Agenda

• NXP MCU Overview

• Enabling Secure Designs
  • PIN Entry Device
  • POS Solution - SLN-POS-RDR
  • Software Architecture
  • IDE & Debug
A NEW POSITION OF STRENGTH

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

~45,000 Employees
11,000+ Engineers
35+ Countries
9,000+ Patents
# NXP MCUs - Powerhouse Portfolio

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARM Expertise</td>
<td>Broadest licensee of ARM cores in industry</td>
</tr>
<tr>
<td>Expansive Portfolio</td>
<td>Most scalable portfolio with optimized performance and capabilities</td>
</tr>
<tr>
<td>Development Tools</td>
<td>Best-in-class hardware platforms and software solutions</td>
</tr>
<tr>
<td>Ecosystem Leadership</td>
<td>Industry leading partnerships for innovation and differentiation</td>
</tr>
<tr>
<td>Customer Centric</td>
<td>Experienced global support team and professional services to accelerate time-to-market</td>
</tr>
</tbody>
</table>
**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**

<table>
<thead>
<tr>
<th>Bosch</th>
<th>Avnet</th>
<th>NXP</th>
<th>Electrolux</th>
<th>ABB</th>
<th>Flextronics</th>
<th>Haier</th>
<th>Honeywell</th>
<th>Continental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulet Corporation</td>
<td>Microsoft</td>
<td>Mouser Electronics</td>
<td>SONOS</td>
<td>LG</td>
<td>Schneider</td>
<td>Siemens</td>
<td>Whirlpool</td>
<td></td>
</tr>
<tr>
<td>LG</td>
<td></td>
<td></td>
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</tr>
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**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>

**Products**

<table>
<thead>
<tr>
<th>Kinetis and LPC 32-bit ARM® Microcontrollers</th>
<th>i.MX ARM® Applications Processors</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td></td>
</tr>
</tbody>
</table>
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
NXP is your one-stop source for scalable POS architectures

PinPad / mPOS
- K21/K81/KL81

Portable POS / Smart POS
- i.MX 6 UL-3
- i.MX7 Solo

High End Smart POS
- i.MX 7Dual; i.MX 8Xseries
- i.MX 6DL/D/Q + K81/KL81

High End Traditional POS
- i.MX6 DQ Plus; i.MX 8Xseries; 8series + K81/KL81/A70CM

- Power Efficient
- Secure & Connected
- Cost optimized

Solutions
Scalable ARM based Processors and Controllers

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

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

Overall Relative Performance

NXp
### General Purpose Application Specific

#### Attributes

<table>
<thead>
<tr>
<th>M0 / M0+</th>
<th>M3/M4</th>
<th>M7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance efficiency</strong></td>
<td><strong>Advanced integration</strong></td>
<td><strong>Target Applications</strong></td>
</tr>
<tr>
<td>KL80/81, M0+</td>
<td>K64/66/65, M4</td>
<td>Always-on devices, Voice control, IoT</td>
</tr>
<tr>
<td>Performance, efficiency</td>
<td>K80/81, M4</td>
<td>Industrial control, Payment, Metering, Wearables, Display UI, Printers</td>
</tr>
<tr>
<td><strong>Low-cost &amp; Small Form Factor</strong></td>
<td><strong>Wireless Connectivity</strong></td>
<td>Consumer/Gaming Accessories, Wearables, Home Automation, Data Concentrators, Industrial</td>
</tr>
<tr>
<td>LPC1700, M0+</td>
<td>KL02/03, M0+</td>
<td>Wake-up unit, System task/co-processor, Power Management Control System</td>
</tr>
<tr>
<td><strong>Motor Control &amp; Power Conversion</strong></td>
<td><strong>Application Specific</strong></td>
<td></td>
</tr>
<tr>
<td>KE02/4/6, M0+</td>
<td>KL17, M0+</td>
<td>Home Automation, Thread, BLE, Apple HomeKit</td>
</tr>
<tr>
<td>5V Robust</td>
<td>KE1xF (M4F), KE1xZ (M0+)</td>
<td>BLDC / PMSM motors, Photo voltaic, Industrial Controls</td>
</tr>
</tbody>
</table>

#### PORTFOLIO

- **M0 / M0+**
  - KE02/4/6, M0+
  - KE1x2 (M0+)
  - LPC5410x, M4 w/M0+ Copr.
  - LPC5411x, M4 w/M0+ Copr.

