# Ultra-Low Power SAM D5/E5 MCU Family
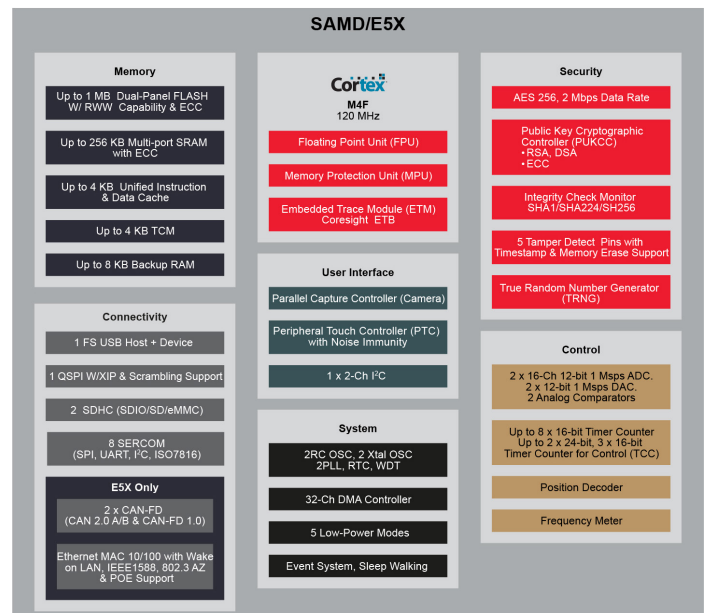
Integrated Enhanced Security and Extensive Connectivity

Summary

The SAMD5 high-performance microcontroller series features a 32-bit ARM® Cortex®-M4 processor with Floating Point Unit (FPU), running up to 120 MHz/400 CoreMark®, up to 1 MB dual-panel Flash with ECC, and up to 256 KB of SRAM with ECC. This series offers excellent features with class-leading power performance and integrated hardware security. The SAME5 series adds an 10/100 Ethernet MAC and two CAN-FD ports targeted for industrial automation, automotive applications and general-purpose applications requiring wired connectivity.
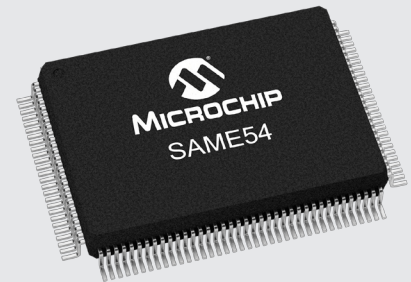
Key Features

- ARM Cortex-M4F core running at 120 MHz (403 CoreMark) with single precision FPU
- Memory architecture
  - User-configurable tightly coupled memory
  - Memory protection unit
- Quad Serial Peripheral Interface (QSPI) with Execute in Place (XIP) support
- Up to two Secure Digital Host Controllers (SDHC)
- 10/100 Ethernet MAC with IEEE1588 support (E53/E54)
- Dual CAN (A/B) / CAN-FD 1.0 controllers (E51/E54)
- Peripheral Touch Controller (PTC) supporting up to 256 channels of capacitive touch
- Full-speed USB with embedded host/device
- Supports five low-power modes with class leading 65 µA/MHz active power performance
- Integrated security
  - One Advanced Encryption System (AES) with 256-bit key length and up to 2 Mbps data rate
  - True Random Number Generator (TRNG)
  - Public Key Cryptography Controller (PUKCC) and associated Classical Public Key Cryptography Library (PUKCL)
    - RSA, DSA
    - Elliptic Curves Cryptography (ECC) ECC GF (2n), ECC GF(p)
  - Integrity Check Module (ICM) based on Secure Hash Algorithm (SHA1, SHA224, SHA256), DMA

- Dual 1 Msps 12-bit ADCs up to 32 channels with offset and gain error compensation.
- Dual 1 Msps, 12-bit DAC and analog comparator
- Serial communication (SERCOM) ports configurable as UART/USART, ISO 7816, SPI or I^{2}C
- 48- to 128-pin package options
- Temperature range : –40°C to 85°C

SAMD/E5X

Memory
- Up to 1 MB Dual-Panel FLASH W/ RWW Capability & ECC
- Up to 256 KB Multi-port SRAM with ECC
- Up to 4 KB Unified Instruction & Data Cache
- Up to 4 KB TCM
- Up to 8 KB Backup RAM

Connectivity
- 1 FS USB Host + Device
- 1 QSPI W/XIP & Scrambling Support
- 2 SDHC (SDIO/SD/eMMC)
- 8 SERCOM (SPI, UART, I^{2}C, ISO7816)

