

NXP® Semiconductors:

# POWERHOUSE PORTFOLIO OF Arm®-BASED MCUs



**NXP**



# CONTENTS

A POWERHOUSE PORTFOLIO OF MCUs .....	3
MCU INNOVATION LEADERSHIP .....	6
MCU SOLUTIONS FOR EVERY DESIGN .....	8
PRODUCT SPOTLIGHT .....	10
TECHNOLOGY .....	12
ENABLEMENT .....	16
PROGRAMS AND PARTNERS.....	19

# A POWERHOUSE PORTFOLIO OF MCUs

NXP's MCUs offer a powerhouse portfolio representing the **broadest selection** of Arm-based solutions for the general market, including general embedded, secure, connected and crossover MCUs.

These innovation-packed devices give you the features you've come to expect from a long-time leader in Arm technology—like optimized CPU speeds and best-in-class power efficiency—along with advanced levels of I/O integration and security. We designed these MCU solutions with market inputs and a true ground-up approach evident in their enhanced connectivity and control features, intelligent peripherals for added functionality, and a range of package options from incredibly small to ones with larger pitches for simplified manufacturing. Our goal: to help save time and resources, while increasing design flexibility and lowering overall system cost. Comprehensive software and hardware enablement along with a common software toolkit further strengthen this powerhouse portfolio of MCUs to enable a broad range of applications.

## A COMPREHENSIVE MCU PORTFOLIO

<b>Arm Expertise</b>	Broadest licensee of Arm cores in the industry, with 1000+ products based on Arm technology
<b>Broad Portfolio</b>	Most scalable portfolio with optimized performance and capabilities: scales from 20 MHz to 600 MHz with a rich mixture of cores from Arm® Cortex®-M0/M0+/M4/M7/M33, and a robust peripheral mix including Ethernet, USB and enhanced analog integration
<b>Enablement</b>	Best-in-class hardware platforms and software solutions to jump-start your design
<b>Ecosystem Leadership</b>	Industry-leading partnerships for innovation and differentiation, with more than 300 partner solutions
<b>Customer Focused</b>	Experienced global support team and professional services to accelerate time-to-market



## TARGET APPLICATIONS

### Wearables



- Earbuds and headphones
- Fitness, activity and wellness trackers
- Portable industrial
- Smart watches
- Personal healthcare devices

### Smart accessories



- eReaders, tablets
- Game controllers
- Outdoor GPS devices
- Smartphone accessories

### Home appliances



- Cookers, ovens, cooktops, microwaves
- Refrigerators, freezers, roomair conditioners
- Washers, dishwashers, dryers

### Motor control



- Drones and UAVs
- Fans, pumps, compressors
- Home appliances
- HVAC systems
- Industrial drives
- Robotics

### Real-time control



- Circuit breakers
- Switch-mode power supplies
- LED lighting
- Industrial automation machinery
- 3D Printers

### Payment and access



- Mobile point-of-sale (POS) readers
- Traditional and portable POS readers
- PIN pads

