NOKIA Bell Labs

Global Product Compliance Laboratory
600-700 Mountain Avenue
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TESTING
NVLAP LAB CODE: 100275-0

FCC Certification Part 30 Test Report

Product Evaluated

FA3UB 24 GHz ASMR mmWave Radio Extension Module with 24 GHz ASMR Base
FCC ID: 2AD8UFA3UB01

Customer

Nokia Solutions and Networks, OY
2000 Lucent Lane
Naperville, Illinois 60563

Test Laboratory

Nokia Bell Labs
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600-700 Mountain Avenue, Rm 5B-108
Murray Hill, New Jersey 07974-0636 USA

Date

June 5, 2022

Revisions

Date	Revision	Section	Change
6/05/2022	0		Initial Release

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1. ATTESTATION OF TEST RESULTS

Equipment Under Test (EUT)	FA3UB 24 GHz ASMR mmWave Radio Extension Module with 24 GHz ASMR Base.
Serial Number(s)	**Radiated Emission:** AWEUD - AH211500018 24 Extension1 (FA3UB) - AH212200012 24 Extension2 (FA3UB) - AH212200010 **Radio Tests:** FA3UB – AH212200010 **Frequency Stability Tests:** AWEUD - YK203900023 FA3UB - YK203900083
FCC ID	2AD8UFA3UB01
Model Name	FA3UB 24 GHz ASMR mmWave Radio Extension Module
Hardware Version	**Radiated Emission:** AWEUD – 475168A.104 24 Extension1 (FA3UB) – 475046A.104 24 Extension2 (FA3UB) – 475046A.104 **Radio Tests:** FA3UB – 475001A **Frequency Stability Tests:** AWEUD – 475169A.101 FA3UB – 475046A.101
GPCL Project Number	2022-0036
Manufacturer	NOKIA SOLUTIONS AND NETWORKS OY KARAKAARI 7, FI-02610 ESPOO FINLAND
Test Requirement	• 47 CFR FCC Part 2 and Part 30 (Part 2.1047, 2.1055)
Test Standard(s)	• 47 CFR FCC Parts 2 and Part 30 • KDB 971168 D01 Power Meas License Digital Systems v03r01 April 9, 2018 • KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013 • KDB 842590 D01 Upper Microwave Flexible Use Service v01r01–April 2020 • Procedures on TRP Compliance for Out of Band and Spurious Emissions C63.26 mmWave JTG - Version # 1 July 14th, 2018
Reference(s)	• ANSI C63.26 (2015) • ANSI C63.4 (2014) • TR 14-1001, MMW Measurements with Harmonic Mixers (April-4-2014)
Test Date	3/22/2022 – 5/19/2022
Test Performed By	Nokia Global Product Compliance Laboratory 600-700 Mountain Avenue P.O. Box 636 Murray Hill, NJ 07974-0636
FCC Registered Test Site Number	Designation Number: **US5302**, Test Firm Registration Number: **395774**
Product Engineer(s)	Jeff Webb
Lead Engineer	W. Steve Majkowski

Test Engineer (s)	W. Steve Majkowski, Mike Soli, Joe Bordonaro

Test Results: The EUT, *as tested* met the above listed Test Requirements. The decision rule employed is binary (Pass/Fail) based on the measured values without accounting for Measurement Uncertainty or any Guard Band. The measured values obtained during testing were compared to a value given in the referenced regulation or normative standard. Report copies and other information not contained in this report are held by either the product engineer or in an identified file at the Global Product Compliance Laboratory in New Providence, NJ.

2. SUMMARY OF THE TEST RESULTS

47 CFR FCC Sections	Description of Tests	Compliance Results
2.1046, 30.202 (a)	RF Power Output	Pass
2.1047,	Modulation Characteristics	Pass
2.1049, 30.203	(a) Occupied Bandwidth (b) Edge-of-Band Emissions	Pass
2.1051, 30.203	Spurious Emissions at Antenna Terminals - Radiated	Pass
2.1053, 30.203	Field Strength of Spurious Radiation	Pass
2.1055,	Measurement of Frequency Stability	Pass

2.1 Measurement Uncertainty

The results of the calculations to estimate uncertainties for the several test methods and standards are shown in the Tables below. These are the worst-case values.

Worst-Case Estimated Measurement Uncertainties

Standard, Method or Procedure	Condition	Frequency MHz	Expanded Uncertainty (k=2)
a. Classical Emissions, (*e.g.*, ANSI C63.4, CISPR 11, 14, 22, *etc.*, using ESHS 30,	Conducted Emissions	0.009 - 30	±3.5 dB
	Radiated Emissions (AR-8 Semi-Anechoic Chamber)	30 MHz – 200MHz H 30 MHz – 200 MHz V 200 MHz – 1000 MHz H 200 MHz – 1000 MHz V 1 GHz- 18 GHz	±5.4 dB ±5.4 dB ±4.7 dB ±4.7 dB ±3.3 dB

Antenna Port Test	Signal Bandwidth	Frequency Range	Expanded Uncertainty (k=2), Amplitude
Occupied Bandwidth, Edge of Band,	10 Hz 100 Hz 10 kHz to 1 MHz 1MHz to 100 MHz	9 kHz to 20 MHz 20 MHz to 1 GHz 1 GHz to 10 GHz 10 GHz to 40 GHz:	±2.2 dB
Conducted Spurious Emissions	30 kHz to 100 MHz	10 MHz to 40 GHz:	±2.8 dB
RF Power, Channel Power	10 Hz to 100 MHz	10 MHz to 40 GHz	±1.4 dB

3. GENERAL INFORMATION

3.1 Product Descriptions

The equipment under test (EUT) has the following specifications.

Table 3.1.1 Product Specifications

Specification Items	Description
Product Type	FA3UB 24 GHz ASMR mmWave Radio Extension Module
Radio Type	Intentional Transceiver
Power Type	DC powered from an ASMR Main Unit (AC or DC)
Modulation	QPSK, 16QAM, 64QAM, 256QAM
Operating Frequency Range	24.25 – 25.25 GHz, NR Band n258
Channel Bandwidth	100, 200, 300, 400, 500, 600, 700 MHz
Max Radiated Power (EIRP)	52 dBm (158.5W) EIRP per Array; 55 dBm (316.2W) EIRP Total for the two Arrays
Antenna Gain	23 dBi
Operating Mode	2x2 MIMO (2 duplex Tx/Rx Ports)
Software Version	5G19B
Antenna(s)	Refer to Section 3.2

3.2 EIRP/ PSD Compliance and Antenna Information.

The product incorporates integrated antennas. Externally mounted antennas cannot be attached to the unit or mounted remotely. The units integrated antennas are electronically steerable with a maximum gain of 23 dBi. There is a single antenna board assembly inside the product. This antenna assembly has two individually polarized antenna Tx/Rx modules. Each antenna Tx/Rx modules is an 8x16 matrix (128 elements each). One antenna Tx/Rx modules is vertically polarized, and the second antenna Tx/Rx modules is horizontally polarized. The antennas nominal RF drive level is 29 dBm. The 29 dBm RF power and 23 dBi gain results in a 52 dBm EIRP per assembly. The sum of the two 52 dBm EIRP beams results in a maximum EIRP of 55 dBm. Antenna Gain vs frequency is detailed in Exhibit 6 of the filing package.

3.3 Antenna Far Field Determination Distance

The Moongilan Test (1) was performed to determine the far field boundary location using calculations and low power measurements. For the antenna array we can calculate the Fraunhofer distance from

$$d_{ff} \geq 2D^2/\lambda$$

where d_{ff} = Far Field distance in meters,
D is the maximum size of the radiating array λ = wavelength of the operating signal in meters

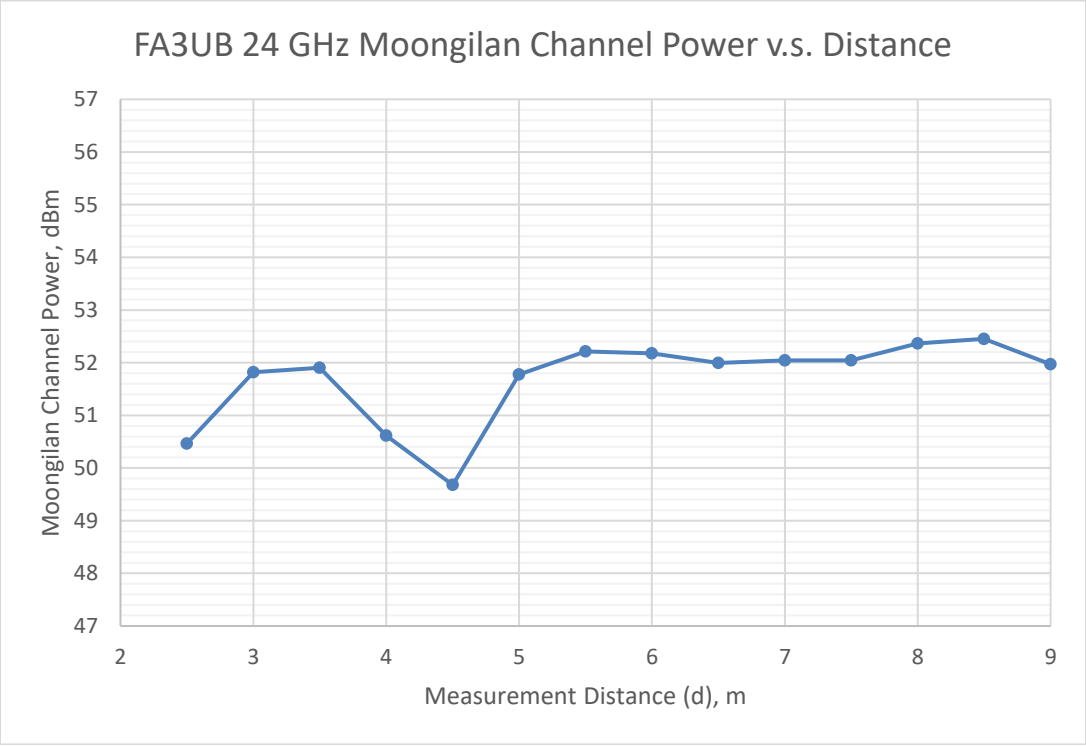
The individual polarization antenna array height is 160 mm and is 81 mm wide with a 180 mm diagional. The diagional for both arrays is 305 mm.
At 25 GHz the individual array dimensions results in a minimum Fraunhofer far field distance, $d_{ff,}$ of 5.5 meters.
At 25 GHz the overall array dimensions results in a minimum Fraunhofer far field distance, $d_{ff,}$ of 15.5 meters.

While the Fraunhofer far field distance is the minimum distance where the far field can occur, it does not predict the actual distance where the far field occurs. The Moongilan Test determines the actual distance where the far field occurs for the specific configuration under test.

Measurements for the Moongilan Test were performed at low power using a standard gain horn antenna. In the vertical polarization the reliable far field distance was determined to be at 6.0 m.

