

# User Manual

## Bluetooth module

panlink3

Mindray

FCC ID: ZLZ-PANLINK3

Shenzhen Mindray Bio-Medical Electronics Co.,Ltd.

## Overview of CBB

### Purpose and scope

This article describes the technical specifications and platform deliverables of the panlink3 BLE5.0 Bluetooth module CBB, as a source of follow-up CBB design and verification solutions, and as a reference document for products that use this CBB.

This article applies to panlink3 BLE5.0 Bluetooth module CBB and related products using this CBB.

### Basic information

CBB name: panlink3

Technical direction: hardware + software

Person in charge of development: Li Linghua

Person in charge of maintenance: Du Xulong, Fu Neng

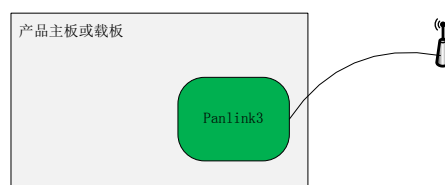
Subordinate functional department: Guardianship Product Development Department

### Composition of CBB

Panlink3 BLE5.0 Bluetooth module CBB is a physical CBB composed of Bluetooth module PCBA and built-in function software. This module is developed based on nordic nRF52840 SOC, supports BLE 5.0 protocol, and is backward compatible with BLE4.2 and BLE4.0 protocols.



Panlink3 is integrated into the motherboard or carrier board by soldering. The antenna is connected to the I-pex socket MHF III (Part No. 20367-001R) on the module via cable;



This CBB provides a set of serial port to Bluetooth low energy (BLE) solutions, which consists of Panlink3 PCBA and built-in software, as well as supporting antennas.

component	Material coding	description
Panlink3	051-003800-00	panlink3 Bluetooth module PCBA, built-in firmware
Panlink3 RF test software	/	RF test software, support Bluetooth module constant frequency, etc.
Panlink3 Boot software	/	Boot, used to support serial port upgrade test software and function software
Panlink3 function software	/	Functional software

## 1.2 Introduction to applicable scenarios

**1.3** Panlink3 is suitable for products such as monitors, lamp bed towers, wearable wireless sensors, etc., and realizes the transmission of device information or patient data within a range of about 10m. Panlink3 can realize the BLE interconnection of Mindray's internal devices, and can also interconnect with third-party BLE devices.

## 1.4 Working mode

Panlink3 networking is very flexible. It can be configured as a BLE master device, or a BLE slave device, or as both a master and slave device. Up to 8 slave devices can be connected simultaneously as a BLE master device, and up to 1 master device can be connected as a slave device.

Panlink3's wireless communication parameter configuration is very flexible. Each Bluetooth connection can be independently configured with different air interface baud rates: 2Mbps, 1Mbps and 125kbps, high baud rate can achieve greater throughput, and low baud rate can achieve longer communication distance. Each Bluetooth connection of Panlink3 can be independently configured with timing parameters and transmit power to adapt to different products' power consumption, communication distance, throughput and immunity requirements. Panlink3 provides a set of default configurations with the best overall performance, reducing the development difficulty of general application requirements.

Panlink3 is a low-power wireless communication module that provides three power consumption states:

Data throughput mode:

Specific power consumption is related to actual throughput, master-slave identity, and connection parameter configuration. For typical power consumption, see the technical specifications table.

Standby mode:

Bluetooth stays connected, does not send or receive application data, and the serial port of the host computer does not perform operations such as querying and sending data. The average power consumption is less than 1mw.

Sleep mode:

The Bluetooth chip sleeps completely, and the average power consumption is less than 0.1mw. It wakes up through the reset pin and needs to be re-initialized after exiting sleep.

## CBB Technical Specifications

The detailed technical specifications are as follows:

Specification Description	Specification Description
Protocol Standard	Support Bluetooth 5 Compatible with Bluetooth low energy 4.0, Bluetooth low energy 4.2
Basic RF specifications	Modulation method: GFSK Working frequency: 2402 ~ 2480MHz Channel interval: 2M Baud rate: 2Mbps, 1Mbps, 125kbps Frequency error: absolute value $\leq 30$ ppm
Output Power	8dBm maximum, Adjustable, minimum -20dBm. Power accuracy $\pm 4$ dB
Receive sensitivity	Not weaker than the typical value +3dB. Typical values: -103dBm at 125kbps, -95dBm at 1Mbps, -92dBm at 2Mbps
Host computer interface	Single power supply 1.75V~3.6V Serial port, the default baud rate is 115200 (the baud rate error is less than $\pm 1\%$ ), The baud rate can be reconfigured to: 1M (the baud rate error is less than $\pm 1\%$ ).
Antenna interface	Support external cable antenna, socket type MHF III, model 20369-001E
Host computer communication	Can communicate with the host computer to realize serial port to BLE data communication;
Host computer status query	<ol style="list-style-type: none"> <li>1. When the Bluetooth connection status changes, actively report to the host computer.</li> <li>2. Because Bluetooth cannot send and receive data, the time threshold for terminating the link can be set by the host computer;</li> <li>3. You can query RSSI through the host computer;</li> <li>4. The firmware version information and mac address can be queried through the host computer.</li> <li>5. Support test mode, realize the scanning analysis of all Bluetooth channel noise, and realize the high-precision collection of RSSI.</li> </ol>
Online upgrade	Support online upgrade through host computer
RF test mode	Support RF test mode, you can set Bluetooth in

