

TEST REPORT

Report Number: 102195685MPK-001

Project Number: G102195685

October 15, 2015

Testing performed on

Novi Security System (Novi Relay Station & Novi Sensor)

Models: NR-2415-P (Novi Relay Station) & NS-2415-P (Novi Sensor)

FCC ID: 2AF7M-NR2415P (Novi Relay Station)

FCC ID: 2AF7M-NS2415P (Novi Sensor)

IC: 20680-NR2415P (Novi Relay Station)

IC: 20680-NS2415P (Novi Sensor)

to

FCC Part 15 Subpart C (15.247)

Industry Canada RSS-247 Issue 1

FCC Part 15, Subpart B

Industry Canada ICES-003

For

Novi Security, Inc

Test Performed by:

Intertek

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Menlo Park, CA 94025 USA

Test Authorized by:

Novi Security, Inc

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Prepared by:


Minh Ly

Date: October 15, 2015

Reviewed by:


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Date: October 15, 2015

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Report No. 102195685MPK-001

Equipment Under Test:	Novi Security System (Novi Relay Station & Novi Sensor)
Model Number:	NR-2415-P (Novi Relay Station) & NS-2415-P (Novi Sensor)
Serial Numbers:	MPK1507090902-001 (Sensor Unit1) MPK1507090902-002 (Sensor Unit 2) MPK1507141124-001 (Relay Station 1) MPK1507141124-002 (Relay Station 2) MPK1507141124-004 (Power Supply)
Applicant:	Novi Security, Inc
Contact:	Ethan Grabau
Address:	Novi Security, Inc 560 S 100 W #11 Provo, UT 84601
Country	USA
Tel. Number:	(801) 923-4250
Email:	ethan@novisecurity.com
Applicable Regulation:	FCC Part 15 Subpart C (15.247) Industry Canada RSS-247, Issue 1 FCC Part 15, Subpart B Industry Canada ICES-003
Date of Test:	July 08 – October 06, 2015

We attest to the accuracy of this report:



Minh Ly
Project Engineer



Krishna K. Vemuri
EMC Senior Staff Engineer

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1.0 Summary of Tests

Test	Reference FCC	Reference Industry Canada	Result
Radiated Emissions	15.109	ICES-003	Complies
AC Line Conducted Emission	15.107	ICES-003	Complies
RF Output Power	15.247(b)(3)	RSS-247, 5.4	Complies
6 dB Bandwidth	15.247(a)(2)	RSS-247, 5.2	Complies
Power Density	15.247(e)	RSS-247, 5.2	Complies
Out of Band Antenna Conducted Emission	15.247(d)	RSS-247, 5.5	Complies
Transmitter Radiated Emissions	15.247(d), 15.209, 15.205	RSS-247, 5.5	Complies
AC Line Conducted Emission	15.207	RSS-GEN	Complies
Antenna Requirement	15.203	RSS-GEN	Complies (Internal Antenna)
RF Exposure	15.247(i), 2.1093(d)	RSS-102	Complies

EUT receive date:

July 08, 2015

EUT receive condition:

The pre-production version of the EUT was received in good condition with no apparent damage. As declared by the Applicant, it is identical to the production units.

Test start date:

July 08, 2015

Test completion date:

October 06, 2015

The test results in this report pertain only to the item tested.

2.0 General Information

2.1 Product Description

The Novi Security System is a DIY Home Security System for renters, homeowners, and small business owners. It consists of four major parts – The Novi Sensor, Novi Relay Station, Novi Cloud Services, and the Novi Mobile App. Users install the battery powered Novi Sensor by either screwing it into a ceiling or wall with screws and anchors, or resting it on a surface.

The Novi Sensor contains a PIR Motion Detector, Camera, LED Flash, 90dB Siren, and an optical smoke detector. From the mobile app, the user can arm the system. When armed, if the Novi Sensor detects motion or smoke, it takes a series of pictures which is transmits over RF to the Relay Station. The Relay Station then sends them to the Novi Cloud and over to the user's mobile device. With pictures in hand, the user can choose to disarm the system, take another picture, sound the siren, or make a call.

The Novi Sensor is battery powered only. The Novi Relay Station can be powered by battery or AC mode.

Information about the 2.4 GHz radio is presented below:

Applicant	Novi Security, Inc
Models	NR-2415-P (Novi Relay Station) and NS-2415-P (Novi Sensor)
FCC Identifier	FCC ID: 2AF7M-NR2415P (Novi Relay Station) FCC ID: 2AF7M-NS2415P (Novi Sensor)
IC Identifier	IC: 20680-NR2415P (Novi Relay Station) IC: 20680-NS2415P (Novi Sensor)
Type of transmission	Digital Transmission System (DTS)
Rated RF Output	17.34 dBm (54.3 mW) (Novi Relay Station) 16.70 dBm (46.77 mW) (Novi Sensor)
Frequency Range	2405 – 2475 MHz
Type of modulation	O-QPSK
Number of Channel(s)	15
Antenna(s) & Gain	PCB antenna, Gain: 0 dBi
Manufacturer Name & Address	Novi Security, Inc 560 S 100 W #11 Provo, UT 84601 USA

2.2 Related Submittal(s) Grants

None.

2.3 Test Facility

The test site used to collect the radiated data is site 1 (10-m semi-anechoic chamber). This test facility and site measurement data have been fully placed on file with the FCC, IC and A2LA accredited.

2.4 Test Methodology

Antenna conducted measurements were performed according to the FCC documents “Guidance for Performing Compliance Measurement on Digital Transmission Systems (DTS) Operating under §15.247” (KDB 558074), and RSS-247, RSS-GEN, and

Radiated emissions and AC mains conducted emissions measurements were performed according to the procedures in ANSI C63.10. Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "Data Sheet" of this report.

2.5 Measurement Uncertainty

Compliance with the limits was based on the results of the measurements and doesn't take into account the measurement uncertainty.

Estimated Measurement Uncertainty

Measurement	Expanded Uncertainty (k=2)		
	0.15 MHz – 1 GHz	1 GHz – 2.5 GHz	> 2.5 GHz
RF Power and Power Density – antenna conducted	-	0.7 dB	-
Unwanted emissions - antenna conducted	1.1 dB	1.3 dB	1.9 dB
Bandwidth – antenna conducted	-	30 Hz	-
Radiated emissions	4.2 dB	3.4 dB	4.4 dB
AC mains conducted emissions	2.4 dB	-	-

3.0 System Test Configuration

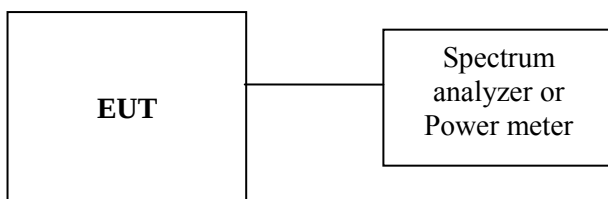
3.1 Support Equipment

Item #	Description	Model No./ Part No.	Serial No.
1	Netgear	FS605 v3	1FM1673H05660
2	USB Flash Drive 16GB	PNY	N/A

3.2 Block Diagram of Test Setup

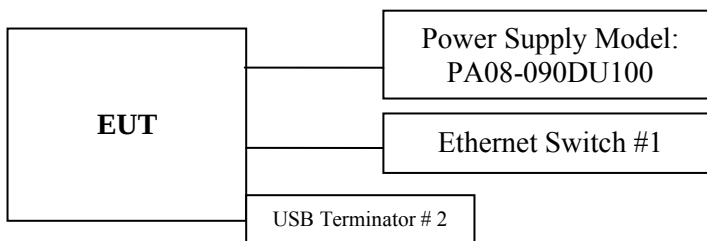
Novi Relay Station & Novi Sensor setup for Conducted Measurements:

Antenna was removed and co-axial connector with a cable was installed for Conducted Measurements. Internal antenna was used for Radiated Measurements.



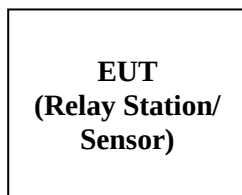
Novi Relay Station for Radiated Measurements:

Radiated Measurement –Novi Relay Station, AC Mode



Novi Relay Station & Novi Sensor for Radiated Measurements:

Radiated Measurement –Battery Mode



S = Shielded	F = With Ferrite
U = Unshielded	m = Length in Meters

3.3 Justification

For radiated emission measurements the EUT is placed on a non-conductive table. The EUT is programmed to transmit full power.

3.4 Software Exercise Program

The EUT exercise program used during radiated and conducted testing was provided by Novi Security, Inc.

3.5 Mode of Operation during Test

During transmitter testing, the transmitter was setup to transmit at maximum RF power on low, middle and high frequencies/channels.

3.5 Modifications Required for Compliance

Intertek installed no modifications during compliance testing in order to bring the product into compliance.

3.6 Additions, Deviations and Exclusions from Standards

No additions, deviations or exclusions from the standard were made.

4.0 Measurement Results

4.1 6-dB Bandwidth and Occupied Bandwidth FCC Rule: 15.247(a)(2); RSS-247 5.2 and RSS-GEN;

4.1.1 Requirement

The minimum 6-dB bandwidth shall be at least 500 kHz

4.1.2 Procedure

The Procedure described in the FCC Publication 558074 was used.

The antenna port of the EUT was connected to the input of a spectrum analyzer (SA). For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was taken, a DISPLAY line was drawn 6 dB lower than PEAK level. The 6-dB bandwidth was determined from where the channel output spectrum intersected the display line.

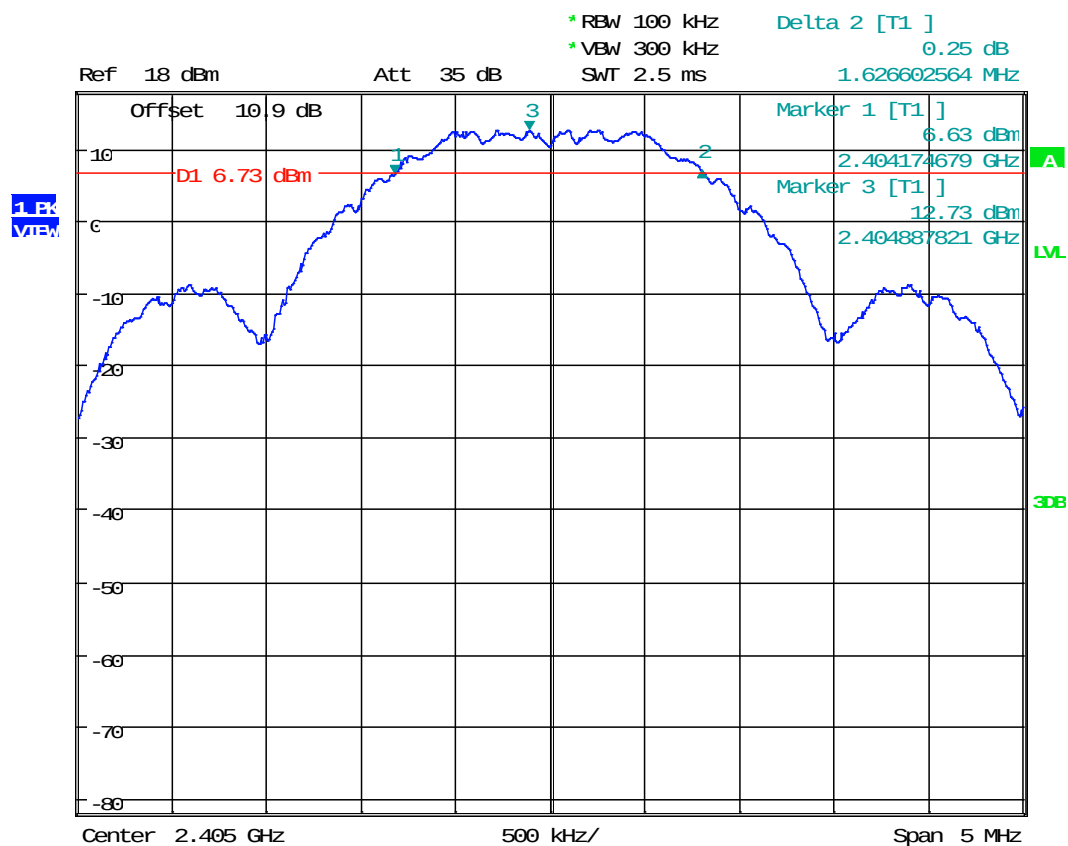
The occupied bandwidth was measured using the built-in spectrum analyzer function for 99% power bandwidth measurement.

4.1.3 Test Result

Frequency (MHz)	6-dB bandwidth FCC 15.247 & RSS-GEN, MHz	Occupied bandwidth, RSS-GEN, MHz	Plot
Novi Relay Station			
2405	1.626		1.1
		2.435	1.7
2440	1.626		1.2
		2.439	1.8
2475	1.636		1.3
		2.500	1.9
Novi Sensor			
2405	1.506		1.4
		2.379	1.10
2440	1.570		1.5
		2.355	1.11
2475	1.602		1.6
		2.403	1.12

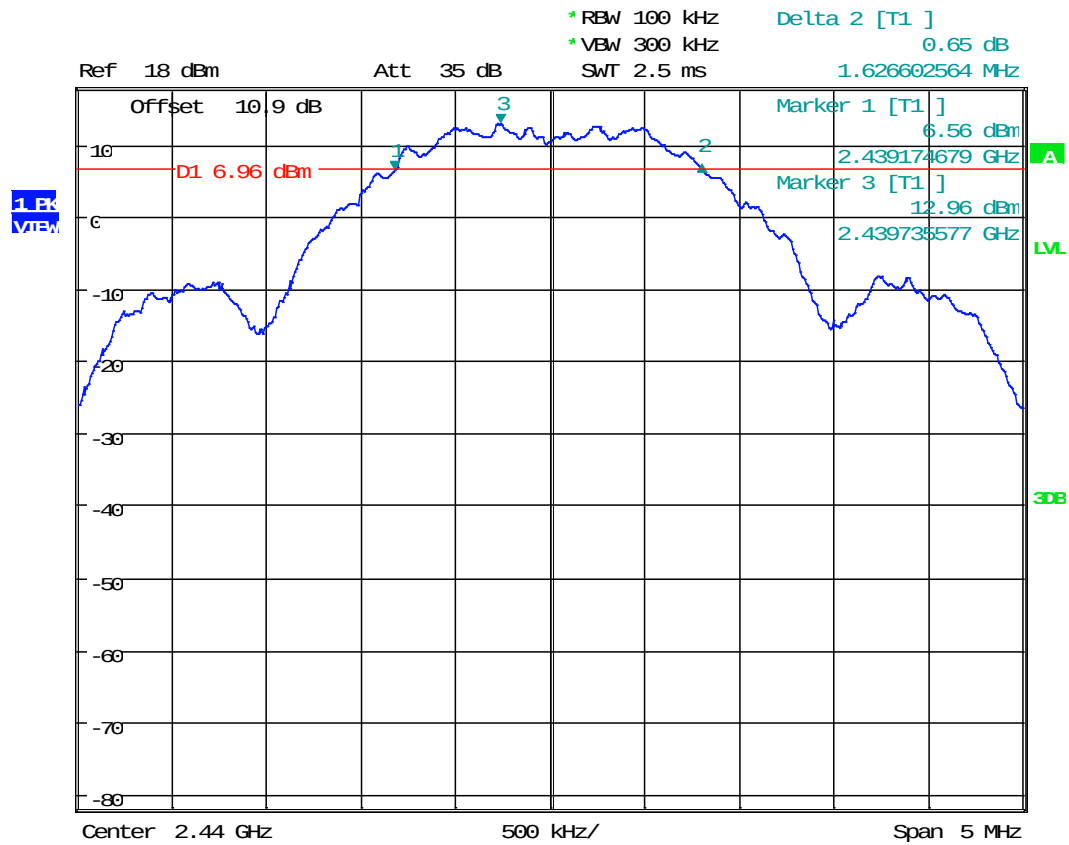
Results	Complies
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Plot 1.1



