

## **ELECTROMAGNETIC COMPATIBILITY**

### **TEST REPORT**

**TO**

**FCC 47 CFR Part 15 Subpart C 15.247, FCC 47 CFR Part 15 Subpart B,  
 RSS-210 Issue 8, RSS-247 & ICES-003 Issue 5**

Report Number: E10700-1501-SENSOR-FCC-IC

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Testing laboratory: Quality Auditing Institute

Address: 16 – 211 Schoolhouse Street, Coquitlam, BC, V3K 4X9, Canada

Accreditations (ISO 17025):



Standard Council of Canada: Accredited Laboratory No. 743

International Accreditation Service Inc.: Accredited Laboratory: No. TL-239

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Applicant's name: 3Z Telecom, Inc.  
 Address: 3361 Executive Way, Miramar, FL, USA 33025  
 Phone Direct: (954) 581-6565 ext. 301

Test Standard: FCC 47 CFR Part 15 Subpart C 15.247, FCC 47 CFR Part 15 Subpart B,  
 RSS-210 Issue 8, RSS-247 & ICES-003 Issue 5

Equipment under Test (EUT): WASP Sensor



Trade Mark:  
 Manufacturer: 3Z Telecom, Inc.  
 Model Number: 3ZAW1000A  
 FCC Registration (FRN): 0024624009  
 FCC ID: 2AEVG3ZAW1000A  
 IC: 20268-3ZAW1000A



WASP Sensor (EUT)

The following tests demonstrate the testimony to "FCC & IC" Mark Electromagnetic compatibility testing for "WASP Sensor" manufactured by 3Z Telecom, Inc.

	Test	Standard	Description	Result
Part 1	Antenna requirement	FCC 47 CFR Part 15.203 RSS-Gen Issue4 (7.1.2)	Soldered, non-replaceable antenna	Complies
Part 2	RF Peak Power Output	FCC Part 15.247 (b)(3) RSS 210 Issue 8 A8.4(5)	Maximum peak conducted output power shall not exceed 1 W. Except as provided in Section RSS 210 A8.4 (5), the e.i.r.p. shall not exceed 4 W.	Complies
Part 3	Occupied Bandwidth 6dB Bandwidth	FCC Part 15.247 (a)(2) RSS 210 Issue 8 A8.2(a)	The minimum -6 dB bandwidth shall be at least 500 kHz.	Complies
Part 4	99% Occupied Bandwidth	RSS-Gen Issue 4	The Bandwidth to be reported	Complies
Part 5	Power Spectral Density	FCC Part 15.247 (e) RSS 210 Issue 8 A8.2(b)	The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission	Complies
Part 6	Out-of-band Emissions (Band Edge)	FCC Part 15.247 (d) RSS 210 Issue 8 A8.5	In any 100 kHz bandwidth outside the frequency band in which the digitally modulated device is operating, the RF power that is produced shall be at least 20dB.	Complies
Part 7	Conducted Spurious Emissions	FCC Part 15.247 (d) RSS 210 Issue 8 A8.5	In any 100 kHz bandwidth outside the frequency band in which the digitally modulated device is operating, the RF power that is produced shall be at least 20dB.	Complies
Part 8	Radiated Spurious Emissions- Transmit Mode	FCC Part 15.247 (d) FCC Part 15.209 (a) RSS 210 Issue 8 A2.5,A8.5 RSS Gen Issue 3	Radiated emissions requirements as stated in the Standards.	Complies
Part 9	Duty Cycle Correction	FCC Part 15.35(C) RSS-GEN,RSS-210	Measurement and Calculation for duty cycle correction as stated in the standards.	Complies
Part 10	RF Exposure Compliance	FCC KDB447498; CFR 47, Part 1.1307, 1310; Part 2, Subpart J 1091,RSS-102(2.5.1)	Any radio transmitter should not emit higher than the limit	Complies
Part 11	Frequency Stability	FCC Part 15.215(c) & RSS-Gen Issue 4 (8.11)	Frequency Stability measurements were performed at extreme temperature conditions	Complies

Tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with CFR 47 FCC Part 15 Subpart C and Industry Canada RSS-Gen Issue 4, RSS-210 Issue 8, RSS-247. The manufacturer is responsible for the tested product configuration, continued product compliance with these standards listed, and for the appropriate auditing of subsequent products as required.

This is to certify that the following report is true and correct to the best of our knowledge.



Written by Jack Qin  
RF/EMC Test Engineer/Technical Writer



Reviewed by Aman Jathaul,  
EMC Project Manager

## Revision History

Date	Report Number	Rev #	Details	Authors Initials
June-25-2015	E10700-1501-SENSOR-FCC-IC	0.0	Draft Test Report	JQ
July-10-2015	E10700-1501-SENSOR-FCC-IC	0.1	Draft Test Report	JQ
July-16-2015	E10700-1501-SENSOR-FCC-IC	1.0	Final Test Report	JQ

All previous versions of this report have been superseded by the latest dated revision as listed in the above table. Please dispose of all previous electronic and paper printed revisions accordingly.

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## Section I: PRODUCT DESCRIPTION

EUT	WASP Sensor
Functional Description	The Antenna WASP monitoring system enables cellular service administrators and technicians to remotely track the operational status of the antennas deployed at each base station, and when necessary, send maintenance personnel to adjust the antennas which require servicing in order to restore optimal cellular service. The WASP Sensor collects operational status of one cellular antenna and reports the data to the Data Collector periodically.
Operational Description	The WASP Sensor measures the angular change of all 3 axes of the cellular antenna on which it is mounted. It also measures the ambient temperature, its own battery condition and the wireless link quality between it and the Data Collector. All collected information is transmitted wirelessly to the Data Collector using a 2.4GHz, IEEE802.15.4-compliant radio transceiver. To conserve battery life, the WASP Sensor reverts to sleep mode after each cycle of measurement and transmission.
Manufacturer	3Z Telecom, Inc.
Model Number	3ZAW1000A
FCC ID	2AEVG3ZAW1000A
IC Number	20268-3ZAW1000A
Serial No.	#2, #5 and #6
Frequency Range	ZigBee 2405-2480MHz
Transmit Type	Wide Band Modulation, Non-Adaptive
Transmit Power	40.6mW
Modulation	DSSS (Direct Sequence Spread Spectrum), O-QPSK with half-sine pulse shaping
Number of Channels	16
Ratings	+3.7 Vdc Battery
Software and Firmware	The EUT driver software installed in the host laptop equipment during testing was controlled using the appropriate commands in the Terminal window in Ubuntu 64-bit OS. Testing was performed using the firmware version 817
Received Date	May 26 2015
Received By	Aman Jathaul
Sample Log	QAI Product Control Log (QM 1305 - Sample Inventory)

**ANTENNA DESCRIPTION**

Description	2.45GHz High Gain SMD Chip Antenna
Manufacturer	Johanson Technology
Part Number	2450AT45A100
Frequency Range	2400-2500MHz
Gain	2.2dBi
Impedance	50 Ohms
Max Power	3Watts
Return Loss	9.5dB min.
Length	9.50mm +/-0.20mm
Width	2mm +/-0.20mm
Operating Temperature	-40°C to +125°C

## Section II: General Information

### **FACILITIES AND ACCREDITATION**

Main Laboratory Headquarters: Quality Auditing Institute  
Headquarters Location/Address: 16 – 211 Schoolhouse Street, Coquitlam, BC, 3K 4X9, Canada  
EMC Laboratory Address: 19473 Fraser Way, Pitt Meadows, BC, V3Y 2V4, Canada  
FCC Test Site Registration Number:  
(3 m /10 m Open Area Test Site [OATS] and 3 m Semi-Anechoic Chamber [SAC]): 226383  
FCC Designation Number: CA9543  
Industry Canada Test Site Registration Number (3m SAC): 9543B-1  
Standard Council of Canada: ISO/IEC 17025:2005 Accredited Laboratory No. 743  
International Accreditation Service Inc.: ISO/IEC 17025:2005 Accredited Laboratory: No. TL-239

### **ENVIRONMENTAL CONDITIONS: INDOORS**

Temperature: 22-28°C R.H.: 39.7 - 54.4%

### **TESTING METHODOLOGY**

The tests documented in this report were performed in accordance with ANSI C63.4-2009, ANSI C63.10-2009, ANSI C63.10-2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15, and RSS-Gen, Issue 4 and RSS-210, Issue 8. The FCC testing was also done using the FCC KDB 558074 D01 DTS Meas Guidance v03r03.

### **EUT TESTING CONFIGURATION**

The transmitter was set for continuous operation on various frequencies in modulated modes of operation.

### **WORST TEST CASE**

Worst-case orientation was determined by rotating the EUT on three orthogonal planes, during the pre-compliance test and final radiated emissions tests were performed in that worst orientation.

### **GENERAL TEST PROCEDURES**

#### RF Conducted Emissions

The EUT is placed on a test bench connected directly to an EMI Receive and Spectrum Analyzer Conducted emissions are measured in the frequency range 10kHz to 25GHz using CISPR Peak, Quasi-Peak and Average detectors.

#### Radiated Emissions

Below 1000MHz, EUT was placed on the turntable 0.8m above a ground plane 3m away from a receiving antenna. Height of receiving antenna varied from 1m to 4m, its polarity changes from vertical to horizontal. Above 1000MHz, EUT was placed 1.5m high from the ground plane on an insulated surface and absorbers were placed on the ground plane as required by the standard. During measurements turntable was also rotated 360 degrees to determine worst case orientation. Motion of turntable and receiving antenna allows determining position of maximum emission level. Quasi-peak detector applies for measurements of emissions with frequency range of 30 to 1000MHz. and average/peak detector otherwise.

## Restricted Bands of Operation

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
1 0.495-0.505*	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	-2
13.36-13.41			

\* - note FCC-specific .

Canada-specific frequency ranges - 3.020-3.026, 5.677-5.683, 121.94-123.0. 149.9-150.05, 162.0125-167.17, 167.72-173.2, 1300-1427, 2483.5-2500, 3500-3600,

(2) Above 38.6 GHz

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in § 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in § 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in § 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in § 15.35 apply to these measurements.

## MEASUREMENT UNCERTAINTY

Parameter	Uncertainty
Radio Frequency	±1 x 10-5 MHz
Total RF power, conducted	±1 dB
RF power density, conducted	±2.75 dB
Spurious emissions, conducted	±3 dB
Radiated Emissions	±3 dB
Temperature	±1°C
Humidity	±5 %
DC and low frequency voltages	±3 %

## Test Equipment List

Manufacturer	Model	Description	Serial No.	Last Cal	Cal Due Date
ETS Lindgren	2165	Turntable	00043677	N/A	N/A
ETS Lindgren	2125	Mast	00077487	N/A	N/A
Rohde & Schwarz	ESU40	EMI Receiver	100011	2014-11-20	2017-11-20
FCC	FCC-LISN-50-25-2	LISN (150kHz-30MHz)	9927	30-Nov-2012	30-Nov-2015
EMCO	6502	Loop Antenna 10kHz-30MHz	2178	8/21/2014	8/21/2017
Sunol Sciences	JB3	Biconilog Antenna 30MHz-3GHz (Prescan use only)	A120106	28-Oct-2013	28-Oct-2015
ETS Lindgren	3117	Horn Antenna 1GHz-18GHz	00075944	29-Aug-2013	29-Aug-2015
EMCO	3160-09	Horn Antenna 18GHz-26.54GHz	9701-1071	30-Aug-13	30-Aug-15
ETS Lindgren	S201	5 meter Semi-Anechoic Chamber	1030	N/A	N/A
A.H.Systems Inc	PAM-1840VH	Preamplifier	152	14-Jun-2013	14-Jun-2016
A.H.Systems Inc	SAC-40G-2.25	RF cable	396	Conditional use	
A.H.Systems Inc	SAC-40G-0.3	RF cable	395	Conditional use	
ETS Lindgren	7002-006	USB RF Power Sensor	14I00048 SNO050	2014-11-20	2017-11-20

## Measurement Software List

Manufacturer	Model	Version	Description
Rhode & Schwarz	EMC 32	6.20.0	Emissions Pre-scan Test Software

## Section III: Test Information

### Part 1 - Antenna Requirements

DATE: June 16, 2015

TEST STANDARD: FCC 47 CFR Part 15.203 and IC RSS-Gen Section 7.1.2

APPLICABLE REGULATIONS: - “An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited.”... “the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.”

RESULT: This unit meets antenna requirement.

## Part 2 - RF Peak Power Output

DATE: June-02-2015

TEST STANDARD: FCC Part 15.247 (b)(3), RSS 210 Issue 8 A8.4(4)

TEST REQUIREMENT: (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode. Except as provided in RSS 210 Section A8.4 (5), the e.i.r.p. shall not exceed 4 W.

TEST SETUP: The antenna port of EUT was directly connected to a spectrum analyzer.

MEASUREMENT METHOD: As called by the standards above.

DEVICE DESCRIPTIONS: As described in the above EUT description and set up section.

