

3.3. Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. The turntable is used for radiated measurement. It is a continuously rotatable, remote controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm high PVC support structure is placed on top of the turntable.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up for frequencies below 1GHz was placed on top of the 0.8 meter high, 1 x 1.5 meter table; and test set-up for frequencies 1-25GHz was placed on top of the 1.5 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, if applicable, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions. According to 3dB Beam-Width of horn antenna, the horn antenna should be always directed to the EUT when rising height.

4. ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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.”

- Use a unique coupling to the intentional radiator.

5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR3	FWXGJC-2016-181	1 year	2024/03/14
Two-Line V-Network	R&S	ENV 216	FWXGJC-2016-182	1 year	2024/05/14
Thermohygrometer	Yuhuaze	HTC-1	FWXDA-2016-385	1 year	2024/03/21

Radiated Emission

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Loop Antenna	Schwarzbeck	FMZB 1519B	FWXGJC-2018-015	3 year	2024/08/13
Bi-Log Antenna	R&S	HL562E	FWXGJC-2016-267-06	3 year	2024/03/10
Broadband Horn Antenna	R&S	HF907	FWXGJC-2016-267-07	1 year	2024/03/02
Broadband Horn Antenna	Schwarzbeck	BBHA9170	FWXGJC-2018-016	3 year	2024/06/04
EMI Receiver	R&S	ESR26	FWXGJC-2016-267-01	1 year	2023/11/08
Pre-Amplifier	R&S	SCU-18D	FWXGJC-2016-267-05	1 year	2023/11/17
Pre-Amplifier	R&S	EMC184055 SE	FWXGJC-2018-018	3 year	2025/04/13
Thermohygrometer	Yuhuaze	HTC-1	FWXDA-2016-386	1 year	2023/11/21
Anechoic Chamber	Aimuke	EMCCT-3	FWXGJC-2016-270	1 year	2025/06/07

Conducted Test Equipment

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EXA Signal Analyzer	Keysight	N9010B	FWXGJC-2018-010	1 year	2024/03/13
RF Control Unit	Toncend	JS0806-2	FWXGJC-2018-013	1 year	2024/05/14
Thermohygrometer	Yuhuaze	HTC-1	FWXDA-2016-385	1 year	2023/11/21

Test Software	Manufacturer	Version	Asset No.	Function
EMI Test Software	tonscend	/	/	/

6. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

AC Conducted Emission Measurement
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 2.05dB
Radiated Emission Measurement
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 30MHz-1GHz: 3.06dB 1GHz-12.75GHz: 4.13dB
Spurious Emissions, Conducted
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 30MHz-1GHz: 1.00 dB 1GHz-26.5GHz: 1.30 dB
Output Power
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 0.60dB
Power Spectrum Density
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 0.80dB
Occupied Bandwidth
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 0.20MHz

7. TEST RESULT

7.1. Summary

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.203	Antenna Requirement	/	/	Pass	Section 4
15.247(a)(2)	6dB Bandwidth	$\geq 500\text{kHz}$	Conducted	Pass	Section 7.2
15.247(b)(3)	Output Power	$\leq 30\text{dBm}$		Pass	Section 7.3
15.247(e)	Power Spectral Density	$\leq 8\text{dBm}/3\text{kHz}$		Pass	Section 7.4
15.247(d)	Band Edge	$\geq 20\text{dBc}$		Pass	Section 7.5
15.247(d)	Out-of-Band Emissions	$\geq 20\text{dBc}$		Pass	Section 7.6
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209	Radiated	Pass	Section 7.7
15.207	AC Conducted Emissions 150kHz - 30MHz	< FCC 15.207 limits	AC Line Conducted	Pass	Section 7.8

Notes:

- 1) All modes of operation and data rates were investigated. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst case emissions.
- 2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- 3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.

7.2. 6dB Bandwidth Measurement

7.2.1. Test Limit

The minimum permissible 6dB bandwidth is 500 kHz.

