FCC IC Test Report

Report No: FCS202007069

Issued for

Applicant:	CRYPTODATA TECH SRL
Address:	Bucuresti,Sectorul 1,Soldat Gheorghe Buciumat,nr.14 Mansarda,Romania
Product Name:	Laptop
Brand Name:	CryptoData
Model Name:	WHIM Business
Series Model:	Whim Pro, Whim Book, N141
FCC ID:	2AWZ7-WHIM
IC:	26331-WHIM

Issued By: Flux Compliance Service Laboratory
Add: Room 105 Floor Bao hao Technology Building 1 NO.15 Gong yeWest Road Hi-Tech Industrial, Song shan lake Dongguan
Tel: 769-27280901 Fax:769-27280901 http://www.FCS-lab.com

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Revision History

Rev.	Issue Date	EFFECT PAGE	Contents
01	07 July 2020	All	Initial Issue

TEST RESULT CERTIFICATION

Applicant's Name .....:	CRYPTODATA TECH SRL
Address .....:	Bucuresti,Sectorul 1,Soldat Gheorghe Buciumat,nr.14 Mansarda,Romania
Manufacture's Name .....:	Shenzhen KEP Technology Co., Ltd
Address .....:	4th Floor, Building B20, Heng Feng Industrial Area, Xixiang Town, Bao'an District, Shenzhen, Guangdong, China 518126

Product Description

Product Name .....:	Laptop
Brand Name .....:	CryptoData
Model Name .....:	WHIM Business
Series Model .....:	Whim Pro, Whim Book, N141
Test Standards .....:	FCC Part 15E 15.407
Test Procedure.....:	ANSI C63.10-2013 and KDB 789033 D02 General UNII Test Procedures New Rules v02r01 . RSS-247 Issue 2: February 2017, RSS-Gen Issue 5: March 2019

This device described above has been tested FCS, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.
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Date of Test.....:

Date (s) of performance of tests	30 June 2020 ~ 07 July 2020
Date of Issue.....:	07 July 2020
Test Result .....:	Pass

Prepared By : Chris chen

(Chris Chen)

Approved By : Brown lu

(Brown Lu)

1. SUMMARY OF TEST RESULTS

The EUT have been tested according to the applicable standards as referenced below.		
FCC Part15 (15.407) , Subpart E		
Description of Test Item	**Standard**	**Results**
AC Power Line Conducted Emissions	FCC §15.207/ RSS-Gen RSS-Gen clause 8.8	PASS
Spurious Radiated Emissions	FCC §15.209(a), 15.407(b) RSS-Gen 8.9 8.10	PASS
26 dB and 99% Emission Bandwidth	FCC §15.407(a) RSS-Gen clause 6.7 & RSS-247 6.2.1.2&6.2.4.2	PASS
Maximum Conducted Output Power	FCC §407(a)(1) RSS-Gen clause 6.12 &RSS-247 6.2.1.1& 6.2.4.1	PASS
Band Edges	FCC §2.1051, §15.407(b) RSS-Gen 8.9 8.10	PASS
Power Spectral Density	FCC §15.407(a)(1) RSS-247 6.2.1.1& 6.2.4.1 & ANSIC63.10: Clause 12.5	PASS
Spurious Emissions at Antenna Terminals	FCC §2.1051, §15.407(b) RSS-247 6.2.1.2&6.2.4.2	PASS
Frequency Stability	FCC §15.407(a)(6)	PASS
Antenna Requirement	FCC §15.203 RSS-Gen clause 6.8	PASS

1.1 Test Laboratory

Company Name:	Flux Compliance Service Laboratory
Address:	Room 105 Floor Bao hao Technology Building 1 NO.15 Gong yeWest Road Hi-Tech Industrial, Song shan lake Dongguan
Telephone:	+86-769-27280901
Fax:	+86-769-27280901
FCC Test Firm Registration Number: 514908 Designation number: CN0127 A2LA accreditation number：5545.01	

1.2 Measurement Uncertainty

The reported uncertainty of measurement **y ±U**,where expended uncertainty **U** is based on a standard uncertainty multiplied by a coverage factor of **k=2**,providing a level of confidence of approximately **95** %.

	Items	Uncertainty
	RF output power, conducted	±0.71dB
	Unwanted Emissions, conducted	±2.988 dB
	Conducted Emission (9KHz-150KHz)	±4.13 dB
	Conducted Emission (150KHz-30MHz)	±4.74 dB
	All emissions,radiated(<1G) 30MHz-1000MHz	±5.2 dB
	All emissions,radiated(>1G) 1000MHz -3000MHz	±4.66 dB
	All emissions,radiated(<1G) 3000MHz -6000MHz	±5.31 dB

1.3 Test Environment Conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature rang:	20-26℃
Humidity range:	40-65%
Pressure range:	86-106Kpa

2. GENERAL TEST INFORMATION

2.1. DESCRIPTION OF EUT

EUT* Name	:	Laptop
Model Number	:	WHIM Business,Whim Pro, Whim Book, N141
EUT function description	:	Laptop with WiFi & BT function.
Power supply	:	Adapter:WA-65B19R INPUT: 100-240V~ 50/60Hz 1.5A OUTPUT: DC 19V 3.43A
Operation frequency	:	WiFi: 802.11a/802.11n(HT20) /ac(VHT20): 5180MHz~5240MHz; 802.11n(HT40)/ac(VHT40): 5190MHz~5230MHz; 802.11ac(VHT80): 5210MHz
Modulation	:	OFDM with OFDM, BPSK, QPSK, 16QAM, 64QAM, 256QAM for 802.11a/n/ac;
Data Rate	:	802.11 a: 6,9,12,18,24,36,48,54Mbps; 802.11n(HT20):MCS0-MCS7; 802.11n(HT40): MCS0-MCS7; 802.11ac(HT20/HT40/HT80):Up to 433Mbps
Antenna Type	:	FPCB Antenna, Antenna A only WIFI, Antenna B WIFI&BT maximum PK gain: Antenna A :1.66dBi(Main) Antenna B : 0.98dBi(Aux)
Battery	:	DC 7.6V 6000mAh Li Battery
Hardware version number		KEP-N141GKR4 MB V11 PCBA SKU1
Software versionnumber		win10_pro_64b_1909_18363.836
Date of Receipt	:	2020/06/30
Sample Type	:	N/A
Connecting I/O Port(s)		Please refer to the User's Manual
Note: For a more detailed features description, please refer to the manufacturer’s specifications or the User's Manual.		

Channel List							
802.11a/n/ac(20MHz)							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
36	5180	40	5200	44	5220	48	5240
802.11n/ac(40MHz)							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
38	5190	46	5230	--	--	--	--
802.11 ac(80MHz)							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
42	5210	--	--	--	--	--	--

2.2. ACCESSORIES OF EUT

Description of Accessories	Shielded Type	Ferrite Core	Length
Adapter	Asian Power Devices Inc.	WA-65B19R	/

2.3. ASSISTANT EQUIPMENT USED FOR TEST

Description of Assistant equipment	Manufacturer	Model number or Type	EMC Compliance	SN
/	/	/	/	/

2.4. BLOCK DIAGRAM OF EUT CONFIGURATION FOR TEST

EUT

2.5. TEST ENVIRONMENT CONDITIONS

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
Mode 1	Link Mode
Mode 2	802.11a / n 20/ac20 CH36/ CH44/ CH48
Mode 3	802.11n40/ac40 CH38/ CH46

For Radiated Emission	
Final Test Mode	Description
Mode 1	Link Mode
Mode 2	802.11a / n 20/ac20 CH36/ CH44/ CH48
Mode 3	802.11n40/ac40 CH38/ CH46
Mode 4	802.11ac80 CH42

Note:

(1) The measurements are performed at the highest, middle, lowest available channels.

(2) The measurements are performed at all Bit Rate of Transmitter, the worst data was reported

(3) The EUT was used fully-charged battery and programmed to be in continuously transmitting mode and the transmit duty cycle is not less than 98%.

(4) The EUT does not support MIMO mode.

2.1 Equipments List

Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Company No.	Last calibration	Calibrated until
EMI Test Receiver	R&S	ESRP 3	FCS-E001	2020.05.31	2021.05.30
Signal Analyzer	R&S	FSV40-N	FCS-E012	2020.06.05	2021.06.04
Active loop Antenna	ZHINAN	ZN30900C	FCS-E013	2019.10.11	2020.10.10
Bilog Antenna	SCHWARZBECK	VULB 9168	FCS-E002	2019.10.26	2020.10.25
Horn Antenna	SCHWARZBECK	BBHA 9120D	FCS-E003	2020.05.31	2021.05.30
SHF-EHF Horn Antenna (18G-40GHz)	A-INFO	LB-180400-KF	FCS-E018	2020.05.31	2021.05.30
Pre-Amplifier(0.1M-3 GHz)	EMCI	EM330N	FCS-E004	2020.05.31	2021.05.30
Pre-Amplifier (1G-18GHz)	N/A	TSAMP-0518SE	FCS-E014	2019.10.03	2020.10.02
Temperature & Humidity	HTC-1	victor	FCS-E005	2020.05.31	2021.05.30

Conduction Test equipment

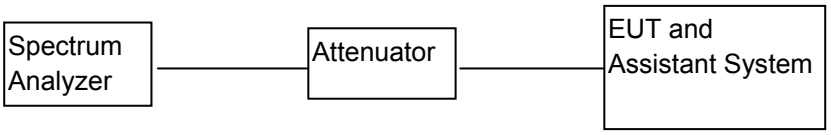
Kind of Equipment	Manufacturer	Type No.	Company No.	Last calibration	Calibrated until
EMI Test Receiver	R&S	ESPI	FCS-E020	2020.05.31	2021.05.30
LISN	R&S	ENV216	FCS-E007	2020.05.15	2021.05.14
LISN	ETS	3810/2NM	FCS-E009	2019.10.15	2020.10.14
Temperature & Humidity	HTC-1	victor	FCS-E008	2020.05.31	2021.05.30

RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Company No.	Last calibration	Calibrated until
MXA SIGNAL Analyzer	Keysight	N9020A	FCS-E015	2019.10.02	2020.10.01

3. POWER SPECTRAL DENSITY TEST

3.1. BLOCK DIAGRAM OF TEST SETUP



3.2. APPLIED PROCEDURES / LIMIT

According to FCC §15.407(a)(3)

For the band 5.15-5.25 GHz,

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the band 5.725-5.85 GHz

For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi..

3.3. TEST PROCEDURE

（For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement

bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, “provided that the measured power is integrated over the full reference bandwidth” to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 KHz bandwidth, the following adjustments to the procedures apply:

a) Set RBW ≥ 1/T, where T is defined in section II.B.I.a).

b) Set VBW ≥ 3 RBW.

c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add 10log(500kHz/RBW) to the measured result, whereas RBW (< 500 KHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.

d) If measurement bandwidth of Maximum PSD is specified in 1 MHz, add 10log(1MHz/RBW) to the measured result, whereas RBW (< 1 MHz) is the reduced resolution bandwidth of spectrum analyzer set during measurement.

e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

Note: As a practical matter, it is recommended to use reduced RBW of 100 KHz for the sections 5.c) and 5.d) above, since RBW=100 KHZ is available on nearly all spectrum analyzers.

3.4. TEST RESULT

CH. No.	Frequency	Power Density ANT A (dBm/MHz)	Power Density ANT B (dBm/MHz)	total power density (dBm/MHz)	Limit (dBm/MHz)	Result
TX 802.11a Mode						
CH36	5180	-3.13	-3.15	--	11	Pass
CH44	5220	-4.28	-4.30	--	11	Pass
CH48	5240	-4.56	-4.59	--	11	Pass
TX 802.11n20 Mode						
CH36	5180	-4.07	-4.11	--	11	Pass
CH44	5220	-4.39	-4.42	--	11	Pass
CH48	5240	-4.05	-4.07	--	11	Pass

CH. No.	Frequency	Power Density ANT A (dBm/MHz)	Power Density ANT B (dBm/MHz)	total power density (dBm/MHz)	Limit (dBm/MHz)	Result
TX 802.11n40 Mode						
CH38	5190	-8.57	-8.60	--	11	Pass
CH46	5230	-9.02	-9.04	--	11	Pass

CH. No.	Frequency	Power Density ANT A (dBm/MHz)	Power Density ANT B (dBm/MHz)	total power density (dBm/MHz)	Limit (dBm/MHz)	Result
TX 802.11 ac(VHT20) Mode						
CH36	5180	-3.78	-3.81	--	11	Pass
CH44	5220	-4.13	-4.15	--	11	Pass
CH48	5240	-4.64	-4.67	--	11	Pass

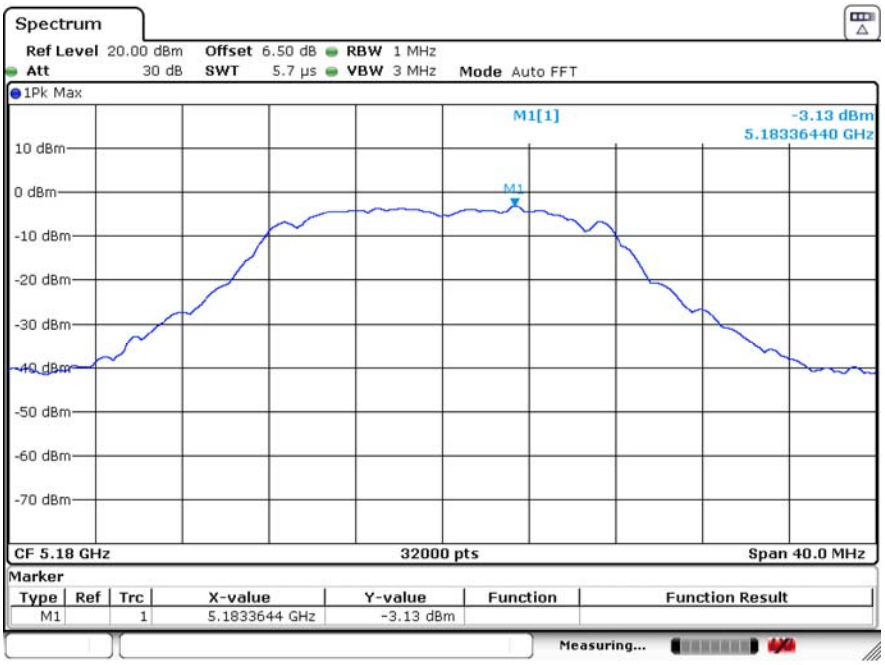
CH. No.	Frequency	Power Density ANT A (dBm/MHz)	Power Density ANT B (dBm/MHz)	total power density (dBm/MHz)	Limit (dBm/MHz)	Result
TX 802.11 ac(VHT40) Mode						
CH38	5190	-9.15	-9.16	--	11	Pass
CH46	5230	-8.93	-8.95	--	11	Pass
TX 802.11 ac(VHT80) Mode						
CH42	5210	-10.78	-10.80	--	11	Pass

Note: The worst data is Antenna A, only shown Antenna A Plot.

Test plots as followed: Antenna A

802.11a

Channel: 36



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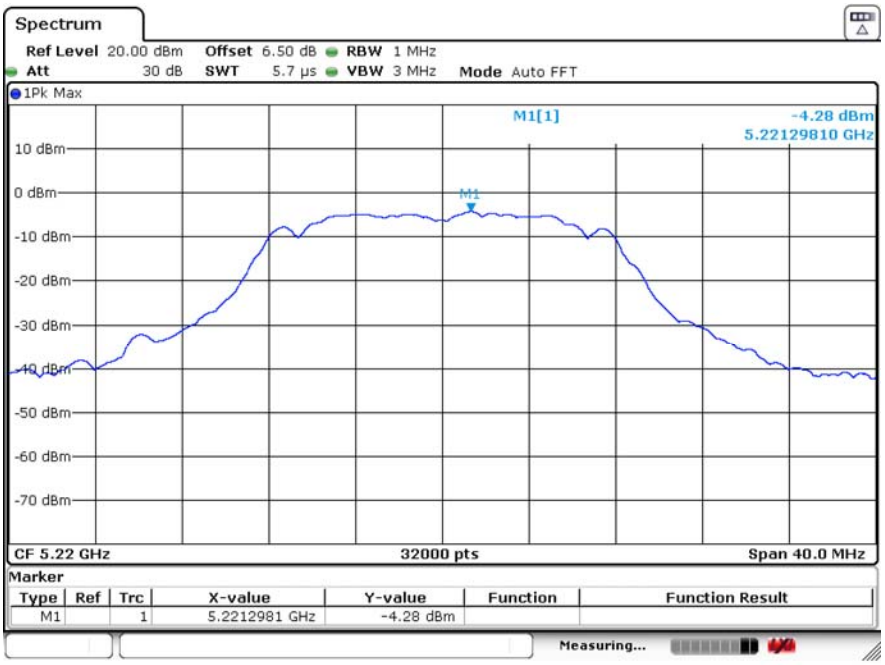

