

M8020A

Bluetooth module/SOC application
software development

Versions: 0.0.1

2024/01/25

Declaration

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Revision History

Date	Version	Comments	Revised by
2024-01-25	0.0.1	First draft	Liao

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1 Product Features

CPU and Flexible IO

- ✚ 32bit High performance CPU with DSP instruction
- ✚ Program memory: internal 8M bit flash
- ✚ Flexible GPIO pins with Programmable pull-up and pull-down resistors;
- ✚ Support GPIO wakeup or interrupt;
- ✚ Support BDR,EDR,BLE

Bluetooth Radio

- ✚ Compliant to Bluetooth 5.3 and BLE specification
- ✚ RX Sensitivity with -94dBm @2M EDR;

Audio Interface

- ✚ High performance mono DAC with 98dB SNR, support single end mode or differential mode;
- ✚ One channel high performance ADC with 90dB SNR;
- ✚ One channel MIC amplifier input;
- ✚ Support flexible audio EQ adjust;
- ✚ Support Sample rate 8, 11.025, 12, 16, 22.05, 32, 44.1 and 48KHz;
- ✚ 4channel Stereo Analog MUX;

Peripheral and Interfaces

- ✚ Three 32-bit timers;
- ✚ Three multi-function 32-bit timers, support Capture and PWM mode;
- ✚ WatchDog;
- ✚ Three full-duplex UART;
- ✚ Two SPI;
- ✚ IR controller;
- ✚ Full speed USB 2.0 HOST/DEVICE controller;
- ✚ Sixteen Channels 10-bit SARADC;
- ✚ Integrate IRTC;
- ✚ Build in PMU, such as charger/buck/LDO;

Temperature

- ✚ Operating temperature: -40℃ to +85℃;
- ✚ Storage temperature: -65℃ to +150℃;

