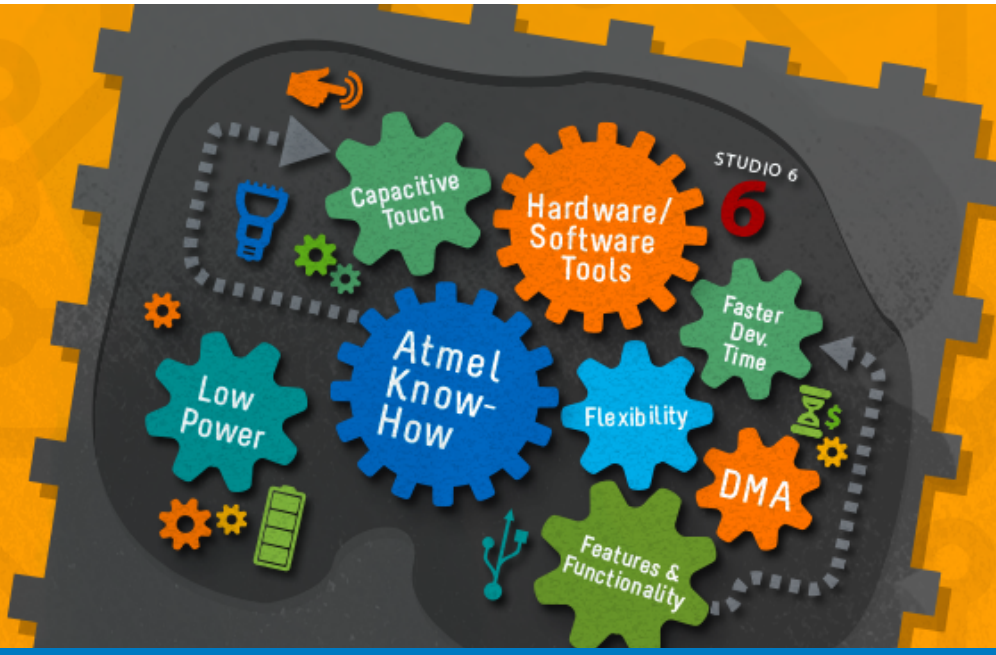
Atmel®

Think Beyond the Core



Atmel SAM D Family

ARM Cortex-M0+ based Flash Microcontrollers

The Atmel® SAM D family of ARM® Cortex®-M0+ based microcontrollers (MCU) leverages two decades of experience. It builds on the success of our popular Atmel AVR® MCUs and ARM-based devices. The Atmel SAM D family delivers a powerful combination of proven technologies—such as our peripheral event system—as well as the latest Atmel innovations, including capacitive touch support for buttons, sliders, wheels and proximity. This truly differentiated general-purpose microcontroller is a perfect fit for many low-power, cost-sensitive industrial and consumer applications.

Key Benefits

High performance

- 48MHz operation
- 2.14 CoreMark/MHz
- Single-cycle IO access
- Up to 12-channel event system
- Up to 12-channel DMA

Low power

- < 70µA/MHz
- <3.5µA RAM retention and RTC
- Internal and external oscillators
- On-the-fly clock switching and prescaling

Robust peripheral set

- Up to six serial communication modules (SERCOM) configurable as UART/USART, SPI or I^2C
- Up to eight 16-bit Timer/Counters
- Peripheral Touch Controller that supports buttons, sliders, wheels and proximity with up to 256 channels
- Real Time Clock (RTC) and Calendar with leap year correction and 1ppm calibration
- 12-bit 350ksps ADC and 10-bit DAC
- Full Speed USB Device and Host
- 2-channel I^2S

World-class tools

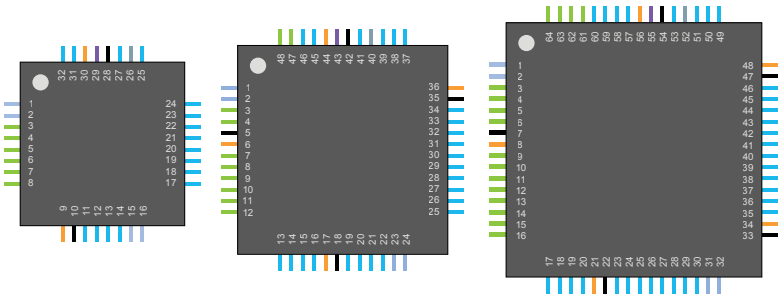
- SAM D family Xplained Pro starter kits – $39
- Atmel Studio with compiler support – Free
- Atmel Software Framework – Free
- Low-level drivers and stacks – Free

ARM Cortex-M0+ Processor

The most energy-efficient ARM processor yet, the Cortex-M0+ builds on the Cortex-M0 processor—retaining its full instruction set and tool compatibility—while further reducing energy consumption and increasing performance. SAM D ARM Cortex-M0+ based MCUs operate at 48MHz and feature a two-stage pipeline, single-cycle I/O access, single-cycle 32x32 multiplier, event system, and a fast and flexible interrupt controller. Highly efficient, the Atmel SAM D family reaches 2.14 CoreMark/MHz – 0.93 DMIPS/MHz.

