Freescale Embedded Solutions Based on ARM® Technology

Kinetis MCUs
Vybrid controller solutions
i.MX MPUs
QorIQ communications processors based on Layerscape architecture

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freescale™

ARM®

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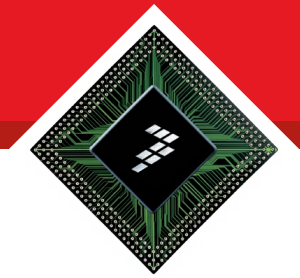


Scalable. Innovative. Leading.

Your Number One Choice for ARM Solutions

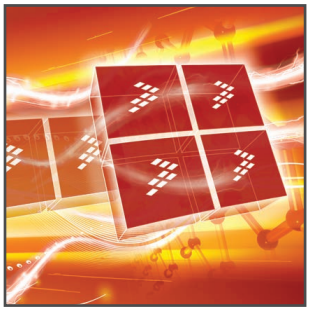
Freescale is the leader in 32-bit embedded control, offering the market's broadest and best-enabled portfolio of solutions based on ARM® technology. Our large portfolio includes scalable MCU and MPU families from small ultra-low-power Kinetis MCUs to Vybrid and i.MX multimedia processors with advanced performance and feature integration to QorIQ communications processors, which deliver industry-leading power and performance. Each family has been designed to offer a broad range of performance, peripheral and packaging options providing migration paths for end product platform development. All families are supported by an industry-leading enablement (software and tool) bundle from Freescale and the extensive ARM ecosystem. Combined, our Kinetis, Vybrid, i.MX and QorIQ solutions offer the highest level of integration, the most comprehensive software and hardware enablement, and the broadest range of performance available within the ARM community. Whether you are a consumer, industrial, automotive or networking product designer, our ARM-based product families offer a solution that meets your requirements.

Kinetis MCUs
Design Potential. Realized.

Hardware- and software-compatible ARM Cortex™-M0+ and ARM Cortex™-M4 MCU families with exceptional low-power performance, feature integration and Freescale enablement support.

Vybrid Controller Solutions
Rich Apps In Real Time

Real-time, highly integrated solutions with dual-display capability to enable your system to control, interface, connect, secure and scale.



i.MX Multimedia Processors
Your Interface to the World

Ultra-versatile solutions for multimedia and display applications, with multicore scalability and market-leading power, performance and integration.

QorIQ Communications Processors
Accelerating the Network's IQ

Next-generation QorIQ processors are based on Layerscape architecture—the industry's first software-aware, core-agnostic architecture, which delivers unprecedented efficiency and scale for the smarter, more capable networks of tomorrow—end to end.

Kinetis ARM Cortex-M0+ and Cortex-M4 MCUs

Scalable, ultra-low-power, mixed-signal MCUs

Our Kinetis portfolio of ARM Cortex MCUs consists of multiple hardware- and software-compatible ARM Cortex-M0+ and Cortex-M4 MCU families with exceptional low-power performance, memory scalability and feature integration. Families range from the entry-level ARM Cortex-M0+ Kinetis L series to the high-performance, feature-rich ARM Cortex-M4 Kinetis K and X series, and include a wide selection of analog, communication, HMI, connectivity and security features. All Kinetis MCUs are supported by a comprehensive Freescale and third-party hardware and software enablement system that reduces development costs and time to market.

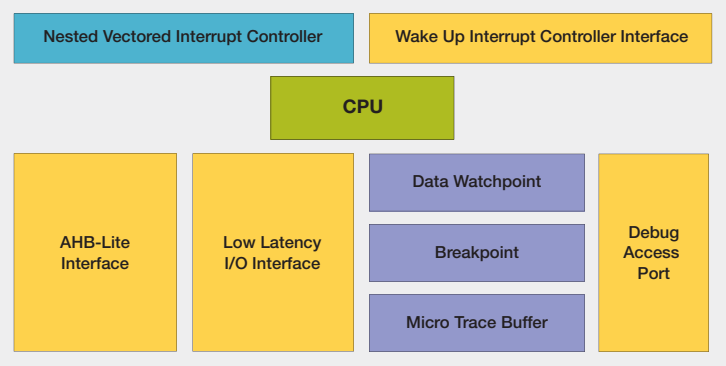
Kinetis L Series

Kinetis L series MCUs combine the exceptional energy efficiency and ease of use of the new ARM Cortex-M0+ processor with the performance, peripheral sets, enablement and scalability of the Kinetis 32-bit MCU portfolio. The Kinetis L series frees power-critical designs from 8- and 16-bit MCU limitations by combining excellent dynamic and stop currents with superior processing performance, a broad selection of on-chip flash memory densities and extensive analog, connectivity and HMI peripheral options. Kinetis L series MCUs are also hardware and software compatible with the ARM Cortex-M4-based Kinetis K series, providing a scalable migration path to more performance, memory and feature integration.

ARM Cortex-M0+ Core

The ARM Cortex-M0+ is the world's most energy-efficient MPU and adds new energy efficiency, performance, ease of use, development and debug capabilities to its predecessor, the Cortex-M0, while maintaining 100 percent instruction set and tool compatibility.

ARM® Cortex™-M0+ Core



Memory protection unit is not shown. This feature is not implemented on Kinetis L series.

Kinetis L Series MCU Families

Common Features

System
ARM® Cortex™-M0+ Core
Multiple Low-Power Operation Modes, Clock Gating, 1.71–3.6 V
DMA, Crossbar Switch
Operating Temp: –40 °C to +105 °C [3]

Memory
90 nm TFS Flash Memory (High Reliability, Fast Access)
SRAM
Internal Memory Security/Protection

Analog Peripherals
16-bit ADC [1]
12-bit DAC
High-Speed Comparators
Low-Power Touch Sense Interface

Serial Interfaces
LPUART, UART [2]
SPI, I²C

Timers
RTC
Low-Power TPMs
Low-Power Timers
System Timers

Optional Features

CPU	Internal Memory	Communications	HMI
KL4 Family: USB, Segment LCD			
48 MHz	128 KB to 256 KB Flash	16 KB to 32 KB SRAM	USB OTG (FS)	Segment LCD
KL3 Family: Segment LCD			
48 MHz	64 KB to 256 KB Flash	8 KB to 32 KB SRAM	—	Segment LCD
KL2 Family: USB			
48 MHz	32 KB to 256 KB Flash	4 KB to 32 KB SRAM	USB OTG (FS)	—
KL1 Family: General Purpose			
48 MHz	32 KB to 256 KB Flash	4 KB to 32 KB SRAM	—	—
KL0 Family: Entry Level			
48 MHz	8 KB to 32 KB Flash	1 KB to 4 KB SRAM	—	—

[1] Feature not available on all KL1, KL2, KL3 MCUs (some have 12-bit ADC)
[2] Feature not available on KL0 MCUs (KL0 MCUs have LPUART)
[3] CSP packages –40 °C to +85 °C

Energy Efficiency

- 1.77 CoreMark/MHz: 2x to 40x more performance than 8- and 16-bit architectures, nine percent more performance than ARM Cortex-M0
- More than 2x CoreMark/mA performance than the closest 8- and 16-bit competitor
- Single-cycle access to I/O and critical peripherals: Up to 50 percent faster than standard I/O, improves reaction time to external events, allowing bit banding and software protocol emulation
- Two-stage pipeline: Reduced number of cycles per instruction (CPI), enabling faster branch instruction and ISR entry
- Excellent code density vs. 8-bit and 16-bit MCUs for reduced flash size, system cost and power consumption
- Optimized access to program memory: Accesses on alternate cycles for reduced power consumption

Ease of Use

- 100 percent compatible with ARM Cortex-M0 and a subset Cortex™-M3/M4: Reuse existing compilers and debug tools
- Simplified architecture: 56 instructions and 17 registers enables easy programming and efficient packaging of 8/16/32-bit data in memory
- Linear 4 GB address space: Removes the need for paging/banking, reducing software complexity
- Micro trace buffer: Lightweight trace solution allows fast bug identification and correction
- ARM third-party ecosystem support: Software and tools help minimize development time/cost

Low-Power MCU Design

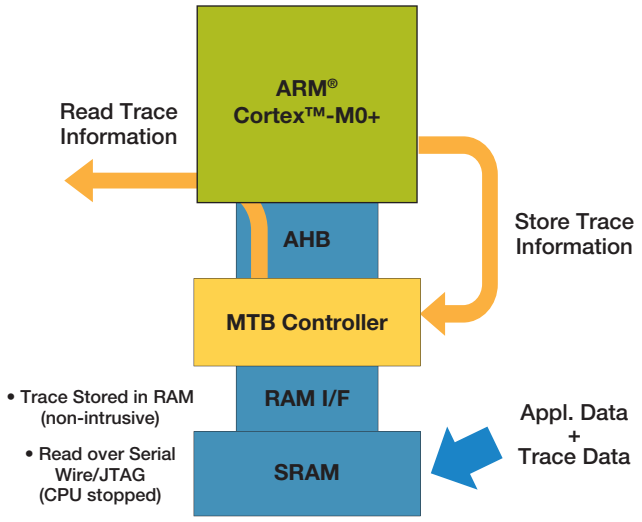
Kinetis L series MCUs include many of the same low-power features as the higher performance K series ARM Cortex-M4 MCUs, but provide additional capabilities for battery-operated applications. The Kinetis L series MCUs supplement the exceptional energy efficiency of the ARM Cortex-M0+ core with the latest in low-power process technology, platform design, operating modes and energy-saving peripherals. Combined, these increase the time spent in deep sleep modes, minimizing CPU activitiy and extending battery life.

- **10 ultra-low-power modes:** Run mode at 3 volts and 48 MHz consumes 84 µA/MHz*. Multiple deep sleep modes with clock and power gating options consume as little as 150 nA* at 3 volts (VLLS0 mode).
- **Energy-saving peripherals:** System, timing, communication and HMI peripherals operate in deep sleep modes, allowing them to collect, process and store data without waking up the CPU.
- **Bit manipulation engine:** Decorated load and store capability for improved peripheral processing efficiency for AND/OR/XOR/CLEAR FLAG/SET FLAG/BIT EXTRACTION functions to individual bits (ideal for 8/16-bit applications where manipulating individual bits is very common).
- **Low-power I/O pin configuration:** I/O pins default to a low-power configuration, disconnecting pin from digital logic and eliminating need to configure un-used I/O pins to reduce pin leakage.

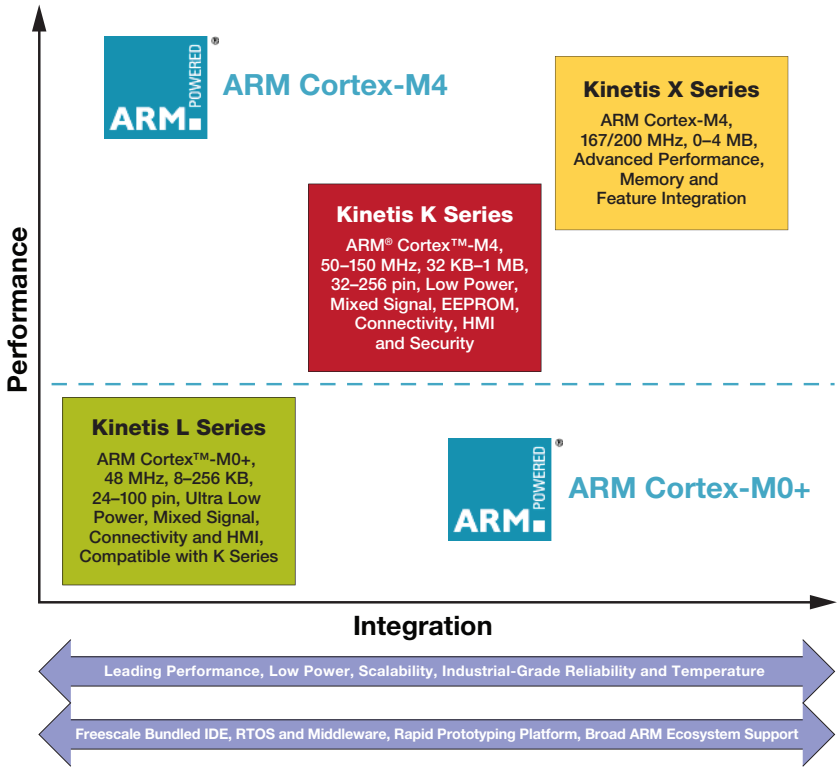
Kinetis Compatibility

- **KL0 family:** Hardware compatible with 8-bit S08Px family in the same package footprint, providing a hardware migration path for customers moving from 8- to 32-bit. Software compatible with all Kinetis L series families.
- **KL1/2/3/4 families:** Hardware and software compatible with each other and with Kinetis K series equivalent families (KL1 and K10, KL2 and K20, KL3 and K30, KL4 and K40).

CoreSight™ Micro Trace Buffer (MTB)

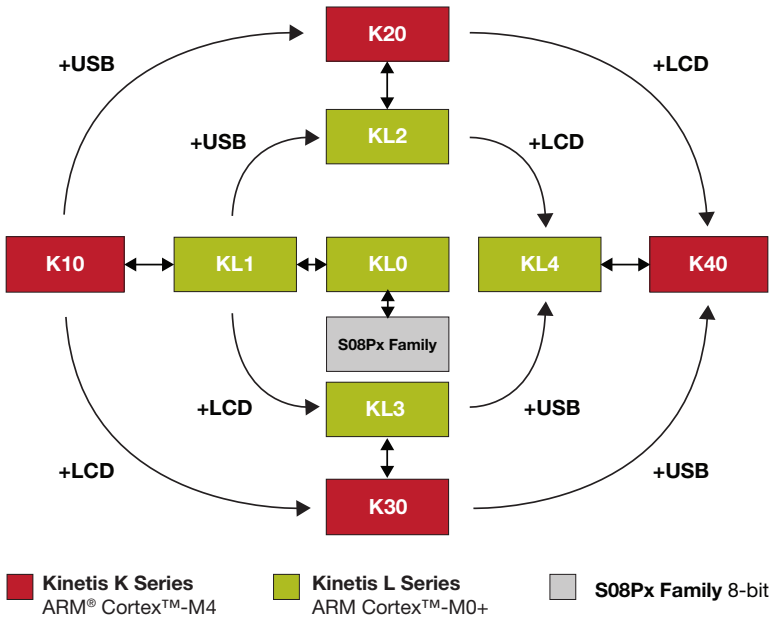


Kinetis MCUs



*Typical current estimates based on operation at 3V and 25°C

Kinetis L/K Series Compatibility



Kinetis K Series

Seven hardware and software compatible ARM Cortex-M4 MCU families with exceptional low-power performance, memory scalability including on-chip FlexMemory/EEPROM and peripheral integration. Devices range from 50 to 150 MHz, 32 KB to 1 MB and include analog, human-machine interface, connectivity, safety and security features.

Kinetis K Series Families

Common Features

System
- ARM® Cortex™-M4 Core + DSP
- Multiple Low-Power Operation Modes, Clock Gating, 1.71–3.6 V, 5 V Tolerant I/O [1]
- DMA, Memory Protection Unit [2], Crossbar Switch
- Operating Temp: –40 °C to +105 °C [3]

Memory
- 90 nm TFS Flash Memory (High Reliability, Fast Access)
- FlexMemory (EEPROM) [4]
- SRAM
- Internal Memory Security/Protection

Analog Peripherals
- 16-bit ADC
- Programmable Gain Amplifiers [1]
- 12-bit DAC [5]
- High-Speed Comparators
- Low-Power Touch Sense Interface [7]

Serial Interfaces
- UART, SPI, I²C
- SAI (I²S)

Timers
- RTC
- Motor Control Timers
- Low-Power Timers
- Programmable Delay Block
- System Timers

Other Peripherals
- CRC
- eSDHC [4]
- External Bus Interface [4]

Optional Features

CPU	Internal Memory	Communication	HMI	Security	Memory/Expansion	Analog
K70 Family: Graphics LCD						
120 to 150 MHz	Floating Point Unit; 512 KB to 1 MB Flash; 128 KB SRAM	USB OTG (FS and HS) [6]; CAN; Ethernet (IEEE® 1588)	Graphics LCD	Hardware Encryption; Tamper Detection	NAND Flash Controller; DRAM Controller	–
K60 Family: Ethernet, Security						
100 to 150 MHz	Floating Point Unit; 256 KB to 1 MB Flash; 64 KB to 128 KB SRAM	USB OTG (FS and HS); CAN; Ethernet (IEEE 1588)	–	Hardware Encryption; Tamper Detection	NAND Flash Controller; DRAM Controller	–
K50 Family: Analog Measurement Engine						
72 to 100 MHz	–	128 KB to 512 KB Flash; 32 KB to 128 KB SRAM; USB OTG (FS); – ; Ethernet (IEEE 1588)	Segment LCD	Hardware Encryption; –	– ; –	Measurement Engine
K40 Family: USB, Segment LCD						
72 to 100 MHz	–	64 KB to 512 KB Flash; 16 KB to 128 KB SRAM; USB OTG (FS); CAN; –	Segment LCD	– ; –	– ; –	–
K30 Family: Segment LCD						
72 to 100 MHz	–	64 KB to 512 KB Flash; 16 KB to 128 KB SRAM; – ; CAN; –	Segment LCD	– ; –	– ; –	–
K20 Family: USB						
50 to 120 MHz	Floating Point Unit; 32 KB to 1 MB Flash; 8 KB to 128 KB SRAM; USB OTG (FS and HS); CAN; – ; –			Hardware Encryption; Tamper Detection	NAND Flash Controller; –	–
K10 Family: General Purpose						
50 to 120 MHz	Floating Point Unit; 32 KB to 1 MB Flash; 8 KB to 128 KB SRAM; – ; CAN; – ; –			Hardware Encryption; Tamper Detection	NAND Flash Controller; –	–

[1] Feature not available on 50 MHz MCUs
[2] Feature not available on 50 MHz and 72 MHz MCUs
[3] Feature not available on K50 MCUs and CSP packages (K50 and CSP packages are –40 °C to +85 °C)
[4] Feature not available on all K10, K20, K30, K40, K50, K60 and K70 MCUs
[5] Feature not available on K10 and K20 50 MHz MCUs
[6] HS USB on 120/150 MHz MCUs only
[7] Feature not available on K11/12/21/22 MCUs

Kinetis KL0 Family

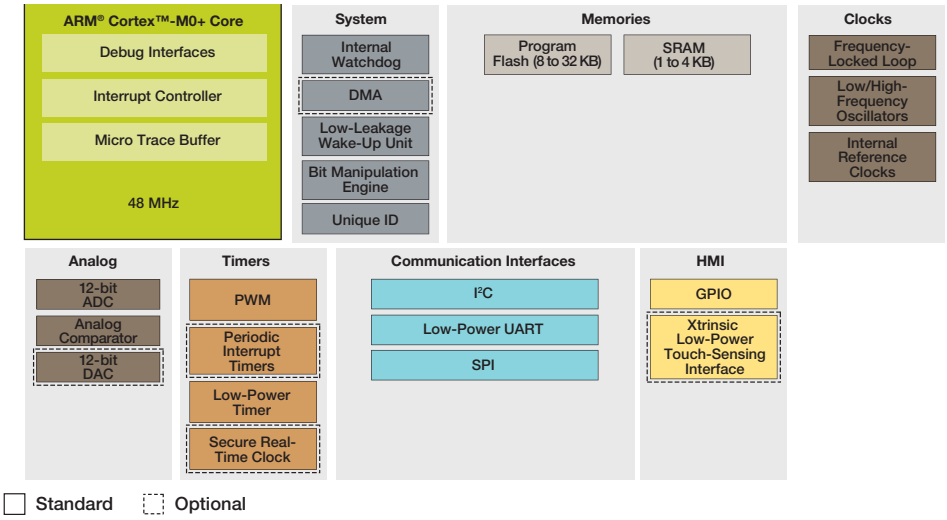
Ultra-low-power, entry-level MCUs

The Kinetis KL0 family is the entry point into the Kinetis L series of ARM® Cortex™-M0+ MCUs. Pin compatible with our 8-bit S08P family, the Kinetis KL0 family provides a bridge for 8-bit customers migrating into the Kinetis portfolio and is software and tool compatible with all other Kinetis L families. Devices start from 8 KB of flash in a small-footprint 4 x 4 mm 24 QFN package extending up to 32 KB in a 48 LQFP package. Each combines ultra-low-power performance with a rich suite of analog, communication, timing and control peripherals.

Target Applications

- Smoke detectors
- Remote sensors
- RFID
- Gaming controllers

Kinetis KL0x Family



Ultra Low Power

- Next-generation 32-bit ARM Cortex-M0+ core: 2x more CoreMark/mA than the closest 8/16-bit architecture
- Single-cycle fast I/O access port facilitates bit banging and software protocol emulation, keeping an 8-bit “look and feel”
- Multiple flexible low-power modes, including new compute clocking option that reduces dynamic power by placing peripherals in an asynchronous stop mode
- LPSCI, SPI, I²C, ADC, DAC, LP timer and DMA support low-power mode operation without waking up the core

Flash and SRAM

- Up to 32 KB flash with 64 byte flash cache, up to 4 KB RAM
- Security circuitry to prevent unauthorized access to RAM and flash contents

Performance

- ARM Cortex-M0+ core, 48 MHz core frequency over full voltage and temperature range (–40 °C to +105 °C)
- Bit manipulation engine for improved bit handling of peripheral modules
- Thumb instruction set combines high code density with 32-bit performance
- Up to 4-ch. DMA for peripheral and memory servicing with reduced CPU loading and faster system throughput
- Independent-clocked COP guards against clock skew or code runaway for fail-safe applications

Kinetis KL0x Family Options

Sub-Family	Part Number	CPU (MHz)	Memory		Features												√ Package					
																	FG	AF	FK	LC	FM	LF
			Flash (KB)	SRAM (KB)	DMA	UART	SPI	I²C	TSI	I²S	RTC	12-bit DAC	16-bit ADC w/DP Ch.	12-bit ADC	Total I/Os	Other	16 QFN (3 x 3, 0.5 mm)	20 WLCSP (2 x 2, 0.4 mm)	24 QFN (4 x 4, 0.5 mm)	32 LQFP (7 x 7, 0.8 mm)	32 QFN (5 x 5, 0.5 mm)	48 LQFP (7 x 7, 0.5 mm)
KL02	MKL02Z8xxx4	48 MHz	8	1		1	1	2						√	14~28		√					
	MKL02Z16xxx4	48 MHz	16	2		1	1	2						√	14~28		√		√		√	
	MKL02Z32xxx4	48 MHz	32	4		1	1	2						√	14~28		√	√	√		√	
KL04	MKL04Z8xxx4	48 MHz	8	1	√	1	1	1			√			√	22~28				√	√	√	
	MKL04Z16xxx4	48 MHz	16	2	√	1	1	1			√			√	22~41				√	√	√	√
	MKL04Z32xxx4	48 MHz	32	4	√	1	1	1			√			√	22~41				√	√	√	√
KL05	MKL05Z8xxx4	48 MHz	8	1	√	1	1	1	√		√	√		√	22~28				√	√	√	
	MKL05Z16xxx4	48 MHz	16	2	√	1	1	1	√		√	√		√	22~41				√	√	√	√
	MKL05Z32xxx4	48 MHz	32	4	√	1	1	1	√		√	√		√	22~41				√	√	√	√

* Proposed family member. Refer to family product brief on freescale.com for latest information.

Mixed Signal

- 12-bit ADC with configurable resolution, sample time and conversion speed/power
- Integrated temperature sensor
- High-speed comparator with internal 6-bit DAC
- 12-bit DAC with DMA support

Timing and Control

- One 6-ch. and one 2-ch. 16-bit low-power timer PWM modules with DMA support
- 2-ch., 32-bit periodic interrupt timer provides time base for RTOS task schedule or trigger source for ADC conversion
- Low-power timer allows operation in all power modes except for VLLS0
- Real-time clock with calendar

HMI

- Capacitive touch sense interface supports up to 16 external electrodes and DMA data transfer
- GPIO with pin interrupt support, DMA request capability and other pin control options

Connectivity and Communications

- I²C with DMA support, up to 100 Kb/s and compatible with SMBus V2 features
- LPUART and SPI with DMA support

Software and Tools

- Freescale Tower System hardware development environment and low-cost demo board
- Integrated development environments
  - Green Hills MULTI IDE
  - CodeWarrior for MCUs V10.x (Eclipse) IDE with Processor Expert
  - IAR Embedded Workbench, Keil MDK, Atollic, CodeRed
- Runtime software and RTOS
  - MQX-Lite, FreeRTOS, CodeSourcery G++ (GNU)
- Full ARM ecosystem support

Kinetis KL1 Family

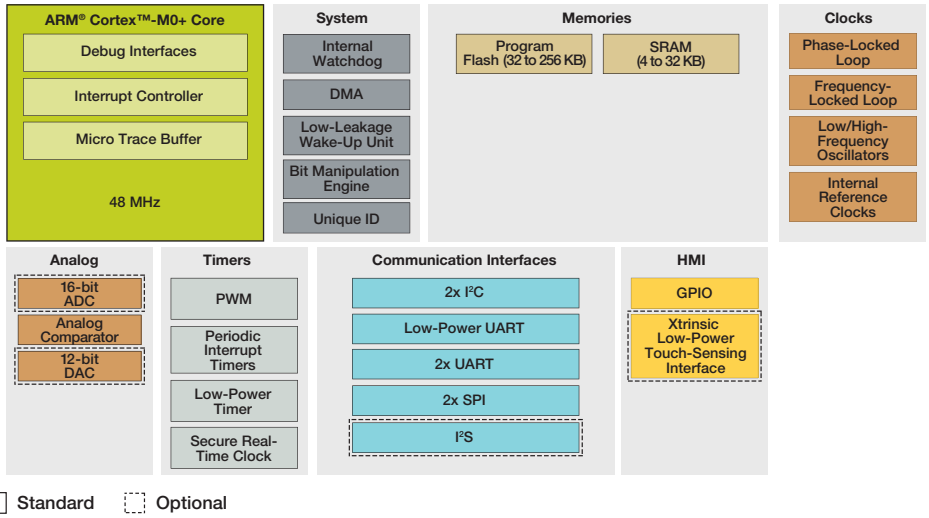
Ultra-low-power, general-purpose MCUs

The Kinetis KL1 MCU family is pin, software and tool compatible with all other Kinetis L families and provides additional memory, communications and analog peripheral options beyond those offered in the Kinetis KL0 family. The Kinetis KL1 family is also compatible with the Kinetis K10 (ARM® Cortex™-M4) family, providing a migration path to higher performance and feature integration. Devices start from 32 KB of flash in a small-footprint 5 x 5 mm 32 QFN package extending up to 256 KB in an 80 LQFP package. Each combines ultra-low-power performance with a rich suite of analog, communication, timing and control peripherals.

Target Applications

- Roller blind control
- Radio controlled toys
- Motor control
- Electronic toll collection

Kinetis KL1x Family



Ultra Low Power

- Next-generation 32-bit ARM Cortex™-M0+ core: 2x more CoreMark/mA than the closest 8/16-bit architecture
- Single-cycle fast I/O access port facilitates bit-banging and software protocol emulation, keeping an 8-bit “look and feel”
- Multiple, flexible low-power modes including new compute clocking option that reduces dynamic power by placing peripherals in an asynchronous stop mode
- LPSCI, SPI, I²C, ADC, DAC, LP timer and DMA support low-power mode operation without waking up the core

Flash and SRAM

- Up to 256 KB flash with 64 byte flash cache, up to 32 KB RAM
- Security circuitry to prevent unauthorized access to RAM and flash contents

Performance

- ARM Cortex-M0+ core, 48 MHz core frequency over full voltage and temperature range (–40 °C to +105 °C)
- Bit manipulation engine for improved bit handling of peripheral modules
- Thumb instruction set combines high code density with 32-bit performance
- Up to 4-ch. DMA for peripheral and memory servicing with reduced CPU loading and faster system throughput
- Independent-clocked COP guards against clock skew or code runaway for fail-safe applications

Kinetis KL1x Family Options

Sub-Family	Part Number	CPU (MHz)	Memory		Features											√ Package				
																FM	AD	FT	LH	LK
			Flash (KB)	SRAM (KB)	DMA	UART	SPI	I²C	TSI	I²S	RTC	12-bit DAC	16-bit ADC w/DP Ch.	12-bit ADC	Total I/Os	Other	32 QFN (5 x 5, 0.5 mm)	35 WLCSP	48 QFN (7 x 7, 0.5 mm)	64 LQFP (10 x 10, 0.5 mm)	80 LQFP (12 x 12, 0.5 mm)
KL14	MKL14Z32xxx4	48 MHz	32	4	√	3	2	2			√			√	28~70		√		√	√	√
	MKL14Z64xxx4	48 MHz	64	8	√	3	2	2			√			√	28~70		√		√	√	√
KL15	MKL15Z32xxx4	48 MHz	32	4	√	3	2	2	√		√	√	√		28~70		√		√	√	√
	MKL15Z64xxx4	48 MHz	64	8	√	3	2	2	√		√	√	√		28~70		√		√	√	√
	MKL15Z128xxx4	48 MHz	128	16	√	3	2	2	√		√	√	√		28~70		√	√	√	√	√
KL16	MKL16Z32xxx4	48 MHz	32	4	√	3	2	2	√	√	√	√	√		28~70		√		√	√	√
	MKL16Z64xxx4	48 MHz	64	8	√	3	2	2	√	√	√	√	√		28~70		√		√	√	√
	MKL16Z128xxx4	48 MHz	128	16	√	3	2	2	√	√	√	√	√		28~70		√		√	√	√
	MKL16Z256xxx4	48 MHz	256	32	√	3	2	2	√	√	√	√	√		54~70					√	√

* Proposed family member. Refer to family product brief on freescale.com for latest information.

Mixed Signal

- Up to 16-bit ADC with configurable resolution, sample time and conversion speed/power
- Integrated temperature sensor
- Single or differential output mode operation for improved noise rejection
- High-speed comparator with internal 6-bit DAC
- 12-bit DAC with DMA support

Timing and Control

- Two 6-ch. and one 2-ch., 16-bit low-power timer PWM modules with DMA support
- 2-ch. 32-bit periodic interrupt timer provides time base for RTOS task schedule or trigger source for ADC conversion
- Real-time clock with calendar

HMI

- Capacitive touch sense interface supports up to 16 external electrodes and DMA data transfer
- GPIO with pin interrupt support, DMA request capability and other pin control options

Connectivity and Communications

- I²C with DMA support, up to 100 Kb/s and compatible with SMBus V2 features
- One LPUART and two UARTs with DMA support
- Two SPIs with DMA support

Software and Tools

- Freescale Tower System hardware development environment and low-cost demo board
- Integrated development environments
  - Green Hills MULTI IDE
  - CodeWarrior for MCUs V10.x (Eclipse) IDE with Processor Expert
  - IAR Embedded Workbench, Keil MDK, Atollic, CodeRed
- Runtime software and RTOS
  - MQX-Lite, FreeRTOS, CodeSourcery G++ (GNU)
- Full ARM ecosystem support

Kinetis KL2 Family

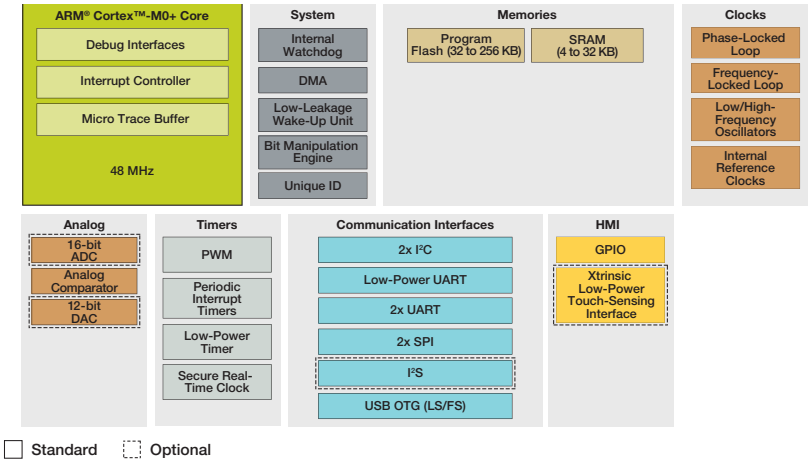
Ultra-low-power MCUs with USB OTG

The Kinetis KL2 MCU family is pin, software and tool compatible with all other Kinetis L families and adds a Full-Speed USB 2.0 On-The-Go controller with an integrated low-voltage regulator. The Kinetis KL2 MCU family is also compatible with the Kinetis K20 (ARM® Cortex™-M4) family, providing a migration path to higher performance and feature integration. Devices start from 32 KB of flash in a small-footprint 5 x 5 mm 32 QFN package extending up to 256 KB in a 100 LQFP/100 MBGA package. Each combines ultra-low-power performance with a rich suite of analog, communication, timing and control peripherals.

