FCC Part 15E
Measurement and Test Report

For

Shenzhen Yunlink Technology Co., Ltd

B2 Building, An'le Industrial Zone, Hangcheng Road, gushu, xixiang town, Baoan, Shenzhen, Guangdong Province, China

FCC ID: 2ADUG-P48

FCC Rule(s):	FCC Part 15E
Product Description:	Outdoor Access Point
Tested Model:	HWAP80-P48
Report No.:	BSL18031023080005Y-ER-2
Tested Date:	2018-03-01 to 2018-03-07
Issued Date:	2018-03-07
Tested By:	Lisa. Li / Engineer
Reviewed By:	arno. Liu / EMC Manager
Approved & Authorized By:	Mike mo / PSQ Manager
Prepared By:	

BSL Testing Co.,LTD.
NO. 24, ZH Park, Nantou, Shenzhen, 518000 China
Tel: 86- 755-26508703 Fax: 86- 755-26508703

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1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant:	Shenzhen Yunlink Technology Co., Ltd
Address of applicant:	B2 Building, An'le Industrial Zone, Hangcheng Road, gushu, xixiang town, Baoan, Shenzhen, Guangdong Province, China
Manufacturer:	Shenzhen Yunlink Technology Co., Ltd
Address of manufacturer:	B2 Building, An'le Industrial Zone, Hangcheng Road, gushu, xixiang town, Baoan, Shenzhen, Guangdong Province, China

General Description of EUT	
Product Name:	Outdoor Access Point
Trade Name:	N/A
Model No.:	HWAP80-P48
Adding Model(s):	AP1200-P48,AP1200-P24,AP750-P48,AP750-P24,OAP95, HWAP610-P48,HWAP610-P24,HWAP2100-P48,XD4200,XD6800,UM-530AC,UM-510AC,UM-520AC,UM-320AC
Rated Voltage:	DC 48V from POE
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 HWAP80-P48, but the circuit and the electronic construction do not change, declared by the manufacturer.	

Technical Characteristics of EUT	
Wi-Fi(5G/5.8G)	
Support Standards:	802.11a, 802.11n(HT20), 802.11n(HT40), 802.11ac(HT80)
Frequency Range:	5745-5825MHz
RF Output Power:	13.00dBm(Conducted)
Type of Modulation:	OFDM, 64-QAM,16-QAM, QPSK, BPSK, 256-QAM
Data Rate:	6-54Mbps, up to 600Mbps
Channel Separation:	20/40/80MHz
Type of Antenna:	RP-SMA Antenna
Antenna Gain:	Chain1:12dBi, Chain 2:12dBi
Lowest Internal Frequency	25MHz

1.2 Test Standards

The following report is prepared on behalf of the Shenzhen Yunlink Technology Co., Ltd in accordance with FCC Part 15, Subpart C&E, and section 15.203, 15.205, 15.207, 15.209 and 15.407 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15, Subpart C&E, and section 15.203, 15.205, 15.207, 15.209 and 15.407 of the Federal Communication Commissions rules.

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 C63.4-2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz. The measurement guide KDB 789033 D02 v01r02 for Unlicensed National Information Infrastructure (U-NII) Devices and KDB 662911 D01 Multiple Transmitter Output v02r01 shall be performed also.

1.4 Table for parameters of Test Software setting

The test utility software used during testing was “RPTA1-71W.M4300.01.GD.2015Sep1”. During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Mode	Test Frequency (MHz)												
	NCB: 20MHz												
	5180	5200	5240	5260	5300	5320	5500	5580	5700	5720	5745	5785	5825
802.11a 6Mbps	/	/	/	/	/	/	/	/	/	/	13	13	13
802.11n-HT20 MCS0	/	/	/	/	/	/	/	/	/	/	13	13	13
Mode	NCB: 40MHz									
	5190	5230	5270	5310	5510	5550	5670	5710	5755	5795
802.11n-HT40 MCS0	/	/	/	/	/	/	/	/	13	13
Mode	NCB: 80MHz					
	5210		5290	5530	5610	5690	5775	
802.11ac-HT80 MCS0/Nss2	/		/	/	/	/	13	

1.5 EUT Operating during test

EUT was programmed to be in continuously transmitting mode. During the test, EUT operation to normal function and programs under WIN XP were executed.

1.6 Test Facility

BSL Testing Co.,LTD.
NO. 24, ZH Park, Nantou, Shenzhen, 518000 China
Designation Number : CN1217
Test Firm Registration Number: 866035
Tel: 86- 755-26508703
Fax: 86- 755-26508703

1.7 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, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	802.11a	5745MHz,5785MHz,5825MHz
TM2	802.11n-HT20	5745MHz,5785MHz,5825MHz
TM3	802.11n-HT40	5755MHz,5795MHz
TM4	802.11ac-HT80	5775MHz
Note: All test modes (different data rate and different modulation) are performed, but only the worst case is recorded in this report.		

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Core
/	/	/	/
/	/	/	/

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

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
Notebook	Lenovo	E10	LR-63C8R

1.8 Test Equipment List and Details

Description	Manufacturer	Model	Serial No.	Cal Date	Due. Date
Communication Tester	Rohde & Schwarz	CMW500	100358	2017-10-21	2018-10-20
Spectrum Analyzer	R&S	FSP40	100550	2017-10-21	2018-10-20
Test Receiver	R&S	ESCI7	US47140102	2017-10-21	2018-10-20
Signal Generator	HP	83630B	3844A01028	2017-10-22	2018-10-21
Test Receiver	R&S	ESPI-3	100180	2017-10-21	2018-10-20
Amplifier	Agilent	8449B	4035A00116	2017-10-22	2018-10-21
Amplifier	HP	8447E	2945A02770	2017-10-22	2018-10-21
Signal Generator	IFR	2023A	202307/242	2017-10-22	2018-10-21
Broadband Antenna	SCHAFFNER	2774	2774	2017-10-17	2018-10-16
Biconical and log periodic antennas	ELECTRO-METRICS	EM-6917B-1	171	2017-10-17	2018-10-16
Horn Antenna	R&S	HF906	100253	2017-10-17	2018-10-16
Horn Antenna	EM	EM-6961	6462	2017-10-17	2018-10-16
LISN	R&S	ESH3-Z5	100196	2017-10-17	2018-10-16
LISN	COM-POWER	LI-115	02027	2017-10-17	2018-10-16
3m Semi-Anechoic Chamber	Chengyu Electron	9 (L)*6 (W)* 6 (H)	BSL086	2017-10-21	2018-10-20
Horn Antenna	A-INFOMW	LB-180400KF	BSL088	2017-10-21	2018-10-20

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§ 15.203; § 15.405	Antenna Requirement	Compliant
§ 15.207; § 15.407(b)(6)	Conducted Emission	Compliant
§ 15.407(a)(1),(2)	Power Spectral Density	Compliant
§ 15.407(e)	Emission Bandwidth and Occupied Bandwidth	Compliant
§ 15.407(a)(1),(2)	Maximum Conducted Output Power	Compliant
§ 15.407(b)(1),(2),(3)	Conducted Spurious Emission	Compliant
§ 15.205; § 15.407(b)(1),(2),(3)	Radiated Emission	Compliant
§ 15.407(g)	Frequency Stability	Compliant
§ 15.407(h)	Dynamic Frequency Selection (DFS)	N/A

N/A: not applicable

3. RF Exposure

3.1 Standard Applicable

According to § 1.1307 and § 2.1093, the portable transmitter must comply the RF exposure requirements.

3.2 Test Result

This product complied with the requirement of the RF exposure, please see the RF Exposure Report.

4. Antenna Requirement

4.1 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.

4.2 Evaluation Information

This product has two RP-SMA antennas, fulfill the requirement of this section.

5. Power Spectral Density

5.1 Standard Applicable

Section 15.407(a) Power limits:

(1) 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 conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, 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).

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, 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.

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, 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. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. 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.

5.2 Test Procedure

According to 789033 D02 v01r02 section F, the following is the measurement 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.l.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.

5.3 Environmental Conditions

Temperature:	20° C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

5.4 Summary of Test Results/Plots

Chain 1 :5745-5825MHz

Operating mode	Test Channel	Ant. Port	RF Power Spectral Density Level in 100KHz RBW (dBm)	Correct Factor 100KHz to 500KHz (dB)	Final RF Power Spectral Density Level in 500KHz RBW (dBm)	Total Power Spectral Density Level in 500KHz RBW (dBm)	Limit * dBm/500kHz
802.11a	5745	Chain 1	-0.63	6.99	6.36	9.41	23
		Chain 2	-0.56	6.99	6.43		
	5785	Chain 1	-1.56	6.99	5.43	8.29	23
		Chain 2	-1.86	6.99	5.13		
	5825	Chain 1	-1.99	6.99	5.00	7.65	23
		Chain 2	-2.75	6.99	4.24		
802.11n-HT20	5745	Chain 1	-1.81	6.99	5.18	8.15	23
		Chain 2	-1.90	6.99	5.09		
	5785	Chain 1	-2.54	6.99	4.45	7.60	23
		Chain 2	-2.26	6.99	4.73		
	5825	Chain 1	-2.23	6.99	4.76	7.34	23
		Chain 2	-3.14	6.99	3.85		
802.11n-HT40	5755	Chain 1	-4.51	6.99	2.48	5.52	23
		Chain 2	-4.45	6.99	2.54		
	5795	Chain 1	-2.87	6.99	4.12	6.95	23
		Chain 2	-3.23	6.99	3.76		
802.11ac-HT80	5775	Chain 1	-7.08	6.99	-0.09	2.75	23
		Chain 2	-7.42	6.99	-0.43		

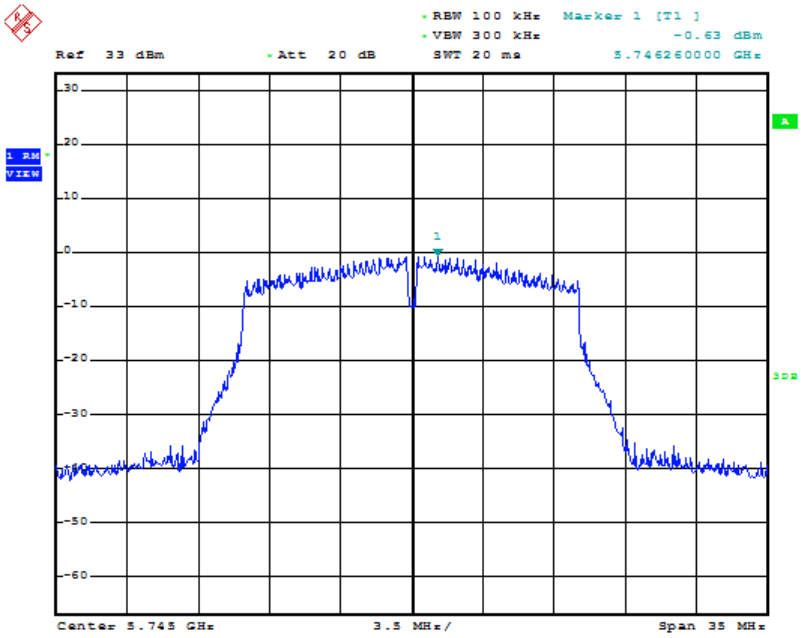
*1.For 5725-5850MHz: Limit=30-(12-6)=23dBm/500kHz

2. The Total PSD Level = $10*\log\{10^{(\text{chain 1 PSD}/10)}+10^{(\text{chain 2 PSD}/10)}\}$

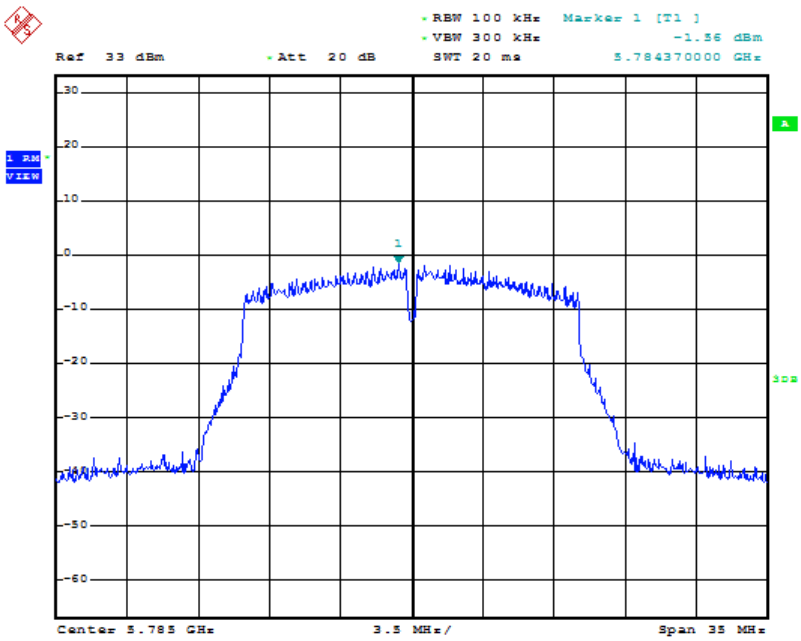
Note: If measurement bandwidth of Maximum PSD is specified in 500 kHz, add 10log(500kHz/RBW) to the measured result, whereas RBW (< 500 KHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement. So Correct Factor 100KHz to 500KHz=10log (5) =6.99dB.

