

TEST REPORT

Report Number: 102960041MPK-004
Project Numbers: G102960041, G1029966706
July 13, 2017

Testing performed on the
Wireless Load Controllers:
Genius Control 10, Genius Pro Control 10, Genius Dimmer 15,
Genius Pro Dimmer 15 & Genius Pro Control 20

Models: GC10, GPC10, GDT15, GPDT15 & GPC20

FCC ID: 2ADH9-G2CF
IC: 12453A-G2CF
to

FCC Part 15 Subpart C (15.247)
Industry Canada RSS-247 Issue 2

For
Levven Automation Inc.

Test Performed by:
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Menlo Park, CA 94025
USA

Test Authorized by:
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Prepared by:



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Date: July 13, 2017

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Date: July 13, 2017

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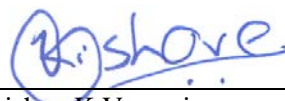
Report No. 102960041MPK-004

Equipment Under Test:	Wireless Load Controllers
Model Name & Number(s):	Genius Control 10; GC10 Genius Pro Control 10; GPC10 Genius Dimmer 15; GDT15 Genius Pro Dimmer 15; GPDT15 Genius Pro Control 20; GPC20
Applicant:	Levven Automation Inc.
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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
Date of Test:	March 21 - June 27, 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	Complies
Antenna Requirement	15.203	RSS-GEN	Complies (Permanently attached)
RF Exposure	15.247(i), 2.1093(d)	RSS-102	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 21, 2017

Test completion date: June 27, 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 permanently connected wireless controller for lighting system. It is intended for household / commercial, indoor dry locations; and installed inside a junction box that supports light fixtures. All products covered in this report must be installed in accordance with local electrical codes.

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

Applicant	Levven Automation Inc.
Model Number	GC10, GPC10, GDT15, GPDT15 & GPC20
FCC Identifier	2ADH9-G2CF
IC Identifier	12453A-G2CF
Modulation Technique	Digital Transmission System (DTS)
Rated RF Output	13.97 dBm
Frequency Range	903 – 927 MHz
Type of modulation	2GFSK
Number of Channel(s)	33
Antenna(s) & Gain	<ul style="list-style-type: none"> •Antenna is single wire quarter wave monopole •Antenna gain theoretical maximum will have a gain of 5.19 dBi (3db higher than a theoretical dipole 2.19 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

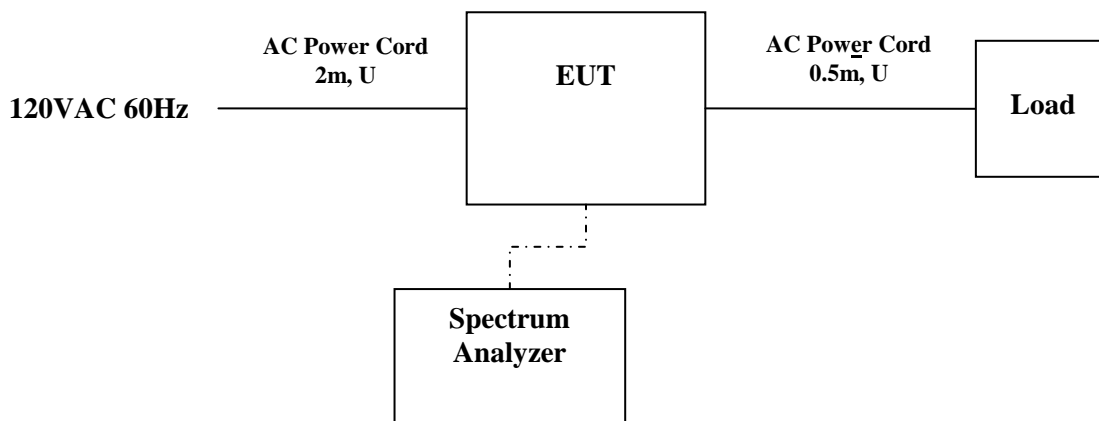
3.1 Support Equipment and description

None

3.2 Block Diagram of Test Setup

Equipment Under Test		
Product Name	Product Model #	Serial Number
Genius Control 10	GC10	MPK1703211148-003 (Conducted)
Genius Pro Control 10	GPC10	MPK1703211148-004 (Radiated)
Genius Dimmer 15	GDT15	MPK1703211148-005 (Conducted)
Genius Pro Dimmer 15	GPDT15	MPK1703211148-006 (Radiated)
Genius Pro Control 20	GPC20	MPK1703211148-001 (Conducted)
		MPK1703211148-002 (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

Genius Control 10 and Genius Pro Control 10 are same design and components, the differences are Genius Control 10 is single voltage and Genius Pro Control 10 is dual voltage.

Genius Dimmer 15 and Genius Pro Dimmer 15 are same design and components, the differences are Genius Dimmer 15 is single voltage and Genius Pro Dimmer 15 is dual voltage.

Genius Control 10, Genius Pro Control 10, Genius Dimmer 15, Genius Pro Dimmer 15 & Genius Pro Control 20 use the same 903-927MHz Radio. Transmitter Output power, Radiated Spurious and AC Line Emissions were conducted on each model.

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) $\geq 3 \times$ 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.

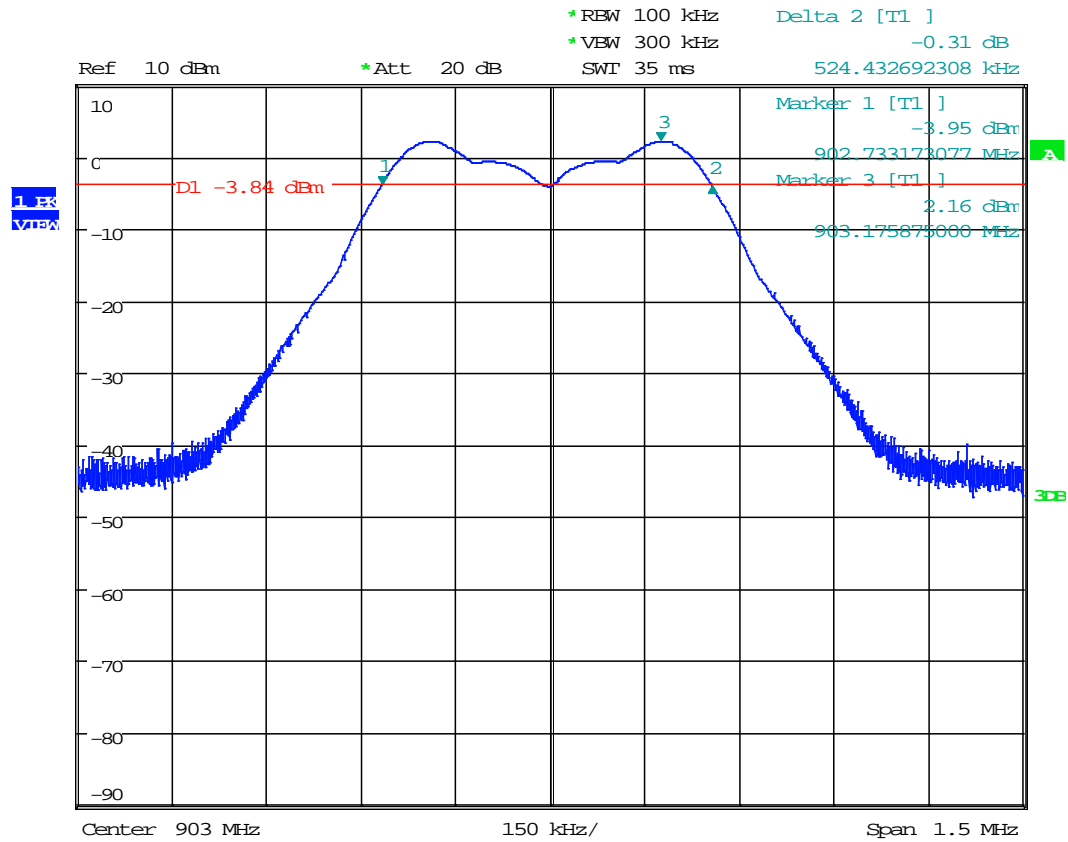
Test Date:	March 27, 2017
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4.1.3 Test Result

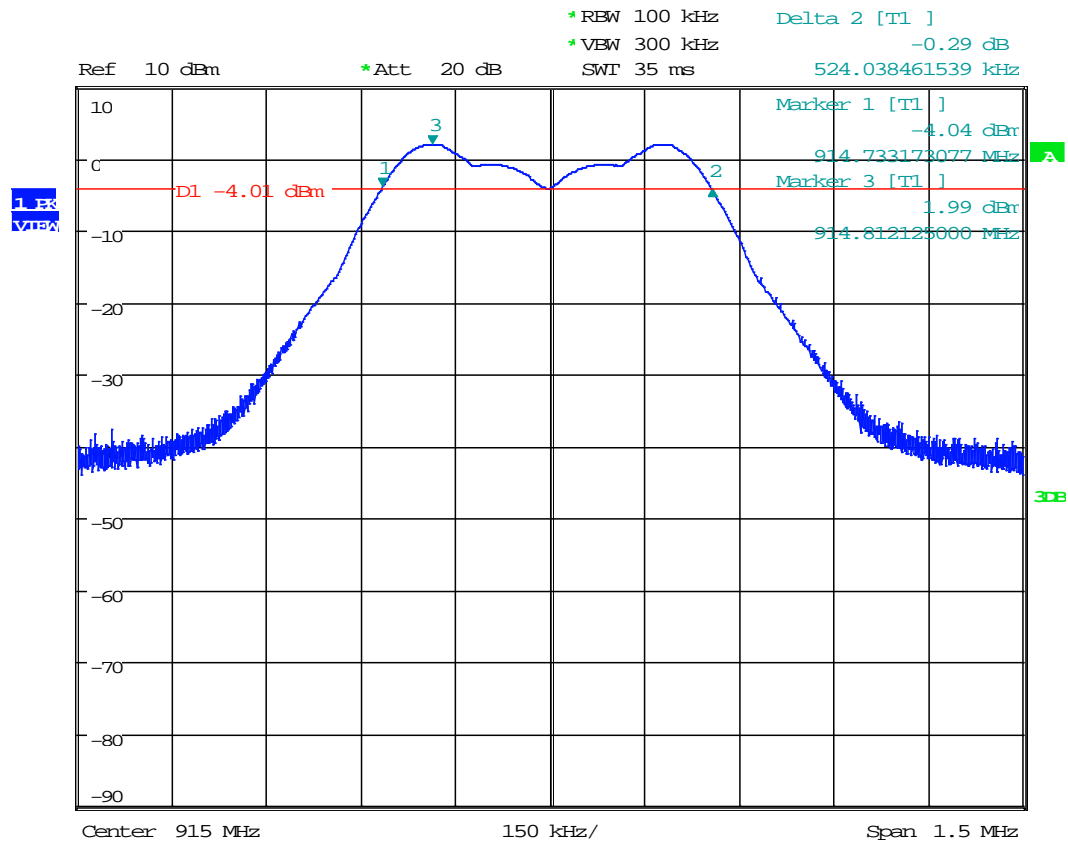
Frequency MHz	6 dB FCC Bandwidth, kHz	Plot #	99% Bandwidth, kHz	Plot #
903	524.43	1.1	523.50	1.4
915	524.04	1.2	523.13	1.5
927	526.44	1.3	523.88	1.6

Plot 1.1 – 6dB Bandwidth (FCC)



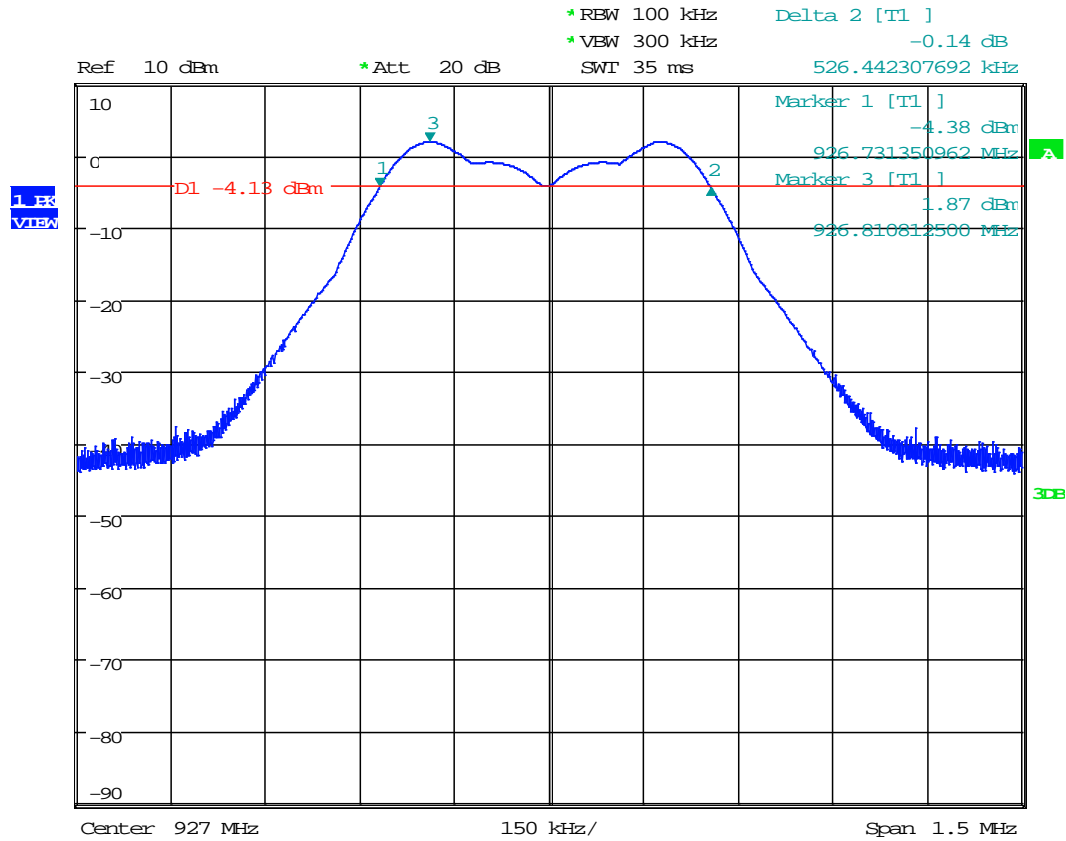
Date: 27.MAR.2017 10:59:38

Plot 1.2 – 6dB Bandwidth (FCC)



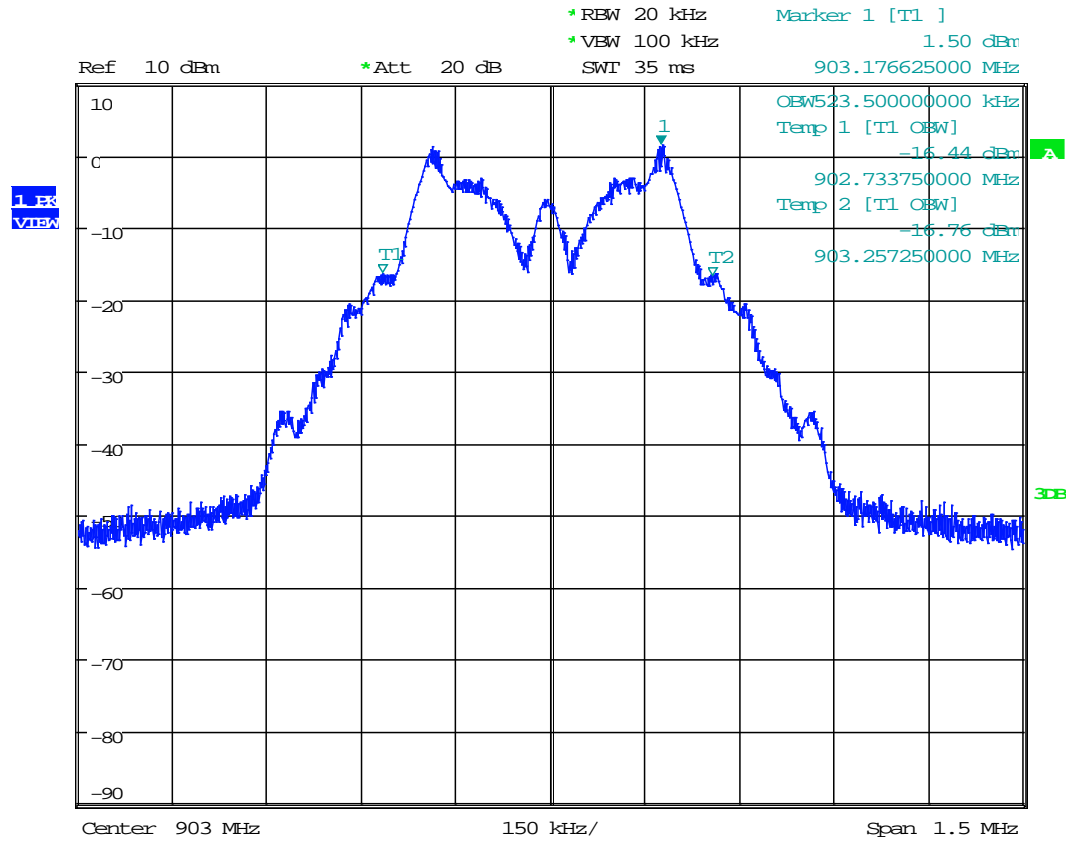
Date: 27.MAR.2017 11:01:07

Plot 1 3 – 6dB Bandwidth (FCC)



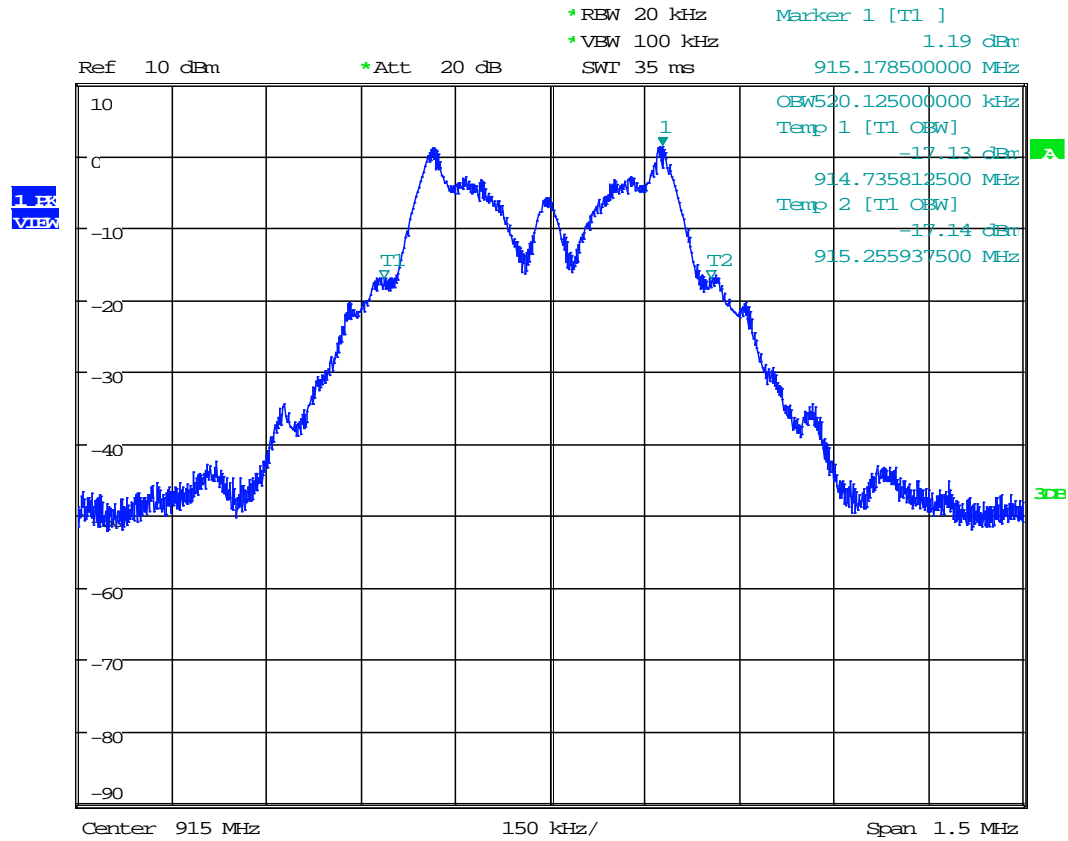
Date: 27.MAR.2017 10:57:49

Plot 1.4 – 6dB Bandwidth (FCC)



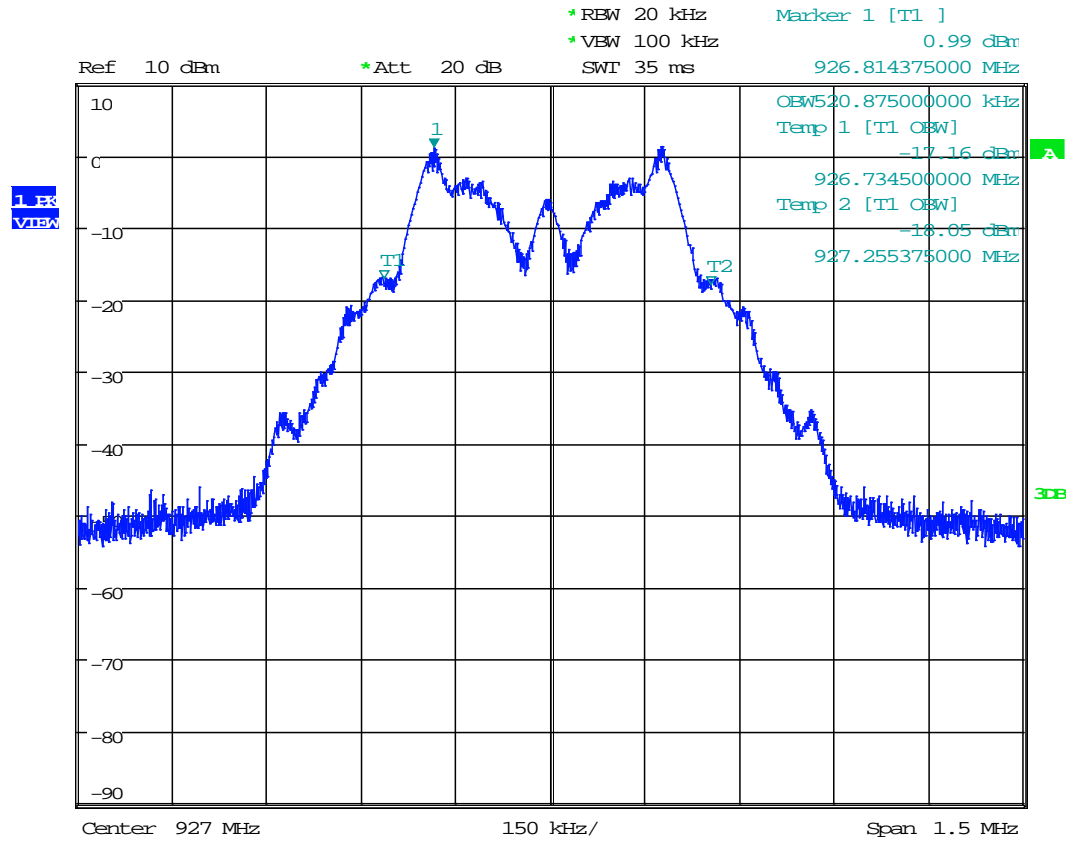
Date: 27.MAR.2017 11:04:08

Plot 1.5 – 6dB Bandwidth (FCC)



Date: 27.MAR.2017 11:02:27

Plot 1.6 – 6dB Bandwidth (FCC)



Date: 27.MAR.2017 11:03:24

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 \geq DTS Bandwidth was utilized as the spectrum analyzer's resolution bandwidth was greater than the DTS bandwidth.

