

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Applicant: Fluidmesh Networks LLC
81 Prospect Street Brooklyn NY 11201 USA
Product Name: FM4200F
Brand Name: Fluidmesh FM4200F
Model No.: FM4200F
Model Difference: N/A
Report Number: ER/2020/30118
FCC ID: R5S-4200F
FCC Rule Part: §15.407, Cat: NII
Issue Date: Jun. 16, 2020
Date of Test: Mar. 20, 2020 ~ Apr. 24, 2020
Date of EUT Received: Mar. 20, 2020

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10: 2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.

The test results of this report relate only to the tested sample identified in this report.

Approved By:

CHUN-CHIEH, CHEN
CHUN-CHIEH, CHEN / Supervisor



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Revision History

Report Number	Revision	Description	Issue Date	Remark
ER/2020/30118	Rev.00	Original.	Jun. 16, 2020	Revised By: Susan Lin

Note:

1、Disclaimer

Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	FM4200F	
Brand Name:	Fluidmesh FM4200F	
Model No.:	FM4200F	
Model Difference:	N/A	
Hardware Version:	N/A	
Software Version:	N/A	
Power Supply:	48Vdc from POE Adapter	
	Adapter:	Model No.: GME241DA-480050G, Supplier: N/A
Modulation type:	64QAM, 16QAM, QPSK, BPSK for OFDM	
Transition Rate:	802.11 n_20MHz: 6.5 – 144.4Mbps 802.11 n_40MHz: 13.5 – 300.0Mbps	

1.2 Antenna Designation

Antenna Type	Supplier	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)	Worst Antenna Gain
Shark Dual	FLUIDMESH	N/A	5725~5850	13	
Tube	FLUIDMESH	N/A	5725~5850	14.6	V

Note: Pre-scanned was done on the above 2 antennas, the Tube Antenna results higher emission at 5GHz. Therefore, the completed set of measurement was done on the antenna to be presented on this test report.

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1.3 FCC worst power

Wi-Fi 802.11	Frequency Range	Channels	Rated Power (Avg.) (dBm) (Worst case)	Modulation Technology
n_HT 20M	5725-5850	5	HT: 18.29	OFDM
n_HT 40M	5725-5850	2	HT: 18.21	OFDM

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1.4 Test Methodology of Applied Standards

FCC Part 15, Subpart E §15.407
FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01
FCC KDB 662911 D01 Multiple Transmitter Output v02r01
ANSI C63.10:2013

1.5 Test Facility

SGS Taiwan Ltd. Central RF Lab (TAF code 3702)
No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan
24803

FCC Designation number: TW0027

1.6 Special Accessories

There are no special accessories used while test was conducted.

1.7 Equipment Modifications

There was no modification incorporated into the EUT.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz. The CISPR Quasi-Peak and Average detector mode is employed. The two LISNs provide 50 μ H/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

2.3.3 Radiated Emissions

The EUT is placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

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2.4 Measurement Results Explanation Example

2.4.1 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m*9m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

2.4.2 For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

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2.5 Configuration of Tested System

Fig. 2-1 Radiated Emission Configuration

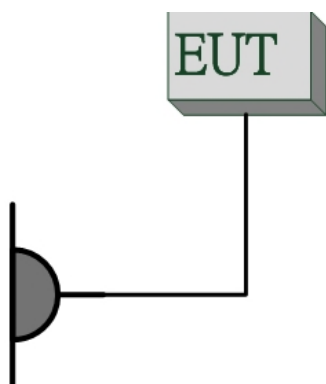


Fig. 2-3 Conducted (AC powerline) Emission Configuration

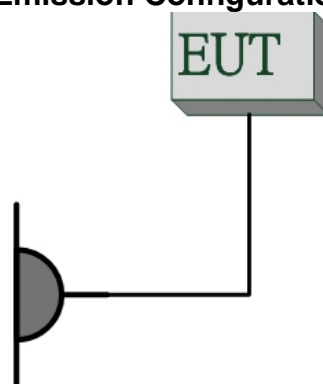


Fig. 2-2 Conducted (Antenna Port) Emission Configuration



Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	WLAN Test Software	N/A	N/A	N/A	N/A	N/A
2.	Notebook	Lenovo	L480	PF-1S9Q32	Unshielded	Shielded

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3 SUMMARY OF TEST RESULT

FCC Rules	Description Of Test	Result
§15.207	AC Power Line Conducted Emission	Compliant
§15.403(i) §15.407(e)	26 dB & 6dB Emission Bandwidth	Compliant
§15.407(a)	Maximum Conducted Output Power	Compliant
§15.407(a)	Power Spectral Density	Compliant
§15.205 §15.209 §15.407(b)	Undesirable Radiated Emissions	Compliant
§15.407(c)	Transmission in case of Absence of Information	Compliant
§15.407(g)	Frequency Stability	Compliant
§15.203 §15.407(a)	Antenna Requirement	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 802.11n operated in U-NII Bands

Operated band in 5745 MHz ~5850 MHz:

20 M		40 M			
CH	Freq (MHz)	CH	Freq (MHz)		
149	5745	151	5755		
153	5765	159	5795		
157	5785				
161	5805				
165	5825				

4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting mode is programmed.
3. Investigation has been done on all the possible configurations for searching the worst case. The given UE is pre-scanned among below modes.

Modulation	Transmission Chain				Multiple Transmission Spatial
<input type="checkbox"/> 802.11 a	<input type="checkbox"/> Ch0	<input type="checkbox"/> Ch1	<input type="checkbox"/> Ch2	<input type="checkbox"/> Ch3	<input type="checkbox"/> 2TX
<input checked="" type="checkbox"/> 802.11 n	<input checked="" type="checkbox"/> Ch0	<input checked="" type="checkbox"/> Ch1	<input type="checkbox"/> Ch2	<input type="checkbox"/> Ch3	<input checked="" type="checkbox"/> MIMO
<input type="checkbox"/> 802.11 ac	<input type="checkbox"/> Ch0	<input type="checkbox"/> Ch1	<input type="checkbox"/> Ch2	<input type="checkbox"/> Ch3	<input type="checkbox"/> MIMO
<input type="checkbox"/> 802.11 ax	<input type="checkbox"/> Ch0	<input type="checkbox"/> Ch1	<input type="checkbox"/> Ch2	<input type="checkbox"/> Ch3	<input type="checkbox"/> MIMO

4. Therefore, below summary is the modes of test configuration that yield the highest reading and generate the highest emission chosen to carry out the relevantly mandatory test items.

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4.2.1 RADIATED EMISSION TEST:

RADIATED EMISSION TEST (BELOW 1 GHz)						
MODE	FREQUENCY BAND (MHz)	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	AN-TENNA PORT
802.11n_HT20	5745~5825	149 to 165	157	OFDM	MCS8	MIMO

RADIATED EMISSION TEST (ABOVE 1 GHz)						
MODE	FREQUENCY BAND (MHz)	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	AN-TENNA PORT
802.11n_HT20	5745~5825	149 to 165	149,157,165	OFDM	MCS8	MIMO
802.11n_HT40	5755~5795	151 to 159	151,159		MCS8	MIMO

Note:

The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for 802.11n WLAN Transmitter for channel Low, Mid and High, the worst case H position was reported.

4.2.2 ANTENNA PORT CONDUCTED MEASUREMENT:

CONDUCTED TEST						
MODE	FREQUENCY BAND (MHz)	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	AN-TENNA PORT
802.11n_HT20	5745~5825	149 to 165	149,157,165	OFDM	MCS8	MIMO
802.11n_HT40	5755~5795	151 to 159	151,159		MCS8	MIMO

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
26dB & 6dB Emission Bandwidth	+/- 123.36 Hz
The Maximum Output Power Measurement	+/- 0.96 dB
Peak Power Spectral Density Measurement	+/- 1.67 dB
Frequency Stability	+/- 123.36 Hz
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC=+/- 0.2%

Radiated Spurious Emission Measurement Uncertainty	
Polarization: Vertical	9kHz~30MHz: +/-2.3dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB
Polarization: Horizontal	9kHz~30MHz: +/-2.3dB
	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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6 CONDUCTED EMISSION TEST

6.1 Standard Applicable

Frequency range within 150 kHz to 30 MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits dB(μV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

6.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI 7	1166.5950.07	07/04/2019	07/03/2020
LISN	SCHWARZ-BECK	NSLK 8127	8127-649	06/02/2019	06/01/2020
Test Software	Farad	EZ-EMC	Ver. SGS-03A2	N.C.R	N.C.R
Coaxial Cables	N/A	WK CE Cable	N/A	01/02/2020	01/01/2021

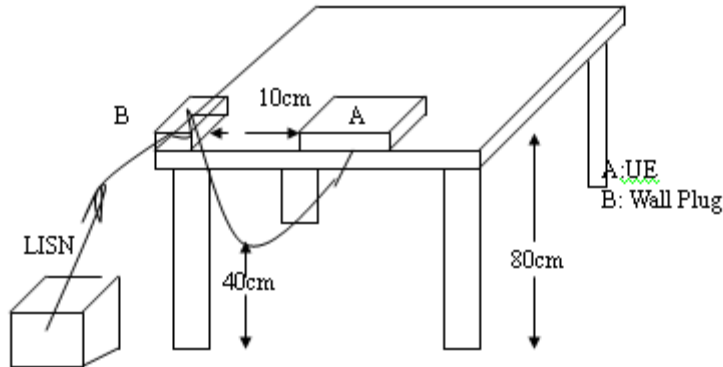
6.3 EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.
3. The LISN was connected with 120Vac/60Hz power source.

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6.4 Test SET-UP



6.5 Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed.

6.6 Measurement Result

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closet to the limit.

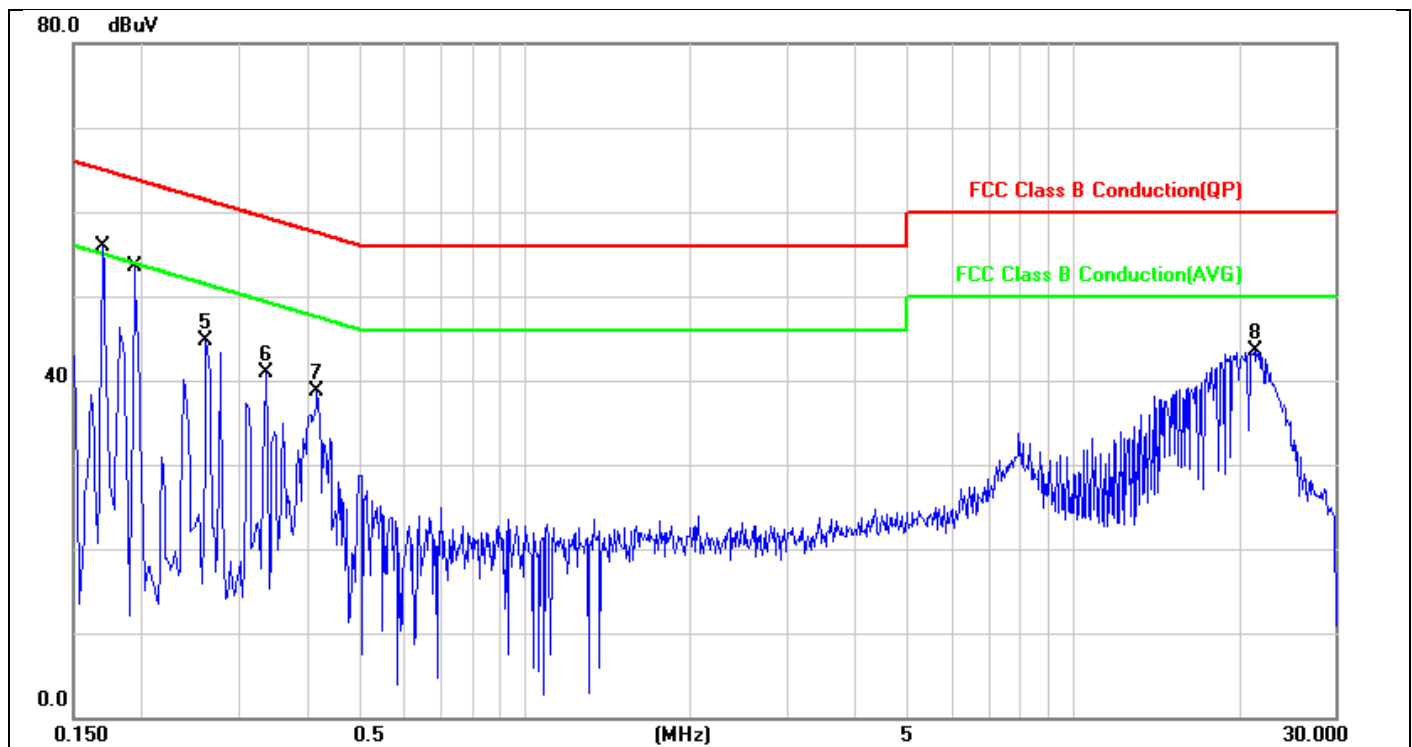
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Shark Dual Antenna

Description:	Operation	Date:	2020/04/07
Line:	L1	Temp.(°C)/Hum.(%):	21(°C)/65%
Test Voltage:	AC 120V/60Hz	Test By:	Nick
Report Number:	ER/2020/30118		



No.	Mk.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Measure- ment (dBuV)	Limit (dBuV)	Over (dB)	Detector	Comment
1	*	0.1700	51.01	0.00	51.01	64.96	-13.95	QP	
2		0.1700	23.80	0.00	23.80	54.96	-31.16	AVG	
3		0.1940	47.67	0.00	47.67	63.86	-16.19	QP	
4		0.1940	19.19	0.00	19.19	53.86	-34.67	AVG	
5		0.2620	44.79	0.00	44.79	61.37	-16.58	peak	
6		0.3380	40.81	0.01	40.82	59.25	-18.43	peak	
7		0.4180	38.67	0.01	38.68	57.49	-18.81	peak	
8		21.4300	42.50	1.01	43.51	60.00	-16.49	peak	

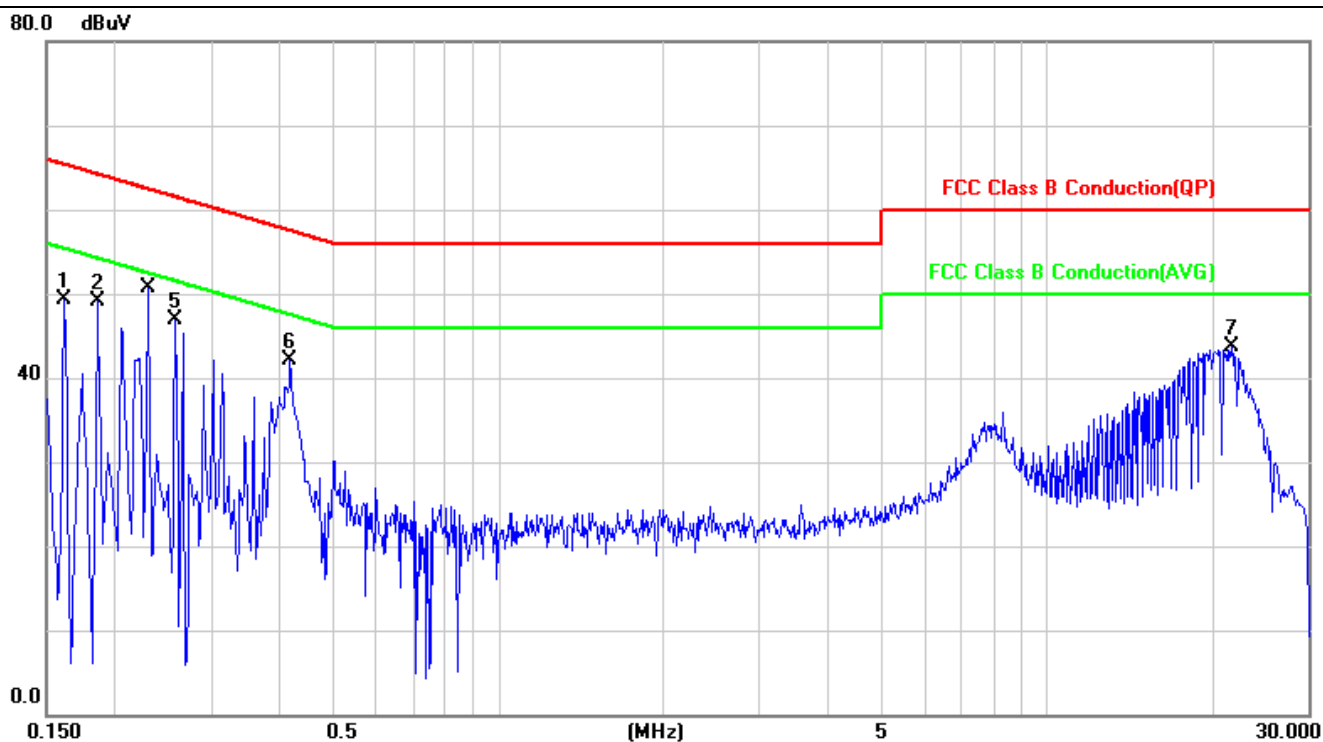
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Description: Operation
Line: N
Test Voltage: AC 120V/60Hz
Report Number: ER/2020/30118

Date: 2020/04/07
Temp.(°C)/Hum.(%): 21(°C)/65%
Test By: Nick



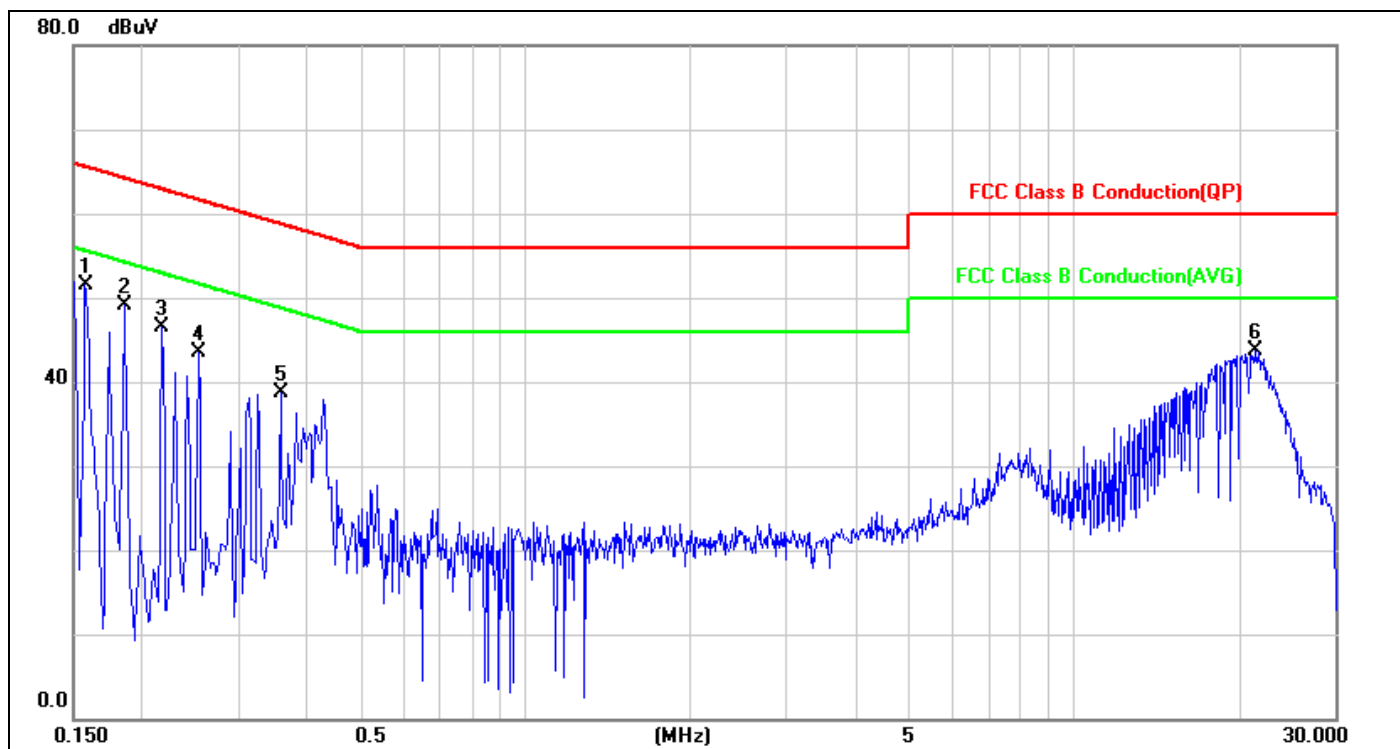
No.	Mk.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Measure- ment (dBuV)	Limit (dBuV)	Over (dB)	Detector	Comment
1		0.1620	48.96	0.25	49.21	65.36	-16.15	peak	
2		0.1860	48.53	0.60	49.13	64.21	-15.08	peak	
3		0.2300	45.21	0.69	45.90	62.45	-16.55	QP	
4		0.2300	21.03	0.69	21.72	52.45	-30.73	AVG	
5	*	0.2580	46.33	0.59	46.92	61.50	-14.58	peak	
6		0.4180	41.98	0.08	42.06	57.49	-15.43	peak	
7		21.8020	42.83	0.89	43.72	60.00	-16.28	peak	

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Tube Antenna

Description:	Operation	Date:	2020/04/07
Line:	L1	Temp.(°C)/Hum.(%):	21(°C)/65%
Test Voltage:	AC 120V/60Hz	Test By:	Nick
Report Number:	ER/2020/30118		

