table of contents

1 The Hypatia Board

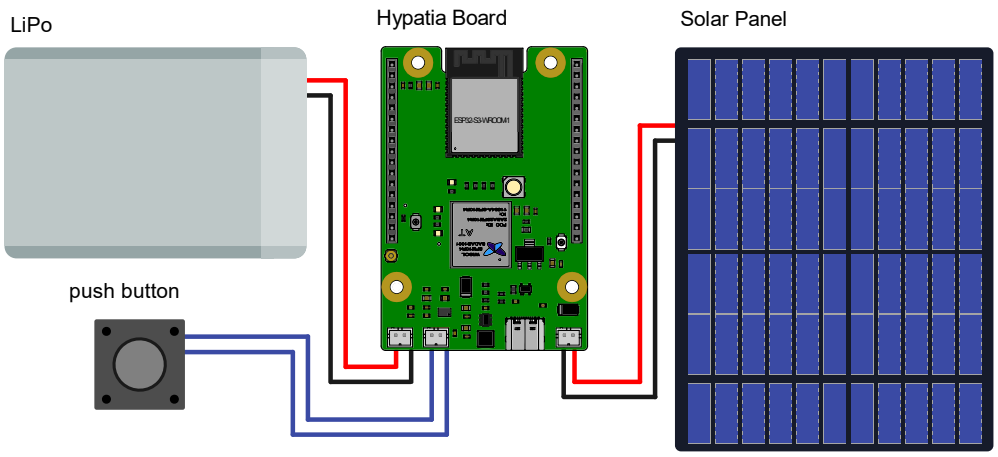

Figure 1

2 Description

The Hypatia Board is a versatile solution designed for IoT applications and beyond. Powered by Espressif's flagship microcontroller, the ESP32-S3, it is available in two versions: one with an external antenna (IPEX) and another with an integrated antenna.

In addition to the powerful ESP32-S3, the board features an integrated LoRa-Sigfox module (LSM100A), which can be easily managed via AT commands through a serial interface.

The Hypatia Board includes a circuit for managing the charging of a LiPo battery, with a dedicated connector. The power section is optimized for LiPo, but it also operates seamlessly with USB power (5V). Furthermore, a separate connector allows for the connection of a small solar panel to charge the battery.

A WS2812 RGB LED offers quick visual diagnostics for the board's status, providing clear feedback during operation.

The ESP32-S3's USB connection supports both firmware programming and power supply for the board.

The Hypatia Board is equipped with breakout pins, laid out in a 2.54mm grid, offering extensive flexibility for a variety of use cases. This allows for compatibility with breakout boards and shields, extending its functionality with additional peripherals, such as LTE modules or stepper motor drivers.

3 Features

3.1 Overview

- ESP32-S3 series of SoCs embedded, Xtensa® dual-core 32-bit LX7 microprocessor (with single precision FPU), up to 240 MHz
- 384 KB ROM
- 512 KB SRAM
- 16 KB SRAM in RTC
- Up to 16 MB PSRAM

3.2 Wi-Fi

- 802.11 b/g/n
- Bit rate: 802.11n up to 150 Mbps
- A-MPDU and A-MSDU aggregation
- 0.4 µs guard interval support
- Center frequency range of operating channel: 2412 ~ 2484 MHz

3.3 Bluetooth

- Bluetooth LE: Bluetooth 5, Bluetooth mesh
- Speed: 125 Kbps, 500 Kbps, 1 Mbps, 2 Mbps
- Advertising extensions
- Multiple advertisement sets
- Channel selection algorithm #2
- Internal co-existence mechanism between Wi-Fi and Bluetooth to share the same antenna

4 Setup

To load the Code, the board must be set in download mode by holding down the Boot-switch and pressing the reset switch once, the options on the IDE must be set as shown in the picture below. After each upload of new code, the board must be reset.

