- Compatibility with SD Memory Card Specification Version 1.1
- Compatibility with SDIO Specification Version V1.0.
- Card clock rate up to Master Clock divided by 2
- Embedded power management to slow down clock rate when not used
- MCI has two slots, each supporting
  - One slot for one MultiMediaCard bus (up to 30 cards) or
  - One SD Memory Card
- Support for stream, block and multi-block data read and write

#### 10.4.7 USB Host Port

- Compliance with Open HCI Rev 1.0 Specification
- Compliance with USB V2.0 Full-speed and Low-speed Specification
- Supports both Low-Speed 1.5 Mbps and Full-speed 12 Mbps devices
- Root hub integrated with two downstream USB ports in the 217-LFBGA package
- Two embedded USB transceivers
- Supports power management
- Operates as a master on the Matrix

#### 10.4.8 USB Device Port

- USB V2.0 full-speed compliant, 12 MBits per second
- Embedded USB V2.0 full-speed transceiver
- Embedded 2,432-byte dual-port RAM for endpoints
- Suspend/Resume logic
- Ping-pong mode (two memory banks) for isochronous and bulk endpoints
- Six general-purpose endpoints
  - Endpoint 0 and 3: 64 bytes, no ping-pong mode
  - Endpoint 1 and 2: 64 bytes, ping-pong mode
  - Endpoint 4 and 5: 512 bytes, ping-pong mode
- Embedded pad pull-up

#### 10.4.9 Ethernet 10/100 MAC

- Compatibility with IEEE Standard 802.3
- 10 and 100 MBits per second data throughput capability
- Full- and half-duplex operations
- MII or RMI interface to the physical layer
- Register Interface to address, data, status and control registers
- DMA Interface, operating as a master on the Memory Controller
- Interrupt generation to signal receive and transmit completion
- 28-byte transmit and 28-byte receive FIFOs
- Automatic pad and CRC generation on transmitted frames
- Address checking logic to recognize four 48-bit addresses
- Support promiscuous mode where all valid frames are copied to memory

- Support physical layer management through MDIO interface

#### **10.4.10 Image Sensor Interface**

- ITU-R BT. 601/656 8-bit mode external interface support
- Support for ITU-R BT.656-4 SAV and EAV synchronization
- Vertical and horizontal resolutions up to 2048 x 2048
- Preview Path up to 640\*480
- Support for packed data formatting for YCbCr 4:2:2 formats
- Preview scaler to generate smaller size image
- Programmable frame capture rate

#### **10.4.11 Analog-to-Digital Converter**

- 4-channel ADC
- 10-bit 312K samples/sec. Successive Approximation Register ADC
- -2/+2 LSB Integral Non Linearity, -1/+1 LSB Differential Non Linearity
- Individual enable and disable of each channel
- External voltage reference for better accuracy on low voltage inputs
- Multiple trigger source – Hardware or software trigger – External trigger pin – Timer Counter 0 to 2 outputs TIOA0 to TIOA2 trigger
- Sleep Mode and conversion sequencer – Automatic wakeup on trigger and back to sleep mode after conversions of all enabled channels
- Four analog inputs shared with digital signals

