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What is "Embedded - Microcontrollers"?

"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	ARM® Cortex®-M7
Core Size	32-Bit Single-Core
Speed	240MHz
Connectivity	CANbus, Ethernet, I²C, SPI, UART/USART
Peripherals	DMA, LVD, POR, PWM, WDT
Number of I/O	74
Program Memory Size	1MB (1M x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	256K x 8
Voltage - Supply (Vcc/Vdd)	1.71V ~ 3.6V
Data Converters	A/D 4x12b, 1x16b; D/A 1x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 105°C (TA)
Mounting Type	Surface Mount
Package / Case	100-LQFP
Supplier Device Package	100-LQFP (14x14)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/mkv58f1m0vll24

Freescale Semiconductor, Inc.
Product Brief

Document Number: KV5xPB
Rev. 0, 02/2015

Kinetis KV5x – Real-Time Control MCUs with Ethernet

Up to 1 MB Flash and 256 KB SRAM

1. Kinetis V family introduction

Kinetis V series microcontrollers (MCUs) combine the performance and precision needed for real-time control applications, such as motor control and power conversion, with the ease-of-use of ARM® Cortex®-M processor combined with the performance, peripheral set, enablement, and scalability of the Kinetis 32-bit MCU portfolio.

The Kinetis KV5x family of MCUs is a high-performance solution offering exceptional precision, sensing, and control for some of the most demanding applications in motor control and power conversion. Built upon the ARM Cortex-M7 core running at 240 MHz with single precision floating point unit, it features advanced high-speed and high-accuracy peripherals such as high-resolution pulse width modulation (PWM) with 312-picosecond resolution, four 12-bit analog-to-digital converters (ADCs) sampling at 5 mega samples per second (MSPS), a total of 44 PWM channels for support of multi-motor systems with PFC, three FlexCAN modules and optional Ethernet communications. The KV5x is supported by a comprehensive enablement suite from Freescale and third-party resources including reference designs, software libraries, and motor configuration tools.

Contents

2. Kinetis KV5x sub-family overview

The Kinetis KV5x is a real-time control MCU family primarily targeting high-performance industrial motor control, industrial drives and automation, and power conversion applications. The KV5x provides an easy migration path from the Kinetis KV4x MCU family with additional memory, Ethernet communications, and high-precision peripheral options beyond those already offered. All Kinetis V series MCUs are compatible with the Kinetis K series MCU family (based on the ARM Cortex-M4 core) and with all Kinetis V series MCU families providing a highly scalable migration path between high performance and rich feature integration for cost-optimized solutions.

- KV56 - Broad offering with high-precision analog and digital integration and scalable Flash and RAM.
- KV58 - Expansion from the KV56 family with addition of the Ethernet communications with true random number generator and cryptography unit.

3. Kinetis KV5x key product features

- High-performance 240 MHz ARM Cortex-M7 core with a high level of analog and digital integration targeted at real-time control applications.
- Utilizes the ARM Cortex-M7, which is ideally suited for real-time control applications.
  - **DSP instructions with single precision floating point** - lower system cost by replacing the DSP or FPGA integrated circuits. Allows faster control loops for improved real-time control. Lower your average power by reducing time spent in chip processing modes.
  - 64-bit tightly-coupled memory interfaces for **high-performance deterministic processing**, increasing system performance and throughput.
  - 64-bit AXI memory interface with I-Cache and D-Cache for **efficient access to external resources**; interface to large external memories for a complete RTOS experience, support for multiple connectivity stacks and middleware.
  - **M-Class compatibility with higher performance** - scalable from existing ARM Cortex-M4 implementations to support faster time to market. Low-interrupt latency for real-time systems.
- Up to 1 MB of Flash and 256 KB of RAM, 16 KB of instruction cache and 8 KB of data cache. 256 KB of RAM includes 64 KB of ITCM RAM, ensuring maximum CPU performance of fast control loops with minimal latency.
- Wide Flash interface supports secure and fast access to safety-critical control parameters, minimizing CPU wait states.
- The four ADC blocks, two banks of two, sampling at 5 MSPS with dual sample and hold circuitry, can capture current and voltage for two motors simultaneously, giving true independent dual motor control, or provide the ability to read all three currents / voltages simultaneously, providing the most accurate results.
- Ethernet option with true random number generator and cryptographic unit provide a low-cost integrated connectivity solution.

