MICROCHIP

32-bit Microcontroller Families

Industry's Broadest and Most Innovative 32-bit MCU Portfolio





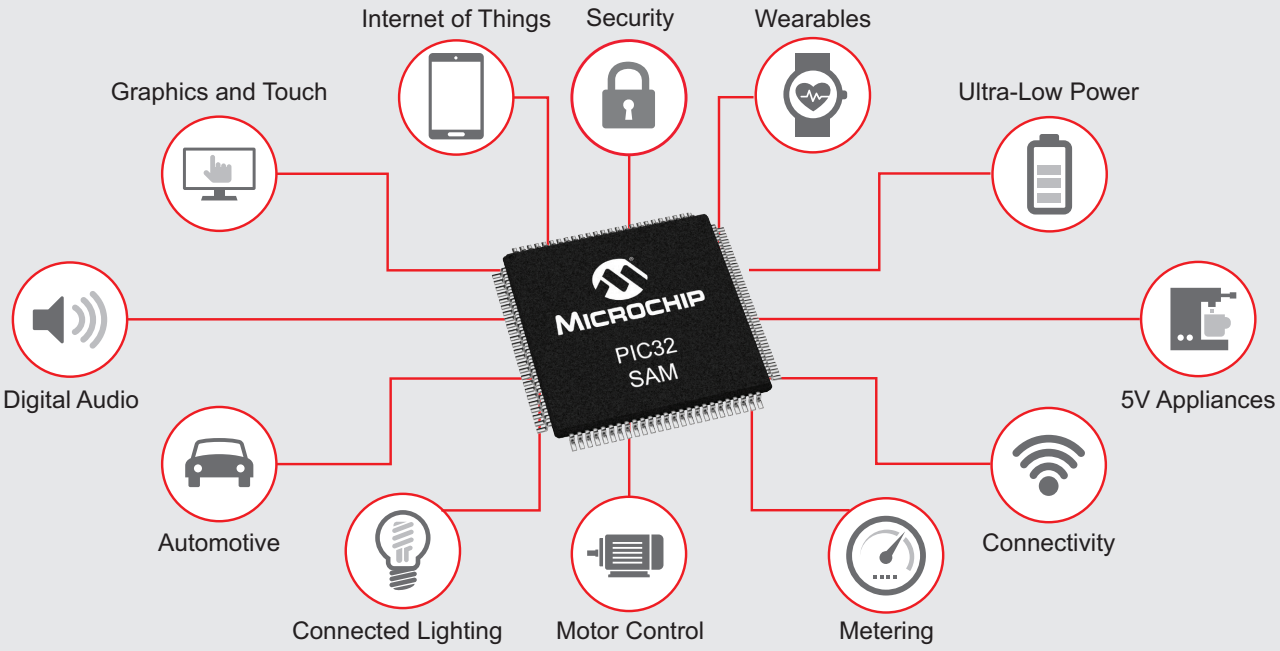




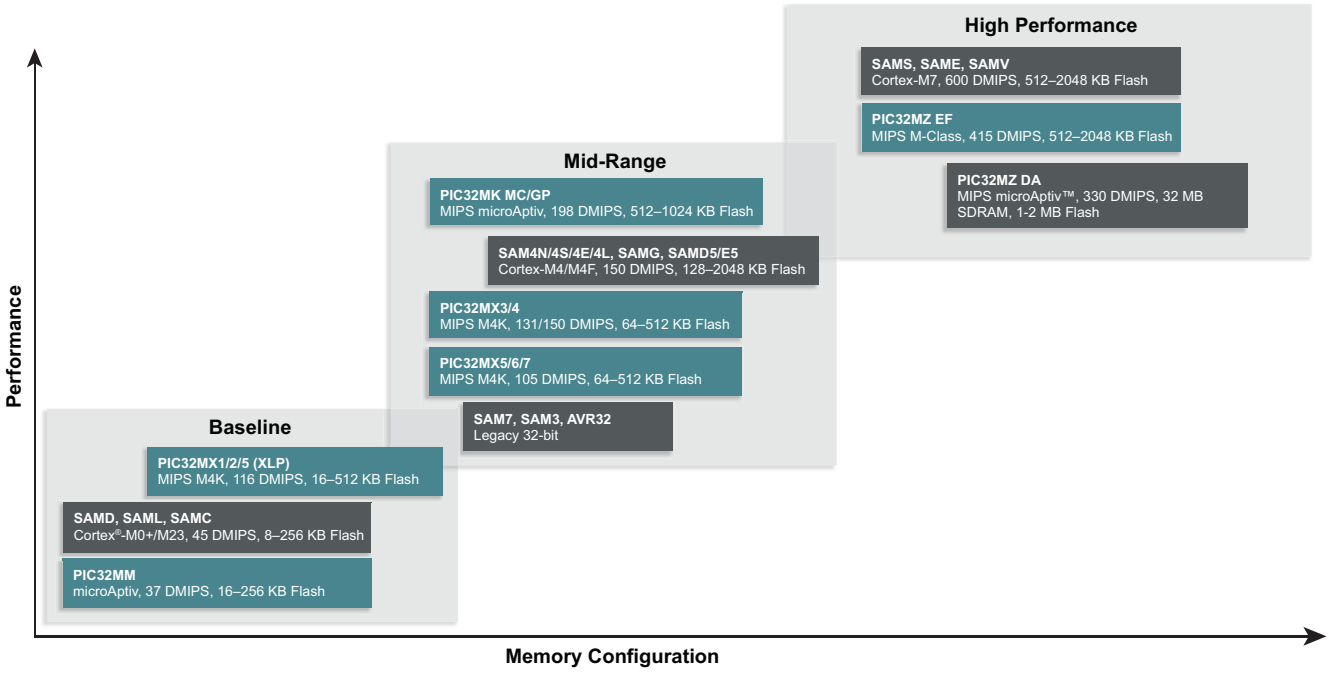


www.microchip.com/32bit

Building on the heritage of Microchip Technology's world-leading 8- and 16-bit microcontrollers, the 32-bit family offers a wide range of products from the industry's lowest-power to highest-performance MCUs coupled with novel and easy-to-use software solutions. With a rich ecosystem of development tools, integrated development environments and third-party partners, Microchip's families of 32-bit microcontrollers accelerate a vast array of embedded designs ranging from secured Internet of Things (IoT) applications to general-purpose embedded control.



