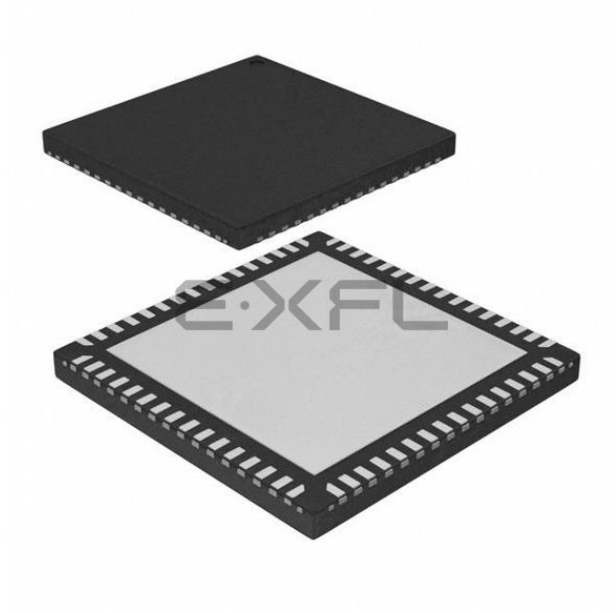

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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	ARM® Cortex®-M3
Core Size	32-Bit Single-Core
Speed	48MHz
Connectivity	I²C, IrDA, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, POR, PWM, WDT
Number of I/O	47
Program Memory Size	64KB (64K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	8K x 8
Voltage - Supply (Vcc/Vdd)	1.62V ~ 3.6V
Data Converters	A/D 10x10b; D/A 1x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	64-VFQFN Exposed Pad
Supplier Device Package	64-QFN (9x9)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/atsam3n1bb-mur

1. SAM3N Description

Atmel's SAM3N series is a member of a family of Flash microcontrollers based on the high performance 32-bit ARM Cortex-M3 RISC processor. It operates at a maximum speed of 48 MHz and features up to 256 Kbytes of Flash and up to 24 Kbytes of SRAM. The peripheral set includes 2x USARTs, 2x UARTs, 2x TWIs, 3x SPI, as well as 1 PWM timer, 6x general purpose 16-bit timers, an RTC, a 10-bit ADC and a 10-bit DAC.

The SAM3N series is ready for capacitive touch thanks to the QTouch library, offering an easy way to implement buttons, wheels and sliders.

The SAM3N device is an entry-level general purpose microcontroller. That makes the SAM3N the ideal starting point to move from 8- /16-bit to 32-bit microcontrollers.

It operates from 1.62V to 3.6V and is available in 48-pin, 64-pin and 100-pin QFP, 48-pin and 64-pin QFN, and 100-pin BGA packages.

The SAM3N series is the ideal migration path from the SAM3S for applications that require a reduced BOM cost. The SAM3N series is pin-to-pin compatible with the SAM3S series. Its aggressive price point and high level of integration pushes its scope of use far into cost-sensitive, high-volume applications.

1.1 Configuration Summary

The SAM3N4/2/1/0/00 differ in memory size, package and features list. Table 1-1 summarizes the configurations of the 9 devices.

Table 1-1. Configuration Summary

Device	Flash	SRAM	Package	Number of PIOs	ADC	Timer	PDC Channels	USART	DAC
SAM3N4A	256 Kbytes	24 Kbytes	LQFP48 QFN48	34	8 channels	6(1)	8	1	_
SAM3N4B	256 Kbytes	24 Kbytes	LQFP64 QFN64	47	10 channels	6(2)	10	2	1
SAM3N4C	256 Kbytes	24 Kbytes	LQFP100 BGA100	79	16 channels	6	10	2	1
SAM3N2A	128 Kbytes	16 Kbytes	LQFP48 QFN48	34	8 channels	6(1)	8	1	_
SAM3N2B	128 Kbytes	16 Kbytes	LQFP64 QFN64	47	10 channels	6((2)	10	2	1
SAM3N2C	128 Kbytes	16 Kbytes	LQFP100 BGA100	79	16 channels	6	10	2	1
SAM3N1A	64 Kbytes	8 Kbytes	LQFP48 QFN48	34	8 channels	6(1)	8	1	_
SAM3N1B	64 Kbytes	8 Kbytes	LQFP64 QFN64	47	10 channels	6(2)	10	2	1
SAM3N1C	64 Kbytes	8 Kbytes	LQFP100 BGA100	79	16 channels	6	10	2	1
SAM3N0A	32 Kbytes	8 Kbytes	LQFP48 QFN48	34	8 channels	6(1)	8	1	_
SAM3N0B	32 Kbytes	8 Kbytes	LQFP64 QFN64	47	10 channels	6(2)	10	2	1
SAM3N0C	32 Kbytes	8 Kbytes	LQFP100 BGA100	79	16 channels	6	10	2	1
SAM3N00A	16 Kbytes	4 KBytes	LQFP48 QFN48	34	8 channels	6(1)	8	1	_
SAM3N00B	16 Kbytes	4 KBytes	LQFP64 QFN64	47	10 channels	6(2)	10	2	1

Notes: 1. Only two TC channels are accessible through the PIO.
2. Only three TC channels are accessible through the PIO.