To eliminate any inconsistancy all Power, OBW and OOBE measurements were made at 6.0 m.

(1) The Moongilan Test is named in honor of the late Dheena Moongilan who discovered it and formulated its use into C63.26.



4. REQUIRED MEASUREMENTS AND RESULTS

Per 47CFR FCC Section 2.1033(c)(14), the following certification tests are required by Section 2.1046 through Section 2.1057. These tests are identified in Table 4.0a below.

Table 4.0a Required Certification Measurements

47 CFR FCC Sections	Description of Tests	Test Required for Class II Authorization
2.1046, 30.202 (a)	**RF Power Output** **(a) Power Limits, EIRP, PSD**	**Yes**
2.1047,	**Modulation Characteristics**	**Yes**
2.1049, 30.203	**(a) Occupied Bandwidth** **(b) Out-of-Band Emissions**	**Yes**
2.1051, 30.203	**Spurious Emissions at Antenna Terminals**	**Yes**
2.1053, 30.203, **30.204, 15.109(a) Class B**	**Field Strength of Spurious Radiation**	**Yes**
2.1055,	**Measurement of Frequency Stability**	**Yes**

The measurements were conducted in accordance with the procedures set out in Section 2.1041 and as appropriate per the test Standards listed in Table 4.0b below. The comprehensive list of tests performed included measurements at Left, Center and Right side of the Part 30 Band. These tests are presented to demonstrate compliance with FCC requirements.

The procedures defined in ANSI C63.26-2015 and KDB 971168 D01 were developed for conducted measurements. The mmWave Joint Technical Group with FCC oversight has been working diligently on revisions to add mmWave measurements for Upper Microwave Flexible Use Service (UMFUS). The new KDB, 842590, is closely aligned with those efforts.

All of the measurements performed herein were performed as radiated measurements. In order to perform these measurements, the equipment settings required to enable the FSW internal noise reduction capability were used. This typically required the use of average detector, and multiple sweep averages. The individual test sections identify any changes in measurement process.

Table 4.0b Test Standards Used for Radiated Measurements of Radio Performance

Test Standard(s)	• 47 CFR FCC Parts 2 and Part 30 • KDB 971168 D01 Power Meas License Digital Systems v03r01 April 9, 2018 • KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013 • KDB 842590 D01 Upper Microwave Flexible Use Service v01r01–April 2020 • Procedures on TRP Compliance for Out of Band and Spurious Emissions C63.26 mmWave JTG - Version # 1 July 14th 2018
Reference(s)	• 47 CFR FCC Part 2 and Part 30 • ANSI C63.26 (2015) • ANSI C63.4 (2014) • TR 14-1001, MMW Measurements with Harmonic Mixers (April-4-2014)

4.1 Section 2.1046 MEASUREMENT REQUIRED: RF POWER OUTPUT

The product incorporates internal antennas that are part of the signal source. There is no antenna terminal connection on the product. Therefore, this test as implemented is not a measurement of the total conducted power at the antenna terminal but rather the total radiated power in terms of the maximum EIRP radiated by the product.

The FCC recognized that these products would use integrated antennas and likewise structured the requirements under Part 30. Under Part 30 the average power of the sum of all antenna elements is limited to an equivalent isotopically radiated power (EIRP) density of +75dBm/100 MHz.

The **Nokia AirScale FA3UB 24 GHz ASMR mmWave Radio Extension Module, FCC ID: 2AD8UFA3UB01**, is a 5G New Radio LTE TDD Remote radio head is configured for one to seven carrier operation. It is specified to provide a maximum power output of 52 dBm /158.5 W EIRP per transmit polarization for a sum total of 55 dBm /317W EIRP per unit. The product is designed for the 5G global market including operation per 47 CFR Part 30 rules for use in the USA authorized portions of 5G New Radio Band, n258, from 24.25-24.45 GHz and 24.75-25.25 GHz.

4.1.1 RF Power Output Measurement

The product was allowed to warm up and stabilize per KDB 971168 D01 and ANSI C63.26.

Radiated Power measurements of the 5G New Radio transmit signal were conducted with an FSW Spectrum Analyzer per KDB 971168 D01 and KDB 842590 D01. Measurements were performed at a 6.0 m distance using a nominal 62 dB offset. An additional FSW transducer correction factor is used to ascertain the actual measured EIRP power. The calculation of path loss, cable loss and measurement antenna gain are listed in Table 4.1.1. below. The unit was configured to transmit at its maximum power.

The Channel Power function of the FSW spectrum analyzer was used to measure the maximum average Horizontal and Vertical EIRP at the 6.0 m measurement distance. The measurements were performed for one through seven carriers filling the 2 carrier (left) and the 5 carrier (right) Blocks of the 24.25 to 25.25 GHz Band. For all measurements a nominal 100 MHz bandwidth carrier with 5G-NR modulations was used. Channel power plots identify the individual carrier power, modulation and the total power.

Table 4.1.1 Corrections For Transmitter Power Measurements

Frequency	Free Space Path Loss, "PL"	Measurement Antenna Gain, "G1"	Measurement Cable Loss, "L1"	Total Offset Required PL -G1 + L1	FSW Measurement Offset	Required Final Correction
GHz	dB	dBi	dB	dB	dB	dB
22.00	74.85	23.46	11.02	62.41	62	0.407
22.50	75.05	23.49	11.17	62.73	62	0.730
23.00	75.24	23.69	11.43	62.98	62	0.981
23.50	75.43	23.80	11.51	63.13	62	1.134
24.00	75.61	23.80	11.41	63.23	62	1.227
24.23	75.69	23.92	11.50	63.27	62	1.270
24.23	75.69	23.92	11.50	63.27	62	1.270
24.50	75.79	24.06	11.60	63.33	62	1.328
25.00	75.96	24.14	11.72	63.55	62	1.549
25.30	76.07	24.10	11.76	63.73	62	1.731
25.30	76.07	24.10	11.76	63.73	62	1.731
25.50	76.14	24.07	11.79	63.86	62	1.859
26.00	76.30	24.28	11.95	63.97	62	1.972
26.50	76.47	24.38	12.16	64.25	62	2.252
27.00	76.63	24.39	12.26	64.50	62	2.504
27.50	76.79	24.39	12.29	64.69	62	2.694
28.00	76.95	24.57	12.40	64.78	62	2.778
28.50	77.10	24.63	12.57	65.05	62	3.045
29.00	77.25	24.53	12.61	65.33	62	3.332
29.50	77.40	24.60	12.82	65.62	62	3.616
30.00	77.55	24.71	12.90	65.73	62	3.733
30.50	77.69	24.63	13.04	66.10	62	4.099
31.00	77.83	24.71	13.13	66.25	62	4.248
31.50	77.97	24.74	13.17	66.40	62	4.399
32.00	78.11	24.75	13.31	66.67	62	4.674
32.50	78.24	24.85	13.37	66.76	62	4.761
33.00	78.38	24.83	13.50	67.05	62	5.047

4.1.1.1 RF Power Output Results

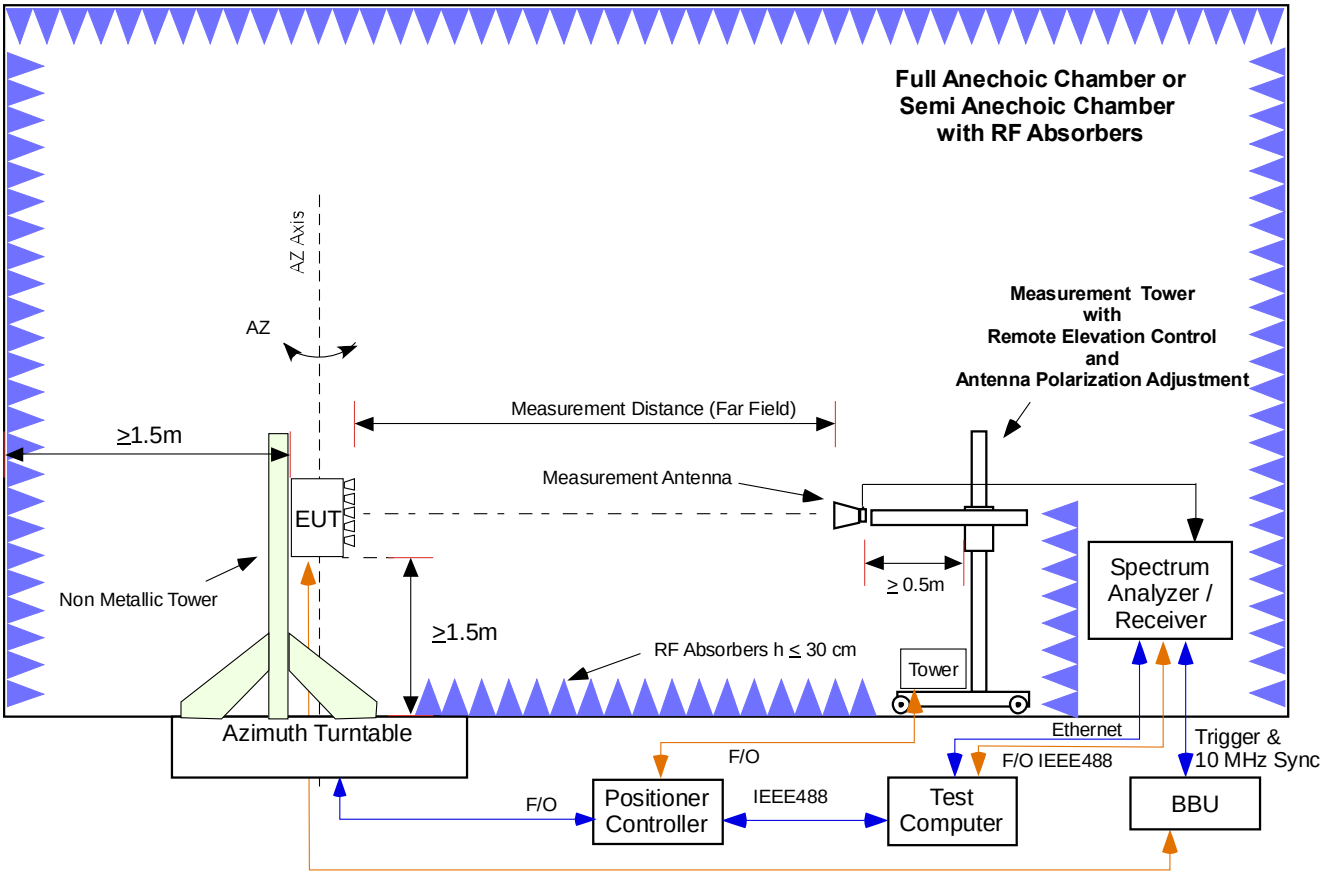
Power output measurements verified the expected performance of 52 dBm EIRP per polarization for a Total Power of 55 dBm. The maximum measured level was **52.85 dBm** for a single polarization and **55.57 dBm** total. This level is well within the maximum Part 30.202a limit of 75 dBm EIRP. Measurements were performed for each modulation.