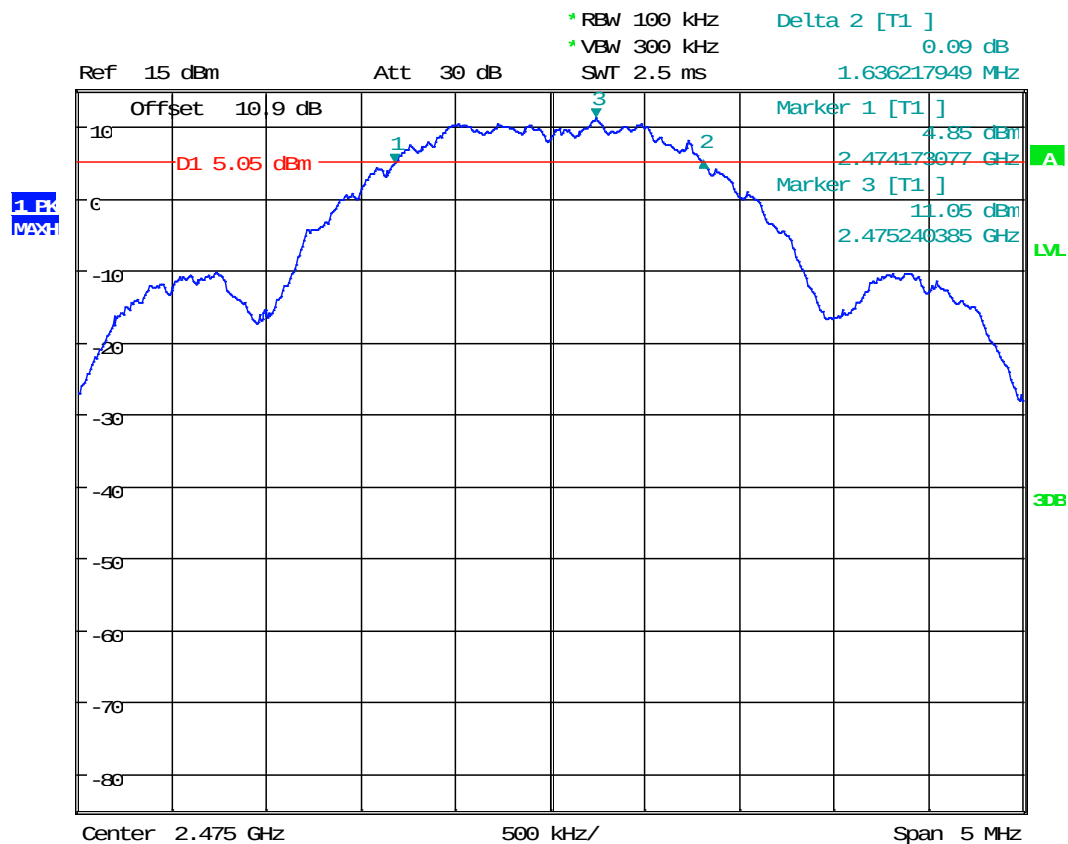
Date: 14.JUL.2015 14:28:58

Plot 1.2



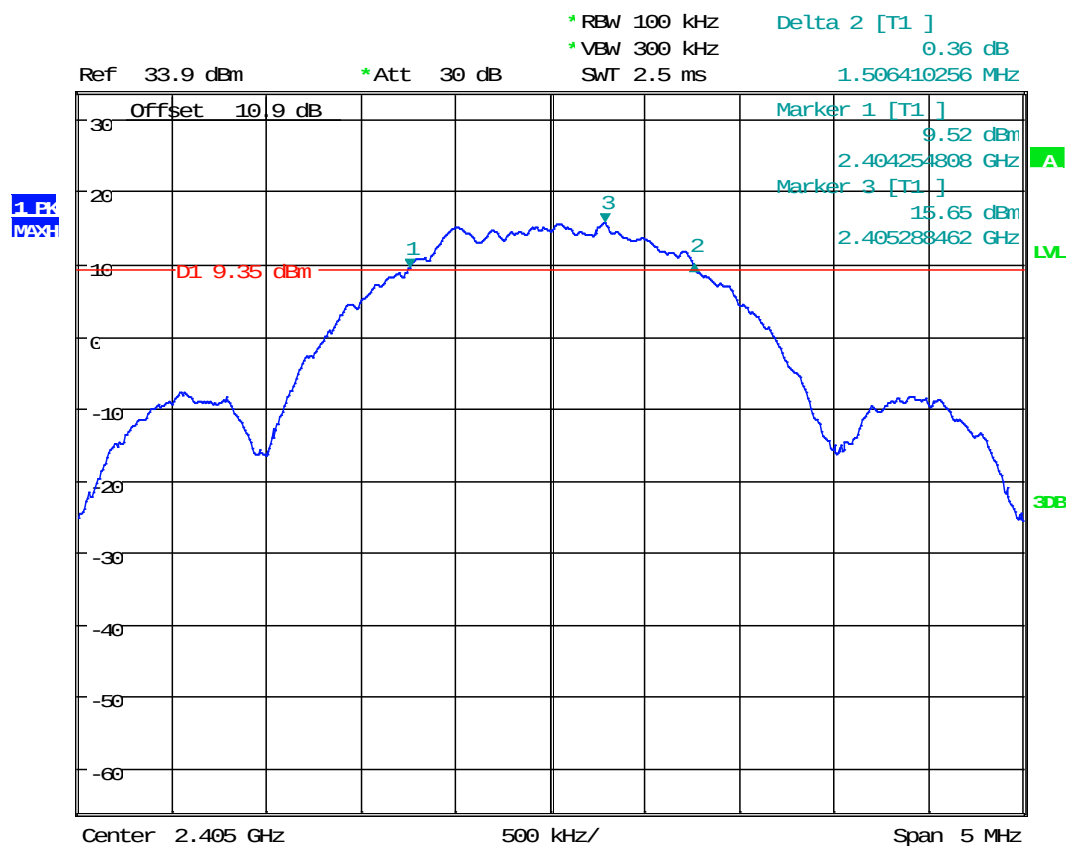
Date: 14.JUL.2015 14:30:19

Plot 1.3



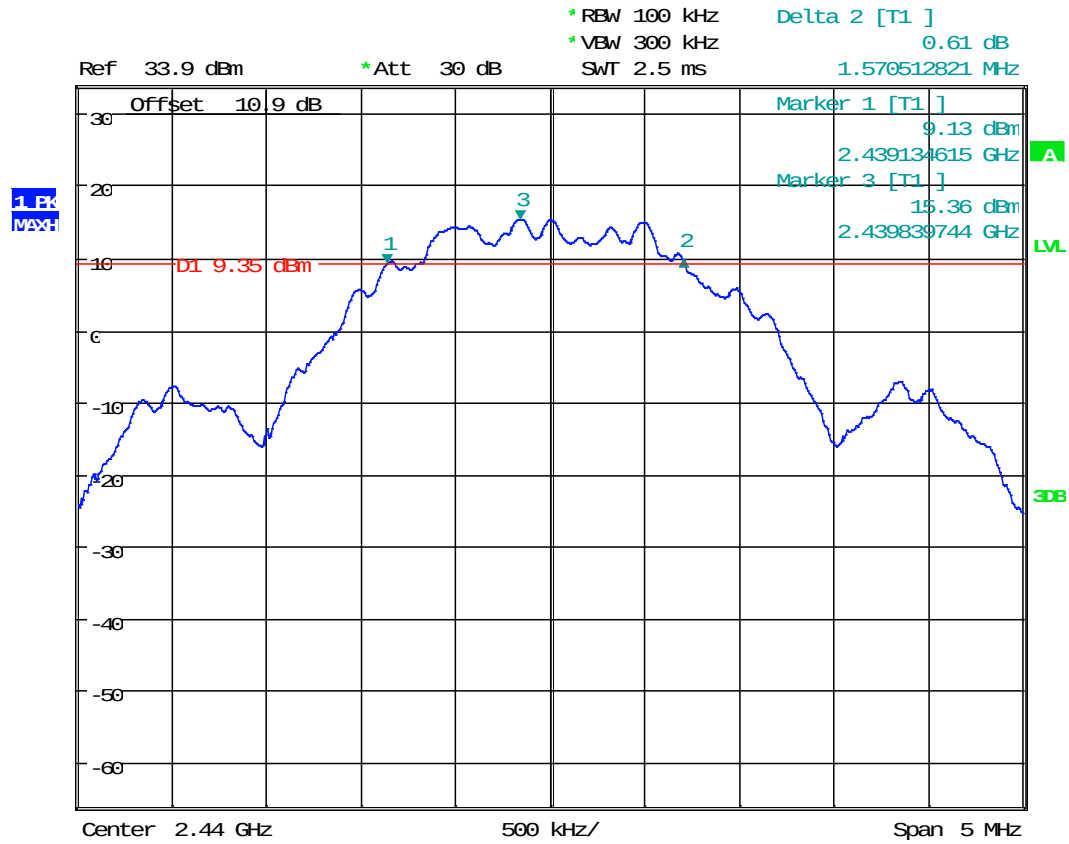
Date: 14.JUL.2015 14:26:14

Plot 1. 4



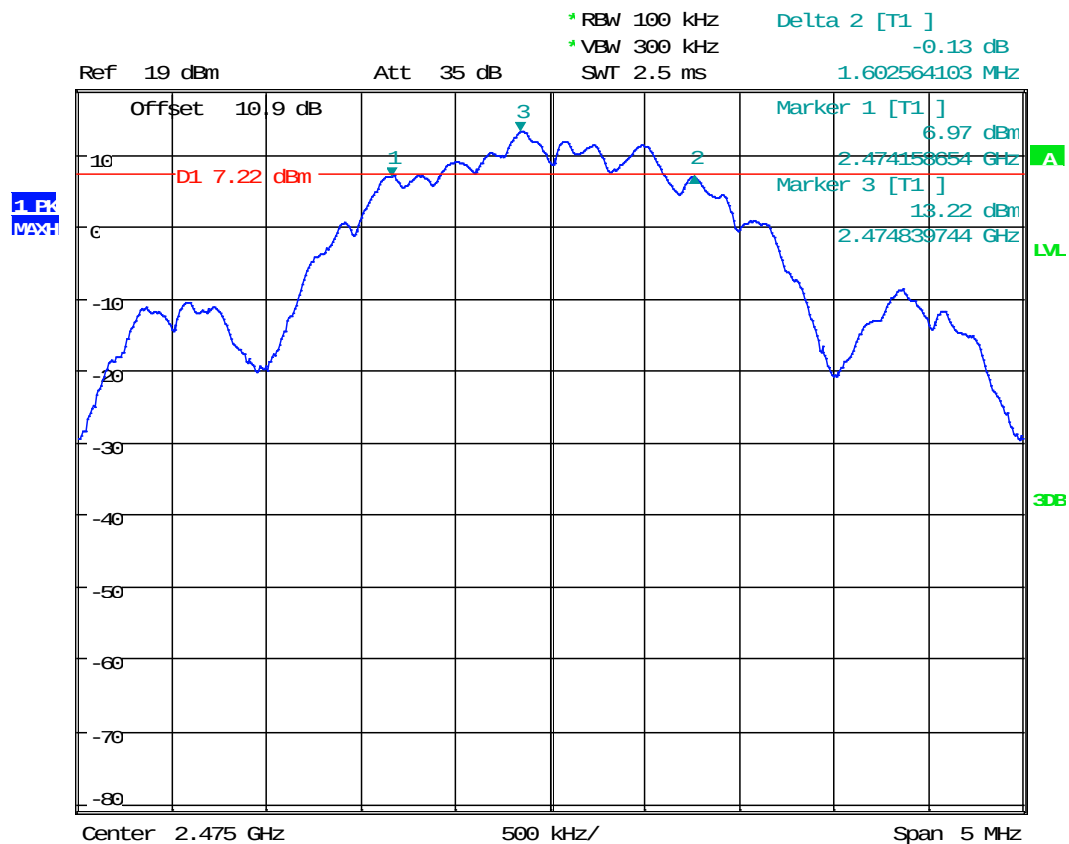
Date: 8.JUL.2015 14:22:22

Plot 1.5



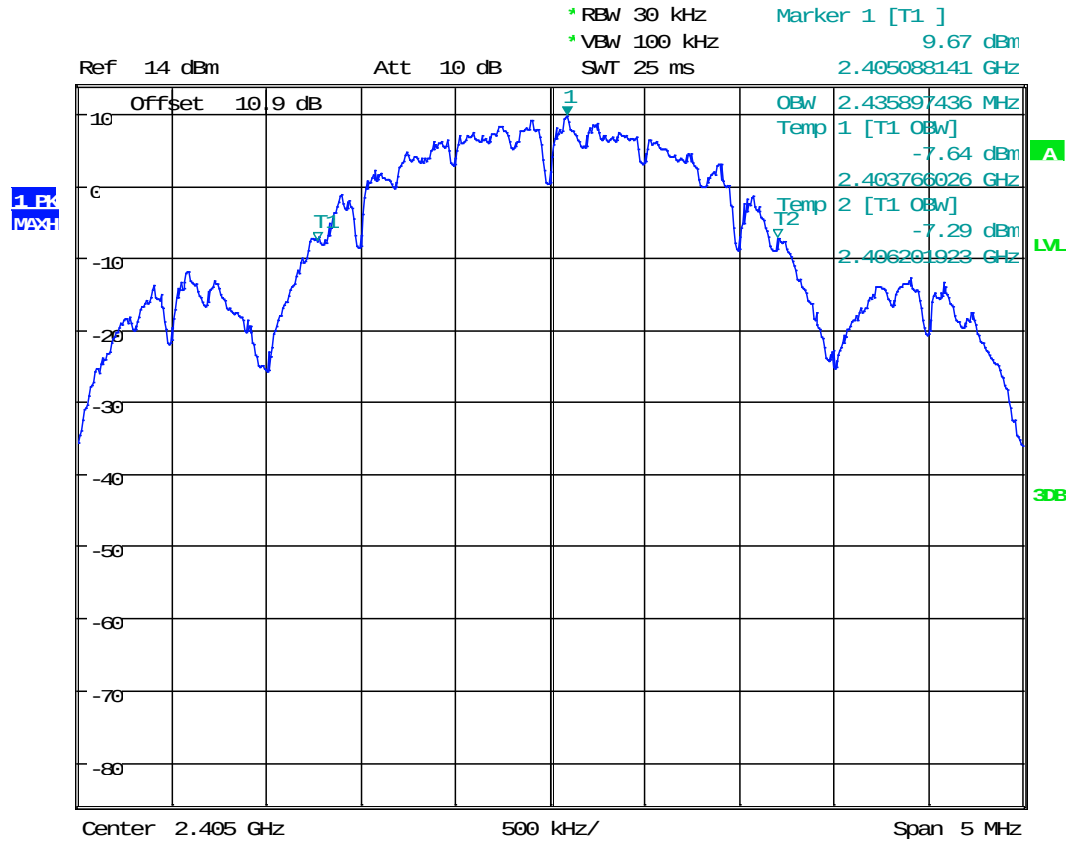
Date: 8.JUL.2015 14:27:05

Plot 1.6



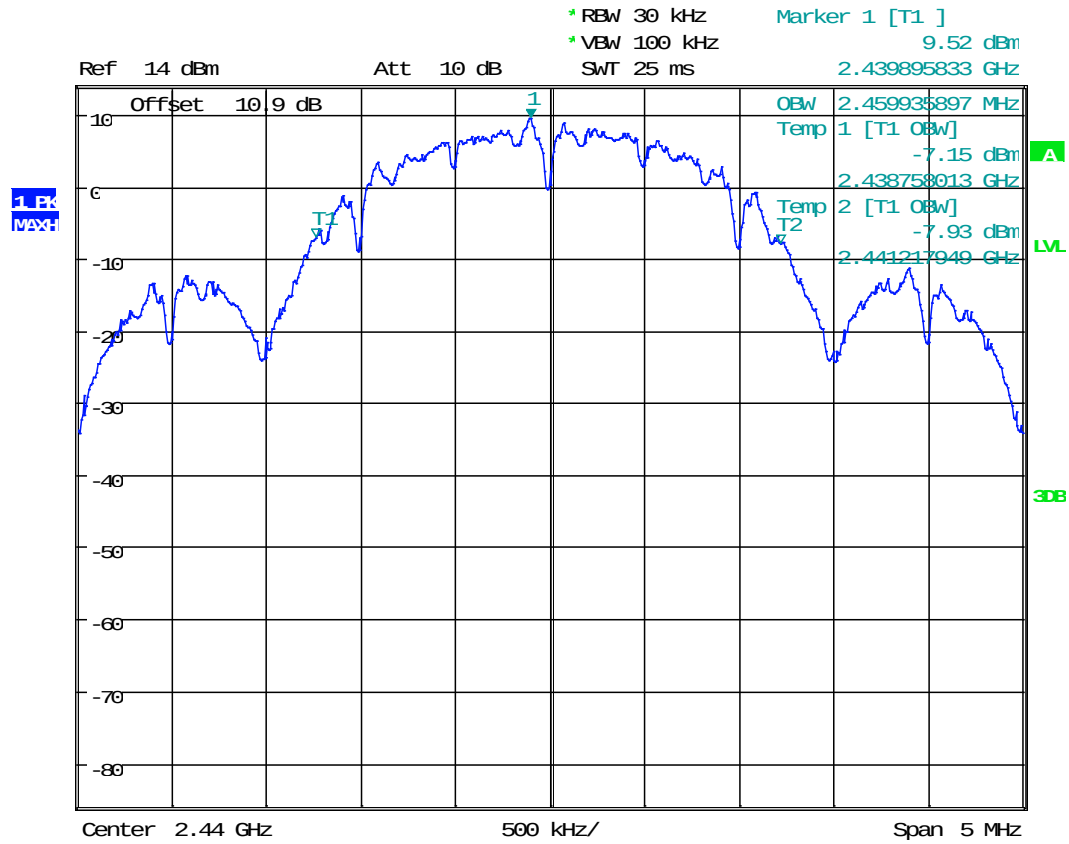
Date: 8.JUL.2015 14:30:19

Plot 1.7



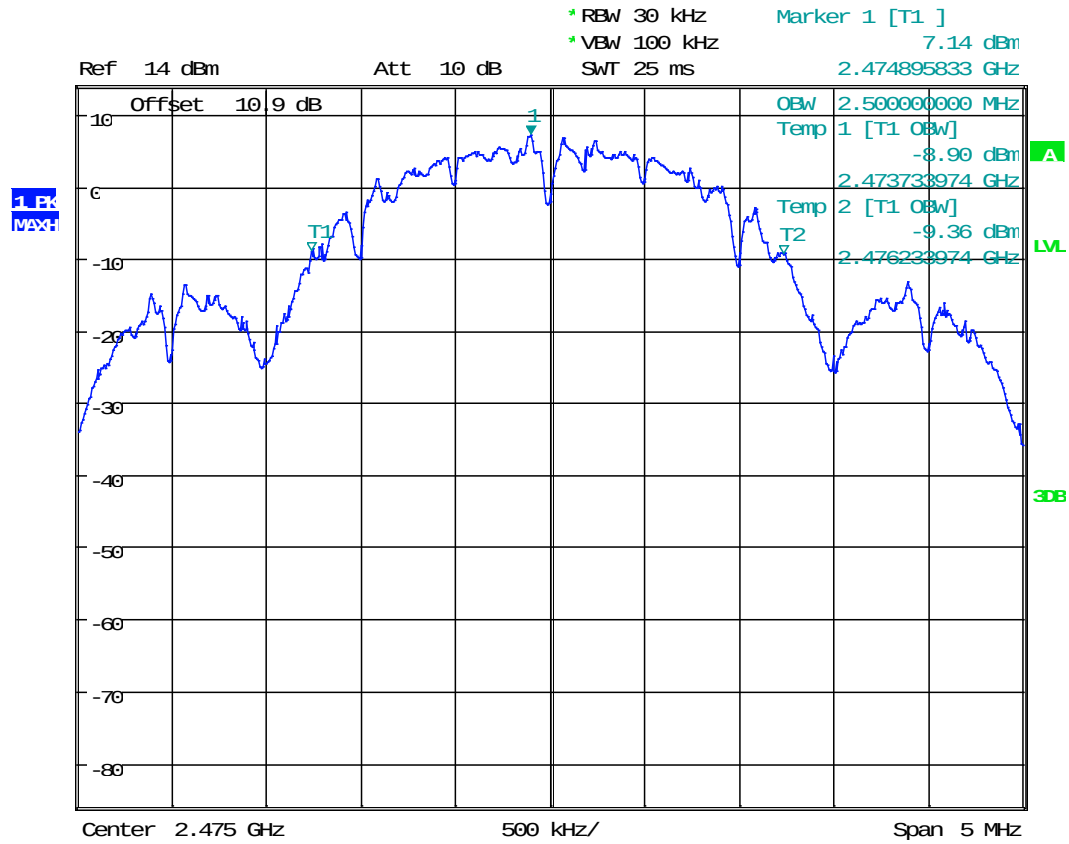
Date: 14.JUL.2015 14:33:17

Plot 1.8



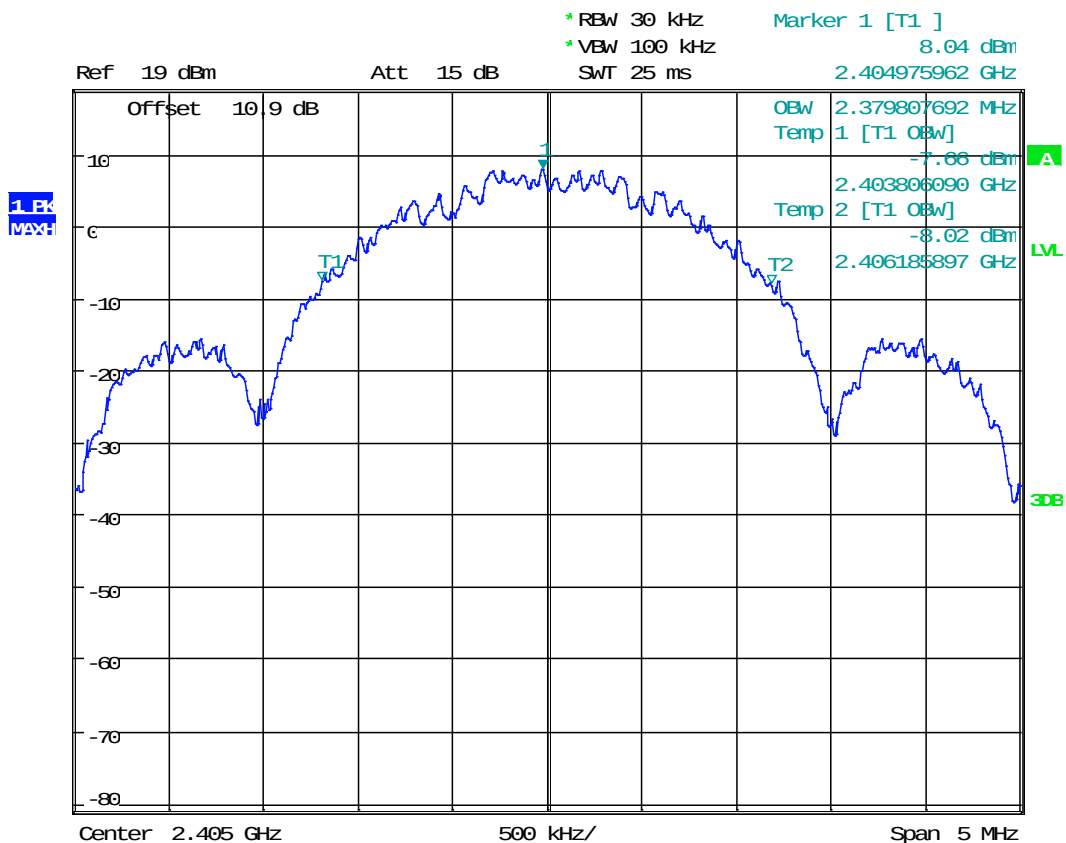
Date: 14.JUL.2015 14:31:49

Plot 1.9



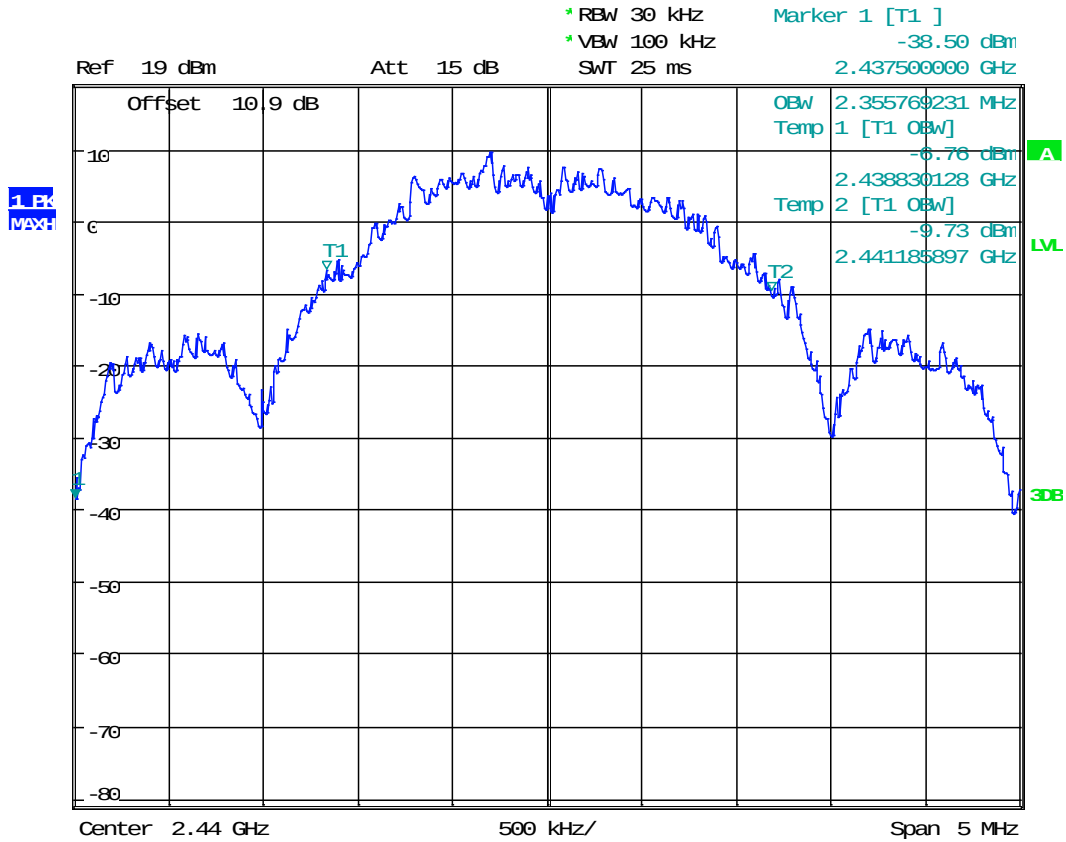