### Home and building automation

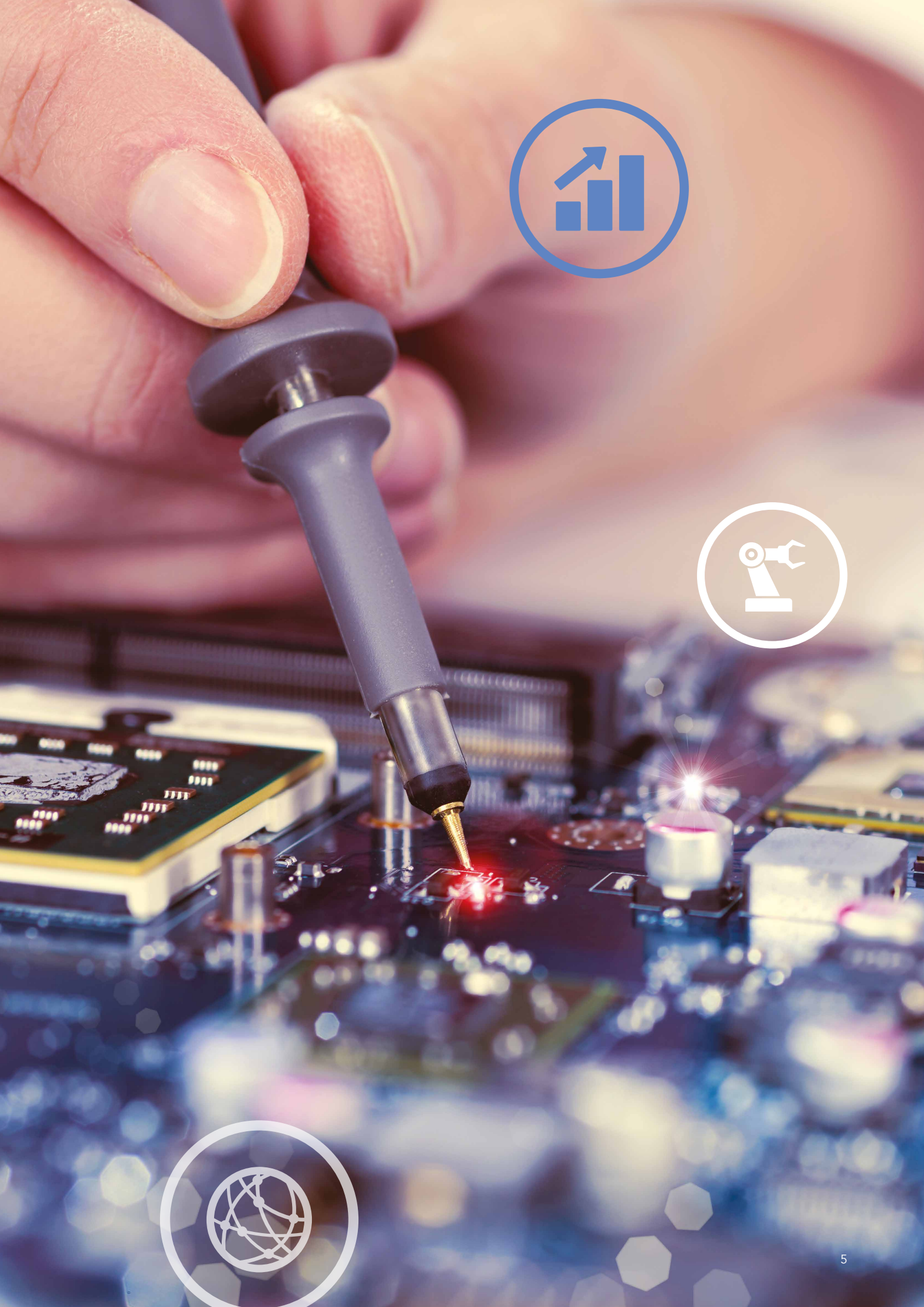


- Thermostats, security, safety, lighting
- Wireless connectivity hubs and gateways
- Wireless sensors and door locks
- Retail and advertising beacons