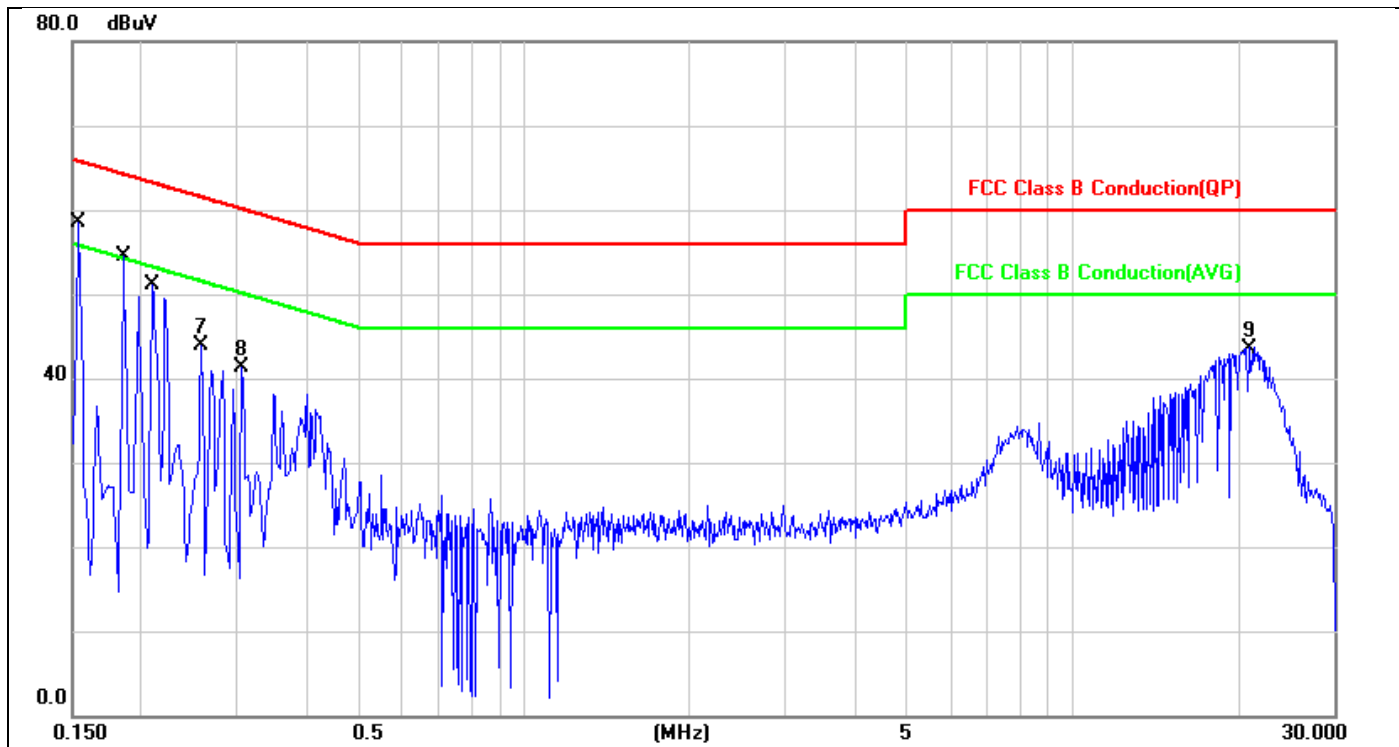


No.	Mk.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Measure- ment (dBuV)	Limit (dBuV)	Over (dB)	Detector	Comment
1	*	0.1580	51.56	0.00	51.56	65.57	-14.01	peak	
2		0.1860	49.14	0.00	49.14	64.21	-15.07	peak	
3		0.2180	46.42	0.00	46.42	62.89	-16.47	peak	
4		0.2540	43.55	0.00	43.55	61.63	-18.08	peak	
5		0.3580	38.67	0.01	38.68	58.77	-20.09	peak	
6		21.4340	42.66	1.01	43.67	60.00	-16.33	peak	

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Description:	Operation	Date:	2020/04/07
Line:	N	Temp.(°C)/Hum.(%):	21(°C)/65%
Test Voltage:	AC 120V/60Hz	Test By:	Nick
Report Number:	ER/2020/30118		



No.	Mk.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Measure- ment (dBuV)	Limit (dBuV)	Over (dB)	Detector	Comment
1	*	0.1540	55.09	0.14	55.23	65.78	-10.55	QP	
2		0.1540	27.86	0.14	28.00	55.78	-27.78	AVG	
3		0.1860	49.38	0.60	49.98	64.21	-14.23	QP	
4		0.1860	22.38	0.60	22.98	54.21	-31.23	AVG	
5		0.2100	46.65	0.76	47.41	63.21	-15.80	QP	
6		0.2100	21.11	0.76	21.87	53.21	-31.34	AVG	
7		0.2580	43.32	0.59	43.91	61.50	-17.59	peak	
8		0.3060	40.96	0.42	41.38	60.08	-18.70	peak	
9		21.0580	42.74	0.86	43.60	60.00	-16.40	peak	

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7 DUTY CYCLE TEST SIGNAL

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle. All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

7.1 Measurement Procedure:

1. Set span = Zero
2. RBW = 8MHz
3. VBW = 8MHz,
4. Detector = Peak

Duty Cycle:

Mode	Duty Cycle (%) =Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
802.11n_20	96.56	0.15	0.63	1.00
802.11n_40	96.13	0.17	0.62	1.00

Duty Cycle Factor: $10 * \log(1/0.9656) = 0.15$

Duty Cycle Factor: $10 * \log(1/0.9613) = 0.17$

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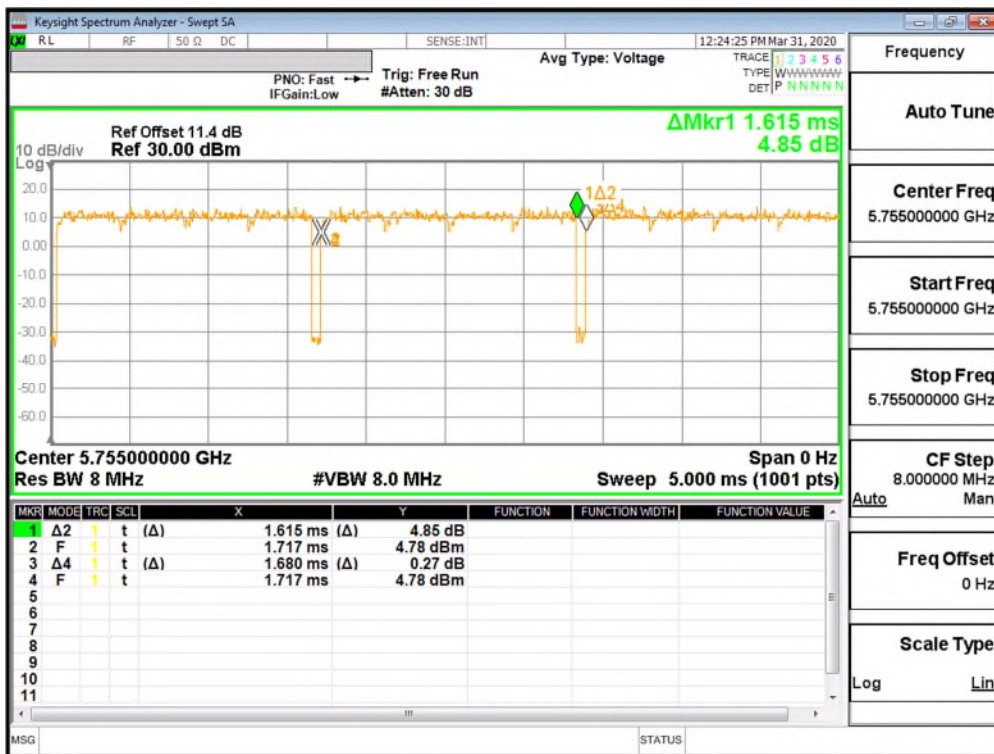
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7.2 DUTY CYCLE TEST SIGNAL MEASUREMENT RESULT

802.11n HT20



802.11n HT40



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8 26DB & 6DB EMISSION BANDWIDTH MEASUREMENT

8.1 Standard Applicable

There is no limit bandwidth for U-NII-1, U-NII-2-A and U-NII-2-C.

The minimum of 6dB Bandwidth measurement is 0.5 MHz for U-NII-3

8.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the Antenna port to the spectrum analyzer.
 - 3.a. 26dB Band width Measurement: Set the spectrum analyzer as 1% of emission BW
Sweep=auto,
Detector = Peak,
Trace Mode = Max Hold,
Manually readjust RBW until the RBW/EBW ratio is 1% based on EBW as observed on the result of pre-sequence measurement.
 - 3.b. Mark the peak frequency and -26dB (upper and lower) frequency.
4. Repeat the procedures as list above until all test default channels (low, middle, and high) are completed.
5. Minimum Emission Bandwidth for the band 5.725-5.850GHz.
 - a. Set the spectrum analyzer as
RBW = 100 kHz,
VBW = 3*RBW,
Span = 30M/50MHz,
Detector=Peak,
Sweep=auto
 - b. Mark the peak frequency and -6dB (upper and lower) frequency.

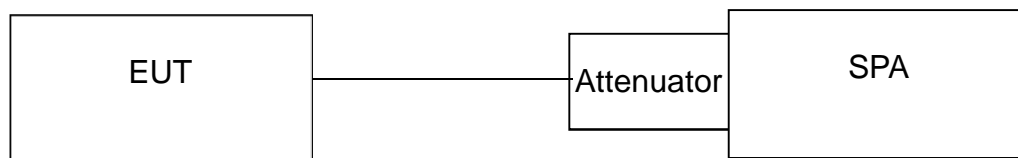
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8.3 Measurement Equipment Used

SGS Conducted Room					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Temperature Chamber	TERCHY	MHG-120LF	911009	05/17/2019	05/16/2020
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY57120290	02/20/2020	02/19/2021
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2020	01/01/2021
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2020	01/01/2021

8.4 Test Set-up



8.5 Measurement Result

8.5.1 6dB Bandwidth (5725 MHz~ 5850 MHz) measure with Peak detector for FCC

802.11n_HT20_Ch0

Freq. (MHz)	6dB BW (MHz)	10 Log (B) (dB)
5745	16.9	12.279
5785	16.54	12.185
5825	16.94	12.289

802.11n_HT20_Ch1

Freq. (MHz)	6dB BW (MHz)	10 Log (B) (dB)
5745	16.54	12.185
5785	16.96	12.294
5825	16.95	12.292

802.11n_HT40_Ch0

Freq. (MHz)	6dB BW (MHz)	10 Log (B) (dB)
5755	35.4	15.490
5795	35.37	15.486

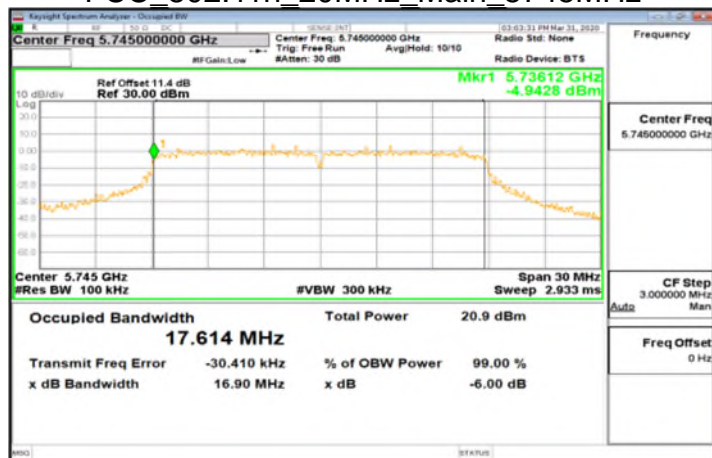
802.11n_HT40_Ch1

Freq. (MHz)	6dB BW (MHz)	10 Log (B) (dB)
5755	35.36	15.485
5795	35.22	15.468

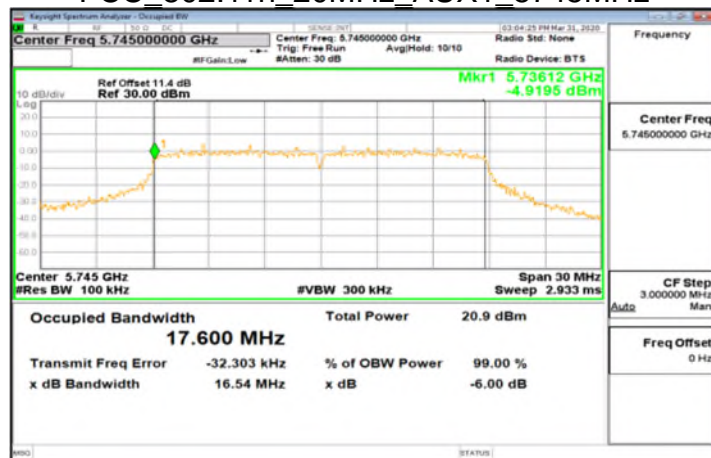
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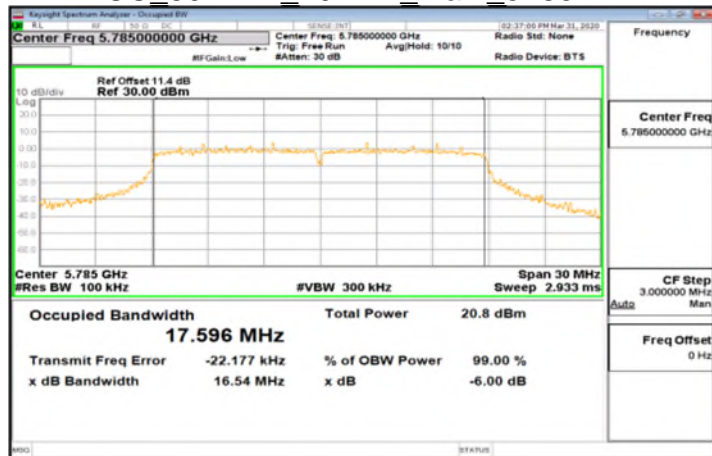
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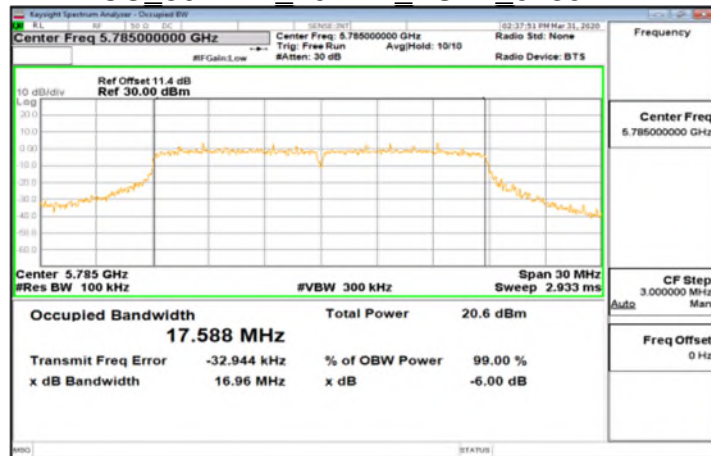
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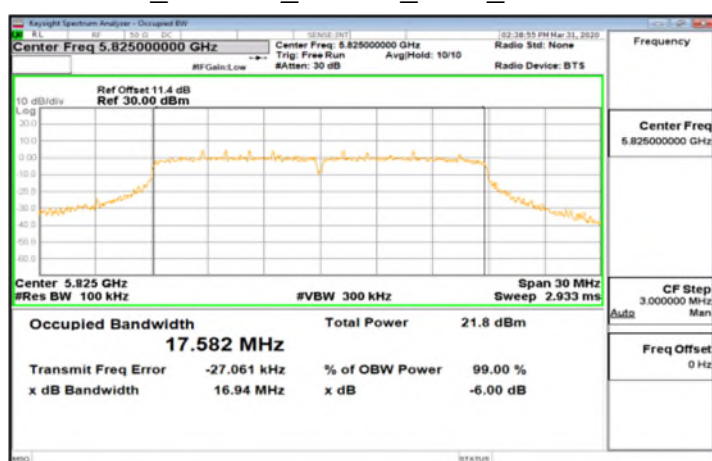
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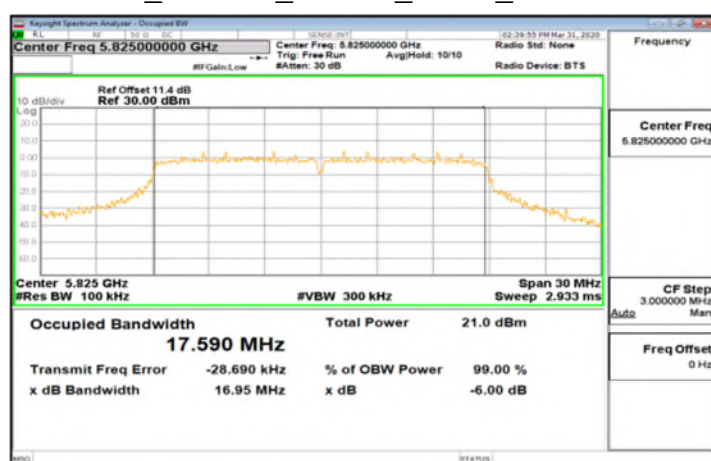
FCC_802.11n_20MHz_AUX1_5785MHz



FCC_802.11n_20MHz_Main_5825MHz



FCC_802.11n_20MHz_AUX1_5825MHz

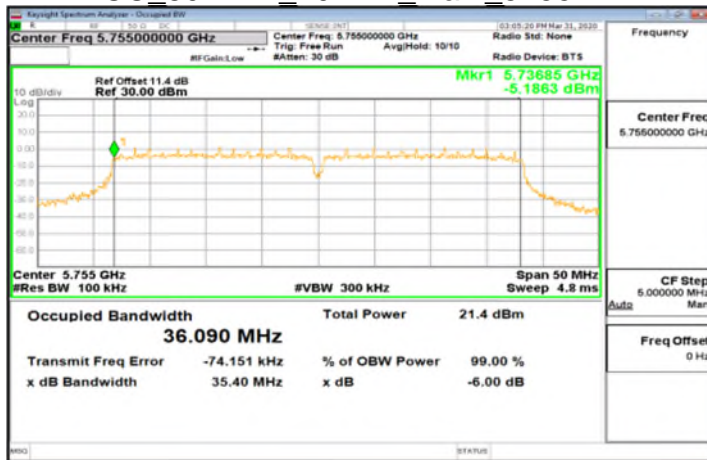


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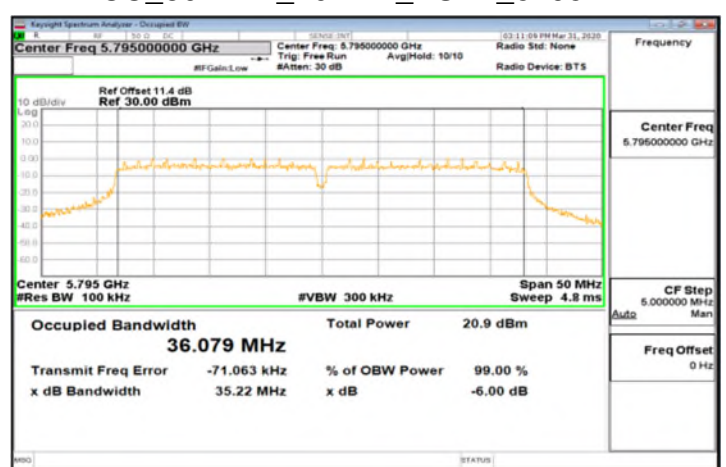
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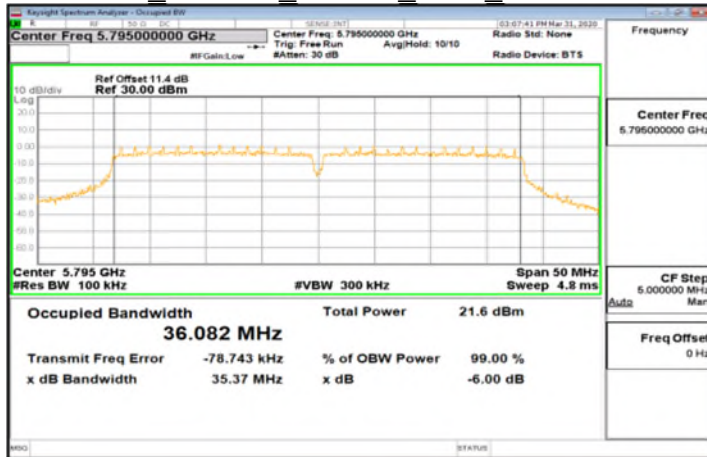
FCC_802.11n_40MHz_Main_5755MHz



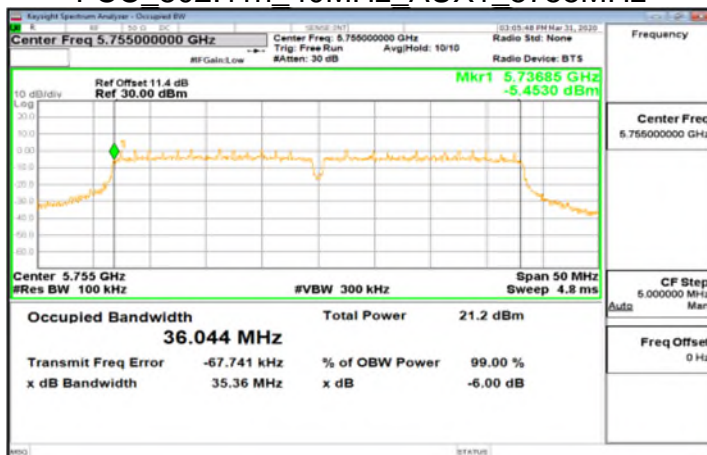
FCC_802.11n_40MHz_AUX1_5795MHz



FCC_802.11n_40MHz_Main_5795MHz



FCC_802.11n_40MHz_AUX1_5755MHz



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8.5.2 99% BW Verification for DFS Function

802.11n_HT20_Ch0

Freq. (MHz)	Measured Freq. (MHz)	Limit (MHz)
5745	5736.12	> 5725

802.11n_HT20_Ch1

Freq. (MHz)	Measured Freq. (MHz)	Limit (MHz)
5745	5736.12	> 5725

802.11n_HT40_Ch0

Freq. (MHz)	Measured Freq. (MHz)	Limit (MHz)
5755	5736.85	> 5725

802.11n_HT40_Ch1

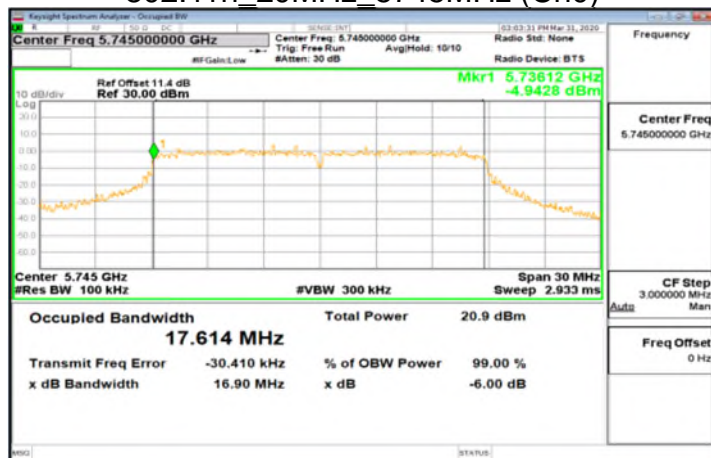
Freq. (MHz)	Measured Freq. (MHz)	Limit (MHz)
5755	5736.85	> 5725

Please see next page for test plots.

