

# Kinetis KE1xF512 MCUs

Robust 5V MCUs with ADCs, FlexTimers, CAN and expanding memory integration in Kinetis E-series. Now up to 512 KB flash and 64 KB SRAM.

## 1. Kinetis E family introduction

The Kinetis E family provides a highly scalable portfolio for robust 5V MCUs, with cores ranging from 20 MHz ARM® Cortex®-M0+ MCUs to 168 MHz ARM® Cortex®-M4 MCUs. With 2.7V ~ 5.5V supply and focus on exceptional EMC/ESD robustness, the Kinetis E family is well-suited for a wide range of applications in electrical harsh environments, and is optimized for cost-sensitive applications. The Kinetis E family offers a broad range of memory, peripherals, and package options.

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## 2. Kinetis KE1xF sub-family overview

Kinetis KE1xF MCUs are the high-end series MCUs in Kinetis E family, providing robust 5V solution with the high performance ARM Cortex-M4 core running at up to 168 MHz. The KE1xF offers multiple ADCs and FlexTimers, a CAN 2.0B-compliant FlexCAN module and a broad suite of communication interfaces including LPUARTs, LPI2Cs, LPSPIs, and FlexIO which provide flexibility for serial communication emulation. The devices range from 256 KB flash in 64LQFP package extending up to 512 KB flash in 100LQFP package.

- KE14F: broad offering with mixed-signal integration, ADCs, DAC, ACMPs, FlexTimers.
- KE16F: expansion from KE14F family, with addition of 1 x FlexCAN module.
- KE18F: expansion from KE14F family, with addition of 2 x FlexCAN module.

## 3. Kinetis KE1xF key product features

- Up to 168 MHz ARM Cortex-M4 core supporting a broad range of processing bandwidth requirements while maintaining excellent cost-effectiveness, easy to use packages and a wide range of memory densities.
- Enhanced robust IOs make sure the high performance under noisy environment.
- FlexTimer featured 8-channel PWM supports three-phase motor control with dead time insertion and fault detect.
- 1-Msps 12-bit ADC with up to a 16-channel input per module with a fast sampling rate for prompt data conversion and storage.
- Analog comparator for fast response to external analog change.
- Programmable delay block with flexible trigger system providing various interconnections for on chip modules; ADC, DAC, FlexTimers, ACMP, and so on.
- CAN 2.0B-compliant FlexCAN provides high reliable serial communication interface for industry applications.
- FlexIO provides flexibility for serial communication interface implementation.
- Boot ROM provides on chip boot code and serial port drivers that could save flash space and provide flexible boot options and in-system programming support.
- Packages with big pin pitch make manufacture easy with high yield.
- 8 KB Cache could improve the code and data access efficiency.
- Digital signal processing capabilities with floating point unit offering outstanding computational power for control algorithms, sensor data processing, audio processing, among others, while increasing math accuracy and reducing code size.
- MPU for memory protect and code safety.
- Faster time to market with comprehensive enablement solutions, including SDK (drivers, libraries, stacks), IDE, bootloader, RTOS, online community and more.

## 4. Kinetis KE1xF product family feature summary

**Table 1. Kinetis KE1xF product family feature summary**

| Sub-Family        | KE14F                                          | KE16F                                          | KE18F                                          |
|-------------------|------------------------------------------------|------------------------------------------------|------------------------------------------------|
| CPU Performance   | 168 MHz                                        | 168 MHz                                        | 168 MHz                                        |
| Flash             | 256-512 KB                                     | 256-512 KB                                     | 256-512 KB                                     |
| SRAM              | 32-64 KB                                       | 32-64 KB                                       | 32-64 KB                                       |
| FlexMemory/EEPROM | 64 KB/4 KB                                     | 64 KB/4 KB                                     | 64 KB/4 KB                                     |
| Analog            | 3 x 12-bit ADC,<br>1 x 12-bit DAC,<br>3 x ACMP | 3 x 12-bit ADC,<br>1 x 12-bit DAC,<br>3 x ACMP | 3 x 12-bit ADC,<br>1 x 12-bit DAC,<br>3 x ACMP |
| Other Features    | 4 x FlexTimers,<br>FlexIO                      | 4 x FlexTimers,<br>FlexIO,<br>1 x FlexCAN      | 4 x FlexTimers,<br>FlexIO,<br>2 x FlexCAN      |
| Package Options   | 100LQFP,<br>64LQFP                             | 100LQFP,<br>64LQFP                             | 100LQFP,<br>64LQFP                             |