E5X Only
- 2 x CAN-FD (CAN 2.0 A/B & CAN-FD 1.0)
- Ethernet MAC 10/100 with Wake on LAN, IEEE1588, 802.3 AZ & POE Support

Cortex M4F 120 MHz
- Floating Point Unit (FPU)
- Memory Protection Unit (MPU)
- Embedded Trace Module (ETM) Coresight ETB

User Interface
- Parallel Capture Controller (Camera)
- Peripheral Touch Controller (PTC) with Noise Immunity
- 1 x 2-Ch I^{2}C

System
- 2RC OSC, 2 Xtal OSC 2PLL, RTC, WDT
- 32-Ch DMA Controller
- 5 Low-Power Modes
- Event System, Sleep Walking

Security
- AES 256, 2 Mbps Data Rate
- Public Key Cryptographic Controller (PUKCC) • RSA, DSA • ECC
- Integrity Check Monitor SHA1/SHA224/SH256
- 5 Tamper Detect Pins with Timestamp & Memory Erase Support
- True Random Number Generator (TRNG)

Control
- 2 x 16-Ch 12-bit 1 Msps ADC, 2 x 12-bit 1 Msps DAC, 2 Analog Comparators
- Up to 8 x 16-bit Timer Counter Up to 2 x 24-bit, 3 x 16-bit Timer Counter for Control (TCC)
- Position Decoder
- Frequency Meter

