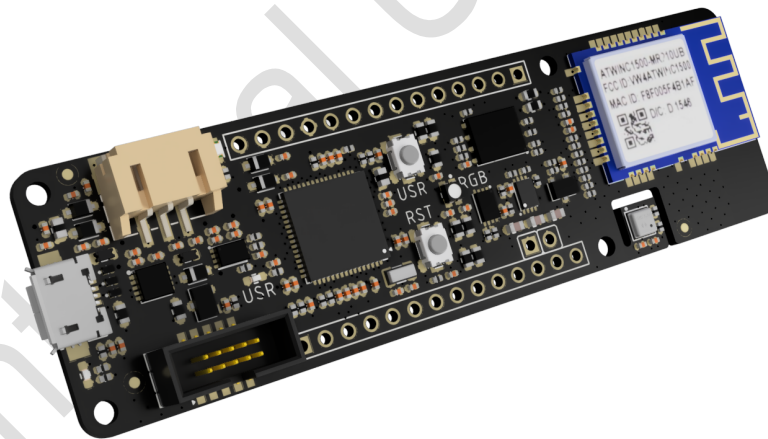


Martinica User Manual

Vacallo, April 19, 2023



All information contained in these materials, including products and product specifications, represents information on the product at the time of publication and is subject to change by BlackIoT Sagl without notice.

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Revisions

REV.	DATE	DESCRIPTION	STATUS	AUTHOR	REVISER
1.0	20220322	First Release	Draft	AU	
1.1	20221023	Added Crypto and other	Draft	AU	
1.2	20230419	Updated Images	Draft	AU	

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Figures

Internal Use Only

Tables

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1 Abstract

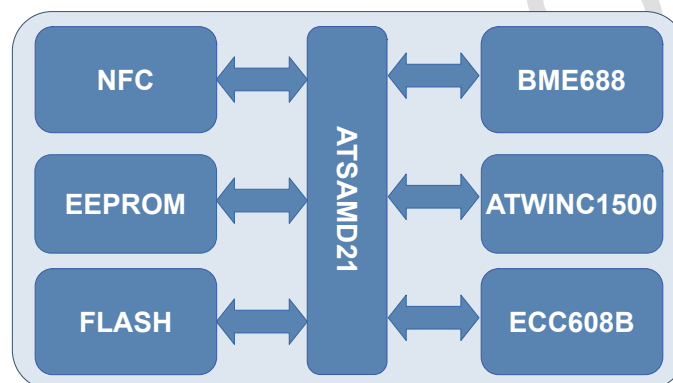
This document describes the Martinica MKR board.

The board is based on:

- ATSAM21 microcontroller
- ATWINC1500 single-band Wi-Fi (802.11 b/g/n)
- ATECC608B CryptoAuthentication™
- BME688 Environmental Sensor with A.I. from Bosch Sensortec

The dimensions and peripheral/pin placement follows the Arduino MKR de-facto standard.

The board can be programmed in the Arduino environment or with Microchip Integrated Development Environment (IDE)



Target application are:

- 24/7 always-on sensor processing at ultra-low power consumption.
- IoT devices
- Sensors Gateway
- Industrial automation, Condition-based monitoring, Security panel, Energy management, Inspection camera, Data logger Building automation
- Smart Home, Thermostat, Air purifier, Air conditioner, Security/monitoring camera, Pet food dispenser

2 Features

The Martinica Arduino MKR form factor board provides an ideal solution for evaluating ATWINC1500 module, ATECC608B CryptoAuthentication™ and Bosch Sensortec BME688 Environmental Sensor.

Hardware Features

MCU Core:

- ARM® Cortex®-M0+ at 48 MHz with 3.3 V power
- 256 kBytes Flash
- 32 kBytes SRAM
- -40 to 85°C operating temperature
- Low power modes
- Idle and standby sleep modes
- USB native support, comes with USB bootloader and serial port debugging
- Hardware Serial, hardware I2C, hardware SPI support
- 8 x PWM pins
- 10 x analog inputs
- 1 x analog output
- SleepWalking peripheral

ATWINC1500 WiFi Module:

- IEEE® 802.11 b/g/n 20 MHz (1x1) solution
- Single spatial stream in 2.4 GHz ISM band
- Integrated Transmit/Receive switch
- Superior sensitivity and range via advanced PHY signal processing
- Wi-Fi® Direct (supported till firmware release 19.5.2)
- Soft-AP support
- Supports IEEE 802.11 WEP, WPA, WPA2 security
- Support Enterprise security with WPA/WPA2 (802.1X)(1)
 - EAP-TLS
 - EAP-PEAPv0/1 with TLS
 - EAP-TTLSv0 with MSCHAPv2

- EAP-PEAPv0/1 with MSCHAPv2
- SPI host interface

ATECC608B CryptoAuthentication™

- Cryptographic co-processor with secure hardware-based key storage
- Protected storage for up to 16 Keys, certificates or data
- ECDH: FIPS SP800-56A Elliptic Curve Diffie-Hellman (ECDH)
- NIST standard P256 elliptic curve support (ECC)
- Hardware support for symmetric algorithms
- SHA-256 & HMAC hash including off-chip context save/restore
- AES-128: encrypt/decrypt, galois field multiply for GCM
- Networking key management support

BME688 Sensor from Bosch Sensortec with A.I.:

- Temperature
- Pressure
- Humidity
- Indoor Air Quality
- Host Interface: SPI

M24SR64 EEPROM External Memory/NFC:

- NFC Forum Type 4 Tag
- ISO/IEC 14443 Type A
- I2C Host Interface
- 8-Kbyte (64-kbit) EEPROM
- Support of NDEF data structure
- Data retention: 200 years

SST26VF064B FLASH External Memory

- 8 Mbyte Memory (NOR)
- Additional 4K bits secured OTP
 - Features unique identifier
 - Factory locked identifiable and customer lockable
- SPI Host Interface

- Low Power Consumption
- Typical 100,000 erase/program cycles
- 20 years data retention

