FCC DTS RF TEST REPORT

Test Report Number……	**WAP-19052921-LC-FCC-DTS-G4L**
Applicant……	**Ford Motor Company**
Applicant Address……	**Building 5, 20300 Rotunda Dr., Dearborn, Michigan, United States 48124**
Product Name……	Vehicle Infotainment System
Model Number……	SYNC-G4L
Family Product/Model……	N/A
FCC ID……	KMH-SYNCG4L
ISED ID……	1422A-SYNCG4L
Date of EUT received……	06/12/2019
Date of Test……	06/12/2019 – 07/29/2019
Report Issue Date……	08/02/2019
Test Standards……	**47CFR Part 15.247**
Test Result……	Pass

Issued By:

Vista Laboratories

1261 Puerta Del Sol, San Clemente, CA 92673 USA

www.vista-compliance.com

Tested by:	**Approved By:**
Bruce Li	
Bruce Li/Test Engineer	**David Zhang/Technical Manager**

Laboratory Introduction

Vista Labs is an A2LA accredited 17025 compliant regulatory compliance testing laboratories (Cert. number: 4848-01) strategically located in Orange County, providing services in the electrical and telecommunication industries. Vista labs is also recognized testing facility for Australia (ACMA), Chinese Taipei (BSMI), Chinese Taipei (NCC), Hong Kong (OFCA), Israel (MOC), Korea (RRA), Singapore (IMDA), Vietnam (MIC), etc.

Our comprehensive testing services include safety testing, EMC emission and susceptibility testing, RF and wireless testing (including DFS).
As your partner, Vista investigates appropriate test standards, develops test plans, performs troubleshooting & failure analysis, reviews documentation, and provides test reports for a complete compliance testing and certification package.

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A2LA has accredited

VISTA LABORATORIES, INC.

San Clemente, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 21st day of June 2018.

President and CEO
For the Accreditation Council
Certificate Number 4848.01
Valid to July 31, 2020

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

17025 Product Testing Accreditation Certificate

Accredited Product Certification Body

A2LA has accredited

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San Clemente, CA

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC 17065:2012 *Requirements for bodies certifying products, processes and services*. This product certification body also meets the A2LA R308 – Specific Requirements – ISO-IEC 17065 – Telecommunication Certification Body Accreditation Program and R322 – Specific Requirements – Notified Body Accreditation Requirements. This accreditation demonstrates technical competence for a defined scope and the operation of a management system.

Presented this 1st day of October 2018.

President and CEO
For the Accreditation Council
Certificate Number 4848.02
Valid to July 31, 2020

For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation.

17065 Product Certification Accreditation Certificate

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REVISION HISTORY

Revision	Issue Date	Description	Note
Original	08/06/2019	Original release	N/A

1 General Information

1.1 Applicant

Applicant:	Ford Motor Company
Applicant address:	Building 5, 20300 Rotunda Dr., Dearborn, Michigan, United States 48124
Manufacturer:	Ford Motor Company
Manufacturer Address:	Building 5, 20300 Rotunda Dr., Dearborn, Michigan, United States 48124

1.2 Product information

Product Name	Vehicle Infotainment System
Model Number	SYNC-G4L
Family Model Number	N/A
Serial Number	1SN003G5 (Conducted), 1SN003GV (Radiated)
Frequency Band	BLE: 2402-2480MHz 802.11b/g/n-20MHz: 2412-2462MHz 802.11a/n-20MHz: 5180-5320MHz, 5500-5720MHz, 5725-5825MHz 802.11n-40MHz: 5190-5310MHz, 5510-5710MHz, 5755-5795MHz 802.11ac: 5210-5290MHz, 5530-5690MHz, 5775MHz
Type of modulation	BLE: GFSK 802.11b: DSSS (CCK, DQPSK, DBPSK) 802.11g: OFDM-CCK (BPSK, QPSK, 16QAM, 64QAM) 802.11a/n/ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)
Equipment Class/ Category	DSS, DTS, UNII
Maximum output power	See test result
Antenna Information	PCB trace antenna (WiFi1 Antenna, WiFi2 Antenna, Bluetooth Antenna) Peak Gain: WiFi1 Antenna: 3.29 dBi @2.4GHz, 8.09 dBi @5GHz WiFi2 Antenna: 0.84 dBi @2.4GHz, 5.68 dBi @5GHz Bluetooth Antenna: 3.02 dBi @2.4GHz Directional Gain: WiFi1 & WiFi2 Antenna: 5.16 dBi @2.4GHz, 9.98 dBi @5GHz
Clock Frequencies	N/A
Port/Connectors	Micro USB, CAN bus
Input Power	Vehicle Battery powered: 12 VDC
Power Adapter Manu/Model	N/A
Power Adapter SN	N/A
Hardware version	N/A
Software version	N/A
Simultaneous Transmission	BT/BLE and WLAN can transmit simultaneously
Additional Info	N/A

1.3 Test standard and method

Test standard	47CFR Part 15.247
Test method	ANSI C63.10: 2013 558074 D01 15.247 Meas Guidance v05r02

1.4 Test Purpose and statement

The purpose of this test report is intended to demonstrate the compliance of product listed in section 1.2, received from company listed in section 1.1, to the requirements of standard and method listed in section 1.3. Based on our test results, we conclude that the product tested complies with the requirements of the standards indicated.

2 Test site information

Lab performing tests	**Vista Laboratories**
Lab Address	1261 Puerta Del Sol, San Clemente, CA 92673 USA
Phone Number	+1 (949) 393-1123
Website	www. Vista-compliance.com

Test condition	Test Engineer	Test Environment	Test Date
RF conducted	Bruce Li	23.5°C / 58.2%/996 mbar	06/12/2019 – 07/29/2019
Radiated	Cameron Wu	23.5°C / 58.2%/996 mbar	06/12/2019 – 07/29/2019

3 Modification of EUT

The EUT is an engineering test sample loaded with RF testing firmware specifically designed to support the RF TX/RX measurement in different aspects.

4 Test configuration and operation

4.1 EUT test configuration

EUT is powered by external DC power supply for testing purpose. EUT's RF antenna port is connected to spectrum analyzer through RF test cable for measurement. The test software is used to set EUT to different transmission mode in terms of radio mode (WLAN, BLE), test channel, data rate, etc.

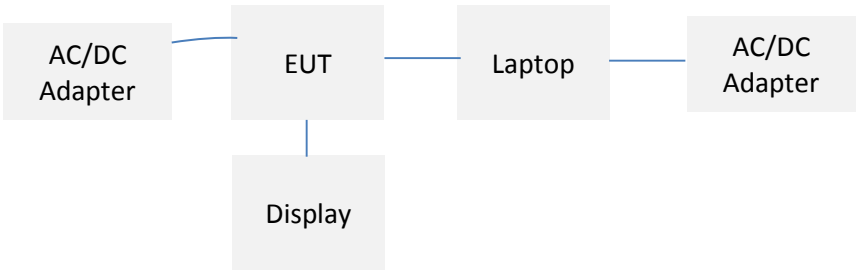
4.2 EUT test mode

Radio	Channel	Frequency (MHz)
BLE	0	2402
BLE	20	2442
BLE	39	2480
802.11-b	1	2412
802.11-b	6	2437
802.11-b	11	2462
802.11-g	1	2412
802.11-g	6	2437
802.11-g	11	2462
802.11-n-20	1	2412
802.11-n-20	6	2437
802.11-n-20	11	2462

4.3 Supporting Equipment

Index	Description	Model	S/N	Brand	Remark
1	AC/DC Adapter	HA45NM140	00285K	DELL	-
2	Laptop	Inspiron 15	245S2F2	DELL	-
3	Display	-	84007293	Ford	-
4	AC/DC Adapter	GST 60A12-P15	EB74QB1066	MEAN WELL	-

4.4 EUT setup diagram



4.5 EUT operation

The test software is used to set EUT to different transmission mode in terms of radio mode (WLAN, BLE), test channel, data rate, etc.

4.6 Test software

Index	Description	Remark
1	Diagnostic Engineering Tool V8.4.0	Load test firmware to EUT and provide basic control
2	PuTTY V0.70	Establish communication to EUT radio module
3	EMISoft Vasona 6.0049	EMC/Spurious emission test software used during testing

5 EUT and test setup pictures

See associated filing

6 Test Summary

FCC Rules	Test Item	Section	Verdict
§15.203	Antenna Requirement	8.1	Pass
§15.207 (a)	AC Power Line Conducted Emissions	N/A	N/A
§15.247 (a)(2)	DTS (6 dB) Channel Bandwidth	8.2	Pass
§15.247(b)(3)	Conducted Maximum Output Power	8.3	Pass
§15.247(e)	Power Spectral Density	8.4	Pass
§15.247(d)	Conducted Band-Edge & Unwanted Emissions	8.5	Pass
§15.205, §15.209	Radiated Emissions & Unwanted Emissions into Restricted Frequency Bands	8.6	Pass

Note1: EUT is powered by Vehicle mains. It does not connect to public AC mains. This item is not applicable.

7 Uncertainty of Measurement

Test item	Measurement Uncertainty (dB)
RF Output Power (Conducted)	±1.2 dB
Power Spectral Density	±0.9 dB
Unwanted Emission (conducted)	±2.6 dB
Occupied Channel Bandwidth	±5 %
Radiated Emission (9KHz-30MHz)	±3.5 dB
Radiated Emission (30MHz-1GHz)	±4.6 dB
Radiated Emission (1-18GHz)	±4.9 dB
Radiated Emission (18-40GHz)	±3.5 dB

8 Test summary and result

8.1 Antenna Requirement

8.1.1 Requirement

Per § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

8.1.2 Result

Analysis:

- EUT uses PCB trace antenna. No standard RF connector or coupling is used.

Conclusion:

EUT complies with antenna requirement in § 15.203.

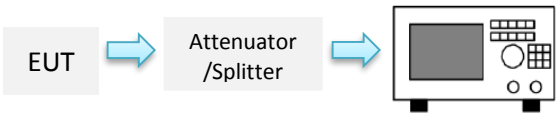
8.2 DTS (6 dB) Bandwidth

8.2.1 Requirement

§ 15.247 (a)(2)

Systems using digital modulation techniques may operate in the 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz bands. The minimum 6 dB bandwidth shall be at least 500 KHz.

8.2.2 Test setup



8.2.3 Test Procedure

According to section 8.2, option 2, in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.8 of ANSI C63.10-2013:

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 × RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

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. Use automatic bandwidth measurement capability on instrument to obtain BW result.

8.2.4 Test Result

Mode/ Bandwidth	Frequency (MHz)	Data rate	Measured Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
BLE	2402	1Mbps	667.6	500	Pass
BLE	2440	1Mbps	669.2	500	Pass
BLE	2480	1Mbps	668.2	500	Pass
11b	2412	1Mbps	10030	500	Pass
11b	2437	1Mbps	10090	500	Pass
11b	2462	1Mbps	10110	500	Pass
11g	2412	6Mbps	16350	500	Pass
11g	2437	6Mbps	16380	500	Pass
11g	2462	6Mbps	16360	500	Pass
11n-20M	2412	MCS0	17110	500	Pass
11n-20M	2437	MCS0	17330	500	Pass
11n-20M	2462	MCS0	17320	500	Pass

8.2.5 Test Plots

BLE-6 dB BW-Low

BLE-6 dB BW-Mid

BLE-6 dB BW-High

11b-6dB BW-Low

11g-6dB BW-Low

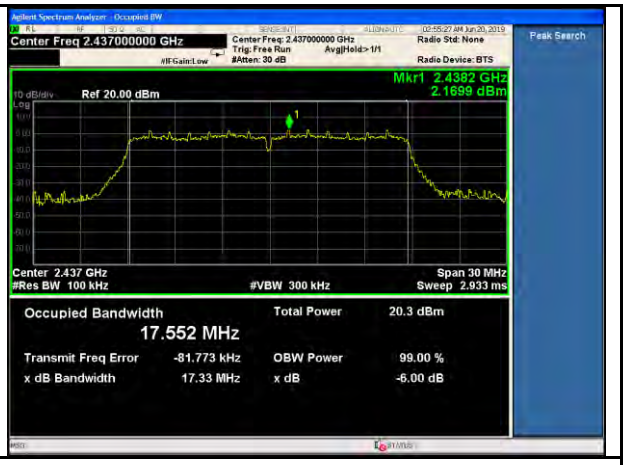
11b-6dB BW-Mid

11g-6dB BW-Mid

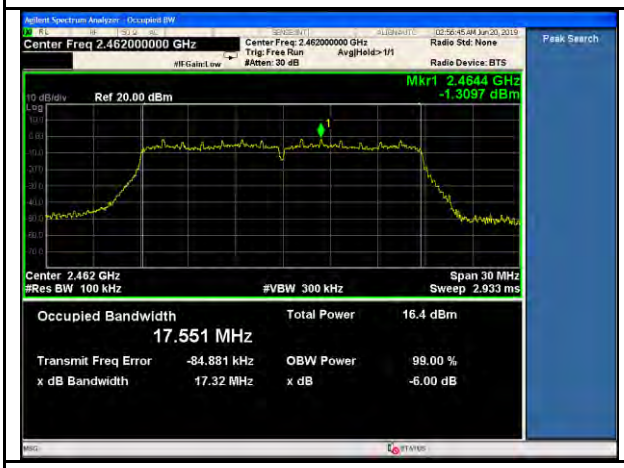
11b-6dB BW-High

11g-6dB BW-High

11n-20MHz-6dB BW-Low



11n-20MHz-6dB BW-Mid



11n-20MHz-6dB BW-High

8.3 Maximum Output Power

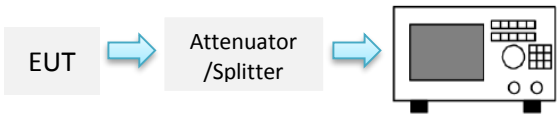
8.3.1 Requirement

§ 15.247 (b)(3)

or systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: the maximum output power is 1 Watt.

If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

8.3.2 Test setup



8.3.3 Test Procedure

For BLE, power measurement is according to subclause 11.9.1.1 of ANSI C63.10-2013:

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

For WLAN, power measurement is according to subclause 11.9.2.2.2 of ANSI C63.10-2013:

1. Set span to at least 1.5 times of the OBW.
2. Set the RBW = 1% to 5% of the OBW, not to exceed 1 MHz.
2. Set VBW ≥ 3 X RBW.
3. Set number of points in sweep ≥ [2 × span / RBW]
4. Sweep time = auto couple.
5. Detector = RMS
6. 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."
7. Trace average at least 100 traces in power averaging (rms) mode.
8. 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.