## 5. Kinetis KE1xF family block diagram

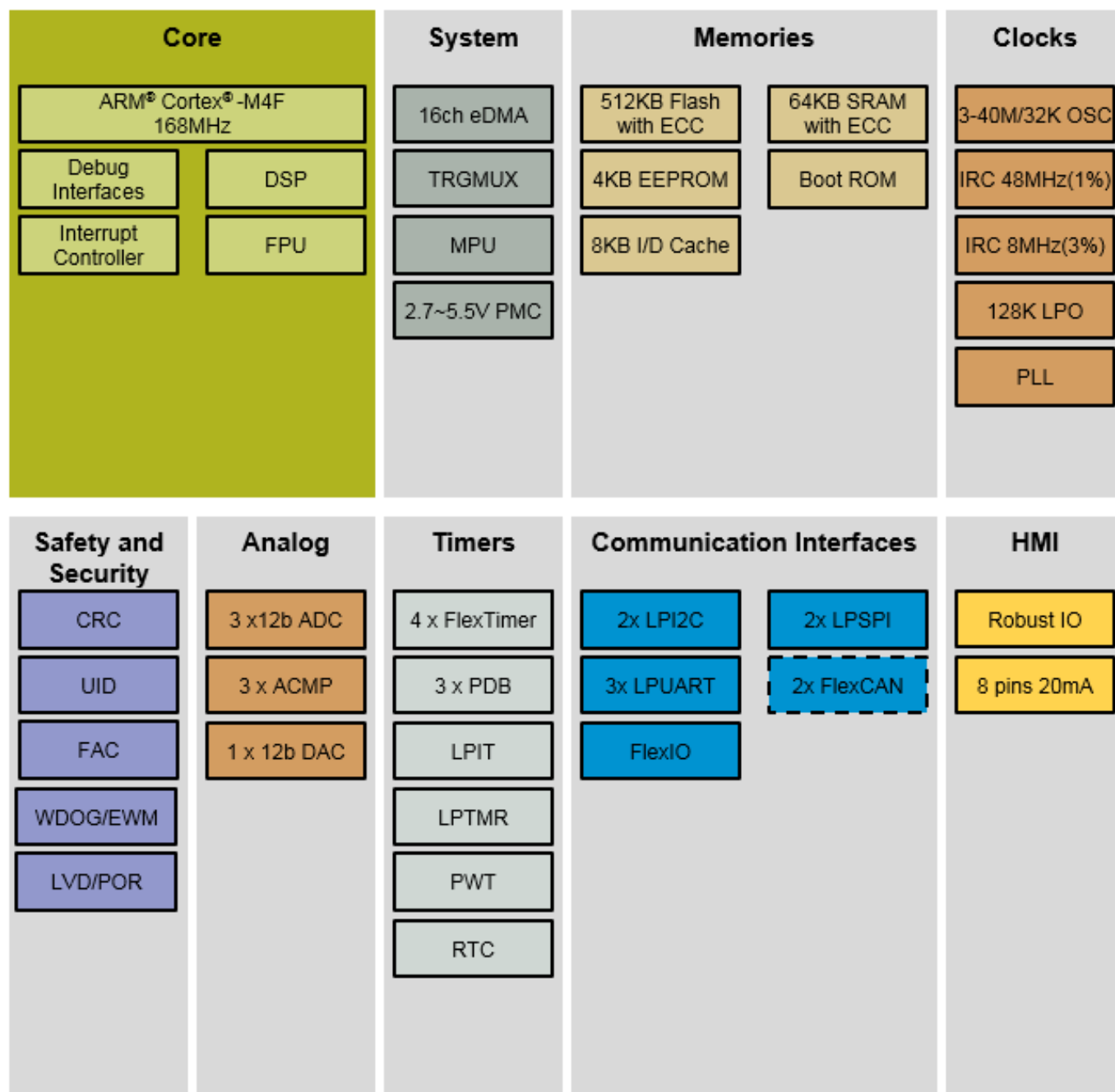


Figure 1. Kinetis KE1xF512 family block diagram

## 6. Kinetis KE1xF product family features

The following features are present for KE1xF product family.

