EMC Test Report

Project Number: 3677409

Report Number: 3677409EMC02 **Revision Level:** 0

Client: Persistent Systems, LLC.

Equipment Under Test: 5GHz Wireless Module

Model Number: XR5

Applicable Standards: FCC Part 15 Subpart C, § 15.247
RSS-210, Issue 8, December 2010
ANSI C63.10: 2009

Report issued on: 21 April 2015

Test Result: Compliant

Tested by: Jeremy O. Pickens, Senior EMC Engineer

Reviewed by: David Schramm, EMC/RF/SAR/HAC Manager

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 Summary of Test Results

Test Description	Test Specification		Test Result
6dB Bandwidth	15.247(a)(2)	RSS-210 A8.2(a)	Compliant
Peak Power Output	15.247(b)(1)	RSS-210 A8.4(4)	Compliant
Conducted Spurious Emissions	15.247(d)	RSS-210 A8.5	Compliant
Band Edge	15.247(d)	RSS-210 A8.5	Compliant
Radiated Spurious Emissions	15.247(d)	RSS-210 A8.5	Compliant
Spectral Density	15.247(e)	RSS-210 A8.2(b)	Compliant

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

2.2 *Test Laboratory*

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

2.3 *General Information of EUT*

Tyoe of Product:	5GHz Wireless Module
Model:	XR5
Serial Number:	00156D6A9AE1
FCC ID:	SWX-XR5
Frequency Range:	5725 to 5850 MHz
Data Modes:	802.11a
Antenna:	9.1dBi Omni-directional, Model: WR-ANT-026
Rated Voltage:	48Vdc (PoE) to interface board
Sample Received Date:	02 February 2015
Dates of testing:	19 February - 12 March 2015

Operating Modes and Conditions

Modulations used: For fundamental and spurious measurements, the EUT was configured to operate continuously with Wi-Fi modulation enabled.

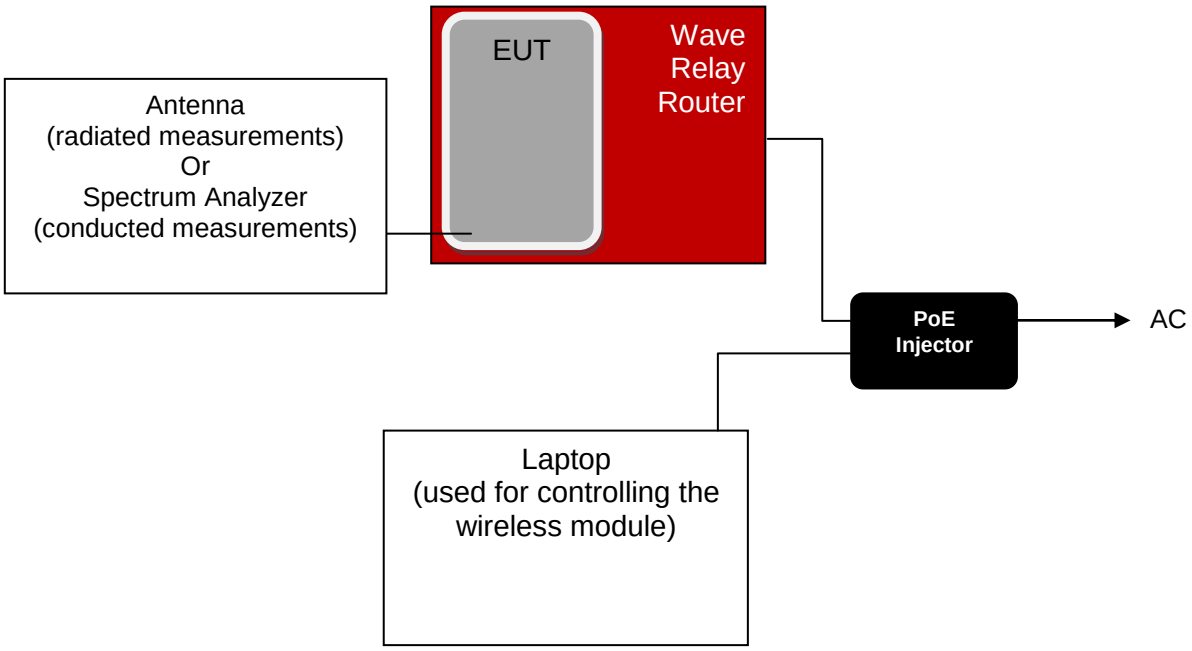
As specified in Section 5.10.5 of ANSI C63.10:2009:

- The software allowed configuration and operation on all available unlicensed wireless device channels.
- The software allowed configuration and operation using all available modulations and data rates
- The software allowed configuration and operation on all available power out levels

For 802.11a, measurements were recorded at 6 and 24Mbps. At data rates over 24Mbps, the output power rolled off.

Note: RF Conducted Measurements were recorded at the end of the shortest cable supplied by the manufacturer for use between the wireless module and an antenna. Effectively, the EUT was directly connected to the spectrum analyzer or attenuator.

2.4 *EUT Connection Block Diagram*



2.5 *System Configurations*

Device reference	Manufacturer	Description	Model Number	Serial Number
A	Ubiquiti Networks	EUT	XR5	00156D6A9AE1
B	Persistent Systems, LLC	Wave Relay Router	MANET	619241
C	Persistent Systems, LLC	PoE Injector	WR-PWR-48V-60W	000027

3 6dB Bandwidth

3.1 *Test Result*

Test Description	Test Specification		Test Result
6dB Bandwidth	15.247(a)(2)	RSS-210 A8.2(a)	Compliant

3.2 *Test Method*

The procedures from ANSI C63.10 (2009) clause 6.9 were used to determine the 6 dB bandwidth.

3.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions
Temperature: 22.4 °C
Relative Humidity: 30.1 %

3.4 *Test Equipment*

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	28-Aug-2015

Note: The calibration period equipment is 1 year.

3.5 *Test Data*

Modulation	Channel	Data Rate (Mbps)	6dB Bandwidth (MHz)
802.11a	149	6	17.1
	157	6	17.1
	165	6	17.0
	149	24	16.9
	157	24	16.8
	165	24	16.7

4 Peak Output Power

4.1 *Test Result*

Test Description	Test Specification		Test Result
Peak Power Output	15.247(b)(1)	RSS-210 A8.4(4)	Compliant

4.2 *Test Method*

The test data was measured using a spectrum analyzer.

Method Used: FCC KDB "558074 D01 DTS Meas Guidance v03r02", Clause 9.2.2.2.

Limit
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

4.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions
Temperature: 22.4 °C
Relative Humidity: 30.1 %

4.4 *Test Equipment*

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	28-Jul-2015
10DB ATTENUATOR	10DB	UNKNOWN	B095594	7-Aug-2015