8.3.4 Test Result

Mode/ Bandwidth	Frequency (MHz)	Data rate	Measured Output Power (dBm)	Max Output Power (dBm)	Result
BLE	2402	1Mbps	10.474	30	Pass
BLE	2440	1Mbps	10.403	30	Pass
BLE	2480	1Mbps	10.208	30	Pass

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX1 power (dBm)	TX2 power (dBm)	Highest or Total power (dBm)	Max Output Power (dBm)	Result
11b	2412	1Mbps	12.17	12.77	12.77	30	Pass
11b	2437	1Mbps	15.11	14.42	15.11	30	Pass
11b	2462	1Mbps	12.09	12.32	12.32	30	Pass
11g	2412	6Mbps	10.45	10.56	10.56	30	Pass
11g	2437	6Mbps	12.71	12.37	12.71	30	Pass
11g	2462	6Mbps	9.38	9.24	9.38	30	Pass
11n-20M	2412	MCS1	10.57	10.45	13.52	30	Pass
11n-20M	2437	MCS1	12.72	12.42	15.58	30	Pass
11n-20M	2462	MCS1	9.44	9.34	12.40	30	Pass

Note:

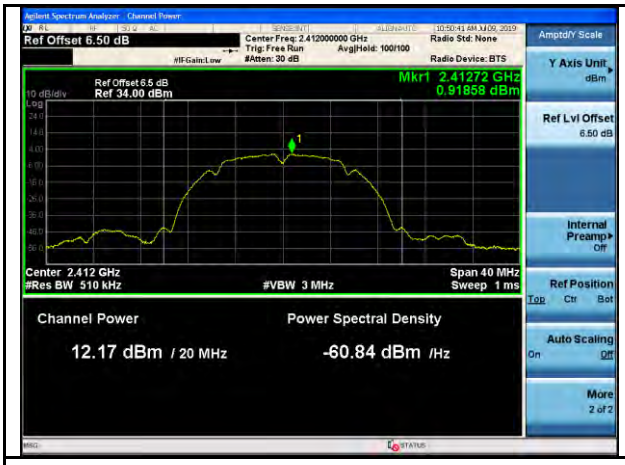
1) For 802.11b/g, the highest output power is recorded.
2) For 802.11n mode, it's under 2x2 MIMO mode, the output power is combined together to compare to limit.
3) For 2.4GHz, directional gain is calculated per KDB 662911 D01. For 2.4GHz WiFi, directional gain = 5.16 dBi

8.3.5 Test Plots

BLE-PWR-Low

BLE-PWR-Mid

BLE-PWR-High



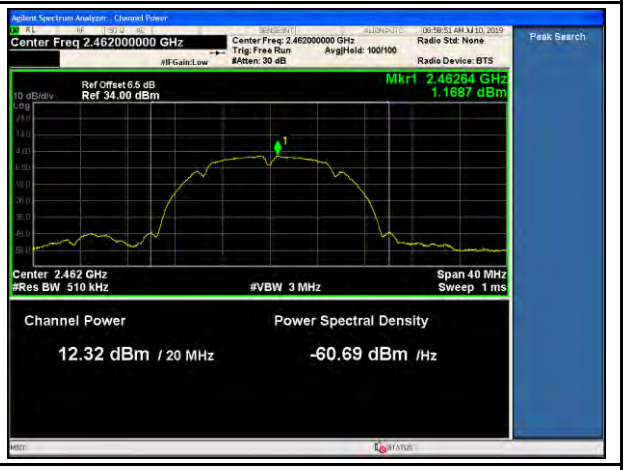
11b-PWR-Low-TX1

11b-PWR-Low-TX2

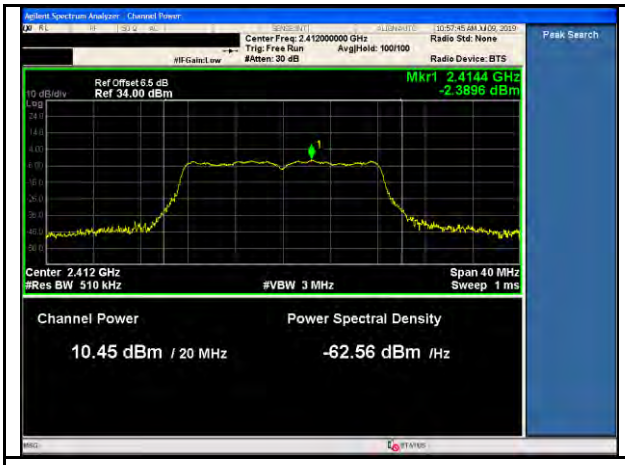
11b-PWR-Mid-TX1

11b-PWR-Mid-TX2

11b-PWR-High-TX1

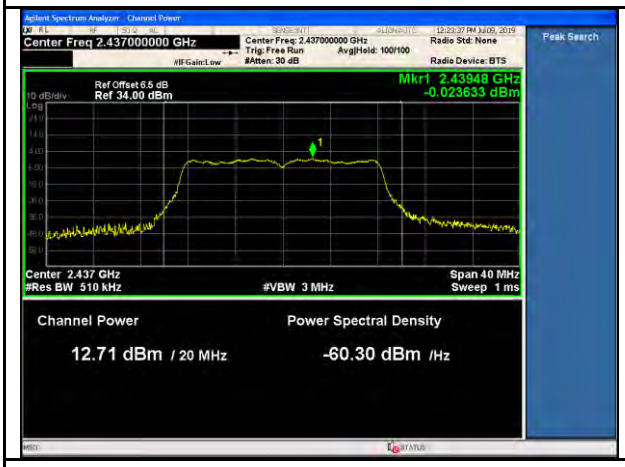


11b-PWR-High-TX2

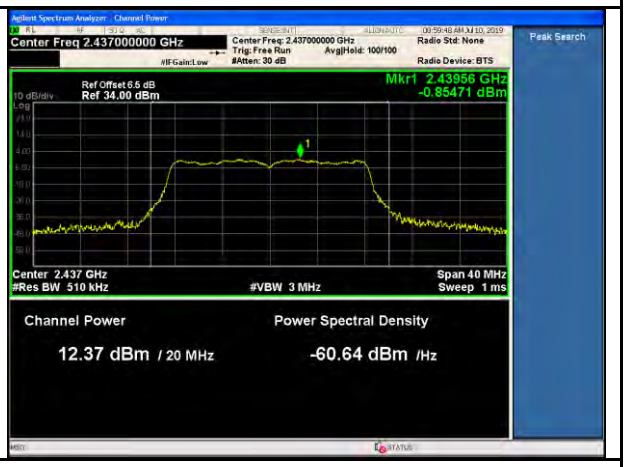


11g-PWR-Low-TX1

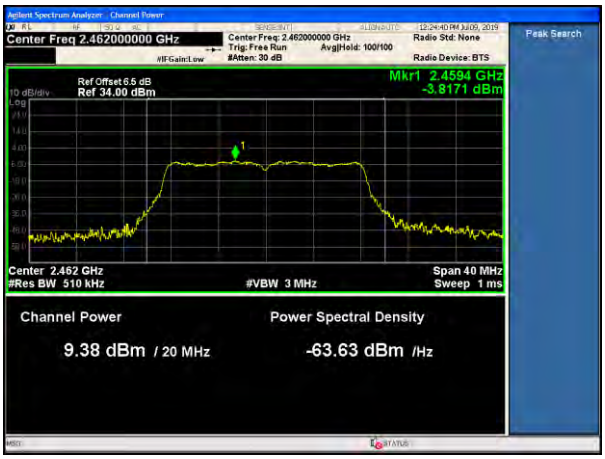
11g-PWR-Low-TX2



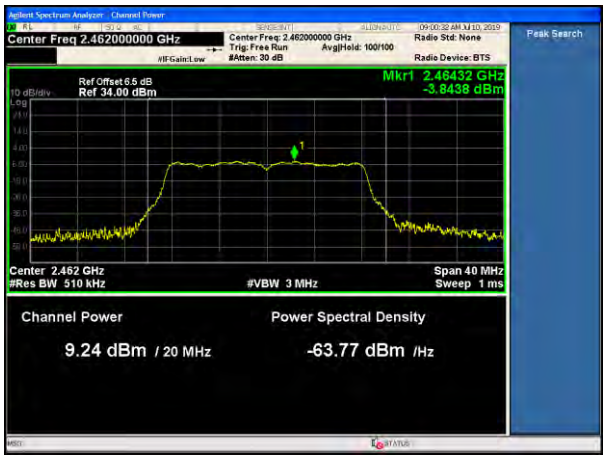
11g-PWR-Mid-TX1



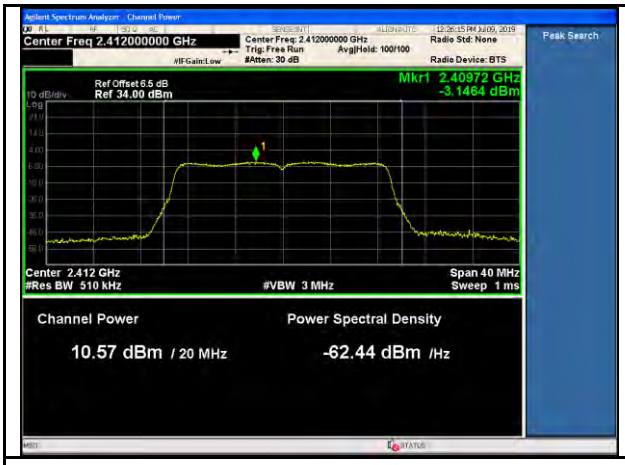
11g-PWR-Mid-TX2



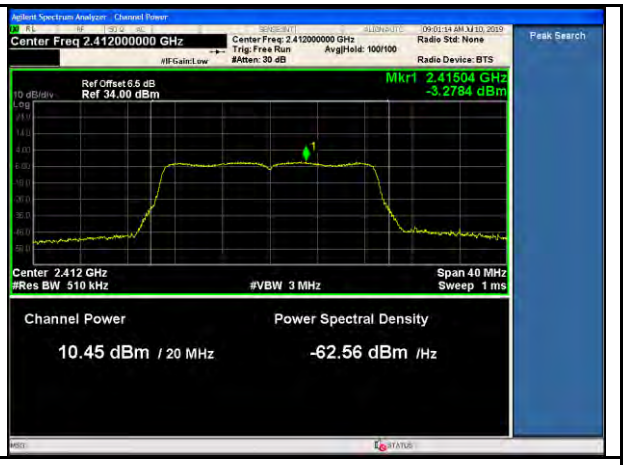
11g-PWR-High-TX1



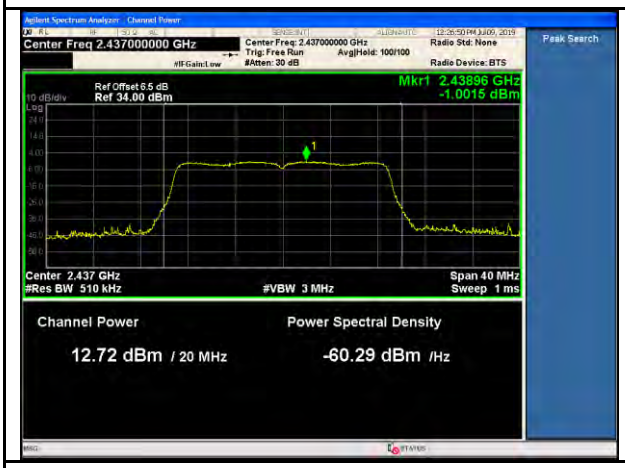
11g-PWR-High-TX2



11n-20MHz-PWR-Low-TX1



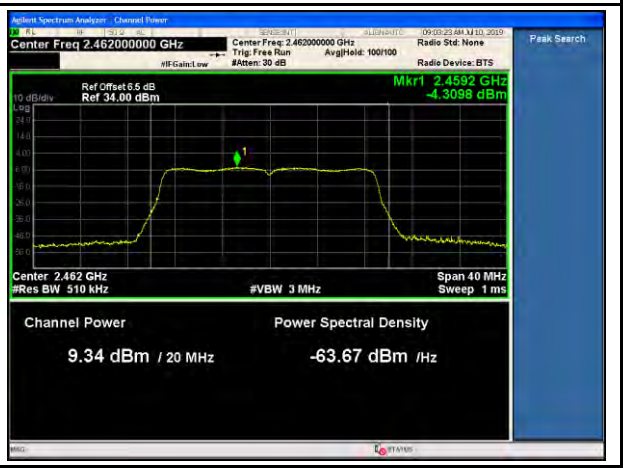
11n-20MHz-PWR-Low-TX2



11n-20MHz-PWR-Mid-TX1

11n-20MHz-PWR-Mid-TX2

11n-20MHz-PWR-High-TX1



11n-20MHz-PWR-High-TX2

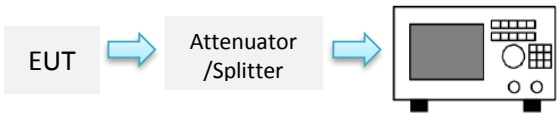
8.4 Power Spectral Density

8.4.1 Requirement

§ 15.247 (e)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power is used to determine the power spectral density.

8.4.2 Test setup



8.4.3 Test Procedure

According to section 8.4 in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.10.2 PKPSD of ANSI C63.10-2013:

1. Set analyser centre frequency to DTS channel centre frequency.
2. Set the span to 1.5 X 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.

8.4.4 Test Result

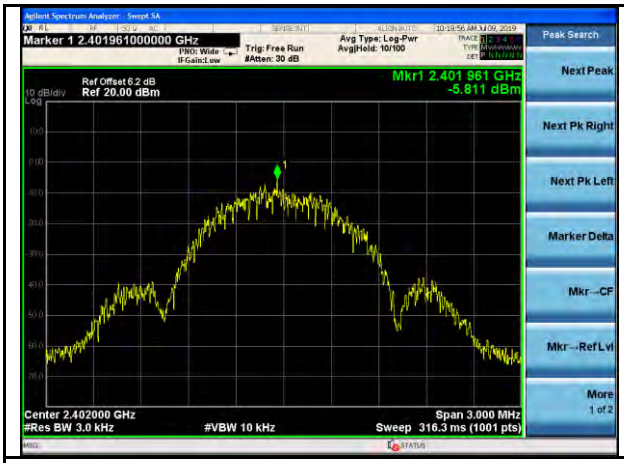
Mode/ Bandwidth	Frequency (MHz)	Data rate	Measured PSD (dBm/3KHz)	Max PSD (dBm/3KHz)	Result
BLE	2402	1Mbps	-5.811	8	Pass
BLE	2440	1Mbps	-5.959	8	Pass
BLE	2480	1Mbps	-6.171	8	Pass

Mode/ Bandwidth	Frequency (MHz)	Data rate	TX1 PSD (dBm/3KHz)	TX2 PSD (dBm/3KHz)	Highest or Total PSD (dBm/3KHz)	Max PSD (dBm/3KHz)	Result
11b	2412	1Mbps	-7.284	-7.529	-7.284	8	Pass
11b	2437	1Mbps	-4.604	-6.006	-4.604	8	Pass
11b	2462	1Mbps	-8.194	-7.956	-7.956	8	Pass
11g	2412	6Mbps	-10.521	-11.642	-10.521	8	Pass
11g	2437	6Mbps	-10.145	-10.145	-10.145	8	Pass
11g	2462	6Mbps	-12.373	-13.316	-12.373	8	Pass
11n-20M	2412	MCS1	-9.869	-9.333	-6.58	8	Pass
11n-20M	2437	MCS1	-7.814	-7.661	-4.73	8	Pass
11n-20M	2462	MCS1	-11.301	-10.824	-8.05	8	Pass

Note:

1) For 802.11b/g, the highest PSD is recorded.
2) For 802.11n mode, it's under 2x2 MIMO mode, the PSD is combined together to compare to limit.
3) For 2.4GHz, directional gain is calculated per KDB 662911 D01. For 2.4GHz WiFi, directional gain = 5.16 dBi.

