![apollo by ambiq inc.]

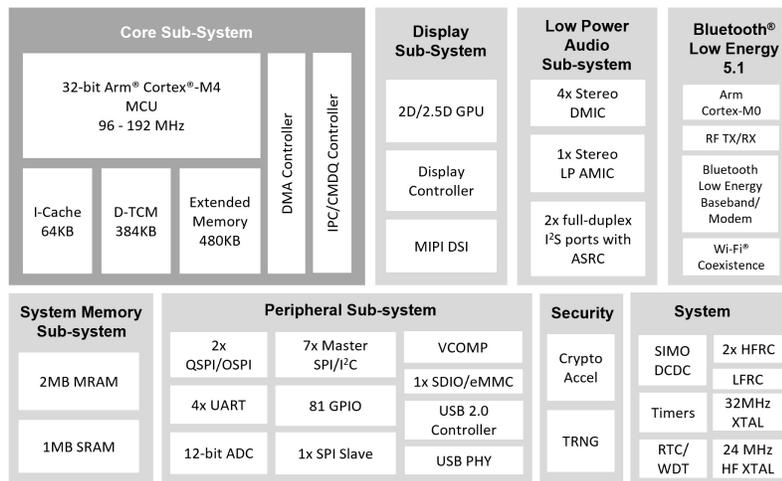# Apollo4 **Blue** Low Power System on Chip

Product Brief

Ambiq®, the leader in low-power system on chip (SoC) design, has once again raised the bar with the Apollo4 Blue SoC. With the lowest dynamic power on the market and flexible low power sleep modes, the Apollo4 Blue SoC allows designers of next generation wearables and smart devices to take their innovative products to the next level.
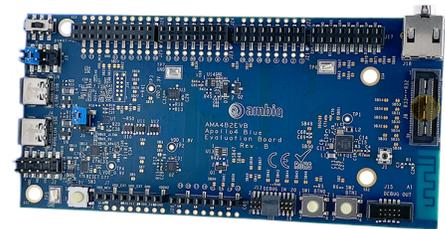
The Apollo4 Blue SoC is the 4th generation system processor solution built upon Ambiq's proprietary Subthreshold Power-Optimized Technology (SPOT®) platform. The Apollo4 Blue's complete hardware and software solution enables the wireless battery-powered endpoint devices of tomorrow to achieve a higher level of intelligence without sacrificing battery life. The Apollo4 Blue includes a 32-bit Arm® Cortex®-M4 core with Floating Point Unit (FPU) and a Bluetooth® Low Energy 5.1 radio in a BGA package.

With data length extension (DLE) and transfer speed of 2 Mbps at high RX sensitivity, the Apollo4 Blue sends more packets and achieves reduced power consumption while maintaining a robust Bluetooth connection. Moreover, 2MB of MRAM and 1.8MB of SRAM provide ample compute and storage to handle complex algorithms and neural networks while displaying vibrant, crystal-clear, and smooth graphics. If additional memory is required, an external memory is supported through Ambiq's multi-bit SPI and eMMC interfaces.

The Apollo4 Blue is purpose-built to serve as both an application processor and a coprocessor for battery-powered endpoint devices, including smartwatches, children's watches, fitness bands, animal trackers, far-field voice remotes, predictive health and maintenance, and the smart home.

Apollo4 Blue EVB

Feature Highlights:

- Achieving an unmatched 5 µA/MHz from MRAM with low power sleep modes

- Up to 192 MHz clock frequency with turboSPOT®

- 2D/2.5D graphics accelerator and MIPI DSI 1.2 with up to 500Mbps delivering a feature-rich user interface

- Apollo4 Blue SoC is embedded with a Bluetooth Low Energy 5.1 radio including Angle of Arrival (AOA) and Angle of Departure (AOD) for always-on applications

- Ultra-low power analog microphone ADC for truly always-on voice processing

- Serves as an applications processor with a fully integrated audio subsystem and interface to other communication devices

- Includes an extensive set of digital and analog peripheral interfaces with integrated ADCs and digital sensor processing using the integrated serial master ports

