KAMAMI

KAmod ESP32 C3

Rev. 20260404124330
Źródło: https://wiki.kamamilabs.com/index.php?title=KAmod_ESP32_C3

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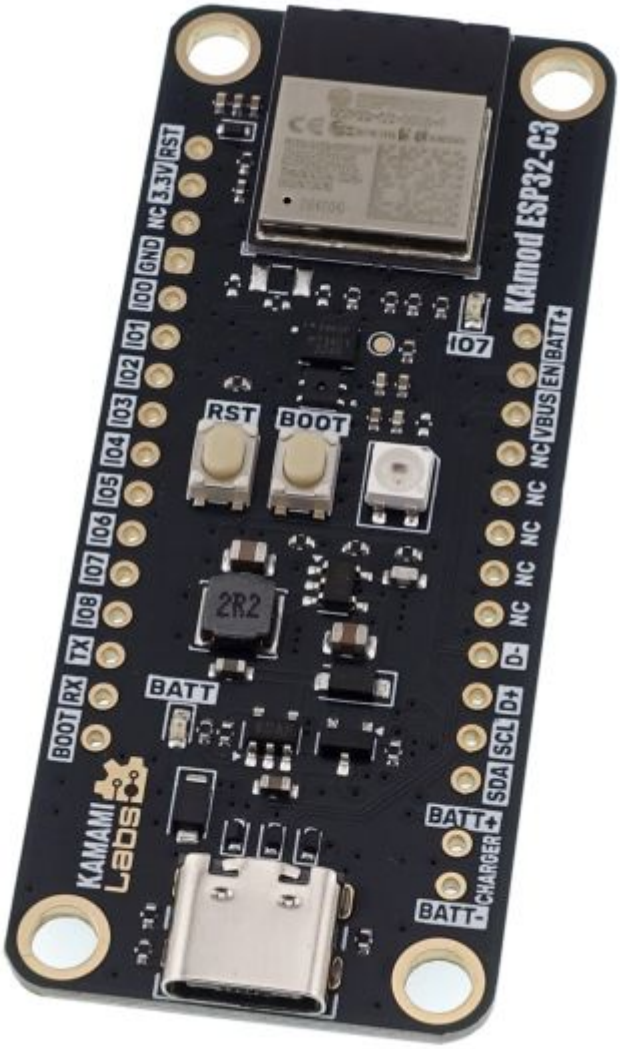
Description

KAmod ESP32-C3 - Development board with ESP32-C3 Mini-1 module
The KAmod ESP32-C3 board features the ESP32-C3 Mini-1 module from Espressif, which contains a 32-bit, single-core SoC microcontroller based on the RISC-V architecture. It includes Wi-Fi and Bluetooth 5 (LE) radio interfaces with Long Range (LR) mode support.

The MCU operates at a maximum clock frequency of 160 MHz and is equipped with 400 kB of RAM and 4 MB of Flash memory. It supports low power consumption modes, operates in temperatures from -40 to +85°C, and implements security features such as Secure Boot and Flash encryption with AES-128/256-XTS. These extensive specifications make it ideal for industrial and IoT applications. Additionally, the board includes a high-precision SHTC3 temperature and humidity sensor, an ICM42670 MEMS sensor (3-axis gyroscope and 3-axis accelerometer), a WS2812 RGB LED, and a standard LED connected to one of the microcontroller ports. These components facilitate the rapid building of diverse applications.

The module is powered by +5V via a USB-C connector or by a Li-Ion battery. The +3.3 V voltage for the microcontroller and peripherals is generated by a SY8088 Buck DC/DC converter (input range 2.5–5 V). If USB-C power is disconnected, power is automatically drawn from the battery (if connected). The power system includes an MCP7381 Li-Ion battery charger powered via USB-C.

The KAmod ESP32-C3 module is designed for developing and testing applications in the Arduino environment (C/C++) as well as in Rust.



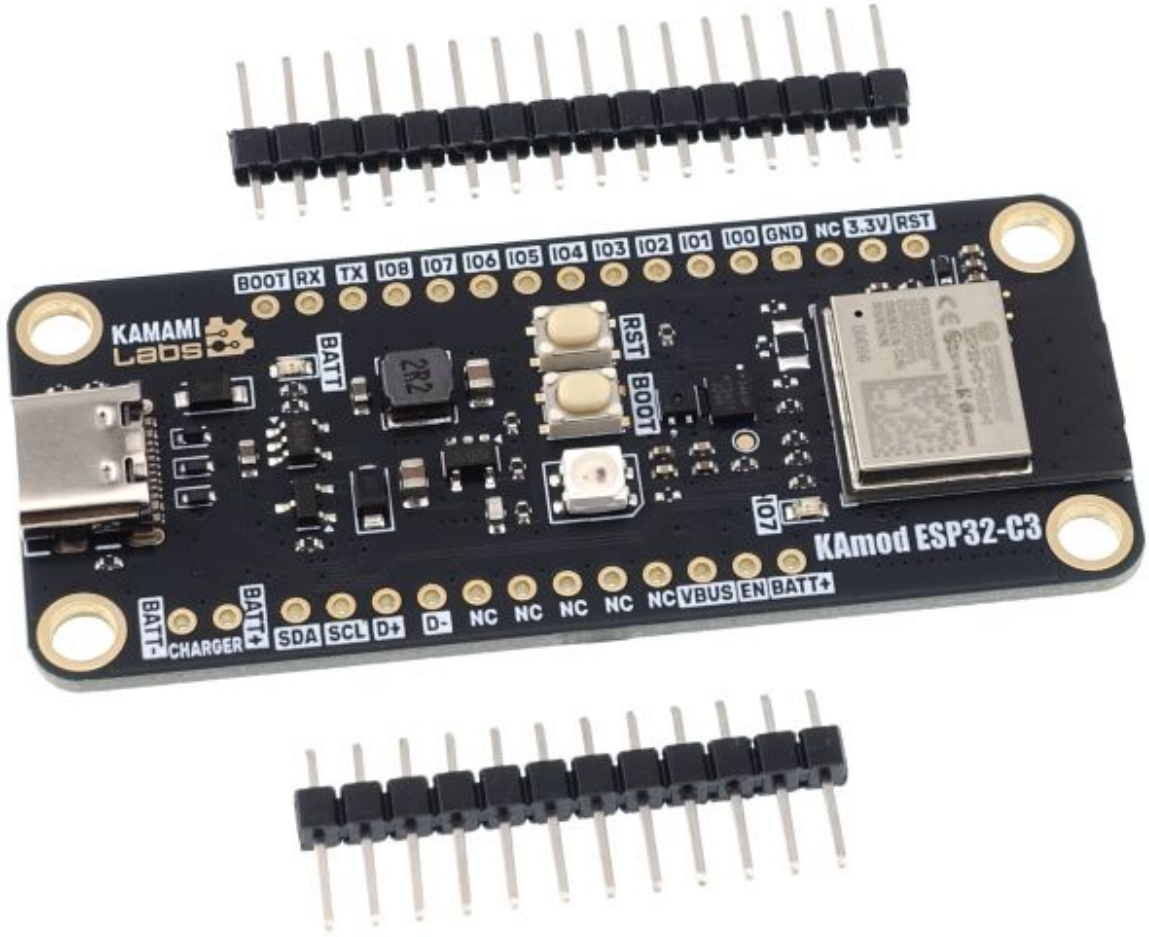
Key Features and Parameters

- ESP32C3 Mini-1 Module (Wi-Fi 802.11 b/g/n, Bluetooth 5 LE)
- 32-bit RISC-V single-core MCU @ 160 MHz, 400 kB SRAM, 4 MB Flash
- 15 GPIO lines
- Communication interfaces: SPI, I2C, I2S, UART, USB
- 12-bit SAR ADC (up to 6 channels)
- ICM42670 Accelerometer/Gyroscope
    - 3-axis MEMS gyroscope (X, Y, Z angular rate)
    - 3-axis MEMS accelerometer (X, Y, Z axis)
    - Communication interface: I2C
- SHTC3 Thermometer/Hygrometer
    - Humidity range: 0...100%RH (+/- 2% accuracy)
    - Temperature range: -40 to +125 °C (+/-0.2°C accuracy from 0°C to +60°C)
    - Communication interface: I2C
- SY8088 DC/DC Converter
- MCP73831 Li-Ion Battery Charger
- Programmable WS2812 RGB LED
- USB-C Connector
    - +5V Power supply