### Automotive

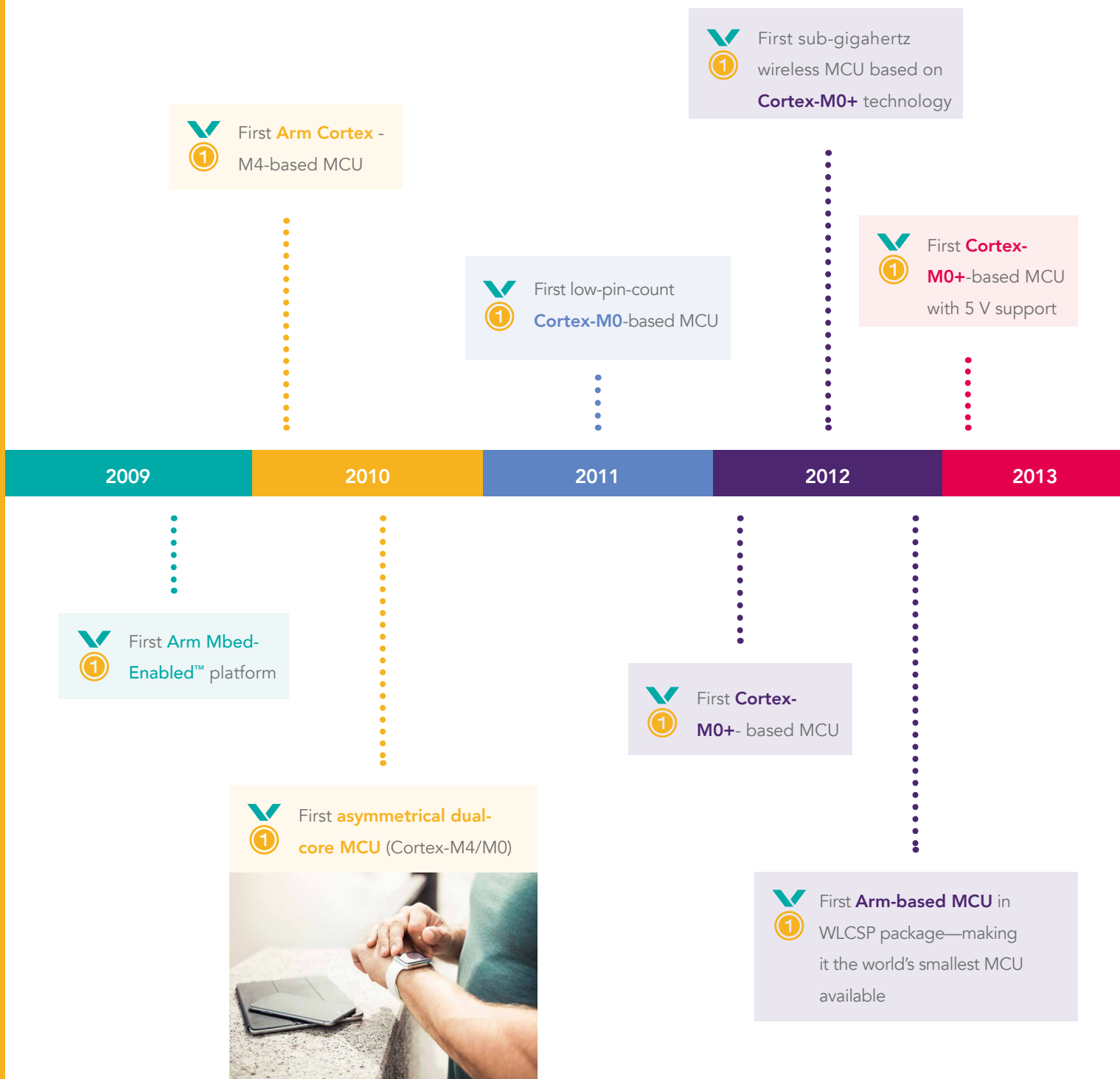


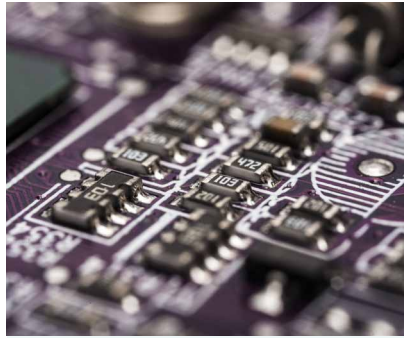
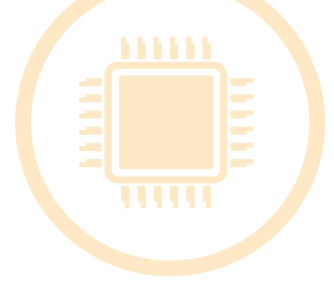
- CAN and LIN nodes
- Car access
- TPMS
- Peripheral gateway
- Lighting control
- Pump/fan controller
- Battery management
- Generic sensor node



# MCU INNOVATION LEADERSHIP

Backed by an established record and decades of design experience, NXP has delivered a number of **industry firsts** based on Arm technology, including being among the first to license the Cortex-M technology:





First with industry's **thinnest MCU**, measuring 0.34 mm

First **1.6 mm x 2 mm MCU** -shrinking its predecessor by 15%

First **crossover processor** delivering high performance with real-time functionality



2013

2014

2015

2016

2017

2018

First with industry's fastest **Cortex-M**-based MCU at 204 MHz

First **Cortex-M7**-based MCU targeted for motor control

First **multi-mode radio** MCU supporting 802.15.4 mesh networking (Thread®) and Bluetooth® low energy

First **Cortex-M33**-based MCU with enhanced levels of security

Lowest power **Bluetooth 5** MCU LE 2M PHY, High Duty Cycle Non-connectable Advertising



# MCU SOLUTIONS FOR EVERY DESIGN

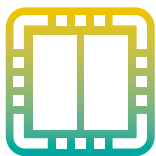


NXP's MCU portfolio offers a wide range of options:

- **General-purpose MCUs** composed of a range of devices spanning from low power consumption and small-package devices to highly integrated, high-performance devices with a range of flexible features, memory, sizes and package options.
- **Application-specific MCUs** that are designed to address particular market needs like advanced timers and high-precision analog integration for motor control, 5V robust solutions for appliances and other industrial applications that have noisy environments, and advanced wireless connectivity including integrated software stacks, which are important for the ever-evolving IoT market.
- **Crossover processors** take advantage of the technological efficiencies of MCUs and the robust peripheral set of applications processors. This new class of crossover processors, targeted for consumer, industrial and the growing IoT applications arena, deliver the performance, functionality and capabilities of an application processor design, with the ease-of-use, low-power and real-time operation of an MCU-based device.