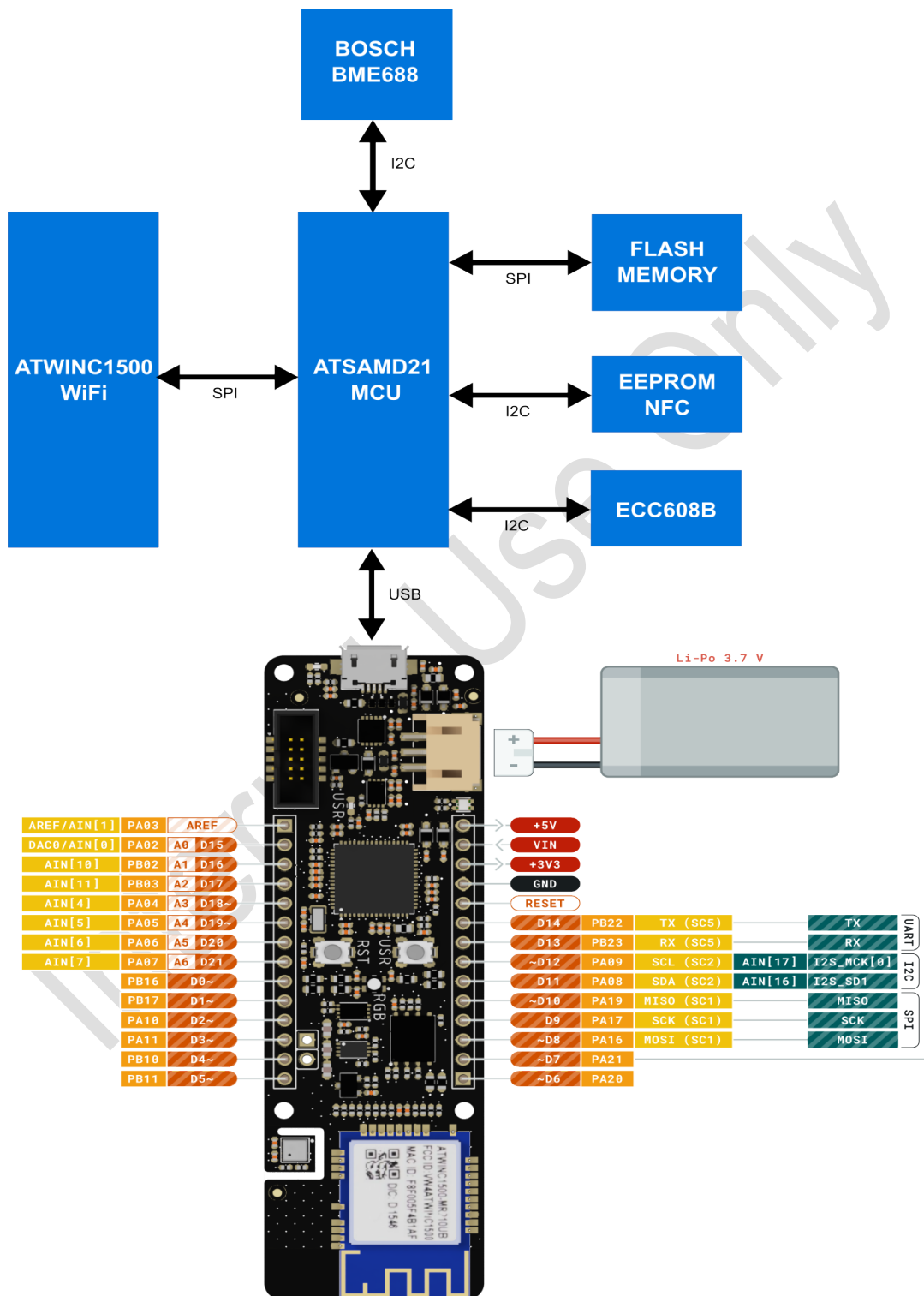
Power Supply:

- from the USBs connections (+5V dc)
- from the VIN pin (+5V dc)
- from a LiPo battery using dedicated connector
- built-in LiPo battery charger (Microchip MCP73833)

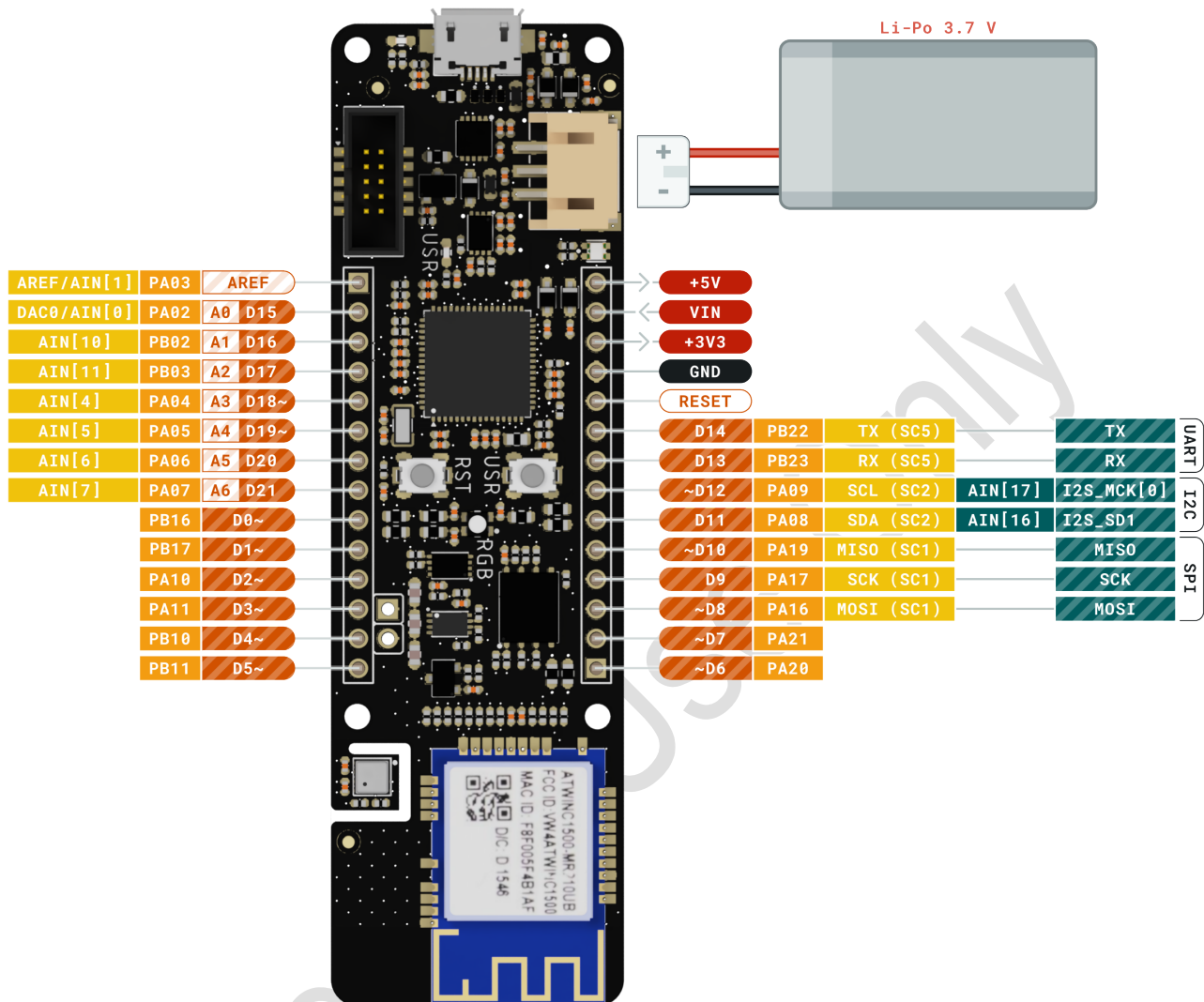
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2.1 Board Layout

