

**ESPRESSIF ESP32-C3-MINI-1 Wi-Fi and Bluetooth LE Module**



# ESPRESSIF ESP32-C3-MINI-1 Wi-Fi and Bluetooth LE Module User Manual

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**ESPRESSIF ESP32-C3-MINI-1 Wi-Fi and Bluetooth LE Module**



## Specifications

- **Protocols:** Wi-Fi and Bluetooth LE
- **Frequency Range:** Not specified
- **Radio Module Interfaces:** Integrated crystal
- **Operating Voltage/Power Supply:** Not specified
- **Operating Current:** 500 mA
- **Minimum Current Delivered by Power Supply:** Not specified
- **Ambient Temperature:** Not specified
- **Moisture Sensitivity Level (MSL):** Not specified

## Module Overview

The ESP32-C3-MINI-1 is a general-purpose Wi-Fi and Bluetooth LE module suitable for smart homes, industrial automation, health care, consumer electronics, etc. Its rich set of peripherals and small size make it an ideal choice for various applications.

## Pin Description

- The module has 53 pins with various functions including GPIO, power supply, and control pins. Refer to the pin layout diagram for more details.

## Pin Layout

- Before starting, ensure you have all the necessary hardware components and tools required for working with the ESP32-C3-MINI-1 module.

## **Hardware Connection**

- Connect the ESP32-C3-MINI-1 module to your development setup following the pin descriptions provided in the manual.

## **Install Prerequisites**

- Install all necessary software and tools required for ESP32-C3-MINI-1 development.

## **Get ESP-IDF**

- Download and set up the ESP-IDF (Espressif IoT Development Framework) for programming the module.

## **Set up Tools**

- Configure development tools such as IDEs, compilers, and debuggers for ESP32-C3-MINI-1 development.

## **Set up Environment Variables**

- Set up environment variables to ensure proper functioning of the development environment.

## **FAQ**

### **Q: Where can I find the latest version of the user manual?**

**A:** You can always refer to the latest version at <https://www.espressif.com/en/support/download/documents>.

### **Q: How many pins does the ESP32-C3-MINI-1 module have?**

**A:** The module has a total of 53 pins with various functions.  
Refer to the pin definitions in the manual for details.

## **About This Document**

- This user manual shows how to get started with the ESP32-C3-MINI-1 module.

## **Document Updates**

- Please always refer to the latest version at <https://www.espressif.com/en/support/download/documents>.

## **Revision History**

- For the revision history of this document, please refer to the last page.

## Documentation Change Notification

- Espressif provides email notifications to keep you updated on changes to technical documentation. Please subscribe at [www.espressif.com/en/subscribe](http://www.espressif.com/en/subscribe).

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## Overview

### Module Overview

ESP32-C3-MINI-1 is a general-purpose Wi-Fi and Bluetooth LE module. The rich set of peripherals and small size make this module an ideal choice for smart homes, industrial automation, health care, consumer electronics, etc.

**Table 1: ESP32C3MINI1 Specifications**

Categories	Parameters	Specifications
Wi-Fi	Protocols	802.11 b/g/n (up to 150 Mbps)
	Frequency range	2412 ~ 2462 MHz
Bluetooth®	Protocols	Bluetooth® LE: Bluetooth 5 and Bluetooth mesh
	Radio	Class-1, class-2 and class-3 transmitter
Hardware	Module interfaces	GPIO, SPI, UART, I2C, I2S, remote control peripheral, LED PWM controller, general DMA controller, TWAI® c controller (compatible with ISO 11898-1), temperature sensor, SAR ADC
	Integrated crystal	40 MHz crystal
	Operating voltage/Power supply	3.0 V ~ 3.6 V
	Operating current	Average: 80 mA
	Minimum current delivered by power supply	500 mA
	Ambient temperature	–40 °C ~ +105 °C
	Moisture sensitivity level (MSL)	Level 3

