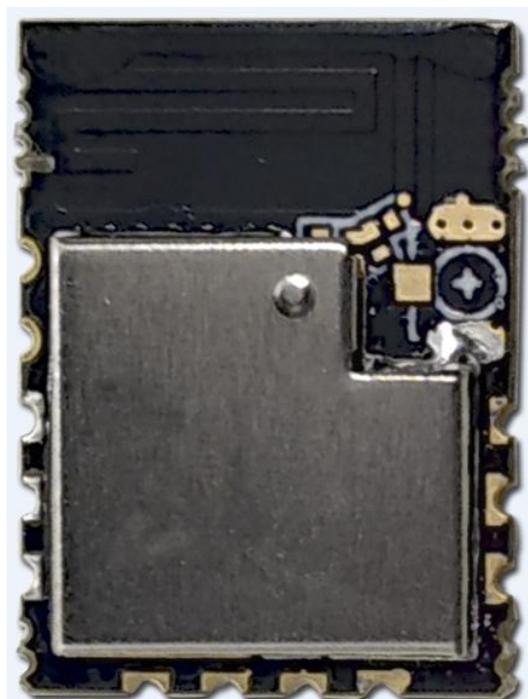


Bluetooth Low Energy ( BLE )  
transparent transmission module  
specification  
HM-BT4531



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## 1 product description

HM-BT4531 is a Bluetooth module based on a new generation of high-performance, ultra-low -power Bluetooth 5.1 chip CMT4531 , using 32-bit ARM® Cortex® -M0 core with a maximum frequency of 64MHz. On -chip

48 KB SRAM 256KB FLASH integrated advanced 5.1 \_ BLE RF transceiver , equipped with integrated PCB antenna and external antenna base , supports wireless data transparent transmission function, and can quickly realize wireless connection and communication between BLE slave devices and BLE master devices such as mobile phones and tablets by communicating with external MCU . Data communication, the resource occupation of the external MCU is low, and the development process is simple .

## 2 Module Features

- Based on ARM ® Cortex ® -M0 32 -bit processor core ;
- Support Bluetooth Low Energy 2.4 GHz multi- protocol ;
- The low-power Bluetooth protocol stack can support 4. X to 5.1, and the protocol stack can be upgraded ;
- -chip integrated 256 KB of FLASH and 48KB of RAM ;
- The user interface uses a general-purpose serial port design, full-duplex two-way communication, and the minimum baud rate supports 9600bps
- default connection interval is 30ms , and the connection is fast
- Support 2M symbol transmission
- Support AT command software reset module, obtain MAC address
- Support AT commands to adjust the Bluetooth connection interval and control different forwarding rates (dynamic power consumption adjustment)
- Support AT commands to adjust transmission power, modify broadcast interval, customize broadcast data, customize device identification code, set data delay ( user CPU serial port receiving preparation time ) , modify serial port baud rate, modify module name, all will be powered off save

- 5K bytes of data can be input to the serial port at one time
- Support mobile device APP to modify module name, save when power off, modify serial port baud rate, product identification code, customize broadcast content, broadcast cycle, save when power off
- Support mobile device APP to reset the module and set the transmit power
- Support mobile device APP to adjust the Bluetooth connection interval, not save when power off (dynamic power consumption adjustment)
- Supports anti-hijacking password setting, modification and recovery to prevent third-party malicious connections. can also not use
- Broadcast content prompt module real-time system status, including battery power, custom device identification code (suitable for broadcast applications)
- Support internal RTC real time clock
- Certified by BQB
- Passed FCC / CE / IC / SRRC certification
- Comply with ROHS / REACH / CA Prop 65 standard requirements

### 3 electrical characteristics

- Working voltage: 1. 8V -3.6V
- Working temperature: -20 °C ~ + 85 °C
- Modulation mode: GFSK Gaussian frequency shift keying
- Modulation frequency: 2402MHz-2483.5MHz
- Receive data instantaneous current: less than 3. 8 mA@3V
- Transient data sending current: less than 4.2mA@3V@0dBm
- Deep sleep mode : 1.4uA @3V Deep Sleep (48KB RAM retention )

- Maximum transmit power: +6dBm
- Receive sensitivity: -94dBm @1Mbps GFSK

## 4 Module function description

After the module is started, it will automatically broadcast, and the mobile phone that has opened a specific APP will scan and connect to it. After successful connection, it can be operated through the BLE protocol. The user's main control MCU can perform two-way communication with the mobile device through the serial port of the module, and the user can also manage and control certain communication parameters through specific interface commands.

