

12. Frequency Stability Measurement

12.1. Block Diagram of Test Setup

Same as section 8.1

12.2. Limit of Frequency Stability

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.

12.3. Test Procedures

(1) To ensure emission at the band edge is maintained within the authorized band, those values shall be measured by radiation emissions at upper and lower frequency points, and finally compensated by frequency deviation as procedures below.

(2) The EUT was operated at the maximum output power, and connected to the spectrum analyzer, which is set to maximum hold function and peak detector. The peak value of the power envelope was measured and noted. The upper and lower frequency points were respectively measured relatively 10 dB lower than the measured peak value.

(3) The frequency deviation was calculated by adding the upper frequency point and the lower frequency point divided by two. Those detailed values of frequency deviation are provided in table below.

12.4. Test Result

Voltage								
Test Mode	Ant.	Freq. (MHz)	Voltage (Vdc)	Temperature (°C)	Deviation (Hz)	Deviation (ppm)	Limit (ppm)	Verdict
11A	ANT 0	5180	NV	NT	47000.00	9.073359	20	PASS
	ANT 1	5180	NV	NT	69000.00	13.320463	20	PASS
	ANT 0	5200	NV	NT	59000.00	11.346154	20	PASS
	ANT 1	5200	NV	NT	39000.00	7.500000	20	PASS
	ANT 0	5240	NV	NT	40000.00	7.633588	20	PASS
	ANT 1	5240	NV	NT	36000.00	6.870229	20	PASS
	ANT 0	5260	NV	NT	39000.00	7.414449	20	PASS
	ANT 1	5260	NV	NT	36000.00	6.844106	20	PASS
	ANT 0	5280	NV	NT	39000.00	7.386364	20	PASS
	ANT 1	5280	NV	NT	36000.00	6.818182	20	PASS
	ANT 0	5320	NV	NT	39000.00	7.330827	20	PASS
	ANT 1	5320	NV	NT	36000.00	6.766917	20	PASS
	ANT 0	5500	NV	NT	41000.00	7.454545	20	PASS
	ANT 1	5500	NV	NT	38000.00	6.909091	20	PASS
	ANT 0	5580	NV	NT	42000.00	7.526882	20	PASS
	ANT 1	5580	NV	NT	38000.00	6.810036	20	PASS
	ANT	5700	NV	NT	43000.00	7.543860	20	PASS

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	ANT 1	5700	NV	NT	39000.00	6.842105	20	PASS
	ANT 0	5720	NV	NT	43000.00	7.517483	20	PASS
	ANT 1	5720	NV	NT	40000.00	6.993007	20	PASS
	ANT 0	5745	NV	NT	43000.00	7.484769	20	PASS
	ANT 1	5745	NV	NT	40000.00	6.962576	20	PASS
	ANT 0	5785	NV	NT	45000.00	7.778738	20	PASS
	ANT 1	5785	NV	NT	40000.00	6.914434	20	PASS
	ANT 0	5825	NV	NT	44000.00	7.553648	20	PASS
	ANT 1	5825	NV	NT	41000.00	7.038627	20	PASS
11N20MI MO	ANT 0	5180	NV	NT	94000.00	18.146718	20	PASS
	ANT 1	5180	NV	NT	93000.00	17.953668	20	PASS
	ANT 0	5200	NV	NT	34000.00	6.538462	20	PASS
	ANT 1	5200	NV	NT	34000.00	6.538462	20	PASS
	ANT 0	5240	NV	NT	35000.00	6.679389	20	PASS
	ANT 1	5240	NV	NT	36000.00	6.870229	20	PASS
	ANT 0	5260	NV	NT	36000.00	6.844106	20	PASS
	ANT 1	5260	NV	NT	36000.00	6.844106	20	PASS
	ANT 0	5280	NV	NT	36000.00	6.818182	20	PASS
	ANT 1	5280	NV	NT	36000.00	6.818182	20	PASS
	ANT 0	5320	NV	NT	36000.00	6.766917	20	PASS
	ANT 1	5320	NV	NT	37000.00	6.954887	20	PASS
	ANT 0	5500	NV	NT	38000.00	6.909091	20	PASS
	ANT 1	5500	NV	NT	38000.00	6.909091	20	PASS
	ANT 0	5580	NV	NT	38000.00	6.810036	20	PASS
	ANT 1	5580	NV	NT	38000.00	6.810036	20	PASS
	ANT 0	5700	NV	NT	39000.00	6.842105	20	PASS
	ANT 1	5700	NV	NT	39000.00	6.842105	20	PASS
	ANT 0	5720	NV	NT	39000.00	6.818182	20	PASS
	ANT 1	5720	NV	NT	39000.00	6.818182	20	PASS
	ANT 0	5745	NV	NT	40000.00	6.962576	20	PASS
	ANT	5745	NV	NT	40000.00	6.962576	20	PASS

	1							
	ANT 0	5785	NV	NT	39000.00	6.741573	20	PASS
	ANT 1	5785	NV	NT	39000.00	6.741573	20	PASS
	ANT 0	5825	NV	NT	40000.00	6.866953	20	PASS
	ANT 1	5825	NV	NT	40000.00	6.866953	20	PASS
11N40MI MO	ANT 0	5190	NV	NT	45000.00	8.670520	20	PASS
	ANT 1	5190	NV	NT	37000.00	7.129094	20	PASS
	ANT 0	5230	NV	NT	42000.00	8.030593	20	PASS
	ANT 1	5230	NV	NT	37000.00	7.074570	20	PASS
	ANT 0	5270	NV	NT	42000.00	7.969639	20	PASS
	ANT 1	5270	NV	NT	37000.00	7.020873	20	PASS
	ANT 0	5310	NV	NT	42000.00	7.909605	20	PASS
	ANT 1	5310	NV	NT	37000.00	6.967985	20	PASS
	ANT 0	5510	NV	NT	45000.00	8.166969	20	PASS
	ANT 1	5510	NV	NT	39000.00	7.078040	20	PASS
	ANT 0	5550	NV	NT	44000.00	7.927928	20	PASS
	ANT 1	5550	NV	NT	40000.00	7.207207	20	PASS
	ANT 0	5670	NV	NT	47000.00	8.289242	20	PASS
	ANT 1	5670	NV	NT	41000.00	7.231041	20	PASS
	ANT 0	5710	NV	NT	47000.00	8.231173	20	PASS
	ANT 1	5710	NV	NT	41000.00	7.180385	20	PASS
	ANT 0	5755	NV	NT	47000.00	8.166811	20	PASS
	ANT 1	5755	NV	NT	41000.00	7.124240	20	PASS
	ANT 0	5795	NV	NT	47000.00	8.110440	20	PASS
	ANT 1	5795	NV	NT	41000.00	7.075065	20	PASS
11AC80 MIMO	ANT 0	5210	NV	NT	47000.00	9.021113	20	PASS
	ANT 1	5210	NV	NT	37000.00	7.101727	20	PASS
	ANT 0	5290	NV	NT	42000.00	7.939509	20	PASS
	ANT 1	5290	NV	NT	37000.00	6.994329	20	PASS
	ANT 0	5530	NV	NT	45000.00	8.137432	20	PASS
	ANT 1	5530	NV	NT	39000.00	7.052441	20	PASS
	ANT	5610	NV	NT	44000.00	7.843137	20	PASS

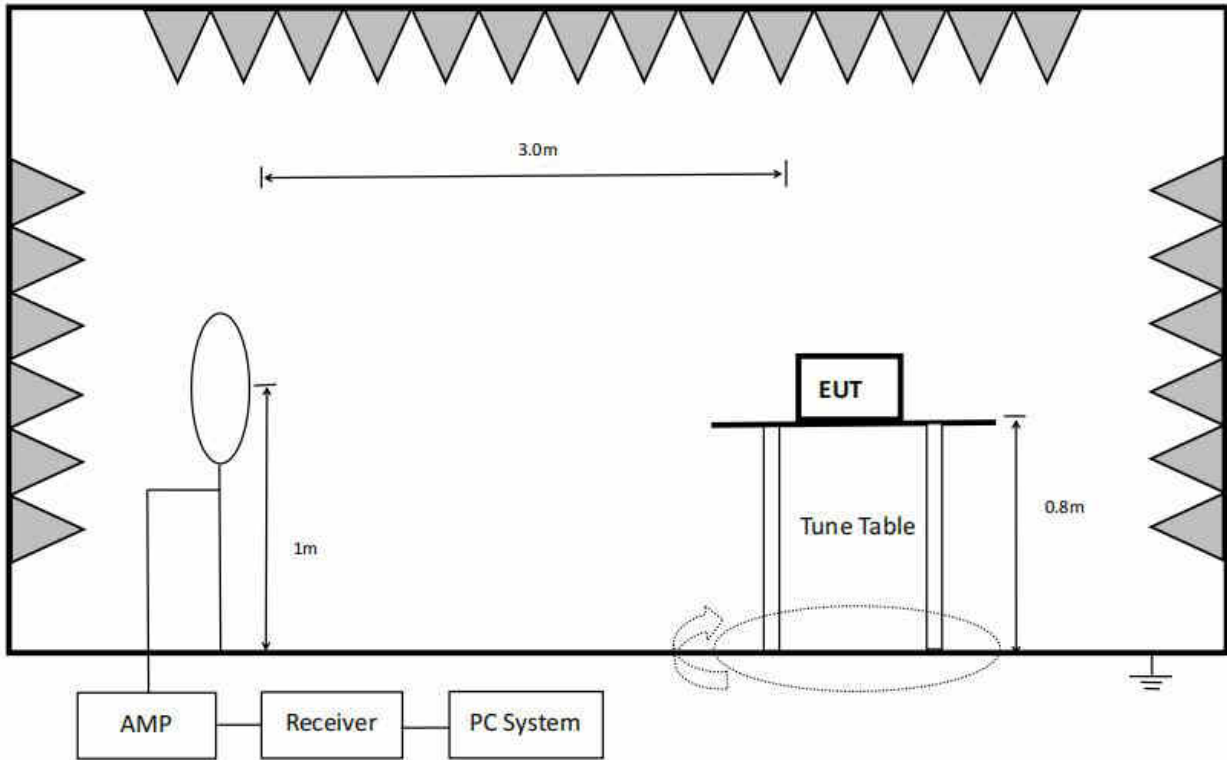
	0							
	ANT 1	5610	NV	NT	40000.00	7.130125	20	PASS
	ANT 0	5690	NV	NT	46000.00	8.084359	20	PASS
	ANT 1	5690	NV	NT	40000.00	7.029877	20	PASS
	ANT 0	5775	NV	NT	47000.00	8.138528	20	PASS
	ANT 1	5775	NV	NT	40000.00	6.926407	20	PASS

