Texas Instruments Embedded Processing Overview

Texas Instruments has the broadest portfolio of DSPs, microcontrollers (MCUs), differentiated ARM® processors, wireless connectivity solutions and complementary analog products, offering complete hardware and software system solutions for embedded developers. This portfolio offers the full range of power/performance requirements ensuring the right combination of attributes for the smallest portable devices to the largest multichannel systems and everything in between. In addition, TI offers design resources including extensive software (including open source), tools, technical training, in-person and online tech support, and engineer-to-engineer forums at e2e.ti.com. Visit www.ti.com for technical literature, system block diagrams and more.

Low-Power MCUs

MSP430™ Ultra-Low-Power MCUs offer the lowest power consumption and the perfect mix of integrated peripherals with a common ecosystem for a wide range of low-power and portable applications.

MSP432™ Low Power + Performance MCUs are MSP MCUs with an ARM Cortex®-M4 core optimized for Internet-of-Things sensor nodes to enable acquisition and processing of high-precision signals without sacrificing power.

SimpleLink™ Ultra-Low Power Wireless MCU platform sets a new benchmark for power consumption. Bluetooth® low energy, Sub-1GHz, ZigBee®, LPWAN and ZigBee 4E™ standards are each supported with software stacks, easy-to-use tools and enabling always-on coin-cell-powered operation for multiple years or battery-less operation with energy harvesting.

SimpleLink Wi-Fi® Family allows applications to be programmed on the industry’s first Internet-on-a-chip™ solution with a user-dedicated MCU. The low-power Wi-Fi platform enables designs to operate for more than a year on two AA batteries. No Wi-Fi experience needed to begin designing with this easy-to-use family.

Performance MCUs

C2000™ Real-Time Control 32-bit MCUs are based on the industry-leading C28x CPU. This CPU features a powerful signal processing engine capable of addressing demanding closed-loop tasks thereby giving designers the means to improve system efficiency, reliability and flexibility.

TM4C12x MCUs are based on the popular ARM® Cortex®-M4 core with scalable memory and package options, unparalleled connectivity peripherals (Ethernet MAC and Phy), hardware encryption accelerator, advanced applications functions, industry-leading analog integration and extensive software solutions.

Hercules™ MCUs are based on the high-performance ARM Cortex-R CPU and offer integrated diagnostic features in hardware to help make development of industrial IEC 61508 and automotive ISO 26262 functional safety applications easier. The Hercules MCU platform offers pin-to-pin- and software-compatible devices ranging in performance from 80 MHz up to 330 MHz and memory options from 128 KB up to 4 MB of on-chip Flash. Complementary SafeTI Design Packages provide documentation, tools and software to assist in development of functional safety applications.

Sitara™ Processors

TI’s Sitara processors are optimized, scalable solutions with a broad portfolio of ARM Cortex-A8, Cortex-A9, ARM9™ and Cortex-A15 solutions. Sitara processors help innovators create a variety of feature-rich, low-power applications. These devices provide robust peripheral support including 3D graphics and industrial communications protocols among others, giving customers flexibility in design. Bringing together flexible hardware solutions with robust software tools enables customers using Sitara processors to create inspiring ARM designs that start to bridge the gap between high-end MCUs and mid-range ARM processor-based devices.

Ultra-Low-Power TMS320C5000™ DSP Platform

The C5000™ DSP platform provides a broad portfolio of the industry’s lowest-power 16-bit DSPs. Total active core power at less than 0.15mW/MHz at 1.05V and standby power at less than 0.15mW extends the battery life of portable applications. Increase processing capability with C5000 DSP processors that offer up to 300 MHz (600 MIPS). High peripheral integration and large on-chip memory help reduce overall system cost.

High Performance: KeyStone™ and TMS320C6000™ DSP Platforms

TI’s KeyStone II platform brings high-performance ARM Cortex-A15 and C66x fixed-/floating-point DSP technology together providing unmatched embedded processing system performance. With general Linux® support as well as real-time operating system support such as VxWorks®, the KeyStone II platforms are ideally suited for industrial, mission critical and other high-performance real-time systems. These devices also offer best-in-class GFLOPS/W performance and high-speed I/O making them also well suited for server-class scientific and computationally intensive computing.