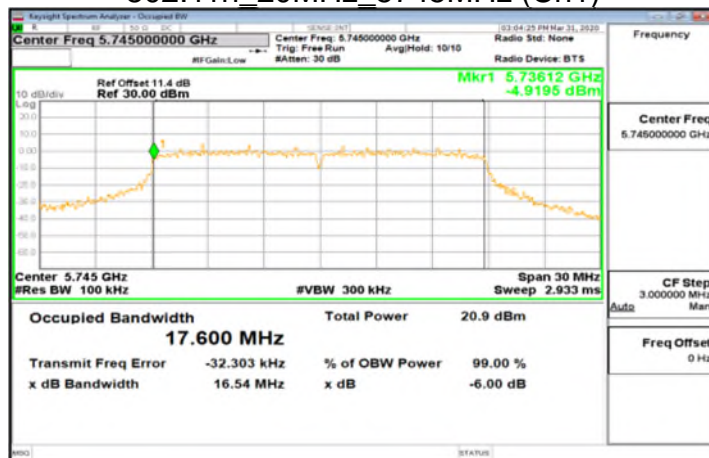
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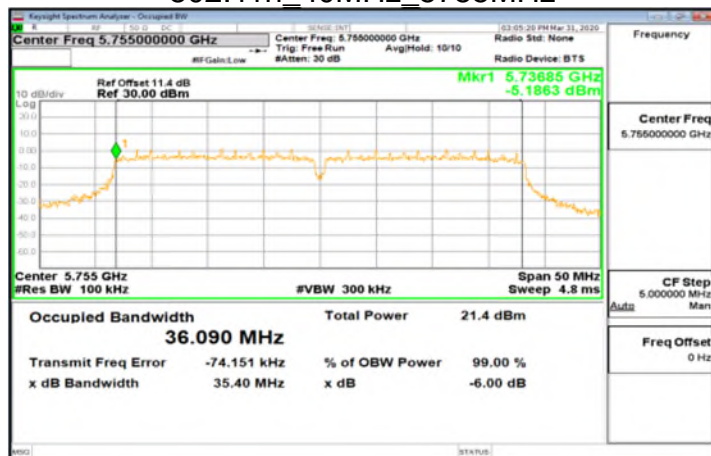
802.11n_20MHz_5745MHz (Ch0)



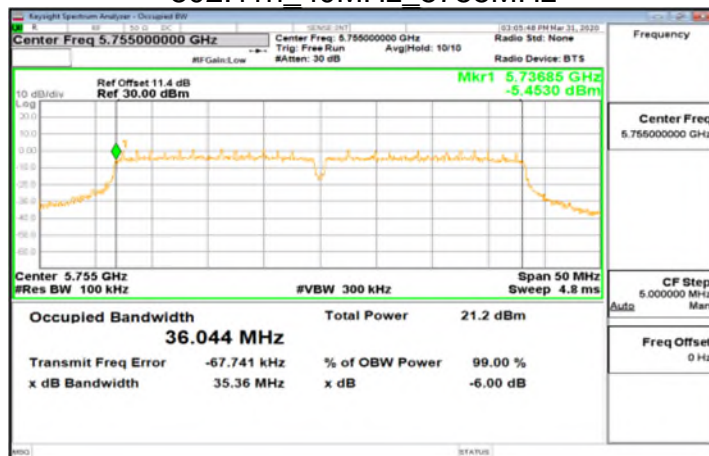
802.11n_20MHz_5745MHz (Ch1)



802.11n_40MHz_5755MHz



802.11n_40MHz_5755MHz



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9 MAXIMUM CONDUCTED OUTPUT POWER MEASUREMENT

9.1 Standard Applicable

FCC

OPERZTION Band	EUT CATEGORY		LIMIT
U-NII-1		Access Point (Master device)	1 Watt(30dBm)
		Fixed point-to-point Access Ponit	1 Watt(30dBm)
		Mobile and portable client device	250mW(23.98dBm)
U-NII-2A			250mW(23.98dBm) or 11dBm+10 log B
U-NII-2C			250mW(23.98dBm) or 11dBm+10 log B
U-NII-3	√		1 Watt(30dBm)
If transmitting antennas of directional gain greater than 6 dBi are used, the Maximum transmit power shall be reduced by the amount in dB that the direction-al gain of the antenna exceeds 6 dBi.			

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Note:

As per FCC KDB 662911 D01

Unequal antenna gains, with equal transmit powers. For antenna gains given by G_1, G_2, \dots, G_N dBi.

(i) If transmit signals are correlated, then Directional gain

$$= 10 \log[(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2 / N_{ANT}] \text{ dBi}$$

[Note the “20”s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

The antenna gain is greater than 6 dBi in MIMO mode, therefore the limit needs to be reduced as below:

	Effective Legacy Gain (dBi)	Maximum Conducted Power Limit	
U-NII-3	17.61	18.39	dBm

9.2 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter
4. Power Meter is used as the auxiliary test equipment to conduct the output power measurement.
5. Record the max. reading and add $10 \log(1/\text{duty cycle})$.
6. Repeat above procedures until all frequency (low, middle, and high channel) measured were complete.

9.3 Measurement Equipment Used

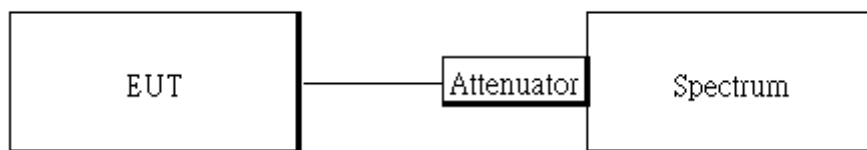
SGS Conducted Room					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Temperature Chamber	TERCHY	MHG-120LF	911009	05/17/2019	05/16/2020
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY57120290	02/20/2020	02/19/2021
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2020	01/01/2021
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2020	01/01/2021

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9.4 Test Set-up



9.5 Measurement Result

9.5.1 Conducted output power (FCC)

802.11n_HT20_MIMO

CH	Frequency (MHz)	Data Rate	Avg. POWER (dBm)		TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
			CH 0	CH 1				
149	5745	MCS8	15.2	15.1	18.29	67.500	18.38970004	PASS
157	5785	MCS8	15.2	15	18.23	66.577	18.38970004	PASS
165	5825	MCS8	15.4	14.4	18.10	64.581	18.38970004	PASS

802.11n_HT40_MIMO

CH	Frequency (MHz)	Data Rate	Avg. POWER (dBm)		TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
			CH 0	CH 1				
151	5755	MCS8	15.2	14.9	18.21	66.219	18.38970004	PASS
159	5795	MCS8	15	14.8	18.05	63.800	18.38970004	PASS

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10 MAXIMUM POWER SPECTRAL DENSITY

10.1 Standard Applicable

FCC

Operation Band	LIMIT
U-NII-3	30dBm/ 500kHz
If transmitting antennas of directional gain greater than 6 dBi are used, the Maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.	

Note:

As per FCC KDB 662911 D01

Unequal antenna gains, with equal transmit powers. For antenna gains given by G_1, G_2, \dots, G_N dBi.

(i) If transmit signals are correlated, then Directional gain

$$= 10 \log[(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2 / N_{ANT}] \text{ dBi}$$

[Note the “20”s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

The antenna gain is greater than 6 dBi in MIMO mode, therefore the limit needs to be reduced as below:

	Effective Legacy Gain (dBi)	PSD Limit	
U-NII-3	17.61	18.39	dBm/500 kHz

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10.2 Measurement Procedure

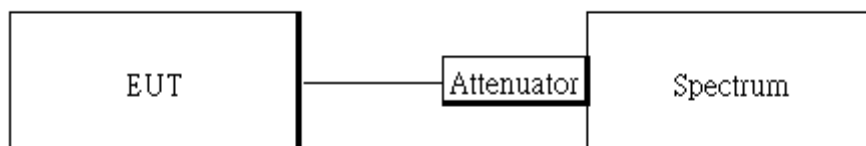
1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules .
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to Spectrum.
4. **For U-NII1, U-NII-2A, U-NII-2C Band:**
Set RBW=1MHz, VBW=3MHz, where span is enough to capture the entire bandwidth, Sweep time = Auto (601 pts), detector = sample, traces 100 sweeps of video averaging. (SA-2 with the omission of procedure x, the integration with 26dB EBW bandwidth)
For U-NII-3 Band:
Set RBW=500 kHz, VBW≥ 3RBW, where span is enough to capture the entire bandwidth, Sweep time = Auto (601 pts), detector = sample, traces 100 sweeps of video averaging. (SA-2 with the omission of procedure x, the integration with 26dB EBW bandwidth)
5. User the cursor on spectrum to peak search the highest level of trace
6. Record the max. reading and add 10 log(1/duty cycle).
7. Repeat above procedures until all default test channel (low, middle, and high) was complete.
8. 802.11n MIMO mode: offset is set following “measure and add 10 Log (N)” on spectrum to measure the PSD for MIMO mode. Offset = cable loss + 10 log (N), where N is number of transmitting antenna. N=3 for this given application.

Note: For the test of PSD at MIMO mode, the highest emission of worst case employing Measure and add 10 log (N) technical is reported on this report after the comparison between Main Antenna at single transmitting mode and Aux that yields the higher value. The MIMO transmitting mode produces higher value of outcome

10.3 Measurement Equipment Used

SGS Conducted Room					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Temperature Chamber	TERCHY	MHG-120LF	911009	05/17/2019	05/16/2020
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY57120290	02/20/2020	02/19/2021
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2020	01/01/2021
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2020	01/01/2021

10.4 Test Set-up



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10.5 Measurement Result

10.5.1 Power spectral density

POWER DENSITY 802.11n HT20 MODE_MIMO					
Frequency (MHz)	PSD W/O Duty Factor (dBm/500kHz)	Duty Factor	PSD With Duty Factor (dBm/500kHz)	Limit (dBm/500kHz)	Margin (dB)
5745	4.18	0.15	4.33	18.3897	-14.06
5785	3.96	0.15	4.11	18.3897	-14.28
5825	3.82	0.15	3.97	18.3897	-14.42

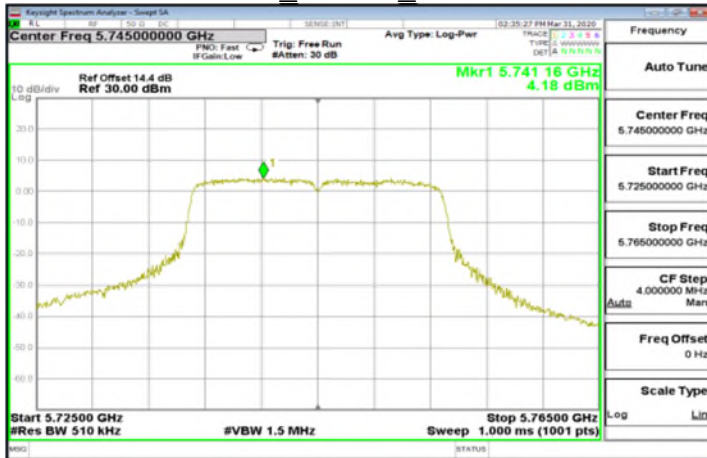
POWER DENSITY 802.11n HT40 MODE_MIMO					
Frequency (MHz)	PSD W/O Duty Factor (dBm/500kHz)	Duty Factor	PSD With Duty Factor (dBm/500kHz)	Limit (dBm/500kHz)	Margin (dB)
5755	1.57	0.17	1.74	18.3897	-16.65
5795	1.08	0.17	1.25	18.3897	-17.14

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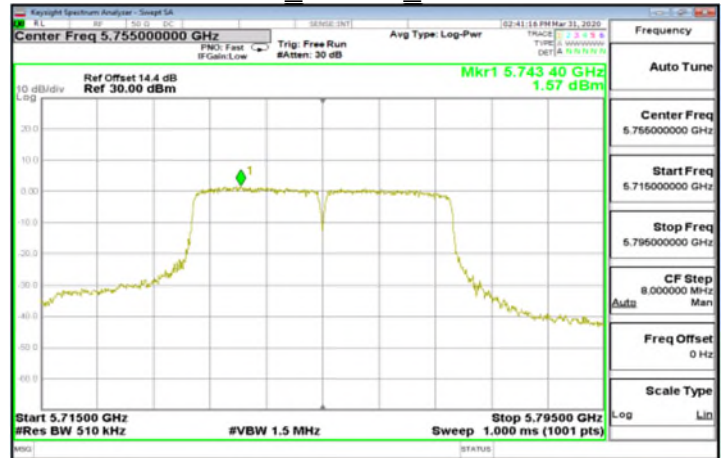
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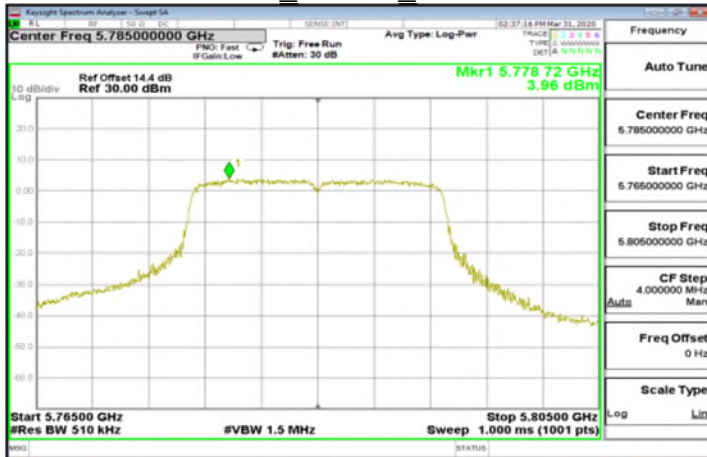
802.11n_20MHz_5745MHz



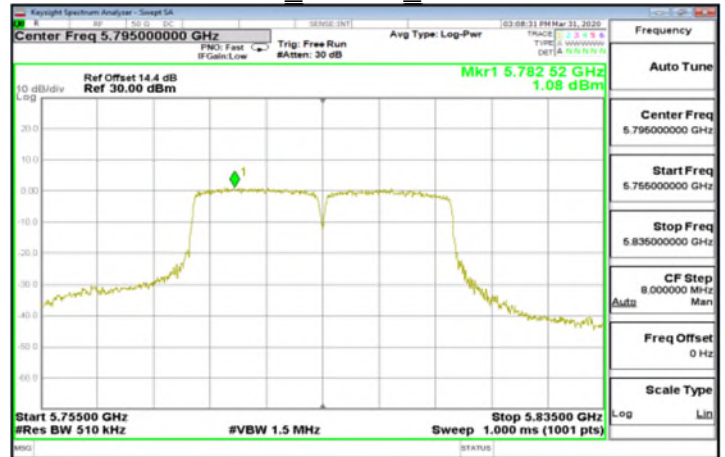
802.11n_40MHz_5755MHz



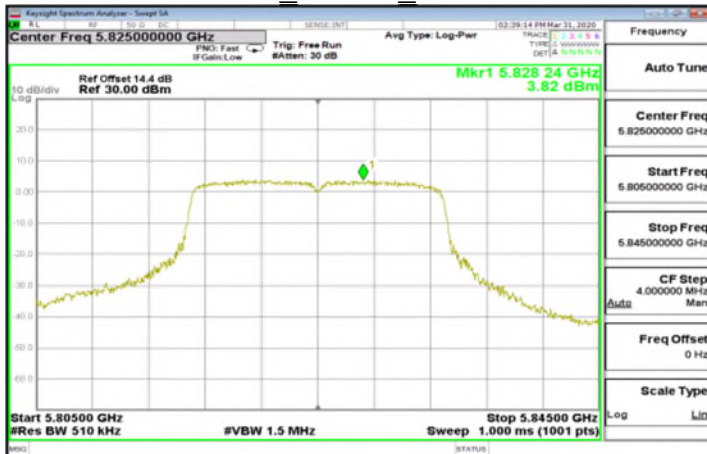
802.11n_20MHz_5785MHz



802.11n_40MHz_5795MHz



802.11n_20MHz_5825MHz



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11 UNDESIRABLE RADIATED EMISSION MEASUREMENT

11.1 Standard Applicable

11.1.1 Band Edge

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 5.725-5.85 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.

APPLICABLE TO	EIRP LIMIT	FIELD STRENGTH AT 3m
15.407(b)(4)(i) RSS-247 §6.2.4.2	PK:-27 (dBm/MHz) *1 PK:10 (dBm/MHz) *2 PK:15.6 (dBm/MHz) *3 PK:27 (dBm/MHz) *4	PK: 68.2(dBμV/m) *1 PK:105.2 (dBμV/m) *2 PK: 110.8(dBμV/m) *3 PK:122.2 (dBμV/m) *4
*1 beyond 75 MHz or more above of the bandedge. *2 below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above. *3 below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above. *4 from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.		

$EIRP = (E \cdot d)^2 / 30$, where E is the field in V/m, d is the measurement distance (3m), $EIRP$ is the equivalent isotropically radiated power in Watts.

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11.1.2 Spurious Emission

Unwanted spurious emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table:

Frequency (MHz)	Field strength (microvolts/meter)	Distance (meters)
0.009-0.490	2400/F(KHz)	300
0.490-1.705	24000/F(KHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBμV/m) = 20 log Emission level (μV/m)

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11.2 Measurement Equipment Used

SGS SAC-III					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Bi-log Antenna	SCHWAZBECK	VULB9168	378	01/03/2020	01/02/2021
Horn Antenna	Schwarzbeck	BBHA9120D	1441	08/20/2019	08/19/2020
Horn Antenna	Schwarzbeck	BBHA9170	184	12/25/2019	12/24/2020
3m Site NSA	SGS	966 chamber	N/A	01/02/2019	01/01/2021
Loop Antenna	ETS.LINDGREN	6502	148045	10/15/2019	10/14/2020
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	04/22/2019	04/21/2020
EMI Test Receiver	R&S	ESCI 7	1166.5950.07	07/04/2019	07/03/2020
Pre-Amplifier	HP	8449B	3008A00578	01/02/2020	01/01/2021
Pre-Amplifier	HP	8447D	2944A07676	01/02/2020	01/01/2021
Pre-Amplifier	EMC Instruments	EMC184045B	980135	01/02/2020	01/01/2021
Filter 5725-5875 MHz	Micro-Tronics	BRM50705	1	01/02/2020	01/01/2021
High Pass Filter	WI	WHKX7.0/18G-8SS	45	01/02/2020	01/01/2021
Low Loss Cable	Huber Suhner	966_RX	9	01/02/2020	01/01/2021

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SGS Taiwan Ltd.