NXP uses the same building blocks in many of its MCUs, and offers pin- and software-compatible options across product families and cores. We make it easier for you to scale and reuse your hardware and software designs, whether you're upgrading or cost optimizing functionality.

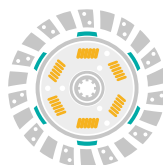
## POWERHOUSE PORTFOLIO OF ARM CORTEX-M DEVICES OFFER A RANGE OF OPTIONS



### i.MX RT Series

#### High Performance

Crossover processors with real-time functionality and MCU usability for next generation consumer and industrial IoT applications.



### Kinetis® V Series

#### Real-time Control

Designed for a wide range of BLDC, PMSM and ACIM motor control and digital power conversion applications.

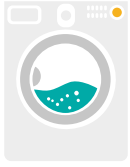


### Kinetis K Series

#### Performance

190+ scalable MCUs with up to 2MB of embedded Flash and 1MB SRAM, advanced security and connectivity such as Ethernet, USB and CAN.





### Kinetis E Series

#### 5V / Robust

5V MCUs designed to maintain high reliability and robustness in harsh electrical noise environments targeting white goods and industrial applications.



### Kinetis L Series

#### Ultra-Low-Power

175+ ultra-low-power, scalable and tiny footprint MCUs, addressing a variety of applications especially where battery life is critical.



### Kinetis EA Series

#### Automotive

Designed for a wide range of automotive and industrial applications requiring the highest level of quality and longevity support.



### LPC800 Series

#### Low-Cost

An entry-level, 8-bit alternative MCU at the right price.



### LPC5500 Series

#### Efficient and Secure

First Cortex M33 processor delivering real-time performance with advanced levels of security in a power efficient core.



### LPC54000 Series

#### Power-Efficient

A power-efficient, mainstream series for everyone.



### Wireless

#### KW, JN and QN

#### Connectivity MCUs

Designed to address a number of monitoring and control applications for the Internet of Things, including consumer, smart energy, industrial and health care.





# PRODUCT SPOTLIGHT



## Kinetis KW36/35 MCUs

### Bluetooth® Low Energy with integrated CAN-FD

The ultra-low power and automotive qualified Kinetis KW36/35 wireless MCUs enable Bluetooth Low Energy Version 5 and Generic FSK RF connectivity for automotive and industrial embedded systems. These MCUs are based on the Arm Cortex-M0+ core, run at 48 MHz and feature up to 512 KB on-chip flash with ECC, 64 KB SRAM and highly-integrated connectivity, security and analog capabilities. Additionally, the Kinetis KW36 MCU exclusively integrates FlexCAN with CAN-FD support and LIN capability for easy integration into automotive in-vehicle communication and industrial networks.



## LPC5500 MCU Series

The LPC5500 MCU Series leverages Arm's most recent Cortex-M33 technology, combining significant product architecture enhancements and greater integration over previous generations; offering dramatic power consumption improvements and advanced security features including SRAM PUF based root of trust and provisioning, execution from encrypted images (internal flash), and asset protection with Arm TrustZone-M. In addition, the LPC5500 MCU series provides a comprehensive offering and several scalability options with seven families coming to round out the series, all of them benefiting from 40nm cost advantages, broad scalable packages and memory options, as well as robust enablement including MCUXpresso Software/Tools ecosystem and low-cost development boards.



### **i.MX RT Crossover Processors**

The i.MX RT Series is the industry's first crossover processor, offering the highest performance Arm Cortex-M core, real-time functionality and MCU usability at an affordable price.

Based on Arm Cortex cores, architected from the versatile i.MX applications processors, the i.MX RT crossover processors offer the first solutions in the market that truly bridge the gap between MCUs and applications processors.

The i.MX RT series consists of the i.MX RT1015 and i.MX RT1020 in pin compatible LQFP packages and i.MX RT1050, i.MX RT1060, and i.MX RT1064 in pin compatible BGA packages with up to 1MB SRAM. In addition, the i.MX RT600 family is optimized for 32-bit immersive audio playback and voice user interface applications combining a high-performance Cadence® Tensilica® Hi-Fi 4 audio DSP core with a next-generation Cortex-M33 core.



### **Kinetis KE15Z/16Z with NXP Touch Solution**

NXP's touch solution accelerates time to market with pre-certified and tested hardware components, an optimized software environment and easy-to-use configuration tools. This solution combines specialized touch software with the Touch Sense Interface (TSI) available on the Kinetis KE15Z/16Z MCUs, along with a complete set of tools enabling designers to easily add touch to user interface applications including home appliances, smart buildings, machines for industrial control and more.



