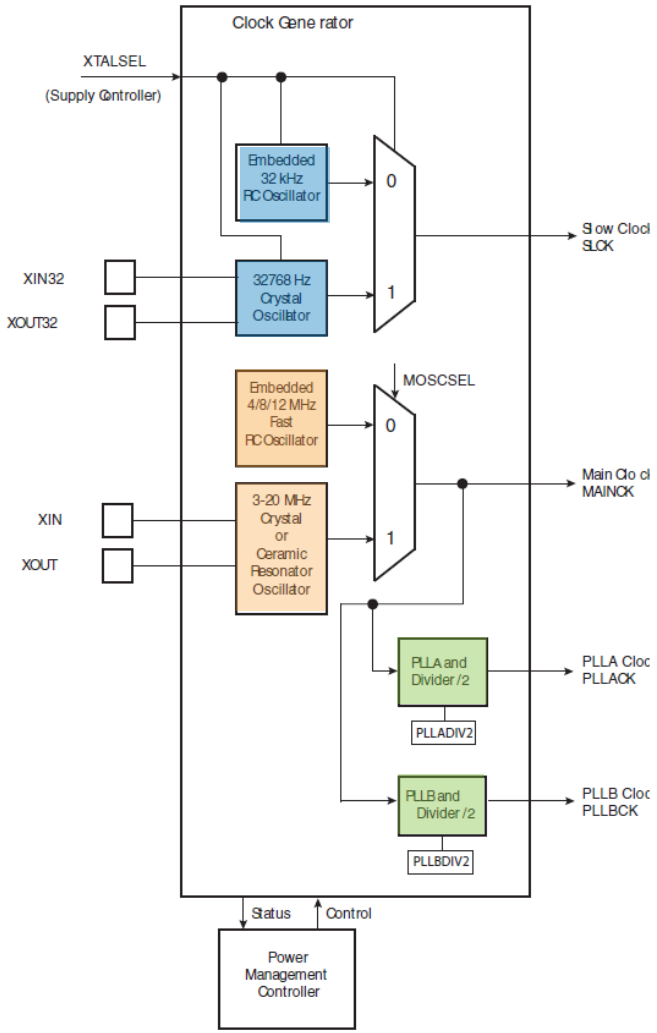
SAM4S Power Management Controller (PMC)

SAM4S Power Management Controller (PMC)

Clock Generator

The clock generator provides the following clocks:

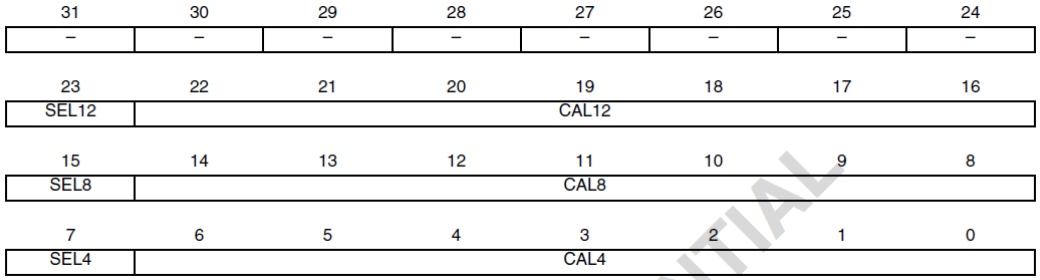
- Slow Clock (SLCK) sources:
  - On-chip 32KHz RC oscillator (20KHz-44KHz)
  - Xtal 32KHz oscillator featuring bypass mode
- Main Clock (MAINCK) sources:
  - On-chip 4/8/12 MHz RC oscillator (Fast RC)
    - 8/12 MHz calibrated in production
    - Trimming capability
  - Xtal and Ceramic 3-20 MHz oscillator featuring bypass mode
  - Main Frequency Counter
- PLLA/PLLB Clocks (PLLACK/PLLBCK) sources:
  - Integrated RC filters
  - One dedicated to USB



SAM4S Power Management Controller (PMC)

Fast RC Trimming

- Possibility to compensate frequency drift due to derating factors such as temperature and voltage by measuring and trimming on the fly the Fast RC frequency
- Oscillator Calibration Register: PMC_OCR



SEL	CAL
0	Factory Trimmed default calibration value *(± 5% for 8/12MHz; ± 30% for 4MHz)*
1	User Calibration value (reset after each power up) *Frequency deviation vs. Trimming code in the Electricals (8/12MHz only)*

- Trimming capability on operating oscillator frequency
  - i.e. for example, when running on 8 MHz, it is possible to change the CAL8 value if SEL8 is set in PMC_OCR.

