

# TEST REPORT

Reference No..... : WTX21X05049596W-3  
FCC ID ..... : 2AHAF-MDT661  
Applicant ..... : TOPICON HK LIMITED  
Address..... : Room 2314-2316, Tower C, Huangdu Plaza, Yitian Road, Futian District,  
Shenzhen, China  
Product Name ..... : Rugged Phone  
Test Model. .... : MDT661  
Standards ..... : FCC Part 15.247  
Date of Receipt sample .... : May. 24, 2021  
Date of Test..... : May. 24, 2021 to Sep. 07, 2021  
Date of Issue ..... : Sep. 07, 2021  
Test Result..... : **Pass**

Remarks:

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

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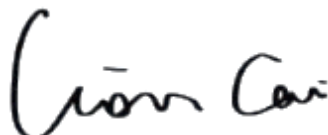
Tested by:

Reviewed By:

Approved & Authorized By:



Jason Su / Project Engineer



Lion Cai / RF Manager



Silin Chen / Manager

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**Report version**

Version No.	Date of issue	Description
Rev.00	Sep. 07, 2021	Original
/	/	/

## 1. GENERAL INFORMATION

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### 1.1 Product Description for Equipment Under Test (EUT)

#### Client Information

Applicant: TOPICON HK LIMITED  
 Address of applicant: Room 2314-2316, Tower C, Huangdu Plaza, Yitian Road, Futian District, Shenzhen, China

Manufacturer: TOPICON HK LIMITED  
 Address of manufacturer: Room 2314-2316, Tower C, Huangdu Plaza, Yitian Road, Futian District, Shenzhen, China

General Description of EUT	
Product Name:	Rugged Phone
Trade Name:	/
Model No.:	MDT661
Adding Model(s):	MDT660, MDT662, OBC661, PN6043, M620, M620A, MDT615D, X6, Paceblade SDT 121
Rated Voltage/ Battery:	Adapter DC5V; Built-in battery DC3.8V; External rechargeable battery DC12, 24V
Adapter Model:	GA-0502000 Input: AC100-240V, 50/60Hz Output:DC5V, 2000mA
Software Version:	mdt661_1.3.5
Hardware Version:	MDT661_V1.0
<p><i>Note: The test data is gathered from a production sample provided by the manufacturer. The appearance of others models listed in the report is different from main-test model MDT661, but the circuit and the electronic construction do not change, declared by the manufacturer.</i></p>	

Technical Characteristics of EUT	
Support Standards:	802.11b, 802.11g, 802.11n
Frequency Range:	2412-2462MHz for 802.11b/g/n(HT20) 2422-2452MHz for 802.11n(HT40)
RF Output Power:	17.01dBm (Conducted)
Type of Modulation:	DBPSK,BPSK,DQPSK,QPSK,16QAM,64QAM
Quantity of Channels:	11 for 802.11b/g/n(HT20); 7 for 802.11n(HT40)
Channel Separation:	5MHz
Type of Antenna:	Integral Antenna
Antenna Gain:	0.99dBi

## 1.2 Test Standards

The tests were performed according to following standards:

**FCC Rules Part 15.247:** Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz.

**558074 D01 15.247 Meas Guidance v05r02:** Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating under section 15.247 of the Fcc rules.

**662911 D01 Multiple Transmitter Output v02r01:** Emissions Testing of Transmitters with Multiple Outputs in the Same Band.

**ANSI C63.10-2013:** American National Standard for Testing Unlicensed Wireless Devices.

**Maintenance of compliance** is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

## 1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 662911 D01 Multiple Transmitter Output v02r01

The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted accordingly in reference to the Operating Instructions.

## 1.4 Test Facility

### Address of the test laboratory

Laboratory: Waltek Testing Group (Shenzhen) Co., Ltd.

Address: 1/F., Room 101, Building 1, Hongwei Industrial Park, Liuxian 2nd Road, Block 70 Bao'an District, Shenzhen, Guangdong, China

### FCC – Registration No.: 125990

Waltek Testing Group (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. The Designation Number is CN5010, and Test Firm Registration Number is 125990.

### Industry Canada (IC) Registration No.: 11464A

The 3m Semi-anechoic chamber of Waltek Testing Group (Shenzhen) Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A.

## 1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, with a duty cycle equal to 100%, and to measure its highest possible emissions level, more detailed description as follows:

<b>Test Mode List</b>		
Test Mode	Description	Remark
TM1	802.11b	Low:2412MHz, Middle:2437MHz,High:2462MHz
TM2	802.11g	Low:2412MHz, Middle:2437MHz,High:2462MHz
TM3	802.11n-HT20	Low:2412MHz, Middle:2437MHz,High:2462MHz
TM4	802.11n-HT40	Low:2422MHz, Middle:2437MHz,High:2452MHz

<b>Test Conditions</b>	
Temperature:	22~25 °C
Relative Humidity:	45~55 %.
ATM Pressure:	1019 mbar

<b>EUT Cable List and Details</b>			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
USB-C Cable	1.0	Shielded	With Ferrite
DC Cable	3.2	Unshielded	Without Ferrite

<b>Special Cable List and Details</b>			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

<b>Auxiliary Equipment List and Details</b>			
Description	Manufacturer	Model	Serial Number
Notebook	Lenovo	TianYi310-14ISK	/
Battery	JIADÉ	DC12-24V	/

## 1.6 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
RF Output Power	Conducted	$\pm 0.42\text{dB}$
Occupied Bandwidth	Conducted	$\pm 1.5\%$
Power Spectral Density	Conducted	$\pm 1.8\text{dB}$
Conducted Spurious Emission	Conducted	$\pm 2.17\text{dB}$
Conducted Emissions	Conducted	9-150kHz $\pm 3.74\text{dB}$
		0.15-30MHz $\pm 3.34\text{dB}$
Transmitter Spurious Emissions	Radiated	30-200MHz $\pm 4.52\text{dB}$
		0.2-1GHz $\pm 5.56\text{dB}$
		1-6GHz $\pm 3.84\text{dB}$
		6-26GHz $\pm 3.92\text{dB}$

**1.7 Test Equipment List and Details**

No.	Description	Manufacturer	Model	Serial No.	Cal Date	Due. Date
SEMT-1075	Communication Tester	Rohde & Schwarz	CMW500	148650	2021-03-27	2022-03-26
SEMT-1063	GSM Tester	Rohde & Schwarz	CMU200	114403	2021-03-27	2022-03-26
SEMT-1072	Spectrum Analyzer	Agilent	E4407B	MY41440400	2021-03-27	2022-03-26
SEMT-1079	Spectrum Analyzer	Agilent	N9020A	US47140102	2021-03-27	2022-03-26
SEMT-1080	Signal Generator	Agilent	83752A	3610A01453	2021-03-27	2022-03-26
SEMT-1081	Vector Signal Generator	Agilent	N5182A	MY47070202	2021-03-27	2022-03-26
SEMT-1028	Power Divider	Weinschel	1506A	PM204	2021-03-27	2022-03-26
SEMT-1082	Power Divider	RF-Lambda	RFLT4W5M18G	14110400027	2021-03-27	2022-03-26
SEMT-1031	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2021-03-27	2022-03-26
SEMT-1007	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2021-03-27	2022-03-26
SEMT-1008	Amplifier	Agilent	8447F	3113A06717	2021-04-12	2022-04-11
SEMT-1043	Amplifier	C&D	PAP-1G18	2002	2021-04-12	2022-04-11
SEMT-1069	Loop Antenna	Schwarz beck	FMZB 1516	9773	2021-03-19	2023-03-18
SEMT-1068	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2021-03-19	2023-03-18
SEMT-1042	Horn Antenna	ETS	3117	00086197	2021-03-19	2023-03-18
SEMT-1121	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170582	2021-04-27	2023-04-26
SEMT-1169	Pre-amplifier	Direction Systems Inc.	PAP-2640	14145-14153	2021-04-27	2022-04-26
SEMT-1163	Spectrum Analyzer	Rohde & Schwarz	FSP40	100612	2021-03-27	2022-03-26
SEMT-1166	Power Limiter	Agilent	N9356B	MY45450376	2021-03-27	2022-03-26
SEMT-1076	RF Switcher	Top Precision	RCS03-A2	/	2021-03-19	2023-03-18
SEMT-C001	Cable	Zheng DI	LL142-07-07-10M(A)	/	/	/
SEMT-C002	Cable	Zheng DI	ZT40-2.92J-2.92J-6M	/	/	/
SEMT-C003	Cable	Zheng DI	ZT40-2.92J-2.92J-2.5M	/	/	/
SEMT-C004	Cable	Zheng DI	2M0RFC	/	/	/
SEMT-C005	Cable	Zheng DI	1M0RFC	/	/	/
SEMT-C006	Cable	Zheng DI	1M0RFC	/	/	/



<b>Software List</b>			
<b>Description</b>	<b>Manufacturer</b>	<b>Model</b>	<b>Version</b>
EMI Test Software (Radiated Emission)*	Farad	EZ-EMC	RA-03A1
EMI Test Software (Conducted Emission)*	Farad	EZ-EMC	RA-03A1

\*Remark: indicates software version used in the compliance certification testing.

## 2. SUMMARY OF TEST RESULTS

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<b>FCC Rules</b>	<b>Description of Test Item</b>	<b>Result</b>
§15.203; §15.247(b)(4)(i)	Antenna Requirement	Compliant
§15.205	Restricted Band of Operation	Compliant
§15.207(a)	Conducted Emission	Compliant
§15.247(e)	Power Spectral Density	Compliant
§15.247(a)(2)	DTS Bandwidth	Compliant
§15.247(b)(3)	RF Output Power	Compliant
§15.209(a)	Radiated Emission	Compliant
§15.247(d)	Band Edge (Out of Band Emissions)	Compliant

N/A: Not applicable.

### **3. Antenna Requirement**

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#### **3.1 Standard Applicable**

According to FCC Part 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.

#### **3.2 Evaluation Information**

This product has an integral antenna, fulfill the requirement of this section.

## 4. Power Spectral Density

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### 4.1 Standard Applicable

According to 15.247(a)(1)(iii), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

### 4.2 Test Setup Block Diagram



### 4.3 Test Procedure

According to the KDB 558074 D01 v05r02 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.10.3, such specifications require that the same method as used to determine the conducted output power shall also be used to determine the power spectral density. The test method of power spectral density as below:

- a) Set instrument center frequency to DTS channel center frequency.
- b) Set span to at least 1.5 times the OBW.
- c) Set RBW to:  $3\text{kHz} \leq \text{RBW} \leq 100\text{kHz}$ .
- d) Set VBW  $\geq 3 \times \text{RBW}$ .
- e) Detector = power averaging (RMS) or sample detector (when RMS not available).
- f) Ensure that the number of measurement points in the sweep  $\geq 2 \times \text{span}/\text{RBW}$ .
- g) Sweep time = auto couple.
- h) Employ trace averaging (RMS) mode over a minimum of 100 traces.
- i) Use the peak marker function to determine the maximum amplitude level.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).

### 4.4 Summary of Test Results/Plots

Please refer to Appendix A

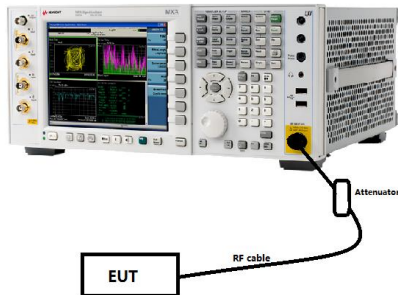
## 5. DTS Bandwidth

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### 5.1 Standard Applicable

According to 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 500kHz.

### 5.2 Test Setup Block Diagram



### 5.3 Test Procedure

According to the KDB 558074 D01 v05r02 Subclause 8.2 and ANSI C63.10-2013 Subclause 11.8.1, the test method of DTS Bandwidth as below:

- a) Set RBW = 100kHz.
- b) Set the video bandwidth (VBW)  $\geq 3 \times$  RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) 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.

### 5.4 Summary of Test Results/Plots

Please refer to Appendix B

## 6. RF Output Power

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### 6.1 Standard Applicable

According to 15.247(b)(3), for systems using digital modulation in the 902–928MHz, 2400–2483.5MHz, and 5725–5850MHz bands: 1 Watt.

### 6.2 Test Setup Block Diagram



### 6.3 Test Procedure

According to the KDB-558074 D01 v05r02 Subclause 8.3.2.2 and ANSI C63.10-2013 Subclause 11.9.2.2, when this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth.

- a) Set span to at least 1.5 times the OBW.
- b) Set RBW = 1-5% of the OBW, not to exceed 1MHz.
- c) Set VBW  $\geq 3 \times$  RBW.
- d) Number of points in sweep  $\geq 2 \times$  span / RBW. (This gives bin-to-bin spacing  $\leq$  RBW/2, so that narrowband signals are not lost between frequency bins.)
- e) Sweep time = auto.
- f) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
- g) 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 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  $\geq 98$  %, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to “free run”.
- h) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
- i) 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.

### 6.4 Summary of Test Results/Plots

Please refer to Appendix C

## 7. Field Strength of Spurious Emissions

### 7.1 Standard Applicable

According to §15.247(d), in any 100kHz 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 20dB below that in the 100kHz 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, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in §15.209(a) 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).

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

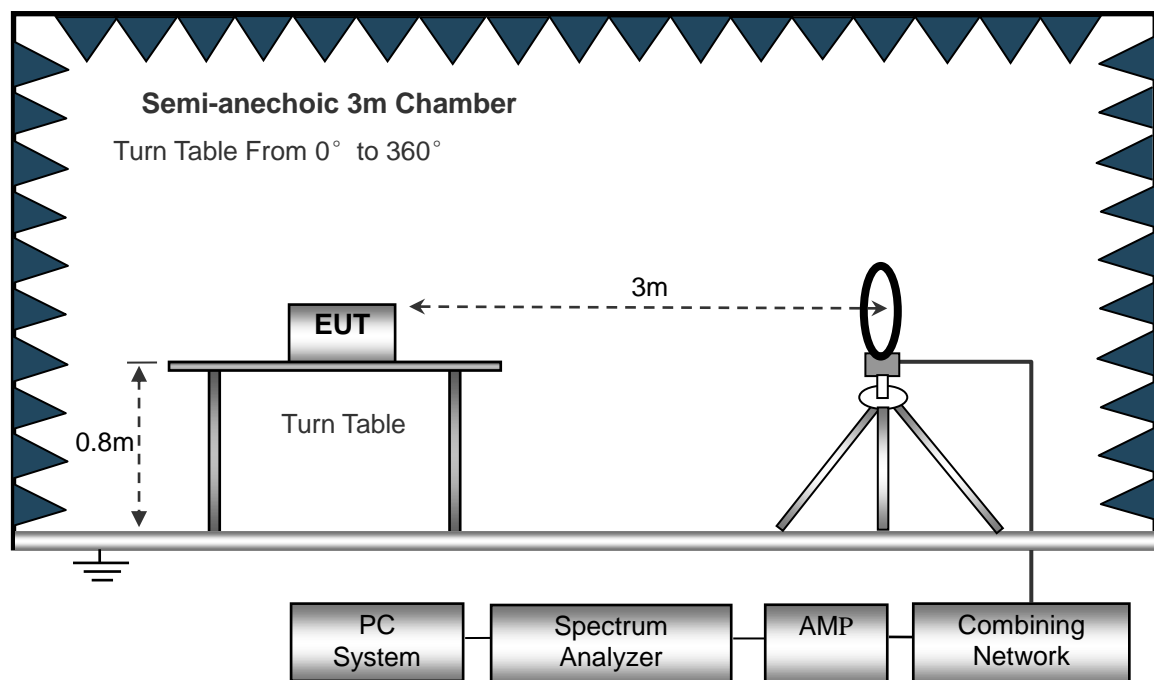
### 7.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.

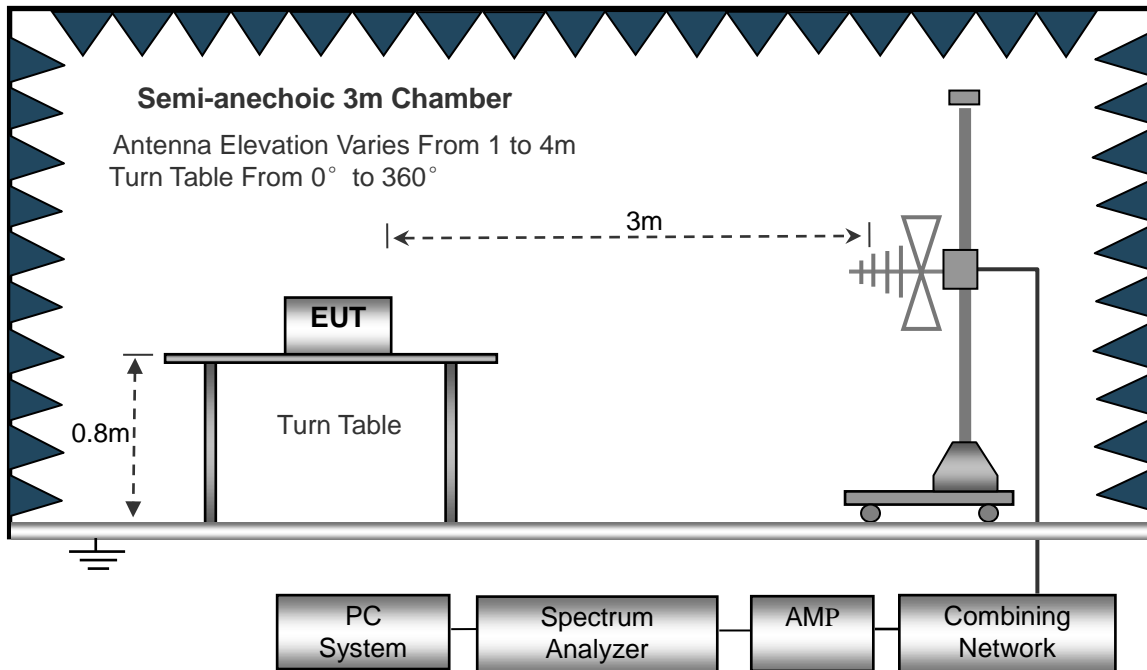
The external I/O cables were draped along the test table and formed a bundle 30 to 40cm long in the middle.