The measured performance was in full compliance with the Rules of the Commission. The data plots are detailed below.

Table 4.1.1.1 – Channel Power Measurements (adjacent)

Location in Band	Channel Center Frequencies, GHz	# of carriers	Modulation	Horizontal Polarization Total Channel Power, EIRP	Vertical Polarization Total Channel Power, EIRP	Sum Total Channel Power EIRP
				dBm	dBm	dBm
Left	24.3	1	64QAM	51.52	52.25	54.91
Left	24.3 24.39984	2	QPSK	51.90	52.39	55.16
Left	24.7992 24.89904 24.99888	3	QPSK	51.88	52.49	55.21
Left	24.7992 24.89904 24.99888 25.09872	4	QPSK	51.70	52.61	55.19
Left	24.7992 24.89904 24.99888 25.09872 25.19856	5	16QAM	51.57	52.45	55.04
Left	24.3 24.39984 24.7992 24.89904 24.99888 25.09872	6	16QAM	51.92	52.44	55.20
Left	24.3 24.39984 24.7992 24.89904 24.99888 25.09872 25.19856	7	QPSK	52.25	52.85	55.57
Left	24.3 24.39984 24.7992 24.89904 24.99888 25.09872 25.19856	7	16QAM	51.70	52.64	55.21
Left	24.3 24.39984 24.7992 24.89904 24.99888 25.09872 25.19856	7	64QAM	51.62	52.61	55.15

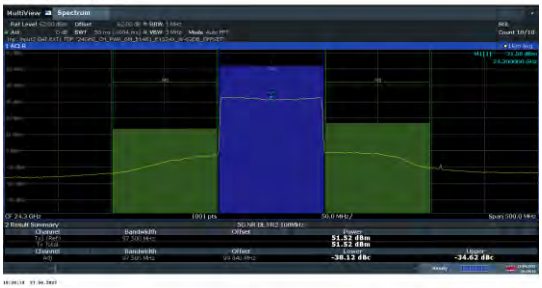
Figure 4.1.1 Test Set-Up for Measurement of Radio Transmitter Performance



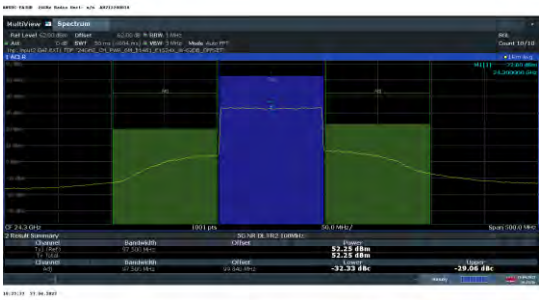
4.1.1.1.1 Channel Power Measurement Plots

Channel Power Measurements, 1 Carrier – 64QAM

Horizontal

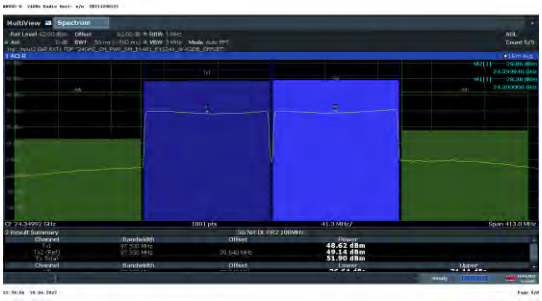


Vertical



Channel Power Measurements, 2 Carrier – QPSK

Horizontal



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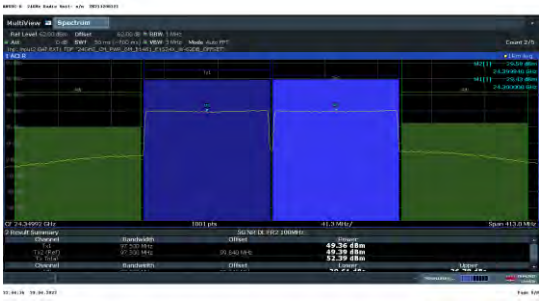


Channel Power Measurements, 3 Carrier – QPSK

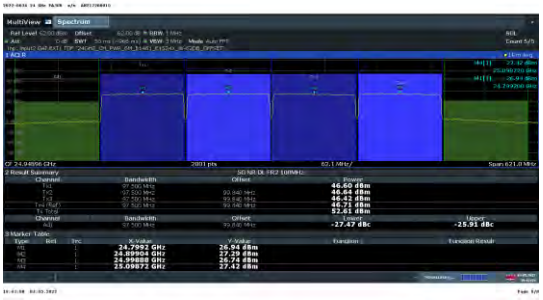
Horizontal

Vertical

Channel Power Measurements, 4 Carrier – QPSK

Horizontal

Vertical



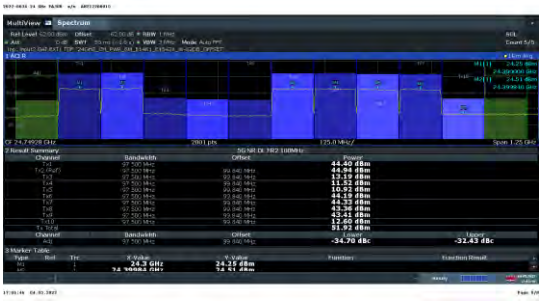
Channel Power Measurements, 5 Carrier – 16QAM

Horizontal

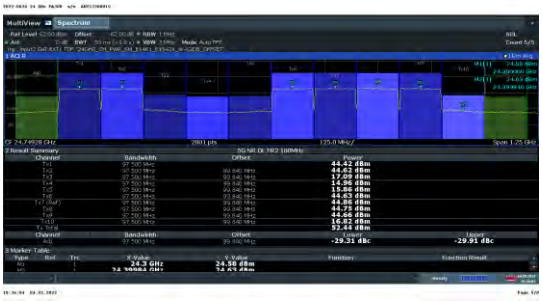
Vertical

Channel Power Measurements, 6 Carrier – 16QAM

Horizontal



Vertical



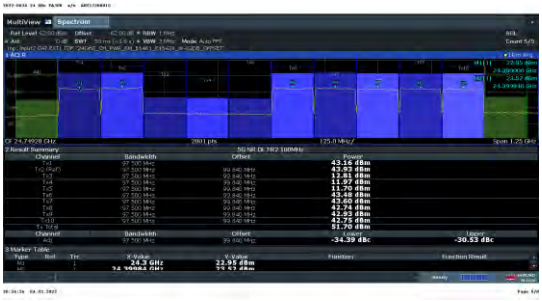
Channel Power Measurements, 7 Carrier – QPSK

Horizontal

Vertical

Channel Power Measurements, 7 Carrier – 16QAM

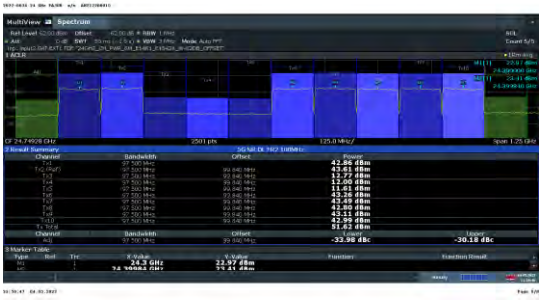
Horizontal



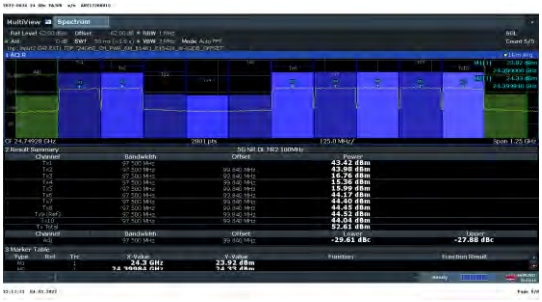
Vertical

Channel Power Measurements, 7 Carrier – 64QAM

Horizontal



Vertical



4.2 Section 2.1047 MEASUREMENT REQUIRED: MODULATION CHARACTERISTICS

The FA3UB FCC ID: **2AD8UFA3UB01** supports the 5G New Radio Modulation Format based upon LTE TDD technologies. LTE utilizes Orthogonal Frequency Division Multiplexing (OFDM) which splits the carrier frequency bandwidth into many small subcarriers. Each individual subcarrier can be modulated with QPSK, 16QAM and 64QAM digital modulation formats.

In QPSK, there are 4 possible symbol states and each symbol carries 2 bits of information. In 16QAM, there are 16 possible symbol states and each 16-QAM symbol carries 4 bits of information. In 64QAM, there are 64 possible symbol states and each 64-QAM symbol carries 6 bits of information. The higher-order modulations, those where the constellations are more dense, are more sensitive to poor channel conditions than the lower-order modulation.

The modulation characteristics measurement of LTE carriers measures the difference between the ideal symbols and the measured symbols after the equalization. The 5G-New Radio format is still in revision in 3GPP and new Releases are expected. The constellations were recorded to assess that the subcarrier configurations were achieved.

There are no FCC Limits for Modulation and all of the formats presented look spectrally the same from a channel edge and regrowth standpoint and we are pleased with the fidelity that available with test equipment as configured.

4.2.1 Modulation Characteristics Measurement

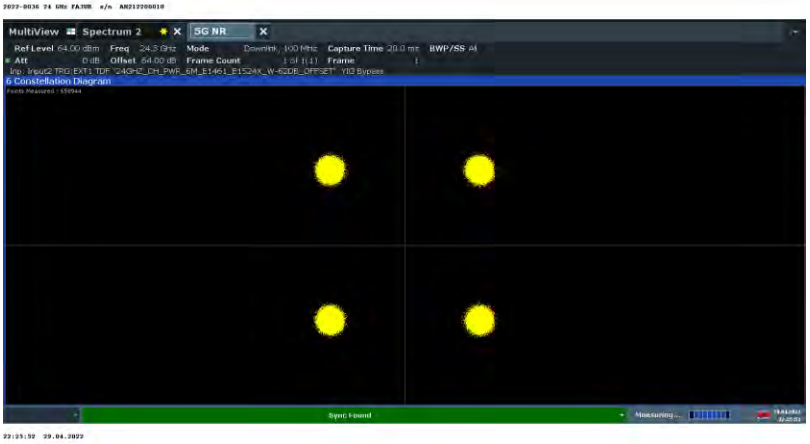
The measurements were performed at a distance of 6.0 m from the unit utilizing the test configuration in Figure 4.4.1 utilizing a Rohde & Schwarz FSW85 Signal analyzer with the 3GPP 5G-NR DL Measurement software option. Representative screen plots of the modulation measurement are attached below for all three of the subcarrier configurations and sample polarizations.

