NXP MICROCONTROLLERS OVERVIEW

JAMES HUANG
REGIONAL MARKETING, BL MICR
GREATER CHINA

MAY 2017
NXP MICROCONTROLLERS A New Position of Strength

- #1 Communications Processors
- #1 Secure Identification
- #1 RF Power Transistors
- #1 Automotive
- #1 Broad-Based MCUs
- #1 Small Signal Discretes

~45,000 Employees  11,000+ Engineers  35+ Countries

9,000+ Patents
Why Customers Choose Us

- Comprehensive portfolio supporting the diverse IoT landscape
- Extensive software and development environment
- Industry leading customer support, quality, and longevity
- Broad ecosystem of partners enabling system solutions
- Ease of use solutions tailored for mass market

Example Customers

Products

| Kinetis & LPC 32-bit ARM® Microcontrollers | i.MX ARM® Applications Processors |

Applications

<table>
<thead>
<tr>
<th>Wearable / Healthcare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health / Fitness &amp; Wireless Healthcare</td>
</tr>
<tr>
<td>Diabetes &amp; Cardiac Care</td>
</tr>
<tr>
<td>Diagnostics &amp; therapy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Smart Home</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart meters &amp; grid</td>
</tr>
<tr>
<td>Integrated wireless connectivity solutions</td>
</tr>
<tr>
<td>Home energy control</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Smart Accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Game controllers and consoles</td>
</tr>
<tr>
<td>Wearable computing</td>
</tr>
<tr>
<td>eReaders, tablets, portable navigation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vehicle Networking &amp; Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infotainment, software define radio</td>
</tr>
<tr>
<td>Navigation systems, E-call</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Home Appliances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy efficient refrigerators, dishwashers</td>
</tr>
<tr>
<td>Human-machine interface</td>
</tr>
<tr>
<td>Connected appliances</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factory Automation &amp; Drives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine-to-machine</td>
</tr>
<tr>
<td>Motor control</td>
</tr>
<tr>
<td>Industrial networking</td>
</tr>
</tbody>
</table>
Scalable ARM based Processors and Controllers

LPC and Kinetis Microcontrollers
For real-time low power control
ARM® Cortex-M based MCUs

i.MX Application Processors
For advanced efficient computing
ARM® based MPUs

Overall Relative Performance
Kinetis + LPC: A Powerhouse Portfolio of ARM-based MCUs

**General Purpose Families**

- **Cortex-M4**
  - LPC54000 Series
    - Mainstream & power efficient
    - 128KB – 512KB Flash
    - Up to 192KB RAM

- **Cortex-M3**
  - LPC1300, 1500
    - Entry level, 72MHz
    - 8KB – 256KB Flash
    - 4KB – 36KB RAM

- **Cortex-M0/M0+**
  - LPC800 Series
    - Entry level, 8-bit simplicity
    - 4KB – 32KB Flash
    - 1KB – 8KB RAM

  - Kinetics KLOx Series
    - Low power, Tiny Packages
    - 8KB – 32KB Flash
    - 1KB – 4K RAM

  - LPC1100, 1200
    - Low power, Rich feature
    - 4KB – 256KB Flash
    - 1KB – 36KB RAM

  - Kinetics KL2x Series
    - Low power, USB Full-Speed
    - 32KB – 512KB Flash
    - 4KB – 128K RAM

**Application Specific Families**

- **Cortex-M7**
  - **M7**
  - Security
  - Kinetics K8x Series
    - HW Crypto, Tamper, QSPI
    - 256KB Flash
    - 256KB RAM

- **Cortex-M4**
  - **M4**
  - Security
  - Kinetics K8x Series
    - HW Crypto, Tamper, QSPI
    - 256KB Flash
    - 256KB RAM

  - **5V, Robust**
  - Kinetics W Series
    - BLE 4.1/4.2, 15.4
    - Sub-GHz radios
    - 128KB – 512KB Flash
    - 16KB - 128KB RAM

  - **Wireless Connectivity**
  - Kinetics V Series
    - Advanced timer & Analog peripherals
    - 16KB – 1MB Flash
    - 8 KB – 256KB RAM

- **Cortex-M0/M0+**
  - **M0+**
  - Metrology
  - Kinetics M Series
    - 24b SD ADC+PGA, Segment LCD
    - 64KB – 256KB Flash
    - 16KB – 32KB RAM

  - **Security**
  - Kinetics KL8x Series
    - HW Crypto, Tamper, QSPI
    - 128KB Flash
    - 96KB RAM

Performance, Integration & Security
# NXP ARM Cortex-M MCUs Powerhouse Portfolio

## Attributes

<table>
<thead>
<tr>
<th>General Purpose</th>
<th>Target Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance efficiency</strong></td>
<td>Always-on devices Voice control IoT</td>
</tr>
<tr>
<td><strong>Advanced integration</strong></td>
<td>Industrial control Payment, Metering Wearables, Display UI Printers</td>
</tr>
<tr>
<td><strong>Mainstream</strong></td>
<td>Consumer/Gaming Accessories Wearables Home Automation Data Concentrators Industrial</td>
</tr>
<tr>
<td><strong>Low-cost &amp; Small Form Factor</strong></td>
<td>Wake-up unit System task/Co-processor Power Management Control System</td>
</tr>
<tr>
<td><strong>Wireless Connectivity</strong></td>
<td>Home Automation Thread BLE Apple HomeKit</td>
</tr>
<tr>
<td><strong>Motor Control &amp; Power Conversion</strong></td>
<td>BLDC / PMSM motors Photo voltaic Industrial Controls</td>
</tr>
<tr>
<td><strong>5V Robust</strong></td>
<td>Appliance Smart Lightning</td>
</tr>
</tbody>
</table>

## Portfolio

### M0/M0+

<table>
<thead>
<tr>
<th><strong>Attributes</strong></th>
<th><strong>Target Applications</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance efficiency</strong></td>
<td><strong>KE02/4/6, M0+</strong> ADC, CAN (KE06) Up to 128K Flash, Up to 16K RAM, 256B EEPROM</td>
</tr>
<tr>
<td><strong>Advanced integration</strong></td>
<td><strong>KV1x, M0+</strong> BLDC entry-level PMFSM Up to 128K Flash, Up to 16K RAM</td>
</tr>
<tr>
<td><strong>Mainstream</strong></td>
<td><strong>KW21/22, M0+</strong> 180MHz, 2x HS USB, LCD, CAN, ENET Flashless, up to 2M Flash, 208K RAM</td>
</tr>
<tr>
<td><strong>Low-cost &amp; Small Form Factor</strong></td>
<td><strong>LPC81x/82x, M0+</strong> 30MHz, ADC, Low Pin Count up to 32K Flash, 8K RAM</td>
</tr>
<tr>
<td><strong>Wireless Connectivity</strong></td>
<td><strong>KW21/22, M0+</strong> 802.15.4 BLE 4.2 Radio, DC/DC, Balun Up to 512K Flash, Up to 128K RAM</td>
</tr>
<tr>
<td><strong>Motor Control &amp; Power Conversion</strong></td>
<td><strong>KV1x, M0+</strong> BLDC, entry-level PMFSM Up to 128K Flash, Up to 16K RAM</td>
</tr>
<tr>
<td><strong>5V Robust</strong></td>
<td><strong>KE02/4/6, M0+</strong> ADC, CAN (KE06) Up to 128K Flash, Up to 16K RAM, 256B EEPROM</td>
</tr>
</tbody>
</table>