The spacing between the peripherals was 10cm.

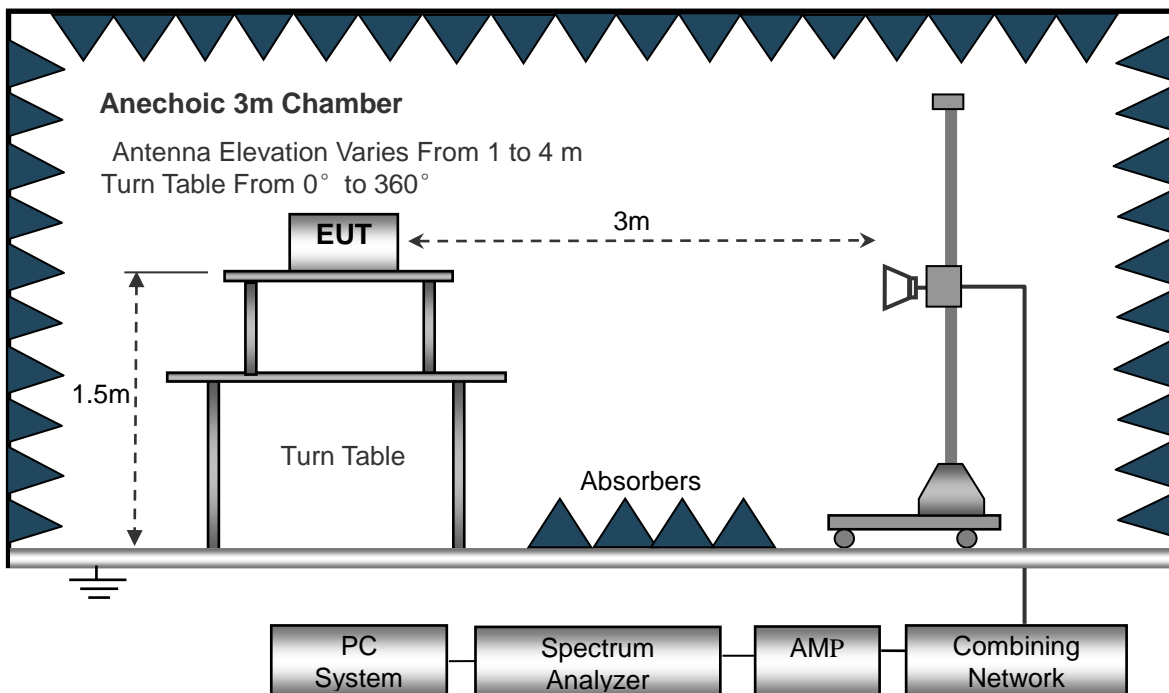
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30MHz to 1GHz.



The test setup for emission measurement above 1GHz.





Frequency :9kHz-30MHz	Frequency :30MHz-1GHz	Frequency :Above 1GHz
RBW=10KHz,	RBW=120KHz,	RBW=1MHz,
VBW =30KHz	VBW=300KHz	VBW=3MHz(Peak), 10Hz(AV)
Sweep time= Auto	Sweep time= Auto	Sweep time= Auto
Trace = max hold	Trace = max hold	Trace = max hold
Detector function = peak	Detector function = peak, QP	Detector function = peak, AV

### 7.3 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Ant. Factor} + \text{Cable Loss} - \text{Ampl. Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dB $\mu$ V means the emission is 6dB $\mu$ V below the maximum limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15 Limit}$$

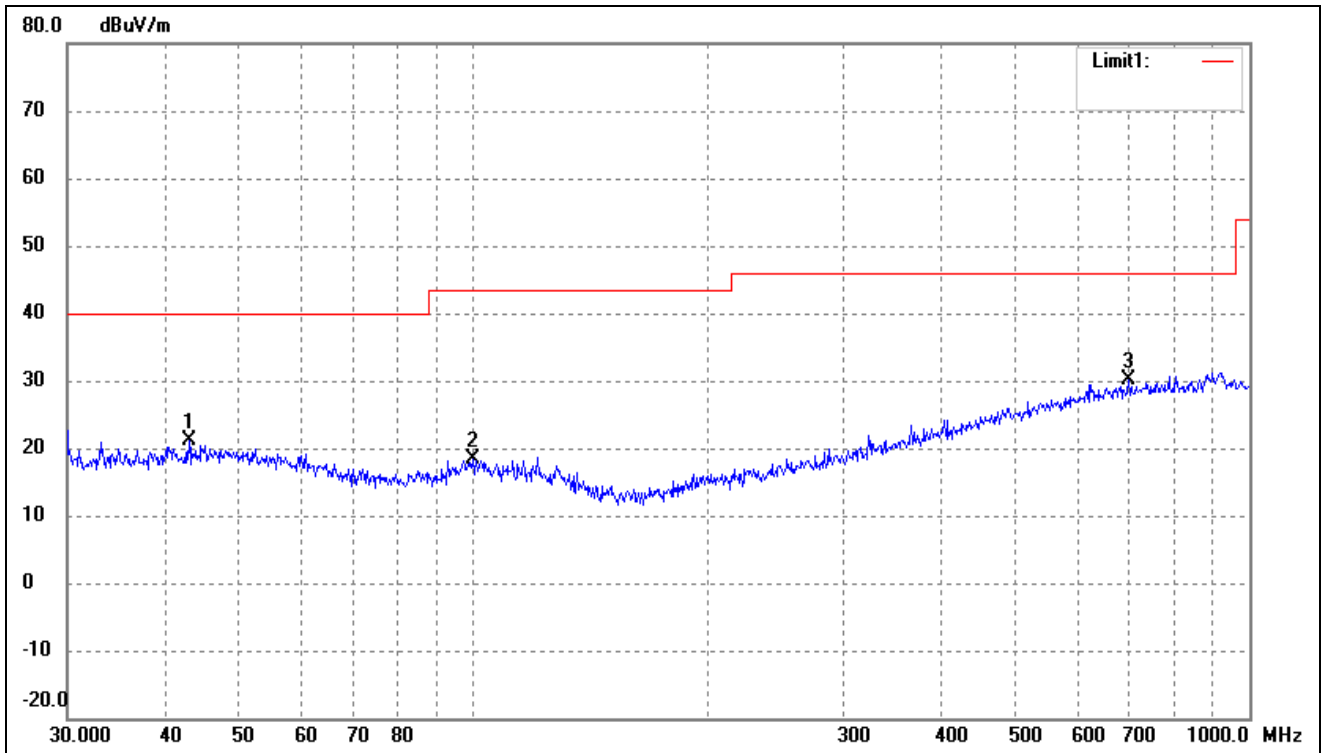
### 7.4 Summary of Test Results/Plots

*Note: 1.This EUT was tested in 3 orthogonal positions and the worst case position data was reported.*

*All test modes (different data rate and different modulation) are performed, but only the worst case(802.11b\_11Mbps) is recorded in this report.*

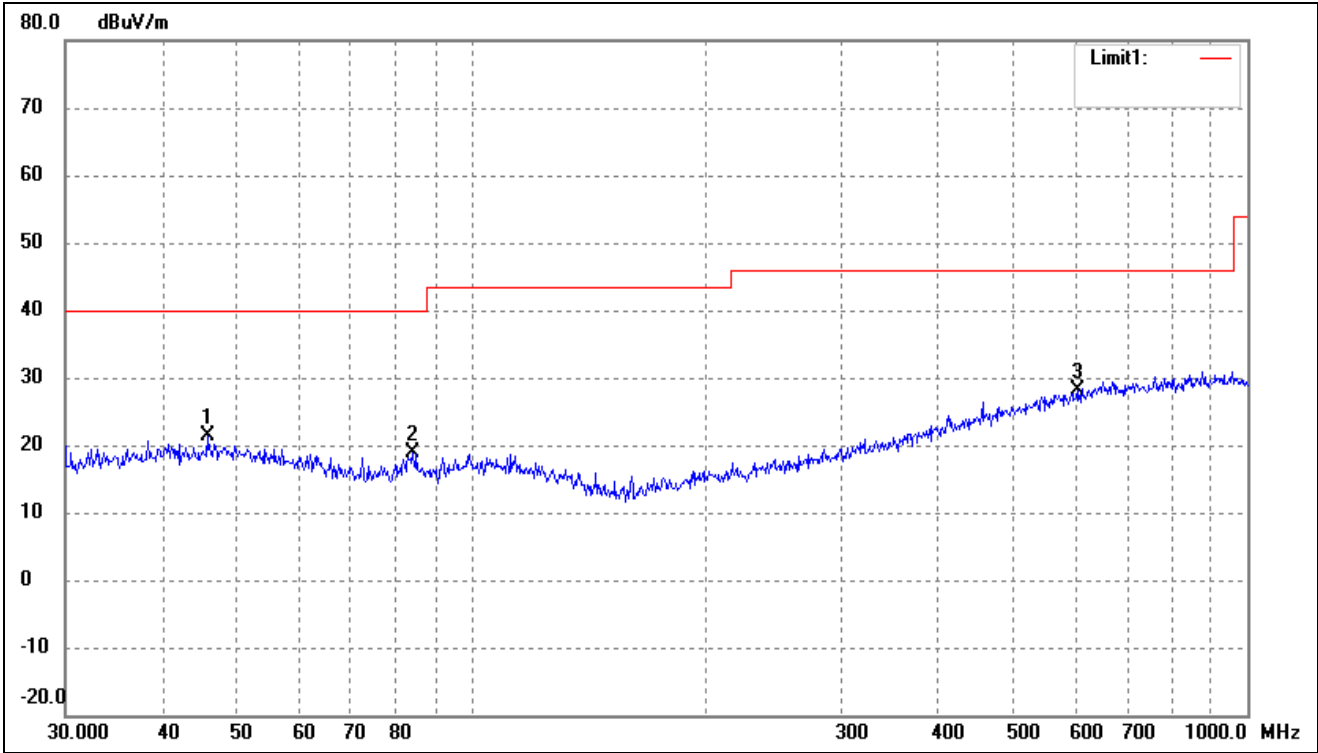
➤ Spurious Emissions Below 1GHz

802.11b_11Mbps			
Test Channel	Low	Polarity:	Horizontal



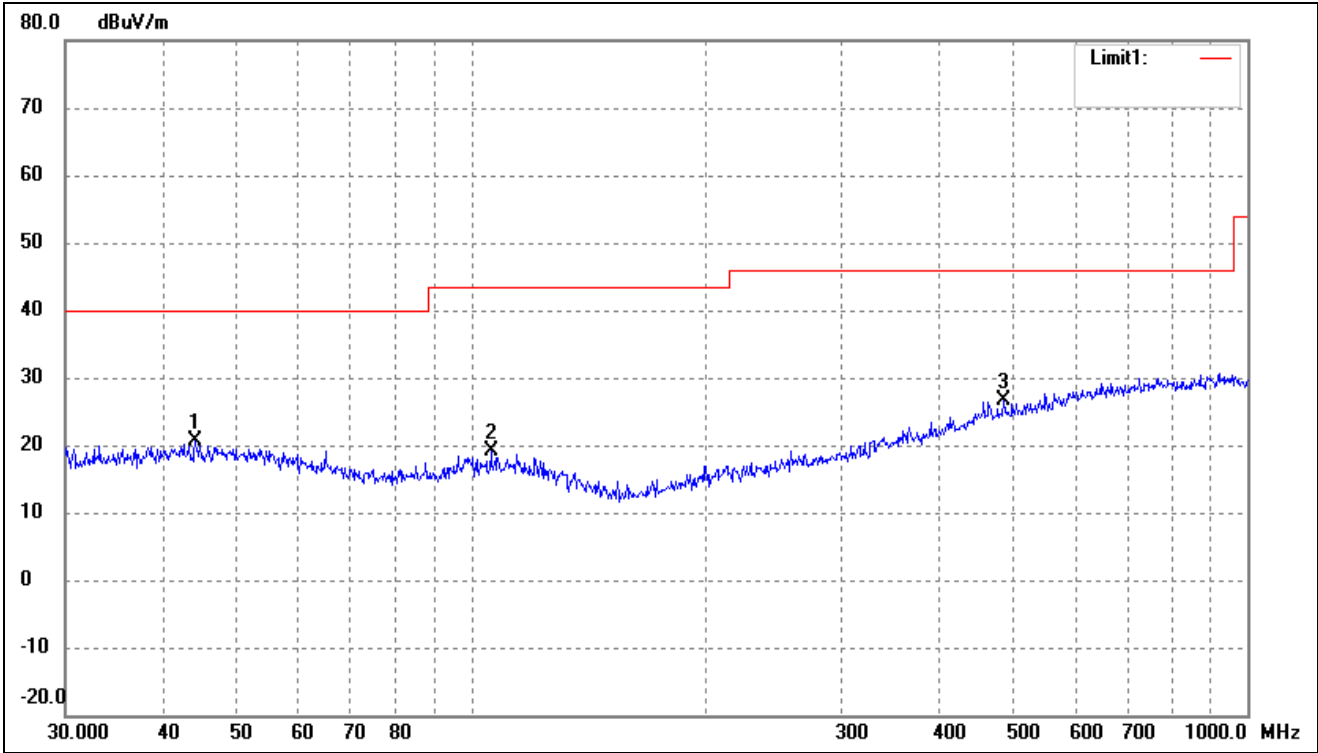
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ( )	Height (cm)	Remark
1	43.0505	28.11	-6.99	21.12	40.00	-18.88	-	-	peak
2	99.8777	27.13	-8.75	18.38	43.50	-25.12	-	-	peak
3	699.3046	28.69	1.42	30.11	46.00	-15.89	-	-	peak

802.11b_11Mbps			
Test Channel	Low	Polarity:	Vertical



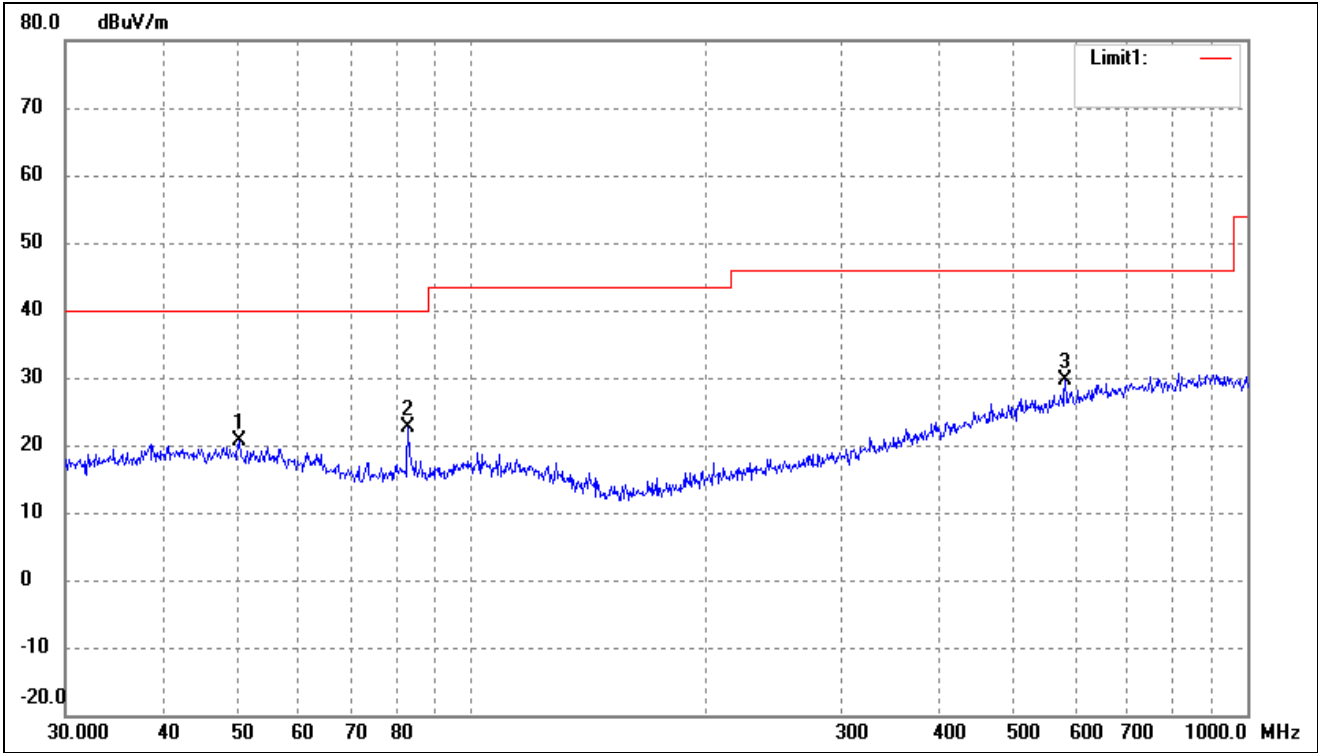
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ( )	Height (cm)	Remark
1	45.6948	28.26	-6.98	21.28	40.00	-18.72	-	-	peak
2	84.1100	29.58	-10.67	18.91	40.00	-21.09	-	-	peak
3	603.5392	27.74	0.41	28.15	46.00	-17.85	-	-	peak