Figure 2-2. SAM3N 64-pin version Block Diagram

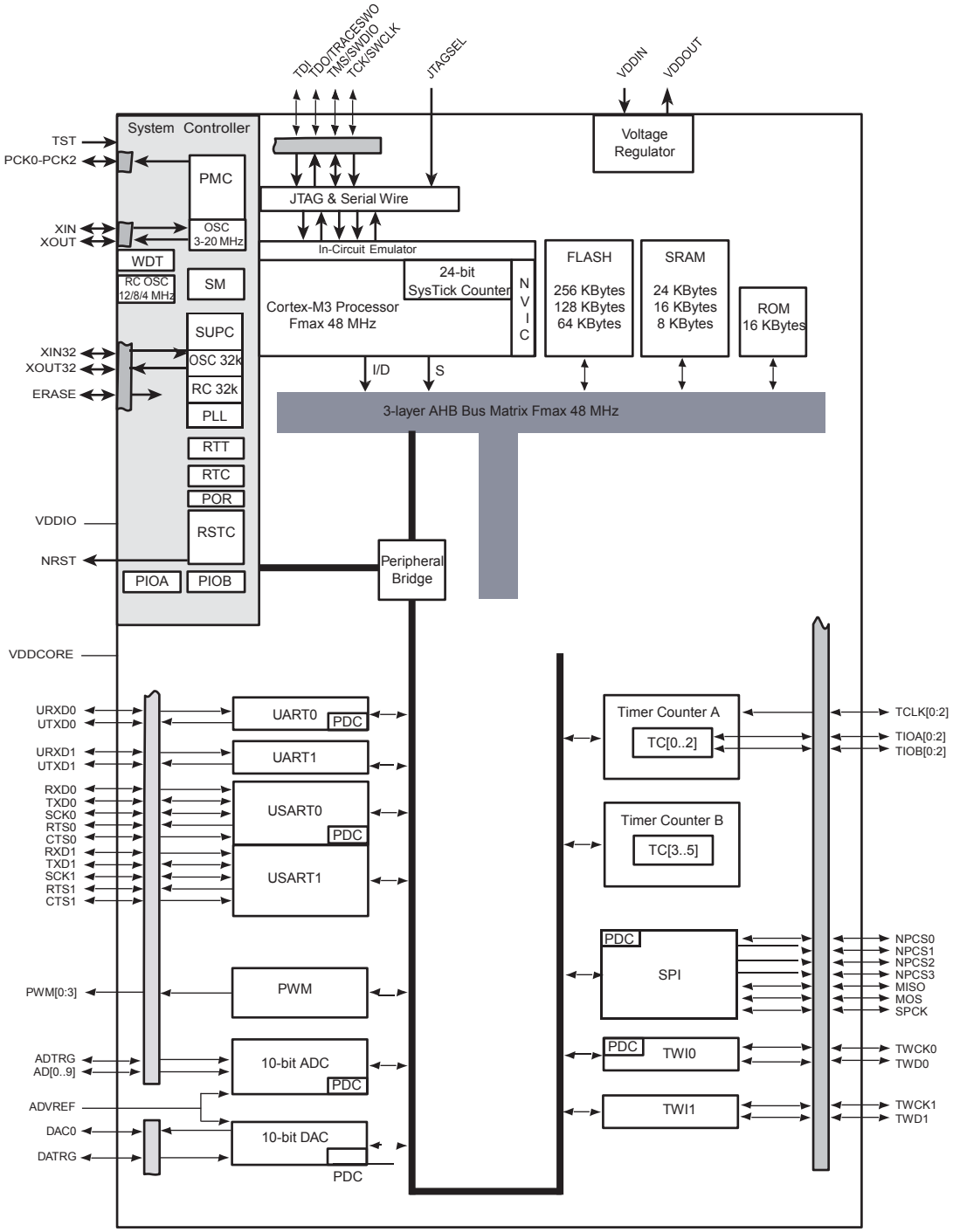


Table 3-1. Signal Description List (Continued)

Signal Name	Function	Type	Active Level	Voltage Reference	Comments
Serial Peripheral Interface - SPI					
MISO	Master In Slave Out	I/O			
MOSI	Master Out Slave In	I/O			
SPCK	SPI Serial Clock	I/O			
SPI_NPCS0	SPI Peripheral Chip Select 0	I/O	Low		
SPI_NPCS1 - SPI_NPCS3	SPI Peripheral Chip Select	Output	Low		
Two-Wire Interface- TWIx					
TWDx	TWIx Two-wire Serial Data	I/O			
TWCKx	TWIx Two-wire Serial Clock	I/O			
Analog					
ADVREF	ADC and DAC Reference	Analog			
10-bit Analog-to-Digital Converter - ADC					
AD0 - AD15	Analog Inputs	Analog			
ADTRG	ADC Trigger	Input		VDDIO	
Digital-to-Analog Converter Controller- DACC					
DAC0	DACC channel analog output	Analog			
DATRG	DACC Trigger	Input		VDDIO	
Fast Flash Programming Interface					
PGMEN0-PGMEN2	Programming Enabling	Input		VDDIO	
PGMM0-PGMM3	Programming Mode	Input			
PGMD0-PGMD15	Programming Data	I/O			
PGMRDY	Programming Ready	Output	High		
PGMNVALID	Data Direction	Output	Low		
PGMNOE	Programming Read	Input	Low		
PGMCK	Programming Clock	Input			
PGMNCMD	Programming Command	Input	Low		

Notes: 1. Schmitt Triggers can be disabled through PIO registers.
2. Some PIO lines are shared with System IOs.
3. See Section 5.3 “Typical Powering Schematics” for restriction on voltage range of Analog Cells.

