

RADIO FREQUENCY EXPOSURE REPORT

FOR THE

**Device: Bluetooth LE Module
Model: MBLE**

Report No.: 96100-24

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The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the sample equipment tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.



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Purpose:

To demonstrate compliance with United States, Canada and/or European Union RF Exposure requirements for Portable equipment (devices used $\leq 20\text{cm}$ from the body) or Mobile equipment (devices used $>20\text{cm}$ from the body) with power output below exemption levels and Mobile equipment, where Maximum Permissible Exposure (MPE) Calculations apply.

United States Compliance Requirements (1.1310):

***RF Exposure Evaluation Limits
Occupational / Controlled Exposure***

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
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	6
300-1500	---	---	f/300	6
1500-100,000	---	---	5.0	6

***RF Exposure Evaluation Limits
General Population / Uncontrolled Exposure***

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	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

* Plane wave equivalent power density

Limit is calculated based on the mid-band frequency used in the operating frequency range.

Exemption Level: Power output $<60/f_{\text{GHz}}$ (mW)

Canadian Compliance Requirements (RSS-102):

**RF Exposure Evaluation Limits
Occupational / Controlled Exposure:**

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (W/m ²)	Averaging Time (minutes)
0.003-1.0	600	4.9	---	6
1.0-10	600/f	4.9/f	---	6
10-30	60	4.9/f	---	6
30-300	60	0.163	10	6
300-1500	3.54 f ^{0.5}	0.0094*f ^{0.5}	f/3	6
1500-15,000	137	0.364	50	6
15,000-150,000	137	0.364	50	616000/f ^{1.2}

**RF Exposure Evaluation Limits
General Population / Uncontrolled Exposure**

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (W/m ²)	Averaging Time (minutes)
0.003-1.0	280	2.19	---	6
1.0-10	280/f	2.19/f	---	6
10-30	28	2.19/f	---	6
30-300	28	0.073	2	6
300-1500	1.585 * f ^{0.5}	0.0042 * f ^{0.5}	f/150	6
1500-15,000	61.4	0.163	10	6
15,000-150,000	61.4	0.163	10	616000/f ^{1.2}

*Power density limit applicable >100MHz

Exemption Level:

Frequency Range (MHz)	Maximum Output Power (Conducted or EIRP)
0.003-1000	≤ 200 mW
1000-2200	≤ 100 mW
2200-3000	≤ 20 mW
3000-6000	≤ 10 mW

European Union Compliance Requirements (ICNIRP):

***RF Exposure Evaluation Limits
Occupational / Controlled Exposure:***

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (W/m²)	Averaging Time (minutes)
0.00082-0.065	610	24.4	---	6
0.065-1.0	610	1.6/f	---	
1.0-10	610/f	1.6/f	---	6
10-400	61	0.16	10	6
400-2000	3.0 * f ^{0.5}	0.008 * f ^{0.5}	f/40	6
2000-300,000	137	0.36	50	6

***RF Exposure Evaluation Limits
General Population / Uncontrolled Exposure***

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (W/m²)	Averaging Time (minutes)
0.003-0.150	87	5.0	---	6
0.150-1.0	87	0.73/f	--	6
1.0-10	87/f ^{0.5}	0.73/f	---	6
10-400	28	0.073	2	6
400-2000	1.375 f ^{0.5}	0.0037*f ^{0.5}	f/200	6
2000-300,000	61	0.16	10	6

**Power density limit applicable >100MHz*

Exemption Level: Power output < 20mW¹

¹ May vary by product type

Device and Antenna Operating Configuration:

Device operating at maximum output power with continuous transmission of modulated data. Measurement performed IAW : KDB 558074 D01 DTS Meas Guidance v03r02 dated June 5, 2014 , Claus : 9.1.1 RBW \geq DTS bandwidth

BLE: 2402-2480MHz.

DL= 716-746MHz, 869-894MHz, 1930-1990 MHz, 2110-2155MHz.
DTS: 5725-3820MHz

Test Procedure:

This equipment is evaluated in accordance with the guidelines set forth in OET Guide 65 & ANSI C95.1 for the US and Health Canada Safety Code 6 & RSS 102 for Canada.

Other Considerations:

None

MPE Calculations

Applicability:

Limit Used	X	General Population / Uncontrolled Exposure
		Occupational / Controlled Exposure
RF Exposure Exemption	NO	United States
	NA	Canada
	NA	Europe

Equipment operational details:

Measurements taken from EMC Test Report(s): R95054 (DTS), R95055 (UNII) 95128-15 (Part 20), 96100-13 (BLE). In operation, the device can maintain a link either with UNII freq band or DTS freq band, from the test reports, the measured power of DTS band is the worst case.

The calculation is based on Power measured from Part 20 report 95128-15, Bluetooth LE test report 96100-13 and DTS band report R95054.

