

RF Exposure Exhibit

Project Number: 4278380

Report Number: 4278380EMC05

Revision Level: 0

Client: Persistent Systems

Equipment Under Test: Upper C Band Radios

Model Name: RF-5100

FCC ID: 2AG3J-RF5100

Applicable Standards: 47 C.F.R. §§ 2.1091 and 2.1093; FCC KDB 447498

FCC OET Bulletin 65 Supplement

Remarks: This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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1 References

- 1) FCC CFR Part 1 (1.1307 & 1.1310), Part 2 (2.1091)
- 2) RSS-102: Issue5 clause 2.5.2
- 3) ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)
- 4) Council Recommendation 1999/519/EC of 12 July 1999 on the limitations of exposure of general public to electromagnetic fields
- 5) Council Recommendation 2004/40/EC of 29 April 2004 on the limitations of exposure of workers to electromagnetic fields
- 6) AS/NZS 2772.1 Radiofrequency fields, Part 1: Maximum exposure limits - 3 kHz to 300 GHz

1.1 ***Modifications Required for Compliance***

None

2 General Information

2.1 Client Information

Name: Persistent Systems, LLC
Address: 303 Fifth Avenue, Suite 306
City, State, Zip, Country: New York, NY 10016

2.1 Test Laboratory

Name: SGS North America, Inc.
Address: 620 Old Peachtree Road NW, Suite 100
City, State, Zip, Country: Suwanee, GA 30024, USA

Accrediting Body: A2LA
Type of lab: Testing Laboratory
Certificate Number: 3212.01

2.2 General Information of EUT

Type of Product: Upper C Band Radio
Model Number: RF-5100
Serial Number: B-3416-4536

Frequency Range: 5150 to 5250 MHz and 5725 to 5850 MHz
Data Modes: 802.11a, 802.11n (HT20)
Antenna: External/Detachable, 3x3 MIMO, 3.5dBi Gain

Rated Voltage: 10.8Vdc 73Wh
Test Voltage: 10.8Vdc 73Wh

Sample Received Date: 20 February 2018
Date of testing: 4-6 April and 20 April 2018

3 RF Exposure

3.1 Introduction

This generic standard applies to low power electronic and electrical apparatus for which no dedicated product – or product family standard regarding human exposure to electromagnetic fields applies. The frequency range covered is 10 MHz to 300 GHz.

The object of this standard is to demonstrate the compliance of such apparatus with the basic restrictions on exposure of the general public to electric, magnetic and electromagnetic fields and contact current.

All electromagnetic fields

If the average power emitted by the apparatus operating in the frequency range 10 MHz to 300 GHz is less than or equal to 20 mW the apparatus is deemed to comply with the basic restrictions without testing.

Averaging time is 6 minutes in the frequency range 10 MHz to 10 GHz. The average time is equal to $68/f^{1.05}$ minutes (where f is in GHz) in the frequency range 10 GHz to 300 GHz.

If the total supply power or the input power to the circuitry producing the greatest emissions in the device is less than or equal to 20 mW then it is assumed that the emitted power is less than 20 mW.

Pulse modulated electromagnetic fields with pulse duration less than 30 micro seconds. For pulse of duration less than 30 microseconds at frequencies between 300 MHz and 10 GHz, there is also a basic restriction on SA. This is 2mJ kg^{-1} in any 10g of tissue in the head. For most pulses, the SAR restriction will be more stringent, but for pulses with a repetition frequency of less than 100 Hz, the SA restriction will predominate. For devices producing pulses with repetition rates below 100 Hz, the average power should be less than $20 \times \text{prf mW}$ (prf in Hz).

Calculations are made using the following equation:

$$P_d = \frac{P_t G_t}{4\pi r^2}$$

Where

P_d = Power Density (W/m^2)

P_t = Power Transmitted (W)

G_t = Gain of Transmitting antenna

r = Distance from Antenna (meters)

3.2 Reference Levels

CFR 47 Part 1.1310

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
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	1.0	6
300-1,500			f/300	6
1,500-100,000			5	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
300-1,500			f/1500	30
1,500-100,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

RSS-102:issue 5, 2.5.2 Exemption Limits for Routine Evaluation — RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, 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 $1.31 \times 10^{-2} \times f^{0.6834}$ 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).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

3.3 Exposure calculations

As per RF report, the maximum power of the EUT is indicated below:

DUT Frequency	Peak Power, dBm	Peak Power, mW	Note
5150-5250 MHz	17.4		Conducted power, not including antenna gain
5725-5850 MHz	30	1000	Conducted power, not including antenna gain

3.4 FCC calculations – UNII Band 1 (Correlated)

EUT Operating Band (MHz):	5150-5250	5150-5250	5150-5250	
Correlated data?:	Yes	Yes	Yes	↓ Units
Average Power at the antenna:	12.7	14.5	17.4	dBm
Average Power at the antenna:	0.02	0.03	0.06	Watts
Antenna gain:	3.5	3.5	3.5	dBi
Tx Chains:	3	2	1	
MIMO Array gain:	4.8	3.0	0.0	dB
Effective antenna gain:	8.3	6.5	3.5	dBi
Distance of interest:	7	7	7	cm
Frequency of operation:	5180	5240	5220	MHz

Estimated RF Power Density:	2.0404	2.0494	2.0211	W/m²
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Results for Uncontrolled Environment				Units
Limit of Maximum Permissible Exposure (MPE)	10	10	10	W/m ²
Distance to Compliance From Centre of Antenna	3.16	3.17	3.15	Inches
	1.24	1.25	1.24	cm
In Compliance at distance of interest?	Yes	Yes	Yes	

3.5 FCC calculations – UNII Band 1 (Un-correlated)

EUT Operating Band (MHz):	5150-5250	5150-5250	5150-5250	
Correlated data?:	Yes	Yes	Yes	↓ Units
Average Power at the antenna:	12.7	14.5	17.4	dBm
Average Power at the antenna:	0.02	0.03	0.06	Watts
Antenna gain:	3.5	3.5	3.5	dBi
Tx Chains:	3	2	1	
MIMO Array gain:	4.8	3.0	0.0	dB
Effective antenna gain:	8.3	6.5	3.5	dBi
Distance of interest:	7	7	7	cm
Frequency of operation:	5180	5240	5220	MHz

Estimated RF Power Density:	2.0404	2.0494	2.0211	W/m^2
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Results for Uncontrolled Environment				Units
Limit of Maximum Permissible Exposure (MPE)	10	10	10	W/m^2
Distance to Compliance From Centre of Antenna	3.16	3.17	3.15	Inches
	1.24	1.25	1.24	cm
In Compliance at distance of interest?	Yes	Yes	Yes	

3.6 FCC calculations – UNII Band 3 (Correlated)

EUT Operating Band (MHz):	5725-5850	5725-5850	5725-5850	
Correlated data?:	Yes	Yes	Yes	↓ Units
Average Power at the antenna:	27.7	29.5	29.9	dBm
Average Power at the antenna:	0.58	0.88	0.98	Watts
Antenna gain:	3.5	3.5	3.5	dBi
Tx Chains:	3	2	1	
MIMO Array gain:	4.8	3.0	0.0	dB
Effective antenna gain:	8.3	6.5	3.5	dBi
Distance of interest:	20	20	20	cm
Frequency of operation:	5875	5825	5825	MHz

Estimated RF Power Density:	7.7777	7.8661	4.3524	W/m^2
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Results for Uncontrolled Environment				↓ Units
Limit of Maximum Permissible Exposure (MPE)	10	10	10	W/m^2
Distance to Compliance From Centre of Antenna	17.64	17.74	13.19	cm
	6.94	6.98	5.19	Inches
In Compliance at distance of interest?	Yes	Yes	Yes	

3.7 FCC calculations – UNII Band 3 (Un-correlated)

EUT Operating Band (MHz):	5725-5850	5725-5850	5725-5850	
Correlated data?:	No	No	No	↓ Units
Average Power at the antenna:	29.6	29.8	29.8	dBm
Average Power at the antenna:	0.92	0.96	0.95	Watts
Antenna gain:	3.5	3.5	3.5	dBi
Tx Chains:	3	2	1	
MIMO Array gain:	0.0	0.0	0.0	dB
Effective antenna gain:	3.5	3.5	3.5	dBi
Distance of interest:	20	20	20	cm
Frequency of operation:	5825	5785	5785	MHz

Estimated RF Power Density:	4.0807	4.2631	4.2533	W/m^2
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Results for Uncontrolled Environment				↓ Units
Limit of Maximum Permissible Exposure (MPE)	10	10	10	W/m^2
Distance to Compliance From Centre of Antenna	12.78	13.06	13.04	cm
	5.03	5.14	5.14	Inches
In Compliance at distance of interest?	Yes	Yes	Yes	

4 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	13 August 2018