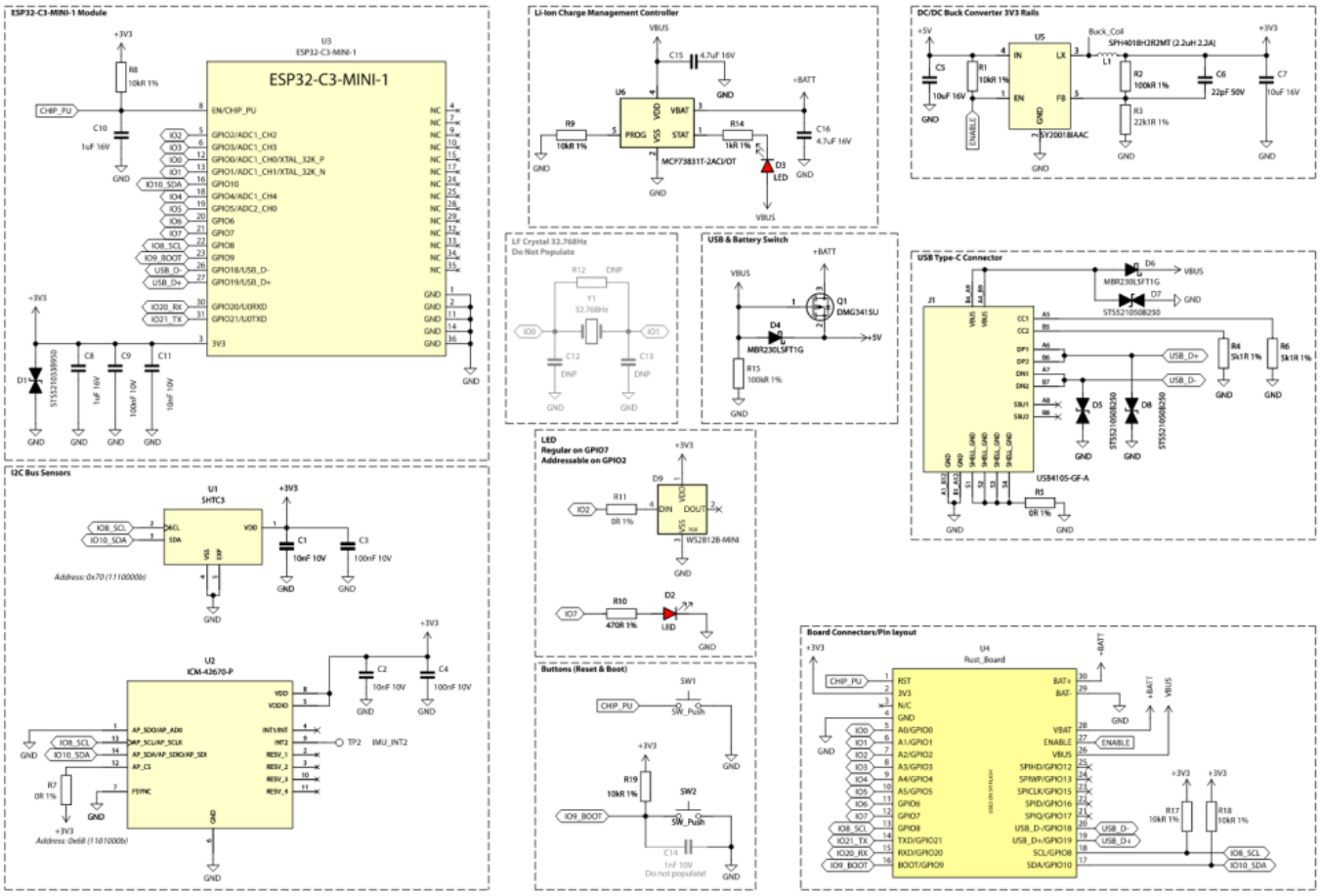
    - Flash programming interface
    - JTAG interface
- Reset and Boot buttons

Standard Equipment

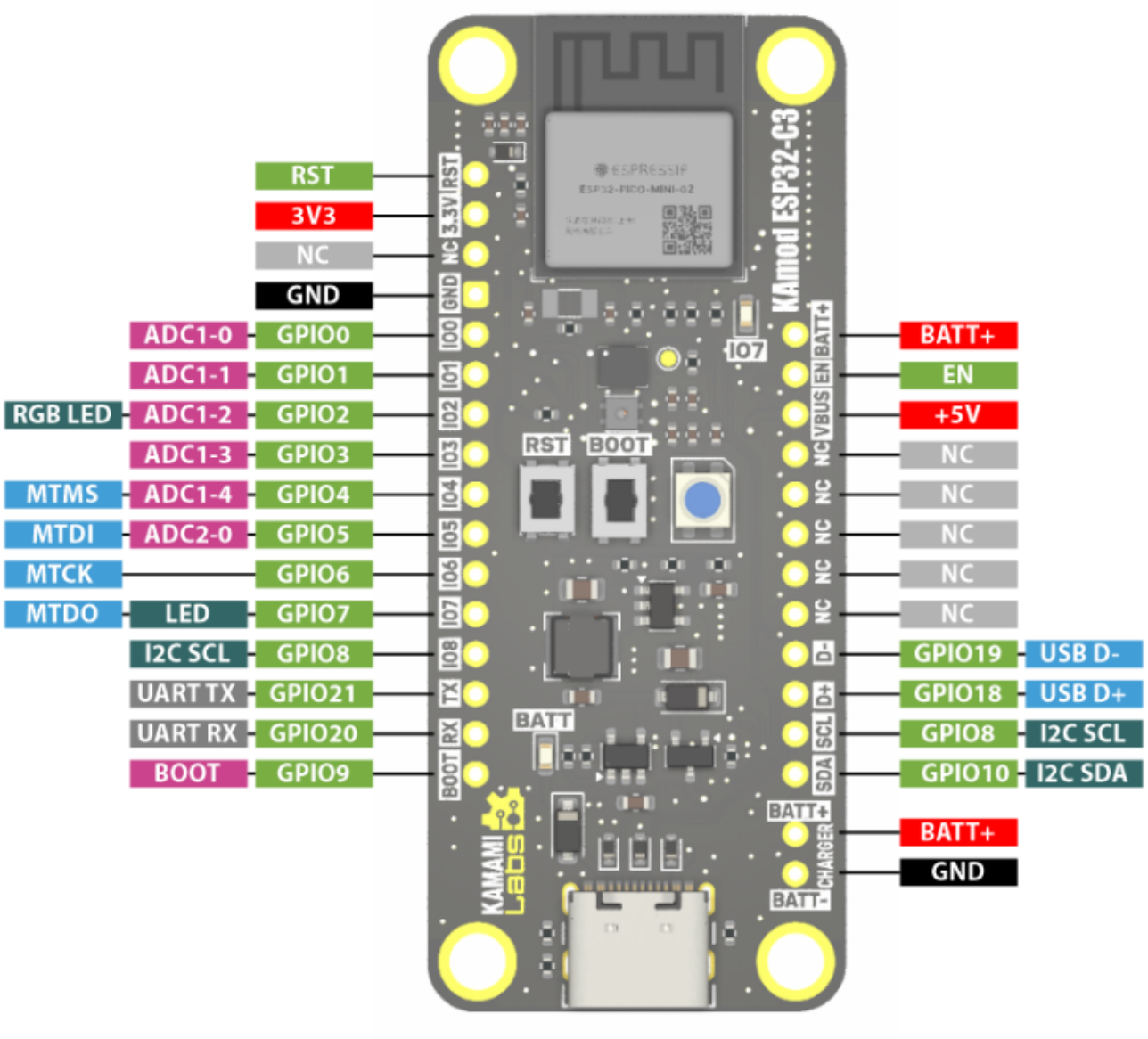
Code	Description
KAmod ESP32-C3	• Assembled and tested module • 1 x straight 12-pin goldpin header (2.54 mm pitch) • 1 x straight 16-pin goldpin header (2.54 mm pitch)