KeyStone I devices and C6000™ DSP devices include multicore C66x DSPs, C674x fixed-/floating-point DSPs, and OMAP-L. The OMAP-L series combines the fixed-/floating-point C674x DSP with an ARM9 processor for low-power, embedded processing complete solutions.

Software and Development Tools

TI’s embedded solutions come with software and tools to make development easier and speed time to market. This includes support for open source software including Linux and Energia as well as TI software stacks, application examples and the new Processor SDK unified software platform for the Sitara portfolio. TI’s embedded tools range from EVMs and reference designs to LaunchPads, BoosterPacks, BeagleBoards and SensorTags to help developers bring their ideas to life.

Complementary Analog Products

TI offers a range of complementary data converter, power management, amplifiers, interface and logic products to complete your design.

Applications Matrix Guideline

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<td>Key feature</td>
<td>Ultra-low power</td>
<td>Real-time control</td>
<td>Open architecture software, rich communications options</td>
<td>Scalable performance with robust peripheral options</td>
<td>Safety integrated in hardware</td>
<td>Ultra-low power</td>
<td>High performance</td>
<td>Easy-to-use, low-power connectivity</td>
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</table>
Low-Power MCUs
MSP Microcontrollers
Ultra-Low-Power, Easy-to-Use, 16-Bit and 32-Bit Microcontrollers

Get samples, data sheets, tools and application reports at: www.ti.com/msp

Key Features
• Ultra-low-power (ULP) architecture enables battery life > 20 years
  - 100 µA/MHz active mode
  - 700 nA RAM retention
  - 450 nA RTC mode
• 7 low-power modes
• Instantaneous wakeup
• Autonomous peripherals

Easy to get started: Complete development ecosystem of tools and software with kits starting at $9.99, multiple IDE options, and direct support available at ti.com/e2e

Integrated intelligent peripherals including a wide range of high-performance analog and digital peripherals that offload the CPU

Scalable platform with 525+ MCUs, 25+ package options and up to 48 MHz of performance

MSP430FRxx FRAM – 16-MHz ultra-low-power MCUs designed for sensing and measurement applications. The family includes a wide range of high-performance and ultra-low-power MCUs with innovative integration of hardware accelerators, enhanced analog and peripherals including CapTiVate™ technology for capacitive touch. FRAM customizable, unified memory provides flexible code and data partitioning with security features allowing developers to maintain one platform across projects with different needs.

MSP432P4x – 32-bit ultra-low-power MCU family with an integrated ARM Cortex-M4F core. MSP432 MCUs are a companion MCU to TI SimpleLink™ wireless connectivity solutions-based applications with high-precision analog, memory extensions and a common software and tool ecosystem. The integrated ADC14 module supports fast 14-bit SAR analog-to-digital conversions at up to 1Msps.

MSP430G2x – 16-MHz Ultra-Low-Power MCU series with a feature set targeted at cost-sensitive applications.

MSP430F5x/6x – 25-MHz Ultra-Low-Power MCU series offers low power with added performance. These devices offer faster CPU speeds, more memory and new integrated peripherals like USB.

MSP430F2x/4x – 16-MHz Ultra-Low-Power MCU series with additional integration offerings such as 24-bit Sigma Delta ADCs or a real-time clock. MSP430F2x devices feature extended temperature ranges.

MSP430F1x – 16-MHz general-purpose Ultra-Low-Power MCU series used for a broad range of applications.

RF430 – MCUs provide tight integration between the microcontroller core, peripherals, software and RF transceiver, creating true SoCs that are easy to use.