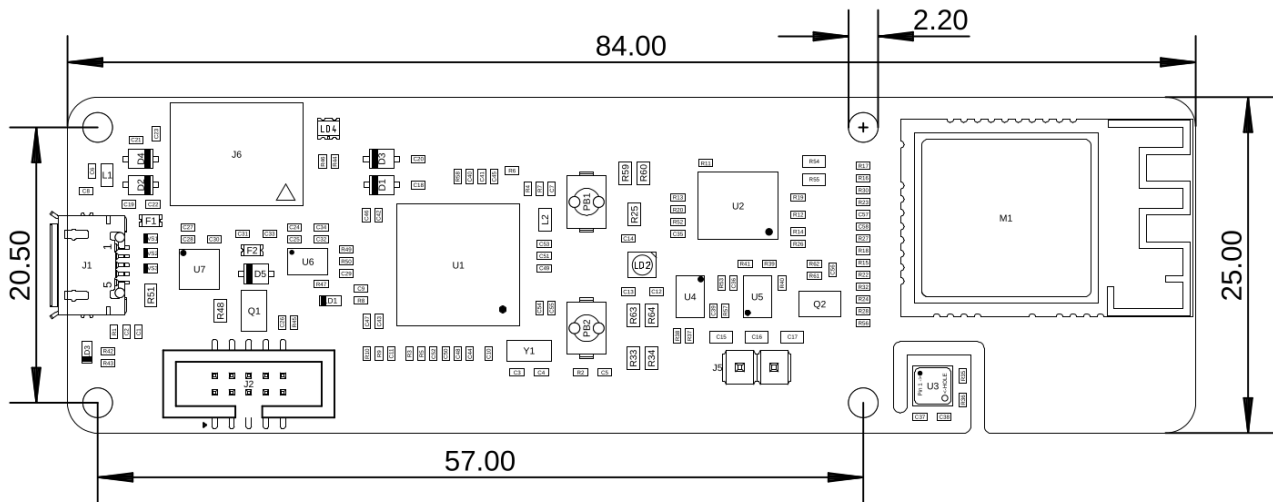
2.1.1 Functional Diagram



2.1.2 Pinout



2.1.3 Dimensional Drawing



Internal Use

3 Software Support

To run examples and Demo Application you must install the following libraries using the library manager:

- Arduino Low Power Library & RTCZero
- WiFi101
- BME68x
- STM32Duino M24SR64-Y
- PubSubClient
- ArduinoECCX08

3.1 MCU

The board is supported by the Arduino IDE for SAMD M0+ processors.

The Arduino IDE Board Manager package is available in support repository.

3.2 WiFi

The on-board WiFi module is supported by the software libraries provided by Arduino.

The Arduino IDE Library manager package is available in arduino library: WiFi101

3.3 Sensors

The on-board WiFi module is supported by the software libraries provided by Bosch Sensortec.

The Arduino IDE Library manager package is available from the Bosch Sensortec website:

<https://www.bosch-sensortec.com/software-tools/software/bme688-software/>

3.4 EEPROM/NFC

The onboard EEPROM/NFC is supported by library package STM32Duino M24SR64-Y

3.5 Crypto Chip

The onboard crypto-chip is supported by Arduino Library ArduinoECCX08

WARNING: Address for ATECC608B-TFLXTLS-PROTO is 0x36 (7bit)

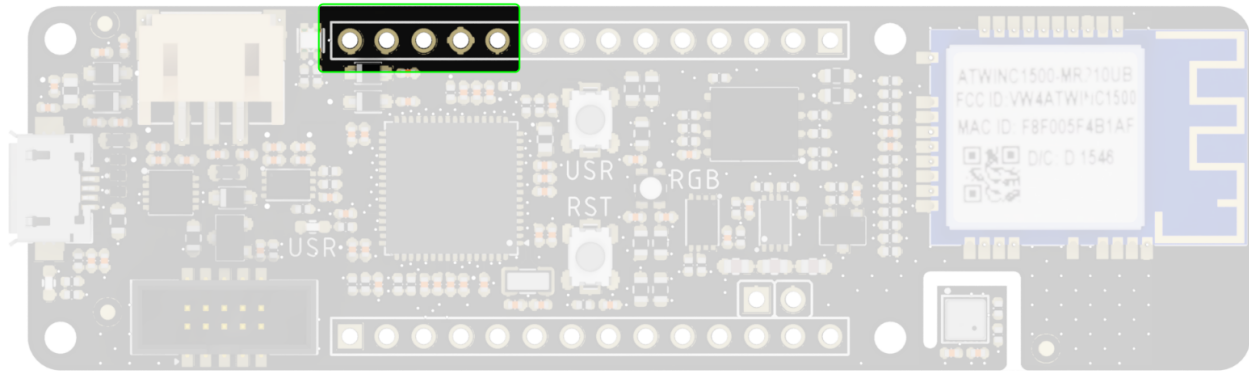
Must be changed in library /libraries/ArduinoECCX08/src/ECCX08.cpp at end of file:

```
#ifdef CRYPTO_WIRE
    ECCX08Class ECCX08(CRYPTO_WIRE, 0x36);
#else
    ECCX08Class ECCX08(Wire, 0x36);
#endif
```