# TECHNOLOGY

NXP's MCUs are built with a foundation of **core technologies** that address various market use cases for an optimized design.



## SECURITY

Securing the IoT is a top priority and a critical element of every connected design. Leveraging years of security expertise and resources, NXP MCUs are making it easier than ever to help you protect your products from various types of attacks with a three-pronged strategy:

- **Trust** – On-chip flash memory with security mechanisms can disable debug ports so firmware software can be locked down on the device and will not be at risk from outside attacks.
- **Cryptography** – Hardware encryption accelerator blocks assist in transporting and protecting data on the way to its intended destination.
- **Anti-tamper detection** – A tamper module with dedicated pins help detect physical system intrusion as well as environmental changes (temperature, voltage, clocking schemes) attempting to unlock protected memory regions or expose encryption keys.



## LOW POWER

Design without compromise using ultra-low-power products. NXP MCUs help system designers optimize power consumption through five key low-power technologies:

- Low-power boot
- Intelligent clocking
- Ultra-efficient processing
- Flexible low-power modes
- Autonomous, low-power peripherals



## WIRELESS CONNECTIVITY

NXP's portfolio of low-power, cost-effective wireless MCUs for embedded devices addresses many monitoring and control applications for the Internet of Things—including consumer, smart energy, industrial, and healthcare. The JN, KW and QN MCUs integrate RF transceivers that support Bluetooth Low Energy, Thread, Zigbee and 2.4GHz proprietary protocols and are based on Arm Cortex cores, providing robust feature sets for reliable, secure and low-power embedded wireless solutions. For Wi-Fi connectivity requirements, NXP supports module solutions through partners.



## WIRED CONNECTIVITY

NXP MCUs make it easy to implement industry-standard connectivity options. They include features such as:

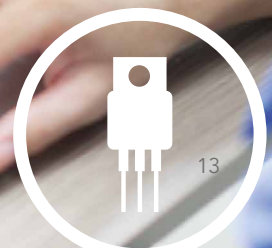
- 10/100 Mbit/s Ethernet with an IEEE 1588® precision time protocol (PTP) transceiver including Ethernet and USB connectivity
- Full-speed and hi-speed controllers
- Crystal-less USB

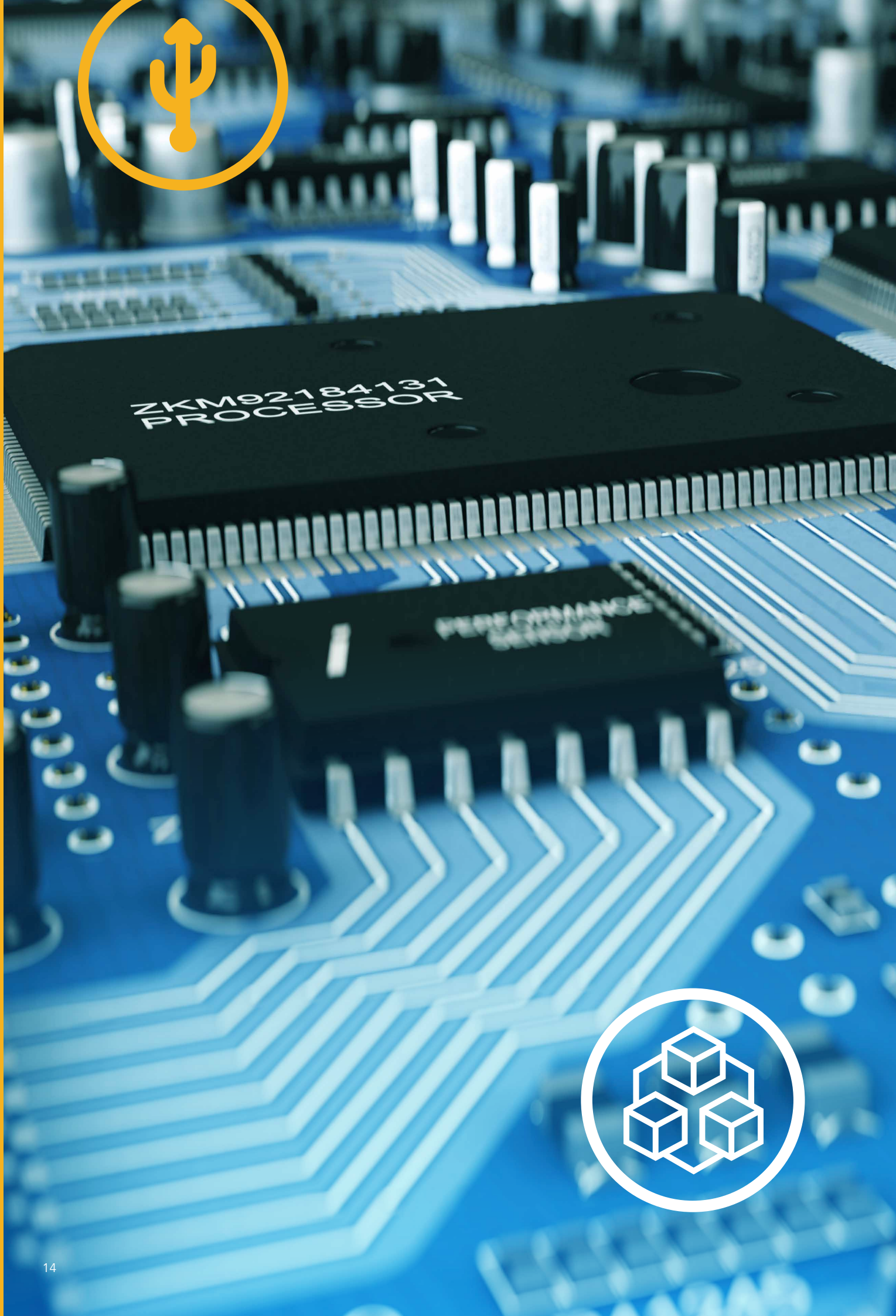
The FlexIO and FlexComm features provide the ultimate flexibility for connectivity requirements because they enable you to configure various serial communication protocols according to your application needs.