4.1.4 100-ball TFBGA Pinout

Table 4-2. 100-ball TFBGA SAM3N4/2/1/0/00C Pinout

A1	PB1	C6	PB7	F1	PA18	H6	PC4
A2	PC29	C7	PC16	F2	PC26	H7	PA11
A3	VDDIO	C8	PA1	F3	VDDOUT	H8	PC1
A4	PB9	C9	PC17	F4	GND	H9	PA6
A5	PB8	C10	PA0	F5	VDDIO	H10	PB4
A6	PB13	D1	PB3	F6	PA27	J1	PC15
A7	PB11	D2	PB0	F7	PC8	J2	PC0
A8	PB10	D3	PC24	F8	PA28	J3	PA16
A9	PB6	D4	PC22	F9	TST	J4	PC6
A10	JTAGSEL	D5	GND	F10	PC9	J5	PA24
B1	PC30	D6	GND	G1	PA21	J6	PA25
B2	ADVREF	D7	VDDCORE	G2	PC27	J7	PA10
B3	GNDANA	D8	PA2	G3	PA15	J8	GND
B4	PB14	D9	PC11	G4	VDDCORE	J9	VDDCORE
B5	PC21	D10	PC14	G5	VDDCORE	J10	VDDIO
B6	PC20	E1	PA17	G6	PA26	K1	PA22
B7	PA31	E2	PC31	G7	PA12	K2	PC13
B8	PC19	E3	VDDIN	G8	PC28	K3	PC12
B9	PC18	E4	GND	G9	PA4	K4	PA20
B10	PB5	E5	GND	G10	PA5	K5	PC5
C1	PB2	E6	NRST	H1	PA19	K6	PC3
C2	VDDPLL	E7	PA29	H2	PA23	K7	PC2
C3	PC25	E8	PA30	H3	PC7	K8	PA9
C4	PC23	E9	PC10	H4	PA14	K9	PA8
C5	PB12	E10	PA3	H5	PA13	K10	PA7

4.2 SAM3N4/2/1/0/00B Package and Pinout

Figure 4-3. Orientation of the 64-pad QFN Package

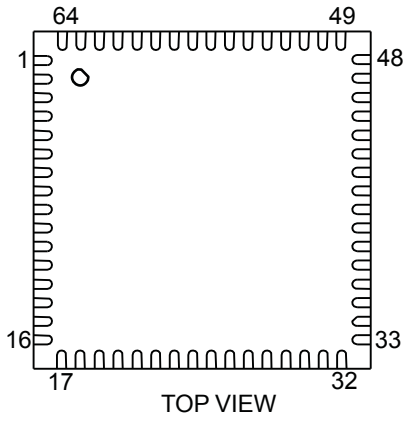
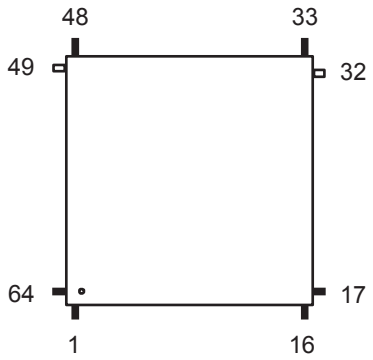


Figure 4-4. Orientation of the 64-lead LQFP Package



4.2.1 64-Lead LQFP and QFN Pinout

64-pin version SAM3N devices are pin-to-pin compatible with SAM3S products. Furthermore, SAM3N products have new functionalities shown in italic in Table 4-3.

Table 4-3. 64-pin SAM3N4/2/1/0/00B Pinout

1	ADVREF	17	GND	33	*TDI/PB4*	49	*TDO/TRACESWO/PB5*
2	GND	18	VDDIO	34	PA6/PGMNOE	50	JTAGSEL
3	*PB0/AD4*	19	PA16/PGMD4	35	PA5/PGMRDY	51	*TMS/SWDIO/PB6*
4	*PB1AD5*	20	PA15/PGMD3	36	PA4/PGMNCMD	52	PA31
5	*PB2/AD6*	21	PA14/PGMD2	37	PA27/PGMD15	53	*TCK/SWCLK/PB7*
6	*PB3/AD7*	22	PA13/PGMD1	38	PA28	54	VDDCORE
7	VDDIN	23	PA24/PGMD12	39	NRST	55	*ERASE/PB12*
8	VDDOUT	24	VDDCORE	40	TST	56	*PB10*
9	PA17/PGMD5/AD0	25	PA25/PGMD13	41	PA29	57	*PB11*
10	PA18/PGMD6/AD1	26	PA26/PGMD14	42	PA30	58	VDDIO
11	PA21/PGMD9/AD8	27	PA12/PGMD0	43	PA3	59	*PB13/DAC0*
12	VDDCORE	28	PA11/PGMM3	44	PA2/PGMEN2	60	GND
13	PA19/PGMD7/AD2	29	PA10/PGMM2	45	VDDIO	61	*XOUT/PB8*
14	PA22/PGMD10/AD9	30	PA9/PGMM1	46	GND	62	*XIN/PGMCK/PB9*
15	PA23/PGMD11	31	PA8/XOUT32/PGMM0	47	PA1/PGMEN1	63	*PB14*
16	PA20/PGMD8/AD3	32	PA7/XIN32/XOUT32/PGMNVALID	48	PA0/PGMEN0	64	VDDPLL

Note: The bottom pad of the QFN package must be connected to ground.