SAM4S Power Management Controller (PMC)

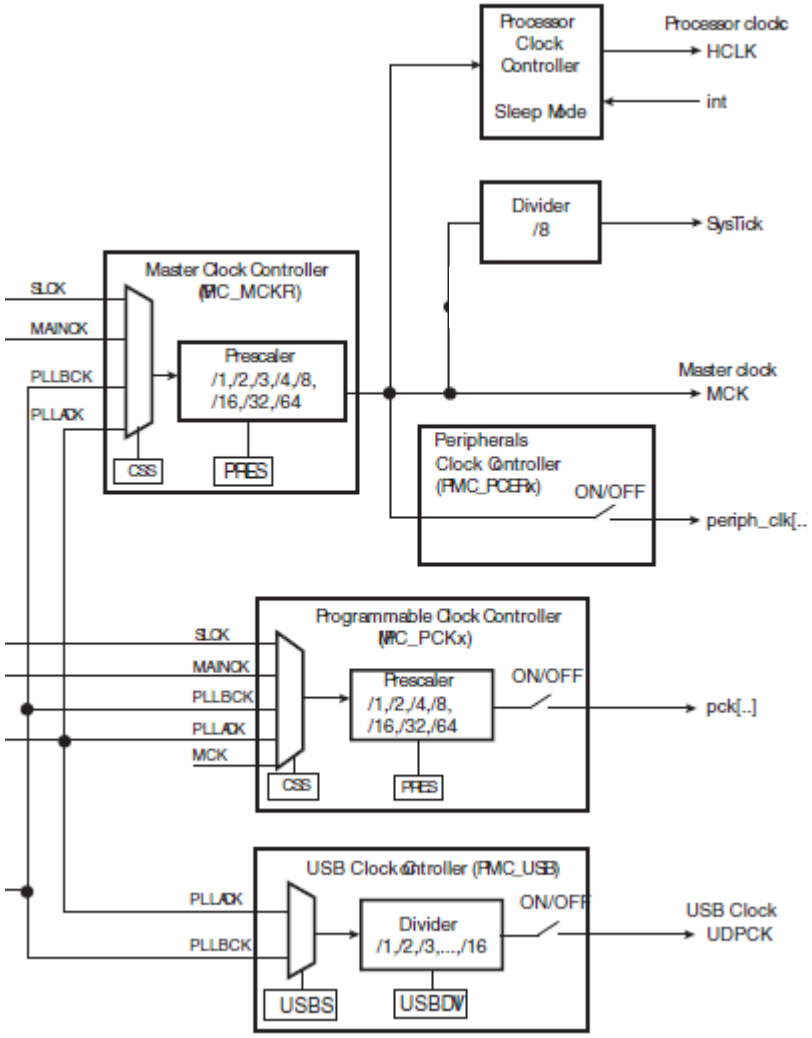
Main Frequency Counter

- Provides the frequency of the main clock (MAINCK)
  - Counter is incremented at main clock speed during 16 slow clock cycles
- Used to determine Fast RC, 3/20MHz crystal or ceramic resonator-based oscillator frequency

SAM4S Power Management Controller (PMC)