Key Applications
• Low-power wireless applications
• Intelligent sensing and control
• Consumer electronics
• Test & measurement
• Utility metering
• Portable medical and instrumentation
• Security systems

Table: MSP430™ Ultra-Low-Power MCUs

<table>
<thead>
<tr>
<th>Series</th>
<th>MSP430™ Ultra-Low-Power MCUs</th>
<th>MSP432™ Low Power + Performance MCUs</th>
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Key Applications
• Low-power wireless applications
• Intelligent sensing and control
• Consumer electronics
• Test & measurement
• Utility metering
• Portable medical and instrumentation
• Security systems

- 16-MHz ultra-low-power MCUs
- 7 low-power modes
- Instantaneous wakeup
- 450 nA RTC mode
- Autonomous peripherals

Easy to get started: Complete development ecosystem of tools and software with kits starting at $9.99, multiple IDE options, and direct support available at ti.com/e2e

Integrated intelligent peripherals including a wide range of high-performance analog and digital peripherals that offload the CPU

Scalable platform with 525+ MCUs, 25+ package options and up to 48 MHz of performance

MSP430FRxx FRAM – 16-MHz ultra-low-power MCUs designed for sensing and measurement applications. The family includes a wide range of high-performance and ultra-low-power MCUs with innovative integration of hardware accelerators, enhanced analog and peripherals including CapTiVate™ technology for capacitive touch. FRAM customizable, unified memory provides flexible code and data partitioning with security features allowing developers to maintain one platform across projects with different needs.

MSP432P4x – 32-bit ultra-low-power MCU family with an integrated ARM Cortex-M4F core. MSP432 MCUs are a companion MCU to TI SimpleLink™ wireless connectivity solutions-based applications with high-precision analog, memory extensions and a common software and tool ecosystem. The integrated ADC14 module supports fast 14-bit SAR analog-to-digital conversions at up to 1Msps.
Everyone says their MCUs are ultra-low power. So what makes us different? Ultra-low power is in our DNA! The MSP MCU is designed from the ground up specifically for ultra-low-power applications.

**Ultra-Low Power and High Performance**
- Memory access speeds 100 times faster than Flash combined with ultra-low-power MSP MCU enables the lowest energy consumption
- Lowest power standby (350 nA with RTC)

**Smart Analog and Digital Integration**
- Energy efficient hardware accelerators
- Enhanced analog integration including ADCs, transimpedance amplifiers (TIA), op amps and more
- CapTivate™ technology for the most noise-immune capacitive touch MCUs

**Flexible Design**
- Easy-to-use unified memory allows developers to maintain one platform across projects with different needs
- FRAM allows customization of memory blocks size at run-time or compile time
- Flexible code and data partitioning
- Protected code and data through integrated security features

**More Benefits with FRAM**
- 250× lower power and 100× faster writes than Flash
- Resistance to electric/magnetic fields, radiation and reflow temperature
- Data security—write speeds and low energy enable data back-up on power fail and quicker refresh of security keys
- Flexible memory configuration

Learn about MSP430FRxx MCUs at [www.ti.com/fram](http://www.ti.com/fram)
MSP432™ MCUs
MSP Microcontrollers
32-bit Ultra-Low-Power and Performance MSP MCUs

Get samples, data sheets, tools and application reports at: www.ti.com/msp432

MSP MCUs with ARM® Cortex®-M4 core optimized for Internet-of-Things sensor nodes enable acquisition and processing of high-precision signals without sacrificing power.

- Increase your product’s performance and processing capability without sacrificing power
- MCU companion to SimpleLink™ wireless connectivity solutions adds high-precision analog and memory extensions
- Higher-precision measurement with 14-bit SAR analog-to-digital converter

### Key features of MSP432 MCUs

- 48-MHz ARM Cortex-M4 with FPU
- DriverLib in ROM
- Wide voltage range
- Simultaneous Flash read/write
- 128-bit Flash buffer and pre-fetch
- Selectable RAM retention
- 64KB RAM
- 1MSPS ADC14
- 8-channel DMA
- Memory protection unit
- Integrated LDO and DC/DC
- NVIC with tail-chaining
- Tuneable DCO
- Peripheral and SRAM memory bit-band

- 20-mA high drive I/Os
- 32-bit timer
- JTAG security and advanced IP protection
- UART I FC I SPI bootstrap loader
- EnergyTrace+

### Ultra-low power

- Increased performance and battery life for a variety of sensing and measurement applications
- 48-MHz ARM-Cortex M4F CPU and MSP core with
  - 80 µA/MHz in active power
  - 660 nA in standby power
  - FPU and DSP extensions

### Connected MCU companion

- Easily add a companion host MCU to your wireless IoT application
- Wide-range of memory footprints to aid wireless MCUs running multiple protocols
- Faster development with TI SimpleLink wireless connectivity solutions through common software and tool ecosystem

