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Coquitlam, British Columbia
Canada V3K 4X9

ELECTROMAGNETIC COMPATIBILITY TEST REPORT TO FCC 47 CFR Part 15 Subpart B & Subpart C 15.247 RSS-247 Issue 1, ICES-003 Issue 5 & RSS-Gen Issue 4

Report Number:	E10739-1501_NYCE-NCZ3010
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Testing laboratory:	Quality Auditing Institute
Address:	3980 North Fraser Way, Burnaby, BC, V5J 5K5, 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:	NYCE SENSORS INC.
Address:	1625 Ingleton Ave, Burnaby BC, Canada V5C 4L8
Phone :	(604) 428-4813
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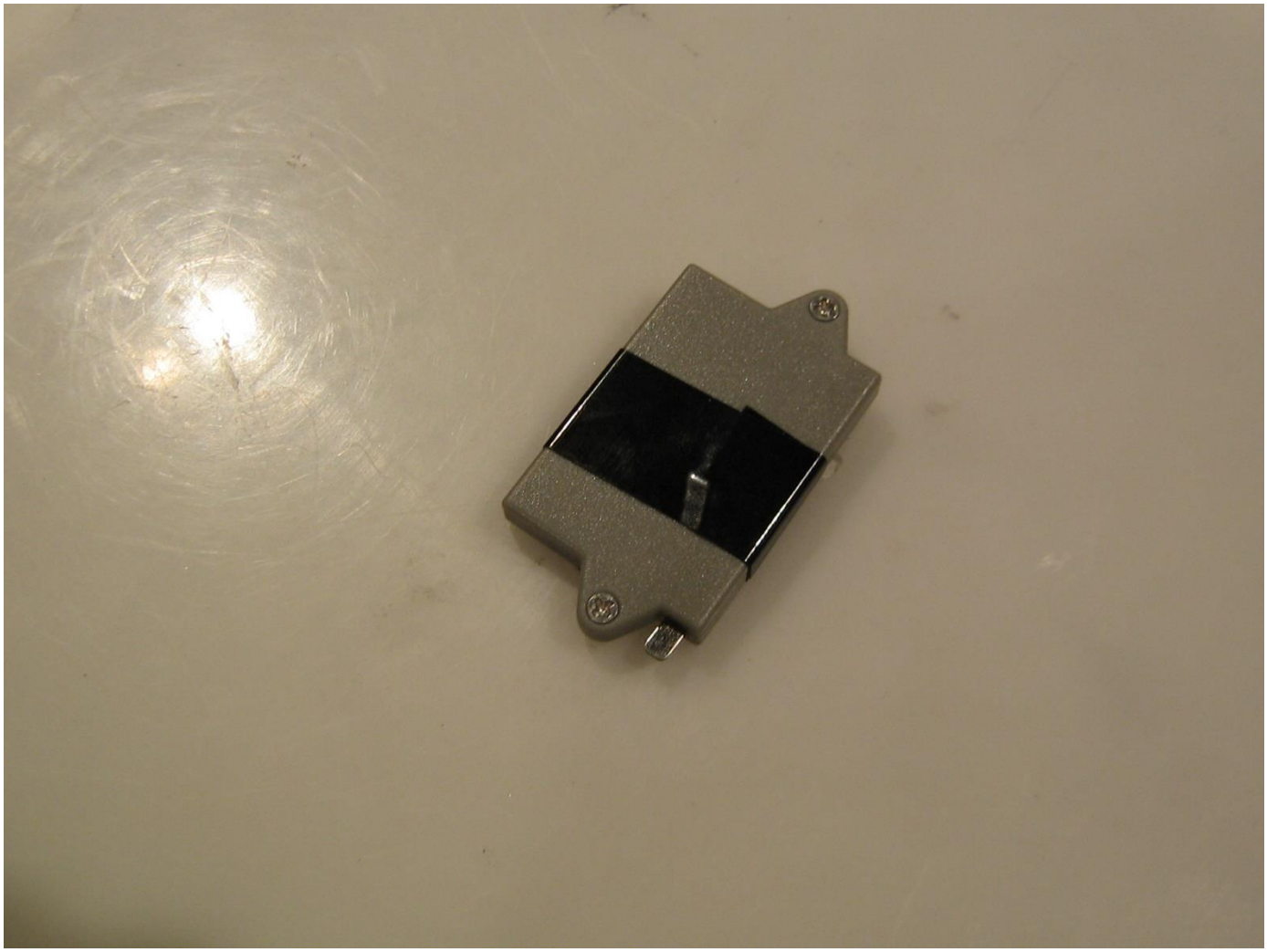
Test Standard:	FCC 47 CFR Part 15 Subpart B & Subpart C 15.247 RSS-247 Issue 1, ICES-003 Issue 5 & RSS-Gen Issue 4

Equipment under Test (EUT):	Door Hinge Sensor, NCZ-3010
EUT Description:	Door Hinge Sensor
Manufacturer:	NYCE SENSORS INC.
Model Number:	NCZ-3010

FCC Registration (FRN):	0020548871
FCC ID:	Y8R -Z30101
IC Certification Number:	9488A-Z30101



NCZ-3010 (EUT)

The following tests demonstrate the testimony to "FCC & IC" Mark Electromagnetic compatibility testing for "NCZ-3010" manufactured by NYCE SENSORS INC.

Test	Standard	Description	Date	Result
Antenna requirement	FCC 47 CFR Part 15.203 RSS-Gen Issue4 8.3	Soldered, non-replaceable antenna	December 1, 2015	Complies
RF Peak Power Output	FCC Part 15.247 (b)(3) RSS-247 Issue 1	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.	October 26,2015	Complies
Occupied Bandwidth 6dB Bandwidth	FCC Part 15.247 (a)(2) RSS-247 Issue 1	The minimum -6 dB bandwidth shall be at least 500 kHz.	October 27,2015	Complies
99% Occupied Bandwidth	RSS-Gen Issue 4	The Bandwidth to be reported	October 27,2015	Complies
Power Spectral Density	FCC Part 15.247 (e) RSS-247 Issue 1	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	October 27,2015	Complies
Out-of-band Emissions (Band Edge)	FCC Part 15.247 (d) RSS-247 Issue 1	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.	November 27, 2015	Complies
Conducted Spurious Emissions	FCC Part 15.247 (d) RSS-247 Issue 1	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.	June-03-2015	Complies
Radiated Spurious Emissions-Transmit Mode	FCC Part 15.247 (d) FCC Part 15.209 (a) RSS-247 Issue 1 RSS Gen Issue 3	Radiated emissions requirements as stated in the Standards.	November 12, 2015	Complies
Duty Cycle Correction	FCC Part 15.35(C) RSS-GEN,RSS-210	Measurement and Calculation for duty cycle correction as stated in the standards.	November 17,2015	Complies
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	December 1, 2015	Complies
Frequency Stability	FCC Part 15.215(c) & RSS-Gen Issue 4 (8.11)	Frequency Stability measurements were performed at extreme temperature conditions	November 17,2015	Complies
Radiated Emissions Testing (Unintentional Mode)	FCC CFR47 Part 15 Subpart B; RSS Gen issue 4, ICES-003 Issue 5	FCC CFR47 Part 15 Subpart B Class B Limits	November 12, 2015	Complies

Tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC 47 CFR Part 15 Subpart B & Subpart C 15.249, RSS-247 Issue 1, ICES-003 Issue 5 & RSS-Gen Issue 4. 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.

X 

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

X 

Reviewed by Aman Jathaul,
EMC Project Manager

Revision History

Date	Report Number	Rev #	Details	Authors Initials
November 25, 2015	E10739-1501_NYCE-NCZ3010	0.0	Draft Test Report	JQ
December 30, 2015	E10739-1501_NYCE-NCZ3010	1.0	Final Test Report	JQ
January 8, 2016	E10739-1501_NYCE-NCZ3010	2.0	Final Test Report	JQ
February 18, 2016	E10739-1501_NYCE-NCZ3010	3.0	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.

Table of Contents

Section I: PRODUCT DESCRIPTION

EUT	NCZ-3010
Manufacturer	NYCE SENSORS INC.
Model Number	NCZ-3010
FCC ID	Y8R -Z30101
IC Number	9488A-Z30101
Frequency Range	2405-2480 MHz
Transmit Power	1.2 mW Max
Modulation	O-QPSK
Number of Channels	16
Voltage Ratings	3V Battery
Software and Firmware	B81

ANTENNA DESCRIPTION

Description	2.45 GHz Chip Antenna
Manufacturer	Johanson Technology
Part Number	2450AT18A100
Frequency Range	2400-2500 MHz
Gain	-0.5 dBi typical (XZ-V)
Impedance	50 Ohms
Max Power	500mW Max
Return Loss	9.5 dB Min
Length	3.2 mm
Width	1.6 mm
Operating Temperature	-40 to +85 °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: 3980 North Fraser Way, Burnaby, BC, V5J 5K5, Canada

FCC Test Site Registration Number:
(3 m /10 m Open Area Test Site [OATS]: 226383
FCC Test Site Registration Number:
(3 m SAC) : 307482
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

ENVIROMENTAL CONDITIONS: INDOORS

Temperature: 22-28ºC 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-2016
ETS Lindgren	3117	Horn Antenna 1GHz-18GHz	00075944	29-Aug-2013	29-Aug-2016
EMCO	3160-09	Horn Antenna 18GHz-26.54GHz	9701-1071	30-Aug-13	30-Aug-16
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	14I00048S NO050	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:	December 1, 2015
TEST STANDARD:	FCC 47 CFR Part 15.203 and RSS-Gen Issue4 8.3
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 device is assembled with a soldered, non-replaceable antenna.

Part 2 - RF Peak Power Output

DATE: October 26,2015

TEST STANDARD: FCC Part 15.247 (b)(3), RSS-247 Issue 1, RSS-102 section 2.5.2.

TEST REQUIREMENT: FCC Part 15.247 (b)(3): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: **1 Watt.**

RSS-247 Issue 1: For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed **1W**. Except as provided in Section 5.4(5), the e.i.r.p. shall not exceed 4 W.

Note: 1W = **30dBm**

RSS-102 section 2.5.2.: 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: • 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 x 10-2 f0.6834 W (adjusted for tune-up tolerance), where f is in MHz;

1.31 x 10-2 f0.6834 W = 2.7W = **34dBm**, where f=2480MHz.

MEASUREMENT METHOD: As called by the standards above.

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

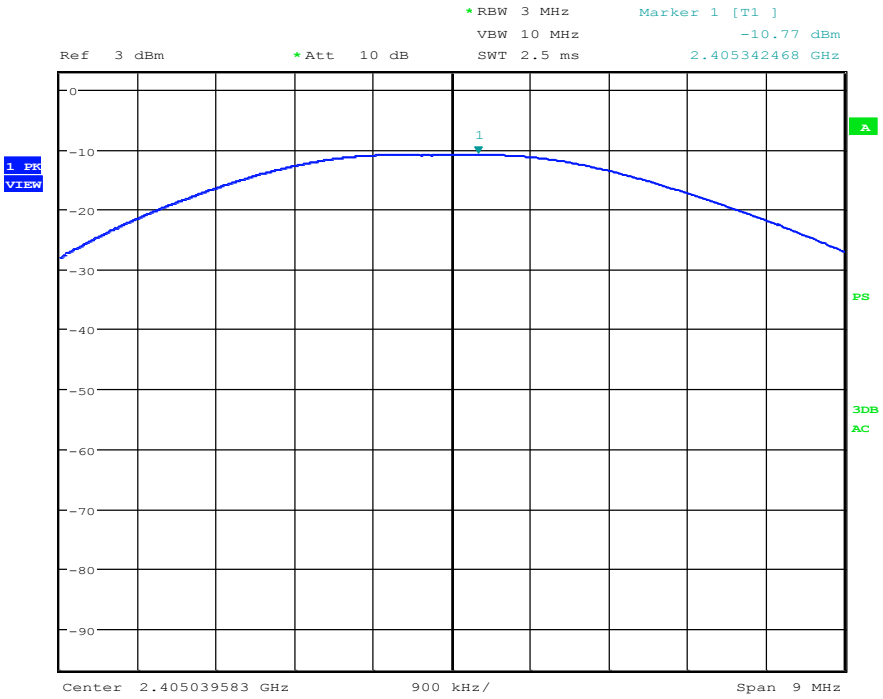
RESULTS: Pass: Complies.