4.3 SAM3N4/2/1/0/00A Package and Pinout

Figure 4-5. Orientation of the 48-pad QFN Package

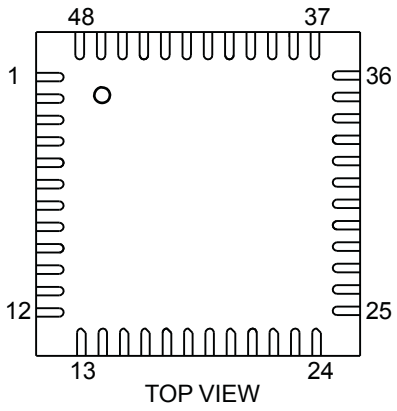


Figure 4-6. Orientation of the 48-lead LQFP Package

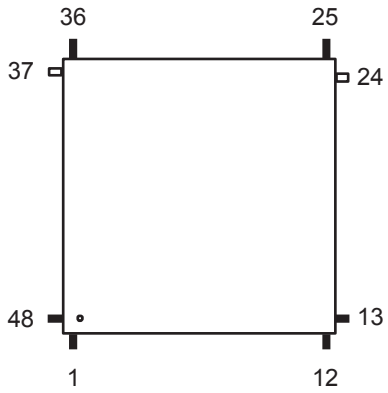


Figure 5-1. Single Supply

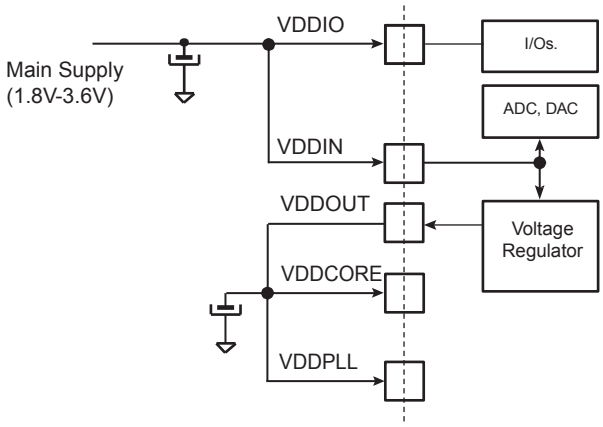
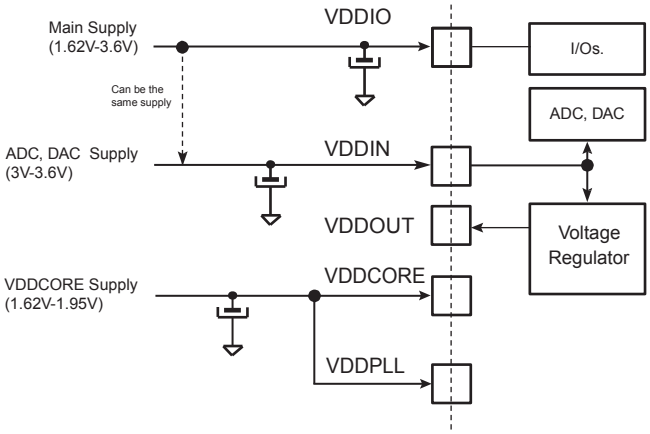


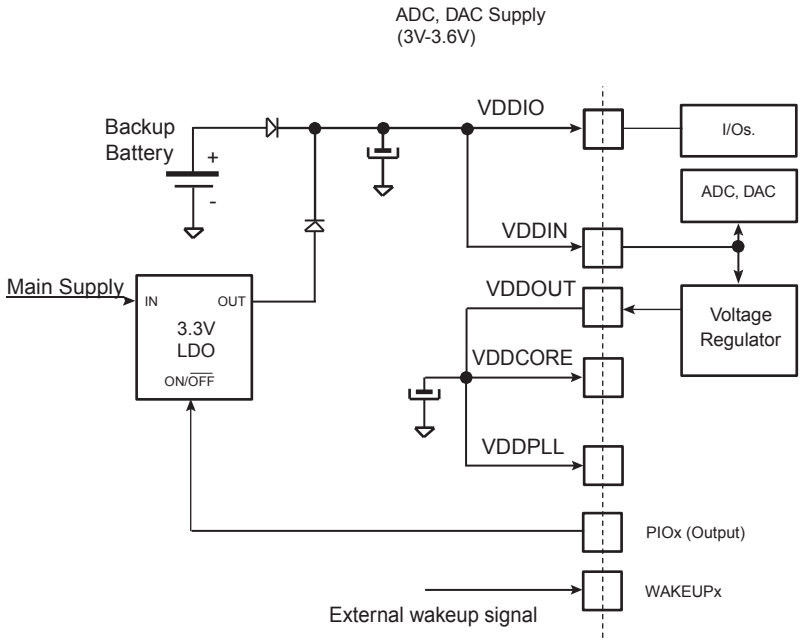
Figure 5-2. Core Externally Supplied



Note: Restrictions
With Main Supply < 3V, ADC and DAC are not usable.
With Main Supply >= 3V, all peripherals are usable.

Figure 5-3 below provides an example of the powering scheme when using a backup battery. Since the PIO state is preserved when in backup mode, any free PIO line can be used to switch off the external regulator by driving the PIO line at low level (PIO is input, pull-up enabled after backup reset). External wake-up of the system can be from a push button or any signal. See Section 5.6 “Wake-up Sources” for further details.TFBGA

Figure 5-3. Core Externally Supplied (backup battery)



Note: The two diodes provide a "switchover circuit" (for illustration purpose) between the backup battery and the main supply when the system is put in backup mode.

5.4 Active Mode

Active mode is the normal running mode with the core clock running from the fast RC oscillator, the main crystal oscillator or the PLL. The power management controller can be used to adapt the frequency and to disable the peripheral clocks.

5.5 Low Power Modes

The various low-power modes of the SAM3N are described below:

5.5.1 Backup Mode

The purpose of backup mode is to achieve the lowest power consumption possible in a system that is performing periodic wakeups to carry out tasks but not requiring fast startup time (<0.1ms). Total current consumption is 3 µA typical.

The Supply Controller, zero-power power-on reset, RTT, RTC, Backup registers and 32 kHz oscillator (RC or crystal oscillator selected by software in the Supply Controller) are running. The regulator and the core supply are off.

Backup mode is based on the Cortex-M3 deep sleep mode with the voltage regulator disabled.

The SAM3N can be awakened from this mode through WUP0-15 pins, the supply monitor (SM), the RTT or RTC wake-up event.

