

# User Manual

## 1. Features

### CPU and On-Chip Memory

- ESP32-S3 series of SoCs embedded, Xtensa® dual-core 32-bit LX7 microprocessor, up to 240 MHz
- 384 KB ROM
- 512 KB SRAM
- 16 KB SRAM in RTC
- Up to 8 MB PSRAM

### Wi-Fi

- 802.11 b/g/n
- Bit rate: 802.11n up to 150 Mbps
- A-MPDU and A-MSDU aggregation
- 0.4  $\mu$ s guard interval support
- Center frequency range of operating channel: 2412 ~ 2462 MHz

### Bluetooth

- Bluetooth LE: Bluetooth 5, Bluetooth mesh
- 2 Mbps PHY
- Long range mode
- Advertising extensions
- Multiple advertisement sets
- Channel selection algorithm #2

### Peripherals

- GPIO, SPI, LCD interface, Camera interface, UART, I2C, I2S, remote control, pulse counter, LED PWM, USB 1.1 OTG, USB Serial/JTAG controller, MCPWM, SDIO host, GDMA, TWAI® controller (compatible with ISO 11898-1), ADC, touch sensor, temperature sensor, timers and watchdogs

### Integrated Components on Module

- 40 MHz crystal oscillator
- Up to 16 MB SPI flash

### Antenna Options

- External antenna via a connector

### Operating Conditions

- Operating voltage/Power supply: 3.0 ~ 3.6 V
- Operating ambient temperature:
  - 65 °C version: -40 ~ 65 °C
  - 85 °C version: -40 ~ 85 °C
  - 105 °C version: -40 ~ 105 °C

## 2. Description

WT1000 is a powerful, generic Wi-Fi + Bluetooth LE MCU modules. On top of a rich set of peripherals, the acceleration for neural network computing and signal processing workloads provided by the SoC make the modules an ideal choice for a wide variety of application scenarios related to AI and Artificial Intelligence of Things (AIoT), such as wake word detection, speech commands recognition, face detection and recognition, smart home, smart appliances, smart control panel, smart speaker, etc.

### 3. Pin Definitions

#### A. Pin Layout

The pin diagram is applicable for WT1000, but has no keepout zone.

