Maximum Permissible Exposure Report

1. Product Information

FCC ID	2ABRU-MP26R
Applicant's Name	Guangzhou BDE Technology Inc.
Address	B2-403, Chuangyi Building, 162 Science Avenue, Huangpu District, Guangzhou 510663, China
Product name	BDE 2.4GHz Multi-Protocol Wireless Module
Test Model	BDE-MP2652R7A32
Additional Model No.	See model list
Ratings	Input: DC 3.3V
Hardware version	V1
Software version	7.41
Bluetooth	
Frequency Range	2402MHz~2480MHz
Channel Number	40 channels for Bluetooth V5.2 (DTS)
Channel Spacing	2MHz for Bluetooth V5.2 (DTS)
Modulation Type	GFSK for Bluetooth V5.2 (DTS)
Bluetooth Version	V5.2
Antenna Description	For PCB Trace Antenna: Integrated PCB trace antenna, -0.84dBi(Max.) For ANT Pin or U.FL connector: Dipole whip antenna, 3.0dBi(Max.)
Zigbee	
Frequency Range	2405MHz-2480MHz
Channel Spacing	5MHz
Channel Number	16 Channels
Modulation Type	O-QPSK
Antenna Description	For PCB Trace Antenna: Integrated PCB trace antenna, -0.84dBi(Max.) For ANT Pin or U.FL connector: Dipole whip antenna, 3.0dBi(Max.)
Exposure category	General population/uncontrolled environment
EUT Type	Production Unit
Device Type	Mobile Devices
Date of Test	August 14, 2024 ~ February 22, 2025
Date of Report	February 24, 2025

Model list:

Model Number	Orderable Part Number	Chipset	Flash (KB)	SRAM (KB)	Antenna on 2.4G	Operating Temperature (℃)	On-Board SPI Nor Flash Support
BDE-MP26R	BDE-MP2652R7A32	CC2652R7	704	152	PCB Trace Antenna	-40℃ ~85℃	32Mbit
	BDE-MP2652R7U32				U.FL Connector		
	BDE-MP2652R7N32				ANT Pin		
	BDE-MP2652R7A0				PCB Trace Antenna		Not Included
	BDE-MP2652R7U0				U.FL Connector		
	BDE-MP2652R7N0				ANT Pin		
	BDE-MP2652R7A32-IN				PCB Trace Antenna	-40℃ ~ 105℃	32Mbit
	BDE-MP2652R7U32-IN				U.FL Connector		
	BDE-MP2652R7N32-IN				ANT Pin		
	BDE-MP2652R7A0-IN				PCB Trace Antenna		Not Included
	BDE-MP2652R7U0-IN				U.FL Connector		
	BDE-MP2652R7N0-IN				ANT Pin		
	BDE-MP2674R10A32	CC2674R10	1024	296	PCB Trace Antenna	-40℃ ~85℃	32Mbit
	BDE-MP2674R10U32				U.FL Connector		
	BDE-MP2674R10N32				ANT Pin		
	BDE-MP2674R10A0				PCB Trace Antenna		Not Included
	BDE-MP2674R10U0				U.FL Connector		
	BDE-MP2674R10N0				ANT Pin		
	BDE-MP2674R10A32-IN				PCB Trace Antenna	-40℃ ~ 105℃	32Mbit
	BDE-MP2674R10U32-IN				U.FL Connector		
	BDE-MP2674R10N32-IN				ANT Pin		
	BDE-MP2674R10A0-IN				PCB Trace Antenna		Not Included
	BDE-MP2674R10U0-IN				U.FL Connector		
	BDE-MP2674R10N0-IN				ANT Pin		
	BDE-MP2651R3A32	CC2651R3	352	40	PCB Trace Antenna	-40℃ ~85℃	32Mbit
	BDE-MP2651R3U32				U.FL Connector		
	BDE-MP2651R3N32				ANT Pin		
	BDE-MP2651R3A0				PCB Trace Antenna		Not Included
	BDE-MP2651R3U0				U.FL Connector		
	BDE-MP2651R3N0				ANT Pin		
	BDE-MP2651R3A32-IN				PCB Trace Antenna	-40℃ ~ 105℃	32Mbit
	BDE-MP2651R3U32-IN				U.FL Connector		
	BDE-MP2651R3N32-IN				ANT Pin		
	BDE-MP2651R3A0-IN				PCB Trace Antenna		Not Included
	BDE-MP2651R3U0-IN				U.FL Connector		
	BDE-MP2651R3N0-IN				ANT Pin		
	BDE-MP2652RA32	CC2652R	352	88	PCB Trace Antenna	-40℃ ~85℃	32Mbit
	BDE-MP2652RU32				U.FL Connector		

	BDE-MP2652RN32				ANT Pin		
	BDE-MP2652RA0				PCB Trace Antenna		Not Included
	BDE-MP2652RU0				U.FL Connector		
	BDE-MP2652RN0				ANT Pin		
	BDE-MP2652RA32-IN				PCB Trace Antenna	-40℃ ~ 105℃	32Mbit
	BDE-MP2652RU32-IN				U.FL Connector		
	BDE-MP2652RN32-IN				ANT Pin		
	BDE-MP2652RA0-IN				PCB Trace Antenna		Not Included
	BDE-MP2652RU0-IN				U.FL Connector		
	BDE-MP2652RN0-IN				ANT Pin		
	BDE-MP2642RA32	CC2642R	352	88	PCB Trace Antenna	-40℃ ~ 85℃	32Mbit
	BDE-MP2642RU32				U.FL Connector		
	BDE-MP2642RN32				ANT Pin		
	BDE-MP2642RA0				PCB Trace Antenna		Not Included
	BDE-MP2642RU0				U.FL Connector		
	BDE-MP2642RN0				ANT Pin		
	BDE-MP2642RA32-IN				PCB Trace Antenna	-40℃ ~ 105℃	32Mbit
	BDE-MP2642RU32-IN				U.FL Connector		
	BDE-MP2642RN32-IN				ANT Pin		
	BDE-MP2642RA0-IN				PCB Trace Antenna		Not Included
	BDE-MP2642RU0-IN				U.FL Connector		
	BDE-MP2642RN0-IN				ANT Pin		

Identities and differences:

The above models have same PCB board and structure, The differences between the above models mainly lie in the main chip model(note: only the Flash and SRAM sizes are different between the main chip models), antenna interface location, antenna type, operating temperature, and whether an external 32Mbit SPI Flash is configured.With the consideration of the identities and differences list above, BDE-MP2652R7A32 is fully tested, at radiated emission test item, we choose BDE-MP2652R7N32 and BDE-MP2652R7U32 for differences test.

2. Evaluation Method and Limit

Systems operating under the provisions of FCC 47 CFR section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.
In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.
In accordance with KDB447498D01 for Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modelled or measured field strengths or power density, is ≤ 1.0. The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

3. Refer Evaluation Method

3. 1 Refer Evaluation Method

ANSI C95.1–2019: IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz
FCC KDB publication 447498 D01 General 1 RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.
FCC CFR 47 part1 1.1310: Radiofrequency radiation exposure limits.
FCC CFR 47 part2 2.1091: Radiofrequency radiation exposure evaluation: mobile devices.

3. 2 Limit

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	6
3.0 – 30	1842/f	4.89/f	($900/f^2$)*	6
30 – 300	61.4	0.163	1.0	6
300 – 1500	/	/	f/300	6
1500 – 100,000	/	/	5	6

Limits for Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for Occupational/Uncontrolled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 30	824/f	2.19/f	($180/f^2$)*	30
30 – 300	27.5	0.073	0.2	30
300 – 1500	/	/	f/1500	30
1500 – 100,000	/	/	1.0	30

F=frequency in MHz
*=Plane-wave equivalent power density

3.3 Description of Test Facility

NVLAP Accreditation Code is 600167-0.

FCC Designation Number is CN5024.

CAB identifier is CN0071.

CNAS Registration Number is L4595.

ISED Designation Number is 9642A.

4. MPE Calculation Method

Predication of MPE limit at a given distance
Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S=power density
P=power input to antenna
G=power gain of the antenna in the direction of interest relative to an isotropic radiator
R=distance to the center of radiation of the antenna

5. Antenna Information

EUT can only use antennas certificated as follows provided by manufacturer;

Internal/External Identification	Antenna type and antenna number	Operate frequency band	Maximum antenna gain
Internal	PCB trace antenna	2400MHz ~ 2500MHz	-0.84dBi
External	Whip antenna	2400MHz ~ 2500MHz	3.0dBi

6. Conducted Power

[BT LE]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
BLE 1M	0	2402	2.89
	19	2440	2.51
	39	2480	2.22
BLE 2M	0	2404	2.91
	19	2440	2.55
	39	2478	2.27
BLE 125Kbps	0	2402	2.98
	19	2440	2.59
	39	2480	2.27
BLE 500Kbps	0	2404	3.0
	19	2440	2.61
	39	2478	2.28

[Zigbee]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
O-QPSK	0	2405	2.97
	7	2440	2.59
	15	2480	2.26

7. Manufacturing Tolerance

BLE 1M(Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	3.0	3.0	3.0
Tolerance ± (dB)	1.0	1.0	1.0

BLE 2M(Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	3.0	3.0	3
Tolerance ± (dB)	1.0	1.0	1.0

BLE 125Kbps(Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	3.0	3.0	3.0
Tolerance ± (dB)	1.0	1.0	1.0

BLE 500Kbps (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	3.0	3.0	3.0
Tolerance ± (dB)	1.0	1.0	1.0

[Zigbee]

O-QPSK (Peak)			
Channel	Channel 0	Channel 7	Channel 15
Target (dBm)	3.0	3.0	3.0
Tolerance ±(dB)	1.0	1.0	1.0

8. Measurement Results

As declared by the Applicant, the EUT is a wireless device used in a fix application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, r =20cm, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

[BT LE]

Modulation Type	Output power		Max. Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mW				
BLE 1M	3.0	1.9953	3.0	1.9953	0.000792	1.0000
BLE 2M	3.0	1.9953	3.0	1.9953	0.000792	1.0000
BLE 125Kbps	3.0	1.9953	3.0	1.9953	0.000792	1.0000
BLE 500Kbps	3.0	1.9953	3.0	1.9953	0.000792	1.0000

[Zigbee]

Modulation Type	Output power		Max. Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm2)	MPE Limits (mW/cm2)
	dBm	mW				
O-QPSK	3.0	1.9953	3.0	1.9953	0.000792	1.0000

7.2 Simultaneous Transmission MPE

The EUT has one 2.4G band. So no need consider simultaneous transmission. According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations; ∑∑of MPE ratios ≤ 1.0

Simultaneous Transmission				
BT LE band antenna Max. MPE ratios	**Zigbee band antenna Max. MPE ratios**	**∑ MPE ratios**	**Limit**	**Results**
0.000792	0.000792	0.001584	1.0	Pass

Remark:
1. *Output power including tune-up tolerance;*
2. *MPE evaluate is assessed based on the maximum antenna gain value(worst case)*
3. *MPE evaluate distance is 20cm from user manual provide by manufacturer.*

9.Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.

----------THE END OF REPORT----------