Chain 1 Test Mode: 802.11a

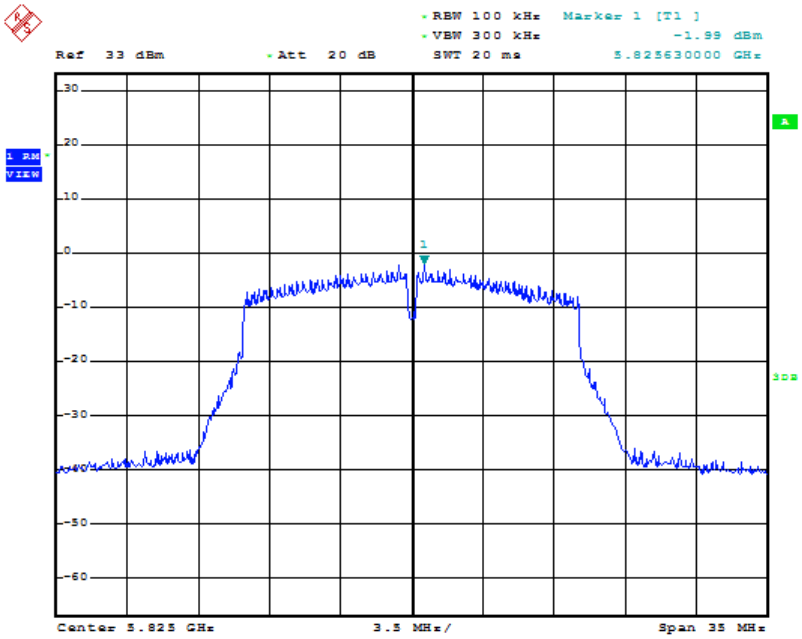
5745MHz



5785MHz

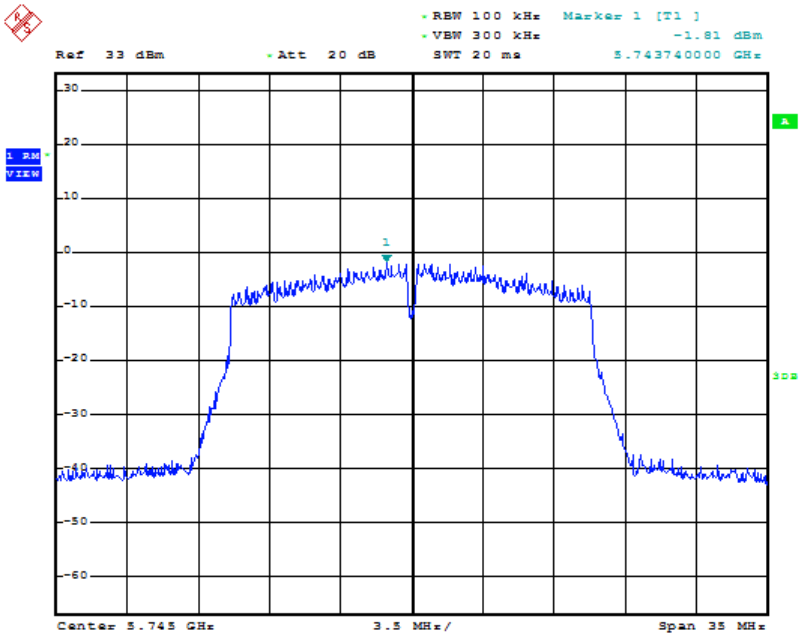


5825MHz

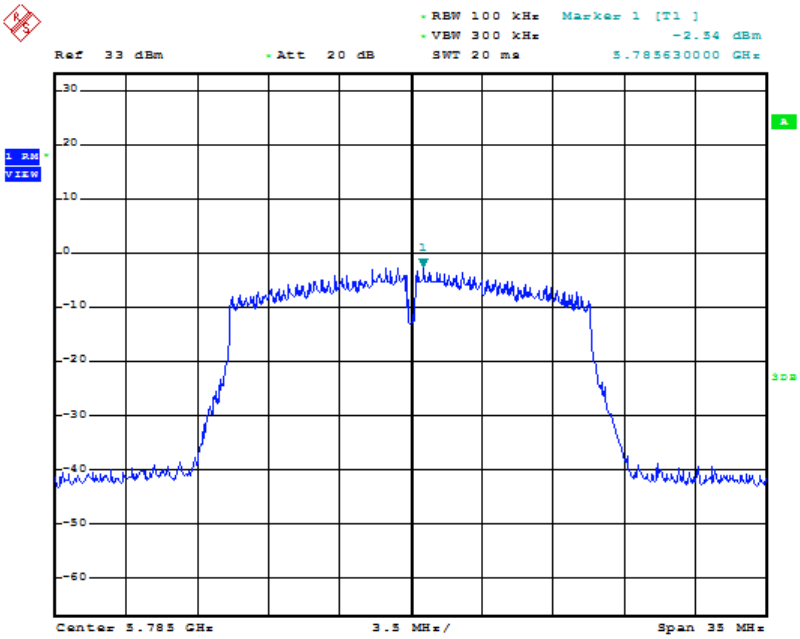


Chain 1 Test Mode: 802.11n-HT20

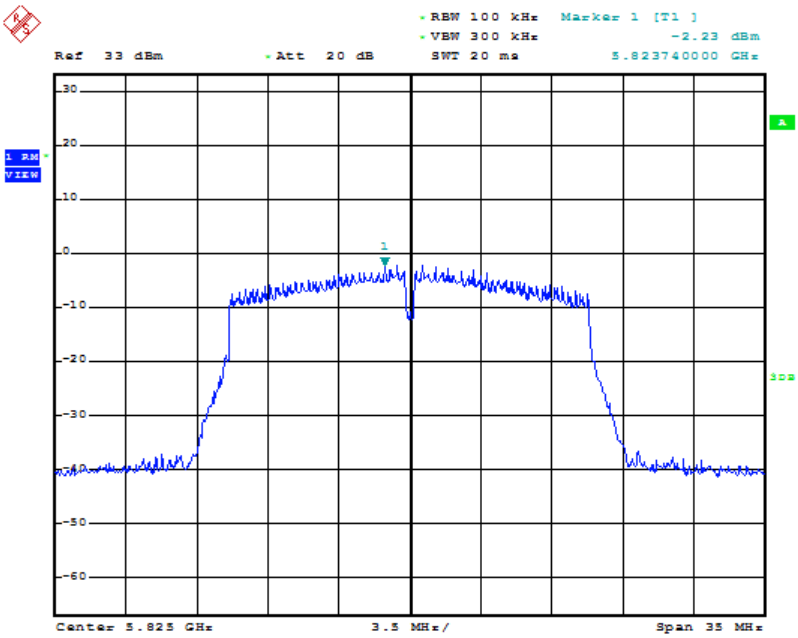
5745MHz



5785MHz

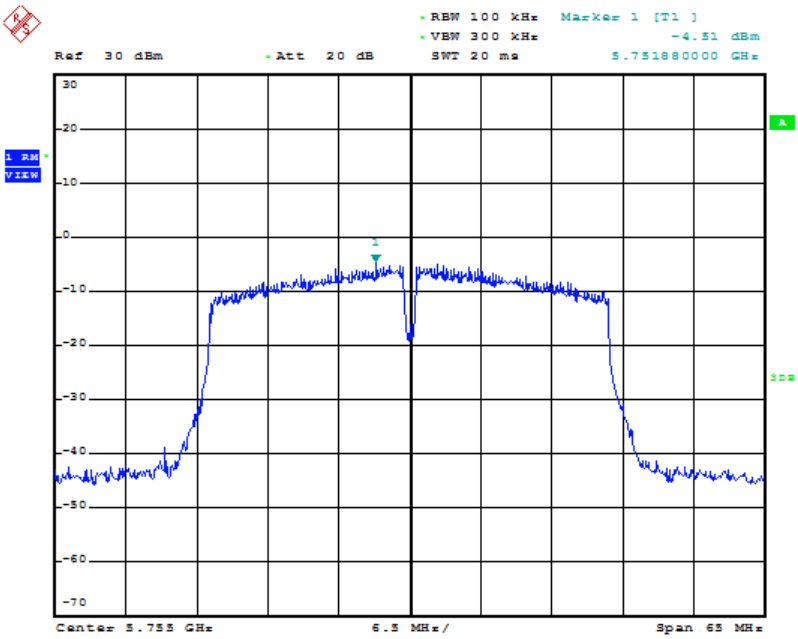


5825MHz

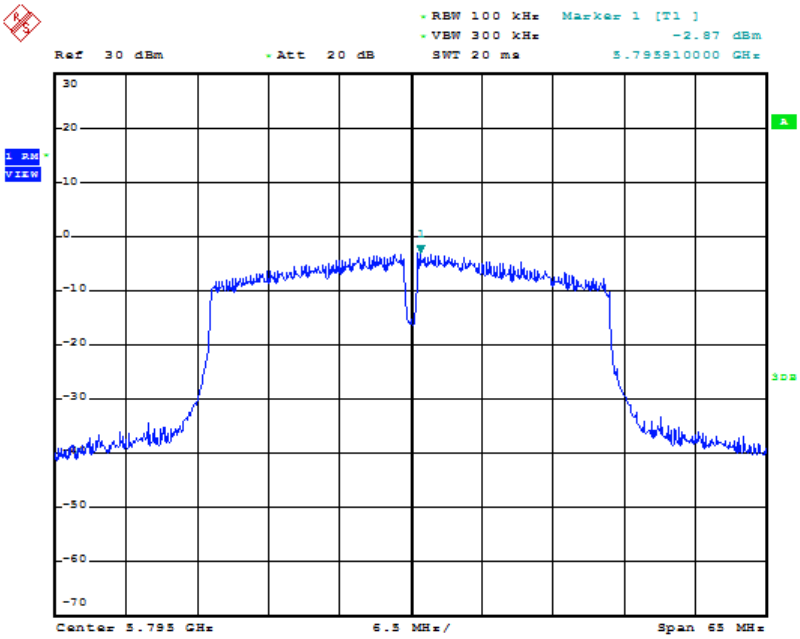


Chain 1 Test Mode: 802.11n-HT40

5755MHz

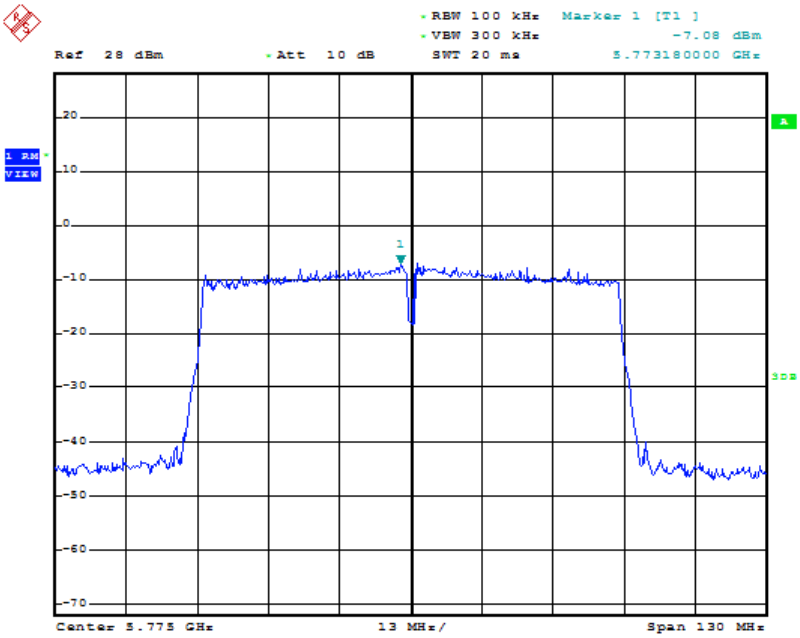


5795MHz



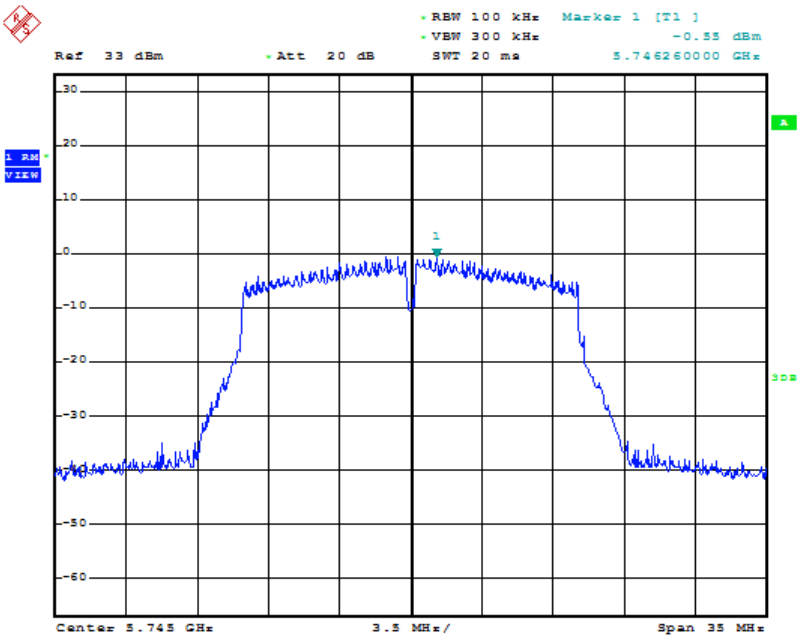
Chain 1 Test Mode: 802.11ac-HT80

5775MHz

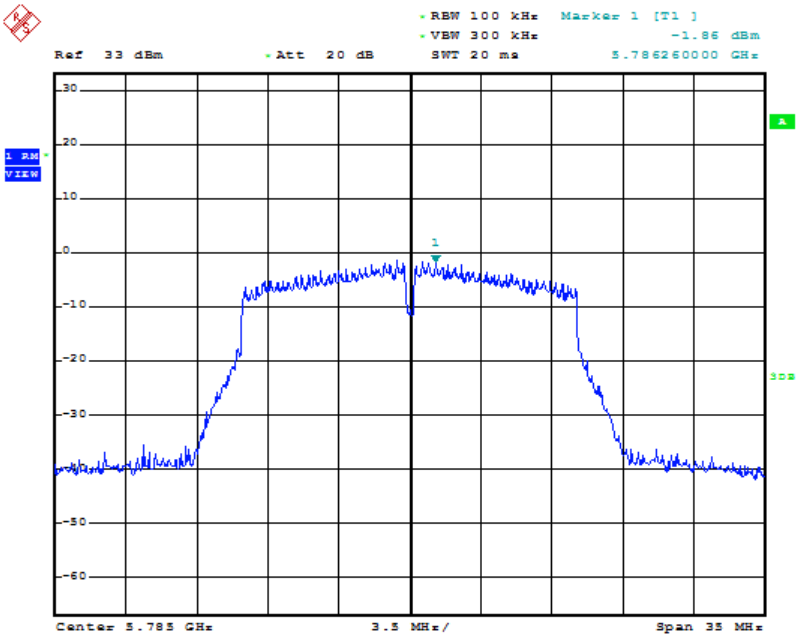


Chain 2 Test Mode: 802.11a

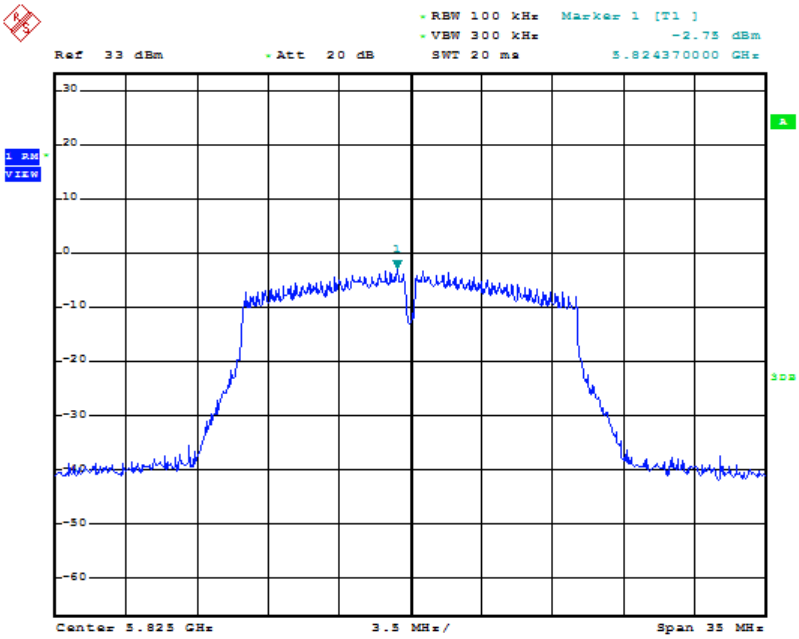
5745MHz



5785MHz

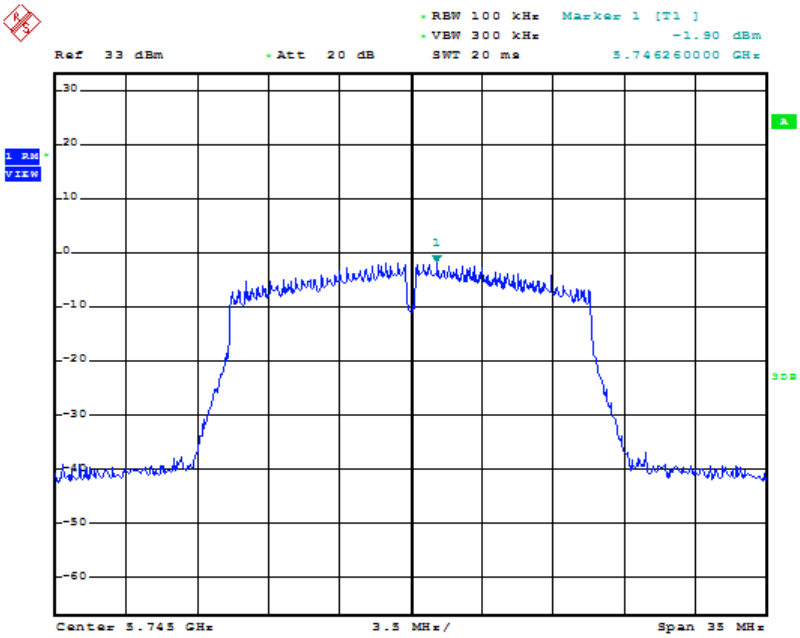


5825MHz

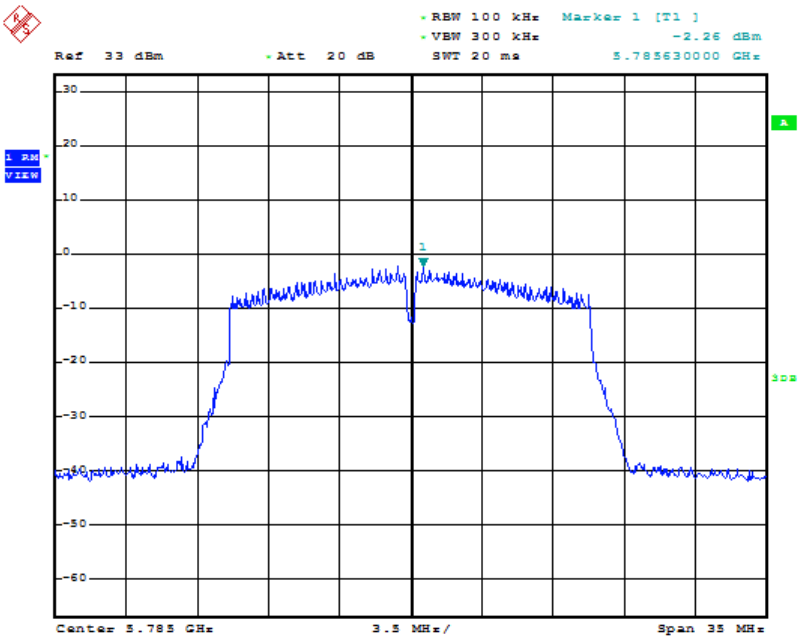


Chain 2 Test Mode: 802.11n-HT20

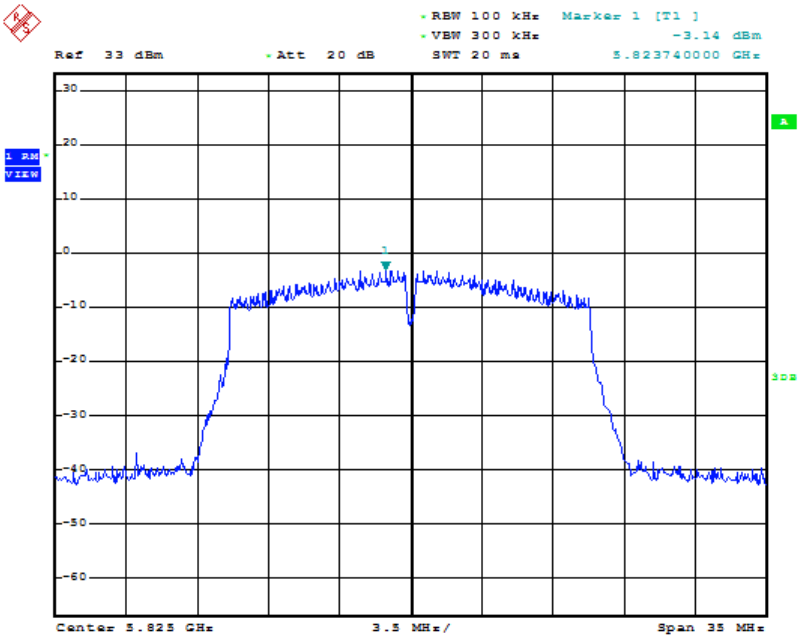
5745MHz



5785MHz

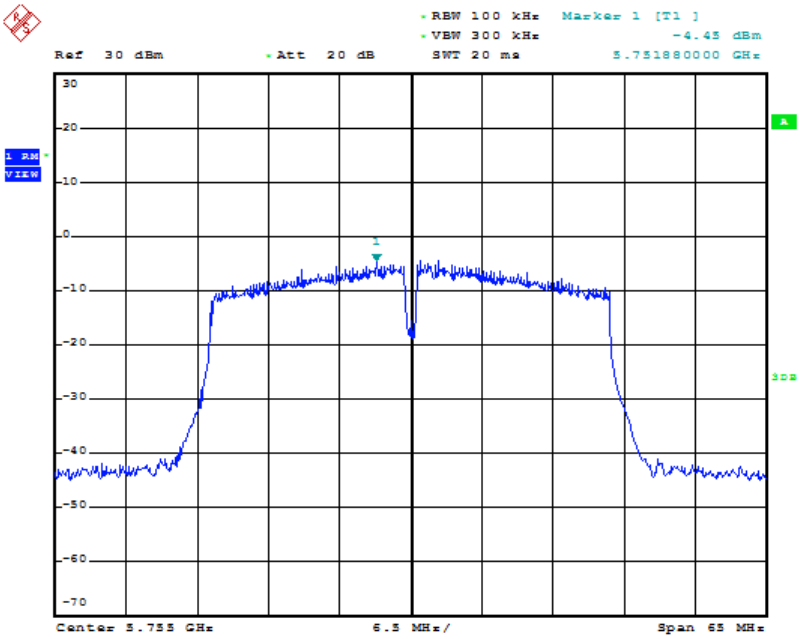


5825MHz

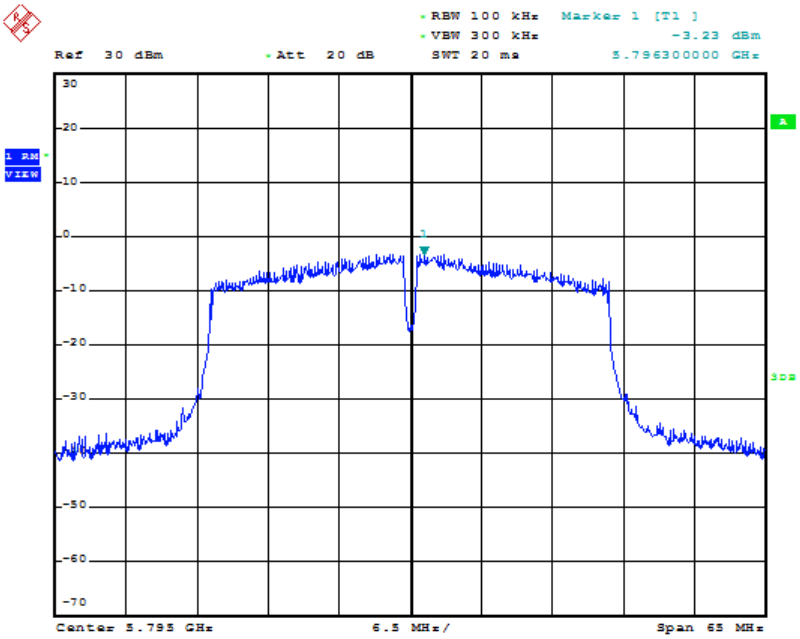


Chain 2 Test Mode: 802.11n-HT40

5755MHz

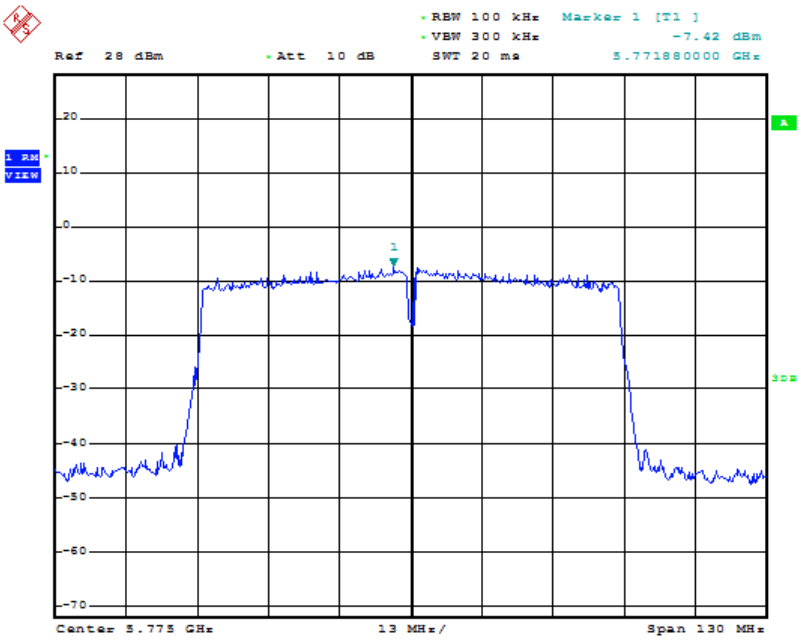


5795MHz



Chain 2 Test Mode: 802.11ac-HT80

5775MHz



6. Emission Bandwidth and Occupied Bandwidth

6.1 Standard Applicable

According to 15.407 (a) and (e)

(1) 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 conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, 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).

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, 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.

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, 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. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. 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.

(e) Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

6.2 Test Procedure

According to 789033 D02 v01r02 section C&D, the following is the measurement procedure.