No.134,Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan/新北市五股區新北產業園區五工路 134 號

台灣檢驗科技股份有限公司

t (886-2) 2299-3279

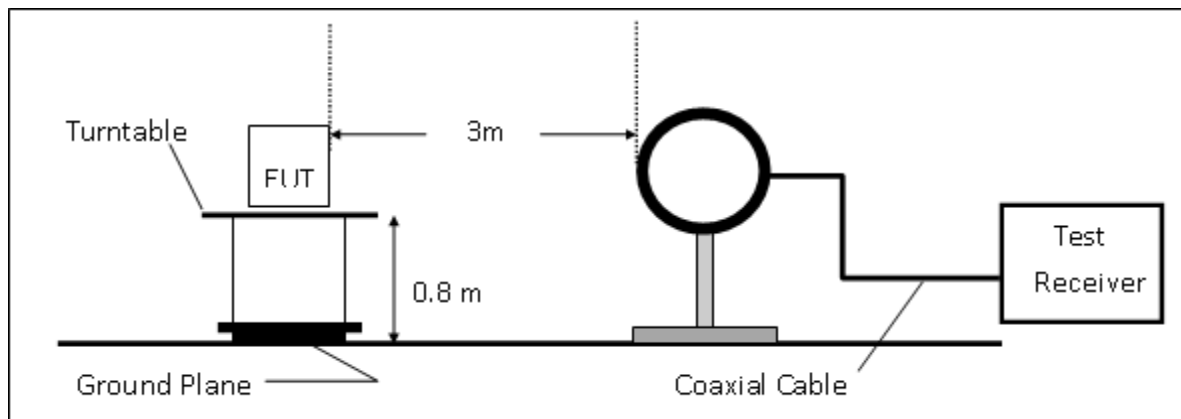
f (886-2) 2298-0488

www.sgs.com.tw

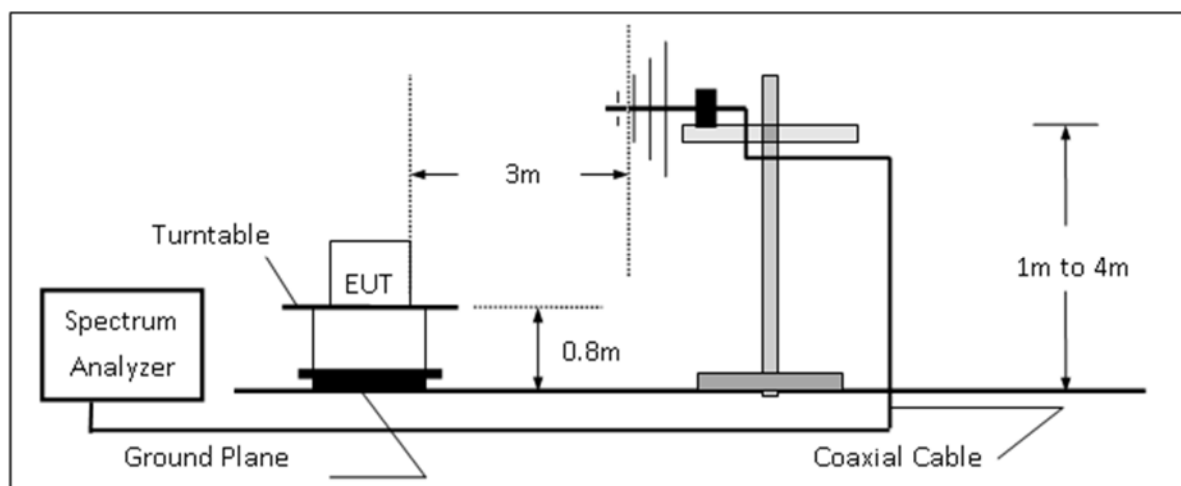
Member of SGS Group

11.3 Test SET-UP

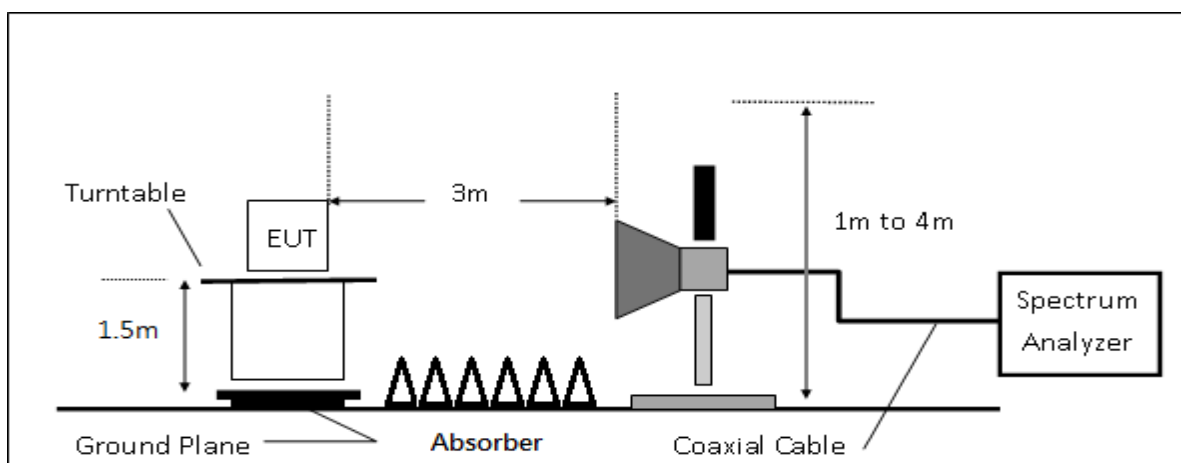
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(B) Radiated Emission Test Set-UP, Frequency form 30MHz to 1000MHz



(C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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11.4 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules .
3. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 1.5m for frequency> 1GHz above ground plane.
4. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
5. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
6. Set the spectrum analyzer as RBW=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
7. At frequency above 1 GHz, Set the spectrum analyzer:
 - A. RBW=1 MHz, VBW=3 MHz for **Peak** Detector.
 - B. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for **Average** Detector.
8. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
9. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
10. Repeat above procedures until all frequency measured were complete.

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11.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where *FS* = Field Strength

CL = Cable Attenuation Factor (Cable Loss)

RA = Reading Amplitude

AG = Amplifier Gain

AF = Antenna Factor

The limit of the emission level is expressed in dBuV/m, which converts $20 \cdot \log(\mu V/m)$

Actual FS(dBuV/m) = SPA. Reading level(dBuV) + Factor(dB)

Factor(dB) = Antenna Factor(dBuV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

11.6 Test Results of Radiated Spurious Emissions form 9 KHz to 30 MHz

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) was not reported.

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11.7 Radiated Spurious Emission Measurement Result

11.7.1 Below 1GHz Worst-Case Data:

Shark Dual Antenna

Report Number :ER-2020-30118

Test Date :2020-04-07

Operation Mode :802.11n20

Temp./Humi. :21.5/65

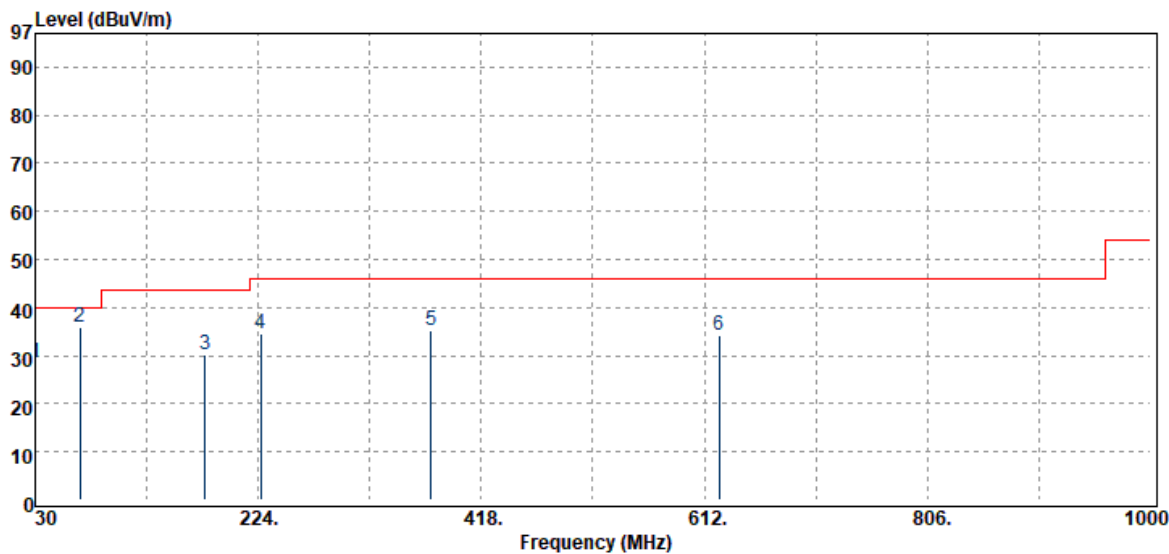
Test Frequency :5785 MHz

Antenna Pol. :VERTICAL

Test Mode :Tx CH Mid

Engineer :Nick

EUT Pol :H Plane



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
30.00	Peak	37.39	-8.72	28.67	40.00	-11.33
68.80	Peak	46.10	-10.13	35.97	40.00	-4.03
177.44	Peak	38.94	-8.61	30.33	43.50	-13.17
225.94	Peak	43.91	-9.30	34.61	46.00	-11.39
374.35	Peak	39.86	-4.66	35.20	46.00	-10.80
624.61	Peak	34.88	-0.57	34.31	46.00	-11.69

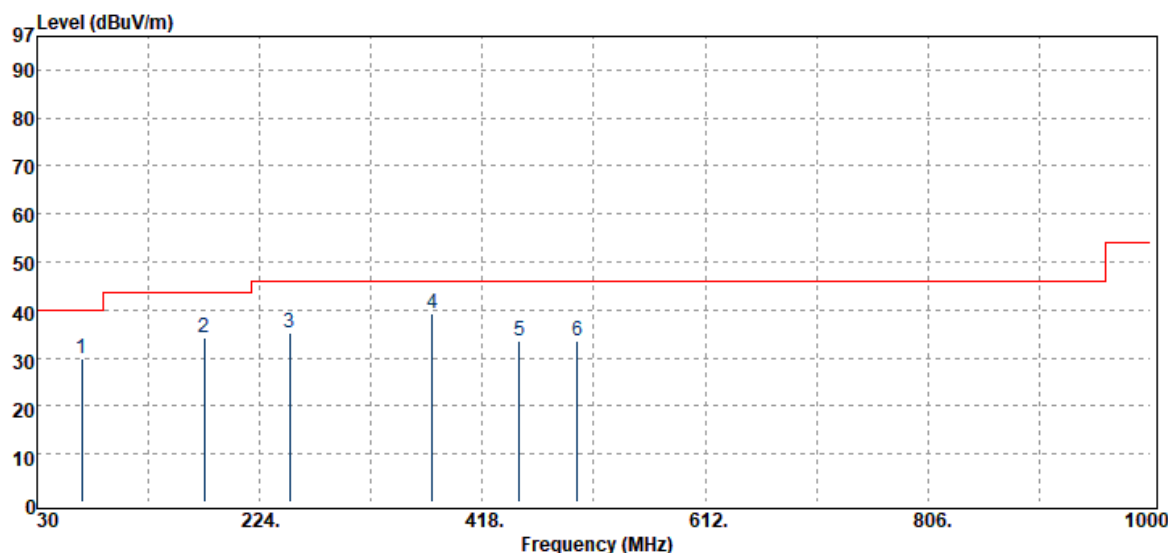
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Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5785 MHz
Test Mode :Tx CH Mid
EUT Pol :H Plane

Test Date :2020-04-07
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBUV	Factor dB	Actual FS dBUV/m	Limit @3m dBUV/m	Margin dB
68.80	Peak	39.89	-10.13	29.76	40.00	-10.24
175.50	Peak	42.45	-8.32	34.13	43.50	-9.37
250.19	Peak	43.16	-7.90	35.26	46.00	-10.74
374.35	Peak	43.82	-4.66	39.16	46.00	-6.84
450.01	Peak	36.06	-2.57	33.49	46.00	-12.51
500.45	Peak	36.46	-2.92	33.54	46.00	-12.46

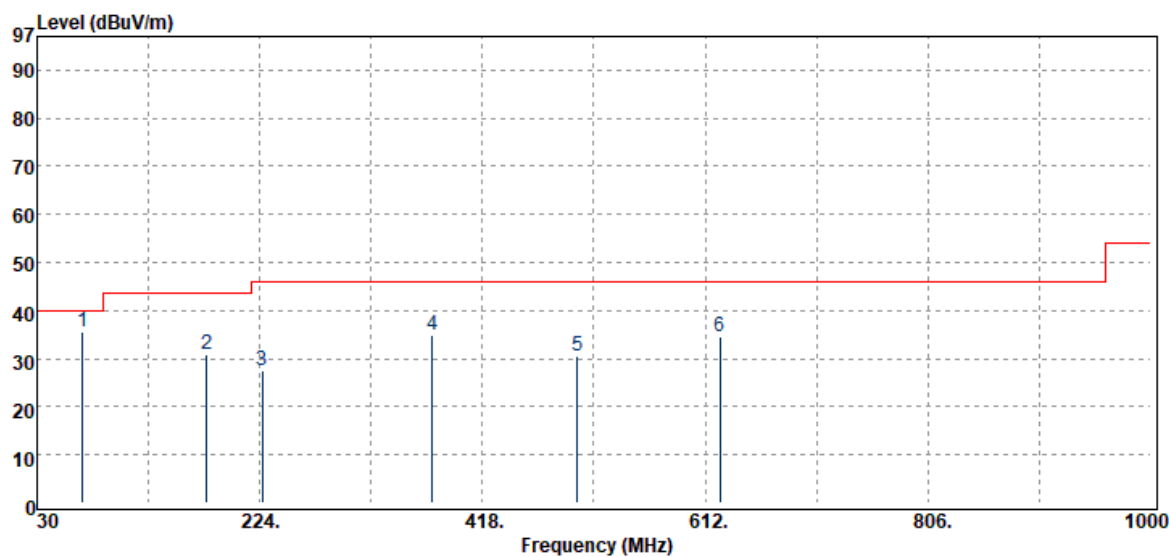
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Tube Antenna

Report Number :ER-2020-30118
 Operation Mode :802.11n20
 Test Frequency :5785 MHz
 Test Mode :Tx CH Mid
 EUT Pol :H Plane

Test Date :2020-04-07
 Temp./Humi. :21.5/65
 Antenna Pol. :VERTICAL
 Engineer :Nick

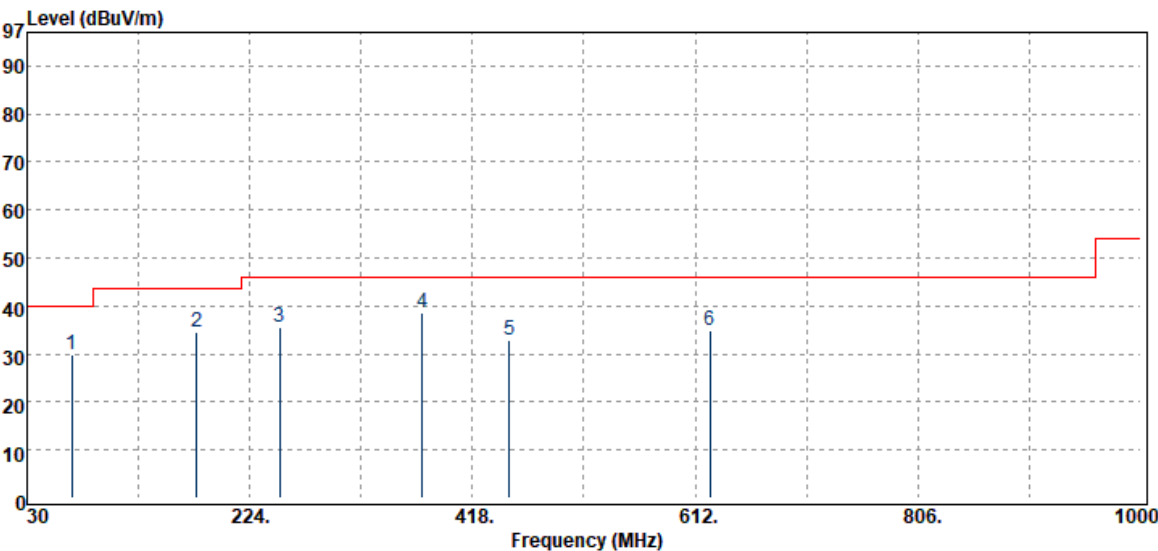


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
69.77	Peak	45.83	-10.25	35.58	40.00	-4.42
177.44	Peak	39.63	-8.61	31.02	43.50	-12.48
225.94	Peak	36.70	-9.30	27.40	46.00	-18.60
374.35	Peak	39.45	-4.66	34.79	46.00	-11.21
500.45	Peak	33.48	-2.92	30.56	46.00	-15.44
624.61	Peak	35.28	-0.57	34.71	46.00	-11.29

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Report Number	:ER-2020-30118	Test Date	:2020-04-07
Operation Mode	:802.11n20	Temp./Humi.	:21.5/65
Test Frequency	:5785 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH Mid	Engineer	:Nick
EUT Pol	:H Plane		



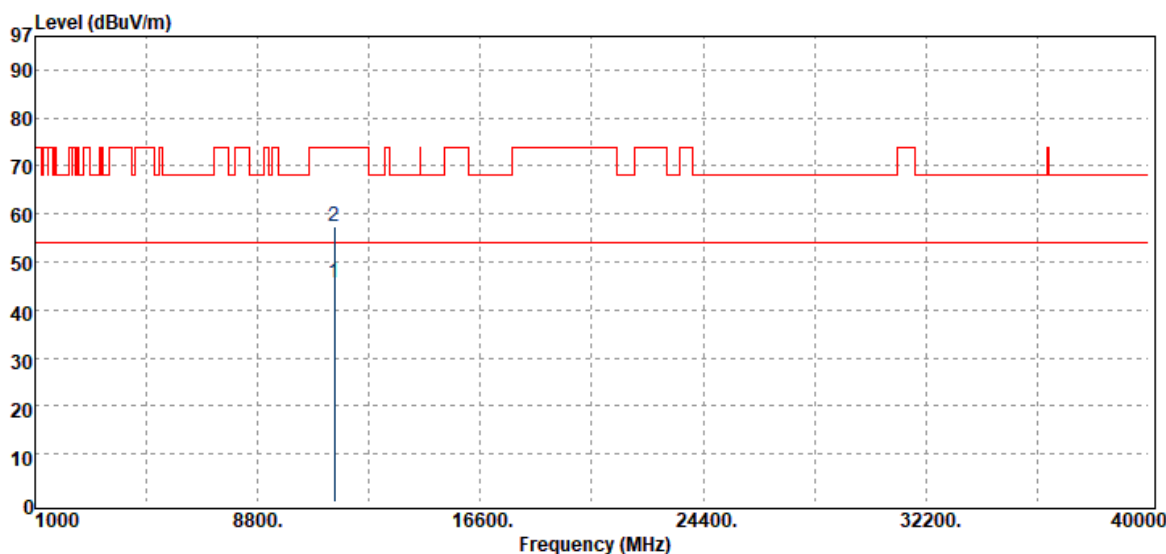
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
68.80	Peak	40.08	-10.13	29.95	40.00	-10.05
177.44	Peak	43.13	-8.61	34.52	43.50	-8.98
250.19	Peak	43.48	-7.90	35.58	46.00	-10.42
374.35	Peak	43.13	-4.66	38.47	46.00	-7.53
450.01	Peak	35.60	-2.57	33.03	46.00	-12.97
624.61	Peak	35.37	-0.57	34.80	46.00	-11.20

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11.7.2 Above 1GHz Worst-Case Data:

Shark Dual Antenna

Report Number	:ER-2020-30118	Test Date	:2020-04-06
Operation Mode	:802.11n20	Temp./Humi.	:21.5/65
Test Frequency	:5745 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH Low	Engineer	:Nick
EUT Pol	:H Plane		

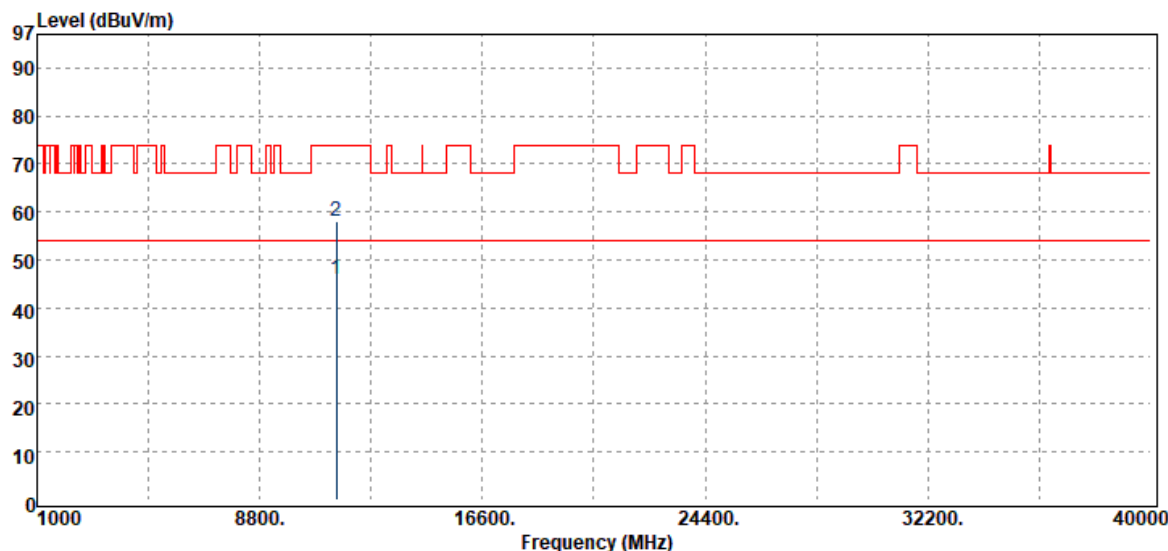


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
11490.00	Average	22.43	23.24	45.67	54.00	-8.33
11490.00	Peak	34.08	23.24	57.32	74.00	-16.68

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Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5745 MHz
Test Mode :Tx CH Low
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



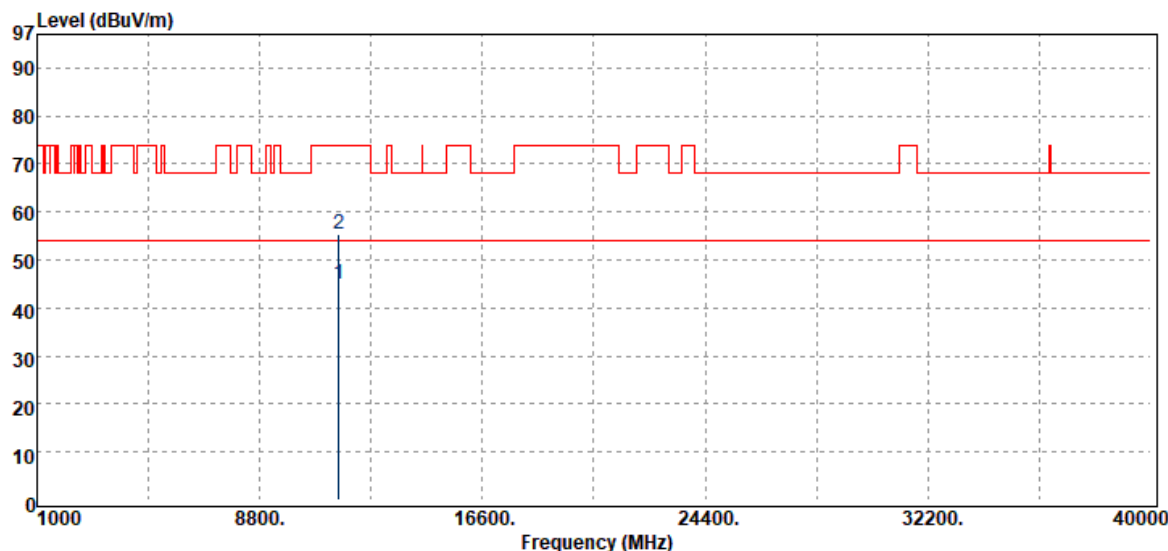
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11490.00	Average	22.91	23.24	46.15	54.00	-7.85
11490.00	Peak	34.90	23.24	58.14	74.00	-15.86

