TEST REPORT

Report Number: 103930307MPK-001
Project Number: G103930307
August 20, 2019

Testing performed on the
Connected AC Android Control Module
Model: AP6255

FCC ID: 2AHLA-SP01500243
IC: 4811A-SP01500243

to

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

For

Bosch Automotive Service Solutions, Inc.

Test Performed by:	Test Authorized by:
Intertek	Bosch Automotive Service Solutions, Inc
1365 Adams Court	655 Eisenhower Dr
Menlo Park, CA 94025 USA	Owatonna, MN 55060 USA

Prepared by: _____ **Date:** August 20, 2019
Todd Moy

Reviewed by: _____ **Date:** August 20, 2019
Krishna K Vemuri

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Report No. 103930307MPK-001	
Equipment Under Test:	Connected AC Android Control Module
Trade Name:	Bosch Automotive Service Solutions, Inc.
Model Number:	AP6255
Part Number:	CBA-G19-UBS2
Applicant:	Bosch Automotive Service Solutions, Inc.
Contact:	Bill Brown
Address:	Bosch Automotive Service Solutions, Inc. 655 Eisenhower Dr Owatonna, MN 55060 USA
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Applicable Regulation:	FCC Part 15 Subpart C (15.247) Industry Canada RSS-247 Issue 2
Date of Test:	June 24-July 25, 2019

We attest to the accuracy of this report:

Todd Moy
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 (Unique Connector Antenna)
RF Exposure	15.247(i), 2.1093(d)	RSS-102	Complies

EUT receive date: June 24, 2019

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: June 24, 2019

Test completion date: August 20, 2019

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

2.0 General Information

2.1 Product Description

Bosch Automotive Service Solutions, Inc. supplied the following description of the EUT:

The module is a single board computer with Rockchip ARM Cortex-A17 CPU, Quad core processor

Features:

- On Board DDR3L 935MHz, 2GB
- Wi-Fi, IEEE 802.11a/b/g/n/ac dual-band radio with virtual-simultaneous dual-band operation
- Bluetooth, V4.2+EDR with integrated PA for Class 1.5 and Low Energy (BLE)
- On Board eMMC, 64GB
- 1 xmicro-SD
- 1 RS232
- 2 2W speaker outputs
- 2 USB 2.0 Host, 1 USB OTG 2.0
- 1 LVDS Output
- 1 Capacitive touchscreen input

For more information, see user's manual provided by the manufacturer.

This test report covers only the 2.4GHz WiFi radio.

Information about the WiFi radio is presented below:

The EUT supports a wide range of data rates in the 2.4GHz band:
IEEE 802.11b
IEEE 802.11g
IEEE 802.11n

Radio Information	
Applicant	Bosch Automotive Service Solutions, Inc.
Model Number	AP6255
FCC Identifier	2AHLA-SP01500243
IC Identifier	4811A-SP01500243
Modulation Technique	DSSS (BPSK, QPSK, CCK), OFDM (BPSK, QPSK, 16QAM, 64QAM)
Rated RF Output	802.11b: 10.36 dBm 802.11g: 12.38 dBm 802.11n: 10.09 dBm
Frequency Range	2412 – 2462 MHz, 802.11b/g/n
Type of modulation	BPSK, QPSK, 16QAM, 64QAM
Number of Channel(s)	11 for 802.11b/g/n
Antenna(s) & Gain	Antenna with Unique Connector, Peak Gain: 5 dBi
Applicant Name & Address	Bosch Automotive Service Solutions, Inc. 655 Eisenhower Dr. Owatonna, MN 55060 USA

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 v05r02), and RSS-247 Issue 2, RSS-GEN Issue 5.

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

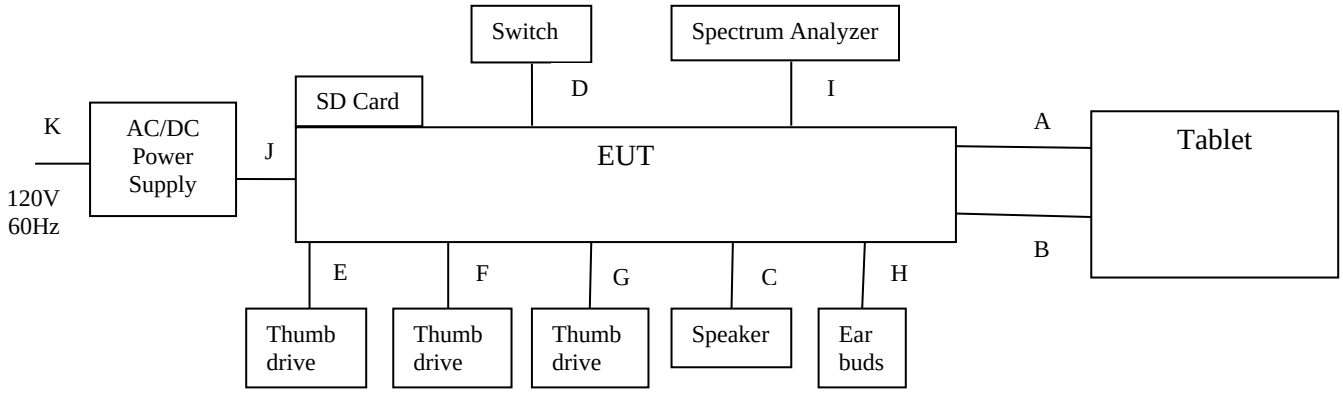
Support Equipment		
Description	**Manufacturer**	**Model Number**
Tablet	OSD DISPLAYS	OSD101T3990-81TS
Power Supply	XP POWER LLC	ECS130US12-XE1141
Thumb drive	Freescale	-
Thumb drive	HP	-
Thumb drive	Kingston	-
Speaker	Visaton	FR 58
Earbuds	-	-
Switch	-	-
SD Memory Card	-	-

Cables					
ID	**Description**	**Length (m)**	**Shielding**	**Ferrites**	**Termination**
A	Ribbon Cable	0.1	No	No	Tablet
B	Ribbon Cable	0.1	No	No	Tablet
C	Power Cable	0.6	No	No	Speaker
D	Power Cable	0.6	No	No	Switch
E	Micro-USB to USB	0.6	Yes	No	Thumb drive
F	USB Extender	0.6	Yes	No	Thumb drive
G	USB Extender	0.6	Yes	No	Thumb drive
H	Headphone Extender	0.4	No	No	Earbuds
I	SMA Cable	0.2	Yes	No	EUT
J	DC Power Cable	0.5	No	No	Power Supply
K	AC Power Cable	2.0	No	No	Power Supply

3.2 Block Diagram of Test Setup

Equipment Under Test			
Description	**Manufacturer**	**Part Number**	**Serial Number (LOT Number)**
Connected AC Android Control Module	Bosch Automotive Service Solutions, Inc	CBA-G19-UBS2	209498-1-010

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



3.3 Justification

Preliminary testing was performed for all modulation/data rate modes. The worse-case data rate with highest power and widest spectrum were selected for final measurements:

CCK 1 Mbps – for 802.11b
OFDM 6 Mbps – for 802.11g
OFDM MCS0 – for 802.11n

Different orientation of the EUT were tested and only the worse-case emissions were reported.

For radiated emission measurements the EUT is placed on a non-conductive table.

3.4 Software Exercise Program

The software "Ampak RFTestTool, VER 5.7" was used to exercise the EUT. The software was provided by Bosch Automotive Service Solutions, Inc.

3.5 Mode of Operation During Test

During transmitter testing, the transmitter was setup to transmit continuously using the maximum RF power setting provided by the manufacturers via test scripts. The corresponding output power in dBm can be found in section 4.2 of this report.

3.6 Modifications Required for Compliance

No modifications were made by the manufacturer or Intertek to the EUT in order to bring the EUT into compliance.

3.7 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 KDB 558074 D01 Meas Guidance v05 was used to determine the DTS occupied bandwidth. Section 11.8.1 Option 1 of ANSI 63.10 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.

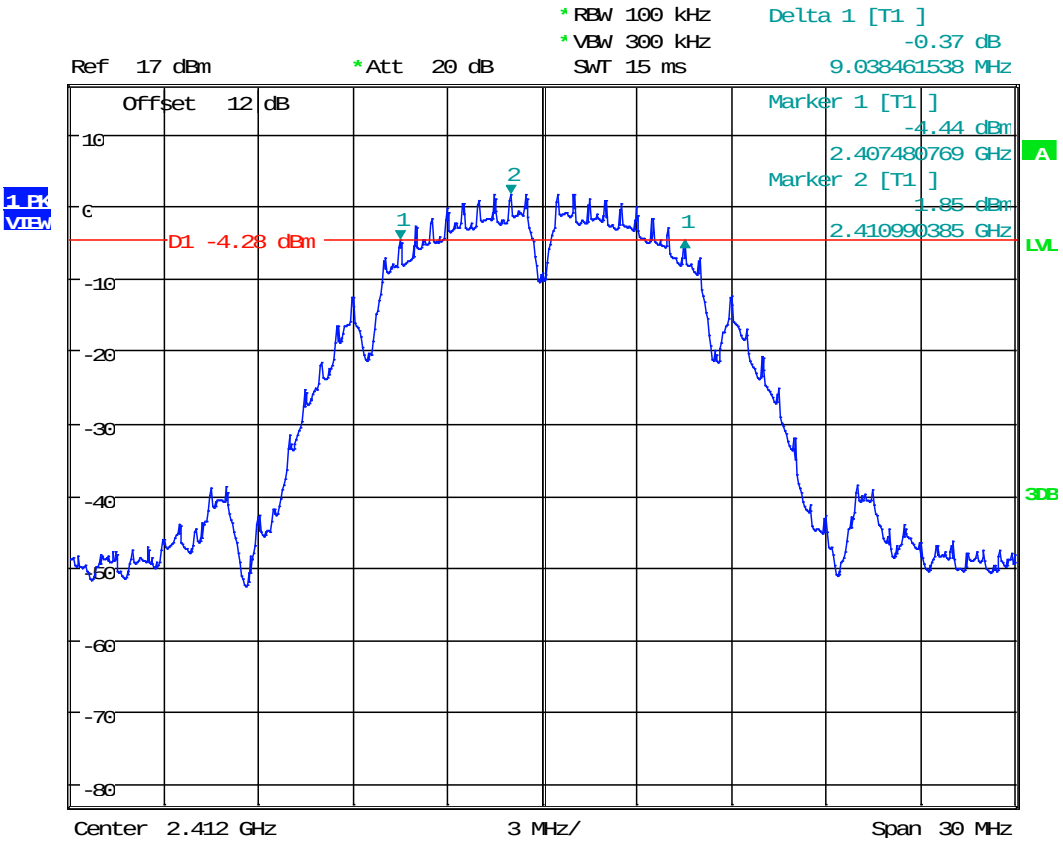
For 99% power bandwidth measurement, the bandwidth was determined by using the built-in 99% occupied bandwidth function of the spectrum analyzer. The resolution bandwidth is set to 1% of the selected span as is without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth.

Tested By	Test Date
Todd Moy	June 25, 2019

4.1.3 Test Result

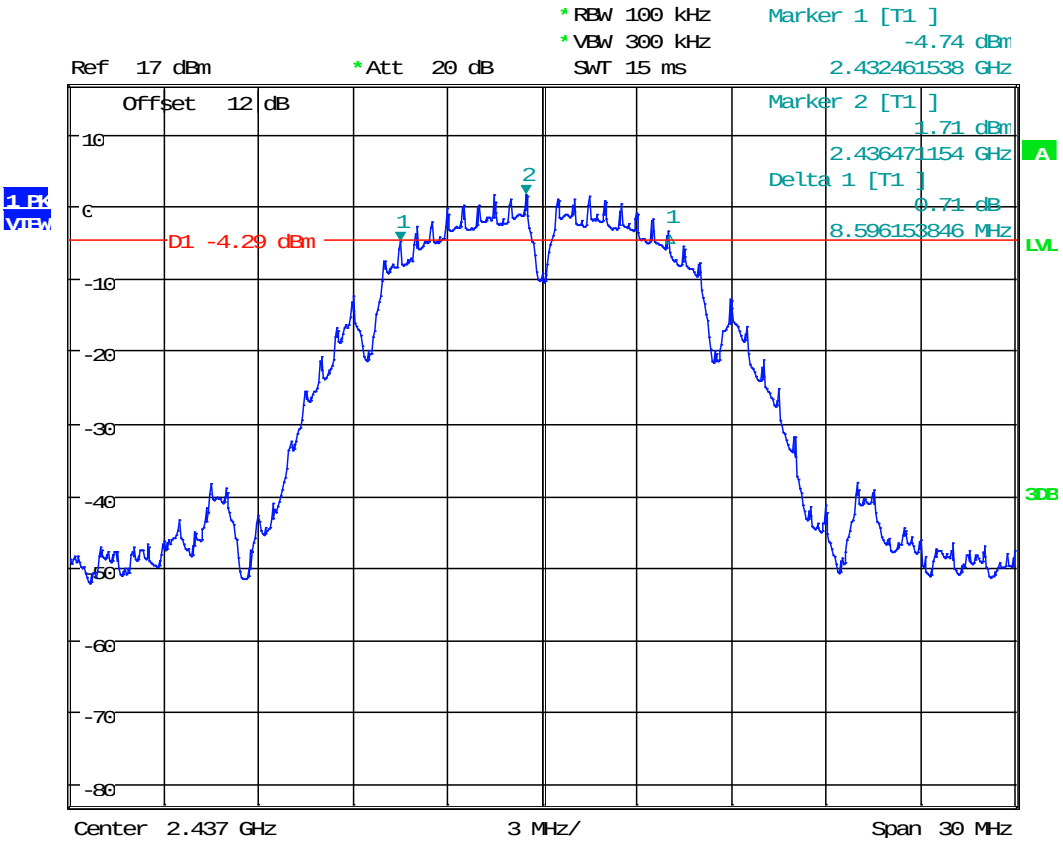
Frequency MHz	Ch.	Frequency MHz	6 dB FCC Bandwidth, MHz	Plot #	99% Bandwidth, MHz	Plot #
802.11b	1	2412	9.038	1.1	11.346	1.10
	6	2437	8.596	1.2	11.394	1.11
	11	2462	8.615	1.3	11.587	1.12
802.11g	1	2412	16.365	1.4	16.971	1.13
	6	2437	16.279	1.5	16.932	1.14
	11	2462	16.173	1.6	16.827	1.15
802.11n	1	2412	17.120	1.7	18.077	1.16
	6	2437	17.740	1.8	18.125	1.17
	11	2462	17.663	1.9	17.933	1.18

Plot 1.1 – 6dB Bandwidth (FCC)



Date: 25.JUN.2019 10:40:44

Plot 1.2 – 6dB Bandwidth (FCC)



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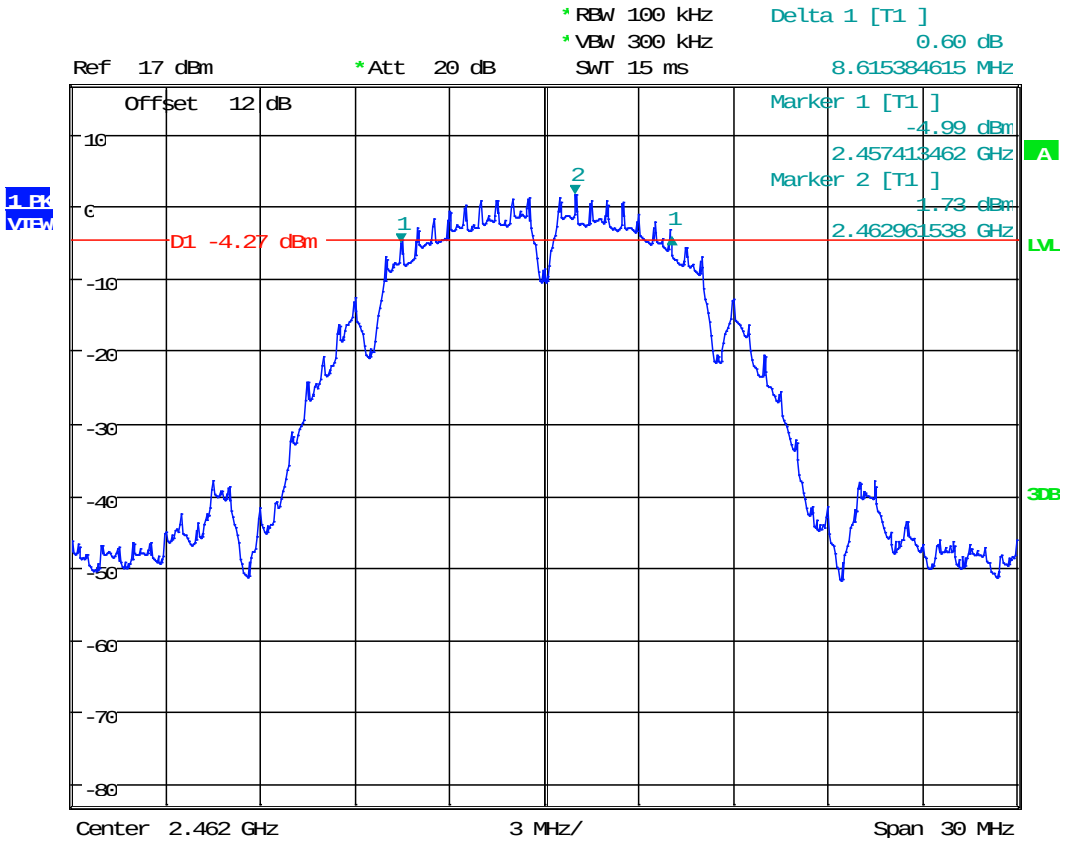
Plot 1 3 – 6dB Bandwidth (FCC)



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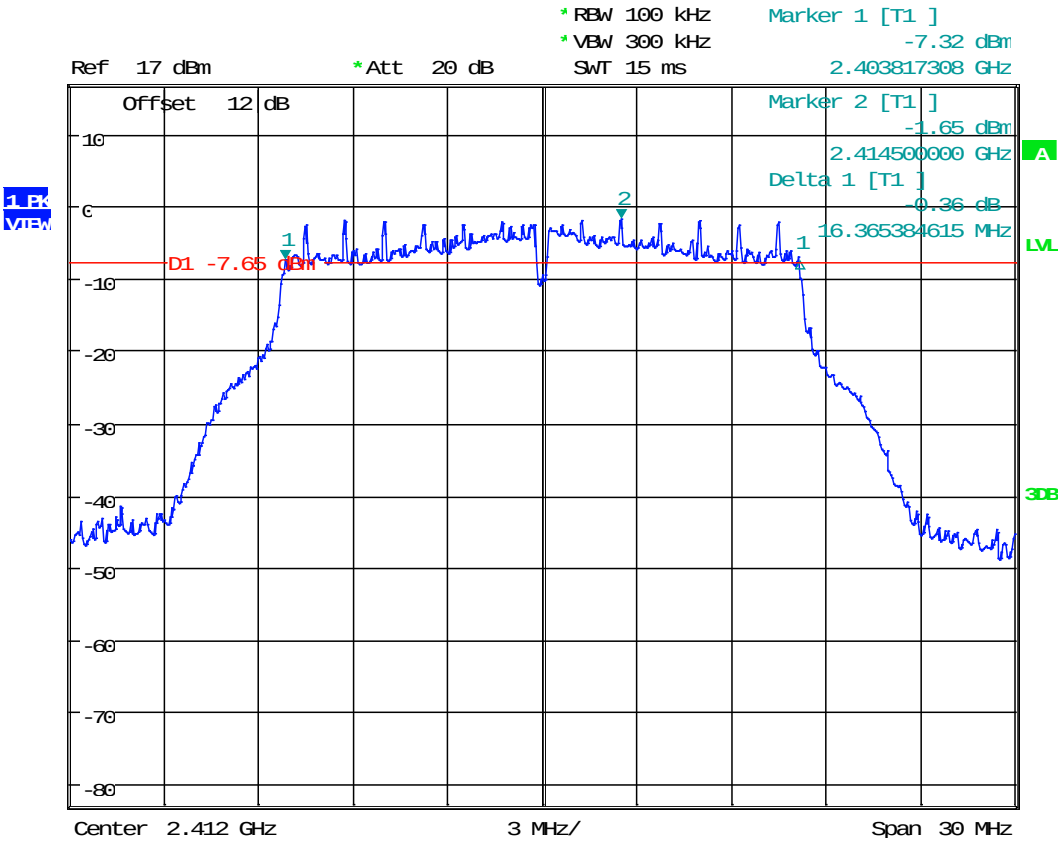
Plot 1.4 – 6dB Bandwidth (FCC)



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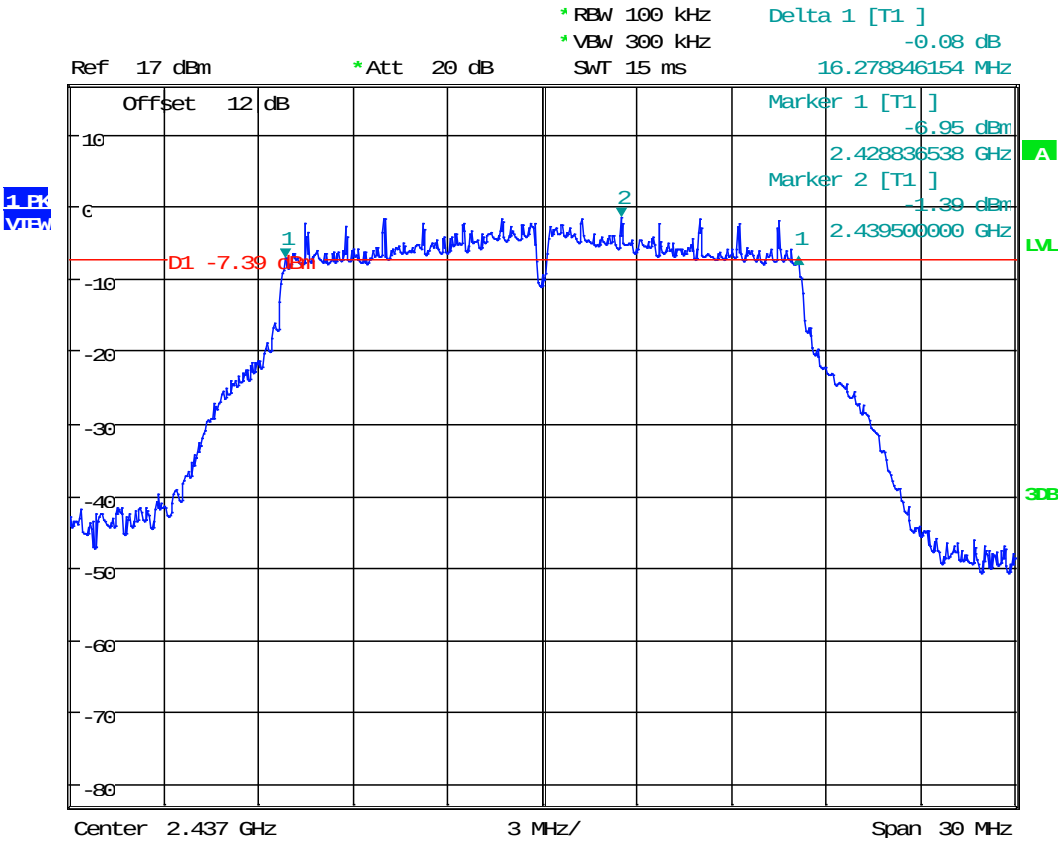
Plot 1.5 – 6dB Bandwidth (FCC)



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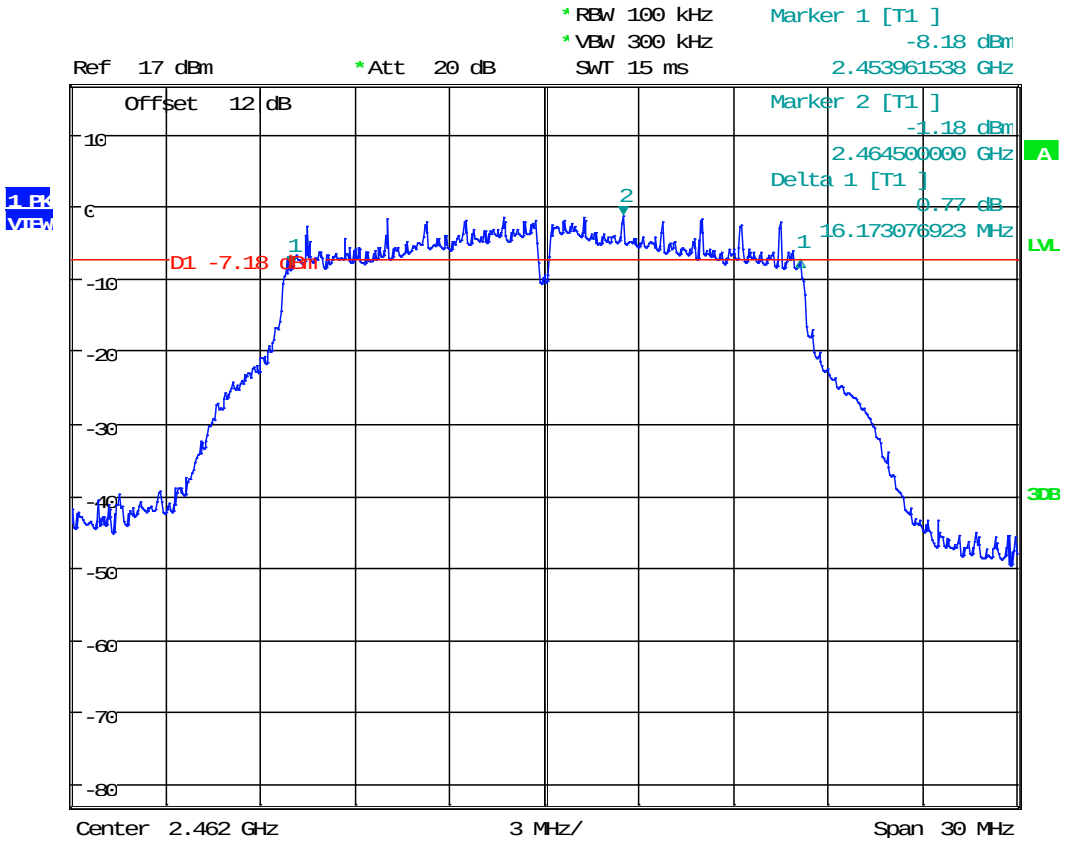
Plot 1.6 – 6dB Bandwidth (FCC)



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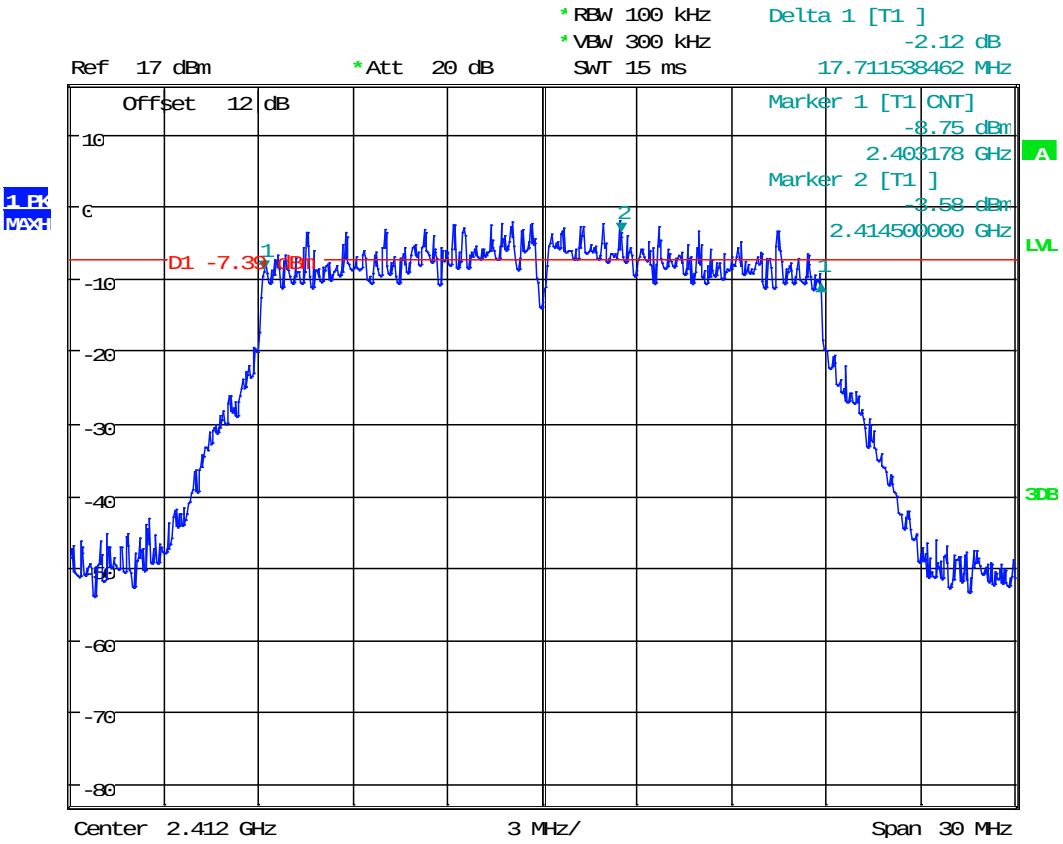
Plot 1.7 – 6dB Bandwidth (FCC)



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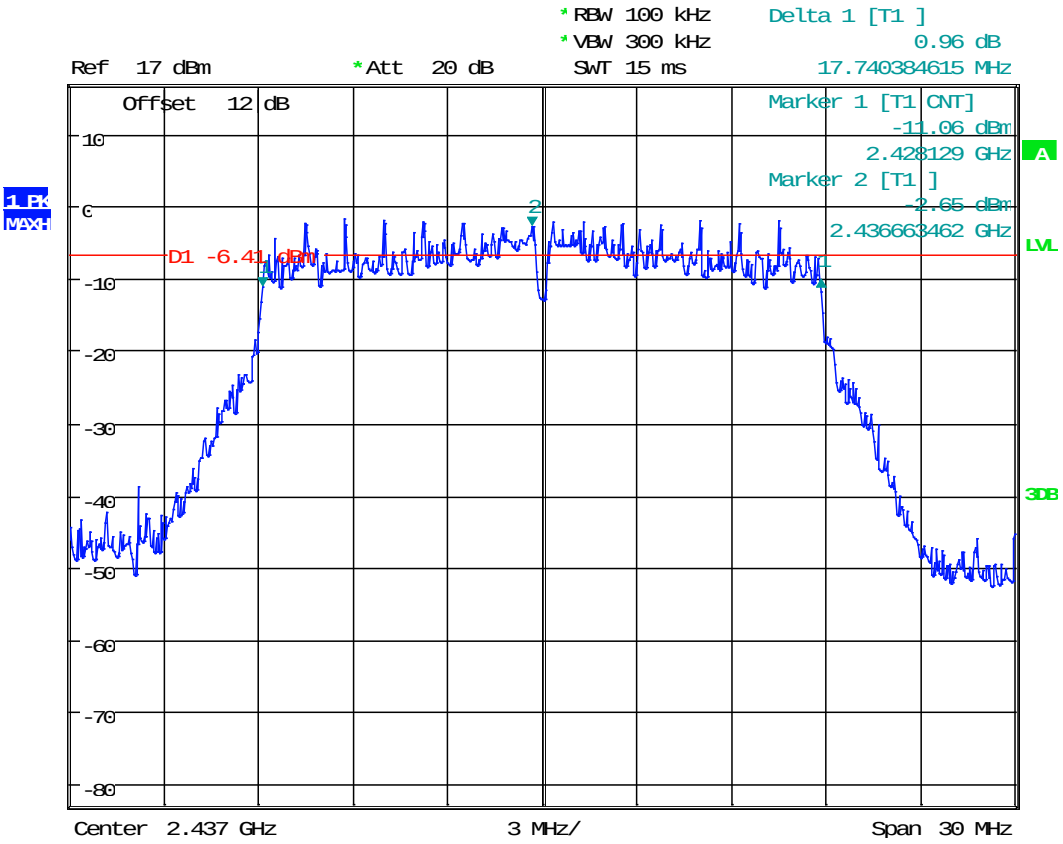
Plot 1.8 – 6dB Bandwidth (FCC)



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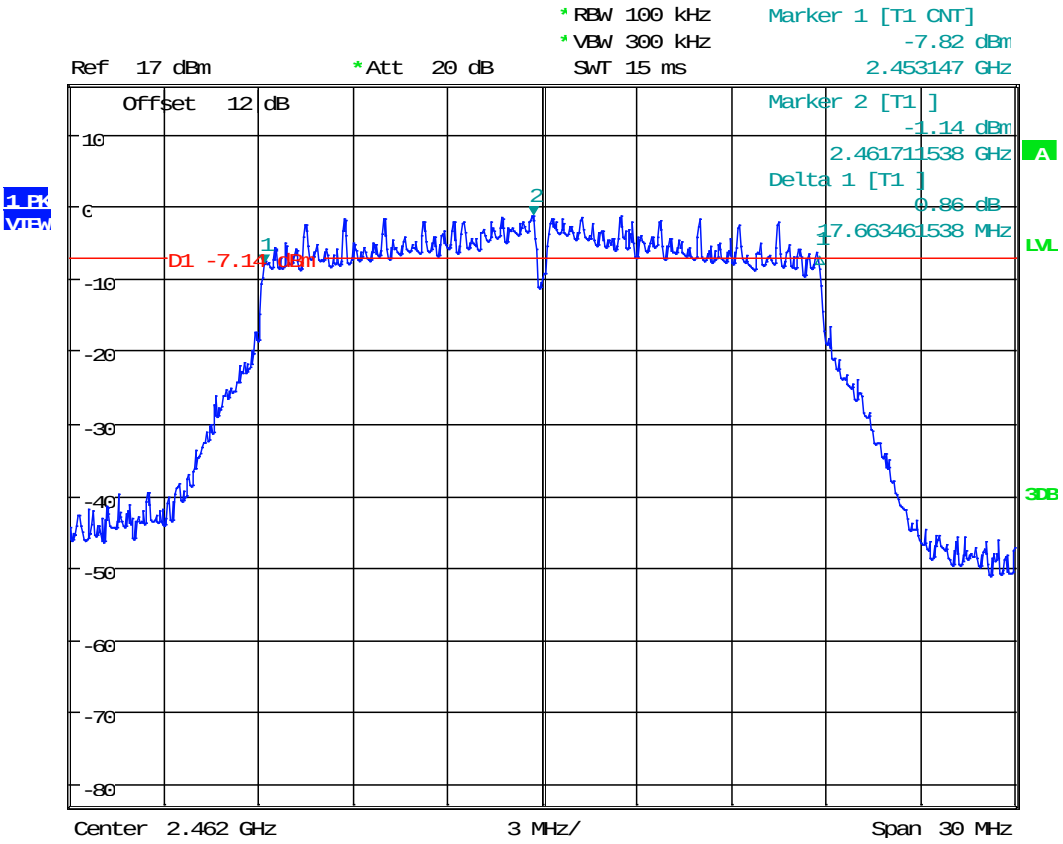
Plot 1.9 – 6dB Bandwidth (FCC)