Broad Portfolio with Smart Peripheral Mix and Multiple Performance Options



Most Comprehensive 32-bit MCU Solutions for a Wide Range of Applications

Device Family	Digital Audio/ Bluetooth®	Graphics/ Segmented Display	Connectivity	Touch	IoT: Nodes/ Gateways	Wearables/ Sensor Hubs	Appliances	Industrial Automation	Automotive	Motor Control	Metering	Connected Lighting
SAMD			✓	✓	✓	✓	✓	✓	✓	✓		✓
SAML		✓	✓	✓	✓	✓	✓	✓	✓		✓	
SAMC			✓	✓			✓	✓	✓	✓	✓	
PIC32MM			✓		✓	✓	✓	✓		✓		
PIC32MX1/2/5 (XLP)	✓	✓	✓		✓	✓	✓	✓	✓			
SAM4S			✓		✓	✓		✓			✓	
SAM4L		✓	✓	✓	✓	✓	✓				✓	
SAM4N			✓					✓			✓	
SAM4E			✓		✓			✓			✓	
SAMG			✓		✓	✓		✓				
SAMD5/E5			✓	✓	✓	✓	✓	✓	✓	✓		
PIC32MX3/4	✓	✓	✓				✓	✓	✓			
PIC32MX5/6/7		✓	✓		✓		✓	✓	✓			✓
PIC32MK	✓	✓	✓		✓		✓	✓	✓	✓	✓	
PIC32MZDA	✓	✓	✓				✓		✓			
PIC32MZEF	✓	✓	✓		✓		✓	✓	✓		✓	✓
SAMS70/E70			✓		✓			✓		✓		
SAMV7x			✓					✓	✓	✓		

Breakthrough Innovative Features and Solutions

- Ultra-low power: < 25 µA/MHz in Active Mode and 100 nA in Sleep Mode
- High Performance: up to 600 DMIPS performance with double-precision Hardware Floating Point and up to 2 MB dual-panel Flash and 512 KB SRAM
- Enhanced Peripheral Touch Controller (PTC): dedicated hardware peripheral for robust capacitive touch solutions facilitating parallel acquisition, superior water tolerance and noise immunity
- Chip-level security and Arm® TrustZone® Technology
- SleepWalking: ability of the peripherals to perform a desired task while the CPU is asleep
- Event system: enables inter-peripheral communication and efficiently offloads the CPU
- 2D Graphics Processing Unit (GPU) and 3-layer Graphics Controller with up to 24-bit color
- picoPower® Technology and eXtreme Low Power (XLP)
- Low-Cost Controllerless Graphics (LCCG) solutions
- Integrated AES and Public Key Cryptography Controller (PUKCC)
- Motor control PWM and motor encoder interface
- Compact packaging options: chip scale packages down to 1.9 × 2.4 mm
- Advanced analog and connectivity peripherals
- microMIPS™ Instruction Set Architecture (ISA) for improved code density
- Dual-panel Flash options for live updates
- 18 MSPS, 12-bit high-speed ADC with 48 channels

SAMD, SAML and SAMC Series

Baseline SAM Family Features	SAMD10/11	SAMD20/21	SAMDA1	SAML21/22	SAMC20/21	SAML10/11	SAML11-KPH
• Cortex® M0+ • Cortex-M23 • Enhanced Security • Arm® TrustZone® • Event system • Sleepwalking peripherals • SERCOM • Enhanced Peripheral Touch Controller (PTC) • 10-/12-bit DAC • Analog comparators • TRNG, AES, tamper detect, CRC • Supports crystal-less USB operation • Configurable Custom Logic (CCL) • I²S, ISO7816 • WDT, POR, BOR, RTC • Automotive qualified	48 MHz			48/32 MHz	48 MHz	32 MHz	32 MHz
	8/16 KB Flash	16–256 KB Flash	16–64 KB Flash	32–256 KB Flash		16-64 KB Flash	32 - 64 KB Flash
	4 KB SRAM	2–32 KB SRAM	4–8 KB SRAM	4–32 KB SRAM		4-16 KB SRAM	8 - 16 KB SRAM
	14, 20, 24 pins	32, 48, 64 pins		32, 48, 64, 100 pins	32, 48, 56, 64 pins	24/32 pins	
	6 ch. DMA	Up to 12 ch. DMA	8 ch. DMA	16 ch. DMA	Up to 12 ch. DMA	8 ch. DMA	
	1 × TC for control	4 × TC for control	3 × TC for control				
	12-bit ADC, 350 ksps			12-bit ADC, 1 Msps	16-bit SDADC and two 12-bit ADC, 1 Msps	12-bit ADC, 1 MSPS	
	FS USB Device	FS USB Host and Device			CAN-FD and CAN 2.0A/B		
				3 × op amps SLCD Controller	DIVAS	3 x op amps	
			Automotive Qualified		5V Operation	Chip-level security Arm® TrustZone®	Chip-level security Arm TrustZone Securely pre-provisioned Kinibi-M Support

Series Descriptions

- **SAMD10/11:** Smaller member of SAMD family with serial interfaces, timers, analog comparators and PTC. SAMD11 adds FS USB.
- **SAMD20/21:** Offers large memory options with rich set of peripherals including PTC, and provides flexibility and ease-of-use with low power consumption. SAMD21 adds FS USB, DMA and timer counter for control.
- **SAMDA1:** Automotive-qualified microcontrollers, featuring embedded PTC enabling efficient button/slider/wheel solutions for automotive HMI and LIN applications.
- **SAML21/22:** Ultra-low power family with 12-bit ADC, analog comparators, PTC, security functions, TC for control and CCL. SAML21 runs at 48 MHz, consumes under 35 µA/MHz in active mode and 200 nA in sleep mode and features op amps, FS USB Host and Device and 12-bit DAC. SAML22 runs at 32 MHz and comes with an integrated SLCD controller, FS USB Device and 100-pin options.
- **SAMC20/21:** 5V MCU family for appliance and industrial applications. This family features 12-bit ADCs, hardware Divide and Square Root (DIVAS), PTC and high-end timers/counters. SAMC21 adds 16-bit Delta-Sigma ADC, CAN FD and CAN 2.0A/B.
- **SAML10/11:** Ultra-low power family with 12-bit ADC, op amps, enhanced PTC. They run at 32 MHz with Arm Cortex M23 core and consume under 25 µA/MHz in active and 100 nA in sleep. SAML11 adds chip-level security, secure boot, Arm TrustZone and secure key provisioning options with Secure Thingz Secure Deploy.
- **SAML11-KPH** variants provide all the hardware security features of SAML11. Additionally, they are securely pre-provisioned with Trustonic Root of Trust (RoT) and are supported by Trustonic Kinibi-M SDK.