Temperature								
Test Mode	Ant.	Freq. (MHz)	Voltage (Vdc)	Temperature (°C)	Deviation (Hz)	Deviation (ppm)	Limit (ppm)	Verdict
TestMode	Antenna	Channel	VolValue	TempValue	Result	Result1	Limit	Verdict

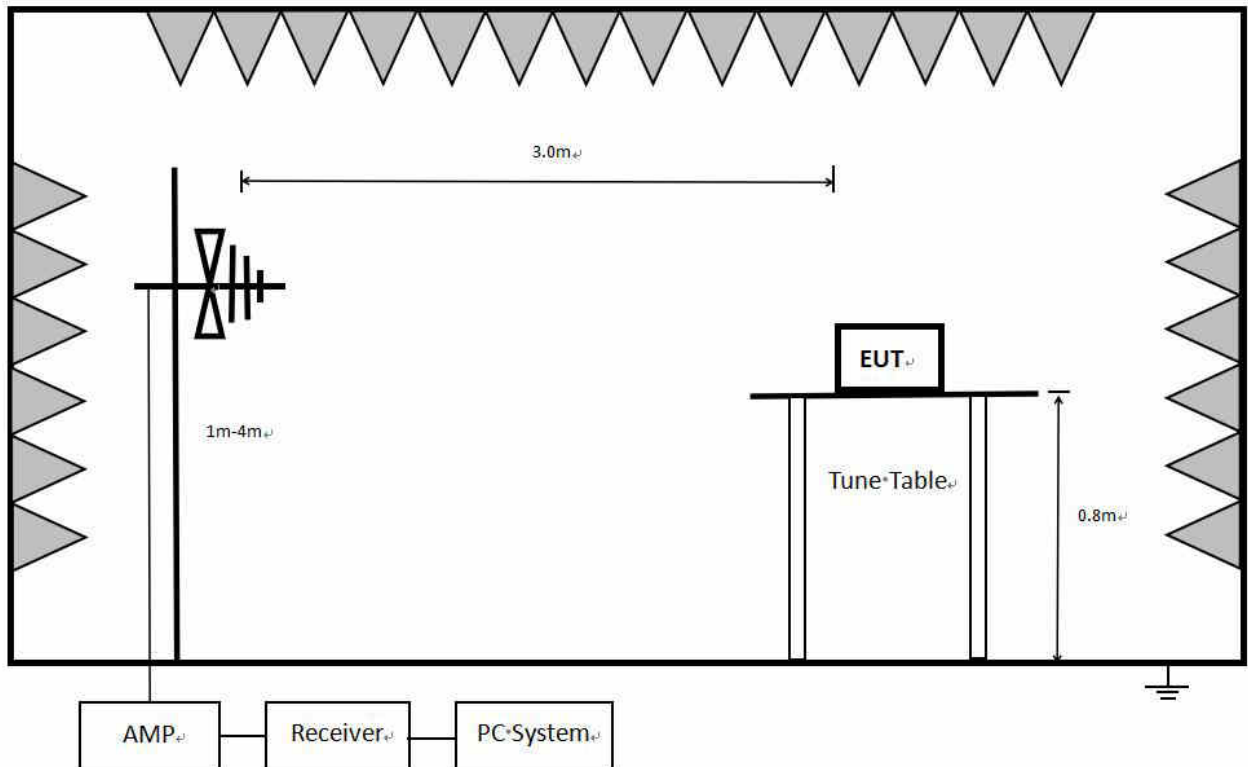
13. Radiated Emission

13.1. Block Diagram of Test Setup

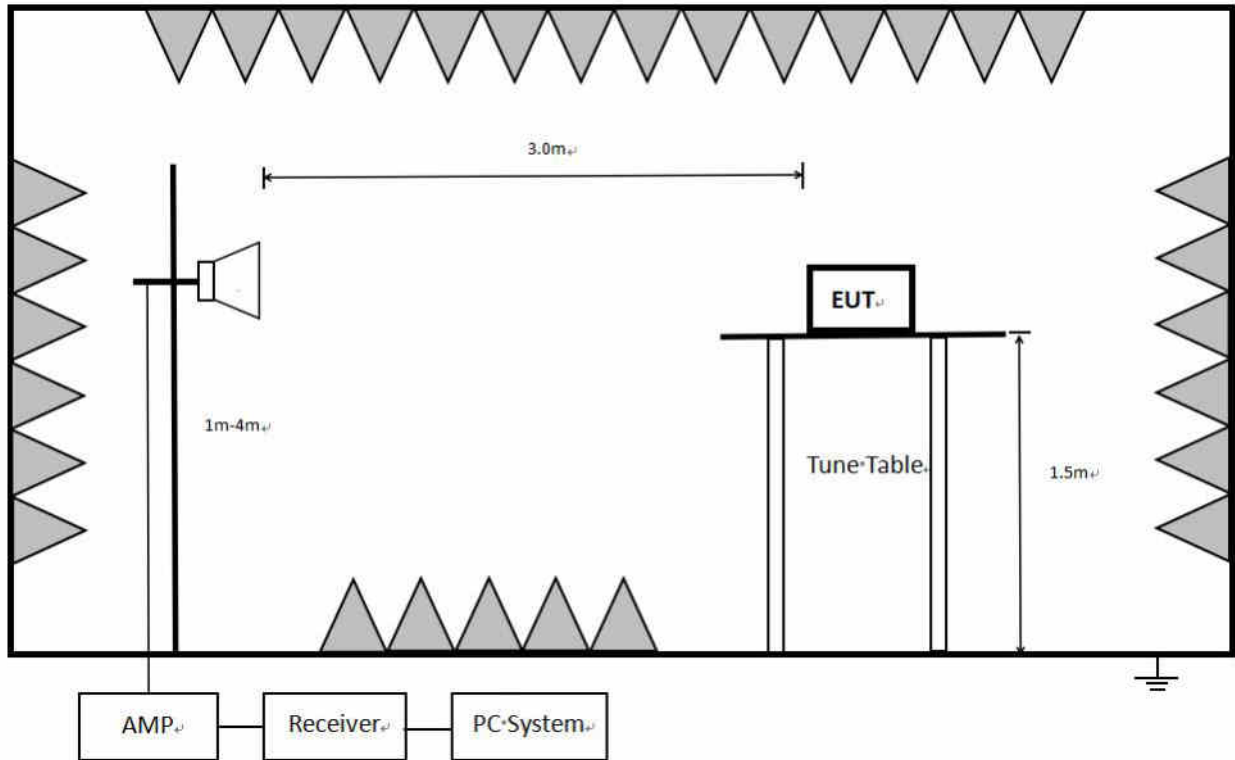
In 3 m Anechoic Chamber, test setup diagram for 9 kHz - 30 MHz:



In 3 m Anechoic Chamber, test setup diagram for 30 MHz - 1 GHz:



In 3 m Anechoic Chamber, test setup diagram for frequency above 1 GHz:



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

13.2. Limit

(1) FCC 15.205 Restricted frequency band

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
¹ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.1772&4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.2072&4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(²)
13.36-13.41			

¹Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

²Above 38.6

(2) FCC 15.209 Limit.

Frequency MHz	Distance Meters	Field strengths limit	
		$\mu\text{V}/\text{m}$	$\text{dB}(\mu\text{V})/\text{m}$
0.009 ~ 0.490	300	$2400/F(\text{kHz})$	$67.6-20\log(F)$
0.490 ~ 1.705	30	$24000/F(\text{kHz})$	$87.6-20\log(F)$
1.705 ~ 30.0	30	30	29.54
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000	3	74.0 $\text{dB}(\mu\text{V})/\text{m}$ (Peak) 54.0 $\text{dB}(\mu\text{V})/\text{m}$ (Average)	

(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm / MHz.

(2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm / MHz.

(3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm / MHz.

(4) For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of -27 dBm / MHz.

(5) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

(6) The provisions of §15.205 apply to intentional radiators operating under this section.

$$-27 \text{ dBm/MHz Limit} = 95.2 + \text{EIRP (dBm)} = 95.2 - 27 = 68.2 \text{ dB}\mu\text{V}/\text{m}$$

Note:

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

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

$$\text{Limit}_{3\text{m}}(\text{dBuV}/\text{m}) = \text{Limit}_{30\text{m}}(\text{dBuV}/\text{m}) + 40\text{Log}(30\text{m}/3\text{m})$$

(3) Limit for this EUT

All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 20dB below the fundamental emissions or comply with 15.209 limits.

13.3. Test Procedure

Below 30 MHz:

The setting of the spectrum Analyzer

RBW	200 Hz (From 9 kHz to 0.15 MHz)/ 9 kHz (From 0.15 MHz to 30 MHz)
VBW	200 Hz (From 9 kHz to 0.15 MHz)/ 9 kHz (From 0.15 MHz to 30 MHz)
Sweep	Auto
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013
2. The EUT was arranged to its worst case and then turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both Horizontal, Face-on and Face-off polarizations of the antenna are set to make the measurement.
3. The EUT was placed on a turntable with 80 cm meter above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of 1 meter height antenna tower.
5. The radiated emission limits are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
6. For measurement below 1 GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
7. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30m open field site. Therefore, sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field site based on KdB 414788.

Below 1 GHz and above 30 MHz:

The setting of the spectrum Analyzer

RBW	120 kHz
VBW	300 kHz
Sweep	Auto
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013.

2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

3. The EUT was placed on a turntable with 80 cm above ground.

4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.

5. For measurement below 1GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

Above 1 GHz:

RBW	1 MHz
VBW	PEAK: 3 MHz AVG: see note 6
Sweep	Auto
Detector	Peak
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013.

2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

3. The EUT was placed on a turntable with 1.5m above ground.

4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.

5. For measurement above 1GHz, the emission measurement will be measured by the peak detector. This peak level, once corrected, must comply with the limit specified in Section 15.209.

6. For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for AVG measurements. For the Duty Cycle please refer to clause 8.1.ON TIME AND DUTY CYCLE.