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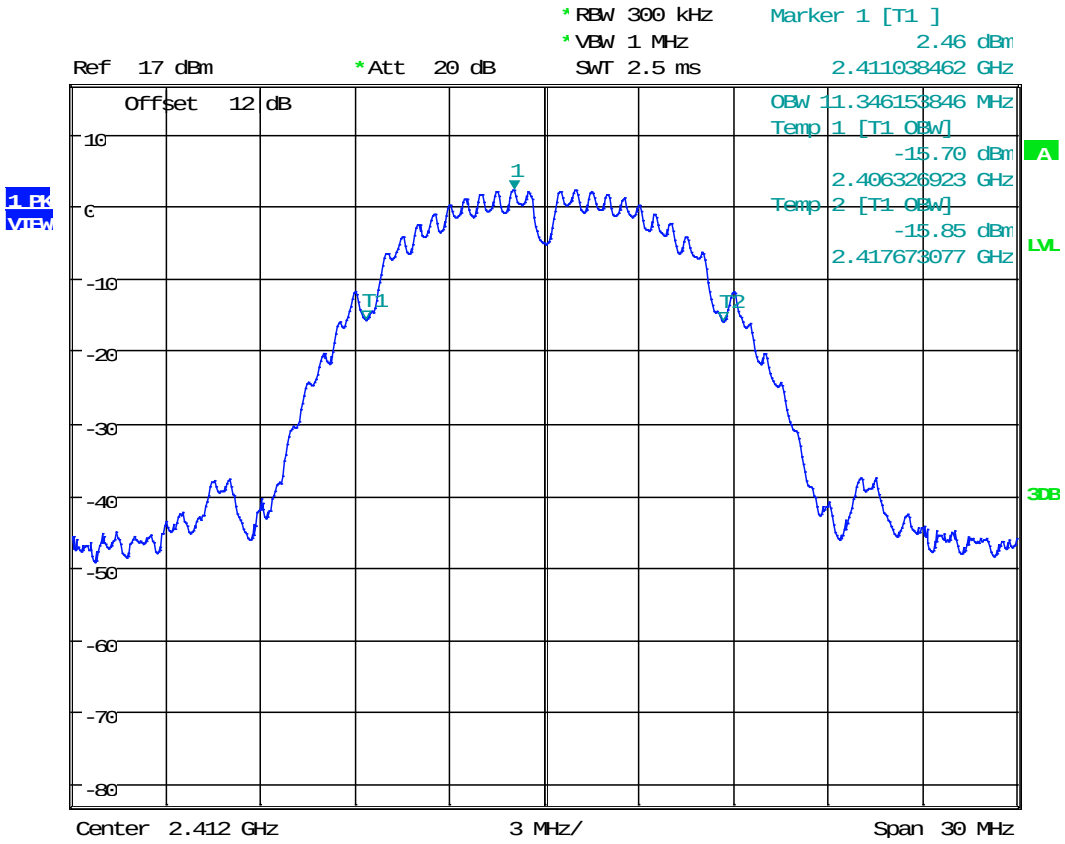
Plot 1.10 – 99% Bandwidth



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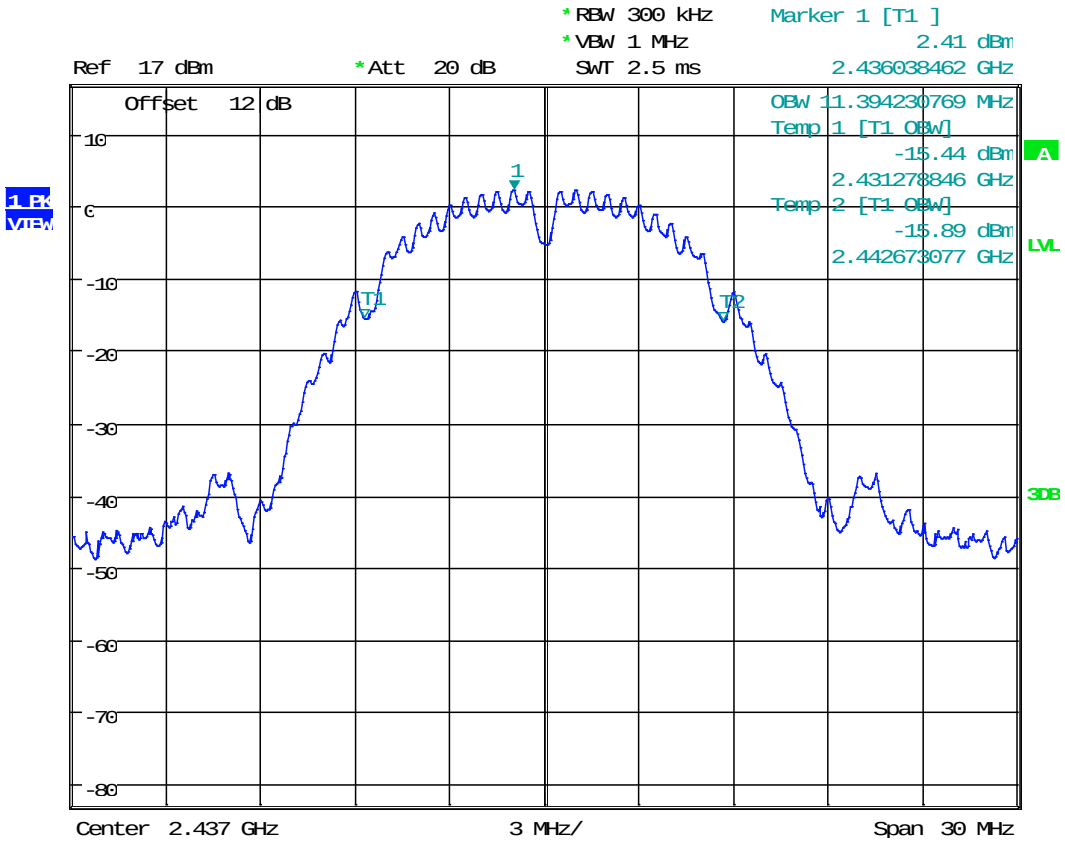
Plot 1.11 – 99% Bandwidth



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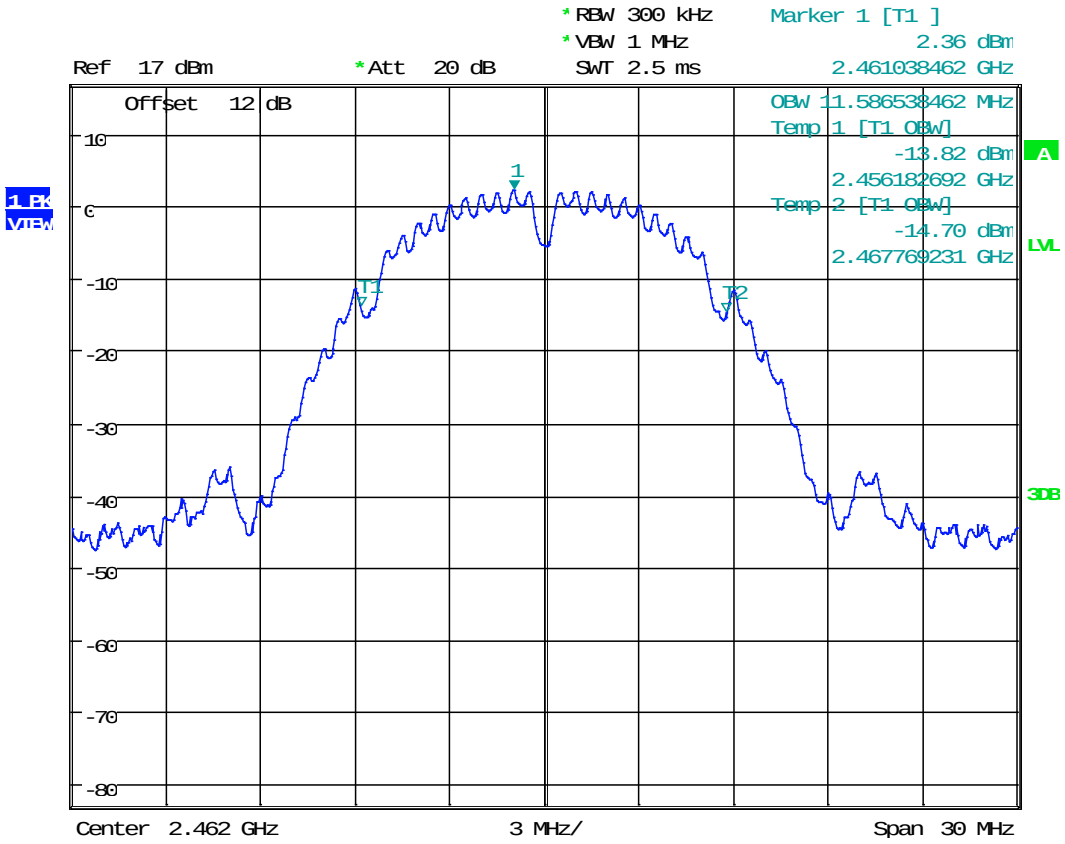
Plot 1.12 – 99% Bandwidth



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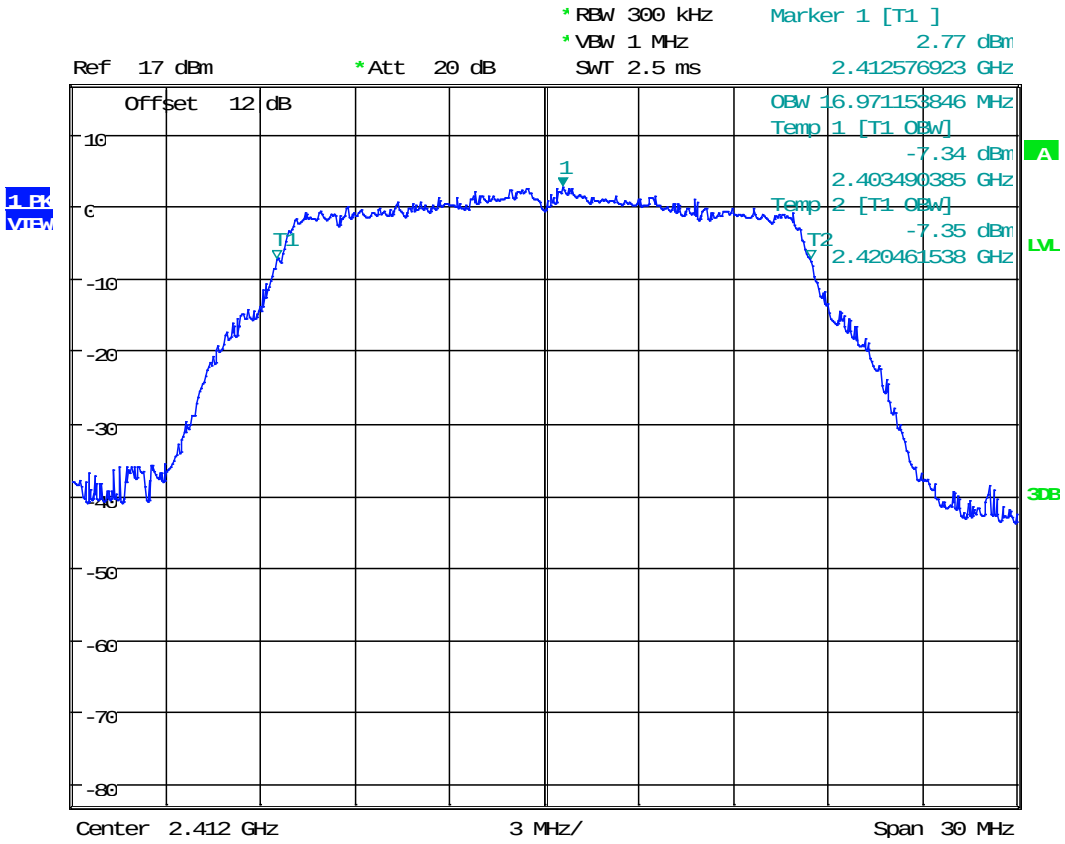
Plot 1.13 – 99% Bandwidth



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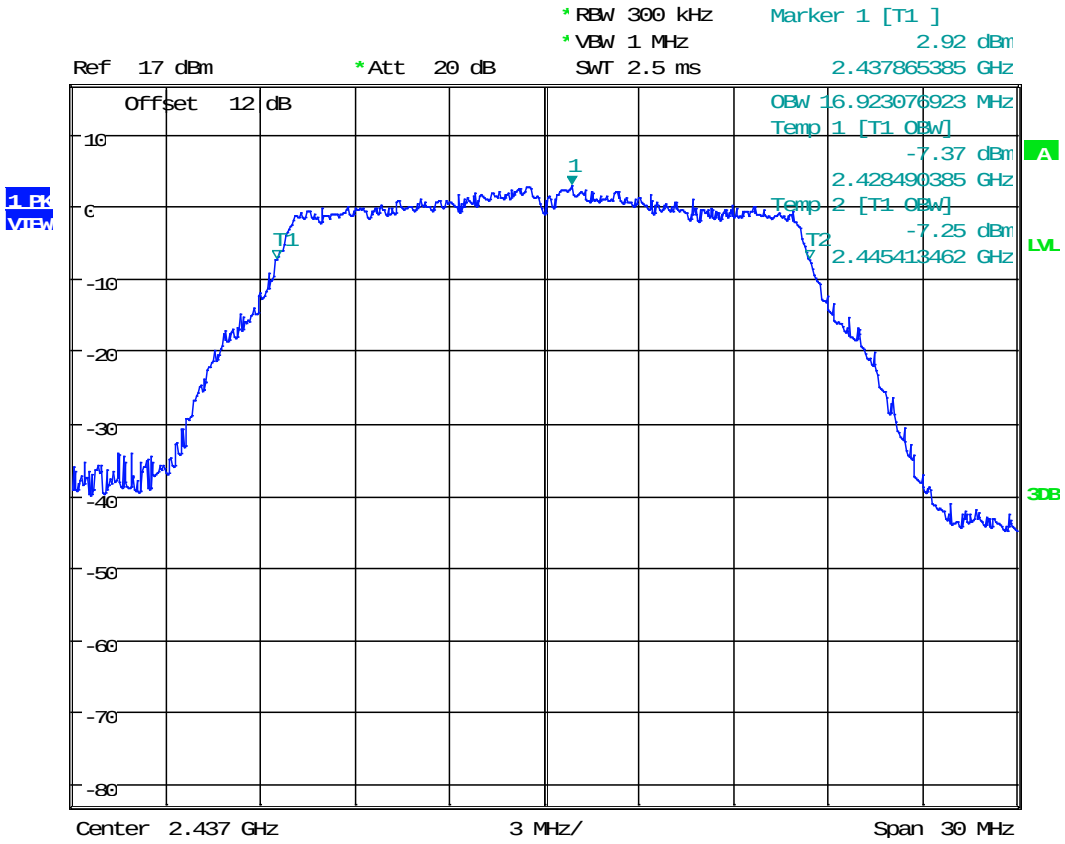
Plot 1.14 – 99% Bandwidth



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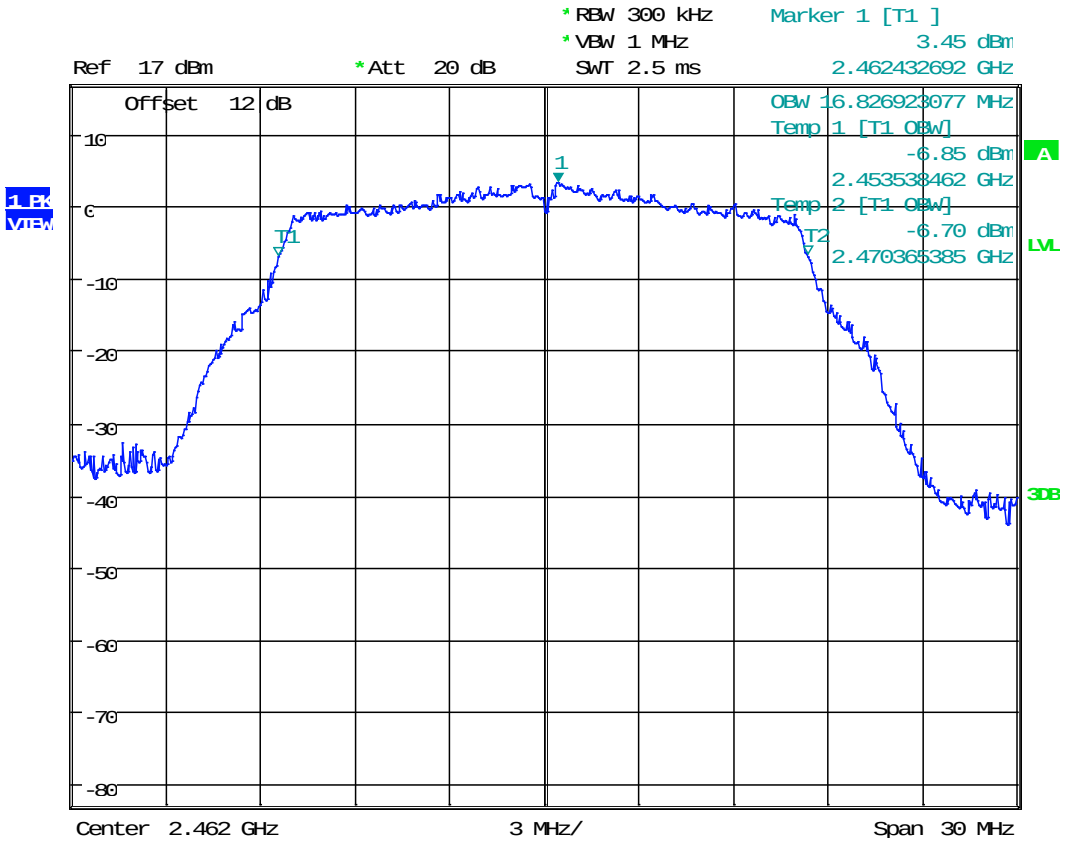
Plot 1.15 – 99% Bandwidth



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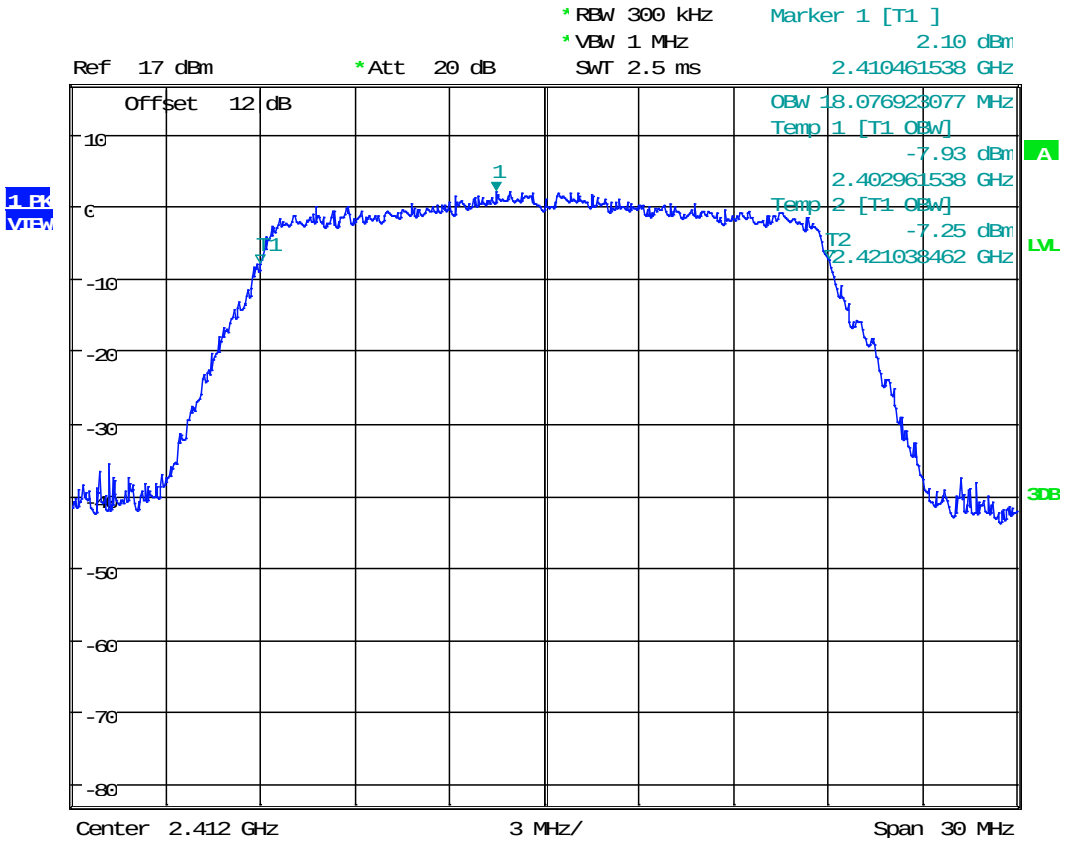
Plot 1.16 – 99% Bandwidth



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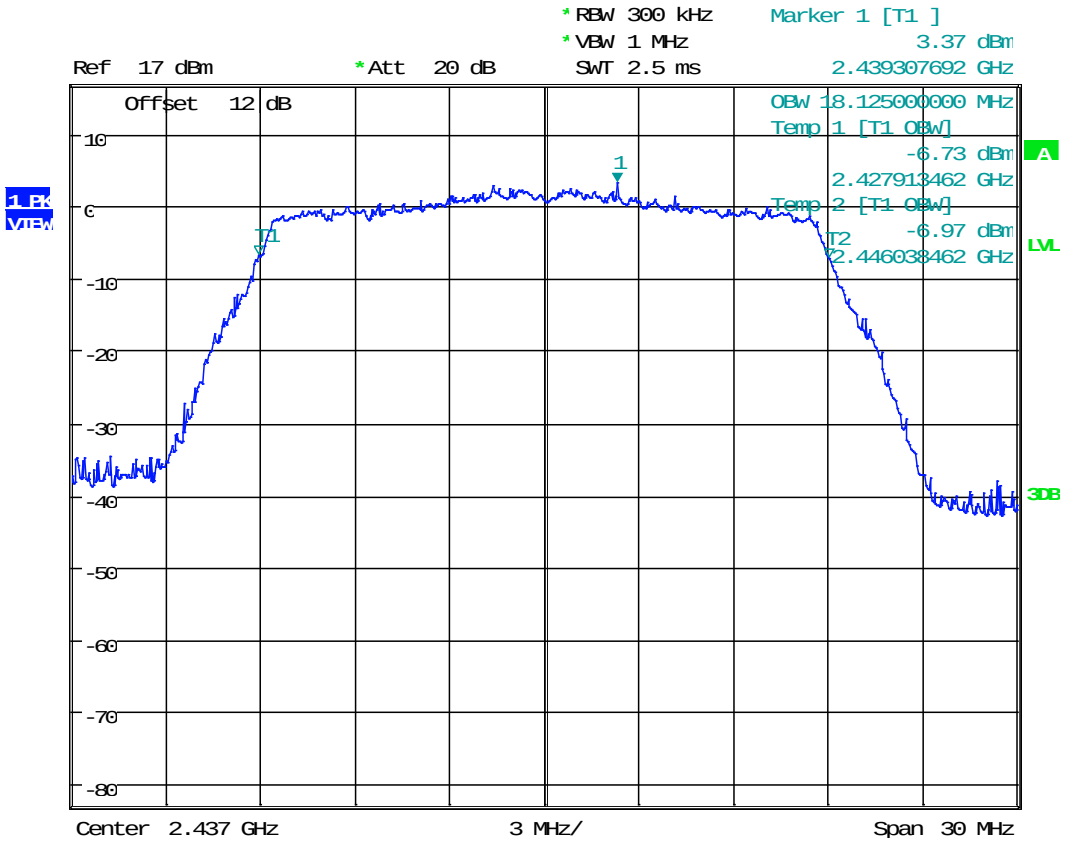
Plot 1.17 – 99% Bandwidth



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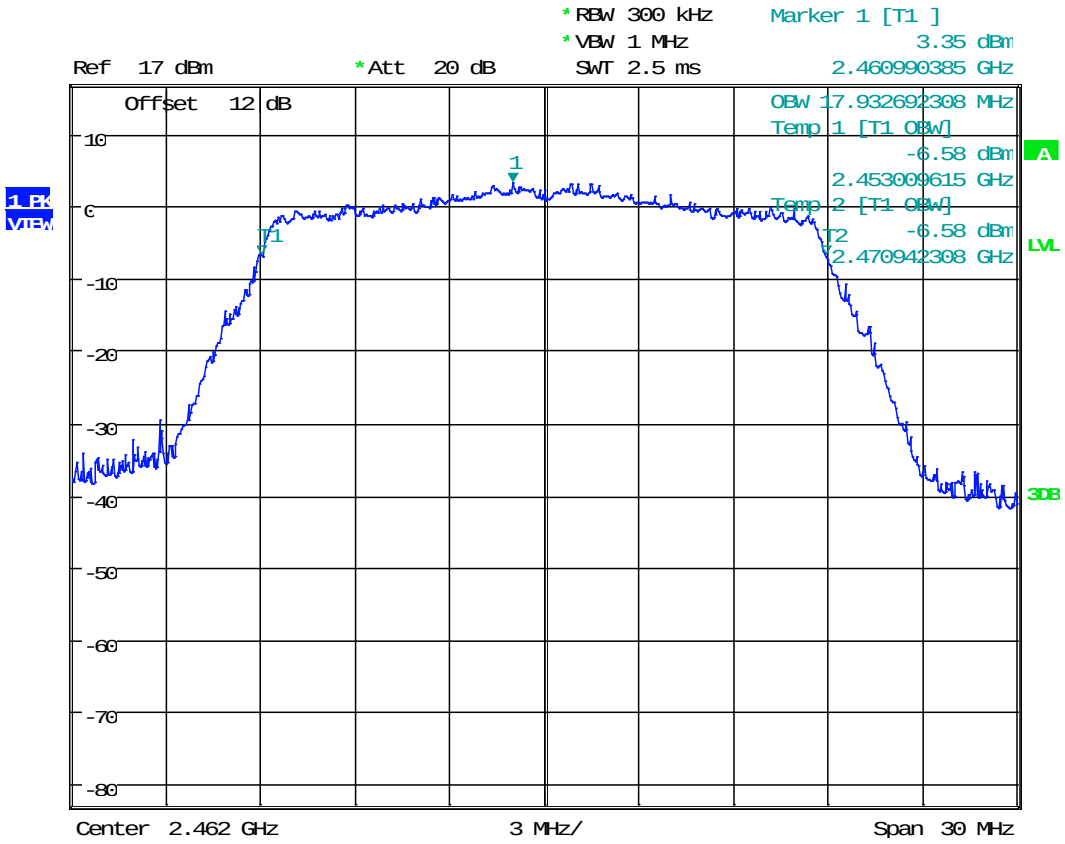
Plot 1.18 – 99% Bandwidth



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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 and duty cycle correction.

The procedure described in FCC Publication KDB 558074 D01 Meas Guidance v05 was used. Specifically, section 11.9.2.2.2 Method AVGSA-1 in ANSI 63.10.

The procedure for this method is as follows:

1. Set span to at least 1.5 times the OBW.
2. Set RBW = 1% to 5% of the OBW, not to exceed 1 MHz.
3. Set VBW ≥ [3 · RBW].
4. Number of points in sweep ≥ [2 · span / RBW]. (This gives bin-to-bin spacing ≤ RBW / 2, so that narrowband signals are not lost between frequency bins.
5. Sweep time = auto.
6. Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
7. If transmit duty cycle < 98%, use a sweep trigger with the level set to enable triggering only on full power pulses. The transmitter shall operate at the maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no OFF intervals) or at duty cycle ≥ 98%, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to "free run."
8. Trace average at least 100 traces in power averaging (rms) mode.
9. Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function, with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

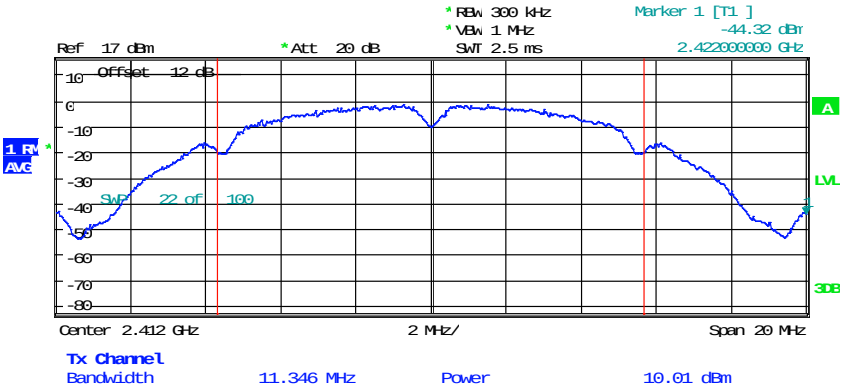
Tested By	Test Date
Todd Moy	June 25, 2019

4.2.3 Test Result

Refer to the following plots for the test result:

Standard	Data Rate	Channel	Frequency MHz	Conducted Average Power dBm	Conducted Average Power mW	Plot #
802.11b	1 Mbps	1	2412	10.01	10.023	2.1
		6	2437	10.36	10.864	2.2
		11	2462	10.12	10.280	2.3
802.11g	6 Mbps	1	2412	12.02	15.922	2.4
		6	2437	12.37	17.258	2.5
		11	2462	12.38	17.298	2.6
802.11n	0 MCS	1	2412	9.65	9.226	2.7
		6	2437	10.09	10.209	2.8
		11	2462	10.06	10.139	2.9

Plot 2. 1



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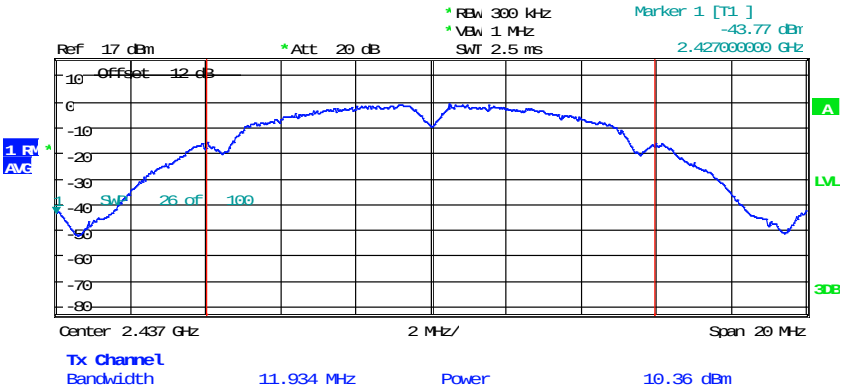
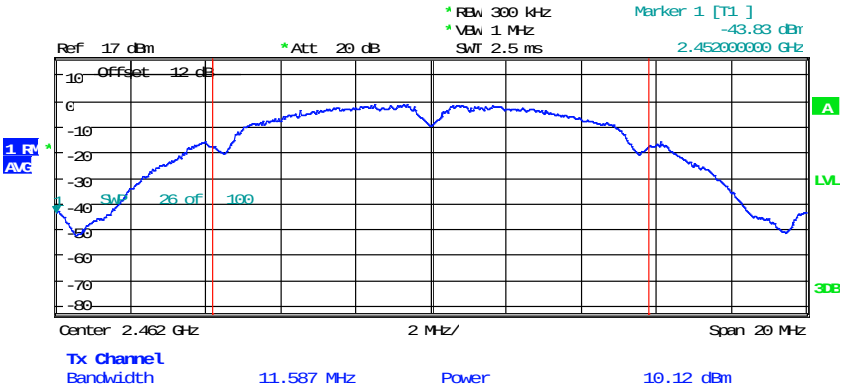
Plot 2. 2