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4 Hardware Description

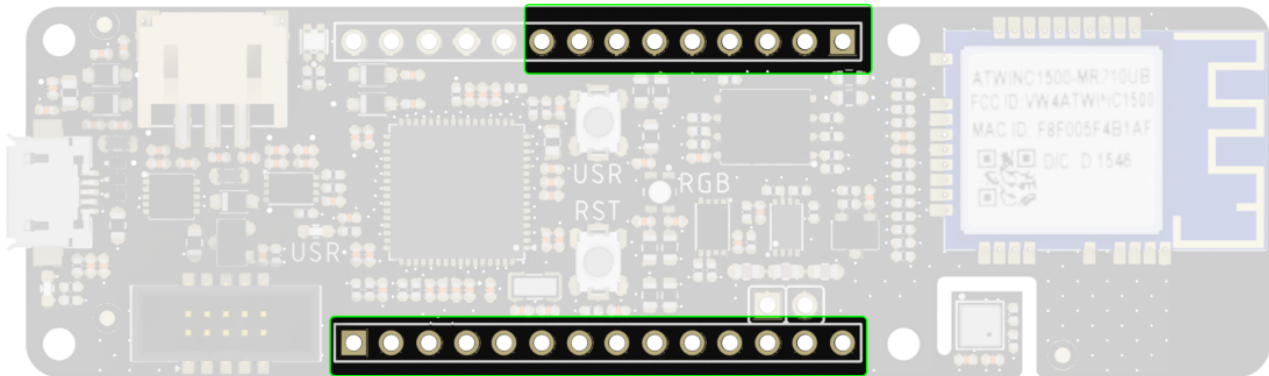
4.1 Power Pins



From left to right

Name	Description
+5V	This is the output from USB/VIN power supply
VIN	Power input
+3V3	Output from 3V3 regulator, ca output XXX mA
GND	Common Ground
RESET	nReset

4.2 Logic Pins



from left to right, lower connector first

Name	MCU Pin	Description
AREF	PA03	Analog reference pin. Normally the reference voltage is the same as the chip logic voltage (3.3V) but if an alternative analog reference is needed, this pin can be connected to the external reference voltage. AREF voltage must be lower than 3.3V. Alternative function: Analog Input
A0/D15	PA02	Analog Input/Analog Output/Digital IO
A1/D16	PB02	Analog Input/Digital IO
A2/D17	PB03	Analog Input/Digital IO
A3/D18	PA04	Analog Input/Digital IO/PWM Out
A4/D19	PA05	Analog Input/Digital IO/PWM Out
A5/D20	PA06	Analog Input/Digital IO
A6/D21	PA07	Analog Input/Digital IO
D0	PB16	Analog Input/Digital IO/PWM Out *
D1	PB17	Analog Input/Digital IO/PWM Out **
D2	PA10	Analog Input/Digital IO/PWM Out
D3	PA11	Analog Input/Digital IO/PWM Out
D4	PB10	Analog Input/Digital IO/PWM Out
D5	PB11	Analog Input/Digital IO/PWM Out
D6	PA20	Digital IO/PWM Out
D7	PA21	Digital IO/PWM Out
D8	PA16	Digital IO/PWM Out/SPI MOSI
D9	PA17	Digital IO/SPI SCK

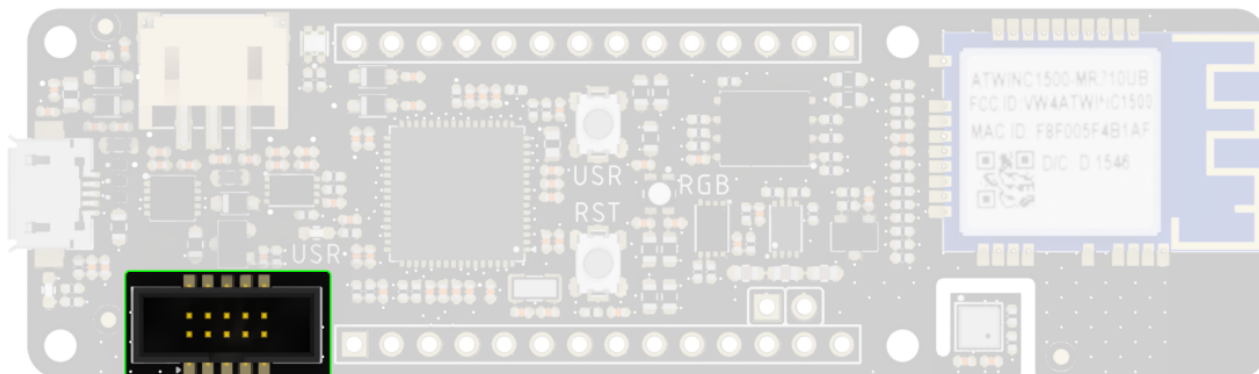
D10	PA19	Digital IO/PWM Out/SPI MISO
D11	PA08	Digital IO/I2C SDA
D12	PA09	Digital IO/I2C SCL
D13	PB23	Digital IO/UART RX
D14	PB22	Digital IO/UART TX

* PA22 in original Arduino schematics

** PA23 in original Arduino schematics

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4.3 Program/Debug connector Pins