- **M3/M4**
  - LPC1700, M3
  - LPC1800, M3
  - LPC4000, M4
  - LPC4300, M4 w/M0+ Copr.
  - LPC5010x, M4 w/M0+ Copr.

- **M7**
  - LPC1500, M3
  - LPC5410x, M4
  - LPC5411x, M4

#### Target Applications

- Always-on devices
- Voice control
- IoT
- Industrial control
- Payment, Metering
- Wearables, Display UI
- Industrial Control
- Wake-up unit
- System task/co-processor
- Power Management Control System
- Consumer/Gaming Accessories
- Wearables
- Home Automation
- Data Concentrators
- Industrial
- Home Automation
- Thread
- BLE
- Apple HomeKit
- BLDC / PMSM motors
- Photo voltaic
- Industrial Controls
- Appliance
- Smart Lightning

---

**Attributes**

<table>
<thead>
<tr>
<th>KL80/81, M0+</th>
<th>K64/66/65, M4</th>
<th>K80/81, M4</th>
</tr>
</thead>
<tbody>
<tr>
<td>HW Security Crypto, USB, FlexIO up to 128K Flash, 96K SRAM</td>
<td>100MHz Power Efficiency up to 512K Flash, 104K SRAM</td>
<td>HW Security Crypto, Tamper, QSPI, USB up to 256K Flash, 256K SRAM</td>
</tr>
</tbody>
</table>

**Advanced integration**

<table>
<thead>
<tr>
<th>LPC1100, M0+/M0+</th>
<th>KL28, M0+</th>
<th>K22/24/26, M4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Options CAN or USB, EEPROM up to 256K Flash, 36K SRAM</td>
<td>72/96MHz, FlexIO, BootROM, more I/O up to 512K Flash, 128K SRAM</td>
<td>Large memory, x-less USB up to 2M Flash, 200K SRAM</td>
</tr>
</tbody>
</table>

**Mainstream**

<table>
<thead>
<tr>
<th>LPC1700, M3</th>
<th>LKC1700, M3</th>
<th>LPC4000, M4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graphics LCD, FS USB, ENET, CAN, up to 512K Flash, 96K SRAM</td>
<td>Graphics LCD, FS USB, ENET, CAN, up to 512K Flash, 96K SRAM</td>
<td>Graphic LCD, FS USB, ENET, CAN, Advanced Analog, PWMs up to 512K Flash, 96K SRAM</td>
</tr>
</tbody>
</table>

**Low-cost & Small Form Factor**

<table>
<thead>
<tr>
<th>LPC81x/82x, M0+</th>
<th>LPC5410x, M4</th>
<th>LPC5411x, M4</th>
</tr>
</thead>
<tbody>
<tr>
<td>30MHz, ADC, Low Pin Count up to 32K Flash, 8K RAM</td>
<td>8-32K Flash, 1-4K RAM</td>
<td>8-32K Flash, 1-4K RAM</td>
</tr>
</tbody>
</table>

**Wireless Connectivity**

<table>
<thead>
<tr>
<th>KW21/31/41Z, M0+</th>
<th>KW21/31/41Z, M0+</th>
<th>KW2xD, M4</th>
</tr>
</thead>
<tbody>
<tr>
<td>802.15.4+BLE 4.1 Radio, DC/DC, Balun Up to 512K Flash, Up to 128K RAM</td>
<td>802.15.4+BLE 4.2 Radio, DC/DC, Balun Up to 512K Flash, Up to 128K RAM</td>
<td>802.15.4 Radio, Thread Up to 512K Flash &amp; 64K RAM</td>
</tr>
</tbody>
</table>

