

TuYa Smart Wi-Fi Module-TYLC5

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1. Product Overview

TYLC5 is a low-power embedded Wi-Fi module developed by Hangzhou Tuya Information Technology Co., Ltd. It consists of a highly integrated wireless radio frequency chip, ESP8285, and a few peripheral devices. It also has a built-in Wi-Fi network protocol stack and abundant library functions. TYLC5 embeds a low-power 32-bit CPU, 1Mbyte of flash memory, 50KB of SRAM and a wealth of peripheral resources.

As an RTOS platform, TYLC5 integrates all the function libraries of the Wi-Fi MAC and the TCP/IP protocol. Based on these function libraries, users can develop different embedded Wi-Fi products to meet their own needs.

1.1 Features

The built-in low-power 32-bit CPU doubles as an application processor.

- The basic frequency of the CPU supports 160MHz.
- ✧ Working voltage: 3.0V-3.6V
- ✧ Peripheral: 3×GPIOs, 1×UART
- ✧ Wi-Fi connectivity
 - 802.11 b/g/n
 - Channels 1-11@2.4GHz
 - Supporting the security mode of WPA/WPA2
 - Supporting the operating mode of STA/AP/STA+AP
 - Supporting both Smart Config and AP network distribution methods (including Android and IOS devices)
 - Soldering external wire antennas
 - Operating temperature: -20°C to 125°C

1.2 Main Application Areas

- ✧ Intelligent building
- ✧ Smart home/home appliances
- ✧ Smart socket, smart LED
- ✧ Industrial wireless control
- ✧ Baby monitors
- ✧ Webcams
- ✧ Smart bus

1.3 Module picture



Front picture



Negative picture

2. Module Interfaces

2.1 Size Package

TYLC5 has 2 rows of pins with the pin pitch being 2mm.

The size of TYLC5: 8.5mm (W)×13.5mm (L) ×3mm (H). The dimensions of TYLC5 is shown in Figure2.

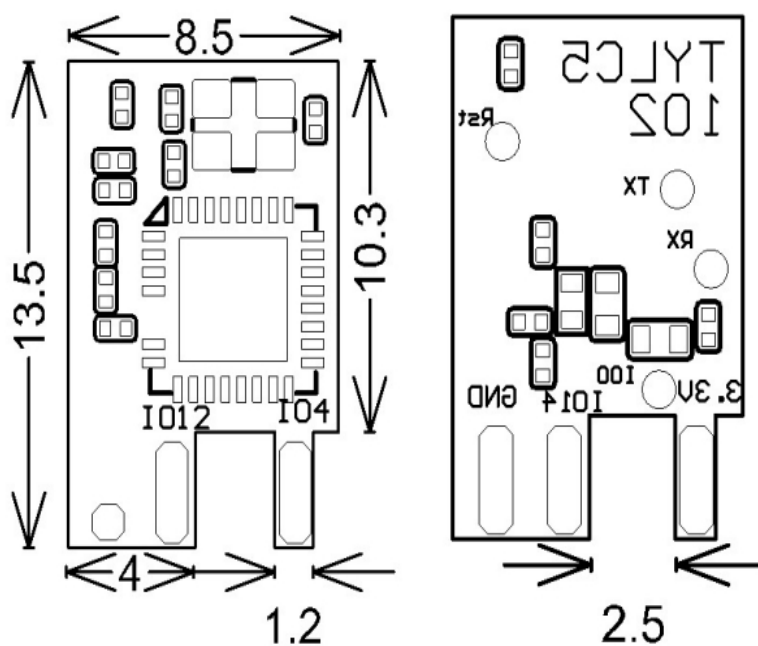


Figure 2 Dimensions of TYLC5

2.2 Pin definition

The definition of the interface pins is shown in Table 1.