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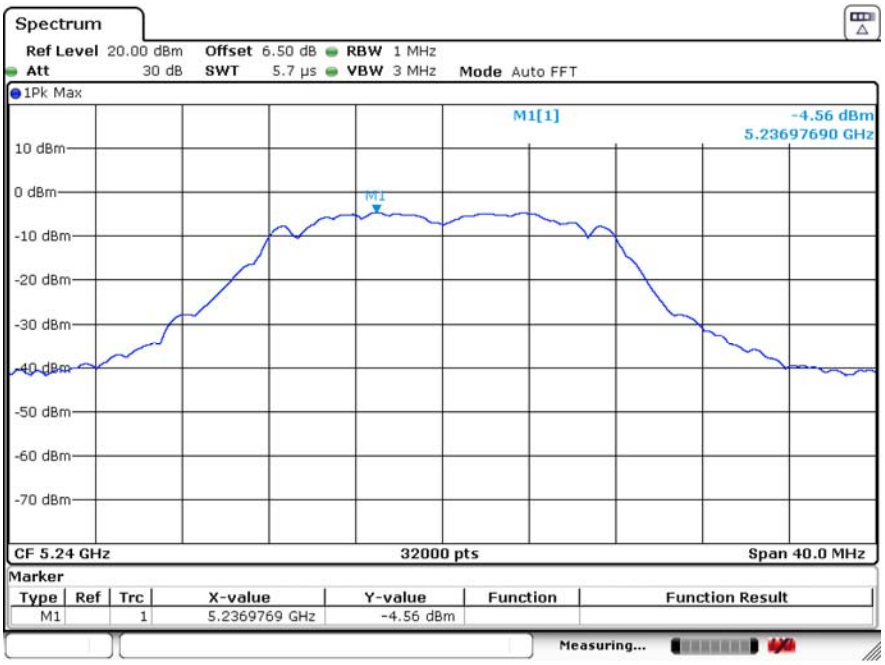
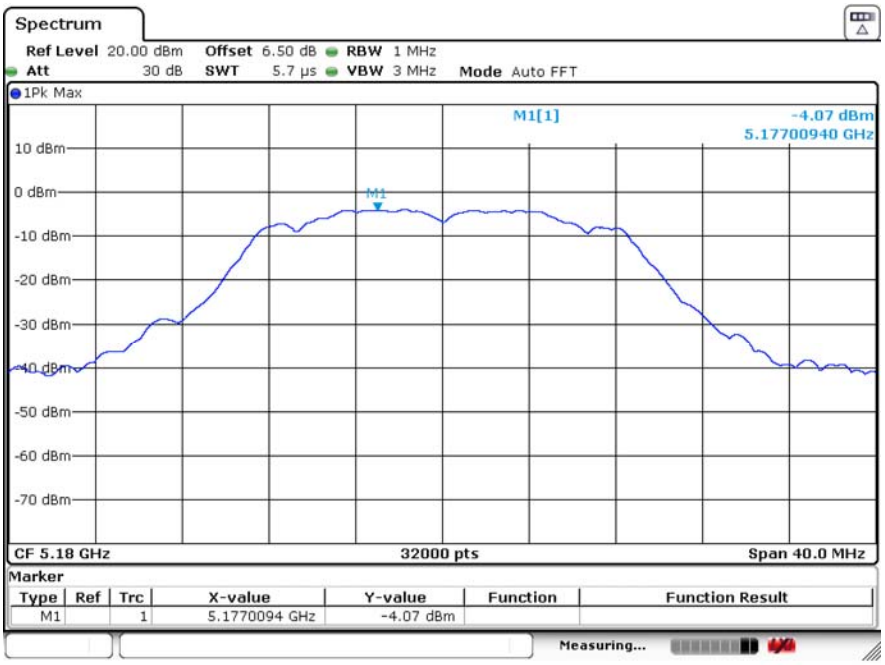

Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 1 MHz
Att 30 dB SWT 5.7 µs VBW 3 MHz Mode Auto FFT
1Pk Max
M1[1] -4.56 dBm
5.23697690 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 5.24 GHz
32000 pts
Span 40.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 5.2369769 GHz -4.56 dBm
Measuring...

802.11n20

Channel: 36



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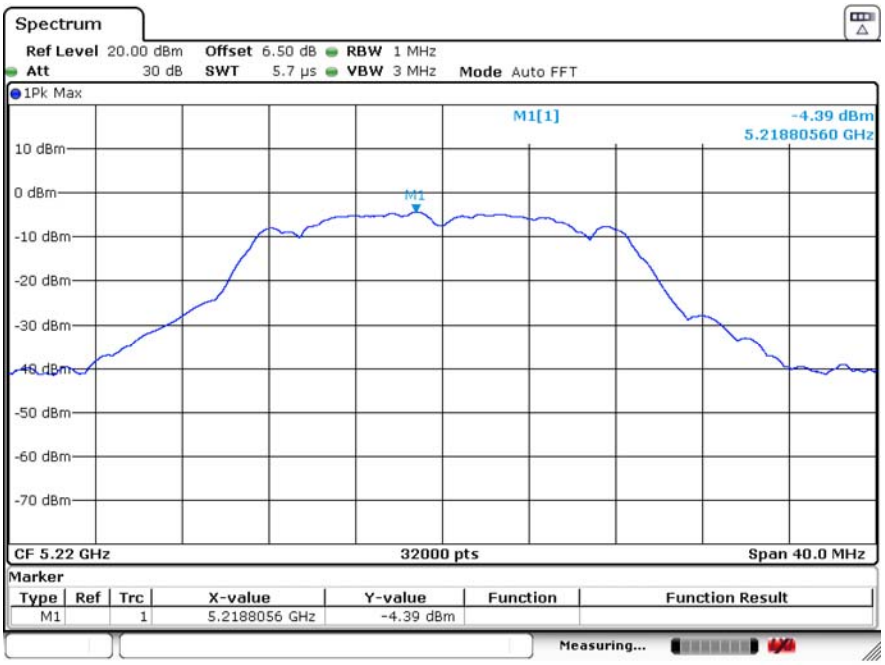

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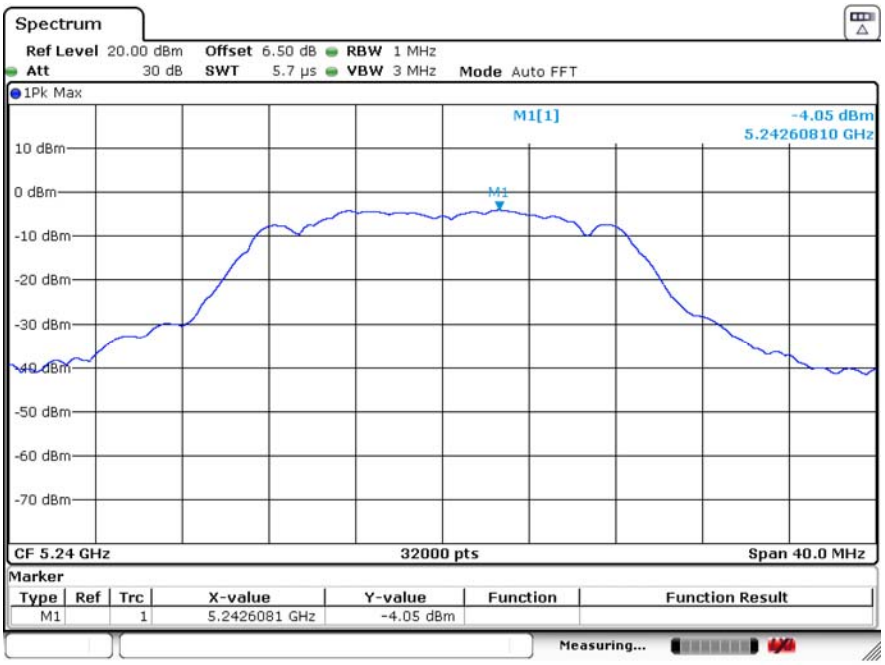
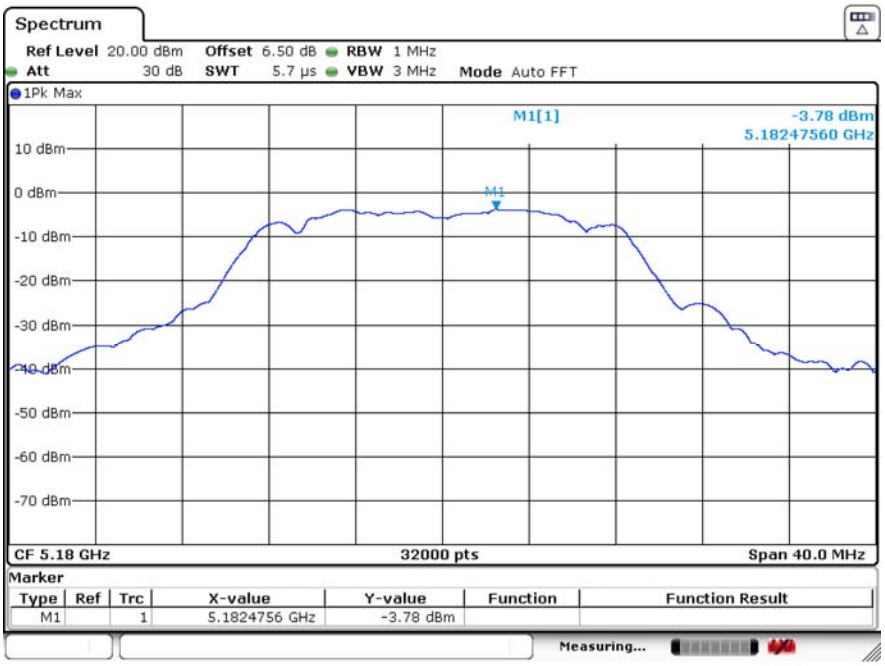

Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 1 MHz
Att 30 dB SWT 5.7 µs VBW 3 MHz Mode Auto FFT
1Pk Max
M1[1]
-4.05 dBm
5.24260810 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
CF 5.24 GHz
32000 pts
Span 40.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 5.2426081 GHz -4.05 dBm
Measuring...

802.11ac20

Channel: 36



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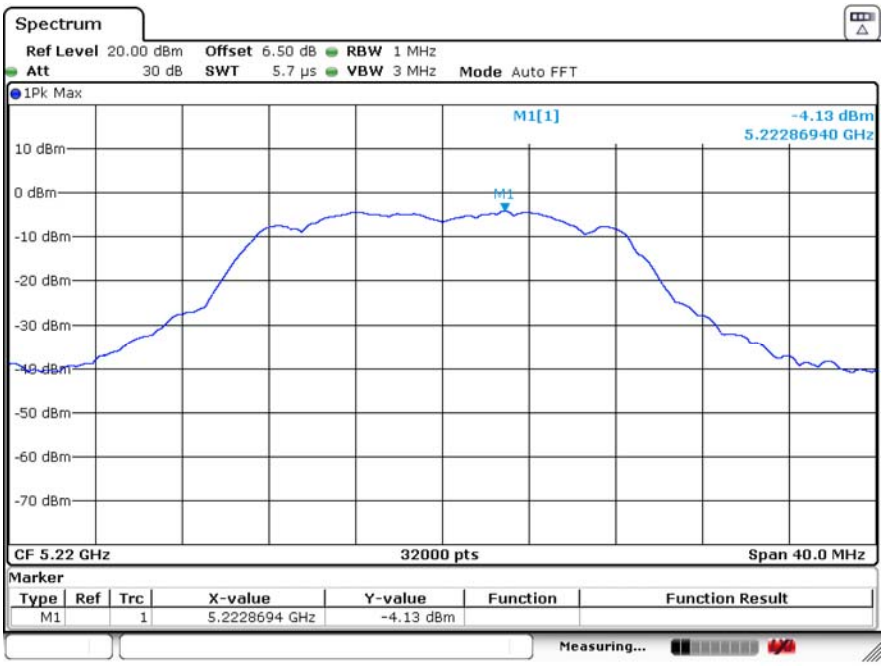

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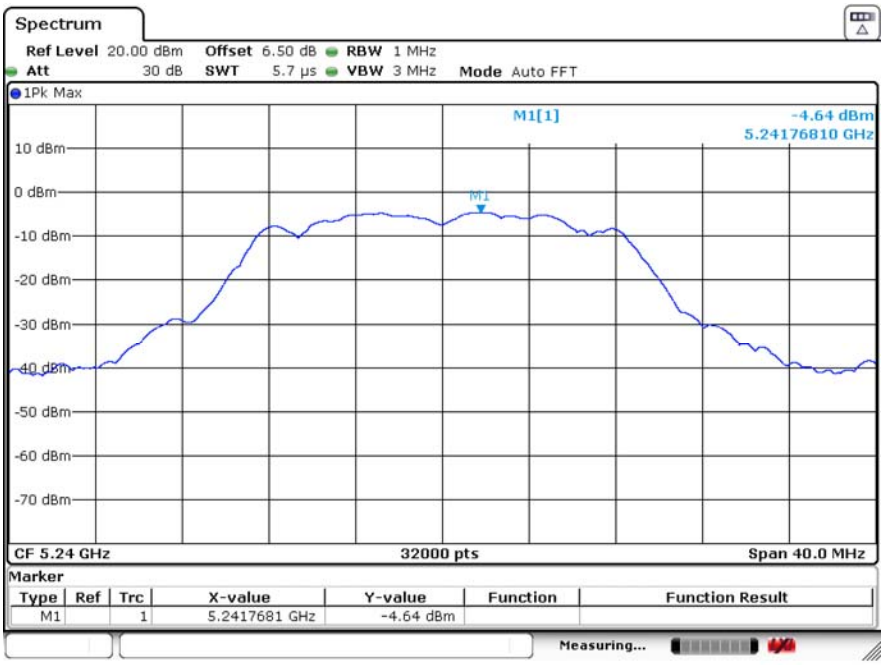
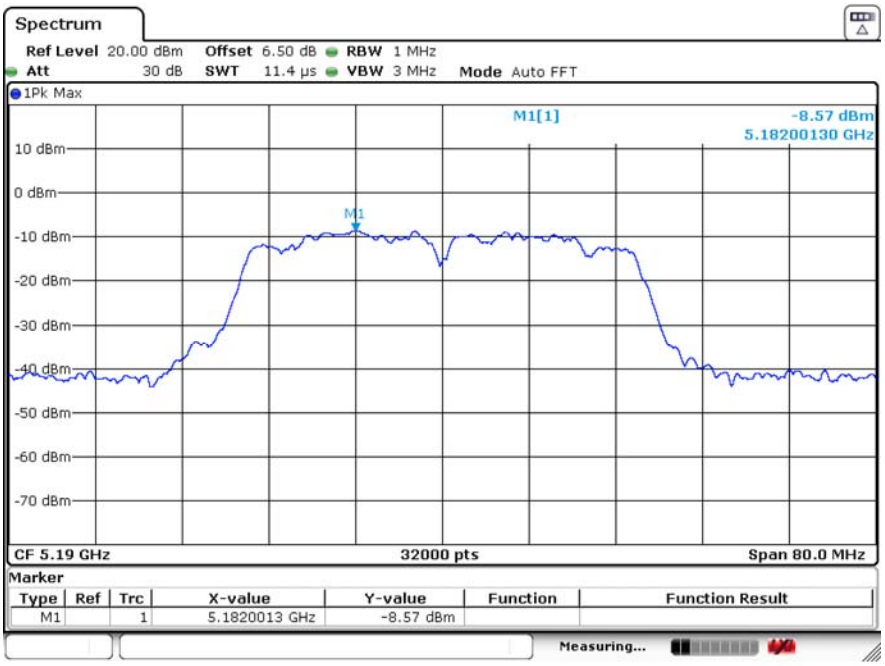

Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 1 MHz
Att 30 dB SWT 5.7 µs VBW 3 MHz Mode Auto FFT
1Pk Max
M1[1] -4.64 dBm
5.24176810 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 5.24 GHz
32000 pts
Span 40.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 5.2417681 GHz -4.64 dBm
Measuring...