## Pin Description

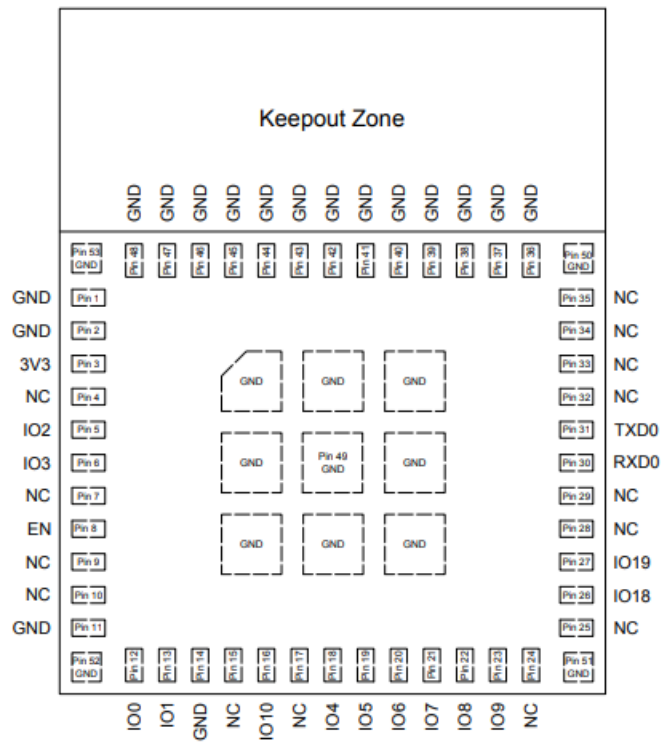


Figure 1: Pin Layout (Top View)

The module has 53 pins. See pin definitions in Table 2.

For peripheral pin configurations, please refer to the [ESP32-C3 Family Datasheet](#).

Table 2: Pin Definitions

Name	No.	Type	Function
GND	1, 2, 11, 14, 36-53	P	Ground
3V3	3	P	Power supply
NC	4	—	NC
IO2	5	I/O/T	GPIO2, ADC1_CH2, FSPIQ
IO3	6	I/O/T	GPIO3, ADC1_CH3
NC	7	—	NC
EN	8	I	High: on, enables the chip. Low: off, the chip powers off. Note: Do not leave the EN pin floating.
NC	9	—	NC
NC	10	—	NC

Name	No.	Type	Function
IO0	12	I/O/T	GPIO0, ADC1_CH0, XTAL_32K_P

IO1	13	I/O/T	GPIO1, ADC1_CH1, XTAL_32K_N
NC	15	—	NC
IO10	16	I/O/T	GPIO10, FSPICS0
NC	17	—	NC
IO4	18	I/O/T	GPIO4, ADC1_CH4, FSPiHD, MTMS
IO5	19	I/O/T	GPIO5, ADC2_CH0, FSPiWP, MTDI
IO6	20	I/O/T	GPIO6, FSPiCLK, MTCK
IO7	21	I/O/T	GPIO7, FSPiD, MTDO
IO8	22	I/O/T	GPIO8
IO9	23	I/O/T	GPIO9
NC	24	—	NC
NC	25	—	NC
IO18	26	I/O/T	GPIO18
IO19	27	I/O/T	GPIO19
NC	28	—	NC
NC	29	—	NC
RXD0	30	I/O/T	GPIO20, U0RXD,
TXD0	31	I/O/T	GPIO21, U0TXD
NC	32	—	NC
NC	33	—	NC
NC	34	—	NC

NC	35	—	NC
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## Get Started on ESP32C3MINI1

### What You Need

- To develop applications for the ESP32-C3-MINI-1 module you need.
- 1 x ESP32-C3-MINI-1 module
- 1 x Espressif RF testing board
- 1 x USB-to-Serial board
- 1 x Micro-USB cable
- 1 x PC running Linux
- In this user guide, we take the Linux operating system as an example. For more information about the configuration on Windows and macOS, please refer to the [ESP-IDF Programming Guide](#).