- The multiple instantiations of timer blocks provide a vast array of timers (44 channels), simplifying the complex task of advanced motor control.
- The two eFlexPWM blocks provide four independent time bases per module with a highly flexible configuration that easily supports motor-control and power-control topologies.
- A single eFlexPWM block featuring 12 channels with nano-edge capability, providing up to 312-picosecond resolution on pulse width and frequency modulation.
- An inter-peripheral cross bar, with And or Invert logic, provides a highly-flexible connection fabric between peripherals that supports simplified control topology implementation.

4. Kinetis KV5x product family feature summary

Table 1. Family feature summary

Feature	Details
System	
Central processing unit (CPU)	ARM Cortex-M7
Max CPU frequency	240 MHz
Caches	16 KB of instruction cache + 8 KB of data cache
Floating point	Single-precision floating point unit (SPFPU)
Direct memory access (DMA)	32 channels
DMA request multiplex	Two 16-channel DMAMUX; each with 64 inputs
Encryption	Memory-mapped crypto acceleration unit (MMCAU)
Software watchdog (iWDOG)	Independent clock source with windowed mode
External watchdog monitor	Watchdog with independent clock source
Debug	JTAG and 2-pin serial wire debug (SWD)
Trace	Instruction trace capability
Memory	
Flash memory	Up to 1 MB x 256-bit wide
Random-access memory (RAM)	Up to 256 KB of total RAM partitioned: 64 KB - ITCM, 64 KB - DTCM0, 64 KB - DTCM1, 64 KB - OCRAM
Memory protection	ARM CM7 memory-protection unit (AMPU) and system memory-protection unit (SMPU)

Table 1. Family feature summary

Feature	Details
Cyclic redundancy check (CRC)	16- or 32-bit CRC with programmable generator polynomial
External bus interface	Flexbus (32- / 24- / 16- / 8-bit muxed support)
Analog modules	
Analog-to-digital converters	Four 12-bit analog-to-digital converters (ADC) with a sample rate of 5 MSPS One 16-bit SAR ADC
High-speed comparator (HSCMP) with internal 6-bit digital-to-analog converter (DAC)	Four modules
12-bit DAC	12-bit DAC with 16-byte FIFO
Nano-edge module	One nano-edge module providing 312-picosecond pulse width and frequency resolution
Timers	
FlexPWM	Two eFlexPWM modules, each consisting of four submodules, with each submodule providing three PWM outputs FlexPWMA has nano-edge support FlexPWMB has dithering support
FlexTimer (FTM)	Two 8-channel FlexTimers backward compatible to KV4x Two 2-channel FlexTimer with quadrature decoding
Quadrature encode / decode unit	One module
Programmable delay block (PDB)	Two modules
LPTimer	CPU wakeup from low-power mode
PIT	One 4-channel PIT
Communication Interfaces	
Ethernet	10 / 100 MB/s Ethernet MAC (MII and RMII) with hardware support for IEEE 1588
Serial peripheral interface (DSPI)	Three modules with 4-word-deep FIFO
Inter-integrated circuit (I2C)	Two modules with SMBUS support
Flexible serial communications interface (FlexSCI)	Six modules All SCIs have IrDA support SCI0 and SCI1 have 8-word-deep FIFO
FlexCAN	Three modules

Table 1. Family feature summary

Feature	Details
Human-machine interface (HMI)	
General-purpose input / output (GPIO)	Three V I/Os with enhanced ESD protection
Maximum number of I/Os	74 on 100-pin 111 on 144-pin
Hardware characteristics	
Package	100 LQFP (14 mm x 14 mm) 144 LQFP (20 mm x 20 mm) 144 MAPBGA (13 mm x 13 mm)
Voltage range	1.71 V to 3.6 V
Temperature range (TA)	-40°C to 105°C