Target Applications

- Cash counters
- PC peripherals
- Data loggers
- Portable medical equipment

Kinetis KL2x Family



Ultra Low Power

- Next-generation 32-bit ARM Cortex-M0+ core: 2x more CoreMark/mA than the closest 8/16-bit architecture
- Single-cycle fast I/O access port facilitates bit-banging and software protocol emulation, keeping an 8-bit “look and feel”
- Multiple, flexible low-power modes including new compute clocking option that reduces dynamic power by placing peripherals in an asynchronous stop mode
- LPSCI, SPI, I²C, ADC, DAC, LP timer and DMA support low-power mode operation without waking up the core

Flash and SRAM

- Up to 256 KB flash with 64 byte flash cache, up to 32 KB RAM
- Security circuitry to prevent unauthorized access to RAM and flash contents

Performance

- ARM Cortex-M0+ core, 48 MHz core frequency over full voltage and temperature range (–40 °C to +105 °C)
- Bit manipulation engine for improved bit handling of peripheral modules
- Thumb instruction set combines high code density with 32-bit performance
- Up to 4-ch. DMA for peripheral and memory servicing with reduced CPU loading and faster system throughput
- Independent-clocked COP guards against clock skew or code runaway for fail-safe applications

Kinetis KL2x Family Options

Sub-Family	Part Number	CPU (MHz)	Memory		Features												√ Package						
																	FM	AD	FT	LH	LK	LL	MC
			Flash (KB)	SRAM (KB)	DMA	UART	SPI	I²C	TSI	I²S	RTC	12-bit DAC	16-bit ADC w/DP Ch.	12-bit ADC	Total I/Os	Other	32 QFN (5 x 5, 0.5 mm)	35 WLCSP	48 QFN (7 x 7, 0.5 mm)	64 LQFP (10 x 10, 0.5 mm)	80 LQFP (12 x 12, 0.5 mm)	100 LQFP (14 x 14, 0.5 mm)	121 MAPBGA (8 x 8, 0.65 mm)
KL24	MKL24Z32xxx4	48 MHz	32	4	ü	3	2	2			√			√	23~66	USB 2.0 FS OTG/Host/Device	√		√	√	√		
	MKL24Z64xxx4	48 MHz	64	8	ü	3	2	2			√			√	23~66	USB 2.0 FS OTG/Host/Device	√		√	√	√		
KL25	MKL25Z32xxx4	48 MHz	32	4	ü	3	2	2	√		√	√	√		23~66	USB 2.0 FS OTG/Host/Device	√		√	√	√		
	MKL25Z64xxx4	48 MHz	64	8	ü	3	2	2	√		√	√	√		23~66	USB 2.0 FS OTG/Host/Device	√		√	√	√		
	MKL25Z128xxx4	48 MHz	128	16	ü	3	2	2	√		√	√	√		23~66	USB 2.0 FS OTG/Host/Device	√	√	√	√	√		
KL26	MKL16Z32xxx4	48 MHz	32	4	ü	3	2	2	√	√	√	√	√		28~70	USB 2.0 FS OTG/Host/Device	√		√	√	√		
	MKL16Z64xxx4	48 MHz	64	8	ü	3	2	2	√	√	√	√	√		28~70	USB 2.0 FS OTG/Host/Device	√		√	√	√		
	MKL26Z128xxx4	48 MHz	128	16	ü	3	2	2	√	√	√	√	√		50~80	USB 2.0 FS OTG/Host/Device	√		√	√	√	√	√
	MKL26Z256xxx4	48 MHz	256	32	ü	3	2	2	√	√	√	√	√		50~80	USB 2.0 FS OTG/Host/Device				√	√	√	√

* Proposed family member. Refer to family product brief on freescale.com for latest information.

Mixed Signal

- Up to 16-bit ADC with configurable resolution, sample time and conversion speed/power
- Integrated temperature sensor
- Single or differential output mode operation in order to achieve improved noise rejection
- High-speed comparator with internal 6-bit DAC
- 12-bit DAC with DMA support

Timing and Control

- Two 6-ch. and one 2-ch., 16-bit low-power timer PWM modules with DMA support
- 2-ch. 32-bit periodic interrupt timer provides time base for RTOS task schedule or trigger source for ADC conversion
- Low-power timer allows operation in all power modes except for VLLS0
- Real-time clock with calendar

HMI

- Capacitive touch sense interface supports up to 16 external electrodes and DMA data transfer
- GPIO with pin interrupt support, DMA request capability and other pin control options

Connectivity and Communications

- USB 2.0 On-The-Go (Full Speed) with integrated USB low-voltage regulator supplies up to 120 mA off chip at 3.3 volts to power external components from 5-volt input
- Two I²C with DMA support, up to 100 Kb/s and compatible with SMBus V2 features
- One LPUART and two UART with DMA support
- Two SPI with DMA support

Software and Tools

- Freescale Tower System hardware development environment and low-cost demo board
- Integrated development environments
  - Green Hills MULTI IDE
  - CodeWarrior for MCUs V10.x (Eclipse) IDE with Processor Expert
  - IAR Embedded Workbench, Keil MDK, Atollic, CodeRed
- Runtime software and RTOS
  - MQX-Lite, FreeRTOS, CodeSourcery G++ (GNU)
- Full ARM ecosystem support

Kinetis KL3 Family

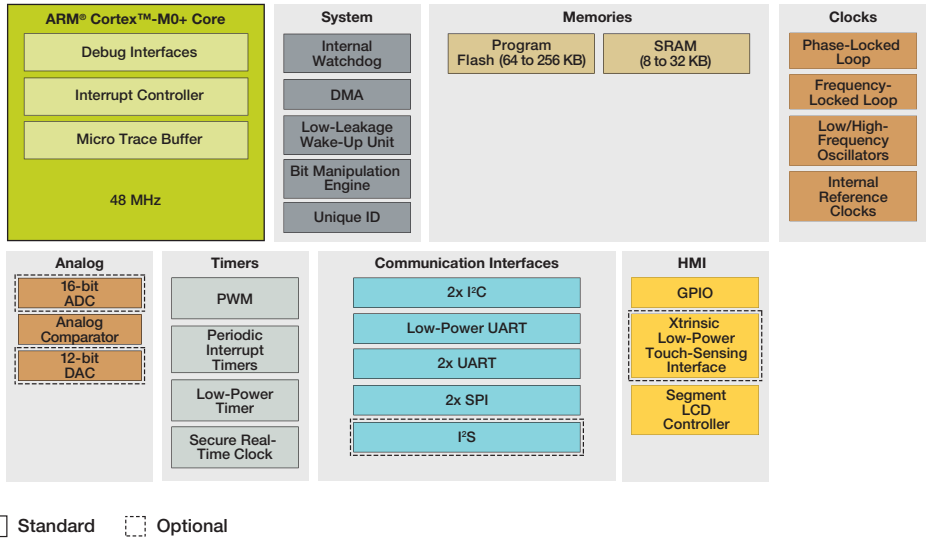
Ultra-low-power MCUs with segment LCD

The Kinetis KL3 MCU family is pin, peripheral and software compatible with all other Kinetis L families and adds a flexible, low-power segment LCD controller with support for up to 376 segments. The Kinetis KL3 family is also compatible with the Kinetis K30 (ARM® Cortex™-M4) family, providing a migration path to higher performance and feature integration. Devices start from 64 KB of flash in a 64 LQFP package extending up to 256 KB in a 121 MBGA package. Each combines ultra-low-power performance with a rich suite of analog, communication, timing and control peripherals.

Target Applications

- Electronic scales
- Thermostats
- Flow meters
- Smart meters

Kinetis KL3x Family



Ultra Low Power

- Next-generation 32-bit ARM Cortex™-M0+ core: 2x more CoreMark/mA than the closest 8/16-bit architecture
- Single-cycle fast I/O access port facilitates bit-banging and software protocol emulation, keeping an 8-bit “look and feel”
- Multiple, flexible low-power modes including new compute clocking option that reduces dynamic power by placing peripherals in an asynchronous stop mode
- LPSCI, SPI, I²C, ADC, DAC, LP timer and DMA support low-power mode operation without waking up the core

Flash and SRAM

- Up to 256 KB flash with 64 byte flash cache, up to 32 KB RAM
- Security circuitry to prevent unauthorized access to RAM and flash contents

Performance

- ARM Cortex-M0+ core, 48 MHz core frequency over full voltage and temperature range (–40 °C to +105 °C)
- Bit manipulation engine for improved bit handling of peripheral modules
- Thumb instruction set combines high code density with 32-bit performance
- Up to 4-ch. DMA for peripheral and memory servicing with reduced CPU loading and faster system throughput
- Independent-clocked COP guards against clock skew or code runaway for fail-safe applications

Kinetis KL3x Family Options

Sub-Family	Part Number	CPU (MHz)	Memory		Features												√ Package		
																	LH	LL	MC
			Flash (KB)	SRAM (KB)	DMA	UART	SPI	I²C	TSI	I²S	RTC	12-bit DAC	16-bit ADC w/DP Ch.	12-bit ADC	Total I/Os	Other	64 LQFP (10 x 10, 0.5 mm)	100 LQFP (14 x 14, 0.5 mm)	121 MAPBGA (8 x 8, 0.65 mm)
KL34	MKL34Z64xxx4	48 MHz	64	8	ü	3	2	2			√			√	36~80	SLCD	√	√	
KL36	MKL36Z64xxx4	48 MHz	64	8	ü	3	2	2	√	√	√	√	√		36~80	SLCD	√	√	
	MKL36Z128xxx4	48 MHz	128	16	ü	3	2	2	√	√	√	√	√		36~80	SLCD	√	√	√
	MKL36Z256xxx4	48 MHz	256	32	ü	3	2	2	√	√	√	√	√		36~80	SLCD	√	√	√

* Proposed family member. Refer to family product brief on freescale.com for latest information.

Mixed Signal

- Up to 16-bit ADC with configurable resolution, sample time and conversion speed/power
- Integrated temperature sensor
- Single or differential output mode operation in order to achieve improved noise rejection
- High-speed comparator with internal 6-bit DAC
- 12-bit DAC with DMA support

Timing and Control

- Two 6-ch. and one 2-ch., 16-bit low-power timer PWM modules with DMA support
- 2-ch. 32-bit periodic interrupt timer provides time base for RTOS task schedule or trigger source for ADC conversion
- Low-power timer allows operation in all power modes except for VLLS0
- Real-time clock with calendar

HMI

- Flexible, low-power LCD controller with up to 376 segments (47 x 8 or 51 x 4)
  - LCD blink mode enables low average power while remaining in low-power mode
  - Segment fail detect alerts the user to failures in the display that helps avoids the possibility of an erroneous readout in medical applications
  - Front plane/backplane reassignment provides pin-out flexibility, easing PCB design and allowing LCD configuration changes via firmware with no hardware re-work
  - Unused LCD pins can be configured as other GPIO functions
- Capacitive touch-sensing inputs support up to 16 external electrodes and DMA data transfer
- GPIO with pin interrupt support, DMA request capability and other pin control options

Connectivity and Communications

- Two I²C with DMA support, up to 100 Kb/s and compatible with SMBus V2 features
- One LPUART and two UART with DMA support
- Two SPI with DMA support

Software and Tools

- Freescale Tower System hardware development environment and low-cost demo board
- Integrated development environments
  - Green Hills MULTI IDE
  - CodeWarrior for MCUs V10.x (Eclipse) IDE with Processor Expert
  - IAR Embedded Workbench, Keil MDK, Atollic, CodeRed
- Runtime software and RTOS
  - MQX-Lite, FreeRTOS, CodeSourcery G++ (GNU)
- Full ARM ecosystem support

Kinetis KL4 Family

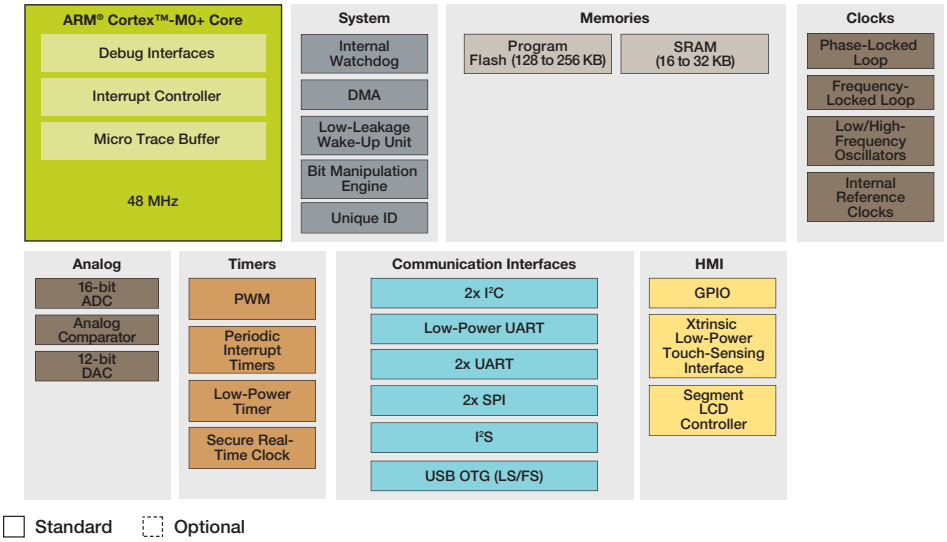
Ultra-low-power MCUs with USB and LCD

The Kinetis KL4 family is pin, peripheral and software compatible with all other Kinetis L families and combines a Full-Speed USB 2.0 On-The-Go controller with integrated low-voltage regulator and a flexible, low-power segment LCD controller with support for up to 376 segments. The Kinetis KL4 family is also compatible with the Kinetis K40 (ARM® Cortex™-M4) family, providing a migration path to higher performance and feature integration. Devices start from 128 KB of flash in a 64 LQFP package extending up to 256 KB in a 121 MBGA package. Each combines ultra-low-power performance with a rich suite of analog, communication, timing and control peripherals.

Target Applications

- Portable instrumentation
- Industrial automation
- Small appliances
- Portable media players

Kinetis KL4x Family



Ultra Low Power

- Next-generation 32-bit ARM Cortex™-M0+ core: 2x more CoreMark/mA than the closest 8/16-bit architecture. Single-cycle fast I/O access port facilitates bit-banging and software protocol emulation, keeping an 8-bit “look and feel”
- Multiple, flexible low-power modes including new compute clocking option that reduces dynamic power by placing peripherals in an asynchronous stop mode
- LPSCI, SPI, I²C, ADC, DAC, LP timer and DMA support low-power mode operation without waking up the core

Flash and SRAM

- Up to 256 KB flash with 64 byte flash cache, up to 32 KB RAM
- Security circuitry to prevent unauthorized access to RAM and flash contents

Performance

- ARM Cortex-M0+ core, 48 MHz core frequency over full voltage and temperature range (–40 °C to +105 °C)
- Bit manipulation engine for improved bit handling of peripheral modules
- Thumb instruction set combines high code density with 32-bit performance
- Up to 4-ch. DMA for peripheral and memory servicing with reduced CPU loading and faster system throughput
- Independent-clocked COP guards against clock skew or code runaway for fail-safe applications

Kinetis KL4x Family Options

Sub-Family	Part Number	CPU (MHz)	Memory		Features											√ Package		
			Flash (KB)	SRAM (KB)	DMA	UART	SPI	I²C	TSI	I²S	RTC	12-bit DAC	16-bit ADC w/DP Ch.	12-bit ADC	Total I/Os	Other	LH	LL	MC
																	64 LQFP (10 x 10, 0.5 mm)	100 LQFP (14 x 14, 0.5 mm)	121 MAPBGA (8 x 8, 0.65 mm)
KL46	MKL46Z128xxx4	48 MHz	128	16	√	3	2	2	√	√	√	√	√		46~80	USB 2.0 FS OTG/Host/Device + Segment LCD	√	√	√
	MKL46Z256xxx4	48 MHz	256	32	√	3	2	2	√	√	√	√	√		46~80	USB 2.0 FS OTG/Host/Device + Segment LCD	√	√	√

* Proposed family member. Refer to family product brief on freescale.com for latest information.

Mixed Signal

- Up to 16-bit ADC with configurable resolution, sample time and conversion speed/power
- Integrated temperature sensor
- Single or differential output mode operation in order to achieve improved noise rejection
- High-speed comparator with internal 6-bit DAC
- 12-bit DAC with DMA support

Timing and Control

- Two 6-ch. and one 2-ch., 16-bit low-power timer PWM modules with DMA support
- 2-ch. 32-bit periodic interrupt timer provides time base for RTOS task schedule or trigger source for ADC conversion
- Low-power timer allows operation in all power modes except for VLLS0
- Real-time clock with calendar

HMI

- Flexible, low-power LCD controller with up to 376 segments (47 x 8 or 51 x 4). LCD blink mode enables low average power while remaining in low-power mode
- Segment fail detect alerts the user to failures in the display that helps avoids the possibility of an erroneous readout in medical applications
- Front plane/backplane reassignment provides pin-out flexibility, easing PCB design and allowing LCD configuration changes via firmware with no hardware re-work
- Unused LCD pins can be configured as other GPIO functions
- Capacitive touch-sensing inputs support up to 16 external electrodes and DMA data transfer
- GPIO with pin interrupt support, DMA request capability and other pin control options

Connectivity and Communications

- USB 2.0 On-The-Go integrated USB low-voltage regulator supplies up to 120 mA off chip at 3.3 volts to power external components from 5-volt input. Up to 480 Mb/s with external ULPI PHY
- Two I²C with DMA support, up to 100 Kb/s and compatible with SMBus V2 features
- One LPUART and two UART with DMA support
- Two SPI with DMA support

Software and Tools

- Freescale Tower System hardware development environment and low-cost demo board
- Integrated development environments
  - Green Hills MULTI IDE
  - CodeWarrior for MCUs V10.x (Eclipse) IDE with Processor Expert
  - IAR Embedded Workbench, Keil MDK, Atollic, CodeRed
- Runtime software and RTOS
  - MQX-Lite, FreeRTOS, CodeSourcery G++ (GNU)
- Full ARM ecosystem support

Kinetis K10 Family

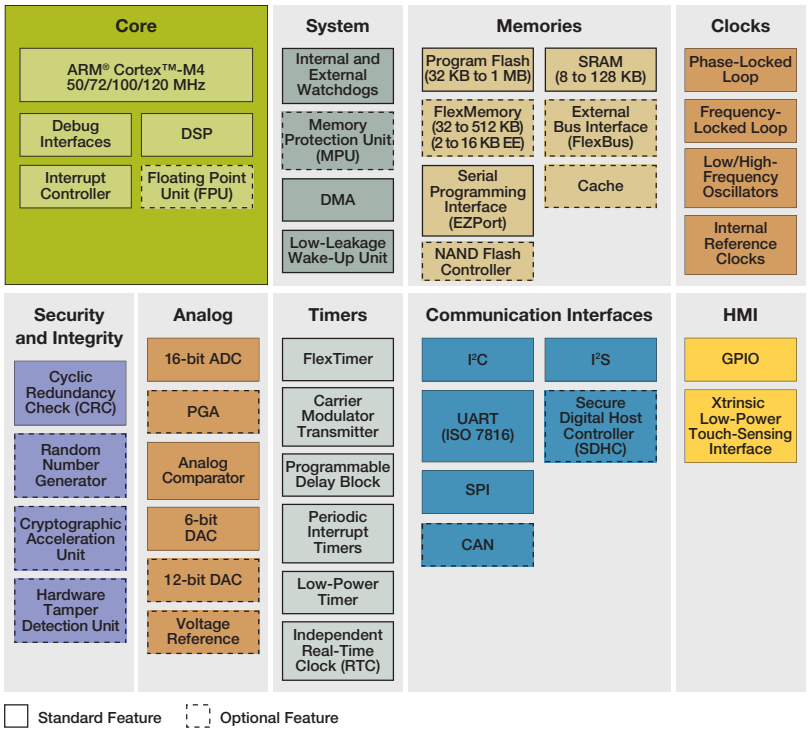
Low-power, mixed-signal MCUs

The Kinetis K10 MCU family is the entry point into the Kinetis K series portfolio. Devices start from 32 KB of flash in a small-footprint 5 x 5 mm 32 QFN package extending up to 1 MB in a 144 MAPBGA package with a rich suite of analog, communication, timing and control peripherals. Additionally, pin compatibility, flexible low-power capabilities and innovative FlexMemory help to solve many of the major pain points for system implementation.

Target Applications

- Remote sensors
- HVAC systems
- Gaming controllers
- Flow meters

Kinetis K10 Family



One-Stop Enablement Offering—MCU + IDE + RTOS

Freescale Tower System hardware development environment:

- Integrated development environments
  - Eclipse-based CodeWarrior V10.0 IDE and Processor Expert
  - IAR Embedded Workbench
  - Keil MDK
  - CodeSourcery Sourcery G++ (GNU)
  - Green Hills MULTI
- Runtime software and RTOS
  - Math, DSP and encryption libraries
  - Motor control libraries
  - Complimentary bootloaders (USB, Ethernet, RF, serial)
  - Complimentary Freescale embedded GUI
  - Complimentary Freescale MQX™
  - Cost-effective Nano™ SSL/Nano™ SSH for Freescale MQX RTOS
  - Micriμm μC/OS-III
  - Express Logic ThreadX
  - SEGGER embOS
  - freeRTOS
  - Mocana (security)
  - Green Hills μ-velOSity
- Full ARM ecosystem

Features

- ARM® Cortex™-M4 core with DSP instruction support and optional single precision floating point unit
- Up to 32-channel DMA. Up to 16 KB of cache. Crossbar switch

- 32 KB–1 MB flash. Up to 128 KB of SRAM
- 32–512 KB FlexMemory

- 10 ultra-low-power modes with flash programming and analog operation down to 1.71 volts
- Low-power timer, low-power RTC, low-leakage wake-up unit

- High-speed 16-bit ADCs. Programmable gain amplifiers
- 12-bit DAC. High-speed comparators
- On-chip voltage reference
- Cryptographic acceleration unit (CAU)
- Hardware tamper detection unit
- Random number generator

- Low-power capacitive touch-sensing interface

- Up to six UARTs with IrDA support. One UART with ISO 7816 support
- I²S interface, up to two CAN modules, up to three DSPI interfaces, up to two I²C interfaces

Benefits

- Up to 120 MHz core supporting a broad range of processing bandwidth needs
- Peripheral and memory servicing with reduced CPU loading. Optimized bus bandwidth and flash execution performance. Concurrent multi-master bus accesses for increased bus bandwidth

- High reliability, fast access program memory with 4-level security protection. Independent flash banks allow concurrent code execution and firmware updating
- FlexMemory provides 32 byte–16 KB of user-segmentable byte write/erase EEPROM. In addition, FlexNVM from 32–512 KB for extra program code, data or EEPROM backup

- Peripheral activity and wake-up times can be optimized to suit application requirements enabling extended battery life (Stop currents of <500 nA, run currents of <200 µA/MHz, 4 µs wake-up from Stop)
- Continual device operation in reduced power states with flexible wake-up options

- Fast, accurate signal conditioning capability with support for single or differential operation for improved noise rejection
- Support for small amplitude signal processing
- Analog signal generation for audio applications
- Fast, accurate motor over-current protection
- Eliminates need for external voltage reference reducing overall system cost
- Secure data transfer and storage. Faster than software implementations and with minimal CPU loading. Supports a wide variety of algorithms: DES, 3DES, AES, MD5, SHA-1, SHA-256
- Secure key storage with internal/external tamper detect for unsecured flash, temperature/clock/supply voltage variations and physical attack

- Provides a modern upgrade from mechanical to touch keypad, rotary and slider user interfaces and operates in all low-power modes with minimal current added. Supports up to 16 inputs

- Variety of data size, format and transmission/reception settings supported for multiple industrial communication protocols
- Multiple communication interfaces for simple and efficient data exchange, industrial network bridging and audio system interfacing

Kinetis K10 Family Options

Part Number	CPU (MHz)	Memory			Feature Options								Other	√ Package									
														FM	FT	LF	MP	LH	LK	LL	AB	MC	LQ	MD
		Flash (KB)	Flex NVM (KB)	SRAM (KB)	Single Precision Floating Point Unit	CAN	Memory Protection Unit	Secure Digital Host Controller	External Bus Interface	12-bit DAC	Prog. Gain Amplifier	5 V Tolerant I/O		32 QFN (5 x 5)	48 QFN (7 x 7)	48 LQFP (7 x 7)	64 MAPBGA (5 x 5)	64 LQFP (10 x 10)	80 LQFP (12 x 12)	100 LQFP (14 x 14)	120 WLCSP (5 x 5)	121 BGA (8 x 8)	144 LQFP (20 x 20)	144 BGA (13 x 13)
MK10DN32Vyy5	50	32	-	8										√	√	√	√	√						
MK10DN64Vyy5	50	64	-	16										√	√	√	√	√						
MK10DX32Vyy5	50	32	32	8										√	√	√	√	√						
MK10DX64Vyy5	50	64	32	16										√	√	√	√	√						
MK10DN128Vyy5	50	128	-	16										√	√	√	√	√						
MK10DX128Vyy5	50	128	32	16										√	√	√	√	√						
MK12DX128Vyy5	50	128	64	32						√						√		√	√			√		
MK12DX256Vyy5	50	256	64	32						√						√		√	√			√		
MK12DN512Vyy5	50	512	-	64						√								√	√			√		
MK11DX128Vyy5	50	128	64	32						√*			Tamper Detect, CAU + RNG						√			√		
MK11DX256Vyy5	50	256	64	32						√*			Tamper Detect, CAU + RNG						√			√		
MK11DN512Vyy5	50	512	-	64						√*			Tamper Detect, CAU + RNG						√			√		
MK10DX64Vyy7	72	64	32	16		√			√	√	√	√						√	√			√		
MK10DX128Vyy7	72	128	32	32		√			√	√	√	√						√	√	√		√		
MK10DX256Vyy7	72	256	32	64		√			√	√	√	√						√	√	√		√		
MK12FX512Vyy10	100	512	128	64	√	√	√	√	√	√		√						√	√	√		√	√	√
MK12FN1M0Vyy10	100	1024	-	128	√	√	√	√	√	√		√						√	√	√		√	√	√
MK11FX512Vyy10	100	512	128	64	√	√	√	√	√	√		√	Tamper Detect, CAU + RNG									√	√	√
MK11FN1M0Vyy10	100	1024	-	128	√	√	√	√	√	√		√	Tamper Detect, CAU + RNG									√	√	√
MK10DX128Vyy10	100	128	128	32		√	√	√	√	√	√	√							√	√		√	√	√
MK10DX256Vyy10	100	256	256	64		√	√	√	√	√	√	√							√	√		√	√	√
MK10DN512Vyy10	100	512	-	128		√	√	√	√	√	√	√							√	√	√**	√	√	√
MK10FX512Vyy12	120	512	512	128	√	√	√	√	√	√	√	√	NAND Flash Ctrlr.										√	√
MK10FN1M0Vyy12	120	1024	-	128	√	√	√	√	√	√	√	√	NAND Flash Ctrlr.										√	√

yy = package designator * 121 BGA package only ** C temp only (–40 °C to +85 °C) Refer to family product brief on freescale.com for full product specs.

Kinetis K20 Family

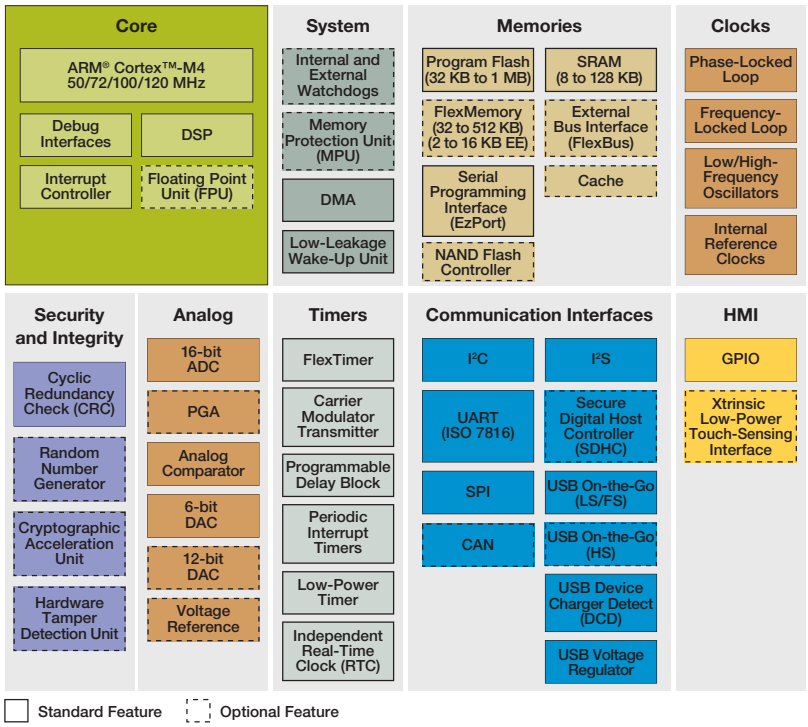
Low-power MCUs with USB On-The-Go

The Kinetis K20 MCU family is pin, peripheral and software compatible with the K10 MCU family and adds Full- and High-Speed USB 2.0 On-The-Go with device charger detect capability. Devices start from 32 KB of flash in 5 x 5 mm 32 QFN packages extending up to 1 MB in a 144 MAPBGA package with a rich suite of analog, communication, timing and control peripherals. High memory density K20 family devices include a single precision floating point unit and NAND flash controller.

Target Applications

- Barcode scanners
- Portable media players
- Printers
- Programmable logic controllers

Kinetis K20 Family



One-Stop Enablement Offering—MCU + IDE + RTOS

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  - IAR Embedded Workbench
  - Keil MDK
  - CodeSourcery Sourcery G++ (GNU)
  - Green Hills MULTI
- Runtime software and RTOS
  - Math, DSP and encryption libraries
  - Motor control libraries
  - Complimentary bootloaders (USB, Ethernet, RF, serial)
  - Complimentary Freescale embedded GUI
  - Complimentary Freescale MQX™
  - Cost-effective Nano™ SSL/Nano™ SSH for Freescale MQX RTOS
  - Micriμm μC/OS-III
  - Express Logic ThreadX
  - SEGGER embOS
  - freeRTOS
  - Mocana (security)
  - Green Hills μ-velOSity
- Full ARM ecosystem

Features

Benefits

Features	Benefits
• ARM® Cortex™-M4 core with DSP instruction support and optional single precision floating point unit • Up to 32-channel DMA. Up to 16 KB of cache. Crossbar switch	• Up to 120 MHz core supporting a broad range of processing bandwidth needs • Peripheral and memory servicing with reduced CPU loading. Optimized bus bandwidth and flash execution performance. Concurrent multi-master bus accesses for increased bus bandwidth
• USB On-The-Go (Full- and High-Speed) with device charger detect	• Optimized charging current/time for portable USB devices, enabling longer battery life. USB low-voltage regulator supplies up to 120 mA off chip at 3.3 volts to power external components from 5-volt input
• Memory protection unit • Hardware cyclic redundancy check engine • Independent-clocked COP. External watchdog monitor • Cryptographic acceleration unit (CAU) • Hardware tamper detection unit • Random number generator	• Provides memory protection for all crossbar switch masters, increasing software reliability • Validates memory contents and communication data, increasing system reliability • Prevents code runaway in fail-safe applications. Drives output pin to safe state external components if watchdog event occurs • Secure data transfer and storage. Faster than software implementations and with minimal CPU loading. Supports a wide variety of algorithms: DES, 3DES, AES, MDS, SHA-1, SHA-256 • Secure key storage with internal/external tamper detect for unsecure flash, temperature/clock/supply voltage variations and physical attack
• Up to four FlexTimers with up to 20 channels • Carrier modulator transmitter • 4-channel, 32-bit periodic interrupt	• General-purpose timers with hardware dead-time insertion and quadrature decoding for motor control • Infrared waveform generation for remote control applications • Time base generation for RTOS task scheduler or trigger source for ADC conversion and programmable delay block
• FlexBus external bus interface • Secure digital host controller • NAND flash controller	• Enables the connection of external memories and peripherals (e.g., graphics displays) • Connection to SD, SDIO, MMC or CE-ATA cards for in-application software upgrades, file systems or adding Wi-Fi® or Bluetooth® support • Supports up to 32-bit ECC current and future NAND types with minimal software overhead

Kinetis K20 Family Options

Part Number	CPU (MHz)	Memory			Feature Options								Other	√ Package									
														FM	FT	LF	MP	LH	LK	LL	AB	MC	LQ	MD
		Flash (KB)	Flex NVM (KB)	SRAM (KB)	Single Precision Floating Point Unit	CAN	Memory Protection Unit	Secure Digital Host Controller	External Bus Interface	12-bit DAC	Prog. Gain Amplifier	5 V Tolerant I/O		32 QFN (5 x 5)	48 QFN (7 x 7)	48 LQFP (7 x 7)	64 MAPBGA (5 x 5)	64 LQFP (10 x 10)	80 LQFP (12 x 12)	100 LQFP (14 x 14)	120 WLCSP (5 x 5)	121 BGA (8 x 8)	144 LQFP (20 x 20)	144 BGA (13 x 13)
MK20DN32Vyy5	50	32	-	8									USB OTG (FS)	√	√	√	√	√						
MK20DN64Vyy5	50	64	-	16									USB OTG (FS)	√	√	√	√	√						
MK20DX32Vyy5	50	32	32	8									USB OTG (FS)	√	√	√	√	√						
MK20DX64Vyy5	50	64	32	16									USB OTG (FS)	√	√	√	√	√						
MK20DN128Vyy5	50	128	-	16									USB OTG (FS)	√	√	√	√	√						
MK20DX128Vyy5	50	128	32	16									USB OTG (FS)	√	√	√	√	√						
MK22DX128Vyy50	50	128	64	32						√			USB OTG (FS)			√		√	√			√		
MK22DX256Vyy50	50	256	64	32						√			USB OTG (FS)			√		√	√			√		
MK22DN512Vyy50	50	512	-	64						√			USB OTG (FS)					√	√			√		
MK21DX128Vyy50	50	128	64	32						√*			USB OTG (FS), Tamper Detect, CAU + RNG						√			√		
MK21DX256Vyy50	50	256	64	32						√*			USB OTG (FS), Tamper Detect, CAU + RNG						√			√		
MK21DN512Vyy50	50	512	-	64						√*			USB OTG (FS), Tamper Detect, CAU + RNG						√			√		
MK20DX64Vyy7	72	64	32	16		√			√	√	√	√	USB OTG (FS)					√	√			√		
MK20DX128Vyy7	72	128	32	32		√			√	√	√	√	USB OTG (FS)					√	√	√		√		
MK20DX256Vyy7	72	256	32	64		√			√	√	√	√	USB OTG (FS)					√	√	√		√		
MK22FX512Vyy10	100	512	128	64	√	√	√	√	√	√		√	USB OTG (FS)					√	√	√		√	√	√
MK22FN1M0Vyy10	100	1024	-	128	√	√	√	√	√	√		√	USB OTG (FS)					√	√	√		√	√	√
MK21FX512Vyy10	100	512	128	64	√	√	√	√	√	√		√	USB OTG (FS), Tamper Detect, CAU + RNG									√	√	√
MK21FN1M0Vyy10	100	1024	-	128	√	√	√	√	√	√		√	USB OTG (FS), Tamper Detect, CAU + RNG									√	√	√
MK20DX128Vyy10	100	128	128	32		√	√	√	√	√	√	√	USB OTG (FS)										√	√
MK20DX256Vyy10	100	256	256	64		√	√	√	√	√	√	√	USB OTG (FS)									√	√	√
MK20DN512Vyy10	100	512	-	128		√	√	√	√	√	√	√	USB OTG (FS)						√	√	√**	√	√	√
MK20FX512Vyy12	120	512	512	128	√	√	√	√	√	√	√	√	USB OTG (FS/HS), NAND Flash Ctrlr.										√	√
MK20FN1M0Vyy12	120	1024	-	128	√	√	√	√	√	√	√	√	USB OTG (FS/HS), NAND Flash Ctrlr.										√	√

yy = package designator * 121 BGA package only ** C temp only (–40 °C to +85 °C) Refer to family product brief on freescale.com for full product specs.