4.2.2 Modulation Measurements Results:

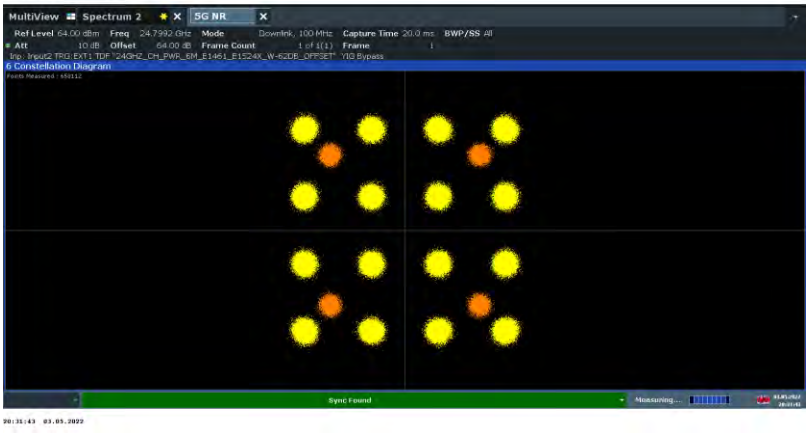
The typical measured modulation characteristics of the EUT are shown below:

Figure 4.2 Sample Modulation Results

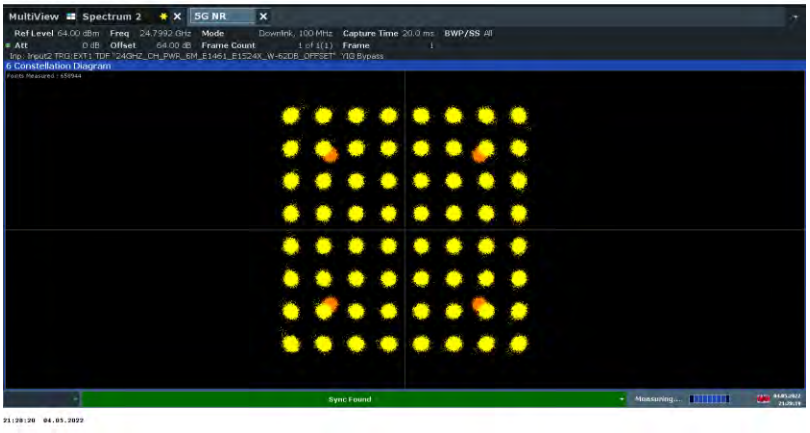
QPSK – 2 Carrier - Vertical Polarization



16QAM – 5 Carrier - Vertical Polarization



64QAM – 7 Carrier – Horizontal Polarization



4.3 Section 2.1049 MEASUREMENT REQUIRED: OCCUPIED BANDWIDTH and EDGE of BAND EMISSIONS

This test measures the Occupied Bandwidth of the transmitting carrier and the Edge of-Block Emissions in the frequency spectrum immediately outside and adjacent to the transmitting carrier(s).

The occupied bandwidth (OBW) is usually defined either as the 99% power OBW or a relative OBW. The 99%
OBW is the signal bandwidth such that, below its lower and above its upper frequency limits, the mean power radiated or conducted are each equal to 0.5 percent of the total mean power radiated or conducted by a given emission. The relative OBW is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are
attenuated by at least X dB below the transmitter power, where the value of X is typically specified as 26.

Per KDB 971168 D01 v02, the relative OBW must be measured and reported when it is specified in the applicable rule part; otherwise, the 99% OBW shall be measured and reported. The OBW shall be measured
when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment is operated.

4.3.1 Results Occupied Bandwidth (Signal Bandwidth)

The measurements of 99% occupied bandwidth were performed with a Rohde & Schwartz FSW85 GHz spectrum analyzer. The measurements of the intended 100 MHz 5G-NR carrier indicated compliance with the 97M5G7D emission designator. Sample results are presented below and shows that the measured signals are within the parameters of the 97M5G7D emissions designator. Most of the multicarrier measurements were made with a carrier spacing of 99.84 MHz.

Tabular Data – Occupied Bandwidth **1MHz** RBW

Location in Band	Carrier Frequencies (GHz)	Number of Carriers	Modulation	Horizontal Polarization Occupied Signal Bandwidth (MHz)	Vertical Polarization Occupied Signal Bandwidth (MHz)
Left	24.3	1	64QAM	94.384	94.4308
Left	24.3 24.39984	2	QPSK	193.415	193.351
Left	24.7992 24.89904 24.99888	3	QPSK	291.624	291.758
Left	24.7992 24.89904 24.99888 25.09872	4	QPSK	390.889	390.816
Left	24.7992 24.89904 24.99888 25.09872 25.19856	5	16QAM	488.697	489.419
Left	24.3 24.39984 24.7992 24.89904 24.99888 25.09872 25.19856	7	16QAM	986.839	986.228
Left	24.3 24.39984 24.7992 24.89904 24.99888 25.09872 25.19856	7	64QAM	988.153	986.227

Tabular Data – Occupied Bandwidth **3MHz** RBW

Location in Band	Carrier Frequencies (GHz)	Number of Carriers	Modulation	Horizontal Polarization Occupied Signal Bandwidth (MHz)	Vertical Polarization Occupied Signal Bandwidth (MHz)
Left	24.3	1	64QAM	95.466	95.642
Left	24.3 24.39984	2	QPSK	194.061	193.945
Left	24.7992 24.89904 24.99888	3	QPSK	291.934	291.964
Left	24.7992 24.89904 24.99888 25.09872	4	QPSK	391.035	390.941
Left	24.7992 24.89904 24.99888 25.09872 25.19856	5	16QAM	488.468	489.275
Left	24.3 24.39984 24.7992 24.89904 24.99888 25.09872 25.19856	7	16QAM	986.906	986.094

Tabular Data – Occupied Bandwidth **5MHz** RBW

Location in Band	Carrier Frequencies (GHz)	Number of Carriers	Modulation	Horizontal Polarization Occupied Signal Bandwidth (MHz)	Vertical Polarization Occupied Signal Bandwidth (MHz)
Left	24.3	1	64QAM	97.230	97.393
Left	24.3 24.39984	2	QPSK	195.277	195.111
Left	24.7992 24.89904 24.99888	3	QPSK	292.616	292.674
Left	24.7992 24.89904 24.99888 25.09872	4	QPSK	391.523	391.441
Left	24.7992 24.89904 24.99888 25.09872 25.19856	5	16QAM	488.668	489.541
Left	24.3 24.39984 24.7992 24.89904 24.99888 25.09872 25.19856	7	16QAM	987.013	986.172

Tabular Data – Occupied Bandwidth **10MHz** RBW

Location in Band	Carrier Frequencies (GHz)	Number of Carriers	Modulation	Horizontal Polarization Occupied Signal Bandwidth (MHz)	Vertical Polarization Occupied Signal Bandwidth (MHz)
Left	24.7992 24.89904 24.99888 25.09872 25.19856	5	16QAM	490.280	491.721
Left	24.3 24.39984 24.7992 24.89904 24.99888 25.09872 25.19856	7	QPSK	988.003	987.082
Left	24.3 24.39984 24.7992 24.89904 24.99888 25.09872 25.19856	7	16QAM	988.209	987.181

4.3.1.1 Results - Occupied Bandwidth Carrier Aggregation

The April 12, 2016 TCBC viewgraph package identified that Carrier Aggregation data should be supplied during filing. This requirement is not yet formalized in a KDB for LTE, 5G-NR or UMFUS but we used the same rules as used for Part 15. The multi-carrier bandwidth of the **FA3UB** is thus defined as follows. We have a two carrier configuration in the lower band and one to five carrier configurations in the USA upper n258 band. In both cases the individual carriers, with a bandwidth of 97.5 MHz maximum, are spaced on center 99.96 MHz apart and they do not overlap.

The overall signal bandwidth for 5 adjacent carriers is depicted in Figure 4.3.1.1. This is the maximum number of adjacent 97M5G7W carriers that can fit in the upper FCC authorized 24.75-25.25 GHz Band. The calculated assessment was that the 5 carrier aggregated bandwidth is 497.34 MHz which translates to an appropriate aggregated emissions designator of 498MG7W. The measurement of 5 adjacent carriers documented a measured maximum 5 carrier bandwidth of 492 MHz which is within the parameters of the selected Carrier Aggregation Emissions Designator.

During operation, one or two carriers may be placed in the lower FCC authorized 24.25-24.45 GHz portion of the spectrum. These were not considered part of the larger upper band aggregated bandwidth as they are non-adjacent and separated by a 300 MHz gap from the 24.75-25.25 portion of the spectrum.

So considered separately, the two carrier configuration produces an aggregated bandwidth of:

99.96 MHz + 97.5 MHz = 197.46 MHz which indicates a 198MG7W Emissions Designator

The calculated assessment for two through seven carriers using a 99.96 channel spacing are identified below.

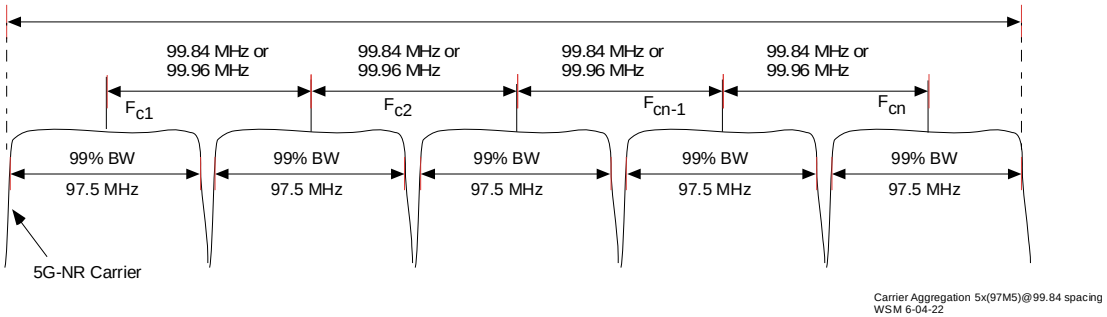
Two Carrier Aggregation Bandwidth = 1(99.96) + 97.5MHz = 197.46 MHz = 198MG7W
Three Carrier Aggregation Bandwidth = 2(99.96) + 97.5MHz = 297.42 MHz = 298MG7W
Four Carrier Aggregation Bandwidth = 3(99.96) + 97.5MHz = 397.38 MHz = 398MG7W
Five Carrier Aggregation Bandwidth = 4(99.96) + 97.5 MHz = 497.34 MHz = 498MG7W

The maximum calculated assessment for two through seven carriers using 99.84 channel spacing are identified below.

Two Carrier Aggregation Bandwidth = 1(99.84) + 97 MHz = 196.84 MHz = 197MG7W
Three Carrier Aggregation Bandwidth = 2(99.84) + 97 MHz = 296.68 MHz = 297MG7W
Four Carrier Aggregation Bandwidth = 3(99.84) + 97 MHz = 396.52 MHz = 397MG7W
Five Carrier Aggregation Bandwidth = 4(99.84) + 97 MHz = 496.36 MHz = 497MG7W

Since the values are nearly identical for two through seven the 99.96 set will be used.

