



Meet the MCX C Series: Elevate Your Design with Energy Efficient and Cost Effective MCUs

July 23, 2024 by [Will Wang](#)



NXP extends its portfolio of MCX microcontrollers with the release of the [MCX C Series](#). MCX C's low-cost design, energy-efficient performance and robust features enhance the overall MCX portfolio.

Arm® Cortex®-Based, Cost Effective and Energy Efficient

Building off NXP's strong MCU legacy with a bold vision for the future, we are proud to launch the MCX C series—a cost effective and energy-efficient Cortex-M0+ MCU with a 15-year longevity, designed to upgrade legacy 8-bit and 16-bit designs. The MCX C Series caters to the specific needs of the entry-level industrial and IoT market, serving as a gateway to a diverse range of applications. From small to medium appliances, home security and surveillance, to smart lighting, smart power sockets and DC fans, this MCU provides customers with a comprehensive family of options, from entry-level to advanced solutions. Powered by a 32-bit Arm® Cortex® M0+ processor at 48 MHz, it offers up to 256 KB Flash, up to 32 KB SRAM and up to 16 KB Boot ROM. Additionally, MCX C features full-speed USB and SLCD interfaces, along with low-power modes for energy-efficient peripherals.

Why Should You Pick the MCX C?

Reliable and Cost Effective

Today, the total cost of ownership of an MCU solution is a significant factor—a cost-effective platform with open-source development tools gives new product developers an advantage. The [MCX C Series](#) is an entry-level MCU that focuses on ease of use that is cost-effective and highly reliable. MCX C is designed to meet the needs of various low-end industrial IoT applications.

Low-Power and High-Speed Interfaces

Energy is precious when edge devices become ubiquitous in deployment environments, but high speed is still important for overall system performance. MCX C supports low-power, energy-saving peripherals and USB interfaces. USB 2.0 is full-speed operating at 12 Mbit/s. Energy-saving peripherals take the load off the core for power-saving and low-power modes keep the peripherals running while the core is asleep. Segmented LCDs support human-machine interfaces (HMI) and the controller can generate the appropriate waveforms to drive multiplexed numeric, alphanumeric or custom-segment LCD panels.

Security

MCX C implements external access security based on the mode selected from the flash module. The flash module provides security information to the MCU, confirming the security request and limiting access to flash resources.

When unsecured, all-flash commands are available on the debug port or user code execution. Only mass erase operations are permitted when the flash is secured and the debug port cannot access memory locations. When mass erase is disabled, mass erase via the debugger is also blocked.

Start developing today with the MCX C Series using the FRDM Development Platform.
Experience the [MCX-powered FRDM board](#).