8.4.5 Test Plots



BLE-PSD-Low

BLE-PSD-Mid

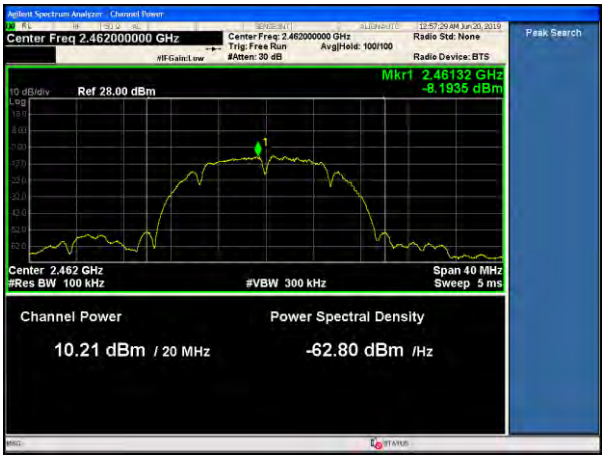
BLE-PSD-High

11b-PSD-Low-TX1

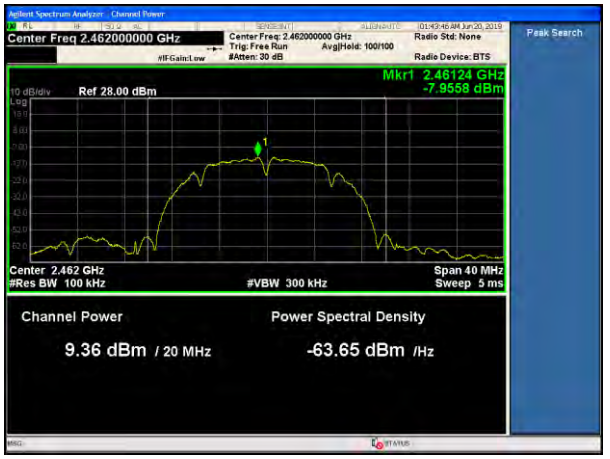
11b-PSD-Low-TX2

11b-PSD-Mid-TX1

11b-PSD-Mid-TX2

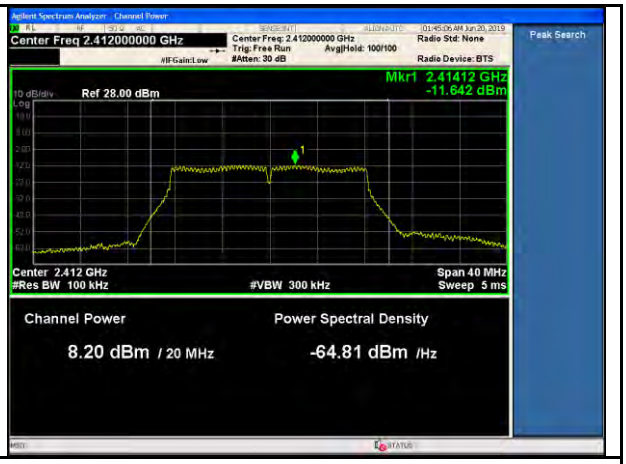


11b-PSD-High-TX1

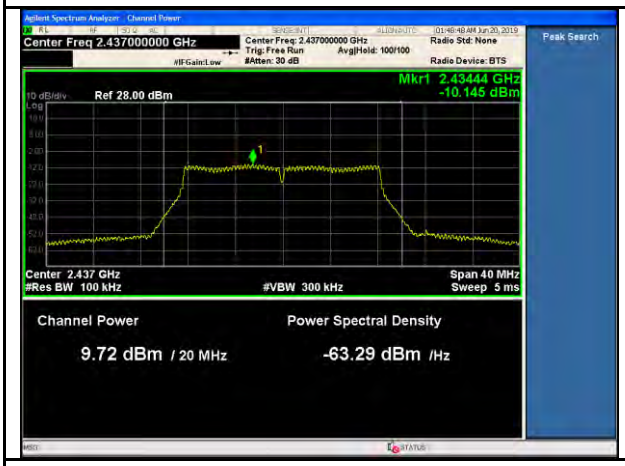


11b-PSD-High-TX2

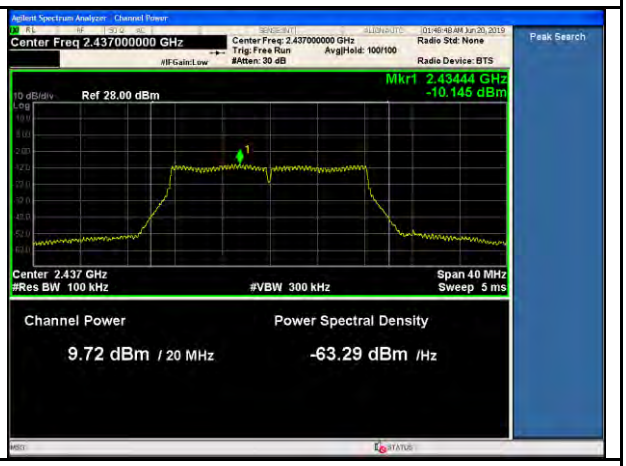
11g-PSD-Low-TX1



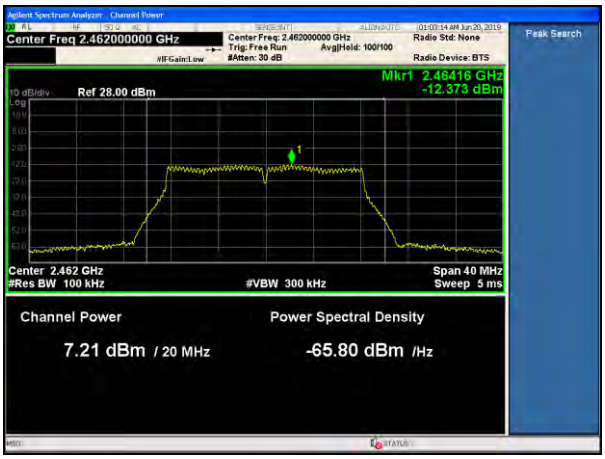
11g-PSD-Low-TX2



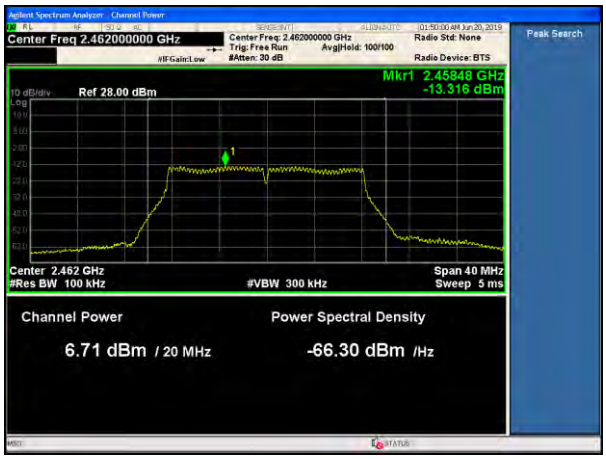
11g-PSD-Mid-TX1



11g-PSD-Mid-TX2

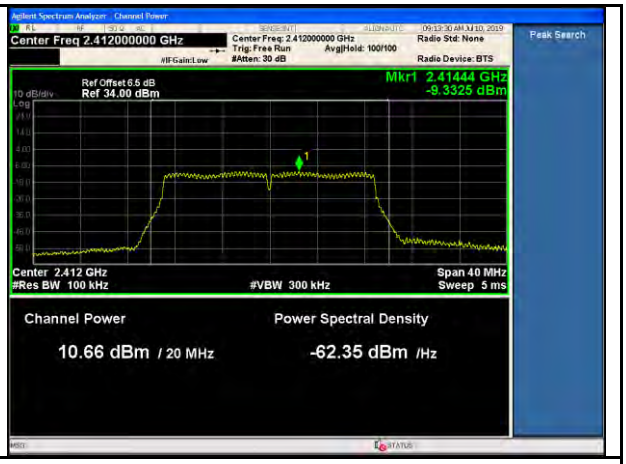


11g-PSD-High-TX1



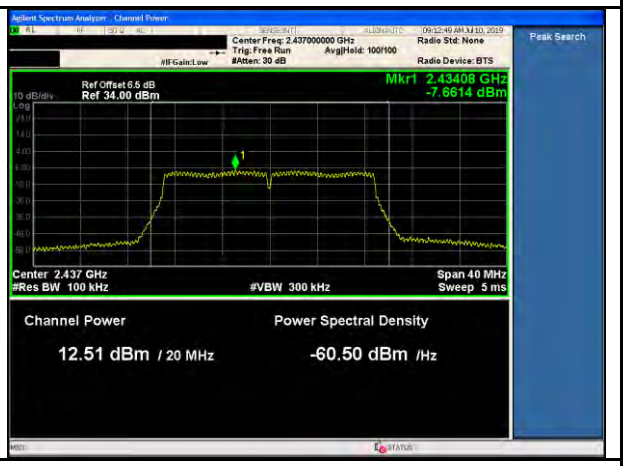
11g-PSD-High-TX2

11n-20MHz-PSD-Low-TX1

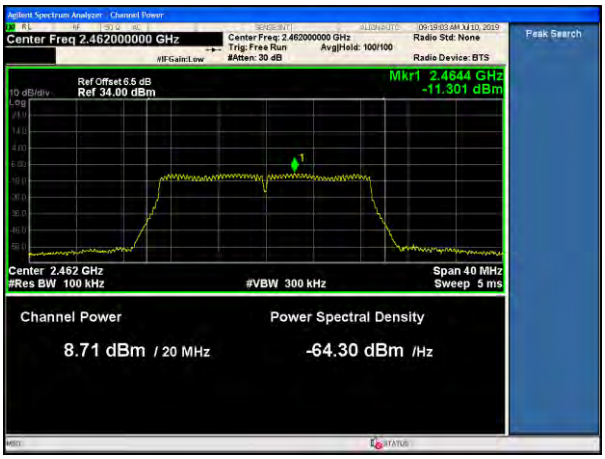


11n-20MHz-PSD-Low-TX2

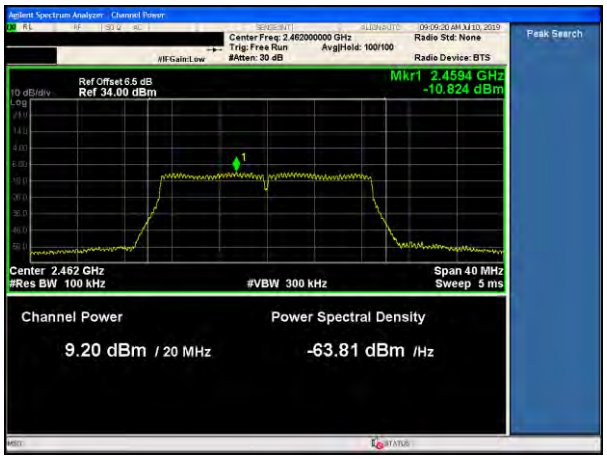
11n-20MHz-PSD-Mid-TX1



11n-20MHz-PSD-Mid-TX2



11n-20MHz-PSD-High-TX1



11n-20MHz-PSD-High-TX2

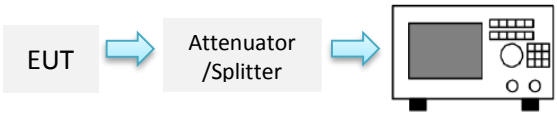
8.5 Conducted Band-Edge & Unwanted Emissions Measurement

8.5.1 Requirement

§ 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

8.5.2 Test setup



8.5.3 Test Procedure

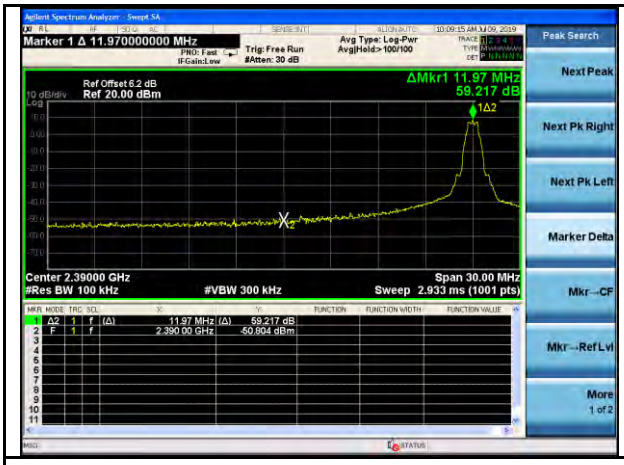
According to section 8.5 Emission level measurement, in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.11.3 in ANSI C63.10-2013:

1. Set the centre frequency and span to encompass frequency range to be measured.
2. Set the RBW = 100 kHz.
3. Set the VBW ≥ 3 X RBW.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the maximum amplitude level.

8.5.4 Test Result

See test plots

8.5.5 Test Plots



BLE-Band Edge-Low

BLE-Band Edge-High

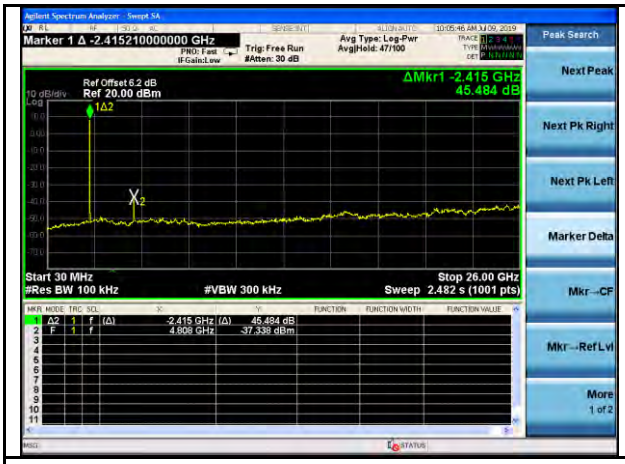
11b-Band Edge-Low

11b-Band Edge-High

11g-Band Edge-Low

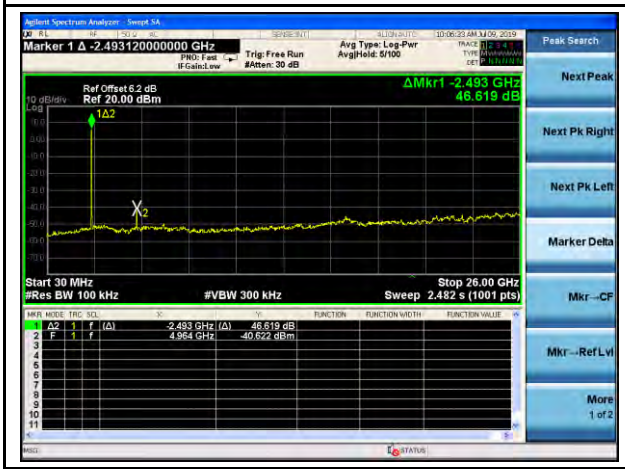
11g-Band Edge-High

	
11n-20MHz-Band Edge-Low	**11n-20MHz-Band Edge-High**



BLE-Out Of Band Emission-Low

BLE-Out Of Band Emission-Mid



BLE-Out Of Band Emission-High

11b-Out Of Band Emission-Low

11g-Out Of Band Emission-Low

11b-Out Of Band Emission-Mid

11g-Out Of Band Emission-Mid

11b-Out Of Band Emission-High

11g-Out Of Band Emission-High

11n 20MHz-Out Of Band Emission-Low

11n 20MHz-Out Of Band Emission-Mid

11n 20MHz-Out Of Band Emission-High

8.6 Radiated Band-Edge & Spurious Emissions into Restricted Frequency Bands

8.6.1 Requirement

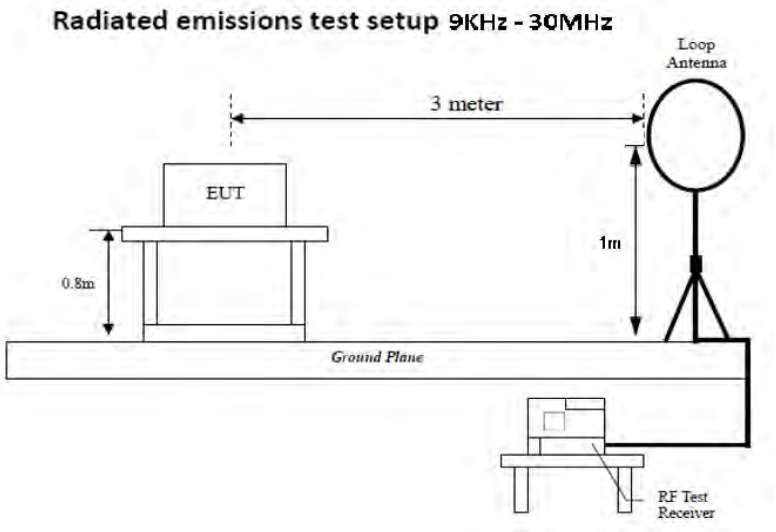
§ 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

