

BLE RF Evaluation Exclusion Exhibit For:

Carrier/ Bryant (BING)

Prepared by:

Coty Hammerer, EMC Engineer

7/11/17

Contents

Product Description:	3
Associated Antenna(s):	3
Limits:	3
Data and calculations:	5
Summary:	7

Product Description:

The EUT, BING, support for 2.4 GHz WLAN (802.11 b/g/n) and BLE 4.1.

Associated Antenna(s):

The associated antenna is a chip antenna, a WiLink 8 CC1835 with a part # of ANT162442DT-2001A2.

The peak antenna gain of this chip antenna is +2.1 dBi.

The EUT, BING, was evaluated against the requirements and limits of OET Bulletin 65, KDB 447498 as well as RSS-102 Issue 5 and was found to be compliant.

Limits:

A. Mobile (MPE)

OET Bulletin 65 limits for General population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (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

f = frequency in MHz

*Plane-wave equivalent power density

RSS 102 limits for General population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	83	90	-	Instantaneous*
0.1-10	-	0.73/ f	-	6**
1.1-10	87/ $f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ $f^{0.25}$	0.1540/ $f^{0.25}$	8.944/ $f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 $f^{0.3417}$	0.008335 $f^{0.3417}$	0.02619 $f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ $f^{1.2}$
150000-300000	0.158 $f^{0.5}$	4.21 x 10 ⁻⁴ $f^{0.5}$	6.67 x 10 ⁻⁵ f	616000/ $f^{1.2}$
Note: f is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).				

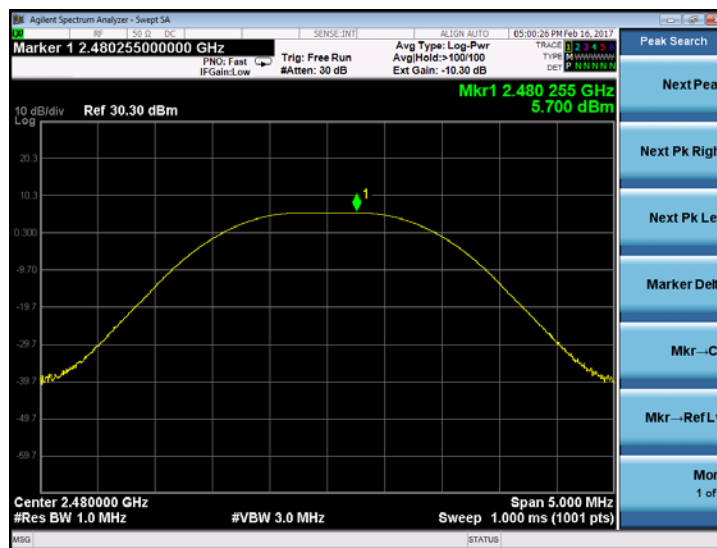
Per RSS 102 issue 5 section 2.5.2, RF exposure evaluation is required if separation distance between the user and/or bystander and the device's radiating element is greater than 20cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $22.48/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

Data and calculations:

Screen Capture of maximum output power

Peak Power



Frequency 2480 MHz; GFSK

A. RF Exposure Exclusion Per MPE Calculation at a prediction Distance of 20 cm

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density

P = power input to the 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

Maximum peak output power at antenna input terminal:	5.70 (dBm)
Maximum peak output power at antenna input terminal:	3.715 (mW)
Antenna gain(typical):	2.1 (dBi)
Maximum antenna gain:	1.622 (numeric)
Prediction distance:	20 (cm)
Prediction frequency:	2480 (MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1 (mW/cm ²)
Power density at prediction frequency:	0.001199 (mW/cm ²)
Maximum allowable antenna gain:	31.3 (dBi)
Margin of Compliance at 20 cm =	29.2 dB

Power Density = 0.0012 mW/cm² = 0.012 W/m²

Therefore 0.0012 mW/cm² is << the limit of 1 mW/cm² from OET Bulletin 65 limits for General population/Uncontrolled Exposure.

B. RF Exposure Exclusion Per RSS 102 Issue 5 Section 2.5.2

- $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;

In this situation f is 2480 MHz. The calculation yields 2.74 Watts the limit.

The max BLE power P_{raw} is 5.7 dBm. Adding the Antenna Gain of 2.1 dBi and a tune-up tolerance of +1.5 = 9.3 dBm for the absolute worst case. This 9.3 dBm equates to 8.51mW.

8.51 mW << than the limit of 2.74 Watts at a minimum separation distance of 20 cm.

Summary:

Based on the calculations above, the EUT, when used in a mobile application complies with SAR test exclusion requirements.