802.11n40

Channel: 38



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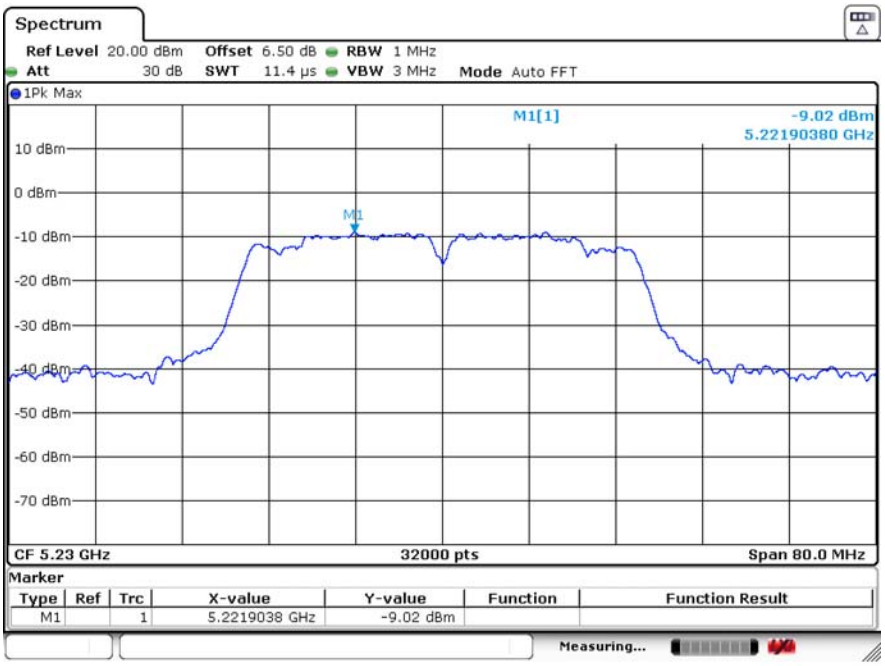
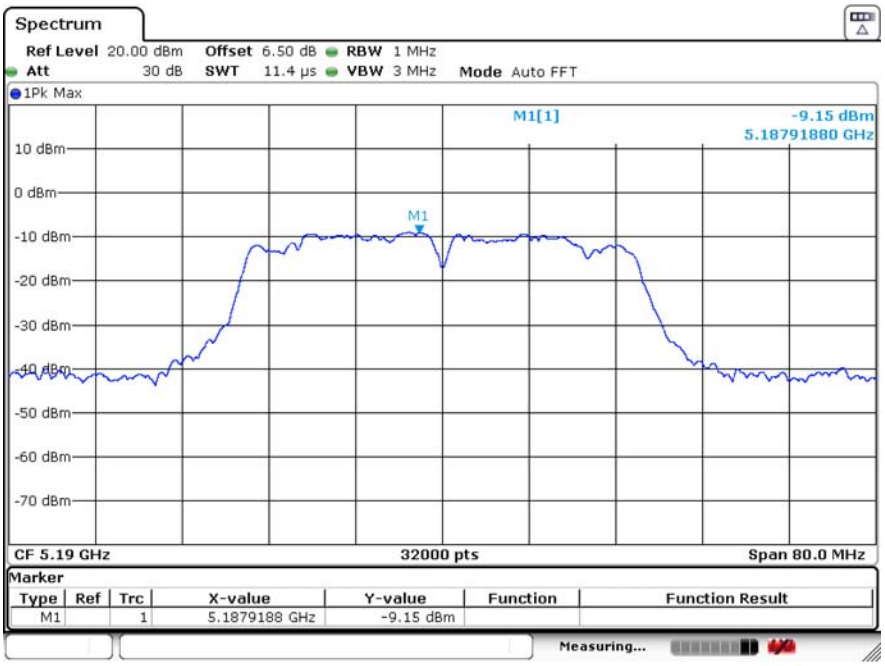


802.11ac40

Channel: 38



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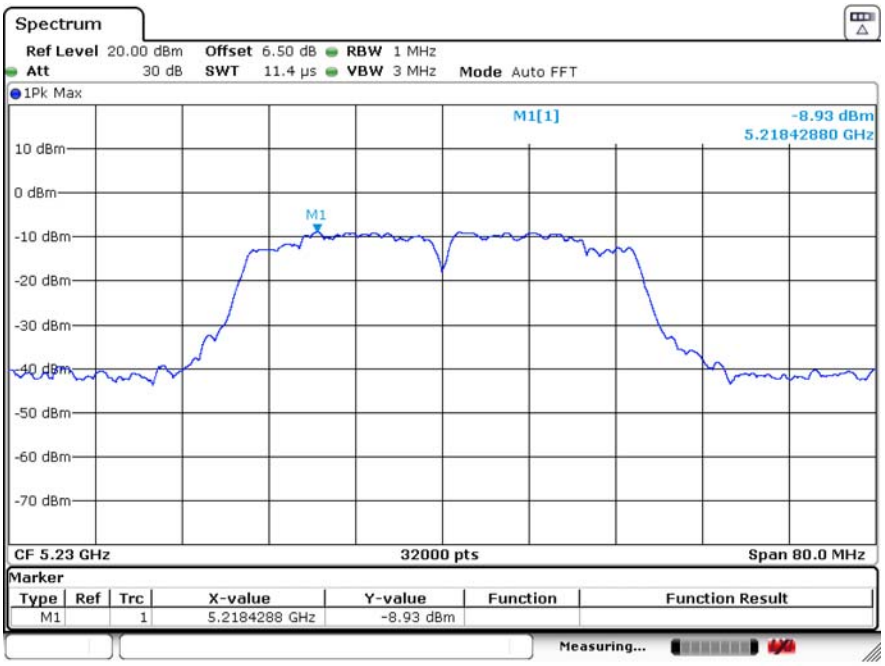
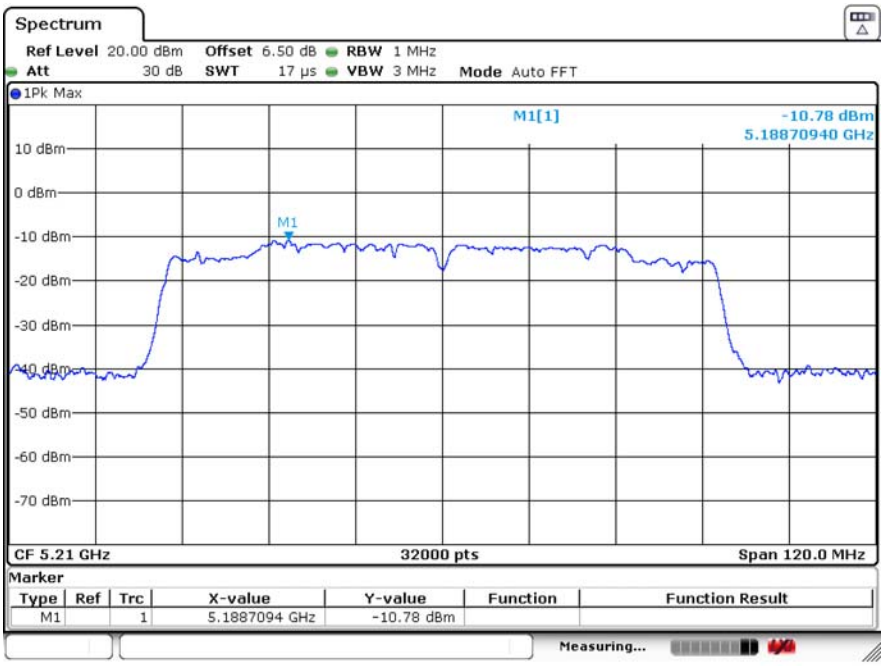
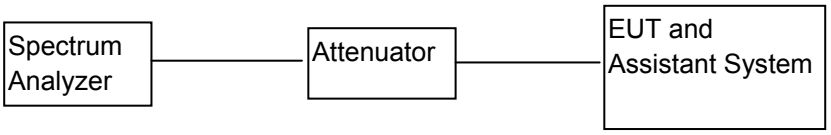


802.11ac80
Channel:42



4. 26 dB & 99% Emission Bandwidth

4.1. BLOCK DIAGRAM OF TEST SETUP



4.2. APPLIED PROCEDURES / LIMIT

The maximum power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements in the 5.725-5.85 GHz band are made over a reference bandwidth of 500 kHz or the 26 dB emission bandwidth of the device, whichever is less. Measurements in the 5.15-5.25 GHz, 5.25-5.35 GHz, and the 5.47-5.725 GHz bands are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power
is integrated over the full reference bandwidth.

4.3. TEST PROCEDURE

a) Set RBW = approximately 1% of the emission bandwidth.

b) Set the VBW > RBW.

c) Detector = Peak.

d) Trace mode = max hold.

e) Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

The following procedure shall be used for measuring (99 %) power bandwidth:

1. Set center frequency to the nominal EUT channel center frequency.
2. Set span = 1.5 times to 5.0 times the OBW.
3. Set RBW = 1 % to 5 % of the OBW
4. Set VBW ≥ 3 · RBW
5. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
6. Use the 99 % power bandwidth function of the instrument (if available).
7. If the instrument does not have a 99 % power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached; that frequency is recorded as

the lower frequency. The process is repeated until 99.5 % of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.

4.4. TEST RESULT

CH. No.	Frequency (MHz)	26dB Occupied Bandwidth (MHz)			99% Occupied Bandwidth (MHz)		
		802.11a	802.11n (HT20)	802.11ac (VHT20)	802.11a	802.11n (HT20)	802.11ac (VHT20)
36	5180.00	24.29	23.63	24.08	16.73	17.83	17.85
44	5220.00	23.67	24.83	25.00	16.72	17.83	17.86
48	5240.00	23.19	24.22	23.80	16.67	17.79	17.84

CH. No.	Frequency (MHz)	26dB Occupied Bandwidth (MHz)		99% Occupied Bandwidth (MHz)	
		802.11n(HT40)	802.11ac(VHT40)	802.11n(HT40)	802.11ac(VHT40)
38	5190.00	44.68	44.93	36.29	36.19
46	5230.00	44.34	45.04	36.33	36.44

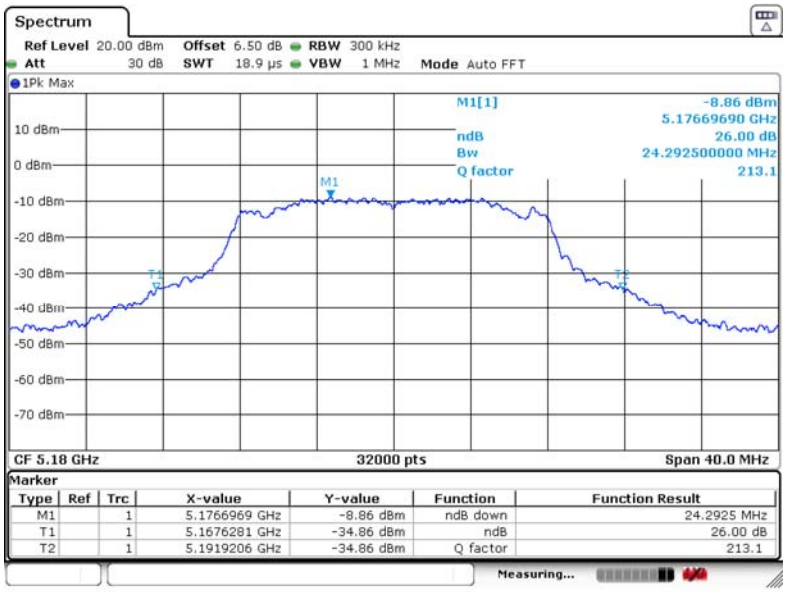
CH. No.	Frequency (MHz)	26dB Occupied Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
		802.11ac(VHT80)	802.11ac(VHT80)
42	5210	80.82	75.41

Note: The worst data is Antenna A, only shown Antenna A Plot.

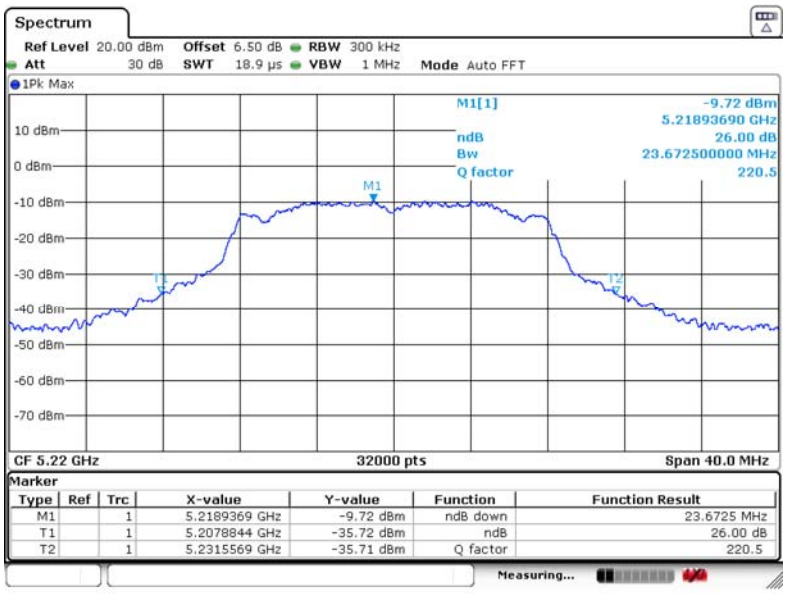
Test plots as followed: Antenna A

26dB BW 802.11a

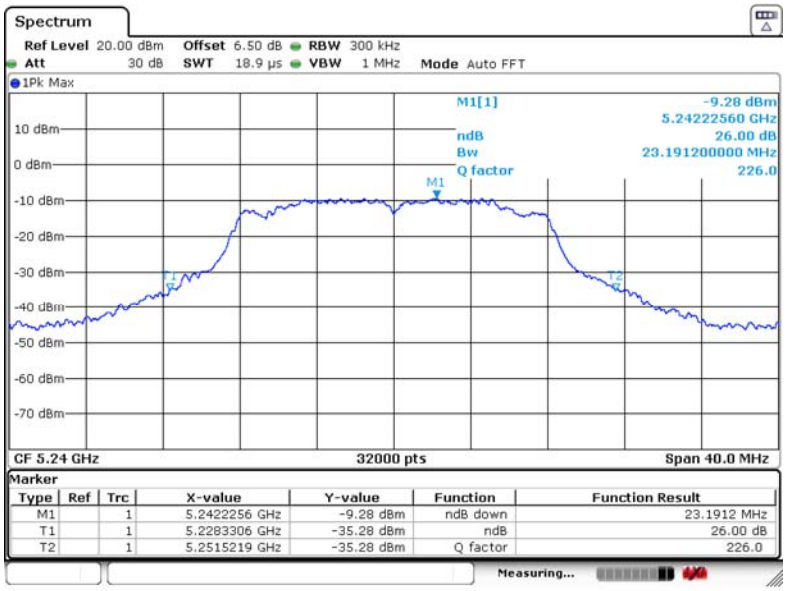
Channel: 36



Channel: 44

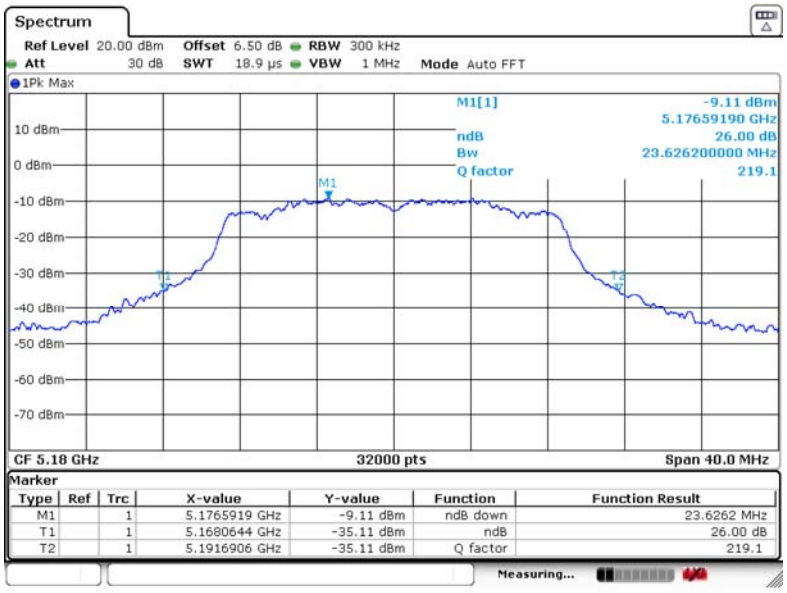


Channel: 48

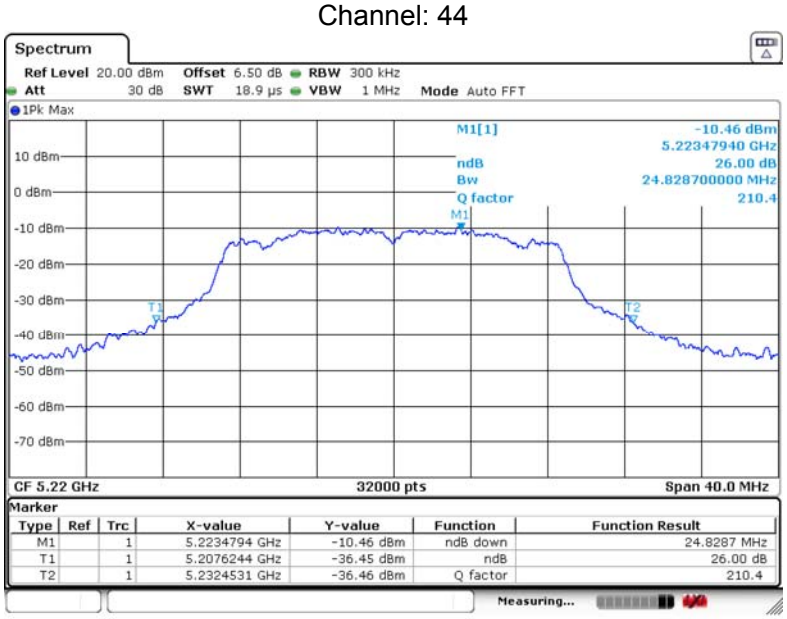

Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 300 kHz
Att 30 dB SWT 18.9 µs VBW 1 MHz Mode Auto FFT
1Pk Max
M1[1] -9.28 dBm
5.24222560 GHz
ndB 26.00 dB
Bw 23.191200000 MHz
Q factor 226.0
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 5.24 GHz
32000 pts
Span 40.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 5.2422256 GHz -9.28 dBm ndB down 23.1912 MHz
T1 1 5.2283306 GHz -35.28 dBm ndB 26.00 dB
T2 1 5.2515219 GHz -35.28 dBm Q factor 226.0
Measuring...