7. Restriction band: Investigated frequency range from 5.15-5.25 GHz, 5250-5350 GHz, 5470-5725 GHz, 5.725-5.85 GHz.

All restriction band should comply with 15.209, other emission should be at least 20 dB below the fundamental.

Note 1: For all radiated test, EUT in each of three orthogonal axis emissions had been tested, but only the worst case (X axis) data recorded in the report.

Note 2: The EUT does not support simultaneous transmission.

Note 3: The EUT was fully exercised with external accessories during the test. In the case of multiple accessory external ports, an external accessory shall be connected to one of each type of port.

13.4. Test Result

PASS. (See below detailed test result)

All the emissions except fundamental emission from 9kHz to 40GHz were comply with 15.209 limit.

Note1: According exploratory test, the emission levels are 20 dB below the limit detected from 9 kHz to 30 MHz and 18 GHz to 40 GHz, so the final test was performed with frequency range from 30 MHz to 18 GHz and recorded in below.

Note2: For emissions below 1 GHz, according exploratory explorer test, when change Tx mode and channel, have no distinct influence on emissions level, so for emissions below 1 GHz, the final test was only performed with EUT working in 11ac mode.

Note3: For below test data, when the limit tabular marked “/” means this frequency point is the fundamental emission and no need comply with this limit.

Note 4: As specified in 15.407(b), emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit of -27 dBm/MHz (or -17 dBm/MHz as specified in 15.407(b)(4)). However, an out-of-band emission that complies with both the average and peak limits of 15.209 is not required to satisfy the -27 dBm/MHz or -17 dBm/MHz peak emission limit

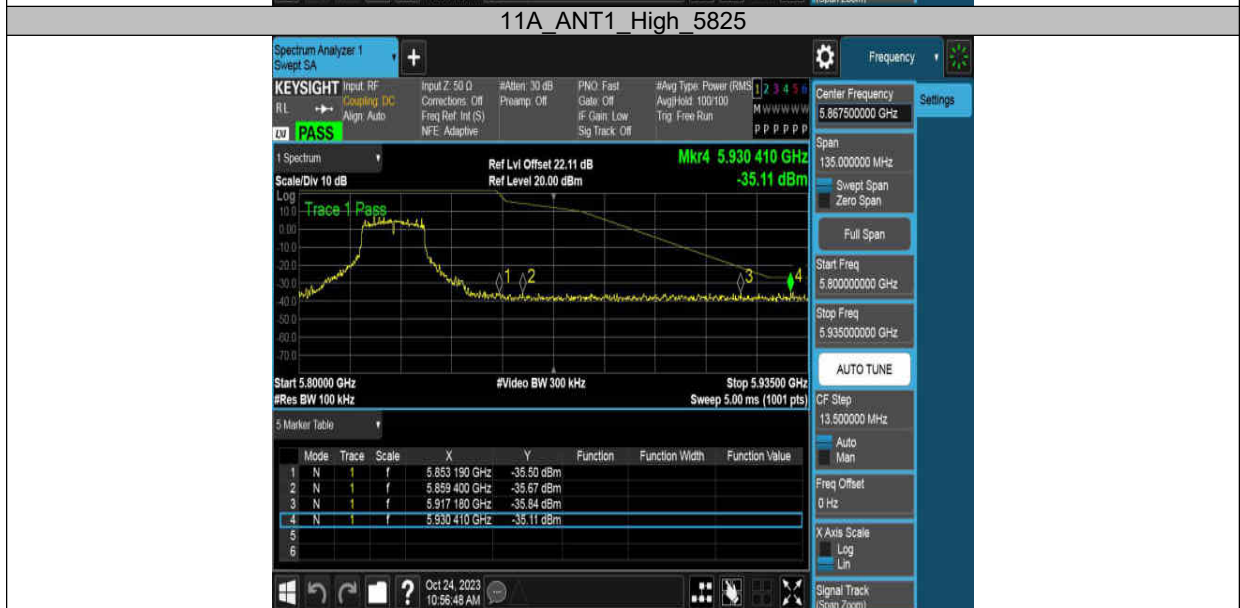
Note 5: For emissions Above 1 GHz, all mode have been tested, 11ac mode is worse case and recorded in report.

13.5. Original Test Data

Below 1 GHz and above 30 MHz test data Refer to appendix A

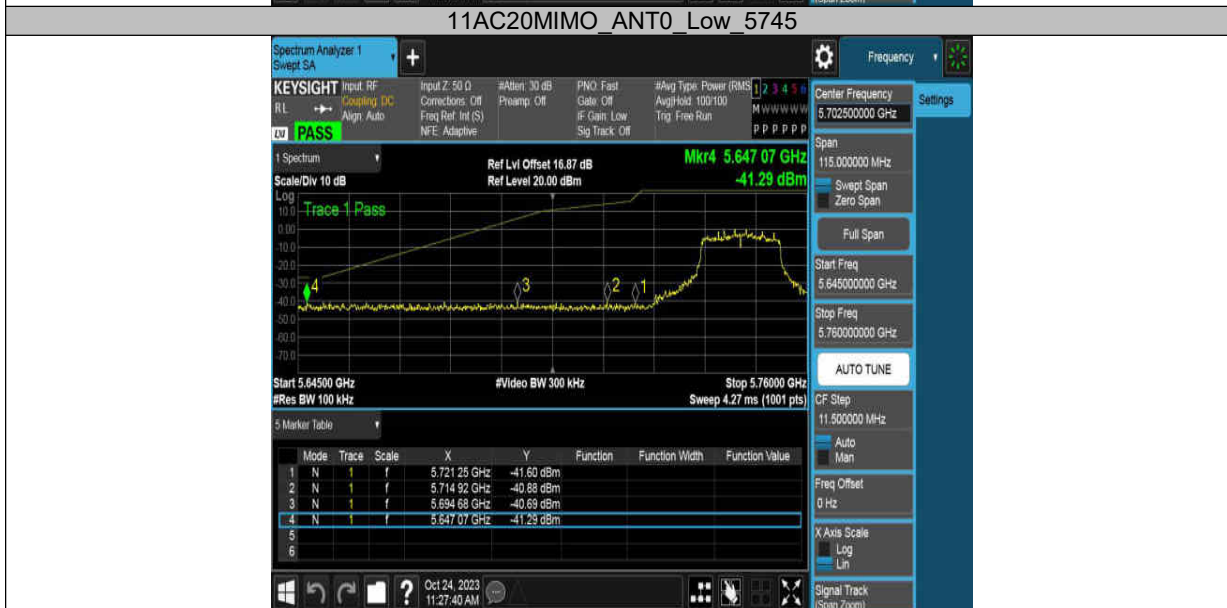
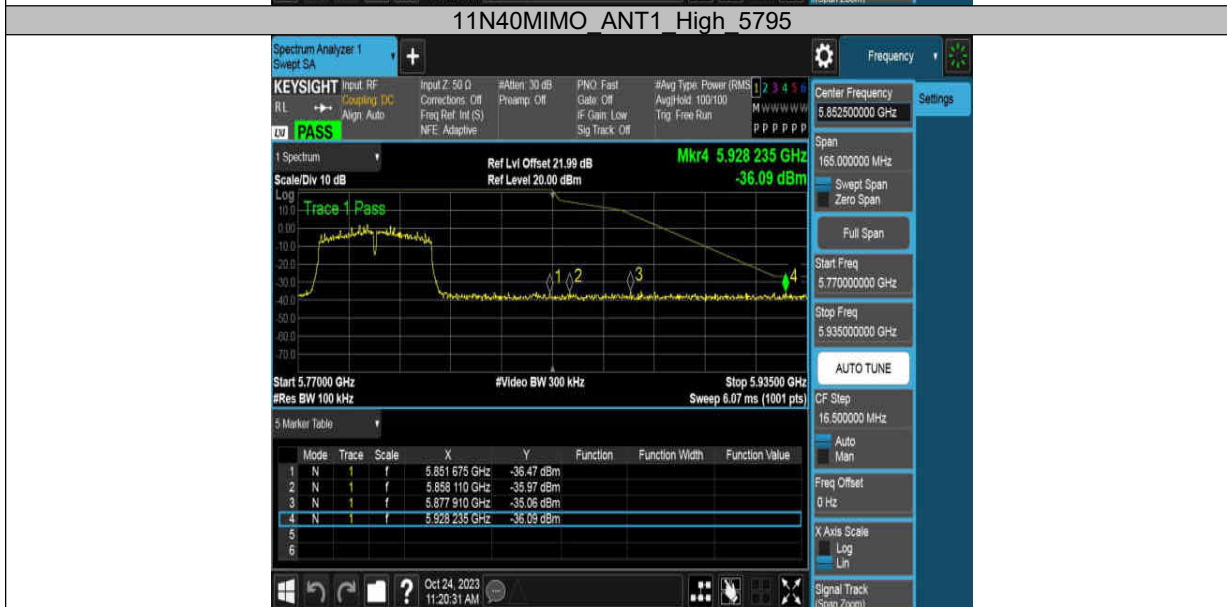
Above 1 GHz test data Refer to appendix B