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Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5785 MHz
Test Mode :Tx CH Mid
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :VERTICAL
Engineer :Nick



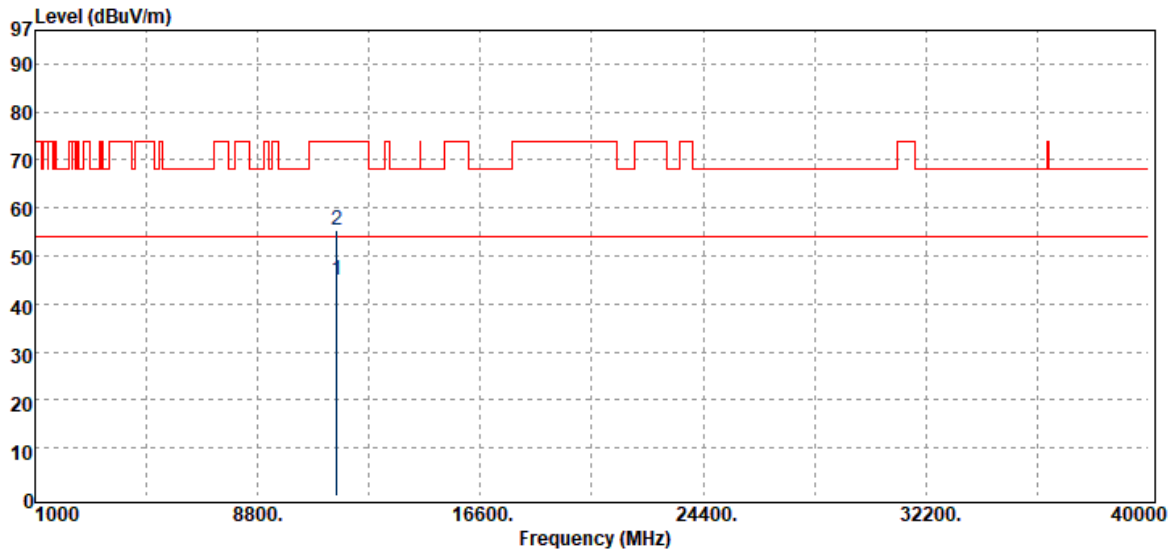
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
11570.00	Average	23.11	22.01	45.12	54.00	-8.88
11570.00	Peak	33.48	22.01	55.49	74.00	-18.51

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Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5785 MHz
Test Mode :Tx CH Mid
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



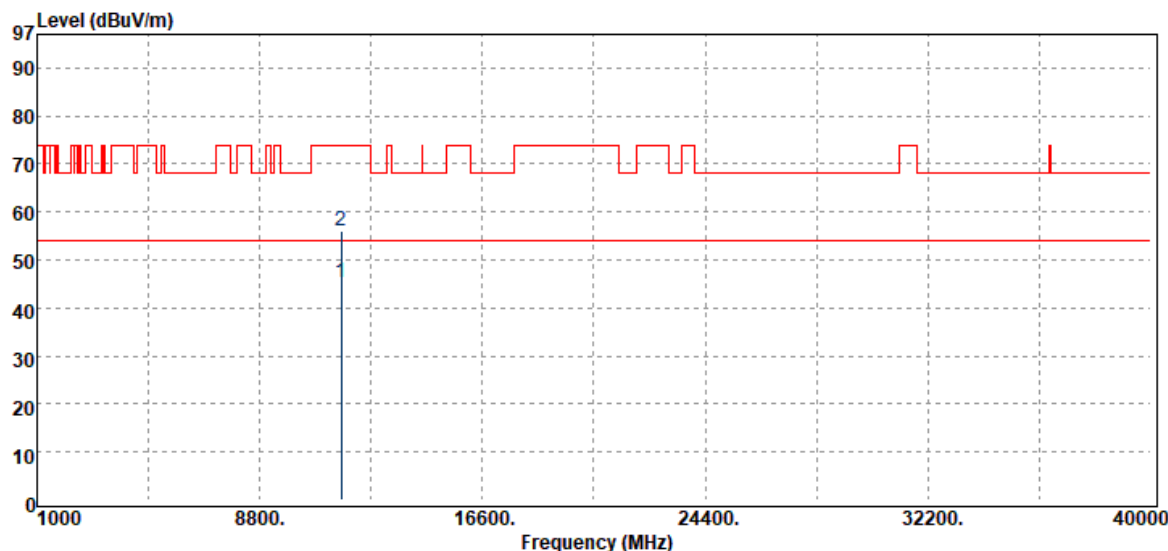
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11570.00	Average	23.03	22.01	45.04	54.00	-8.96
11570.00	Peak	33.21	22.01	55.22	74.00	-18.78

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Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5825 MHz
Test Mode :Tx CH High
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :VERTICAL
Engineer :Nick



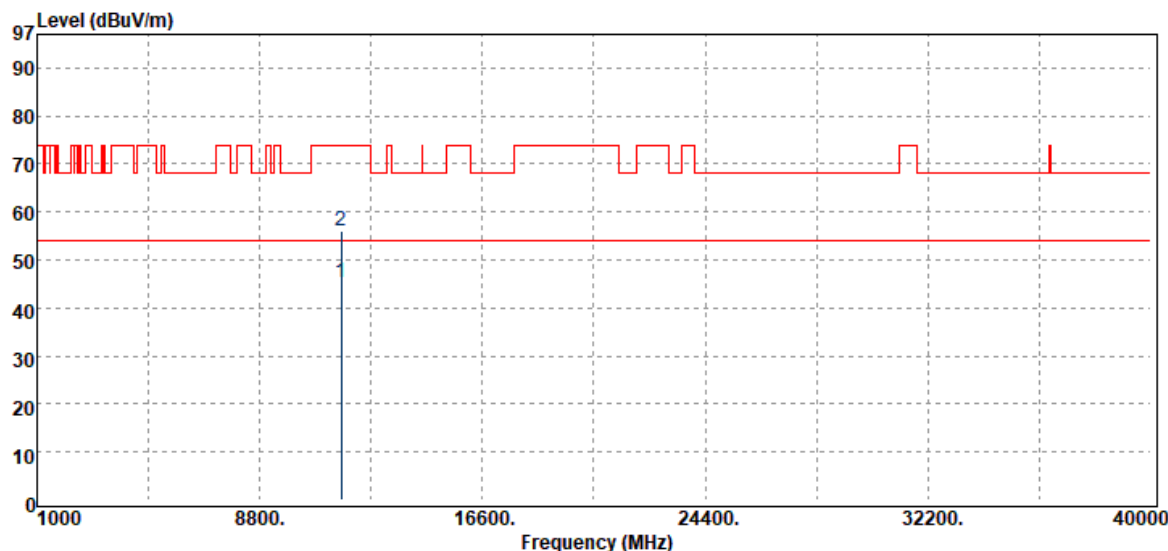
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBUV	Factor dB	Actual FS dBUV/m	Limit @3m dBUV/m	Margin dB
11650.00	Average	23.02	22.45	45.47	54.00	-8.53
11650.00	Peak	33.48	22.45	55.93	74.00	-18.07

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Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5825 MHz
Test Mode :Tx CH High
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



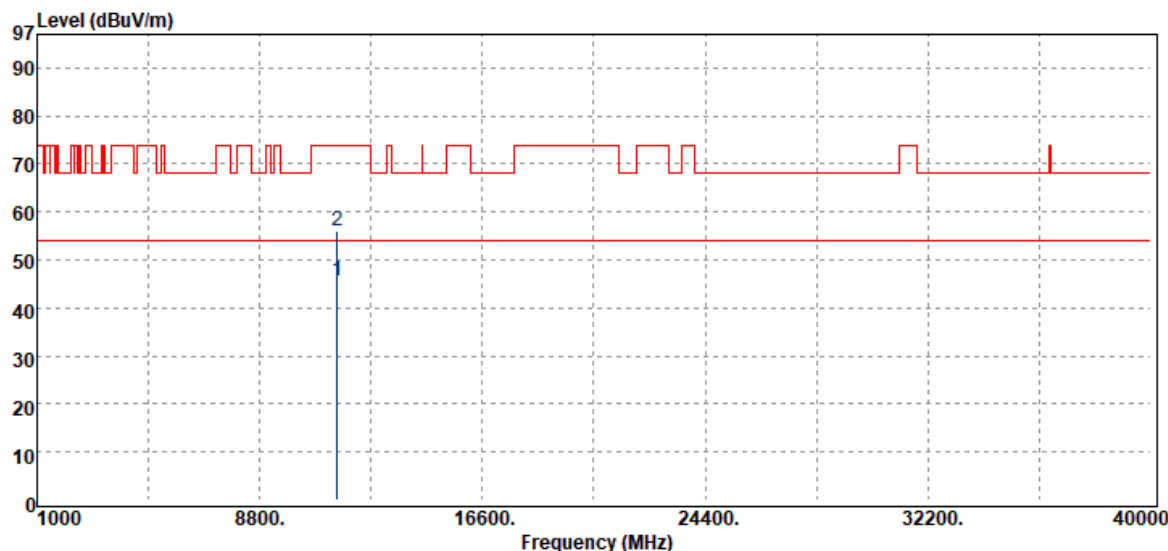
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11650.00	Average	22.90	22.45	45.35	54.00	-8.65
11650.00	Peak	33.48	22.45	55.93	74.00	-18.07

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Report Number :ER-2020-30118
Operation Mode :802.11n40
Test Frequency :5755 MHz
Test Mode :Tx CH Low
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :VERTICAL
Engineer :Nick



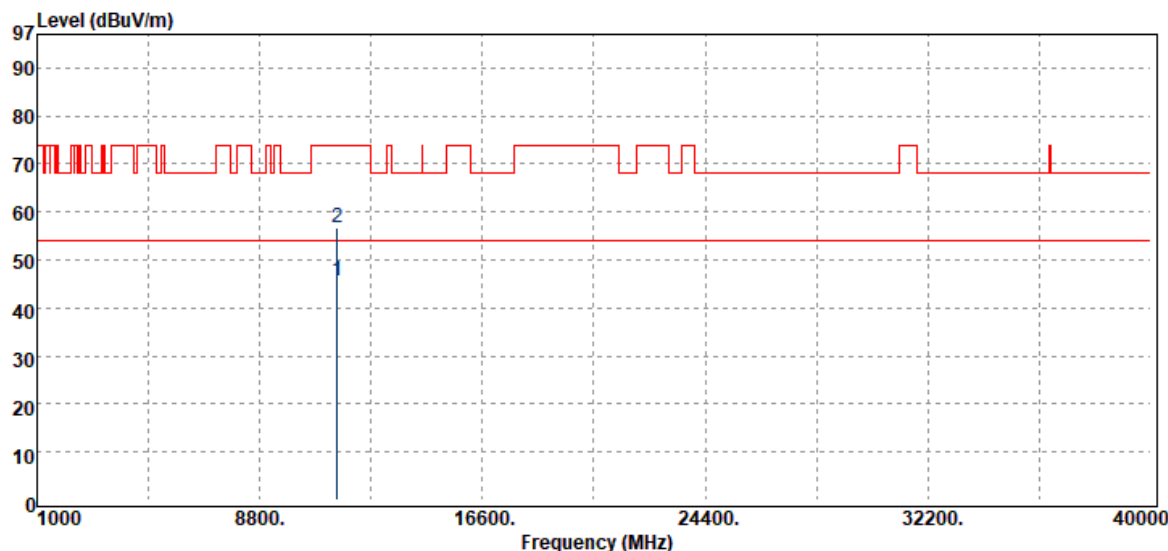
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11510.00	Average	22.61	23.13	45.74	54.00	-8.26
11510.00	Peak	33.04	23.13	56.17	74.00	-17.83

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Report Number :ER-2020-30118
Operation Mode :802.11n40
Test Frequency :5755 MHz
Test Mode :Tx CH Low
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



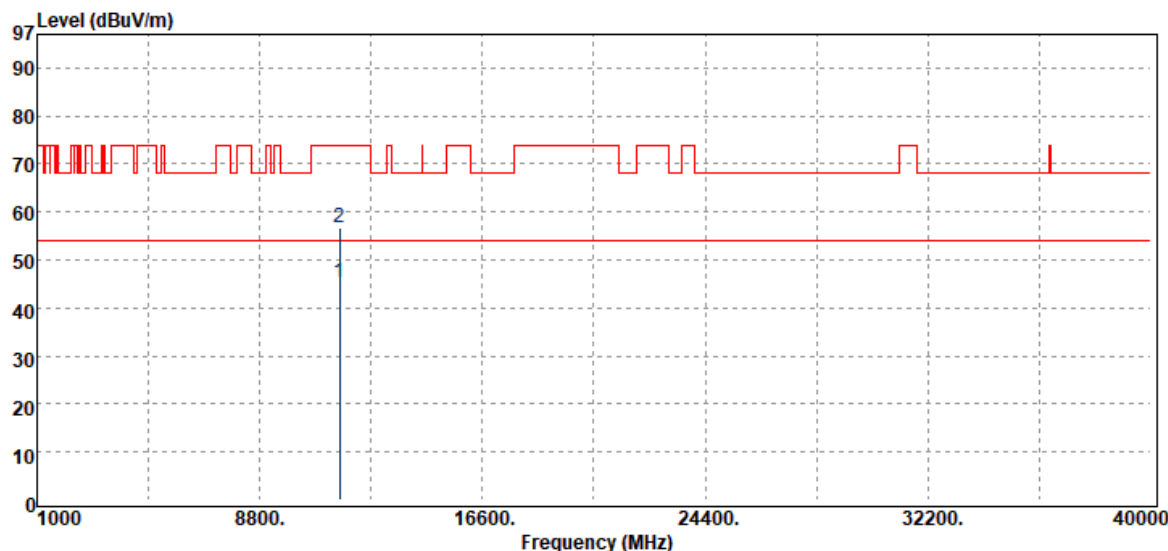
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11510.00	Average	22.56	23.13	45.69	54.00	-8.31
11510.00	Peak	33.50	23.13	56.63	74.00	-17.37

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Report Number :ER-2020-30118
Operation Mode :802.11n40
Test Frequency :5795 MHz
Test Mode :Tx CH High
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :VERTICAL
Engineer :Nick



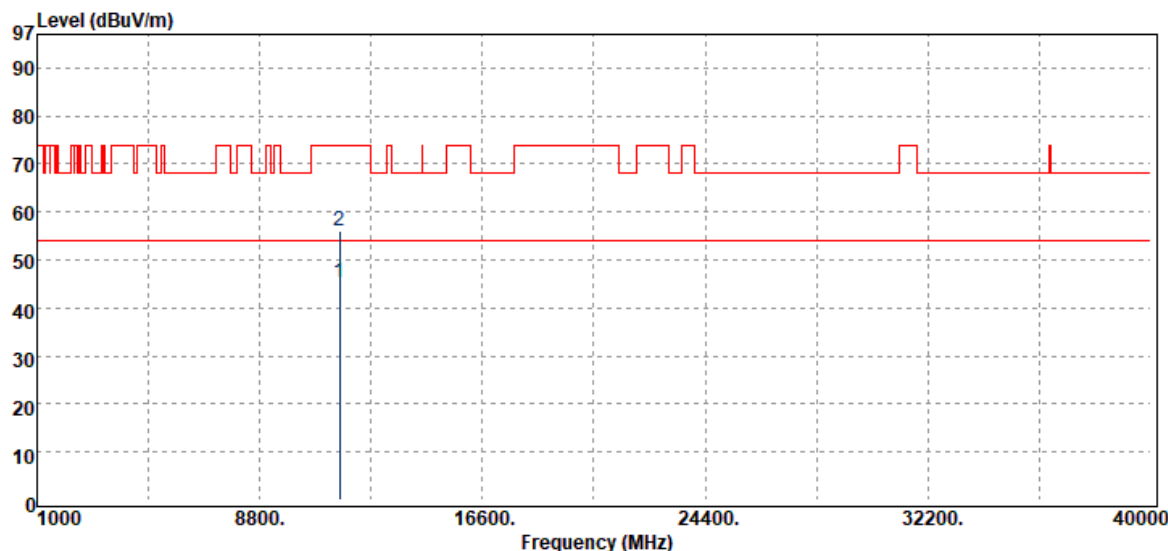
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBUV	Factor dB	Actual FS dBUV/m	Limit @3m dBUV/m	Margin dB
11590.00	Average	23.39	21.84	45.23	54.00	-8.77
11590.00	Peak	34.93	21.84	56.77	74.00	-17.23

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Report Number :ER-2020-30118
Operation Mode :802.11n40
Test Frequency :5795 MHz
Test Mode :Tx CH High
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11590.00	Average	23.41	21.84	45.25	54.00	-8.75
11590.00	Peak	34.13	21.84	55.97	74.00	-18.03

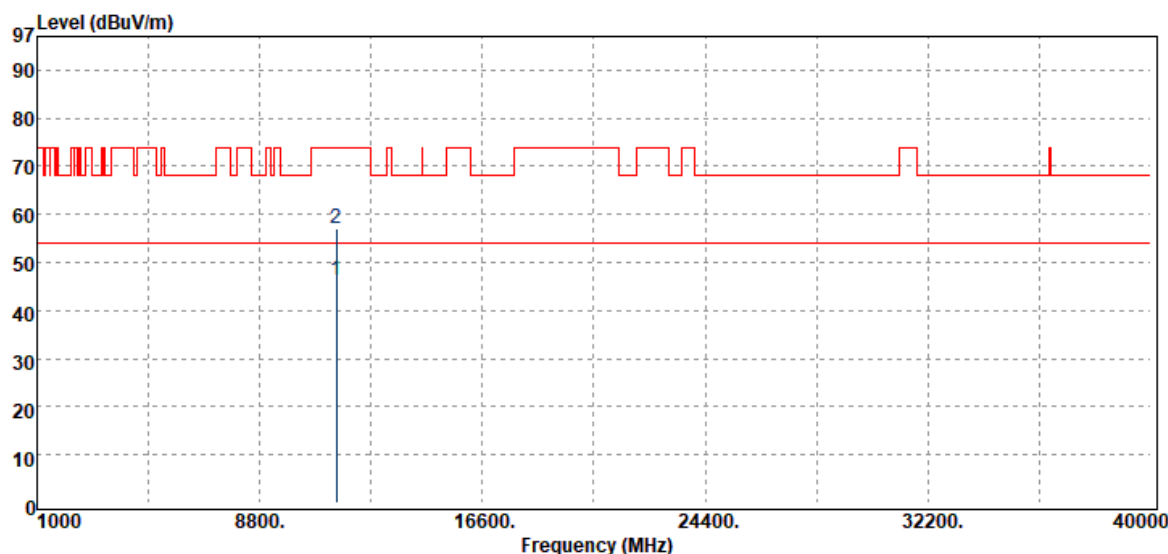
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Tube Antenna

Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5745 MHz
Test Mode :Tx CH Low
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :VERTICAL
Engineer :Nick



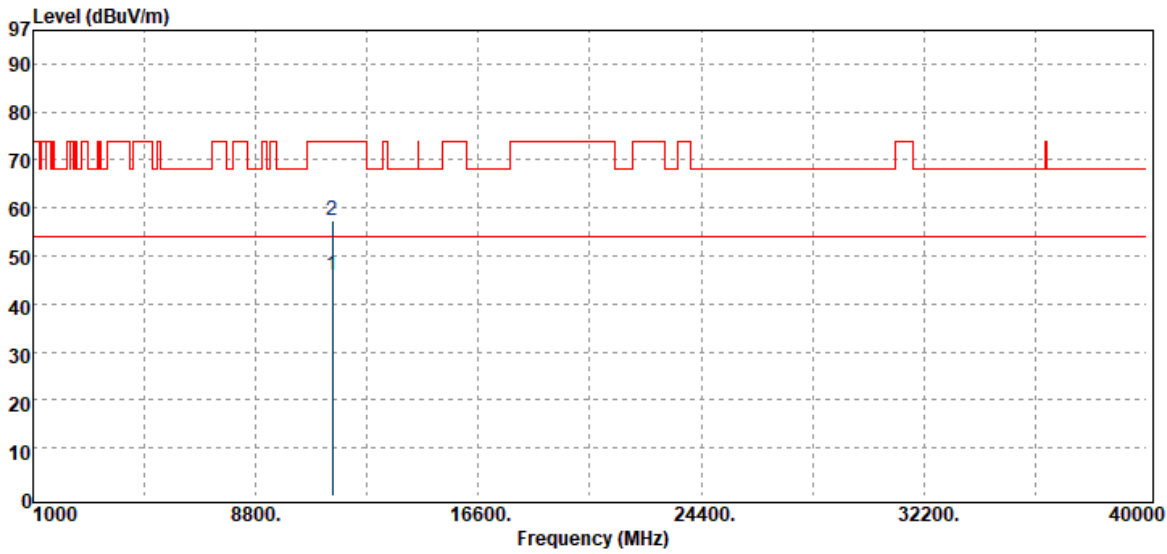
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11490.00	Average	22.94	23.24	46.18	54.00	-7.82
11490.00	Peak	33.95	23.24	57.19	74.00	-16.81