### Higher precision measurement

- Integrated ADC14 module for fast 14-bit analog-to-digital conversions at up to 1Mps
- 14-bit SAR core, sample select control, reference generator, two-window comparator and direct data transfer using DMA
- When combined with DMA, samples can be converted and stored in memory without CPU intervention
Performance MCUs
C2000™ Real-Time Control Microcontrollers
Performance MCUs for applications needing low-latency closed-loop control

Applications
- Digital motor control (white goods, industrial drives, medical)
- Digital power supplies (telecom and server rectifiers, wireless base-stations, UPS)
- Renewable energy (solar, wind, fuel cells)
- Intelligent LED lighting
- Automotive (HEV/EV, electric power steering, driver's assistance radar, wipers, HVAC, pumps)
- Power line communications (PLC)

Key Features
Processing
- More performance per MHz with 32-bit C28x DSP core optimized for complex single-cycle operations common to control theory
- Meet the demands of a wide range of applications with optimized processing options from 40 MIPS to 800 MIPS of performance
- Add functionality with the Control Law Accelerator (CLA) processing engine. Great for controlling multiple motors, power stages and more
- Accelerate complex control theory and signal processing, such as trigonometric math, FFTs, and complex math, with built-in hardware accelerators

Actuation
- Achieve higher system performance with micro edge positioning of PWM outputs, including support of PWM phase, duty cycle and period
- Control a variety of applications and power-stage topologies with ultra-configurable PWM generation
- Support even complex peak current mode control of power stages through ramp-generation logic and integrated analog comparators

Sensing
- Accurately sample signals with 12-bit and 16-bit analog-to-digital converters (ADC)
- Run systems at high frequencies with ADC conversion rates up to 12.5 MSPS
- Protect systems better with responsive analog comparators – 30ns response time
- Interface with high-performance external sensors using C2000 high-resolution captures

Learn more and get samples, data sheets, tools and application guides at: www.ti.com/c2000
Overview

TI TM4C12x MCUs are the industry’s leading family of robust, real-time microcontrollers based on the revolutionary ARM® Cortex®-M4F-based technology. The award-winning TM4C12x 32-bit MCUs combine sophisticated, flexible mixed-signal system-on-chip integration with unparalleled real-time multitasking capabilities. Complex applications previously impossible with legacy MCUs can now be accommodated with ease by powerful, cost-effective and simple-to-program TM4C12x MCUs. With hundreds of available offerings, the TM4C12x family offers the widest selection of precisely compatible MCUs in the industry.

TM4C12x is positioned for cost-conscious applications requiring significant control processing and connectivity capabilities, including IoT gateway, motion control, monitoring (remote, fire/security, etc.), HVAC and building automation, power and energy monitoring and conversion, factory automation, electronic point-of-sale machines, test and measurement equipment, medical instrumentation and gaming equipment.

Addressing the critical need for security in the Internet of Things (IoT) TM4C12x solutions also provide the performance and hardware-encryption needed for a secure cloud connection.

In addition to MCUs configured for general-purpose real-time systems, the TM4C12x family offers distinct solutions for advanced motion control and energy-conversion applications and combinations of these applications including connected motion control and hard real-time networking.

Why Choose Cortex-M4F?

Cortex-M4F is the MCU version of ARM’s V7 instruction set architecture family of cores:
- Optimized for single-cycle Flash usage
- Deterministic, fast interrupt processing: always 12 cycles, or just 6 cycles with tail chaining
- Three sleep modes with clock gating for low power
- Single-cycle multiply instruction and hardware divide
- Atomic operations
- ARM Thumb® 2 mixed 16-/32-bit instruction set
- 1.25 DMIPS/MHz
- Extra debugging support including data watchpoints and Flash patching

Capabilities of the TM4C12x series using the Cortex-M4F technology:
- Single-cycle multiply-accumulate (MAC) instructions
- Optimized SIMD arithmetic and saturating arithmetic instructions
- IEEE 754 standard compliant single-precision floating-point unit

Why Choose the TM4C12x Family?

