TEST REPORT

Report Number: 102960041MPK-005
Project Numbers: G102960041, G1029966706
July 14, 2017

Testing performed on the
Genius Switch
Model: GSW

FCC ID: 2ADH9-GSW
IC: 12453A-GSW
to

FCC Part 15 Subpart C (15.247)
Industry Canada RSS-247 Issue 2
FCC Part 15, Subpart B
Industry Canada ICES-003

For

Levven Automation Inc.

Test Performed by:	Test Authorized by:
Intertek	Levven Automation Inc.
1365 Adams Court	9741 54 Avenue
Menlo Park, CA 94025	Edmonton, AB T6E 5J4
USA	Canada

Prepared by: _____ **Date:** July 14, 2017
Anderson Soungpanya

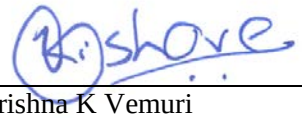
Reviewed by: _____ **Date:** July 14, 2017
Krishna K Vemuri

Report No. 102960041MPK-005

Equipment Under Test:	Genius Switch
Model Number(s):	GSW
Applicant:	Levven Automation Inc.
Contact:	Jim Qualie
Address:	Levven Automation Inc. 9741 54 Avenue Edmonton, AB T6E 5J4
Country	Canada
Tel. Number:	+1 780-391-3004
Email:	Jqualie@levven.com
Applicable Regulation:	FCC Part 15 Subpart C (15.247) Industry Canada RSS-247 Issue 2 FCC Part 15, Subpart B Industry Canada ICES-003
Date of Test:	March 28 - July 06, 2017

We attest to the accuracy of this report:

Anderson Soungpanya
Project Engineer



Krishna K Vemuri
Engineering Team Lead

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1.0 Summary of Tests

Test	Reference FCC	Reference Industry Canada	Result
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	Not Applicable (EUT is Battery Powered)
Antenna Requirement	15.203	RSS-GEN	Complies (Internal Antenna)
RF Exposure	15.247(i), 2.1093(d)	RSS-102	Complies
Conducted Emission	15.107	ICES-003	Not Applicable (EUT is Battery Powered)
Radiated Emissions	15.109	ICES-003	Complies

EUT receive date: March 21, 2017

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: March 28, 2017

Test completion date: July 06, 2017

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

2.0 General Information

2.1 Product Description

Levven Automation Inc. supplied the following description of the EUT:

The product covered by this report is a wireless switch for lighting system. It is intended for household / commercial, indoor dry locations.

This test report covers only the 903-927MHz radio.

Applicant	Levven Automation Inc.
Model Number	GSW
FCC Identifier	2ADH9-GSW
IC Identifier	12453A-GSW
Type of transmission	Digital Transmission System (DTS)
Rated RF Output	12.24 dBm
Frequency Range	903 – 927 MHz
Type of modulation	2GFSK
Number of Channel(s)	33
Antenna(s) & Gain	•Antenna Based on SiLabs Application Note AN848 (Small Sized Printed ILA Antenna WES0118-01-APL915S-01) •Antenna gain measured is -3.6 dBi
Applicant Name & Address	Levven Automation Inc. 9741 54 Avenue Edmonton, AB T6E 5J4 Canada

2.2 Related Submittal(s) Grants

None.

2.3 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 D01 DTS MEAS GUIDANCE V04), and RSS-247, RSS-GEN, and

Radiated emissions and AC mains conducted emissions measurements were performed according to the procedures in ANSI C63.10: 2013. Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "Data Sheet" of this report.

2.4 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.

2.5 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	-

Measurement	Expanded Uncertainty (k=2)			
	0.15 MHz – 30MHz	30 – 200 MHz	200 MHz – 1 GHz	1 GHz – 18 GHz
Radiated emissions	-	4.7	4.6	5.1 dB
AC mains conducted emissions	2.1 dB	-	-	-

3.0 System Test Configuration

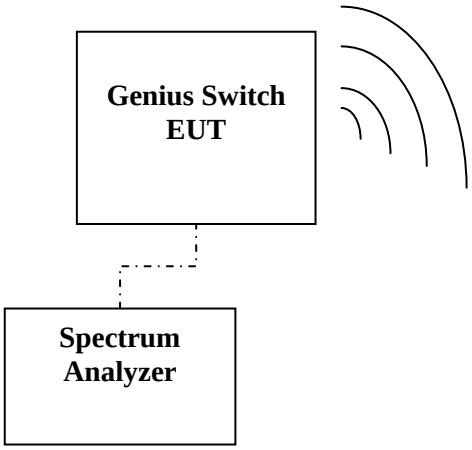
3.1 Support Equipment and description

None

3.2 Block Diagram of Test Setup

Equipment Under Test		
Product Name	Product Model #	Serial Number
Genius Switch	GSW	MPK1703211148-007 (Conducted) MPK1703211148-008 (Radiated)

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



S = Shielded **U** = Unshielded	**F** = With Ferrite **M** = Meter

3.3 Justification

Testing was performed for all modulation/data rate modes.

Unless otherwise stated in this report, measurements made for Power Density, Bandwidth, Conducted Spurious, Radiated Spurious were made with the worst case power setting

3.4 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.

During transmitter testing, the transmitter was setup to transmit using the maximum RF power setting provided by the manufacturer. Their corresponding output power in dBm can be found in section 4.2 of this report.

3.5 Modifications Required for Compliance

No modifications were made by the manufacturer or Intertek to the EUT in order to bring the EUT 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 99% Occupied Bandwidth
FCC Rule: 15.247(a)(2); RSS-247 A8.2 and RSS-GEN;

4.1.1 Requirement

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

4.1.2 Procedure

A spectrum analyzer was connected to the antenna port of the transmitter.

For FCC 6dB Channel Bandwidth the Procedure described in the FCC Publication 558074 D01 DTS Meas Guidance v04 was used to determine the DTS occupied bandwidth. Section 8.1 Option 1 was used.

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

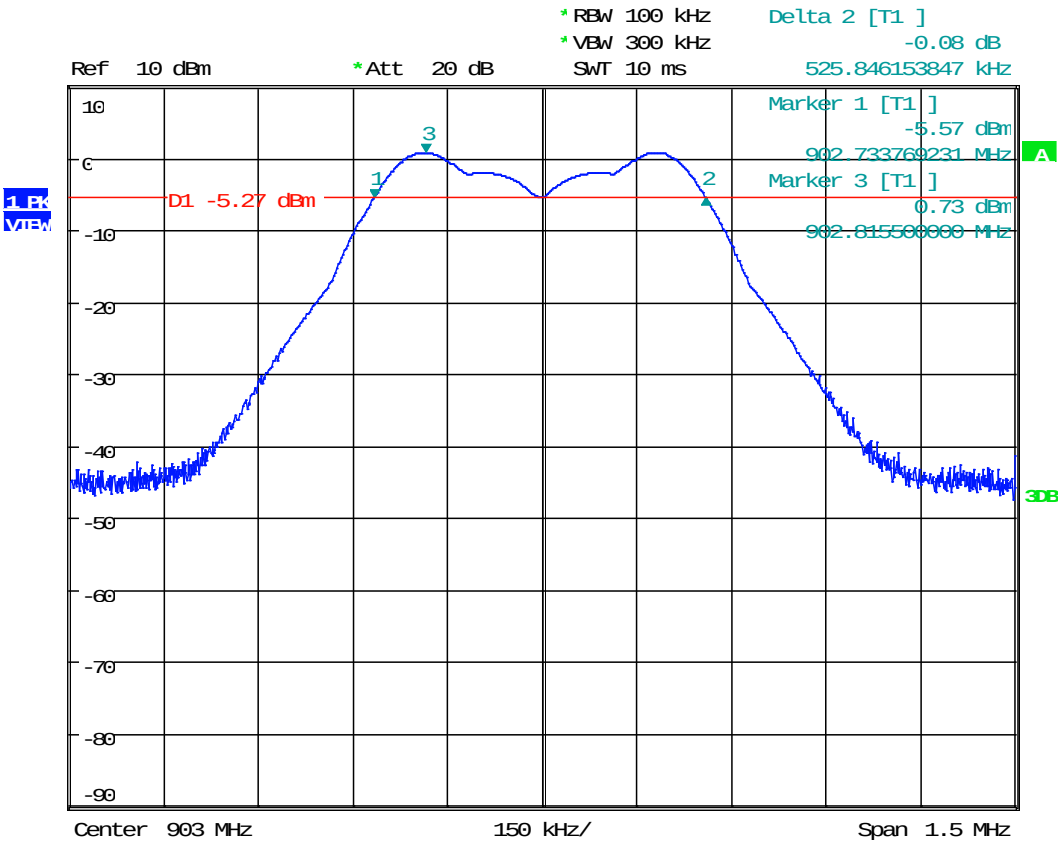
For 99% power bandwidth measurement, the bandwidth was determined by using the built-in 99% occupied bandwidth function of the spectrum analyzer. The resolution bandwidth is set to 1% of the selected span as is without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth.

Test Date:	March 28, 2017

4.1.3 Test Result

Frequency MHz	6 dB FCC Bandwidth, kHz	Plot #	99% Bandwidth, kHz	Plot #
903	525.85	1.1	520.50	1.4
915	524.65	1.2	522.00	1.5
927	525.85	1.3	519.75	1.6

Plot 1.1 – 6dB Bandwidth (FCC)



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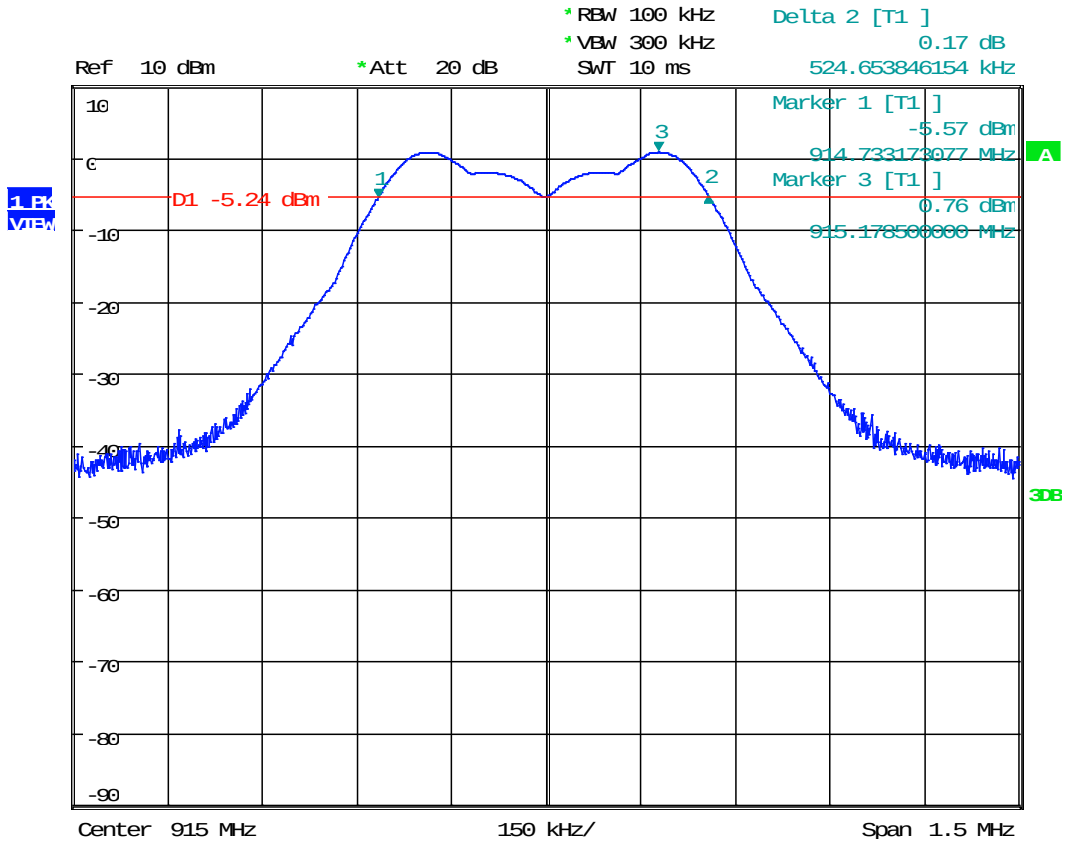
Plot 1.2 – 6dB Bandwidth (FCC)