# 11. AT91SAM9260 Mechanical Characteristics

## 11.1 Package Drawings

Figure 11-1. 217-ball LFBGA Package Drawing

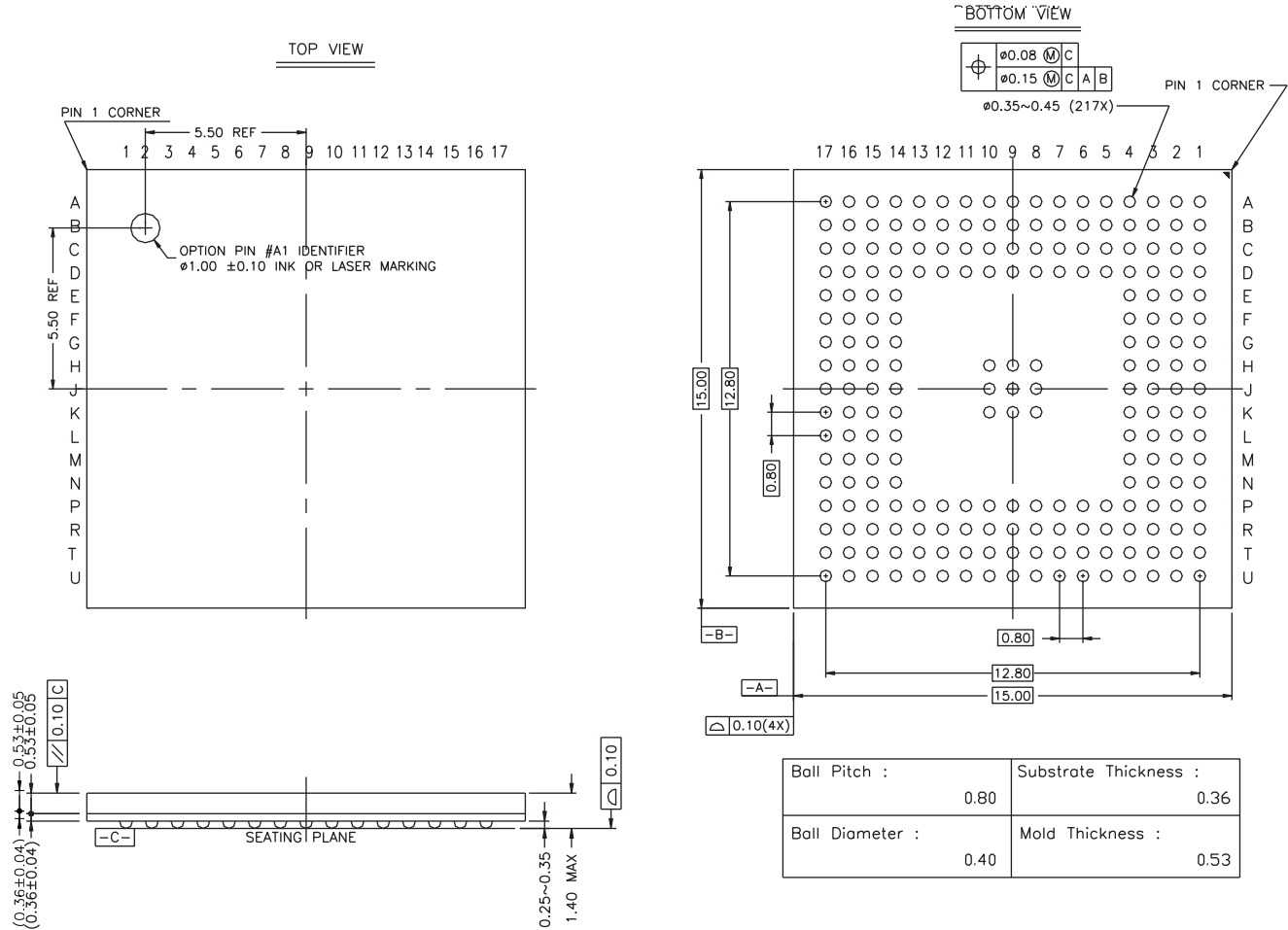


Table 11-1. Soldering Informations

|                        |                  |
|------------------------|------------------|
| Ball Land              | 0.43 mm +/- 0.05 |
| Soldering Mask Opening | 0.30 mm +/- 0.05 |