802.11b_11Mbps			
Test Channel	Middle	Polarity:	Horizontal



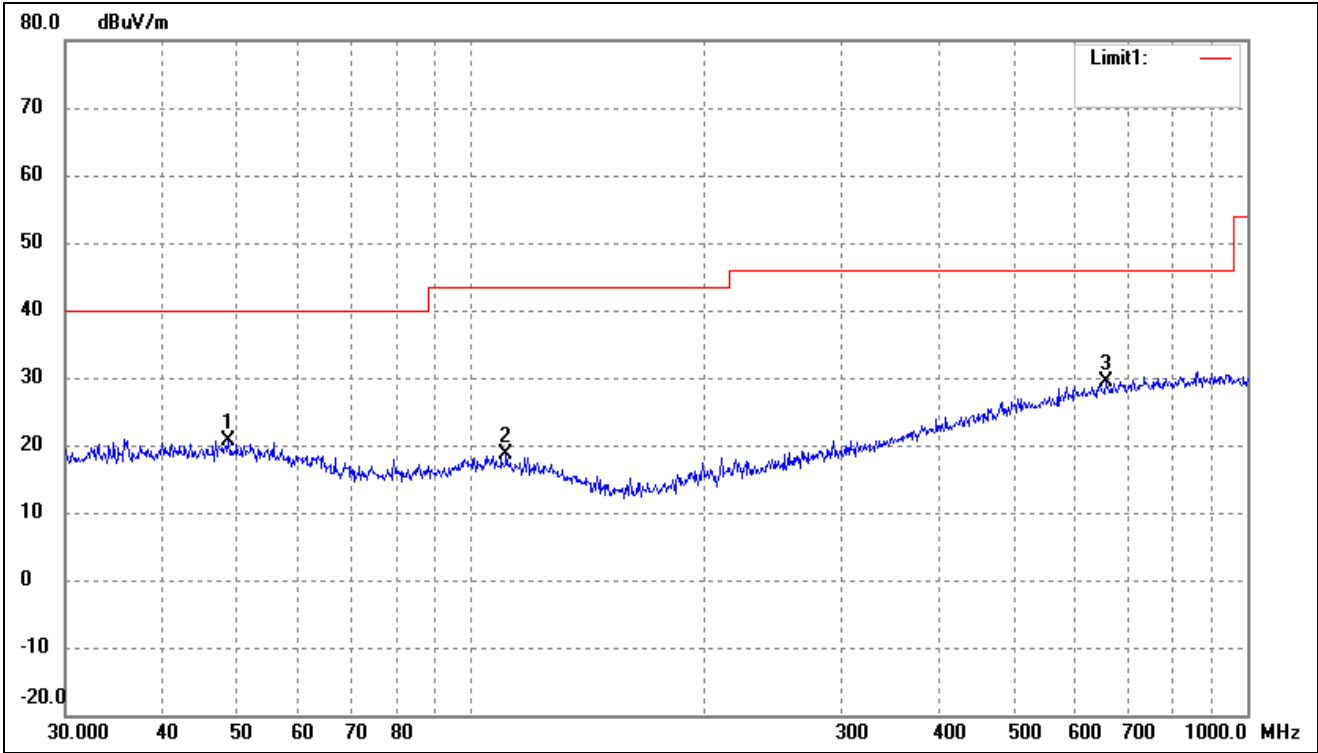
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ( )	Height (cm)	Remark
1	44.1202	27.56	-6.98	20.58	40.00	-19.42	-	-	peak
2	106.0126	27.99	-8.82	19.17	43.50	-24.33	-	-	peak
3	485.6093	28.38	-1.67	26.71	46.00	-19.29	-	-	peak

802.11b_11Mbps			
Test Channel	Middle	Polarity:	Vertical



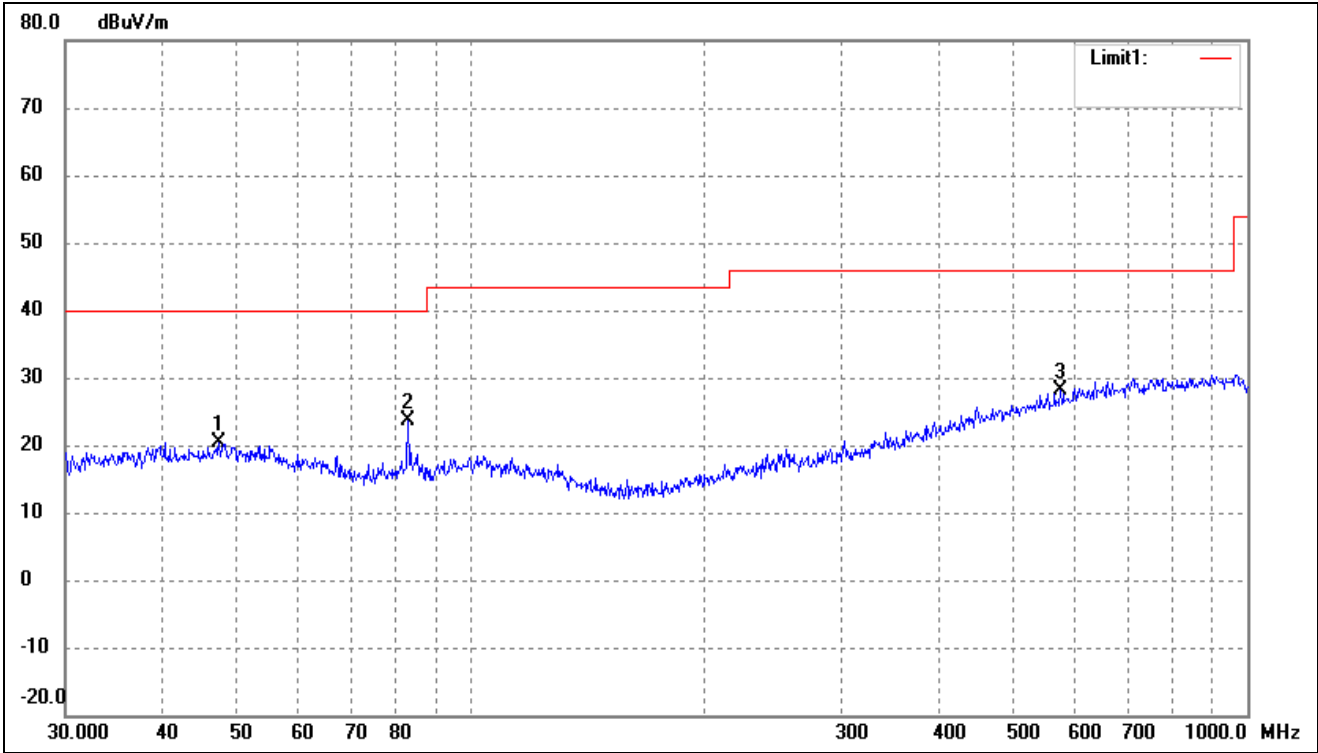
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ( )	Height (cm)	Remark
1	50.2325	27.61	-6.99	20.62	40.00	-19.38	-	-	peak
2	82.9385	33.21	-10.69	22.52	40.00	-17.48	-	-	peak
3	582.7425	29.49	0.08	29.57	46.00	-16.43	-	-	peak

802.11b_11Mbps			
Test Channel	High	Polarity:	Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ( )	Height (cm)	Remark
1	48.6719	27.68	-6.97	20.71	40.00	-19.29	-	-	peak
2	110.9571	27.58	-8.94	18.64	43.50	-24.86	-	-	peak
3	656.5300	28.39	0.98	29.37	46.00	-16.63	-	-	peak

802.11b_11Mbps			
Test Channel	High	Polarity:	Vertical



No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ( )	Height (cm)	Remark
1	47.3255	27.46	-6.97	20.49	40.00	-19.51	-	-	peak
2	82.9385	34.33	-10.69	23.64	40.00	-16.36	-	-	peak
3	574.6258	28.13	-0.06	28.07	46.00	-17.93	-	-	peak

Remark: '-' Means the test Degree and Height are not recorded by the test software and only show the worst case in the test report.

- Spurious Emissions Above 1GHz
- Test Mode: 802.11b\_11Mbps (worst case)

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2412MHz							
4824.000	58.35	-3.86	54.49	74	-19.51	H	PK
4824.000	42.44	-3.86	38.58	54	-15.42	H	AV
7236.000	54.17	1.1	55.27	74	-18.73	H	PK
7236.000	38.48	1.1	39.58	54	-14.42	H	AV
4824.000	61.83	-3.86	57.97	74	-16.03	V	PK
4824.000	41.19	-3.86	37.33	54	-16.67	V	AV
7236.000	53.82	1.1	54.92	74	-19.08	V	PK
7236.000	38.78	1.1	39.88	54	-14.12	V	AV
Middle Channel-2437MHz							
4874.000	61.09	-3.74	57.35	74	-16.65	H	PK
4874.000	42.97	-3.74	39.23	54	-14.77	H	AV
7311.000	55.57	1.47	57.04	74	-16.96	H	PK
7311.000	38.43	1.47	39.9	54	-14.1	H	AV
4874.000	60.88	-3.74	57.14	74	-16.86	V	PK
4874.000	42.76	-3.74	39.02	54	-14.98	V	AV
7311.000	53.74	1.47	55.21	74	-18.79	V	PK
7311.000	38.15	1.47	39.62	54	-14.38	V	AV
High Channel-2462MHz							
4924.000	61.13	-3.63	57.5	74	-16.5	H	PK
4924.000	42.73	-3.63	39.1	54	-14.9	H	AV
7386.000	53.08	1.62	54.7	74	-19.3	H	PK
7386.000	38.83	1.62	40.45	54	-13.55	H	AV
4924.000	60.68	-3.63	57.05	74	-16.95	V	PK
4924.000	43.64	-3.63	40.01	54	-13.99	V	AV
7386.000	52.3	1.62	53.92	74	-20.08	V	PK
7386.000	39.24	1.62	40.86	54	-13.14	V	AV

*Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, other than listed in the table above are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*



## 8. Out of Band Emissions

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### 8.1 Standard Applicable

According to §15.247(d), in any 100kHz 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 20dB below that in the 100kHz 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, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in §15.209(a) 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).

### 8.2 Test Procedure

According to the KDB 558074D01 v05r02 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.11, the Emissions in nonrestricted frequency bands test method as follows:

- a) Set the center frequency and span to encompass frequency range to be measured.
- b) Set the RBW = 100kHz.
- c) Set the VBW  $\geq [3 \times \text{RBW}]$ .
- d) Detector = peak.
- e) Sweep time = auto couple.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use the peak marker function to determine the maximum amplitude level.

According to the KDB 558074 D01 v05r02 Subclause 8.5 and ANSI C63.10-2013 Subclause 11.12, the Emissions in restricted frequency bands test method as follows:

#### A. Radiated emission measurements:

Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (2310MHz to 2420MHz for low bandedge, 2460MHz to 2500MHz for the high bandedge)

RBW = 1MHz, VBW = 1MHz for peak value measured

RBW = 1MHz, VBW = 10Hz for average value measured

Sweep = auto; Detector function = peak/average; Trace = max hold

All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission must comply with the 15.209 limit for fall in the restricted bands listed in section 15.205. Note that the method of measurement

KDB publication number: 913591 may be used for the radiated bandedge measurements.

#### B. Antenna-port conducted measurements

Peak emission levels are measured by setting the instrument as follows:

- a) RBW = as specified in Table 9.
- b) VBW  $\geq$   $[3 \times \text{RBW}]$ .
- c) Detector = peak.
- d) Sweep time = auto.
- e) Trace mode = max hold.
- f) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be lengthened for low-duty-cycle applications.)

**Table 9—RBW as a function of frequency**

Frequency	RBW
9 kHz to 150 kHz	200 Hz to 300 Hz
0.15 MHz to 30 MHz	9 kHz to 10 kHz
30 MHz to 1000 MHz	100 kHz to 120 kHz
>1000 MHz	1 MHz

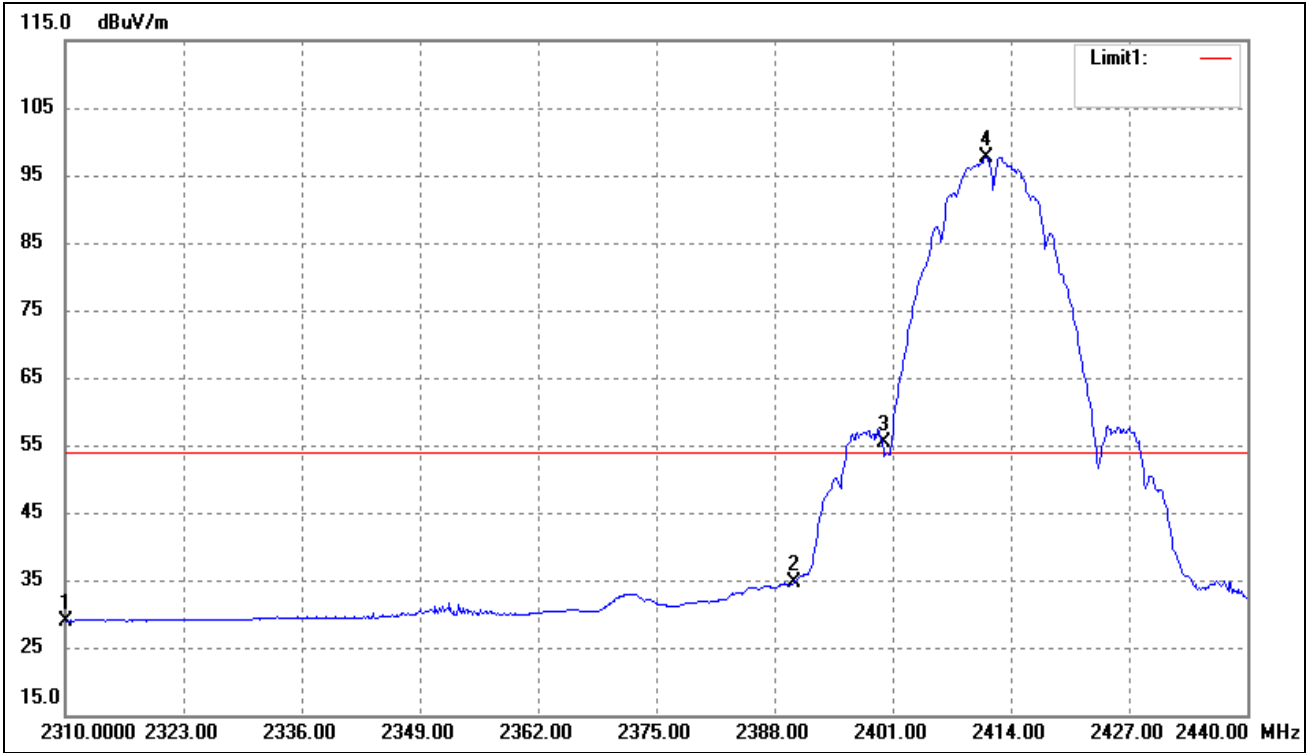
If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in section 8.1. Report the three highest emissions relative to the limit.

### 8.3 Summary of Test Results/Plots

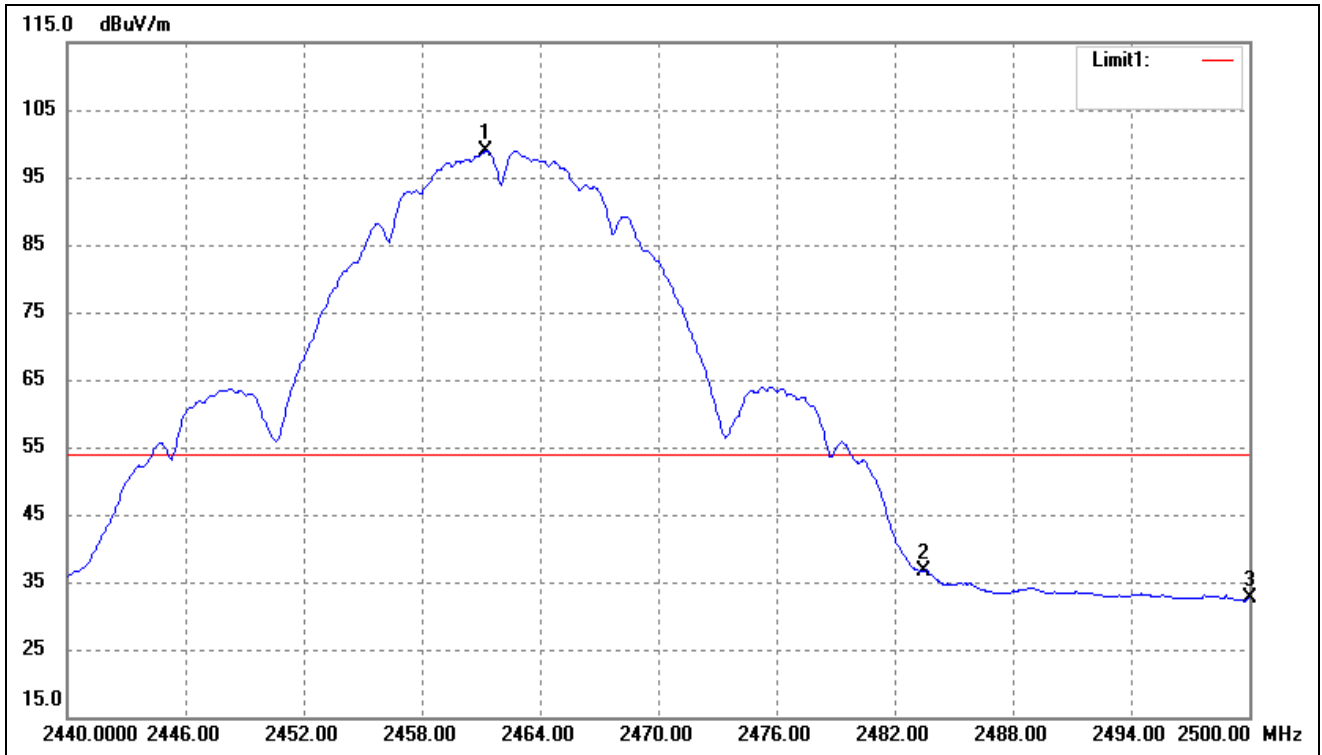
➤ Radiated test

802.11b_11Mbps			
Test Channel	Low	Polarity:	Vertical(worst case)