### M3/M4

<table>
<thead>
<tr>
<th><strong>Attributes</strong></th>
<th><strong>Target Applications</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance efficiency</strong></td>
<td><strong>LPC5410x, M4 w/M0+ Copr.</strong> 100MHz Power Efficiency up to 128K Flash, 104K SRAM</td>
</tr>
<tr>
<td><strong>Advanced integration</strong></td>
<td><strong>KL80/81, M0+</strong> HW Security Crypto, USB, FlexIO up to 128K Flash, 96K SRAM</td>
</tr>
<tr>
<td><strong>Mainstream</strong></td>
<td><strong>KL17, M0+</strong> FlexIO, BootROM Up to 256K Flash, 32K RAM</td>
</tr>
<tr>
<td><strong>Low-cost &amp; Small Form Factor</strong></td>
<td><strong>KL02/03, M0+</strong> Small Form Factor, Low Power 8-32K Flash, 1-4K RAM</td>
</tr>
<tr>
<td><strong>Wireless Connectivity</strong></td>
<td><strong>KW21/22, M0+</strong> 802.15.4 BLE 4.2 Radio, DC/DC, Balun Up to 512K Flash, Up to 128K RAM</td>
</tr>
<tr>
<td><strong>Motor Control &amp; Power Conversion</strong></td>
<td><strong>KV3x, M4</strong> Mid-range PMFSM, UPS power control, KMS Up to 512K Flash, Up to 96K RAM</td>
</tr>
<tr>
<td><strong>5V Robust</strong></td>
<td><strong>KE02/4/6, M0+</strong> ADC, CAN (KE06) Up to 128K Flash, Up to 16K RAM, 256B EEPROM</td>
</tr>
</tbody>
</table>

### M7

<table>
<thead>
<tr>
<th><strong>Attributes</strong></th>
<th><strong>Target Applications</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance efficiency</strong></td>
<td><strong>LPC5411x, M4 w/M0+ Copr.</strong> FlexComm Interfaces, Voice Triggering, 4less USB, up to 256K Flash, 192K SRAM</td>
</tr>
<tr>
<td><strong>Advanced integration</strong></td>
<td><strong>KL28, M0+</strong> 72/96MHz, FlexIO, BootROM, more I/O up to 128K Flash, 128K RAM</td>
</tr>
<tr>
<td><strong>Mainstream</strong></td>
<td><strong>KL27, M0+</strong> FlexIO, BootROM, x-less USB Up to 256K Flash, 12K RAM</td>
</tr>
<tr>
<td><strong>Low-cost &amp; Small Form Factor</strong></td>
<td><strong>KL05, M0+</strong> Low Power, DAC, TSI 8-32K Flash, 1-4K RAM</td>
</tr>
<tr>
<td><strong>Wireless Connectivity</strong></td>
<td><strong>KW23, M0+</strong> 802.15.4 Radio, Thread Up to 512K Flash &amp; 64K RAM</td>
</tr>
<tr>
<td><strong>Motor Control &amp; Power Conversion</strong></td>
<td><strong>KV4x, M4</strong> High-perf motors, UPS, solar &amp; mid-range AC/DC control, KMS Up to 256K Flash, 128K RAM</td>
</tr>
<tr>
<td><strong>5V Robust</strong></td>
<td><strong>KE1x (M4F) / KE1x2 (M0+)</strong> Higher perf. &amp; more comm. interfaces 256K / 512K Flash, 32K / 64K RAM, 2xCAN, new TSI (Z)</td>
</tr>
</tbody>
</table>

(not a complete portfolio summary)
Strength in Product Longevity

► NXP (both NXP LPC and former Freescale) have longstanding track records of providing long-term production support for our products.

► NXP has a formal product longevity program for the market segments we serve:
  • For the automotive and medical segments, NXP will make a broad range of solutions available for a minimum of 15 years.
  • For all other market segments in which NXP participates, NXP will make a broad range of solutions available for a minimum of 10 years.
  • Life cycles begin at the time of launch.
  • Includes NXP’s standard end-of-life notification policy.

► For a complete list of participating products, visit, nxp.com/productlongevity.
LPC REFERENCE
DESIGN/DEMOS
Reference Design 1 — Wearable

Features:
• Targeting sports, environment and health
• Support NFC, Single BT BLE & Dual band BT
• Support true color 160*128 OLED
• Onboard 1MB SPI Flash and 1Mbit SRAM
• Buzzer and vibration motor
• Easy to measure power consumption
Reference Design 2 — Voice triggering implementation with H/W VAD

Features:

- Stereo PDM-PCM decimation, DC filtering, saturation
- H/W VAD Wave Envelope and floor noise detection

Voice Detection Stages

<table>
<thead>
<tr>
<th>Stage</th>
<th>Detection</th>
<th>Uses</th>
<th>Average current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>Always on listening • Detects audio envelope change • No audio batching • Runs only under quiet environment</td>
<td>• DMIC at lowest sample rate • VAD • WD osc (600 kHz)</td>
<td>*&lt;50µA</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Detects possible speech • Audio data batching • Speech envelope detection</td>
<td>• FRO (12 MHz) and nominal DMIC sample rate (800kHz) • M4 • DMA</td>
<td>*&lt;300µA</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Recognizer • Trigger command recognition</td>
<td>• FRO (48 MHz) • M4</td>
<td>*&lt;1.5mA</td>
</tr>
</tbody>
</table>
Reference Design 4 — Audio Decoder

**Features:**
- Based on LPC5411x series
- Single CM4F for audio decoder
- Based on SDK2.0.0 and IAR
- Based on xFSL Picus Audio decoder library
- Support FreeRTOS with Shell & FatFS
- SPI connect with TFcard
- Support wav, mp3, flac
- Support play, pause, next song, volume +/-
- USB MSC update music
Reference Design 1 – QR Decoder

QR decoder can quickly scan and decode both 1D and 2D barcode information. It is based on the NXP tower system, utilizes the Kinetis SDK FlexIO camera driver to bring in image data and display the decode result on TWR-LCD and/or a terminal.

**Supported Symbologies:**
- QR (Quick Response Code)
- UPC-A UPC-E
- EAN8 EAN13 EAN128
- ITF-6 ITF-14 Interleaved 2 to 5
- CODE39 CODE128
- CodaBar

[Image of QR code and diagram showing the process of scanning and decoding.]
Reference Design 2 – Smart Plug

• Based on the Kinetis MKM14Z64 MCU
  – a low-power high-performance 32-bit ARM® Cortex™-M0+ core @50MHz

• Cost optimized solution with single-phase meter and wireless control.

• Includes two parts
  – Metering part is used to measure electronic power in single-phase
  – WiFi part is used for wireless control.

• Users can use application in an android phone to check plug status, e.g. current active power, reactive power, grid frequency, history run time, etc, and control it by setting it to ON/Off, setting timer for ON/Off at fixed time.
Reference Design 3 – Three Phase Power Meter

- Low cost NXP ARM Cortex™ M0+ SoC KM14 for metering
- Conforms to China National Grid Standard
- High performance of 0.5% accuracy for Active and Reactive energy under full temperature range
- ESD performance up to +/- 12KV
- High accuracy RTC clocking with 5ppm resolution
Demo 1 - FlexIO Camera Demo

- Based on FRDM-KL28Z EVK board.
- FlexIO emulates camera interface
- Captures 320x240 QVGA images via 8-bit width data bus.
- Displays images on a TFT LCD via SPI bus.
- The sample rate is up to 15fps.
Demo 3 – New TSI Demo

- FRDM-TOUCH is a shield board connected to the FRDM-KE15Z board which integrates new generation touch sensing interface
  - supporting both self capacitance and mutual capacitance mode
  - 16-bit conversion resolution and configurable sensitivity to handle different overlay material, thickness
  - IEC61000-4-6 certified (both 3V/10V), immunity to a wide range of noise

- Demo touch keys, touch slider, rotary & touch key matrix

- When you touch the keys on FRDM-TOUCH board, the RGB LED is turned on. When you touch the slider, the blue LED will gradually illuminate based on the distance your finger moved on the touch slider
INTRODUCING LPC MICROCONTROLLERS FOR THE BROAD MARKET
Where Does LPC Fit in the Market