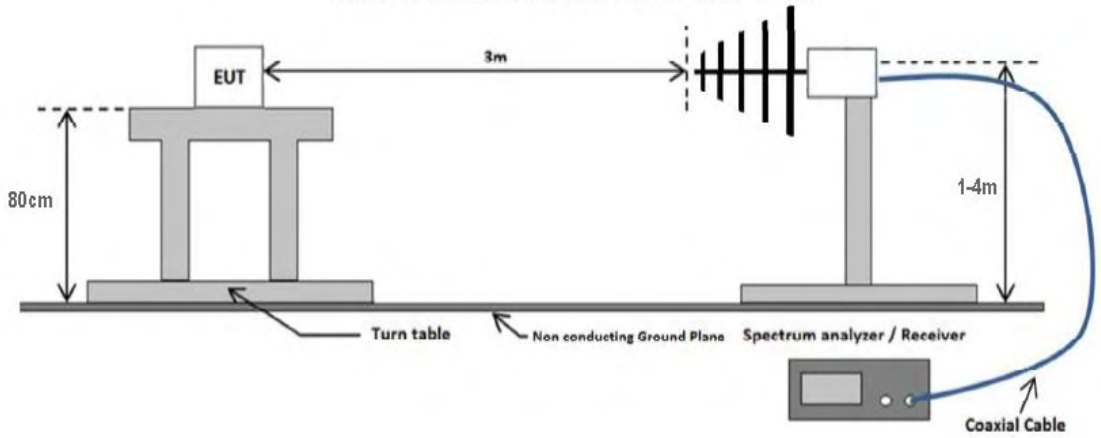
Attenuation below the general limits specified in §15.209(a) and RSS-Gen is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Frequency range (MHz)	Field Strength (µV/m)
0.009~0.490	2400/F(KHz)
0.490~1.705	24000/F(KHz)
1.705~30.0	30
30 – 88	100
88 – 216	150
216 960	200
Above 960	500

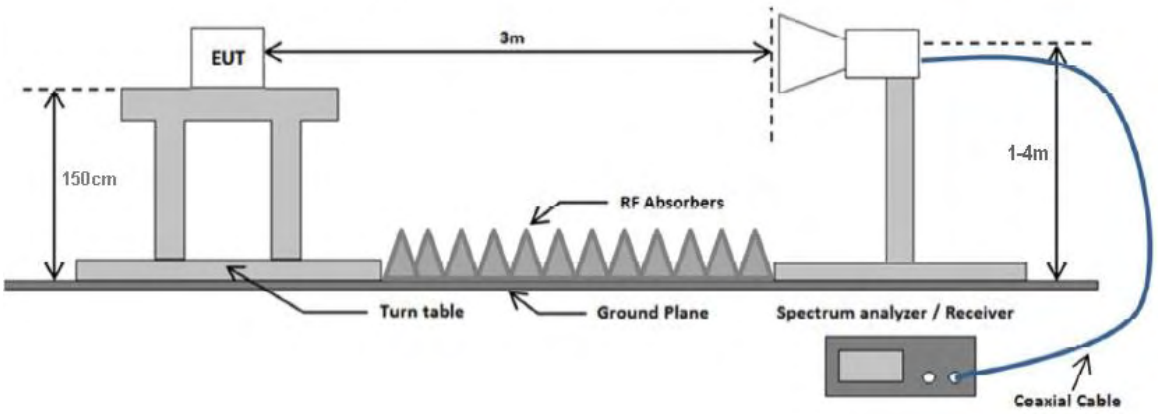
8.6.2 Test setup



Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



8.6.3 ***Test Procedure***

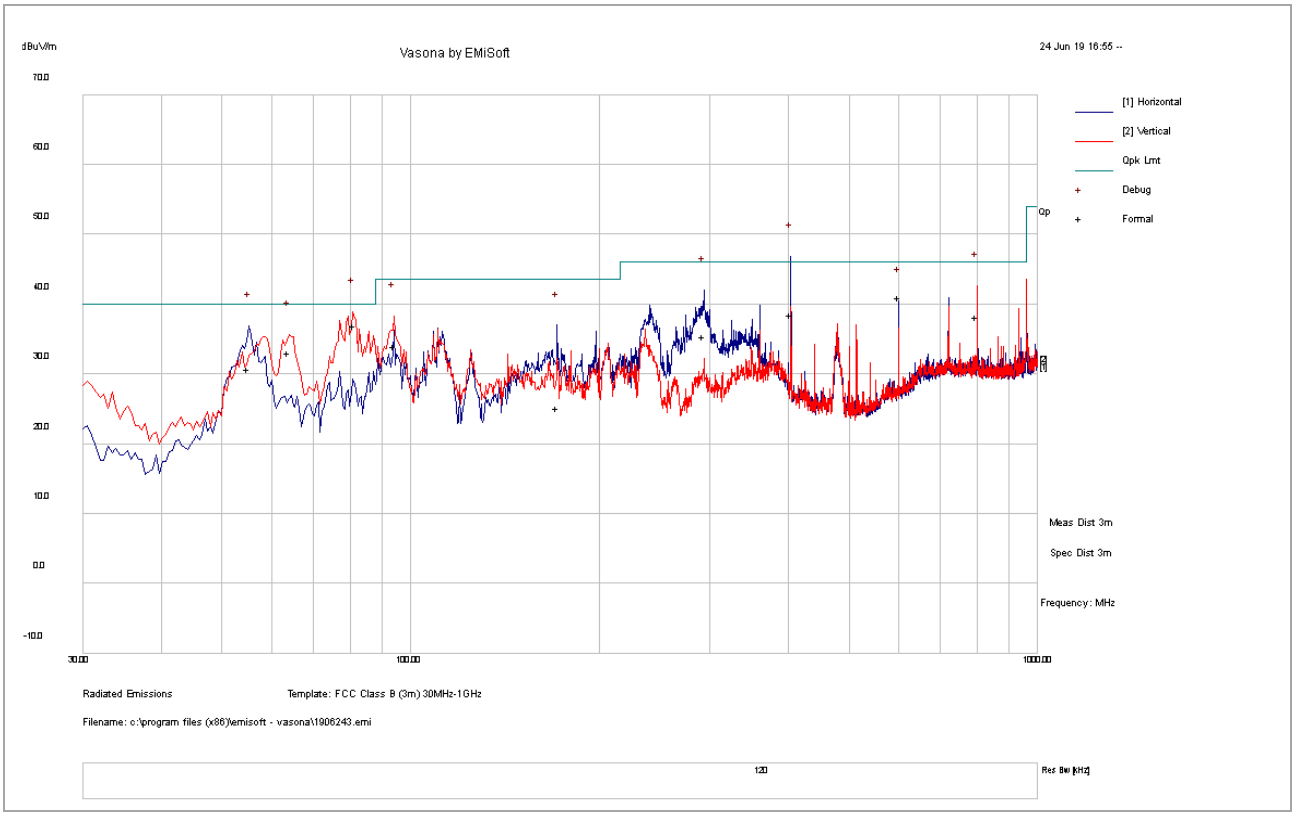
According to section 8.6 in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.12.2.7 Radiated spurious emission measurements in ANSI C62.10-2013 as well as the procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 was followed. Boresight antenna mast was used during the scanning to point to EUT to maximize the emission. The process will be repeated in 3 EUT orientations.

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
   a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
   b. The EUT was then rotated to the direction that gave the maximum emission.
   c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 300 Hz for frequency below 150KHz.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for frequency between 150KHz – 30MHz.
5. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-Peak detection at frequency between 30MHz - 1GHz.
6. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak and average measurement at frequency above 1GHz.
7. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.

8.6.4 Test Result

30-1000MHz test result

Test Standard:	**15.209, 15.247**	**Mode:**	**BLE Mode**
Frequency Range:	**30-1000MHz**	**Test Date:**	**06/24/2019**
Antenna Type/Polarity:	**Bi-Log/Hor & Ver**	**Test Personnel:**	**Cameron Wu**
Remark:	**N/A**	**Test Result:**	**Pass**



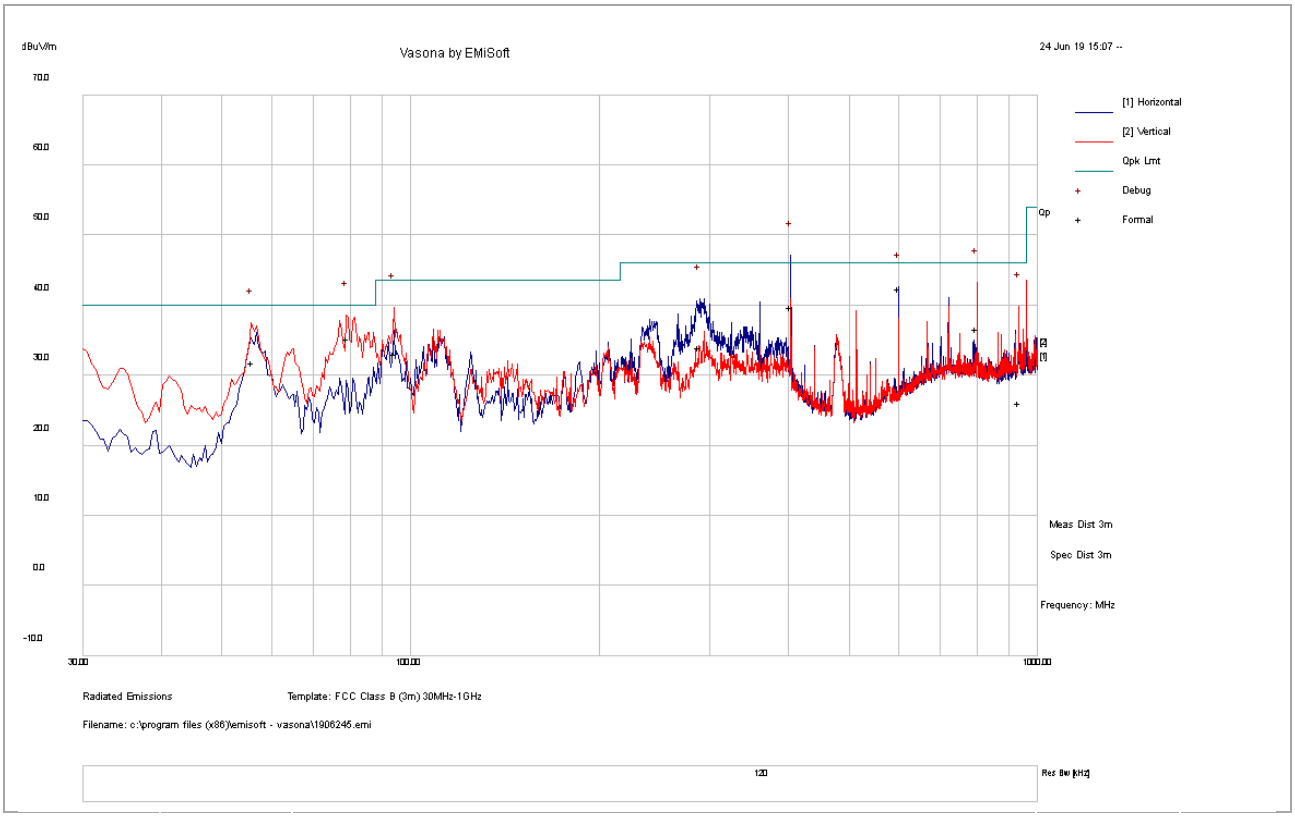
Frequency MHz	Raw dB	Cable dB	AF dB	Level dBuV/m	Det	Pol deg	Height cm	Table deg	Limit dBuV/m	Margin dB
403.95	45.74	6.36	-13.48	38.62	QP	H	267	325	46.00	-7.38
81.17	58.25	3.33	-24.61	36.97	QP	V	124	66	40.00	-3.03
54.98	52.63	2.90	-24.73	30.80	QP	H	112	220	40.00	-9.20
799.99	37.78	7.24	-6.76	38.26	QP	V	295	39	46.00	-7.74
293.54	48.58	5.63	-18.79	35.41	QP	H	126	336	46.00	-10.59
63.89	54.52	3.07	-24.48	33.10	QP	V	128	104	40.00	-6.90
94.15	54.72	3.50	-24.21	34.00	QP	V	136	134	43.50	-9.50
600.02	43.83	7.17	-9.91	41.09	QP	H	100	62	46.00	-4.91
170.91	42.84	4.47	-22.20	25.11	QP	H	110	87	43.50	-18.39

Note:

1) For below 1GHz, all different channel and modes were verified but only the worst case result is shown here.