Figure 4.3.1.1 Carrier Aggregation

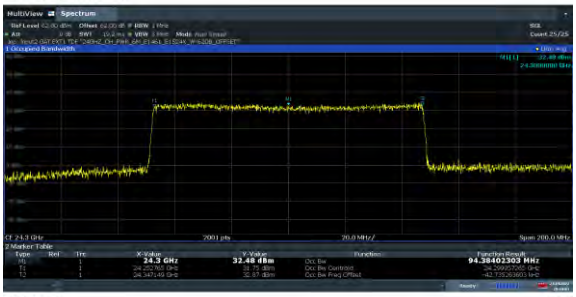


4.3.1.2 99% Signal Bandwidth Plots

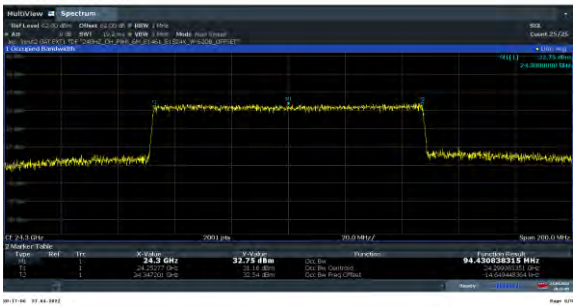
1MHz RBW

1 Carrier, 64QAM

Horizontal

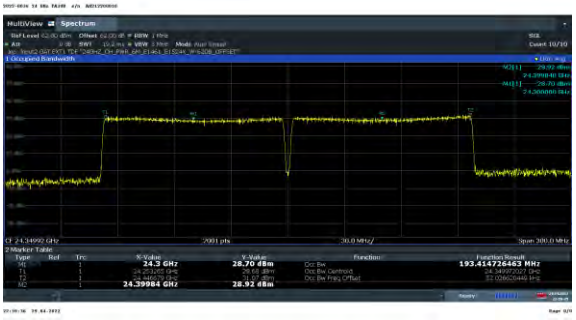


Vertical



2 Carrier, QPSK

Horizontal



Vertical

3 Carrier, QPSK

Horizontal

Vertical

4 Carrier, QPSK

Horizontal

Vertical

5 Carrier, 16QAM

Horizontal

Vertical

7 Carrier, 16QAM

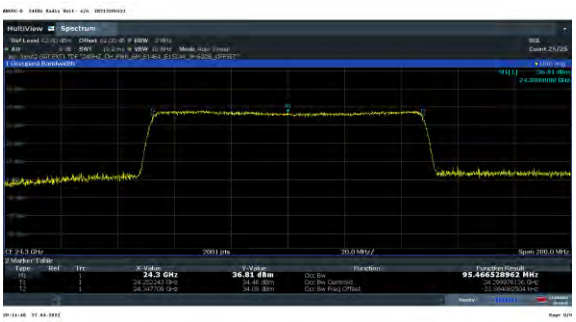
Horizontal

Vertical

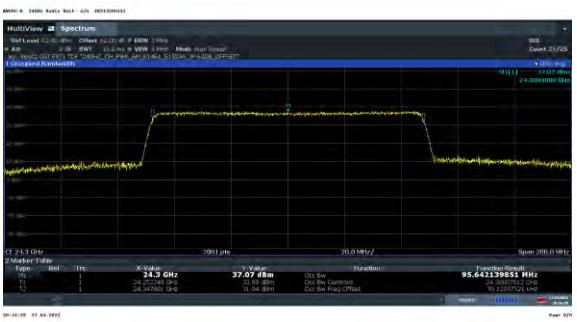
3MHz RBW

1 Carrier, 64QAM

Horizontal

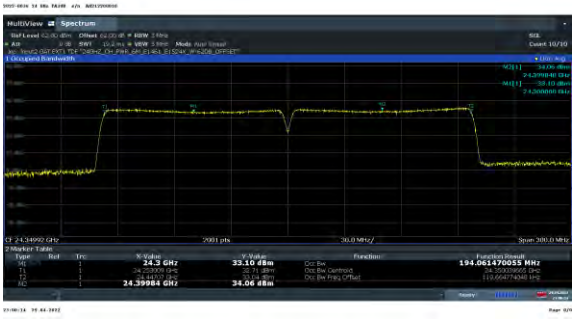


Vertical

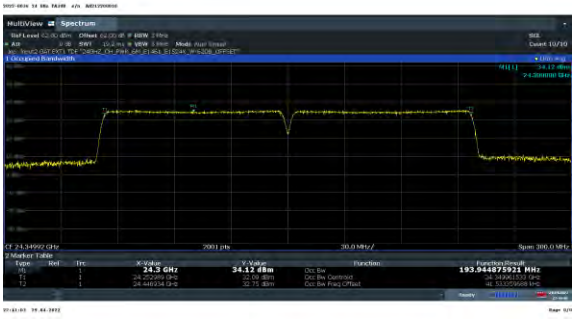


2 Carrier, QPSK

Horizontal



Vertical



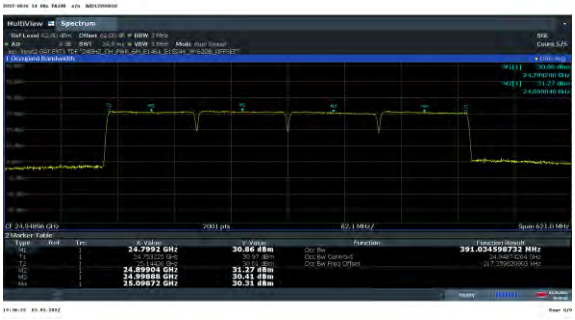
3 Carrier, QPSK

Horizontal

Vertical

4 Carrier, QPSK

Horizontal



Vertical

5 Carrier, 16QAM

Horizontal

Vertical

7 Carrier, 16QAM

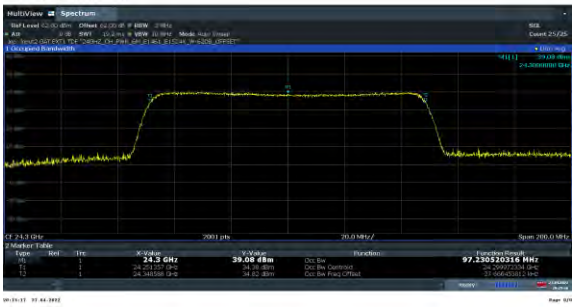
Horizontal

Vertical

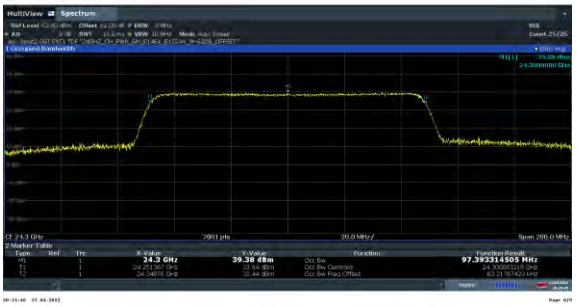
5MHz RBW

1 Carrier, 64QAM

Horizontal

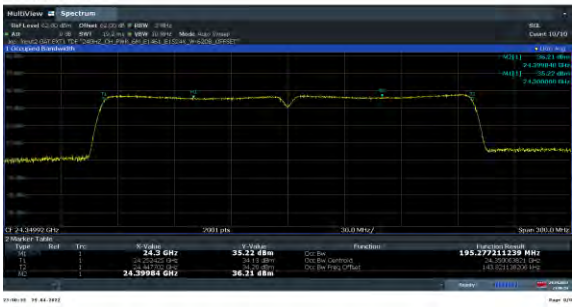


Vertical

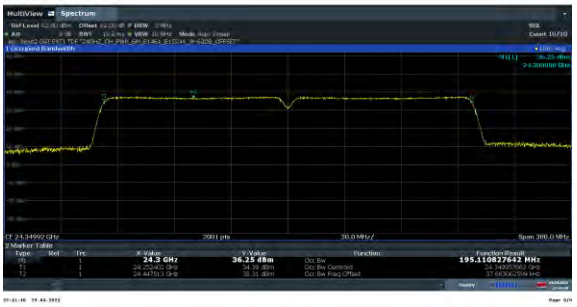


2 Carrier, QPSK

Horizontal



Vertical



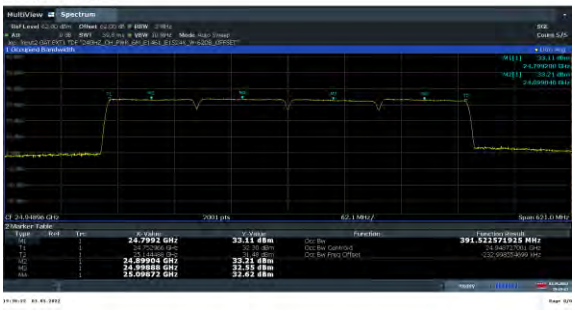
3 Carrier, QPSK

Horizontal

Vertical

4 Carrier, QPSK

Horizontal



Vertical

5 Carrier, 16QAM

Horizontal

Vertical

7 Carrier, 16QAM

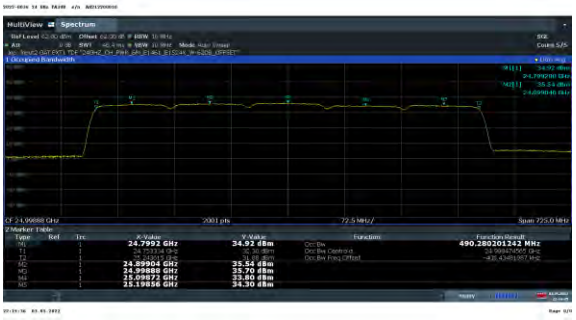
Horizontal

Vertical

10MHz RBW

5 Carrier, 16QAM

Horizontal



Vertical

7 Carrier, QPSK

Horizontal

Vertical

7 Carrier, 16QAM

Horizontal

Vertical

4.3.2 Occupied Bandwidth-Edge of Block Emissions

The classical Occupied Bandwidth measurement of Edge of Block Emissions or conveniently Out Of Band Emissions (OOBE) is an evaluation of the transmit carrier compliance with edge of block/edge of band requirements. This measurement documents the product's ability to maintain compliance with FCC Parts 2 and Part 30.203 limitations on emissions outside the block/ band of operation.

The **2AD8UFA3UB01 FA3UB 5G AirScale 24 GHz mmWave ASMR Radio** presently supports nominal 100 MHz bandwidth 5G-New Radio LTE TDD technologies. The Out Of Band evaluation addresses operation with one through seven carriers.