1. Emission Bandwidth (EBW)
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%.

2. Minimum Emission Bandwidth for the band 5.725-5.85 GHz

Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz. The following procedure shall be used for measuring this bandwidth:

a) Set RBW = 100 kHz.

b) Set the video bandwidth (VBW) ≥ 3 × 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.

Note: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described above.

D. 99 Percent Occupied Bandwidth

The 99-percent occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5 % of the total mean power of the given emission. Measurement of the 99-percent occupied bandwidth is required only as a condition for using the optional band-edge measurement techniques described in section II.G.3.d). Measurements of 99-percent occupied bandwidth may also optionally be used in lieu of the EBW to 789033 D02 v01r02 General UNII Test Procedures New Rules v01 define the minimum frequency range over which the spectrum is integrated when measuring maximum conducted output power as described in section II.E. However, the EBW must be measured to determine bandwidth dependent limits on maximum conducted output power in accordance with 15.407(a).

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.

6.3 Environmental Conditions

Temperature:	24° C
Relative Humidity:	53%
ATM Pressure:	1018 mbar

6.4 Summary of Test Results/Plots

Chain 1 5725-5850MHz

Test Mode	Test Channel MHz	26 dB Bandwidth MHz	6 dB Bandwidth MHz	99% Bandwidth MHz	Limit kHz
802.11a	5745	20.54	16.45	17.76	≥500
	5785	20.64	16.45	17.76	≥500
	5825	20.72	16.45	17.84	≥500
802.11n-HT20	5745	20.65	17.57	17.78	≥500
	5785	20.51	17.64	17.78	≥500
	5825	20.58	17.64	17.71	≥500
802.11n-HT40	5755	42.08	36.32	36.64	≥500
	5795	41.76	36.16	36.32	≥500
802.11ac-HT80	5775	82.36	77.12	75.84	≥500

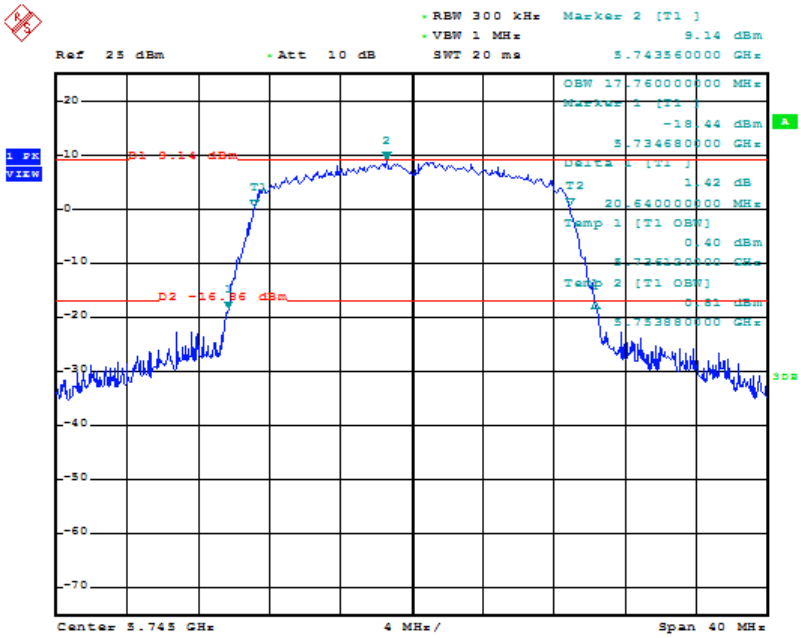
Chain 2 5725-5850MHz

Test Mode	Test Channel MHz	26 dB Bandwidth MHz	6 dB Bandwidth MHz	99% Bandwidth MHz	Limit kHz
802.11a	5745	20.56	16.45	17.76	≥500
	5785	20.64	16.45	17.76	≥500
	5825	20.72	16.45	17.76	≥500
802.11n-HT20	5745	20.65	17.57	17.78	≥500
	5785	20.65	17.64	17.78	≥500
	5825	20.51	17.64	17.78	≥500
802.11n-HT40	5755	41.92	36.32	36.48	≥500
	5795	41.92	36.16	36.64	≥500
802.11ac-HT80	5775	82.56	77.12	75.84	≥500

