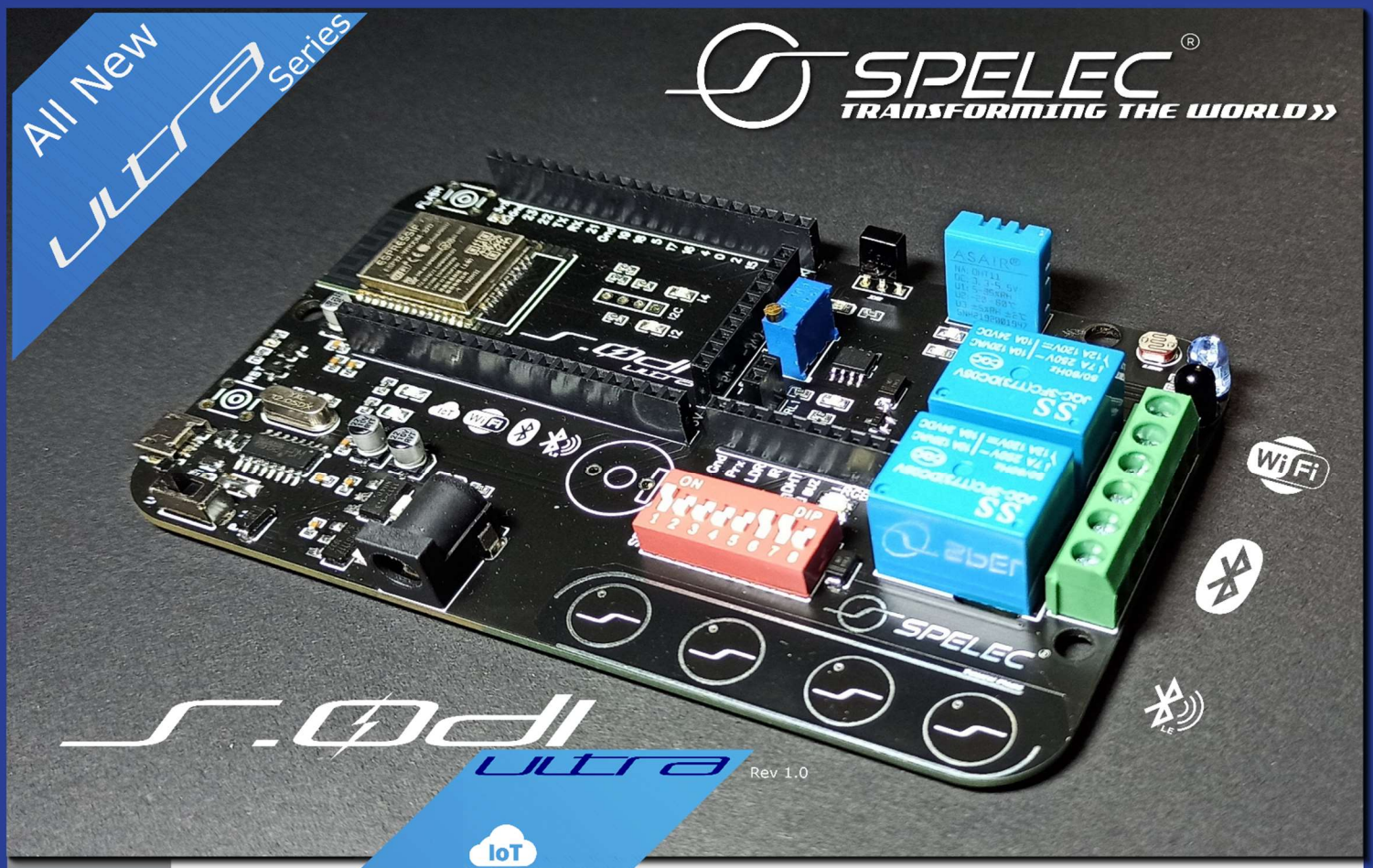
All New ultra Series

SPELEC®
TRANSFORMING THE WORLD»



S.ODI ultra

Rev 1.0

IoT

ARDUINO IDE

PLATFORM IO

MICRO-PYTHON

OPEN-HARDWARE

GETTING STARTED WITH S.ODI ultra

Powered by Dual core40nm technology, S.ODI Ultra provides a robust,highly integratedplatform, which helps to develop effecient prototype & application development with its compact design,mululiple sensor interfaces and high Performance cores

get related documents at:
github.com/MySPELEC/S.ODI_ultra

follow us:
linktr.ee/spelec

SYSTEM. ON-BOARD DEVELOPMENT INTERFACES

TRANSFORM YOUR DREAMS TO REALITY

Get Started

SYSTEM. ON-BOARD DEVELOPMENT INTERFACES

TRANSFORM YOUR DREAMS TO REALITY

You can construct your intelligent hardware system with very low to no effort using our development board S.ODI developed by SPELEC.

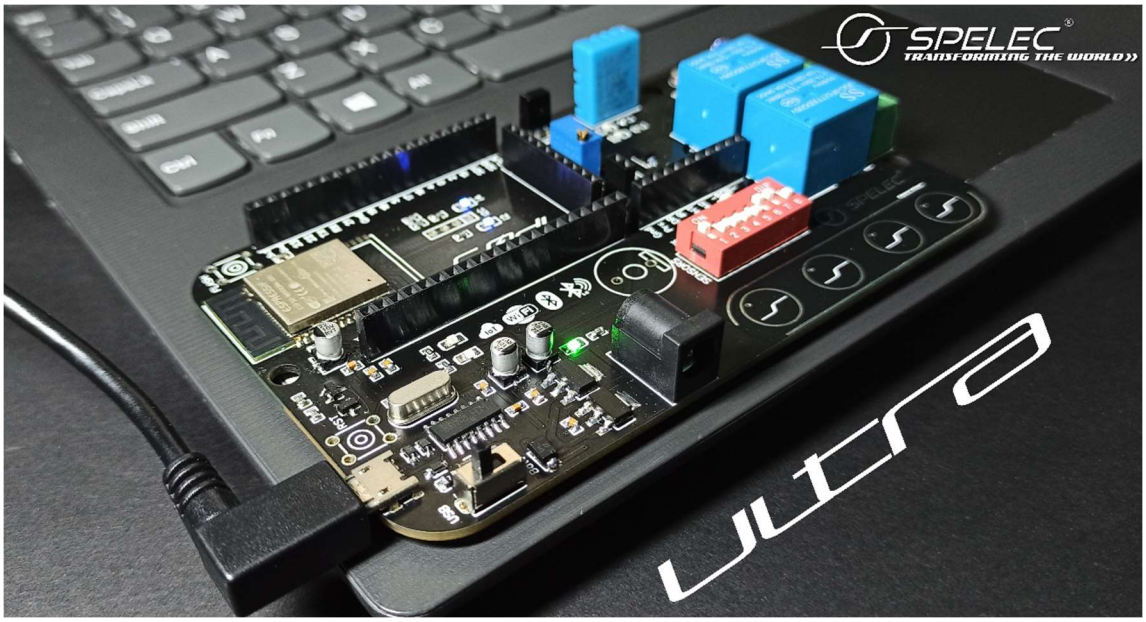
The S.ODI (System onboard development interface) is a Development board that has integrated sensors regarding Humidity, Temperature, flame, LDR and infrared it also has RGB (LED light) which works as an indicator. S.ODI also comes with onboard WI-FI, Bluetooth, BLE which are used to connect with various devices.