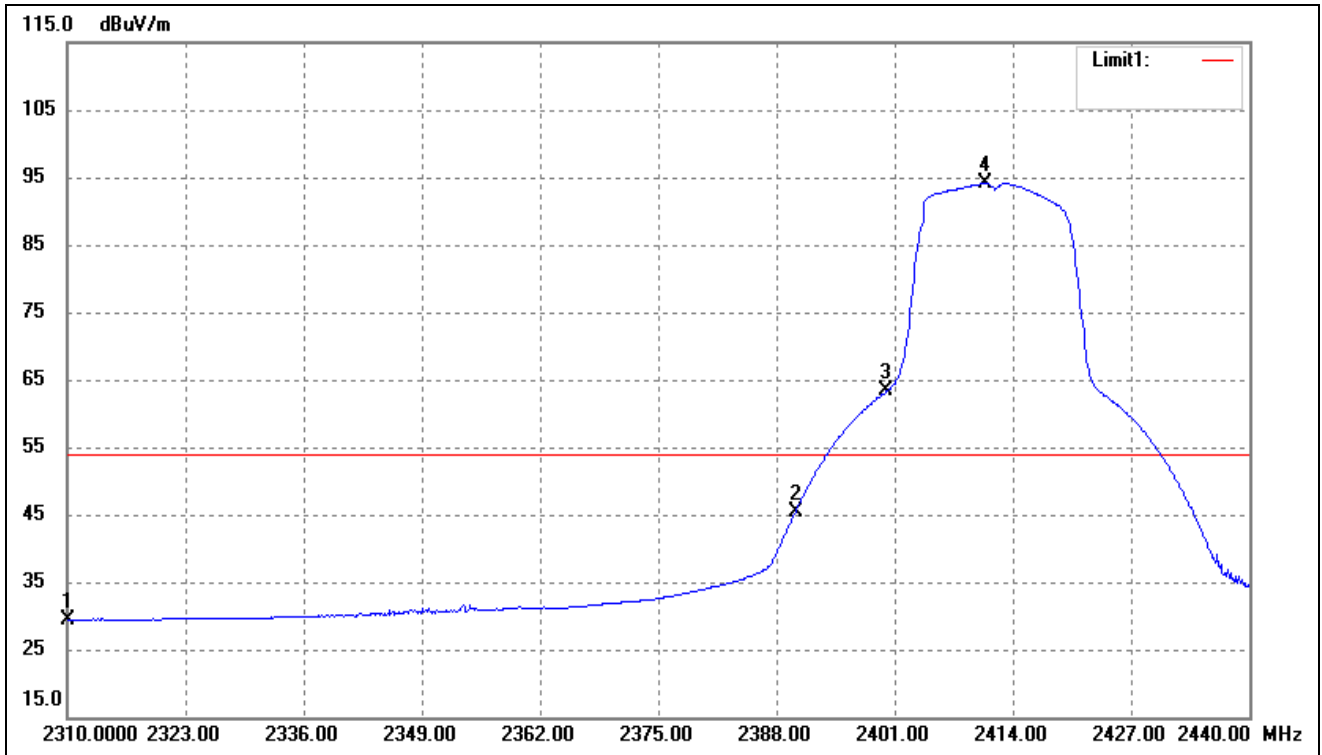
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2310.000	39.79	-10.82	28.97	54.00	-25.03	Average Detector
	2310.000	53.09	-10.82	42.27	74.00	-31.73	Peak Detector
2	2390.000	45.27	-10.70	34.57	54.00	-19.43	Average Detector
	2390.000	58.36	-10.70	47.66	74.00	-26.34	Peak Detector
3	2400.000	66.07	-10.69	55.38	Delta=42.32dBc		Average Detector
4	2411.270	108.38	-10.68	97.70			Average Detector

802.11b_11Mbps			
Test Channel	High	Polarity:	Vertical(worst case)



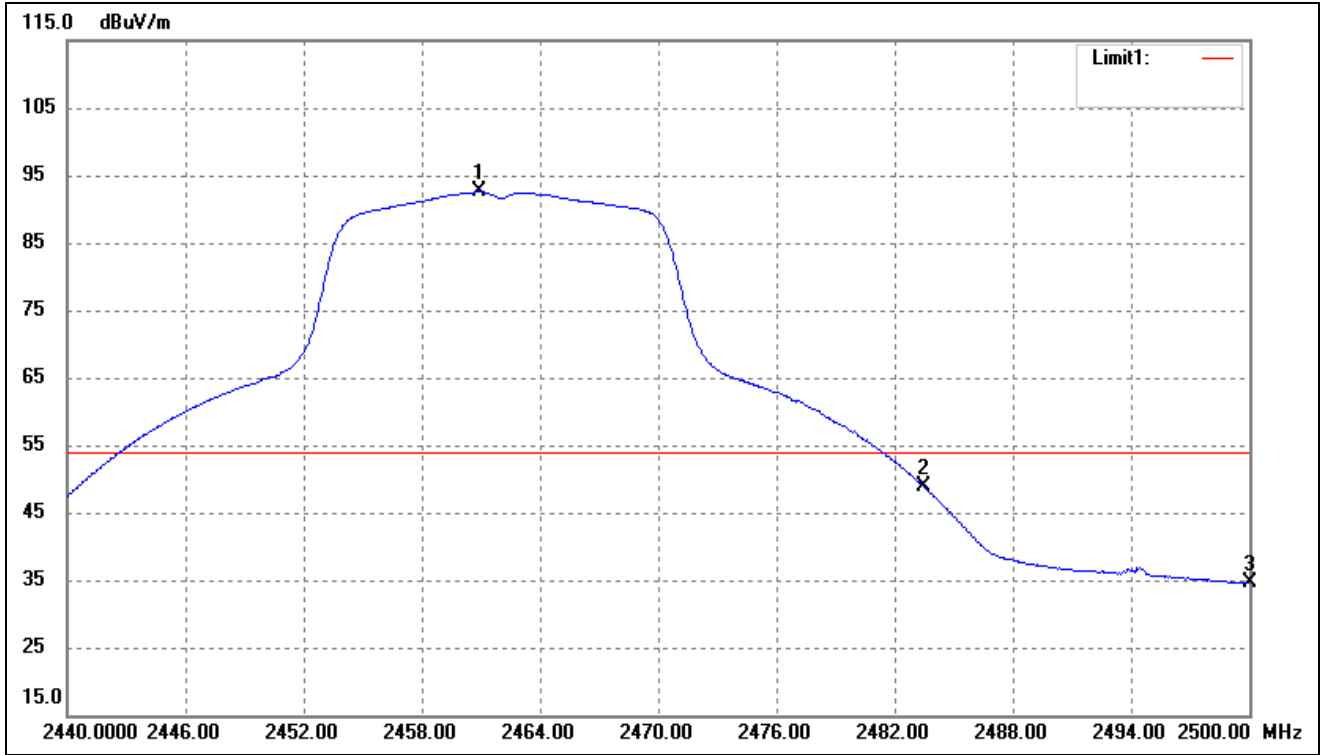
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2461.240	109.50	-10.61	98.89	/	/	Average Detector
	2463.100	114.00	-10.60	103.40	/	/	Peak Detector
2	2483.500	47.18	-10.58	36.60	54.00	-17.40	Average Detector
	2483.500	58.30	-10.58	47.72	74.00	-26.28	Peak Detector
3	2500.000	43.08	-10.55	32.53	54.00	-21.47	Average Detector
	2500.000	54.12	-10.55	43.57	74.00	-30.43	Peak Detector

802.11g_54Mbps			
Test Channel	Low	Polarity:	Vertical(worst case)



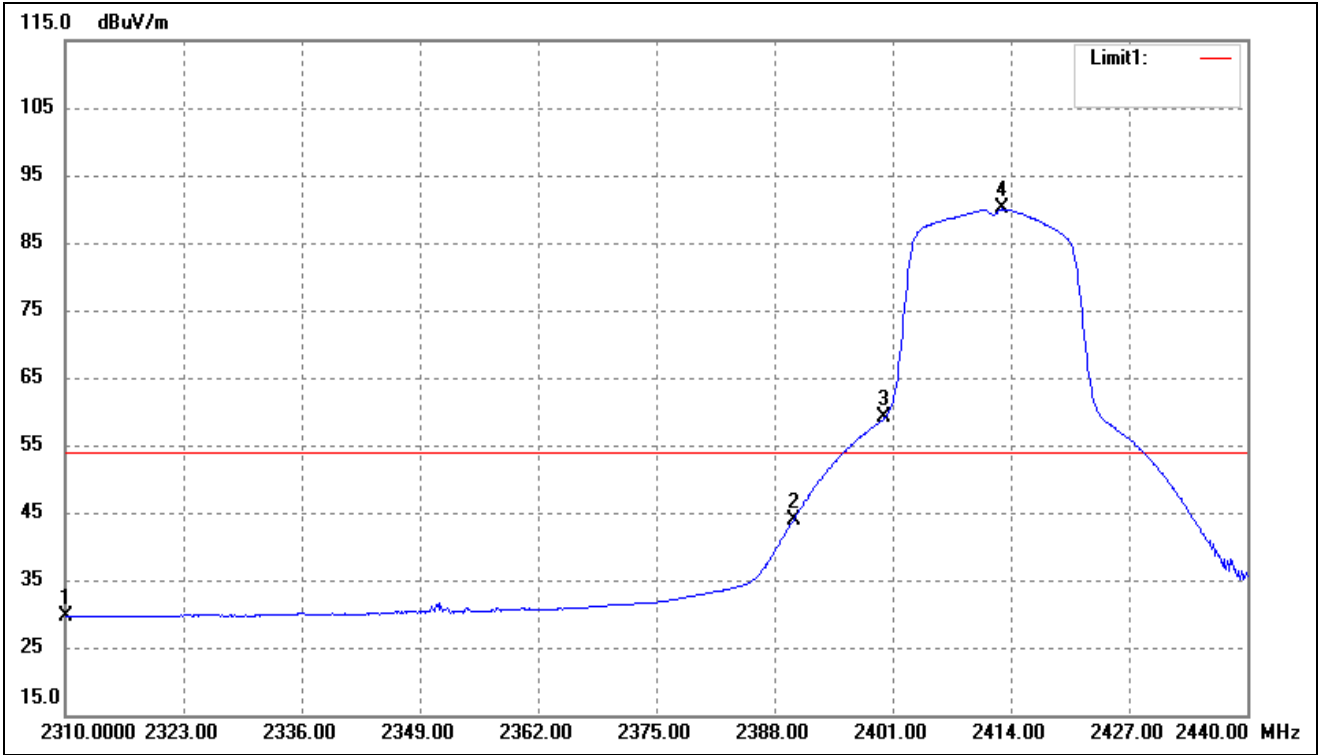
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2310.000	40.25	-10.82	29.43	54.00	-24.57	Average Detector
		52.65	-10.82	41.83	74.00	-32.17	Peak Detector
2	2390.000	56.14	-10.70	45.44	54.00	-8.56	Average Detector
		74.30	-10.70	63.60	74.00	-10.40	Peak Detector
3	2400.000	73.95	-10.69	63.26	Delta=30.85dBc	Average Detector	
4	2410.880	104.79	-10.68	94.11		Average Detector	

802.11g_54Mbps			
Test Channel	High	Polarity:	Vertical(worst case)



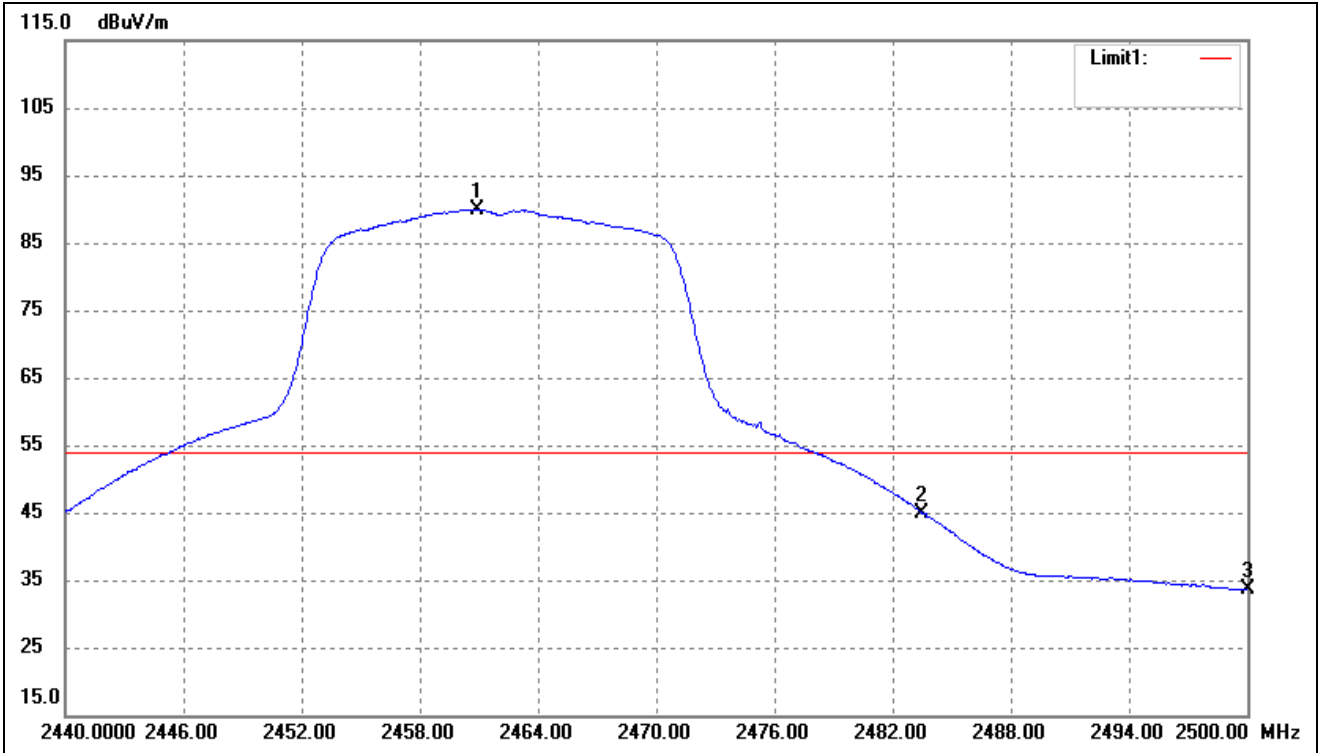
No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2460.880	103.15	-10.61	92.54	/	/	Average Detector
	2461.000	114.19	-10.61	103.58	/	/	Peak Detector
2	2483.500	59.37	-10.58	48.79	54.00	-5.21	Average Detector
	2483.500	75.55	-10.58	64.97	74.00	-9.03	Peak Detector
3	2500.000	45.07	-10.55	34.52	54.00	-19.48	Average Detector
	2500.000	56.06	-10.55	45.51	74.00	-28.49	Peak Detector

802.11n-HT20_MCS7			
Test Channel	Low	Polarity:	Vertical(worst case)



No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2310.000	40.39	-10.82	29.57	54.00	-24.43	Average Detector
		53.63	-10.82	42.81	74.00	-31.19	Peak Detector
2	2390.000	54.60	-10.70	43.90	54.00	-10.10	Average Detector
		76.61	-10.70	65.91	74.00	-8.09	Peak Detector
3	2400.000	69.75	-10.69	59.06	Delta=30.95dBc	Average Detector	
4	2413.090	100.68	-10.67	90.01		Average Detector	

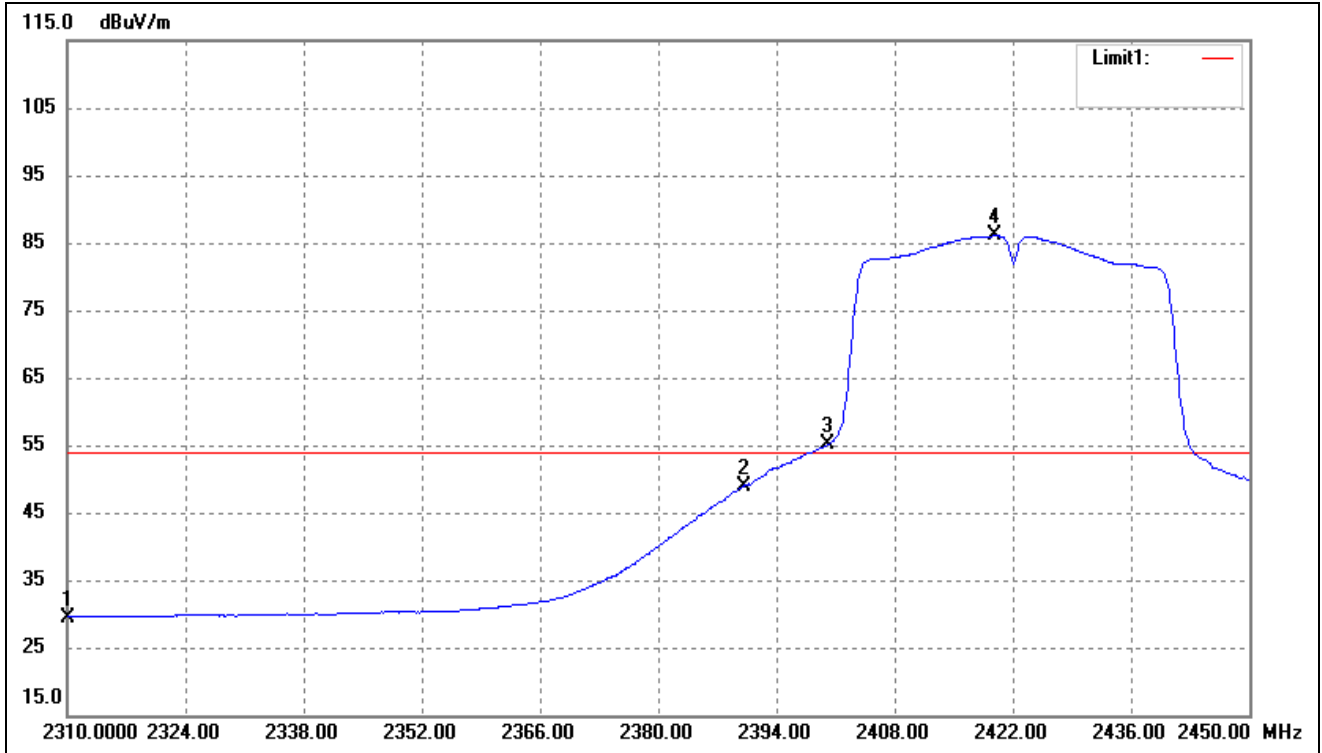
802.11n-HT20_MCS7			
Test Channel	High	Polarity:	Vertical(worst case)



No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2460.880	100.58	-10.61	89.97	/	/	Average Detector
	2460.460	111.67	-10.61	101.06	/	/	Peak Detector
2	2483.500	55.56	-10.58	44.98	54.00	-9.02	Average Detector
	2483.500	71.36	-10.58	60.78	74.00	-13.22	Peak Detector
3	2500.000	44.10	-10.55	33.55	54.00	-20.45	Average Detector
	2500.000	56.67	-10.55	46.12	74.00	-27.88	Peak Detector



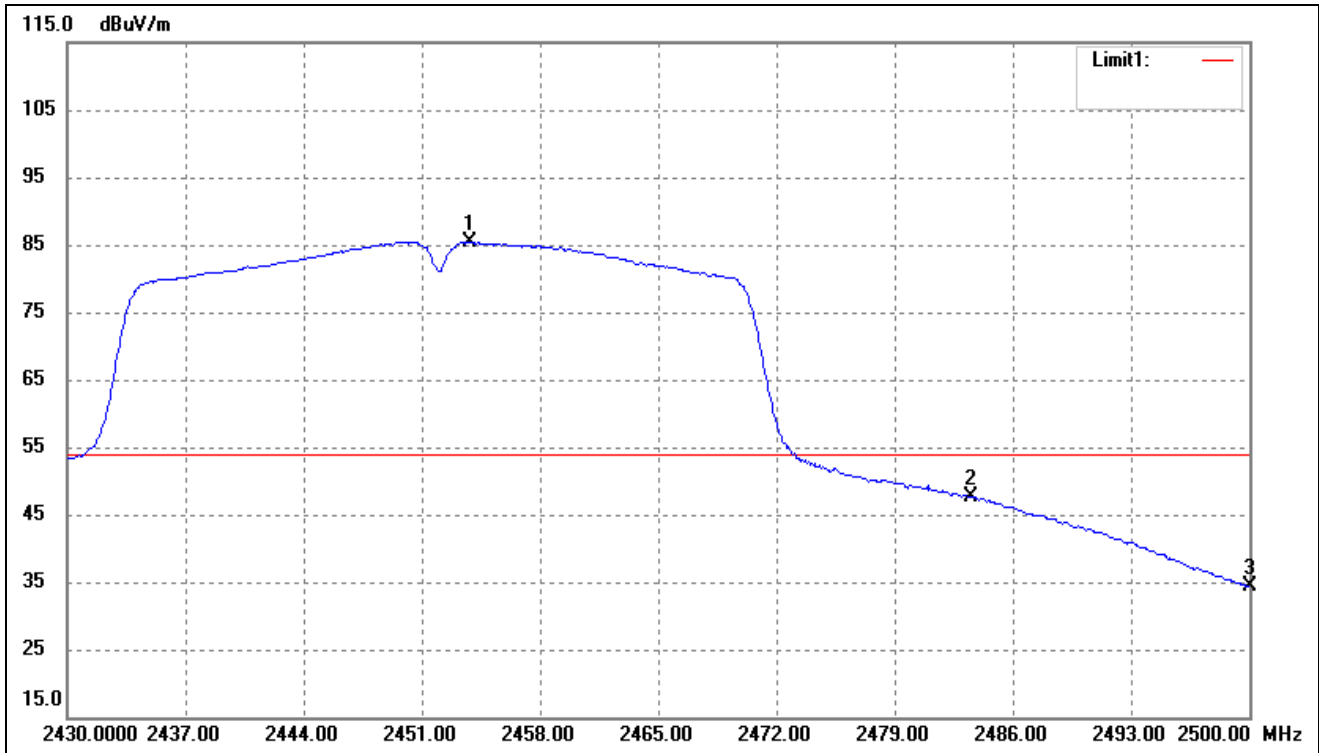
802.11n-HT40_MCS7			
Test Channel	Low	Polarity:	Vertical(worst case)



No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2310.000	40.32	-10.82	29.50	54.00	-24.50	Average Detector
		53.45	-10.82	42.63	74.00	-31.37	Peak Detector
2	2390.000	59.63	-10.70	48.93	54.00	-5.07	Average Detector
		79.19	-10.70	68.49	74.00	-5.51	Peak Detector
3	2400.000	65.77	-10.69	55.08	Delta=30.97dBc	Average Detector	
4	2419.900	96.71	-10.66	86.05		Average Detector	

802.11n-HT40\_MCS7

Test Channel	High	Polarity:	Vertical(worst case)
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2453.870	96.10	-10.62	85.48	/	/	Average Detector
	2448.620	107.33	-10.62	96.71	/	/	Peak Detector
2	2483.500	58.23	-10.58	47.65	54.00	-6.35	Average Detector
	2483.500	74.19	-10.58	63.61	74.00	-10.39	Peak Detector
3	2500.000	44.93	-10.55	34.38	54.00	-19.62	Average Detector
	2500.000	61.31	-10.55	50.76	74.00	-23.24	Peak Detector

➤ Conducted test

Please refer to Appendix D

## 9. Conducted Emissions

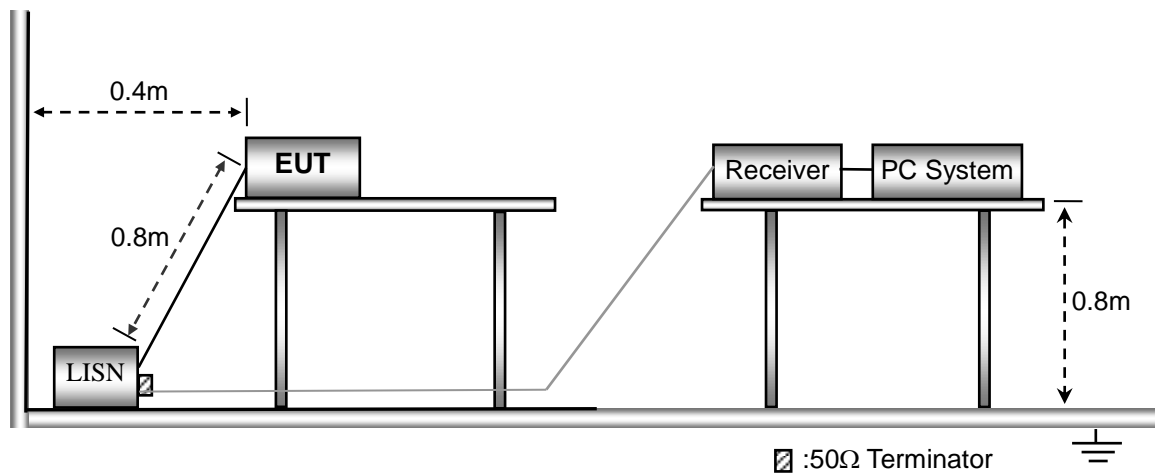
### 9.1 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40cm long in the middle.

The spacing between the peripherals was 10cm.

### 9.2 Basic Test Setup Block Diagram



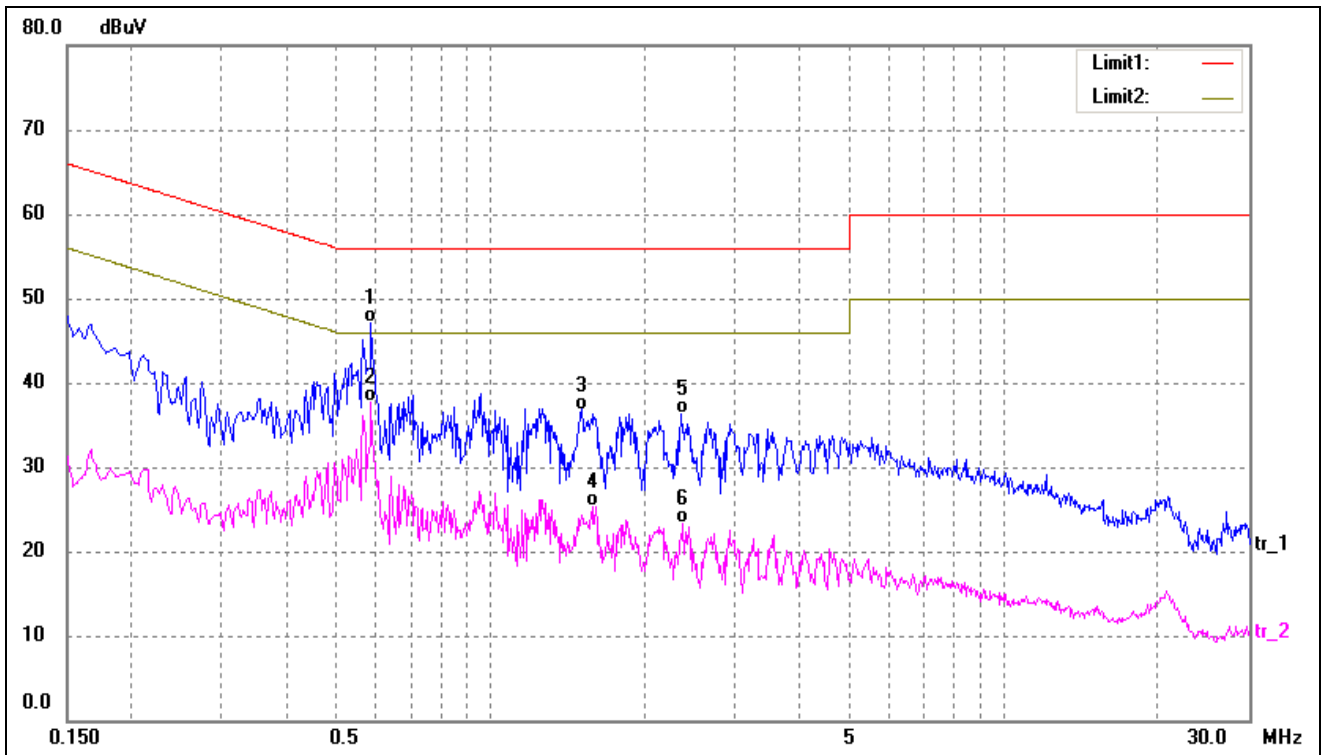
### 9.3 Test Receiver Setup

During the conducted emission test, the test receiver was set with the following configurations:

Start Frequency .....	150kHz
Stop Frequency .....	30MHz
Sweep Speed .....	Auto
IF Bandwidth.....	10kHz
Quasi-Peak Adapter Bandwidth .....	9kHz
Quasi-Peak Adapter Mode .....	Normal

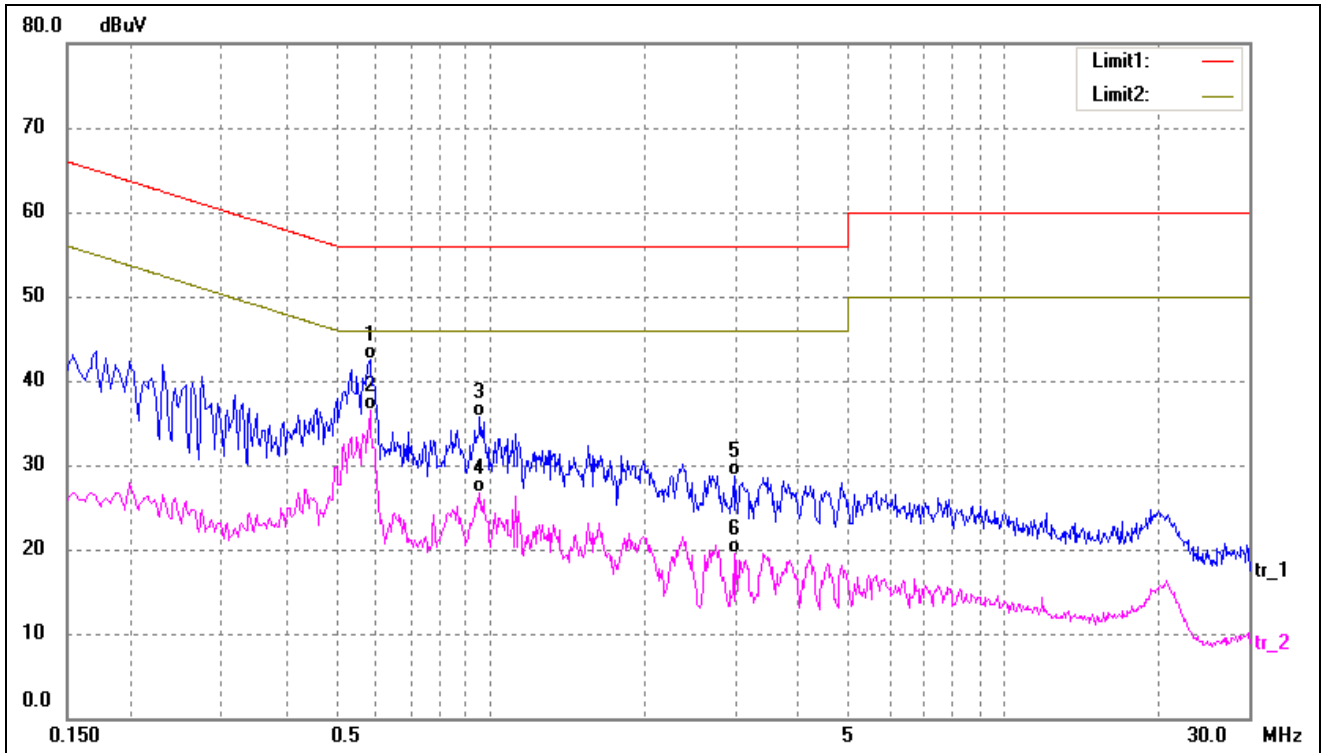
### 9.4 Summary of Test Results/Plots

Test Mode	Communication	AC120V 60Hz	Polarity:	Neutral
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.5860	36.97	10.21	47.18	56.00	-8.82	QP
2*	0.5860	27.47	10.21	37.68	46.00	-8.32	AVG
3	1.5060	26.57	10.23	36.80	56.00	-19.20	QP
4	1.5860	15.07	10.24	25.31	46.00	-20.69	AVG
5	2.3580	25.95	10.29	36.24	56.00	-19.76	QP
6	2.3780	12.96	10.29	23.25	46.00	-22.75	AVG

Test Mode	Communication	AC120V 60Hz	Polarity:	Line
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.5820	32.36	10.21	42.57	56.00	-13.43	QP
2*	0.5820	26.34	10.21	36.55	46.00	-9.45	AVG
3	0.9580	25.51	10.21	35.72	56.00	-20.28	QP
4	0.9580	16.56	10.21	26.77	46.00	-19.23	AVG
5	2.9780	18.50	10.27	28.77	56.00	-27.23	QP
6	2.9780	9.25	10.27	19.52	46.00	-26.48	AVG

**APPENDIX SUMMARY**

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Project No.	WTX21X05049596W	Test Engineer	Gala
Start date	2021/8/17	Finish date	2021/8/17
Temperature	23°C	Humidity	50%
RF specifications	WIFI-2.4G		

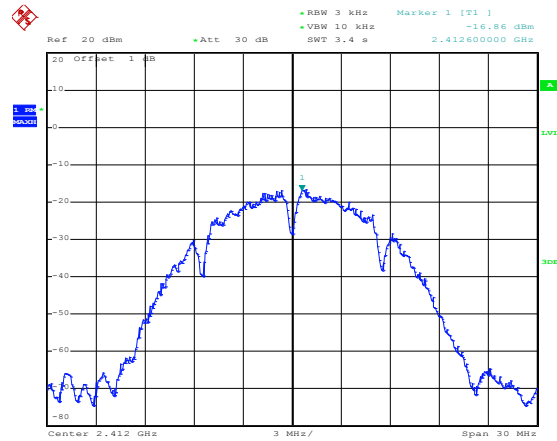
<b>APPENDIX</b>	<b>Description of Test Item</b>	<b>Result</b>
A	Power Spectral Density	Compliant
B	DTS Bandwidth	Compliant
C	RF Output Power	Compliant
D	Conducted Out of Band Emissions	Compliant

## APPENDIX A

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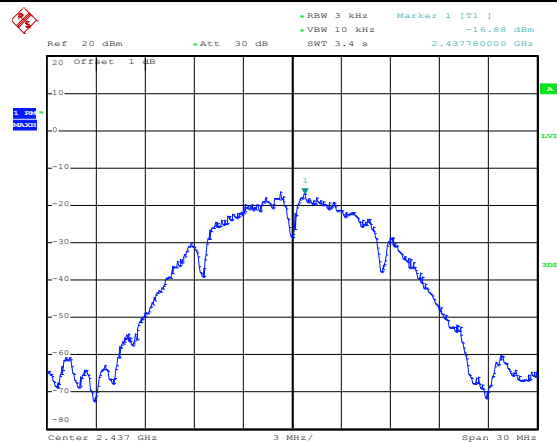
Power Spectral Density			
Test Mode	Test Channel MHz	Power Spectral Density dBm/3kHz	Limit dBm/3kHz
802.11b_11Mbps	2412	-16.86	8
	2437	-16.88	8
	2462	-17.62	8
802.11g_54Mbps	2412	-21.98	8
	2437	-21.94	8
	2462	-23.08	8
802.11n-HT20_MCS7	2412	-22.10	8
	2437	-23.15	8
	2462	-23.15	8
802.11n-HT40_MCS7	2422	-26.03	8
	2437	-26.79	8
	2452	-26.25	8