The OOBE evaluation is used to measure the maximum average spurious levels outside the transmit band as measured at the 6.0 m far field distance. The measurements were performed for one and two carriers in the lower 24.25-24.45 GHz Block and one to five carriers in the upper 24.75-25.25 GHz Block for a nominal 100 MHz bandwidth carrier with 5G-NR. Channel power plots identify the individual carrier power, modulation and the total power. The measurement process meets the requirements of ANSI C63.26 and ISO17025. The test setup was as shown in Figure 4.1.1. Measurements were performed at 5.7m for both vertical and horizontal polarizations.

The Out Of Band Emissions of each of the signals identified in Table 4.3.6 was measured using a Rohde & Schwarz FSW85 Spectrum analyzer, a remote PC based instrumentation controller and the same calibrated RF attenuation path used for channel power. The correction included the products antenna gain to correct the emissions to the relative "antenna connection" port. All spurious emissions > 10% Signal BW outside the band was evaluated for compliance without the product gain as is required.

Plots are provided using the triggered functionality of the test analyzer and demonstrate compliance with edge of band limits.

These sheets contain data for multiple mixed carrier configurations for "Left Edge of Block", and "Right Edge of Block" across the Part 30 Upper Microwave Flexible Use Service spectrum.

4.3.3 Requirements 39 GHz Emissions Limits

The Limit in 47 CFR 30.203 for Emissions Limits is as follows:

(a) The conductive power or the total radiated power of any emission outside a licensee's frequency block shall be −13 dBm/MHz or lower. However, in the bands immediately outside and adjacent to the licensee's frequency block, having a bandwidth equal to 10 percent of the channel bandwidth, the conductive power or the total radiated power of any emission shall be −5 dBm/MHz or lower.

(b)(1) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater.

(2) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges as the design permits.

(3) The measurements of emission power can be expressed in peak or average values.

In order to address the limit as imposed for the requirement in 47CFR 96.41 we evaluated emissions per the requirements in ANSI C63.26 and per KDB 940660 D01 Part 30 CBRS Equipment.
The average detector function was used for all MXA measurements and the Peak detector function were used for EMC receiver measurements.

4.3.4 Measurement Offset and MIMO

As this was a radiated EIRP measurement no MIMO adjustment was used.

4.3.5 Mask Parameters

The mask parameters are in units as stated in Part 30 and are listed in Table 4.3.5. Mask parameters are as stated in Table 4.3.5. The Guard band was adjusted for 10% of the maximum signal bandwidth (80 MHz). Mask Edge Offsets = ½ the measurement Resolution Bandwidth were not used.

Table 4.3.5 - Mask Parameters Out Of Band / Edge of Band Emissions

Frequency	Part 30 Limit
GHz	dBm
22.00	-13.0
24.24	-13.0
24.24	-5.0
24.25	-5.0
24.25	28.0
24.45	28.0
24.45	-5.0
24.46	-5.0
24.46	-13.0
24.74	-13.0
24.74	-5.0
24.75	-5.0
24.75	28.0
24.75	28.0
25.25	28.0
25.25	-5.0
25.26	-5.0
25.26	-13.0
33.00	-13.0

4.3.6 Measurement Path Adjustments

The measured power at the spectrum analyzer input was adjusted for calculated free space loss, cable loss, measurement antenna gain and the product antenna gain over its applicable frequency range as documented in Exhibit 6 of the filing and in the table below. This is appropriate for Out Of Band Emissions / Edge of Band emissions only for the frequency range that the transmit antenna has documentable and consistent gain. Since different products have different gain responses vs frequency, the products documentable antenna gain only applies for the operational frequency range for which the product is designed.

Sample calculation: The sample calculation below is the formula and the correction for 25 GHz;

Adjustment **=** Free Space Path Loss - Measurement Antenna Gain + Cable Loss - Product Antenna Gain.

Total Required Adjustment (@25 GHz) **=** 38.01 dB = 75.96dB -24.14dBi + 11.72dB – 25.53 dBi

This adjustment was only used for the OOBE/EoB frequency range. Table 4.3.6 below lists the offset correction factors used for the measurement distance of 6.0 m including the FA3UB product gain. The measurements were made using a flat offset of 37 dB with a transducer correction identified below.

Table 4.3.6 Measurement Correction for Edge of Band / Out of Band Emissions

Frequency	Free Space Path Loss, PL	Measurement Antenna Gain, "G"	Measurement Cable Loss, "L"	PL-G1+L1	AEWF Antenna Gain, IEEE	Total Required Adjustment	FSW Offset	Transducer Correction Factor
GHz	dB	dBi	dB	dB	dBi	dB	dB	dB
22.00	74.85	23.46	11.02	62.41	24.77	37.64	37	0.637
22.50	75.05	23.49	11.17	62.73	24.90	37.83	37	0.833
23.00	75.24	23.69	11.43	62.98	25.02	37.96	37	0.957
23.50	75.43	23.80	11.51	63.13	25.15	37.98	37	0.982
24.00	75.61	23.80	11.41	63.23	25.28	37.95	37	0.947
24.50	75.79	24.06	11.60	63.33	25.41	37.92	37	0.921
25.00	75.96	24.14	11.72	63.55	25.53	38.01	37	1.014
25.50	76.14	24.07	11.79	63.86	25.72	38.14	37	1.141
26.00	76.30	24.28	11.95	63.97	25.90	38.07	37	1.071
26.50	76.47	24.38	12.16	64.25	26.16	38.09	37	1.087
27.00	76.63	24.39	12.26	64.50	26.43	38.08	37	1.077
27.50	76.79	24.39	12.29	64.69	26.72	37.97	37	0.972
28.00	76.95	24.57	12.40	64.78	27.02	37.76	37	0.760
28.50	77.10	24.63	12.57	65.05	27.41	37.64	37	0.637
29.00	77.25	24.53	12.61	65.33	27.80	37.53	37	0.532
29.50	77.40	24.60	12.82	65.62	27.41	38.21	37	1.208
30.00	77.55	24.71	12.90	65.73	27.02	38.72	37	1.717
30.50	77.69	24.63	13.04	66.10	25.06	41.04	37	4.041
31.00	77.83	24.71	13.13	66.25	23.10	43.15	37	6.149
31.50	77.97	24.74	13.17	66.40	23.87	42.53	37	5.526
32.00	78.11	24.75	13.31	66.67	24.65	42.02	37	5.025
32.50	78.24	24.85	13.37	66.76	24.75	42.02	37	5.015
33.00	78.38	24.83	13.50	67.05	24.84	42.21	37	5.205

4.3.7 Edge of Band Measurements

The Occupied Bandwidth and Edge-of-Band emissions measurements were made as a radiated measurement at a distance of 6.0 m. The measurements were performed with an FSW spectrum analyzer in compliance with the procedure and requirements of ANSI C63.26. The test set-up diagram in Figure 4.1.1 was used. Testing was performed for the 100 MHz carrier configurations at the left side, and right side of the Part 30 Band. All of the Edge of Band measurements were performed at the specified 1 MHz resolution bandwidths. Adjustment factors were as described in Section 4.3.6 above.

4.3.7.1 Initial Results - Edge of Band Measurements

The initial Occupied Bandwidth and Edge-of-Band emissions measurements identified a single significant Out Of Band Emissions (OOBE). This emission was identified as a single LO narrowband spurious signal at 27.899285 GHz. Multiple transmit configurations were evaluated to determine the worst case operating configuration for generating the maximum spurious signal at 27.899285 GHz. . Multiple scans confirmed that the maximum signal was generated by a QPSK seven carrier configuration.

The OOBE measurements determined that the 27.899285 GHz signal maximum value was -0.66 dBm when not adjusted for the FA3UB Transmit Antenna gain. Per KDB 842590 D01 guidance these emissions needed to be evaluated using the Total Radiated Power methodology.

4.3.8 Total Radiated Power Evaluation of Out Of Band Emissions

Per KDB 842590 D01 the use of product array gain to reference the radiated spurious to the conducted transmit signal is not valid at greater than 10% of signal bandwidth outside the band. For reference, if the gain was allowable for the 27.8993 GHz spur it would result in a final value of -27.68 dBm which is 14.68 dB of margin to the limit. Without the consideration for transmit antenna gain the OOBE measurements determined that the 27.8993 GHz signals maximum value was -0.66 dBm and needed to be evaluated for Total Radiated Power.

Following the requirements and guidance of KDB 842590 D01 a Two and Three Cut Total Radiated Power (TRP) evaluation was performed on the spurious signals.

Two Cut and Three cut TRP evaluations were performed at a measurement distance of 4m per KDB 842590 D01. We used our ISO 17025 accredited Radiated Emissions measurement process software with updated software drivers for control of the FSW85 analyzer and modifications for data export. Measurements were performed every 4 degrees. For cuts one and two the maximum beam height was 168 cm. For Cut 3 the height was 193 cm. The first cut was performed with the receive antenna Vertically polarized and the second cut was performed with the receive antenna Horizontally polarized. The product under test has two arrays (H&V) which are at the same height and their peak beam is also at the same height but about 1 degrees apart in azimuth. There was no attempt to duplicate the data cuts as it would not result in any change in average value. The sweeps were performed with the following settings as follows:

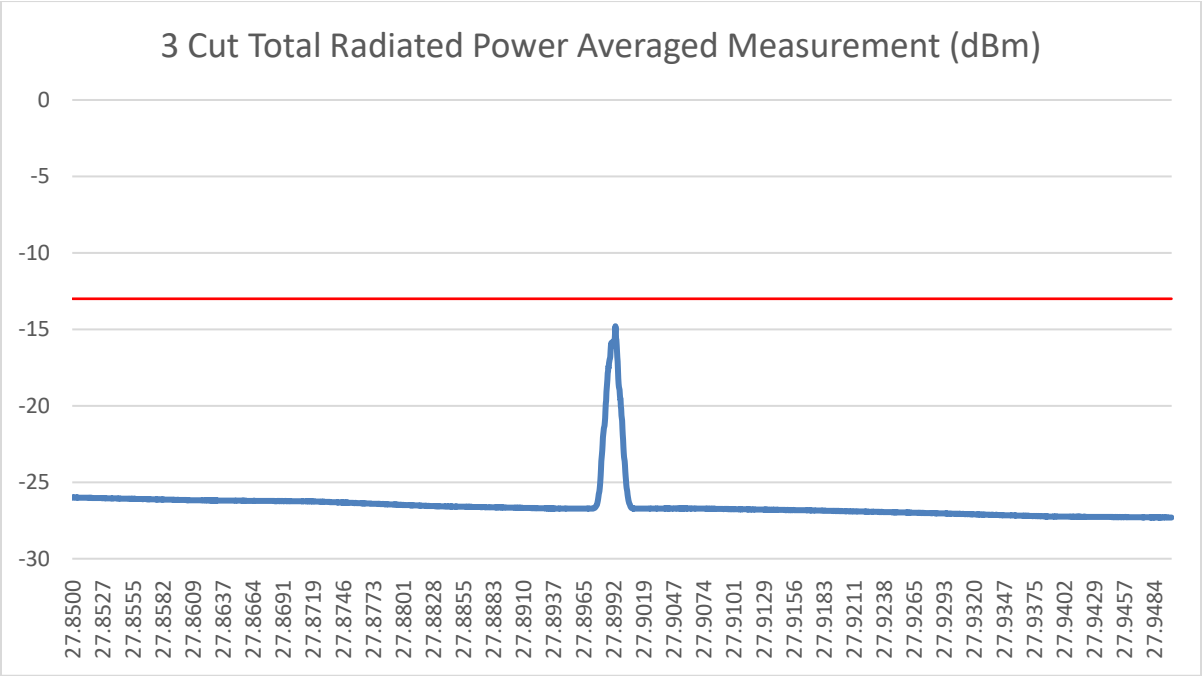
	Spur #1
Frequency range:	27.85 GHz to 27.95 GHz
Resolution Bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector:	RMS
Trace averaging Factor	120
Number of points	3001
Turntable step size	4 degrees
Three cut correction factor	1.5 dB

4.3.8.1 Total Radiated Power Results

The net result for the Spur was a maximum corrected TRP value of -14.986 dBm at 27.899258 GHz. Which demonstrates 1.99 dB margin to the -13 dBm limit. This emission is reportable.