## MULTICORE

NXP designed the world's first asymmetrical dual-core digital signal controller architecture, featuring Cortex-M4 and Cortex-M0 core technology. These NXP Cortex-M4-based MCUs with optional Cortex-M0 or Cortex-M0+ co-processors bring the advantage of developing digital signal processor (DSP) and MCU applications within a single architecture and development environment. Multi-core architectures allow efficient application partitioning and/or scalable power performance. Designers can offload tasks and improve power efficiency by taking advantage of the heterogeneous multicore processing that NXP offers. NXP provides simplified programmability and debugging by leveraging the same tools for both cores.







## MEMORY

NXP MCUs boast a unique expandable memory architecture for tailoring cost and memory size to the application. The expandable memory architecture, with its SPI flash interface (SPIFI) and 8-/16-/32-bit external memory controller (EMC) with SDRAM support, enables powerful options for scaling memory to your application requirements. In addition, flashless options with SPIFI or QSPI with execute-in-place capabilities lower BOM cost and maximize internal SRAM.



## ANALOG INTEGRATION

Advanced analog peripherals such as ADCs, DACs, programmable gain amplifiers and comparators are integrated in the broad portfolio of NXP microcontroller products. More advanced analog integration within the Kinetis V series supports high-end, real-time control applications with features such as high-resolution PWMs with 260 picosecond resolution and multiple 12-bit ADCs sampling at 5 megasamples per second (MS/s). These features enable precision timing and control for BLDC, PMSM and ACIM motors as well as power control applications. For applications that deal with tough environments, the Kinetis E series provides enhanced noise and immunity protection with a 5 V solution.



## GRAPHICS

NXP MCUs drive a wide range of color and monochrome LCD displays without loading the CPU. This highly optimized peripheral features:

- Resolutions up to 1366 x 768 and support for 24 bpp (up to 16 M colors)
- Ability to drive single and dual TFT panels
- Dedicated LCD DMA controller
- Touch Sensing Interface support for hardware cursor
- Graphics libraries integrated with MCUXpresso
- Integrated options for expanding external memory to support higher resolutions



## PACKAGING

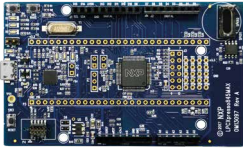
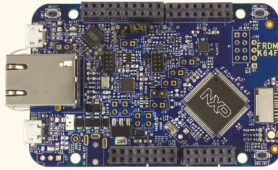

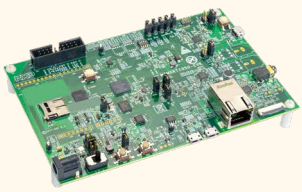
NXP MCUs are available in a broad range of packages. From ultra-small 1.6 x 2.0 mm<sup>2</sup> chip-scale packages (CSPs) for area-constrained applications to large pitch and high-pin-count 20 x 20 mm<sup>2</sup> quad flat packages (QFPs) for single- or dual-layer printed circuit board (PCB) designs, and over 20 different packages in between, including MAPBGA and QFN package options in various sizes and pin counts. NXP also offers thin packages in BGA and WLCSP format for designs with height restrictions.

