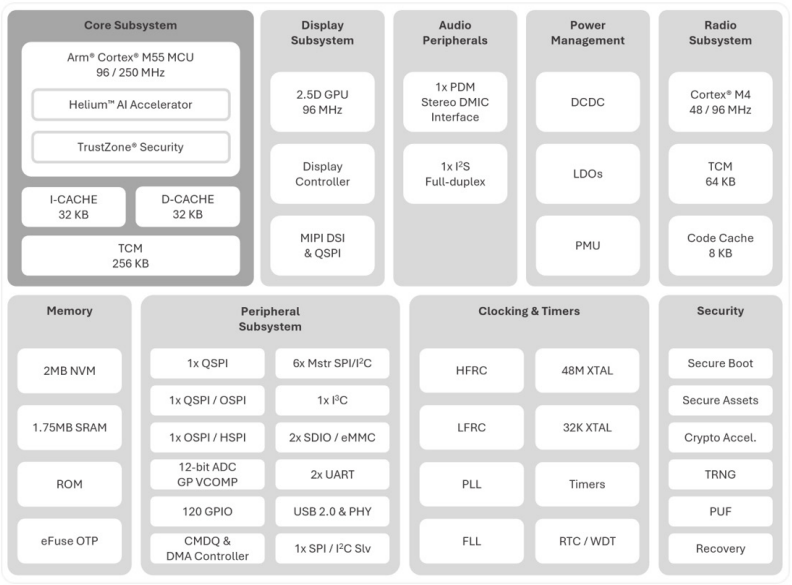
Apollo510 **Lite Series** Ultra-Low Power SoCs

Product Brief

Introducing the *Apollo510 Lite* System-on-Chip (SoC), a cutting-edge solution engineered to revolutionize the landscape of ultra-low-power performance in conventional edge and AI applications. Leveraging Ambiq's advanced Subthreshold Power Optimized Technology (SPOT®), Apollo510 Lite delivers exceptional energy efficiency, operating on minimal power while providing unparalleled performance. Equipped with an Arm® Cortex®-M55 application processor running at up to 250MHz and a dedicated Arm Cortex-M4F network processor for radio communication, this SoC enables efficient and high-performance computing, empowering developers to design innovative devices with ease.

Apollo510B Lite extends upon the Apollo510 Lite with seamless connectivity through Bluetooth® Low Energy and a rich set of peripherals for body-worn and ambient AI applications. *Apollo510D Lite* further extends connectivity with the addition of an integrated Bluetooth dual-mode radio with Classic support. These SoCs allow for effortless communication and interfacing with various devices, facilitating interoperability and data exchange in diverse endpoints. Additionally, the SoC incorporates advanced security features in secureSPOT® 3.0 with TrustZone® technology, such as secure boot and secure firmware updates, ensuring the integrity and confidentiality of data transmitted and processed by connected devices, making it an ideal choice for secure deployment in various applications.

Designed to meet the evolving needs of conventional edge and AI devices, Apollo510 Lite Series SoCs represent a significant leap forward in energy efficiency, performance, and security. With an unparalleled combination of ultra-low-power operation, high-performance computing capabilities, and robust security features, these SoCs are designed to drive innovation and enable the next generation of smart and connected devices.



Block Diagram for the Ultra-Low Power Apollo510 Lite / Apollo510B Lite / Apollo510D Lite

Apollo510 Lite, Apollo510B Lite, and Apollo510D Lite[1]

Feature Highlights:

- Up to 250 MHz Arm Cortex-M55 application processor with turboSPOT® and Helium™ technology
- 48/96 MHz Arm Cortex-M4F network coprocessor and multi-protocol radio in wireless product options
- Enhanced memory performance with 32kB I-cache and 32kB D-cache, 2MB of system RAM, and 2MB of embedded non-volatile memory for code/data
- Ultra-low power digital microphone PDM for truly always-on voice
- Wide range of integrated peripheral interfaces including ADC, SPI, I²C, I³C, and UART
- Multiple package and connectivity options for diverse endpoints

Features and Specifications

Arm Cortex-M55 Processor with Helium Technology

- Up to 250 MHz clock frequency
- Helium (MVE) AI accelerator, up to 8 MACs per cycle
- Scalar floating-point: double, single, and half-precision arithmetic
- Supports TrustZone security extensions
- Integrated 32 kB Instruction Cache and 32 kB Data Cache
- Integrated 256 kB Instr./Data Tightly Coupled Memory (TCM)
- Memory Protection Unit (MPU)