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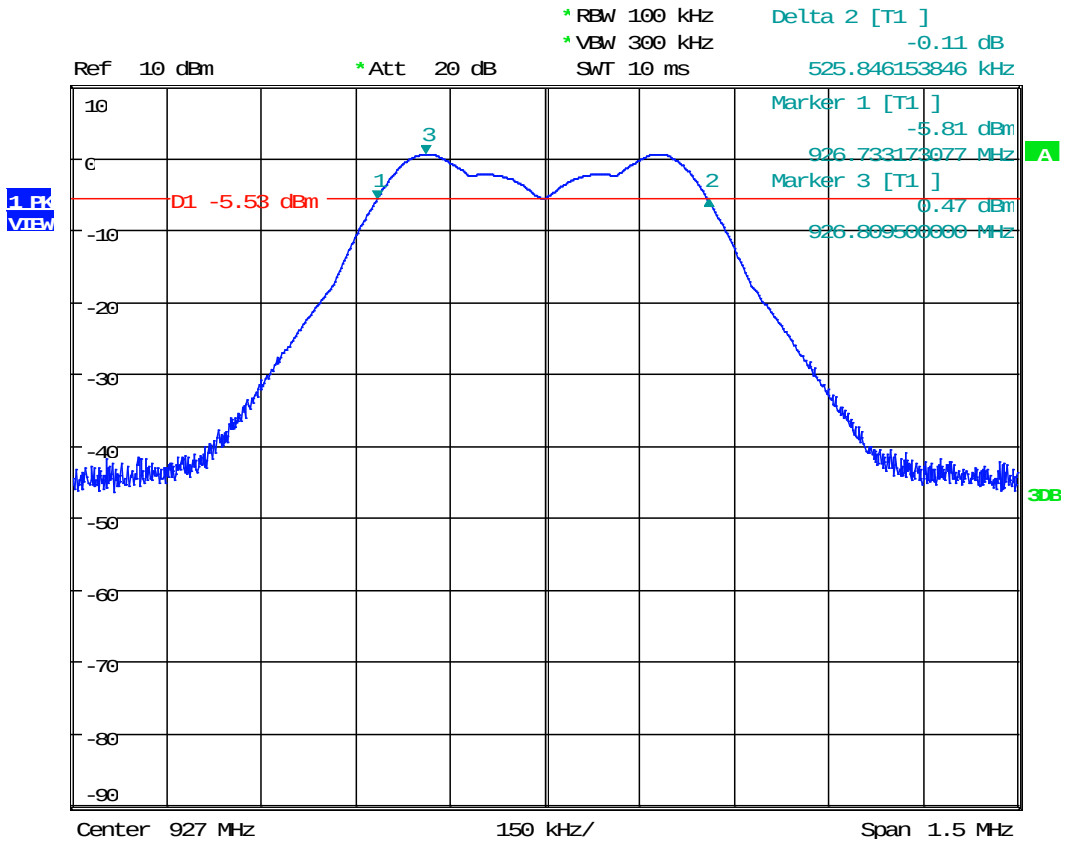
Plot 1 3 – 6dB Bandwidth (FCC)



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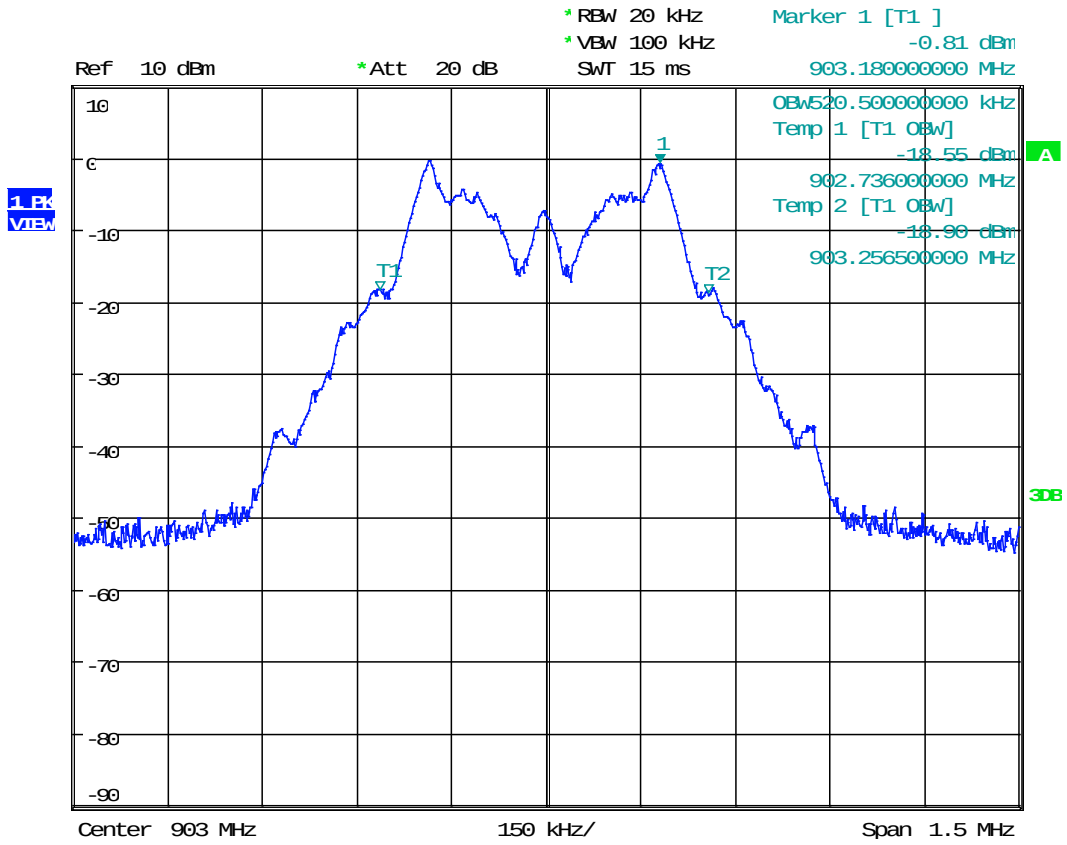
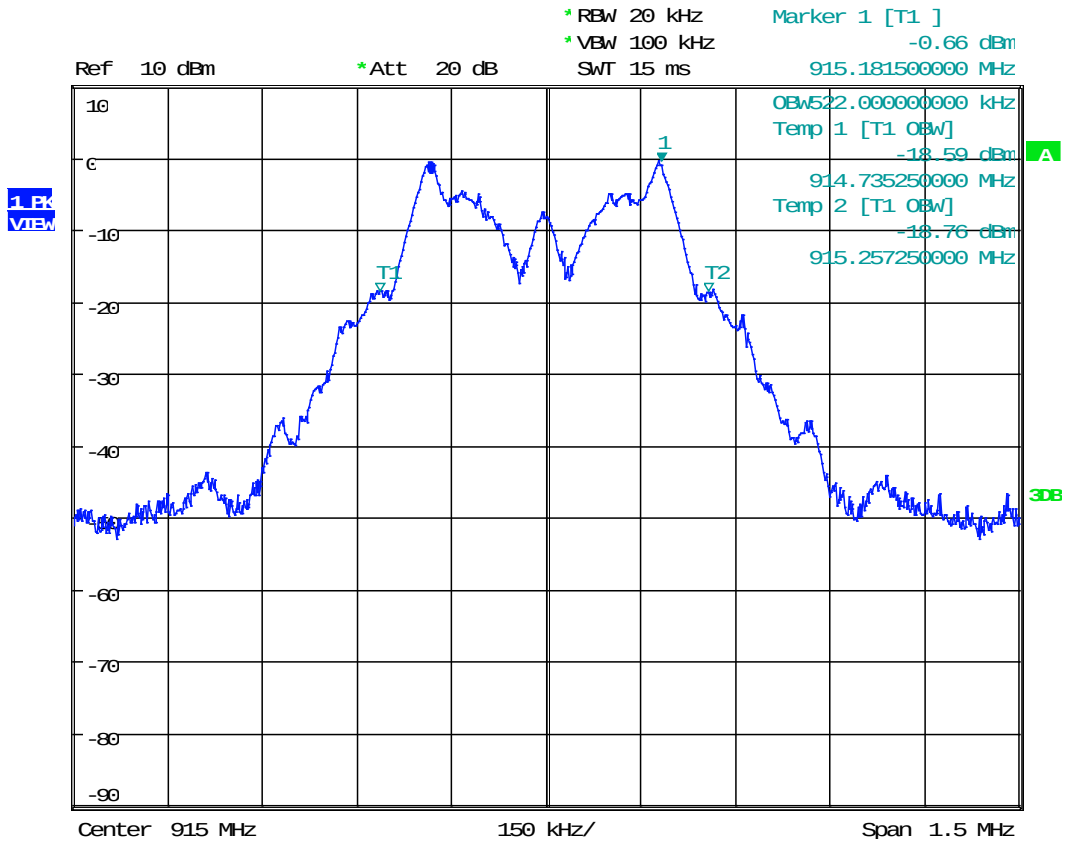
Plot 1.4 – 6dB Bandwidth (FCC)



Plot 1.5 – 6dB Bandwidth (FCC)



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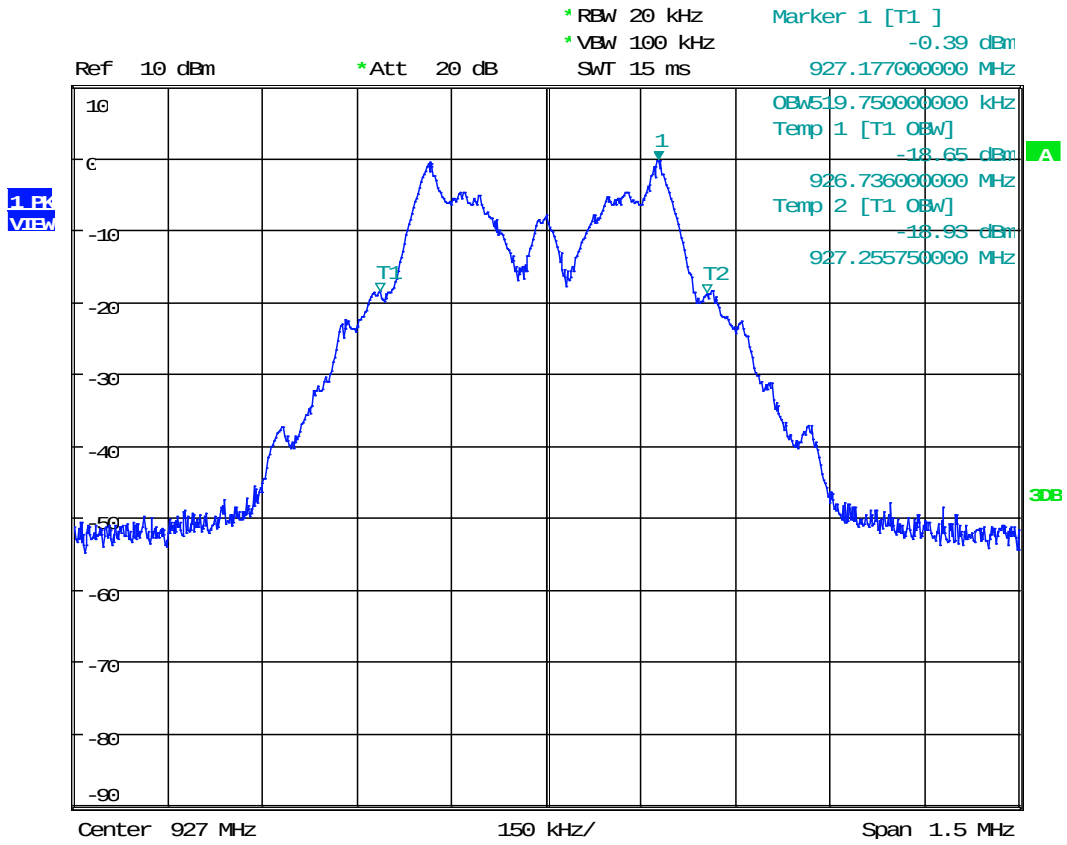
Plot 1.6 – 6dB Bandwidth (FCC)



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4.2 Maximum Conducted Output Power at Antenna Terminals
FCC Rule 15.247(b)(3)

4.2.1 Requirement

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt (+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 to measure the Maximum Conducted Transmitter Output Power. The offset programmed on the analyzer is corrected to include cable loss & attenuator.

The procedure described in FCC Publication 558074 D01 DTS Meas Guidance v04 was used. Specifically, section 9.1.1 RBW ≥ DTS Bandwidth was utilized as the spectrum analyzer's resolution bandwidth was greater than the DTS bandwidth.

1. Set the RBW ≥ DTS Bandwidth
2. Set the VBW ≥ 3 x RBW
3. Set the span ≥ 3 x RBW
4. Sweep time = Auto couple
5. Detector = Peak
6. Trace mode = Max Hold
7. Allow trace to fully stabilize
8. Use peak marker function to determine the peak amplitude level.

A spectrum analyzer was connected to the antenna port of the transmitter.

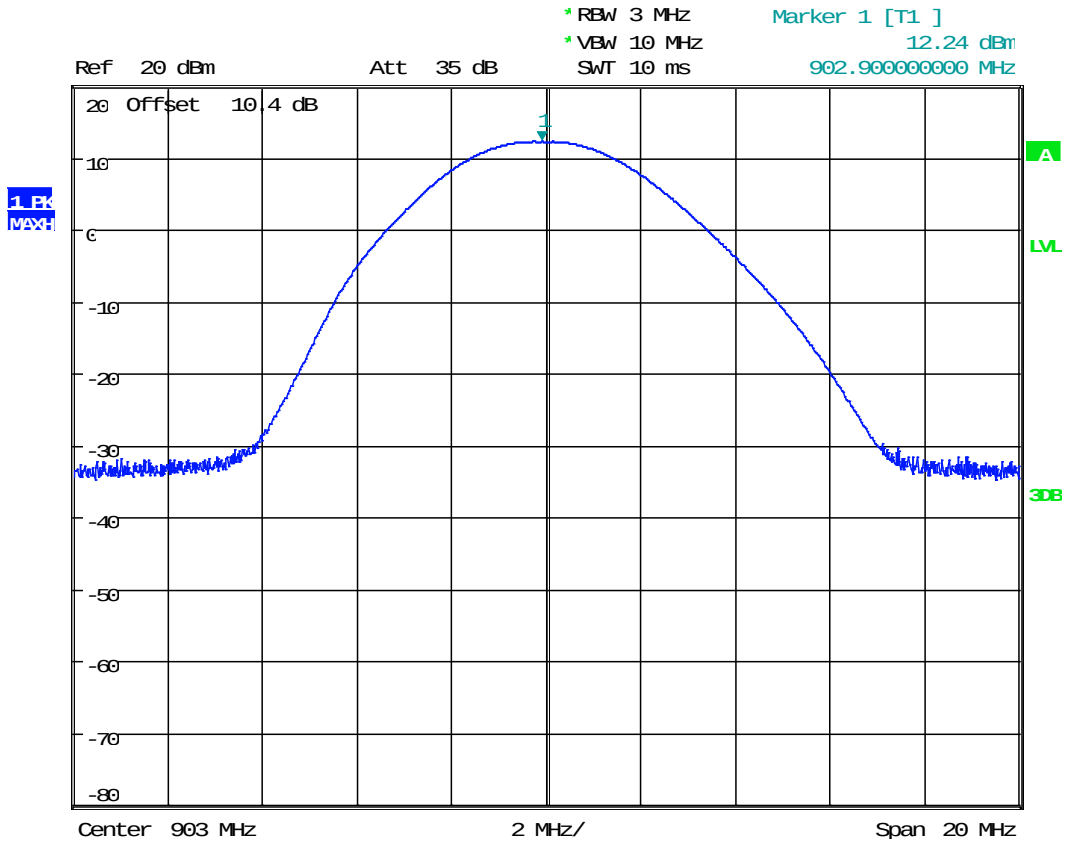
Test Date:	March 28, 2017

4.2.3 Test Result

Refer to the following plots for the test result:

Model Number	Frequency MHz	Conducted Peak Power dBm	Conducted Peak Power mW	Plot #
GSW	903	12.24	16.75	2.1
	915	11.92	15.56	2.2
	927	11.67	14.69	2.3

Plot 2.1



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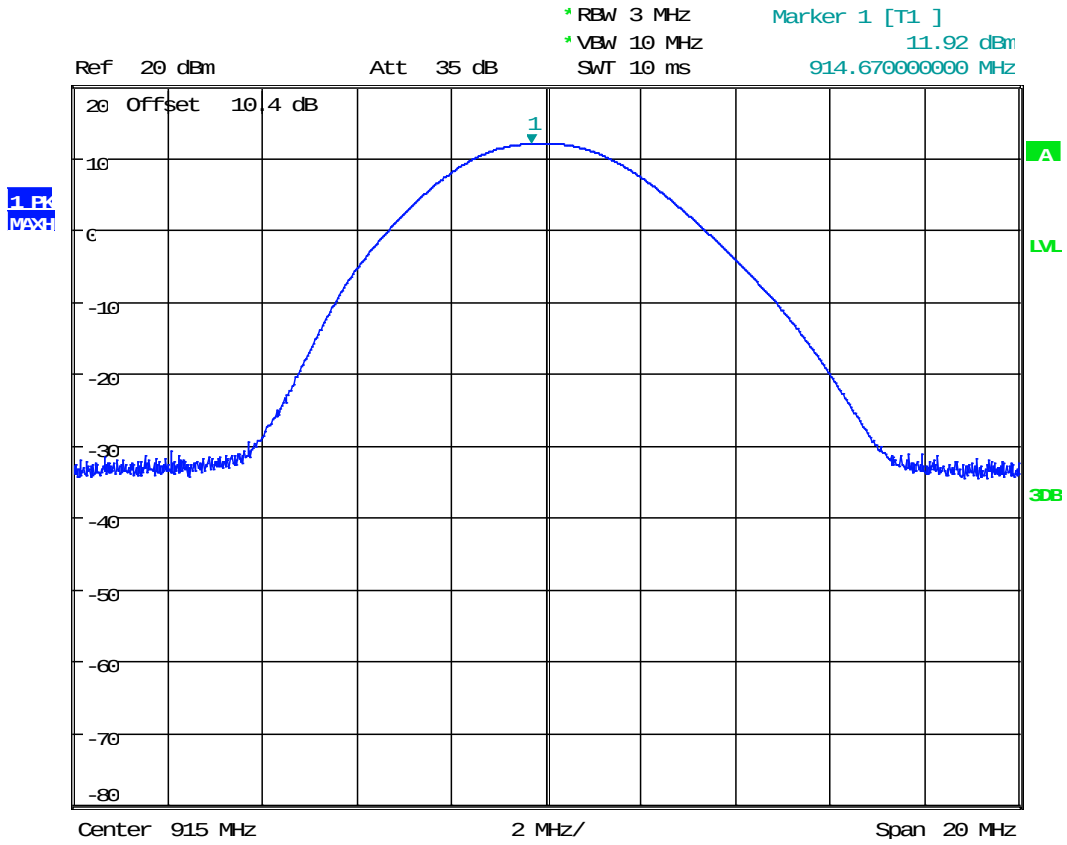
Plot 2.2



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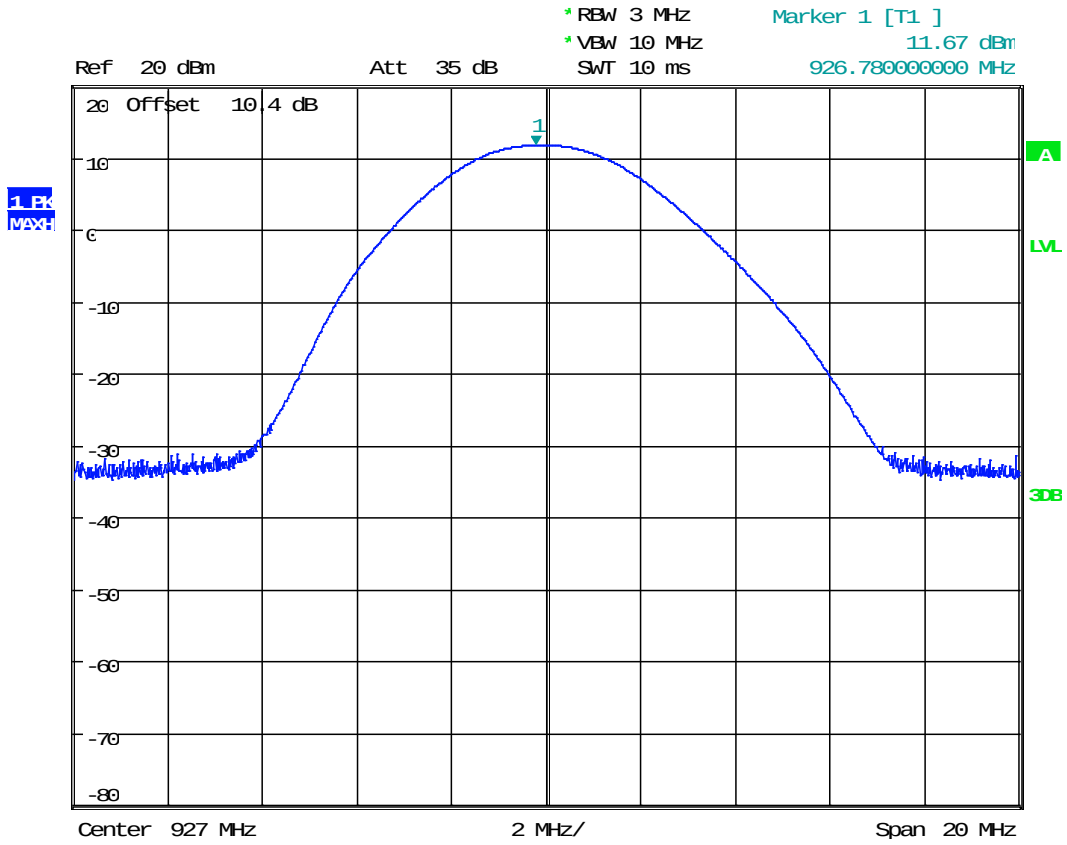
Plot 2.3



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4.3 Power Spectral Density
FCC 15.247 (e)

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 8dBm 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 offset programmed on the analyzer is corrected to include cable loss, attenuator.

The procedure described in FCC Publication 558074 D01 DTS Meas Guidance, specifically section 10.2 Method PKPSD (peak PSD).

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the *DTS bandwidth*.
3. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

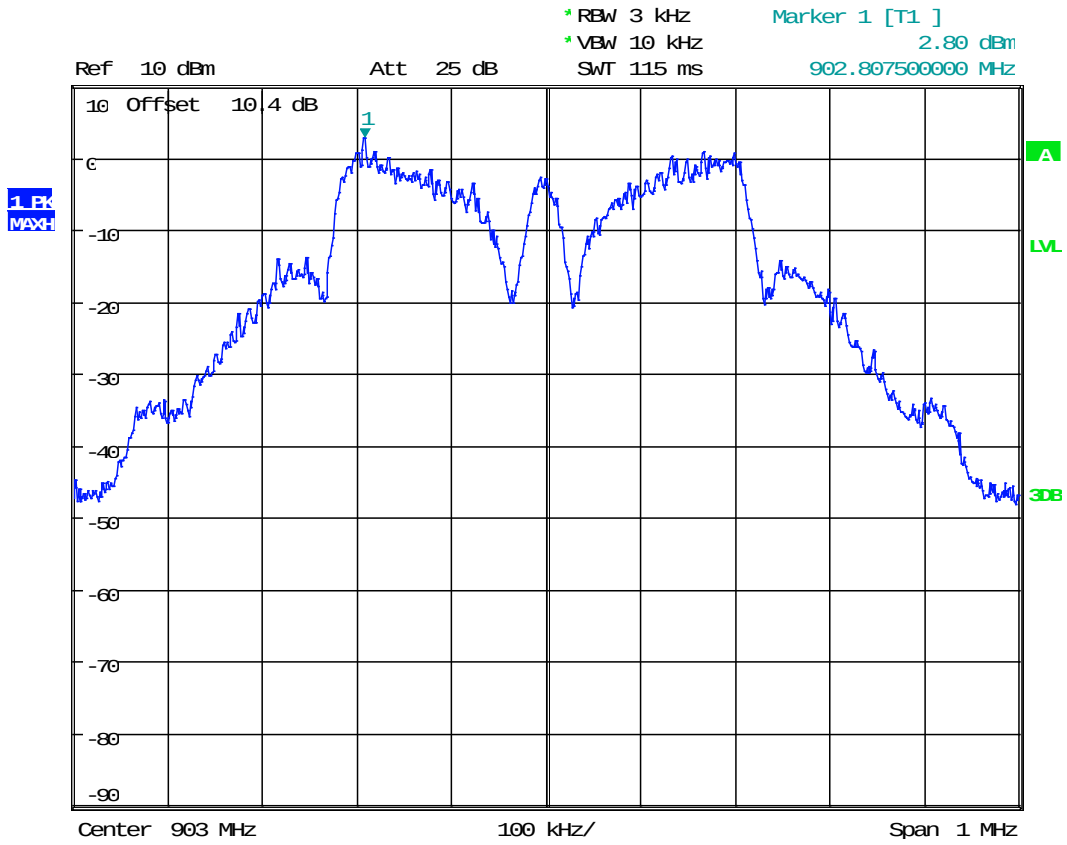
Test Date:	March 28, 2017

4.3.3 Test Result

Refer to the following plots for the test result:

Frequency MHz	PSD (Peak) dBm	Margin to 8dBm Limit dB	Plot #
903	2.80	-5.20	3.1
915	2.16	-5.84	3.2
927	3.08	-4.92	3.3

Plot 3. 1



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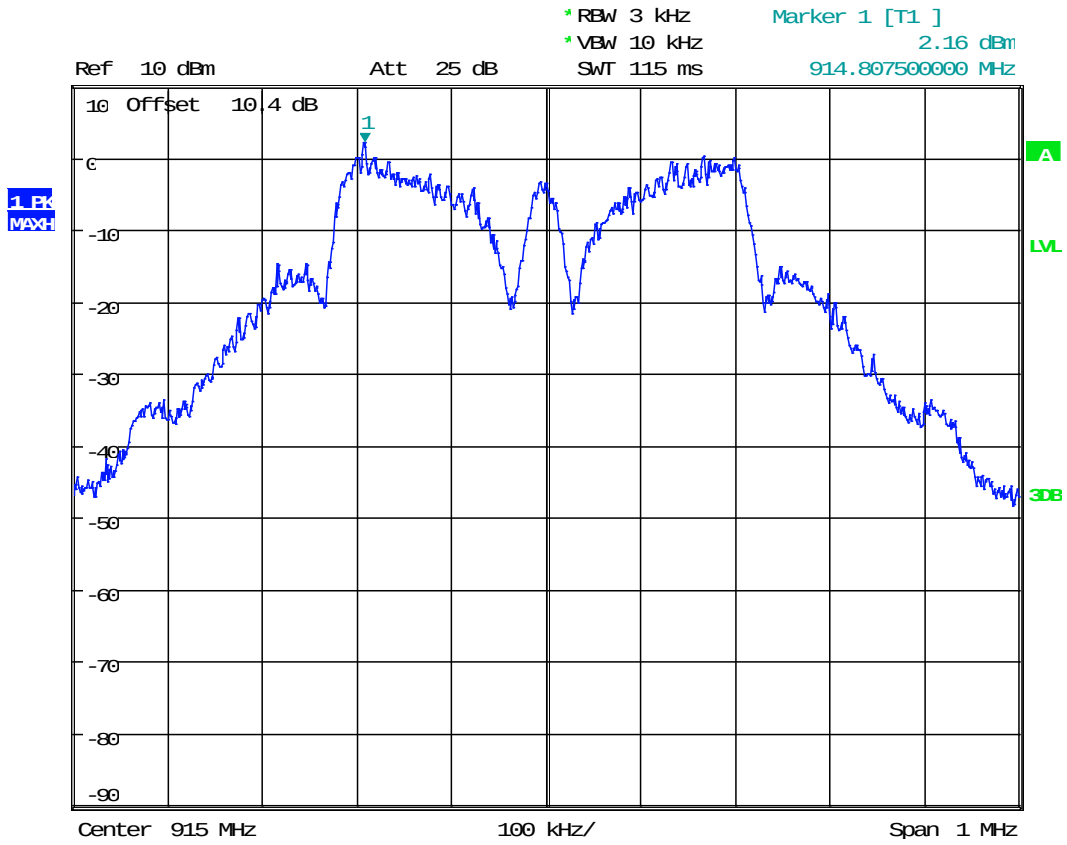
Plot 3. 2



