

# M05L User manual

## 1. General Description

### 1.1. Overview

The RTL8762CK (hereafter referred to as the RTL8762C except where differences exist) is an ultra-low-power system on-chip solution for Bluetooth 5.0 low energy applications that combines the excellent performance of a leading RF transceiver with a low-power ARM Cortex-M4F and rich powerful supporting features and peripherals.

The RTL8762C supports an analog MIC interface that integrates a sigma-delta ADC, programmable gain amplifier, 5-Band equalizer and microphone bias circuit for voice command application. The RTL8762C embeds IR transceiver, hardware key-scan, and Quad-decoder on a single IC, and is provided in a QFN package.

### 1.2. MCU Platform

The embedded ARM Cortex-M4F 32-bit CPU features a 16-bit instruction set with 32-bit extensions (Thumb-2® technology) that delivers high-density code with a small memory footprint. By using a single-cycle 32-bit multiplier, a 3-stage pipeline, and a Nested Vector Interrupt Controller (NVIC), the ARM Cortex-M4F makes program execution simple and highly efficient. Serial Wire Debug (SWD) interface provided as part of the Debug Access Port (DAP), in conjunction with the Basic Branch Buffer (BBB). This offers a flexible and powerful mechanism for non-intrusive program code debugging. Developers can easily add breakpoints in the code and perform single-step debugging.

The RTL8762C memory architecture includes ROM, 160kByte RAM and 8MByte Flash Address Space.

The 160kByte RAM consists of RAM1 (112kByte Data RAM), RAM2 (8kByte Cache Shared RAM), RAM3 (8kByte Cache Shared RAM), and RAM4 (32kByte Buffer RAM). All the RAM regions can be used to execute code and hold data.

Flash Address Space is a virtual space which is mapped to external Flash to extend the code space in XIP (eXecute In Place) mode.

## 2. Features

### General

- Ultra low power consumption with intelligent PMU
- Supports Bluetooth 5.0 core specification
- Supports 2Mbps LE
- LE advertising Extensions
- LE Long Range

- Additional Adv channel
- Channel Selection #2
- High Duty Cycle Non-Connectable Adv
- Direction Find – Connection mode AoA/AoD
- Integrated MCU to execute Bluetooth protocol stack
- Supports multiple level Low Energy states
- Supports LE L2CAP Connection Oriented Channel Support
- Supports LE low duty directed advertising
- Supports LE data length extension feature
- Supports OTA (Over-the-Air) programming mechanism for firmware upgrade
- Supports GAP, ATT/GATT, SMP, L2CAP
- Generic Applications for GAP Central, Peripheral, Observer and Broadcaster Roles

#### **Platform**

- ARM Cortex-M4 with floating-point unit (Maximum 40MHz)
- Serial flash controller (One and Quad-bits mode) with 16kB 4-way cache.
- Total 160kB SRAM
- 4Kbits eFUSE for manufacturer use
- Supports AES128/192/256 encrypt/decrypt engine

#### **Bluetooth Transceiver**

- RX sensitivity: -97dBm BLE(min)
- Fast AGC control to improve receiving dynamic range
- Supports Bluetooth Low Energy PHY

#### **Peripheral Interfaces**

- Flexible General Purpose IOs

RTL8762CK: 32GPIOs (max)

- Hardware Keyscan and Quad-decoder
- Embedded IR transceiver

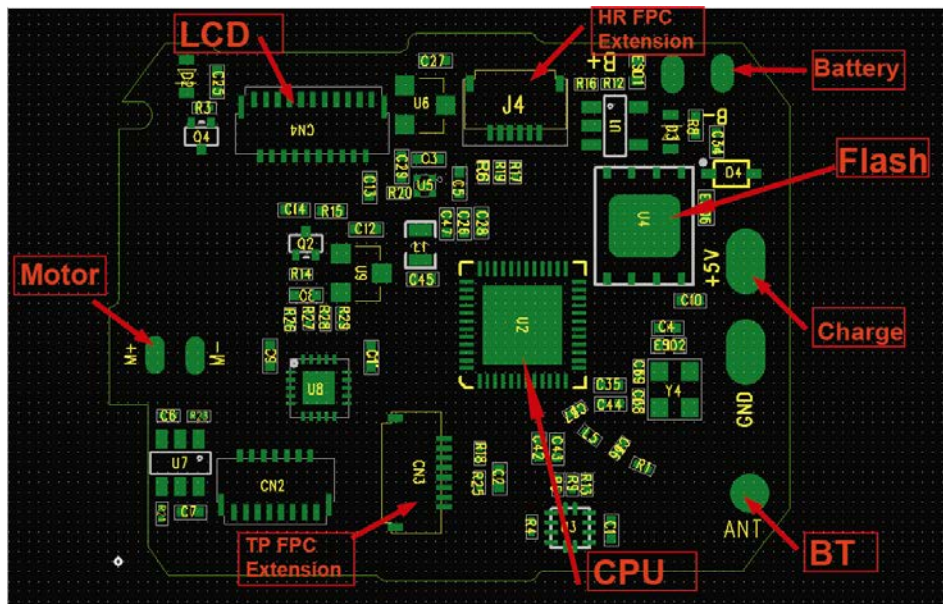
- Real-Time Counters (RTC)
  - Supports generic 4-wire SPI master/slave
  - Supports 8 channel Low power comparator
  - 400ksps, 12bit, 8channel AUXADC
  - Timers x 8
  - I2C x 2
  - PWM x 8
  - UART x 2
  - I2S/PCM interface for external audio codec
  - Supports I8080 interface for LCD
  - Supports external 40MHz XTAL without capacitor (in limited condition)
  - Supports external 32.768kHz XTAL without capacitor (in limited condition)
  - Support embedded internal 32K RCOSC to keep BLE link (in limited condition)
  - Embedded PGA and audio ADC with 5-band EQ for analog MIC interface
- Package**
- RTL8762CK: 48-pin 6x6mm QFN