**Motor Control & Power Conversion**

<table>
<thead>
<tr>
<th>KV1x, M0+</th>
<th>KV3x, M4</th>
<th>KV4x, M4</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLDC, entry-level PMSM, Up to 128K flash, Up to 16K RAM</td>
<td>Mid-range PMSM, UPS power control, KMS Up to 512K Flash, Up to 96K RAM</td>
<td>High-perf motors, UPS, solar &amp; mid-range AC/DC control, KMS Up to 1MB Flash, Up to 256K RAM</td>
</tr>
</tbody>
</table>

**5V Robust**

<table>
<thead>
<tr>
<th>KE02/4/6, M0+</th>
<th>KE1xF (M4F) / KE1xZ (M0+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADC, CAN (KE06) Up to 128K Flash, Up to 16K RAM, 256B EEPROM</td>
<td>Higher perf. &amp; more comm. interfaces 256K / 512K Flash, 32K / 64K RAM, 2xCAN, new TSI (Z)</td>
</tr>
</tbody>
</table>

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**KMS = Kinetis Motor Suite**
## NXP MCU Pillars

### Secure
- **Anti-Tamper:** Kinetis MCUs have tamper pins that detect passive and active tamper events
- **Cryptography:** On-chip hardware acceleration for symmetric cryptography reduces CPU loading
- **Trust:** On-chip flash memory with security mechanisms can disable debug ports

### Control
- **Kinetis V and Kinetis E MCUs with enhanced analog integration**
- **Kinetis V and Kinetis E with advanced control peripherals for demanding motor control and power conversion systems**
- **Simplify Motor Control design through Kinetis Motor Suite**

### Connect
- **Kinetis KW, JN and QN MCUs**
- **Multi-Protocol Radio – high performance radio supporting Bluetooth Smart/Bluetooth Low Energy (BLE) and IEEE 802.15.4 based standards**
- **Fully compliant, certified Bluetooth Low Energy and 802.15.4 MAC**

### Enable
- **Low cost development platforms for evaluation and rapid prototyping**
- **Free software development environment (MCUXpresso): IDE, SDK and Config Tools**
- **Application layer software: connectivity, motor control**
- **NXP Designs reference solutions: SW, schematics, BOM**
- **Advanced support and services for time to market**
- **Application focused solutions: Tested, validated and certified HW and SW**

### Kinetis + LPC 32-bit ARM® microcontrollers

<table>
<thead>
<tr>
<th>Secure</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinetis V and E</td>
<td>Kinetis V and Kinetis E MCUs with enhanced analog integration</td>
</tr>
<tr>
<td></td>
<td>Kinetis V and Kinetis E with advanced control peripherals for demanding</td>
</tr>
<tr>
<td></td>
<td>motor control and power conversion systems</td>
</tr>
<tr>
<td></td>
<td>Simplify Motor Control design through Kinetis Motor Suite</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Connect</th>
<th>Enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinetis KW, JN</td>
<td>Low cost development platforms for evaluation and rapid prototyping</td>
</tr>
<tr>
<td>and QN MCUs</td>
<td>Free software development environment (MCUXpresso): IDE, SDK and Config</td>
</tr>
<tr>
<td></td>
<td>Tools</td>
</tr>
<tr>
<td></td>
<td>Application layer software: connectivity, motor control</td>
</tr>
<tr>
<td></td>
<td>NXP Designs reference solutions: SW, schematics, BOM</td>
</tr>
<tr>
<td></td>
<td>Advanced support and services for time to market</td>
</tr>
<tr>
<td></td>
<td>Application focused solutions: Tested, validated and certified HW and SW</td>
</tr>
</tbody>
</table>
# NXP Kinetis Microcontroller Portfolio