The TM4C12x family provides entry into the industry’s strongest ecosystem.
- Advanced sensor hub technology enabling modern applications
- Seventy compatible TM4C12x devices to choose from
- Real MCU GPIOs – all can generate interrupts, are 5-V tolerant and have programmable drive strength and slew-rate control
- Advanced communication capabilities, including USB and USB OTG and CAN controllers
- Motion-control support in hardware and software
- Both analog comparators and ADC functionality provide on-chip system options to balance hardware and software performance
- Development is easy with the royalty-free TivaWare™ Software

Get samples, data sheets, tools and application reports at: www.ti.com/tm4c
Performance MCUs
Hercules™ ARM® Cortex® R-Based MCUs
Simply Design with Functional Safety-Certified Hercules MCUs

Get samples, data sheets, tools and application guides at: www.ti.com/hercules

Key Applications
Industrial/medical applications
• Industrial automation and control
• Safety Programmable Logic Controllers (PLCs)
• Power generation and distribution
• Turbines and windmills
• Ventilators and defibrillators
• Infusion and insulin pumps

Transportation applications
• Braking systems (ABS and ESC)
• Electric power steering (EPS)
• HE/VEV inverter systems
• Aerospace
• Railway control, communications and signaling
• Off-road vehicles
• Automotive infrastructure
• Commercial vehicles
• Off-road vehicles
• Airbags, electric park brake, safe communication, parking assist

Key Features
Hercules RM MCUs
• ARM Cortex-R core with floating-point support
• Up to 330 MHz (550 DMIPS)
• Integrated safety features simplify IEC 61508 functional safety applications
• Up to 4MB Flash/512KB RAM with ECC
• Memory protection units in CPU and DMA
• Multiple communication peripherals:
  – Ethernet, USB, CAN
  – Dual-timer co-processors
  – Dual 12-bit analog/digital converters
  – External memory interface
• –40 to 105°C operation

Hercules TMS570 MCUs
• ARM Cortex-R core with floating-point support
• Up to 300 MHz (500 DMIPS)
• Integrated safety features simplify ISO 26262 functional safety applications
• Up to 4MB Flash/512KB RAM with ECC
• Memory protection units in CPU and DMA
• Multiple communication peripherals:
  – Ethernet, FlexRay™, CAN, LIN, SPI
  – Dual-timer co-processors
  – 12-bit analog/digital converters
  – External memory interface
• –40 to 125°C operation
• Automotive Q100 qualified

Hercules MCUs help reduce risk and effort to achieve system-level safety certification
Choose from a broad, scalable portfolio of certified devices.
For industrial, medical and transportation applications.

High performance with real-time control
With a large portfolio of software- and pin-compatible devices, RM and TMS570 Hercules products offer ARM Cortex-R-based MCUs from 80 MHz up to 330 MHz with real-time control features including:
• Floating point
• Timers
• Analog-to-digital converters

On-chip diagnostics
Maximize performance and reduce software overhead by utilizing on-chip diagnostic features. Diagnostic features include:
• CPUs in lockstep
• ECC on Flash and RAM
• Built-in self-test

Assist certification
Start evaluating today with comprehensive support designed specifically to help simplify the development/certification of functional safety applications
• Breath of tools including TI LaunchPad Evaluation Kits, SafeTI HALCoGen Compliance Support Packages (CSPs) and SafeTI Hercules Diagnostic Library CSPs
• Easy-to-use, proven software
• Robust, technical documentation

www.eecatalog.com/dsp
Sitara™ Processors
Highly Integrated; Scalable From 300MHz to 1.5GHz with 3D Graphics

Get samples, data sheets, tools and application reports at: www.ti.com/sitara

Specifications
- ARM® Cortex®-A8, ARM®9™ and Cortex-A15 processors
- Optional high-performance 3D graphics accelerator
- Optional Programmable Real-time Unit and Industrial Communication Sub-System (PRU-ICSS)
- Robust display options
- Optimized for low-power applications
- Linux®, Android™, RTOS and StarterWare™ software

Targeted Applications
- Automation and control, human machine interface, medical, portable data terminals