5. Kinetis KV5x family block diagram

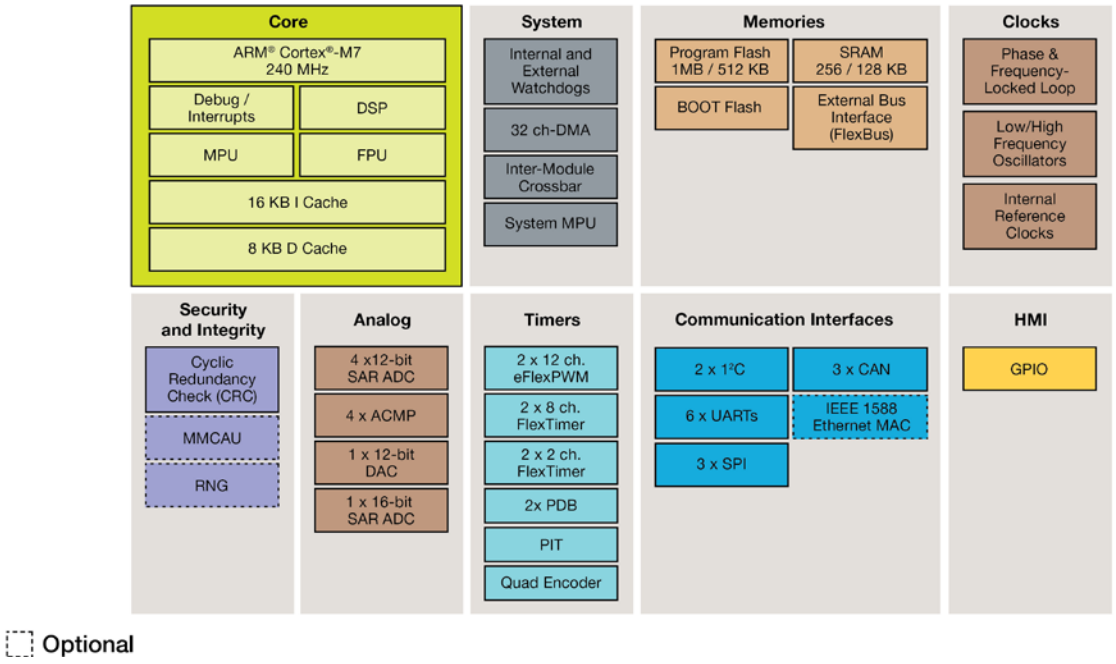

Figure 1. Kinetis KV5x family block diagram

6. Kinetis KV5x product family

Table 2. Product family

Device	Max. Freq.	Pins	Flash	SRAM	ENET	Flex. Bus	HS ADC		eFlexPWM	FlexTimers	CAN	Max I/O
MKV58F1M0	240 MHz	144	1 MB	256 KB	Yes	Yes	4	8-ch	2 x 12-ch	2 x 8-ch, 2 x 2-ch	3	111
MKV58F1M0	240 MHz	100	1 MB	256 KB	Yes	Yes	4	8-ch	2 x 12-ch	2 x 8-ch, 2 x 2-ch	3	74
MKV56F1M0	240 MHz	144	1 MB	256 KB	No	Yes	4	8-ch	2 x 12-ch	2 x 8-ch, 2 x 2-ch	2	111
MKV56F1M0	240 MHz	100	1 MB	256 KB	No	Yes	4	8-ch	2 x 12-ch	2 x 8-ch, 2 x 2-ch	2	74
MKV58F512	240 MHz	144	512 KB	128 KB	Yes	Yes	4	8-ch	2 x 12-ch	2 x 8-ch, 2 x 2-ch	3	111
MKV58F512	240 MHz	100	512 KB	128 KB	Yes	Yes	4	8-ch	2 x 12-ch	2 x 8-ch, 2 x 2-ch	3	74
MKV56F512	240 MHz	144	512 KB	128 KB	No	Yes	4	8-ch	2 x 12-ch	2 x 8-ch, 2 x 2-ch	2	111
MKV56F512	240 MHz	100	512 KB	128 KB	No	Yes	4	8-ch	2 x 12-ch	2 x 8-ch, 2 x 2-ch	2	74

7. Comprehensive enablement solutions

7.1. Freescale Embedded Motor Control and Power Conversion libraries

- Extensive suite of complimentary software libraries for motor-control and power-conversion applications.
- A group of algorithms, ranging from basic mathematical operations to advanced transformations and observers that can be easily incorporated into complex real-time control applications.
- The complimentary algorithms help to speed up development and ease of use in applications that require intensive math computation and control.

7.2. Freescale MQX™ RTOS and complimentary TCP/IP stack

- Freescale MQX RTOS is a full-featured, complimentary, real-time operating system including the MQX kernel, TCP/IP stack, embedded MS-DOS file system, and more.
- The MQX multi-tasking kernel provides preemptive scheduling, fast interrupt response, extensive inter-process communication and synchronization facilities.
- The MQX RTOS features the Freescale MQX real-time TCP/IP Communication Suite (RTCS) that now supports IPv6. The RTCS provides IP networking for embedded devices, supporting a rich assortment of TCP/IP networking application protocols.