2 Package Definition

2.1 Pin Assignment

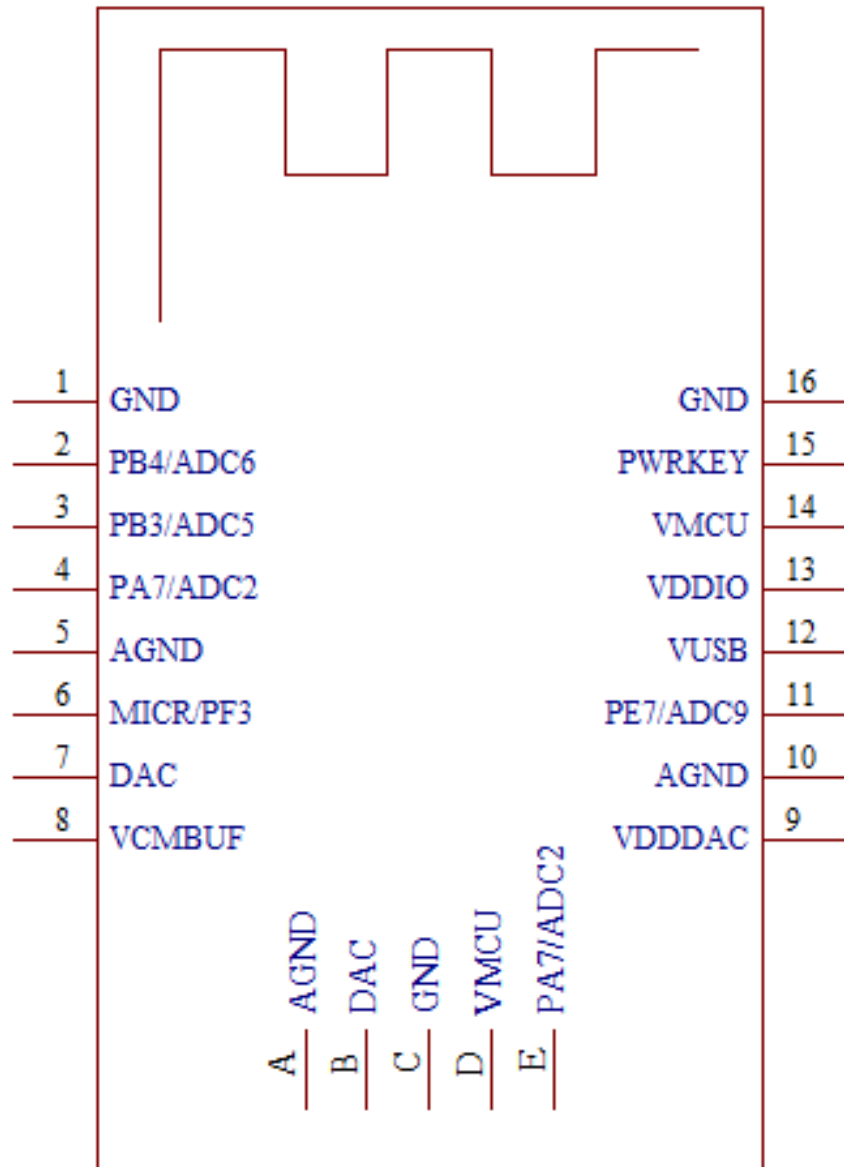


Figure 2-1 Pin assignment for M8020A

2.2 Pin Descriptions

Table 2-1 M8020A pin description

Pin No.	Name	Type	Function
1	GND	GND	GND
2	PB4	I/O	ADC6 PDM_DATLR-G4 SDDAT0-G4 SDDAT0-G6 SPI0CLK-G3 RX0-G3 HSTRX-G8 PWM1-T3-G2 IIC_DAT-G8 PB4
3	PB3	I/O	ADC5 PDM_CLKLR-G4 SDDAT0-G5 SDCMD-G6 SPI0DO-G3 TX0-G3(RX) HSTRX-G3 PWM0-T3-G2 IIC_CLK-G8 PB3
4	PA7	I/O	ADC2 AUXR0 PDM_DATLR-G3 SDDAT0-G1/G7 SPI1DO-G2 TX0-G1(RX) TX1-G1(RX) HSTRX-G1 PWM2-T5-G1 IIS_DO-G1 IIC_DAT-G1 PA7
5	AGND	GND	DAC GROUND
6	PF3/MICPR	I/O	MICPR PWM2-T4-G2 PF3
7	DAC	A	DACL
8	VCMBUF	PWR	VCM buffer output
9	VDDDAC	PWR	DAC power
10	AGND	GND	DAC GROUND
11	PE7	I/O	ADC9 AUXR2 PDM_DATLR-G2 SDDAT0-G3 SPI1DO-G4 TX0-G4 HSTRX-G4 PWM2-T4-G1 IISDO-G2 IISDO-G3 IIC_DAT-G5 TMR4CAP_G1/IR_G8 PE7

12	VUSB	PWR	VUSB power input TX0-G8 TX1-G3 TX2-G3 HSTRX-G11
13	VDDIO	PWR	VDDIO power output
14	VMCU	PWR	VBAT power input
15	PWRKEY	I/O	ADC12 PWM2-T3-G2 IISDI-G3 WKO PB5
16	GND	GND	GND
A	AGND	GND	DAC GROUND
B	DAC	A	DACL
C	GND	GND	GND
D	VMCU	PWR	VBAT power input
E	PA7	I/O	ADC2 AUXR0 PDM_DATLR-G3 SDDAT0-G1/G7 SPI1DO-G2 TX0-G1(RX) TX1-G1(RX) HSTRX-G1 PWM2-T5-G1 IIS_DO-G1 IIC_DAT-G1 PA7

Note: I/O: Digital input/output; I : Digital input; A : Analog Pin; PWR: Power Pin; GND: Ground.

3 Characteristics

3.1 PMU Parameters

Table 3-1 PMU voltage input Parameters

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
VUSB	Charger Voltage input	3.0	5.0	5.5	V	
VBAT	Voltage input	3.0	3.7	5.0	V	

Table 3-2 3.3V LDO Parameters

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
VDDIO	3.3V LDO voltage output	-	3.3	-	V	Light Loading condition
Δ VVDDIO	Output Mismatch 1-sigma	-	56	-	mV	VDDIO=3.3v
ILOAD	Maximum output current	-	-	150	mA	@VBAT=3.6v
ISC	Short Circuit Current Limit	-	-	300	mA	@VBAT=3.8v

Table 3-3 1.2V LDO Parameters

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
VDDBT	1.2V LDO voltage output	-	1.2	-	V	Light Loading condition
Δ VVDDBT	Output Mismatch 1-sigma	-	27	-	mV	VDDBT=1.2v
ILOAD	Maximum output current	-	-	100	mA	@VBAT=3.0v
ISC	Short Circuit Current Limit	-	-	200	mA	@VBAT=3.8v