Electrical Schematic

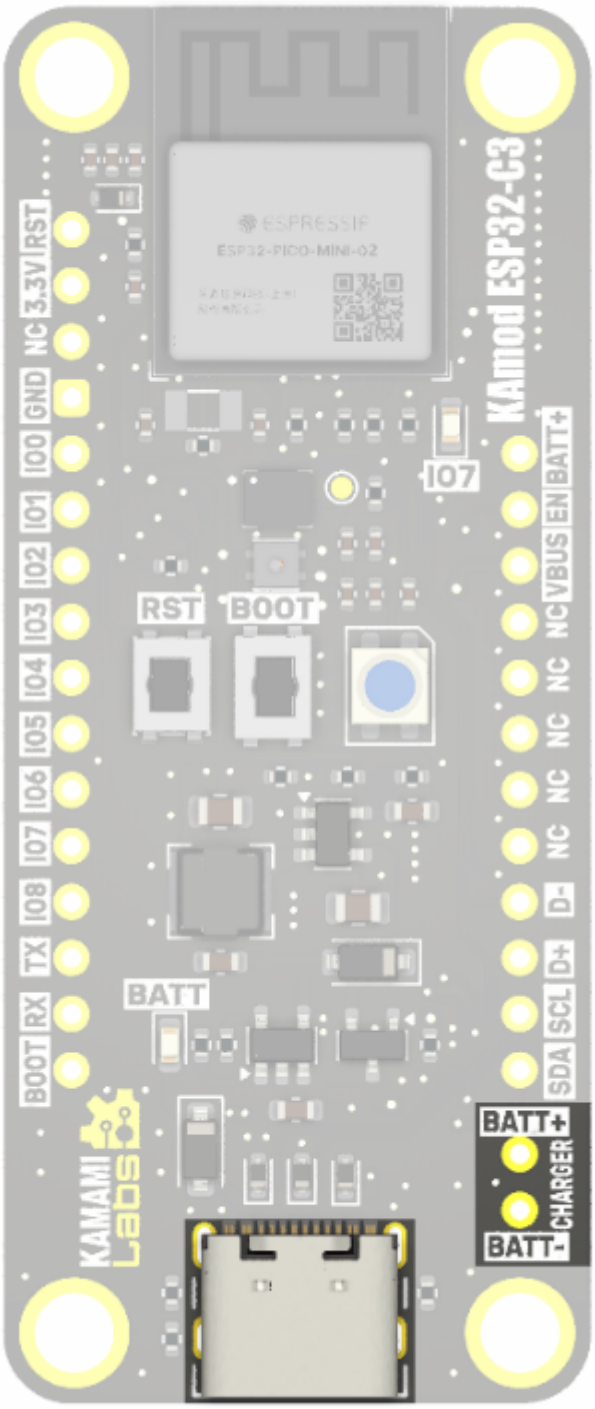


Pinout Description



Power Supply

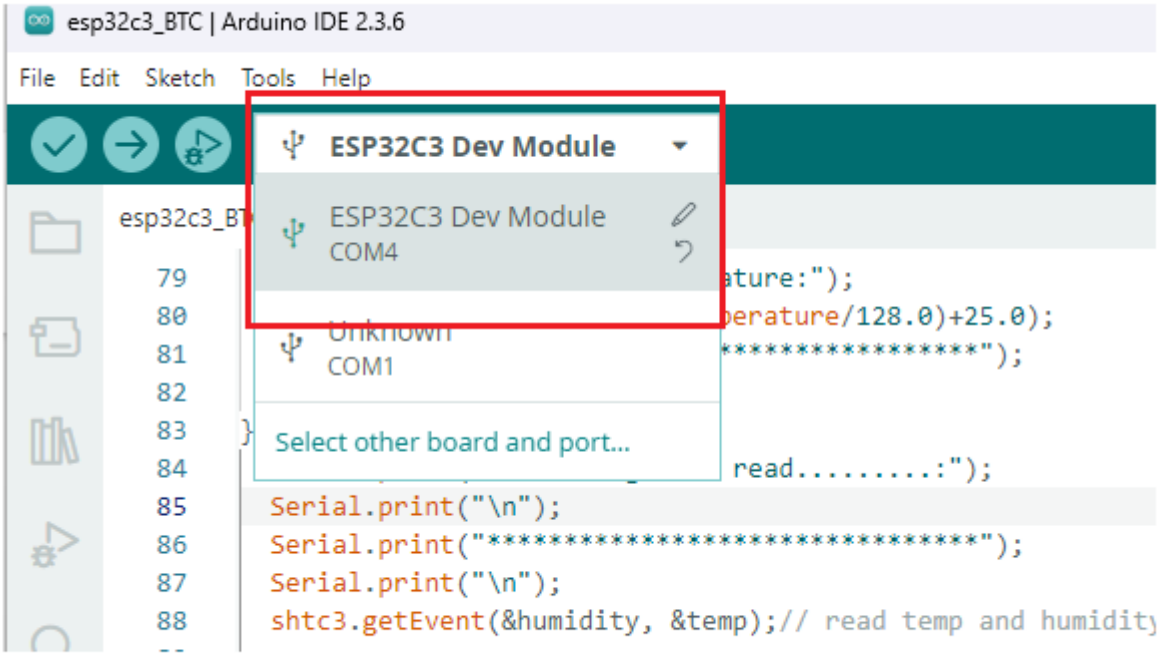
The module is powered by VBUS (+5 V) from the USB-C connector. This voltage also charges the 4.2 V Li-Ion battery if connected to the Charger output. The MCP7381 chip manages the charging process using a Constant Current/Constant Voltage (CC/CV) algorithm, with the charging current set to 100 mA and the termination voltage to 4.20 V.



