VTech Communications LTD.

R&D Department

VTBM-A02 BT MODULE Specification

Rev.	Date	By	Changes
1.0	20220527	*Sam/Y C Jiang*	*First version*

Bluetooth® 5.1 Stereo Audio Module

Features:

- Complete, Fully Certified, Embedded 2.4GHz Bluetooth®Version5.1 Module
- Bluetooth Classic (BDR/EDR)
- Firmware can be field upgradable via USB/TRB
- Compact surface mount module: 30 x 17 x 3mm^3
- Perfect for Portable Battery Operated Devices
- Audio-In / Out

Operational:

- Operation voltage: 3.7V to 5V
- Temperature range: -20C to 60°C
- 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: -94 dBm (type) BDR receiver sensitivity
- Power Output: class 1 / +9dBm max.
- Connection Distance: >10m (free space and no interference)

Integrated power control regulation:

Audio processor：

- Dual I^{2}S outputs

Supported sample rates of 8, 11.025,16, 22.05, 32,44.1, and 48kHz (DAC only)

- I^{2}S input, SPDIF input (uncompressed PCM only) Stereo codec with 1 microphone input , stereo audio DAC
- USB audio
- Stereo audio ADC with line input, stereo audio DAC
- Support SCMS-T

Auxiliary features:

- Crystal oscillator with built-in digital trimming

Physical interfaces:

UART interface

- USB 2.0 (full-speed) interface, including
- USB charger detection
- I^{2}C master support
- 3 LED drivers with PWM flasher independent of MCU

Battery charger:

- 2 high-efficiency switch-mode regulators with 1.8 V and 1.35 V outputs direct from battery supply
- 3.3 V linear regulator for USB supply
- Low-voltage linear regulator for internal digital circuits
- Low-voltage linear regulator for internal analog circuits
- Power-on-reset detects low supply voltage
- Power management for ultralow power mode

Bluetooth features:

- Bluetooth v5.1 specification support
- A2DP v1.3.1
- AVRCP v1.6
- HFP v1.7
- QTIL's proximity pairing and QTIL's proximity connection

- Lithium ion / Lithium polymer battery charger
- Charger supports 4.20 V and 4.35 V cells
- Instant-on function automatically selects the power supply between battery and USB, which enables operation even if the battery is fully discharged
- Fast charging support
  - Up to 200 mA with no external components
  - Up to 500 mA with external pass transistor
- Supports USB charger detection
- Support for thermistor protection of battery pack

Audio features:

- SBC, and AAC audio codecs
- Configurable Signal Detection to trigger events
- 6 banks of up to 5-stage User Parametric EQ for music enhancement
- Compander to compress or expand the dynamic range of the audio
- Post Mastering to improve DAC fidelity

Device overview

The stereo module VTBM-A02 BT Module provides a complete 2.4GHz Bluetooth system, based on Qualcomm 3021 chip which is a single-chip radio and baseband IC for Bluetooth,2.4GHz systems including basic rate, EDR. The chip integrates Bluetooth 5.1 radio transceiver.

Figure 1-1 shows the application block diagram.

Figure 1-1: Block Diagram:

The following depicts an example of VTBM-A02 BT Module operates as an independent system or connected to an MCU.

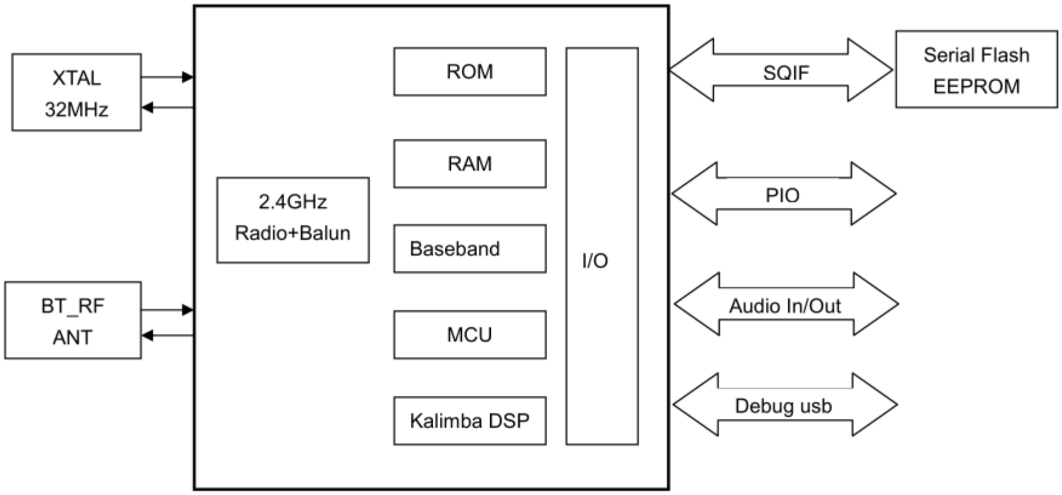
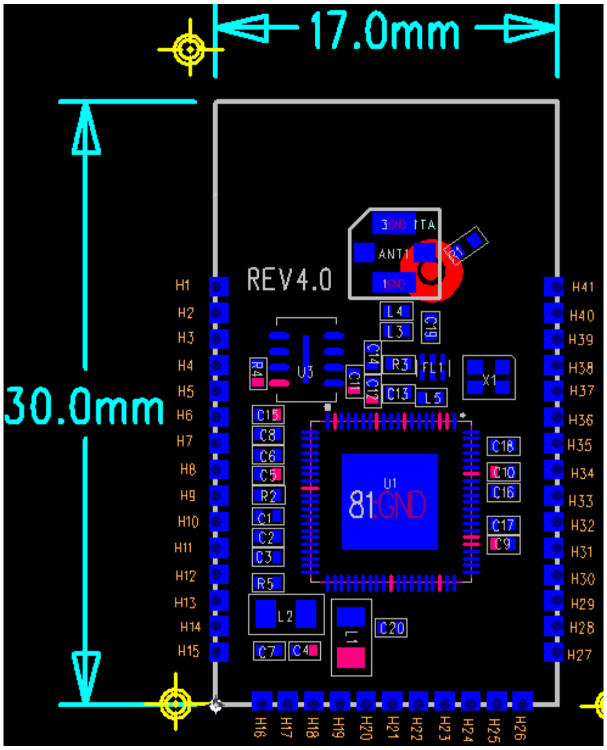