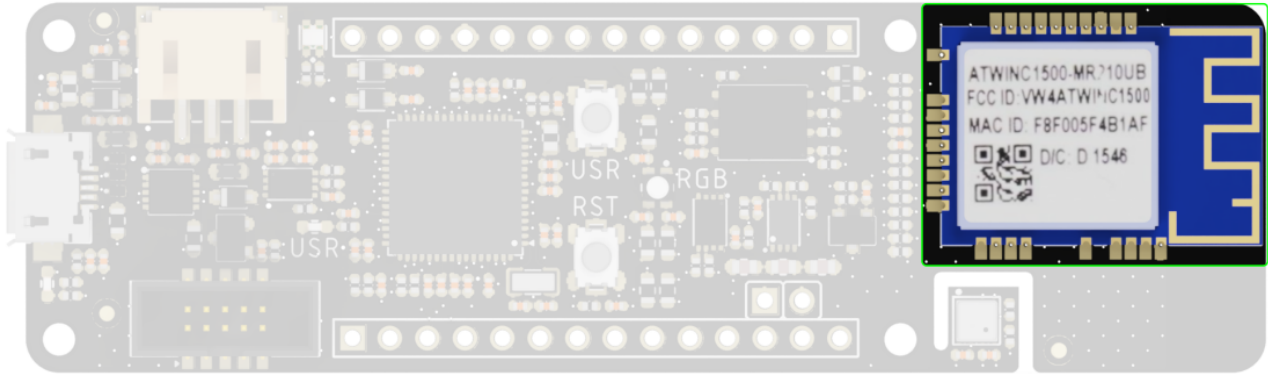
Cortex Debug
10-pin Connector



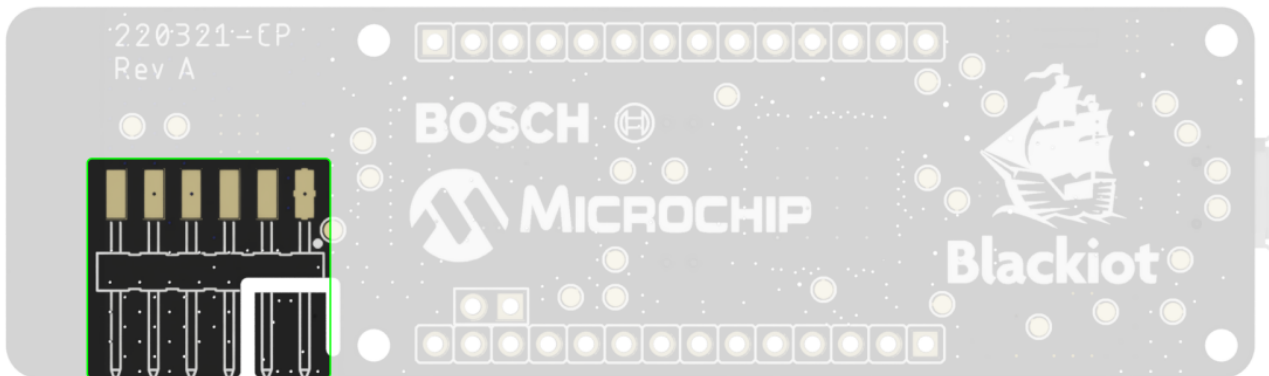
Name	Pin #	Description
VTref	1	Target Voltage
SWDIO	2	Debugger I/O
GND	3,5	Power input
SWCLK	4	Debugger Clock
SWO	6	Not connected
TDI	8	Not connected
GNDDetect	9	Not connected
nRESET	10	Target Reset

4.4 WiFi Module Pins

The wifi module is connected on SERCOM2



Name	MCU Pin	Arduino Pin	Arduino Name	Description
EN	PB06	31	WINC1501_CHIP_EN_PIN	Chip Enable
IRQn	PA15	29	WINC1501_INTN_PIN	IRQ from WiFi Module
MISO	PA14	28	PIN_SPI1_MISO	MISO (SERCOM2 SPI)
MOSI	PA12	26	PIN_SPI1_MOSI	MOSI (SERCOM2 SPI)
SCK	PA13	27	PIN_SPI1_SCK	SCK (SERCOM2 SPI)
CS	PB04	30	PIN_SPI1_SS WINC1501_SPI_CS_PIN	CS
WAKE			NC	
RESETn	PA28	32	WINC1501_RESET_PIN	RESETn

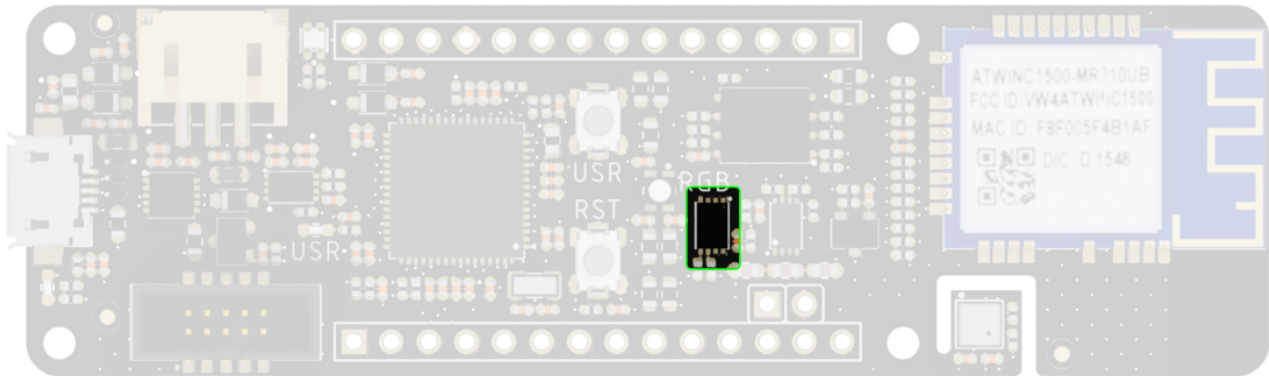


Pin 1 is right pin in image.

Name	Pin	Description
GND	1	Ground
	2	N.C.
	3	N.C.
RXD	4	Pin 14 UART_TXD
TXD	5	Pin 19 UART_RXD
	6	N.C.