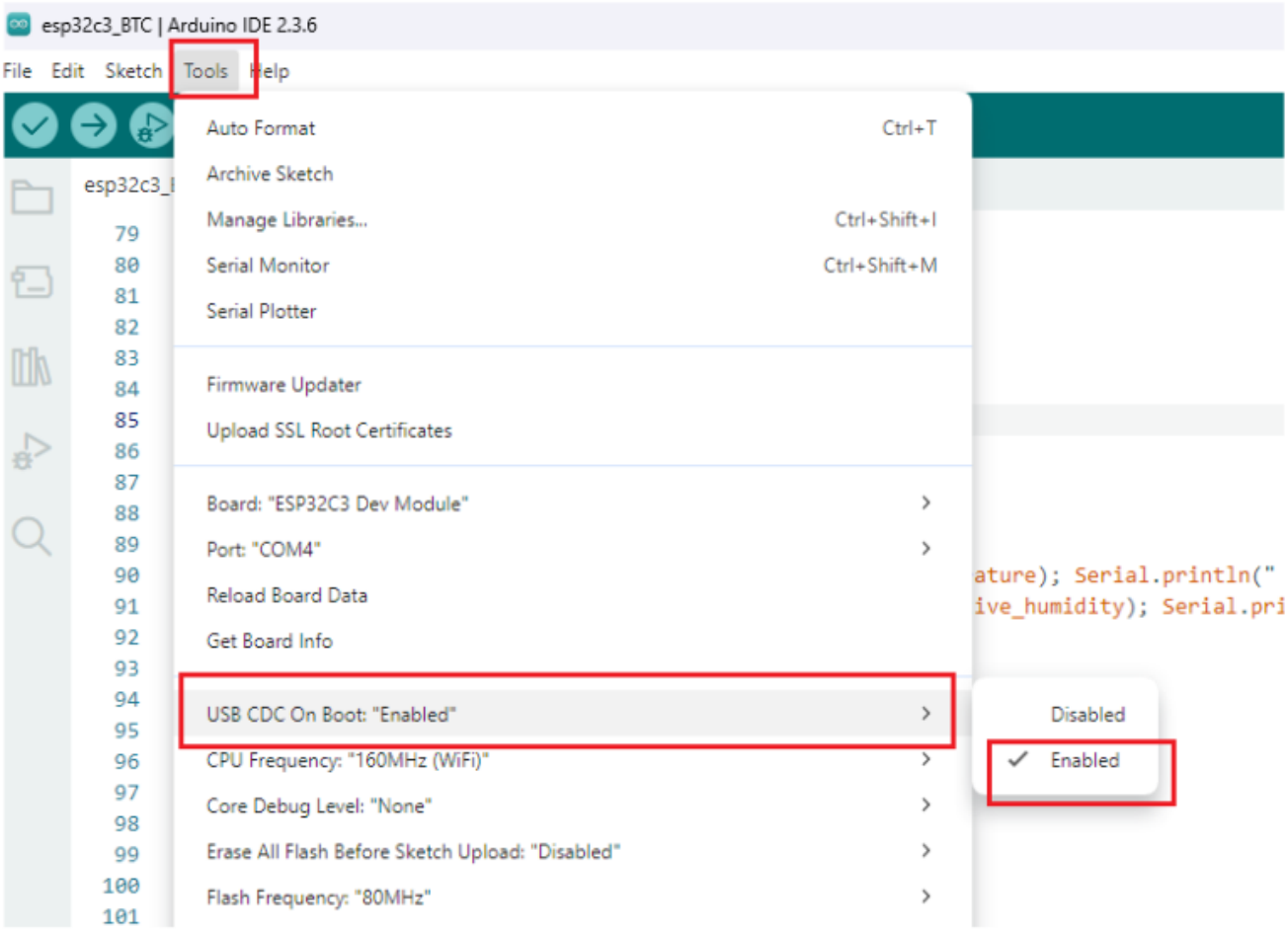
Arduino IDE Configuration and Test Program

Preliminary Steps

Connect the KAmod ESP-C3 module to a computer with Arduino IDE installed. In the board selection menu, choose *ESP32C3 Dev Module* and the corresponding virtual COMx port.

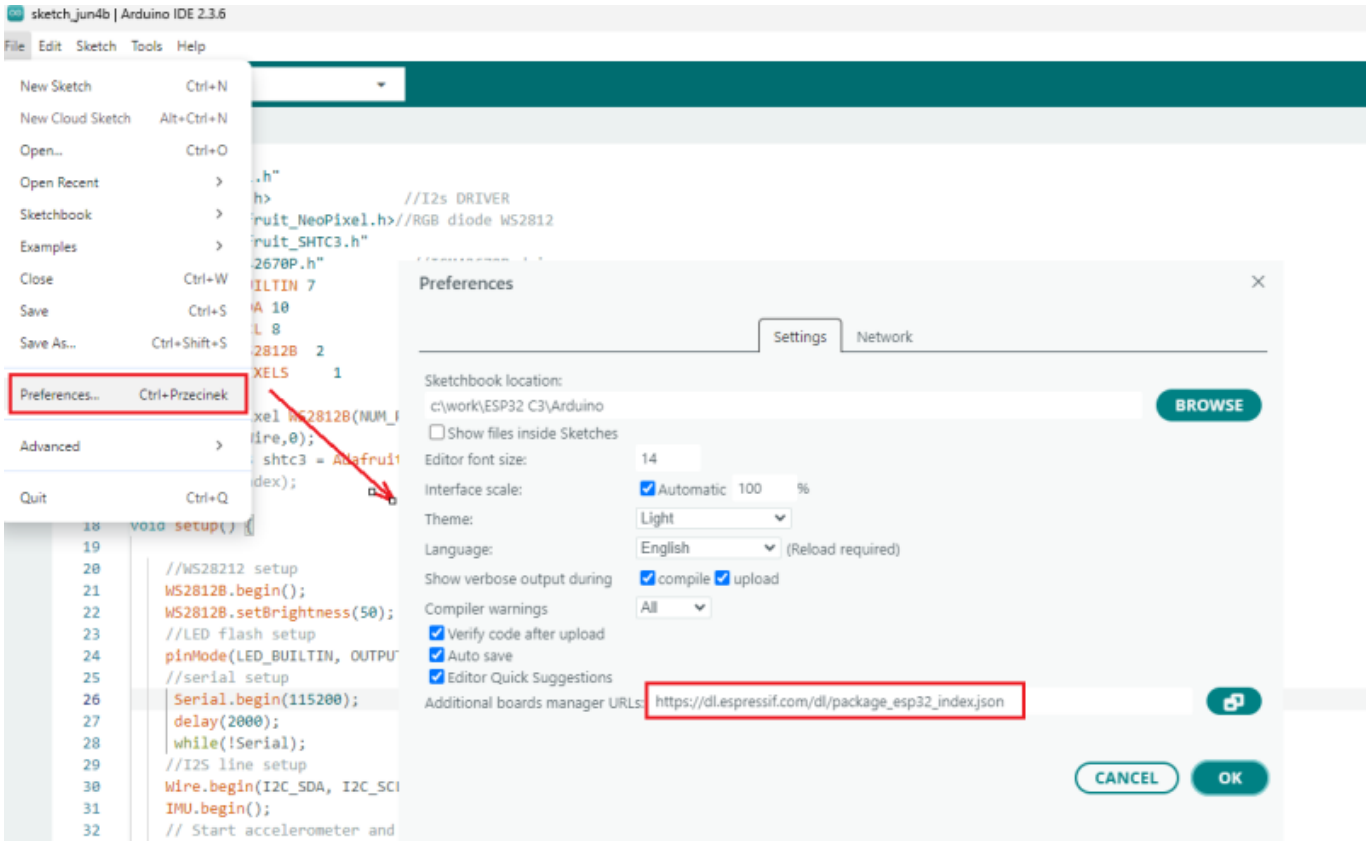


For the test procedure, we will use the Serial Monitor to display results. To enable this, you must unlock the *USB CDC On Boot* option (disabled by default).