XTAL
32MHz
BT_RF
ANT
ROM
RAM
2.4GHz
Radio+Balun
Baseband
MCU
Kalimba DSP
I/O
SQIF
Serial Flash
EEPROM
PIO
Audio In/Out
Debug usb

Figure 1-1

1.1 Interface description

VTBM-A02 pin diagram is shown in Figure 1-2. The pin descriptions are shown in Table 1-1

FIGURE 1-2: VTBM-A02 PIN DIAGRAM


17.0mm
30.0mm
REV4.0
ANT1
U3
U1
X1
FL1
L1
L2
L3
L4
L5
H1
H2
H3
H4
H5
H6
H7
H8
H9
H10
H11
H12
H13
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H15
H16
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H22
H23
H24
H25
H26
H27
H28
H29
H30
H31
H32
H33
H34
H35
H36
H37
H38
H39
H40
H41

Figure 1-2

TABLE 1-1: VTBM-A02 **PIN DESCRIPTION**

PIN NO.	Pin TYP	Pin Name	Description
H1		GND	GND
H2	O	SPK_RN	Speaker output negative, right
H3	O	SPK_RP	Speaker output positive, right
H4	I/O	PIO	
H5	I	MIC_BP	
H6	O	SPK_LN	Speaker output negative, left
H7	O	SPK_LP	Speaker output positive, left
H8		PIO	
H9	I/O	PIO	
H10		NC	
H11	I/O	PIO	
H12		VCHG_Sense	
H13		VDD_BYP_CHP	
H14	I/O	PIO	
H15		GND	GND

H16		NC	
H17	O	LED	
H18	O	LED	
H19		SY_CTRL	
H20	P	SMPS_VCHG	
H21	P	VBAT	Battery positive terminal.
H22		PIO	
H23	P	CHG_EXT	
H24		VBAT_SENSE	Battery charger sense input.
H25		LED	
H26		GND	GND
H27		GND	GND
H28	USB_N	USB_N	USB data minus
H29	USB_P	USB_P	USB data plus
H30	I/O	PIO	
H31	I/O	PIO	
H32	I/O	PIO	
H33		NC	
H34	I/O	PIO	
H35	I/O	PIO	
H36	I/O	PIO	
H37		NC	
H38	O	LED	
H39		NC	
H40		NC	
H41		MIC_BIAS	Microphone bias

- I: input pin
- O: Output pin
- I/O: Input/Output pin
- P: Power pin

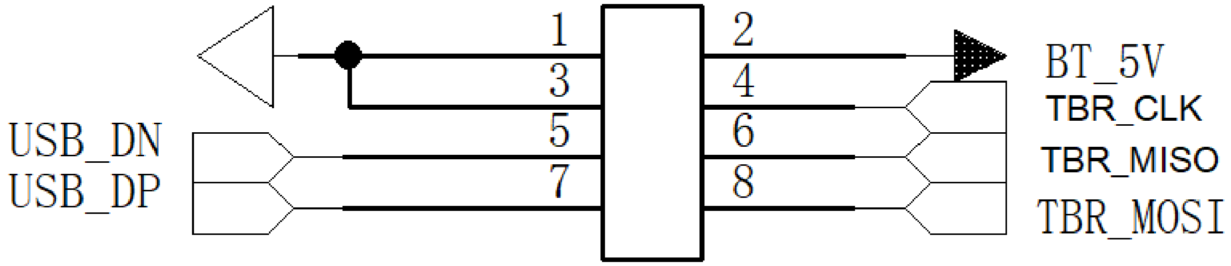


FIGURE 1-3:External Programming Header Connections for debug

Configuration and firmware programming modes are entered according to the system configuration I/O pins as shown in the figure above.

2 Bluetooth modem

The Bluetooth modem includes the following components:

- RF ports
- RF receiver
- RF transmitter
- Bluetooth radio synthesizer
- Baseband

2.1 RF ports (BT-RF)

VTBM-A02 BT Module contains a balun that combines the balanced outputs of the PA on transmit and produces the balanced input signals for the LNA required on receive.

2.2 RF receiver

The receiver features a near-zero IF architecture that enables the channel filters to be integrated onto the die. Sufficient out-of-band blocking specification at the LNA input enables the receiver to operate close to GSM and WCDMA cellular phone transmitters without being desensitized. A digital FSK discriminator means that no discriminator tank is needed and its excellent performance in the presence of noise enables VTBM-A02 BT Module to exceed the Bluetooth requirements for co-channel and adjacent channel rejection.

2.3 RF transmitter

2.3.1 IQ modulator

The transmitter features a direct IQ modulator to minimize frequency drift during a transmit timeslot, which results in a controlled modulation index. Digital baseband transmit circuitry provides the required spectral shaping.

2.3.2 Power amplifier

The internal PA output power is software controlled and configured through a PS Key. The internal PA on the VTBM-A02 BT Module has a maximum output power that enables it to operate as an up to Class 1 Bluetooth radio without requiring an external RF PA.

2.3 Bluetooth radio synthesizer

The Bluetooth radio synthesizer is fully integrated onto the die with no requirement for an external VCO screening can, varactor tuning diodes, LC resonators, or loop filter. The synthesizer is guaranteed to lock in sufficient time across the guaranteed temperature range to meet the Bluetooth v5.1specification.

2.4 Baseband

The baseband handles the digital functions of the Bluetooth modem, for example the Burst Mode Controller and Physical Layer Hardware Engine.

3.0 Clock generation

3.1 Crystal calibration

lity Error must be kept below the Bluetooth specification of
±20 ppm. Typically a crystal with ±15 ppm Frequency Stability over temperature/aging can be used.
To improve startup time and achieve minimum current consumption, crystals with low capacitive loading requirement
are preferred, but this may come at the expense of greater susceptibility to frequency variation caused by the environment.

4 Serial Quad I/O Flash

The VTBM-A02 BT Module uses serial flash ICs for storage of:

- Device-specific data
- Application
- Libraries
- Voice prompt files
- Proprietary data

5 Serial interfaces

5.1 USB interface

VTBM-A02 BT Module has a full-speed (12 Mbps) USB interface for communicating with other compatible digital devices. The USB interface on VTBM-A02 BT Module acts as a USB peripheral, responding to requests from a master host controller.

VTBM-A02 BT Module contains internal USB termination resistors and requires no external resistors.