EMISSIONS DATA: Conducted Output Power Measurements

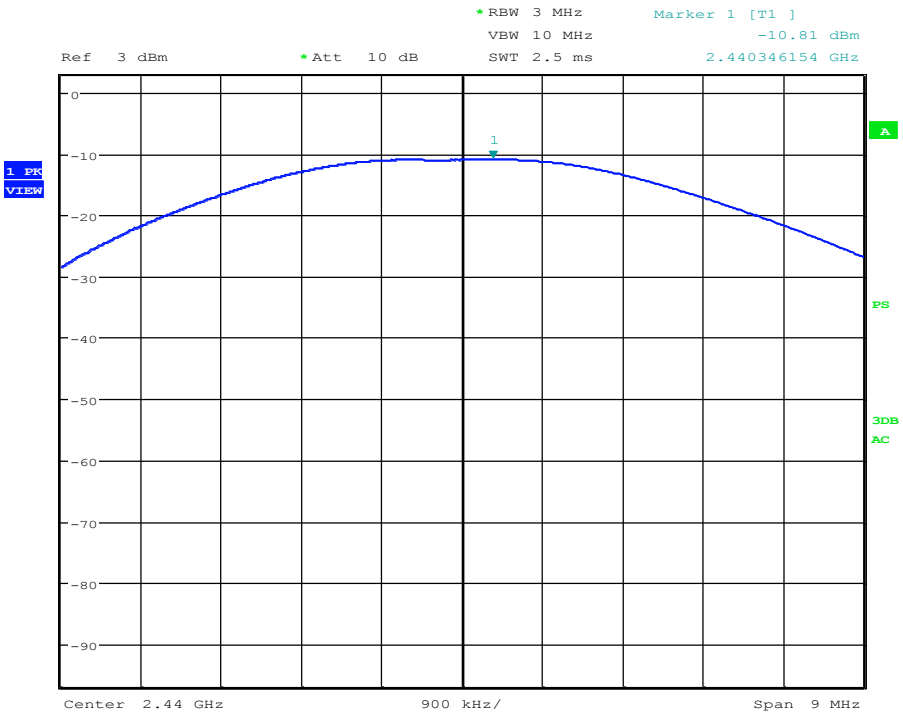
Channel	Frequency (GHz)	Un-Corr (dBm)	Cable Loss (dB)	Conducted Power (dBm)	Limit (dBm)	RSS-102 section 2.5.2 Limit (dBm)
Low	2405.32	-10.77	11.38	0.61	30	34
Mid	2439.41	-10.81	11.37	0.56	30	34
High	2479.49	-10.78	11.56	0.78	30	34

EIRP Measurements

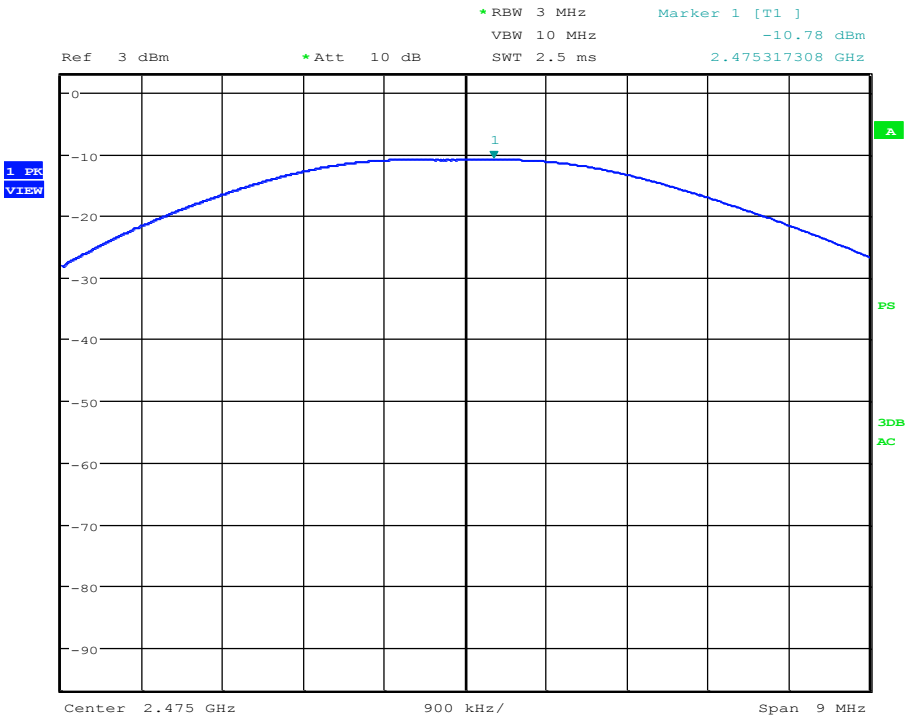
Channel	Frequency (GHz)	Peak at 3m (dBuV/m)	3m EIRP (dBm)	Limit (dBm)	RSS-102 section 2.5.2 Limit (dBm)
Low	2405.32	97.38	4.82	30	34
Mid	2439.41	98.87	6.31	30	34
High	2479.49	95.25	-0.01	30	34



Peak Power, Low Channel



Peak Power, Mid Channel



Peak Power, High Channel

Part 3 - Occupied Bandwidth 6dB Bandwidth

DATE: October 27,2015

TEST STANDARD: FCC Part 15.247 (a) (2), RSS-247 Issue 1

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.

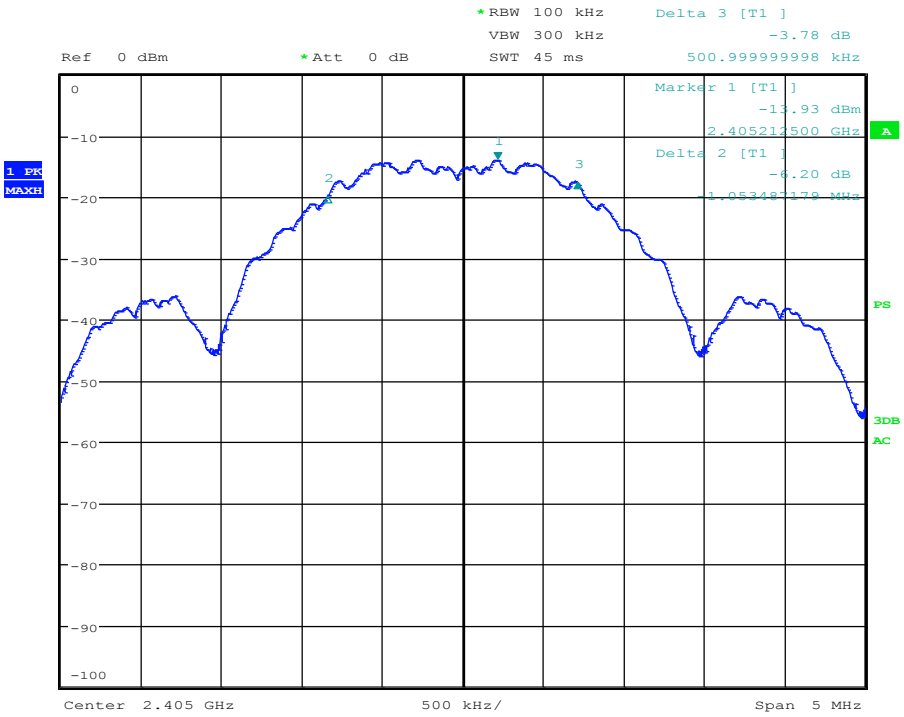
DEVICE DESCRIPTIONS: As described in the above EUT description and set up section.

MEASUREMENT DATA:

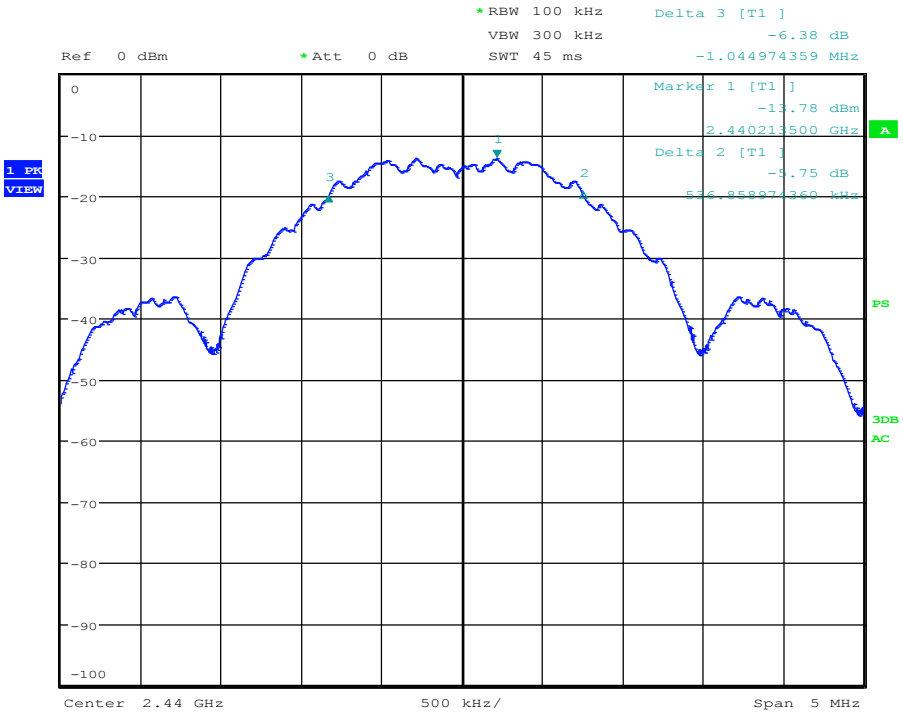
Channel	Frequency (MHz)	6dB Bandwidth (MHz)
Low	2405	1.55
Mid	2440	1.57
High	2480	1.60

RESULTS: Pass: Complies.

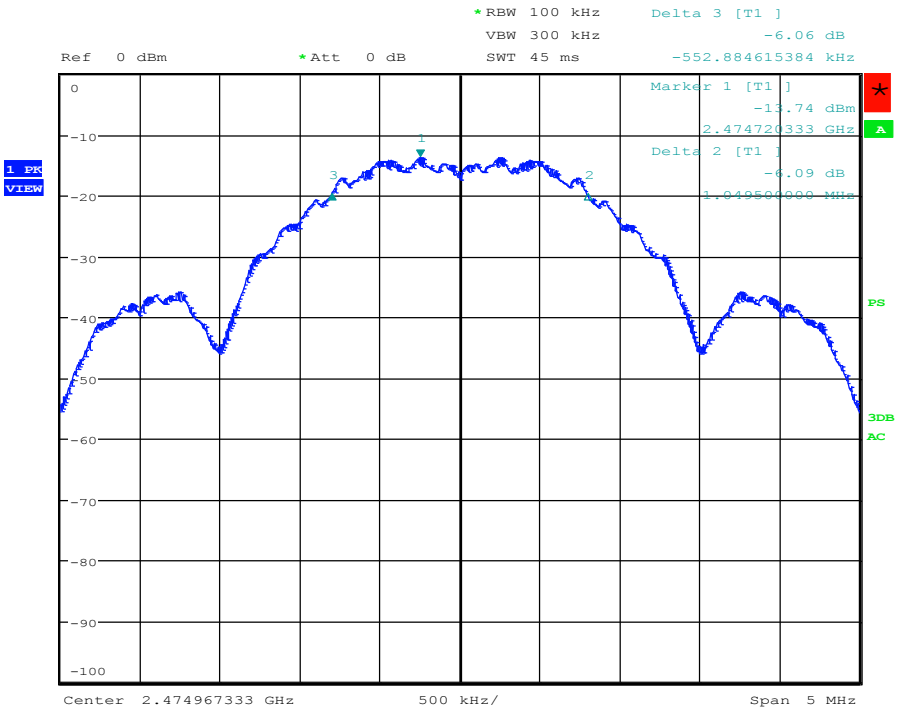
MEASUREMENT PLOT:



LOW CHANNEL – 6dB OCCUPIED BANDWIDTH



MID CHANNEL – 6dB OCCUPIED BANDWIDTH



HIGH CHANNEL – 6dB OCCUPIED BANDWIDTH

Part 4 - 99% Occupied Bandwidth

DATE: October 27, 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.