esp32c3_BTC | Arduino IDE 2.3.6
File Edit Sketch Tools Help
Auto Format Ctrl+T
Archive Sketch
Manage Libraries... Ctrl+Shift+I
Serial Monitor Ctrl+Shift+M
Serial Plotter
Firmware Updater
Upload SSL Root Certificates
Board: "ESP32C3 Dev Module"
Port: "COM4"
Reload Board Data
Get Board Info
USB CDC On Boot: "Enabled"
CPU Frequency: "160MHz (WiFi)"
Core Debug Level: "None"
Erase All Flash Before Sketch Upload: "Disabled"
Flash Frequency: "80MHz"
Disabled
Enabled

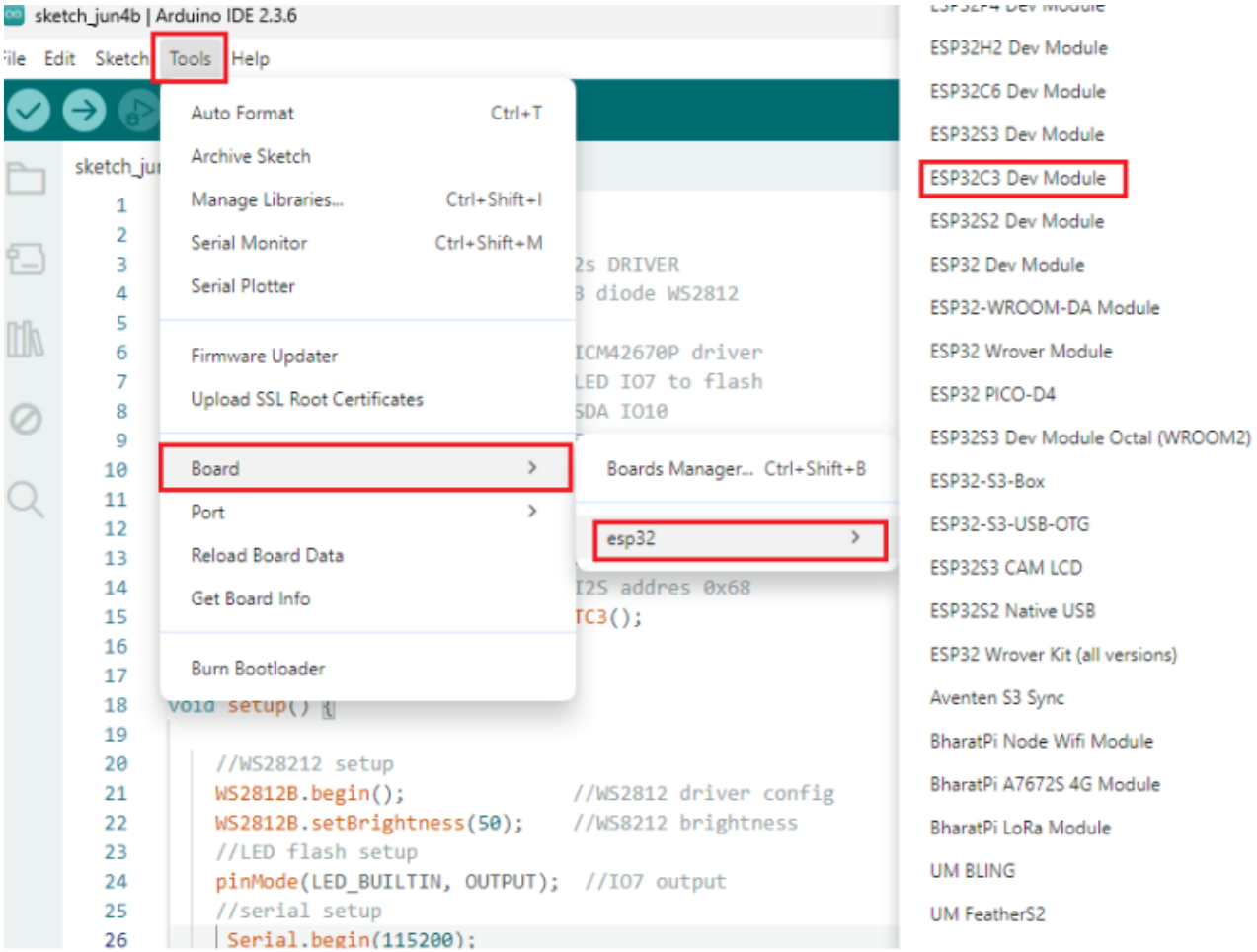
Preferences Configuration

Open *File -> Preferences*. In the *Additional boards manager URLs* field, enter:
https://dl.espressif.com/dl/package_esp32_index.json



Selecting the Processor Type

Navigate to *Tools -> Board -> esp32 -> ESP32C3 Dev Module*. This step ensures the project compiles for the correct architecture.

