Sunrise

BM2020

Bluetooth® 3.0 Stereo Audio Module

Features:

- Complete, Fully Certified, Embedded 2.4 GHz Bluetooth® Version 3.0 Module
- Bluetooth Classic
- Bluetooth SIG Certified
- Onboard embedded Bluetooth Stack
- Easy to configure with Windows GUI or direct by MCU
- Compact surface mount module: 29 x 15 x 2.5 mm^3
- Castellated surface mount pads for easy and reliable host PCB mounting
- Environmentally friendly, RoHS compliant
- Perfect for Portable Battery Operated Devices
- Internal Battery Regulator Circuitry
- Worldwide regulatory certifications
- Audio-In / Out

  BM20 support analog audio output.

Operational:

- Operating voltage: 3.0V to 4.2V
- Temperature range: -20C to 70°C
- Simple, UART interface
- Integrated crystal, internal voltage regulator, and matching circuitry
- Multiple I/O pins for control and status

RF/Analog:

- Frequency: 2.402 to 2.480 GHz
- Receive Sensitivity: -91 dBm (π/4 DQPSK)
- Power Output: class 2 / +4dBm max.
- Connection Distance: >10m (free space and no interference)

Audio processor

- Support 64 kb/s A-Law or μ-Law PCM format, or CVSD (Continuous Variable Slope Delta Modulation) for SCO channel operation.
- Noise suppression
- Echo suppression
- SBC and optional AAC decoding
- Packet loss concealment
- Build-in four languages (Chinese/ English/ Spanish/ French) voice prompts and 20 events for each one
- Support SCMS-T

Audio Codec

- 20 bit DAC and 16 bit ADC codec
- 98dB SNR DAC playback

Peripherals

- Built-in Lithium-ion battery charger (up to 350mA)
- Integrate 3V, 1.8V configurable switching regulator and LDO
- Built-in ADC for battery monitor and voltage sense.
- A line-in port for external audio input
- Two LED drivers

Flexible HCI interface

- High speed HCI-UART (Universal Asynchronous Receiver Transmitter) interface (up to 921600bps)

MAC/Baseband/Higher Layer:

- Secure AES128 encryption
- Bluetooth profiles
  - HFP v1.6
  - HSP v1.1
  - A2DP v1.2
  - AVRCP v1.5
  - SPP v1.0
  - PBAP v1.0

Antenna:

- Printed Antenna

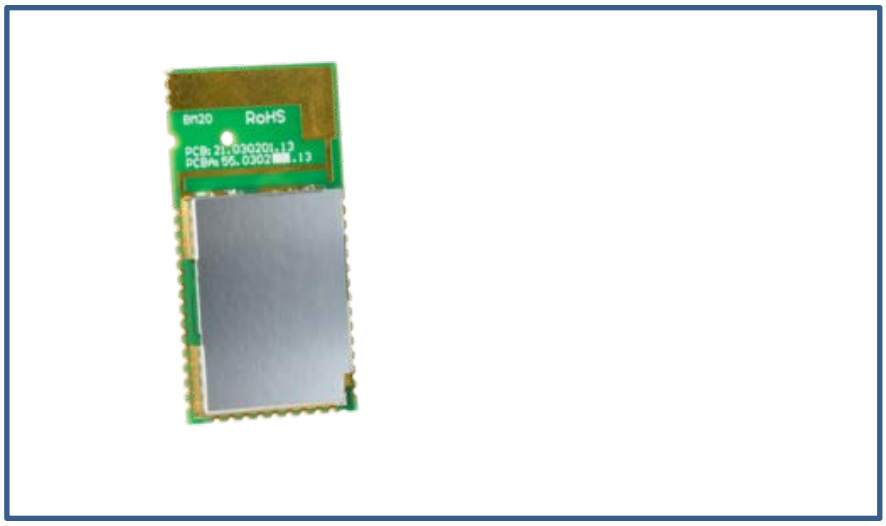
Compliance:

- Bluetooth SIG QDID
- Module certified for the United States (FCC)

Abbreviations List:

HFP: Hands-free Profile
AVRCP: Audio Video Remote Control Profile
A2DP: Advanced Audio Distribution Profile
PBAP: Phone Book Access Profile
HSP: Headset Profile
SPP: Serial Port Profile

Figure 1:



General Description:

Stereo module is a fully-certified Bluetooth® Version 3.0 module for designers who want to add Bluetooth® wireless audio and voice applications to their products.

This Bluetooth SIG certified module provides a complete wireless solution with Bluetooth stack, integrated antenna, and worldwide radio certifications in a compact surface mount package, 29x15x2.5 mm^3.

This stereo module built-in Li-Ion charger . Note that the customer must connect their own external analog CODEC/DSP/amplifier and MCU for audio output.

Applications:

- Bluetooth sound bar
- Bluetooth stereo speaker phone

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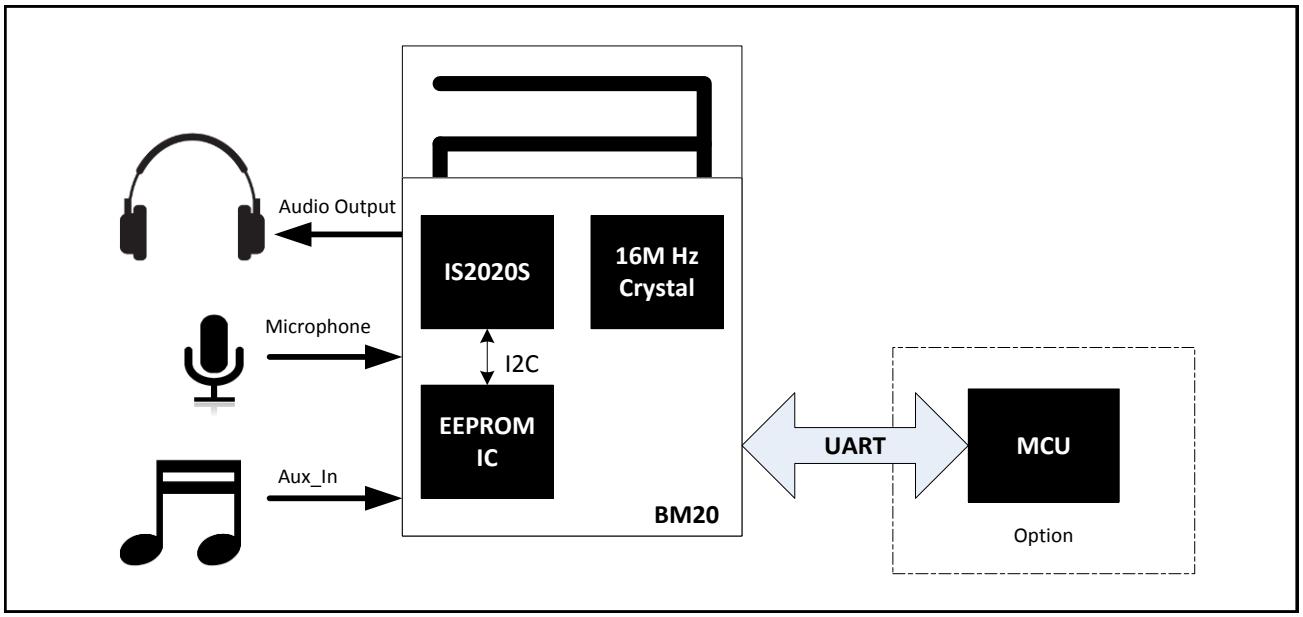
1. DEVICE OVERVIEW

The stereo module series include BM2020. The chip integrates Bluetooth 3.0 radio transceiver, PMU and DSP. Figure 1-1 shows the application block diagram.

FIGURE 1-1: BM2020 Typical Application

The following depicts an example of BM2020 module operate as an independent system or connected to an MCU.