EMISSIONS DATA: Conducted Output Power Measurements

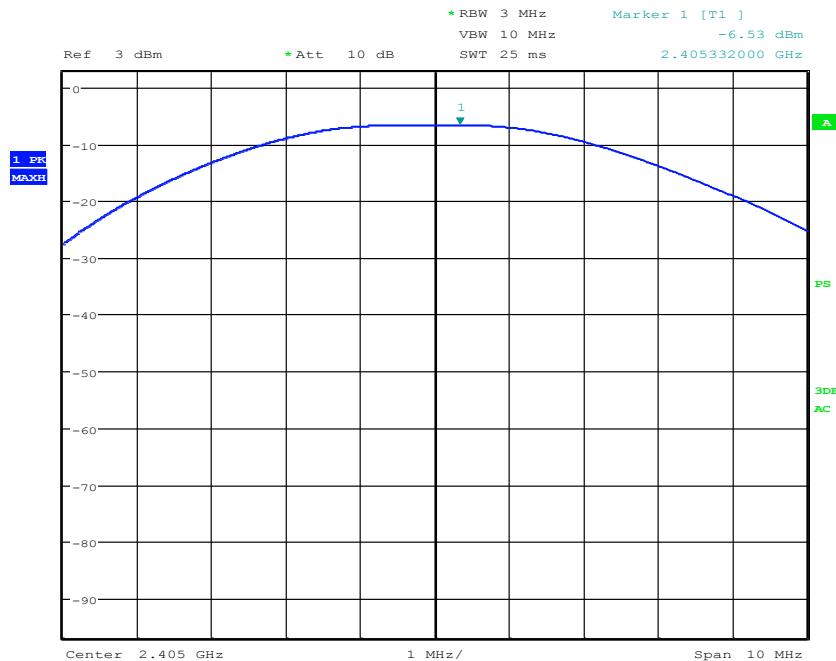
Channel	Frequency (GHz)	Un-Corr (dBm)	Cable Loss (dB)	Conducted Power (dBm)	Limit (dBm)
Low	2405.32	-6.53	22.62	16.09	30
Mid	2439.41	-7.66	22.79	15.13	30
High	2479.49	-8.2	22.66	14.46	30

### EIRP Measurements

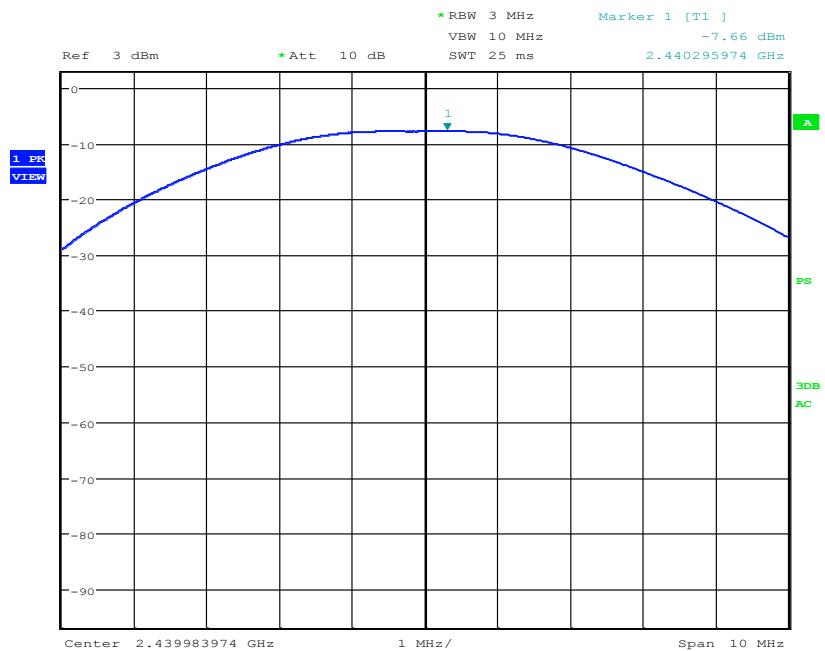
Channel	Frequency (GHz)	Peak at 3m (dBuV/m)	3m EIRP (dBm)	Limit (dBm)
Low	2405.32	113.86	18.6	36
Mid	2439.41	112.76	17.5	36
High	2479.49	113.52	18.26	36

RESULTS: Pass: Complies.

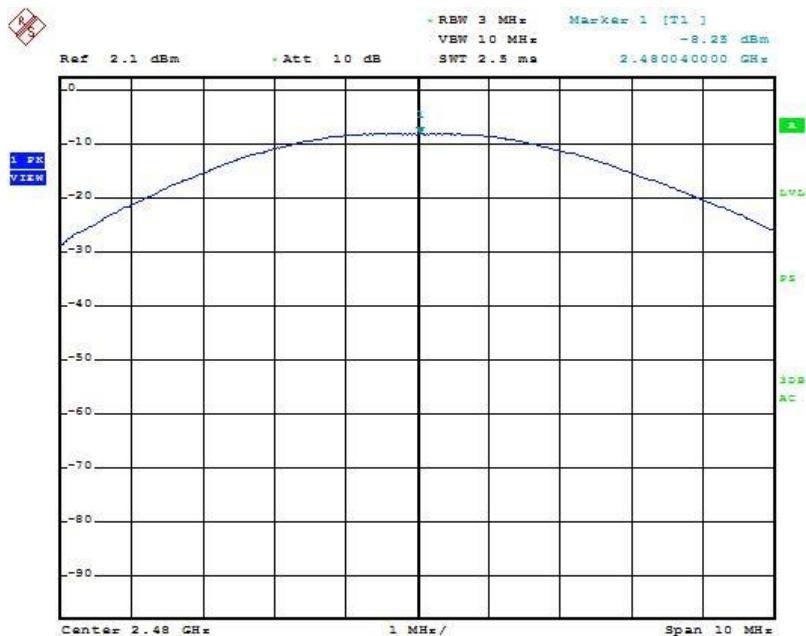
EMISSIONS PLOT:



PEAK OUTPUT POWER, LOW CHANNEL



PEAK POWER, MID CHANNEL



### Part 3 - Occupied Bandwidth 6dB Bandwidth

DATE: June-02-2015

TEST STANDARD: FCC Part 15.247 (a) (2) and RSS 210 Issue 8 A8.2

TEST REQUIREMENT: The minimum -6 dB bandwidth shall be at least 500 kHz.

TEST SETUP: The antenna port of EUT was directly connected to a spectrum analyzer.

MEASUREMENT METHOD: As called by the standards above.

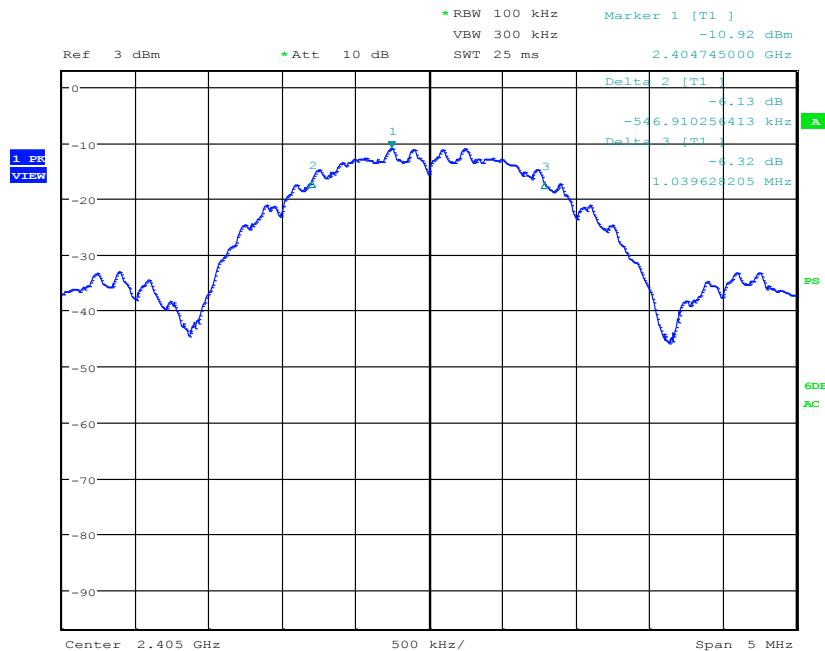
DEVICE DESCRIPTIONS: As described in the above EUT description and set up section.

MEASUREMENT DATA:

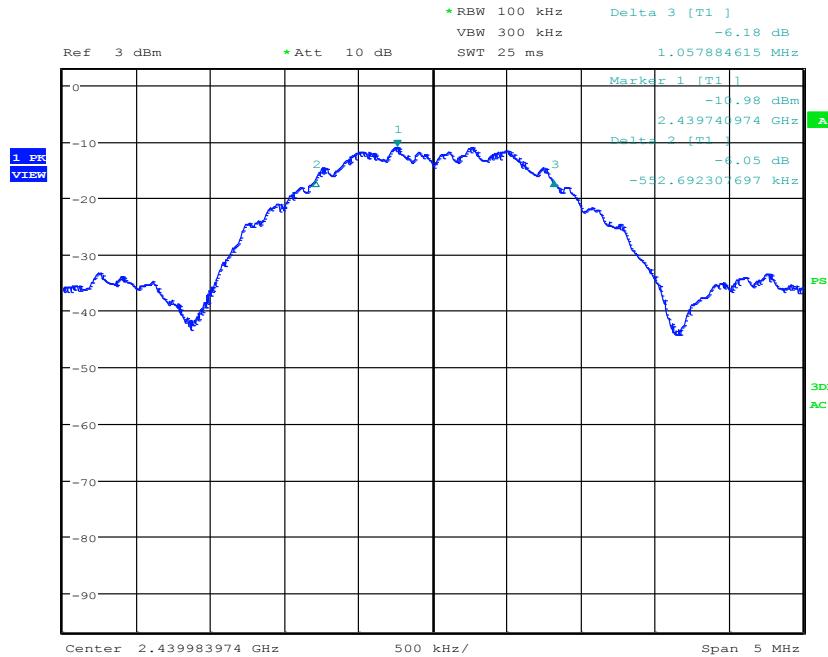
Channel	Frequency (MHz)	6dB Bandwidth (MHz)
Low	2405	1.59
Mid	2440	1.61
High	2480	1.61

RESULTS: Pass: Complies.

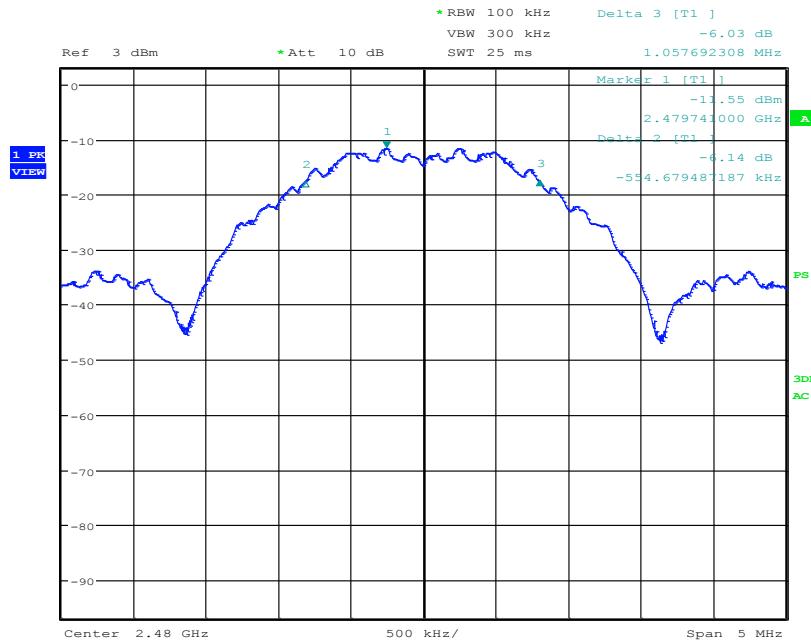
MEASUREMENT PLOT:



LOW CHANNEL – 6dB OCCUPIED BANDWIDTH



#### MID CHANNEL – 6dB OCCUPIED BANDWIDTH



#### HIGH CHANNEL – 6dB OCCUPIED BANDWIDTH

**Part 4 - 99% Occupied Bandwidth**

DATE: June-02-2015

TEST STANDARD: RSS-Gen Issue 4

TEST SETUP: The antenna port of EUT was directly connected to a spectrum analyzer.

MEASUREMENT METHOD: As called by the standards above.

DEVICE DESCRIPTIONS: As described in the above EUT description and set up section.