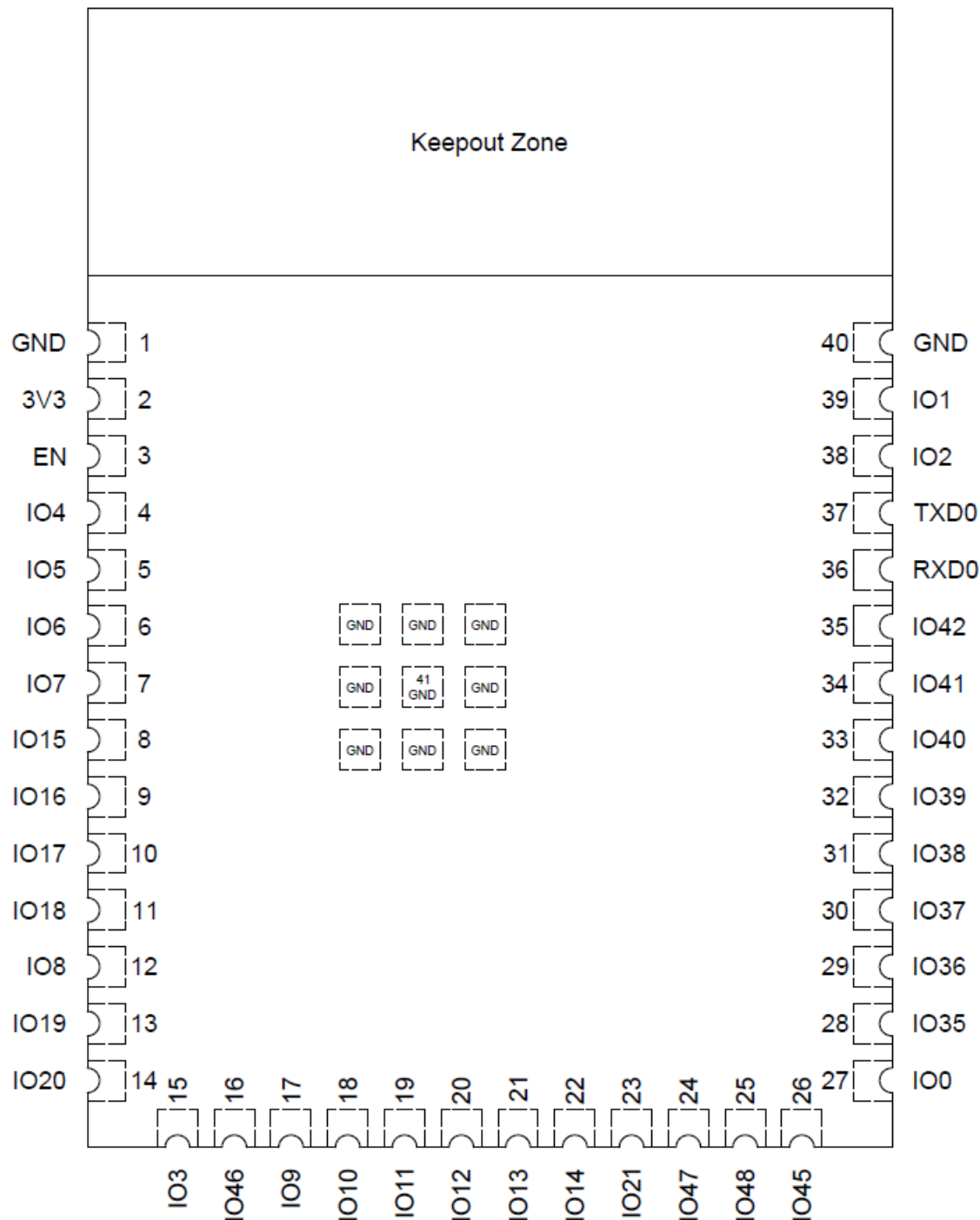


Figure 1: Pin Layout (Top View)

#### B. Pin Description

The module has 41 pins. See pin definitions in Table 2.