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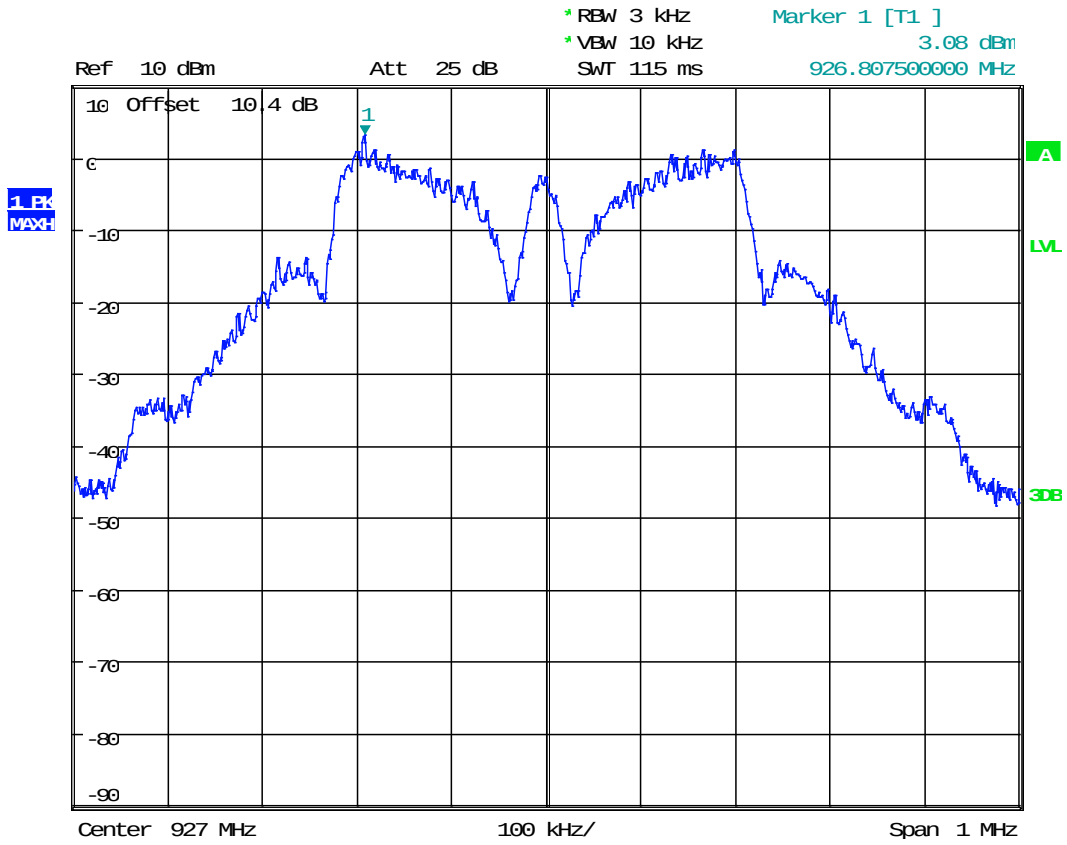
Plot 3. 3



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4.4 Out-of-Band Conducted Emissions
FCC 15.247(d)

4.4.1 Requirement

In any 100 kHz bandwidths outside the EUT pass-band, the RF power shall be at least 20dB (peak) or 30 dB (average) below that of the maximum in-band 100 kHz emissions.

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 out-of-band emission measurements were performed. The out-of-band emissions were measured from 30 MHz to 10 GHz.

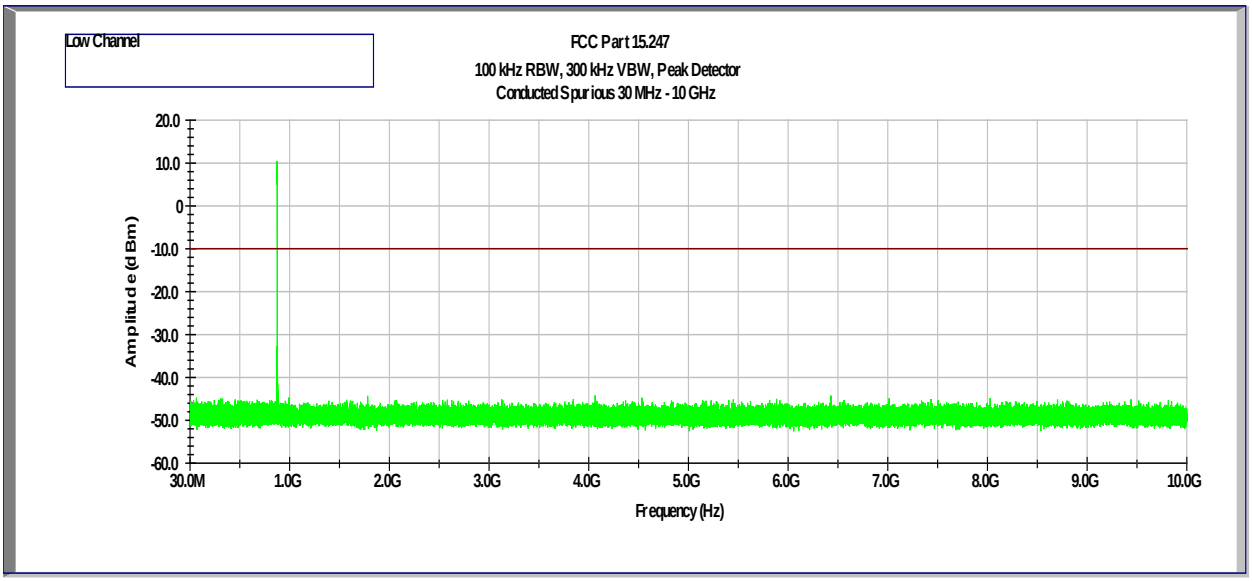
4.4.3 Test Result

Refer to the following plots 4.1 – 4.5 for unwanted conducted emissions. The plot shows -20dB attenuation limit line.