Key Features
- AM57x processors
  - Up to two 1.5GHz ARM Cortex-A15, two ARM Cortex-M4s, two C66x DSPs, one quad-core PRU-ICSS module
  - Up to two SGX544 3D graphic accelerators, GC320 2D graphic accelerator, 1080p60 video accelerator and output to multi-display user interfaces
- AM437x processors
  - Up to 1-GHz ARM Cortex-A9
  - LPDDR2/DDR3(L)
  - Quad-core PRU-ICSS
  - Gigabit EMAC switch
- AM35x processors
  - Up to 1-GHz ARM Cortex-A8
  - Optional 3D graphics accelerator, based on Imagination Technology’s POWERVR™ SGX graphics accelerator, with up to 20Mflops performance
  - Support for LPDDR1/DDR2/DDR3 memory
  - ≤5mW power
  - PRU-ICSS subsystem provides additional device flexibility
  - Optional support for industrial protocols such as EtherCAT® and PROFIBUS®

AM335x processors
- 600-MHz processor
- Sub-1-W power consumption
- 3.3-V and 1.8-V I/O
- Display subsystem with picture-in-picture

Key Peripherals
- AM57x processors
  - PCIe, SATA, Gigabit Ethernet, USB 3.0
- AM57x processors
  - PCIe, SATA, Gigabit Ethernet, USB 3.0
- AM57x processors
  - PCIe, SATA, Gigabit Ethernet, USB 3.0
- AM57x processors
  - PCIe, SATA, Gigabit Ethernet, USB 3.0

Featured Processor

Sitara processor: Ideal for range of use cases and markets
By using ARM-based processors and common peripheral sets, Sitara processors offer highly reusable software code bases that allow designers to easily scale within the product family. Multiple operating frequencies, 3D graphics acceleration, multiple packaging options and temperature operating points provide optimal flexibility to fit most application requirements.

Processor SDK Unified Software Platform
The new Processor SDK is a unified software platform for the Sitara portfolio that uses a consistent software foundation including a mainline LTS Linux kernel, U-Boot, TI-RTOS, Linaro™ tool chain and Yocto Project™-compatible file system that scales across the entire Sitara portfolio.

AM57x Processor Block Diagram
C5000™ and C6000™ DSPs, Fixed- and Floating-Point
High-Performance, Low-Power DSPs

Get samples, data sheets, tools and application reports at: www.ti.com/dsp

Specifications
- C6000 high-performance fixed-/floating-point DSPs
- C5000 ultra-low-power fixed-point DSPs, lowest power DSPs
- Robust software and tools; Code Composer Studio™ Integrated Development Environment, software development kits, application software and libraries
- SYS/BIOS™, StarterWare™, and Linux® software development kits, developed and supported by TI
- Real-time signal processing

Key Features
KeyStone™ high-performance DSPs
- Industry-leading 16 GFLOPS/W on KeyStone devices
- >200 GFLOPS per device
- Up to 1.2-GHz embedded processing speeds
- High-speed DDR3 (supports DDR 3L)
- Large on-chip memory (up to 18MB)
- High-speed I/O including GigE, PCIe Gen 2, and RapidIO®

C6000 high-performance DSPs
- Up to 1.2 GHz 32-bit
- Fixed-/floating-point DSP
- Up to 256 KB RAM
- DDR2, MDDR
- McBSP
- $5.00 to $200.00

C6000 DSP+ARM9™
- Up to 456 MHz
- Fixed-/floating-point DSP
- L2 cache
- DDR2
- McBSP

C5000 ultra-low-power DSPs
- Up to 300 MHz
- 16-bit, fixed-point + FFT accelerator
- Up to 320 KB RAM
- Up to 256 KB ROM
- HS USB 2.0

DSP Roadmap
TI DSP devices focus on embedded computing and real-time applications, driving system cost down while balancing power and performance.