- LPC800 Cortex-M0+
  - Gaming Controllers
  - Virtual Reality
  - Fish finders
  - Medical equipment
  - Mobile USB Battery Pack
  - Audio accessories
  - Wearable Band
  - Contactless POS
  - Large format collaboration touch panel
  - Surveillance cameras
  - Smart meters
  - Control panels
  - ATMs
  - Wireless transmitters
  - Thermostats
  - Printers
  - Mixing boards

- LPC1100 Cortex-M0+/M0
  - Gaming mice & Keyboards
  - Data loggers
  - Lab tools
  - Kiosks
  - Home appliances
  - Elevator controls
  - Musical instruments
  - Projectors
  - Digital tachographs
  - Smoke/toxic gas detector
  - Fingerprint scanners
  - Large format collaboration touch panel
  - Surveillance cameras
  - Smart meters
  - Control panels
  - ATMs
  - Wireless transmitters
  - Thermostats
  - Printers
  - Mixing boards

- LPC1300, LPC1700 & LPC1800 Cortex-M3
  - Gaming mice & Keyboards
  - Data loggers
  - Lab tools
  - Kiosks
  - Home appliances
  - Elevator controls
  - Musical instruments
  - Projectors
  - Digital tachographs
  - Smoke/toxic gas detector
  - Fingerprint scanners
  - Large format collaboration touch panel
  - Surveillance cameras
  - Smart meters
  - Control panels
  - ATMs
  - Wireless transmitters
  - Thermostats
  - Printers
  - Mixing boards

- LPC541xx Cortex-M4/M0
  - Gaming mice & Keyboards
  - Data loggers
  - Lab tools
  - Kiosks
  - Home appliances
  - Elevator controls
  - Musical instruments
  - Projectors
  - Digital tachographs
  - Smoke/toxic gas detector
  - Fingerprint scanners
  - Large format collaboration touch panel
  - Surveillance cameras
  - Smart meters
  - Control panels
  - ATMs
  - Wireless transmitters
  - Thermostats
  - Printers
  - Mixing boards

- LPC4380 Cortex-M4/M0
  - Gaming mice & Keyboards
  - Data loggers
  - Lab tools
  - Kiosks
  - Home appliances
  - Elevator controls
  - Musical instruments
  - Projectors
  - Digital tachographs
  - Smoke/toxic gas detector
  - Fingerprint scanners
  - Large format collaboration touch panel
  - Surveillance cameras
  - Smart meters
  - Control panels
  - ATMs
  - Wireless transmitters
  - Thermostats
  - Printers
  - Mixing boards
LPC Our Product Positioning

Maintain Global Leadership in the Broad Market by Continuing to Invest in Innovative & Differentiated Technologies

LPC800 MCU Series
- Cortex-M0+ up to 30 MHz
- Differentiated features
- From 8 to 64K flash range
- Down to TSSOP 16

LPC54000 MCU Series
- Cortex-M4 100MHz & 180MHz platforms
- Improved power-efficiency
- Flexible comm. Interfaces
- Advanced Peripheral Integration
- From 128K to 512K Flash
INTRODUCING LPC800 MCU SERIES CORTEX-M0+
FOR THE BROAD 8-BIT MARKET
Expanding our Cortex-M0+ based LPC800 MCU series,
- Addressing market’s aggressive move from 8- to 32-bit architecture
- Satisfying need for improved power-efficiency & portfolio scalability
- Simple Code Bundles & ROM drivers
- Differentiated features in a low-price MCU

<table>
<thead>
<tr>
<th>Entry</th>
<th>Peripheral &amp; Memory Expansion from NXP’s Popular LPC824</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPC800 Series Cortex-M0+</td>
<td>LPC845: 64K Flash, 8-16K RAM [QFN, LQFP]</td>
</tr>
<tr>
<td></td>
<td>LPC802: Addressing the Growing Demand for 8-bit Alternative MCUs 16K Flash, 2K RAM [TSSOP]</td>
</tr>
<tr>
<td></td>
<td>LPC804: NXP’s Game Changing 8-bit Alternative MCU 32K Flash, 4K RAM</td>
</tr>
</tbody>
</table>
LPC800 MCU Series
Global Market Success

• Low-power Cortex-M0+ based solution
• LPC800 provides
  - ADC for analog battery monitor functionality
  - SCTimer/PWM handles IR/RF signal generation without CPU intervention
  - UART and SPI peripherals for interface to external RF frontends
  - GPIO for interface to
    ▪ LED and LCD control
    ▪ Pushbuttons/switches

Industrial RFID Tag & Reader

Smart Home Remote Control
LPC82x Overview
Builds on LPC800 Series Power Efficiency & Flexibility

- **System**
  - 30-MHz Cortex-M0+ ARM core
  - 32 kB Flash, with 64 B page size
  - 8 kB RAM
  - 18-channel DMA

- **Exceptional power efficiency**
  - Down to 90 µA/MHz (active)
  - Five power modes
  - Power profile APIs for simple runtime power optimization
  - Integrated PMU

- **Ample serial connectivity**
  - 4 I²C (1 Fm+, 3 Fm), 2 SPI, 3 UART
  - 29 GPIO with pattern matching

- **Switch matrix for flexible I/O pin assignment of common blocks**

- **Analog**
  - 1.2 Msp ADC: 12 ch, 12-bit with flexible triggers to optimize power use
  - Comparator: four input pins, external or internal VREF

- **Timers**
  - SCTimer/PWM
  - multi-rate
  - windowed watchdog
  - self wake-up

- **Single power supply:** 1.8 to 3.6V
- **Temperature range:** -40 to +105 °C
- **Packages:** TSSOP20, HVQFN33
LPC824-Lite Board Introduction

- NXP LPC824 in HVQFN33 package based on Cortex-M0+ Cores
- Debug interface
  - On-board CMSIS-DAP debug interface
  - 10 pins JTAG connector, support SWD mode
  - mbed tools and USB virtual COM
- One adjustable potentiometer
- Four buttons
- Eight user LEDs
- Three debugger LEDs
- Expansion options
  - Arduino UNO R3-compatible connectors
  - Prototyping area

- LPC824-Lite Board Kit
  - Schematic (Format: PDF, ORCAD)
  - Chip documents
  - User guide
  - Virtual COM tool and driver
  - Target firmware
  - Example code
INTRODUCING
LPC54000 MCU SERIES
CORTEX-M4
FOR THE BROAD MAINSTREAM MARKET
Expanding our Cortex-M4 based LPC54000 MCU series,
- Address market’s need for scalable, mainstream portfolio
- Range of power & performance scalability
- Differentiated set of features

<table>
<thead>
<tr>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LPC546xx Family of Microcontrollers</strong></td>
<td><strong>Up to 180 MHz Core</strong></td>
<td><strong>Up to 180 MHz Core</strong></td>
<td>More to Come</td>
</tr>
<tr>
<td><strong>NXP’s Latest Mainstream MCU; Upgrade Path from LPC1700</strong></td>
<td><strong>256-512K Flash</strong></td>
<td><strong>0K Flash</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>16K EEPROM</strong></td>
<td><strong>36K RAM</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>136-200K RAM</strong></td>
<td><strong>Memory Expansion</strong></td>
<td></td>
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<tr>
<td></td>
<td><strong>Memory Expansion</strong></td>
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<tr>
<td></td>
<td><strong>[ LQFP, TFBGA ]</strong></td>
<td><strong>[ LQFP, TFBGA ]</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Ultimate Power &amp; Performance Scalability with Numerous Connectivity &amp; HMI Options</strong></td>
<td><strong>Updated Peripherals, Added Security &amp; Protection</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Up to 180 MHz Core</strong></td>
<td></td>
</tr>
</tbody>
</table>