PIC32MX1/2/5 and PIC32MM Series

Baseline PIC32 Family Features	PIC32MX1	PIC32MX2	PIC32MX5	PIC32MM
• MIPS core • UART • SPI • I²C • PPS • 32-bit CRC • RTCC • WDT, BOR, POR • Timer/compare/capture • XLP • Automotive qualified	40/50/72 MHz			25 MHz
	16–512 KB Flash		64–512 KB Flash	16–256 KB Flash
	4–64 KB SRAM		8–64 KB SRAM	4–32 KB SRAM
	28, 36, 44, 64, 100 pins		64, 100 pins	20, 28, 36, 40, 48, 64 pins
		FS USB Host, Device and OTG		FS USB Host, Device and OTG
			CAN 2.0B	
	DMA and PMP			
	10-bit 1 Msps ADC			10-bit 300 ksps, 12-bit 200 ksps ADC
	Analog Comparators			
	I²S			
	AEC-Q100 Qualified			

Series Descriptions

- **PIC32MX1:** 32-bit family optimized for cost and performance with additional features such as DMA and PMP and more serial interfaces, comparators and ADC channels compared to the PIC32MM family. Targeted for general-purpose embedded control and graphics. *Select variants feature eXtreme Low Power (XLP) options.*
- **PIC32MX2:** Feature upgrade from PIC32MX1 with the addition of Full-Speed USB targeting cost-sensitive digital audio, graphics and USB applications. *Select variants feature eXtreme Low Power (XLP) options.*
- **PIC32MX5:** Feature upgrade from PIC32MX2 with the addition of CAN 2.0B targeting industrial, automotive (cabin/infotainment), digital audio, graphics, USB and CAN applications.
- **PIC32MM:** The PIC32MM family is the lowest-power and smallest member of the PIC32 family, offering sleep modes down to 500 nA and packages as small as 4 × 4 mm which makes them suitable for low-power and space-constrained applications. They are compatible with the PIC32MX1/MX2 families.

SAMD5/E5, SAM4 and SAMG Series

Mid-Range SAM Family Features	SAM4N	SAM4S	SAM4E	SAM4L	SAMG	SAMD5/E5
• Cortex® M4/M4F • DSP instructions and FPU • Event system • Sleepwalking peripherals • High I/O pin count • 10-/12-bit DACs • Analog comparators • Communication (USB, CAN, Ethernet) • EBI with memory controller • Safety and security • ISO7816 • POR, BOR, WDT, RTC • QSPI eXecute-In-Place (XIP) support • Automotive Qualified	100 MHz	120 MHz	120 MHz	48 MHz	120 MHz	120 MHz
	512 KB–1 MB Single Bank –	128 KB–2 MB Single/Dual Bank Cache	512 KB–1 MB Single Bank Cache	128–512 KB Single Bank –	256–512 KB Single Bank Cache	256 KB–1 MB Dual Bank Cache
	64/80 KB SRAM	64–160 KB SRAM	128 KB SRAM	32/64 KB SRAM	64–176 KB SRAM	128 KB–256 KB SRAM
	48, 64, 100 pins		100, 144 pins	48, 64, 100 pins	49, 64 pins	48, 64, 100, 120, 128 pins
	DMA	DMA	DMA	DMA	DMA	DMA
		FS USB Device – –	FS USB Device 2× CAN 1× Ethernet	FS USB Host & Device – –	FS USB Host & Device – –	FS USB Host & Device 2× CAN-FD 1× Ethernet
		CMOS Interface		SLCD Controller		PCC
	10-bit ADC, 510 ksps	12-bit ADC, 1 Msps	2× 16-bit ADCs	12-bit ADC, 500 ksps		2× 12-bit ADCs
		CRC – –	CRC AES –	CRC AES TRNG	CRC – –	PUKCC ICM AES
		I²S/TDM		I²S	I²S	I²S

Series Descriptions

- **SAM4N:** Ideal for a wide range of applications in industrial automation, consumer and appliance and energy metering markets. Pin compatible with SAM3S, SAM3N and SAM7S.
- **SAM4S:** Features a multi-layer bus matrix, multi-channel Direct Memory Access (DMA) and distributed memory to support high data-rate communication.
- **SAM4E:** Offers a rich set of connectivity peripherals including 10/100 Mbps Ethernet MAC supporting IEEE 1588 and dual CAN 2.0B as well as single-precision FPU.
- **SAM4L:** Ideal for power-sensitive designs delivering down to 90 µA/MHz in Active Mode as well as Sleep Mode with full RAM retention of 1.5 µA and wake-up time of 1.5 µs.
- **SAMG:** Optimized for ultra-low power and high performance. Small form factor bundled with FPU, DMA and good SRAM-to-Flash ratio in a very tiny 2.8 × 2.8 mm WLCSP.
- **SAMD5/E5:** Ideal for connectivity and security applications. Runs at 120 MHz and consumes under 65 µA/MHz in active mode, features PTC, Parallel Capture Control (PCC) for image sensing, Public Key Cryptography Controller (PUKCC) and Integrity Check Module (ICM) based on Secure Hash Algorithm.

Mid-Range: PIC32MK, PIC32MX3/4 and PIC32MX5/6/7 Series

PIC32MK, PIC32MX3/4 and PIC32MX5/6/7 Series

Mid-Range PIC32 Family Features	PIC32MX3	PIC32MX4	PIC32MX5	PIC32MX6	PIC32MX7	PIC32MK
• MIPS core • UART • SPI • I²C • PPS • 32-bit CRC • RTCC • WDT, BOR, POR • Timers/compare/capture	Up to 120 MHz		80 MHz			120 MHz
	64–512 KB Flash					512–1024 KB Dual Bank
	16–128 KB SRAM					128–256 KB RAM
	64, 100, 124 pins		64, 100, 121, 124 pins			64, 100 pins
		FS USB Device, Host, OTG	FS USB Device, Host, OTG			FS USB Device, Host, OTG
			CAN 2.0B		Dual CAN 2.0B	CAN 2.0B
				10/100 Ethernet MAC		MC PWM and QEI
	DMA and PMP					DMA and PMP
	10-bit 1 Msps ADC					12-bit 1 MSPS ADC
	Analog Comparators					Op amp, 12-bit CDAC, Analog Compare
	I²S					I²S
	AEC-Q100 Qualified					AEC-Q100 Qualified

Series Descriptions

- **PIC32MX3:** General-purpose 32-bit familiy with up to 120 MHz performance for complex embedded applications requiring larger code and data size.
- **PIC32MX4:** Feature upgrade from the PIC32MX3 family with the addition of Full-Speed USB targeting Bluetooth®, high-end digital audio, graphics and USB applications.
- **PIC32MX5:** Mid-range embedded connectivity family with large RAM, FS USB and CAN 2.0B targeting industrial, automotive (cabin/infotainment), USB and graphics applications.
- **PIC32MX6:** Mid-range embedded connectivity family with large RAM, FS USB and 10/100 Ethernet MAC targeting IoT, gateways, industrial, USB and graphics applications.
- **PIC32MX7:** Upgrade from the PIC32MX5 and PIC32MX6 families with a rich set of connectivity peripherals including dual CAN 2.0B, Full-Speed USB and 10/100 Ethernet MAC targeting a broad range of embedded connectivity applications.
- **PIC32MK:** Motor control and general purpose family with up to 1 MB dual panel Flash with live update, features Motor Control PWM, Quadrature Encoder Interface (QEI), four CAN modules and advanced analog.