Kinetis K30 Family

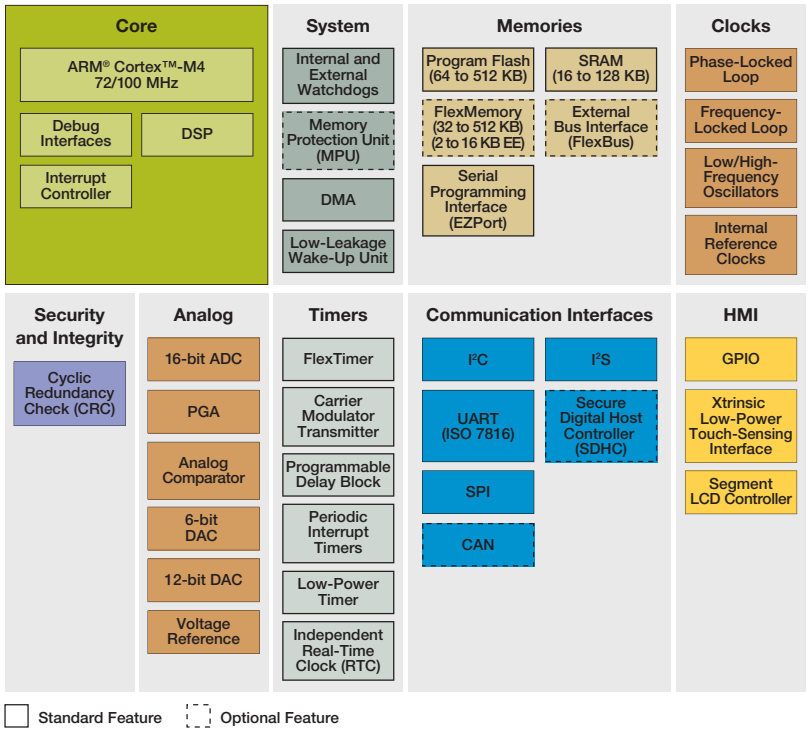
Low-power MCUs with segment LCD

The Kinetis K30 MCU family is pin, peripheral and software compatible with the K10 MCU family and adds a flexible low-power segment LCD controller with support for up to 320 segments. Devices start from 64 KB of flash in 64 LQFN packages extending up to 512 KB in a 144 MAPBGA package with a rich suite of analog, communication, timing and control peripherals.

Target Applications

- Thermostats
- Smart meters
- Heart rate monitors
- Blood gas analyzers

Kinetis K30 Family



One-Stop Enablement Offering—MCU + IDE + RTOS

Freescale Tower System hardware development environment:

- Integrated development environments
  - Eclipse-based CodeWarrior V10.x IDE and Processor Expert
  - IAR Embedded Workbench
  - Keil MDK
  - CodeSourcery Sourcery G++ (GNU)
  - Green Hills MULTI
- Runtime software and RTOS
  - Math, DSP and encryption libraries
  - Motor control libraries
  - Complimentary bootloaders (USB, Ethernet, RF, serial)
  - Complimentary Freescale embedded GUI
  - Complimentary Freescale MQX™
  - Cost-effective Nano™ SSL/Nano™ SSH for Freescale MQX RTOS
  - Micrium µC/OS-III
  - Express Logic ThreadX
  - SEGGER embOS
  - freeRTOS
  - Mocana (security)
  - Green Hills µ-velOSity
- Full ARM® ecosystem

Features	Benefits
• ARM® Cortex™-M4 core with DSP instruction support • Up to 16-channel DMA. Crossbar switch	• Up to 100 MHz core supporting a broad range of processing bandwidth needs • Peripheral and memory servicing with reduced CPU loading • Concurrent multi-master bus accesses for increased bus bandwidth
• Flexible, low-power LCD controller with support for up to 320 segments (40 x 8 or 44 x 4)	• LCD blink mode enables low average power while remaining in low-power mode • Segment fail detect guards against erroneous readouts and reduces LCD test costs • Frontplane/backplane reassignment provides pin-out flexibility, easing PCB design and allows LCD configuration changes via firmware with no hardware re-work • Supports multiple 3-volt and 5-volt LCD panel sizes with fewer segments (pins) than competitive controllers and no external components • Unused LCD pins can be configured as other GPIO functions
• Low-power capacitive touch-sensing interface	• Provide a modern upgrade from mechanical to touch keypad, rotary and slider user interfaces and operates in all low-power modes with minimal current added. Supports up to 16 inputs
• 10 ultra-low-power modes with flash programming and analog operation down to 1.71 volts • Low-power timer, low-power RTC, low-leakage wake-up unit	• Peripheral activity and wake-up times can be optimized to suit application requirements, enabling extended battery life (Stop currents of <500 nA, run currents of <200 µA/MHz, 4 µs wake-up from Stop) • Continual device operation in reduced power states with flexible wake-up options
• Memory protection unit • Hardware cyclic redundancy check engine • Independent-clocked COP. External watchdog monitor	• Provides memory protection for all crossbar switch masters, increasing software reliability • Validates memory contents and communication data, increasing system reliability • Prevents code runaway in fail-safe applications. Drives output pin to safe state external components if watchdog event occurs
• 64–512 KB flash. Up to 128 KB of SRAM • 32–256 KB FlexMemory	• High reliability, fast access program memory with 4-level security protection. Independent flash banks allow concurrent code execution and firmware updating • FlexMemory provides 32 byte–4 KB of user-segmentable byte write/erase EEPROM. FlexNVM 32–256 KB for extra program code, data or EEPROM backup

Kinetis K30 Family Options

Part Number	CPU (MHz)	Memory			Feature Options							Other	√ Package					
		Flash (KB)	Flex NVM (KB)	SRAM (KB)	CAN	Memory Protection Unit	Secure Digital Host Controller	External Bus Interface	12-bit DAC	Prog. Gain Amplifier	5 V Tolerant I/O		LH 64 LQFP (10 x 10)	LK 80 LQFP (12 x 12)	LL 100 LQFP (14 x 14)	MC 121 BGA (8 x 8)	LQ 144 LQFP (20 x 20)	MD 144 BGA (13 x 13)
MK30DX64Vyy7	72	64	32	16	√				√	√	√	Segment LCD (up to 25 x 8/29 x 4)	√	√		√		
MK30DX128Vyy7	72	128	32	32	√				√	√	√	Segment LCD (up to 36 x 8/40 x 4)	√	√	√	√		
MK30DX256Vyy7	72	256	32	64	√				√	√	√	Segment LCD (up to 36 x 8/40 x 4)	√	√	√	√		
MK30DX128Vyy10	100	128	128	32	√	√	√	√	√	√	√	Segment LCD (up to 40 x 8/44 x 4)					√	√
MK30DX256Vyy10	100	256	256	64	√	√	√	√	√	√	√	Segment LCD (up to 40 x 8/44 x 4)					√	√
MK30DN512Vyy10	100	512	-	128	√	√	√	√	√	√	√	Segment LCD (up to 40 x 8/44 x 4)	√	√	√	√	√	√

yy = package designator Refer to family product brief on freescale.com for full product specs.

Kinetis K40 Family

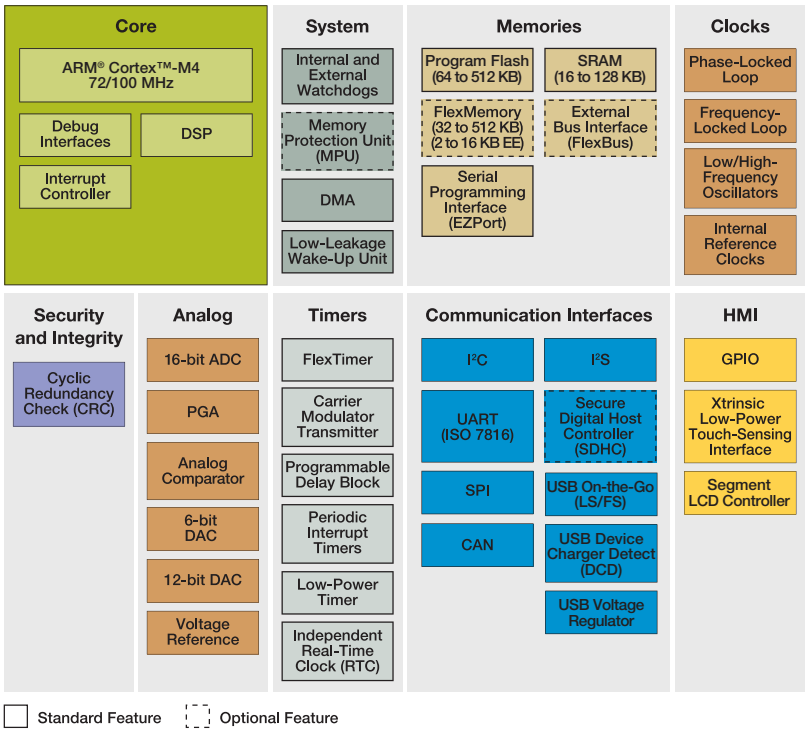
Low-power MCUs with USB and LCD

The Kinetis K40 MCU family adds Full-Speed USB 2.0 On-The-Go with device charger detect capability and a flexible, low-power segment LCD controller with support for up to 320 segments. Devices start from 64 KB of flash in 64 LQFN packages extending up to 512 KB in a 144 MAPBGA package with a rich suite of analog, communication, timing and control peripherals.

Target Applications

- GPS receivers
- Blood glucose meters
- Bike computers
- Currency counters

Kinetis K40 Family



One-Stop Enablement Offering—MCU + IDE + RTOS

Freescale Tower System hardware development environment:

- Integrated development environments
  - Eclipse-based CodeWarrior V10.x IDE and Processor Expert
  - IAR Embedded Workbench
  - Keil MDK
  - CodeSourcery Sourcery G++ (GNU)
  - Green Hills MULTI
- Runtime software and RTOS
  - Math, DSP and encryption libraries
  - Motor control libraries
  - Complimentary bootloaders (USB, Ethernet, RF, serial)
  - Complimentary Freescale embedded GUI
  - Complimentary Freescale MQX™
  - Cost-effective Nano™ SSL/Nano™ SSH for Freescale MQX RTOS
  - Micriμm μC/OS-III
  - Express Logic ThreadX
  - SEGGER embOS
  - freeRTOS
  - Mocana (security)
  - Green Hills μ-velOSity
- Full ARM ecosystem

Features	Benefits
• ARM® Cortex™-M4 core with DSP instruction support • Up to 16-channel DMA. Crossbar switch	• Up to 100 MHz core supporting a broad range of processing bandwidth needs • Peripheral and memory servicing with reduced CPU loading. Concurrent multi-master bus accesses for increased bus bandwidth
• USB On-The-Go (Full-Speed) with device charger detect	• Optimized charging current/time for portable USB devices, enabling longer battery life. USB low-voltage regulator supplies up to 120 mA off chip at 3.3 volts to power external components from 5-volt input
• Flexible, low-power LCD controller with support for up to 320 segments (40 x 8 or 44 x 4)	• LCD blink mode enables low average power while remaining in low-power mode • Segment fail detect guards against erroneous readouts and reduces LCD test costs • Frontplane/backplane reassignment provides pin-out flexibility, easing PCB design and allows LCD configuration changes via firmware with no hardware re-work • Supports multiple 3-volt and 5-volt LCD panel sizes with fewer segments (pins) than competitive controllers and no external components • Unused LCD pins can be configured as other GPIO functions
• FlexBus external bus interface Secure digital host controller	• Enables the connection of external memories and peripherals (e.g., graphics displays) • Connection to SD, SDIO, MMC or CE-ATA cards for in-application software upgrades, file systems or adding Wi-Fi® or Bluetooth® support
• Up to three FlexTimers with up to 12 channels • Carrier modulator transmitter • 4-channel, 32-bit interrupt	• General-purpose timers with hardware dead-time insertion and quadrature decoding for motor control • Infrared waveform generation for remote control applications • Time base generation for RTOS task scheduler or trigger source for ADC conversion and programmable delay block
• 64–512 KB flash. Up to 128 KB of SRAM • 32–256 KB FlexMemory	• High reliability, fast access program memory with 4-level security protection. Independent flash banks allow concurrent code execution and firmware updating • FlexMemory provides 32 byte–4 KB of user-segmentable byte write/erase EEPROM. In addition, Flex NVM 32–256 KB for extra program code, data or EEPROM backup

Kinetis K40 Family Options

Part Number	CPU (MHz)	Memory			Feature Options							Other	√ Package					
		Flash (KB)	Flex NVM (KB)	SRAM (KB)	CAN	Memory Protection Unit	Secure Digital Host Controller	External Bus Interface	12-bit DAC	Prog. Gain Amplifier	5 V Tolerant I/O		LH 64 LQFP (10 x 10)	LK 80 LQFP (12 x 12)	LL 100 LQFP (14 x 14)	MC 121 BGA (8 x 8)	LQ 144 LQFP (20 x 20)	MD 144 BGA (13 x 13)
MK40DX64Vyy7	72	64	32	16	√				√	√	√	USB OTG (FS), Segment LCD (up to 25 x 8/29 x 4)	√	√		√		
MK40DX128Vyy7	72	128	32	32	√				√	√	√	USB OTG (FS), Segment LCD (up to 36 x 8/40 x 4)	√	√	√	√		
MK40DX256Vyy7	72	256	32	64	√				√	√	√	USB OTG (FS), Segment LCD (up to 36 x 8/40 x 4)	√	√	√	√		
MK40DX128Vyy10	100	128	128	32	√	√	√	√	√	√	√	USB OTG (FS), Segment LCD (up to 40 x 8/44 x 4)					√	√
MK40DX256Vyy10	100	256	256	64	√	√	√	√	√	√	√	USB OTG (FS), Segment LCD (up to 40 x 8/44 x 4)					√	√
MK40DN512Vyy10	100	512	-	128	√	√	√	√	√	√	√	USB OTG (FS), Segment LCD (up to 40 x 8/44 x 4)		√	√	√	√	√

yy = package designator Refer to family product brief on freescale.com for full product specs.

Kinetis K50 Family

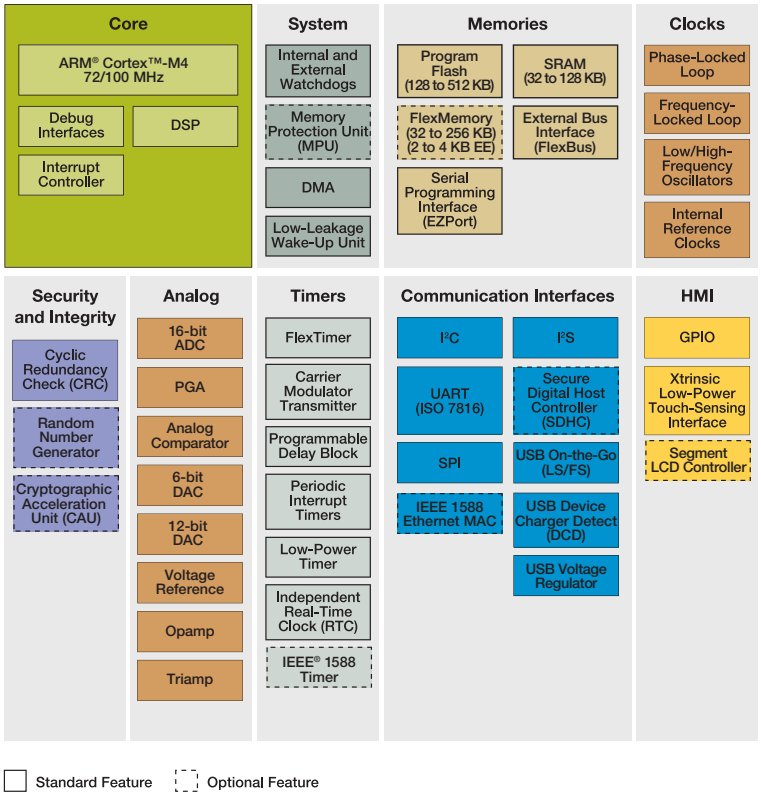
Integrated measurement engine, Ethernet and LCD

The Kinetis K50 MCU family provides designers with an analog measurement engine consisting of integrated operational and transimpedance amplifiers as well as high-resolution ADC and DAC modules. The family also features IEEE® 1588 Ethernet and hardware encryption, Full-Speed USB 2.0 On-The-Go with device charger detect capability and a flexible low-power segment LCD controller with support for up to 320 segments. Devices start from 128 KB of flash in 64 QFN packages extending up to 512 KB in a 144 MAPBGA package.

Target Applications

- Low-power portable medical devices
- Clinical and lab equipment
- Test/measurement equipment
- Instrumentation applications
- Monitor and telehealth applications

Kinetis K50 Family



One-Stop Enablement Offering: MCU + IDE + RTOS

Freescale Tower System hardware development environment:

- TWR-K53N512-KIT ($179)
  - Includes TWR-SER, TWR-ELEV and TWR-K53N512 modules
- TWR-K53N512 ($109)
  - Includes TWR-K53N512 and TWRPI-SLCD daughter card
- Integrated development environments
  - Eclipse-based CodeWarrior IDE and Processor Expert
  - IAR Embedded Workbench
  - Keil MDK
  - CodeSourcery Sourcery G++ (GNU)
  - Green Hills MULTI
- Portable medical applications demo software: EKG, pulse oximeter, blood pressure monitor, spirometer
- Math, DSP and encryption libraries
- Motor control libraries
- Complimentary bootloaders (USB, Ethernet, RF, serial)
- Complimentary Freescale embedded GUI
- Complimentary Freescale MQX™ RTOS
- Cost-effective Nano™ SSL/Nano™ SSH for Freescale MQX RTOS
- Micriμm μC/OS-III
- Express Logic ThreadX
- SEGGER embOS
- FreeRTOS
- Green Hills μ-velOSity
- Mocana (security)
- Full ARM ecosystem
- Reduces core interruption, increasing performance
- Design flexibility and system cost reduction
- Increases system safety by restricting access to key memory locations
- Provides scalability needed for key digital power and motor control applications

Features	Benefits
• ARM® Cortex™-M4 core with DSP instruction support • Up to 16-channel DMA and crossbar switch	• Up to 100 MHz core supporting a broad range of processing bandwidth needs • Peripheral and memory servicing with reduced CPU loading. Concurrent multi-master bus accesses for increased bus bandwidth
• Up to 2 x 16-bit ADC with PGA • Up to 2 x 12-bit DAC • Programmable delay block • Operational and transimpedance amplifiers • Voltage reference (VREF)	• High-resolution and high-accuracy ADC provides accurate signal acquisition • Digital-to-analog converter with clock gating optimized for low-power usage • PDB precisely triggers ADC and DAC blocks to complete sensor biasing and measurement (i.e. glucometry strips) • Opamps allow signal filtering and amplification, triamps are optimized for converting current inputs into voltages that can be read by the ADC • VREF allows enhanced accuracy by supplying analog peripherals with fixed reference
• IEEE® 1588 Ethernet MAC with hardware time stamping • Hardware encryption coprocessor	• Precision clock synchronization for real-time networked industrial automation and control • Secure data transfer and storage. Faster than software implementations and with minimal CPU loading. Supports a wide variety of algorithms
• USB On-The-Go (Full-Speed) with device charger detect	• Optimized charging current/time for portable USB devices enabling longer battery life USB low-voltage regulator supplies up to 120 mA off chip at 3.3 volts to power external components from 5-volt input
• Flexible, low-power LCD controller with support for up to 320 segments (40 x 8 or 44 x 4)	• LCD blink mode enables low average power while remaining in low-power mode • Segment fail detect guards against erroneous readouts and reduces LCD test costs • Frontplane/backplane reassignment provides pin-out flexibility easing PCB design and allows LCD configuration changes via firmware with no hardware re-work • Supports multiple 3-volt and 5-volt LCD panel sizes with fewer segments (pins) than competitive controllers and no external components • Unused LCD pins can be configured as other GPIO functions
• FlexBus external bus interface and secure digital host controller	• Enables the connection of external memories and peripherals (e.g., graphics displays) • Connection to SD, SDIO, MMC or CE-ATA cards for in-application software upgrades, file systems or adding Wi-Fi® or Bluetooth® support
• 128–512 KB flash. Up to 128 KB of SRAM • 32–256 KB FlexMemory	• High reliability, fast access program memory with 4-level security protection • Independent flash banks allow concurrent code execution and firmware updating • FlexMemory provides 2–4 KB of user-segmentable byte write/erase EEPROM. In addition, Flex NVM from 32–256 KB for extra program code, data or EEPROM backup

Kinetis K50 Family Options

Part Number	CPU (MHz)	Memory			Feature Options							Other	√ Package					
		Flash (KB)	Flex NVM (KB)	SRAM (KB)	Triamp	Opamp	12-bit DAC	IEEE® 1588 Ethernet	Segment LCD	External Bus Interface	16-bit ADC		LH 64 LQFP (10 x 10)	LK 80 LQFP (12 x 12)	LL 100 LQFP (14 x 14)	MC 121 BGA (8 x 8)	LQ 144 LQFP (20 x 20)	MD 144 BGA (13 x 13)
MK50DX128Vyy7	72	128	32	32	√	√	√			√	√		√	√		√		
MK51DX128Vyy7	72	128	32	32	√	√	√		√		√		√	√		√		
MK50DX256Vyy7	72	256	32	64	√	√	√			√	√			√	√	√		
MK51DX256Vyy7	72	256	32	64	√	√	√		√		√			√	√	√		
MK51DN256Vyy10	100	256	-	64	√	√	√		√	√	√						√	√
MK50DX256Vyy10	100	256	256	64	√	√	√			√	√			√	√	√		
MK51DX256Vyy10	100	256	256	64	√	√	√		√		√			√	√	√		
MK53DX256Vyy10	100	256	256	128	√	√	√	√	√	√	√	CAU + RNG					√	√
MK50DN512Vyy10	100	512	-	128	√	√	√			√	√				√	√	√	√
MK51DN512Vyy10	100	512	-	128	√	√	√		√	√	√				√	√	√	√
MK52DN512Vyy10	100	512	-	128	√	√	√	√		√	√	CAU + RNG					√	√
MK53DN512Vyy10	100	512	-	128	√	√	√	√	√	√	√	CAU + RNG					√	√

yy = package designator Refer to family product brief on freescale.com for full product specs.

Kinetis K60 Family

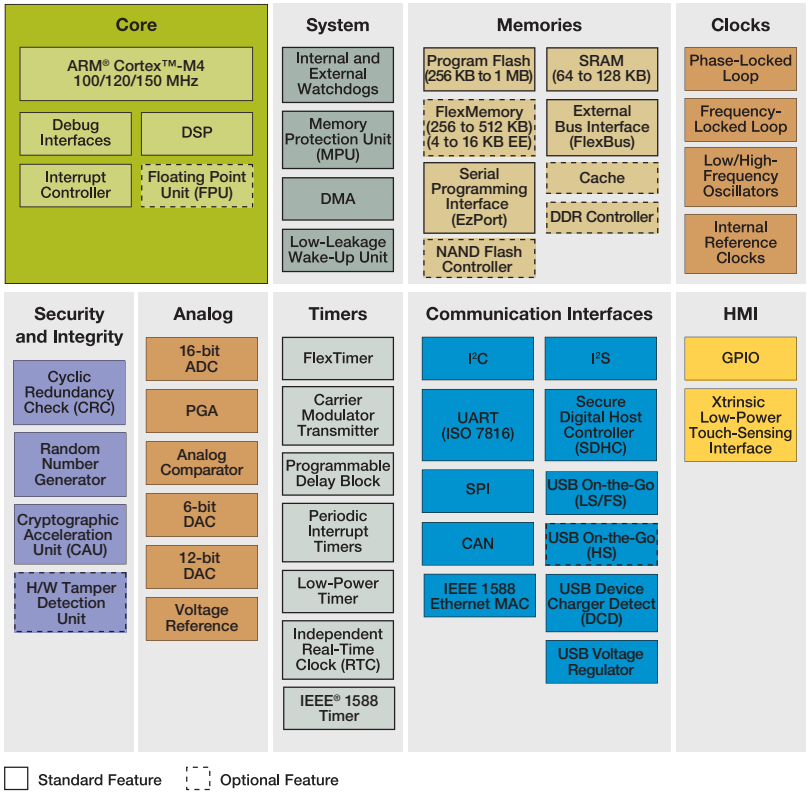
Low-power MCUs with Ethernet and security

The Kinetis K60 MCU family includes IEEE® 1588 Ethernet, Full- and High-Speed USB 2.0 On-The-Go with device charger detect capability, hardware encryption and tamper detection capabilities. Devices start from 256 KB of flash in 100 LQFP packages extending up to 1 MB in a 256 MAPBGA package with a rich suite of analog, communication, timing and control peripherals. High memory density K60 family devices include an optional single precision floating point unit, NAND flash controller and DRAM controller.

Target Applications

- Building automation controllers
- Elevator control panels
- Instrumentation clusters
- Surveillance cameras

Kinetis K60 Family



One-Stop Enablement Offering—MCU + IDE + RTOS

Freescale Tower System hardware development environment:

- Integrated development environments
  - Eclipse-based CodeWarrior V10.x IDE and Processor Expert
  - IAR Embedded Workbench
  - Keil MDK
  - CodeSourcery Sourcery G++ (GNU)
  - Green Hills MULTI
- Runtime software and RTOS
  - Math, DSP and encryption libraries
  - Motor control libraries
  - Complimentary bootloaders (USB, Ethernet, RF, serial)
  - Complimentary Freescale embedded GUI
  - Complimentary Freescale MQX™
  - Cost-effective Nano™ SSL/Nano™ SSH for Freescale MQX RTOS
  - Micriμm μC/OS-III
  - Express Logic ThreadX
  - SEGGER embOS
  - freeRTOS
  - Mocana (security)
  - Green Hills μ-velOSity
- Full ARM ecosystem

Features	Benefits
• ARM® Cortex™-M4 core with DSP instruction support and optional single precision floating point unit • Up to 32-channel DMA. Up to 16 KB of cache. Crossbar switch	• Up to 150 MHz core supporting a broad range of processing bandwidth needs • Peripheral and memory servicing with reduced CPU loading. Optimized bus bandwidth and flash execution performance. Concurrent multi-master bus accesses for increased bus bandwidth
• IEEE® 1588 Ethernet MAC with hardware time stamping • USB On-The-Go (Full- and High-Speed) with device charger detect	• Precision clock synchronization for real-time, networked industrial automation and control • Optimized charging current/time for portable USB devices, enabling longer battery life. Integrated USB low-voltage regulator supplies up to 120 mA off chip at 3.3 volts to power external components from 5-volt input
• Hardware encryption coprocessor • System security with hardware tamper detect	• Secure data transfer and storage. Faster than software implementations and with minimal CPU loading. Supports a wide variety of algorithms, including DES, 3DES, AES, MD5, SHA-1 and SHA-256 • Secure real-time clock with independent battery supply. Secure key storage with internal/external tamper detect for unsecure flash, temperature/clock/supply voltage variations and physical attack
• FlexBus external bus interface • Secure digital host controller • NAND flash controller • DRAM controller	• Enables the connection of external memories and peripherals (e.g. graphics displays) • Connection to SD, SDIO, MMC or CE-ATA cards for in-application software upgrades, file systems or adding Wi-Fi® or Bluetooth® support • Supports up to 32-bit ECC current and future NAND types with minimal software overhead • Supports connection of DDR, DDR2 and low-power DDR memories
• 256 KB–1 MB flash. Up to 128 KB of SRAM • 32–512 KB FlexMemory	• High reliability, fast access program memory with 4-level security protection. Independent flash banks allow concurrent code execution and firmware updating • FlexMemory provides 32 bytes–16 KB of user-segmentable byte write/erase EEPROM. In addition, Flex NVM 256–512 KB for extra program code, data or EEPROM backup

Kinetis K60 Family Options

Part Number	CPU (MHz)	Memory			Feature Options								Other	√ Package						
		Flash (KB)	Flex NVM (KB)	SRAM (KB)	Single Precision Floating Point Unit	CAN	Memory Protection Unit	Secure Digital Host Controller	External Bus Interface	12-bit DAC	Prog. Gain Amplifier	5 V Tolerant I/O		LL 100 LQFP (14 x 14)	AB 120 WLCSP (5 x 5)	MC 121 BGA (8 x 8)	AA 143 WLCSP (6 x 5)	LQ 144 LQFP (20 x 20)	MD 144 BGA (13 x 13)	MJ 256 BGA (17 x 17)
MK60DN256Vyy10	100	256	-	64		√	√	√	√	√	√	√	IEEE® 1588 Eth, USB OTG (FS), CAU + RNG	√		√		√	√	
MK60DN512Vyy10	100	512	-	128		√	√	√	√	√	√	√	IEEE 1588 Eth, USB OTG (FS), CAU + RNG	√	√**	√		√	√	
MK60DX256Vyy10	100	256	256	64		√	√	√	√	√	√	√	IEEE 1588 Eth, USB OTG (FS), CAU + RNG	√		√		√	√	
MK60FX512Vyy12	120	512	512	128	√	√	√	√	√	√	√	√	IEEE 1588 Eth, USB OTG (FS/HS), CAU + RNG, NAND Flash Ctrlr., 4 ADCs					√	√	
MK60FX512Vyy15	150	512	512	128	√	√	√	√	√	√	√	√	IEEE 1588 Eth, USB OTG (FS/HS), CAU + RNG, NAND Flash Ctrlr., 4 ADCs					√	√	
MK60FN1M0Vyy12	120	1024	-	128	√	√	√	√	√	√	√	√	IEEE 1588 Eth, USB OTG (FS/HS), CAU + RNG, NAND Flash Ctrlr., 4 ADCs					√	√	
MK60DN1M0Vyy15	150	1024	-	128	√	√	√	√	√	√	√	√	IEEE 1588 Eth, USB OTG (FS/HS), CAU + RNG, NAND Flash Ctrlr., 4 ADCs					√	√	
MK61FX512Vyy12	120	512	512	128	√	√	√	√	√	√	√	√	Tamper Detect, IEEE 1588 Eth, USB OTG (FS/HS), CAU + RNG, NAND Flash Ctrlr., 4 ADCs, *DRAM Ctrlr.						√	√
MK61FX512Vyy15	150	512	512	128	√	√	√	√	√	√	√	√	Tamper Detect, IEEE 1588 Eth, USB OTG (FS/HS), CAU + RNG, NAND Flash Ctrlr., 4 ADCs, *DRAM Ctrlr.						√	√
MK61FN1M0Vyy12	120	1024	-	128	√	√	√	√	√	√	√	√	Tamper Detect, IEEE 1588 Eth, USB OTG (FS/HS), CAU + RNG, NAND Flash Ctrlr., 4 ADCs, *DRAM Ctrlr.				√**		√	√
MK61FN1M0Vyy15	150	1024	-	128	√	√	√	√	√	√	√	√	Tamper Detect, IEEE 1588 Eth, USB OTG (FS/HS), CAU + RNG, NAND Flash Ctrlr., 4 ADCs, *DRAM Ctrlr.						√	√

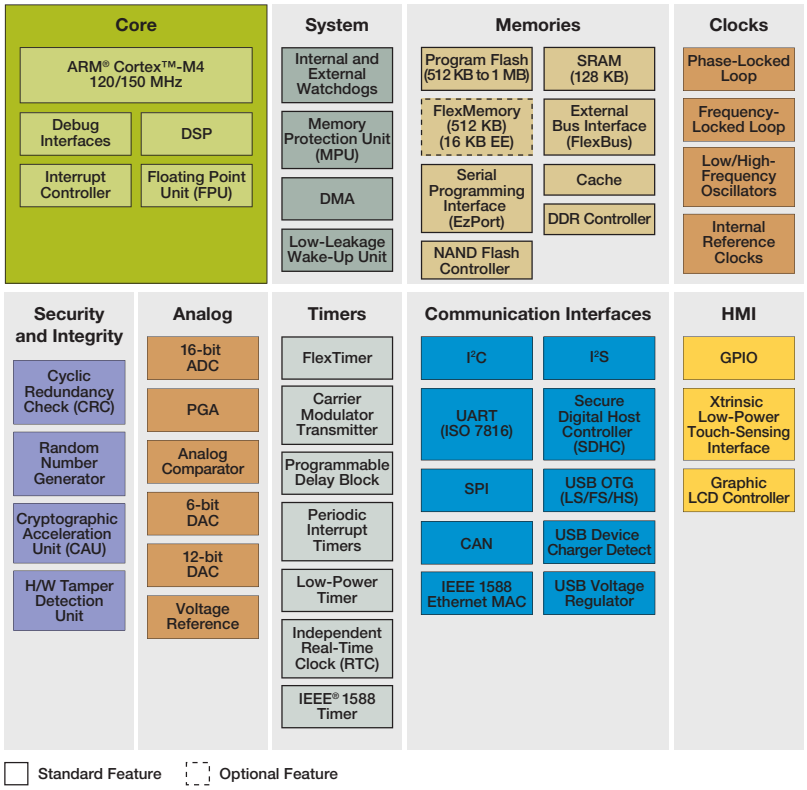
yy = package designator * 256-pin only ** C temp only (–40 °C to +85 °C) Refer to family product brief on freescale.com for full product specs.