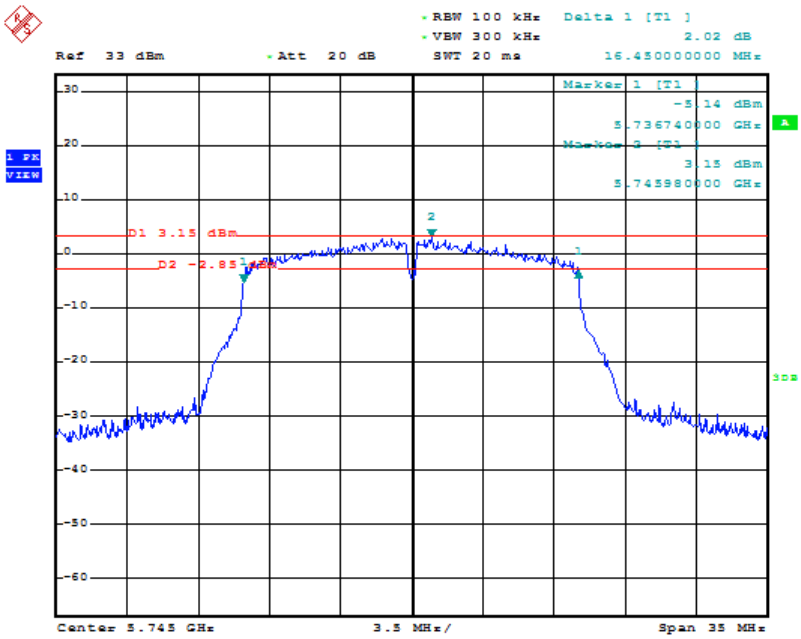
Chain 1 Test mode：802.11a

5745MHz

26dB and 99% bandwidth

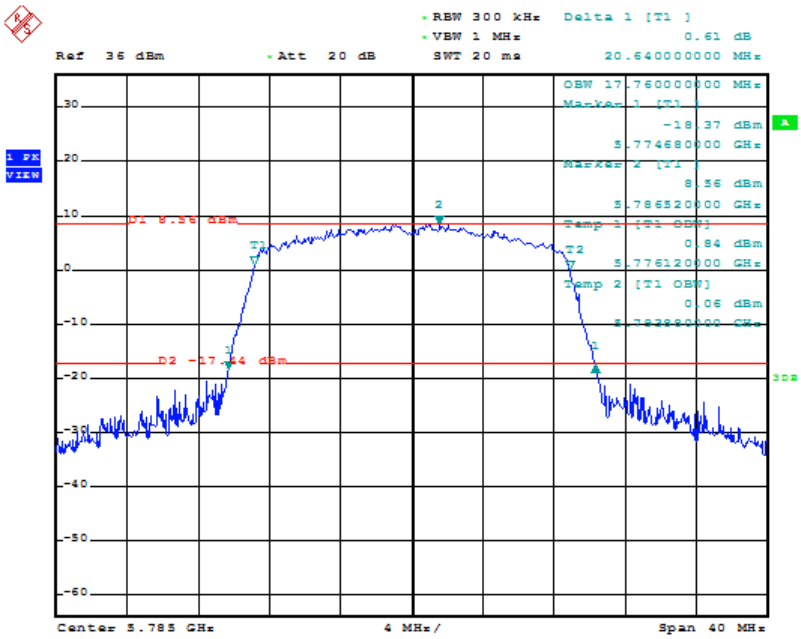


6dB bandwidht

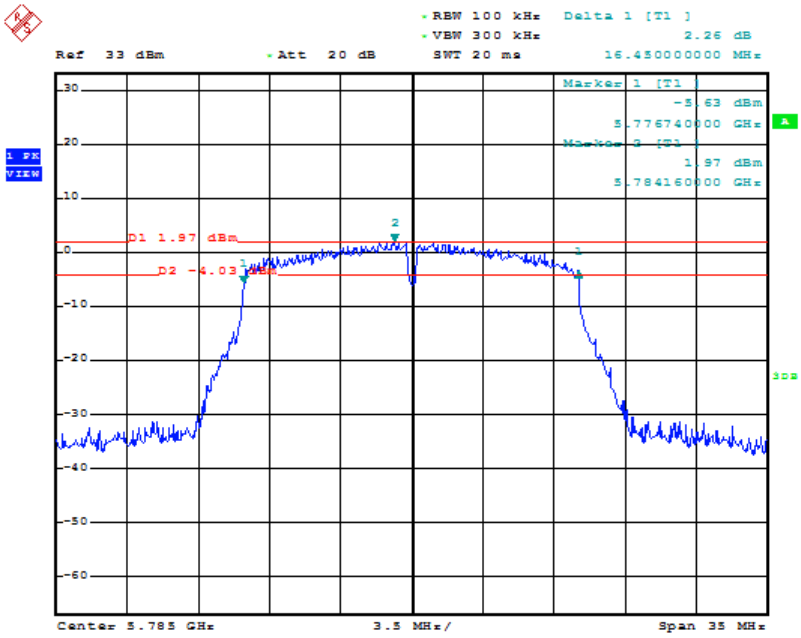


5785MHz

26dB and 99% bandwidth

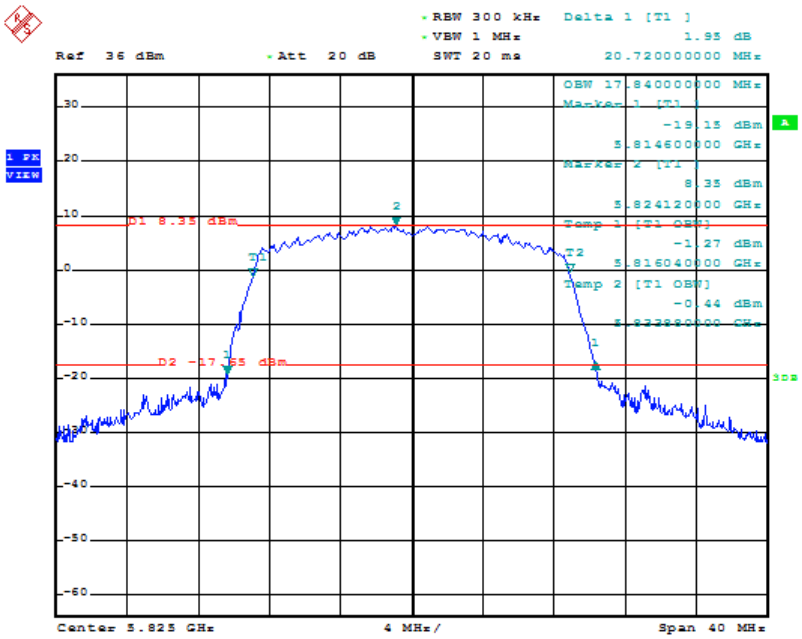


6dB bandwidht

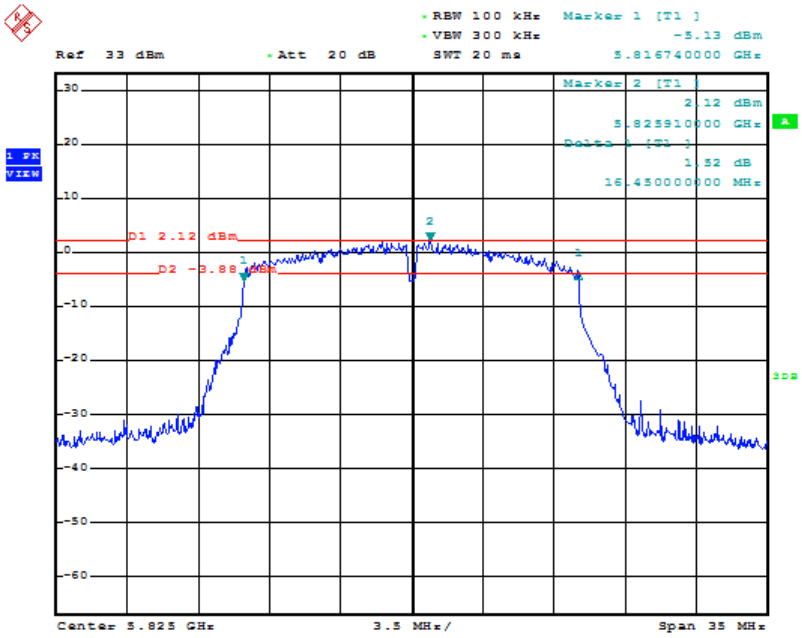


5825MHz

26dB and 99% bandwidth



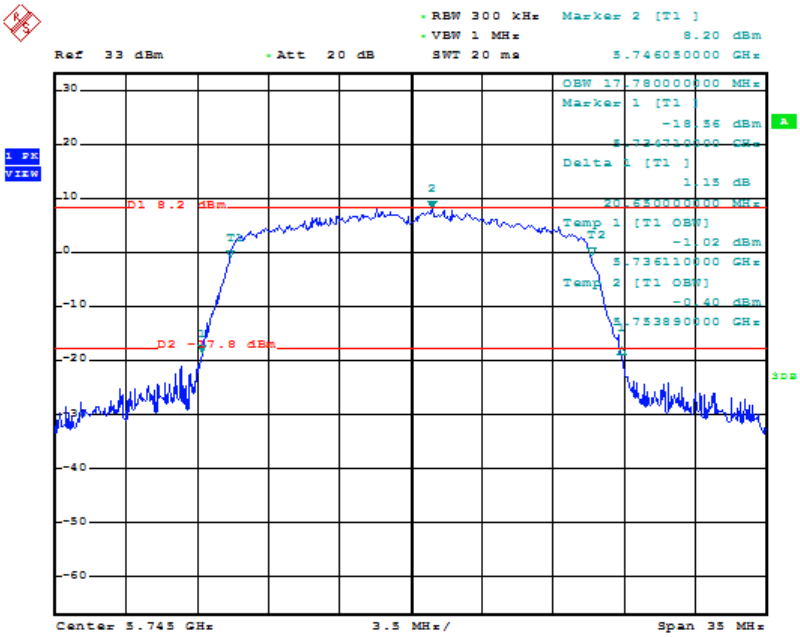
6dB bandwidht



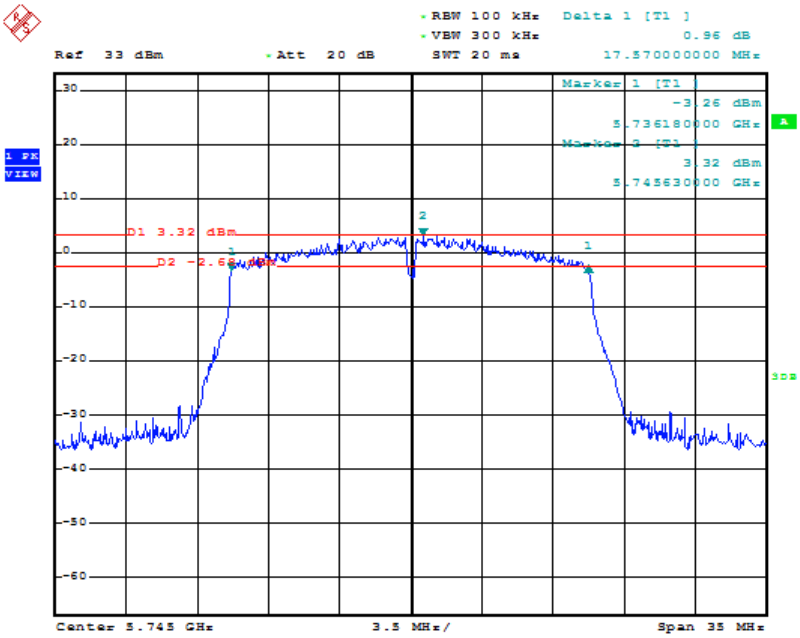
Chain 1 Test mode：802.11n-HT20

5745MHz

26dB and 99% bandwidth

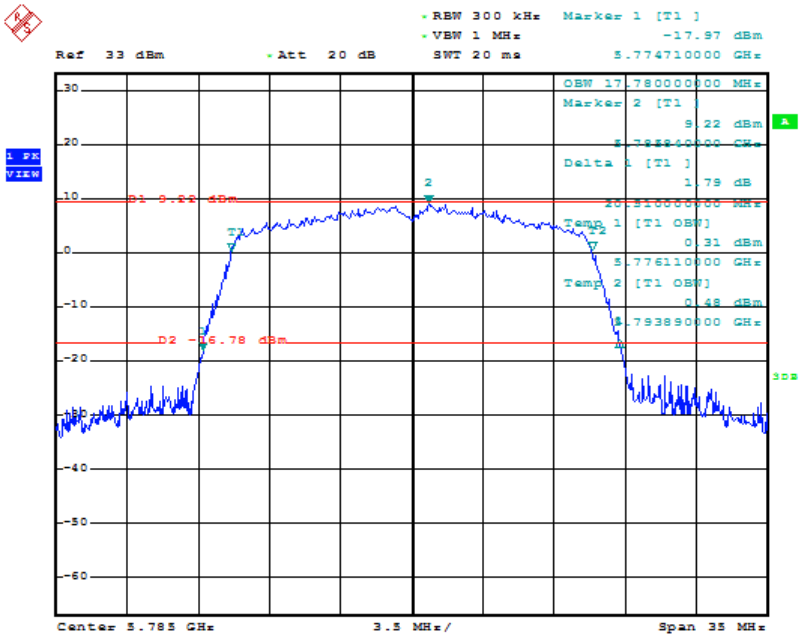


6dB bandwidth

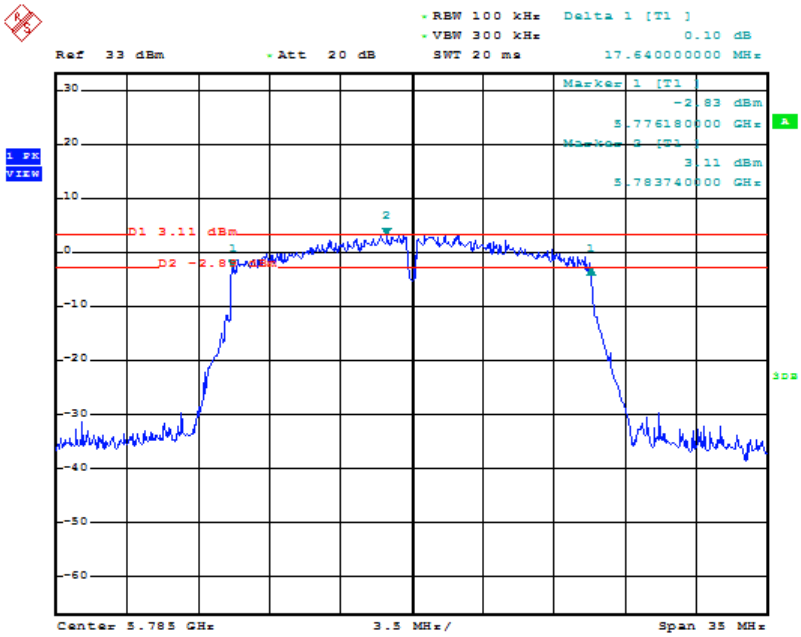


5785MHz

26dB and 99% bandwidth

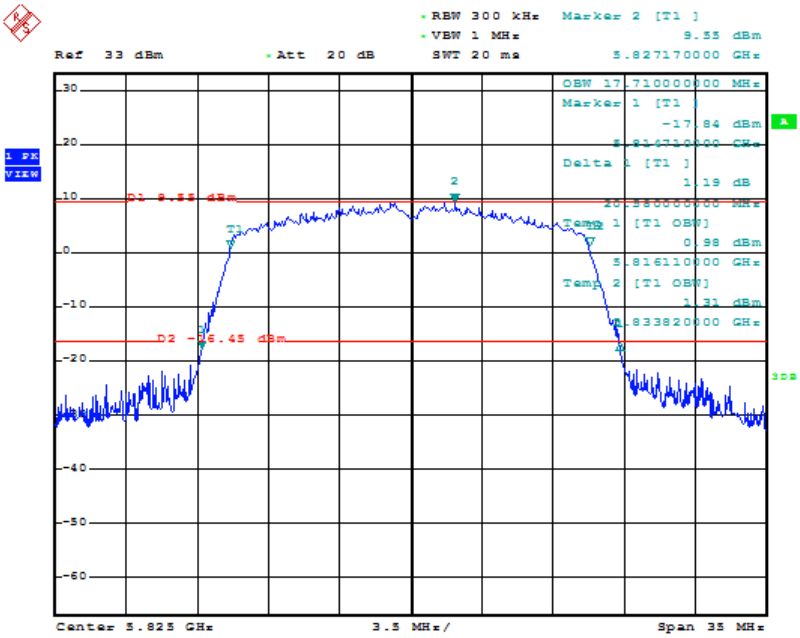


6dB bandwidth

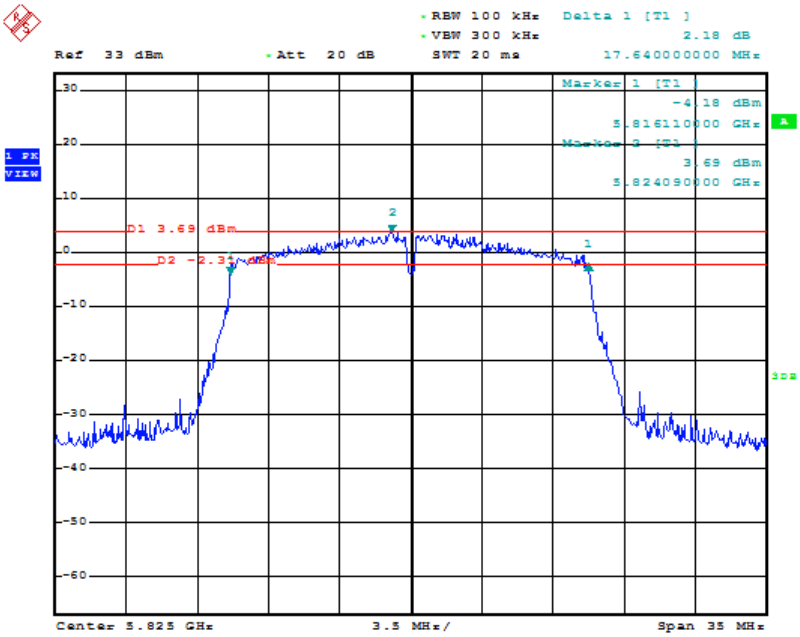


5825MHz

26dB and 99% bandwidth



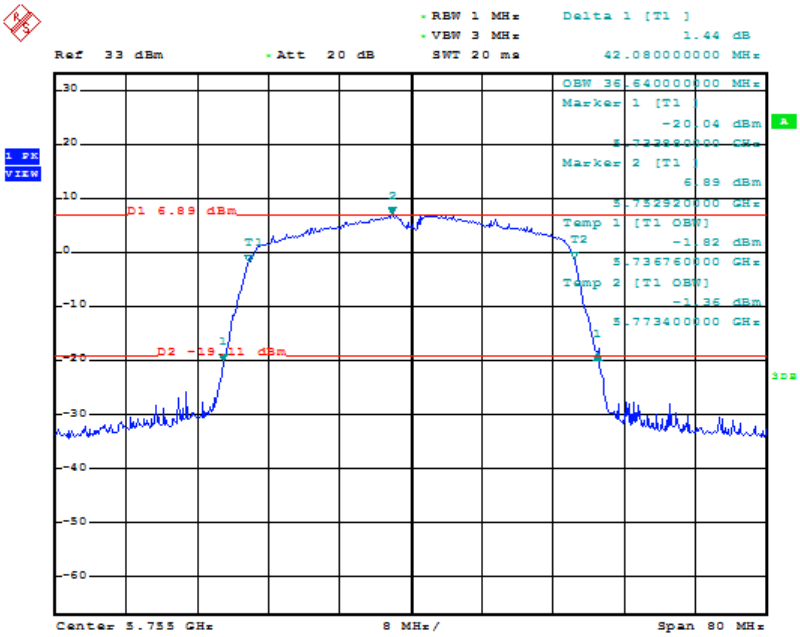
6dB bandwidth



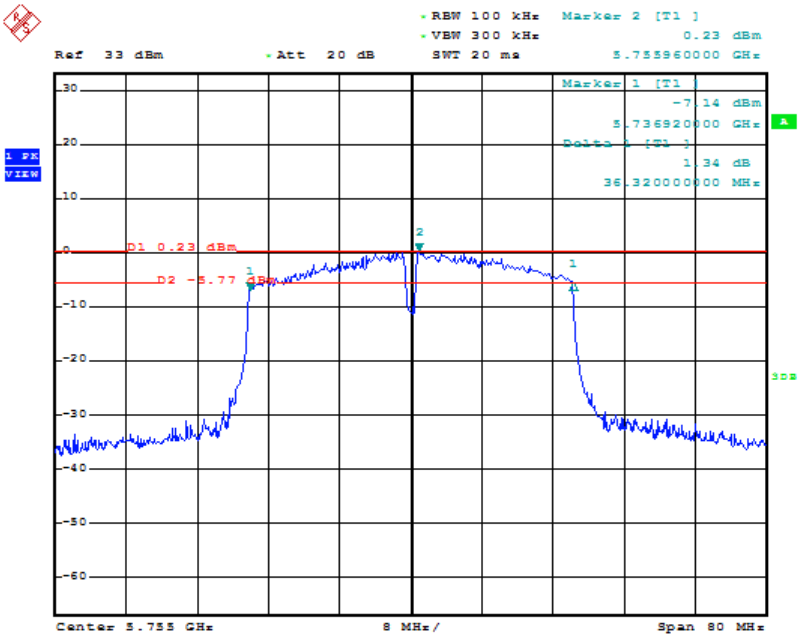
Chain 1 Test mode：802.11n-HT40

5755MHz

26dB and 99% bandwidth

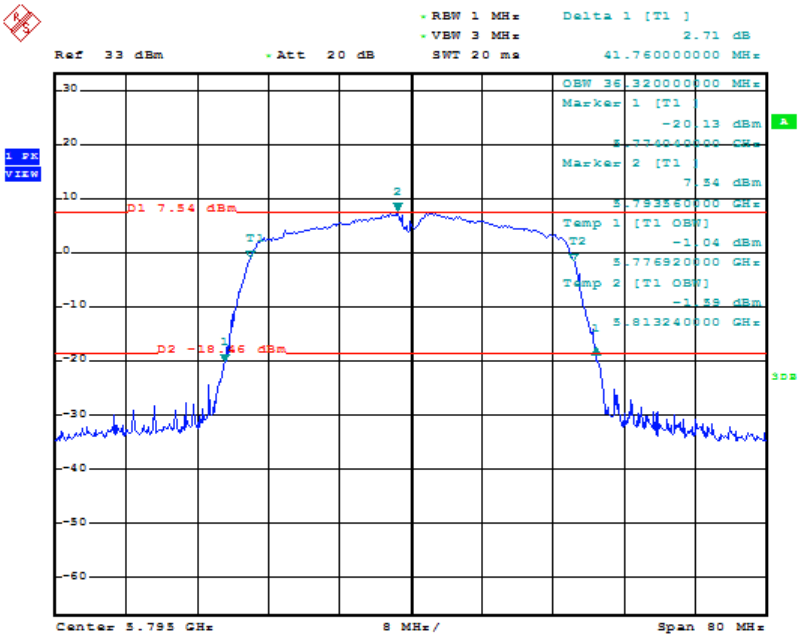


6dB bandwidth

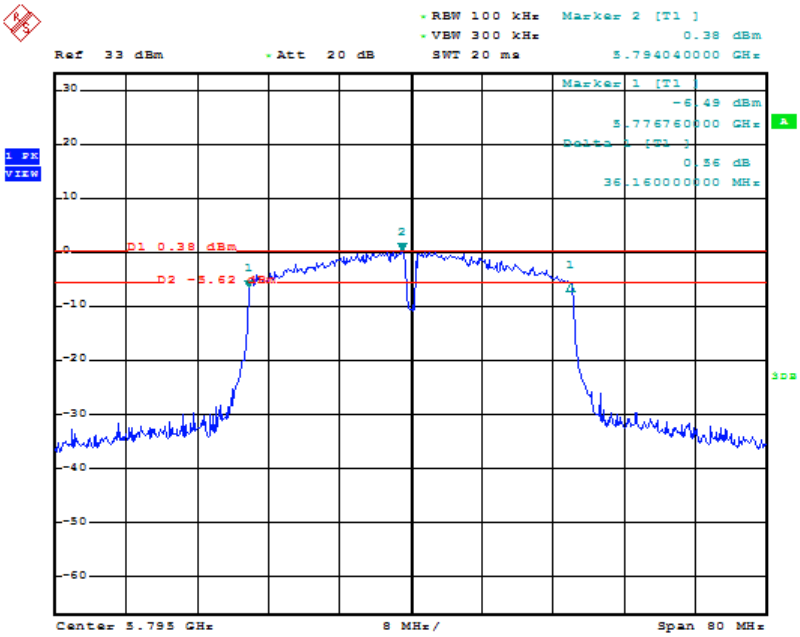


5795MHz

26dB and 99% bandwidth



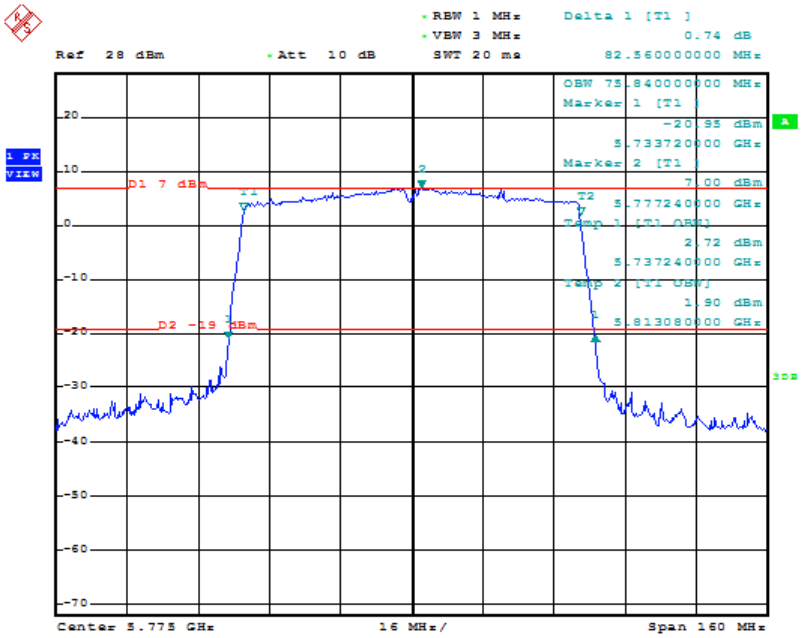
6dB bandwidth



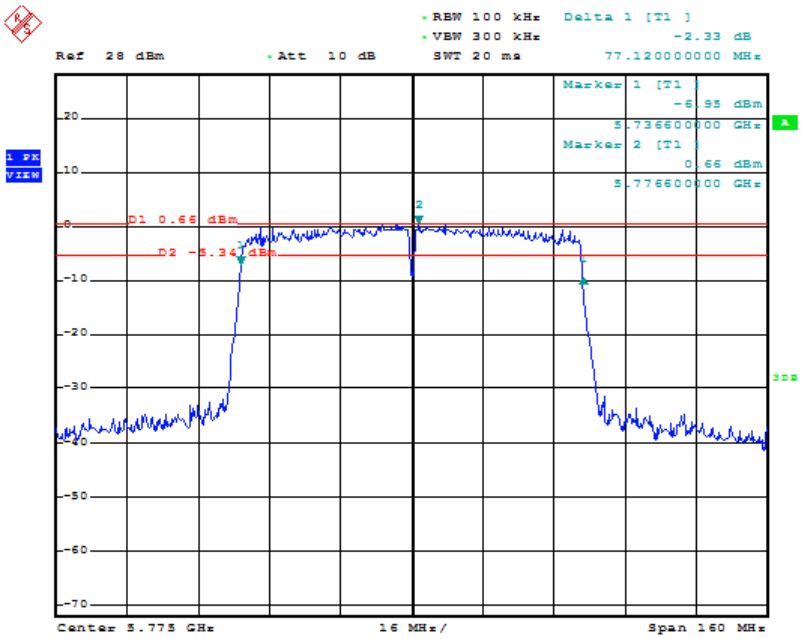
Chain 1 Test mode：802.11ac-HT80

5775MHz

26dB and 99% bandwidth



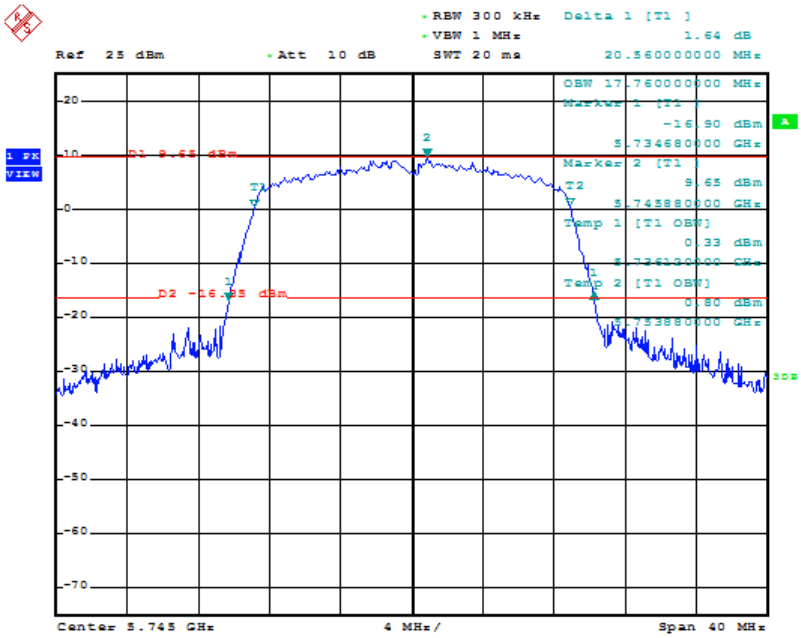
6dB bandwidth



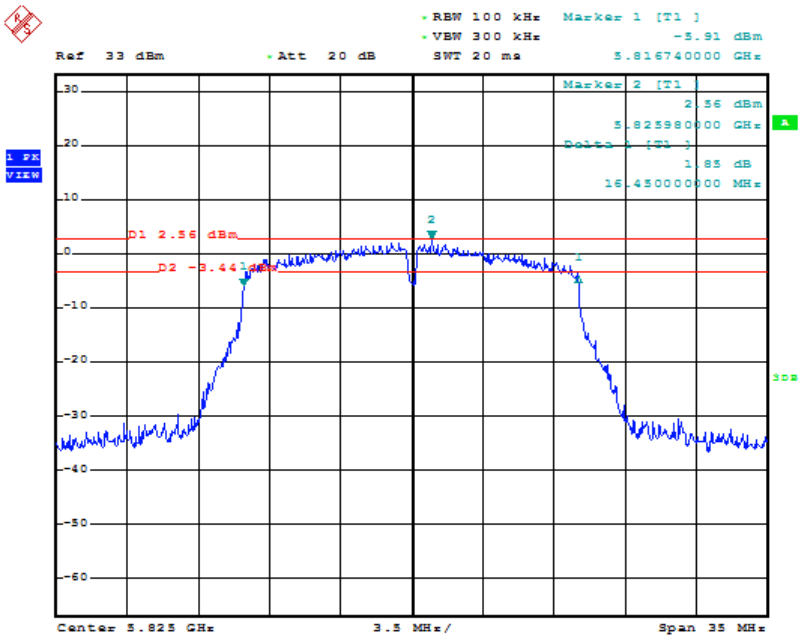
Chain 2 Test mode：802.11a

5745MHz

26dB and 99% bandwidth