Providing our developers on LPC1768 platform with an upgrade path

* Information Subject to Change
## Migration to LPC54xxx

<table>
<thead>
<tr>
<th>Legacy part</th>
<th>Migrating part</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPC23xx/24xx</td>
<td>LPC54605/54606</td>
</tr>
<tr>
<td>LPC175x/176x (80/100pin)</td>
<td></td>
</tr>
<tr>
<td>LPC2000, LPC17xx/40xx (180/208pin)</td>
<td>LPC5460x</td>
</tr>
<tr>
<td>LPC213x (64pin)</td>
<td>LPC54101 or LPC5411x</td>
</tr>
</tbody>
</table>
Introducing LPC54000 Series of Power-efficient Microcontrollers

<table>
<thead>
<tr>
<th>LPC5410x</th>
<th>LPC5411x</th>
</tr>
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<tbody>
<tr>
<td>Cortex-M4F at 100 MHz</td>
<td>Cortex-M4F at 100 MHz</td>
</tr>
<tr>
<td>256-512 KB Flash</td>
<td>128-256 KB Flash</td>
</tr>
<tr>
<td>104 KB RAM</td>
<td>96-192 KB RAM</td>
</tr>
<tr>
<td>FRO, FS USB, DMIC Subsystem</td>
<td>FRO, FS USB, DMIC Subsystem</td>
</tr>
</tbody>
</table>

### LPC546xx MCU Series

**Broad Family of Products Offering Scalable performance, advanced integration & flexible connectivity**

<table>
<thead>
<tr>
<th>Cortex-M4F at 180 MHz</th>
<th>Cortex-M4F at 180 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>256-512 KB Flash</td>
<td>0 KB Flash</td>
</tr>
<tr>
<td>136-200 KB RAM</td>
<td>360 KB RAM</td>
</tr>
<tr>
<td>FRO, FS/HS USB, DMIC Subsystem</td>
<td>FRO, FS/HS USB, DMIC Subsystem</td>
</tr>
</tbody>
</table>

**Six product families,**
- TFT-LCD Controller,
- Ethernet,
- CAN2.0 / CAN FD,
- Optional Security

**Six product families,**
- TFT-LCD Controller,
- Ethernet,
- CAN2.0 / CAN FD,
- Optional Security

- **Boards, Samples and Software (IAR/Keil) available today**
- **Mass Production shipping January-2017**
LPC54000 MCU Series
Global Market Success

In Home Display for Smart Energy

- Power-efficient LPC54000 MCU Series
  - Options for Large SRAM
  - Advanced Peripherals digital sensor interface, external wireless connectivity
- Integrated Graphics Controller, Digital Microphone Subsystem to detect voice triggers

Elderly Care Monitoring w/ Voice Activation

Standard TFT display (Parallel LCD)
## LPC5411x Overview

Low-Power Microcontrollers Based on Cortex-M4 Cores With Optional M0+ Co-processor

### Block Diagram

- **CPU**
  - 100MHz Cortex-M4F
  - Cortex-M0+ Co-processor
- **Memory**
  - 256 KB Flash, 192 KB RAM
- **Interfaces for connectivity & sensors**
  - Stereo DMIC subsystem (PDM, decimator, HW VAD)
  - 8 Flexcomm interfaces: 8 SPI, 8 I2C, 8 UART, 2 I²S channels. Max 8 channels
  - Crystal-less FS USB
  - Power-efficient **5.0 Msps, 12-bit ADC:** full-spec performance (1.62 to 3.6V, -40 to 105 °C)
- **Clocks & timers**
  - 12/48/96 MHz FRO
  - 100 kHz-1.5MHz WDOG OSC,
  - 32 Xtal OSC
  - external clock input
  - Basic & advanced timers including SCTimer/PWM
  - Asynchronous peripheral bus
- **Packages**
  - LQFP64 (10 x 10 mm)
  - WLCSP49 (3.45 x 3.45 mm)
- **Other**
  - Operating voltage: 1.62 to 3.6V
  - Temperature range: -40 to 105 °C

### Low Active Currents for Always-On Processing

- 900µA @12MHz w/ 2µs wakeup time in Sleep mode
- 7µA w/ 19µS wakeup time in Deep Sleep mode
- 300nA w/ 1.2mS wakeup time in Deep Power Down mode
LPC54114-Lite Board Introduction

- LPC54114J256BD64 Cortex-M4/M0+ Dual Core
- Debug interface
  - On-board CMSIS-DAP debug interface
  - 10 pins JTAG connector, support SWD mode
  - mbed tools and USB virtual COM
  - ISP jumpers
- One adjustable potentiometer
- Four user buttons and one reset button
- Four user LEDs for and one power LED
- One set of 3.5 mm audio jack
- One TF card interface, One stereo Mic
- One I2C temperature sensor, One SPI Flash

- Expansion options
  - Arduino UNO R3-compatible connectors
  - Prototyping area
- LPC54114-Lite Board Kit
  - Schematic
  - Chip documents
  - User guide
  - Virtual COM tool and driver
  - Target firmware
  - Example code
LPC546xx Overview
Power-Efficient Microcontrollers (MCUs) With Advanced Peripherals

**Connectivity, High-end Graphical UI & Security**

- **Core & Memory**
  - Cortex-M4F, 180MHz
  - 1.71 V to 3.6 V, -40 C to 105 C
  - Up to 512 KB Flash & Up to 200 KB RAM
  - 16 KB EEPROM
  - XIP from QSPI via SPIFI
- **Key Features**
  - Graphic LCD with resolutions up to 1024 x 768
  - CAN-FD controller x2
  - Digital mic subsystem supporting voice detection

- Hi-Speed and Full Speed USB
- USB: 1x HS (H/D) w/on-chip HS PHY
- XTAL-less FS USB (H/D)
- FlexComm-flexible serial connectivity
  - 10 Flexcomm interfaces: 10 SPI, 10 I2C, 10 UART, 2 I²S channels. Max 10 channels

- **Advanced Security Option**
  - OTP for enhanced CRP
  - True Random Number Generator
  - verification
  - Single and dual-image boot support
**LPCXpresso54608 Board Introduction**

**Key Features**
- 272x480 color LCD with capacitive touch screen
- On-board, high-speed USB, Link2 debug probe with CMSIS-DAP and SEGGER J-Link protocol options, support for external debug probe
- UART and SPI port bridging from LPC546xx target to USB via the on-board debug probe
- 3 x user LEDs, plus Reset, ISP (3) and user buttons
- Multiple Expansion options, including Arduino UNO and PMod
- Built-in power consumption measurement for target LPC546xx MCU
- 128Mb Micron MT25QL128 Quad-SPI flash
- 8MB Micron MT48LC8M16A2B4 SDRAM
- Knowles SPH0641LM4H digital microphone
- Full size SD/MMC card slot
- NXP MMA8652FCR1 accelerometer
- Stereo audio codec with line in/out
- High and full speed USB ports with micro A/B connector for host or device functionality
- 10/100Mbps Ethernet (RJ45 connector)

**Support Materials**
- NXP.com Board Page
- Start Guideline
- LPCXpresso54608: Out of Box & Getting Started Introduction
- Board Schematics
- Board User Manual
INTRODUCING
KINETIS PORTFOLIO
FOR MARKET SPECIFIC APPLICATIONS
Winning across segments with Kinetis MCUs
Kinetis Microcontroller Portfolio

Kinetis K Series
- Performance and Integration
- Cortex-M4-based MCUs

Kinetis L Series
- Ultra-Low Power
- Cortex-M0+-based MCUs

Kinetis E Series
- 5 V / Robust
- Cortex-M0+/M4 MCUs

Kinetis V Series
- Real-time control; Motor and Power Conversion
- Cortex-M0+/M4/M7 cores