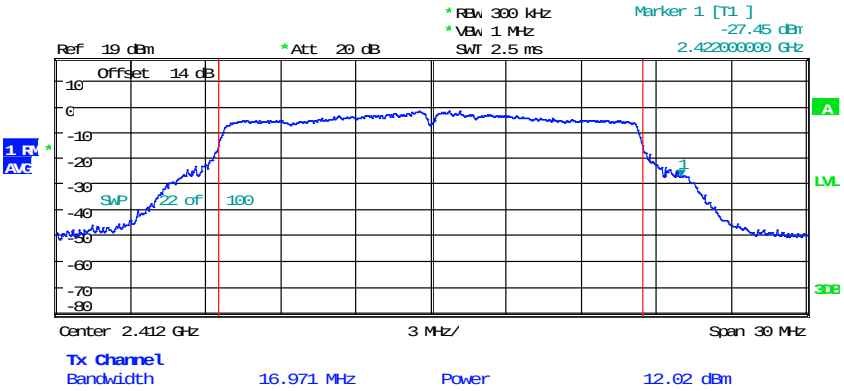
Date: 25.JUN.2019 11:52:49

Plot 2. 3



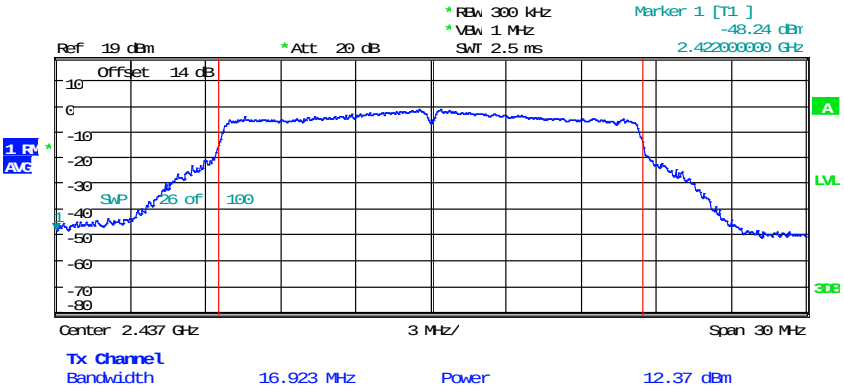
Date: 25.JUN.2019 11:53:46

Plot 2. 4



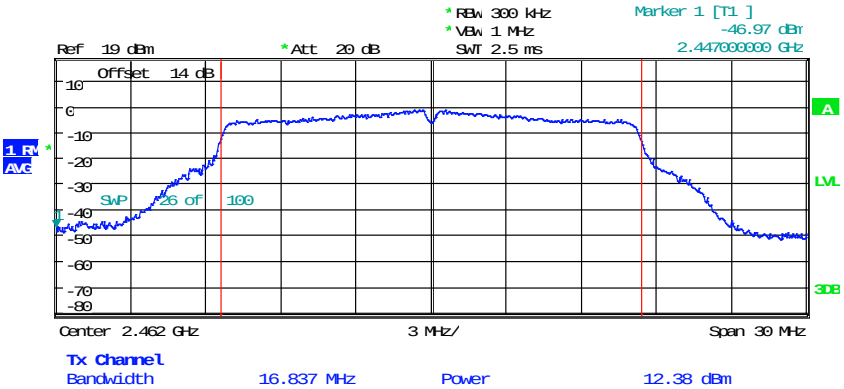
Date: 25.JUN.2019 11:58:50

Plot 2. 5



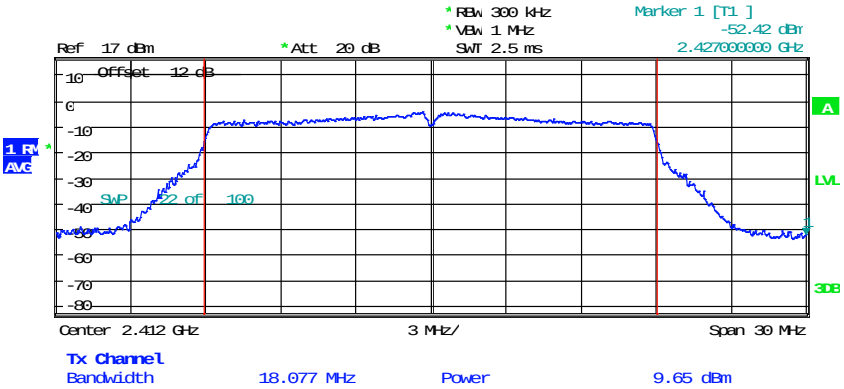
Date: 25.JUN.2019 11:59:53

Plot 2. 6



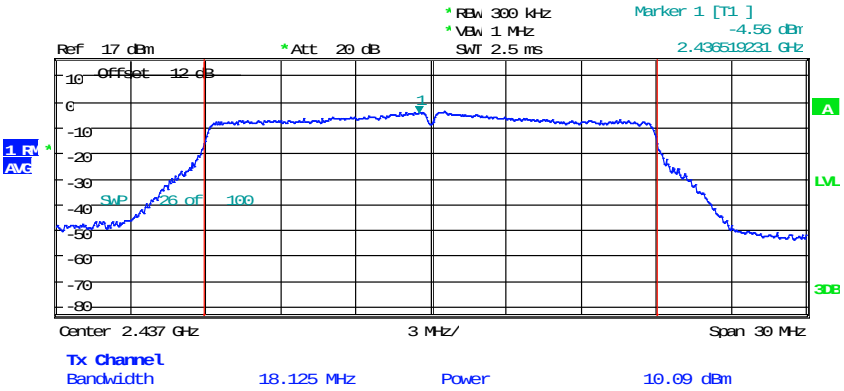
Date: 25.JUN.2019 12:00:44

Plot 2. 7



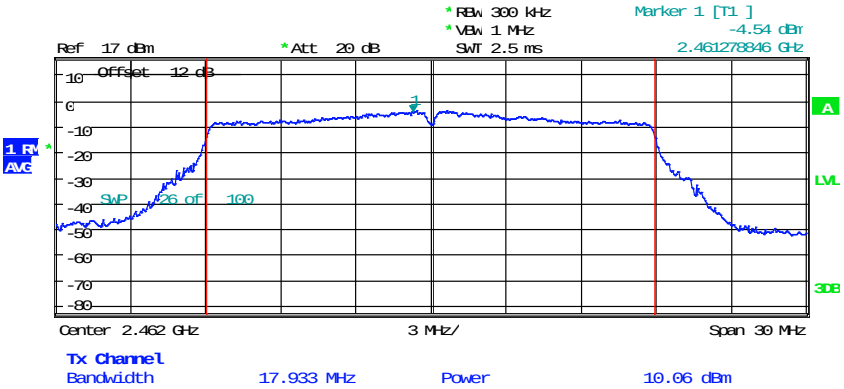
Date: 25.JUN.2019 12:02:37

Plot 2. 8



Date: 25.JUN.2019 12:03:31

Plot 2. 9



Date: 25.JUN.2019 12:04:33

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 KDB 558074 D01 Meas Guidance v05, specifically section 11.10.2 Method PKPSD (peak PSD) of ANSI 63.10.

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.

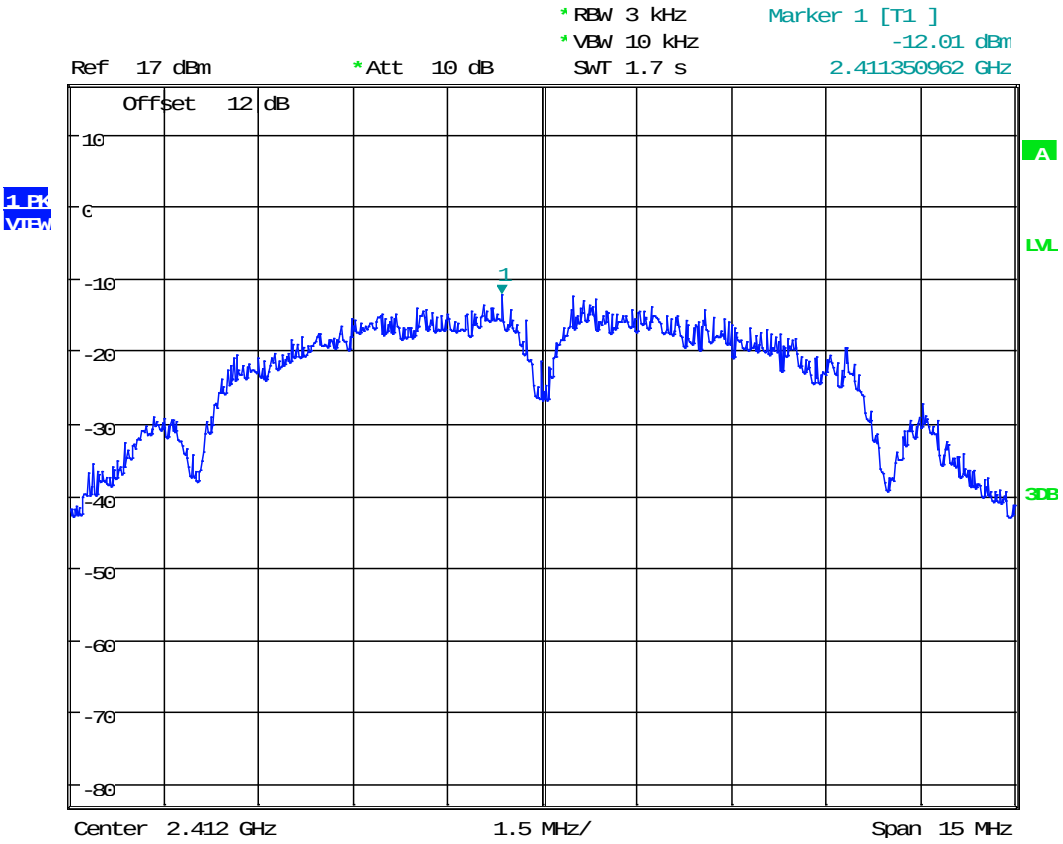
Tested By	Test Date
Todd Moy	June 25, 2019

4.3.3 Test Result

Refer to the following plots for the test result:

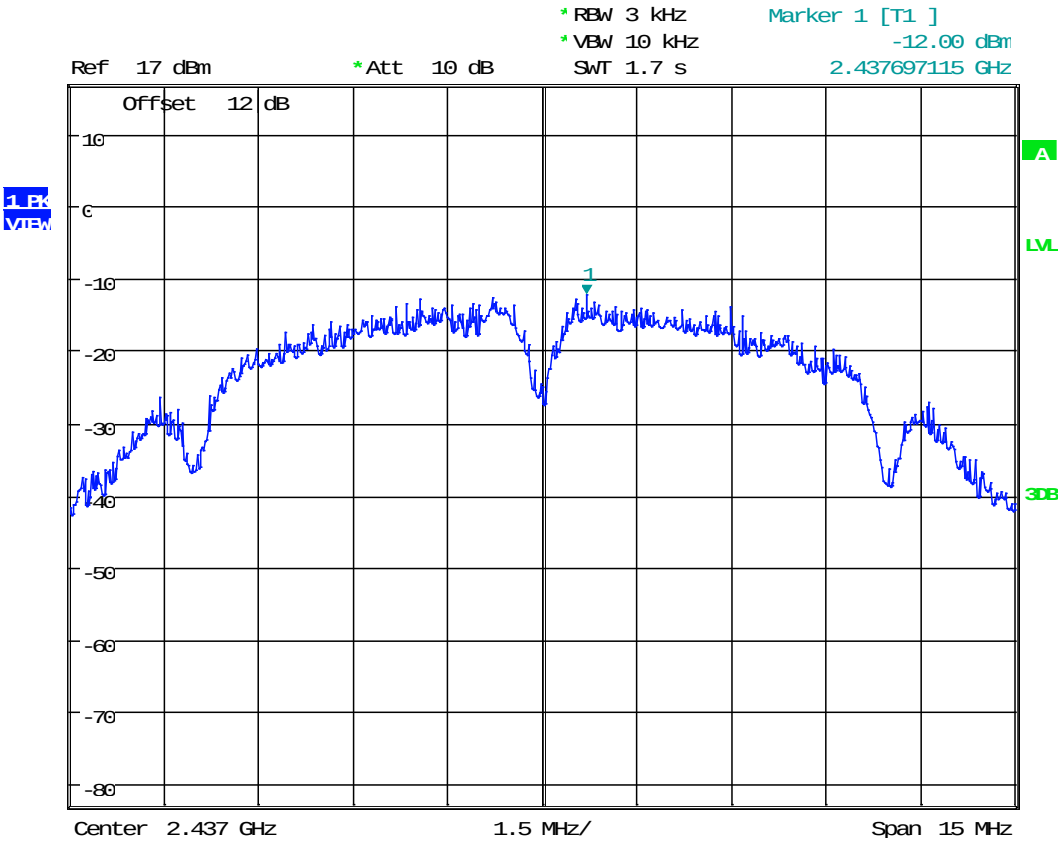
Standard	Channel	Frequency MHz	PSD (Peak) dBm	Margin to 8dBm Limit dB	Plot #
802.11b	1	2412	-12.01	-20.01	3.1
	6	2437	-12	-20.00	3.2
	11	2462	-12.97	-20.97	3.3
802.11g	1	2412	-14.66	-22.66	3.4
	6	2437	-13.4	-21.40	3.5
	11	2462	-13.21	-21.21	3.6
802.11n	1	2412	-14.33	-22.33	3.7
	6	2437	-14.07	-22.07	3.8
	11	2462	-14.7	-22.70	3.9

Plot 3. 1



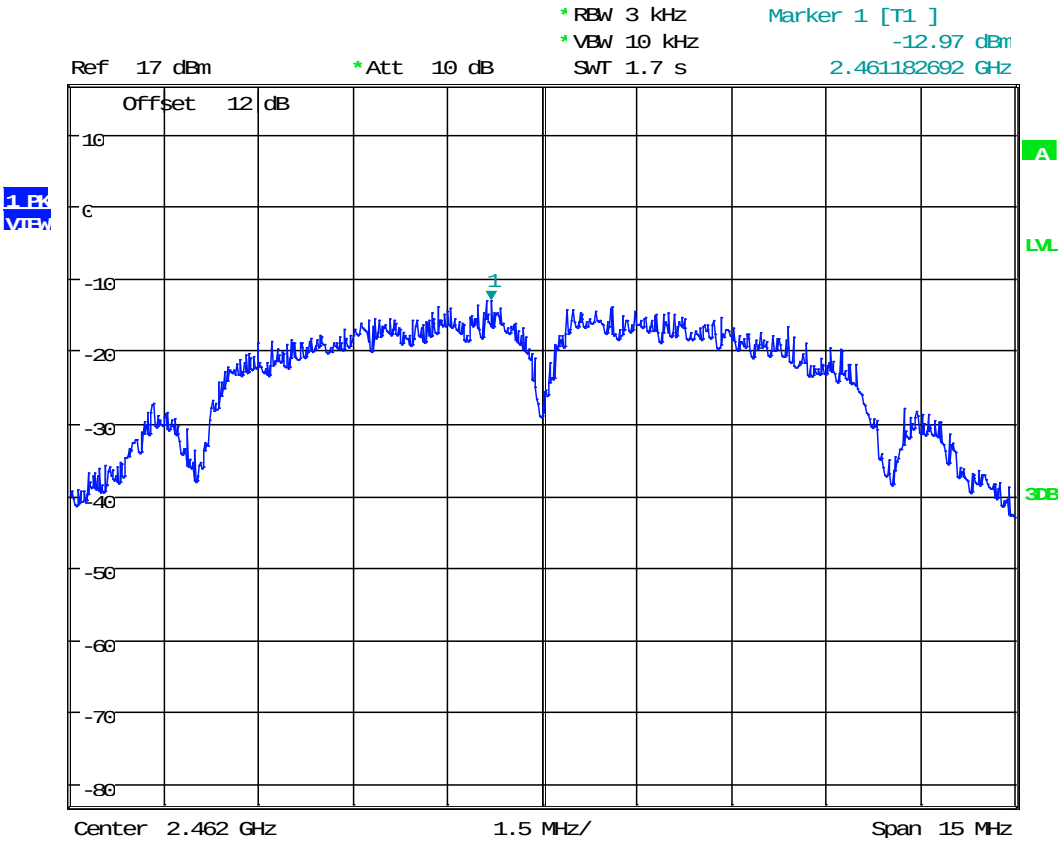
Date: 25.JUN.2019 13:19:27

Plot 3. 2



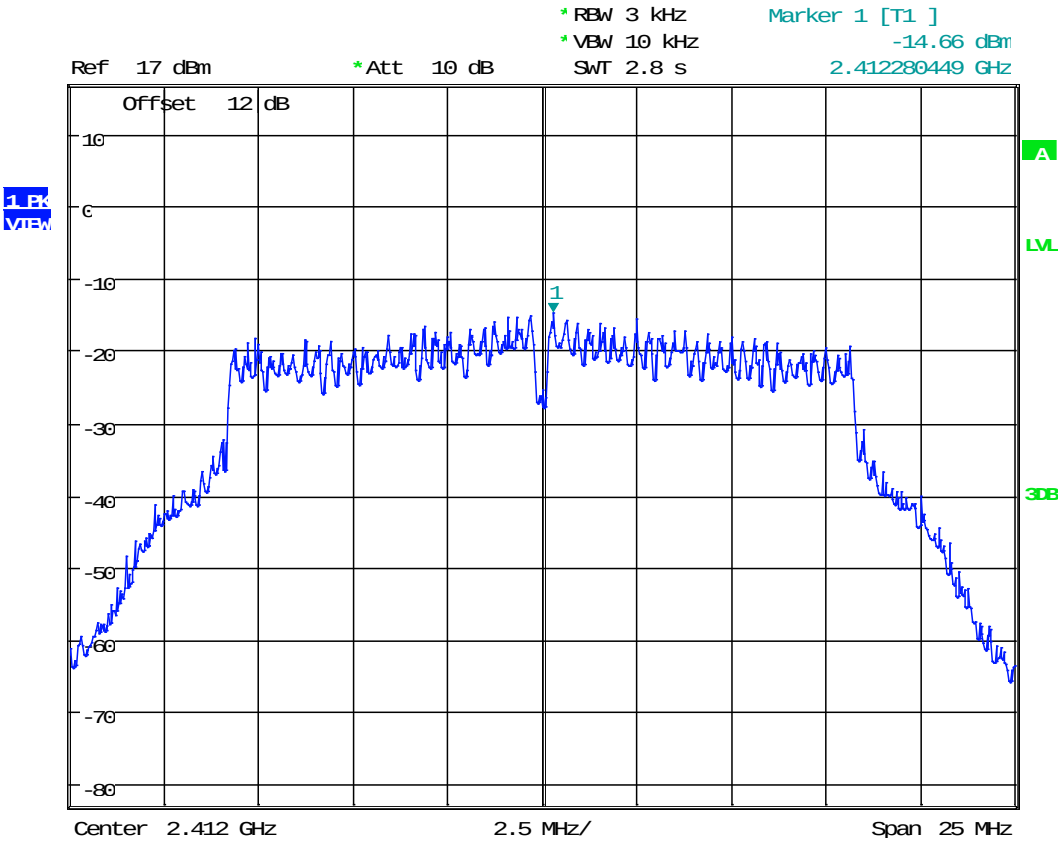
Date: 25.JUN.2019 13:20:29

Plot 3. 3



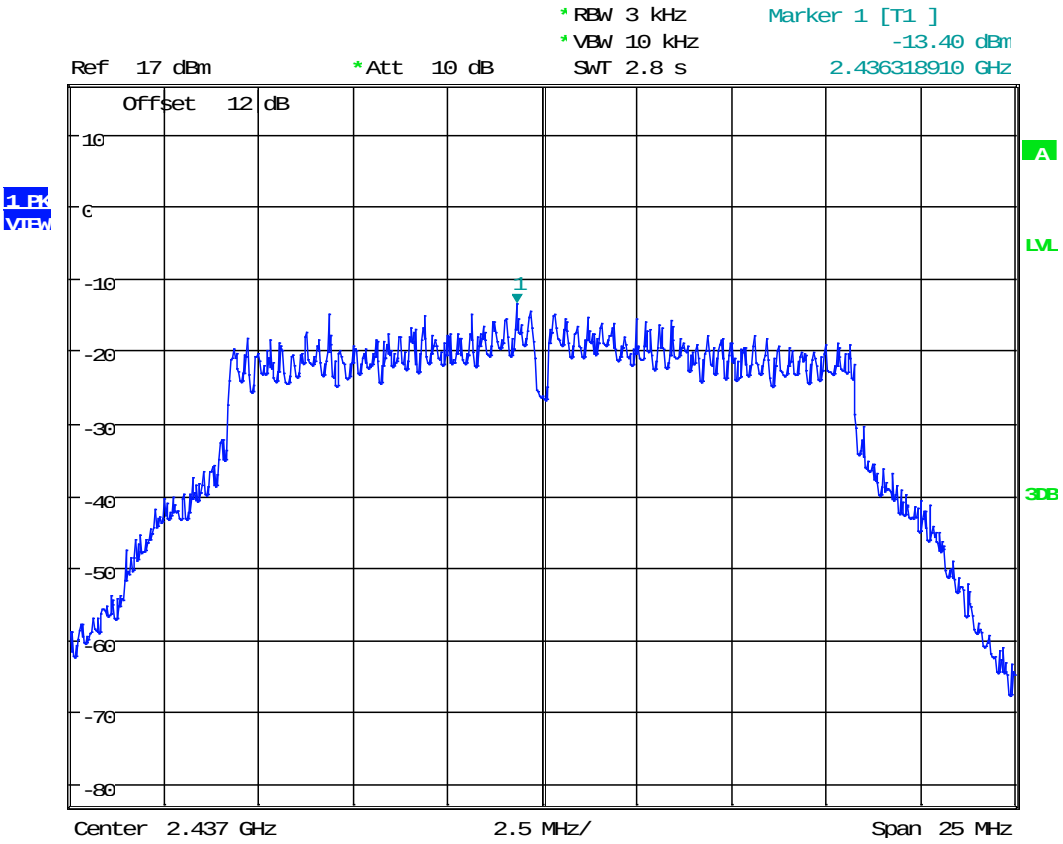
Date: 25.JUN.2019 13:21:09

Plot 3. 4



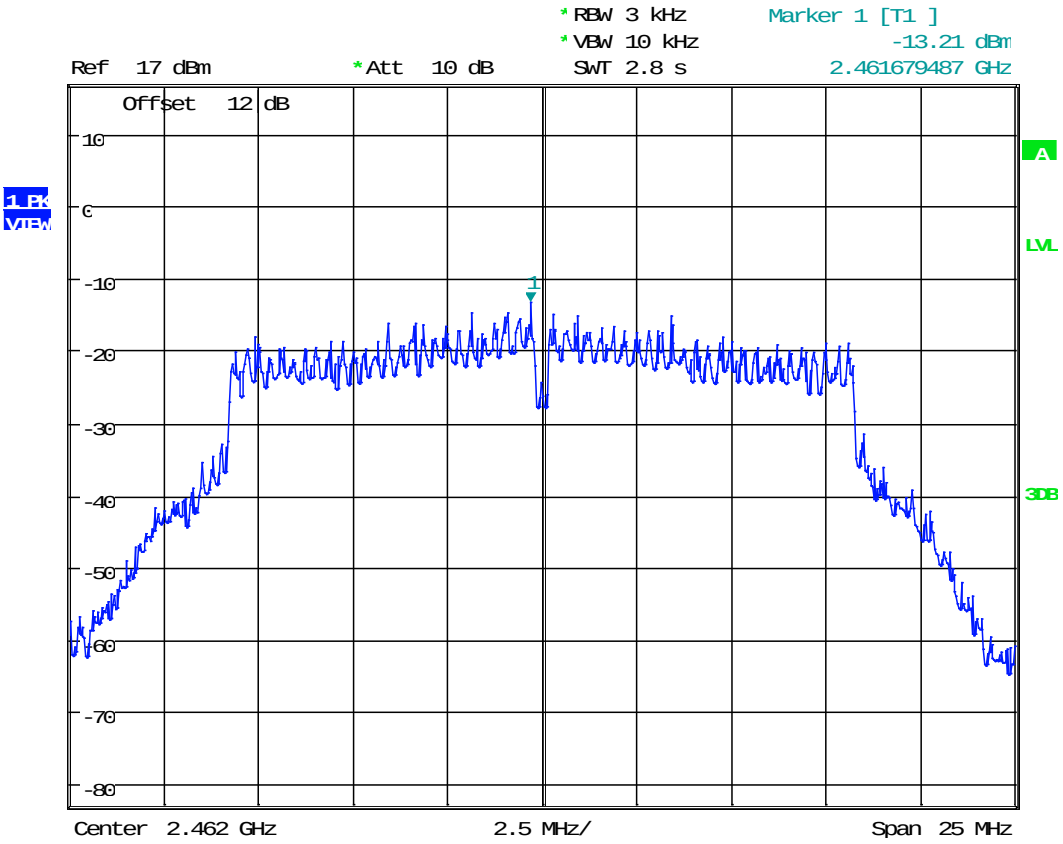
Date: 25.JUN.2019 13:23:19

Plot 3. 5



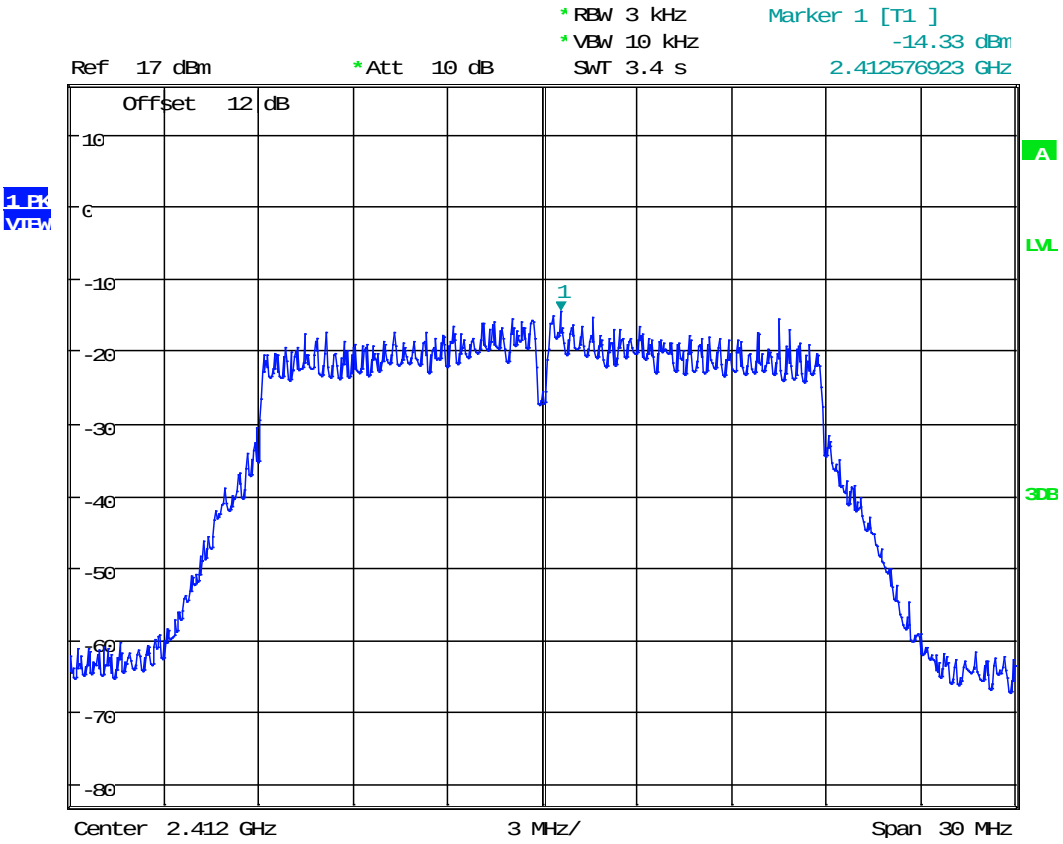
Date: 25.JUN.2019 13:23:58

Plot 3. 6



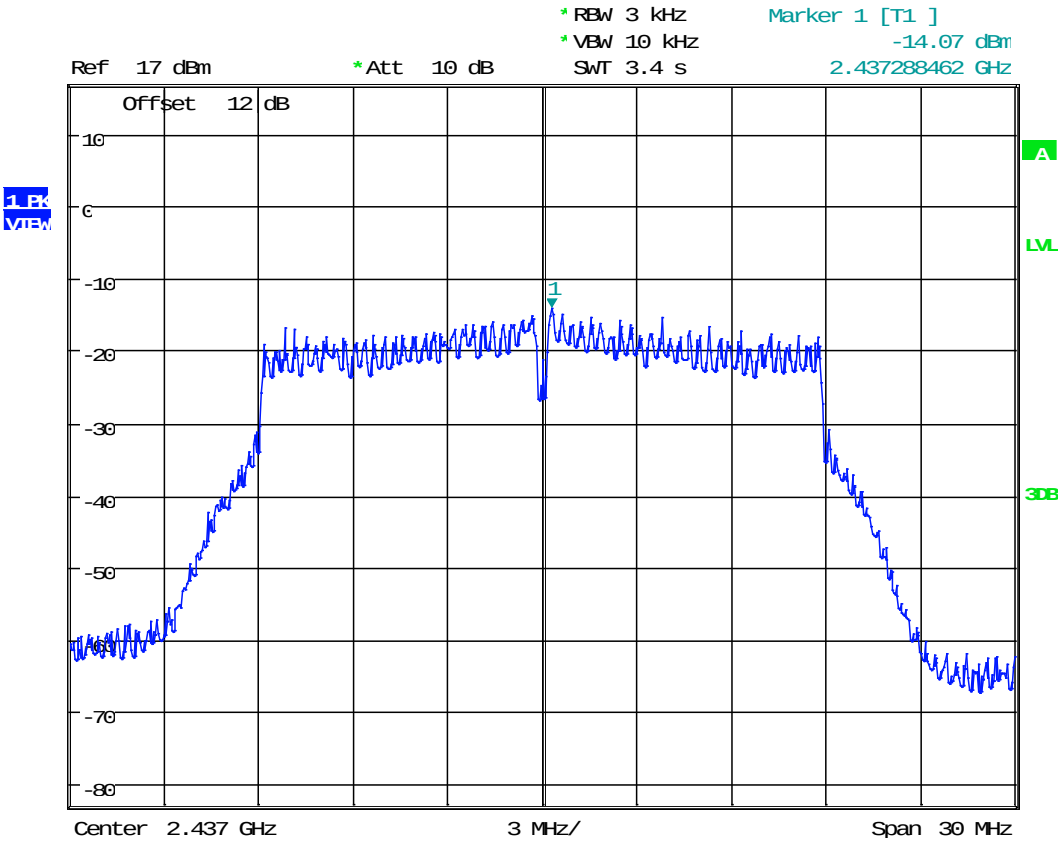
Date: 25.JUN.2019 13:25:08

Plot 3. 7



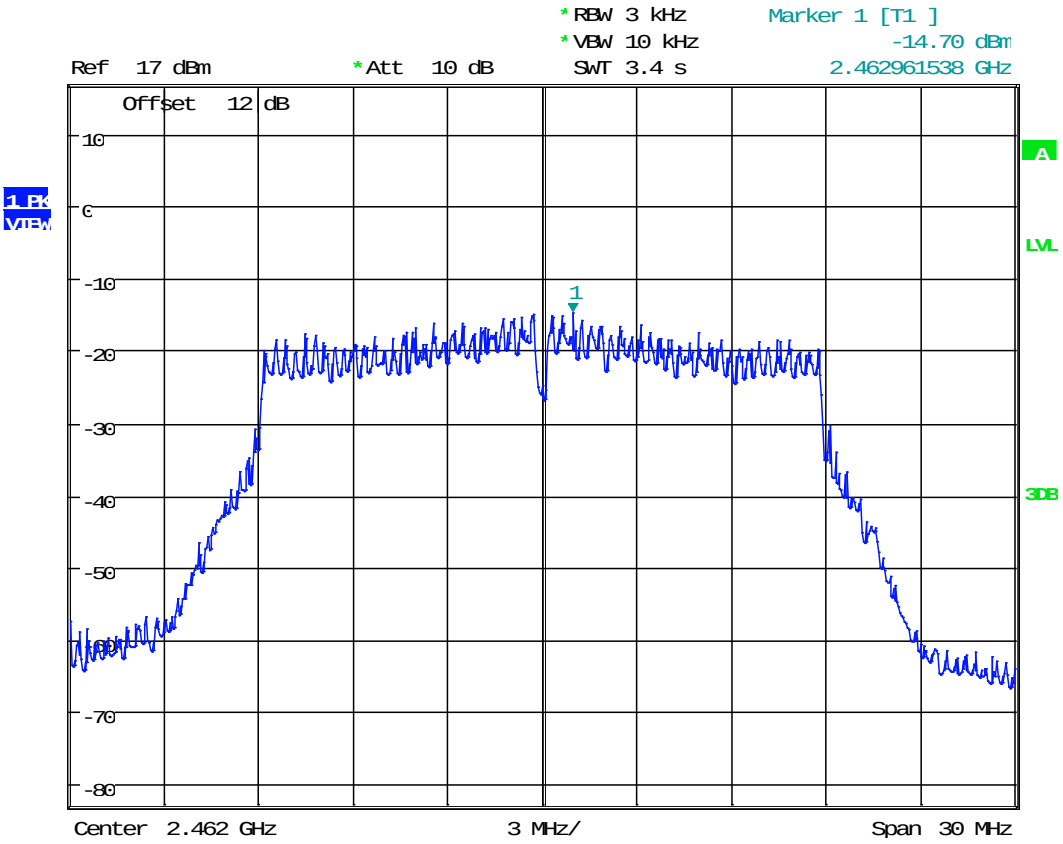
Date: 25.JUN.2019 13:27:10

Plot 3. 8



Date: 25.JUN.2019 13:28:11

Plot 3. 9



Date: 25.JUN.2019 13:28:56

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

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

The procedure described in FCC Publication KDB 558074 D01 Meas Guidance v05, specifically section 11.11 DTS Emissions in non-restricted frequency bands of ANSI 63.10.

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

1. Set the RBW = 100 kHz.
2. Set the VBW ≥ 3 x RBW.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

The unwanted emissions were measured from 30 MHz to 25 GHz. Plots below are corrected for cable loss and then compared to the limits.

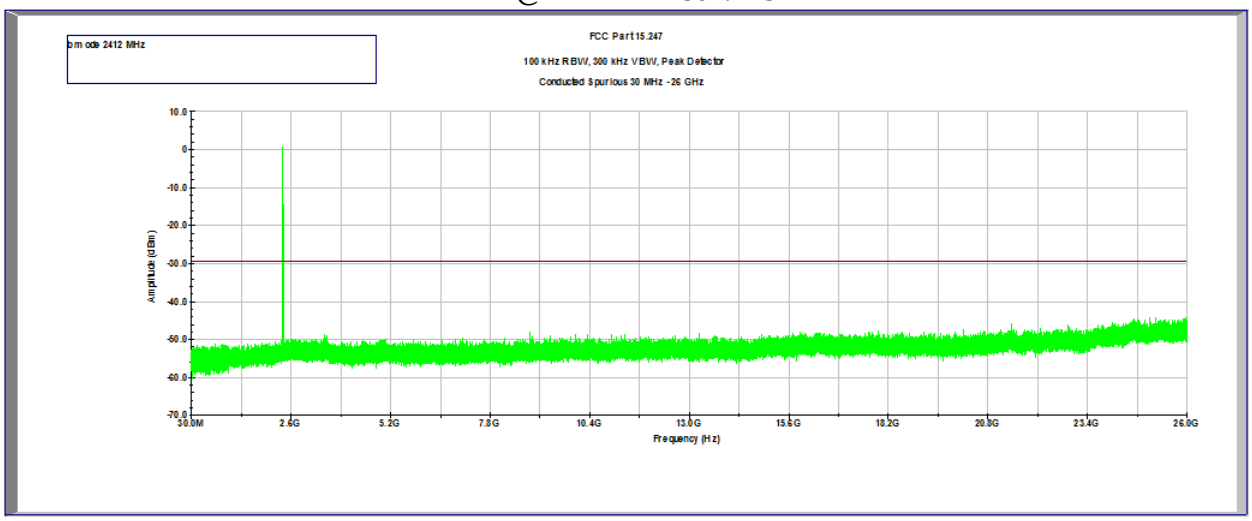
4.4.3 Test Result

Refer to the following plots 4.1 – 4.9 for unwanted conducted emissions. The plot shows -30dB attenuation limit line.

Tested By	Test Date
Todd Moy	June 25, 2019

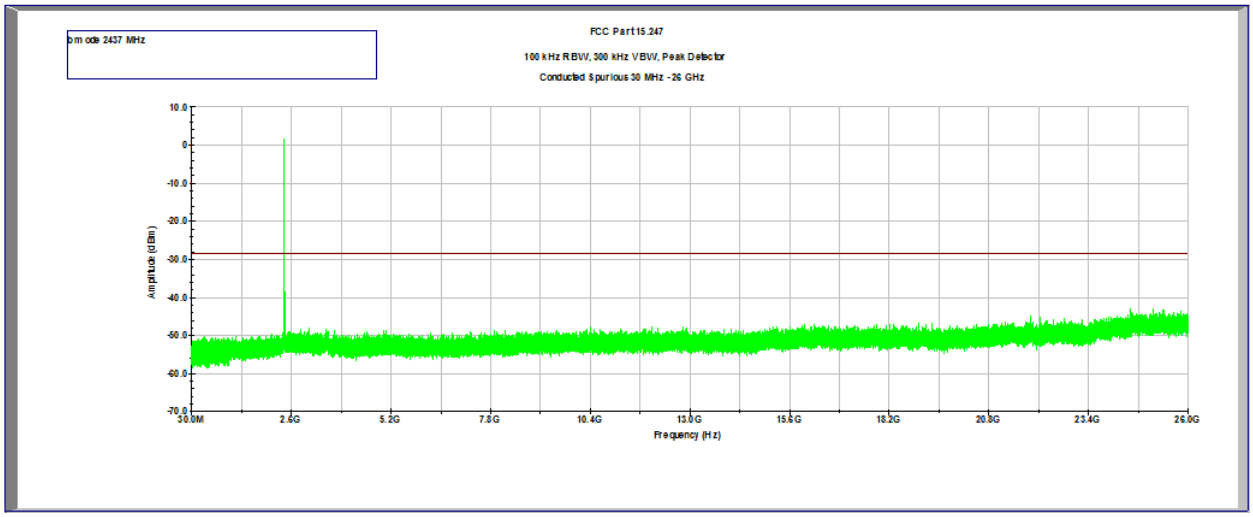
Plot 4.1

Tx @ 2412MHz 802.11b



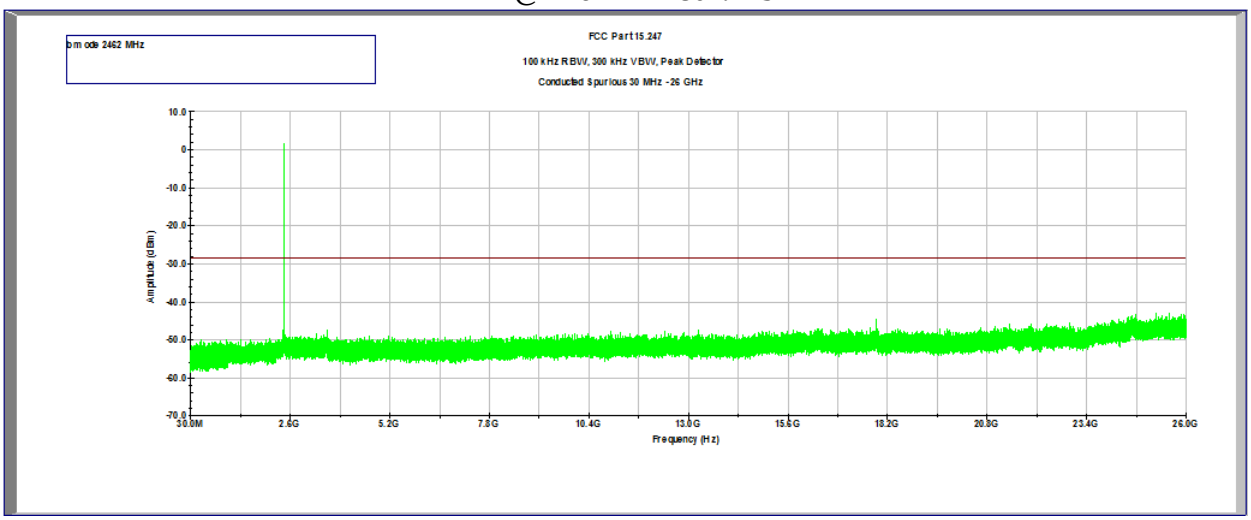
Plot 4.2

Tx @ 2437MHz 802.11b



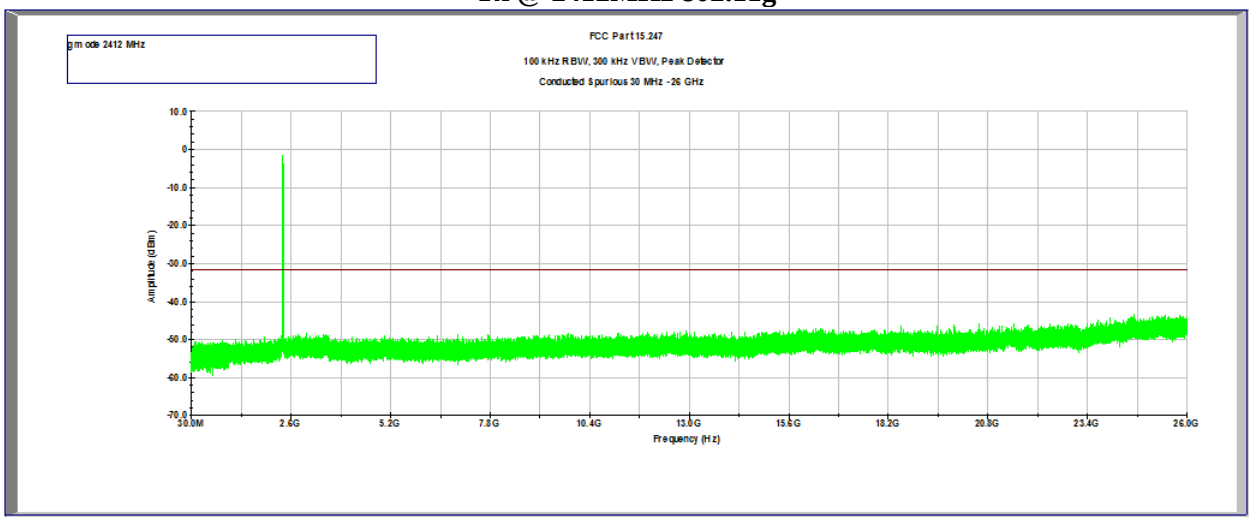
Plot 4.3

Tx @ 2462MHz 802.11b



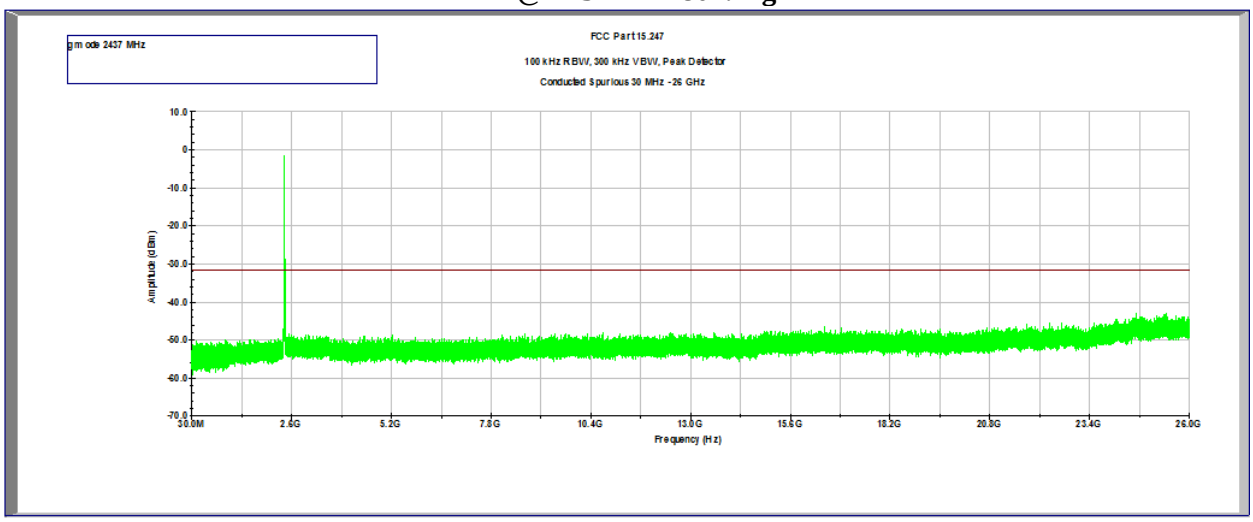
Plot 4.4

Tx @ 2412MHz 802.11g



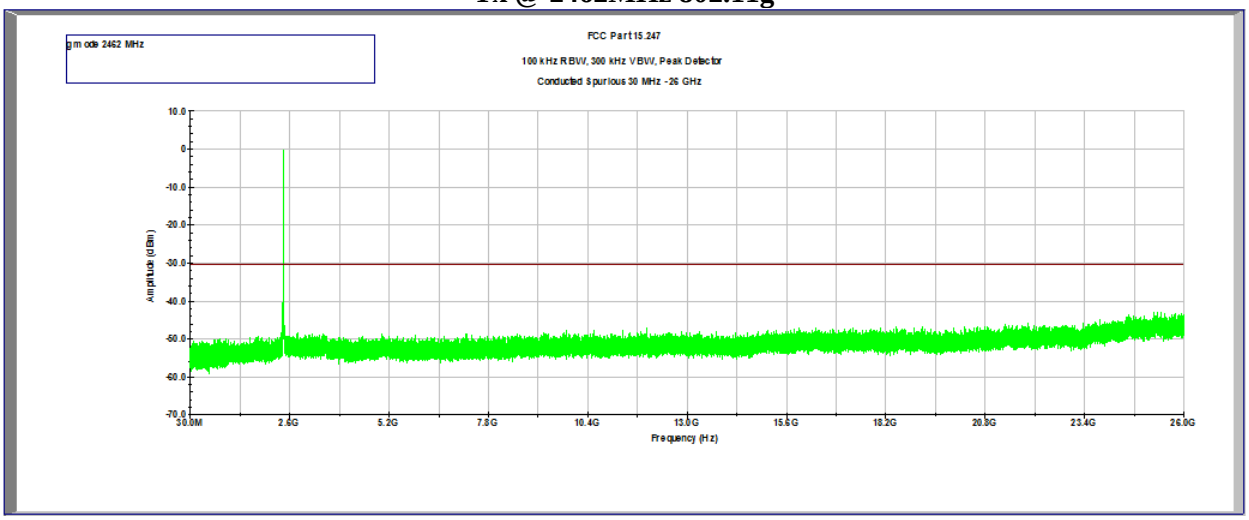
Plot 4.5

Tx @ 2437MHz 802.11g



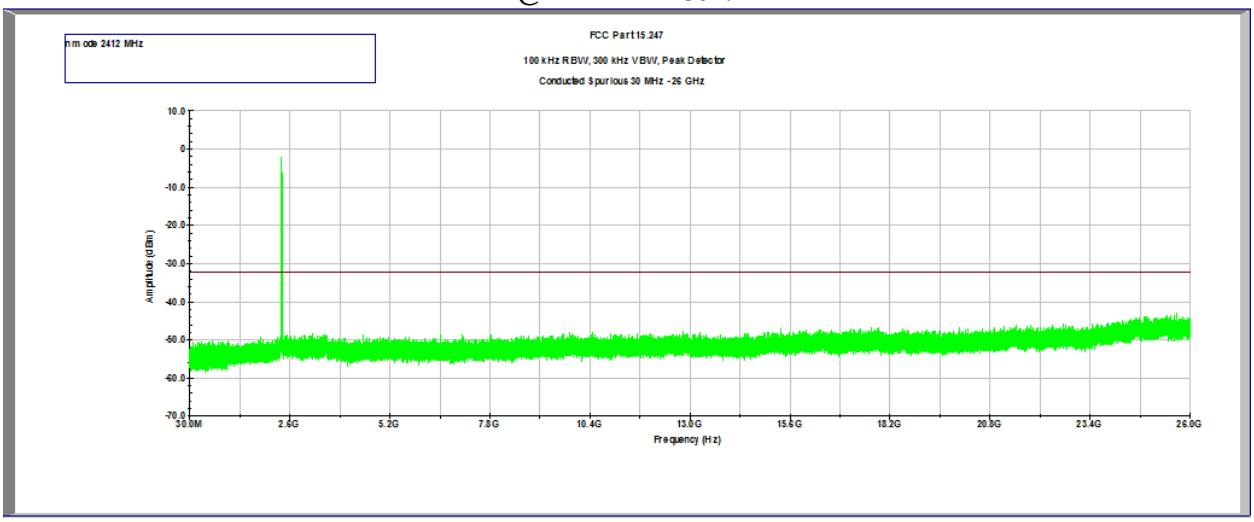
Plot 4.6

Tx @ 2462MHz 802.11g



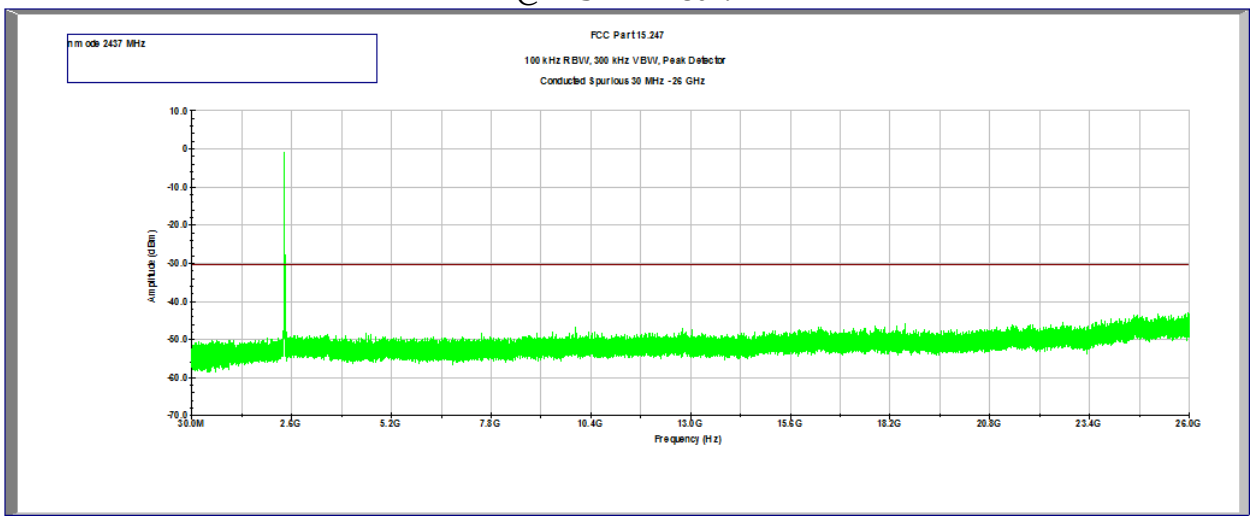
Plot 4.7

Tx @ 2412MHz 802.11n



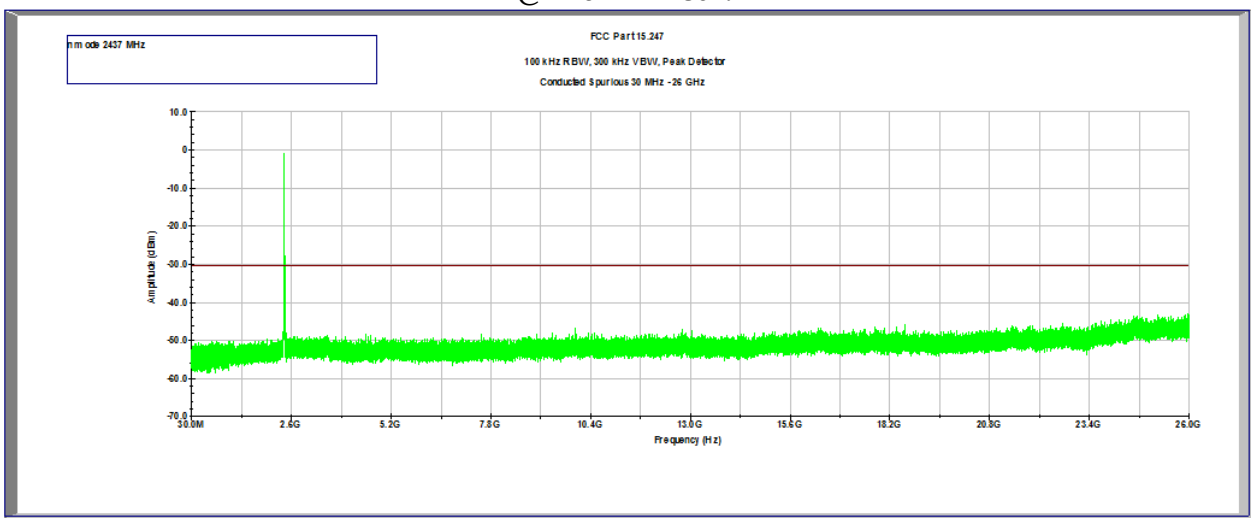
Plot 4.8

Tx @ 2437MHz 802.11n



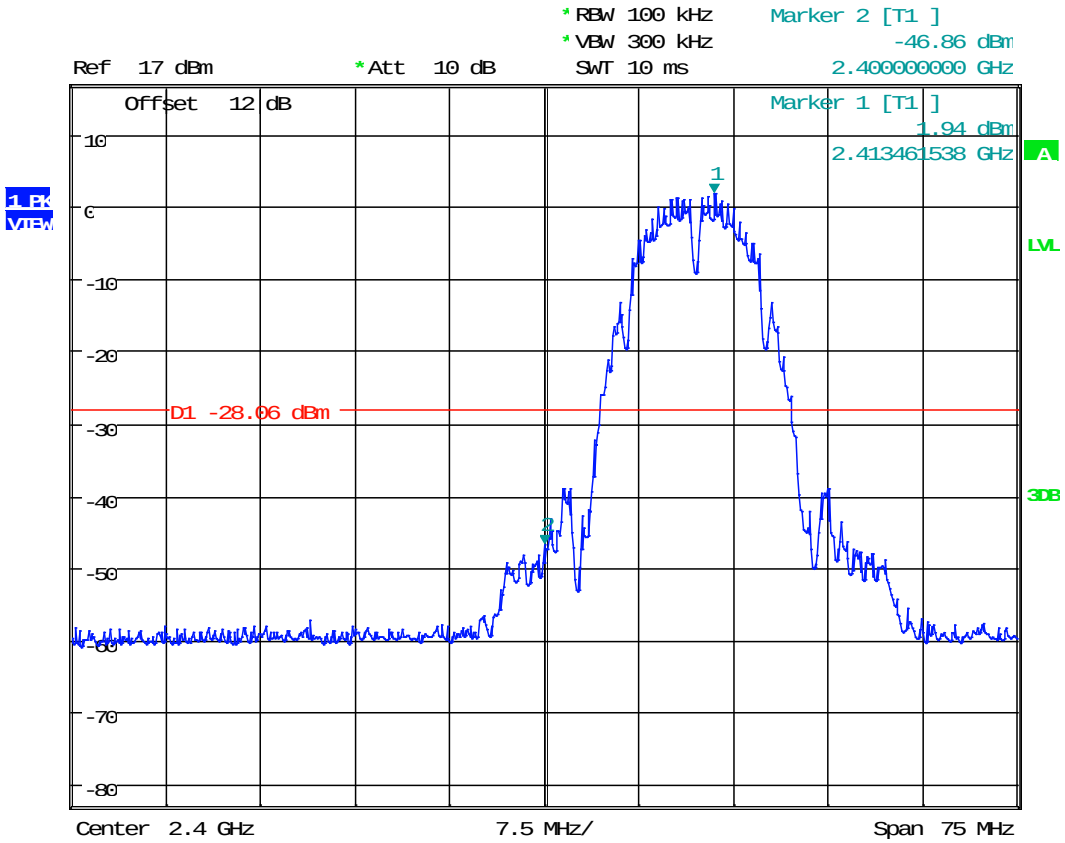
Plot 4.9

Tx @ 2462MHz 802.11n



Plot 4.10

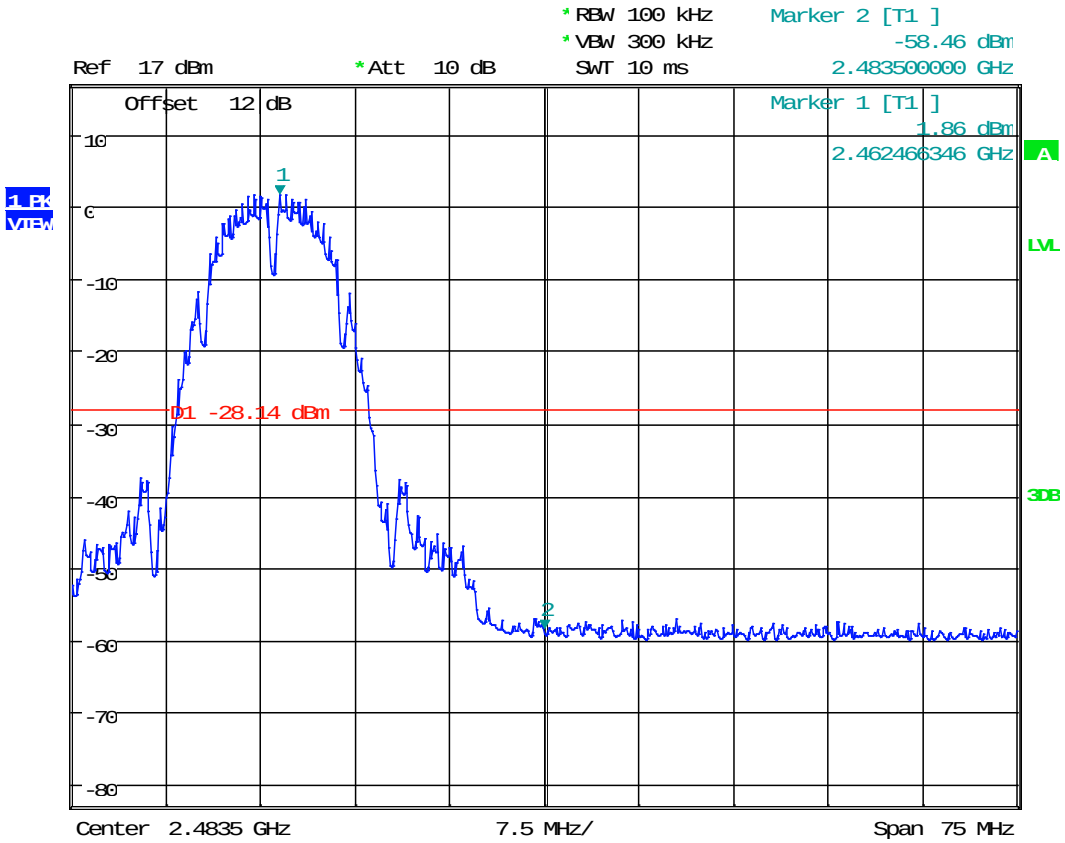
Conducted Band Edge, Tx @ 2412MHz 802.11b



Date: 25.JUN.2019 13:33:43

Plot 4.11

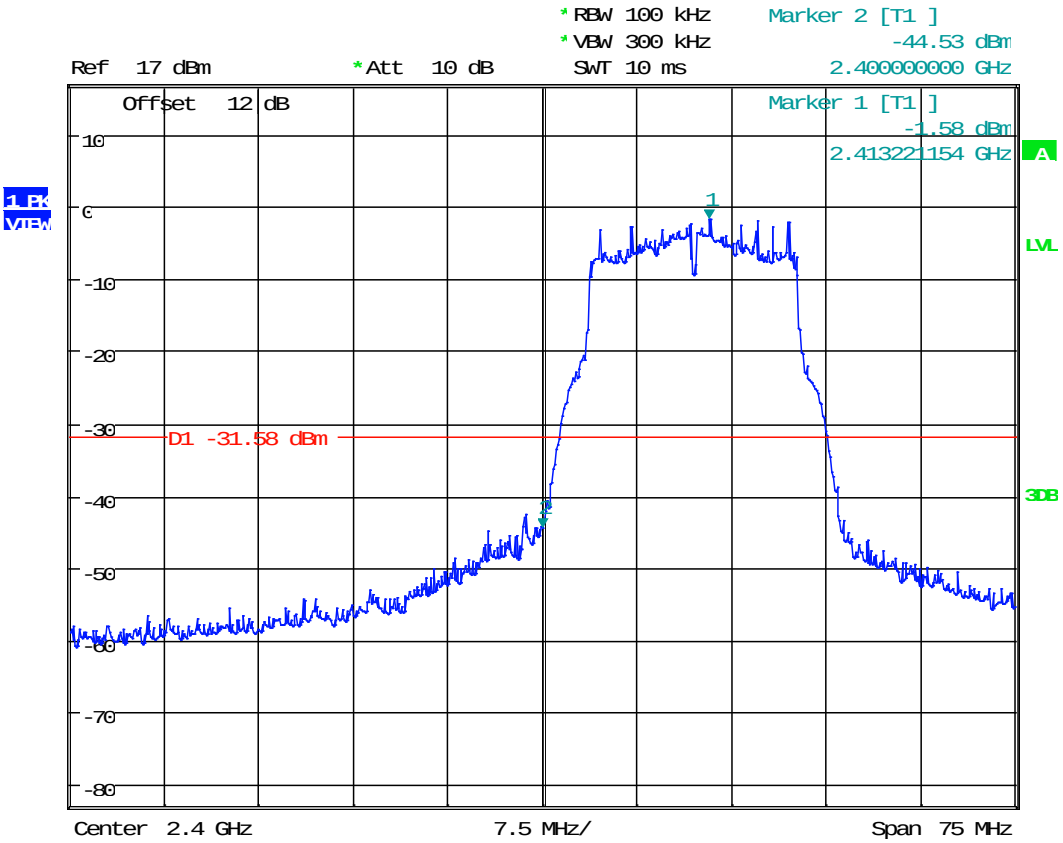
Conducted Band Edge, Tx @ 2462MHz 802.11b



Date: 25.JUN.2019 13:35:17

Plot 4.12

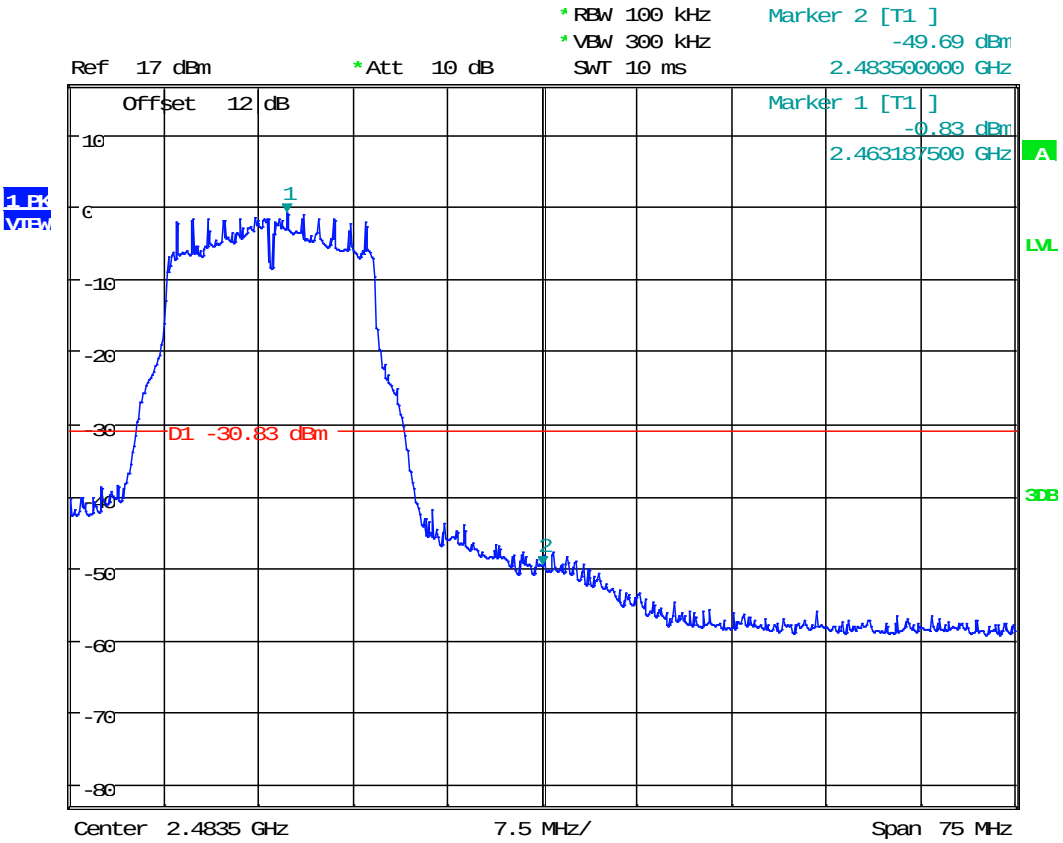
Conducted Band Edge, Tx @ 2412MHz 802.11g



Date: 25.JUN.2019 13:38:58

Plot 4.13

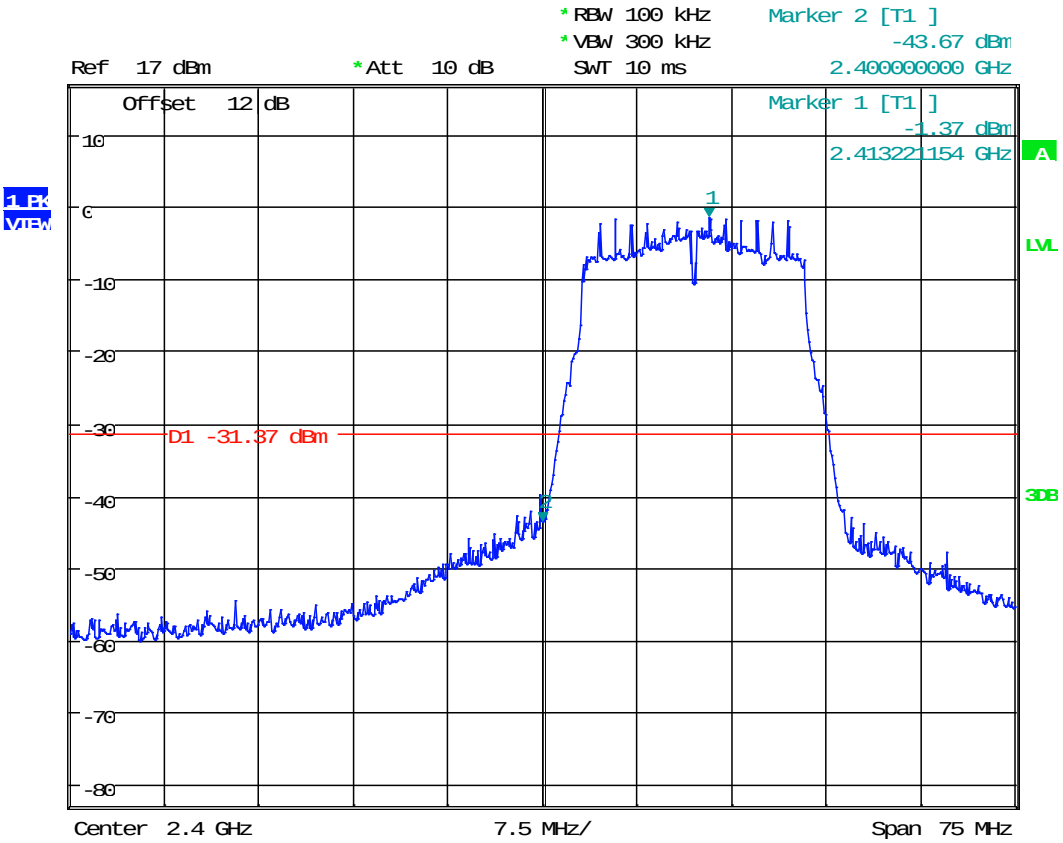
Conducted Band Edge, Tx @ 2462MHz 802.11g



Date: 25.JUN.2019 13:41:20

Plot 4.14

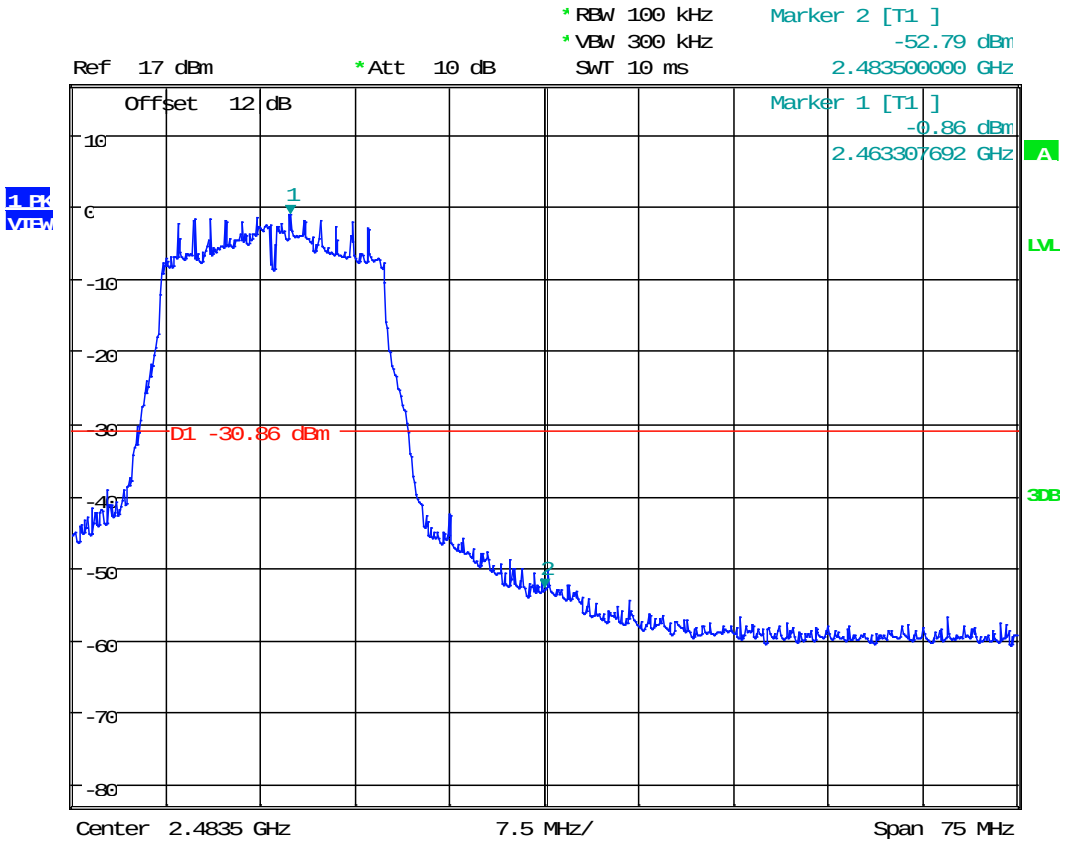
Conducted Band Edge, Tx @ 2412MHz 802.11n



Date: 25.JUN.2019 13:42:26

Plot 4.15

Conducted Band Edge, Tx @ 2462MHz 802.11n



Date: 25.JUN.2019 13:43:28

4.5 Transmitter Radiated Emissions & Antenna Port 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 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 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 1 GHz to 18GHz had a 2.4-2.5GHz notch filter in place. A preamp was used from 30MHz to 26GHz.

All measurements were made with a Peak Detector and compared to QP limits for 30MHz – 1GHz and Average limits for 1GHz – 26GHz.

Radiated measurements were performed on the X, Y and Z orientation of the EUT. Data is presented with 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(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

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
FS = 52.0+7.4+1.6-29.0 = 32 dB(μV/m).
Level in μV/m = Com
mon Antilogarithm [(32 dBμV/m)/20] = 39.8 μV/m.

Tested By	Test Date
Todd Moy	June 25 – August 20, 2019

4.5.4 Antenna-port conducted measurements

Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required.

4.5.6 General Procedure for conducted measurements in restricted bands

a) Measure the conducted output power (in dBm) using the detector specified for determining quasi-peak, peak, and average conducted output power, respectively.

b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)

c) Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).

d) For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (*e.g.*, Watts, mW).

e) Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:
E = EIRP – 20log D + 104.8+DCF (DCF for Average measurements)
where:
E = electric field strength in dBμV/m,
EIRP = equivalent isotropic radiated power in dBm
D = specified measurement distance in meters.
DCF = Duty Cycle Correction Factor
f) Compare the resultant electric field strength level to the applicable limit.
g) Perform radiated spurious emission test

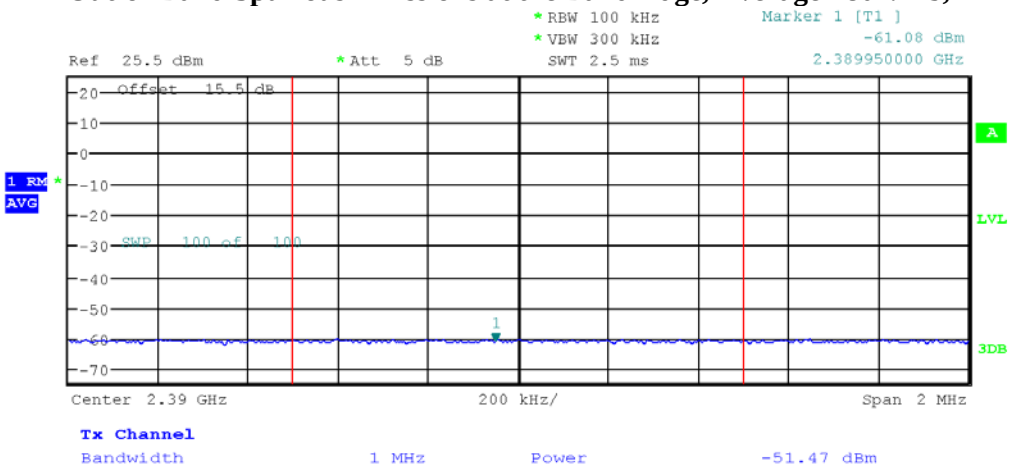
4.5.7 Test Results

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

Conducted Out-of-Band Spurious Emissions at the Band Edge were made with the consideration of cable loss and the addition of a 5dBi Antenna.

Test Results: 15.209/15.205 Restricted Band Emissions at Antenna Port

Out-of-Band Spurious Emissions at the Band Edge, Average - 802.11b, 2412 MHz

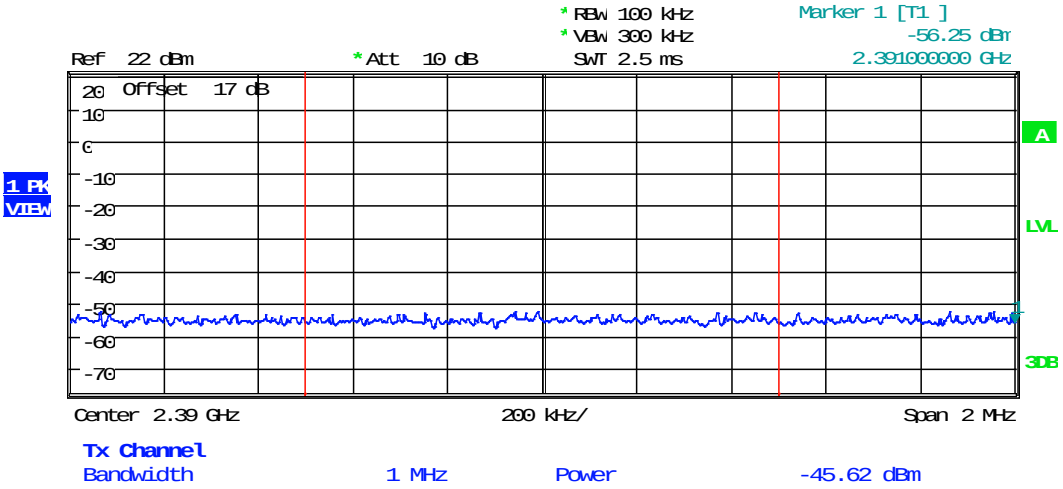


Date: 20.AUG.2019 08:47:54

Frequency	Corrected Amplitude	Corrected Amplitude	Limit	Margin	Detector	Results
GHz	dBm	dB(µV/m)	dB(µV/m)	dB		
2.390	-51.47	43.79	54	-10.21	RMS	Pass

E = Corrected Amplitude – 20log D + 104.8
Corrected Amplitude = EIRP+ δ
D = 3 (meters)
Section 11.13.3.4 "Trace averaging across on- and off-times of the EUT transmissions followed by duty cycle correction" of ANSI 63.10 was utilized per KDB 558074 D01 DTS Meas Guidance v05r02

Out-of-Band Spurious Emissions at the Band Edge, Peak - 802.11b, 2412 MHz

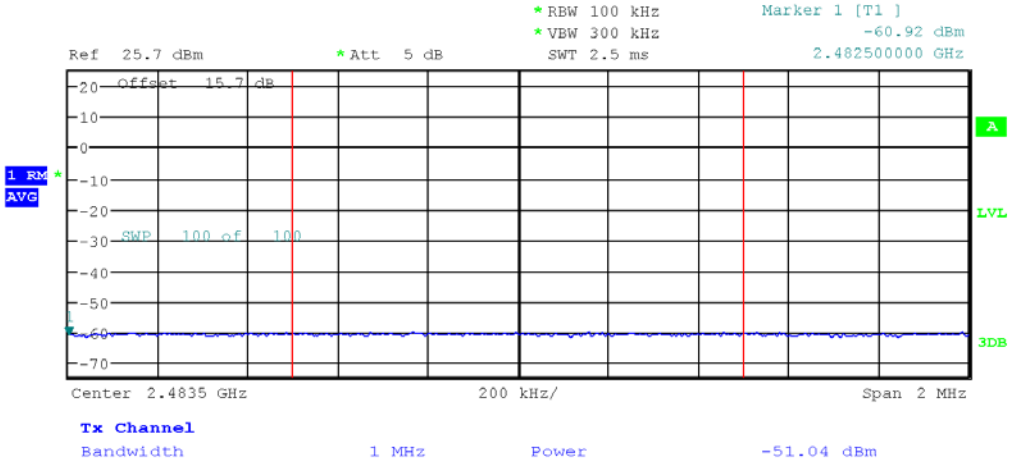


Date: 25.JUN.2019 13:49:10

Frequency	Corrected Amplitude	Corrected Amplitude	Limit	Margin	Detector	Results
GHz	dBm	dB(µV/m)	dB(µV/m)	dB		
2.390	-45.62	48.72	74	-25.28	Peak	Pass

E = Corrected Amplitude – 20log D + 104.8
Corrected Amplitude = EIRP
D = 3 (meters)
Section 11.13.3.2 “Peak detection” of ANSI 63.10 was utilized per KDB 558074 D01 DTS Meas Guidance v05r02

Out-of-Band Spurious Emissions at the Band Edge, Average - 802.11b, 2462 MHz

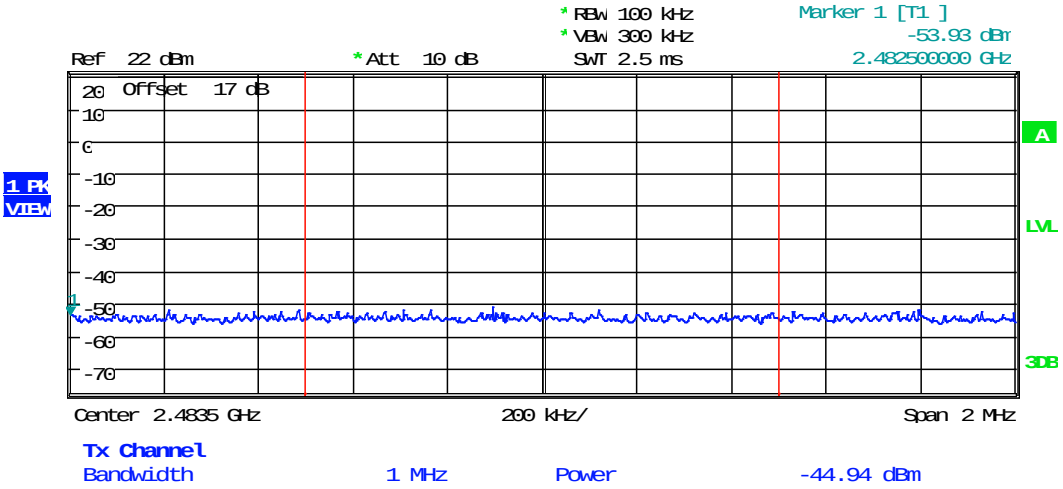


Date: 20.AUG.2019 08:56:09

Frequency	Corrected Amplitude	Corrected Amplitude	Limit	Margin	Detector	Results
GHz	dBm	dB(µV/m)	dB(µV/m)	dB		
2483.5	-51.04	44.22	54	-9.78	RMS	Pass

E = Corrected Amplitude – 20log D + 104.8
Corrected Amplitude = EIRP+ δ
D = 3 (meters)
Section 11.13.3.4 “Trace averaging across on- and off-times of the EUT transmissions followed by duty cycle correction” of ANSI 63.10 was utilized per KDB 558074 D01 DTS Meas Guidance v05r02

Out-of-Band Spurious Emissions at the Band Edge, Peak - 802.11b, 2462 MHz

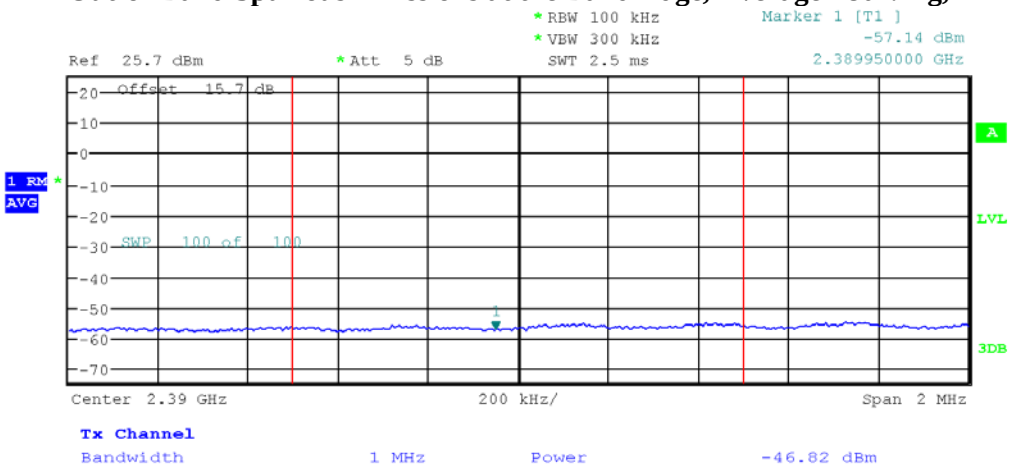


Date: 25.JUN.2019 13:48:38

Frequency	Corrected Amplitude	Corrected Amplitude	Limit	Margin	Detector	Results
GHz	dBm	dB(µV/m)	dB(µV/m)	dB		
2483.5	-44.94	49.40	74	-24.60	Peak	Pass

E = Corrected Amplitude – 20log D + 104.8
Corrected Amplitude = EIRP
D = 3 (meters)
Section 11.13.3.2 “Peak detection” of ANSI 63.10 was utilized per KDB 558074 D01 DTS Meas Guidance v05r02

Out-of-Band Spurious Emissions at the Band Edge, Average - 802.11g, 2412 MHz

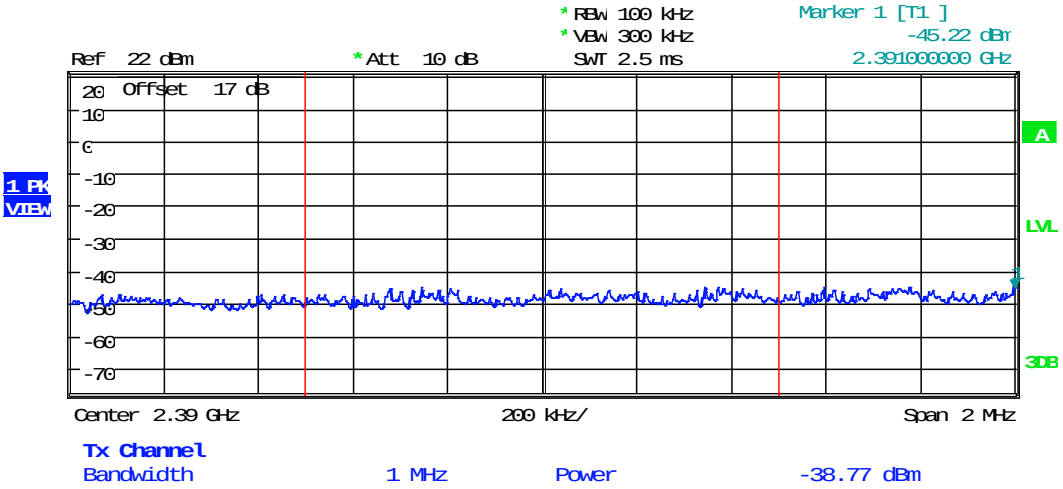


Date: 20.AUG.2019 08:49:35

Frequency	Corrected Amplitude	Corrected Amplitude	Limit	Margin	Detector	Results
GHz	dBm	dB(µV/m)	dB(µV/m)	dB		
2.390	-46.82	48.44	54	-5.56	RMS	Pass

E = Corrected Amplitude – 20log D + 104.8
Corrected Amplitude = EIRP+ δ
D = 3 (meters)
Section 11.13.3.4 “Trace averaging across on- and off-times of the EUT transmissions followed by duty cycle correction” of ANSI 63.10 was utilized per KDB 558074 D01 DTS Meas Guidance v05r02

Out-of-Band Spurious Emissions at the Band Edge, Peak - 802.11g, 2412 MHz

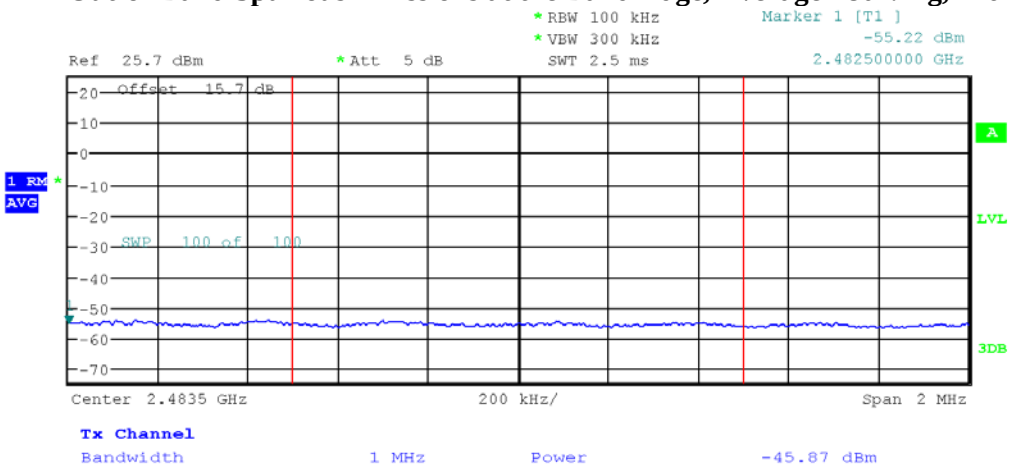


Date: 25.JUN.2019 13:50:40

Frequency	Corrected Amplitude	Corrected Amplitude	Limit	Margin	Detector	Results
GHz	dBm	dB(µV/m)	dB(µV/m)	dB		
2.390	-38.77	55.57	74	-18.43	Peak	Pass

E = Corrected Amplitude – 20log D + 104.8
Corrected Amplitude = EIRP
D = 3 (meters)
Section 11.13.3.2 “Peak detection” of ANSI 63.10 was utilized per KDB 558074 D01 DTS Meas Guidance v05r02

Out-of-Band Spurious Emissions at the Band Edge, Average - 802.11g, 2462 MHz

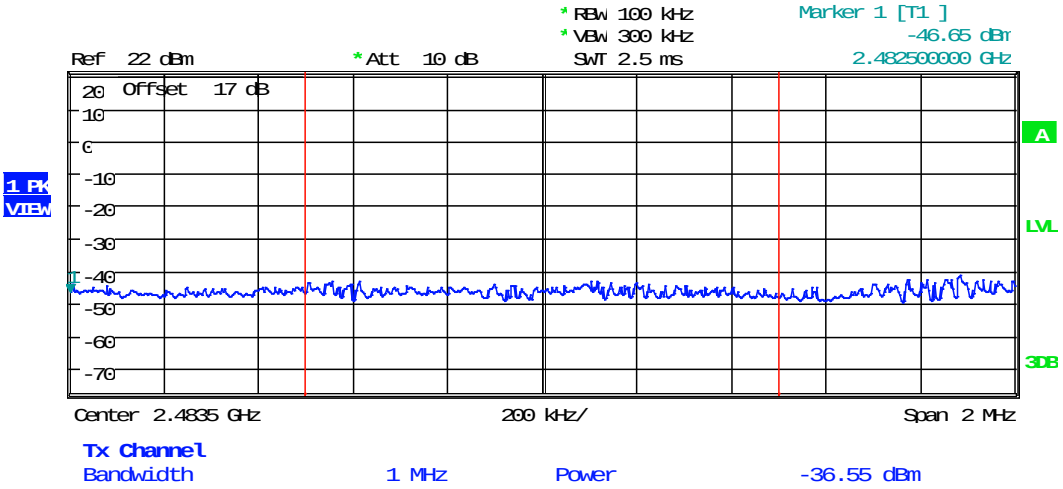


Date: 20.AUG.2019 08:54:02

Frequency	Corrected Amplitude	Corrected Amplitude	Limit	Margin	Detector	Results
GHz	dBm	dB(µV/m)	dB(µV/m)	dB		
2483.5	-45.87	49.39	54	-4.61	RMS	Pass

E = Corrected Amplitude – 20log D + 104.8
Corrected Amplitude = EIRP+ δ
D = 3 (meters)
Section 11.13.3.4 “Trace averaging across on- and off-times of the EUT transmissions followed by duty cycle correction” of ANSI 63.10 was utilized per KDB 558074 D01 DTS Meas Guidance v05r02

Out-of-Band Spurious Emissions at the Band Edge, Peak - 802.11g, 2462 MHz

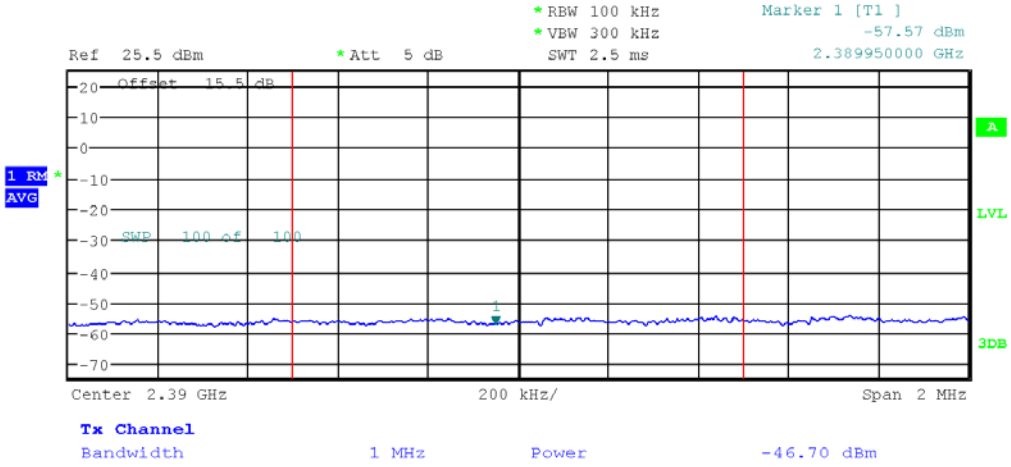


Date: 25.JUN.2019 13:51:27

Frequency	Corrected Amplitude	Corrected Amplitude	Limit	Margin	Detector	Results
GHz	dBm	dB(µV/m)	dB(µV/m)	dB		
2483.5	-36.55	57.79	74	-16.21	Peak	Pass

E = Corrected Amplitude – 20log D + 104.8
Corrected Amplitude = EIRP
D = 3 (meters)
Section 11.13.3.2 “Peak detection” of ANSI 63.10 was utilized per KDB 558074 D01 DTS Meas Guidance v05r02

Out-of-Band Spurious Emissions at the Band Edge, Average - 802.11n, 2412 MHz

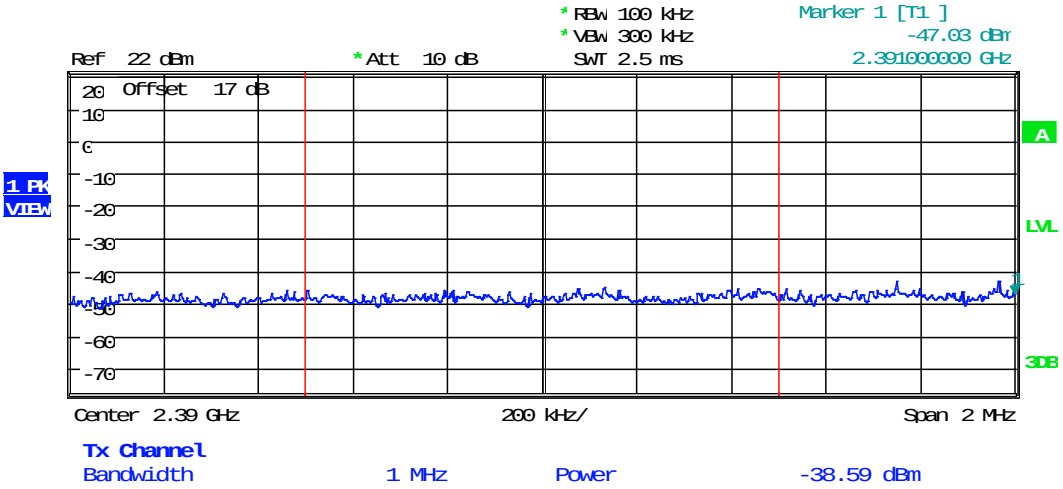


Date: 20.AUG.2019 08:50:53

Frequency	Corrected Amplitude	Corrected Amplitude	Limit	Margin	Detector	Results
GHz	dBm	dB(µV/m)	dB(µV/m)	dB		
2.390	-46.70	48.56	54	-5.44	RMS	Pass

E = Corrected Amplitude – 20log D + 104.8
Corrected Amplitude = EIRP+ δ
D = 3 (meters)
Section 11.13.3.4 “Trace averaging across on- and off-times of the EUT transmissions followed by duty cycle correction” of ANSI 63.10 was utilized per KDB 558074 D01 DTS Meas Guidance v05r02

Out-of-Band Spurious Emissions at the Band Edge, Peak - 802.11n, 2412 MHz

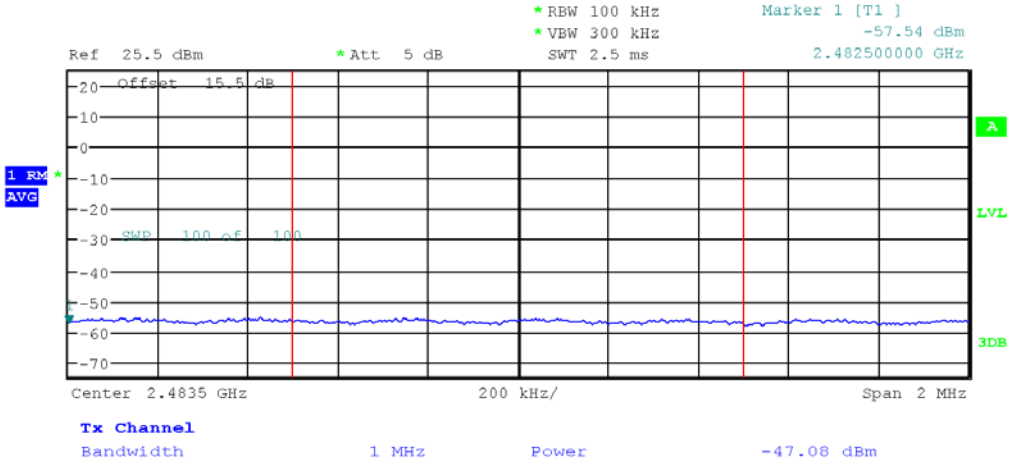


Date: 25.JUN.2019 13:52:29

Frequency	Corrected Amplitude	Corrected Amplitude	Limit	Margin	Detector	Results
GHz	dBm	dB(µV/m)	dB(µV/m)	dB		
2.390	-38.59	55.75	74	-18.25	Peak	Pass

E = Corrected Amplitude – 20log D + 104.8
Corrected Amplitude = EIRP
D = 3 (meters)
Section 11.13.3.2 “Peak detection” of ANSI 63.10 was utilized per KDB 558074 D01 DTS Meas Guidance v05r02

Out-of-Band Spurious Emissions at the Band Edge, Average - 802.11n, 2462 MHz

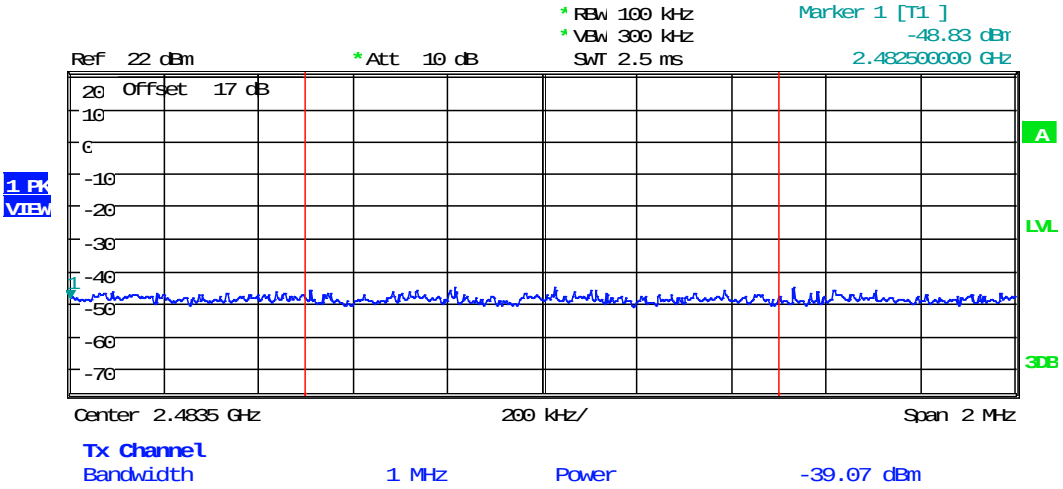


Date: 20.AUG.2019 08:52:18

Frequency	Corrected Amplitude	Corrected Amplitude	Limit	Margin	Detector	Results
GHz	dBm	dB(µV/m)	dB(µV/m)	dB		
2483.5	-47.08	48.18	54	-5.82	RMS	Pass

E = Corrected Amplitude – 20log D + 104.8
Corrected Amplitude = EIRP+ δ
D = 3 (meters)
Section 11.13.3.4 “Trace averaging across on- and off-times of the EUT transmissions followed by duty cycle correction” of ANSI 63.10 was utilized per KDB 558074 D01 DTS Meas Guidance v05r02

Out-of-Band Spurious Emissions at the Band Edge, Peak - 802.11n, 2462 MHz



Date: 25.JUN.2019 13:53:45

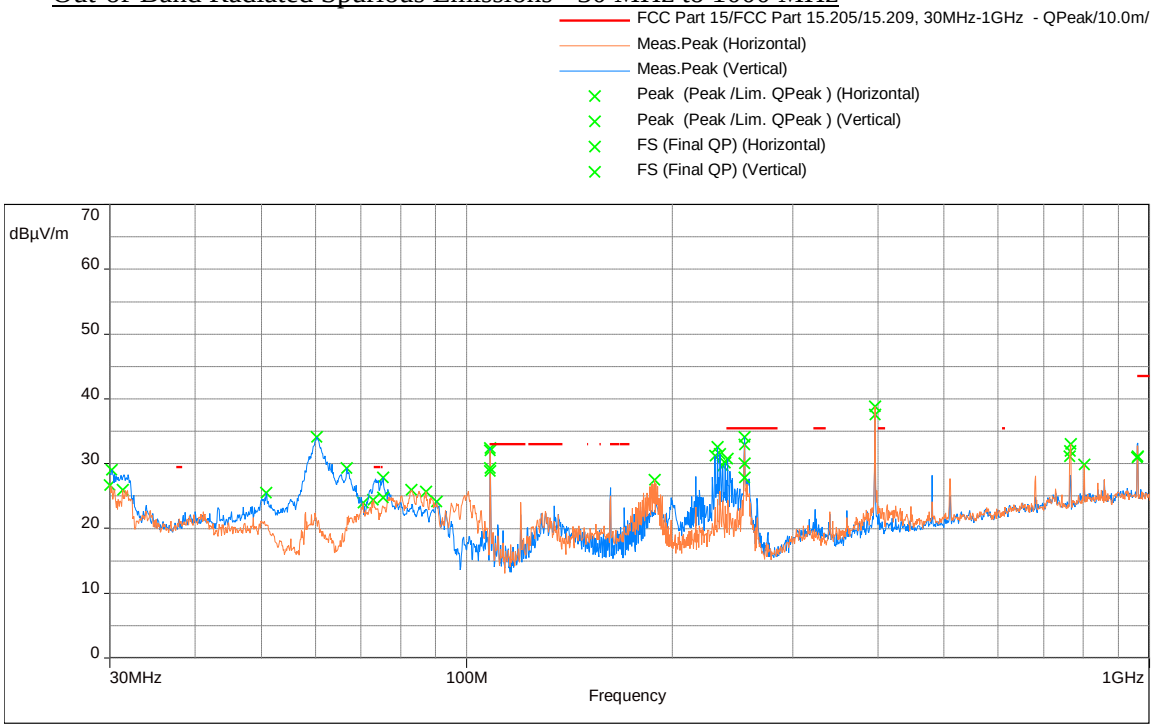
Frequency	Corrected Amplitude	Corrected Amplitude	Limit	Margin	Detector	Results
GHz	dBm	dB(µV/m)	dB(µV/m)	dB		
2483.5	-39.07	55.27	74	-18.73	Peak	Pass

E = Corrected Amplitude – 20log D + 104.8
Corrected Amplitude = EIRP
D = 3 (meters)
Section 11.13.3.2 “Peak detection” of ANSI 63.10 was utilized per KDB 558074 D01 DTS Meas Guidance v05r02

Out-of-Band Radiated Spurious Emissions

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11b 2412MHz

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



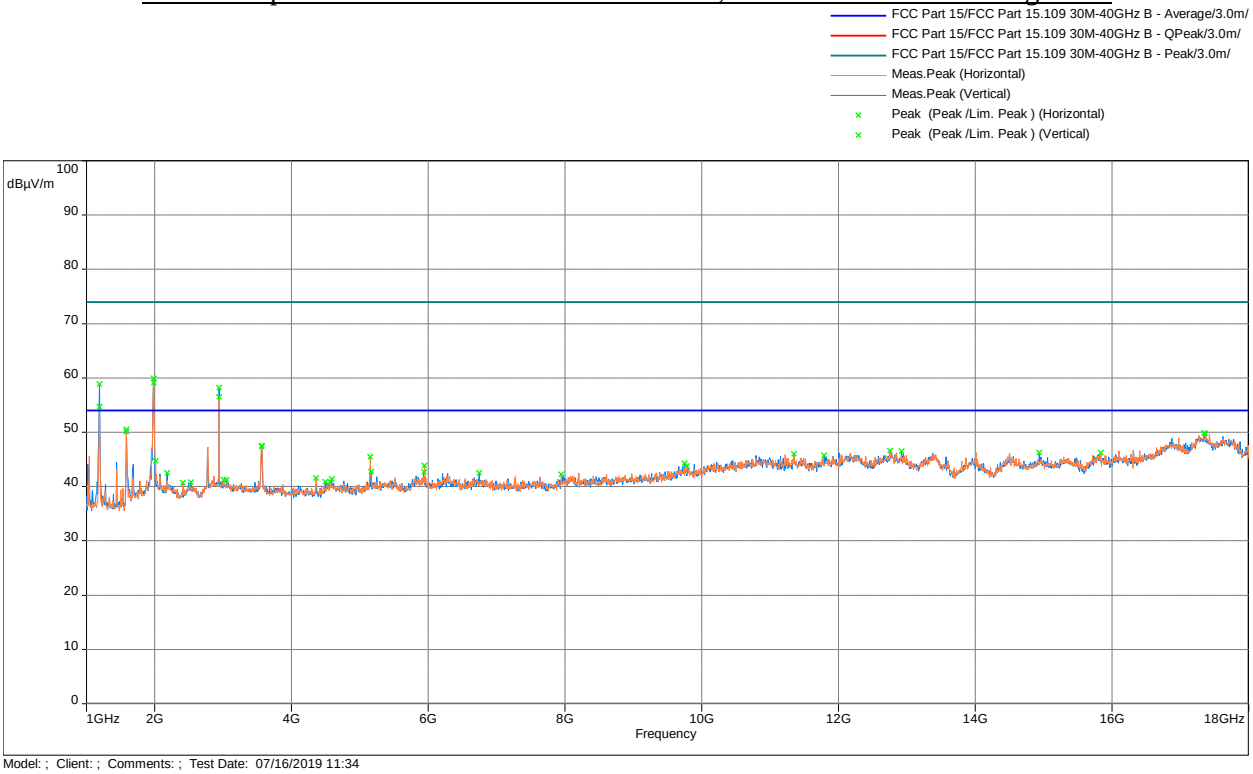
Model: ; Client: ; Comments: ; Test Date: 07/17/2019 14:38

Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
75.414	24.7	29.5	-4.8	2.52	86.5	Vertical	43.1	-18.4
108.116	29.3	33.0	-3.7	4	131	Horizontal	43.6	-14.3
108.184	28.8	33.0	-4.2	1.29	224.75	Vertical	43.2	-14.3
255.051	27.8	35.5	-7.7	3.8	11	Horizontal	39.4	-11.6
255.130	30.0	35.5	-5.5	1	224.25	Vertical	41.6	-11.6
960.020	30.9	43.5	-12.6	1	47.5	Horizontal	31.1	-0.1
960.351	31.1	43.5	-12.4	1.7	299.75	Vertical	31.3	-0.1

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
60.329	34.1	54.8*	-20.7	3	304.5	Vertical	49.5	-15.4
66.731	29.3	54.8*	-25.5	2	97	Vertical	46.3	-17.0
396.110	38.8	54.8*	-16.0	2.98	302.75	Horizontal	46.4	-7.6
396.110	37.6	54.8*	-17.2	1	184.5	Vertical	45.2	-7.6

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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



Model: ; Client: ; Comments: ; Test Date: 07/16/2019 11:34

Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.109	38.4	54	-15.6	173.25	1.25	Vertical	-16.1
1188.294	35.1	54	-18.9	66.5	3.24	Horizontal	-16.1

Note: Final average measurements were performed using section 11.12.2.5.2 of ANSI 63.10; when utilizing 11.12.2.5.2, the Trace mode was set to Max Hold and the measurement correction factor in 11.12.2.5.2 i) is not added (reference KDB 558074 D01 DTS Meas Guidance v05r02; FAQ #3(b)).