7.3. Kinetis Software Development Kit (SDK)

- Extensive suite of robust peripheral drivers, stacks, middleware, and example applications designed to simplify and accelerate application development on any Kinetis MCU.
- Software examples include demonstrating the usage of the hardware abstraction layer (HAL), peripheral drivers, middleware, and RTOS's.
- The Kinetis SDK is complimentary and includes full source code under a permissive open-source license for all hardware abstraction and peripheral driver software.

7.4. Processor Expert software

- Building on the Kinetis SDK drivers, Processor Expert software is a development system to create, configure, optimize, migrate, and deliver software components that generate source code for Freescale silicon.

7.5. Integrated development environments (IDE)

- Freescale Kinetis Design Studio IDE freescale.com/kds
  - No-cost integrated development environment (IDE) for Kinetis MCUs
  - Eclipse and GCC-based IDE for C / C++ editing, compiling, and debugging
- IAR Embedded Workbench® iar.com/kinetis
- ARM Keil® Microcontroller Development Kit keil.com/freescale
- Atollic® TrueSTUDIO® atollic.com/index.php/partnerfreescale
- Green Hills Software MULTI ghs.com/partners/freescale_partner.html
- Broad ARM ecosystem support through Freescale Connect partners

7.6. Online enablement with ARM mbed™ development platform

- Rapid and easy Kinetis MCU prototyping and development
- Online mbed SDK, developer community
- Free software libraries

7.7. Bootloader

- Common bootloader for all Kinetis MCUs
- In-system flash programming over a serial connection: erase, program, verify
- Flash-based bootloader with open-source software and host-side programming utilities

7.8. Development hardware

- Tower System modular development platform
  - Rapid prototyping and evaluation
  - Low cost, interchangeable modules

8. Part identification

8.1. Description

Part numbers for the chip have fields that identify the specific part. You can use the values of these fields to determine the specific part you have received.

8.2. Format

Part numbers for this device have the following format: Q KL## A FFF T PP CC (N)

8.3. Fields

The following table lists the possible values for each field in the part number (not all combinations are valid).

Table 3. Part number field descriptions

Field	Description	Values
Q	Qualification status	M = fully qualified, general market flow P = prequalification
KV##	Kinetis family	KV56 KV58
A	Key attribute	F = floating point
FFF	Program flash memory size	512 = 512 KB 1M0 = 1 MB
R	Silicon revision	(Blank) = Main A = Revision after main
T	Temperature range	V = -40°C to 105°C
PP	Package identifier	LL = 100 LQFP (14 mm x 14 mm) LQ = 144 LQFP (20 mm x 20 mm) MD = 144 MAPBGA (13 mm x 13 mm)
CC	Maximum CPU frequency (MHz)	24 = 240 MHz

Table 3. Part number field descriptions

Field	Description	Values
N	Packaging type	R = tape and reel (Blank) = trays

9. Orderable part numbers

Table 4. Ordering information

MC Part Number	Pin Count	Package	Flash	SRAM
MKV58F1M0VMD24*	144	MAPBGA	1 MB	256 KB
MKV58F1M0VLQ24	144	LQFP	1 MB	256 KB
MKV58F1M0VLL24	100	LQFP	1 MB	256 KB
MKV56F1M0VMD24*	144	MAPBGA	1 MB	256 KB
MKV56F1M0VLQ24	144	LQFP	1 MB	256 KB
MKV56F1M0VLL24	100	LQFP	1 MB	256 KB
MKV58F512VMD24*	144	MAPBGA	512 KB	128 KB
MKV58F512VLQ24	144	LQFP	512 KB	128 KB
MKV58F512VLL24	100	LQFP	512 KB	128 KB
MKV56F512VMD24*	144	MAPBGA	512 KB	128 KB
MKV56F512VLQ24	144	LQFP	512 KB	128 KB
MKV56F512VLL24	100	LQFP	512 KB	128 KB

* The 144 MAPBGA package for this product is not yet available. However, it is included in the Package Your Way program for Kinetis MCUs. Visit freescale.com/KPYW for more details.

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