## Performance & Integration

<table>
<thead>
<tr>
<th>General Purpose</th>
<th>Wireless Connectivity</th>
<th>Secure</th>
<th>Control &amp; Power Conversion</th>
<th>5V / Robust</th>
<th>Ultra-Low Power</th>
<th>Metrology</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 Packages</td>
<td>4 Packages</td>
<td>5 Packages</td>
<td>5 Packages</td>
<td>10 Packages</td>
<td>4 Packages</td>
<td>4 Packages</td>
</tr>
</tbody>
</table>

### 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

### 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
  - Options with:
    - Advanced Security & Protection
    - FlexIO

### Metrology
- Application Specific
  - 4 Packages
  - Options with:
    - LCD

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# Summary of Devices in Production Today

## ARM Cortex-M4 Based MCUs

- **K Series**
- **W Series**
- **K8x KL8x Series**

## ARM Cortex-M7 Based MCUs

## ARM Cortex-M0+ Based MCUs
ENABLING SECURE DESIGNS
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
- Tamper Detection
- Secure Storage
<table>
<thead>
<tr>
<th>Key Features</th>
<th>KL81 NEW</th>
<th>K81F NEW</th>
<th>K21D</th>
<th>K21F</th>
<th>K63F</th>
<th>K65F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash</td>
<td>128 KB</td>
<td>256 KB</td>
<td>512 KB</td>
<td>1 MB</td>
<td>1 MB</td>
<td>2 MB</td>
</tr>
<tr>
<td>RAM</td>
<td>96 KB</td>
<td>256 KB</td>
<td>64 KB</td>
<td>128 KB</td>
<td>128 KB</td>
<td>256 KB</td>
</tr>
<tr>
<td>Max Freq</td>
<td>72 MHz</td>
<td>150 MHz</td>
<td>50 MHz</td>
<td>120 MHz</td>
<td>120 MHz</td>
<td>180 MHz</td>
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<tr>
<td>Core</td>
<td>M0+</td>
<td>M4F</td>
<td>M4</td>
<td>M4F</td>
<td>M4F</td>
<td>M4F</td>
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<tr>
<td>RNG</td>
<td>TRNG</td>
<td>TRNG</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>DRYICE Secure Memory</td>
<td>32 Bytes + 128 Bytes</td>
<td>32 Bytes + 128 Bytes</td>
<td>32 Bytes</td>
<td>32 Bytes</td>
<td>32 + 128 Bytes</td>
<td>32 +128 Bytes</td>
</tr>
<tr>
<td>Secure RAM</td>
<td>N/A</td>
<td>2 KB</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>No. of Tamper Pins</td>
<td>8</td>
<td>8</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Frequency, Voltage, Temperature Tamper</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>DES/3DES/AES</td>
<td>LTC Enc. Engine DPA</td>
<td>LTC Enc. Engine DPA</td>
<td>MMCAU</td>
<td>MMCAU</td>
<td>MMCAU</td>
<td>MMCAU</td>
</tr>
<tr>
<td>RSA/ECC</td>
<td>LTC Enc. Engine</td>
<td>LTC Enc. Engine</td>
<td>MMCAU</td>
<td>MMCAU</td>
<td>MMCAU</td>
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</tr>
<tr>
<td>SHA</td>
<td>LTC Enc. Engine</td>
<td>MMCAU</td>
<td>MMCAU</td>
<td>MMCAU</td>
<td>MMCAU</td>
<td>MMCAU</td>
</tr>
<tr>
<td>Protection on External Storage</td>
<td>N/A</td>
<td>Y(QSPI)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>ISO7816-3 / EMV</td>
<td>EMVSIM</td>
<td>EMVSIM</td>
<td>UART</td>
<td>UART</td>
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<td>UART</td>
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<tr>
<td>Others</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Ethernet</td>
<td>Ethernet</td>
<td></td>
</tr>
<tr>
<td>Package</td>
<td>121MBGA/80LQFP</td>
<td>121 Thin MBGA /100LQFP</td>
<td>121 MBGA/80LQFP</td>
<td>144MBGA/144LQFP/ 121 MBGA</td>
<td>144 MBGA</td>
<td>169MBGA</td>
</tr>
</tbody>
</table>