# ENABLEMENT

Comprehensive NXP and third-party hardware and software enablement solutions support all NXP MCUs, **reducing development costs** and time-to-market.

## DEVELOPMENT BOARDS

NXP offers several rapid prototyping and evaluation platforms for its MCUs, including Freedom, LPCXpresso, evaluation kits (EVK) and Tower® System development boards. These platforms offer cost-effective options that speed your time-to-market.

Boards/Kits	
	<p><b>LPCXpresso development boards</b> have a small form factor, are cost effective and are designed for rapid prototyping and evaluation with LPC MCUs. The latest LPCXpresso boards include Arduino® Uno and Pmod™ connectors with free pads for easy prototyping.</p>
	<p><b>Freedom development boards</b> are a small, low-power, cost-effective evaluation platforms perfect for quick application prototyping with Kinetis MCUs. These boards include an easy-to-use mass storage device mode flash programmer, a virtual serial port, classic programming and run-control capabilities, and are form-factor compatible with the Arduino R3 pin layout.</p>
	<p>NXP's <b>Rapid IoT kit</b> is a comprehensive, secure and power-optimized solution designed to accelerate prototyping and development of an IoT end node. Rapid IoT integrates hardware design (processing, connectivity, sensing and trusted security) with robust software enablement including a web-based graphical interface allowing anyone to easily and rapidly take their idea to a proof-of-concept. Rapid IoT integrates 11 NXP devices and is powered by NXP's Kinetis MK64 Arm Cortex-M4 as the main MCU with the Kinetis MKW41Z5 Arm Cortex M0 for Wireless connectivity over Bluetooth Low Energy, Thread and Zigbee.</p>
	<p><b>Evaluation kits</b> are a market-focused development tool supporting i.MX processors. This EVK enables an LCD display and audio playback as well as many connectivity options. It is designed to showcase the most commonly used features of the MCU in a small, low cost package and to facilitate software development.</p>





# MCUXPRESSO SOFTWARE AND TOOLS

Developed as a cohesive set of software development tools, MCUXpresso software and tools bring together the best of NXP's software enablement into one platform for a shared software experience across NXP's powerhouse portfolio. This common toolkit supports Kinetis, LPC, QN MCUs and i.MX RT crossover processors with a software development kit (SDK), an integrated development environment (IDE), and configuration tools. The common software framework found in MCUXpresso software and tools further streamlines end application development and enables easy migration and scalability for your future design needs.



## SOFTWARE DEVELOPMENT KITS (SDK)

NXP's Kinetis, LPC, JN, QN MCUs and i.MX RT crossover processors are supported by the MCUXpresso software development kit (SDK) that includes system startup, peripheral drivers, USB and connectivity stacks, middleware, and real-time operating system (RTOS) kernels. Usage examples and demo applications are included with the free SDK download, and allow you to leverage toolchains from NXP, Arm Keil®, IAR, and other widely used IDEs.

## INTEGRATED DEVELOPMENT ENVIRONMENTS (IDE)

Software enablement for Kinetis, LPC, QN MCUs and i.MX RT crossover processors includes NXP's highly-integrated open-source Eclipse-based software toolchains, including the new MCUXpresso IDE and the widely used Kinetis Design Studio and LPCXpresso IDEs. Featuring industry-standard GNU Compiler Collection (GCC) and GNU Debugger (GDB), among others; these IDEs make it easy to develop high-quality embedded applications.

## MCUXPRESSO CONFIGURATION TOOLS

Designing with NXP's i.MX RT, Kinetis and LPC microcontrollers based on Arm Cortex-M cores is made easier with the MCUXpresso Config Tools, which allow developers to quickly build a custom SDK, update existing IDE projects, and generate initialization C code for custom board support. MCUXpresso Config Tools are available directly within the MCUXpresso IDE. For other supported IDE / toolchain options, a standalone desktop version of the Config Tools is available for download. The Pins perspective assigns internal signals to external pins, provides drop-down electrical properties settings, and detects any I/O conflicts. The Clocks perspective provides a graphical representation of the MCU clock tree system and interactive user controls, as well as assistance with system fine-tuning. The Peripheral tool features an interactive graphical interface for initialization of MCUXpresso SDK peripheral drivers.