## 2.Electrical specifications

|                                 |                                                          |
|---------------------------------|----------------------------------------------------------|
| Core module                     | RTL8762CK                                                |
| MCU core                        | ARM Cortex-M4F 32-bit                                    |
| Flash                           | 128Kb+128Mb                                              |
| LCD                             | 1.3 Inch TFT BOE IPS 240*240                             |
| G- sensor                       | STK8321                                                  |
| TP                              | All touch                                                |
| BT                              | Bluetooth 5. 0 (Bluetooth Low Energy or Bluetooth Smart) |
| Motor                           | Wire bonding                                             |
| FPC external expansion function | Heart rate + charging                                    |
| Mechanical specifications       |                                                          |
| Material                        | PCB Module                                               |

|                              |                |
|------------------------------|----------------|
| Size                         | 34.8*28*0.6MM  |
| Opening                      | SMD            |
| Protection                   | Upon system    |
| Flammability                 | FR4            |
| Environmental specifications |                |
| Operating temperature        | -20°C to +60°C |
| Storage temperature          | -20°C to +60°C |

### 3:Interface definition description



# FCC Regulatory notices

## **Modification statement**

**Timex Group USA, Inc.** has not approved any changes or modifications to this device by the user. Any changes or modifications could void the user's authority to operate the equipment. **Interference**

## **statement**

This device complies with Part 15 of the FCC Rules and Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

## **RF exposure**

This equipment complies with FCC and ICSED radiation exposure limits set forth for an uncontrolled environment. The antenna should be installed and operated with minimum distance of 20 cm between the radiator and your body. Antenna gain must be below 3 dBi.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. The host end product must include a user manual that clearly defines operating requirements and conditions that must be observed to ensure compliance with current FCC RF exposure guidelines.

For portable devices, in addition to above, a separate approval is required to satisfy the SAR requirements of FCC Part 2.1093.

If the device is used for other equipment that separate approval is required for all other operating configurations, including portable configurations with respect to 2.1093 and different antenna configurations.

## **FCC Class B digital device notice**

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.

## **Labelling Requirements for the Host device**

The host device shall be properly labelled to identify the modules within the host device. The certification label of the module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labelled to display the FCC ID and ICSED of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as follows:

Model: WIFI module

Contains FCC ID: EP9-TMXM05L

The host OEM user manual must also contain clear instructions on how end users can find and/or access the module and the FCC ID and ISSED.

Model: WIFI module

Contains FCC ID: EP9-TMXM05L

## OEM Statement

- a. The module manufacturer must show how compliance can be demonstrated only for specific host or hosts
- b. The module manufacturer must limit the applicable operating conditions in which the transmitter will be used, and
- c. The module manufacturer must disclose that only the module grantee can make the evaluation that the module is compliant in the host. When the module grantee either refuses to make this evaluation, or does not think it is necessary, the module certification is rendered invalid for use in the host, and the host manufacturer has no choice other than to use a different module, or take responsibility (§ 2.929) and obtain a new FCC ID for the product.
- d. The module manufacturer must provide the host manufacturer with the following requirements:
  - i. The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part 15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be transmitting and the evaluation should confirm that the module's intentional emissions are compliant (i.e. fundamental and out of band emissions).

## 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 Part 15 Subpart C Section 15.249

### 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 uses external antenna, antenna gain: 0 dBi. There is no restriction on the installation method.

### 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 limited 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 without trace antenna designs.

## 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 module is designed to comply with the FCC statement, FCC ID is: EP9-TMXM05L

## 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 uses external antenna, antenna gain: 0 dBi.



## **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: : EP9-TMXM05L

## **2.9 Information on test modes and additional testing requirements**

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:** Data transfer module demo board can control the EUT work in RF test mode at specified test channel.

## **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.