Multicore Navigator

C66x DSP
- L1
- L2

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- L1
- L2

Memory Subsystem
- DDR3-32b
- Multicore shared memory controller (MSMC)
- Shared memory 1MB

System elements
- Power management
- System monitor
- Debug
- EDMA

AccelerationPacs
- 2x VCP2
- TCP3d

Peripherals & I/O
- Ethernet SGMII
- McBSP
- SRIO x4
- PCIe x2
- EMI 16
- uPP
- PC SPI
- UART

C66xx DSP Block Diagram
The C66xx DSPs are based on TI’s KeyStone multicore architecture and integrate single- or dual-core C66x DSPs to offer real-time performance that helps customers realize R&D savings while getting to market faster.
KeyStone™ II Multicore Processors (66AK2Hx, 66AK2Ex, 66AK2Lx, AM5K2Ex SoCs)

Multicore DSP + ARM Processors

Get samples, data sheets, tools and application reports at: www.ti.com/keystone2

Key Features

- Up to 4 cores of 1.4GHz per ARM® Cortex®-A15 cores with NEON (up to 19,600 DMIPs)
- Up to 8 cores of 1.4GHz of fixed- and floating-point performance per C66x DSP core
- Large embedded memory and high-bandwidth DDR3/DDR3L interface
- KeyStone architecture for full multicore entitlement
- Network Coprocessor (NetCP) with up to 1.5M pps
- Security / Crypto accelerator
- High-speed I/O including Gigabit Ethernet (with integrated switches), PCIe, Serial RapidIO® (66AK2Hx), USB 3.0, HyperLink
- Pin-compatible devices in the 66AK2Ex and 66AK2Hx families
- 10 Gigabit Ethernet in the 66AK2Ex, AMK2Ex and 66AK2Hx families
- Fast Fourier Transform accelerator and Digital Front End on 66AK2Lx family
- JESD204B interface for direct connect to data converters in 66AK2Lx family

Featured Applications

- Avionics and defense
- Communications and telecom
- Industrial and process control
- Test and measurement
- Medical
- Software-defined radio (SDR)
- Analytics
- High-performance computing
- Application-specific cloud computing

66AK2Ex SoC Block Diagram

The 66AK2Ex, based on TI’s KeyStone II architecture, is a performance-optimized ARM Cortex-A15 processor, single-core or quad-core CorePac and C66x DSP core, that can run at a core speed of up to 1.4 GHz.

KeyStone II Processor Family

<table>
<thead>
<tr>
<th>Feature</th>
<th>66AK2Ex</th>
<th>66AK2Gx</th>
<th>66AK2Hx</th>
<th>66AK2Lx</th>
<th>AMK2Ex</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHz per core</td>
<td>1.25–1.4 GHz</td>
<td>600</td>
<td>1.0–1.4 GHz (ARM)</td>
<td>1.2 GHz</td>
<td>1.25–1.4 GHz</td>
</tr>
<tr>
<td>Number of ARM® Cortex®-A15 cores</td>
<td>1–4</td>
<td>1</td>
<td>2–4</td>
<td>2</td>
<td>2–4</td>
</tr>
<tr>
<td>Max DMIPs (ARM Cortex-A15 cores)</td>
<td>4900–19600 (@ 1.4 GHz)</td>
<td>2100</td>
<td>9800–19600 (@ 1.4 GHz)</td>
<td>8400 (@ 1.2 GHz)</td>
<td>9800–19600 (@ 1.4 GHz)</td>
</tr>
<tr>
<td>C66x DSP cores</td>
<td>1</td>
<td>1</td>
<td>4–8</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Max GMACs (from C66x DSP)</td>
<td>44.8 @ 1.4 GHz</td>
<td>19.2</td>
<td>153.6–307.2 @ 1.2 GHz</td>
<td>153.6 @ 1.2 GHz</td>
<td>n/a</td>
</tr>
<tr>
<td>Max GFLOPS (DSP + NEON®)</td>
<td>33.6–67.2</td>
<td>28.8</td>
<td>99.2–198.4</td>
<td>96</td>
<td>22.4–44.8 @ 1.4 GHz from NEON</td>
</tr>
<tr>
<td>L1 KB per core</td>
<td>32D/32P</td>
<td>32 KB</td>
<td>32D/32P</td>
<td>32D/32P</td>
<td>32D/32P</td>
</tr>
<tr>
<td>L2 shared cache</td>
<td>4 MB</td>
<td>1024 KB</td>
<td>4 MB</td>
<td>1 MB</td>
<td>4 MB</td>
</tr>
<tr>
<td>Shared SRAM</td>
<td>2 MB</td>
<td>1 MB</td>
<td>6 MB</td>
<td>3 MB</td>
<td>2 MB</td>
</tr>
<tr>
<td>DDR (with ECC) MHz</td>
<td>64b 1600 MHz</td>
<td>DDR3L/800MTS 2× 64b 1600 MHz</td>
<td>64b 1600 MHz</td>
<td>64b 1600 MHz</td>
<td>64b 1600 MHz</td>
</tr>
<tr>
<td>Gigabit Ethernet</td>
<td>8 lanes</td>
<td>1</td>
<td>4 lanes</td>
<td>4 lanes</td>
<td>8 lanes</td>
</tr>
<tr>
<td>10 Gigabit Ethernet</td>
<td>0–2 lanes</td>
<td>–</td>
<td>0–2 lanes</td>
<td>No</td>
<td>0–2 lanes</td>
</tr>
<tr>
<td>PCI Express Gen 2</td>
<td>2 lanes of ×2</td>
<td>1</td>
<td>1 lane of ×2</td>
<td>1 lane of ×2</td>
<td>2 lanes of ×2</td>
</tr>
<tr>
<td>Serial RapidIO®</td>
<td>No</td>
<td>–</td>
<td>1×4 or 2×2 or 4×1</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Extended case temperature</td>
<td>–40°C to 100°C</td>
<td>–40°C to 105°C</td>
<td>–40°C to 100°C</td>
<td>–40°C to 100°C</td>
<td>–40°C to 100°C</td>
</tr>
</tbody>
</table>
SimpleLink™ Solutions
Low-Power Wireless Connectivity

