



TESTING LABORATORY  
CERTIFICATE#4323.01



## FCC PART 15.407

## TEST REPORT

For

### Yunee Technology Co., Limited

Unit 2301, 23/F, 9 Chong Yip Street, Kwun Tong, Kowloon, Hong Kong, China

**FCC ID: 2ACS5-YUNMGA**

<b>Report Type:</b> Original Report		<b>Product Type:</b> Mantis G	
<b>Test Engineer:</b>	Max Min	<i>Max Min</i>	
<b>Report Number:</b>	RSHA181204001-00B		
<b>Report Date:</b>	2019-03-04		
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## TABLE OF CONTENTS

<b>GENERAL INFORMATION.....</b>	<b>3</b>
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....	3
OBJECTIVE .....	3
RELATED SUBMITTAL(S)/GRANT(S).....	3
TEST METHODOLOGY .....	3
MEASUREMENT UNCERTAINTY .....	4
TEST FACILITY .....	4
<b>SYSTEM TEST CONFIGURATION.....</b>	<b>5</b>
DESCRIPTION OF TEST CONFIGURATION .....	5
EUT EXERCISE SOFTWARE .....	5
EQUIPMENT MODIFICATIONS .....	12
SUPPORT EQUIPMENT LIST AND DETAILS .....	12
EXTERNAL I/O CABLE.....	12
BLOCK DIAGRAM OF TEST SETUP .....	12
<b>SUMMARY OF TEST RESULTS .....</b>	<b>14</b>
<b>TEST EQUIPMENT LIST .....</b>	<b>15</b>
<b>FCC §1.1310 &amp; §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE).....</b>	<b>16</b>
APPLICABLE STANDARD .....	16
CALCULATED DATA:.....	17
<b>FCC §15.203 – ANTENNA REQUIREMENT.....</b>	<b>18</b>
APPLICABLE STANDARD .....	18
ANTENNA CONNECTOR CONSTRUCTION .....	18
<b>§15.205 &amp; §15.209 &amp; §15.407(B) (1), (4), (6),(7) – UNDESIRABLE EMISSION &amp; RESTRICTED BANDS....</b>	<b>19</b>
APPLICABLE STANDARD .....	19
EUT SETUP .....	19
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP .....	21
TEST PROCEDURE .....	21
CORRECTED AMPLITUDE & MARGIN CALCULATION .....	21
TEST DATA .....	22
<b>FCC §15.407(a) &amp;§15.407(e)–EMISSION BANDWIDTH.....</b>	<b>44</b>
APPLICABLE STANDARD .....	44
TEST PROCEDURE .....	44
TEST DATA .....	45
<b>FCC §15.407(a) (1)(3) – CONDUCTED TRANSMITTER OUTPUT POWER .....</b>	<b>64</b>
APPLICABLE STANDARD .....	64
TEST PROCEDURE .....	64
TEST DATA .....	64
<b>FCC §15.407(a) (1) (3) - POWER SPECTRAL DENSITY.....</b>	<b>66</b>
APPLICABLE STANDARD .....	66
TEST PROCEDURE .....	66
TEST DATA .....	66

## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

Applicant	Yunec Technology Co., Limited
Tested Model	YUNMGA
Product Type	Mantis G
Dimension	168mm(L)* 96 mm(W)* 58 mm(H)
Power Supply	DC 11.4V from battery

*\*All measurement and test data in this report was gathered from production sample serial number: 20181204001. (Assigned by the BACL. The EUT supplied by the applicant was received on 2018-12-04.*

### Objective

This type approval report is prepared on behalf of Yunec Technology Co., Limited in accordance with Part 2-Subpart J, Part 15-Subparts A and E of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart E, section 15.203, 15.205, 15.209 and 15.407 rules.

### Related Submittal(s)/Grant(s)

FCC Part 15.247 DTS submissions with FCC ID: 2ACS5-YUNMGA.

### Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Kunshan).

**Measurement Uncertainty**

Item		Uncertainty
AC Power Lines Conducted Emissions		3.19 dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	6.11dB
	1GHz~6GHz	4.45dB
	6GHz~18GHz	5.23dB
	18GHz~40GHz	5.65dB
Occupied Bandwidth		0.5kHz
Temperature		1.0°C
Humidity		6%

**Test Facility**

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 under the FCC KDB 974614 D01. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

The EUT was configured for testing in an engineering mode which was provided by the manufacturer.

In **5150~5250 MHz** band, test channel list is as below,

For 802.11a and 802.11n-HT20 mode, EUT was tested with channel 36, 40 and 48.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
36	5180	44	5220
40	5200	48	5240

In **5725~5850 MHz** band, test channel list is as below,

For 802.11a and 802.11n-HT20 mode, EUT was tested with channel 149, 157 and 165.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
149	5745	165	5825
153	5765	/	/
157	5785	/	/
161	5805	/	/

For Conducted Test:

802.11a: each transmit chains were tested

802.11n: each transmit chains were tested

For Radiated Test:

For 802.11a, SISO for each transmit chain

For 802.11n: MIMO for two transmit chains

### EUT Exercise Software

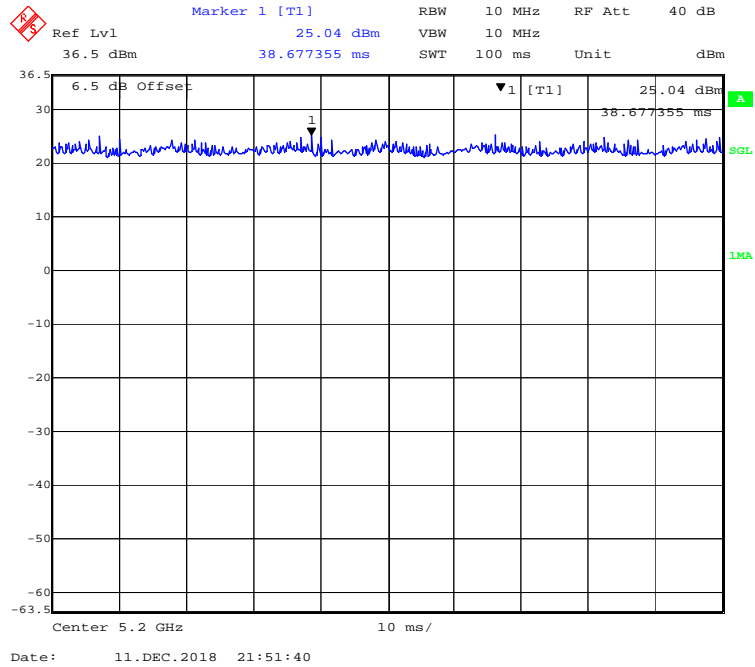
RF test tool: MPTool

The worst case was performed under:

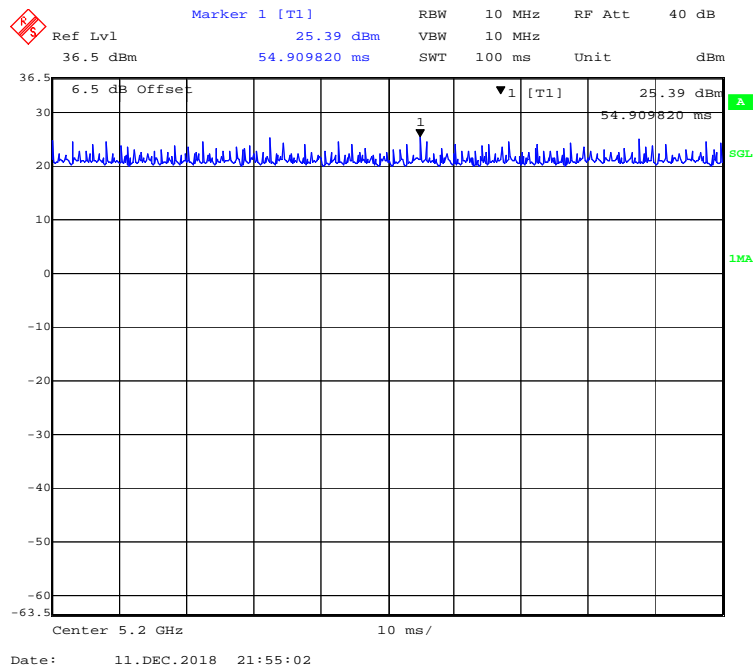
Mode	Data rate	Power level	
		5150-5250 Band	5725-5850 Band
802.11a	6 Mbps	36	38
802.11n-HT20	MCS0	36	38

**Duty Cycle(Chain 0):**  
**5150MHz-5250MHz Band:**

**802.11a mode**

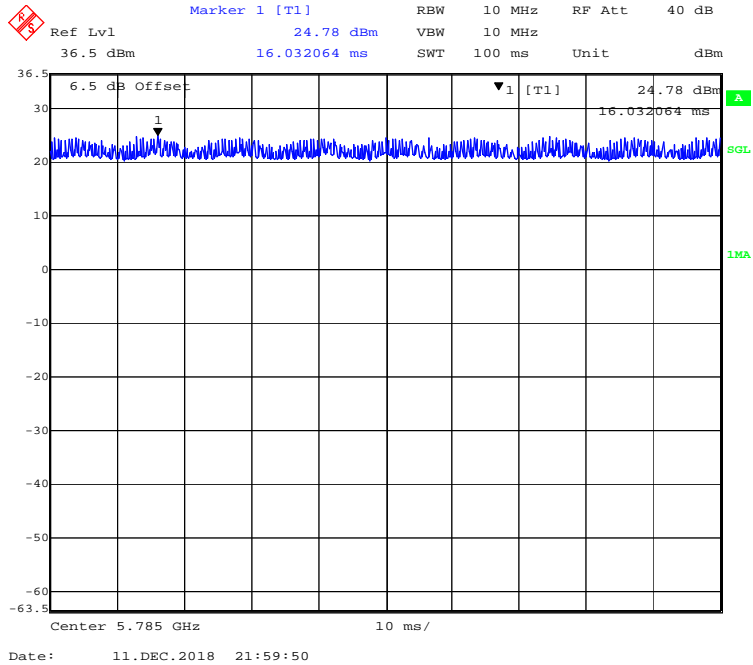


**802.11n-HT20 mode**

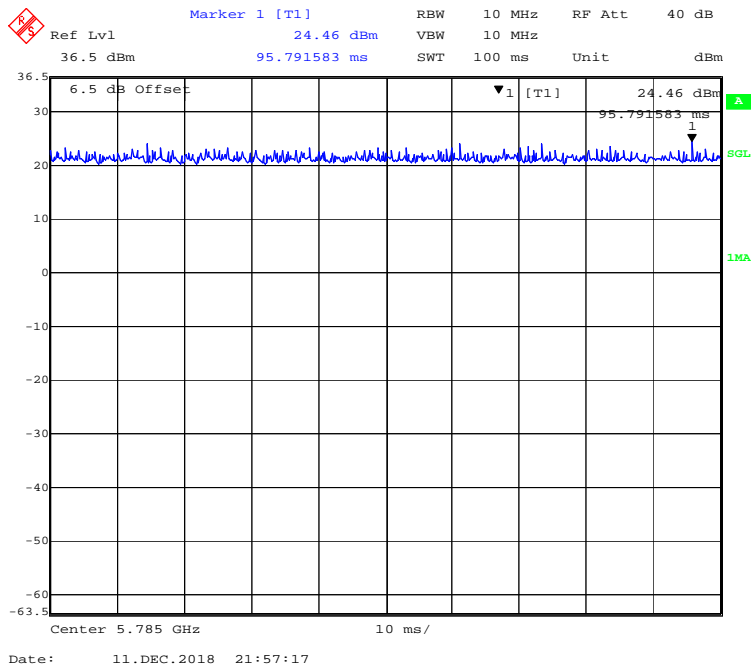


5725MHz-5850MHz Band

802.11a mode



802.11n-HT20 mode



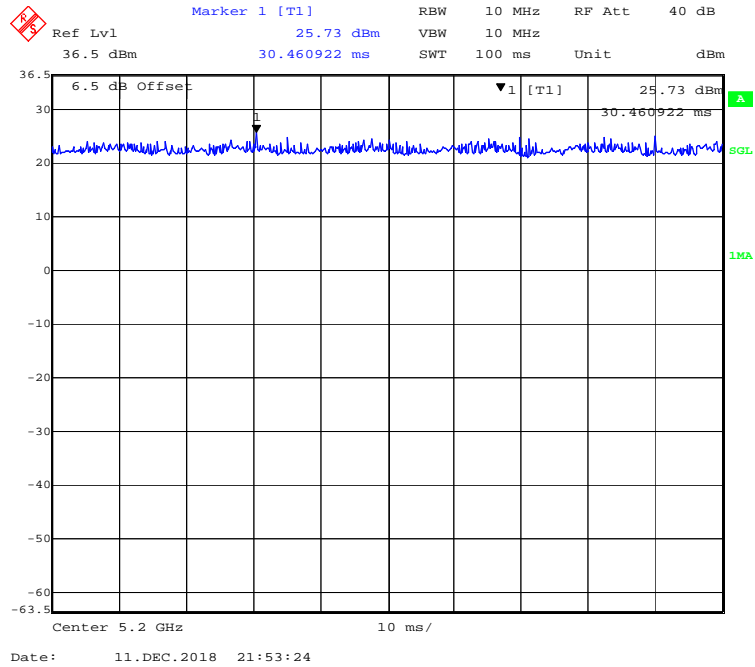
Mode	Frequency Range (MHz)	Duty Cycle (%)	T (ms)	1/T (kHz)	10log(1/x)
802.11a	5150-5250	100	/	/	0
802.11n-HT20		100	/	/	0
802.11a	5725-5850	100	/	/	0
802.11n-HT20		100	/	/	0

**Note:** “x” means duty cycle.

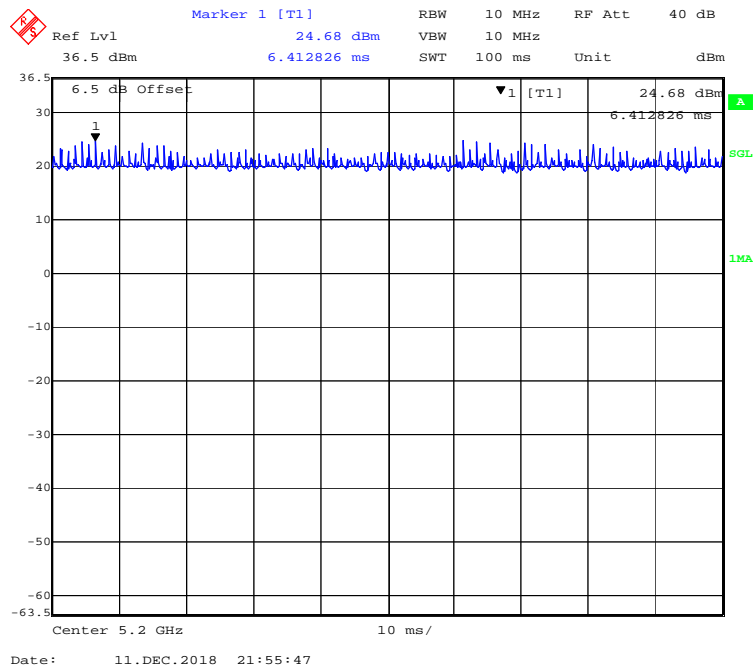


**Duty Cycle (Chain 1):  
5150MHz-5250MHz Band**

**802.11a mode**

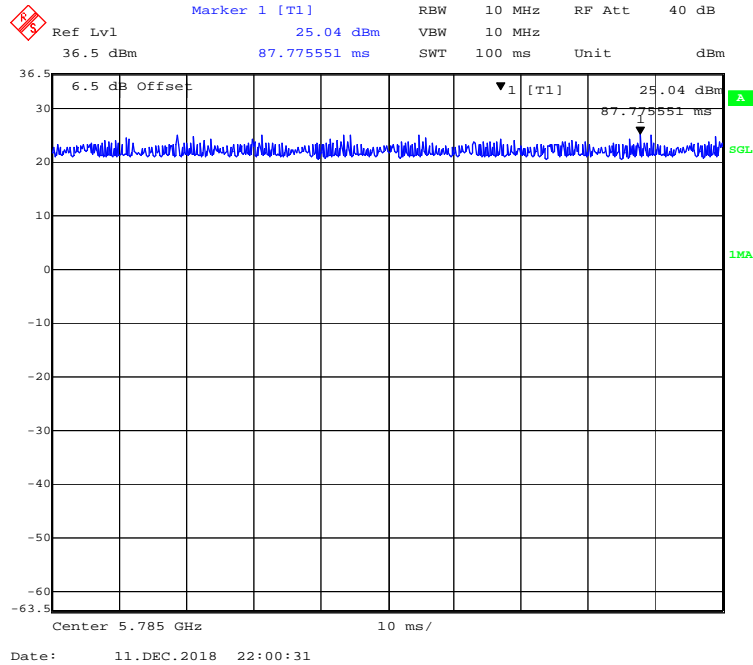


**802.11n-HT20 mode**

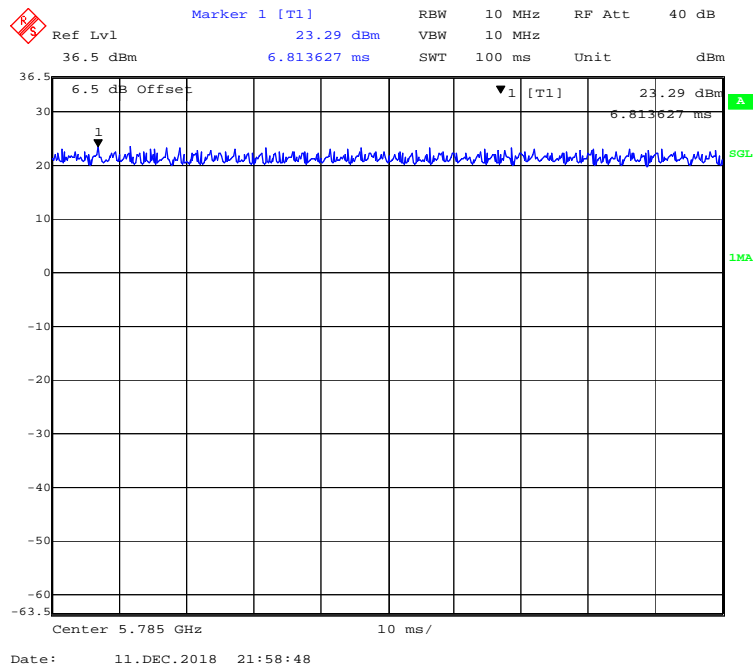


5725MHz-5850MHz Band:

802.11a mode



802.11n-HT20 mode



Mode	Frequency Range (MHz)	Duty Cycle (%)	T (ms)	1/T (kHz)	10log(1/x)
802.11a	5150-5250	100	/	/	0
802.11n-HT20		100	/	/	0
802.11a	5725-5850	100	/	/	0
802.11n-HT20		100	/	/	0

**Note:** “x” means duty cycle.

**Equipment Modifications**

No modification was made to the EUT.

**Support Equipment List and Details**

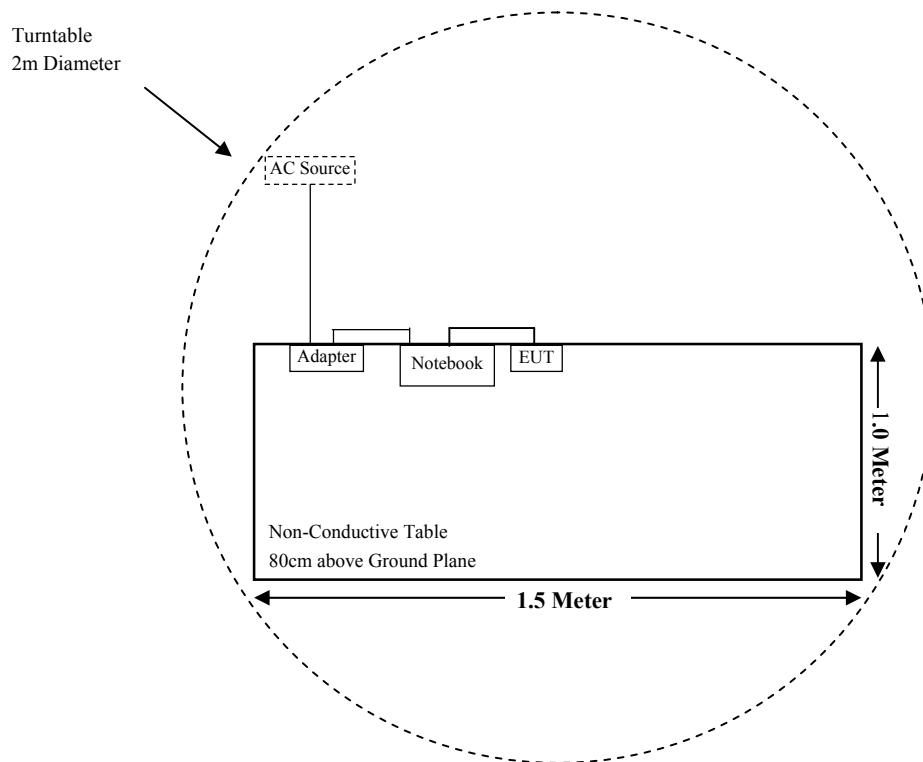
Manufacturer	Description	Model	Serial Number
DELL	Notebook	GX620	D65874152
DELL	Adapter	LA65NS0-00	DF263

**External I/O Cable**

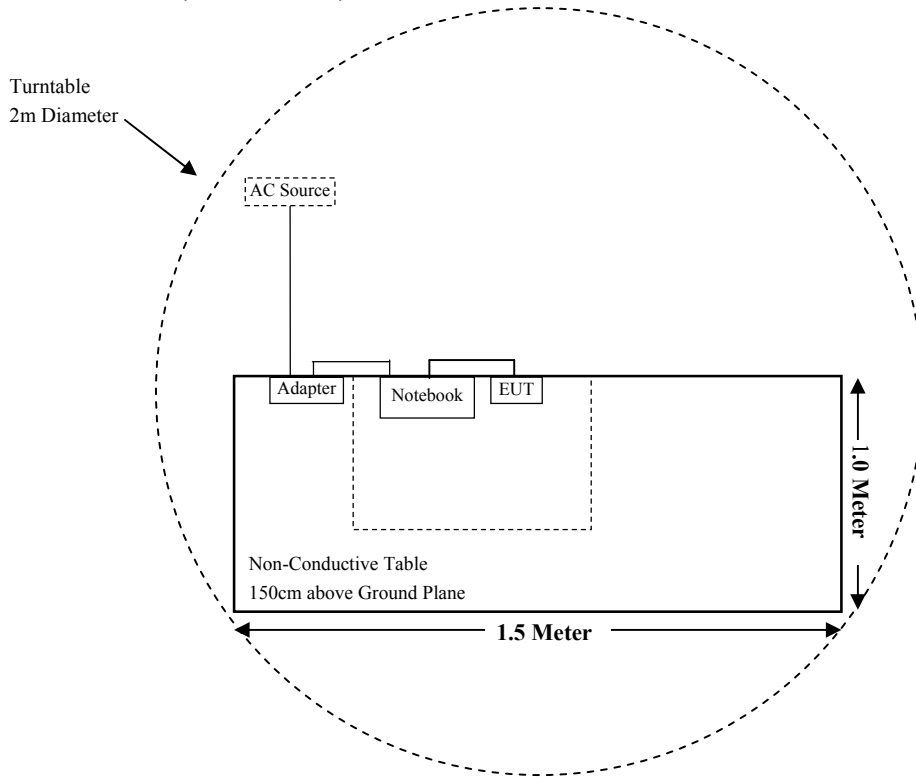
Cable Description	Length (m)	From Port	To
Data Cable	0.5	EUT	Notebook

**Block Diagram of Test Setup**

For Radiated Emissions(Below 1GHz):



For Radiated Emissions(Above 1GHz):



**SUMMARY OF TEST RESULTS**

<b>FCC Rules</b>	<b>Description of Test</b>	<b>Result</b>
§15.407(f) & §2.1091	Maximum Permissible Exposure (MPE)	Compliant
§15.203	Antenna Requirement	Compliant
FCC §15.207 & §15.407(b) (6)	AC Power Line Conducted Emissions	Not Applicable (See Note 1)
§15.205 & §15.209 & §15.407(b) (1), (4), (6), (7)	Undesirable Emission & Restricted Bands	Compliant
§15.407(a)(1) (5) & §15.407 (e)	Emission Bandwidth	Compliant
§15.407 (a)(1)(3)	Conducted Transmitter Output Power	Compliant
§15.407 (a)(1) (3)	Power Spectral Density	Compliant

Note 1: The EUT is powered by battery.