1. Set the RBW \geq DTS Bandwidth
2. Set the VBW $\geq 3 \times$ RBW
3. Set the span $\geq 3 \times$ 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 21, April 3 & June 7, 2017
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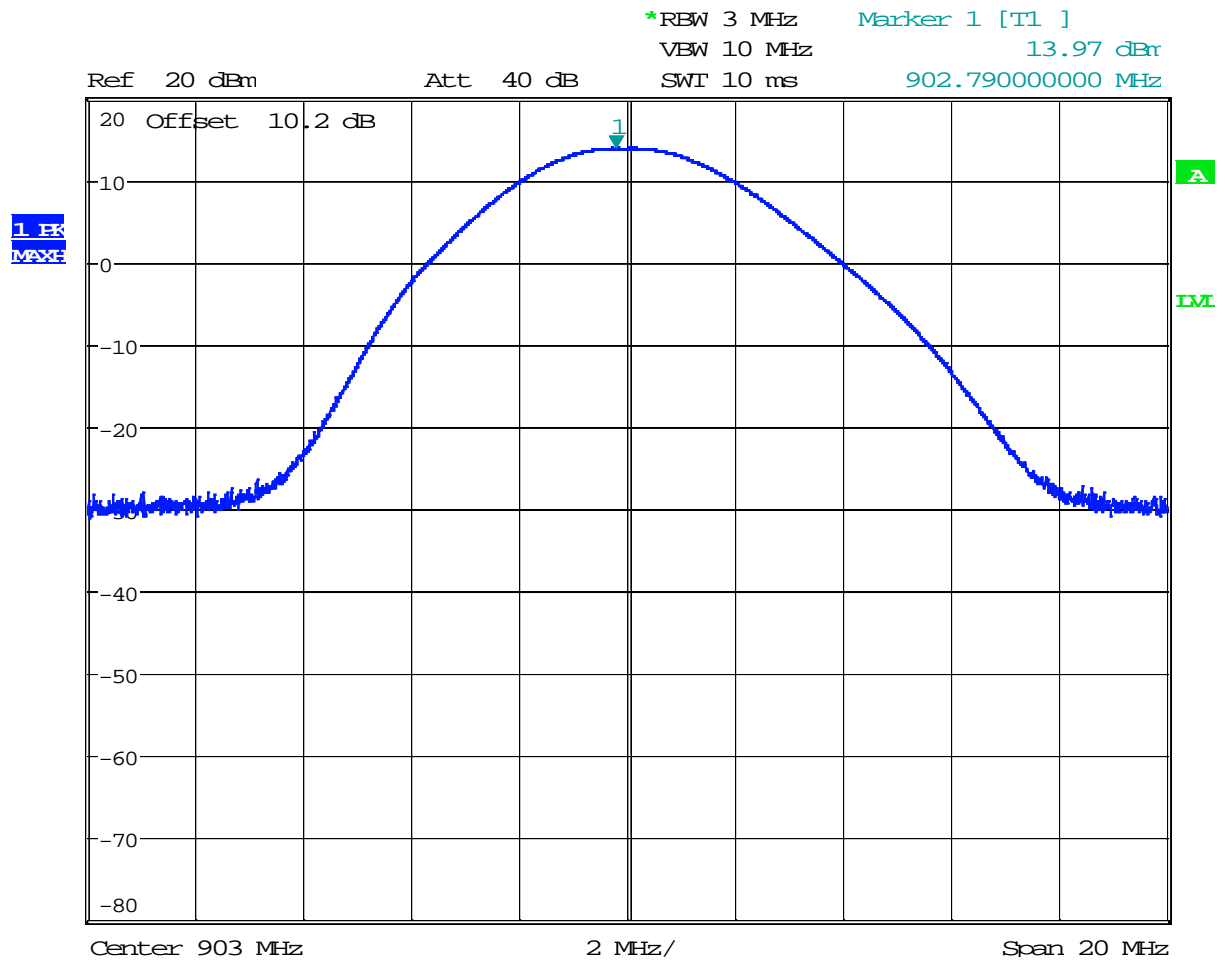


4.2.3 Test Result

Refer to the following plots for the test result:

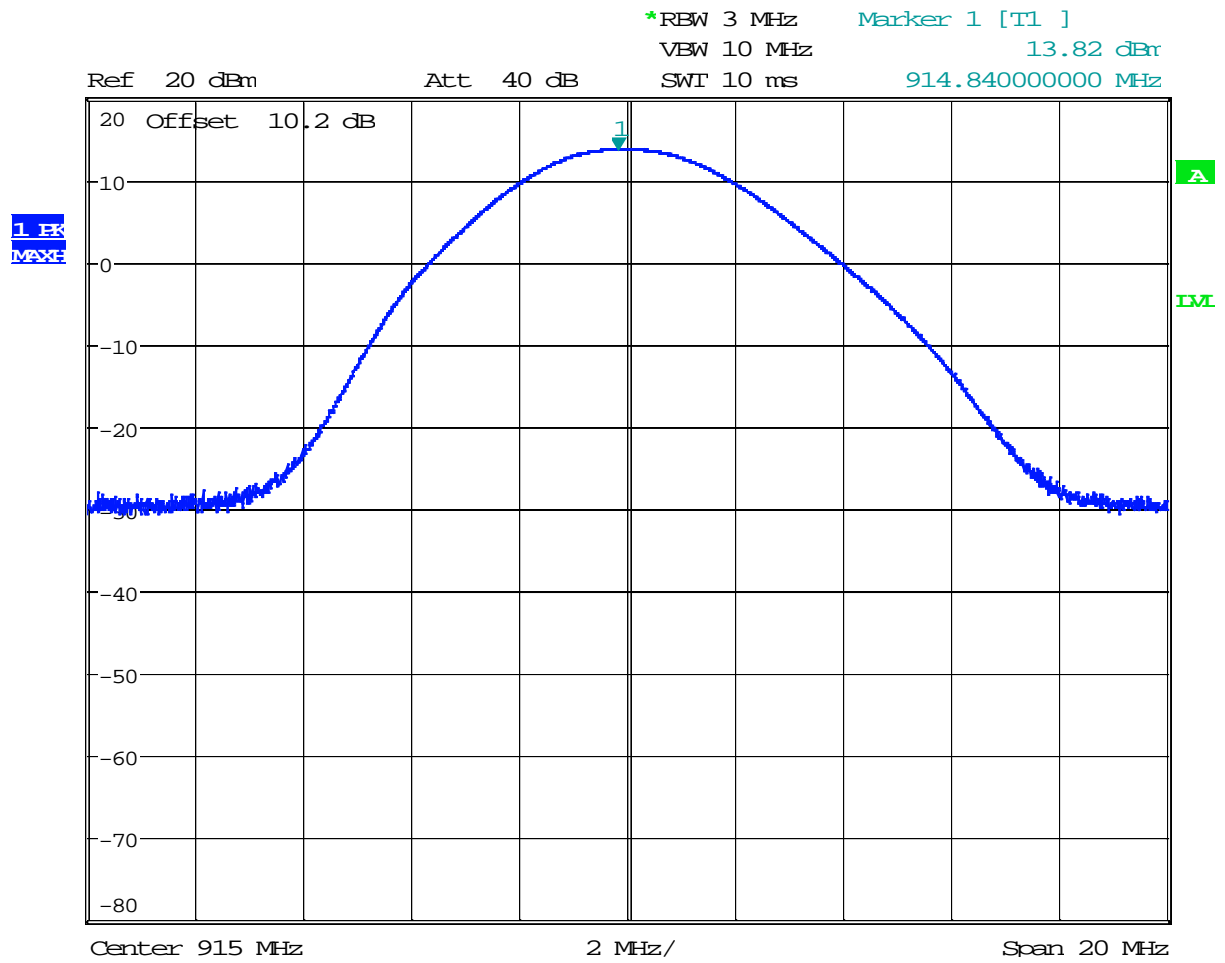
Model Number	Frequency MHz	Conducted Peak Power dBm	Conducted Peak Power mW	Plot #
GC10 & GPC10	903	13.97	24.946	2.1
	915	13.82	24.099	2.2
	927	13.60	22.909	2.3
GDT15 & GPDT15	903	13.00	19.953	2.4
	915	12.68	18.535	2.5
	927	12.60	18.197	2.6
GPC20	903	13.44	22.080	2.7
	915	13.25	21.135	2.8
	927	13.06	20.230	2.9