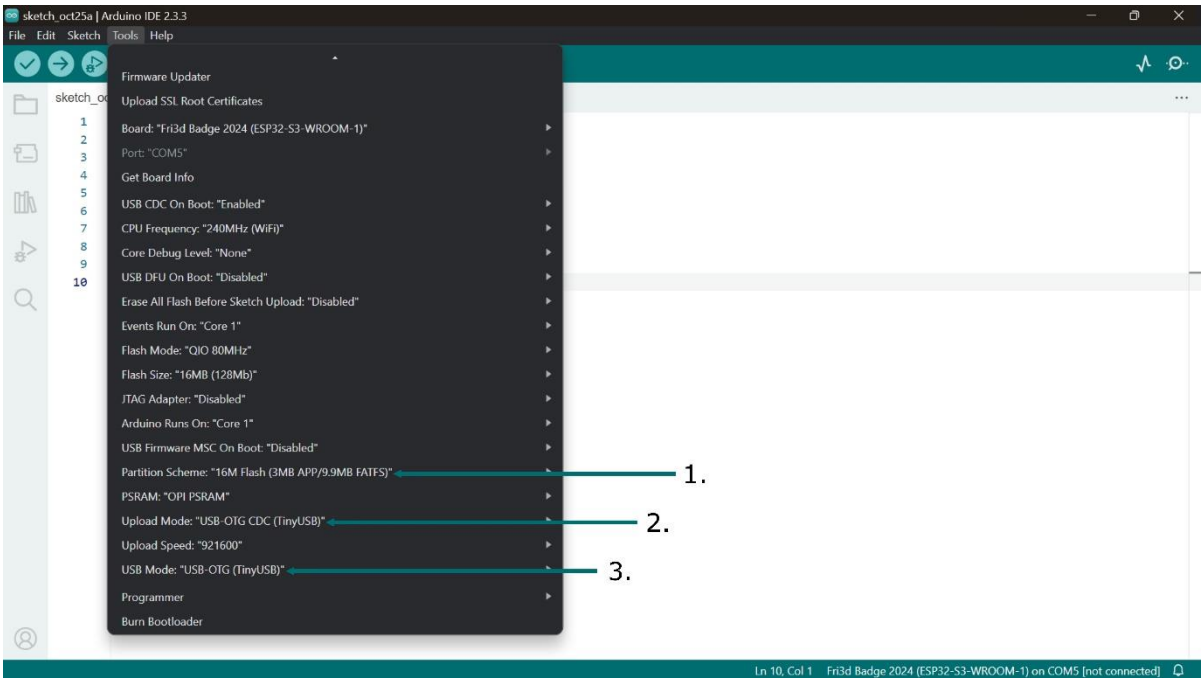

Figure 2

5 The board

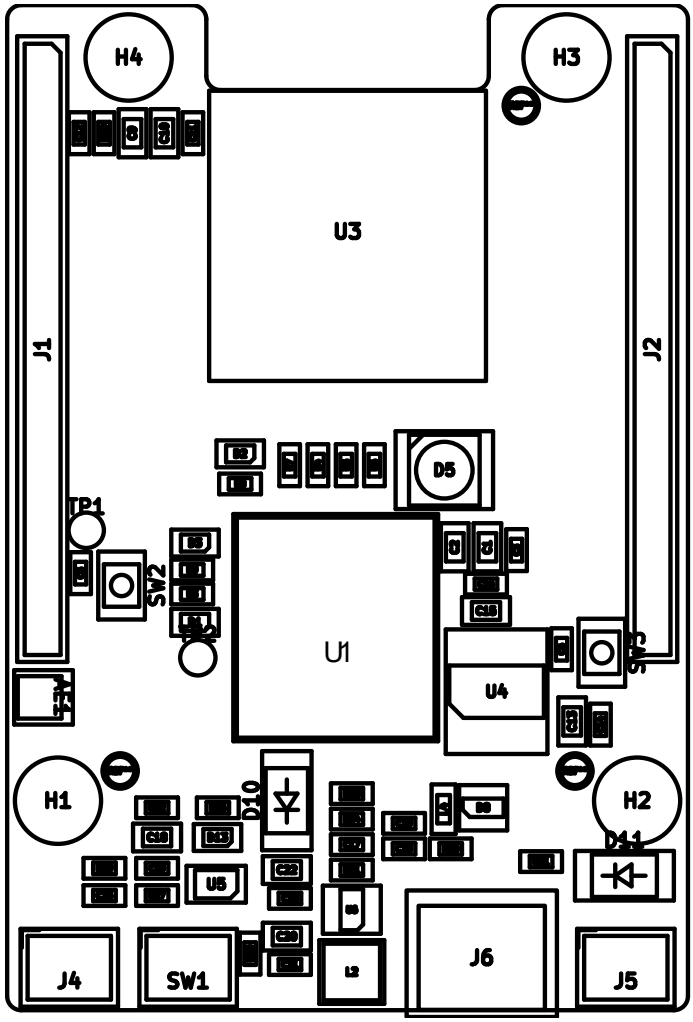

Figure 3

Ref.	Description
J1	
J2	
J4	Power Supply Battery
J6	USB-C Port
U1	LSM100A
U3	ESP32-S3-WROOM-1
U4	AMS1117-3.3
U5	MC34673
U6	TLV61046ADB
U7	
SW1	external Switch SW_DIP_x01
SW2	Reset Switch SW_Push
SW3	Boot Switch SW_Push

