



## Delivering Processor Capabilities at MCU Prices

# i.MX RT Crossover MCUs

**2X**   
PERFORMANCE

**2X**   
BATTERY LIFE

**2X**   
INTEGRATION

**2X**   
FASTER  
DEVELOPMENT

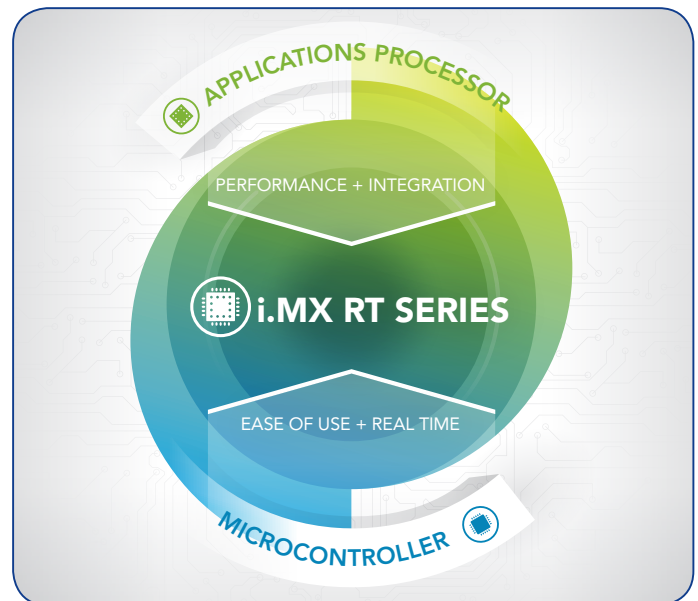
**1/2X**   
THE COST

### USHERING IN THE GHZ MCU ERA

NXP's crossover processors and MCUs marry the simplicity of MCUs with the complexity of applications processors into the ultimate hybrid device to address the growing consumer demand for enhanced user experiences in smart, secure, high-performance products. Included in this new class of product is the i.MX RT series of crossover MCUs that combines unprecedented performance - offering the industry's only GHz MCU - with reliability and high levels of integration and security to propel industrial, IoT and automotive applications.

### PORTFOLIO HIGHLIGHTS

- › Highest performing Arm® Cortex®-M based device
  - Up to 6468 total CoreMarks with Cortex-M7 @ 1GHz + Cortex-M4 @ 400 MHz
- › Real-time, low-latency response
  - Up to 2 MB of SRAM
    - 512 KB of TCM with ECC for Cortex-M7
    - 256 KB of TCM with ECC for Cortex-M4
  - Fast real-time response with latency as low as 12 ns
- › Low-power operation
  - Industry's lowest dynamic power with integrated DC-DC converter
  - Low-power run modes at 24 MHz
- › Highly integrated
  - Advanced multimedia for GUI and enhanced HMI
- › Extensive memory interface options
  - Quad/Octal SPI and Hyper Flash/RAM, SDRAM, NAND Flash, NOR Flash, SD/eMMC
- › Security
  - Hardware protected keys for secure boot
  - AES engine for data encryption
  - On-The-Fly Decryption for execute-in-place (XIP) from Quad/Octal SPI / Hyper Flash



## i.MX RT CROSSOVER MCUs | PORTFOLIO FEATURES

Feature	i.MX RT1010	i.MX RT1015	i.MX RT1020	i.MX RT1050	i.MX RT1060/RT1064	i.MX RT1170
Core/Speed	Cortex-M7 @ 500 MHz	Cortex-M7 @ 500 MHz	Cortex-M7 @ 500 MHz	Cortex-M7 @ 600 MHz	Cortex-M7 @ 600 MHz	Cortex-M7 @ 1GHz, Cortex-M4@ 400 MHz
Cache	16 KB-I, 8 KB-D	16 KB-I, 16 KB-D	16 KB-I, 16 KB-D	32 KB-I, 32 KB-D	32 KB-I, 32 KB-D	32 KB-I, 32 KB-D
TCM	Up to 128 KB	Up to 128 KB	Up to 256 KB	Up to 512 KB	Up to 512 KB	Up to 512 KB
On-chip RAM	128 KB	128 KB	256 KB	512 KB	1 MB	2 MB
On-chip Flash	-	-	-	-	Up to 4 MB	-
External Memory	-	-	8-/16-bit interface for SDRAM, SRAM, NOR, NAND	8-/16-bit interface for SDRAM, SRAM, NOR, NAND	8-/16-bit interface for SDRAM, SRAM, NOR, NAND	8-/16-/32-bit interface for SDRAM, SRAM, NOR, NAND
Quad/Octal SPI/ HyperBus	Dual-channel/8-bit	Dual-channel/8-bit	Dual-channel/8-bit	Dual-channel/8-bit	Up to 2 x Dual-channel/8-bit	1 x Dual-channel/8-bit 1 x Dual-channel/16-bit
SDIO	-	-	SD3.0/eMMC4.5 x 2	SD3.0/eMMC4.5 x 2	SD3.0/eMMC4.5 x 2	SD3.0/eMMC5.0 x 2
Ethernet	-	-	10/100 Mbit/s x 1 w/ IEEE 1588	10/100 Mbit/s x 1 w/ IEEE 1588	10/100 Mbit/s x 2 w/ IEEE 1588	1Gbit/s w/ AVB + 1Gbit/s w/ TSN + 10/100 Mbit/s w/ IEEE 1588
USB with PHY	OTG, HS/FS x 1	OTG, HS/FS x 1	OTG, HS/FS x 1	OTG, HS/FS x 2	OTG, HS/FS x 2	OTG, HS/FS x 2
CAN	-	-	FlexCAN x 2	FlexCAN x 2	FlexCAN x 2 + CANFD x 1	CAN-FD x 3
Graphics	-	-	-	PxP for 2D acceleration	PxP for 2D acceleration	PxP for 2D acceleration, OpenVG 1.1
CSI	-	-	-	8-/10-/16-bit parallel	8-/10-/16-bit parallel	8-/10-/16-bit parallel, 2-lane MIPI CSI
LCD	-	-	-	8-/16-/18-/24-bit parallel	8-/16-/18-/24-bit parallel	8-/16-/18-/24-bit parallel, 2-lane MIPI DSI
Security	TRNG, AES-128, SHA, Secure Boot	TRNG, AES-128, SHA, Secure Boot	TRNG, AES-128, SHA, Secure Boot	TRNG, AES-128, SHA, Secure Boot	TRNG, AES-128, SHA, Secure Boot	TRNG, AES-128/256, SHA, Secure Boot, RSA4096, DES/3DES, Tamper Detection PUF, UDF, Secure RAM
UART/SPI/I <sup>2</sup> C/FlexIO	4/2/2/1	4/2/2/1	8/4/4/1	8/4/4/2	8/4/4/3	12/6/6/2
I <sup>2</sup> S/SPDIF	2/1	3/1	3/1	3/1	3/1	4/1
ADC	1M sample/s x 1	1M sample/s x 1	1M sample/s x 2	1M sample/s x 2	1M sample/s x 2	2M sample/s x 2
ACMP/DAC	-	-	4/-	4/-	4/-	4/1
FlexPWM/Quad Timer/ Quad ENC	1/0/0	1/1/1	2/2/2	4/4/4	4/4/4	4/4/4
GP Timer / WDOG	3/4	6/4	6/4	6/4	6/4	6/4
Package	80 LQFP	100 LQFP	100 LQFP, 144 LQFP	196 BGA	196 BGA	289 BGA
Temperature (Tj)	Consumer: 0 to 95 °C Industrial: -40 to 105 °C	Consumer: 0 to 95 °C Industrial: -40 to 105 °C	Consumer: 0 to 95 °C Industrial: -40 to 105 °C	Consumer: 0 to 95 °C Industrial: -40 to 105 °C	Consumer: 0 to 95 °C Industrial: -40 to 105 °C	Consumer: 0 to 95 °C Industrial: -40 to 105 °C Automotive: -40 to 125 °C

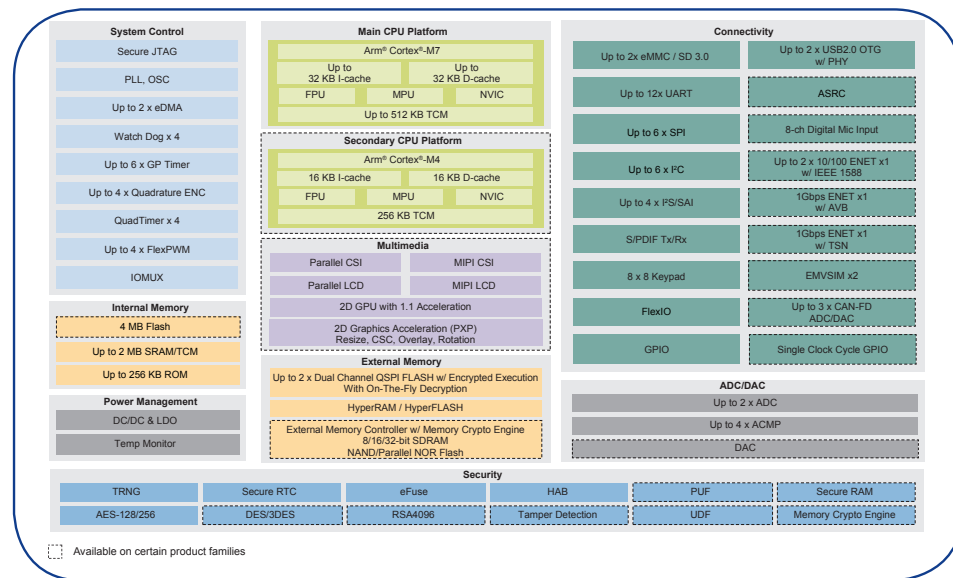
### MEMORY EXPANSION WITH i.MX RT

i.MX RT crossover MCUs shed the burden of on-chip flash, which not only reduces the cost, but it also enables higher frequency operation for increased performance—which in turn lets you boost capabilities, increase efficiency and add more features. The i.MX RT FlexSPI interface provides memory

expansion for external memories such as serial Flash / PSRAM, Quad or Octal data lines. This offers maximum design flexibility, while still ensuring a high-level of performance and security. The i.MX RT series integrates high densities of SRAM, which is further configured within the crossover design architecture to function as TCM with ‘zero-wait’ single

cycle access to dramatically increase system performance. This key design feature enables the crossover processor's effective performance to be significantly better than any traditional MCU counterpart.

## i.MX RT CROSSOVER MCUs | PORTFOLIO BLOCK DIAGRAM



## TARGET APPLICATIONS

- Audio Subsystem
- Consumer Products
- Home and Building Automation
- Industrial Computing Designs
- Motor Control and Power Conversion
- Automotive

## ACHIEVING END-TO-END SECURITY

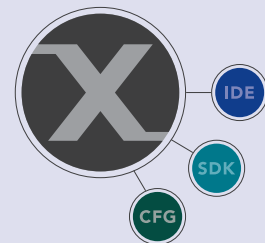
Secure development with the i.MX RT leverages years of experience gained from its applications processor lineage. The ROM firmware on the devices, as well as the tools used in the development and manufacturing processes, have been heavily used and tested. With the i.MX RT and its associated software and tools for secure boot, the foundation for meeting today's security requirements can be achieved.

## MAXIMUM FLEXIBILITY WITH FlexIO

FlexIO is a highly configurable module providing a wide range of functionality including emulation of a variety of communication protocols such as UART, I²C, SPI, I²S. This means that you have the ultimate flexibility in your design to add more of the peripherals you need. Additionally, the FlexIO module consists of a flexible 16-bit timer with support for a variety of trigger, reset, enable and disable conditions.

## i.MX RT CROSSOVER MCUs | SOFTWARE AND TOOLS

NXP's **MCUXpresso software and tools** offer comprehensive development solutions designed to optimize, ease and accelerate embedded system development of applications based on Cortex-M core devices, including Kinetis and LPC microcontrollers, and i.MX RT crossover MCUs.



## NXP eIQ™ Machine Learning Software Development Environment

The NXP eIQ ("edge intelligence") ML software environment provides the key ingredients to do inference with neural network (NN) artificial intelligence (AI) models on embedded systems and deploy various ML algorithms on NXP microprocessors and microcontrollers for edge nodes. It includes inference engines, NN compilers, libraries, and hardware abstraction layers that support Google TensorFlow Lite, Arm NN, Arm® CMSIS-NN, and OpenCV.

## GET STARTED NOW

Take advantage of the robust enablement to reduce development effort and speed time-to-market with a comprehensive offering of software and development tools.

The i.MX RT evaluation kits (EVKs) help you take your design to the next level by reducing complexity and accelerating time to market. Additionally, enjoy the ability to expand upon this feature-rich EVK with compatible Arduino™ hardware shields.

## Toolchains

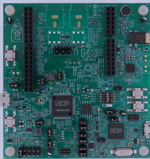
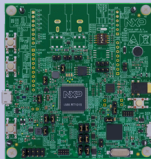
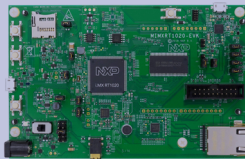
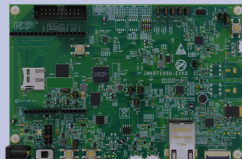
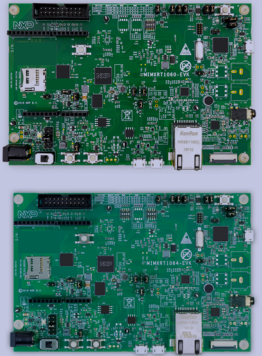
- › MCUXpresso software and tools
- › IAR® Embedded Workbench® IDE
- › Keil® IDE

## Software

- › MCUXpresso SDK with Amazon FreeRTOS™
- › Zephyr® Operating System
- › Arm® Mbed™ and the global Arm ecosystem

i.MX RT1010, i.MX RT1015 and i.MX RT1020 EVKs are two-layer through-hole PCBs enabled with a six-axis eCompass sensor, multiple audio features and debug options.

i.MX RT1050, i.MX RT1060 and i.MX RT1064 EVKs are four-layer through-hole PCBs that also offer additional features, including camera and LCD support.

EVK	i.MX RT1010	i.MX RT1015	i.MX RT1020	i.MX RT1050	i.MX RT1060/RT1064
<b>Processor</b>	• MIMXRT1011DAE5A	• MIMXRT1015DAF5A	• MIMXRT1021DAG5A	• MIMXRT1052DVL6B	• MIMXRT1062DVL6A/ MIMXRT1064DVL6A
<b>Memory</b>	• 128 Mb QSPI Flash	• 128 Mb QSPI Flash	• 256 Mb SDRAM memory • 64 Mb QSPI Flash • TF socket for SD card	• 256 Mb SDRAM memory • 512 Mb Hyper Flash • 64 Mb QSPI Flash • TF socket for SD card	• 256 Mb SDRAM memory • 512 Mb Hyper Flash • 64 Mb QSPI Flash • TF socket for SD card
<b>Display</b>	N/A	N/A	N/A	• Parallel LCD connector • Camera connector	• Parallel LCD connector • Camera Sensor Module
<b>Audio</b>	• Audio codec • 4-pole audio headphone jack • External speaker connection • Microphone	• Audio codec • 4-pole audio headphone jack • External speaker connection • Microphone	• Audio codec • 4-pole audio headphone jack • External speaker connection • Microphone	• Audio codec • 4-pole audio headphone jack • External speaker connection • Microphone • SPDIF connector	• Audio codec • 4-pole audio headphone jack • External speaker connection • Microphone • SPDIF connector
<b>Connectivity</b>	• Micro USB OTG connector • Arduino® interface	• Micro USB OTG connector • Arduino® interface	• Micro USB host connector • Micro USB OTG connector • Ethernet (10/100T) connector • CAN transceivers • Arduino® interface	• Micro USB host connector • Micro USB OTG connector • Ethernet (10/100T) connector • CAN transceivers • Arduino® interface	• Micro USB host connector • Micro USB OTG connector • Ethernet (10/100T) connector • CAN transceivers • Arduino® interface
<b>Debug</b>	• JTAG connector • Onboard DAP-link debugger	• JTAG connector • Onboard DAP-link debugger	• JTAG connector • Onboard DAP-link debugger	• JTAG connector • Onboard DAP-link debugger	• JTAG connector • Onboard DAP-link debugger
<b>Sensor</b>	• 6-axis eCompass (3-axis magnetometer, 3-axis accelerometer) sensor FXOS8700CQ	• 6-axis eCompass (3-axis magnetometer, 3-axis accelerometer) sensor FXOS8700CQ	• 6-axis eCompass (3-axis magnetometer, 3-axis accelerometer) sensor FXOS8700CQ	• 6-axis eCompass (3-axis magnetometer, 3-axis accelerometer) sensor FXOS8700CQ	• 6-axis eCompass (3-axis magnetometer, 3-axis accelerometer) sensor FXOS8700CQ
<b>Part Number</b>	MIMXRT1010-EVK	MIMXRT1015-EVK	MIMXRT1020-EVK	IMXRT1050-EVKB	MIMXRT1060-EVK/ MIMXRT1064-EVK
<b>Camera Sensor</b>	N/A	N/A	N/A	N/A	MT9M114 image sensor (included)
<b>Display</b>	N/A	N/A	N/A	RK043FN02H-CT 4.3" (purchased separately)	RK043FN02H-CT 4.3" (purchased separately)
					
	i.MX RT1010	i.MX RT1015	i.MX RT1020	i.MX RT1050	i.MX RT1060/RT1064

[nxp.com/iMXRT](http://nxp.com/iMXRT) and [community.nxp.com/community/iMXRT](http://community.nxp.com/community/iMXRT)

NXP, eIQ and the NXP logo are trademarks of NXP B.V. All other product or service names are the property of their respective owners. TensorFlow, the TensorFlow logo and any related marks are trademarks of Google Inc. Arm, Cortex, Keil and Mbed are registered trademarks of Arm Limited (or its subsidiaries) in the US and/or elsewhere. All rights reserved. © 2019 NXP B.V.

Document Number: IMXRTPORTFS REV 0