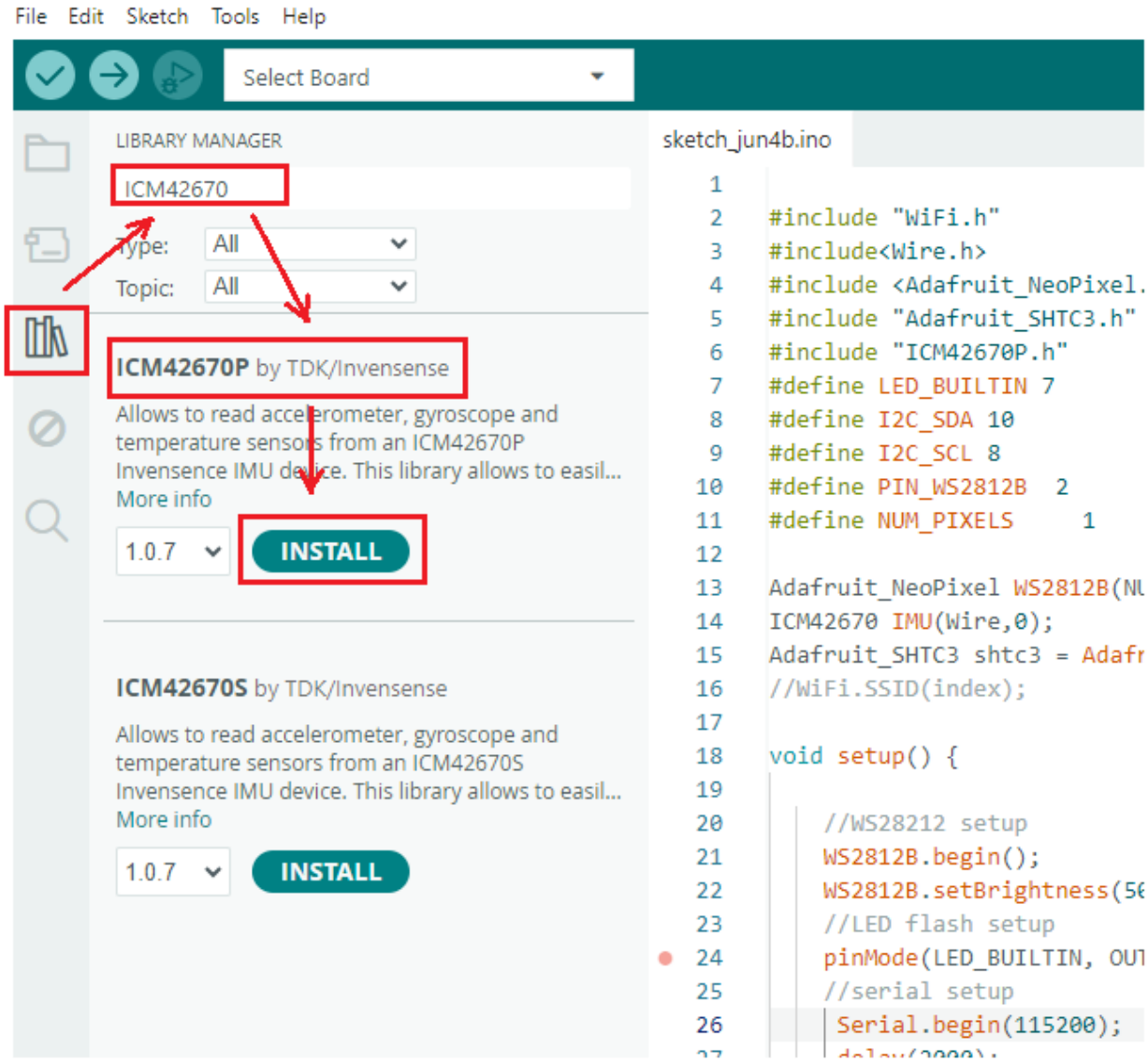


Installing Libraries

The test program requires libraries for the ICM42670P accelerometer, SHTC3 thermometer/hygrometer, and WS2812B RGB LED.

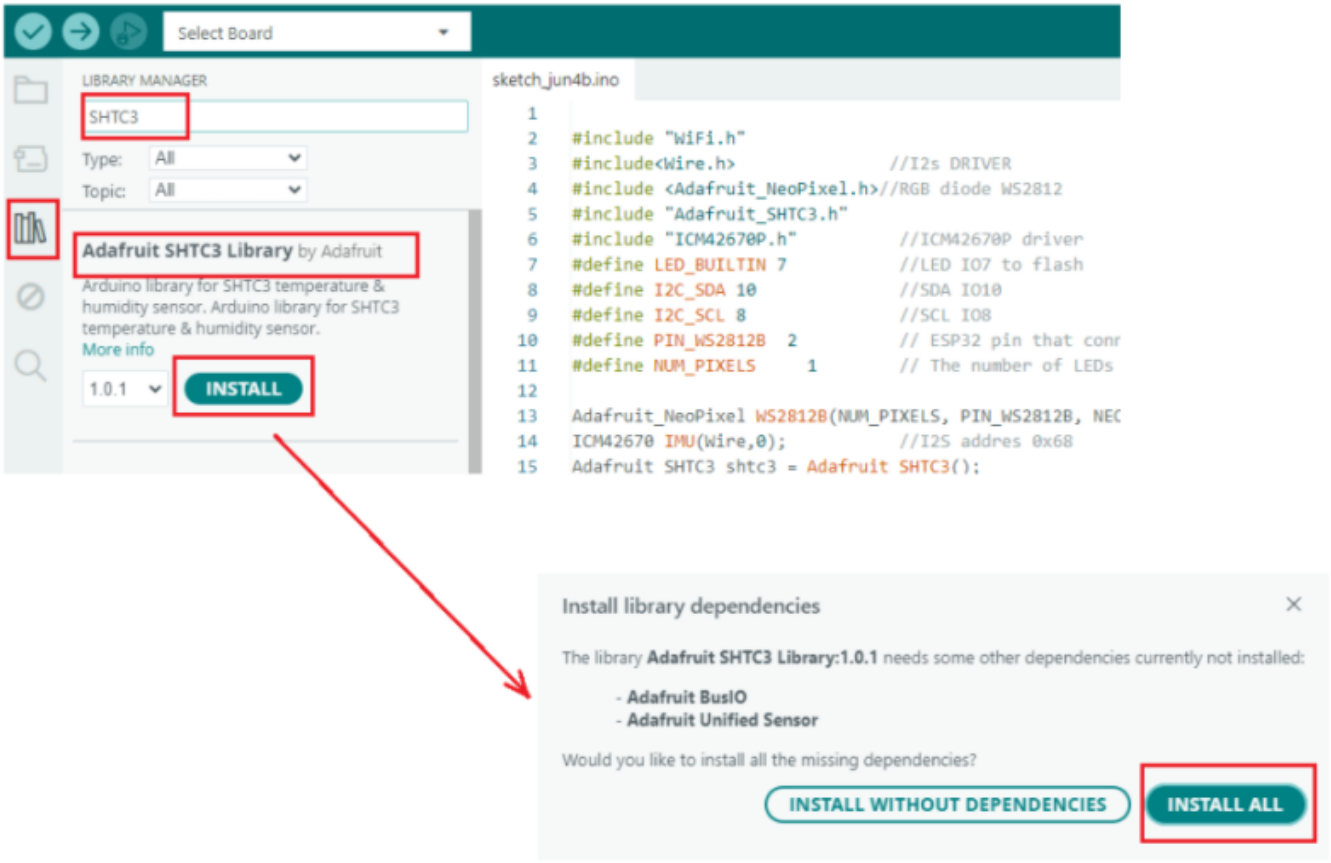
ICM42670P Library

Search for "ICM42670" in the Library Manager, select *ICM42670P by TDK/Invensense* and click *Install*.