26dB BW 802.11n20

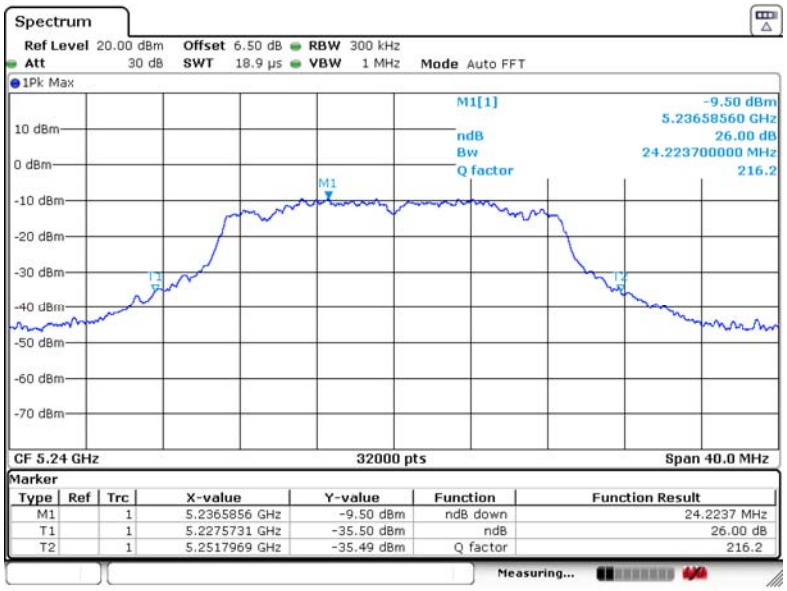
Channel: 36



Channel: 44

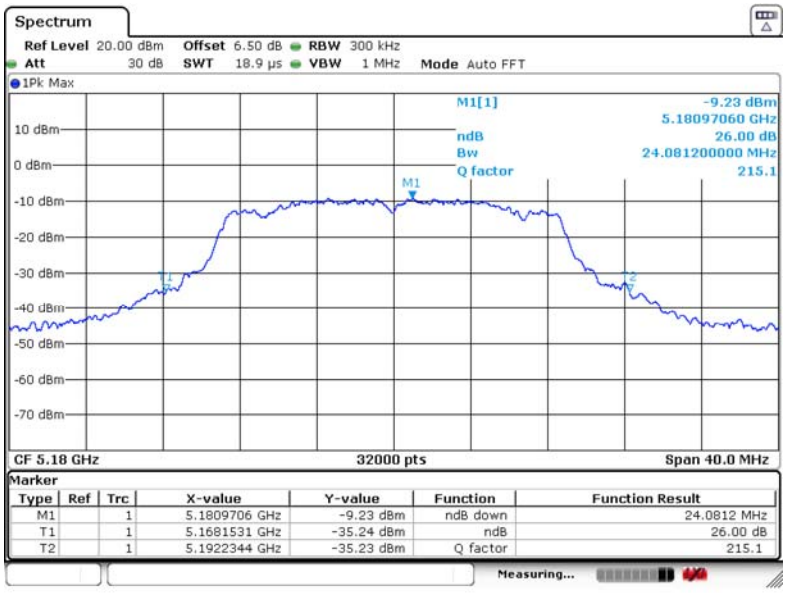


Channel: 48

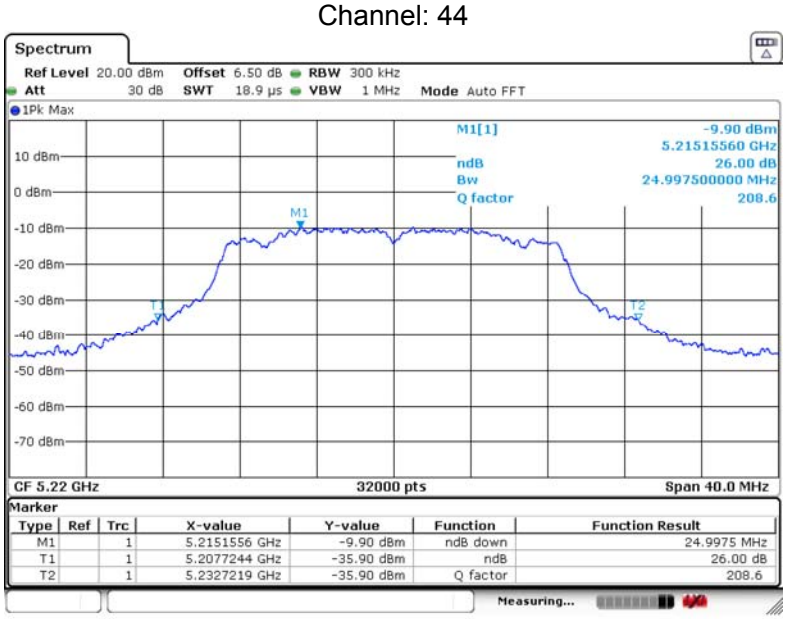

Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 300 kHz
Att 30 dB SWT 18.9 µs VBW 1 MHz Mode Auto FFT
1Pk Max
M1[1] -9.50 dBm
5.23658560 GHz
ndB 26.00 dB
Bw 24.223700000 MHz
Q factor 216.2
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
T1
T2
CF 5.24 GHz
32000 pts
Span 40.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 5.2365856 GHz -9.50 dBm ndB down 24.2237 MHz
T1 1 5.2275731 GHz -35.50 dBm ndB 26.00 dB
T2 1 5.2517969 GHz -35.49 dBm Q factor 216.2
Measuring...

26dB BW 802.11ac20

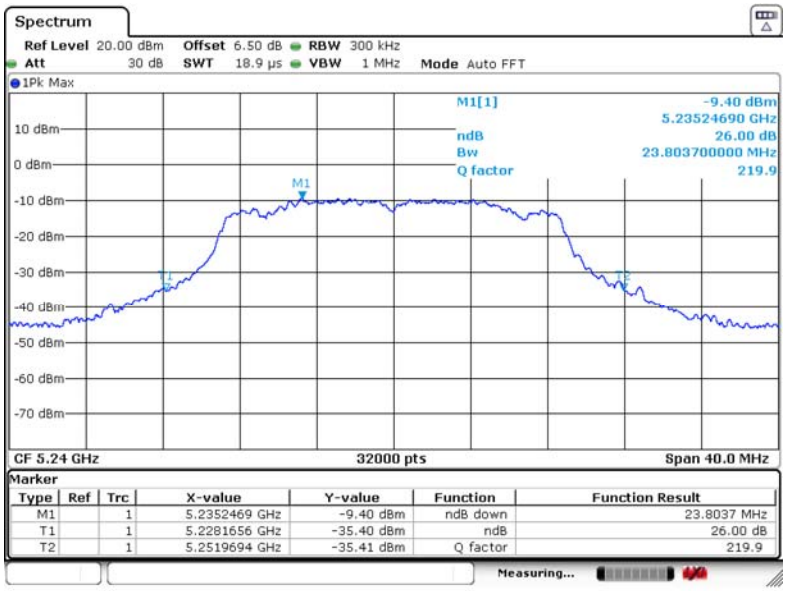
Channel: 36



Channel: 44

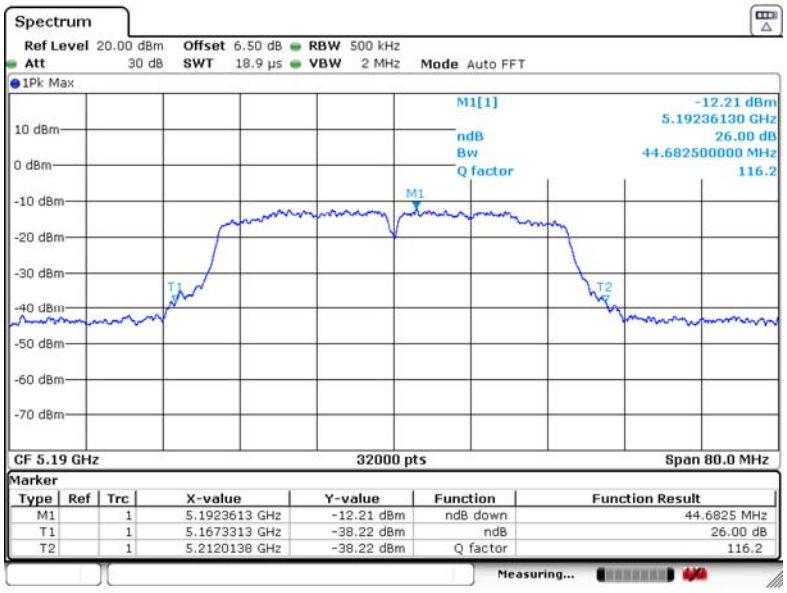


Channel: 48

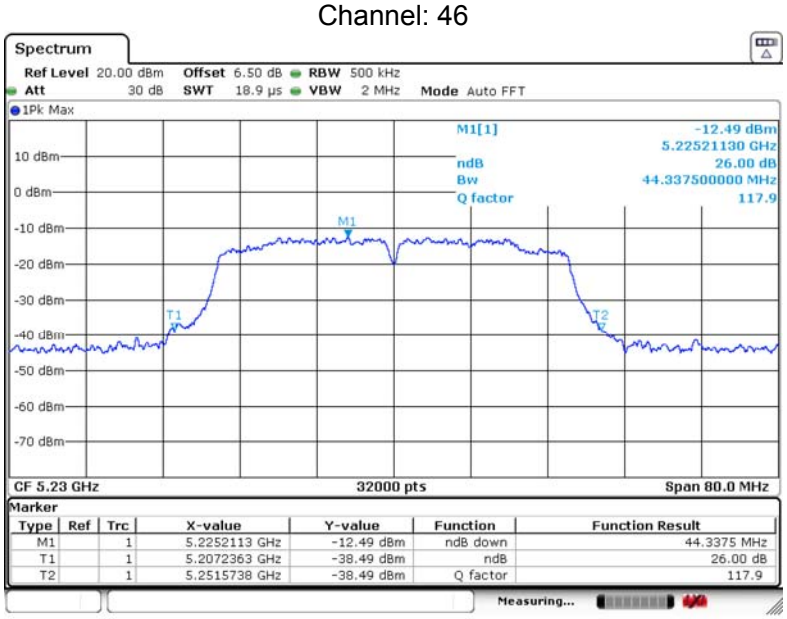

Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 300 kHz
Att 30 dB SWT 18.9 µs VBW 1 MHz Mode Auto FFT
1Pk Max
M1[1] -9.40 dBm
5.23524690 GHz
ndB 26.00 dB
Bw 23.803700000 MHz
Q factor 219.9
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
T1
T2
CF 5.24 GHz
32000 pts
Span 40.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 5.2352469 GHz -9.40 dBm ndB down 23.8037 MHz
T1 1 5.2281656 GHz -35.40 dBm ndB 26.00 dB
T2 1 5.2519694 GHz -35.41 dBm Q factor 219.9
Measuring...