Plot 2.1



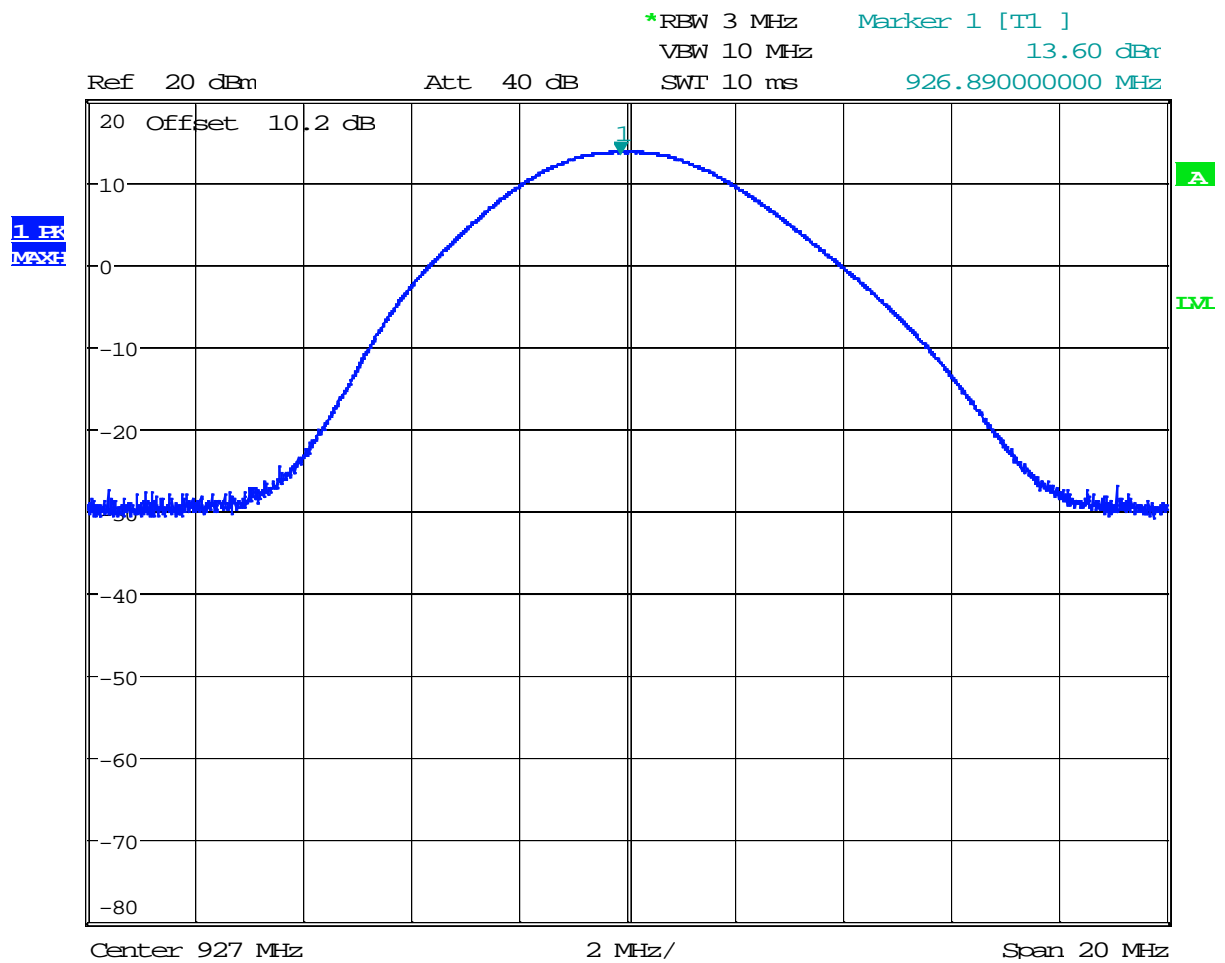
Date: 7.JUN.2017 12:24:00

Plot 2.2



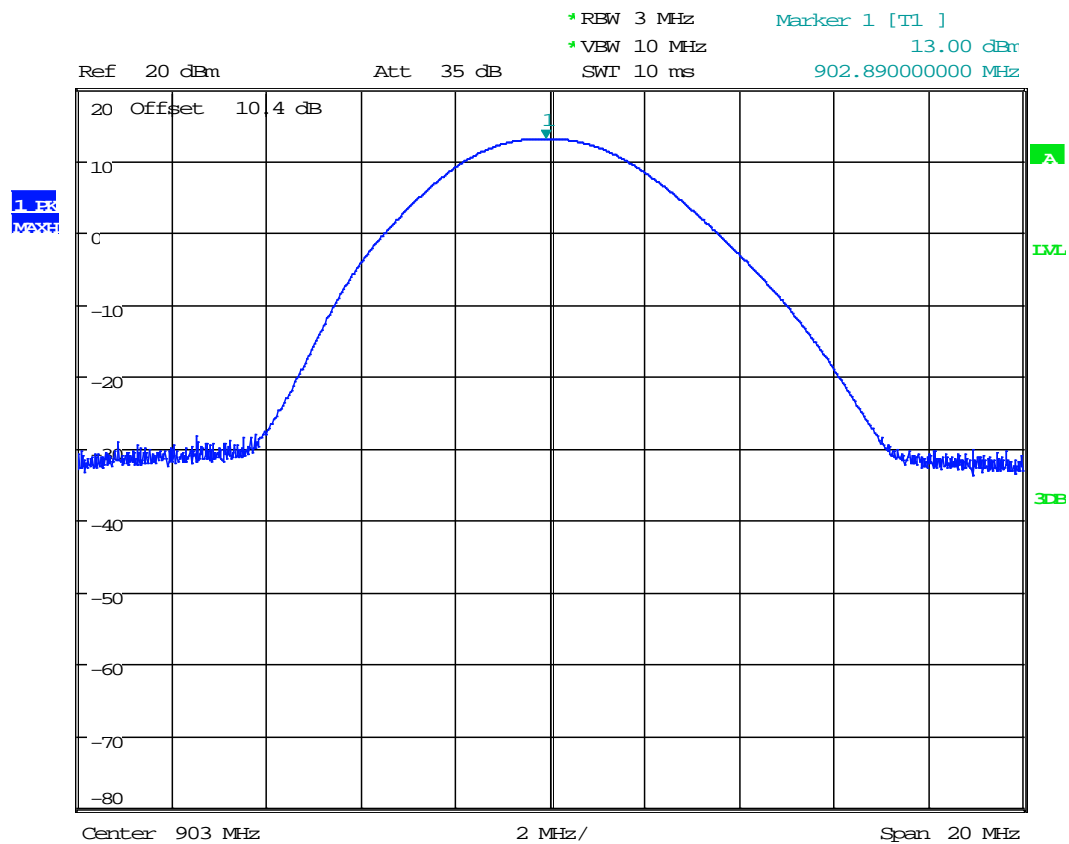
Date: 7.JUN.2017 12:24:53

Plot 2.3



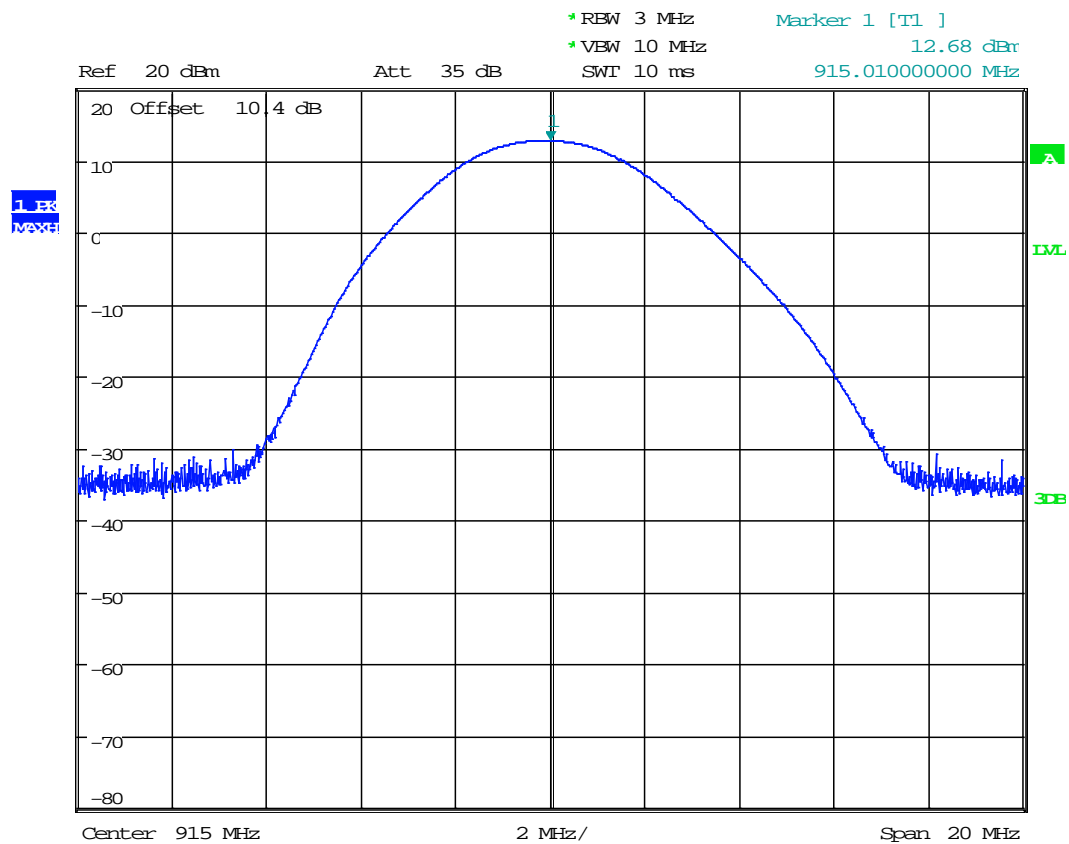
Date: 7.JUN.2017 12:25:22

Plot 2.4



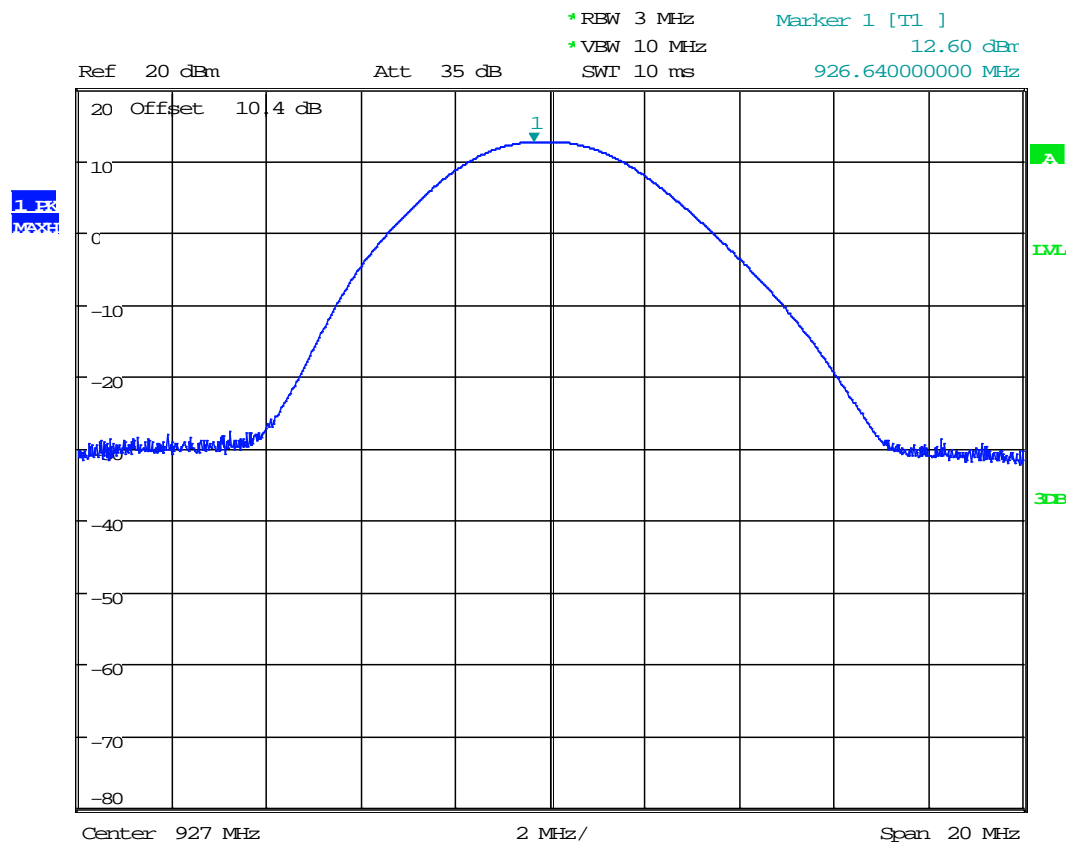
Date: 21.MAR.2017 07:21:30

Plot 2.5



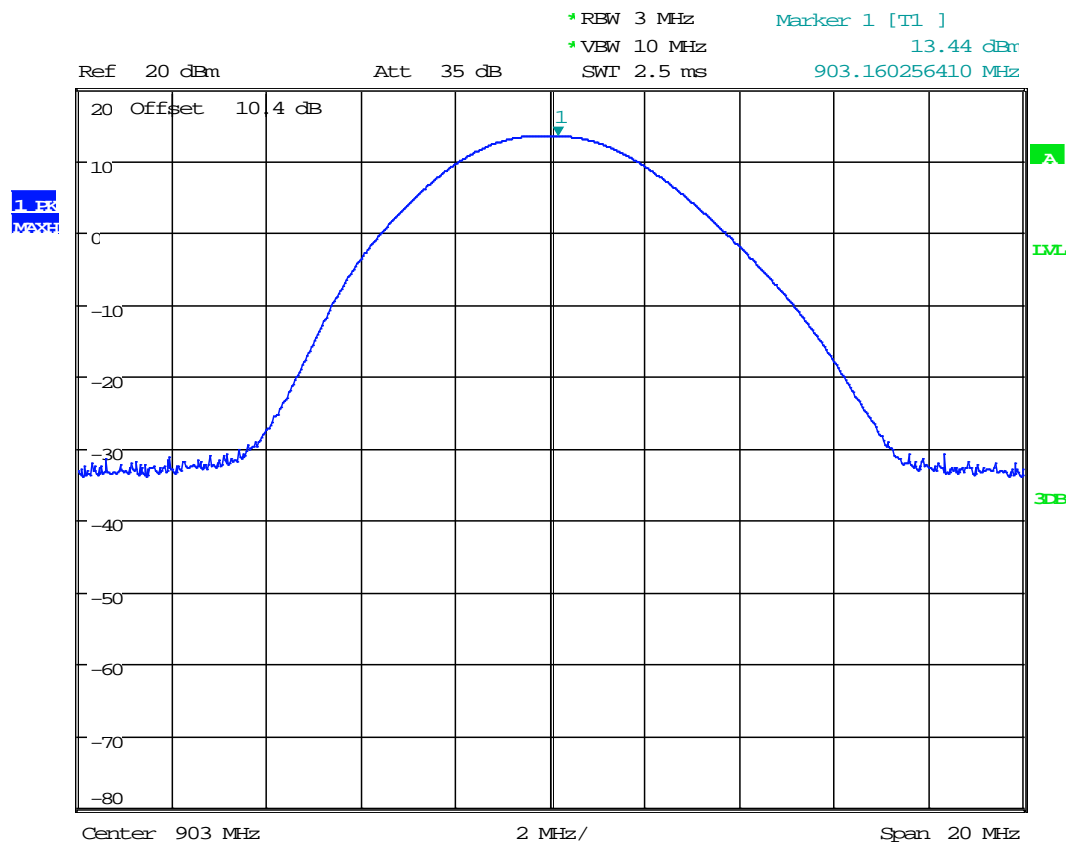
Date: 21.MAR.2017 07:23:19

Plot 2.6



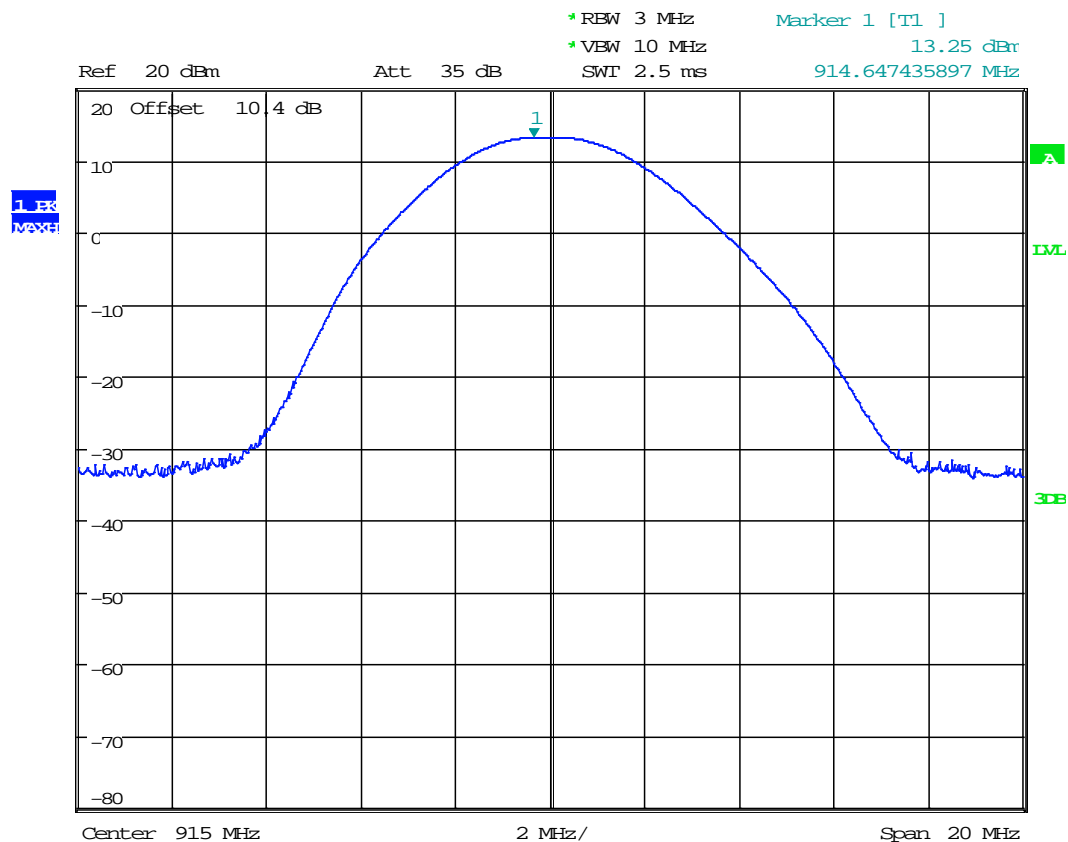
Date: 21.MAR.2017 07:48:57

Plot 2.7



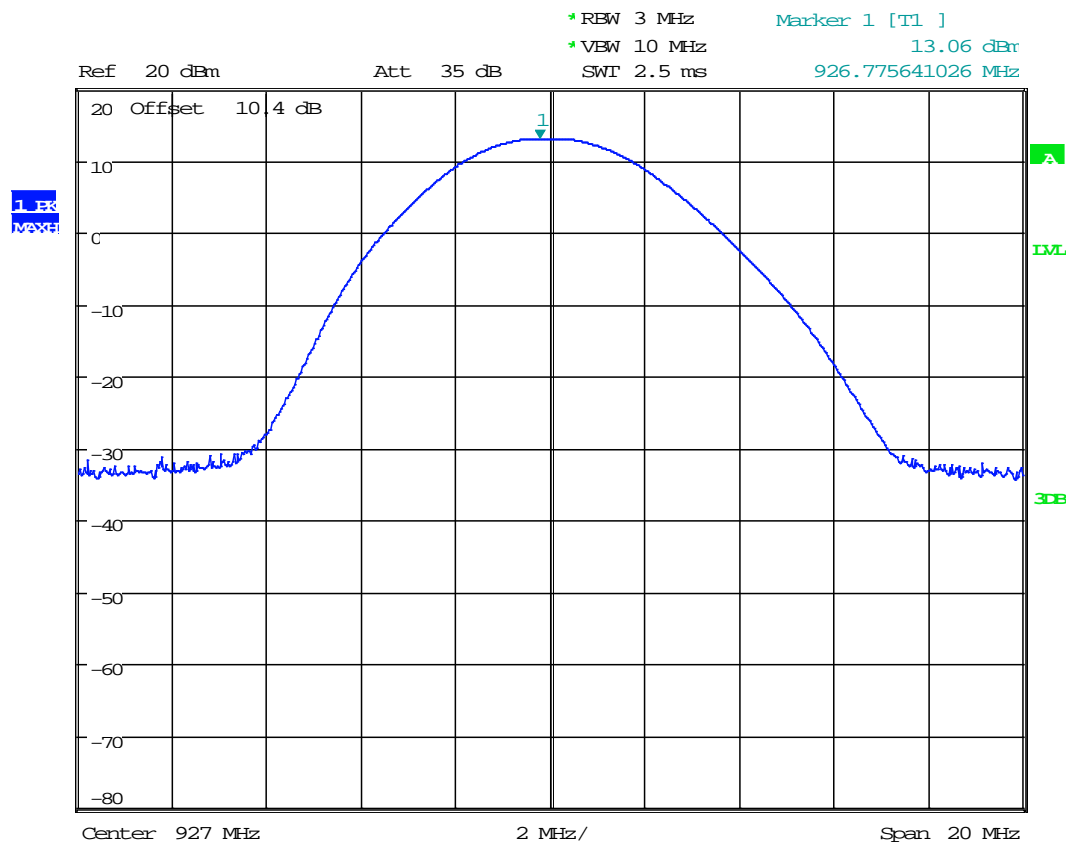
Date: 3.APR.2017 09:28:28

Plot 2.8



Date: 3.APR.2017 09:29:21

Plot 2.9



Date: 3.APR.2017 09:30:00

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: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
4. Set the VBW $\geq 3 \times \text{RBW}$.
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:	June 7, 2017
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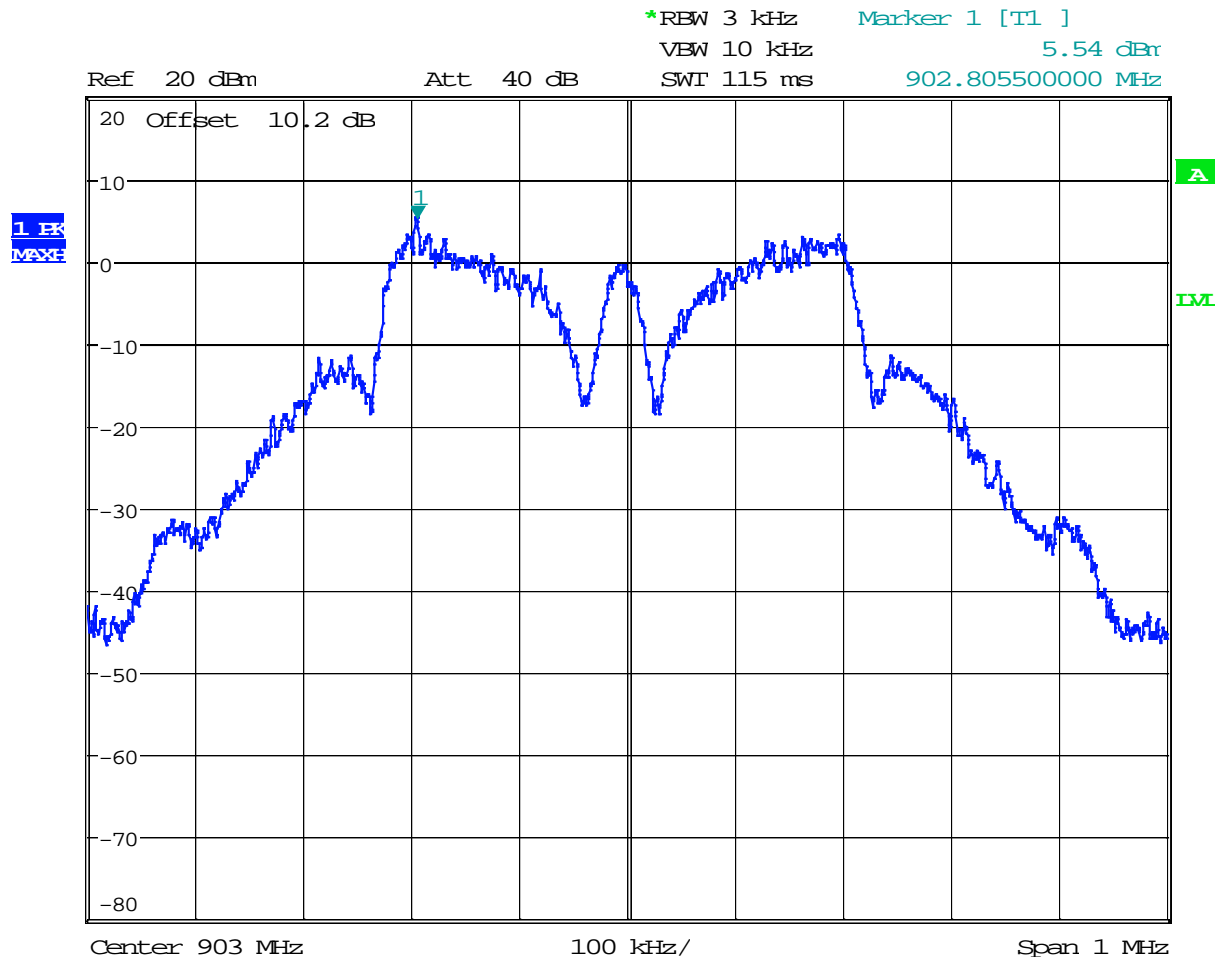


4.3.3 Test Result

Refer to the following plots for the test result:

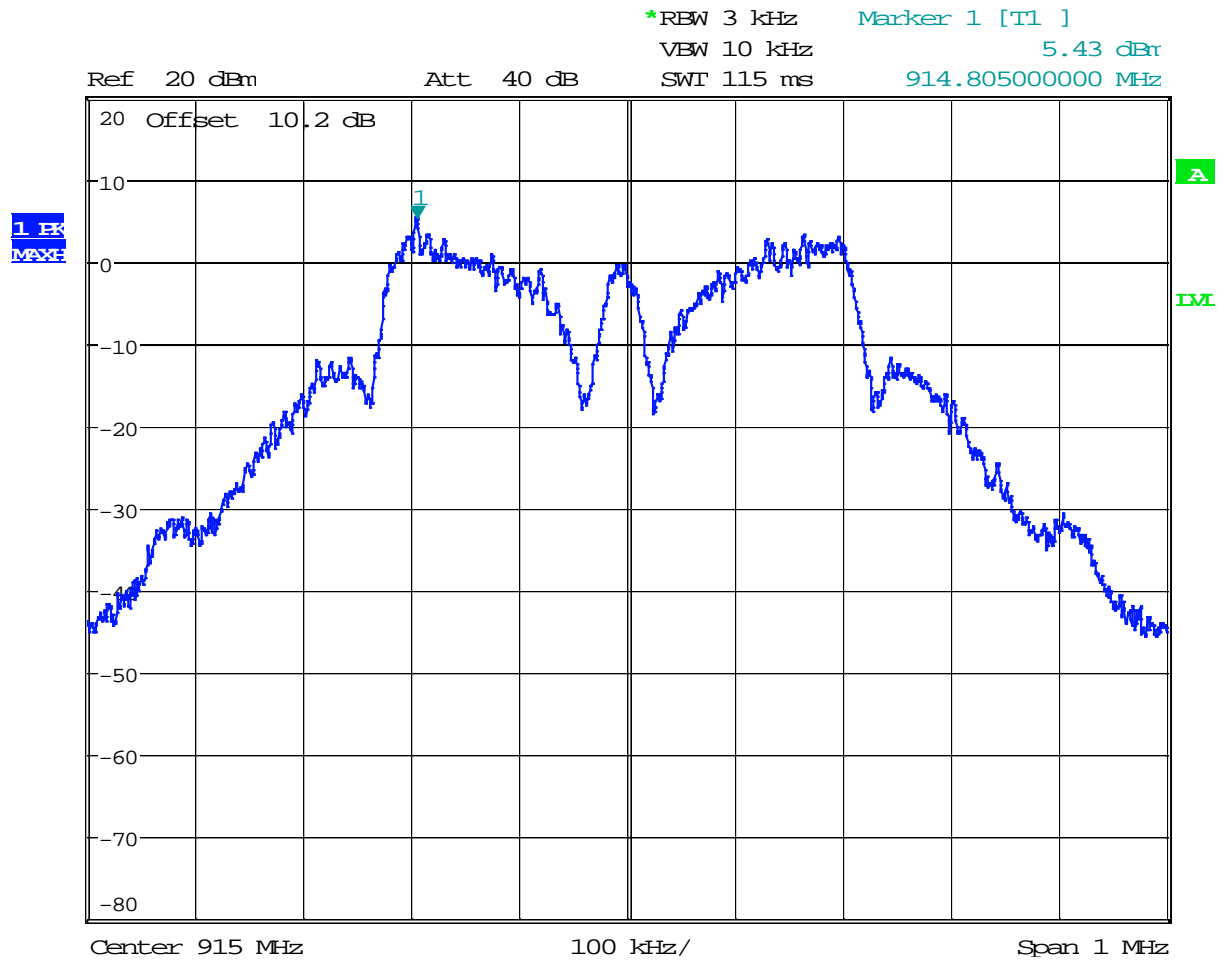
Frequency MHz	PSD (Peak) dBm	Margin to 8dBm Limit dB	Plot #
903	5.54	-2.46	3.1
915	5.43	-2.57	3.2
927	5.36	-2.64	3.3

Plot 3.1



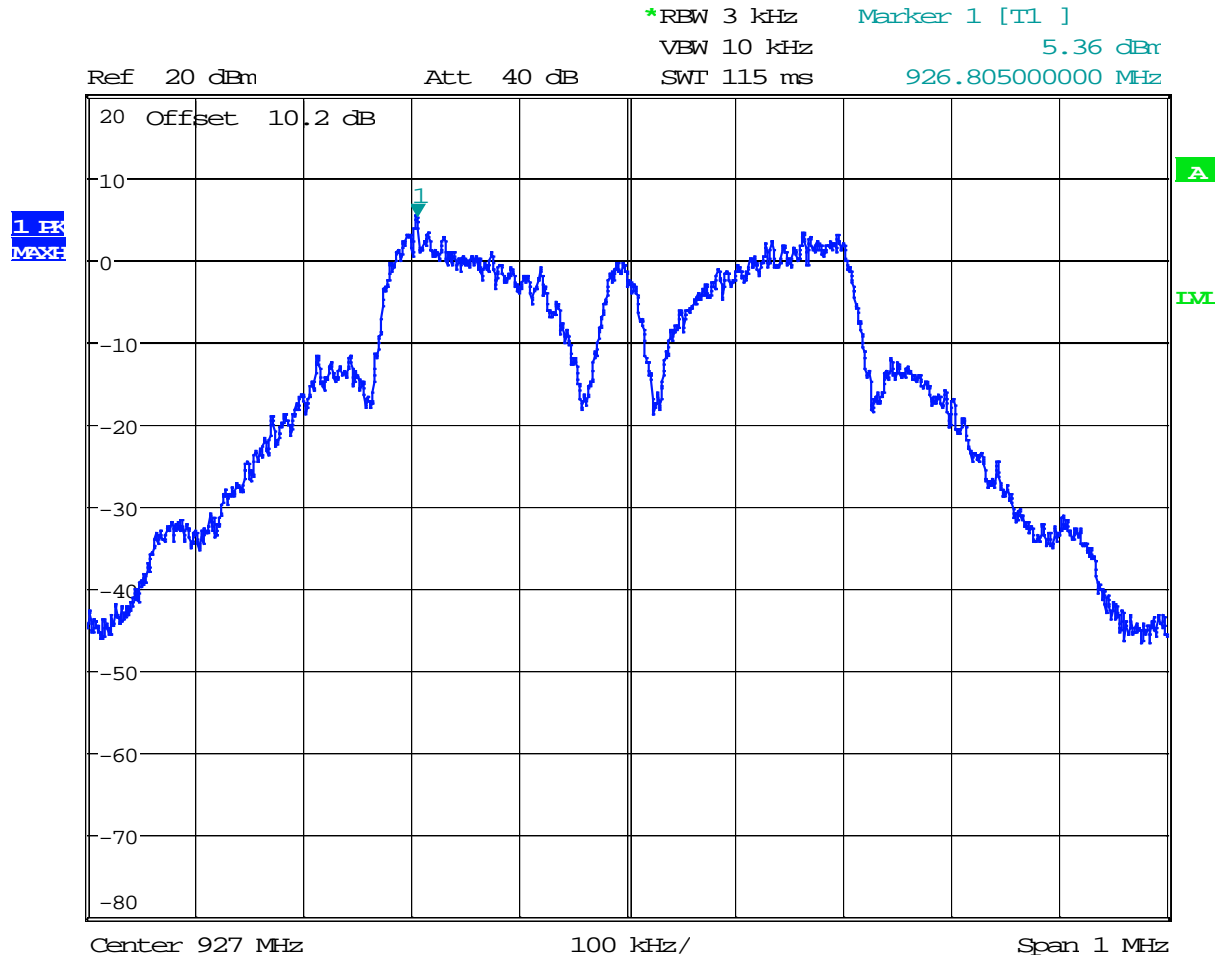
Date: 7.JUN.2017 12:27:18

Plot 3.2



Date: 7.JUN.2017 12:28:49

Plot 3.3



Date: 7.JUN.2017 12:26:21

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.