D1	
D2	
D3	
D5	RGB LED WS282B
D8	
D10	
D11	
D13	
AE1	Sigfox Antenna
H1	Mounting Hole
H2	Mounting Hole
H3	Mounting Hole
H4	Mounting Hole
TP1	/
TP2	/
L2	
L4	
R	

6 Power consumption

Symbol	Description	Type	Value	Unit
BATT	Input supply from Battery	JST	4.2	V
	Input supply from USB	USB-C	5.0	V
FV	Input supply from Solar Pannel	JST	5.0	V

7 Pinout

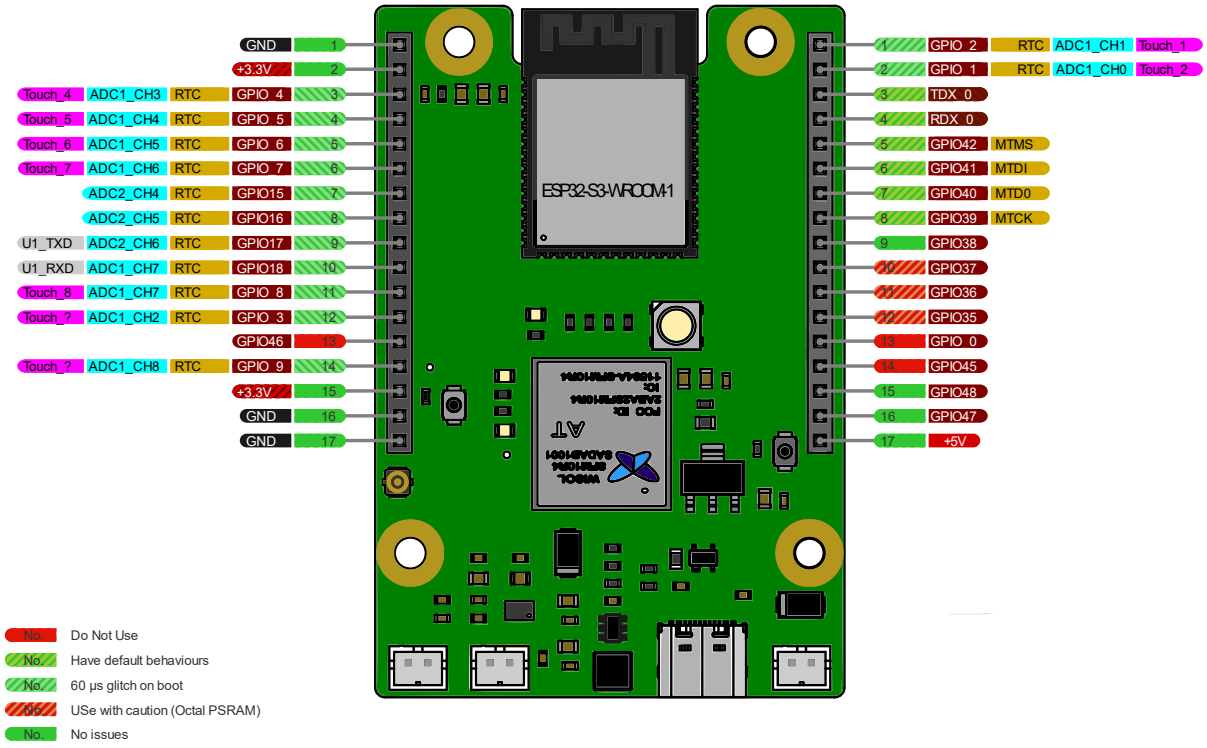

Figure 4

Pin J1	Function	Description
1	GND	GND
2	+3.3V	Power supply
3	GPIO 4	RTC_GPIO4,GPIO4,TOUCH4,ADC1_CH3
4	GPIO 5	RTC_GPIO5,GPIO5,TOUCH5,ADC1_CH4
5	GPIO 6	RTC_GPIO6,GPIO6,TOUCH6,ADC1_CH5
6	GPIO 7	RTC_GPIO7,GPIO7,TOUCH7,ADC1_CH6
7	GPIO 15	RTC_GPIO15,GPIO15,U0RTS,ADC2_CH4,XTAL_32K_P
8	GPIO 16	RTC_GPIO16,GPIO16,U0CTS,ADC2_CH5,XTAL_32K_N
9	GPIO 17	RTC_GPIO17,GPIO17,U1TXD,ADC2_CH6
10	GPIO 18	RTC_GPIO18,GPIO18,U1RXD,ADC2_CH7,CLK_OUT3
11	GPIO 8	RTC_GPIO8,GPIO8,TOUCH8,ADC1_CH7,SUBSPICS1
12	GPIO 3	RTC_GPIO3,GPIO3,TOUCH3,ADC1_CH2
13	GPIO 46	GPIO46
14	GPIO 9	RTC_GPIO9,GPIO9,TOUCH9,ADC1_CH8,FSPIHD,SUBSPIHD
15	+3.3 V	Power supply
16	GND	GND
17	GND	GND

Pin J2	Function	Description
1	GPIO 1	RTC_GPIO1,GPIO1, TOUCH1, ADC1_CH0
2	GPIO 2	RTC_GPIO2,GPIO2, TOUCH2, ADC1_CH1
3	TXD0	RTC_GPIO17,GPIO17,U1TXD,ADC2_CH6
4	RXD0	RTC_GPIO18,GPIO18,U1RXD,ADC2_CH7,CLK_OUT3
5	GPIO 42	MTMS,GPIO42
6	GPIO 41	MTDI,GPIO41, CLK_OUT1
7	GPIO 40	MTDO,GPIO40,CLK_OUT2
8	GPIO 39	MTCK,GPIO39,CLK_OUT3, SUBSPICS1
9	GPIO 38	GPIO38,FSPIWP, SUBSPIWP
10	GPIO 37	SPIDQS,GPIO37,FSPIQ, SUBSPIQ
11	GPIO 36	SPIIO7,GPIO36,FSPICLK,SUBSPICLK
12	GPIO 35	SPIIO6,GPIO35,FSPID,SUBSPID
13	GPIO 0	RTC_GPIO0,GPIO0
14	GPIO 45	GPIO45
15	GPIO 48	SPICLK_N_DIFF,GPIO48,SUBSPICLK_N_DIFF
16	GPIO 47	SPICLK_P_DIFF,GPIO47,SUBSPICLK_P_DIFF
17	+ 5V	

