RF Exposure Exhibit

EUT Name: Radio Module

Model No.: FWCS

CFR 47 Part 1.1310 and RSS 102

Prepared for:

Joseph E. Swanzy
Fluke Corporation
6920 Seaway Blvd
Everett, WA 98206 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: August 24, 2012
Report Number: 31261836.003 Appendix A

Contents

1 Test Methodology

In this document, we try to prove the safety of radiation harmfulness to the human body for our product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. The Gain of the antenna used in this product is measured in a Semi-Anechoic Chamber, and also the maximum total power input to the antenna is measured. 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				
300 - 1500	…	…	F/300	6
1500 - 100,000	…	…	5	6
(B)Limits For General Population / Uncontrolled Exposure				
300 - 1500	…	…	F/1500	6
1500 - 100,000	…	…	1.0	30

F = Frequency in MHz

1.2 EUT Operating Condition

The software provided by Manufacturer enabled the EUT to transmit data at lowest, middle and highest channel individually. Software provided enables to transmit on multi channels simultaneously.

1.2.1 Classification

The antenna of the product, under normal use condition, is at least 20cm away from the body of the user. Warning statement to the user for keeping at least 20cm or more separation distance with the antenna should be included in user's manual. So, this device is classified as a portable device.

1.3 Test Results

1.3.1.1 Antenna Gain

The transmitting antenna was integrated. The antenna gain was +3.0 dBi

Output Power into Antenna & RF Exposure value at distance 20cm:

Calculations for this report are based on highest power measurement.

Limit for MPE (from FCC part 1.1310 table1) is 1.0 mW/cm^2

Band	Mode	Output Power dBm	Antenna gain (Max)	EIRP		Channels Available	Channels Used	Total EIRP	
				dBm	W			W	dBm
2400 - 2483.5	CCK	1.79	3.0	4.79	3.01	11	1	3.01	4.79
						Totals:		3.01	4.79

The highest measured power is +1.79 dBm.

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

Pd= EIRP/(1600π)

Pd = (3.01) / (1600π) = 0.00056mW/cm2,

which is below to the limit.

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

Calculating the distance at which Power density equals the limit

Calculation uses the free space transmission formula:

$$S = (PG)/(4\pi d^2)$$

Where: S is power density (W/m^2), P is output power (W), G is antenna gain relative to isotropic, d is separation distance from the transmitting antenna (m).

d = Sqroot (PG/4π) d in Cm when PG in mW/cm^2 Limit extended to 2.4 GHz permissible power density 1.0 mW/cm^2

d = Sqroot 3.01/4π0.2

D= 1.19 cms or d = 0.0012 meters

Calculating the distance at which power density equals to the limit.

1.3.2 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).