WS8623

BlueNRG-332AC BLE Module

Data Sheet

BLE Module

- Bluetooth® 5.3 Low Energy
- High-performance ultra-low power consumption of 32-bit Arm ® Cortex® -M0 + (running rate up to 64 MHz)
- Support for data transfer rates of 2Mbps, 1Mbps, 500 kbps, and 125 kbps
- The max tx power is 3.501dBm
- 192 KB Flash, 24 KB RAM+4KB PKA RAM
- 1 xSPI / I2S, 1x LPUART, 1x USART (support for ISO 7816 (smart card mode), IrDA and Modbus mode, 1 xI 2 C (support for SMBus / PMBus)
- The power supply voltage range is 1 V to 3 V.7.6
- Off mode 8 nA @ 1.8 V, deep stop mode 0 uA @ 1.8 V (with external LSE and BLE wake source)
- PCB onboard antenna, 18mm x 12mm ultra-small size

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1	v1.0	The initial version	2024.01.23	

1. Product overview

1.1 Product Introduction

WS8623 Wireless SOC module based on ST Company's BlueNRG-332AC chip scheme design. Working in the 2GHz frequency band, with multiple transmission modes, and a TTL level output.
The BlueNRG-332AC is an ultra-low power programmable Bluetooth® Low Energy chip system (SoC) with built-in ST advanced 2GHz wireless IP, with low power consumption and excellent wireless performance. It supports peer-to-point connectivity and Bluetooth mesh networks, allowing coverage in a reliable way. It is also suitable for 2.4GHz proprietary wireless communication and supports ultra-low latency applications.
WS8623 IO all out, convenient for customer application, with a shield, PCB onboard, 18mm x 12mm ultra small size.

1.2 Features

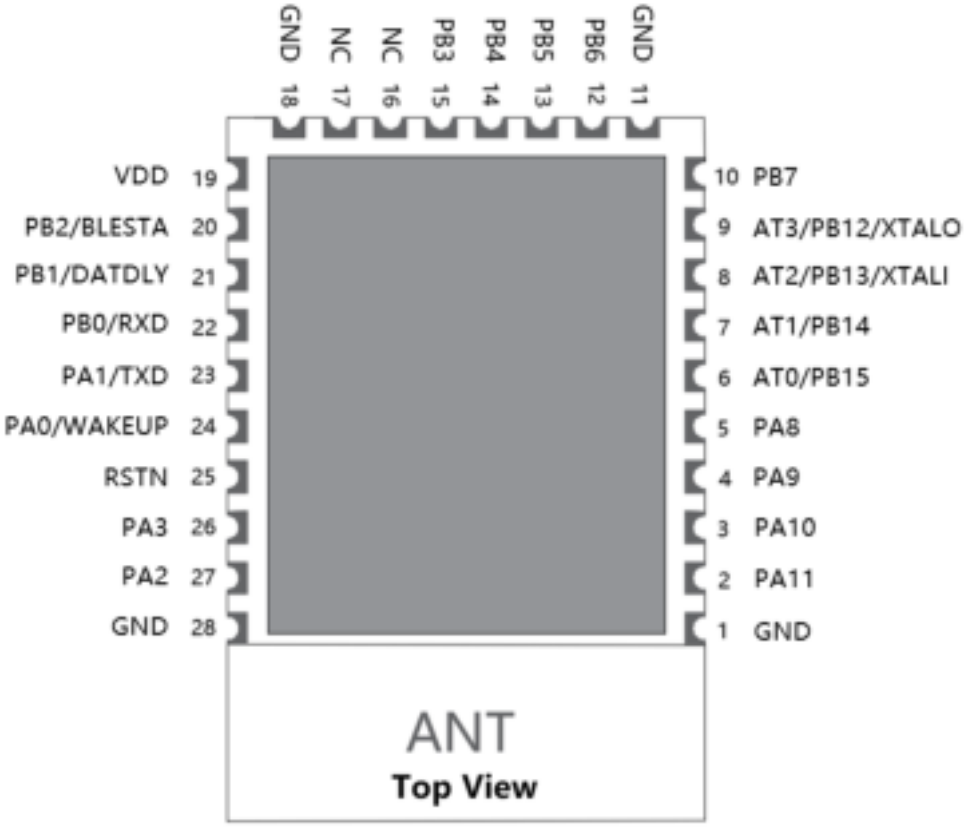
Features
The measured communication distance is subject to the actual test environment
Bluetooth® 5.3 Low Energy
High-performance ultra-low power consumption of 32-bit Arm ® Cortex® -M0 + (running rate up to 64 MHz)
192 KB Flash, 24 KB RAM+4KB PKA RAM
Global ISM 2.4 GHz band with maximum output power + 3.501 dBm@2M
1 xSPI / I2S, 1x LPUART, 1x USART (support for ISO 7816 (smart card mode), IrDA and Modbus mode, 1 xI 2 C (support for SMBus / PMBus)
Off mode 8 nA @ 1.8 V, deep stop mode 0 uA @ 1.8 V (with external LSE and BLE wake source)
The power supply voltage range is 1 V to 3 V.7.6
Industrial grade standard design, support-40℃ ~85℃ for long time use
PCB onboard, 18mm x 12mm, ultra-small size
Support for custom Uart Porter rate: 1200bps- -1Mbps
UART delivery buffer: 2048 bytes
The broadcast gap can be modified
The connection parameters can be modified
The BLE name can be modified
MTU max. 247 bytes, and supports MTU updates
1M, 2 MPHY, and PHY updates
1s broadcast period, with an average current below 13 uA
Support AT instruction and data transmission transmission