### Hardware Connection

1. Solder the ESP32-C3-MINI-1 module to the RF testing board as shown in Figure 2.

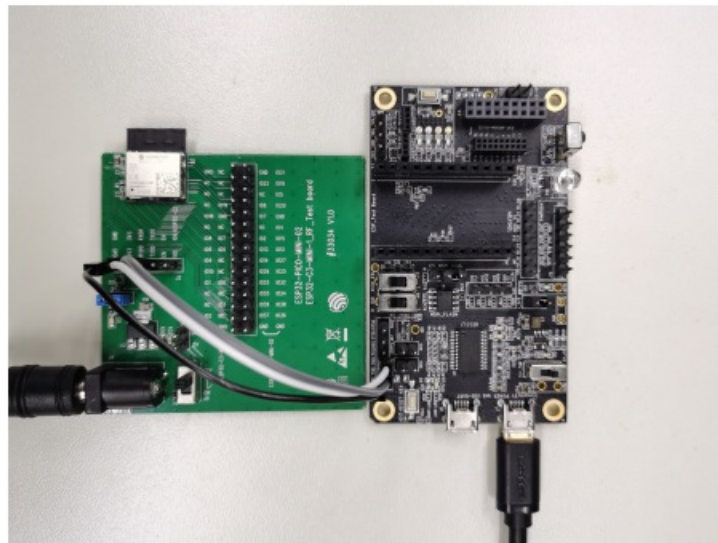


Figure 2: Hardware Connection

2. Connect the RF testing board to the USB-to-Serial board via TXD, RXD, and GND.
3. Connect the USB-to-Serial board to the PC.
4. Connect the RF testing board to the PC or a power adapter to enable a 5 V power supply, via the Micro-USB cable.
5. During download, connect IO0 to GND via a jumper. Then, turn "ON" the testing board.
6. Download firmware into Flash. For details, see the sections below.
7. After downloading, remove the jumper on IO0 and GND.
8. Power up the RF testing board again. ESP32-C3-MINI-1 will switch to working mode. The chip will read programs from Flash upon initialization.

**Note:** IO0 is internally logic high. If IO0 is set to pull-up, the Boot mode is selected. If this pin is pull-down or left floating, the Download mode is selected. For more information on ESP32-C3-MINI-1, please refer to ESP32-C3-MINI-1 Datasheet.

- CentOS 7.

```
1 sudo yum install git wget flex bison gperf python cmake ninja-build ccache dfu-util
```

- Ubuntu and Debian (one command breaks into two lines).

```
1 sudo apt-get install git wget flex bison gperf python python-pip python-setuptools cmake
2 ninja-build ccache libffi-dev libssl-dev dfu-util
```

- Arch.

```
1 sudo pacman -S --needed gcc git make flex bison gperf python-pip cmake ninja-ccache dfu-util
```

## Note:

- This guide uses the directory ~/esp on Linux as an installation folder for ESP-IDF.
- Keep in mind that ESP-IDF does not support spaces in paths.

## Get ESPIDF

- To build applications for the ESP32-C3-MINI-1 module, you need the software libraries provided by Espressif in the [ESP-IDF repository](#).
- To get ESP-IDF, create an installation directory (~/esp) to download ESP-IDF to and clone the repository with 'git clone':

```
1 mkdir -p ~/esp
2 cd ~/esp
3 git clone --recursive https://github.com/espressif/esp-idf.git
```

- ESP-IDF will be downloaded into ~/esp/esp-idf. Consult [ESP-IDF Versions](#) for information about which ESP-IDF version to use in a given situation.

## Set up Tools

- Aside from the ESP-IDF, you also need to install the tools used by ESP-IDF, such as the compiler, debugger, Python packages, etc. ESP-IDF provides a script named 'install. sh,' to help set up the tools in one go.

```
1 cd ~/esp/esp-idf
2 ./install.sh
```

## Set up Environment Variables

- The installed tools are not yet added to the PATH environment variable. To make the tools usable from the command line, some environment variables must be set.
- ESP-IDF provides another script 'export. sh,' which does that. In the terminal where you are going to use ESP-IDF, run:

```
1 . $HOME/esp/esp-idf/export.sh
```



- Now everything is ready, you can build your first project on the ESP32-C3-MINI-1 module.

## Create Your First Project Start a Project

- Now you are ready to prepare your application for the ESP32-C3-MINI-1 module. You can start with the [get-started/hello\\_world](#) project from the [examples directory](#) in ESP-IDF.
- Copy get-started/hello\_world to ~/esp directory:

```
1 cd ~/esp
2 cp -r $IDF_PATH/examples/get-started/hello_world .
```

- There is a range of [example projects](#) in the examples directory in ESP-IDF. You can copy any project in the same way as presented above and run it. It is also possible to build examples in place, without copying them first.