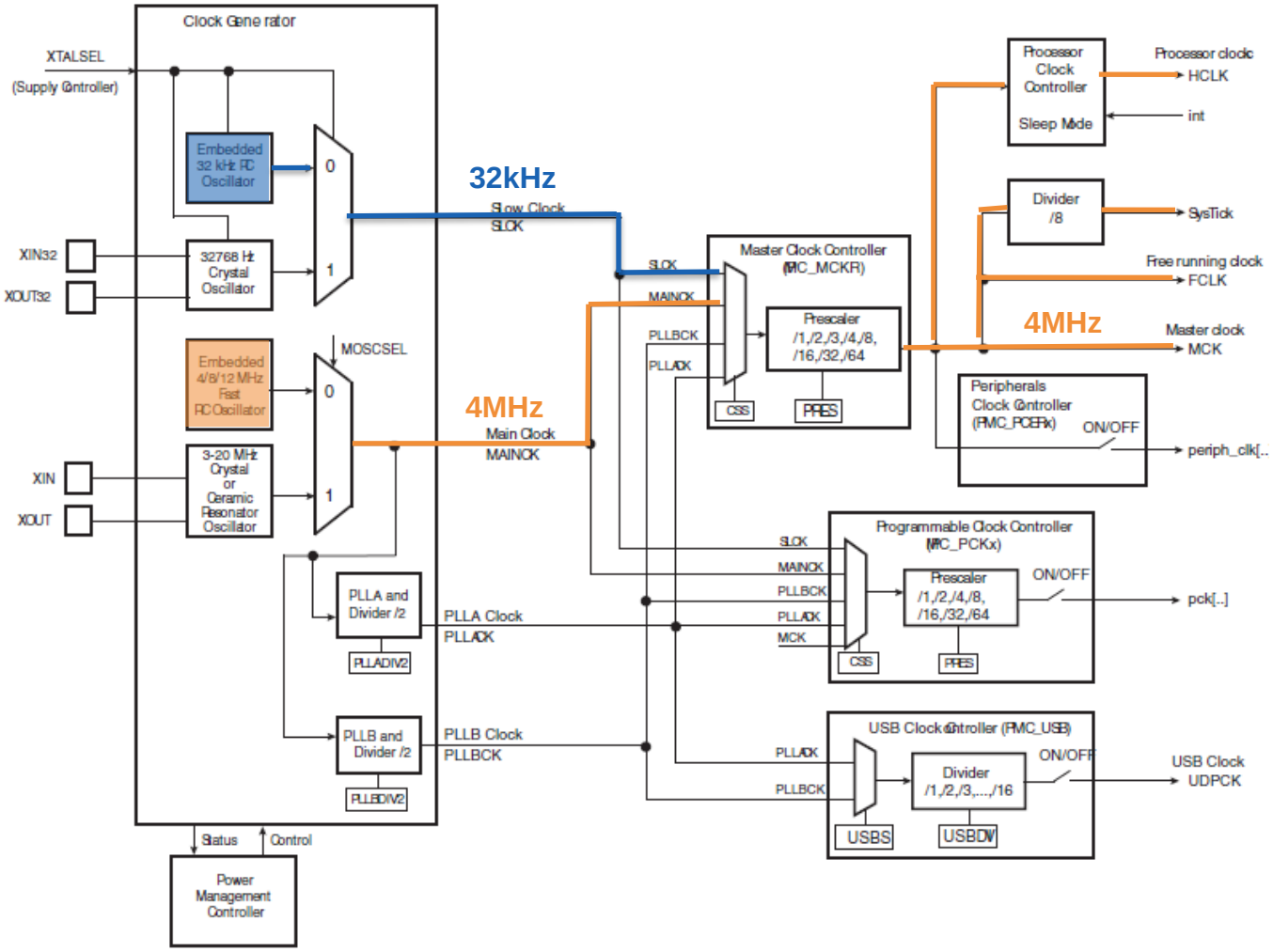
Power Management Controller

- The PMC controls the following clocks:
  - HCLK:
    - Processor clock
  - MCK:
    - Master clock (Bus Clock)
  - Peripheral Clocks
    - USART, SPI Clocks…
  - PCKx:
    - Programmable Clock Outputs on PCKx pins
  - UDPCK:
    - USB Device clock
  - Systick



SAM4S Power Management Controller (PMC)