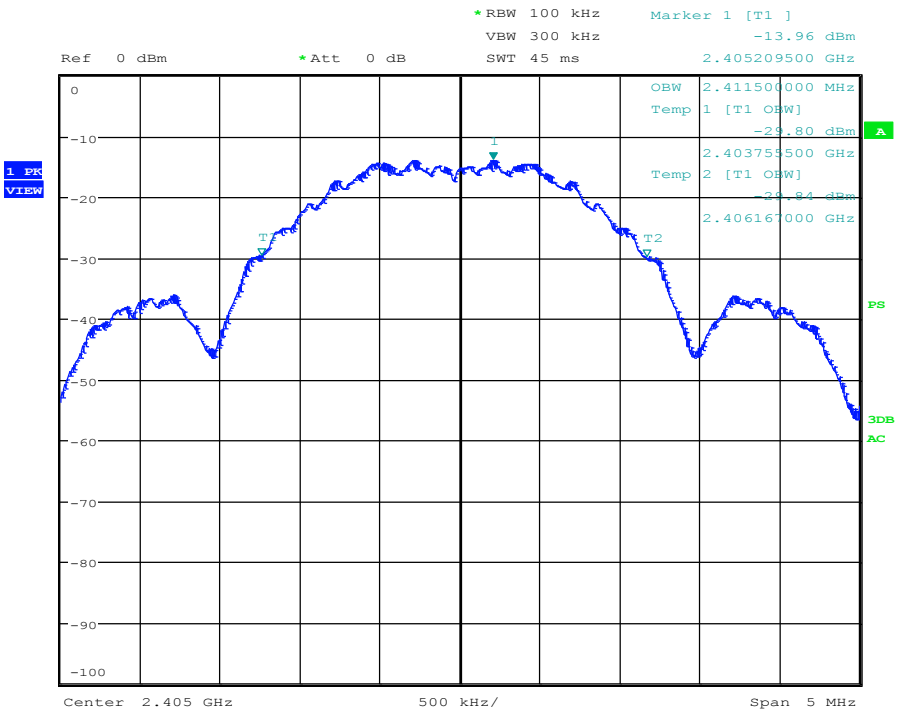
MEASUREMENT DATA:

Channel	Frequency	99% Bandwidth
	MHz	MHz
Low	2402	2.4115
Mid	2440	2.3975
High	2480	2.42

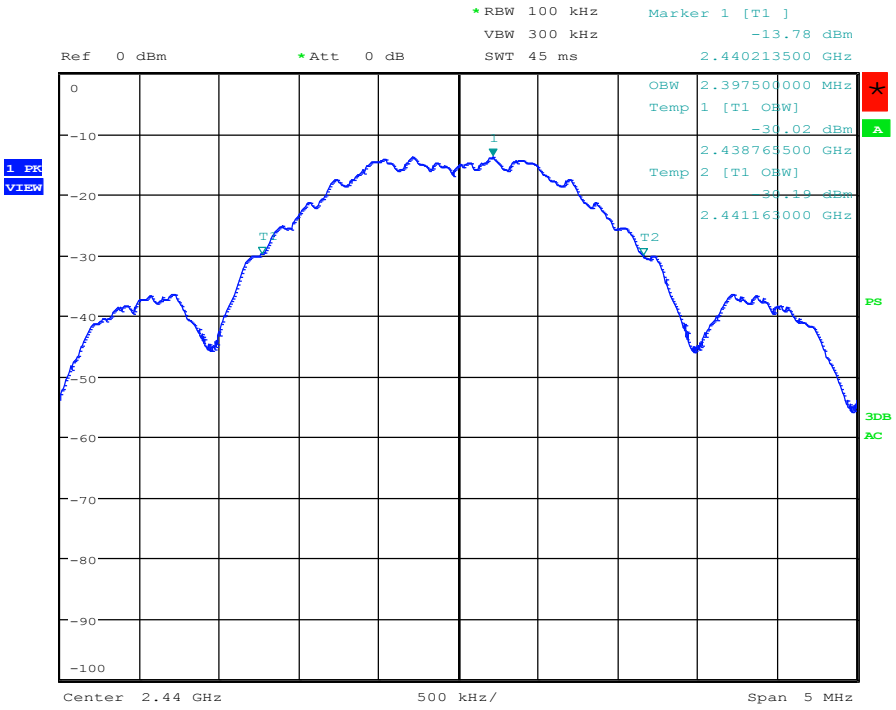
OBSERVATIONS: The EUT performed as expected.

PERFORMANCE: Complies

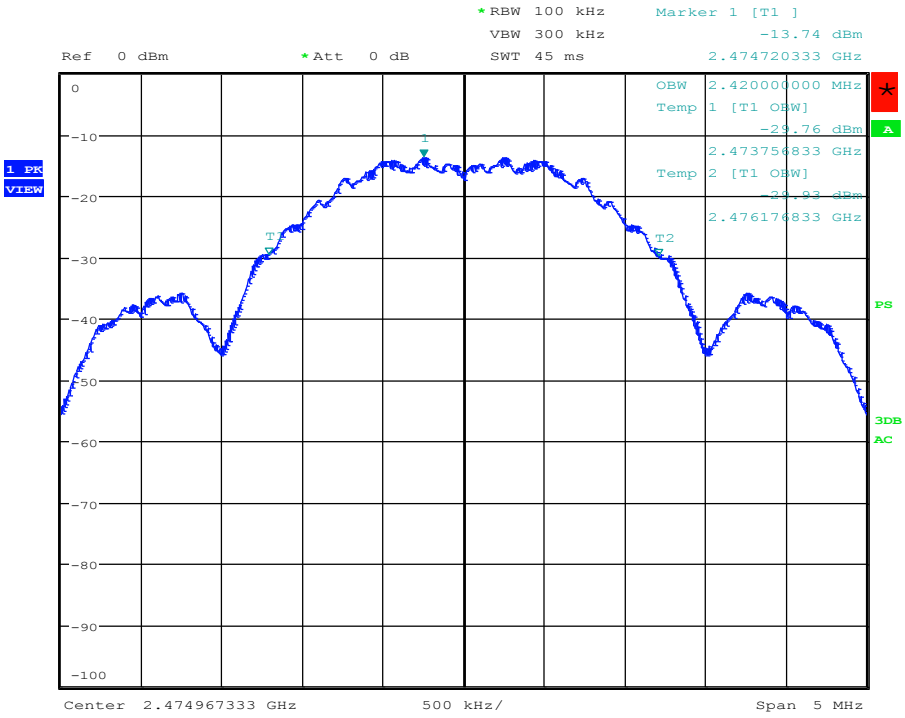
MEASUREMENT PLOT:



LOW CHANNEL – 99% OCCUPIED BANDWIDTH



MIDDLE CHANNEL – 99% OCCUPIED BANDWIDTH



HIGH CHANNEL – 99% OCCUPIED BANDWIDTH

Part 5 - Power Spectral Density

DATE: October 27,2015

TEST STANDARD: FCC Part 15.247 (e) and RSS 247 Issue 1

TEST METHOD: As called by the standards above

MINIMUM STANDARD: 8 dBm in any 3 kHz band

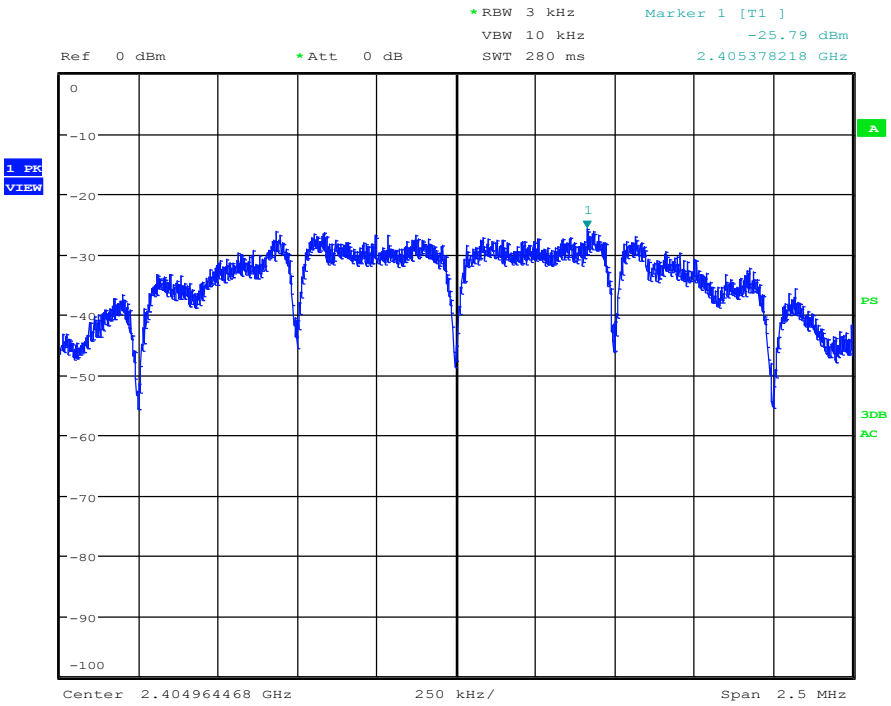
TEST SETUP: The EUT was connected to the DUT in conducted mode likewise for output power measurements.

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

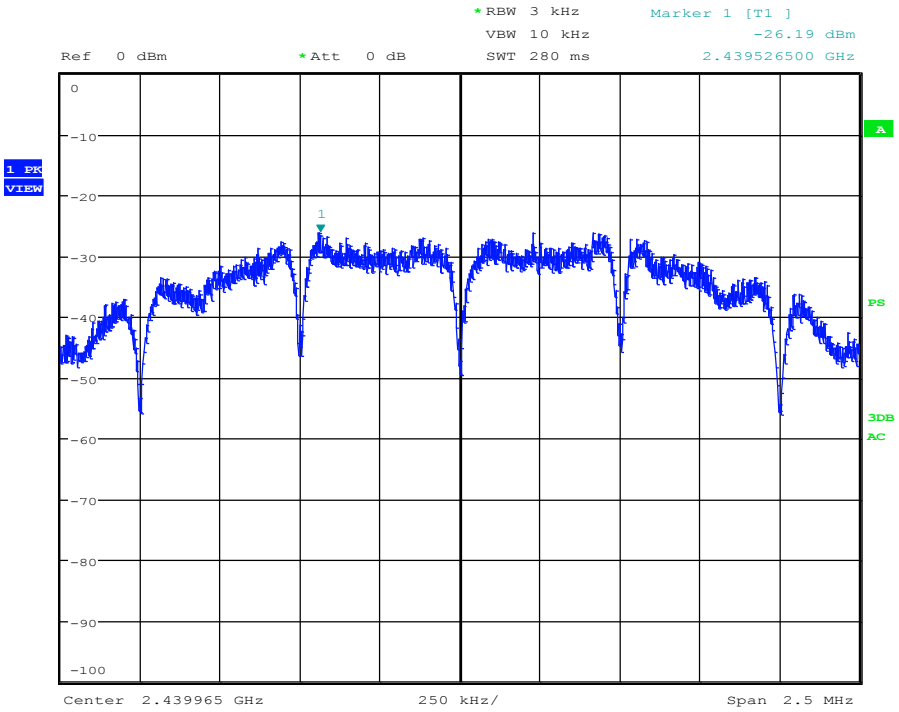
PERFORMANCE: Complies with Standard

MEASUREMENT DATA & PLOT:

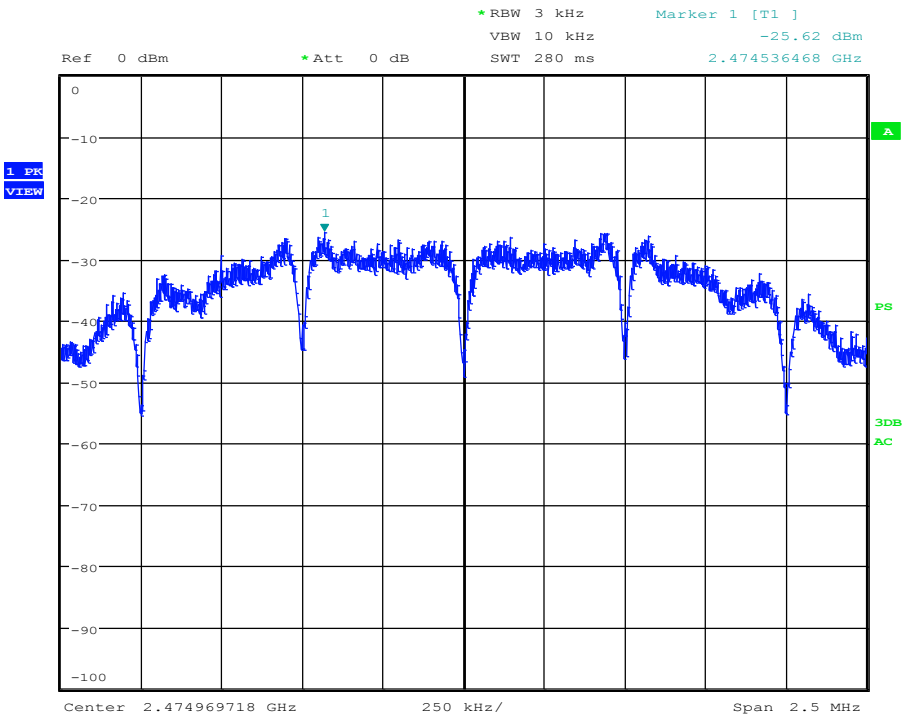
Channel	Frequency	Un-Corrected PSD	Cable Loss	Corrected PSD	Limit	Results
	(GHz)	(dBm)	(dB)	(dBm)	(dBm)	Pass/Fail
Low	2.405	-25.79	11.38	-14.41	8	Pass
Mid	2.44	-26.19	11.37	-14.82	8	Pass
High	2.48	-25.62	11.56	-14.06	8	Pass



LOW CHANNEL - POWER SPECTRAL DENSITY



MID CHANNEL - POWER SPECTRAL DENSITY



HIGH CHANNEL - POWER SPECTRAL DENSITY

Part 6 - Out of Band Emissions (Band Edge)

DATE: November 27, 2015

TEST STANDARD: FCC Part 15.247 (d) and RSS 247 Issue 1 5.5

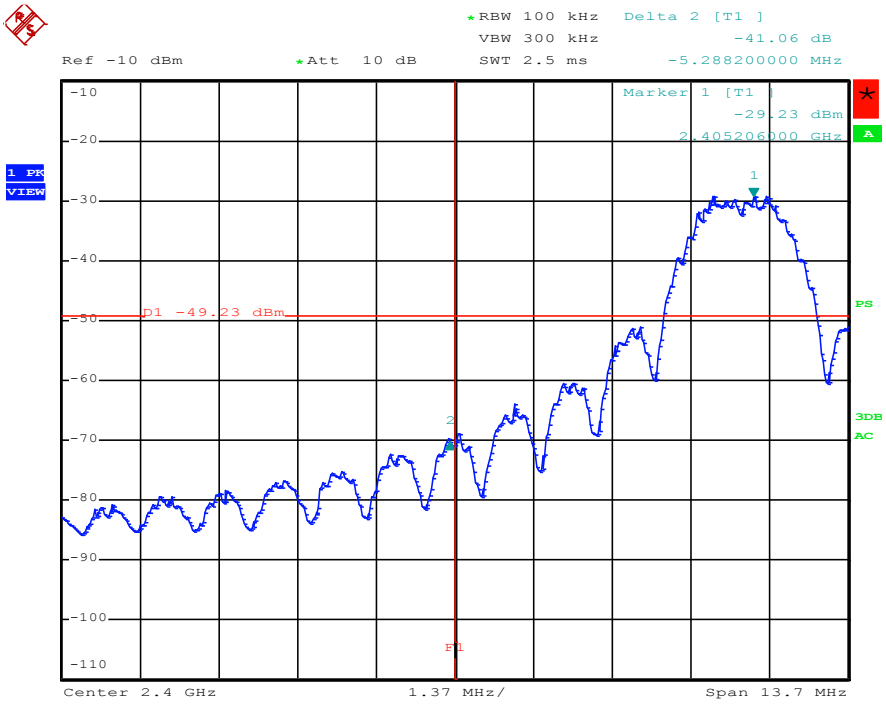
TEST REQUIREMENTS:

(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)).

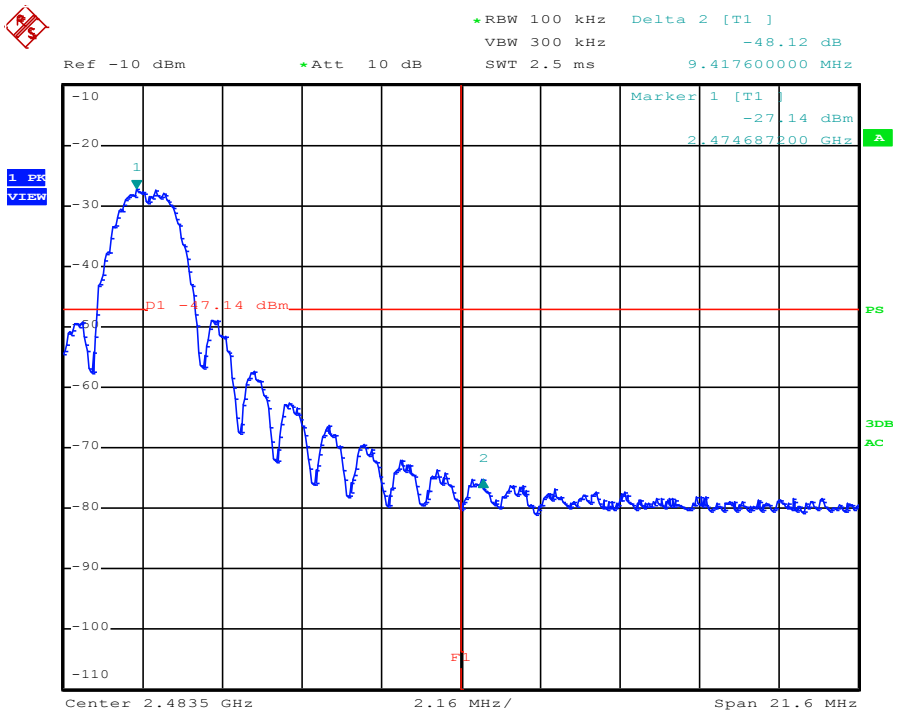
MEASUREMENT METHOD: As called by the standards above.

RESULTS: Pass: Complies

MEASUREMENT DATA & PLOT:



OUT OF BAND EMISSIONS - LOW CHANNEL



OUT OF BAND EMISSIONS - HIGH CHANNEL

Part 7 - Conducted Spurious Emissions

DATE: June-03-2015

TEST STANDARD: FCC Part 15.247 (d), RSS-247 Issue 1 5.5

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)). Attenuation below the general field strength limits specified in RSS-Gen is not required.

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

RESULTS: Pass: Complies

MEASUREMENT DATA & PLOT:

Low Channel Conducted Spurious Emissions

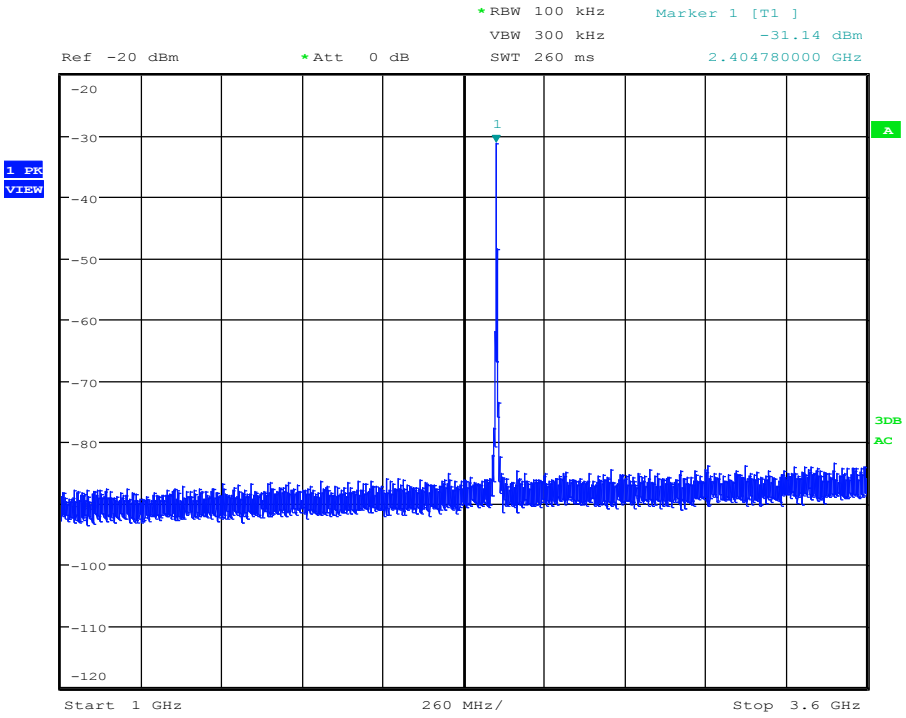
Freq (MHz)	Raw Peak (dBm)	cable loss (dB)	Corrected Peak (dBm)	Reference Level (dBm)	Limit 20dBc	Result
4210	-83.16	12.6	-70.56	0.78	-19.22	Pass
7215	-84.62	12.21	-72.41	0.78	-19.22	Pass
9620	-88	12.32	-75.68	0.78	-19.22	Pass
12025	-89.05	13.35	-75.7	0.78	-19.22	Pass

Middle Channel Conducted Spurious Emissions

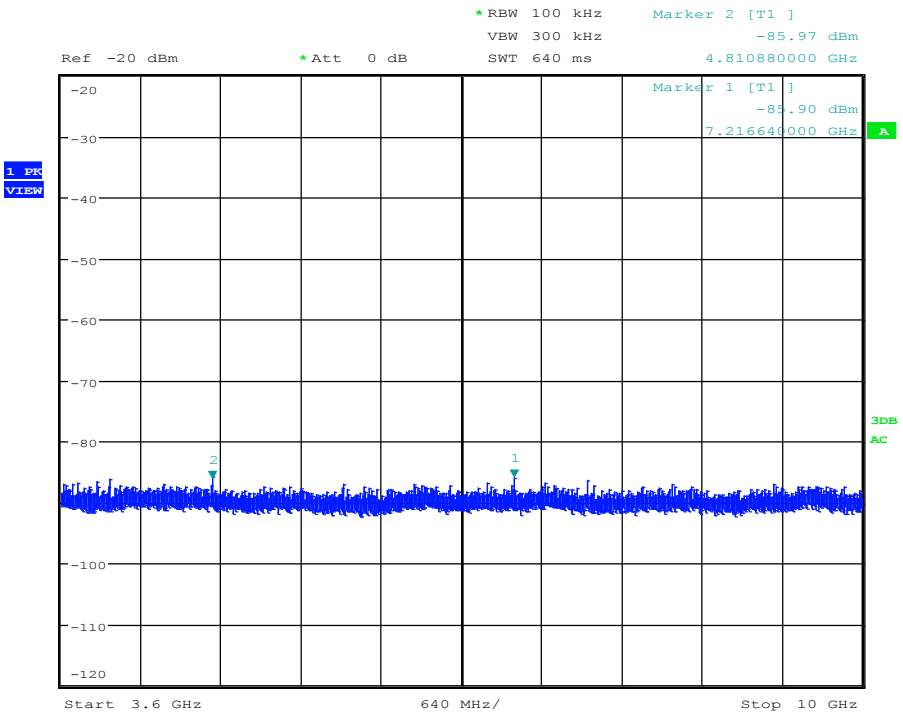
Freq (MHz)	Raw Peak (dBm)	cable loss (dB)	Corrected Peak (dBm)	Reference Level (dBm)	Limit 20dBc	Result
4880	-80.6	12.09	-68.51	0.78	-19.22	Pass
7320	-86.5	12.42	-74.08	0.78	-19.22	Pass
9760	-88.6	12.94	-75.66	0.78	-19.22	Pass
12200	-88.64	13.44	-75.2	0.78	-19.22	Pass