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Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5745 MHz
Test Mode :Tx CH Low
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



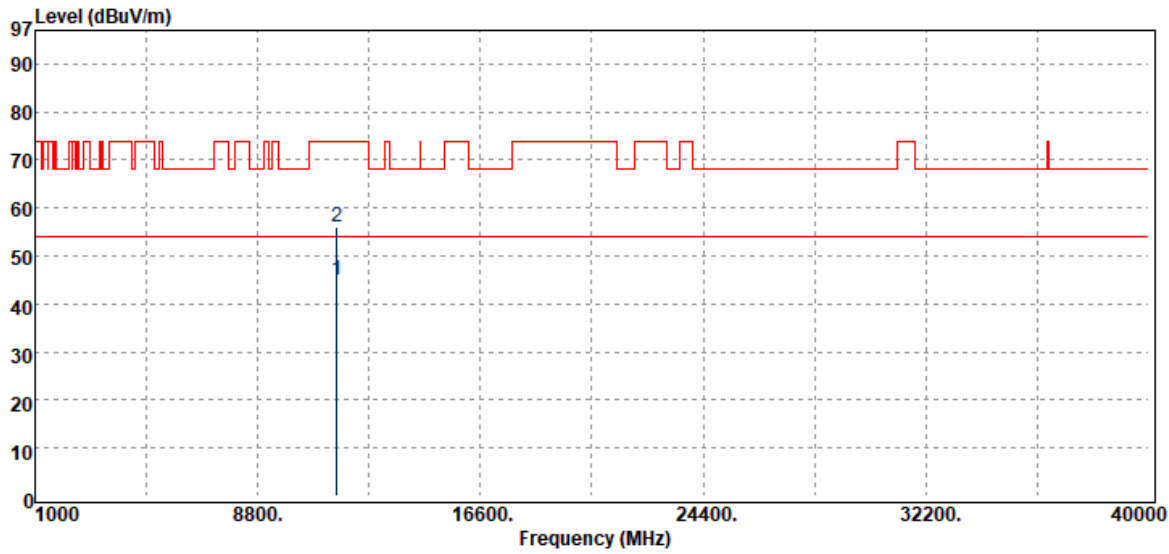
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11490.00	Average	22.74	23.24	45.98	54.00	-8.02
11490.00	Peak	34.24	23.24	57.48	74.00	-16.52

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Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5785 MHz
Test Mode :Tx CH Mid
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :VERTICAL
Engineer :Nick



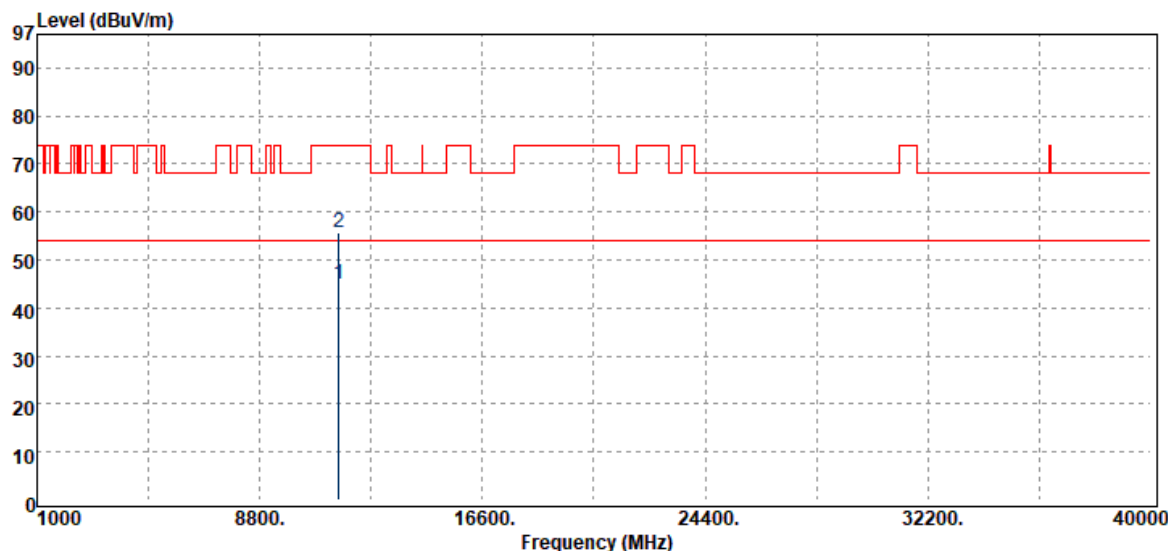
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11570.00	Average	22.99	22.01	45.00	54.00	-9.00
11570.00	Peak	34.02	22.01	56.03	74.00	-17.97

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Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5785 MHz
Test Mode :Tx CH Mid
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



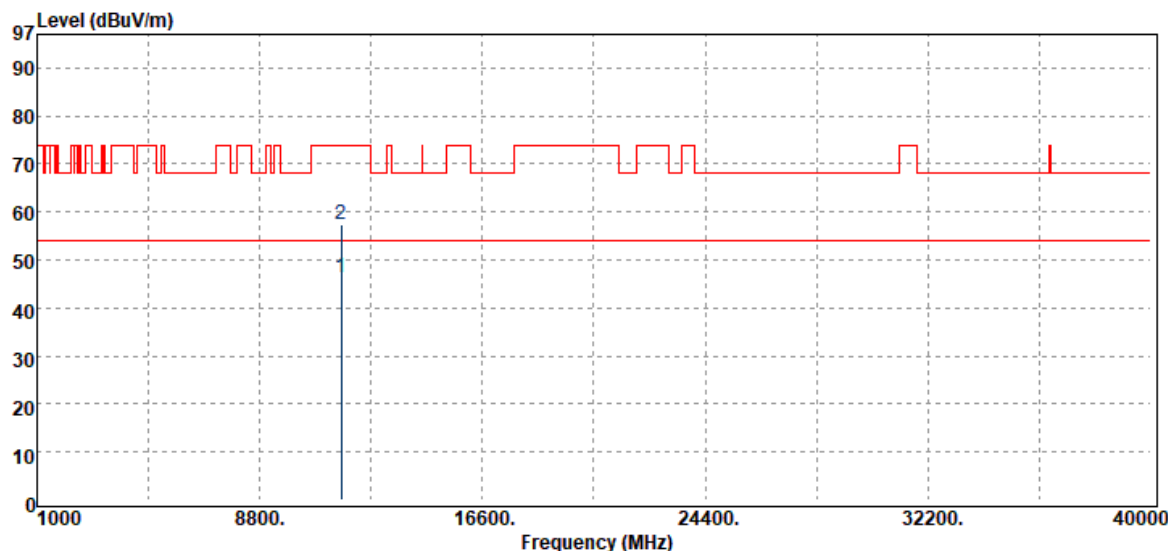
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11570.00	Average	22.98	22.01	44.99	54.00	-9.01
11570.00	Peak	33.81	22.01	55.82	74.00	-18.18

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Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5825 MHz
Test Mode :Tx CH High
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :VERTICAL
Engineer :Nick



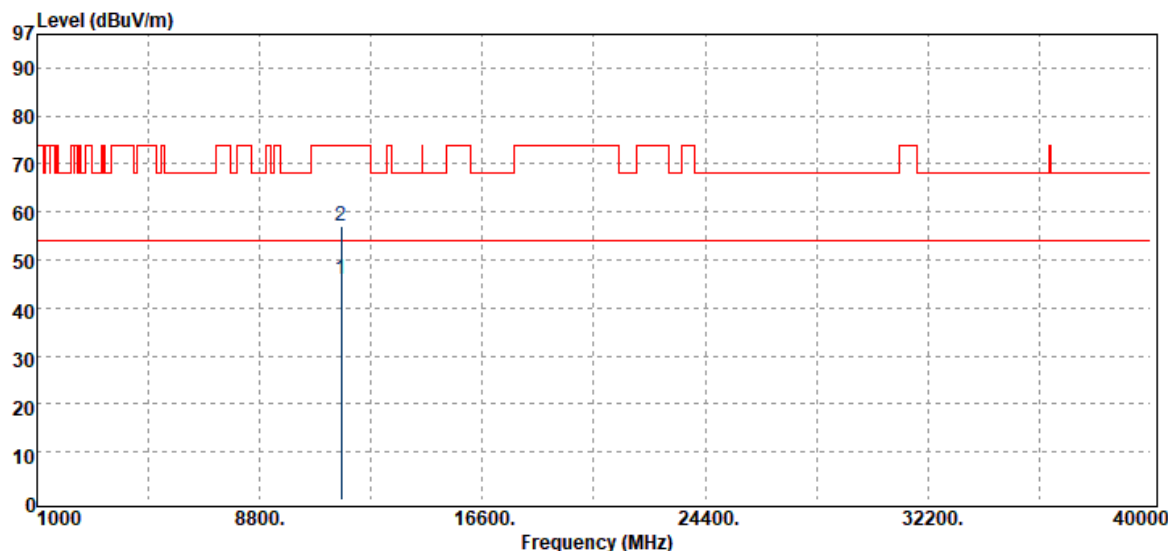
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11650.00	Average	23.97	22.45	46.42	54.00	-7.58
11650.00	Peak	34.79	22.45	57.24	74.00	-16.76

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Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5825 MHz
Test Mode :Tx CH High
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



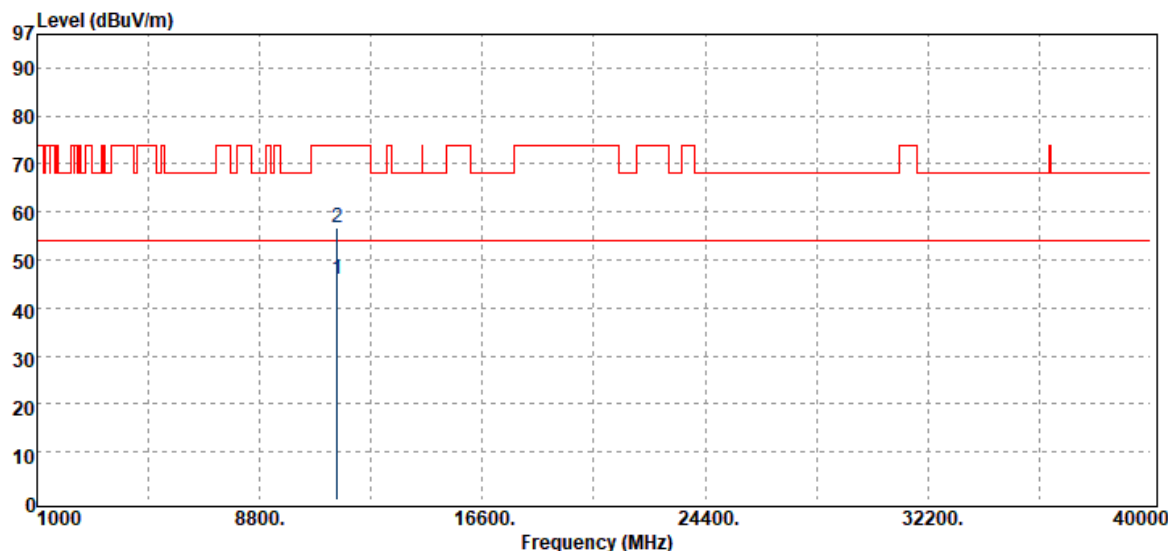
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11650.00	Average	23.52	22.45	45.97	54.00	-8.03
11650.00	Peak	34.53	22.45	56.98	74.00	-17.02

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Report Number :ER-2020-30118
Operation Mode :802.11n40
Test Frequency :5755 MHz
Test Mode :Tx CH Low
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :VERTICAL
Engineer :Nick



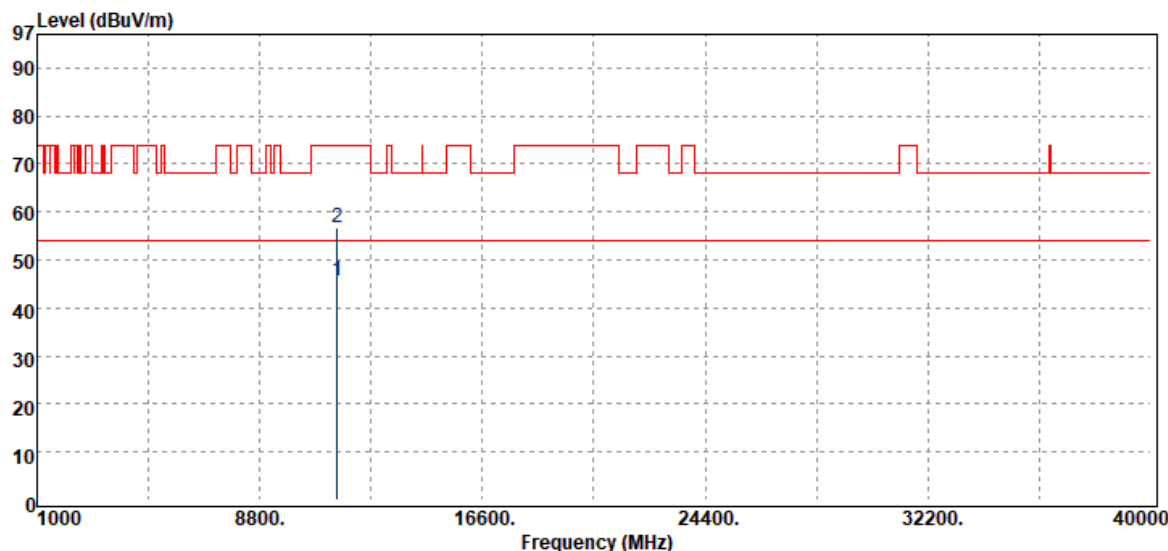
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11510.00	Average	22.69	23.13	45.82	54.00	-8.18
11510.00	Peak	33.70	23.13	56.83	74.00	-17.17

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Report Number :ER-2020-30118
Operation Mode :802.11n40
Test Frequency :5755 MHz
Test Mode :Tx CH Low
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



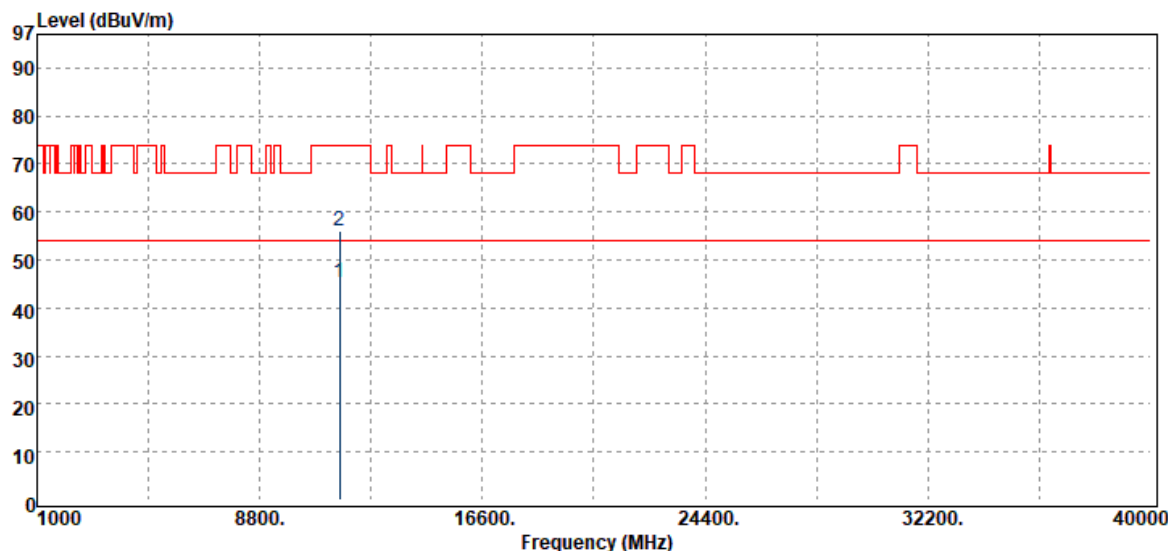
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11510.00	Average	22.63	23.13	45.76	54.00	-8.24
11510.00	Peak	33.45	23.13	56.58	74.00	-17.42

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Report Number :ER-2020-30118
Operation Mode :802.11n40
Test Frequency :5795 MHz
Test Mode :Tx CH High
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :VERTICAL
Engineer :Nick



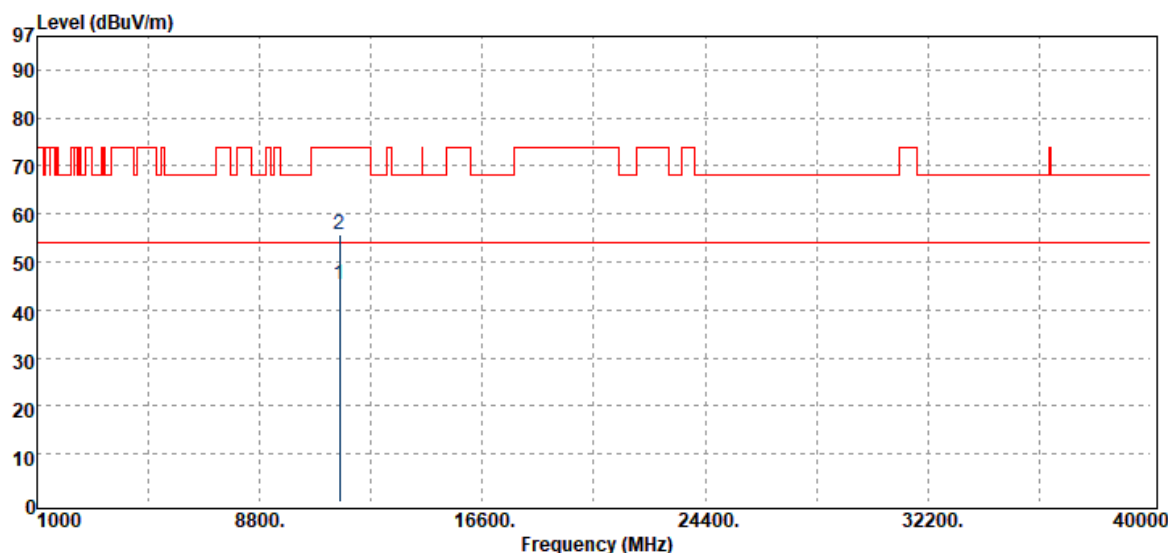
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11590.00	Average	23.46	21.84	45.30	54.00	-8.70
11590.00	Peak	34.24	21.84	56.08	74.00	-17.92

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Report Number :ER-2020-30118
Operation Mode :802.11n40
Test Frequency :5795 MHz
Test Mode :Tx CH High
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11590.00	Average	23.43	21.84	45.27	54.00	-8.73
11590.00	Peak	34.04	21.84	55.88	74.00	-18.12

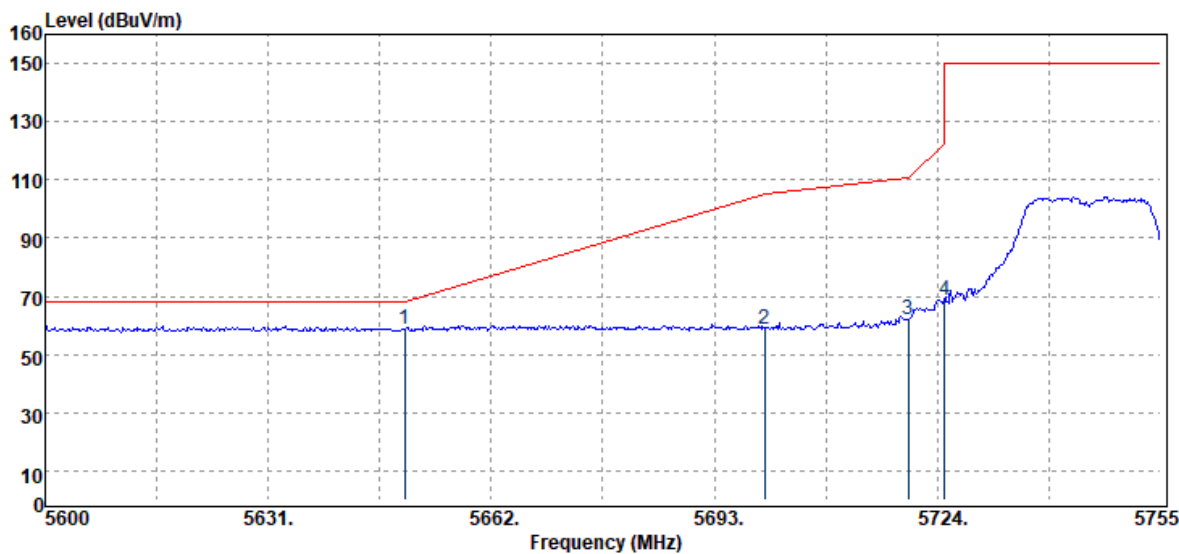
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11.7.3 Band edge falling to restricted band

Shark Dual Antenna

Report Number	:ER-2020-30118	Test Date	:2020-04-06
Operation Mode	:802.11n20	Temp./Humi.	:21.5/65
Test Frequency	:5745 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH Low	Engineer	:Nick
EUT Pol	:H Plane		

