Apollo and Apollo **Blue** System on Chips

Family Brochure

Ambiq® is a leader in ultra-low power design with the Apollo and Apollo Blue family of wireless system on chips (SoCs) providing energy efficient sensor processing solutions. At the heart of each device is Ambiq's patented Subthreshold Power Optimized Technology (SPOT®) platform, which dramatically reduces energy consumption without compromising performance, quality, or functionality.

Ambiq's SPOT-based processors are breaking new ground in bringing neural network-based technologies to battery and energy harvesting powered edge and endpoint devices with always-on/hands-free wake word recognition, voice assistant command and control, complex sleep and hear rate analysis, and contextually-aware sensor processing. Tens of millions of hearables, wearables, medical monitors, IoT devices, and remote wireless sensors are benefiting from Apollo and Apollo Blue SoC by gaining the flexibility to dramatically increase battery life, add more complex intelligent processing, and use smaller batteries or unique power supplies.

The Apollo510 SoC is a complete overhaul of hardware and software that fully leverages Arm's AI-focused Cortex®-M55® CPU with Helium technology and reaches processing speeds up to 250MHz. The Apollo510 achieves 16x better latency while reducing power by over 2x compared to Apollo4 Plus. The combination of performance and efficiency allows our customers to deploy sophisticated speech, vision, health, and industrial AI models on battery-powered devices everywhere, making it the most efficient semiconductor on the market to operate with the M55.

Apollo4 Plus and Apollo4 Lite SoCs offer updated peripherals, multiple memory configurations, an advanced DMA engine, turboSPOT® which operates at 192 MHz, an integrated Graphics Processing Unit (GPU), robust audio capabilities, and active power consumption reaching as low as 4 µA/MHz. Moreover, Ambiq's secureSPOT® 2.0 technology supports key aspects of developing, deploying, and maintaining security. It natively supports secure boot, secure wired and OTA updates, secure life cycles, and OTP memory for provisioning.
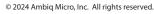

Ambiq Apollo SoC Family

Feature Highlights:

- Optimizes both active and sleep mode power
- Intelligent peripheral management for power optimized sensor processing
- Trusted platform through Ambiq's secureSPOT technology
- Uses patented Subthreshold Power Optimized Technology (SPOT) platform to dramatically reduce energy consumption
- Powerful processors enable next-generation AI applications
- As low as 4 µA/MHz power efficiency to meet the most battery constrained processing needs
- Multiple package options

