smôl ESP32 Hookup Guide

Introduction

smôl is a new board format and, as the name suggests, they're *really* small!

smôl ESP32

◉ SPX-18619

The smôl ESP32 is a Processor Board for smôl, based on the excellent Espressif ESP32 processor.

Each smôl board measures just 1.60" by 0.42" (40.6mm by 10.7mm). We made the boards just wide enough so we could squeeze USB-C and 16-way Flexible Printed Circuit (FPC) connectors on there. Some of the boards have components on both top and bottom layers which again helps keep the boards small.

smôl boards are designed to stack one on top of the other, using 16-way 0.5mm-pitch FPCs to provide the interconnect from one board to the next. Each board has an **IN** FPC connector on the bottom layer and an **OUT** FPC connector on the top layer. The boards stack in a zig-zag daisy chain; signals and power are passed from one board to the next up and down the chain through the FPCs.

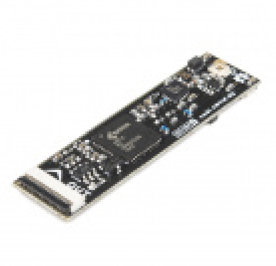
Required Materials

As a minimum, you're going to need a USB-C cable to connect your smôl ESP32 to your computer:

USB 3.1 Cable A to C - 3 Foot
◉ CAB-14743

Reversible USB A to C Cable - 2m
◉ CAB-15424

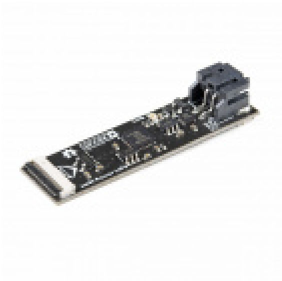
The ESP32 Processor Board is part of the smôl ecosystem. Why not pair it with one of the smôl Peripheral Boards?



smôl ARTIC R2
⊖ SPX-18618

smôl ZOE-M8Q
◉ SPX-18623

To be able to reduce the sleep current below 10µA, you're going to want to pair the ESP32 with one of our intelligent smôl Power Boards:



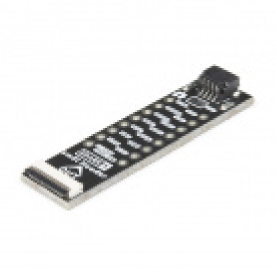
smôl Power Board LiPo
⊖ SPX-18622

smôl Power Board AAA
◉ SPX-18621

Don't forget that you will need Flexible Printed Circuits to connect your smôl boards together. You're going to need one FPC per board. Our 36mm FPC is the perfect length if you want the smôl boards to stack neatly, one on top of the other.

smôl 36mm 16-way Flexible Printed Circuit
◉ CAB-18731

Need to do some prototyping with smôl? Or want to connect standard SPI or Qwiic (I^2C) boards to your stack? The smôl Header is perfect for that:



smôl Header
◉ SPX-18620

Suggested Reading

This is the hookup guide for the smôl ESP32 Processor Board. Click the button below if you want to find out more about smôl itself.

GET STARTED WITH THE SMÔL HOOKUP GUIDE

We recommend taking a look through the following tutorials if you are not familiar with the concepts covered in them:

Serial Peripheral Interface (SPI)

I2C

SPI is commonly used to connect microcontrollers to peripherals such as sensors, shift registers, and SD cards.

An introduction to I2C, one of the main embedded communications protocols in use today.

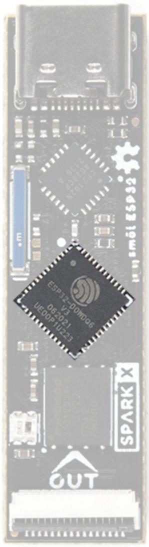
Hardware Overview

In this section we'll cover what's included on the smôl ESP32 Processor Board.