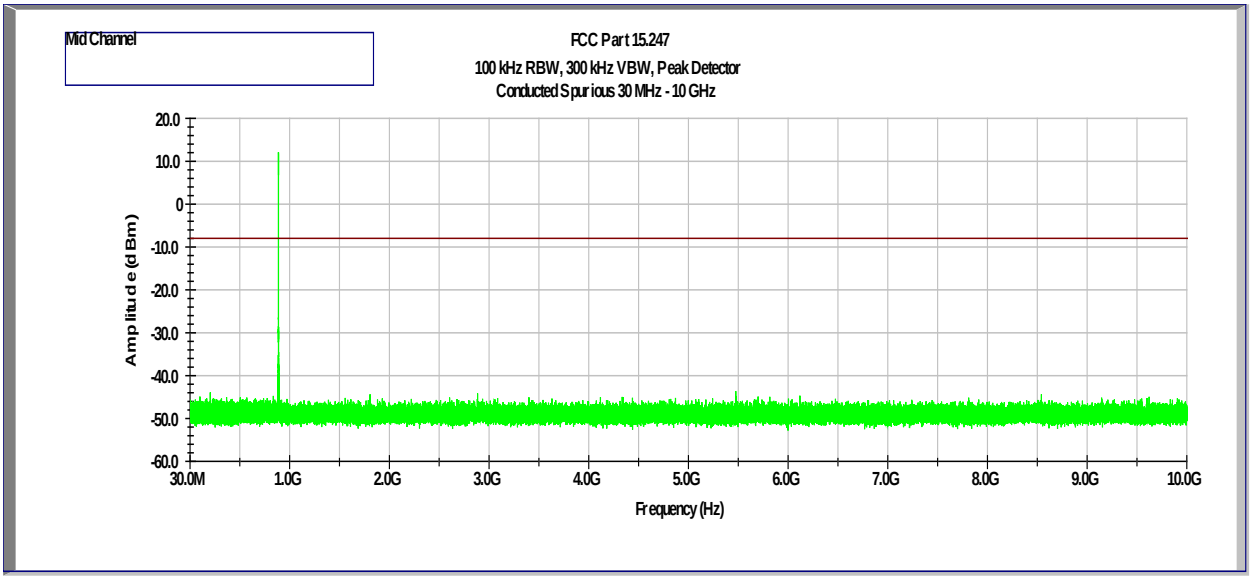
Test Date:	March 28, 2017

Results	**Complies**

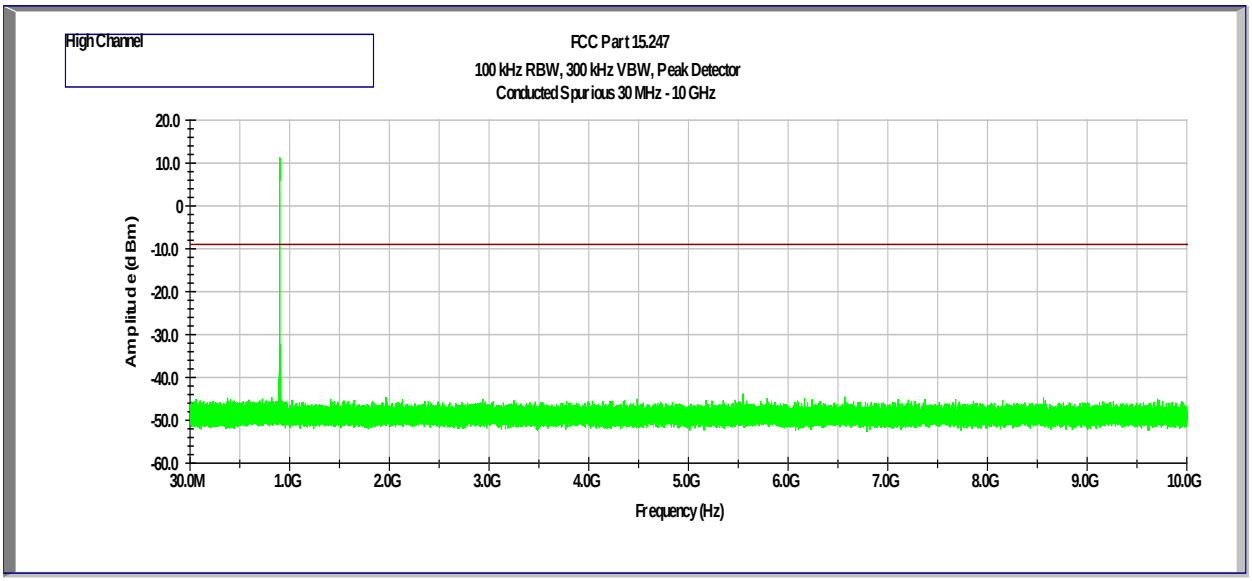
Plot 4.1
Tx @ 903MHz



Plot 4.2
Tx @ 915MHz

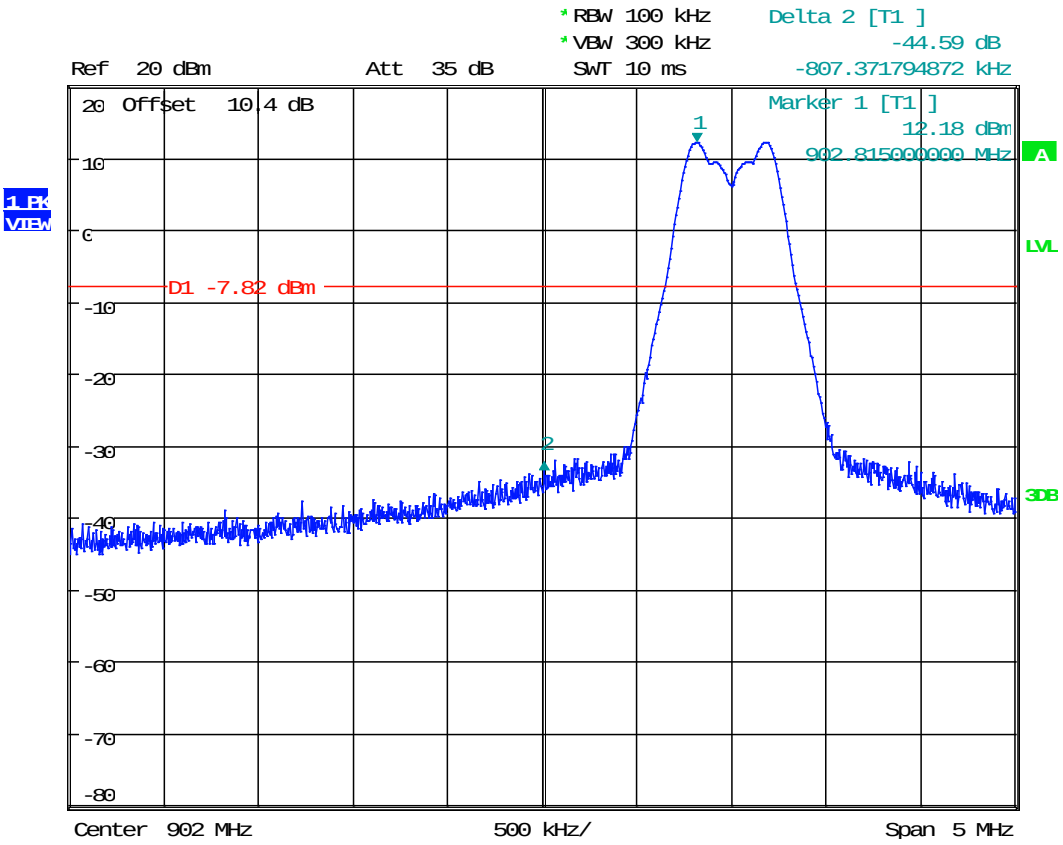


Plot 4.3
Tx @ 927MHz



Plot 4.4

Conducted Band Edge, Tx @ 903MHz



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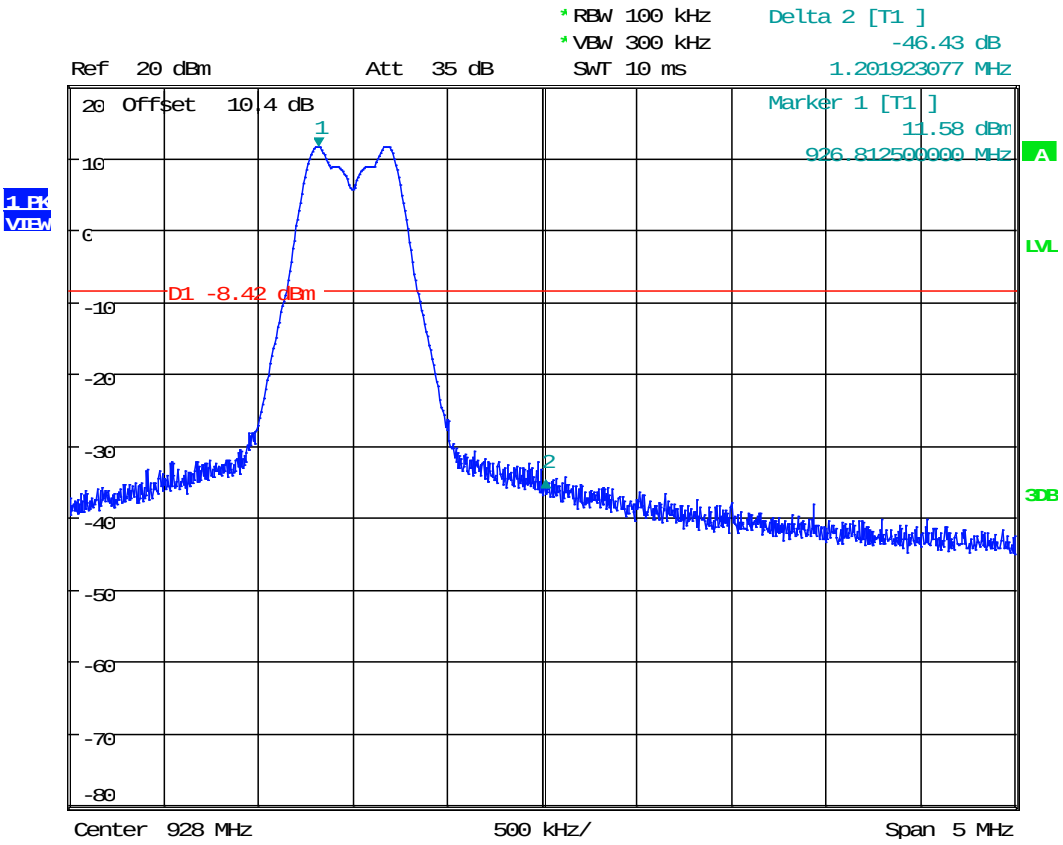
Plot 4.5

Conducted Band Edge, Tx @ 927MHz



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4.5 Transmitter Radiated Emissions
FCC Rule 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 also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

For out of band radiated emissions (except for frequencies in restricted bands), in any 100 kHz bandwidths outside the EUT pass-band, the RF power shall be at least 20dB (peak) or 30 dB (average) below that of the maximum in-band 100 kHz emissions.

4.5.2 Procedure – Radiated Emissions

Radiated emission measurements were performed from 30 MHz to 10 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 for below 1000MHz and 1.5m in height for above 1GHz. 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 3 meters for frequencies above 1 GHz and at 10 meters for frequencies below 1 GHz.

Measurements made from 30MHz to 1GHz had a notch filter in place. Measurements made from 1 GHz to 10GHz had a high pass filter in place. A preamp was used from 30MHz to 10GHz.

All measurements were made with a Peak Detector and compared to QP limits for 30MHz – 1GHz and Average limits for 1GHz – 10GHz.

Data is included 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 – **δ (for average measurement only)**; 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(μV/m)
RA = Receiver Amplitude (including preamplifier) in dB(μV)
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB
AG = Amplifier Gain in dB
δ = Duty cycle correction factor, see Annex A

Assume a receiver reading of 52.0 dB(μV) 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(μV/m). This value in dB(μV/m) was converted to its corresponding level in μV/m.
RA = 52.0 dB(μV)
AF = 7.4 dB(1/m)
CF = 1.6 dB
AG = 29.0 dB
δ = 20.0 dB

FS = 52.0+7.4+1.6-29.0 = 32 dB(μV/m) Peak.
FS = 52.0+7.4+1.6-29.0-20.0= 12 dB(μV/m) Average.

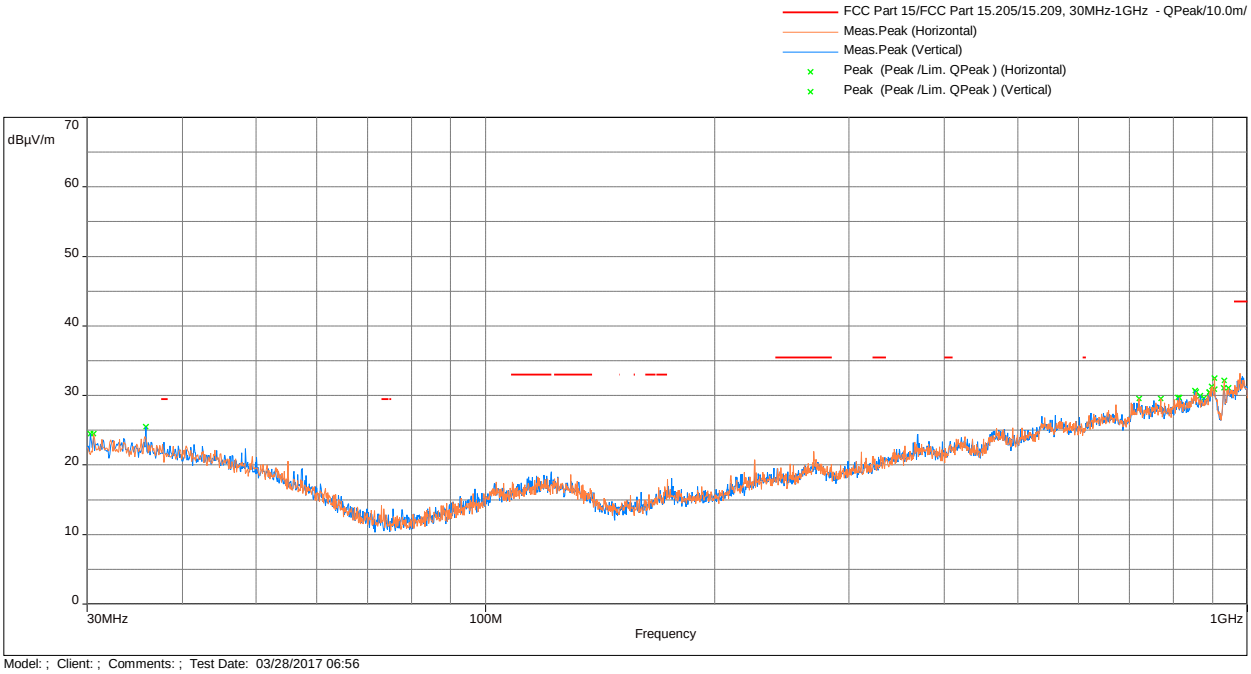
Test Date:	March 28 – June 14, 2017

Result:	**Complies** by 2.05dB

4.5.4 Test Results

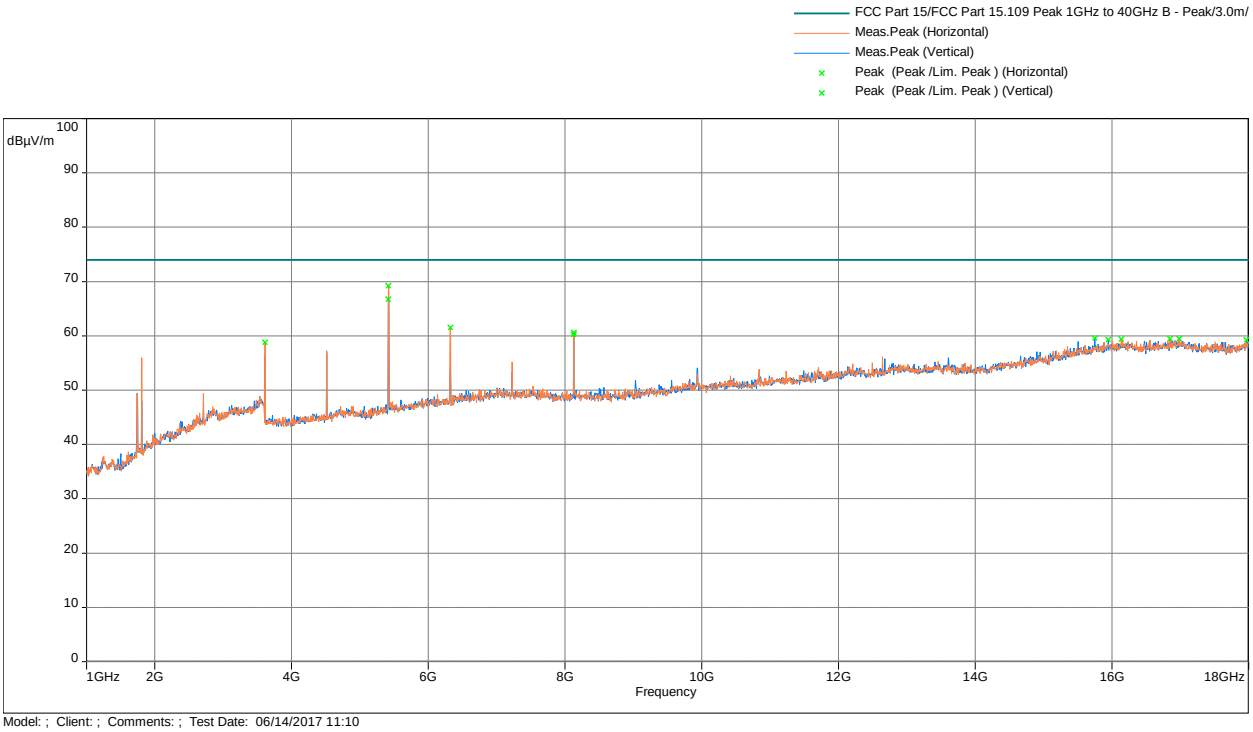
Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 903MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz



Model: ; Client: ; Comments: ; Test Date: 03/28/2017 06:56

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak Limit

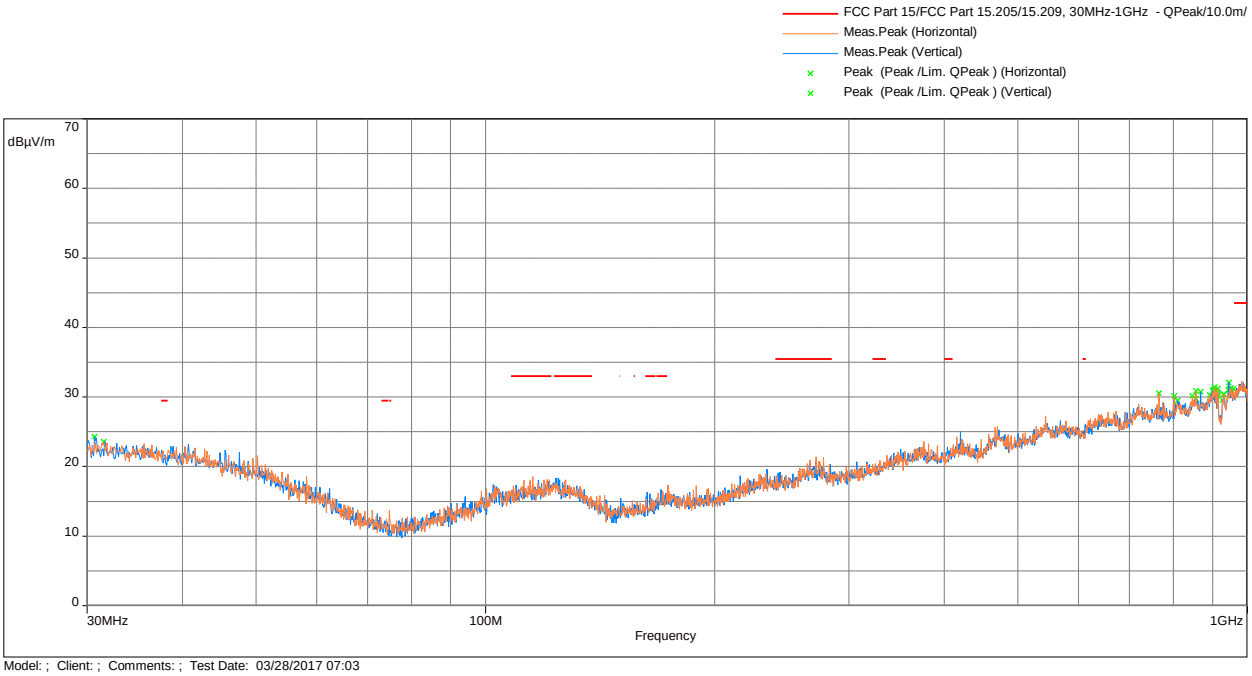


Frequency	Peak Amplitude	Peak Limit	Peak Margin	Avg Amplitude	Avg Limit	Avg Margin	Polarity	Height	Angle
MHz	**dBµV/m**	**dBµV/m**	**dB**	**dBµV/m**	**dBµV/m**	**dB**	**H/V**	**m**	°
3611.2	58.84	74	-15.16	38.84	54	-15.16	H	2.08	273
5416.6	69.22	74	-4.78	49.22	54	-4.78	H	2.10	349
5416.6	66.70	74	-7.30	46.70	54	-7.30	V	1.62	58
6322.7	61.53	74	-12.47	41.53	54	-12.47	H	1.98	349
8128.1	60.57	74	-13.43	40.57	54	-13.43	H	1.61	334
8128.1	60.27	74	-13.73	40.27	54	-13.73	V	1.62	349
Test Result : **Pass** at 903MHz									

Note: The peaks showed are compliant with 15.209 Average limit (54dBuV/m) by applying Duty Cycle Correction Factor of 20dB (See Annex A for Duty Cycle calculation).