4.5 ATECC608B CryptoAuthentication™

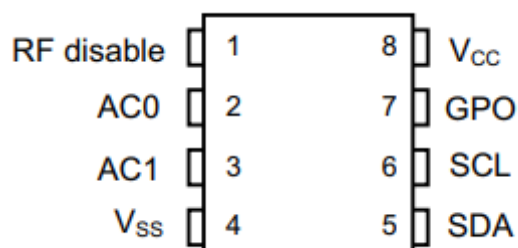
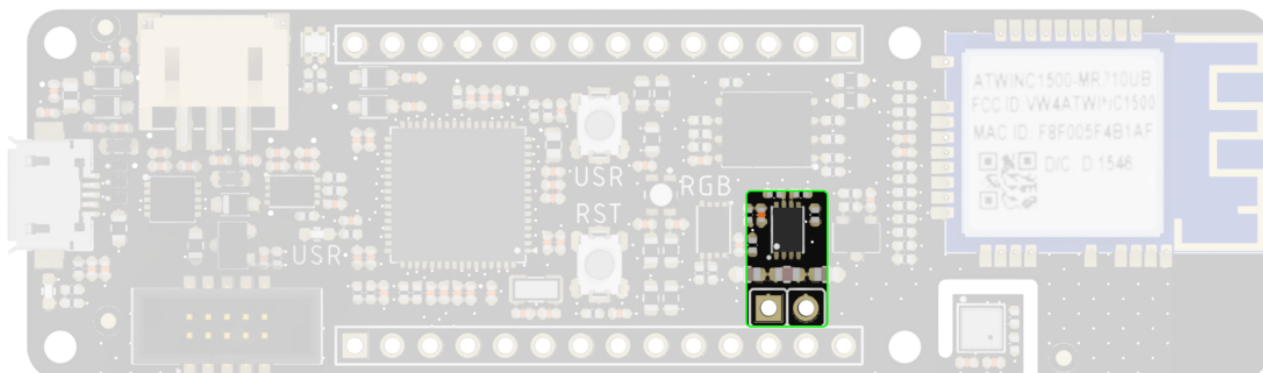
Crypto chip is connected to SERCOM3 as I2C @ address: 0x36



Name	MCU Pin	Arduino Pin	Arduino Name	Description
SCL	PA23	42	PIN_WIRE1_SCL	I2C Serial Clock
SDA	PA22	41	PIN_WIRE1_SDA	I2C Serial Data

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4.6 EEPROM/NFC Pins

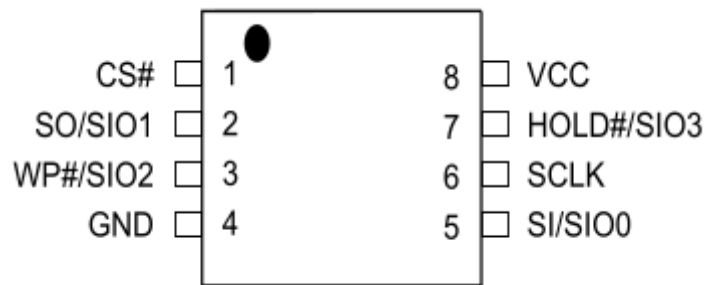
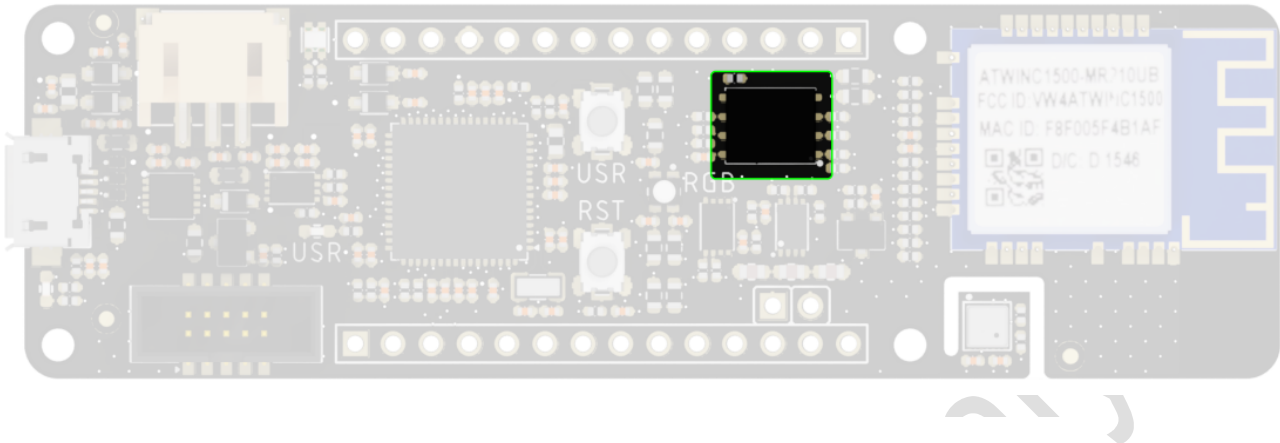


ST M24SR64-YMC6T/2 on SERCOM3 as I2C @ address:

Name	MCU Pin	Arduino Pin	Arduino Name	Description
SCL	PA23	42	PIN_WIRE1_SCL	I2C Serial Clock
SDA	PA22	41	PIN_WIRE1_SDA	I2C Serial Data
GPO	PB01	43	NFC_INT	Interrupt Output

PTH 2 pin connector for NFC Antenna connection

4.7 FLASH Memory Pins

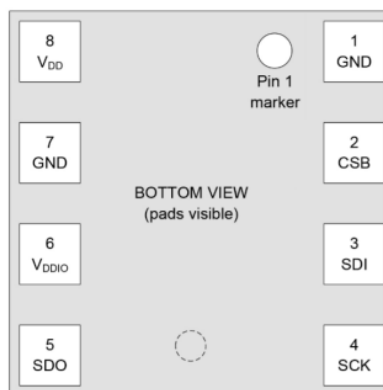
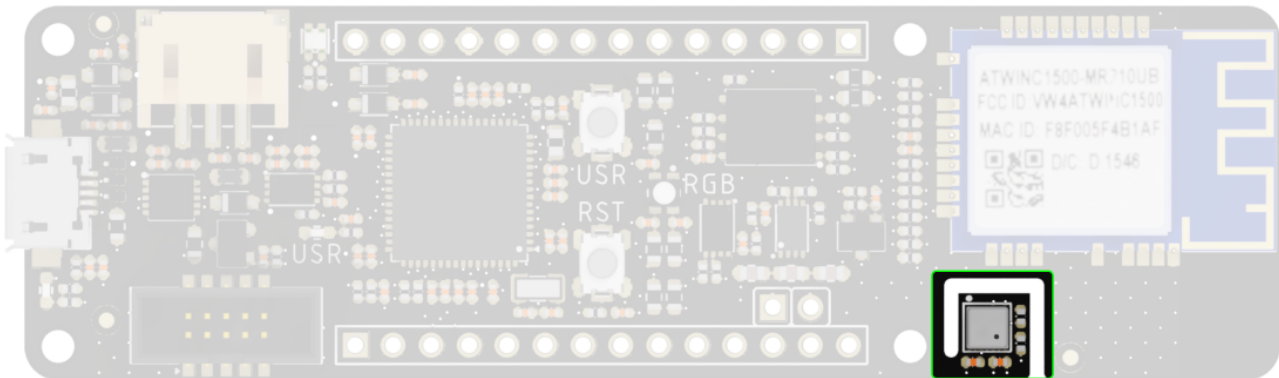