1.1. INTERFACE DESCRIPTION

BM20 pin diagram is shown in Figure 1-3. The pin descriptions are shown in Table 1-1

FIGURE 1-3: BM20 PIN DIAGRAM

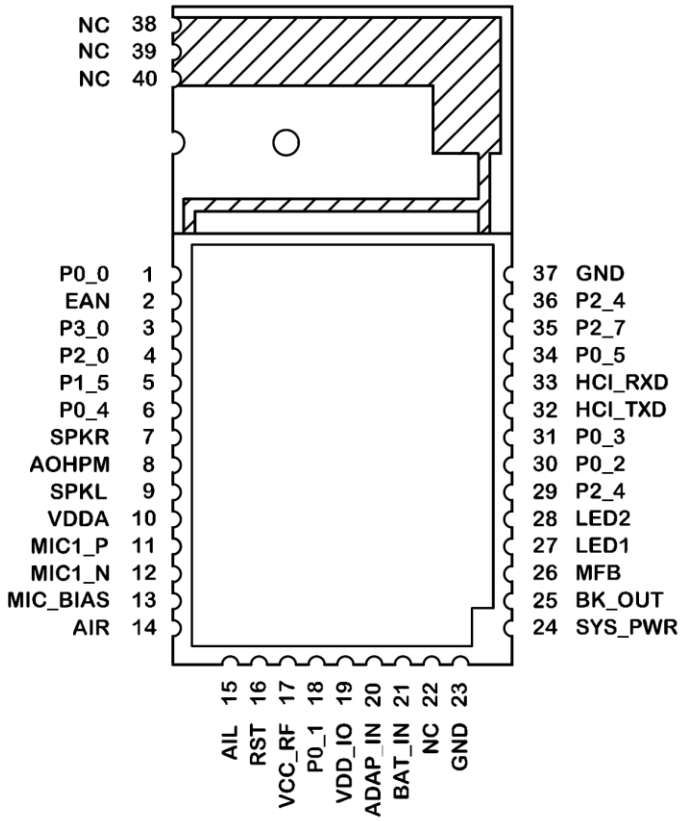


TABLE 1-1: BM20 PIN DESCRIPTION

Pin No.	Pin type	Name	Description
1	I/O	P0_0	IO pin, default pull-high input (Note 1) 1. Slide Switch Detector, active low. 2. UART TX_IND, active low.
2	I	EAN	Embedded ROM/External Flash enable H: Embedded; L: External Flash
3	I	P3_0	IO pin, default pull-high input (Note 1) Line-in Detector (default), active low.
4	I	P2_0	IO pin, default pull-high input System Configuration, H: Application L: Baseband(IBDK Mode)
5	I/O	P1_5	IO pin, default pull-high input (Note 1) 1. NFC detection pin, active low. 2. Out_Ind_0 3. Slide Switch Detector, active low. 4. Buzzer Signal Output
6	I/O	P0_4	IO pin, default pull-high input. (Note 1) 1. NFC detection pin, active low. 2. Out_Ind_0
7	O	SPKR	R-channel analog headphone output
8	O	AOHPM	Headphone common mode output/sense input.

Pin No.	Pin type	Name	Description
9	O	SPKL	L-channel analog headphone output
10	P	VDDA	Positive power supply/reference voltage for CODEC, no need to add power to this pin.
11	I	MIC1_P	Mic 1 mono differential analog positive input
12	I	MIC1_N	Mic 1 mono differential analog negative input
13	P	MIC_BIAS	Electric microphone biasing voltage
14	I	AIR	R-channel single-ended analog inputs
15	I	AIL	L-channel single-ended analog inputs
16	I	RST	System Reset Pin, Low: reset
17	P	VCC_RF	1.28V RF LDO output, no need to add power to this pin.
18	I/O	P0_1	IO pin, default pull-high input (Note 1) 1. FWD key when class 2 RF (default), active low. 2. Class1 TX Control signal of external RF T/R switch, active high.
19	P	VDD_IO	Power output , no need to add power to this pin
20	P	ADAP_IN	5V Power adaptor input
21	P	BAT_IN	3.0V~4.2V Li-Ion battery input
22	-	NC	No Connection
23	P	GND	Ground Pin
24	P	SYS_PWR	System Power Output BAT mode: 3.0~4.2V Adapter mode: 4.0V
25	P	BK_OUT	1.8V buck output, no need to add power to this pin
26	I	MFB	1. Power key when in off mode 2. UART_RX_IND: MCU use to wakeup BT (Note 1)
27	I	LED1	LED Driver 1
28	I	LED2	LED Driver 2
29	I	P2_4	IO pin, default pull-high input System Configuration, L: Boot Mode with P2_0 low combination
30	I	P0_2	IO pin, default pull-high input (Note 1) Play/Pause key (default), active low.
31	I/O	P0_3	IO pin, default pull-high input (Note 1) 1. REV key (default), active low. 2. Buzzer Signal Output 3. Out_Ind_1 4. Class1 RX Control signal of external RF T/R switch, active high.
32	O	HCI_TXD	HCI-UART TX data
33	I	HCI_RXD	HCI-UART RX data
34	I	P0_5	IO pin, default pull-high input (Note 1) Volume down (default), active low.
35	I	P2_7	IO pin, default pull-high input (Note 1) Volume up key (default), active low.

Pin No.	Pin type	Name	Description
36	I	P2_4	IO pin, default pull-high input System Configuration, L: Boot Mode with P2_0 low combination
37	P	GND	Ground Pin
38	-	NC	No Connection
39	-	NC	No Connection
40	-	NC	No Connection

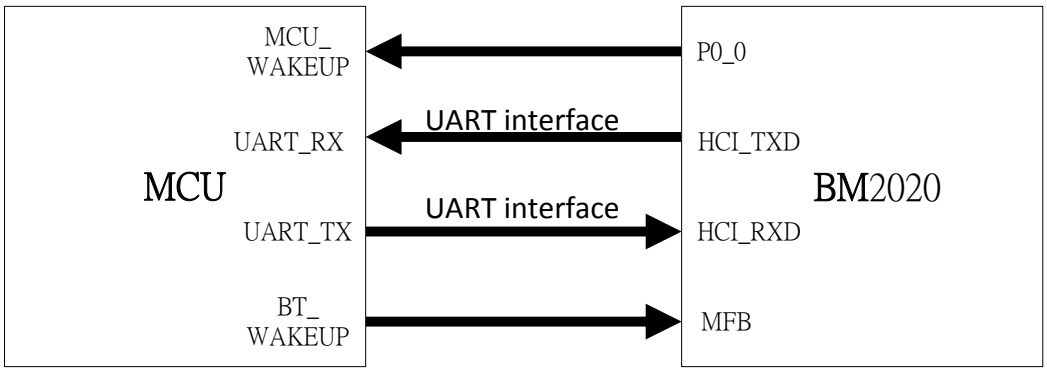
* I: signal input pin
* O: signal output pin
* I/O: signal input/output pin
* P: power pin

2. APPLICATION INFORMATION

2.1. OPERATION WITH EXTERNAL MCU

Stereo module support UART command set to make an external MCU to control module. Here is the connection interface between BM2020 and MCU.

FIGURE 2-1: INTERFACE BETWEEN MCU AND BM2020 MODULE



MCU can control module by UART interface and wakeup module by PWR pin. Stereo module provide wakeup MCU function by connect to P0_0 pin of module.

"UART Command Set" document provide all function which module support and UI tool will help you to set up your system support UART command.

Here are some suggestions of UART control signal timing sequence:

FIGURE 2-2: POWER ON/OFF SEQUENCE

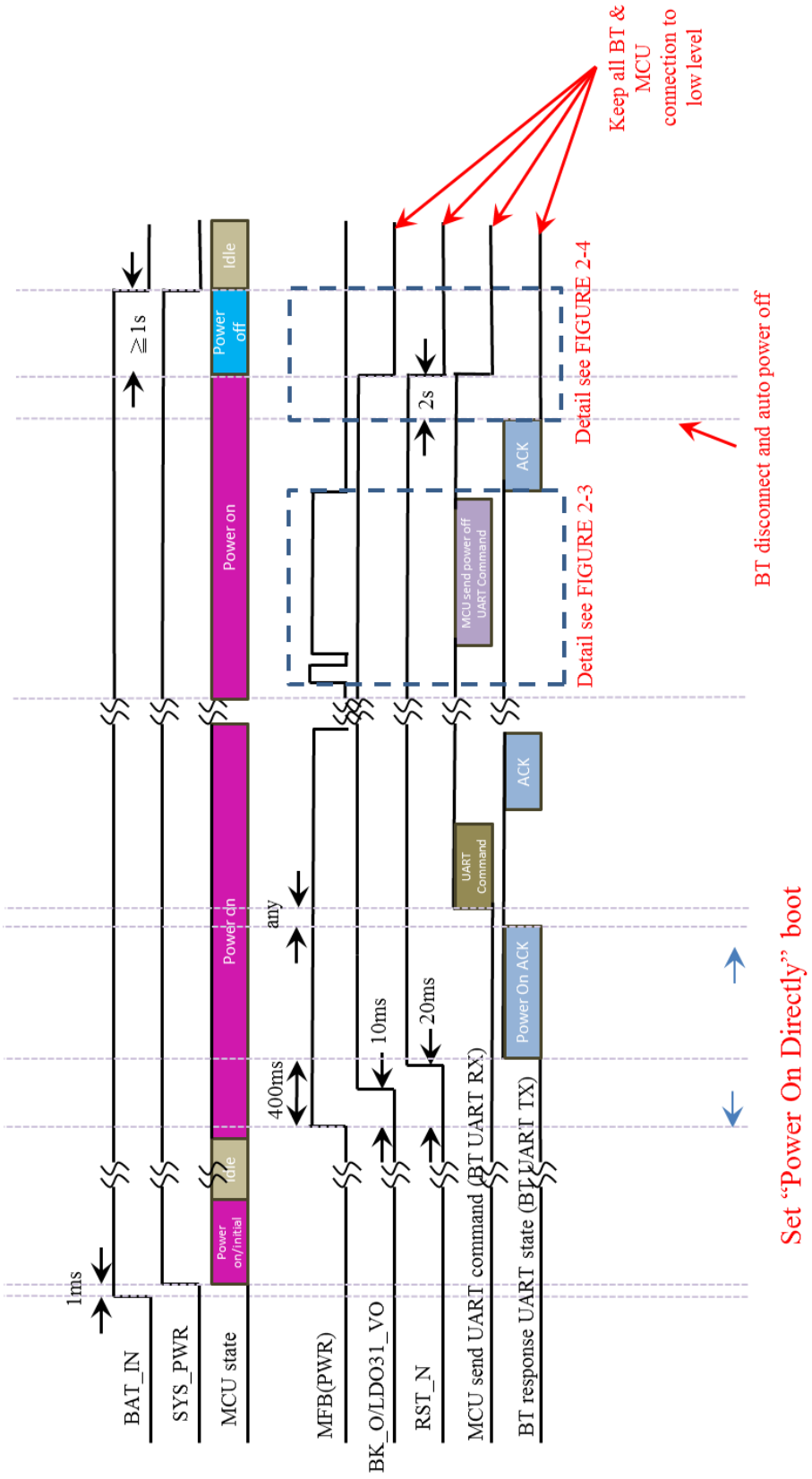


FIGURE 2-3: TIMING SEQUENCE OF RX INDICATION AFTER POWER ON

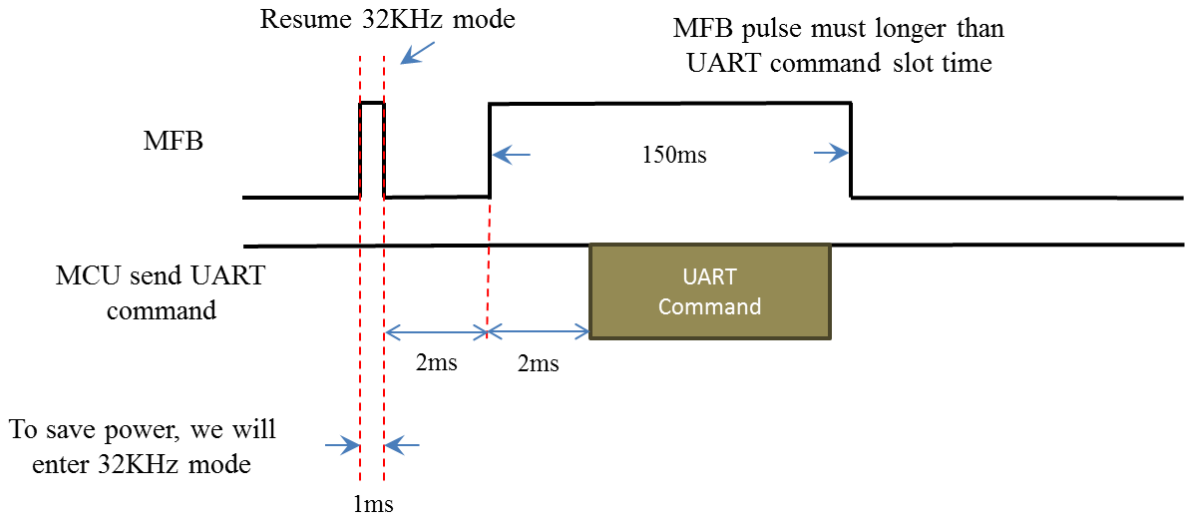
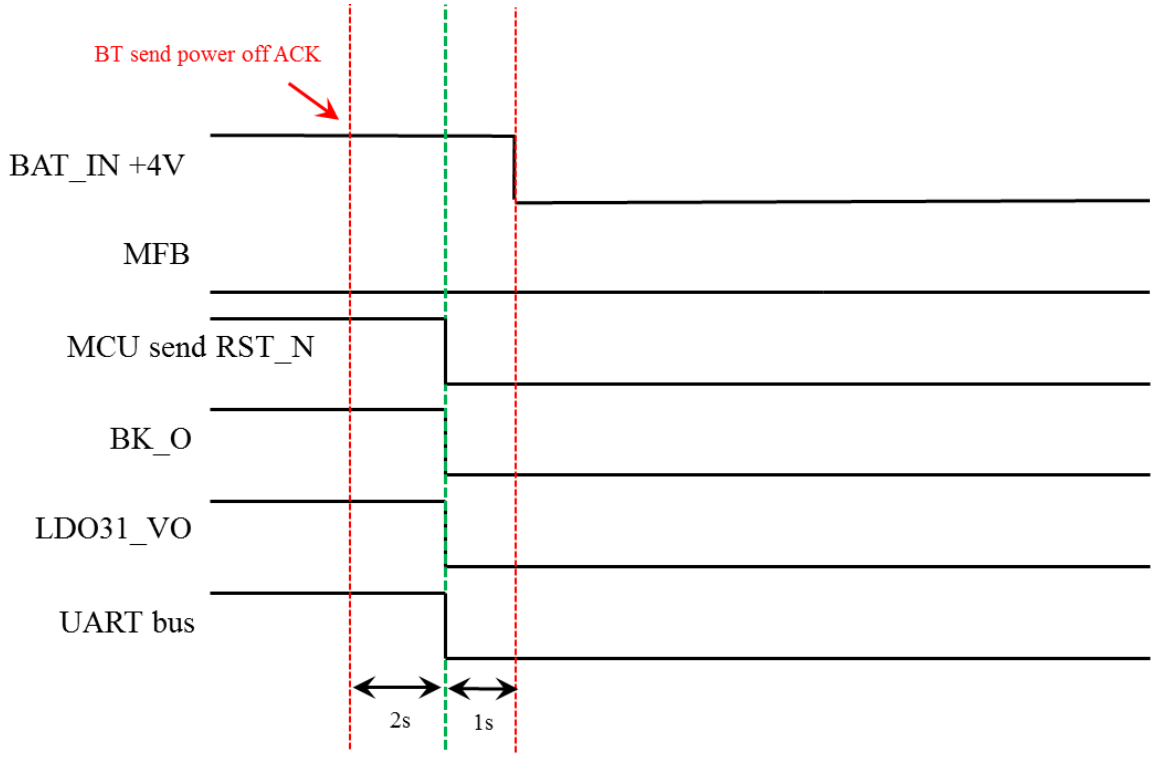
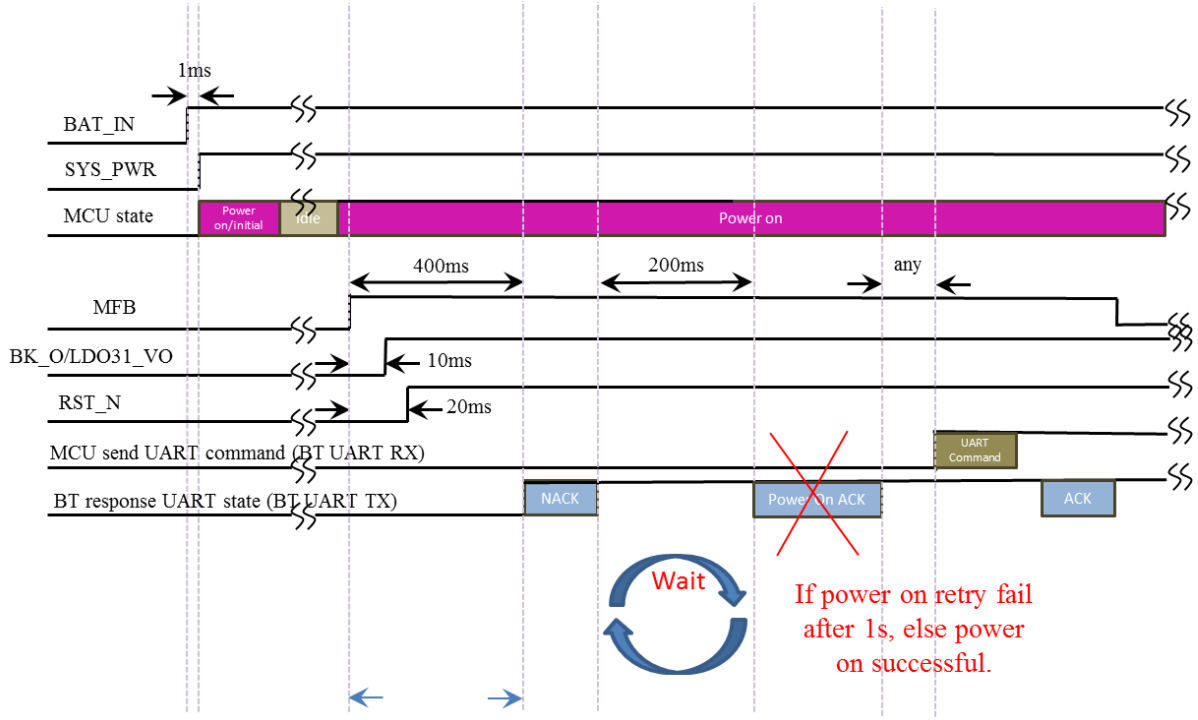