Kinetis EA Series
- Automotive
- Cortex-M0+-based MCUs

Kinetis M Series
- Metrology
- Cortex-M0+ core

Kinetis MINI MCUs
- Miniature chip-scale packages
- World's smallest ARM-based MCUs

Kinetis W Series
- Wireless Connectivity
- Cortex-M0+/M4 cores
## NXP Kinetis Microcontroller Portfolio

### General Purpose
- **23 Packages**
  - From 50 to 180 MHz
  - 32kB to 2MB Flash 8 to 256 kB SRAM
  - Memory Expansion
  - High Precision Analog
  - Options with
    - Advanced Security Protection
    - FS/HS+PHY USB
    - CAN, Ethernet
    - Segment/Graphics LCD
    - PGA/OpAmps
    - FlexIO

### Wireless Connectivity
- **Application Specific 4 Packages**
  - Sub-1GHz and 2.4GHz (inc. BLE & 802.15.4, Zigbee, Thread)
  - 128 to 512kB Flash 16 to 64 kB SRAM
  - High Precision Analog
  - Options with FS USB

### Secure
- **Application Specific 4 Packages**
  - From 72 to 120 MHz
  - HW Cryptography
  - Anti-Tamper
  - 128 to 256kB Flash 128 to 256KB RAM
  - QSPI
  - Options with CAN

### Control & Power Conversion
- **Application Specific 5 Packages**
  - From 75 to 168 MHz
  - 16 to 512kB Flash 8 to 96 kB SRAM
  - Fast, High Precision Analog, Timers/PWM
  - Real-time computation and math acceleration
  - Options with CAN

### 5V / Robust
- **Application Specific 10 Packages**
  - From 20 to 168 MHz
  - 8kB to 512kB Flash 1 to 64 kB SRAM
  - Enhanced ESD/EMC Performance
  - High Current Output
  - Options with
    - CAN
    - New touch sensor
    - FlexIO

### Ultra-Low Power
- **General Purpose 19 Packages**
  - From 48 to 72 MHz
  - 8kB to 512kB Flash 1 to 128 kB SRAM
  - Smart, Autonomous Peripherals/Timers
  - High Precision Analog
  - Options with
    - Advanced Security Protection
    - FlexIO

### Metrology
- **Application Specific 4 Packages**
  - From 50 to 75 MHz
  - 64kB to 256kB Flash 16 to 32 kB SRAM
  - AFE w/ up to Quad 24b Sigma-Delta ADCs
  - Options with
    - LCD

### Summary of Devices in Production Today

#### ARM Cortex-M4 Based MCUs
- K Series
- W Series
- K8x
- KL8x

#### ARM Cortex-M7 Based MCUs
- V Series
- E Series
- L Series
- M Series

#### ARM Cortex-M0+ Based MCUs
- Secure
- K8x
- KL8x

---

**EXTERNAL USE**
<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JN5169</td>
<td>Low power, High Performance 802.15.4 wireless microcontroller</td>
</tr>
<tr>
<td>JN5174/76/79</td>
<td>Low power, High Performance 802.15.4 wireless microcontroller</td>
</tr>
<tr>
<td>KW2xD</td>
<td>High Performance 802.15.4 wireless microcontroller</td>
</tr>
<tr>
<td>KW21Z</td>
<td>Very Low power, High Performance 802.15.4 wireless microcontroller</td>
</tr>
<tr>
<td>KW3x1Z</td>
<td>Very Low power, High Performance BLE 4.2 wireless microcontroller</td>
</tr>
<tr>
<td>QN9080</td>
<td>Ultra Low Power, High Performance BLE 4.2 wireless microcontroller</td>
</tr>
<tr>
<td>KW41Z</td>
<td>Very Low power, High Perf 15.4 / BLE 4.2 wireless microcontroller</td>
</tr>
</tbody>
</table>

### Development Kit
- **JN5169**
  - **Type:** Power +10dBm
  - **Dimensions:** 32b RISC @32MHz 32kB RAM 512kB flash
  - **Tx Power:** +10dBm
  - **Rx Sensitivity:** -96dBm
  - **Other:** Tx 23.3mA, Rx 14.7mA
  - **Compatibility:** QFN40 6x6mm
  - **Temperature:** Tamb -40°C / +125°C

- **JN5174/76/79**
  - **Type:** Power +10dBm
  - **Dimensions:** 32b RISC @32MHz 32kB RAM 160/256/512kB flash
  - **Tx Power:** +10dBm
  - **Rx Sensitivity:** -96dBm
  - **Other:** TX 19mA, Rx 17mA
  - **Compatibility:** QFN40 6x6mm
  - **Temperature:** Tamb -40°C / +125°C

- **KW2xD**
  - **Type:** Power +8dBm
  - **Dimensions:** TSSOP8 (8pin)

- **KW21Z**
  - **Type:** Power +4dBm
  - **Dimensions:** KW21Z
  - **Tx Power:** 22.5mA, Rx 14.8mA
  - **Other:** 3.4mA, Rx 3.6mA

- **KW3x1Z**
  - **Type:** Power +4dBm
  - **Dimensions:** QFN40 6x6mm
  - **Tx Power:** 19mA, Rx 17mA

- **QN9080**
  - **Type:** Power +8dBm
  - **Dimensions:** KW3x1Z
  - **Comparison:** TX 6.5mA, Rx 6.5mA

- **KW41Z**
  - **Type:** Power +8dBm
  - **Dimensions:** QFN7x7mm, WLCSP
  - **Temperature:** Tamb -40°C / +125°C
Kinetis KW41Z/31Z/21Z

**Core/System**
- Cortex-M0+ running up to 48 MHz
- Four independently programmable DMA controller channels

**Memory**
- Up to 512kB Flash
- Up to 128 kB SRAM

**Radio**
- Support for BLE v4.2, 802.15.4, Generic FSK
  - -95 dBm in BLE mode, -100 dBm in 802.15.4 mode
  - 30 to +3.5 dBm programmable output power
  - 6.8 mA Rx & 6.1 mA Tx (8dBm) current target (DC-DC enabled)
  - On-chip balun with single ended bidirectional RF port

**Communications/HMI/Timers**
- 2xSPI, 2xI2C, LP-UART, GPIO with IRQ capability (KBi)
- Carrier Modulated Timer (CMT) for infrared transmissions
- Hardware Capacitive Touch Sensing Interface (TSI)
- 3xFlexTimer (TPM) with PWM & quadrature decode support
- Low Power (LPTMR), Programmable Interrupt (PIT) and RTC timers

**Analog**
- 16-bit ADC with integrated temperature sensor and battery monitor
- 12-bit DAC and 6-bit High-speed Comparator

**Security**
- AES-128 Accelerator and True Random Number Generator
- Advanced flash security

**Integrated DC/DC Converter**
- Normal: 1.71V to 3.6V
- Buck: 2.1V to 4.2V for coin cell operation
- Boost: 0.9V to 1.795V for single alkaline battery operation

**Unique Identifiers**
- 80-bit unique device ID programmed at factory
- 40-bit unique media access control (MAC) subaddress can be used for Bluetooth Low Energy or IEEE 802.15.4 MAC Address

**Features**
- Supports concurrent operation
- 40º C to +105º C (QFN)
- 40º C to +85º C (WLCSP)

**Device and Protocols**

<table>
<thead>
<tr>
<th>Device</th>
<th>Memory (Flash/RAM)</th>
<th>Protocol</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MKW21Z128VHT4</td>
<td>512 KB / 128 KB</td>
<td>BLE 4.2 / Generic FSK</td>
<td>7x7 48-pin Laminate QFN 4x4 75-pin WLCSP</td>
</tr>
<tr>
<td>MKW21Z256VHT4</td>
<td>256 KB / 128 KB</td>
<td>802.15.4</td>
<td>7x7 48-pin Laminate QFN 4x4 75-pin WLCSP</td>
</tr>
<tr>
<td>MKW31Z128VHT4</td>
<td>512 KB / 128 KB</td>
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</tr>
</tbody>
</table>