Date: 14.JUL.2015 14:32:34

Plot 1.10



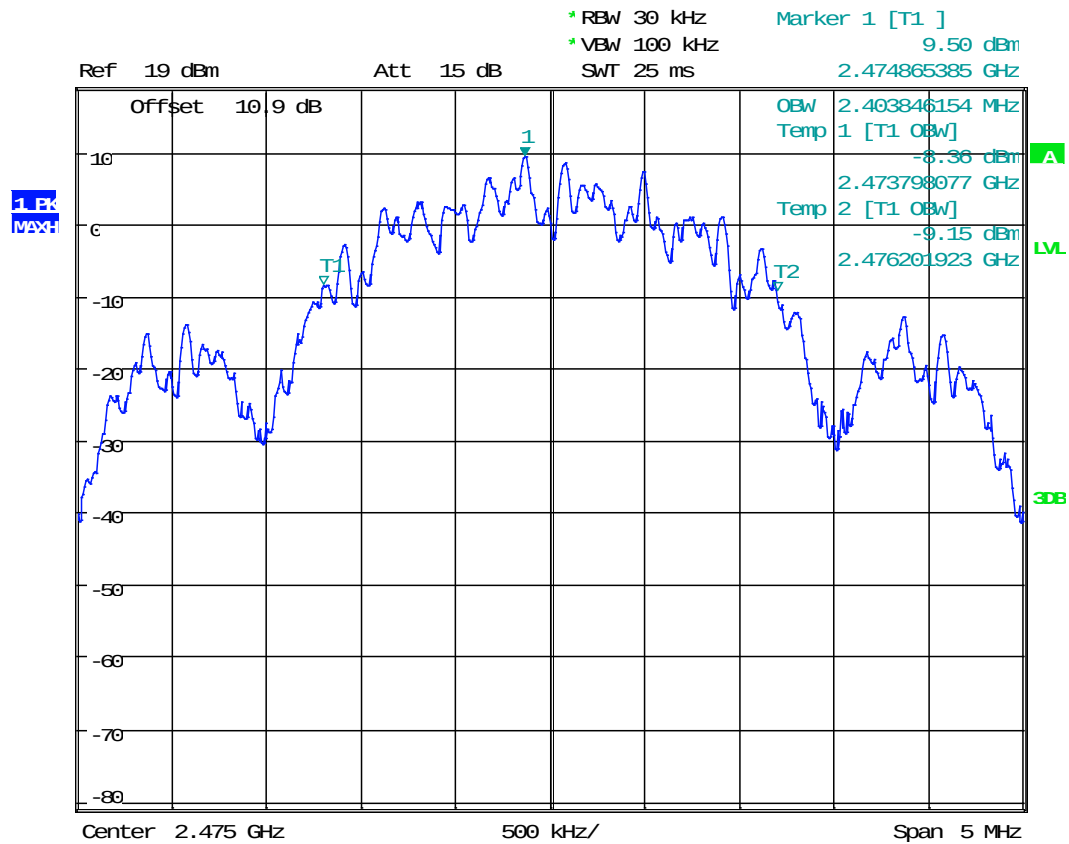
Date: 8.JUL.2015 14:40:34

Plot 1.11



Date: 8.JUL.2015 14:41:17

Plot 1.12



Date: 8.JUL.2015 14:39:29

4.2 Maximum Peak Conducted Output Power at Antenna Terminals FCC Rule: 15.247(b)(3); RSS-247 5.4;

4.2.1 Requirement

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt or 30 dBm.
For antennas with gains greater than 6 dBi, transmitter output level must be decreased appropriately, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

4.2.2 Procedure

The antenna port of the EUT was connected to the input of a spectrum analyzer/power meter to measure the Maximum Conducted Transmitter Output Power.

