SparkFun Electronics
Artemis Module
Integration Guide
Version: 1p0p0

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1. Overview

The SparkFun Artemis is a Cortex-M4F based BLE module using the Apollo3 micrcontroller from Ambiq. The Artemis is capable of running machine learning algorithms with the low current consumption of 6 μA/MHz at 3.3V. The Artemis has an integrated 2.4GHz antenna and incorporates all the necessary circuitry to implement a low power BLE enabled microcontroller.

2. Features

Ultra-low supply current
- 6μA/MHz executing from flash at 3.3V
- 1μA deep sleep mode (BLE Off) with RTC at 3.3V
- Supply voltage: 1.75V to 3.63V with onboard DC/DC regulation

High-performance ARM Cortex-M4 Processor
- Up to 48 GPIO
- 48 MHz nominal clock frequency, with 96 MHz burst mode
- Floating point unit
- Memory protection unit
- Wake-up interrupt controller with 32 interrupts
- Up to 1 MB of flash memory for code/data
- Up to 384 KB of low leakage RAM for code/data
- 16 kB 2-way Associative/Direct-Mapped Cache

Integrated Bluetooth 5 low-energy module
- RF sensitivity: -93 dBm (typical)
- TX: 3 mA @ 0 dBm, RX: 3 mA
- TX peak output power: 4.0 dBm (max)

Small Size
- 15.5 x 10.5mm including antenna

Easy Integration
- Large SMD pads and spacing allow for low cost 2-layer carrier board implementations
- Programming over pre-configured serial bootloader or JTAG

Ultra-low power ADC
- 14 bit ADC at up to 2.67 MS/s effective continuous, multi-slot sampling rate
- 15 selectable input channels
- Voltage Comparator

- Temperature sensor with +/-3ºC accuracy

ISO7816 Secure 'Smart Card' interface

Flexible serial peripherals
- 1x 2/4/8-bit SPI master interface
- 6x I2C/SPI masters for peripheral communication
- I2C/SPI slave for host communications
- 2x UART modules with 32-location Tx and Rx FIFOs
- PDM for mono and stereo audio microphone
- 1x I2S slave for PDM audio pass-through