High Channel Conducted Spurious Emissions

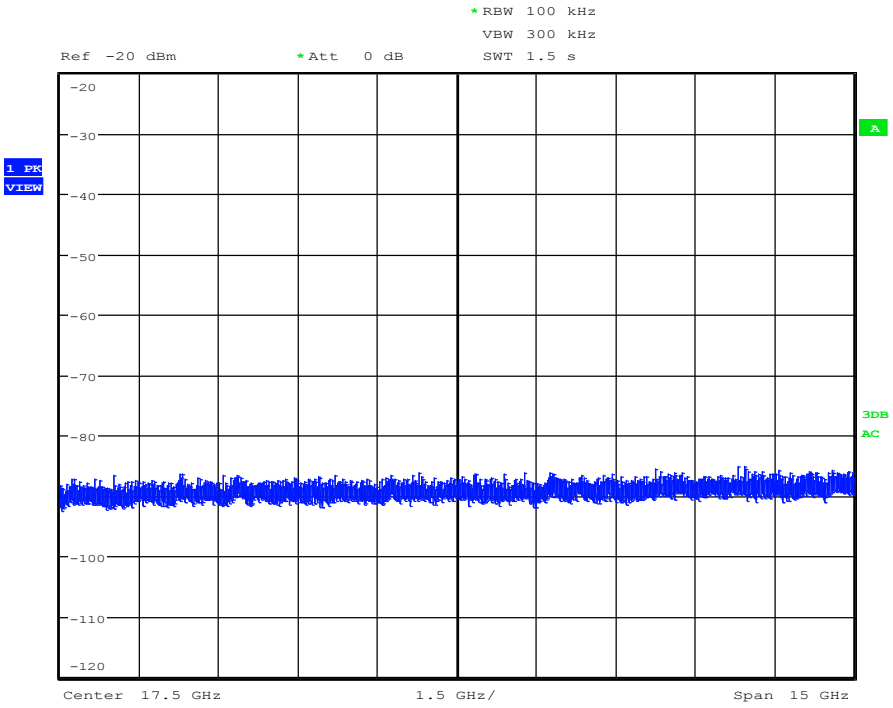
Freq (MHz)	Raw Peak (dBm)	cable loss (dB)	Corrected Peak (dBm)	Reference Level (dBm)	Limit 20dBc	Result
4950	-80.57	11.61	-68.96	0.78	-19.22	Pass
7425	-86.6	12.11	-74.49	0.78	-19.22	Pass
9900	-86.17	13.03	-73.14	0.78	-19.22	Pass
12375	-86.66	13.21	-73.45	0.78	-19.22	Pass



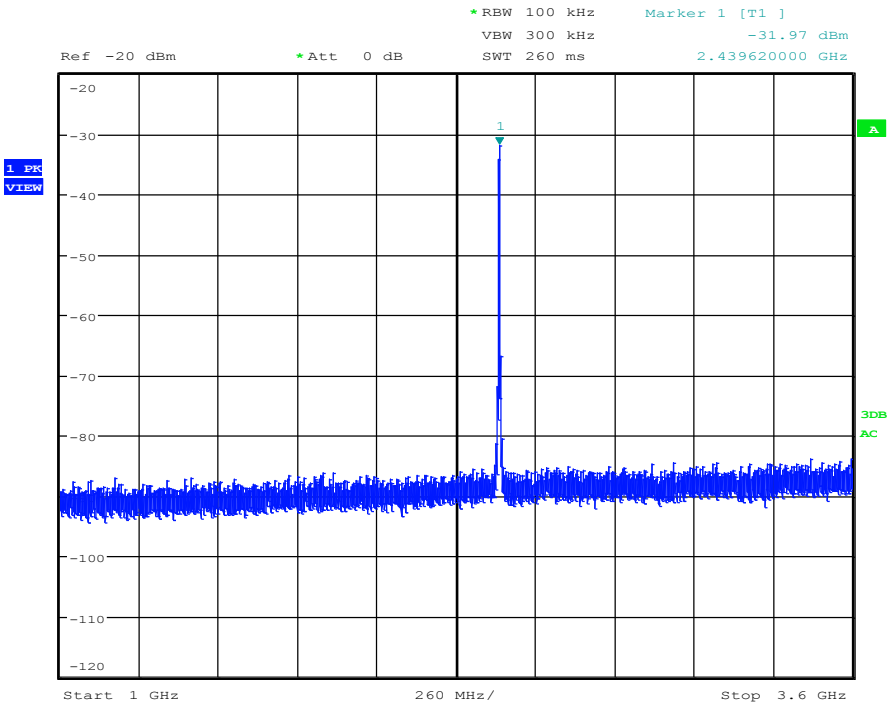
Low Channel - Conducted Spurious Emissions 1 -3.6 GHz



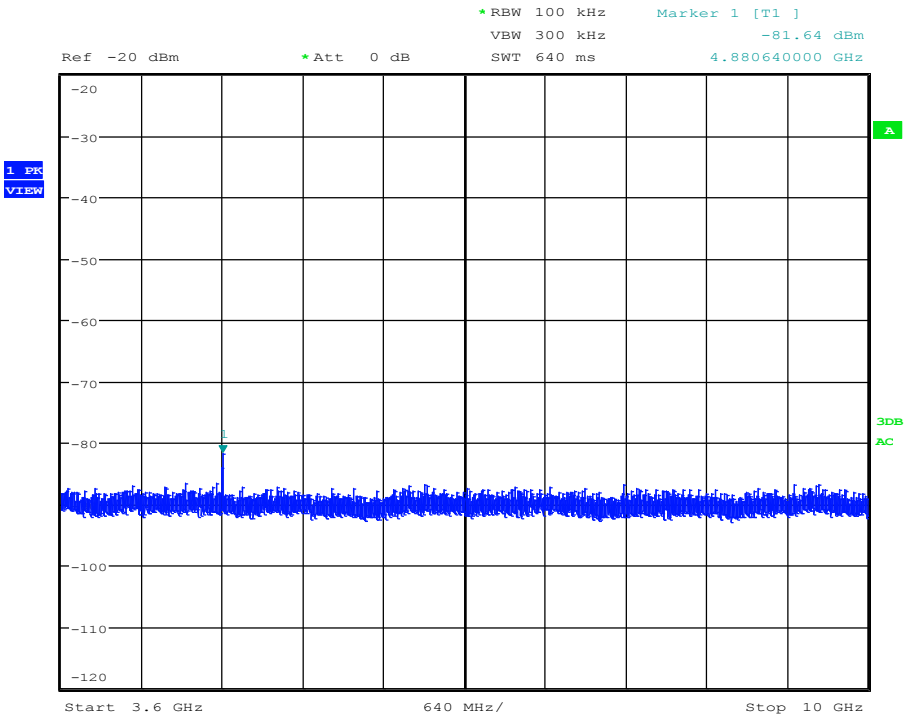
Low Channel - Conducted Spurious Emissions 3.6– 10GHz



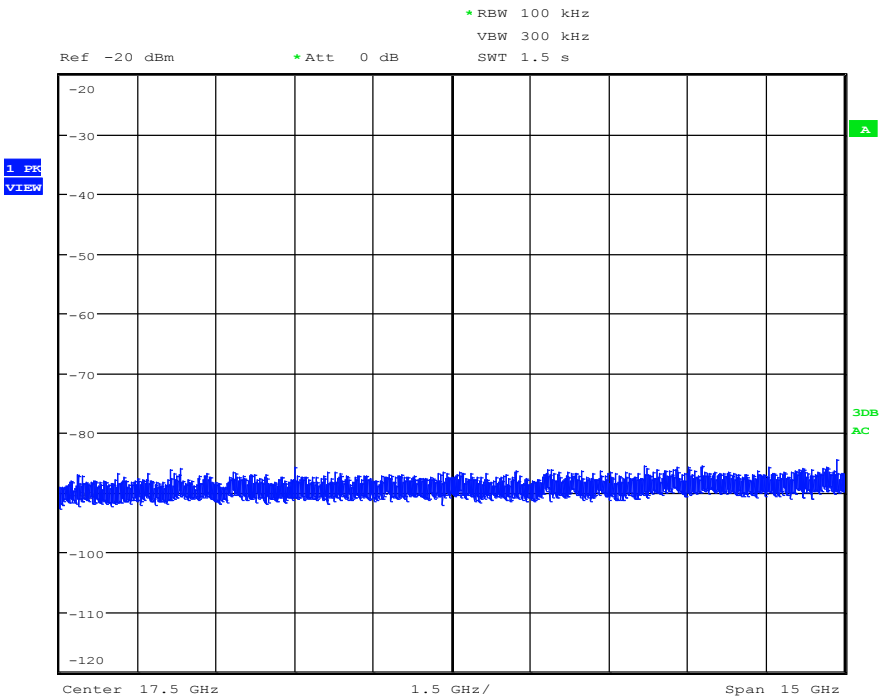
Low Channel - Conducted Spurious Emissions 10 - 25GHz



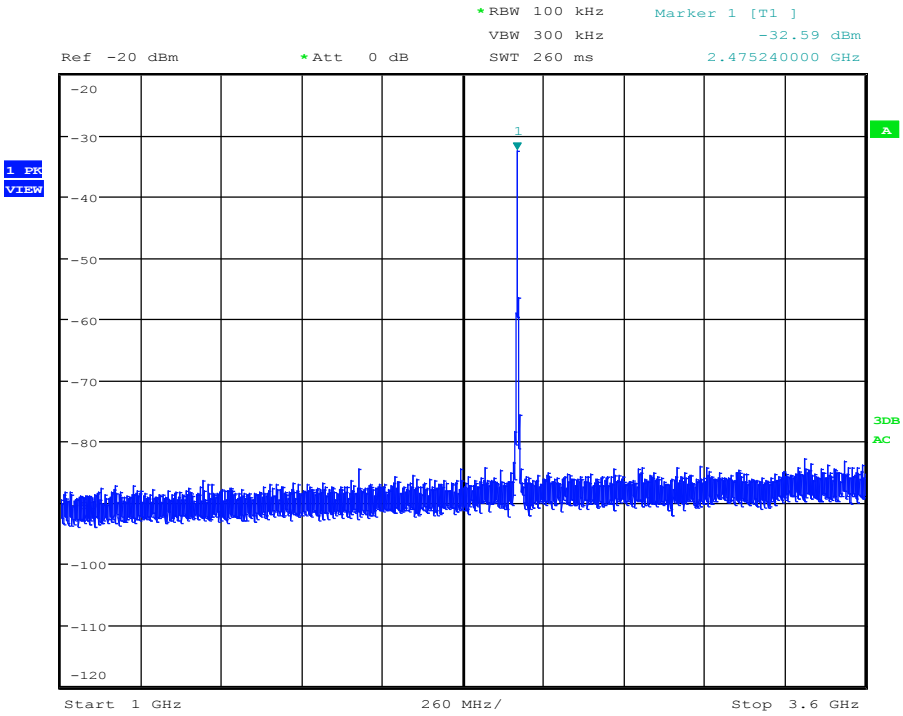
Middle Channel - Conducted Spurious Emissions 1 -3.6 GHz