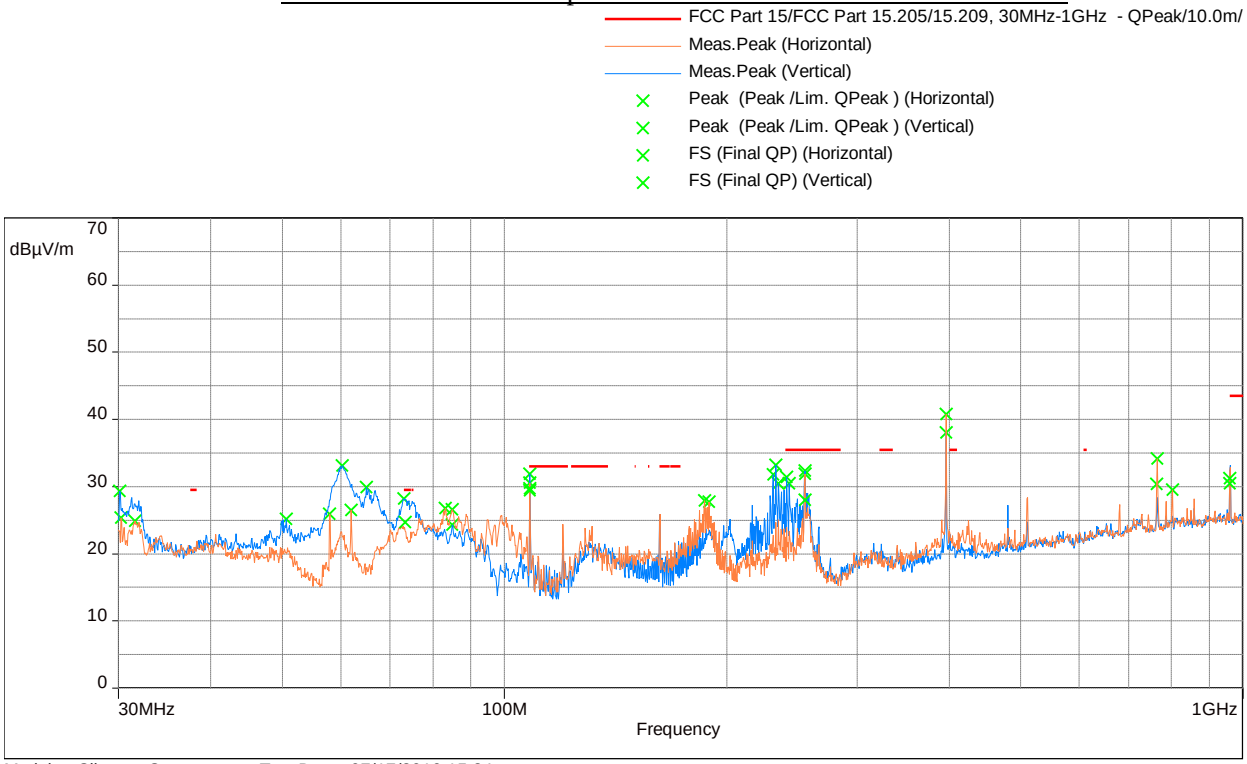
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1980.333	59.1	65.26*	-6.2	7.75	1.26	Vertical	-13.5
1980.333	59.9	65.26*	-5.4	26.5	1.26	Horizontal	-13.5
2939.700	56.5	65.26*	-8.8	342.75	3.23	Horizontal	-12.4
2940.267	57.3	65.26*	-7.9	123.5	3.24	Vertical	-12.4

Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11b 2437MHz

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



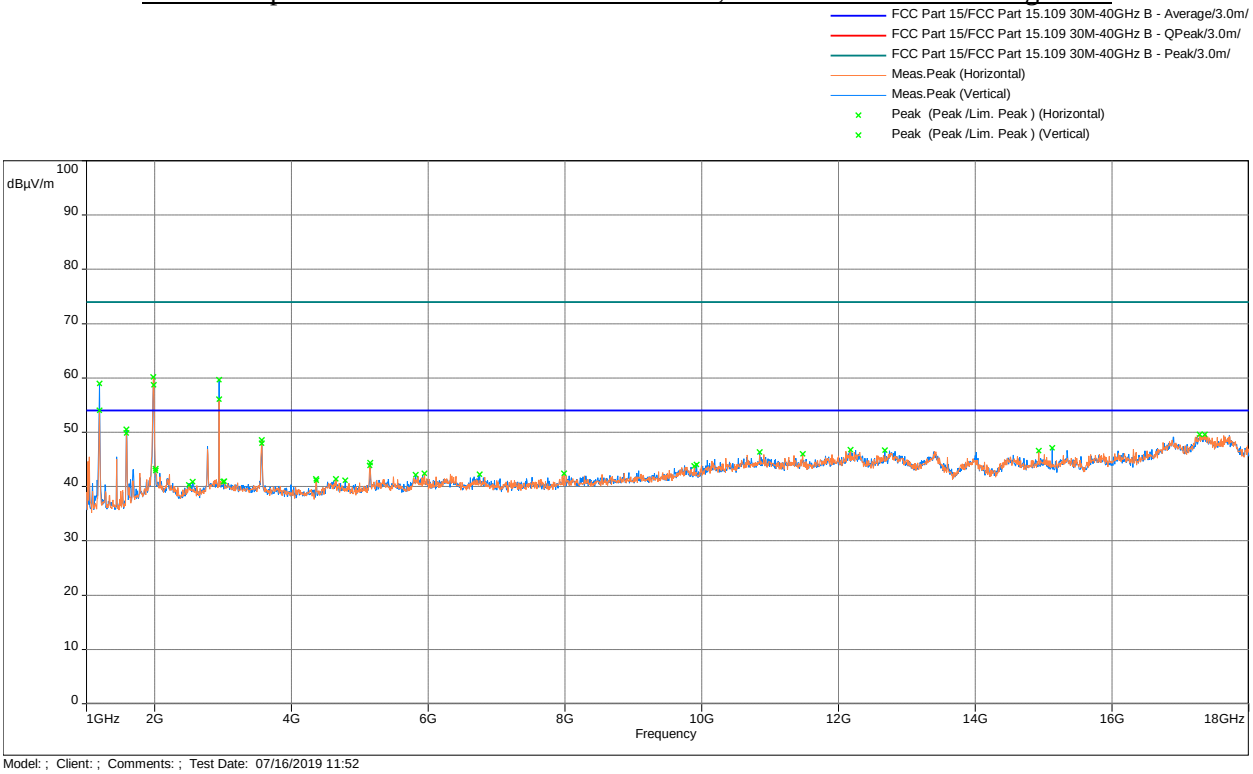
Model: ; Client: ; Comments: ; Test Date: 07/17/2019 15:24

Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
73.381	24.7	29.5	-4.8	85.25	3.01	Vertical	42.9	-18.2
108.197	29.5	33.0	-3.5	218.5	1.25	Vertical	43.8	-14.3
108.213	29.7	33.0	-3.3	310.25	4	Horizontal	44.0	-14.3
255.054	28.0	35.5	-7.5	20.5	3.29	Horizontal	39.6	-11.6
960.220	31.2	43.5	-12.3	299	1.98	Vertical	31.4	-0.1
960.251	30.5	43.5	-13.1	123.5	1.12	Horizontal	30.6	-0.1

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
60.296	33.1	55.4*	-22.3	298.75	3.99	Vertical	48.5	-15.4
61.978	26.5	55.4*	-29.0	234.75	1.98	Horizontal	43.5	-17.0
396.110	40.8	55.4*	-14.6	84.5	1.98	Horizontal	48.4	-7.6
396.110	38.1	55.4*	-17.4	186.25	1	Vertical	45.7	-7.6

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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



Model: ; Client: ; Comments: ; Test Date: 07/16/2019 11:52

Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.414	36.4	54	-17.6	70.75	2.1	Horizontal	-16.1
1188.171	39.4	54	-14.6	173.5	1.66	Vertical	-16.1

Note: Final average measurements were performed using section 11.12.2.5.2 of ANSI 63.10; when utilizing 11.12.2.5.2, the Trace mode was set to Max Hold and the measurement correction factor in 11.12.2.5.2 i) is not added (reference KDB 558074 D01 DTS Meas Guidance v05r02; FAQ #3(b)).

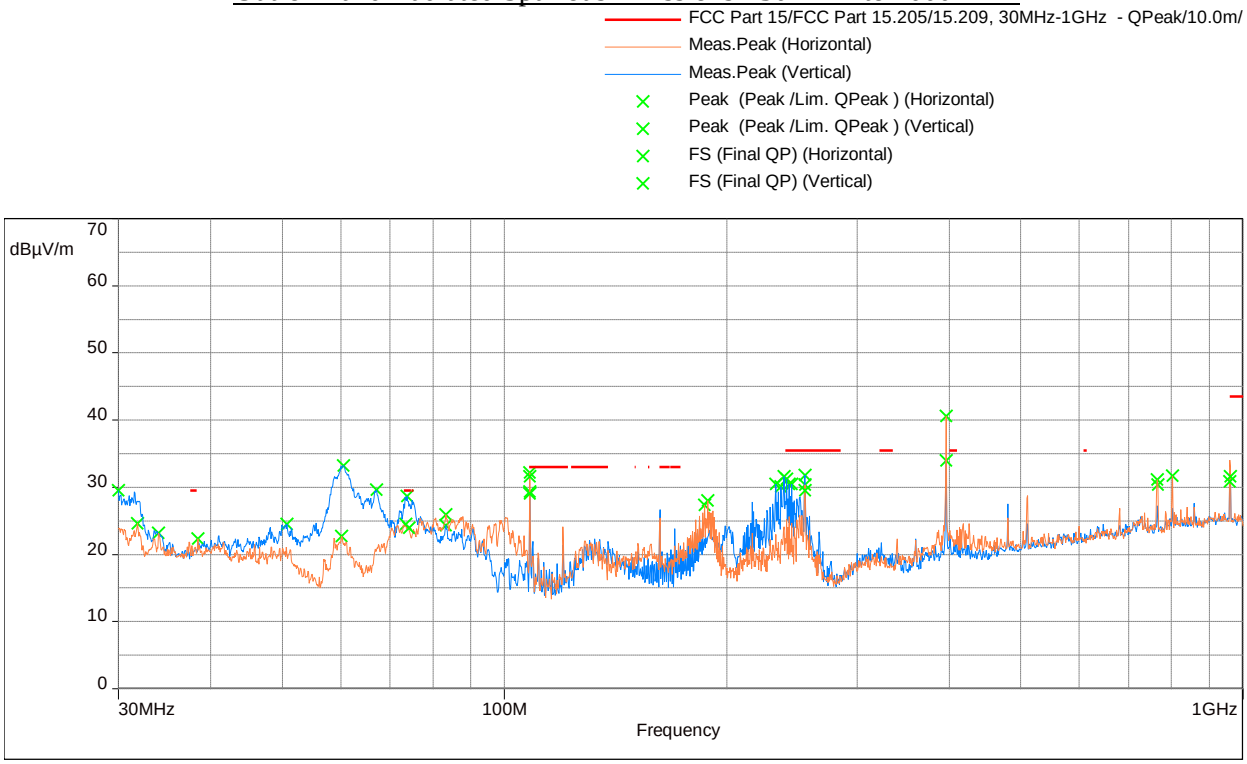
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1979.200	60.2	65.9*	-5.7	8.25	1.25	Horizontal	-13.5
1980.900	58.7	65.9*	-7.2	351.75	2.24	Vertical	-13.5
2939.133	59.6	65.9*	-6.3	208.25	2.24	Vertical	-12.4
2939.133	56.1	65.9*	-9.8	343.25	3.23	Horizontal	-12.4

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11b 2462MHz

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



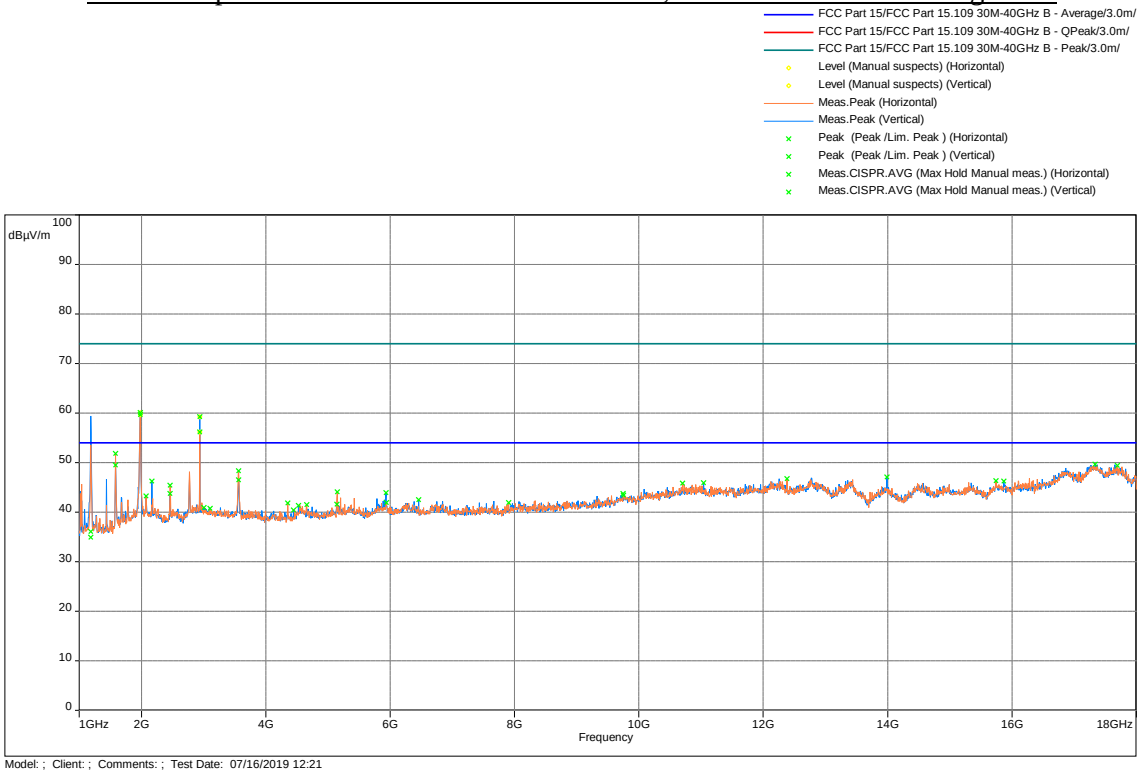
Model: ; Client: ; Comments: ; Test Date: 07/17/2019 16:07

Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
74.152	23.9	29.5	-5.6	2.52	87.5	Vertical	42.2	-18.2
108.100	29.1	33.0	-3.9	1.7	216.5	Vertical	43.4	-14.3
108.206	31.6	33.0	-1.4	4	134.75	Horizontal	46.0	-14.3
255.086	29.5	35.5	-6.0	1	235	Vertical	41.1	-11.6
960.040	30.8	43.5	-12.7	1	50.25	Horizontal	31.0	-0.1
960.335	31.6	43.5	-11.9	1.71	298.5	Vertical	31.7	-0.1

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
60.038	33.2	56.4*	-23.3	318.25	3	Vertical	48.6	-15.4
67.054	29.6	56.4*	-26.8	106	3	Vertical	46.6	-17.0
396.110	34.0	56.4*	-22.4	194.75	1	Vertical	41.6	-7.6
396.110	40.6	56.4*	-15.8	169.25	1.98	Horizontal	48.2	-7.6

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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



Model: ; Client: ; Comments: ; Test Date: 07/16/2019 12:21

Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.294	34.9	54	-19.1	1.39	35.75	Horizontal	-16.1
1188.532	36.1	54	-17.9	3.24	19.25	Vertical	-16.1

Note: Final average measurements were performed using section 11.12.2.5.2 of ANSI 63.10; when utilizing 11.12.2.5.2, the Trace mode was set to Max Hold and the measurement correction factor in 11.12.2.5.2 i) is not added (reference KDB 558074 D01 DTS Meas Guidance v05r02; FAQ #3(b)).

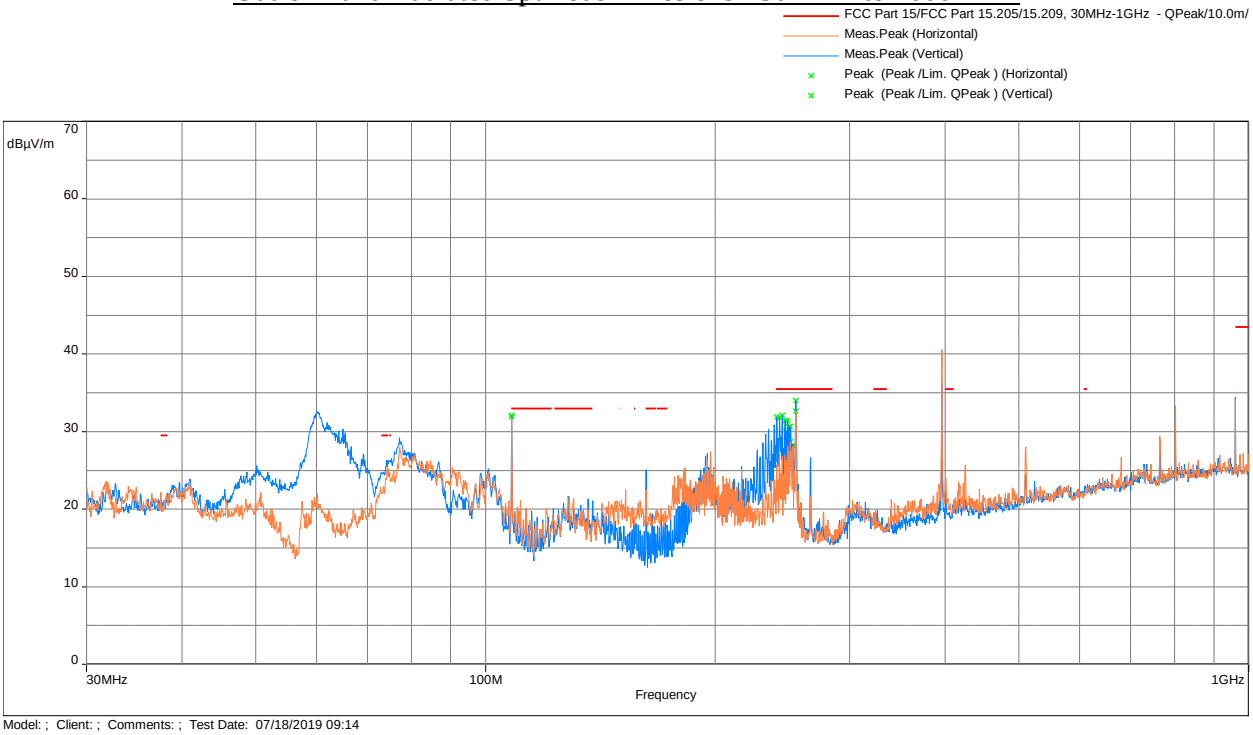
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1979.77	60.1	66.9*	-6.8	342.75	3.24	Vertical	-13.5
1980.33	59.7	66.9*	-7.2	18	2.27	Horizontal	-13.5
2937.43	56.2	66.9*	-10.7	351.5	3.24	Horizontal	-12.4
2938.00	59.3	66.9*	-7.6	231.5	1.26	Vertical	-12.4

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11g 2412MHz

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



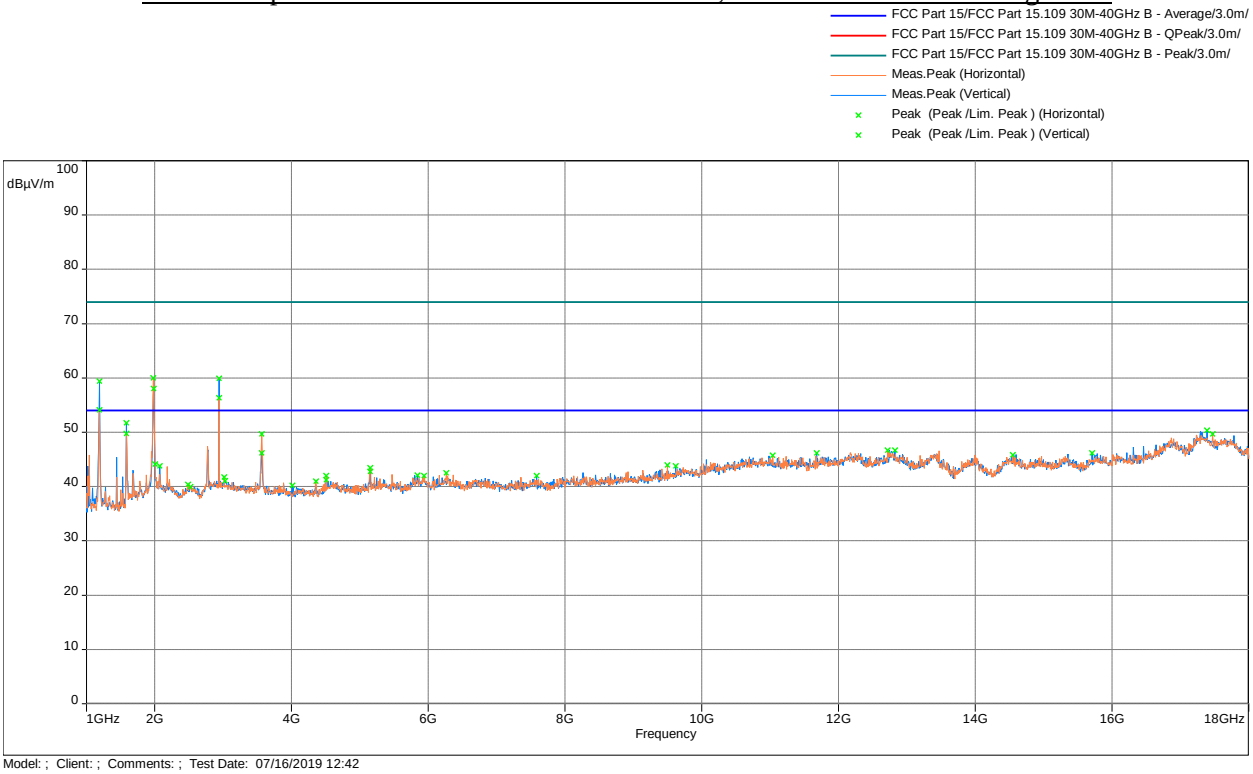
Model: ; Client: ; Comments: ; Test Date: 07/18/2019 09:14

Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
108.228	30.4	33	-2.6	197.5	1.24	Vertical	44.7	-14.3
108.275	30.8	33	-2.2	137.25	4	Horizontal	45.2	-14.3
255.084	29.4	35.5	-6.1	131.5	1	Vertical	40.9	-11.6
255.106	28.0	35.5	-7.6	175.5	3.65	Horizontal	39.5	-11.6

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
60.102	32.6	53.3*	-20.7	293.5	3	Vertical	48.0	-15.4
396.110	40.6	53.3*	-12.7	319.25	2.02	Horizontal	48.2	-7.6
396.110	36.3	53.3*	-16.9	187.5	0.99	Vertical	43.9	-7.6

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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



Model: ; Client: ; Comments: ; Test Date: 07/16/2019 12:42

Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.294	40.3	54	-13.7	1.66	170	Vertical	-16.1
1188.358	35.3	54	-18.7	3.24	36.25	Horizontal	-16.1

Note: Final average measurements were performed using section 11.12.2.5.2 of ANSI 63.10; when utilizing 11.12.2.5.2, the Trace mode was set to Max Hold and the measurement correction factor in 11.12.2.5.2 i) is not added (reference KDB 558074 D01 DTS Meas Guidance v05r02; FAQ #3(b)).

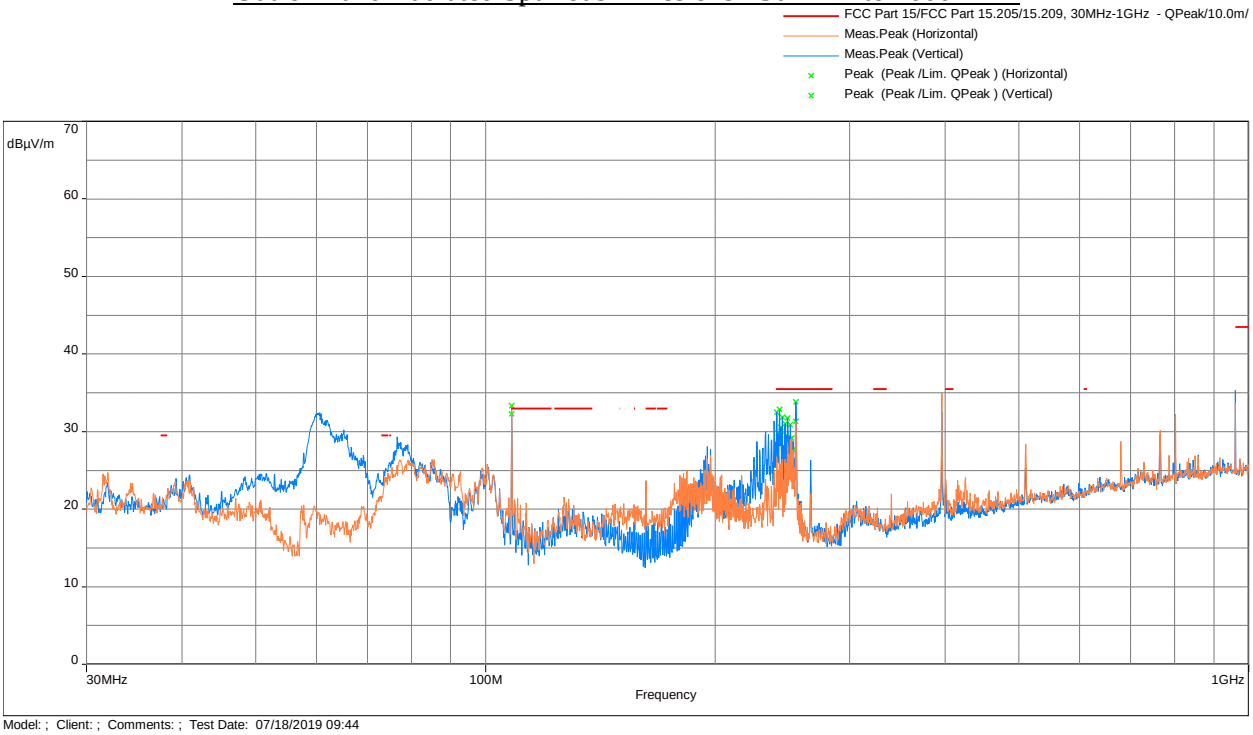
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1979.767	60.0	63.7*	-3.7	26.5	1.26	Horizontal	-13.5
1980.333	58.1	63.7*	-5.7	343.25	3.24	Vertical	-13.5
2938	59.9	63.7*	-3.8	240	1.26	Vertical	-12.4
2938	56.3	63.7*	-7.4	351.5	3.23	Horizontal	-12.4

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11g 2437MHz

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



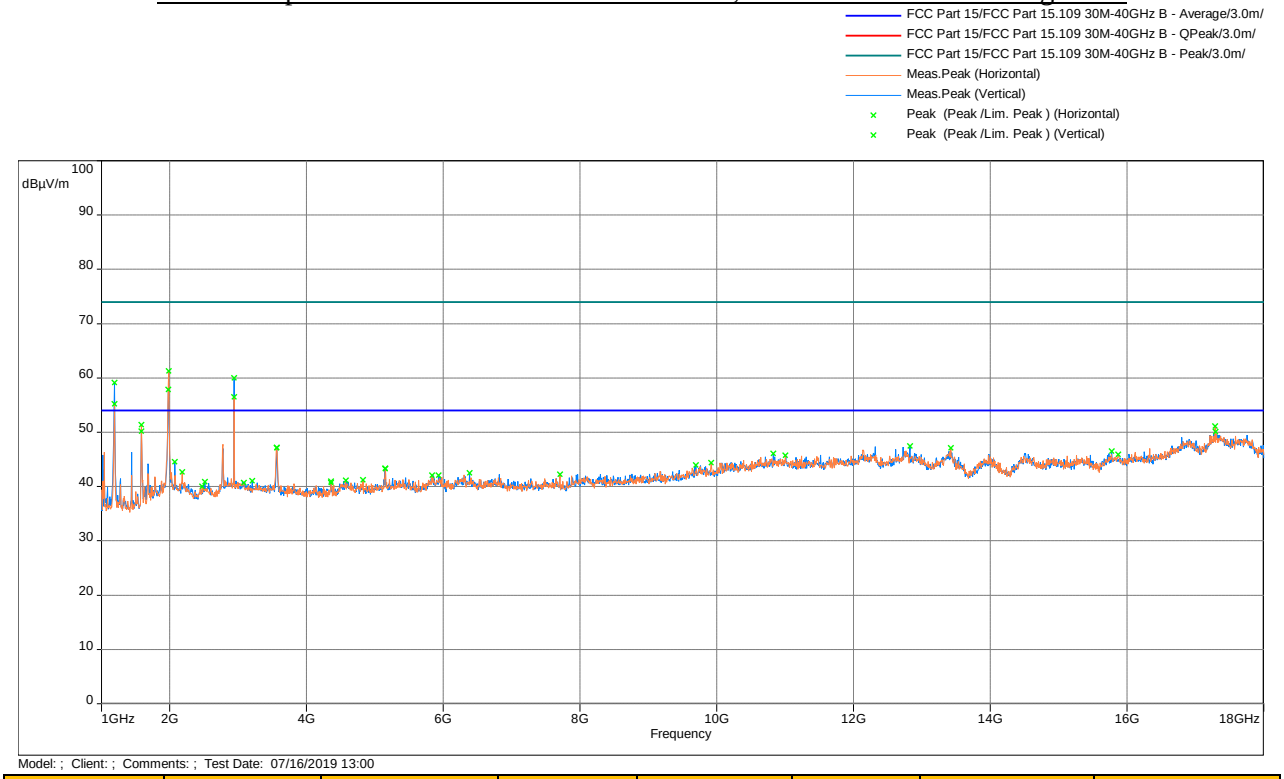
Model: ; Client: ; Comments: ; Test Date: 07/18/2019 09:44

Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
108.222	28.8	33	-4.2	216.25	2.41	Vertical	43.2	-14.3
108.232	29.5	33	-3.5	323	4	Horizontal	43.8	-14.3
242.743	30.4	35.5	-5.1	319.25	1.01	Vertical	41.8	-11.4
255.048	29.7	35.5	-5.8	131.75	1	Vertical	41.3	-11.6
255.054	27.8	35.5	-7.8	185.5	3.68	Horizontal	39.3	-11.6

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
60.102	32.6	53.3*	-20.7	293.5	3	Vertical	48.0	-15.4
396.110	36.3	53.3*	-16.9	187.5	0.99	Vertical	43.9	-7.6
396.110	40.6	53.3*	-12.7	319.25	2.02	Horizontal	48.2	-7.6

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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



Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.165	36.5	54	-17.5	3.25	19	Vertical	-16.1
1188.229	35.2	54	-18.8	1.4	36	Horizontal	-16.1

Note: Final average measurements were performed using section 11.12.2.5.2 of ANSI 63.10; when utilizing 11.12.2.5.2, the Trace mode was set to Max Hold and the measurement correction factor in 11.12.2.5.2 i) is not added (reference KDB 558074 D01 DTS Meas Guidance v05r02; FAQ #3(b))

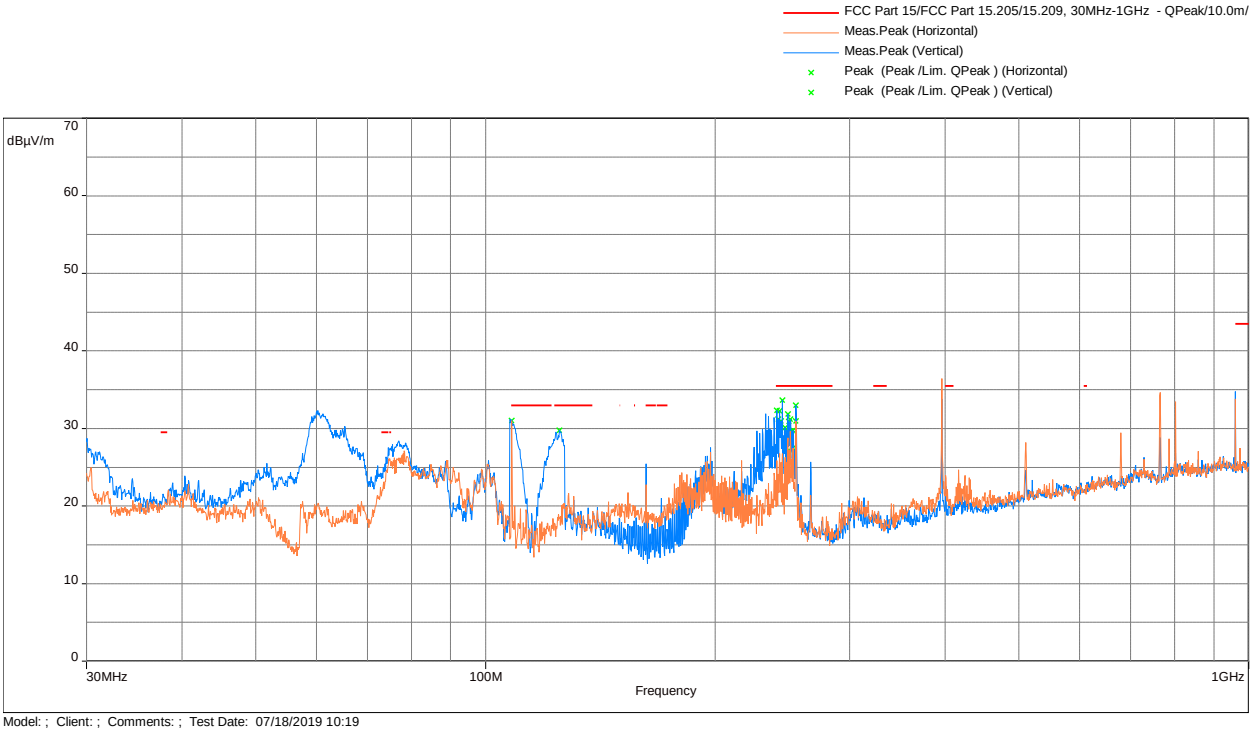
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1979.200	57.8	63.7*	-5.9	16.75	1.26	Vertical	-13.5
1980.333	61.3	63.7*	-2.4	25.75	1.27	Horizontal	-13.5
2938.000	60.0	63.7*	-3.7	240.25	1.26	Vertical	-12.4
2938.000	56.5	63.7*	-7.2	351	3.25	Horizontal	-12.4

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11g 2462MHz

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



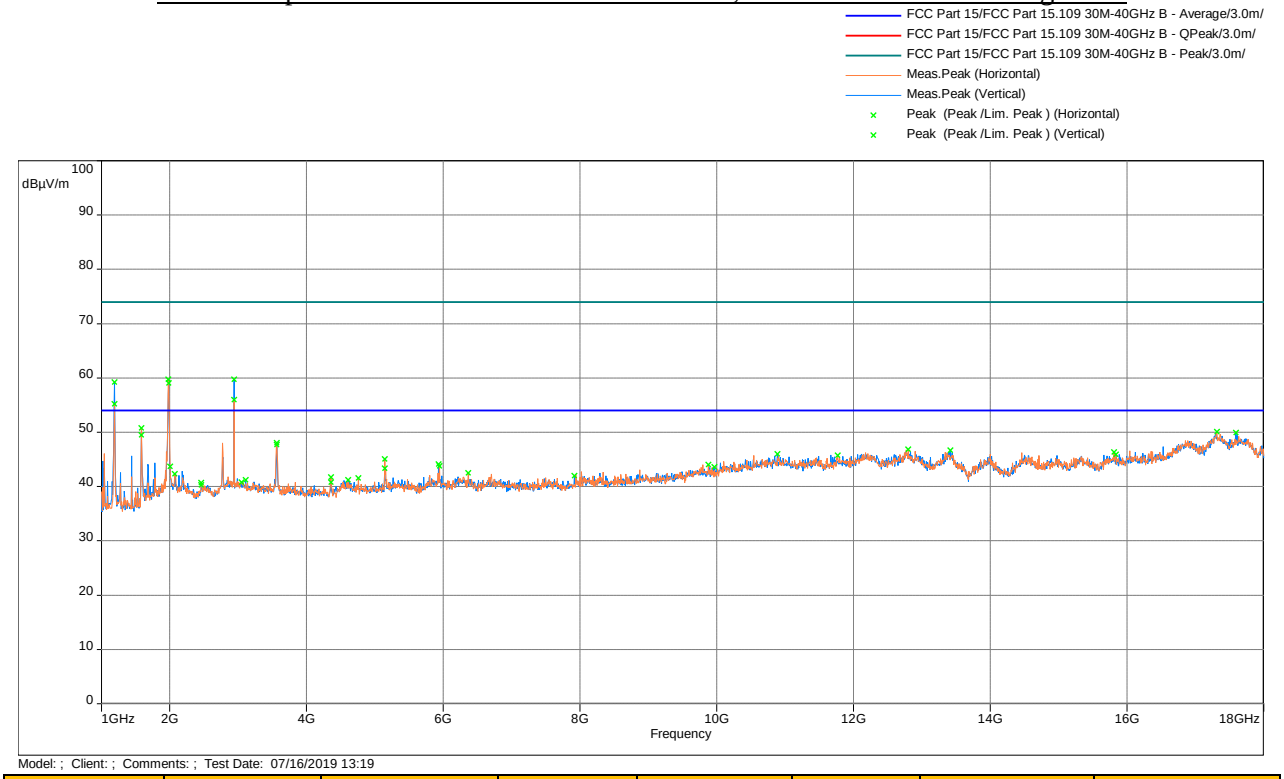
Model: ; Client: ; Comments: ; Test Date: 07/18/2019 10:19

Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
108.218	29.7	33	-3.3	141	3.96	Horizontal	44.0	-14.3
108.256	24.0	33	-9.1	359	1.2	Vertical	38.3	-14.3
124.744	13.5	33	-19.5	360	1.08	Vertical	25.6	-12.1
244.888	27.8	35.5	-7.7	326	1.12	Vertical	39.3	-11.6
255.046	26.2	35.5	-9.3	8	3.75	Horizontal	37.8	-11.6
255.137	29.5	35.5	-6.0	231	1	Vertical	41.0	-11.6

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
60.329	32.3	53.3*	-20.9	274.25	3	Vertical	47.7	-15.4
396.110	33.8	53.3*	-19.4	180.5	1	Vertical	41.4	-7.6
396.110	36.5	53.3*	-16.8	250	1.98	Horizontal	44.1	-7.6

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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



Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.414	40.1	54	-13.9	1.67	171.5	Vertical	-16.1
1188.229	35.2	54	-18.8	3.24	35	Horizontal	-16.1

Note: Final average measurements were performed using section 11.12.2.5.2 of ANSI 63.10; when utilizing 11.12.2.5.2, the Trace mode was set to Max Hold and the measurement correction factor in 11.12.2.5.2 i) is not added (reference KDB 558074 D01 DTS Meas Guidance v05r02; FAQ #3(b))

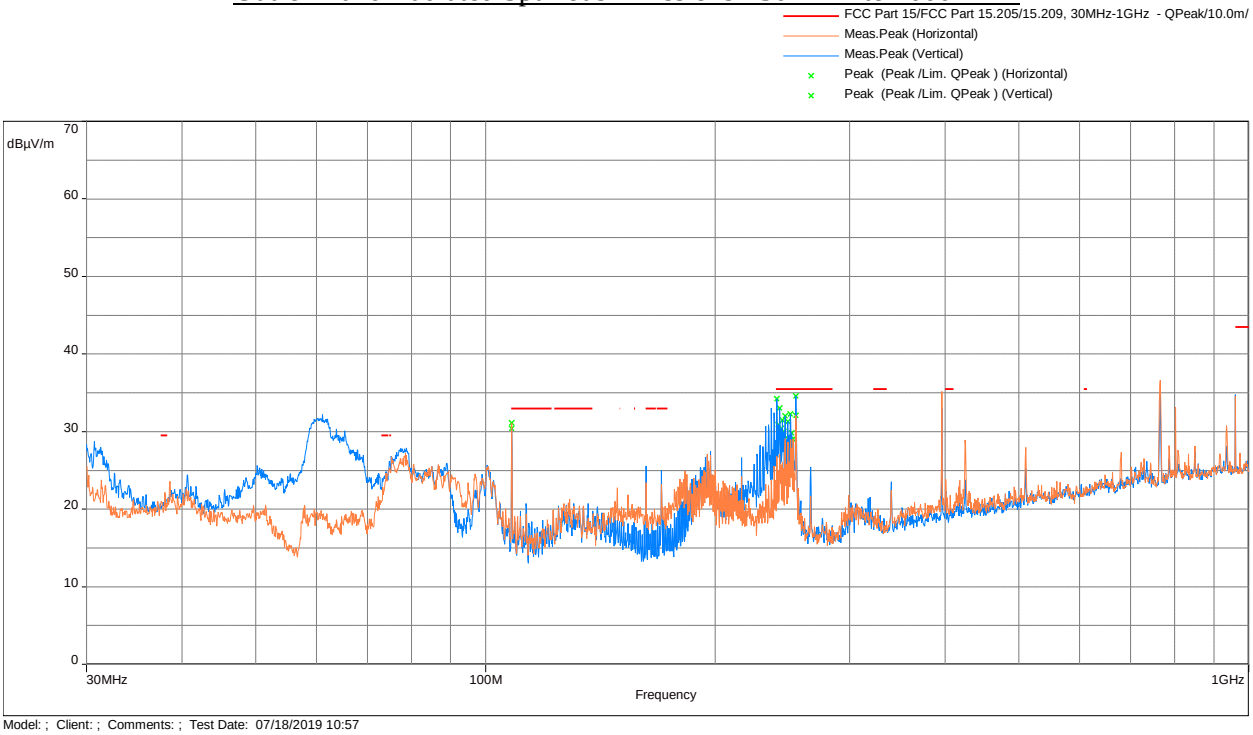
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1979.767	59.7	63.7*	-4.0	18.5	2.23	Horizontal	-13.5
1980.333	59.1	63.7*	-4.6	16.75	1.25	Vertical	-13.5
2938.000	59.7	63.7*	-4.0	238	1.25	Vertical	-12.4
2938.000	56.0	63.7*	-7.7	351.5	3.23	Horizontal	-12.4

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n, 2412MHz

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



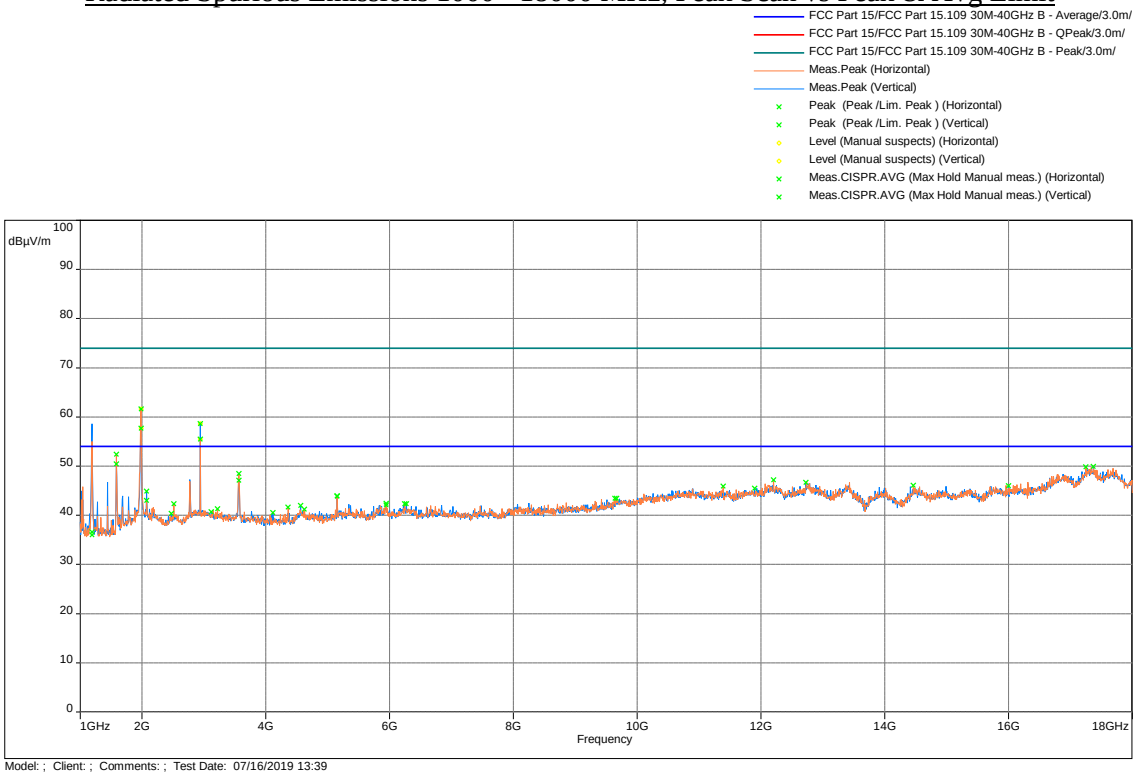
Model: ; Client: ; Comments: ; Test Date: 07/18/2019 10:57

Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
108.222	28.2	33	-4.8	224	1.37	Vertical	42.5	-14.3
108.224	28.6	33	-4.4	135.5	4	Horizontal	42.9	-14.3
240.859	31.2	35.5	-4.3	239.75	1	Vertical	42.6	-11.4
255.058	30.7	35.5	-4.8	143	1	Vertical	42.3	-11.6
255.065	30.0	35.5	-5.5	167.75	3.72	Horizontal	41.6	-11.6

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
61.137	32.2	54.4*	-22.2	264.25	3	Vertical	47.6	-15.4
396.110	33.1	54.4*	-21.3	190	0.99	Vertical	40.7	-7.6
396.143	35.1	54.4*	-19.3	298.75	1.98	Horizontal	42.7	-7.6

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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



Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.416	36.0	54	-18.0	1.4	38.5	Horizontal	-16.1
1188.294	36.6	54	-17.4	3.25	19.5	Vertical	-16.1

Note: Final average measurements were performed using section 11.12.2.5.2 of ANSI 63.10; when utilizing 11.12.2.5.2, the Trace mode was set to Max Hold and the measurement correction factor in 11.12.2.5.2 i) is not added (reference KDB 558074 D01 DTS Meas Guidance v05r02; FAQ #3(b))

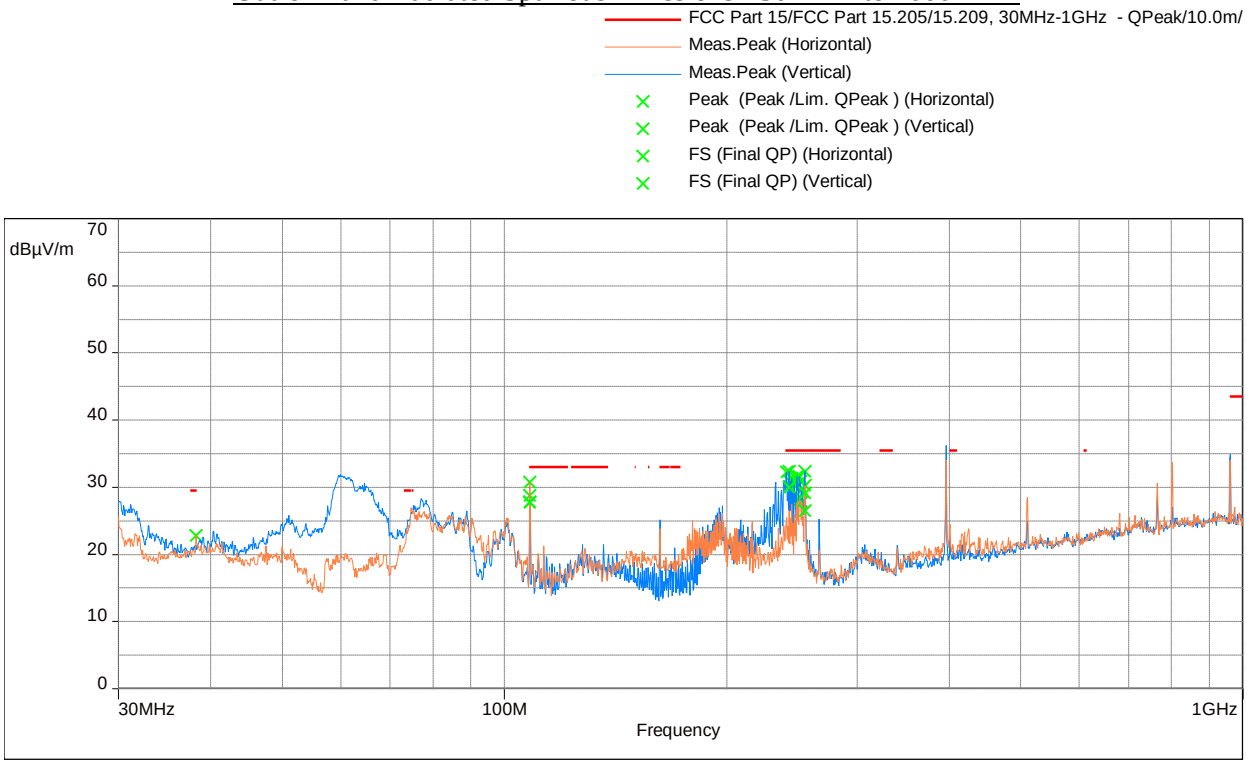
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1980.3	57.7	64.8*	-7.1	342	3.24	Vertical	-13.5
1980.3	61.6	64.8*	-3.2	26.25	1.27	Horizontal	-13.5
2938.0	58.6	64.8*	-6.2	232	1.26	Vertical	-12.4
2938.0	55.4	64.8*	-9.4	359.5	3.24	Horizontal	-12.4

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n, 2437MHz

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



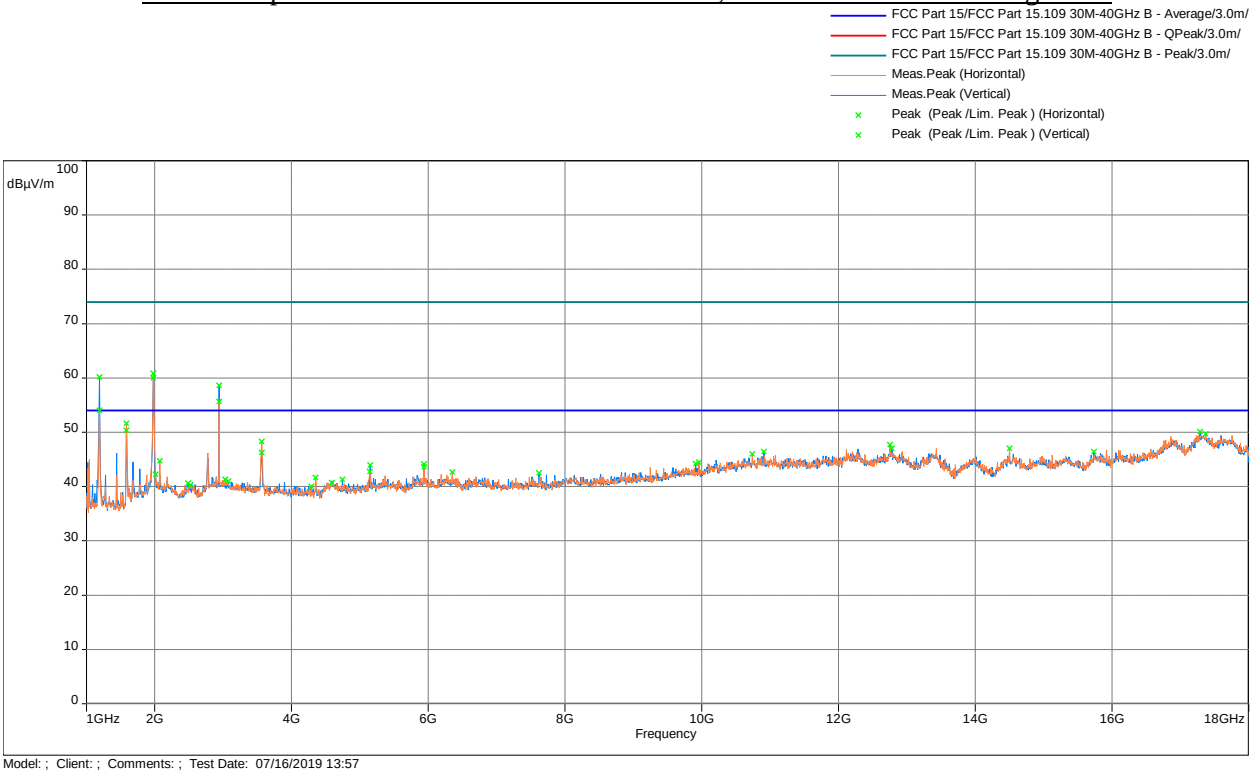
Model: ; Client: ; Comments: ; Test Date: 07/18/2019 11:32

Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
108.146	27.8	33	-5.3	320.25	4	Horizontal	42.1	-14.3
108.244	27.8	33	-5.2	225.5	1.36	Vertical	42.1	-14.3
242.856	30.0	35.5	-5.5	316.25	1.08	Vertical	41.4	-11.4
255.099	26.5	35.5	-9.0	19.25	3.64	Horizontal	38.1	-11.6
255.158	29.2	35.5	-6.4	135.5	1	Vertical	40.7	-11.6

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
59.973	31.9	52.4*	-20.5	299.75	3	Vertical	47.3	-15.4
396.110	34.1	52.4*	-18.4	156.25	1	Horizontal	41.7	-7.6
396.175	35.0	52.4*	-17.4	82.75	1	Vertical	42.6	-7.6

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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



Model: ; Client: ; Comments: ; Test Date: 07/16/2019 13:57

Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.229	40.1	54	-13.9	1.67	170.75	Vertical	-16.1
1188.294	35.2	54	-18.8	3.24	34.75	Horizontal	-16.1

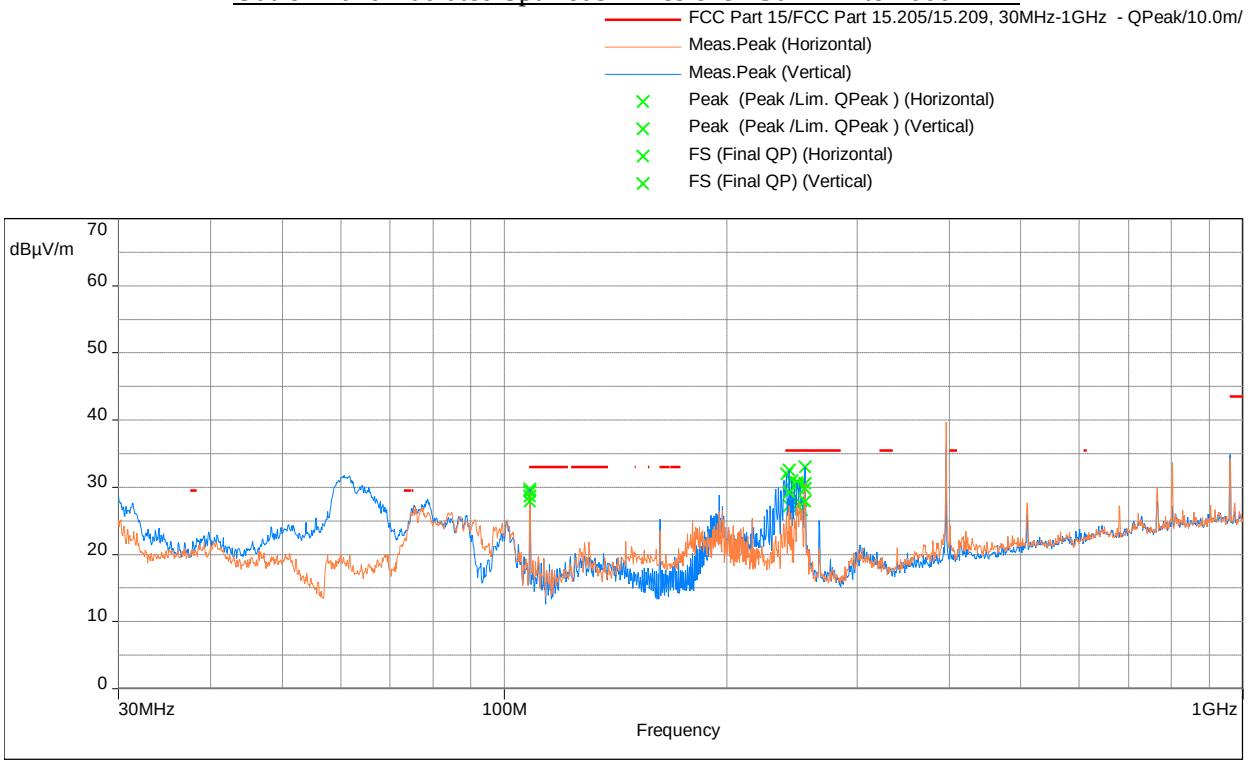
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1979.767	60.0	62.9*	-2.9	343.25	3.24	Vertical	-13.5
1979.767	60.9	62.9*	-2.0	27	1.26	Horizontal	-13.5
2938.000	58.6	62.9*	-4.3	238.5	1.26	Vertical	-12.4
2938.000	55.7	62.9*	-7.2	359.5	3.23	Horizontal	-12.4

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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

Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 802.11n, 2462MHz

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



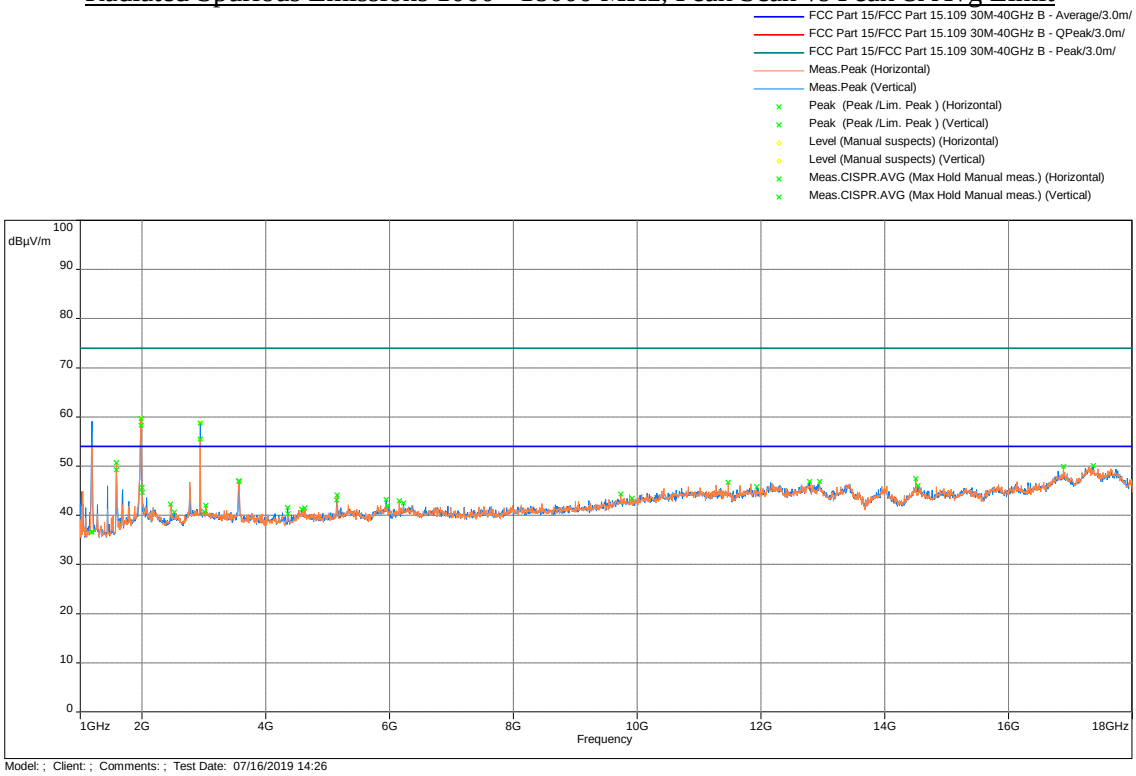
Model: ; Client: ; Comments: ; Test Date: 07/18/2019 12:06

Frequency (MHz)	QP@10m (dBµV/m)	QP Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
108.224	28.7	33	-4.3	143.5	4	Horizontal	43.0	-14.3
108.236	27.9	33	-5.1	207.25	1.3	Vertical	42.3	-14.3
242.761	29.2	35.5	-6.3	338	1	Vertical	40.6	-11.4
255.077	29.8	35.5	-5.7	138.5	1	Vertical	41.4	-11.6
255.072	27.9	35.5	-7.6	183.5	3.6	Horizontal	39.5	-11.6

Frequency (MHz)	PK@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
60.652	31.8	53.9*	-22.2	310.25	3.99	Vertical	47.2	-15.4
396.110	36.1	53.9*	-17.8	338.5	1	Vertical	43.7	-7.6
396.143	39.5	53.9*	-14.4	90.75	3.02	Horizontal	47.1	-7.6

*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

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



Freq. MHz	Ave@3m dB(uV/m)	Ave Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1188.229	40.1	54	-13.9	1.67	170.75	Vertical	-16.1
1188.294	35.2	54	-18.8	3.24	34.75	Horizontal	-16.1

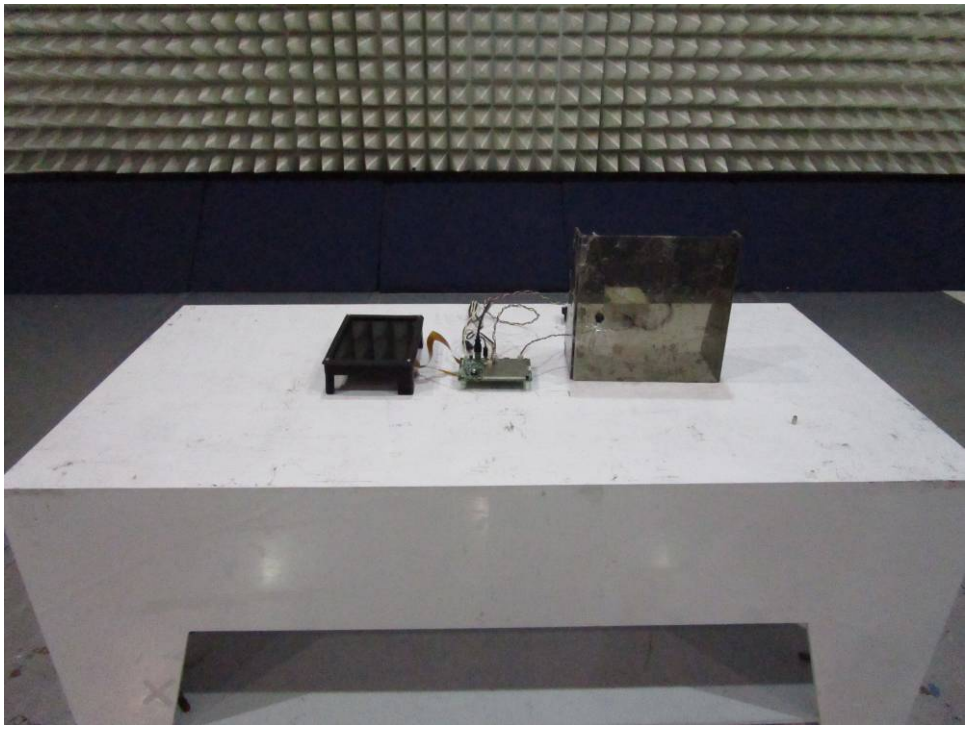
Note: Final average measurements were performed using section 11.12.2.5.2 of ANSI 63.10; when utilizing 11.12.2.5.2, the Trace mode was set to Max Hold and the measurement correction factor in 11.12.2.5.2 i) is not added (reference KDB 558074 D01 DTS Meas Guidance v05r02; FAQ #3(b))