With the collection of onboard hardware components and the open-source firmware that we supply one can quickly learn how to get hardware connected online, and how to use Web API and/or smartphones to interact with it.

Get Started

This document is intended to help you set up the software development environment for the hardware based on the S.ODI Ultra Dev Board by SPELEC.

After that, a simple example will show you how to use S.ODI (System onboard Development Interfaces) and software's for menu configuration, then building, and flashing firmware onto an S.ODI board.



Introduction

S.ODI is a system on board that integrates the following features:

- **Wi-Fi (2.4 GHz band)**
- **Bluetooth 4.2**
- **Bluetooth low Energy**
- **Infrared comm**
- **Dual high-performance cores**
- **Ultra-Low Power co-processor**
- **Several peripherals & Sensors**

Powered by 40 nm technology, S.ODI provides a robust, highly integrated platform, which helps meet the continuous demands for efficient power usage. It also comes with compact design, security, high performance and reliability.

SPELEC provides basic hardware and software resources to help application developers realize their ideas using the S.ODI series hardware. The software development framework by SPELEC is intended for the development of Internet-of-Things (IoT) applications with Wi-Fi, Bluetooth, power management and several other system features.

What You Need

Hardware:

- An S.ODI Dev board
- USB cable - USB A to micro B

Computer running Windows, Linux, or macOS Software:

- Arduino IDE
- ESP-IDF
- Micro-Python

S.ODI is an ESP32-based development board produced by SPELEC. This board features multiple integrated sensors and interfaces.

It's another distinguishing feature includes the multiple Embedded Sensors, Interfaces and CH340G / CP2102 - advanced multi-interface USB bridges. This chip enables usage of UART for direct debugging of S.ODI through the USB interface. S.ODI makes development effortless, convenient, easy, and cost-effective. Most of the S.ODI I/O pins are broken out to the board's pin headers for easy access.

Functionality Overview

- **Wi-Fi Key Features**

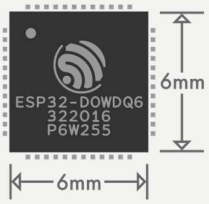
802.11 b/g/n

- 802.11 n (2.4 GHz), up to 150 Mbps
- WMM
- TX/RX A-MPDU, RX A-MSDU
- Immediate Block ACK
- Defragmentation
- Automatic Beacon monitoring (hardware TSF)
- 4 × virtual Wi-Fi interface
- Antenna diversity

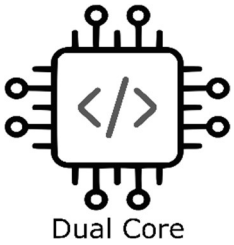
- **BT Key Features**
  - Enhanced Power Control
  - +12 dBm transmitting power
  - NZIF receiver with –97 dBm BLE sensitivity
  - Compliant with Bluetooth v4.2 BR/EDR and BLE specification
  - Class-1, class-2 and class-3 transmitter without external power amplifier
  - Adaptive Frequency Hopping (AFH)
  - Standard HCI based on SDIO/SPI/UART
  - High-speed UART HCI, up to 4 Mbps
  - Bluetooth 4.2 BR/EDR BLE dual mode controller
  - Synchronous Connection-Oriented/Extended (SCO/eSCO)
  - CVSD and SBC for audio codec
  - Bluetooth Pico net and Scatter net
  - Multi-connections in Classic BT and BLE
  - Simultaneous advertising and scanning
  - Ultra-Low Power Consumption

Robust Design

- **MCU and Advanced Features**

PROCESSOR SERIES	PROCESSOR CORES	EMBEDDED FLASH MEM.	PACKAGE SIZE
ESP32-D0WDQ6	DUAL PRO_CPU APP_CPU	16MB	

- **CPU and Memory**
  - Xtensa® single-/dual-core
  - 32-bit LX6 microprocessor(s), up to 600 MIPS
  - 16 MB FLASH Memory
  - 520 KB SRAM
  - 16 KB SRAM in RTC
  - QSPI supports multiple flash/SRAM chips



- **Clocks and Timers**
  - Internal 240 MHz oscillator with calibration
  - Internal RC oscillator with calibration
  - External 2 MHz ~ 60 MHz crystal oscillator (40 MHz only for Wi-Fi/BT functionality)
  - External 32 kHz crystal oscillator for RTC with calibration
  - Two timer groups, including 2 × 64-bit timers and 1 × main watchdog in each group
  - One RTC timer
  - RTC watchdog

- **Advanced Peripheral Interfaces**
  - 30 × programmable GPIOs
  - 12-bit SAR ADC up to 18 channels
  - 2 × 8-bit DAC
  - 10 × touch sensors (4 On-board)
  - 4 × Hi-SPI
  - 2 × I²S
  - 2 × I²C
  - 3 × UART
  - 1 host (SD/eMMC/SDIO)
  - 1 slave (SDIO/SPI)
  - Ethernet MAC interface with dedicated DMA and IEEE 1588 support
  - CAN BUS 2.0

- **Flash encryption**
  - 1024-bit OTP, up to 768-bit for customers
  - Cryptographic hardware acceleration

- **On-board Sensors and Interfaces**
  - Motor PWM
  - LED PWM up to 16 channels
  - Hall sensor
  - Temperature and Humidity Sensor
  - Proximity Sensor o Dual Channel Relay's
  - 4 Touch Sensor's
  - LDR
  - Buzzer
  - DHT Sensor
  - Infrared Remote
  - Thermal sensor
  - RGB LED

Multiple Sensors & interfaces

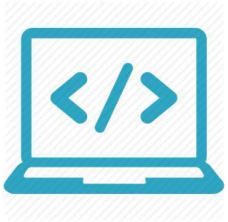
Development

- Arduino IDE (C++)
- Zephyr Project

  A scalable real-time operating system (RTOS) supporting multiple hardware architectures, optimized for resource constrained devices, and built with security in mind.
- Mongoose OS
- Amazon AWS IoT
  - Internet button & Amazon AWS IoT
  - Secure remote device management
- Micro Python
- Lua Script
- Lua Node

  Programming with the Lua programming language directly or using a block-based programming language that translates blocks to Lua.
- Espruino (java script based firmware)

etc…….