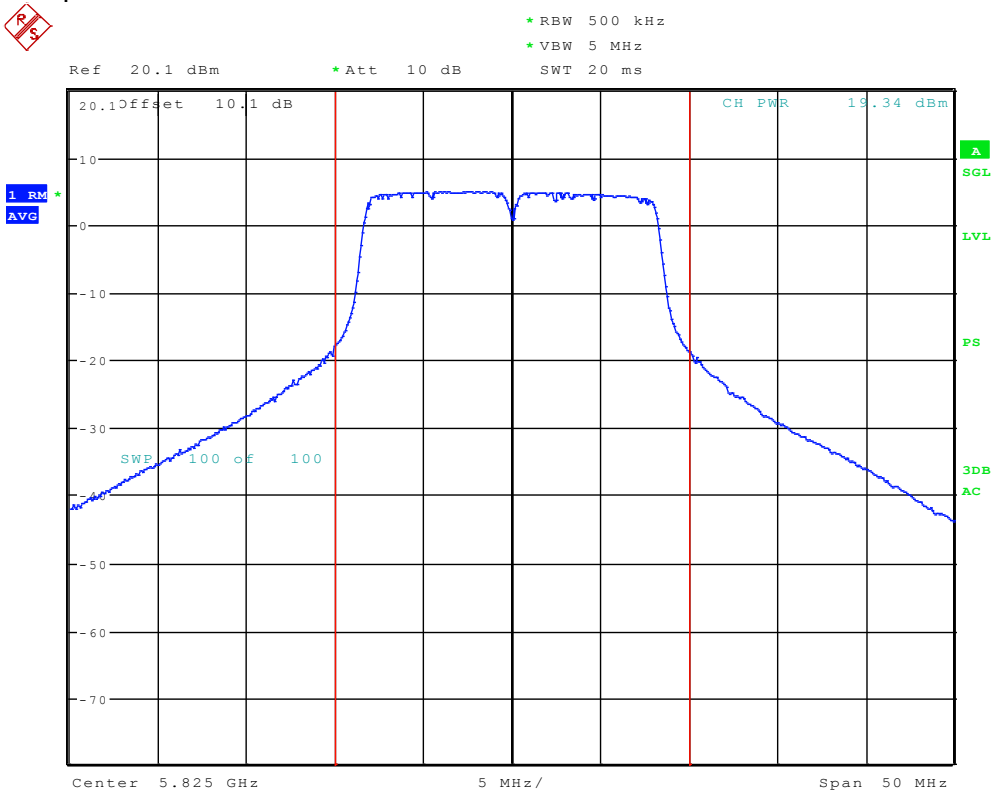
Note: The calibration period equipment is 1 year.

4.5 *Test Data*

Protocol	Channel	Data Rate	Power, dBm
802.11a	149	6	18.39
802.11a	149	24	18.34
802.11a	157	6	18.39
802.11a	157	24	18.50
802.11a	165	6	19.34
802.11a	165	24	19.44

At data rates over 24Mbps, the output power rolled off.

Sample Plot:



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5 Conducted Spurious Emissions

5.1 *Test Result*

Test Description	Test Specification		Test Result
Conducted Spurious Emissions	15.247(d)	RSS-210 A8.5	Compliant

5.2 *Test Method*

The test data was measured using a spectrum analyzer with

- Peak detector, max hold
- Resolution bandwidth of at least 100 kHz
- Video bandwidth at least 3x RBW
- Frequency range: 30 MHz to 25 GHz

Using a 24Mbps data rate was determined to be the worst-case

The limit is 20 dB below the measured peak power.

5.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.1 °C
Relative Humidity: 30.5 %

5.4 *Test Equipment*

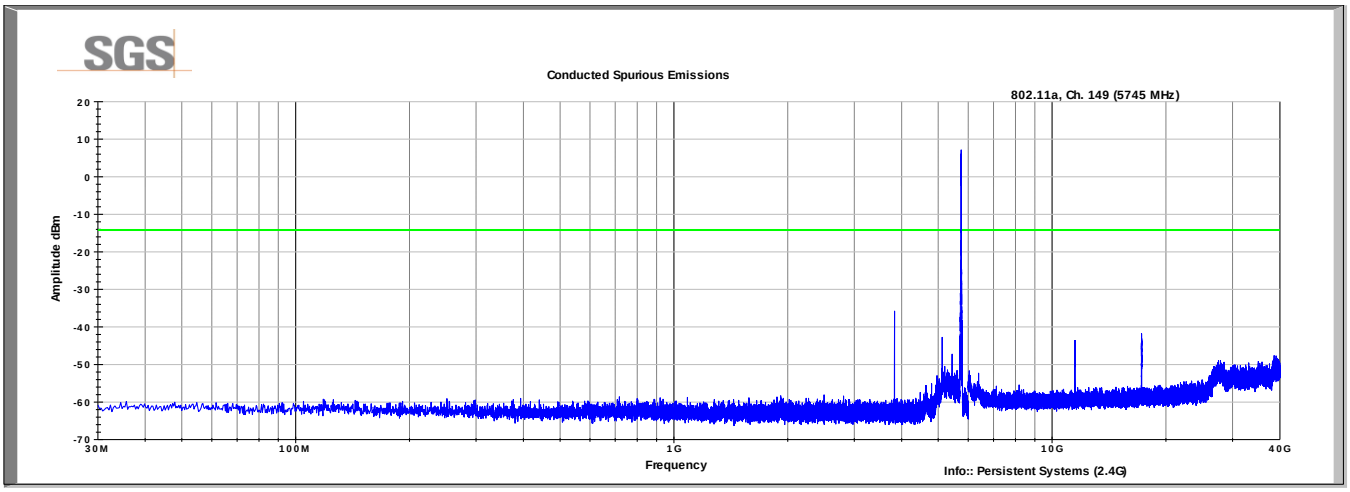
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	28-Jul-2015
10DB ATTENUATOR	10DB	UNKNOWN	B095594	7-Aug-2015