8 Mounting Holes and Board Outline

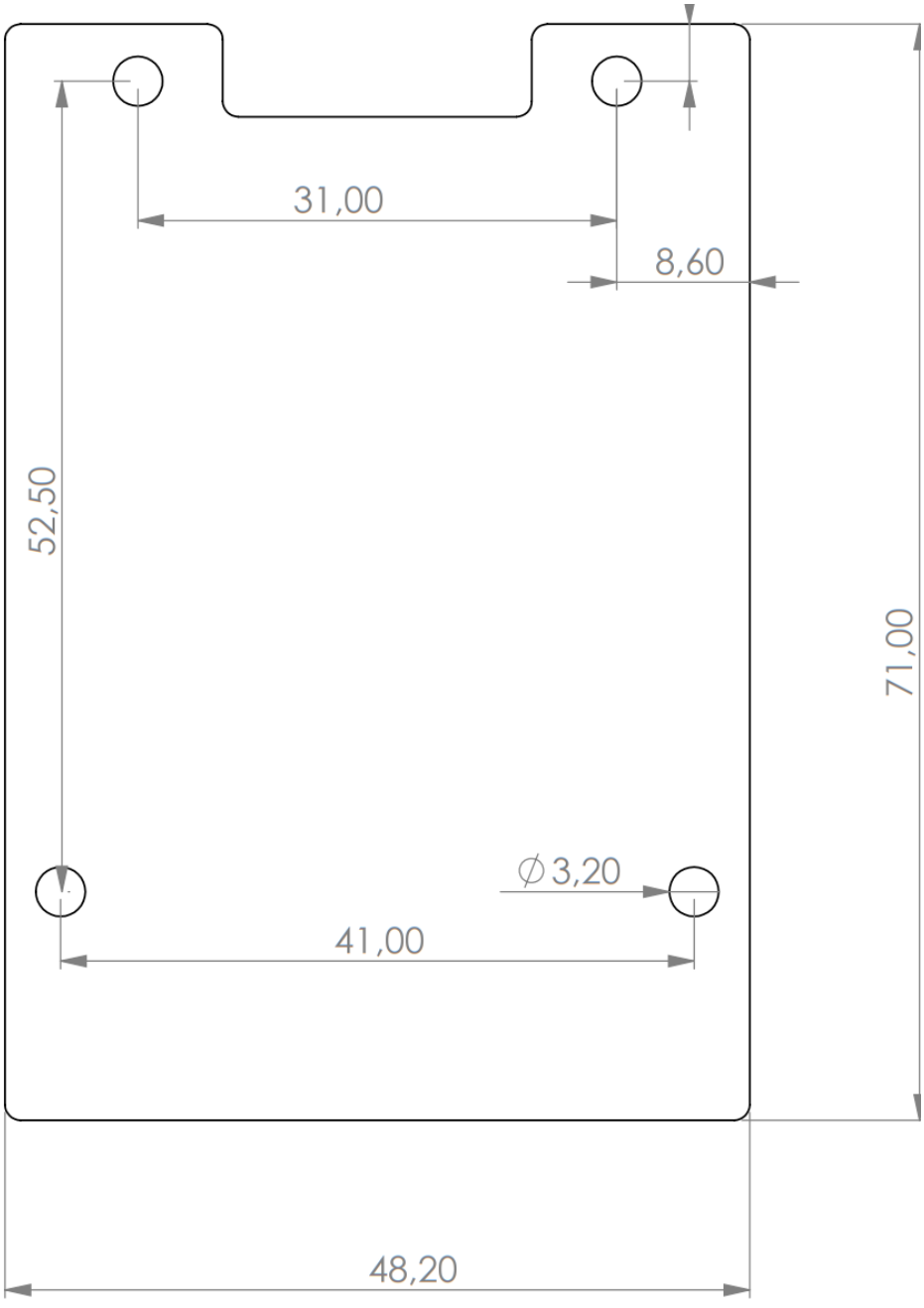

Figure 5

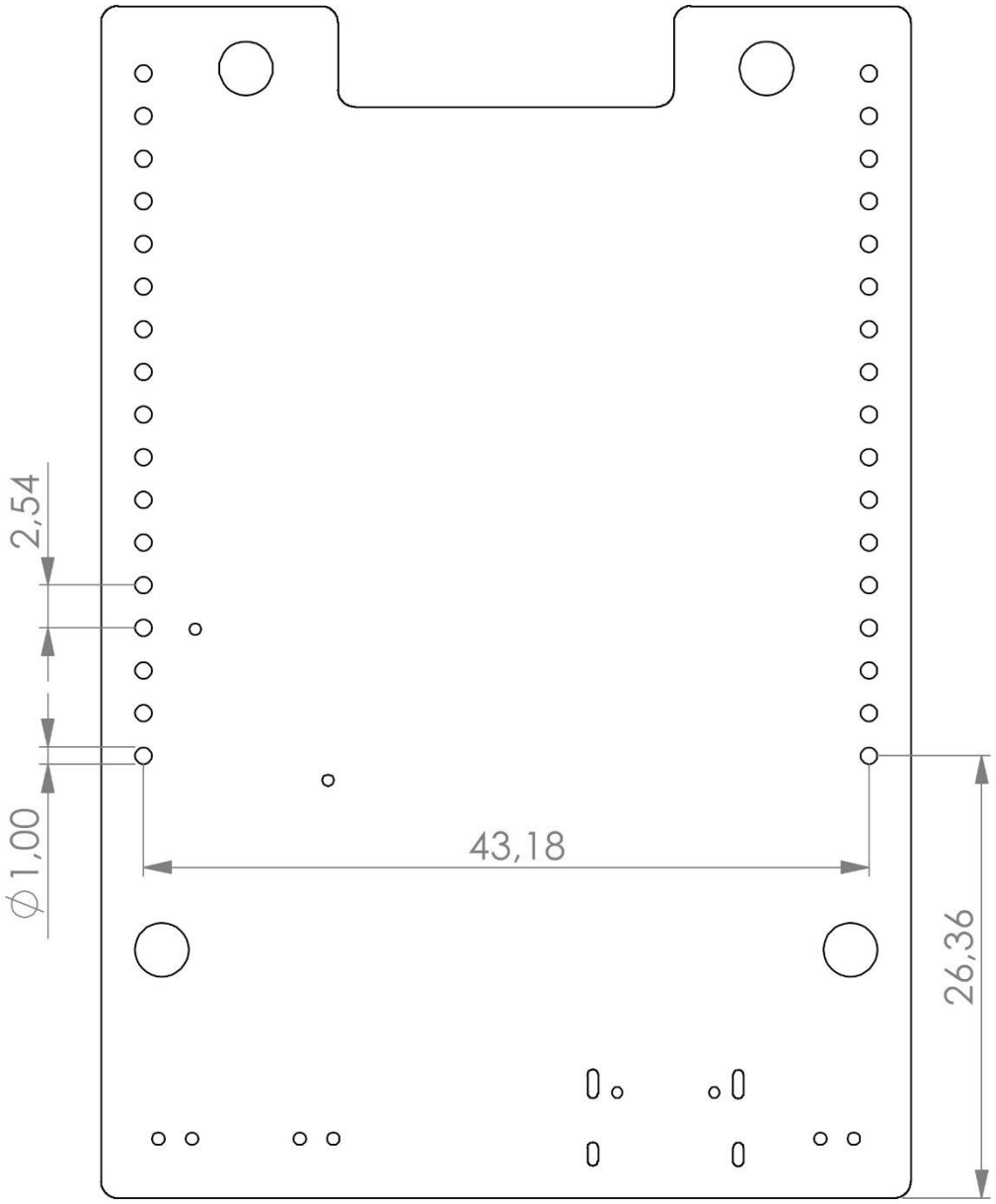

Figure 6

9 Overview

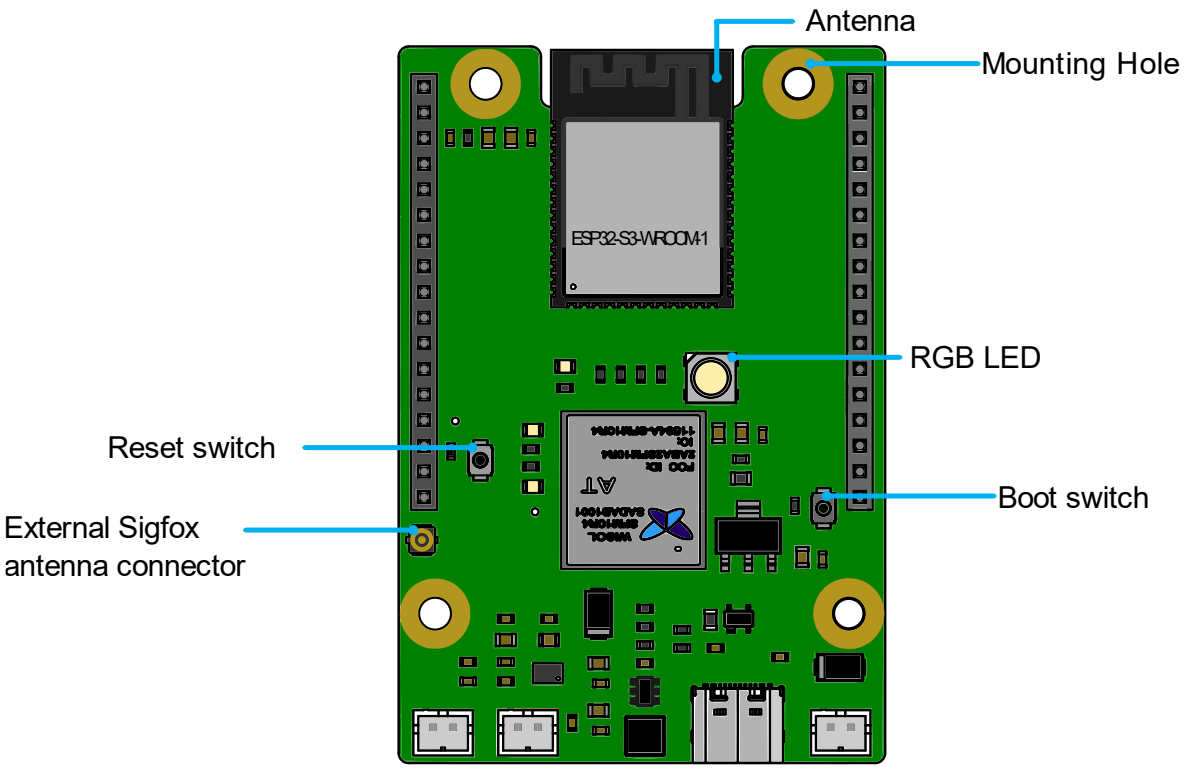

Figure 7

10 control of integrated components

10.1 WS2812B RGBLed

This code snippet demonstrates how to control a single WS2812B RGB LED using the Adafruit NeoPixel library. It is designed for an Arduino environment, utilizing the specified GPIO pin 21 for data transmission to the LED.

```
#include <Adafruit_NeoPixel.h>

// Define the pin to which the WS2812B LED is connected
#define LED_PIN    21

// We only have one LED
#define NUM_LEDS   1

// Create a NeoPixel object
Adafruit_NeoPixel strip = Adafruit_NeoPixel(NUM_LEDS, LED_PIN, NEO_GRB + NEO_KHZ800);

void setup() {
  // Initialize the LED
  strip.begin();
  strip.show(); // Make sure all LEDs are off
}

void loop() {
  // Set the LED to red
  strip.setPixelColor(0, strip.Color(255, 0, 0));  // red
  strip.show();
  delay(50);  // wait for one second

  // Set the LED to green
  strip.setPixelColor(0, strip.Color(0, 255, 0));  // green