Available 4Q2024

	Apollo	Apollo2	Apollo3	Apollo4 Plus	Apollo510
SoC Frequency	24 MHz	48 MHz	48 MHz 96 MHz turboSPOT®	96 MHz 192 MHz turboSPOT	96 MHz 250 MHz turboSPOT
SoC	32-bit Arm® Cortex®-M4F	32-bit Arm Cortex-M4F	32-bit Arm Cortex-M4F, DMA	32-bit Arm Cortex-M4F, DMA	32-bit Arm Cortex-M55 with Helium, DMA
SoC CoreMark® Power Efficiency	92 µW/MHz	39 µW/MHz	33 µW/MHz	29 µW/MHz	Contact Ambiq
NVM	512KB	1MB	1MB	2MB	4MB
SRAM	64KB	256KB	384KB	2.75MB	3.75MB
Voltage	2.2-3.8 V	1.755-3.63 V	1.755-3.63 V	1.71-2.2 V	1.71-3.63 V
ADC	10-bit, 13-channel, up to 800 kSps Sampling Rate ADC	14-bit, 15-channel, up to 2.67 MS/s Sampling Rate ADC	14-bit, 15-channel, up to 2.67 MS/s Sampling Rate ADC	12-bit, 11-channel, up to 2.8 MS/s Sampling Rate ADC	12-bit, 11-channel, up to 2.8 MS/s Sampling Rate ADC
UART	1	2	2	4	4
I/O	I²C/SPI Master (2x) I²C/SPI Slave	I²C/SPI Master (6x)	I²C/SPI Master (6x) I²C/SPI Slave	I²C/SPI Master (8x) I²C/SPI Slave USB 2.0 FS/HS SDIO v3.0/eMMC (1x)	I²C/SPI Master (8x) 1x full-duplex/1x half-duplex I²C/SPI Slave USB 2.0 FS/HS SDIO v3.0/eMMC (2x)
MSPI Master	--	--	1/2/4/8-bit wide up to 48 MT/s (SDR) ISO7816 Master	1/2/4/8-bit wide (2x) 1/2/4/8/16-bit wide up to 96 MT/s (SDR/DDR)	1/2/4/8-bit wide (2x) up to 96 MT/s (SDR/DDR) 1/2/4/8/16-bit wide (2x) up to 250 MT/s (SDR/DDR)
I²S	--	I²S Slave for PDM Audio Pass-through	I²S Slave for PDM Audio Pass-through	I²S Master/Slave (2x) full-duplex with ASRC	I²S Master/Slave (2x) full-duplex with ASRC
Audio	--	Dual Interface PDM for Mono and Stereo Audio Microphones	Dual Interface PDM for Mono and Stereo Audio Microphones	Stereo PDM (4x) Low Power Stereo Audio ADC (1x)	Stereo PDM (2x) Low Power Stereo Audio ADC (1x)
Display	--	--	SPI 3-wire/4-wire	SPI 3-wire/4-wire Dual/QuadSPI MIPI DSI (2x) 4-layer Display Controller	SPI 3-wire/4-wire Dual/QuadSPI MIPI DSI (2x) 4-layer Display Controller Memory in Pixel (MiP) Interface
Graphics	--	--	--	2D/2.5D GPU with anti-aliasing, dithering, and vector graphics assist	2D/2.5D GPU with anti-aliasing, dithering, and vector graphics acceleration
Security	--	--	secureSPOT®	secureSPOT 2.0	secureSPOT 3.0 Arm TrustZone®
Connectivity	--	--	--	--	--
RF Sensitivity	--	--	--	--	--
Tx Output Power	--	--	--	--	--
Packages	• 4.5 mm x 4.5 mm, 64-pin BGA with 50 GPIO • 2.49 mm x 2.90 mm, 41-pin WLCSP with 27 GPIO	• 4.5 mm x 4.5 mm, 64-pin BGA with 50 GPIO • 2.5 mm x 2.5 mm, 49-pin WLCSP with 34 GPIO • 2.5 mm x 2.5 mm, 49-pin WLCSP 300um with backside coating (Thin)	• 5 mm x 5 mm, 81-pin BGA with 50 GPIO • 3.25 mm x 3.37 mm, 66-pin WLCSP with 37 GPIO	• 5 mm x 5 mm, 146-pin BGA with 105 GPIO	• 6.6 mm x 6.6 mm, BGA with 183 GPIO • 4.9 mm x 4.7 mm, WLCSP with 144 GPIO
Ordering Information	• APOLLO512-KBR (BGA) • APOLLO512-KCR (WLCSP) • AMAP1EVB (EVB)	• AMAPH1KK-KBR (BGA) • AMAPH1KK-KCR (WLCSP) • AMAPH1KK-KCR-TB (Thin) • AMAPHEVB (EVB)	• AMAP31KK-KBR (BGA) • AMAP31KK-KCR (WLCSP) • AMA3BEVB	• AMAP42KP-KBR (BGA) • AMAP4PEVB (EVB) • AMAP4PDISP (Display Kit)	• AP510NFA-CBR (BGA) • AP510NFA-CCR (CSP)