Note: The calibration period equipment is 1 year.

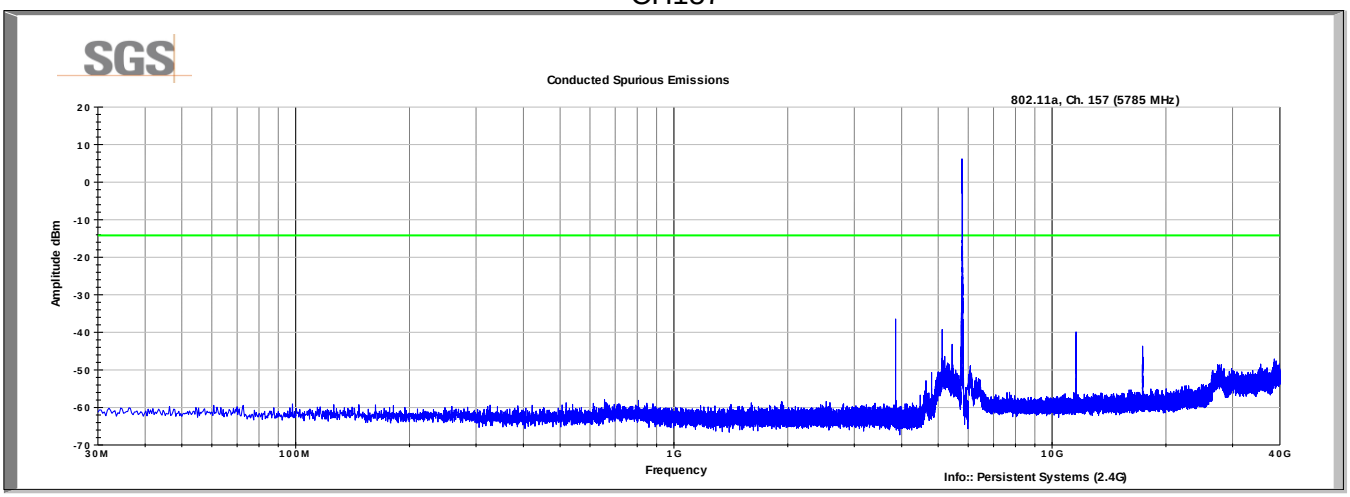
5.5 *Test Data*

802.11a

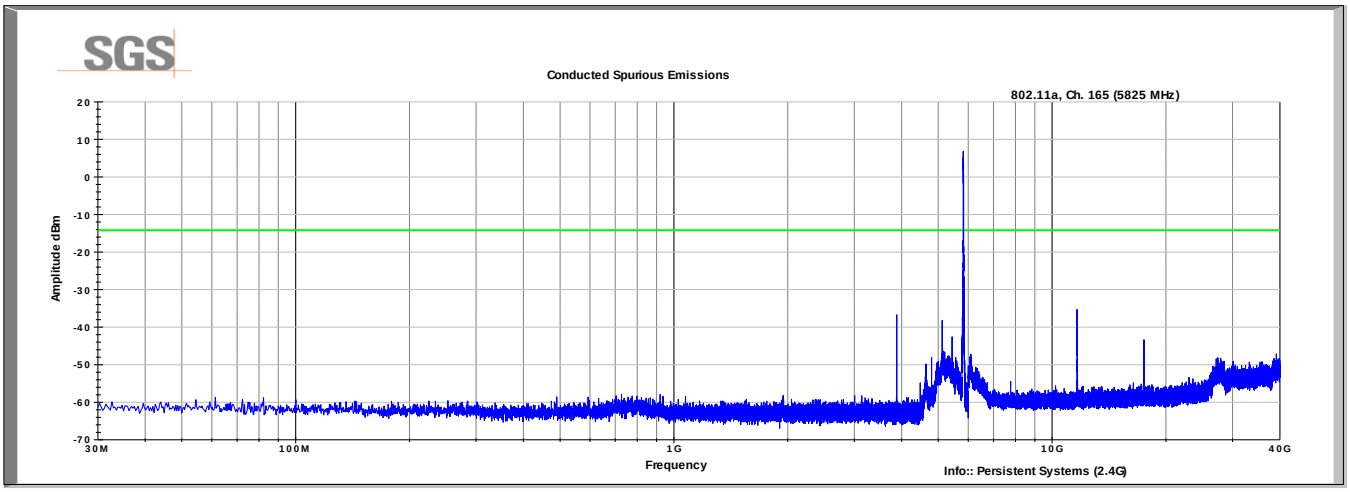
CH149



CH157

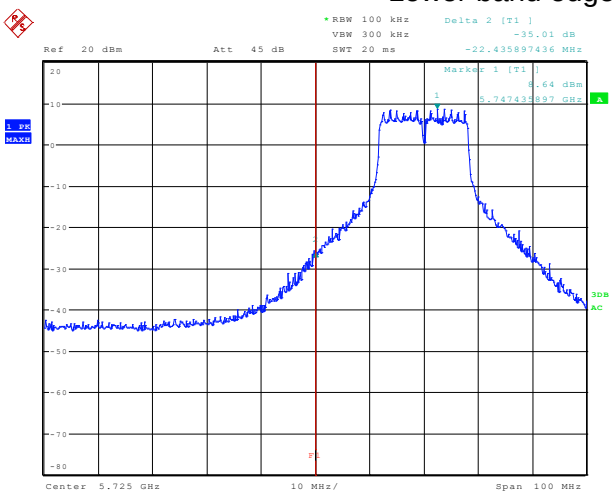


CH165



802.11a

Lower band edge / Upper band edge



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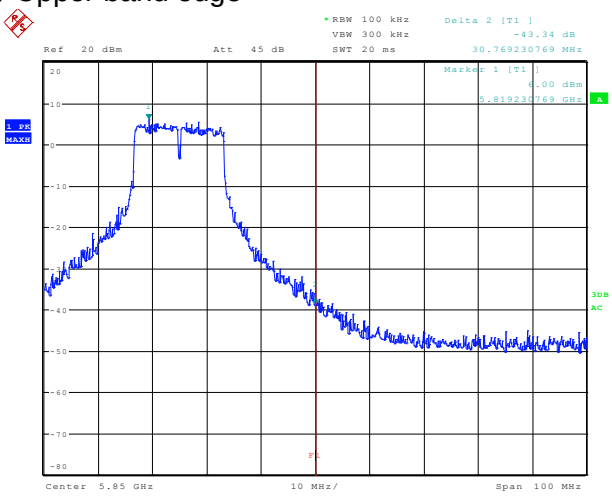

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6 Power Spectral Density

6.1 *Test Result*

Test Description	Test Specification		Test Result
Power Spectral Density	15.247(e)	RSS-210 A8.2(b)	Compliant

6.2 *Test Method*

- RMS detector, trace averaging over 100 sweeps
- Resolution bandwidth of 100 kHz
- Video bandwidth > 300 kHz

The limit is +8 dBm.