Easy Migration

Made with portability in mind, these devices are code-compatible so that you can easily move between both memory densities and pinouts. Plus, the different pin options are designed to minimize PCB changes when going from one pin count to another. With the TQFP package, you can even lay out the three different packages inside each other.



Atmel SAM D Family

ARM Cortex-M0+ based Flash Microcontrollers

The Atmel SAM D family consists of four pin- and code-compatible product series and a total of 35 different microcontrollers. They all use the same processor, bus matrix, interrupt system and other core features, but they are differentiated in regards to pin counts, memories and peripheral mix.

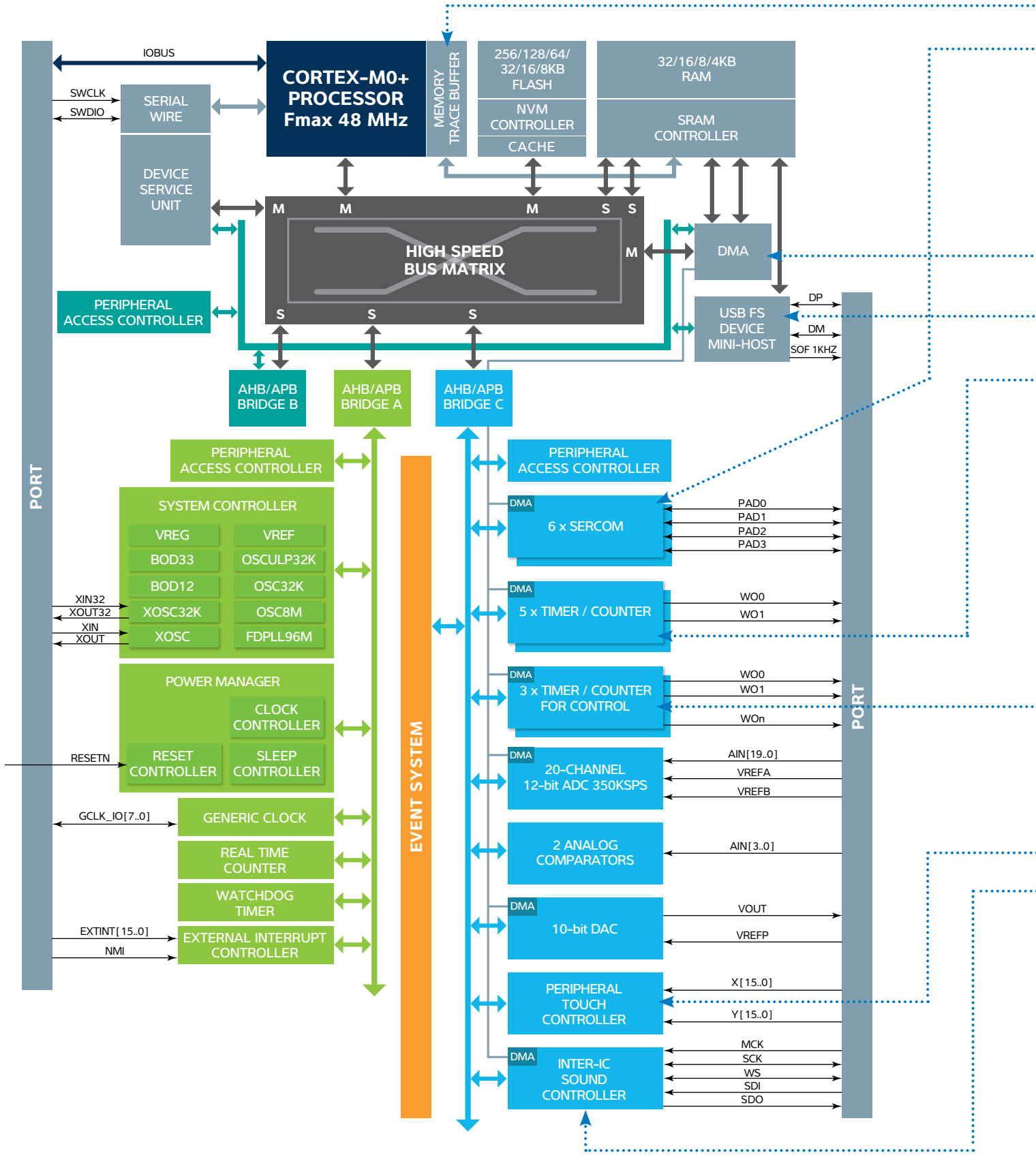
SAM D Family Features	SAM D10	SAM D11	SAM D20	SAM D21
Cortex-M0+ CPU Event system SERCOM PTC 12-bit 350 ksps ADC 10-bit 350 ksps DAC 2xAnalog Comp 32-bit RTC w/Calendar Serial Wire Debug BOD and POR Internal RCs Watchdog High GPIO Count	8-16KB Flash		16-256KB Flash	32-256KB Flash
	14, 20, and 24 pins		32, 48, and 64 pins	
	6-ch DMA			12-ch DMA
	1x T/C for Control			3x T/C for Control
		FS USB Device		FS USB H&D
				I^2S

