# ESP32-C6-MINI-1U

## User Manual

Module that supports 2.4 GHz Wi-Fi 6 (802.11ax), Bluetooth® 5 (LE), Zigbee and Thread (802.15.4)
Built around ESP32-C6 series of SoCs, 32-bit RISC-V single-core microprocessor
4 MB flash in chip package
22 GPIOs, rich set of peripherals
External antenna connector

ESP32-C6-MINI-1U

Pre-release v1.0
Espressif Systems
Copyright © 2024

# 1 Module Overview

## 1.1 Features

**CPU and On-Chip Memory**

- ESP32-C6FH4 embedded, 32-bit RISC-V single-core microprocessor, up to 160 MHz
- ROM: 320 KB
- HP SRAM: 512 KB
- LP SRAM: 16 KB
- 4 MB flash in chip package

**Wi-Fi**

- 1T1R in 2.4 GHz band
- Operating frequency: 2412 ~ 2462 MHz
- IEEE 802.11ax-compliant
  - 20 MHz-only non-AP mode
  - MCS0 ~ MCS9
  - Uplink and downlink OFDMA, especially suitable for simultaneous connections in high-density environments
  - Downlink MU-MIMO (multi-user, multiple input, multiple output) to increase network capacity
  - Beamformee that improves signal quality
  - Channel quality indication (CQI)
  - DCM (dual carrier modulation) to improve link robustness
  - Spatial reuse to maximize parallel transmissions
  - Target wake time (TWT) that optimizes power saving mechanisms
- Fully compatible with IEEE 802.11b/g/n protocol
  - 20 MHz and 40 MHz bandwidth
  - Data rate up to 150 Mbps
  - Wi-Fi Multimedia (WMM)
  - TX/RX A-MPDU, TX/RX A-MSDU
  - Immediate Block ACK
  - Fragmentation and defragmentation
  - Transmit opportunity (TXOP)
  - Automatic Beacon monitoring (hardware TSF)
  - 4 × virtual Wi-Fi interfaces
  - Simultaneous support for Infrastructure BSS in Station mode, SoftAP mode, Station + SoftAP mode, and promiscuous mode *Note that when ESP32-C6 scans in Station mode, the SoftAP channel will change along with the Station channel*
  - 802.11mc FTM

**Bluetooth**

- Bluetooth LE: Bluetooth 5.3 certified
- Bluetooth mesh
- High power mode
- Speed:125 **kbps**, **500 kbps** 1 Mbps, 2 Mbps
- Advertising extensions
- Multiple advertisement sets
- Channel selection algorithm #2
- LE power control
- Internal co-existence mechanism between Wi-Fi and Bluetooth to share the same antenna

**IEEE 802.15.4**

- Compliant with IEEE 802.15.4-2015 protocol
- OQPSK PHY in 2.4 GHz band
- Data rate: 250 Kbps
- Thread 1.3
- Zigbee 3.0

#### Peripherals

- GPIO, SPI, parallel IO interface, UART, I2C, I2S, RMT (TX/RX), pulse counter, LED PWM, USB Serial/JTAG controller, MCPWM, SDIO2.0 slave controller, GDMA, TWAI® controller, on-chip debug functionality via JTAG, event task matrix, ADC, temperature sensor, general-purpose timers, watchdog timers, etc.

#### Integrated Components on Module

- 40 MHz crystal oscillator

#### Antenna Options

- External antenna via a connector

#### Operating Conditions

- Operating voltage/Power supply: 3.0 ~ 3.6 V
- Operating ambient temperature:
  - 85 °C version module: −40 ~ 85 °C
  - 105 °C version module: −40 ~ 105 °C

## 1.2 Description

dESP32-C6-MINI-1U is a general-purpose Wi-Fi, IEEE 802.15.4, and Bluetooth LE module. The rich set of peripherals and high performance make the module an ideal choice for smart homes, industrial automation, health care, consumer electronics, etc.