6.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.4 °C
Relative Humidity: 30.1 %

6.4 *Test Equipment*

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	28-Jul-2015
10DB ATTENUATOR	10DB	UNKNOWN	B095594	7-Aug-2015

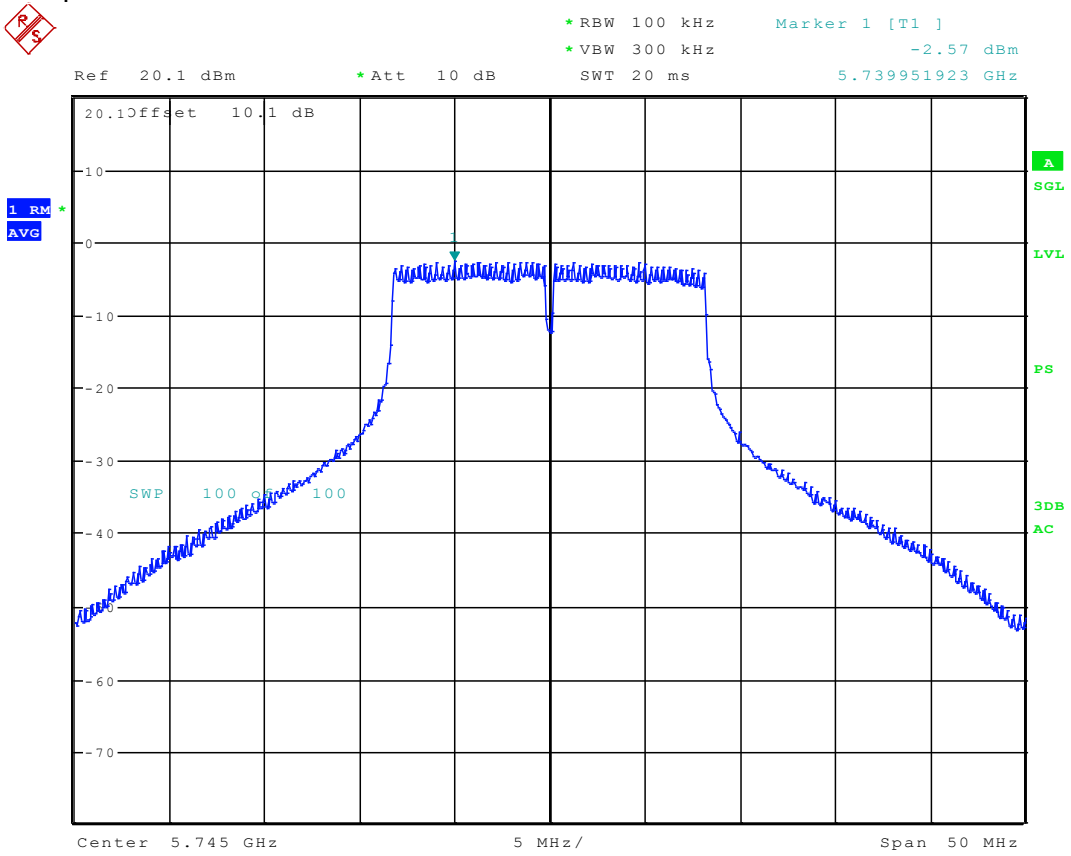
Note: The calibration period equipment is 1 year.

6.5 *Test Data*

Protocol	Channel	Data Rate	PSD, dBm
802.11a	149	6	-2.57
802.11a	149	24	-1.66
802.11a	157	6	-2.26
802.11a	157	24	-1.91
802.11a	165	6	-1.51
802.11a	165	24	-0.84

At data rates over 24Mbps, the output power rolled off.