1.3 Applications

Applications
Building automation (wireless sensor, lighting control, beacon)
Security system, positioning system

Armamentarium
ESL (electronic shelf label)
Personal electronics (toys, HID, stylus)
Wear a health sensor
Smart logistics / transportation / city
Smart home

2. Pin definition



1Figure 1 WS8623, the pin defining Fig

Pin No.	Item	Direction	Description
1	GND	I	Power reference
2	PA11	I/O	be in common use IO
3	PA10	I/O	be in common use IO
4	PA9	I/O	be in common use IO
5	PA8	I/O	be in common use IO
6	PB15	I/O	be in common use IO
7	PB14	I/O	be in common use IO
8	PB13	I/O	be in common use IO
9	PB12	I/O	be in common use IO
10	PB7	I/O	be in common use IO
11	GND	I	Power reference
12	PB6	I/O	be in common use IO
13	PB5	I/O	be in common use IO
14	PB4	I/O	be in common use IO
15	PB3	I/O	be in common use IO
16	NC		
17	NC		

18	GND	I	Power reference
19	VDD	I	The module power supply is 1.7V~3V.6
20	BLE STA	I/O	The BLE connection status output indication. The internal pull. ● Bluetooth connection: low level ● Bluetooth without connection: high level
21	DATDLY	I/O	Data output indication. The internal pull. ● Have data output: low level ● No data output: high level
22	UART_RX	I/O	UART, to receive the pins
23	U ART_TX	I/O	UART, to send the pins
24	PA0	I/O	be in common use IO
25	RSTN	I/O	Reset the pin, and the low level is effective
26	PA3/SWCLK	I/O	Serial line debugging clock input debugging and programming
27	PA2/SWDIO	I/O	Serial line debugging and programming debugging
28	GND	I	Power reference
See ST official BlueNRG-332AC Datasheet			