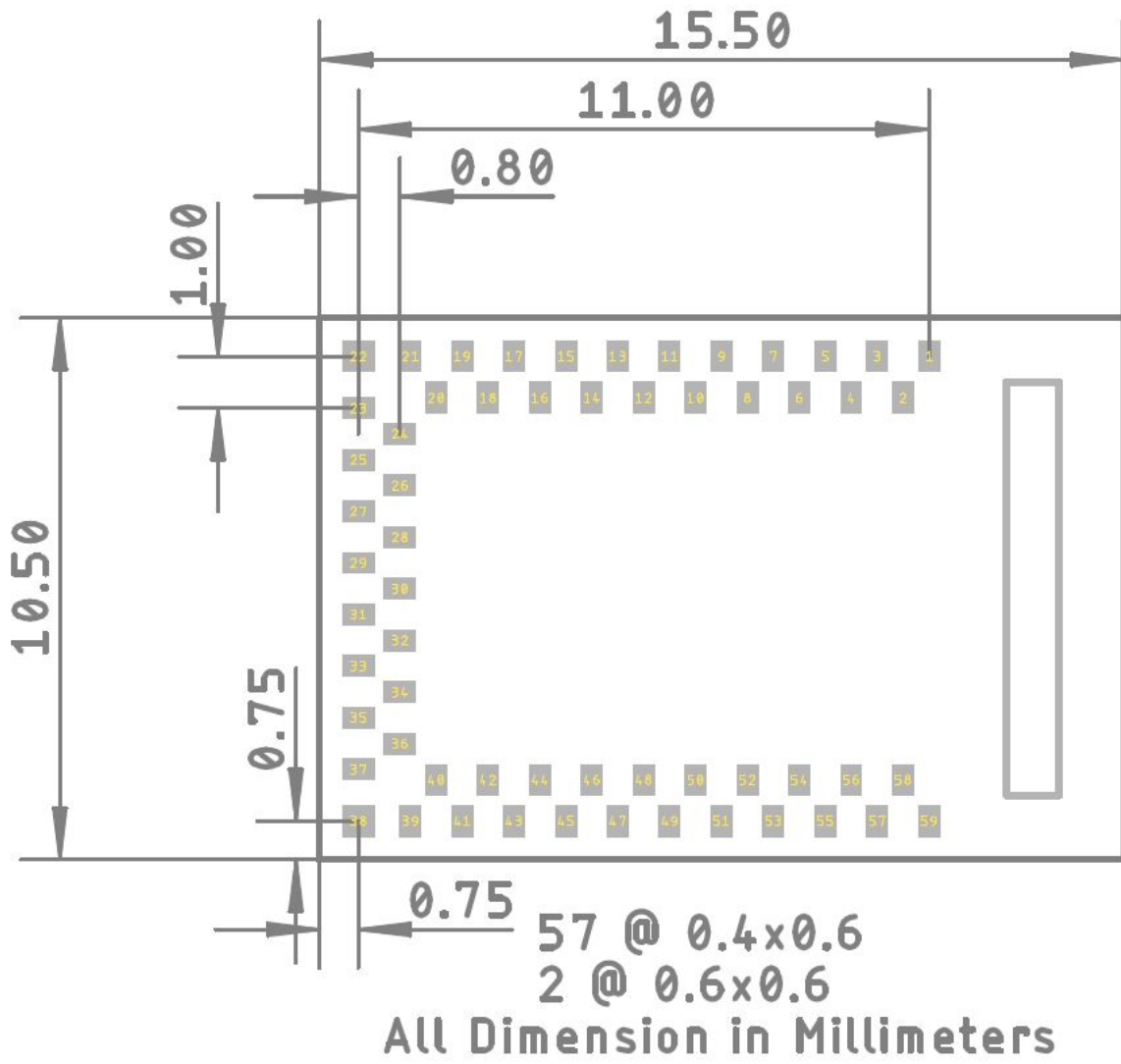Rich set of clock sources
- 32.768 kHz XTAL oscillator
- Low frequency RC oscillator – 1.024 kHz
- High frequency RC oscillator – 48/96 MHz
- RTC based on Ambiq's AM08X5/18X5 families

3. Mechanical Specifications
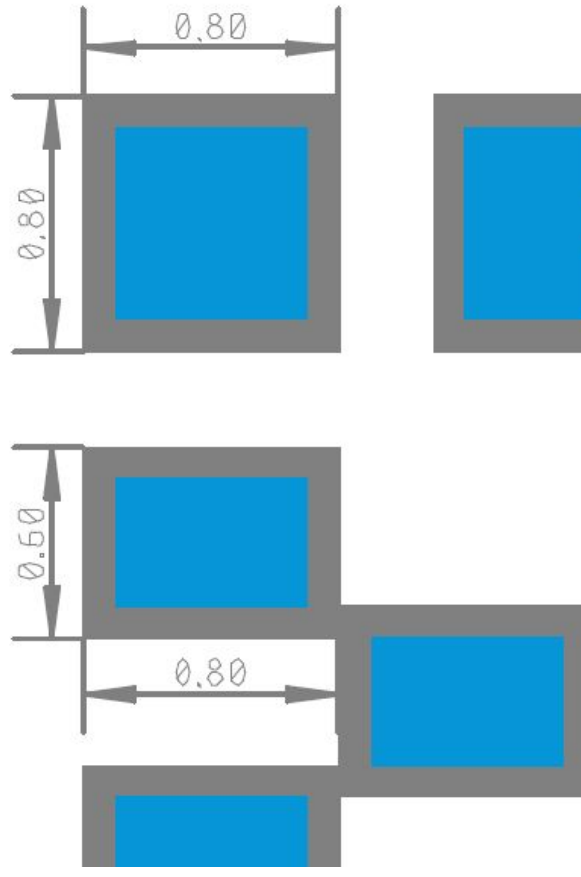
Module Dimensions	15.5 x 10.5 x 2.3mm
Weight	0.6g
Antenna	2.4 - 2.5GHz Chip