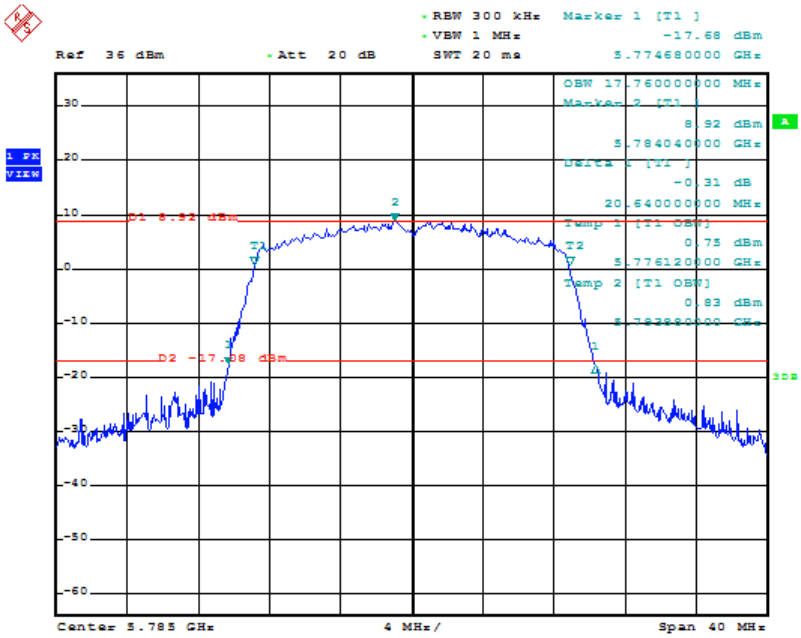


6dB bandwidht

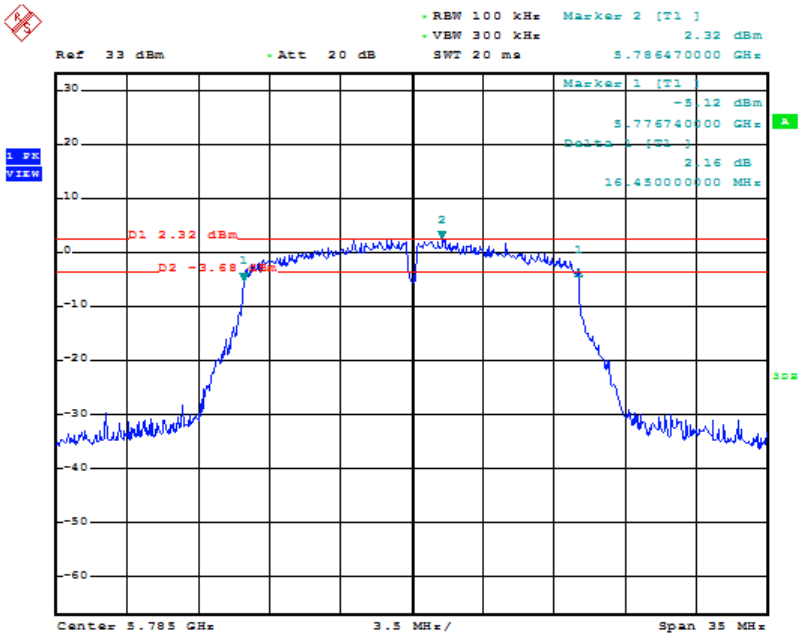


5785MHz

26dB and 99% bandwidth

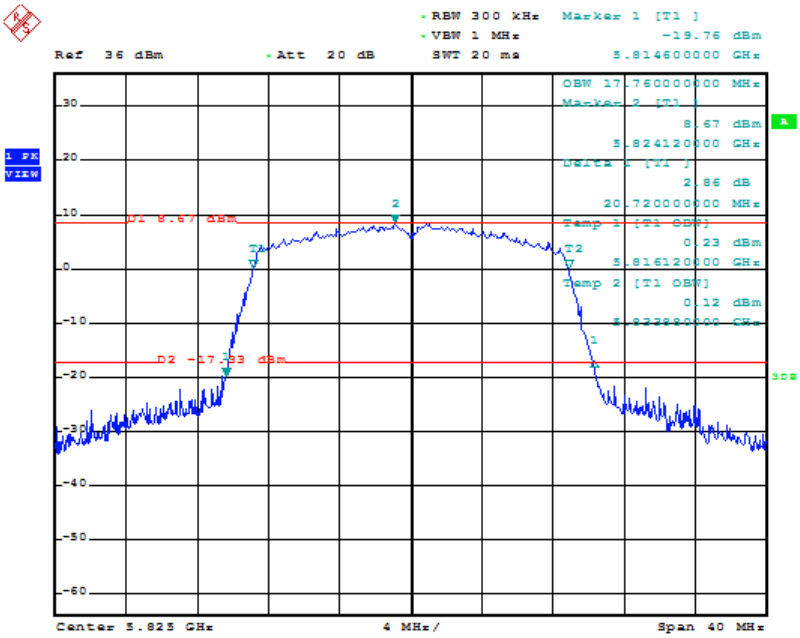


6dB bandwidht

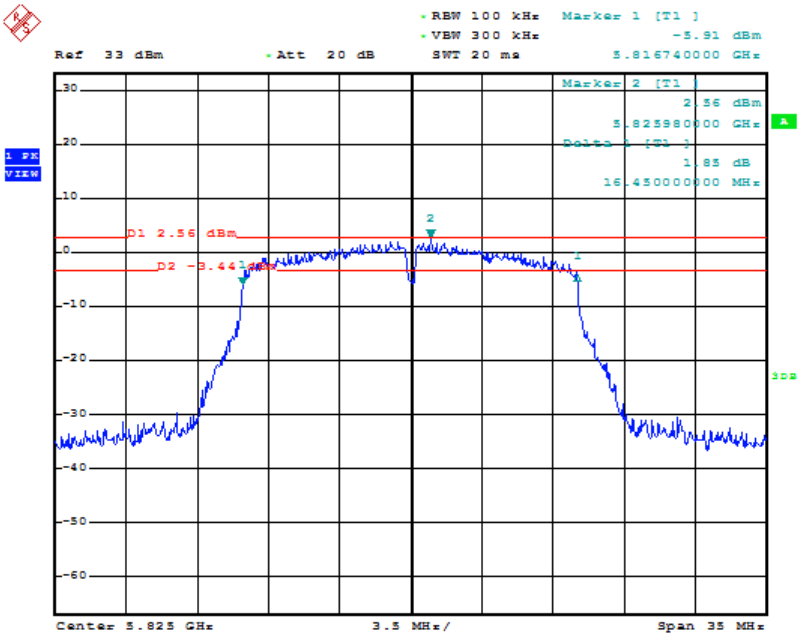


5825MHz

26dB and 99% bandwidth



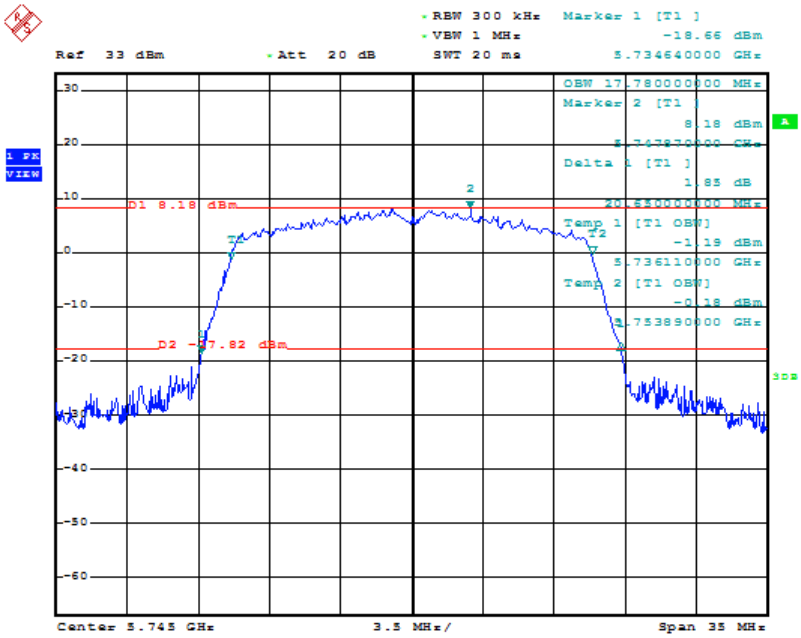
6dB bandwidht



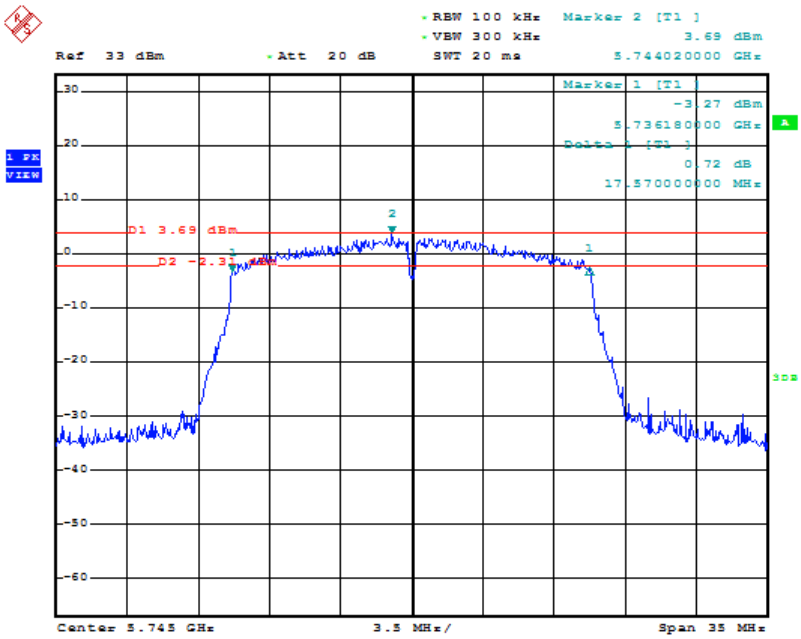
Chain 2 Test mode：802.11n-HT20

5745MHz

26dB and 99% bandwidth



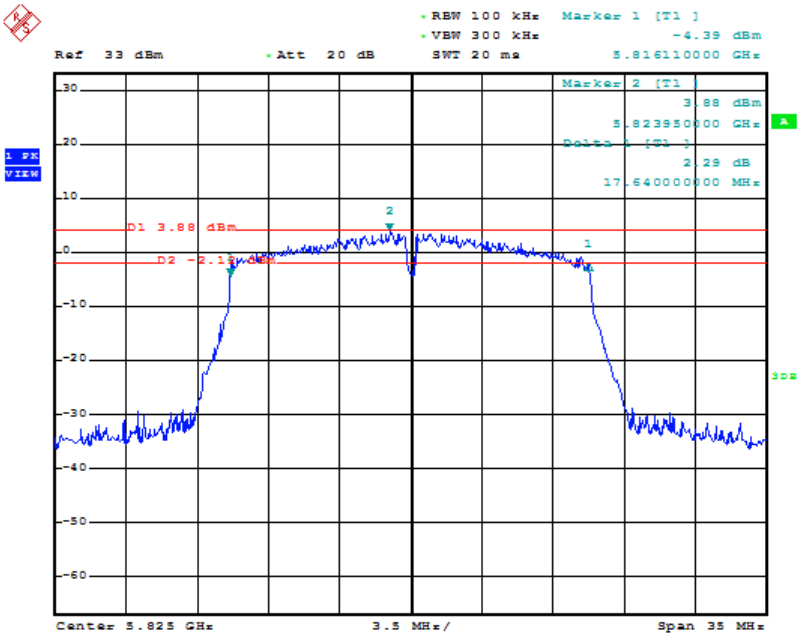
6dB bandwidth



5785MHz

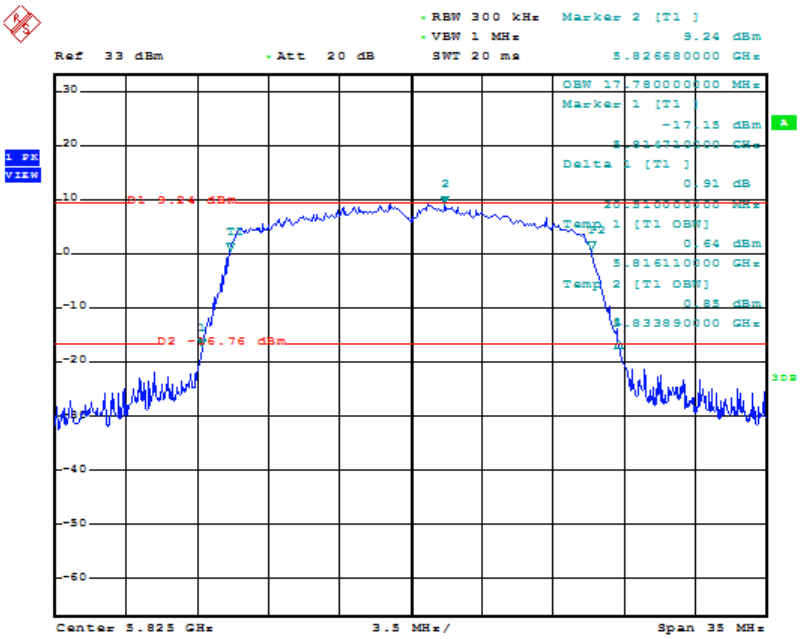
26dB and 99% bandwidth

6dB bandwidth

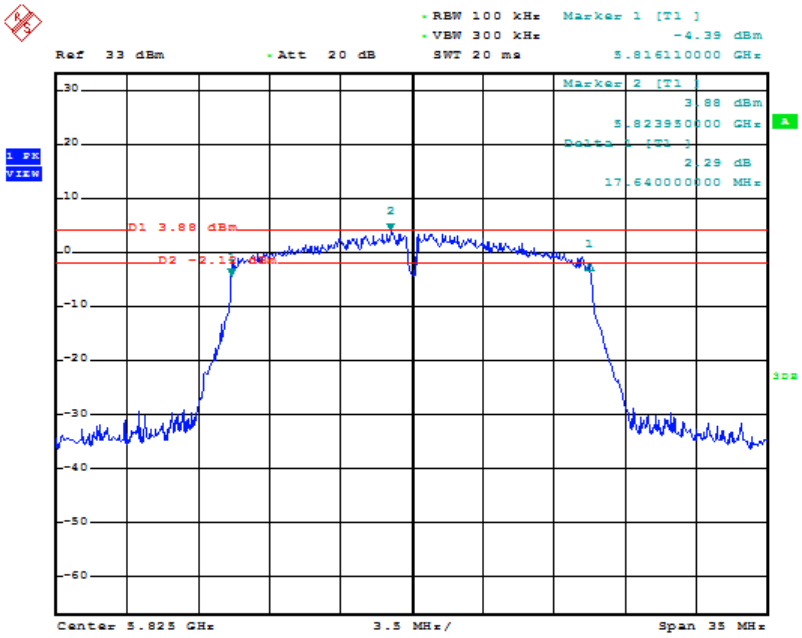


5825MHz

26dB and 99% bandwidth



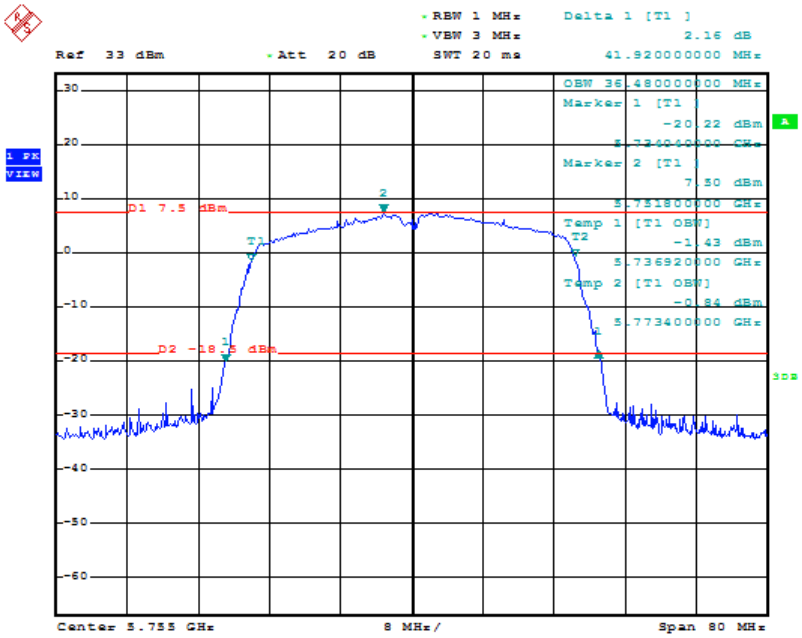
6dB bandwidth



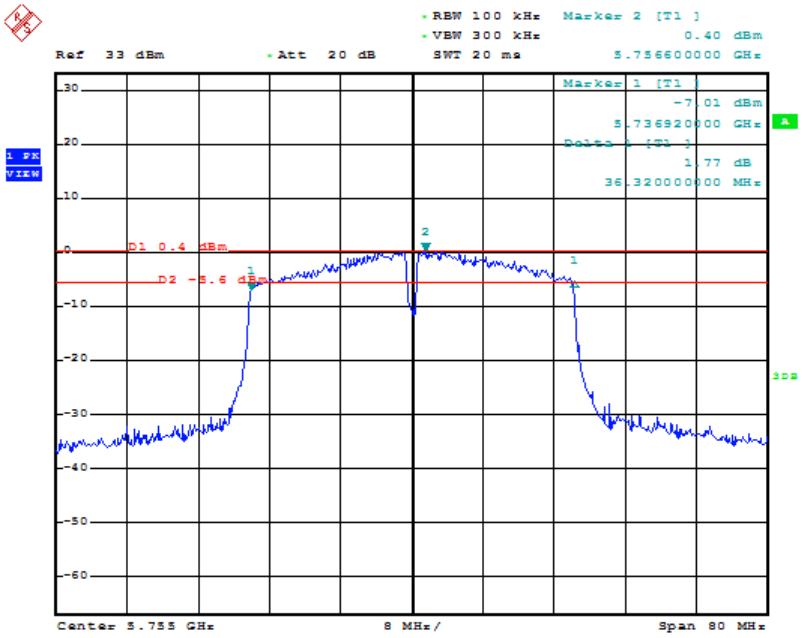
Chain 2 Test mode：802.11n-HT40

5755MHz

26dB and 99% bandwidth

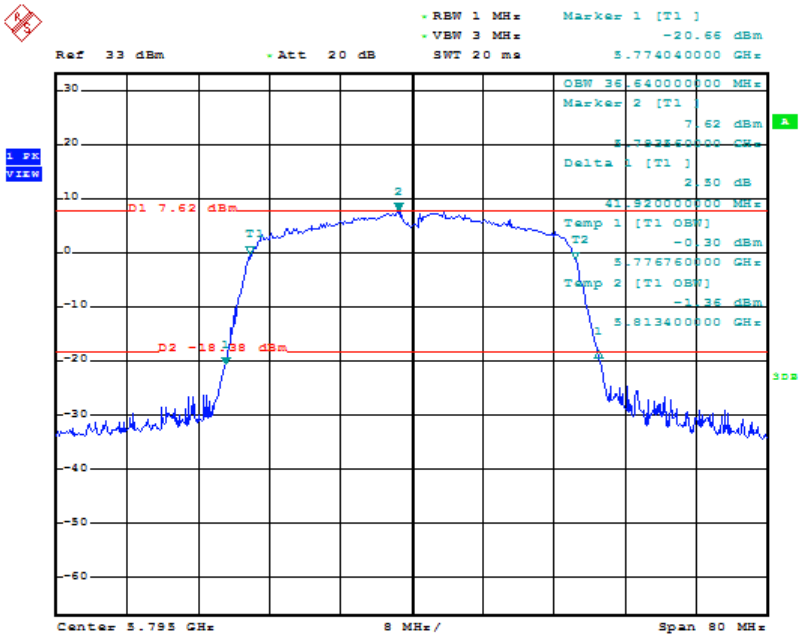


6dB bandwidth

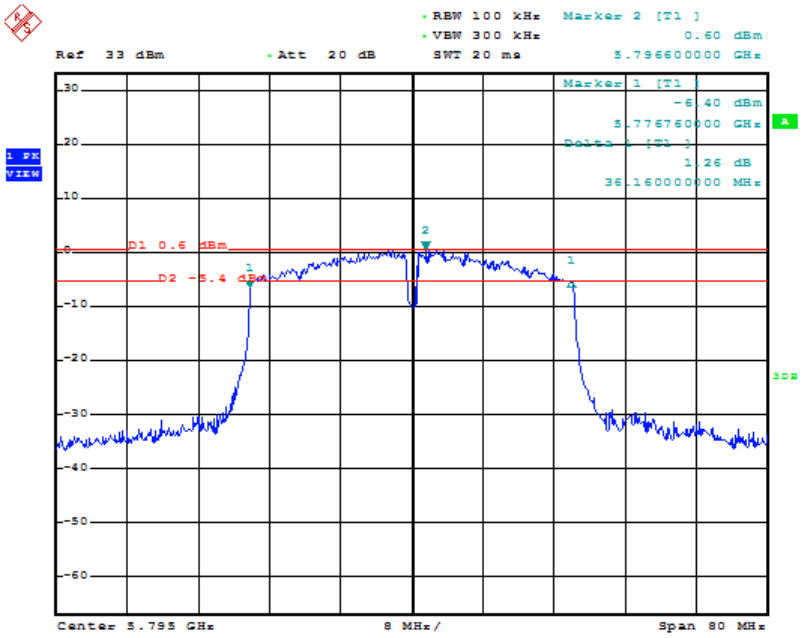


5795MHz

26dB and 99% bandwidth



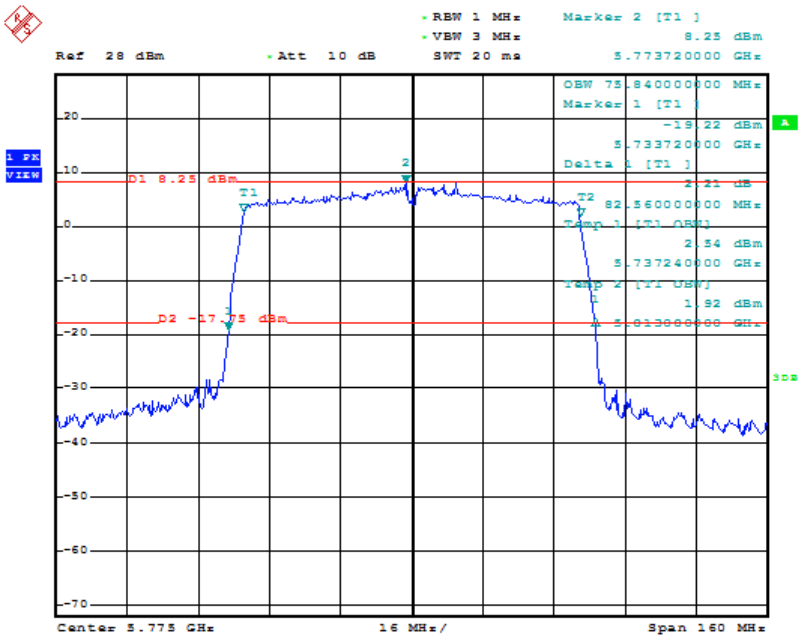
6dB bandwidth



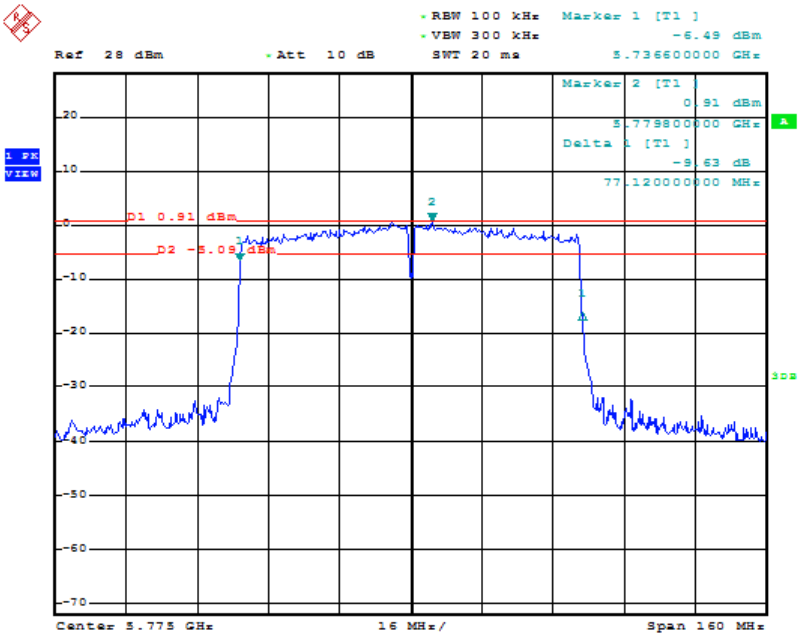
Chain 2 Test mode：802.11ac-HT80

5775MHz

26dB and 99% bandwidth



6dB bandwidth



7. Maximum Conducted Output Power

7.1 Standard Applicable

According to 15.407(a) Power limits:

(1) 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 conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, 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).