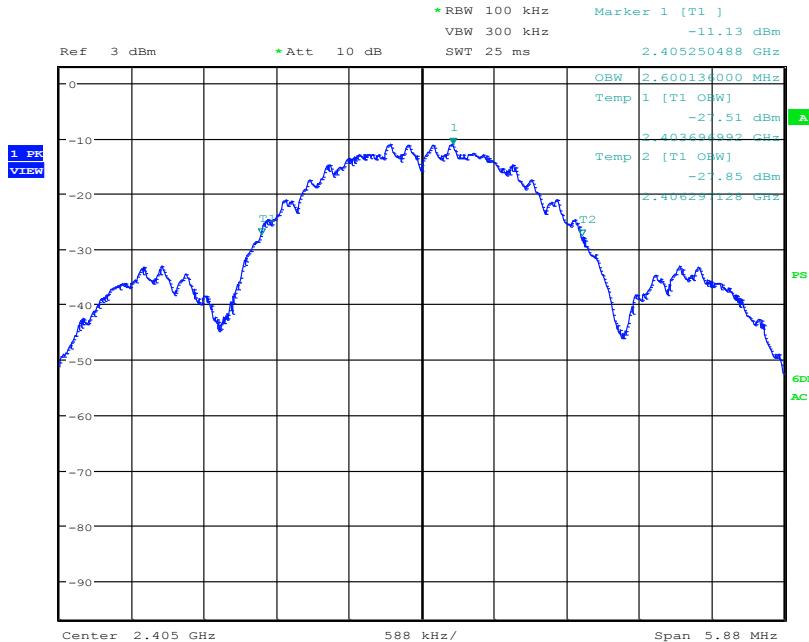
MEASUREMENT DATA:

Channel	Frequency	Bandwidth	Result
	MHz	MHz	
Low	2405	2.6	Pass
Mid	2440	2.598	Pass
High	2480	2.572	Pass

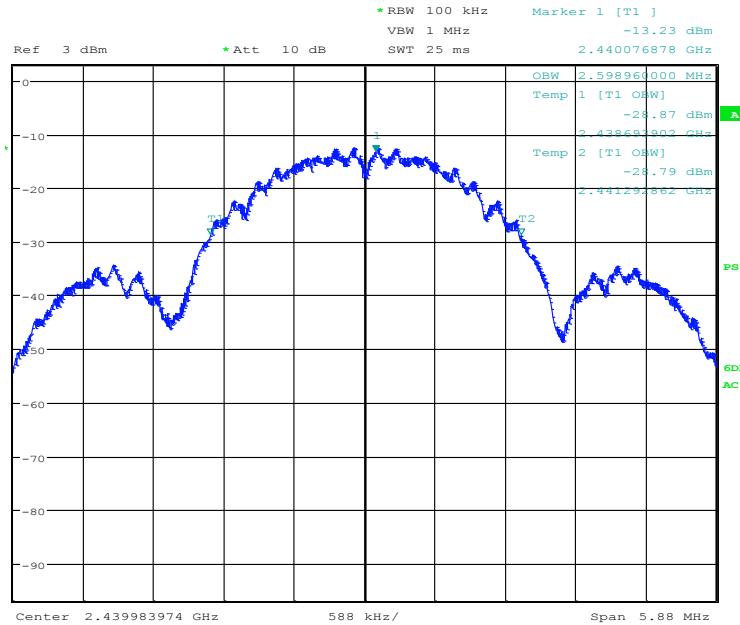
OBSERVATIONS: The EUT performed as expected.

PERFORMANCE: Complies

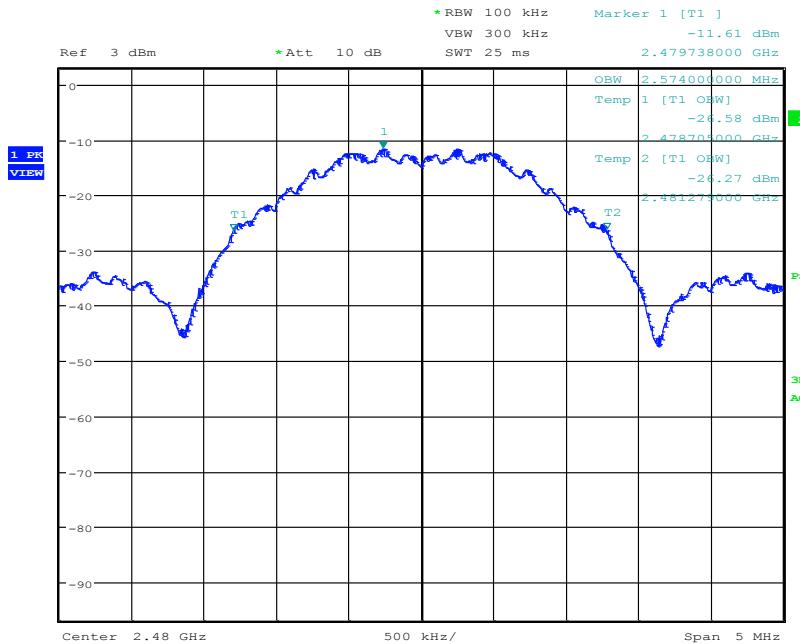
MEASUREMENT PLOT:



LOW CHANNEL – 99% OCCUPIED BANDWIDTH



### MIDDLE CHANNEL – 99% OCCUPIED BANDWIDTH



### HIGH CHANNEL – 99% OCCUPIED BANDWIDTH

## Part 5 - Power Spectral Density

DATE: June-02-2015

TEST STANDARD: FCC Part 15.247 (e) and RSS 210 Issue 8 A 8.2(b)

TEST METHOD: As called by the standards above

MINIMUM STANDARD: 8 dBm in any 3 kHz band

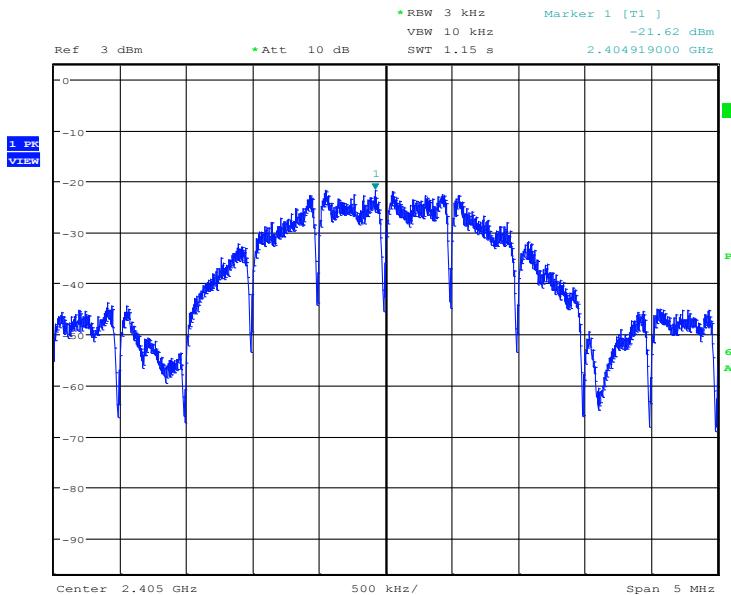
TEST SETUP: The EUT was connected to the DUT in conducted mode likewise for output power measurements.

METHOD OF MEASUREMENT: Measurements were made using a spectrum analyser with 100 kHz resolution bandwidth, peak and detector.

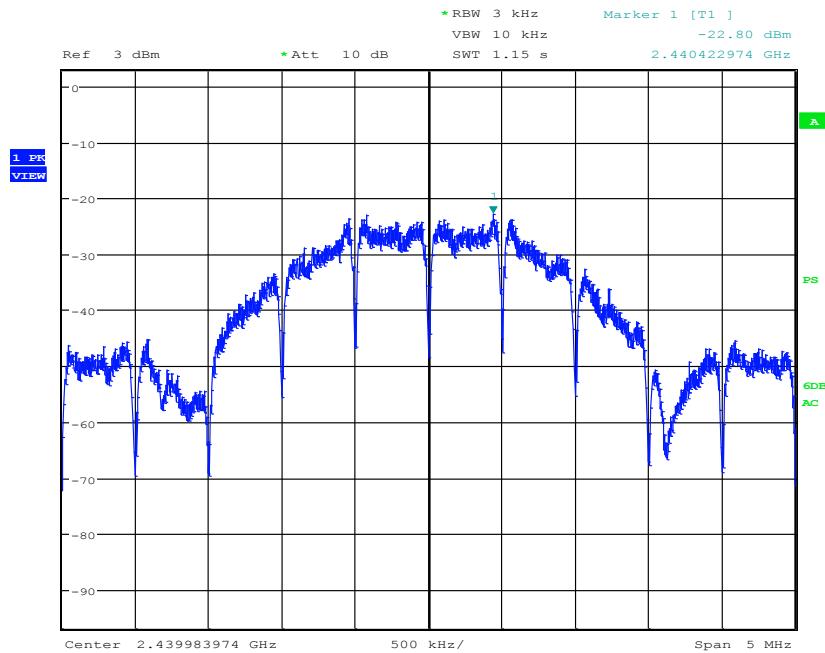
PERFORMANCE: Complies with Standard

### MEASUREMENT DATA & PLOT:

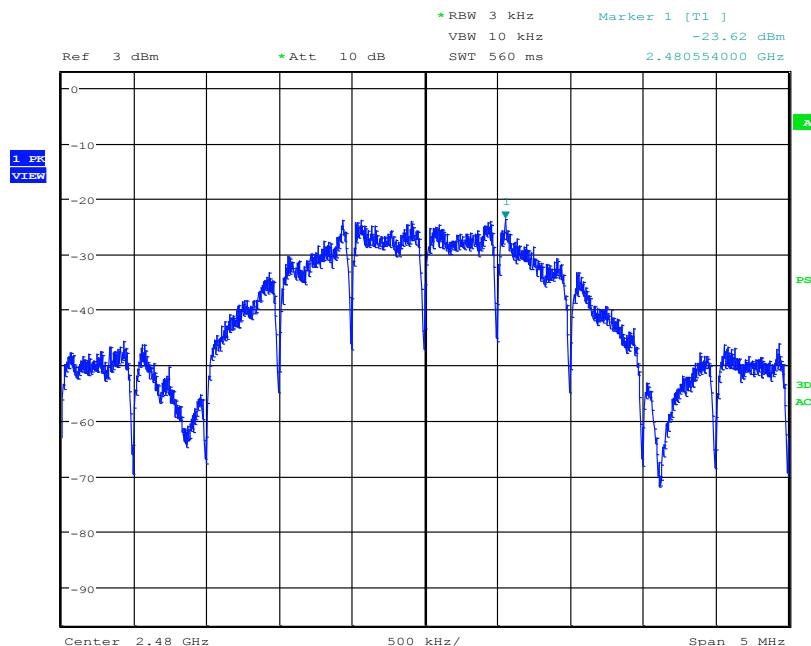
Channel	Frequency	Un-Corrected PSD	Cable Loss	Corrected PSD	Limit	Margin	Results
	(GHz)	(dBm)	(dB)	(dBm)	(dBm)	(dB)	Pass/Fail
Low	2.405	-21.72	22.62	0.9	8	7.1	Pass
Mid	2.44	-22.8	22.79	-0.01	8	8.01	Pass
High	2.48	-23.6	22.66	-0.94	8	8.94	Pass



LOW CHANNEL - POWER SPECTRAL DENSITY



MID CHANNEL - POWER SPECTRAL DENSITY



HIGH CHANNEL - POWER SPECTRAL DENSITY

## Part 6 - Out of Band Emissions (Band Edge)

DATE: June-02-2015

TEST STANDARD: FCC Part 15.247 (d) and RSS 210 Issue 8 A8.5

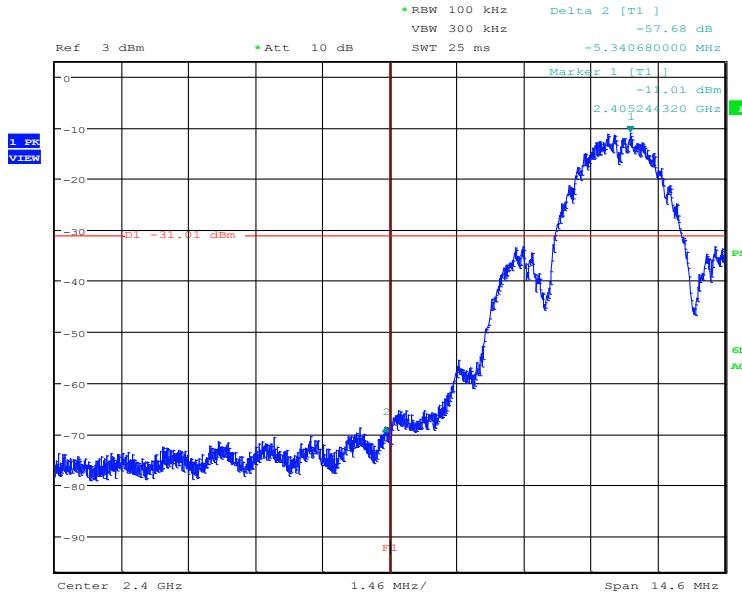
TEST REQUIREMENTS:

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

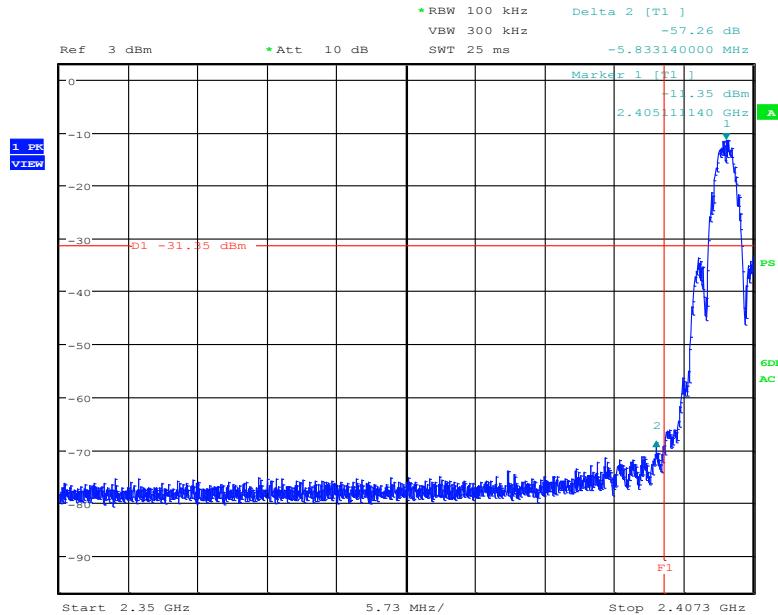
MEASUREMENT METHOD: As called by the standards above.