SAMS70/E70/V7x Series

Feature	SAMS70	SAME70	SAMV70	SAMV71
Frequency	300 MHz			
Flash	512 KB/1 MB/2 MB	512 KB/1 MB/2 MB	512 KB/1 MB	512 KB/1/MB/2 MB
SRAM	256 KB/384 KB/384 KB	256 KB/384 KB/384 KB	256 KB/384 KB	256 KB/384 KB/384 KB
Backup SRAM	1 KB			
Ext. Bus Interface	16-bit (SDRAM, SRAM)			
Ethernet 1588 (MAC)	–	10/100 Mbps	–	10/100 Mbps
CAN FD	–	2	2	2
MediaLB®	–		Yes	
Hi-Speed USB	1			
Automotive Qualified	–		Yes	
Camera interface	1			
QSPI	1			
HSMCI/SDIO/eMMC	1× HS			
USART or SPI/UART	5/3			
SPI/I²C/SSC (I²S/TDM)	2/3/1			
12-bit ADC	2× 12-ch 2 Msps			
12-bit DAC	2-ch 2 Msps			
Timers/PWM	12/8			
Crypto	TRNG, AES 256, SHA 1/256			
Pin Count	64–144			
Package	QFN, QFP, BGA			

High Performance

- Arm Cortex-M7: 300 MHz, 1500 CoreMark™
- Single- and double-precision hardware Floating Point Unit (FPU)
- 16 KB+ 16 KB of I&D cache with ECC
- Execution in place from on-chip Flash NVM connected to QSPI and EBI
- Multi-port SRAM minimizing latency
- User-configurable SRAM and TCM size

Advanced Analog Front-End (AFE)

- Dual S&H, 12-bit ADC and 16-bit hardware averaging
- Differential input, programmable gain
- Automatic gain and offset error correction
- DMA support, hardware and software trigger

Features

- Hi-Speed USB host/device with integrated PHY
- Memory integrity check monitor
- CMOS camera interface
- Ethernet and dual CAN on SAME70 and SAMV71
- Sleepwalking on UART and I²C
- Event system

Temperature Options

- –40 to 105°C
- AEC-Q100, –40 to 105°C (Grade 2)

PIC32MZ Series

Parameter	PIC32MZ EF	PIC32MZ DA
Speed	252 MHz	200 MHz
Floating Point Unit (FPU)	Yes	–
2D Graphics Processing Unit (GPU)	–	Yes
3-Layer Graphics Controller	–	Yes
DDR2 SDRAM	–	32 MB
Flash	512 KB/1 MB/2 MB	1/2 MB
SRAM	128/256/512 KB	256/640 KB
Boot Flash	160 KB	
DMA	26 ch.	
Ethernet	10/100 Ethernet MAC	
USB	Hi-Speed Device, Host and OTG	
CAN	Dual CAN 2.0B	
ADC	12-bit, 18 MSPS, 48 channel	12-bit, 18 MSPS, 45 channel
Analog Compare	Two AC with 32 programmable voltage references	
TRNG	Yes	
Crypto Engine	AES 256, DES/TDES, SHA1/256, MD-5, AES GCM	
Timers/Compare/Capture	9/9/9	
AEC-Q100	Grade1	Grade 2
RTCC	Yes	
PMP	Yes	
SQI	Yes	
SD/SDIO/eMMC bus interface	–	Yes
DDR2 SDRAM I/F	–	Yes
EBI	Yes	
SPI/I²S	6	
I²C	5	
UART	6	
Pin Count	64, 100, 124, 144	169, 176, 288
Packages	QFN, TQFP, VTLA, LQFP, TFBGA	LFBGA, LQFP

High Performance

- MIPS M-Class Core: 252 MHz, 415 DMIPS
- MIPS microAptiv Core: 200 MHz, 330 DMIPS
- Seven-stage FPU for 32-bit and 64-bit floating point math
- microMIPS mode for up to 35% smaller code size
- 32 KB I-Cache, 32 KB D-Cache
- DSP - enhanced core

High-Performance Graphics Features

- 3-Layer graphics controller with up to 24-bit color support
- High-performance 2D Graphics Processing Unit (GPU)

Advanced Analog

- 12-bit ADC
  - 18 Msps, 6 S&H, 48 channel
  - Six digital comparators and filters
  - Sleep and Idle Mode operation
- Two analog comparators with 32 programmable voltage references
- Temperature sensor with ±2°C accuracy

Features

- Dual-panel Flash for live updates
- Memory management unit for optimum embedded OS execution
- Hi-Speed USB Device/Host/OTG with PHY
- 10/100 Ethernet MAC with MII and RMII interface
- Dual CAN 2.0B with DeviceNet addressing support
- SPI/I²S for audio
- Crypto engine with TRNG
- Peripheral Pin Select (PPS) for function remap

Temperature Options

- –40 to 85°C, –40 to 105°C, –40 to 125°C
- AEC-Q100 (Grade 1 –40 to 125°C)
- AEC-Q100 (Grade 2 –40 to 105°C)

AVR32 Series

UC3L

Offers up to 256 KB Flash, 16 KB SRAM, 50 MHz performance and available in 48- and 64-pin options with picoPower® peripherals, CAT module, Full-Speed USB and Flashvault code protection.

UC3C

Offers up to 512 KB Flash, 68 KB SRAM, 66 MHz performance and available in 64-, 100- and 144-pin options with automotive qualification, FPU, Ethernet, USB, dual CAN, dual LIN and FlashVault code protection.

UC3D

Offers up to 128 KB Flash, 16 KB SRAM, 48 MHz performance and available in 48- 64-pin options with hardware QTouch® technology, Full-Speed USB and CAT module.

UC3A3/A4

Offers up to 256 KB Flash, 128 KB SRAM, 84 MHz performance and available in 100- and144-pin options with Hi-Speed USB, NAND Flash and SDRAM interface, SD/SDIO, AES and crypto module.

UC3A0/A1

Offers up to 512 KB Flash, 64 KB SRAM, 66 MHz performance and available in 100- and 144-pin options with Ethernet MAC, USB and SDRAM interfaces.

UC3B

Offers up to 512 KB Flash, 96 KB SRAM, 60 MHz performance and available in 48- and 64-pin options with USB and I²S.

SAM7 Series

SAM7S

Offers up to 512 KB of dual-bank Flash, 64 KB SRAM, 55 MHz performance and available in 48- and 64-pin options with Full-Speed USB, SPI, USART, I²C and 10-bit ADC.

