1. Product Overview

The TYZS5 is a low-power embedded Zigbee module developed by Hangzhou Tuya Information Technology Co., Ltd. The module consists of a EFR32MG13P732HG highly integrated wireless RF processor chip and a small number of peripheral devices. It has a built-in 802.15.4 PHY/MAC Zigbee network protocol and a large number of library functions. The TYZS5 embeds a low-power 32-bit ARM Cortex-M4 core, 512KByte Flash program memory, 64KB RAM data memory, and a wealth of peripheral resources.

The TYZS5 is a FreeRTOS platform that gathers all Zigbee MAC and TCP/IP libraries into one place. It enables users to build on the product and develop embedded Zigbee products that suit their individual needs.

1.1 Features

A built-in low-power 32-bit ARM Cortex-M4 processor with a DSP instruction set and a floating point unit that doubles as an application processor
Wide operating voltage: 1.8V-3.8V
Peripherals: 6×GPIOs, 1×UART (with flow control),

Zigbee operating characteristics:

- Supports 802.15.4 MAC/PHY
- Operating channels 11to 26@2.405-2.480GHz, air-interface rate 250Kbps
- Built-in DC-DC circuit for maximum power efficiency
- 63uA/MHz operating power consumption; 1.4 uA sleep current
- Active net pairing with terminal devices
- Built-in PCB onboard antenna
- Operating temperature: -40℃ to 85℃
- Supports hardware encryption and supports AES 128/256

1.2 Primary application fields

✧Smart buildings
✧Smart homes/appliances
✧Smart plugs, smart lighting
✧Industrial wireless control
✧Health and measurements
✧Asset tracking

2. Module interfaces

2.1 Package dimensions

The TYZS5 has 2 rows of pins with a 2mm gap and a total of 14 external pins.

TYZS5 dimensions: 14.8mm (W) x 20.4mm (L) x 2.0mm (H),TYZS5 dimensions are as shown in Figure 1:

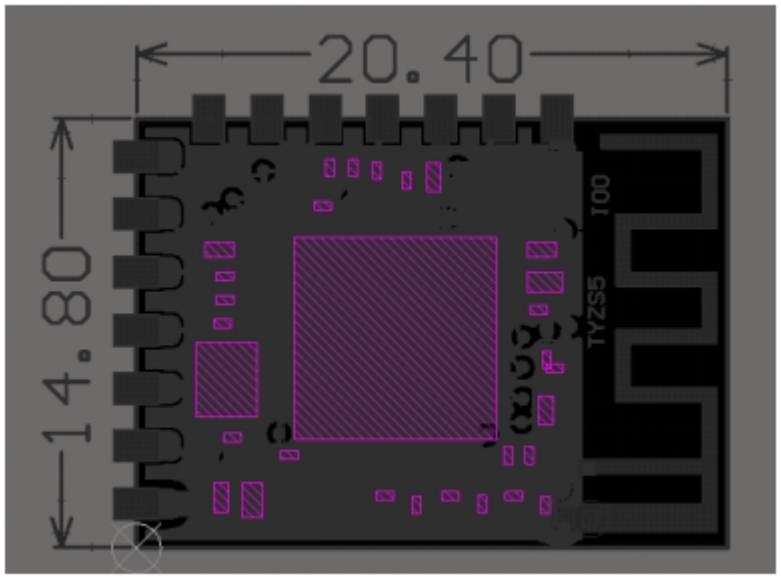


Figure1. TYZS5dimensional drawing

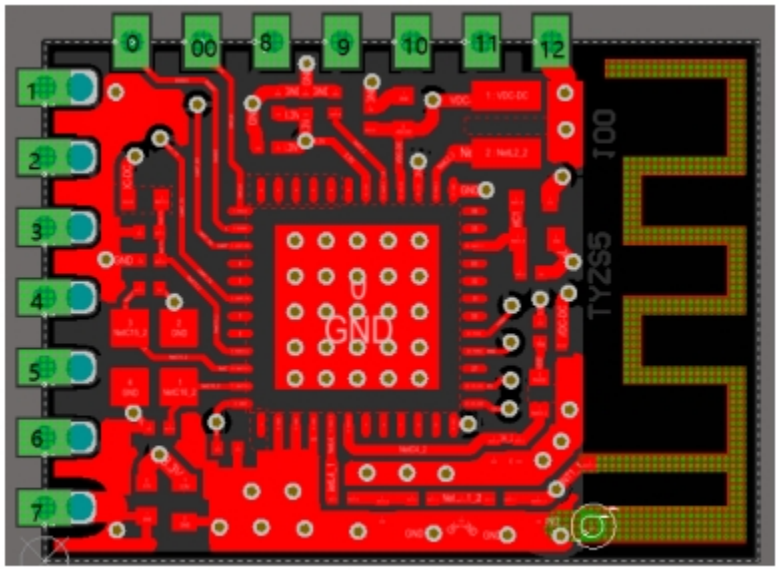


Figure2： Pin numbers

2.2 Pin definition

Interface pins are defined as shown in Table 1:

Table 1, TYZS5 interface pins description

Pin number	Symbol	IO type	Function
1	PWM1	I/O	Light driver port/GPIO pin usage.
2	PWM2	I/O	Light driver port/GPIO pin usage.
3	I2C_SDA	I/O	I2C_SDA, GPIO pin usage.
4	I2C_SCL	I/O	I2C_SCL, GPIO pin usage.
5	VCC	P	Module power supply pin (common supply voltage: 3.3V)
6	ADC	AI	ADC![img](file:///C:\Users\hyper\AppData\Local\Temp\ksohtml\wpsC81C.tmp.png), 12-bit precision SAR analog to digital converter
7	GND	P	The reference ground of the module.
0	SWDIO	I/O	JLINK SWDIO programming pin. Can be used as a GPIO pin in normal applications.
00	SWCLK	I/O	JLINK SWCLK programming pin. Can be used as a GPIO pin in normal applications.
8	RXD	I/O	UART0_RXD, RX serial port.
9	nRST	I	Hardware reset pin, the chip is reset when the pin is LOW; Power-on reset of the module, the user can use this pin as needed.
10	VCC	P	Module power supply pin (common supply voltage: 3.3V); Since there's an internal connection to the 3.3V network, no external handling is necessary.
11	TXD	O	UART0_TXD, TX serial port.
12	GND	P	The reference ground of the module is internally connected to GND and does not need to be handled externally.

Description: P indicates the power pin; I/O indicates the input/output pin; AI indicates analog input pin.

nRST is only the module hardware reset pin; it cannot clear Zigbee net-pairing information.

AI: This pin can only be used as an ADC port. It cannot be used as a normal IO port. If it is not used, it needs to be left floating.

As an ADC input, the input voltage range is limited to 0-AVDD and can be configured by software.

2.3 Test point definition

Test pins are defined in Table 2:

Table 2, TYZS5 test pins description

Pin number	Symbol	IO type	Function
8/11	RXD/TXD	I/O	For module production testing

Description: This test pin is bottom PAD and is not recommended for use.

3. Electrical parameters

3.1 Absolute electrical parameters

Table 3, Absolute parameters

Parameters	Description	Minimum value	Maximum value	Unit
Ts	Storage temperature	-50	150	℃
VCC	Input voltage	-0.3	3.8	V
Electrostatic discharge voltage (human-body model)	TAMB-25℃	-	2.5	KV
Electrostatic discharge voltage (machine model)	TAMB-25℃	-	0.5	KV

3.2 Operating conditions

Table 4, Normal operating conditions

Parameters	Description	Minimum value	Typical value	Maximum value	Unit
Ta	Operating temperature	-40	-	85	℃
VCC	Operating voltage	1.8	3.3	3.8	V
VIL	IO low input	-0.3	-	VCC*0.25	V
VIH	IO high input	VCC*0.75	-	VCC	V
VOL	IO low output	-	-	VCC*0.1	V
VoH	IO high output	VCC*0.8	-	VCC	V
Imax	IO drive current	-	-	12	mA

3.3 Zigbee TX power consumption

Table 5, Power consumption during continuous TX

Symbol	Rate	Transmission power	Typical value	Unit
IRF	250Kbps	+11.66dBm	118	mA
IRF	250Kbps	+11.28dBm	32	mA
IRF	250Kbps	+11.02dBm	17	mA

Note: When testing the above data, continuous transmission duty cycle=100%.

3.4 The Zigbee RX power consumption

Table 6, Power consumption during continuous RX

Symbol	Rate	Typical value	Unit
IRF	250Kbps	8	mA

Note: When UART is active, the RX mode current is 14mA.

3.5 Power consumption when operating

Table 7, TYZS5 operating current

Operation mode	Operating condition, Ta=25℃	Average value	Maximum value	Unit
Quick configuration	Module in quick configuration state	10	40	mA
Network connection state	Connected to a network	-	-	mA
Deep sleep mode	Deep sleep mode and retains 64KB Flash	1.4	3	uA

4. RF Characteristics

4.1 Basic RF characteristics

Table 8, Basic RF characteristics

Parameter	Description
Operating frequency	2.405 to 2.480GHz
Physical layer standard	IEEE 802.15.4
Data transfer rate	250Kbps
Antenna type	PCB antenna
Line of sight	>100m

4.2 Zigbee Output performance

Table 9, Continuous TX performance

Parameter	Minimum value	Typical value	Maximu m value	Unit
Maximum output	-	+11.66	-	dBm
Minimum output	-	+11.02	-	dBm
Output power adjustment step	-	-	-	dB
Frequency error	-15	-	+15	ppm
Output adjacent channel suppression		-31		dBc

4.3 Zigbee RX sensitivity

Table 10, RX Sensitivity

Parameter	Minimu m value	Typical value	Maximu m value	Unit
PER<10%, RX sensitivity, 250Kbps@OQPSK	-	-102	-	dBm

5. Antenna signal

5.1 Antenna type

Default PCB onboard antenna connection

5.2 Antenna interference reduction

To optimize Zigbee performance of the wireless module in combination with the PCB onboard antenna, it is recommended to keep the antenna at least 15mm from other metal parts.