RESULTS: Pass: Complies

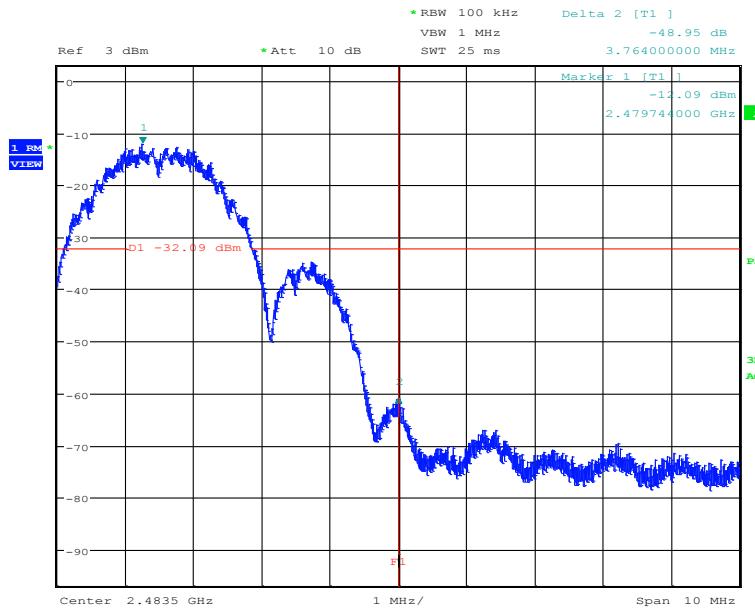
MEASUREMENT DATA & PLOT:



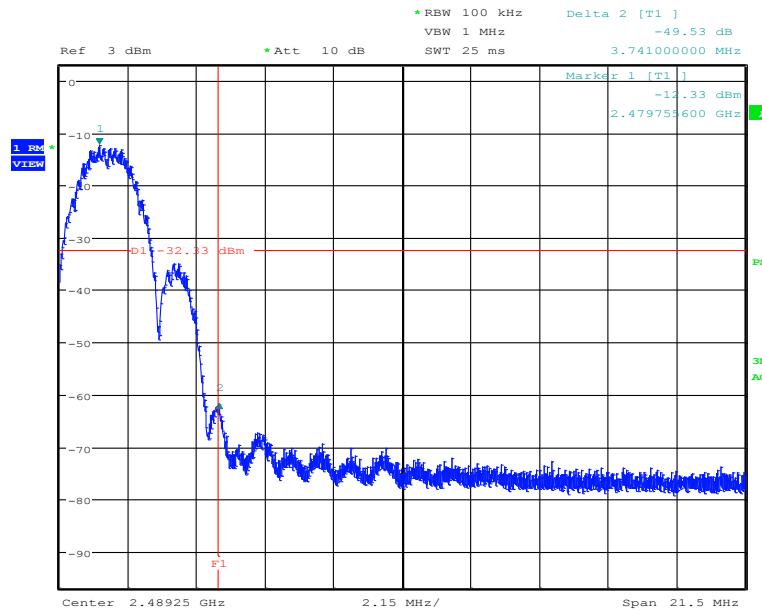
OUT OF BAND EMISSIONS - LOW CHANNEL



### OUT OF BAND EMISSIONS - LOW CHANNEL



### OUT OF BAND EMISSIONS - HIGH CHANNEL



**OUT OF BAND EMISSIONS - HIGH CHANNEL**

## Part 7 - Conducted Spurious Emissions

DATE: June-03-2015

TEST STANDARD: FCC Part 15.247 (d), RSS 210 Issue 8

TEST REQUIREMENTS: (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

MEASUREMENT METHOD: As called by the standards above. Conducted spurious emissions were measured up to 25GHz

(b) Emissions emitted outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in RSS-Gen, whichever is less stringent.

TEST SETUP: The EUT was directly connected to a spectrum analyser. The transmitter was set for continuous transmission. Measurements were done up to 25GHz.

RESULTS: Pass: Complies

### MEASUREMENT DATA & PLOT:

#### Low Channel Conducted Spurious Emissions

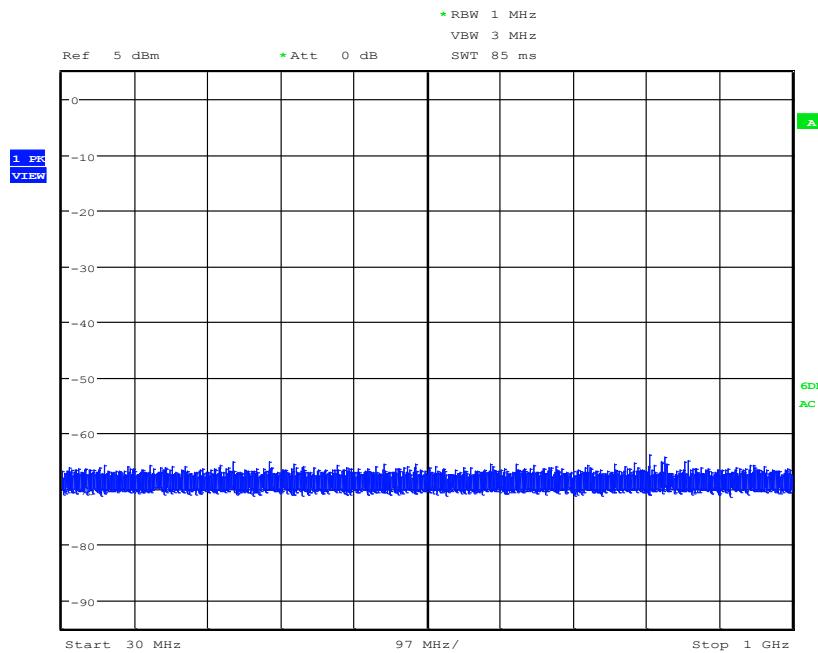
Frequency (GHz)	Peak-Raw (dBm)	RBW (kHz)	Cable Loss	Corrected Peak (dBm)	Reference Level (dBm)	Limit 20dBc	Result
4.8099	-81.84	100	24.73	-57.11	10.98	-9.02	Pass
7.21497	-84.73	100	24.51	-60.22	10.98	-9.02	Pass
9.6186	-84.42	100	23.74	-60.68	10.98	-9.02	Pass
12.02349	-84.6	100	21.71	-62.89	10.98	-9.02	Pass

#### Middle Channel Conducted Spurious Emissions

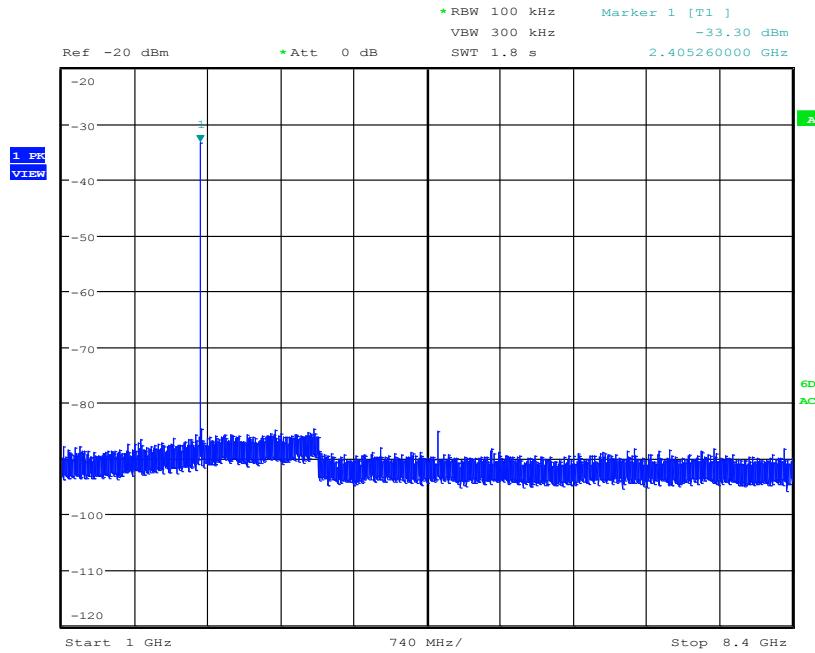
Frequency (GHz)	Peak-Raw (dBm)	RBW (kHz)	Cable Loss	Corrected Peak (dBm)	Reference Level (dBm)	Limit 20dBc	Result
4881.35	-81.59	100	24.76	-56.83	10.98	-9.02	Pass
7319.9	-86.64	100	25.02	-61.62	10.98	-9.02	Pass
9.7626	-81.9	100	23.84	-58.06	10.98	-9.02	Pass
12.198	-82.74	100	22.97	-59.77	10.98	-9.02	Pass
14.6379	-87.09	100	22.7	-64.39	10.98	-9.02	Pass

High Channel Conducted Spurious Emissions

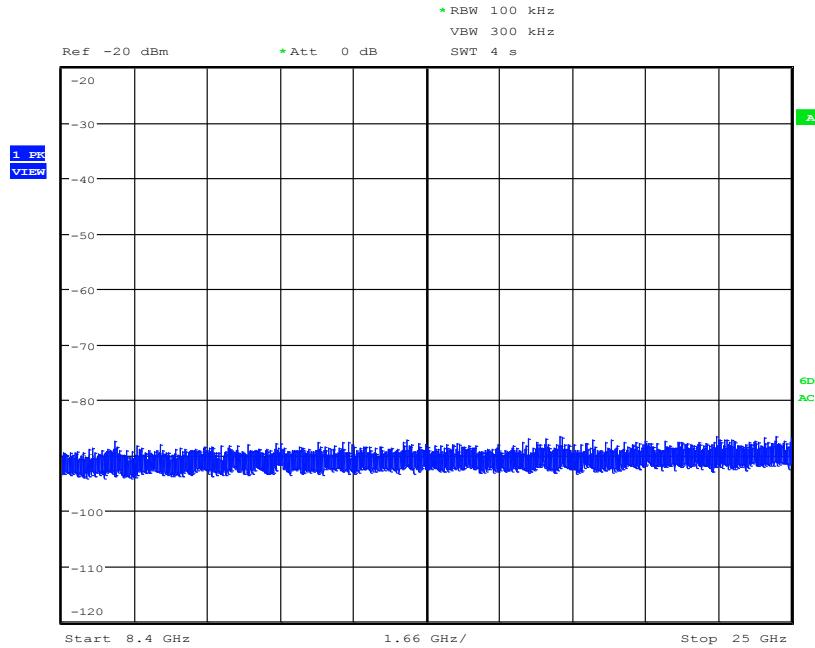
Frequency (GHz)	Peak-Raw (dBm)	RBW (kHz)	Cable Loss	Corrected Peak (dBm)	Reference Level (dBm)	Limit 20dBc	Result
4961.3	-80.66	100	24.72	-55.94	10.98	-9.02	Pass
7.4399	-85.4	100	24.54	-60.86	10.98	-9.02	Pass
9.91867	-83.26	100	23.25	-60.01	10.98	-9.02	Pass
12.4034	-84.7	100	20.71	-63.99	10.98	-9.02	Pass



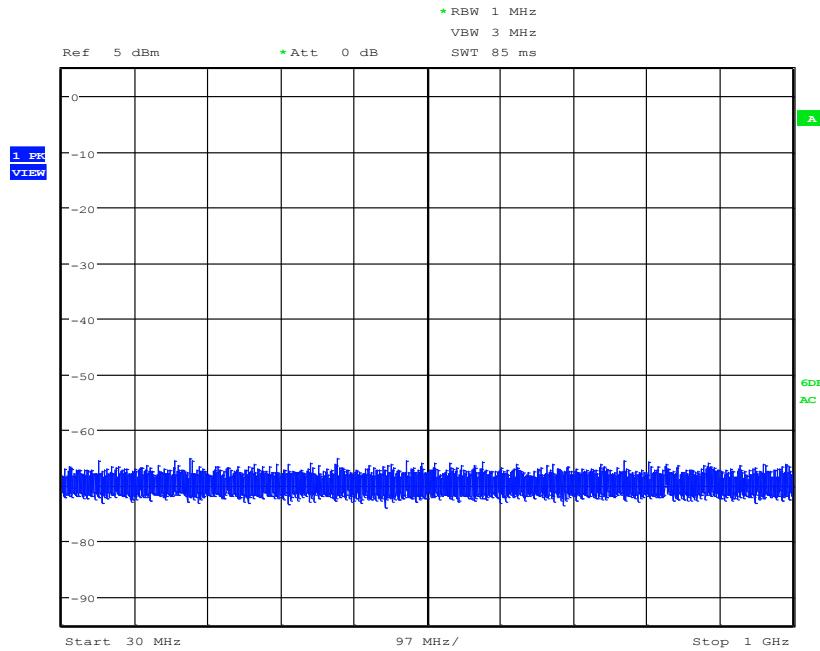
Low Channel - Conducted Spurious Emissions 30MHz-1GHz



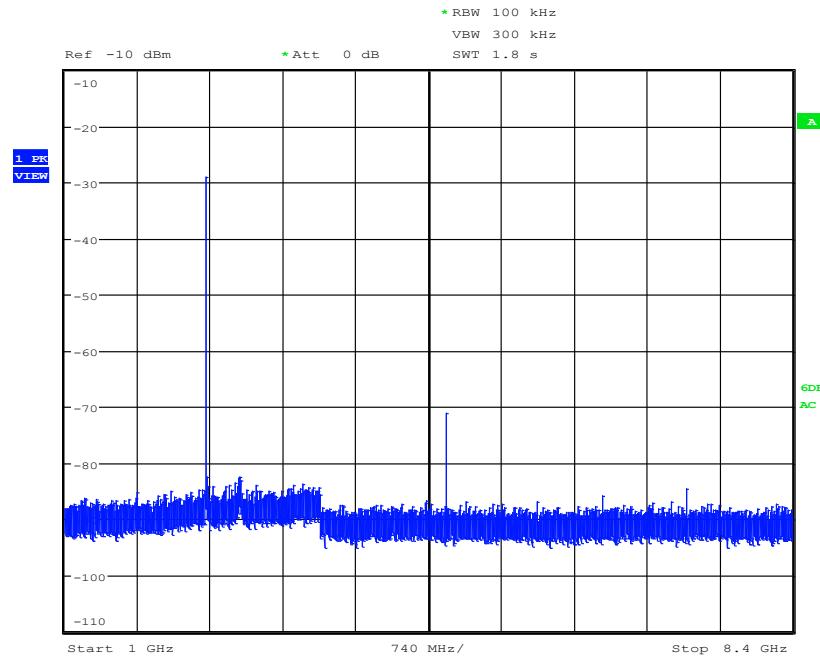
Low Channel - Conducted Spurious Emissions 1 – 8.4GHz