The procedure described in FCC Publication 558074, was used. Specifically, section 9.1.1 for Maximum Peak Conducted Output Power, with the spectrum analyzer's peak detector and Resolution Bandwidth RBW > DTS Bandwidth.

4.3.3 Test Result

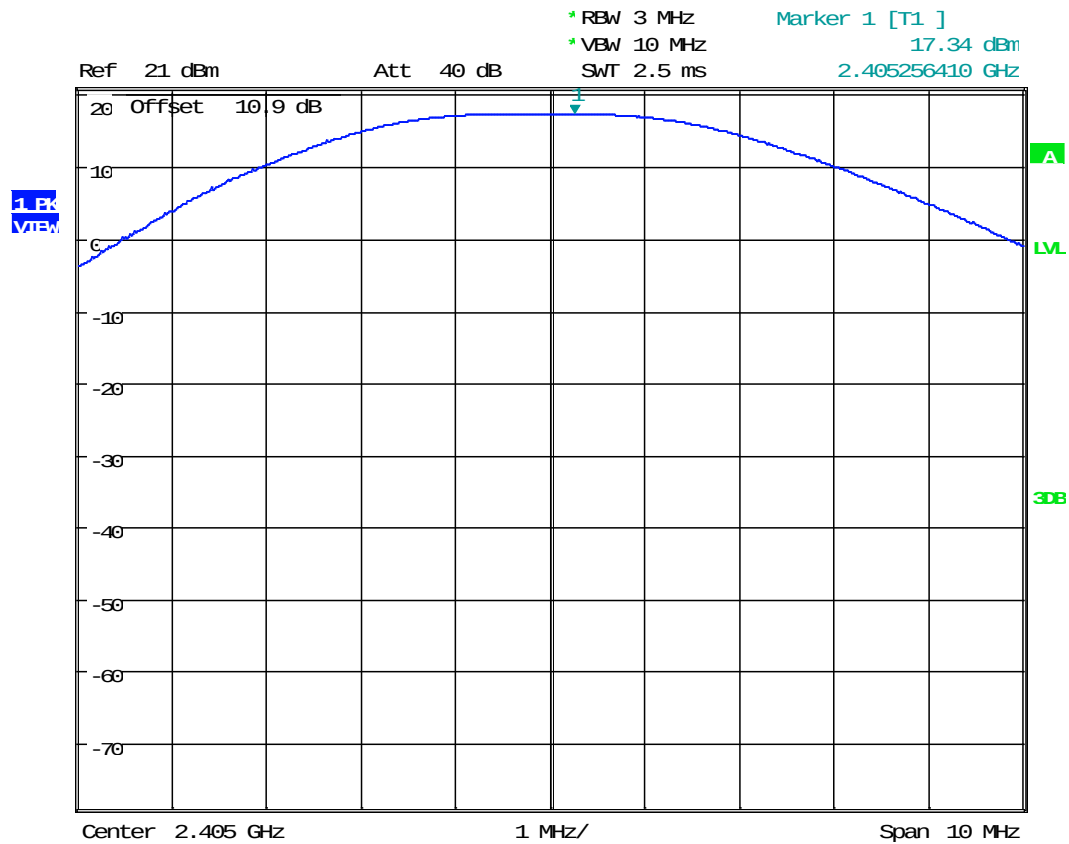
Refer to the following plots 2.1 – 2.3 for the test details.

Frequency, MHz	Conducted Power (peak), dBm	Conducted Power (peak), mW	Plot
Novi Relay Station			
2405	17.34	54.328	2.1
2440	17.21	52.726	2.2
2475	14.91 *	31.047	2.3
Novi Sensor			
2405	16.70	46.884	2.4
2440	16.43	44.058	2.5
2475	13.25 *	21.185	2.6

* RF power setting is reduced to comply with band-edge requirement

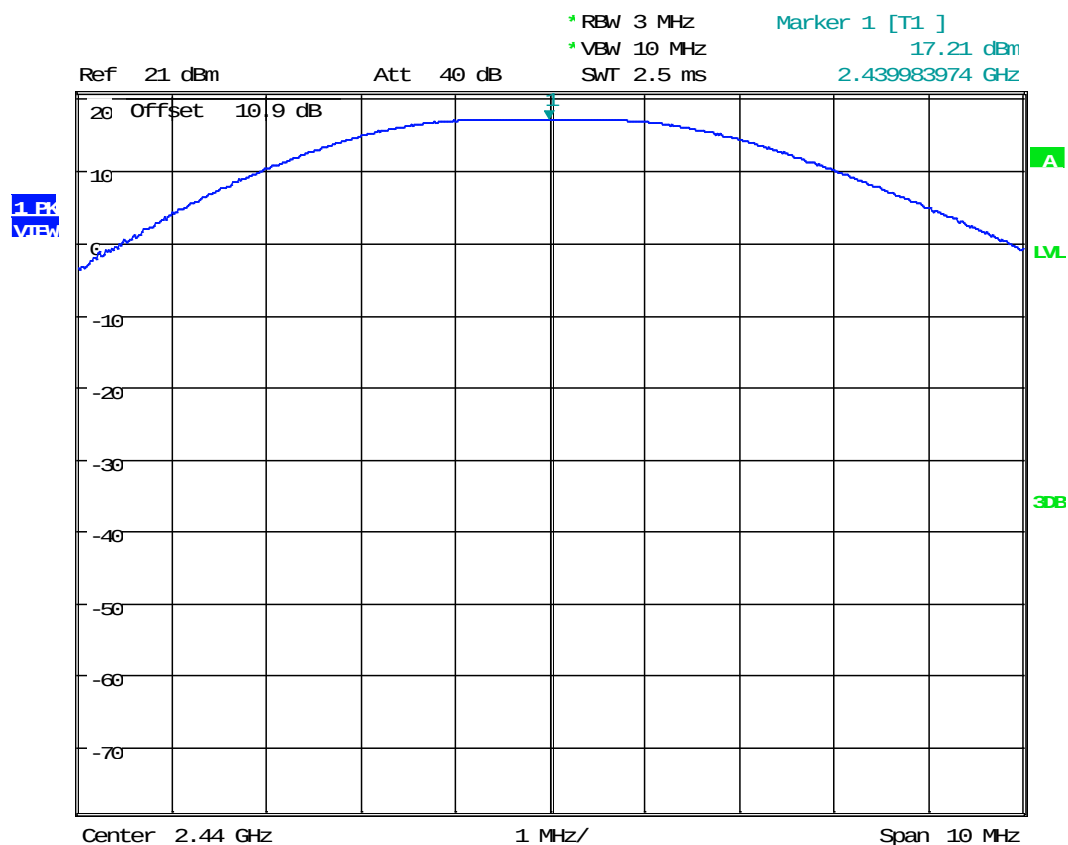
Results	Complies
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Plot 2. 1