  strip.show();
  delay(50);  // wait for one second

  // Set the LED to blue
  strip.setPixelColor(0, strip.Color(0, 0, 255));  // blue
  strip.show();
  delay(50);  // wait for one second

}
```

10.2 Battery

With the help of the integrated voltage divider, the battery voltage can be read from the Arduino.

```
const int pinVoltage = 10; // GPIO 10 pin for the voltage divider
const float referenceVoltage = 3.3; // Reference Voltage of the ESP32-S3 (in volts)
const float dividerFactor = 2.0; / / Voltage divider ratio (R27 = 100 kΩ, R29 = 100 kΩ)

void setup() {
  Serial.begin(115200); // Serial communication
  Serial.println("Battery voltage measurement with ESP32-S3 started...");
}

void loop() {
// 1. Read the raw value from the ADC (ESP32 returns values between 0 and 4095)
  int rawValue = analogRead(pinVoltage);

  // 2. Calculate the measured voltage
  float measuredVoltage = rawValue * (referenceVoltage / 4095.0);

  // 3. Calculate the actual battery voltage (considering the voltage divider)
  float batteryVoltage = measuredVoltage * dividerFactor;

  // 4. Output the results to the serial monitor
  Serial.print("ADC-Wert: ");
  Serial.print(rawValue); // ADC value

  Serial.print(" | Gemessene Spannung (V): ");
  Serial.print(measuredVoltage, 2); // Voltage at the voltage divider in volts

  Serial.print(" | Batteriespannung (V): ");
  Serial.print(batteryVoltage, 2); // Actual battery voltage in volts

  Serial.println(); // Line break

  delay(1000); // Wait 1 second
}
```

10.3 LSM100A

Pin ESP	Function Sigfox	Pin LSM100A	Description
GPIO 11	Sigfox-RST	30	NRST
GPIO 12	Sigfox-GPIO	6	RF-BUSY
GPIO 13	Sigfox-TX	14	USART2_TX
GPIO 14	Sigfox-RX	13	USART2_RX

PIN	PIN Name	PIN Type	MCU Pin	Description
1	GND	Ground	-	Ground
2	PB2	I/O	PB2	General purpose IO, selectable ADC functionality
3	PA9	I/O	PA9	General purpose IO, selectable I2C (SCL) functionality
4	PA10	I/O	PA10	General purpose IO, selectable I2C (SDA) functionality
5	PA11	I/O	PA11	General purpose IO, selectable I2C2 (SDA) functionality
6	PA12	I/O	PA12	General purpose IO, selectable I2C2 (SCL) functionality