Sample Plot:



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7 Field Strength of Spurious Radiation

7.1 *Test Result*

Test Description	Test Specification		Test Result
Radiated Spurious Emissions	15.247(d)	RSS-210 A8.5	Compliant

7.2 *Test Method*

Exploratory scans were performed over the frequency range as indicated in the tables below using the max hold function and incorporating a Peak detector and using TILE! software. The final test data was measured using a Quasi-Peak detector below 1GHz and a Peak detector above 1GHz. For harmonics of the fundamental, Average measurements were made by correcting the peak value with the duty cycle correction factor. For emissions other than harmonics of the fundamental, the Average measurements were made using the Average detector. The receivers resolution bandwidth was set to 120 kHz for measurements taken in the 30MHz to 1GHz frequency range and 1MHz for measurements for 1GHZ and higher. Measurements were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency. The radiated measurements were recorded and compared to the limits indicated in the table below.

There is a limit on spurious emissions produced by an intentional radiator in any 100 kHz Bandwidth outside the intentional emission band of -20dBc provided the radiator complies with the limits specified in 15.205(c) and 15.209(a).

Test distance:

30 MHz to 1 GHz - The EUT to measurement antenna distance is 3 meters
1 to 18 GHz - The EUT to measurement antenna distance is 3 meters
18 to 40 GHz - The EUT to measurement antenna distance is 1 meter

Frequency	Limits(1)		Peak Limits dBuV/m
	Microvolts/m	dBuV/m	
30 - 88 MHz	100	40 (2)	--
88 - 216 MHz	150	43.5 (2)	--
216 - 960 MHz	200	46 (2)	--
960 - 1000 MHz	500	54 (2)	--
1 - 40 GHz	500	54 (3)	74

(1) These limits are applicable to emissions outside of the intentional transmit frequency band.
(2) Quasi-peak limit
(3) Average limit

For other frequencies that do not fall within the restricted band, the limits of 15.247(d) apply (i.e. 20 dBc / 100kHz).

Using a 24Mbps data rate was determined to be the worst-case

7.3 *Test Site*

10m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions

Temperature: 23.1 °C
Relative Humidity: 37.8 %

7.4 *Test Equipment*

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	26-Jun-2015
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	28-Jul-2015
ANTENNA, BILOG	JB6	SUNOL	B079690	7-Oct-2015
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079711	4-Aug-2015
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079713	4-Aug-2015
RF CABLE	SF106	HUBER&SUHNER	B085892	5-Aug-2015
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2016
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	24-Jun-2015
RF CABLE - 7000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079712	4-Aug-2015
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079713	4-Aug-2015
DRG HORN (SMALL)	3116B	ETS-LINDGREN	B079695	13-Mar-2015
COAXIAL CABLE	SUCOFLEX 102	HUBER&SUHNER	B079822	6-Aug-2015
COAXIAL CABLE	SUCOFLEX 102	HUBER&SUHNER	B079824	6-Aug-2015
FIXED GAIN AMPLIFIER	NSP1840-HG	MITEQ	B087572	14-Oct-2015

Note: The calibration period equipment is 1 year.