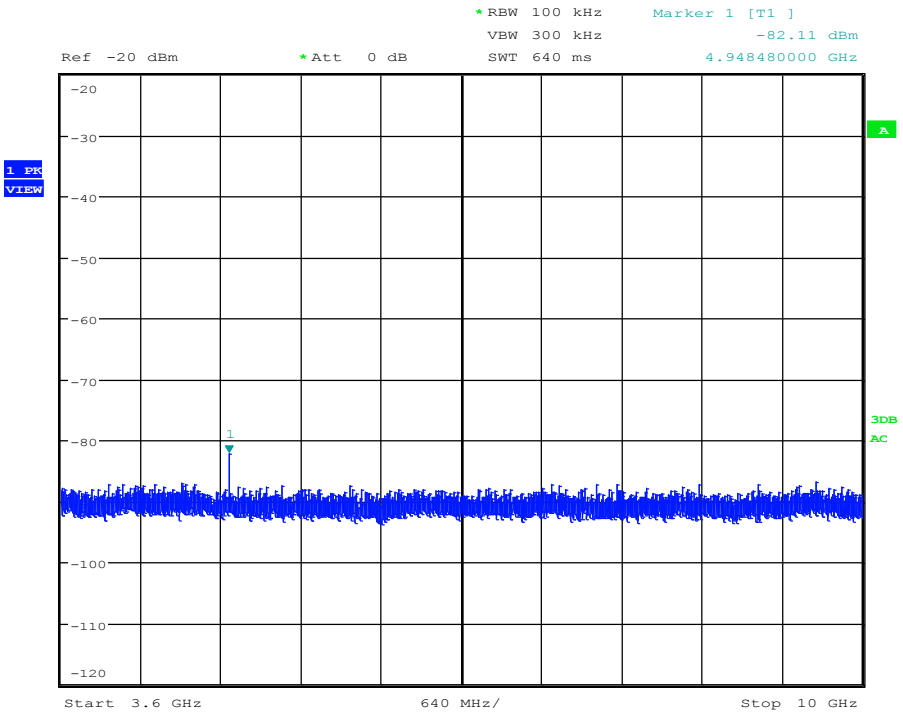
Middle Channel - Conducted Spurious Emissions 3.6 – 10GHz



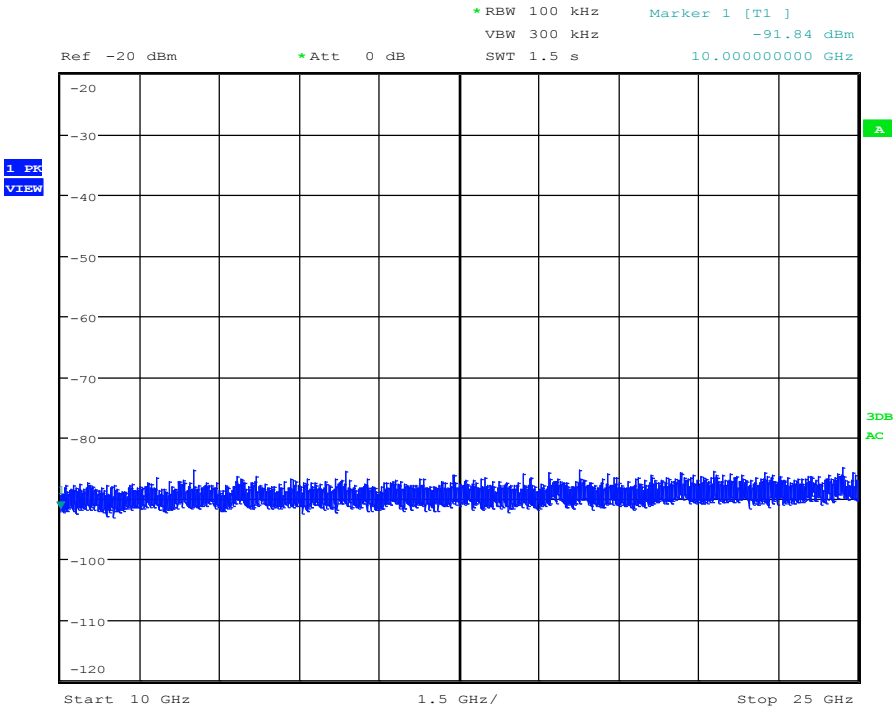
Middle Channel - Conducted Spurious Emissions 10 – 25GHz



High Channel - Conducted Spurious Emissions 1 – 3.6GHz



High Channel - Conducted Spurious Emissions 3.6 - 10 GHz



High Channel - Conducted Spurious Emissions 10 - 25GHz

Part 8 - Radiated Spurious Emissions-Transmit Mode

DATE: November 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 uV/m	Distance 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 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 rangs - 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 of shall comply with the limits specified below

Frequency (MHz)	Field Strength	
	uV/m @ 3-m	Calculated dBμV/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.

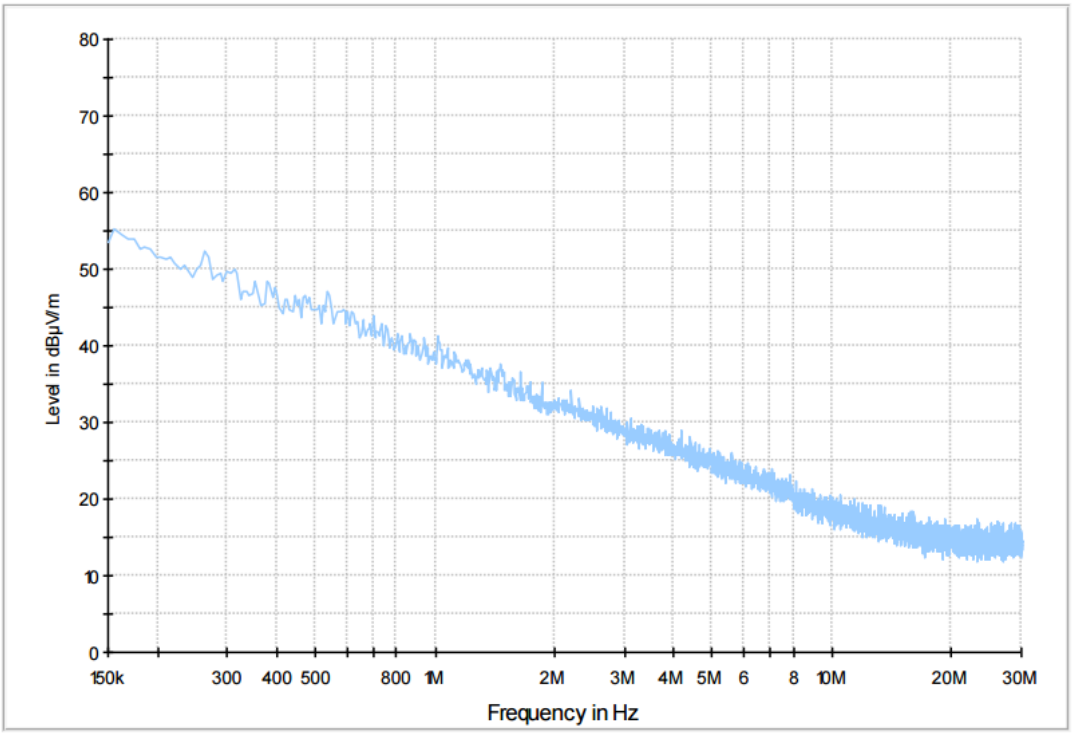
MEASUREMENT METHOD: Measurements were made using spectrum analyser and receiver, 200Hz RBW average detector for the frequency range 9-150KHz; 9kHz RBW average detector for the Frequency range 150kHz to 30MHz; 120kHz RBW quasi-peak detector using the appropriate antennas, amplifiers and filters.
The measurement results are obtained as described below:
E [dBµV/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

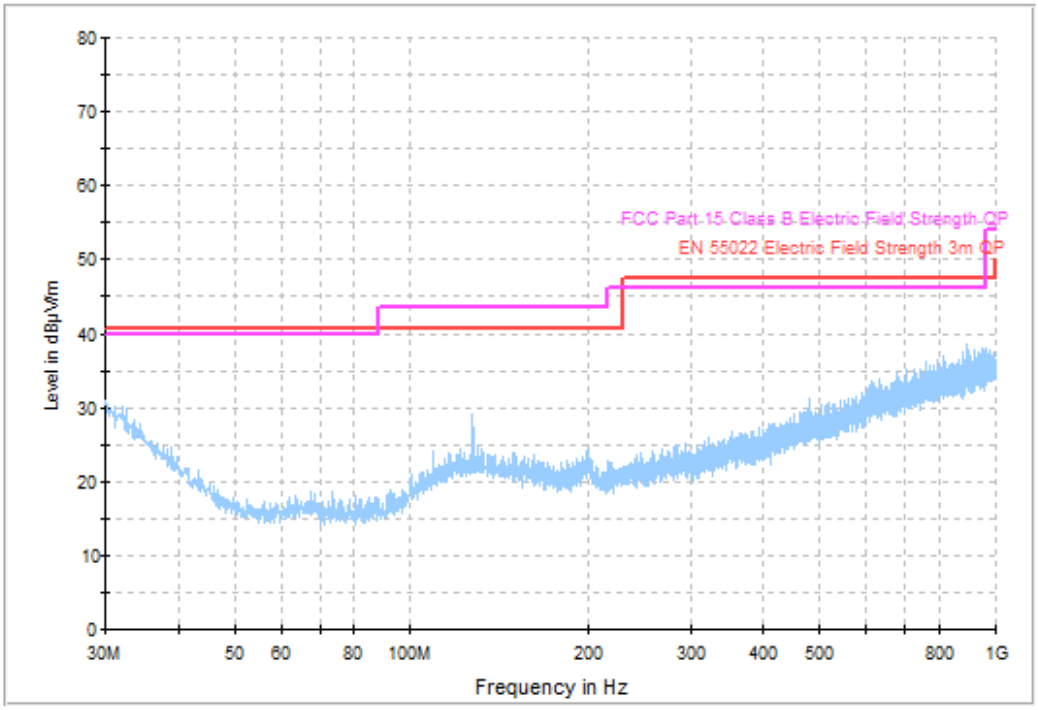
EMISSIONS DATA AND PLOT:

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.

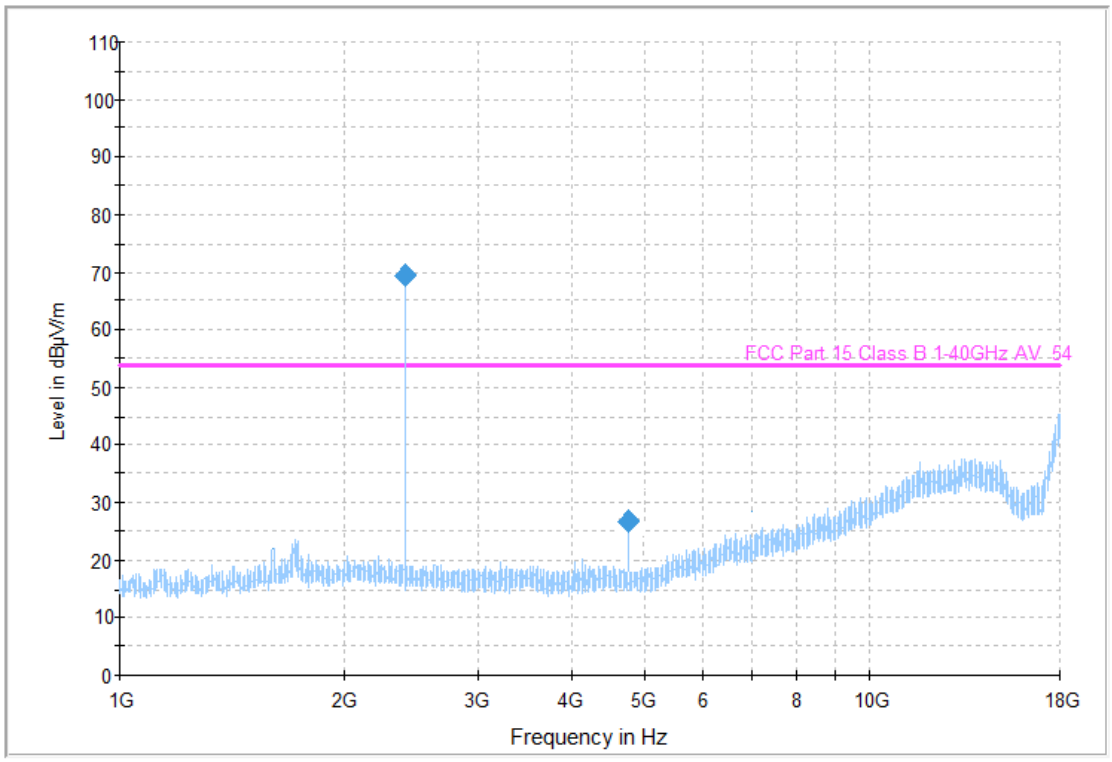
Low Channel 2405MHz EUT Oriented Flat on table											
Freq. (MHz)	Peak-Raw (dBuV/m)	Aver-Raw (dBuV/m)	Pol. (V/H)	Height (cm)	Angle (deg)	Gain (dB)	AF (dB/m)	Peak-Corr. (dBuV/m)	Aver.-Corr. (dBuV/m)	Peak Limit (dBuV/m)	Aver. Limit (dBuV/m)
4810	44.98	37.66	H	103	232	-23.87	34.1	55.21	47.89	74	54
4810	42.05	34.54	V	100	127	-23.87	34.1	52.28	44.77	74	54
Middle Channel 2440 EUT Oriented Sideways											
Freq. (MHz)	Peak-Raw (dBuV/m)	Aver-Raw (dBuV/m)	Pol. (V/H)	Height (cm)	Angle (deg)	Gain (dB)	AF (dB/m)	Peak-Corr. (dBuV/m)	Aver.-Corr. (dBuV/m)	Peak Limit (dBuV/m)	Aver. Limit (dBuV/m)
4880	40.65	32.79	H	101	175	-24.09	34.1	50.66	42.8	74	54
4880	41.83	33.44	V	100	272	-24.09	34.1	51.84	43.45	74	54
High Channel 2475 EUT Oriented Sideways											
Freq. (MHz)	Peak-Raw (dBuV/m)	Aver-Raw (dBuV/m)	Pol. (V/H)	Height (cm)	Angle (deg)	Gain (dB)	AF (dB/m)	Peak-Corr. (dBuV/m)	Aver.-Corr. (dBuV/m)	Peak Limit (dBuV/m)	Aver. Limit (dBuV/m)
4950	42.11	34.09	H	100	346	-23.87	34.1	52.34	44.32	74	54
4950	44.4	36.34	V	118	185	-23.87	34.1	54.63	46.57	74	54