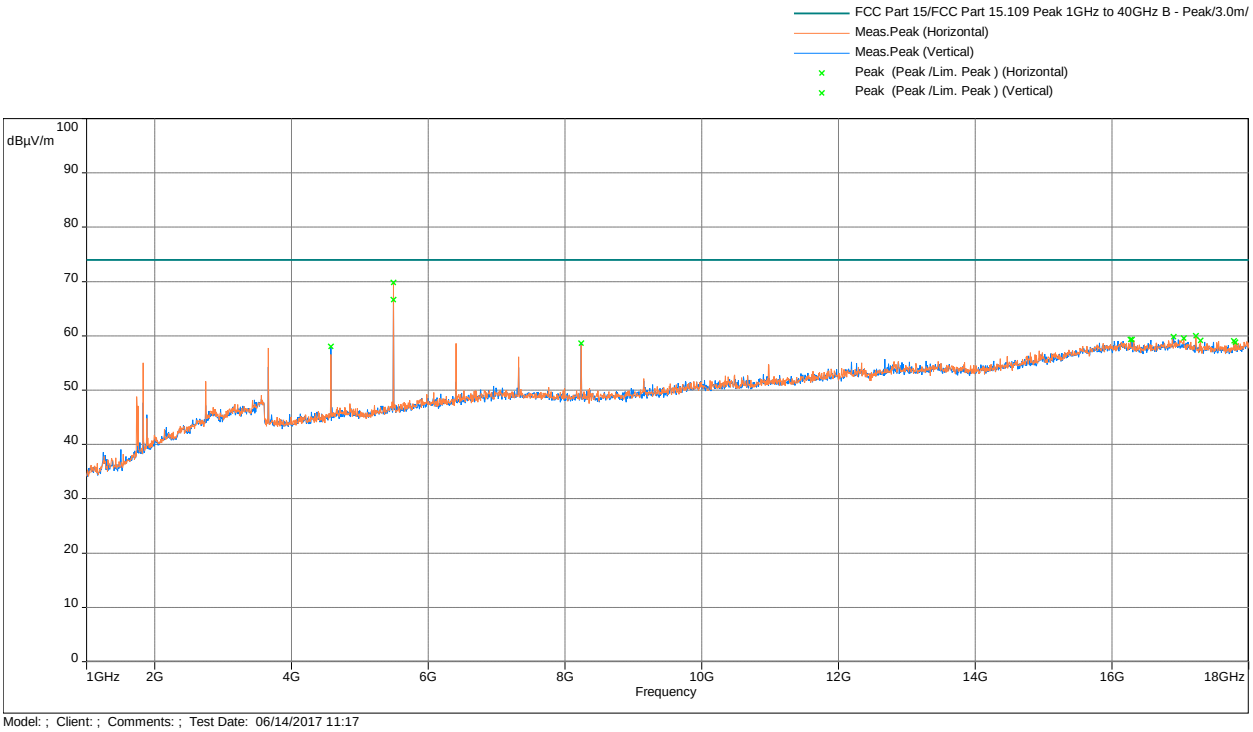
Test Results: 15.209 Radiated Spurious Emissions Mid Channel, Tx at 915MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz



Model: ; Client: ; Comments: ; Test Date: 03/28/2017 07:03

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak Limit

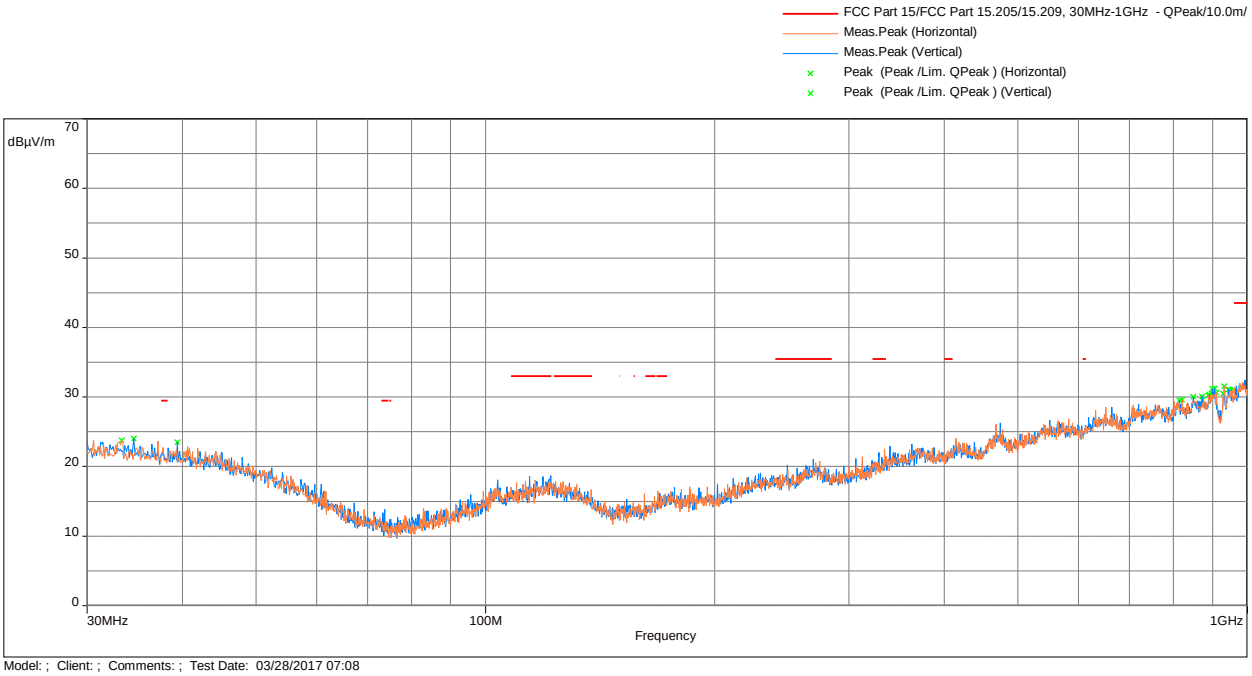


Frequency	Peak Amplitude	Peak Limit	Peak Margin	Avg Amplitude	Avg Limit	Avg Margin	Polarity	Height	Angle
MHz	**dBµV/m**	**dBµV/m**	**dB**	**dBµV/m**	**dBµV/m**	**dB**	**H/V**	**m**	°
4575.1	57.99	74	-16.01	37.99	54	-16.01	V	1.79	103
5488.0	69.78	74	-4.22	49.78	54	-4.22	H	1.85	350
5488.0	66.66	74	-7.34	46.66	54	-7.34	V	1.94	118
8236.9	58.64	74	-15.36	38.64	54	-15.36	V	1.52	341
Test Result : **Pass** at 915MHz									

Note: The peaks showed are compliant with 15.209 Average limit (54dBuV/m) by applying Duty Cycle Correction Factor of 20dB (See Annex A for Duty Cycle calculation).

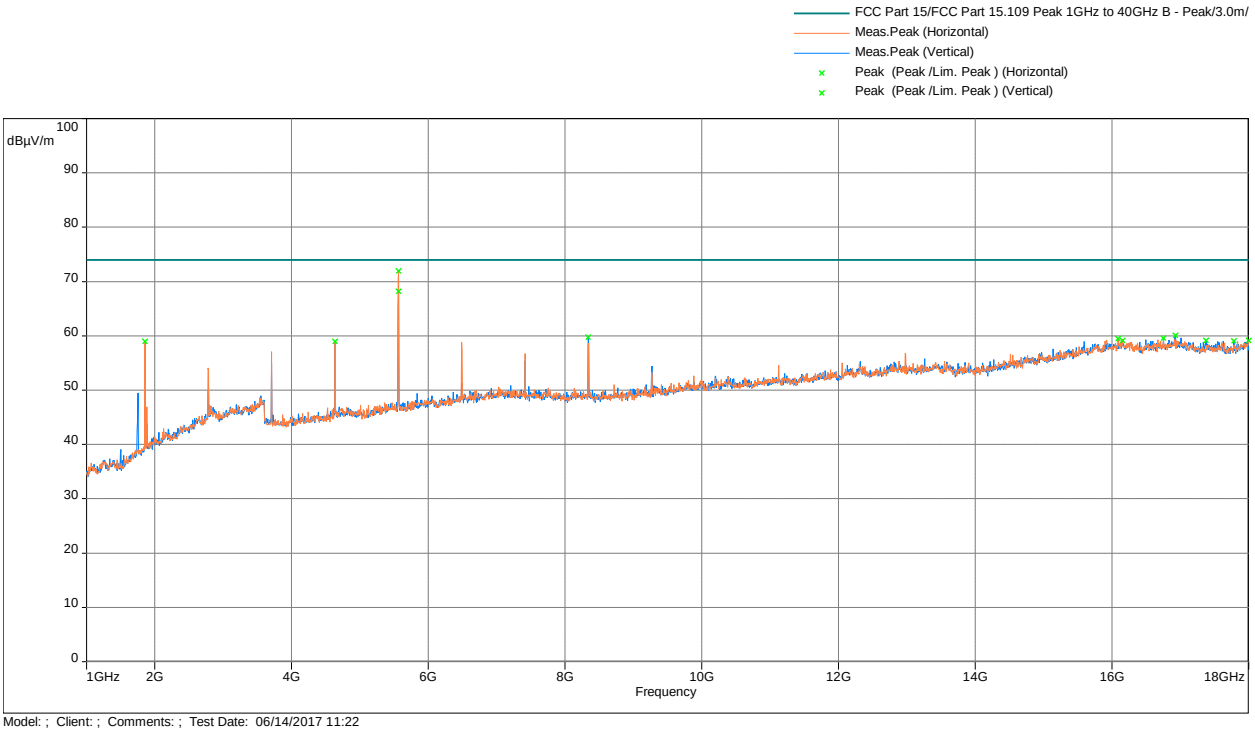
Test Results: 15.209 Radiated Spurious Emissions High Channel, Tx at 927MHz

Out-of-Band Radiated Spurious Emissions - 30 MHz to 1000 MHz



Model: ; Client: ; Comments: ; Test Date: 03/28/2017 07:08

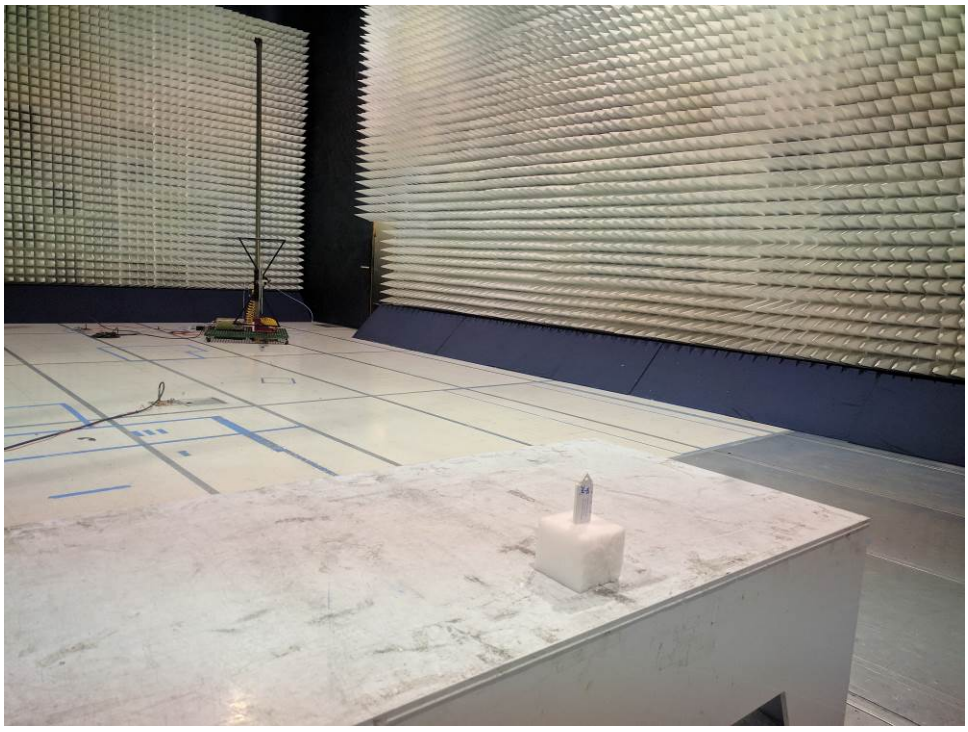
Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak Limit