26dB BW 802.11n40

Channel: 38

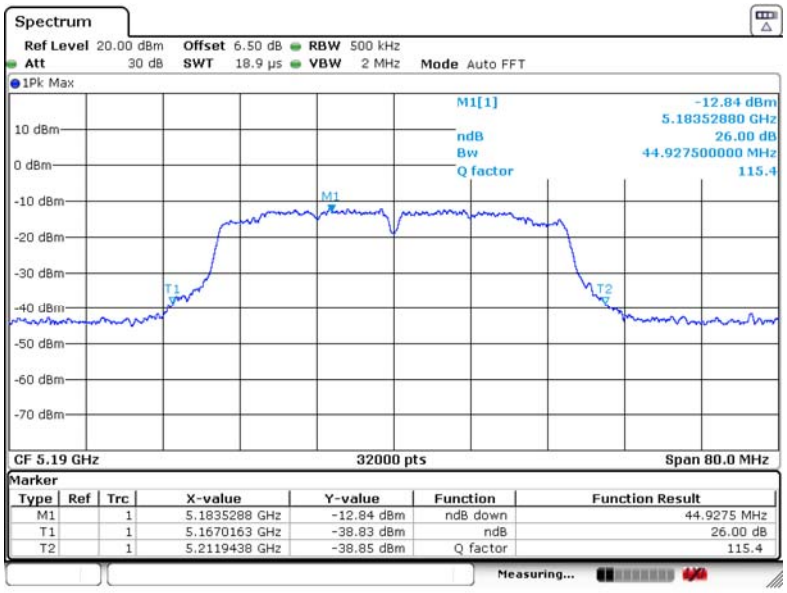


Channel: 46

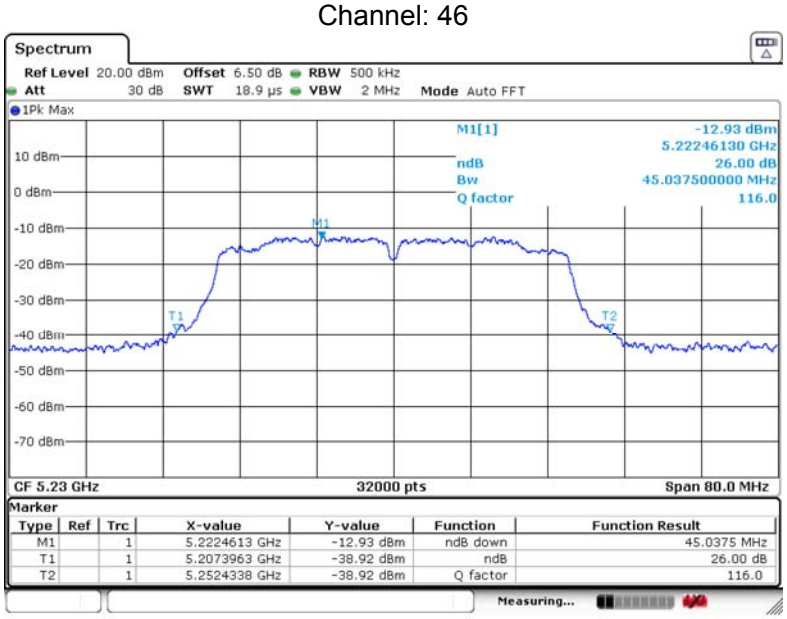


26dB BW 802.11ac40

Channel: 38

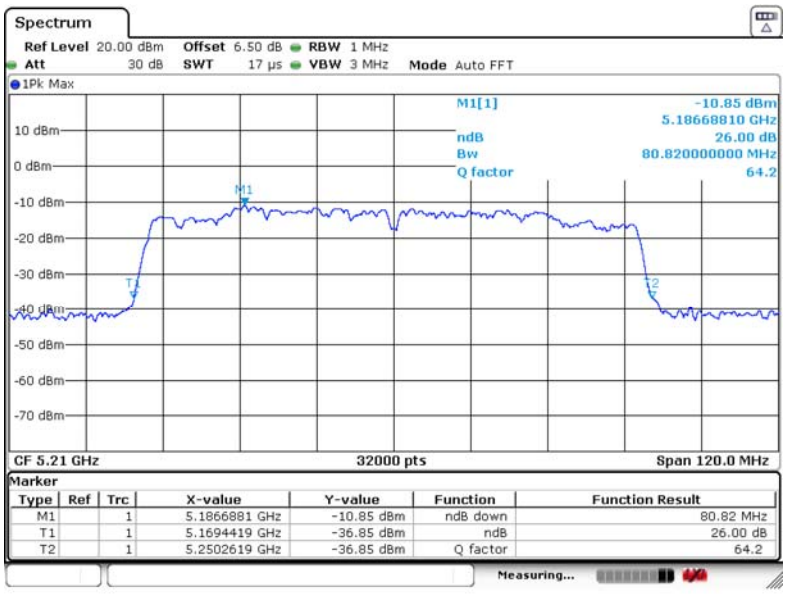


Channel: 46



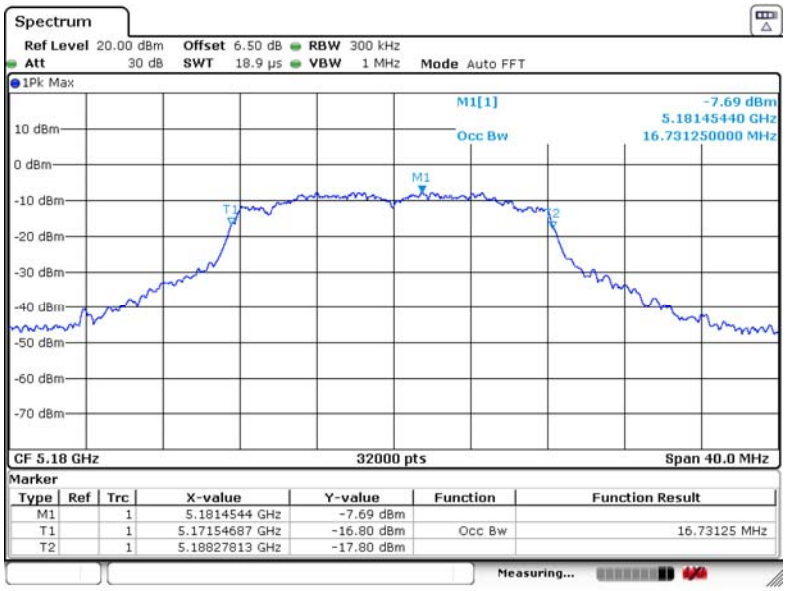
26dB BW 802.11ac80

Channel:42

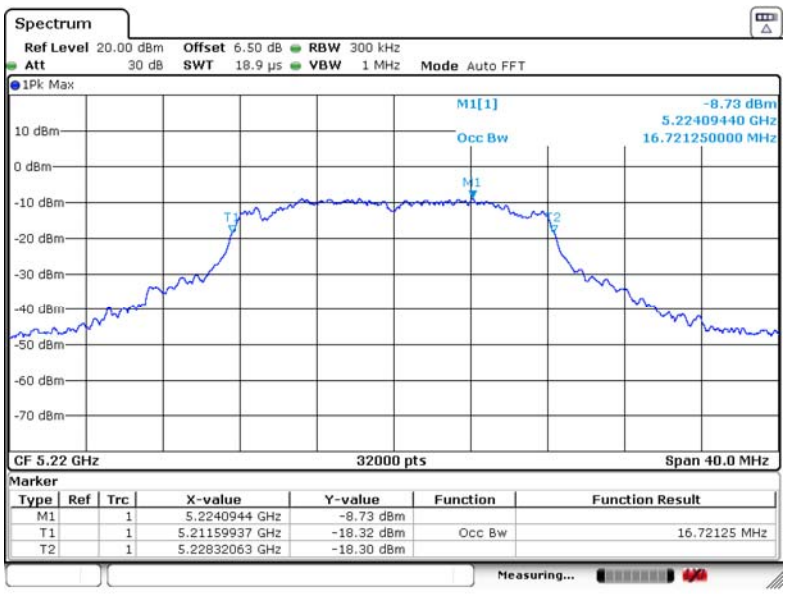


99% OBW 802.11a

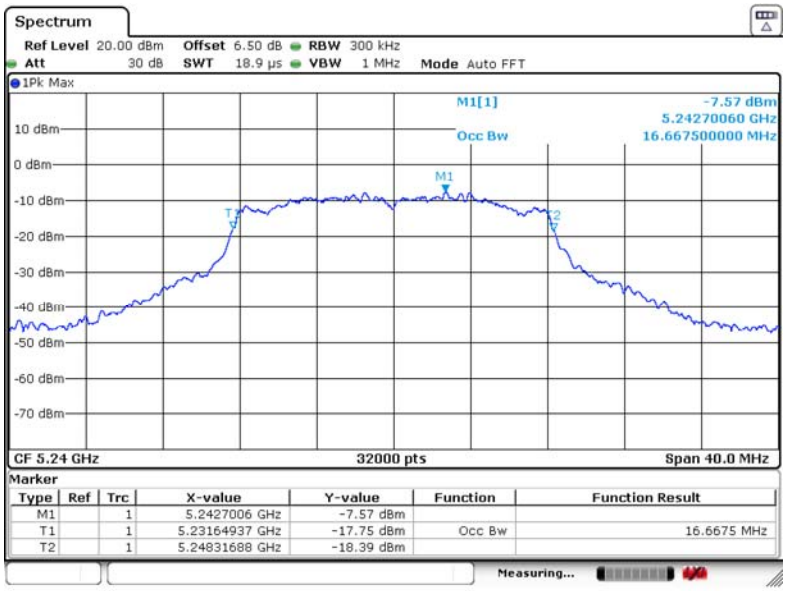
Channel: 36



Channel: 44

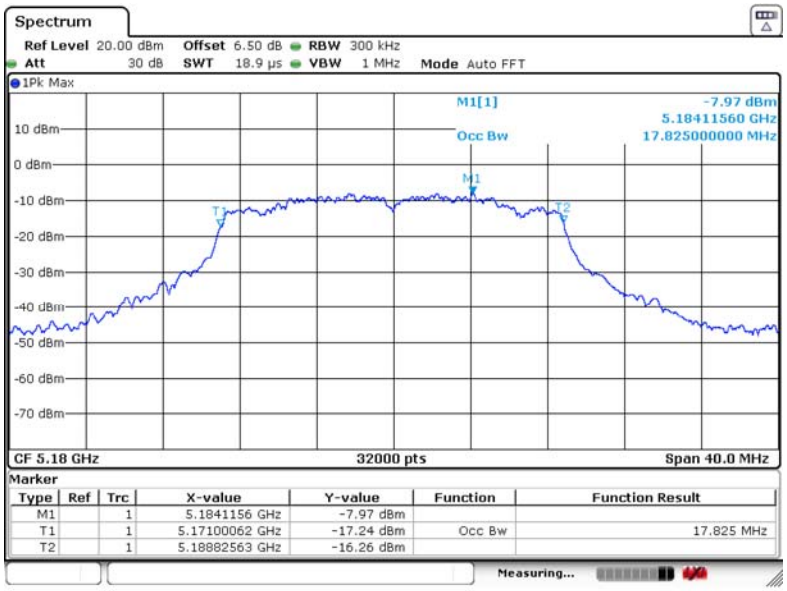


Channel: 48

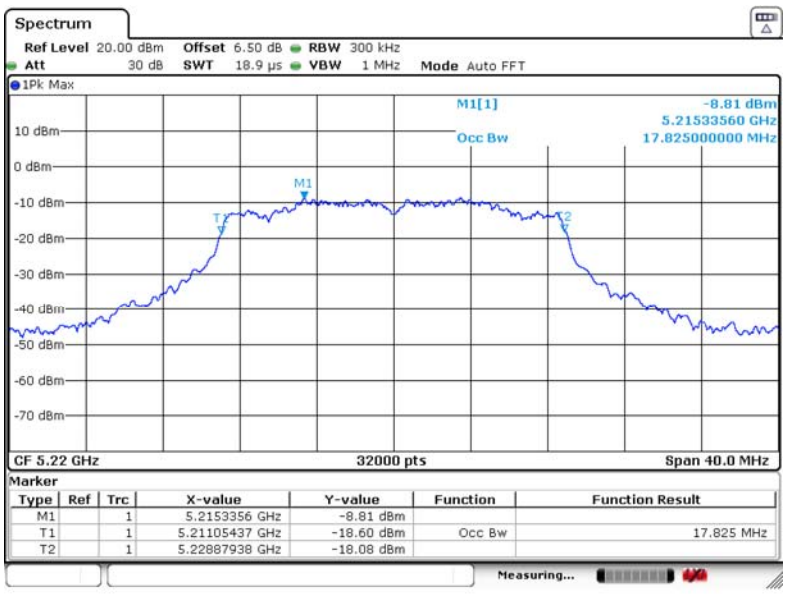

Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 300 kHz
Att 30 dB SWT 18.9 µs VBW 1 MHz Mode Auto FFT
1Pk Max
M1[1] -7.57 dBm
5.24270060 GHz
16.667500000 MHz
Occ Bw
M1
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 5.24 GHz
32000 pts
Span 40.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 5.2427006 GHz -7.57 dBm
T1 1 5.23164937 GHz -17.75 dBm Occ Bw 16.6675 MHz
T2 1 5.24831688 GHz -18.39 dBm
Measuring...

99% OBW 802.11n20

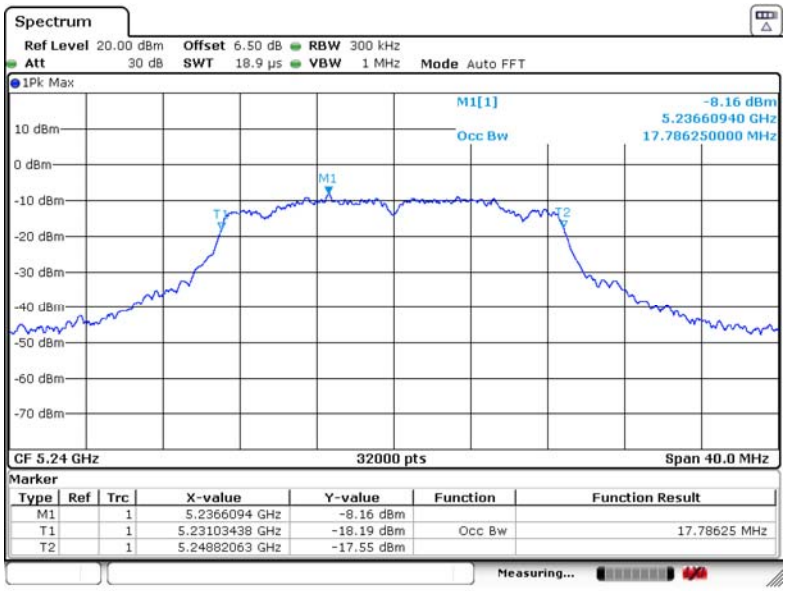
Channel: 36



Channel: 44

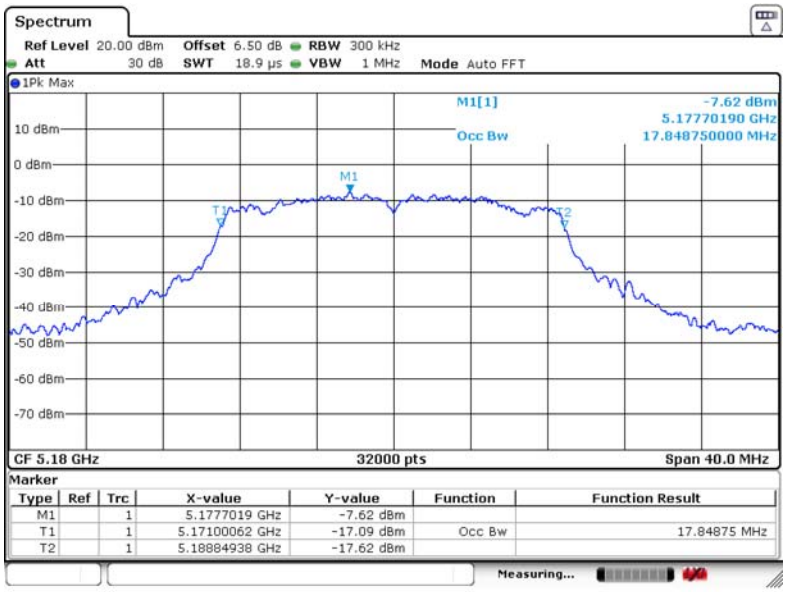


Channel: 48

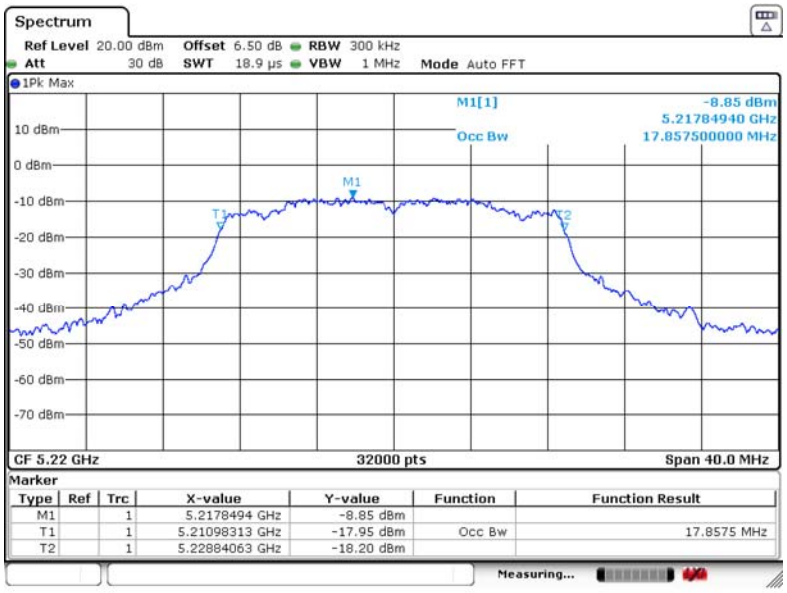

Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 300 kHz
Att 30 dB SWT 18.9 µs VBW 1 MHz Mode Auto FFT
1Pk Max
M1[1] -8.16 dBm
5.23660940 GHz
Occ Bw 17.786250000 MHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
T1
T2
CF 5.24 GHz 32000 pts Span 40.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 5.2366094 GHz -8.16 dBm
T1 1 5.23103438 GHz -18.19 dBm Occ Bw 17.78625 MHz
T2 1 5.24882063 GHz -17.55 dBm
Measuring...

99% OBW 802.11ac20

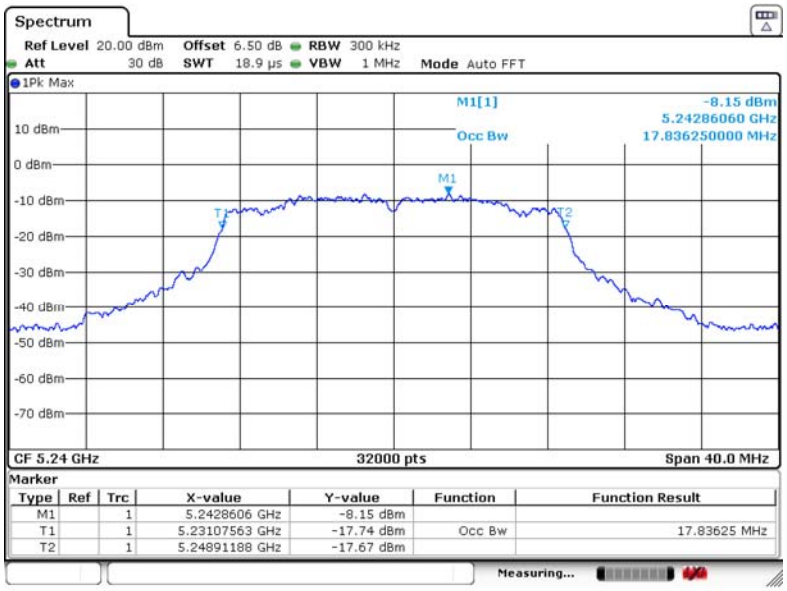
Channel: 36



Channel: 44

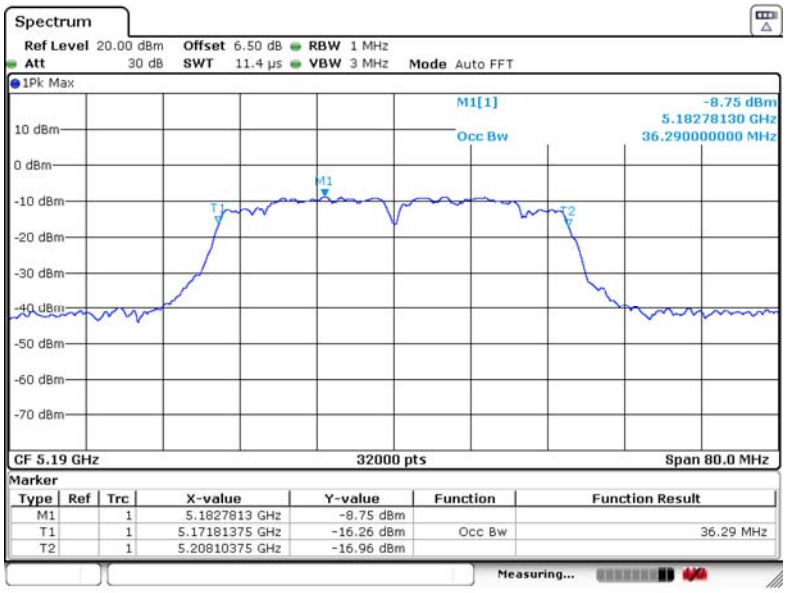


Channel: 48

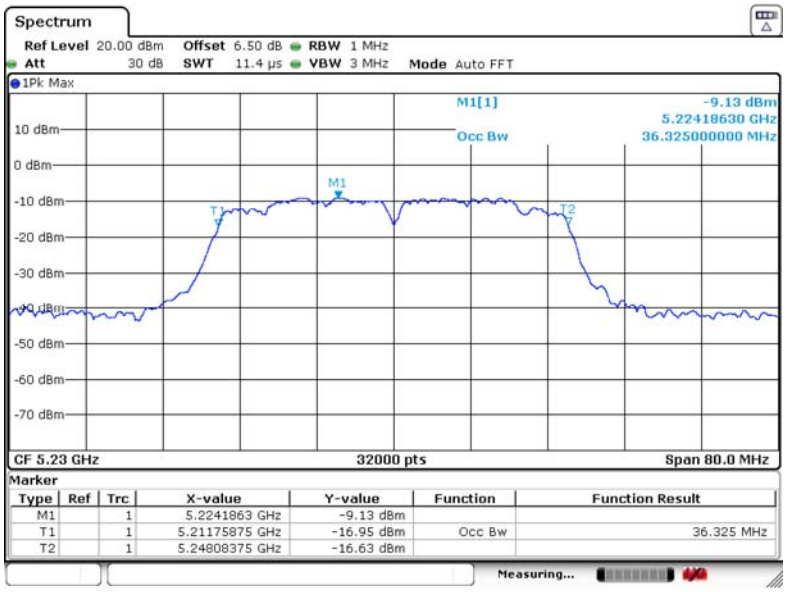

Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 300 kHz
Att 30 dB SWT 18.9 µs VBW 1 MHz Mode Auto FFT
1Pk Max
M1[1] -8.15 dBm
5.24286060 GHz
Occ Bw 17.836250000 MHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
T1
T2
CF 5.24 GHz
32000 pts
Span 40.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 5.2428606 GHz -8.15 dBm
T1 1 5.23107563 GHz -17.74 dBm Occ Bw 17.83625 MHz
T2 1 5.24891188 GHz -17.67 dBm
Measuring...