7.2.2. Test Procedure used

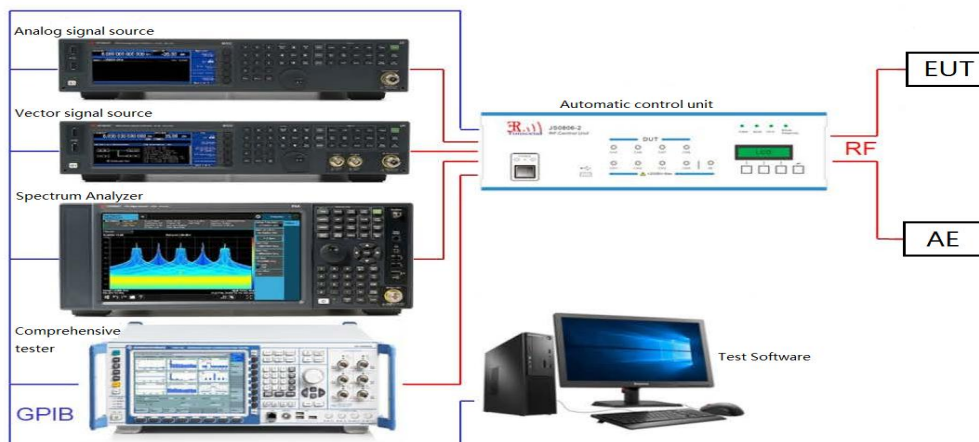
ANSI C63.10-2013 Section 11.8.2 Option 1

KDB 558074 D01 v05r02 – Section 8.2

7.2.3. Test Setting

1. Set RBW = 100 kHz
2. VBW $\geq 3 \times$ RBW
3. Detector = peak
4. Trace mode = max hold
5. Sweep = auto couple
6. Allow the trace was allowed to stabilize
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