3.2 IO Parameters

Table 3-4 I/O Parameters

GPIO—Electrical Characteristics							
Symbol	Description	Related GPIO	Min	Typical	Max	Units	Conditions
V _{IL}	Low-level input voltage		-0.3		1.27	V	VDDIO=3.3V
V _{IH}	High-level input voltage		2.03		3.6	V	VDDIO=3.3V
Driver Ability 1	Output Driver Ability 1			32		mA	VDDIO=3.3V
Driver Ability 0	Output Driver Ability 0			8		mA	VDDIO=3.3V
R _{PUP0}	Internal pull-up resistor 0		8	10	12	K Ω	
R _{PUP1}	Internal pull-up resistor 1		0.24	0.3	0.36	K Ω	
R _{PUP2}	Internal pull-up resistor 2		160	200	240	K Ω	
R _{PDN0}	Internal pull-down resistor 0		8	10	12	K Ω	
R _{PDN1}	Internal pull-down resistor 1		0.24	0.3	0.36	K Ω	
R _{PDN2}	Internal pull-down resistor 2		160	200	240	K Ω	

3.3 Audio DAC Parameters

Table 3-5 Audio DAC Parameters

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
SNR		-	98.8	-	dB	VCM cap=NC

3 Characteristics

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
						VDDDAC cap=1uF with A-wt filter Output -4.2dBV Fin=1KHz
THD+N		-	-73	-	dB	VCM cap=NC VDDDAC cap=1uF with A-wt filter Output -4.2dBV with 10K loading Fin=1KHz
Output Range	Maximum output voltage	-	-4.2		dBVrms	32ohm Loading

3.4 Audio ADC Parameters

Table 3-6 Audio ADC Parameters

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
SNR		-	90	-	dB	VCM cap=NC VDDDAC cap=1uF with A-wt filter Input sine amplitude, 850mV RMS Fin=1KHz
THD+N		-	-	-	dB	VCM cap=NC VDDDAC cap=1uF with A-wt filter Input sine amplitude, 850mV RMS Fin=1KHz.
Input Range	Input sine wave peak amplitude	VCM-1.2V		VCM+1.2	V	From aux input, aux 0db gain, VCM represent VCM voltage.

3.5 BT Parameters

Table 3-7 BT Parameters

Characteristics	Min	Typical	Max	Unit	Conditions
RMS DEVM	-	5.5		%	Maximum TX power 2-DH5 packet
Peak DEVM	-	12.5		%	
EDR Relative Transmit Power		-0.2		dB	
Sensitivity @ Basic Rate		-91.8		dBm	BER=0.1%, using DH5 packet
Sensitivity @ EDR		-94		dBm	BER=0.01%, using 2-DH5 packet