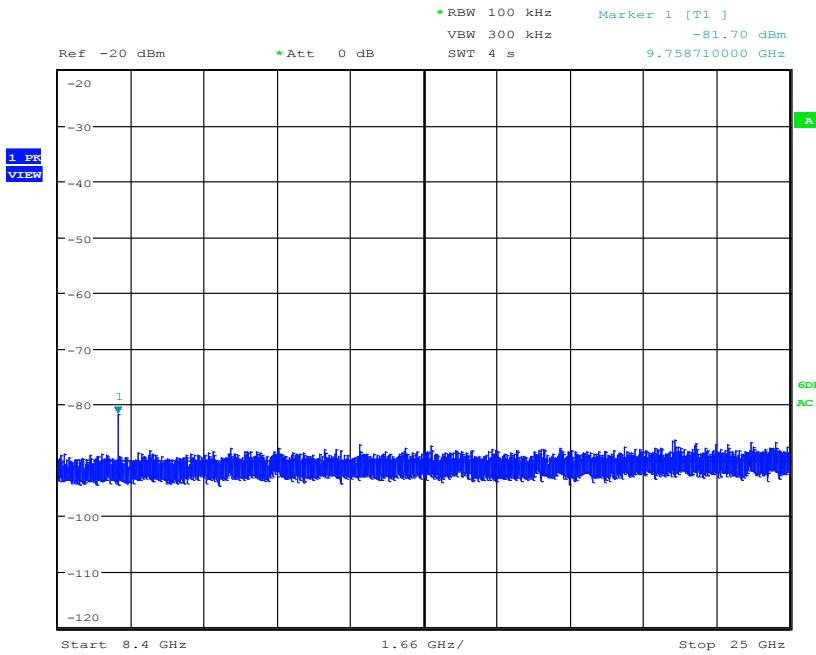
Low Channel - Conducted Spurious Emissions 8.4 - 25GHz



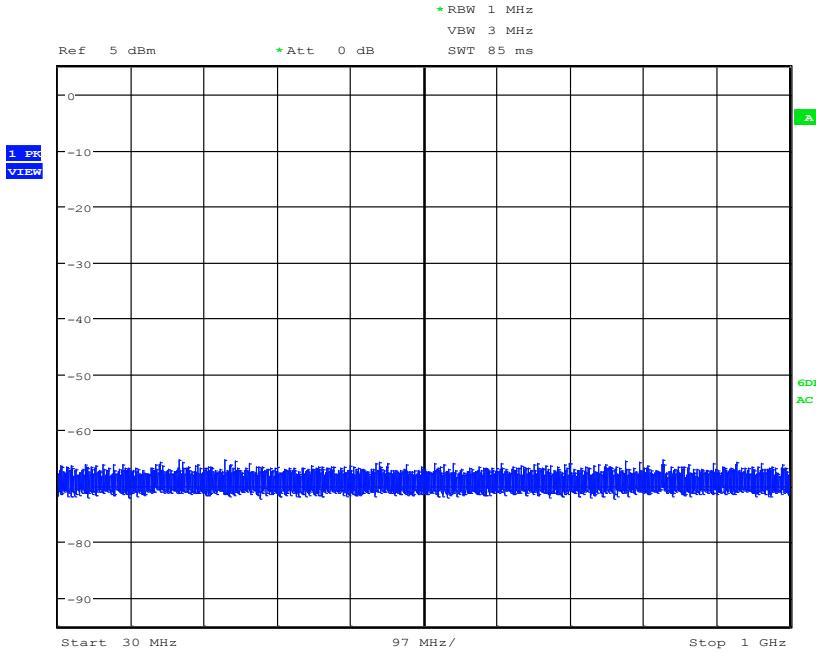
Middle Channel - Conducted Spurious Emissions 30MHz-1G



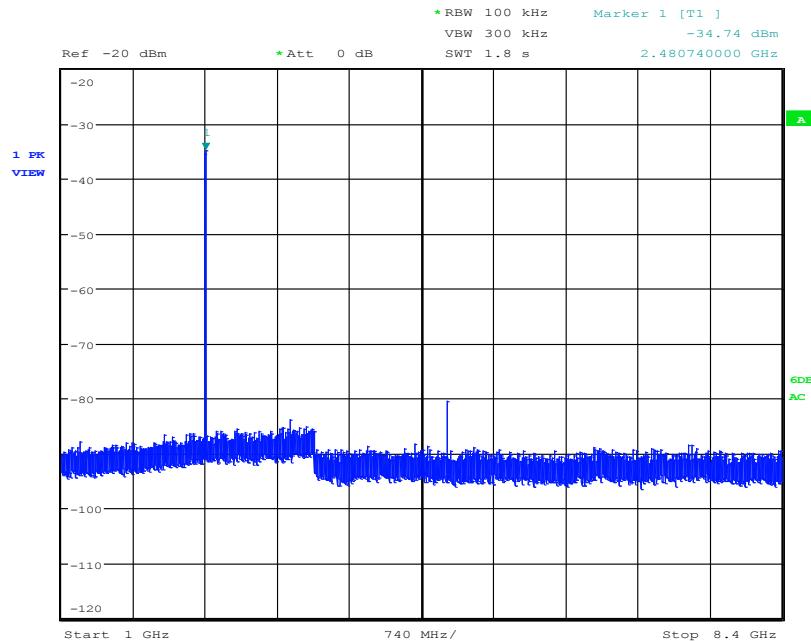
Middle Channel - Conducted Spurious Emissions 1 – 8.4GHz



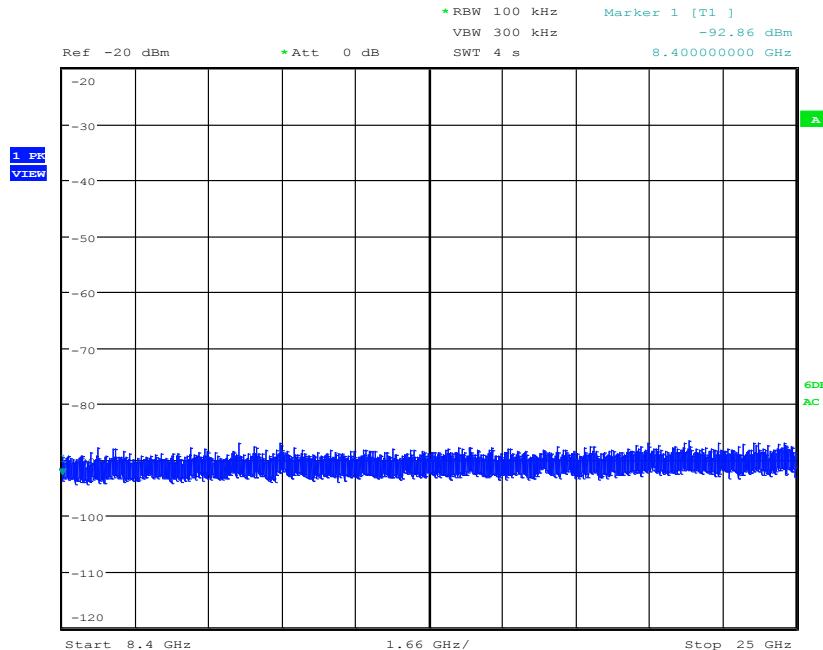
Middle Channel - Conducted Spurious Emissions 8.4 – 25GHz



High Channel - Conducted Spurious Emissions 30MHz-1GHz



High Channel - Conducted Spurious Emissions 1 – 8.4GHz



High Channel - Conducted Spurious Emissions 8.4 - 25GHz

## Part 8 - Radiated Spurious Emissions-Transmit Mode

DATE: June-12-2015

TEST STANDARD: FCC Part 15.247 (d), FCC Part 15.209 (a), FCC Part 15.205, IC RSS-210 Annex 2 Section (A2.2)(b), RSS-Gen Section (7.2.5)

MINIMUM STANDARD: a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength	Distance
	uV/m	m
0.009-0.49	2400/F(kHz)	300
0.49-1.705	24000/F(kHz)	30
1.705 - 30	30	30
30 - 88	100	3
88 - 216	150	3
216 – 960	200	3
Above 960	500	3

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20 dB below the level of the fundamental or to the general field strength limits listed in RSS-Gen, whichever is less stringent. In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency ... if the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

### FCC PART 15.205-RESTRICTED BANDS OF OPERATION

**(a)** Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
1.0495-0.505*	16.69475- 16.60525	608-614	5.35-5.46
2.1735-2.1905	16.80425- 16.90475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475- 156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0

12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(2)
13.36-13.41			

\* - note FCC-specific .

Canada-specific frequency ranges - 3.020-3.026, 5.677-5.683, 121.94-123.0, 149.9-150.05, 162.0125-167.17, 167.72-173.2, 1300-1427, 2483.5-2500, 3500-3600, (2) Above 38.6 GHz

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in § 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in § 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in § 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in § 15.35 apply to these measurements.

#### RESTRICTED FREQUENCY BANDS (RSS-GEN)

MHz
0.090-0.110
2.1735-2.1905
3.020-3.026
4.125-4.128
4.17725-4.17775
4.20725-4.20775
5.677-5.683
6.215-6.218
6.26775-6.26825
6.31175-6.31225
8.291-8.294
8.362-8.366
8.37625-8.38675
8.41425-8.41475
12.29-12.293
12.51975-12.52025
12.57675-12.57725
13.36-13.41
16.42-16.423
16.69475-16.69525
16.80425-16.80475
25.5-25.67
37.5-38.25
73-74.6
74.8-75.2
108-138
156.52475-156.52525
156.7-156.9

MHz
240-285
322-335.4
399.9-410
608-614
960-1427
1435-1626.5
1645.5-1646.5
1660-1710
1718.8-1722.2
2200-2300
2310-2390
2655-2900
3260-3267
3332-3339
3345.8-3358
3500-4400
4500-5150
5350-5460
7250-7750
8025-8500

GHz
9.0-9.2
9.3-9.5
10.6-12.7
13.25-13.4
14.47-14.5
15.35-16.2
17.7-21.4
22.01-23.12
23.6-24.0
31.2-31.8
36.43-36.5
Above 38.6

**Note:** Certain frequency bands listed in Table 3 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in the 200- and 300- series RSSs, such as RSS-210 and RSS-310, which contain the requirements that apply to licence-exempt radio apparatus.

Unwanted emissions falling into restricted bands shall comply with the limits specified below

Frequency (MHz)	Field Strength	
	uV/m @ 3-m	Calculated dB $\mu$ V/m at 3m
30 – 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
960 - 1000	500	54.0

**TEST SETUP:**

The EUT was tested in our 3 m SAC and was positioned on the center of the turntable and connected to a 3Vdc battery. The transmitter was set for continuous transmission. The lowest, middle and highest channels in the 2400-2483.5 MHz band were measured for all radiated emissions 10kHz to 18 GHz. The EUT was pre-scanned in 3 different orthogonal orientations and was found to radiate highest when placed flat on the table top as indicated in the test photos.

**MEASUREMENT METHOD:**

Measurements were made using spectrum analyser and receiver, 200Hz RBW average detector for the frequency range 9-150KHz; 9kHz RBW average detector for the Frequency range 150kHz to 30MHz; 120kHz RBW quasi-peak detector using the appropriate antennas, amplifiers and filters.

The measurement results are obtained as described below:

$E$  [dB $\mu$ V/m] = Un-Corrected Value + ATOT

Where ATOT is total correction factor including cable loss, antenna factor and preamplifier gain (ATOT = LCABLES + AF - AMP).

**PERFORMANCE:**

Complies with Standard

**EMISSIONS DATA AND PLOT:**

1. Radiated Emissions test was performed from 9 kHz-25GHz
2. All emissions below 1GHz were more than 20dB lower than the limit line.
3. Except the emissions reported below, all emissions above 1GHz were more than 20dB lower than the limit.

