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# NSM-B01 Bluetooth Module Specifications

## Version update record

Version	Date	Update content
V001	2021/10/22	First release

**Note:** The document will be optimized and updated from time to time. Before using this document, please ensure that it is the latest version.

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## 一、 Summary

The NSM-B01 is a highly integrated BLE 5.1 module for low-speed, short-range wireless communication in the 2.4GHz ISM band. This module is based on N32WB03x Bluetooth wireless transceiver chip. Based on ARM® Cortex®-M0 CPU core. The main frequency is 64MHz. At the same time built-in 48KB RAM and 512KB Flash. It can support analog or digital peripherals. This module provides low-power, cost-effective Bluetooth transmission applications.

The Bluetooth LE modules which are mentioned in this document can work in bridge mode (transparent transmission mode) and direct-driven mode.

After the module starts to broadcast, smart phone with specific APP running will scan and pair with it. When connection is successful, the smart phone can monitor and control the module through Bluetooth protocol.

In bridge mode, user CPU can communicate with the mobile device bi-directionally through the serial ports of modules. Users can also manage and control certain communication parameters through specific AT commands of serial ports. The detailed meaning of the user data is defined by the up-application. Mobile devices can write the module through the APP. And the data written will be sent to the user CPU through serial ports. Then the module will transmit the data packet from user CPU to the mobile devices automatically. Under the development in this mode, the user needs to undertake the code design for master CPU and the APP for mobile devices.

In the direct drive mode, the user can simply expand the periphery of the module, and the app can directly drive the module through the ble protocol to complete the monitoring and control of the module by the smart mobile device. For software development in this mode, users only need to be responsible for the app code design of smart mobile device.

## 二、 Features

- 1、Easy to use, no need of any application experience of Bluetooth protocol stack.
- 2、Support manual adjustment of physical layer bandwidth to improve communication distance and rate
- 3、UART design for user interface, full-duplex bi-directional communication, and support the minimum baud rate of 9600 bps.
- 4、Default connection interval of 20 ms, which makes quick connection and enhance the compatible stability of Android and iOS phones.
- 5、ServiceUUID; Through AT command , Support modify ServiceUUID
- 6、Through AT command, support software reset.
- 7、Through AT command, support acquire MAC address and modify MAC address (Modified MAC address is effective after reset).
- 8、Support at command to adjust Bluetooth connection interval and control different forwarding rates (dynamic power consumption adjustment)
- 9、Through AT command, support the adjustment of the transmit power and broadcast interval, the customization of broadcast data and product ID, the modification of the serial port baud rate and module names.
- 10、The length of the UART data packet can be any value lower than 512-Byte (automatic sub-packet of large ones).
- 11、High-speed transparent transmission rate is maximum to 12.4 K/s and the stable rate is 5 K/s.
- 12、Through APP, support the modification of module name, UART baud rate and product ID, support the customization of broadcast packet and cycles.
- 13、Through APP, support the remote reset of module and the configuration of transmit power.
- 14、Through APP, support the adjustment of Bluetooth connection interval (dynamic power consumption adjustment).

15、Support the configuration, modification and recover of anti-hijacking password, and prevent from the malicious connection of a third party. This function can be ignored. The independent result notification of password operation to simplify the APP programming.

16、Through AT command and APP, Support remote recovery of factory settings.

17、Support string prompts of module real-time system status, including MAC address, connection interval, broadcast cycle, data delay time, baud rate, product ID, anti-hijacking password enable and other configuration information.

18、Support the light recovery and deep recovery modes, which can recover user data flexibly while reserve the essential configurations.

19、Extremely low power in standby mode, N32WB031 chip sleep current  $1.4 \mu A$ , and the measured power consumption data is as follows.

