# Apollo and Apollo **Blue** MCU and SoC

Family Brochure

Ambiq is the leader in ultra-low power design with the Apollo and Apollo Blue family of microcontrollers and wireless SoCs providing the most 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 MCU and 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 MCUs and SoCs include a standard Arm® Cortex®-M4F core, generous amounts of non-volatile Flash and SRAM, and a broad suite of interfaces to enable multiple sensors, microphones, or displays. The Apollo Blue family integrates an energy-efficient Bluetooth® 5 LE radio combined with improved communication features to enable always-connected, ultra-low power designs. The Apollo Blue family also provides a dedicated second core providing superior RF throughput and leaving plenty of resources available for demanding user applications.

The latest generation of Apollo4 and Apollo4 Blue products includes updated peripherals, additional memory, an advanced DMA engine, TurboSPOT™ which increases the computational capabilities of the Arm Cortex-M4F core to 192 MHz, and active power consumption reaching as low as 3 µA/MHz.
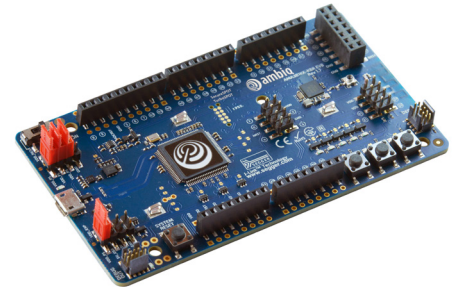
Apollo Family

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
- Arm Cortex-M4F core offers the computational horsepower required in an internet of things (IoT) world
- As low as 3 µA/MHz power efficiency to meet the most battery constrained processing needs
- 512KB to 2MB non-volatile flash memory
- 64KB to 1.8MB SRAM
- Offered in BGA and WLCSP package options

	Apollo	Apollo2	Apollo3	Apollo4
MCU Frequency	24 MHz	48 MHz	48 MHz 96 MHz TurboSPOT	96 MHz 192 MHz TurboSPOT
MCU	32-bit Arm Cortex-M4F	32-bit Arm Cortex-M4F	32-bit Arm Cortex-M4F, DMA	32-bit Arm Cortex-M4F, DMA
MCU Power Efficiency	34 µA/MHz	10 µA/MHz	6 µA/MHz	3 µA/MHz
NVM	512KB Flash	1MB Flash	1MB Flash	2MB MRAM
SRAM	64KB	256KB	384KB	1.8MB
Voltage	2.2-3.8 V	1.755-3.63 V	1.755-3.63 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
UART	1	2	2	4
I/O	I^2C/SPI master (2x) I^2C/SPI slave	I^2C master (6x) I^2C/SPI slave	I^2C/SPI master (6x) I^2C/SPI slave	I^2C/SPI master (8x) I^2C/SPI slave USB FS/HS SDIO v3.0/1x eMMC
MSPI	--	--	Dual/Quad/Octal-SPI Master 48 MHz SDR ISO7816 Master	Dual/Quad/Octal-SPI Master (3x) 96 MHz SDR 48 MHz DDR
I^2S	--	I^2S slave for PDM Audio Pass-through	I^2S slave for PDM Audio Pass-through	I^2S 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	4x Stereo Digital Microphones 2x LP Analog Microphone with PGA
Display	--	--	SPI 3-wire/4-wire	SPI 3-wire/4-wire Dual/QuadSPI MIPI DSI x2 4-layer Display Controller
Graphics	--	--	--	2D/2.5D GPU
Security	--	--	SecureSPOT	SecureSPOT 2.0
Connectivity	--	--	--	--
RF Sensitivity	--	--	--	--
Rx Current	--	--	--	--
Tx Current	--	--	--	--
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-pins BGA with 105 GPIO • 3.9 mm x 3.9 mm, 121-pin WLCSP with 82 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)	• AMAP42KK-KBR (BGA) • AMAP42KK-KCR (WLCSP)

Apollo2 Blue	Apollo3 Blue	Apollo3 Blue Plus	Apollo4 Blue	
48 MHz	48 MHz 96 MHz TurboSPOT	48 MHz 96 MHz TurboSPOT	96 MHz 192 MHz TurboSPOT	**MCU Frequency**
32-bit Arm Cortex-M4F Dedicated BLE Core	32-bit Arm Cortex-M4F DMA, Arm Cortex-M0 for BLE	32-bit Arm Cortex-M4F DMA, Arm Cortex-M0 for BLE	32-bit Arm Cortex-M4F, DMA, Arm Cortex-M0 for BLE	**MCU**
10 µA/MHz	6 µA/MHz	6 µA/MHz	3 µA/MHz	**MCU Power Efficiency**
1MB Flash	1MB Flash	2MB Flash	2MB MRAM	**NVM**
256KB	384KB	768KB	1.8MB	**SRAM**
1.755-3.63 V	1.755-3.63 V	1.755-3.63 V	1.71-2.2 V	**Voltage**
14-bit, 11-channel, up to 2.67 MS/s 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	**ADC**
2	2	2	4	**UART**
I^2C/SPI master (4x) I^2C/SPI slave	I^2C/SPI master (6x) I^2C/SPI slave	I^2C master (6x) I^2C/SPI slave	I^2C/SPI master (7x) I^2C/SPI slave USB FS/HS SDIO v3.0/1x eMMC	**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 (3x) 96 MHz SDR 48 MHz DDR	**MSPI**
I^2S slave for PDM Audio Pass-through	I^2S slave for PDM Audio Pass-through	I^2S slave for PDM Audio Pass-through	I^2S 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	Dual Interface PDM for Mono and Stereo Audio Microphones	4x Stereo Digital Microphones 2x LP Analog Microphone with PGA	**Audio**
--	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	**Display**
--	--	--	2D/2.5D GPU	**Graphics**
AES 128-bit Encryption	SecureSPOT	SecureSPOT	SecureSPOT 2.0	**Security**
BLE 5	BLE 5	BLE 5	BLE 5	**Connectivity**
-95 dBm	-94 dBm	-94 dBm	-97 dBm	**RF Sensitivity**
3.5 mA	3 mA	3 mA	3 mA	**Rx Current**
5 mA @ 0 dBm	3 mA @ 0 dBm	3 mA @ 0 dBm	3 mA @ 0dBm	**Tx Current**
-40 dBm to +5 dBm	-20 dBm to +4 dBm	-20 dBm to +4 dBm	-20 dBm to +6.8 dBm	**Tx Output Power**
4 mm x 4 mm x 0.9 mm, 64-pin LGA with up to 31 GPIO	• 4.5 mm x 4.5 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)	5.3 mm x 4.3 mm x 0.8 mm, 108-pin BGA with 74 GPIO	4.7mm x 4.7mm, 131-pin SiP BGA with 81 GPIO	**Packages**
• AMA2B1KK-KLR • AMA2BEVB (EVB)	• AMA3B1KK-KBR-B0 (BGA) • AMA3B1KK-KCR-B0 (WLCSP) • AMA3B1KK-KCR-TB (Thin) • AMA3BEVB (EVB)	• AMA3B2KK-KBR • AMA3B2EVB (EVB)	AMA4B2KK-KBR	**Ordering Information**

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