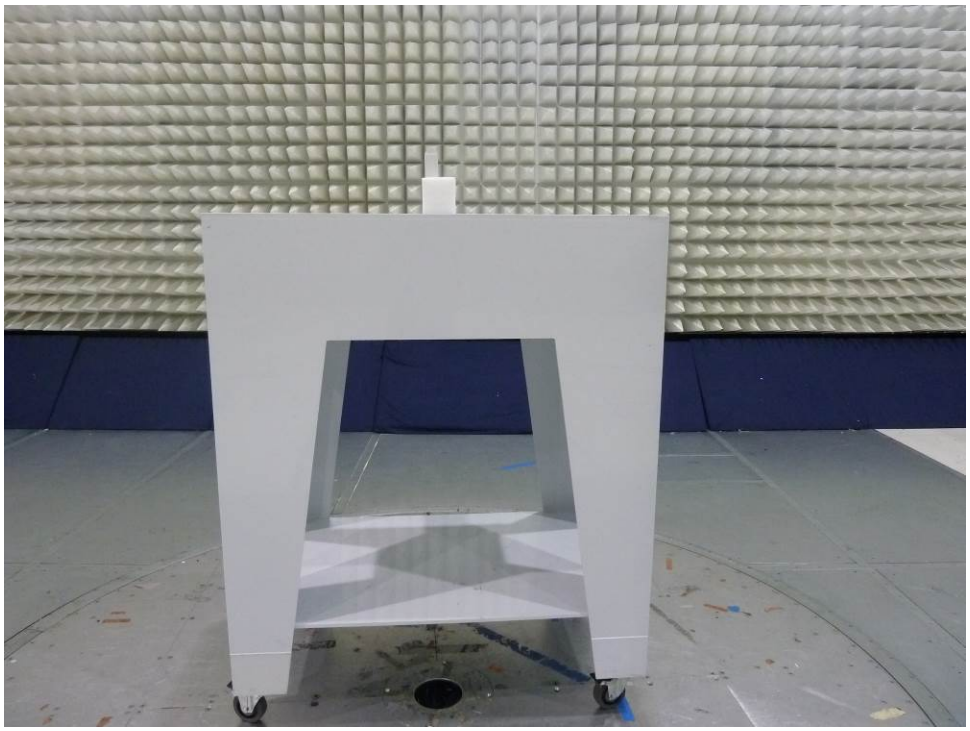


Frequency	Peak Amplitude	Peak Limit	Peak Margin	Avg Amplitude	Avg Limit	Avg Margin	Polarity	Height	Angle
MHz	**dBµV/m**	**dBµV/m**	**dB**	**dBµV/m**	**dBµV/m**	**dB**	**H/V**	**m**	°
1853.4	58.97	74	-15.03	38.97	54	-15.03	H	1.95	334
4634.6	58.98	74	-15.02	38.98	54	-15.02	H	2.01	271
5562.8	68.16	74	-5.84	48.16	54	-5.84	V	1.54	66
5562.8	71.95	74	-2.05	51.95	54	-2.05	H	1.77	305
8340.6	59.71	74	-14.29	39.71	54	-14.29	V	1.65	0
Test Result : **Pass** at 927MHz									

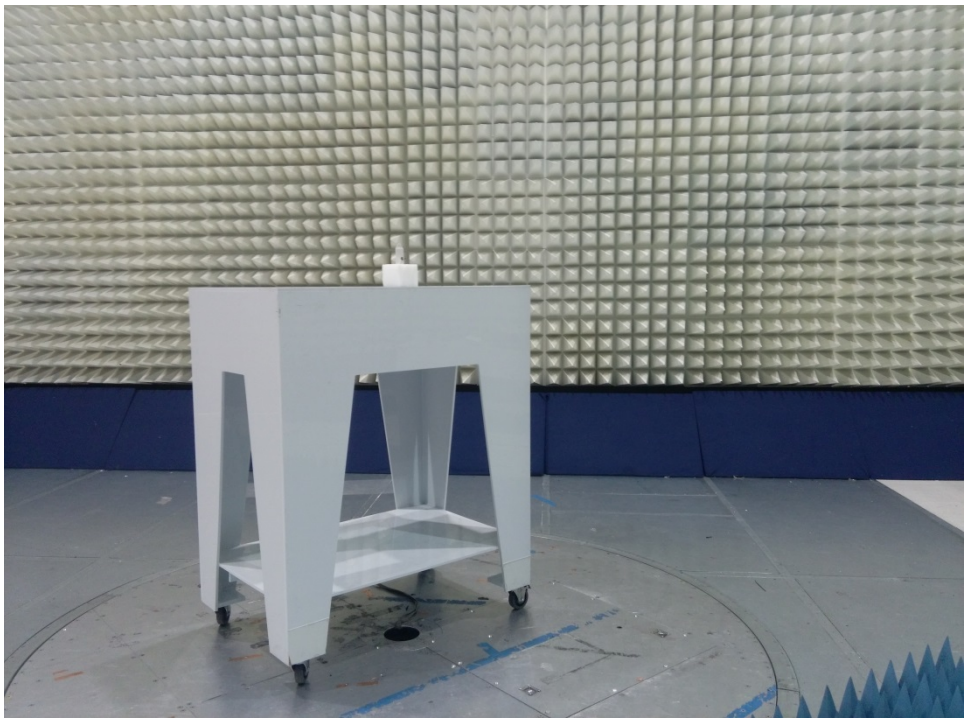
Note: The peaks showed are compliant with 15.209 Average limit (54dBuV/m) by applying Duty Cycle Correction Factor of 20dB (See Annex A for Duty Cycle calculation).

4.5.5 Test Setup Photographs





4.5.5 Test Setup Photographs (continued)



4.6 Radiated Emissions

FCC Ref: 15.109, ICES 003

4.6.1 Requirement

Limits for Electromagnetic Radiated Emissions FCC Section 15.109(b), ICES 003*, RSS GEN

Frequency (MHz)	**Class A at 10m dB(µV/m)**	**Class B at 3m dB(µV/m)**
30-88	39	40.0
88-216	43.5	43.5
216-960	46.4	46.0
Above 960	49.5	54.0

* According to FCC Part 15.109(g) an alternative to the radiated emission limits shown above, digital devices may be shown to comply with the limit of CISPR Pub. 22

4.6.2 Procedures

Measurements are conducted with a quasi-peak detector instrument in the frequency range of 30 MHz to 1000 MHz and with the average detector instrument in the frequency range above 1000 MHz. The measuring receiver meets the requirements of Section One of CISPR 16 and the measuring antenna correlates to a balanced dipole.

Measurements of the radiated field are made with the antenna located at a distance of 10 meters from the EUT. If the field-strength measurements at 10m cannot be made because of high ambient noise level or for other reasons, measurements of Class B equipment may be made at a closer distance, for example 3m. An inverse proportionality factor of 20 dB per decade should be used to normalize the measured data or limit line to the specified distance for determining compliance.

The antenna is adjusted between 1m and 4m in height above the ground plane for maximum meter reading at each test frequency.

The antenna-to-EUT azimuth is varied during the measurement to find the maximum field-strength readings.

The antenna-to-EUT polarization (horizontal and vertical) is varied during the measurements to find the maximum field-strength readings.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for a larger EUT.

Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material.

Equipment setup for radiated disturbance tests followed the guidelines of ANSI C63.4: 2014

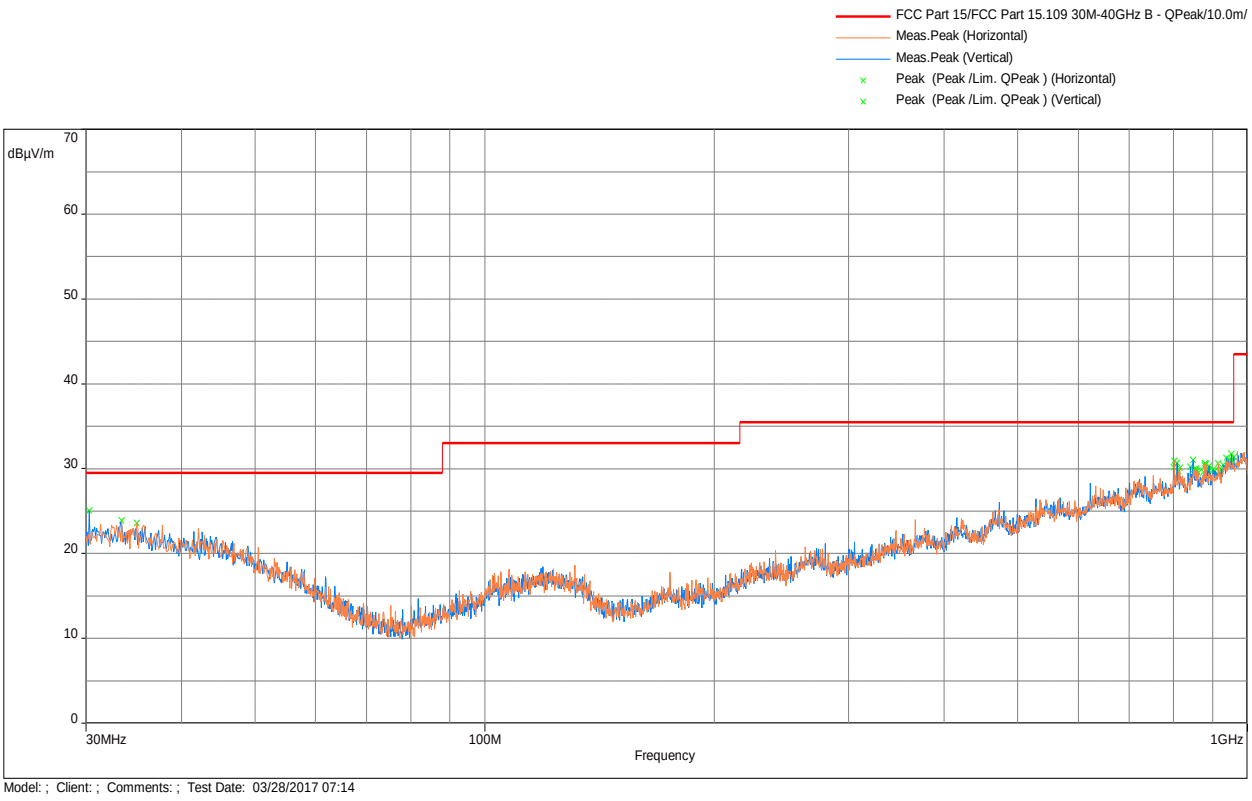
Radiated emission measurements were performed from 30 MHz to 10 GHz. The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

An inverse proportionality factor of 20 dB per decade was used to normalize the limit line of 30MHz to 1000MHz to the specified distance for determining compliance

Tested By:	Anderson Soungpanya
Test Date:	March 28 & July 6, 2017

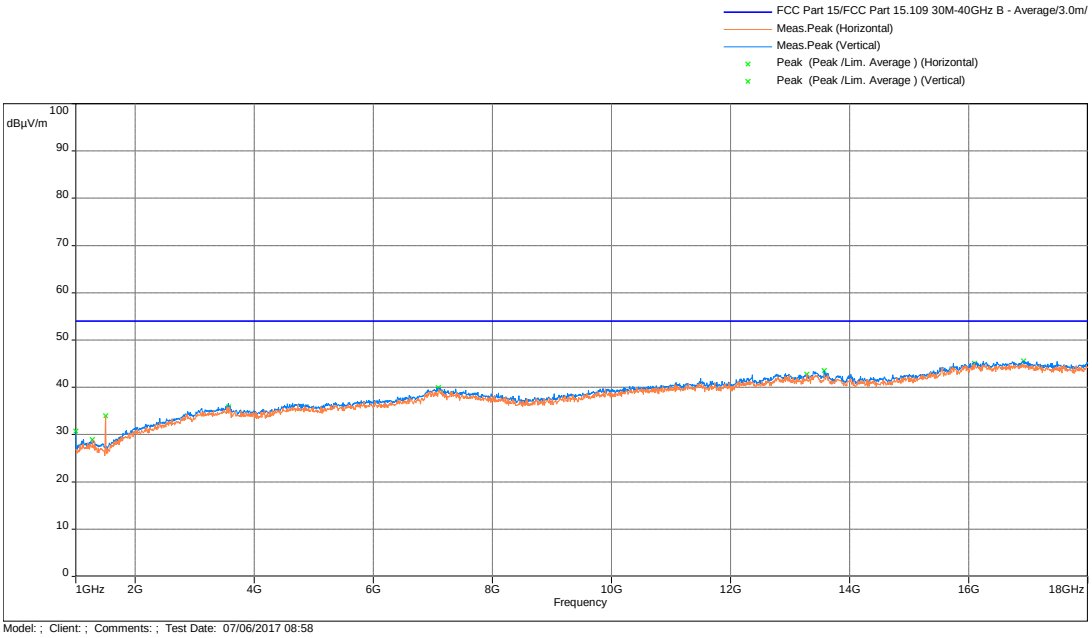
4.6.3 Test Results

Test Results: Radiated Emissions 30 MHz – 1000MHz



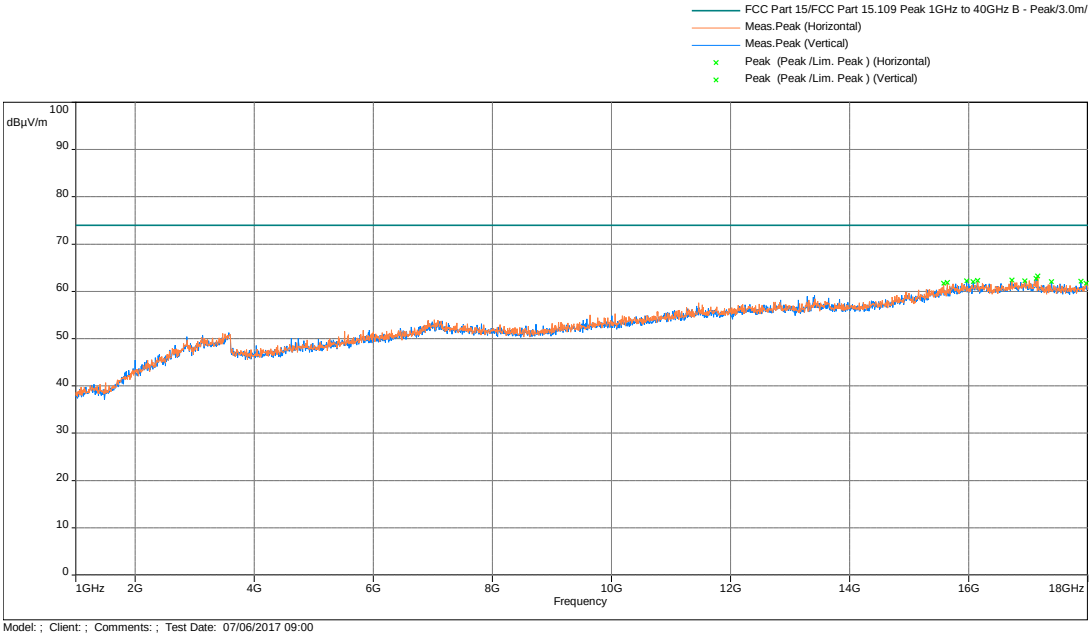
Frequency MHz	FS dBµV/m	Limit dBuV/m	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
30.511	18.20	30	-11.80	42	3.01	Vertical	22.28	-4.08
33.110	19.57	30	-10.44	234	1.55	Horizontal	23.74	-4.17
44.801	17.71	30	-12.29	324	1.15	Horizontal	23.54	-5.83
45.410	17.60	30	-12.40	32	3.52	Horizontal	23.55	-5.95
801.820	31.66	37	-5.34	110	1.41	Vertical	29.20	2.46
811.841	26.04	37	-10.96	244	3.1	Vertical	22.91	3.13