Espressif ESP32

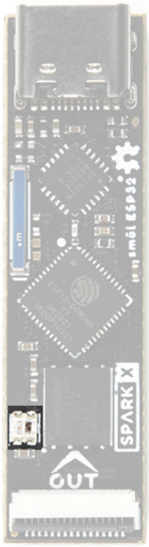
Ahhh, the Espressif ESP32. It's one of the most unique microcontrollers on the market. In it's native form, it has a laundry list of features. On the smôl Processor Board, we include the following:

- Dual-core Tensilica LX6 microprocessor
- Up to 240MHz clock frequency
- 520kB internal SRAM
- Integrated 802.11 B/G/N WiFi transceiver
- Hardware accelerated encryption (AES, SHA2, ECC, RSA-4096)
- 16MByte Flash Storage
- Typical current draw: from USB (5V); using on-board regulator; CP210x active:
    - SimpleWiFiServer (receive): 64.7mA (AVG); 59.1mA (MIN); 144mA (MAX)
    - SPIFFS_Test (writing): 87.4mA (AVG)
    - Light sleep: 11.1mA (AVG)
    - Deep sleep: 9.6mA (AVG)
- Typical current draw: from smôl 3.3V; on-board regulator disabled; CP210x inactive:
    - SimpleWiFiServer (receive): 63.6mA (AVG); 58.5mA (MIN); 142mA (MAX)
    - SPIFFS_Test (writing): 74.9mA (AVG)
    - Light sleep: 1.4mA (AVG)
    - Deep sleep: 450μA (AVG)
- The sleep current can be reduced to less than 10μA by pairing the smôl ESP32 with one of our intelligent Power Boards



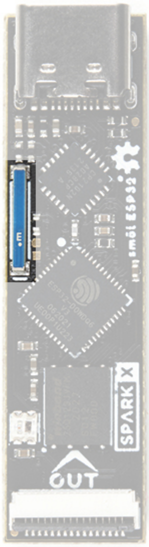
WS2812C RGB Status LED

We've included a miniature WS2812C RGB LED for visual status feedback:



Wireless Antenna

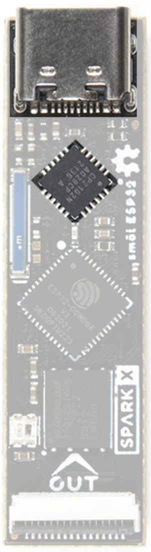
Need wireless? The Espressif chip provides a WiFi transceiver which sends and receives data through a 2.4GHz Antenna.



USB-C Connector and CP210x USB Interface

The USB-C connector allows you to connect the smôl ESP32 to your computer for programming and diagnostics.

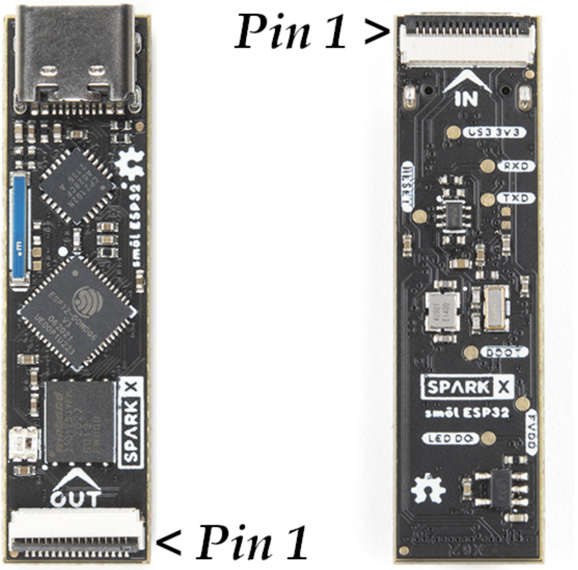
Important: If you've never connected a CP210x device to your computer before, you will need to install drivers for the USB-to-serial converter. Check out our section on How to Install CP2104 Drivers for help with the installation. If you try to use a default generic USB driver, automatic uploading from the Arduino IDE is likely to fail.



FPC Connections

Like all of our smôl boards, the ESP32 Processor Board is equipped with two 16-way 0.5mm-pitch Flexible Printed Circuit connectors. FPCs are used to link the smôl boards together in a daisy-chain.

The pin-out for the smôl ESP32 is as follows:



Connector Pin No.	Signal Name	Function	Arduino Digital Pin No.
1	PROC_PWR_EN	Processor Power Enable	N/A
2	3V3	3.3V Power Rail	N/A
3	GND	Power Ground / 0V	N/A
4	SCLK	SPI Clock	18
5	COPI	SPI Controller Out Peripheral In	23

6	CIPO	SPI Controller In Peripheral Out	19
7	CS0	SPI Chip Select 0	5
8	CS1	SPI Chip Select 1	14
8	CS2	SPI Chip Select 2	13
10	GPIO0	General Purpose Input / Output 0	27
11	GPIO1	General Purpose Input / Output 1	26
12	SDA	I^{2}C Data	21
13	SCL	I^{2}C Clock	22
14	GND	Power Ground / 0V	N/A
15	3V3	3.3V Power Rail	N/A
16	V_USB	USB Power Rail (5V)	N/A

The IN and OUT pin connections are identical on the smôl ESP32. (That's not always true on smôl Peripheral Boards. Check the Peripheral Board Hookup Guide for full details.)

We use a technique called *waterfalling* on the SPI Chip Select and GPIO signals. If you haven't used waterfalling before, please check out the smôl Hookup Guide.

The smôl ESP32 has an on-board 3.3V regulator for stand-alone use, powered by 5V from the USB-C connector. The PROC_PWR_EN signal allows a smôl Power Board to disable the Processor Board regulator. Please see the smôl Hookup Guide for more details.

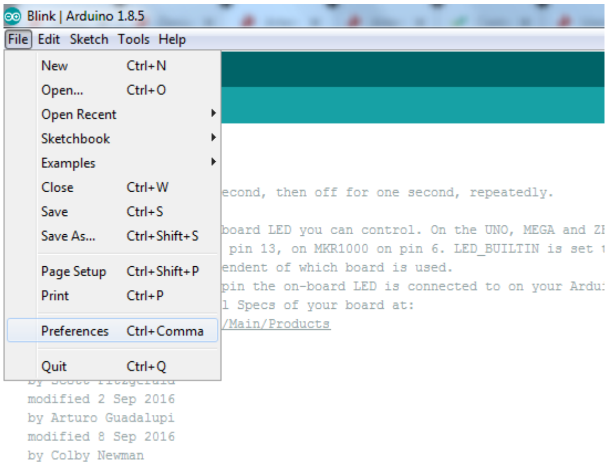
GET STARTED WITH THE SMÔL HOOKUP GUIDE

Software Setup and Programming

Note: All of the examples in this tutorial assume you are using the latest version of the Arduino IDE on your desktop. If this is your first time using Arduino, please review our tutorial on installing the Arduino IDE. If you have not previously installed an Arduino library, please check out our installation guide.

Important: If you've never connected a CP210x device to your computer before, you will need to install drivers for the USB-to-serial converter. Check out our section on How to Install CP2104 Drivers for help with the installation. If you try to use a default generic USB driver, automatic uploading from the Arduino IDE is likely to fail.

To get started with the smôl ESP32 Processor Board, you'll need to install the ESP32 Board Definition. Open the Arduino IDE (must be v1.8.13 or later) and navigate to **File**->**Preferences**, like so:



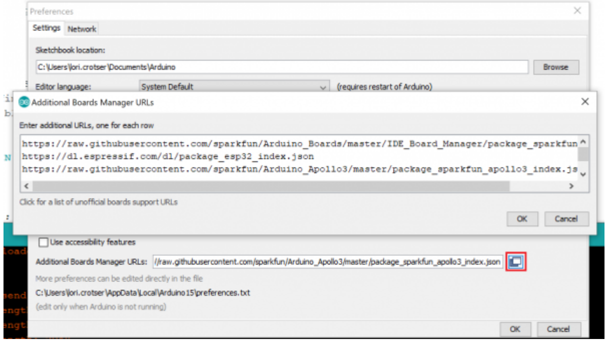
```
econd, then off for one second, repeatedly.

board LED you can control. On the UNO, MEGA and ZE
 pin 13, on MKR1000 on pin 6. LED_BUILTIN is set t
endent of which board is used.
pin the on-board LED is connected to on your Ardu:
l Specs of your board at:
/Main/Products
by Scott Fitzgerald
modified 2 Sep 2016
by Arturo Guadalupi
modified 8 Sep 2016
by Colby Newman
```

Having a hard time seeing? Click the image for a closer look.

In the "Additional Board Manager URL" box, make sure you have the following two json files included. If you do not have them, add them to your preferences.

```
https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.json
https://raw.githubusercontent.com/sparkfun/Arduino_Boards/main/IDE_Board_Manager/package_sparkfu
n_index.json
```

If you have more than one json file, you can click on the button outlined in red and add the json links at the end. It'll look something like the following:



Sketchbook location: C:\Users\lori.crotser\Documents\Arduino

Editor language: System Default (requires restart of Arduino)

Enter additional URLs, one for each row

```
https://raw.githubusercontent.com/sparkfun/Arduino_Boards/master/IDE_Board_Manager/package_sparkfun
https://dl.espressif.com/dl/package_esp32_index.json
https://raw.githubusercontent.com/sparkfun/Arduino_Apollo3/master/package_sparkfun_apollo3_index.js
```

Click for a list of unofficial boards support URLs

□ Use accessibility features

Additional Boards Manager URLs: //raw.githubusercontent.com/sparkfun/Arduino_Apollo3/master/package_sparkfun_apollo3_index.json

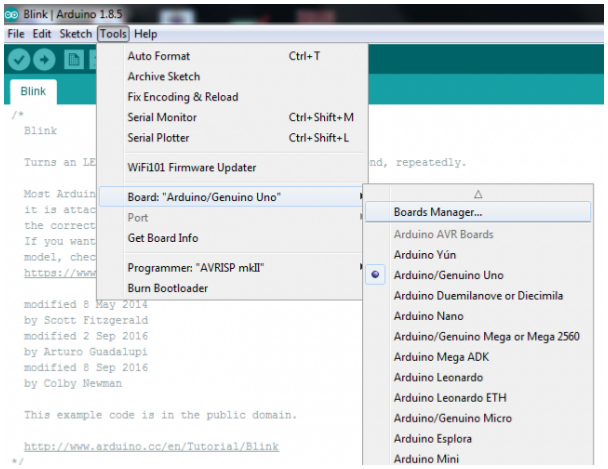
More preferences can be edited directly in the file

C:\Users\lori.crotser\AppData\Local\Arduino15\preferences.txt

(edit only when Arduino is not running)

Having a hard time seeing? Click the image for a closer look.

Once you've got your preferences updated, go to **Tools** -> **Board** and select the **Boards Manager** like so:



```
/*
  Blink

  Turns an LE                                nd, repeatedly.

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  it is attac
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  model, chec
  https://www

  modified 8 May 2014
  by Scott Fitzgerald
  modified 2 Sep 2016
  by Arturo Guadalupi
  modified 8 Sep 2016
  by Colby Newman

  This example code is in the public domain.

  http://www.arduino.cc/en/Tutorial/Blink
*/
```
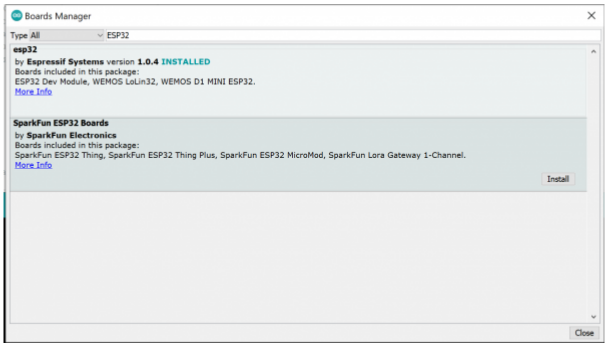

Having a hard time seeing? Click the image for a closer look.

Search for "ESP32", and you should find both the **esp32** and **SparkFun ESP32 Boards** board packages. Make sure the latest version selected and click **Install** for the **esp32** boards. Repeat for the **SparkFun ESP32 Boards**.



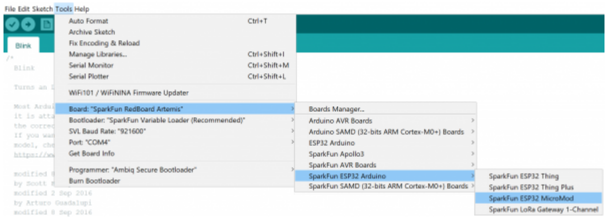
ESP32

esp32
by Espressif Systems version 1.0.4 INSTALLED
Boards included in this package:
ESP32 Dev Module, WEMOS LoLin32, WEMOS D1 MINI ESP32.
More Info

SparkFun ESP32 Boards
by SparkFun Electronics
Boards included in this package:
SparkFun ESP32 Thing, SparkFun ESP32 Thing Plus, SparkFun ESP32 MicroMod, SparkFun Lora Gateway 1-Channel.
More Info

Having a hard time seeing? Click the image for a closer look.

Once the board definitions have been installed, you should see the **SparkFun ESP32 Thing** Board under your **Tools -> Board -> SparkFun ESP32 Arduino** menu. The smôl ESP32 uses the same board definition as the SparkFun ESP32 Thing; select that (and ignore the Thing Plus, MicroMod and LoRa Gateway options).



File Edit Sketch Tools Help
Blink
Auto Format Ctrl+T
Archive Sketch
Fix Encoding & Reload
Manage Libraries... Ctrl+Shift+I
Serial Monitor Ctrl+Shift+M
Serial Plotter Ctrl+Shift+L
WiFi101 / WiFiNINA Firmware Updater
Board: "SparkFun RedBoard Artemis"
Bootloader: "SparkFun Variable Loader (Recommended)"
SVL Baud Rate: "921600"
Port: "COM4"
Get Board Info
Programmer: "Ambiq Secure Bootloader"
Burn Bootloader
Boards Manager...
Arduino AVR Boards
Arduino SAMD (32-bits ARM Cortex-M0+) Boards
ESP32 Arduino
SparkFun Apollo3
SparkFun AVR Boards
SparkFun ESP32 Arduino
SparkFun SAMD (32-bits ARM Cortex-M0+) Boards
SparkFun ESP32 Thing
SparkFun ESP32 Thing Plus
SparkFun ESP32 MicroMod
SparkFun LoRa Gateway 1-Channel

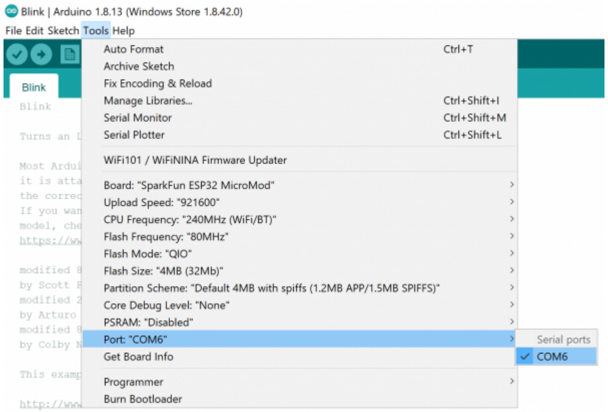
Note: Our board definition package should install all of the tools needed to compile code for the ESP32. If you run into trouble having code compile or downloading due to tools not being found, you may need to install Espressif's Arduino ESP32 package manually.

Voila! You're ready to rock with your smôl ESP32 Processor Board!

Arduino Example: RGB_LED

With the SparkFun ESP32 Arduino core installed, you're ready to begin programming. Make sure you have the **ESP32 Thing** definition selected under your **Tools** > **Board** menu, then it is time to connect your smôl ESP32 to your computer using a USB-C cable.

Next, select your serial port under the **Tools** > **Port** menu.



Blink | Arduino 1.8.13 (Windows Store 1.8.42.0)

Board: "SparkFun ESP32 MicroMod"
Upload Speed: "921600"
CPU Frequency: "240MHz (WiFi/BT)"
Flash Frequency: "80MHz"
Flash Mode: "QIO"
Flash Size: "4MB (32Mb)"
Partition Scheme: "Default 4MB with spiffs (1.2MB APP/1.5MB SPIFFS)"
Core Debug Level: "None"
PSRAM: "Disabled"
Port: "COM6"

File Edit Sketch Tools Help
Blink
Auto Format Ctrl+T
Archive Sketch
Fix Encoding & Reload
Manage Libraries... Ctrl+Shift+I
Serial Monitor Ctrl+Shift+M
Serial Plotter Ctrl+Shift+L
WiFi101 / WiFiNINA Firmware Updater
Get Board Info
Programmer
Burn Bootloader
Serial ports
✓ COM6

Having a hard time seeing? Click the image for a closer look.

You can also select the **Upload Speed: "921600"** baud -- the fastest selectable rate -- will get the code loaded onto your ESP32 the fastest, but may fail to upload once-in-a-while. (It's still way worth it for the speed increase!)

Loading the RGB_LED Demo

To make sure your toolchain and board are properly set up, we'll upload a simple sketch -- RGB_LED! The WS2812C LED on the ESP32 Processor Board is perfect for this test. Copy and paste the example sketch below into a fresh Arduino sketch:

```
// smôl ESP32 LED Demo
//
// Select SparkFun ESP32 Thing as the board
//
// Make sure you have the correct drivers installed for the Silicon Labs
// CP210x USB to UART Bridge otherwise the automatic upload may fail
// https://www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers

#include <FastLED.h> // http://librarymanager/All#FastLED

#define LED_PIN     25 //GPIO25 on smôl ESP32 is connected to WS2812 LED
#define COLOR_ORDER GRB
#define CHIPSET     WS2812
#define NUM_LEDS    1

#define BRIGHTNESS  50

CRGB leds[NUM_LEDS];

uint8_t gHue = 0; // rotating "base color" used by many of the patterns

void setup() {
    delay(30); // sanity delay
    FastLED.addLeds<CHIPSET, LED_PIN, COLOR_ORDER>(leds, NUM_LEDS).setCorrection( TypicalLEDStri
p );
    FastLED.setBrightness( BRIGHTNESS );
}

void loop()
{
  fill_rainbow( leds, NUM_LEDS, gHue, 7);
  FastLED.show();

  EVERY_N_MILLISECONDS( 10 ) { gHue++; } // cycle the "base color" through the rainbow
}
```

With everything set up correctly, click the arrow icon to upload the code! Once the code finishes transferring, the RGB LED should start cycling through all the colors of the rainbow. Hypnotic isn't it?!

Troubleshooting

If you haven't used the fantastic **FastLED** library before, you will need to install it through the IDE Library Manager. The easiest way to do that is to click the link next to the `#include <FastLED.h>` . When the Library Manager has finished searching, select the latest version of FastLED and click Install.

If the code fails to upload when you click the upload (arrow) icon, check you have the correct port selected and have the official CP210x driver installed. If you're trying to use a generic USB driver, it won't be able to initialize the Bootloader via DTR and RTS pins.

Further Examples

You can find more tried-and-tested examples in the GitHub repo:

- **SPIFFS_Test** will format part of the Processor Board's flash memory as an SPI Flash File System and check it is working correctly by creating, editing, renaming and deleting a text file
- **SimpleWiFiServer** is a fun little demo:
  - Edit the code and replace `yourssid` and `yourpasswd` with the name and password of your WiFi network
  - Upload the code and open the Arduino IDE **Tools** > **Serial Monitor** at 115200 baud to see the diagnostic messages
  - Make a note of the smôl ESP32's IP Address
  - Open a web browser on your computer and open the web page at `http://nnn.nnn.nnn.nnn` where *nnn.nnn.nnn.nnn* is the smôl ESP32's IP address
  - Click the web page buttons to change the color of the RGB LED

Troubleshooting

Not working as expected and need help? SparkX products are rapidly produced to bring you the most cutting edge technology as it becomes available. These products are tested but come with no guarantees. Live technical support is not available for SparkX products. Head on over to our forum for support or to ask a question and we will get back to you as soon as we can.

Resources and Going Further

For more information about the smôl ESP32 Processor Board, check out the following links:

- Schematic
- Eagle Files
- Board Dimensions
- Datasheet (ESP32-D0WDQ6-V3)
- GitHub Hardware Repo
- Arduino Examples

smôl Documentation:

- smôl Hookup Guide

ESP32 Documentation:

- ESP32.com
- Espressif ESP32 Resource Page