Macronix MX25L3233FM2I-08Q on SERCOM4 SPI

Name	MCU Pin	Arduino Pin	Arduino Name	Description
CS#	PB15	37	PIN_SPI2_SS	Chip Select
SI/SIO0	PB12	34	PIN_SPI2_MOSI	Serial Data Input (for 1xI/O)/ Serial Data Input & Output (for 2xI/O mode and 4xI/O mode)
SO/SIO1	PB14	36	PIN_SPI2_MISO	Serial Data Output (for 1xI/O)/Serial Data Input & Output (for 2xI/O mode and 4xI/O mode)
SCLK	PB13	35	PIN_SPI2_SCK	Clock Input
WP#/ SIO2	NC			Write protection Active Low or Serial Data Input & Output (for 4xI/O mode)
HOLD#/ SIO3	NC			To pause the device without deselecting the device or Serial data Input/Output for 4 x I/O mode
VCC				Power Supply
GND				Ground
NC				No Connection

4.8 BME688 Sensor

Bosch Sensortech BME688 on SERCOM3 as I2C device @ address 0x76

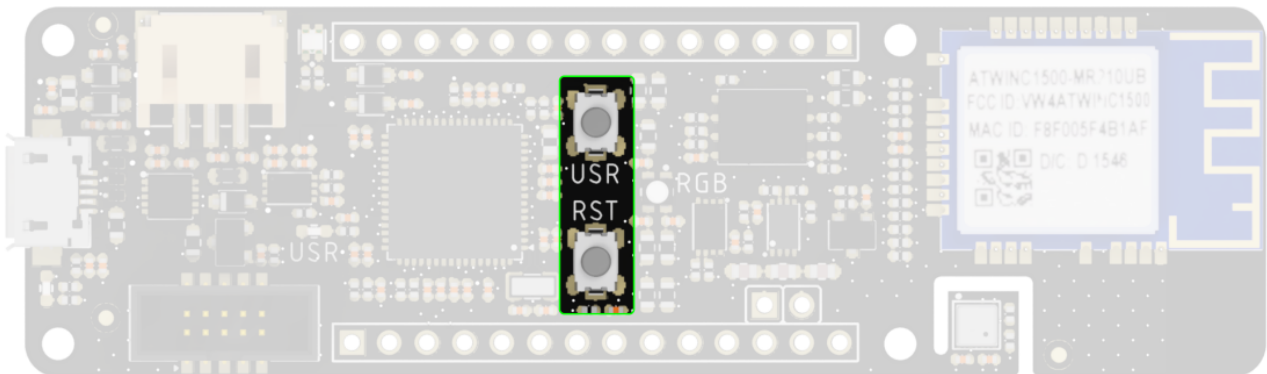


Name	Sensor Pin	MCU Pin	Pin	Description
GND	1	GND		Ground
CSB	2	CSx	3v3	Connected to VDD selects I2C
SDI	3	MOSI	PA22	Serial Data Input (SPI)
SCK	4	SCK	PA23	Serial Clock (SPI)
SDO	5	MISO	GND	Serial Data Output (SPI)
V _{DDIO}	6	V _{DD}	3v3	Digital Supply
GND	7	GND		Ground
V _{DD}	8	V _{DD}	3v3	Analog Supply

WARNING: CSB, V_{DD} and V_{DDIO} are connected to 3v3 if MCU PB05 is RESET (LOW) .

Name	MCU Pin	Arduino Pin	Arduino Name	Description
CS#	PB05	45	BME_OFF	Turns ON/OFF the BME688 sensor

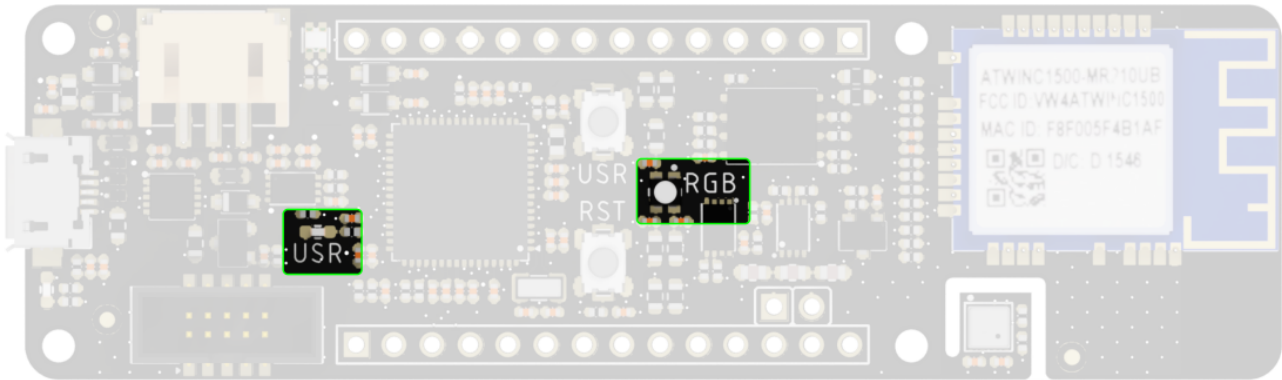
4.9 Buttons



USR Button on top of image, RST Button at bottom.