SAM7SE

Offers up to 512 KB of dual-bank Flash and 32 KB SRAM, 55 MHz performance and available in 128- and 144-pin options with EBI (supports static memory, NAND, CompactFlash® and SDRAM), Full-Speed USB, USART, SPI, I²C and 10-bit ADC.

SAM7X

Offers up to 512 KB dual-bank Flash, 128 KB SRAM, 55 MHz performance and available in 100-pin options with Full-Speed USB, Ethernet MAC, CAN 2.0A and 2.0B, USART, SPI, I²C and 10-bit ADC.

SAM7XC

Offers up to 512 KB dual-bank Flash, 128 KB SRAM, 55 MHz performance and available in 100-pin options with two crypto blocks, Full-Speed USB, Ethernet MAC, CAN 2.0A and 2.0B, USARTs, SPI, I²C and 10-bit ADC.

SAM3 Series

SAM3N

Offers up to 64 KB Flash, 8 KB SRAM, 48 MHz performance and available in 48-, 64- and 100-pin options with touch support, USART, SPI, I²C , 10-bit ADC and 10-bit DAC.

SAM3S

Offers up to 512 KB dual-bank Flash, 64 KB SRAM, 64 MHz performance and available in 48-, 64- and 100-pin options with SDIO/SD/MMC interface, touch support, I²S, SPI, I²C, UARTs, 12-bit ADC and 12-bit DAC.

SAM3U

Offers up to 256 KB dual-bank Flash, 48 KB SRAM, 96 MHz performance and comes in 100- and 144-pin options with static memory controller, SDIO/SD/MMC interface, touch, HS USB, SPI, I²C, I²S, UARTs and 10-/12-bit ADCs.

SAM3X/A

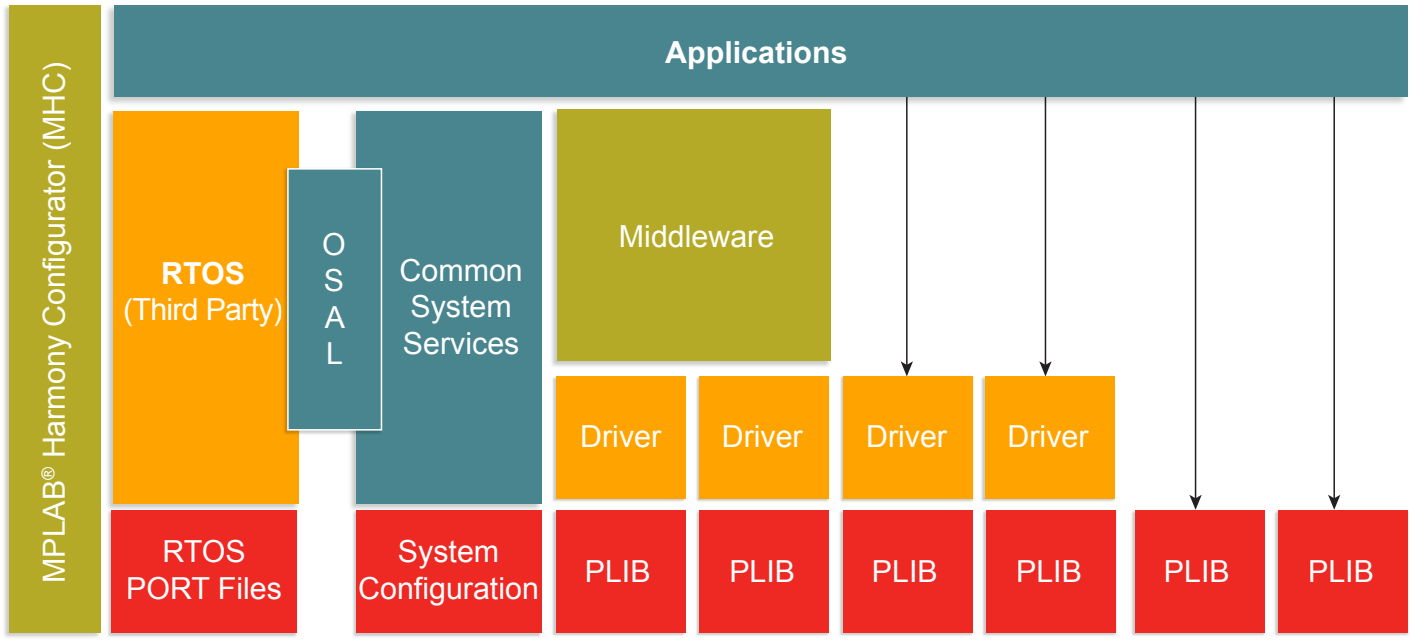
Offers up to 512 KB dual-bank Flash with safety and security features, 96 KB SRAM, 84 MHz performance and comes in 100- and 144-pin options with NAND Flash controller, touch, dual CAN, Ethernet MAC, HS USB, SDIO/SD/MMC interface, SPI, I²C, I²S, UARTs, 12-bit ADC and 12-bit DAC.

MPLAB® Harmony Software Framework

A unified and powerful content development and delivery environment, MPLAB Harmony Software Framework together with MPLAB X Integrated Development Environment (IDE), enhances your application development experience with a set of optimized peripheral libraries, simplified drivers and modular software downloads.

It provides flexible choices spanning architectures, performance and various applications. It enables development of robust, interoperable, RTOS-friendly applications with quick and extensive support for third-party software integration. The improved MPLAB Harmony Configurator (MHC), now with a modular download manager facilitates to select and configure all MPLAB Harmony components in a graphical way, including middleware, system services and peripherals.

MPLAB Harmony Block Diagram



Key Highlights

- Unified Development Platform supports both PIC® and SAM 32-bit microcontrollers and microprocessors
- MPLAB Harmony Configurator (MHC) for enhanced user experience
- RTOS integration options available
- MPLAB Harmony is delivered via GitHub to streamline application development
- Optimized peripheral libraries for size and performance
- Simplified drivers supporting development at silicon level
- Smaller/Modular downloads of software or services

Software Solutions Support

USB	USB Host, HUB, Device, Dual Role with Class Drivers (Audio, CDC, HID, MSD, Generic)
Graphics and Touch	MPLAB® Harmony Graphics Suite 32-bit Color and Multi-layer Support maXTouch® PCAP Driver Video Streaming/Animation support Seamless 3rd Party Graphics Library Integration Automatic display driver configuration Touch Library, Touch Configurator, Data Visualizer
CAN	CAN Driver and PLIB supporting both CAN2.0 and CAN-FD modes
Audio and Speech	Basic Audio Decoders: Speex, WAV, Opus, ADPCM; Premium Audio Decoders: MP3, AAC, WMA, USB Audio 2.0 Device Class (Hi-Res Audio); Bluetooth Audio Software; FLAC
Wi-Fi®, Bluetooth® and Ethernet	Microchip TCP/IP with Wi-Fi support; Bluetooth SPP Stack; Bluetooth Audio Software, Bluetooth Low Energy (BLE) support
IoT and Security	Cryptographic Library; wolfSSL SSL/TLS Library, wolfMQTT
Basic Libraries	File System Library; Floating Point Math Library; Peripheral Library; Class B; Fixed Point Math Library; Fixed Point DSP Library
Bootloader	Serial Port Bootloader USB Host, HUB Bootloader Ethernet Bootloader USB Device Bootloader SD Card Bootloader
RTOS	expresslogic, Micrium, Segger, FreeRTOS, OPENRTOS
Motor Control	Sensored and Sensorless Field Oriented Control of PMSM Average Constant Current Mode PFC PLL and Reduced Order Luenberger Observer based rotor position with windmilling capability

Get the latest updates at www.microchip.com/harmony.