802.11b-Low



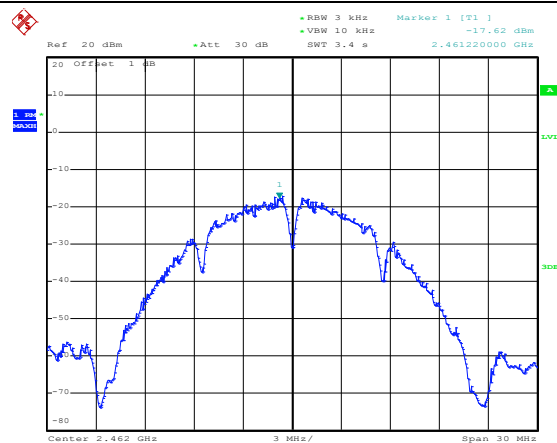
Date: 17.AUG.2021 15:52:55

802.11b-Middle



Date: 17.AUG.2021 15:53:26

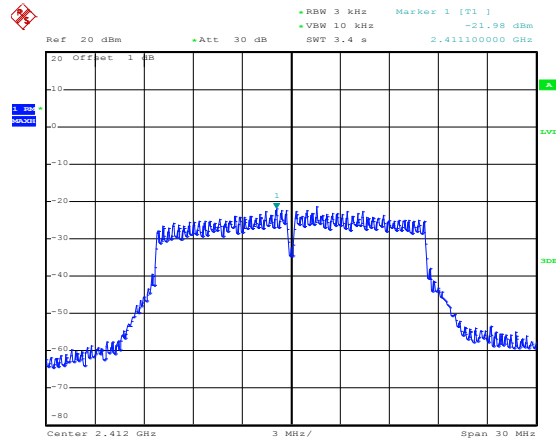
802.11b-High



Date: 17.AUG.2021 15:53:48

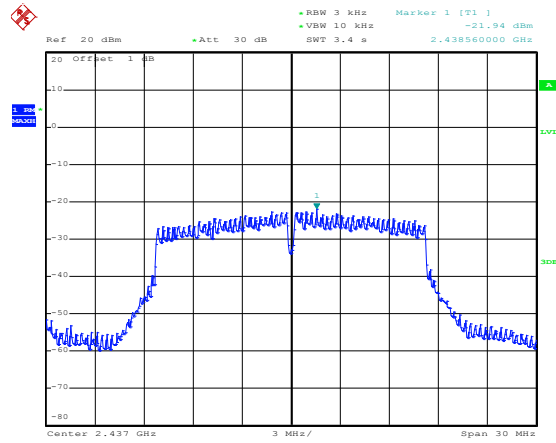


802.11g-Low



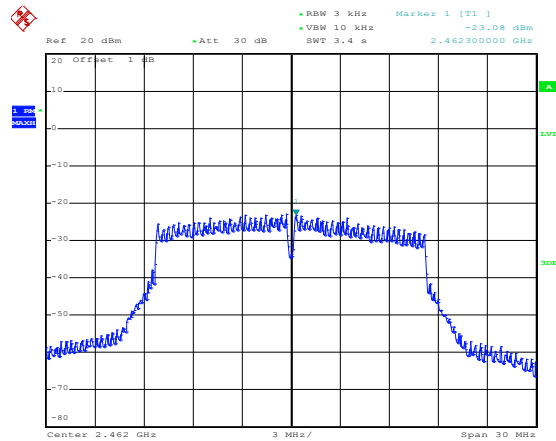
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802.11g-Middle



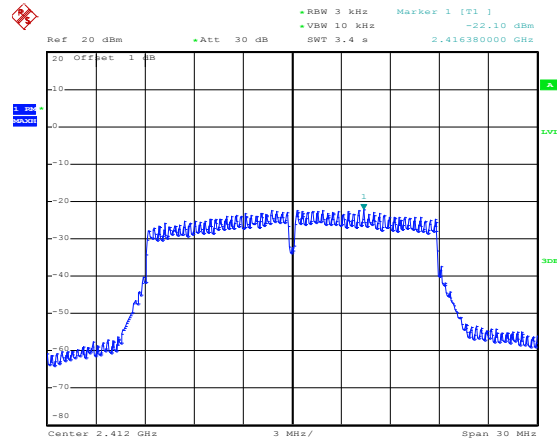
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802.11g-High



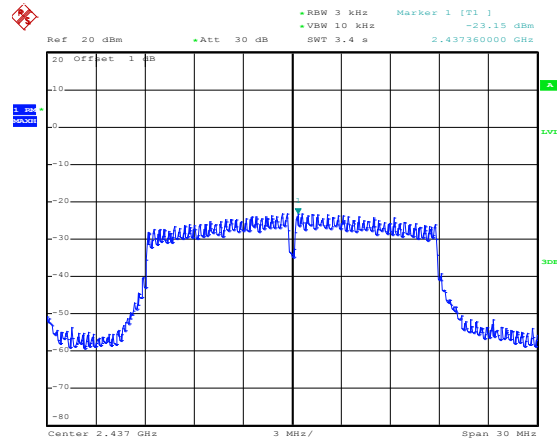
Date: 17.AUG.2021 15:55:49

802.11n-HT20-Low



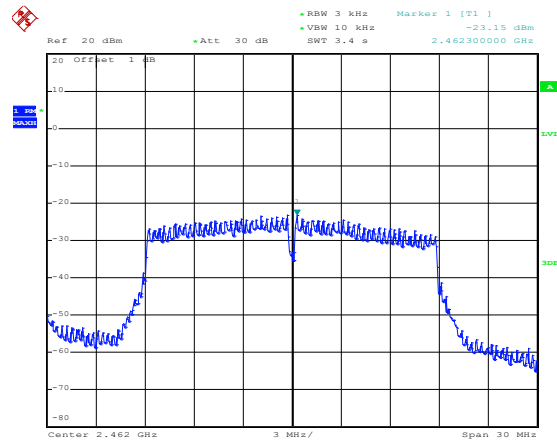
Date: 17.AUG.2021 15:57:35

802.11n-HT20-Middle

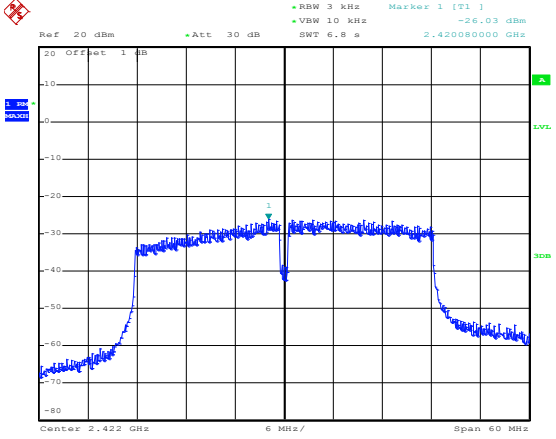
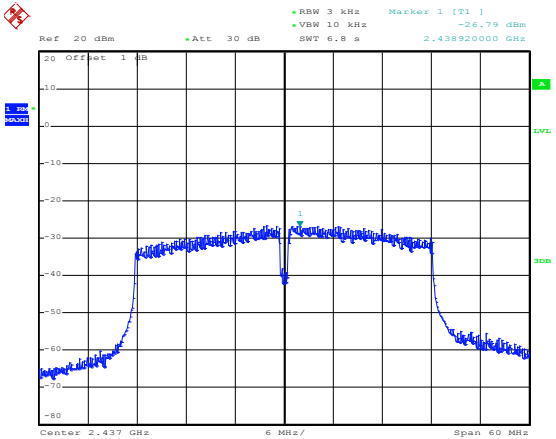
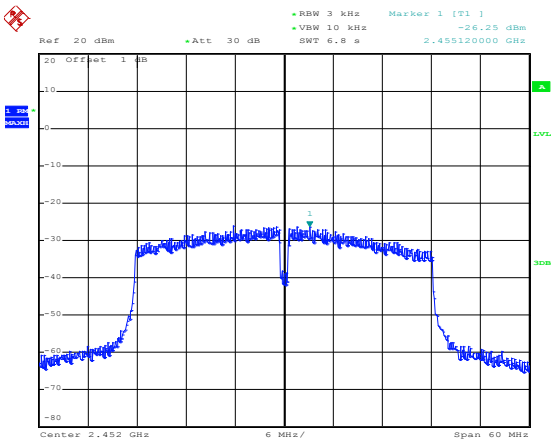


Date: 17.AUG.2021 15:58:03

802.11n-HT20-High



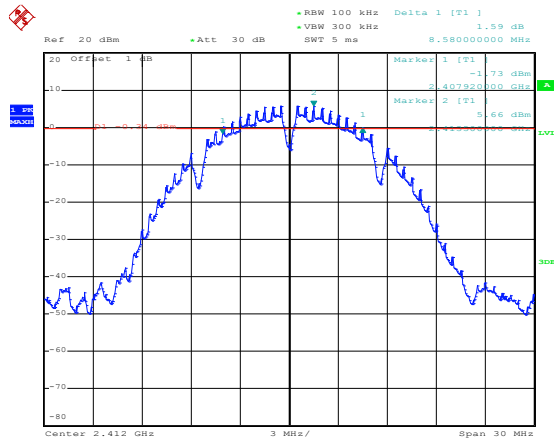
Date: 17.AUG.2021 15:58:28

<p>802.11n-HT40-Low</p>	 <p>Ref 20 dBm +Att 30 dB -RBW 3 kHz Marker 1 [T1] -26.03 dBm +VBW 10 kHz SWT 6.8 s 2.42080000 GHz</p> <p>20 Offset 1 dB -10 -20 -30 -40 -50 -60 -70 -80</p> <p>Center 2.422 GHz 6 MHz/ Span 60 MHz</p> <p>Date: 17.AUG.2021 15:59:00</p>
<p>802.11n-HT40-Middle</p>	 <p>Ref 20 dBm +Att 30 dB -RBW 3 kHz Marker 1 [T1] -26.79 dBm +VBW 10 kHz SWT 6.8 s 2.438920000 GHz</p> <p>20 Offset 1 dB -10 -20 -30 -40 -50 -60 -70 -80</p> <p>Center 2.437 GHz 6 MHz/ Span 60 MHz</p> <p>Date: 17.AUG.2021 15:59:27</p>
<p>802.11n-HT40-High</p>	 <p>Ref 20 dBm +Att 30 dB -RBW 3 kHz Marker 1 [T1] -26.25 dBm +VBW 10 kHz SWT 6.8 s 2.455120000 GHz</p> <p>20 Offset 1 dB -10 -20 -30 -40 -50 -60 -70 -80</p> <p>Center 2.452 GHz 6 MHz/ Span 60 MHz</p> <p>Date: 17.AUG.2021 16:00:00</p>

**APPENDIX B**

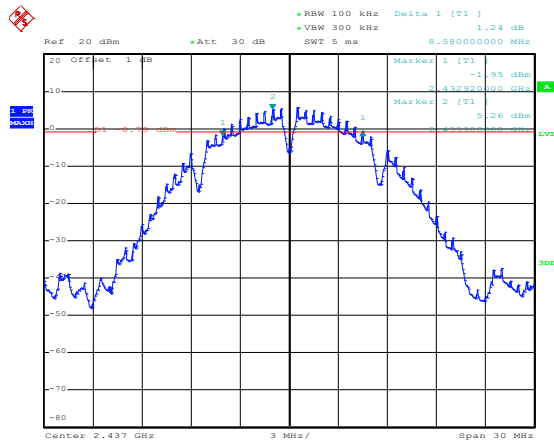
DTS Bandwidth			
Test Mode	Test Channel MHz	6 dB Bandwidth MHz	Limit kHz
802.11b_11Mbps	2412	8.58	≥500
	2437	8.58	≥500
	2462	9.06	≥500
802.11g_54Mbps	2412	16.44	≥500
	2437	16.44	≥500
	2462	16.44	≥500
802.11n-HT20_MCS7	2412	17.76	≥500
	2437	17.70	≥500
	2462	17.76	≥500
802.11n-HT40_MCS7	2422	36.24	≥500
	2437	36.36	≥500
	2452	35.76	≥500