The ordering information for ESP32-C6-MINI-1U is as follows:

**Table 1: ESP32-C6-MINI-1U Ordering Information**

| Ordering Code | Flash | Ambient Temp. (°C) | Size (mm) |
|---|---|---|---|
| ESP32-C6-MINI-1U-N4 | 4 MB (Quad SPI) | −40 ~ 85 | 13.2 × 12.5 × 2.4 |
| ESP32-C6-MINI-1U-H4 | | −40 ~ 105 | |

At the core of this module is ESP32-C6FH4, a 32-bit RISC-V single-core processor.

ESP32-C6FH4 integrates a rich set of peripherals including SPI, parallel IO interface, UART, I2C, I2S, RMT (TX/RX), LED PWM, USB Serial/JTAG controller, MCPWM, SDIO2.0 slave controller, GDMA, TWAI® controller, on-chip debug functionality via JTAG, event task matrix, as well as up to 22 GPIOs, etc.

**Note:**
* For more information on ESP32-C6FH4, please refer to *ESP32-C6 Series Datasheet*.

# Contents


1 Module Overview 2
1.1 Features 2
1.2 Description 3
2 Pin Definitions 5
2.1 Pin Layout 5
2.2 Pin Description 5
3 Get Started 7
3.1 What You Need 7
3.2 Hardware Connection 7
3.3 Set up Development Environment 8
3.3.1 Install Prerequisites 8
3.3.2 Get ESP-IDF 8
3.3.3 Set up Tools 9
3.3.4 Set up Environment Variables 9
3.4 Create Your First Project 9
3.4.1 Start a Project 9
3.4.2 Connect Your Device 9
3.4.3 Configure 10
3.4.4 Build the Project 10
3.4.5 Flash onto the Device 11
3.4.6 Monitor 12
4 U.S. FCC Statement 14
5 Industry Canada Statement 18
6 Related Documentation and Resources 21
Revision History 22

# 2 Pin Definitions

## 2.1 Pin Layout

The pin diagram below shows the approximate location of pins on the module, but ESP32-C6-MINI-1U has no keepout zone.