PCI PTS V5
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 EMVSIM, 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

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
K81 (256KB Flash, 256KB SRAM)

**Core**
- ARM Cortex-M4 - MPU
  - Up to 150 MHz with HSRUN
- Debug Interfaces
- DSP
- Interrupt Controller
- Floating Point Unit (fFPU)
- 8KB I/D Cache
- 8KB Sys Sys Cache

**System**
- Direct Memory Access - 16ch
- Power Management Controller
- Low-Leakage Wakeup Unit
- Bit Manipulate Engine
- Watchdog
- Memory Protection Unit

**Memories**
- Flash 256KB
- SRAM 256KB
- QSPI 256KB
- External Bus Interface
- SDRAM Controller
- 2KB Secure RAM

**Clocks**
- Low & High Frequency Oscillators
- Internal Reference Clocks 48MHz/4MHz/32kHz
- Low Power Clock 1KHz
- PLL/PLL

**Security**
- Flash Security and Access Control
- Cyclic Redundancy Check
- DryICE with 8 tamper pins
- True Random Number Generator
- Low-power Trusted Cryptographic engine AES128/192/256 DES/3DES with DPA
- RSA2048/ECC
- True Random Number Generator
- AES128/192/256
- RSA2048
- ECC: ECDSA and ECDH for up to P256
- DES/3DES with HW DPA
- AES256/192/128 with DPA
- Up to 8 Tamper Pins

**Analog**
- 16-bit SAR ADC
- High Speed Analog Comparator
- 12-bit DAC
- 1.2V Internal Voltage Reference

**Timers**
- 4x FlexTimer
- 2x Timer/PWM
- 2x Low Power Timer
- 4ch Periodic Interrupt Timers
- Real Time Clock
- Programmable Delay Block
- Carrier Modulator Transmitter

**Communication Interfaces**
- 4x Low Power UART
- 3x SPI
- 4x I2C
- 2x ISO7816-EMV/EMV
- 2xFS

**Human Machine Interface**
- GPIOs
- Touch Sensing Interface
- Crystal-less USB Device
- 32-ch FlexIO

**Packages**
- 121MAPBGA 8x8x1.4/0.65mm
- 100LQFP 14x14x1.4/0.5mm

**Temperature**
- -40-105°C

**Features Highlight**
- Cortex-M4 with 8KB I/D-Cache
- FPU and MPU , BME
- up to 256KB Flash, up to 256KB SRAM
- QSPI Flash interface
- QSPI Flash interface with OTF
- True Random Number Generator
- Crypto acceleration MMCAU
- 160B(32B+128B) Secure RAM for Key storage
- Enc. Engine (DES/3DES/AES/RSA)
- RSA2048 support (3 decrypt and 1 encrypt <750ms)
- ECC: ECDSA and ECDH for up to P256
- DES/3DES with HW DPA
- AES256/192/128 with DPA
- Up to 8 Tamper Pins
- Independent Real-Time Clock (RTC)
- 2x EMV compatible ISO7816-3 interfaces
- Crystal-less USB Device
- 32-ch FlexIO
## KL81 (128KB Flash, 96KB SRAM)

### Core
- ARM Cortex-M0+ 72/96MHz
- Single Wire Debug
- Micro Trace Buffer
- Interrupt Controller

### System
- Direct Memory Access - 8ch
- Power Management Controller
- Low-Leakage Wakeup Unit
- Bit Manipulate Engine
- Watchdog
- Memory Protection Unit

### Memories
- Flash 128KB
- SRAM 96KB
- QSPI Interface
- Boot ROM 32KB

### Clocks
- Low & High Frequency Oscillators
- Internal Reference Clocks 48MHz/4MHz/32KHz
- Low Power Clock 1KHz
- PLL/PLL

### Security
- Flash Security and Access Control
- Cycle Redundancy Check
- DryICE with 8 tamper pins
- True Random Number Generator
- Low-power Trusted Cryptographic engine
  - AES128/192/256
  - DES/3DES with DPA
  - RSA2048/ECC
  - SHA1/224/256