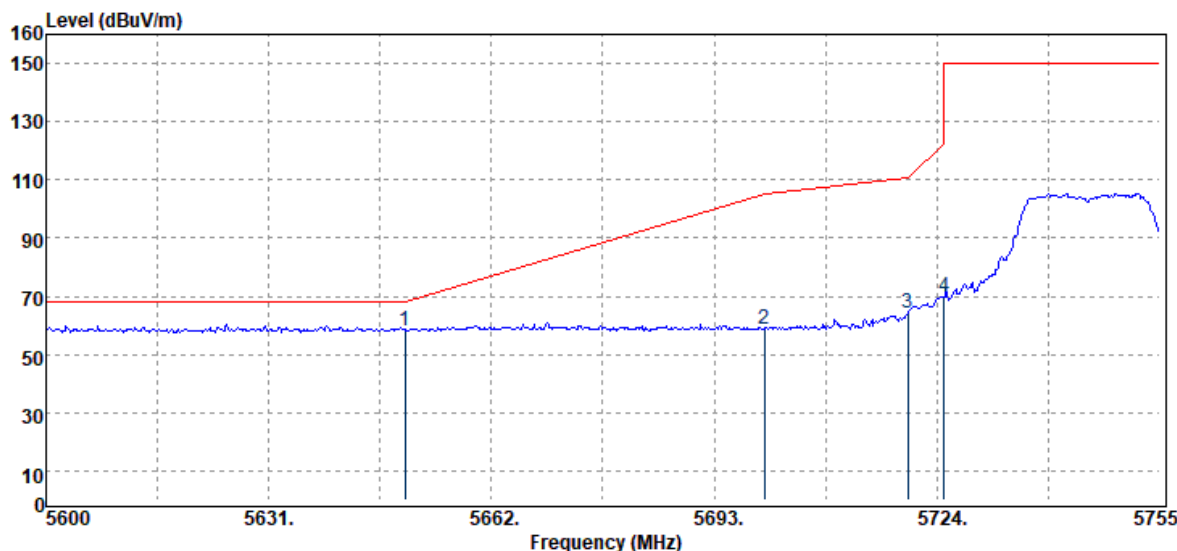


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
5650.00	Peak	50.40	8.32	58.72	68.20	-9.48
5700.00	Peak	50.13	8.69	58.82	105.20	-46.38
5720.00	Peak	53.46	8.78	62.24	110.80	-48.56
5725.00	Peak	59.69	8.81	68.50	122.20	-53.70

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Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5745 MHz
Test Mode :Bandedge CH Low
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



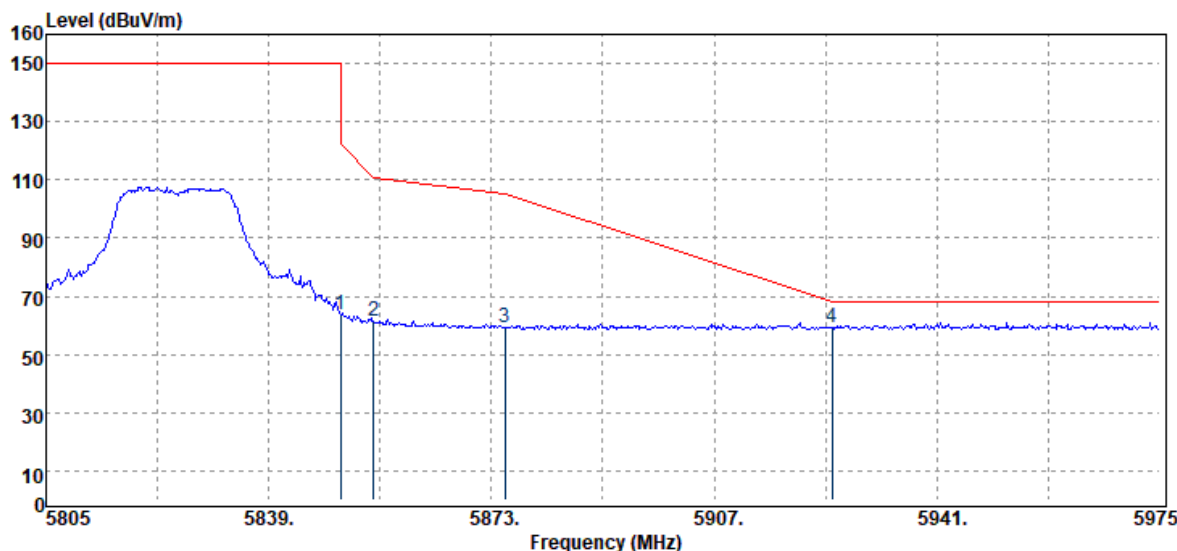
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
5650.00	Peak	49.88	8.32	58.20	68.20	-10.00
5700.00	Peak	50.04	8.69	58.73	105.20	-46.47
5720.00	Peak	55.60	8.78	64.38	110.80	-46.42
5725.00	Peak	60.87	8.81	69.68	122.20	-52.52

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Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5825 MHz
Test Mode :Bandedge CH High
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :VERTICAL
Engineer :Nick



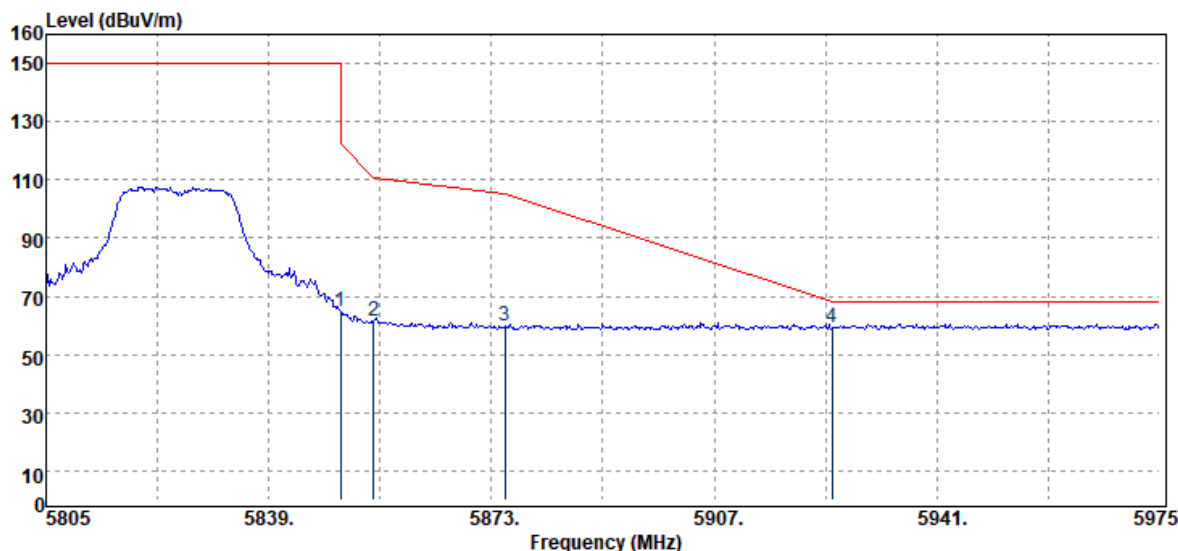
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
5850.00	Peak	54.32	9.42	63.74	122.20	-58.46
5855.00	Peak	51.78	9.44	61.22	110.80	-49.58
5875.00	Peak	49.69	9.50	59.19	105.20	-46.01
5925.00	Peak	49.53	9.65	59.18	68.20	-9.02

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Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5825 MHz
Test Mode :Bandedge CH High
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



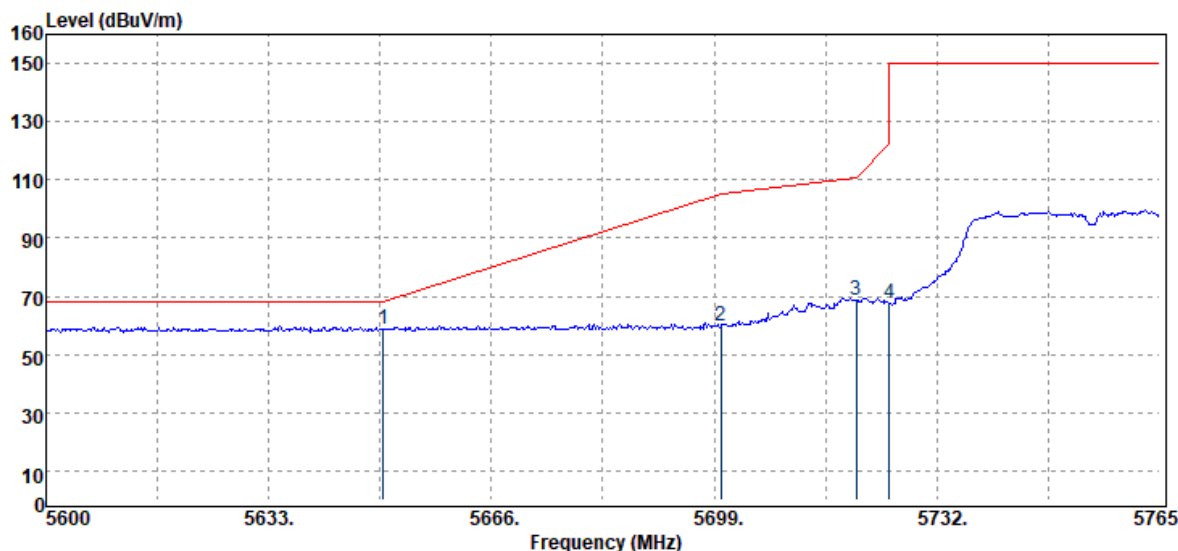
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
5850.00	Peak	55.33	9.42	64.75	122.20	-57.45
5855.00	Peak	52.18	9.44	61.62	110.80	-49.18
5875.00	Peak	50.30	9.50	59.80	105.20	-45.40
5925.00	Peak	49.35	9.65	59.00	68.20	-9.20

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Report Number :ER-2020-30118
Operation Mode :802.11n40
Test Frequency :5755 MHz
Test Mode :Bandedge CH Low
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :VERTICAL
Engineer :Nick



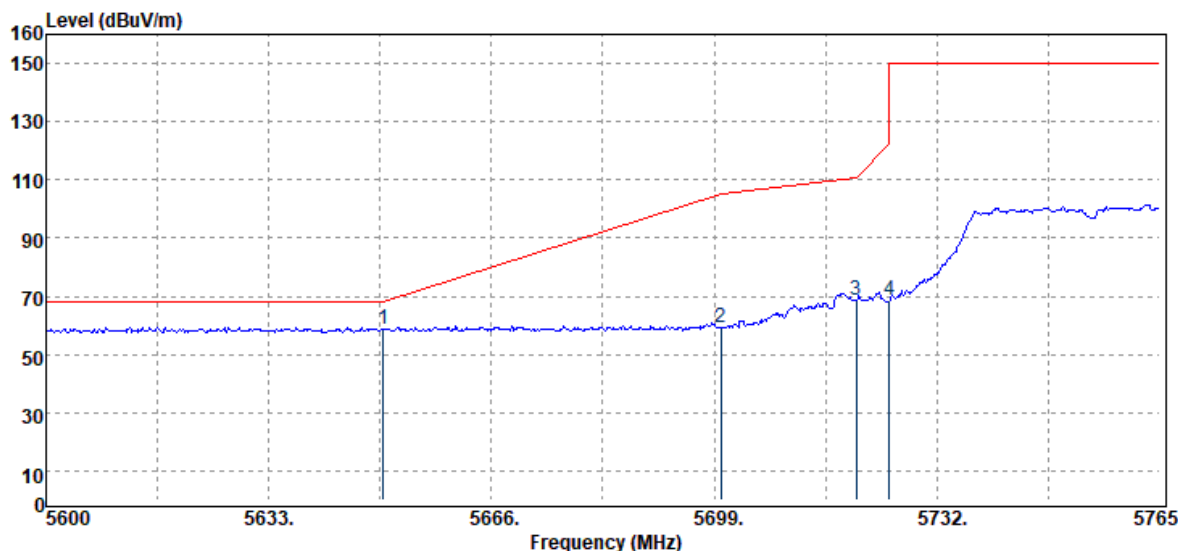
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
5650.00	Peak	50.34	8.32	58.66	68.20	-9.54
5700.00	Peak	51.08	8.69	59.77	105.20	-45.43
5720.00	Peak	59.71	8.78	68.49	110.80	-42.31
5725.00	Peak	58.98	8.81	67.79	122.20	-54.41

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Report Number :ER-2020-30118
Operation Mode :802.11n40
Test Frequency :5755 MHz
Test Mode :Bandedge CH Low
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



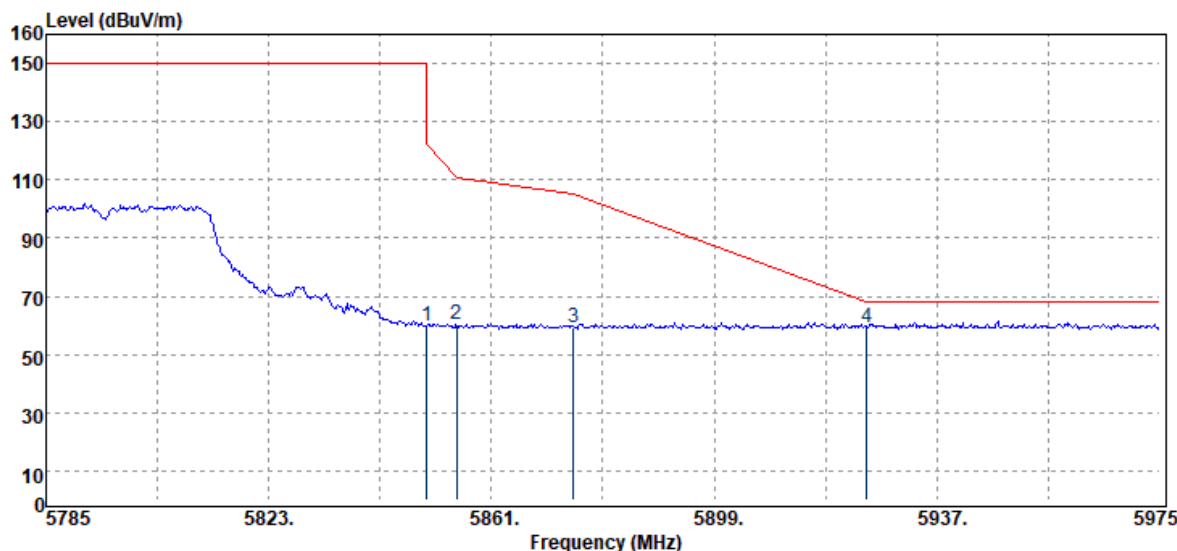
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
5650.00	Peak	50.38	8.32	58.70	68.20	-9.50
5700.00	Peak	50.46	8.69	59.15	105.20	-46.05
5720.00	Peak	59.90	8.78	68.68	110.80	-42.12
5725.00	Peak	59.62	8.81	68.43	122.20	-53.77

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Report Number :ER-2020-30118
Operation Mode :802.11n40
Test Frequency :5795 MHz
Test Mode :Bandedge CH High
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :VERTICAL
Engineer :Nick



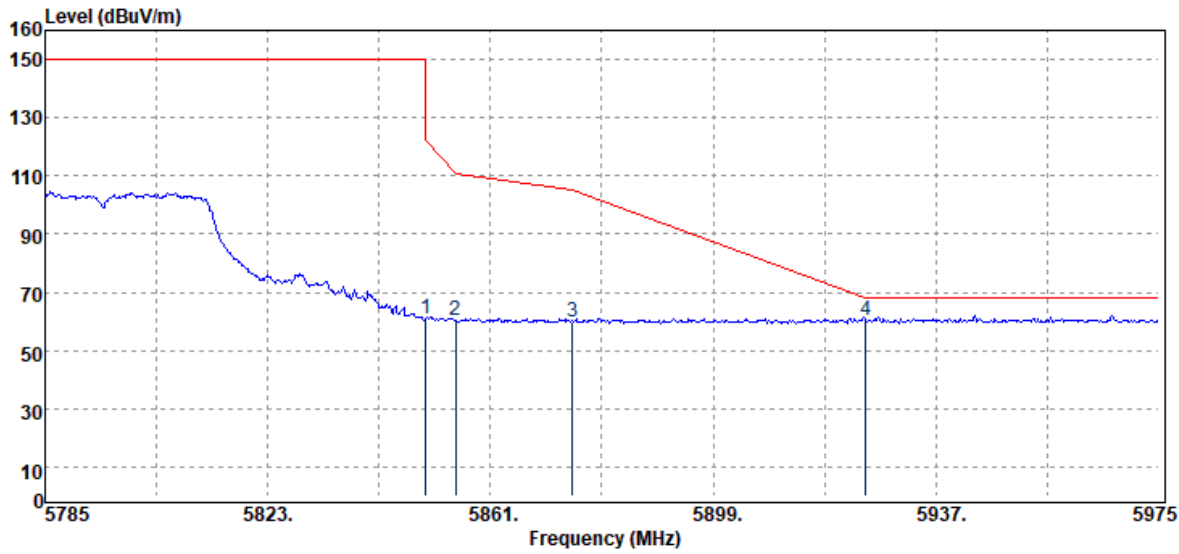
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
5850.00	Peak	50.58	9.42	60.00	122.20	-62.20
5855.00	Peak	50.70	9.44	60.14	110.80	-50.66
5875.00	Peak	50.00	9.50	59.50	105.20	-45.70
5925.00	Peak	49.83	9.65	59.48	68.20	-8.72

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Report Number :ER-2020-30118
Operation Mode :802.11n40
Test Frequency :5795 MHz
Test Mode :Bandedge CH High
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
5850.00	Peak	51.62	9.42	61.04	122.20	-61.16
5855.00	Peak	51.03	9.44	60.47	110.80	-50.33
5875.00	Peak	50.55	9.50	60.05	105.20	-45.15
5925.00	Peak	50.64	9.65	60.29	68.20	-7.91

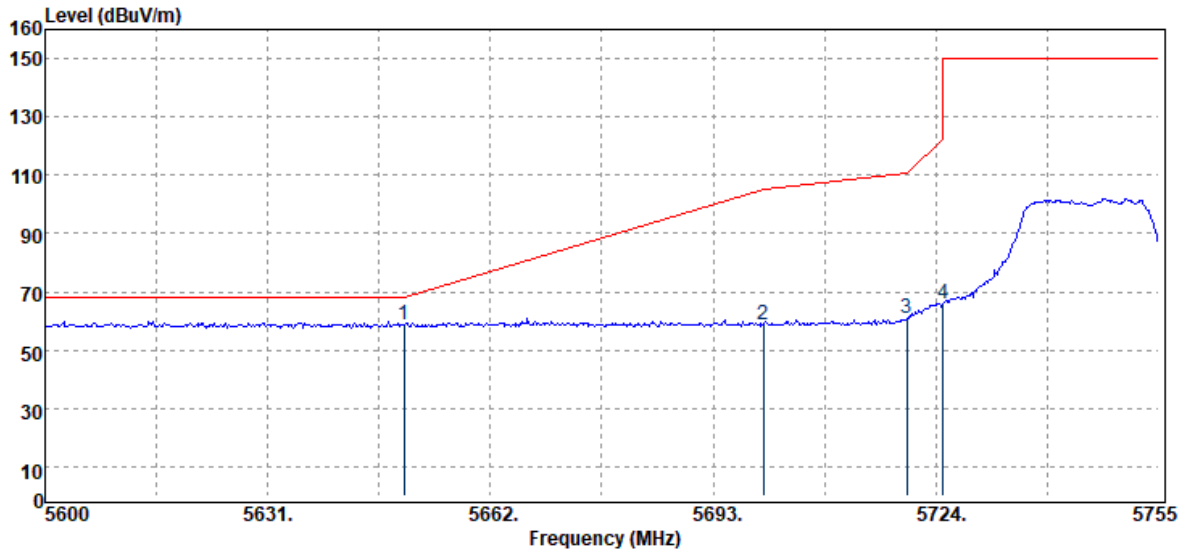
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Tube Antenna

Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5745 MHz
Test Mode :Bandedge CH Low
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :VERTICAL
Engineer :Nick



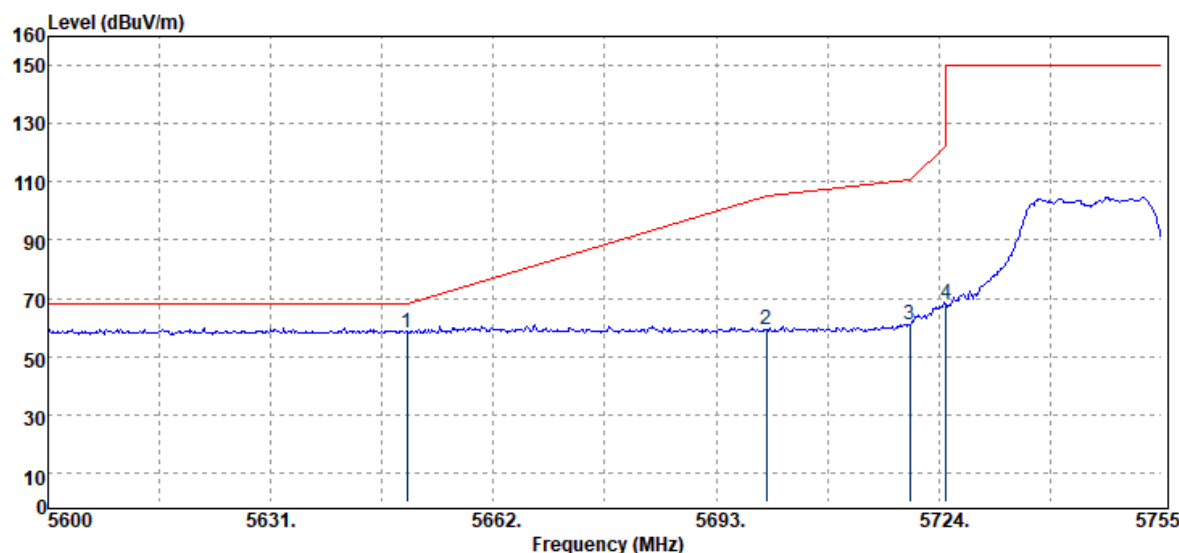
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
5650.00	Peak	50.20	8.32	58.52	68.20	-9.68
5700.00	Peak	49.93	8.69	58.62	105.20	-46.58
5720.00	Peak	51.98	8.78	60.76	110.80	-50.04
5725.00	Peak	56.82	8.81	65.63	122.20	-56.57