Recommended PCB Layout:

Top View
Copper Pad and Paste Aperture Dimensions

Recommended Soldermask Layout:

Solder Mask Dimensions

4.Pad Signals and Assignment

Module Pad No.	Name	Pin Function	Description
1	GND	Power	Ground
2	GPIO20	SWDCK	JTAG single wire clock
3	GPIO49	RX0 Bootload	RX pin for serial bootloading
4	GPIO39		
5	GPIO40		
6	GPIO9		
7	BOOT	Bootload	Hold pin high during reset to initiate bootloader
8	GPIO10		
9	GPIO48	TX0 Bootload	TX pin for serial bootloading
10	GPIO21	SWDIO	JTAG single wire I/O
11	GPIO8		
12	GPIO5		
13	GPIO7		
14	GPIO35		All GPIOs have up to 8 possible functions ranging from I2C,
15	GPIO4		SPI, PDM, SCC, UART, I2S, and clock sources. Please
16	GPIO24		see the Apollo3 datasheet for a complete listing of capabilities.
17	GPIO22		
18	GPIO23		
19	GPIO27		
20	GPIO14		
21	GPIO28		
22	GND	Power	
23	GPIO6		
24	GPIO32		
25	GPIO25		
26	GPIO12		
27	GPIO26		
28	GPIO13		
29	GPIO15		
30	GPIO33		
31	GPIO34		
32	GPIO11		
33	GPIO29		

34	XO	32kHz Xtal	Connection for external 32.768kHz RTC crystal
35	XI	32kHz Xtal	Connection for external 32.768kHz RTC crystal
36	VDD	Power	
37	VDD	Power	
38	GND	Power	
39	GND	Power	
40	GPIO19		
41	GPIO18		
42	GPIO16		
43	GPIO17		
44	GPIO31		
45	GPIO41		
46	GPIO45		
47	GND	Power	
48	GPIO2		
49	GPIO1		
50	nRESET	System Reset	Pull pin low to reset system
51	GPIO0		
52	GPIO43		
53	GPIO42		
54	GPIO3		
55	GPIO36		
56	GPIO38		
57	GPIO37		
58	GPIO44		
59	GND	Power	