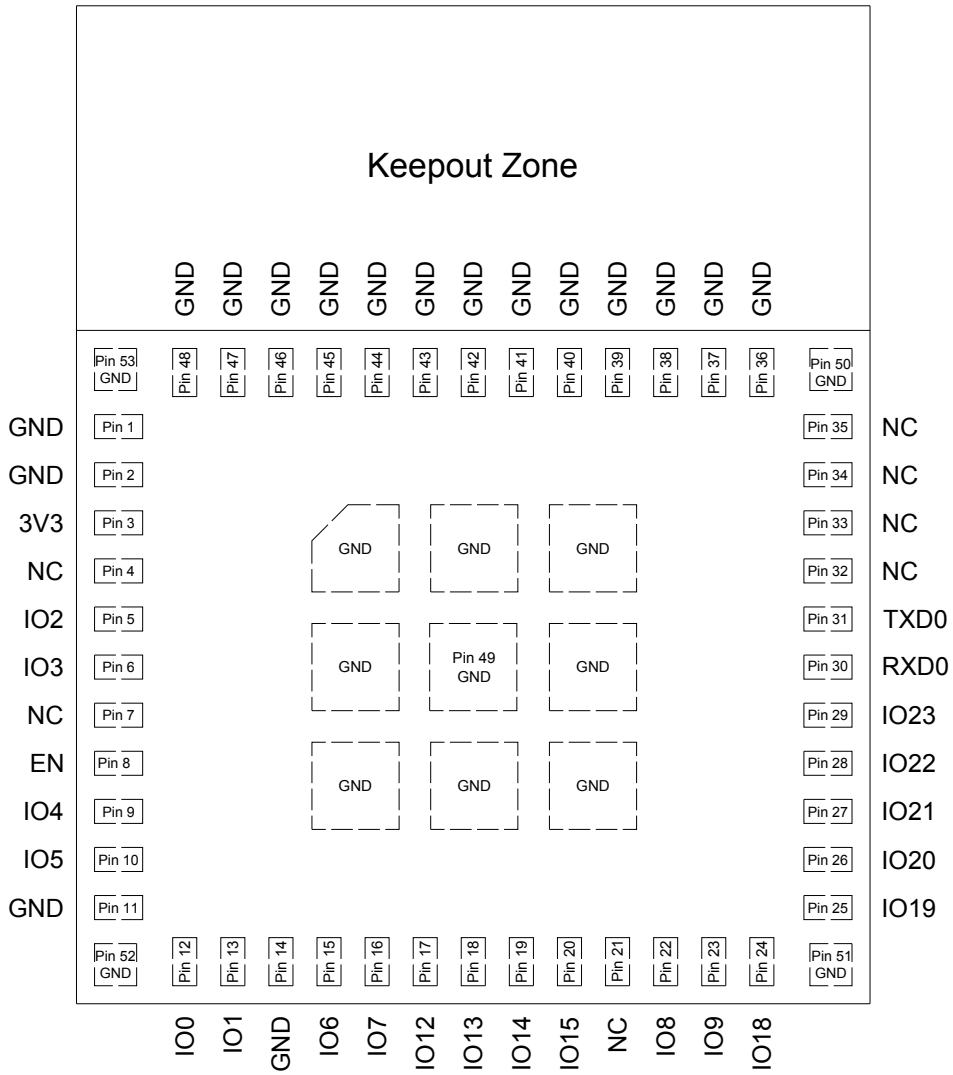


Figure 1: Pin Layout (Top View)

## 2.2 Pin Description

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

For peripheral pin configurations, please refer to *ESP32-C6 Series Datasheet*.

Table 2: Pin Definitions

| Name | No. | Type[1] | Function |
|---|---|---|---|
| GND | 1, 2, 11, 14, 36~53 | P | Ground |
| 3V3 | 3 | P | Power supply |
| NC | 4 | — | NC |
| IO2 | 5 | I/O/T | GPIO2, LP_GPIO2, LP_UART_RTSN, ADC1_CH2, FSPIQ |
| IO3 | 6 | I/O/T | GPIO3, LP_GPIO3, LP_UART_CTSN, ADC1_CH3 |
| NC | 7 | — | NC |
| EN | 8 | I | High: on, enables the chip.<br>Low: off, the chip powers off.<br>Note: Do not leave the EN pin floating. |
| IO4 | 9 | I/O/T | MTMS, GPIO4, LP_GPIO4, LP_UART_RXD, ADC1_CH4, FSPIHD |
| IO5 | 10 | I/O/T | MTDI, GPIO5, LP_GPIO5, LP_UART_TXD, ADC1_CH5, FSPIWP |
| IO0 | 12 | I/O/T | GPIO0, XTAL_32K_P, LP_GPIO0, LP_UART_DTRN, ADC1_CH0 |
| IO1 | 13 | I/O/T | GPIO1, XTAL_32K_N, LP_GPIO1, LP_UART_DSRN, ADC1_CH1 |
| IO6 | 15 | I/O/T | MTCK, GPIO6, LP_GPIO6, LP_I2C_SDA, ADC1_CH6, FSPICLK |
| IO7 | 16 | I/O/T | MTDO, GPIO7, LP_GPIO7, LP_I2C_SCL, FSPID |
| IO12 | 17 | I/O/T | GPIO12, USB_D- |
| IO13 | 18 | I/O/T | GPIO13, USB_D+ |
| IO14 | 19 | I/O/T | GPIO14 |
| IO15 | 20 | I/O/T | GPIO15 |
| NC | 21 | — | NC |
| IO8 | 22 | I/O/T | GPIO8 |
| IO9 | 23 | I/O/T | GPIO9 |
| IO18 | 24 | I/O/T | GPIO18, SDIO_CMD, FSPICS2 |
| IO19 | 25 | I/O/T | GPIO19, SDIO_CLK, FSPICS3 |
| IO20 | 26 | I/O/T | GPIO20, SDIO_DATA0, FSPICS4 |
| IO21 | 27 | I/O/T | GPIO21, SDIO_DATA1, FSPICS5 |
| IO22 | 28 | I/O/T | GPIO22, SDIO_DATA2 |
| IO23 | 29 | I/O/T | GPIO23, SDIO_DATA3 |
| RXD0 | 30 | I/O/T | U0RXD, GPIO17, FSPICS1 |
| TXD0 | 31 | I/O/T | U0TXD, GPIO16, FSPICS0 |
| NC | 32 | — | NC |
| NC | 33 | — | NC |
| NC | 34 | — | NC |
| NC | 35 | — | NC |

[1] P: power supply; I: input; O: output; T: high impedance.