**Software and Protocol Stacks**
- Bluetooth Smart Host Stack & Profiles
- Generic FSK (250 kbps, 500 kbps, 1Mbps)
- Thread Stack, IEEE 802.15.4 MAC, SMAC
- Thread + BLE Multi-Protocol Stack
- KSDK, RTOSes, IAR & KDS Support
Kinetis KW41Z/31Z/21Z: Key Differentiators

**Multi-Protocol Radio** – High performance radio supporting Bluetooth Smart/Bluetooth Low Energy (BLE) v4.2, Generic FSK and IEEE 802.15.4 (Thread) based standards

**Large Memory** – Enough memory to adequately contain desired networking stack(s) with ample room remaining for custom applications

**Low Power** – Low transmit, receive and standby currents that maximizes battery life, including standard coin-cells

**Complete Enablement** – Fully compliant, certified Bluetooth Low Energy, Thread and 802.15.4 MAC/PHY. Support for Generic FSK, BLE Mesh, SMAC, multiple RTOSes, KSDK 2.0, KDS and IAR IDEs.
Complete Enablement: Software

- Thread R1.1 Compliant Network Stack
- Thread + BLE Combo Stack
- IEEE 802.15.4 MAC/PHY
- Qualified Bluetooth Low Energy v4.2 Stack + Application Profiles
- Bluetooth Low Energy Mesh Stack
- IPv6 over BLE
- Generic FSK at 250, 500 and 1000 kbps
- SMAC w/ Connectivity Test for Regulatory Certification
- Support for Host MCU and MPU (Linux®) Processors
- Full integration with Kinetis SDK
- Multiple RTOS, including FreeRTOS and uCOSII (BLE)
- Kinetis Design Studio (KDS)
- IAR Embedded Workbench®
KW41Z Development Hardware

- **FRDM-KW41Z** Freedom Development Hardware
  - Can be configured as Host or Shield for connection to Host Processor
  - Supports all DC-DC configurations
  - PCB inverted F-type antenna
  - Minimum number of matching components
  - FCC Part15 & EN300 328 compliant
  - Serial Flash for OTA firmware upgrades
  - On board NXP FXOS8700CQ digital sensor, 3D Accelerometer (±2g/±4g/±8g) + 3D Magnetometer
  - OpenSDA and JTAG debug
  - Full KSDK support
  - Resale $145 (2 boards/kit)

- **USB-KW41Z** USB Dongle
  - Ideal for BLE/802.15.4 sniffer or connection to PC/Tablet
  - FCC Part15 & EN300 328 compliant
  - Resale $60
KW41Z Development Software

- Thread R1.1 Compliant Network Stack
- Thread + BLE Combo Stack
- IEEE 802.15.4 MAC/PHY
- Qualified Bluetooth Low Energy v4.2 Stack + Application Profiles
- Bluetooth Low Energy Mesh Stack
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Thread Router (Ethernet/Wi-Fi)

- Kinetis **K64** is standalone MCU with up to 1MB Flash, up to 256K RAM and embedded Ethernet
- Kinetis **K63** MCU adds tamper protection DryIce module
- **MCR20** is an 802.15.4 transceiver
- Thread, Wi-Fi and Ethernet share same IP stack

**RTOS Boarder Router**

- Communication
- Control
- Sensors
- Input/Output

**Linux Gateway**

- **i.MX 6** Linux system handles Data Management and Analytics, Events Processing and Cloud Connection
- Kinetis **KW2x MCU** runs the Thread Border Router functionality

- **K64/63**
- **WiFi**
- **MCR20**
- **ENET PHY**
Thread Router and End Device

- **KW** devices with 512kB Flash and 64k RAM can run **Border Router or Router Eligible End Device** configurations with an Application
- **KW** devices with 32kB RAM can run **Thread End Device** configurations with an Application
- **Kinetis L** devices with 32kB RAM can run 802.15.4 MAC/PHY, Thread Network and Application as an **End Device**
- **MCR20A** is the 2.4GHz Transceiver
Target Development Systems: Gateways/Border Routers/End Nodes

K64F Freedom Board
- 120 MHz Cortex-M4F
- Up to 1 MB Flash, Up to 258 KB RAM
- Integrated Ethernet
- Thread and ZigBee
- Launching Oct 6th

KW2x FRDM-KW24D512

USB-KW24D512

i.MX6UL EVK
- 528MHz Cortex-A7 CPU
- 4 GB DDR3L DRAM memory
- 256 MB Quad SPI Flash
- Arduino/Freedom connector
- Launching Oct 6th
KINETIS

CONTROL
Target Market and Applications

Appliance (Kinetis E)
- Convection Oven
- Air-conditioner
- Microwave Oven
- Induction Cooker
- Washer
- Refrigerator

Motor Control
- E-Bike
- AC Motor
- DC Motor

Industrial
- Intelligent MCCB
- Circuit Breaker

Smart Lighting (Kinetis E)
- CFL Ballast
- LED Street Light
- LED Lighting

General Purpose
- UPS
- HVAC
- Industrial HMI

Touch Sensing (Kinetis E)

General Purpose
- AC Motor
- Kinetis E & V

Smart Lighting
- LED Lighting
- Touch Sensing
- Smart Lighting

Motor Control
- E-Bike
- AC Motor
- DC Motor

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Kinetis E & V

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Smart Lighting (Kinetis E)
- CFL Ballast
- LED Street Light
- LED Lighting

General Purpose
- UPS
- HVAC
- Industrial HMI

Touch Sensing (Kinetis E)
Kinetis V series MCU
For Motor Control & Digital Power Conversion

- April 26, 2017

- ARM Cortex-M0+ / M4 / M7 cores bring broad choice, and smooth upgrade.

- Scalable MCU families from 75MHz to 240MHz MCUs, maximize resource reuse and flexibility

- Optimized MCU performance and high speed/resolution analogy peripherals.

- Tower and FRDM boards, Libraries and KMS (Kinetis motor suite) reduced motor control learning curve and speed time to market.
Kinetis V - Target Applications

- **KV1x**: 1 PMSM Motor
- **KV3x**: Up to 2 x PMSM Motors
- **KV4x**: Up to 4 x PMSM Motors
- **KV5x**: Up to 8 x PMSM Motors

- **FOC ACIM**:
  - **KV3x**: Up to 2 x FOC ACIM
  - **KV4x**: Up to 4 x PMSM Motors
  - **KV5x**: Up to 2 x FOC ACIM

- **Low Dynamic PMSM FOC**: 1 or 2 BLDC Motors
- **High Dynamic PMSM FOC**: Up to 4 x BLDC Motors

- **BLDC Motors – FOC; Sensorless & Sensor’d**: Up to 8 x BLDC Motors

- **Industrial Real Time Control**:

**Additional Information**:
- **Power Control**: UPS, SMPS, Photo Voltaic
- **BLDC Motors**: FOC; Sensorless & Sensor’d
- **PMSM Motor**: FOC ACIM
- **Kinetics V**: Target Applications
New Levels of Performance, Reliability and Power Efficiency for Motor Control and Digital Power Conversion

**KV1x MCU Family**
- BLDC, entry-level PMSM
- ARM® Cortex®-M0+
- + Motor Control Software

**KV3x MCU Family**
- Mid-range PMSM, UPS power control
- ARM® Cortex®-M4
- + Multi Channel Timers
- + Floating Point Unit

**KV4x MCU Family**
- High-performance motors, UPS, solar and mid-range AC/DC control
- ARM® Cortex®-M7
- + Advanced Memory, Connectivity and Communications

**KV5x MCU Family**
- High-performance single/multi motor systems with connectivity & security, Advanced digital power conversion
- ARM® Cortex®-M7