7.5 *Test Data*

Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
39.00	49.5	V	253.0	100.0	15.1	0.5	31.7	33.5	40.0	-6.5
39.29	50.3	V	257.0	100.0	14.9	0.5	31.7	34.0	40.0	-6.0
39.58	51.6	V	204.0	110.0	14.6	0.5	31.7	35.1	40.0	-4.9
40.15	50.9	V	172.0	109.0	14.2	0.5	31.7	33.9	40.0	-6.1
51.13	56.4	V	152.0	120.0	8.2	0.6	31.7	33.5	40.0	-6.5
61.53	57.4	V	270.0	100.0	7.5	0.6	31.6	34.0	40.0	-6.0
61.55	49.7	H	280.0	289.0	7.5	0.6	31.6	26.2	40.0	-13.8
130.51	51.9	H	107.0	224.0	13.8	0.9	31.5	35.2	43.5	-8.3
913.47	41.0	H	45.0	100.0	23.0	2.5	30.6	36.0	46.0	-10.0
931.94	36.0	H	57.0	100.0	23.2	2.5	30.6	31.3	46.0	-14.7
933.85	37.1	H	49.0	169.0	23.2	2.5	30.6	32.4	46.0	-13.6
935.91	36.1	H	35.0	157.0	23.2	2.5	30.6	31.5	46.0	-14.5
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Frequency MHz	Raw Meas (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	Corr Value dBuV/m	Limit (dBuV/m)	Margin (dB)	Detector
Channel 149											
11490.00	53.6	V	214.1	181.3	38.1	9.7	32.2	69.2	74.0	-4.8	Peak
11490.00	37.6	V	214.2	180.9	38.1	9.7	32.2	53.2	54.0	-0.8	Average
17235.00	40.8	V	262.8	118.0	40.8	12.2	33.4	60.4	74.0	-13.6	Peak
17235.00	26.9	V	262.4	118.3	40.8	12.2	33.4	46.5	54.0	-7.5	Average
11490.00	46.7	H	152.7	181.9	38.1	9.7	32.2	62.3	74.0	-11.7	Peak
11490.00	30.9	H	152.8	181.8	38.1	9.7	32.2	46.5	54.0	-7.5	Average
17235.00	40.2	H	128.8	192.9	40.8	12.2	33.4	59.8	74.0	-14.2	Peak
17235.00	24.4	H	128.8	193.2	40.8	12.2	33.4	44.0	54.0	-10.0	Average
Channel 157											
11570.00	53.1	V	242.2	150.6	38.1	9.8	32.2	68.8	74.0	-5.2	Peak
11570.00	37.3	V	242.4	151.0	38.1	9.8	32.2	53.0	54.0	-1.0	Average
17355.00	42.1	V	259.0	119.7	40.8	12.2	32.9	62.2	74.0	-11.8	Peak
17355.00	26.4	V	258.6	120.7	40.8	12.2	32.9	46.5	54.0	-7.5	Average
11570.00	47.0	H	151.5	178.9	38.1	9.8	32.2	62.7	74.0	-11.3	Peak
11570.00	31.2	H	151.0	178.9	38.1	9.8	32.2	46.9	54.0	-7.1	Average
17355.00	40.0	H	130.4	187.4	40.8	12.2	32.9	60.1	74.0	-13.9	Peak
17355.00	24.5	H	130.0	188.1	40.8	12.2	32.9	44.6	54.0	-9.4	Average
Channel 165											
11650.00	53.3	V	154.6	147.9	38.2	9.9	32.9	68.5	74.0	-5.5	Peak
11650.00	37.2	V	154.5	148.3	38.2	9.9	32.9	52.4	54.0	-1.6	Average
17475.00	45.4	V	260.4	122.2	40.6	12.3	33.0	65.3	74.0	-8.7	Peak
17475.00	29.6	V	260.1	122.6	40.6	12.3	33.0	49.5	54.0	-4.5	Average
11650.00	47.9	H	145.2	175.6	38.2	9.9	32.9	63.1	74.0	-10.9	Peak
11650.00	32.6	H	145.2	175.7	38.2	9.9	32.9	47.8	54.0	-6.2	Average
17475.00	40.4	H	131.0	185.2	40.6	12.3	33.0	60.3	74.0	-13.7	Peak
17475.00	25.0	H	131.2	185.0	40.6	12.3	33.0	44.9	54.0	-9.1	Average
Avg Value = Level + AF + CL - Amp											
Margin = Avg Value - Limit											

- The 3rd harmonic emissions at 17.235GHz, 17.355GHz, and 17.475GHz were not in a restricted band but meet the 15.209 limits.
- No other emissions were detected within 10dB of the limit.

8 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	21 April 2015