Bluetooth Low Energy 5.4 (Apollo510B Lite and Apollo510D Lite)

- Low Energy Audio with Auracast™ broadcast audio with LC3 codec
- Direction Finding (single antenna)
- Long Range
- Periodic Advertising with Response (PAwR)
- Tx Power: Up to +14dBm output power
- Rx Sensitivity: -95/-98/-104dBm (2Mbps/1Mbps/125kbps)

Bluetooth Classic (Apollo510D Lite)

- Bluetooth Classic Audio including A2DP and HFP

secureSPOT 3.0 Security Features

- Arm TrustZone technology
- Secure boot
- OTP key storage
- PUF-based identity/sign/verify
- Secure over-the-air (OTA) updates
- Key revocation

Ultra-Low Power Memory

- Up to 2MB of non-volatile memory for code/data
- 2MB of TCM and system RAM for code/data

Ultra-Low Power Interface for On- and Off-Chip Sensors

- 12-bit ADC, 11 selectable input channels
- Up to 1.7 MS/s sampling rate
- Integrated temperature sensor

Ultra-Low Power Flexible Serial Peripherals

- 1x I^3C master interface
- 6x I^2C/SPI masters for peripheral communication
- Full-duplex I^2C/SPI slave for host communications
- Pin Config 1 (BGA): 2x QSPI at 96 MT/s + 1x HSPI at 250 MT/s
- Pin Config 2 (BGA): 1x QSPI at 96 MT/s + 2x OSPI at 96/192 MT/s
- Pin Config 3 (CSP): 1x QSPI at 250MT/s + 1x OSPI at 250 MT/s or 1x HSPI at 250 MT/s
- 2x UART modules with FIFOs and flow control
- 2x SDIO (v3.0) / eMMC (v4.51)
- 1x USB 2.0 FS/HS device controller
- Up to 120 GPIO

Display

- Memory in Pixel (MiP) display interface with fast-forward
- MIPI DSI 1.2 with 2 data lanes up to 1.5 Gbps (768 Mbps per lane)
- QSPI display interface (up to 125MHz MT/s)
- Up to 480 x 480 resolution at 60 FPS
- Frame buffer decompression

graphiqSPOT 2.0 Graphics Features

- 2D/2.5D GPU with vector graphics (VG) acceleration
- Anti-aliasing hardware acceleration
- Rasterizer / full alpha blending / texture mapping
- Texture / frame buffer compression (TSC4, 6, 6A and 12)
- Dithering and radial/conical fill support

Audio Processing

- 1x PDM stereo DMIC interface
- 1x full-duplex multichannel I^2S port

Rich Set of Clock Sources

- PLL for precise clocking applications
- 48 MHz and 32.768 kHz Crystal (XTAL) oscillators
- Low Frequency RC (LFRC) oscillator
- High Frequency RC (HFRC) oscillator

Power Management

- Operating range: 1.71-2.2V
- Single Inductor Multiple Outputs (SIMO) Buck Converter
- Multiple I/O voltages supported

Applications

- Smartwatches/bands
- Smart home devices
- Body-worn and ambient AI
- Wireless sensors and industrial edge
- Smart remotes
- Patient health monitoring
- Hearing assist
- Condition monitoring
- Factory predictive maintenance
- Livestock monitoring
- Asset tracking

Package Options

- 5.3 x 5.3mm, BGA with 120 GPIO
- 4.0 x 4.0mm, CSP with 68 GPIO

Ordering Information

Product	SKU	Type	Connectivity Type	Package
Apollo510 Lite	AP510NLA-CCR	Commercial SKU (-20°C to +70°C)	No Connectivity	CSP
Apollo510 Lite	AP510NLA-CBR		No Connectivity	BGA
Apollo510B Lite	AP510BLA-ICR	Industrial SKU (-40°C to +85°C)	Bluetooth Low Energy	CSP
Apollo510D Lite	AP510DLA-CCR	Commercial SKU (-20°C to +70°C)	Dual-Mode Bluetooth	CSP
Apollo510D Lite	AP510DLA-CBR		Dual-Mode Bluetooth	BGA
Apollo510D Lite	AP510DLA-IBR	Industrial SKU (-40°C to +85°C)	Dual-Mode Bluetooth	BGA

[1] Product images shown are for illustration purposes only and may not be an exact representation of the products.

ambiq

www.ambiq.com
sales@ambiq.com
+1.512. 879.2850

6500 River Place Boulevard, Building 7, Suite 200, Austin, TX 78730

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