MICROCHIP

| Device	Program Memory (KB)	Data Memory (KB)	Pins	Packages	Ethernet Controller	CAN-FD	SERCOM	TC/Compare	TCC (24-bit/16-bit)	I²S	USB	QSPI	SDHC	DMA Channels	PCC (data size)	CCL	Position Decoder	RTC	WDT	Frequency Measurement	Event System (Channels)	External Interrupt Lines	I/O Pins	ADC (Channels ADC0/ADC1)	Analog Comparators (Channels)	DAC (Channels)	PTC (Mutual/Self-capacitance Channels)	Temperature Sensor	AES	TRNG	Public Key Cryptography (PUKCC)	Integrity Check Monitor	Tamper Pins
SAME53N20	1024	256	100	TQFP	Y	N	8	8/2	2/3	Y	Y	Y	2	32	14	4	Y	Y	Y	Y	32	16	81	16/12	4	2	256/32	Y	Y	Y	Y	Y	5
SAME53N19	512	192	100	TQFP	Y	N	8	8/2	2/3	Y	Y	Y	2	32	14	4	Y	Y	Y	Y	32	16	81	16/12	4	2	256/32	Y	Y	Y	Y	Y	5
SAME53J20	1024	256	64	TQFP, QFN	Y	N	6	6/2	2/3	Y	Y	Y	1	32	10	4	Y	Y	Y	Y	32	16	51	16/8	4	2	256/32	Y	Y	Y	Y	Y	3
SAME53J19	512	192	64	TQFP, QFN	Y	N	6	6/2	2/3	Y	Y	Y	1	32	10	4	Y	Y	Y	Y	32	16	51	16/8	4	2	256/32	Y	Y	Y	Y	Y	3
SAME53J18	256	128	64	TQFP, QFN	Y	N	6	6/2	2/3	Y	Y	Y	1	32	10	4	Y	Y	Y	Y	32	16	51	16/8	4	2	256/32	Y	Y	Y	Y	Y	3
SAME54P20	1024	256	128	TQFP	Y	Y	8	8/2	2/3	Y	Y	Y	2	32	14	4	Y	Y	Y	Y	32	16	99	16/16	4	2	256/32	Y	Y	Y	Y	Y	5
SAME54P19	512	192	128	TQFP	Y	Y	8	8/2	2/3	Y	Y	Y	2	32	14	4	Y	Y	Y	Y	32	16	99	16/16	4	2	256/32	Y	Y	Y	Y	Y	5
SAME54N20	1024	256	100	TQFP	Y	Y	8	8/2	2/3	Y	Y	Y	2	32	14	4	Y	Y	Y	Y	32	16	81	16/12	4	2	256/32	Y	Y	Y	Y	Y	5
SAME54N19	512	192	100	TQFP	Y	Y	8	8/2	2/3	Y	Y	Y	2	32	14	4	Y	Y	Y	Y	32	16	81	16/12	4	2	256/32	Y	Y	Y	Y	Y	5
SAMD51P20	1024	256	128	TQFP	N	N	8	8/2	2/3	Y	Y	Y	2	32	14	4	Y	Y	Y	Y	32	16	99	16/16	4	2	256/32	Y	Y	Y	Y	Y	5
SAMD51P19	512	192	128	TQFP	N	N	8	8/2	2/3	Y	Y	Y	2	32	14	4	Y	Y	Y	Y	32	16	99	16/16	4	2	256/32	Y	Y	Y	Y	Y	5
SAMD51N20	1024	256	100	TQFP	N	N	8	8/2	2/3	Y	Y	Y	2	32	14	4	Y	Y	Y	Y	32	16	81	16/12	4	2	256/32	Y	Y	Y	Y	Y	5
SAMD51N19	512	192	100	TQFP	N	N	8	8/2	2/3	Y	Y	Y	2	32	14	4	Y	Y	Y	Y	32	16	81	16/12	4	2	256/32	Y	Y	Y	Y	Y	5
SAMD51J20	1024	256	64	TQFP, QFN, WLCSP	N	N	6	6/2	2/3	Y	Y	Y	1	32	10	4	Y	Y	Y	Y	32	16	51	16/8	4	2	256/32	Y	Y	Y	Y	Y	3
SAMD51J19	512	192	64	TQFP, QFN, WLCSP	N	N	6	6/2	2/3	Y	Y	Y	1	32	10	4	Y	Y	Y	Y	32	16	51	16/8	4	2	256/32	Y	Y	Y	Y	Y	3
SAMD51J18	256	128	64	TQFP, QFN	N	N	6	6/2	2/3	Y	Y	Y	1	32	10	4	Y	Y	Y	Y	32	16	51	16/8	4	2	256/32	Y	Y	Y	Y	Y	3
SAMD51G19	512	192	48	QFN	N	N	8	4/2	2/1	N	Y	Y		32		4	Y	Y	Y	Y	32	16	37	16/4	4	2	144/22	Y	Y	Y	Y	Y	2
SAMD51G18	25	128	48	QFN	N	N	8	4/2	2/1	N	Y	Y		32		4	Y	Y	Y	Y	32	16	37	16/4	4	2	144/22	Y	Y	Y	Y	Y	2
SAME51N20	1024	256	100	TQFP	Y	Y	8	8/2	2/3	Y	Y	Y	2	32	14	4	Y	Y	Y	Y	32	16	81	16/12	4	2	256/32	Y	Y	Y	Y	Y	5
SAME51N19	512	192	100	TQFP	Y	Y	8	8/2	2/3	Y	Y	Y	2	32	14	4	Y	Y	Y	Y	32	16	81	16/12	4	2	256/32	Y	Y	Y	Y	Y	5
SAME51J20	1024	256	64	TQFP, QFN	Y	Y	6	6/2	2/3	Y	Y	Y	1	32	10	4	Y	Y	Y	Y	32	16	51	16/8	4	2	256/32	Y	Y	Y	Y	Y	3
SAME51J19	512	192	64	TQFP, QFN	Y	Y	6	6/2	2/3	Y	Y	Y	1	32	10	4	Y	Y	Y	Y	32	16	51	16/8	4	2	256/32	Y	Y	Y	Y	Y	3
SAME51J18	256	128	64	TQFP, QFN	Y	Y	6	6/2	2/3	Y	Y	Y	1	32	10	4	Y	Y	Y	Y	32	16	51	16/8	4	2	256/32	Y	Y	Y	Y	Y	3

Atmel Studio

Studio 7 is the Integrated Development Platform (IDP) for developing and debugging all Microchip ARM-based and AVR® microcontroller applications. The Atmel Studio 7 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 also connects seamlessly to the debuggers, programmers and development kits.

Atmel START

Atmel START is an innovative online tool for intuitive, graphical configuration of embedded software projects. It lets you select and configure software components, drivers and middleware, as well as complete example projects, specifically tailored to the needs of your application. The configuration stage lets you review dependencies between software components, conflicts and hardware constraints. In the case of a conflict, Atmel START will automatically suggest solutions that fit your specific setup.

Development Tools
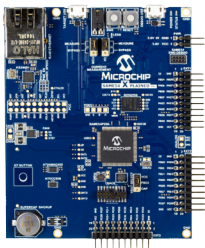
The SAME54 Xplained Pro Evaluation Kit is a hardware platform for evaluating the ATSAMD51/ATSAME54 microcontroller (MCU) family. Supported by the Studio integrated development platform, the kit provides easy access to the features and explains how to integrate the device into a custom design.

The Xplained Pro MCU series evaluation kits include an on-board embedded debugger, eliminating the need for external tools to program or debug the microcontroller. The kits offers additional peripherals to extend the features of the board and ease the development of custom designs.