**TEST EQUIPMENT LIST**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
<b>Radiated Emission Test (Chamber 1#)</b>					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2018-11-12	2019-11-11
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2016-12-26	2019-12-25
Sonoma Instrument	Pre-amplifier	310N	171205	2018-08-15	2019-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	N/A	N/A
MICRO-COAX	Coaxial Cable	Cable-8	008	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2018-08-15	2019-08-14
<b>Radiated Emission Test (Chamber 2#)</b>					
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2018-08-27	2019-08-26
ETS-LINDGREN	Horn Antenna	3115	6229	2016-01-11	2019-01-10
ETS-LINDGREN	Horn Antenna	3116	00084159	2016-10-18	2019-10-17
Mini-Circuits	Amplifier	ZVA-183W-S+	220701818	2018-05-20	2019-05-19
EM Electronics Corporation	Amplifier	EM18G40G	060726	2018-03-22	2019-03-21
MICRO-TRONICS	Band Reject Filter	BRC50703	G094	2018-08-05	2019-08-04
MICRO-TRONICS	Band Reject Filter	BRC50705	G085	2018-08-05	2019-08-04
Narda	Attenuator	10dB	010	2018-08-15	2019-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2018-08-15	2019-08-14
<b>RF Conducted Test</b>					
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2018-11-12	2019-11-11
Agilent	Power Meter	N1912A	MY5000492	2018-11-18	2019-11-17
Agilent	Power Sensor	N1921A	MY54210024	2018-11-18	2019-11-17
Narda	Attenuator/6dB	6dB	/	2018-01-10	2019-01-09
Narda	Attenuator/6dB	6dB	/	2019-01-10	2020-01-09
Yuneec	RF Cable	YuneecC01	C01	Each Time	/

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

**FCC §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)**

**Applicable Standard**

According to §2.1091 and §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission’s guideline.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
<b>Frequency Range (MHz)</b>	<b>Electric Field Strength (V/m)</b>	<b>Magnetic Field Strength (A/m)</b>	<b>Power Density (mW/cm<sup>2</sup>)</b>	<b>Averaging Time (minutes)</b>
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; \* = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

**Calculated Formulary:**

Predication of MPE limit at a given distance

S = PG/4πR<sup>2</sup> = power density (in appropriate units, e.g. mW/cm<sup>2</sup>);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);



**Calculated Data:**

**For worst case:**

Mode	Frequency Range (MHz)	Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
		(dBi)	(numeric)	(dBm)	(mW)			
802.11b	2412~2462	3.00	2.00	18.00	63.10	20	0.0250	1.00
802.11g		3.00	2.00	22.00	158.49	20	0.0629	1.00
802.11n-HT20		3.00	2.00	24.00	251.19	20	0.0997	1.00

Mode	Frequency (MHz)	Antenna Gain		Tune-up Conducted output power		Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
		(dBi)	(numeric)	(dBm)	(mW)			
802.11a	5150-5250	3.00	2.00	25.00	316.23	20	0.1258	1.0
802.11n-HT20		3.00	2.00	28.00	630.96	20	0.2510	1.0
802.11a	5725-5850	3.00	2.00	26.00	398.11	20	0.1580	1.0
802.11n-HT20		3.00	2.00	28.00	630.96	20	0.2504	1.0

Note:

- (1) The Tune-up output power was declared by the Manufacturer.
- (2) 2.4GWi-Fi and 5GWi-Fi cannot transmit simultaneously.

**Result:** The device meet FCC MPE at 20 cm distance.

**FCC §15.203 – ANTENNA REQUIREMENT**

**Applicable Standard**

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.407, if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

**Antenna Connector Construction**

The EUT has two PCB antennas which used unique couplings to the intentional radiator; fulfill the requirement of this section. Please refer to the EUT photos.

ANT	Antenna Type	Max. Antenna Gain
0	PCB	3.0 dBi
1	PCB	3.0 dBi

**Result:** Compliant.

**§15.205 & §15.209 & §15.407(B) (1), (4), (6),(7) – UNDESIRABLE EMISSION & RESTRICTED BANDS**

**Applicable Standard**

FCC §15.407 (b) (1), (4), (6), (7); §15.209; §15.205;

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 –27dBm/MHz

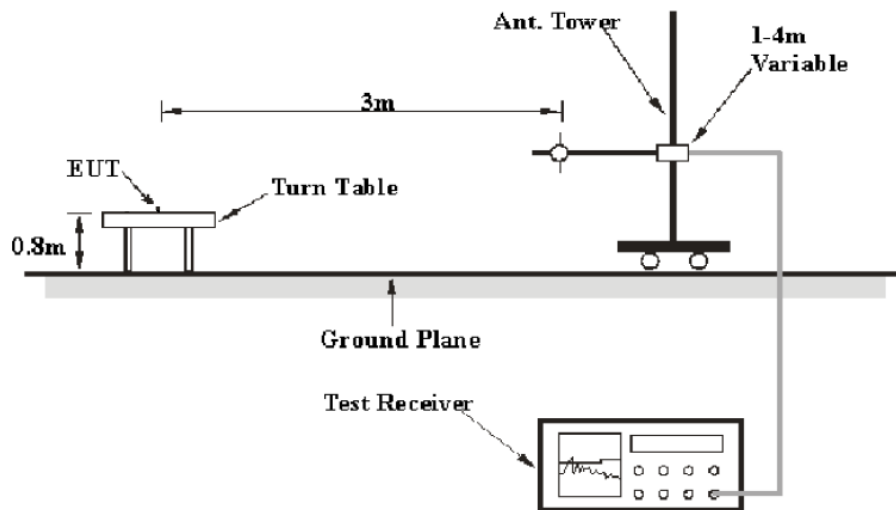
For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of –27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

As per FCC §15.35(d):Unless otherwise specified, on any frequency or frequencies above 1000MHz,the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000MHz shall be performed using a minimum resolution bandwidth of 1MHz.

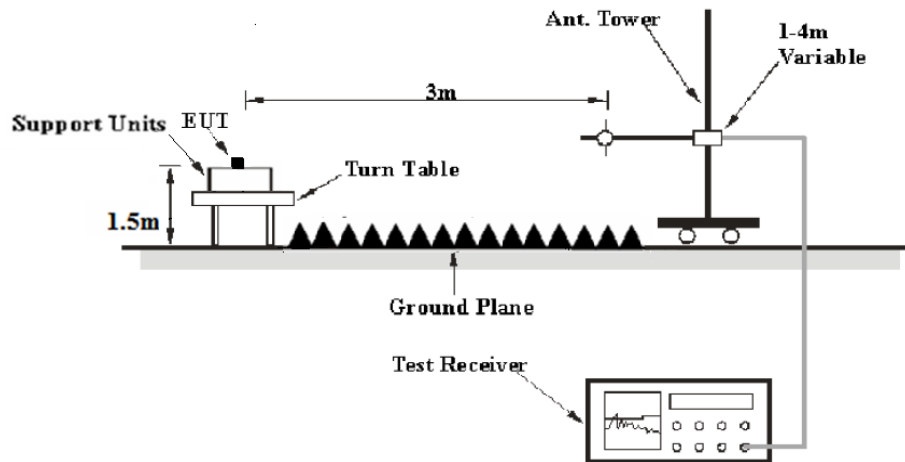
According to 789033 D02 General UNII Test Procedures New Rules v02r01, emission shall be computed as:  $E [dB\mu V/m] = EIRP [dBm] + 95.2$ , for  $d = 3$  meters.

**EUT Setup**

Below 1 GHz:



Above 1GHz:



The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC 15.209 and FCC 15.407 limits.

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.

**EMI Test Receiver & Spectrum Analyzer Setup**

The system was investigated from 30 MHz to 40 GHz.

During the radiated emission test, the EMI test receiver Setup was set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1GHz	1MHz	3 MHz	/	PK
	1MHz	3 MHz	/	Ave.

**Test Procedure**

During the radiated emission test, the adapter was connected to the first AC floor outlet and the other support equipments were connected to the second AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1GHz, peak and Average detection modes for frequencies above 1GHz.

**Corrected Amplitude & Margin Calculation**

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

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Extrapolation result}$$

**Test Data**

**Environmental Conditions**

<b>Temperature:</b>	20.2 °C
<b>Relative Humidity:</b>	51 %
<b>ATM Pressure:</b>	101.3 kPa

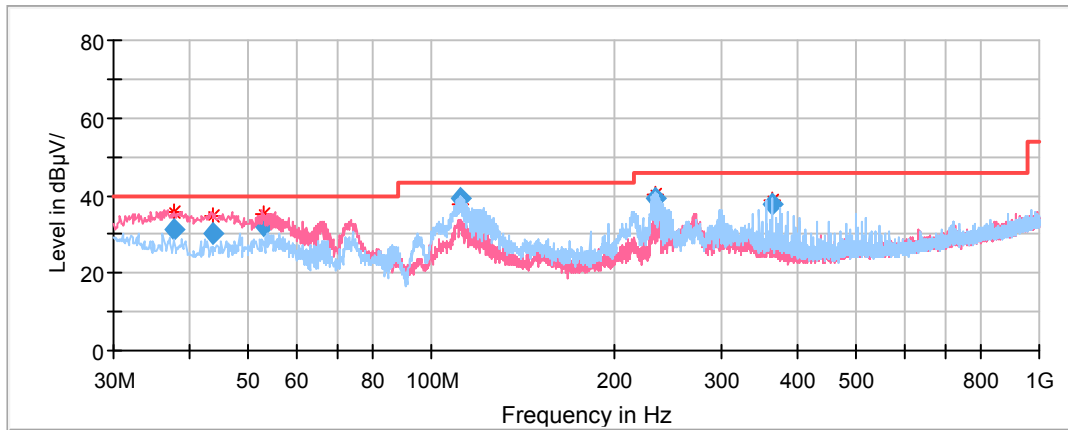
The testing was performed by Max Min on 2018-12-25

Mode: Transmitting

**Spurious Emission Test**

**30MHz-1GHz(5150-5250MHz Band):**

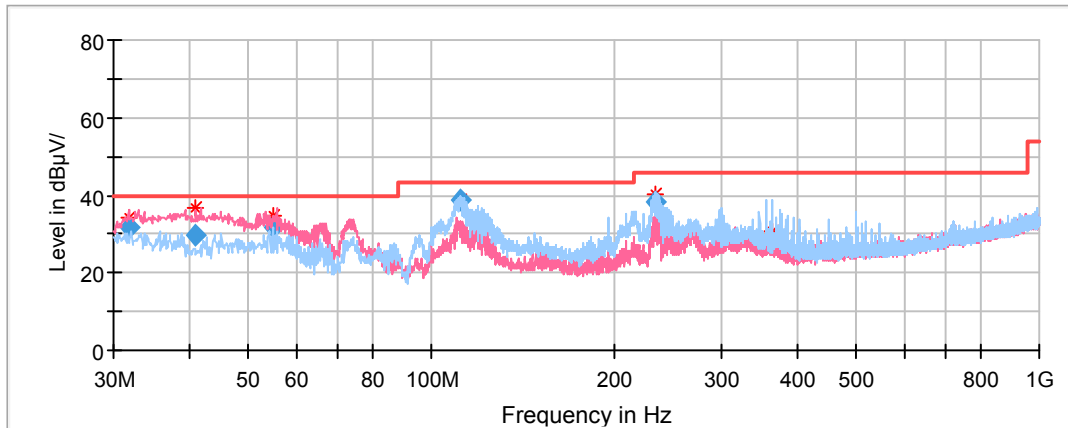
Pre-scan with 802.11a and 802.11n-HT20 modes of operation in the X,Y and Z axes of orientation, the worst case 802.11a mode in channel 5180 in Z-axis of orientation was recorded



Frequency (MHz)	Corrected Amplitude QuasiPeak (dBµV/m)	Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
		Height (cm)	Polar (H/V)				
37.600850	30.98	101.0	V	359.0	-9.1	40.00	9.02
43.782450	30.04	101.0	V	359.0	-13.3	40.00	9.96
53.118950	31.99	101.0	V	71.0	-17.6	40.00	8.01
111.322700	39.29	101.0	V	71.0	-12.8	43.50	4.21
233.438000	39.20	101.0	H	336.0	-12.2	46.00	6.80
364.550350	37.92	101.0	H	336.0	-8.9	46.00	8.08

**30MHz-1GHz(5725-5850MHz Band):**

*Pre-scan with 802.11a and 802.11n-HT20 modes of operation in the X,Y and Z axes of orientation, the worst case 802.11a mode in channel 5825 in Z-axis of orientation was recorded*



Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	QuasiPeak (dBµV/m)	Height (cm)	Polar (H/V)				
31.830450	31.73	100.0	V	253.0	-5.2	40.00	8.27
40.990250	29.68	100.0	V	253.0	-11.4	40.00	10.32
54.883850	31.67	100.0	V	30.0	-17.7	40.00	8.33
111.319850	38.66	100.0	V	30.0	-12.8	43.50	4.84
233.084750	38.49	199.0	H	266.0	-12.2	46.00	7.51
363.674100	27.89	199.0	H	266.0	-9.0	46.00	18.11

**1GHz-18GHz (5150-5250MHz Band):**

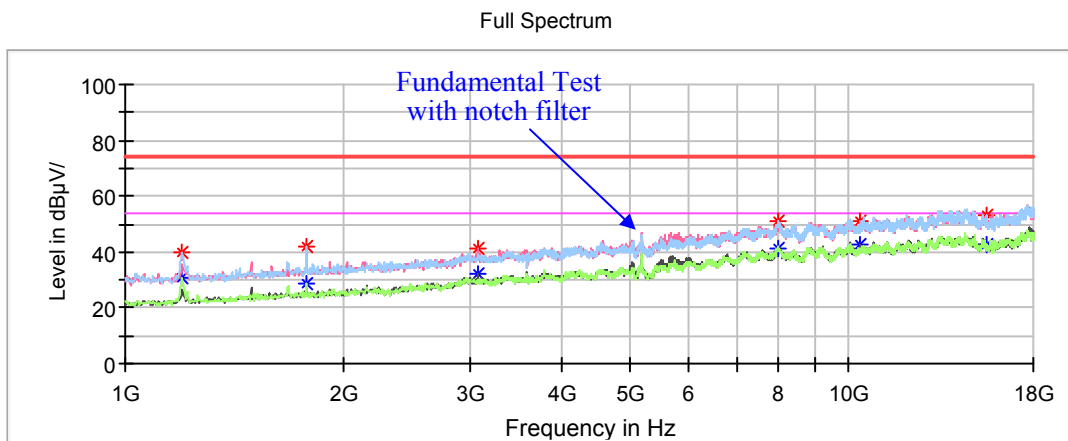
**802.11a Mode(Worst case:Chain 1):**

(Pre-scan in the X, Y and Z axes of orientation, the worst case Z-axis of orientation was recorded.)

Note:

1. This test was performed with the 5150-5250MHz band reject filter.
2. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor  
 Corrected Amplitude = Corrected Factor + Reading  
 Margin = Limit - Corrected. Amplitude

**Low Channel: 5180MHz**

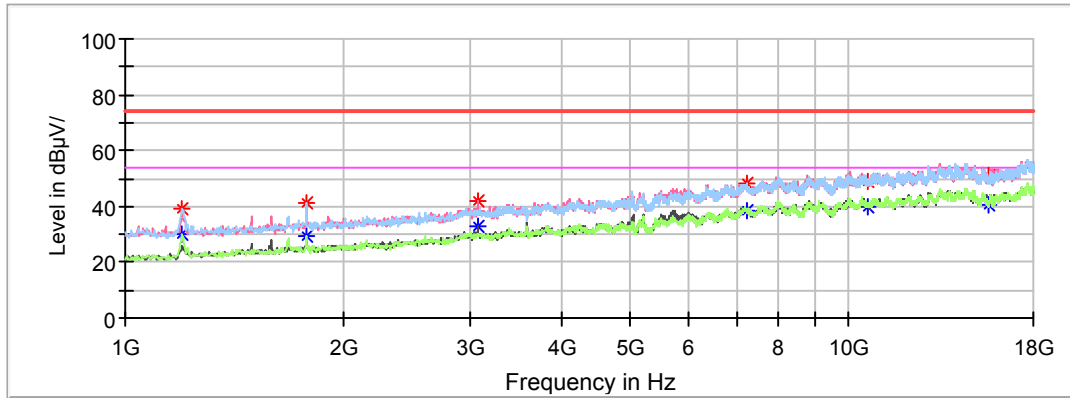


Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1200.600000	---	30.67	150.0	H	122.0	-9.3	54.00	23.33
1200.600000	39.86	---	150.0	H	122.0	-9.3	74.00	34.14
1778.600000	42.27	---	150.0	H	309.0	-6.6	68.20	25.93
3070.600000	41.51	---	150.0	V	164.0	-1.5	68.20	26.69
7997.200000	50.80	---	150.0	V	57.0	10.7	68.20	17.40
10360.000000	50.92	---	150.0	V	154.0	12.7	68.20	17.28
15540.000000	---	42.31	150.0	H	266.0	12.5	54.00	11.69
15540.000000	53.27	---	150.0	H	266.0	12.5	74.00	20.73



**Middle Channel: 5200MHz**

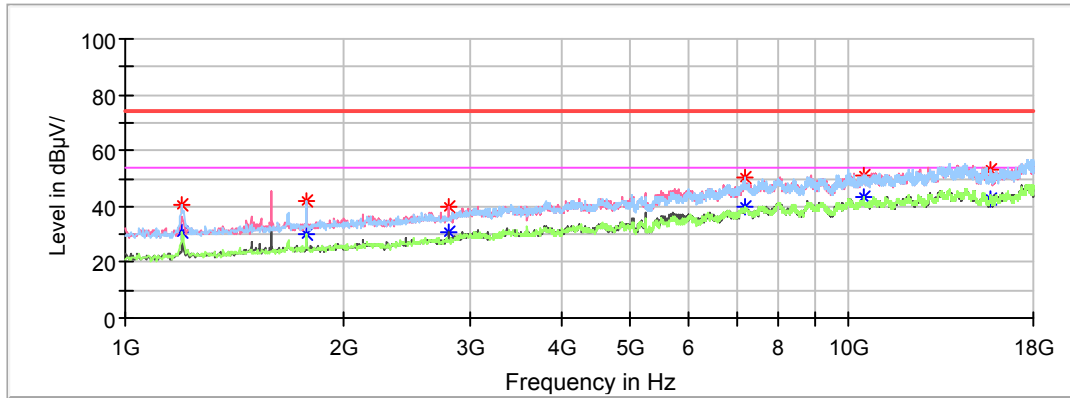
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1200.600000	39.39	---	150.0	H	223.0	-9.3	74.00	34.61
1200.600000	---	29.89	150.0	H	223.0	-9.3	54.00	24.11
1782.000000	41.51	---	150.0	H	308.0	-6.6	68.20	26.69
3070.600000	42.10	---	150.0	V	164.0	-1.5	68.20	26.10
7245.800000	48.28	---	150.0	H	244.0	9.0	68.20	19.92
10400.000000	49.22	---	150.0	H	100.0	12.9	68.20	18.98
15600.000000	---	40.74	150.0	H	292.0	12.6	54.00	13.26
15600.000000	50.71	---	150.0	H	292.0	12.6	74.00	23.29

**High Channel: 5240MHz**

Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1197.200000	---	30.43	150.0	H	115.0	-9.3	54.00	23.57
1197.200000	40.53	---	150.0	H	115.0	-9.3	74.00	33.47
1782.000000	42.05	---	150.0	H	308.0	-6.6	68.20	26.15
2798.600000	---	30.87	150.0	V	74.0	-2.7	54.00	23.13
2798.600000	40.15	---	150.0	V	74.0	-2.7	74.00	33.85
7171.000000	50.01	---	150.0	H	212.0	8.8	68.20	18.19
10480.000000	51.03	---	150.0	H	105.0	12.7	68.20	17.17
15720.000000	---	42.59	150.0	H	308.0	12.7	54.00	11.41
15720.000000	52.96	---	150.0	H	308.0	12.7	74.00	21.04

**1GHz-18GHz (5725-5850MHz Band):**

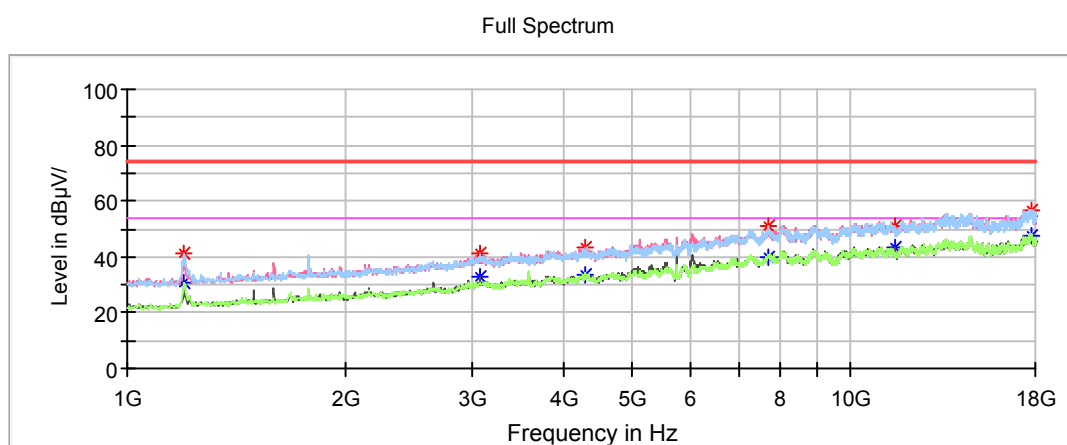
**802.11a Mode(Worst case:Chain 0):**

(Pre-scan in the X,Y and Z axes of orientation, the worst case Z-axis of orientation was recorded.)