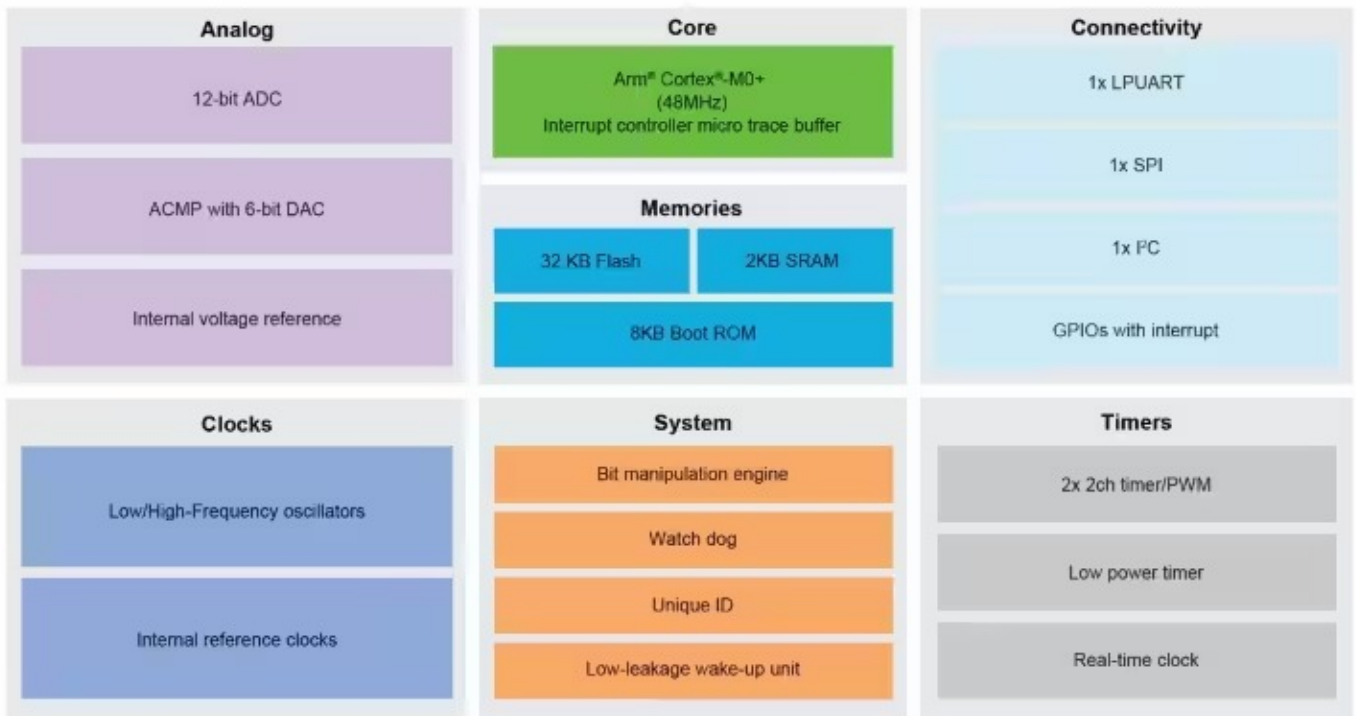
MCX C Application Areas

MCX C will find a home in a wide range of application areas in diverse markets, including small to medium appliances, home security and surveillance, smart lighting, smart power sockets and DC fans.



MCX C: Up-Close and In Detail

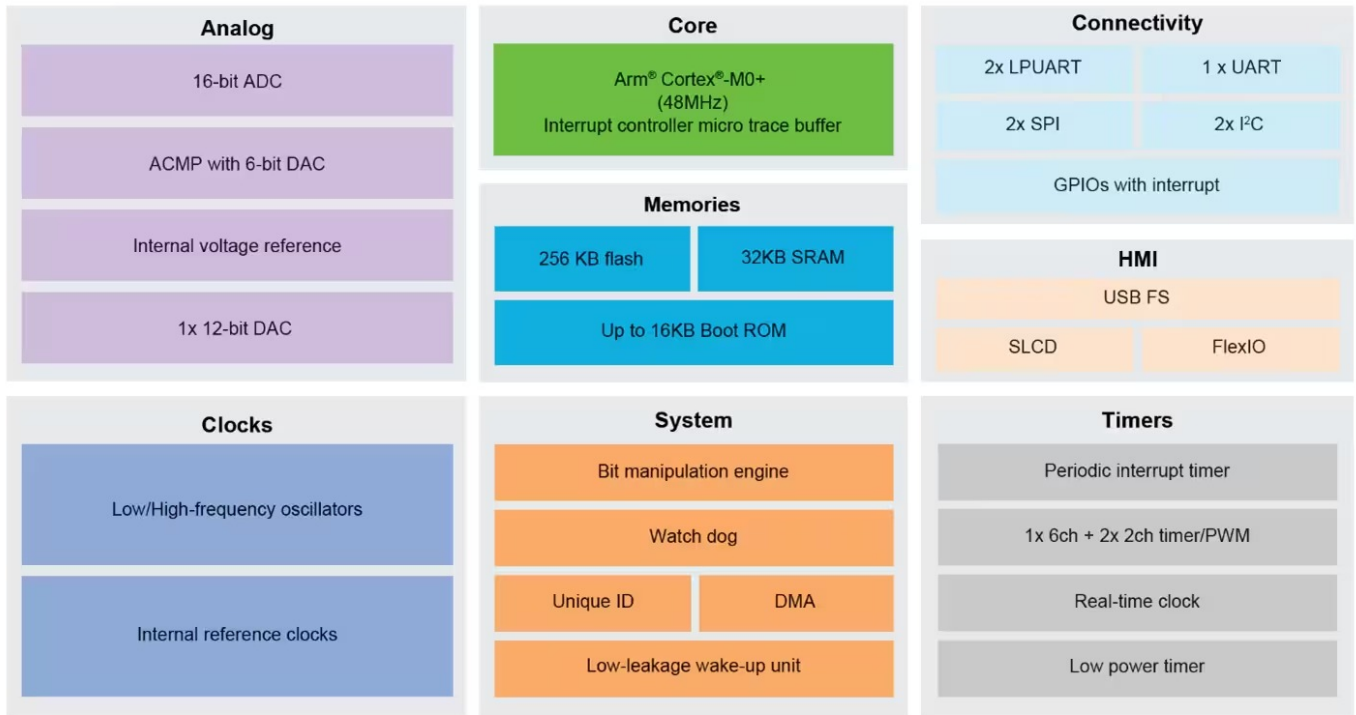
The MCX C Series features multiple families all powered by an Arm Cortex-M0+ 48MHz. [MCX C04x](#) is the entry-level device available in 16 or 24-pin QFN packages. Memory is 32KB Flash, 2KB SRAM and 8KB Boot ROM. The run power consumption can be as low as 50 $\mu\text{A}/\text{MHz}$.