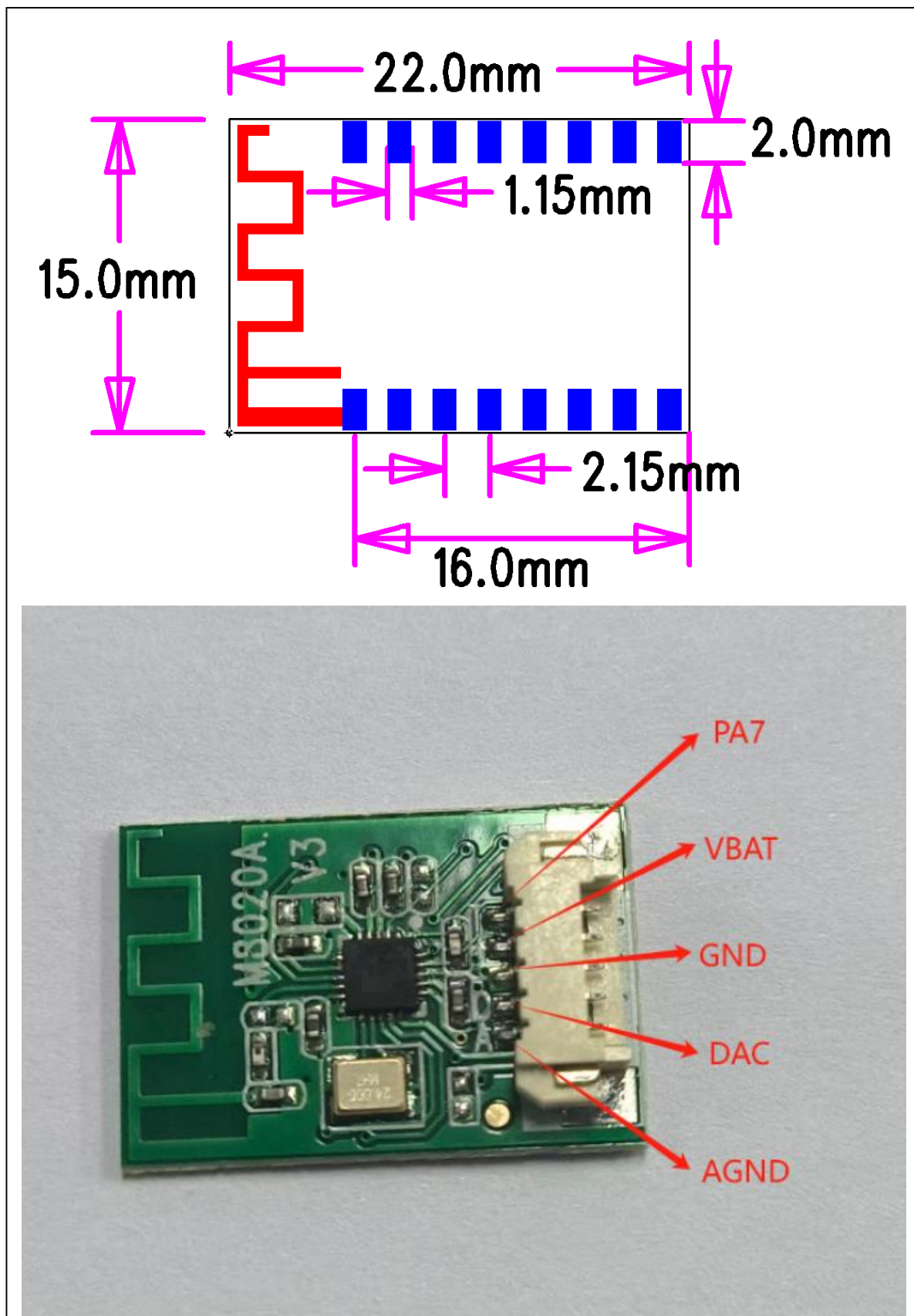
3.6 Current Parameters

Table 3-8 Current Parameters

3Characteristics

Sym	Characteristics	Min	Typ	Max	Unit	Conditions
IRTC	RTC mode current	-	4	-	uA	4.2V input, room temp.
Sleep	Sleep current	-	500	2000	uA	3.3V input, room temp

4 Package Information



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 establish the 6dB Bandwidth, Peak Output Power, Radiated Spurious Emission, Power Spectral Density, Restricted Band of Operation and Band Edge (Out of Band Emissions)

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 module has one **PCB antenna**, the antenna cannot be removed.

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 a limited single module. But there is no shield shell, it can be tested independently.

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 is PCB antenna designs, the antenna cannot be removed. See antenna report for antenna details.

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 device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction." This module is designed to comply with the FCC statement, FCC ID: **2BFB8-M8020A**.

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 one **PCB Antenna**, the antenna cannot be removed.

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: **2BFB8-M8020A**

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: **BT Module** 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 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 should be evaluated by the FCC Subpart B.

Module with no shield Class II Permissive Change (C2PC)**Test plan:**

- (1) Conducted Emission
- (2) Radiated Spurious Emission.
- (3) Output Power.
- (4) Restricted Band of Operation

Note: These tests be based on C63.10 and FCC Part15.247 as guidance, according to the operating frequency High, medium and low channel test.

For each new host configuration, a test plan needs to be formulated.

The host integrator can contact the grantee of the C2PC filing through the following contact information.

Tel: +86-755-36564272

Email: sam@brandsound.cn

OEM integration instructions:

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

The transmitter module may not be co-located with any other transmitter or antenna. This module can only use the PCB antenna designed by ourselves.

As long as the 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.).

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.

End product labeling:

The final end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID: 2BFB8-M8020A".

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.

FCC Caution :

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.

Any 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.

The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction.