Espressif ESP32-C6-MINI-1U RFand Wireless RFTransceiver Modules and Modems User Manual

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Espressif ESP32-C6-MINI-1U RFand Wireless RFTransceiver Modules and Modems

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- Rich set of peripherals
- High performance
- Ideal for smart homes, industrial automation, health care, consumer electronics, etc.

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Ensure you have the ESP32-C6-MINI-1U module and necessary hardware for development.

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Connect the ESP32-C6-MINI-1U module to your development setup following the pin layout provided.

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Frequently Asked Questions (FAQ)

- **Q: What are the ordering options for ESP32-C6-MINI-1U?**
  A: The ordering options include ESP32-C6-MINI-1U-N4 with 4MB flash and ESP32-C6-MINI-1U-H4 with ambient temperature specifications. Refer to the ordering information table for more details.
- **Q: How many pins does the module have?**
  A: The module has a total of 53 pins. Refer to the pin definitions table for detailed information on each pin.

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

Module Overview

Features
CPU and On-Chip Memory

- 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

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:

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.

Pin Definitions

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

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.	Type1	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. Low: off, the chip powers off. 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.

Get Started

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.

Hardware Connection

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

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.

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.

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’:

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 esp32c6

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 ESP32-C6-MINI-1U module.

Create Your First Project

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:

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 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 3.4.1. Start a Project, set ESP32-C6 chip as the target and run the project configuration utility 'menuconfig'.

1. cd ~/esp/hello_world
2. idf.py set-target esp32c6
3. 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:

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.

Build the Project
Build the project by running:

1 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.

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
17. write_flash –flash_mode dio –flash_size detect –flash_freq 40m
18. 0x10000 build/hello_world.bin build 0x1000 build/bootloader/bootloader.bin 0x8000
19. build/partition_table/partition-table.bin
20. 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 module by running:

1. 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:

1. …
2. 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
3. esptool.py v4.3
4. Serial port /dev/ttyUSB0
5. Connecting….

6. Chip is ESP32-C6 (revision v0.0)
7. Features: WiFi 6, BT 5
8. Crystal is 40MHz
9. MAC: 60:55:f9:f6:01:38
10. Changing baud rate to 460800
11. Changed.
12. Enabling default SPI flash mode…
13. Configuring flash size…
14. Flash will be erased from 0x00000000 to 0x00004fff…
15. Flash will be erased from 0x00010000 to 0x00028fff…
16. Flash will be erased from 0x00008000 to 0x00008fff…
17. Erasing flash…
18. Took 0.17s to erase flash block
19. Writing at 0x00000000… (5 %)
20. Writing at 0x00000c00… (23 %)
21. Writing at 0x00001c00… (47 %)
22. Writing at 0x00003000… (76 %)
23. Writing at 0x00004000… (100 %)
24. Wrote 17408 bytes at 0x00000000 in 0.5 seconds (254.6 kbit/s)…
25. Hash of data verified.
26. Erasing flash…
27. Took 0.85s to erase flash block
28. Writing at 0x00010000… (1 %)
29. Writing at 0x00014c00… (20 %)
30. Writing at 0x00019c00… (40 %)
31. Writing at 0x0001ec00… (60 %)
32. Writing at 0x00023c00… (80 %)
33. Writing at 0x00028c00… (100 %)
34. Wrote 102400 bytes at 0x00010000 in 3.2 seconds (253.5 kbit/s)…
35. Hash of data verified.
36. Erasing flash…
37. Took 0.04s to erase flash block
38. Writing at 0x00008000… (33 %)
39. Writing at 0x00008400… (66 %)
40. Writing at 0x00008800… (100 %)
41. Wrote 3072 bytes at 0x00008000 in 0.1 seconds (269.0 kbit/s)…
42. Hash of data verified.
43.
44. Leaving…
45. 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.

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:

1. $ idf.py -p <PORT> 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 <PORT> 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. …

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 esp32c6 chip with 1 CPU core(s), WiFi/BLE, 802.15.4 (Zigbee/Thread), silicon revision v0.0, 2 MB external flash
5. Minimum free heap size: 337332 bytes
6. Restarting in 9 seconds… 7 Restarting in 8 seconds… 8 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.

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”.

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.

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.

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.

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.

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.

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”.

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.

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

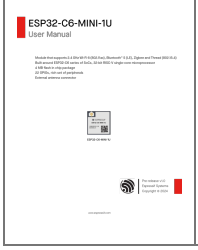
Contact Us

- 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

Documents / Resources

	Espressif ESP32-C6-MINI-1U RFand Wireless RFTransceiver Modules and Modems [pdf] User Manual ESP32-C6-MINI-1U RFand Wireless RFTransceiver Modules and Modems, ESP32-C6-MINI-1U , RFand Wireless RFTransceiver Modules and Modems, RFTransceiver Modules and Modems, Modules and Modems, and Modems, Modems

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- esp-idf/examples at master · espressif/esp-idf · GitHub
- ESP Product Selector
- User Manual