7	PA13	I/O	PA13	Serial-Wire Debug Data (FW Download)
8	PA14	I/O	PA14	Serial-Wire Debug Clock (FW Download)
9	PA15	I/O	PA15	General purpose IO
10	GND	Ground	-	Ground
11	VDD	P	-	Power Supply (+1.8V ~ +3.6V)
12	GND	Ground	-	Ground
13	PA3	I/O	PA3	USART2 RX Data
14	PA2	I/O	PA2	USART2 TX Data
15	PA1	I	PA1	Wake-up, General purpose IO
16	PA0	I/O	PA0	General purpose IO
17	PB8	I/O	PB8	General purpose IO
18	PB7	I/O	PB7	USART1 RX Data
19	PB6	I/O	PB6	USART1 TX Data
20	GND	Ground	-	Ground
21	PB3	I/O	PB3	General purpose IO
22	PB4	I/O	PB4	General purpose IO
23	GND	Ground	-	Ground
24	PA8	I/O	PA8	General purpose IO
25	PA7	I/O	PA7	General purpose IO
26	PB5	I/O	PB5	General purpose IO, selectable SPI1 MOSI functionality
27	PA6	I/O	PA6	General purpose IO, selectable SPI1 MISO functionality
28	PA5	I/O	PA5	General purpose IO, selectable SPI1 SCK functionality
29	PA4	I/O	PA4	General purpose IO, selectable SPI1 NSS functionality
30	NRST	I/O	NRST	IC Reset
31	BOOT	I/O	BOOT0	IC BOOT0 (Internal pull-down 10Kohm resistor)
32	GND	Ground	-	Ground
33	RFOUT	A	-	RF input/output
34	GND	Ground	-	Ground