Hardware and Software Tools

Prototype your designs with the Atmel SAM D20 Xplained Pro, which incorporates an embedded programmer and debugger. If you prefer to use a standalone programmer/debugger, Atmel SAM-ICE™, JTAGICE3 and Atmel-ICE debuggers fully supports the SAM D family. Atmel Studio and the Atmel Software Framework also support the SAM D family of products, providing an easy-to-use and low-cost development platform to reduce your time to market.

Low Power

The SAM D family implements a wide range of features to drive down power consumption, including low-power oscillators, clock gating and prescaling, Atmel SleepWalking technology and a proprietary low-power process. All this enables down to 70µA/MHz in active mode and less than 3.5µA with full RAM retention and RTC running in sleep mode.



SERCOM

SAM D devices feature multiple instances of the Serial Communication Module (SERCOM). The SERCOM is configurable to operate as I²C, SPI or USART, giving developers extended flexibility to mix serial interfaces and greater freedom in PCB layout. Each SERCOM instance can be assigned to different I/O pins through I/O multiplexing, further increasing versatility.

Timers/Counters

SAM D devices include multiple instances of 16-bit Timer/Counters (TC). Each TC can be individually programmed to perform frequency and waveform generation, accurate program execution timing, and input capture with time and frequency measurement of digital signals. Each TC can be configured to operate as 2x8-bit timers, as a 16-bit timer, and two TCs can be combined to a 32-bit TC. In addition, the SAM D family features a 32-bit RTC with full calendar and leap year support.

Timers/Counters for Control

Selected SAM D have T/CCs, these are Timers/Counters for control applications like switch mode power supplies, lighting and motor control. The T/CCs support up to 96MHz and 24 bit resolution.

I²S

The Inter-IC Sound Controller (I²S) provides a bidirectional, synchronous digital audio link with external audio devices. Peripheral DMA channels, separate for each Serializer, allow a continous high bit rate data transfer without processor intervention. The SAM D devices with I²S have a built in frational PLL to support glitch free audio streaming from USB to I²S.

Micro Trace Buffer

The Micro Trace Buffer available in selected SAM D devices enables enhanced on-chip debugging with trace capabilities supported by Atmel and third-party debuggers.

DMA

Up to 12 DMA channels are available in SAM D. The DMA supports data transfers from 1B to 256KB and has selectable transfer triggers and priority levels. The DMA is connected to the ADC, DAC, I²S, SERCOM, T/C and the T/CC.

FS USB 2.0

Selected SAM D products feature Full Speed USB device and embedded host. In Device mode, a SAM D device can operate from the internal RC oscillator giving you a minimum Bill of materials and PCB-area implementation. The USB drivers are available from Atmel through the Atmel Software Framework.

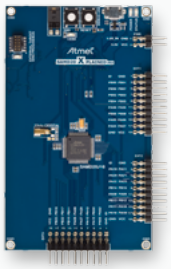
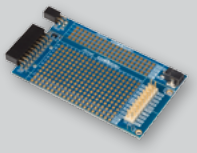
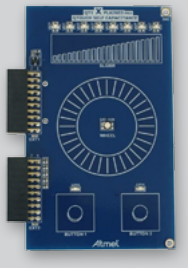
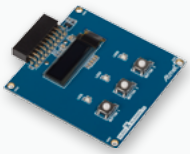
Peripheral Touch Controller

An embedded peripheral touch controller (PTC) makes it easy to add capacitive touch sensing to your project with buttons, sliders, wheels and proximity. The PTC supports Mutual and self capacitive touch and offers superb sensitivity and noise tolerance as well as self-calibration, the PTC eliminates the need for external components and minimizes CPU overhead. Implementing one button takes one channel, while wheels and sliders take 3 channels to implement.