Note:

1. This test was performed with the 5725-5850MHz band reject filter.
2. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor  
 Corrected Amplitude = Corrected Factor + Reading  
 Margin = Limit - Corrected. Amplitude

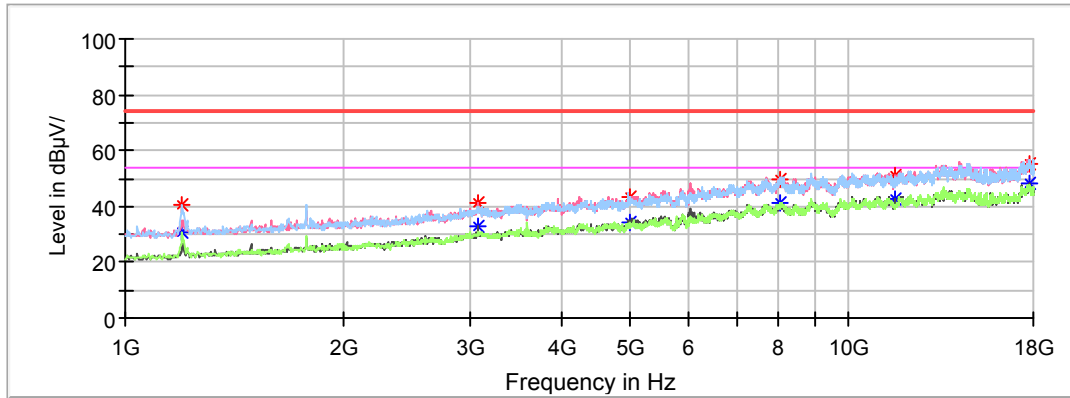
**Low Channel: 5745MHz**



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1200.600000	41.21	---	150.0	H	223.0	-9.3	74.00	32.79
1200.600000	---	31.05	150.0	H	223.0	-9.3	54.00	22.95
3070.600000	41.52	---	150.0	V	173.0	-1.5	68.20	26.68
4291.200000	43.36	---	250.0	V	247.0	1.2	74.00	30.64
4291.200000	---	33.41	250.0	V	247.0	1.2	54.00	20.59
7708.200000	51.32	---	150.0	H	191.0	10.1	74.00	22.68
7708.200000	---	40.19	150.0	H	191.0	10.1	54.00	13.81
11490.000000	50.85	---	200.0	V	356.0	12.8	74.00	23.15
11490.000000	---	43.03	200.0	V	356.0	12.8	54.00	10.97
17235.000000	56.36	---	200.0	V	282.0	17.4	68.20	11.84

**Middle Channel: 5785MHz**

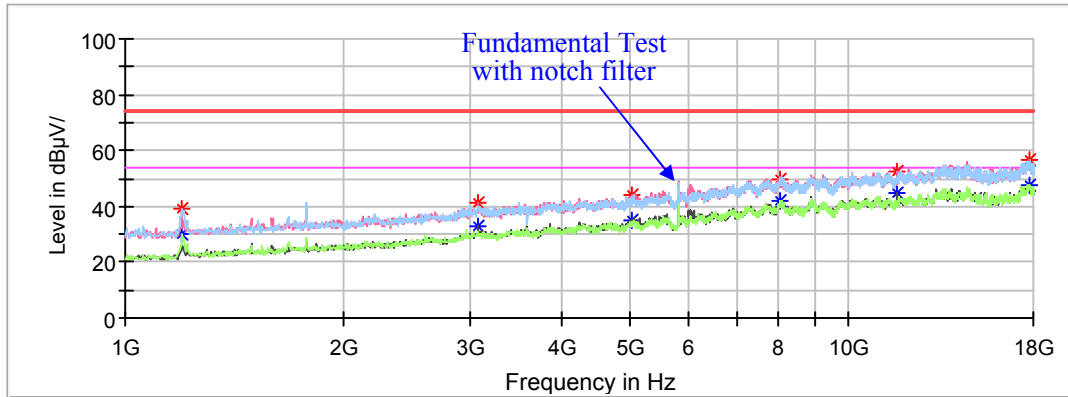
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1200.600000	---	30.82	150.0	H	217.0	-9.3	54.00	23.18
1200.600000	40.39	---	150.0	H	217.0	-9.3	74.00	33.61
3070.600000	41.39	---	150.0	V	170.0	-1.5	68.20	26.81
4974.600000	---	34.33	150.0	H	0.0	2.1	54.00	19.67
4974.600000	43.18	---	150.0	H	0.0	2.1	74.00	30.82
8048.200000	---	41.56	150.0	V	95.0	10.7	54.00	12.44
8048.200000	49.71	---	150.0	V	95.0	10.7	74.00	24.29
11570.000000	---	42.96	150.0	V	5.0	12.9	54.00	11.04
11570.000000	50.72	---	150.0	V	5.0	12.9	74.00	23.28
17355.000000	55.43	---	150.0	V	1.0	17.5	68.20	12.77

**High Channel: 5825MHz**

Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV/m)	Average (dBµV/m)	Height (cm)	Polar (H/V)				
1200.600000	39.03	---	150.0	H	218.0	-9.3	74.00	34.97
1200.600000	---	30.16	150.0	H	218.0	-9.3	54.00	23.84
3070.600000	41.42	---	150.0	V	166.0	-1.5	68.20	26.78
5029.000000	44.32	---	150.0	V	70.0	2.2	74.00	29.68
5029.000000	---	35.11	150.0	V	70.0	2.2	54.00	18.89
8044.800000	---	42.19	150.0	V	273.0	10.7	54.00	11.81
8044.800000	49.33	---	150.0	V	273.0	10.7	74.00	24.67
11650.000000	---	44.95	150.0	V	17.0	13.0	54.00	9.05
11650.000000	52.79	---	150.0	V	17.0	13.0	74.00	21.21
17475.000000	56.33	---	150.0	V	27.0	17.5	68.20	11.87

**1GHz-18GHz (5150-5250MHz Band):**

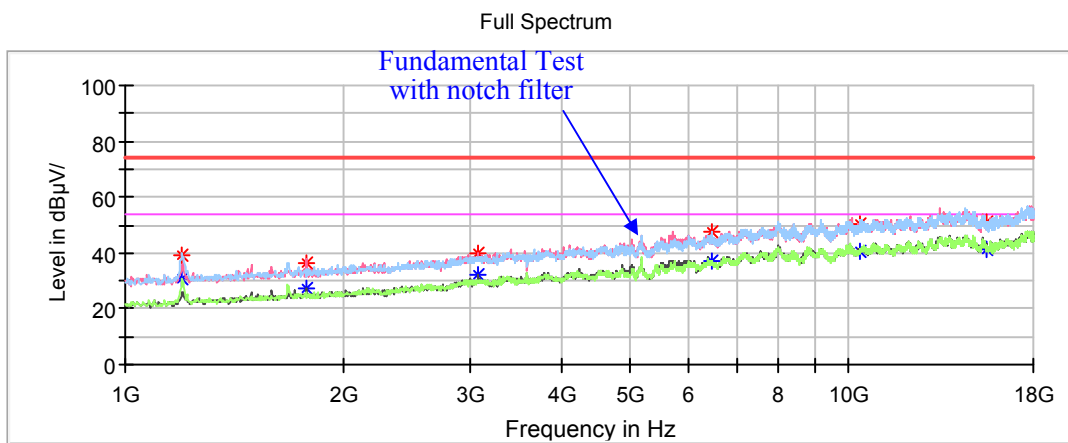
**802.11n-HT20 Mode (Chain0+chain1):**

*Pre-scan with X,Y and Z axes of orientation, the worst case Z-axis of orientation was recorded*

Note:

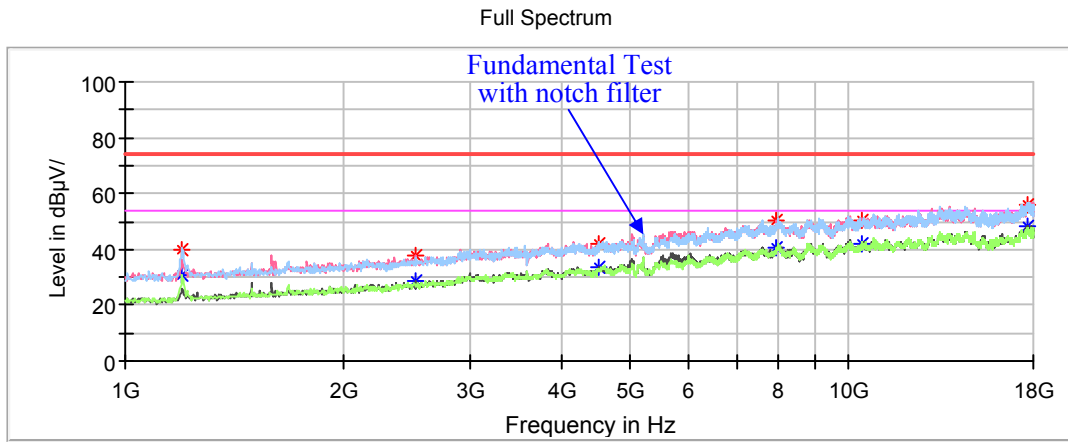
1. This test was performed with the 5150-5250MHz band reject filter.
2. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor  
 Corrected Amplitude = Corrected Factor + Reading  
 Margin = Limit - Corrected. Amplitude

**Low Channel: 5180MHz**



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1200.600000	---	30.79	150.0	H	116.0	-9.3	54.00	23.21
1200.600000	39.21	---	150.0	H	116.0	-9.3	74.00	34.79
1782.000000	36.62	---	150.0	V	358.0	-6.6	68.20	31.58
3070.600000	40.06	---	150.0	V	169.0	-1.5	68.20	28.14
6453.600000	47.42	---	150.0	H	2.0	6.5	68.20	20.78
10360.000000	50.33	---	150.0	V	41.0	12.7	68.20	17.87
15540.000000	---	40.97	150.0	V	169.0	12.5	54.00	13.03
15540.000000	51.17	---	150.0	V	169.0	12.5	74.00	22.83

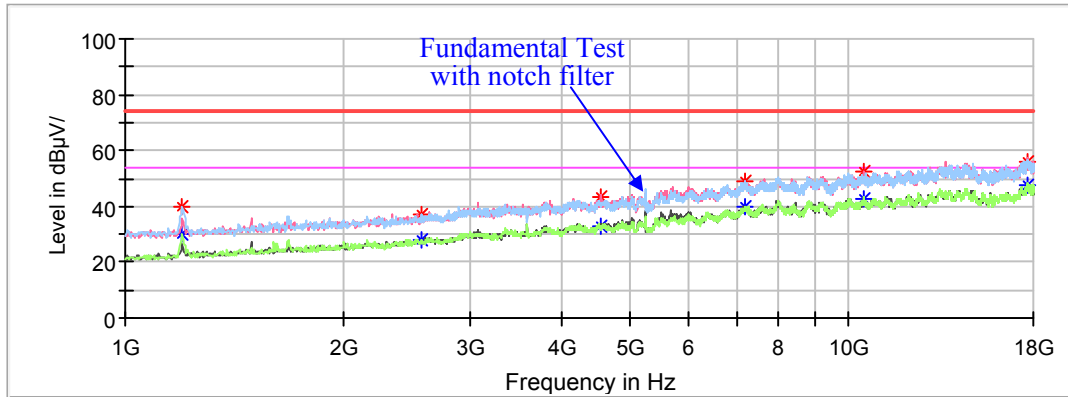
**Middle Channel: 5200MHz**



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1197.200000	39.98	---	150.0	H	121.0	-9.3	74.00	34.02
1197.200000	---	30.96	150.0	H	121.0	-9.3	54.00	23.04
2523.200000	37.57	---	150.0	V	69.0	-4.2	68.20	30.63
4522.400000	41.88	---	150.0	V	111.0	1.5	74.00	32.12
4522.400000	---	33.68	150.0	V	111.0	1.5	54.00	20.32
7959.800000	50.57	---	150.0	V	0.0	10.6	68.20	17.63
10400.000000	50.63	---	150.0	V	342.0	12.7	68.20	17.57
15600.000000	---	47.96	150.0	V	69.0	17.4	54.00	6.04
15600.000000	56.25	---	150.0	V	69.0	17.4	74.00	17.75

**High Channel: 5240MHz**

Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1197.200000	40.13	---	150.0	H	222.0	-9.3	74.00	33.87
1197.200000	---	30.18	150.0	H	222.0	-9.3	54.00	23.82
2570.800000	37.12	---	150.0	H	297.0	-3.9	68.20	31.08
4553.000000	43.05	---	150.0	V	143.0	1.5	74.00	30.95
4553.000000	---	33.11	150.0	V	143.0	1.5	54.00	20.89
7174.400000	49.10	---	150.0	V	74.0	8.8	68.20	19.10
10480.000000	52.61	---	150.0	V	228.0	12.7	68.20	15.59
15720.000000	55.92	---	150.0	V	168.0	17.3	74.00	18.08
15720.000000	---	47.57	150.0	V	168.0	17.3	54.00	6.43



**1GHz-18GHz (5725-5850MHz Band):**

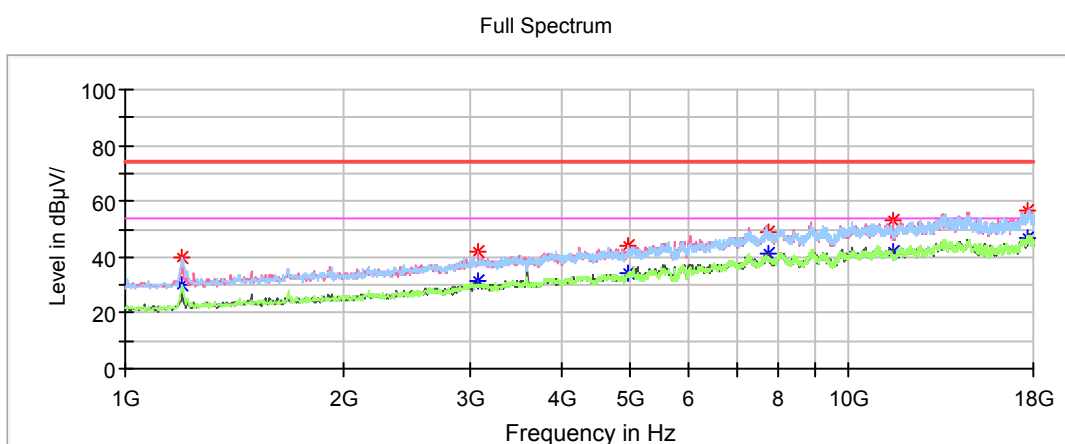
**802.11n-HT20 Mode (Chain0+chain1):**

(Pre-scan with X,Y and Z axes of orientation, the worst case Z-axis of orientation was recorded)

Note:

1. This test was performed with the 5725-5850MHz band reject filter.
2. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor  
 Corrected Amplitude = Corrected Factor + Reading  
 Margin = Limit - Corrected. Amplitude

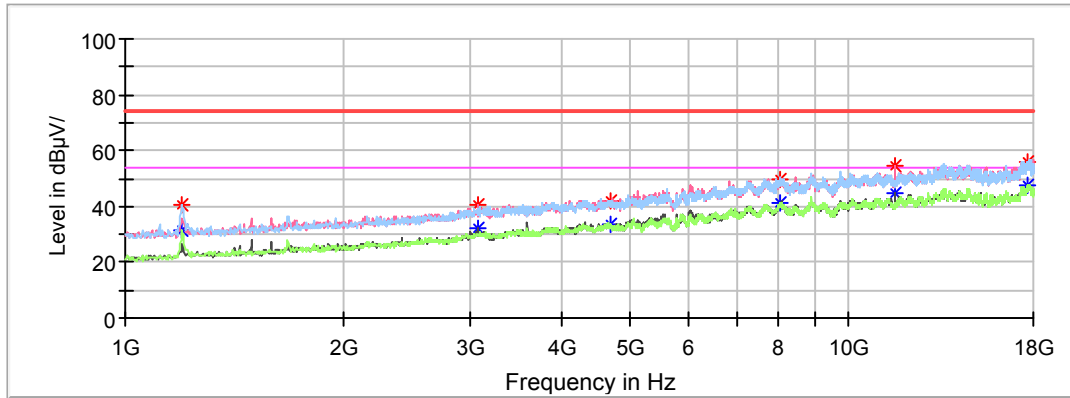
**Low Channel: 5745MHz**



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1200.600000	39.98	---	150.0	H	227.0	-9.3	74.00	34.02
1200.600000	---	30.27	150.0	H	227.0	-9.3	54.00	23.73
3070.600000	41.95	---	150.0	V	159.0	-1.5	68.20	26.25
4967.800000	44.04	---	150.0	H	0.0	2.1	74.00	29.96
4967.800000	---	34.19	150.0	H	0.0	2.1	54.00	19.81
7725.200000	48.75	---	150.0	V	255.0	10.2	74.00	25.25
7725.200000	---	41.01	150.0	V	255.0	10.2	54.00	12.99
11490.000000	53.07	---	150.0	V	346.0	12.9	74.00	20.93
11490.000000	---	42.28	150.0	V	346.0	12.9	54.00	11.72
17235.000000	56.49	---	150.0	V	5.0	17.4	68.20	11.71

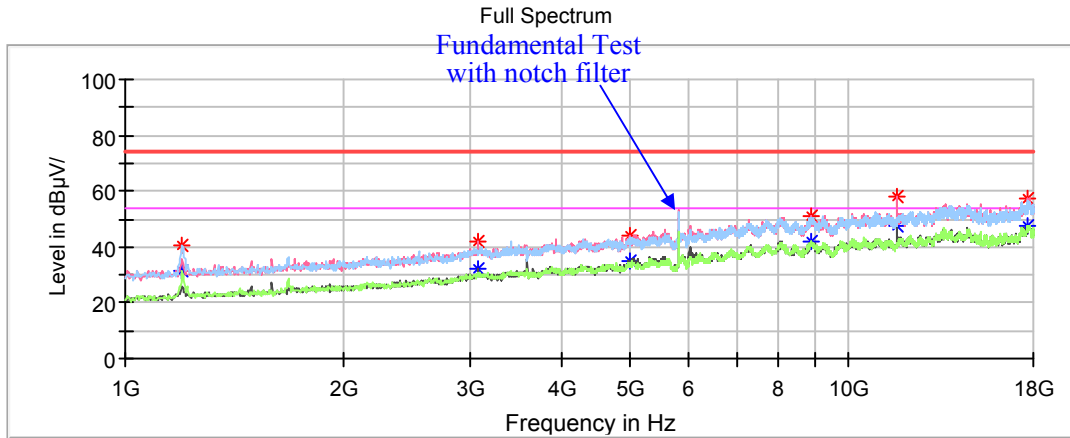
**Middle Channel: 5785MHz**

Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV/m)	Average (dBµV/m)	Height (cm)	Polar (H/V)				
1197.200000	40.81	---	150.0	H	217.0	-9.3	74.00	33.19
1197.200000	---	31.34	150.0	H	217.0	-9.3	54.00	22.66
3070.600000	40.23	---	150.0	V	156.0	-1.5	68.20	27.97
4675.400000	41.73	---	150.0	V	124.0	1.7	74.00	32.27
4675.400000	---	33.36	150.0	V	124.0	1.7	54.00	20.64
8051.600000	49.56	---	150.0	H	153.0	10.7	74.00	24.44
8051.600000	---	41.49	150.0	H	153.0	10.7	54.00	12.51
11570.000000	54.44	---	150.0	V	188.0	12.9	74.00	19.56
11570.000000	---	44.49	150.0	V	188.0	12.9	54.00	9.51
17355.000000	55.82	---	150.0	V	131.0	17.4	68.20	12.38

**High Channel: 5825MHz**



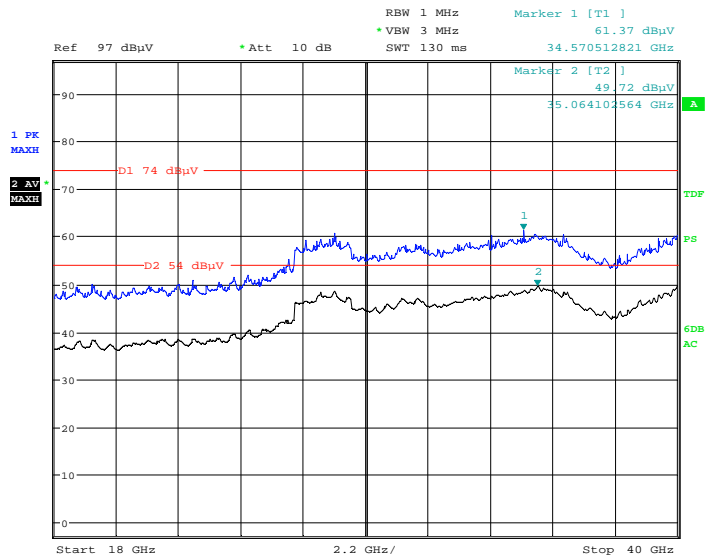
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1200.600000	40.64	---	150.0	H	122.0	-9.3	74.00	33.36
1200.600000	---	31.18	150.0	H	122.0	-9.3	54.00	22.82
3070.600000	42.23	---	150.0	V	168.0	-1.5	68.20	25.97
4971.200000	44.00	---	150.0	V	135.0	2.1	74.00	30.00
4971.200000	---	35.23	150.0	V	135.0	2.1	54.00	18.77
8864.200000	51.28	---	150.0	V	0.0	11.4	68.20	16.92
11650.000000	---	47.71	150.0	V	189.0	13.0	54.00	6.29
11650.000000	57.96	---	150.0	V	189.0	13.0	74.00	16.04
17475.000000	57.60	---	150.0	V	93.0	17.4	68.20	10.60

**18GHz-40GHz (5150-5250MHz Band):**

**Worst case:Chain 1**

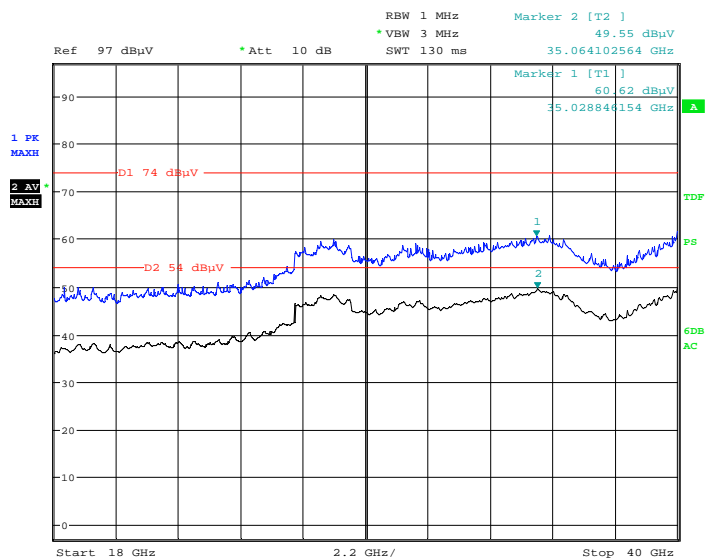
Pre-scan with 802.11a and 802.11n-HT20 modes of operation in the X,Y and Z axes of orientation, the worst case **low** channel of 802.11a mode in Z-axis of orientation was recorded

