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# Radxa Zero 3W User Manual

A Compact yet Impressive SBC with WiFi & BT

Revision 1.2

2023-08-01



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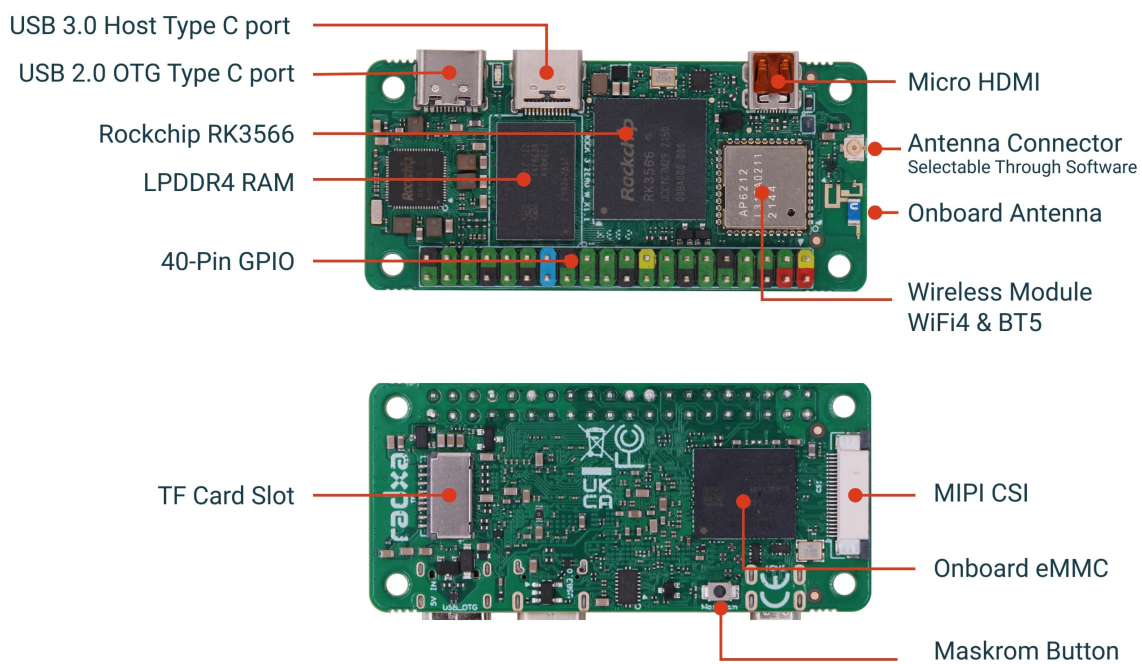
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## 1 Revision Control Table

| Version | Date       | Changes from previous version |
|---------|------------|-------------------------------|
| 1.0     | 14/03/2022 | First version                 |
| 1.1     | 14/07/2023 | Update Images                 |
| 1.2     | 01/08/2023 | Update Information            |

## 2 Introduction

Radxa Zero 3W is a Single Board Computer (SBC) in an ultra-tiny form factor that offers class-leading performance while leveraging outstanding mechanical compatibility. The Radxa Zero 3W offers makers, IoT enthusiasts, hobbyists, PC DIY enthusiasts and others a reliable and extremely capable platform for building and tinkering their ideas into reality.



## 3 Features

### 3.1 Hardware

- Rockchip RK3566 SoC
- Quad-core Arm® Cortex®-A55 (ARMv8) 64-bit @ 1.6GHz
- Arm Mali™-G52-2EE, OpenGL® ES1.1/2.0/3.2, Vulkan® 1.1, OpenCL™ 2.0
- 1GB/2GB LPDDR4 RAM
- Optional Onboard eMMC Module 4GB/8GB
- Display via Micro HDMI
- H.264/H.265 decoder up to 4K@60fps