Name	MCU Pin	Arduino Pin	Arduino Name	Description
USR Button	PB09	44	USER_BUTTON, BUTTON_PIN	Pin RESET when button pressed
RST Button	nRST			

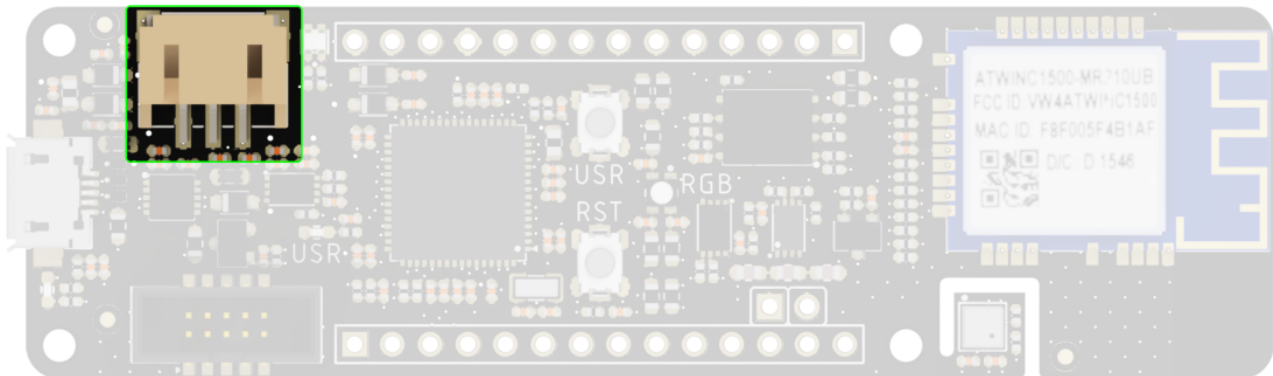
4.10 LEDs



USR Led at left in image, RGB Led at right in image.

Name	MCU Pin	Ardui no Pin	Arduino Name	Description
USR Led - RED	PA27	33	LED_BUILTIN, PIN_LED	Led ON if pin RESET
RGB Led - RED	PB30	38	LED_R, PIN_LED_R	Led ON if pin RESET
RGB Led - GREEN	PB31	39	LED_G, PIN_LED_G	Led ON if pin RESET
RGB Led - BLUE	PA18	24	LED_B, PIN_LED_B	Led ON if pin RESET

4.11 Battery Connector Pins



Pin 1 is right pin in image.

Name	Pin #	Description
VBAT	1	Battery +
THERM	2	Battery's NTC
GND	3	Battery -

Use Li-Ion battery $V_{nom} = 3.7V$, $V_{chg} = 4.2V$ Capacity ≥ 700 mAh

Li-Po batteries are charged at 4,2V with a current that is usually half of the nominal capacity (C/2). This board has a specialized chip that has a preset charging current of 350mAh. This means that the MINIMUM capacity of the Li-Po battery shall be 700 mAh. Smaller cells will be damaged by this current and may overheat, develop internal gasses and explode, setting on fire the surroundings. We strongly recommend that you select a Li-Po battery of at least 700mAh capacity. A bigger cell will take more time to charge, but won't be harmed or overheated.

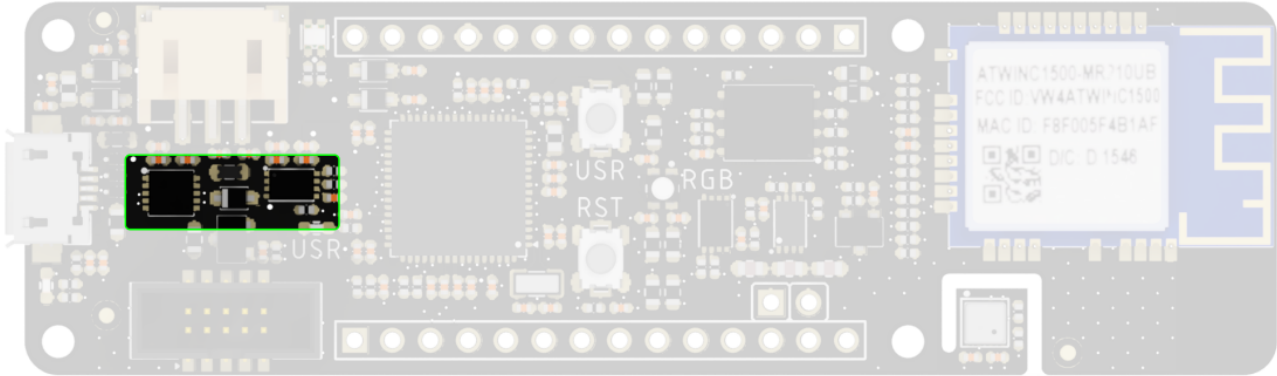
4.12 Battery Monitoring

Battery voltage can be monitored on MCU Pin PB00, Arduino pin 40. Arduino name ADC_BATTERY.

Voltage is scaled $316/(115+316) = 0,733$,

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4.13 Power Supply



Power Supply is based on MCP1725-3302 (LDO) at right and MCP73833 (Battery Charger) at left, both from Microchip.

MCP1725-3302 Features:

- 500 mA Output Current Capability
- Input Operating Voltage Range: 2.3V to 6.0V
- Low Dropout Voltage: 210 mV typical at 500 mA
- Typical Output Voltage Tolerance: 0.5%
- Fast response to Load Transients
- Low Supply Current: 120 μ A (typical)
- Low Shutdown Supply Current: 0.1 μ A (typical)

MCP73833 Features:

- Complete Linear Charge Management Controller
 - Integrated Pass Transistor
 - Integrated Current Sense
 - Integrated Reverse Discharge Protection
- Constant Current / Constant Voltage Operation with Thermal Regulation
- High Accuracy Preset Voltage Regulation: - 4.2V, 4.35V, 4.4V, or 4.5V, + 0.75%
- Programmable Charge Current: 1A Maximum
- Cell Temperature Monitor
- Low-Dropout Linear Regulator Mode
- Automatic Power-Down when Input Power Removed
- Under Voltage Lockout

5 References

5.1 MCU

<https://www.microchip.com/en-us/product/ATsamd21g18>

5.2 WiFi

<https://www.microchip.com/en-us/product/ATWINC1500>

5.3 Sensor

<https://www.bosch-sensortec.com/products/environmental-sensors/gas-sensors/bme688/>

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