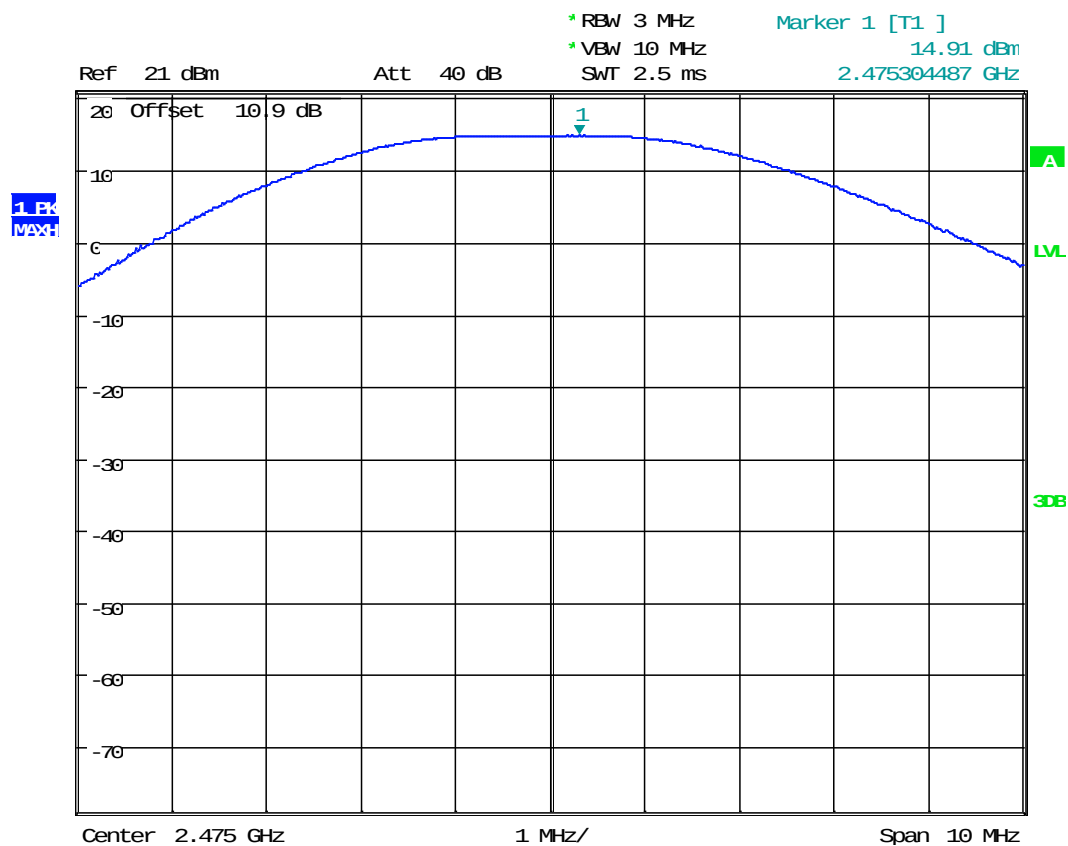
Date: 15.JUL.2015 10:13:33

Plot 2. 2



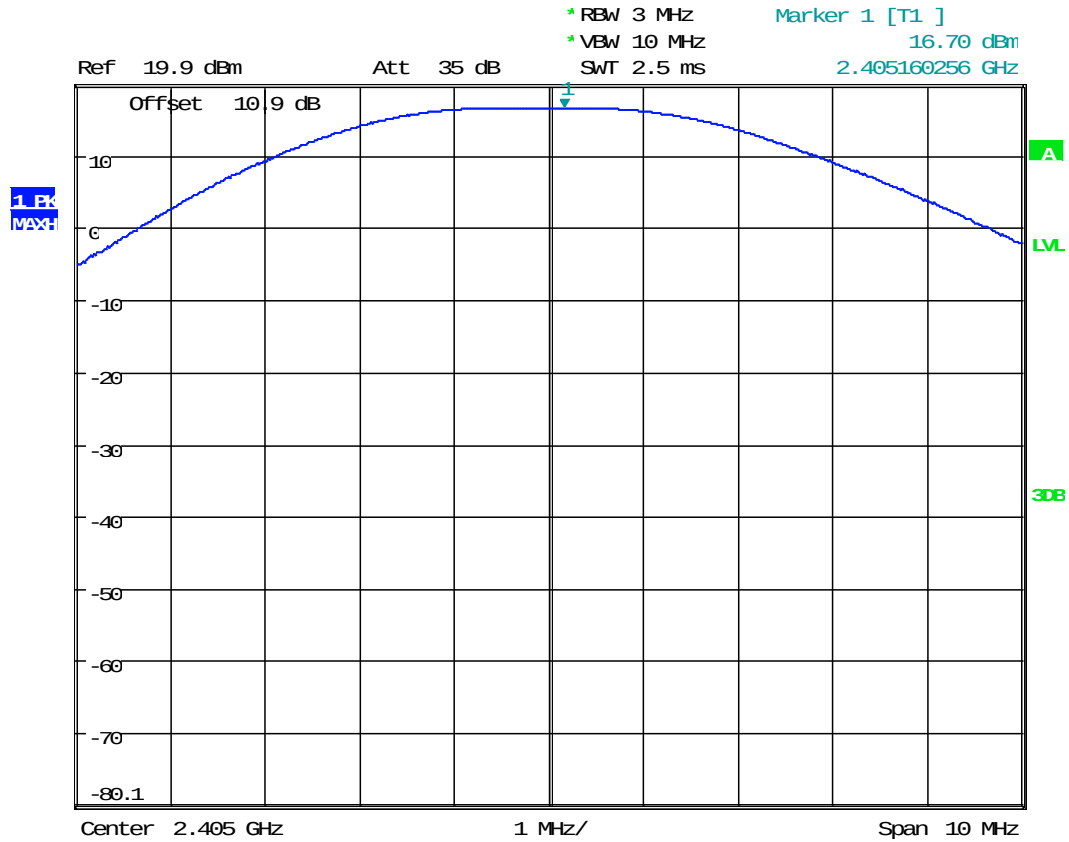
Date: 15.JUL.2015 10:13:53

Plot 2.3



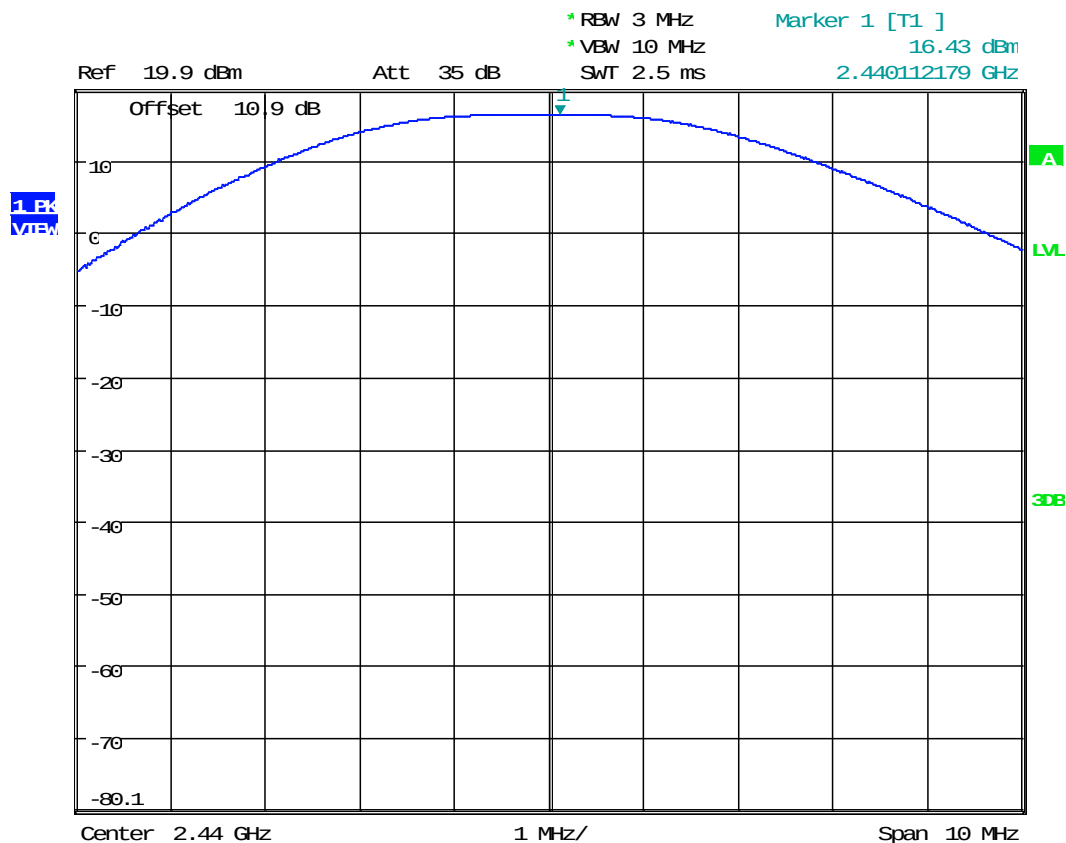
Date: 15.JUL.2015 10:14:22

Plot 2. 4



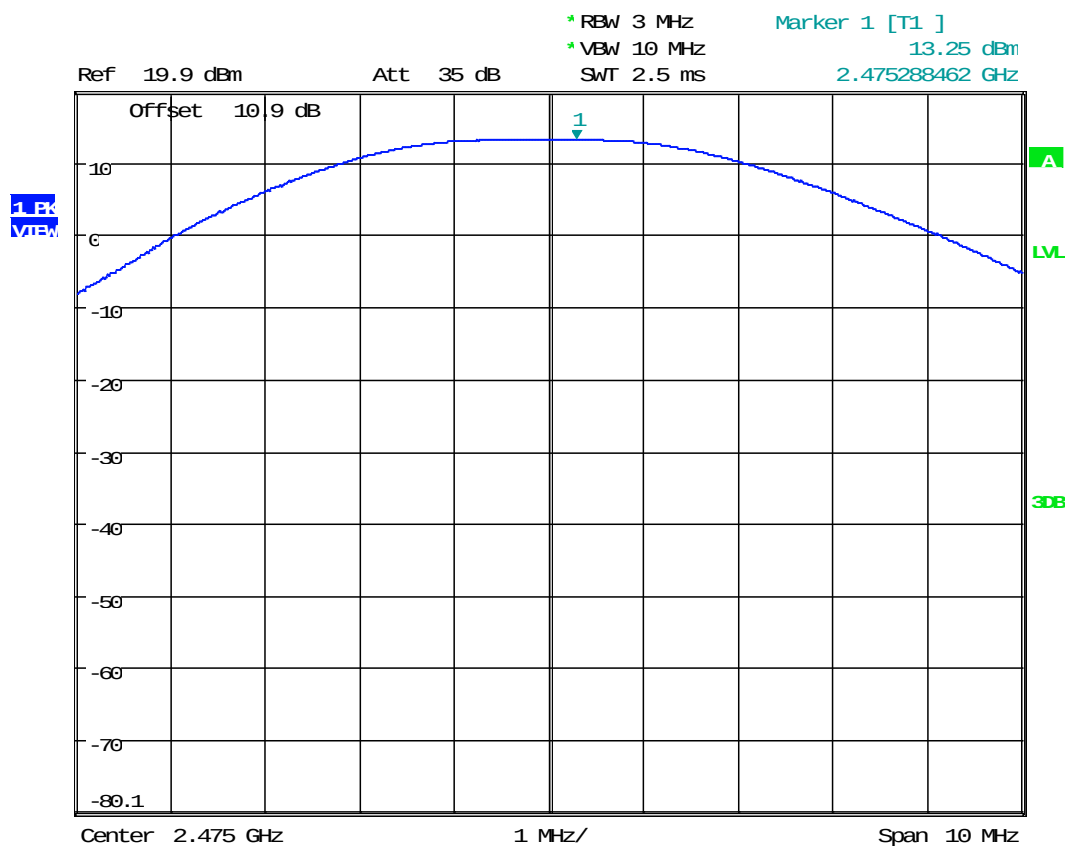
Date: 15.JUL.2015 10:03:18

Plot 2.5



Date: 15.JUL.2015 10:04:07

Plot 2. 6



Date: 15.JUL.2015 10:04:54

4.3 Maximum Power Spectral Density

FCC: 15.247 (e); RSS-247 5.2;

4.3.1 Requirement

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna should not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

4.3.2 Procedure

The antenna port of the EUT was connected to the input of a spectrum analyzer to measure the Transmitter Power Density (PSD).

The procedure described in FCC Publication 558074 was used. Specifically, section 10.2, Peak PSD, with peak detector and max hold trace mode. Spectrum analyzer resolution bandwidth was set to 3 kHz and span to at least 1.5 times the DTS (6 dB) channel bandwidth.

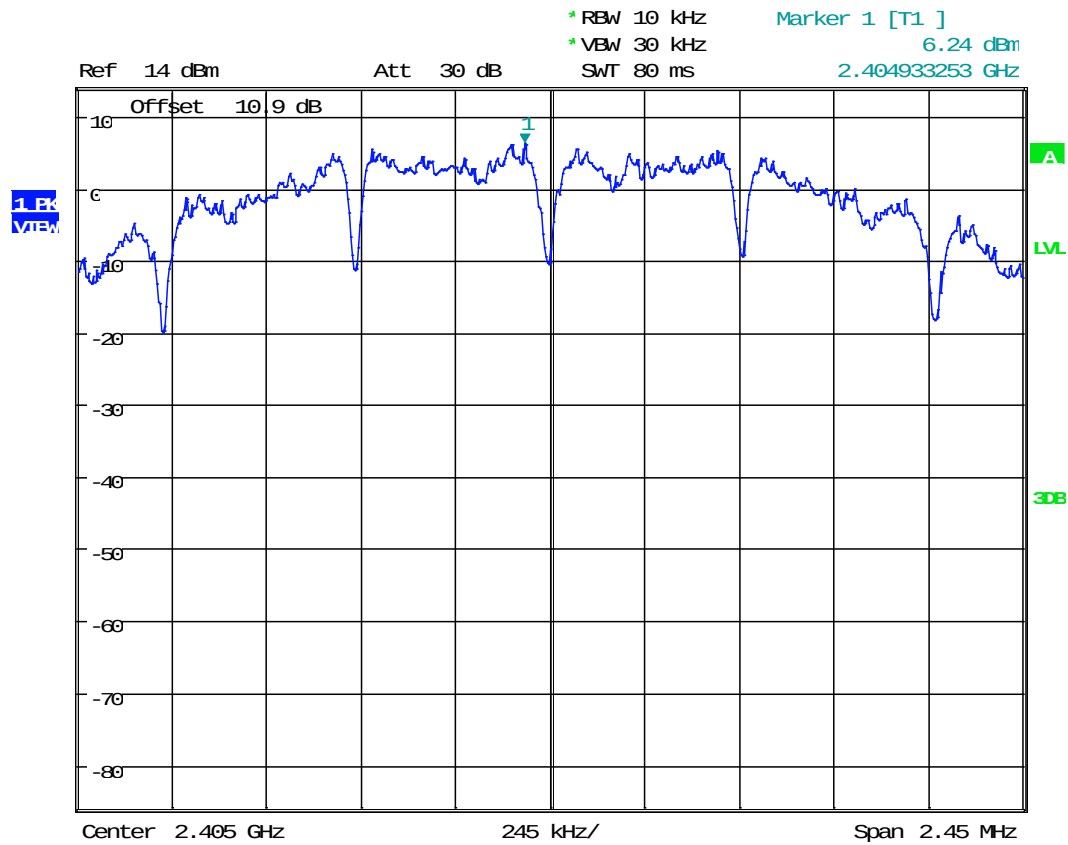
4.3.3 Test Result

Refer to the following plots for the test result

Frequency, MHz	Maximum Power Spectral Density, dBm	Maximum Power Spectral Density Limit, dBm	Margin, dB	Plot
Novi Relay Station				
2405	6.24	8.0	-1.76	3.1
2440	6.67	8.0	-1.33	3.2
2475	2.23	8.0	-5.77	3.3
Novi Sensor				
2405	4.87	8.0	-3.13	3.4
2440	2.35	8.0	-5.65	3.5
2475	1.11	8.0	-6.89	3.6

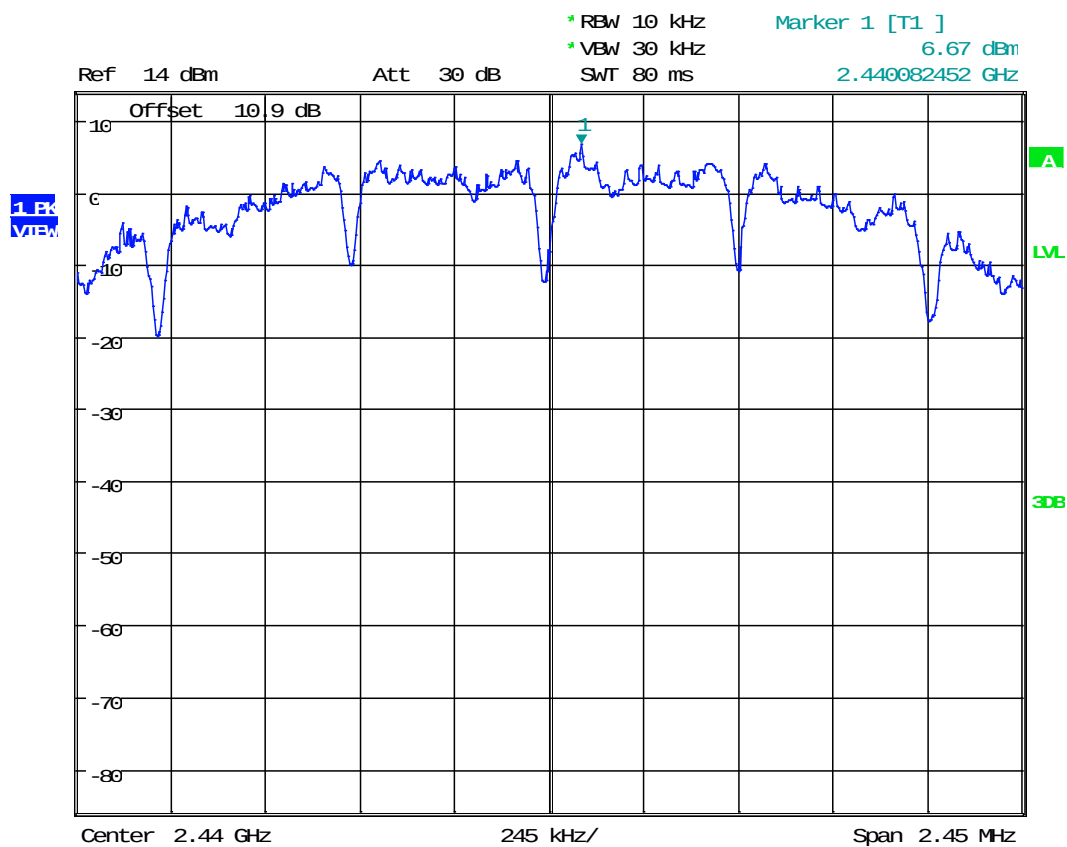
Results	Complies
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Plot 3. 1