Pad	PADnFNCSEL							
	0	1	2	3	4	5	6	7
0	SLSCL	SLSCK	CLKOUT	GPIO00		MSPI4		NCE0
1	SLSDAWIR3	SLMOSI	UART0TX	GPIO01		MSPI5		NCE1
2	UART1RX	SLMISO	UART0RX	GPIO02		MSPI6		NCE2
3	UA0RTS	SLnCE	NCE3	GPIO03		MSPI7	TRIG1	I2SWCLK
4	UA0CTS	SLINT	NCE4	GPIO04		UART1RX	CT17	MSPI2
5	M0SCL	M0SCK	UA0RTS	GPIO05		-		CT8
6	M0SDAWIR3	M0MISO	UA0CTS	GPIO06		CT10		I2SDAT
7	NCE7	M0MOSI	CLKOUT	GPIO07	TRIG0	UART0TX		CT19
8	M1SCL	M1SCK	NCE8	GPIO08	SCCCLK		UART1TX	
9	M1SDAWIR3	M1MISO	NCE9	GPIO09	SCCIO		UART1RX	
10	UART1TX	M1MOSI	NCE10	GPIO10	PDMCLK	UA1RTS		
11	ADCSE2	NCE11	CT31	GPIO11	SLINT	UA1CTS	UART0RX	PDMDATA
12	ADCD0NSE9	NCE12	CT0	GPIO12	SLnCE	PDMCLK	UA0CTS	UART1TX
13	ADCD0PSE8	NCE13	CT2	GPIO13	I2SBCLK	-	UA0RTS	UART1RX
14	ADCD1P	NCE14	UART1TX	GPIO14	PDMCLK	-	SWDCK	32KHzXT
15	ADCD1N	NCE15	UART1RX	GPIO15	PDMDATA	-	SWDIO	SWO
16	ADCSE0	NCE16	TRIG0	GPIO16	SCCRST	CMPIN0	UART0TX	UA1RTS
17	CMPRF1	NCE17	TRIG1	GPIO17	SCCCLK		UART0RX	UA1CTS
18	CMPIN1	NCE18	CT4	GPIO18	UA0RTS	-	UART1TX	SCCIO
19	CMPRF0	NCE19	CT6	GPIO19	SCCCLK	-	UART1RX	I2SBCLK
20	SWDCK	NCE20		GPIO20	UART0TX	UART1TX	I2SBCLK	UA1RTS
21	SWDIO	NCE21		GPIO21	UART0RX	UART1RX	SCCRST	UA1CTS
22	UART0TX	NCE22	CT12	GPIO22	PDMCLK	-	MSPI0	SWO
23	UART0RX	NCE23	CT14	GPIO23	I2SWCLK	CMPOUT	MSPI3	-
24	UART1TX	NCE24	MSPI8	GPIO24	UA0CTS	CT21	32KHzXT	SWO
25	UART1RX	NCE25	CT1	GPIO25	M2SDAWIR3	M2MISO		
26	-	NCE26	CT3	GPIO26	SCCRST	MSPI1	UART0TX	UA1CTS
27	UART0RX	NCE27	CT5	GPIO27	M2SCL	M2SCK		
28	I2SWCLK	NCE28	CT7	GPIO28		M2MOSI	UART0TX	
29	ADCSE1	NCE29	CT9	GPIO29	UA0CTS	UA1CTS	UART0RX	PDMDATA
30	-	NCE30	CT11	GPIO30	UART0TX	UA1RTS	BLEIF_SCK	I2SDAT
31	ADCSE3	NCE31	CT13	GPIO31	UART0RX	SCCCLK	BLEIF_MISO	UA1RTS
32	ADCSE4	NCE32	CT15	GPIO32	SCCIO	-	BLEIF_MOSI	UA1CTS
33	ADCSE5	NCE33	32KHzXT	GPIO33	BLEIF_CSN	UA0CTS	CT23	SWO
34	ADCSE6	NCE34	UA1RTS	GPIO34	CMPRF2	UA0RTS	UART0RX	PDMDATA
35	ADCSE7	NCE35	UART1TX	GPIO35	I2SDAT	CT27	UA0RTS	BLEIF_STATUS
36	TRIG1	NCE36	UART1RX	GPIO36	32KHzXT	UA1CTS	UA0CTS	PDMDATA
37	TRIG2	NCE37	UA0RTS	GPIO37	SCCIO	UART1TX	PDMCLK	CT29
38	TRIG3	NCE38	UA0CTS	GPIO38		M3MOSI	UART1RX	
39	UART0TX	UART1TX	CT25	GPIO39	M4SCL	M4SCK		
40	UART0RX	UART1RX	TRIG0	GPIO40	M4SDAWIR3	M4MISO		
41	NCE41	BLEIF_IRQ	SWO	GPIO41	I2SWCLK	UA1RTS	UART0TX	UA0RTS
42	UART1TX	NCE42	CT16	GPIO42	M3SCL	M3SCK		
43	UART1RX	NCE43	CT18	GPIO43	M3SDAWIR3	M3MISO		
44	UA1RTS	NCE44	CT20	GPIO44		M4MOSI	UART0TX	
45	UA1CTS	NCE45	CT22	GPIO45	I2SDAT	PDMDATA	UART0RX	SWO
46	I2SBCLK	NCE46	CT24	GPIO46	SCCRST	PDMCLK	UART1TX	SWO
47	32KHzXT	NCE47	CT26	GPIO47		M5MOSI	UART1RX	
48	UART0TX	NCE48	CT28	GPIO48	M5SCL	M5SCK		
49	UART0RX	NCE49	CT30	GPIO49	M5SDAWIR3	M5MISO		