# 3 Get Started

## 3.1 What You Need

To develop applications for module you need:

- 1 x ESP32-C6-MINI-1U
- 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 Linux operating system as an example. For more information about the configuration on Windows and macOS, please refer to ESP-IDF Programming Guide.

## 3.2 Hardware Connection

1. Solder the ESP32-C6-MINI-1U module to the RF testing board as shown in Figure 2.

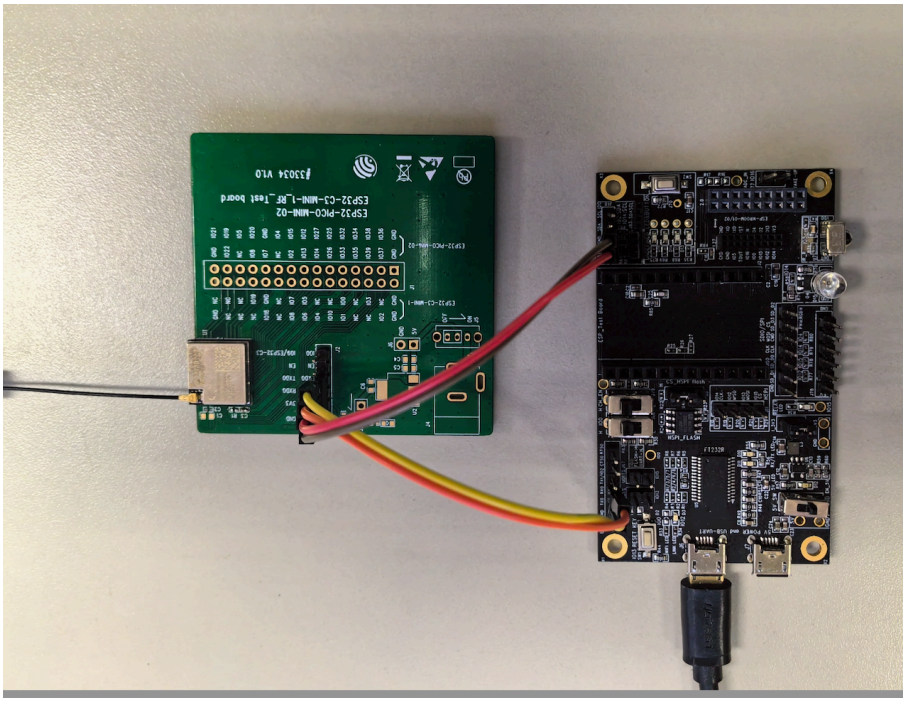

Figure 2: Hardware Connection

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 5 V power supply, via the Micro-USB cable.
5. During download, connect IO9 to GND via a jumper. Then, turn "ON" the testing board.
6. Download firmware into flash. For details, see the sections below.

7. After download, remove the jumper on IO9 and GND.
8. Power up the RF testing board again. The module will switch to working mode. The chip will read programs from flash upon initialization.

**Note:**
IO9 is internally logic high. If IO9 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-C6-MINI-1U, please refer to ESP32-C6 Series Datasheet.

## 3.3 Set up Development Environment

The Espressif IoT Development Framework (ESP-IDF for short) is a framework for developing applications based on the Espressif ESP32. Users can develop applications with ESP32-C6 in Windows/Linux/macOS based on ESP-IDF. Here we take Linux operating system as an example.

### 3.3.1 Install Prerequisites

To compile with ESP-IDF you need to get the following packages:

- CentOS 7 & 8:

```
sudo yum -y update && sudo yum install git wget flex bison gperf python3
    cmake ninja-build ccache dfu-util libusbx
```

- Ubuntu and Debian:

```
sudo apt-get install git wget flex bison gperf python3 python3-venv cmake
    ninja-build ccache libffi-dev libssl-dev dfu-util libusb-1.0-0
```

- Arch:

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

**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.

### 3.3.2 Get ESP-IDF

To build applications for ESP32-C6-MINI-1U module, you need the software libraries provided by Espressif in ESP-IDF repository.