Atmel Software Framework (ASF)

The Atmel Software Framework provides software drivers and libraries to build applications and help develop and glue together the different components of a software design. It can easily integrate into an operating system or run as a standalone product. It features Atmel START, which allows you to select the MCU, and configure software components, drivers, middleware and example projects to tailor your embedded application in a usable and optimized manner.

Applications

- Provides application examples that are based on services, components and driver-modules

Services

- Provides more application-oriented software such as USB classes, FAT file system, architecture-optimized DSP library, graphical library, etc.

Components

- Provides software drivers to access external hardware components such as memory (for example SDRAM, SRAM, and NAND Flash), displays, sensors, wireless, etc.

Drivers

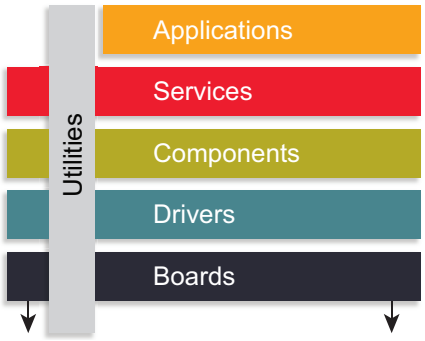
- Each driver is composed of a driver.c and driver.h file that provides low-level register interface functions to access a peripheral or device-specific feature

Boards

- Contains the various board definitions for the given architecture; the board code abstracts the modules above the board from the lower level details

Utilities

- Provides several linker script files, common files for the build system and C/C++ files with general usage defines, macros and functions



ASF is organized in layers for each supported family of devices.

Key Features and Benefits

- Simplifies the usage of microcontrollers, providing an abstraction to the hardware and high-value middleware
- Designed to be used for evaluation, prototyping, design and production phases
- Integrated in the Atmel Studio IDE with a graphical user interface or available standalone for GCC, IAR compilers
- Atmel START to easily select and configure software
- Data visualizer to profile applications run-time behavior and live power measurements
- QTouch composer allows you to seamlessly develop capacitive touch functionality to your application
- Atmel START TrustZone Manager to simplify configuration of Arm TrustZone

Software Solutions Support

Touch	QTouch® software library with QTouch composer and analyzer
USB	USB Device and Host stack with class drivers (CDC, HID, DFU, MSD, Vendor, AOA, Composite, PHDC)
TCP/IP	LwIP - Lightweight open source TCP/IP stack
Wi-Fi®	WINC1500, WILC1000, WILC3000, WINC3400 library and demo
Bluetooth®	BTLC1000 Bluetooth Low Energy (BLE) stack and demo
802.15.4	Lightweight mesh software stack (lwMesh), 6LoWPAN, MiWi Stack
IoT, Security and Cloud	CryptoAuthentication™ library, LoRaWAN™, Trustonic Kinibi-M, Secure Thingz Key Provisioning, SEGGER emCrypt crypto library, AWS and Google Cloud support
CAN	CAN 2.0B and CAN FD drivers
Sensor Library	Bosch BNO055, Microchip AT30TSE758, ADI ADXL345z, AKM AK8975, Honeywell HMC5883L, Invensense IMU-3000, Kionix KXTF9, OSRAM SFH5712/SFH7770, Pololu MMA7341L
RTOS	FreeRTOS, Micrium, SEGGER embOS

Comprehensive Suite of Development Tools

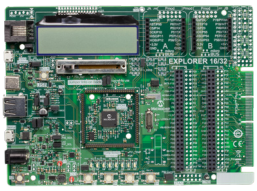
Microchip offers MPLAB X IDE and Atmel Studio IDE to support the broad range of 32-bit MCUs. They both are free and easy to use.

Developing with 32-bit Microcontrollers

32-bit Starter Kits and Curiosity Development Kits

Getting started is easy with any of the fully integrated Starter Kits or Curiosity Boards. They are supported by various application demos, software libraries and Board Support Packages (BSP) for faster development.

Explorer 16/32 Development Board (DM240001-2)



The Explorer 16/32 Development Board is a flexible and convenient development platform for 16-bit PIC24 MCUs, dsPIC® DSCs and 32-bit MCUs. The board is driven by the processor Plug-in Modules (PIMs) and facilitates hardware expansion through the use of PICtail™ Plus daughter cards and mikro-BUS™ accessory boards. The PIMs are supported by various application demos, software libraries and BSPs for faster development.

Starter Kits and Curiosity Boards

Product Family	Starter Kits and Curiosity Boards	Part Number
PIC32MX1/2/5	PIC32MX1/2/5 Starter Kit	DM320100
	PIC32 Bluetooth® Starter Kit	DM320018
	Microstick II	DM330013-2
	PIC32MX274 XLP Starter Kit	DM320105
PIC32MM	PIC32MM USB Curiosity Development Board	DM320107
	PIC32MM Curiosity Development Board	DM320101
PIC32MX3/4	PIC32 USB Starter Kit III	DM320003-3
	PIC32 Starter Kit	DM320001
	Curiosity PIC32MX Board	DM320103
PIC32MX5/6/7	PIC32 Ethernet Starter Kit II	DM320004-2
PIC32MK	PIC32MK GP Development Kit	DM320106
PIC32MZ	PIC32MZ with FPU Embedded Connectivity Starter Kit	DM320007
	PIC32MZ with FPU Embedded Connectivity Starter Kit with Crypto Engine	DM320007-C
	Curiosity PIC32MZ Development Board	DM320104
	Amazon FreeRTOS Curiosity PIC32MZ EF Bundle	DM320104-BNDL
	PIC32MZ Embedded Graphics with External DRAM (DA) Starter Kit	DM320008
	PIC32MZ Embedded Graphics with Stacked DRAM (DA) Starter Kit (Crypto)	DM320010-C
	PIC32MZ Embedded Graphics with Stacked DRAM (DA) Starter Kit	DM320010
	PIC32MZ Embedded Graphics with External DRAM (DA) Starter Kit (Crypto)	DM320008-C
	Curiosity 2.0 PIC32MZ Development Board	DM320209