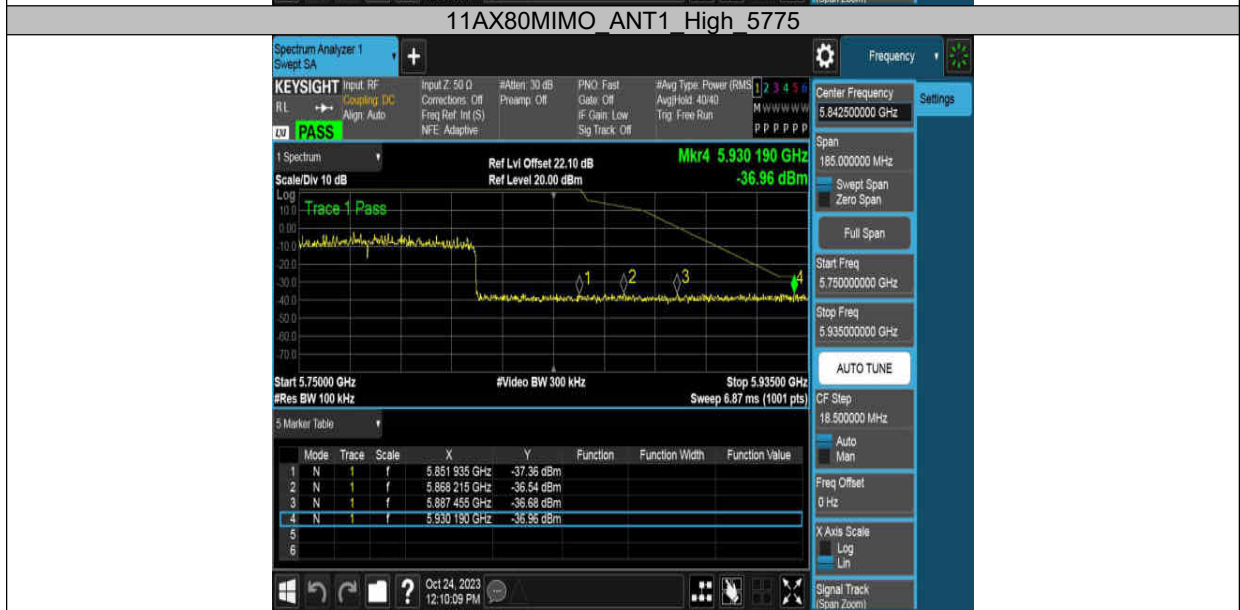






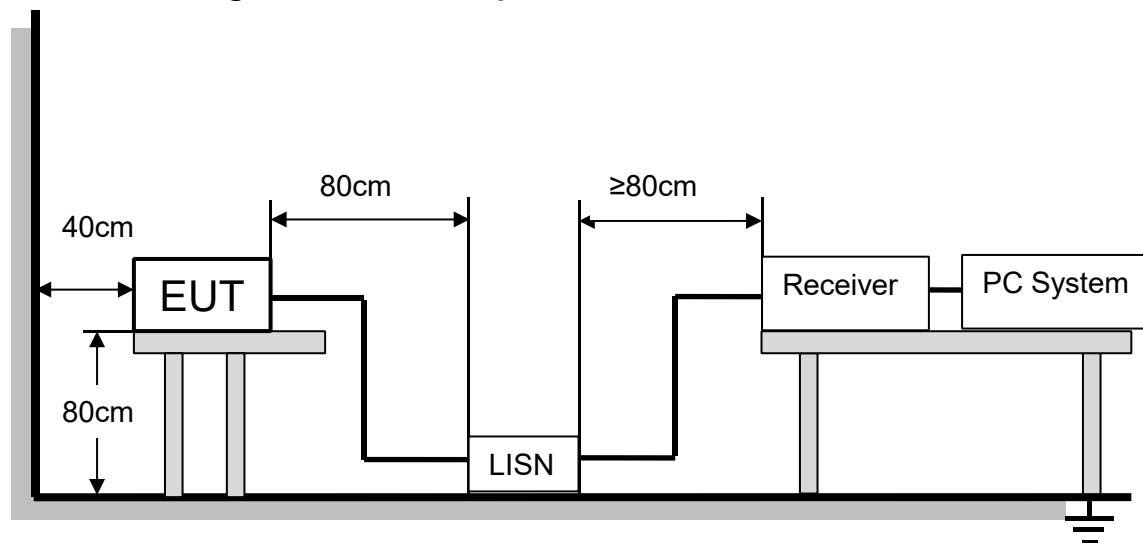






14. AC Power Line Conducted Emissions

14.1. Block Diagram of Test Setup



The EUT is put on a table of non-conducting material that is 80 cm high. The vertical conducting wall of shielding is located 40 cm to the rear of the EUT. The power line of the EUT is connected to the AC mains through an Artificial Mains Network (A.M.N.). A EMI Measurement Receiver (R&S Test Receiver ESR3) is used to test the emissions from both sides of AC line. According to the requirements in Section 6.2 of ANSI C63.10-2013. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-Peak and average detector mode. The bandwidth of EMI test receiver is set at 9 kHz.

The arrangement of the equipment is installed to meet the standards and operating in a manner, which tends to maximize its emission characteristics in a normal application.

14.2. Limits

Please refer to CFR 47 FCC §15.207 (a) and ISED RSS-Gen Clause 8.8.

Frequency (MHz)	Quasi-peak	Average
0.15 -0.5	66 - 56 *	56 - 46 *
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00

Note 1: * Decreasing linearly with logarithm of frequency.

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

14.3. Test Procedure

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

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

All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.

All support equipment power received from a second LISN.

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

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

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

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

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

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

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

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

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

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

The bandwidth of test receiver is set at 9 kHz.

14.4. Test Result

According to 15.207, power Line Conducted Emission is not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.

15. Dynamic Frequency Selection

15.1. Applicability of DFS Requirements

A U-NII network will employ a DFS function to detect signals from radar systems and to avoid co-channel operation with these systems. This applies to the 5250-5350 MHz and/or 5470-5725 MHz bands.

Within the context of the operation of the DFS function, a U-NII device will operate in either Master Mode or Client Mode. U-NII devices operating in Client Mode can only operate in a network controlled by a U-NII device operating in Master Mode.

Table 1: Applicability of DFS Requirements Prior to Use of a Channel

Requirement	Operational Mode		
	<input type="checkbox"/> Master	<input checked="" type="checkbox"/> Client Without Radar Detection	<input type="checkbox"/> Client with Radar Detection
Non-Occupancy Period	Yes	Not required	Yes
DFS Detection Threshold	Yes	Not required	Yes
Channel Availability Check Time	Yes	Not required	Not required
U-NII Detection Bandwidth	Yes	Not required	Yes

Table 2: Applicability of DFS requirements during normal operation

Requirement	Operational Mode	
	<input type="checkbox"/> Master Device or Client with Radar Detection	<input checked="" type="checkbox"/> Client Without Radar Detection
DFS Detection Threshold	Yes	Not required
Channel Closing Transmission Time	Yes	Yes
Channel Move Time	Yes	Yes
U-NII Detection Bandwidth	Yes	Not required

Additional requirements for devices with multiple bandwidth modes	<input type="checkbox"/> Master Device or Client with Radar Detection	<input checked="" type="checkbox"/> Client Without Radar Detection
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be tested	Not required
Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using the widest BW mode available for the link
All other tests	Any single BW mode	Not required

Note: Frequencies selected for statistical performance check should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency.

15.2. Limit

(1) DFS Detection Thresholds

Table 3: DFS Detection Thresholds for Master Devices and Client Devices with Radar Detection

Maximum Transmit Power	Value (See Notes 1, 2, and 3)
EIRP ≥ 200 milliwatt	-64 dBm
EIRP < 200 milliwatt and power spectral density < 10 dBm/MHz	-62 dBm
EIRP < 200 milliwatt that do not meet the power spectral density requirement	-64 dBm

Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna.
 Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.
 Note3: EIRP is based on the highest antenna gain. For MIMO devices refer to KdB Publication 662911 D01.

(2) DFS Response Requirements

Table 4: DFS Response Requirement Values

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1.
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
U-NII Detection Bandwidth	Minimum 100% of the U-NII 99% transmission power bandwidth. See Note 3.

Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.
 Note 2: The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required facilitating a Channel move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.
 Note 3: During the U-NII Detection Bandwidth detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

15.3. Parameters of Radar Test Waveform

This section provides the parameters for required test waveforms, minimum percentage of successful detection, and the minimum number of trials that must be used for determining DFS conformance. Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of Shrapnel

test waveforms.

Table 5 Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A	Roundup $\left\{ \frac{1}{360} \right\}$	60%	30
		Test B			
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120
<p>Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.</p> <p>Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a</p> <p>Test B: 15 unique PRI values randomly selected within the range of 518-3066 μsec, with a minimum increment of 1 μsec, excluding PRI values selected in Test A</p>					

A minimum of 30 unique waveforms are required for each of the Short Pulse Radar Types 2 through 4. If more than 30 waveforms are used for Short Pulse Radar Types 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. If more than 30 waveforms are used for Short Pulse Radar Type 1, then each additional waveform is generated with Test B and must also be unique and not repeated from the previous waveforms in Tests A or B. Test aggregate is average of the percentage of successful detections of short pulse radar types 1-4

15.4. Calibration of Radar Waveform

Radar Waveform Calibration Procedure:

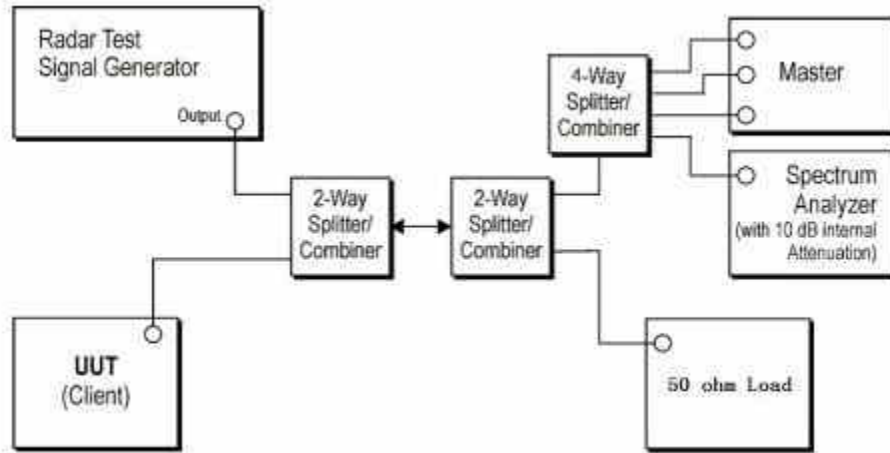
A 50 ohm load is connected in place of the spectrum analyzer, and the spectrum analyzer is connected to place of the master

The interference Radar Detection Threshold Level is $-62\text{dBm} + 0\text{dBi} + 1\text{dB} = -61\text{dBm}$ that had been taken into account the output power range and antenna gain.

The following equipment setup was used to calibrate the conducted radar waveform. A vector signal generator was utilized to establish the test signal level for radar type 0. During this process there were no transmissions by either the master or client device. The spectrum analyzer was switched to the zero spans (time domain) at the frequency of the radar waveform generator. Peak detection was used. The spectrum analyzer resolution bandwidth (RBW) and video bandwidth (VBW) were set to 3 MHz. The spectrum analyzer had offset -1.0dB to compensate RF cable loss 1.0dB.

The vector signal generator amplitude was set so that the power level measured at the spectrum analyzer was $-62\text{dBm} + 0\text{dBi} + 1\text{dB} = -61\text{dBm}$. Capture the spectrum analyzer plots on short pulse radar waveform.