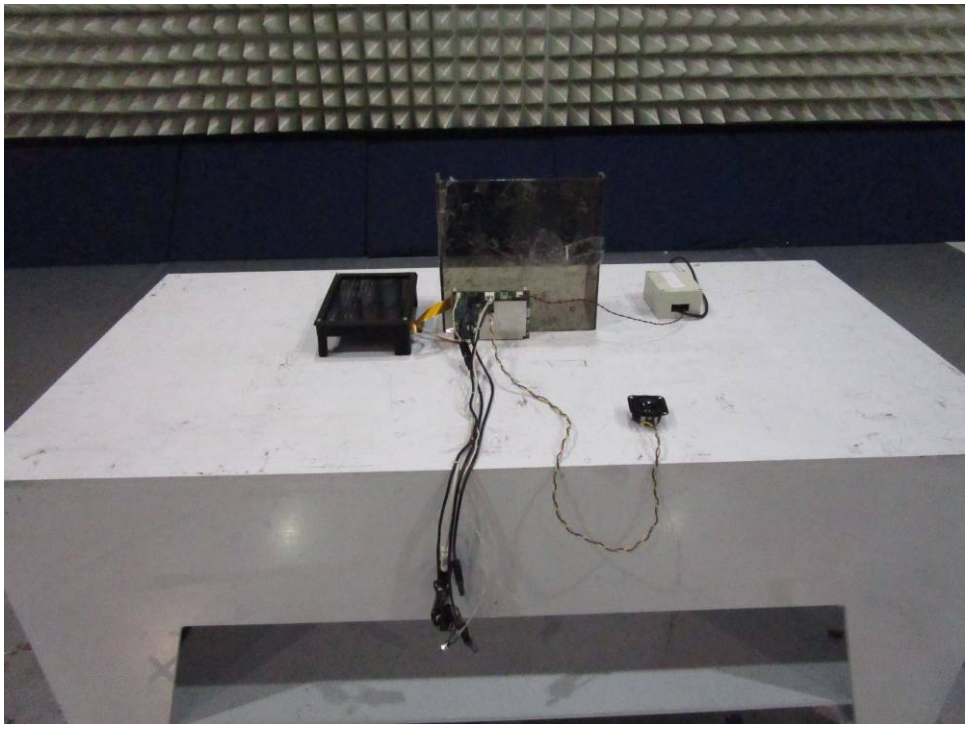
Freq. MHz	Peak@3m dB(uV/m)	Limit@3m dB(µV/m)	Margin dB	Azimuth deg	Height m	Polarity	Correction dB
1979.767	60.0	62.9*	-2.9	343.25	3.24	Vertical	-13.5
1979.767	60.9	62.9*	-2.0	27	1.26	Horizontal	-13.5
2938.000	58.6	62.9*	-4.3	238.5	1.26	Vertical	-12.4
2938.000	55.7	62.9*	-7.2	359.5	3.23	Horizontal	-12.4

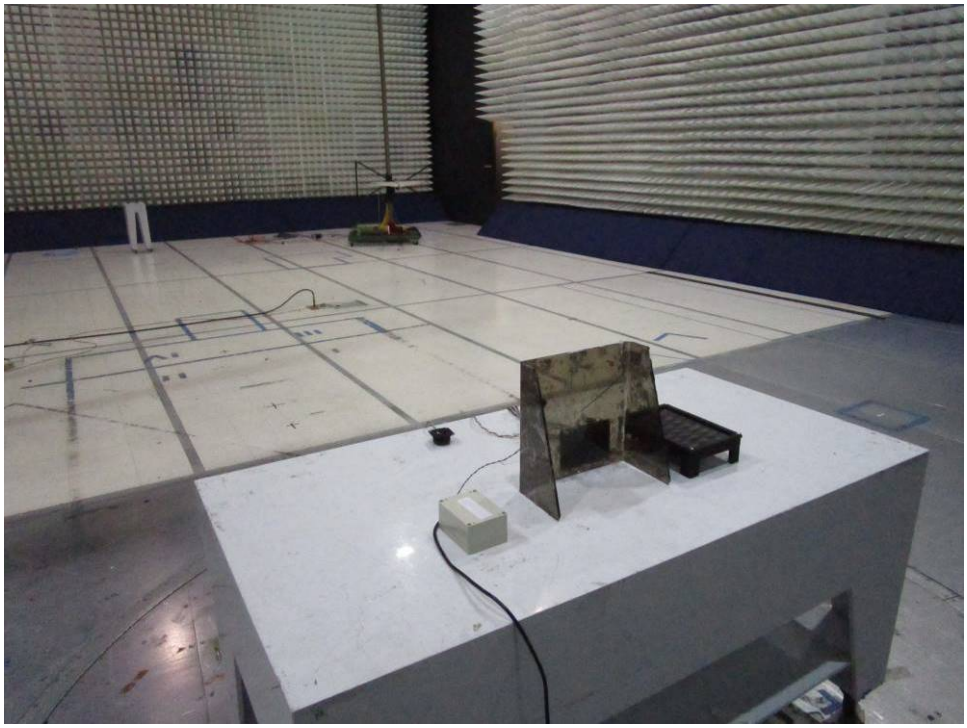
*Note: The following frequencies do not fall into the restricted band of FCC PT 15. 205, the limits for these frequencies are subject to FCC PT 15.247(d).

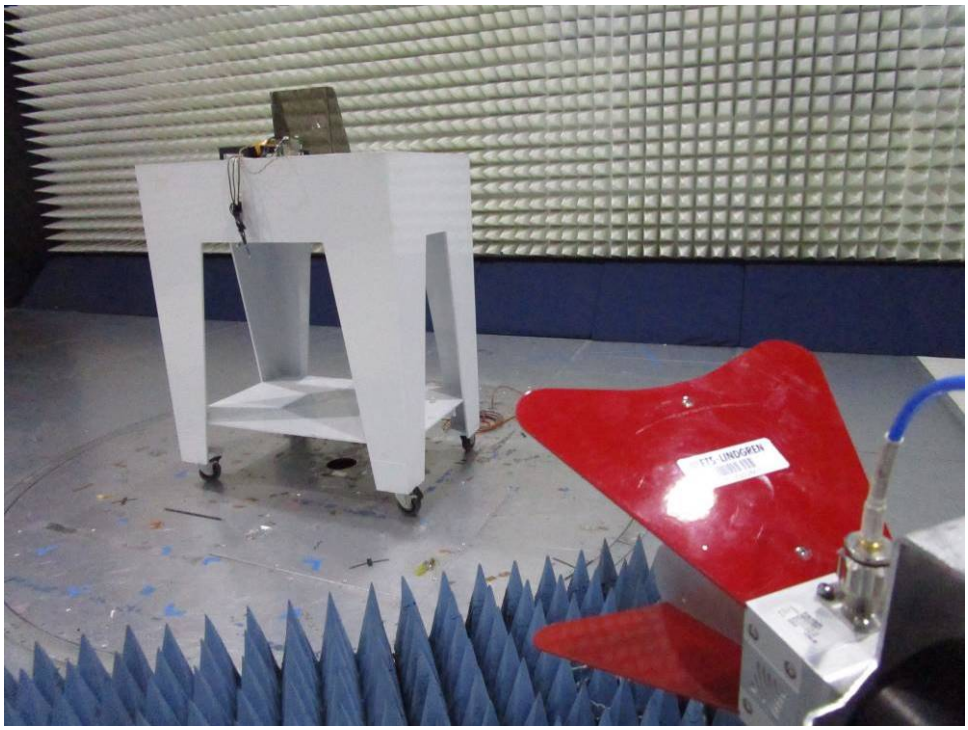
Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

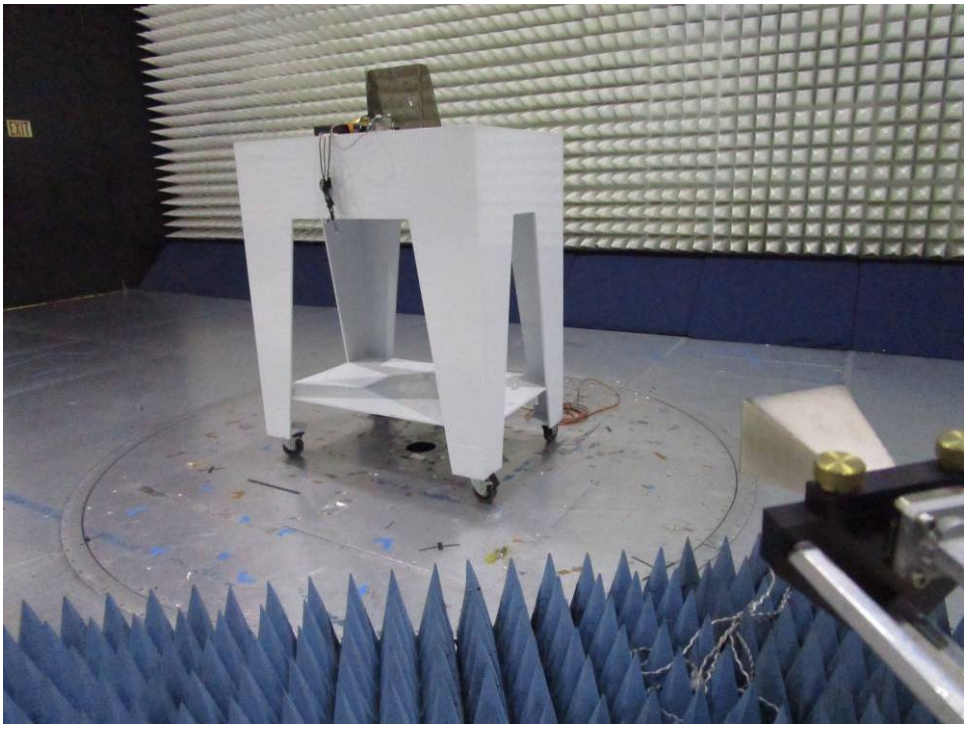
4.5.8 Test Setup Photographs











4.6 AC Line Conducted Emission
FCC: 15.207; RSS-GEN

4.6.1 Requirement

Frequency Band MHz	FCC Part 15.207 Limits	
	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	Test Date
Todd Moy	July 22, 2019

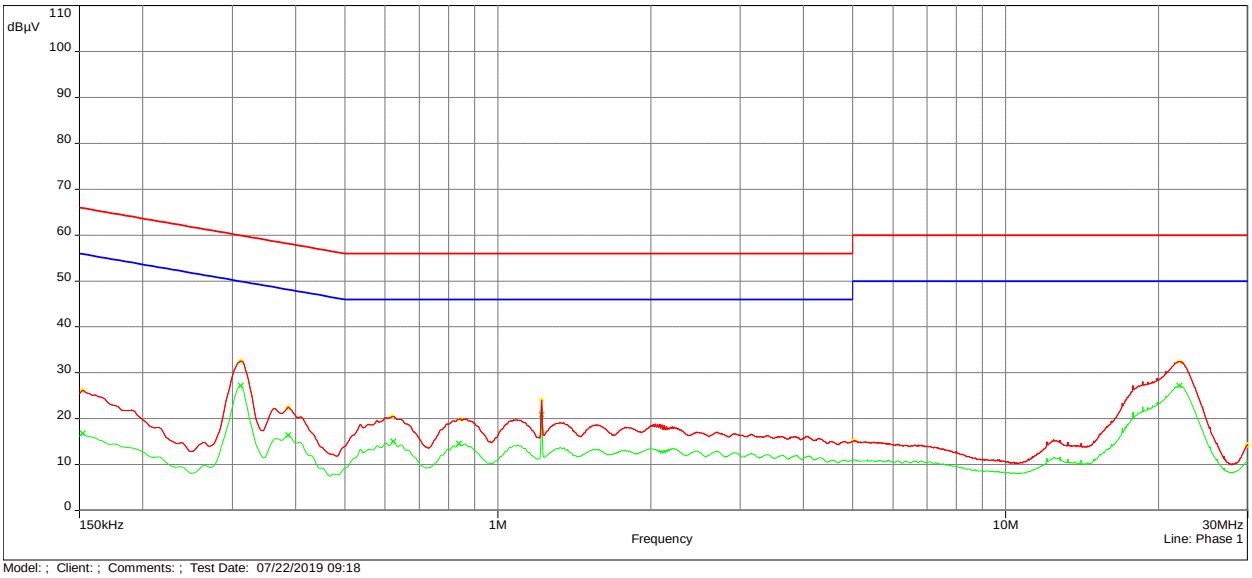
4.6.3 Test Results

15.207: Conducted Emissions 120VAC 60Hz

Phase 1

Sub-range 2
Frequencies: 150 kHz - 30 MHz (Mode: - Step: 2.25 kHz)
Settings: RBW: 9kHz, VBW: 30kHz, Sweep time: 1e+03 ms, Attenuation: 10 dB, Sweep count 3, Preamp: Off, LN Preamp: Off, Preselector: On
Line: Phase 1

FCC Part 15/FCC Part 15.107 B - Average/
FCC Part 15/FCC Part 15.107 B - QPeak/
Meas.QPeak (Phase 1)
Mes. CISPR AVG (Phase 1)
QPeak (QPeak /Lim. QPeak) (Phase 1)
CISPR AVG (CISPR AVG /Lim. Average) (Phase 1)

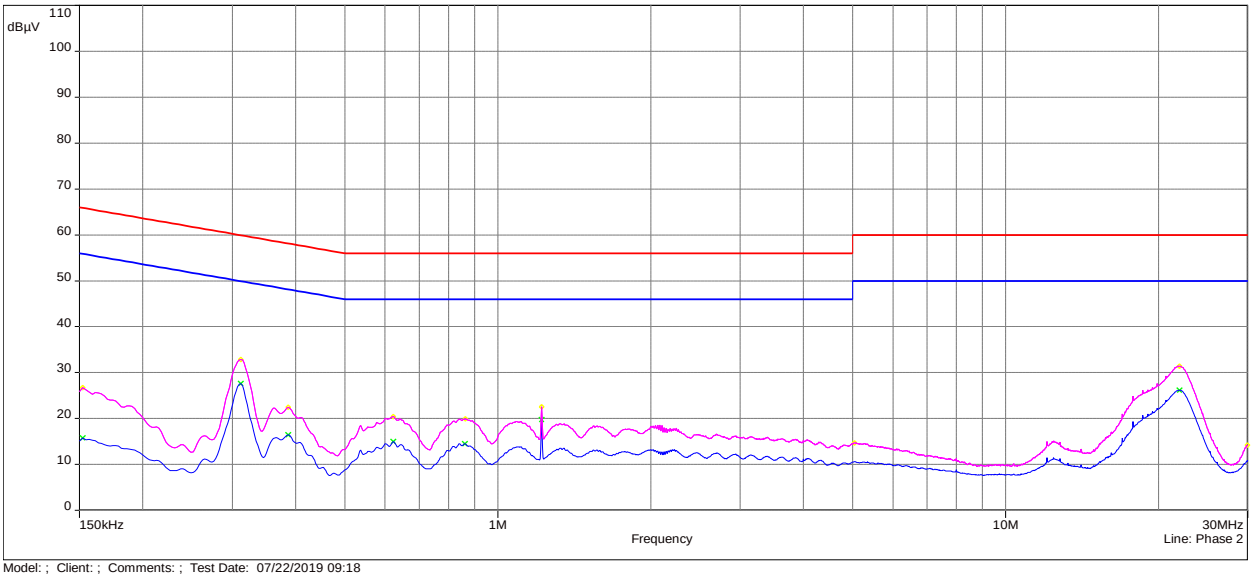


Model: ; Client: ; Comments: ; Test Date: 07/22/2019 09:18

Phase 2

Sub-range 1
Frequencies: 150 kHz - 30 MHz (Mode: - Step: 2.25 kHz)
Settings: RBW: 9kHz, VBW: 30kHz, Sweep time: 1e+03 ms, Attenuation: 10 dB, Sweep count 1, Preamp: Off, LN Preamp: Off, Preselector: On
Line: Phase 2

FCC Part 15/FCC Part 15.107 B - Average/
FCC Part 15/FCC Part 15.107 B - QPeak/
Meas.QPeak (Phase 2)
Mes. CISPR AVG (Phase 2)
QPeak (QPeak /Lim. QPeak) (Phase 2)
CISPR AVG (CISPR AVG /Lim. Average) (Phase 2)



Model: ; Client: ; Comments: ; Test Date: 07/22/2019 09:18

4.6.3 Test Results (Continued)

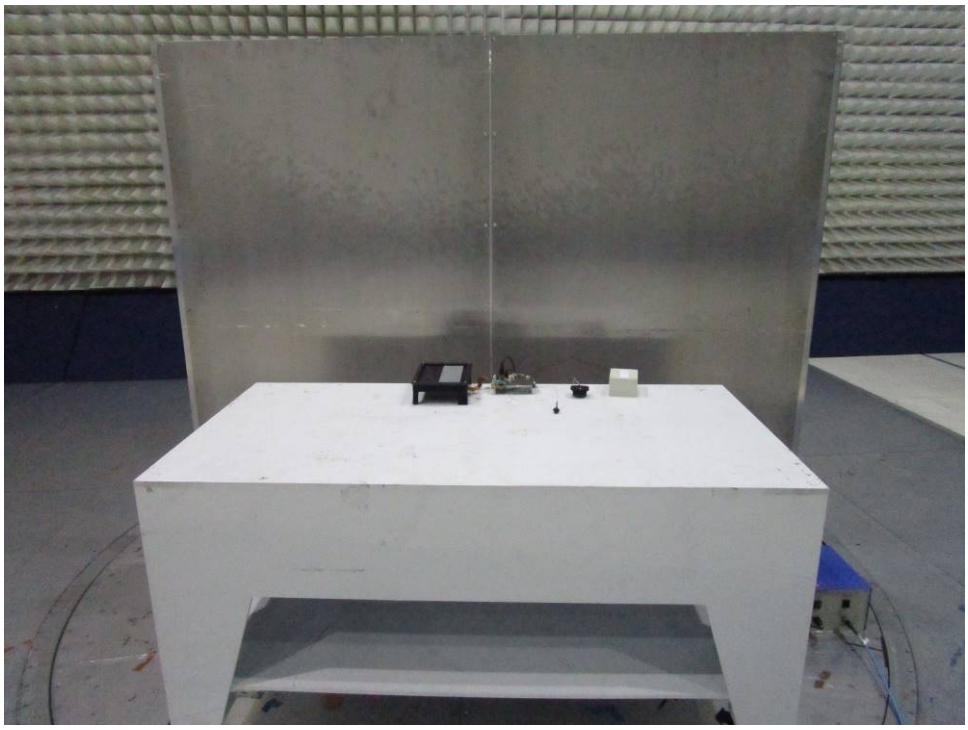
Quasi Peak Table					
Frequency (MHz)	QPeak (dBµV)	Lim. QPeak (dBµV)	QPeak-Lim (dB)	Phase	Correction (dB)
0.152	26.8	65.88	-39.1	Phase 2	11.3
0.152	26.3	65.88	-39.6	Phase 1	11.3
0.312	32.9	59.92	-27.1	Phase 2	11.0
0.312	32.6	59.92	-27.4	Phase 1	11.0
0.386	22.5	58.14	-35.7	Phase 2	10.9
0.386	22.5	58.14	-35.6	Phase 1	10.9
0.620	20.6	56	-35.4	Phase 1	10.9
0.623	20.4	56	-35.6	Phase 2	10.9
0.845	19.9	56	-36.1	Phase 1	10.9
0.863	19.9	56	-36.1	Phase 2	10.9
1.221	22.5	56	-33.5	Phase 2	10.9
1.221	24.1	56	-31.9	Phase 1	10.9
5.026	15.3	60	-44.7	Phase 1	11.1
5.044	14.7	60	-45.3	Phase 2	11.1
22.004	31.4	60	-28.6	Phase 2	11.3
22.013	32.5	60	-27.5	Phase 1	11.3
29.960	14.2	60	-45.8	Phase 2	11.2
29.963	14.3	60	-45.7	Phase 1	11.2

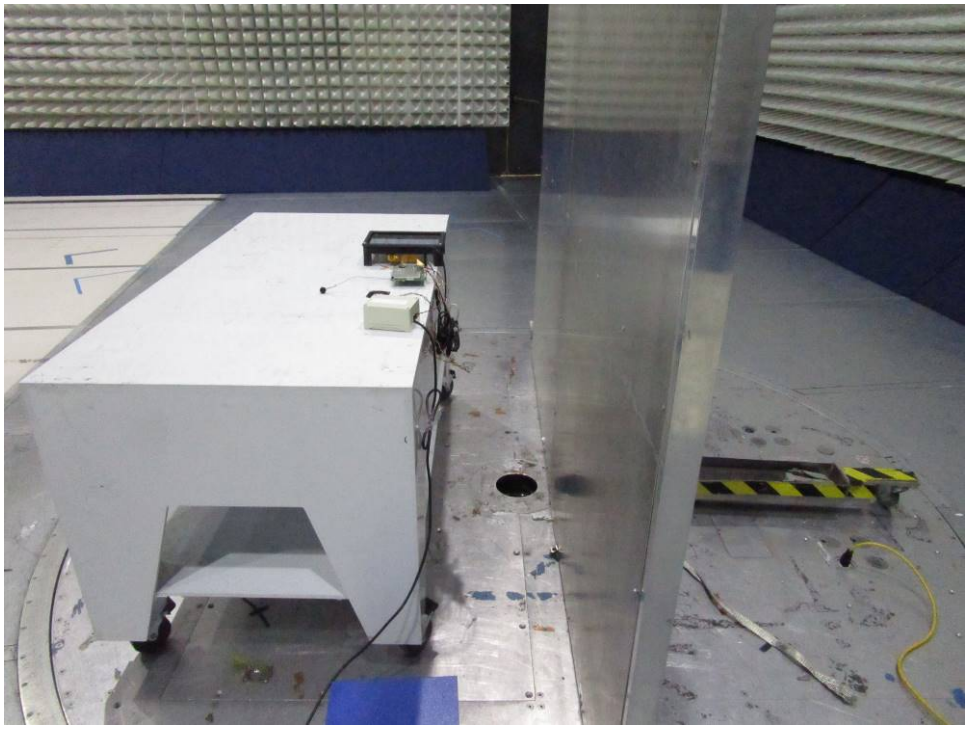
4.6.3 Test Results (Continued)

Average Table					
Frequency (MHz)	AVG (dBµV)	Lim. Average (dBµV)	AVG-Lim (dB)	Phase	Correction (dB)
0.152	15.7	55.88	-40.2	Phase 2	11.3
0.152	16.8	55.88	-39.1	Phase 1	11.3
0.312	27.6	49.92	-22.3	Phase 2	11.0
0.312	27.2	49.92	-22.7	Phase 1	11.0
0.386	16.5	48.14	-31.7	Phase 2	10.9
0.386	16.4	48.14	-31.7	Phase 1	10.9
0.623	15.0	46	-31.0	Phase 1	10.9
0.623	14.9	46	-31.1	Phase 2	10.9
0.839	14.5	46	-31.5	Phase 1	10.9
0.861	14.5	46	-31.5	Phase 2	10.9
1.221	19.7	46	-26.3	Phase 2	10.9
1.221	20.9	46	-25.1	Phase 1	10.9
22.009	26.2	50	-23.8	Phase 2	11.3
22.011	27.2	50	-22.8	Phase 1	11.3

Results: **Complies** by 22.3 dB

4.6.4 Test Setup Photographs





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	03/26/20
EMI Receiver	Rohde and Schwarz	ESR7	ITS 01607	12	10/23/19
Pre-Amplifier (18-40GHz)	Miteq	TTA1840-35-S-M	ITS 01393	12	02/08/20
Active Horn Antenna	ETS-Lindgren	3117-PA	ITS 01636	12	01/17/20
Horn Antenna (10-40 GHz)	ETS-Lindgren1376	3116C	ITS 01376	12	04/15/20
Bi-Log Antenna	Antenna Research	LPB-2513	ITS 00355	12	04/24/20
Pre-Amplifier	Sonoma Instrument	310N	ITS 00415	12	04/17/20
RE Cable	TRU Corporation	TRU CORE 300	ITS 01462	12	09/17/19
RE Cable	TRU Corporation	TRU CORE 300	ITS 01465	12	09/17/19
RE Cable	TRU Corporation	TRU CORE 300	ITS 01470	12	09/17/19
RF Cable	TRU Corporation	TRU CORE 300	ITS 01342	12	12/05/19
LISN	Com-Power	LIN-115A	ITS 01283	12	10/03/19
Transient Limiter	Com-Power	LIT-153A	ITS 01457	12	09/20/19
Notch Filter	MICRO-TRONICS	BRM50702	ITS 01166	12	05/14/20
RF Cable	Mega Phase	EMC1-K1K1-236	ITS 01537	12	02/20/20
10 dB Attenuator	Mini Circuits	BW-S10W5+	ITS 01582	12	10/07/19
RF Cable	Mega Phase	TM40-K1K1-59	ITS 01156	12	02/20/20

No Calibration required

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	3.17.0.10	Bosch July 15, 2019
BAT-EMC	Nexio	3.17.0.10	Bosch July 17, 2019
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 / G103930307	TM	KV	August 20, 2019	Original document

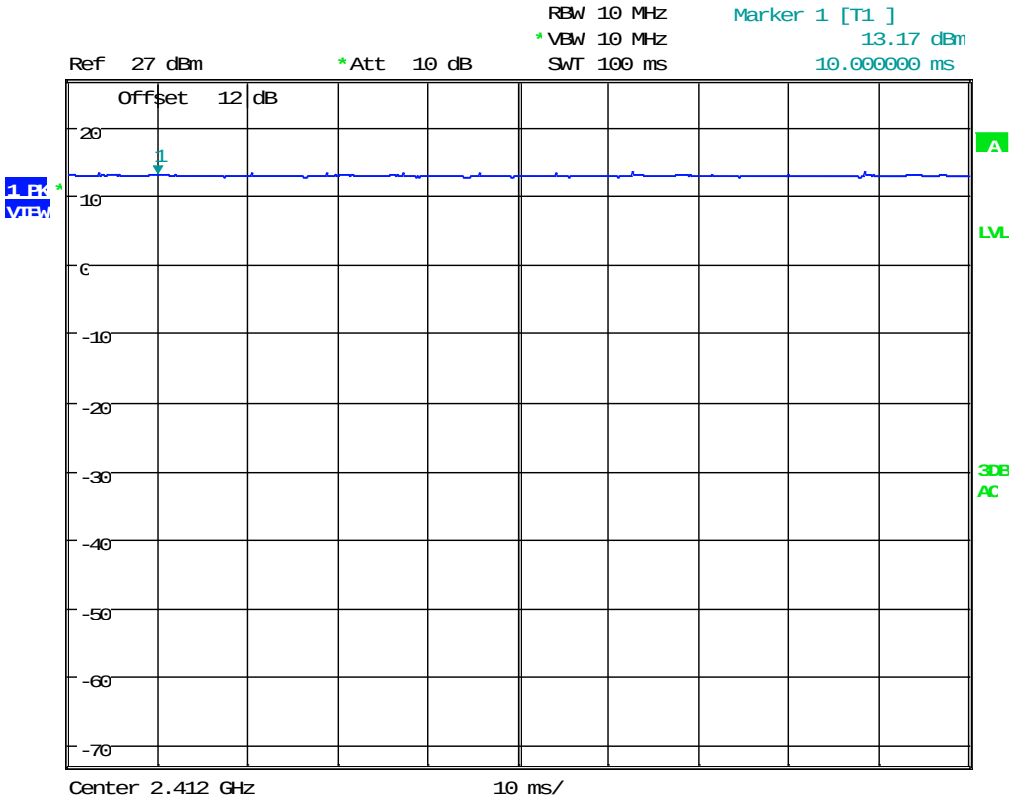
Annex A – Duty Cycle Measurement

Standard	Data Rate	On Time ms	Period ms	DCF Power Averaging	DCF Linear Voltage Averaging	Plot #
802.11b	1 Mbps	10	10	0	0	A.1
802.11g	6 Mbps	1.389	1.446	0.186	0.373	A.2
802.11n	0 MCS	1.324	1.348	0.056	0.131	A.3

Duty Cycle:
DC= On Time / Period

Duty Cycle Correction Factor (DCF) δ (dB):
DCF Power Averaging = 10 log (1/DC)
DCF Linear Voltage Averaging = 20 log (1/DC)

Plot A.1 – 802.11b duty cycle



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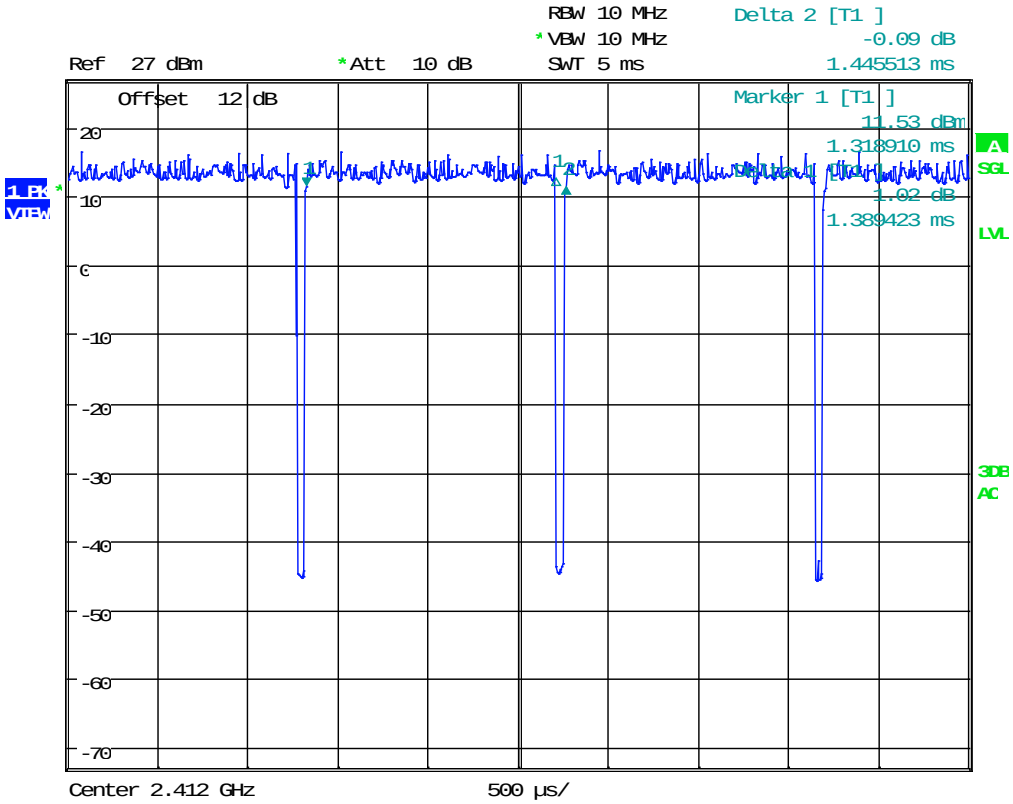
Plot A.2 – 802.11g duty cycle



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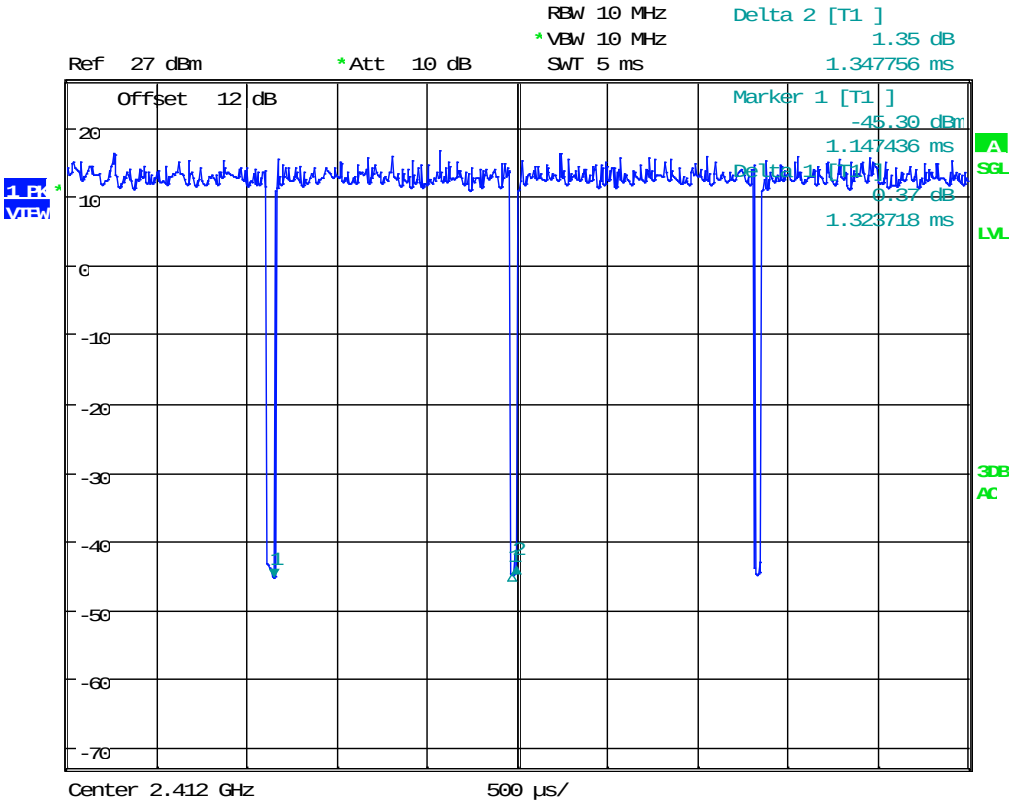
Plot A.3 – 802.11n20 duty cycle



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