**Horizontal**



Date: 28.DEC.2018 14:39:27

**Vertical**



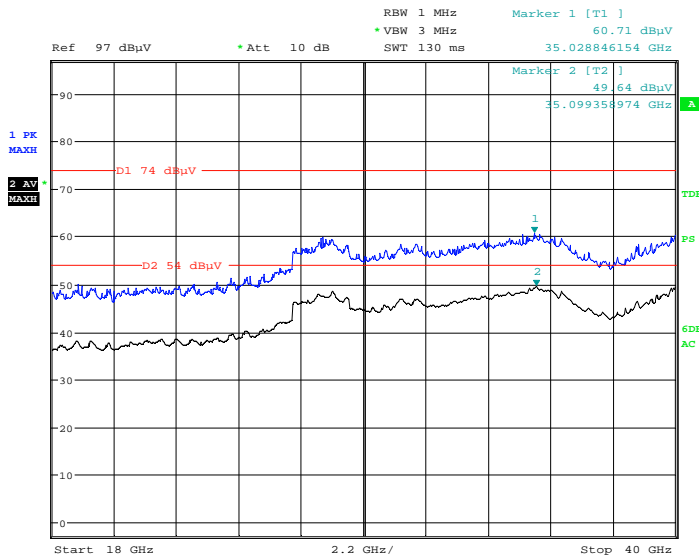
Date: 28.DEC.2018 15:00:18

**18GHz-40GHz (5725-5850 Band):**

**Worst case:Chain 1**

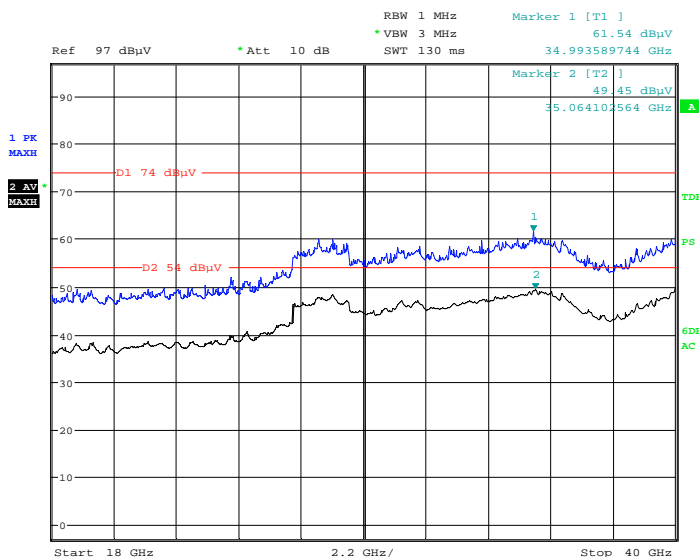
Pre-scan with 802.11a and 802.11n-HT20 modes of operation in the X,Y and Z axes of orientation, the worst case high channel of 802.11a mode in Z-axis of orientation was recorded

**Horizontal**



Date: 28.DEC.2018 15:05:28

**Vertical**



Date: 28.DEC.2018 15:31:02

**Fundamental Test & Restricted Bands Emissions Test (5150-5250MHz Band):**

Note:

Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

Margin = Limit - Corrected. Amplitude

**802.11a Mode (Chain 0):** (Pre-scan in the X, Y and Z axes of orientation, the worst case in Z-axis of orientation was recorded)

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
Low Channel: 5180MHz								
5180.000000	115.46	---	250.0	V	189.0	11.9	/	/
5180.000000	---	108.63	250.0	V	189.0	11.9	/	/
5180.000000	110.70	---	150.0	H	106.0	11.9	/	/
5180.000000	---	103.76	150.0	H	106.0	11.9	/	/
5150.000000	---	50.83	100.0	V	320.0	11.9	54.00	3.17
5150.000000	61.56	---	100.0	V	320.0	11.9	74.00	12.44
Middle Channel: 5200MHz								
5200.000000	115.83	---	200.0	V	60.0	11.9	/	/
5200.000000	---	108.81	200.0	V	60.0	11.9	/	/
5200.000000	111.03	---	200.0	H	151.0	11.9	/	/
5200.000000	---	103.93	200.0	H	151.0	11.9	/	/
High Channel: 5240MHz								
5240.000000	115.51	---	150.0	V	317.0	12.0	/	/
5240.000000	---	108.69	150.0	V	317.0	12.0	/	/
5240.000000	110.76	---	150.0	H	280.0	12.0	/	/
5240.000000	---	103.81	150.0	H	280.0	12.0	/	/
5350.000000	57.96	---	250.0	V	59.0	12.2	74.00	16.04
5350.000000	---	47.56	250.0	V	59.0	12.2	54.00	6.44

**802.11a Mode (Chain 1):** (Pre-scan in the X, Y and Z axes of orientation, the worst case in Z-axis of orientation was recorded)

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
Low Channel: 5180MHz								
5180.000000	114.64	---	150.0	V	8.0	11.9	/	/
5180.000000	---	107.75	150.0	V	8.0	11.9	/	/
5180.000000	109.67	---	150.0	H	7.0	11.9	/	/
5180.000000	---	102.94	150.0	H	7.0	11.9	/	/
5150.000000	---	50.96	200.0	V	108.0	11.9	54.00	3.04
5150.000000	61.43	---	200.0	V	108.0	11.9	74.00	12.57
Middle Channel: 5200MHz								
5200.000000	114.87	---	200.0	V	112.0	11.9	/	/
5200.000000	---	107.93	200.0	V	112.0	11.9	/	/
5200.000000	112.90	---	200.0	H	344.0	11.9	/	/
5200.000000	---	106.11	200.0	H	344.0	11.9	/	/
High Channel: 5240MHz								
5240.000000	114.56	---	200.0	V	61.0	12.0	/	/
5240.000000	---	107.63	200.0	V	61.0	12.0	/	/
5240.000000	112.68	---	150.0	H	147.0	12.0	/	/
5240.000000	---	105.77	150.0	H	147.0	12.0	/	/
5350.000000	58.11	---	200.0	V	191.0	12.2	74.00	15.89
5350.000000	---	47.69	200.0	V	191.0	12.2	54.00	6.31

**802.11n-HT20 Mode (Chain0+Chain1):** (Pre-scan in the X, Y and Z axes of orientation, the worst case in Z-axis of orientation was recorded)

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
Low Channel: 5180MHz								
5180.000000	116.25	---	200.0	V	208.0	11.9	/	/
5180.000000	---	109.34	200.0	V	208.0	11.9	/	/
5180.000000	111.37	---	150.0	H	260.0	11.9	/	/
5180.000000	---	104.43	150.0	H	260.0	11.9	/	/
5150.000000	---	52.16	150.0	V	331.0	11.9	54.00	1.84
5150.000000	62.76	---	150.0	V	331.0	11.9	74.00	11.24
Middle Channel: 5200MHz								
5200.000000	116.12	---	200.0	V	199.0	11.9	/	/
5200.000000	---	109.21	200.0	V	199.0	11.9	/	/
5200.000000	111.14	---	250.0	H	59.0	11.9	/	/
5200.000000	---	104.34	250.0	H	59.0	11.9	/	/
High Channel: 5240MHz								
5240.000000	115.98	---	150.0	V	7.0	12.0	/	/
5240.000000	---	109.05	150.0	V	7.0	12.0	/	/
5240.000000	111.14	---	150.0	H	127.0	12.0	/	/
5240.000000	---	104.25	150.0	H	127.0	12.0	/	/
5350.000000	58.13	---	100.0	V	162.0	12.2	74.00	15.87
5350.000000	---	47.86	100.0	V	162.0	12.2	54.00	6.14



**Fundamental Test & Restricted Bands Emissions Test (5725-5850MHz band):**

Note:

1. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
2. Corrected Amplitude = Corrected Factor + Reading
3. Margin = Limit - Corrected. Amplitude

**802.11a Mode (Chain 0):** (Pre-scan in the X, Y and Z axes of orientation, the worst case in Z-axis of orientation was recorded)

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
Low Channel: 5745MHz								
5745.000000	---	108.31	150.0	V	178.0	12.7	/	/
5745.000000	115.11	---	150.0	V	178.0	12.7	/	/
5745.000000	---	103.52	200.0	H	75.0	12.7	/	/
5745.000000	110.20	---	200.0	H	75.0	12.7	/	/
5650.000000	60.89	---	100.0	V	42.0	12.7	68.20	7.31
5700.000000	61.25	---	250.0	V	44.0	12.7	105.20	43.95
5720.000000	61.33	---	150.0	V	251.0	12.7	110.80	49.47
5725.000000	61.56	---	250.0	V	244.0	12.7	122.20	60.64
Middle Channel: 5785MHz								
5785.000000	115.43	---	200.0	V	350.0	12.7	/	/
5785.000000	---	108.61	200.0	V	350.0	12.7	/	/
5785.000000	110.69	---	250.0	H	246.0	12.7	/	/
5785.000000	---	103.84	250.0	H	246.0	12.7	/	/
High Channel: 5825MHz								
5825.000000	115.15	---	150.0	V	79.0	12.8	/	/
5825.000000	---	108.34	150.0	V	79.0	12.8	/	/
5825.000000	110.19	---	150.0	H	174.0	12.8	/	/
5825.000000	---	103.62	150.0	H	174.0	12.8	/	/
5850.000000	61.05	---	250.0	V	44.0	12.8	122.20	61.15
5855.000000	60.57	---	150.0	V	61.0	12.8	110.80	50.23
5875.000000	60.12	---	200.0	V	4.0	12.8	105.20	45.08
5925.000000	59.83	---	250.0	V	8.0	12.8	68.20	8.37

**802.11a Mode (Chain 1):** (Pre-scan in the X, Y and Z axes of orientation, the worst case in Z-axis of orientation was recorded)

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
Low Channel: 5745MHz								
5745.000000	---	107.96	100.0	V	147.0	12.7	/	/
5745.000000	114.86	---	100.0	V	147.0	12.7	/	/
5745.000000	---	103.24	200.0	H	280.0	12.7	/	/
5745.000000	110.04	---	200.0	H	280.0	12.7	/	/
5650.000000	60.69	---	250.0	V	167.0	12.7	68.20	7.51
5700.000000	61.34	---	100.0	V	133.0	12.7	105.20	43.86
5720.000000	61.42	---	250.0	V	93.0	12.7	110.80	49.38
5725.000000	61.87	---	150.0	V	119.0	12.7	122.20	60.33
Middle Channel: 5785MHz								
5785.000000	114.56	---	100.0	V	217.0	12.7	/	/
5785.000000	---	107.75	100.0	V	217.0	12.7	/	/
5785.000000	109.68	---	200.0	H	286.0	12.7	/	/
5785.000000	---	102.96	200.0	H	286.0	12.7	/	/
High Channel: 5825MHz								
5825.000000	114.71	---	150.0	V	309.0	12.8	/	/
5825.000000	---	107.89	150.0	V	309.0	12.8	/	/
5825.000000	109.88	---	150.0	H	89.0	12.8	/	/
5825.000000	---	103.17	150.0	H	89.0	12.8	/	/
5850.000000	61.23	---	250.0	V	243.0	12.8	122.20	60.97
5855.000000	60.54	---	200.0	V	94.0	12.8	110.80	50.26
5875.000000	60.01	---	150.0	V	309.0	12.8	105.20	45.19
5925.000000	59.73	---	100.0	V	36.0	12.8	68.20	8.47

**802.11n-HT20 Mode (Chain0+Chain1):** (Pre-scan in the X, Y and Z axes of orientation, the worst case in Z-axis of orientation was recorded)

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
Low Channel: 5745MHz								
5745.000000	---	109.36	150.0	V	210.0	12.7	/	/
5745.000000	116.11	---	150.0	V	210.0	12.7	/	/
5745.000000	---	103.42	150.0	H	209.0	12.7	/	/
5745.000000	111.23	---	150.0	H	209.0	12.7	/	/
5650.000000	62.77	---	250.0	V	168.0	12.7	68.20	5.43
5700.000000	63.01	---	200.0	V	6.0	12.7	105.20	42.19
5720.000000	63.25	---	150.0	V	166.0	12.7	110.80	47.55
5725.000000	63.68	---	250.0	V	343.0	12.7	122.20	58.52
Middle Channel: 5785MHz								
5785.000000	116.21	---	100.0	V	249.0	12.7	/	/
5785.000000	---	109.39	100.0	V	249.0	12.7	/	/
5785.000000	111.30	---	250.0	H	111.0	12.7	/	/
5785.000000	---	104.52	250.0	H	111.0	12.7	/	/
High Channel: 5825MHz								
5825.000000	116.36	---	100.0	V	229.0	12.8	/	/
5825.000000	---	109.51	100.0	V	229.0	12.8	/	/
5825.000000	111.48	---	150.0	H	113.0	12.8	/	/
5825.000000	---	104.67	150.0	H	113.0	12.8	/	/
5850.000000	62.06	---	150.0	V	69.0	12.8	122.20	60.14
5855.000000	61.24	---	200.0	V	249.0	12.8	110.80	49.56
5875.000000	60.93	---	250.0	V	335.0	12.8	105.20	44.27
5925.000000	60.61	---	200.0	V	210.0	12.8	68.20	7.59

## **FCC §15.407(a) & §15.407(e)–EMISSION BANDWIDTH**

### **Applicable Standard**

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 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.

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

### **Test Procedure**

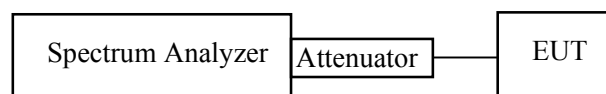
#### **1. Emission Bandwidth (EBW)**

- 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 5.725-5.85 GHz. The following procedure shall be used for measuring this bandwidth:

- a) Set RBW = 100 kHz.
- b) Set the video bandwidth (VBW)  $\geq 3 \times$  RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.



**Test Data**

**Environmental Conditions**

<b>Temperature:</b>	23.5 °C
<b>Relative Humidity:</b>	50 %
<b>ATM Pressure:</b>	101.2 kPa

The testing was performed by Max Min on 2018-12-11.

**Test Result:** Pass.

5150-5250 MHz:

Test mode	Channel	Frequency (MHz)	26dB Bandwidth (MHz)		99% Bandwidth (MHz)	
			Chain0	Chain1	Chain0	Chain1
802.11a	Low	5180	24.168	27.415	17.194	17.315
	Middle	5200	25.13	27.415	17.194	17.315
	High	5240	27.054	27.174	17.315	17.315
802.11n-HT20	Low	5180	22.846	23.687	18.156	18.397
	Middle	5200	23.206	23.808	18.156	18.397
	High	5240	22.966	23.808	18.156	18.277

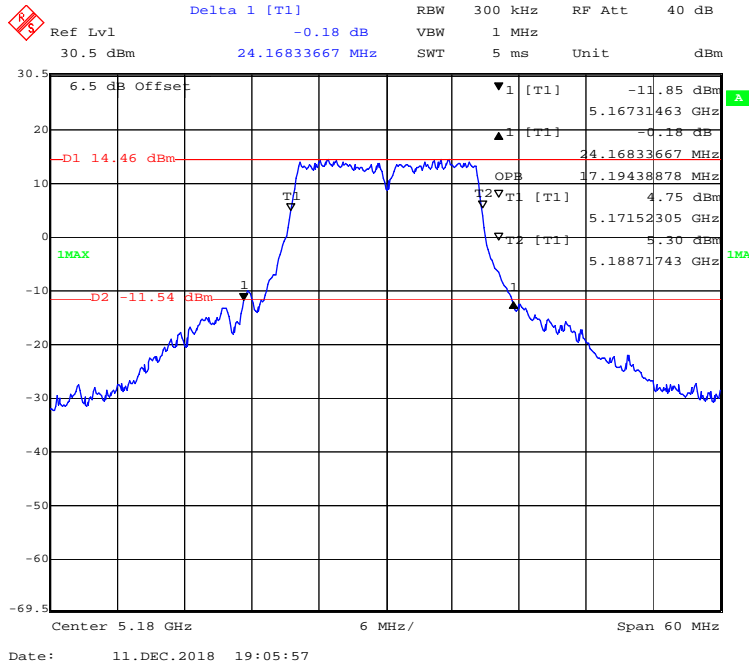
5725-5850MHz:

Test mode	Channel	Frequency (MHz)	6dB Bandwidth (MHz)		99% Bandwidth (MHz)		Limit (MHz)
			Chain0	Chain1	Chain0	Chain1	
802.11a	Low	5745	16.593	16.653	17.615	17.194	≥0.5
	Middle	5785	16.593	16.653	18.457	17.194	≥0.5
	High	5825	16.593	16.653	19.238	17.194	≥0.5
802.11n-HT20	Low	5745	17.856	17.856	18.337	18.156	≥0.5
	Middle	5785	17.856	17.856	18.517	18.216	≥0.5
	High	5825	17.796	17.856	18.756	18.277	≥0.5