FIGURE 2-4: TIMING SEQUENCE OF POWER OFF



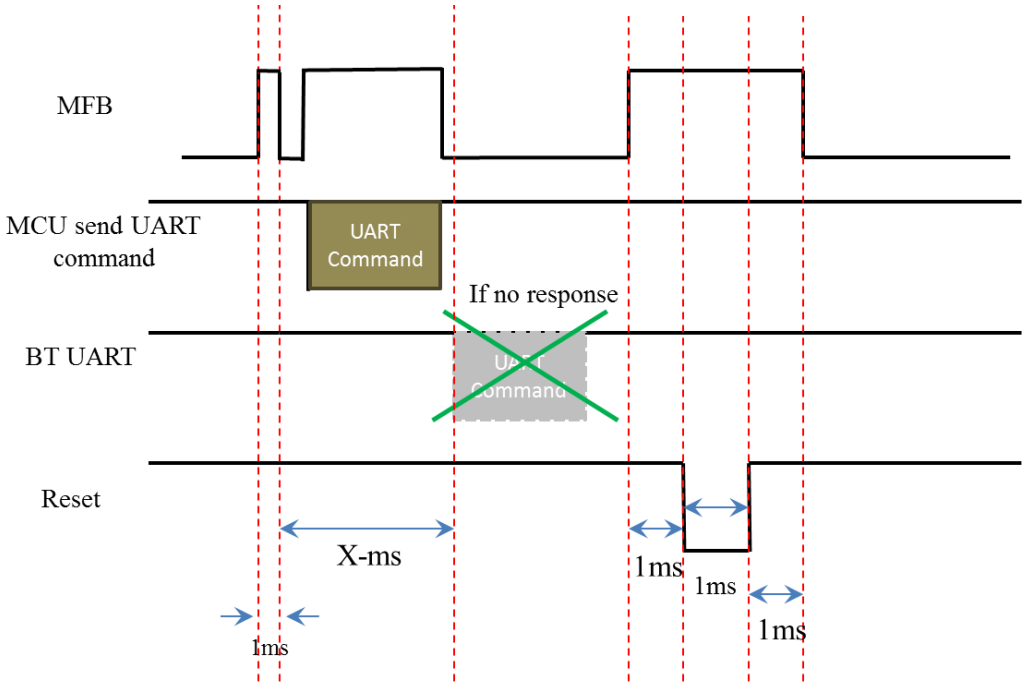
EEPROM clock= 100KHz
For a byte write, 0.01ms*32clock*2= 640us
If power drop faster than 640us, some issue may occurs, but the possibility is low

FIGURE 2-5: TIMING SEQUENCE OF POWER ON (NACK)



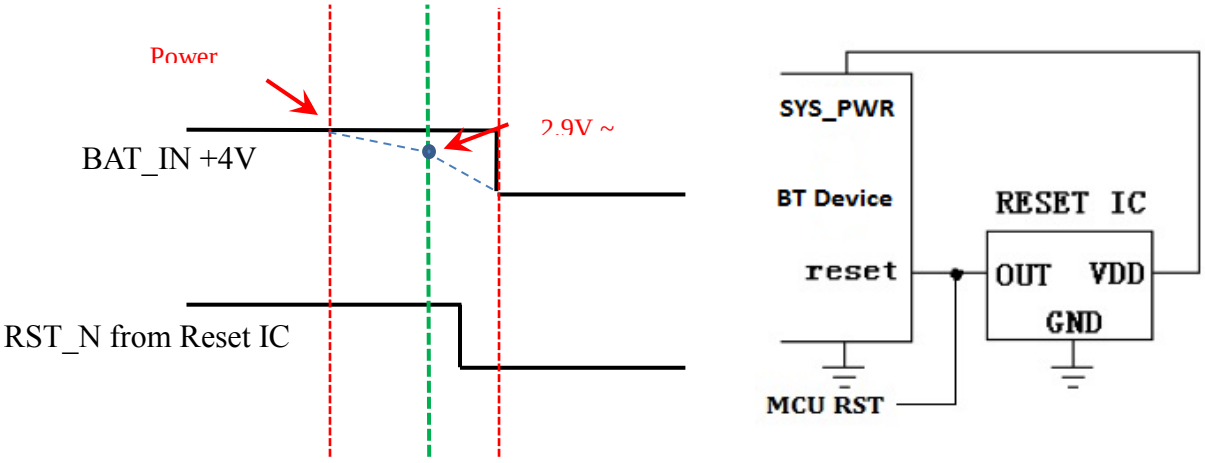
Set "Power On Directly" boot Maximum: 5 times (1s)

FIGURE 2-6: RESET TIMING SEQUENCE IF MODULE HANGS UP



If MCU send UART command, but BT does not response within X-ms, MCU will send a reset signal to BT to do hardware reset

FIGURE 2-7: TIMING SEQUENCE OF POWER DROP PROTECTION



If BT's BAT use adaptor translates voltage by LDO, we recommend use "Reset IC" to avoid power off suddenly. Rest IC spec output pin must be "Open Drain"、delay time ≦ 10ms

Recommend part: TCM809SVNB713 or G691L263T73

2.2. **RESET (RST_N)**

RST is module reset pin which is active LOW. To reset the module, the RST_N must hold LOW for at least 63ns.

2.4. **STATUS LED (LED1, LED2)**

The status LED provide below status indication:

- Standby
- Inquiry
- Link
- Link Back
- Low Battery
- Page
- Battery Charging

Each status indication LED flashing sequence and brightness is configurable by UI tool.

2.4. EXTERNAL CONFIGURATION

Stereo module can be configured and firmware programmed using an external configuration and programming tool available from Microchip. Figure 2-13 shows the configuration and firmware programming interface on BM2020. It is recommended to include a pin header on the main PCB for development.

Configuration and firmware programming modes are entered accordingly to the system configuration I/O pins as shown in Table 2-1. Pin P2_0, P2_4 and EAN pin have internal pull-up.

FIGURE 2-13: EXTERNAL PROGRAMMING HEADER CONNECTIONS

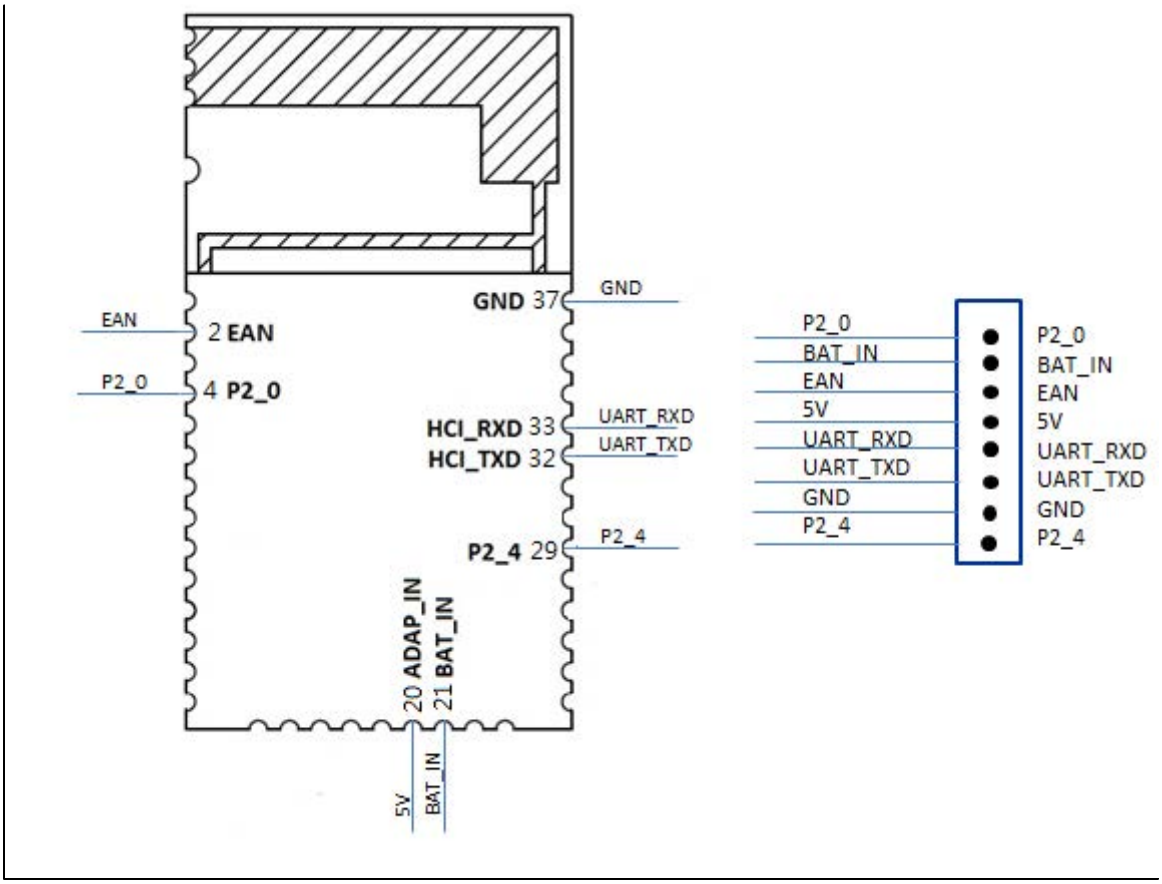


TABLE 2-1: SYSTEM CONFIGURATION SETTINGS

P2_0	P2_4	EAN	Operational Mode
High	High	High	APP mode (Normal operation)
Low	High	High	Test mode (Write EEPROM)
Low	Low	High	Write Flash (Firmware programming if flash build-in in chip)

3. ELECTRICAL CHARACTERISTICS

Table 3-1: ABSOLUTE MAXIMUM SPECIFICATION

Symbol	Parameter	Min	Max	Unit
BAT_IN	Input voltage for battery	0	4.3	V
ADAP_IN	Input voltage for adaptor	0	7.0	V
T_{STORE}	Storage temperature	-65	+150	ºC
$T_{OPERATION}$	Operation temperature	-20	+70	ºC

Table 3-2: RECOMMENDED OPERATING CONDITION

Symbol	Parameter	Min	Typical	Max	Unit
BAT_IN	Input voltage for battery	3	3.7	4.2	V
ADAP_IN	Input voltage for adaptor	4.5	5	5.5	V
$T_{OPERATION}$	Operation temperature	-20	+25	+70	ºC

Note:
Absolute and Recommended operating condition tables reflect typical usage for device.