Backup mode is entered by using WFE instructions with the SLEEPDEEP bit in the System Control Register of the Cortex-M3 set to 1. (See the Power management description in The ARM Cortex M3 Processor section of the product datasheet).

Exit from Backup mode happens if one of the following enable wake-up events occurs:

- WKUPEN0-15 pins (level transition, configurable debouncing)

- Supply Monitor alarm
- RTC alarm
- RTT alarm

5.5.2 Wait Mode

The purpose of the wait mode is to achieve very low power consumption while maintaining the whole device in a powered state for a startup time of less than 10 µs. Current Consumption in Wait mode is typically 15 µA (total current consumption) if the internal voltage regulator is used or 8 µA if an external regulator is used.

In this mode, the clocks of the core, peripherals and memories are stopped. However, the core, peripherals and memories power supplies are still powered. From this mode, a fast start up is available.

This mode is entered via Wait for Event (WFE) instructions with LPM = 1 (Low Power Mode bit in PMC_FSMR). The Cortex-M3 is able to handle external or internal events in order to wake up the core (WFE). By configuring the WUP0-15 external lines as fast startup wake-up pins (refer to Section 5.7 “Fast Start-Up”). RTC or RTT Alarm wake-up events can be used to wake up the CPU (exit from WFE).

Entering Wait Mode:

- Select the 4/8/12 MHz fast RC oscillator as Main Clock
- Set the LPM bit in the PMC Fast Startup Mode Register (PMC_FSMR)
- Execute the Wait-For-Event (WFE) instruction of the processor

Note: Internal Main clock resynchronization cycles are necessary between the writing of MOSCRCEN bit and the effective entry in Wait mode. Depending on the user application, Waiting for MOSCRCEN bit to be cleared is recommended to ensure that the core will not execute undesired instructions.

5.5.3 Sleep Mode

The purpose of sleep mode is to optimize power consumption of the device versus response time. In this mode, only the core clock is stopped. The peripheral clocks can be enabled. The current consumption in this mode is application dependent.

This mode is entered via Wait for Interrupt (WFI) or Wait for Event (WFE) instructions with LPM = 0 in PMC_FSMR.

The processor can be woke up from an interrupt if WFI instruction of the Cortex M3 is used, or from an event if the WFE instruction is used to enter this mode.

5.5.4 Low Power Mode Summary Table

The modes detailed above are the main low power modes. Each part can be set to on or off separately and wake up sources can be individually configured. Table 5-1 below shows a summary of the configurations of the low power modes.

Table 5-1. Low Power Mode Configuration Summary

Mode	SUPC, 32 kHz Oscillator RTC RTT Backup Registers, POR (Backup Region)	Regulator	Core Memory Peripherals	Mode Entry	Potential Wake Up Sources	Core at Wake Up	PIO State while in Low Power Mode	PIO State at Wake Up	Consumption (2) (3)	Wake Up Time(1)
Backup Mode	ON	OFF	OFF (Not powered)	WFE +SLEEPDEEP bit = 1	WUP0-15 pins BOD alarm RTC alarm RTT alarm	Reset	Previous state saved	PIOA & PIOB & PIOC Inputs with pull ups	3 µA typ(4)	< 0.1 ms
Wait Mode	ON	ON	Powered (Not clocked)	WFE +SLEEPDEEP bit = 0 +LPM bit = 1	Any Event from: Fast startup through WUP0-15 pins RTC alarm RTT alarm	Clocked back	Previous state saved	Unchanged	5 µA/15 µA (5)	< 10 µs
Sleep Mode	ON	ON	Powered(7) (Not clocked)	WFE or WFI +SLEEPDEEP bit = 0 +LPM bit = 0	Entry mode = WFI Interrupt Only; Entry mode = WFE Any Enabled Interrupt and/or Any Event from: Fast start-up through WUP0-15 pins RTC alarm RTT alarm	Clocked back	Previous state saved	Unchanged	(6)	(6)

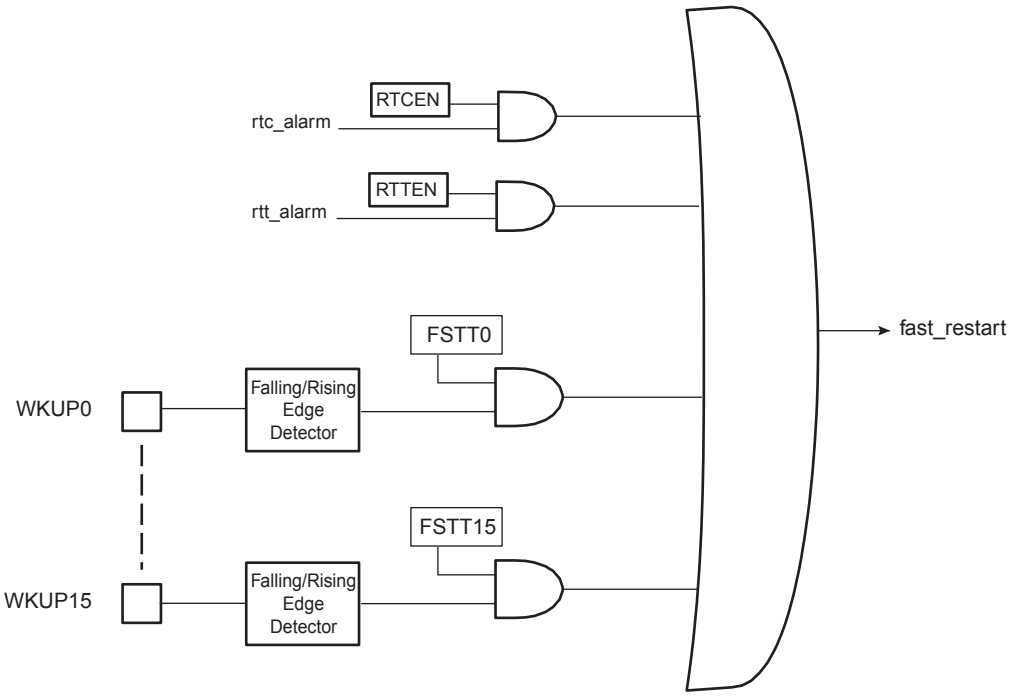
Notes:
1. When considering wake-up time, the time required to start the PLL is not taken into account. Once started, the device works with the 4/8/12 MHz Fast RC oscillator. The user has to add the PLL start-up time if it is needed in the system. The wake-up time is defined as the time taken for wake up until the first instruction is fetched.
2. The external loads on PIOs are not taken into account in the calculation.
3. Supply Monitor current consumption is not included.
4. Total Current consumption.
5. 5 µA on VDDCORE, 15 µA for total current consumption (using internal voltage regulator), 8 µA for total current consumption (without using internal voltage regulator).
6. Depends on MCK frequency.
7. In this mode the core is supplied and not clocked but some peripherals can be clocked.

