

RADIO FREQUENCY EXPOSURE REPORT

FOR THE

Device: 802.15.4 Wireless Mesh Mote
Model: ETERNA1

Report No.: 93690-20

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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

Device and Antenna Operating Configuration:

Device operating at maximum output power with continuous transmission of modulated data.

Antenna gain: not to exceed 6.6 dBi

Modulation: 802.15.4

Firmware power setting = 8dBm

Measurement procedure IAW FCC document KDB558074 D01 DTS Meas Guidance V02, 8.1.1 15.31(e) compliance: the supply voltage was varied between 85% and 115% of the nominal rated supply voltage, the following change in the Fundamental signal level was observed.

	2405MHz			2445 MHz		2475MHz	
3.45V	8.46 dBm	0.0070W	8.68 dBm	0.0074W	8.79dBm	0.0076W	
3.00V	8.03 dBm	0.0063W	8.00 dBm	0.0063W	7.99dBm	0.0063W	
2.55V	6.06 dBm	0.0040W	6.29 dBm	0.0043W	6.35dBm	0.0043W	

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 or Delete "none & Insert specific

MPE Calculations

Applicability:

<i>Limit Used</i>	X	General Population / Uncontrolled Exposure
		Occupational / Controlled Exposure
<i>RF Exposure Exemption</i>	x	United States
	x	Canada

Equipment Operational Details:

<i>Config #</i>	<i>Operating Frequency (MHz)</i>	<i>Measured Output Power (dBm)</i>	<i>Antenna Gain (dBi)</i>	<i>Antenna Type / Configuration</i>	<i>EIRP (dBm)</i>
1	2412-2472	8.79	6.6	Ant1	15.39

Measurements based from EMC Test Report(s): 93690-12

MPE Calculation:

$$Power\ Density = \frac{EIRP}{4\pi d^2} \quad \text{Given: EIRP in mW or W and d in cm or m}$$

<i>Config #</i>	<i>Distance (cm)</i>	<i>US (1.1310)</i>		<i>Canada (RSS-102)</i>	
		<i>Power Density (mW/cm²)</i>	<i>Limit (mW/cm²)</i>	<i>Power Density (W/m²)</i>	<i>Limit (W/m²)</i>
1	20	0.0068	1	0.068	10

Summary:

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)