**Table 2. KE1xF product family features**

| Sub-Family                    | KE14F                                                                                     | KE16F                                                                                     | KE18F                                                                                     |
|-------------------------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Core                          | M4                                                                                        | M4                                                                                        | M4                                                                                        |
| FPU                           | Yes                                                                                       | Yes                                                                                       | Yes                                                                                       |
| Frequency                     | 168 MHz                                                                                   | 168 MHz                                                                                   | 168 MHz                                                                                   |
| Flash                         | 256 KB-512 KB                                                                             | 256 KB-512 KB                                                                             | 256 KB-512 KB                                                                             |
| Cache                         | 8 KB                                                                                      | 8 KB                                                                                      | 8 KB                                                                                      |
| SRAM                          | 32-64 KB                                                                                  | 32-64 KB                                                                                  | 32-64 KB                                                                                  |
| FlexMemory/EEPROM             | 64 KB/4 KB                                                                                | 64 KB/4 KB                                                                                | 64 KB/4 KB                                                                                |
| Clock                         | 48 MHz FIRC (1%),<br>8 MHz SIRC (3%),<br>XOSC (3-40 MHz, 30-40 KHz)<br>128 KHz LPO<br>PLL | 48 MHz FIRC (1%),<br>8 MHz SIRC (3%),<br>XOSC (3-40 MHz, 30-40 KHz)<br>128 KHz LPO<br>PLL | 48 MHz FIRC (1%),<br>8 MHz SIRC (3%),<br>XOSC (3-40 MHz, 30-40 KHz)<br>128 KHz LPO<br>PLL |
| BootROM (UART, SPI, IIC, CAN) | Yes                                                                                       | Yes                                                                                       | Yes                                                                                       |
| DMA                           | 16 channels                                                                               | 16 channels                                                                               | 16 channels                                                                               |
| WDT/POR/LVD                   | Yes                                                                                       | Yes                                                                                       | Yes                                                                                       |
| ADC                           | 3 x 12-bit, 1 $\mu$ s                                                                     | 3 x 12-bit, 1 $\mu$ s                                                                     | 3 x 12-bit, 1 $\mu$ s                                                                     |
| ACMP                          | 3                                                                                         | 3                                                                                         | 3                                                                                         |
| DAC                           | 12-bit                                                                                    | 12-bit                                                                                    | 12-bit                                                                                    |
| Timer                         | 4 x FlexTimer<br>1 x LPTMR                                                                | 4 x FlexTimer<br>1 x LPTMR                                                                | 4 x FlexTimer<br>1 x LPTMR                                                                |
| PDB                           | 3                                                                                         | 3                                                                                         | 3                                                                                         |
| PIT                           | 1                                                                                         | 1                                                                                         | 1                                                                                         |
| RTC                           | 1                                                                                         | 1                                                                                         | 1                                                                                         |
| CAN                           | -                                                                                         | 1                                                                                         | 2                                                                                         |
| UART                          | 3                                                                                         | 3                                                                                         | 3                                                                                         |
| SPI                           | 2                                                                                         | 2                                                                                         | 2                                                                                         |
| I2C                           | 2                                                                                         | 2                                                                                         | 2                                                                                         |
| FlexIO                        | 4 timers, 4 shifters, 8 pins                                                              | 4 timers, 4 shifters, 8 pins                                                              | 4 timers, 4 shifters, 8 pins                                                              |
| VDD                           | 2.7~5.5V                                                                                  | 2.7~5.5V                                                                                  | 2.7~5.5V                                                                                  |
| Temperature(Ta)               | -40~105 °C                                                                                | -40~105 °C                                                                                | -40~105 °C                                                                                |
| Package(GPIOs)                | 100LQFP,<br>64LQFP                                                                        | 100LQFP,<br>64LQFP                                                                        | 100LQFP,<br>64LQFP                                                                        |

## 7. Comprehensive enablement solutions

### 7.1. Kinetis Software Development Kit (SDK)

- Extensive suite of robust peripheral drivers, stacks and middleware.
- Includes software examples demonstrating the usage of the HAL, peripheral drivers, middleware and RTOSes.
- Operating system abstraction (OSA) for NXP MQX™ RTOS, FreeRTOS, and Micrium µC/OS kernels and bare metal (no RTOS) applications.