## Connect Your Device

- Now connect your ESP32-C3-MINI-1 module to the computer and check under what serial port the module is visible. Serial ports in Linux start with '/dev/tty' in their names.
- Run the command below two times, first with the board unplugged, then with plugged in. The port which appears the second time is the one you need:

```
1 ls /dev/tty*
```

- **Note:** Keep the port name handy as you will need it in the next steps.

## Configure

- Navigate to your 'hello\_world' directory from Step 2.4.1. Start a Project, set ESP32-C3 as the target, and run the project configuration utility 'menuconfig'.

```
1 cd ~/esp/hello_world
2 idf.py set-target esp32c3
3 idf.py menuconfig
```

- Setting the target with 'idf.py set-target esp32c3' should be done once, after opening a new project. If the project contains some existing builds and configurations, they will be cleared and initialized.
- The target may be saved in the environment variable to skip this step at all. See [Selecting the Target](#) for additional information.
- If the previous steps have been done correctly, the following menu appears:

```
(Top)
      Espressif IoT Development Framework Configuration
SDK tool configuration --->
Build type --->
Application manager --->
Bootloader config --->
Security features --->
Serial flasher config --->
Partition Table --->
Compiler options --->
Component config --->
Compatibility options --->

[Space/Enter] Toggle/enter  [ESC] Leave menu          [S] Save
[O] Load                  [?] Symbol info          [/] Jump to symbol
[F] Toggle show-help mode  [C] Toggle show-name mode [A] Toggle show-all mode
[Q] Quit (prompts for save) [D] Save minimal config (advanced)
```

Figure 3: Project Configuration - Home Window

- The colors of the menu could be different in your terminal. You can change the appearance with the option ‘--style’. Please run ‘idf.py menu config --help’ for further information.

## Build the Project

- Build the project by running

```
1 idf.py build
```

- This command will compile the application and all ESP-IDF components, and then it will generate the bootloader, partition table, and application binaries.

```
1 $ idf.py build
2 Running cmake in directory /path/to/hello_world/build
3 Executing "cmake -G Ninja --warn-uninitialized /path/to/hello_world"...
4 Warn about uninitialized values.
5 -- Found Git: /usr/bin/git (found version "2.17.0")
6 -- Building empty aws_iot component due to configuration
7 -- Component names: ...
8 -- Component paths: ...
9
10 ... (more lines of build system output)
11
12 [527/527] Generating hello-world.bin
13 esptool.py v2.3.1
14
15 Project build complete. To flash, run this command:
16 ../../../../components/esptool_py/esptool/esptool.py -p (PORT) -b 921600 write_flash --flash_
    mode dio
17 --flash_size detect --flash_freq 40m 0x10000 build/hello-world.bin build 0x1000
18 build/bootloader/bootloader.bin 0x8000 build/partition_table/partition-table.bin
19 or run 'idf.py -p PORT flash'
```

- If there are no errors, the build will finish by generating the firmware binary .bin file.

## Flash onto the Device

- Flash the binaries that you just built onto your ESP32-C3-MINI-1 module by running.

```
1 idf.py -p PORT [-b BAUD] flash
```