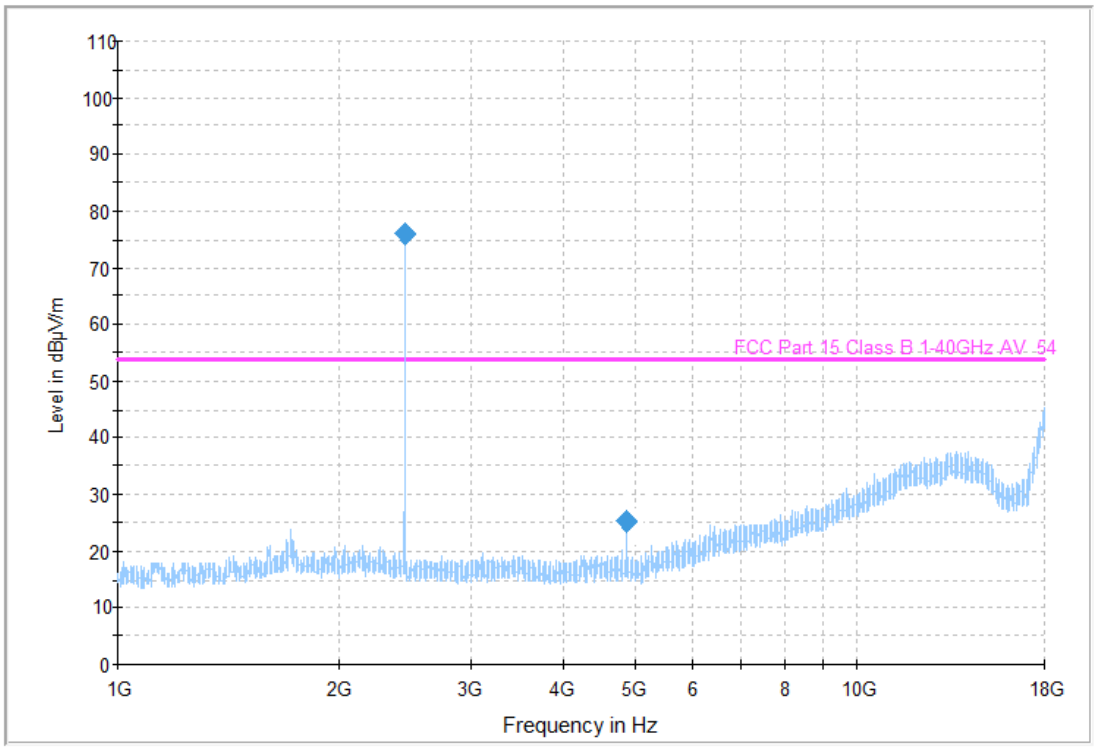
Radiated Emissions, 3m, 150KHz-30MHz



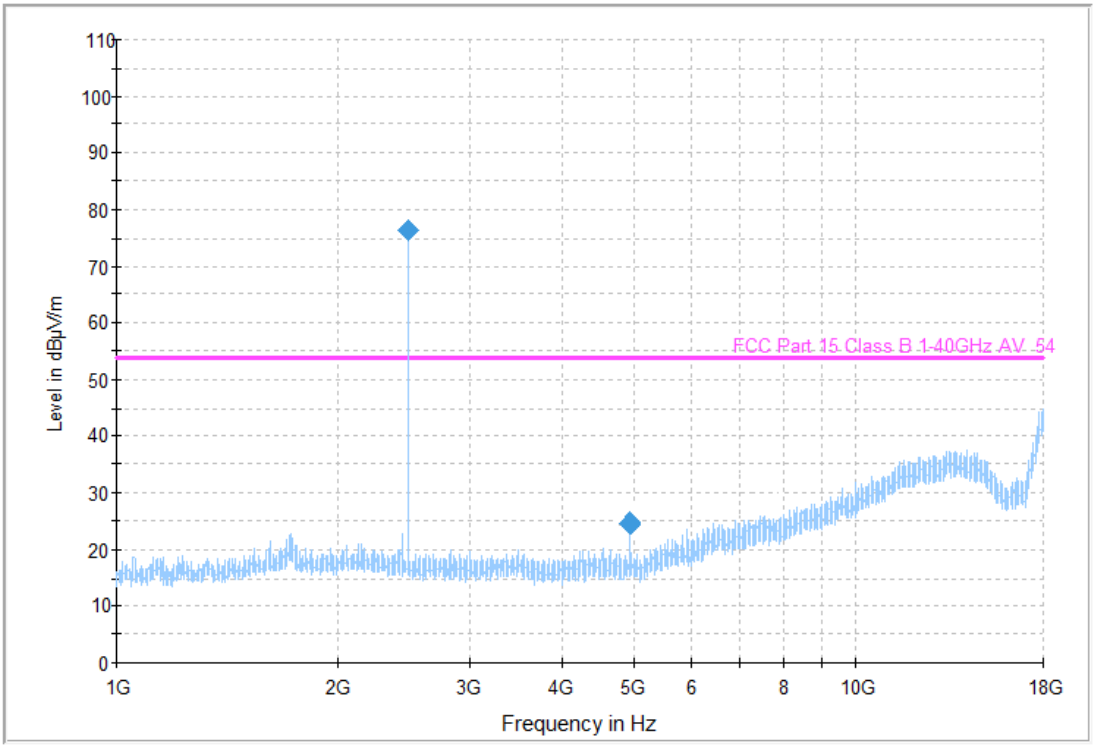
Radiated Spurious Emissions 30MHz – 1GHz



Radiated Emissions, 3m, 1G-18GHz, Low Channel-0, 2405MHz



Radiated Emissions, 3m, 1G-18GHz, Mid Channel-19, 2440MHz



Radiated Emissions, 3m, 1G-18GHz, High Channel-25, 2475MHz

Part 9 - DUTY CYCLE CORRECTION FACTOR FOR RADIATED EMISSIONS

DATE: November 17,2015

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

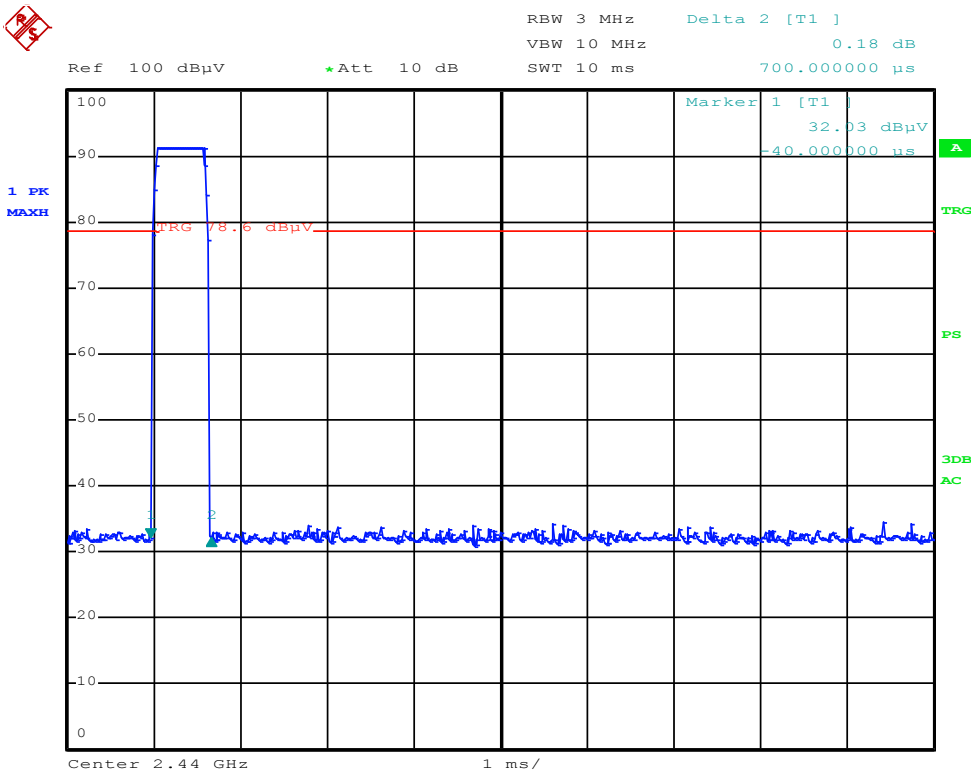
MEASUREMENT METHOD: The FCC regulations provide an allowance for correcting pulsed transmissions when the limits are expressed in terms of an average, and the average measurement may be derived from the peak pulse amplitude corrected for the duty cycle.

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

Duty Cycle = 0.74ms/100ms = 0.74%



Part 10 - RF Exposure Evaluation

DATE: December 1, 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	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density	Average Time (s)
(A) Limits for Occupational/Control Exposures				
300-1500	-	-	F/300	6
1500-	-	-	5	6
(B) Limits for General Population/Uncontrolled Exposures				
300-1500	-	-	F/1500	6
1500-	-	-	1	30

TABLE 1 - POWER DENSITY LIMITS

RF EXPOSURE EVALUATION DISTANCE CALCULATION

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^2.

Max EIRP	Max EIRP	Power Density Limit	Safe distance
dBm	mW	mW/cm2	cm
6.31	4.3	1	0.6

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

Where: d = Distance to the center of radiation of the antenna (cm) for the allowable
S = Allowable Power density Limit (mW/cm^2)
EIRP = Equivalent isotopically radiated power (mW)

As shown above, the minimum distance where the MPE limit is reached is 0.6cm from the EUT.
The EUT is safe for touching with a hand when it transmits signal, if the space between the case surface and the antenna is taken into account.

As per Table 4 of RSS-102, the power density limit **is 5.4W/m2 (0.54mW/cm2)** where the frequency is 2400MHz.

Max EIRP	Max EIRP	Distance	Power Density of the EUT @ 20cm	Power Density Limit
dBm	mW	cm	mW/cm2	mW/cm2
6.31	4.3	20	0.001	0.54

Power Density = EIRP/4πd^2

Part 11 - Frequency Stability

DATE: November 17,2015

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

MINIMUM STANDARD: RSS-Gen Issue 4 (8.11):

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.The EUT voltage and temperature range was specified by the manufacturer. The transmitter was set for Carrier Wave (CW) mode and the lowest, middle and highest channel frequency was measured at each temperature setting. Measurements were made using a Spectrum Analyzer with 100Hz RBW, 300Hz VBW and average detector.