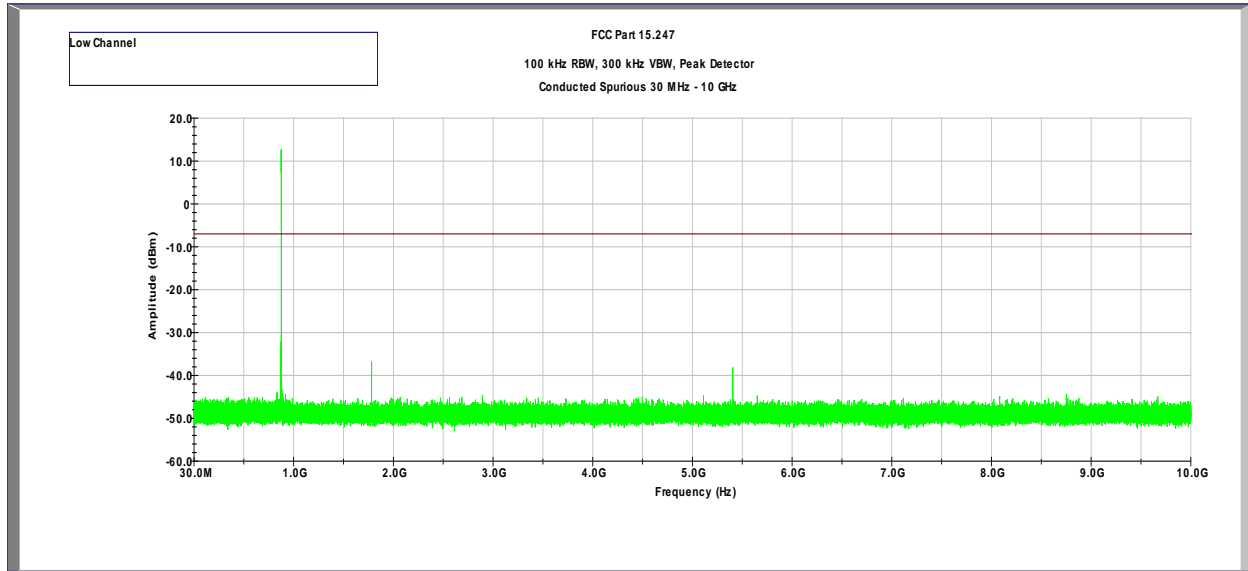
4.4.3 Test Result

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

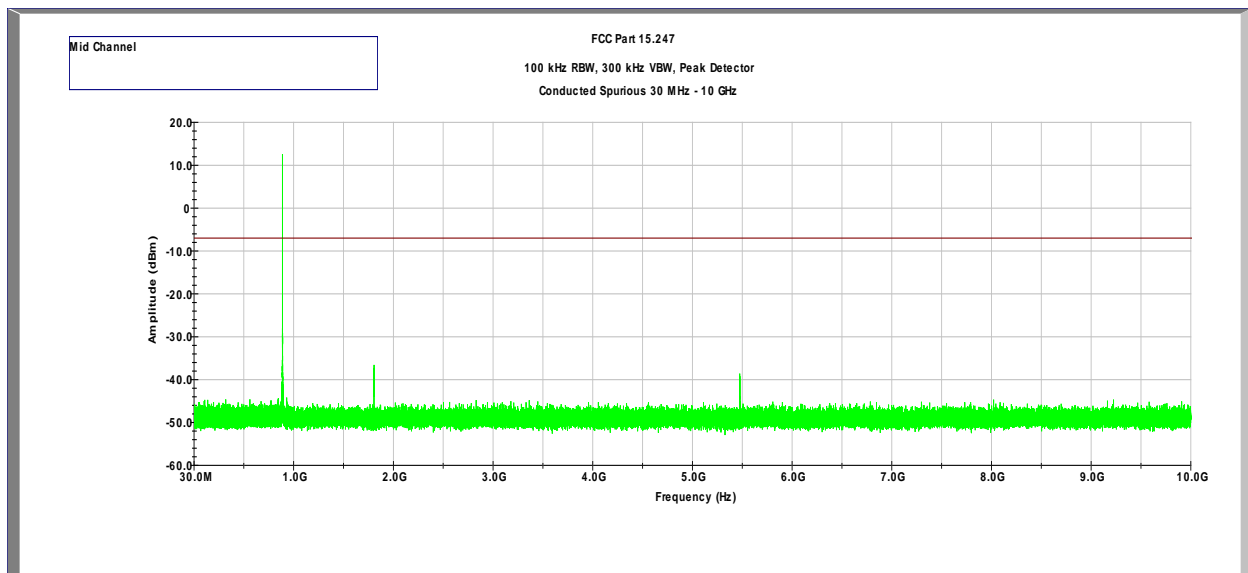
Test Date:	March 21, 2017
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Results	Complies
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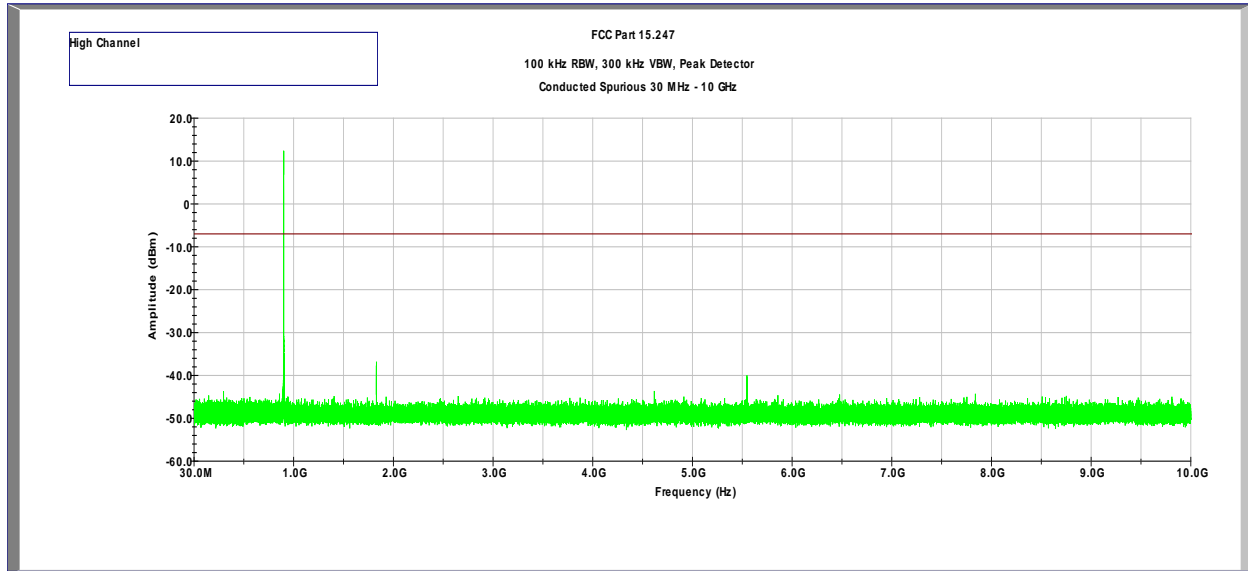
Plot 4.1
Tx @ 903MHz



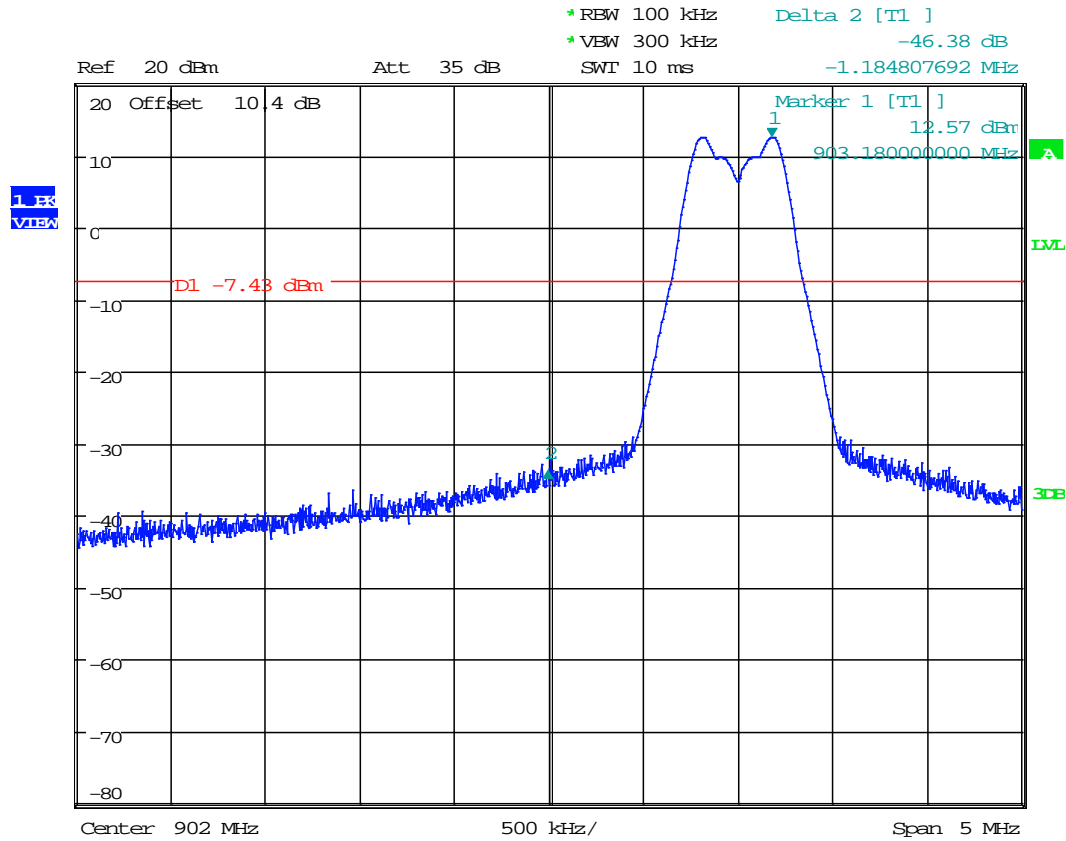
Plot 4.2
Tx @ 915MHz



Plot 4.3
Tx @ 927MHz

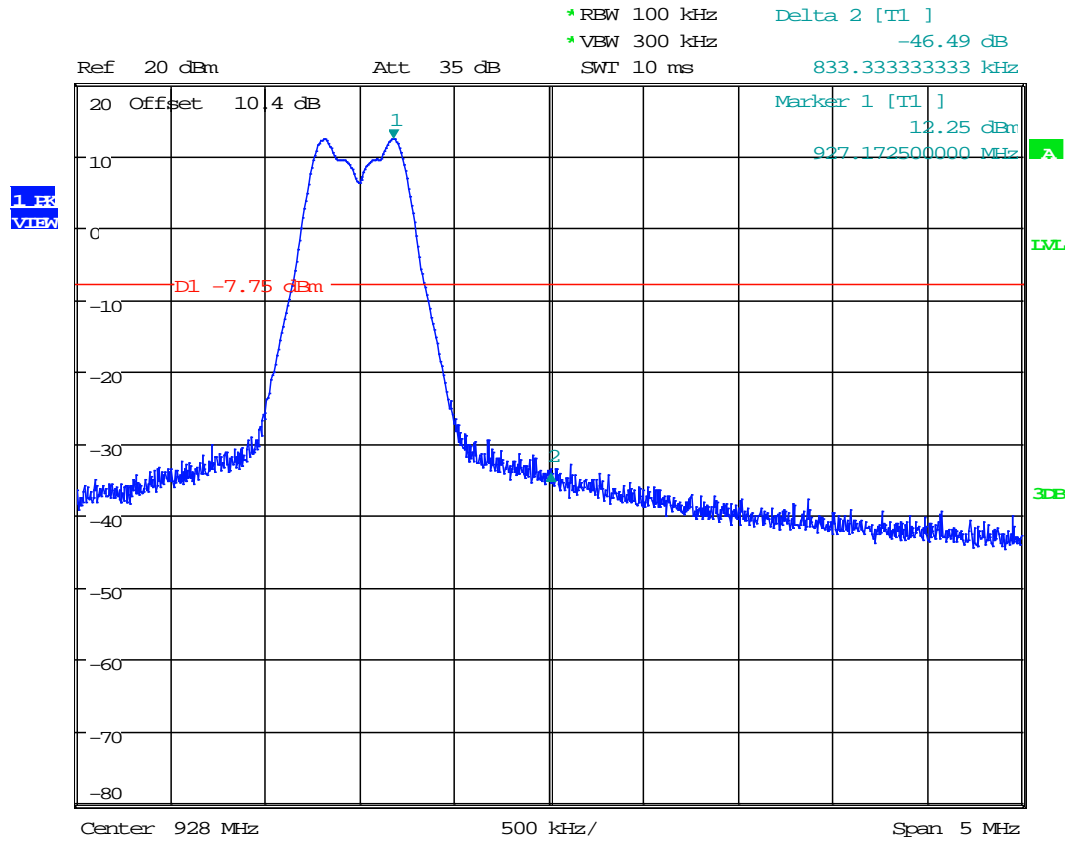


Plot 4.4
Conducted Band Edge, Tx @ 903MHz



Date: 21.MAR.2017 08:44:25

Plot 4.5
Conducted Band Edge, Tx @ 927MHz



Date: 21.MAR.2017 08:46:04

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 ANSIC64.10. 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:

$FS = RA + AF + CF - AG - \delta$ (**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(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

δ = **Duty cycle correction factor, see Annex A**

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

δ = **20.0 dB**

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

$FS = 52.0 + 7.4 + 1.6 - 29.0 - 20.0 = 12$ dB(μ V/m) Average.

Test Date:	March 24 – June 14, 2017
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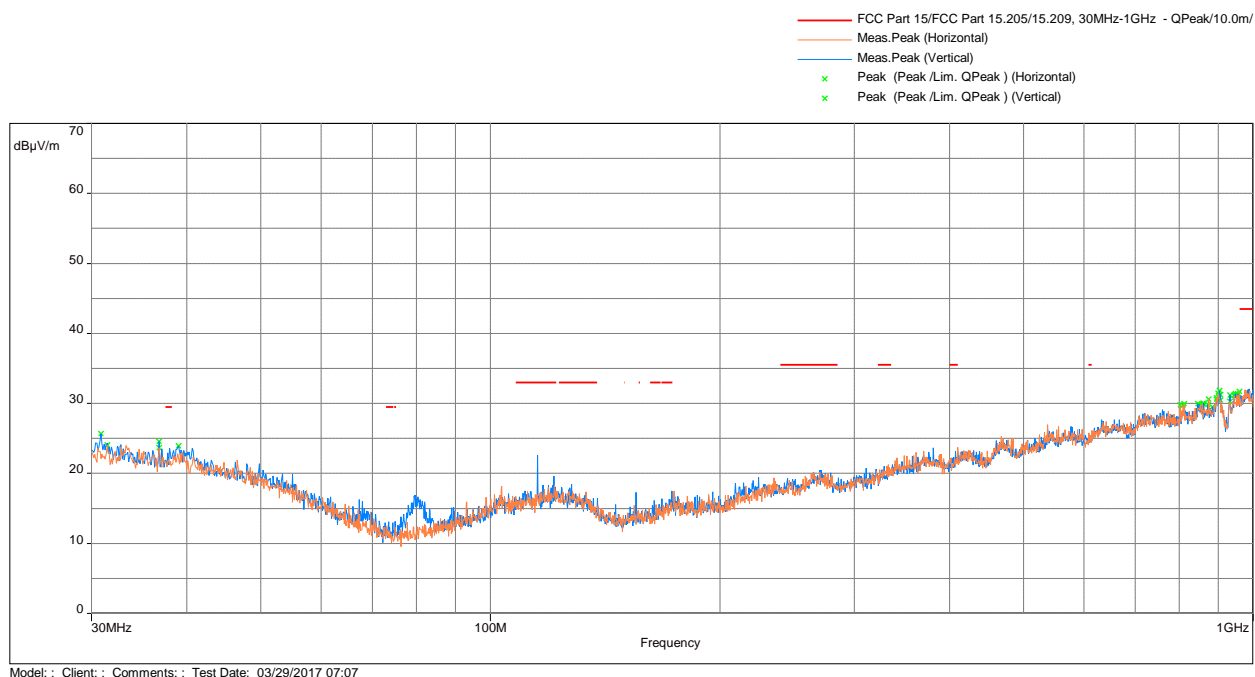
Result:	Complies by 0.31dB
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4.5.4 Test Results

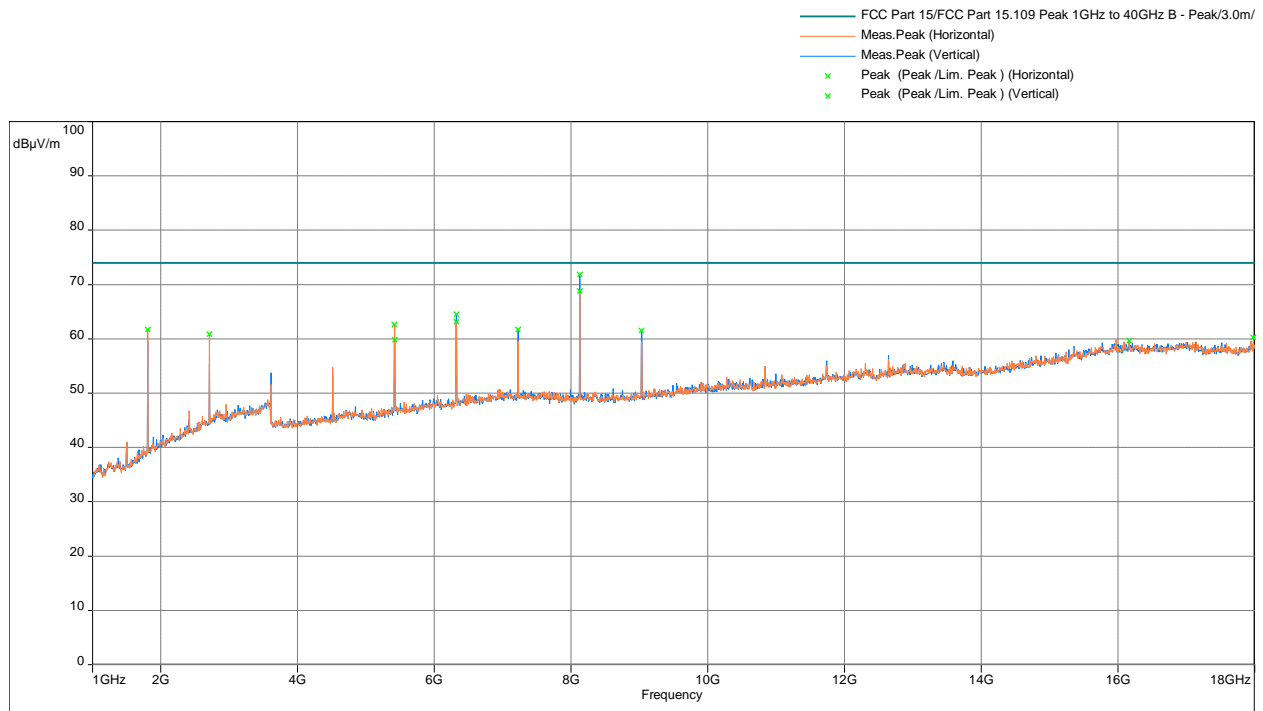
GC10 & GPC10

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

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



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



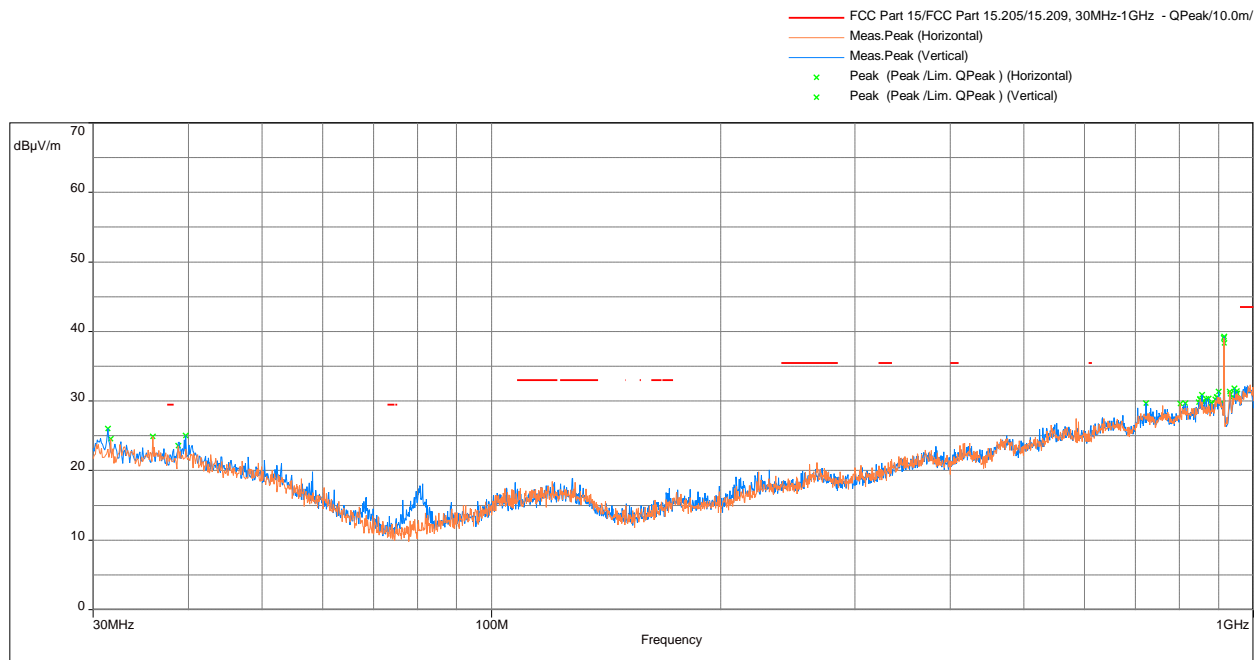
Frequency	Peak Amplitude	Peak Limit	Peak Margin	Avg Amplitude	Avg Limit	Avg Margin	Polarity	Height	Angle
MHz	dBμV/m	dBμV/m	dB	dBμV/m	dBμV/m	dB	H/V	m	°
1805.8	61.66	74	-12.34	41.66	54	-12.34	H	1.98	294
2708.5	60.82	74	-13.18	40.82	54	-13.18	H	1.48	141
5418.3	62.67	74	-11.33	42.67	54	-11.33	H	1.01	95
5418.3	59.80	74	-14.20	39.80	54	-14.20	V	1.99	37
6322.7	63.16	74	-10.84	43.16	54	-10.84	H	1.48	155
6322.7	64.48	74	-9.52	44.48	54	-9.52	V	1.52	223
7222.0	61.73	74	-12.27	41.73	54	-12.27	V	1.02	260
8128.1	68.76	74	-5.24	48.76	54	-5.24	H	1.98	154
8128.1	71.83	74	-2.17	51.83	54	-2.17	V	1.02	246
9027.4	61.50	74	-12.50	41.50	54	-12.50	V	1.02	161

Test Result : Pass at 903MHz

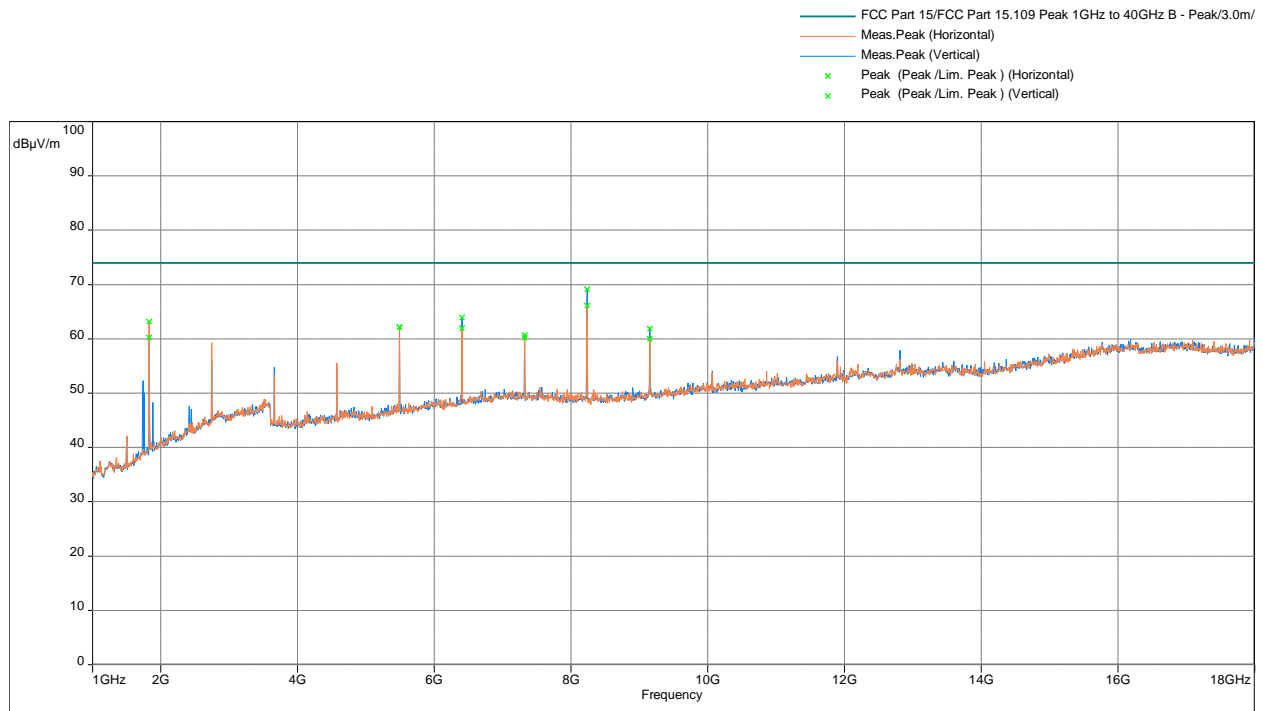
Note: The peaks showed are compliant with 15.209 Average limit (54dBuV/m) by applying Duty Cycle Correction Factor of 20dB (See Annex A for Duty Cycle calculation).