- Replace PORT with your module's serial port name from Step: Connect Your Device.
- You can also change the flasher baud rate by replacing BAUD with the baud rate you need. The default baud rate is 460800.
- For more information on idf.py arguments, see [idf.py](#).
- **Note:** The option 'flash' automatically builds and flashes the project, so running 'idf.py build' is not necessary.

```
1      ...
2      esptool.py --chip esp32c3 -p /dev/ttyUSB0 -b 460800 --before=default_reset --after
      =hard_reset write_flash --flash_mode dio --flash_freq 80m --flash_size 2MB 0x
      8000 partition_table/partition-table.bin 0x0 bootloader/bootloader.bin 0x10000
      hello-world.bin
3      esptool.py v3.0
4      Serial port /dev/ttyUSB0
5      Connecting...
6      Chip is ESP32-C3
7      Features: Wi-Fi
8      Crystal is 40MHz
9      MAC: 7c:df:a1:40:02:a4
10     Uploading stub...
11     Running stub...
12     Stub running...
13     Changing baud rate to 460800
14     Changed.
15     Configuring flash size...
16     Compressed 3072 bytes to 103...
17     Writing at 0x00008000... (100 %)
18     Wrote 3072 bytes (103 compressed) at 0x00008000 in 0.0 seconds (effective 4238.1
      kbit/s)...
19     Hash of data verified.
```

```

20     Compressed 18960 bytes to 11311...
21     Writing at 0x00000000... (100 %)
22     Wrote 18960 bytes (11311 compressed) at 0x00000000 in 0.3 seconds (effective 584.9
        kbit/s)...
23     Hash of data verified.
24     Compressed 145520 bytes to 71984...
25     Writing at 0x00010000... (20 %)
26     Writing at 0x00014000... (40 %)
27     Writing at 0x00018000... (60 %)
28     Writing at 0x0001c000... (80 %)
29     Writing at 0x00020000... (100 %)
30     Wrote 145520 bytes (71984 compressed) at 0x00010000 in 2.3 seconds (effective
        504.4 kbit/s)...
31     Hash of data verified.
32
33     Leaving...
34     Hard resetting via RTS pin...
35     Done

```

- If everything goes well, the “hello\_world” application starts running after you remove the jumper on IO0 and GND, and re-power up the testing board.

## Monitor

- To check if “hello\_world” is indeed running, type ‘idf.py -p PORT monitor’ (Do not forget to replace PORT with your serial port name).

```

1  $ idf.py -p /dev/ttyUSB0 monitor
2  Running idf_monitor in directory [...]/esp/hello_world/build
3  Executing "python [...]/esp-idf/tools/idf_monitor.py -b 115200 [...]/esp/hello_world/build
    /hello-world.elf"...
4  --- idf_monitor on /dev/ttyUSB0 115200 ---
5  --- Quit: Ctrl+] | Menu: Ctrl+T | Help: Ctrl+T followed by Ctrl+H ---
6  ets Jun  8 2016 00:22:57
7
8  rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
9  ets Jun  8 2016 00:22:57
10 ...

```

## This command launches the IDF Monitor application:

- After startup and diagnostic logs scroll up, you should see “Hello world!” printed out by the application.

```

1  ...
2  Hello world!
3  Restarting in 10 seconds...
4  This is esp32c3 chip with 1 CPU core, WiFi/BLE, 4MB external flash
5  Restarting in 9 seconds...
6  Restarting in 8 seconds...
7  Restarting in 7 seconds...

```

- To exit the IDF monitor use the shortcut Ctrl+].
- That's all that you need to get started with the ESP32-C3-MINI-1 module! Now you are ready to try some other [examples](#) in ESP-IDF or go right to developing your applications.

## Learning Resources

### MustRead Documents

- Please familiarize yourself with the following documents.
- [ESP32-C3 Family Datasheet](#)
  - This is an introduction to the specifications of the ESP32-C3 hardware, including overview, pin definitions, functional description, peripheral interface, electrical characteristics, etc.
- [ESP-IDF Programming Guide](#)
  - Extensive documentation for the ESP-IDF development framework, ranging from hardware guides to API references.
- [ESP32-C3 Technical Reference Manual](#)
  - Detailed information on how to use the ESP32-C3 memory and peripherals.
- [Espressif Products Ordering Information](#)

### Important Resources

- Here are the important ESP32-C3-related resources.
- [ESP32 BBS](#) Engineer-to-Engineer (E2E) Community for Espressif products where you can post questions, share knowledge, explore ideas, and help solve problems with fellow engineers.

## Revision History

Date	Version	Release notes
2021-02-01	V0.1	Preliminary release

### List of Applicable FCC Rules

- FCC Part 15 Subpart C 15.247 & 15.209

### Specific Operational Use Conditions

- The module has WiFi and BLE functions.