5.7 Fast Start-Up

The SAM3N allows the processor to restart in a few microseconds while the processor is in wait mode. A fast start up can occur upon detection of a low level on one of the 19 wake-up inputs (WKUP0 to 15 + SM + RTC + RTT).

The fast restart circuitry, as shown in Figure 5-5, is fully asynchronous and provides a fast start-up signal to the Power Management Controller. As soon as the fast start-up signal is asserted, the PMC automatically restarts the embedded 4 MHz fast RC oscillator, switches the master clock on this 4 MHz clock and reenables the processor clock.

Figure 5-5. Fast Start-Up Sources



6. Input/Output Lines

The SAM3N has several kinds of input/output (I/O) lines such as general purpose I/Os (GPIO) and system I/Os. GPIOs can have alternate functionality due to multiplexing capabilities of the PIO controllers. The same PIO line can be used whether in IO mode or by the multiplexed peripheral. System I/Os include pins such as test pins, oscillators, erase or analog inputs.

6.1 General Purpose I/O Lines

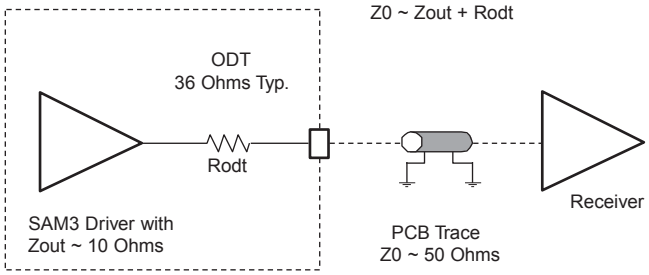
GPIO Lines are managed by PIO Controllers. All I/Os have several input or output modes such as pull-up or pull-down, input Schmitt triggers, multi-drive (open-drain), glitch filters, debouncing or input change interrupt. Programming of these modes is performed independently for each I/O line through the PIO controller user interface. For more details, refer to the product PIO controller section.

The input output buffers of the PIO lines are supplied through VDDIO power supply rail.

The SAM3N embeds high speed pads able to handle up to 45 MHz for SPI clock lines and 35 MHz on other lines. See AC Characteristics Section in the Electrical Characteristics Section of the datasheet for more details. Typical pull-up and pull-down value is 100 kΩ for all I/Os.

Each I/O line also embeds an ODT (On-Die Termination), (see Figure 6-1). It consists of an internal series resistor termination scheme for impedance matching between the driver output (SAM3N) and the PCB trace impedance preventing signal reflection. The series resistor helps to reduce I/O switching current (di/dt) thereby reducing in turn, EMI. It also decreases overshoot and undershoot (ringing) due to inductance of interconnect between devices or between boards. In conclusion ODT helps diminish signal integrity issues.

Figure 6-1. On-Die Termination



6.2 System I/O Lines

System I/O lines are pins used by oscillators, test mode, reset and JTAG to name but a few. Described below are the SAM3N system I/O lines shared with PIO lines:

These pins are software configurable as general purpose I/O or system pins. At startup the default function of these pins is always used.

9.1.3.4 Flash Speed

The user needs to set the number of wait states depending on the frequency used.

For more details, refer to the AC Characteristics sub section in the product Electrical Characteristics Section.

9.1.3.5 Lock Regions

Several lock bits used to protect write and erase operations on lock regions. A lock region is composed of several consecutive pages, and each lock region has its associated lock bit.

Table 9-1. Lock bit number

Product	Number of lock bits	Lock region size
SAM3N4	16	16 kbytes (64 pages)
SAM3N2	8	16 kbytes (64 pages)
SAM3N1	4	16 kbytes (64 pages)

If a locked-region's erase or program command occurs, the command is aborted and the EEFC triggers an interrupt.

The lock bits are software programmable through the EEFC User Interface. The command "Set Lock Bit" enables the protection. The command "Clear Lock Bit" unlocks the lock region.

Asserting the ERASE pin clears the lock bits, thus unlocking the entire Flash.

9.1.3.6 Security Bit Feature

The SAM3N features a security bit, based on a specific General Purpose NVM bit (GPNVM bit 0). When the security is enabled, any access to the Flash, either through the ICE interface or through the Fast Flash Programming Interface, is forbidden. This ensures the confidentiality of the code programmed in the Flash.

This security bit can only be enabled, through the command "Set General Purpose NVM Bit 0" of the EEFC User Interface. Disabling the security bit can only be achieved by asserting the ERASE pin at 1, after a full Flash erase is performed. When the security bit is deactivated, all accesses to the Flash are permitted.