Measurement Data:

Temp	Channl	Frequrency	Freq Shift	PPM	Uncorrctd MxPeak
DegC		GHz	Hz		dBm
50	Low	2.404951	-4800	-2.00	-47
	Mid	2.439955	-4180	-1.71	-44
	High	2.474958	-4320	-1.75	-43
40	Low	2.404953	-3030	-1.26	-46
	Mid	2.439956	-3110	-1.27	-44
	High	2.47496	-3090	-1.25	-44
30	Low	2.404954	-1650	-0.69	-44
	Mid	2.439958	-1570	-0.64	-43
	High	2.474961	-1860	-0.75	-43
20	Low	2.404956	0	0.00	-45
	Mid	2.439959	0	0.00	-43
	High	2.474963	0	0.00	-42
10	Low	2.404957	568	0.24	-44
	Mid	2.43996	900	0.37	-43
	High	2.474963	710	0.29	-43
0	Low	2.404957	1136	0.47	-42
	Mid	2.439961	1800	0.74	-42
	High	2.474964	1420	0.57	-42
-10	Low	2.404958	1704	0.71	-42
	Mid	2.439962	2700	1.11	-41
	High	2.474965	2130	0.86	-42
-20	Low	2.404958	2272	0.94	-41
	Mid	2.439963	3600	1.48	-41
	High	2.474966	2840	1.15	-40
-30	Low	2.404959	2840	1.18	-42
	Mid	2.439964	4500	1.84	-41
	High	2.474966	3550	1.43	-41

Part 12 - Radiated Emissions Testing (Unintentional Mode)

DATE: November 12, 2015

TEST STANDARD: FCC CFR47 Part 15 Subpart B; RSS Gen issue 4, ICES-003 Issue 5

MINIMUM STANDARD: Except as provided elsewhere in FCC Part 15.249 and RSS-247 Issue 1 , the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

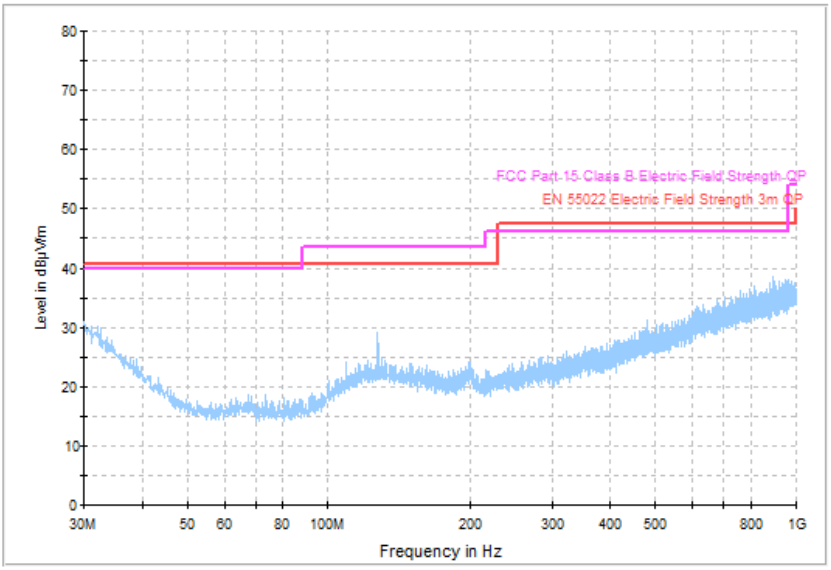
Frequency (MHz)	Field Strength (dBµV/m) at 3m
30 – 88	40
88 – 216	43.5
216 - 960	46
960 – above	54

Note: In the above emission table, the tighter limit applies at the band edges.

TEST SETUP: The EUT was placed on a turntable, which is 0.8 m above ground plane. Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable and moving the receiving antenna from 1m to 4 m high to maximize the emissions signal strength. The equipment was set up in a 3-meter Semi Anechoic Chamber for preliminary measurements and finals were completed in 3m/10m Open Air Test Site at 3 meters.

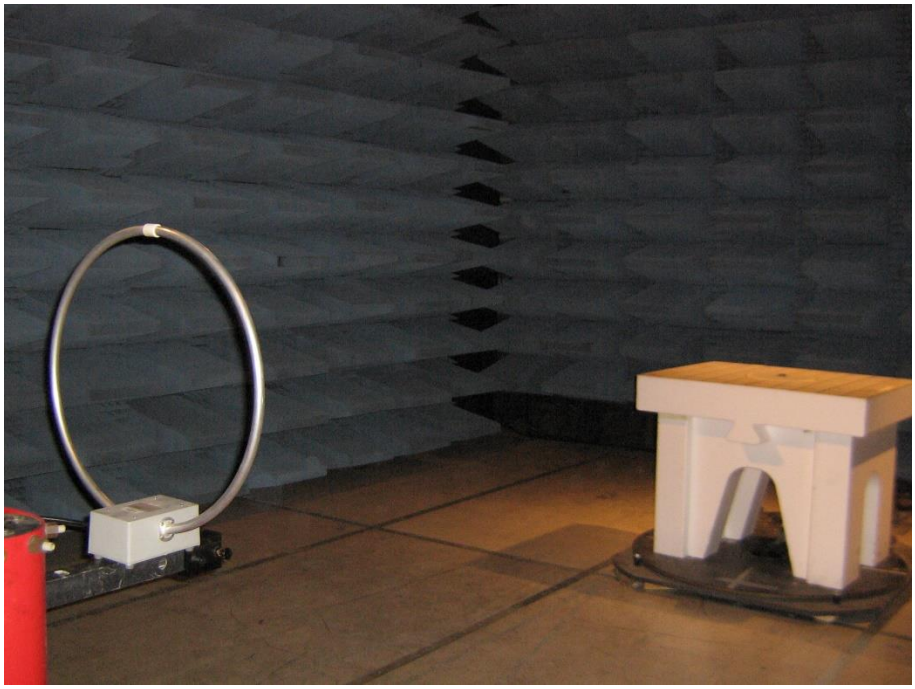
MEASUREMENT DATA & PLOT:

All radiated emissions were at least 20 dB below the required limit line.



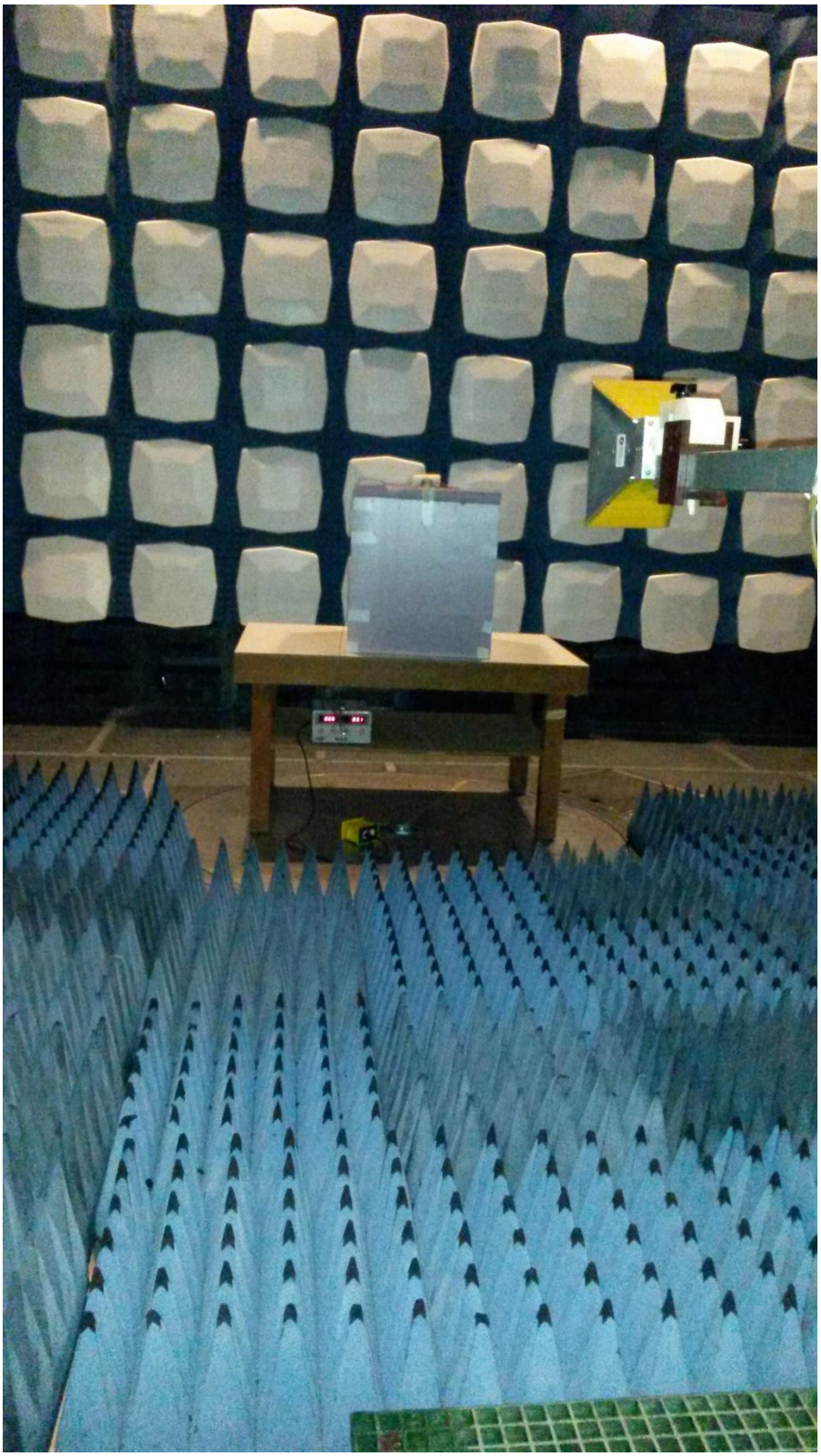
PERFORMANCE: Complies with standard.

Appendix A: photos during the testing

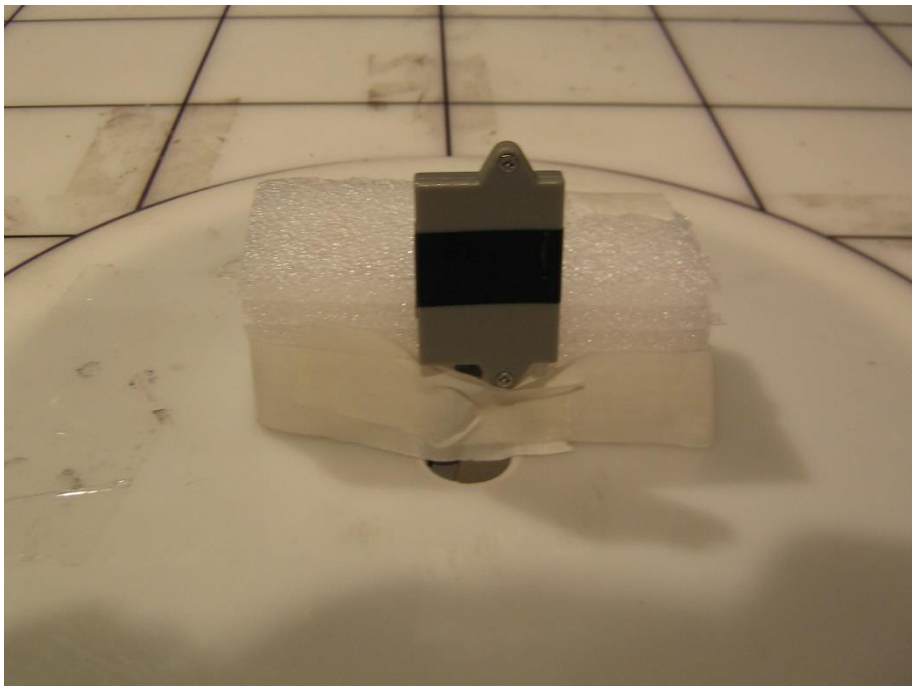


Radiated Emissions Setup in Semi-Anechoic Chamber, 150 kHz-30MHz

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



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



Radiated Emissions Setup in Semi-Anechoic Chamber