99% OBW 802.11n40

Channel: 38

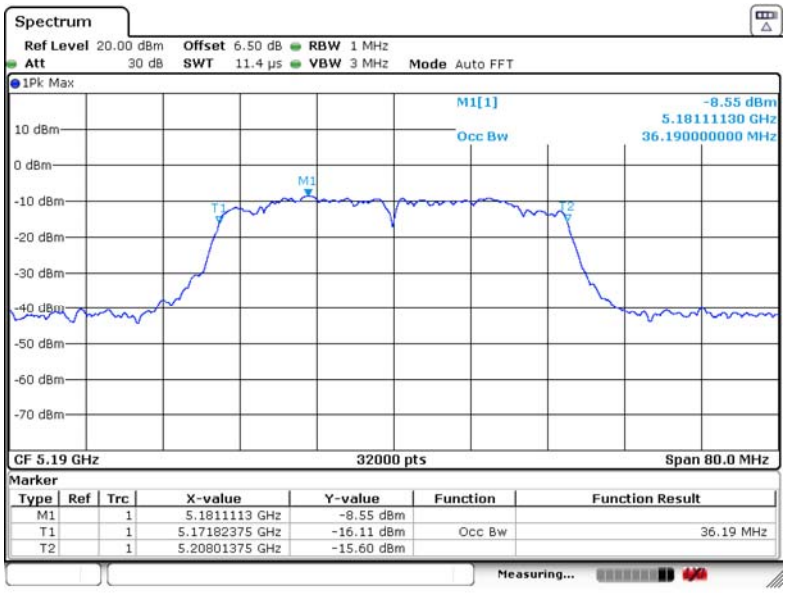


Channel: 46

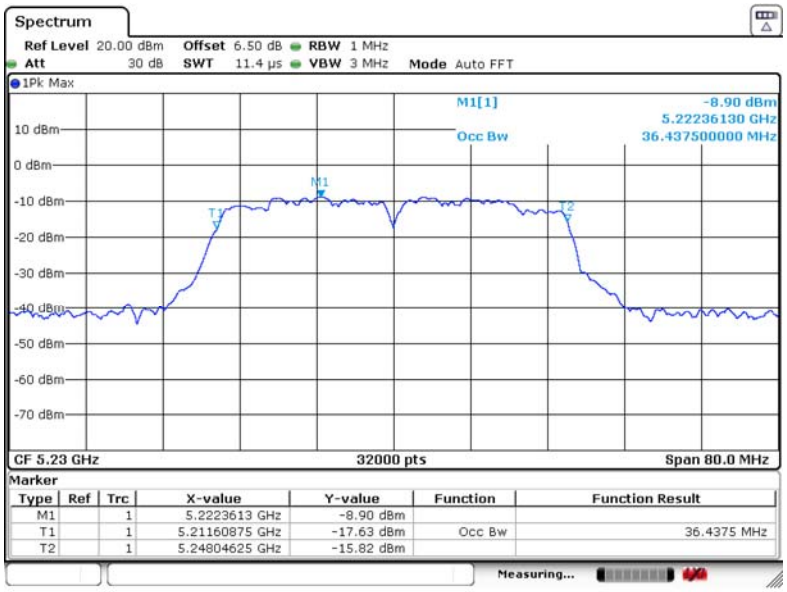


99% OBW 802.11ac40

Channel: 38

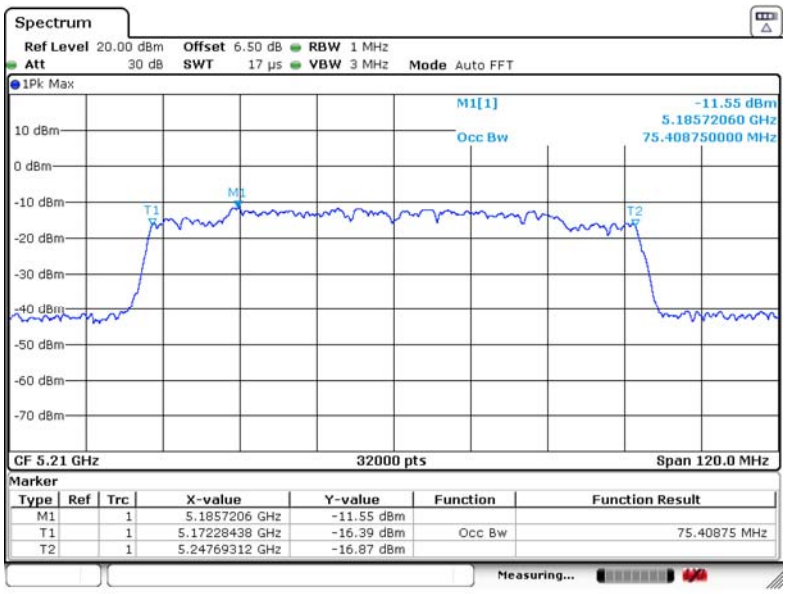


Channel: 46

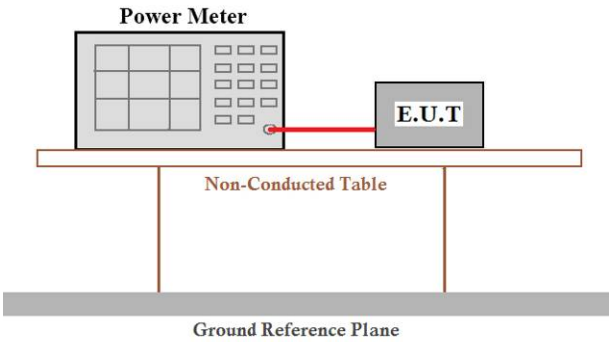


99% OBW 802.11ac80

Channel:42



5. MAXIMUM CONDUCTED OUTPUT POWER

Test Requirement:	FCC Part15 E Section 15.407
Test Method:	KDB 789033 D02 General UNII Test Procedures New Rules v02r01
Limit:	For the band 5.15-5.25 GHz, the maximum conducted output power over the frequency bands of operation shall not exceed 250mW. For the band 5.745-5.850 GHz, the maximum conducted output power over the frequency bands of operation shall not exceed 30dBm
Test setup:	
Test procedure:	**Measurement using an RF average power meter** (i) Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied a) The EUT is configured to transmit continuously or to transmit with a constant duty cycle. b) At all times when the EUT is transmitting, it must be transmitting at its maximum power control level. c) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five. (ii) If the transmitter does not transmit continuously, measure the duty cycle, x, of the transmitter output signal as described in section B). (iii) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter. (iv) Adjust the measurement in dBm by adding 10 log(1/x) where x is the duty cycle (e.g., 10log(1/0.25) if the duty cycle is 25 percent).
Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.3 for details

5.1. TEST RESULT

Antenna A:

CH. No.	Frequency (MHz)	Output Power (dBm)			Limit(dBm)	Result
		802.11a	802.11n (HT20)	802.11ac (VHT20)		
36	5180.00	-2.72	-3.56	-3.45	24	Pass
44	5220.00	-3.92	-3.37	-3.33	24	Pass
48	5240.00	-3.56	-3.18	-3.18	24	Pass

CH. No.	Frequency (MHz)	Output Power (dBm)		Limit(dBm)	Result
		802.11n(HT40)	802.11ac(VHT40)		
38	5190.00	-5.62	-5.55	24	Pass
46	5230.00	-5.26	-5.20	24	Pass

CH. No.	Frequency (MHz)	Output Power (dBm)	Limit(dBm)	Result
		802.11ac(VHT80)		
42	5210.00	-6.05	24	Pass

Antenna A Directional Gain=1.66 dBi

CH. No.	Frequency (MHz)	EIRP (dBm)			Limit(dBm)	Result
		802.11a	802.11n (HT20)	802.11ac (VHT20)		
36	5180.00	-1.06	-1.9	-1.79	24	Pass
44	5220.00	-2.26	-1.71	-1.67	24	Pass
48	5240.00	-1.90	-1.52	-1.52	24	Pass

CH. No.	Frequency (MHz)	EIRP (dBm)		Limit(dBm)	Result
		802.11n(HT40)	802.11ac(VHT40)		
38	5190.00	-3.96	-3.89	24	Pass
46	5230.00	-3.60	-3.54	24	Pass

CH. No.	Frequency (MHz)	EIRP (dBm)	Limit(dBm)	Result
		802.11ac(VHT80)		
42	5210.00	-4.39	24	Pass

Antenna B:

CH. No.	Frequency (MHz)	Output Power (dBm)			Limit(dBm)	Result
		802.11a	802.11n (HT20)	802.11ac (VHT20)		
36	5180.00	-2.81	-3.66	-3.71	24	Pass
44	5220.00	-3.74	-3.94	-4.00	24	Pass
48	5240.00	-3.66	-3.83	-3.93	24	Pass

CH. No.	Frequency (MHz)	Output Power (dBm)		Limit(dBm)	Result
		802.11n(HT40)	802.11ac(VHT40)		
38	5190.00	-5.61	-5.61	24	Pass
46	5230.00	-5.28	-5.16	24	Pass

CH. No.	Frequency (MHz)	Output Power (dBm)	Limit(dBm)	Result
		802.11ac(VHT80)		
42	5210.00	-6.03	24	Pass

Antenna B Directional Gain=0.99 dBi

CH. No.	Frequency (MHz)	Output Power (dBm)			Limit(dBm)	Result
		802.11a	802.11n (HT20)	802.11ac (VHT20)		
36	5180.00	-1.82	-2.67	-2.72	24	Pass
44	5220.00	-2.75	-2.95	-3.01	24	Pass
48	5240.00	-2.67	-2.84	-2.94	24	Pass

CH. No.	Frequency (MHz)	Output Power (dBm)		Limit(dBm)	Result
		802.11n(HT40)	802.11ac(VHT40)		
38	5190.00	-4.62	-4.62	24	Pass
46	5230.00	-4.29	-4.17	24	Pass

CH. No.	Frequency (MHz)	Output Power (dBm)	Limit(dBm)	Result
		802.11ac(VHT80)		
42	5210.00	-5.04	24	Pass

6. Band Edges Measurement

Test Requirement:	FCC Part15 E Section 15.407 and 5.205
Test Method:	ANSI C63.10:2013
Test site:	Measurement Distance: 3m
Receiver setup:	

Frequency	Detector	RBW	VBW	Remark
30MHz-1GHz	Quasi-peak	100KHz	300KHz	Quasi-peak Value
Above 1GHz	Peak	1MHz	3MHz	Peak Value
	AV	1MHz	3MHz	Average Value

Limit:

Frequency	Limit (dBuV/m @3m)	Remark
30MHz-88MHz	40.0	Quasi-peak Value
88MHz-216MHz	43.5	Quasi-peak Value
216MHz-960MHz	46.0	Quasi-peak Value
960MHz-1GHz	54.0	Quasi-peak Value
Above 1GHz	54.0	Average Value
	74.0	Peak Value

Undesirable emission limits:

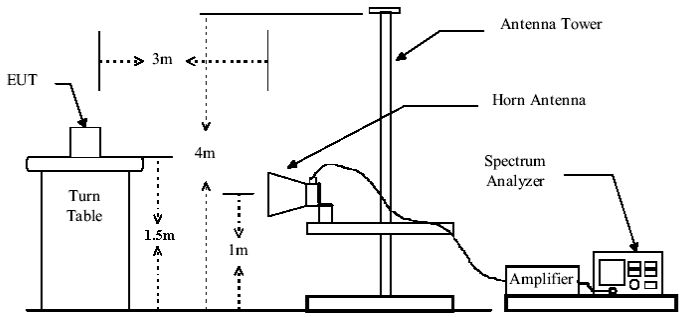
(1) For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz.

(2) For transmitters operating in the 5.25-5.35 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz. Devices operating in the 5.25-5.35 GHz band that generate emissions in the 5.15-5.25 GHz band must meet all applicable technical requirements for operation in the 5.15-5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15-5.25 GHz band.

(3) For transmitters operating in the 5.47-5.725 GHz band: all emissions outside of the 5.47-5.725 GHz band shall not exceed an EIRP of −27 dBm/MHz.

Test Procedure:

a. The EUT was placed on the top of a rotating table 1.5 m above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Test setup:	Above 1GHz 
Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.3 for details
Test results:	Pass

Remark:

According to KDB 789033 v02r01 section G) 1) (d), for For measurements above 1000 MHz @ 3m distance, the limit of field strength is computed as follows:

E[dBuV/m] = EIRP[dBm] + 95.2;

For example, if EIRP = -27dBm

E[dBuV/m] = -27 + 95.2 = 68.2dBuV/m.

6.1. TEST RESULT

Peak value:

Test mode:		802.11a		Test channel:		Lowest	
Frequency (MHz)	Reading Level (dBuV)	Factor (dB/m)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over limit(dB)	Detector	Antenna Pol.
5150	47.46	7.18	54.64	68.2	-13.56	PK	H
5150	46.32	7.18	53.5	68.2	-14.7	PK	V
Test mode:		802.11a		Test channel:		Highest	
Frequency (MHz)	Reading Level (dBuV)	Factor (dB/m)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over limit(dB)	Detector	Antenna Pol.
5350	43.52	7.2	50.72	68.2	-17.48	PK	H
5350	51.14	7.2	58.34	68.2	-9.86	PK	V

Peak value:

Test mode:		802.11n(HT20)		Test channel:		Lowest	
Frequency (MHz)	Reading Level (dBuV)	Factor (dB/m)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over limit(dB)	Detector	Antenna Pol.
5150	48.36	7.18	55.54	68.2	-12.66	PK	H
5150	54.75	7.18	61.93	68.2	-6.27	PK	V
Test mode:		802.11n(HT20)		Test channel:		Highest	
Frequency (MHz)	Reading Level (dBuV)	Factor (dB/m)	Measure Level (dBuV/m)	Limit (dBuV/m)	Over limit(dB)	Detector	Antenna Pol.
5350	45.33	7.2	52.53	68.2	-15.67	PK	H
5350	50.25	7.2	57.45	68.2	-10.75	PK	V

Peak value:

Test mode:		802.11n(HT40)		Test channel:		Lowest	
Frequency (MHz)	Reading Level	Factor	Measure Level	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Pol.
5150	43.63	7.18	50.81	68.2	-17.39	PK	H
5150	42.19	7.18	49.37	68.2	-18.83	PK	V
Test mode:		802.11n(HT40)		Test channel:		Highest	
Frequency (MHz)	Reading Level	Factor	Measure Level	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Pol.
5350	47.25	7.2	54.45	68.2	-13.75	PK	H
5350	45.58	7.2	52.78	68.2	-15.42	PK	V

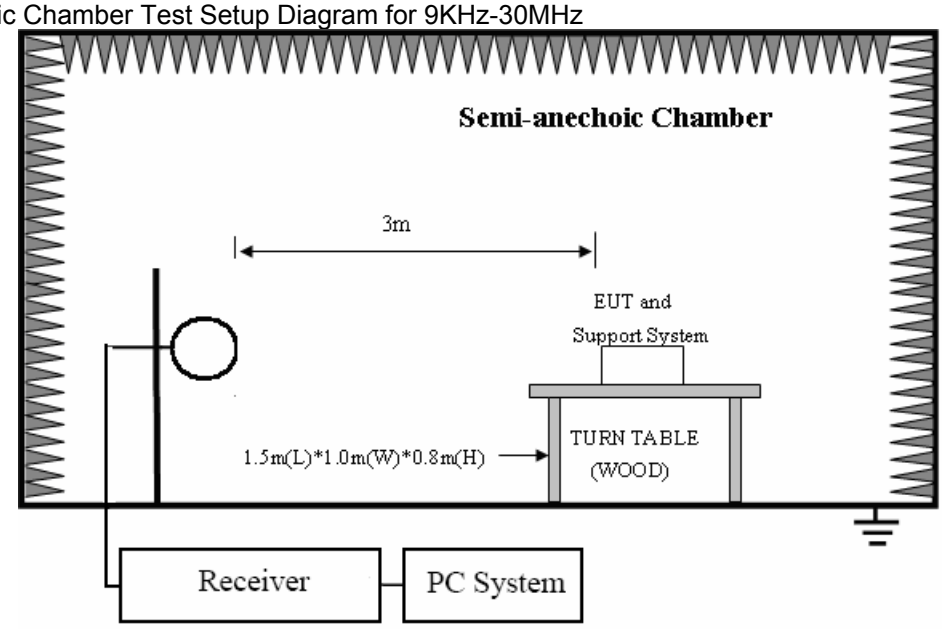
Peak value:

Test mode:		802.11ac(VHT80)		Test channel:		Lowest	
Frequency (MHz)	Reading Level	Factor	Measure Level	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Pol.
5150	47.46	7.18	54.64	68.2	-13.56	PK	H
5150	46.36	7.18	53.54	68.2	-14.66	PK	V
Test mode:		802.11ac(VHT80)		Test channel:		Highest	
Frequency (MHz)	Reading Level	Factor	Measure Level	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Pol.
5350	47.02	7.2	54.22	68.2	-13.98	PK	H
5350	44.35	7.2	51.55	68.2	-16.65	PK	V

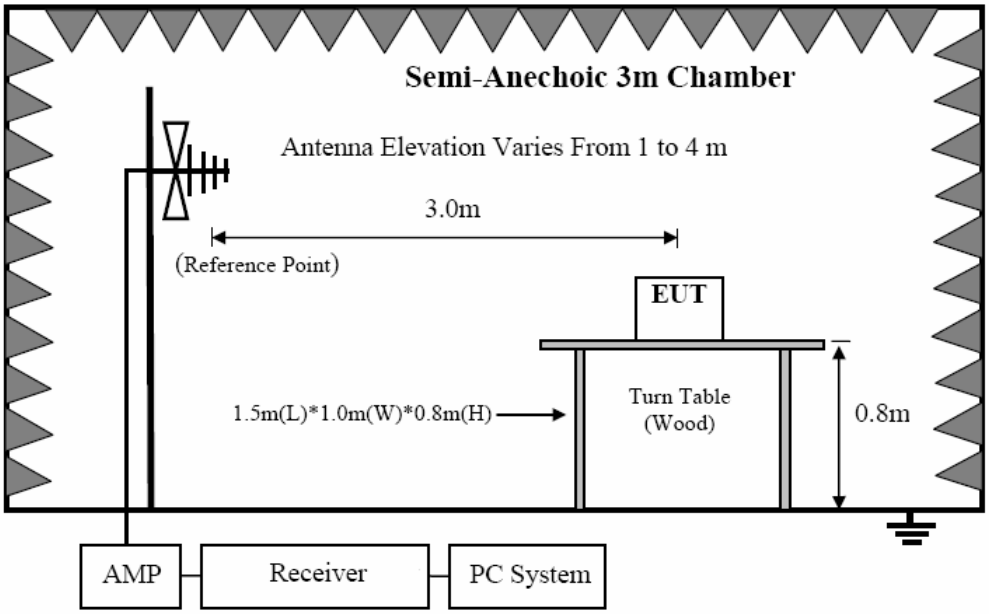
7. RADIATED EMISSION MEASUREMENT

7.1. Block diagram of test setup

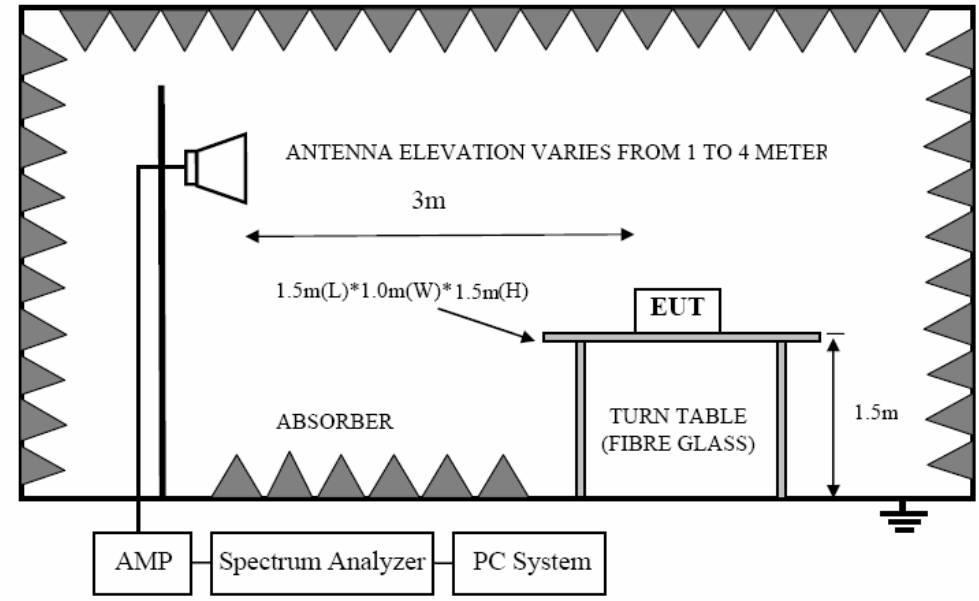
In 3m Anechoic Chamber Test Setup Diagram for 9KHz-30MHz



In 3m Anechoic Chamber Test Setup Diagram for 30MHz-1GHz



In 3m Anechoic Chamber Test Setup Diagram for frequency above 1GHz



Note: For harmonic emissions test a appropriate high pass filter was inserted in the input port of AMP.