30-1000MHz test result

Test Standard:	**15.209, 15.247**	**Mode:**	**2.4GHz WLAN mode**
Frequency Range:	**30-1000MHz**	**Test Date:**	**06/27/2019**
Antenna Type/Polarity:	**Bi-Log/Hor & Ver**	**Test Personnel:**	**Cameron Wu**
Remark:	**N/A**	**Test Result:**	**Pass**



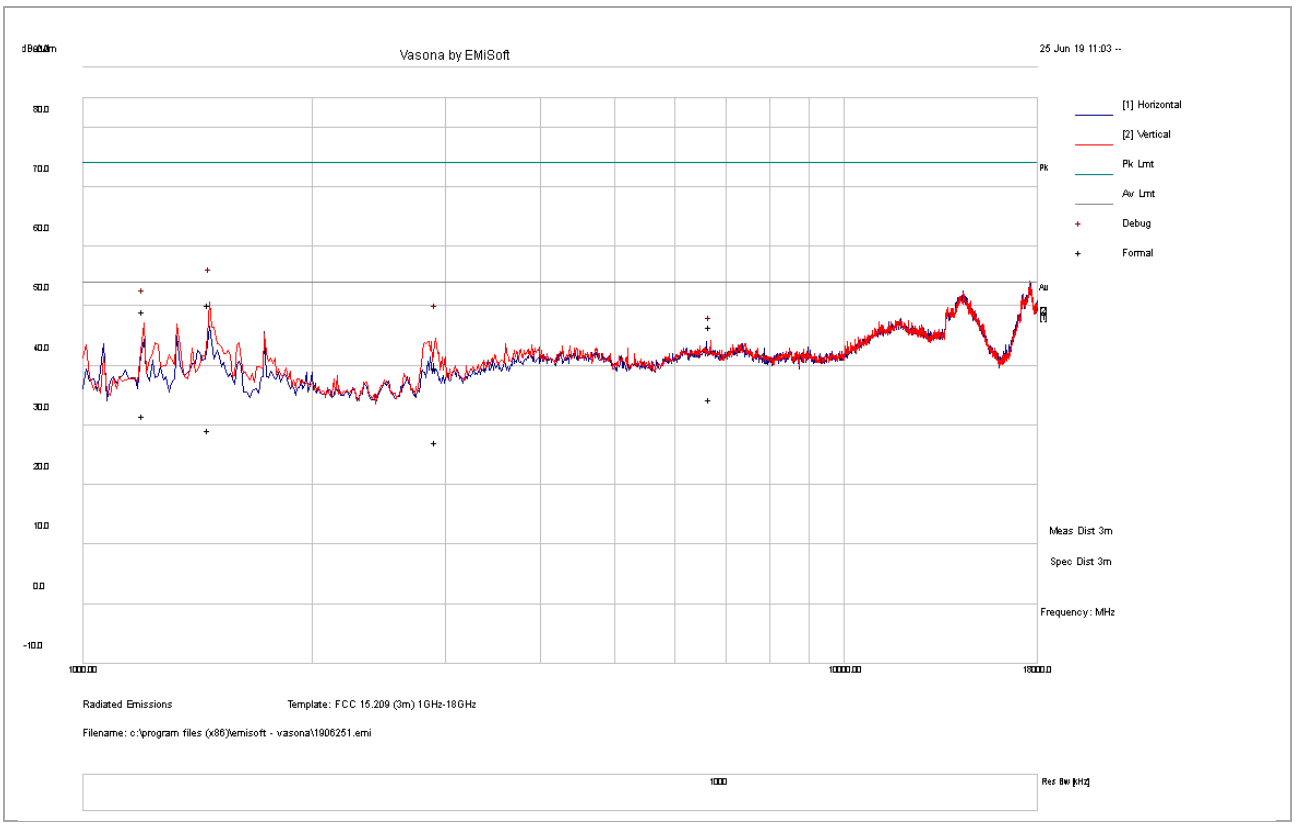
Frequency MHz	Raw dB	Cable dB	AF dB	Level dBuV/m	Det	Pol deg	Height cm	Table deg	Limit dBuV/m	Margin dB
403.88	46.91	6.36	-13.48	39.79	QP	H	280	319	46.00	-6.21
79.22	56.53	3.30	-24.58	35.26	QP	V	147	30	40.00	-4.74
55.85	53.74	2.92	-24.72	31.93	QP	V	203	76	40.00	-8.07
800.00	36.22	7.24	-6.76	36.70	QP	V	358	53	46.00	-9.30
600.01	45.13	7.17	-9.91	42.38	QP	H	109	62	46.00	-3.62
94.13	53.77	3.50	-24.22	33.05	QP	V	169	140	43.50	-10.45
288.88	47.34	5.59	-18.84	34.09	QP	H	139	332	46.00	-11.91
933.52	25.20	7.74	-6.87	26.08	QP	V	336	43	46.00	-19.92

Note:

1) For below 1GHz, all different channel and modes were verified but only the worst case result is shown here.

1GHz – 18GHz test result

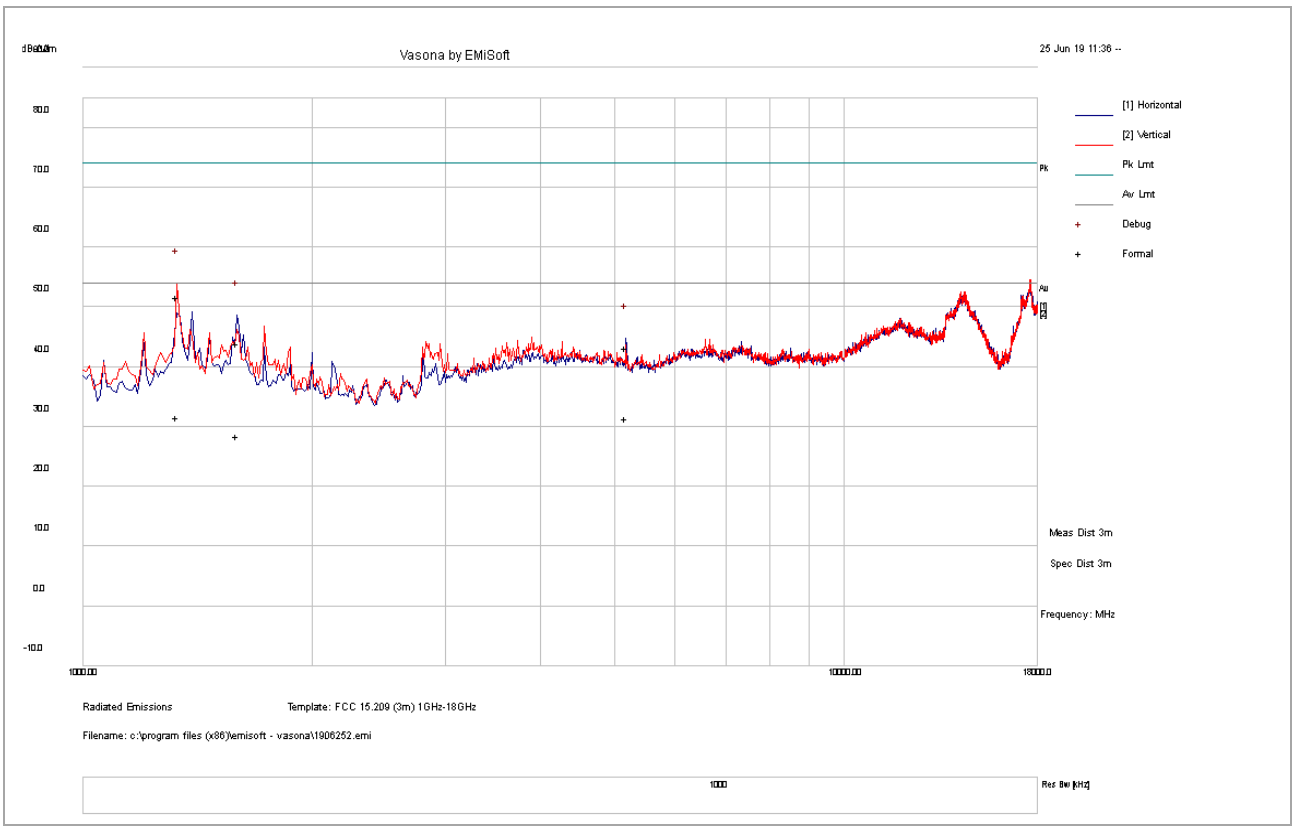
Test Standard:	**15.209, 15.247**	**Mode:**	**BLE-Low CH**
Frequency Range:	**1GHz-18GHz**	**Test Date:**	**06/27/2019**
Antenna Type/Polarity:	**Horn/Hor & Ver**	**Test Personnel:**	**Cameron Wu**
Remark:	**N/A**	**Test Result:**	**Pass**



Frequency MHz	Raw dB	Cable dB	AF dB	Level dBuV/m	Det	Pol deg	Height cm	Table deg	Limit dBuV/m	Margin dB
1466.55	43.24	10.81	-3.75	50.30	PK	V	156	254	74	-23.70
1200.19	43.00	10.30	-4.18	49.12	PK	V	149	356	74	-24.88
2911.83	26.01	11.23	2.55	39.80	PK	V	308	67	74	-34.20
6667.60	19.55	15.37	11.68	46.60	PK	H	244	224	74	-27.40
1466.55	22.09	10.81	-3.75	29.15	AV	V	156	254	54	-24.85
1200.19	25.44	10.30	-4.18	31.56	AV	V	149	356	54	-22.44
2911.83	13.36	11.23	2.55	27.15	AV	V	308	67	54	-26.85
6667.60	7.24	15.37	11.68	34.28	AV	H	244	224	54	-19.72

1GHz – 18GHz test result

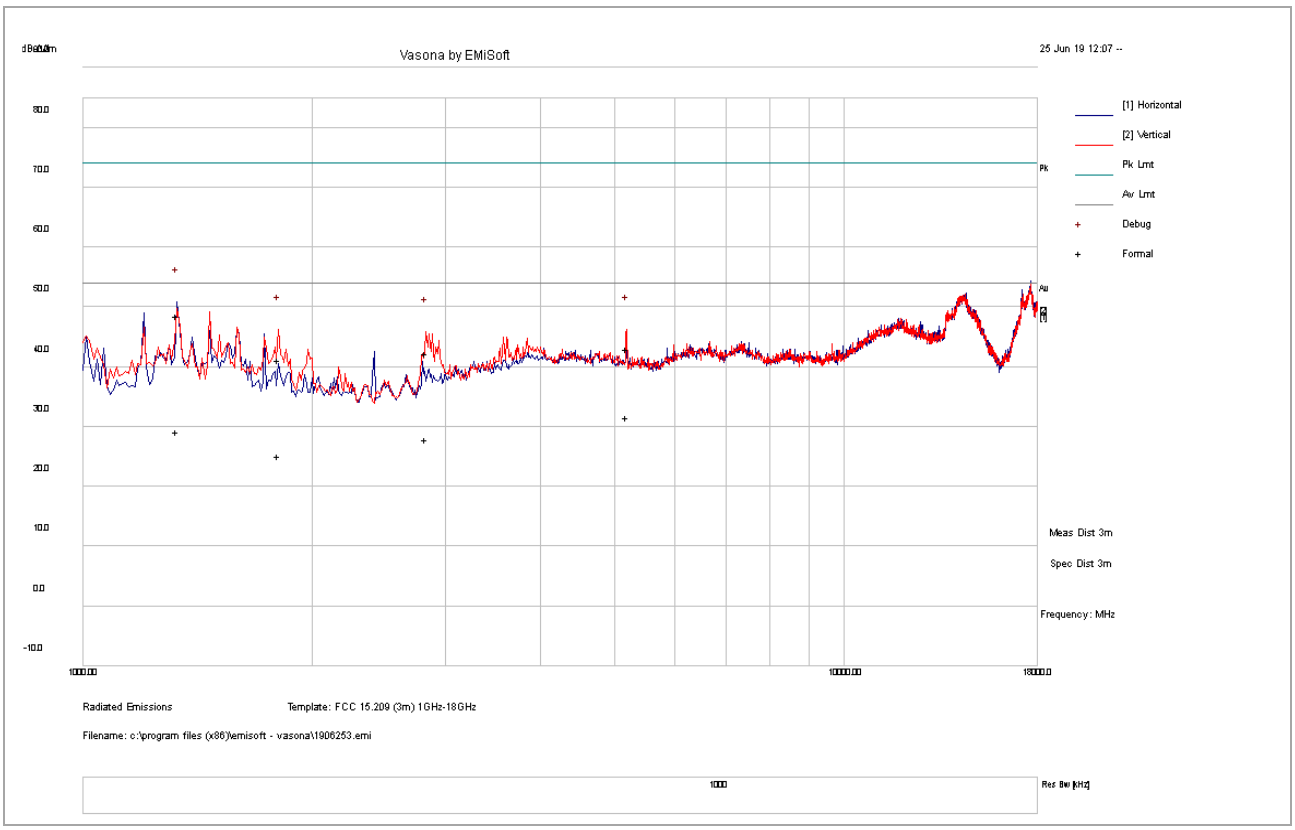
Test Standard:	**15.209, 15.247**	**Mode:**	**BLE-Mid CH**
Frequency Range:	**1GHz-18GHz**	**Test Date:**	**06/27/2019**
Antenna Type/Polarity:	**Horn/Hor & Ver**	**Test Personnel:**	**Cameron Wu**
Remark:	**N/A**	**Test Result:**	**Pass**



Frequency MHz	Raw dB	Cable dB	AF dB	Level dBuV/m	Det	Pol deg	Height cm	Table deg	Limit dBuV/m	Margin dB
1329.23	44.94	10.56	-3.81	51.68	PK	V	155	263	74	-22.32
1595.71	36.62	10.73	-3.37	43.99	PK	H	101	254	74	-30.01
5175.33	19.50	13.45	10.33	43.28	PK	V	259	138	74	-30.72
1329.23	24.79	10.56	-3.81	31.54	AV	V	155	263	54	-22.46
1595.71	21.11	10.73	-3.37	28.48	AV	H	101	254	54	-25.52
5175.33	7.71	13.45	10.33	31.49	AV	V	259	138	54	-22.51

1GHz – 18GHz test result

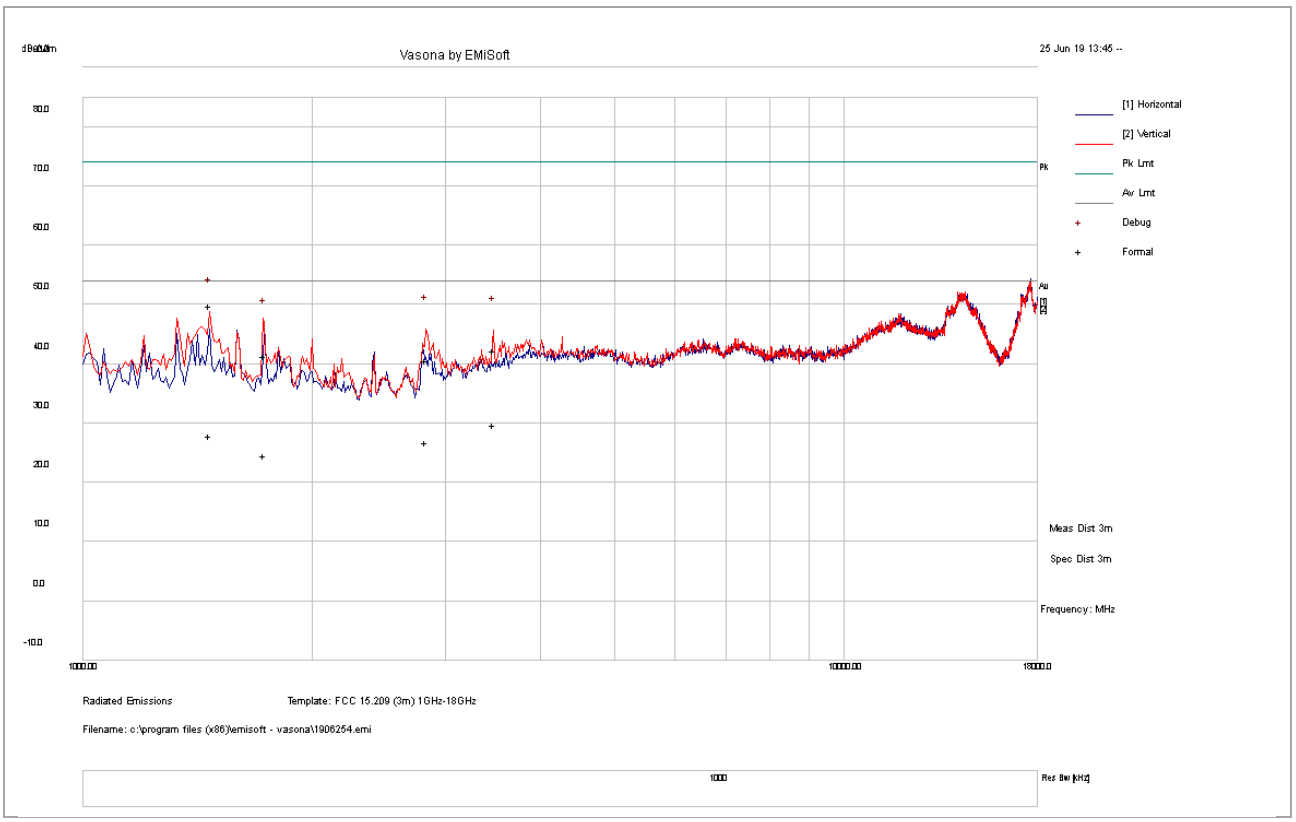
Test Standard:	**15.209, 15.247**	**Mode:**	**BLE-High CH**
Frequency Range:	**1GHz-18GHz**	**Test Date:**	**06/27/2019**
Antenna Type/Polarity:	**Horn/Hor & Ver**	**Test Personnel:**	**Cameron Wu**
Remark:	**N/A**	**Test Result:**	**Pass**