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

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



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



Model : Client : Comments : Test Date: 06/07/2017 08:43

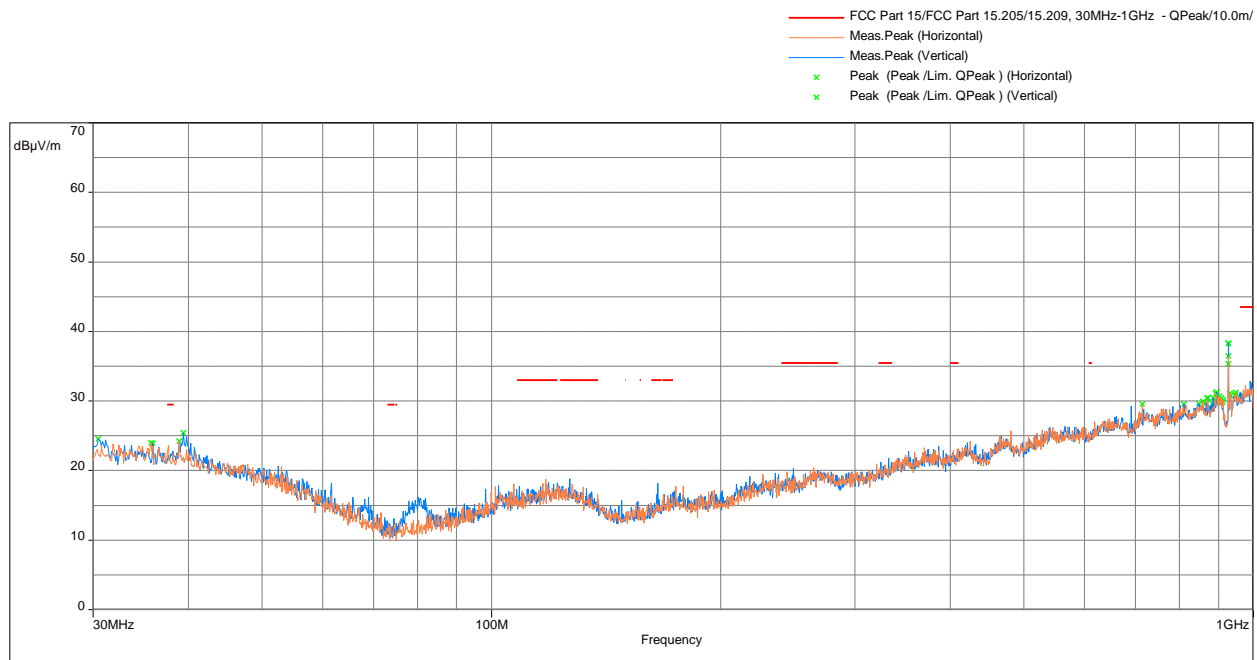
Frequency	Peak Amplitude	Peak Limit	Peak Margin	Avg Amplitude	Avg Limit	Avg Margin	Polarity	Height	Angle
MHz	dBμV/m	dBμV/m	dB	dBμV/m	dBμV/m	dB	H/V	m	°
1829.6	63.18	74	-10.82	43.18	54	-10.82	H	1.48	111
1829.6	60.23	74	-13.77	40.23	54	-13.77	V	1.02	83
5490.0	62.10	74	-11.90	42.10	54	-11.90	H	1.01	79
5490.0	62.08	74	-11.92	42.08	54	-11.92	V	1.99	226
6406.0	61.99	74	-12.01	41.99	54	-12.01	H	1.98	153
6406.0	63.91	74	-10.09	43.91	54	-10.09	V	1.52	236
7320.6	60.16	74	-13.84	40.16	54	-13.84	H	1.48	153
7320.6	60.66	74	-13.34	40.66	54	-13.34	V	1.02	267
8233.5	66.15	74	-7.85	46.15	54	-7.85	H	1.48	280
8233.5	69.13	74	-4.87	49.13	54	-4.87	V	1.02	267
9151.5	59.99	74	-14.01	39.99	54	-14.01	H	1.48	209
9151.5	61.90	74	-12.10	41.90	54	-12.10	V	1.52	164

Test Result : **Pass** at 915MHz

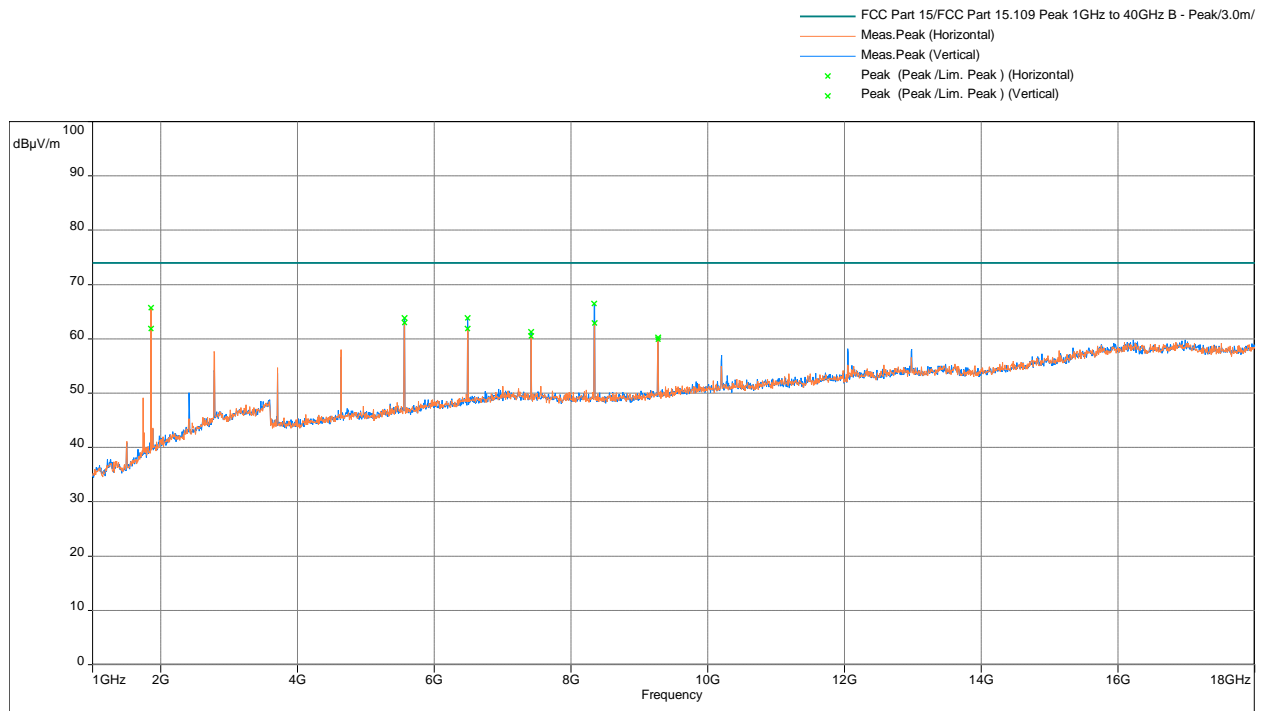
Note: The peaks showed are compliant with 15.209 Average limit (54dBuV/m) by applying Duty Cycle Correction Factor of 20dB (See Annex A for Duty Cycle calculation).

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

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



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



Model : Client : Comments : Test Date: 06/07/2017 08:55

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	65.70	74	-8.30	45.70	54	-8.30	H	1.48	110
1853.4	61.84	74	-12.16	41.84	54	-12.16	V	1.02	81
5562.8	63.02	74	-10.98	43.02	54	-10.98	H	1.01	79
5562.8	63.82	74	-10.18	43.82	54	-10.18	V	1.02	9
6489.3	63.82	74	-10.18	43.82	54	-10.18	V	1.99	222
6489.3	61.83	74	-12.17	41.83	54	-12.17	H	1.48	138
7416.5	61.27	74	-12.73	41.27	54	-12.73	V	1.99	222
7416.5	60.47	74	-13.53	40.47	54	-13.53	H	1.01	79
8344.0	66.44	74	-7.56	46.44	54	-7.56	V	1.02	110
8344.0	62.89	74	-11.11	42.89	54	-11.11	H	1.98	140
9272.2	59.92	74	-14.08	39.92	54	-14.08	H	1.01	65

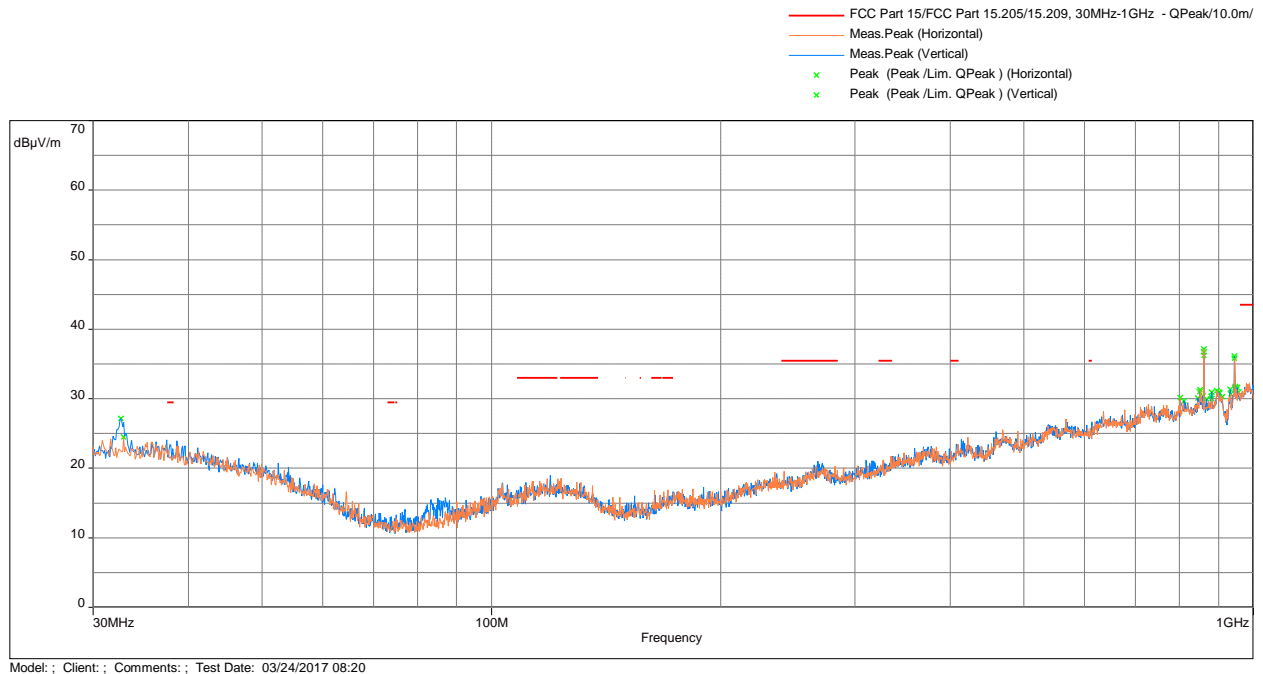
Test Result : **Pass** at 927MHz

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).

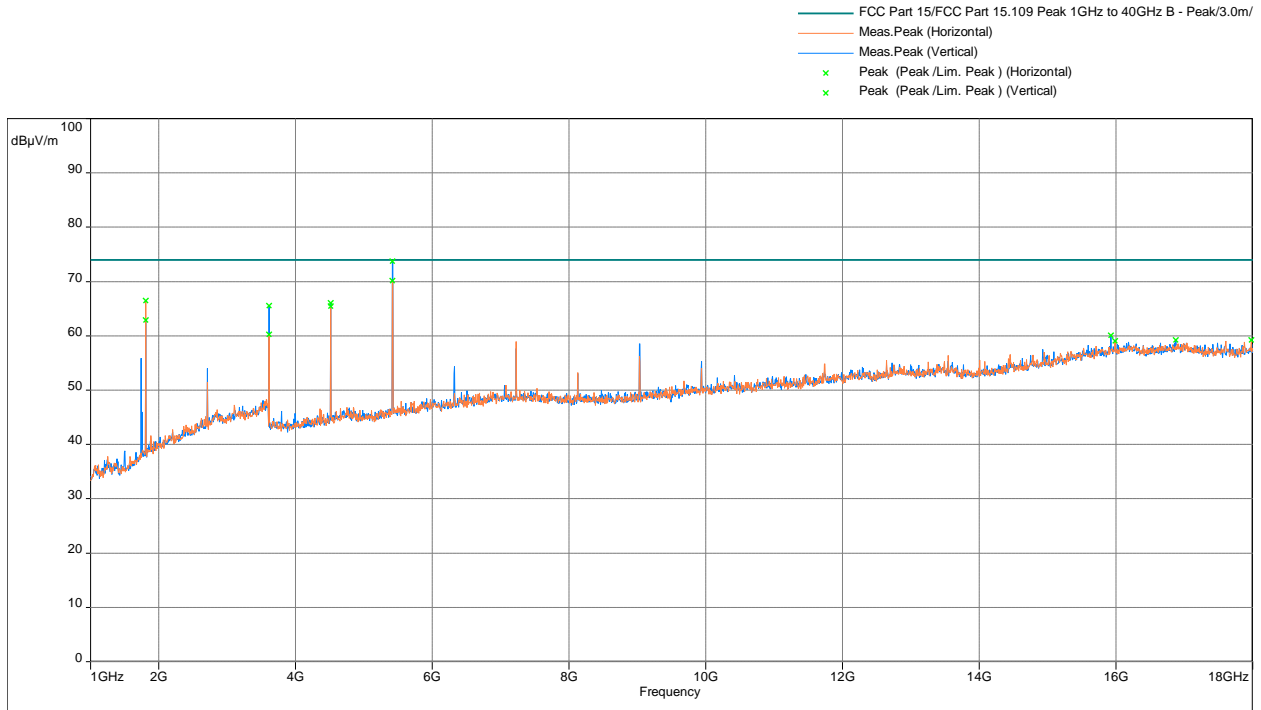
GDT15 & GPDT15

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

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



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



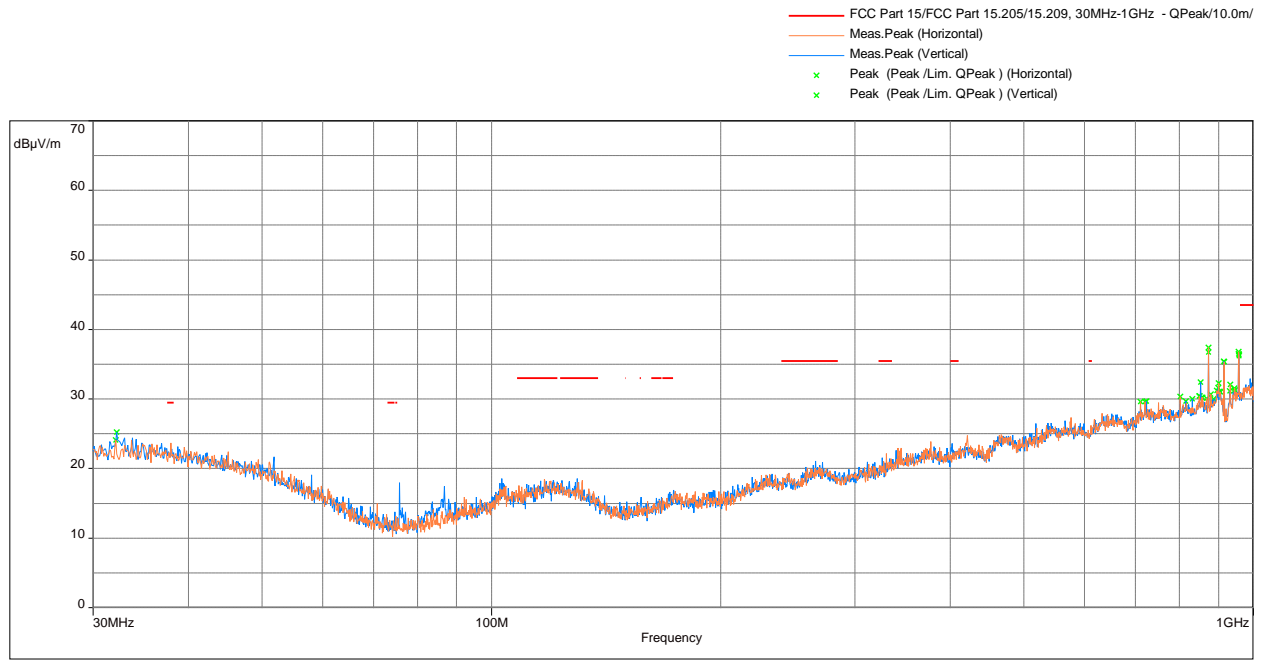
Frequency	Peak Amplitude	Peak Limit	Peak Margin	Avg Amplitude	Avg Limit	Avg Margin	Polarity	Height	Angle
MHz	dBμV/m	dBμV/m	dB	dBμV/m	dBμV/m	dB	H/V	m	°
1805.8	66.44	74	-7.56	46.44	54	-7.56	H	1.81	194
1805.8	62.89	74	-11.11	42.89	54	-11.11	V	1.41	110
3611.2	60.22	74	-13.78	40.22	54	-13.78	H	1.52	286
3611.2	65.50	74	-8.50	45.50	54	-8.50	V	1.51	198
4515.6	66.04	74	-7.96	46.04	54	-7.96	V	1.80	261
4515.6	65.46	74	-8.54	45.46	54	-8.54	H	1.74	166
5416.6	70.16	74	-3.84	50.16	54	-3.84	H	1.81	347
5416.6	73.69	74	-0.31	53.69	54	-0.31	V	1.85	231

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).

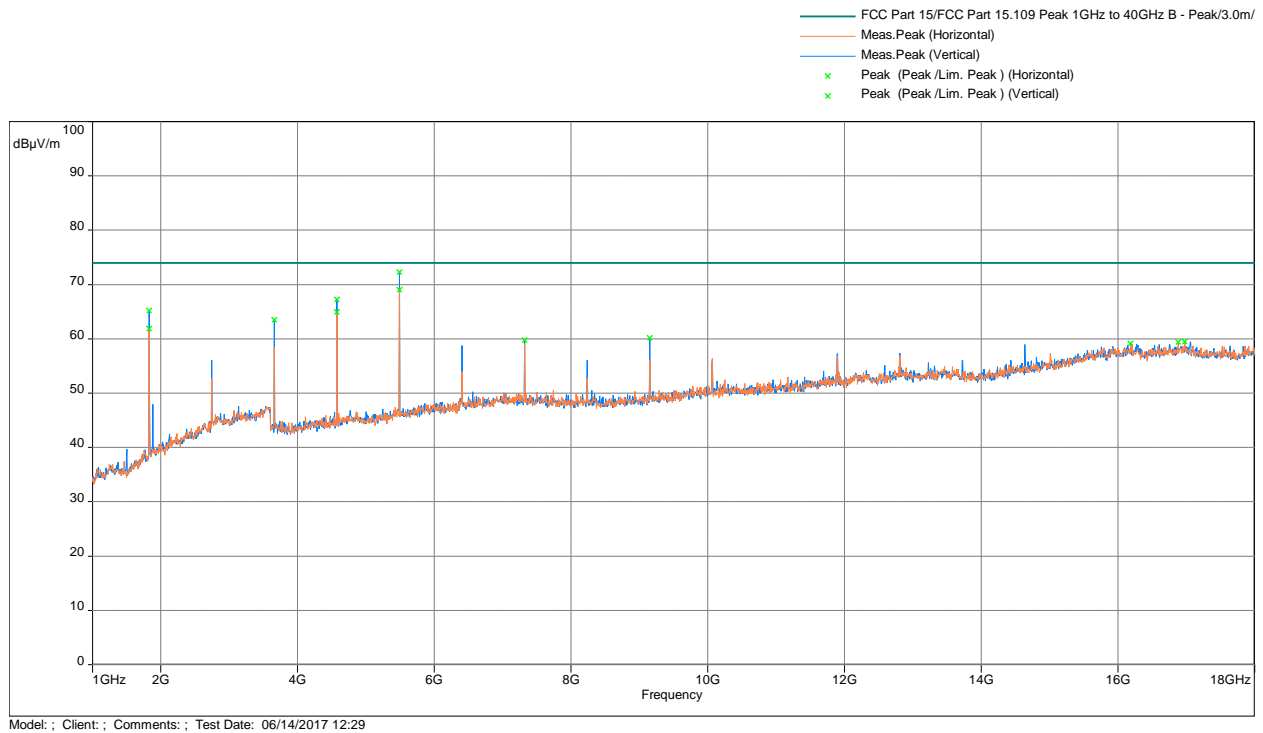
Test Results: 15.209 Radiated Spurious Emissions Mid Channel, Tx at 915MHz

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



Model: ; Client: ; Comments: ; Test Date: 03/24/2017 08:37

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

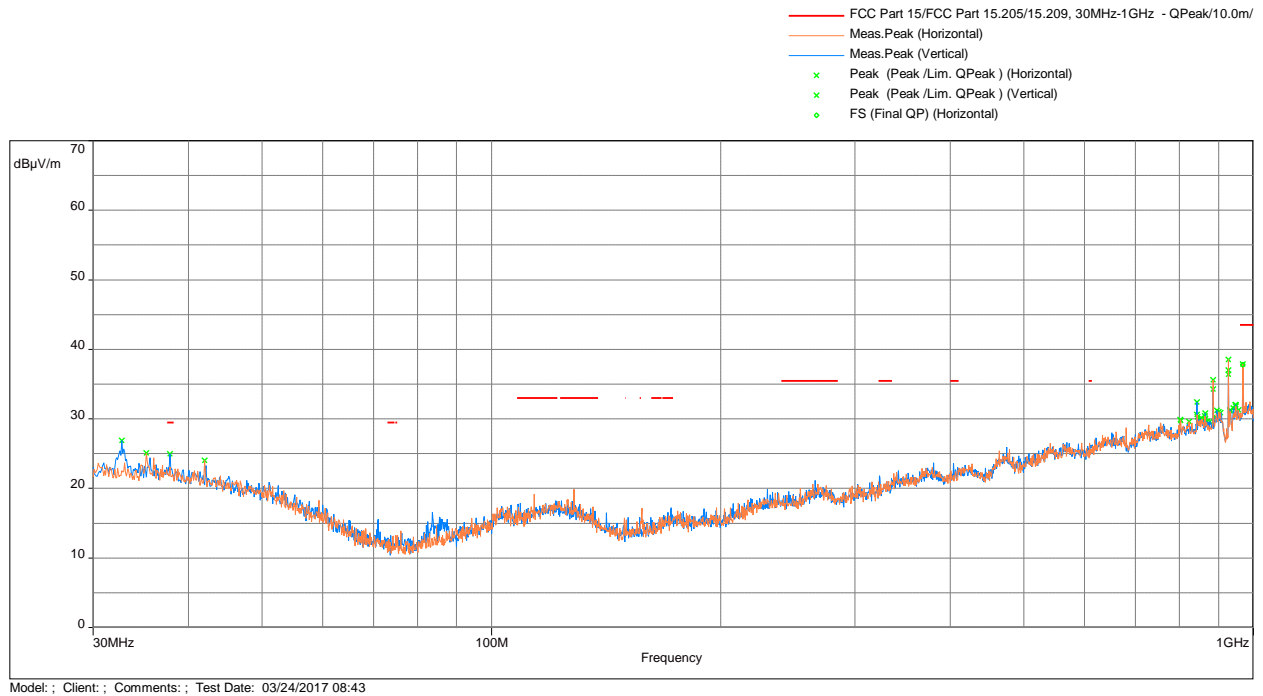


Frequency	Peak Amplitude	Peak Limit	Peak Margin	Avg Amplitude	Avg Limit	Avg Margin	Polarity	Height	Angle
MHz	dBμV/m	dBμV/m	dB	dBμV/m	dBμV/m	dB	H/V	m	°
1829.6	61.88	74	-12.12	41.88	54	-12.12	H	1.75	133
1829.6	65.17	74	-8.83	45.17	54	-8.83	V	1.84	107
3660.5	63.47	74	-10.53	43.47	54	-10.53	V	1.64	107
4575.1	64.92	74	-9.08	44.92	54	-9.08	H	1.75	282
4575.1	67.23	74	-6.77	47.23	54	-6.77	V	1.66	197
5488.0	69.01	74	-4.99	49.01	54	-4.99	H	1.51	251
5488.0	72.25	74	-1.75	52.25	54	-1.75	V	1.44	167
7318.9	59.70	74	-14.30	39.70	54	-14.30	V	1.91	18
9151.5	60.17	74	-13.83	40.17	54	-13.83	V	1.97	0
Test Result : Pass at 915 MHz									

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).