To get ESP-IDF, create an installation directory (~/esp) to download ESP-IDF to and clone the repository with 'git clone':

```
mkdir -p ~/esp
cd ~/esp
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.

### 3.3.3 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.

```
cd ~/esp/esp-idf
./install.sh esp32c6
```

### 3.3.4 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:

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

Now everything is ready, you can build your first project on ESP32-C6-MINI-1U module.

## 3.4 Create Your First Project

### 3.4.1 Start a Project

Now you are ready to prepare your application for ESP32-C6-MINI-1U module. You can start with get-started/hello_world project from examples directory in ESP-IDF.

Copy get-started/hello_world to ~/esp directory:

```
cd ~/esp
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.

### 3.4.2 Connect Your Device

Now connect your 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:

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

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

### 3.4.3 Configure

Navigate to your 'hello_world' directory from Step 3.4.1. Start a Project, set ESP32-C6 chip as the target and run the project configuration utility 'menuconfig'.

```
cd ~/esp/hello_world
idf.py set-target esp32c6
idf.py menuconfig
```

Setting the target with 'idf.py set-target ESP32-C6' should be done once, after opening a new project. If the project contains some existing builds and configuration, they will be cleared and initialized. The target may be saved in 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:

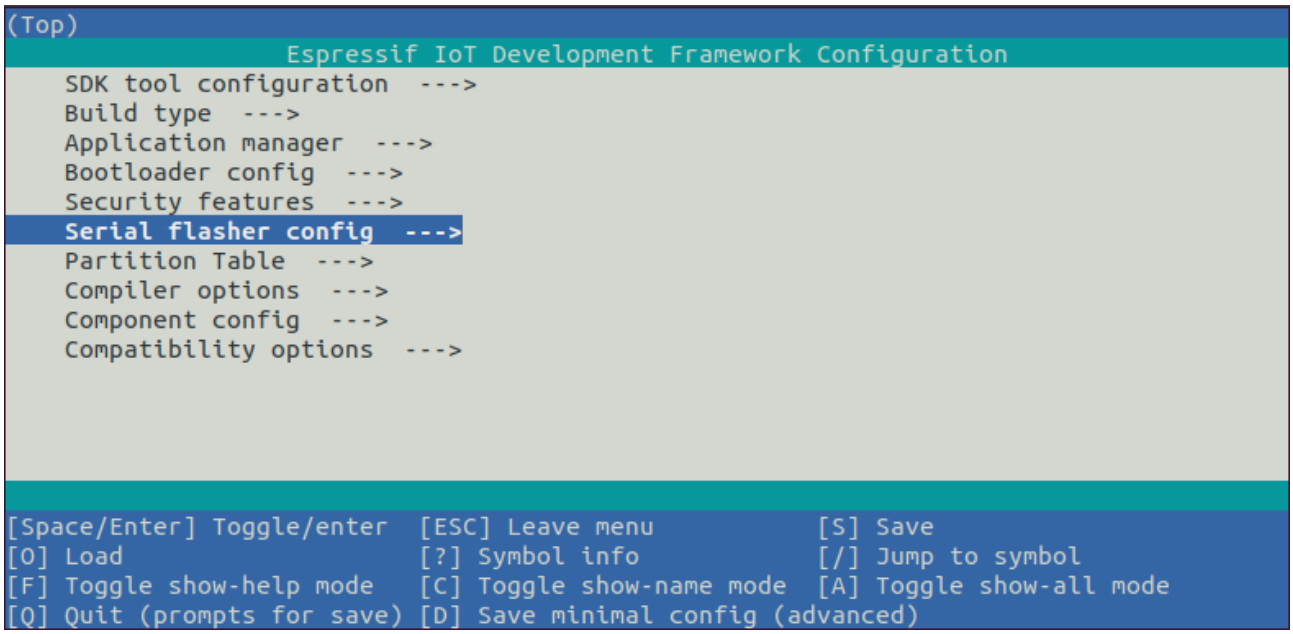


Figure 3: Project Configuration - Home Window

You are using this menu to set up project specific variables, e.g. Wi-Fi network name and password, the processor speed, etc. Setting up the project with menuconfig may be skipped for "hello_word". This example will run with default configuration