VTBM-A02 BT Module supports the Universal Serial Bus Specification, Revision v2.0 (USB v2.0 Specification), supports USB standard charger detection, and fully supports the USB Battery Charging Specification v1.2.

VTBM-A02 USB support enter test mode software program /crystal trim tune

5.2 UART interface

VTBM-A02 BT Module has a UART serial interface that provides a simple mechanism for communicating with other serial devices using the RS232 protocol, including for test and debug. The UART interface is multiplexed with PIOs and other functions, and hardware flow control is optional.

The uart controller can be assigned to any PIOs using configuration file.

NOTE To communicate with the UART at its maximum data rate using a standard PC, the PC requires an accelerated serial port adapter card.The use of UART and USB are mutually exclusive.

Table 5-2 Possible UART settings

Parameter		**Possible values**
Baud rate	Minimum	2400 baud (≤ 2% Error)
		19200baud (≤ 1% Error)
	Maximum	4 M baud (≤ 1% Error)
Flow control		RTS/CTS or None
Parity		None, Odd or Even
Number of stop bits		1 or 2
Bits per byte		8

Table 5-3 lists common baud rates and their associated error values for PSKEY_UART_BITRATE. To set the UART baud rate, load PSKEY_UART_BITRATE with the number of bits per second.

Table 5-3 Standard baud rates

Baud rate	**PS Key value (bits per second)**	**Error**
1200	1200	18.62%
2400	2400	1.73%
4800	4800	1.73%
9600	9600	1.73%
19200	19200	0.82%
38400	38400	-0.45%
57600	57600	-0.03%
76800	76800	0.18%
115200	115200	-0.03%
230400	230400	-0.03%
460800	460800	-0.03%
921600	921600	0.02%
1382400	1382400	0.01%
1843200	1843200	0.00%

2764800	2764800	0.01%
3686400	3686400	0.00%
4000000	4000000	0.00%

5.3 SPI interface

VTBM-A02 BT Module provides a standard SPI interface and can be assigned to any PIOs using configuration file.

5.4 I²C interface

The VTBM-A02 BT Module is compliant with the Fast-mode UM10204 I²C-bus specification, and the I²C controller can be assigned to any PIOs using configuration file.

NOTE The I²C interface requires external pull-up resistors. Ensure that external pull-up resistors are suitably sized for the I²C interface speed and PCB track capacitance.

6 Interfaces

6.1 Programmable I/O ports (PIO)

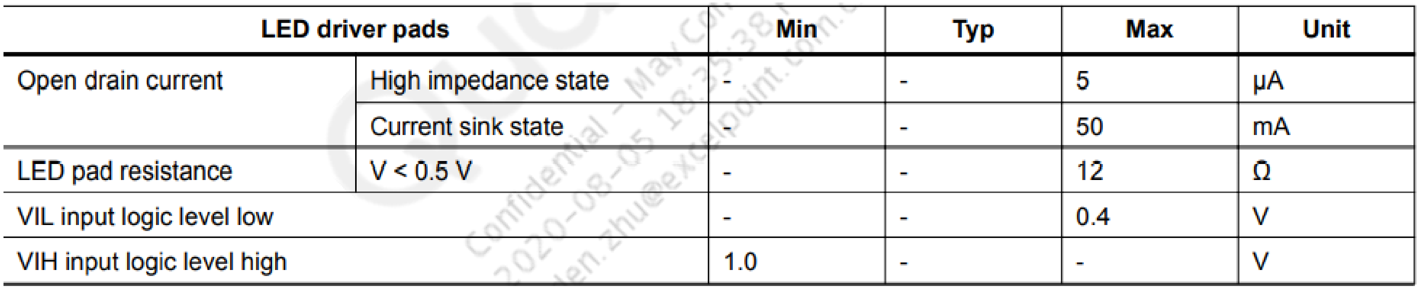
VTBM-A02 BT Module provides up to 17 lines of programmable bidirectional I/O(see table 1-1)

6.2 LED drivers

This mode is designed for driving LEDs. The pad operates as an open-drain pad, tolerant of voltages up to 6.5 V. The LED cathode should be connected to the QCC3021 QFN LED pad. Each pad is rated to sink up to 50 mA of current. The PCB routing should ensure that the tracking is of sufficient current capacity.

An application may configure the LED flash rate and ramp time using a dedicated API.

Table 6-2 show the LED driver pads characteristic



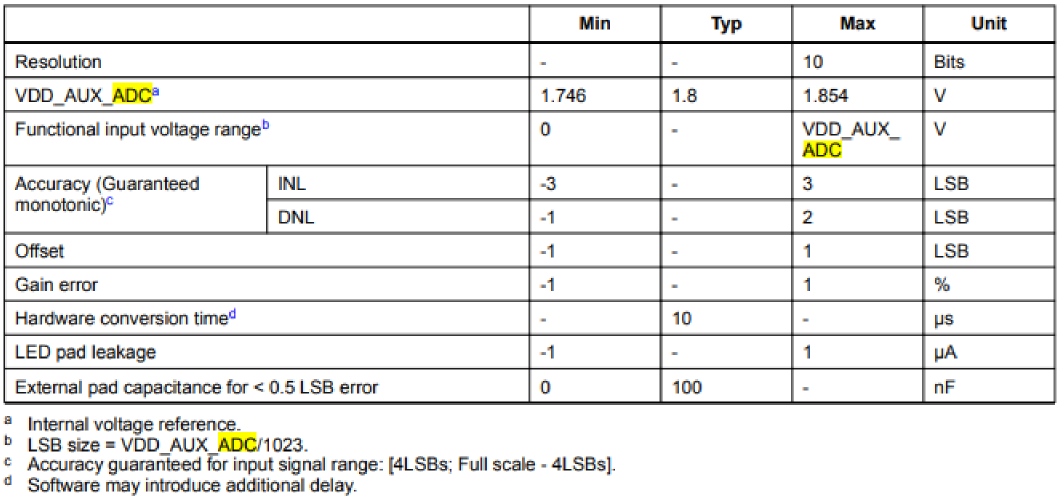
LED driver pads		Min	Typ	Max	Unit
Open drain current	High impedance state	-	-	5	µA
	Current sink state	-	-	50	mA
LED pad resistance	V < 0.5 V	-	-	12	Ω
VIL input logic level low		-	-	0.4	V
VIH input logic level high		1.0	-	-	V

NOTE :Because of the high current capability, these pads are capable of fast edge switching. The effects of noise from PWM operation of the LED’s should be considered.