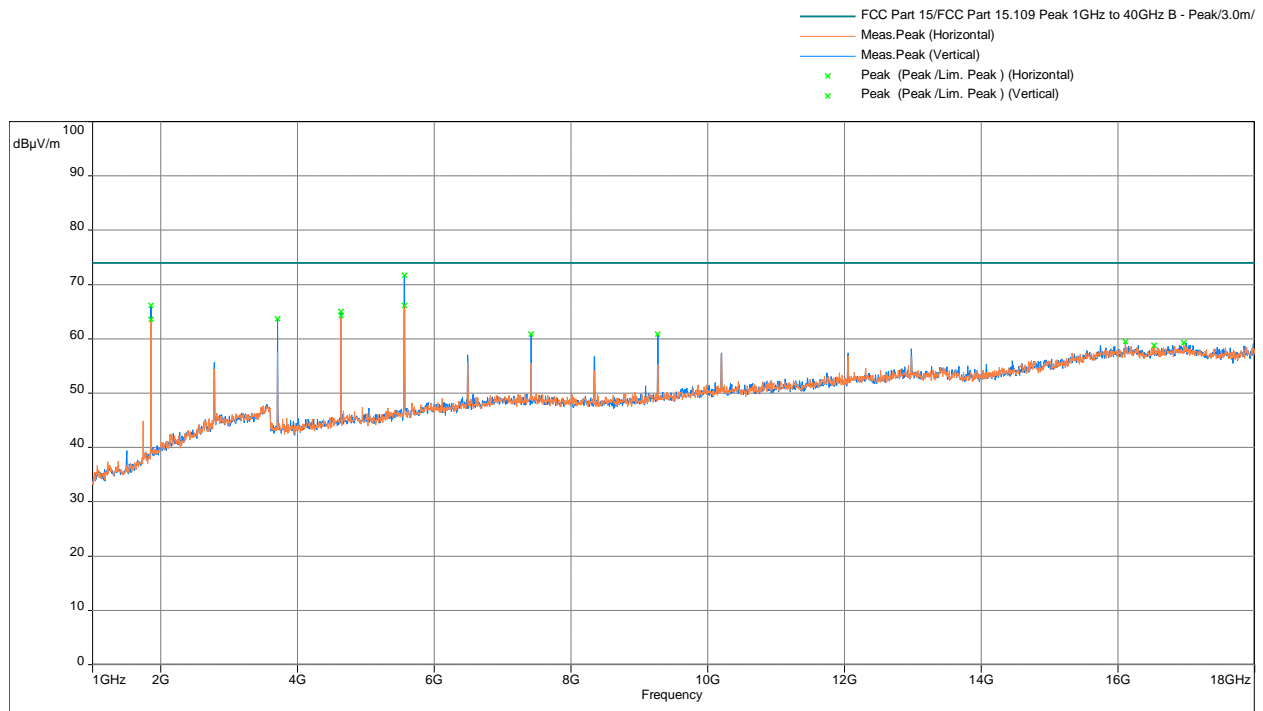
Test Results: 15.209 Radiated Spurious Emissions High Channel, Tx at 927MHz

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



Frequency	QP Field Strength	QP Limit	QP Margin	Azimuth	Height	Polarity	RA	Correction
MHz	dBμV/m	dB(uV/m)	dB	°	m		dBuV	(dB
968.653	37.78	43.5	-5.72	84.5	1.00	Horizontal	32.74	5.04

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



Model: ; Client: ; Comments: ; Test Date: 06/14/2017 12:32

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	63.58	74	-10.42	43.58	54	-10.42	H	1.80	148
1853.4	66.14	74	-7.86	46.14	54	-7.86	V	1.81	104
3706.4	63.67	74	-10.33	43.67	54	-10.33	V	1.75	104
4634.6	64.27	74	-9.73	44.27	54	-9.73	H	1.53	248
4634.6	64.99	74	-9.01	44.99	54	-9.01	V	1.94	195
5561.1	66.11	74	-7.89	46.11	54	-7.89	H	1.77	311
5561.1	71.69	74	-2.31	51.69	54	-2.31	V	1.75	165
7417.5	60.83	74	-13.17	40.83	54	-13.17	V	1.92	17
9268.8	60.81	74	-13.19	40.81	54	-13.19	V	1.64	17

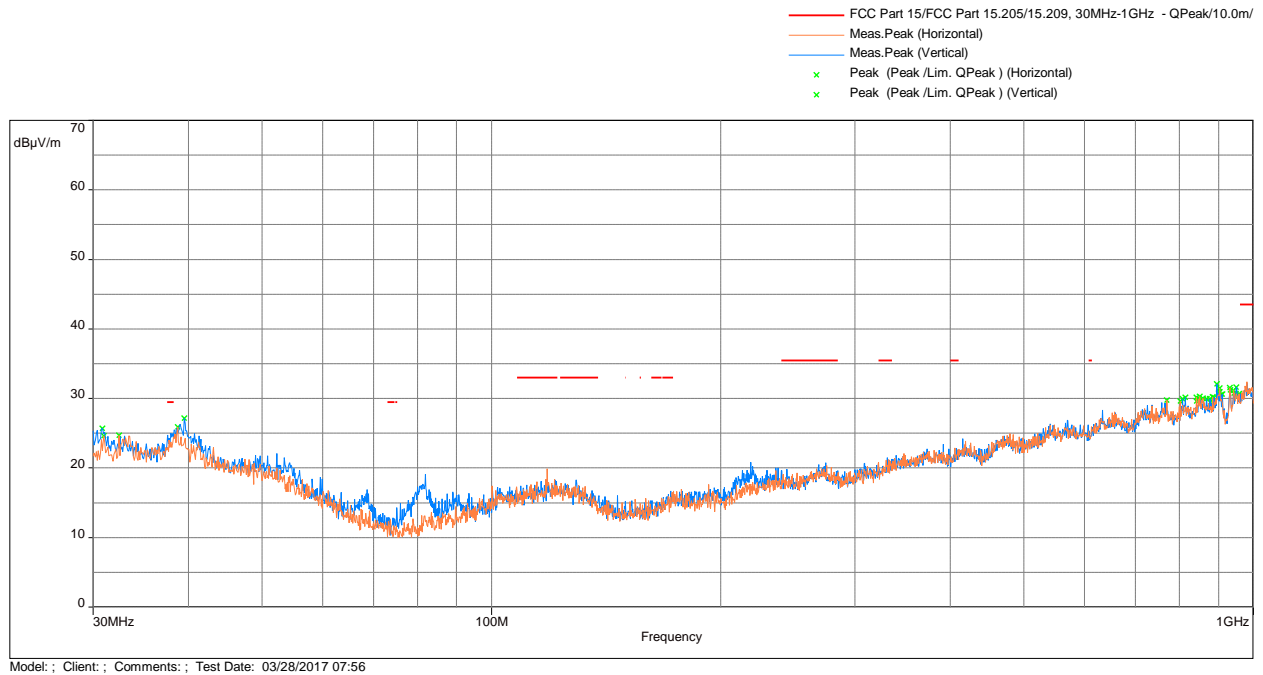
Test Result : **Pass** at 927 MHz

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).

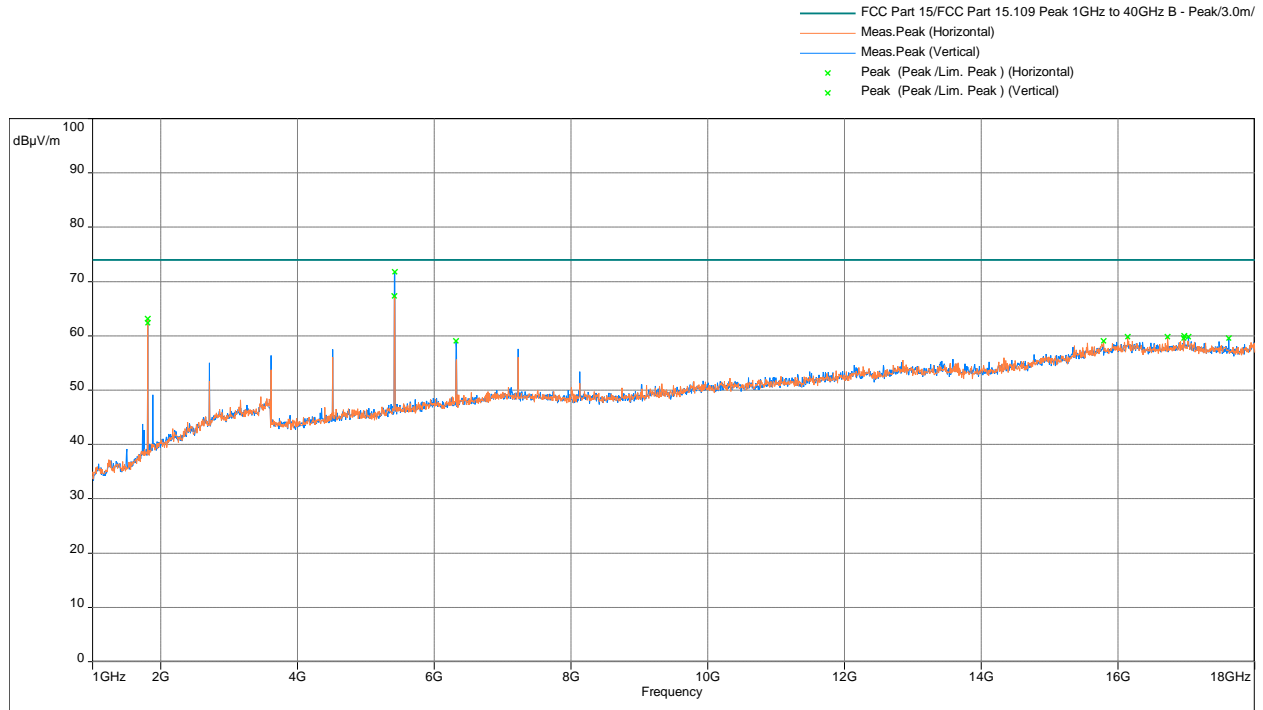
GPC20

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

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



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



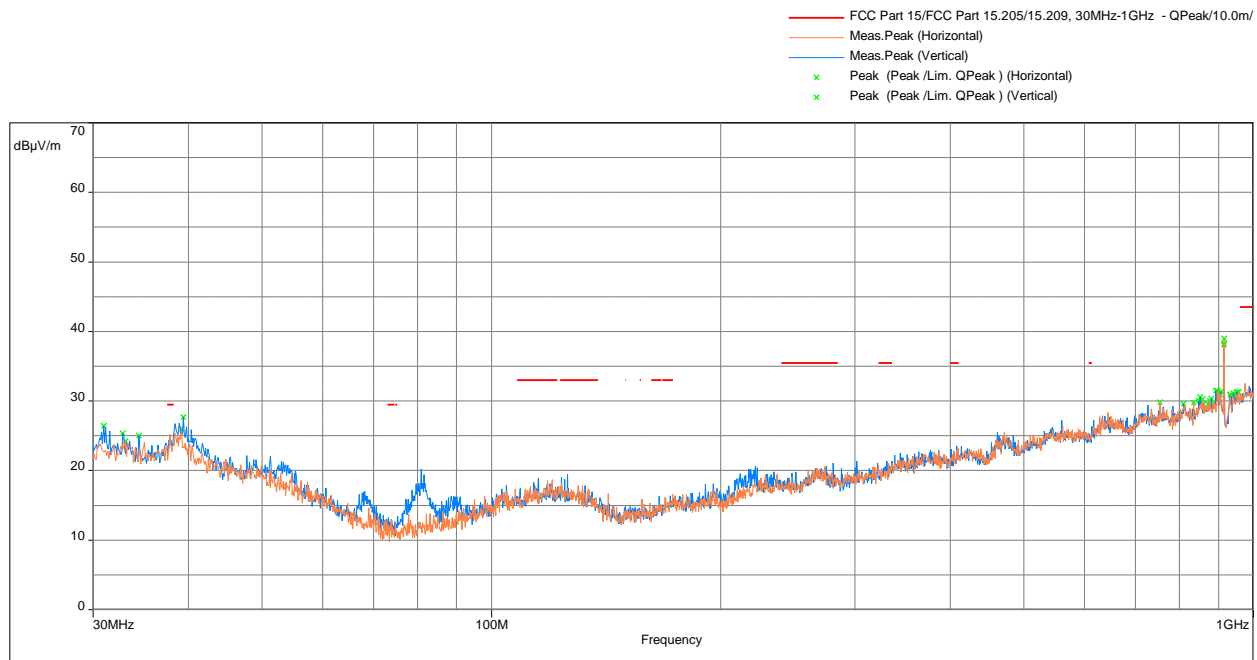
Frequency	Peak Amplitude	Peak Limit	Peak Margin	Avg Amplitude	Avg Limit	Avg Margin	Polarity	Height	Angle
MHz	dBμV/m	dBμV/m	dB	dBμV/m	dBμV/m	dB	H/V	m	°
1805.8	63.17	74	-10.83	43.17	54	-10.83	H	1.82	131
1805.8	62.40	74	-11.60	42.40	54	-11.60	V	1.81	197
5416.6	67.29	74	-6.71	47.29	54	-6.71	H	1.72	299
5418.3	71.72	74	-2.28	51.72	54	-2.28	V	1.74	274
6319.3	59.09	74	-14.91	39.09	54	-14.91	V	1.61	260

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).

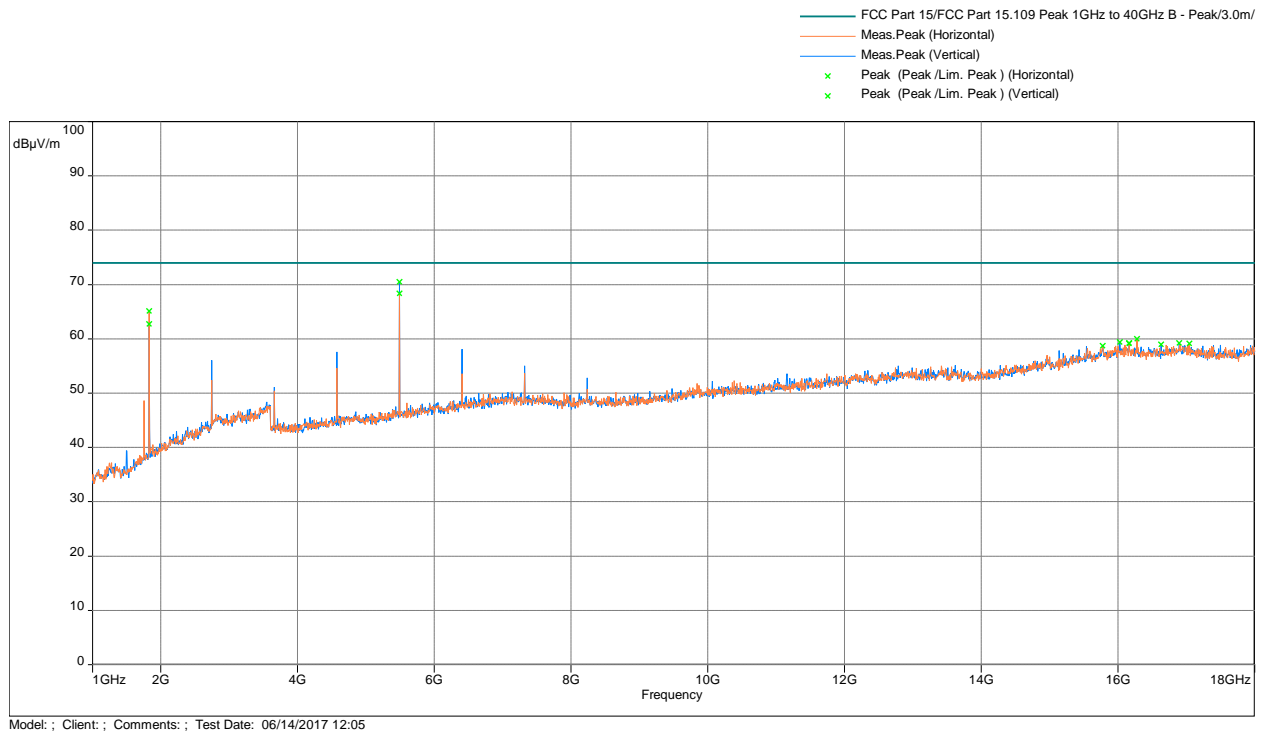
Test Results: 15.209 Radiated Spurious Emissions Mid Channel, Tx at 915MHz

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



Model: ; Client: ; Comments: ; Test Date: 03/28/2017 08:04

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



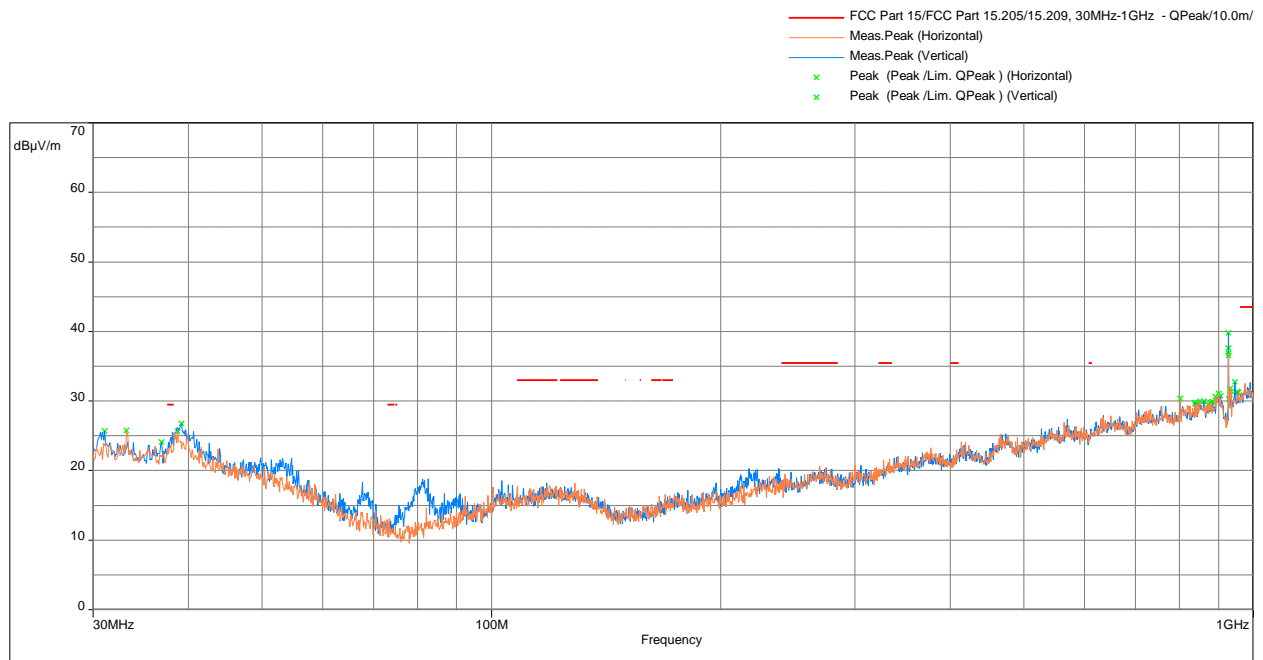
Frequency	Peak Amplitude	Peak Limit	Peak Margin	Avg Amplitude	Avg Limit	Avg Margin	Polarity	Height	Angle
MHz	dBμV/m	dBμV/m	dB	dBμV/m	dBμV/m	dB	H/V	m	°
1829.6	65.12	74	-8.88	45.12	54	-8.88	H	1.75	138
1829.6	62.68	74	-11.32	42.68	54	-11.32	V	1.82	192
5489.7	70.48	74	-3.52	50.48	54	-3.52	V	1.69	75
5489.7	68.35	74	-5.65	48.35	54	-5.65	H	1.77	318

Test Result : **Pass** at 915 MHz

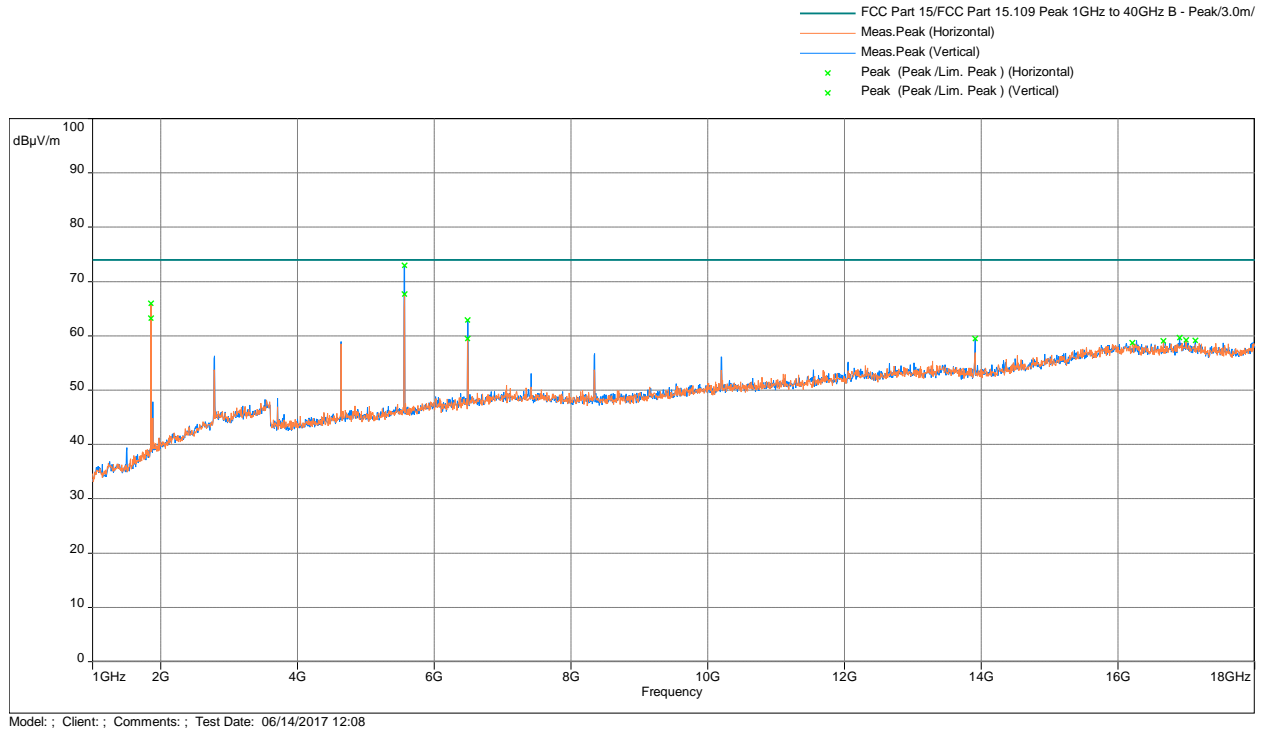
Note: The peaks showed are compliant with 15.209 Average limit (54dBuV/m) by applying Duty Cycle Correction Factor of 20dB (See Annex A for Duty Cycle calculation).