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, 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.

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, 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. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. 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.

7.2 Test Procedure

According to KDB789033 D02 v01r02 section E, the following is the measurement procedure.

(i) Set span to encompass the entire emission bandwidth (EBW) (or, alternatively, the entire 99% occupied bandwidth) of the signal.

(ii) Set RBW = 1 MHz.

(iii) Set VBW ≥ 3 MHz.

(iv) Number of points in sweep ≥ 2 Span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)

(v) Sweep time = auto.

(vi) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.

(vii) If transmit duty cycle < 98 percent, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must 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 ≥ 98 percent, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to "free run".

(viii) Trace average at least 100 traces in power averaging (i.e., RMS) mode.

(ix) Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument's band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the spectrum.

7.3 Environmental Conditions

Temperature:	26° C
Relative Humidity:	65%
ATM Pressure:	1011 mbar

7.4 Summary of Test Results/Plots

For the frequency band , 5.725-5.850GHz

Test mode	Frequency MHz	Chain 1 Power dBm	Chain 2 Power dBm	Total Power dBm	Output Power mW	Limit* mW
802.11a	5745	12.59	12.30	15.46	35.14	251
	5785	12.33	12.41	15.38	34.52	251
	5825	12.47	12.53	15.51	35.57	251
802.11n-HT20	5745	11.68	11.82	14.76	29.93	251
	5785	13.0	13.10	16.06	40.37	251
	5825	11.44	12.71	15.13	32.60	251
802.11n-HT40	5755	12.88	12.93	15.92	39.04	251
	5795	11.98	11.98	14.99	31.55	251
802.11ac-HT80	5775	12.60	12.47	15.55	35.86	251

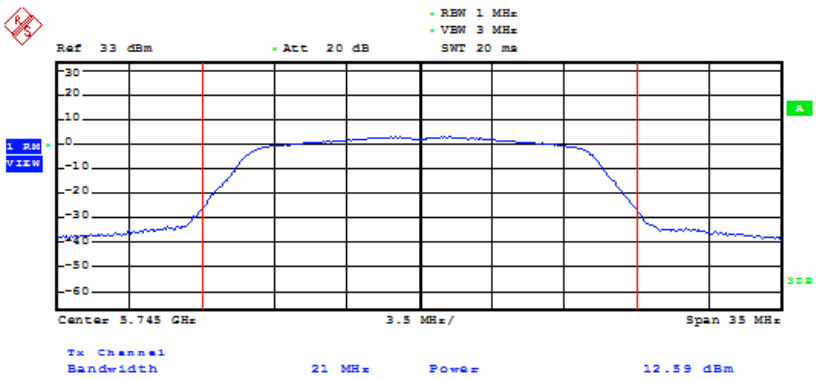
*

For 5745-5850MHz: 1.Limit=30-(12-6)=24dBm

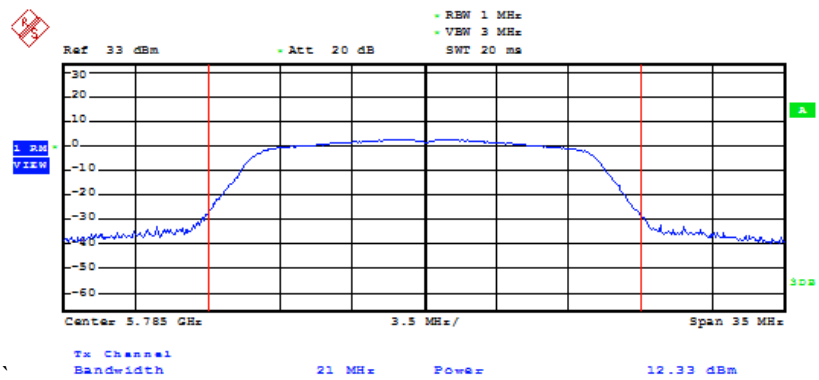
2. The Total Power (dBm) = $10*\log\{10^{(\text{Chain 1 Power }/10)}+10^{(\text{Chain 2 Power }/10)}\}$.

Chain 1 Test Mode: 802.11a

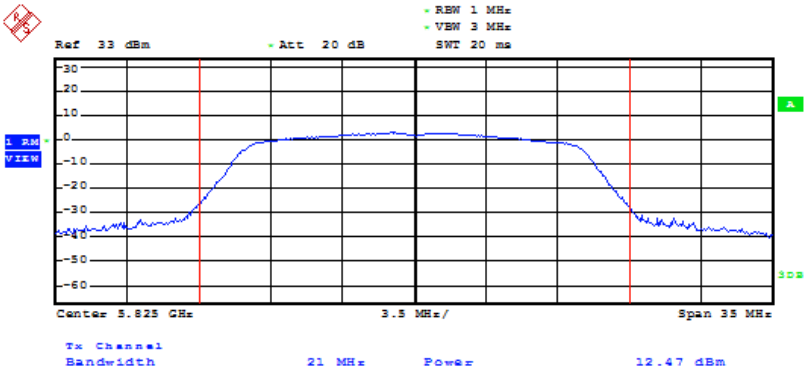
5745MHz



5785MHz

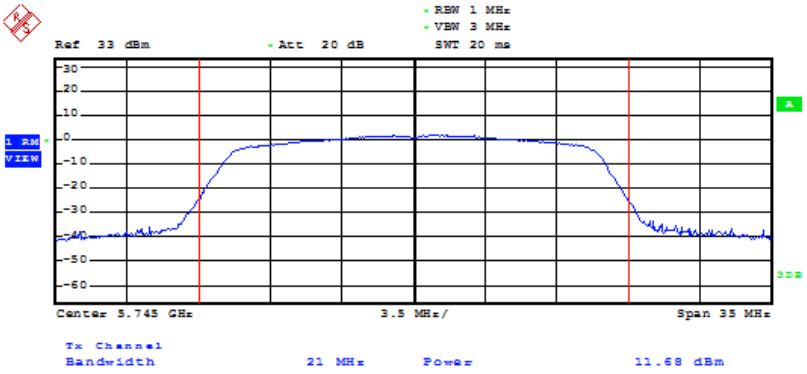


5825MHz

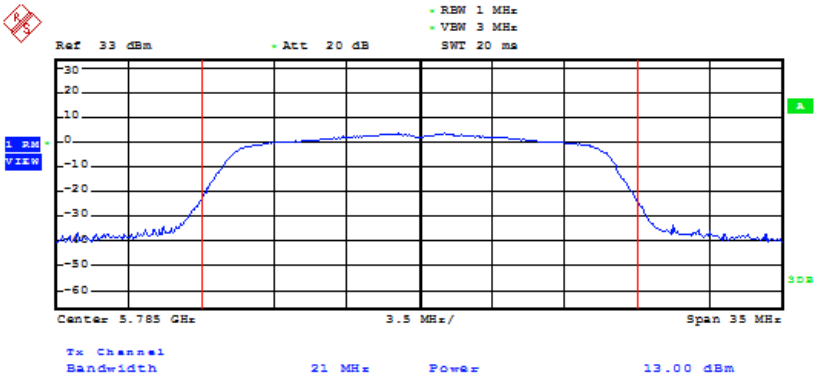


Chain 1 Test Mode: 802.11n-HT20

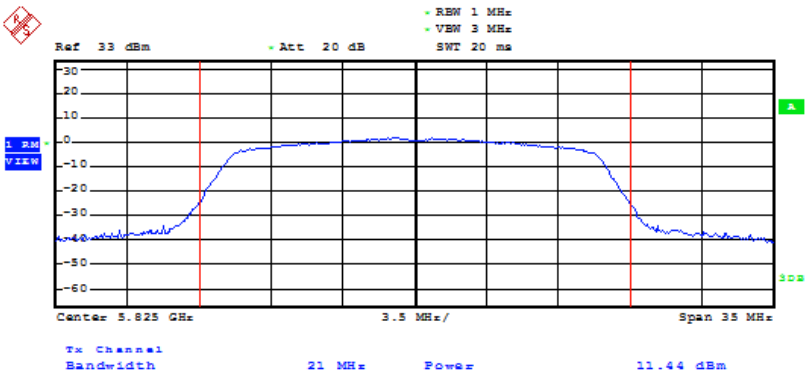
5745MHz



5785MHz

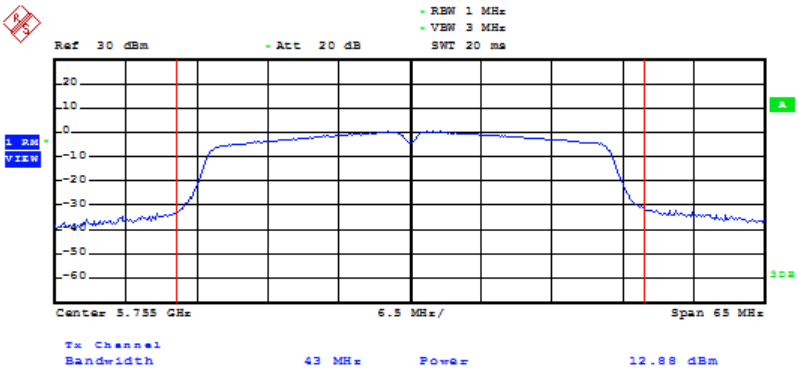


5825MHz

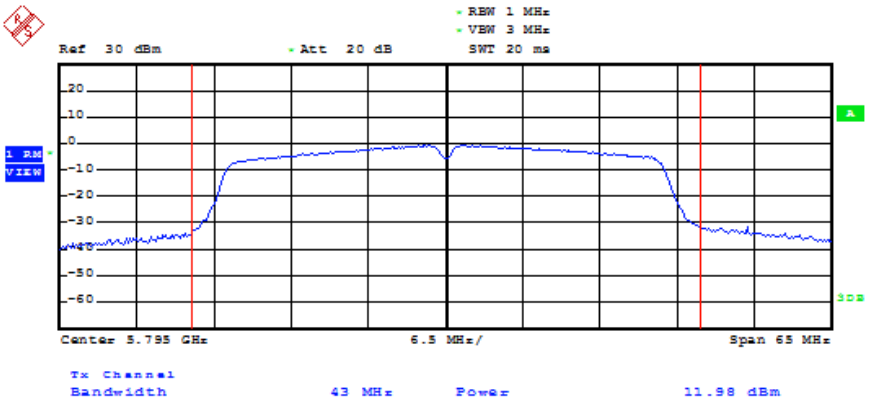


Chain 1 Test Mode: 802.11n-HT40

5755MHz

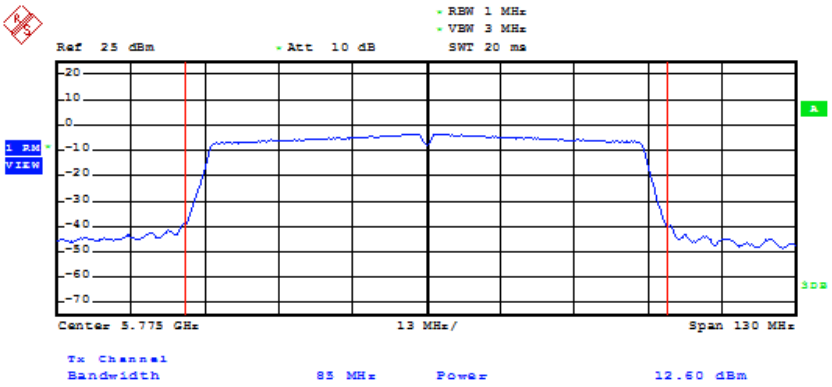


5795MHz



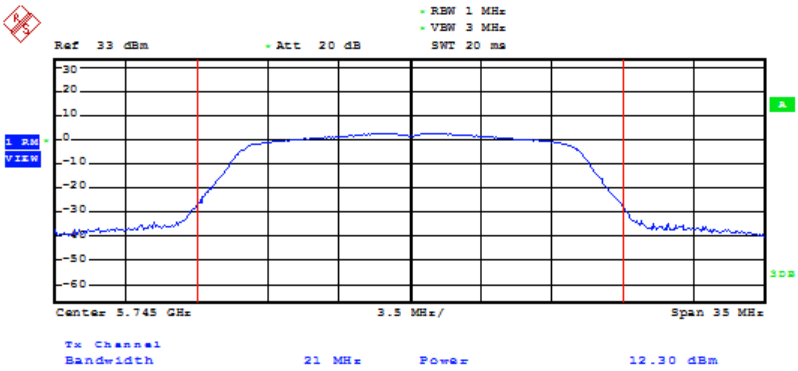
Chain 1 Test Mode: 802.11ac-HT80

5775MHz

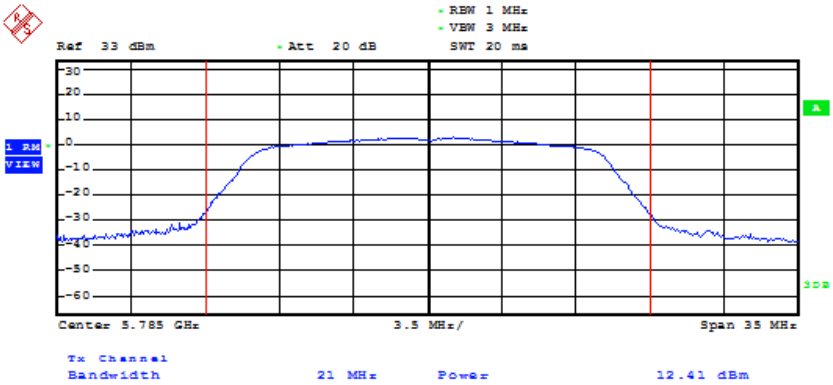


WIFI 2 Test Mode: 802.11a

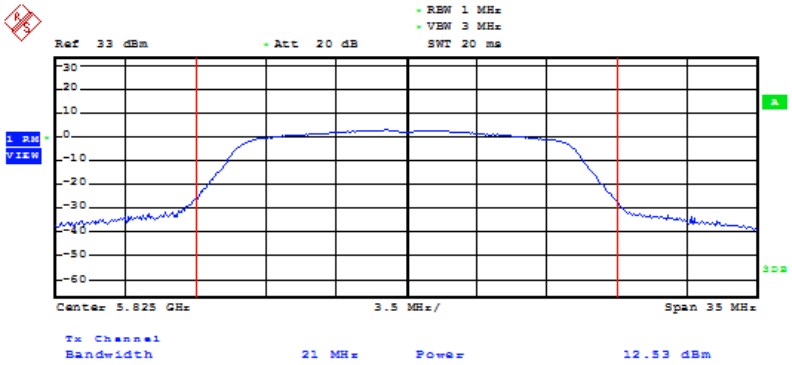
5745MHz



5785MHz

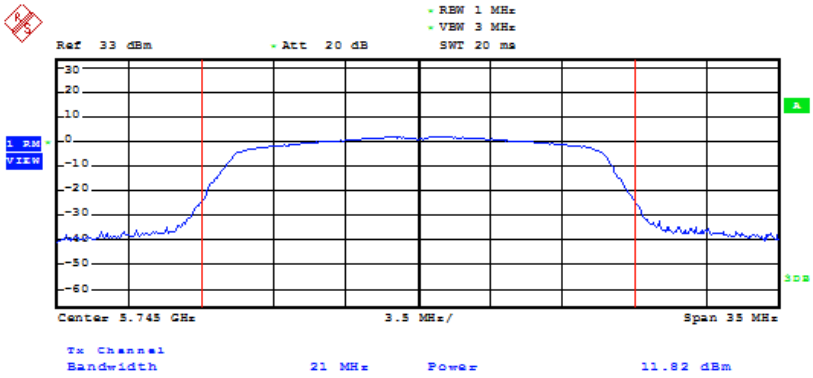


5825MHz

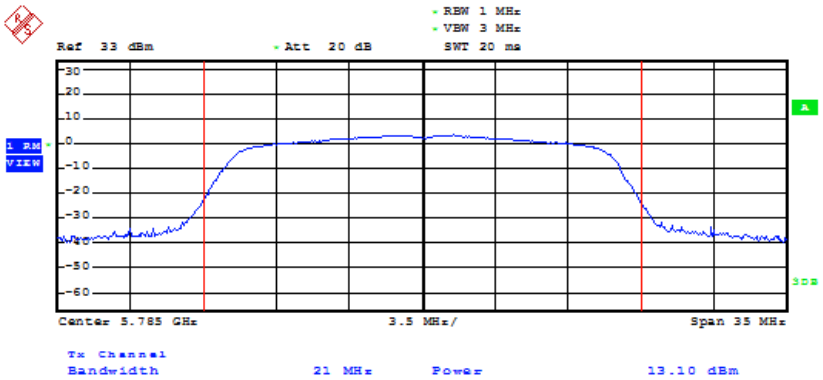


Chain 2 Test Mode: 802.11n-HT20

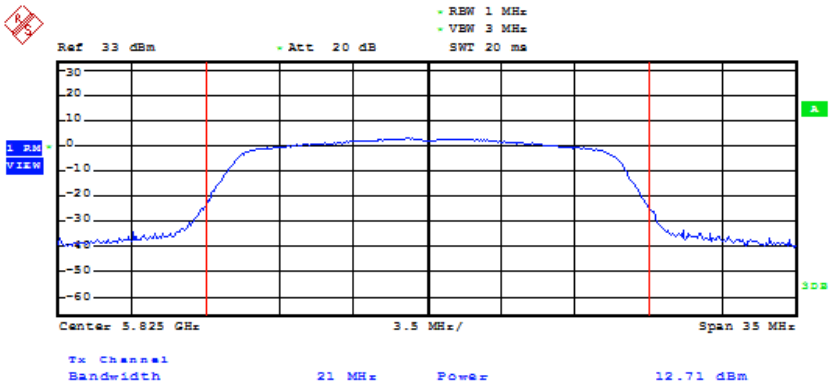
5745MHz



5785MHz

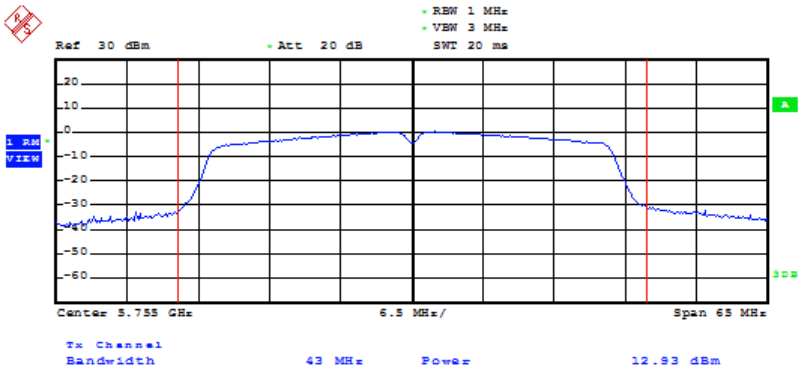


5825MHz

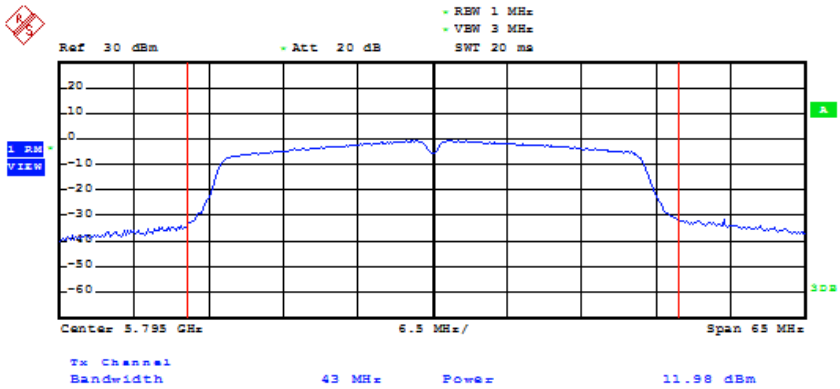


Chain 2 Test Mode: 802.11n-HT40

5755MHz

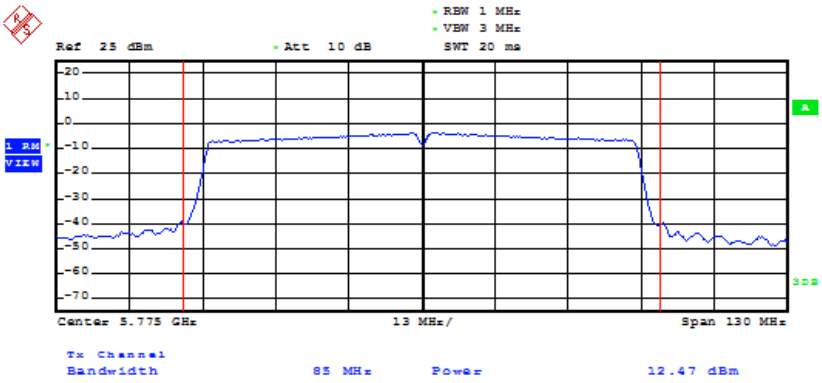


5795MHz



Chain 2 Test Mode: 802.11ac-HT80

5775MHz



8. Conducted Spurious Emissions

8.1 Standard Applicable

According to §15.407 (b) (b) Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following 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 e.i.r.p. 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 e.i.r.p. of −27 dBm/MHz.
(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 e.i.r.p. of −27 dBm/MHz.
(4) For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of −17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of −27 dBm/MHz.