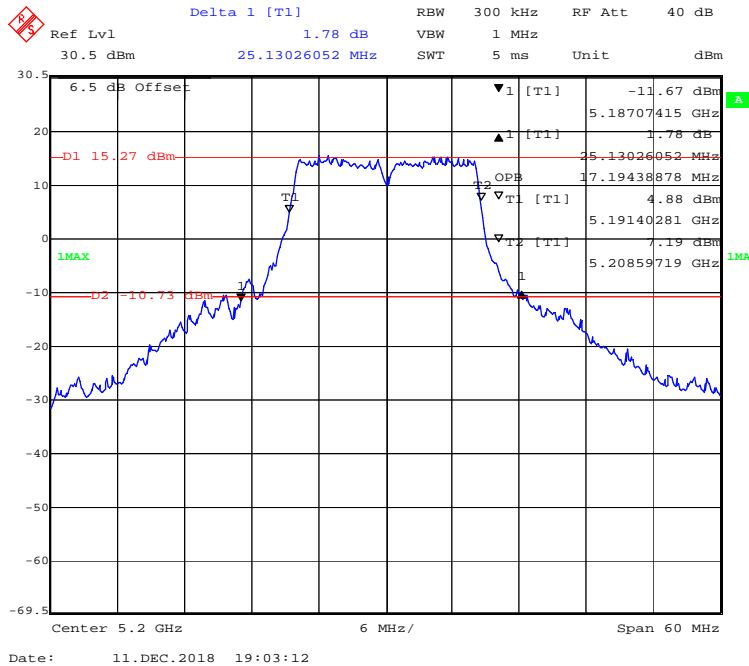
**5150-5250 MHz Band:**

**26 Bandwidth+99% Occupied Bandwidth**

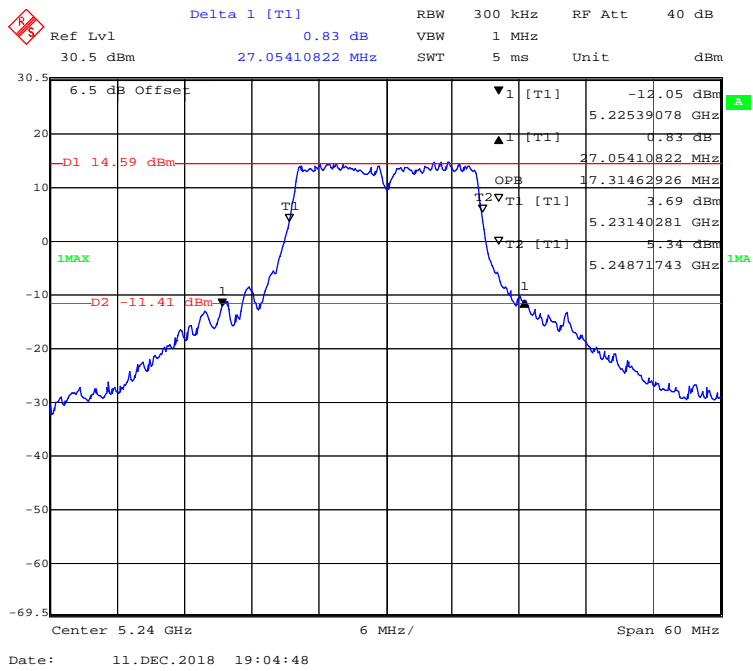
**802.11a mode, Chain 0: 5180MHz**



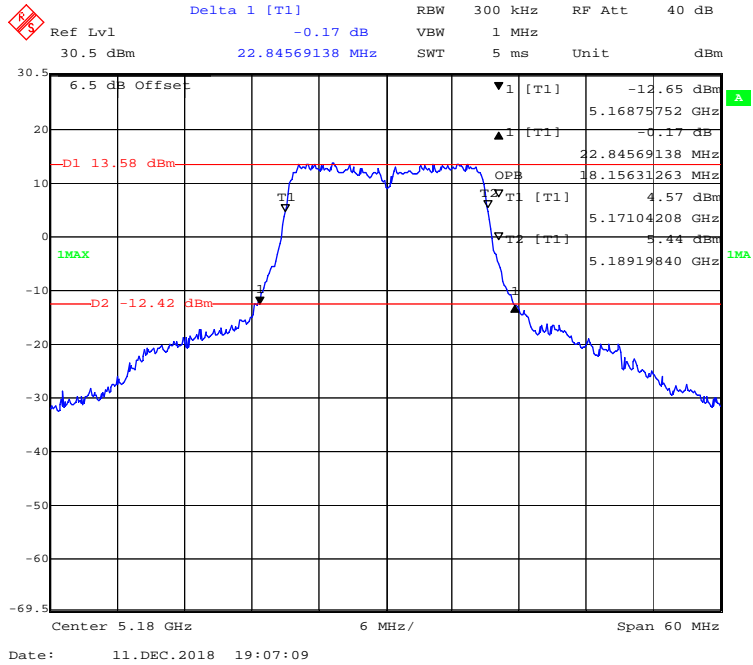
**802.11a mode, Chain 0: 5200MHz**



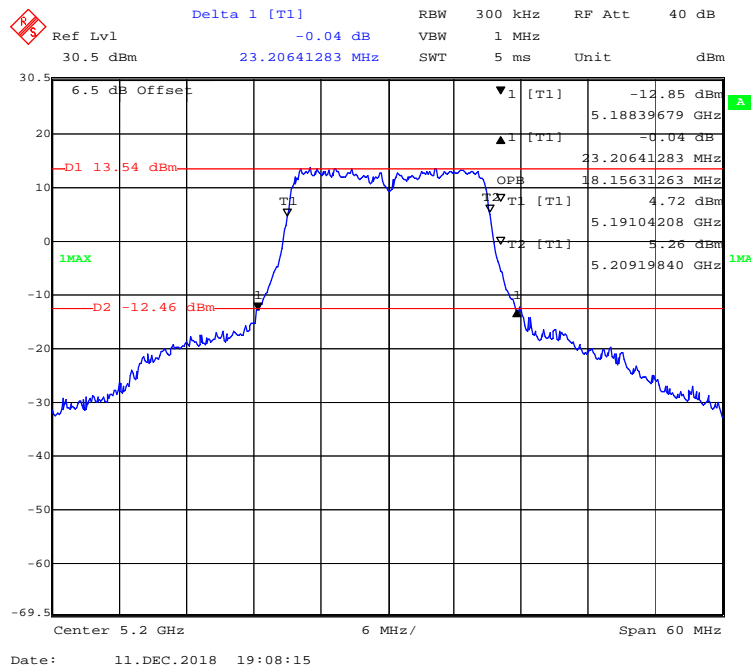
**802.11a mode, Chain 0: 5240MHz**



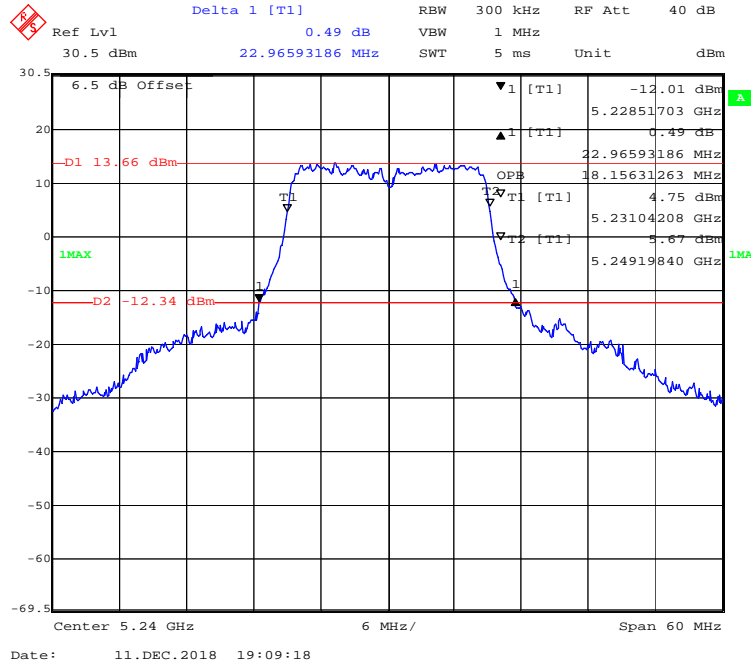
**802.11n-HT20 mode, Chain 0: 5180MHz**



802.11n-HT20 mode, Chain 0: 5200MHz

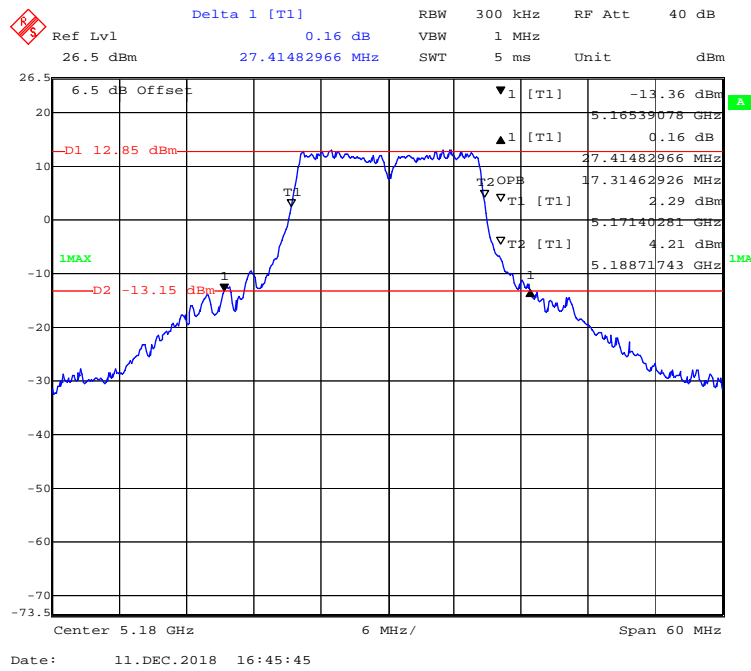


802.11n-HT20 mode, Chain 0: 5240MHz

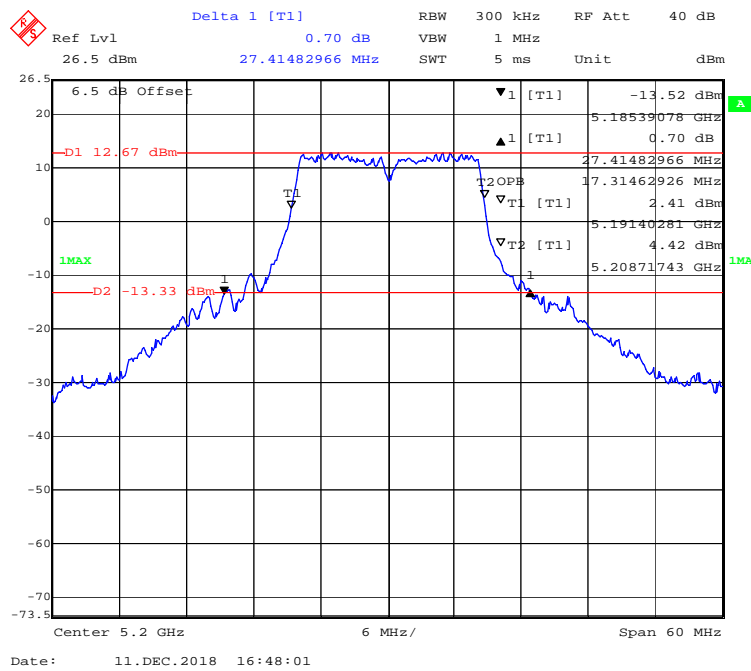




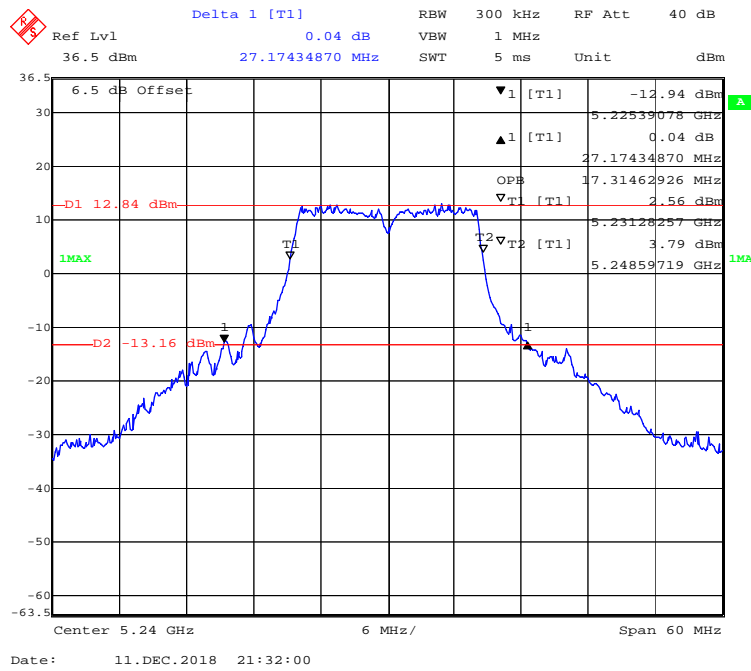
802.11a mode, Chain 1: 5180MHz



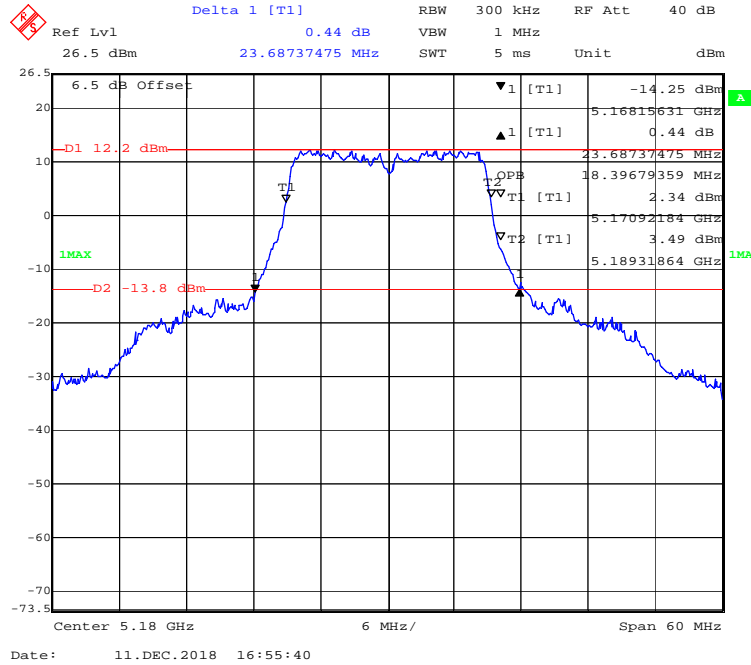
802.11a mode, Chain 1: 5200MHz



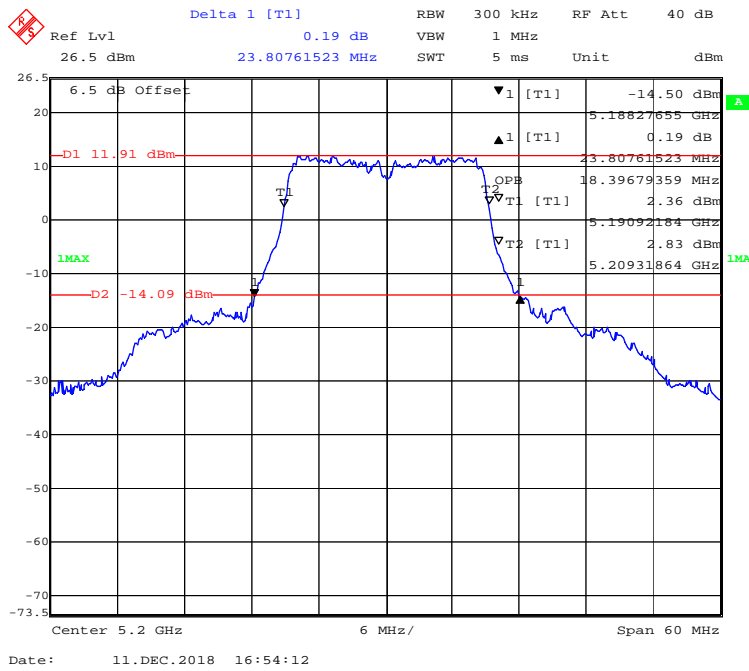
802.11a mode, Chain 1: 5240MHz



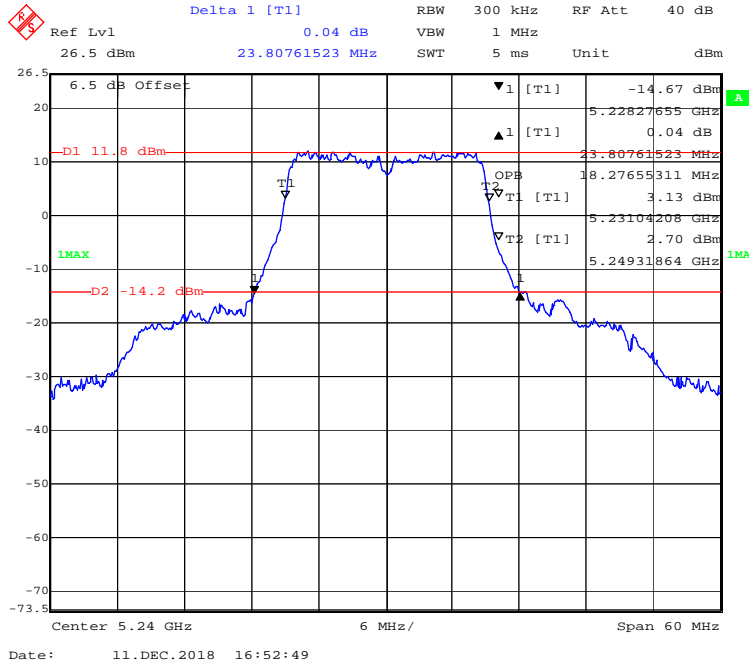
802.11n-HT20 mode, Chain 1: 5180MHz



802.11n-HT20 mode, Chain 1: 5200MHz



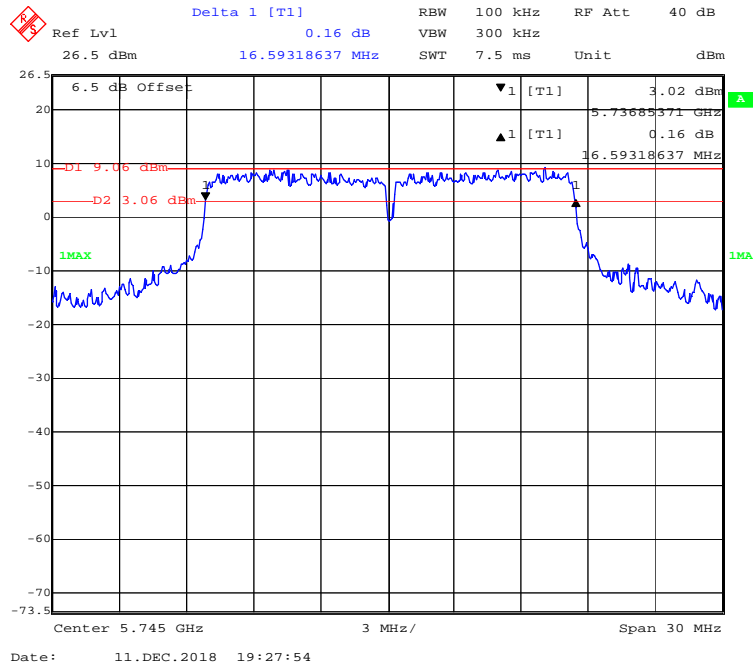
802.11n-HT20 mode, Chain 1: 5240MHz



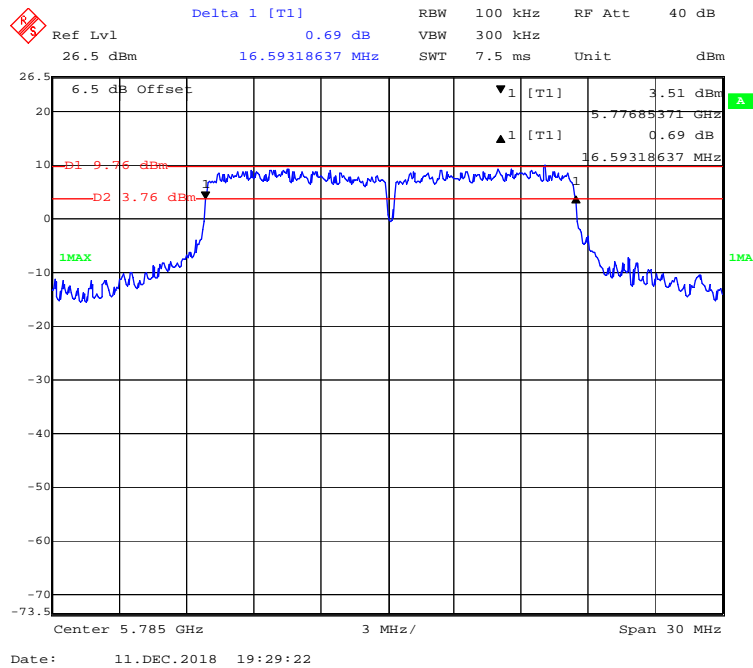
5725-5850 MHz Band:

6 Bandwidth

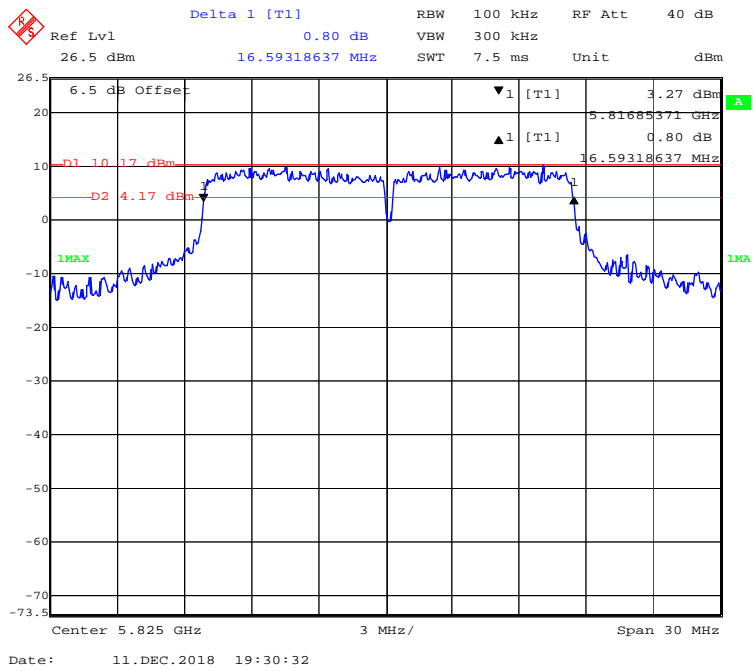
802.11a mode, Chain 0: 5745MHz



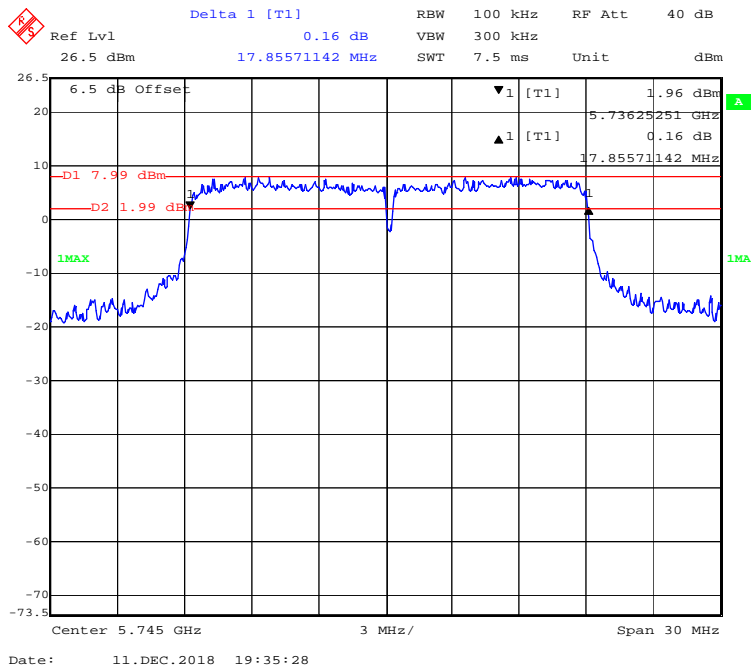
802.11a mode, Chain 0: 5785MHz



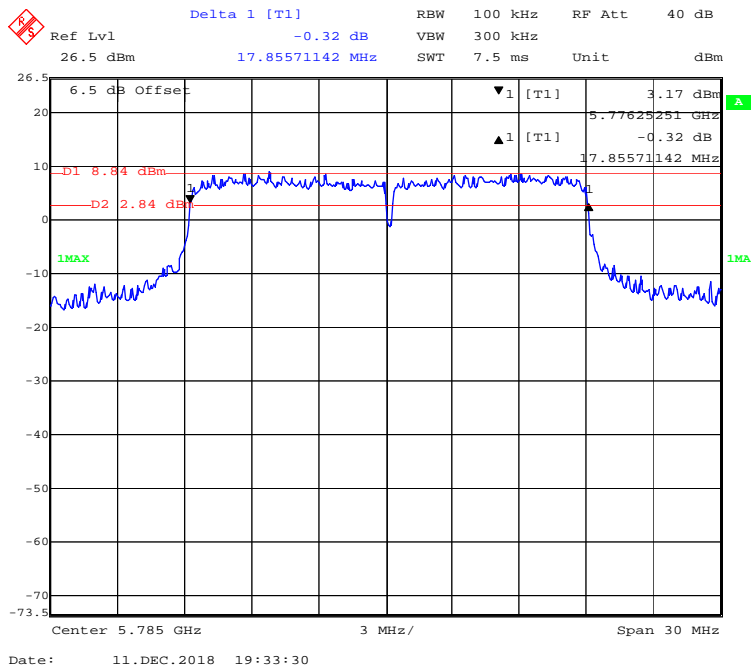
**802.11a mode, Chain 0: 5825MHz**



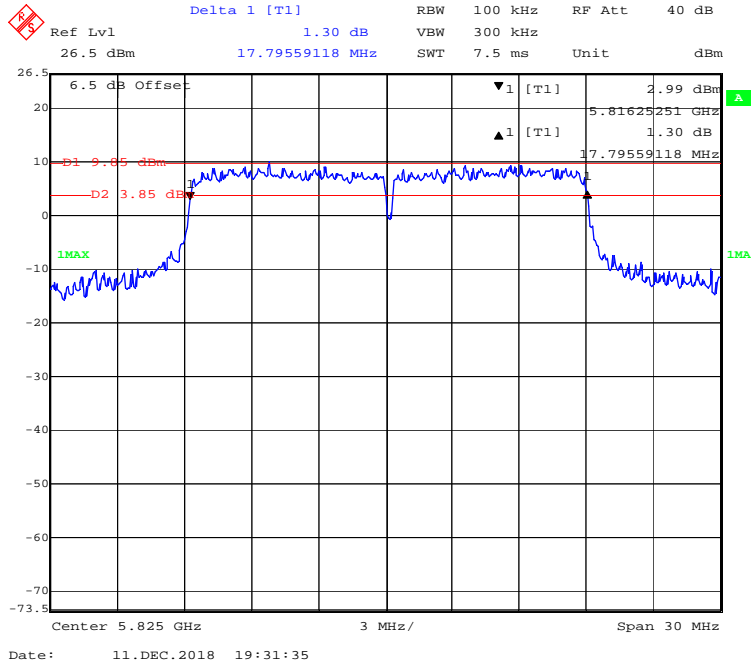
**802.11n-HT20 mode, Chain 0: 5745MHz**



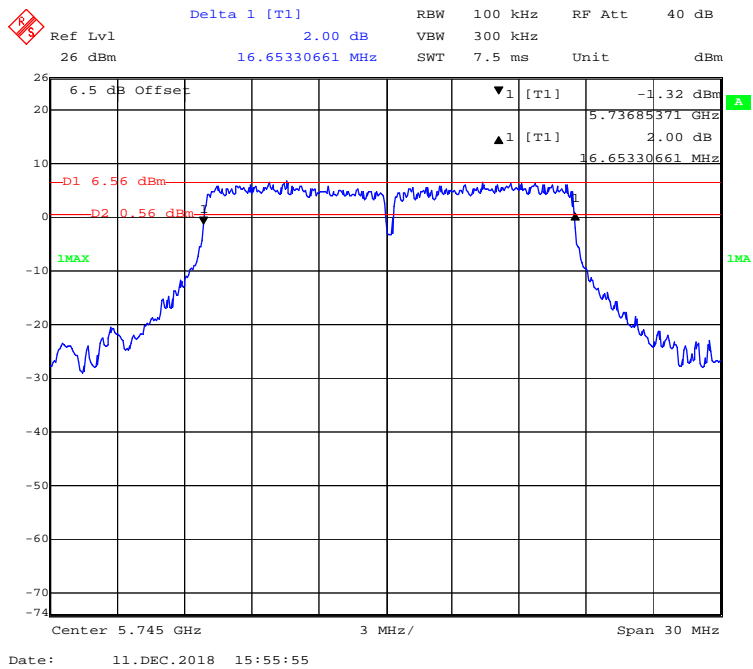
**802.11n-HT20 mode, Chain 0: 5785MHz**



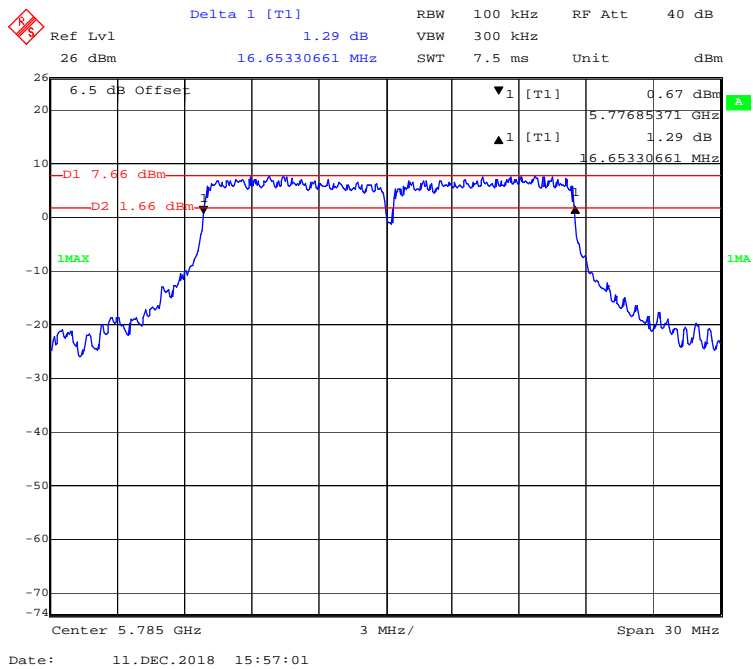
**802.11n-HT20 mode, Chain 0: 5825MHz**



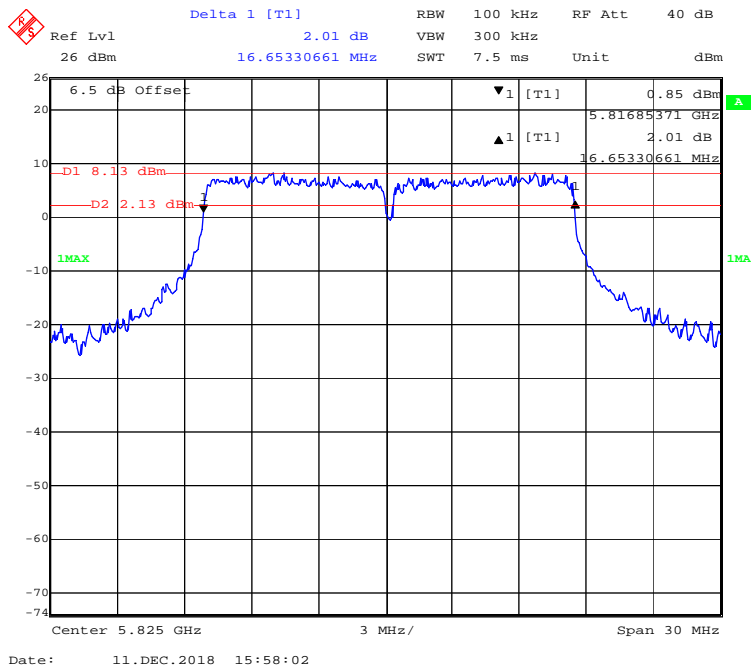
802.11a mode, Chain 1: 5745MHz



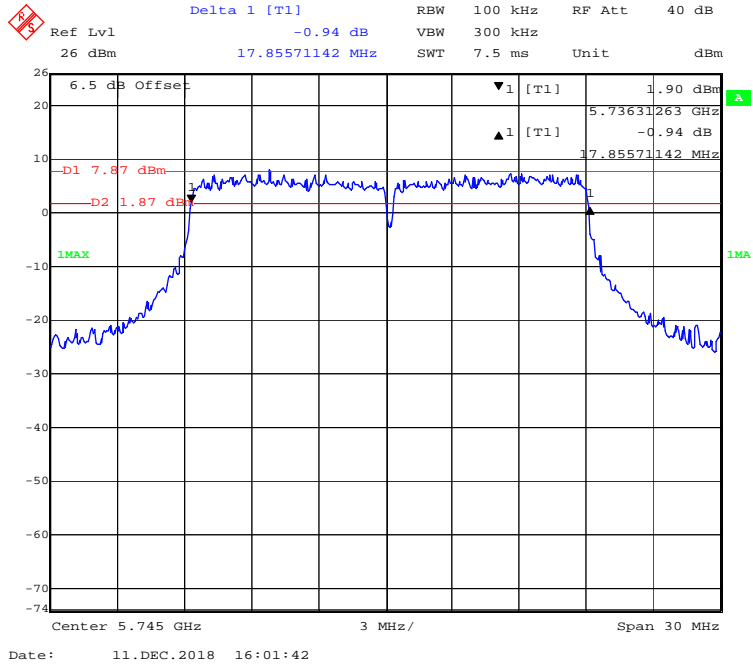
802.11a mode, Chain 1: 5785MHz



**802.11a mode, Chain 1: 5825MHz**

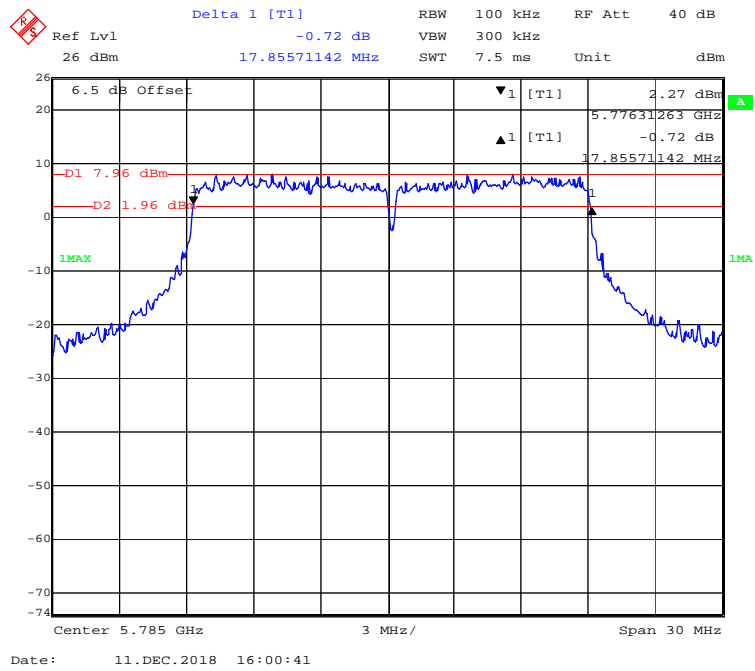


**802.11n-HT20 mode, Chain 1: 5745MHz**

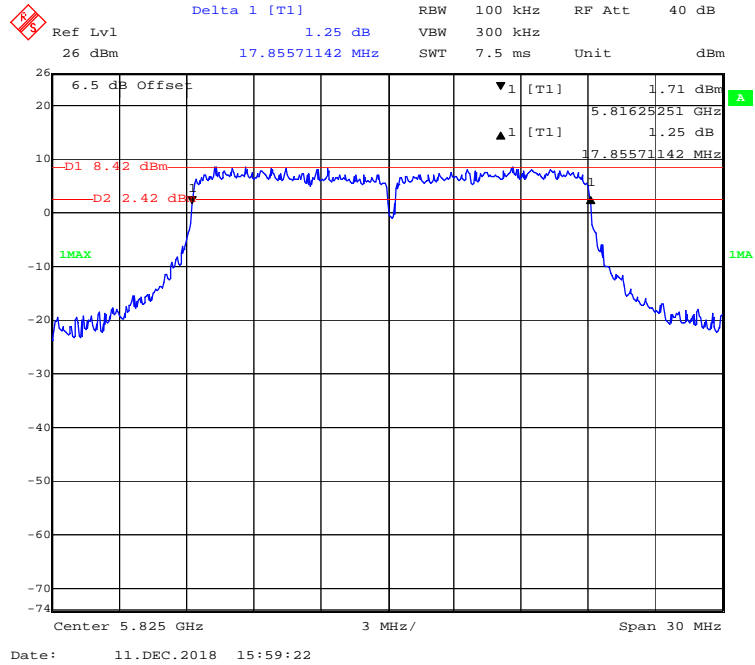




**802.11n-HT20 mode, Chain 1: 5785MHz**

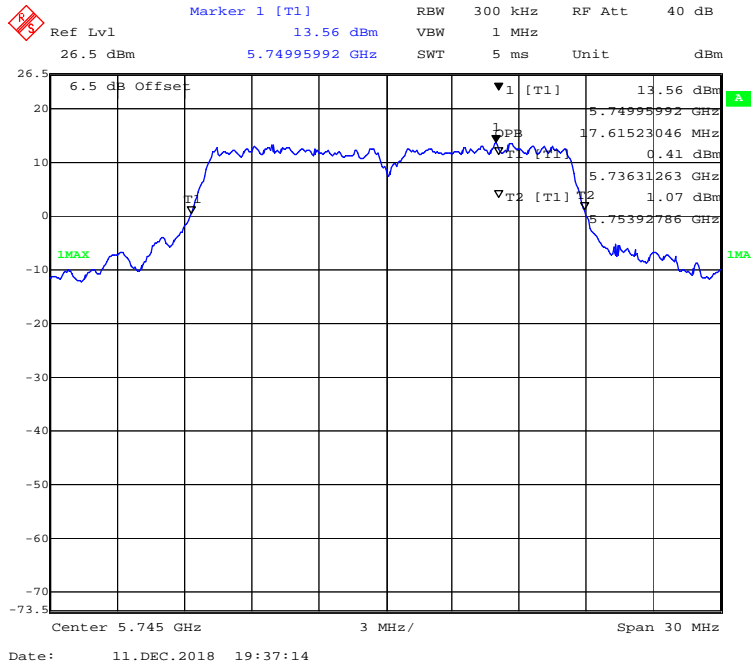


**802.11n-HT20 mode, Chain 1: 5825MHz**

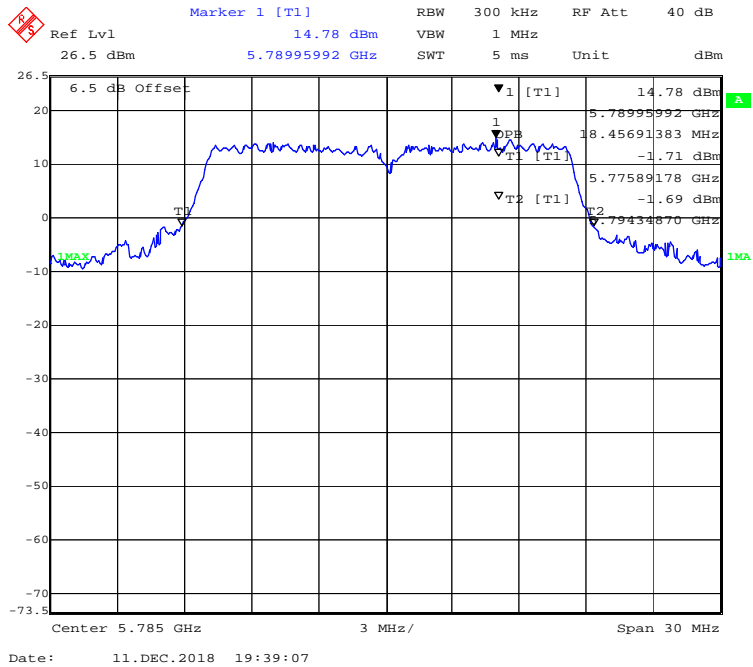


99% Occupied Bandwidth

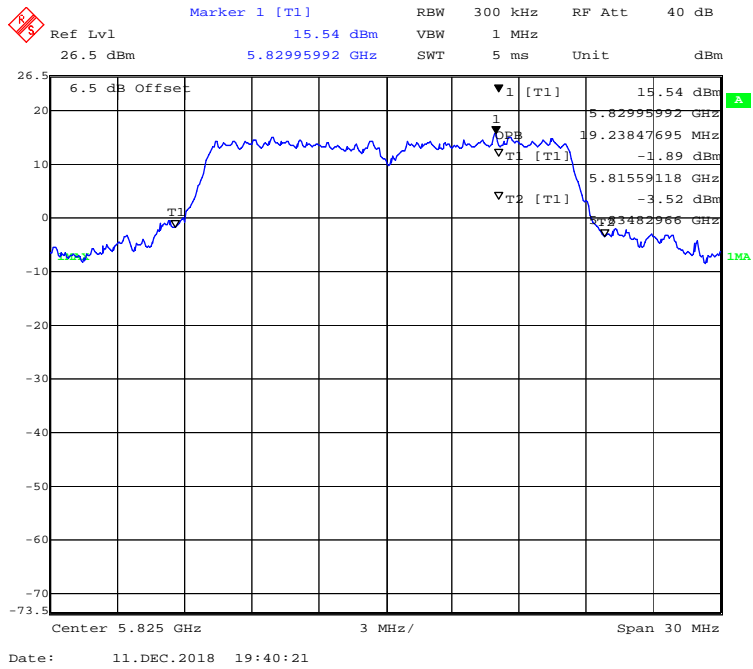
802.11a mode, Chain 0: 5745MHz



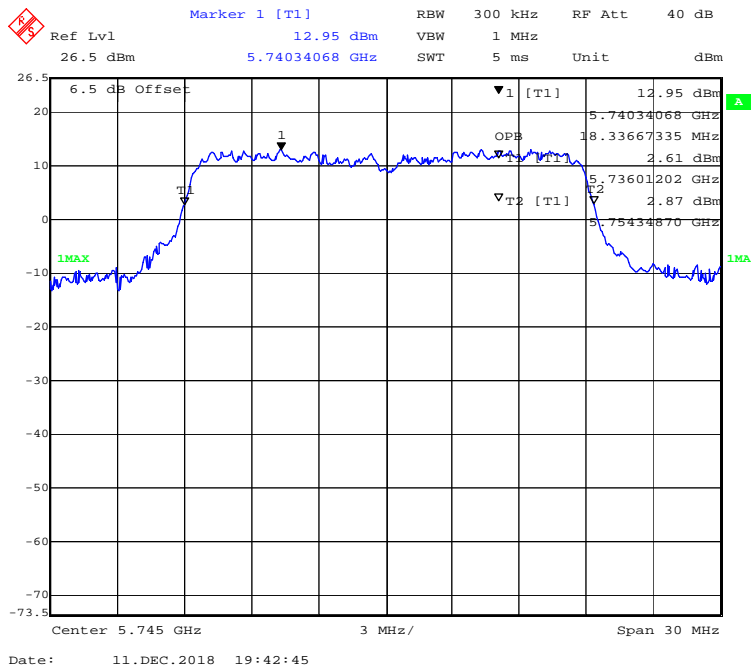
802.11a mode, Chain 0: 5785MHz



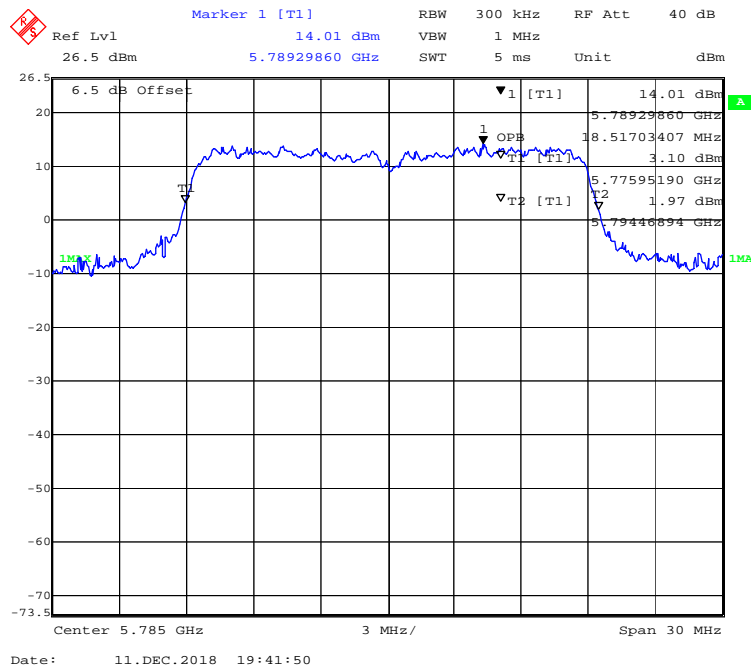
**802.11a mode, Chain 0: 5825MHz**



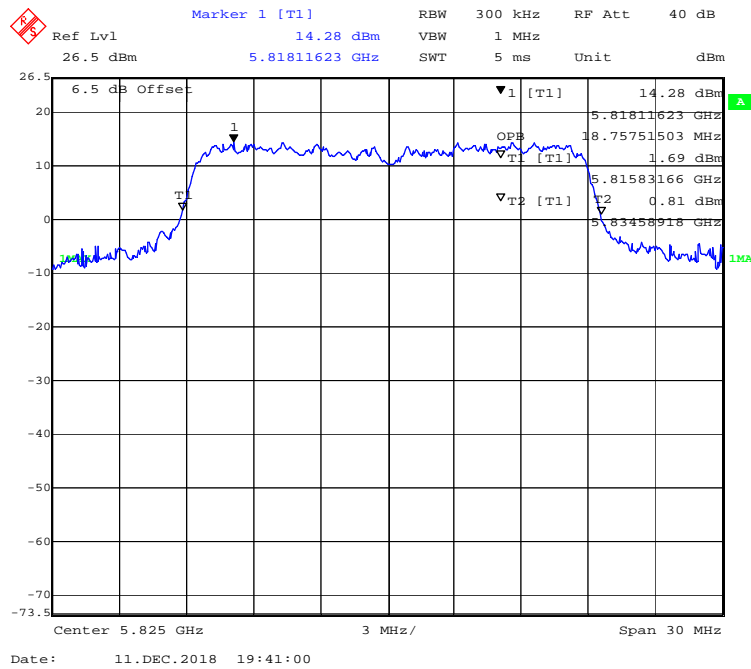
**802.11n-HT20 mode, Chain 0: 5745MHz**



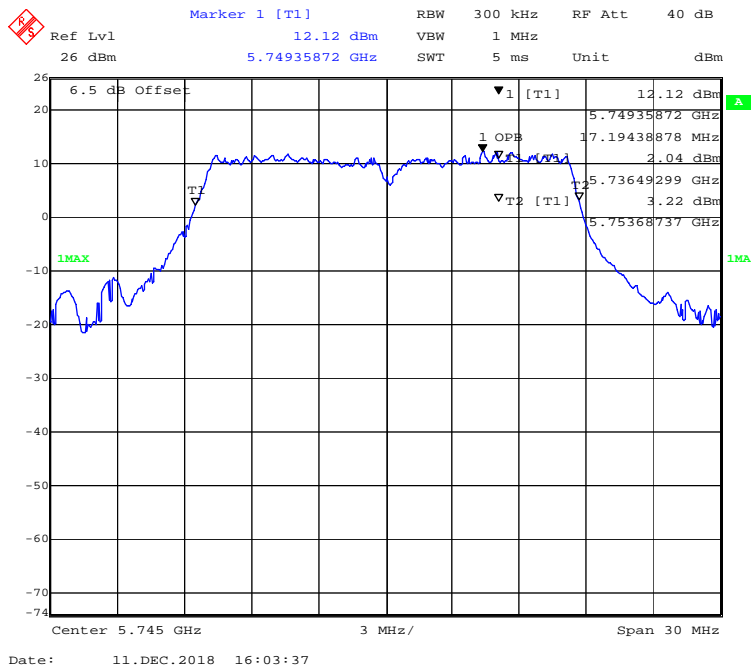
802.11n-HT20 mode, Chain 0: 5785MHz



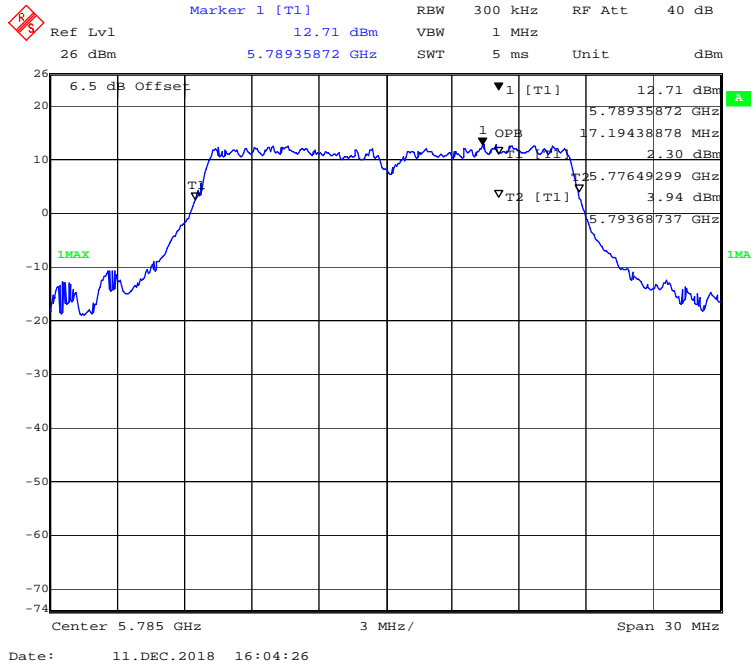
802.11n-HT20 mode, Chain 0: 5825MHz



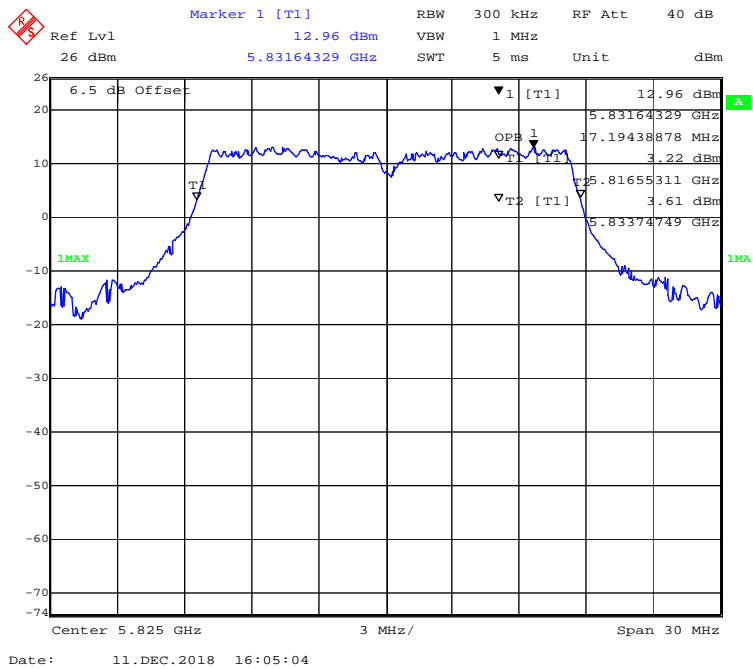
802.11a mode, Chain 1: 5745MHz



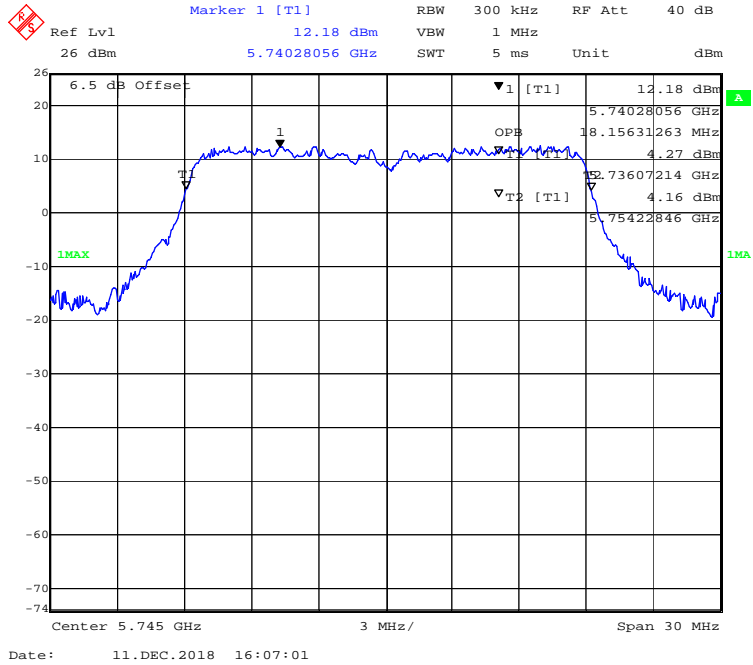
802.11a mode, Chain 1: 5785MHz



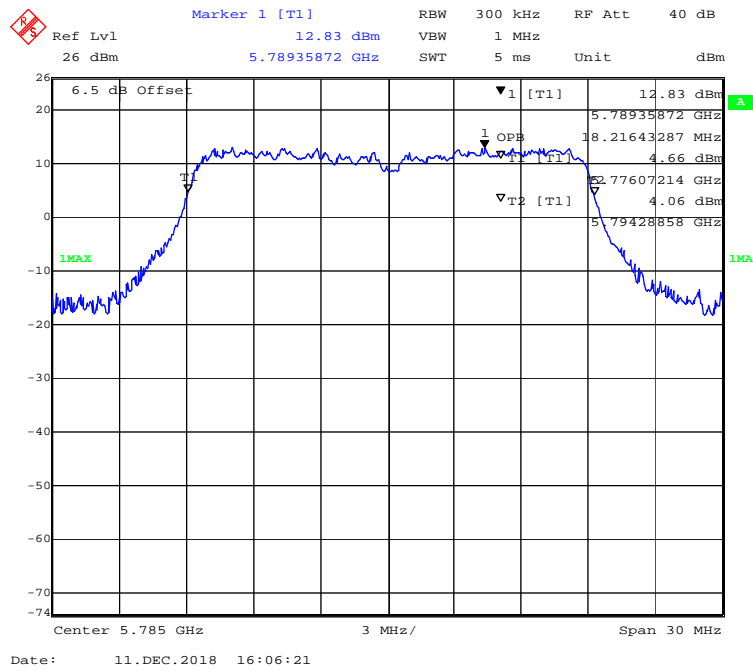
**802.11a mode, Chain 1: 5825MHz**



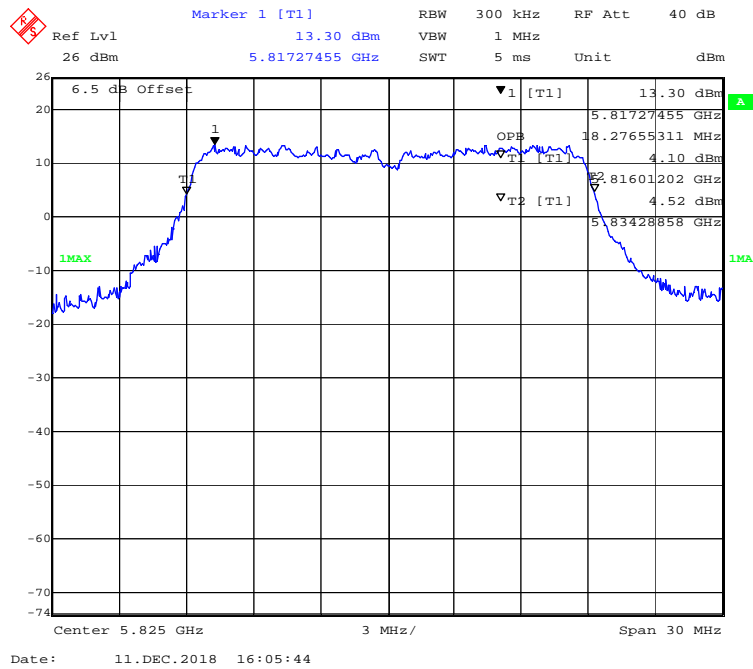
**802.11n-HT20 mode, Chain 1: 5745MHz**



**802.11n-HT20 mode, Chain 1: 5785MHz**



**802.11n-HT20 mode, Chain 1: 5825MHz**



**FCC §15.407(a) (1)(3) – CONDUCTED TRANSMITTER OUTPUT POWER**

**Applicable Standard**

According to §15.407(a)(1)

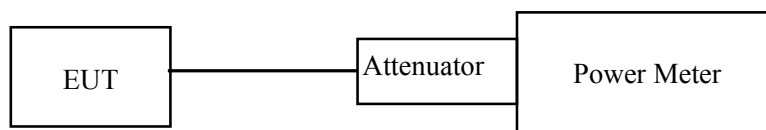
(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices 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.