	normal transmission mode and normal reception mode, you can change the Bluetooth working channel, transmit power, datarate
Sleep wake-up function	Provides three power consumption states: data throughput, standby, and sleep, and has the following functions: 1. The Bluetooth module can be controlled to sleep through the serial port command of the host computer; 2. The Bluetooth module can be woken up by the host computer IO;
Data Security	AES128, with pairing password mechanism
Operating mode	It can be configured as a BLE master device, or a BLE slave device, or both as a master and slave device through the host computer. As a BLE master device, connect up to 8 slave devices at the same time, typically 4 slave devices, as slave devices, you can connect up to 1 master device.
Delay	The end-to-end data transmission delay from serial port to serial port between Bluetooth master and slave is less than 1s Bluetooth connection establishment time is less than 4s
Communication reliability and power consumption	Specification 1: 1, 24h cumulative packet loss rate is less than 0.1%. 2, 3.3V working voltage, the average power consumption of the master node is less than 10mw; the average power consumption of the slave node is less than 5mw. Based on conditions: 1, 20*5m space, realize 6 groups of Bluetooth communication at the same time, the efficiency of Bluetooth antenna is not less than 20%, and the apparent distance between connected nodes is greater than 15m. 4 groups of master-slave one-to-one communication, the application layer rate is 42kbps. 1 group 1 master 4 slave communication, application layer rate 20kbps, 20kpps, 1kbps, 1kpbs. 1 group, 1 master, 1 master and slave, and 4

	<p>slaves at the same time, the application layer rate is 20kbps, 20kpps, 1kbps, 1kbps, 1kbps.</p> <p>2. Test under low wifi interference (1, 6, 11 channels of wifi exist, but the distance from Bluetooth is greater than 20m). 2, 3. 3V working voltage, the average power consumption of the master node is less than 20mw; the average power consumption of the slave node is less than 5mw.</p> <p>Based on conditions:</p> <p>1, 20*5m space, realize 6 groups of Bluetooth simultaneous communication, Bluetooth antenna efficiency is not less than 20%.</p> <p>Four groups of master-slave one-to-one communication, the application layer rate is 42kbps, and the apparent distance between connected nodes is greater than 15m.</p> <p>1 group, 1 master and 4 slave communication, the application layer rate is 20kbps, 20kpps, 1kbps, 1kbps, and the apparent distance between connected nodes is greater than 15m.</p> <p>1 group, 1 master, 1 master and slave, and 4 slaves at the same time, the application layer rate is 20kbps, 20kpps, 1kbps, 1kbps, 1kbps, and the apparent distance between the connected nodes is greater than 5m.</p> <p>2. Test under the condition of strong wifi interference (there are 1, 6, 11 channels of wifi, among which ch1 and ch11 interference sources are 0.5m~0.6m from the Bluetooth node, and ch6 is more than 20m from Bluetooth).</p>
Sleep power consumption	Working voltage 3.3V, average power consumption is less than 0.1mw
Standby power consumption	Working voltage 3.3V, average power consumption is less than 1mw
Testability Repairability Manufacturability	<p>1. There are test points to support online download and code debugging;</p> <p>2. Provide constant frequency constant sending mode, you can change the channel, transmit power and datarate through the serial port, support regulatory testing and PCBA RF hardware testing, and product assembly testing</p> <p>3. Broadcast response can be enabled to support the testing of the product comprehensive tester;</p>
Volume and weight	Independent module with shielding cover within

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	9.7*14.0*2.4mm, weight less than 1g.
Operating temperature	Working environment temperature, 0~70°C
Regulations	Completed FCC, IC, CE, SRRC, Brazil certification



## CBB Interface Definition

### Mechanical interface

The outline drawing is as follows, the pin definition is consistent with panlink2, and there is an optional external antenna pin and stamp hole pin.