3. Hardware Design

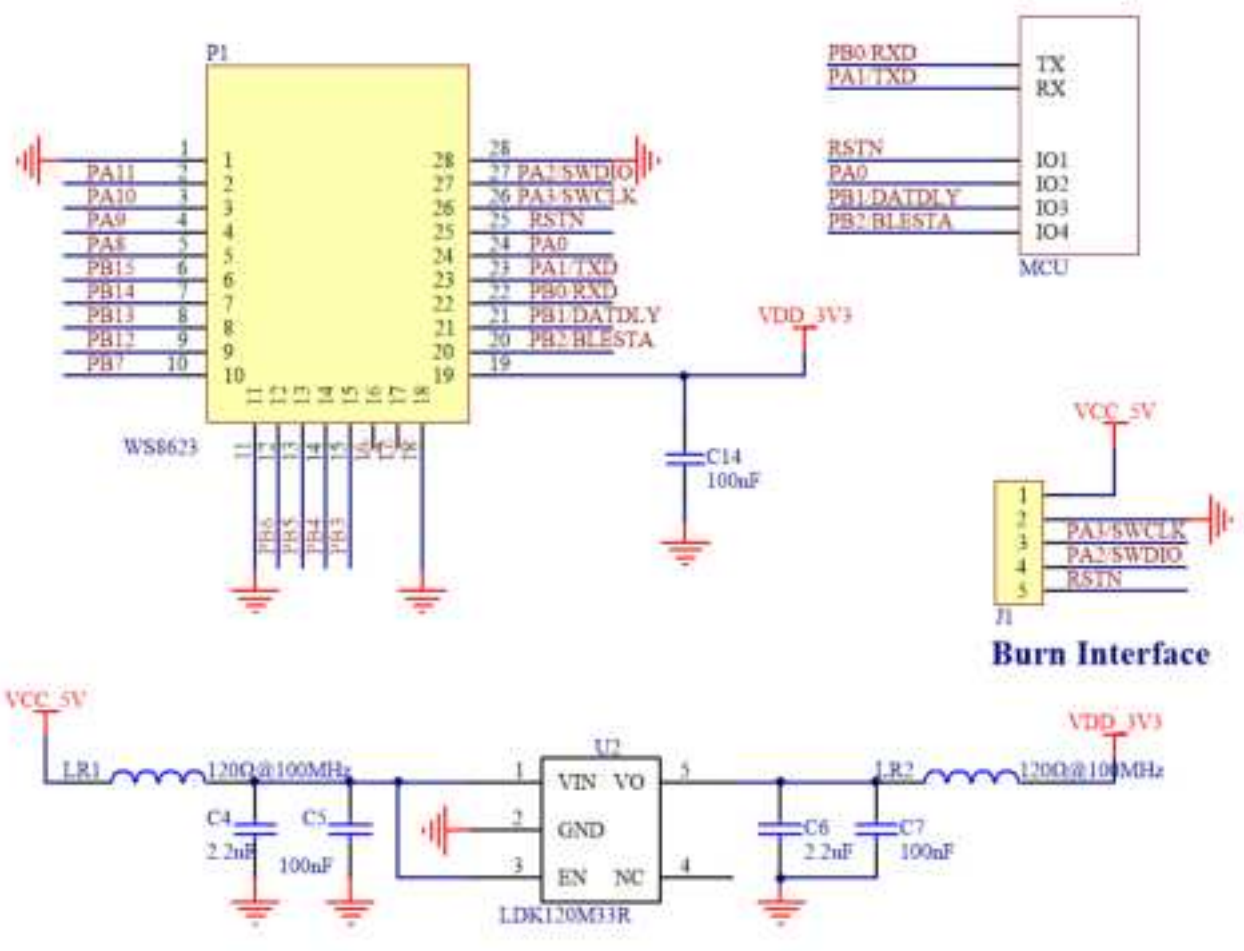


Figure 2 WS8623 Recommended schematic diagram

- This recommended circuit can be used for test circuits and design circuits;
- As needed, the corresponding IO can be introduced;
- The module input recommended voltage suppression ratio (SVR) is better than 50dB and LDO with driving capacity above 150 mA;

4. Electrical and other parameters

4.1 Absolute rating

Parameter	Symbol	Min value	Max value	Unit
Supply voltage	V DD	-0.3	3.9	V
Interface voltage	V_{IN}	-0.3	3.9	V
PB 12 and PB 13 voltage	V_{IN}	-0.3	3.6	V
Storage temperature	T_{STG}	-40	125	℃

4.2 Operational parameter

Parameter	Symbol	Min value	Typical value	Max value	Parameter
working voltage	VDD	1.7	3.3	3.6	V
working temperature	T_{OP}	-40		85	℃