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

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



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

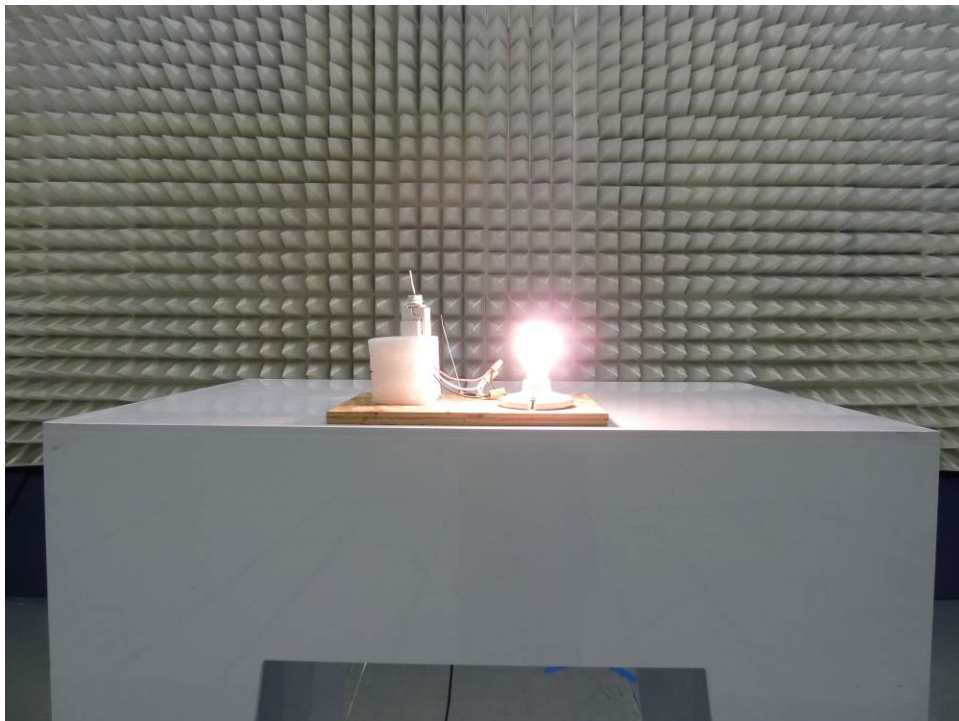


Frequency	Peak Amplitude	Peak Limit	Peak Margin	Avg Amplitude	Avg Limit	Avg Margin	Polarity	Height	Angle
MHz	dBμV/m	dBμV/m	dB	dBμV/m	dBμV/m	dB	H/V	m	°
1853.4	65.94	74	-8.06	45.94	54	-8.06	H	1.75	135
1853.4	63.20	74	-10.80	43.20	54	-10.80	V	1.74	196
5561.1	67.66	74	-6.34	47.66	54	-6.34	H	1.82	308
5562.8	72.99	74	-1.01	52.99	54	-1.01	V	1.81	77
6487.6	62.85	74	-11.15	42.85	54	-11.15	V	1.61	284
6489.3	59.47	74	-14.53	39.47	54	-14.53	H	1.69	340

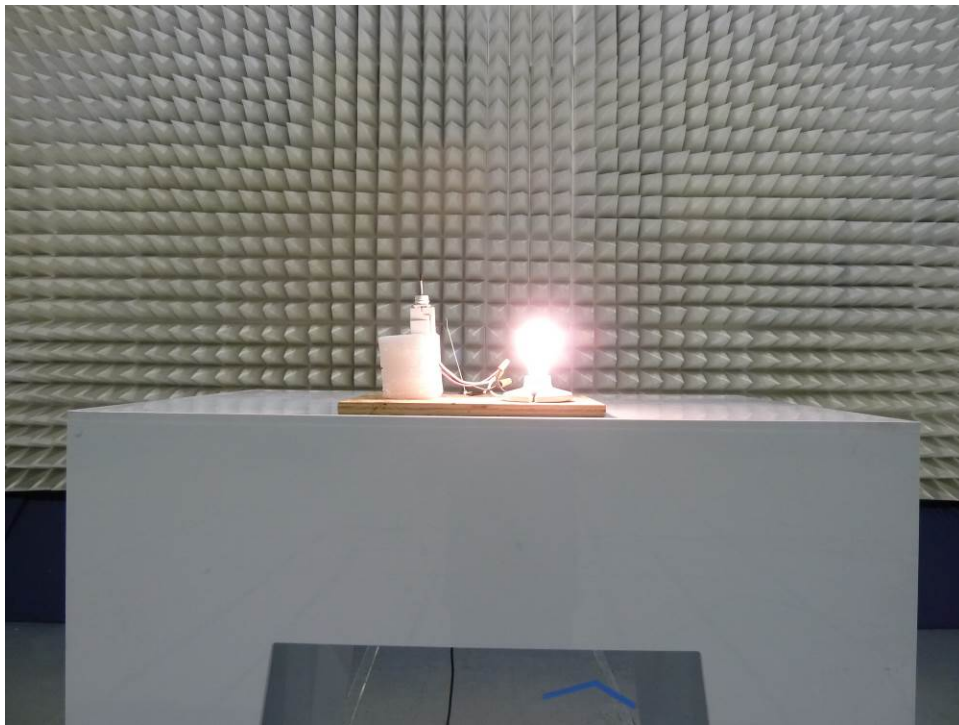
Test Result : **Pass** at 927 MHz

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).

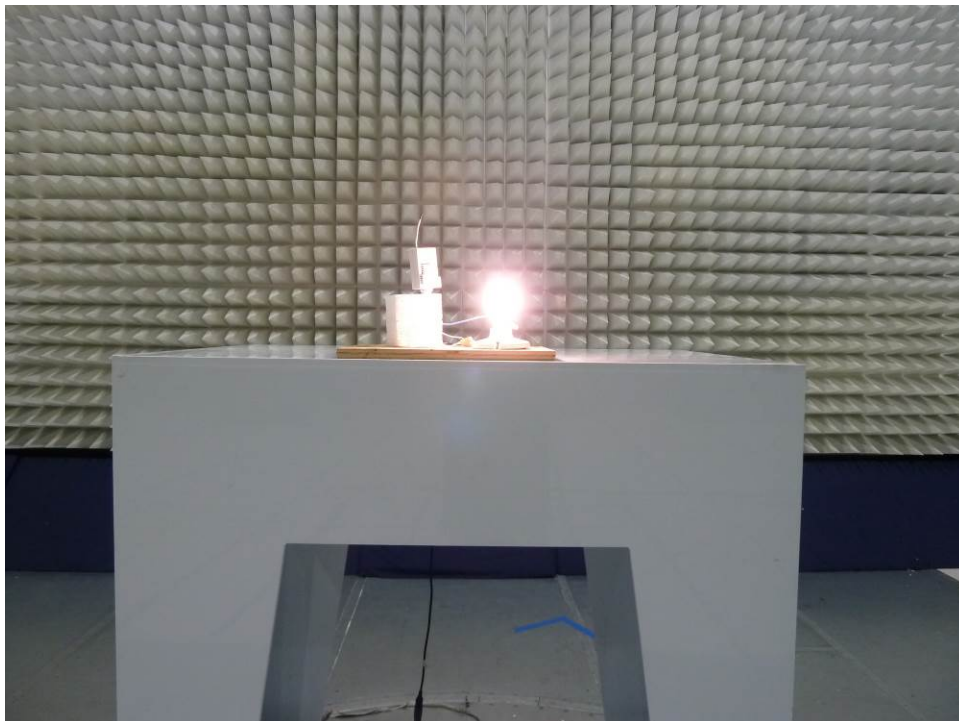
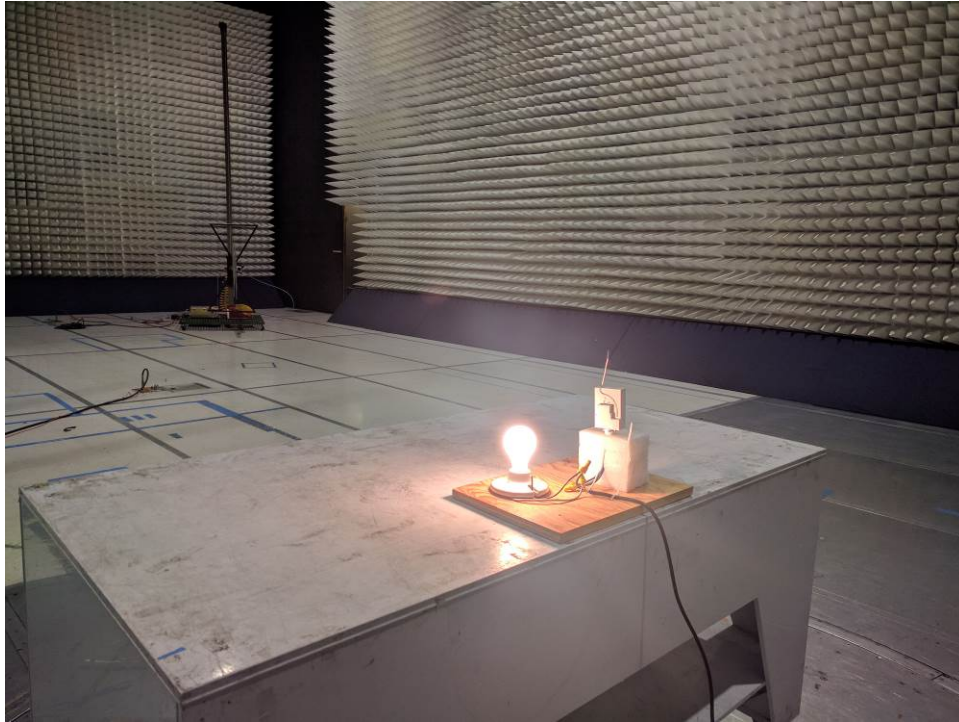
4.5.5 Test Setup Photographs



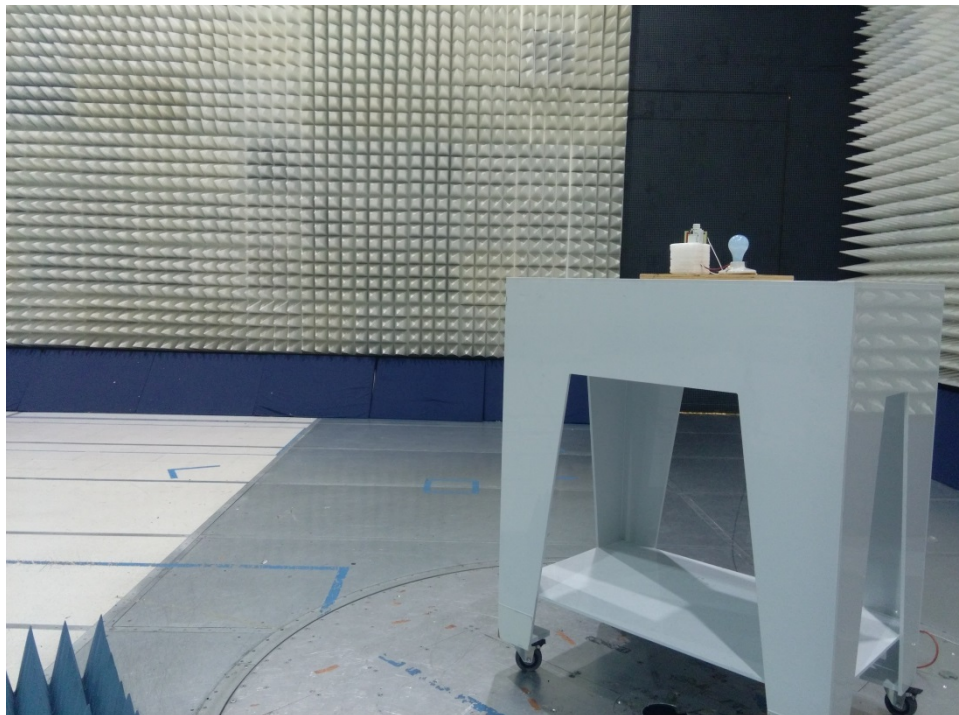
4.5.8 Test Setup Photographs (Continued)



4.5.8 Test Setup Photographs (Continued)



4.5.8 Test Setup Photographs (Continued)



4.6 AC Line Conducted Emission FCC: 15.207

4.6.1 Requirement

Frequency Band MHz	FCC 15.207 Limit dB(μV)	
	Quasi-Peak	Average
0.15-0.50	66 to 56 *	56 to 46 *
0.50-5.00	56	46
5.00-30.00	60	50

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

4.6.2 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.

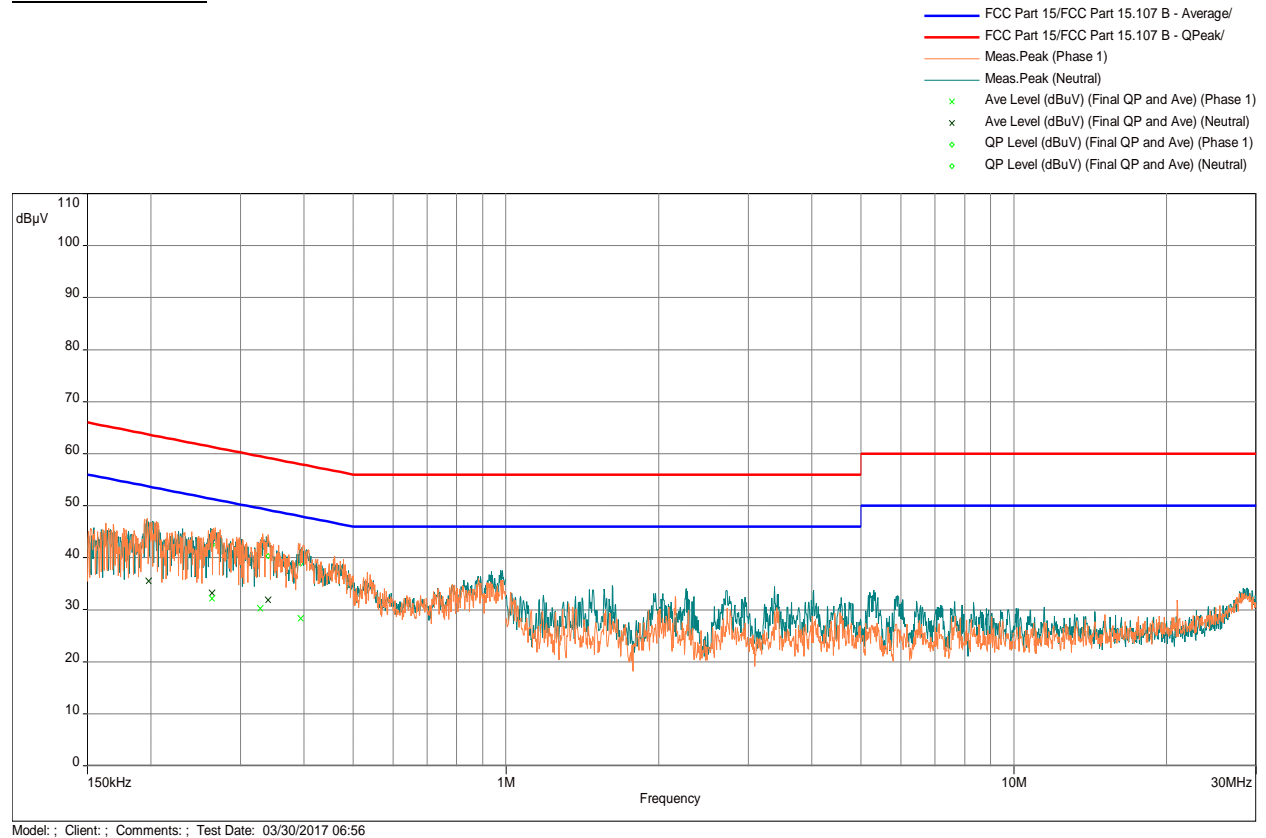
Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

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

Tested By:	Anderson Soungpanya
Test Date:	March 30, 2017

4.6.3 Test Results

The EUT met the conducted disturbance requirement of FCC 15.207 with the transmitter on.
GC10 & GPC10

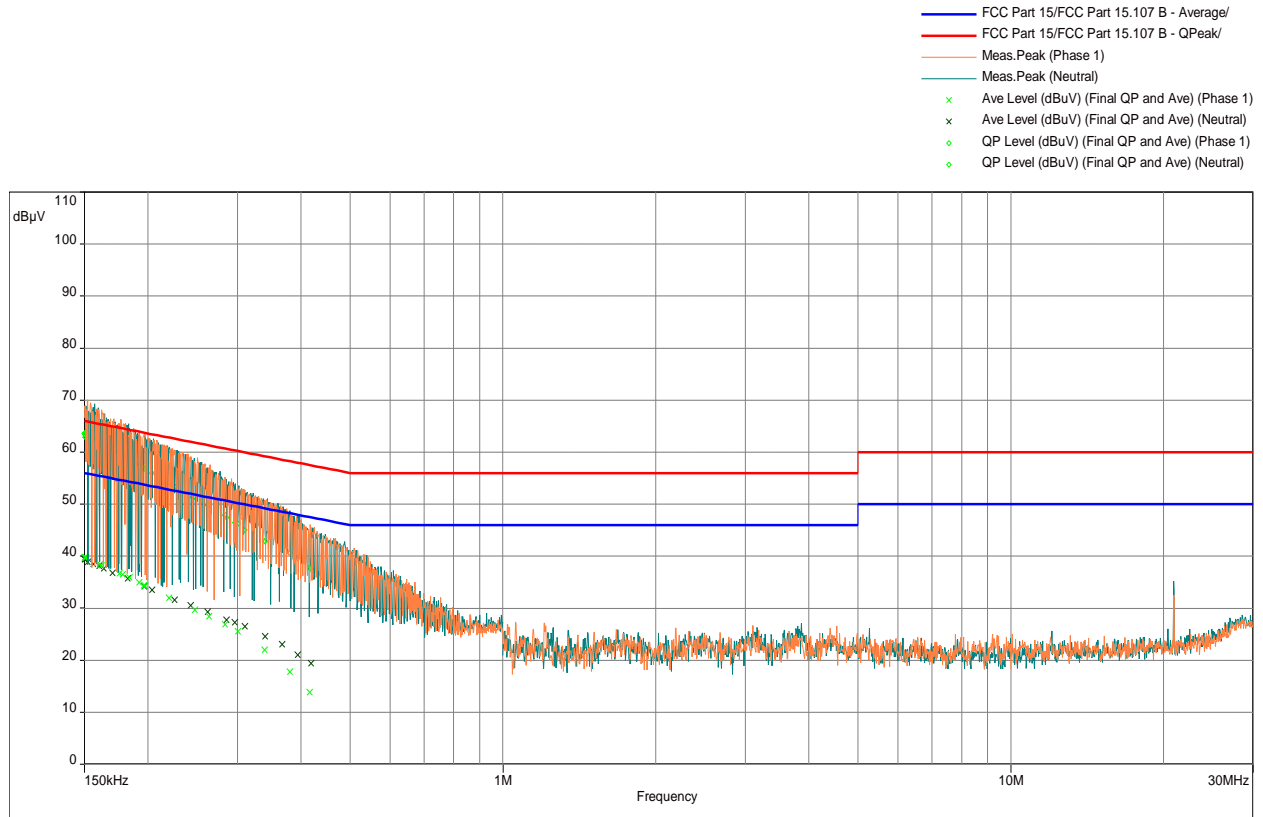


Frequency (MHz)	Ave Level (dBμV)	QP Level (dBμV)	Ave Limit (dBμV)	QP Limit (dBμV)	Ave Margin (dB)	QP Margin (dB)	Line	Correction (dB)
0.263	32.19	42.72	51.32	61.32	-19.13	-18.60	Phase 1	11.07
0.328	30.28	41.00	49.49	59.49	-19.21	-18.49	Phase 1	11.10
0.394	28.34	38.83	47.97	57.97	-19.63	-19.14	Phase 1	11.10
0.197	35.53	44.75	53.70	63.70	-18.17	-18.96	Neutral	11.05
0.263	33.24	42.36	51.32	61.32	-18.08	-18.96	Neutral	11.07
0.339	31.88	40.34	49.20	59.20	-17.33	-18.87	Neutral	11.10

