

Apollo and Apollo Blue Microprocessor

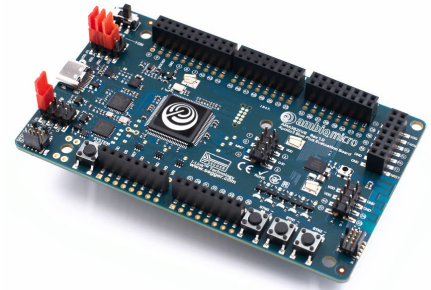
Family Brochure

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 microcontrollers by gaining the flexibility to dramatically increase battery life, add more complex intelligent processing, and use smaller batteries or unique power supplies.

All Apollo microcontrollers include a standard Arm® Cortex®-M4F core, generous amounts of Flash and SRAM, and a broad suite of interfaces to enable multiple sensors, microphones, or displays. The Apollo Blue microcontroller family integrates an energy-efficient Bluetooth® 5 low-energy 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 user applications.

The latest generation of Apollo3 Blue products, including the recently released Apollo3 Blue Plus, includes updated peripherals, additional memory, an advanced DMA engine, TurboSPOT™ which increases the computational capabilities of the Arm Cortex M4F core to 96 MHz, and active power consumption reaching as low as 6uA/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 6uA/MHz power efficiency to meet the most battery constrained processing needs
- 512KB to 2MB Flash Non-Volatile Memory
- 64KB to 768KB SRAM
- Offered in BGA and WLCSP package options



	Apollo	Apollo2	Apollo4
MCU Frequency	24 MHz	48 MHz	96 MHz 192 MHz TurboSPOT
MCU	32-bit Arm Cortex-M4F	32-bit Arm Cortex-M4F	32-bit Arm Cortex-M4F, DMA
MCU Power Efficiency	34 μ A/MHz	10 μ A/MHz < 3 μ A Deep Sleep Mode	< 3 μ A/MHz
NVM	512KB Flash	1MB Flash	2MB MRAM
SRAM	64KB	256KB	1.8MB
Voltage	2.2-3.8 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	12-bit, 11-channel, up to 2.8 MS/s Sampling Rate ADC
UART	1	2	4
I/O	I ² C/SPI master (2x) I ² C/SPI slave	I ² C master (6x) I ² C/SPI slave	I ² C/SPI master (8x) I ² C/SPI slave USB FS/HS SDIO v3.0/1x eMMC
MSPI	--	--	Dual/Quad/Octal-SPI Master (3x) 96 MHz SDR 48 MHz DDR
I²S	--	I ² S slave for PDM Audio Pass-through	I ² S master/slave (2x) full-duplex with ASRC
Audio	--	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 Dual/QuadSPI MIPI DSI x2 4-layer Display Controller
Graphics	--	--	2D/2.5D GPU
Security	--	--	SecureSPOT 2.0
Connectivity	--	--	--
RF Sensitivity	--	--	--
Rx Current	--	--	--
Tx Current	--	--	--
Tx Output Power	--	--	-20 dBm to +6.8 dBm
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, 146-pins BGA with 105 GPIO 3.9 mm x 3.9 mm, 121-pin WLCSP with 82 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"> 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 μ A/MHz < 3 μ A Deep Sleep Mode	< 6 μ A/MHz < 1 μ A Deep Sleep Mode	< 6 μ A/MHz < 1 μ A Deep Sleep Mode	< 3 μ A/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 ² C/SPI master (4x) I ² C/SPI slave	I ² C/SPI master (6x) I ² C/SPI slave	I ² C master (6x) I ² C/SPI slave	I ² C/SPI master (7x) I ² C/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 ² S slave for PDM Audio Pass-through	I ² S slave for PDM Audio Pass-through	I ² S slave for PDM Audio Pass-through	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	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	<ul style="list-style-type: none"> 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 5.3 mm x 0.8 mm, 108-pin BGA with 74 GPIO	4.7mm x 4.7mm, 131-pin SiP BGA with 81 GPIO	Packages
<ul style="list-style-type: none"> AMA2B1KK-KLR AMA2BEVB (EVB) 	<ul style="list-style-type: none"> AMA3B1KK-KBR-B0 (BGA) AMA3B1KK-KCR-B0 (WLCSP) AMAP31KK-KCR (WLCSP, non-BLE) AMA3B1KK-KCR-TB (Thin) AMA3BEVB (EVB) 	<ul style="list-style-type: none"> AMA3B2KK-KBR AMA3B2EVB (EVB) 	AMA4B2KK-KBR	Ordering Information