6.3 Analog I/O ports (AIO)

In this mode, the LED pad is used as an analog input port. The pad voltage is routable to the 10-bit auxiliary ADC.

Table 6-2 show the 10-bit auxiliary ADC characteristic



		Min	Typ	Max	Unit
Resolution		-	-	10	Bits
VDD_AUX_ADC[a]		1.746	1.8	1.854	V
Functional input voltage range[b]		0	-	VDD_AUX_ADC	V
Accuracy (Guaranteed monotonic)[c]	INL	-3	-	3	LSB
	DNL	-1	-	2	LSB
Offset		-1	-	1	LSB
Gain error		-1	-	1	%
Hardware conversion time[d]		-	10	-	µs
LED pad leakage		-1	-	1	µA
External pad capacitance for < 0.5 LSB error		0	100	-	nF

[a] Internal voltage reference.
[b] LSB size = VDD_AUX_ADC/1023.
[c] Accuracy guaranteed for input signal range: [4LSBs; Full scale - 4LSBs].
[d] Software may introduce additional delay.

NOTE In analog input mode, the input range is 0 to VDD_AUX_ADC. Damage may be caused if input voltages exceed 1.8 V.

7 Audio interface

The audio interface circuit consists of the following components:

- Dual analog audio inputs
- Dual analog audio outputs
- 1 digital microphone input
- 2 configurable I²S interfaces
- Configurable SPDIF input interface

Figure 7-1 shows the functional blocks of the audio interface. The codec supports stereo/dual-mono playback and recording of audio signals at multiple sample rates with a 16-bit resolution. The ADC and the DAC of the codec each contain two independent high-quality channels. Each ADC or DAC channel runs at its own independent sample rate.

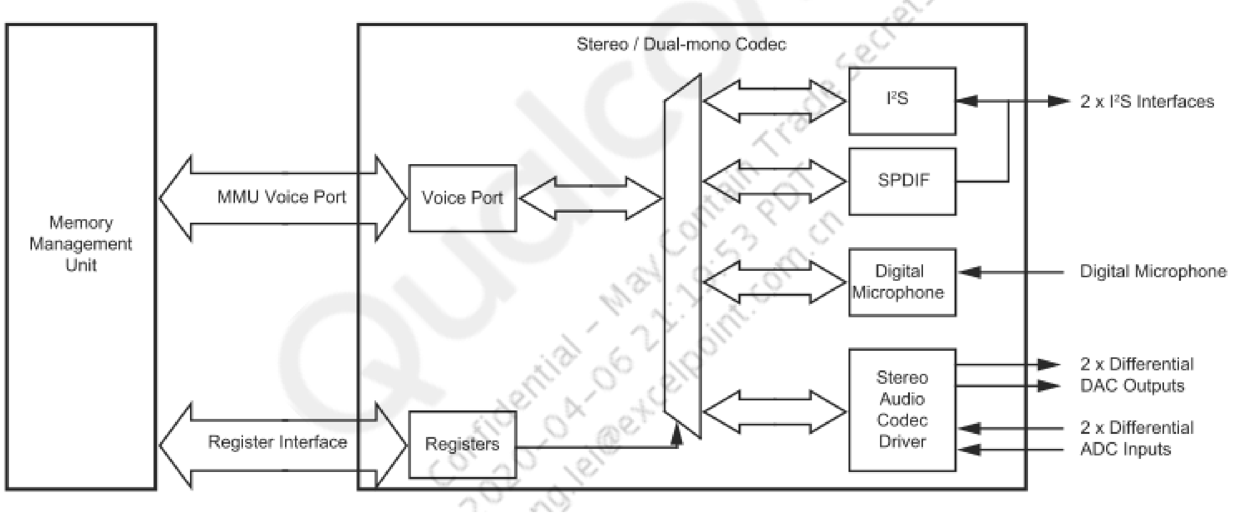

Memory Management Unit
MMU Voice Port
Register Interface
Stereo / Dual-mono Codec
Voice Port
Registers
I^{2}S
SPDIF
Digital Microphone
Stereo Audio Codec Driver
2 x I^{2}S Interfaces
Digital Microphone
2 x Differential DAC Outputs
2 x Differential ADC Inputs

Figure 7-1 VTBM-02 BT Module audio interface

7.1 Audio input and output

The audio input circuitry consists of 2 independent 16-bit high-quality ADC channels:

- Programmable as either stereo or dual-mono inputs.
- 1 input programmable as either microphone or line input, the other as line input only.
- Each channel can be connected as either single-ended or fully differential.
- Each channel has an analog and digital programmable gain stage.

The audio output circuitry consists of a dual differential class A-B output stage.

NOTE VTBM-A02 BT module is designed for a differential audio output. If a single-ended audio output is required, use an external differential to single-ended converter.

7.2 Audio codec interface

The interface has the following features:

- Stereo and mono analog input for voice band and audio band
- Stereo and mono analog output for voice band and audio band

NOTE To avoid any confusion regarding stereo operation, this data sheet explicitly states which is the left and right channel for audio output. Regarding audio input, software, and any registers, channel 0 or channel A represents the left channel and channel 1 or channel B represents the right channel.

7.2.1 ADC

The VTBM-A02 BT Module consists of two high-quality ADCs:

- Each ADC has a second-order Sigma-Delta converter.
- Each ADC is a separate channel with identical functionality.
- Each channel has an analog and a digital gain stage.

7.2.2.1 ADC sample rate selection

Each ADC supports the following predefined sample rates:

- 8 kHz
- 11.025 kHz
- 16 kHz
- 22.050 kHz
- 24 kHz
- 32 kHz
- 44.1 kHz
- 48 kHz

7.2.3 DAC

The DAC consists of two high-quality DACs

- Each DAC has a fourth-order Sigma-Delta converter.
- Each DAC is a separate channel with identical functionality.
- Each channel has an analog and a digital gain stage.

7.2.3.1 DAC sample rate selectio

Each DAC supports the following sample rates:

- 8 kHz
- 11.025 kHz
- 16 kHz
- 22.050 kHz
- 32 kHz

- 40 kHz
- 44.1 kHz
- 48 kHz

7.2.4 Microphone bias generator

VTBM-A02 BT Module contains an independent low-noise microphone bias generator. The microphone bias generator is recommended for biasing electret condensor microphones.