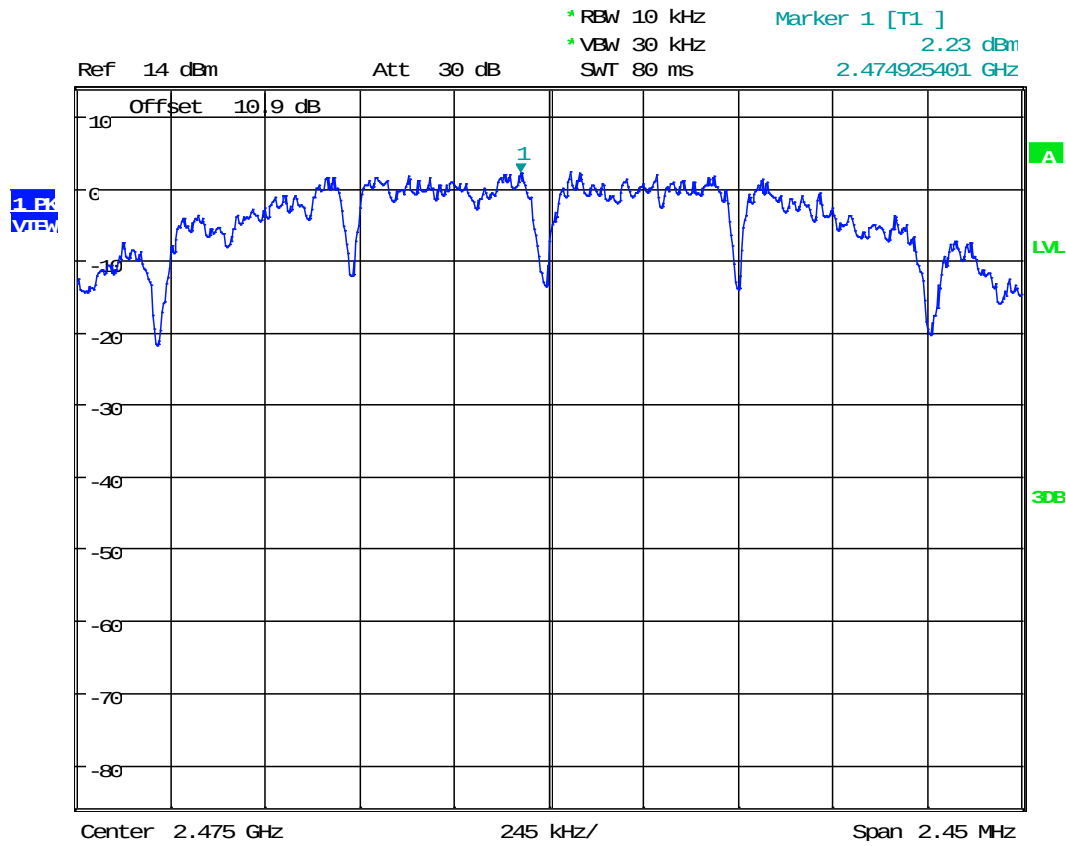
Date: 15.JUL.2015 10:17:03

Plot 3. 2



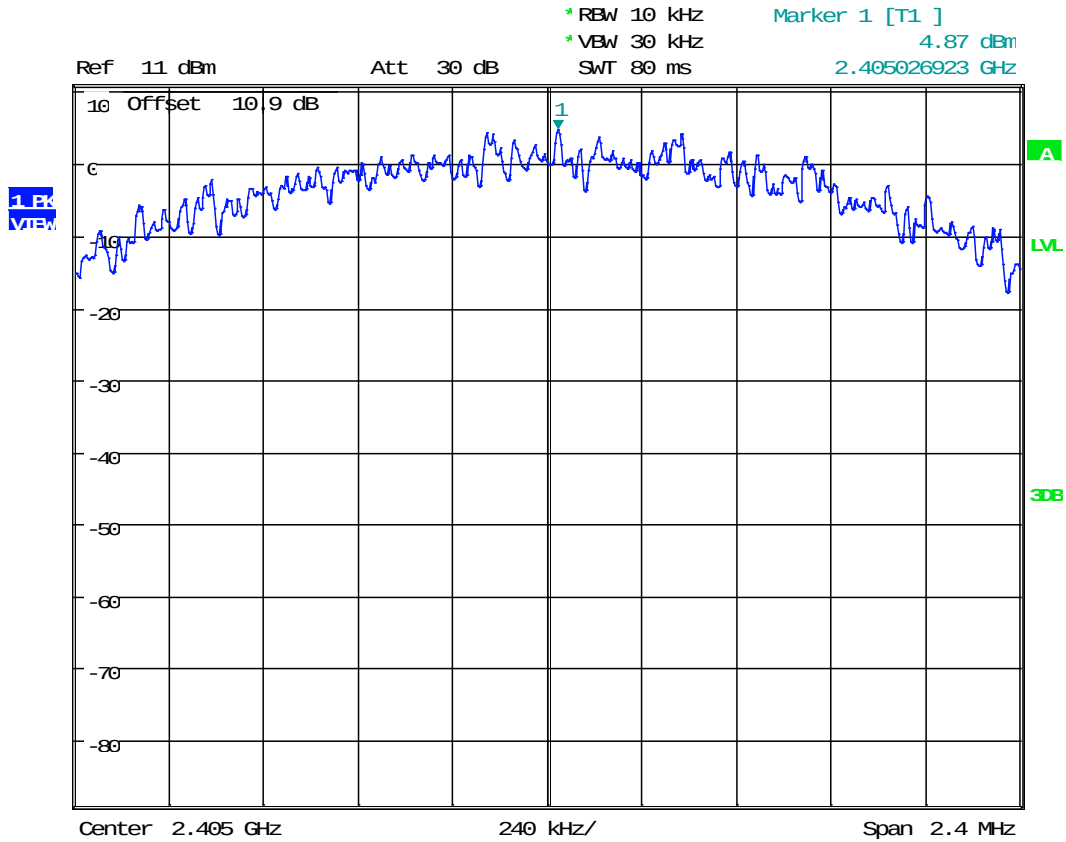
Date: 14.JUL.2015 14:37:20

Plot 3.3



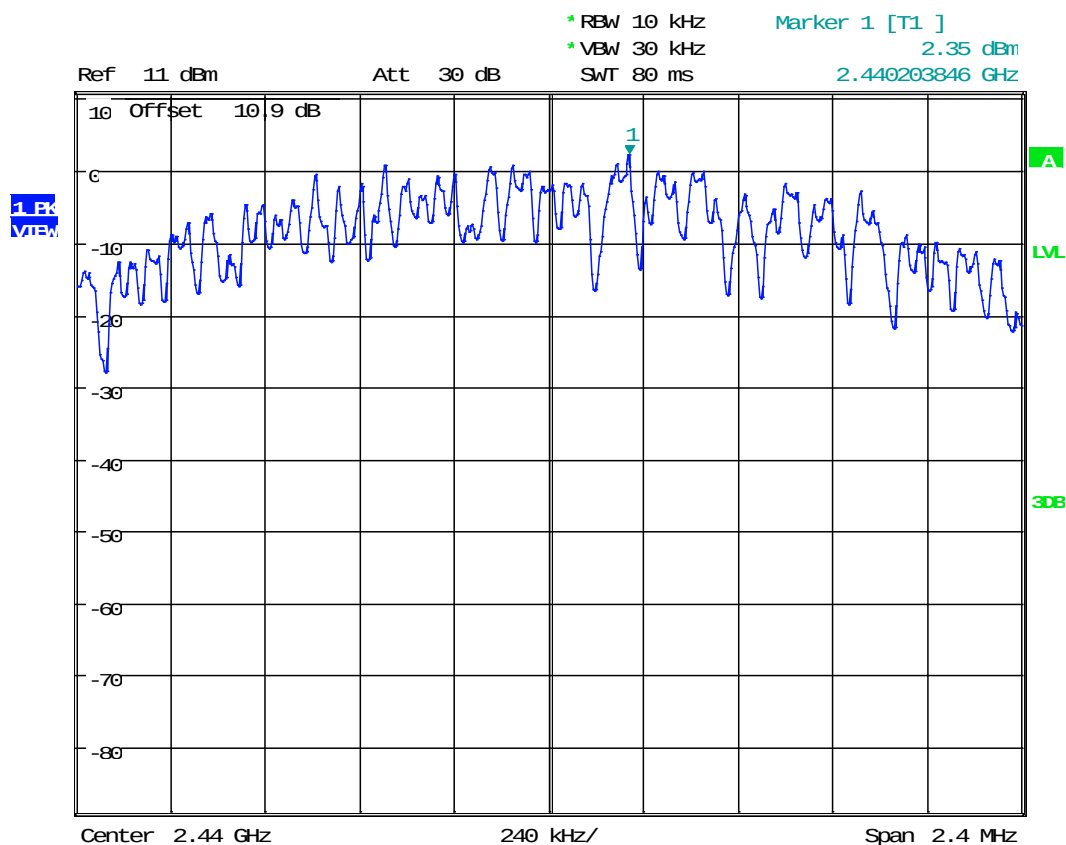
Date: 14.JUL.2015 14:37:47

Plot 3. 4



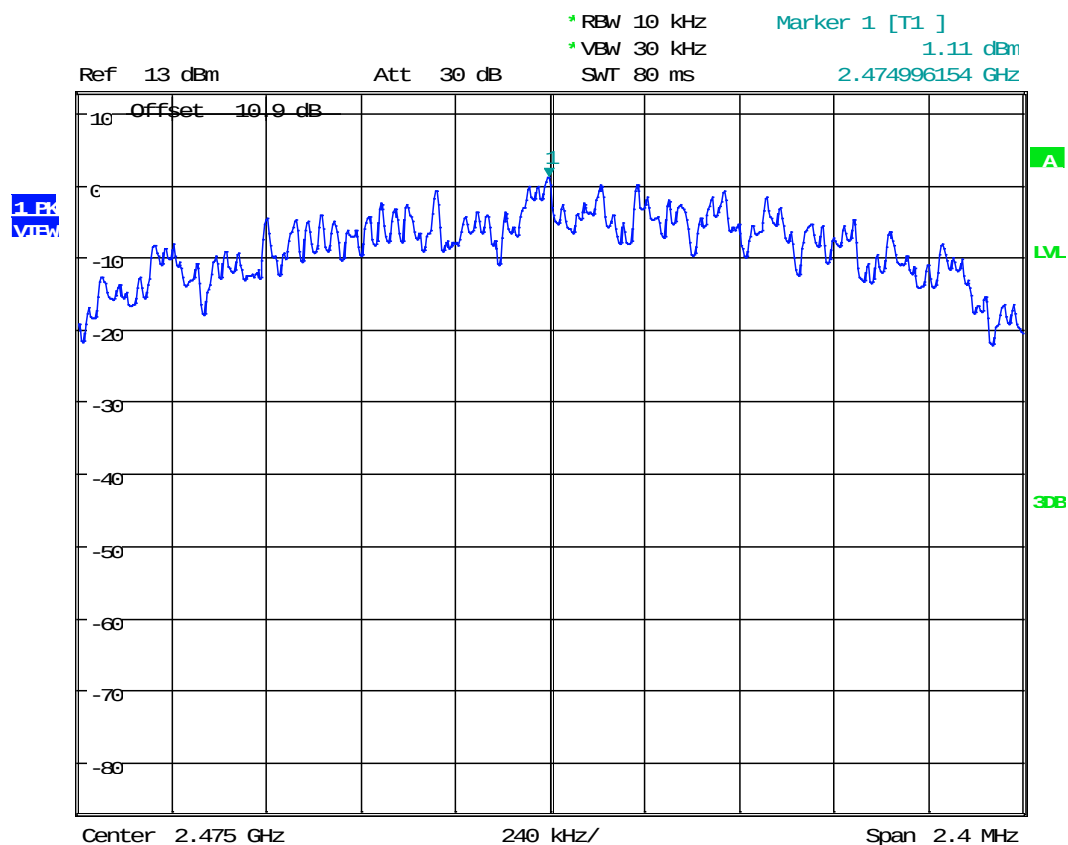
Date: 14.JUL.2015 15:16:08

Plot 3.5



Date: 14.JUL.2015 15:17:10

Plot 3. 6



Date: 15.JUL.2015 10:06:57

4.4 Unwanted Conducted Emissions

FCC: 15.247(d); RSS-247 5.5;

4.4.1 Requirement

In any 100 kHz bandwidth outside the EUT pass-band, the RF power shall be below the maximum in-band 100 kHz emissions by at least 20 dB (if peak power of in-band emission is measured) or 30 dB (if average power of in-band emission is measured).

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)

4.4.2 Procedure

A spectrum analyzer was connected to the antenna port of the transmitter. Analyzer Resolution Bandwidth was set to 100 kHz. For each channel investigated, the in-band and unwanted peak emission measurements (with max hold) were performed. For the wideband scan, Spectrum Analyzer setting of number of points 30000 was used.

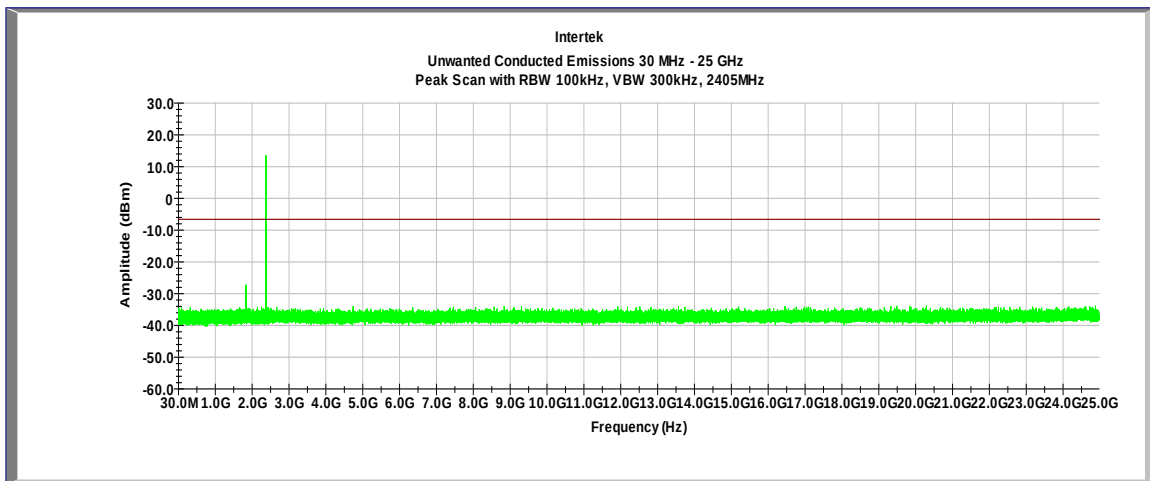
The unwanted emissions were measured from 30 MHz to 25 GHz.

4.4.3 Test Result

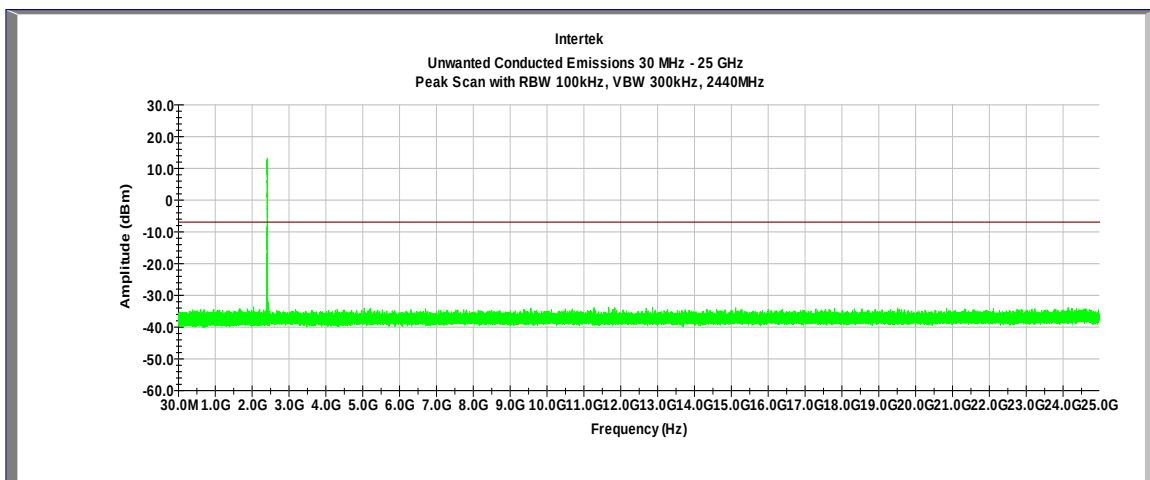
Refer to the following plots 4.1 – 4.6 for unwanted conducted emissions. The plot shows -20dB attenuation limit line.

Results	Complies
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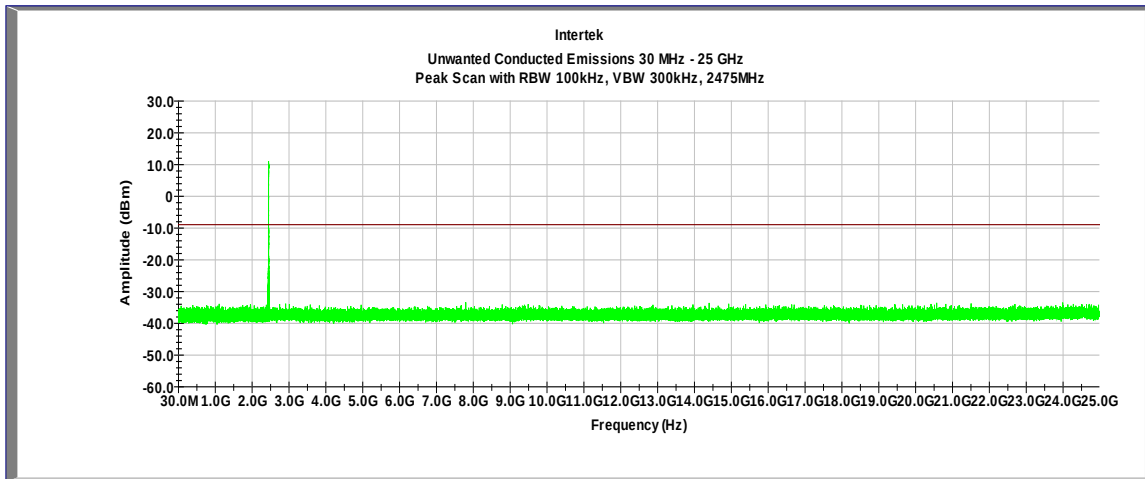
Plot 4.1 Novi Relay Station, Tx @ Low Channel, 2405 MHz



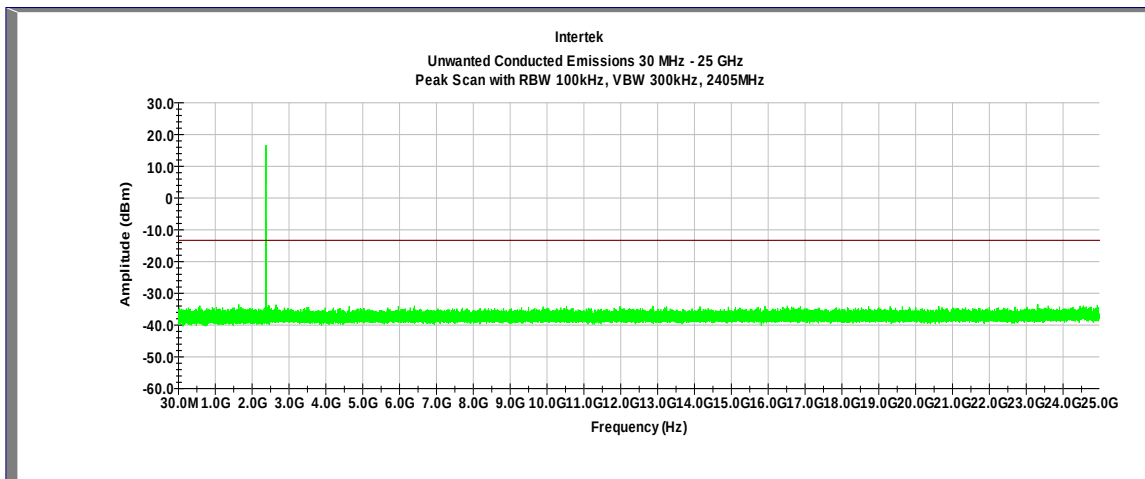
Plot 4.2 Novi Relay Station, Tx @ Mid Channel, 2440 MHz