The user PCB board should not be routed around the antenna area and should not be covered with copper to avoid affecting the antenna radiation performance. It is recommended that the adapter board antenna area be hollowed out.

For the module PCB onboard antenna area refer to Figure 3 “The TYZS5 mechanical dimensional drawing” below.

6.Packaging information and production guide

6.1 Mechanical dimensions

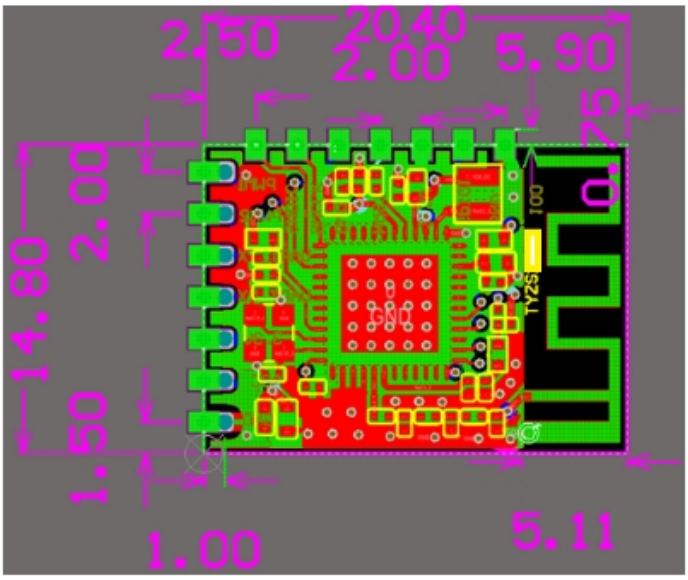


Figure 3: The TYZS5mechanical dimensional drawing

6.2 Production Guide

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

1.The moisture resistant bag must be stored at a temperature below 30℃, and under a relative humidity below 85%.

2. The shelf life of dry packed products is six months following the packaged date.

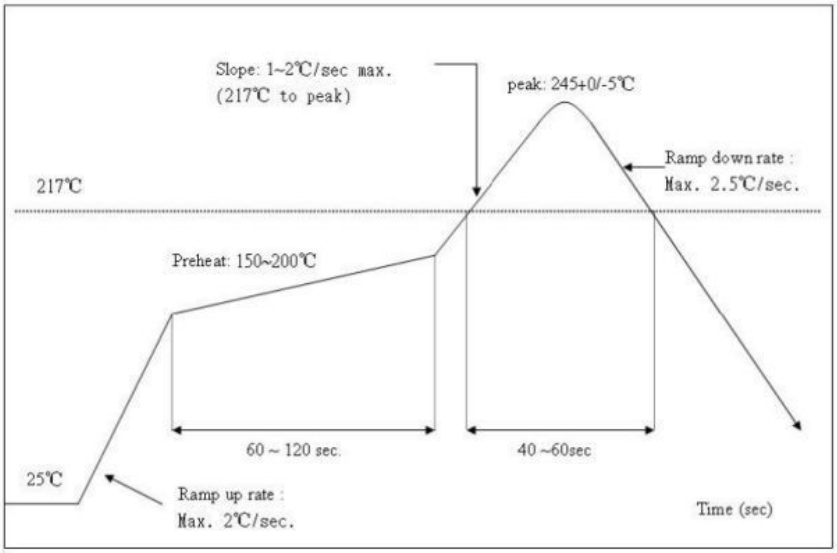
Important information

1.All line workers must wear anti-static wrist straps and anti-static clothing throughout the entire production process.

2.It is strictly prohibited to allow a module to come into contact with water or other contaminants during operations.

6.3 Recommended furnace temperature curve

Refer to IPC/JEDEC standard ; Peak Temperature : <250°C ; Number of Times: ≤2 times ;



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 1.8~3.8 V_{DC} ,typical value 3.3V_{DC} and the ambient temperature of the module should not exceed 85℃.

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 1.8-3.8V, 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 PCB 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-TYZS5 ””,or “Contains FCC ID: 2ANDL-TYZS5 ”, 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 on test modes：

plugin mfglib mfgenable 1 //1 presents enable

plugin mfglib start 0 //0 presents transmitting

plugin mfglib set-channel 11 // channel config, 11 presents carrier frequency 2405MHz, 26 presents carrier frequency 2480MHz

plugin mfglib stream start //transmiting modulated zigbee waveform

plugin mfglib stream stop //stop transmiting modulated zigbee waveform

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 placed into a normal ‘paired’ mode with another ZigBee device, as per the normal intended use of the product (for example, transferring data).

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 operatio