TABLE 3-3: I/O AND RESET LEVEL

Parameter	Min.	Typ.	Max.	Units
I/O Supply Voltage (VDD_IO)	2.7	3.0	3.3	V
I/O Voltage Levels				
V_{IL} input logic levels low	-0.3		0.8	V
V_{IH} input logic levels high	2.0		3.6	V
V_{OL} output logic levels low			0.4	V
V_{OH} output logic levels high	2.4			V
RESET				
$V_{TH,RES}$ threshold voltage		1.6		V

Note:
(1) VDD_IO voltage is programmable by EEPROM parameters.
(2) These parameters are characterized but not tested in manufacturing.

Table 3-4: BATTERY CHARGER

Parameter		Min	Typical	Max	Unit
ADAP_IN Input Voltage		4.5	5.0	5.5	V
Supply current to charger only			3	4.5	mA
Maximum Battery Fast Charge Current Note: ENX2=0	Headroom > 0.7V (ADAP_IN=5V)	170	200	240	mA
	Headroom = 0.3V (ADAP_IN=4.5V)	160	180	240	mA
Maximum Battery Fast Charge Current Note: ENX2=1	Headroom > 0.7V (ADAP_IN=5V)	330	350	420	mA
	Headroom = 0.3V (ADAP_IN=4.5V)	180	220	270	mA
Trickle Charge Voltage Threshold			3		V
Battery Charge Termination Current, (% of Fast Charge Current)			10		%

Note:
(1) Headroom = $V_{ADAP\_IN} - V_{BAT}$
(2) ENX2 is not allowed to be enabled when $V_{ADAP\_IN} - V_{BAT} > 2V$
(3) These parameters are characterized but not tested in manufacturing.

Table 3-5: LED DRIVER

Parameter	Min	Typical	Max	Unit
Open-drain Voltage			3.6	V
Programmable Current Range	0		5.25	mA
Intensity Control		16		step
Current Step		0.35		mA
Power Down Open-drain Current			1	μA
Shutdown Current			1	μA

Note:
(1) Test condition: SAR_VDD=1.8V, temperature=25 ºC.
(2) These parameters are characterized but not tested in manufacturing.

Table 3-6: AUDIO CODEC ANALOGUE TO DIGITAL CONVERTER

T= 25°C, V_{dd}=3.0V, 1KHz sine wave input, Bandwidth = 20Hz~20KHz				
Parameter (Condition)	**Min.**	**Typ.**	**Max.**	**Unit**
Resolution			16	Bits
Output Sample Rate	8		48	KHz
Signal to Noise Ratio **Note: 1** (SNR @MIC or Line-in mode)		88		dB
Digital Gain	-54		4.85	dB
Digital Gain Resolution		2~6		dB
MIC Boost Gain		20		dB
Analog Gain			60	dB
Analog Gain Resolution		2.0		dB
Input full-scale at maximum gain (differential)		4		mV rms
Input full-scale at minimum gain (differential)		800		mV rms
3dB bandwidth		20		KHz
Microphone mode (input impedance)		24		KΩ
THD+N (microphone input) @30mVrms input		0.02		%

Note:

(1) f_{in}=1KHz, B/W=20~20KHz, A-weighted, THD+N < 1%, 150mV_{pp} input

(2) These parameters are characterized but not tested in manufacturing.

Table 3-7: AUDIO CODEC DIGITAL TO ANALOGUE CONVERTER

T= 25°C, V_{dd}=3.0V, 1KHz sine wave input, Bandwidth = 20Hz~20KHz					
Parameter (Condition)		**Min.**	**Typ.**	**Max.**	**Unit**
Over-sampling rate			128		f_s
Resolution		16		20	Bits
Output Sample Rate		8		48	KHz
Signal to Noise Ratio **Note: 1** (SNR @cap-less mode) for 48kHz			96		dB
Signal to Noise Ratio **Note: 1** (SNR @single-end mode) for 48kHz			98		dB
Digital Gain		-54		4.85	dB
Digital Gain Resolution			2~6		dB
Analog Gain		-28		3	dB
Analog Gain Resolution			1		dB
Output Voltage Full-scale Swing (AVDD=2.8V) **Note:3**			742.5		mV rms
Maximum Output Power (16Ω load)			34.5		mW
Maximum Output Power (32Ω load)			17.2		mW
Allowed Load	Resistive	8	16	O.C.	Ω
	Capacitive			500	pF
THD+N (16Ω load)				0.05	%
Signal to Noise Ratio (SNR @ 16Ωload)				96	dB

Note:
(1) f_{in}=1KHz, B/W=20~20KHz, A-weighted, THD+N < 0.01%, 0dBFS signal, Load=100KΩ
(2) These parameters are characterized but not tested in manufacturing.
(3) Vdd, AVDD are generated by internal LDO

Table 3-8: SYSTEM CURRENT CONSUMPTION OF ANALOG AUDIO OUTPUT

System Status	Typ.	Max.	Unit
System Off Mode	2	5	uA
Standby Mode	0.8		mA
Linked Mode	0.4		mA
SCO Link	7.8		mA
A2DP Link (V_{p-p}=200mV; 1k tone signal)	10.7		mA

Note: Use BM20 EVB as test platform.
Test condition: BAT_IN= 3.8V, link with HTC EYE cell phone; distance between cell phone and EVB: 30cm.

4. PRINTED ANTENNA INFORMATION

4.1. MODULE RADIATION PATTERN

The stereo module contains a PCB printed antenna. The PCB printed antenna radiation pattern is shown in Figure 4-2.