Overview of Pad Functions
Note: Apollo Pad# maps to GPIO# on Artemis
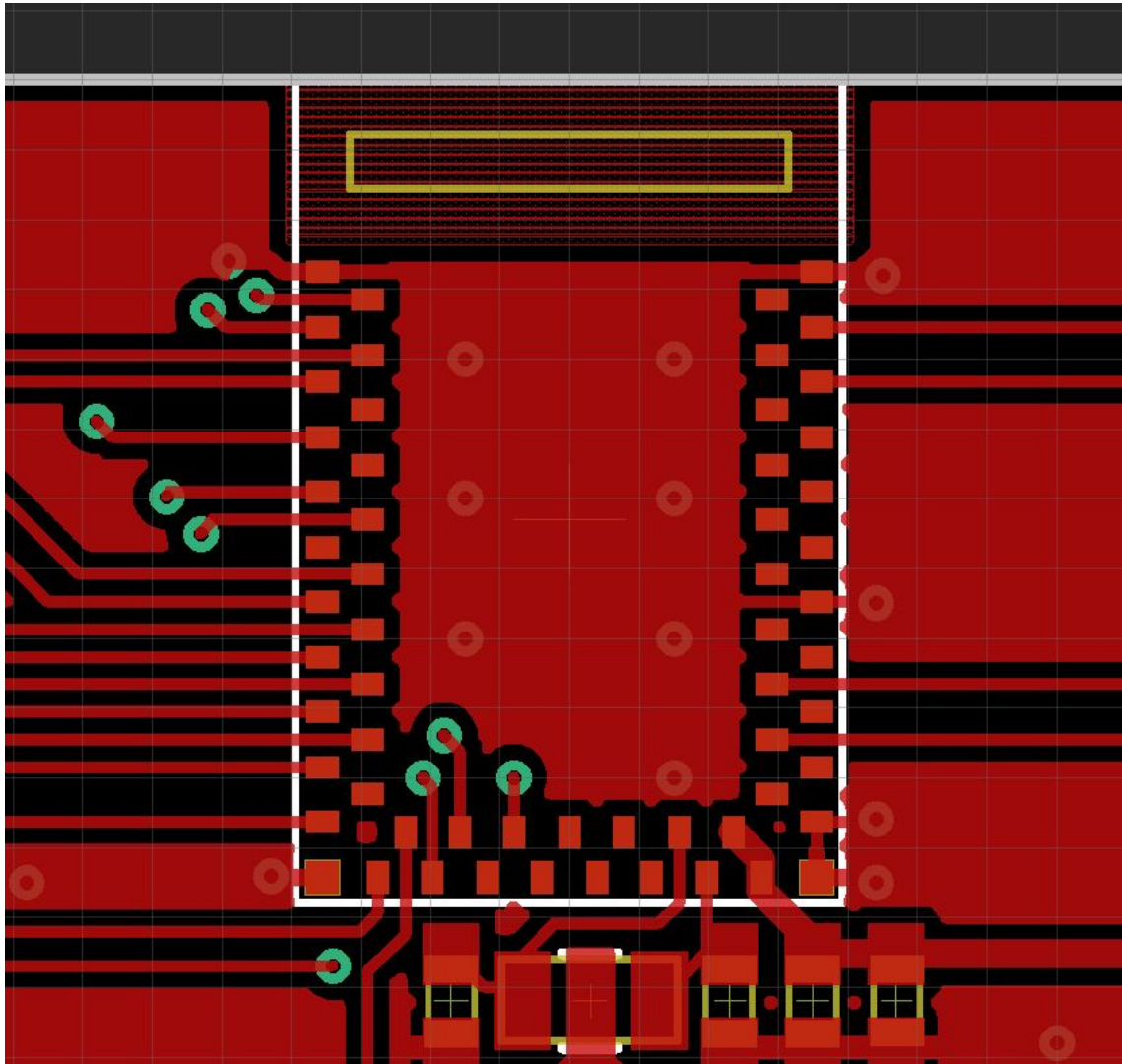
An example layout with ground pour and ground vias

The Artemis module was designed to be implemented onto low cost 2-layer PCBs with easy 8mil trace/space routing. A good ground connection is essential. Routing under the module is allowed. Keep all ground pours away from the antenna area. If mechanical exposure allows for it the antenna can be extended over the edge of the PCB for increased reception.

5. Revision History

Revision	Date	Description
1p0p0	June-2-2019	Initial Release