Results: Complies by 17.33 dB at 120V 60Hz

4.6.3 Test Results (Continued)

GDT15 & GPDT15



Model: ; Client: ; Comments: ; Test Date: 03/30/2017 08:11

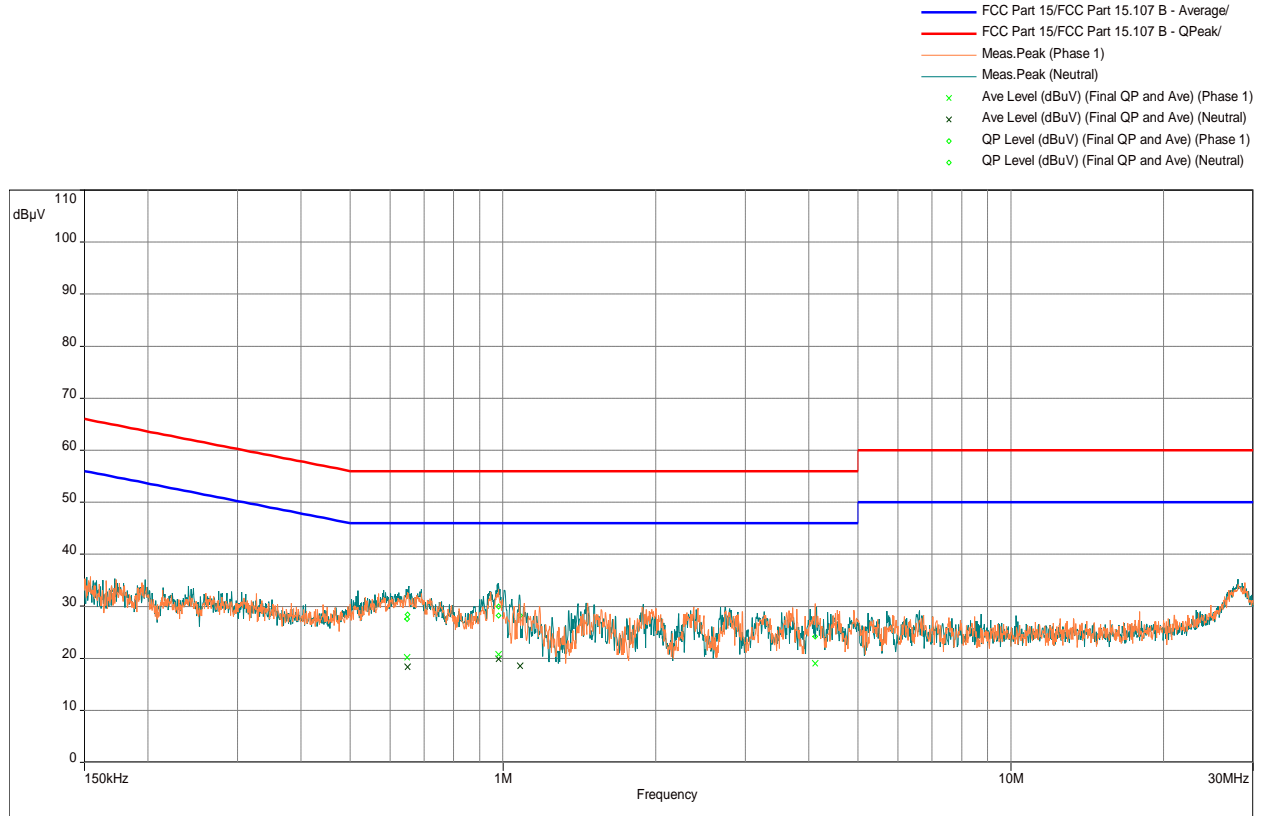
Frequency (MHz)	Ave Level (dBuV)	QP Level (dBuV)	Ave Limit (dBuV)	QP Limit (dBuV)	Ave Margin (dB)	QP Margin (dB)	Line	Correction (dB)
0.150	39.79	63.62	56.00	66.00	-16.21	-2.38	Phase 1	11.02
0.151	39.76	62.92	55.97	65.97	-16.21	-3.05	Phase 1	11.02
0.151	39.75	62.92	55.96	65.96	-16.21	-3.05	Phase 1	11.02
0.151	39.71	63.47	55.95	65.95	-16.24	-2.48	Phase 1	11.02
0.161	38.40	61.89	55.43	65.43	-17.03	-3.55	Phase 1	11.03
0.162	38.25	61.66	55.36	65.36	-17.11	-3.70	Phase 1	11.03
0.176	36.67	59.72	54.69	64.69	-18.02	-4.97	Phase 1	11.03
0.178	36.48	59.48	54.56	64.56	-18.08	-5.08	Phase 1	11.03
0.184	35.89	58.73	54.31	64.31	-18.42	-5.58	Phase 1	11.04
0.192	34.91	57.73	53.93	63.93	-19.02	-6.20	Phase 1	11.05
0.196	34.39	57.14	53.76	63.76	-19.37	-6.62	Phase 1	11.05
0.198	34.29	56.75	53.71	63.71	-19.42	-6.96	Phase 1	11.05
0.220	31.98	54.21	52.82	62.82	-20.84	-8.61	Phase 1	11.06

0.248	29.68	51.45	51.84	61.84	-22.16	-10.39	Phase 1	11.06
0.264	28.45	49.87	51.31	61.31	-22.87	-11.44	Phase 1	11.07
0.284	26.90	47.88	50.71	60.71	-23.81	-12.83	Phase 1	11.09
0.301	25.56	46.25	50.23	60.23	-24.67	-13.98	Phase 1	11.10
0.340	21.99	42.88	49.21	59.21	-27.23	-16.34	Phase 1	11.10
0.380	17.72	40.61	48.27	58.27	-30.55	-17.66	Phase 1	11.10
0.416	13.80	37.81	47.52	57.52	-33.73	-19.72	Phase 1	11.10
0.150	39.46	63.59	56.00	66.00	-16.54	-2.41	Neutral	11.02
0.150	39.36	63.50	55.98	65.98	-16.62	-2.48	Neutral	11.02
0.152	38.93	63.07	55.88	65.88	-16.95	-2.81	Neutral	11.02
0.156	38.47	62.47	55.67	65.67	-17.20	-3.20	Neutral	11.02
0.160	38.10	61.96	55.45	65.45	-17.36	-3.50	Neutral	11.03
0.164	37.67	61.34	55.28	65.28	-17.61	-3.94	Neutral	11.03
0.170	36.80	60.29	54.95	64.95	-18.15	-4.66	Neutral	11.03
0.183	35.76	58.81	54.36	64.36	-18.60	-5.56	Neutral	11.04
0.197	34.22	56.83	53.74	63.74	-19.52	-6.92	Neutral	11.05
0.204	33.52	55.95	53.45	63.45	-19.94	-7.50	Neutral	11.06
0.225	31.62	53.42	52.61	62.61	-20.99	-9.19	Neutral	11.06
0.243	30.53	51.71	52.00	62.00	-21.48	-10.29	Neutral	11.06
0.262	29.25	49.78	51.36	61.36	-22.11	-11.58	Neutral	11.07
0.286	27.78	47.43	50.64	60.64	-22.86	-13.21	Neutral	11.09
0.296	27.27	46.48	50.35	60.35	-23.08	-13.87	Neutral	11.10
0.311	26.46	45.06	49.96	59.96	-23.50	-14.89	Neutral	11.10
0.341	24.57	42.77	49.19	59.19	-24.62	-16.42	Neutral	11.10
0.367	23.01	41.26	48.57	58.57	-25.55	-17.30	Neutral	11.10
0.394	21.07	39.68	47.98	57.98	-26.91	-18.30	Neutral	11.10
0.419	19.36	37.55	47.48	57.48	-28.11	-19.93	Neutral	11.10

Results: Complies by 2.41dB at 120V 60Hz
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4.6.3 Test Results (Continued)

GPC20

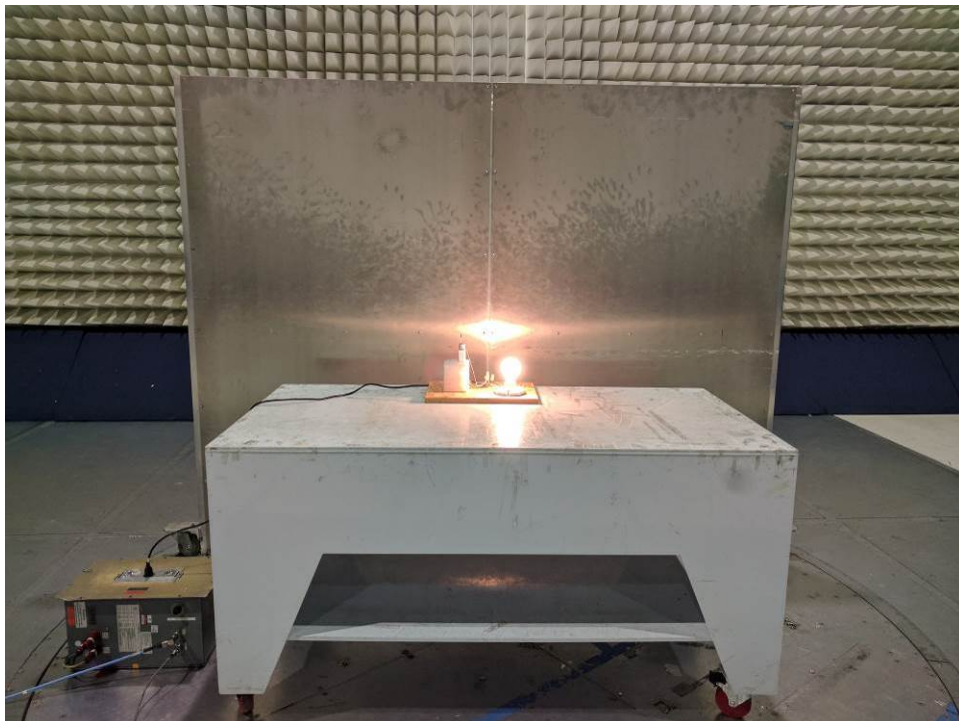


Model: ; Client: ; Comments: ; Test Date: 03/30/2017 07:26

Frequency (MHz)	Ave Level (dBμV)	QP Level (dBμV)	Ave Limit (dBμV)	QP Limit (dBμV)	Ave Margin (dB)	QP Margin (dB)	Line	Correction (dB)
0.647	20.14	27.6	46	56	-25.86	-28.40	Phase 1	11.10
0.980	20.74	28.24	46	56	-25.26	-27.76	Phase 1	11.14
4.116	18.99	24.19	46	56	-27.01	-31.81	Phase 1	11.27
0.648	18.35	28.41	46	56	-27.65	-27.59	Neutral	11.10
0.981	19.88	29.98	46	56	-26.12	-26.02	Neutral	11.14
1.079	18.50	28.18	46	56	-27.50	-27.82	Neutral	11.14

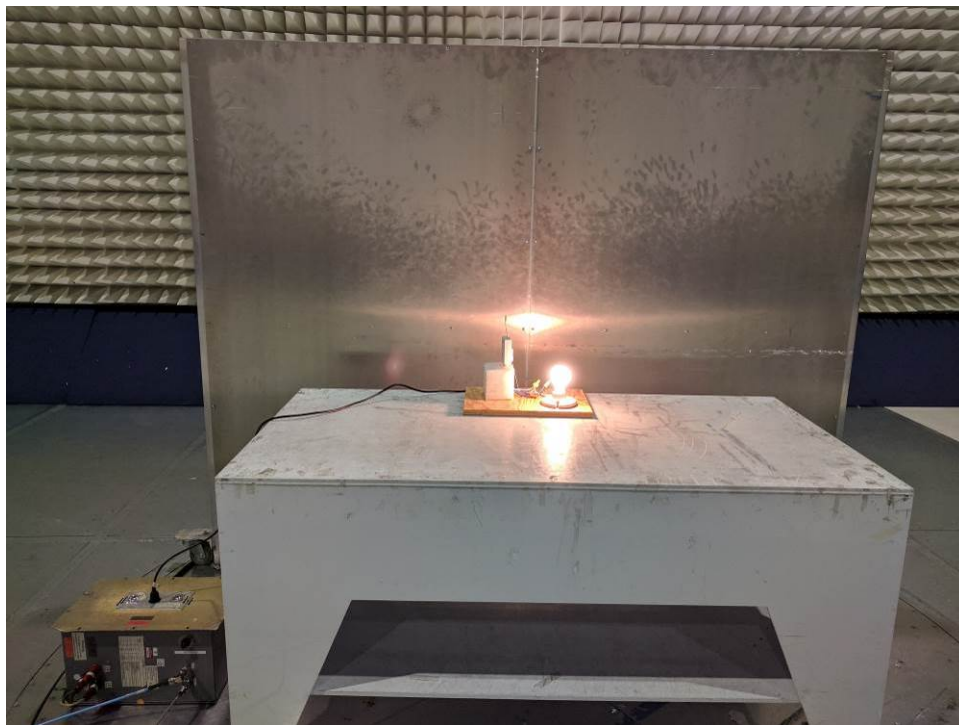
Results: Complies by 25.26 at 120V 60Hz

4.6.4 Test Configuration Photographs



AC Mains Line-Conducted Disturbance Setup Photograph

4.6.4 Test Configuration Photographs (Continued)



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 13, 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)

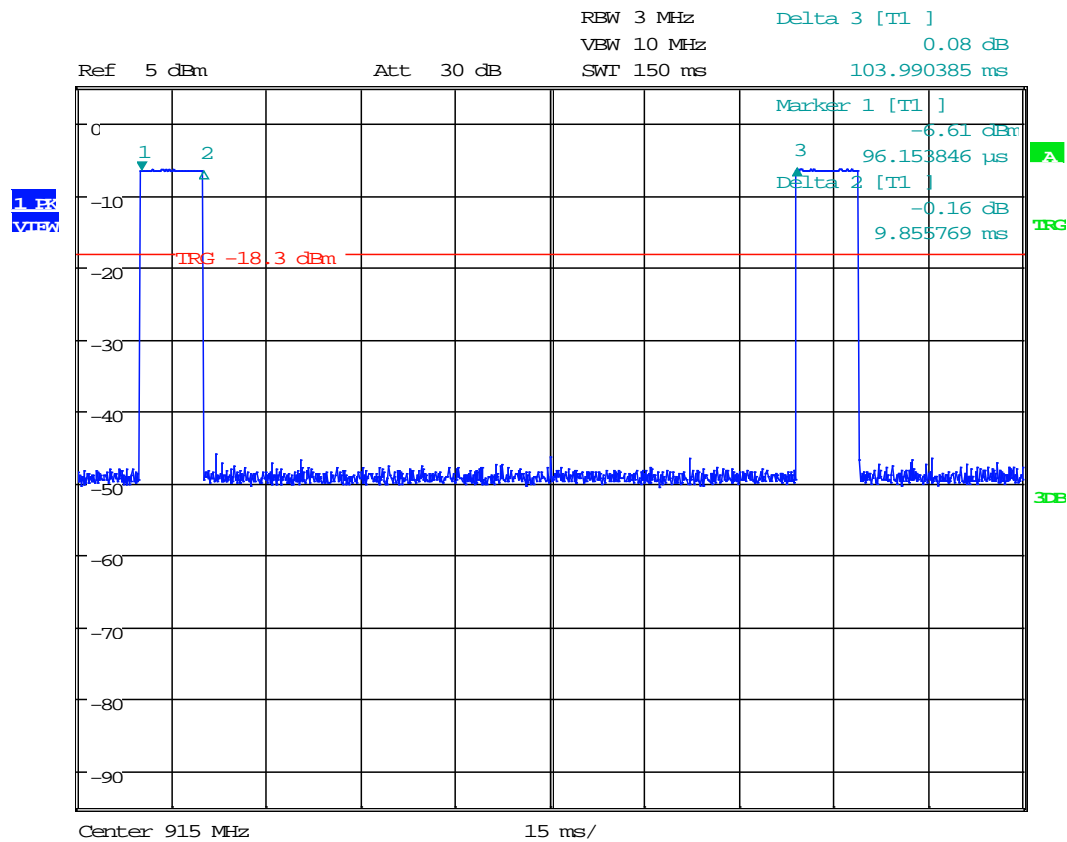
Δ is the duty cycle (dimensionless)

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

GC10 & GPC10

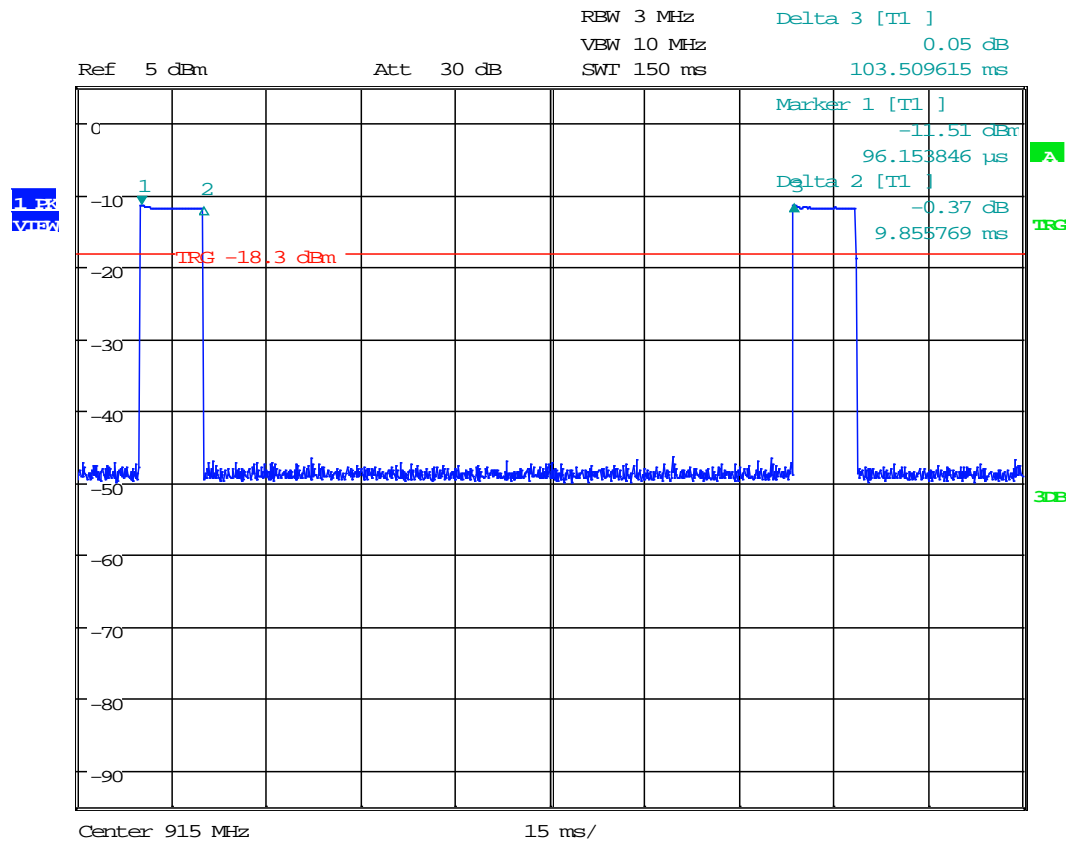


Date: 27.JUN.2017 09:42:37

Duty Cycle: $DC = 9.86 / 100 = 0.0986$ or 9.86%

Duty Cycle Correction Factor δ (dB) = $20 \log (0.0986) = -20.1$ dB

GDT15 & GPDT15

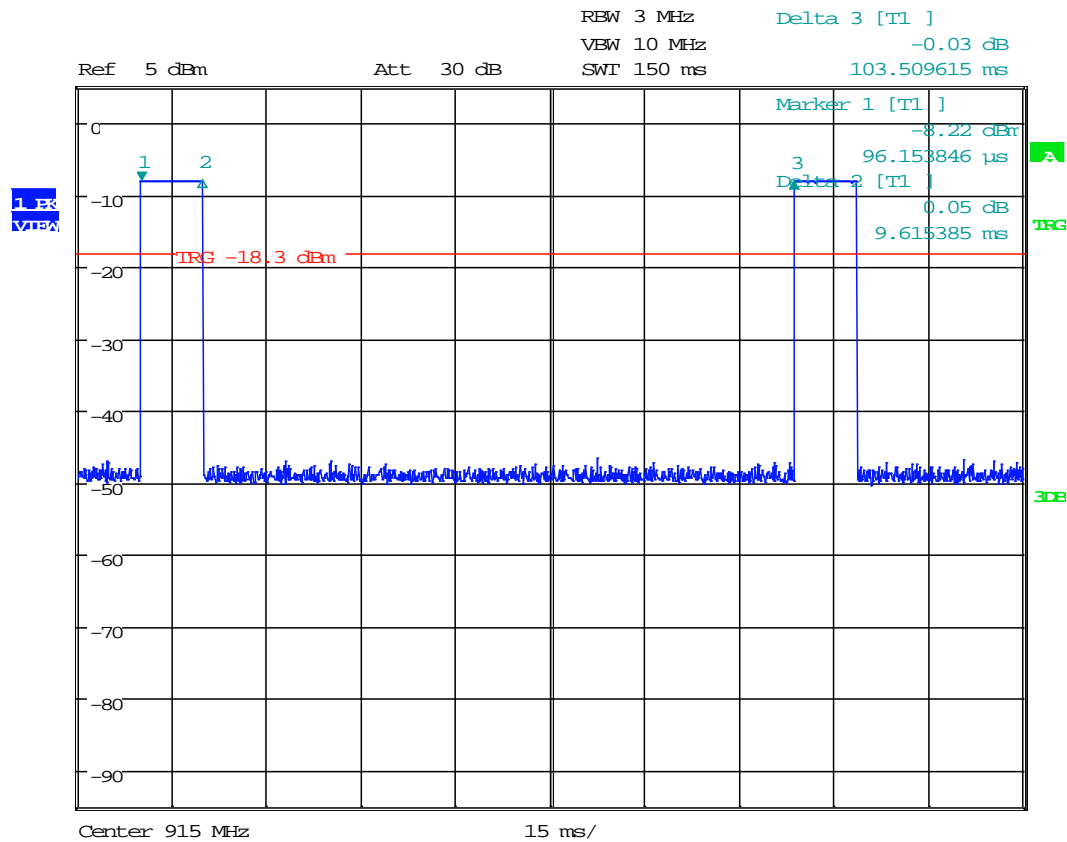


Date: 27.JUN.2017 10:32:33

Duty Cycle: $DC = 9.86 / 100 = 0.0986$ or 9.86%

Duty Cycle Correction Factor δ (dB) = $20 \log (0.0986) = -20.1$ dB

GPC20



Date: 27.JUN.2017 10:30:10

Duty Cycle: $DC = 9.62/100 = 0.0962$ or 9.62%

Duty Cycle Correction Factor δ (dB) = $20 \log (0.0962) = -20.3$ dB