Kinetis K70 Family

Low-power MCUs with graphics LCD, connectivity and security

The Kinetis K70 MCU family includes an integrated graphics LCD controller, IEEE® 1588 Ethernet MAC, Full- and High-Speed USB 2.0 On-The-Go with device charger detect capability, hardware encryption and tamper detection capabilities. The K70 is available with 512 KB or 1 MB of flash in 196- and 256-pin MBGA packages. Each MCU includes a rich suite of analog, communication, timing and control peripherals. All K70 MCUs include a single precision floating point unit and NAND flash controller. 256-pin versions include an on-chip DRAM controller for system expansion.

Kinetis K70 Family



Target Applications

- Industrial control panels
- Navigational displays
- Point-of-sale terminals
- Medical monitoring equipment

One-Stop Enablement Offering: MCU + IDE + RTOS

Freescale Tower System hardware development environment:

- Integrated development environments
  - Eclipse-based CodeWarrior V10.1 IDE and Processor Expert
  - IAR Embedded Workbench
  - Keil MDK
  - CodeSourcery Sourcery G++ (GNU)
  - Green Hills MULTI
- Runtime software and RTOS
  - Freescale Portable Embedded GUI (PEG) GUI library
  - Math, DSP and encryption libraries
  - Motor control libraries
  - Complimentary bootloaders (USB, Ethernet, RF, serial)
  - Complimentary Freescale embedded GUI
  - Complimentary Freescale MQX™
  - Cost-effective Nano™ SSL/Nano™
  - SSH for Freescale MQX RTOS
  - Micriμm μC/OS-III
  - Express Logic ThreadX
  - SEGGER embOS
  - freeRTOS
  - Mocana (security)
  - Green Hills μ-velOSity
- Full ARM ecosystem

Features	Benefits
• ARM® Cortex™-M4 core with DSP instruction support and optional single precision floating point unit • Up to 32-channel DMA. Up to 16 KB of cache. Crossbar switch	• Up to 150 MHz core supporting a broad range of processing bandwidth needs • Peripheral and memory servicing with reduced CPU loading. Optimized bus bandwidth and flash execution performance. Concurrent multi-master bus accesses for increased bus bandwidth
• Graphics LCD controller • Low-power capacitive touch-sensing	• Support for color QVGA displays as single chip or up to 24-bit SVGA displays using external memory. Supported by Freescale's Portable Embedded GUI (PEG) library with simple WindowBuilder interface for powerful GUI development • Provides a modern upgrade from mechanical to touch keypad, rotary and slider user interfaces and operates in all low-power modes with minimal current added. Supports up to 16 inputs
• Hardware encryption coprocessor • Hardware tamper detection • Memory protection unit • Hardware cyclic redundancy check engine • Independent-clocked COP. External watchdog monitor	• Secure data transfer and storage. Faster than software implementations and with minimal CPU loading. Supports a wide variety of algorithms: DES, 3DES, AES, MD5, SHA-1, SHA-256 • Secure real-time clock with independent battery supply. Secure key storage with internal/external tamper detect for unsecure flash, temperature/clock/supply voltage variations and physical attack • Provides memory protection for all crossbar switch masters, increasing software reliability • Validates memory contents and communication data, increasing system reliability • Prevents code runaway in fail-safe applications. Drives output pin to safe state external components if watchdog event occurs
• USB On-The-Go (Full- and High-Speed) with device charger detect • IEEE® 1588 Ethernet MAC with HW time stamping • Up to six UARTs with IrDA support. One UART with ISO 7816 support • I²S interface, up to two CAN modules, up to three DSPI and up to two I²C interfaces	• Optimized charging current/time for portable USB devices, enabling longer battery life. USB low-voltage regulator supplies up to 120 mA off chip at 3.3 volts to power external components from 5-volt input • Precision clock synchronization for real-time, networked industrial automation and control • Variety of data size, format and transmission/reception settings supported for multiple industrial communication protocols • Multiple communication interfaces for simple and efficient data exchange, industrial network bridging and audio system interfacing
• FlexBus external bus interface • Secure digital host controller • NAND flash controller • DRAM controller	• Enables the connection of external memories and peripherals (e.g., graphics displays) • Connection to SD, SDIO, MMC or CE-ATA cards for in-application software upgrades, file systems or adding Wi-Fi® or Bluetooth® support • Supports up to 32-bit ECC current and future NAND types with minimal software overhead • Supports connection of DDR, DDR2 and low-power DDR memories
• 32 KB–1 MB flash Up to 128 KB of SRAM • 32–512 KB FlexMemory	• High reliability, fast access program memory with 4-level security protection. Independent flash banks allow concurrent code execution and firmware updating • FlexMemory provides 32 bytes–16 KB of user-segmentable byte write/erase EEPROM. In addition, Flex NVM from 32–512 KB for extra program code, data or EEPROM backup

Kinetis K70 Family Options

Part Number	CPU (MHz)	Memory			Feature Options								Other	√ Package						
		Flash (KB)	Flex NVM (KB)	SRAM (KB)	Single Precision Floating Point Unit	CAN	Memory Protection Unit	Secure Digital Host Controller	External Bus Interface	12-bit DAC	Prog. Gain Amplifier	5 V Tolerant I/O		LL 100 LQFP (14 x 14)	AB 120 WLCSP (5 x 5)	MC 121 BGA (8 x 8)	AA 143 WLCSP (6 x 5)	LQ 144 LQFP (20 x 20)	MD 144 BGA (13 x 13)	MJ 256 BGA (17 x 17)
MK70FX512Vyy12	120	512	512	128	√	√	√	√	√	√	√	√	Graphics LCD Ctrlr., IEEE® 1588 Eth, USB OTG (FS/HS), CAU + RNG, Tamper Detect, NAND Flash Ctrlr., 4 ADCs, DRAM Ctrlr.								√
MK70FX512Vyy15	150	512	512	128	√	√	√	√	√	√	√	√	Graphics LCD Ctrlr., IEEE 1588 Eth, USB OTG (FS/HS), CAU + RNG, Tamper Detect, NAND Flash Ctrlr., 4 ADCs, DRAM Ctrlr.								√
MK70FN1M0Vyy12	120	1024	-	128	√	√	√	√	√	√	√	√	Graphics LCD Ctrlr., IEEE 1588 Eth, USB OTG (FS/HS), CAU + RNG, Tamper Detect, NAND Flash Ctrlr., 4 ADCs, DRAM Ctrlr.								√
MK70FN1M0Vyy15	150	1024	-	128	√	√	√	√	√	√	√	√	Graphics LCD Ctrlr., IEEE 1588 Eth, USB OTG (FS/HS), CAU + RNG, Tamper Detect, NAND Flash Ctrlr., 4 ADCs, DRAM Ctrlr.								√

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Kinetis X Series MCUs

High-performance MCUs with advanced performance and feature integration

The Kinetis X series extends the high end of the Kinetis 32-bit MCU portfolio with devices that provide an optimal combination of performance, memory and integrated peripherals, all backed by a vast ecosystem of development support.

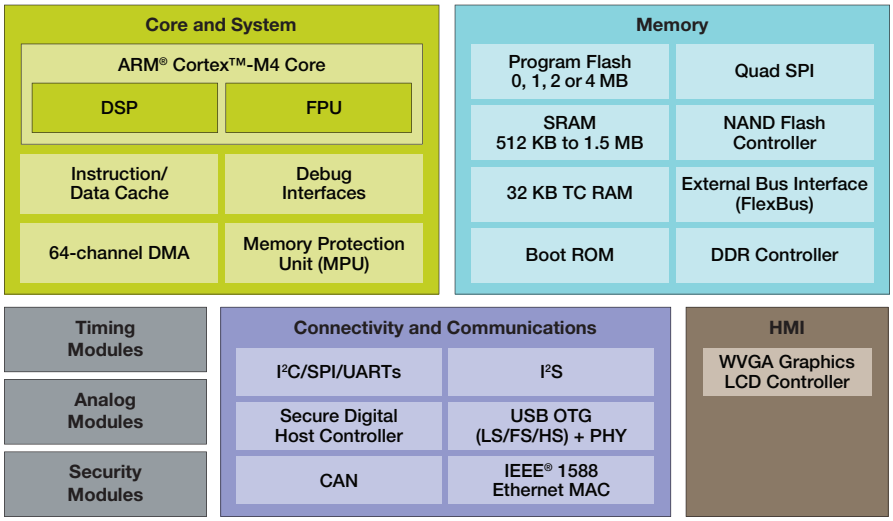
The Kinetis X series is based on the powerful ARM® Cortex™-M4 core (with DSP and floating point instructions) with an operating frequency up to 200 MHz. Kinetis X series internal memories include 0, 1, 2 or 4 MB of flash and 0.5 to 1.5 MB of SRAM, with multiple off-chip memory options also available for expansion headroom. In addition, the X series offers an advanced suite of connectivity, security and HMI peripherals, all accompanied by our bundled software enablement.

This powerful combination of processing performance, feature integration and extensive support makes the Kinetis X series optimal for a broad range of applications, including automation, point-of-sale, medical instrumentation, test and measurement and systems that incorporate a human-machine interface (HMI).

Target Applications

- Industrial automation
- Test and measurement
- Point-of-sale terminals
- Digital signage
- Medical instrumentation

Kinetis X Series Family



One-Stop Enablement Offering: MCU + IDE + RTOS

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  - Keil MDK
  - CodeSourcery Sourcery G++ (GNU)
- Runtime software and RTOS
  - Green Hills µ-velOSity
  - Freescale Portable Embedded GUI (PEG) library
  - Math, DSP and encryption libraries
  - Complimentary Freescale embedded GUI
  - Complimentary Freescale MQX™
- Full ARM ecosystem

Features	Benefits
• ARM® Cortex™-M4 core up to 200 MHz	• Very high-performance computation capability
• DSP instruction support	• Enhanced signal processing capabilites
• Single precision floating point, IEEE® 754 compliant	• Facilitates algorithm development and improved analog signal processing
• Instruction and data caches	• Maximized flash execution performance, reduced power consumption
• 32 KB tightly coupled memory	• Single-cycle memory access
• 64-bit AXI bus	• Increases concurrent data transfer capabilities from several bus masters
• Up to 64-channel DMA	• Peripheral and memory servicing with reduced CPU loading
• Memory protection unit	• Provides memory protection for all crossbar switch masters, increasing software reliability
• 1, 2 or 4 MB integrated flash (0 MB version available)	• Store large amount of code or non-volatile data
• Up to 1.5 MB of on-chip SRAM, a portion of it (512 KB) with ECC	• High reliability, fast-access RAM
• FlexBus external bus interface	• Enables the connection of external memories and peripherals (e.g., graphics displays)
• NAND flash controller	• Supports up to 32-bit ECC current and future NAND types with minimal software overhead
• Dual quad SPI with execute in place (flashless variants only)	• Supports up to 80 MHz external SPI flash
• DRAM controller	• Support for DDR3 and LPDDR2 memories
	• ECC support
• USB On-The-Go (High-, Full- and Low-Speed) with integrated PHY	• Optimized charging current/time for portable USB devices, enabling longer battery life. USB low-voltage regulator supplies up to 120 mA off chip at 3.3 volts to power external components from 5-volt input
• 10/100 Ethernet MAC with IEEE® 1588 HW time stamping	• Precision clock synchronization for real-time, networked industrial automation and control
• Serial interfaces	• Multiple communication interfaces for simple and efficient data exchange, industrial network bridging and audio system interfacing • Variety of data size, format and transmission/reception settings supported for multiple industrial communication protocols
• Hardware encryption accelerator	• Secure data transfer and storage. Faster than software implementations and with minimal CPU loading. Supports a wide variety of algorithms: DES, 3DES, AES, MD5, SHA-1, SHA-256
• Hardware tamper detection	• Secure real-time clock with independent battery supply. Secure key storage with internal/external tamper detect for unsecure flash, temperature/clock/supply voltage variations and physical attack
• High assurance boot	• Supports encrypted boot with code signing
	• Peripheral access policy control
• Hardware cyclic redundancy check engine	• Validates memory contents and communication data, increasing system reliability
• Independent-clocked COP, external watchdog monitor	• Prevents code runaway in fail-safe applications. Drives output pin to safe state external components if watchdog event occurs
• Graphics LCD controller	• Support for up to wide VGA resolution TFT displays up to WQVGA with no external DRAM
	• Supported by Freescale Portable Embedded GUI (PEG) library with simple WindowBuilder interface for powerful GUI development

Vybrid Controller Solutions

A multicore platform for industrial applications

The increasing complexity and demands of embedded systems creates greater need for sophisticated human-machine interfaces (HMI) and multiple connectivity options with safe, secure and predictable operation. To concurrently provide rich HMI and real-time control means bringing together two very different system paradigms. For example, HMI computation focuses on efficiently processing pixels and displaying them on a screen, while guaranteed determinism requires highly predictable response times for tasks.

A traditional systems-level solution for such divergent needs would combine different pieces of silicon, such as an applications MPU and a real-time MCU, on a board. It would also require developing software and a protocol to enable simultaneous communication between real-time control and rich HMI. Application developers face a tremendous challenge of seamlessly integrating these diverse technologies in a single system.

Our Vybrid portfolio brings to market a unique, low-power system solution that provides customers a way to combine rich applications requiring high-resolution graphical displays and connectivity with real-time determinism. The Vybrid portfolio enables customers to create systems that concurrently run a high-level operating system such as Linux® and a real-time operating system such as MQX™ on the same device. This, along with a communication API between the rich domain, the real-time domain and a tool chain that eases debug of such systems, dramatically shortens customer time to revenue. The families in the Vybrid portfolio span entry-level products for customers who want to upgrade from the Kinetis MCU to devices with large on-chip SRAM up to highly integrated, dual-core solutions intended to serve industrial markets.

Scalable Across Multiple Cores

Vybrid devices have a dual-core architecture that combines the ARM® Cortex™-A5 application processor and the ARM Cortex™-M4 for real-time control. The Vybrid portfolio is designed to be a transitional product from Kinetis MCUs featuring the ARM Cortex-M4 core and the i.MX 6 series featuring the ARM Cortex™-A9 core, while also providing scalable devices that can address the needs of a market that demands critical safety and security, connectivity and rich HMI in the same piece of silicon. The Vybrid roadmap is built with this scalability and code compatibility in mind so that the performance of the device roadmap grows with the customer's needs long into the future.

One of the key benefits of the Vybrid architecture that combines the ARM Cortex-A5 core with the ARM Cortex-M4 core is the partitioning of tasks based on their characteristics. For tasks that need predictable interrupt management, for example, a typical need for real-time applications, the Vybrid platform has the ARM Cortex-M4 core with a Nested Vector Interrupt Controller (NVIC) while allowing graphical applications and connectivity stacks to be run on the ARM Cortex-A5 applications processor.

Software can be segmented so that tasks that need predictable latencies can be run on the ARM Cortex-M4 core and computer-intensive processes run on the ARM Cortex-A5 core.

Total System Solution

Vybrid devices take a total system approach. Complementing the low-power silicon is a reference Linux BSP, a full-featured MQX RTOS, reference MQX BSP and a processor-to-processor communication API that lets customers partition their code between the ARM Cortex-A5 (e.g., running Linux) and ARM Cortex-M4 (e.g., running MQX) to implement the lowest power solution for their application demands. In addition, customers have access to industry-leading IDE tool chains such as ARM DS-5™ and IAR. A selection of connectivity, motor control, LCD, security stacks and drivers is also available. Vybrid devices are supported by Freescale's Tower System, offering the flexibility to easily scale and expand customer designs based on market need. Tower Systems allow rapid prototyping in a development platform that maximizes hardware reuse and speeds time to market.

Low-Power Process

One of the critical foundational pieces of the Vybrid platform is its low-power process technology. The devices in this portfolio are fabricated in the 40 nm low-power process. This enables more integration for a given power envelope thus dissipating much less power for the same device.

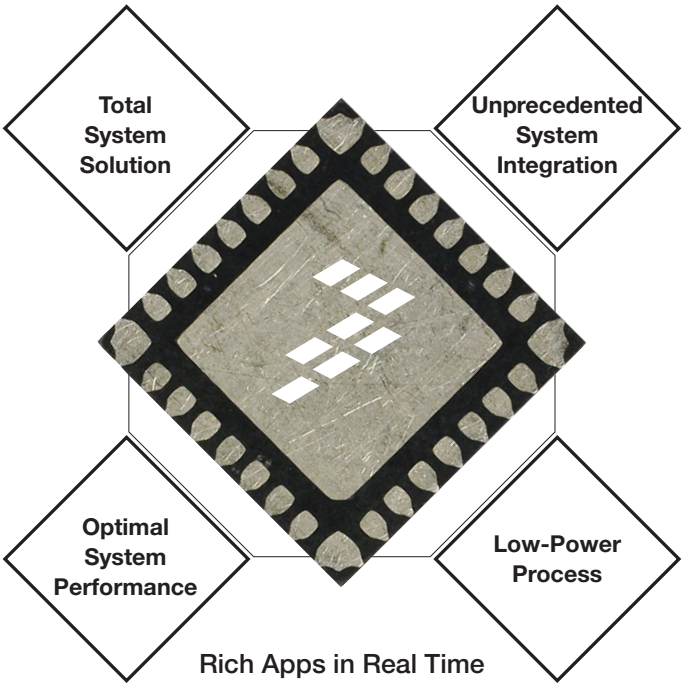
Unprecedented System Integration

The Vybrid platform has an unprecedented level of system integration for a solution of its class. The centerpiece is the core complex featuring the ARM Cortex-A5 and ARM Cortex-M4 cores.

ARM Cortex-A5 Core

The ARM Cortex-A5 processor is a high-performance, low-power core with an L1 and L2 cache subsystem that provides full virtual memory capabilities, double precision floating-point unit (FPU) and the NEON media processing engine. It is intended as an upgrade for the ARM9™ and ARM11™ cores and is architecturally compatible with Cortex-A9. The ARM Cortex-A5 also has TrustZone® technology for creating secure applications.

Vybrid Portfolio Key Attributes



ARM Cortex-M4 Core

The ARM Cortex-M4 core retains all the advantages of the ARM Cortex™-M3 core with an NVIC, which gives deterministic interrupt handling capability demanded by real-time applications along with tightly coupled memory (TCM). Determinism is a factor of NVIC + TCM. The ARM Cortex-M4 adds digital signal processing (DSP) capability in the form of DSP and SIMD instruction extensions, a single cycle MAC unit and single precision FPU. In addition, Freescale has added a direct memory access (DMA) controller, crossbar switch and L1 on-chip cache memories, which maximize processor performance and bus bandwidth.

Communication Interfaces

Vybrid devices feature a number of connectivity peripherals, including dual USB 2.0 (Low-, Full- and High-Speed) device/host/On-The-Go with integrated PHYs, dual 10/100 Ethernet with layer 2 Ethernet switch with IEEE® 1588 hardware time stamping and reduced media independent interface (RMII) support for real-time industrial control. Multiple serial interfaces include UARTs with support for ISO7816 SIM/ smart cards, SPI and I²C, while dual CAN modules enable industrial network bridging.

Support for External Peripherals and Memory

In addition to having up to 1.5 MB of on-chip SRAM for speedy code and data execution, Vybrid devices can interface to a variety of external peripherals and memories for system expansion and data storage. Dual quad SPI interfaces with execute-in-place (XiP) support can interface with the latest flash memory to offer up to 160 MB/s of throughput. This allows for a very powerful single-chip solution when the large DDR memory sizes are not required. A secure digital host controller supports SD, SDIO, MMC or CE-ATA cards for in-application software upgrades, media files or adding Wi-Fi® support. For interfacing to external peripherals such as external SRAM, EEPROM and other peripherals, a FlexBus external bus interface is provided. NAND flash and DRAM controllers with ECC support allow connection to a wide variety

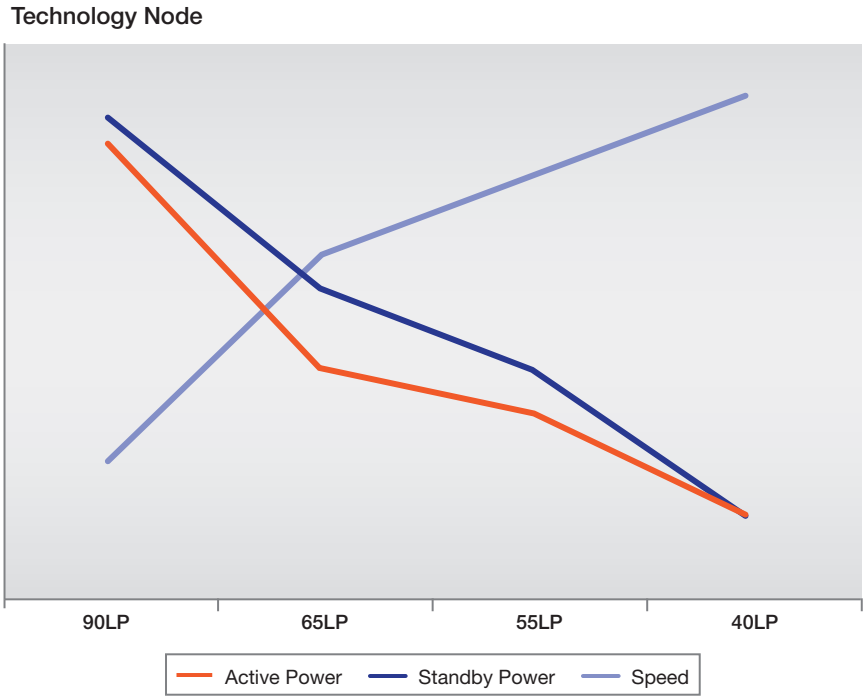
Vybrid Family Details

Vybrid Families	DDR	Camera Interface	Video ADC	USB Host w/PHY	USB OTG w/PHY	Segment LCD	TFT LCD (w/ Touch Screen)	Ethernet Controller	L2 Switch	Security (HAB, Tamper, Det.)	External Bus
VF6xx Family [Heterogenous Dual Core] ARM® Cortex™-A5 up to 500 MHz ARM Cortex™-M4 up to 167 MHz 364-pin MAPBGA	●	●	○	●	●	○	●	❷	●	●	●
VF5xx Family ARM Cortex-A5 up to 500 MHz 364-pin MAPBGA	●	●	○	●	●	○	●	❷	●	●	●
VF3xx Family ARM Cortex-A5 up to 266 MHz 176-pin LQFP		●	○	○	●	●	●	❷	●	●	●

Common Platform, Analog and Digital	
CRC and TZ Address Space Controllers	12-bit ADC
I²C	12-bit DAC
Programmable Delay Block	Secure JTAG
Flash Controller	Secure Fuses
UARTs	Timers
Low-Voltage, Low-Power Multiple Operating Modes, Clock Gating (1.73–3.6V)	Secure RAM
	eSDHC
	DMA
ESAI	SRAM

Tools
Packaged IDE
Packaged OS and Multicore Communication API
Application Software Ind. Protocols, Peripheral Drivers
Broad Third-Party Ecosystem Support

Process Technology Node Comparison



of memory types for critical applications. Battery-backed RAM is critical for secure systems to store authentication keys; Vybrid devices provide 16 KB of secure RAM. The platform also provides 96 KB ROM used for high assurance boot (HAB).

Multimedia Options

The Vybrid platform offers a host of multimedia options enabling customers to run rich applications with real-time control.

Audio

Three different types of audio interfaces are supported: synchronous audio interface (SAI) for full-duplex audio transfer, enhanced serial audio interface (ESAI) that is also full duplex and adds support for interfacing with SPDIF transceivers and the Sony/Philips Digital Interface (SPDIF) for digital audio support.

Display Controller

Two independent display controller units (DCU) interface with TFT LCD displays. The DCU can drive LCD displays up to a resolution of XGA (1024 x 768). Also included is a segment LCD controller with up to 288 segments.

Video Interface Unit (VIU)

For image and vision capture, a VIU provides a 24-bit parallel interface for digital video. In addition, an optional video ADC will convert composite video into digital format.

Reliability, Safety and Security

Vybrid devices include a variety of data integrity and security hardware features for safeguarding memory, communication and system data. A cyclic redundancy check module is available for validating memory contents and communication data, while a memory protection unit provides data protection and increased software reliability. For fail-safe applications, an independently clocked watchdog offers protection against runaway code. When it comes to security, a hardware encryption unit supports several encryption and hashing algorithms for program validation as well as authentication and securing data for transfer and storage. The system security module includes a unique chip identifier, secure key storage and a hardware tamper detection system. The tamper detection system has integrated sensors for voltage, frequency, temperature and external sensing for physical attack detection.

Optimal System Performance

Vybrid devices are ideal for modern industrial applications that require higher integration of communication and connectivity interfaces, as well as HMI and UI acceleration. Customers can easily take full advantage of all the integrated Vybrid features to create differentiated products by leveraging the provided reference board support packages (BSP) for high-level operating systems (such as Linux) and real-time operating systems (such as MQX), which include libraries and media framework tuned to the silicon architecture. The combination of high-efficiency silicon design, low-leakage process technology and software tuned for the silicon architecture results in low power consumption, eliminating the need for a fan or heat sink and helping to lower overall system BOM cost. As an example, because the platform architecture partitions tasks between the applications processor and the deterministic MCU, the ARM Cortex-M4 core helps to improve efficiency in industrial motor control applications that can result in a reduced carbon footprint.

Vybrid VF3xx Family

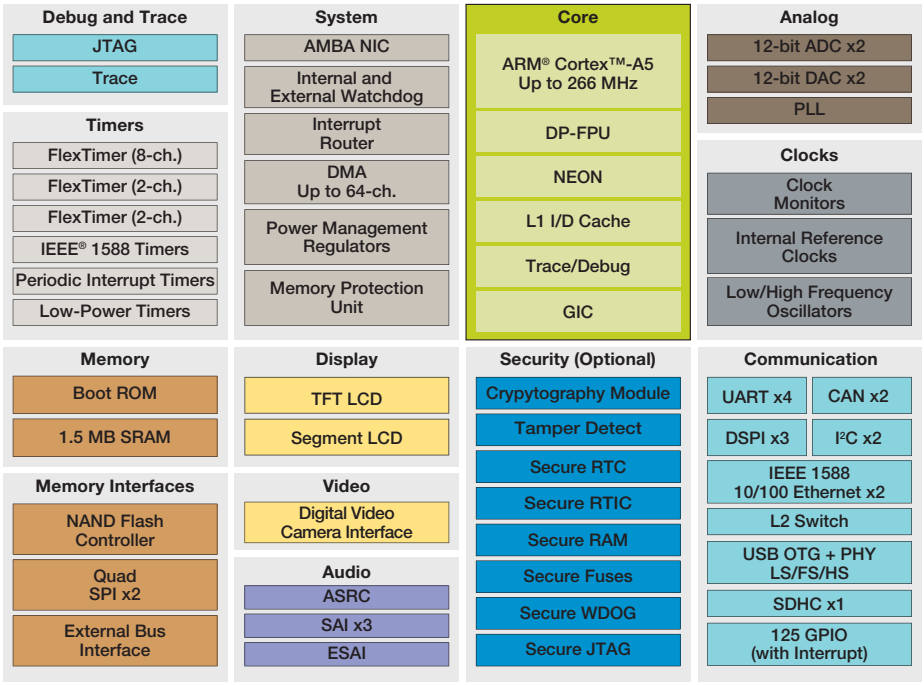
Single-core solution with dual XiP quad SPI, dual Ethernet and L2 switch for appliances and energy control

The VF3xx family is the entry point into the Vybrid portfolio and features the ARM® Cortex™-A5 core. It provides an efficient solution for an applications processor with up to 1.5 MB of on-chip SRAM and a rich suite of communication, connectivity and human-machine interfaces (HMI).

Target Applications

- Industrial automation
  - Applications requiring simple 2D graphics (HMI)
- Industrial scanners and printers
- Large or high-quality small appliances
- Portable patient monitors
- Simple vending machines

Vybrid VF3xx Family



Mixed-Signal Capability

- Two 12-bit ADCs with configurable resolution. Single or differential output mode operation for improved noise rejection. 500 ns conversion time achievable with programmable delay block triggering
- Two 12-bit DACs for analog waveform generation for audio applications or sensor manipulation

Memory

- Dual quad SPI supporting a double data rate interface, an enhanced read data buffering scheme, execute-in-place (XiP) and support for dual-die flashes
- Boot ROM with optional high assurance boot for secure booting capability
- Up to 1.5 MB on-chip SRAM with ECC support on 512 KB

Performance

- ARM Cortex-A5 core running at 266 MHz, with double precision floating point, NEON media processing engine for acceleration of media and signal processing, and TrustZone security extensions. 32 KB each of instruction and data L1 cache and 512 KB L2 cache for optimized bus bandwidth and on-chip SRAM execution performance
- Up to 64-channel DMA for peripheral and memory servicing with reduced CPU loading and faster system throughput
- Crossbar switch enables concurrent multi-master bus accesses, increasing bus bandwidth

Timing and Control

- Three FlexTimers with a total of 12 channels. Hardware dead-time insertion and quadrature decoding for motor control

- Four-channel 32-bit periodic interrupt timer provides time base for RTOS task scheduler or trigger source for ADC conversion and programmable delay block

HMI

- TFT LCD display capable of WQVGA resolution
- 288 segment LCD controller

Multimedia

- Video interface unit with parallel camera support for 8- and 10-bit ITU656 video, up to 24-bit digital RGB
- Three synchronous audio interfaces implementing full-duplex serial interfaces with frame synchronization such as I²S, AC97 and CODEC/DSP interfaces
- Optional enhanced serial audio interface that provides a full-duplex serial port for communication with a variety of serial devices, including industry-standard codecs, SPDIF transceivers and other processors
- Asynchronous sample rate converter for rate conversion between 32, 44.1, 48 and 96 kHz

Connectivity and Communications

- USB 2.0 OTG controller with integrated high-speed PHY
- 10/100 Ethernet controllers with hardware time-stamping
- Layer 2 Ethernet switch
- Four UARTs with IrDA support, including two UART with ISO7816 smart card support. Variety of data size, format and transmission/reception settings supported for multiple industrial communication protocols
- Two CAN modules for industrial network bridging
- Three DSPI and two I²C interfaces

Reliability, Safety and Security

- TrustZone Address Space Controllers provide memory protection for all masters on the crossbar switch, increasing software reliability
- Cyclic redundancy check engine validates memory contents and communication data, increasing system reliability
- Independent clocked COP guards against clock skew or code runaway for fail-safe applications such as the IEC 60730 safety standard for household appliances
- External watchdog monitor drives output pin to safe state external components if watchdog event occurs

Optional Secure Application Support

- Cryptography acceleration and assurance module
  - Supports acceleration and off-loading for selected crypto algorithms such as AES, DES, 3 DES, ArcFour Symmetric key blog ciphers
- Random number generation
  - NIST compliant SP800-90
  - Combination of a true random number generator and a pseudo-random number generator
- Real-time integrity checker
  - Periodic check on system memory for unauthorized modifications
- Secure non-volatile storage
  - Secure non-rollover real-time counter
  - Non-rollover monotonic counter
  - Zeroizable 256-bit secret key

External Peripheral Support

- Secure digital host controller supports SD, SDIO, MMC or CE-ATA cards for in-application software upgrades, media files or adding Wi-Fi® support
- NAND flash controller supports up to 32-bit ECC current and future NAND types. ECC management handled in hardware, minimizing software overhead
- FlexBus external bus interface provides glueless interface options to memories and peripherals such as graphics displays. Supports up to four chip selects

Software and Tools

- Freescale Tower System hardware development environment with complimentary MQX BSP
- Integrated development environments
  - Green Hills MULTI IDE
  - ARM Development Studio 5 (DS-5)
  - Atollic TrueSTUDIO
  - IAR Embedded Workbench
- Runtime software and RTOS
  - Motor control libraries
  - Green Hills INTEGRITY
- Full ARM ecosystem
- U-boot

Vybrid VF5xx Family

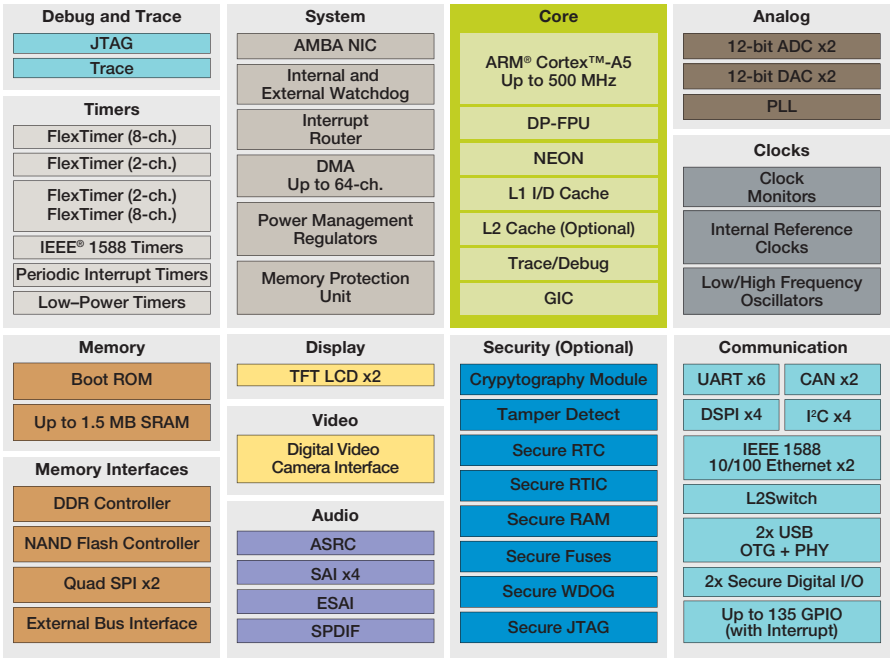
Single-core solution with dual Ethernet and L2 switch for automation and control

The VF5xx family features the ARM® Cortex™-A5 core with speeds up to 500 MHz with 512 KB L2 cache, dual USB 2.0 OTG controllers with integrated PHY, dual 10/100 Ethernet controllers with L2 switch, up to 1.5 MB of on-chip SRAM and a rich suite of communication, connectivity and human-machine interfaces (HMI). The VF5xx family is pin and software compatible with the VF6xx family.