Table 11-2. Device and 217-ball LFBGA Package Maximum Weight

|     |    |
|-----|----|
| 450 | mg |
|-----|----|

Table 11-3. 217-ball LFBGA Package Characteristics

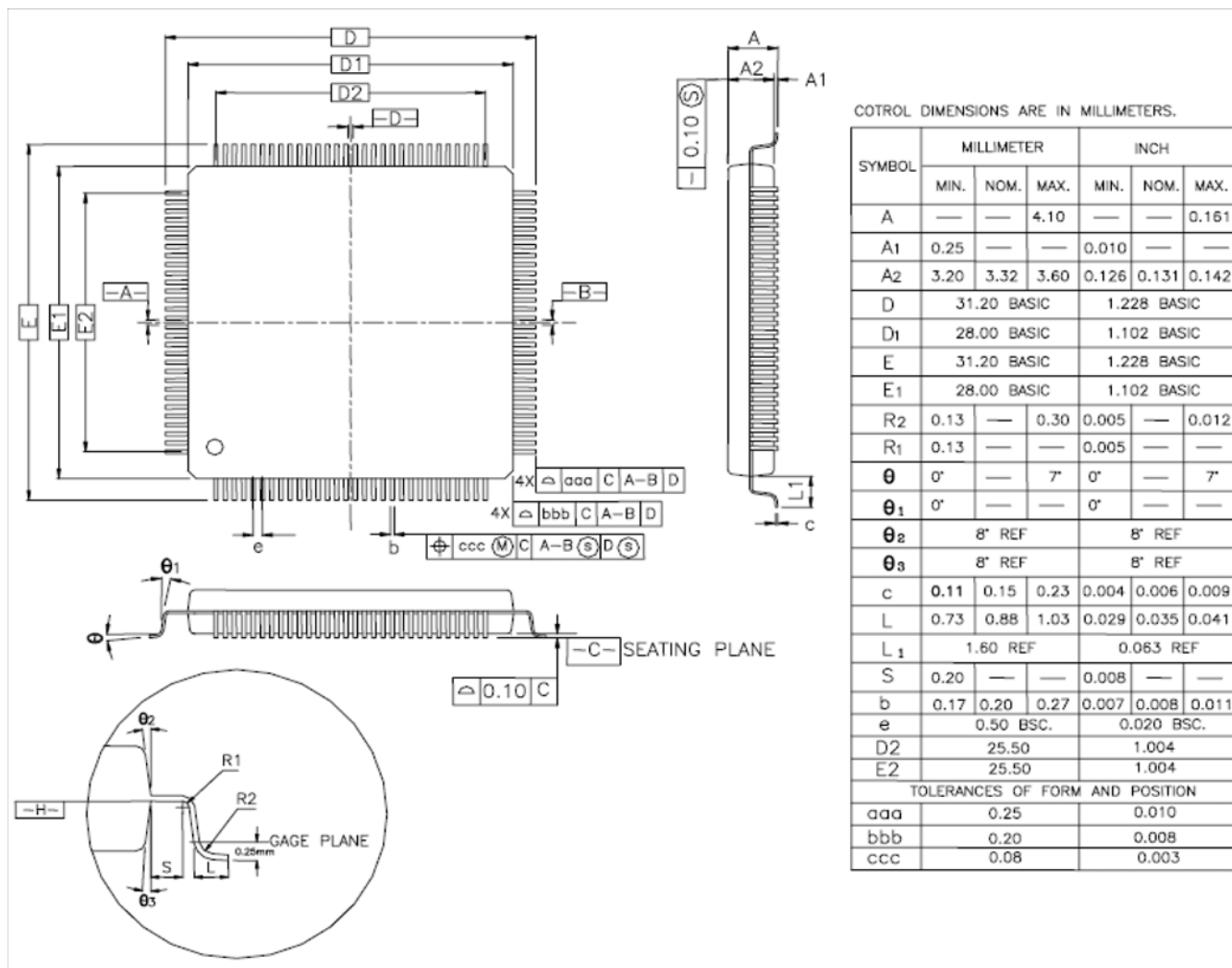
|                            |   |
|----------------------------|---|
| Moisture Sensitivity Level | 3 |
|----------------------------|---|

Table 11-4. Package Reference

|                         |        |
|-------------------------|--------|
| JEDEC Drawing Reference | MO-205 |
| JESD97 Classification   | e1     |



**Figure 11-2.** 208-lead PQFP Package Drawing



**Table 11-5.** Device and 208-lead PQFP Package Maximum Weight

|     |   |
|-----|---|
| 5.5 | g |
|-----|---|

**Table 11-6.** 208-lead PQFP Package Characteristics

|                            |   |
|----------------------------|---|
| Moisture Sensitivity Level | 3 |
|----------------------------|---|

**Table 11-7.** Package Reference

|                         |        |
|-------------------------|--------|
| JEDEC Drawing Reference | MS-022 |
| JESD97 Classification   | e3     |

## 11.2 Soldering Profile

Table 11-8 gives the recommended soldering profile from J-STD-20.