Functional Description

USB-to-UART Bridge

A single chip USB-to-UART bridge provides up to 3 Mbps transfers rates.

Boot Button

Download button - holding down the Boot button and pressing the EN button initiates the firmware download mode. Then user can download firmware through the serial port. EN Button

Reset button - pressing this button resets the system.

Micro USB Port

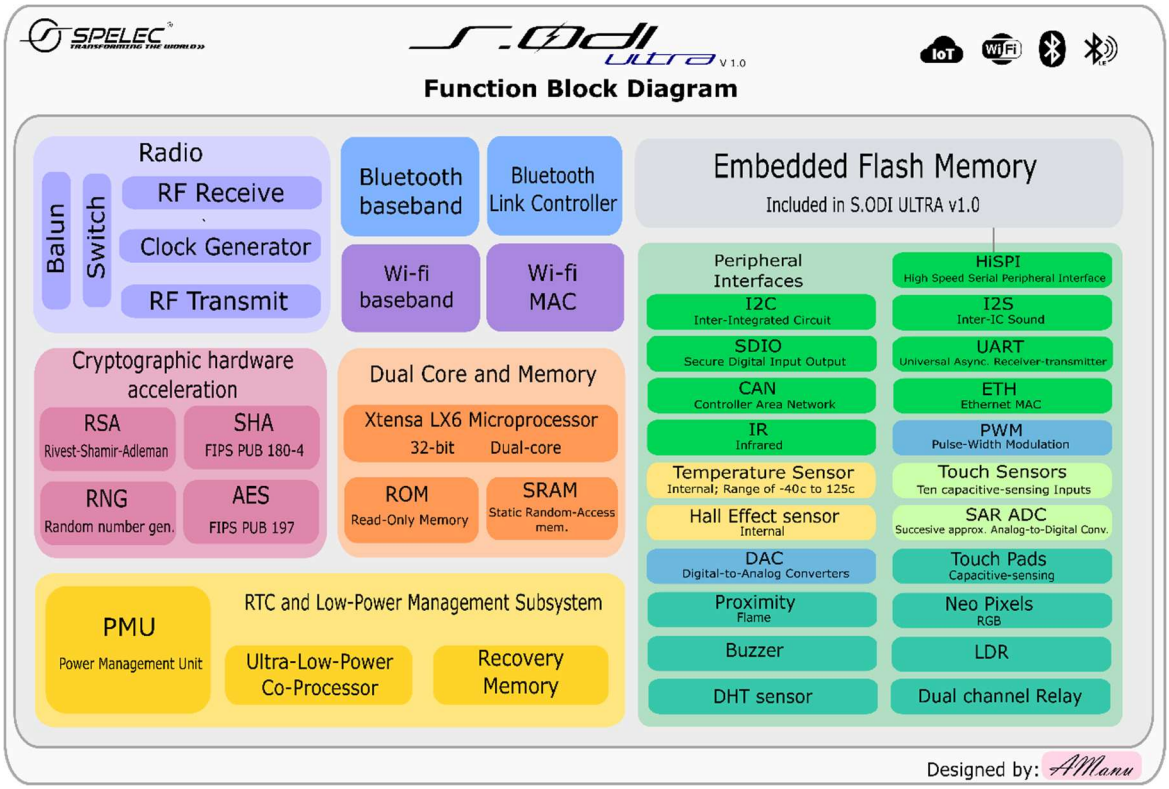
USB interface- It functions as the power supply for the board and the communication interface between PC and the ESP module. Power on LED -Turns on when the power supply is applied to the board.

I/O Connector

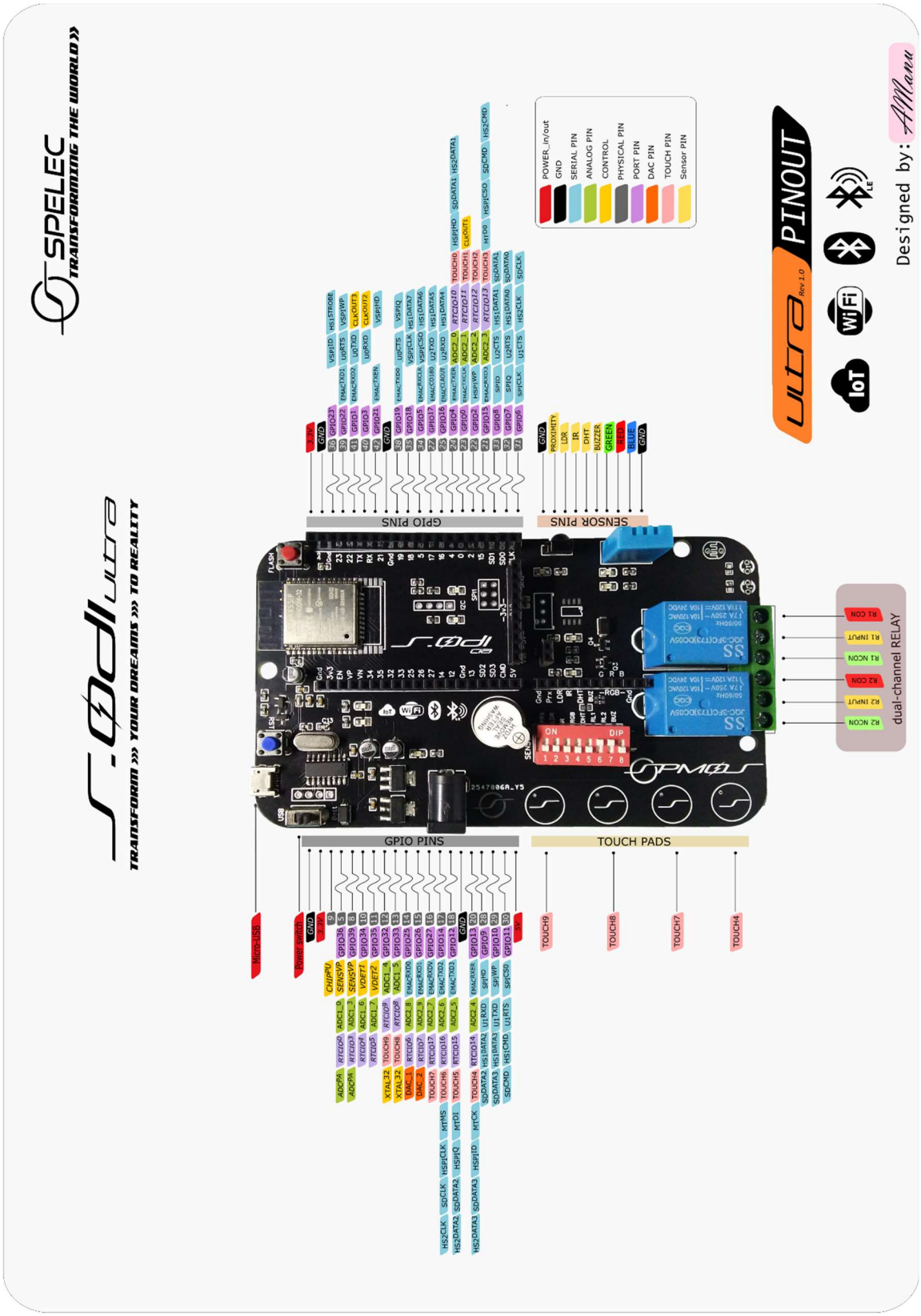
Most of the pins on the ESP module are broken out to the female pin headers on the board. Users can program ESP32 to enable multiple functions such as **PWM, ADC, DAC, I2C, I2S, SPI**, etc.