FIGURE 4-1: ANTENNA KEEP OUT AREA EXAMPLES

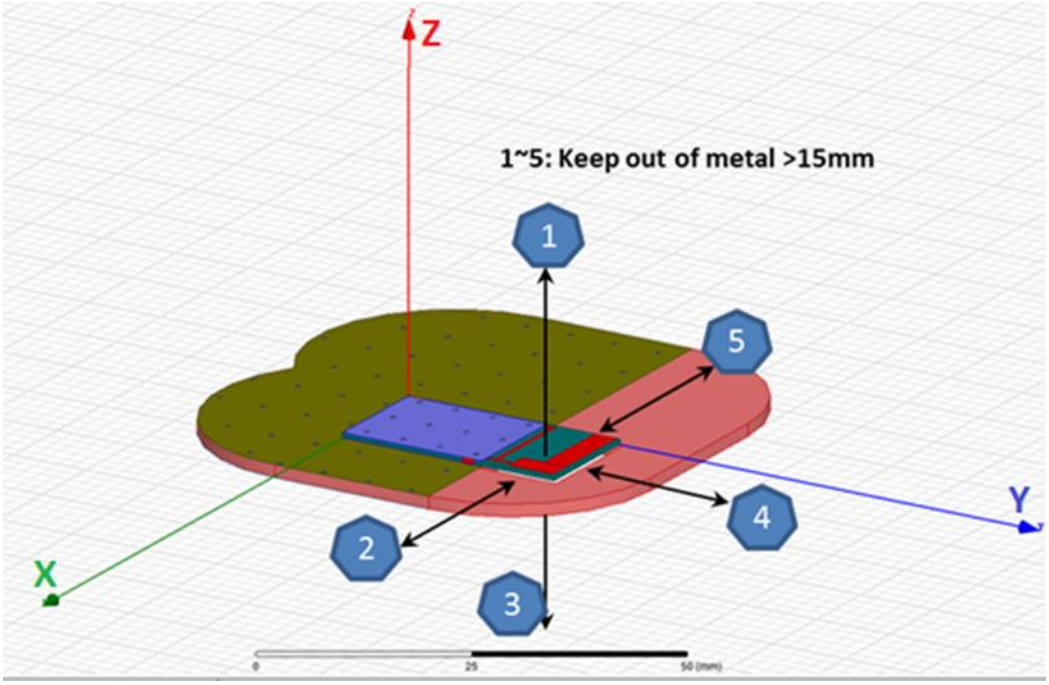
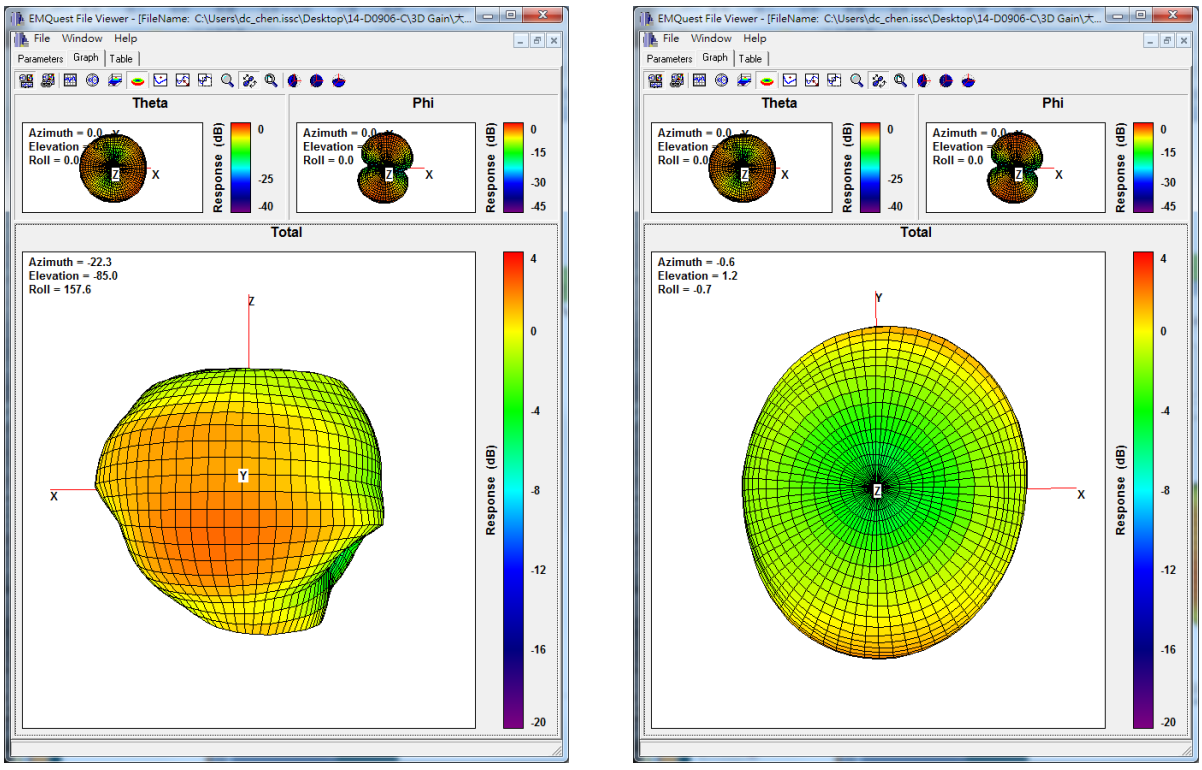


FIGURE 4-2: ANTENNA 3D RADIATION PATTERN @2441 MHz



4.2. MODULE PLACEMENT RULE

On the main PCB, the areas under the antenna should not contain any top, inner layer, or bottom copper as shown in Figure 4-1. A low-impedance ground plane will ensure the best radio performance (best range, lowest noise). The ground plane can be extended beyond the minimum recommended as need for the main PCB EMC noise reduction. For the best range performance, keep all external metal away from the ceramic chip antenna at least 15 mm.

Here are some examples of good and poor placement on a carrier board with GND plane.

FIGURE 4-3: MODULE PLACEMENT EXAMPLES

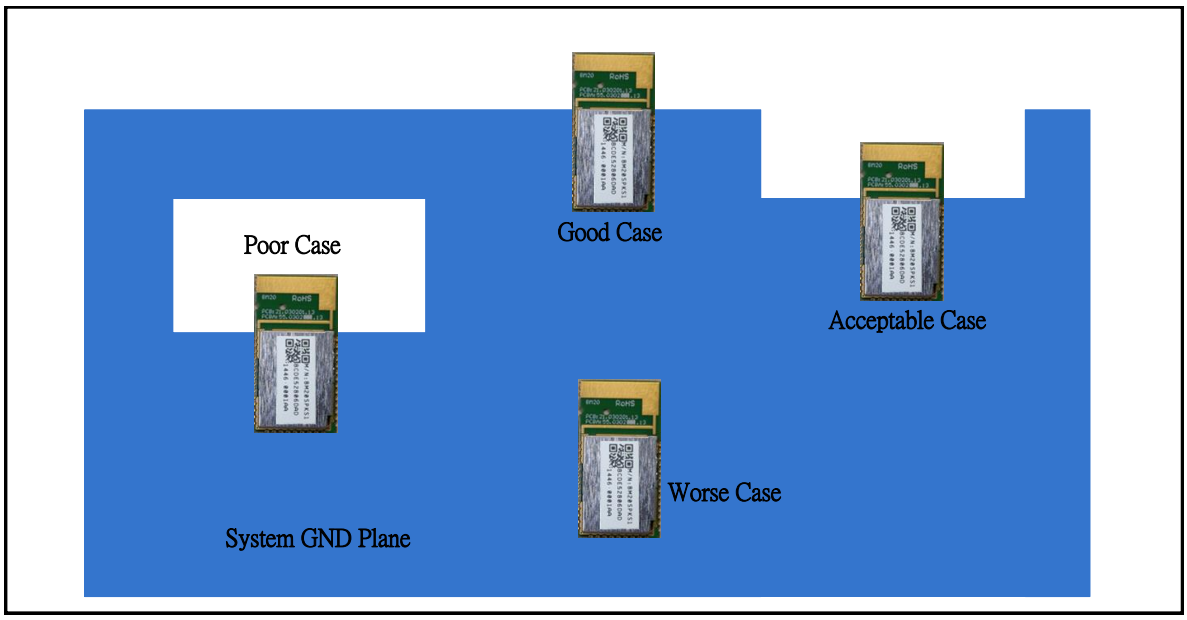
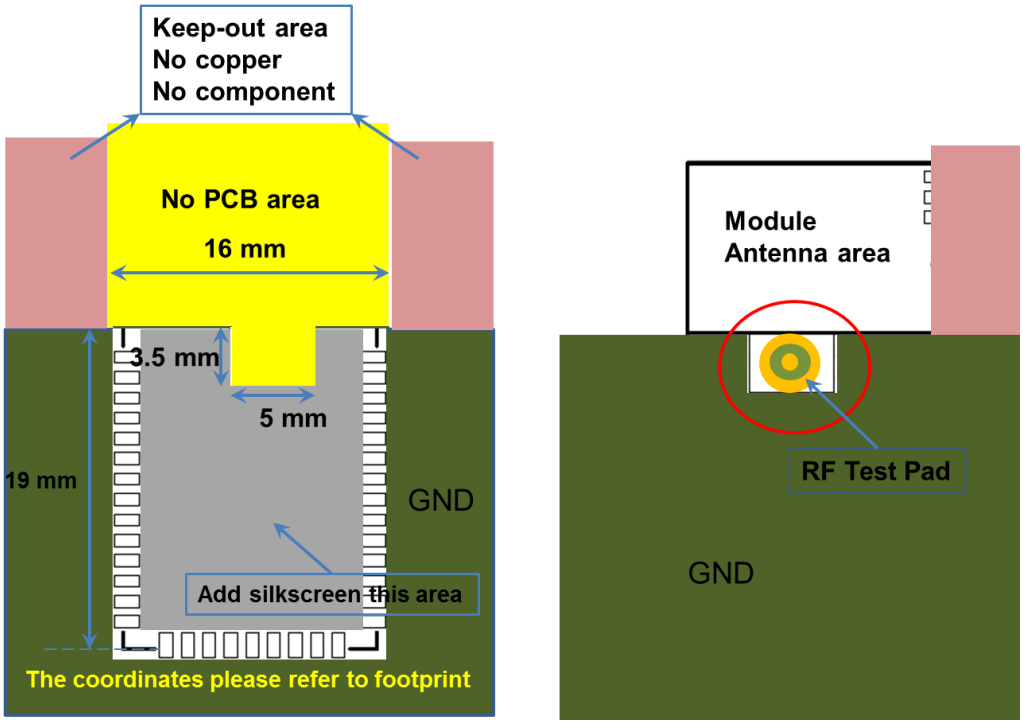
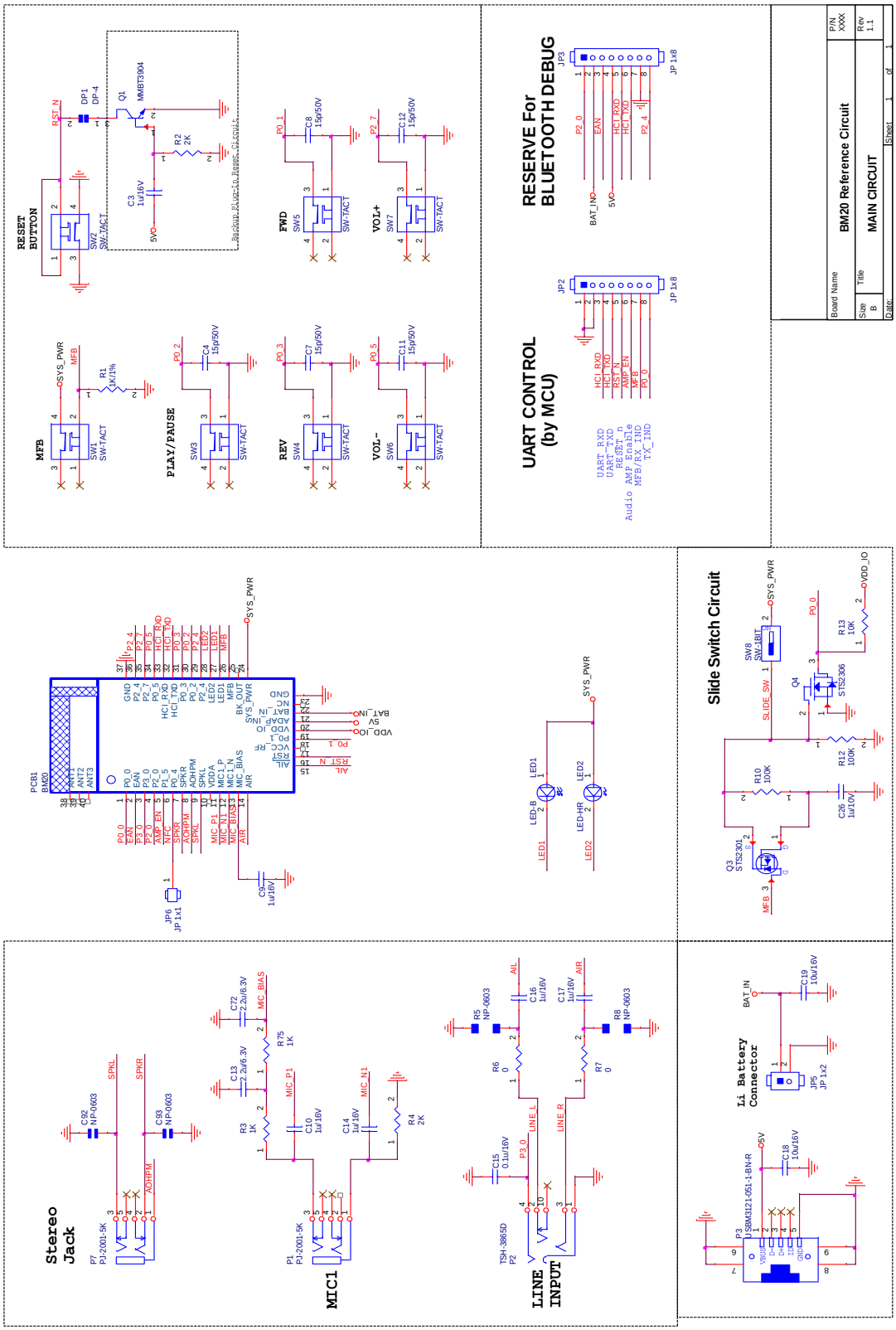


