RF Exposure Exhibit

EUT Name: Campfire BT Yoke

Model No.: 4000

CFR Part 1.1310 and RSS 102 Iss. 5 March 2015

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Report/Issue Date: 5/20/2019
Job # 0000162485
Report Number: 31950605.001

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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	*($900/f^2$)	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	*($180/f^2$)	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

According to RSS-102 Issue 5: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation

RF FIELD STRENGTH LIMITS FOR DEVICES USED BY THE GENERAL PUBLIC (UNCONTROLLED ENVIRONMENT)

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	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

1.2 EUT Operating Condition

The software provided by Manufacturer enabled the EUT to transmit data at lowest, middle and highest channel individually.

The Campfire BT Yoke model nr. 4000, is a Bluetooth Module with an x.fl antenna pcb port, tested with a manufacturer supplied x.fl whip antenna

1.3 MPE calculation

1.3.1 Antenna Gain

The antenna used is 3 dBi / 2.0 (numeric).

1.3.2 Conducted Output Power

The highest transmission power of the 2.4 GHz BT BLE radio as referenced in TUV Test Report 31950605.001, shows an maximum conducted output power of: -1.0 dBm (0.794 mW)

The maximum declared output power is -0.91dBm conducted output power and maximum EIRP of 2.09 dBm.

Note: Measurement executed via peak detector. EUT Duty cycle of 86 % represents maximum duty cycle of the device technology. Following calculations based on 100% DC weighting.

1.3.3 2.4 GHz Output Power into Antenna & RF Exposure value at distance 20cm

Calculations for this report are based on highest power measurement**.**

l (including cal factors) Measurment:		-1.00	dBm
	The Gain of the antenna:	3.00	dBi
	Type of Measurment:	Conducted	Direct me
	Impedance:	50.00	**Ω**
	Measureing Distance:	3.00	m
	Time weighted Duty Cycle:	100.00	%
	The Power Out would be:	0.000794328	Watts
	or:	0.79433	mW
	or:	794.33	µW
	or:	-1.00	dBm
Frequency range from 10 MHz to 40 GHz:			
	Frequency:	2480	GHz
Power output with DC and antenna Gain (EiRP):			
	Power (dBm):	2.09	
	Power (mW):	1.618	
	Power (W):	0.001618	
	R = distance in	20	cm

Note: Maximum declared output power = 2.09 dBm EIRP

FCC:		
Controlled Exposures - Limit =	5	mW/cm^2
Uncontrolled Exposures - Limit =	1	mW/cm^2
Pd =	0.0003219	mW/cm^2
Controlled Margin to Limit =	4.9997	mW/cm^2
Uncontrolled Margin to Limit =	0.9997	mW/cm^2
* = Plane-wave equivalent power density		
IC:		
Controlled Exposures to Limit =	50	W/m^2
Uncontrolled Exposures Limit =	10	W/m^2
Pd =	0.003219	W/m^2
Controlled Margin to Limit =	49.9968	W/m^2
Uncontrolled Margin to Limit =	9.9968	W/m^2

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

1.3.4 Sample Calculation

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

Where;

Pd = power density in mW/cm^2
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).