Learn more about MCUXpresso Config Tools at: [www.nxp.com/mcuxpresso/config](http://www.nxp.com/mcuxpresso/config)

## Arm MBED™

The **Arm Mbed IoT device platform** provides free software libraries, hardware designs, tools and a developer ecosystem for professional developing of IoT devices and solutions based on Arm technology. The platform includes a standards-based C/C++ SDK, a microcontroller HDK with supported development boards, support for the industry's most popular compilers, and developer collaboration tools. NXP and Arm partnered to introduce the first Mbed Enabled™ board based on the LPC1768 microcontroller, and the portfolio now includes options for more than 35 boards based on NXP MCUs, including the i.MX RT1050, Kinetis KW41Z, Kinetis K82F and LPC546xx development boards.

## ZEPHYR™ OS

NXP is a founding member of **The Zephyr™ Project**, a collaborative effort to develop an open-source, scalable, and robust RTOS optimized for resource-constrained embedded devices and built with security in mind. NXP offers a variety of evaluation and prototyping platforms supported Zephyr OS, including the IMXRT1050-EVKB, FRDM-K64F, LPCXpresso54114, and more. Developers are able to easily tailor a solution to meet their needs using a true open-source project with hardware, developer tools, and sensor and device drivers. Security enhancements with Zephyr OS enable the simple implementation of device management, connectivity stacks, and file systems.

## KINETIS MOTOR CONTROL SOFTWARE

NXP provides a compelling suite of software enablement tools for motor control to reduce customers development time. There is a fully tested and complementary Real Time Control Embedded Software Library, Reference Solutions for BLDC and PMSM motors within the SDK, and Certified Safety Routines for Class B to help customers comply with legislation. FreeMaster is a complimentary GUI based run-time debug monitor and data visualisation tool, which comes with MCAT, a plug-in for real-time monitoring, tuning and updating of motor control system parameters.

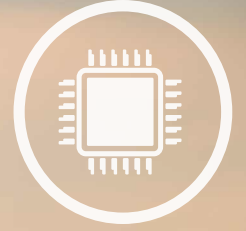
Learn more at [www.nxp.com/motorcontrol](http://www.nxp.com/motorcontrol)

## NXP DESIGNS

NXP Designs is an online resource that provides comprehensive, open-source reference design files, making it easier for engineers to address common design challenges such as security, power consumption, and connectivity. NXP Designs offers one of the most comprehensive sets of reference design packages in the market today. Bill of materials, schematics, PCB layout, software snippets, how-to documentation, and user guides are all available at no cost. Download and reuse all parts of the design to jump-start your own.

For more information, visit [www.nxp.com/NXPDesigns](http://www.nxp.com/NXPDesigns)





Did you know that the **Kinetis K66** is the MCU used to power NXP HoverGames.com, a complete PX4 drone development kit. Also available are single, dual and quad BLDC motor controller designs (ESC) using Kinetis KV and i.MX RT MCUs that can offer advanced Field Oriented Control (FOC) and Adaptive Disturbance Rejection Control (ADRC) single parameter tuning.

Look for these solutions at [www.nxp.com/NXPDesigns](http://www.nxp.com/NXPDesigns) and [www.nxp.com/HoverGames](http://www.nxp.com/HoverGames)



## PROGRAMS AND PARTNERS



### PRODUCT LONGEVITY

The NXP Product Longevity Program ensures a stable supply of products for your embedded designs. Participating products are available for a minimum of 10 to 15 years from product launch, and are supported by standard end-of-life notification policies.

For a complete list of participating products, visit [www.nxp.com/productlongevity](http://www.nxp.com/productlongevity)

### OUR ECOSYSTEM PARTNERS

Collaboration with ecosystem partners is the best way to provide you with innovative options in developing your NXP MCU applications, while helping you get to market faster. NXP relationships with third-party experts have yielded a long list of ground-breaking solutions, from our revolutionary, low-entry-cost evaluation boards to our feature-packed development platforms and application-specific design tools.

Toolchains are the cornerstone of MCU software development, and we recognize that one size does not fit all needs. Our third-party partners help us tailor our offerings for specific applications, so you always get the best options for developing and debugging software on your chosen NXP MCU.

We also work with middleware solution providers and other key partners such as module vendors for our wireless solutions. Training and independent design houses extend the partnership with knowledge sharing and expertise for turnkey solutions. This collaboration creates more ways for you to save time, so you can focus on the features that set your product apart.

For more information, please visit [www.nxp.com/partners](http://www.nxp.com/partners)

Explore the NXP portfolio of powerhouse MCUs to find the right fit  
for your next design by visiting [www.nxp.com/Arm](http://www.nxp.com/Arm)

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