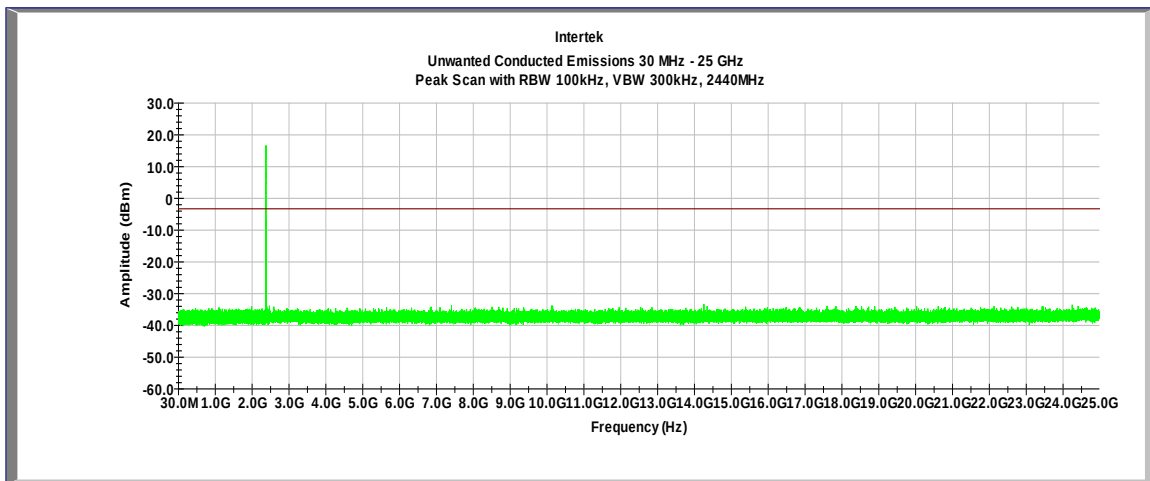
Plot 4.3 Novi Relay Station, Tx @ High Channel, 2475 MHz



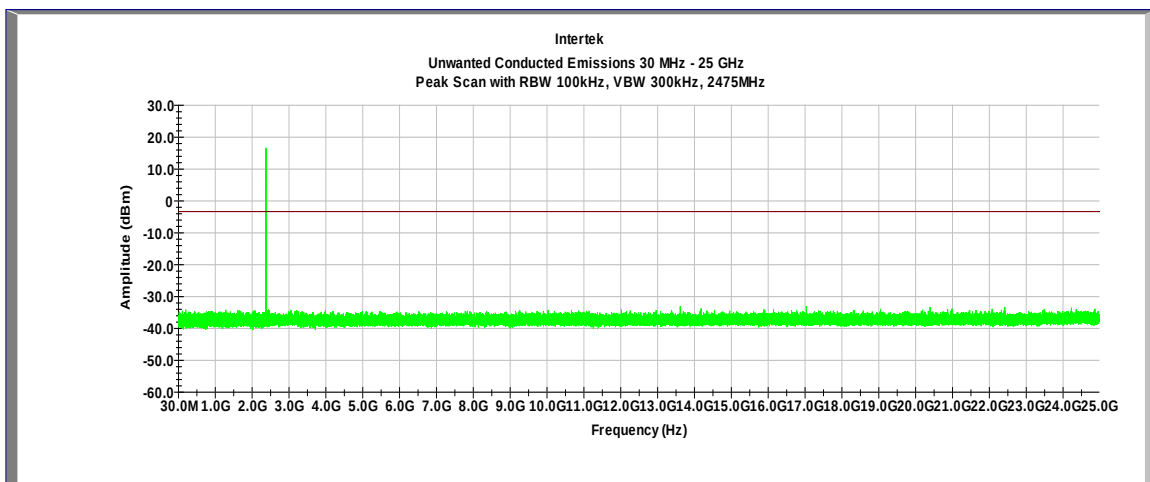
Plot 4.4 Novi Sensor, Tx @ Low Channel, 2405 MHz



Plot 4.5 Novi Sensor, Tx @ Mid Channel, 2440 MHz



Plot 4.6 Novi Sensor, Tx @ High Channel, 2475 MHz



4.5 Transmitter Radiated Emissions

FCC Rules: 15.247(d), 15.209, 15.205; RSS-247;

4.5.1 Requirement

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

In any 100 kHz bandwidth outside the EUT pass-band, the RF power shall be below the maximum in-band 100 kHz emissions by at least 20 dB (if peak power of in-band emission is measured) or 30 dB (if average power of in-band emission is measured).

4.5.2 Procedure

Radiated emission measurements were performed from 30 MHz to 25 GHz according to the procedure described in ANSI C64.10. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz to 1000 MHz, 1 MHz for frequencies above 1000 MHz. Above 1000 MHz Peak and Average measurements were performed.

The EUT is placed on a plastic turntable that is 80 cm in height. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst-case emissions. The signal is maximized through rotation. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at 10 meters for frequencies below 1 GHz and at 3 meters for frequencies above 1 GHz, except measurement at 1 meter for all band edge measurement.

Data included is representative of the worst-case configuration (the configuration which resulted in the highest emission levels).

4.5.3 Field Strength Calculation

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$FS = RA + AF + CF - AG$; if measurement is performed at a distance other than specified in the rule, a Distance Correction Factor (DCF) shall be added.

Where FS = Field Strength in dB(μ V/m)

RA = Receiver Amplitude (including preamplifier) in dB(μ V); AF = Antenna Factor in dB(1/m)

CF = Cable Attenuation Factor in dB; AG = Amplifier Gain in dB

Assume a receiver reading of 52.0 dB(μ V) is obtained. The antennas factor of 7.4 dB(1/m) and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving field strength of 32 dB(μ V/m). This value in dB(μ V/m) was converted to its corresponding level in μ V/m.

RA = 52.0 dB(μ V)

AF = 7.4 dB(1/m)

CF = 1.6 dB

AG = 29.0 dB

$FS = 52.0 + 7.4 + 1.6 - 29.0 = 32$ dB(μ V/m).

Level in μ V/m = Common Antilogarithm $[(32 \text{ dB}\mu\text{V/m})/20] = 39.8 \mu\text{V/m}$.

4.5.4 Test Results

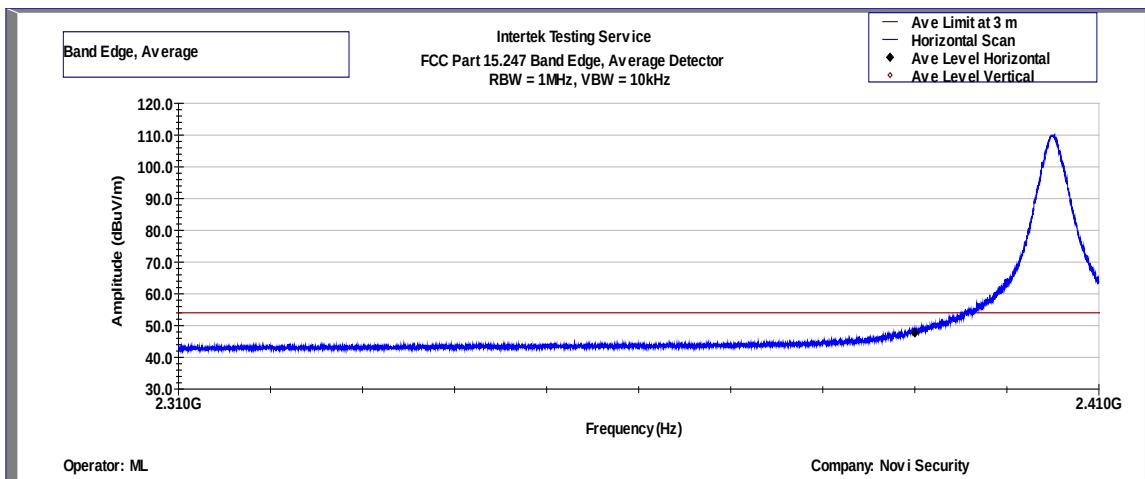
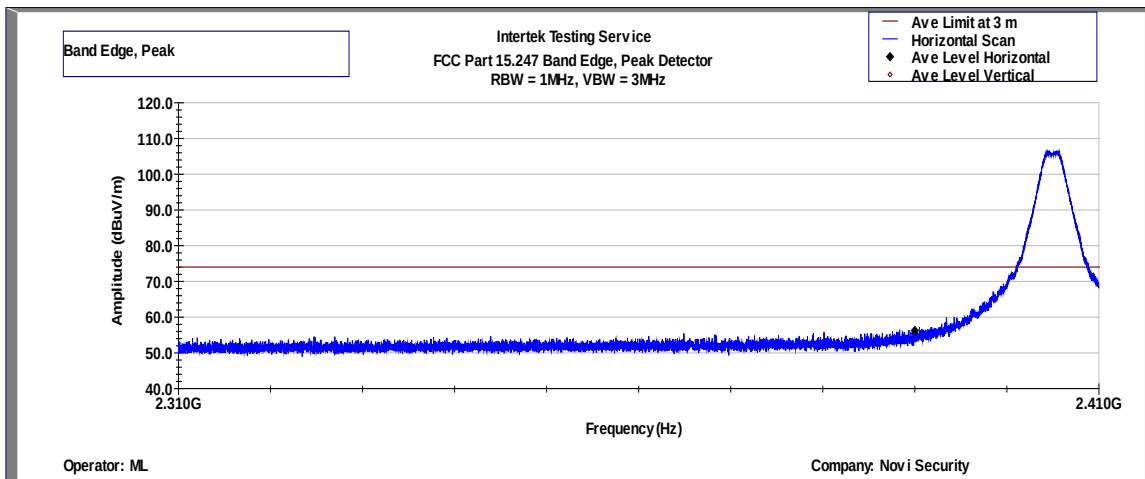
The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

The EUT passed the test by 0.4dB

Test Results: 15.209/15.205 Restricted Band Emissions

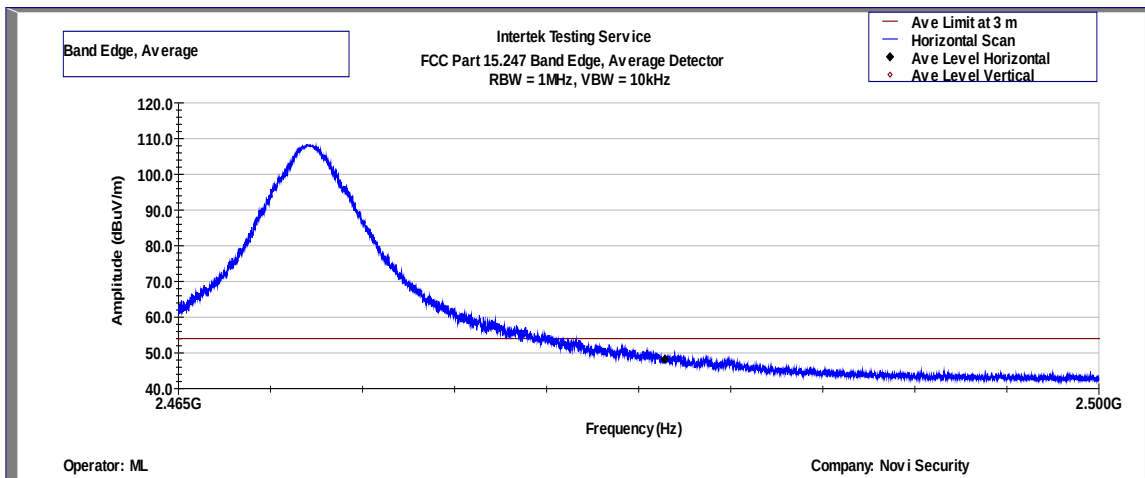
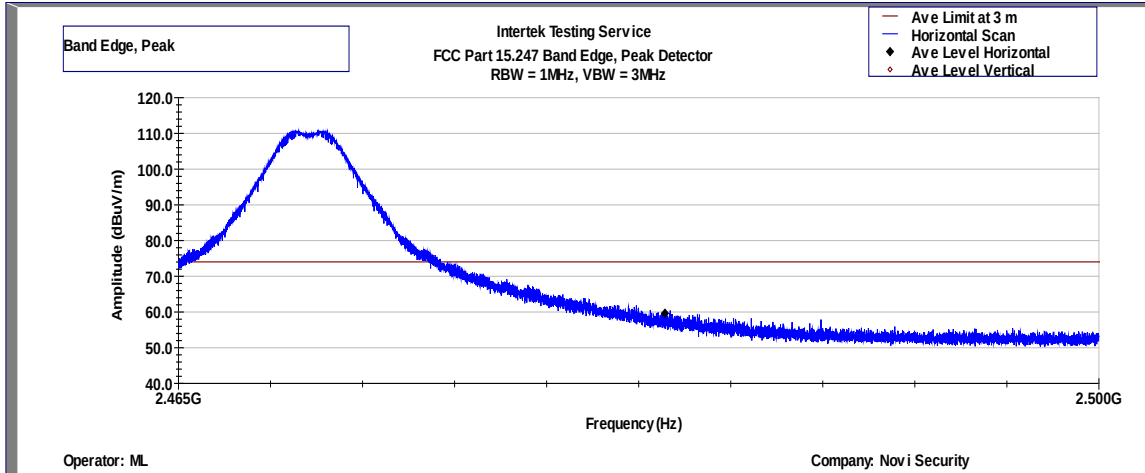
Out-of-Band Radiated spurious emissions at the Band-edge @1m distance
Novi Relay Station, 2310–2390 MHz
Tx @ 2405MHz



Frequency	RA @ 1 m	AF	DCF	CF + Attenuator	FS @ 3m	Detector	Limit @ 3 m	Margin
(MHz)	(dBuV/m)	(dB/m)	(dB)	(dB)	(dBuV/m)	(Peak) / (Average)	(dBuV/m)	(dB)
Tx @ 2405MHz								
2390.00	32.6	28.0	9.54	5.3	56.4	Peak	74.0	-17.6
	23.1	28.0	9.54	5.3	46.9	Average	54.0	-7.1

Note: $FS@3m = RA + AF - DCF + (CF + Attenuator)$

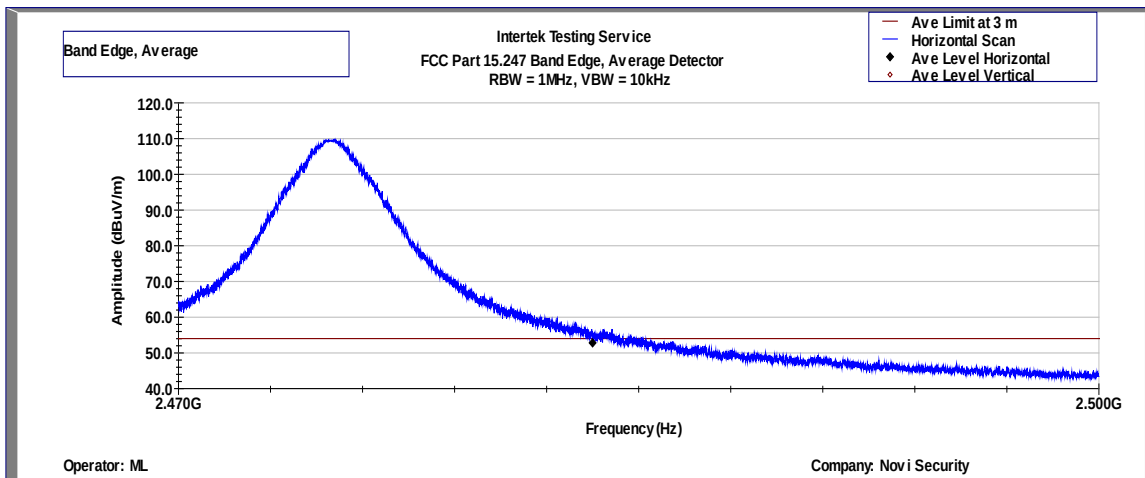
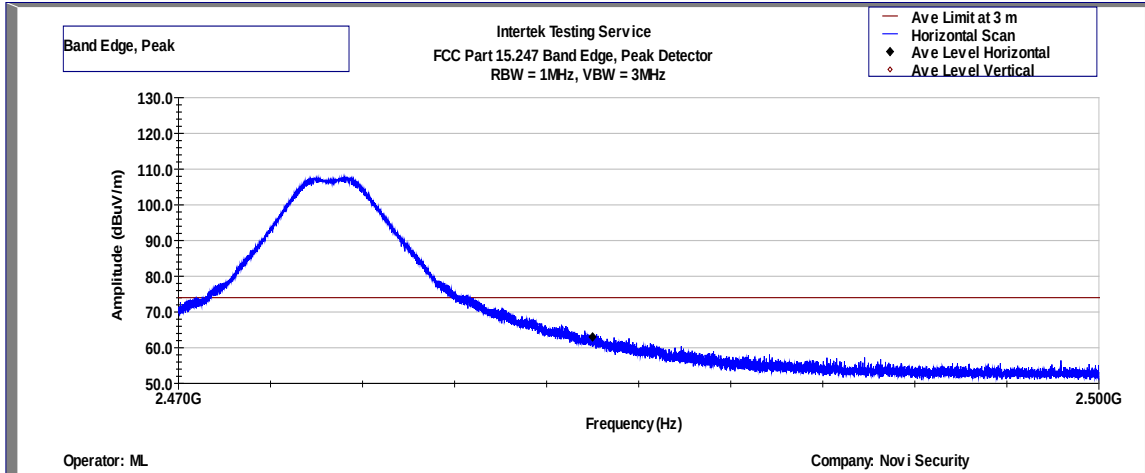
Out-of-Band Radiated spurious emissions at the Band-edge @1m distance
Novi Relay Station, 2483.5–2500 MHz
Tx @ 2470MHz