MCX C04x Block Diagram

[MCX C24x](#) provides more functionality and resources. Memory is up to 64KB Flash, up to 16KB SRAM and 16KB Boot ROM. An embedded ROM with a bootloader provides flexible program upgrades using the integrated USB FS 2.0 device. FlexIO can support any standard and customized serial peripheral emulation. Power consumption can be down to 46 $\mu\text{A}/\text{MHz}$ in very low power run mode and 1.68 μA in stop mode with RAM and RTC retained. The device is available in either 64-pin LQFP or 32-pin QFN packages.

[MCX C44x](#) is the highest performing family. Memory is up to 256KB Flash, up to 32KB SRAM and 16KB Boot ROM. In addition to MCX C24x features, the segment LCD supports up to 24x8 or 28x4 segments. Power is down to 54 $\mu\text{A}/\text{MHz}$ in very low power run mode and 1.96 μA in deep sleep mode (RAM + RTC retained). There are more packaging options, including 32 and 48-pin QFN, 64-pin LQFP and 64-pin BGA.



MCX C14x/24x/44x Block Diagram

Low Power

The power management controller (PMC) provides multiple power options to allow the user to optimize power consumption for the level of functionality needed. It supports multiple RUN/WAIT/STOP modes. The MCU can run at less than 50µA/MHz and can run at 2µA with Deep Sleep I_{dd} with register retention. When in deep sleep mode, the microcontroller can wake up in just 4µs.

Most modules' clocks can be turned off to conserve power. The PMC has a low-voltage detection (LVD) system to guard against low-voltage conditions.

Communication and HMI

The MCX C has a wide range of communication and HMIs. USB operates at full speed (USB 2.0 at 12 Mbit/s) and a segmented LCD interface. FlexIO is provided for customizable interfaces and is capable of supporting a wide range of protocols, including, but not limited to, UART, I2C, SPI, I2S, Camera IF and PWM / Waveform generation.

There are two low-power UART channels, SPI and I2C interfaces for device-to-device communications. A number of general-purpose input/output (GPIO) pins are provided, which can be used to drive LEDs or power MOSFETs directly. The segmented LCD controller can generate the appropriate waveforms to drive multiplexed numeric, alphanumeric or custom-segment LCD panels. It can interface up to 8 backplanes and up to 47 frontplanes, such as 8X47 or 4X51.

Segment fault detection is also supported.



Communication and HMI

Precision Analog

The MCX C contains a 16-bit successive approximation high-speed ADC with up to 16 channels and supports 12/16-bit output modes (12-bit successive approximation ADC and up to 8 channels in the MCX C04x devices). There is a 12-bit high-speed, low-power, general-purpose DAC. The output of the DAC can be placed on an external pin or set as one of the inputs to the analog comparator, op-amps or ADC. The analog comparator (CMP) module provides a circuit for comparing two analog input voltages with a 6-bit digital-to-analog converter able to provide one signal. It includes an Analog MUX, which provides a circuit for selecting an analog input signal from eight channels. A voltage reference provides a buffered reference voltage as an external reference. The buffered reference is also internally available with the ADC, DAC and analog comparator. The voltage reference output can be trimmed with a resolution of 0.5mV and output on a dedicated pin.

Enhanced Performance

The MCX C Series provides a number of advanced core features for enhanced performance.

The DMA module can move data within system memory and peripheral devices asynchronously with minimal processor intervention, improving overall system performance.