7.2. Limit

9.3.1 FCC 15.205 Restricted frequency band

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])

9.3.2. FCC 15.209 Limit.

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		μV/m	dB(μV)/m
0.009 ~ 0.490	300	2400/F(KHz)	67.6-20log(F)
0.490 ~ 1.705	30	24000/F(KHz)	87.6-20log(F)
1.705 ~ 30.0	30	30	29.54
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000	3	74.0 dB(μV)/m (Peak) 54.0 dB(μV)/m (Average)	

Note: (1) The emission limits shown in the above table are based on measurements employing a CISPR QP detector except for the frequency bands 9-90KHz, 110-490KHz and above 1000MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector.

(2) At frequencies below 30MHz, measurement may be performed at a distance closer then that specified, and the limit at closer measurement distance can be extrapolated by below formula:

$Limit_{3m}$(dBuV/m)= $Limit_{30m}$(dBuV/m) + 40Log(30m/3m)

9.3.3. Limit for this EUT

All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 30dB below the fundamental emissions, or comply with 15.209 limits.

7.3. Test Procedure

(1) EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber.

(2) Setup EUT and assistant system according clause 2.4 and 7.2

(3) Test antenna was located 3m(except 18GHz-40GHz was 1m) from the EUT on an adjustable mast, and the antenna used as below table.

Test frequency range	Test antenna used
9KHz-30MHz	Active Loop antenna
30MHz-1GHz	Trilog Broadband Antenna
1GHz-18GHz	Double Ridged Horn Antenna(1GHz-18GHz)
18GHz-40GHz	Horn Antenna(18GHz-40GHz)

According ANSI C63.10:2013 clause 6.4.4.2 and 6,5.3, for measurements below 30 MHz, the loop antenna was positioned with its plane vertical from the EUT and rotated about its vertical axis for maximum response at each azimuth position around the EUT. And the loop antenna also be positioned with its plane horizontal at the specified distance from the EUT. The center of the loop is 1 m above the ground. for measurement above 30MHz, the Trilog Broadband Antenna or Horn Antenna was located 3m from EUT, Measurements were made with the antenna positioned in both the horizontal and vertical planes of Polarization, and the measurement antenna was varied from 1 m to 4 m. in height above the reference ground plane to obtain the maximum signal strength.

(4) Below pre-scan procedure was first performed in order to find prominent frequency spectrum radiated emissions from 9KHz to 25GHz:

(a) Scanning the peak frequency spectrum with the antenna specified in step (3), and the EUT was rotated 360 degree, the antenna height was varied from 1m to 4m(Except loop antenna, it's fixed 1m above ground.)

(b) Change work frequency or channel of device if practicable.

(c) Change modulation type of device if practicable.

(d) new battery is used during testing

(e) Rotated EUT though three orthogonal axes to determine the attitude of EUT arrangement produces highest emissions.

Spectrum frequency from 9KHz to 25GHz (tenth harmonic of fundamental frequency) was investigated, and no any obvious emission were detected from 18GHz to 25GHz, so below final test was performed with frequency range from 9KHz to 18GHz.

(5) For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1m and 4m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. In order to find the maximum emission, the relative positions of equipments and all of the interface cables were changed according to ANSI C63.10 2013 on Radiated Emission test.

(6) The emissions from 9KHz to 1GHz were measured based on CISPR QP detector except for the frequency bands 9-90KHz, 110-490KHz, for emissions from 9KHz-90KHz,110KHz-490KHz and above 1GHz were measured based on average detector, for emissions above 1GHz, peak emissions also be measured and need comply with Peak limit.

(7) The emissions from 9KHz to 1GHz, QP or average values were measured with EMI receiver with below RBW

Frequency band	RBW
9KHz-150KHz	200Hz
150KHz-30MHz	9KHz
30MHz-1GHz	120KHz

（8）For emissions above 1GHz, both Peak and Average level were measured with Spectrum Analyzer, and the RBW is set at 1MHz, VBW is set at 3MHz for Peak measure; RBW is set at 1MHz, VBW is set at 10Hz for Average measure(according ANSI C63.10:2013 clause 4.2.3.2.3 procedure for average measure). Peak detector is used for Peak and AV measurement both.

7.4. Test result(Below 30MHz)

EUT:	Laptop	**Model No.:**	WHIM Business
Temperature:	24℃	**Relative Humidity:**	55%
Distance:	3m	**Test Power:**	120V 60Hz
Polarization:	--	**Test Result:**	Pass
Test Mode:	Keeping TX mode	**Test By:**	Smile

Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	P
--	--	--	--	P

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

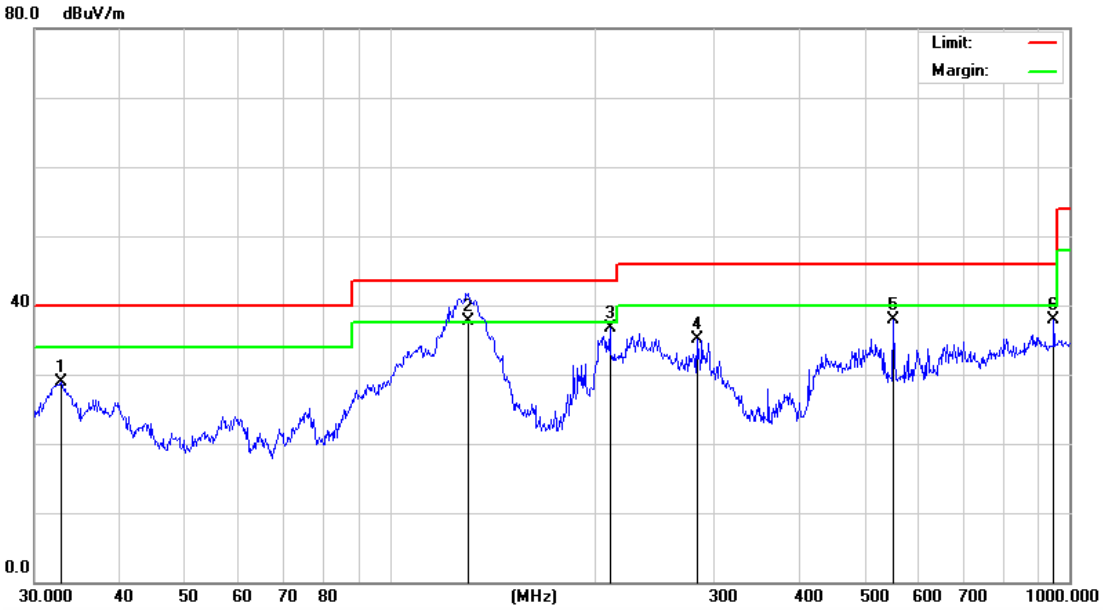
Distance extrapolation factor =20 log (specific distance/test distance)(dB);

Limit line = specific limits(dBuv) + distance extrapolation factor.

Note: The worst data is Antenna A, only shown Antenna A Plot.

TEST RESULTS (Between 30M – 1000 MHz)

EUT:	Laptop	**Model No.:**	WHIM Business
Temperature:	24	**Relative Humidity:**	55%
Distance:	3m	**Test Power:**	AC120V/60Hz
Polarization:	Vertical	**Test Result:**	Pass
Standard:	(RE)FCC PART 15	**Test By:**	Smile
Test Mode:	Keeping TX mode		

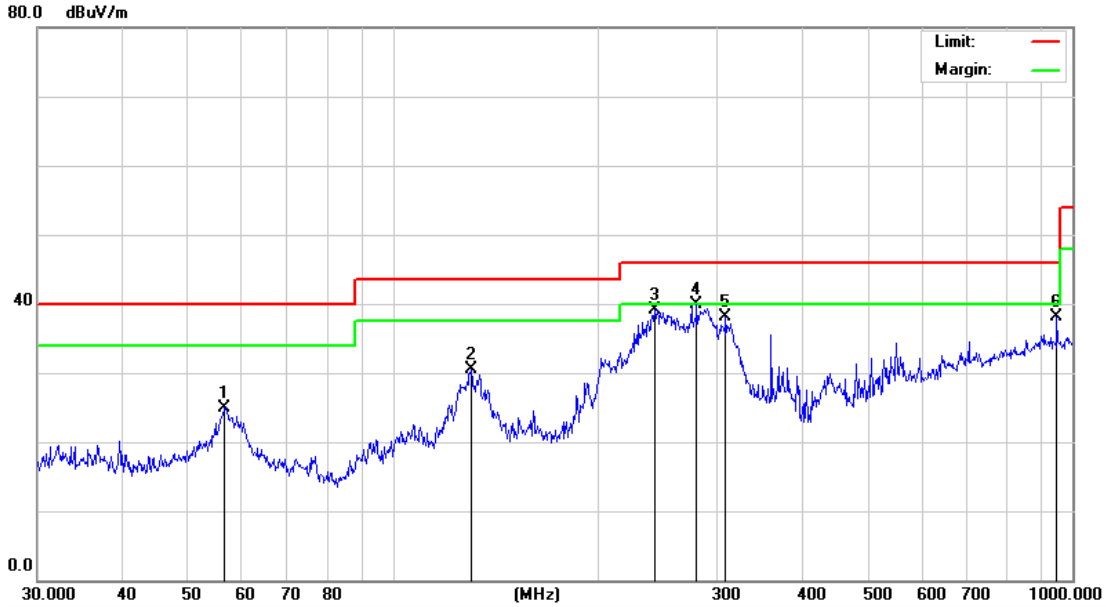


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		32.8637	35.63	-6.81	28.82	40.00	-11.18	peak
2	*	130.3789	43.67	-5.91	37.76	43.50	-5.74	QP
3		210.7860	43.43	-6.77	36.66	43.50	-6.84	peak
4		282.9852	42.56	-7.49	35.07	46.00	-10.93	peak
5		550.9480	34.10	3.85	37.95	46.00	-8.05	peak
6		948.7610	28.94	9.05	37.99	46.00	-8.01	peak

The test result is calculated as the following:

(1) Result = Reading + Correct Factor
(2) Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain + Attenuator
(3) Margin = Result - Limit

EUT:	Laptop	**Model No.:**	WHIM Business
Temperature:	24	**Relative Humidity:**	55%
Distance:	3m	**Test Power:**	AC120V/60Hz
Polarization:	**Horizontal**	**Test Result:**	Pass
Standard:	(RE)FCC PART 15	**Test By:**	Smile
Test Mode:	Keeping TX mode		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		56.3948	31.93	-6.94	24.99	40.00	-15.01	peak
2		130.3789	36.35	-5.91	30.44	43.50	-13.06	peak
3		242.5253	44.75	-5.60	39.15	46.00	-6.85	peak
4	*	280.0237	47.48	-7.56	39.92	46.00	-6.08	peak
5		308.9126	44.89	-6.84	38.05	46.00	-7.95	peak
6		948.7610	28.97	9.05	38.02	46.00	-7.98	peak

The test result is calculated as the following:

(4) Result = Reading + Correct Factor
(5) Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain + Attenuator
(6) Margin = Result - Limit

TEST RESULTS (Above 1000 MHz)

EUT:	Laptop	**Model No.:**	WHIM Business
Temperature:	24℃	**Relative Humidity:**	55%
Distance:	3m	**Test Power:**	120V 60Hz
Polarization:		**Test Result:**	Pass
Test Mode:	TX-802.11a/n20/n40/ac20/ac40/ac/80	**Test By:**	Smile

Above 1GHz:

Mode	Polar (H/V)	Frequency (MHz)	Reading (dBμV)	Factor (dB)	Result (dBμV)	Limit (dBμV/m)	Margin (dB)	Detector (PK/AV)
802.11a-5180MHz	H	10360	34.87	12.56	47.43	74.00	-26.57	PEAK
	H	15540	35.99	16.45	52.44	74.00	-21.56	PEAK
	V	10360	35.47	12.56	48.03	74.00	-25.97	PEAK
	V	15540	36.19	16.45	52.64	74.00	-21.36	PEAK
802.11a-5220 MHz	H	10440	35.43	12.64	48.07	74.00	-25.93	PEAK
	H	15660	35.90	16.53	52.43	74.00	-21.57	PEAK
	V	10440	37.10	12.64	49.74	74.00	-24.26	PEAK
	V	15660	35.86	16.53	52.39	74.00	-21.61	PEAK
802.11a-5240 MHz	H	10480	33.59	12.68	46.27	74.00	-27.73	PEAK
	H	15720	35.00	16.54	51.54	74.00	-22.46	PEAK
	V	10480	36.45	12.68	49.13	74.00	-24.87	PEAK
	V	15720	34.33	16.54	50.87	74.00	-23.13	PEAK
Mode	**Polar (H/V)**	**Frequency (MHz)**	**Reading (dBμV)**	**Factor (dB)**	**Result (dBμV)**	**Limit (dBμV/m)**	**Margin (dB)**	**Detector (PK/AV)**
802.11n HT20-5180MHz	H	10360	33.32	12.56	45.88	74.00	-28.12	PEAK
	H	15540	35.24	16.45	51.69	74.00	-22.31	PEAK
	V	10360	35.90	12.56	48.46	74.00	-25.54	PEAK
	V	15540	35.91	16.45	52.36	74.00	-21.64	PEAK
802.11n HT20-5220MHz	H	10440	35.22	12.64	47.86	74.00	-26.14	PEAK
	H	15660	33.60	16.53	50.13	74.00	-23.87	PEAK
	V	10440	35.97	12.64	48.61	74.00	-25.39	PEAK
	V	15660	35.72	16.53	52.25	74.00	-21.75	PEAK
802.11n HT20-5240MHz	H	10480	35.28	12.68	47.96	74.00	-26.04	PEAK
	H	15720	32.10	16.54	48.64	74.00	-25.36	PEAK
	V	10480	33.94	12.68	46.62	74.00	-27.38	PEAK

	V	15720	33.99	16.54	50.53	74.00	-23.47	PEAK

Mode	Polar (H/V)	Frequency (MHz)	Reading (dBμV)	Factor (dB)	Result (dBμV)	Limit (dBμV/m)	Margin (dB)	Detector (PK/AV)
802.11n HT40-5190MHz	H	10380	35.41	12.58	47.99	74.00	-26.01	PEAK
	H	15570	33.65	16.48	50.13	74.00	-23.87	PEAK
	V	10380	36.48	12.58	49.06	74.00	-24.94	PEAK
	V	15570	33.34	16.48	49.82	74.00	-24.18	PEAK
802.11n HT40-5230MHz	H	10460	37.15	12.66	49.81	74.00	-24.19	PEAK
	H	15690	34.66	16.53	51.19	74.00	-22.81	PEAK
	V	10460	35.40	12.66	48.06	74.00	-25.94	PEAK
	V	15690	33.59	16.53	50.12	74.00	-23.88	PEAK

Mode	Polar (H/V)	Frequency (MHz)	Reading (dBμV)	Factor (dB)	Result (dBμV)	Limit (dBμV/m)	Margin (dB)	Detector (PK/AV)
802.11ac HT20-5180MHz	H	10360	34.09	12.56	46.65	74.00	-27.35	PEAK
	H	15540	34.31	16.45	50.76	74.00	-23.24	PEAK
	V	10360	33.31	12.56	45.87	74.00	-28.13	PEAK
	V	15540	34.34	16.45	50.79	74.00	-23.21	PEAK
802.11ac HT20-5220MHz	H	10440	34.04	12.64	46.68	74.00	-27.32	PEAK
	H	15660	31.54	16.53	48.07	74.00	-25.93	PEAK
	V	10440	33.21	12.64	45.85	74.00	-28.15	PEAK
	V	15660	31.06	16.53	47.59	74.00	-26.41	PEAK
802.11ac HT20-5240MHz	H	10480	34.10	12.68	46.78	74.00	-27.22	PEAK
	H	15720	32.70	16.54	49.24	74.00	-24.76	PEAK
	V	10480	32.55	12.68	45.23	74.00	-28.77	PEAK
	V	15720	34.03	16.54	50.57	74.00	-23.43	PEAK