### Analog
- 16-bit SAR ADC
- High Speed Analog Comparator
- 12-bit DAC
- 1.2V Internal Voltage Reference

### Timers
- 1x 6ch Low Power Timer/PWM
- 2x 2ch Low Power Timer/PWM
- 2x Low Power Timer
- 4ch Periodic Interrupt Timers
- Real Time Clock

### Communication Interfaces
- 3x Low Power UART
- 2x SPI
- 2x I2C
- 2x ISO7816-EMV SIM

### Human Machine Interface
- GPIOs
- Touch Sensing Interface

### Packages
- 121MAPBG 8x8x1.4/0.65mm
- 80LQFP 12x12x1.4/0.5mm

### Features Highlight
- Cortex-M0+
- MTB, BME
- up to 128KB Flash, up to 96KB SRAM
- QSPI Flash interface
- True Random Number Generator
- 160B(32B+128B) Secure RAM for Key storage
- Enc. Engine (DES/3DES/AES/RSA)
  - RSA2048 support (3 decrypt and 1 encrypt <750ms)
  - ECC: ECDSA and ECDH for up to P256
  - DES/3DES with HW DPA
  - AES256/192/128 with DPA
  - SHA1/224/256
- Up to 8 Tamper Pins
- Independent Real-Time Clock (RTC)
- 2x EMV compatible ISO7816-3 interfaces
- Crystal-less USB Device w/2K dedicated USB RAM
- 32-ch FlexIO

### Availability
- Sample Sep’15
- Production Nov’15
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
- 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)
Point of Sale (POS) Reader Solution Architecture

Secure Microcontroller
PCI Compliant

Kinetis: KL81, K81

Crypto Engine
LTC Engine
(RSA, ECC, 3DES, ECC, SHA, DPA)

TRNG
FAC

DryICE W/ Tamper Pins

Sensors (for tamper resistance)

LEDs
Display (+ LCD Driver if not in the MCU)

User Interface / Pin Entry

21.
PIN ENTRY DEVICE
PIN Entry Device – TWR-POS-K81
PCI 4.1 Certified as Pen Entry Device (PED)
PIN Pad POS Solution

- K81 Secure Micro w/ Tamper and Crypto
- Secure Capacitive Touch (by Cirque) Pin Pad
- Tamper Header providing access to 8 tamper signals
- Chip on glass 2 lines x16 Character segment LCD
- 4 user controled status LEDs
- Independent, battery-operated power supply for real-time clock (RTC) module
- Production Quality Software EMVCo L1
- Production Quality Documentation
- PCI 4.x Certified
POINT OF SALE (POS) SOLUTION
Point of Sale (POS) Solution – SLN-POS-RDR
POINT OF SALE (POS) SOLUTION PLATFORM

**HW**
- Reference design
- Secure Touch PIN Pad, CT/CL

**SW**
- Professional Grade EMV L1/L2
- Full Transaction Simulation

**Support**
- Application Expertise
- Detailed software documentation

**Certification**
- PCI 4.1 PED Certification
- EMV L1/L2 CT/CL pre-certification

**Benefits:**
- Reduced Time to Market
- Reduced Risk
- Reduced Development Cost
Point of Sale (POS) Reader Solution – SLN-POS-RDR

- POS Reader Reference Design for applications requiring Payment Card Industry certifications, supporting QVGA display
- NXP PN5180 Contactless, TDA8035 Contact card reader module with KSDK driver support
- Hardware and software, including all drivers, cryptographic libraries, NXP Secure Kinetis K81/KL81 MCUs - Pin to pin compatible, covering range of performance and price targets
- Chip-and-PIN keypad based on Cirque® SecureSense™ technology
- CardTek L2 CT/CL EMVCo Certifiable Stack

**Target Applications:**
- Point of Sales Terminals, Contact & Contactless
- Automatic Teller Machine PIN Pad + Reader
- Building and Home Automation, Secure Access Control