The bit manipulation engine provides hardware support for atomic read-modify-write memory operations to the peripheral address space. The implementation provides a robust and efficient read-modify-write capability for this class of general-purpose microcontrollers.

A symmetric crossbar switch implementation allows concurrent access from different main devices to different subdevices, with 32-bit transfers up to a single clock. The crossbar can be configured for fixed-priority or round-robin subdevice port arbitration.

Clock and Timing

The MCX C offers various clock source options for the MCU. It has a high-frequency internal reference clock running at 48 MHz and a low-frequency internal reference clock that can run at 8 MHz or 2 MHz. Additionally, an external crystal oscillator can be used as a clock source. Divider/prescalers can be utilized for various frequency options, including 1 KHz, 32 KHz and 4 MHz. An external crystal oscillator can run at 32 kHz or 3–32 MHz.

The timer/PWM module provides a 2–to 8-channel timer that supports input capture, output compare and the generation of PWM signals to control electric motors and power management applications. The counter, compare and capture registers are clocked by an asynchronous clock that can remain enabled in low-power modes.

The low-power timer can be configured to operate as a time counter with a 16-bit resolution or as a pulse counter. It works across all power modes and can continue operating through most system reset events, allowing it to be used as a time-of-day counter.

The real-time clock provides a 32-bit seconds counter with roll-over protection and a 32-bit alarm. There are software-selectable clock sources for input and a programmable 16-bit prescaler.

Scalable Packages

MCX C is designed to offer an optimal balance of cost and performance, with scalable memory and package options. This flexibility ensures that the MCX C Series meets diverse application requirements while maintaining cost-effectiveness and high-quality standards.



MCX C is supplied in the following range of industry-standard packages: QFN16, QFN24, QFN32, QFN48, BGA64, LQFP64.

MCUXpresso Developer Experience

MCX C applications can be developed rapidly and efficiently using the MCUXpresso suite of software and tools. We offer developers the freedom of choice in how they develop software.

The [MCUXpresso suite of software and tools](#) offers core software development kits (SDKs), integrated development environments (IDEs) and configuration tooling.

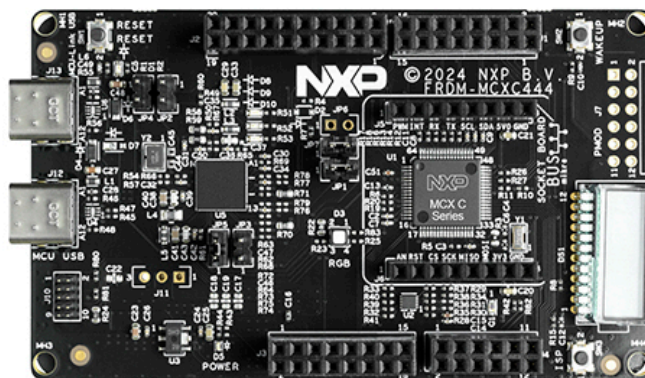
The SDK for MCX C includes low-level peripheral drivers, configuration utilities and middleware such as a USB device stack.

The SDKs are flexible and can be used with a range of IDEs, such as:

- MCUXpresso for Visual Studio Code (VS Code): VS Code extension to enable fast, flexible development
- MCUXpresso IDE: Custom, Eclipse-based IDE optimized for ease of use
- IAR Embedded Workbench: Safety certified, highly optimizing compiler and development environment for C/C++
- Arm Keil MDK: High-performance Arm Compiler with extensive middleware

Development Boards

Three [FRDM development boards](#) are available to provide a cost-effective and easy-to-use development platform. They are programmable through a USB-C connector and have I/O pins through Arduino-compatible headers. Extra rows of pins are provided for complete access to MCX C peripherals. The debugger header provides a serial interface. Expansion add-on boards are available from NXP's [Expansion Board Hub](#) and partners with related MCUXpresso SDK-compatible drivers and examples.



FRDM-MCXC444 Development Board

The FRDM development boards have variable packages:

- FRDM-MCXC041: 48 MHz Cortex-M0+, 32KB Flash, QFN-24
- FRDM-MCXC242: 48 MHz Cortex-M0+, 64KB Flash, QFP-64, Full Speed USB
- FRDM-MCXC444: 48 MHz Cortex-M0+, 256KB Flash, QFP-64, Full Speed USB & Segment LCD

The MCX C Series Advantage

With its cost-effective design and energy-efficient Arm Cortex-M0+ processor, the MCX C Series delivers high performance at a lower cost. It features up to 256 KB of Flash memory, 32 KB of SRAM, full speed USB and a segment LCD interface making it ideal for Edge devices. The MCX C Series is fully supported by the MCUXpresso Developer Experience, offering easy access to FRDM Development Boards and support for popular IDEs like MCUXpresso for VS Code.