Without antenna size: maximum 9.7\*14.0\*2.3mm.

After the MHF socket is attached to the antenna, the height is 2.4mm at the maximum.

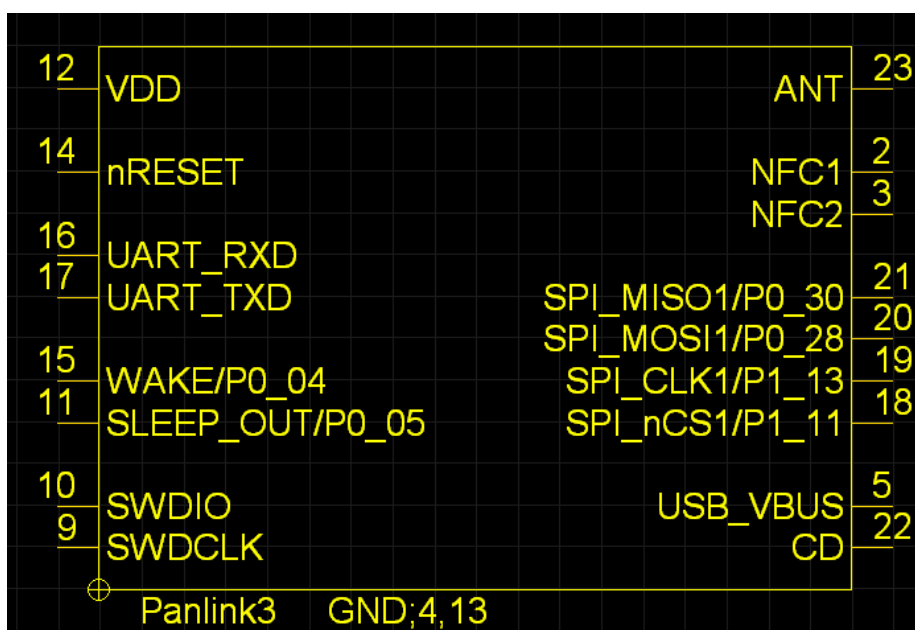
Weight: less than 1g



### Electrical interface

#### Pin definition

panlink3 is called as an independent device by the motherboard or carrier board. The corresponding schematic symbol (part name: panlink3) is shown in the following figure:



Pin definitions are as follows:

#	name	Types	Functional description	Connection when not in use
2	NFC1	A	NFC tag 1 pin reserved	Leave open
3	NFC2	A	Reserved NFC tag 2 feet	Leave open
4	GND	P	Ground	/
5	USB_VBUS	p	Internal USB peripheral power supply	接地
9	DD	I/O	Two-wire debug signal: SWD_DD	Leave open
10	DC	I	SWD_DC	Leave open
11	SLEEP_OUT/P3_0	O	Reserved GPIO	Leave open
12	VDD	P	power supply (1.75~3.6V)	/
13	GND	P	Ground	/
14	RESET	I	Reset signal, low level is effective, you can use the reset signal to exit the Bluetooth module from sleep state.	/
15	WAKE/P0_3	I	. Set aside GPIO	Leave open
16	UART_RXD0	I	Serial input, baud rate 115200	/
17	UART_TXD0	O	Serial output, baud rate 115200	/
18	nCS1/CTS <sub>n</sub> 1/P1_2	I	Leave SPI port or GPIO port □	Leave open
19	CLK1/RTS <sub>n</sub> 1/P1_3	I	Leave SPI port or GPIO port □	Leave open
20	MOSI1/TXD1/P1_1	I	Leave SPI port or GPIO port □	Leave open
21	MISO1/RXD1/P1_0	O	Leave SPI port or GPIO port □	Leave open
22	CD	O	In-position detection, module internal grounding	Leave open
23	ANT	A	Optional, the external antenna version (without the ipex socket on the module) is effective, the antenna signal is led out to achieve a more flexible antenna configuration, 50 ohm impedance matching	Leave open

## Recommended working conditions

The stress constraints are as follows:

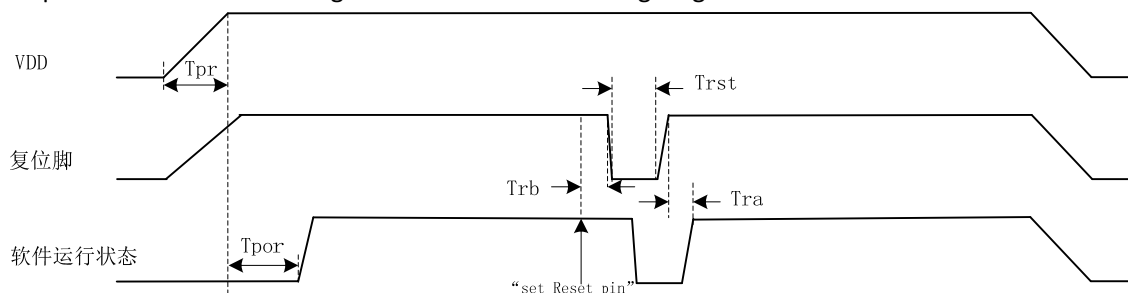
parameter	Minimum value	Maximum	unit	Remarks
Supply voltage				
VDD	-0.3	+3.9	V	/
VDD ripple	/	$\pm 2\% \cdot VDD$	V	The maximum value cannot exceed 3.6V; Refers to the standard of MSD45N wifi module
IO voltage				
Vio, VDD $\leq$ 3.6V	-0.3	VDD+0.3	V	/
Vio, VDD > 3.6V	-0.3	+3.9	V	/
RADIO				
RF input power	/	10	dBm	/
Environmental constraints				
storage temperature	-40	125	°C	/
Operating temperature	-40	85	°C	/
ESM HBM	/	1000	V	Mannequin
ESD CDM	/	500	V	Machine model
Internal flash reliability				
Program storage time	10 years	/	/	40° in environment
Read and write times	10 000	/	Read and write times	

The recommended working conditions are as follows:

parameter	Description	Min	Type	Max
VDD	Operating Voltage (V)	1.75	3.0	3.6
Trf,50pf	IO 10~90% rise or fall time under 50pf load	/	25ns	/
V <sub>OH</sub>	Output high level, output current 3mA	VDD - 0.4	/	VDD
V <sub>OL</sub>	Output low level, output current 3mA	0	/	0.4
V <sub>IH</sub>	Input high	0.7*VDD	/	VDD
V <sub>IL</sub>	Input low	0	/	0.3*VCC

## Timing requirements

The power-on and reset timing are shown in the following diagram:



The Bluetooth chip has its own power-on reset circuit. The IO reset pin P0.18 is a GPIO by default. It needs software initialization to set it before it can truly become a reset pin. After being set as the reset pin, P0.18 automatically enables the 13K pull-up resistor.

parameter	description	Min	Max	other information
Tpr(1.7V)	Rise time requirements for supply voltage from 0v to 1.7V	/	60ms	Slow power-on may result in poor power-on reset
Tpr(3.7V)	Rise time requirements for supply voltage from 0v to 3.7V	/	100ms	Slow power-on may result in poor power-on reset
Tpor	The time from the successful power-on of the Bluetooth module to the exit of the reset state	/	110ms	When VDD reaches 1.75V, the power-on is successful. After Tpor, the software starts to run and initializes. After the initialization is OK, the status information will be pushed to the host computer through the serial port.
Trb	The time difference between the reset pin and the upper computer can be lowered by the software.	0ms	/	Only when the reset pin is set in the software, the host computer will be effective when the reset pin is pulled down. For specific timing requirements, see the CBB software instructions
Trst	Reset low time	0.2us	/	0.2us mail from Nordic, the reset low time of the nordic demo board is 30ms
Tra	The time from reset to high until the Bluetooth module exits the reset state	0	650ms	/

## CBB multiplexing instructions

### Scope of application:

Panlink3 is suitable for products such as monitors, lamp bed towers, and some wearable wireless sensors, and realizes the transmission of device information or patient data within 10m. As a PCBA device, Panlink3 is integrated into the hardware board of the product by soldering. According to the specific system design, different Bluetooth antennas are used to implement the Bluetooth function.

For detailed reuse instructions, see: "BLE5.0 Module CBB Hardware Instructions", this chapter outlines the main points.