Conducted Calibration Setup:

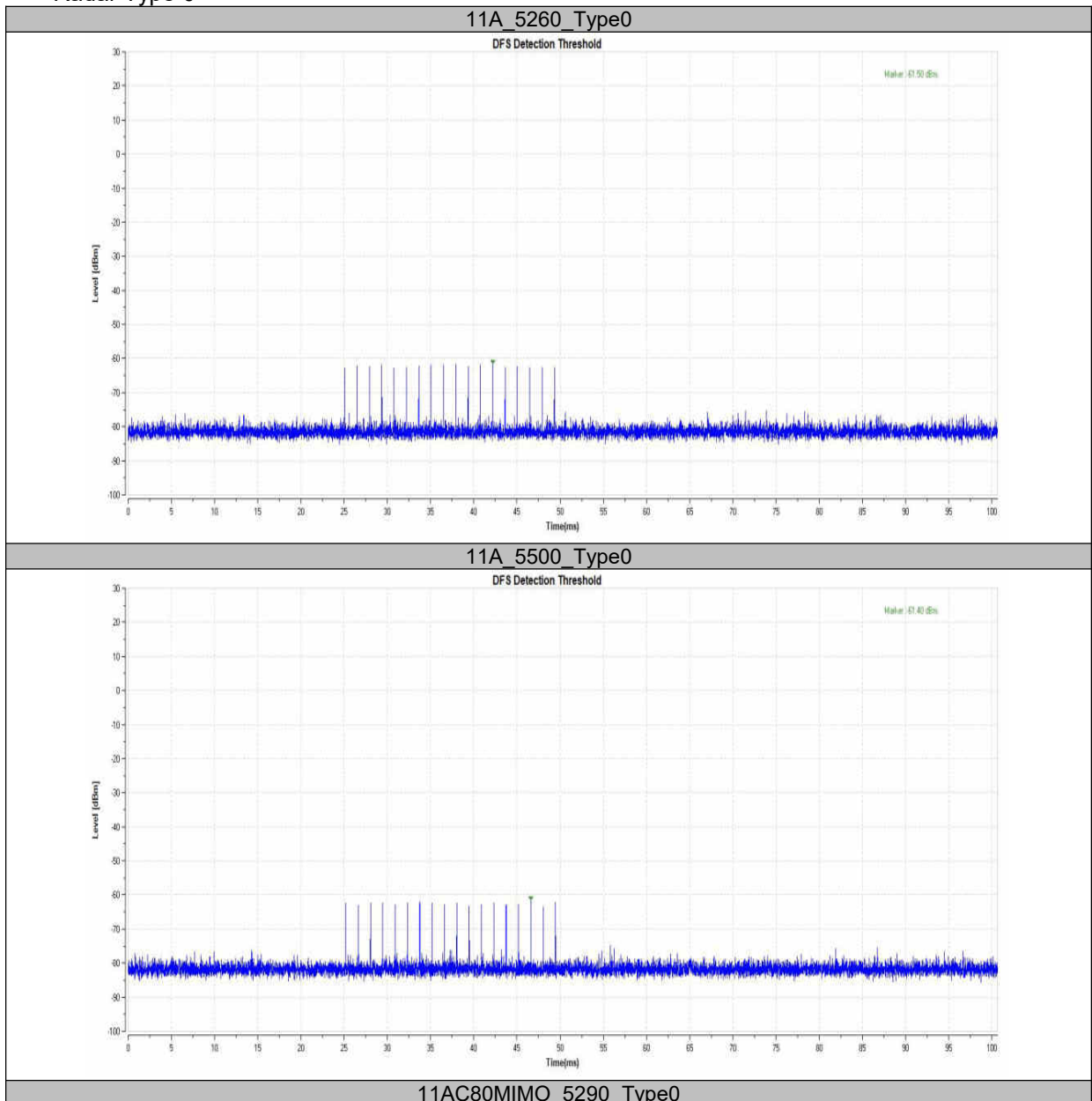


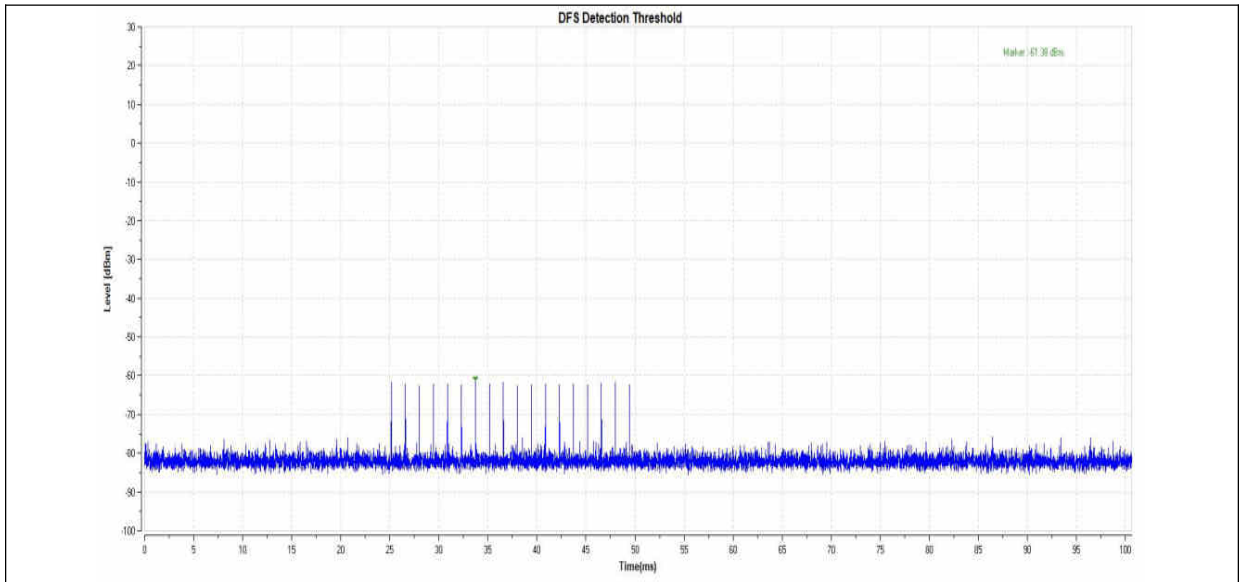
Note: 1. Use the software "Web" to set the frequency channel.

2. EUT is not support TPC and not with Radar detection.

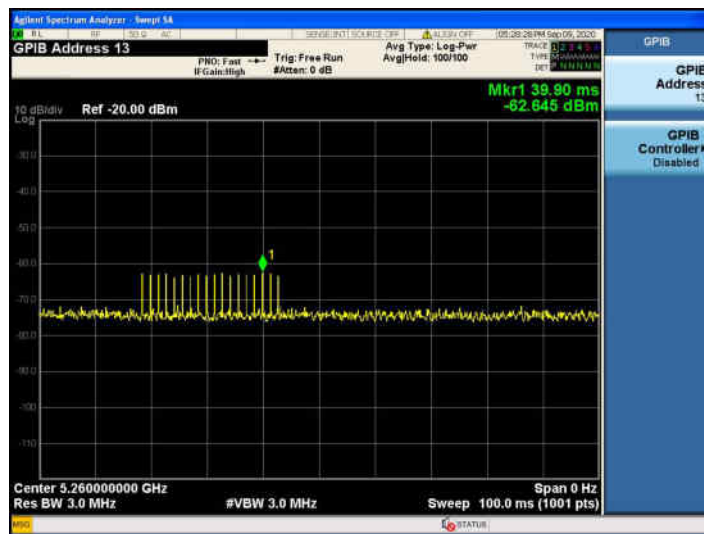
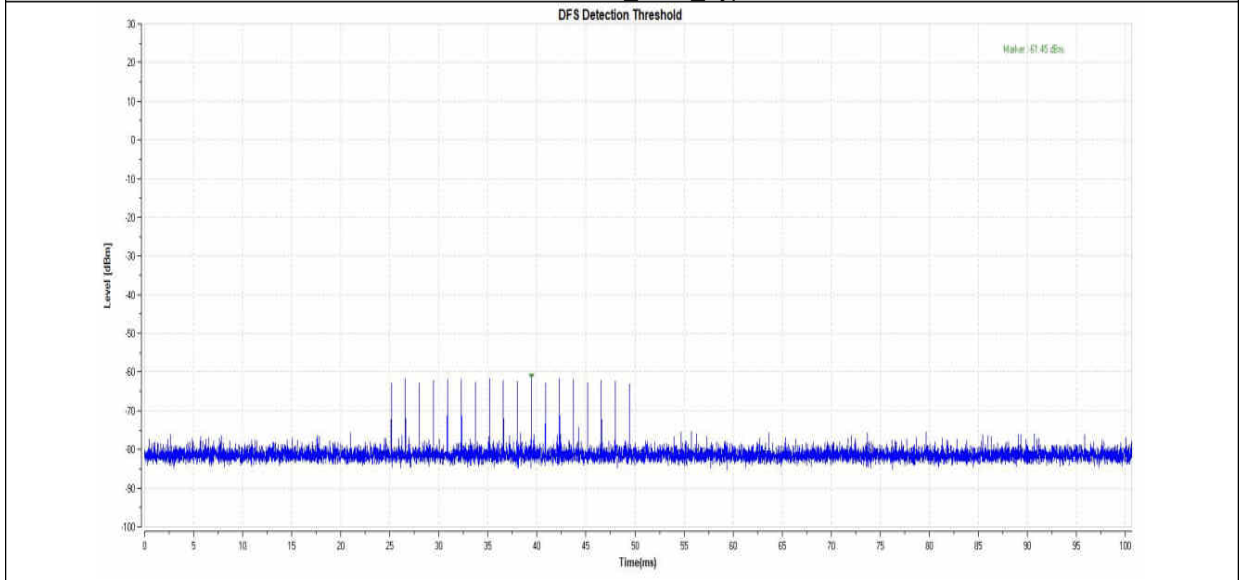
Radar Waveform Calibration Result:

Radar Type 0





11AC80MIMO 5530_Type0



15.5. Channel Closing Transmission Time, Channel Move Time and Non-Occupancy Period

Block diagram of test setup Test Procedure:

The radar pulse generator is setup to provide a pulse at frequency that the master and client are operating. A type 0 radar pulse with a 1us pulse width and a 1428us PRI is used for the testing.