MPE Calculations

	Freq Range	Meas Power (dBm)	Antenna Gain (dBi)	Antenna Type	EIRP (dBm)	EIRP (mW)	US mW/cm²
DL	2110-2155	12.90	2.00	Internal	1.49E+01	30.90	1.00
BLE	2402-2480	-2.98	3.00	Internal	2.00E-02	1.00	1.00
DTS	5725-5820	19.40	6.00	Internal	2.54E+01	346.74	1.00
Total						378.64	
dBm						25.78	

	Freq Range	Meas Power (dBm)	Antenna Gain (dBi)	Antenna Type	EIRP (dBm)	EIRP (mW)	US mW/cm²
DL	1930-1995	9.80	3.00	Internal	1.28E+01	19.05	1.00
BLE	2402-2480	-2.98	3.00	Internal	2.00E-02	1.00	1.00
DTS	5725-5820	19.40	6.00	Internal	2.54E+01	346.74	1.00
Total						366.80	
dBm						25.64	

	Freq Range	Meas Power (dBm)	Antenna Gain (dBi)	Antenna Type	EIRP (dBm)	EIRP (mW)	US mW/cm ²
DL	869-894	10.10	0.00	Internal	1.01E+01	10.23	0.58
BLE	2402-2480	-2.98	3.00	Internal	2.00E-02	1.00	1.00
DTS	5725-5820	19.40	6.00	Internal	2.54E+01	346.74	1.00
Total						357.97	
dBm						25.54	

	Freq Range	Meas Power (dBm)	Antenna Gain (dBi)	Antenna Type	EIRP (dBm)	EIRP (mW)	US mW/cm ²
DL	716-746	10.60	0.00	Internal	1.06E+01	11.48	0.48
BLE	2402-2480	-2.98	3.00	Internal	2.00E-02	1.00	1.00
DTS	5725-5820	19.40	6.00	Internal	2.54E+01	346.74	1.00
Total						359.22	
dBm						25.55	

MPE Calculation:

$$Power\ Density = \frac{EIRP}{4\pi d^2}$$

Given: EIRP in mW or W and d in cm or m

Confi	Freq Range	EIRP	Distance	US	Canada		
#		(mW)	(cm)	mW/cm ²	Limit	W/m ²	Limit
DL/CU	2110-2155	378.64	20.00	0.08	1.00	0.75	10.00
	1930-1995	366.80	20.00	0.07	1.00	0.73	10.00
	869-894	357.97	20.00	0.07	0.58	0.71	10.00
	716-746	359.22	20.00	0.07	0.48	0.71	10.00

No less than
20cm

Summary:**Exemptions:**

In the case the equipment meets compliance requirements by exemption the product is approved for use under mobile or portable conditions without further testing under the condition that any additional collocation or simultaneous transmission requirements (including necessary separation distances) have been met.

MPE Calculation Results:

In the case the equipment meets compliance by MPE Calculations the product is approved for use under mobile conditions without further testing under the condition that any additional collocation or simultaneous transmission requirements (including necessary separation distances) have been met. It is assumed that the manufacturer shall design the equipment such that the minimum separation distance of 20cm (or greater, as listed above) is met or that the manufacturer provides a protection guide (or installation instructions) to the end user such that the antenna(s) may be installed in accordance with the manufacturer's instructions in such a manor to maintain the minimum separation distance.

The Absorption and distribution of Electromagnetic energy in the body is a very complex phenomena that depends on the mass, shape and physiological condition of the body; the orientation of the body with respect to the fields; and, the electrical properties of the body and the environment. Variables that may play a substantial role in possible biological effects are those that characterize the environment (including but not limited to: ambient temperature, air velocity, relative humidity and body insulation); and those that characterize the individual (including but not limited to: age, gender, activity level and existing debilitation or disease). Because innumerable factors may interact to determine specific biological effects of exposure to electromagnetic fields, any protection guide should consider both intended and unintended operational environments and provide guidance for installation and use of the product such that proper separation distances can be maintained. (ANSI C95.1)

References

Federal Communications Commission Knowledge Database (KDB) Publication 447498, "What are the RF exposure requirements and procedures for mobile and portable devices?" As in effect on the issue date of this report.

Federal Communications Commission Bulletin OET 65 Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" June 2001

Title 47 Code of Federal Regulations, Part 1.1310, "Radiofrequency radiation exposure limits." As in effect on the issue date of this report.

Title 47 Code of Federal Regulations, Part 2.1091, "Radiofrequency radiation exposure evaluation: mobile devices." As in effect on the issue date of this report.

Health Canada Safety Code 6 Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz, 2009

Health Canada Safety Code 6 Technical Guide, 2009

Industry Canada RSS-102 Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands) Issue 4, March 2010 (including update December, 2010)

International Commission on Non-Ionizing Radiation Protection. Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz). Health Physics 74 (4): 494-522; 1998.

International Commission on Non-Ionizing Radiation Protection Statement on the "Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz). Health Physics 97(3):257-259; 2009.

European Committee for Electrotechnical Standardization. European Normative, EN 62479 Assessment of the compliance of low power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz) 2002.