Table 2: Pin Definitions

| Name              | No. | Type <sup>a</sup> | Function                                                                                                 |
|-------------------|-----|-------------------|----------------------------------------------------------------------------------------------------------|
| GND               | 1   | P                 | GND                                                                                                      |
| 3V3               | 2   | P                 | Power supply                                                                                             |
| EN                | 3   | I                 | High: on, enables the chip.<br>Low: off, the chip powers off.<br>Note: Do not leave the EN pin floating. |
| IO4               | 4   | I/O/T             | RTC_GPIO4, <b>GPIO4</b> , TOUCH4, ADC1_CH3                                                               |
| IO5               | 5   | I/O/T             | RTC_GPIO5, <b>GPIO5</b> , TOUCH5, ADC1_CH4                                                               |
| IO6               | 6   | I/O/T             | RTC_GPIO6, <b>GPIO6</b> , TOUCH6, ADC1_CH5                                                               |
| IO7               | 7   | I/O/T             | RTC_GPIO7, <b>GPIO7</b> , TOUCH7, ADC1_CH6                                                               |
| IO15              | 8   | I/O/T             | RTC_GPIO15, <b>GPIO15</b> , U0RTS, ADC2_CH4, XTAL_32K_P                                                  |
| IO16              | 9   | I/O/T             | RTC_GPIO16, <b>GPIO16</b> , U0CTS, ADC2_CH5, XTAL_32K_N                                                  |
| IO17              | 10  | I/O/T             | RTC_GPIO17, <b>GPIO17</b> , U1TXD, ADC2_CH6                                                              |
| IO18              | 11  | I/O/T             | RTC_GPIO18, <b>GPIO18</b> , U1RXD, ADC2_CH7, CLK_OUT3                                                    |
| IO8               | 12  | I/O/T             | RTC_GPIO8, <b>GPIO8</b> , TOUCH8, ADC1_CH7, SUBSPICS1                                                    |
| IO19              | 13  | I/O/T             | RTC_GPIO19, GPIO19, U1RTS, ADC2_CH8, CLK_OUT2, <b>USB_D-</b>                                             |
| IO20              | 14  | I/O/T             | RTC_GPIO20, GPIO20, U1CTS, ADC2_CH9, CLK_OUT1, <b>USB_D+</b>                                             |
| IO3               | 15  | I/O/T             | RTC_GPIO3, <b>GPIO3</b> , TOUCH3, ADC1_CH2                                                               |
| IO46              | 16  | I/O/T             | <b>GPIO46</b>                                                                                            |
| IO9               | 17  | I/O/T             | RTC_GPIO9, <b>GPIO9</b> , TOUCH9, ADC1_CH8, FSPiHD, SUBSPiHD                                             |
| IO10              | 18  | I/O/T             | RTC_GPIO10, <b>GPIO10</b> , TOUCH10, ADC1_CH9, FSPICS0, FSPiIO4, SUBSPICS0                               |
| IO11              | 19  | I/O/T             | RTC_GPIO11, <b>GPIO11</b> , TOUCH11, ADC2_CH0, FSPID, FSPiIO5, SUBSPID                                   |
| IO12              | 20  | I/O/T             | RTC_GPIO12, <b>GPIO12</b> , TOUCH12, ADC2_CH1, FSPICLK, FSPiIO6, SUBSPICLK                               |
| IO13              | 21  | I/O/T             | RTC_GPIO13, <b>GPIO13</b> , TOUCH13, ADC2_CH2, FSPiQ, FSPiIO7, SUBSPiQ                                   |
| IO14              | 22  | I/O/T             | RTC_GPIO14, <b>GPIO14</b> , TOUCH14, ADC2_CH3, FSPiWP, FSPIDQS, SUBSPiWP                                 |
| IO21              | 23  | I/O/T             | RTC_GPIO21, <b>GPIO21</b>                                                                                |
| IO47              | 24  | I/O/T             | SPICLK_P_DIFF, <b>GPIO47</b> , SUBSPICLK_P_DIFF                                                          |
| IO48              | 25  | I/O/T             | SPICLK_N_DIFF, <b>GPIO48</b> , SUBSPICLK_N_DIFF                                                          |
| IO45              | 26  | I/O/T             | <b>GPIO45</b>                                                                                            |
| IO0               | 27  | I/O/T             | RTC_GPIO0, <b>GPIO0</b>                                                                                  |
| IO35 <sup>b</sup> | 28  | I/O/T             | FSPiIO6, <b>GPIO35</b> , FSPID, SUBSPID                                                                  |
| IO36 <sup>b</sup> | 29  | I/O/T             | FSPiIO7, <b>GPIO36</b> , FSPICLK, SUBSPICLK                                                              |
| IO37 <sup>b</sup> | 30  | I/O/T             | FSPIDQS, <b>GPIO37</b> , FSPiQ, SUBSPiQ                                                                  |
| IO38              | 31  | I/O/T             | <b>GPIO38</b> , FSPiWP, SUBSPiWP                                                                         |
| IO39              | 32  | I/O/T             | <b>MTCK</b> , GPIO39, CLK_OUT3, SUBSPICS1                                                                |
| IO40              | 33  | I/O/T             | <b>MTDO</b> , GPIO40, CLK_OUT2                                                                           |
| IO41              | 34  | I/O/T             | <b>MTDI</b> , GPIO41, CLK_OUT1                                                                           |

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Table 2 – cont'd from previous page

| Name | No. | Type <sup>a</sup> | Function                                   |
|------|-----|-------------------|--------------------------------------------|
| IO42 | 35  | I/O/T             | MTMS, GPIO42                               |
| RXD0 | 36  | I/O/T             | U0RXD, GPIO44, CLK_OUT2                    |
| TXD0 | 37  | I/O/T             | U0TXD, GPIO43, CLK_OUT1                    |
| IO2  | 38  | I/O/T             | RTC_GPIO2, <b>GPIO2</b> , TOUCH2, ADC1_CH1 |
| IO1  | 39  | I/O/T             | RTC_GPIO1, <b>GPIO1</b> , TOUCH1, ADC1_CH0 |
| GND  | 40  | P                 | GND                                        |
| EPAD | 41  | P                 | GND                                        |

## 4. Engineering Mode

### A. What You Need

To develop applications for module you need:

- 1 x WT1000
- 1 x Espressif RF testing board
- 1x 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.