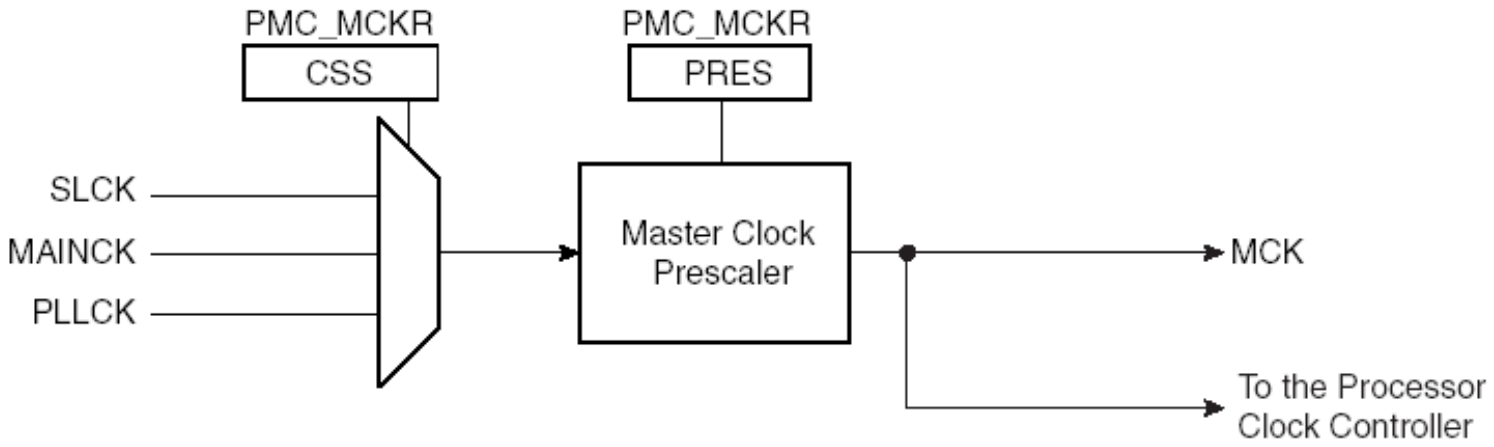
Clocks Startup Configuration



SAM4S Power Management Controller (PMC)

Master Clock Controller (MCK)

- Master Clock Controller Register (PMC_MCKR) provides selection and division of the Master Clock (MCK)
  - CSS selects the clock: SLCK, MAINCK or PLLCK
  - PRES divides the selected clock by 1, 2, 4, 8, 16, 32 or 64



SAM4S Power Management Controller (PMC)

Processor Clock Controller (HCLK)

- HCLK = MCK
- HCLK is automatically:
  - Disabled by entering any low power mode using the Wait for Interrupt instruction (WFI) or Wait for Event (WFE)
  - Re-enabled by any triggered interrupts or by a reset of the product.

SAM4S Power Management Controller (PMC)

Peripheral Clock Controller

- User Peripheral clocks can be individually enabled or disabled:
  - by setting their corresponding bit in the PMC peripheral clock enable/disable register (PMC_PCER/PMC_PCDR)

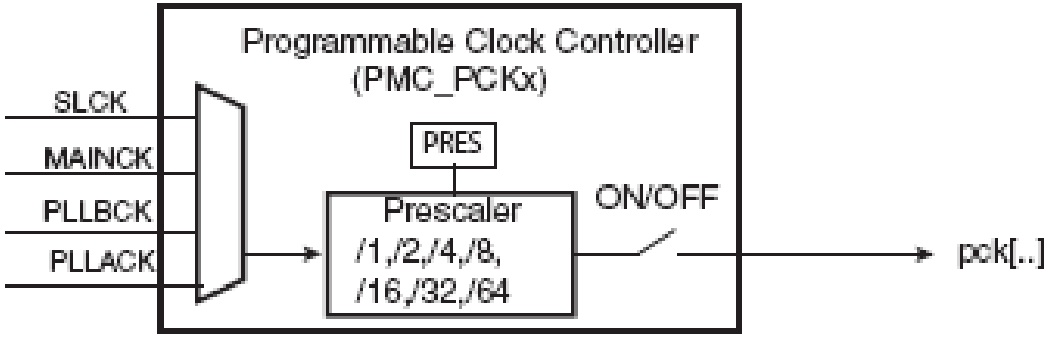
```
// Enable all peripheral clocks
AT91C_BASE_PMC->PMC_PCER = 0xFFFFFFFF;

// Disable all peripheral clocks
AT91C_BASE_PMC->PMC_PCDR = 0xFFFFFFFF;
```

- When enabled, the user peripherals are clocked @ MCK.
- Some peripherals are continuously clocked
  - SUPC, RSTC, RTC, RTT, WDT, PMC, EEFC0/1 (peripherals ID #0-#7)
- After reset, peripheral clocks are disabled by default to reduce power consumption

SAM4S Power Management Controller (PMC)

Programmable Clock outputs (PCKx)