Frequency MHz	Raw dB	Cable dB	AF dB	Level dBuV/m	Det	Pol deg	Height cm	Table deg	Limit dBuV/m	Margin dB
1329.83	41.90	10.56	-3.81	48.64	PK	H	100	238	74	-25.36
5187.92	19.24	13.45	10.35	43.05	PK	V	100	37	74	-30.96
1806.39	32.40	10.47	-1.59	41.28	PK	V	300	342	74	-32.72
2827.79	29.18	11.15	1.97	42.30	PK	V	100	296	74	-31.70
1329.83	22.44	10.56	-3.81	29.19	AV	H	100	238	54	-24.81
5187.92	7.71	13.45	10.35	31.51	AV	V	100	37	54	-22.49
1806.39	16.24	10.47	-1.59	25.12	AV	V	300	342	54	-28.88
2827.79	14.82	11.15	1.97	27.94	AV	V	100	296	54	-26.06

1GHz – 18GHz test result

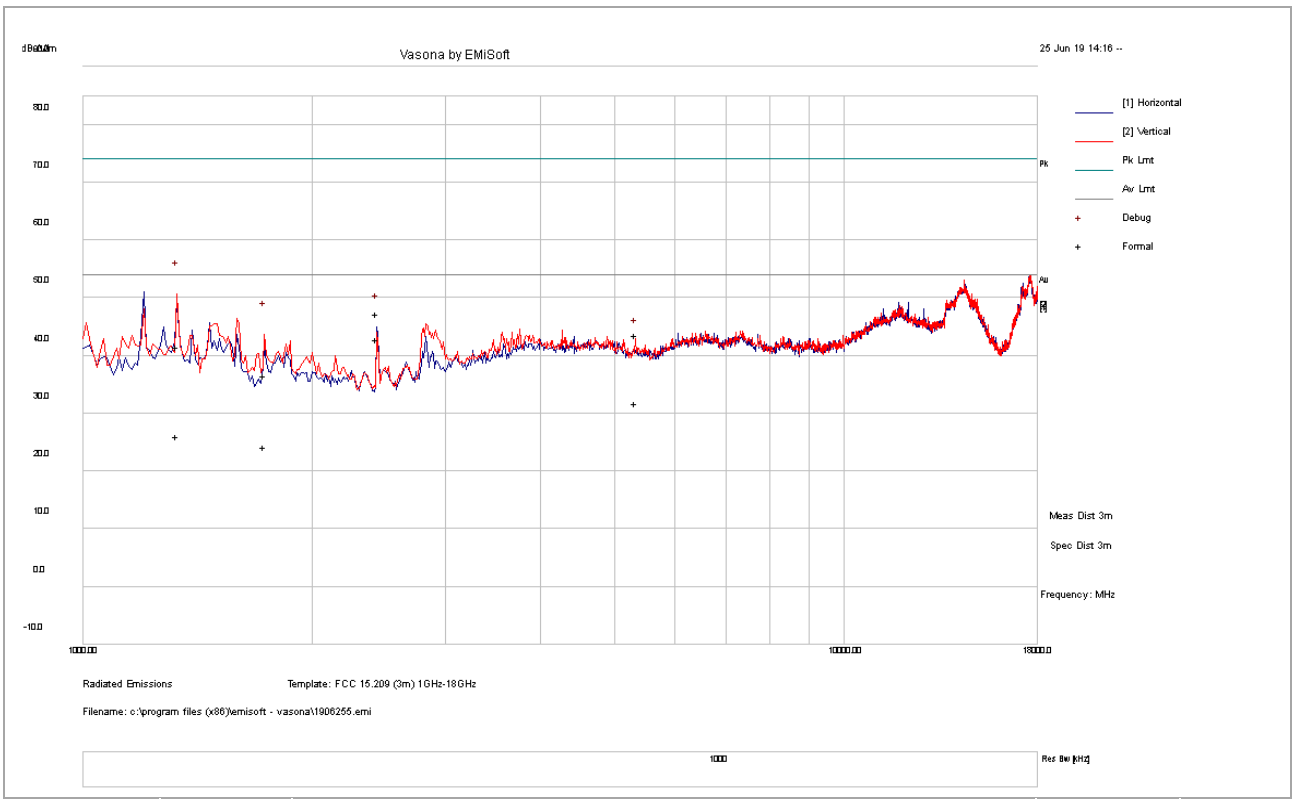
Test Standard:	**15.209, 15.247**	**Mode:**	**11b-2412MHz**
Frequency Range:	**1GHz-18GHz**	**Test Date:**	**06/27/2019**
Antenna Type/Polarity:	**Horn/Hor & Ver**	**Test Personnel:**	**Cameron Wu**
Remark:	**N/A**	**Test Result:**	**Pass**



Frequency MHz	Raw dB	Cable dB	AF dB	Level dBuV/m	Det	Pol deg	Height cm	Table deg	Limit dBuV/m	Margin dB
1466.65	42.83	10.81	-3.75	49.89	PK	V	226	68	74	-24.11
2825.61	27.56	11.15	1.96	40.67	PK	V	266	160	74	-33.33
3465.22	25.16	11.85	5.30	42.31	PK	V	235	327	74	-31.69
1733.27	33.46	10.56	-2.68	41.34	PK	V	140	248	74	-32.66
1466.65	20.78	10.81	-3.75	27.84	AV	V	226	68	54	-26.16
2825.61	13.64	11.15	1.96	26.75	AV	V	266	160	54	-27.25
3465.22	12.66	11.85	5.30	29.81	AV	V	235	327	54	-24.19
1733.27	16.78	10.56	-2.68	24.66	AV	V	140	248	54	-29.35

1GHz – 18GHz test result

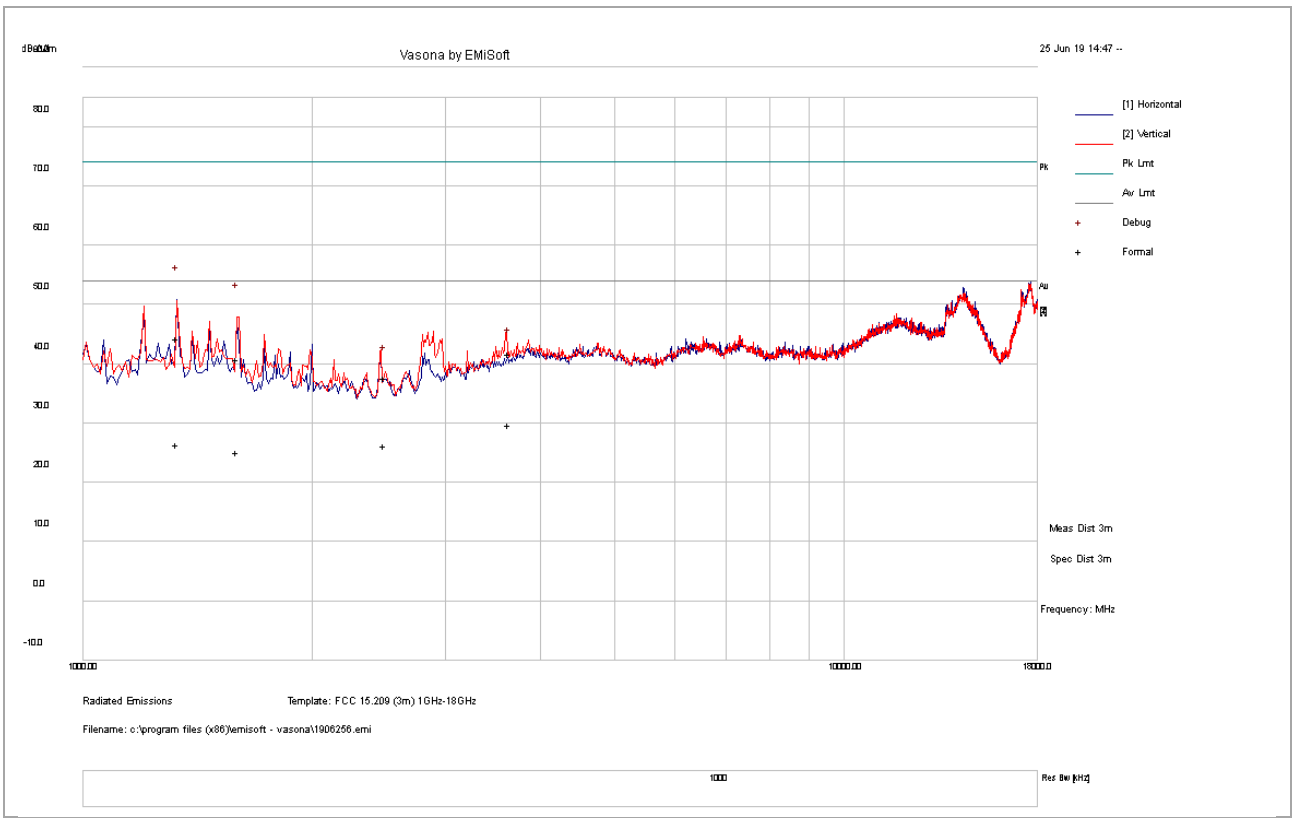
Test Standard:	**15.209, 15.247**	**Mode:**	**11b-2437MHz**
Frequency Range:	**1GHz-18GHz**	**Test Date:**	**06/27/2019**
Antenna Type/Polarity:	**Horn/Hor & Ver**	**Test Personnel:**	**Cameron Wu**
Remark:	**N/A**	**Test Result:**	**Pass**



Frequency MHz	Raw dB	Cable dB	AF dB	Level dBuV/m	Det	Pol deg	Height cm	Table deg	Limit dBuV/m	Margin dB
1328.59	34.89	10.56	-3.81	41.64	PK	V	182	69	74	-32.36
2434.88	36.34	10.75	0.13	47.22	PK	H	350	281	74	-26.78
1733.84	28.63	10.56	-2.67	36.52	PK	V	112	6	74	-37.49
5327.01	19.68	13.49	10.50	43.67	PK	V	334	86	74	-30.33
1328.59	19.41	10.56	-3.81	26.16	AV	V	182	69	54	-27.84
2434.88	31.99	10.75	0.13	42.87	AV	H	350	281	54	-11.13
1733.84	16.25	10.56	-2.67	24.14	AV	V	112	6	54	-29.86
5327.01	7.85	13.49	10.50	31.84	AV	V	334	86	54	-22.16

1GHz – 18GHz test result

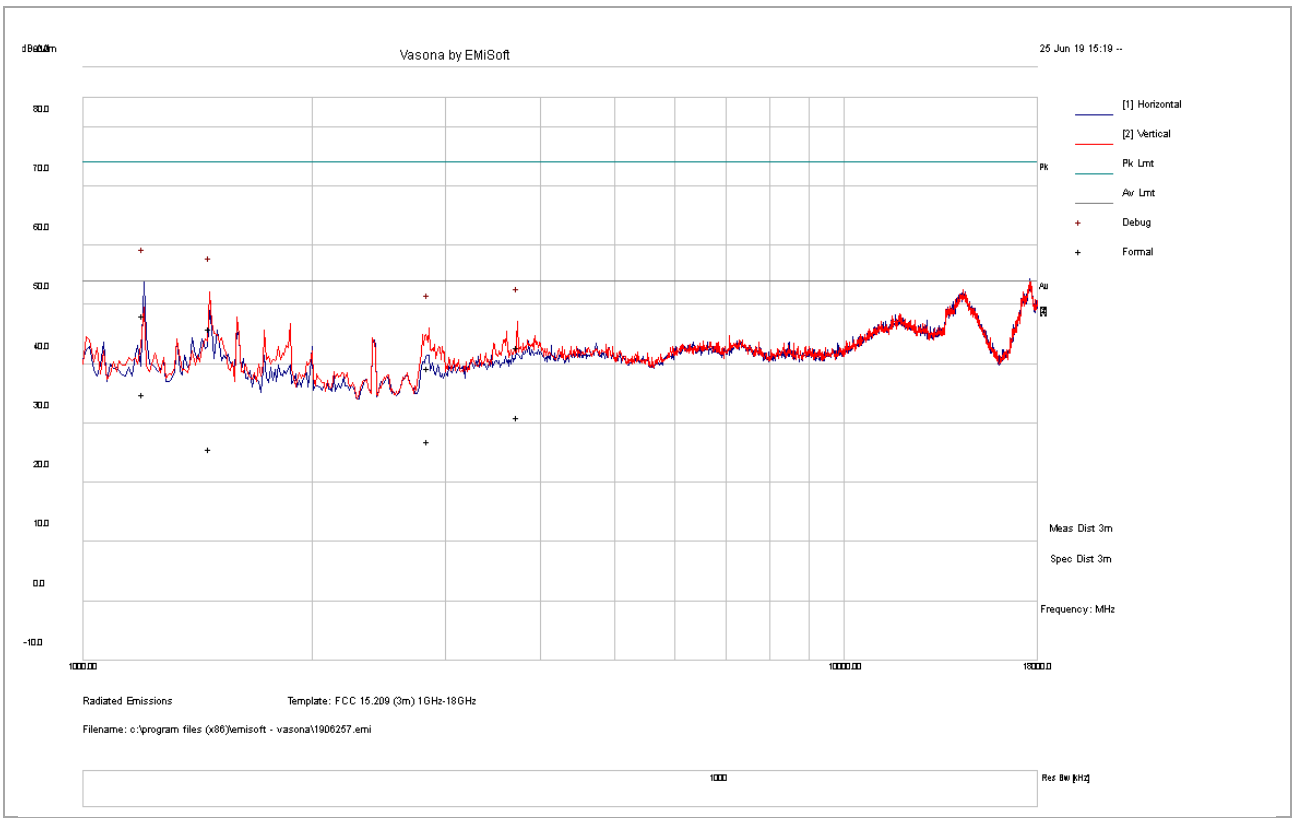
Test Standard:	**15.209, 15.247**	**Mode:**	**11b-2462MHz**
Frequency Range:	**1GHz-18GHz**	**Test Date:**	**06/27/2019**
Antenna Type/Polarity:	**Horn/Hor & Ver**	**Test Personnel:**	**Cameron Wu**
Remark:	**N/A**	**Test Result:**	**Pass**



Frequency MHz	Raw dB	Cable dB	AF dB	Level dBuV/m	Det	Pol deg	Height cm	Table deg	Limit dBuV/m	Margin dB
1328.18	37.52	10.56	-3.81	44.27	PK	H	100	230	74	-29.73
1593.33	33.42	10.74	-3.38	40.78	PK	V	177	180	74	-33.22
3638.32	23.30	12.14	6.32	41.76	PK	V	121	136	74	-32.24
2490.70	26.41	10.81	0.48	37.70	PK	V	184	122	74	-36.30
1328.18	19.67	10.56	-3.81	26.42	AV	H	100	230	54	-27.58
1593.33	17.83	10.74	-3.38	25.18	AV	V	177	180	54	-28.82
3638.32	11.25	12.14	6.32	29.71	AV	V	121	136	54	-24.30
2490.70	15.02	10.81	0.48	26.30	AV	V	184	122	54	-27.70