The user data format is defined by the upper application program. The mobile device can write to the module through the APP, and the written data will be sent to the user's MCU through the external interface of the module. After the module interface receives the data packet from the external MCU, it will automatically forward it to the connected mobile device. The user needs to complete the code design of the main MCU and the APP code design of the smart mobile device.

## 5 Application Diagram



Figure 1 Application Diagram of Transparent Transmission Module

## 6 module pin

### 6.1 Module pin distribution

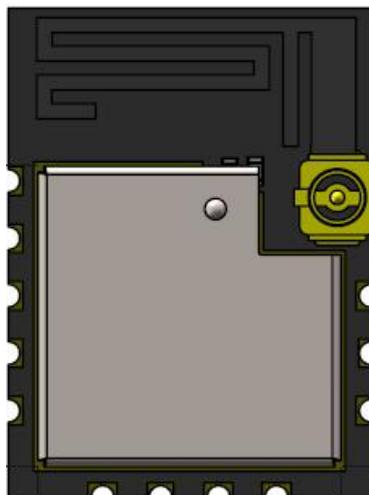


Figure 2 Module pin layout (front view )

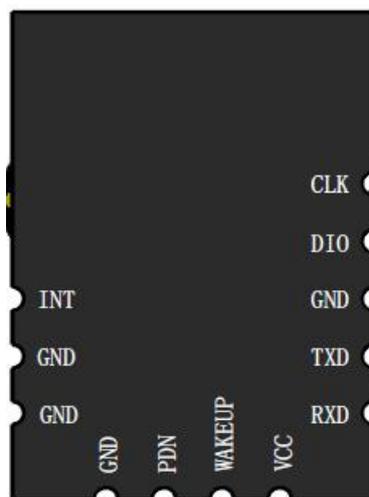


Figure 3 Module pin layout (rear view )

## 6.2 Definition of module pins

Pin No.	Pin Name	type	Description
1	INT	do	Interrupt Pin , Module to MCU; 1-0: Module UART Start to Send Data 0-1: Module UART Stop Sending Data
2	GND	DG	Digital Ground
3	GND	DG	Digital Ground
4	GND	DG	Digital Ground
5	PDN	DI	Power-down Pin; MCU to Module; 1-0: Module BLE Start to Advertise 0-1: Module Go to Sleep
6	WAKEUP	DI	Wakeup Pin; MCU to Module 1-0: Module UART Start to Receive Data 0-1: Module Go to Sleep
7	VDD	AP, DP	Power Supply; 1.8V~3.6V
8	RXD	DI	UART RXD
9	TXD	do	UART TXD
10	GND	DG	Digital Ground
11	DIO	I/O	SWDIO/PA5 ; serial debug programming interface data
12	CLK	I/O	SWCLK/PA4 ; serial debug programming interface clock

Table 1 Definition of module pins

## 7 module size

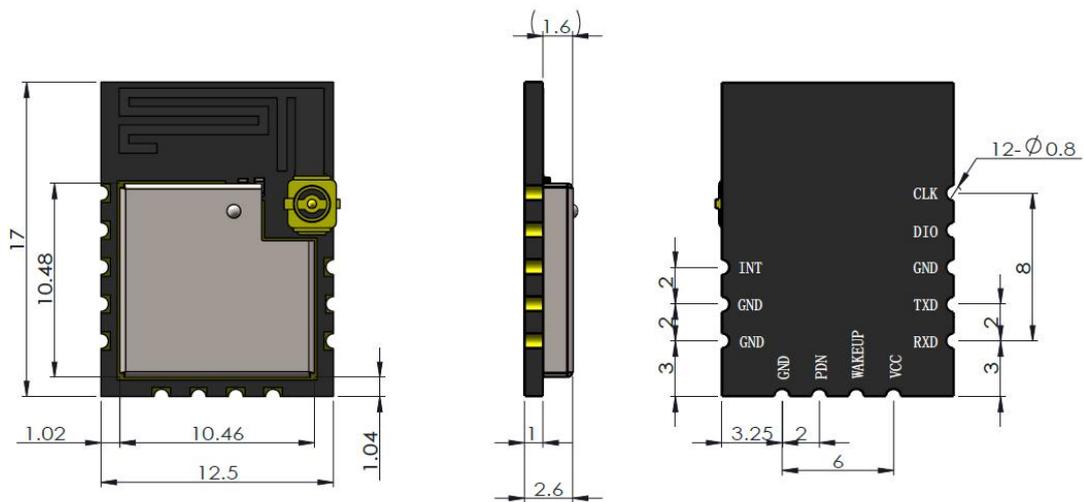


Figure 4 HM-BT4531 module size with shield cover

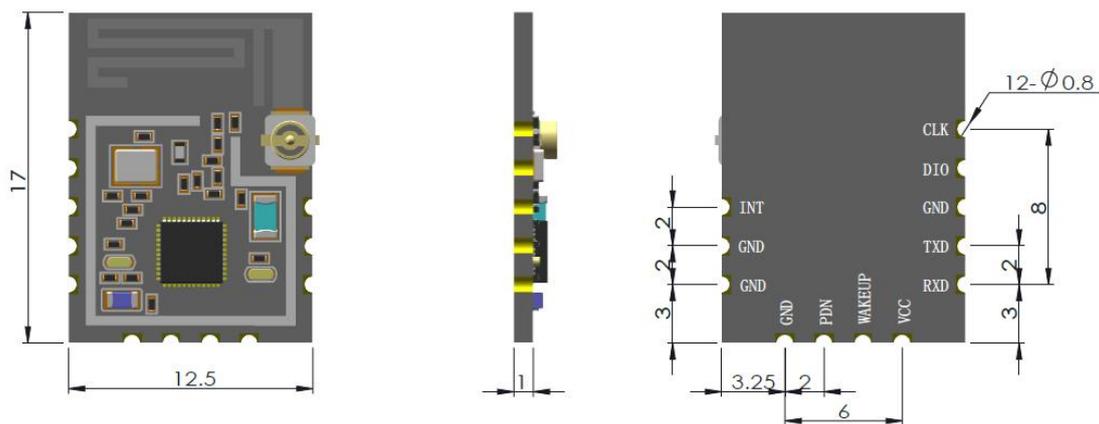


Figure 5 HM-BT4531 module size without shield cover

## 8 Hardware Design Considerations

1. It is recommended to use a DC regulated power supply to supply power to the module. The ripple coefficient of the power supply should be as small as possible, and the module must be reliably grounded; please pay attention to the correct connection of the positive and negative poles

of the power supply. Reverse connection may cause permanent damage to the module;

2. Please check the power supply to ensure that it is within the recommended power supply voltage. If it exceeds the maximum value, it will cause permanent damage to the module; please check the stability of the power supply, and the voltage cannot fluctuate greatly and frequently;

3. When designing the power supply circuit for the module, it is recommended to reserve more than 30% margin, which is conducive to the long-term stable operation of the whole machine; the module should be kept away from the power supply, transformer, high-frequency wiring and other parts with large electromagnetic interference;

4. High-frequency digital wiring, high-frequency analog wiring, and power wiring must avoid the bottom of the module. If it is necessary to pass through the bottom of the module, assuming that the module is soldered to the Top Layer, lay the ground on the Top Layer of the module contact part (all Copper and good grounding), the wiring must be close to the digital part of the module, and the wiring should be in the Bottom Layer;

5. Assuming that the module is soldered or placed on the Top Layer, it is also wrong to randomly route the wires on the Bottom Layer or other layers, which will affect the stray and receiving sensitivity of the module to varying degrees;

6. Assuming that there are devices with large electromagnetic interference around the module, which will greatly affect the performance of the module, it is recommended to keep away from the module according to the intensity of the interference . If the situation permits, appropriate isolation and shielding can be done;

7. Assuming that there are traces with large electromagnetic interference around the module (high-frequency digital, high-frequency analog, power supply traces) will also greatly affect the performance of the module.

It is recommended to keep away from the module according to the intensity of the interference. If the situation permits, you can Do proper isolation and shielding;

8. If the communication line uses 5V level, a level conversion circuit must be used;

9. Try to stay away from some TTL protocols whose physical layer is also in the 2.4 GHz frequency band, such as USB3.0.

10. Please refer to the figure below for the module antenna layout:

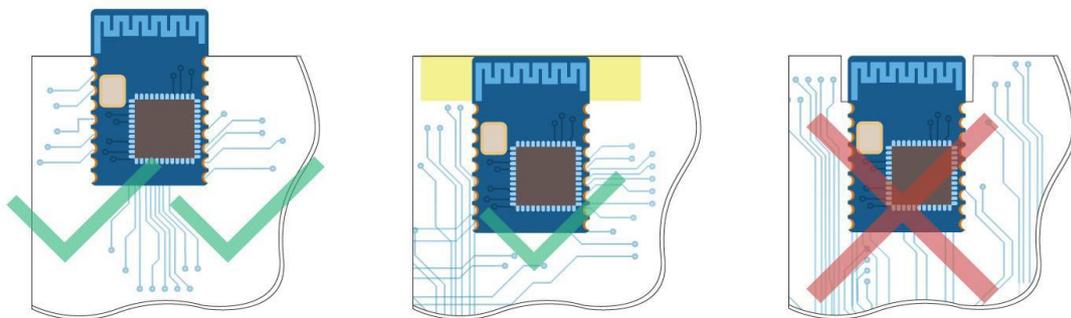


Figure 6 PCB trace suggestion

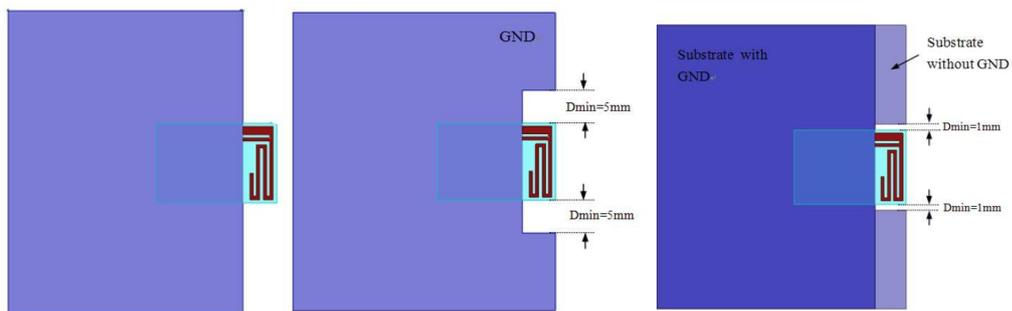


Figure 7 PCB Layout Recommendations

## 9 common problem

### 9.1 The transmission distance is not ideal

1. When there is a straight-line communication obstacle, the communication distance will be attenuated accordingly; temperature, humidity, and co-frequency interference will increase the communication packet loss rate; the ground absorbs and reflects radio waves, and the test effect close to the ground is poor;
2. Seawater has a strong ability to absorb radio waves, so the seaside test effect is poor;
3. There are metal objects near the antenna, or placed in a metal case, the signal attenuation will be very serious;
4. The power register is set incorrectly, and the air speed is set too high (the higher the air speed, the closer the distance);
5. The power supply voltage at room temperature is lower than the recommended value, the lower the voltage, the lower the transmission power;
6. The matching degree between the antenna and the module is poor , or the quality of the antenna itself is faulty.