**Table 11-8.** Soldering Profile

| Profile Feature                             | PQFP208 Green Package | BGA217 Green Package |
|---|-----------------------|----------------------|
| Average Ramp-up Rate (217°C to Peak)        | 3° C/sec. max.        | 3° C/sec. max.       |
| Preheat Temperature 175°C ±25°C             | 180 sec. max.         | 180 sec. max.        |
| Temperature Maintained Above 217°C          | 60 sec. to 150 sec.   | 60 sec. to 150 sec.  |
| Time within 5° C of Actual Peak Temperature | 20 sec. to 40 sec.    | 20 sec. to 40 sec.   |
| Peak Temperature Range                      | 260 +0 °C             | 260 +0 °C            |
| Ramp-down Rate                              | 6° C/sec. max.        | 6° C/sec. max.       |
| Time 25° C to Peak Temperature              | 8 min. max.           | 8 min. max.          |

Note: It is recommended to apply a soldering temperature higher than 250°C  
A maximum of three reflow passes is allowed per component.

## 12. AT91SAM9260 Ordering Information

**Table 12-1.** AT91SAM9260 Ordering Information

| Marketing Revision Level A<br>Ordering Code | Marketing Revision Level B<br>Ordering Code | Package | Package Type | Temperature Operating<br>Range |
|---|---|---------|--------------|--------------------------------|
| AT91SAM9260-QU                              | AT91SAM9260B-QU                             | PQFP208 | Green        | Industrial<br>-40°C to 85°C    |
| AT91SAM9260-CU                              | AT91SAM9260B-CU                             | BGA217  | Green        |                                |

## 13. Revision History

**Table 13-1.** Revision History - current version appears first

| Revision | Comments  | Change Req. Ref. |
|----------|---|------------------|
| 6221JS   | Line added to • "Debug Unit (DBGU)" on page 2   | 5846             |
|          | Note edited after Table 10-1, "AT91SAM9260 Peripheral Identifiers" on page 31   | 5854             |
|          | 'Manchester Encoding/Decoding' removed from Section • "Four Universal Synchronous/Asynchronous Receiver Transmitters (USART)" on page 2   | 5933             |
|          | Section 6.6 "Shutdown Logic Pins" on page 15 edited   | 6030             |
|          | Features list shortened and reorganized, from new structure in Datasheet AT91SAM9G45  | RFO              |
| 6221IS   |  Section 12. "AT91SAM9260 Ordering Information" on page 43, New Ordering codes for Version B added.  | 5686             |
|          | Table 3-1, "Signal Description List", Image Sensor Interface, ISI_MCK line, added comments.   | 5330             |
|          | Table 10-3, "Multiplexing on PIO Controller B", PB31 line, removed ISI_MCK.   | 5422             |
|          | Table 3-1, "Signal Description List", Reset/Test, BMS line, added comments.   |                  |
| 6221HS   | "Power Considerations", in Section 5.1 "Power Supplies", VDDCORE and VDDDBU startup voltage restraints removed.   | 5229             |
| 6221GS   | Updated all references to 217-ball LFBGA to Green package.  | Review           |
|          | In Section 5.1 "Power Supplies" on page 14, VDDCORE and VDDDBU, added information on supply voltage during startup.   | Review           |
|          | In Section 6.5 "I/O Line Drive Levels" on page 16, added information on PC4 to PC31.  | Review           |
|          | In Section 6.7 "Slow Clock Selection" on page 16, corrected startup delay for internal RC oscillator.   | Review           |
|          | In Section 10.4.6 "Multimedia Card Interface" on page 38, corrected specification version compatibility.  | 4944             |
|          | In Section 8.1.1 "Boot Strategies" on page 22, removed sentence "When REMAP = 1, BMS is ignored."   | 5026             |
|          | Changed divider value for Master Clock Controller in Figure 9-3, "AT91SAM9260 Power Management Controller Block Diagram" on page 30.  | 4833             |
|          | Corrected package reference to PQFP in Figure 11-2, "208-lead PQFP Package Drawing," on page 41.  | 4740             |
|          | Updated BGA ordering code in Section 43. "AT91SAM9260 Ordering Information" on page 780.  | 4768             |
| 6221FS   |  All new information in Section 7.2.1 "Matrix Masters", Table 7-1, "List of Bus Matrix Masters," on page 18 and Section 7.2.3 "Master to Slave Access", Table 7-3, "AT91SAM9260 Masters to Slaves Access," on page 18. | 4457             |
|          | In Figure 2-1 "AT91SAM9260 Block Diagram" on page 4, updated EBI signals NRD, NWR0, NWR1, NWR3.   | 4431             |
|          | Added details on Timer/Counter blocks in Section 10.4.5 "Timer Counter" on page 38.   | 4369             |
|          | Updated Chip ID in Section 9.12 "Chip Identification" on page 32.   | 4582             |