The vector signal generator is adjusted to provide the radar burst (18 pulses) at the level of approximately -61dBm at the antenna port of the master device.

A trigger is provided from the pulse generator to the DFS monitoring system in order to capture the traffic and the occurrence of the radar pulse.

EUT will associate with the master at channel. The file "iperf.exe" specified by the FCC is streamed from the PC 2 through the master and the client device to the PC 1 and played in full motion video using Test Software in order to properly load the network for the entire period of the test.

When radar burst with a level equal to the DFS Detection Threshold +1dB is generated on the operating channel of the U-NII device. At time T0 the radar waveform generator sends a burst of pulse of the radar waveform at Detection Threshold +1dB.

Observe the transmissions of the EUT at the end of the radar Burst on the Operating Channel. Measure and record the transmissions from the UUT during the observation time (Channel Move Time). One 15 seconds plot is reported for the Short Pulse Radar Type 0. The plot for the Short Pulse Radar Types start at the end of the radar burst. The Channel Move Time will be calculated based on the zoom in 600ms plot of the Short Pulse Radar Type.

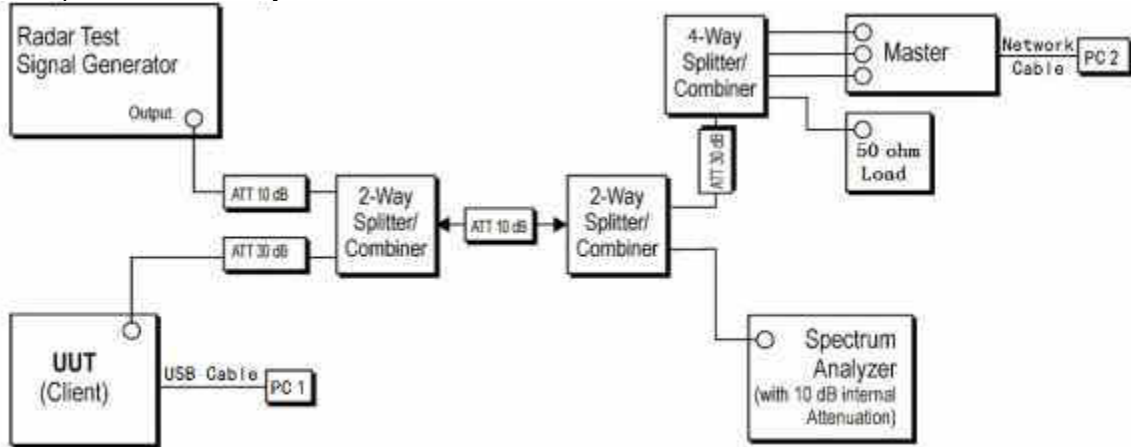
Measurement of the aggregate duration of the Channel Closed Transmission Time method. With the

spectrum analyzer set to zero span tuned to the center frequency of the EUT operating channel at the radar simulated frequency, peak detection, and max hold, the dwell time per bin is given by: $Dwell (0.3ms) = S (12000ms) / B (4000)$; where Dwell is the dwell time per spectrum analyzer sampling bin, S is sweep time and B is the number of spectrum analyzer sampling bins. An upper bound of the aggregate duration of the intermittent control signals of Channel Closing Transmission Time is calculated by: $C (ms) = N \times Dwell (0.3ms)$; where C is the Closing Time, N is the number of spectrum analyzer sampling bins (intermittent control signals) showing a U-NII transmission and Dwell is the dwell time per bin.

Measurement the EUT for more than 30 minutes following the channel move time to verify that no transmission or beacons occur on this channel.

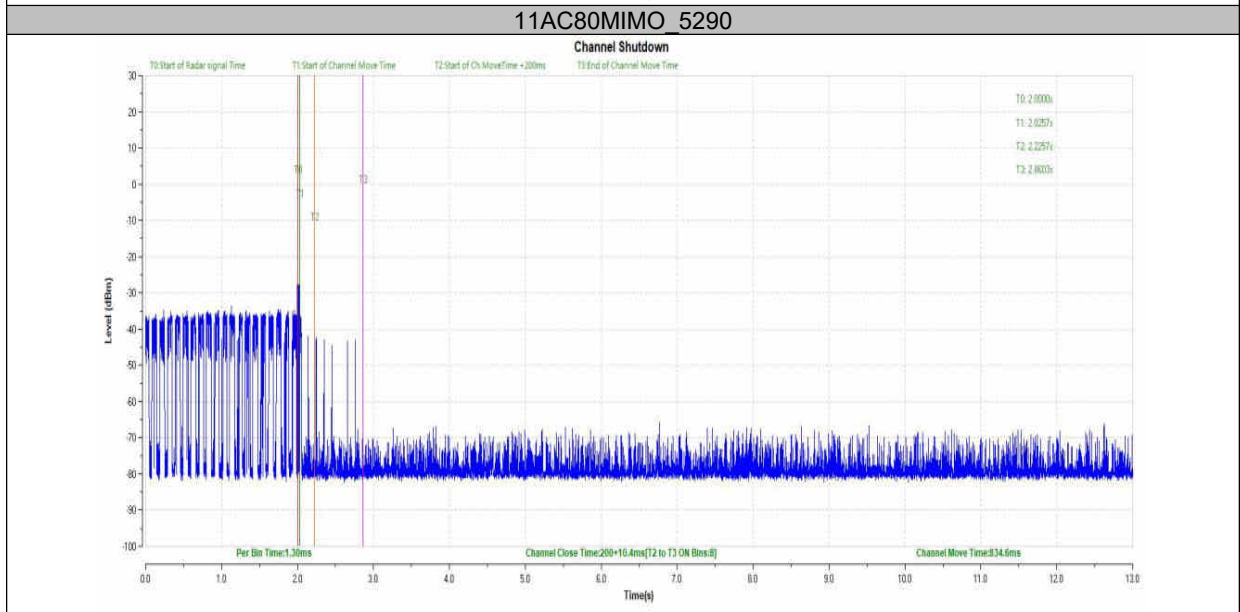
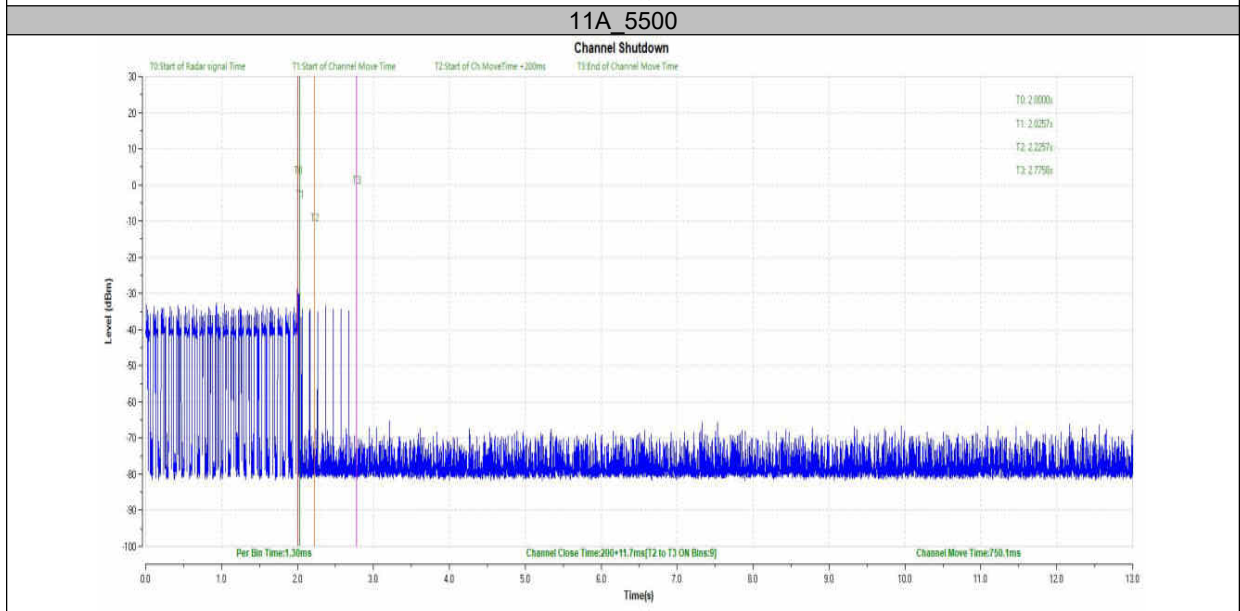
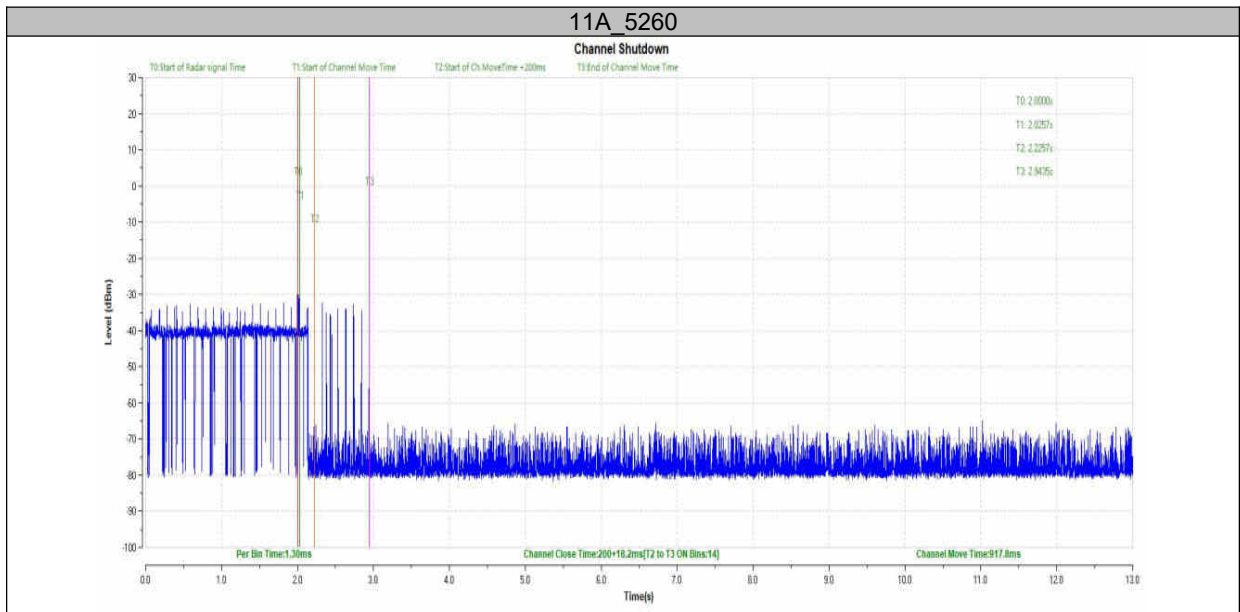
15.6. Test Setup