It is important to note that the assertion of the ERASE pin should always be longer than 200 ms.

As the ERASE pin integrates a permanent pull-down, it can be left unconnected during normal operation. However, it is safer to connect it directly to GND for the final application.

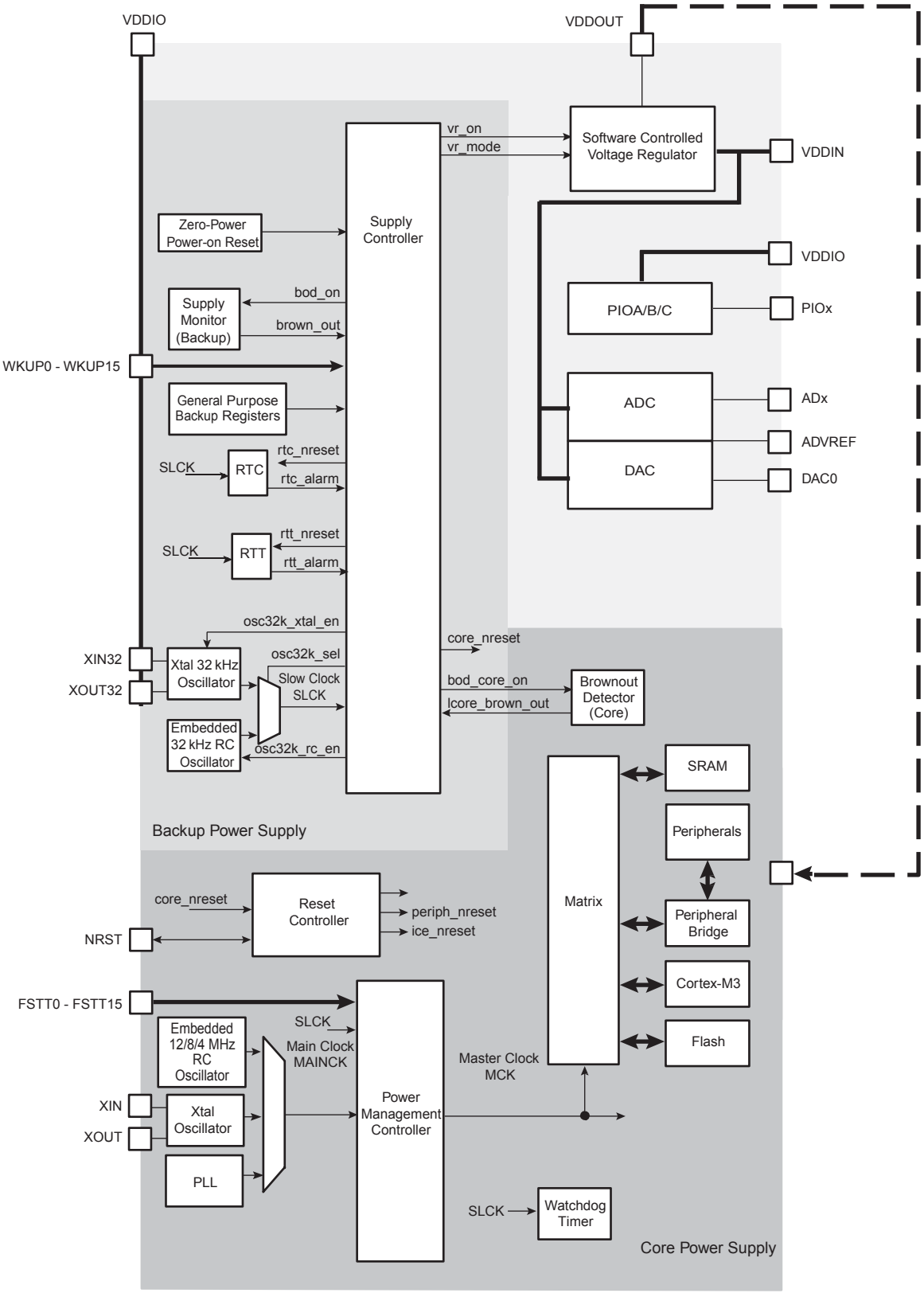
9.1.3.7 Calibration Bits

NVM bits are used to calibrate the brownout detector and the voltage regulator. These bits are factory configured and cannot be changed by the user. The ERASE pin has no effect on the calibration bits.

9.1.3.8 Unique Identifier

Each device integrates its own 128-bit unique identifier. These bits are factory configured and cannot be changed by the user. The ERASE pin has no effect on the unique identifier.

Figure 10-1. System Controller Block Diagram



FSTT0 - FSTT15 are possible Fast Startup Sources, generated by WKUP0-WKUP15 Pins, but are not physical pins.

The reset circuitry is based on a zero-power power-on reset cell and a brownout detector cell. The zero-power power-on reset allows the Supply Controller to start properly, while the software-programmable brownout detector allows detection of either a battery discharge or main voltage loss.

The Slow Clock generator is based on a 32 kHz crystal oscillator and an embedded 32 kHz RC oscillator. The Slow Clock defaults to the RC oscillator, but the software can enable the crystal oscillator and select it as the Slow Clock source.

The Supply Controller starts up the device by sequentially enabling the internal power switches and the Voltage Regulator, then it generates the proper reset signals to the core power supply.