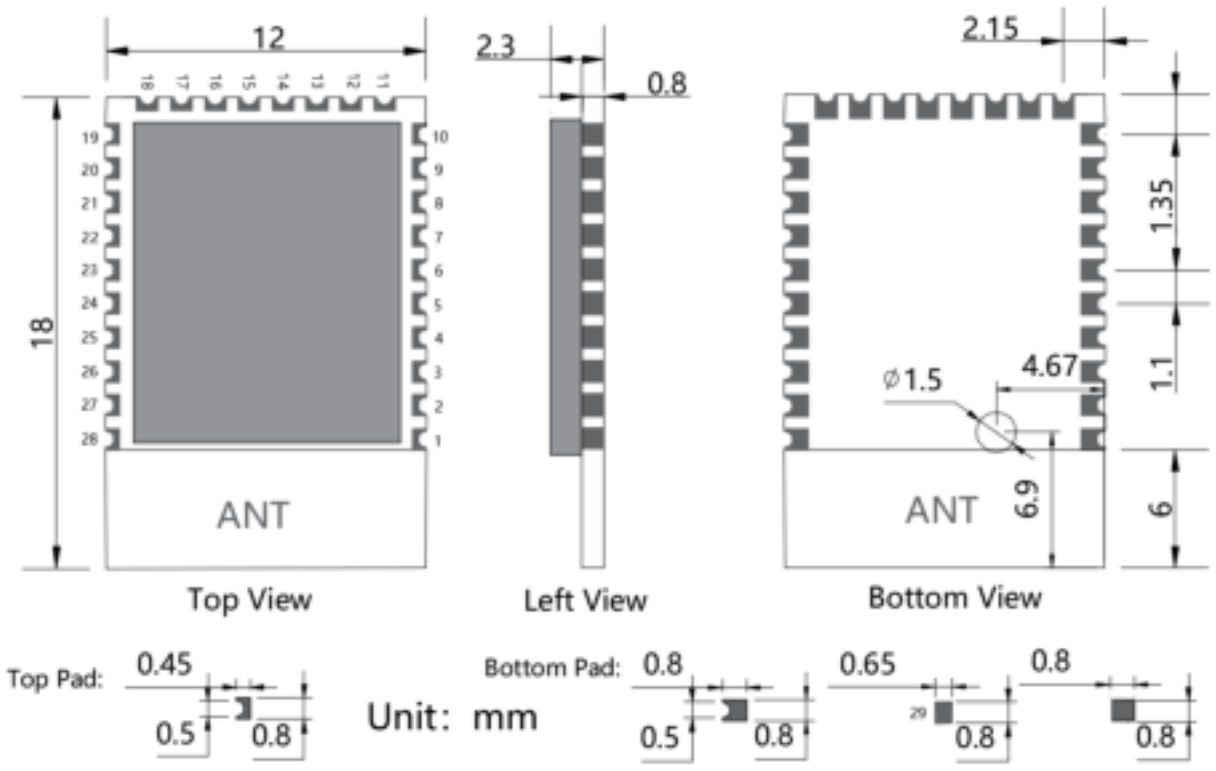
4.3 RF performance parameters

Parameter	Min value	Typical value	Max value	Unit	Note
Work frequency band	2402	2440	2480	MHz	
Wireless protocol	Bluetooth® 5.3 Low Energy				
Air rate	0.125	1	2	Mbps	
Maximum emission power	-20	0	3.501	dBm	
receiving sensitivity	-	-97	-	dBm	@1 Mbps
emission current	-	8.5	-	mA	@3.3V,@0dBm
Connect current	-	8.5	-	m A	@3.3V
Average dormant current	-	19	-	uA	@3.3V, @ 0 dBm, with a broadcast gap of 1s

4.4 Other parameters

Parameter	Description
CI	UART
radio frequency interface	PCB onboard antenna
Packaging method	Patch type
Interface mode	1.1mm spacing stamp hole
outline dimension	18*12*2.5mm