The plot of the Three Cut Average TRP measurements over frequency are plotted below.

TRP Data Plot for 27.85-27.95 GHz



4.3.8.2 Out Of Band Emissions Results

The Out Of Band Emissions plots for the tested configurations of one through seven carriers operation are below. These Occupied Bandwidth and Edge-of-Band emissions measurements were made as a radiated measurement at the verified far field measurement distance of 6.0 m. The plots show compliance to the Part 30 FCC limit for the n258 Band for all signals except the single narrowband local oscillator spurious at 27.8993 GHz. This spur was evaluated for compliance using the three cut TRP method and found to be compliant.
The out-of-band emissions plots attached below document that all the emissions are compliant.

The measurement results of the occupied bandwidth and the out-of-band emissions as documented in the plots and Table 4.3.6.1 demonstrate the full compliance with the Rules of the Commission for the operating band.

Table 4.3.7.1 Results - Occupied Bandwidth-Edge of Block Emissions/ OOBE

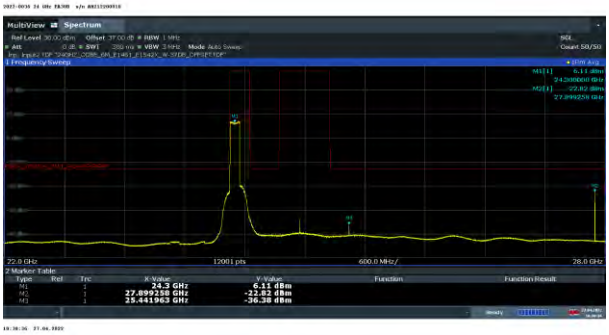
Center Frequencies of Edge Channels, GHz	Location	Number of Carriers	Modulation	Polarization	Occupied Bandwidth Edge of Block / OOBE Compliance
24.3	Left Side of Band	1	64QAM	Horizontal	Compliant
				Vertical	Compliant
24.3 24.39984	Left Side of Band	2	QPSK	Horizontal	Compliant
				Vertical	Compliant
24.7992 24.89904 24.99888	Left Side of Right Block	3	QPSK	Horizontal	Compliant
				Vertical	Compliant
24.7992 24.89904 24.99888 25.09872	Left Side of Right Block	4	QPSK	Horizontal	Compliant
				Vertical	Compliant
24.7992 24.89904 24.99888 25.09872 25.19856	Right Block	5	16QAM	Horizontal	Compliant
				Vertical	Compliant
24.3 24.39984 24.7992 24.89904 24.99888 25.09872	1c Left + 5c Right	6	16QAM	Horizontal	Compliant
				Vertical	Compliant
24.3 24.39984 24.7992 24.89904 24.99888 25.09872 25.19856	Full Band	7	QPSK	Horizontal	Compliant
				Vertical	Compliant
24.3 24.39984 24.7992 24.89904 24.99888 25.09872 25.19856	Full Band	7	16QAM	Horizontal	Compliant
				Vertical	Compliant
24.3 24.39984 24.7992 24.89904 24.99888 25.09872 25.19856	Full Band	7	64QAM	Horizontal	Compliant
				Vertical	Compliant

4.3.8.2.1 Occupied Bandwidth Edge of Band Plots

1 Carrier – 64QAM / Left

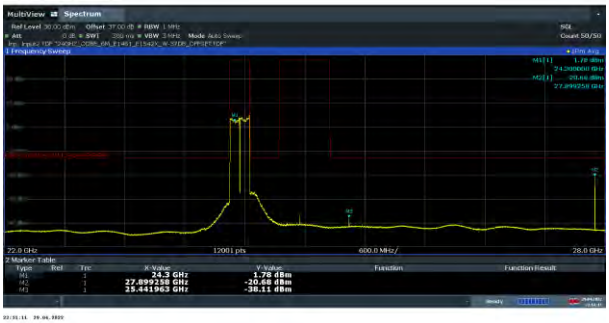
OOBE/EoB – Horizontal Polarization

OOBE/EoB – Vertical Polarization

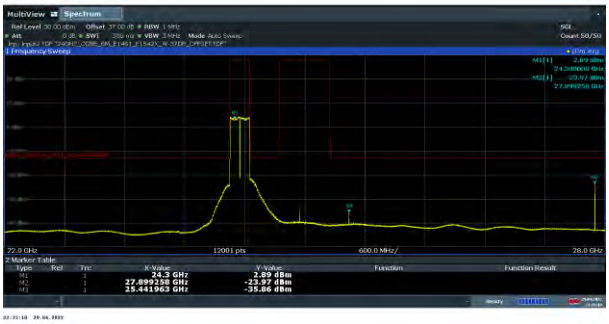


2 Carrier – QPSK / Left

OOBE/EoB – Horizontal Polarization

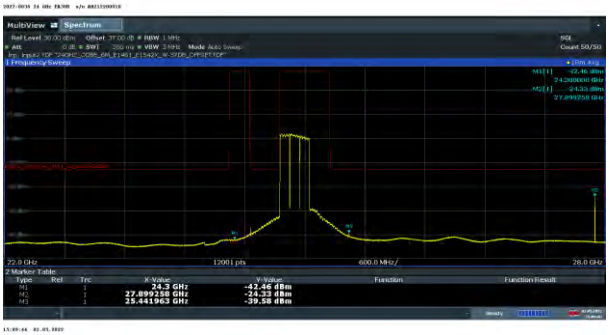


OOBE/EoB – Vertical Polarization



3 Carrier – QPSK / Left

OOBE/EoB – Horizontal Polarization



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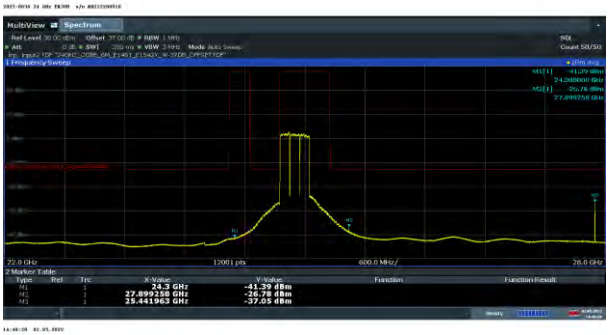
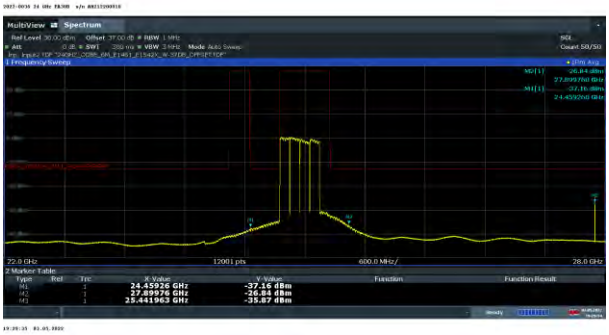
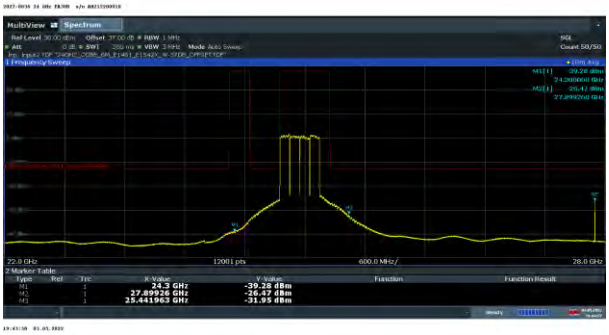