- H.264/H.265 encoder up to 1080P@60fps

### 3.2 Interfaces

- 802.11 b/g/n (WiFi 4) Wireless LAN
- BT 5.0 with BLE
- 1x Micro SD Card
- 1x Micro HDMI ports supporting displays up to 1080P@60fps resolution
- 1x Micro USB2 OTG port for power and data
- 1x Micro USB2 HOST port
- 1x MIPI CSI
- 40x user GPIO supporting various interface options:
  - up to 5 x UART
  - 1 x SPI bus
  - up to 2 x I2C bus
  - 1 x PCM/I2S
  - up to 6 x PWM
  - up to 28 x GPIO
  - 2 x 5V DC power in
  - 2 x 3.3V power pin

### 3.3 Software

- ARMv8 Instruction Set
- Debian/Ubuntu Linux support
- Hardware access/control library for Linux

## 4 Electrical Specification

### 4.1 Power Requirements

The Radxa Zero 3W support DC +5V voltage:

- Power adapter with 5V/1A on the micro USB power port
- 5V Power from the GPIO PIN 2 & 4

## 5 Peripherals

### 5.1 GPIO Interface

Radxa Zero 3W offers 40P GPIO expansion which is compatible with many accessories on the market.

#### 5.1.1 GPIO Alternate Functions

| Function5   | Function4    | Function3       | Function2    | Function1 | Pin# | Pin# | Function1 | Function2   | Function3 | Function4   | Function5    |
|-------------|--------------|-----------------|--------------|-----------|------|------|-----------|-------------|-----------|-------------|--------------|
|             |              |                 |              | +3.3V     | 1    | 2    | +5.0V     |             |           |             |              |
|             |              | I2C3_SDA_M0     | UART3_RX_M0  | GPIO1_A0  | 3    | 4    | +5.0V     |             |           |             |              |
|             |              | I2C3_SCL_M0     | UART3_TX_M0  | GPIO1_A1  | 5    | 6    | GND       |             |           |             |              |
|             | PWM14_M0     |                 |              | GPIO3_C4  | 7    | 8    | GPIO0_D1  | UART2_TX_M0 |           |             |              |
|             |              |                 |              | GND       | 9    | 10   | GPIO0_D0  | UART2_RX_M0 |           |             |              |
|             |              |                 |              | GPIO3_A1  | 11   | 12   | GPIO3_A3  |             |           |             | I2S3_SCLK_M0 |
|             | I2S3_MCLK_M0 |                 |              | GPIO3_A2  | 13   | 14   | GND       |             |           |             |              |
|             |              |                 |              | GPIO3_B0  | 15   | 16   | GPIO3_B1  | UART4_RX_M1 | PWM8_M0   |             |              |
|             |              |                 |              | +3.3V     | 17   | 18   | GPIO3_B2  | UART4_TX_M1 | PWM9_M0   |             |              |
|             | PWM15_IR_M1  | I2S3_SCLK_M1    | SPI3_MOSI_M1 | GPIO4_C3  | 19   | 20   | GND       |             |           |             |              |
| UART9_TX_M1 | PWM12_M1     | I2S3_SDO_M1     | SPI3_MISO_M1 | GPIO4_C5  | 21   | 22   | GPIO3_C1  |             |           |             | I2S1_SDO2_M2 |
|             | PWM14_M1     | I2S3_MCLK_M1    | SPI3_CLK_M1  | GPIO4_C2  | 23   | 24   | GPIO4_C6  | SPI3_CS0_M1 | PWM13_M1  | UART9_RX_M1 | I2S3_SDI_M1  |
|             |              |                 |              | GND       | 25   | 26   | GPIO4_D1  | SPI3_CS1_M1 |           |             |              |
|             | I2C4_SDA_M0  | I2S2_SDI_M1     |              | GPIO4_B2  | 27   | 28   | GPIO4_B3  |             |           | I2C4_SCL_M0 | I2S2_SDO_M1  |
|             |              |                 |              | GPIO3_B3  | 29   | 30   | GND       |             |           |             |              |
|             |              |                 |              | GPIO3_B4  | 31   | 32   | GPIO3_C2  | UART5_TX_M1 |           |             | I2S1_SDO3_M2 |
| UART5_RX_M1 |              | I2S1_SCLK_RX_M2 |              | GPIO3_C3  | 33   | 34   | GND       |             |           |             |              |
|             |              | I2S3_LRCK_M0    |              | GPIO3_A4  | 35   | 36   | GPIO3_A7  |             |           |             |              |
|             |              | I2S1_SCLK_RX_M0 |              | GPIO1_A4  | 37   | 38   | GPIO3_A6  |             |           |             | I2S3_SDI_M0  |
|             |              |                 |              | GND       | 39   | 40   | GPIO3_A5  |             |           |             | I2S3_SDO_M0  |