Table 1 Description of TYLC5's Interface Pin Arrangement

| Pin | Symbol | IOType | Function |
|-----|--------|--------|---|
| 1 | ANT | - | RF antenna port, spot to solder external antennas |
| 2 | GND | P | Power reference point |
| 3 | GPIO12 | I/O | GPIO 12 |
| 4 | GPIO14 | I/O | GPIO 14 |
| 5 | GPIO4 | I/O | GPIO 04 |
| 6 | VCC | P | Power pin of the module (3.3V) |

Note: "P" represents the power pin, "I/O" represents the input and output pin.

2.3 Definition of the Test Points

The definition of the test pins is shown in Table 2.

Table 2 Description of TYLC5's Test Pin Arrangement

| Pin | Symbol | IOType | Function |
|-----|--------|--------|--|
| - | TP1 | Rst | Hardware reset pin; Cannot clear the distribution network information of Wi-Fi. |
| - | TP 2 | I/O | GPIO0; Testing the module production. |
| - | TP3 | U0TXD | User serial port; Information output from the serial port can be used for testing the module production. |
| - | TP4 | U0RXD | User serial port; Information output from the serial port can be used for testing the module production. |

3. Electrical Parameters

3.1 Absolute electrical parameters

Chart 3 Absolute Parameters

| Parameters | Description | Minimum value | Maximum value | Unit |
|---|---------------------|---------------|---------------|------|
| Ts | Storage temperature | -20 | 85 | °C |
| VCC | Supply voltage | -0.3 | 3.6 | V |
| Electrostatic Discharge Voltage (human model) | TAMB-25°C | - | 2 | KV |
| Electrostatic Discharge Voltage (machine model) | TAMB-25°C | - | 0.5 | KV |

3.2 Operating conditions

Chart 4 Normal Operating Conditions

| Parameters | Description | Min | Typ | Max | Unit |
|------------------|---------------------------------|----------|-----|----------|------|
| Ta | Operating temperature | -20 | - | 125 | °C |
| VCC | Operating voltage | 3.0 | 3.3 | 3.6 | V |
| VIL | IO low electrical level input | -0.3 | - | VCC*0.25 | V |
| VIH | IO high electrical level input | VCC*0.75 | - | VCC | V |
| VOL | IO low electrical level output | - | - | VCC*0.1 | V |
| VoH | IO high electrical level output | VCC*0.8 | - | VCC | V |
| I _{max} | IO drive current | - | - | 12 | mA |

3.3 Power Consumption of Wi-Fi Transmission

Table 5 Power Consumption of Continuous TX Transmission

| Symbol | Mode | Power | Transmit power | Typ | Unit |
|--------|-------|-------|----------------|-----|------|
| IRF | 11b | 1Mbps | 21.21dBm | 220 | mA |
| IRF | 11g | 6Mbps | 24.99dBm | 110 | mA |
| IRF | 11n20 | MCS0 | 24.88dBm | 100 | mA |

3.4Power Consumption of Wi-Fi Reception

Table 6 Power Consumption of Continuous RX Reception

| Symbol | Mode | Rate | Typ | Unit |
|--------|------|--------|-----|------|
| IRF | 11b | 11Mbps | 76 | mA |
| IRF | 11g | 54Mbps | 76 | mA |
| IRF | 11n | MCS7 | 76 | mA |

3.5 Power consumption in operating mode

Table 7 Working Current of TYLC5

| Operation Mode | Operating condition, TA=25°C | Typ | Peak | Unit |
|-----------------------|---------------------------------|------|------|------|
| Easy mode | WIFI indicator flashes quickly. | 80 | 151 | mA |
| Hotspot mode | WIFI indicator flashes slowly. | 90 | 451 | mA |
| Network connection | WIFI indicator is always on. | 58.5 | 411 | mA |
| Network disconnection | WIFI indicator is always off. | 80 | 430 | mA |

4. Characteristics of Radio Frequency

4.1 Basic Characteristics of Radio Frequency

Table 4.1, Basic RF characteristics

| Parameter | Description |
|---------------------------|---|
| Working frequency | 2.412~2.462GHz |
| Wi-Fi standard | IEEE 802.11b/g/n(Channel 1-11) |
| Rate of data transmission | 11b:1,2,5.5, 11 (Mbps) 11g:6,9,12,18,24,36,48,54(Mbps) 11n:HT20 MCS0~7 |
| Type of antenna | External antenna soldered |