8.2 Test Procedure

1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer via a RF combiner.
2. Set the spectrum analyzer as RBW = 100kHz/1MHz, VBW=300kHz/3MHz, Sweep = auto
3. Set the Lowest, Middle and Highest Transmitting Channel, observed the outside band of 30MHz to 40GHz, then mark the higher-level emission for comparing with the FCC rules.

8.3 Environmental Conditions

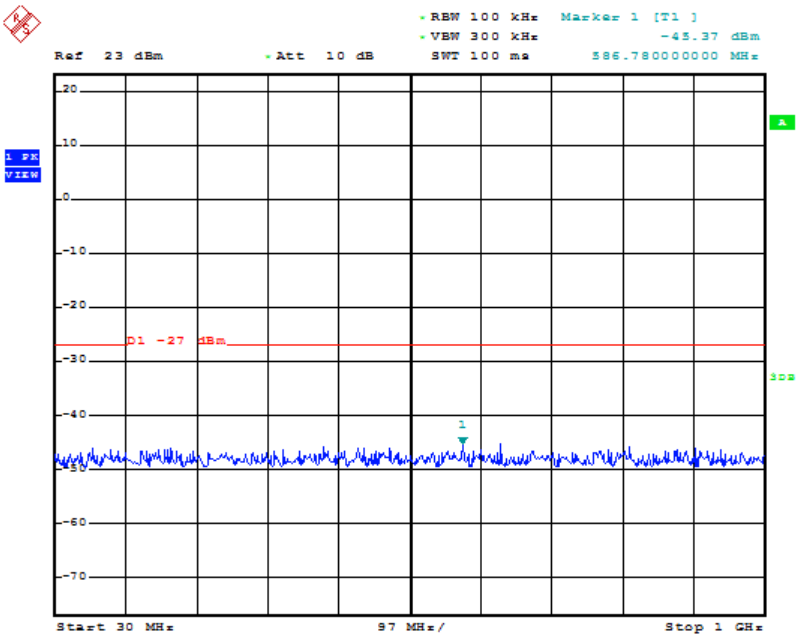
Temperature:	21° C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

8.4 Summary of Test Results/Plots

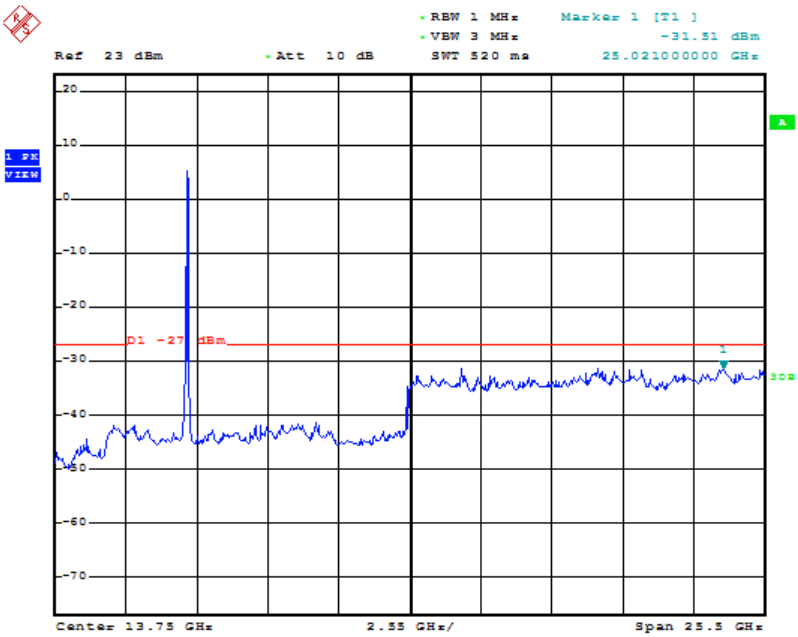
Note: 1.Emissions above 26.5GHz are attenuated more than 20dB below the permissible limits and test data are not reported.

2. Worst-case Conducted Spurious Emissions above 1GHz is 802.11a (Chain 1)802.11ac (Chain 2) mode.

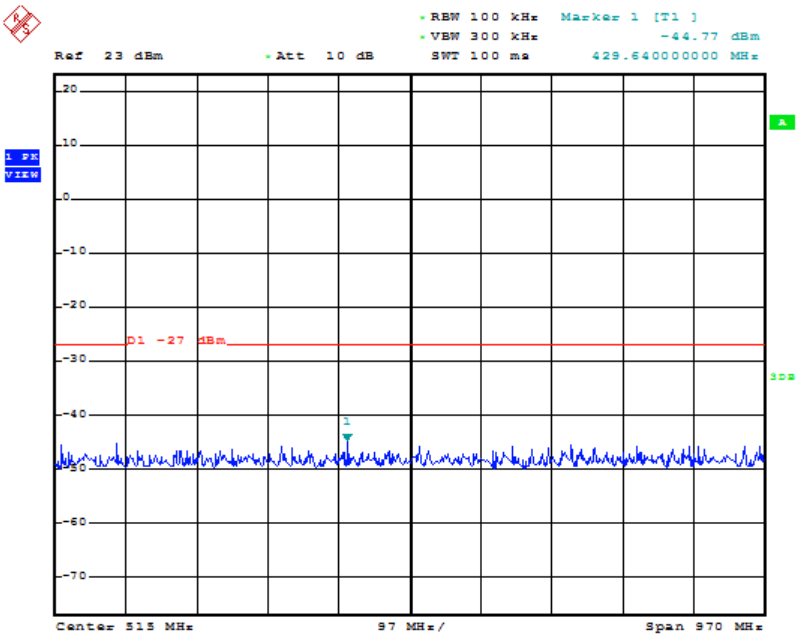
Chain 1 30MHz-1000MHz



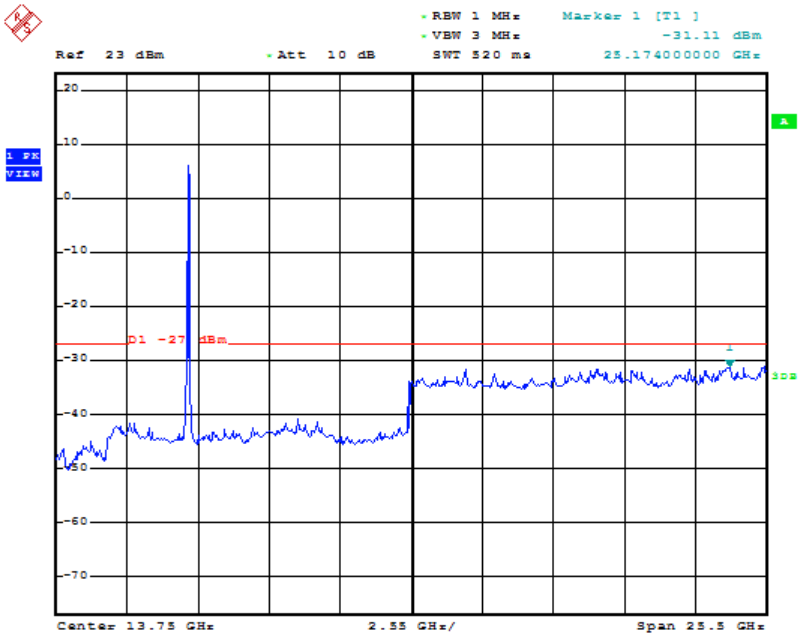
Chain 1 above 1GHz



Chain 2 30MHz-1000MHz



Chain 2 above 1GHz



9. Radiated Spurious Emissions

9.1 Measurement Uncertainty

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement is ±5.10 dB.

9.2 Standard Applicable

According to §15.407(b)(6), Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.
According to §15.407(b)(7), The provisions of §15.205 apply to intentional radiators operating under this section.
789033 D02 v01r02 General UNII Test Procedures New Rules v01
If radiated measurements are performed, field strength is then converted to EIRP as follows:

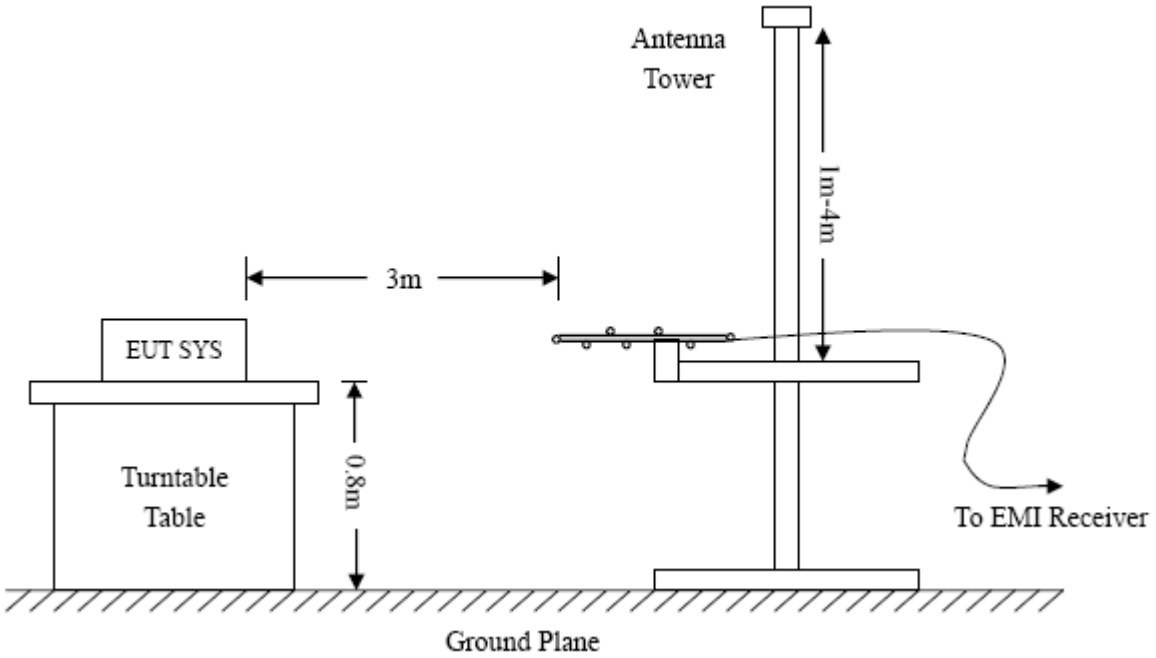
EIRP = ((E*d)^2) / 30

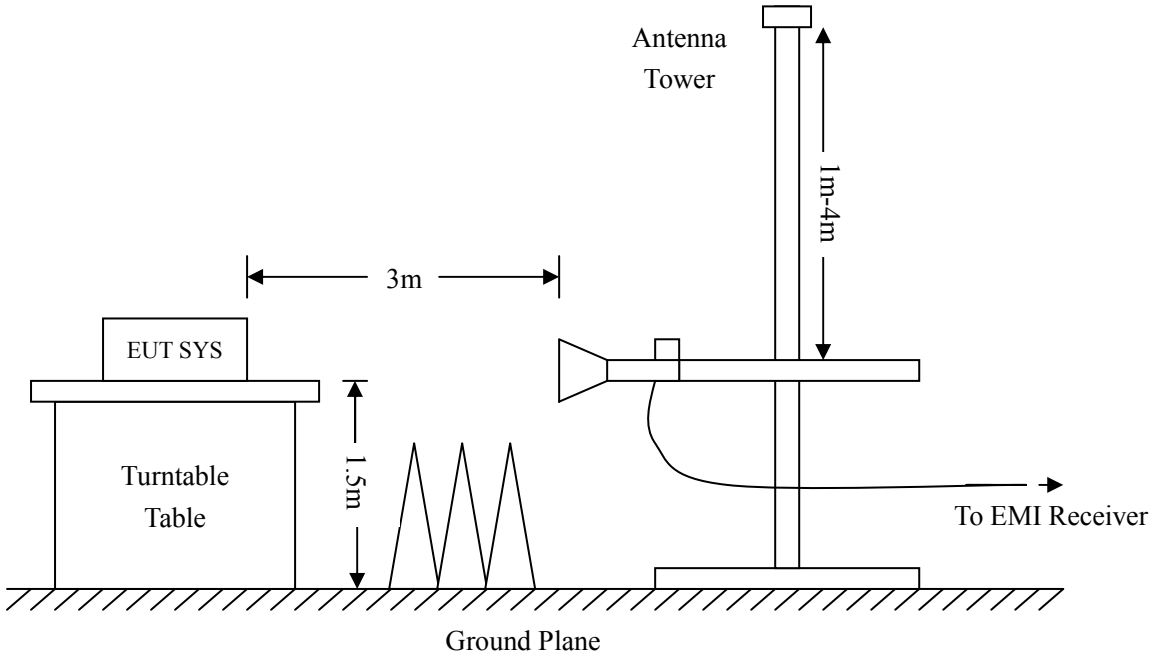
where:

- E is the field strength in V/m;
- d is the measurement distance in meters;
- EIRP is the equivalent isotropically radiated power in watts.

9.3 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 15.407(b)(6) and FCC Part 15.209 Limit..
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.
The spacing between the peripherals was 10 cm.





9.4 Test Receiver Setup

During the radiated emission test for above 1GHz, the test receiver was set with the following configurations:

For peak detector:
RBW = 1000kHz, VBW = 3000kHz, Sweep Time = Auto

For average detector:
RBW = 1000kHz, VBW = 10Hz, Sweep Time = Auto

9.5 Corrected Amplitude & Margin Calculation

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

Corr. Ampl. = Indicated Reading + Ant. Factor + Cable Loss – Ampl. Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dBμV means the emission is 6dBμV below the maximum limit. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – FCC Part 15 Limit

9.6 Environmental Conditions

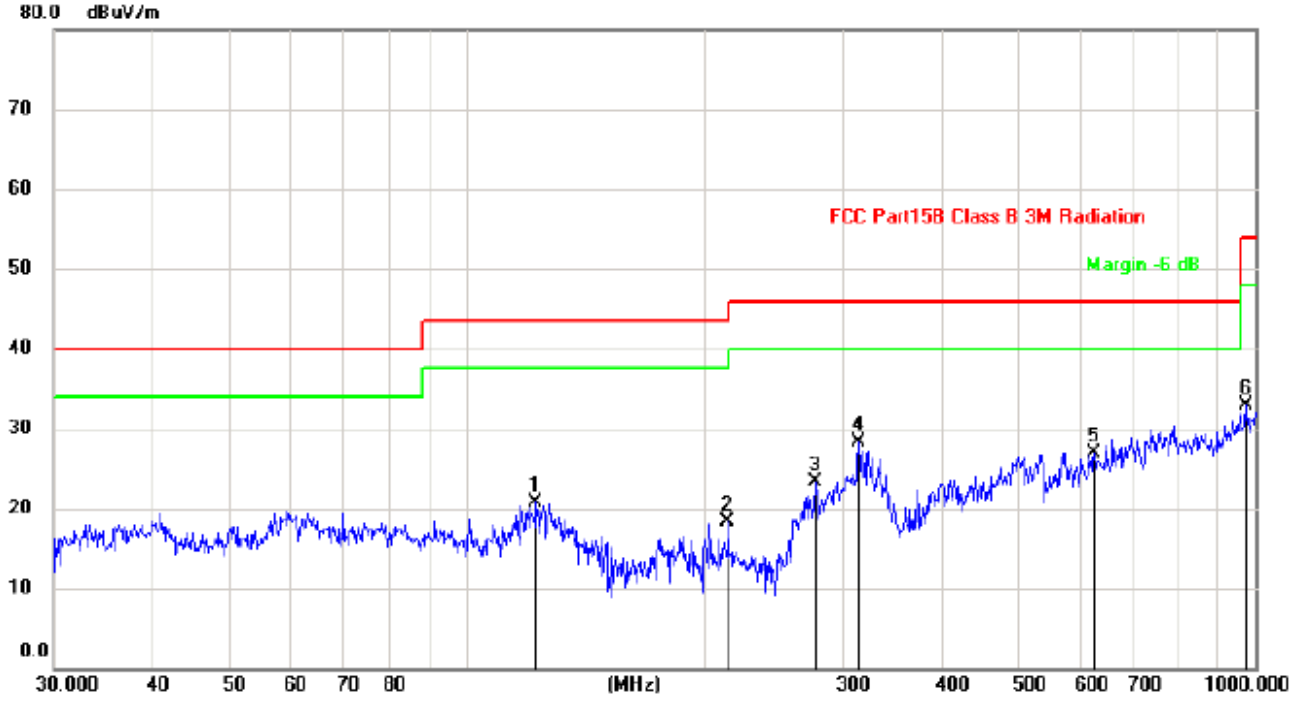
Temperature:	22° C
Relative Humidity:	52%
ATM Pressure:	1012 mbar

9.7 Summary of Test Results/Plots

According to the data below, the FCC Part 15.205, 15.209 and 15.407(b)(6) standards, and had the worst margin of:

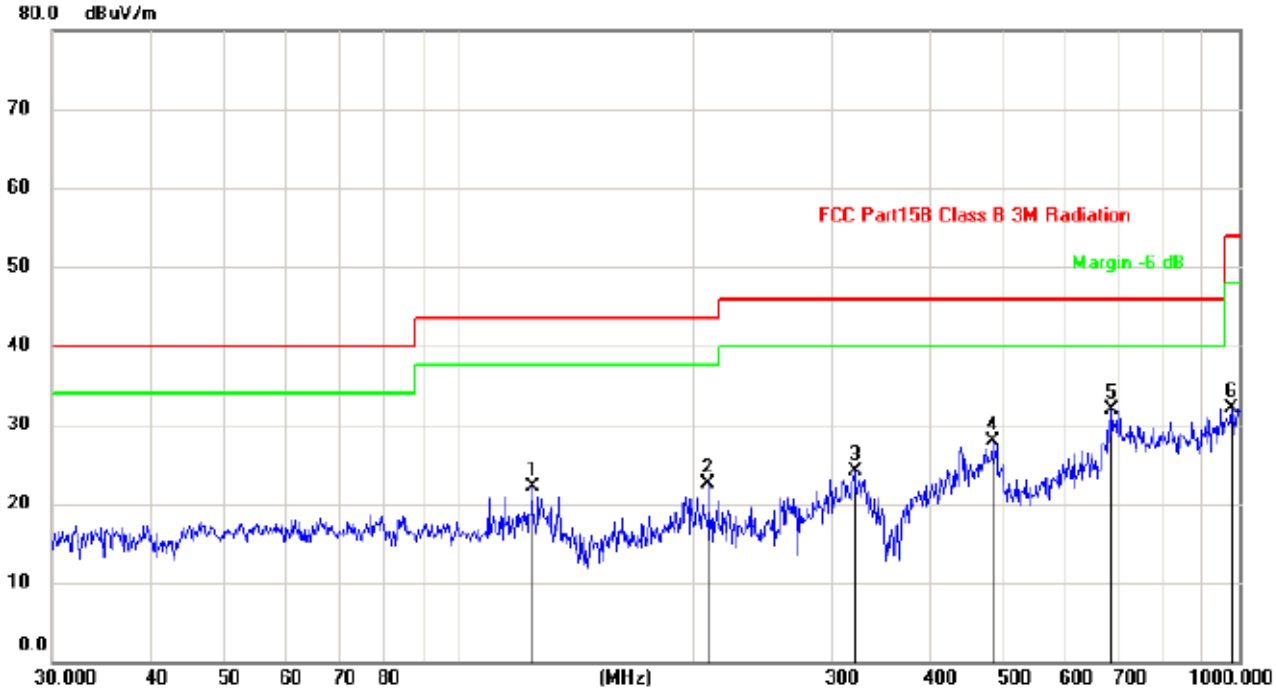
Note:
1. Worst-case radiated emission below 1GHz is 802.11a 5725-5850MHz band low channel(5745MHz) of Chain 1 mode.
2. Worst-case radiated emission above 1GHz is 802.11a (Chain 1)802.11ac (Chain 2) mode.