Radiated Spurious Emissions 1000 - 18000 MHz, Avg Scan vs Avg Limit



Model: ; Client: ; Comments: ; Test Date: 07/06/2017 08:58

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak Limit

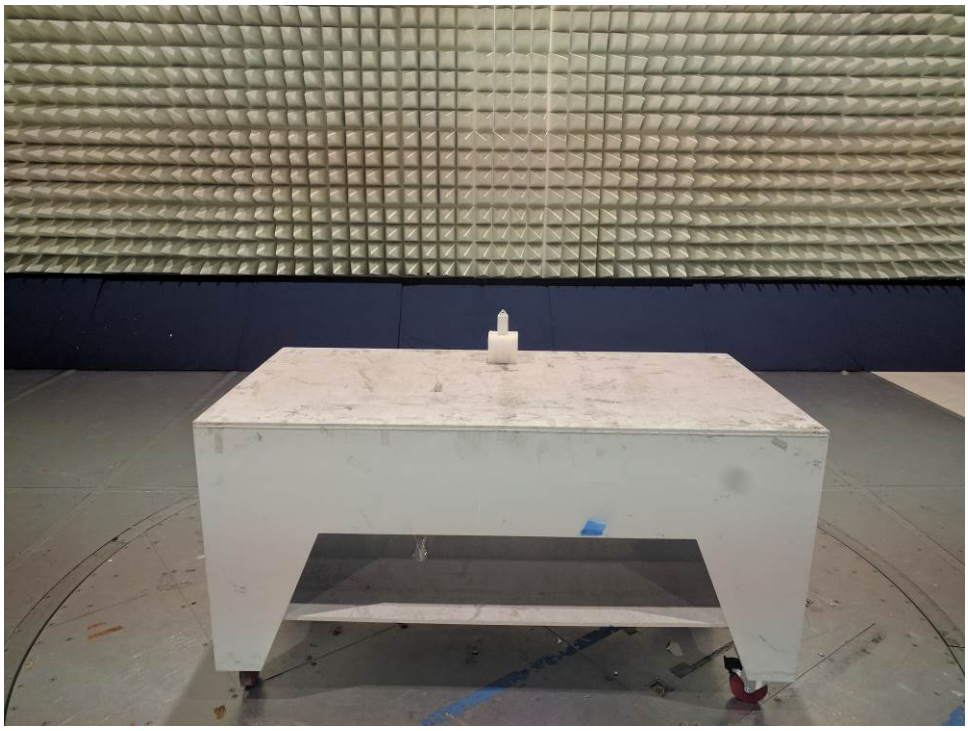


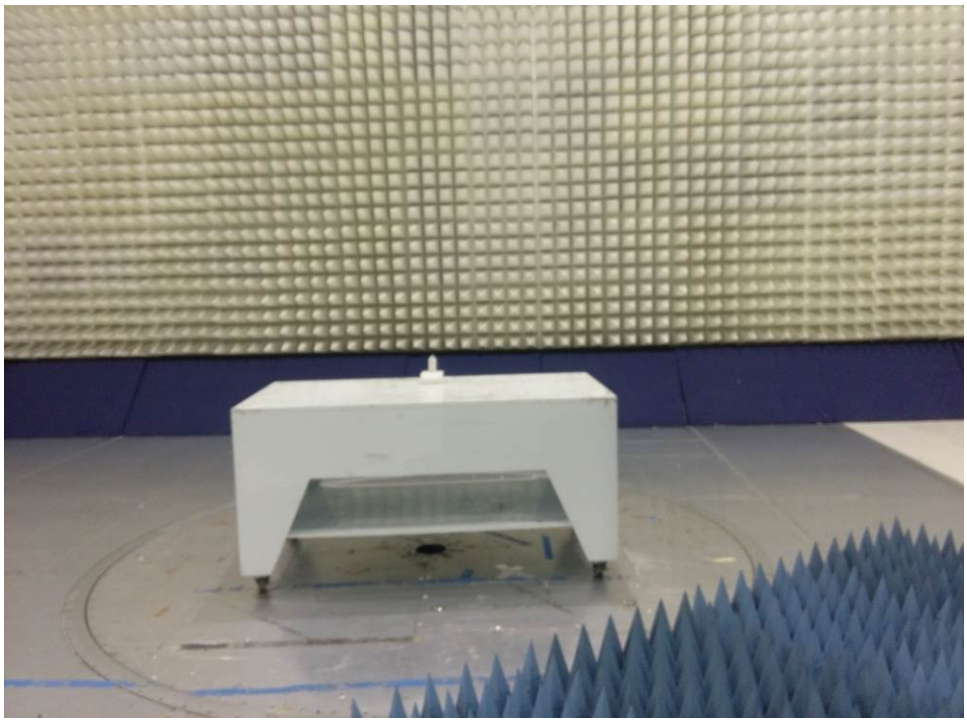
Model: ; Client: ; Comments: ; Test Date: 07/06/2017 09:00

Result:	**Complies** by 5.34 dB

4.6.4 Test Configuration Photographs

The following photographs show the testing configurations used.





4.7 AC Line Conducted Emission
FCC: 15.207, 15.107; RSS-GEN;

4.7.1 Requirement

Frequency Band MHz	Class B Limit dB(μV)		Class A Limit dB(μV)	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15-0.50	66 to 56 *	56 to 46 *	79	66
0.50-5.00	56	46	73	60
5.00-30.00	60	50	73	60

*Note: *Decreases linearly with the logarithm of the frequency at the transition frequency the lower limit applies.*

4.7.2 Procedure
Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.4:2014.

4.7.3 Test Results

Not Applicable, EUT is Battery Powered and not recharegable.

5.0 List of Test Equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model/Type	Asset #	Cal Int	Cal Due
Spectrum Analyzer	Rohde and Schwarz	FSU	ITS 00913	12	01/12/18
Pre-Amplifier (1-18GHz)	Miteq	AMF-4D-001180-24-10P	ITS 00526	12	09/29/17
Horn Antenna	ETS-Lindgren	3117	ITS 01325	12	09/07/17
High Pass Filter	Reactel	7HS-1.5G/15G-S11	ITS 001416	12	05/03/18
Notch Filter	Micro-Tronics	BRM50722	ITS 01170	12	01/19/18
EMI Receiver	Rohde and Schwarz	ESU	ITS 00961	12	07/07/17
BI-Log Antenna	Antenna Research	LPB-2513	ITS 00355	12	09/09/17
Pre-Amplifier	Sonoma Instrument	310	ITS 01493	12	09/28/17
LISN	FCC	FCC-LISN-50-50-M-H	ITS 00551	12	09/14/17
RE Cable	TRU Corporation	TRU CORE 300	ITS 1462	12	08/24/17
RE Cable	TRU Corporation	TRU CORE 300	ITS 1465	12	08/24/17
RE Cable	TRU Corporation	TRU CORE 300	ITS 1470	12	08/24/17
Attenuator	Mini Circuits	BW-N3W5+	ITS 1315	12	10/19/17
Notch Filter	MICRO-TRONICS	BRM50702	ITS 1166	12	12/08/18
Attenuator	Weinschel	50-10	ITS 1224	12	11/08/17
RE Cable	Megaphase	EMC1-K1K1-236	IT 1538	12	06/13/18
RE Cable	Megaphase	EMC1-K1K1-19	ITS 1482	12	08/25/17
RE Cable	Megaphase	TM40-K1K1-19	ITS 1154	12	01/26/18
Transient Limiter	COM-POWER	LIT-153A	ITS 1452	12	06/19/18
RE Cable	TRU Corporation	TRU CORE 300	ITS 1462	12	08/24/17

Software used for emission compliance testing utilized the following:

Name	Manufacturer	Version	Template/Profile
Tile	Quantum Change	3.4.K.22	Conducted Spurious_30M-26GHz
BAT-EMC	Nexio	3.16.0.64	102960041_Levven.bpp
RS Commander	Rohde Schwarz	1.6.4	Not Applicable (Screen grabber)

6.0 Document History

Revision/ Job Number	Writer Initials	Reviewers Initials	Date	Change
1.0 / G102960041	AS	KV	July 14, 2017	Original document

Annex A - Duty Cycle Measurement

A.1 Procedure

ANSI C63.10:2013; Section 7.5

Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 s (100 ms). In cases where the pulse train exceeds 0.1 s, the measured field strength shall be determined during a 0.1 s interval. The following procedure is an example of how the average value may be determined. The average field strength may be found by measuring the peak pulse amplitude (in log equivalent units) and determining the duty cycle correction factor (in dB) associated with the pulse modulation as shown in Equation:

$$\delta\ (\text{dB}) = 20 \log (\Delta)$$

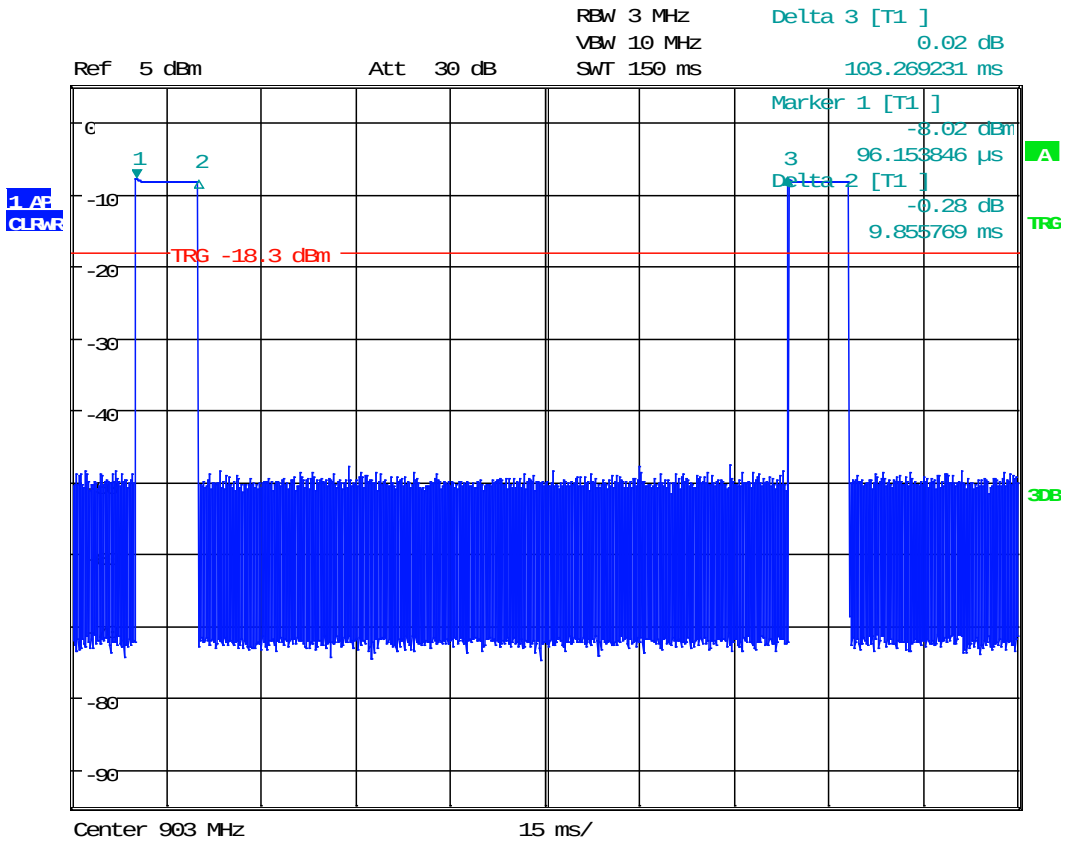
where

δ is the duty cycle correction factor (dB)
Δ is the duty cycle (dimensionless)

This correction factor may then be subtracted from the peak pulse amplitude (in dB) to find the average emission. This correction may be applied to all emissions that demonstrate the same pulse timing characteristics as the fundamental emission (e.g., the fundamental and harmonic emissions). In cases where the pulse train is truly random or pseudo random, some regulatory agencies may accept a declaration by the manufacturer of the worst-case value of t_{ON}.

When the duty cycle correction factor is calculated to be less than -20.0 dB, -20.0 dB is used to find the average emission.

A.2 Test Results



Date: 27.JUN.2017 10:34:24

Duty Cycle: DC = 9.86/ 100 = 0.0986 or 9.86%
Duty Cycle Correction Factor **δ (dB)** = 20 log (0.0986) = -20.1 dB