**Radiated Spurious Emissions – Low Channel**

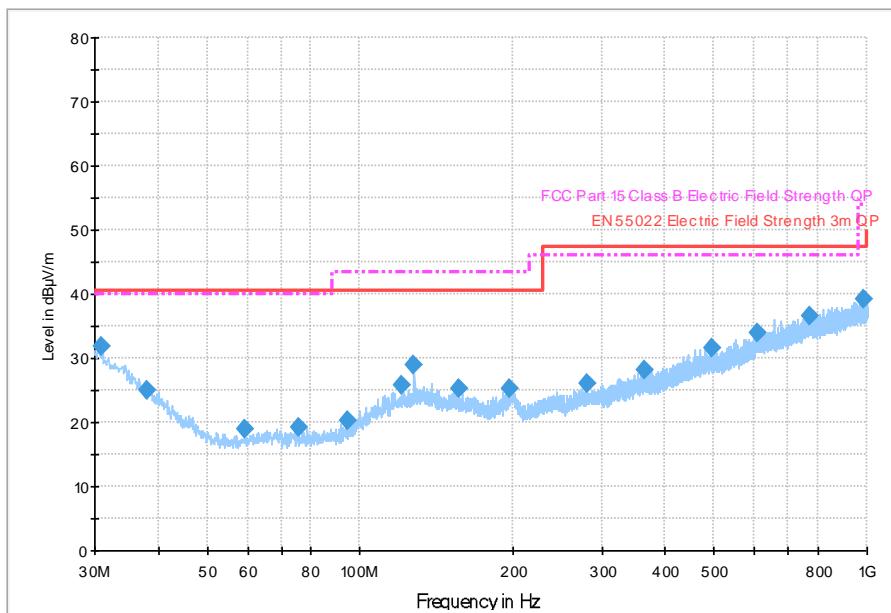
Freq.	Peak-Raw	Pol	Height	Angl.	Loss	Antenn a factor	Peak-Corr.	Duty Cycle Corr. Factor	Avg-Corr.	Peak Limit	Avg Limit	Peak Margin	Avg. Margin
GHz	dB $\mu$ V/m		cm	deg	dB	dBm	dB $\mu$ V/m	dB	dB $\mu$ V/m	dB $\mu$ V/m	dB $\mu$ V/m	dB	dB
4.8099	42	H	202	299	-20.8	34.1	55.3	-24.97	30.33	74	54	18.7	23.67
4.8099	40.04	V	250	337	-20.8	34.1	53.34	-24.97	28.37	74	54	20.66	25.63
7.21697	40.46	H	244	360	-14.24	35.51	61.73	-24.97	36.76	74	54	12.27	17.24
7.21697	38.7	V	223	292	-14.24	35.51	59.97	-24.97	35	74	54	14.03	19
9.61996	32.12	H	113	292	-6.45	36.99	62.66	-24.97	37.69	74	54	11.34	16.31
9.61996	31.94	V	113	292	-6.45	36.99	62.48	-24.97	37.51	74	54	11.52	16.49

**Radiated Spurious Emissions – Middle Channel**

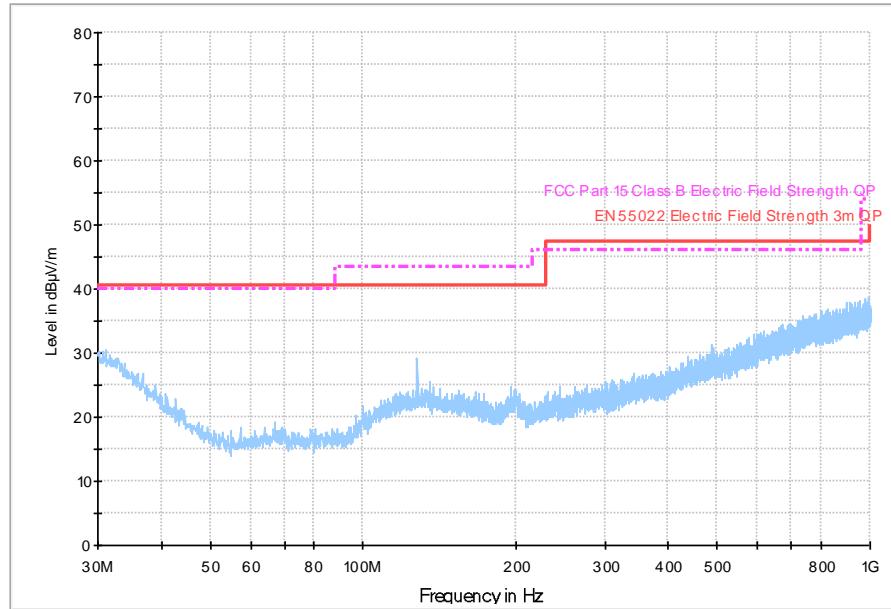
Freq.	Peak-Raw	Pol	Height	Angl.	Loss	Antenn a factor	Peak-Corr.	Duty Cycle Corr. Factor	Avg-Corr.	Peak Limit	Avg Limit	Peak Margin	Avg. Margin
GHz	dBuV/m		cm	deg	dB	dBm	dBuV/m	dB	dBuV/m	dBuV/m	dBuV/m	dB	dB
4.89597	45.47	H	281	52	-21.56	34.1	58.01	-24.97	33.04	74	54	15.99	20.96
4.89597	40.17	V	145	175	-21.56	34.1	52.71	-24.97	27.74	74	54	21.29	26.26
7320	35.37	H	233	48.4	-13.34	35.53	57.56	-24.97	32.59	74	54	16.44	21.41
7320	37.55	V	100	6	-13.34	35.53	59.74	-24.97	34.77	74	54	14.26	19.23
9760	30	H	154	31	-3.11	37.24	64.13	-24.97	39.16	74	54	9.87	14.84
9760	28.4	V	136	15	-3.11	37.24	62.53	-24.97	37.56	74	54	11.47	16.44

#### Radiated Spurious Emissions – High Channel

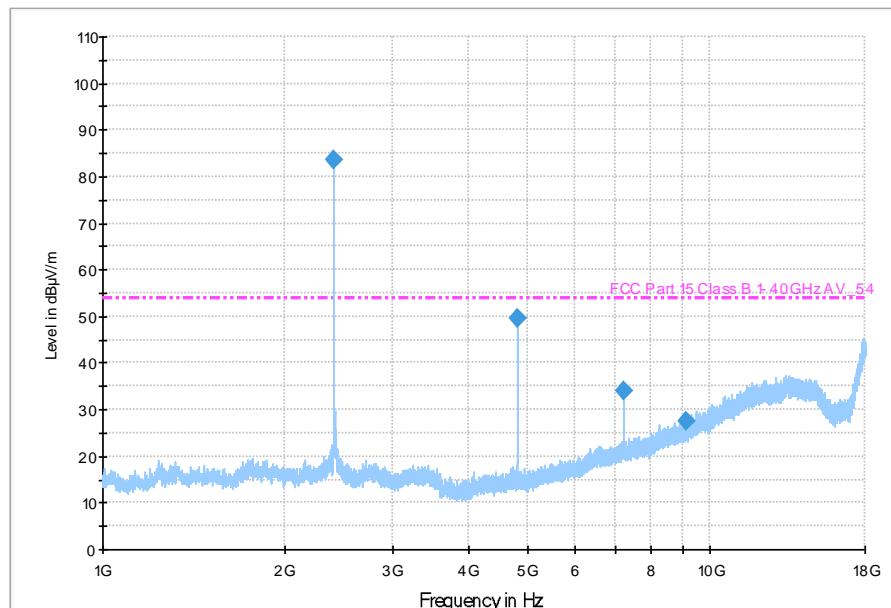
Freq.	Peak-Raw	Pol	Height	Angl.	Loss	Antenn a factor	Peak-Corr.	Duty Cycle Corr. Factor	Avg-Corr.	Peak Limit	Avg Limit	Peak Margin	Avg. Margin
GHz	dBuV/m		cm	deg	dB	dBm	dBuV/m	dB	dBuV/m	dBuV/m	dBuV/m	dB	dB
4.95994	53.77	H	125	27	-21.12	34.1	66.75	-24.97	41.78	74	54	7.25	12.22
4.95994	45.55	V	211	343	-21.12	34.1	58.53	-24.97	33.56	74	54	15.47	20.44
7.4399	38.68	H	125	56	-11.49	35.58	62.77	-24.97	37.8	74	54	11.23	16.2
7.4399	36.54	V	223	292	-14.24	35.58	57.88	-24.97	32.91	74	54	16.12	21.09
9.61996	30.6	H	190	309	-4.93	37.54	63.21	-24.97	38.24	74	54	10.79	15.76
9.61996	28.2	V	150	200	-4.93	37.54	60.81	-24.97	35.84	74	54	13.19	18.16



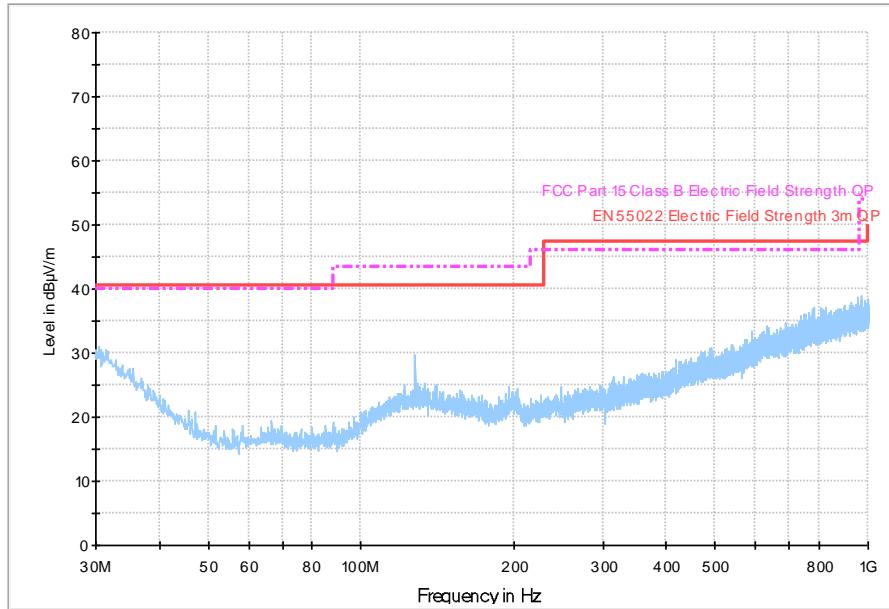
Radiated Emissions 30MHz – 1GHz, No-TX



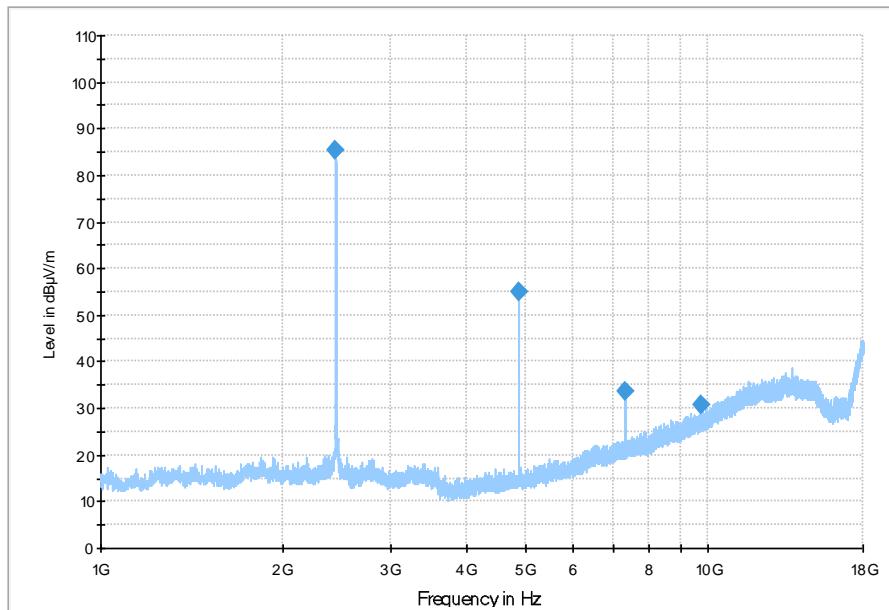
Low Channel Radiated Spurious Emissions 30MHz – 1GHz



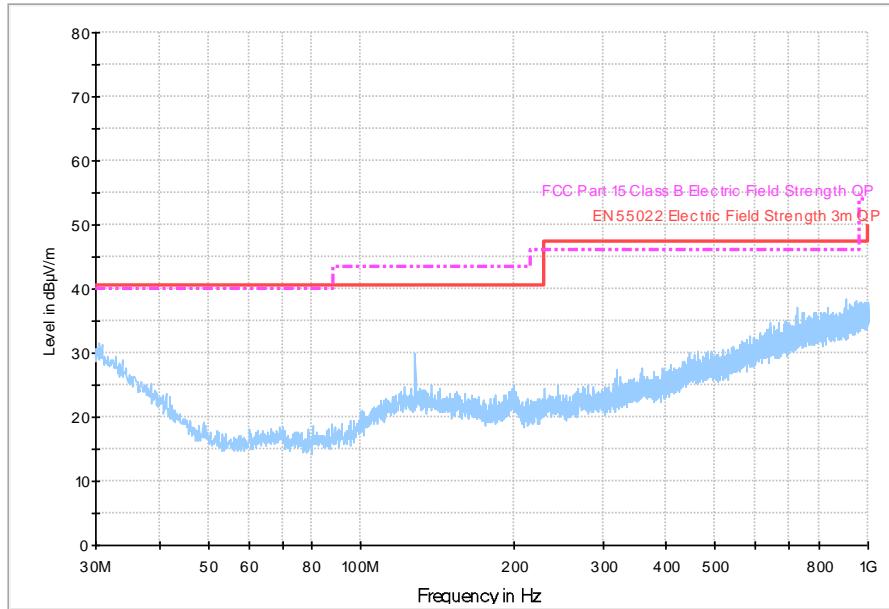
Low Channel Radiated Spurious Emissions 1 – 18GHz



