RF Exposure Exhibit

EUT Name: Radio Module

Model Nos.: FBLE

CFR Part 1.1310 and RSS 102

Prepared for:

Fluke Corporation.
6920 Seaway Blvd
Everett, WA 98203 USA
Tel: (425) 446-5626

Prepared by:

TUV Rheinland of North America, Inc.

1279 Quarry Lane
Pleasanton, CA 94566
Tel: (925) 249-9123
Fax: (925) 249-9124
http://www.tuv.com/

Report/Issue Date: October 03, 2013
Report Number: 31362113.001 Appendix A

Contents

1   Test Methodology

In this document, we evaluate the RF Exposure to human body due the intentional transmission from the transmitter (EUT). The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

1.1   RF Exposure Limit

According to FCC 1.1310 table 1: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm$_2$)	Average Time (minutes)
(A)Limits For Occupational / Control Exposures				
0.3-1.34	614	1.63	*(100)	6
1.34-30	1842/f	4.89/f	*(900/f²)	6
30-300	61.4	0.163	1.0	6
30-1500	…	…	F/300	6
1500-100000	…	…	1.0	6
(B)Limits For General Population / Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f²)	30
30-300	27.5	0.073	0.2	30
30-1500	…	…	F(MHz)/1500MHz	30
1500-100000	…	…	1.0	30

F = Frequency in MHz

*=Plane wave equivalent density

1.2   EUT Operating Condition

This module is normally installed inside Fluke devices. The antenna used is a 2.45GHz Ceramic Chip Antenna with a peak gain of 3.0dBi. The antenna of this device is integral part of the PCB. The output power of the device is less than 1mwatt. RF exposure is evaluated in this report. EUT can be installed in portable as mobile or fixed devices. EUT is installed in hosts which are hand held, will not be installed in devices held to ear or in-front of face.

1.3   SAR requirements and justification FCC

1.3.1   Antenna Gain

The antenna used is a 2.45GHz Ceramic Chip Antenna with a peak gain of 3.0dBi.

1.3.2   Portable configuration

Transmitter in Wi-Fi band transmitter with EIRP less than 25mWatts is excluded from SAR testing as per guide lines given appendix A of KDB 447498 D01 General 1 RF Exposure Guidance v05r01 dated 05/18/2013. The devices at distance shown below are exempted from the SAR.

Appendix A of KDB 447498

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50mm

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation

Distances are illustrated in the following Table.

MHz	5	10	15	20	25	mm
150	39	77	116	155	194	SAR Test Exclusion Threshold (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	

Note: 10-g Extremity SAR Test Exclusion Power Thresholds are 2.5 times higher than the 1-g SAR Test Exclusion Thresholds indicated above. These thresholds do not apply, by extrapolation or other means, to occupational exposure limits.

SAR does not apply as FBLE EIRP 1.53mWatts much less than the limit.

Using the equation

> *100 MHz – 6GHz with a test separation distance of ≤50 mm*
> *– [(max. power of channel, including tolerance, mW)/(min. test separation*
> *distance, mm)]*[√f(GHz)] ≤3.0 for 1g and ≤7.5 for 10g SAR*
> *– Use 5 mm for equation if distance is <5 mm*

1.53/5 *(√2.45) = 0.1999

This is much less than the limit   0.3 for 1g   SAR

Less than limit   7.5 for 10g SAR

EUT does not require SAR test.

1.4   SAR requirements and justification Industry Canada

As per IEEE publication 1528-2013 (adopted by Industry Canada by NOTICE 2013-DRS0911) are given below.

Exemption Limits for Routine Evaluation – SAR Evaluation

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.

Table 1: SAR evaluation – exemption limits for routine evaluation based on frequency and separation distance[1].

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

SAR does not apply as FBLE EIRP 1.53mWatts much less than the limit.

1.5   MPE calculation

1.5.1   Mobile & Fixed Configuration

1.5.2   Calculations for this report are based on highest permitted power.

Band MHz	Mode	Output Power dBm	Antenna gain (Max)	EIRP/ERP		Channels Available	Channels used	Total EIRP	
				dBm	W			W	dBm
							1		
2400-2483.5	Blue-tooth Low power	-1.15	3.0	1.85	0.00153 (1.53) mWatts	1		0.0015	1.85
Total								0.0015	1.85

Highest EIRP possible is 1.85dBm

The highest measured power is +1.85dBm or 0.00153W.

Using the Friss transmission formula, the EIRP is Pout*G, and R is 20cm.

Pd= EIRP/(1600π)

Pd = (1.53) / (1600π) =   0.000304 mW/cm2, which is well below the limit.

Limit at 2440MHz permissible power density 1.0 mW/cm^2

1.5.3   Sample Calculation

The Friss transmission formula: $Pd = (Pout*G) / (4*\pi*R^2)$

Where;
Pd = power density in mW/cm2
Pout = output power to antenna in mW
G = gain of antenna in linear scale
$\pi \approx 3.1416$
R = distance between observation point and center of the radiator in cm

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition, Page 640, Eq. (11-133).