4.2 Output Power of Wi-Fi

Table 9 Power of Continuous TX Transmission

| Parameter | | Min | Typ | Max | Unit |
|---|-------|-----|-------|-----|------|
| Peak output power of RF, 802.11b CCK Mode | 1Mbps | - | 21.21 | - | dBm |
| Peak output power of RF,802.11g OFDM Mode | 6Mbps | - | 24.99 | - | dBm |
| Peak output power of RF,802.11n OFDM Mode | MCS0 | - | 24.88 | - | dBm |
| Frequency error | - | -10 | - | 10 | ppm |

4.3 Sensitivity of Receiving Wi-Fi

Table 10 RX Sensitivity

| Parameter | | Min | Typ | Max | Unit |
|--|------|-----|-----|-----|------|
| PER<8%, RX Sensitivity, 802.11b CCK Mode | 1M | - | -91 | - | dBm |
| PER<10%, RX Sensitivity, 802.11g OFDM Mode | 6M | - | -75 | - | dBm |
| PER<10%, RX Sensitivity, 802.11n OFDM Mode | MCS0 | - | -72 | - | dBm |

5.Information of Antennas

5.1 Type of Antennas

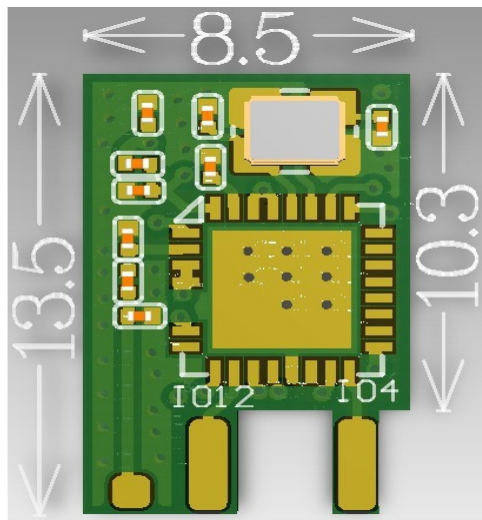
They are external antennas soldered to the ANT pad of the module.

5.2 Reducing Antenna Interference

When an external antenna is soldered to the Wi-Fi module, to optimize the Wi-Fi performance, it is recommended that the distance between the antenna part and the other metal parts be at least 10 mm.

6.Packaging Information andProduction Guide

6.1 Mechanical dimensions


Figure 3 Mechanical Dimensions of TYLC5

6.2 Recommended Package for PCB

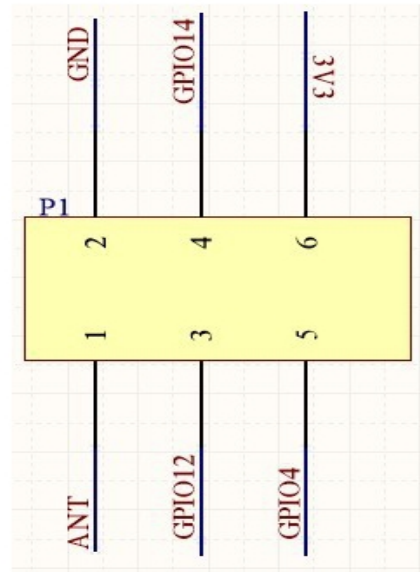


Figure 4 Schematic & Pin Map of TYLC5

6.3 Production guide

The storage conditions for the module after it has been shipped are as follows:

1.The moisture barrier bag must be stored in an environment with a temperature $<30^{\circ}\text{C}$ and a humidity $<85\%$ RH.

2.Dry-packaged products should have a shelf life of 6 months from the date when the package is sealed.

Precautions:

- 1.Every operator must wear an electrostatic ring in the whole process of production.
- 2.When operating, operators must prevent the module from getting wet or dirty.