Apollo3 Blue	Apollo3 Blue Plus	Apollo4 Blue Lite	Apollo4 Blue Plus	
48 MHz 96 MHz turboSPOT	48 MHz 96 MHz turboSPOT	96 MHz 192 MHz turboSPOT	96 MHz 192 MHz turboSPOT	**SoC Frequency**
32-bit Arm Cortex-M4F, DMA, Arm Cortex-M0 for Bluetooth Low Energy	32-bit Arm Cortex-M4F DMA, Arm Cortex-M0 for Bluetooth Low Energy	32-bit Arm Cortex-M4F, DMA, Arm Cortex-M0 for Bluetooth Low Energy	32-bit Arm Cortex-M4F, DMA, Arm Cortex-M0 for Bluetooth Low Energy	**SoC**
33 µW/MHz	33 µW/MHz	38 µW/MHz	29 µW/MHz	**SoC CoreMark Power Efficiency**
1MB	2MB	2MB	2MB	**NVM**
384KB	768KB	1.4MB	2.75MB	**SRAM**
1.755-3.63 V	1.755-3.63 V	1.71-2.2 V	1.71-2.2 V	**Voltage**
14-bit, 15-channel, up to 2.67 MS/s Sampling Rate ADC	14-bit, 15-channel, up to 2.67 MS/s Sampling Rate ADC	12-bit, 11-channel, up to 2.8 MS/s Sampling Rate ADC	12-bit, 11-channel, up to 2.8 MS/s Sampling Rate ADC	**ADC**
2	2	4	4	**UART**
I^{2}C/SPI Master (6x) I^{2}C/SPI Slave	I^{2}C/SPI Master (6x)	I^{2}C/SPI Master (7x) I^{2}C/SPI Slave SDIO v3.0/eMMC (1x)	I^{2}C/SPI Master (7x) I^{2}C/SPI Slave USB 2.0 FS/HS SDIO v3.0/eMMC (1x)	**I/O**
1/2/4/8-bit wide up to 48 MT/s (SDR) ISO7816 Master	1/2/4/8-bit wide (3x) up to 48 MT/s (SDR) ISO7816 Master	1/2/4/8-bit wide (2x) 1/2/4/8/16-bit wide up to 96 MT/s (SDR/DDR)	1/2/4/8-bit wide (2x) 1/2/4/8/16-bit wide (KXR pkg only) up to 96 MT/s (SDR/DDR)	**MSPI Master**
I^{2}S Slave for PDM Audio Pass-through	I^{2}S Slave for PDM Audio Pass-through	I^{2}S Master/Slave full-duplex	I^{2}S Master/Slave (2x) full-duplex with ASRC	**I^{2}S**
Dual Interface PDM for Mono and Stereo Audio Microphones	Dual Interface PDM for Mono and Stereo Audio Microphones	Stereo PDM (1x)	Stereo PDM (4x) LP Analog Microphone with PGA (1x)	**Audio**
SPI 3-wire/4-wire	SPI 3-wire/4-wire Dual/QuadSPI	SPI 3-wire/4-wire Dual/QuadSPI	SPI 3-wire/4-wire Dual/QuadSPI MIPI DSI (2x) 4-layer Display Controller	**Display**
--	--	2D/2.5D GPU with anti-aliasing and dithering	2D/2.5D GPU with anti-aliasing, dithering, and vector graphics assist	**Graphics**
secureSPOT	secureSPOT	secureSPOT 2.0	secureSPOT 2.0	**Security**
Bluetooth Low Energy 5	Bluetooth Low Energy 5	Bluetooth Low Energy 5.4	Bluetooth Low Energy 5.4	**Connectivity**
-93 dBm	-93 dBm	-95 dBm	-95 dBm	**RF Sensitivity**
Up to +3 dBm	Up to +3 dBm	Up to +6 dBm	Up to +6 dBm	**Tx Output Power**
• 5 mm x 5 mm, 81-pin BGA with 50 GPIO • 3.25 mm x 3.37 mm, 66-pin WLCSP with 37 GPIO • 3.25 mm x 3.37 mm, 66-pin WLCSP 300um with backside coating (Thin) • 8 mm x 8 mm, 64-pin QFN with 38 GPIO	• 5.3 mm x 4.3 mm x 0.8 mm, 108-pin BGA with 74 GPIO	• 4.7 mm x 4.7 mm, 131-pin BGA with 75 GPIO	• 4.7 mm x 4.7 mm, 131-pin BGA with 81 GPIO	**Packages**
• AMA3B1KK-KBR-B0 (BGA) • AMA3B1KK-KCR-B0 (WLCSP) • AMA3B1KK-KCR-TB (Thin) • AMA3B1KK-KQR-B0 (QFN) • AMA3BEVB (EVB)	• AMA3B2KK-KBR (BGA) • AMA3B2EVB (EVB)	• AMA4B2KL-KXR (BGA) • AMA4BLEVB (EVB)	• AMA4B2KP-KXR (BGA) • AMA4B2KP-KBR (BGA) • AMAP4BPXEVB (EVB)	**Ordering Information**