### 5.2 USB

The Radxa Zero 3W has 1x Micro USB2.0 Type C Host port with currently limited at 500mA and 1x Micro USB2.0 OTG Type C port, which can be powered by 5V PSU or PC/Laptop USB port with data access.

### 5.3 Camera Interfaces

Radxa Zero 3W has 1x 2-lane MIPI CSI camera connector. This connectors are backwards compatible with standard industrial camera peripherals.

### 5.4 HDMI

The Radxa Zero 3W has 1x Micro HDMI port, which support CEC and HDMI 2.0 with resolutions up to 1080p60.

### 5.5 Temperature Range and Thermals

The recommended ambient operating temperature range is 0 to 50 degrees Celcius.

To reduce thermal output when idling or under light load, the Radxa Zero reduces the CPU clock speed and voltage. During heavier load the speed and voltage (and hence thermal output) are increased. The internal governor will throttle back both the CPU speed and voltage to make sure the CPU temperature never exceeds 85 degrees C.

The Radxa Zero 3W will operate perfectly well without any extra cooling and is designed for sprint performance - expecting a light use case on average and ramping up the CPU speed when needed (e.g. when loading a webpage). If a user wishes to load the system continually or operate it at a high temperature at full performance, further cooling may be needed.

## 6 Availability

Radxa guarantees availability of the Radxa Zero 3W until at least September 2033.

## 7 Support

For support please see the hardware documentation section of the [Radxa Wiki](#) website and post questions to the [Radxa forum](#).

## 7 FCC WARNING

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

15.105 Information to the user.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant 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 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 or more 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 equipment complies with FCC 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.

**Radiation Exposure Statement:**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

The availability of some specific channels and/or operational frequency bands are country dependent and are firmware programmed at the factory to match the intended destination.

The firmware setting is not accessible by the end user.

The final end product must be labelled in a visible area with the following:

“Contains Transmitter Module 2BC6T-RADXAZERO3W”

**Requirement per KDB996369 D03****2.2 List of applicable FCC rules**

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.<sup>3</sup>

**Explanation:** This module meets the requirements of FCC part 15C(15.247).

**2.3 Summarize the specific operational use conditions**

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer’s instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

**Explanation:** The EUT has Chip antenna, The antenna gain is 0.61dBi.

## 2.4 Limited module procedures

If a modular transmitter is approved as a “limited module,” then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

**Explanation:** The module is a single module.

## 2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects: layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

- a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);
- b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
- c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;
- d) Appropriate parts by manufacturer and specifications;
- e) Test procedures for design verification; and
- f) Production test procedures for ensuring compliance.

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

**Explanation:** Yes, The module with Chip antenna designs, and This manual has been shown the layout of FPC design, antenna, connectors, and isolation requirements.

## 2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

**Explanation:** This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment, This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body." This module is designed to comply with the FCC statement, FCC ID is: 2BC6T-RADXAZERO3W.

## 2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an "omni-directional antenna" is not considered to be a specific "antenna type")).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

**Explanation:** The EUT has Chip antenna, The antenna gain is 0.61dBi.

## 2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating "Contains FCC ID" with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

**Explanation:** The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: 2BC6T-RADXAZERO3W"

## 2.9 Information on test modes and additional testing requirements<sup>5</sup>

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer's determination that a module as installed in a host complies with FCC requirements.

**Explanation:** Can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

## 2.10 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, 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 circuitry), 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.

**Explanation:** The module without unintentional-radiator digital circuitry, so the module does not require an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.