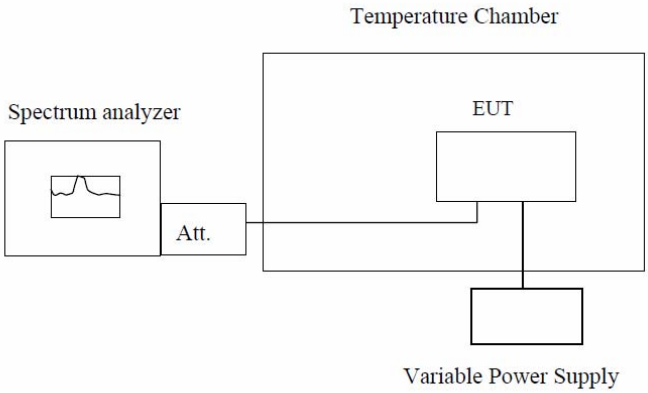
Mode	Polar (H/V)	Frequency (MHz)	Reading (dBμV)	Factor (dB)	Result (dBμV)	Limit (dBμV/m)	Margin (dB)	Detector (PK/AV)
802.11ac HT40-5190MHz	H	10380	32.84	12.58	45.42	74.00	-28.58	PEAK
	H	15570	34.64	16.48	51.12	74.00	-22.88	PEAK
	V	10380	35.13	12.58	47.71	74.00	-26.29	PEAK
	V	15570	32.70	16.48	49.18	74.00	-24.82	PEAK
802.11ac HT40-5230MHz	H	10460	34.68	12.66	47.34	74.00	-26.66	PEAK
	H	15690	31.86	16.53	48.39	74.00	-25.61	PEAK

	V	10460	33.87	12.66	46.53	74.00	-27.47	PEAK
	V	15690	32.75	16.53	49.28	74.00	-24.72	PEAK

Mode	Polar (H/V)	Frequency (MHz)	Reading (dBµV)	Factor (dB)	Result (dBµV)	Limit (dBµV/m)	Margin (dB)	Detector (PK/AV)
802.11ac HT80-5210MHz	H	10420	32.79	12.62	45.41	74.00	-28.59	PEAK
	H	15630	33.17	16.52	49.69	74.00	-24.31	PEAK
	V	10420	33.54	12.62	46.16	74.00	-27.84	PEAK
	V	15630	31.55	16.52	48.07	74.00	-25.93	PEAK

The field strength is calculated by adding the Antenna Factor. Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Final Test Level =Receiver Reading + Antenna Factor + Cable Factor –Preamplifier Factor.
Average measurement was not performed if peak level lower than average limit. No any other emissions level very low which are attenuated less than 20dB below the limit. According to 15.31(o), The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this Part. Hence there no other emissions have been reported.

8. FREQUENCY STABILITY

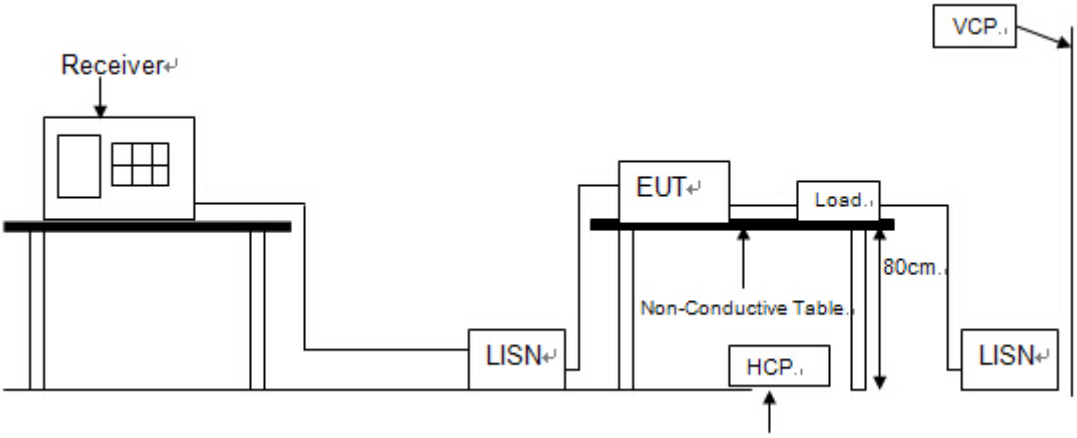
Test Requirement:	FCC Part15 C Section 15.407(g)
Test Method:	ANSI C63.10:2013, FCC Part 2.1055
Limit:	Manufactures of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified
Test Procedure:	The EUT was setup to ANSI C63.4, 2014; tested to 2.1055 for compliance to FCC Part 15.407(g) requirements.
Test setup:	 **Note :** Measurement setup for testing on Antenna connector
Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.3 for details
Test results:	Pass

Frequency stability versus Temp.					
Power Supply: DC 7.6V					
Temp. (°C)	Operating Frequency (MHz)	0 minute	2 minute	5 minute	10 minute
		Measured Frequency (MHz)	Measured Frequency (MHz)	Measured Frequency (MHz)	Measured Frequency (MHz)
-30	5180	5180.0768	5180.1575	5180.7272	5180.1587
	5200	5199.8483	5200.8066	5199.9792	5199.3914
	5220	5220.0996	5220.2916	5220.6476	5220.4354
	5240	5239.9857	5240.6455	5240.2121	5239.7094
-20	5180	5179.7998	5180.4610	5180.7079	5180.2387
	5200	5199.6113	5200.4471	5200.3023	5199.7127
	5220	5219.3260	5220.5834	5220.1242	5219.6955
	5240	5239.1472	5240.1485	5240.3614	5239.0560
-10	5180	5178.9284	5180.3999	5180.0833	5178.7144
	5200	5199.9244	5200.6555	5200.7669	5198.8720
	5220	5219.3994	5220.8225	5220.1201	5219.5844
	5240	5239.4026	5240.5330	5240.8870	5239.3386
0	5180	5180.4718	5180.7600	5180.4496	5179.3295
	5200	5199.4126	5200.7405	5200.5069	5199.8162
	5220	5219.2713	5219.7723	5220.1685	5220.0323
	5240	5239.6555	5240.8615	5240.2258	5239.4423
10	5180	5179.8765	5180.2522	5180.1498	5179.9424
	5200	5199.7764	5200.1856	5200.4094	5199.6231
	5220	5219.1608	5220.1911	5220.3709	5219.9688
	5240	5239.8102	5240.3641	5240.6457	5239.6286
20	5180	5179.9381	5180.1661	5180.2850	5179.4251
	5200	5199.7046	5200.3935	5200.8174	5199.3711
	5220	5219.3509	5220.9109	5220.4676	5219.5035
	5240	5239.2423	5240.7689	5240.2008	5239.5924
30	5180	5179.6930	5180.0951	5180.0724	5179.7799
	5200	5199.3115	5200.1919	5200.4674	5199.6010
	5220	5219.3932	5220.4776	5220.9559	5219.5190
	5240	5239.5160	5240.2274	5240.3301	5239.9719
40	5180	5179.6959	5180.8535	5180.2855	5180.1952
	5200	5199.1924	5200.4999	5200.7955	5199.7556
	5220	5219.4804	5220.6530	5220.8310	5219.9185
	5240	5239.1295	5240.9833	5240.9381	5240.0857
50	5180	5179.3294	5180.8584	5180.4182	5179.3860
	5200	5199.4006	5200.9164	5200.3681	5199.2636
	5220	5219.6891	5220.9101	5220.4892	5219.2989
	5240	5239.3615	5240.1878	5240.0569	5239.2262

Frequency stability versus Voltage					
Temperature: 25°C					
Power Supply (VDC)	Operating Frequency (MHz)	0 minute	2 minute	5 minute	10 minute
		Measured Frequency (MHz)	Measured Frequency (MHz)	Measured Frequency (MHz)	Measured Frequency (MHz)
6.9	5180	5180.0289	5180.1297	5180.3942	5180.3264
	5200	5200.0576	5199.9288	5199.6672	5199.9628
	5220	5220.1585	5220.6731	5219.8848	5220.1270
	5240	5240.9439	5240.8619	5239.9706	5239.4340
7.6	5180	5181.2093	5180.0896	5179.1654	5179.1249
	5200	5200.1292	5200.5180	5199.9557	5199.2257
	5220	5220.2773	5220.2947	5219.8907	5219.5153
	5240	5239.7530	5240.7048	5239.0745	5239.6018
8.4	5180	5180.0139	5180.4563	5179.3073	5179.2530
	5200	5200.2673	5200.3796	5199.0055	5199.1763
	5220	5219.8959	5220.7292	5219.1521	5219.0118
	5240	5240.7119	5240.5690	5239.4222	5239.2227

9. POWER LINE CONDUCTED EMISSION

9.1 Block diagram of test setup



9.2 Power Line Conducted Emission Limits(Class B)

Frequency	Quasi-Peak Level dB(μV)	Average Level dB(μV)
150kHz ~ 500kHz	66 ~ 56*	56 ~ 46*
500kHz ~ 5MHz	56	46
5MHz ~ 30MHz	60	50

Note 1: * Decreasing linearly with logarithm of frequency.

Note 2: The lower limit shall apply at the transition frequencies.

9.3 TEST PROCEDURE

The EUT and Support equipment, if needed, were put placed on a non-metallic table, 80cm above the ground plane.

Configuration EUT to simulate typical usage as described in clause 2.4 and test equipment as described in clause 10.2 of this report.

All I/O cables were positioned to simulate typical actual usage as per ANSI C63.4.

All support equipment power received from a second LISN.

Emissions were measured on each current carrying line of the EUT using an EMI Test Receiver connected to the LISN powering the EUT.

The Receiver scanned from 150 kHz to 30MHz for emissions in each of the test modes.

During the above scans, the emissions were maximized by cable manipulation.

The test mode(s) described in clause 2.4 were scanned during the preliminary test.

After the preliminary scan, we found the test mode producing the highest emission level.

The EUT configuration and worse cable configuration of the above highest emission levels were recorded for reference of the final test.

EUT and support equipment were set up on the test bench as per the configuration with highest emission level in the preliminary test.

A scan was taken on both power lines, Neutral and Line, recording at least the six highest emissions.

Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit.

The test data of the worst-case condition(s) was recorded.

The bandwidth of test receiver is set at 9 KHz.

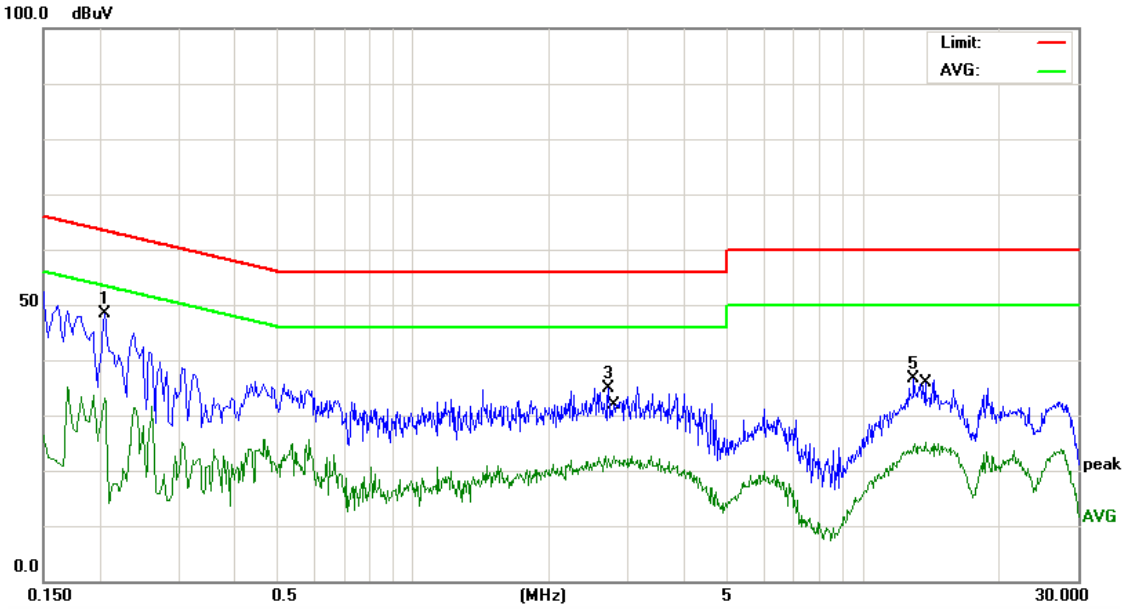
9.4 Test Result

PASS. (See below detailed test result)

Note1: All emissions not reported below are too low against the prescribed limits.

Note2: “-----” means peak detection; “-----” mans average detection

EUT:	Laptop	Model No.:	WHIM Business
Temperature:	23℃	Relative Humidity:	52%
Probe:	N	Test Power:	AC 120V/60Hz
Test Time:	2020-07-01	Test Result:	Pass
Standard:	(CE)FCC PART 15 class B_QP		
Test Mode:	TX		
Note:			

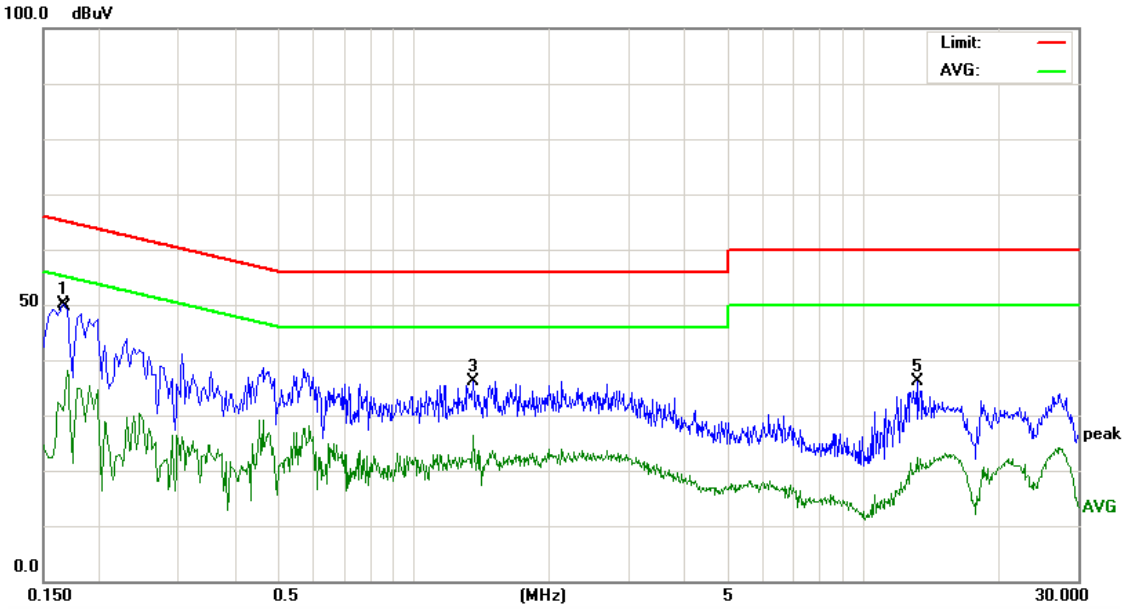


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1	*	0.2060	37.37	11.09	48.46	63.36	-14.90	peak
2		0.2060	22.07	11.09	33.16	53.36	-20.20	AVG
3		2.7100	24.96	9.98	34.94	56.00	-21.06	peak
4		2.7820	12.68	9.99	22.67	46.00	-23.33	AVG
5		12.9300	35.48	1.23	36.71	60.00	-23.29	peak
6		13.6980	23.96	1.24	25.20	50.00	-24.80	AVG

The test result is calculated as the following:

(1) Result = Reading + Correct Factor
(2) Correct Factor = (LISN, ISN, PLC or Current Probe) Factor + Cable Loss +Attenuator
(3) Margin = Result - Limit

EUT:	Laptop	Model No.:	WHIM Business
Temperature:	23℃	Relative Humidity:	52%
Probe:	L1	Test Power:	AC 120V/60Hz
Test Time:	2020-07-01	Test Result:	Pass
Standard:	(CE)FCC PART 15 class B_QP		
Test Mode:	TX		
Note:			



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1	*	0.1660	38.57	11.61	50.18	65.15	-14.97	peak
2		0.1700	26.67	11.55	38.22	54.96	-16.74	AVG
3		1.3540	26.23	9.92	36.15	56.00	-19.85	peak
4		1.3540	16.37	9.92	26.29	46.00	-19.71	AVG
5		13.1900	34.78	1.24	36.02	60.00	-23.98	peak
6		13.1900	21.19	1.24	22.43	50.00	-27.57	AVG

The test result is calculated as the following:

(1) Result = Reading + Correct Factor
(2) Correct Factor = (LISN, ISN, PLC or Current Probe) Factor + Cable Loss +Attenuator
(3) Margin = Result - Limit

10. ANTENNA REQUIREMENTS

10.1. Limit

15.203 requirement: For intentional device, according to 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.

10.2. EUT ANTENNA

The antennas used for this product are built-in undetachable FPCB antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only 1.66 dBi. and the antenna connector is designed with permanent attachment and no consideration of replacement. Therefore the EUT is considered sufficient to comply with the provision.

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