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Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5745 MHz
Test Mode :Bandedge CH Low
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



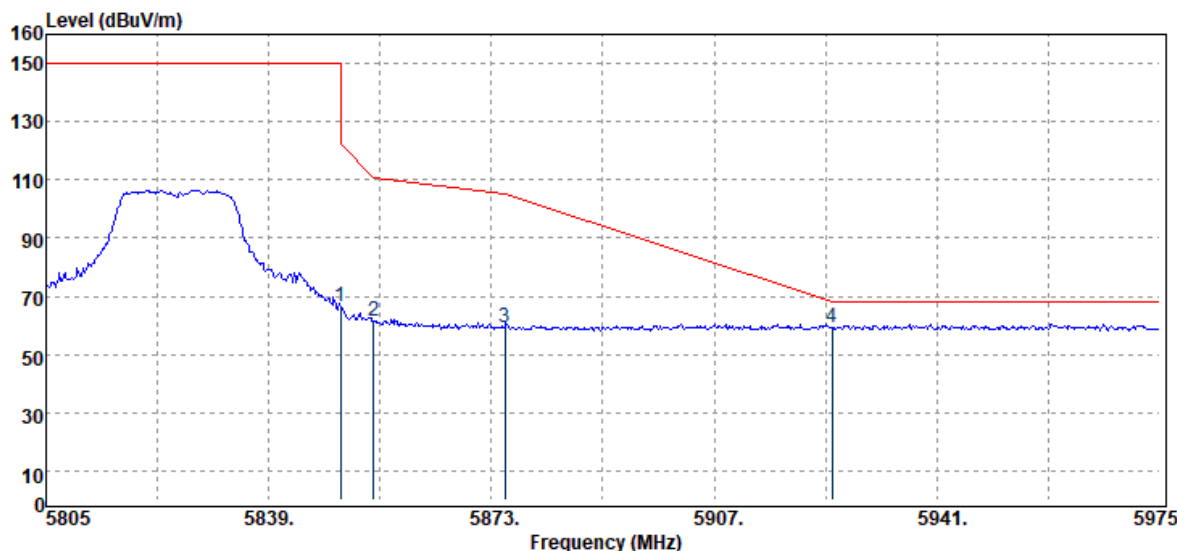
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
5650.00	Peak	50.05	8.32	58.37	68.20	-9.83
5700.00	Peak	50.71	8.69	59.40	105.20	-45.80
5720.00	Peak	52.36	8.78	61.14	110.80	-49.66
5725.00	Peak	59.27	8.81	68.08	122.20	-54.12

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Report Number :ER-2020-30118
 Operation Mode :802.11n20
 Test Frequency :5825 MHz
 Test Mode :Bandedge CH High
 EUT Pol :H Plane

Test Date :2020-04-06
 Temp./Humi. :21.5/65
 Antenna Pol. :VERTICAL
 Engineer :Nick



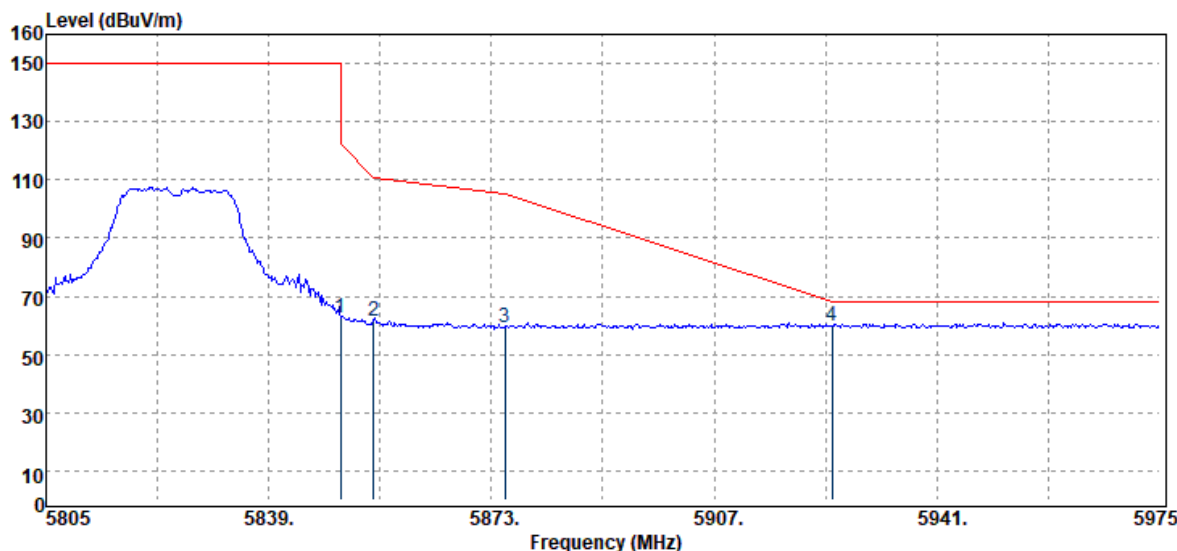
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
5850.00	Peak	56.85	9.42	66.27	122.20	-55.93
5855.00	Peak	52.15	9.44	61.59	110.80	-49.21
5875.00	Peak	49.65	9.50	59.15	105.20	-46.05
5925.00	Peak	49.39	9.65	59.04	68.20	-9.16

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Report Number :ER-2020-30118
Operation Mode :802.11n20
Test Frequency :5825 MHz
Test Mode :Bandedge CH High
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



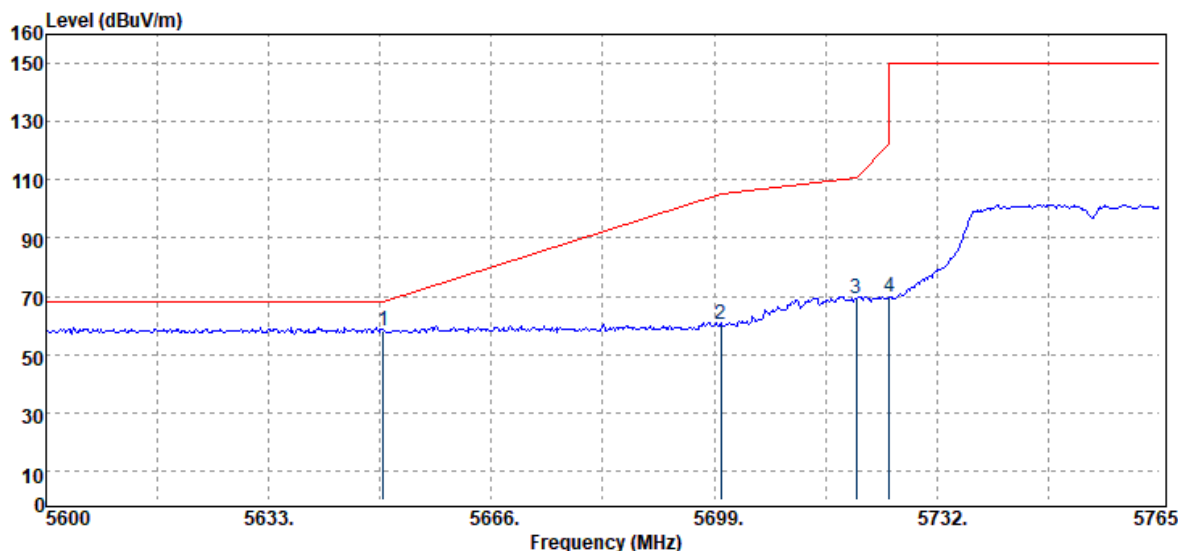
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
5850.00	Peak	53.33	9.42	62.75	122.20	-59.45
5855.00	Peak	51.99	9.44	61.43	110.80	-49.37
5875.00	Peak	49.92	9.50	59.42	105.20	-45.78
5925.00	Peak	50.17	9.65	59.82	68.20	-8.38

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Report Number :ER-2020-30118
Operation Mode :802.11n40
Test Frequency :5755 MHz
Test Mode :Bandedge CH Low
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :VERTICAL
Engineer :Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
5650.00	Peak	50.03	8.32	58.35	68.20	-9.85
5700.00	Peak	51.47	8.69	60.16	105.20	-45.04
5720.00	Peak	60.18	8.78	68.96	110.80	-41.84
5725.00	Peak	60.81	8.81	69.62	122.20	-52.58

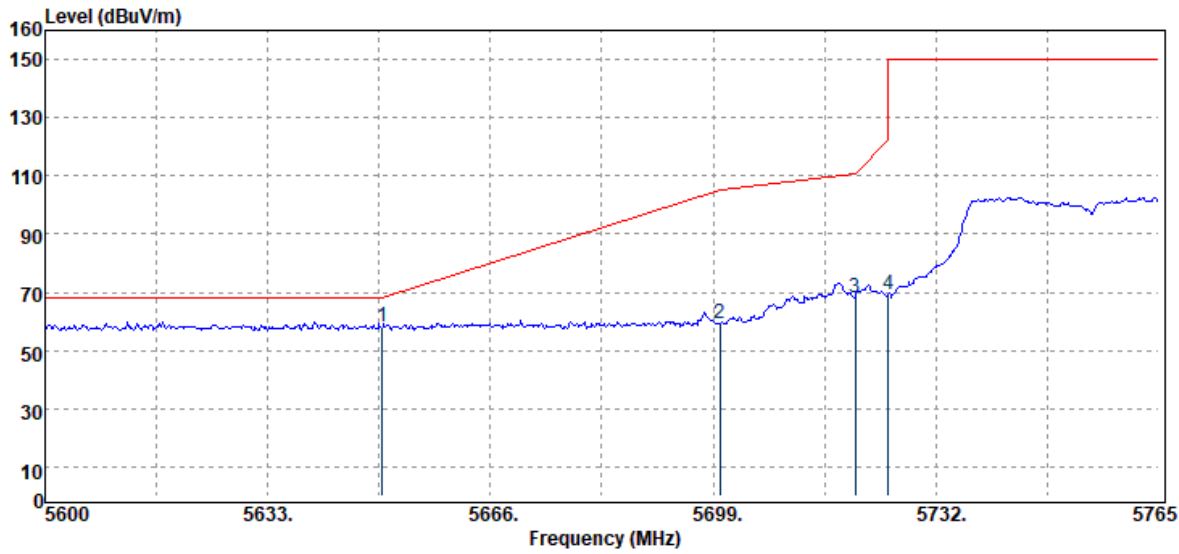
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Report Number :ER-2020-30118
Operation Mode :802.11n40
Test Frequency :5755 MHz
Test Mode :Bandedge CH Low
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



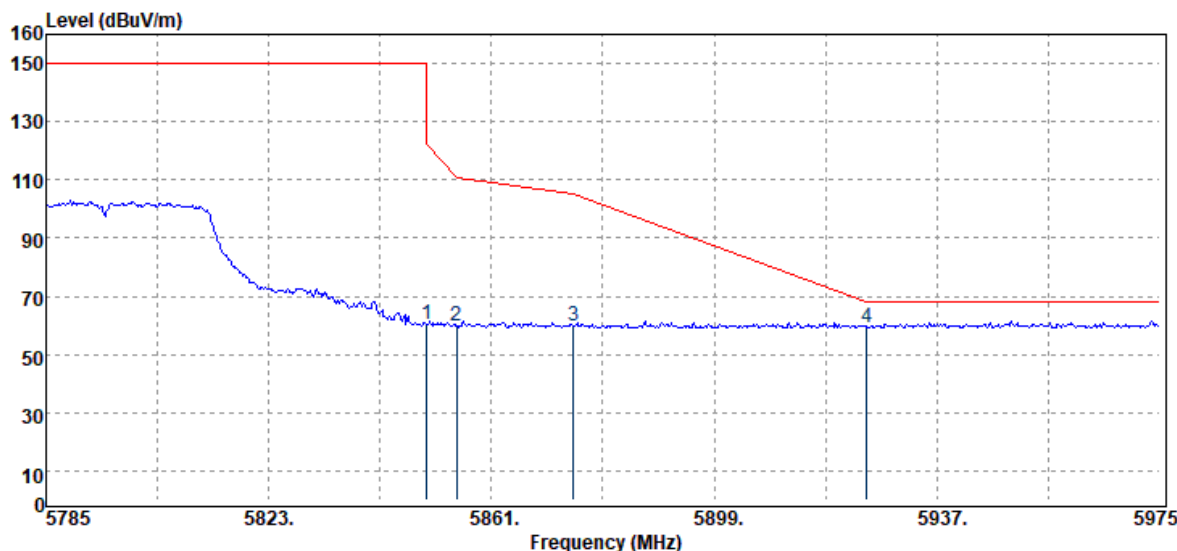
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
5650.00	Peak	50.08	8.32	58.40	68.20	-9.80
5700.00	Peak	50.67	8.69	59.36	105.20	-45.84
5720.00	Peak	59.58	8.78	68.36	110.80	-42.44
5725.00	Peak	60.21	8.81	69.02	122.20	-53.18

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Report Number :ER-2020-30118
Operation Mode :802.11n40
Test Frequency :5795 MHz
Test Mode :Bandedge CH High
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :VERTICAL
Engineer :Nick



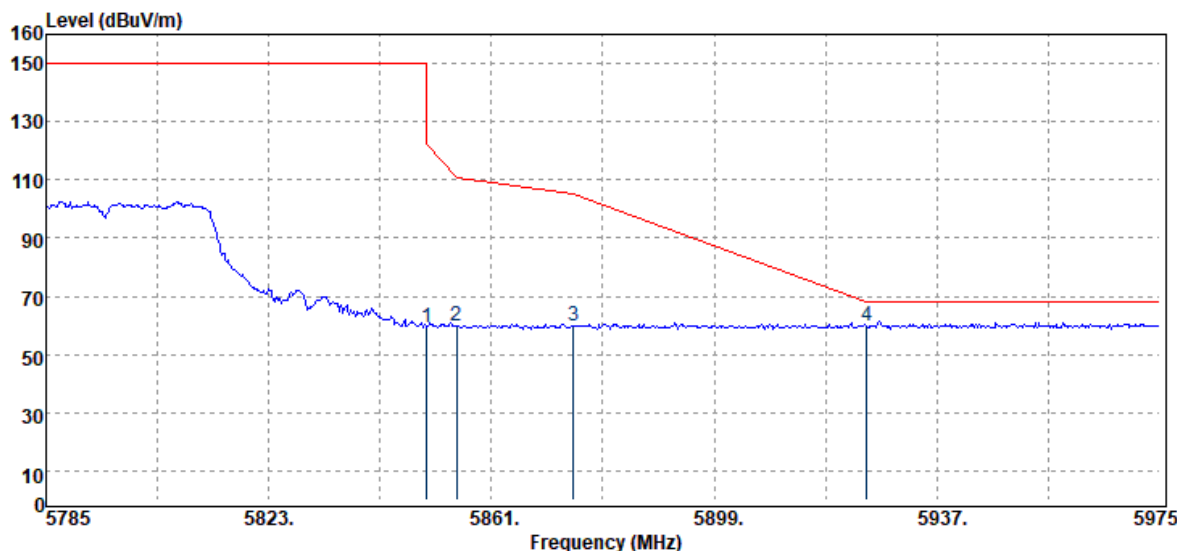
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
5850.00	Peak	50.85	9.42	60.27	122.20	-61.93
5855.00	Peak	50.48	9.44	59.92	110.80	-50.88
5875.00	Peak	50.17	9.50	59.67	105.20	-45.53
5925.00	Peak	49.73	9.65	59.38	68.20	-8.82

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Report Number :ER-2020-30118
Operation Mode :802.11n40
Test Frequency :5795 MHz
Test Mode :Bandedge CH High
EUT Pol :H Plane

Test Date :2020-04-06
Temp./Humi. :21.5/65
Antenna Pol. :HORIZONTAL
Engineer :Nick



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
5850.00	Peak	50.09	9.42	59.51	122.20	-62.69
5855.00	Peak	50.19	9.44	59.63	110.80	-51.17
5875.00	Peak	50.25	9.50	59.75	105.20	-45.45
5925.00	Peak	50.00	9.65	59.65	68.20	-8.55

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12 TRANSMISSION IN THE ABSENCE OF DATA

12.1 Standard Applicable

According to §15.407(c)

The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signaling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization a description of how this requirement is met.

12.2 Result

While the EUT is not transmitting any information, the EUT can automatically discontinue transmission and become standby mode for power saving. The EUT can detect the controlling signal of ASK message transmitting from remote device and verify whether it shall resend or discontinue transmission.

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13 FREQUENCY STABILITY

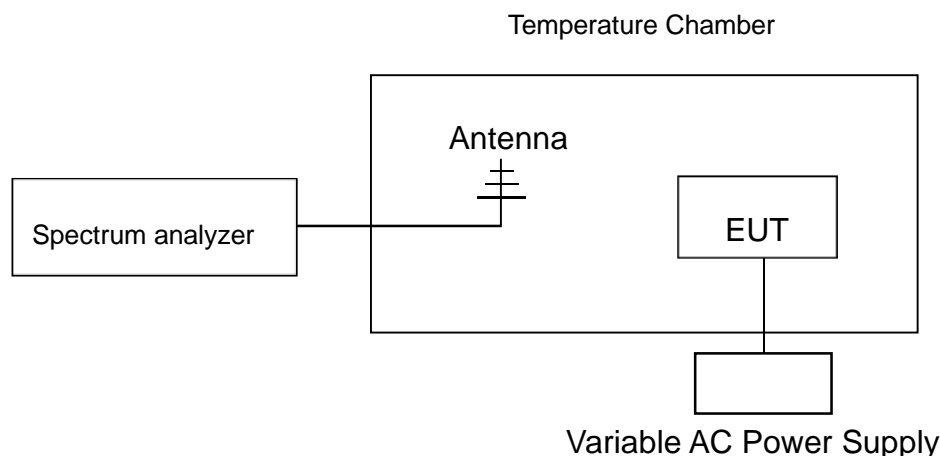
13.1 Standard Applicable

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 user's manual.

13.2 Measurement Procedure

1. The EUT was placed inside temperature chamber and powered and powered by nominal DC voltage.
2. Set EUT as normal operation.
3. Turn the EUT on and couple its output to spectrum.
4. Turn the EUT off and set the chamber to the highest temperature specified.
5. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT and measure the operating frequency.
6. Repeat step with the temperature chamber set to the lowest temperature.

13.3 Test SET-UP



13.4 Measurement Equipment Used:

SGS Conducted Room					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Temperature Chamber	TERCHY	MHG-120LF	911009	05/17/2019	05/16/2020
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY57120290	02/20/2020	02/19/2021
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2020	01/01/2021
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2020	01/01/2021
Power Meter	Anritsu	ML2496A	1804001	02/20/2020	02/19/2021
Power Sensor	Anritsu	MA2411B	1726104	02/20/2020	02/19/2021
Power Sensor	Anritsu	MA2411B	1726107	02/20/2020	02/19/2021

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13.5 Measurement Result

Start up

Operation Mode	802.11 a	Test Date	2020.03.31
Temperature	: 21.4°C	Test By	Gary
Humidity	: 56%		

Test Temp.(°C)	Test Voltage(V)	Channel	Measured Frequency (MHz)	Spectrum Frequency (MHz)	ΔFrequency (MHz)
-20	0	149	5745	5,744.99240	0.00000132
	0	149	5745	5,744.99094	0.00000158
25	48	149	5745	5,745.00349	-0.00000061
50	0	149	5745	5,745.00958	-0.00000167
	0	149	5745	5,745.00439	-0.00000076

2 minutes

Operation Mode	802.11 a	Test Date	2020.03.31
Temperature	: 21.4°C	Test By	Gary
Humidity	: 56%		

Test Temp.(°C)	Test Voltage(V)	Channel	Measured Frequency (MHz)	Spectrum Frequency (MHz)	ΔFrequency (MHz)
-20	0	149	5745	5,744.99266	0.00000128
	0	149	5745	5,744.99048	0.00000166
25	48	149	5745	5,745.00479	-0.00000083
50	0	149	5745	5,745.00564	-0.00000098
	0	149	5745	5,745.00716	-0.00000125

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5 minutes

Operation Mode	802.11 a	Test Date	2020.03.31
Temperature	: 21.4°C	Test By	Gary
Humidity	: 56%		

Test Temp.(°C)	Test Voltage(V)	Channel	Measured Frequency (MHz)	Spectrum Frequency (MHz)	ΔFrequency (MHz)
-20	0	149	5745	5,744.99418	0.00000101
	0	149	5745	5,744.99802	0.00000035
25	48	149	5745	5,745.00038	-0.00000007
50	0	149	5745	5,745.00685	-0.00000119
	0	149	5745	5,745.00662	-0.00000115

10 minutes

Operation Mode	802.11 a	Test Date	2020.03.31
Temperature	: 21.4°C	Test By	Gary
Humidity	: 56%		

Test Temp.(°C)	Test Voltage(V)	Channel	Measured Frequency (MHz)	Spectrum Frequency (MHz)	ΔFrequency (MHz)
-20	0	149	5745	5,744.99508	0.00000086
	0	149	5745	5,744.99611	0.00000068
25	48	149	5745	5,745.00615	-0.00000107
50	0	149	5745	5,745.00601	-0.00000105
	0	149	5745	5,745.00571	-0.00000099

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14 ANTENNA REQUIREMENT

14.1 Standard Applicable

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

According to §15.407, 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.

14.2 Antenna Connected Construction

The antenna is designed with unique RF connector and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.
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