### 7.2. Integrated Development Environments (IDE)

- Atollic® TrueSTUDIO® <http://timor.atollic.com/products/target-support/nxp-freescale/>
- IAR Embedded Workbench® <https://www.iar.com/iar-embedded-workbench/partners/nxp>
- ARM Keil® Microcontroller Development Kit <http://www2.keil.com/nxp>
- Kinetis Design Studio (KDS)
  - No-cost integrated development environment (IDE) for Kinetis MCUs
  - Eclipse and GCC-based IDE for C/C++ editing, compiling and debugging
- Broad ARM ecosystem support through NXP Connect partners

### 7.3. Online enablement with ARM mbed™ development platform

- Rapid and easy Kinetis MCU prototyping and development
- Online mbed SDK, Developer Community
- Free software libraries

### 7.4. Boot-loader

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

### 7.5. 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 K## A M FFF R 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<br>P = Prequalification |
| KE##  | Kinetis family              | KE14F<br>KE16F<br>KE18F                                          |
| A     | Key attribute               | F = Cortex-M4 W/ DSP and FPU                                     |
| FFF   | Program Flash memory size   | 512 = 512 KB<br>256 = 256 KB                                     |
| R     | Silicon revision            | (Blank) = Main<br>A = Revision after main                        |
| T     | Temperature range           | V = -40°C – 105 °C                                               |
| PP    | Package identifier          | LL = 100LQFP (14 mm × 14 mm)<br>LH = 64LQFP (10 mm × 10 mm)      |
| CC    | Maximum CPU frequency (MHz) | 16 = 168 MHz                                                     |
| N     | Packaging type              | R = Tape and reel<br>(Blank) = Trays                             |

## 9. Orderable part numbers

**Table 4. Ordering information**

| Product        | Memory |      | Package   |         | IO and ADC Channel |                                  |                                           |
|----------------|--------|------|-----------|---------|--------------------|----------------------------------|-------------------------------------------|
| MC Part Number | Flash  | SRAM | Pin Count | Package | GPIOs              | GPIOs<br>(INT / HD) <sup>1</sup> | ADC <sup>2</sup><br>channels<br>(SE / DP) |
| MKE14F256VLH16 | 256KB  | 32KB | 64        | LQPF    | 58                 | 58/8                             | 38/0                                      |
| MKE14F256VLL16 | 256KB  | 32KB | 100       | LQPF    | 89                 | 89/8                             | 48/0                                      |
| MKE14F512VLH16 | 512KB  | 64KB | 64        | LQPF    | 58                 | 58/8                             | 38/0                                      |
| MKE14F512VLL16 | 512KB  | 64KB | 100       | LQPF    | 89                 | 89/8                             | 48/0                                      |
| MKE16F256VLH16 | 256KB  | 32KB | 64        | LQPF    | 58                 | 58/8                             | 38/0                                      |
| MKE16F256VLL16 | 256KB  | 32KB | 100       | LQPF    | 89                 | 89/8                             | 48/0                                      |
| MKE16F512VLH16 | 512KB  | 64KB | 64        | LQPF    | 58                 | 58/8                             | 38/0                                      |
| MKE16F512VLL16 | 512KB  | 64KB | 100       | LQPF    | 89                 | 89/8                             | 48/0                                      |
| MKE18F256VLH16 | 256KB  | 32KB | 64        | LQPF    | 58                 | 58/8                             | 38/0                                      |
| MKE18F256VLL16 | 256KB  | 32KB | 100       | LQPF    | 89                 | 89/8                             | 48/0                                      |
| MKE18F512VLH16 | 512KB  | 64KB | 64        | LQPF    | 58                 | 58/8                             | 38/0                                      |
| MKE18F512VLL16 | 512KB  | 64KB | 100       | LQPF    | 89                 | 89/8                             | 48/0                                      |

<sup>1</sup> INT: interrupt pin numbers; HD: high drive pin numbers

<sup>2</sup> ADC0 + ADC1

## 10. Revision history

**Table 5. Revision history**

| Revision | Date           | Substantial changes                                                      |
|----------|----------------|--------------------------------------------------------------------------|
| 0        | 15 May 2016    | Initial release                                                          |
| 1        | 31 July 2016   | Frequency from 160 MHz to 168 MHz.<br>Updated enablement solution parts. |
| 1.1      | 16 August 2016 | Memory size update                                                       |





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