802.11b-Low



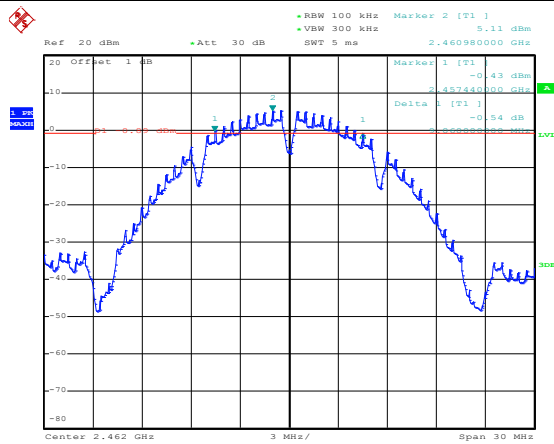
Date: 17.AUG.2021 15:20:41

802.11b-Middle



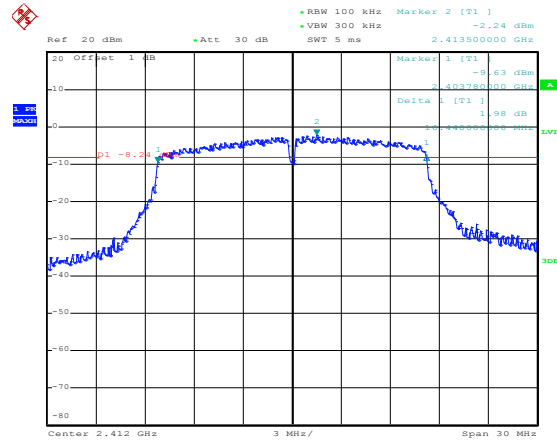
Date: 17.AUG.2021 15:21:50

802.11b-High



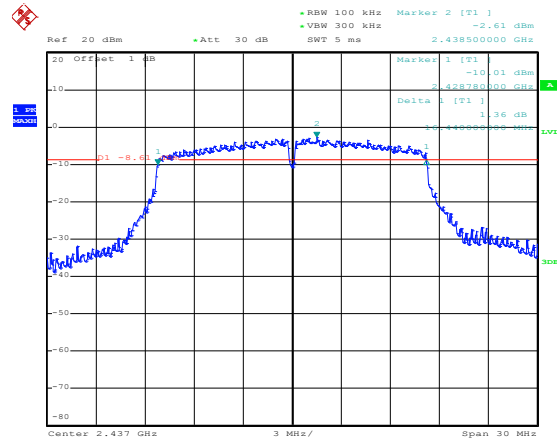
Date: 17.AUG.2021 15:02:15

802.11g-Low



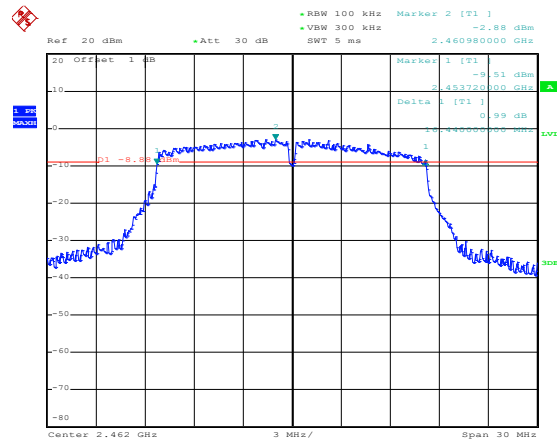
Date: 17.AUG.2021 15:05:21

802.11g-Middle



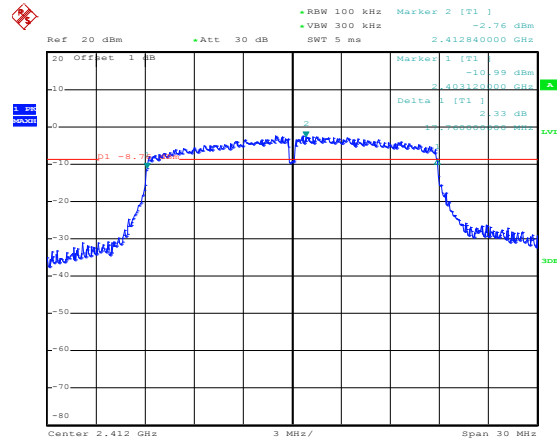
Date: 17.AUG.2021 15:06:43

802.11g-High



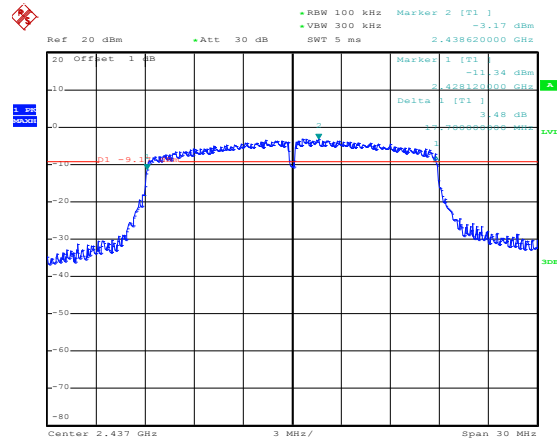
Date: 17.AUG.2021 15:09:02

802.11n-HT20-Low



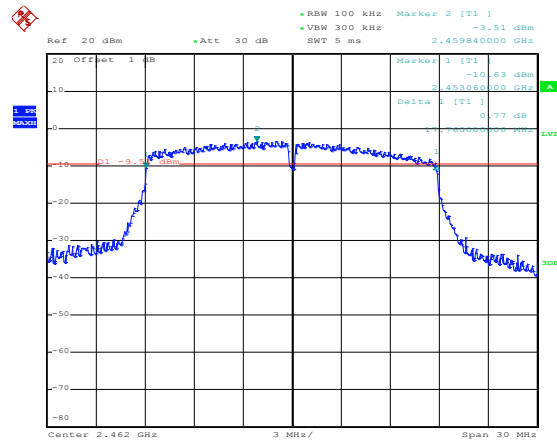
Date: 17.AUG.2021 15:10:55

802.11n-HT20-Middle



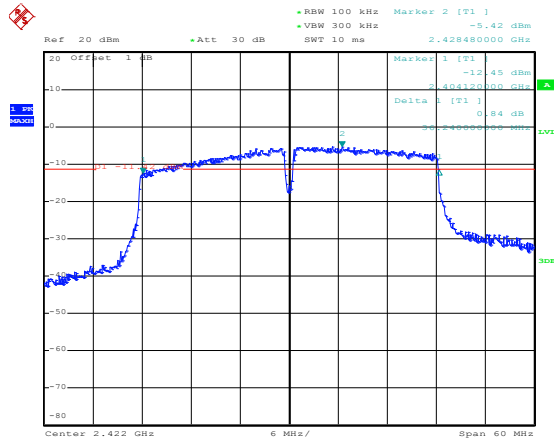
Date: 17.AUG.2021 15:12:23

802.11n-HT20-High



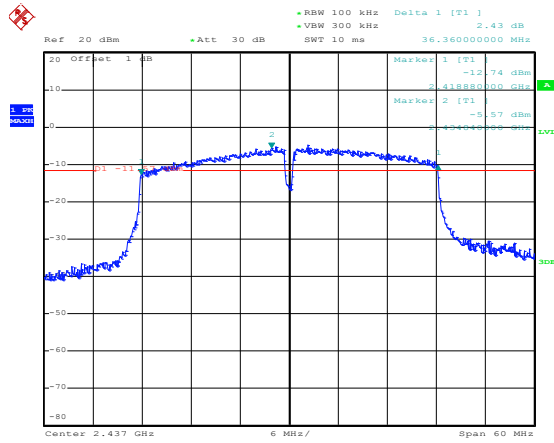
Date: 17.AUG.2021 15:13:59

802.11n-HT40-Low



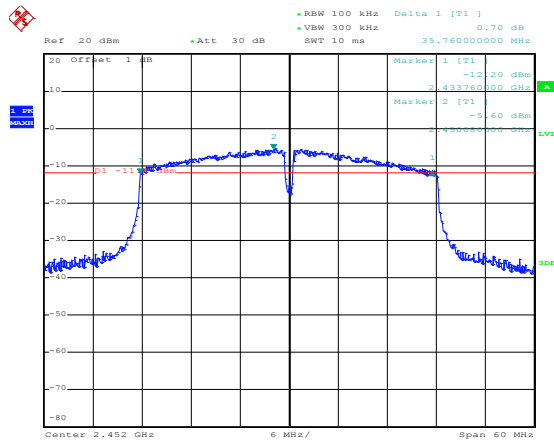
Date: 17.AUG.2021 15:17:09

802.11n-HT40-Middle



Date: 17.AUG.2021 15:18:18

802.11n-HT40-High



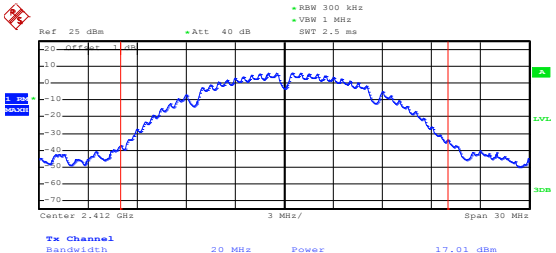
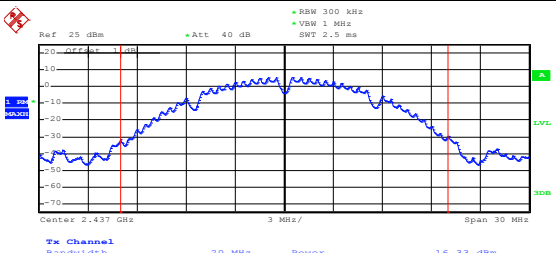
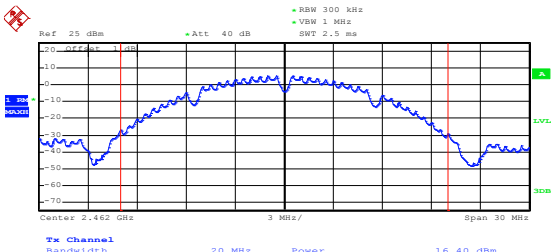
Date: 17.AUG.2021 15:19:13

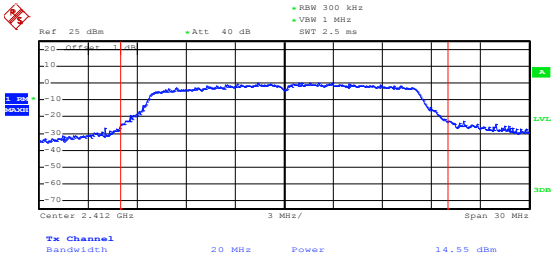
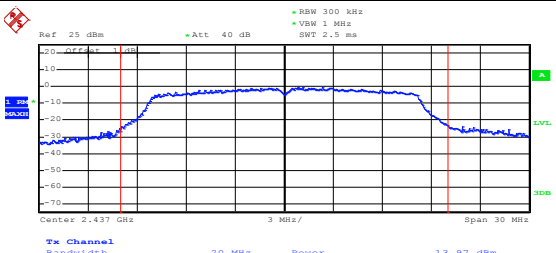
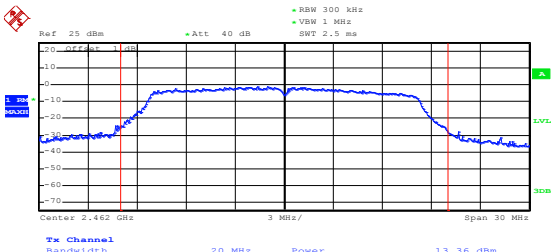


**APPENDIX C**

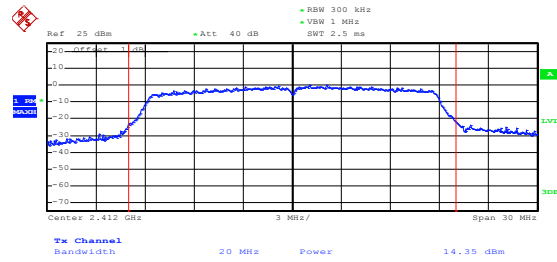
---

<b>Test Mode</b>	<b>Frequency MHz</b>	<b>Reading dBm</b>	<b>Limit dBm</b>
802.11b _ 11Mbps	2412	17.01	30.00
	2437	16.33	30.00
	2462	16.40	30.00
802.11g_54Mbps	2412	14.55	30.00
	2437	13.97	30.00
	2462	13.36	30.00
802.11n HT20_MCS7	2412	14.35	30.00
	2437	13.55	30.00
	2462	13.15	30.00
802.11n HT40_MCS7	2422	12.66	30.00
	2437	12.05	30.00
	2452	12.15	30.00

<p>802.11b-Low</p>	 <p>Date: 17.AUG.2021 12:55:13</p>
<p>802.11b-Middle</p>	 <p>Date: 17.AUG.2021 12:56:04</p>
<p>802.11b-High</p>	 <p>Date: 17.AUG.2021 12:56:22</p>

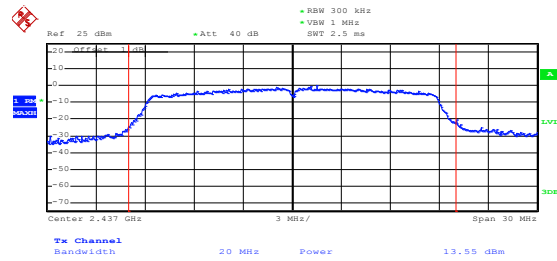
<p>802.11g-Low</p>	 <p>Date: 17.AUG.2021 12:58:38</p>
<p>802.11g-Middle</p>	 <p>Date: 17.AUG.2021 12:59:04</p>
<p>802.11g-High</p>	 <p>Date: 17.AUG.2021 12:59:30</p>

802.11n-HT20-Low



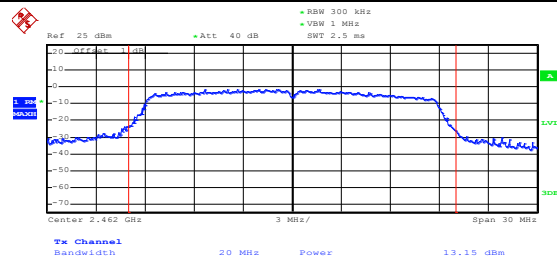
Date: 17.AUG.2021 13:00:16

802.11n-HT20-Middle

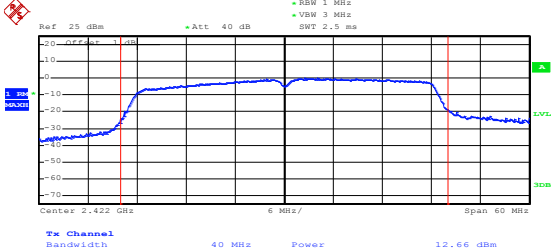
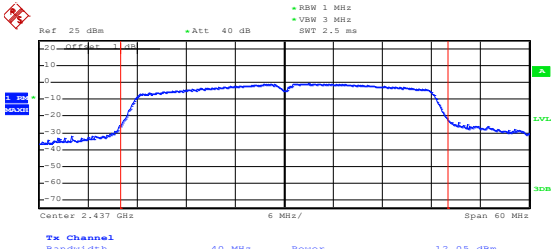
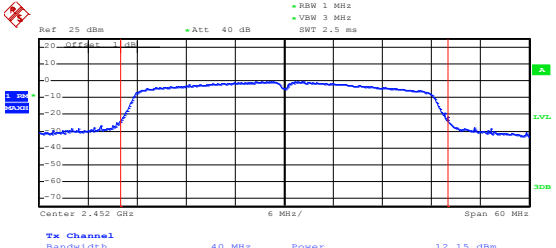


Date: 17.AUG.2021 13:00:31

802.11n-HT20-High



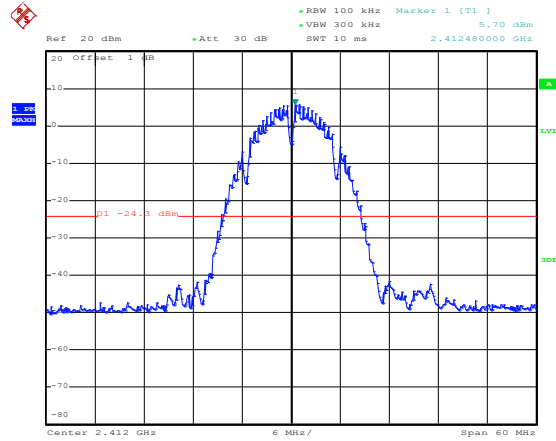
Date: 17.AUG.2021 13:00:48

<p>802.11n-HT40-Low</p>	 <p>Ref: 25 dBm +Att: 40 dB RBW: 1 MHz VSW: 3 MHz SWT: 2.5 ms</p> <p>Center: 2.422 GHz Span: 60 MHz</p> <p>Tx Channel Bandwidth: 40 MHz Power: 12.66 dBm</p> <p>Date: 17.AUG.2021 13:02:32</p>
<p>802.11n-HT40-Middle</p>	 <p>Ref: 25 dBm +Att: 40 dB RBW: 1 MHz VSW: 3 MHz SWT: 2.5 ms</p> <p>Center: 2.437 GHz Span: 60 MHz</p> <p>Tx Channel Bandwidth: 40 MHz Power: 12.05 dBm</p> <p>Date: 17.AUG.2021 13:02:51</p>
<p>802.11n-HT40-High</p>	 <p>Ref: 25 dBm +Att: 40 dB RBW: 1 MHz VSW: 3 MHz SWT: 2.5 ms</p> <p>Center: 2.452 GHz Span: 60 MHz</p> <p>Tx Channel Bandwidth: 40 MHz Power: 12.15 dBm</p> <p>Date: 17.AUG.2021 13:03:34</p>

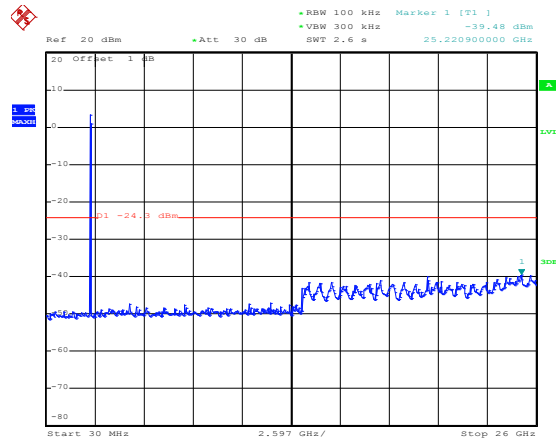
# APPENDIX D

## Conducted Out of Band Emissions

802.11b-Low

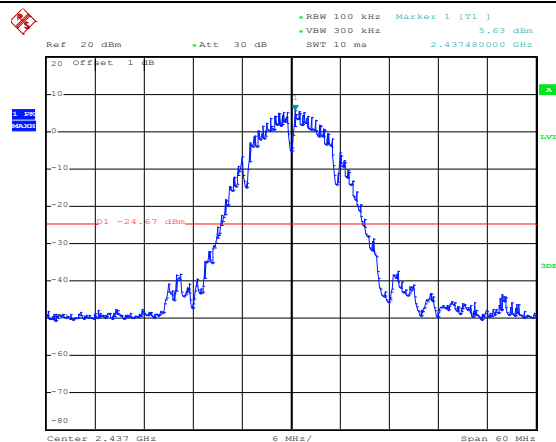


Date: 17.AUG.2021 15:28:59

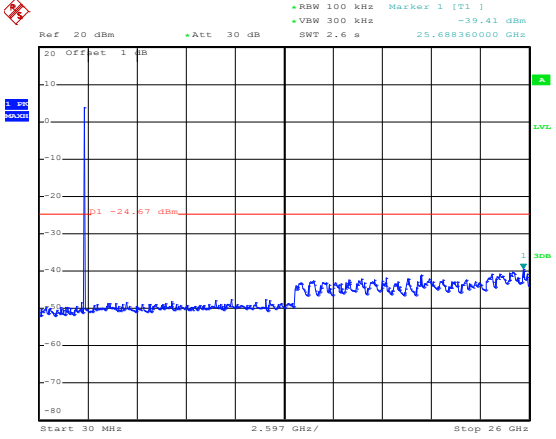
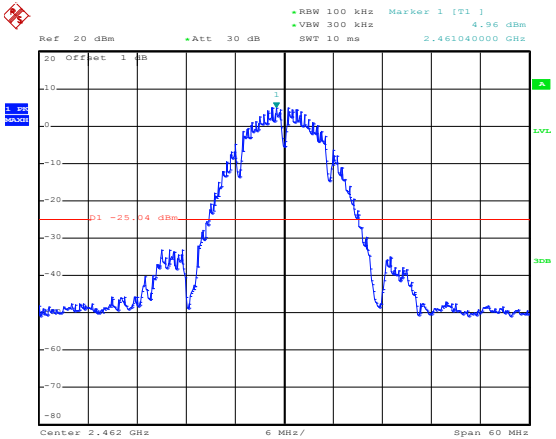
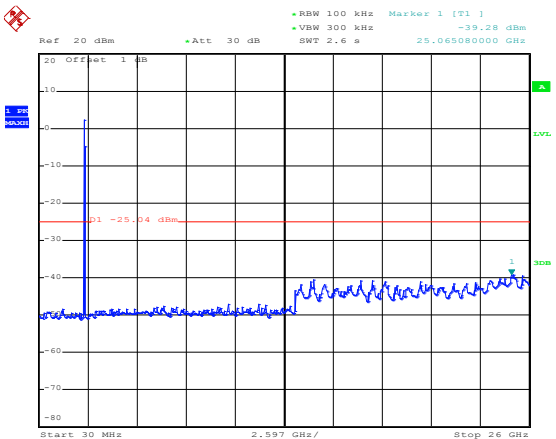


Date: 17.AUG.2021 15:29:30

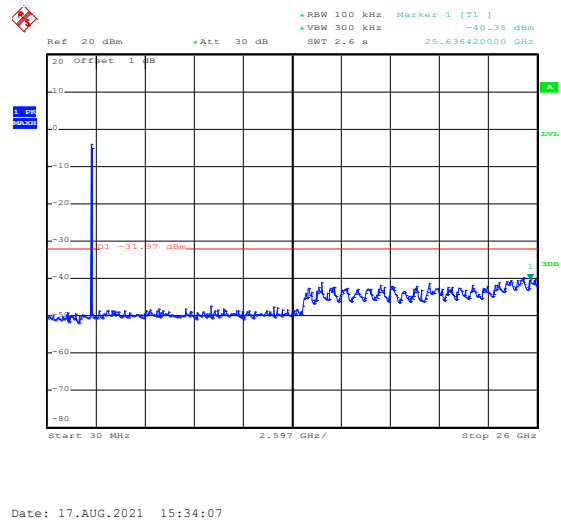
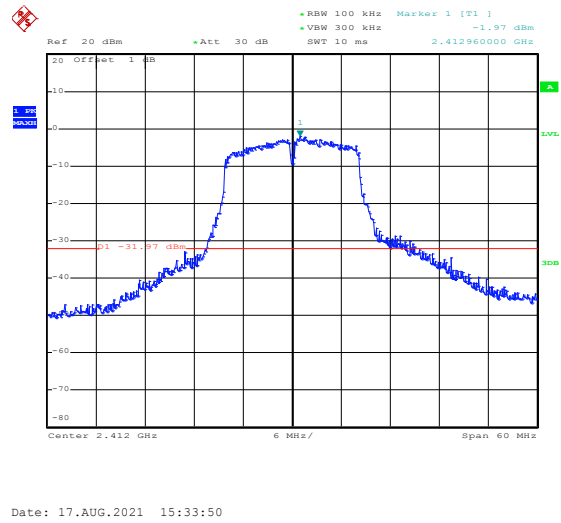
802.11b-Middle