7.2.5 Line input

Figure 7-5 and Figure 7-6 show 2 circuits for line input operation and show connections for either differential or single-ended inputs.

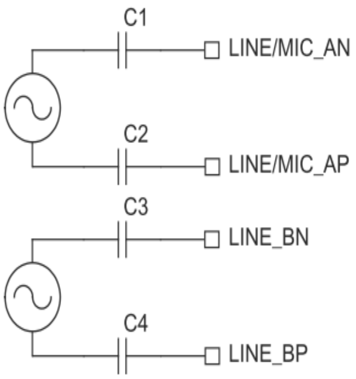

C1
LINE/MIC_AN
C2
LINE/MIC_AP
C3
LINE_BN
C4
LINE_BP

Figure 7-5 Differential input

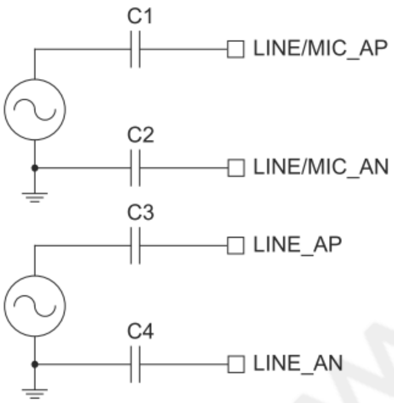

C1
LINE/MIC_AP
C2
LINE/MIC_AN
C3
LINE_AP
C4
LINE_AN

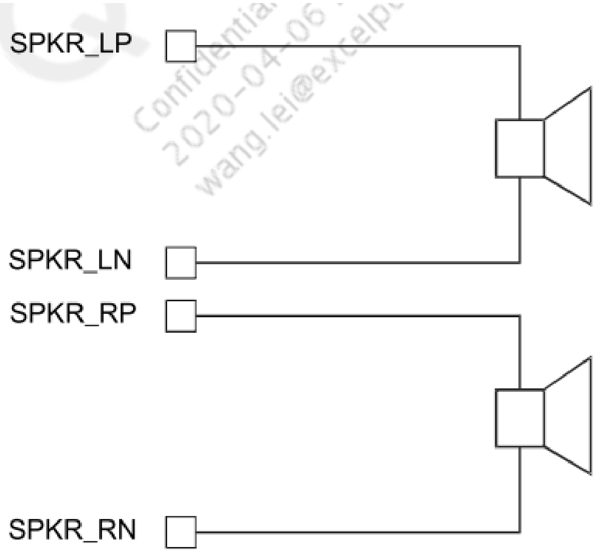
Figure 7-6 Single-ended input

7.2.6 Output stage

The output stage digital circuitry converts the signal from 16 bit per sample, linear PCM of variable sampling frequency to bit stream, which is fed into the analog output circuitry.

The analog output circuit comprises a DAC, a buffer with gain-setting, a low pass filter, and a class AB output stage amplifier.

Figure 7-7 shows that the output is available as a differential signal between SPKR_LN and SPKR_LP for the left channel, and between SPKR_RN and SPKR_RP for the right channel.



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2020-04-06
wang.lei@excelpo

Figure 7-7 Speaker output

8 Power control

8.1 Switch-mode regulators

For greater power efficiency, the VTBM-A02 BT Module contains 2 switch-mode regulators:

- One to generate a 1.8 V supply rail with an output current of 185 mA.
- One to generate a 1.35 V supply rail with an output current of 160 mA.
- Combining the 2 switch-mode regulators in parallel generates a single 1.8 V supply rail with an output current of 340 mA.

8.2 Reset, RST#

VTBM-A02 BT Module is reset from several sources:

- RST# pin(H31)
- Power-on reset
- USB charger attach reset

- Software configured watchdog timer

The RST# pin is an active low reset. Assert the reset signal for a period > 5 ms to ensure a full reset. At reset the digital I/O pins are set to inputs for bidirectional pins and outputs are set to tristate.

NOTE Reset can also be triggered by a UART break symbol if:

- Host interface is any UART transport

9 Battery charger

The battery charger hardware is controlled by the on-chip application. The battery charger has 5 modes:

- Disabled
- Trickle charge
- Fast charge
- Standby: fully charged or float charge
- Error: charging input voltage, VCHG, is too low

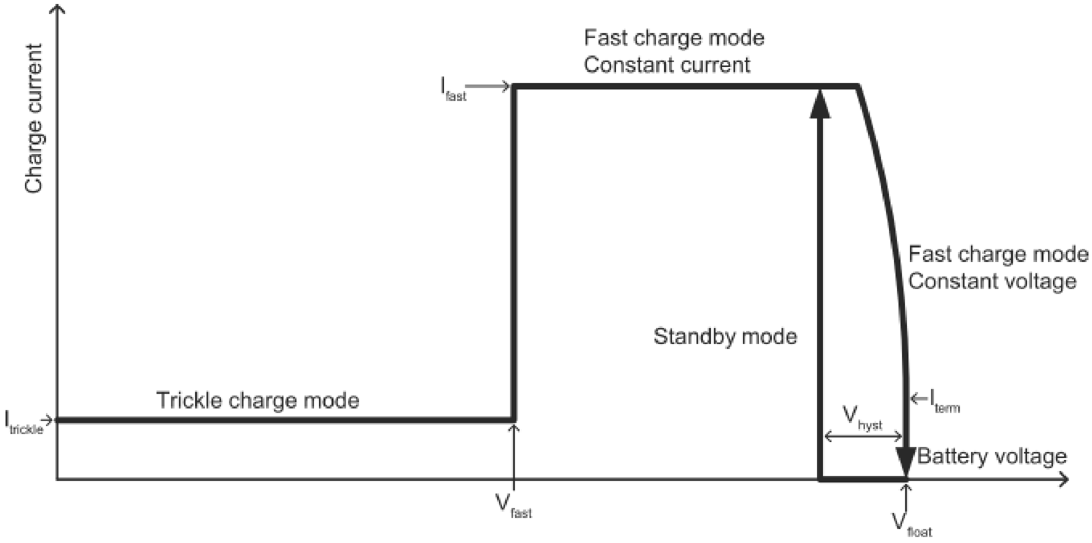
Transitions between the trickle charge, fast charge and standby modes are triggered by changes in battery voltageand charger current.