**Table 13-1.** Revision History - current version appears first

| Revision | Comments   | Change Req. Ref. |
|----------|--|------------------|
| 6221ES   | Updated information on programmable pull-up resistor in <a href="#">Section 6.4 "PIO Controllers" on page 15</a> .   | 3972             |
|          | Updated <a href="#">Section 6.7 "Slow Clock Selection" on page 15</a> .  |                  |
|          | In <a href="#">Table 10-1, "AT91SAM9260 Peripheral Identifiers," on page 31</a> , added Note on clocking and corrected Peripheral Name for PID12, PID13 and PID14.   | 3504 and 3543    |
|          | Placed comment on RDY/BUSY with PC13 in <a href="#">Table 10-4, "Multiplexing on PIO Controller C," on page 35</a> .   | 3406             |
| 6221DS   | Removed references to VDDOSC in "Features", in <a href="#">Table 3-1, "Signal Description List"</a> , and in <a href="#">Section 5.1 "Power Supplies" on page 13</a> . Corrected VDDPLLA and VDDPLLB with VDDPLL and GNDPLLA and GNDPLLB with GNDPLL in <a href="#">Table 4-1, "Pinout for 208-pin PQFP Package," on page 10</a> and in <a href="#">Table 4-2, "Pinout for 217-ball LFBGA Package," on page 12</a> . | 3183             |
|          | In <a href="#">Figure 2-1 on page 3</a> , corrected range for SCKx pins; label change on matrix block.   | 3235, 3071       |
|          | In <a href="#">Figure 2-1 on page 3</a> and <a href="#">Section 7.3 "Peripheral DMA Controller" on page 18</a> , removed TWI PDC channels.   | 3066             |
|          | In <a href="#">Section 6.3 "Reset Pins" on page 14</a> , added NRST as bidirectional.  | 3236             |
|          | In <a href="#">Figure 9-3 on page 29</a> , added UHPCK as USB Clock Controller output.   | 3237             |
|          | In <a href="#">Section 10.4.3 "USART" on page 36</a> , added information on modem signals.   | 3245             |
| 6221CS   | For VDDIOP1, added supported voltage levels in <a href="#">Table 3-1, "Signal Description List," on page 4</a> and corrected supported voltage levels in <a href="#">Section 5.2 "Power Consumption" on page 13</a> .  | 2874             |
|          | Removed package marking and updated package outline information in <a href="#">Section 4. "Package and Pinout" on page 9</a> .   | 2922             |
|          | Change to signal name for pin 147 in <a href="#">Section 4-1 "Pinout for 208-pin PQFP Package" on page 10</a> .  | 2907             |
|          | Inserted new voltage information for JTAGSEL signal in <a href="#">Table 3-1, "Signal Description List"</a> and in <a href="#">Section 6.1 "JTAG Port Pins" on page 14</a> .   | 2947             |
|          | In <a href="#">Table 3-1, "Signal Description List," on page 5</a> , added new voltage information for OSCSEL and TST pins.  | 2979             |
|          | In <a href="#">Section 6.3 "Reset Pins" on page 15</a> , new information on NRST and NRTST pins.   | 3003             |
|          | Corrected ADC features in <a href="#">Section 10.4.11 "Analog-to-Digital Converter" on page 39</a> .   | 2923             |
| 6221BS   | Power consumption figures updated with current values in <a href="#">Section 5.2 "Power Consumption" on page 13</a> .  | 2843             |
|          | Change to signal name for pin 47 in <a href="#">Section 4-1 "Pinout for 208-pin PQFP Package" on page 10</a> .   |                  |
| 6221AS   | First issue.   |                  |





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