**Table 2-1** Power Consumption of NSM-B01

Event	Average Current (Enable EN Internal Pull-up)	Average Current (Enable EN Internal Pull-up)	Testing Conditions / Remark
Sleeping	2.31 $\mu A$		—
Broadcast	78.22 $\mu A$	52.86 $\mu A$	Broadcast cycle: 200ms
Broadcast	46.51 $\mu A$	22.36 $\mu A$	Broadcast cycle: 500ms
Broadcast	36.46 $\mu A$	12.23 $\mu A$	Broadcast cycle: 1000ms
Broadcast	28.90 $\mu A$	4.07 $\mu A$	Broadcast cycle: 5000ms
Connection Event	314.76 $\mu A$	292.66 $\mu A$	Connection interval: 20ms
Connection Event	82.41 $\mu A$	61.89 $\mu A$	Connection interval: 100ms

**Note:** Above is the measured sampling data of module NSMB01 and for reference only. If the lower power consumption is expected, connection interval or broadcast cycle can be appropriately increased, as shown in the chapters of module parameter configuration and AT command.

### 三、 Application scenarios

- 1、**Fitness category:** Sports metering (running, cycling, golf).
- 2、**Smart home categories:** socket transformation, remote control switches, dimming and color lighting, door locks, curtains, temperature and humidity meters, smart scales, environmental smoke detectors, pet supervision.
- 3、**Health care category:** Medical detection/tracking (heart rate, blood pressure, blood oxygen, pulse, body temperature).
- 4、**Baby care:** real-time body temperature detection, smart crib, anti-loss.
- 5、**Toys:** interactive remote control toys, robots, aircraft, toy cars, anti-lost devices.
- 6、**Automotive electronics:** tire pressure detection, automatic car locks, parking space records, electric vehicle anti-theft devices, data acquisition and monitoring.
- 7、**Human-machine interface:** HID keyboard, mouse, remote control, handle.
- 8、**Security industrial control category:** intelligent charging pile, sensorless access control system, subway rolling mill.



Figure 3-1 Module application scenarios

## 四、 Schematic Diagram of Working Mode

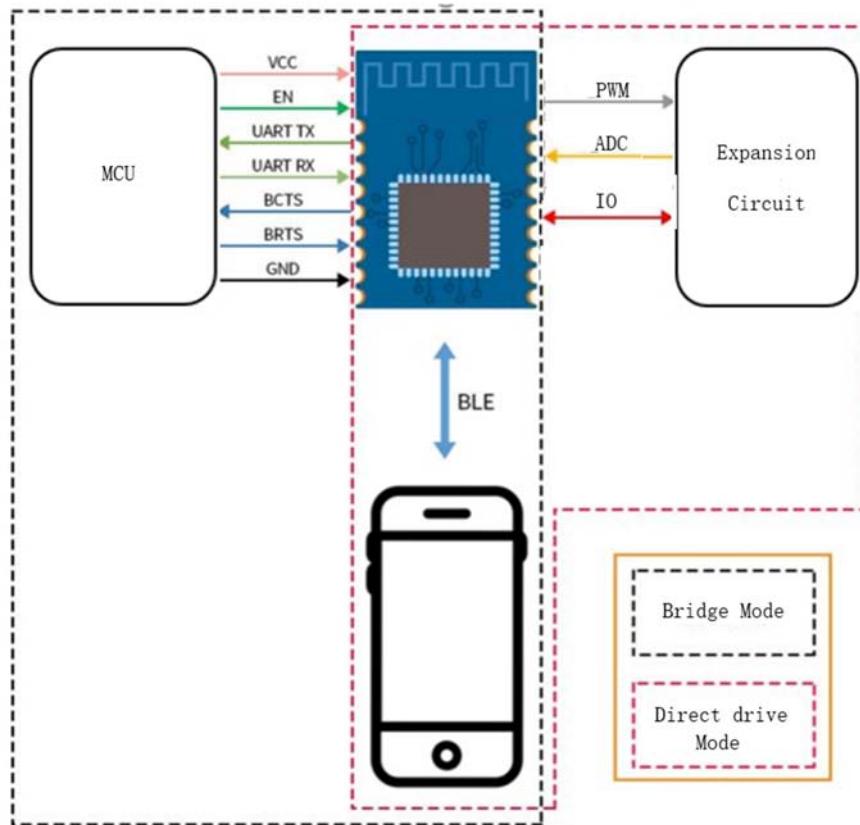


Figure 4-1 Schematic diagram of module bridge mode and direct drive mode

**Note:** In order to avoid the high current caused by the output level difference between user MCU IO and module IO, a small isolation resistor is suggested to be connected in series in the output signal line TX, BCTS.