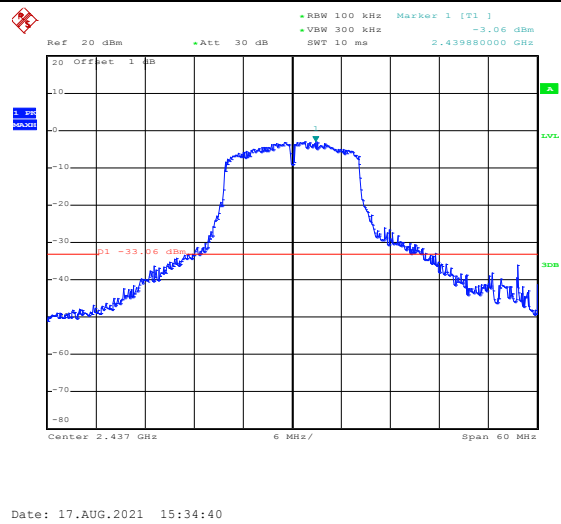
Date: 17.AUG.2021 15:31:00

	 <p>Date: 17.AUG.2021 15:31:24</p>
802.11b-High	 <p>Date: 17.AUG.2021 15:32:12</p>
	 <p>Date: 17.AUG.2021 15:33:05</p>

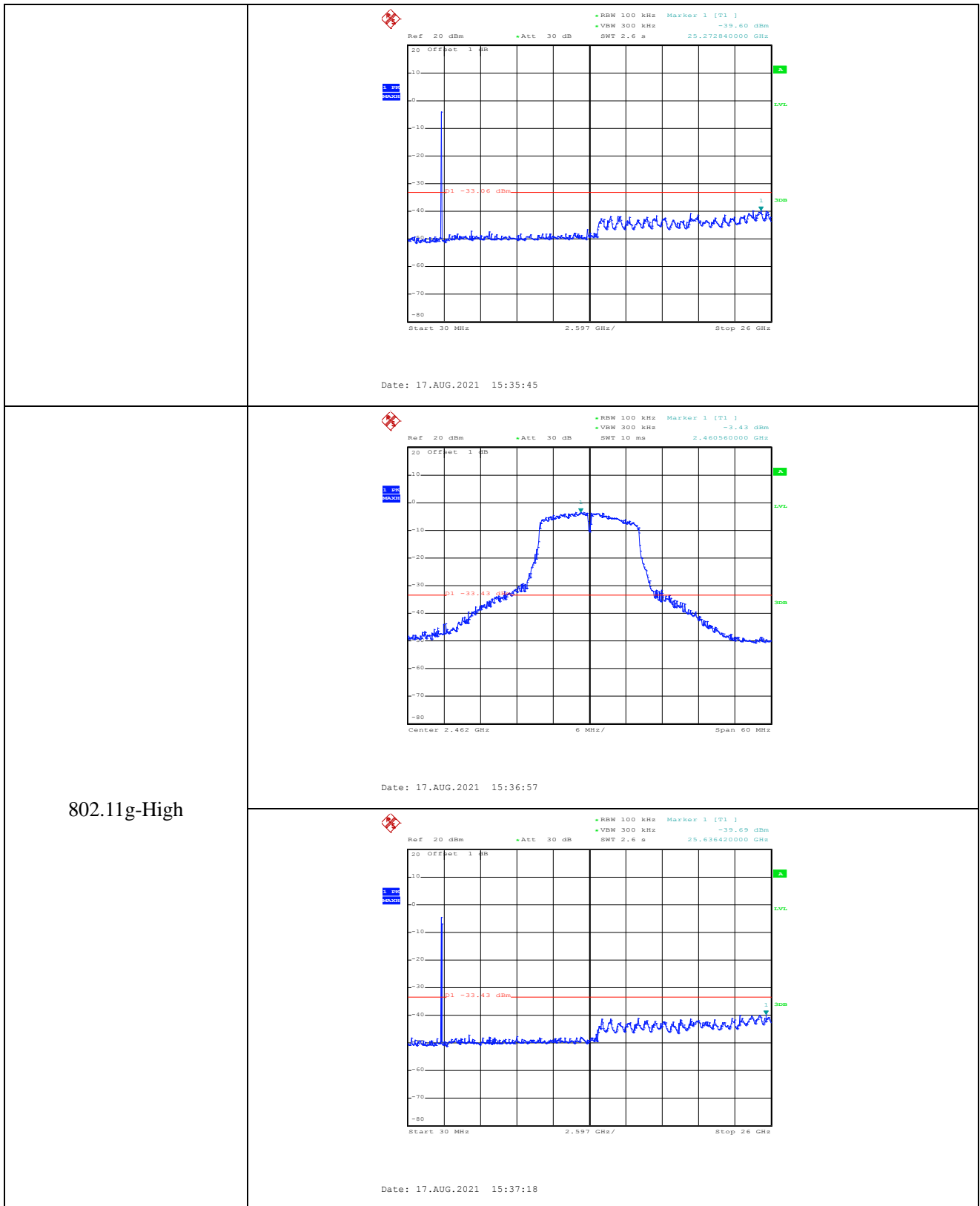
802.11g-Low



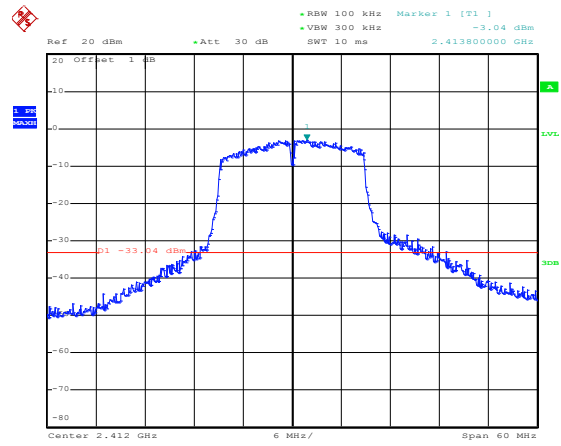
802.11g-Middle





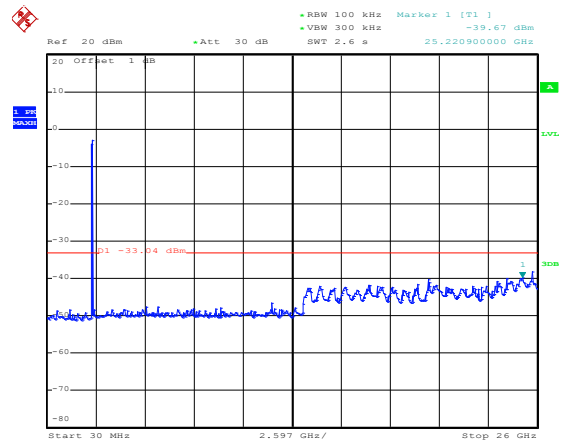


802.11n-HT20-Low

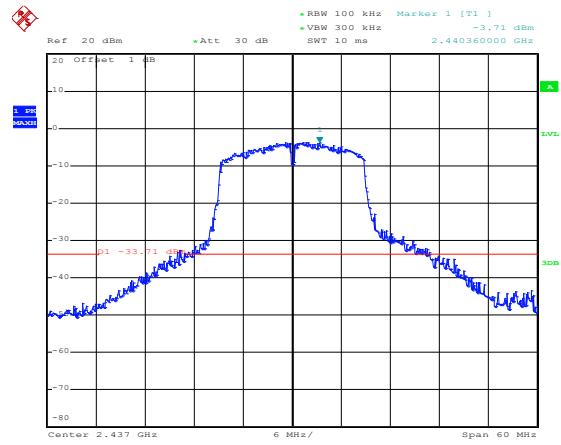


Date: 17.AUG.2021 15:37:57

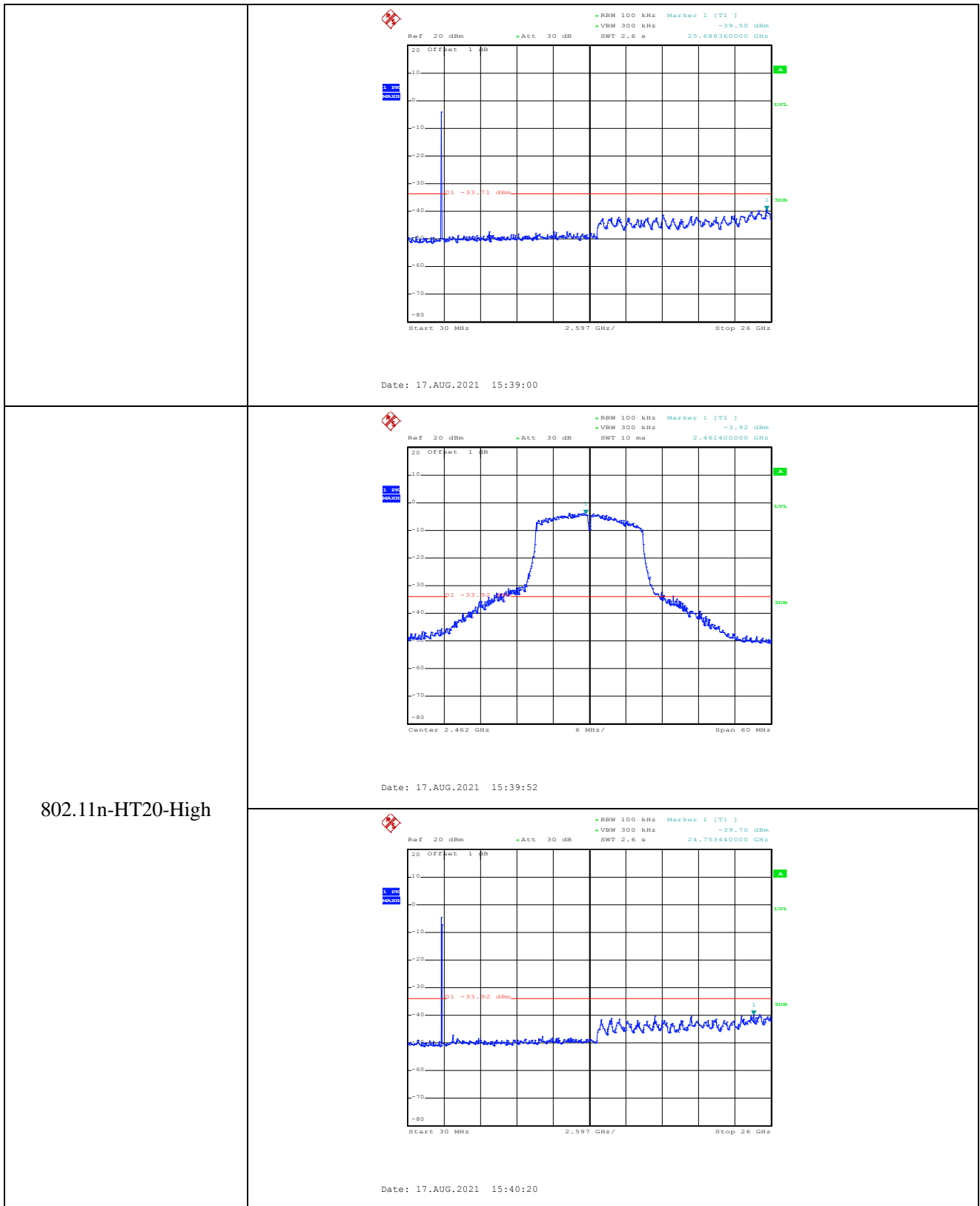
802.11n-HT20-Middle



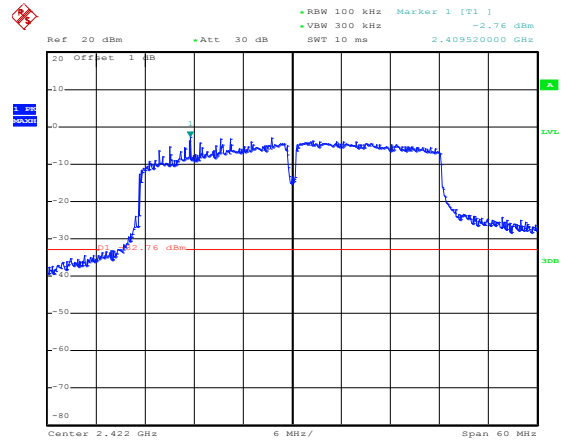
Date: 17.AUG.2021 15:38:14



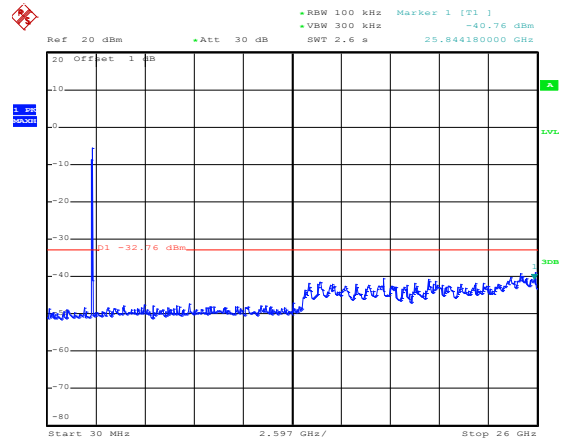
Date: 17.AUG.2021 15:38:43



802.11n-HT40-Low

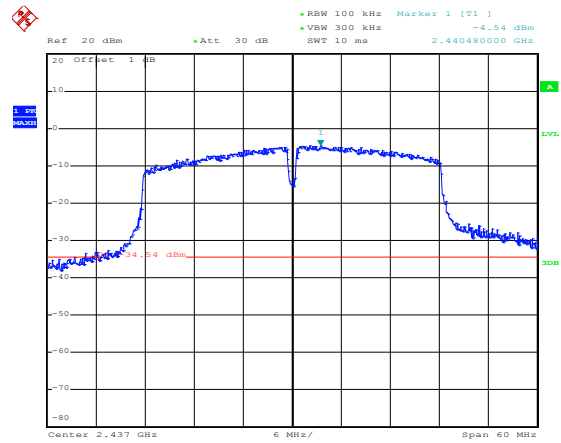


Date: 17.AUG.2021 15:41:49

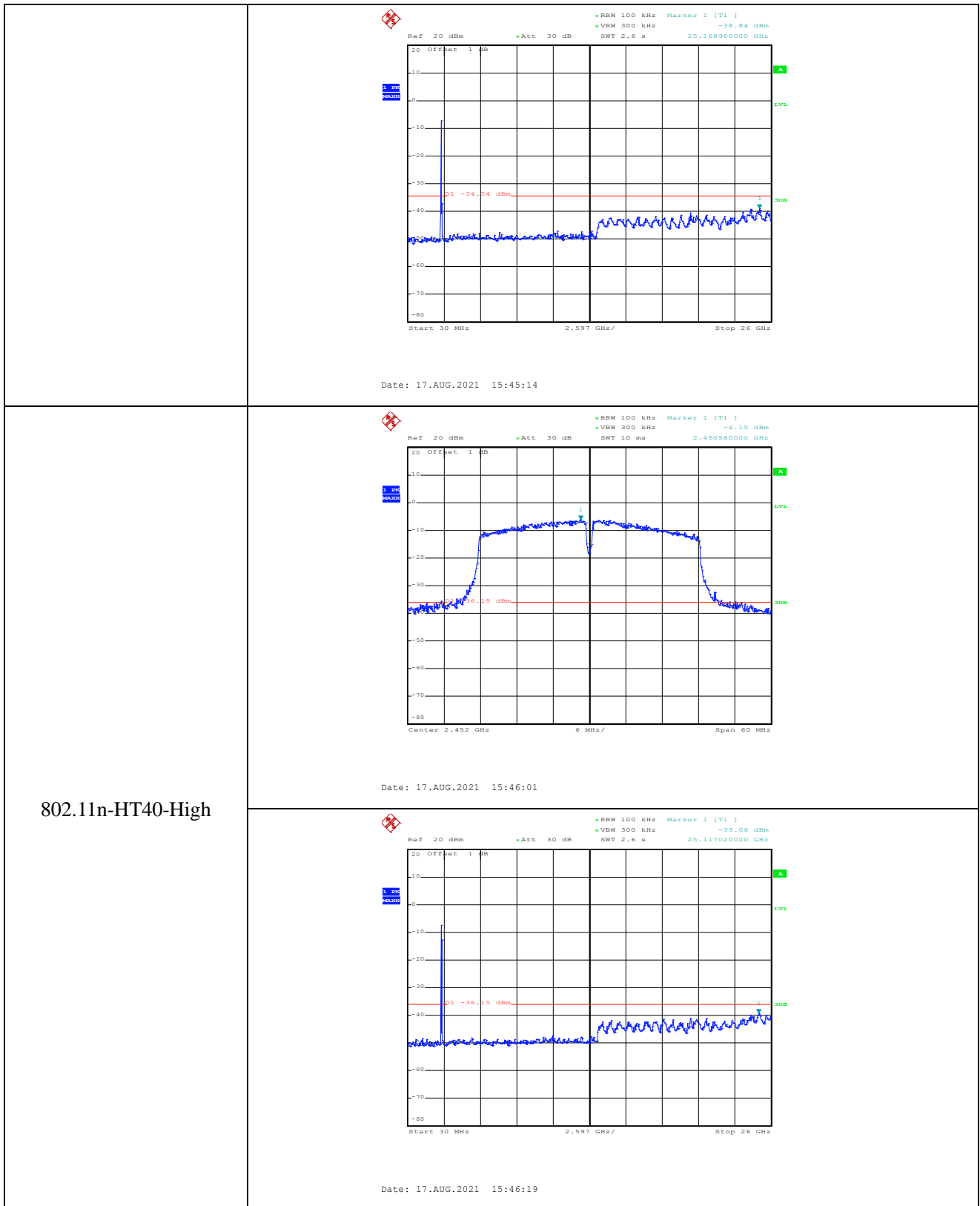


Date: 17.AUG.2021 15:42:06

802.11n-HT40-Middle



Date: 17.AUG.2021 15:44:44



## **APPENDIX PHOTOGRAPHS**

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**Please refer to “ANNEX”**

**\*\*\*\*\* END OF REPORT \*\*\*\*\***