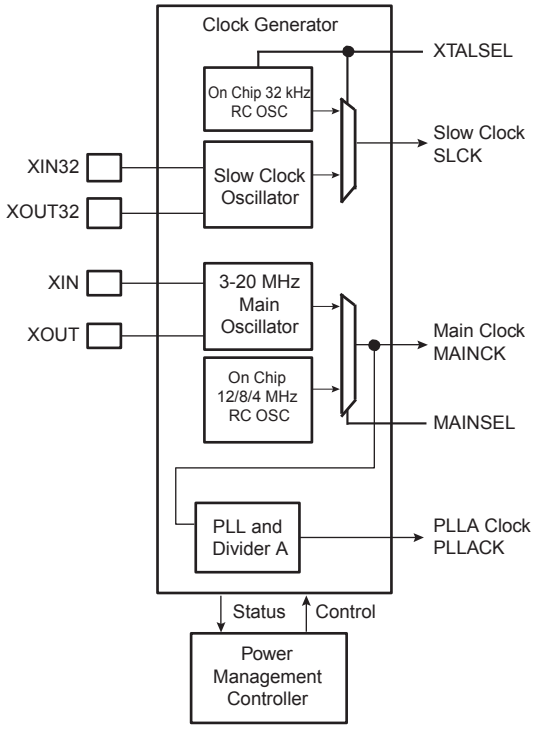
It also enables to set the system in different low power modes and to wake it up from a wide range of events.

10.5 Clock Generator

The Clock Generator is made up of:

- One Low Power 32768Hz Slow Clock Oscillator with bypass mode
- One Low-Power RC Oscillator
- One 3-20 MHz Crystal or Ceramic resonator Oscillator, which can be bypassed
- One Fast RC Oscillator factory programmed, 3 output frequencies can be selected: 4, 8 or 12 MHz. By default 4 MHz is selected.
- One 60 to 130 MHz programmable PLL, capable to provide the clock MCK to the processor and to the peripherals. The input frequency of PLL is from 3.5 to 20 MHz.

Figure 10-2. Clock Generator Block Diagram



10.8 SysTick Timer

- 24-bit down counter
- Self-reload capability
- Flexible System timer

10.9 Real-time Timer

- Real-time Timer, allowing backup of time with different accuracies
  - 32-bit Free-running back-up Counter
  - Integrates a 16-bit programmable prescaler running on slow clock
  - Alarm register capable to generate a wake-up of the system through the Shut Down Controller

10.10 Real Time Clock

- Low power consumption
- Full asynchronous design
- Two hundred year calendar
- Programmable Periodic Interrupt
- Alarm and update parallel load
- Control of alarm and update Time/Calendar Data In

10.11 General Purpose Backup Registers

- Eight 32-bit general-purpose backup registers

10.12 Nested Vectored Interrupt Controller

- Thirty Two maskable external interrupts
- Sixteen priority levels
- Processor state automatically saved on interrupt entry, and restored on
- Dynamic reprioritization of interrupts
- Priority grouping
  - selection of pre-empting interrupt levels and non pre-empting interrupt levels
- Support for tail-chaining and late arrival of interrupts
  - back-to-back interrupt processing without the overhead of state saving and restoration between interrupts.
- Processor state automatically saved on interrupt entry and restored on interrupt exit, with no instruction overhead

  - Multi-drive option enables driving in open drain
  - Programmable pull up on each I/O line
  - Pin data status register, supplies visibility of the level on the pin at any time
- Selection of the drive level
- Synchronous output, provides Set and Clear of several I/O lines in a single write

11. Peripherals

11.1 Peripheral Identifiers

Table 11-1 defines the Peripheral Identifiers of the SAM3N4/2/1/0/00. A peripheral identifier is required for the control of the peripheral interrupt with the Nested Vectored Interrupt Controller and for the control of the peripheral clock with the Power Management Controller.

Table 11-1. Peripheral Identifiers

Instance ID	Instance Name	NVIC Interrupt	PMC Clock Control	Instance Description
0	SUPC	**X**		**Supply Controller**
1	RSTC	**X**		Reset Controller
2	RTC	**X**		Real Time Clock
3	RTT	**X**		Real Time Timer
4	WDT	**X**		Watchdog Timer
5	PMC	**X**		Power Management Controller
6	EEFC	**X**		Enhanced Flash Controller
7	-	**-**		Reserved
8	UART0	**X**	**X**	UART 0
9	UART1	**X**	**X**	UART 1
10	-	**-**	**-**	Reserved
11	PIOA	**X**	**X**	Parallel I/O Controller A
12	PIOB	**X**	**X**	Parallel I/O Controller B
13	PIOC	**X**	**X**	Parallel I/O Controller C
14	USART0	**X**	**X**	USART 0
15	USART1	**X**	**X**	USART 1
16	-	**-**	**-**	Reserved
17	-	**-**	**-**	Reserved
18	-	**-**	**-**	Reserved
19	TWI0	**X**	**X**	Two Wire Interface 0
20	TWI1	**X**	**X**	Two Wire Interface 1
21	SPI	**X**	**X**	Serial Peripheral Interface
22	-	**-**	**-**	Reserved
23	TC0	**X**	**X**	Timer/Counter 0
24	TC1	**X**	**X**	Timer/Counter 1

11.2.2 PIO Controller B Multiplexing

Table 11-3. Multiplexing on PIO Controller B (PIOB)

I/O Line	Peripheral A	Peripheral B	Peripheral C	Extra Function	System Function	Comments
PB0	PWM0			AD4		
PB1	PWM1			AD5		
PB2	URXD1	NPCS2		AD6/WKUP12		
PB3	UTXD1	PCK2		AD7		
PB4	TWD1	PWM2			TDI	
PB5	TWCK1			WKUP13	TDO/ TRACESWO	
PB6					TMS/SWDIO	
PB7					TCK/SWCLK	
PB8					XOUT	
PB9					XIN	
PB10						
PB11						
PB12					ERASE	
PB13		PCK0		DAC0		64/100-pin versions
PB14	NPCS1	PWM3				64/100-pin versions