

Apollo 和 Apollo Blue SoC

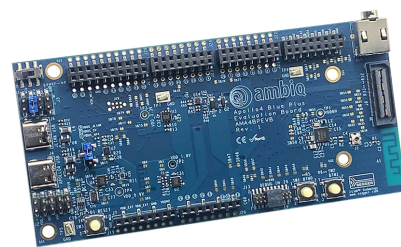
产品系列手册

Ambiq® 是超低功耗设计领域的领导者，公司推出的 Apollo 和 Apollo Blue SoC 产品系列是高效的传感处理解决方案。这些产品的核心是基于 Ambiq 的亚阈值功耗优化专利技术 (SPOT®) 平台，该平台能够在不影响性能、质量或功能的情况下显著降低能耗。

同时，Ambiq 还实现了全新的突破，两款基于 SPOT 技术的新产品成功地将神经网络技术引入了由电池或能量收集供电的边缘/终端设备，实现了永久在线/唤醒词识别、语音助手命令、复杂睡眠/心率分析，以及场景感知传感器处理等功能。Apollo 和 Apollo Blue SoC 将最佳灵活性赋能于数千万可听戴设备、可穿戴设备、医疗监测器、物联网设备和远程无线传感器，使之大为延长续航时间，实现复杂智能指令处理，并缩小了电池的体积，增加了电源供应的可选性。

所有 Apollo SoCs 都包含标准的 Arm® Cortex®-M4F 核心、内嵌大容量 NVM 和 SRAM，以及丰富的接口，用于支持多个传感器、麦克风和显示屏。Apollo Blue 系列集成高效的蓝牙® 技术，可实现可靠、稳定的无线通信。Apollo4 Blue 系列 SoC 经过深度定制和优化，拥有完整的蓝牙低功耗协议栈，设计人员能够基于超低功耗技术自由开发，而无需考虑匹配完整蓝牙标准所带来的额外开发成本。

最新的 Apollo4 Plus 和 Apollo4 Lite 产品升级了外设支持、多存储器配置、先进的 DMA 引擎、turboSPOT® 技术 (工作频率高达 192 MHz)、集成的图形处理单元 (GPU)、强大的音频功能以及低至 4 μ A/MHz 的超高能效。此外，Ambiq 的 secureSPOT® 2.0 技术在产品开发、技术部署和维护安全等关键方面全程发挥作用。它支持安全引导、安全线刷和 OTA 更新、安全生命周期管理，同时还拥有可用于配置权限的 OTP 存储器。



Apollo4 Blue Plus EVB

关键特性：

- 优化的主动模式以及睡眠模式功耗
- 支持智能外设管理，可实现低功耗的传感器处理
- 支持 Ambiq secureSPOT 技术，高度可靠
- 基于亚阈值功耗优化专利技术 (SPOT) 平台设计，能够显著降低功耗
- Arm Cortex-M4F 核心能够提供物联网各类应用所需的算力
- 低至 4 μ A/MHz 的功耗，满足最严苛的电池使用场景
- 512KB 到 2MB NVM 可选
- 64KB 到 2.75MB SRAM 可选
- BGA 和 WLCSP 封装选项可选
- 经过 PSA-L1 认证 (仅适用于 Apollo4 系列)



	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