According to §15.407(a) (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.

**Test Procedure**

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.



**Test Data**

**Environmental Conditions**

<b>Temperature:</b>	23.5 °C
<b>Relative Humidity:</b>	50 %
<b>ATM Pressure:</b>	101.2 kPa

*The testing was performed by Max Min on 2018-12-11.*



Test Mode: Transmitting

Test mode	Band	Channel	Frequency (MHz)	Conducted Output Power (dBm)			Limit (dBm)	Result
				Chain0	Chain1	Total		
802.11a	5150-5250 MHz	Low	5180	24.56	24.89	/	30	PASS
		Middle	5200	24.04	24.56	/	30	PASS
		High	5240	24.16	24.75	/	30	PASS
	5725-5850 MHz	Low	5745	24.09	23.18	/	30	PASS
		Middle	5785	24.70	23.56	/	30	PASS
		High	5825	25.26	23.96	/	30	PASS
802.11n-HT20	5150-5250 MHz	Low	5180	24.48	24.60	27.55	30	PASS
		Middle	5200	24.49	24.11	27.31	30	PASS
		High	5240	24.72	24.04	27.40	30	PASS
	5725-5850 MHz	Low	5745	23.97	24.46	27.23	30	PASS
		Middle	5785	24.88	24.13	27.53	30	PASS
		High	5825	25.11	24.54	27.84	30	PASS

Note 1: The total output power= $10\log_{10}(10^{(Chain\ 0/10)}+10^{(Chain\ 1/10)})$

Note 2: The maximum antenna gain is 3.0 dBi, the device employed Cyclic Delay Diversity (CDD) for 802.11 MIMO transmitting, per KDB 662911 D01 Multiple Transmitter Output v02r01, for power measurements on IEEE 802.11 devices:

Array Gain = 0 dB (i.e., no array gain) for  $NANT \leq 4$ ;

So:

Directional gain =  $GANT + Array\ Gain = 3dBi < 6dBi$

## **FCC §15.407(a) (1) (3) - POWER SPECTRAL DENSITY**

### **Applicable Standard**

According to §15.407(a) (1)

(iii) For fixed point-to-point access points 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. In addition, 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.

According to §15.407(a) (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.

### **Test Procedure**

The measurements are base on FCC KDB 789033 D02 General UNII Test Proceдыres New Rules v01: Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices section F: Maximum power spectral density (PPSD)

### **Test Data**

#### **Environmental Conditions**

<b>Temperature:</b>	23.5-24.8 °C
<b>Relative Humidity:</b>	48-50 %
<b>ATM Pressure:</b>	100.1-101.2 kPa

*The testing was performed by Max Min from 2018-12-11 to 2018-02-28.*

Test Mode: Transmitting

**5150MHz-5250MHz:**

Mode	Channel	Frequency (MHz)	PSD (dBm/MHz)			Limit (dBm/MHz)	Result
			Chain0	Chain1	Total		
802.11a	Low	5180	12.30	12.47	/	17	PASS
	Middle	5200	12.27	12.55	/	17	PASS
	High	5240	12.33	12.59	/	17	PASS
802.11n20	Low	5180	11.88	11.91	14.91	17	PASS
	Middle	5200	12.19	12.16	15.19	17	PASS
	High	5240	12.22	11.64	14.95	17	PASS

**5725MHz-5850MHz:**

Mode	Channel	Frequency MHz	PSD (dBm/500kHz)			Limit (dBm/500kHz)	Result
			Chain0	Chain1	Total		
802.11a	Low	5745	11.16	10.29	/	30	PASS
	Middle	5785	11.47	10.20	/	30	PASS
	High	5825	11.93	10.46	/	30	PASS
802.11n20	Low	5745	11.22	11.53	14.39	30	PASS
	Middle	5785	11.77	11.20	14.50	30	PASS
	High	5825	12.08	11.78	14.94	30	PASS

Note1: The total PSD= $10\log_{10}(10^{Chain\ 0/10}+10^{Chain\ 1/10})$

Note2: The maximum antenna gain is 3 dBi. The device employed Cyclic Delay Diversity (CDD) for 802.11MIMO transmitting, per KDB 662911 D01 Multiple Transmitter Output v02r01, for power spectral density (PSD) measurements on the devices:

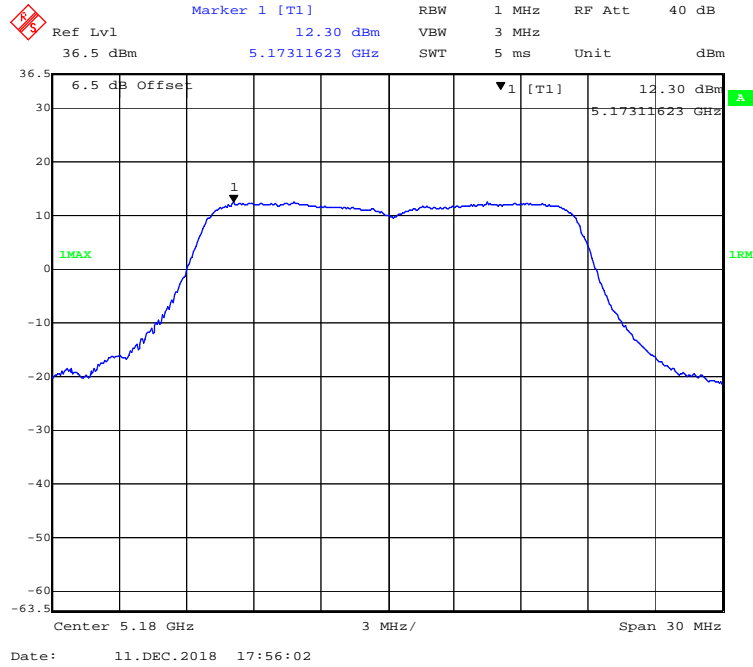
Array Gain =  $10\log(N_{ANT}/N_{SS})$  dB.

So:

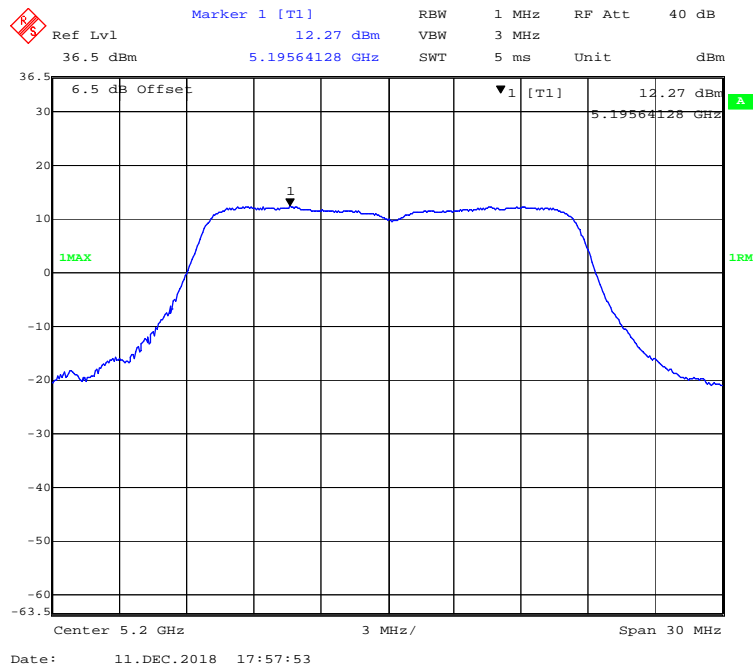
Directional gain = GANT + Array Gain =  $3+10*\log(2/1)=6.0$  dBi

5150MHz-5250MHz Band:

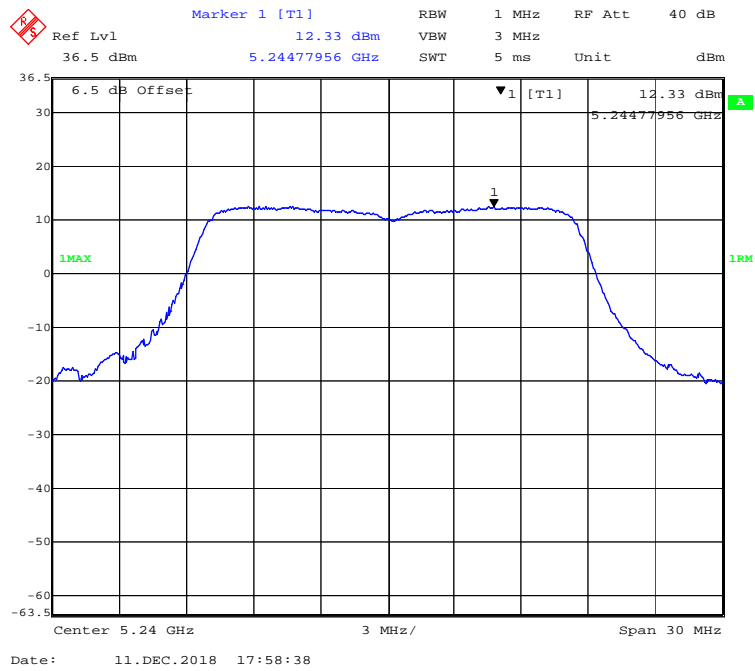
802.11a mode, Chain 0: Power spectral density-5180MHz



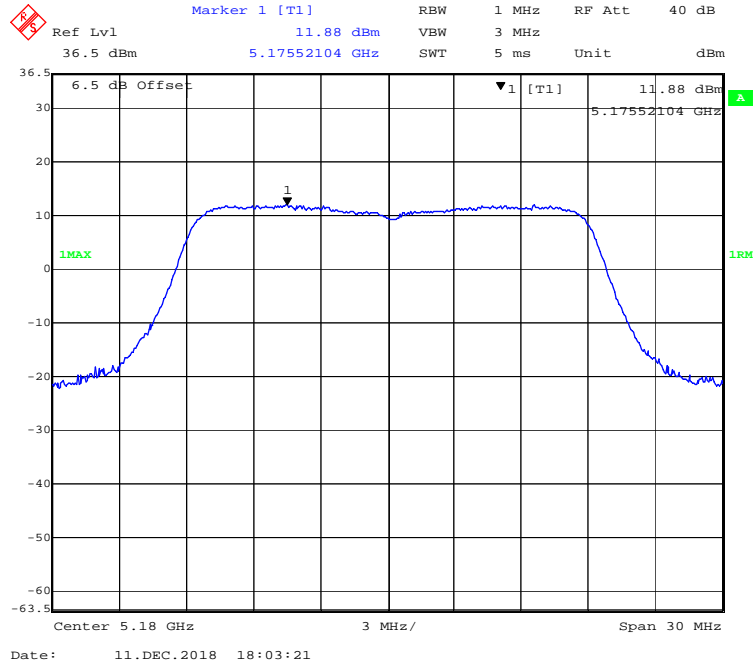
802.11a mode, Chain 0: Power spectral density-5200MHz



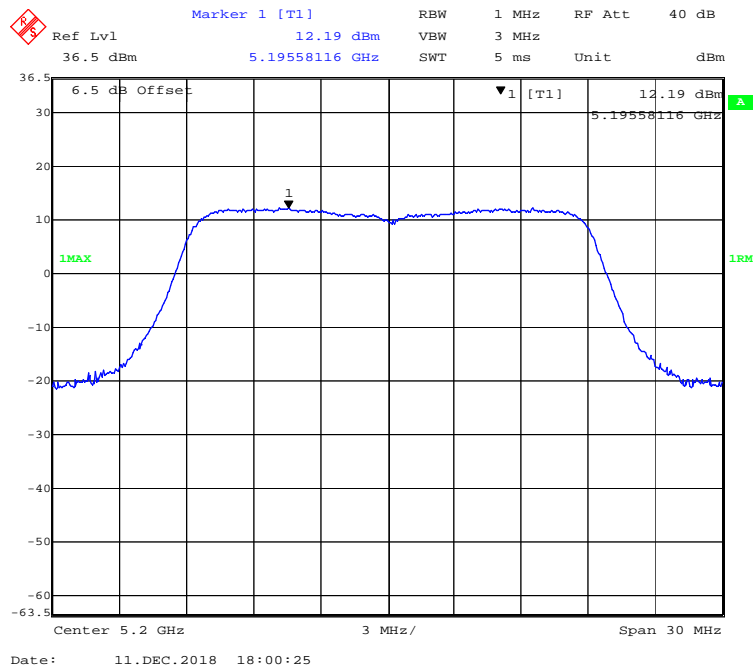
802.11a mode, Chain 0: Power spectral density-5240MHz



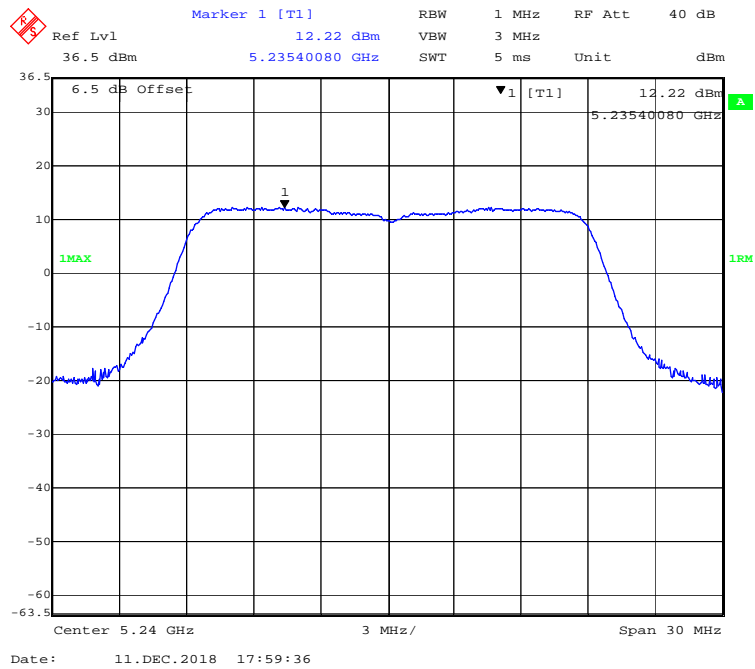
802.11n-HT20 mode, Chain 0: Power spectral density-5180MHz



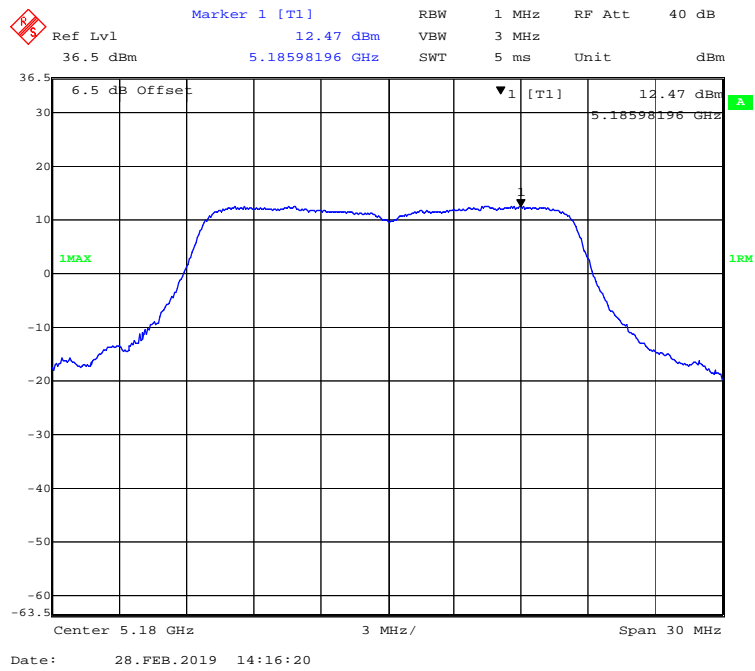
**802.11n-HT20 mode, Chain 0: Power spectral density-5200MHz**



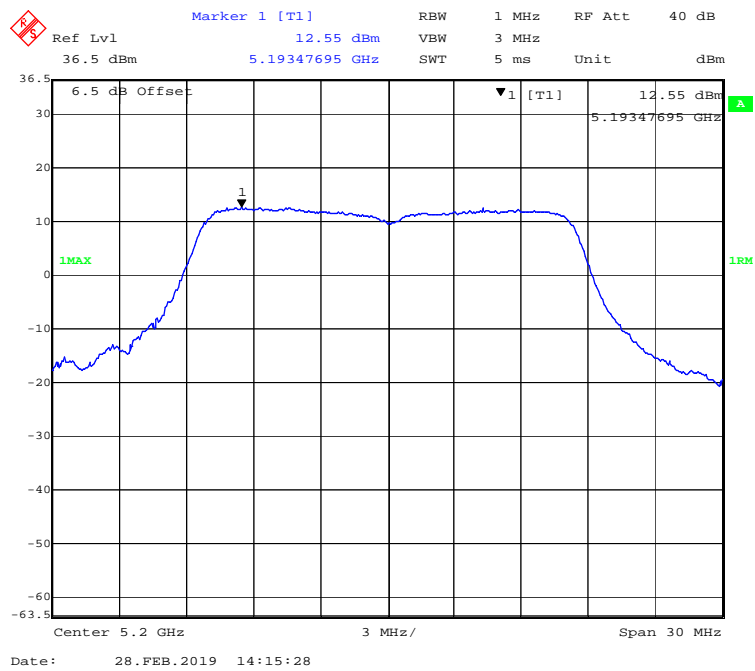
**802.11n-HT20 mode, Chain 0: Power spectral density-5240MHz**



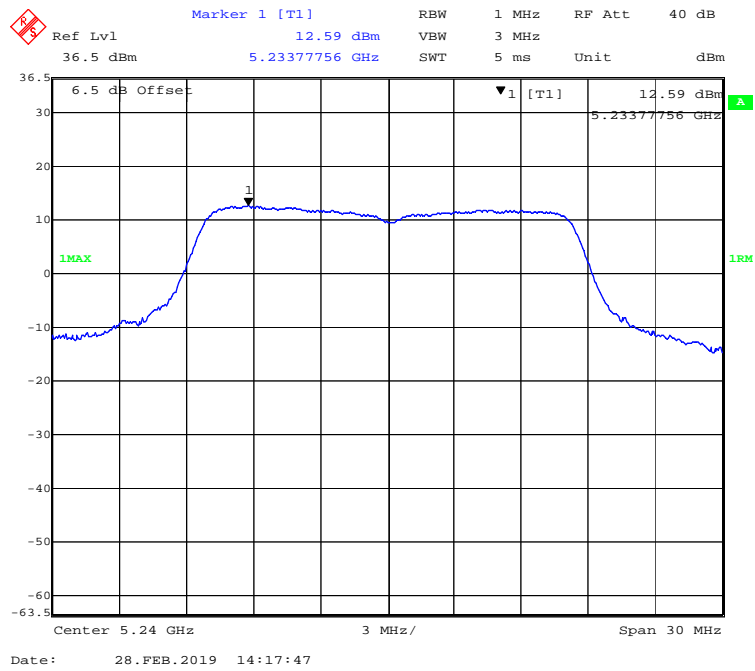
**802.11a mode, Chain 1: Power spectral density-5180MHz**



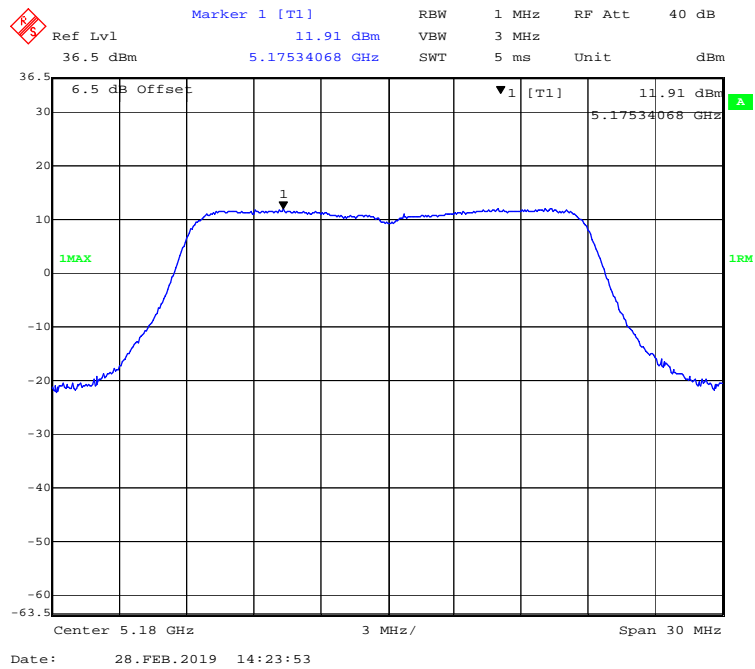
**802.11a mode, Chain 1: Power spectral density-5200MHz**