- 8 PDM channels, 2 stereo I²S channels with ASRC, and an ultra-low power ADC for analog mics

- PSA-L1 certified

Core Sub-System				Display Sub-System	Low Power Audio Sub-system	Bluetooth® Low Energy 5.1
32-bit Arm® Cortex®-M4 MCU 96 - 192 MHz		DMA Controller	IPC/CMDQ Controller	2D/2.5D GPU	4x Stereo DMIC	Arm Cortex-M0
						RF TX/RX
				Display Controller	1x Stereo LP AMIC	Bluetooth Low Energy Baseband/ Modem
I-Cache 64KB	D-TCM 384KB	Extended Memory 480KB		MIPI DSI	2x full-duplex I²S ports with ASRC	Wi-Fi® Coexistence

System Memory Sub-system	Peripheral Sub-system			Security	System	
	2x QSPI/OSPI	7x Master SPI/I²C	VCOMP	Crypto Accel	SIMO DCDC	2x HFRC
2MB MRAM			1x SDIO/eMMC			LFRC
	4x UART	81 GPIO	USB 2.0 Controller		Timers	32MHz XTAL
1MB SRAM	12-bit ADC	1x SPI Slave	USB PHY	TRNG	RTC/ WDT	24 MHz HF XTAL

Block Diagram for the Ultra-Low Power Apollo4 Blue SoC

Features and Specifications

Ultra-Low Supply Current
- 5 µA/MHz executing from MRAM (with cache)
- Low-power sleep and deep sleep modes with selectable levels of RAM/cache retention

High-Performance Arm Cortex-M4 Processor with FPU
- Up to 192 MHz clock frequency
- Floating Point Unit (FPU)
- Memory Protection Unit (MPU)

Bluetooth Low Energy 5.1
- 2 Mbps, extended advertising packets
- Angle of Arrival (AOA) and Angle of Departure (AOD)
- Tx: Up to +6 dBm output power
- Rx Sensitivity: -95 dBm

Security Features
- Secure Boot
- Secure over-the-air (OTA) updates
- Secure wired updates
- Key Revocation

Ultra-Low Power Memory
- Up to 2MB of non-volatile MRAM for code/data
- Up to 1.8MB of low power SRAM for code/data

Ultra-Low Power Interface for On- and Off-Chip Sensors
- 12-bit ADC, 11 selectable input channels
- Up to 2.8 MS/s sampling rate
- Temperature sensor with ±3°C accuracy

Ultra-Low Power Flexible Serial Peripherals
- 2x 2/4/8-bit SPI master interfaces
- 7x I²C/SPI masters for peripheral communication
- 1x SPI slave for host communications
- 4x UART modules with flow control
- 1x USB 2.0 HS/FS device controller
- 1x SDIO (SD3.0)/1x eMMC (v4.51)

Display
- MIPI DSI 1.2 up to 500 Mbps
- Up to 454 x 454 resolution
- 4 layers with alpha blending
- Frame Buffer Decompression

Graphics
- 2D/2.5D graphics accelerator
- Full Alpha Blending
- Texture and Frame Buffer Compression

Audio Processing
- 1x stereo Low Power Analog microphones
- 4x stereo Digital microphones
- 2x full-duplex I²S ports with ASRC

Rich Set of Clock Sources
- 16-52 MHz and 32.768 kHz Crystal (XTAL) oscillators
- 1 kHz Low Frequency RC (LFRC) oscillator
- 2x High Frequency RC (HFRC) oscillator

Power Management
- Operating range: 1.71-2.2 V, −20°C to 60°C
- SIMO buck
- Multiple I/O voltages supported

Applications
- Smart watches/bands
- Wireless sensors and IoT
- Activity and fitness monitors
- Children's watches
- Animal trackers
- Motion and tracking devices
- Alarms and security system
- Far-field voice remotes
- Consumer medical devices
- Predictive maintenance
- Smart home

Package Options
- 4.7 mm x 4.7 mm, 131-pin SIP BGA

Ordering Information
- AMA4B2KK-KBR-B2

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