### 9.2 Vulnerable—abnormal damage

1. Please check the power supply to ensure that it is within the recommended power supply voltage. If it exceeds the maximum value, it will cause permanent damage to the module; please check the stability of the power supply, and the voltage cannot fluctuate greatly and frequently;
2. Please ensure anti-static operation during installation and use , high-frequency devices are electrostatic sensitive devices ;

during installation and use should not be too high, some components are humidity sensitive devices; if there is no special requirement, it is not recommended to use it at too high or too low temperature.

## 9.3 The bit error rate is too high

1. There is interference from the same frequency signal nearby, stay away from the interference source or modify the frequency and channel to avoid interference;
2. Unsatisfactory power supply may also cause garbled characters, so be sure to ensure the reliability of the power supply;
3. If the quality of the extension line or the feeder line is too poor or too long, it will also cause a high bit error rate.

## 10 Reflow Soldering Conditions

1. Heating method: conventional convection or IR convection;
2. Allowable number of reflow soldering: 2 times, based on the following reflow soldering (conditions) ( see the figure below);
3. Temperature curve: reflow soldering should follow the following temperature curve ( see the figure below);
4. Maximum temperature: 245° C.

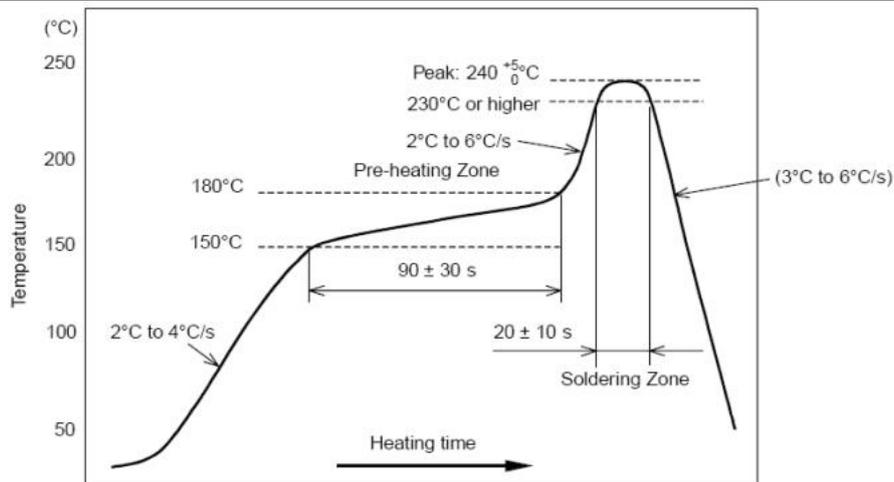


Figure 8 Soldering heat resistance temperature curve of components  
(soldering point)

## 11 Electrostatic Discharge Warning

Modules can be damaged due to electrostatic discharge, it is recommended that all modules should be handled under the following 3 precautions:

1. Anti-static measures must be followed, and the module cannot be held with bare hands.
2. The module must be placed in a placement area that can prevent static electricity.
3. The anti-static circuit at the high-voltage input or high-frequency input should be considered in product design.

Static electricity can cause results ranging from subtle performance degradation to complete equipment failure. Modules are more susceptible to damage since very small parameter changes can cause the device not to comply with the value limits required for its certification.

## 12. Document Change Record

Table 2. Documentation Change History

document version	change description	update date
V1.0	Initial Release	2023.4.03

## 13. Contact information

Shenzhen Huapu Microelectronics Co., Ltd.

Address: Floor 30, Block A, Building 8, Phase III, Vanke Cloud City, Xili Street, Nanshan District,  
Shenzhen

Tel: +86-0755-82973805

E-mail: sales@hoperf.com

URL: <http://www.hoperf.cn>