

Apollo and Apollo **Blue** System on Chips

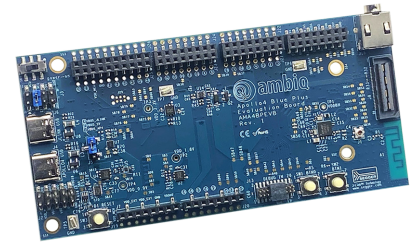
Family Brochure

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 in the market. 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 also 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.

All Apollo SoCs include a standard Arm® Cortex®-M4F core, abundant embedded non-volatile memory and SRAM, and a broad suite of interfaces to enable multiple sensors, microphones, or displays. The Apollo Blue family integrates an energy-efficient Bluetooth® radio to enable reliable, always-connected, wireless communications. With a highly optimized, dedicated SoC for the Bluetooth Low Energy stack, the Apollo4 Blue family affords designers the benefits of ultra-low power designs without the overhead of implementing a fully compliant Bluetooth solution.

The latest Apollo4 Plus and Apollo4 Lite variants 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 μ A/MHz. Moreover, Ambiq's secureSPOT® 2.0 technology supports key aspects of developing, deploying, and maintaining security for the product's life. It natively supports secure boot, secure wired and OTA updates, secure life cycles, and OTP memory for provisioning.



Apollo4 Blue Plus EVB

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
- Arm Cortex-M4F core offers the computational horsepower required in an internet of things (IoT) world
- As low as 4 μ A/MHz power efficiency to meet the most battery constrained processing needs
- 512KB to 2MB non-volatile memory
- 64KB to 2.75MB SRAM
- Offered in BGA and WLCSP package options
- PSA-L1 certified (Apollo4 family only)



	Apollo	Apollo2	Apollo3	Apollo4 Lite	Apollo4 Plus
SoC Frequency	24 MHz	48 MHz	48 MHz 96 MHz turboSPOT®	96 MHz 192 MHz turboSPOT	96 MHz 192 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-M4F, DMA
SoC Power Efficiency	34 µA/MHz	10 µA/MHz	6 µA/MHz	4 µA/MHz	4 µA/MHz
NVM	512KB	1MB	1MB	2MB	2MB
SRAM	64KB	256KB	384KB	1.4MB	2.75MB
Voltage	2.2-3.8 V	1.755-3.63 V	1.755-3.63 V	1.71-2.2 V	1.71-2.2 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	I ² C/SPI Master (2x) I ² C/SPI Slave	I ² C/SPI Master (6x)	I ² C/SPI Master (6x) I ² C/SPI Slave	I ² C/SPI Master (8x) I ² C/SPI Slave SDIO v3.0/eMMC (1x)	I ² C/SPI Master (8x) I ² C/SPI Slave USB FS/HS SDIO v3.0/eMMC (1x)
MSPI	--	--	Dual/Quad/Octal-SPI Master 48 MHz SDR ISO7816 Master	Dual/Quad/Octal-SPI Master (2x) QSPI/OSPI/HexSPI 96 MHz SDR 48 MHz DDR	Dual/Quad/Octal-SPI Master (2x) QSPI/OSPI/HexSPI 96 MHz SDR 48 MHz DDR
I²S	--	I ² S Slave for PDM Audio Pass-through	I ² S Slave for PDM Audio Pass-through	I ² S Master/Slave (1x) full-duplex	I ² S 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 Interfaces (1x)	Stereo PDM (4x) Low Power Stereo Audio ADC (1x)
Display	--	--	SPI 3-wire/4-wire	SPI 3-wire/4-wire Dual/QuadSPI	SPI 3-wire/4-wire Dual/QuadSPI MIPI DSI x2 4-layer Display Controller
Graphics	--	--	--	2D/2.5D GPU with anti-aliasing and dithering	2D/2.5D GPU with anti-aliasing, dithering, and vector graphics
Security	--	--	secureSPOT®	secureSPOT 2.0	secureSPOT 2.0
Connectivity	--	--	--	--	--
RF Sensitivity	--	--	--	--	--
Tx Output Power	--	--	--	--	--
Packages	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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) 	<ul style="list-style-type: none"> 5 mm x 5 mm, 81-pin BGA with 50 GPIO 3.25 mm x 3.37 mm, 66-pin WLCSP with 37 GPIO 	<ul style="list-style-type: none"> 5 mm x 5 mm, 146-pin BGA with 84 GPIO 	<ul style="list-style-type: none"> 5 mm x 5 mm, 146-pin BGA with 105 GPIO
Ordering Information	<ul style="list-style-type: none"> APOLLO512-KBR (BGA) APOLLO512-KCR (WLCSP) AMAP1EVB (EVB) 	<ul style="list-style-type: none"> AMAPH1KK-KBR (BGA) AMAPH1KK-KCR (WLCSP) AMAPH1KK-KCR-TB (Thin) AMAPHEVB (EVB) 	<ul style="list-style-type: none"> AMAP31KK-KBR (BGA) AMAP31KK-KCR (WLCSP) 	<ul style="list-style-type: none"> AMAP42KL-KBR (BGA) AMAP4LEVB (EVB) 	<ul style="list-style-type: none"> AMAP42KP-KBR (BGA) AMAP4PEVB (EVB) AMAP4PDISP (Display Kit)

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
6 μA/MHz	6 μA/MHz	4 μA/MHz	4 μA/MHz	SoC 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 FS/HS SDIO v3.0/eMMC (1x)	I/O
Dual/Quad/Octal-SPI Master 48 MHz SDR ISO7816 Master	Dual/Quad/Octal-SPI Master (3x) 48 MHz SDR ISO7816 Master	Dual/Quad/Octal-SPI Master (2x) QSPI/OSPI/HexSPI 96 MHz SDR 48 MHz DDR	Dual/Quad/Octal-SPI Master (2x) QSPI/OSPI/HexSPI (KXR package only) 96 MHz SDR 48 MHz DDR	MSPI
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	I²S
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 x2 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	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
<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 5.3 mm x 4.3 mm x 0.8 mm, 108-pin BGA with 74 GPIO 	<ul style="list-style-type: none"> • 4.7 mm x 4.7 mm, 131-pin BGA with 75 GPIO 	<ul style="list-style-type: none"> • 4.7 mm x 4.7 mm, 131-pin BGA with 81 GPIO 	Packages
<ul style="list-style-type: none"> • AMA3B1KK-KBR-B0 (BGA) • AMA3B1KK-KCR-B0 (WLCSP) • AMA3B1KK-KCR-TB (Thin) • AMA3B1KK-KQR-B0 (QFN) • AMA3BEVB (EVB) 	<ul style="list-style-type: none"> • AMA3B2KK-KBR (BGA) • AMA3B2EVB (EVB) 	<ul style="list-style-type: none"> • AMA4B2KL-KXR (BGA) • AMA4BLEVB (EVB) 	<ul style="list-style-type: none"> • AMA4B2KP-KXR (BGA) • AMA4B2KP-KBR (BGA) • AMAP4BPXEVB (EVB) 	Ordering Information