11 Block Diagram

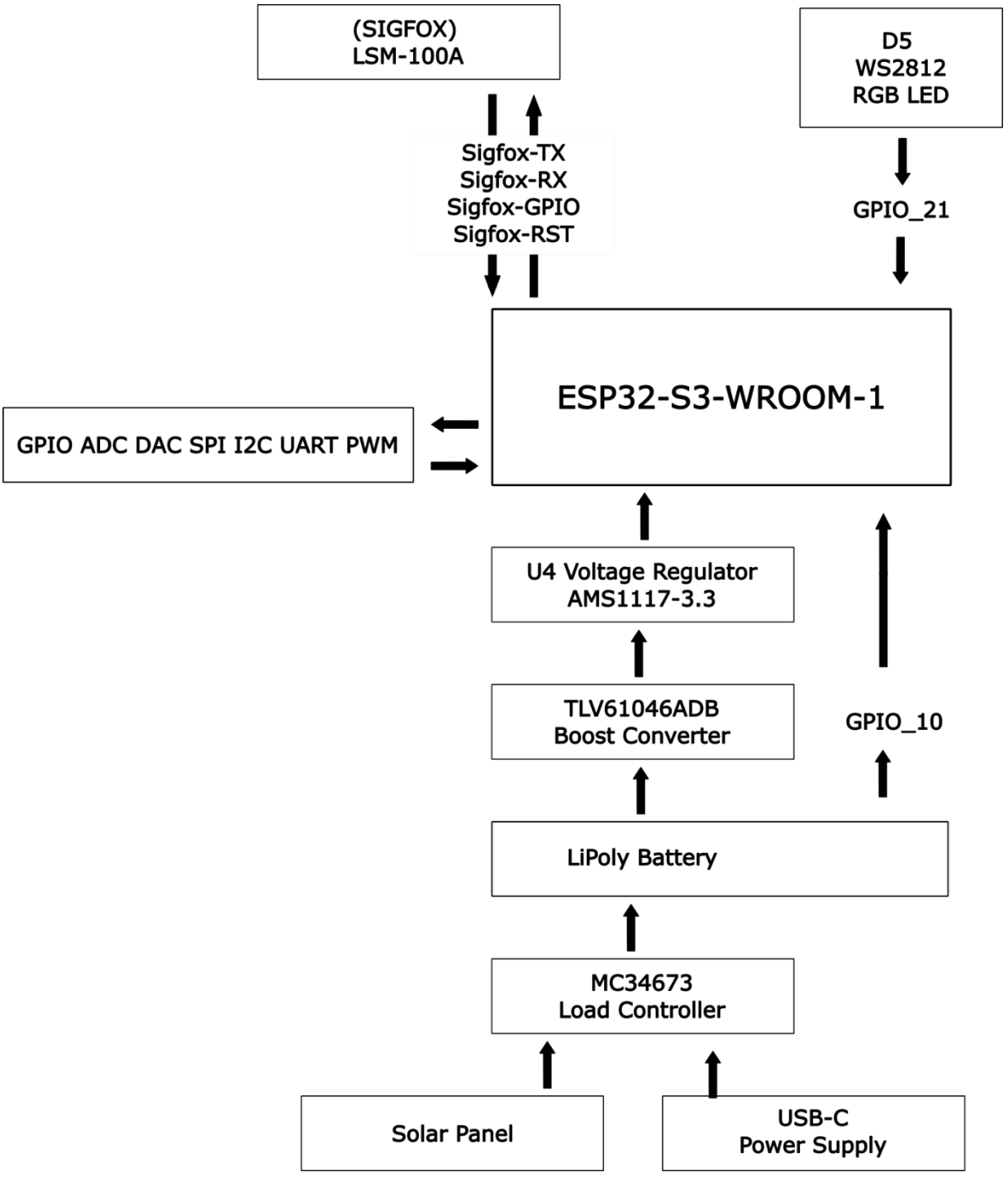

Figure 8