Feature Integration:
- NXP IDE, RTOS, Software Libraries and Motor Control Development Tools
Kinetis E series MCUs Based on ARM® Cortex® Cores

5V
- Wide range power supply 2.7V – 5.5V

Robust
- EMC/ESD technology to ensure strong noise immunity

Scalable Performance & High Efficiency
up to 40x higher performance than 8/16-bit MCUs
- ARM Cortex M0+ core up to 72MHz
- ARM Cortex M4 core up to 168MHz

Low Cost
- Optimized for cost-sensitive applications
- Offering low pin count options
Kinetis E Series Product Roadmap

2.7-5.5V MCUs with high reliability and robustness,
Based on ARM® Cortex-M® with best-in-class Enablement

**Touch Sense Interface Value Features**

- Two operation modes
  - Self-cap: up to 25 keys
  - Mutual: up to 36 keys
- Advanced robust in EMC
  - Pass IEC61000-4-6 standard test
- Advanced robust in waterproof
- High sensitivity and resolution
- No need for CPU interfere
- Ease of use
  - NXP Touch Library support
  - SDK touch APIs support
- No need for external components

<table>
<thead>
<tr>
<th>Integration</th>
<th>KE1xF – 168 MHz CM4, ADCs</th>
<th>KE1xZ – 72 MHz CM0+, Enhanced features</th>
<th>KE0xZ – 40/48 MHz CM0+, Entry level</th>
</tr>
</thead>
<tbody>
<tr>
<td>KE18F</td>
<td>CM4, ECC, 3xADCs, 2xCANs</td>
<td>KE16F – CM4, ECC, 3xADCs, CAN</td>
<td></td>
</tr>
<tr>
<td>KE16F</td>
<td>CM4, ECC, 3xADCs, CAN</td>
<td>KE14F – CM4, ECC, 3xADCs</td>
<td></td>
</tr>
<tr>
<td>KE15Z</td>
<td>CM0+, 72MHz</td>
<td>KE15Z – CM0+, 72MHz, TSI</td>
<td></td>
</tr>
<tr>
<td>KE14Z</td>
<td>CM0+</td>
<td>KE14Z – CM0+, 72MHz</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Memory Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 KB</td>
</tr>
</tbody>
</table>

- KE02Z – CM0+, 48MHz, CAN
- KE04Z – CM0+, 48MHz
- KE02Z – CM0+, 40MHz, EEPROM

NXP
**KE15Z/14Z Block Diagram**

**Key Features:**

**Core/System**
- ARM® Cortex®-M0+ up to 72MHz
- 8ch eDMA
- TRGOMUX
- MMDVSQ

**Memory**
- up to 256KB Flash with ECC
- up to 32KB SRAM
- up to 32KB FlexMemory / 2KB EEPROM
- Boot ROM

**Communications**
- 3 x LPUART / 2 x LPSPI / 2 x LPI2C / FlexIO

**Analog**
- 2 x 12b ADC, 1MSPS
- 2 x ACMP
- 1 x 8b DAC

**Timers**
- 1 x 8ch FTM (PWM)
- 2 x 4ch FTM (PWM/Quad Dec.)
- 1 x PDB
- 1 x 4ch LPIT / 1 x LPTMR / 1 x PWT
- 1 x RTC

**Others**
- Up to 36ch TSI (KE15Z only)
- Up to 89 GPIO with glitch filter
- 2.7-5.5V, -40 to 105°C

**Packages**
- 100LQFP(0.5mm pitch)
- 64LQFP(0.5mm pitch)
- Pin compatible within KE

### Core

- ARM® Cortex®-M0+ up to 72MHz
  - Debug Interfaces
  - Interrupt Controller

### System

- 8ch eDMA
- TRGOMUX
- MMDVSQ
  - Boot ROM
  - 256KB Flash with ECC
  - 2KB EEPROM
  - 32KB SRAM
  - 2.7-5.5V PMC

### Memories

- BME
- 32KB SRAM
- 8ch FlexIO

### Clocks

- 3-40M/32K OSC
- IRC 48MHz(1%)
- IRC 8MHz(3%)
- 128K LPO
- LPFLL

### Safety and Security

- CRC
- UID
- FAC
- Watchdog
- LVD/POR

### Analog

- 2 x 12b ADC
- 2 x ACMP
- 1 x 8b DAC

### Timers

- 3 x FlexTimer
- 1 x PDB
- LPIT
- LPTMR
- PWT
- RTC

### Communication Interfaces

- 2x LPI2C
- 2x LPSPI
- 3x LPUART

### HMI

- 36ch TSI
- Robust IO
- 8 pins 20mA
**Key Features:**

**Core/System**
- ARM® Cortex®-M4F up to 160MHz
- 16ch eDMA
- TRGMUX
- MPU

**Memory**
- up to 512KB Flash with ECC
- up to 64KB SRAM with ECC
- up to 64K FlexMemory / 4KB EEPROM
- 8KB I/D Cache
- Boot ROM

**Communications**
- 2 x FlexCAN
- 3 x LPUART / 2 x LPSPI / 2 x LPI2C / FlexIO

**Analog**
- 3 x 12b ADC, 1MSPS
- 3 x ACMP
- 1 x 12b DAC

**Timers**
- 2 x 8ch FTM (PWM)
- 2 x 8ch FTM (PWM/Quad Dec.)
- 3 x PDB
- 1 x 4ch LPIT / 1 x LPTMR / 1 x PWT
- 1 x RTC

**Others**
- Up to 89 GPIO with glitch filter
- 2.7-5.5V, -40 to 105°C

**Packages:**
- 100LQFP (0.5mm pitch)
- 64LQFP (0.5mm pitch)
- Pin compatible within KE
Kinetis E Touch HW and SW Support

**Freedom Platform**
- **FRDM-KE15Z**
  - Ultra low-cost/power development platform
  - Form factor compatible with Arduino platform
  - Compatible with Freedom shield
  - Support touch pad

**Freedom Shield**
- **FRDM-TOUCH**
  - Daughter card of FRDM-KE15Z.
  - Easy and simple way to evaluate the touch pad, slide and wheel. Including self-cap and mutual-cap mode.

**TSI Evaluation Board**
- **RD-KE15Z-TSI**
  - Evaluation board for new TSI hardware and software design
  - More touch keys and types

---

NXP Touch Library v2.x / NXP KSDK v2.0
KINETIS
SECURE
SECURE
Kinetis Security Overview

**Authorized Access**
- Code I/P Protection
  - Internal Memory Protection
  - External Memory Protection
- Debug Port Protection
- Authentication
  - Software Updates
  - Device Verification
- Secure Boot

**Data Protection**
- Symmetric Encryption
  - DES/DES3, AES
- Asymmetric Encryption
  - RSA, ECC
- Hashing
  - CRC, MD5, SHA
- True Random Number Generation
- Security Protocols
  - SSL, HomeKit, Thread

**Monitoring of physical and environmental attacks**
- Tamper Detection
  - Physical
    - Enclosure Intrusion
    - Drilling and Probing
  - Environmental
    - Voltage
    - Temperature
    - Frequency
- Secure Storage
Kinetis KL8x to K8x

World’s most secure ARM® Cortex®-M based MCUs

**Kinetis KL8x MCU**
72MHz ARM Cortex-M0+

- Advanced Security
  - Secure RAM & Boot, Memory Protection Unit, Low Power Trusted Crypto. Engine (DES/3DES/AES/RSA), Tamper Detection, ISO7816-3 EMV SIM, Random Number Generator
  - 128/96KB Flash/SRAM, USB, FlexIO, QuadSPI (XIP), 121 MBGA / 80 LQFP

**Kinetis K8x MCU**
150MHz ARM Cortex-M4

- Advanced Security
  - Crypto. Acceleration Unit, On-the-Fly Decryption for external memories