802.11a mode, Chain 1: Power spectral density-5240MHz

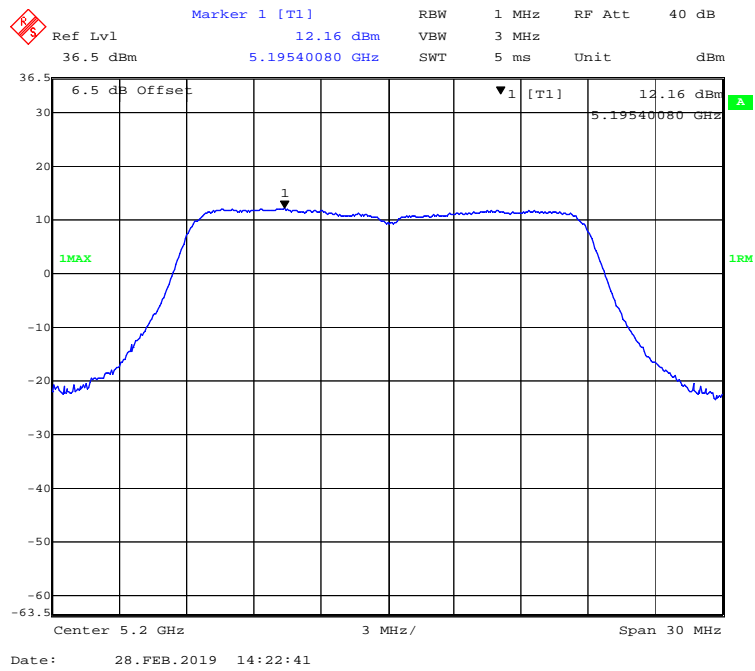


802.11n-HT20 mode, Chain 1: Power spectral density-5180MHz

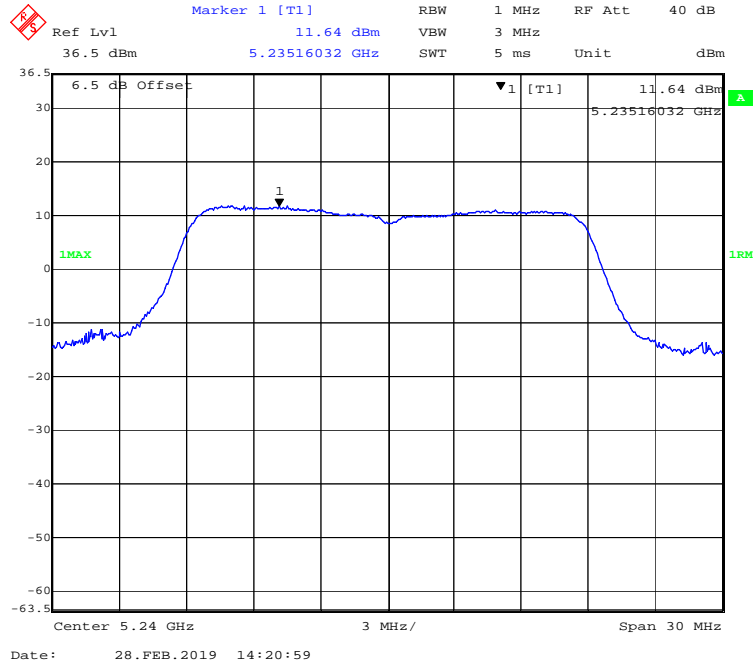




**802.11n-HT20 mode, Chain 1: Power spectral density-5200MHz**

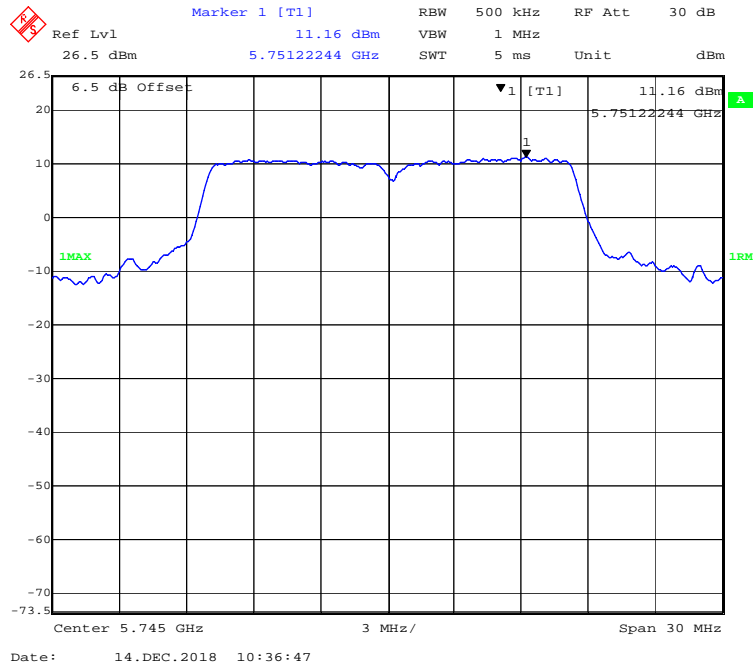


**802.11n-HT20 mode, Chain 1: Power spectral density-5240MHz**

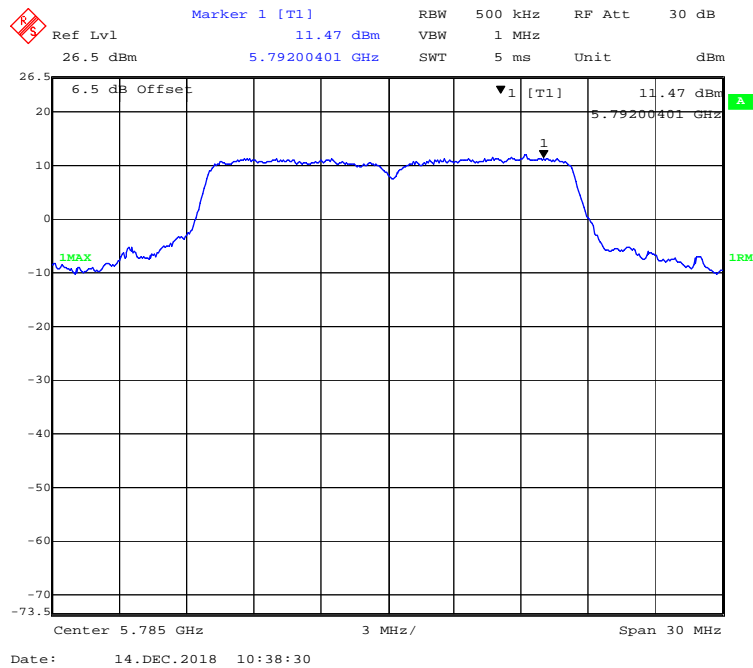


**5725MHz-5850 MHz Band:**

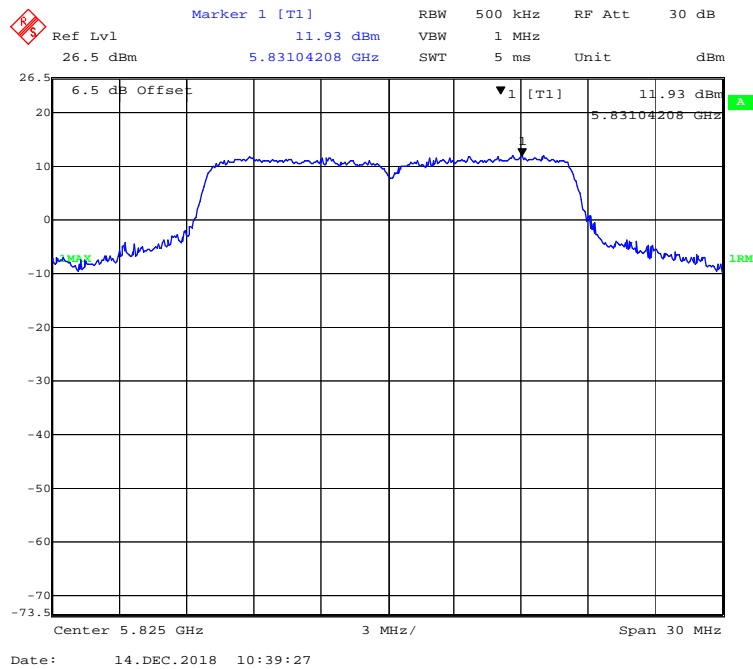
**802.11a mode, Chain 0: Power spectral density-5745MHz**



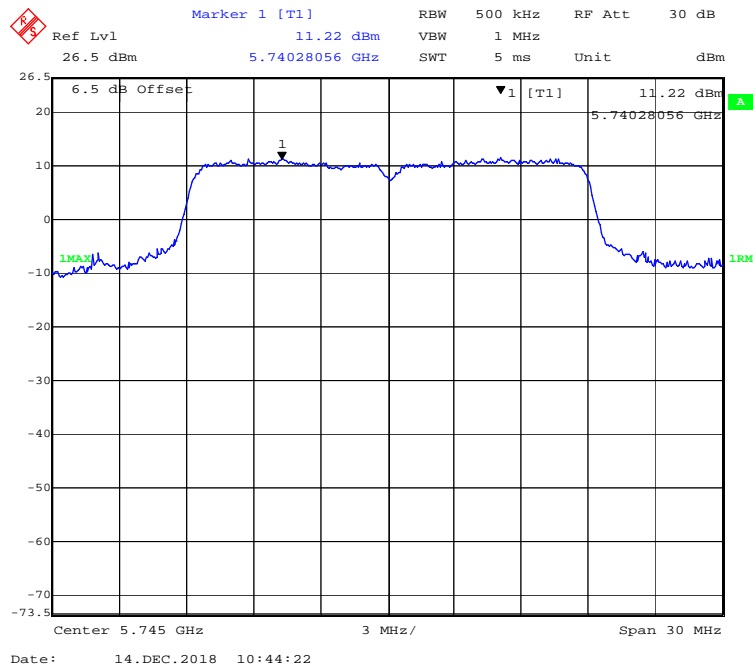
**802.11a mode, Chain 0: Power spectral density-5785MHz**



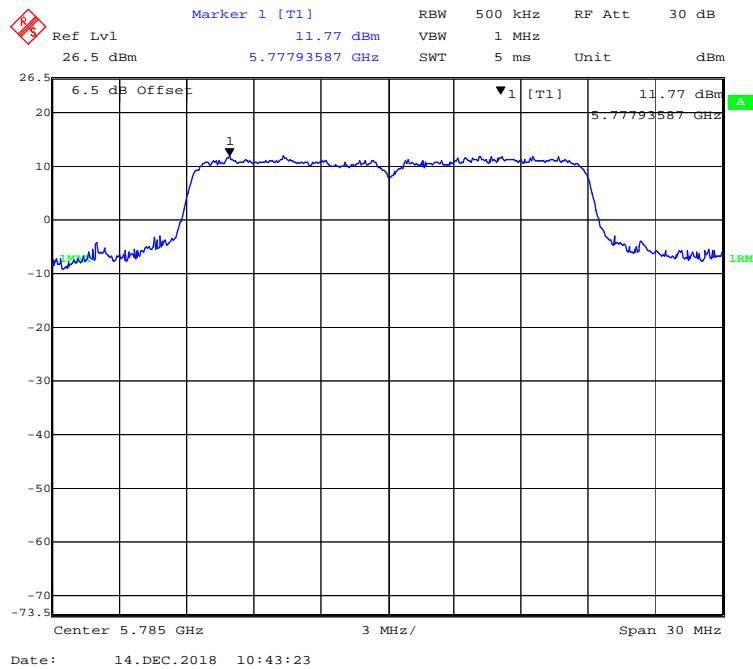
**802.11a mode, Chain 0: Power spectral density-5825MHz**



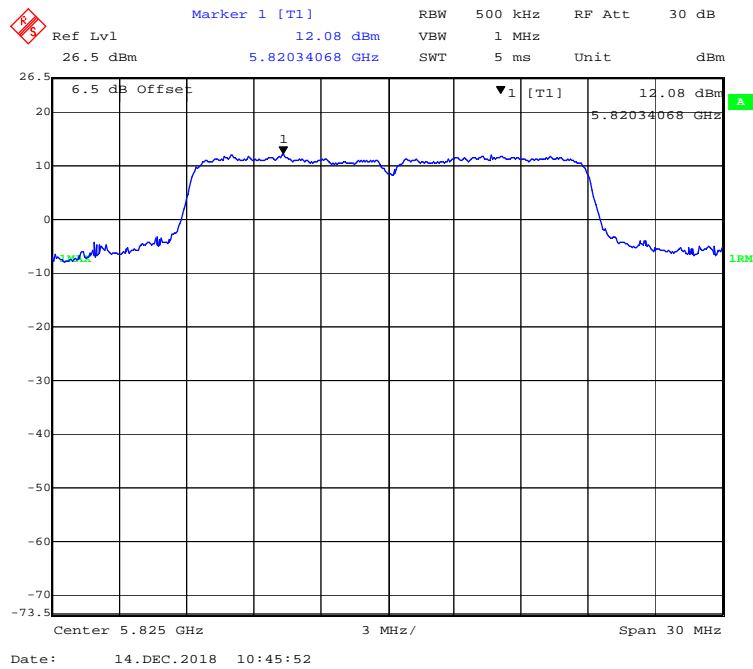
**802.11n-HT20 mode, Chain 0: Power spectral density-5745MHz**



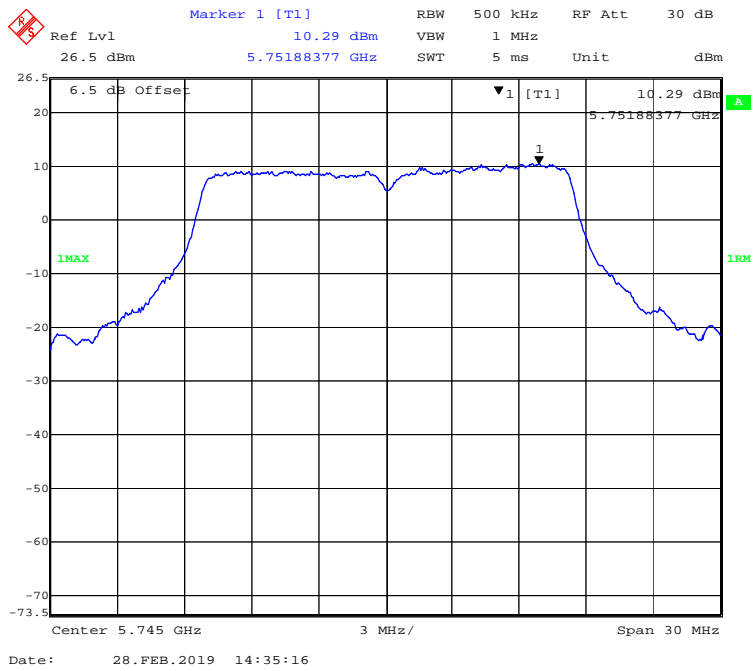
**802.11n-HT20 mode, Chain 0: Power spectral density-5785MHz**



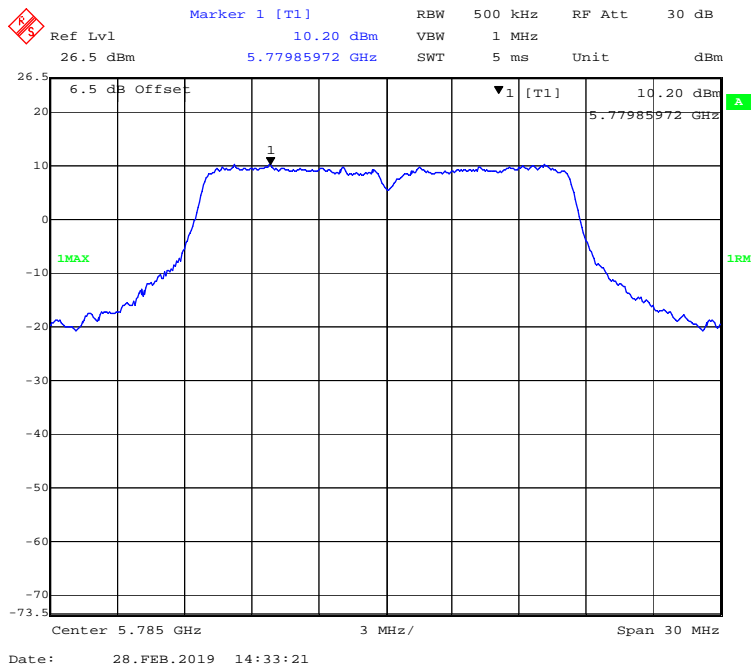
**802.11n-HT20 mode, Chain 0: Power spectral density-5825MHz**



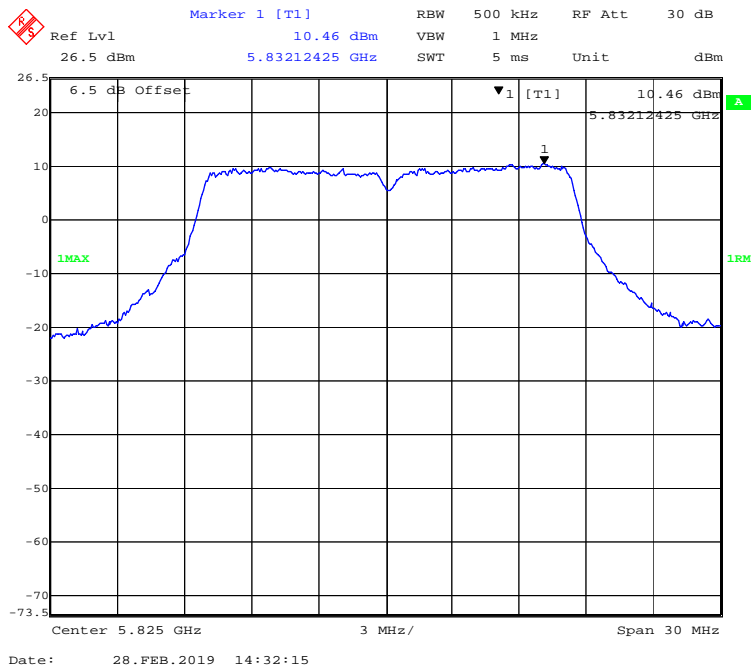
802.11a mode, Chain 1: Power spectral density-5745MHz



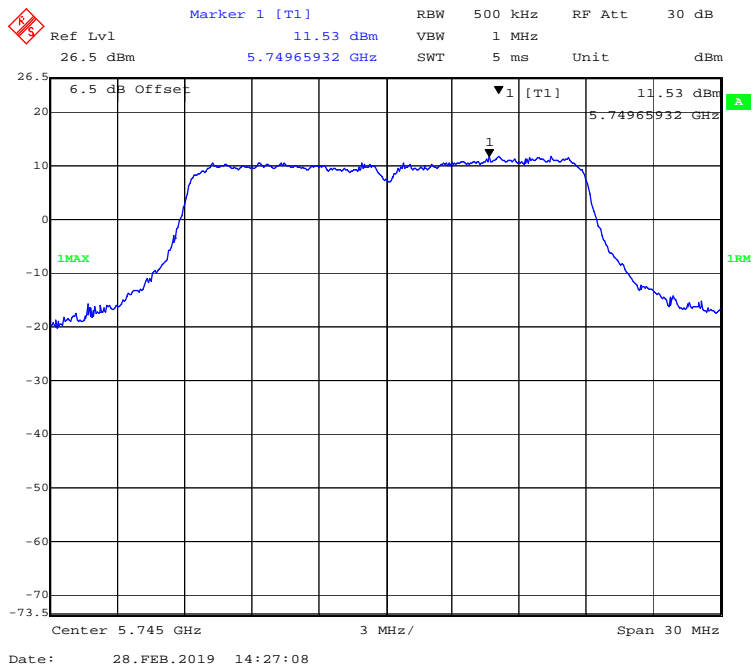
802.11a mode, Chain 1: Power spectral density-5785MHz



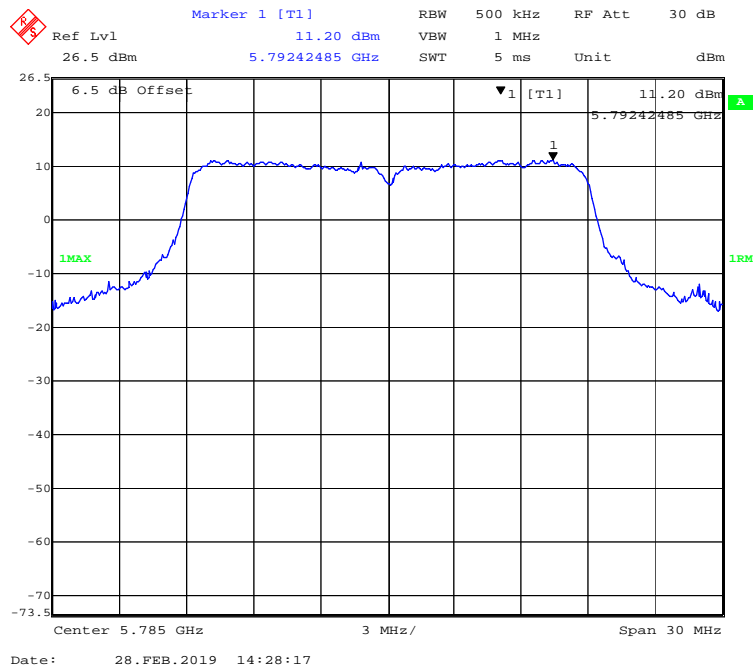
802.11a mode, Chain 1: Power spectral density-5825MHz



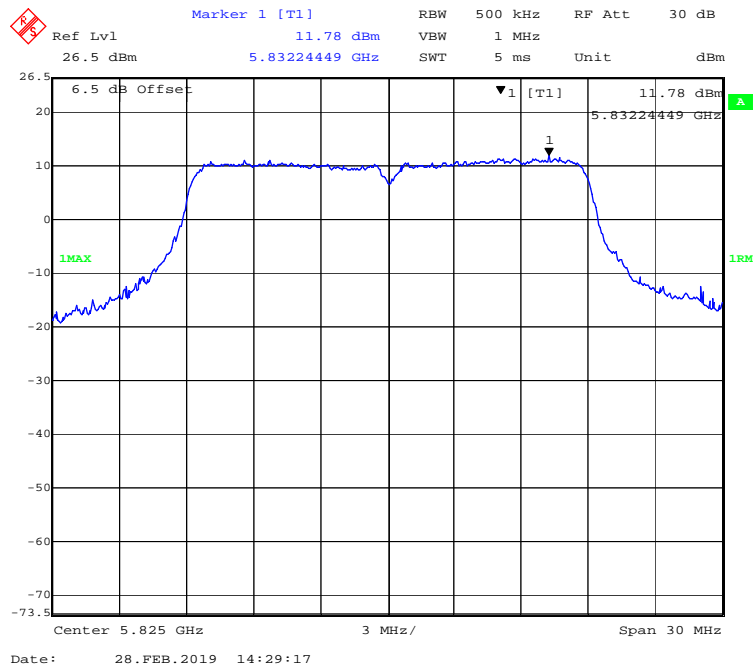
802.11n-HT20 mode, Chain 1: Power spectral density-5745MHz



**802.11n-HT20 mode, Chain 1: Power spectral density-5785MHz**



**802.11n-HT20 mode, Chain 1: Power spectral density-5825MHz**



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