When the SimpleLink ultra-low power wireless MCU platform was introduced, TI set a new industry power consumption benchmark for Bluetooth® low energy, Sub-1GHz, ZigBee®, 6LoWPAN and ZigBee RF4CE™ wireless MCUs. The SimpleLink Wi-Fi® Internet-on-a-chip™ platform also delivers a low-power wireless MCU for battery-operated products and systems. Additionally, TI offers SimpleLink wireless network processors and smart RF transceivers as well as combo connectivity solutions through the WiLink™ platform, allowing customers to add low-power connectivity for a variety of applications.

Featured Applications
• Industrial
• Home/building automation
• Wearables
• Portable electronics
• Embedded automotive designs
• Medical

Power Management Resources
• SimpleLink Wi-Fi CC3100/CC3200 Internet-on-a-chip Sub-system Power Management
• SimpleLink Wi-Fi CC3100/CC3200 WLAN RF Transmit Power Peak and Average Measurements
• Taking power to a new low with the SimpleLink ULP wireless MCU platform

Driving the Lowest-Power Solution

Wireless for battery-less to coin-cell-powered applications

SimpleLink ultra-low power CC26xx/CC13xx platform
Using the unique sensor controller, this solution can run on a coin cell battery for 5–10 years making it the most power-efficient Flash-based wireless microcontroller.

Wi-Fi for AA battery-powered applications

SimpleLink Wi-Fi CC31xx/CC32xx platform
A low-power radio and advanced low-power modes enable this platform to run on two AA batteries for more than a year.

The IoT is pushing the boundaries of power consumption requirements for product and system designs. Energy harvesting, always-on coin cell or AA battery-operated sensor products can now operate optimally for several years and offer efficient processing.

Overall power consumption and battery life are very important in many applications. TI wireless connectivity solutions are created and optimized with battery life in mind, making sure that solution performance can be achieved.

Average power consumption is key:
• Functions can execute so the system can go back to sleep – using more processing power can give a better system performance: TI has the lowest power wireless MCU with 61 µA/ MHz.
• Low power in sleep and hibernate modes and low Tx and Rx power consumption.
• Sensor data can be detected in lowest power modes: TI has a unique sensor controller allowing the MCU to sleep while collecting sensor information while the main CPU can be continuously turned off.
• Including built-in DC–DC for system power efficiency.
• Power efficiency of system – low-power modes and key use cases – Learn more about EEMBC ULPBench™.

Our wireless connectivity portfolio is IoT-ready and enables easy-to-implement and robust wireless systems with unprecedented battery life through development of the lowest power wireless solutions in the industry.

For more information about TI’s low-power wireless connectivity offerings visit: www.ti.com/simplelink