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

### 3.4.4 Build the Project

Build the project by running:

```
idf.py build
```

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

```
$ idf.py build
Running cmake in directory /path/to/hello_world/build
Executing "cmake -G Ninja --warn-uninitialized /path/to/hello_world"...
```

```
Warn about uninitialized values.
-- Found Git: /usr/bin/git (found version "2.17.0")
-- Building empty aws_iot component due to configuration
-- Component names: ...
-- Component paths: ...

... (more lines of build system output)

[527/527] Generating hello_world.bin
esptool.py v2.3.1

Project build complete. To flash, run this command:
../../../components/esptool_py/esptool/esptool.py -p (PORT) -b 921600
write_flash --flash_mode dio --flash_size detect --flash_freq 40m
0x10000 build/hello_world.bin build 0x1000 build/bootloader/bootloader.bin 0x8000
build/partition_table/partition-table.bin
or run 'idf.py -p PORT flash'
```

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

### 3.4.5 Flash onto the Device

Flash the binaries that you just built onto your module by running:

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

Replace PORT with your ESP32-C6 board'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.

When flashing, you will see the output log similar to the following:

```
...
esptool esp32c6 -p /dev/ttyUSB0 -b 460800 --before=default_reset --after=hard_reset
    --no-stub write_flash --flash_mode dio --flash_freq 80m --flash_size 2MB 0x0
    bootloader/bootloader.bin 0x10000 hello_world.bin 0x8000 partition_table/
    partition-table.bin
esptool.py v4.3
Serial port /dev/ttyUSB0
Connecting....
Chip is ESP32-C6 (revision v0.0)
Features: WiFi 6, BT 5
Crystal is 40MHz
MAC: 60:55:f9:f6:01:38
Changing baud rate to 460800
Changed.
```

```
Enabling default SPI flash mode...
Configuring flash size...
Flash will be erased from 0x00000000 to 0x00004fff...
Flash will be erased from 0x00010000 to 0x00028fff...
Flash will be erased from 0x00008000 to 0x00008fff...
Erasing flash...
Took 0.17s to erase flash block
Writing at 0x00000000... (5 %)
Writing at 0x00000c00... (23 %)
Writing at 0x00001c00... (47 %)
Writing at 0x00003000... (76 %)
Writing at 0x00004000... (100 %)
Wrote 17408 bytes at 0x00000000 in 0.5 seconds (254.6 kbit/s)...
Hash of data verified.
Erasing flash...
Took 0.85s to erase flash block
Writing at 0x00010000... (1 %)
Writing at 0x00014c00... (20 %)
Writing at 0x00019c00... (40 %)
Writing at 0x0001ec00... (60 %)
Writing at 0x00023c00... (80 %)
Writing at 0x00028c00... (100 %)
Wrote 102400 bytes at 0x00010000 in 3.2 seconds (253.5 kbit/s)...
Hash of data verified.
Erasing flash...
Took 0.04s to erase flash block
Writing at 0x00008000... (33 %)
Writing at 0x00008400... (66 %)
Writing at 0x00008800... (100 %)
Wrote 3072 bytes at 0x00008000 in 0.1 seconds (269.0 kbit/s)...
Hash of data verified.

Leaving...
Hard resetting via RTS pin...
```

If there are no issues by the end of the flash process, the board will reboot and start up the "hello_world" application.

### 3.4.6 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).

This command launches the IDF Monitor application:

```
$ idf.py -p <PORT> monitor
Running idf_monitor in directory [...]/esp/hello_world/build
Executing "python [...]/esp-idf/tools/idf_monitor.py -b 115200 [...]/esp/hello_world/
    build/hello_world.elf"...
--- idf_monitor on <PORT> 115200 ---
--- Quit: Ctrl+] | Menu: Ctrl+T | Help: Ctrl+T followed by Ctrl+H ---
```

```
ets Jun  8 2016 00:22:57

rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
ets Jun  8 2016 00:22:57
...
```

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

```
...
Hello world!
Restarting in 10 seconds...
This is esp32c6 chip with 1 CPU core(s), WiFi/BLE, 802.15.4 (Zigbee/Thread), silicon
    revision v0.0, 2 MB external flash
Minimum free heap size: 337332 bytes
Restarting in 9 seconds...
Restarting in 8 seconds...
Restarting in 7 seconds...
```

To exit IDF monitor use the shortcut Ctrl+].