6.4 Curve of the Furnace Temperature Recommended

Refer to IPC/JEDEC standard ; Peak Temperature : $<250^{\circ}\text{C}$; Number of Times: ≤ 2 times ;

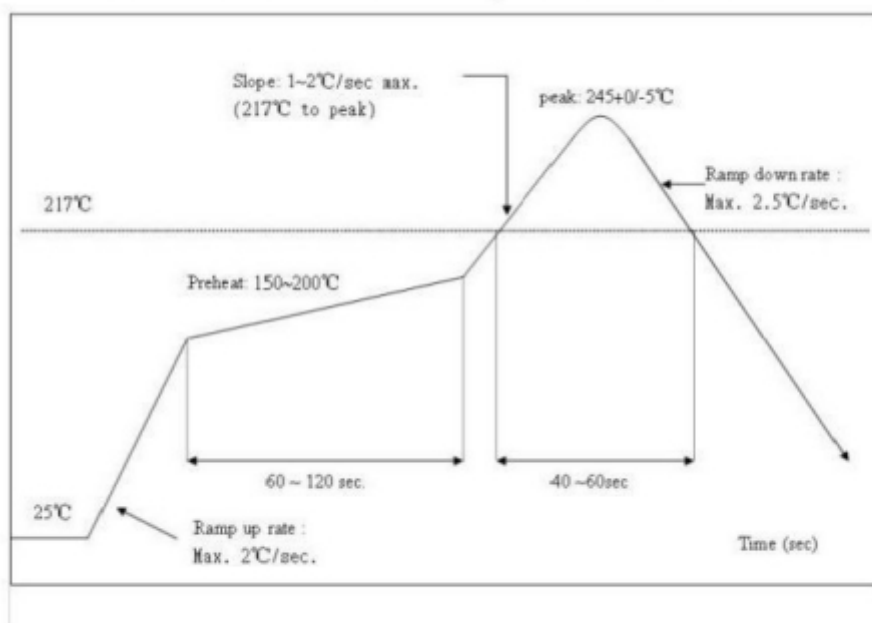


Figure 5 Curve of the Furnace Temperature

Regulatory Module Integration Instructions

2.2 List of applicable FCC rules

This device complies with part 15.247 of the FCC Rules.

2.3 Summarize the specific operational use conditions

This module can be used in household electrical appliances as well as lighting equipments. The input voltage to the module should be nominally 3.0~3.6 V_{DC}, typical value 3.3V_{DC} and the ambient temperature of the module should not exceed 125°C.

This module using only one kind of antennas with maximum gain is 2.0 dBi .Other antenna arrangement is not covered by this certification.

The antenna is not field replaceable. If the antenna needs to be changed, the certification should be re-applied.

2.4 Limited module procedures

This module can be used in lighting equipment, smart frontpanel, household electrical appliances. Normally host device should provide a power supply in range 3.0-3.6V, typically 3.3V for this module. The limited module manufacturer will reviews detailed test data or host designs prior to giving the host manufacturer approval.

2.5 Trace antenna designs

Not applicable

2.6 RF exposure considerations

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment .This equipment should be installed and operated with minimum distance 20cm between the radiator& your body. If the device built into a host as a portable usage,

the additional RF exposure evaluation may be required as specified by § 2.1093.

2.7 Antennas

Module only contains one wire antenna. No additional external connectors.

2.8 Label and compliance information

The outside of final products that contains this module device must display a label referring to the enclosed module. This exterior label can use wording such as: “Contains Transmitter Module FCC ID: 2ANDL-TYLC5”, or “Contains FCC ID: 2ANDL-TYLC5”, Any similar wording that expresses the same meaning may be used.