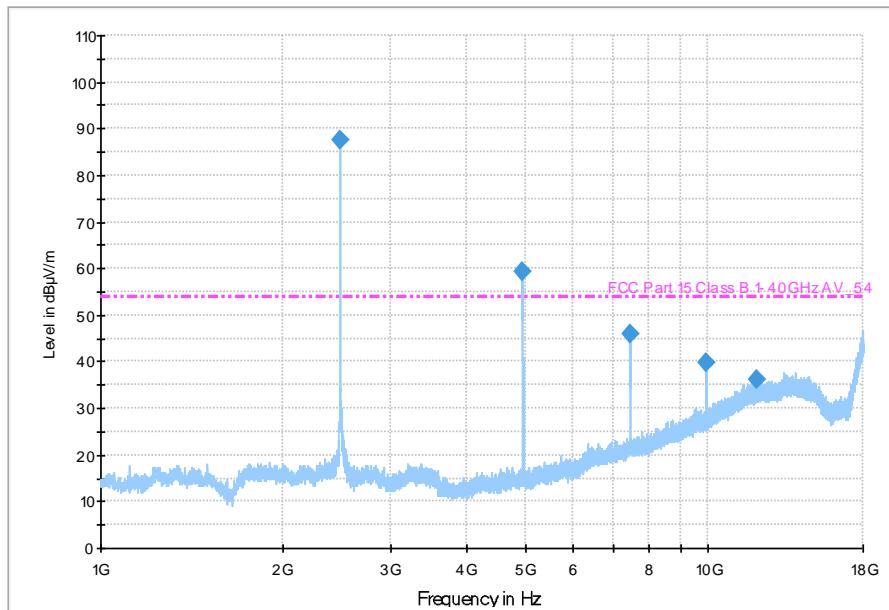
Middle Channel - Radiated Spurious Emissions 30MHz – 1GHz



Middle Channel - Radiated Spurious Emissions 1-18GHz



High Channel - Radiated Spurious Emissions 30MHz – 1000GHz



High Channel - Radiated Spurious Emissions 1 – 18GHz

## Part 9 - DUTY CYCLE CORRECTION FACTOR FOR RADIATED EMISSIONS

DATE: June-10-2015

TEST STANDARD: FCC Part 15.35 (d), FCC Part 15.209 (a) and ICES-003 Issue 5

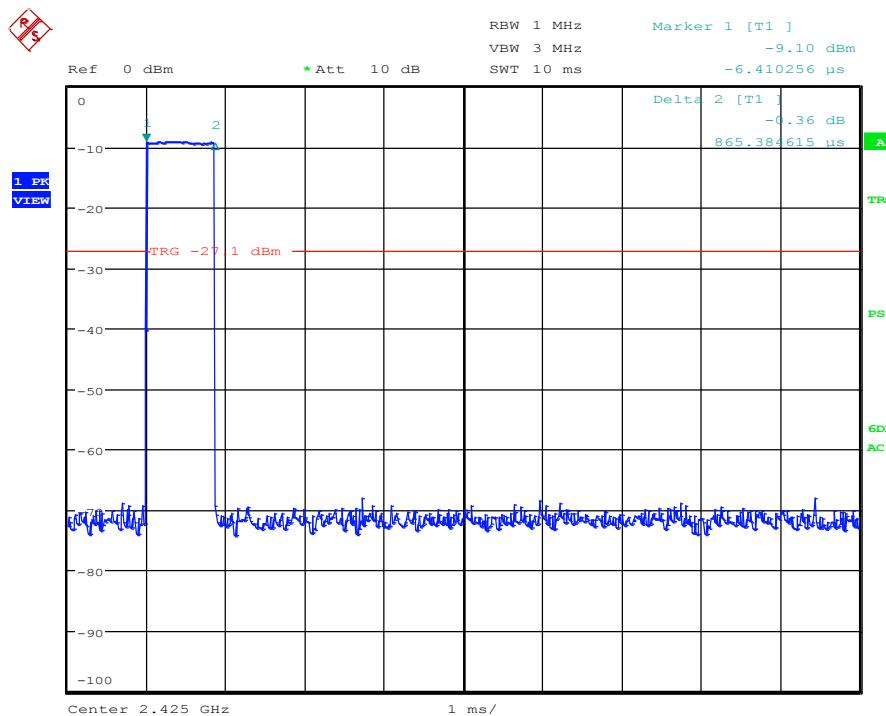
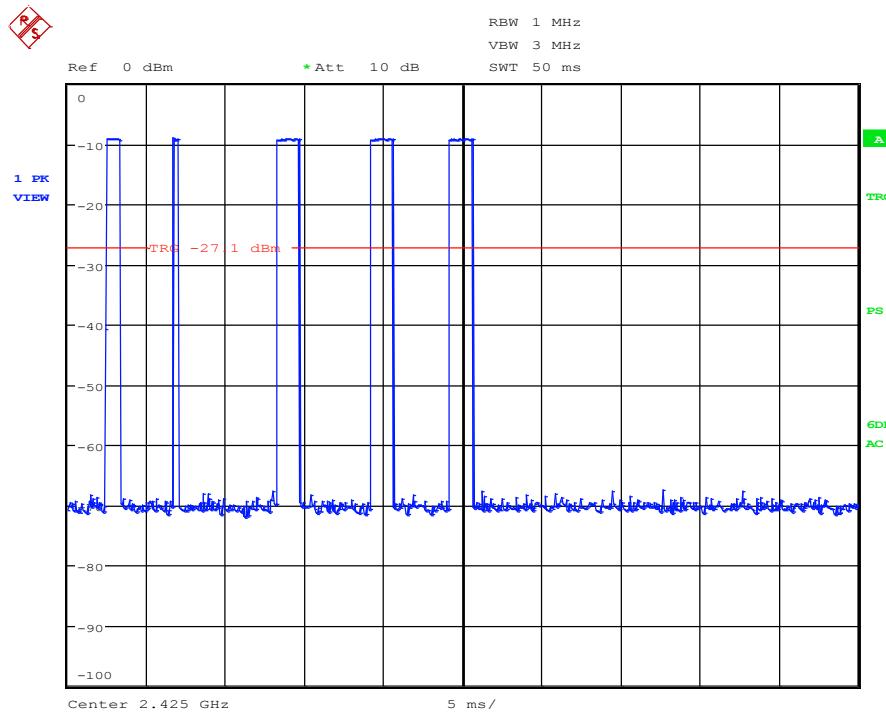
MEASUREMENT METHOD: The FCC regulations provide an allowance for correcting pulsed transmissions when the limits are expressed in terms of an average, and the average measurement may be derived from the peak pulse amplitude corrected for the duty cycle.

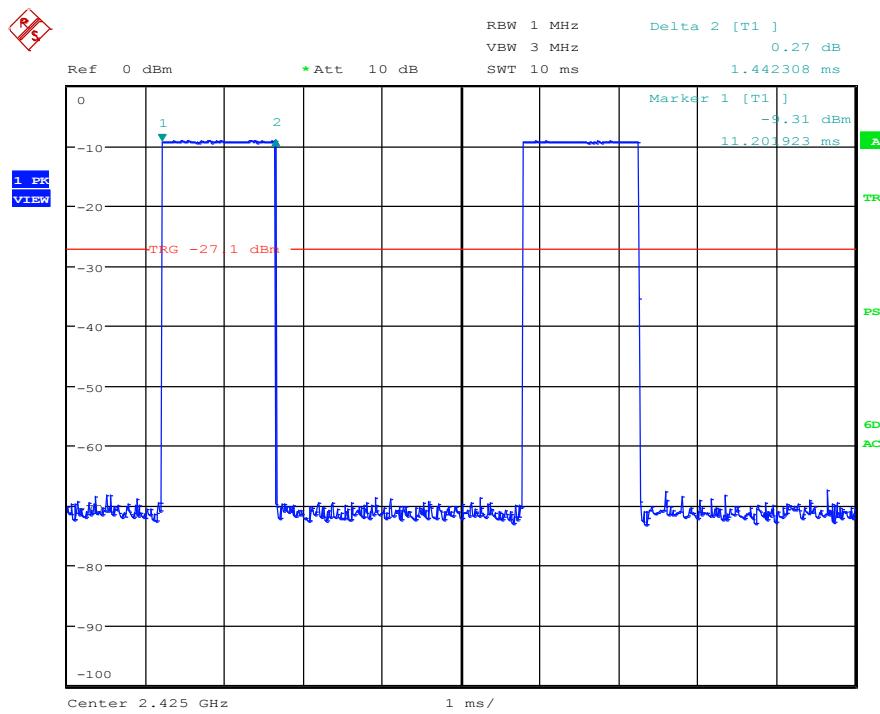
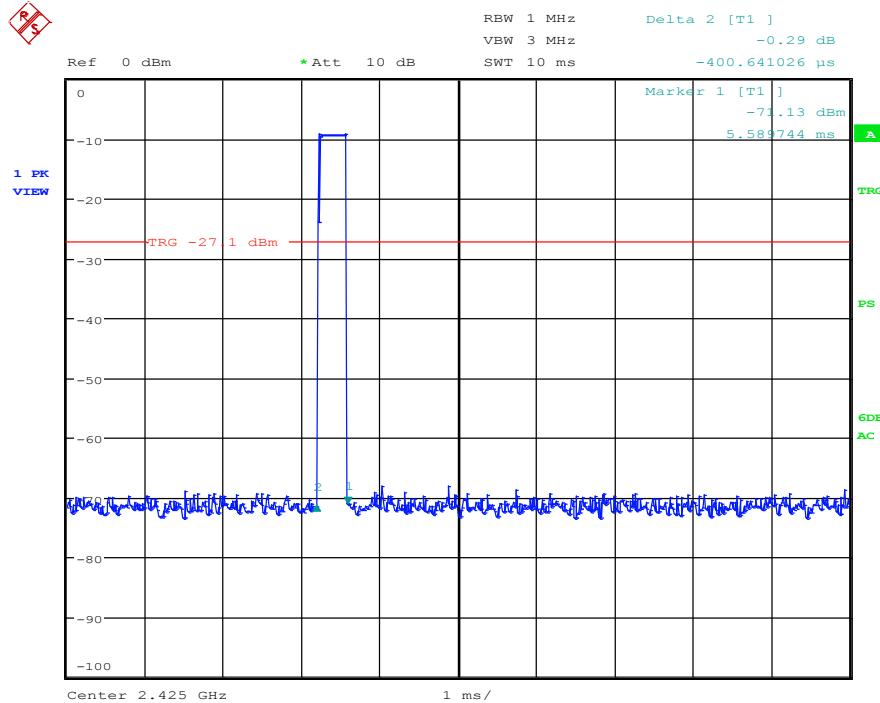
As detailed in 47 CFR Part 15.35(c), the correction factor of a transmission is a 100 ms capture of a characteristic pulse train of "on time". In the event that the pulse train is greater than 100 ms, the 100 ms pulse train captured must include a representation of worst-case "on time" pulses.

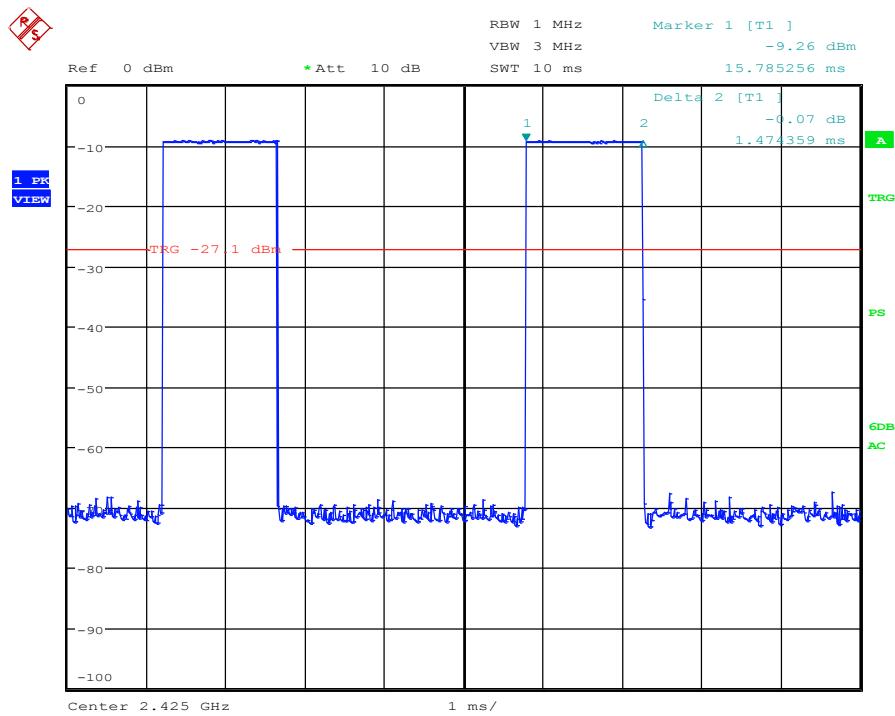
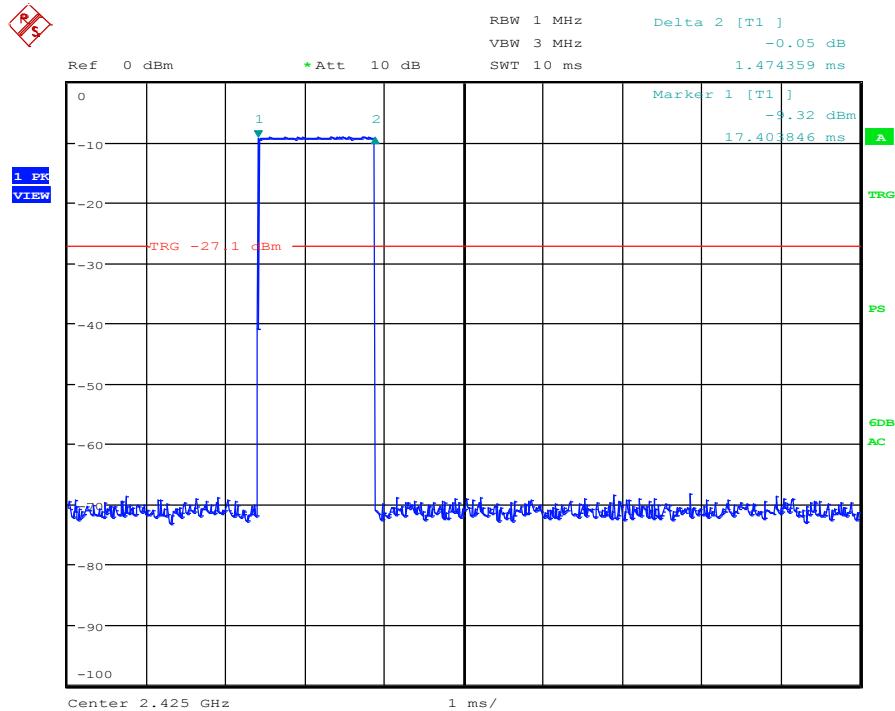
TEST SETUP: EUT was set up to operate in its normal mode of operation and communicating with data collector unit.