That's all what you need to get started with ESP32-C6-MINI-1U module! Now you are ready to try some other examples in ESP-IDF, or go right to developing your own applications.

# 4 U.S. FCC Statement

The device complies with KDB 996369 D03 OEM Manual v01. Below are integration instructions for host product manufacturers according to the KDB 996369 D03 OEM Manual v01.

### List of Applicable FCC Rules

FCC Part 15 Subpart C 15.247

### Specific Operational Use Conditions

The module has WiFi and BLE functions.

- Operation Frequency:
  - WiFi: 2412 ~ 2462 MHz
  - Bluetooth: 2402 ~ 2480 MHz
  - Zigbee/Thread: 2405 ~ 2480 MHz
- Number of Channel:
  - WiFi: 11
  - Bluetooth: 40
  - Zigbee/Thread: 26
- Modulation:
  - WiFi: DSSS; OFDM
  - Bluetooth: GFSK
  - Zigbee/Thread: O-QPSK
- Type: Sleeve Monopole Antenna
- Gain: 2.33 dBi Max

The module can be used for IoT applications with a maximum 2.33 dBi antenna. The host manufacturer installing this module into their product must ensure that the final composit product complies with the FCC requirements by a technical assessment or evaluation to 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/warning as show 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 own 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 users' body; and if RF exposure statement or module layout is changed, then the host product manufacturer required to take responsibility of 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.

### Antennas

Antenna specification are as follows:

- Type: Sleeve Monopole Antenna
- Gain: 2.33 dBi

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 has 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 test 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: 2AC7Z-ESPC6MINIU" with their finished product.

### Information on test modes and additional testing requirements

- Operation Frequency:
  - WiFi: 2412 ~ 2462 MHz
  - Bluetooth: 2402 ~ 2480 MHz
  - Zigbee/Thread: 2405 ~ 2480 MHz
- Number of Channel:
  - WiFi: 11
  - Bluetooth: 40
  - Zigbee/Thread: 26
- Modulation:
  - WiFi: DSSS; OFDM

- Bluetooth: GFSK
- Zigbee/Thread: O-QPSK

Host manufacturer must perform test 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 can be sold legally.

#### Additional testing, Part 15 Subpart B compliant

The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.247 and that the host product manufacturer is responsible for compliance to 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 B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part15 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 in accordance with 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 receiver.
- Connect the equipment into 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.

**Caution:**

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 has been originally tested and certified with this module.

As long as the conditions above are met, further transmitter test 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 final end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID: 2AC7Z-ESPC6MINIU".

# 5 Industry Canada Statement

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:

- This device may not cause interference; and
- This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- l'appareil ne doit pas produire de brouillage, et
- l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

**Radiation Exposure Statement**

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body.

**Déclaration d'exposition aux radiations:**

Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

**RSS-247 Section 6.4 (5)**

The device could automatically discontinue transmission in case of absence of information to transmit, or operational failure. Note that this is not intended to prohibit transmission of control or signaling information or the use of repetitive codes where required by the technology.

L'appareil peut interrompre automatiquement la transmission en cas d'absence d'informations à transmettre ou de panne opérationnelle. Notez que ceci n'est pas destiné à interdire la transmission d'informations de contrôle ou de signalisation ou l'utilisation de codes répétitifs lorsque cela est requis par la technologie.

**This device is intended only for OEM integrators under the following conditions (For module device use):**

- The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test 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.

**Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes (Pour utilisation de dispositif module):**

- L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et
- Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 2 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

**IMPORTANT NOTE:**

In the event that these conditions can not be met (for example certain laptop configurations or colocation with another transmitter), then the Canada authorization is no longer considered valid and the IC ID can not 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 Canada authorization.