Board Architecture

Function Block Diagram of S.ODI ultra



Pin Description




Program Flow
Plug
Program
Play
USB-TTL-Programming
CHANNEL
DUAL-CORE
CORE-0
CORE-1
MEMORY UNIT
Hi-SPI
I2C
I2S
SPI
UART
CAN
SDIO
JTAG
RESET
FLASH
Wi Fi
SENSORS
&
ACTUATORS
GPIO
PWM
DIGITAL
DAC
ADC
IoT

GPIO	Input	Output	Multiplexed	Notes
0	pulled up	OK	ADC2_1, Touch 1, RTC_11	outputs PWM signal at boot RTC GPIO is routed to the RTC Low-Power Subsystem.
1	TX pin	OK		debug output at boot
2	OK	OK	ADC2_2, Touch 2, RTC_12	connected to the on-board LED 1 RTC Low-Power Subsystem.
3	OK	RX pin		HIGH at boot
4	OK	OK	ADC2_0, Touch 0, RTC_10	connected to the on-board LED 2 RTC Low-Power Subsystem.
5	OK	OK	VSPI CSO	outputs PWM signal at boot
6	x	x	SCK/CLK	connected to the integrated SPI flash
7	x	x	SDO/SD0	connected to the integrated SPI flash
8	x	x	SDI/SD1	connected to the integrated SPI flash
9	x	x	SHD/SD2	connected to the integrated SPI flash
10	x	x	SWP/SD3	connected to the integrated SPI flash
11	x	x	CSC/CMD	connected to the integrated SPI flash
12	OK	OK	HSPI MISO, RTC_15, ADC2_5	boot fail if pulled high. RTC Low-Power Subsystem.
13	OK	OK	Touchpad 4, HSPI, RTC_14, ADC2_4	Touch 4, RTC Low-Power Subsystem.
14	OK	OK	HSPI CLK, RTC_16, ADC2_6	outputs PWM signal at boot, SPI CLK RTC Low-Power Subsystem.
15	OK	OK	ADC, Touch 3, HSPI CS, RTC_13, ADC2_3	outputs PWM signal at boot RTC Low-Power Subsystem.
16	OK	OK	HSPI Data4	U2 Rx
17	OK	OK		U2 Tx
18	OK	OK		VSPI CLK
19	OK	OK		VSPI MISO
21	OK	OK		SDA of I2C
22	OK	OK		SCL OF I2C
23	OK	OK		VSPI MOSI

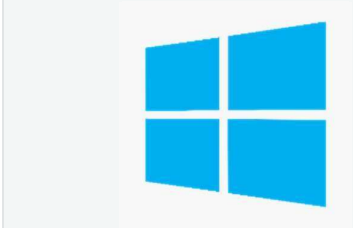
25	OK	OK	RTC_6, ADC2_8, DAC_1	DAC(Digital to Analog Converter) RTC Low-Power Subsystem.
26	OK	OK	RTC_8, ADC2_9, DAC_1	DAC(Digital to Analog Converter) RTC Low-Power Subsystem.
27	OK	OK	TouchPad 7, RTC_17, ADC2_7	TouchPad 7 RTC Low-Power Subsystem.
32	OK	OK	TouchPad 9, RTC_9, ADC1_4	TouchPad 9 RTC Low-Power Subsystem.
33	OK	OK	TouchPad 8, RTC_8, ADC1_5	TouchPad 8 RTC Low-Power Subsystem.
34	OK		RTC_4, ADC1_6	Input only RTC Low-Power Subsystem.
35	OK		RTC_5, ADC1_7	Input only RTC Low-Power Subsystem.
36	OK		RTC_0, ADC1_0	Input only RTC Low-Power Subsystem.
37	OK		ADC1_1	ADC input channels
38	OK		ADC1_2	ADC input channels
39	OK		RTC_3	Input only RTC Low-Power Subsystem.
Prx		OK	Sensor pin	output only Proximity Sensor
LDR		OK	Sensor pin	output only LDR (Light Dependent Resistor) used in light varying sensor circuits.
IR	OK	OK		IR(Infrared) communication
DHT		OK	Sensor pin	output only DHT 11 sensor
BUZ	OK		Actuators pin	Buzzer for audio Signalling devices, alarms.
RGB	OK		RGB pin	Neo Pixel PWM and Digital supported.
And	OK			Power Grounding
R1	OK		Actuator pin	input only Relay1 Control Unit
R2	OK		Actuator pin	input only Relay2 Control Unit
USB			Power switch-USB power	USB Power.
Batt	DC Jack		DC-input	switch to battery mode.