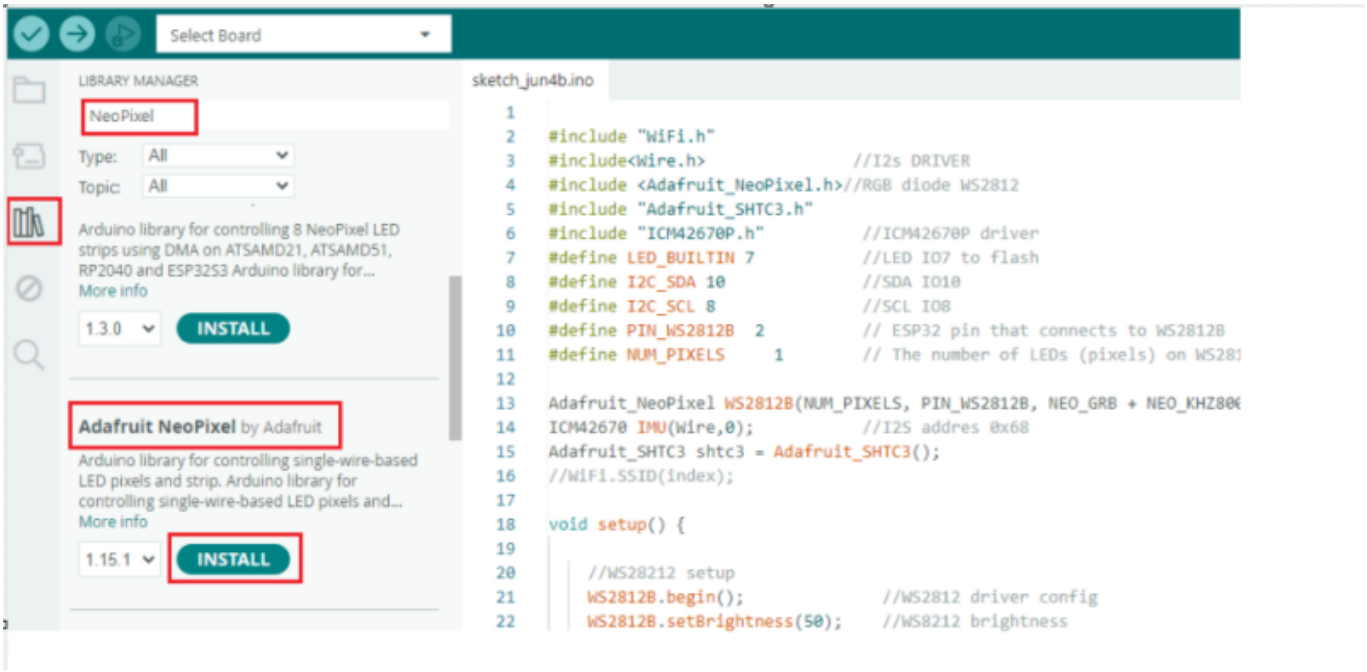
SHTC3 Library

Search for *Adafruit SHTC3 Library*. When prompted, click *Install All* to include necessary dependencies.



WS2812 RGB LED Library

Install the *Adafruit NeoPixel* library.



Handling the ICM42670P Accelerometer

The sensor uses the I2C bus. We initialize the interface using the Wire library:

1. define I2C_SDA 10 // SDA on IO10
2. define I2C_SCL 8 // SCL on IO8

Wire.begin(I2C_SDA, I2C_SCL);

Handling the SHTC3 Sensor

Initialized via the standard begin method:

```
shtc3.begin();
```
Reading data:

```
shtc3.getEvent(&humidity, &temp); // read temp and humidity
```
Results are stored in `temp.temperature` and `humidity.relative_humidity`.

```
********************************
SHTC3 Temperature: 31.54 deg C
SHTC3 Humidity: 46.78% rH
********************************
```

Handling the WS2812B RGB LED

Define the number of pixels and the data pin:

1. define PIN_WS2812B 2 // Data pin
2. define NUM_PIXELS 1 // One LED

Adafruit_NeoPixel WS2812B(NUM_PIXELS, PIN_WS2812B, NEO_GRB + NEO_KHZ800);

Wi-Fi Module Testing

The test scans local networks and displays the SSID, signal strength (RSSI), channel, and encryption type in the console.

```
WiFi.mode(WIFI_STA); // Station mode
WiFi.disconnect(); // Clear previous connections
numNetworks = WiFi.scanNetworks();
```

```
**********
Scan done
5 networks found
Nr | SSID                             | RSSI | CH | Encryption
 1 | ZTE-SKOK                         |  -56 |  5 | WPA+WPA2
 2 | NET_SKOK                         |  -77 | 11 | WPA
 3 | Derkom52                         |  -81 |  5 | WPA+WPA2
 4 | MIK_ZAM                          |  -90 |  7 | WPA2
 5 | TP-Link_Extender                 |  -93 |  2 | WPA2
```

Arduino Test Program Code

The full test program blinks the LED, reads IMU and SHTC3 data, scans Wi-Fi, and cycles the RGB LED colors.

```
#include "WiFi.h"
#include <Wire.h>
#include <Adafruit_NeoPixel.h>
#include "Adafruit_SHTC3.h"
#include "ICM42670P.h"

#define LED_BUILTIN 7
#define I2C_SDA 10
#define I2C_SCL 8
#define PIN_WS2812B 2
#define NUM_PIXELS 1

Adafruit_NeoPixel WS2812B(NUM_PIXELS, PIN_WS2812B, NEO_GRB + NEO_KHZ800);
ICM42670 IMU(Wire,0);
Adafruit_SHTC3 shtc3 = Adafruit_SHTC3();

void setup() {
    WS2812B.begin();
    WS2812B.setBrightness(50);
    pinMode(LED_BUILTIN, OUTPUT);
    Serial.begin(115200);
    delay(2000);
    while(!Serial);
    Wire.begin(I2C_SDA, I2C_SCL);
    IMU.begin();
    IMU.startAccel(100, 16);
    IMU.startGyro(100, 2000);
    shtc3.begin();
    WiFi.mode(WIFI_STA);
    WiFi.disconnect();
    delay(100);
}

void loop() {
    int numNetworks;
    sensors_event_t humidity, temp;
    inv_imu_sensor_event_t imu_event;
    digitalWrite(LED_BUILTIN, HIGH);
    Serial.println("\n*********************************");
    if (IMU.getDataFromRegisters(imu_event) == 0) {
        Serial.print("Accel X: "); Serial.println(imu_event.accel[0] / 2048.0);
        Serial.print("Gyro X: "); Serial.println(imu_event.gyro[0] / 16.4);
    }
    shtc3.getEvent(&humidity, &temp);
    Serial.print("SHTC3 Temp: "); Serial.println(temp.temperature);
    numNetworks = WiFi.scanNetworks();
    Serial.print(numNetworks); Serial.println(" networks found.");
    digitalWrite(LED_BUILTIN, LOW);
    WS2812B.setPixelColor(0, WS2812B.Color(255, 0, 0)); WS2812B.show(); delay(500);
    WS2812B.setPixelColor(0, WS2812B.Color(0, 255, 0)); WS2812B.show(); delay(500);
    WS2812B.setPixelColor(0, WS2812B.Color(0, 0, 255)); WS2812B.show(); delay(500);
    WS2812B.clear(); WS2812B.show();
}
```

Rust Programming Setup and Test Programs

This section describes how to configure the environment on Linux Ubuntu (24.04.2 LTS) to develop for ESP32-C3 in Rust.

Step 1: Install Prerequisites

Install essential libraries, Clang compiler, and Python tools:

```
sudo apt install --yes clang curl git libssl-dev libudev-dev=251.4-1ubuntu7
     pkg-config python3-pip
```

Step 2: Install Rust and Cargo Tools

```
curl --proto '=https' --tlsv1.2 --fail --show-error --silent https://sh.rustup.rs | sh -s -- -y
    source "$HOME/.cargo/env
```