Plug-In Module Platform

Development Board	Part Number
Explorer 16/32 Development Board	DM240001-2
Motor Control MCHV-2 Development Board	DM330023-2
Motor Control MCLV-2 Development Board	DM330021-2

Product Family	Plug-In Module	Part Number
PIC32MM	PIC32MM0064GPL036	MA320020
	PIC32MM0256GPM064	MA320023
PIC32MX1/2/5	PIC32MX250F128D PIM	MA320011
	PIC32MX270F256D PIM	MA320014
	PIC32MX570F512L PIM	MA320015
	PIC32 XLP PIM	MA320021
PIC32MX3/4	PIC32MX360F512L PIM	MA320001
	PIC32MX460F512L PIM	MA320002
	PIC32MX450/470 PIM	MA320002-2
PIC32MX5/6/7	PIC32MX795F512L PIM	MA320003
PIC32MZ	PIC32MZ with FPU PIM	MA320019
PIC32MK	Motor Control Plug-In Module: PIC32MK1024 PIM*	MA320024

*Works with MCHV-2 (DM330023-2) and MCLV-2 (DM330021-2) Motor Control Development Boards.

PICtail Plus Daughter Boards

Application	PICtail™ Plus Daughter Board	Part Number
CAN	CAN/LIN PICtail (Plus) Daughter Card	AC164130-2
USB	USB PICtail Plus Daughter Card	AC164131
Ethernet	Ethernet PICtail Plus Daughter Card	AC164123
	Fast 100 Mbps Ethernet PICtail Plus Daughter Card	AC164132
Wi-Fi®	MRF24WN0MA module	AC164153
	MRF24WG0MA module	AC164149
	WINC1500 module	AC164156
Graphics	Graphics Controller PICtail Plus Epson S1D13517 Board	AC164127-7
Storage	PICtail Daughter Board for SD and MCC Cards	AC164122

*Note: Starter Kits require I/O Expansion Board (DM320002) to connect PICtail Plus Daughter Cards.

Expansion Boards and Development Kits

Expansion Board	Part Number
I/O Expansion Board	DM320002
Multimedia Expansion Board II (MEB II)	DM320005-5
5" WVGA PCAP Display for MEB II	AC320005
PIC32 Audio Codec Daughter Card (AK4642EN)	AC320100
PIC32 Audio DAC Daughter Card	AC320032-2
PIC32 Audio Codec Daughter Card (WM8904)	AC328904
High-Performance 4.3" WQVGA Display Module with maXTouch®	AC320005-4
High-Performance WVGA LCD Display Module with maXTouch	AC320005-5
KSZ8863 Ethernet PHY Daughter Board	AC320004-7

Development Kit	Part Number
PIC32 Bluetooth® Audio Development Kit	DV320032

PIMs for PIC32 Bluetooth® Audio Development Kit	Part Number
PIC32MZ EF Bluetooth Audio PIM	MA320018*
PIC32MX270F256D Bluetooth Audio PIM	MA320013*
PIC32MX270F512L Bluetooth Audio PIM	MA320017*

*Note: Does not work with Explorer 16/32 Development Board.

Emulators and Debuggers

Emulator/Debugger	Part Number
MPLAB® PICkit™ 4 In-Circuit Debugger	PG164140
MPLAB ICD 4 In-Circuit Debugger	DV164045
MPLAB Snap	PG164100

Developing with SAM and AVR32 Microcontrollers

SAM and AVR32 Xplained Platforms

Xplained is a fast prototyping and evaluation platform for SAM and AVR32 MCUs. These low-cost, easy-to-use evaluation kits are ideal for demonstrating the features and capabilities of your selected device, and can be customized with a wide range of extension boards. Development is easy with a rich selection of example projects and code drivers.

Choose from four types of Xplained platforms:

- **Xplained Pro** – A professional evaluation board featuring auto-identification, with an on-board debugger and standardized extension connectors
- **Xplained Mini** – An ultra-low-cost platform for evaluating low pin-count parts. It features an on-board debugger, access to all device pins, and auto-identification
- **Xplained Ultra** – An evaluation platform for high-end microcontrollers with access to high-speed data and external memory interfaces
- **Xplained** – A fast prototyping and evaluation platform for 32-bit AVR® and SAM microcontrollers

Xplained Pro Platform

Product Family	Board	Part Number
SAMC	SAMC21 Xplained Pro	ATSAMC21-XPRO
	SAMC21N Xplained Pro	ATSAMC21N-XPRO
SAMD	SAMDA1 Xplained Pro	ATSAMDA1-XPRO
	SAMD11 Xplained Pro	ATSAMD11-XPRO
	SAMD20 Xplained Pro	ATSAMD20-XPRO
	SAM HA1G16A Xplained Pro	ATSAMHA1G16A-XPRO
	SAMD21 Xplained Pro	ATSAMD21-XPRO
SAML	SAML10 Xplained Pro	DM320204
	SAML11 Xplained Pro	DM320205
	SAML21 Xplained Pro	ATSAML21-XPRO-B
	SAML22 Xplained Pro	ATSAML22-XPRO-B
SAMG	SAMG53 Xplained Pro	ATSAMG53-XPRO
	SAMG55 Xplained Pro	ATSAMG55-XPRO
SAM4	SAM4E Xplained Pro	ATSAM4E-XPRO
	SAM4L Xplained Pro	ATSAM4L-XPRO
	SAM4L Xplained Pro Starter Kit	ATSAM4L-XSTK
	SAM4L8 Xplained Pro	ATSAM4L8-XPRO
	SAM4N Xplained Pro	ATSAM4N-XPRO
	SAM4S Xplained Pro	ATSAM4S-XPRO
	SAM4S Xplained Pro Starter Kit	ATSAM4S-XSTK
SAMD5/E5	SAME54 Xplained Pro	ATSAME54-XPRO

Xplained Mini Platform

Product Family	Board	Part Number
SAMD	SAMD10 Xplained Mini	ATSAMD10-XMINI

Xplained Ultra Platform

Product Family	Board	Part Number
SAMV	SAMV71 Xplained Ultra	ATSAMV71-XULT
SAME	SAME70 Xplained Ultra	DM320113

Xplained Platform

Product Family	Board	Part Number
SAM4	SAM4S Xplained	ATSAM4S-XPLD
SAME	SAME70 Xplained	ATSAME70-XPLD

Legacy Xplained Platform

Product Family	Board	Part Number
AVR32	UC3-A3 Xplained	AT32UC3A3-XPLD
	UC3-L0 Xplained	AT32UC3L0-XPLD

Extension Boards

The following Extension Boards are add-on boards for Xplained Pro Kits for expanded functionality.