1GHz – 18GHz test result

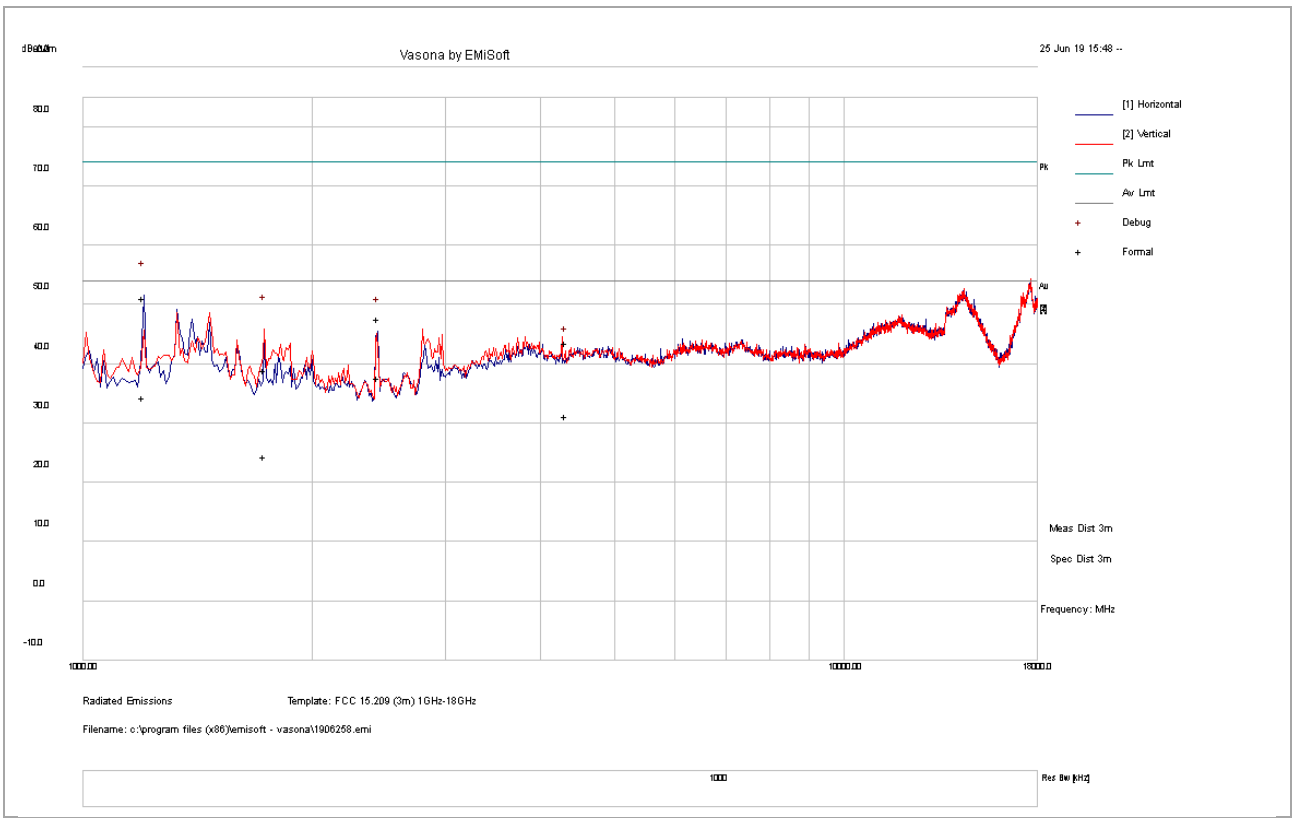
Test Standard:	**15.209, 15.247**	**Mode:**	**11n-2412MHz**
Frequency Range:	**1GHz-18GHz**	**Test Date:**	**06/27/2019**
Antenna Type/Polarity:	**Horn/Hor & Ver**	**Test Personnel:**	**Cameron Wu**
Remark:	**N/A**	**Test Result:**	**Pass**



Frequency MHz	Raw dB	Cable dB	AF dB	Level dBuV/m	Det	Pol deg	Height cm	Table deg	Limit dBuV/m	Margin dB
1200.08	42.06	10.30	-4.18	48.18	PK	H	250	237	74	-25.82
1468.02	38.98	10.81	-3.75	46.04	PK	V	243	313	74	-27.96
3731.38	23.48	12.30	7.01	42.79	PK	V	213	81	74	-31.21
2849.20	26.06	11.17	2.11	39.35	PK	V	350	251	74	-34.65
1200.08	28.86	10.30	-4.18	34.98	AV	H	250	237	54	-19.02
1468.02	18.72	10.81	-3.75	25.78	AV	V	243	313	54	-28.22
3731.38	11.82	12.30	7.01	31.14	AV	V	213	81	54	-22.86
2849.20	13.61	11.17	2.11	26.90	AV	V	350	251	54	-27.10

1GHz – 18GHz test result

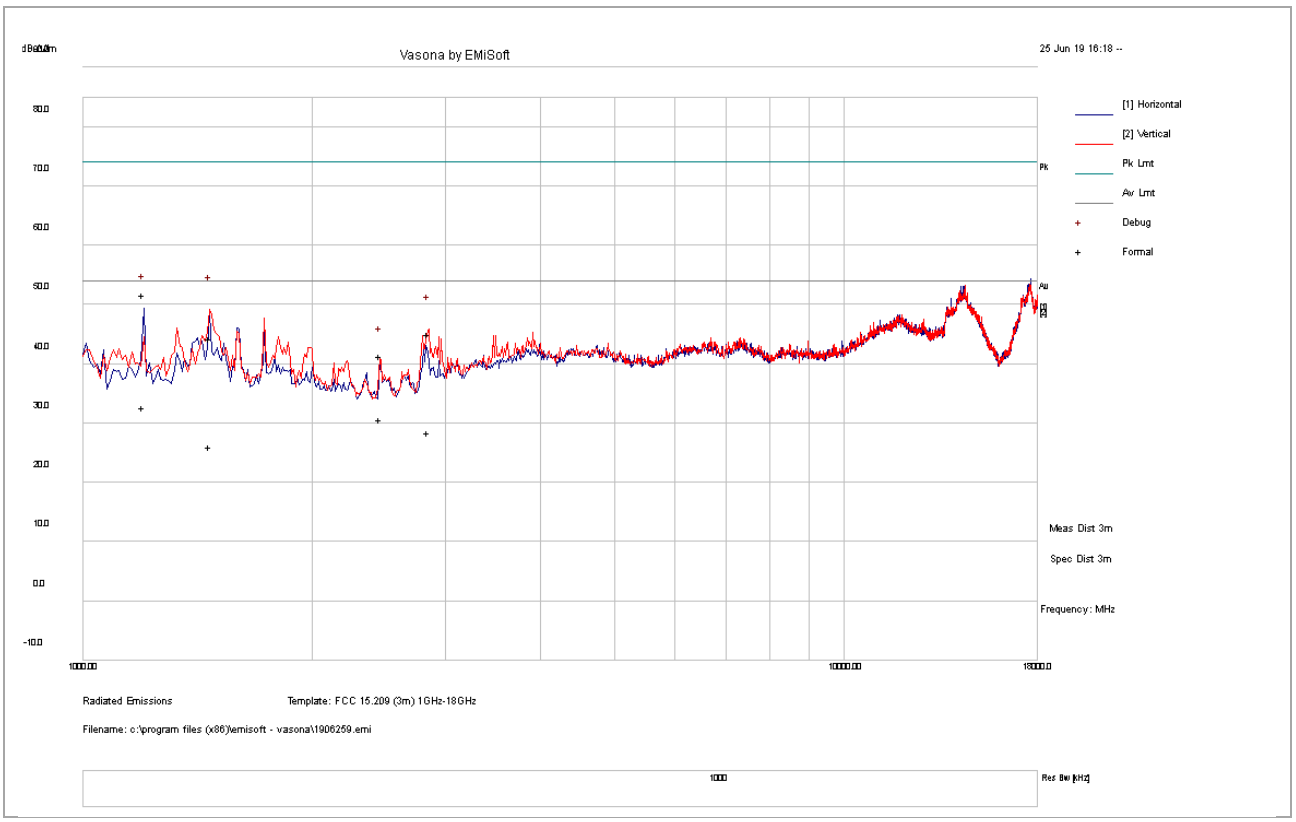
Test Standard:	**15.209, 15.247**	**Mode:**	**11n-2437MHz**
Frequency Range:	**1GHz-18GHz**	**Test Date:**	**06/27/2019**
Antenna Type/Polarity:	**Horn/Hor & Ver**	**Test Personnel:**	**Cameron Wu**
Remark:	**N/A**	**Test Result:**	**Pass**



Frequency MHz	Raw dB	Cable dB	AF dB	Level dBuV/m	Det	Pol deg	Height cm	Table deg	Limit dBuV/m	Margin dB
1199.93	44.94	10.30	-4.18	51.06	PK	H	103	292	74	-22.94
1733.54	31.02	10.56	-2.68	38.90	PK	V	320	168	74	-35.10
2444.34	36.77	10.76	0.16	47.68	PK	H	324	56	74	-26.32
4310.98	21.88	13.08	8.61	43.57	PK	V	223	317	74	-30.43
1199.93	28.19	10.30	-4.18	34.31	AV	H	103	292	54	-19.69
1733.54	16.58	10.56	-2.68	24.46	AV	V	320	168	54	-29.54
2444.34	26.71	10.76	0.16	37.62	AV	H	324	56	54	-16.38
4310.98	9.55	13.08	8.61	31.25	AV	V	223	317	54	-22.75

1GHz – 18GHz test result

Test Standard:	**15.209, 15.247**	**Mode:**	**11n-2462MHz**
Frequency Range:	**1GHz-18GHz**	**Test Date:**	**06/27/2019**
Antenna Type/Polarity:	**Horn/Hor & Ver**	**Test Personnel:**	**Cameron Wu**
Remark:	**N/A**	**Test Result:**	**Pass**

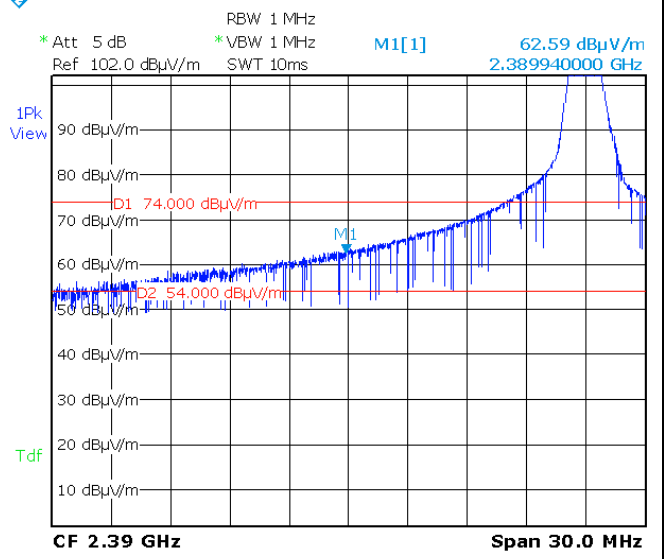


Frequency MHz	Raw dB	Cable dB	AF dB	Level dBuV/m	Det	Pol deg	Height cm	Table deg	Limit dBuV/m	Margin dB
1199.98	45.56	10.30	-4.18	51.68	PK	H	105	313	74	-22.32
1466.63	37.33	10.81	-3.75	44.40	PK	V	110	329	74	-29.61
2847.85	31.73	11.17	2.11	45.01	PK	V	105	219	74	-28.99
2457.98	30.45	10.77	0.23	41.45	PK	V	101	39	74	-32.55
1199.98	26.61	10.30	-4.18	32.73	AV	H	105	313	54	-21.27
1466.63	19.02	10.81	-3.75	26.08	AV	V	110	329	54	-27.92
2847.85	15.22	11.17	2.11	28.50	AV	V	105	219	54	-25.50
2457.98	19.68	10.77	0.23	30.68	AV	V	101	39	54	-23.32

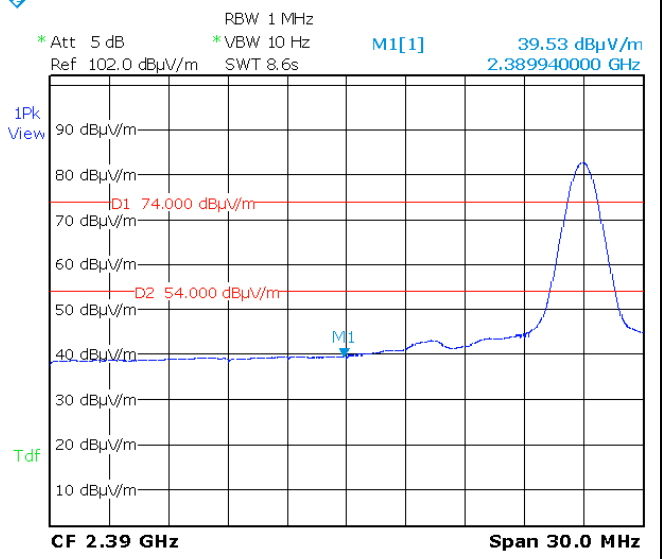
18GHz – 40GHz test result

Note: no substantial emission is found other than the noise floor. Different modes have been verified.