Setup for Client with injection at the Master

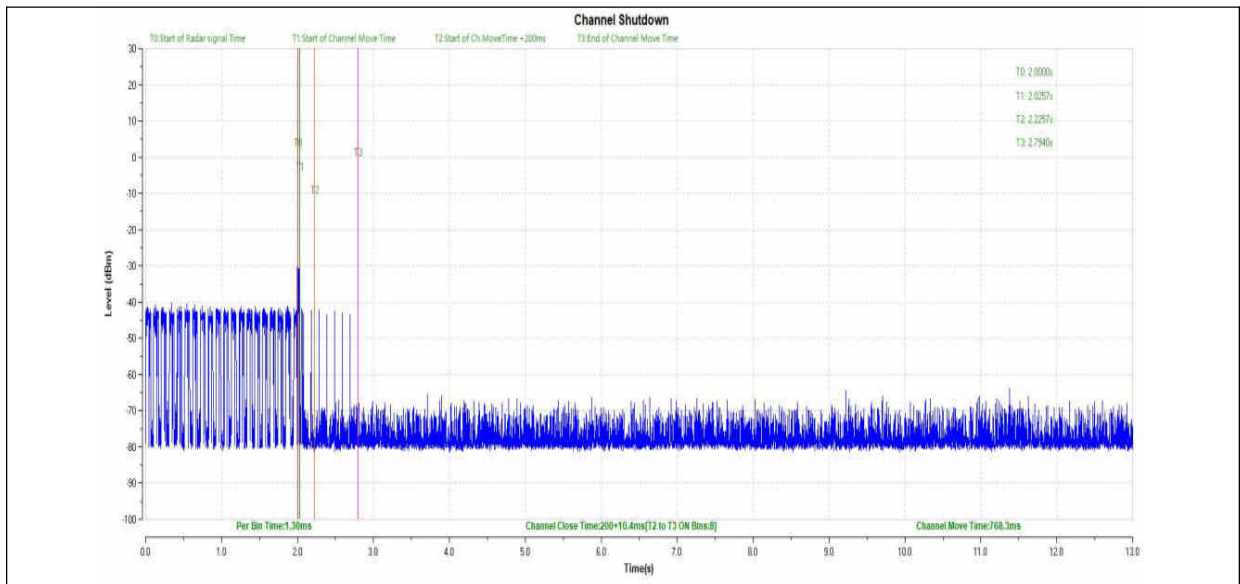


15.7. Test Result

BW/Channel	Test Item	Test Result	Limit	Results
20M/5260MHz	Channel Move Time	0.918	< 10s	pass
	Channel Closing Transmission Time	0.218	< 0.26s	pass
20M/5500MHz	Channel Move Time	0.750	< 10s	pass
	Channel Closing Transmission Time	0.212	< 0.26s	pass
80M/5290MHz	Channel Move Time	0.835	< 10s	pass
	Channel Closing Transmission Time	0.210	< 0.26s	pass
80M/5530MHz	Channel Move Time	0.768	< 10s	pass
	Channel Closing Transmission Time	0.210	< 0.26s	pass



11AC80MIMO_5530



16. Antenna Requirements

16.1. Applicable Requirements

Please refer to FCC §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 use of a standard antenna jack or electrical connector is prohibited.

Please refer to FCC §15.247(b)(4)

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

16.2. Result

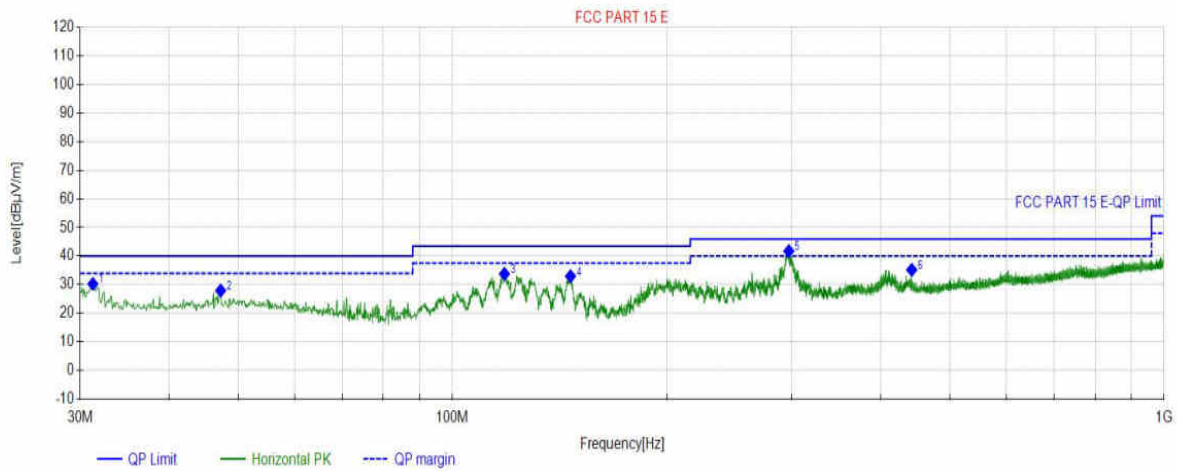
The device support 2T2R MIMO, the antennas both used for this product are dedicated Shrapnel antennas and other than that furnished by the responsible party shall be used with the device, maximum antenna gain is 0.90 dBi for antenna 0, 6.08 dBi for antenna 1.

APPENDIX A - Radiated Emission Below 1GHz Test Data Test Report

Project Information			
EUT:	WiFi Module	Environment:	23.6°C 52%
Model:	SKO.WB920TU.3	SN:	
Mode:	11AC20_5700	Voltage:	DC 5V+/-0.3
Customer:		Engineer:	Soho Liu
Remark:	Power set: 10		

Start of Test: 2023-11-01 09:48:48

Test Graph



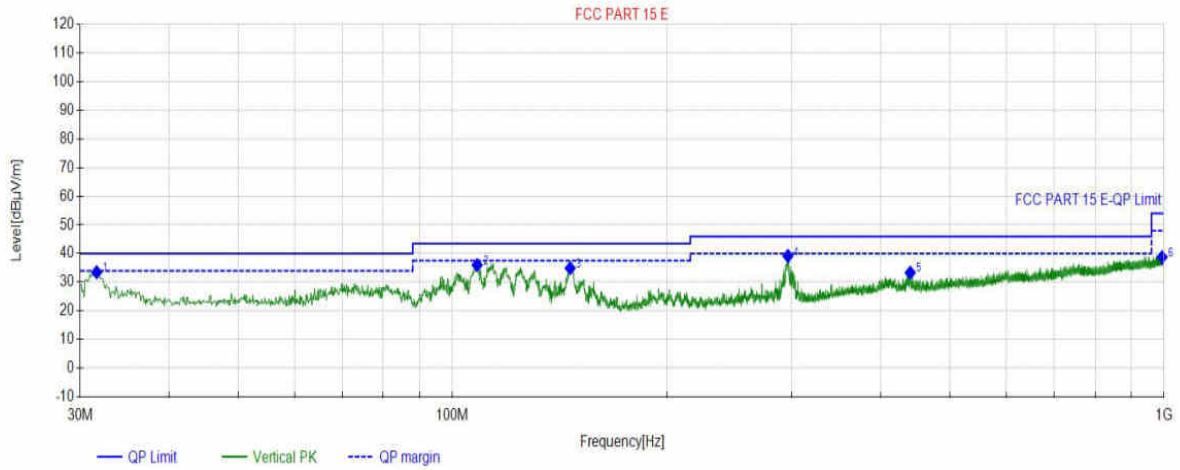
Final Data List								
NO.	Freq. (MHz)	Factor (dB)	QP Value (dBµV/m)	QP Limit (dBµV/m)	QP Margin (dB)	Height (cm)	Angle (°)	Polarity
1	31.2611	19.12	30.25	40.00	9.75	100	2	Horizontal
2	47.2677	22.14	27.94	40.00	12.06	100	4	Horizontal
3	118.3758	18.85	33.78	43.50	9.72	100	111	Horizontal
4	146.6057	17.04	32.97	43.50	10.53	100	2	Horizontal
5	297.0677	21.82	41.72	46.00	4.28	100	14	Horizontal
6	442.0972	26.43	35.18	46.00	10.82	100	258	Horizontal

Test Report

Project Information			
EUT:	WiFi Module	Environment:	23.6°C 52%
Model:	SKO.WB920TU.3	SN:	
Mode:	11AC20_5700	Voltage:	DC 5V+/-0.3
Customer:		Engineer:	Soho Liu
Remark:	Power set: 10		