**Availability:** Q1 2017

**Certifications & Testing:**
- TWR-POS-K81 PCI 4.1 Certified as PIN Pad *
- PCI silicon pre-certification
- Side channel attack testing *
- CAVP (crypto assurance validation program) certified
- TRNG entropy evaluation
- EMVCo L1 CT/CL pre-certified
• Point of Sale Card Reader Board
  - PCB Antenna for contactless payment
    - NXP NFC: PN5180 NFC Front end
    - Full EMV L1 2.5 compliant stack available in KSDK
    - EMVCo L1 report from independent test house
  - Smart Card reader PHY
    - NXP: TDA8035 Smart card interface
    - EMV L1 4.3 compliant stack available in KSDK
    - EMVCo L1 report from independent test house
POS-RDR-SLN Kit – Material List

- The cube
  - TWR-POS-K81
  - TWR-POS-PN5180
  - TWR-LCD
  - TWR-ELEV
- Coin battery
- Cables
- Demo payment card
The File System is used to store configuration, runtime data, and code in the external QSPI flash.

Since there are multiple external interfaces, an RTOS is used to increase overall system robustness and enable the best user experience.

Hardware abstraction for on-chip peripherals is provided by the SDK.

The DryICE is always monitoring the system to detect tamper events.
Software Layering Model – NXP L2 HAL

EMV L1 CL interface access is done via NXP NFC Reader Library

EMV L1 CT interface access is done via a SDK middleware component

The Crypto provides a generic API to RNG, AES, TDES, RSA functionality

Date & Time provides a generic API to the RTC and calendar functions

EMV L1 CT interface access is done via a SDK middleware component
Software Layering Model – COMMIF (Host Interface)

Provides generic API to the host communication link - in this case, USB CDC. Future support options include BLE and WiFi.
Software Layering Model – PIN Entry

Generic API to obtain PIN, button presses (navigation) and generate PIN blocks for online or offline authentication - PIN data is secured by the MPU.

Third party library provided by our partner Cirque to obtain PIN pad button presses.

MPU is used to protect sensitive information.
Software Layering Model – User Interface

**Generic API providing access to all UI-related elements. In most applications, this would most likely be customized**

**The graphical LCD (TWR-LCD) leverages the open source eGUI graphics package**

**The segment LCD is used to display various messages for the payment application**

**Provides an RTOS-friendly way to enable/run LEDs and the buzzer. The LEDs are virtualized on the graphical LCD**

**The graphical LCD (TWR-LCD) leverages the open source eGUI graphics package**

**The segment LCD is used to display various messages for the payment application**

**Provides an RTOS-friendly way to enable/run LEDs and the buzzer. The LEDs are virtualized on the graphical LCD**
The L2 stack is provided by our partner Cardtek. It contains all L2 functionality including entry point, kernel and supports both CT (EMV 4.3) and CL (EMV 2.6, Visa) interfaces.

The L2 HAL Shim is the “glue” between the L2 stack and the rest of the system. This translates the L2 HAL API into calls to our Solution software.
Software Layering (payment_demo)

Payment Application (L3)

- Cardtek EMV L2
- Cardtek L2 HAL (Shim)
- NXP L2 HAL
- Card Reader
- Crypto
- Date & Time
- DryIC

KDSK 2.0

- FILE
- SPI FFS
- QSPI Flash
- eGUI
- Seg LCD
- LED & Buzz
- Cirque CST
- MPU
- USB CDC
- NFC RdLib (CL)
- EMV L1 (CT)
- DRB

Issuer Host Simulator – PC Application

TWR-LCD
- LCD COLOR
- Buzz
- LEDs
- Seg LCD
- Tamper Mesh
- Cirque SecureSens e AFE
- QSPI Flash

TWR-POS-K81

TWR-POS-PN5180

- TDA8035
- PN-5180

- SDK
- Middleware
- NXP Solution Software
- Third Party Proprietary
- Application
Demo Applications

• **payment_demo**: Full payment demonstration application leveraging Cardtek’s EMV L2 stack and issuer host simulator tool (IHS). The IHS tool can simulate online and offline transactions in addition to advanced features such as issuer scripting. All NXP Solution Software modules are used in this application.