Target Applications

- Industrial automation
  - Applications requiring simple 2D graphics (HMI)
- Industrial scanners and printers
- Industrial vehicle control with HMI
- Large or high-quality small appliances
- Metering
  - Data concentrator
- Portable patient monitors
- Simple vending machines

Vybrid VF5xx Family



Mixed-Signal Capability

- Two 12-bit ADCs with configurable resolution. Single or differential output mode operation for improved noise rejection. 500 ns conversion time achievable with programmable delay block triggering
- Two 12-bit DACs for analog waveform generation for audio applications or sensor manipulation

Memory

- Dual quad SPI supporting a double data rate interface, an enhanced read data buffering scheme, execute-in-place (XiP) and support for dual-die flashes
- Boot ROM with optional high assurance boot for secure booting capability
- Up to 1.5 MB on-chip SRAM with ECC support on 512 KB
- 16-bit DDR controller with PHY and ECC support capable of DDR3/LPDDR2 800 MHz data rate

Performance

- ARM Cortex-A5 core with frequency up to 500 MHz, with double precision floating point, NEON media processing engine for acceleration of media and signal processing, and TrustZone security extension. 32 KB each of instruction and data L1 cache and 512 KB L2 cache for optimized bus bandwidth and on-chip SRAM execution performance
- Up to 64-channel DMA for peripheral and memory servicing with reduced CPU loading and faster system throughput
- Crossbar switch enables concurrent multi-master bus accesses, increasing bus bandwidth

Timing and Control

- Four FlexTimers with a total of 20 channels. Hardware dead-time insertion and quadrature decoding for motor control
- Four-channel 32-bit periodic interrupt timer provides time base for RTOS task scheduler or trigger source for ADC conversion and programmable delay block

HMI

- TFT LCD displays capable of XGA resolution

Multimedia

- Video interface unit with parallel camera support for 8- and 10-bit ITU656 video, up to 24-bit digital RGB
- Up to four synchronous audio interfaces implementing full-duplex serial interfaces with frame synchronization such as I²S, AC97 and CODEC/DSP interfaces
- Optional enhanced serial audio interface that provides a full-duplex serial port for serial communication with a variety of serial devices, including industry-standard codecs, SPDIF transceivers and other processors
- Sony Philips Digital Interface receives and transmits digital audio using the IEC60958 standard consumer format
- Asynchronous sample rate converter for rate conversion between 32, 44.1, 48 and 96 kHz

Connectivity and Communications

- Dual USB 2.0 OTG controller with integrated PHY
- Dual 10/100 Ethernet controller with hardware time-stamping
- Layer 2 Ethernet switch
- Up to six UARTs with IrDA support, including two UARTs with ISO7816 smart card support. Variety of data size, format and transmission/reception settings supported for multiple industrial communication protocols
- Two CAN modules for industrial network bridging
- Four DSPI and four I²C interfaces

Reliability, Safety and Security

- TrustZone Address Space Controllers provide memory protection for all masters on the crossbar switch, increasing software reliability
- Cyclic redundancy check engine validates memory contents and communication data, increasing system reliability
- External watchdog monitor drives output pin to safe state external components if watchdog event occurs

Optional Secure Application Support

- Cryptography acceleration and assurance module
  - Supports acceleration and off-loading for selected crypto algorithms such as AES, DES, 3 DES, ArcFour Symmetric key blog ciphers
- Random number generation
  - NIST compliant SP800-90
  - Combination of a true random number generator and a pseudo-random number generator
- Real-time integrity checker
  - Periodic check on system memory for unauthorized modifications
- Secure non-volatile storage
  - Secure non-rollover real-time counter
  - Non-rollover monotonic counter
  - Zeroizable 256-bit secret key
- Tamper detection
  - Support for up to six external passive tamper detection pins or five active external tamper detection pin pairs

External Peripheral Support

- Secure digital host controller supports SD, SDIO, MMC or CE-ATA cards for in-application software upgrades, media files or adding Wi-Fi® support
- NAND flash controller supports up to 32-bit ECC current and future NAND types. ECC management handled in hardware, minimizing software overhead
- FlexBus external bus interface provides glueless interface options to memories and peripherals such as graphics displays. Supports up to four chip selects

Software and Tools

- Freescale Tower System hardware development environment with complimentary MQX BSP
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Vybrid VF6xx Family

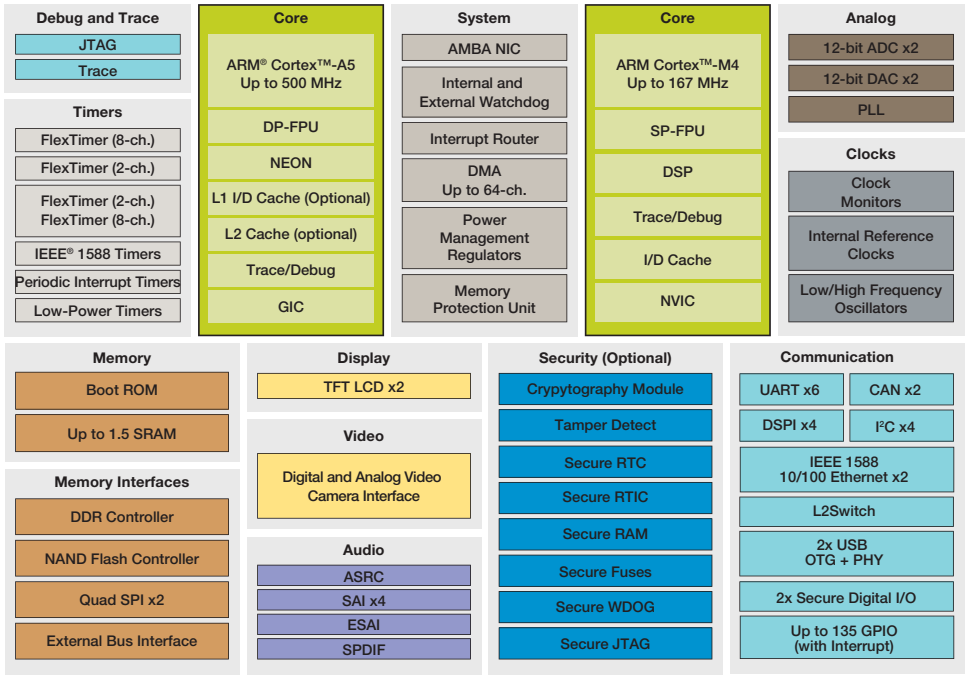
Dual heterogeneous core solution with XGA display, dual USB, dual Ethernet and L2 switch for automation and HMI

The VF6xx is the heterogeneous dual-core family combining the ARM® Cortex™-A5 and Cortex™-M4 cores. It includes dual USB 2.0 OTG controllers with integrated PHY, dual 10/100 Ethernet controllers with L2 switch, up to 1.5 MB of on-chip SRAM and a rich suite of communication, connectivity and human-machine interfaces (HMI).

Target Applications

- Motor drives
- Industrial pumps and fans
- Power inverters
- Mobile patient care
  - Infusion pumps and respirators
- Energy grid protection
  - Circuit breakers, monitors and hubs
- Infrastructure control
  - Water treatment and gas pipelines
- Building control
  - Elevator and automated doors
- Kiosks with 2D displays
- Service robots

Vybrid VF6xx Family



Mixed-Signal Capability

- Two 12-bit ADCs with configurable resolution. Single or differential output mode operation for improved noise rejection. 500 ns conversion time achievable with programmable delay block triggering
- Two 12-bit DACs for analog waveform generation for audio applications or sensor manipulation

Memory

- Dual quad SPI supporting a double data rate interface, an enhanced read data buffering scheme, execute-in-place (XiP) and support for dual-die flashes
- Boot ROM with optional high assurance boot for secure booting capability
- Up to 1.5 MB on-chip SRAM with ECC support on 512 KB
- 16-bit DDR controller with PHY and ECC support capable of DDR3/LPDDR2 800 MHz data rate

Performance

- ARM Cortex-A5 core with frequency up to 500 MHz, with 32 KB each instruction and data L1 cache and 512 KB L2 cache double precision floating point, NEON media processing engine for acceleration of media and signal processing, and TrustZone security extension
- ARM Cortex-M4 core running up to 167 MHz, with 16 KB of instruction/data L1 cache plus 64 KB of tightly coupled memory, DSP support for single cycle 32-bit MAC, single instruction multiple data extensions and single precision floating point unit
- Up to 64-channel DMA for peripheral and memory servicing with reduced CPU loading and faster system throughput

- Crossbar switch enables concurrent multi-master bus accesses, increasing bus bandwidth

Timing and Control

- Four FlexTimers with a total of 20 channels. Hardware dead-time insertion and quadrature decoding for motor control
- Four-channel 32-bit periodic interrupt timer provides time base for RTOS task scheduler or trigger source for ADC conversion and programmable delay block

HMI

- TFT LCD displays capable of up to XGA resolution

Multimedia

- Digital and analog video interface unit with parallel camera support for 8- and 10-bit ITU656 video, up to 24-bit digital RGB
- Up to four synchronous audio interfaces implementing full-duplex serial interfaces with frame synchronization such as I²S, AC97 and CODEC/DSP interfaces
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- Two CAN modules for industrial network bridging
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Reliability, Safety and Security

- TrustZone Address Space Controllers provide memory protection for all masters on the crossbar switch, increasing software reliability
- Cyclic redundancy check engine validates memory contents and communication data, increasing system reliability
- Independent-clocked COP guards against clock skew or code runaway for fail-safe applications such as the IEC 60730 safety standard for household appliances
- External watchdog monitor drives output pin to safe state external components if watchdog event occurs

Optional Secure Application Support

- Cryptography acceleration and assurance module
  - Supports acceleration and off-loading for selected crypto algorithms such as AES, DES, 3 DES, ArcFour Symmetric key blog ciphers
- Random number generation
  - NIST compliant SP800-90
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- Full ARM ecosystem
- U-boot

i.MX Multimedia Applications Processors

Scalable multicore platform with single-, dual- and quad-core families

The most versatile platform for multimedia and display applications, Freescale ARM® based i.MX processors deliver an optimal balance of power, performance and integration to enable next-generation smart devices. i.MX solutions include processors based on ARM9™, ARM11™, ARM Cortex™-A8 and Cortex™-A9 core technologies, and are powering applications across a rapidly growing number of consumer, automotive and industrial markets. Our solutions bring interactivity to a whole new world of products.

Multimedia Powerhouse

i.MX application processors have been implementing leading-edge multimedia capabilities for almost a decade by providing direct interfaces to high-end LCDs and cameras, and integrating hardware acceleration for a number of advanced video codecs and graphics standards, enabling up to full HD 1080p video playback and an amazing user interface experience. Combine that with on-chip features such as the image processing unit (IPU), camera interfaces, connectivity ports and performance enhancing capabilities such as the NEON SIMD accelerometer and vector floating point coprocessors, and i.MX devices provide customers with a balanced multimedia solution that offers best-in-class performance for power.

Advanced HMI

Display-centric devices across all market segments require an increasingly advanced and intuitive user interface in order to deliver the richest customer experience. The i.MX applications processor portfolio enables this experience by integrating separate graphics accelerators to support both 2D and 3D graphics in hardware that can create and deliver stunning and realistic images to LCD panels ranging from QVGA up to WUXGA resolution with integrated touch screen capabilities. By using on-chip acceleration, customers can easily add rich graphics, font rendering and enhanced web browsing with the provided device drivers and partner application software.

Energy Efficiency

i.MX multimedia applications processors deliver an optimal balance of performance and long battery life for rich multimedia experiences on the go. Plugged or unplugged, applications designed today must consider the total cost of using energy and the impact any excess power will have on the environment. A mix of integrated power management and companion PMIC solutions from Freescale ensure that the overall solution is optimized for energy efficiency and simplified implementation.

- Multiple independent power domains
- Dynamic voltage and frequency scaling
- Dynamic process and temperature compensation
- Proprietary power gating

Smart Processing Solutions for the Connected World

The i.MX applications processor portfolio provides solutions across multiple market segments. With long product longevity and automotive qualification, i.MX processors are used for infotainment, gateways, connected radio and telematics systems. Customers developing consumer applications take advantage of i.MX integration, low power consumption and extensive software support to get to market

i.MX Multimedia Markets

quickly and under budget. i.MX plays a critical role in applications such as e-readers, tablets, smartphones and IPTV/streaming media.

The i.MX portfolio also has broad traction in the embedded market by enabling multimedia and connectivity everywhere. Example applications include medical systems for patient monitoring and diagnostics and imaging, smart energy solutions to support the global smart grid transition with smart thermostats, appliances and home energy management systems, industrial factory automation for HMI and industrial control, scanners/printers, building control, education devices and in-flight infotainment.

Connectivity and Communication

The i.MX portfolio features a number of options to support the continuously connected world. These include Ethernet with IEEE® 1588 hardware time stamping for real-time control, SD/SDIO/MMC ports for external portable data storage and connectivity to wireless protocols such as ZigBee®, Wi-Fi® and Bluetooth® modules, USB modules with PHY for field upgradability, portable data storage and multiple serial ports to provide support for various network interfaces such as RS-232 and RS485. Additional connectivity features include I²S serial interfaces for connectivity to audio peripherals, dual CAN modules to enable industrial and automotive network bridging and interfaces for external mass storage.

Reliability, Safety and Security

The i.MX portfolio includes a variety of security features such as high assurance boot, run-time integrity check, secure JTAG, secure storage, secure real-time clock and physical tamper detection. High assurance boot with authenticity checking is used to ensure the correct software is on the correct device and is run every time the chip is reset. When it comes to security, a hardware encryption unit supports several encryption and hashing algorithms for program validation as well as authentication and securing data for transfer and storage. The tamper detection system has integrated sensors for voltage, frequency, temperature and external sensing for physical attack detection. For fail-safe applications, an independently clocked watchdog offers protection against code runaway.

Support for External Memory

i.MX application processors can interface to a variety of memories for program and data storage. Depending on the specific processor, external memory support for DRAMs includes 16-bit and/or 32-bit SDRAM, DDR1, DDR2, DDR3, mDDR, LP-DDR2 and LV-DDR2 for flexibility in cost vs. performance and power.

For external flash support, i.MX processors can support a variety of NAND flash memories such as SLC, MLC or managed NANDs as well as NOR memories. The i.MX processors also provide error correction functionality to improve the reliability of raw NAND. A parallel bus is supported for interfacing to external memory mapped peripherals such as FPGAs and ASICs.

Intelligent Integration

i.MX processors offer extensive peripheral integration, including display, connectivity, analog and security along with standard system features such as timers, pulse width modulators, DMA and debug support. Through this intelligent integration of optimized peripherals along with exceptional product scalability, i.MX processors reduce system-level discrete components, power consumption, board size, development effort and system cost.

i.MX Community

imxcommunity.org is an open community of developers with the common interest in transforming i.MX applications processors into practically anything imaginable. The i.MX Community is the place to share your knowledge, development tips and code, learn from your peers and take your design to a new level.

i.MX 6 Series

Scalable multicore platform with single-, dual- and quad-core families

The i.MX 6 series unleashes a scalable multicore platform that includes single-, dual- and quad-core families based on the ARM® Cortex™-A9 architecture for next-generation consumer, industrial and automotive applications. By combining the power-efficient processing capabilities of the ARM Cortex-A9 architecture with bleeding edge 3D and 2D graphics, as well as high-definition video, the i.MX 6 series provides a new level of multimedia performance to enable an unbounded next-generation user experience.

Complimenting the industry-leading scalability of the i.MX 6 single-, dual- and quad-core offering is the PF series of power management ICs. Combined with the simplified power requirements of the i.MX 6 platforms, the PF series is capable of supplying all the voltage rails required in numerous applications, significantly reducing the bill of materials and simplifying the system design.

Target Applications

- Media tablets
- Education tablets
- E-Readers
- Automotive infotainment
- Aero infotainment
- HMI
- Portable medical
- IPTV
- IP phones
- Smart energy systems
- Intelligent industrial control systems

i.MX 6 Series at a Glance

Red indicates change from column to the left

i.MX 6SoloLite	i.MX 6Solo	i.MX 6DualLite	i.MX 6Dual	i.MX 6Quad
• Single ARM® Cortex™-A9 at 1.0 GHz	• Single ARM Cortex-A9 at 1.0 GHz	• Dual ARM Cortex-A9 at 1.0 GHz	• Dual ARM Cortex-A9 at 1.2 GHz	• Quad ARM Cortex-A9 at 1.2 GHz
• 256 KB L2 cache, Neon, VFPvd16 Trustzone	• 512 KB L2 cache, Neon, VFPvd16 Trustzone	• 512 KB L2 cache, Neon, VFPvd16 Trustzone	• 1 MB L2 cache, Neon, VFPvd16 Trustzone	• 1 MB L2 cache, Neon, VFPvd16 Trustzone
• 2D graphics	• 3D graphics with one shader	• 3D graphics with one shader	• 3D graphics with four shaders	• 3D graphics with four shaders
• 32-bit DDR3 and LPDDR2 at 400 MHz	• 2D graphics	• 2D graphics	• Two 2D graphics engines	• Two 2D graphics engines
• Integrated EPD controller	• 32-bit DDR3 and LPDDR2 at 400 MHz	• 64-bit DDR3 and 2-channel 32-bit LPDDR2 at 400 MHz	• 64-bit DDR3 and 2-channel 32-bit LPDDR2 at 533 MHz	• 64-bit DDR3 and 2-channel 32-bit LPDDR2 at 533 MHz
	• Integrated EPD controller	• Integrated EPD controller	• Integrated SATA-II	• Integrated SATA-II

i.MX 6 Series Highlights

- ARM Cortex-A9-based solutions ranging up to 1.2 GHz
- HD 1080p encode and decode (except 6SL)
- 3D video playback in High definition (except 6SL)
- Low-power 1080p playback at 350 mW integrated I/Os that include HDMI v1.4, MIPI and LVDS display ports, MIPI camera, Gigabit Ethernet, multiple USB 2.0 and PCI Express®
- SW support Google Android™, Windows® Embedded CE, Ubuntu, Linux®, Skype™

Consumer | Industrial | Automotive

The market for intelligent, multimedia-centric, touch-based devices is increasing exponentially. Tomorrow's battery-powered smart devices, auto infotainment and aero infotainment systems, medical systems, personal and enterprise class intelligent control and data systems and new classes of devices never before seen need to present data and user interface choices to the end user primarily through rich sound, video, voice, pictures and touch, rather than keyboards and mice. And the need for manufacturers to quickly provide multiple devices to fit specific market segments or niches and provide their customers with a broader range of choices is increasing just as quickly.

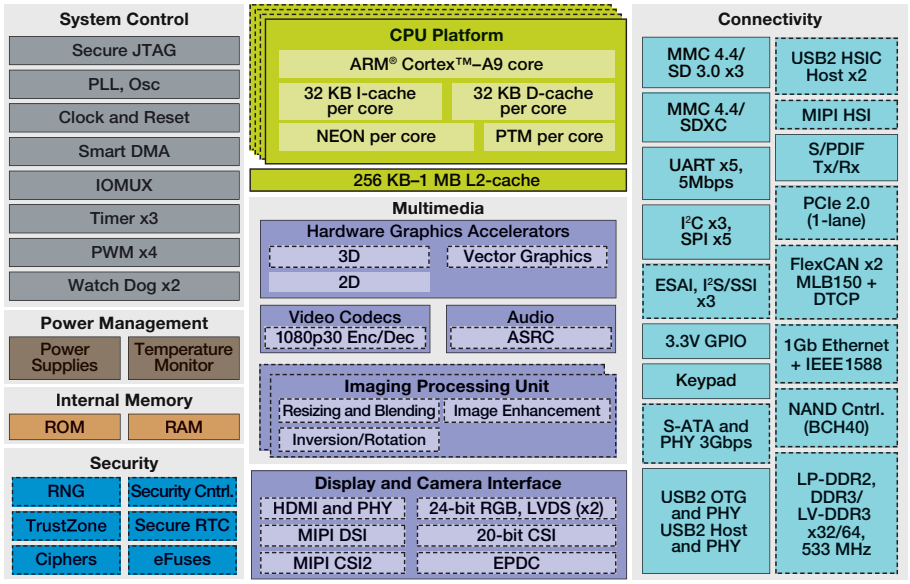
The i.MX 6 series was designed specifically to enable this new market by bringing together high-performance scalable multimedia processing, a software-compatible family of five processors and pin-compatible processor solutions with integrated power management so that a manufacturer can deploy a full portfolio of products with a single hardware design.

Scalable Multicore Solutions

The i.MX 6 series reaches a new level of power versus performance by providing a scalable family of single-, dual- and quad-core processor families based on the ARM Cortex-A9 architecture. Single- and dual-core designs provide cost-effective performance scalability while the flagship i.MX 6Quad processor provides more performance at lower power for the most demanding applications with constrained power budgets. The pin*- and software-compatible i.MX 6 series allows designers to create a broad portfolio of products based on a common platform while providing compelling performance advantages for systems with constrained power budgets.

*i.MX 6SoloLite not pin compatible

i.MX 6 Series Applications Processors Block Diagram



Five Scalable Families

The i.MX 6Quad family encompasses a quad-core platform running up to 1.2 GHz with 1 MB of L2 cache and 64-bit DDR3 or 2-ch., 32-bit LPDDR2 support. Integrated FlexCAN, MLB busses, PCI-e and SATA-2 provide excellent connectivity, while integration of LVDS, MIPI display port, MIPI camera port and HDMI v1.4 makes it an ideal platform for consumer, automotive and industrial multimedia applications.

The i.MX 6Dual family provides dual cores running up to 1.2 GHz with 1 MB of L2 cache, and 64-bit DDR3 or 2-ch., 32-bit LPDDR2 support. Leveraging the same integration of the i.MX 6Quad family, the i.MX 6Dual provides a scalable solution for consumer, automotive and industrial applications.

The i.MX 6DualLite family introduces dual cores running up to 1.0 GHz with 512 KB of L2 cache, and 64-bit DDR3 or 2-ch., 32-bit LPDDR2 support. Integrated FlexCAN, MLB busses and PCI-e provide excellent connectivity, while integration of LVDS, MIPI display port, MIPI camera port and HDMI v1.4 makes the i.MX 6DualLite processor ideal for consumer and industrial applications such as media or market-specific smart devices.

The i.MX 6Solo family provides a single core running up to 1.0 GHz with 512 KB of L2 cache and 32-bit DDR3/LPDDR2 support. Integrated LVDS, MIPI display, MIPI camera port, HDMI v1.4, FlexCAN and MLB enables the i.MX 6Solo to be a flexible platform for consumer, automotive and industrial applications.

The i.MX 6SoloLite family introduces a single core running up to 1.0 GHz with 256 KB of L2 cache and 32-bit DDR3/LPDDR2 support. Targeted integration of EPD controller and an LCD controller makes it ideal for next-generation e-readers and smart devices.

Unbounded User Experience

Next-generation graphics and high-definition video are centric to the i.MX 6 series, with the series supporting an integrated 1080p encoder/decoder hardware engine (except 6SL) and high-performance graphics accelerators in its high-performance families. The i.MX 6 series supports up to 1080p video playback (except 6SL) at 350 mW, enabling exceptionally long battery life for playback of high-definition content. The 3D graphics engine is capable of providing up to 200 Mt/s, which enables ultra vivid, realistic graphics critical for gaming and tablet applications. The combined multimedia processing power of the i.MX 6 series enables a new generation of smart devices and auto infotainment with compelling features such as augmented reality applications, content creation capabilities and multi-channel HD video processing for a new level of user experience.

i.MX 6 Series Features

- Scalable single-, dual- and quad-core offerings based on ARM Cortex-A9 up to 1.2 GHz, with ARMv7™, Neon, VFPv3 and TrustZone support
- 32 KB instruction and data L1 caches and 256 KB to 1 MB of L2 cache
- Multi-stream-capable HD video engine delivering 1080p60 decode, 1080p30 encode and 3D video playback in HD in high-performance families
- Superior 3D graphics performance with up to quad shaders performing 200 MT/s
- Separate 2D and/or Vertex acceleration engines for an optimal user interface experience
- Stereoscopic image sensor support for 3D imaging
- Integrated market-specific I/Os, which may include HDMI v1.4 with integrated PHY, SD3.0, multiple USB 2.0 ports with integrated PHY, Gigabit Ethernet with integrated PHY, SATA-II with integrated PHY, PCI Express® with integrated PHY, MIPI CSI, MIPI DSI, MIPI HSI and FlexCAN for automotive applications
- Comprehensive security features
- Optional integration of an EPD display controller for e-reader and similar applications

Software and Tools

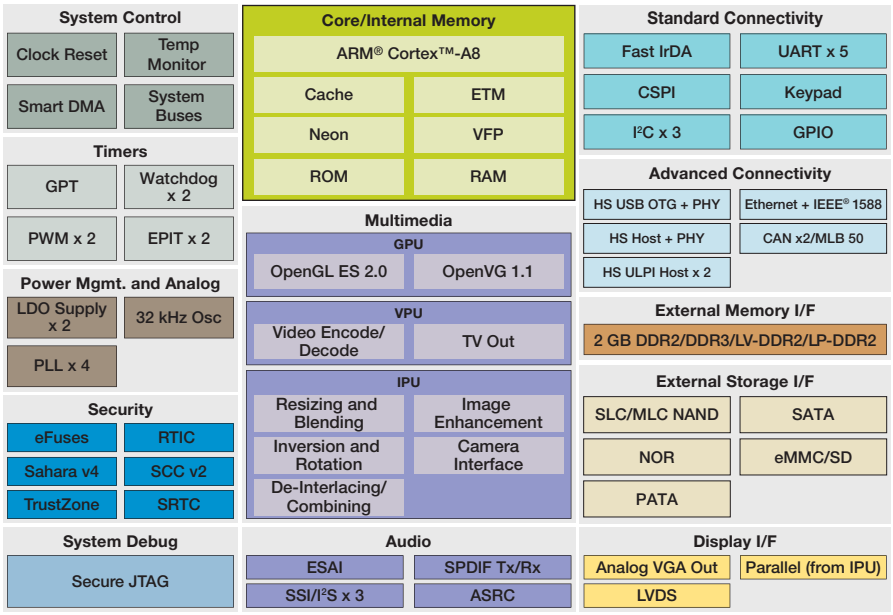
- i.MX 6 series Freescale supported
  - SABRE for automotive infotainment
  - SABRE platform for smart devices
  - SABRE board for smart devices
  - Google Android™ OS
  - Linux® OS
  - Ubuntu
- i.MX 6 series partner supported
  - SABRE-Lite community board
  - Microsoft® Windows Embedded CE
  - Various RTOS, embedded boards, development tools, UI tools and software and middleware offerings (see Partner Enablement Solutions)

i.MX53 Applications Processors

Take your multimedia experience to the max

The i.MX53 family of processors represents our next-generation of advanced multimedia and power-efficient implementation of the ARM® Cortex™-A8 core with core processing speeds up to 1.2 GHz. It is optimized for both performance and power to meet the demands of high-end, advanced applications. Ideal for a broad range of applications in the consumer, automotive, medical and industrial markets, the i.MX53 includes an integrated display controller, full HD capability, enhanced graphics and connectivity features. The i.MX53 family also boasts a companion power management IC (PMIC)—MC34708—designed exclusively for i.MX processors.

i.MX53 Block Diagram



Note: Features vary depending on product selected.

Target Applications

- Smart mobile devices
- Gaming devices
- Smart monitors
- Auto infotainment
- Digital signage
- Telehealth
- Video-enabled IP phones
- HMI for appliances, building control, factory/home automation, printers and security panels
- Patient monitors
- Point-of-sale terminals
- Surveillance cameras
- Security
- Barcode scanners

Consumer Applications

The i.MX535 supports 1080p multi-standard video playback with industry-leading low power consumption. With up to 1.2 GHz core speed, a faster graphics core enabling a more responsive user experience plus a higher level of system integration, i.MX535 applications processors balance the performance, power consumption, connectivity and multimedia capabilities necessary to drive the latest consumer products. These processors are ideal for products that require advanced user interfaces, sophisticated video processing, multiple connectivity options and a high level of system integration. These features are the building blocks to power the next great applications at an approachable price target.

Automotive Applications

Our automotive i.MX53 processors provide the advanced performance required to drive the latest automotive systems. These processors are designed for applications that require advanced user interfaces, sophisticated video processing, 2D and 3D graphics, multiple connectivity options and a high level of system integration. Building on the success of the i.MX515 and i.MX535 in the consumer market, the automotive family of i.MX53 processors brings the consumer electronics user experience and device connectivity into the vehicles of the future.

Industrial Applications

The i.MX537 with core processing speeds up to 800 MHz is optimized for both performance and power to meet the demands of high-end advanced industrial and medical applications. Integrated display controller, 1080p HD

video decode and 720p video encode, enhanced graphics and connectivity features make the i.MX537 suitable for a wide range of applications such as human-machine interfaces (HMI) and patient monitors that require rich user interfaces with high color displays and user interaction.

The i.MX537 provides key environmental differentiators for the industrial market. These include 3.3-volt I/O support, a 0.8 mm pitch package to reduce PCB and manufacturing costs, extended temperature coverage for harsh environments, industrial qualification for extended reliability and a formal long product supply guarantee to support product life spans.