Start of Test: 2023-11-01 09:49:24

Test Graph



Final Data List

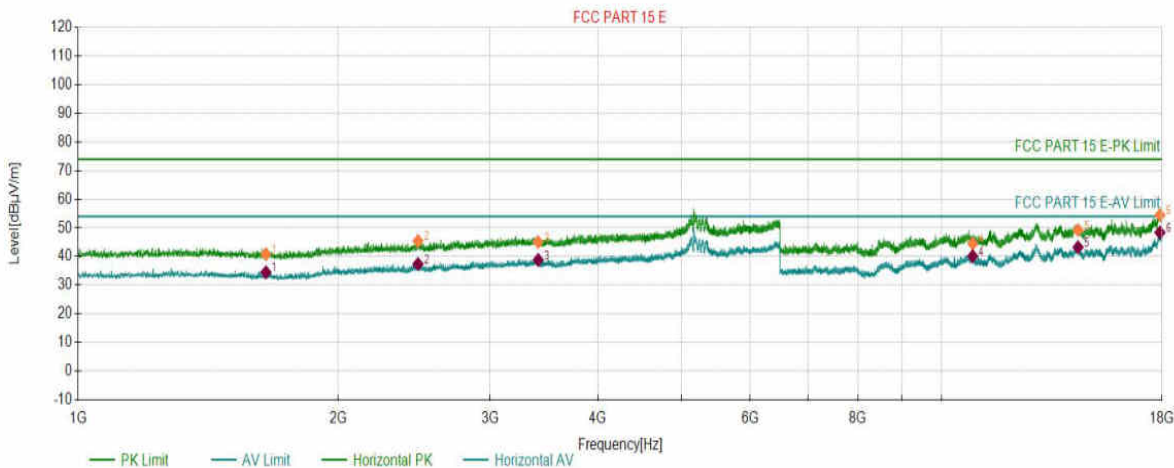
NO.	Freq. (MHz)	Factor (dB)	QP Value (dBµV/m)	QP Limit (dBµV/m)	QP Margin (dB)	Height (cm)	Angle (°)	Polarity
1	31.6492	19.22	33.49	40.00	6.51	100	164	Vertical
2	108.3838	20.28	36.00	43.50	7.50	100	71	Vertical
3	146.4116	17.04	34.91	43.50	8.59	100	127	Vertical
4	296.1946	21.82	39.18	46.00	6.82	100	358	Vertical
5	439.9630	26.39	33.34	46.00	12.66	100	120	Vertical
6	993.7914	35.47	38.76	54.00	15.24	100	296	Vertical

APPENDIX B - Radiated Emission Above 1GHz Test Data Test Report

Project Information			
EUT:	WiFi Module	Environment:	24.5°C 50%
Model:	SKO.WB920TU.3	SN:	
Mode:	11AC20_5180	Voltage:	DC 5V+/-0.3
Customer:		Engineer:	Soho Liu
Remark:	Power set: 6		

Start of Test: 2023-10-26 19:37:10

Test Graph



PK Final Data List								
NO.	Freq. (MHz)	Factor (dB)	PK Value (dBµV/m)	PK Limit (dBµV/m)	PK Margin (dB)	Height (cm)	Angle (°)	Polarity
1	1650.1650	3.55	40.84	74.00	33.16	150	257	Horizontal
2	2475.2475	7.23	45.45	74.00	28.55	150	314	Horizontal
3	3410.3410	10.49	45.06	74.00	28.94	150	51	Horizontal
4	10864.6865	5.49	44.53	74.00	29.47	150	299	Horizontal
5	14388.6389	11.41	49.22	74.00	24.78	150	82	Horizontal
6	17901.0901	17.46	54.47	74.00	19.53	150	198	Horizontal

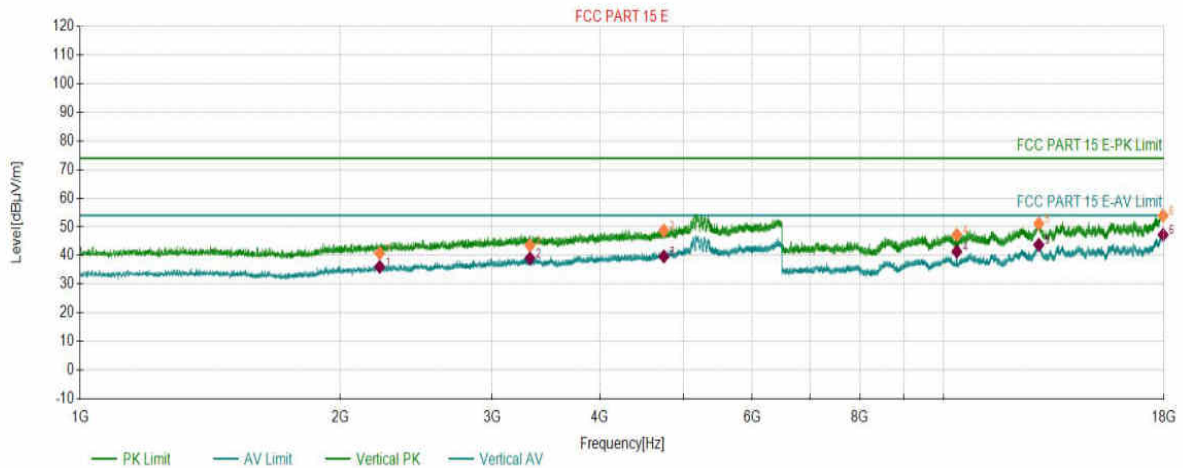
AV Final Data List								
NO.	Freq. (MHz)	Factor (dB)	AV Value (dBµV/m)	AV Limit (dBµV/m)	AV Margin (dB)	Height (cm)	Angle (°)	Polarity
1	1650.1650	3.55	34.49	54.00	19.51	150	257	Horizontal
2	2475.2475	7.23	37.39	54.00	16.61	150	314	Horizontal
3	3410.3410	10.49	38.82	54.00	15.18	150	51	Horizontal
4	10864.6865	5.49	40.14	54.00	13.86	150	299	Horizontal
5	14388.6389	11.41	43.24	54.00	10.76	150	82	Horizontal
6	17901.0901	17.46	48.38	54.00	5.62	150	198	Horizontal

Test Report

Project Information			
EUT:	WiFi Module	Environment:	24.5°C 50%
Model:	SKO.WB920TU.3	SN:	
Mode:	11AC20_5180	Voltage:	DC 5V+/-0.3
Customer:		Engineer:	Soho Liu
Remark:	Power set: 6		

Start of Test: 2023-10-26 19:38:38

Test Graph



PK Final Data List								
NO.	Freq. (MHz)	Factor (dB)	PK Value (dBµV/m)	PK Limit (dBµV/m)	PK Margin (dB)	Height (cm)	Angle (°)	Polarity
1	2222.7723	6.47	40.85	74.00	33.15	150	14	Vertical
2	3318.4818	10.27	43.55	74.00	30.45	150	251	Vertical
3	4743.1243	15.65	48.77	74.00	25.23	150	196	Vertical
4	10358.6359	3.92	47.26	74.00	26.74	150	116	Vertical
5	12888.8889	10.50	51.15	74.00	22.85	150	316	Vertical
6	17957.4457	17.06	53.92	74.00	20.08	150	308	Vertical

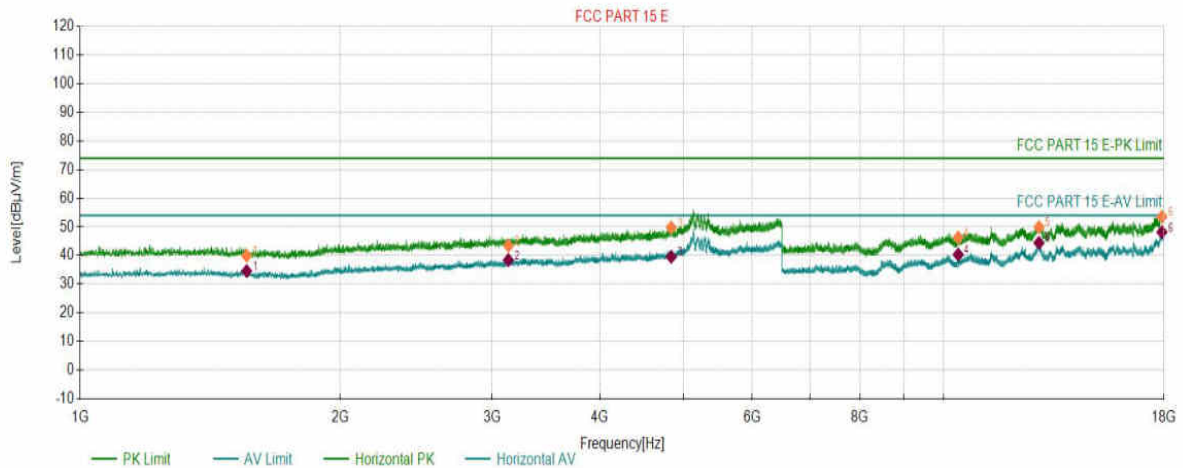
AV Final Data List								
NO.	Freq. (MHz)	Factor (dB)	AV Value (dBµV/m)	AV Limit (dBµV/m)	AV Margin (dB)	Height (cm)	Angle (°)	Polarity
1	2222.7723	6.47	36.07	54.00	17.93	150	14	Vertical
2	3318.4818	10.27	39.05	54.00	14.95	150	251	Vertical
3	4743.1243	15.65	39.67	54.00	14.33	150	196	Vertical
4	10358.6359	3.92	41.41	54.00	12.59	150	116	Vertical
5	12888.8889	10.50	43.73	54.00	10.27	150	316	Vertical
6	17957.4457	17.06	47.24	54.00	6.76	150	308	Vertical

Test Report

Project Information			
EUT:	WiFi Module	Environment:	24.5°C 50%
Model:	SKO.WB920TU.3	SN:	
Mode:	11AC20_5200	Voltage:	DC 5V+/-0.3
Customer:		Engineer:	Soho Liu
Remark:	Power set: 6		

Start of Test: 2023-10-26 19:43:02

Test Graph



PK Final Data List

NO.	Freq. (MHz)	Factor (dB)	PK Value (dBμV/m)	PK Limit (dBμV/m)	PK Margin (dB)	Height (cm)	Angle (°)	Polarity
1	1558.8559	3.51	39.94	74.00	34.06	150	167	Horizontal
2	3133.1133	9.70	43.44	74.00	30.56	150	68	Horizontal
3	4836.6337	16.28	49.81	74.00	24.19	150	167	Horizontal
4	10396.5897	3.79	46.28	74.00	27.72	150	44	Horizontal
5	12895.7896	10.62	49.92	74.00	24.08	150	219	Horizontal
6	17899.9400	17.47	53.55	74.00	20.45	150	196	Horizontal

AV Final Data List

NO.	Freq. (MHz)	Factor (dB)	AV Value (dBμV/m)	AV Limit (dBμV/m)	AV Margin (dB)	Height (cm)	Angle (°)	Polarity
1	1558.8559	3.51	34.58	54.00	19.42	150	167	Horizontal
2	3133.1133	9.70	38.44	54.00	15.56	150	68	Horizontal
3	4836.6337	16.28	39.57	54.00	14.43	150	167	Horizontal
4	10396.5897	3.79	40.35	54.00	13.65	150	44	Horizontal
5	12895.7896	10.62	44.43	54.00	9.57	150	219	Horizontal
6	17899.9400	17.47	48.18	54.00	5.82	150	196	Horizontal