Key Components

Key Components	Description
USB-TTL CH340G	CH340 is a USB bus converter chip and it can realize USB converter to serial interface, USB converter to IrDA infrared or USB converter to printer interface. In serial interface mode, CH340 supplies common MODEM liaison signal, used to enlarge asynchronous serial interface of a computer or upgrade the common serial device to USB bus directly Defragmentation
12MHz Program OSC	To synchronize the programming serial data to be written into the processor
PWR SWITCH	To switch ON/OFF the MCU with USB power or external power source
DUAL CORE PROCESSOR	This is a 32bit dual core processor featuring 16 MB of Memory and 512KB RAM with 240MHz clock which runs up to 600 MIPS
Antenna FOR Wi-Fi, Bluetooth, BLE	The 2.4 GHz transmitter modulates the quadrature baseband signals to the 2.4 GHz RF signal and drives the antenna with a high-powered Complementary Metal Oxide Semiconductor (CMOS) power amplifier. It delivers up to +20.5 dBm of power for an 802.11b transmission and +18 dBm for an 802.11n transmission.
HISPD-SPI	ESP32 features three SPIs (SPI, HSPI and VSPI) in slave and master modes in 1-line full-duplex and 1/2/4-line half-duplex communication modes. Four modes of SPI transfer format, which depend on the polarity (CPOL) and the phase (CPHA) of the SPI clock up to 80 MHz to 64-byte FIFO. All SPIs can also be connected to the external flash/SRAM and LCD. Each SPI can be served by DMA controllers.
2x On-board PWM LED	These are 2 pulse width modulation enabled LED's connected to GPIO-2 and GPIO-4
DC external Power	To give external power from 9V to 5V
Buzzer	On-board buzzer for applications
Sensor Switch	To switch ON/OFF the sensors on board

Proximity & Flame	IT is used to detect the presence of nearby objects without any physical contact.
IR Sensor	Used to transmit and receive infrared rays for IR remote application and wireless IR transmissions
4+6 Touch Sensor	These are capacitive touch sensors on board for T4, T7, T8, T9(13,27,33,32) and 6 touch sense enabled pins
LDR Sensor	Light Dependent resistor sensor is used to detect light
DHT-Sensor	Digital Humidity and Temperature Sensor is used to find the humidity and temperature of the surroundings
Dual-channel Relay	Dual relay unit for switching high voltage devices for IoT applications
Sensor threshold adjusters	To adjust the threshold of the digital sensors for various applications
Hall & CPU temp Sensor	Integrated with a Hall sensor based on a N carrier resistor. When the chip is in the magnetic field, the Hall sensor develops a small voltage laterally on the resistor, which can be directly measured by the ADC.
SD-card interface	External SD-card interfacing GPIO's for Memory Expansion and Data applications.
USB interface	Universal Serial Bus type-B for serial data programming and serial monitoring providing read and write applications for the processor.
GPIO's	All the pins on the S.ODI are broken out to pin headers. You can program S.ODI to enable multiple functions, such as PWM, ADC, DAC, I2C, I2S, SPI, etc

Setup Toolchain

		
Windows	Linux	Mac OS

For Programmer CH340G Drivers

Download and Install S.ODI Programmer Drivers

The CH340 chip is used by several Arduino compatible boards to provide USB connectivity, you may need to install a driver, don't panic, it's much easier than it sounds all you need to do is just click on the link provided below and install it and follow the instructions provided below.

Get the drivers here: S.ODI ultra-programmer drivers

Arduino IDE

Using Arduino IDE with the development repository

- Instructions for Windows
- Instructions for Mac
- Instructions for Debian/Ubuntu Linux

Prerequisites: Arduino IDE Installed

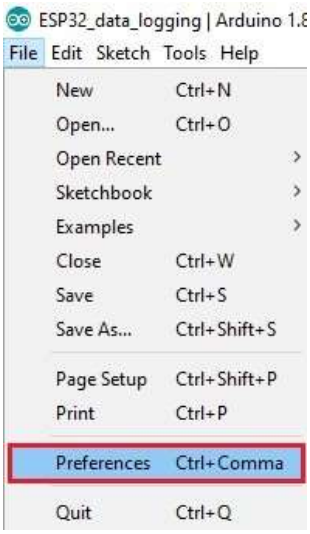
Before starting this installation procedure, make sure you have the latest version of Arduino IDE installed in your computer. If you don't, uninstall it and install it again. Otherwise, it may not work.

Having the latest Arduino IDE software installed from arduino.cc/en/Main/Software, continue with this tutorial.

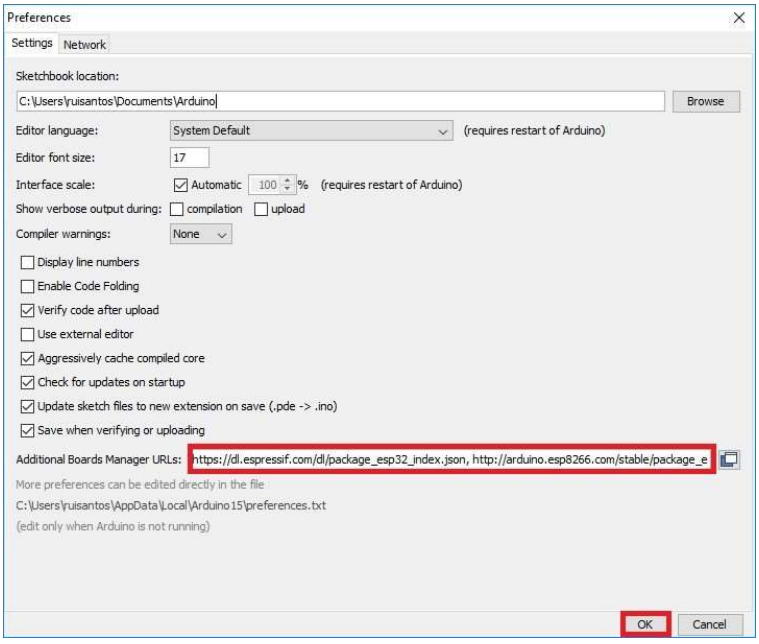
Installing step by step S.ODI $_{ESP32}$ Add-on in Arduino IDE

To install the S.ODI Dev board in your Arduino IDE, follow these next instructions:

1. In your Arduino IDE, go to File> Preferences



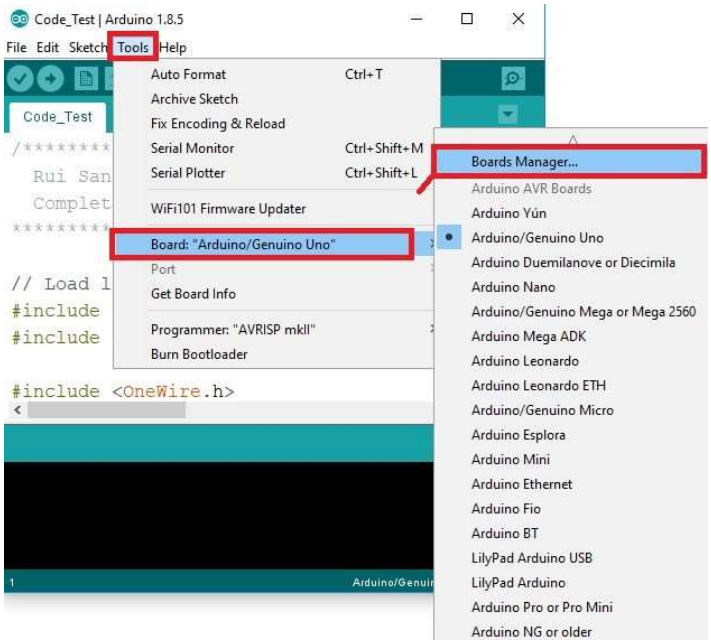
2. Enter https://dl.espressif.com/dl/package_esp32_index.json into the "Additional Board Manager URLs" field as shown in the figure below. Then, click the "OK" button:



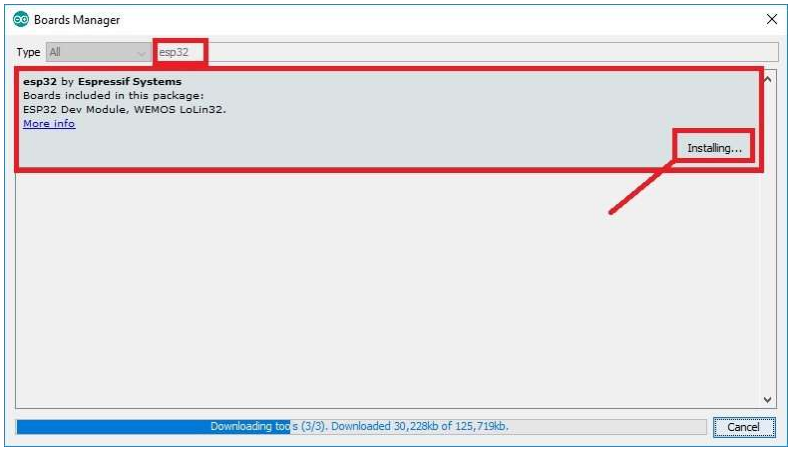
Note: if you already have the ESP8266 boards URL, you can separate the URLs with a comma as follows:

https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.json

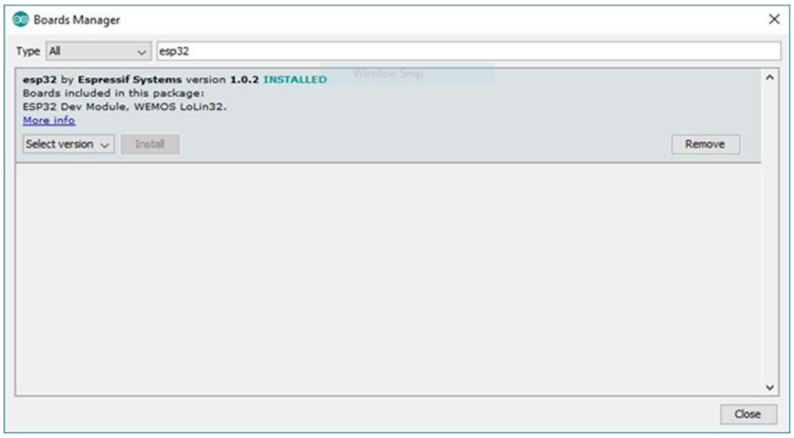
3. Open the Boards Manager. Go to Tools > Board > Boards Manager…



4. Search for ESP32 and press install button for the “ESP32 by Espressif Systems“:



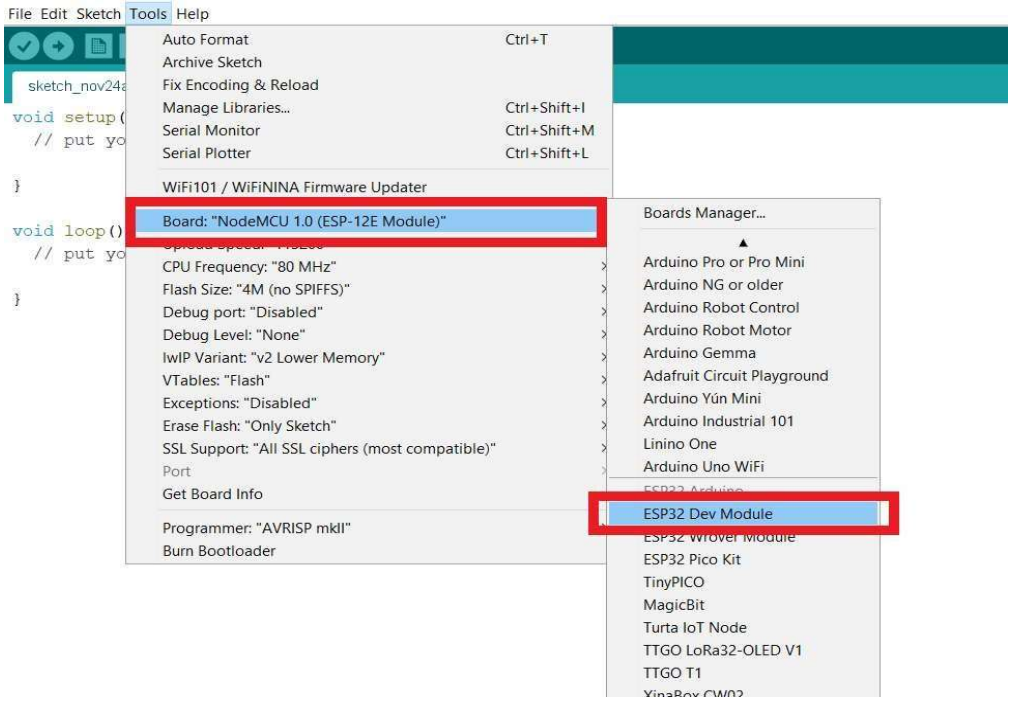
5. That’s it. It should be installed after a few seconds.



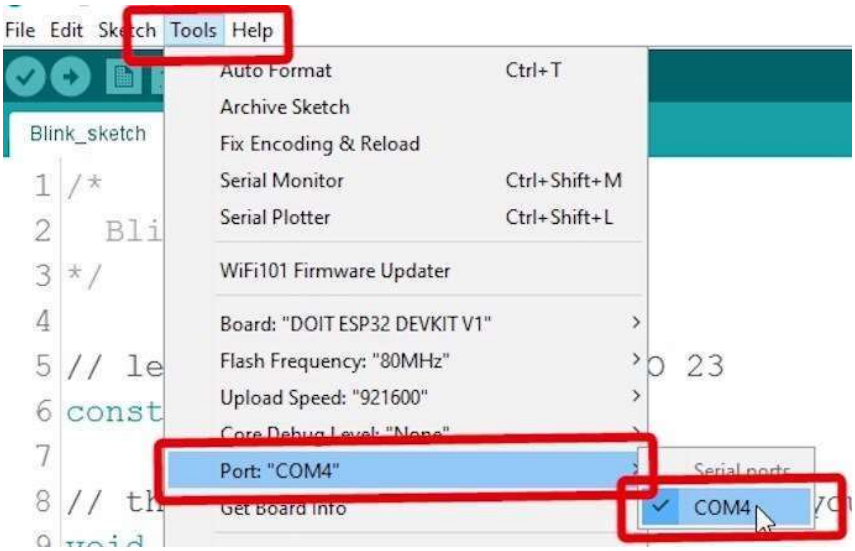
Start a Project

Plug the S.ODI Dev board to your computer. With your Arduino IDE open, follow these steps:

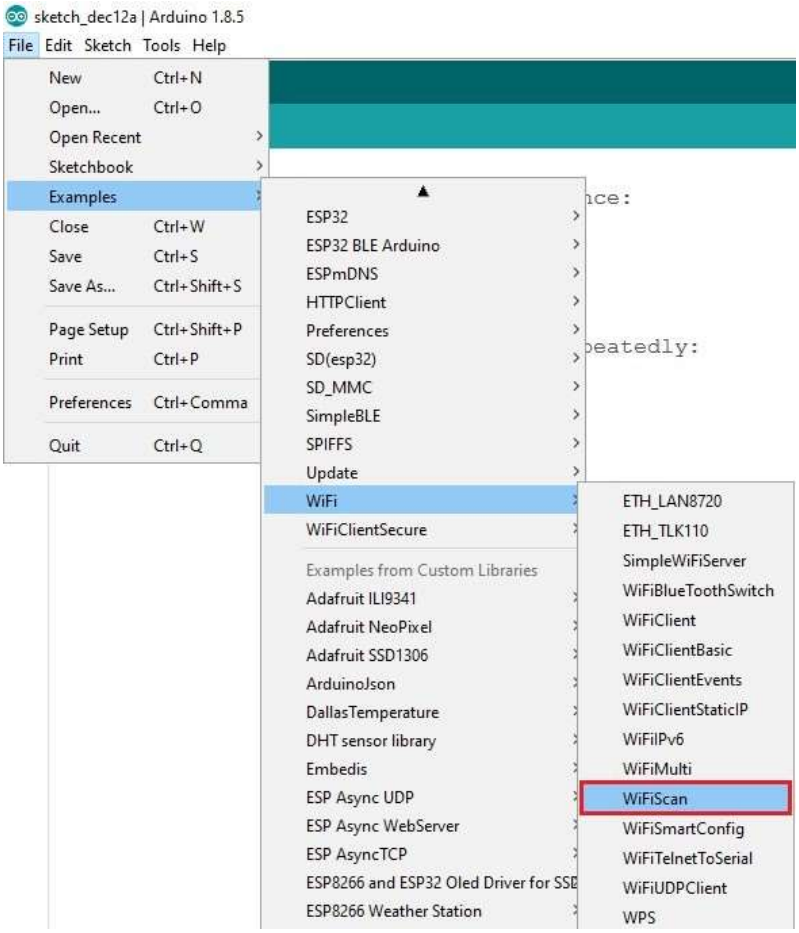
1. Select your Board in Tools > Board menu (in my case it's the)



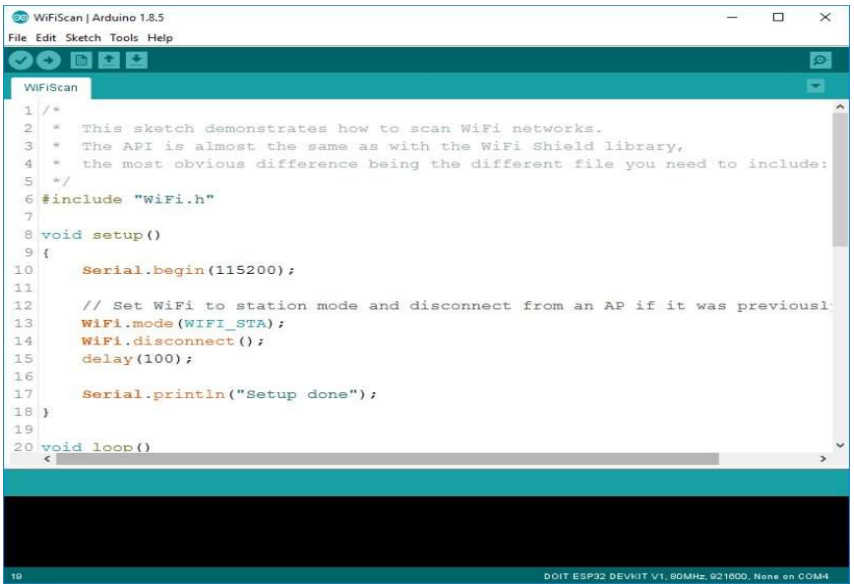
2. Select the Port (if you don't see the COM Port in your Arduino IDE, you need to install the CH340G USB to UART - TTL DRIVER):