• **emvco_loopback**: Provides a mechanism for customers to run CT and CL EMV L1 certification. This demo also doubles as a reference for using some of the NXP Solution Software modules without the Cardtek L2 and L2 HAL shim.
Payment Demo

<table>
<thead>
<tr>
<th>Payment Application</th>
<th>Cardtek EMV L2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wait for IHS</td>
<td></td>
</tr>
<tr>
<td>Config</td>
<td></td>
</tr>
<tr>
<td>Payment</td>
<td>Read Card</td>
</tr>
<tr>
<td>Enter Amount</td>
<td>Request PIN</td>
</tr>
<tr>
<td></td>
<td>Capture PIN and generate PIN block</td>
</tr>
<tr>
<td></td>
<td>Generate ISO 8583 message</td>
</tr>
<tr>
<td>Remove Card</td>
<td>Send data to IHS</td>
</tr>
</tbody>
</table>

Send data to IHS
IDE & DEBUG
Required Hardware

• Segger JTAG Probe J-Link Base + 19-pin Cortex-M Adapter
  • https://www.segger.com/jlink_base.html
  • https://www.segger.com/jlink-adapters-19pin-cortexm.html
  • SW Package: https://www.segger.com/downloads/jlink
Integrated Development Kit (IDE)

- Two IDEs solutions are available for this project:
  - IAR – Minimum required version is 7.70.0
  - KDS – Minimum required version is 3.2.0
    GET KDS Link

- Demonstration
  → Go Live (steps in following slides)
## Application Mapping

<table>
<thead>
<tr>
<th>NXP Security MCU</th>
<th>Smart POS</th>
<th>Traditional POS</th>
<th>Telephone POS</th>
<th>mPOS</th>
<th>PINPAD &amp; Secure Card Reader</th>
</tr>
</thead>
<tbody>
<tr>
<td>NXP Security MCU</td>
<td>KL81, K81F, K21D, K21F (Coprocessor)</td>
<td>i.MX6UL-3, i.MX7D</td>
<td>K81F, K21F, K63F, K65F, i.MX6UL-3</td>
<td>KL81, K81F, K21D, K21F, i.MX6UL-3</td>
<td>KL81</td>
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<tr>
<td>NXP CT/CL</td>
<td>TDA8026/TDA8035/PN5180</td>
<td>TDA8026/TDA8035/PN5180</td>
<td>TDA8026/TDA8035/PN5180</td>
<td>TDA8035/PN5180/PN7462</td>
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<td>(Must have)</td>
<td>(Must have)</td>
<td>(Must have)</td>
<td>(Must have)</td>
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<tr>
<td></td>
<td>Contactless</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Pin-Pad</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Display</td>
<td>Graphic/Segment</td>
<td>Graphic/Segment</td>
<td>Graphic/Segment</td>
<td>Graphic/Segment</td>
<td>Optional</td>
</tr>
<tr>
<td>Interface to Smart Devices (Mobile phone, tablet, PC)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Audio Jack, USB, BT</td>
<td>USB, Audio Jack</td>
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<td>✓</td>
<td>✓</td>
<td>Mandatory EMEA/AMEC, Optional in China</td>
</tr>
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<td>EMV</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>OSICCA &amp; PBOC</td>
<td>Must in China</td>
<td>Must in China</td>
<td>Must in China</td>
<td>Must in China</td>
</tr>
<tr>
<td>Printer</td>
<td>Mandatory and Integrated</td>
<td>Mandatory and Integrated</td>
<td>Mandatory and Integrated</td>
<td>Optional</td>
<td>N/A</td>
</tr>
<tr>
<td>Applications running location</td>
<td>Natively</td>
<td>Natively</td>
<td>Natively</td>
<td>Natively/SmarPhone/Tablet</td>
<td>Desktop Equipment</td>
</tr>
</tbody>
</table>

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54.