Software and Tools

- i.MX53 SABRE for Tablets
- i.MX53 Quick Start Board

Development on the i.MX535 is made easy with a range of Freescale-provided board support packages (BSPs) optimized for multimedia performance and low-power operation. BSPs are available for the following operating systems:

- Android™
- Linux®
- Various RTOS, embedded boards, development tools, UI tools and software and middleware offerings (see Partner Enablement Solutions)

i.MX53 Applications Processors: Features

- CPU complex
- Up to 1.2 GHz ARM Cortex-A8
- 32 KB instruction and data caches
- Unified 256 KB L2 cache
- NEON SIMD media accelerator
- Vector floating point coprocessor
- Multimedia
  - Independent OpenGL® ES 2.0 and OpenVG™ 1.1 hardware accelerators
  - Multi-format 1080p HD video decoder and 720p HD video encoder hardware engine
  - 24-bit primary display support up to WSXGA resolution
  - 18-bit secondary display support
  - Analog 720p HD component TV output
  - High-quality hardware video de-interlacing
  - Image and video resize, inversion and rotation hardware
  - Alpha blending and color space conversion
  - Video/graphics combines four planes and hardware cursor
  - Display quality enhancement includes color correction, gamut mapping and gamma correction
- External memory interface
  - Up to 2 GB LP-DDR2, LV-DDR2, DDR2 and DDR3 SDRAM, 16/32-bit
  - SLC/MLC NAND flash, 8/16-bit
- Advanced power management
  - Multiple independent power domains
  - Dynamic voltage and frequency scaling
- Connectivity
  - High-Speed USB 2.0 OTG with PHY
  - High-Speed USB 2.0 host with PHY
  - Two additional High-Speed USB 2.0 controllers
  - Integrated LVDS display interface
  - Wide array of serial interfaces, including SDIO, SPI, I^2C and UART
  - I^2S and S/PDIF audio interfaces
  - 10/100 Ethernet controller
  - PATA
  - SATA controller and PHY up to 1.5 Gb/s
  - CAN
- Security
  - Security controller, including secure RAM and security monitor
  - High assurance boot, JTAG controller and real-time clock
  - Cipher and random number generator accelerators
  - Runtime integrity checker
  - Universal unique identification
  - Tamper detection

General

- 19 x 19 mm, 0.8 mm pitch TEPBGA-2 package
- Industrial temperature grade offered

i.MX53 Applications Processors: Benefits

- Ultra-fast processing and high-performance multimedia capabilities
- Complete hardware and software package provided to enable faster time to market and lower R&D investment
- Dedicated video and independent 2D/3D graphics hardware acceleration engines provides best-in-class performance for power
- Increased core speed for faster browsing
- Up to 2 GB external memory support prepares your end device for cloud computing applications and future OSs and browsers
- LP-DDR2, LV-DDR2, DDR2-800 and DDR3-800 SDRAM ready for greater design flexibility
- Optimized for low-power operation to give best performance for battery life
- Smartly integrated i.MX53 offers more on chip, including LVDS, USB PHYs, Ethernet and SATA, reducing the need for external components and passing on significant BoM savings

Multimedia Powerhouse

The multimedia performance of the i.MX53 processor is boosted by a multi-standard hardware video codec, autonomous image processing HD unit, NEON SIMD, accelerometer, vector floating point coprocessor and a programmable Smart DMA (SDMA) controller. Powerful 3D graphics acceleration is the key to mobile game designs.

i.MX53 processors provide an integrated 3D graphics processing unit with an incredible 33 Mt/s and effective 800 Mp/s (with overdraw). The 3D unit is provides an exceptional user experience with hardware-accelerated Flash Player 10.x, gaming and advanced user interfaces. In addition, i.MX53 incorporates a 2D graphics processing unit to accelerate the windowing system and fonts.

Smart Speed Technology

Advanced power management features throughout the i.MX53 processor enable a rich suite of multimedia features and peripherals while maintaining minimum system power consumption in active and low power modes.

i.MX50 Applications Processors

Streamlined performance

The i.MX50 family of applications processors delivers a low-power, streamlined solution for customers seeking ARM® Cortex™-A8 performance levels with flexible design features. The family features four derivatives, including the market-leading i.MX508 processor for e-readers, running at core speeds of 800 MHz and can be targeted towards a variety of consumer applications offering support for electronic paper display (EPD) in addition to LCD. The i.MX50 family also boasts a companion power management IC (PMIC) designed exclusively for i.MX processors.

Target Applications

- E-Readers
- Portable navigation devices
- Outdoor and digital signage
- Patient/client monitoring
- Home and office automation
- DECT phones

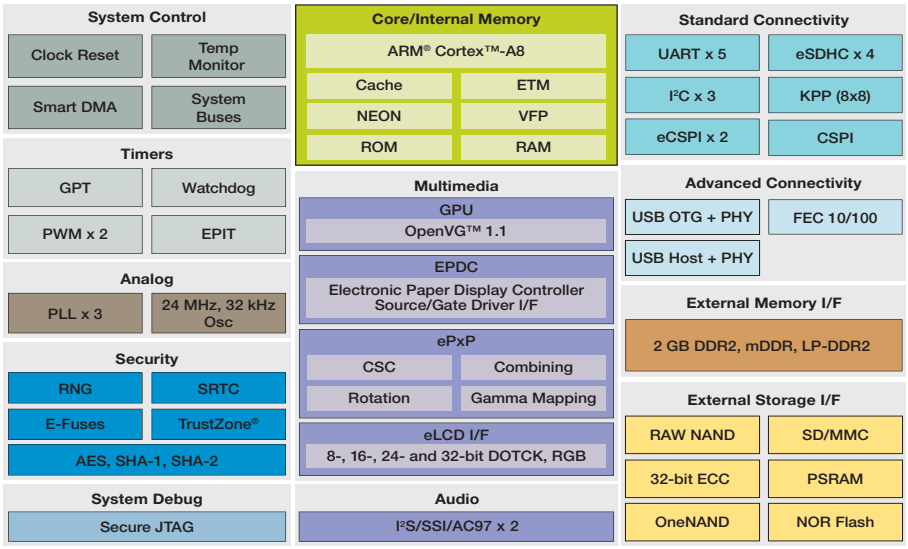
Electronic Paper Displays

The i.MX50 family consists of the first ARM-based device with an integrated EPD hardware interface. EPDs offer the following advantages:

- High resolution from any angle
- Sunlight readability
- Mimics the appearance of ink on paper
- Flexible
- Light weight
- Durable
- Extremely low power
- Replaces paper in many applications

Part of the i.MX50 family, the i.MX508 is the first system on chip (SoC) solution designed specifically for e-readers that incorporates an ARM Cortex-A8 CPU and an integrated E Ink® certified EPD controller to drive current and next-generation Pearl™ panels. The i.MX508 enables reduced system cost, longer battery life and higher performance for faster page flips and a better reading experience.

i.MX50 Block Diagram



Note: Features vary depending on product selected.

i.MX50 Key Features

- ARM Cortex-A8 800 MHz performance at 1.0 volts with NEON™ coprocessor
- Enhanced LCD controller interface supporting up to 1400 x 1050 resolution
- EPD controller for E Ink panels
- Enhanced pixel processing pipeline (ePxP) to handle post display frame pre-processing
- OpenVG™ 2D graphics acceleration for enhanced user interfaces
- LP-DDR2 support for next-generation, low-power and high-speed memories, in addition to mDDR and DDR2
- Support for SD, SDIO and MMC based media
- Static bus interface (WEIM) to support NOR and other memory mapped devices
- Dual full duplex I²S interfaces for audio connectivity
- Three I²C interfaces and three SPI interfaces for peripheral control
- RAW NAND flash support with up to 32-bit ECC-level protection
- Dual USB controller and PHYs (OTG/host)
- 10/100 Ethernet
- Advanced security features such as high-assurance boot, DRM support and AES encryption/decryption

Software and Tools

- i.MX50 evaluation kit (EVK)
- SABRE platform for e-readers
- i.MX50 quick start board (partner supported)

Development on the i.MX50 is made easy with a range of Freescale-provided board support packages (BSPs) optimized for multimedia performance and low-power operation and multimedia software codecs.

- Android™
- Linux®
- Various RTOS, embedded boards, development tools, UI tools and software and middleware offerings (see Partner Enablement Solutions)

Power Efficiency

The MC34708 PMIC is optimized for use with the i.MX50 and helps maximize power efficiency and battery life while supporting higher levels of integration to minimize board space and cost.

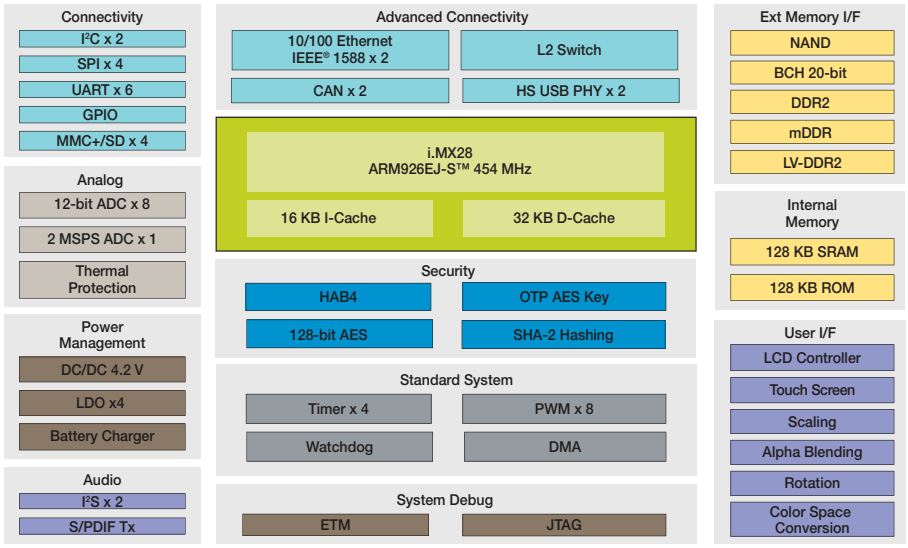
The i.MX50 family also includes power saving modes and techniques, such as state retention power gating and dynamic voltage frequency scaling, and has five independent power domains for low power modes.

i.MX28 Applications Processors

Intelligent integration, unmatched

The i.MX28 family of multimedia applications processors is part of our ARM9™ product portfolio. The i.MX28 family integrates display, power management and connectivity features unmatched in ARM9-based devices, reducing system cost and complexity for cost-sensitive applications. With optimized performance and power consumption, the i.MX28 is an ideal fit for battery-operated or fanless equipment. Additionally, the LCD controller with touch screen capability makes it possible to design creative and intuitive user interfaces. The i.MX28 family reaches new levels of integration in ARM9 devices and provides the enablement needed to help design differentiated industrial, automotive and consumer products in less time.

i.MX28 Family Block Diagram



Target Applications

- Smart appliances
- Human-machine interface for appliances, building contol, factory automation, printers and security panels
- Industrial control
- Media gateways/accessories
- Portable medical
- Smart energy gateways/meters
- Automotive audio systems
- Automotive connectivity modules

Industrial Needs

Like the rest of the i.MX portfolio, the i.MX28 family provides key environmental differentiators for the industrial market. These include 3.3-volt I/O support, a 0.8 mm pitch package to reduce PCB and manufacturing costs, extended temperature coverage for harsh environments, industrial qualification for extended reliability, a formal long product supply guarantee to support product life spans and a strong ecosystem, including module manufacturers, software integrators and development tools.

i.MX28 Key Features

- 454 MHz ARM926EJ-STM™-core with 16 KB/32 KB I and D cache
- PMU to power the device and drive external components supports li-ion batteries and direct connection to 5-volt supplies
- Dual IEEE® 1588 10/100 Ethernet with RMII support and L2 switch
- Dual CAN interfaces
- NAND support: SLC/MLC and eMMC 4.4 (managed NAND)
- Hardware BCH (up to 20-bit correction)
- 200 MHz 16-bit DDR2, LV-DDR2, mDDR external memory support
- Dual High-Speed USB with PHY
- Up to eight general-purpose 12-bit ADC channels and single 2 Ms/s ADC channel
- Temperature sensor for thermal protection
- Multiple connectivity ports (UARTs, SSP, SDIO, SPI, I²C, I²S)
- Product family supports various feature sets

Benefits

Industrial-strength integration

- Reduces system cost and complexity and provides greater flexibility in system design
- Industry-leading power management eliminates external components
- High level of peripheral integration, including display, connectivity, real-time control, security and networking

Industrial qualification and product longevity

- Supports the full life of the product in the field

Optimized performance and power consumption

- Increased battery life for portable equipment
- Improved energy efficiency for wall-powered or fanless systems

Software and Tools

- Linux® and Windows® Embedded CE BSPs
- Multimedia codecs: Proven codecs enable faster time to market
- Various RTOS, embedded boards, development tools, UI tools and software and middleware offerings (see Partner Enablement Solutions)

QorIQ Processors Built on Layerscape Architecture

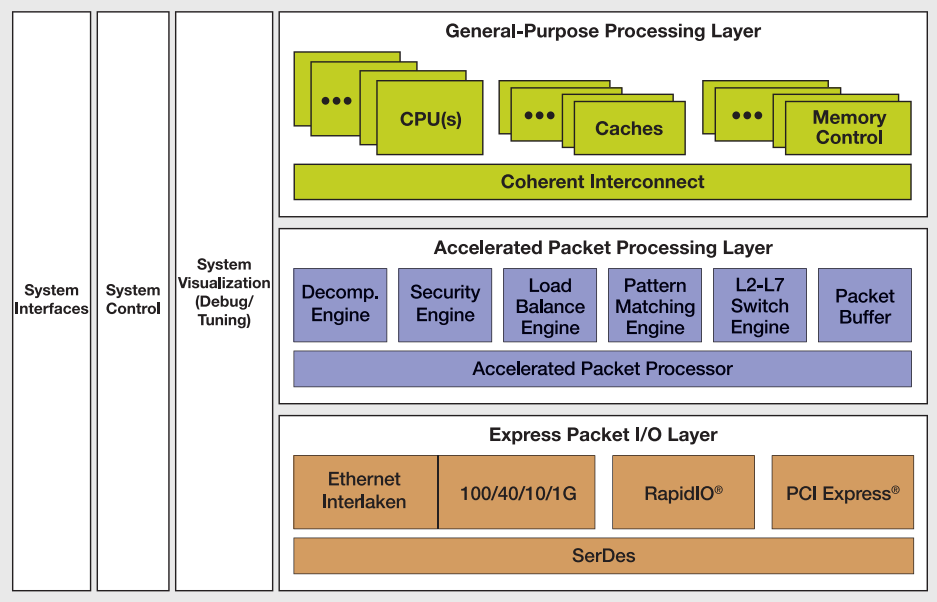
Based on a revolutionary new software-aware networking system architecture

The Freescale QorIQ communications processor portfolio is unmatched in depth and breadth. With the addition of the next-generation QorIQ LS1 and LS2 product families built on Layerscape architecture integrating the ARM Cortex™-A7 or ARM Cortex™-A15 core, the portfolio extends performance to the smallest-form-factor, power-constrained networking applications. Optimized performance and power efficiency are key advantages of these new families, which feature complete compatibility of features such as virtualization and cache coherency, together with pin compatibility, to enable customers to simply and smoothly migrate applications between these next-generation QorIQ families. Additionally, QorIQ processors built on Layerscape architecture will deliver a unique combination of our unmatched networking expertise with ARM's extensive ecosystem.

Layerscape Architecture

Layerscape is the underlying network system architecture of the QorIQ LS1 and LS2 family devices. The architecture enables next-generation networks with up to 100 Gb/s performance and enhanced packet processing capabilities. Design effort is simplified with a standard, open programming model and a software-aware architecture framework that enables customers to fully exploit the underlying hardware for maximum optimization, with the capability to easily adapt to network changes for real-time "soft" control over the network. A uniform hardware and software model provides the compatibility and scalability required for customers designing end-to-end networking equipment from home- to carrier-class products. The unique, core-agnostic architecture incorporates the optimum core for the given application—ARM or Power Architecture® cores.

Layerscape Architecture Block Diagram



The first families of processors built on Layerscape architecture will integrate the ARM Cortex-A7 or Cortex-A15 core.

QorIQ LS1 devices incorporate dual ARM Cortex-A7 cores running up to 1.2 GHz each and are purpose built to deliver a highly optimized blend of performance and features for power-constrained networking applications. The LS1 family will deliver CoreMark® performance of over 6,000, as well as virtualization support, advanced security features and the broadest array of high-speed interconnects ever offered in a sub-3 W processor.

LS1 Family Target Applications

- Industrial automation controllers
- Low-end routers
- Networked media hubs
- Smart energy

QorIQ LS2 devices are designed to be both powerful and highly integrated to reduce BOM costs for the most demanding fanless applications. Incorporating powerful dual ARM Cortex-A15 cores running up to 1.5 GHz each and less than 5 W total power, the LS2 family will deliver CoreMark performance of over 10,000, as well as support for virtualization, advanced security features and the latest high-speed interconnects.

LS2 Family Target Applications

- Industrial network communications
- Multiservice routers
- Residential gateways
- UTM and security appliances
- WLAN enterprise access points

Design Resources

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Freescale Enablement Solutions

Software and development solutions

Freescale Tower System

The Freescale Tower System is a modular development platform for 8-, 16- and 32-bit MCUs and MPUs that enables advanced development through rapid prototyping. Featuring multiple development boards or modules, the Tower System provides designers with building blocks for entry-level to advanced MCU development.

Modular and Expandable

- Controller modules provide easy-to-use, reconfigurable hardware
- Interchangeable peripheral modules (including communications, memory and graphical LCD) make customization easy
- Open-source hardware and standardized specifications promote the development of additional modules for added functionality and customization

Speeds Development Time

- Open source hardware and software allows quick development with proven designs
- Integrated debugging interface allows for easy programming and run control via standard USB cable

Cost Effective

- Interchangeable peripheral modules can be re-used with all Tower System controller modules, eliminating the need to purchase redundant hardware for future designs
- Enabling technologies like LCD, Wi-Fi®, motor control, serial and memory interfacing are offered off-the-shelf at a low cost to provide a customized enablement solution

The Freescale Tower System

Controller/Processor Module (MCU/MPU)

- Tower MCU/MPU board
- Works stand-alone or in Tower System
- Features integrated debugging interface for easy programming and run control via standard USB cable

Secondary Elevator

- Additional and secondary serial and expansion bus signals
- Standardized signal assignments
- Mounting holes and expansion connectors for side-mounting peripheral

Primary Elevator

- Common serial and expansion bus signals
- Two 2x80 connectors on back side for easy signal access and side-mounting board (LCD module)
- Power regulation circuitry
- Standardized signal assignments
- Mounting holes

Size

- Fully assembled Tower System is approx. 3.5” H x 3.5” W x 3.5” D

Board Connectors

- Four card-edge connectors
- Uses PCI Express® connectors (x16, 90 mm/ 3.5” long, 164 pins)

Peripheral Module

- Adds features and functionality to your designs
- Interchangeable with other peripheral modules and compatible with all controller/processor modules
- Examples include serial interface, memory, Wi-Fi®, graphical LCD, motor control, audio, Xtrinsic sensing and high precision analog modules

Tower Plug-In (TWRPI)

- Designed to attach to modules that have a TWRPI socket(s)
- Adds features and functionality
- Swappable with other TWRPIs
- Examples include accelerometers, key pads, touch pads, sliders and rotary touch pads

Tower System Modules

Controller/Processor Modules (8-, 16-, 32-bit)	freescale.com/TowerController
Works stand alone or as part of Tower System	Allows rapid prototyping
Features open source debugging interface	Provides easy programming and run control via standard USB cable
Peripheral Modules	**freescale.com/TowerPeripheral**
Can be re-used with all Tower System controller modules	Eliminates the need to buy/develop redundant hardware
Interchangeable peripheral modules: Serial, memory, graphical LCD, prototyping, sensor	Enables advanced development and broad functionality
Tower Plug-Ins	**freescale.com/TWRPI**
Designed to attach to any Tower System module with a TWRPI socket(s)	Adds features and functionality with little investment
Swappable components	Allows for design flexibility
Elevator Modules	**freescale.com/TowerELEV**
Two 2x80 connectors	Provides easy signal access and side-mounting board (i.e. LCD module)
Power regulation circuitry	Provides power to all boards
Standardized signal assignments	Allows for customized peripheral module development
Four card-edge connectors available	Allows easy expansion using PCI Express® connectors (x16, 90 mm/3.5" long, 164 pins)

Take Your Design to the Next Level

For a complete list of development kits and modules offered as part of the Freescale Tower System, please visit **freescale.com/Tower**.

Partner Modules

Tap into a powerful ecosystem of Freescale technology alliances for building smarter, better connected solutions. Designed to help you shorten your design cycle and get your products to market faster, these technology alliances provide you with access to rich design tools, peripherals and world-class support and training. A number of partners have developed modules for the Tower System. Some examples include the i.MX515 ARM® Cortex™-A8 Tower computer module and StackableUSB™ I/O device carrier module from Micro/sys, as well as the rapid prototyping system (RPS) AM1 and FM1 modules from iMN MicroControl.

Tower Geeks Online Community

TowerGeeks.org is an online design engineer community that allows members to interact, develop designs and share ideas. Offering a direct path to explore and interact with other engineers designing with the Tower System, TowerGeeks.org is a great way to discuss your projects, post videos of your progress, ask questions through the forum and upload software. With updates through Twitter and Facebook, it's easy to get involved.

Follow Tower Geeks on Twitter
twitter.com/towergeeks

Visit Freescale on Facebook
facebook.com/freescale

Freescale Virtual Hardware Platform

Vybrid families support a wide variety of complex I/O controllers, display subsystems and communication interfaces while supporting a highly configurable multicore and multi-memory programmer's model. Vybrid families are designed to efficiently handle numerous application-level design challenges as well as traditional real-time embedded tasks. This is where our virtual hardware platform provides an additional resource for managing the design and debug of your application.

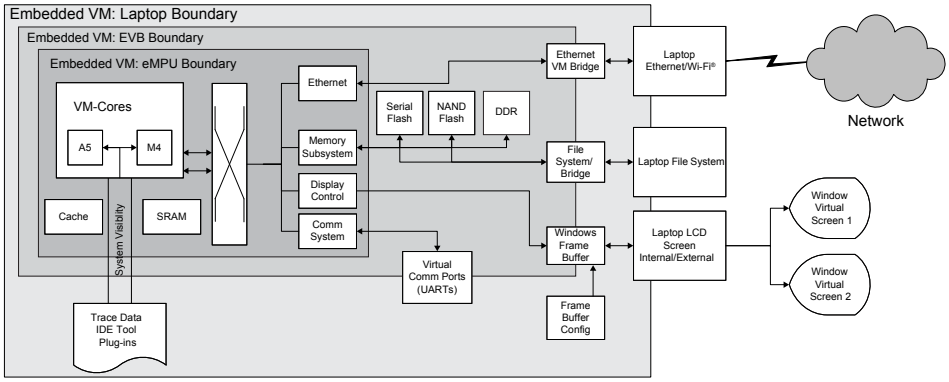
The virtual hardware platform brings many features found in standard desktop virtual machine environments to embedded customers who need a platform to accelerate software development. Unlike traditional modeling environments, this tool leverages a fast instruction set model that runs natively with no code conversion requirements between x86 and ARMV7™.

This is combined with broad system modeling techniques, resulting in a Vybrid device with an example EVB hardware environment that can be virtually represented on any Windows-enabled machine.

Features

- Single executable product that loads editable data-driven files
  - Editable bootimages
  - Peripheral parameters (e.g., target display screen parameters)
  - Feature/mux configurations on select features (I/Os, UARTs, GPIOs)
  - EVB memory sizes (editable virtual machine configuration files to set EVB memory)
- Fast instruction execution for one or both ARM® cores
  - Full support for ARM Cortex™-A5 and Cortex™-M4 cores as implemented in Vybrid families
  - Code execution capable of running high-level operating systems (Linux® or others) at chip-level performance or faster

Diagram of Virtual Hardware Platform



- Bridged peripheral support between host platform and embedded virtual machine
  - File system on host machine can be mapped to embedded virtual machine file system
    - Allows rapid testing of board support/ processor support packages
    - Allows rapid application development (Java™, Android™, Linux, MQX™ and others)
  - Ethernet nodes on host machine can be mapped to Ethernet nodes on virtual target (Ethernet bridging ability)
  - Display controller output to host machine display
    - Leverage GUI development packages to develop and test HMI/UI applications, on virtual display controllers. Control one or two screens at the same time
  - Serial interface input and capture
    - Configure test files to generate/receive serial communications for testing and validating code
    - Leverage virtualized UARTs in Windows to transmit/receive live data with model
- Advanced debugging features
  - Industry-leading IDE support allows real-time debug, trace and visibility to internal debug data providing enhanced application-level development
  - Debug access available through Windows DLL extensions

i.MX Development Tools

Take your designs to the next level, reduce your design complexity and accelerate your time to market with i.MX development boards and solutions. Our i.MX development boards support a broad portfolio of products, include readily available design files and are supported by a rich ecosystem and community of developers at **imxcommunity.org**.

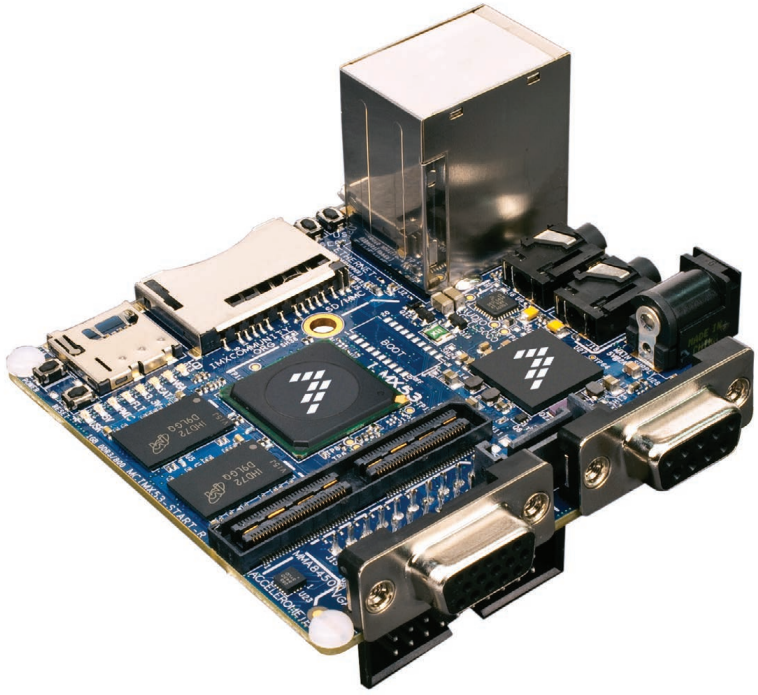
SABRE: Smart Application Blueprint for Rapid Engineering

Accelerate your time to market with the Smart Application Blueprint for Rapid Engineering (SABRE) series of market-focused development systems based on the i.MX family of multimedia applications processors. SABRE platforms deliver the advanced technology features required for your market's next-generation applications, including tablets, e-readers and automotive infotainment systems. From hardware accelerators and multimedia codecs to an expansive portfolio of software development tools including board support packages (BSPs), SABRE platforms come highly optimized with the best offerings from Freescale and our technology partners so you can maximize the performance and power savings features of the processor in your design.

SABRE Reference Designs

- SABRE platform for smart devices based on i.MX 6 series
- SABRE board for smart devices based on i.MX 6 series
- SABRE platform for tablets based on i.MX53
- SABRE platform for e-readers based on i.MX50
- SABRE for automotive infotainment based on i.MX 6 series

i.MX53 Quick Start Board



i.MX53 Quick Start Board

Our most popular i.MX development tool to date, i.MX53 Quick Start board is a $149 open source development platform integrated with an ARM Cortex™-A8 1 GHz processor and the MC34708 PMIC. The Quick Start board includes a display controller, hardware-accelerated graphics, 1080p video decode and 720p encode as well as numerous connectivity options ideally suited for applications such as human-machine interface in embedded consumer, industrial and medical markets.

i.MX Evaluation Kits (EVKs)

Our EVKs offer developers a cost-effective platform to develop, debug and demonstrate their next great product without compromising performance. EVKs support the features of the device in a small, single-board design with optional add-on modules to enable developers with a complete development platform for less than $600. A range of peripheral and connectivity options makes the EVK suitable for developing a wide range of consumer, industrial and automotive applications.

i.MX28 evaluation kit:
freescale.com/iMX28evk

i.MX50 evaluation kit:
freescale.com/iMX50evk

i.MX 6SoloLite evaluation kit:
freescale.com/6SLevk

Freescale MQX Software Solutions

The increasing complexity of industrial applications and expanding functionality of semiconductors are driving embedded developers toward solutions that combine proven hardware and software platforms. To help accelerate time to market and improve application development success, we offer the MQX real-time operating system (RTOS) with TCP/IP and USB software stacks and peripheral drivers to Kinetis ARM MCU, Vybrid controller solutions, PX series Power Architecture® MCU and ColdFire MCU customers at no additional charge. MQX solutions also support several i.MX MPUs*. The combination of Freescale MQX software solutions with our silicon portfolio creates a comprehensive source for hardware, software, tools and services.

Reducing Cost, Accelerating Success

Providing complimentary Freescale MQX software solutions with our silicon products helps to alleviate much of the initial software investment hurdle faced by embedded developers. Comparable full-featured software offerings may cost developers as much as $95,000 (USD) in licensing fees.

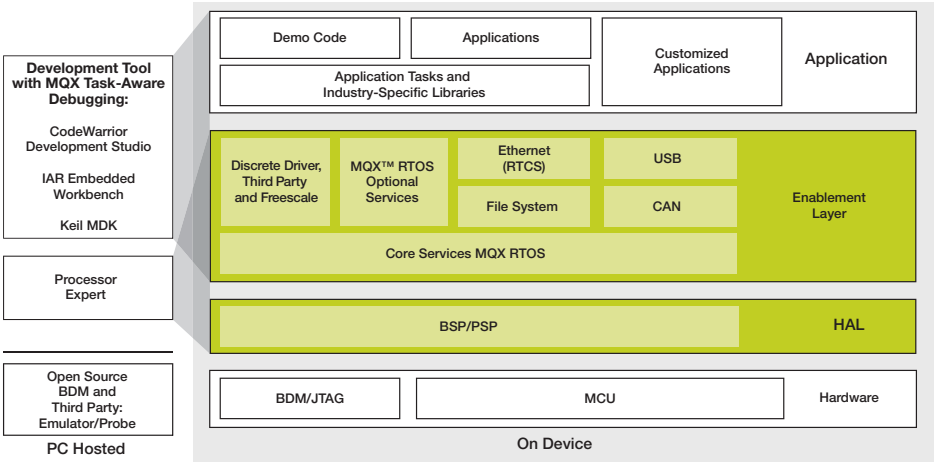
Freescale MQX is deployed as production-ready source code, including communications software stacks and peripheral drivers, at no additional cost. Freescale MQX is provided with a commercial-friendly software licensing model, enabling developers to keep their source modifications while being able to distribute the required binary code.

Full Featured, Proven and Scalable

The MQX RTOS has been the backbone of embedded products based on Freescale silicon for more than 15 years. MQX software deployment spans a broad range of market segments and leading manufacturers worldwide.

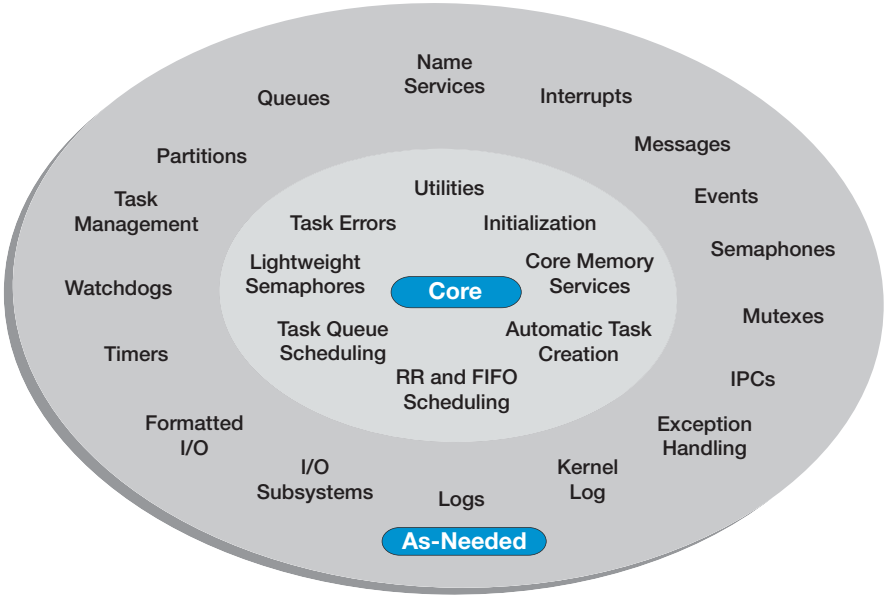
*via partner support.

Comprehensive Freescale Solution



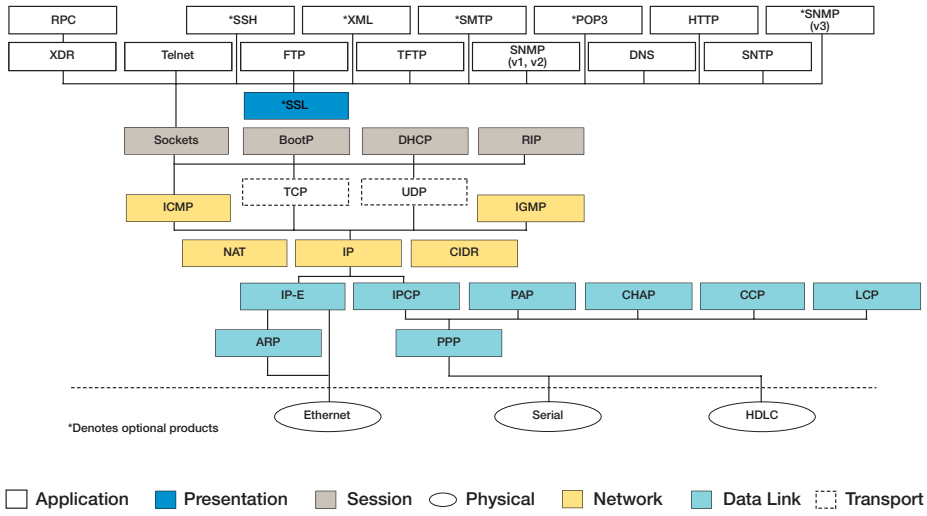
Freescale MQX™ Software Solutions

MQX™ RTOS: Customizable Component Set



The Freescale MQX RTOS offers powerful, preemptive real-time performance with optimized context switch and interrupt time to enable fast, highly predictable response times. Its small, configurable size conserves memory space for embedded applications and it can be configured to take as little as 6 KB of ROM, including kernel, interrupts, semaphores, queues and memory manager. The Freescale MQX RTOS offers a straightforward application programming interface with a modular, component-based architecture that makes it very scalable. Components are linked in only if needed, preventing unused functions from bloating the memory footprint. Plug-ins, such as security, industrial protocols and graphical interfaces from our strong network of partners, can also be added.