Frequency	RA @ 1 m	AF	DCF	CF + Attenuator	FS @ 3m	Detector	Limit @ 3 m	Margin
(MHz)	(dBuV/m)	(dB/m)	(dB)	(dB)	(dBuV/m)	(Peak) / (Average)	(dBuV/m)	(dB)
Tx @ 2470MHz								
2483.50	35.8	28.1	9.5	6.1	60.5	Peak	74.0	-13.5
	24.3	28.1	9.5	6.1	49.0	Average	54.0	-5.0

Note: $FS@3m = RA + AF - DCF + (CF + Attenuator)$

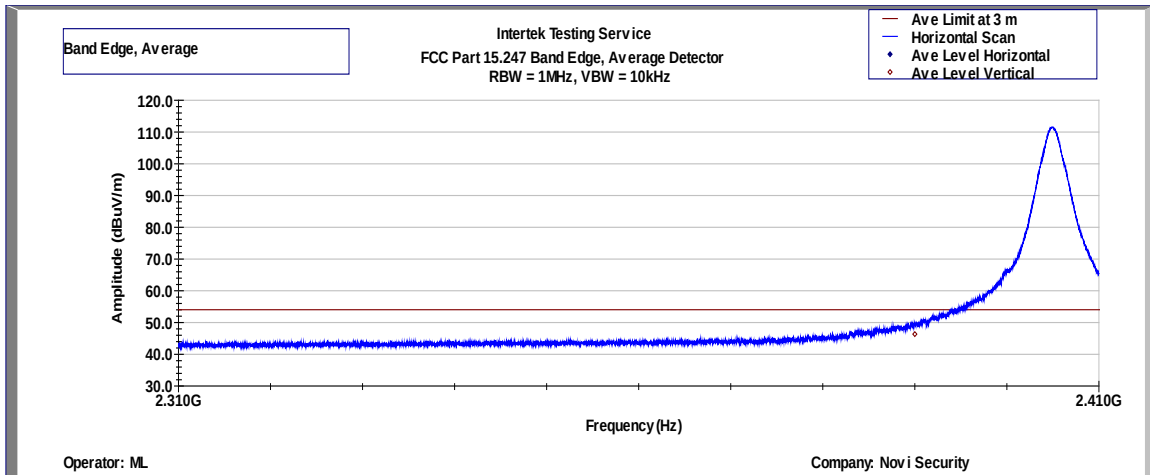
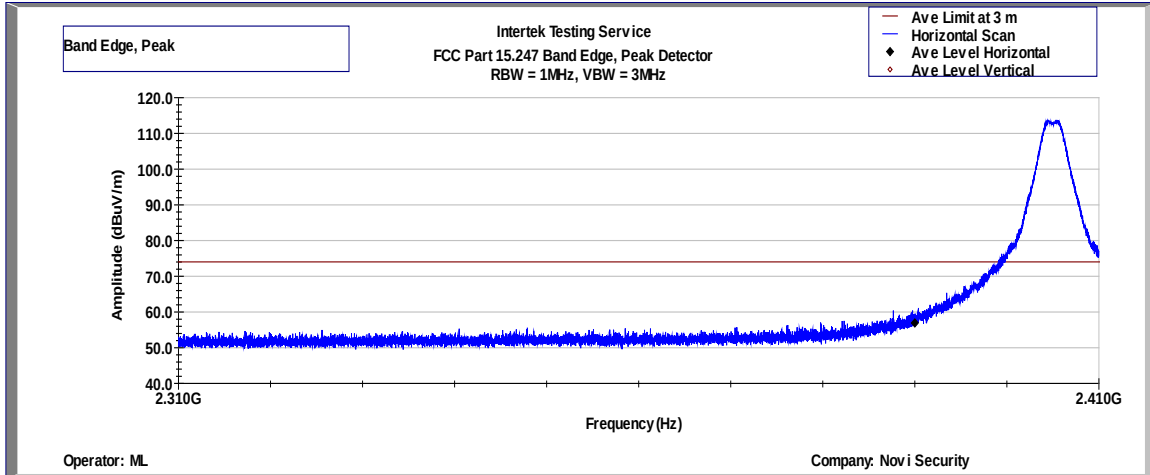
Out-of-Band Radiated spurious emissions at the Band-edge @1m distance
Novi Relay Station, 2483.5–2500 MHz
Tx @ 2475MHz



Frequency	RA @ 1 m	AF	DCF	CF + Attenuator	FS @ 3m	Detector	Limit @ 3 m	Margin
(MHz)	(dBuV/m)	(dB/m)	(dB)	(dB)	(dBuV/m)	(Peak) / (Average)	(dBuV/m)	(dB)
Tx @ 2475MHz								
2483.50	39.1	28.1	9.54	6.1	60.0	Peak	74.0	-14.0
	28.9	28.1	9.54	6.1	53.6	Average	54.0	-0.4

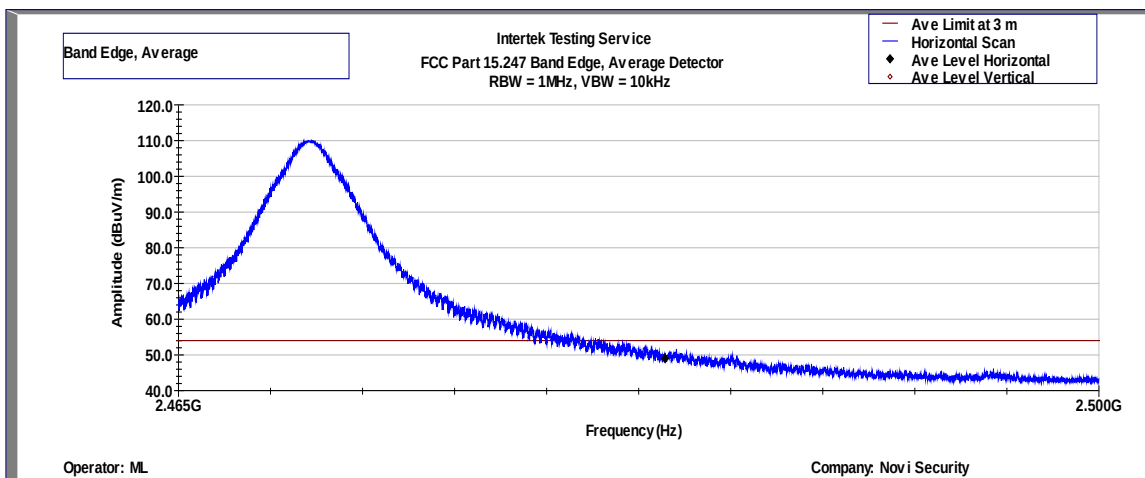
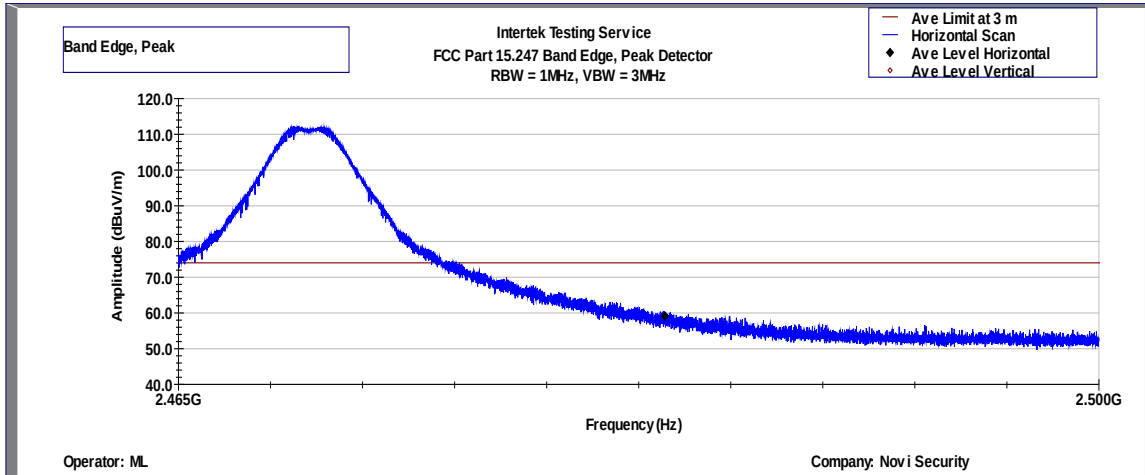
Note: $FS@3m = RA + AF - DCF + (CF + Attenuator)$

Out-of-Band Radiated spurious emissions at the Band-edge @1m distance
Novi Sensor, 2310–2390 MHz
Tx @2405MHz



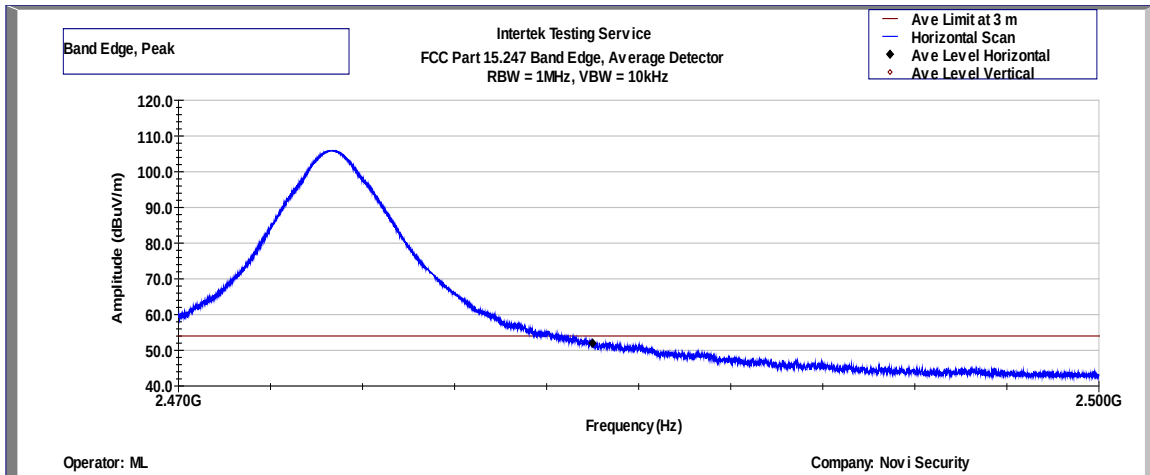
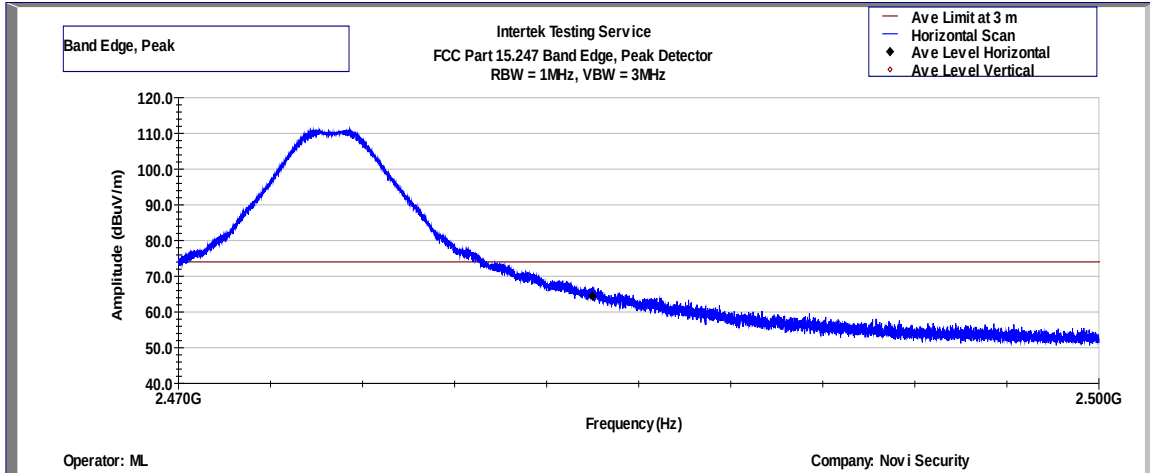
Frequency	RA @ 1 m	AF	DCF	CF + Attenuator	FS @ 3m	Detector	Limit @ 3 m	Margin
(MHz)	(dBuV/m)	(dB/m)	(dB)	(dB)	(dBuV/m)	(Peak) / (Average)	(dBuV/m)	(dB)
Tx @ 2405MHz								
2390.00	33.2	28.0	9.54	5.3	57.0	Peak	74.0	-17.0
	21.7	28.0	9.54	5.3	45.5	Average	54.0	-8.5

Out-of-Band Radiated spurious emissions at the Band-edge @1m distance
Novi Sensor, 2483.5–2500 MHz
Tx @ 2470MHz



Frequency	RA @ 1 m	AF	DCF	CF + Attenuator	FS @ 3m	Detector	Limit @ 3 m	Margin
(MHz)	(dBuV/m)	(dB/m)	(dB)	(dB)	(dBuV/m)	(Peak) / (Average)	(dBuV/m)	(dB)
Tx @ 2470MHz								
2483.50	35.2	28.1	9.54	6.12	59.9	Peak	74.0	-14.1
	25.1	28.1	9.54	6.12	49.8	Average	54.0	-4.2

Out-of-Band Radiated spurious emissions at the Band-edge @1m distance
Novi Sensor, 2483.5–2500 MHz
Tx @ 2475MHz



Frequency	RA @ 1 m	AF	DCF	CF + Attenuator	FS @ 3m	Detector	Limit @ 3 m	Margin
(MHz)	(dBuV/m)	(dB/m)	(dB)	(dB)	(dBuV/m)	(Peak) / (Average)	(dBuV/m)	(dB)
Tx @ 2475MHz								
2483.50	40.6	28.1	9.54	6.12	64.5	Peak	74.0	-9.5
	28.1	28.1	9.54	6.12	52.8	Average	54.0	-1.2

Results

Complies