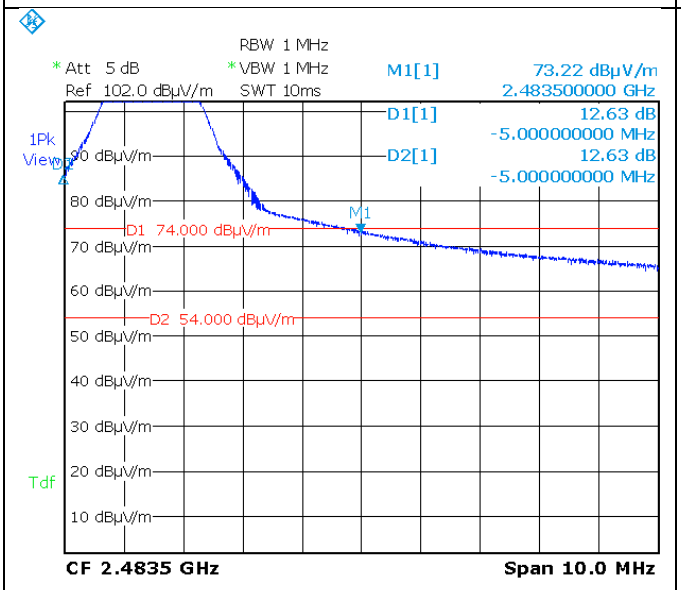
Restricted Band Measurement Result



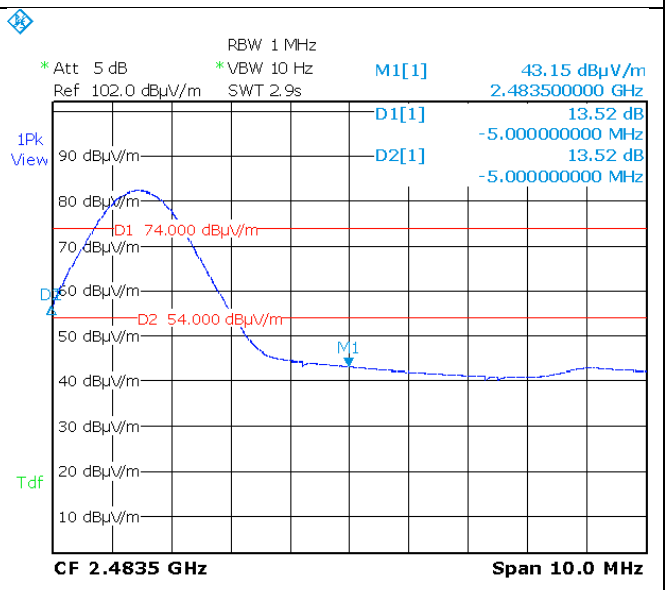
BLE-2402MHz-Peak



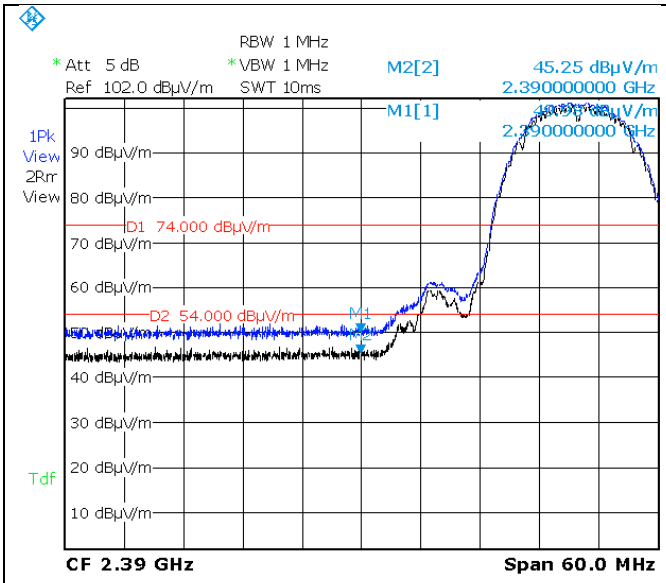
BLE-2402MHz-Average



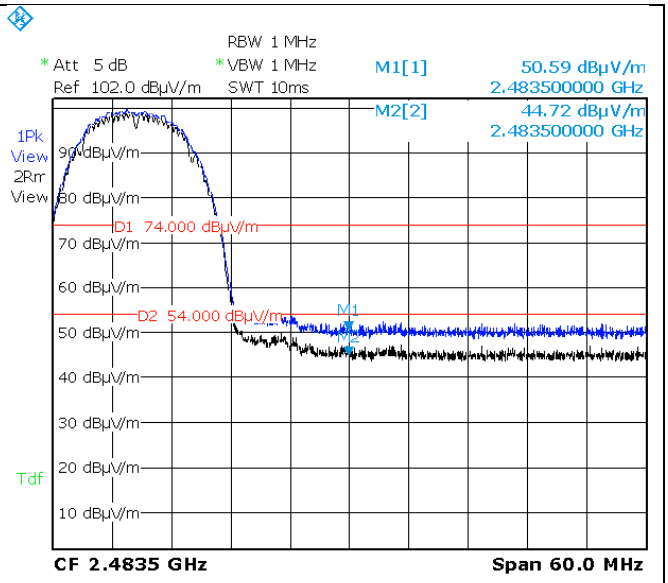
BLE-2480MHz-Peak



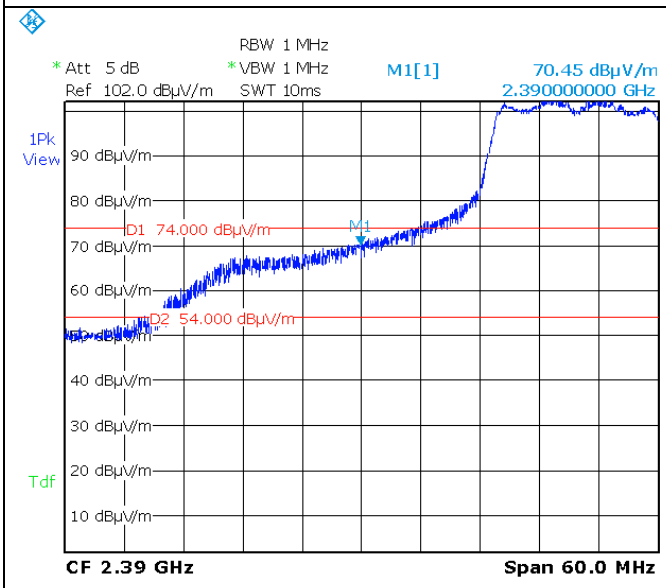
BLE-2480MHz-Average



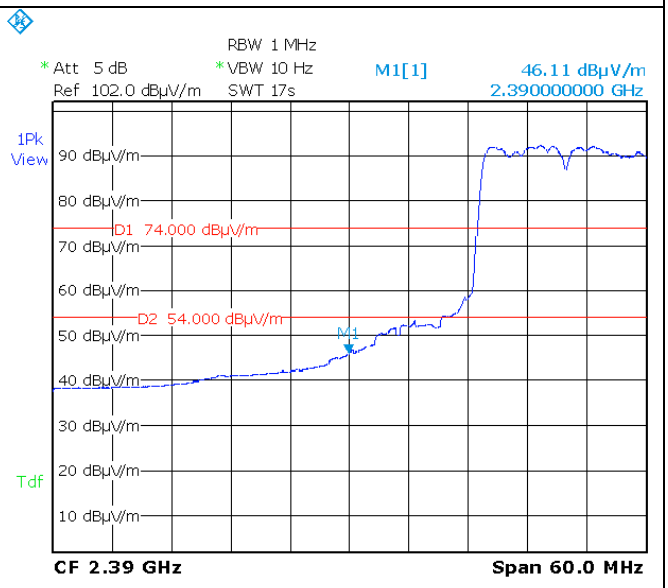
802.11b-2412MHz



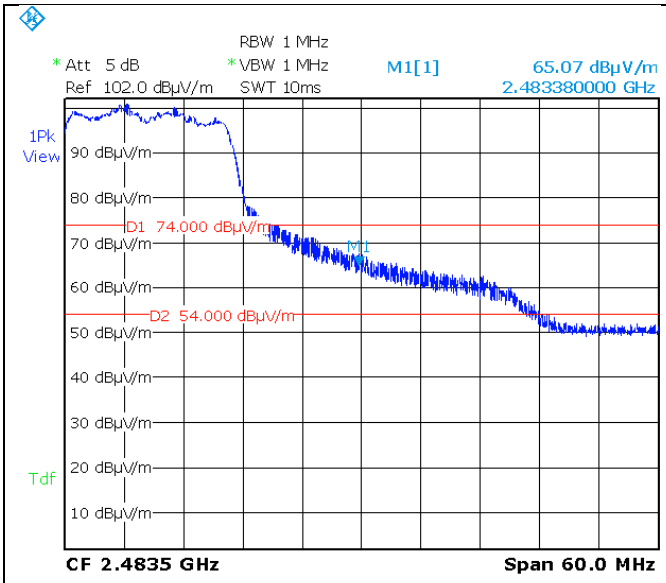
802.11b-2462MHz



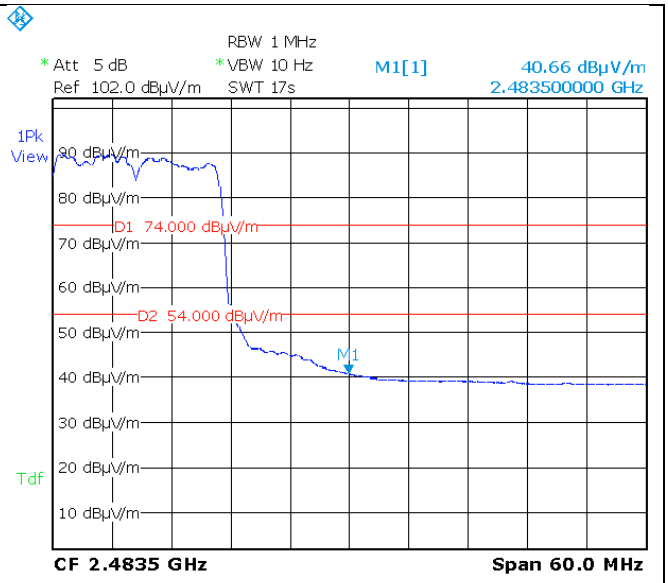
802.11g-2412MHz-Peak



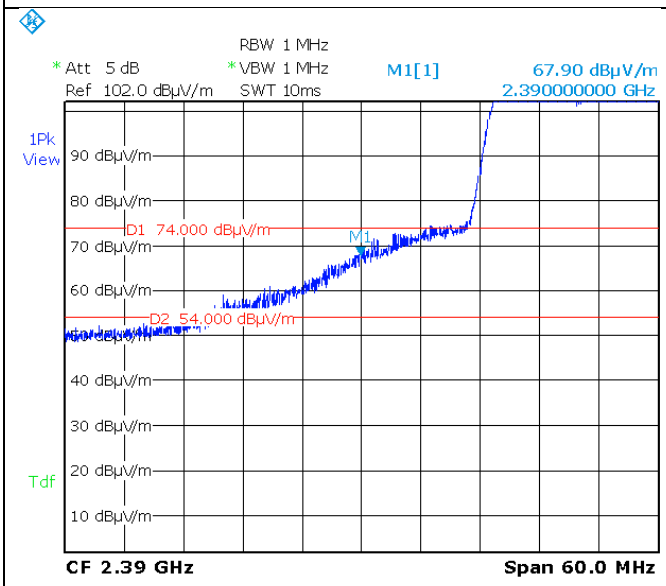
802.11g-2412MHz-Aveage



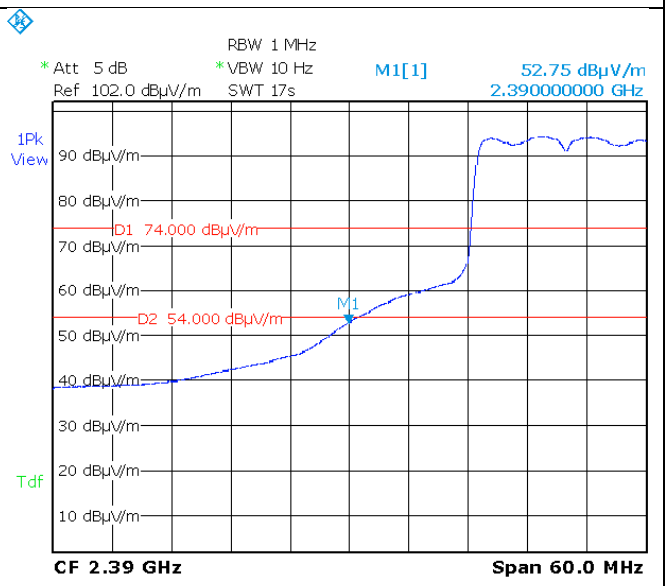
802.11g-2462MHz-Peak



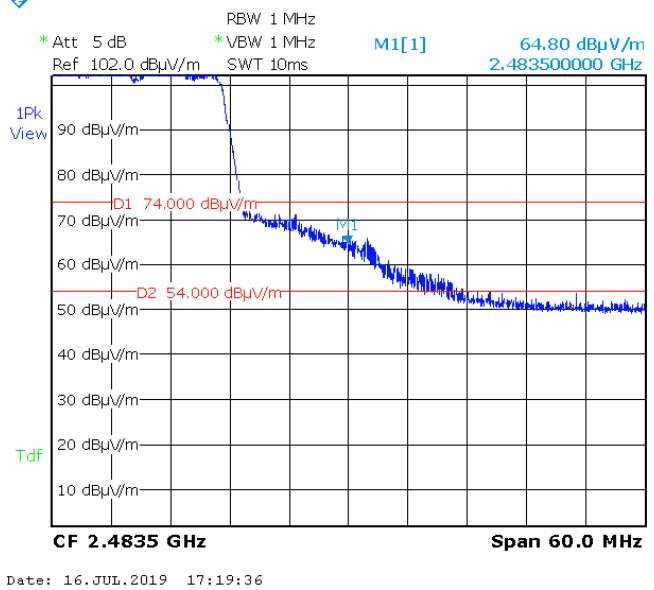
802.11g-2462MHz-Aveage



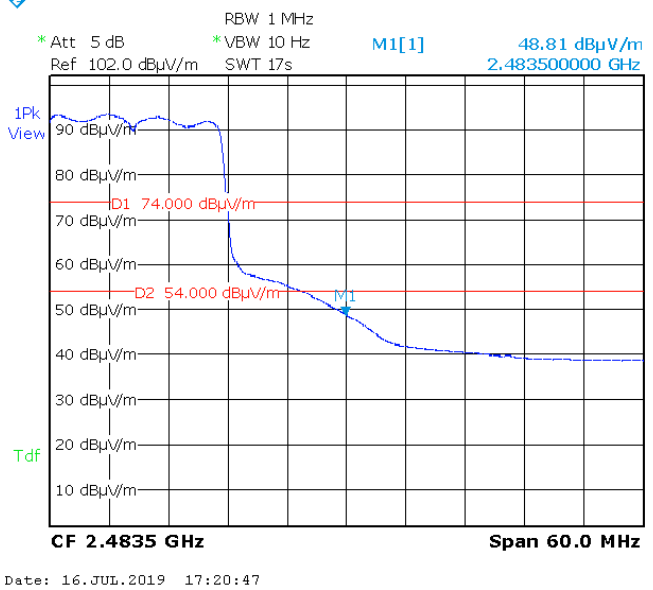
802.11n-2412MHz-Peak



802.11n-2412MHz-Aveage



802.11n-2462MHz-Peak



802.11n-2462MHz-Aveage

9 Test instrument list

Equipment	Manufacturer	Model	Serial Number	Cal. Date	Cal. Due
Semi-Anechoic Chamber	ETS-Lindgren	10M	VL001	5/11/2019	5/11/2020
Shielding Control Room	ETS-Lindgren	Series 81	VL006	N/A	N/A
Spectrum Analyzer	Keysight	N9020A	MY50110074	5/4/2019	5/4/2020
EMC Test Receiver	R&S	ESL6	100230	5/7/2019	5/7/2020
LISN (9KHz – 30MHz)	EMCO	3816/2	9705-1066	5/4/2019	5/4/2020
Bi-Log Antenna	ETS-Lindgren	3142E	217921	11/15/2018	11/15/2019
Horn Antenna (1-18GHz)	Electro-Metrics	EM-6961	6292	5/2/2019	5/2/2020
Horn Antenna (18-40GHz)	Com-Power	AH-840	101109	5/2/2019	5/2/2020
Preamplifier	RF Bay, Inc.	LPA-10-20	11180621	5/10/2019	5/10/2020
True RMS Multi-meter	UNI-T	UT181A	C173014829	5/10/2019	5/10/2020
Temp / Humidity / Pressure Meter	PCE Instruments	PCE-THB 40	R062028	5/9/2019	5/9/2020
RF Attenuator	Pasternack	PE7005-3	VL061	5/10/2019	5/10/2020
Preamplifier 100KHz - 40GHz	Aeroflex	33711-392-77150-11	064	5/10/2019	5/10/2020
EM Center Control	ETS-Lindgren	7006-001	160136	N/A	N/A
Turn Table	ETS-Lindgren	2181-3.03	VL002	N/A	N/A
Boresight Antenna Tower	ETS-Lindgren	2171B	VL003	N/A	N/A
Loop Antenna (9k-30MHz)	Com-Power	AL-130	121012	5/9/2019	5/9/2020
RE test cable(below 6GHz)	Vista	RE-6GHz-01	RE-6GHz-01	5/10/2019	5/10/2020
RE test cable (1-18GHz)	PhaseTrack	II-240	RE-18GHz-01	5/10/2019	5/10/2020
RE test cable (>18GHz)	Sucoflex	104	344903/4	5/10/2019	5/10/2020
Pulse limiter	Com-Power	LIT-930A	531727	5/15/2019	5/15/2020
CE test cable #1	FIRST RF	FRF-C-1002-001	CE-6GHz-01	5/10/2019	5/10/2020
CE test cable#2	FIRST RF	FRF-C-1002-001	CE-6GHz-02	5/9/2019	5/9/2020
Wideband Communication	R&S	CMW500	147508	5/8/2019	5/8/2020