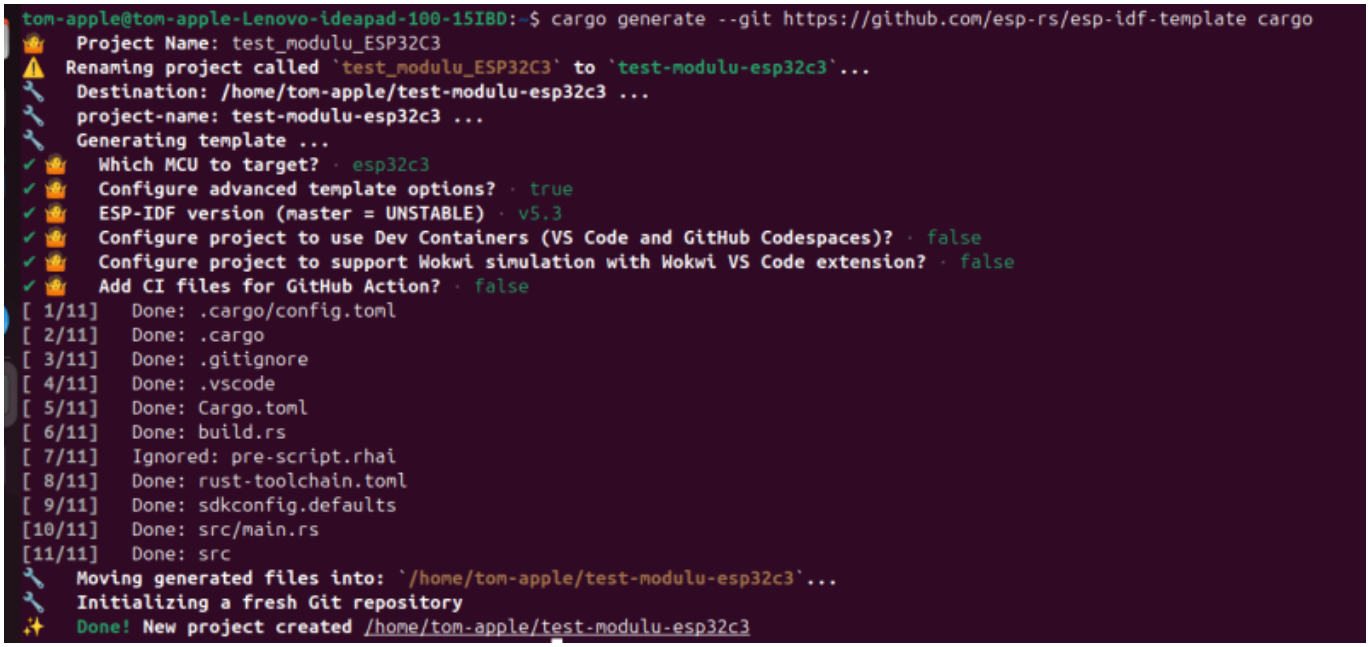
Install Cargo modules for ESP development:

- `espflash` for flashing memory
- `ldproxy` for linker arguments
- `cargo-generate` for project templates

```
cargo install espflash ldproxy cargo-generate
```

Step 3: Creating a Project

Run `cargo generate esp-rs/esp-idf-template cargo`. Select MCU `ESP32C3` and ESP-IDF version `v5.3`.



To compile and run: `cargo run`.

Rust Example: Blinking LED

```
use esp_idf_svc::hal::{delay::FreeRtos, gpio::PinDriver, peripherals::Peripherals};

fn main() {
    esp_idf_svc::sys::link_patches();
    let peripherals = Peripherals::take().expect("Failed to take peripherals");
    let mut led = PinDriver::output(peripherals.pins.gpio7).expect("Failed to create led
driver");
    loop {
        led.toggle().expect("Failed to toggle LED");
        FreeRtos::delay_ms(500);
    }
}
```

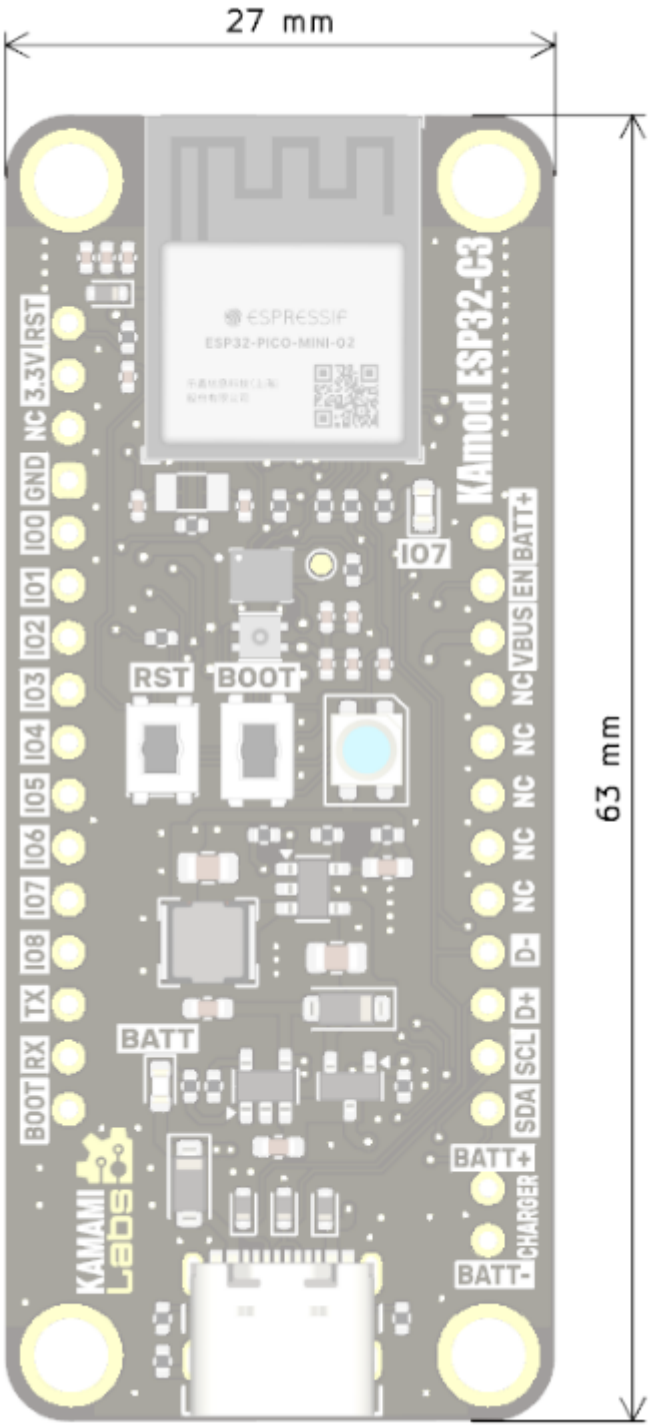
Rust Example: SHTC3 and ICM42670 Data

After running `cargo run`, the terminal will display sensor data every second.

```
SHTC3:
        - temp: 26.056
        - hum: 40.002
ICM42670:
        - temp: 26.1875
        - accel: -0.296875, 0.09375, 1.0717773
        - gyro: -0.06097561, -10.243902, 21.341463
SHTC3:
        - temp: 26.045
        - hum: 40.069
ICM42670:
        - temp: 26.21875
        - accel: -0.30908203, 0.24023438, 0.91552734
        - gyro: -8.353659, -13.658537, 7.4390244
SHTC3:
        - temp: 26.01
        - hum: 40.107
ICM42670:
        - temp: 26.1875
        - accel: 0.15966797, -0.36621094, 0.8330078
        - gyro: -5.8536587, 66.95122, 43.719513
SHTC3:
        - temp: 25.944
        - hum: 40.089
ICM42670:
        - temp: 26.28125
        - accel: 0.11621094, -0.053222656, 1.0834961
        - gyro: -4.634146, 4.085366, -9.756098
```

Dimensions

The KAmod ESP32-C3 board dimensions are 63 x 27 mm.



External Links

- ESP32-C3 Documentation
- SHTC3 Sensor Datasheet
- ICM42670 Documentation
- Learn Rust
- Cargo Documentation

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