MEASUREMENT DATA & PLOT: Worst case duty cycle measured

Pulse 1 T(on)ms	0.87
Pulse 2 T(on)ms	0.40
Pulse 3 T(on)ms	1.44
Pulse 4 T(on)ms	1.47
Pulse 5 T(on)ms	1.47
Total T(on) ms	5.65
Duty Cycle Correction Factor(dB)	-24.97







## Part 10 - RF Exposure Evaluation

DATE: June-25-2015

FCC 1.1310 states the criteria listed in the table below shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Section 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Section 2.1093. Further information on evaluating compliance with these limits can be found in the FCC's OST/OET Bulletin Number 65, "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation".

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Average Time (s)
(A) Limits for Occupational/Control Exposures				
300-1500	-	-	F/300	6
1500-100,000	-	-	5	6
(B) Limits for General Population/Uncontrolled Exposures				
300-1500	-	-	F/1500	6
1500-100,000	-	-	1	30

TABLE 1 - POWER DENSITY LIMITS

### RF EXPOSURE EVALUATION DISTANCE CALCULATION

- Maximum gain of antenna: 2.2 dBi
- Highest measured conducted power output: 16.1dBm
- From the above Table, the Maximum Power Density safe exposure level for General Population Uncontrolled Exposure of 30 Seconds for the frequency range of 2.4 to 2.4835GHz is 1mW/cm<sup>2</sup>.

Conducted Output Power	Max Antenna Gain	Max EIRP	Max EIRP	Power Density Limit	Safe distance
dBm	dBi	dBm	mW	mW/cm <sup>2</sup>	cm
16.1	2.2	18.3	67.5	1.0	2.3

$$d = \sqrt{\left(\frac{EIRP}{4\pi S}\right)}$$

where: d = Distance to the center of radiation of the antenna (cm) for the allowable  
 S = Allowable Power density Limit (mW/cm<sup>2</sup>)  
 EIRP = Equivalent isotropically radiated power (mW)

As shown above, the minimum distance where the MPE limit is reached is 2.3 cm from the EUT with the 2.2dBi antenna.

It is recommended that the unit is positioned so that the typical distance from the antenna to the end user is 20cm or greater.

## Part 11 - Frequency Stability

DATE: June-22-2015

TEST STANDARD: FCC Part 15.215(c) and RSS-Gen Issue 4 (8.11)

MINIMUM STANDARD: Not specified.  
RSS-Gen (8.8): Transmitter frequency stability for licence-exempt radio apparatus shall be measured in accordance with Section 6.11. For licence-exempt radio apparatus, the frequency stability shall be measured at temperatures of -20°C (-4°F), +20°C (+68°F) and +50°C (+122°F) instead of at the temperatures specified in Section 6.11. If the frequency stability of the licence-exempt radio apparatus is not specified in the applicable standard (RSS), measurement of the frequency stability is not required provided that the occupied bandwidth of the licence-exempt radio apparatus lies entirely outside the restricted bands and the prohibited TV bands of 54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-806 MHz.  
FCC (15.215(c)): The 20dB bandwidth must remain within the designated frequency band over the expected variations in temperature and voltage range

TEST SETUP: The EUT was bench tested and in our temperature chamber. Due to the outdoor location and mounting method of the EUT, the EUT voltage and temperature range was specified by the manufacturer and verified at 2.6, 3 and 5Vdc; +50 to -30° Celsius. The transmitter was set for Carrier Wave (CW) mode and the lowest and highest channel Frequency was measured at each Temperature setting, after the Transmitter stabilized at the temperature.

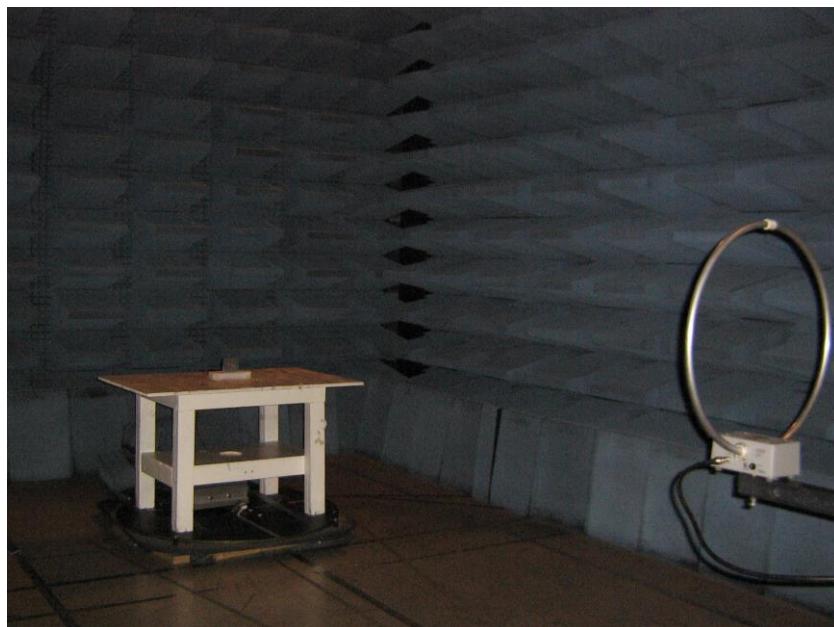
MEASUREMENT METHOD: Measurements were made using a Spectrum Analyzer with 120kHz RBW Average detector while directly connected to the EUT through the antenna port.

DEVICE DESCRIPTIONS: As described in the above EUT description and setup section

Measurement Data:

Voltage	Temp	Channl	Frequency	Freq Shift	Freq Shift PPM	Uncorrctd MxPeak	Cable Loss	Antena Gain	Conducted Power
	DegC	MHz	MHz	KHz	PPM	dBm	dB	dBi	dBm
3.7V	-30.0	Low	2404.85687500	4.37	1.82	-6.78	22.62	2.2	18.04
		Mid	2439.87562500	-31.88	-13.06	-6.62	22.79	2.2	18.37
		High	2479.88750100	-56.88	-22.94	-6.84	22.66	2.2	18.02
3v	-30.0	Low	2404.87562500	-14.38	-5.98	-7.08	22.62	2.2	17.74
		Mid	2440.04562500	-201.88	-82.74	-7.45	22.79	2.2	17.54
		High	2479.73500000	95.62	38.56	-8.00	22.66	2.2	16.86
2.073V	-30.0	Low	2404.90375000	-42.50	-17.67	-9.86	22.62	2.2	14.96
		Mid	2439.91687500	-73.12	-29.97	-10.96	22.79	2.2	14.03
		High	2479.81125000	19.37	7.81	-11.29	22.66	2.2	13.57
3.7V	-20.0	Low	2404.89812500	-36.88	-15.33	-6.81	22.62	2.2	18.01
		Mid	2439.91625000	-72.50	-29.72	-7.17	22.79	2.2	17.82
		High	2479.78062500	50.00	20.16	-7.05	22.66	2.2	17.81
3.7V	-10.0	Low	2404.92562500	-64.37	-26.77	-7.20	22.62	2.2	17.62
		Mid	2439.84812500	-4.37	-1.79	-7.57	22.79	2.2	17.42
		High	2479.85687500	-26.25	-10.59	-7.39	22.66	2.2	17.47
3.7V	0.0	Low	2404.88187500	-20.63	-8.58	-7.54	22.62	2.2	17.28
		Mid	2439.97500000	-131.25	-53.79	-7.87	22.79	2.2	17.12
		High	2479.83625000	-5.62	-2.27	-7.69	22.66	2.2	17.17
3.7V	10.0	Low	2405.01375000	-152.50	-63.41	-7.87	22.62	2.2	16.95
		Mid	2439.74875000	95.00	38.94	-8.24	22.79	2.2	16.75
		High	2479.85125000	-20.63	-8.32	-8.12	22.66	2.2	16.74
3.7V	20.0	Low	2404.86125000	0	0	-8.24	22.62	2.2	16.58
		Mid	2439.84375000	0	0	-8.58	22.79	2.2	16.41
		High	2479.83062500	0	0	-8.52	22.66	2.2	16.34
3.7V	30.0	Low	2404.95230100	-91.05	-37.86	-8.58	22.62	2.2	16.24
		Mid	2439.84190300	1.85	0.76	-9.03	22.79	2.2	15.96
		High	2479.97458100	-143.96	-58.05	-8.94	22.66	2.2	15.92
3.7V	40.0	Low	2405.02111900	-159.87	-66.48	-9.03	22.62	2.2	15.79
		Mid	2439.90204200	-58.29	-23.89	-9.52	22.79	2.2	15.47
		High	2479.88282200	-52.20	-21.05	-9.52	22.66	2.2	15.34
3.7V	50.0	Low	2404.86116300	0.09	0.04	-9.61	22.62	2.2	15.21
		Mid	2439.83694300	6.81	2.79	-10.10	22.79	2.2	14.89
		High	2479.82826300	2.36	0.95	-10.13	22.66	2.2	14.73
3.7V	60.0	Low	2404.86625000	-5.00	-2.08	-10.38	22.62	2.2	14.44
		Mid	2439.85562500	-11.88	-4.87	-10.83	22.79	2.2	14.16
		High	2479.94687500	-116.25	-46.88	-10.90	22.66	2.2	13.96
3.7V	70.0	Low	2404.86062500	0.63	0.26	-10.96	22.62	2.2	13.86
		Mid	2439.93437500	-90.62	-37.14	-11.48	22.79	2.2	13.51
		High	2479.88312500	-52.50	-21.17	-11.69	22.66	2.2	13.17
3.7V	80.0	Low	2404.86750000	-6.25	-2.60	-11.75	22.62	2.2	13.07
		Mid	2439.90187500	-58.13	-23.82	-12.30	22.79	2.2	12.69
		High	2479.80687500	23.75	9.58	-12.57	22.66	2.2	12.29
3V	80.0	Low	2404.87937500	-18.13	-7.54	-12.15	22.62	2.2	12.67
		Mid	2439.84937500	-5.62	-2.31	-12.67	22.79	2.2	12.32
		High	2479.80437500	26.25	10.59	-13.03	22.66	2.2	11.83
1.981V	80.0	Low	2404.81562500	45.62	18.97	-14.13	22.62	2.2	10.69
		Mid	2439.94687500	-103.13	-42.27	-14.74	22.79	2.2	10.25
		High	2479.91250000	-81.87	-33.02	-15.14	22.66	2.2	9.72

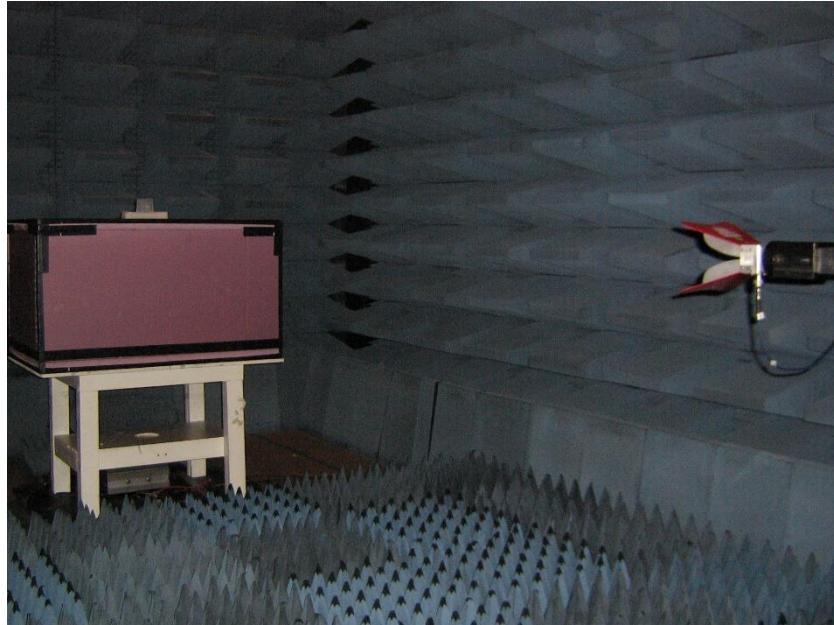
## Appendix A: photos during the testing



Radiated Emissions Setup in Semi-Anechoic Chamber, 150 kHz-30MHz



Radiated Emissions Setup in Semi-Anechoic Chamber, 30MHz-1GHz



Radiated Emissions Setup in Semi-Anechoic Chamber, 1GHz-18GHz



Radiated Emissions Setup in Semi-Anechoic Chamber, 18GHz-26GHz



The EUT Setup in Semi-Anechoic Chamber