3. Open the following example under File > Examples > WIFI (ESP32) > WIFI Scan

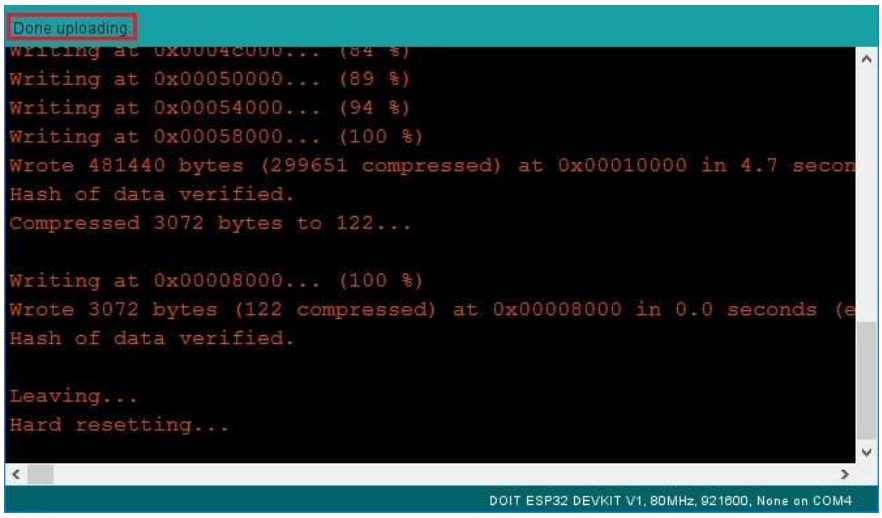


4. A new sketch opens in your Arduino IDE:



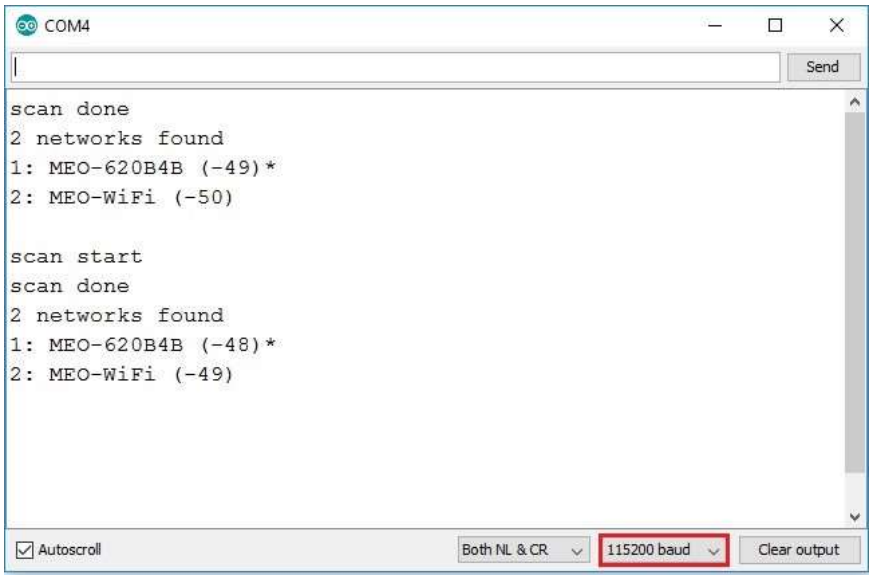
5. Press the Upload button in the Arduino IDE. Wait a few seconds while the code compiles and uploads to your board.

6. If everything went as expected, you should see a “Done uploading.” message.



7. Open the Arduino IDE Serial Monitor at a baud rate of 115200:

8. Press the S.ODI on-board Enable button and you should see the networks available near your S.ODI :



Libraries & Frameworks

Arduino-esp32 includes libraries for Arduino compatibility along with some object wrappers around hardware specific devices. Examples are included in the examples folder under each library folder. The ESP32 includes additional examples which need no special drivers.
https://github.com/espressif/arduino-esp32/tree/master/libraries

Arduino OTA: Over the Air firmware update daemon.
Use espota.py to upload to the device.

Async UDP: Asynchronous task driven UDP datagram client/server

Azure IoT: Library to interact with Microsoft Azure IoT services

ESPmDNS: mDNS service advertising

FFat: FAT indexed filesystem on SPI flash

FS: Filesystem virtualization framework

HTTP Client: A simple HTTP client, compatible with WiFiClientSecure

HTTP Update: Download a firmware update from HTTP and apply it using Update

SPI: Arduino compatible Serial Peripheral Interface driver (master only)

SPIFFS: SPI Flash Filesystem

(see spiffs-plugin to upload to device)

Ticker: A timer to call functions on an interval

Update Sketch Update using ESP32 OTA

Functionality.

BLE: Bluetooth Low Energy v4.2 client/server framework

Bluetooth Serial: Serial to Bluetooth redirection server

DNS Server: A basic UDP DNS daemon (includes captive portal demo)

EEPROM: Arduino compatibility for EEPROM (using flash)

NetBIOS: NetBIOS name advertiser

SD input: Secure Digital card filesystem using SPI access

SD_MMC: Secure Digital card filesystem using 4-lane access

Simple BLE: Minimal BLE advertiser

Webserver: A simple HTTP daemon
Wi-Fi Arduino compatible Wi-Fi driver (includes Ethernet driver)

Wi-Fi Client Secure: Arduino compatible Wi-Fi client object using embedded encryption

Wire: Arduino compatible I2C driver (master

ESP32 Additional examples

- Analog Out
- Camera
- Chip ID
- Deep Sleep
- ESP Now
- Free RTOS
- GPIO
- Hall Sensor
- I2S
- Reset Reason
- RMT
- Time
- Timer
- Touch

ESP-IDF installation guide

Related Documents

Go to this link to get support: ESP-IDF installation

Micro Python Installation Guide

Related Documents

Go to this link to get support: Micro Python Installation

Applications

- **Generic Low-power IoT Sensor Hub**
- **Generic Low-power IoT Data Loggers**
- **Cameras for Video Streaming**
- **Over-the-top (OTT) Devices**
- **Speech Recognition**
- **Image Recognition**
- **Mesh Network**
- **Home Automation**
  - Light control
  - Smart plugs
  - Smart door locks
- **Smart Building**
  - Smart lighting Energy monitoring
  - Smart cities
  - Smart Grids
- **Industrial Automation**
  - Industrial wireless control
  - Industrial robotics
- **Smart Agriculture**
- **Wi-Fi-enabled Toys**
  - Smart greenhouses
  - Remote control toys
  - Smart irrigation
  - Proximity sensing toys
  - Agriculture robotics
  - Educational toys
- **Audio Applications**

- **Wearable Electronics**
  - Internet music players
  - Smart watches
  - Live streaming devices
  - Smart bracelets
  - Internet radio players
  - Audio headsets
- **Service robots**
- **Health Care Applications**
  - Cleaning Robots
  - Health monitoring
  - Autonomous cars
  - Baby monitors
  - Automated Toll Gates

Product Comparisons

Based on trending boards available

Specs & Features	Arduino	Node-MCU	STM32(F103)	S.ODI ultra
processor cores	Single	Single	Single	**Dual**
Architecture	AVR RISC (8-Bit)	ESP8266(LX106) (32-Bit)	Arm Cortex-M3 (32-Bit)	**Xtensa LX6 (32-Bit)**
CPU frequency	16MHz	80MHz	72MHz	**240MHz**
Speed (1000000 operations)	7.11sec	3.82sec		**0.39sec**
Wi-Fi	No	Yes	No	**Yes**
Bluetooth	No	No	No	**Yes (v4.2)**
BLE	No	No	No	**Yes**
Flash	32KB	4MB	64KB	**16MB**
EEPROM	1KB	4 to 4096 Bytes	NA	**4KB**
SRAM	2KB	128KB	20KB	**520KB**
GPIO	14 (10-Bit)	17 (10-Bit)	32 (12-Bit)	**38** (12-Bit)
Busses	SPI, I2C, UART	SPI, I2C, UART, I2S	SPI, 2-I2C, 3-UART, CAN, USB	**High-Speed SPI, 2-I2C, 2-I2S, 3-UART, SDIO, CAN**

Proximity Sensor	No	No	No	**Yes**
LDR Sensor	No	No	No	**Yes**
IR Comm	No	No	No	**Yes**
DHT Sensor	No	No	No	**Yes**
Buzzer	No	No	No	**Yes**
Neo Pixel (RGB)	No	No	No	**Yes**
Relays (R1 & R2)	No	No	No	**Yes**
PWM	6	10	20	**32**
Input voltage	5v-9v	3.3v - 5v	2v – 3.6v	**5v - 25v**