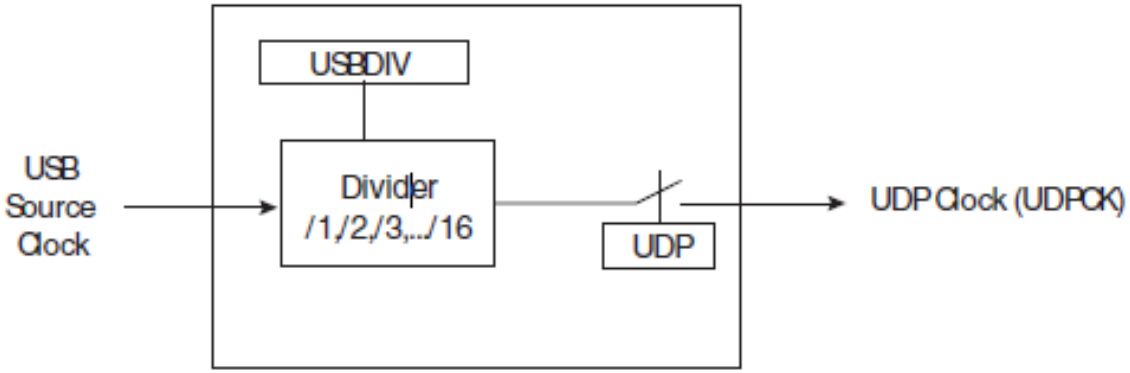
- SAM4S features up to 3 programmable clock outputs
  - PCK0, PCK1 and PCK2 which are multiplexed with I/Os
- Interest is to remove use of external crystals/oscillators.
- Programmable clocks can be enabled or disabled:
  - by setting their corresponding bit in the PMC system clock enable/disable register (PMC_SCER/PMC_SCDR)



SAM4S Power Management Controller (PMC)

USB Device Clock Controller

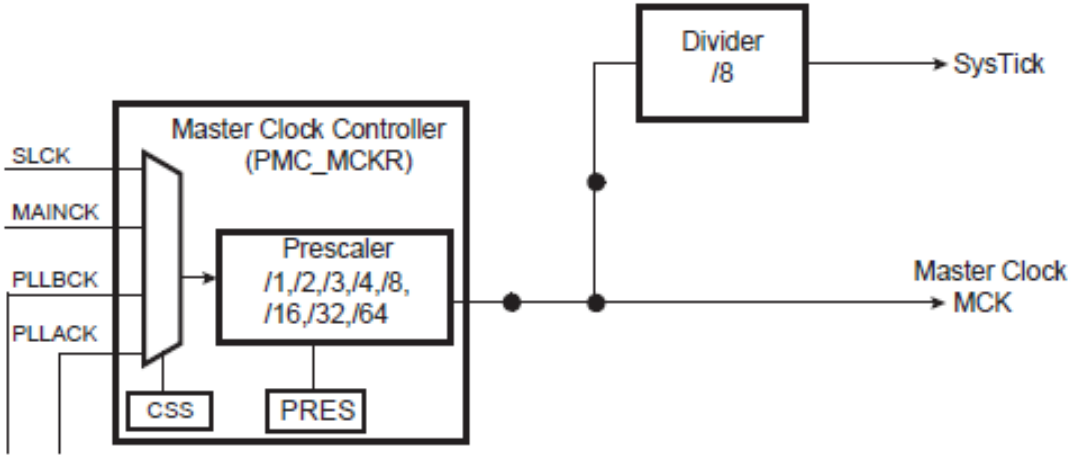
- The user must program one PLL to generate a UDPCK frequency equal to 48MHz.
- UDPCK is the PLL Output (PLLCK) divided by 1,2,... to 16 (USBDIV field)
  - Right divider must be chosen based on PLL Output Frequency range
- User can select either PLLA or PLLB output as USB clock source



SAM4S Power Management Controller (PMC)

Systick

- 24-bit count-down timer embedded in the Cortex-M4
- Divider by 8 embedded in the SAM4S PMC
  - Allows generation of a time base of 1 ms with SysTick clock equal to 1 MHz (ie. when MCK=8MHz).



SAM4S Power Management Controller (PMC)

Main Clock Failure Detector

- Monitors the main crystal oscillator or ceramic resonator-based oscillator to identify an eventual failure.
  - No need for CPU intervention
- Automatically switches the master clock source (MCK) on main clock (MAINCK) with Fast RC as main clock source
  - MCK = MAINCK = Fast RC
- Puts PWM outputs in safe mode
  - A clock failure detection activates a fault output connected to the PWM
  - PWM can force its outputs and protect the driven device