Table 10-1 Battery charger operating modes determined by battery voltage and charger current

Mode	Battery charger enabled	VBAT_SENSE
Disabled	No	X
Trickle charge	Yes	> 0 and < V_{fast}
Fast charge	Yes	> V_{fast} and < V_{float}
Standby	Yes	I_{term} and > (V_{float} - V_{hyst})
Error	Yes	> (VCHG - 50mV)

I_{term} is approximately 10% of I_{fast} for a given I_{fast} setting

Figure 9-1 shows the mode-to-mode transition voltages.



9.1 External mode

The external mode is for charging higher capacity batteries using an external pass device. The current is controlled by sinking a varying current into the CHG_EXT pin, and the current is determined by measuring the voltage drop across a resistor, Rsense, connected in series with the external pass device. The voltage drop is determined by looking at the difference between the VBAT_SENSE and VBAT pins. The charger regulates the current drawn from CHG_EXT pin to maintain nominal voltage drop of 200 mV across Rsense. The value of the external series resistor determines the charger current. This current can be trimmed with a PS Key.

Figure 9-2 shows R1 (220 mΩ) and C1 (4.7 µF) form a RC snubber that is required to maintain stability across all battery ESRs. The battery ESR must be < 1.0 Ω.

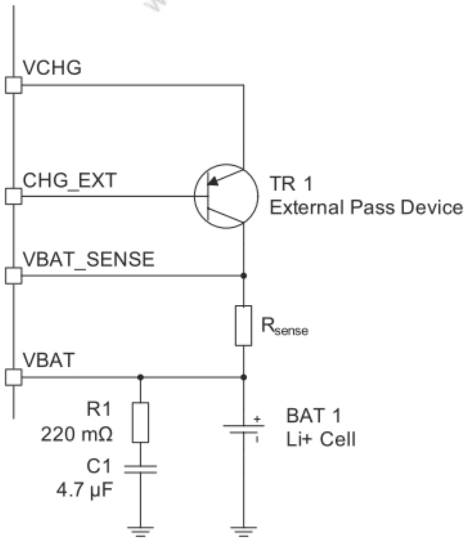


Figure 9-2 Battery charger external mode typical configuration

10 Electrical characteristic

10.1 Absolute maximum rating

Parameter	Min	Max	Unit
Storage temperature	-40	85	° C
Supply voltage			
5 V (USB VBUS)			
CHG_EXT	-0.4	7	V
LX_1V8			
LX_DIG			
SMPS_DCPL			
SMPS_VCHG			
VCHG_SENSE			
VDD_BYP_CHG			
Battery			
SMPS_VBAT	-0.4	4.8	V
VBAT			
VBAT_SENSE			
3.3 V			
USB_DN	-0.4	3.8	V
USB_DP			
VDD_BYP			

NOTE Voltage must not exceed 3.6 V on any I/O.

10.2 Recommended operating condition

Parameter	Min	Type	Max	Unit
Operation temperature range	-40	25	85	° C
Charging temperature range	-10	25	85	° C
5 V (USB VBUS) 4.75 / 4.0a 5.0 6.5 V				
Supplier				
5 V (USB VBUS)				
CHG_EXT	4.75	5	6.5	V
SMPS_VCHG				
VCHG_SENSE				
VDD_BYP_CHG				
SMPS_DCPL 2.8	2.8	3.7 / 5.0	6.5	V
Battery				
SMPS_VBAT	3	3.7	4.6	V
VBAT				
VBAT_SENSE				
3.3 V				
VDD_BYP	2.8	2.9/3.3	3.5	V
USB_DN 0 – 3.6 V				
USB_DP	0		3.6	

10.3 Input/Output terminal characteristic

For all I/O terminal characteristics:

- Current drawn into a pin is defined as positive.
- Current supplied out of a pin is defined as negative.

10.3.1 LED driver pads

LED driver pads		Min	Typ	Max	Unit
Current, IPAD	High impedance state	–	–	5	µA
	Current sink state	–	–	10	mA
LED pad voltage, VPAD	IPAD = 10 mA	–	–	0.55	V
VOL output logic level low		–	0	–	V
VOH output logic level high		–	0.8	–	V
VIL input logic level low		–	0	–	V
VIH input logic level high		–	0.8	–	V

NOTE LED output port is open-drain and requires a pull-up

10.4 Battery charger

Battery charger	Min	Typ	Max	Unit
Input voltage, VCHG, 4.20 V float setting	4.75/3.10	5.00	6.50	V
Input voltage, VCHG, 4.35 V float setting	4.90/3.10	5.00	6.,50	V

NOTE Reduced specification if VCHG - VBAT < 0.55 V. Full specification > 4.75 V.
Reduced specification if VCHG - VBAT < 0.55 V. Full specification > 4.90 V.

Trickle charge mode	Min	Typ	Max	Unit
Charge current Itrickle, as percentage of fast charge current	8	10	12	%
V_{fast} rising threshold	-	2.9	-	V
V_{fast} rising threshold trim step size	-	0.1	-	V
V_{fast} falling threshold	-	2.8	-	V

Fast charge mode		Min	Typ	Max	Unit
Charge current during constant current mode, I_{fast}	Maximum charge setting (VCHG - VBAT > 0.55 V)	194	200	206	mA
	Minimum charge setting (VCHG - VBAT > 0.55 V)	-	10	-	mA
Reduced headroom charge current, as a percentage of I_{fast}	(VCHG - VBAT < 0.55 V)	50-	-	100	%
Charge current step size		-	10	-	mA
Vfloat threshold, 4.20 V		4.16	4.20	4.24	V
Vfloat threshold, 4.35 V		4.31	4.35	4.39	V
Charge termination current I_{term}, as percentage of I_{fast}		7	10	20	%

Standby mode	Min	Typ	Max	Unit
Voltage hysteresis on VBAT, Vhyst	100	–	150	mV

Error charge mode	Min	Typ	Max	Unit
Headroom error falling threshold	–	50	–	mV

NOTE Headroom = VCHG – VBAT

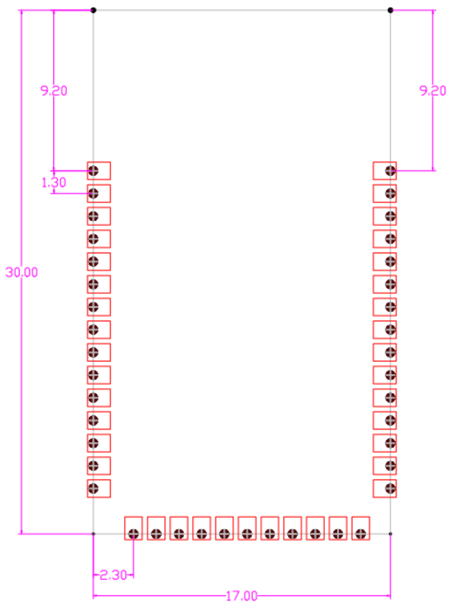
External charge mode	Min	Typ	Max	Unit
Fast charge current, I_{fast}	200	–	500	mA
Control current into CHG_EXT	0	–	20	mA
Voltage on CHG_EXT	0	–	6.50	V
External pass device h_{fe}	–	50	–	–
Sense voltage, between VBAT_SENSE and VBAT at maximum current	195	200	205	mV

NOTE   In the external mode, the battery charger meets all the previous charger electrical characteristics and the additional or superseded electrical characteristics are listed in this table.

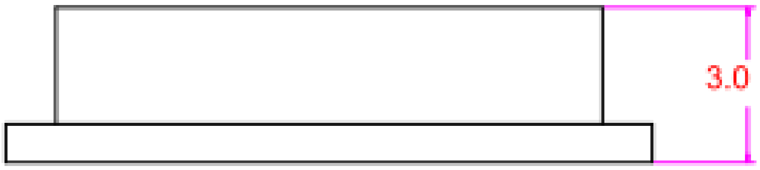
10.5 System current consumption

System Status	Typ.	Max.	Unit
System Off Mode	300	500	uA
Standby Mode	6.5	8	mA
Linked Mode	15	17	mA

11 Physical outline (unit mm)



Top View

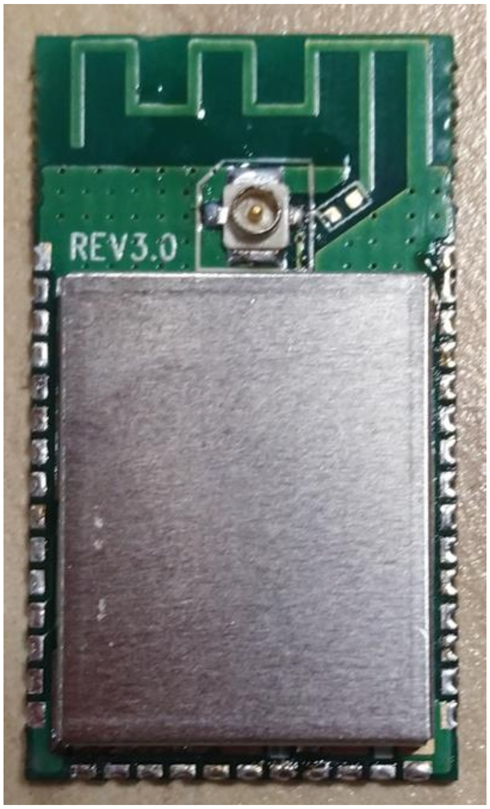


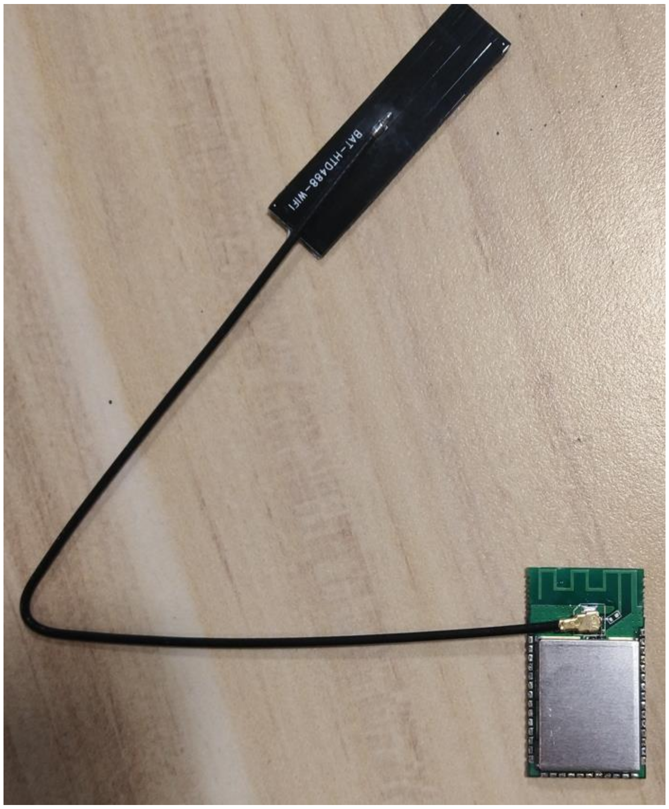
Side View

12 Module photo

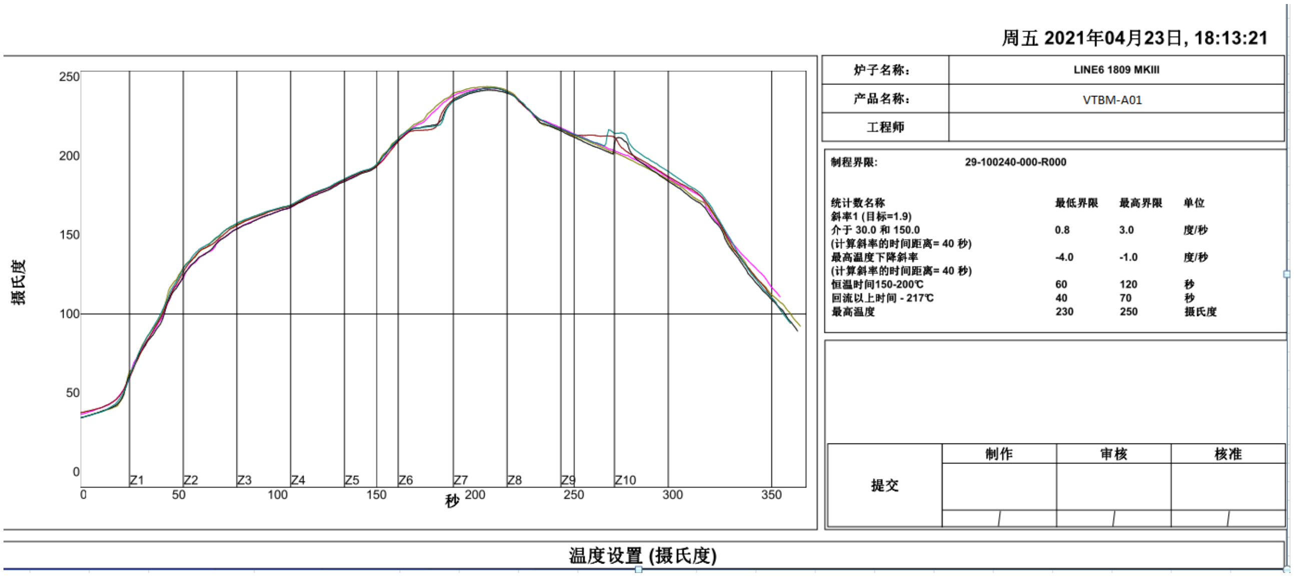
Top View (PCB Ant Version)