## 五、 Module parameters

Table 5-1 Moudle Parameters

Chipset	N32WB03X
Supply Power Voltage	2.32V~3.6V, Recommend 3.3V
Transmit Power	-20~-+6dBm
Receiving Sensitivity	-94dBm@1M
SRAM	48KB
Flash	512KB
GPIO	12
Crystal	32MHz
Package	15.20x11.20x2.50mm, SMT (Stamp half hole)
Operating Temperature	-30°C~+85°C
Storage Temperature	-40°C~+105°C

## 六、 Package and Pin Assignment

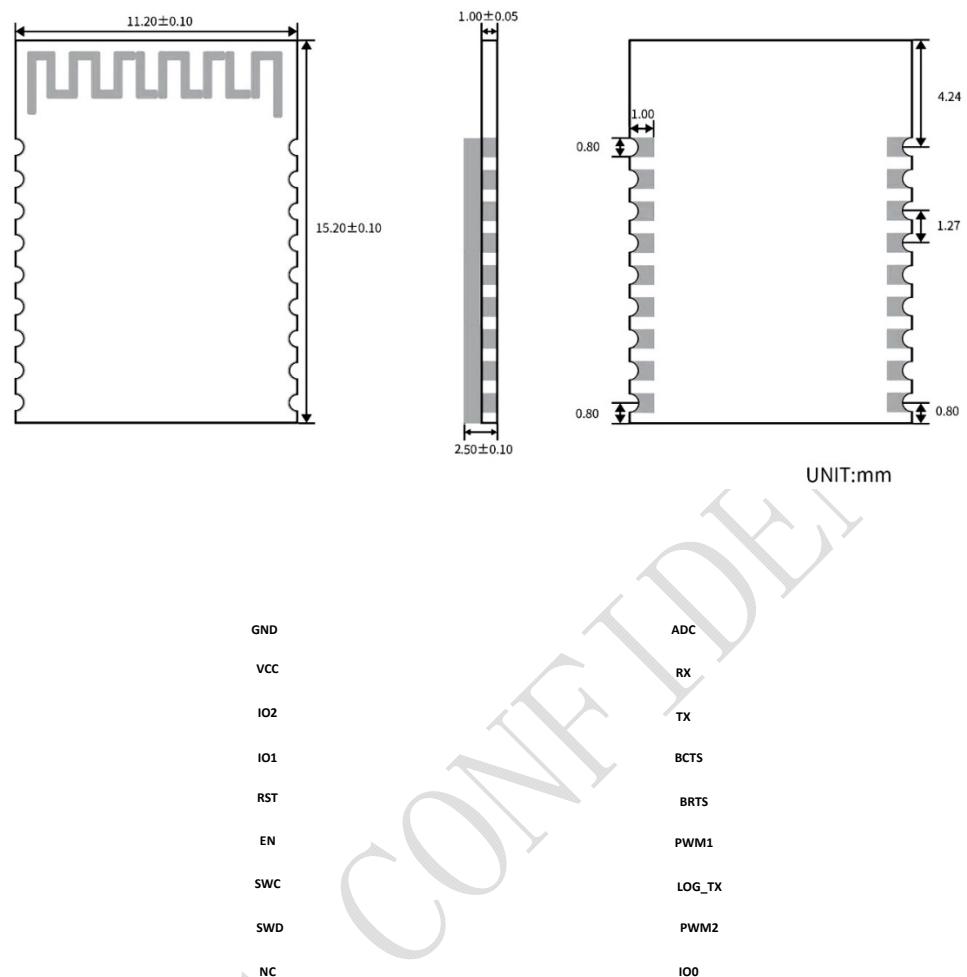


Figure 6-1 Pin Assignment of NSM-B01

Table 6-1 Pin Functions of NSM-B01

Pin	Name	Chip Pin	I/O	Description
1	GND	GND	—	Ground
2	VCC	VCC	—	Power Supply 2.3 V ~ 3.6 V
3	IO2	PA2	0	Function 1: Sleep status indication; Function 2: Output port (can be flipped regularly).
4	IO1	PA3	0	Function 1: connection status indication. 0: Bluetooth is connected 1: Bluetooth not connected Function 2: Output port (can be flipped regularly).
5	RST	RST	I	Reset, active low, no internal pull-up

6	EN	PB3	I	The module enables the control line (active low), and has a built-in pull-up resistor, which can perform pull-up operations through instructions. 0: Module starts to broadcast, until it connects to the mobile device. 1: Enter sleep mode immediately, regardless of the current status.
7	SWC	SWC	-	JTAG clock Pin.
8	SWD	SWD	-	JTAG data Pin.
9	NC	PA6	-	NC, undefined, module reserved Pin.
10	I00	PB2	I	The default is analog input, there is no internal pull-up.
11	PWM2	PB5	I/O	Use FFB1 to control PWM output after bluetooth connection.
12	LOG_TX	PB6	0	Debug log Tx
13	PWM1	PB7	I/O	Use FFB1 to control PWM output after bluetooth connection.
14	BRTS	PB11	I	As the request of data sending (for module wake-up) 0: Master has data to send, and module will wait for data transmission from the master, so the module will not sleep. 1: Master has no data to send, or data has been sent. So, the value of the signal line should be set at "1".
15	BCTS	PB12	0	Data input signal (for master wake-up, optional) 0: Module has data to send, and the master will receive the data from the module. 1: Module has no data to send, or data has been sent, and the value of the signal line should be set at "1".
16	TX	PB4	0	Serial port TX
17	RX	PB10	I	Serial port RX
18	ADC	PB9	I	The default configuration is ADC (the ADC conversion function is not enabled), and the input voltage range is 0.150~+0.85V.

## 七、 Contact Us

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## FCC MODULAR APPROVAL INFORMATION EXAMPLES for Manual

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.
- (2) This device must accept any interference received, including interference that may cause undesired operation.

**CAUTION:** Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: 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.

NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

### FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

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## **OEM INTEGRATION INSTRUCTIONS:**