Chain 1: For 802.11a
5725-5850MHz band
Spurious Emission From 30 MHz to 1 GHz
Test mode: Transmitting Low Channel 5745MHz
Horizontal



No.	Mk.	Freq.	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		122.4040	20.80	43.50	-22.70	QP			
2		214.5143	18.36	43.50	-25.14	QP			
3		277.0935	23.34	46.00	-22.66	QP			
4	*	314.3765	28.24	46.00	-17.76	QP			
5		625.0780	26.95	46.00	-19.05	QP			
6		972.3374	32.90	54.00	-21.10	QP			

Test Specification: *Vertical*



No.	Mk.	Freq.	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		123.6985	22.03	43.50	-21.47	QP			
2		208.5803	22.57	43.50	-20.93	QP			
3		321.0608	24.10	46.00	-21.90	QP			
4		482.2156	27.99	46.00	-18.01	QP			
5	*	687.1507	31.82	46.00	-14.18	QP			
6		979.1804	32.13	54.00	-21.87	QP			

Chain 1:802.11a Mode:
For the frequency band 5.725-5.850GHz

Hormonics And Spurious Emissions

Frequency MHz	Detector	Meter Reading dBuV	Direction Degree	Polar H / V	Antenna Loss dB	Cable loss dB	Amplifier dB	Correction Amplitude dBuV/m	Limit dBuV/m	Margin dB
Low Channel (5725MHz)										
11450	PK	51.1	360	V	38.9	9.8	40.1	59.7	74	-14.3
11450	PK	49.9	360	H	38.9	9.8	40.1	58.5	74	-15.5
11450	AV	35.3	360	V	38.9	9.8	40.1	43.9	54	-10.1
11450	AV	33.2	360	H	38.9	9.8	40.1	41.8	54	-12.2
High Channel (5825MHz)										
11650	PK	52.8	360	V	38.9	9.8	40.1	61.4	74	-12.6
11650	PK	51.7	360	H	38.9	9.8	40.1	60.3	74	-13.7
11650	AV	33.3	360	V	38.9	9.8	40.1	41.9	54	-12.1
11650	AV	31.5	360	H	38.9	9.8	40.1	40.1	54	-13.9

Out of Band edge

Test CH.	Test Segment	Result	Limit
	MHz	dBm/MHz	dBm/MHz
Lowest	Below 5715	-48.31	-27
	5715 to 5725	-44.32	-17
Highest	5850 to 5860	-45.35	-17
	Above 5860	-48.63	-27
Note: the data just list the worst cases			

Chain 2:802.11ac Mode:
For the frequency band 5.725-5.85GHz

Hormonics And Spurious Emissions

Frequency MHz	Detector	Meter Reading dBuV	Direction Degree	Polar H / V	Antenna Loss dB	Cable loss dB	Amplifier dB	Correction Amplitude dBuV/m	Limit dBuV/m	Margin dB
Low Channel (5775MHz)										
11550	PK	49.4	360	V	38.9	9.8	40.1	58.0	74	-16.0
11550	PK	49.0	360	H	38.9	9.8	40.1	57.6	74	-16.4
11550	AV	31.4	360	V	38.9	9.8	40.1	40.0	54	-14.0
11550	AV	30.8	360	H	38.9	9.8	40.1	39.4	54	-14.6

Out of Band edge

Test CH.	Test Segment	Result	Limit
	MHz	dBm/MHz	dBm/MHz
Lowest	Below 5715	-45.96	-27
	5715 to 5725	-43.37	-17
Highest	5850 to 5860	-45.78	-17
	Above 5860	-46.62	-27
Note: the data just list the worst cases			

Note: Testing is carried out with frequency rang 30MHz to 40GHz, which above 3th Harmonics are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

10. Conducted Emissions

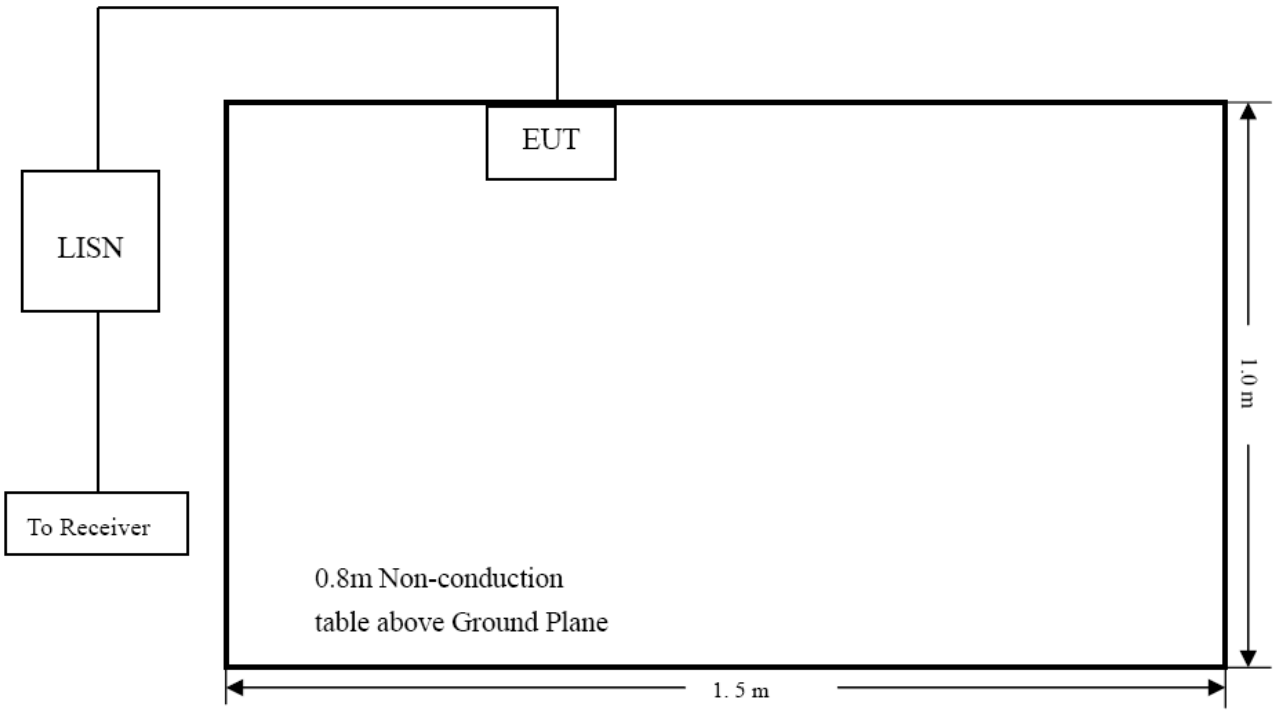
10.1 Measurement Uncertainty

Base on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of any conducted emissions measurement is ± 2.88 dB.

10.2 Test Procedure

The setup of EUT is according with per ANSI C63.4-2014 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 40 cm long in the middle.
The spacing between the peripherals was 10 cm.

10.3 Basic Test Setup Block Diagram



10.4 Environmental Conditions

Temperature:	25 °C
Relative Humidity:	52%
ATM Pressure:	1012 mbar

10.5 Test Receiver Setup

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

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

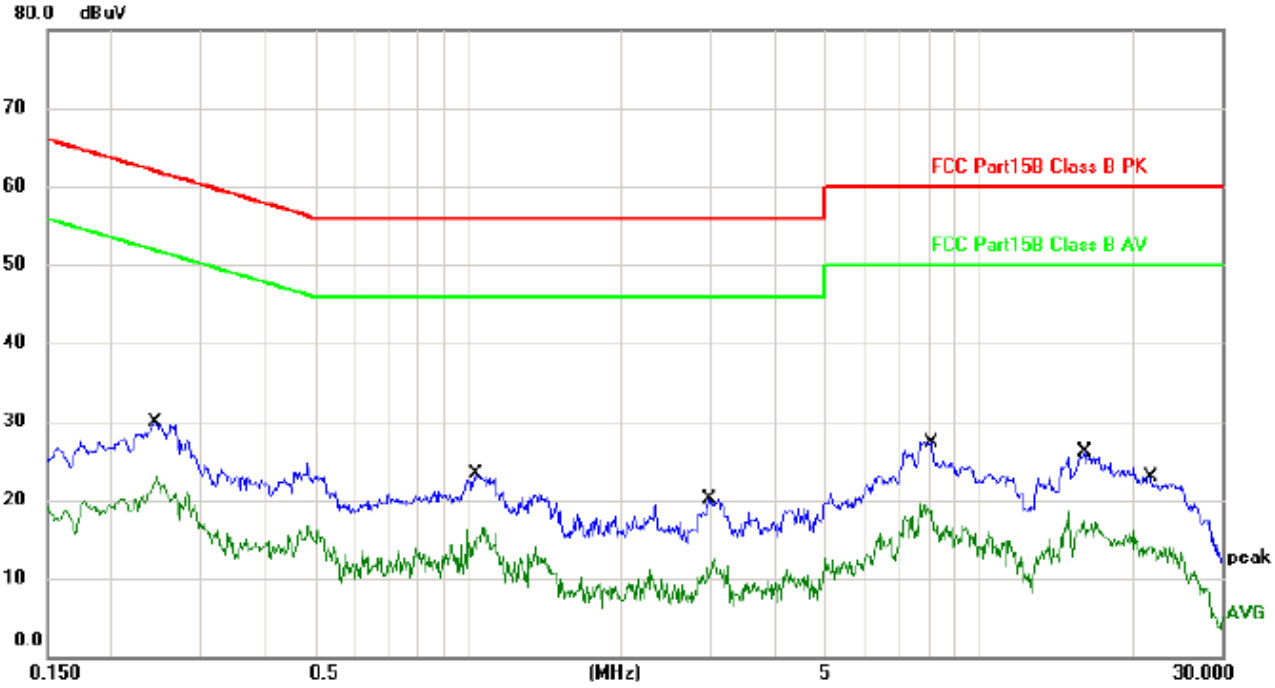
10.6 Summary of Test Results/Plots

According to the data in section 5.7, the EUT complied with the FCC Part 15.207 Conducted margin for this device, with the worst data.

10.7 Conducted Emissions Test Data

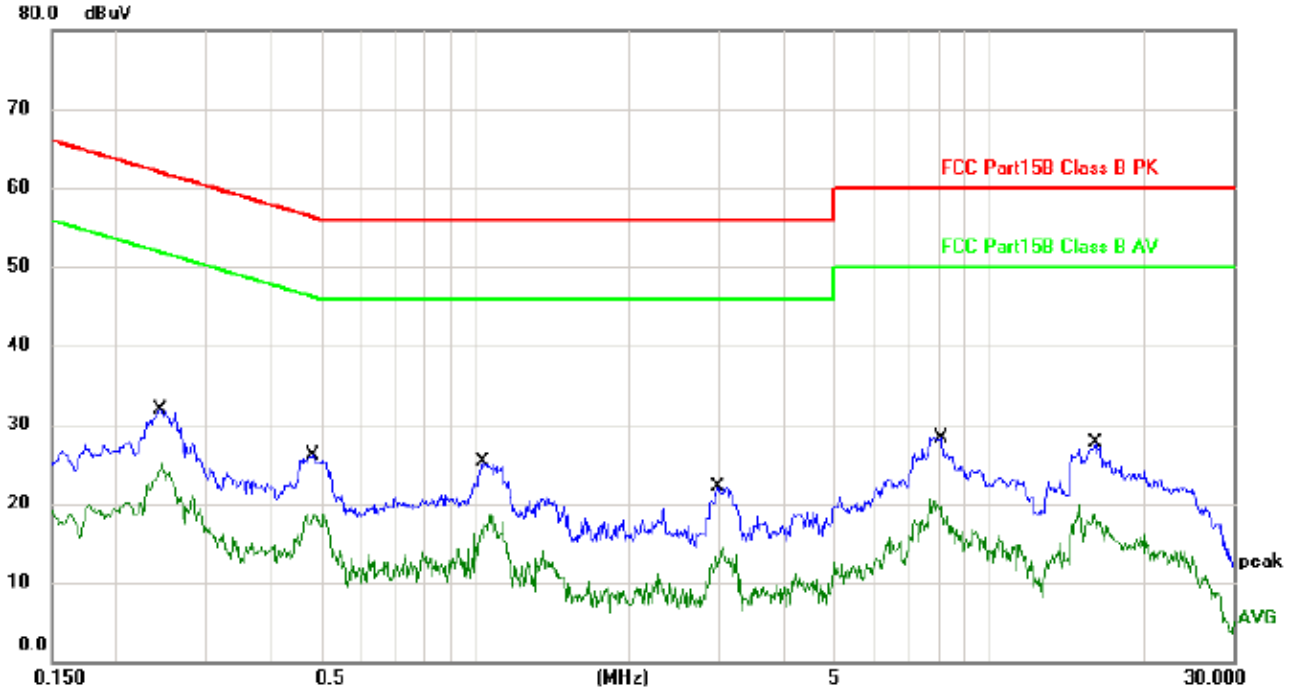
Plot of Conducted Emissions Test Data

Test Specification: *Neutral*



No.	Mk.	Freq.	Measure-ment	Limit	Over		
		MHz	dBuV	dBuV	dB	Detector	Comment
1	*	0.2429	29.94	61.99	-32.05	QP	
2		0.2429	19.69	51.99	-32.30	AVG	
3		1.0339	23.23	56.00	-32.77	QP	
4		1.0339	13.32	46.00	-32.68	AVG	
5		2.9700	20.13	56.00	-35.87	QP	
6		2.9700	8.29	46.00	-37.71	AVG	
7		8.0860	27.34	60.00	-32.66	QP	
8		8.0860	16.22	50.00	-33.78	AVG	
9		16.1900	26.15	60.00	-33.85	QP	
10		16.1900	16.31	50.00	-33.69	AVG	
11		21.7420	22.85	60.00	-37.15	QP	
12		21.7420	13.07	50.00	-36.93	AVG	

Test Specification: *Line*



No.	Mk.	Freq.	Measure-ment	Limit	Over		
		MHz	dBuV	dBuV	dB	Detector	Comment
1		0.2429	31.94	61.99	-30.05	QP	
2		0.2429	20.22	51.99	-31.77	AVG	
3		0.4860	26.16	56.24	-30.08	QP	
4	*	0.4860	18.59	46.24	-27.65	AVG	
5		1.0339	25.23	56.00	-30.77	QP	
6		1.0339	13.79	46.00	-32.21	AVG	
7		2.9700	22.13	56.00	-33.87	QP	
8		2.9700	13.42	46.00	-32.58	AVG	
9		8.0860	28.34	60.00	-31.66	QP	
10		8.0860	17.72	50.00	-32.28	AVG	
11		16.1900	27.65	60.00	-32.35	QP	
12		16.1900	16.31	50.00	-33.69	AVG	

11. Frequency Stability

11.1 Standard Applicable

According to §15.407(g), Manufacturers 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 in the users manual.

11.2 Test Procedure

According to §2.1055, the following test procedure was performed.
The Frequency Stability is measured directly with a Frequency Domain Analyzer. Frequency Deviation in ppm is calculated from the measured peak to peak value.
The Carrier Frequency Stability over Power Supply Voltage and over Temperature is measured with a Frequency Domain Analyzer in histogram mode

Temperature:	Supply Voltage
20°C	85-115% of declared nominal voltage
-30°C to +50°C	Normal

11.3 Environmental Conditions

Temperature:	20°C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

11.4 Summary of Test Results/Plots

5725-5850MHz

802.11a_HT20

Reference Frequency(Middle Channel): 5785MHz			
Environment Temperature (°C)	Power Supplied (VAC)	Frequency Measure with Time Elapsed	
		MCF (Hz)	Error (ppm)
50	120	118	0.0338
40	120	124	0.0349
30	120	134	0.0367
20	120	125	0.0351
10	120	116	0.0335
0	120	147	0.0390
-10	120	157	0.0407
-20	120	184	0.0455
-30	120	164	0.0420

802.11n_HT20

Reference Frequency(Middle Channel): 5785MHz			
Environment Temperature (°C)	Power Supplied (VAC)	Frequency Measure with Time Elapsed	
		MCF (Hz)	Error (ppm)
50	120	117	0.0227
40	120	127	0.0244
30	120	145	0.0276
20	120	154	0.0292
10	120	165	0.0312
0	120	185	0.0347
-10	120	154	0.0292
-20	120	181	0.0340
-30	120	157	0.0297

802.11n_HT40

Reference Frequency(Fixed Channel): 5755 MHz			
Environment Temperature (°C)	Power Supplied (VAC)	Frequency Measure with Time Elapsed	
		MCF (Hz)	Error (ppm)
50	120	155	0.0269
40	120	162	0.0281
30	120	161	0.0280
20	120	148	0.0257
10	120	129	0.0223
0	120	200	0.0347
-10	120	169	0.0294
-20	120	167	0.0289
-30	120	159	0.0276

802.11ac_HT80

Reference Frequency(Fixed Channel): 5775 MHz			
Environment Temperature (°C)	Power Supplied (VAC)	Frequency Measure with Time Elapsed	
		MCF (Hz)	Error (ppm)
50	120	160	0.0277
40	120	156	0.0270
30	120	163	0.0281
20	120	156	0.0270
10	120	159	0.0275
0	120	167	0.0288
-10	120	172	0.0298
-20	120	167	0.0288
-30	120	171	0.0295

So, Frequency Stability Versus Input Voltage is:

5725-5850MHz

802.11a_HT20

Reference Frequency(Middle Channel): 5785 MHz			
Environment Temperature (°C)	Power Supplied (VAC)	Frequency Measure with Time Elapsed	
		Frequency (Hz)	Error (ppm)
20	102	147	0.0270
	120	154	0.0306
	138	186	0.0367

802.11n_HT20

Reference Frequency(Middle Channel): 5785 MHz			
Environment Temperature (°C)	Power Supplied (VAC)	Frequency Measure with Time Elapsed	
		Frequency (Hz)	Error (ppm)
20	102	184	0.0335
	120	149	0.0296
	138	158	0.0313

802.11n_HT40

Reference Frequency(Fixed Channel): 5755 MHz			
Environment Temperature (°C)	Power Supplied (VAC)	Frequency Measure with Time Elapsed	
		Frequency (Hz)	Error (ppm)
20	102	167	0.0289
	120	150	0.0260
	138	152	0.0264

802.11ac_HT80

Reference Frequency(Fixed Channel): 5775MHz			
Environment Temperature (°C)	Power Supplied (VAC)	Frequency Measure with Time Elapsed	
		Frequency (Hz)	Error (ppm)
20	102	163	0.0281
	120	164	0.0284
	138	175	0.0303

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