2.9 Information on test modes and additional testing requirements

a) The modular transmitter has been fully tested by the module grantee on the required number of channels, modulation types, and modes, it should not be necessary for the host installer to re-test all the available transmitter modes or settings. It is recommended that the host product manufacturer, installing the modular transmitter, perform some investigative measurements to confirm that the resulting composite system does not exceed the spurious emissions limits or band edge limits (e.g., where a different antenna may be causing additional emissions).

b) The testing should check for emissions that may occur due to the intermixing of emissions with the other transmitters, digital circuitry, or due to physical properties of the host product (enclosure). This investigation is especially important when integrating multiple modular transmitters where the certification is based on testing each of them in a stand-alone configuration. It is important to note that host product manufacturers should not assume that because the modular transmitter is certified that they do not

have any responsibility for final product compliance.

c) If the investigation indicates a compliance concern the host product manufacturer is obligated to mitigate the issue. Host products using a modular transmitter are subject to all the applicable individual technical rules as well as to the general conditions of operation in Sections 15.5, 15.15, and 15.29 to not cause interference. The operator of the host product will be obligated to stop operating the device until the interference has been corrected

Below are steps for TX verification :

```
tx_contin_en 1      // return : wifi tx continuous test!
```

```
wifitxout < parameter 1> < parameter 2> < parameter 3>
```

< parameter 1> : Send channel option and allowed number is 1~11.

< parameter 2> : Send data rate option, the relationship between input parameters and rates is shown in table 1.

< parameter 3> : Send power attenuation, which is 8 bits directed number and 0.25 dB unit.

for , 4 equals power decrease 1dB , 252 equals power increase 1dB.

Table 1: allowed input for speed of receiving or sending data package

| 11b mode | | 11g mode | | 11n mode | |
|----------|------------|----------|------------|----------|--------------|
| Input | Dial Speed | Input | Dial Speed | Input | Dial Speed |
| 0x0 | 1M | 0xb | 6M | 0x10 | 6.5M / MCS0 |
| 0x1 | 2M | 0xf | 9M | 0x11 | 13M / MCS1 |
| 0x2 | 5.5M | 0xa | 12M | 0x12 | 19.5M / MCS2 |

| | | | | | |
|-----|-----|-----|-----|------|--------------|
| 0x3 | 11M | 0xe | 18M | 0x13 | 26M / MCS3 |
| | | 0x9 | 24M | 0x14 | 39M / MCS4 |
| | | 0xd | 36M | 0x15 | 52M / MCS5 |
| | | 0x8 | 48M | 0x16 | 58.5M / MCS6 |
| | | 0xc | 54M | 0x17 | 65M / MCS7 |

cmdstop // Stop sending data package command

2.10 Additional testing, Part 15 subpart B disclaimer

The final host / module combination need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.

The host integrator installing this module into their product must ensure that the final composite product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation and should refer to guidance in KDB 996369.

Frequency spectrum to be investigated

For host products with certified modular transmitter, the frequency range of investigation of the composite system is specified by rule in Sections 15.33(a)(1) through (a)(3), or the range applicable to the digital device, as shown in Section 15.33(b)(1), whichever is the higher frequency range of investigation.

Operating the host product

When testing the host product, all the transmitters must be operating. The transmitters can be enabled by using publicly-available drivers and turned on, so the transmitters are active. In certain conditions it might be appropriate to use a technology-specific call box (test set) where accessory devices or drivers are not available.

When testing for emissions from the unintentional radiator, the transmitter shall be placed in the receive mode or idle mode, if possible. If receive mode only is not possible then, the radio shall be passive (preferred) and/or active scanning. In these cases, this would need to enable activity on the communication BUS (i.e., PCIe, SDIO, USB) to ensure the unintentional radiator circuitry is enabled. Testing laboratories may need to add attenuation or filters depending on the signal strength of any active beacons (if applicable) from the enabled radio(s). See ANSI C63.4, ANSI C63.10 and ANSI C63.26 for further general testing details.

The product under test is set into a link/association with a partnering WLAN device, as per the normal intended use of the product. To ease testing, the product under test is set to transmit at a high duty cycle, such as by sending a file or streaming some media content.

FCC Statement

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the 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