Package	PTC Channels Mutual Cap	PTC Channels Self Cap
64-pin	Up to 256	Up to 16
48-pin	Up to 120	Up to 10
32-pin	Up to 60	Up to 6
24-pin	Up to 72	Up to 16
20-pin	Up to 42	Up to 13
14-pin	Up to 12	Up to 7

Hardware and Software Tools

The Xplained Pro products available for the SAM D Family are perfect for rapid prototyping and development. Xplained Pro boards feature an embedded programmer and debugger, and they easily connect to you computer and Atmel Studio. Several expansion wings are available for Xplained Pro boards. The wings enable evaluation of different interfaces and peripherals. Wings are also available from third parties.

	Xplained Pro Boards are available for the SAM D11, SAM D20, and SAM D21 series of microcontrollers.		The I/O1 extension expands your Xplained Pro with a light and temperature sensor, a microSD card and HW to test UART, SPI and I^2C.
			The PROTO1 extension provides a bread-bording area for general prototyping with the SAM D Xplained Pro boards.
	The QT1 extension is perfect for evaluating the Peripheral Touch Controller in the SAM D family.		The OLED1 wing connects a 128x32 OLED display, LEDs and buttons to the Xplained Pro.

In addition to the Xplained Pro platform, the SAM D family is fully supported by the STK600 development platform and Atmel and third-party debuggers and programmers.

Atmel Studio 6 is the integrated development platform (IDP) for developing and debugging Atmel ARM Cortex-M based and AVR microcontroller applications. The Studio 6 IDP gives you a seamless and easy-to-use environment to write, build and debug your applications written in C/C++ or assembly code. It includes the Atmel Software Framework, a vast source code library, including drivers, stacks and more than 2000 project examples. Atmel Studio also incorporates a unique feature to enhance your productivity—Atmel Gallery. This online apps store built into Studio 6 allows you to easily access development tools and embedded software integrated with Atmel Studio.

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ARM Cortex-M0+ based Flash Microcontrollers

	32-pin	48-pin	64-pin	32-pin	48-pin	64-pin	14-pin	20-pin	24-pin
	SAM D21E	SAM D21G	SAM D21J	SAM D20E	SAM D20G	SAM D20J	SAM D10C SAM D11C	SAM D10D SAM D11D	SAM D10D SAM D11D
Flash	32-256KB	32-256KB	32-256KB	16-128KB	16-256KB	16-256KB	8-16KB	8-16KB	8-16KB
SRAM	4-16KB	4-32KB	4-32KB	2-16KB	2-32KB	2-32KB	4KB	4KB	4KB
Event System	12-ch	12-ch	12-ch	8-ch	8-ch	8-ch	6-ch	6-ch	6-ch
DMA	12-ch	12-ch	12-ch	--	--	--	6-ch	6-ch	6-ch
SERCOM (I^2C, USART, SPI)	4	6	6	4	6	6	2	3	3
I^2S and FPLL	2-ch	2-ch	2-ch	--	--	--	--	--	--
FS USB Embedded Host	Yes	Yes	Yes	--	--	--	--	--	--
FS USB Device	Yes	Yes	Yes	--	--	--	Yes on SAM D11	Yes on SAM D11	Yes on SAM D11
Timer/Counter	3	3	5	6	6	8	2	2	2
Timer/Counter for Control	3	3	3	--	--	--	1	1	1
12-bit 350ksps ADC	10-ch	14-ch	20-ch	10-ch	14-ch	20-ch	8-ch	8-ch	10-ch
10-bit 350ksps DAC	1-ch	1-ch	1-ch	1-ch	1-ch	1-ch	1-ch	1-ch	1-ch
GPIO	26	38	54	26	38	52	12	18	22
Capacitive Touch Channels	Up to 48	Up to 144	Up to 256	Up to 60	Up to 120	Up to 256	Up to 12	Up to 42	Up to 72

Package type

A = TQFP
M = QFN
SS = SOIC

Plating material and temp grade

U = -40 — 85˚C Matte Sn plating
N = -40 — 105˚C Matte Sn plating

Package carrier

T = Tape & Reel
No character = Tray/Tube (Default)

SAM D 20 E 14 A – M U T

Product Family

SAM D = General Purpose MCU

Product Series

10 = Cortex-M0+ CPU, Basic Feature Set, TCC, DMA
11 = D10 + USB Device
20 = Cortex-M0+ CPU, Basic Feature Set
21 = D20 + USB Device and Embedded Host, I^2S, DMA, TCC, 3.4MHz I^2C

Pin Count

C = 14 pins
D = 20/24 pins
E = 32 pins
G = 48 pins
J = 64 pins

Marketing Revision

A = Initial Revision

Memory Density

13 = 8KB
14 = 16KB
15 = 32KB
16 = 64KB
17 = 128KB
18 = 256KB

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