This device is intended only for OEM integrators under the following conditions:

The module must be installed in the host equipment such that 5 mm is maintained between the antenna and users, and the transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the internal on-board antenna that has been originally tested and certified with this module. External antennas are not supported. As long as these 3 conditions above are met, further transmitter test will not be required.

However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.). The end-product may need Verification testing, Declaration of Conformity testing, a Permissive Class II Change or new Certification. Please involve a FCC certification specialist in order to determine what will be exactly applicable for the end-product.

### **Validity of using the module certification:**

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization. In such cases, please involve a FCC certification specialist in order to determine if a Permissive Class II Change or new Certification is required.

### **Upgrade Firmware:**

The software provided for firmware upgrade will not be capable to affect any RF parameters as certified for the FCC for this module, in order to prevent compliance issues.

### **End product labeling:**

This transmitter module is authorized only for use in device 'u

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### **Information that must be placed in the end user manual:**

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

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## 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 FCC part 15C(15.247).

### 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 has a  $\hat{\cup}$  Antenna, and the antenna use a permanently attached antenna which is not replaceable. The EUT has a PIFA Antenna, and the antenna use a permanently attached antenna which is not replaceable.

### 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 not a limited module.

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## 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 with trace antenna designs, and This manual has been shown the layout of trace design, antenna, connectors, and isolation requirements.

## 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, u

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## 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 has a PCB Antenna, and the antenna use a permanently attached antenna unique. u -yu h@

## 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: 2A7DO-2206B01”

## 2.9 Information on test modes and additional testing requirements5

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:** Top band can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

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## **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 shoule be evaluated by the FCC Subpart B.