- Performance
- Memory
- Crypto throughput
- Ext. memory expansion & protection

256/256/16KB Flash/SRAM/Cache, USB, FlexIO, QuadSPI (XIP), SDRAM, SD/eMMC, FlexBus, 121 XFBGA / 100 LQFP

Hardware and software compatibility with PCI-certified enablement
Kinetis K8x/KL8x MCUs: Enablement

**TWR-POS-K81**
PIN Pad Reference Design

- POS PIN Pad Reference Design for customers seeking Payment Card Industry certifications
- Kinetis K81/KL81 MCU: tamper pins, chip security, EMVSIM, Kinetis SDK w/ Cryptographic Driver s/w
- Chip-and-PIN keypad based on Cirque® SecureSense™ technology (PCI PTS compliant without requiring physical protection for touch sensor)
- Available under NDA (incl. pre-PCI4.x certification reports. Full PCI 4.1 Certification expected Oct 2016)

**Tower & Freedom Modules**

- TWR (full evaluation) or FRDM (entry-level) development modules
- KL8x MCU:
  - TWR-KL82Z72M
  - FRDM-KL82Z
- K8x MCU:
  - TWR-K80F150M
  - FRDM-K82F
- 8MB SDRAM, 8MB Serial NOR Flash
- Multiple TWR and Arduino™ form-factor compatible peripheral modules
- Available (K8x/KL8x)

**Security Software**

- Freescale Kinetis SDK software drivers for public key cryptography
- Support for multiple toolchains including GNU GCC, IAR, Keil, and Kinetis Design Studio

POS PIN Pad Reference Design for customers seeking Payment Card Industry certifications

Freescale Kinetis SDK software drivers for public key cryptography

Support for multiple toolchains including GNU GCC, IAR, Keil, and Kinetis Design Studio
KINETIS GENERAL
KS22 Series MCU

- Member of Kinetis K series
- Initiated from China market demand, designed & manufactured locally
- Same quality standard as NXP Kinetis MCU
- Longevity Program to ensure a minimum of 10 years supply
- Both English and Chinese language technical support (websites, documents, community) provided by China team

Cost Effective with Optimized Performance
- ARM Cortex-M4 @120MHz
- DSP and Floating point unit (FPU)

Power Efficiency
- Leverages the ultra low power technology of Kinetis L series MCUs
- Integration of low-power peripherals
- Run mode power consumption is as low as 158μA / MHz

Smart Integration
- Reduce BOM & system cost: Crystal-less USB device
- Various communication interfaces: CAN, I2S, UART, SPI, LPI2C
- Flexible Communication Interface: FlexIO

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63

EXTERNAL USE
KS22 Target Applications

- Car audio
- Smart audio
- CAN Bus
- GPS Tracker
- Car Infotainment co-processor

High performance, Low power

General Market

Smart Devices
Wearables

Finger printer
KS22_128/256 Block Diagram

Key Features:

Core/System
- Cortex-M4 @ 120MHz / FPU / DSP

Memory
- 128KB/256KB Flash
- 64KB SRAM

Communications
- USB OTG FS/LS
- 2* + 3x UART, 1x LPUART
- 2* + 2x SPI
- 2* + 2x LPI2C
- 2* + 2x I2S (SAI)
- 2x CAN
- FlexIO*

Analog
- 1x 16-bit ADC, 1x 12-bit DAC
- 1x ACMP

Timers
- 1x 6ch LPTPM, 2x 2ch LPTPM
- Low Power Timer
- Periodic Interrupt Timers (PIT)
- RTC with independent Vbat. Supply

Others
- 8 high-drive I/Os (20mA) – SPI / LPI2C
- 1.71V-3.6V; -40C to 105C

Packages
100LQFP, 64LQFP, 48QFN

* FlexIO can emulate 2x UART, or 2x SPI, or 2x I2C, or 2x I2S, or PWM, etc
# KS22 Orderable Part Numbers

GIBC is open for registration

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<th>Features</th>
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<th>MKS22FN128</th>
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* PK Sample is now available. Mass production on July 2016 for 48QFN.
# NXP Microcontroller Enablement Consolidation

## Hardware Development Tools

<table>
<thead>
<tr>
<th>Baseline Evaluation Kits</th>
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<tbody>
<tr>
<td>LPC Xpresso</td>
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<tr>
<td>Freedom Development Platform</td>
</tr>
<tr>
<td>Tower System</td>
</tr>
</tbody>
</table>

## Runtime Software

### Baseline

- Kinetis SDK/LPCOpen
  - Drivers
  - System Services
  - FreeRTOS
  - USB
  - emWIN
  - TCP/IP
  - Filesystem

### Expansion – Connect, Control, Graphics

- HomeKit SDK
- Motor Control
- Wireless Charging
- Sensor Fusion
- MFi
- Graphics Partners
- POS / EMV
- Connectivity Solutions

## SW Development Tools

### IDE Toolchain

- Power Estimation
- BSP Tools
- Project Generator
- Power Analyzer

### Configuration Tools

Industry leading IDE support and intuitive software configuration tools to accelerate application development

## Expansion & Partner Solutions

- MCU Expansion boards from NXP & 3rd Parties
  - LPC-Link2
  - SYSTEM
- Low cost hardware platforms for evaluation and application development. Partner solutions for hardware debugging solutions

## Software frameworks and development tools for targeted applications and certified connectivity solutions
NXP Microcontroller Enablement Consolidation

LPC PRESSO
LPCware
LPCOpen v2/3

MCUXpresso Software and Tools
- IDE
- SDK
- Config Tools

NXP Cortex-M Microcontrollers
- LPC + Kinetis
MCUXpresso Software and Tools
for LPC & Kinetis Microcontrollers

MCUXpresso Software and Tools
- IDE
- SDK
- Config Tools

NXP Cortex-M Microcontrollers
- LPC + Kinetis

MCUXpresso IDE
Edit, compile, debug and optimize in an intuitive and powerful IDE

MCUXpresso SDK
Runtime software including peripheral drivers, middleware, RTOS, demos and more

MCUXpresso Config Tools
Online and desktop tool suite for system configuration and optimization
NXP Designs

• A one-stop-website to help customers develop their embedded design using complete NXP technology with,
• Projects, solutions and reference designs using NXP technology
• Access to information such as software, schematics and user documentation for quick use and customization
• Designed by NXP technical experts and third party partners

www.nxp.com/nxpdesigns
Hexiwear Next Gen IoT Solution for Innovators

Value Proposition

Fastest Time to Market
Versatile solution created to reduce development and design time for IoT applications

Path to Manufacturing
Designed to accelerate the customer’s time to manufacturing. The BOM is readily available in the market and the design files/schematic is open source.

Optimized Hardware Design
The hardware design is optimized and includes several best practices suggested for designing low power IoT applications

Robust Software
The software includes everything from the embedded drivers to the cloud connectivity - all open source, easy to use and optimized

Community Supported
Hexiwear is a true community based solution and enables customers to access the rich pool of resources created by community

Target Applications
IoT end nodes & Wearables

Key Components

Total NXP BOM
$16 - 7 NXP components: MCUs, connectivity, sensors and battery charger - Kinetis K64 MCU based on ARM Cortex-M4 core

Kinetis KW40Z multimode BLE and 802.15.4 radio SoC

Color OLED Display, Rechargeable battery, External flash

Design Resources Available

Software
Schematic, Design Files, Bill of Material (BOM)
iOS and Android App

Software Development Environment

Kinetis SDK (Open-source and Free)
Kinetis Design Studio (Open-source and Free)
FreeRTOS (Open-source and Free)
Visit Us Online

LPCmcu.org
English

NXPic.org
Chinese

Thank You.
Partnerships
Built on Trust.
SECURE CONNECTIONS FOR A SMARTER WORLD