Explore the [MCX C Series](#) to access datasheets, reference manuals and all the resources you need to get started.

Tags: [Industrial](#), [Power and Energy](#).

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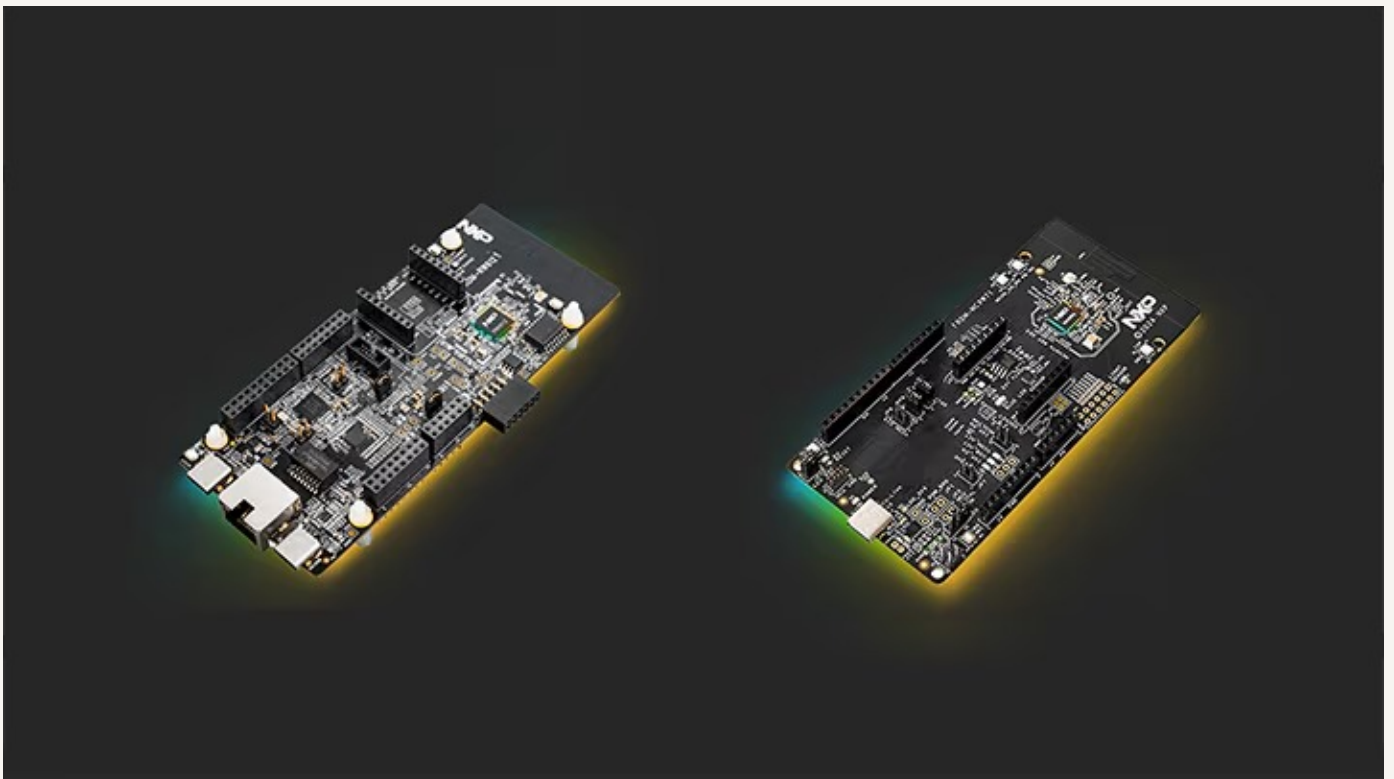
Will Wang

MCU NPI Product Manager, NXP Semiconductors

Will Wang takes the product manager role for 12 years crossing multiple departments in NXP and mainly focus on MCU new product introduction and rich management experience for wireless power and IIOT solutions. Bachelor of Electronic and communication systems in University of Bristol, Master of Computer Science in Oxford Brookes University.

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