7.2.4. Test Setup



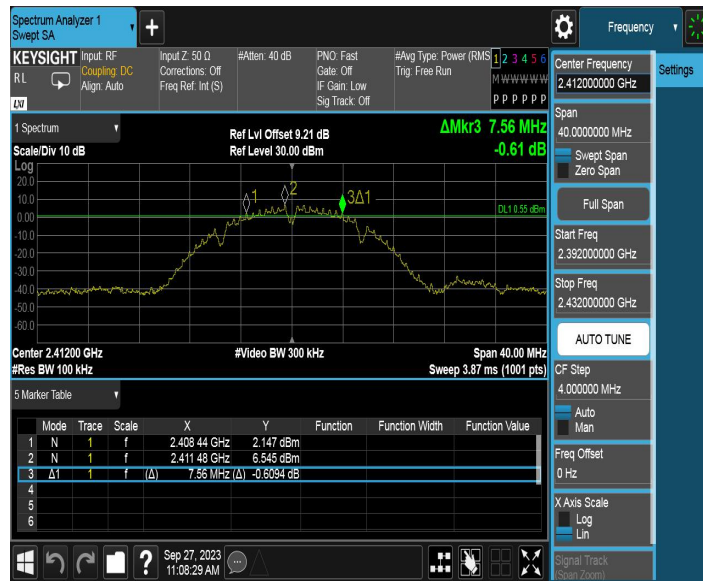
7.2.5. Test Result

Test Mode	Antenna	Frequency [MHz]	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[M Hz]	99%B W	Verdict
11B	Ant1	2412	7.560	2408.440	2416.000	0.5	12.761	PASS
	Ant2	2412	8.040	2407.960	2416.000	0.5	12.534	PASS
	Ant1	2437	8.040	2432.960	2441.000	0.5	12.726	PASS
	Ant2	2437	8.040	2432.960	2441.000	0.5	12.532	PASS
	Ant1	2462	8.040	2457.920	2465.960	0.5	12.767	PASS
	Ant2	2462	8.000	2457.960	2465.960	0.5	12.633	PASS
11G	Ant1	2412	12.560	2407.560	2420.120	0.5	16.976	PASS
	Ant2	2412	14.440	2404.080	2418.520	0.5	16.843	PASS
	Ant1	2437	16.440	2428.760	2445.200	0.5	17.807	PASS
	Ant2	2437	16.280	2428.840	2445.120	0.5	17.871	PASS
	Ant1	2462	16.360	2453.760	2470.120	0.5	18.213	PASS
	Ant2	2462	16.080	2453.800	2469.880	0.5	18.144	PASS
11N20MIMO	Ant1	2412	14.200	2406.560	2420.760	0.5	17.921	PASS
	Ant2	2412	15.040	2403.840	2418.880	0.5	17.666	PASS
	Ant1	2437	17.640	2428.160	2445.800	0.5	18.974	PASS
	Ant2	2437	17.560	2428.200	2445.760	0.5	18.345	PASS
	Ant1	2462	17.640	2453.120	2470.760	0.5	19.047	PASS
	Ant2	2462	17.160	2453.160	2470.320	0.5	18.378	PASS
11AX20MIMO	Ant1	2412	18.880	2402.520	2421.400	0.5	18.828	PASS
	Ant2	2412	18.800	2402.560	2421.360	0.5	18.815	PASS
	Ant1	2437	18.960	2427.480	2446.440	0.5	19.092	PASS
	Ant2	2437	18.800	2427.600	2446.400	0.5	19.137	PASS
	Ant1	2462	18.920	2452.480	2471.400	0.5	19.085	PASS
	Ant2	2462	18.800	2452.560	2471.360	0.5	19.132	PASS
11N40MIMO	Ant1	2422	36.240	2403.840	2440.080	0.5	36.433	PASS
	Ant2	2422	35.600	2403.840	2439.440	0.5	36.255	PASS
	Ant1	2437	35.760	2419.160	2454.920	0.5	36.209	PASS
	Ant2	2437	30.000	2423.800	2453.800	0.5	35.953	PASS
	Ant1	2452	35.440	2434.080	2469.520	0.5	36.269	PASS
	Ant2	2452	25.600	2437.600	2463.200	0.5	36.006	PASS
11AX40MIMO	Ant1	2422	38.000	2402.960	2440.960	0.5	37.754	PASS
	Ant2	2422	36.080	2404.000	2440.080	0.5	37.719	PASS
	Ant1	2437	37.840	2418.040	2455.880	0.5	37.580	PASS

	Ant2	2437	35.600	2419.640	2455.240	0.5	37.592	PASS
	Ant1	2452	37.600	2433.040	2470.640	0.5	37.665	PASS
	Ant2	2452	36.240	2433.120	2469.360	0.5	37.645	PASS