Top View (External Ant Version)





13 Recommended Reflow Profile



周五 2021年04月23日, 18:13:21

炉子名称:	LINE6 1809 MKIII
产品名称:	VTBM-A01
工程师	

制程界限: 29-100240-000-R000

统计数名称	最低界限	最高界限	单位
斜率1 (目标=1.9)			
介于 30.0 和 150.0	0.8	3.0	度/秒
(计算斜率的时间距离= 40 秒)			
最高温度下降斜率	-4.0	-1.0	度/秒
(计算斜率的时间距离= 40 秒)			
恒温时间150-200℃	60	120	秒
回流以上时间 - 217℃	40	70	秒
最高温度	230	250	摄氏度

	制作	审核	核准
提交	/	/	/

温度设置 (摄氏度)

14 Integration introductions

14.1 This modular transmitter complies FCC Rules part 15

14.2 This modular transmitter complies CE/RED

15. Certification Notices

VTBM-A02 module has received the regulatory approval as following

- United States: FCC ID: 2AZ2A-VTBMA02
- Canada IC：27317-VTBMA02
- Europe/CE:RED

16. Labeling and User information requirement

16.1 United States

- Label requirement

Please notice that if the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains FCC ID: 2AZ2A-VTBMA02" any similar wording that expresses the same meaning may be used.

§ 15.19 Labelling requirements shall be complied on end user device.

Labelling rules for special device, please refer to §2.925, § 15.19 (a)(5) and relevant KDB publications. For E-label, please refer to §2.935.

- FCC regulatory compliance statement

This module is not a limited module, This module can be used in IOT devices, the input voltage to the module is 3.7- 5V. Only the embedded integral antenna is allowed. Any other external antenna is prohibited.

This Module complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

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.

- FCC other Parts, Part 15B Compliance Requirements for Host product manufacturer

This modular transmitter is only FCC authorized for the specific rule parts listed on our grant, 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.

Host manufacturer in any case shall ensure host product which is installed and operating with the module is in compliant with Part 15B requirements.

Please note that For a Class B or Class A digital device or peripheral, the instructions furnished the user manual of the end-user product shall include statement set out in *§15.105 Information to the user* or such similar statement and place it in a prominent location in the text of host product manual. Original texts as following:

For Class B

> *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.*

For Class A

> *Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.*

●List of applicable FCC rules:

47 CFR Part 15, Subpart C 15.203
47 CFR Part 15, Subpart C 15.205
47 CFR Part 15, Subpart C 15.207
47 CFR Part 15, Subpart C 15.209
47 CFR Part 15, Subpart C 15.247
47 CFR Part 2 2.1091

●Warning:

i) changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

ii) The antenna is not a trace antenna, if you desire to increase antenna gain and either change antenna type or use same antenna type certified, a Class II permissive change application is required to be filed by us, or you (host manufacturer) can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application

iii) The OEM integrator is responsible for ensuring that the end-user has no manual instruction to remove or install module.

The module is limited to installation in mobile application, a separate approval is required for all other operating configurations, including portable configurations with respect to §2.1093 and difference antenna configurations.

16.2 Canada

●Label requirement

Please notice that if the IC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains IC: 27317-VTBMA02" any similar wording that expresses the same meaning may be used.

L'étiquette d'homologation d'un module d'Innovation, Sciences et Développement économique Canada devra être posée sur le produit hôte à un endroit bien en vue, en tout temps. En l'absence d'étiquette, le produit hôte doit porter une étiquette sur laquelle figure le numéro d'homologation du module d'Innovation, Sciences et Développement économique Canada, précédé du mot « contient », ou d'une formulation similaire allant dans le même sens et qui va comme suit :
Contient IC : 27317-VTBMA02 est le numéro d'homologation du module

●Regulatory compliance statement

User manual notice for license-exempt radio apparatus shall contain the following or equivalent notice in a conspicuous location in the user manual, on the device or both

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:
(1) This device may not cause interference.
(2) This device must accept any interference, including interference that may cause undesired operation of the device.
L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :
(1) L'appareil ne doit pas produire de brouillage;
(2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This equipment complies with IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body.
Cet équipement est conforme aux limites d'exposition aux radiations IC CNR-102 établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec une distance minimale de 20 cm entre le radiateur et votre corps. Cet émetteur ne doit pas être colocalisé ou fonctionner en conjonction avec une autre antenne ou un autre émetteur.

This radio transmitter [IC: 27317-VTBMA02] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

a list of all antenna types

PCB Antenna	0.81dBi, 50Ω
Dipole Antenna	0.45dBi, 50Ω

16.3 Europe

This module is a Radio Equipment Directive (RED) assessed radio module that is CE marked and has been manufactured and tested with the intention of being integrated into a final product

This module has been tested to RED 2014/53/EU Essential Requirements for Health and Safety, Electromagnetic Compatibility (EMC), and Radio, which is summarized in the following table

Certification	Standard	Report number	Date
safety			
EMC			
Radio			
Health			

●Label and others requirement

The label on the final product which contains this module must follow CE marking requirement

● Simplified EU Declaration of Conformity

Hereby, Vtech communications ltd, declares that VTBM-A02 model is in compliance with Directive 2014/53/EU.

The end