### Operation Frequency:

- **WiFi:** 2412 ~ 2462 MHz
- **Bluetooth:** 2402 ~ 2480 MHz

### Number of Channels:

- **WiFi:** 12
- **Bluetooth:** 40

#### **Modulation:**

- **WiFi:** DS; OFDM
- **Bluetooth:** GFSK
- **Type:** On-board PCB antenna
- **Gain:** 3.96 dBi Max

The module can be used for IoT applications with a maximum 3.96 dBi antenna. The host manufacturer installing this module into their product must ensure that the final composite product complies with the FCC requirements by a technical assessment or evaluation of the FCC rules, including the transmitter operation. The host manufacturer has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warnings as shown in this manual.

#### **Limited Module Procedures**

Not applicable. The module is a single module and complies with the requirement of FCC Part 15.212.

#### **Trace Antenna Designs**

Not applicable. The module has its antenna and does not need a host's printed board microstrip trace antenna, etc.

#### **RF Exposure Considerations**

The module must be installed in the host equipment such that at least 20cm is maintained between the antenna and user body; and if the RF exposure statement or module layout is changed, then the host product manufacturer is required to take responsibility for the module through a change in FCC ID or new application. The FCC ID of the module cannot be used on the final product.

In these circumstances, the host manufacturer will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

#### **Antenna specifications are as follows:**

- **Type:** On-board PCB antenna
- **Gain:** 3.96 dB
- This device is intended only for host manufacturers under the following conditions:
  - The transmitter module may not be co-located with any other transmitter or antenna.
  - The module shall be only used with the external antenna(s) that have been originally tested and certified with this module.
  - The antenna must be either permanently attached or employ a 'unique ' antenna coupler.
- As long as the conditions above are met, further transmitter tests will not be required. However, the host manufacturer is still responsible for testing their end product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

## Label and Compliance Information

- Host product manufacturers need to provide a physical or e-label stating “Contains FCC ID: 2BDC6-SHELLYXMOD1H8” with their finished product.
- Information on test modes and additional testing requirements

## Operation Frequency:

- **WiFi:** 2412 ~ 2462 MHz
- **Bluetooth:** 2402 ~ 2480 MHz

## Number of Channels:

- **WiFi:** 12
- **Bluetooth:** 40

## Modulation:

- **WiFi:** DS; OFDM
- **Bluetooth:** GFSK
- Host manufacturers must perform tests of radiated and conducted emission and spurious emission, etc., according to the actual test modes for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product. Only when all the test results of test modes comply with FCC requirements, then the end product be sold legally.

## FCC

### Additional testing, Part 15 Subpart B compliant

The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.247 & 15.209 and the host product manufacturer is responsible for compliance with any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart stating that the host product complies with Part 15 Subpart B compliance testing at the modular transmitter installed. This equipment has been tested and found to comply with the limits for a Class B digital device, according to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used by the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:  
This device may not cause harmful interference.

This device must accept any interference received, including interference that may cause undesired operation. Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter. The antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

## **OEM Integration Instructions**

This device is intended only for OEM integrators under the following conditions:

The transmitter module may not be co-located with any other transmitter or antenna.

The module shall be only used with the external antenna(s) that have been originally tested and certified with this module.

As long as the conditions above are met, further transmitter tests will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

## **Validity of Using the Module Certification**

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

## **End Product Labeling**


The end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID: 2BDC6-SHELLYXMOD1H8".

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## **Documents / Resources**



	<p><a href="#">ESPRESSIF ESP32-C3-MINI-1 Wi-Fi and Bluetooth LE Module</a> [pdf] User Manual ESP32-C3-MINI-1, ESP32-C3-MINI-1 Wi-Fi and Bluetooth LE Module, Wi-Fi and Bluetooth LE Module, Bluetooth LE Module, LE Module, Module</p>
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## References

-  [GitHub - espressif/esp-idf: Espressif IoT Development Framework. Official development framework for Espressif SoCs.](#)
-  [esp-idf/examples/get-started/hello\\_world at c77c4ccf6c43ab09fd89e7c907bf5cf2a3499e3b · espressif/esp-idf · GitHub](#)
-  [esp-idf/examples at master · espressif/esp-idf · GitHub](#)
-  [ESP32 Forum - Index page](#)
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