5. Module size

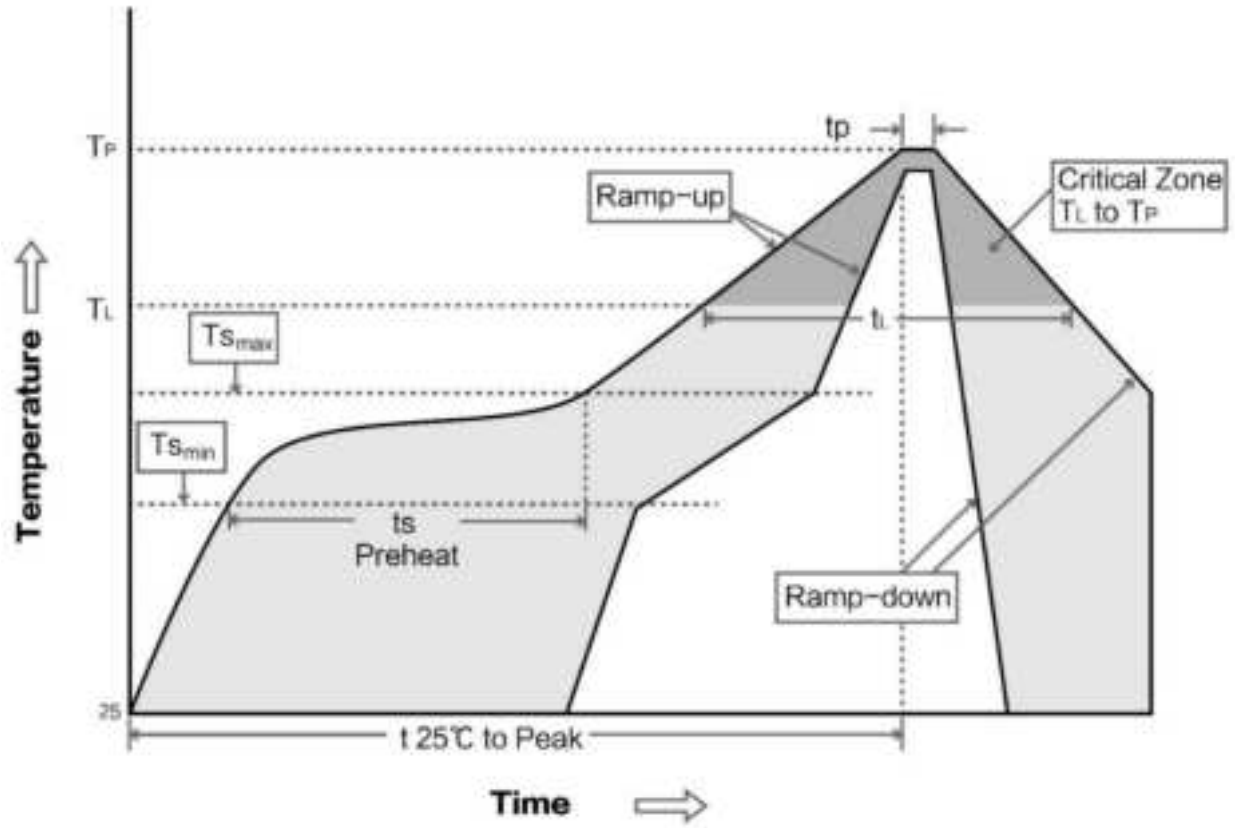


2 Figure 11 module package dimensions

- Recommended pad design: length 2*0.8mm = 1.6mm and width 0.8mm.
- The annular area of 1mm diameter is the RF test point area, and copper laying is prohibited in this area and ANT area.

6. Operation instruction

6.1 Flow welding curve diagram



3Figure 12 Reflow weld curve diagram

6.2 Reflow welding temperature and time

Profile Feature	Curve characteristics	Sn-Pb Assembly	Pb-Free Assembly
Solder paste	Solder Paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Minimum preheating temperature	Preheat Temperature min （Tsmin）	100℃	150℃
Maximum preheating temperature	Preheat temperature max (Tsmax)	150℃	200℃
preheating time	Preheat Time (Tsmin to	60-120 sec	60-120 sec

	Tsmax)(ts)		
Average rise rate	Average ramp-up rate(Tsmax to Tp)	3℃/second max	3℃/second max
Fluid phase temperature	Liquidous Temperature (TL)	183℃	217℃
Time taken above the liquid-phase line	Time (tL) Maintained Above (TL)	60-90 sec	30-90 sec
Peak temperature	Peak temperature (Tp)	220-235℃	230-250℃
Average decrease rate	Aveage ramp-down rate (Tp to Tsmax)	6℃/second max	6℃/second max
25℃ to peak temperature	Time 25℃ to peak temperature	6 minutes max	8 minutes max

7. Contact information

Contacts	Cell	Email
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Tel.: 028-64823553

Address: 3-307, Floor 3, Building 12, No.38, South Jinke Road, Jinniu Hi-tech Industrial Park, Chengdu

FCC WARNING

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this 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.

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

15.105 Information to the user.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

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.

This equipment complies with FCC radiation exposure limits set forth for an uncon- trolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body. Radiation Exposure Statement:

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

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

The availability of some specific channels and/or operational frequency bands are country dependent and are firmware programmed at the factory to match the intended destination.

The firmware setting is not accessible by the end user.

The final end product must be labelled in a visible area with the following: “Contains Transmitter Module “FCC ID: 2BB8U-WS8623”

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.3

Explanation: This module meets the requirements of FCC part 15C (15.247).it Specifically identified AC Power Line Conducted Emission, Radiated Spurious emissions, Band edge and RF Conducted Spurious Emissions, Conducted Peak Output Power, Bandwidth, Power Spectral Density, Antenna Requirement.

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 product antenna uses an irreplaceable antenna with a gain of 0dBi

2.4 Single Modular

If a modular transmitter is approved as a “Single Modular,” then the module manufacturer is responsible for approving the host environment that the Single Modular is used with. The manufacturer of a Single Modular must describe, both in the filing and in the installation instructions, the alternative means that the Single Modular manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A Single Modular 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 Single Modular 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 a single module.

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

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: The module complies with FCC radiofrequency radiation exposure limits for uncontrolled environments. The device is installed and operated with a distance of more than 20 cm between the radiator and your body." This module follows FCC statement design, FCC ID: 2BB8U-WS8623

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 product antenna uses an irreplaceable antenna with a gain of 0dBi

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: 2BB8U-WS8623

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: Chengdu Silent Smart Technology Co., Ltd. can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.
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 circuity), 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 circuity, so the module does not require an evaluation by FCC Part 15 Subpart B. The host shoule be evaluated by the FCC Subpart B.