Test Graphs of 6dB Bandwidth

11B_Ant1_2412



11B_Ant2_2412



11B_Ant1_2437



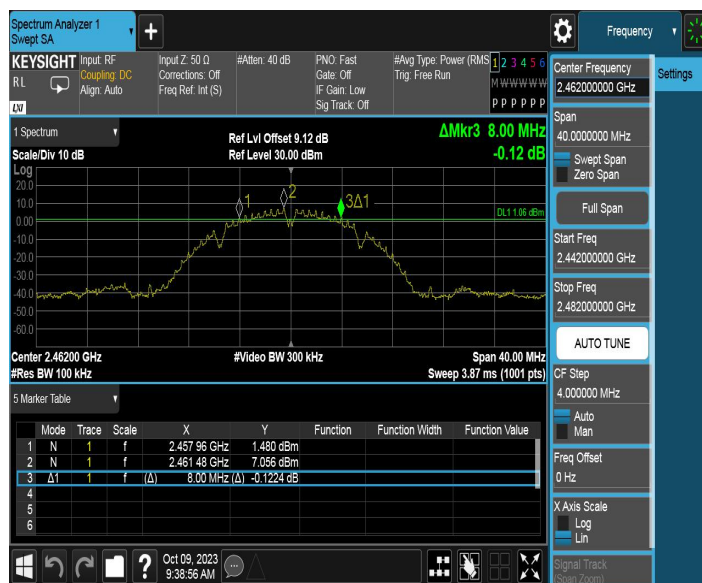
11B_Ant2_2437



11B_Ant1_2462



11B_Ant2_2462



11G_Ant1_2412



11G_Ant2_2412



11G_Ant1_2437



11G_Ant2_2437



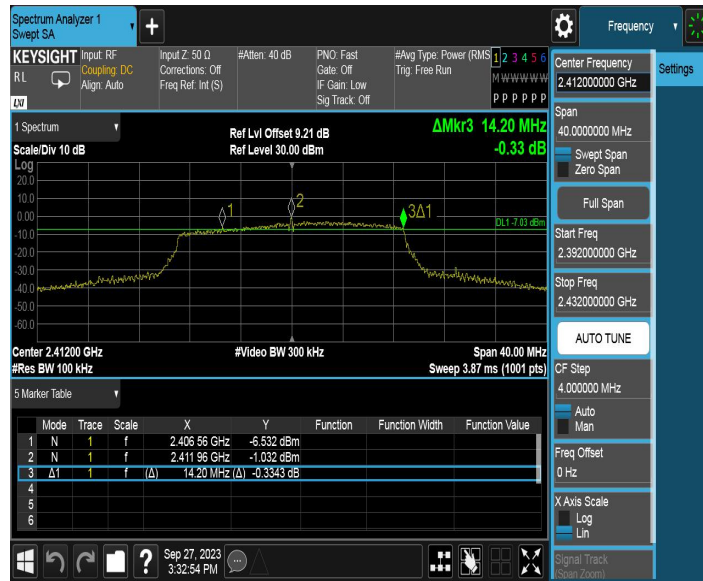
11G_Ant1_2462



11G_Ant2_2462



11N20MIMO_Ant1_2412



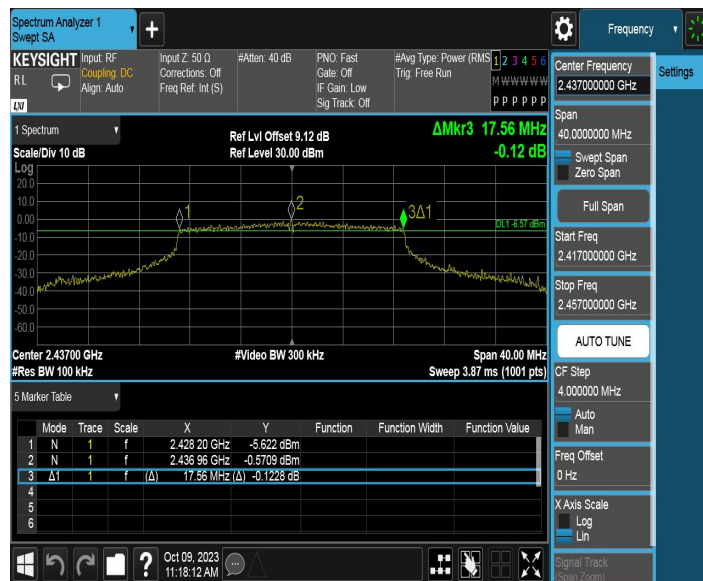
11N20MIMO_Ant2_2412



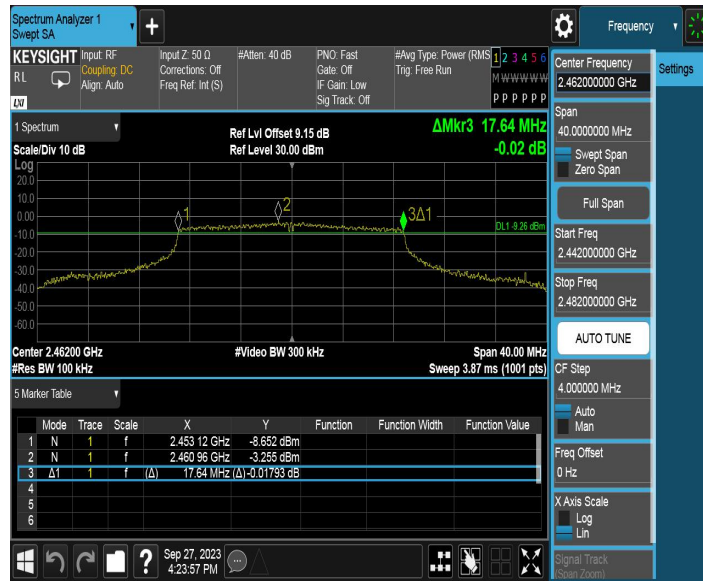
11N20MIMO_Ant1_2437



11N20MIMO_Ant2_2437



11N20MIMO_Ant1_2462



11N20MIMO_Ant2_2462



11N40MIMO_Ant1_2422



11N40MIMO_Ant2_2422



11N40MIMO_Ant1_2437



11N40MIMO_Ant2_2437



11N40MIMO_Ant1_2452



11N40MIMO_Ant2_2452



11AX20MIMO_Ant1_2412



11AX20MIMO_Ant2_2412



11AX20MIMO_Ant1_2437



11AX20MIMO_Ant2_2437



11AX20MIMO_Ant1_2462