FIGURE 4-4: GND PLANE ON MAIN APPLICATION BOARD



5. REFERENCE CIRCUIT

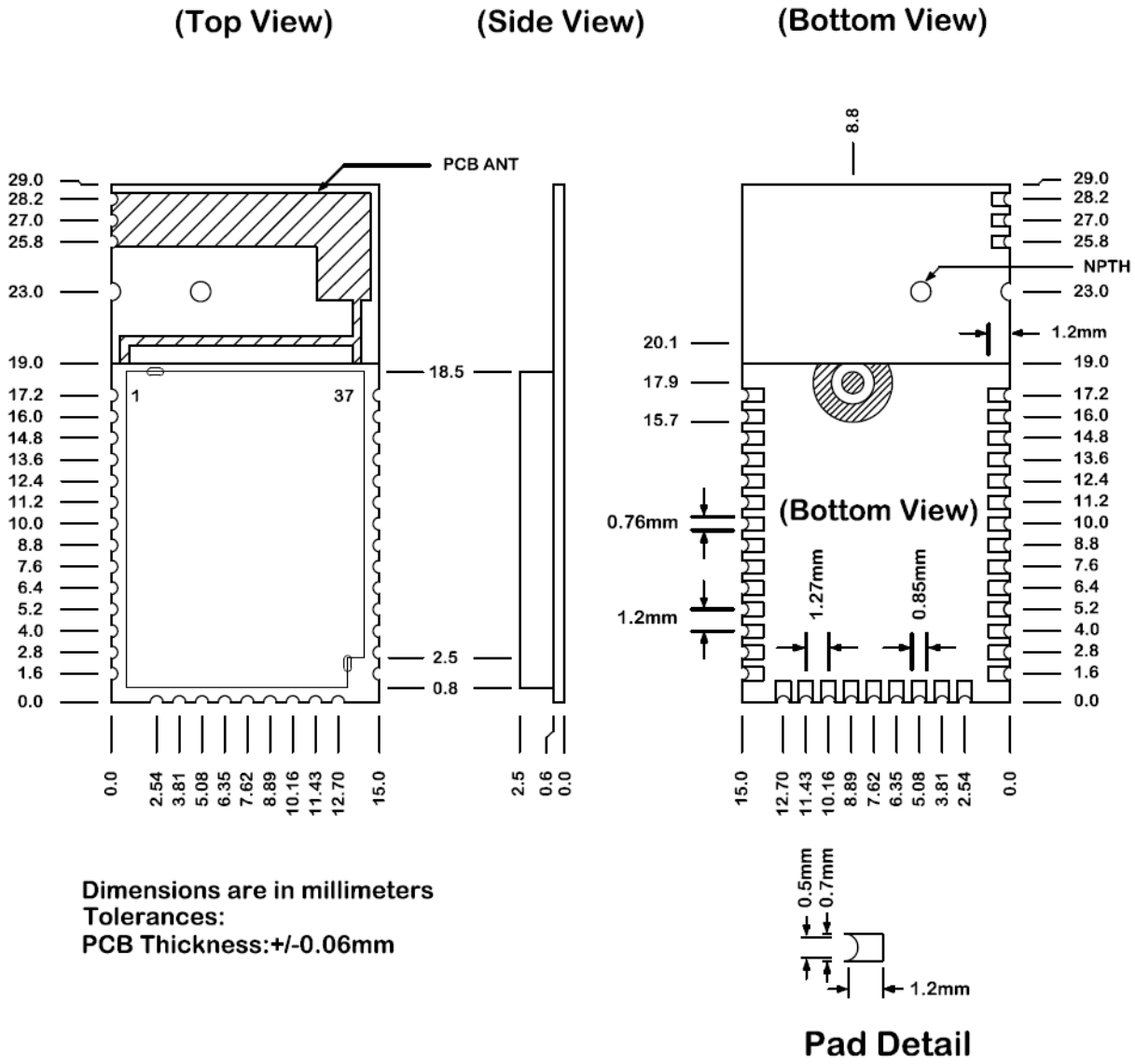
5.1. BM20 REFERENCE CIRCUIT



6. MODULE OUTLINE AND REFLOW PROFILE

6.1. MODULE DIMENSION AND PCB FOOT PRINT

FIGURE 6-1: BM2020 Outline Dimension



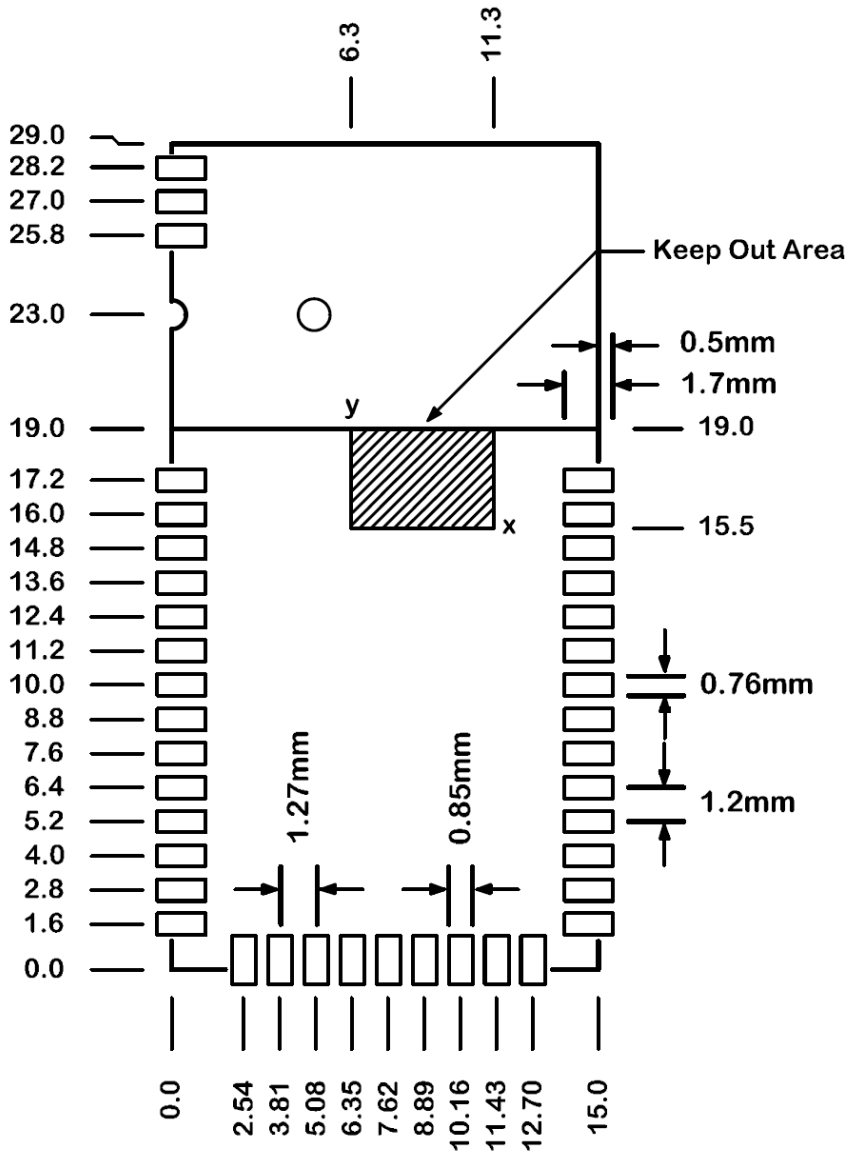
PCB dimension:

X : 15.0 mm

Y : 29.0 mm

Tolerances: 0.25 mm

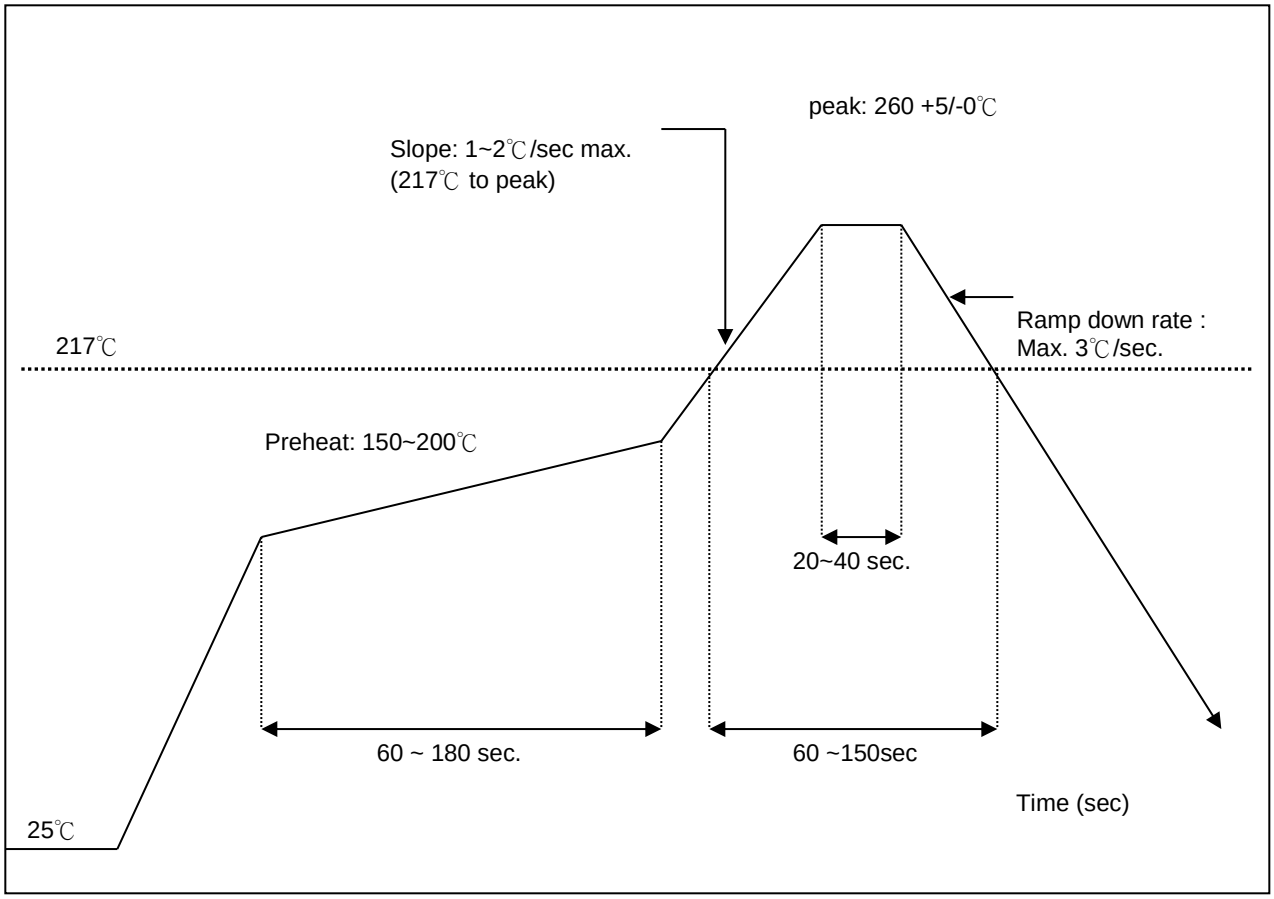
FIGURE 6-3: BM2020 PCB FOOT PRINT



Note: The “Keep Out Area” is reserved for RF performance check.

6.2 REFLOW PROFILE

FIGURE 6-5: REFLOW PROFILE



Soldering Recommendations

Stereo module was assembled using standard lead-free reflow profile IPC/JEDEC J-STD-020. The module can be soldered to the main PCB using standard leaded and lead-free solder reflow profiles. To avoid damaging of the module, the recommendations are listed as follows:

- Refer to Microchip Technology Application Note AN233 Solder Reflow Recommendation (DS00233) for the soldering reflow recommendations
- Do not exceed peak temperature (Tp) of 250 degree C
- Refer to the solder paste data sheet for specific reflow profile recommendations
- Use no-clean flux solder paste
- Do not wash as moisture can be trapped under the shield
- Use only one flow. If the PCB requires multiple flows, apply the module on the final flow.

APPENDIX A: CERTIFICATION NOTICES

BM2020 module has received the regulatory approval for the following:

- United States: FCC ID: 2AMPPBM2020

A.1 REGULATORY APPROVAL

This section outlines the regulatory information for the BM2020 module for the following countries:

•United States

A.2 United States

The BM2020 module has received Federal Communications Commission (FCC) CFR47 Telecommunications, Part 15 Subpart C "Intentional Radiators" modular approval in accordance with Part 15.212 Modular Transmitter approval. Modular approval allows the end user to integrate the BM2020 module into a finished product without obtaining subsequent and separate FCC approvals for intentional radiation, provided no changes or modifications are made to the module circuitry. Changes or modifications could void the user's authority to operate the equipment. The end user must comply with all of the instructions provided by the Grantee, which indicate installation and/or operating conditions necessary for compliance.

The finished product is required to comply with all applicable FCC equipment authorizations regulations, requirements and equipment functions not associated with the transmitter module portion. For example, compliance must be demonstrated to regulations for other transmitter components within the host product; to requirements for unintentional radiators (Part 15 Subpart B “Unintentional Radiators”), such as digital devices, computer peripherals, radio receivers, etc.; and to additional authorization requirements for the non-transmitter functions on the transmitter module (i.e., Verification, or Declaration of Conformity) (e.g., transmitter modules may also contain digital logic functions) as appropriate.

A.2.1 LABELING AND USER INFORMATION REQUIREMENTS

The BM2020 module has been labeled with its own FCC ID number, and if the FCC ID is not visible when the module is installed inside another device, then the outside of the finished product into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording as follows:

For BM20 Module:

> Contains Transmitter Module FCC ID:
> 2AMPPBM2020
>
> or
> Contains FCC ID:
> 2AMPPBM2020
>
> 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

A user's manual for the finished product should include the following statement:

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.

Additional information on labeling and user information requirements for Part 15 devices can be found in KDB Publication 784748 available at the FCC Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB) http://apps.fcc.gov/oetcf/kdb/index.cfm.

A.2.2 RF EXPOSURE

All transmitters regulated by FCC must comply with RF exposure requirements. KDB 447498 General RF Exposure Guidance provides guidance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to Radio Frequency (RF) fields adopted by the Federal Communications Commission (FCC).

From the FCC Grant: Output power listed is conducted. This grant is valid only when the module is sold to OEM integrators and must be installed by the OEM or OEM integrators. This transmitter is restricted for use with the specific antenna(s) tested in this application for Certification and must not be co-located or operating in conjunction with any other antenna or transmitters within a host device, except in accordance with FCC multi-transmitter product procedures.

A.2.3 HELPFUL WEB SITES

Federal Communications Commission (FCC): http://www.fcc.gov

FCC Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB): http://apps.fcc.gov/oetcf/kdb/index.cfm

Federal Communications Commission (FCC) Statement

You are cautioned that changes or modifications not expressly approved by the part responsible for compliance could void the user's authority to operate the equipment.

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 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 of the device.

FCC RF Radiation Exposure Statement:
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Note: The end product shall has the words "Contains Transmitter Module FCC ID: 2AMPPBM2020"