MQX Real-Time TCP/IP Communication Suite



Freescale MQX™ Add-on Software

Real-time TCP/IP communication suite (RTCS) optional components Available from Embedded Access Inc.	• Network management: Support for SNMP version 1 and 2 is built into RTCS. EAI offers MQX SNMPv3 • XML parsing and framing: The MQX XML component enables your device to accept data in XML, as well as send data packaged in XML • Email communication: The MQX SMTP module provides your device with outbound email communication and MQX POP3 provides the capability to accept incoming email communication
NanoSSL™ and NanoSSH™ software by Mocana Available from **freescale.com/nanossl**, **freescale.com/nanossh**	• NanoSSH: Provides privacy, authentication and ensures data integrity between a secure server and its clients • NanoSSL: Cyptographic protocols that provide security for communications over networks such as the Internet
PEG+ graphics library Available from **swellsoftware.com**	• Portable embedded GUI library designed to provide a professional-quality GUI for embedded systems applications • Small, fast and easily ported to virtually any hardware configuration capable of supporting graphical output
SEGGER emWin graphics library/GUI Available from SEGGER Microcontroller	• emWin is designed to provide an efficient, LCD controller-independent GUI for any application that operates with a graphical LCD
Freescale eGUI: Graphical LCD driver Available from **freescale.com/EGUI**	• The complimentary Freescale embedded graphical user interface (eGUI) allows single-chip MCU systems to implement a graphical user interface and drive the latest generation of color graphics LCD panels with integrated display RAM and simple serial peripheral interface (SPI) or parallel bus interface
CANOpen master/slave for embedded devices Available from IXXAT, Inc.	• Unburdens the developer from dealing with CAN-specific details such as bit-timing and implementation-specific functions
Industrial network and field bus protocols Available from IXXAT, Inc.	• Profinet RT for I/O device • EtherNet/IP for adapter and scanner • Ethernet powerlink for managing and controlled nodes • EtherCAT for slave nodes • SERCOS III for slave devices • Precision time protocol IEEE® 1588-2008 (v2)
SFFS flash file system Available from Embedded Access, Inc.	• SFFS is a safe flash file system that can support almost any NOR or NAND flash device • Provides wear leveling, bad block handling and ECC K30C algorithms to ensure you get optimal use out of a flash device
MicroBrowsers Available from Motomic Software, Inc.	The uButterfly Browser runs on MQX and browses, parses and renders HTML/CSS content • Browse HTML 4/CSS 2.1 web pages • Enable dynamic HTML, active graphics and media • An optional SDK allows browsing embedded/instanced within C, C++ or Qt apps (available as a separate product)
OS Changer—Reuse application on MQX Available from MapuSoft Technologies	OS Changer is a C/C++ source-level virtualization technology that allows you to easily re-use your software developed for one OS on MQX, while providing real-time performance. Available OS Changer Porting Kits: VxWorks Porting Kit, pSOS Porting Kit, Linux/POSIX Porting Kit, Windows Porting Kit, Nucleus Porting Kit, micro-ITRON Porting Kit
Floodgate Packet Filter, an embedded firewall product Available from Icon Labs	Floodgate provides protection from Internet-based threats by controlling what packets are the embedded device processes. Encryption and authentication may protect your device from a hacker trying to access your device, but Floodgate can prevent the hacker from even attempting to connect.

Freescale MQX Real-Time TCP/IP Communication Suite

The Freescale MQX real-time communication suite (RTCS) is a fast, efficient and low-footprint embedded Internet stack that supports a rich set of standard TCP/IP protocols. It comes complete with a number of application layer protocols such as Telnet, FTP, SNMP v1 and SNMP v2. A number of optional, pre-integrated protocols and products are also available from third parties. The scalability of the Freescale MQX RTCS allows developers to easily define the feature set needed to accommodate a variety of ROM and RAM memory budgets.

Certifiable to Medical and Aerospace Standards

Even for applications that do not require formal certification, the robustness of MQX provides a trusted platform that has been proven in thousands of time-critical, sophisticated applications. For designs that do have a formal certification process to follow, MQX is an excellent choice. Past licensees have certified MQX-based applications to medical specifications (CFR 820.30 Part 21, IEC 60601-1) and the aerospace requirements listed under DO-178b. Safety critical applications based on MQX include eye surgery equipment, drug injection equipment, radiation dose monitoring equipment, aircraft braking systems and aircraft navigation equipment.

Features and Benefits

Freescale MQX™ RTOS	
Small code density	• Context switch and low-level interrupt routines hand-optimized in assembly • Can be configured to a memory footprint of 12 KB ROM and 2.5 KB RAM on CFV2, including kernel, task applications, LW semaphore, interrupt stack, queues and memory manager
Component-based architecture	• 25 components—eight core, 17 optional • Components are linked in only if needed, preventing unused functions from bloating the memory footprint
Full and lite services	• Further control of size, RAM/ROM utilization and performance options
Real-time, priority-based preemptive multithreading	• Threads execute in order of priority • Allows high-priority threads to meet their deadlines consistently, no matter how many other threads are competing for CPU time
Optimized for Freescale architecture	• Optimized assembly code to accelerate key real-time portions of the RTOS such as context switching
Faster development time	• Allows for faster development time by relieving engineers from creating an efficient scheduling system and interrupt handling • Use of multiple communication protocols such as USB or TCP/IP
Code reuse	• Provides a framework with a simple API to build and organize the features across our broad portfolio of embedded processors
Intuitive API	• Writing code for MQX is straightforward with a complete API and available reference documentation
Fast boot sequence	• Ensures the application is running fast after the hardware has been reset
Simple message passing between processors	• Messages can be either from a system/private pool and sent with either an urgent status, or a user-defined priority, and can be broadcast or task specific • For maximum flexibility, a receiving task can be operating on either the same CPU as the sending task or on a different CPU within the same system
Freescale MQX RTCS	
Designed for embedded applications	• Specifically designed for adding TCP/IP connectivity to embedded systems • Provides fully compliant feature set of networking stacks and configurable enough to fit into the small memory confines of an embedded devices • Tightly integrated with Freescale MQX RTOS device drivers for Ethernet and other access layers • Tested on Freescale embedded architectures
Small configurable memory footprint	• Implemented as a C library • Allows only the features and protocols used by the application to be included in the image • Can be configured to take as little as 30 KB of ROM
RTCS protocol support	• Provided with a large number of standard protocols • One product allows real TCP/IP applications without the need to acquire other application-level protocols
Advanced networking protocols for RTCS	• RTCS can be extended to support additional industry-standard protocols, including security, advanced routing/network access, embedded web server/email support and network management protocols
Very scalable	• Customizable suite can meet a wide range of application RAM and ROM requirement by selectively choosing only the necessary protocols for your design
Full featured	• Great flexibility in the way you provide connectivity to your device, ranging from simple application such as Ethernet-serial to complex gateway systems
Support for standard protocols and sockets	• RTCS not only provides application layer protocols but is a complete OSI model solution that spans data link to application layer standard protocols
Freescale MQX File System	
Designed for embedded applications	• Provides full MS-DOS compatible file system that is configurable to fit into small memory footprint • Brings support for desktop PC features such as long file names, multiple disk volumes and directory handling to embedded systems
Portability and modularity	• The MFS FAT file system provides a portable, compatible implementation of the MS-DOS file system and library of file system functions • File system functions are separated from the device driver functions, allowing for increased modularity • Supports different types of storage media • Trivial file system is a simple read-only file system used to avoid the need of MFS in HTTP
Freescale MQX USB Host/Device Stack	
Designed for embedded applications	• Specifically designed for adding USB functionality to embedded systems • Provides fully compliant USB 1.1 and 2.0 feature set of stacks and drivers
Small configurable memory footprint	• Designed to fit in a small <10 KB RAM with code size of <32 KB
Supports a variety of class functionality	• Supports personal health care device class (PHDC), human interface device (HID), mass storage device (MSD), communications device class (CDC), audio class, On-The-Go USB 2.0 standard supplement and PHDC USB.org standard classes.

CodeWarrior Development Studio for MCUs V10.x

The CodeWarrior Development Studio for Microcontrollers V10.x integrates the development tools for the ColdFire, ColdFire+, DSC, Kinetis, Qorivva, RS08 and S08 architectures into a single product based on the Eclipse open development platform. Eclipse offers an excellent framework for building software development environments and is becoming a standard framework used by many embedded software vendors.

- Eclipse IDE 3.6
- Build system with optimizing C/C++ compilers for ColdFire, ColdFire+, DSC, Kinetis, Qorivva, PX, RS08 and S08 processors
- Extensions to Eclipse C/C++ development tools (CDT) to provide sophisticated features to troubleshoot and repair embedded applications

Processor Expert Software

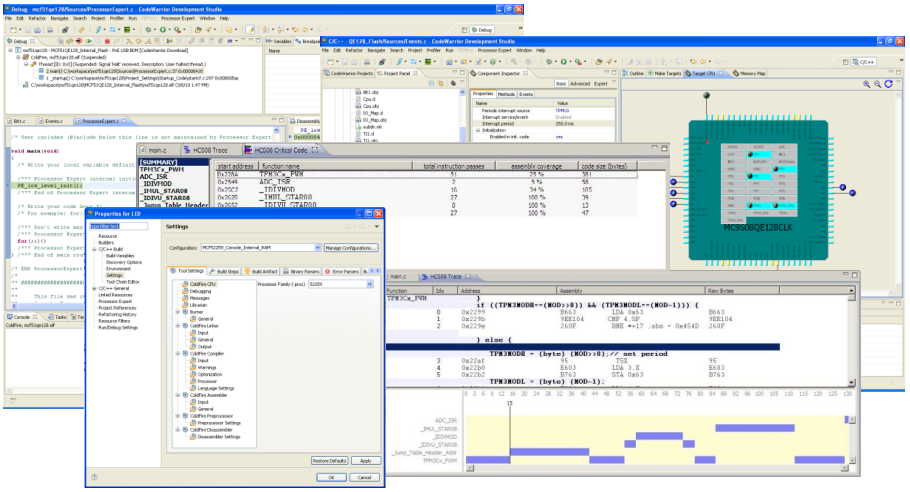
Processor Expert is a rapid application design tool that combines easy-to-use component based application creation with an expert knowledge system.

- CPU, on-chip peripherals, external peripherals and software functionality are encapsulated into embedded components.
- Each component's functionality can be tailored to fit application requirements by modifying the component's properties, methods and events.
- When the project is built, Processor Expert automatically generates highly optimized embedded C code.

Processor Expert software, MCU driver suite is delivered as an Eclipse plug-in. This extends Processor Expert functionality to non-CodeWarrior users for the Kinetis and ColdFire+ platforms.

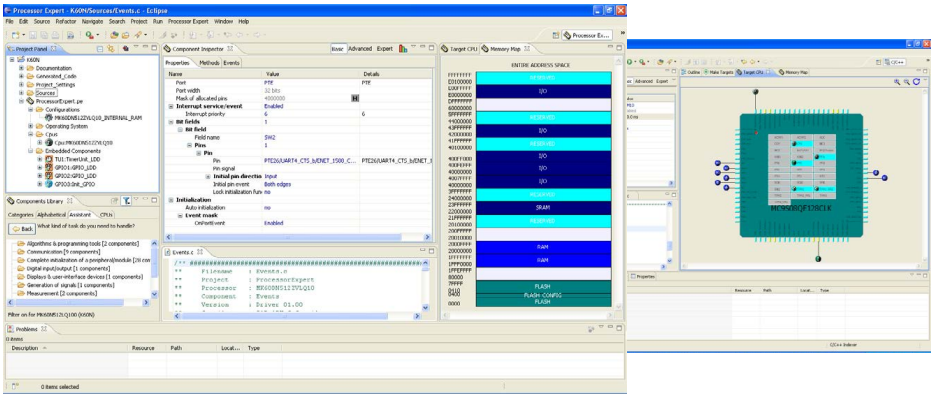
You do not have to accept generic one-size-fits-all drivers. You design custom peripheral drivers ideally suited to your needs, without having to know everything about the hardware.

CodeWarrior Development Studio V10.x



Features	Benefits
• Graphical user interface	• Allows an application to be specified by the functionality needed
• Automatic code generator	• Creates tested, optimized C code tuned to application needs and the selected Freescale device
• Built-in knowledge base	• Immediately flags resource conflicts and incorrect settings so errors are caught early in design cycle
• Component development environment	• Allows user-specific hardware-independent embedded components to be created

Processor Expert: Eclipse Plug-in and CodeWarrior Integration



Features	Benefits
• Processor Expert	• Problems in hardware layer can be resolved during initial design phase
• Trace and profile support for on-chip and external trace buffers	• Sophisticated emulator debug capability
• LiveView	• Ability to monitor registers, memory and global variables without stopping the processor
• Low-power debugging	• Ability to debug Kinetis MCU low-power applications including wake up from low-power states and stepping over low-power instructions

PEG GUI Development Tools

Swell Software provides graphical user interface (GUI) solutions for embedded devices. Swell's PEG Pro, PEG+ and C/PEG product offering includes a GUI library for embedded development that works tightly with real-time operating systems. The development tool allows developers to layout user interface screens and controls using the PEG library and external resources to generate C/C++ code.

The PEG product family of tools is designed to meet widely varying power, performance and memory requirements, helping to:

- Reduce product development risk
- Lower in-house development costs
- Accelerate time to market

PEG software accelerates GUI design for embedded devices by allowing developers to create prototypes on a Windows® or Linux® based PC by providing a complete visual layout and design tool to enable GUI design to take place in parallel to the embedded software/hardware development.

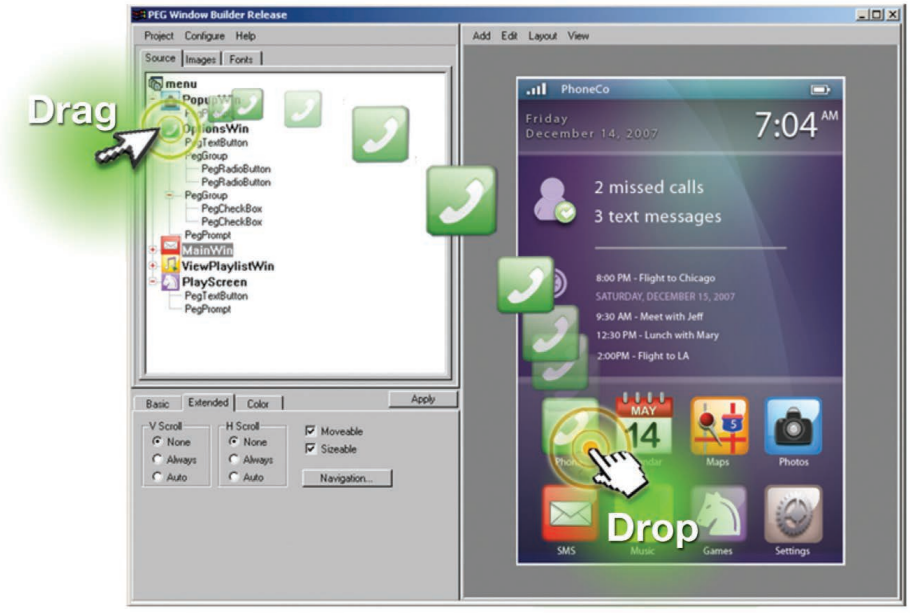
The PEG WindowBuilder automatically generates C/C++ source code that is ready to be compiled and linked into any application, further accelerating the deployment of the final product.

Swell's GUI software products work hand in hand with Freescale customers' real-time operating systems to incorporate LCD screens and display interfaces into future products. The GUI development tools address a variety of embedded systems, including consumer electronics, industrial, medical and communications markets.

Features

- Highly customizable, small footprint for cost-sensitive applications
- Multi-lingual support, including UNICODE
- High color, including true anti-alias line and font drawing support and per-pixel alpha blending
- Designed for cross platform application development, highly portable across OS and CPUs
- Screen transition effects: Slide-in, wipe, fade
- Touch screen support
- Support for multiple graphics layers
- Runtime "theme" support
- Button, sliders, scrolling text, dials, progress bars, multiline text box and spreadsheet
- Integrated font creation and image conversion utilities

PEG GUI Development Tools



Target Applications

Appliance	Consumer	General Purpose	Medical	Factory Automation
• Human-machine interface • Small home appliances • Large appliances	• Digital TV and set-top box applications • Hand-held GPS units • Printers • Smartphones • Digital cameras	• Connected multimedia devices • Automotive infotainment • Home security systems • Test and measurement devices • POS kiosks	• Blood glucose monitors • Electro cardiogram • Ventilators • Patient monitors • Defibrillators	• Industrial automation • Human-machine interface

Benefits

- Reduce development time and costs
- Rapid user interface development
- Resolve product usability issues before committing to a physical design
- Standardize on graphics software solutions across products
- Differentiate your product with a sophisticated user experience
- Flexibility in selecting the processor/ graphics controller

Swell Software Product Line

PEG Pro	PEG+	C/PEG
• Screen transitions • Blending of transparent images and windows • True anti-aliasing • Gradient manager • Open GL support • Written in C++	• Multiple window updates • Alpha-blended images • Runtime image decoders and language resources • Custom widget integration • Dynamic themes • Written in C++	• Designed for small LCDs (QVGA) • Low color-depth • Very small footprint • Single window update • Multi-language capable • Written in ANSI C
One of the smallest footprints and most efficient code bases available.		
Starting 64 KB Typical 64–96 KB	Starting at 48 KB Typical 48–72 KB	Starting at 42 KB Typical 42–52 KB
Professional Services team provides custom consulting and software development, including driver development, UI development and graphic design.		

Licensing Option for PEG Software (Discount available when using Freescale silicon)

	Part Number	Developer project license* (DPL)	Part Number	Runtime license** (In addition to DPL price)
C/PEG	F-PEGC-LICDL-N	$5,994	F-PEGC-LICRL-N	$11,988
PEG+	F-PEG-LICDL-N	$8,394	F-PEG-LICRL-F	$16,788
PEG Pro	F-PEGP-LICDL-N	$8,994	F-PEGP-LICRL-F	$17,988
Additional Seat	F-PEGA-LICDL-N	$1,868.70		
	Part Number	**Developer project license (DPL) technical support renewal*** **	**Part Number**	**Runtime license technical support renewal*** **
C/PEG	F-PEGC-SUPDS-N	$1,498	F-PEGC-SUPRS-N	$2,997
PEG+	F-PEG-SUPDS-N	$2,098	F-PEG-SUPRS-N	$4,197
PEG Pro	F-PEGP-SUPDS-N	$2,248	F-PEGP-SUPRS-N	$4,497

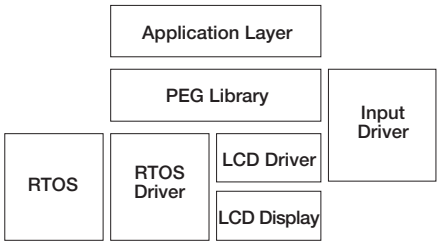
* Developer project license includes up to 10,000 unit runtime, 12 months DPL technical support and 3 developer seats.
** Must have a Developer Project license to purchase additional runtime license that includes 10,000+ unit runtime
*** (In addition to DPL support renewal price)

PEG Window Builder for Rapid Development

WindowBuilder allows a designer to layout each of the screens for a project through a simple-to-use interface, providing a "what you see is what you get (WYSIWYG)" display.

- Full WYSIWYG development
  - Simulation environment for PEG+ and PEG Pro
  - Runs on PC/Linux/X11 to allow proof of concept development
  - Enables parallel hardware/software development
  - Made available for free evaluation

PEG Software Architecture



Supported Ecosystem and Partners

RTOS

- Analog Devices VDK
- Mentor Graphic Nucleus
- Pharlap ETS
- CMX RTX
- eCosPro
- Freescale MQX
- ENEA OSE
- eSol PrKernel eT-KERNELv4
- Express Logic ThreadX
- Green Hills INTEGRITY and µ-velOSity
- C Executive
- Kadak AMX
- Keil RTX, ARTX
- LYNUXWORKS
- LynxOS
- Micrium µC/OS-II
- Micro Digital SMX
- WinCE, 2000, XP, Vista
- On Time
- Quadros RTXC
- Any uITRON compatible
- WindRiver VxWorks

Hardware

- Freescale ColdFire and Kinetis MCUs, i.MX processors and Power Architecture cores
- Renesas H8,SH
- MIPS R3000, R4000
- All ARM cores, including NXP and Samsung
- Intel/Marvell StrongARM
- Altera NIOSII
- Analog Devices Blackfin
- Texas Instruments

Free Evaluation—swellsoftware.com
For other licensing options, please contact sales@swellsoftware.com or 1-810-385-2893
Pricing subject to change. For current pricing contact a sales representative.

GUI Interface: Three Basic Drivers

- LCD driver
- RTOS driver
- Input drivers

PEG's modular form enables a rapid development process

- The core library interfaces to different RTOSs, input devices and LCD controllers by replacing the underlining drivers

SWELL software

i.MX Applications Processor Software Solutions

Our i.MX portfolio is provided with highly optimized BSPs, multimedia codecs and middleware to shorten product development and speed time to market all while maximizing the capabilities of the i.MX series feature sets.

Android™

Freescale fully supports the Android OS through BSPs for the i.MX range of application processors and featured tools such as SABRE for tablets.

Using a layered approach with the right selection of components to interface into the Android stack results in a more complete and ready solution. Designers can directly develop applications on this integrated solution or easily modify their own drivers based on our reference code.

The i.MX family of applications processors running Android OS is an excellent platform for building a high-performance, low-power and cost-effective mobile device that successfully passes the Android Compatibility Test Suite.

Features

- Fully integrated and tested Android framework with optimized codecs, graphics and a development and debug environment
- Based off the latest stable Android kernel/ release and previous releases for vertical markets
- Common code base across i.MX SoCs to greatly reduce porting effort to next-generation i.MX processors
- Source code for selected drivers and middleware
- Source code for unit tests
- Tool chain included with the BSP
- Documentation (reference manual, user guide, release notes)

For more information, visit **freescale.com/iMXAndroid**.

Linux®

Quickly get your Linux-based designs started with the i.MX family of processors by using our Linux development tools. Our goal is to provide you with a comprehensive Linux environment that is easy to develop your designs and reduce your time to market.

Linux board support packages (BSPs) are tested and certified ensuring a fully operational tool chain, kernel and board specific modules that are ready to use together within a fixed configuration for i.MX hardware development tools. These BSPs provide the foundation you need to begin your project quickly.

Features

- Linux kernel and device drivers
- Applications/services
- Libraries
- GNU tools (compilers, linkers, etc.)
- Deployment mechanisms

For more information, visit **freescale.com/iMXLinux**.

Microsoft®

Windows Embedded Compact 7 provides the latest technologies to enable OEMs to create devices that stand out through rich user interfaces and connection to the information customers care about the most. Windows Embedded Compact 7 provides highly reliable, high-performance technologies to power differentiated devices leveraging the latest hardware platforms. OEMs can use familiar tools to create devices that deliver compelling user experiences using Silverlight, a powerful browsing experience with Internet Explorer, rich media playback capabilities and seamless connections to information and devices.

Benefits

- Connect and consume rich media
- Seamless connection to Microsoft Windows 7
- Connect to Office and personal information
- Extensible rich UI framework
- Rich desktop browsing
- Immersive experiences with natural touch input
- Streamlined developer experience with Visual Studio integration
- Increased graphics performance with Open GL ES 2.0
- Reliable wireless connectivity and Wi-Fi® support Bluetooth® support (2.1) with connectivity to latest devices

For more information, visit **freescale.com/iMXWindowsEmbedded**.

i.MX High-Performance Multimedia Codecs

These high-performance multimedia codecs enable a series of popular audio, video and image applications using i.MX applications processors. The multimedia codecs are provided as fully functional, product-ready software packages to support various use cases, such as audio playback, video record and image display, with codecs for H.264, H.263, MPEG-4, Windows Media Video (WMV), Windows Media Audio (WMA), Advanced Audio Encoding (AAC) and Enhanced aacPlus. Also available are imaging codecs such as JPEG, GIF, PNG and BMP. The multimedia codecs support the Windows Media Player (DShow multimedia framework) running on the Windows Embedded CE operating system, the GStreamer multimedia framework running on the Linux operating system and OpenMAX framework for Android.

For more information, visit **freescale.com/iMXtools**.

Partner Enablement Solutions

Design and support ecosystem for embedded solutions

ARM

Keil MCU Development Kit

The Keil MCU Development Kit (MDK-ARM™) supports all ARM® Cortex™-M MCUs, including our Kinetis MCU family. It combines the µVision™ 4 IDE/debugger with ARM Compiler toolchain to provide developers with an easy-to-use, feature-rich environment.

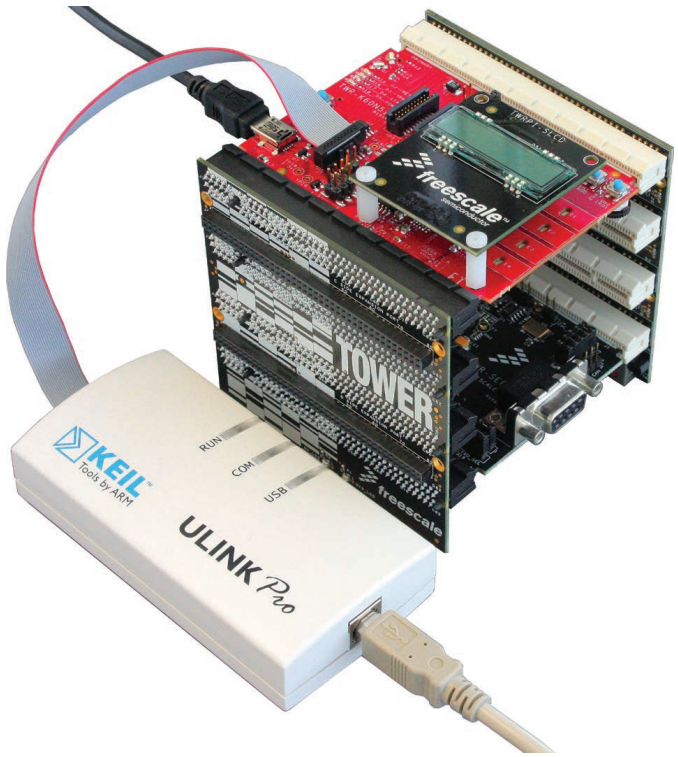
MDK provides many unique features designed to help you quickly develop your project.

- **Device database:** Automatically configures device and project parameters
- **Trace and analysis tools:** Optimizes and verifies the application by measuring performance and code coverage
- **Fully functional RTX™ real-time operating system:** Adds resource management to the application
- **Extensive middleware:** MDK-ARM Professional contains a rich set of middleware components, including a TCP/IP networking stack, USB host and device support and a flash file system. Kinetis K60 and K70 devices are fully supported.

MDK-ARM consists of the several powerful components for debugging and analysis:

- **ARM compilation tools:** Deliver optimized, high-performance code for all ARM-powered devices. Further code size savings can be gained by selecting the MicroLib library.
- **Debugger:** Can be configured as a simulator or target debugger and provides a single environment for application testing.
- **System viewer:** Provides an advanced method of viewing and modifying peripheral registers.
- **Analysis tools:** Work with the simulator or with target hardware via the ULINK™Pro streaming trace adapter.
- **Configurable logic analyzer:** Provides a graphical display of signals and variables. Users can display the specific instructions that caused variable changes.
- **Debugger:** Provides code coverage statistics to verify applications that require certification testing and validation.

Keil ULINK Pro



- **Performance analyzer:** Displays the execution time recorded for functions, including the time spent in a function and the number of calls to it.
- **Execution profiler:** Records execution statistics for each CPU instruction, including the execution count and execution time for each instruction.

All ARM Cortex-M-based devices feature ARM CoreSight technology with advanced debug and trace capabilities. With a ULINK adapter it allows the user to control the CPU, single step one source or assembler line, set breakpoints while the processor is running, and read/write memory and peripheral registers on the fly. All ARM Cortex™-M3 and Cortex™-M4 devices provide data and event trace. MDK provides a number of ways to analyze this information while your system is running, including a trace window, debug viewer, exceptions window, event counters and a logic analyzer.

All Cortex-M devices with ETM provide instruction trace. The Keil ULINKpro is the only trace adapter that streams instruction trace directly to your PC. This enables debugging of historical sequences, execution profiling and code coverage analysis. The virtually unlimited stream of trace information enables MDK to provide complete code coverage of your program. Code coverage identifies every instruction that has been executed, ensuring thorough testing of your application. This is an essential requirement for complete software verification and certification.

For more information, visit **keil.com/freescale**.

KEIL™ Tools by ARM

ARM®

Development Studio 5 (DS-5™)

The ARM Development Studio 5 (DS-5) is a complete suite of software development tools for ARM processor-based cores, including Vybrid controller solutions and i.MX applications processor families. DS-5 accelerates software development by providing an easy-to-use, integrated and validated toolchain.

Key Features and Benefits

- Support for all ARM processors
- Integration with the industry standard Eclipse IDE, which provides a large ecosystem of third-party plug-ins
- Powerful C/C++ compilation tools
- Debugger supports all phases of development from bootloader to Linux®/RTOS kernel and applications
- System-wide performance and power analysis for Linux and Android™
- Correlation of performance bottlenecks (cache misses, interrupts) and software execution
- Fast simulator for ARM software development on the host computer with typical speeds above 250 MHz
- Support and maintenance contract
- Flexible C/C++ editor and project manager

DSTREAM™

The ARM DSTREAM high-performance debug and trace unit enables software debug and optimization on any ARM processor-based hardware target. DSTREAM enables the connection of DS-5 debugger and third-party debuggers to ARM processor-based devices via JTAG or serial-wire debug. DSTREAM uses FPGA acceleration to deliver high download speeds and fast stepping through code on single and multi-processor devices.

DS-5 Debugger and DSTREAM

Key Features

- Code download at speeds of up to 2500 Kb/s
- JTAG clocks of up to 60 MHz provide fast software upload over the existing debug port
- Large 4 GB trace buffer enables long-time trace on fast targets

Energy Analysis

The ARM Energy Probe is an easily deployable Streamline accessory that collects voltage, current and power from up to three probe points in the system to allow software developers to optimize system energy consumption.

Key Features

- **Simple setup:** No dependency on ICE or trace units means easy connection and cost effectiveness to enable wide deployment.
- **Multiple channels:** Each of the three channels is independently configured to permit simultaneous measurement of peak and average current, voltage and/or power on key system components.
- **Energy information:** Just select any time slice on the Streamline Timeline view to accumulate power readings and estimate the energy consumed within that time window.
- **Smart data synchronization:** Streamline uses advanced DSP techniques to detect known power consumption patterns on the CPU to synchronize performance data and the probe readings, which are received via an independent USB connection to the host PC.

Atollic
TrueSTUDIO®

Atollic tools provide you with powerful features that reduce your development time and enable you to release a software product with higher quality with less effort.

Atollic aims to provide an embedded systems toolset that covers all work tasks that embedded developers perform on a daily basis. The Atollic product portfolio not only covers great tools for editing, building and debugging but offers powerful solutions for team collaboration, system and code analysis as well as test automation.

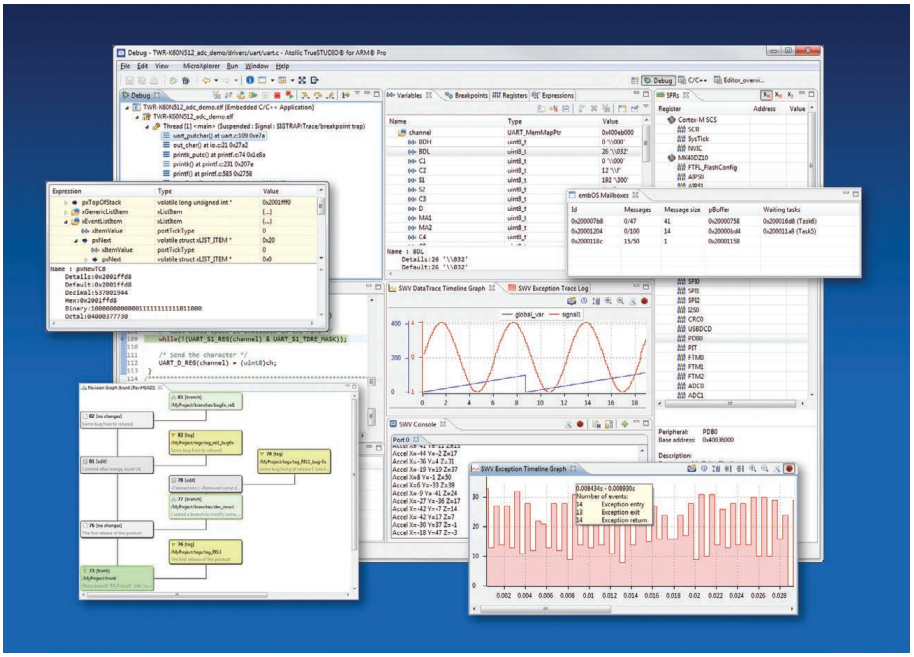
TrueSTUDIO: The Embedded Systems Development Tool for the Next Decade

Atollic TrueSTUDIO is the premier C/C++ development tool for embedded systems development with unrivalled feature set and unprecedented integration. In addition to the state-of-the-art editor, the optimizing C/C++ compiler and multiprocessor-aware debugger with tracing support, Atollic TrueSTUDIO also includes features for team collaboration, graphical modeling and design, code review and review meetings.

TrueINSPECTOR®: Improve Software Quality with Static Source Code Analysis

Atollic TrueINSPECTOR is a tool for professional code analysis. The product performs static source code inspection and generates software metrics including code complexity measurements. The source code is validated against a database of formal coding standards and coding constructs that are known to be error-prone are detected automatically. Atollic TrueINSPECTOR supports the MISRA®-C:2004 rule standard.

Atollic TrueSTUDIO®



TrueVERIFIER™: Get Superior Software Quality with Embedded Test Automation

Atollic TrueVERIFIER is a tool for advanced test automation. The product performs source code analysis and auto-generate unit-test suites that exercise an extensive set of different execution paths. The tool downloads the test cases and runs them in a target board with code coverage monitoring. Finally, Atollic TrueVERIFIER visualizes the test results and the achieved code coverage (MC/DC-level).

TrueANALYZER®: Measure Test Quality with Dynamic Execution Flow Analysis

Atollic TrueANALYZER is a tool for in-target measurement of test quality. The product performs system-level dynamic execution flow analysis and provides rigorous code coverage measurements. Atollic TrueANALYZER supports many types of code coverage analysis up to the level of modified condition/ decision coverage (MC/DC-level), which is required by RTCA DO-178B (Level A) for flight-control-system software.

For more information on Atollic tools, visit **atollic.com**.

Code Red Technologies

Code Red Technologies is focused on full-chip support for 32-bit ARM® based MCUs, with a goal of enabling embedded systems designers to get running with their applications in just minutes instead of weeks. Code Red Technologies' products include software development tools, such as debut probes (JTAG and SWD) and hardware development kits.

Red Suite

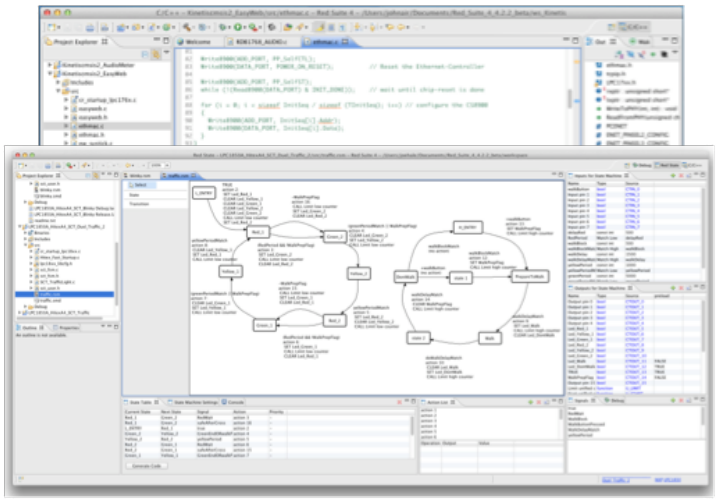
Red Suite 4 is a highly integrated C/C++ software development environment for ARM-based MCUs and includes all the tools necessary to develop high-quality software solutions in a timely and cost-effective fashion. Red Suite features the industry standard GNU tool chain with Code Red Technologies MCU optimized C libraries based around the latest version of Eclipse with many ease-of-use and MCU- specific enhancements.

The Red Suite Integrated Development Environment (IDE) provides a C/C++ programming environment second to none, with syntax-coloring, source formatting, function folding, online and offline integrated help, extensive project management automation and integrated source repository support (CVS integrated or subversion via download). Being Eclipse based also allows the use of many additional plug-in tools such as unit testing automation, source code analysis and more.

Key Features

- Delivered electronically as a no-fuss, single install for the complete product
- Supports ARM Cortex™-M0, -M0+, -M3, -M4 based devices, including floating point units
- Support for all Kinetis MCUs
- Includes small footprint Redlib MCU optimized C library, as well as GNU Newlib
- Full support for both JTAG and low-pin count SWD debugging via Red Probe+ and other supported debug probes
- Runs on Windows XP, Vista, Windows 7 (32-bit and 64-bit), Linux® and Mac OS X
- Command-line flash utility provided for batch/production operation
- Fully functional, time-limited, evaluation available for all host platforms

Red Suite IDE



Project Wizards

A variety of different project wizard templates are provided for each supported MCU, allowing the rapid creations of correctly configured application and library projects, including support for creation of projects based on latest version of the ARM Cortex MCU Software Interface Standard.

Peripheral Views

The peripheral viewer provides complete visibility into all target peripherals in a simple structured display and shows all registers and bit fields, including enumerations.

Target Memory Layout

The knowledge that Red Suite has of the target MCU allows an appropriate linker script to be automatically generated at build time.

Red Suite also offers a memory editor and external flash driver mechanism. This allows for the details of external flash to be defined or for the layout of internal RAM to be reconfigured. In addition, it allows a flash driver to be allocated for use with parts with no internal flash, but where an external flash part is connected.

Red Trace

When used with Red Probe+ on ARM Cortex-M3 and ARM Cortex-M4 based MCUs, the integrated Red Trace functionality provides an unprecedented level of visibility into what is really happening on the target device. Unlike traditional trace solutions, Red Trace gathers trace data non intrusively while the target application continues to run at full speed. Instruction tracing technology allows post-mortem views of the instructions that have been executed up to an event and is available on devices implement the ARM ETB hardware.

Red State

Red State is a graphical tool for designing state machines and automatically generating the code required to implement the state machine. It supports both software state machines and the hardware assisted state machine peripherals.

Red Probe+

Red Probe+ is a High-Speed USB debug probe specially designed for use with ARM-based MCUs. Featuring complete integration with the Red Suite family, Red Probe+ allows high-speed download to RAM and direct programming of on-chip flash. When used with ARM Cortex-M3 and Cortex-M4 targets, built-in support for SWV allows full support for data trace, instruction and exception profiling and application sourced diagnostics. Together with the Red Suite family, Red Probe+ provides a complete development and debug environment for ARM-based MCUs.

For more information, visit **code-red-tech.com/freescale**.

code_red™

IAR Systems

IAR Embedded Workbench

IAR Embedded Workbench is a set of development tools for building and debugging embedded applications using assembler, C and C++. It integrates the highly optimizing IAR C/C++ compiler, assembler, linker, librarian, text editor, project manager and C-SPY debugger in a user-friendly IDE. In a continuous workflow, you can create source files and projects, build applications and debug them in a simulator or on hardware.

IAR Embedded Workbench is available for nearly the entire lineup of Freescale MCUs, including the S08, HCS12, ColdFire, i.MX and Kinetis families, and Vybrid controller solutions. Regardless of which Freescale device you have chosen to work with, you will experience the same intuitive user interface coupled with target-specific support for each device. Reuse of code and migration to new MCU architectures is made easy. Included with IAR Embedded Workbench for ARM® are over 3,000 example projects to help you get your project off the ground quickly.

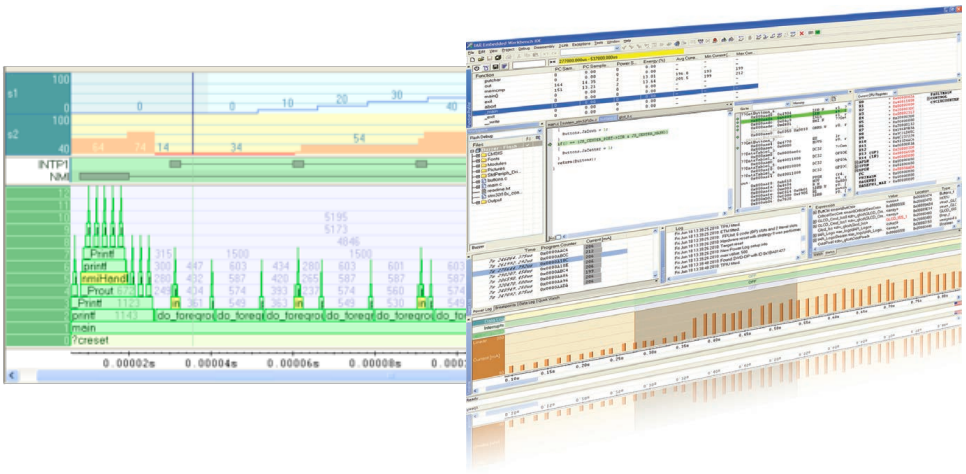
IAR Systems supplies the I-jet and JTAGjet in-circuit debugging probes, with support for ARM and ARM Cortex™ cores. Extensive technical support is provided by IAR Systems.

IAR Embedded Workbench IDE

Key Components

- Integrated development environment with project management tools and editor
- Highly optimized C and C++ compiler generating extremely compact code
- C-SPY® simulator and hardware debugger systems
- Timeline window visualizes call stack, interrupts and variable values over time
- Power debugging visualizes power consumption correlated to the code execution
- Code coverage and function profiling analysis utilities
- Static and runtime stack analysis
- Built-in MISRA C checker
- Integration with Subversion and other source code control systems

IAR Embedded Workbench



- Kernel-aware debugging for most RTOS, including MQX™, Express Logic's ThreadX, FreeRTOS and Micrium uC/OS-II and III
- Information center provides quick access to user guides, examples and other useful information
- User and reference guides in PDF format
- Context-sensitive online help

Timeline

IAR Embedded Workbench provides advanced features for powerful trace debugging. The timeline window graphically displays correlated information about various properties on a single timeline.

- Visualization of the call stack provides information about depth of stack and length of each function call
- Interrupt graph displays events taking place in the application
- Variable values are plotted over time

Power Debugging

IAR Systems' innovative power debugging technology allows you to optimize your system for lower power consumption.

- Visualization of power consumption over time in the timeline window
- Simultaneous visualization of the call stack, interrupts and variable values provides a high-level view of the system's power consumption
- Power log provides high-resolution power data
- Power consumption is correlated to the source code (Click in the power graph and the corresponding source code is highlighted)
- Power profiling utility

IAR-MQX Integration

The Freescale MQX software solution has been integrated with IAR Embedded Workbench. A ready-made port that can be compiled and linked using IAR Embedded Workbench is available and ready for use. IAR C-SPY debugger provides kernel awareness for the MQX RTOS, as well as other operating systems. Kernel awareness in the debugger allows the user to examine operating system properties during a debug session.

- Operating system properties such as tasks, semaphores and mailboxes can be monitored
- Execution control can be kernel dependent. For instance, it is possible to set breakpoints on conditions for specific operating system properties

IAR Systems has an extensive RTOS Partner Program that includes FreeRTOS and ThreadX. IAR Systems also offers state machine tools and provides professional worldwide technical support.

For more information, visit **iar.com/freescale**.

IAR SYSTEMS

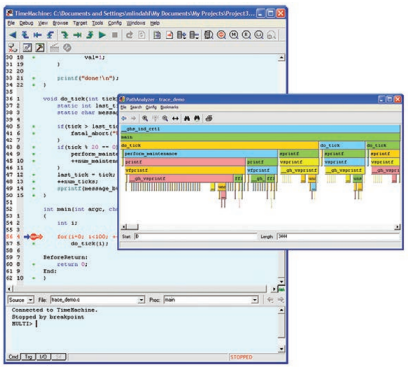
Green Hills Software

MULTI Development Environment and JTAG/trace Probes

MULTI provides a host-based (Windows®, Linux® or UNIX workstation) graphical environment for ARM target development. Host-target connectivity is provided through a variety of means, depending on the target environment. MULTI supports many ARM® targets.

The DoubleCheck integrated static analyzer finds code sequences that may result in buffer overflows, resource leaks and many other security and reliability problems. It is effective at locating a significant class of defects that are not detected by compilers during standard builds and often go undetected during runtime testing or typical field operation.

TimeMachine™ Debugging



The TimeMachine suite extends the range of the MULTI IDE by providing a window into the complex interactions in software that can result in bugs, performance problems and testing nightmares.

The MULTI TimeMachine™ debugging suite offers a wide variety of trace analysis tools that enable embedded software developers to find and fix bugs faster, optimize with ease and test with confidence. By presenting the information in easy-to-understand displays, TimeMachine enables developers to quickly navigate through trace data and produce better code in less time.

Learn more at **ghs.com/products/arm_development.html**.

IDEs and Hardware Emulators/Debuggers

Lauterbach

MPU Development Tools

The TRACE32 PowerTools are designed with an open debug environment that offers sophisticated features for quick and effective testing of your i.MX, Vybrid or Kinetis design.

The optional ETM/PTM trace port analyzer allows detection of complex errors that only occur under runtime conditions as well as powerful performance and runtime statistic analysis to optimize the program's behavior.

Lauterbach Development Tools

Debug Features

- Hosts: Windows, Linux, Solaris, OS-X
- Host interfaces: USB 2.0, Gigabit Ethernet
- Target interfaces: JTAG, Serial Wire Debug, IEEE1149.7, 0.4–5.0 V, 4 kHz–100 MHz
- Support for more than 60 core architectures
- C and C++ support for all standard compilers
- Awareness for all commonly used RTOS
- Multicore debugging for any mixture of ARM and DSP cores
- Support for symmetric multiprocessing (SMP)
- Flash programming support
- Instruction set simulator for debugging without target hardware
- Interface for debugging virtual prototypes (Synopsys, ARM)
- Integration of third-party tools (Eclipse, Rhapsody, etc.)
- CoreSight technology support
- TrustZone technology support
- VFP, NEON support
- Support for debug communication channel and semihosting
- Halt mode and monitor mode debugging

Trace Port Analyzer Features

- Up to 32-bit ETM/PTM trace port width
- Off-chip trace data rate beyond 600 Mb/s per channel
- Up to 4 GB trace memory
- All ETM/PTM protocols and modes supported
- Powerful trace filter and trigger
- Runtime analysis of functions and tasks
- Code coverage analysis
- Cache analysis
- Context tracking system for re-debugging of the sampled program flow
- Real-time streaming of trace data to a host application
- Energy consumption measurement correlated with program flow
- Logic analyzer (timing and state analyzer)
- Support for on-chip trace memory (ETB, TMC)
- Time correlated display of multiple trace sources (CoreSight ETM, PTM, HTM, ITM, STM)
- Support for CoreSight Single Wire Viewer

For more info, visit **lauterbach.com**.

freescale.com/ARM

P&E Microcomputer Systems

Multilink and Cyclone

USB Multilink Debug Interfaces

P&E Microcomputer Systems' USB multilinks are affordable, development-oriented interfaces that allow access to the debug interface on a target MCU from the user's PC. The new Multilink Universal and Multilink Universal FX combine support in a single interface for many Freescale architectures, including Vybrid controller solutions and Kinetis MCUs. The FX version also provides much higher communications speeds for some architectures (up to a 10x speed improvement), and can be used to power the target device. These "universal" Multilinks include ribbon cables

Multilink and Cyclone

to allow connections to all of the supported architectures. P&E's Multilinks are supported by CodeWarrior as well as toolchains from Keil, IAR, Cosmic and others.

Cyclone Production Programmers

P&E's Cyclone products are geared towards in-circuit production programming, including both low-volume, operator-controlled programming and high-volume automated programming. The Cyclone can be used to program both internal memory on a Freescale processor/MCU as well as external memory connected to the processor's address/data bus.

For more information, visit **pemicro.com**.

IDEs and Hardware Emulators/Debuggers

SEGGER

J-Link and Flasher

Designed using SEGGER's industry-leading embedded software, SEGGER's development and production tools offer a wide array of advanced features and boast support for a broad spectrum of MCUs and MPUs, including Freescale i.MX processors, Kinetis MCUs and Vybrid controller solutions.

J-Link Industry-Leading JTAG/SWD Probe

J-Link is the de facto standard for JTAG probes in the ARM® world and is known for its ease of use and setup. The unlimited flash breakpoints technology lifts the limited availability of breakpoints when debugging in flash memory. Additionally the J-Link comes with incredibly fast flash download algorithms, which are complemented by the very high download speed of up to 1.5 Mb/s (J-Link ULTRA). J-Link is supported by all popular tool-chains, such as CodeWarrior, TrueStudio, MDK, Embedded Workbench and any GDB-based debug solution.

J-Link

The J-Link is available in a variety of models to fit every development/production need:

- J-Link
- J-Link ULTRA (higher performance)
- J-Link ULTRA+ (higher performance, all enhancement module licenses)
- J-Link PRO (adds Ethernet interface, all enhancement module licenses)
- J-Trace ARM Cortex™-M (including embedded trace macrocell support)
- J-Link Lite (very small form factor, emulator solution for evaluation boards)

Flasher ARM Production Tool

Flasher ARM uses the same fast flash download algorithms as the J-Link and offers multiple connectivity options to easily integrate into any production environment. The Flasher can be connected by USB, RS232 or Ethernet. The operation of the Flasher can be triggered by pressing a button, by command line interface, by graphical user interface, or by terminal or two-wire-handshake hardware interface.

For more info, visit **segger.com/jlink.html**.

RTOS, Embedded Software Tools and Middleware

Express Logic

ThreadX

ThreadX is Express Logic's advanced RTOS designed specifically for deeply embedded applications. ThreadX has many advanced features, including its picokernel™ architecture, preemption-threshold™ event-chaining,™ and a rich set of system services. Combined with its superior ease of use, ThreadX is the ideal choice for the most demanding of embedded applications. Express Logic also offers FileX, NetX, PEGX, USBX, TraceX and StackX.

For more details, visit **rtos.com/products/threadx**.

RTOS, Embedded Software Tools and Middleware

Real Time Engineers Ltd.

FreeRTOS

FreeRTOS is a market-leading priority-based pre-emptive RTOS that supports 31 architectures and receives 77,500 downloads a year. It is professionally developed, strictly quality controlled, robust, supported, free to download, and free to use in commercial products without any requirement to expose your proprietary source code. Each official port includes a pre-configured example application that demonstrates the kernel features, expedites learning and enables out-of-the-box development. Such projects are included for popular Freescale designs, including the Tower System modular development platform. The FreeRTOS+IO input/output abstraction layer and FreeRTOS+CLI command line interface add-on components are also available.

RTOS, Embedded Software Tools and Middleware

Green Hills Software

INTEGRITY RTOS, u-velOSity™ RTOS and Middleware

Real-Time Operating Systems

- µ-velOSity royalty-free RTOS is a small, fast, easy-to-learn operating system for the most cost-sensitive and resource-constrained devices. Supported on the Kinetis and Vybrid products.
- INTEGRITY RTOS is built around a partitioning architecture to provide embedded systems with total reliability, absolute security and maximum real-time performance. Supported on the i.MX products.

Software Development Tool

- MULTI® and AdaMULTI™ development environments allow to quickly develop, debug, test and optimize embedded and real-time applications
- TimeMachine™ debugging suite allows the user to find the most outrageously difficult bugs—in minutes
- DoubleCheck™ integrated static analyzer easily pinpoint bugs early in development
- Green Hills optimizing compilers generate the smallest and fastest code from C, C++, Ada 95 and Fortran

Processor Probes

- SuperTrace™ Probe allows for fast trace, download and debug
- Green Hills Probe for high-performance real-time debugging

ARM Optimizing Compilers

The Green Hills Compiler for ARM generates architecture-specific and even processor-specific optimizations to use the pipeline and instruction set characteristics of each supported ARM processor model. Green Hills offers further optimization through CodeFactor, a link-time optimization that reduces overall program size by identifying and removing redundant segments of code from object files.

Green Hills C/C++ Compilers fully conform to ANSI/ISO industry standards and include optional enforcement of MISRA C programming guidelines.

Mentor Graphics

Nucleus

Since the first release on ARM® in 1993, Nucleus has become the most deployed commercial RTOS shipped in nearly 3 billion units, many of which are ARM-based devices. Nucleus is a proven RTOS that's stable, deterministic and highly scalable with kernel sizes that can go as small as 2K. Nucleus is supported on the i.MX products. ReadyStart for the i.MX28 family includes rich connectivity support fully integrated out of the box with USB, Wi-Fi®, CAN, I²C, SPI, ZigBee®, Bluetooth® and more. The Nucleus Power Management Framework takes full advantage of readily available power management APIs and enables power-aware peripherals to minimize power consumption. Nucleus automatically manages dynamic voltage frequency scaling (DVFS) with a single API to help increase battery life, simplify mechanical design and stay compliant with industry power standards.

For more information, visit **mentor.com/embedded-software/nucleus**.

RTOS, Embedded Software Tools and Middleware

Micrium

µC/OS

µC/OS-III is Micrium's newest RTOS, designed to save time on embedded system projects. In addition to the features inherent in µC/OS-II, µC/OS-III also manages an unlimited number of application tasks and features an interrupt disable time of near zero. Micrium's µC/OS-III supports the i.MX applications processors, Kinetis MCU families and Vybrid controller solutions.

µC/OS-III: The Real-Time Kernel and the Freescale Kinetis ARM® Cortex™-M4 Textbook

Learn the essentials of real-time operating systems. Part I of this comprehensive and detailed book provides a thorough explanation of Micriµm's popular µC/OS-III real-time kernel. Part II describes practical, working applications for embedded medical devices built on µC/OS-III and our TWR-K53N512 Tower System module for medical applications, which is based on the ARM Cortex-M4 processor, and uses CodeWarrior development studio and IAR Systems development tools. The hands-on working examples include a heart rate monitor, blood glucose meter, pulse oximeter and blood pressure monitor.

µC/OS-III

For more information, visit **freescale.com/TWR-K53N512**.

Micriµm
Empowering Embedded Systems

RTOS, Embedded Software Tools and Middleware

SEGGER

embOS-RTOS

SEGGER offers a feature-rich, high-performance RTOS, GUI and family of middleware (file system, USB host and device, IP stack), all of which adhere to strict, yet efficient coding and documentation standards. The software is optimized for the lowest of resource usage. The software is very easy to use and works right out of the box. BSPs and projects for popular evaluation boards and tool chains are available, including BSPs for the popular Freescale-based designs. SEGGER offers very flexible license models to meet the needs of any sized project.

Embedded Software

- embOS: RTOS offering a very small footprint, fast context switch
- emWin: GUI runs on any MCU, any display controller, any display
- emFile: File system with fail-safe driver level, sophisticated flash memory support
- emUSB: USB host and device with flexible communication classes
- embOS/IP: One of the fastest embedded IP Stacks in the market

For more details, visit **segger.com/freescale.html**.

SEGGER
www.segger.com

Timesys
LinuxLink

Timesys helps to eliminate the learning time, complexity and risk in building and maintaining embedded Linux® devices. As a leader among embedded Linux solution providers, Timesys offerings are available for Freescale ARM®-based solutions, including Kinetis, i.MX and Vybrid products.

Timesys offers the award-winning LinuxLink embedded development system, expert Linux support and experienced professional services to help development teams bring open source Linux-based products to market faster and cheaper.

With a LinuxLink subscription for your Freescale processor, you can:

- Quickly assemble and boot an initial embedded Linux image on your Freescale development kit.
- Patch/configure/rebuild/update your custom Linux platform on your desktop with a properly installed and configured development environment.
- Debug/tune the platform with common open source development tools and development libraries/utilities.
- Obtain help with common development tasks via technical assistance and a rich library of Timesys-authored "How To" documentation.

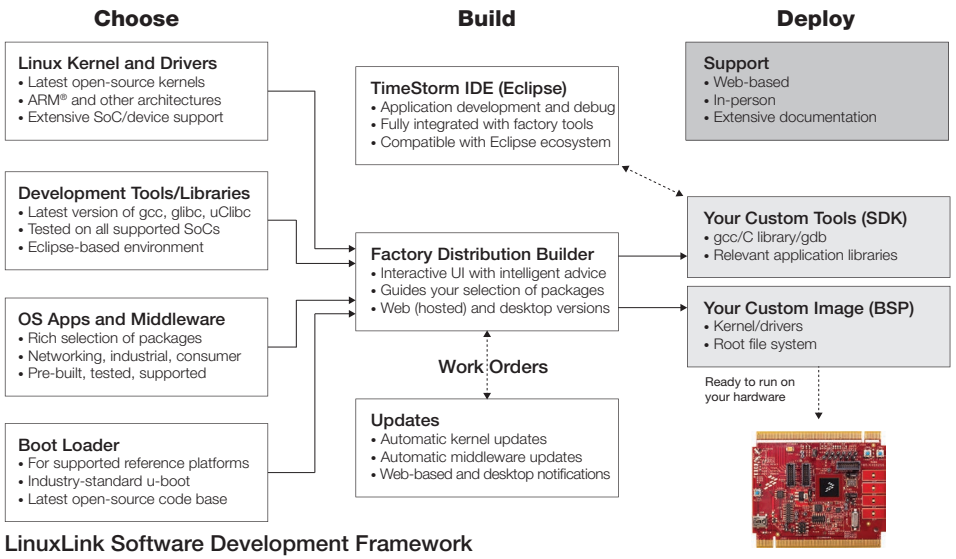
Key LinuxLink Components: Linux Kernel, Toolchain, Software Packages, Bootloader

All Timesys Linux platforms are built and tested for compatibility with our semiconductor partners' suggested bootloader, saving time with initial board bring up.

Factory Distribution Builder

Timesys' Factory Distribution Builder enables complete customization of your Linux platform and integration of third-party and proprietary software. Also includes innovative "advice" and "recommendation" engines to minimize mistakes.

Timesys LinuxLink



LinuxLink Software Development Framework

TimeStorm IDE

TimeStorm's powerful suite of application development tools expertly handles embedded chores like cross-compiling and remote debugging while including support for advanced features like profiling, testing and leak detection. And TimeStorm is built on the Eclipse IDE foundation, a platform already familiar to developers.

Update Notifications

As a LinuxLink user, you'll only receive automatic notifications of updates relevant to the Linux components used in your software.

Unmetered Expert Linux Help

As a LinuxLink subscriber, you'll have access to responsive technical support from our expert engineers. Intuitive online support enables detailed information exchanges and allows you to submit, view and update requests, and access or reopen resolved requests.

Get Your Free LinuxLink—Build Your Custom BSP/SDK in Minutes

Register for a Free LinuxLink account, and assemble a Linux image that you can download and run on your board. Register at **timesys.com/register**.

For more information about Timesys' LinuxLink embedded Linux build system, visit **timesys.com/linuxlink**.

Embedded Linux from a Trusted Source
timesys®

RTOS, Embedded Software Tools and Middleware

Wind River

VXWorks

Wind River is proud to support Freescale i.MX processors with VxWorks, the industry-leading real-time operating system with a demonstrated track record of success across millions of applications in the Embedded Systems market. Deployed in diverse verticals, from consumer devices to aerospace and defense, from networking to medical, VxWorks maintains its leadership position by providing a mature and proven foundation for customer innovation.

Wind River also supports i.MX processors with a marketing-lead commercial embedded Linux platform and a suite of Android™ based products for embedded applications.

For more information, visit **windriver.com**.

WIND RIVER

RTOS, Embedded Software Tools and Middleware

QNX

RTOS Software, Development Tools, Multimedia and HMI Middleware

QNX Software Systems is a leading provider of safe and secure RTOS software, development tools, multimedia and HMI middleware and services for embedded design. For 30 years, QNX has served the complex needs of the embedded market, with millions of installations worldwide, in mission-critical and life-critical environments.

Together, QNX and Freescale address the needs of the embedded market. QNX's state-of-the-art multicore programming capabilities and highly distributed architecture combined with our leading multicore processors position the two companies uniquely going forward. QNX's advanced multimedia capabilities and our automotive, medical, industrial and consumer products provide a compelling joint value proposition for these markets.

For more information, visit **qnx.com**.

QNX SOFTWARE SYSTEMS

UI Tools

Advanced UI Tools for i.MX-Based 2D and 3D Graphic Solutions

The primary differentiator in smart devices is the user experience. The marketplace demands increasingly sophisticated user interfaces that provide stunning graphics and intuitive operation, often at a significant development investment. To simplify UI development by reducing product development risk with lower in-house development costs, Freescale has teamed up with a solid set of partners with UI tools and expertise to accelerate products to market.

Most partners are compatible with a broad range of operating systems, including Android™ and Linux®, either out of the box or with custom configurations.

UI Tools—Advanced Tools for i.MX

Partner	Offering	Link
Mentor Inflexion	Hardware-optimized 3D i.MX graphics	**mentor.com/embedded-software/inflexion/freescale**
Nokia/Qt	Community open source	**imxdev.org/wiki/index.php?title=All_Boards_Qt**
Crank Software, Inc.	Storyboard suite: Rapid development environment for rich animated user interfaces (UI/HMI)	**cranksoftware.com/services_support/iMX.php**
Rightware	Custom optimization for the i.MX 6 series triple play GPU architecture	**rightware.com/en/Kanzi+UI+Solution/**
Youl Labs	Natural user interface framework, UX tools and development services	**youilabs.com**

Embedded Board Solutions

OEMs are faced with the increasing challenge of bringing innovative products to the market quicker. In many cases, their resources have seen a dramatic change from hardware to software engineering. Add to this the increasing complexity of today's high-performance MPUs with high-speed memory and I/O signals. To aid OEMs in designing with our latest MPUs, we offer a robust ecosystem of software and hardware enablement.

Embedded Board Solutions

The embedded board industry has developed the expertise necessary to assist OEMs with the challenges of time to market and dealing with high-speed processors, memory and I/O signals. These companies take an active role in standards development for form factors, signals and operating systems that ultimately help with the final board cost and reduce the OEM's time to market. Companies such as those that support i.MX products and are listed in the above table provide a broad spectrum of form factors, processors, features and software enablement to ease the "make vs. buy" decision process for OEMs.

Embedded Board Solutions Enablement

Freescale has long-standing relationships within the embedded board industry. We serve the same markets, including aerospace and defense, industrial and consumer. Our support for these markets is not in silicon alone. A close working relationship with OS and tool vendors is essential to ensure our customers have access to complete solutions that enable them to achieve their time to market goals. Our system integrators provide Linux®, WinCE®, Android™ OS and RTOS requirements that our customers require.

In addition, we are an active member of standards committees that support this industry, such as RapidIO® Trade Associate, PICMG®, Linaro™ and The Multicore Association™. These standards bodies work with other industry participants to provide specifications that allow for richer and more cost-effective solutions to the market.

Our participation allows for a broad ecosystem that enables our technologies and products. To ease the "make vs. buy" decision, Freescale has partnered to provide a series of development systems that include an array of modules satisfying the needs of our target markets. These systems aid in software development and provide access to i.MX processors.

More Information

The Freescale Connect Program highlights ecosystem partners that provide products and services enabling Freescale products. Our embedded board partners provide a complete spectrum of solutions and supporting software. For more information, visit **freescale.com/EBS**.

i.MX Embedded Board Solutions

Embedded Board Eco-Partner	i.MX Technology				Embedded Market Segments			
	i.MX28	i.MX50	i.MX53	i.MX 6 Series	General Embedded	Industrial	Medical	Telecom
Advantech			√	√	√	√	√	√
SECO	√		√	√	√	√	√	
Boundary Devices			√	√	√	√		
Digi International	√		√		√	√	√	√
TechNexion			√	√	√	√		
iWave Systems		√	√	√	√	√	√	
KaRo	√		√		√	√	√	√
NovTech			√	√	√	√	√	√
TQ-Components	√		√		√	√		

Partner Driven i.MX Development Tools

Boards built to Freescale SABRE Lite design (available now)

An ecosystem-supported board is a low-cost open source development platform integrated with an ARM® Cortex™-A9 1.2 GHz processor. The Freescale SABRE Lite design includes a display controller, hardware accelerated graphics, 1080p video decode and 720p encode as well as numerous connectivity options ideally suited for applications such as human-machine interface in embedded consumer, industrial and medical markets.

freescale.com/ARM

Production-ready ecosystem solutions already exist around most major operating systems to accelerate your time to market. Order at **boundarydevices.com/products-2/sabre-lite-imx6-sbc/** or at **element14.com/community/docs/DOC-49013?CMP=KNC-USA-Knode-SabreLiteDoc**.

i.MX50 Quick Start Board

The i.MX50 partner-supported board is a cost-effective, open source multipurpose platform. It includes a built-in EPD controller for compact e-readers using the Freescale ARM Cortex-A8 800 MHz processor with lower power consumption. Linux® and Android™ support make it ideally suited for industrial, medical, e-readers and general embedded applications.

Order at **iwavesystems.com**.

For more information about Freescale ARM products and documentation, please visit freescale.com/Kinetis and freescale.com/ARM

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