Application	Extension Board	Part Number
Connectivity	WINC1500 Xplained Pro (Wi-Fi®)	ATWINC1500-XPRO
	WINC3400 Xplained Pro	ATWINC3400-XPRO
	BTLC1000 Xplained Pro (BLE)	ATBTLC1000-XPRO
	Ethernet1 Xplained Pro	ATETHERNET1-XPRO
Touch and Graphics	QT1 Xplained Pro	ATQT1-XPRO
	QT2 Xplained Pro	ATQT2-XPRO
	QT3 Xplained Pro	ATQT3-XPRO
	QT4 Xplained Pro	ATQT4-XPRO
	QT6 Xplained Pro	ATQT6-XPRO
	maXTouch® Xplained Pro	ATMXT-XPRO
	QT7 Xplained Pro	ATQT7-XPRO
	mXT143E Xplained	ATmXT143E-XPLD
	SLCD1 Xplained Pro	ATSLCD1-XPRO
	QT8 Xplained Pro Extension Kit	AC164161
General Purpose	OLED1 Xplained Pro	ATOLED1-XPRO
	PROTO1 Xplained Pro	ATPROTO1-XPRO
	I/O1 Xplained Pro	ATIO1-XPRO
Sensors	BNO055 Xplained Pro	ATBNO055-XPRO
	Inertial One Sensor Board	ATAVRSBIN1
	Pressure One Sensor Board	ATAVRSBPR1
	Inertial Two Sensor Board	ATAVRSBIN2
	Light and Proximity One Sensor Board	ATAVRSBLP1
Security	CryptoAuth Xplained Pro	ATCRYPTOAUTH-XPRO-B

Programming and Debugging

Programmer/Debugger	Part Number
Atmel-ICE	ATATMEL-ICE
MPLAB® Snap	PG164100
MPLAB ICD4	DV164045
MPLAB PICkit™	PG164140

Motor Control PIM

Product Family	Motor Control Plug-in Module (PIM)	Part Number
SAME70	ATSAME70 Motor Control Plug In Module*	MA320203
SAMC21	ATSAMC21 Motor Control Plug In Module*	MA320206
SAME54	ATSAME54 Motor Control Plug In Module*	MA320207

*Works with MCHV-2 (DM330023-2) and MCLV-2 (DM330021-2) Motor Control Development Boards

Reference Designs and Demo Kits

Product Family	Demo/Reference Design	Part Numbers/References
SAMC20	SAMC20 QTR Demo	ATSAMC20-QTRDEMO
SAMC21	SAMC21 MCU Card for BLDC 24V Motor Control Kit	ATSAMC21MOTOR
	SAMC21 Industrial CAN Touch Demo	ATSAMC21-XPRO (2×), ATQT1-XPRO (2×)
SAMD20	SAMD20 QTouch® Robustness Evaluation Kit	ATSAMD20-QTRDEMO
SAMD21	BLDC 24V Motor Control Kit	ATSAMD21BLDC24V-STK
	SAMD21E16L Motor Control Card	ATSAMD21E16LMOTOR
	SAMD21 Blood Pressure Beacon	ATSAMD21-XPRO, ATBTLC1000-XPRO
	Smart Plug Reference Design	ATSMARTPLUG-US
	SAMD21 Google Cloud Demo	ATSAMD21-Xpro, CryptoAuth-XPRO-B, ATWINC1500-XPRO
SAMG55	Zero Touch Provisioning Kit for AWS IoT	AT88CKECC-AWS-XSTK-B
	SAMG55 Afero Cloud Demo	ATAFERO-MOD2-XPRO
SAML10	Low-Power Weather Station	DM320204, ATMBUSADAPTER-XPRO, MIKROE-1978, MIKROE-1630,1.54 inch e-Paper Module
	Low-Power SleepWalking	DM320204, ATIO1-Xpro
	Water-Tolerant Touch	DM320204, ATQT7-Xpro
	Keypad Touch	DM320204, ATQT3-Xpro
	Water Tolerant Surface Touch	DM320204, AC164161
SAML11	Trusted Execution Environment	DM320205, ATIO1-Xpro
	Secure LoRa® IoT node	Refer to Application Note AN2835
	Cloud Enrollment With Trustonic Kinibi-M	DM320205, MIKROE-958, ATIO1-Xpro
	Water Tolerant Touch	DM320205, ATQT7-Xpro
	Keypad Touch	DM320205, ATQT3-Xpro
SAML21	Ultra-Low Power Demo With SAML21 and BTLC1000	ATULPC-DEMO
	SAML21 Low-Power QTouch Demo	ATSAML21-XPRO-B, ATQT3-XPRO, ATPOWERDEBUGGER
SAML22	Connected Wearable Electrocardiogram (ECG) Demo	WearableECG
SAMV71	Ethernet AVB Demo	ATSAMV71-XULT (2×)
PIC32MZ	PIC32MZEF AWS Cloud Demo	DM320104-BNDL
	PIC32MZDA Graphics Demos	Refer to www.microchip.com/harmony
	PIC32MZEF Graphics, Connectivity & Audio Demos	Refer to www.microchip.com/harmony
	PIC32MK Motor Control Demos	Refer to www.microchip.com/harmony

Note: For availability and/or getting started information, please contact your local Microchip sales office.

Package Options

Package	Size (mm)	Pin Count
WLCSP	1.9 × 2.4	20
	2.8 × 2.6	35
	2.7 × 2.7	45
	2.79 × 2.79	32
	2.84 × 2.84	49
	3.2 × 3.4	56
	5.2 × 5.3	64
Thin WLCSP	4.4 × 4.7	64
QFN	4 × 4	24
	5 × 5	32
	6 × 6	28
	7 × 7	48
	8 × 8	44
	9 × 9	64
UFBGA	5 × 5	64
	6 × 6	100
	6 × 6	144
VFGBA	7 × 7	100
TFBGA	7 × 7	100
	7 × 7	144
	10 × 10	121
FFBGA	11 × 11	144

Package	Size (mm)	Pin Count
LFBGA	11 × 11	144
	15 × 15	288
TQFP	7 × 7	32
	7 × 7	48
	10 × 10	44
	10 × 10	64
	12 × 12	100
	14 × 14	100
	14 × 14	128
	16 × 16	144
LQFP	20 × 20	176
	20 × 20	144
VTLA	5 × 5	36
	6 × 6	44
	9 × 9	124
SOIC	3.9 × 8.7	14
	7.5 × 12.8	20
	7.5 × 17.9	28
SSOP	5.3 × 10.2	28
	5.3 × 8.2	24
SPDIP	7.3 × 34.7	28

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