### B. Hardware Connection

- Solder the WT1000 module to the RF testing board as shown in Figure 2.

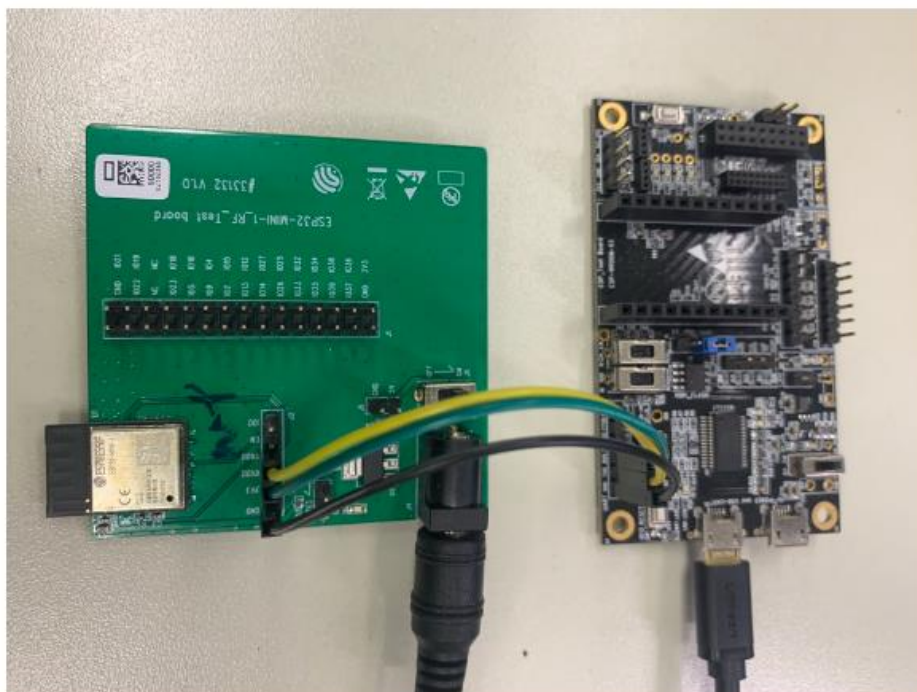


Figure 2: Hardware Connection

- b.** Connect the RF testing board to the USB-to-Serial board via TXD, RXD, and GND.
- c.** Connect the USB-to-Serial board to the PC.
- d.** Connect the RF testing board to the PC or a power adapter to enable 5 V power supply, via the Micro-USB cable.
- e.** During download, connect IO0 to GND via a jumper. Then, turn "ON" the testing board.
- f.** Download firmware into flash. For details, see the sections below.
- g.** After download, remove the jumper on IO0 and GND.
- h.** Power up the RF testing board again. The module will switch to working mode. The chip will read programs from flash upon initialization.

## 5. U.S. FCC Statement

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.

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 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.

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 module can be used to installation in another host. 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 transmit or antenna. The module shall be only used with the integral antenna(s) that has been originally tested and certified with this module. As long as 3 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 requirement with this module installed (for example, digital device emission, PC peripheral requirements, etc.)

Notice:

In the event that these conditions cannot be met (for example certain laptop configuration 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 and circumstance, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC 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 FCC ID: 2A6RN-WT1000".

## **6. IC 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**

StatementThis 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 & 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 coimplanté 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: 28517-WT1000".

### **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: 28517-WT1000".

### **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.