**NOTE IMPORTANTE:**

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

**End Product Labeling**

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains IC: 21098-ESPC6MINIU".

**Plaque signalétique du produit final**

Ce module émetteur est autorisé uniquement pour une utilisation dans un dispositif où l'antenne peut être installée de telle sorte qu'une distance de 20cm peut être maintenue entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 21098-ESPC6MINIU".

**Manual Information to the End User**

The OEM integrator 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/warning as show in this manual.

**Manuel d'information à l'utilisateur final**

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.

Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

# 6 Related Documentation and Resources

## Related Documentation

- ESP32-C6 Series Datasheet – Specifications of the ESP32-C6 hardware.
- ESP32-C6 Technical Reference Manual – Detailed information on how to use the ESP32-C6 memory and peripherals.
- ESP32-C6 Hardware Design Guidelines – Guidelines on how to integrate the ESP32-C6 into your hardware product.
- *Certificates*
  https://espressif.com/en/support/documents/certificates
- *Documentation Updates and Update Notification Subscription*
  https://espressif.com/en/support/download/documents

## Developer Zone

- ESP-IDF Programming Guide for ESP32-C6 – Extensive documentation for the ESP-IDF development framework.
- *ESP-IDF* and other development frameworks on GitHub.
  https://github.com/espressif
- *ESP32 BBS Forum* – Engineer-to-Engineer (E2E) Community for Espressif products where you can post questions, share knowledge, explore ideas, and help solve problems with fellow engineers.
  https://esp32.com/
- *The ESP Journal* – Best Practices, Articles, and Notes from Espressif folks.
  https://blog.espressif.com/
- See the tabs *SDKs and Demos*, *Apps*, *Tools*, *AT Firmware*.
  https://espressif.com/en/support/download/sdks-demos

## Products

- *ESP32-C6 Series SoCs* – Browse through all ESP32-C6 SoCs.
  https://espressif.com/en/products/socs?id=ESP32-C6
- *ESP32-C6 Series Modules* – Browse through all ESP32-C6-based modules.
  https://espressif.com/en/products/modules?id=ESP32-C6
- *ESP32-C6 Series DevKits* – Browse through all ESP32-C6-based devkits.
  https://espressif.com/en/products/devkits?id=ESP32-C6
- *ESP Product Selector* – Find an Espressif hardware product suitable for your needs by comparing or applying filters.
  https://products.espressif.com/#/product-selector?language=en

## Contact Us

- See the tabs *Sales Questions*, *Technical Enquiries*, *Circuit Schematic & PCB Design Review*, *Get Samples* (Online stores), *Become Our Supplier*, *Comments & Suggestions*.
  https://espressif.com/en/contact-us/sales-questions

# Revision History

| Date | Version | Release notes |
|---|---|---|
| 2024-01-26 | v1.0 | Official release |

www.espressif.com

## Disclaimer and Copyright Notice

Information in this document, including URL references, is subject to change without notice.

ALL THIRD PARTY'S INFORMATION IN THIS DOCUMENT IS PROVIDED AS IS WITH NO WARRANTIES TO ITS AUTHENTICITY AND ACCURACY.

NO WARRANTY IS PROVIDED TO THIS DOCUMENT FOR ITS MERCHANTABILITY, NON-INFRINGEMENT, FITNESS FOR ANY PARTICULAR PURPOSE, NOR DOES ANY WARRANTY OTHERWISE ARISING OUT OF ANY PROPOSAL, SPECIFICATION OR SAMPLE.

All liability, including liability for infringement of any proprietary rights, relating to use of information in this document is disclaimed. No licenses express or implied, by estoppel or otherwise, to any intellectual property rights are granted herein.

The Wi-Fi Alliance Member logo is a trademark of the Wi-Fi Alliance. The Bluetooth logo is a registered trademark of Bluetooth SIG.

All trade names, trademarks and registered trademarks mentioned in this document are property of their respective owners, and are hereby acknowledged.

**Copyright © 2024 Espressif Systems (Shanghai) Co., Ltd. All rights reserved.**