### Reuse considerations:

1. Prevent interference by other circuits: when the whole machine is integrated, it is necessary to avoid panlink3 from being subjected to 2.4G electromagnetic interference in the receiver (such as magnetic couple device, 2.4G wifi antenna, etc.), otherwise it will reduce the radio frequency sensitivity, resulting in reduced communication distance. When using the whole machine, it is necessary to avoid other devices working in the 2.4G frequency band, such as microwave ovens, high-throughput wifi devices, which are too close, otherwise the communication distance will be reduced.
2. **Prevent interference with other sensitive circuits: panlink3 is a radio frequency module, and system integration needs to consider to avoid radio frequency signals from interfering with other sensitive circuits.**
3. **Risk management: wireless transmission is affected by interference and occlusion, and the probability of data loss is greater than that of wired transmission. The product must carry out risk analysis and risk management of the related functions implemented by panlink3.**
4. Radio frequency regulations: Panlink3 is a wireless module. If you sell panlink3, you must pass the wireless regulations certification required by the sales area. The specific requirements for certification need to be determined by technical regulations engineers in specific product projects.
5. Maintainability: When the software system is integrated, the status reporting function of panlink3 must be fully utilized to realize real-time display of status information and log storage:
  - 5.1 After Bluetooth wireless communication is restored, data communication can be automatically restored and reported to the host computer;
  - 5.2 Bluetooth can be set by the host computer because the communication is interrupted, and the time threshold for terminating the link can be set;
  - 5.3, RSSI can be queried through the host computer;
  - 5.4, you can query the firmware version information and Bluetooth mac address through the host computer.

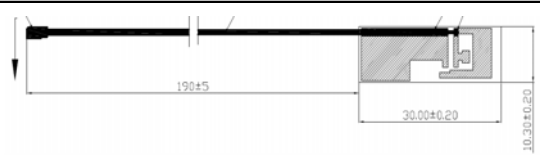
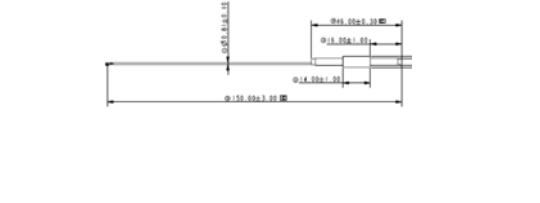
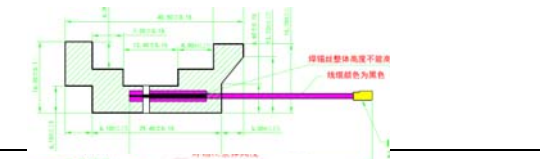
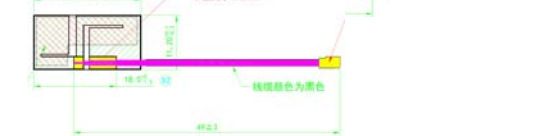
5.5 Support test mode, realize the scanning analysis of all Bluetooth channel noise, and realize the high-precision collection of RSSI.

6. Information security: Compared with wired communication, wireless communication has a higher risk of information security, and product integration requires additional consideration for data security.

7. ESD: The ESD protection capability of the RF module, especially the antenna port, is weak, and ESD protection needs to be done in transit and use.

## Link CBB:

The Bluetooth module needs to be used with an antenna. The list of recommended antennas is as follows:

component	Material coding	description	Dimensional drawings
ANT 1	024-001018-00	AZM24000-3, FPC dipole antenna, cable length 190mm, body 30*11*0.2mm	
ANT 2	024-000718-00	MG7019-41-000-R, copper tube dipole antenna, cable length 150mm, body 46*4.8mm	
ANT 3	024-000748-00	AZM24000-1A, FPC dipole antenna, cable length 112mm, body 16.2*40.5*0.2mm	
ANT 4	024-000750-00	AZM24510-2A, FPC dipole antenna, cable length 49mm, body 11.2*22.2*0.2mm	

The selection and design of the antenna need to have a relevant professional background. In order to ensure wireless communication performance, it is necessary to involve guardianship wireless related engineers in the early mechanical design of the product.

## CBB deliverables

The relevant regulatory reports are stored on the server designated by the Product Safety Department. For details, please refer to "KF-JH-0608 Panlink3 BLE5.0 Module CBB Hardware Instructions".

Related hardware technical files are archived in the PLM system, catalog: 0010/hardware.

Related software technical files are archived in the PLM system, directory: 0010/software development.

The development documents are archived in the PLM system, and the catalogues are: General Guardianship Specification and Technology Accumulation/Hardware; General Guardianship Specification and Technology Accumulation/Software Development; General Guardianship Specification and Technology Accumulation/Software Testing

mainly include:

NO.	Development document name
1	Panlink3 BLE5.0 module CBB specification
2	Panlink3 BLE5.0 module CBB hardware design plan
3	Panlink3 BLE5.0 module CBB hardware test solution
4	Panlink3 BLE5.0 module CBB hardware test report
5	Panlink3 BLE5.0 module CBB hardware instructions
6	Panlink3 BLE5.0 module CBB software design solution
7	Panlink3 BLE5.0 module CBB software test solution
8	Panlink3 BLE5.0 module CBB software test report
9	Instructions for using CBB software of Panlink3 BLE5.0 module
10	Panlink3 BLE5.0 module CBB requirement traceability table