4 Carrier – QPSK / Left

OOBE/EoB – Horizontal Polarization

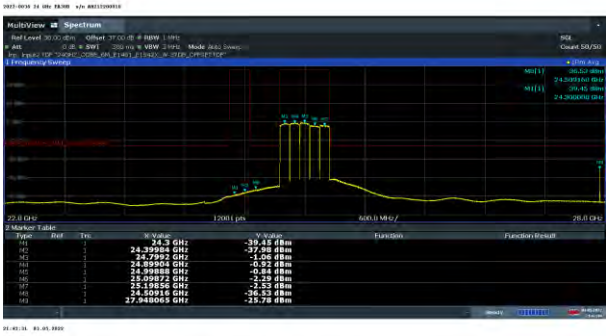


OOBE/EoB – Vertical Polarization

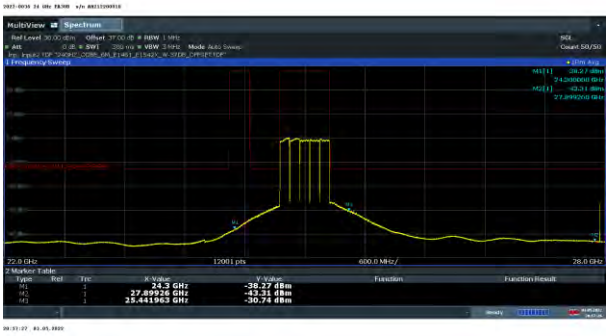


5 Carrier – 16QAM / Left

OOBE/EoB – Horizontal Polarization

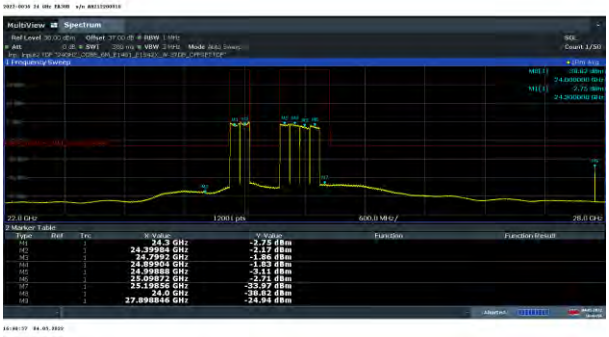


OOBE/EoB – Vertical Polarization

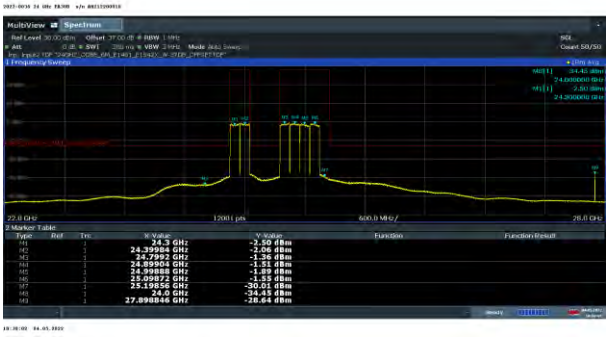


6 Carrier – 16QAM / Left

OOBE/EoB – Horizontal Polarization

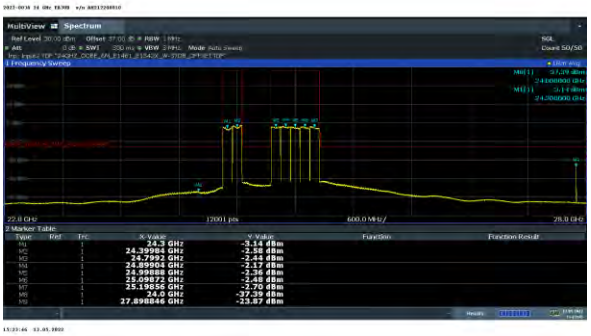


OOBE/EoB – Vertical Polarization

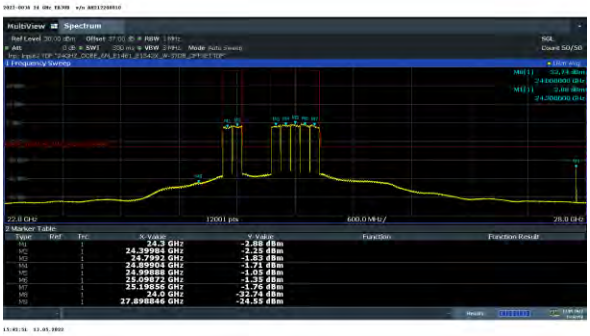


7 Carrier – QPSK / Left

OOBE/EoB – Horizontal Polarization

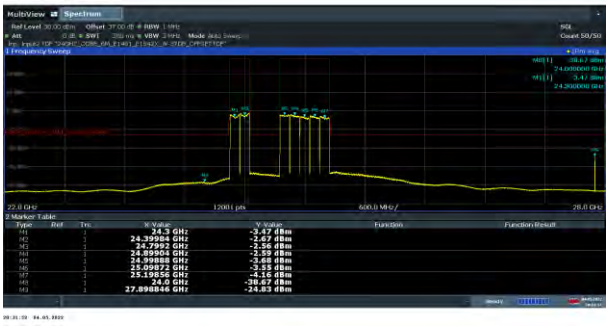


OOBE/EoB – Vertical Polarization

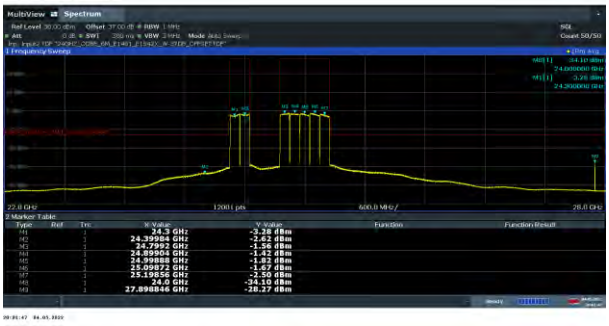


7 Carrier – 16QAM / Left

OOBE/EoB – Horizontal Polarization

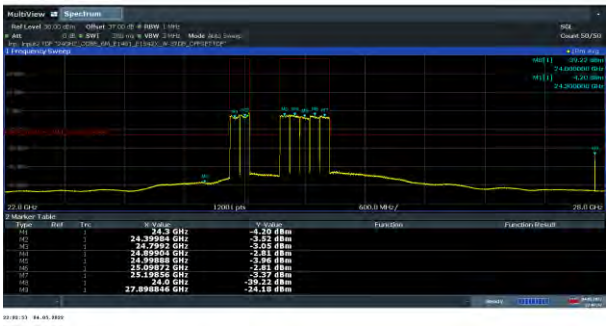


OOBE/EoB – Vertical Polarization

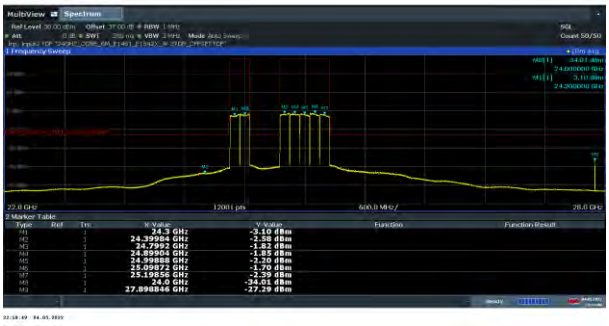


7 Carrier – 64QAM / Left

OOBE/EoB – Horizontal Polarization

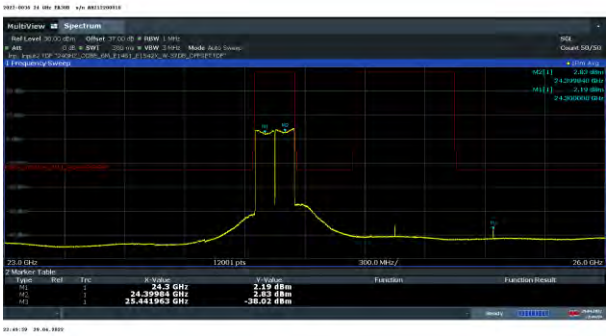


OOBE/EoB – Vertical Polarization

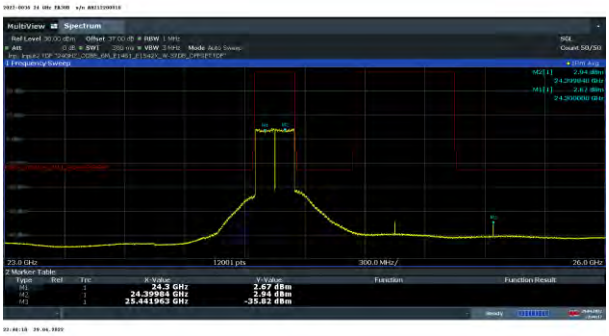


2 Carrier – QPSK / Left

OOBE-n/EoB – Horizontal Polarization

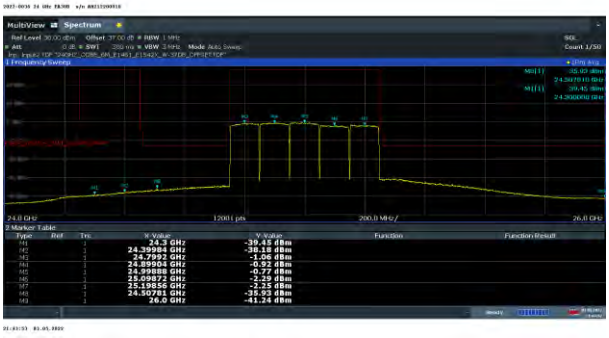


OOBE-n/EoB – Vertical Polarization

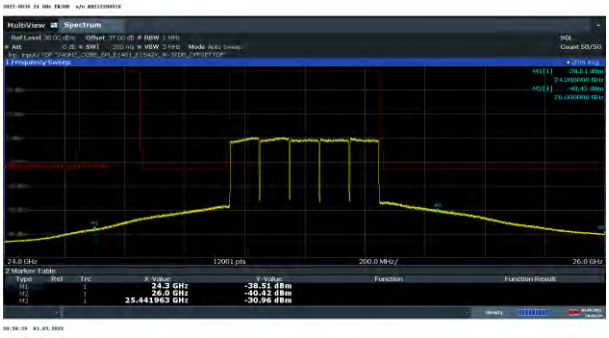


5 Carrier – 16QAM / Left

OOBE-n/EoB – Horizontal Polarization



OOBE-n/EoB – Vertical Polarization



4.4 Section 2.1051 MEASUREMENT REQUIRED: SPURIOUS EMISSIONS AT THE ANTENNA TERMINALS

This test measures the emissions of spurious signals which may come from harmonic, parasitic, intermodulation and frequency conversion products and are outside the necessary bandwidth but excludes Edge-of-Band emissions.

4.4.1 Section 2.1051 Spurious Emissions at Antenna Terminals

Spurious Emissions were investigated per 47CFR Section 2.1057(a)(1) over the frequency range of 30 MHz to 100 GHz as specified in 2.1057(a)(2).

> 2.1057(a) In all of the measurements set forth in §§2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:
>
> (2) If the equipment operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.
>
> (b) Particular attention should be paid to harmonics and subharmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.
>
> (c) The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.
>
> (d) Unless otherwise specified, measurements above 40 GHz shall be performed using a minimum resolution bandwidth of 1 MHz.

4.4.2 Required Limit

The required emission limitation specified in 47CFR 30.203 (a) was applied to these tests. Based upon the criterion given in Section 30 of the Code and as developed in 4.3.3, the required emission limit for emissions outside a licensee's frequency block is stated in 47CFR 30.203 (a):

> (a) The conductive power or the total radiated power of any emission outside a licensee's frequency block shall be -13 dBm/MHz or lower. However, in the bands immediately outside and adjacent to the licensee's frequency block, having a bandwidth equal to 10 percent of the channel bandwidth, the conductive power or the total radiated power of any emission shall be -5 dBm/MHz or lower.

4.4.3 Results

Since there is no antenna terminal, all measurements were performed as radiated measurements and standard radiated emissions. The Edge of Band emissions, presented in Section 4.3.7 and the Total Radiated Power (TRP) evaluation in 4.3.8 document the OOBE compliance for the 22-28 GHz frequency range which is well beyond the transmit band range of 24.25 – 25.25 GHz. Those measurements are appropriate as the products antenna gain is documented over the same ranges. There was one significant emission detected and was shown to be compliant in Section 4.3.8.1. There were no other emissions detected in these ranges within 20 dB of the limit.

The standard radiated emissions are documented in Section 4.5 "*Section 2.1053 Measurement Required: Field Strength of Spurious Radiation*". The test configuration is shown in Figure 4.4.1 documents the test set up used for the measurements. The measurements in Section 4.5 were performed in compliance with ANSI C63.26, KDB 842590 D01, C63.26 mmWave JTG, and our ISO17025 process. The measurement meets the ANSI C63.26 requirements in paragraphs 5.2.4.4.1 and 5.7 which requires that the number of points in the sweep be > 2 × Span/RBW. The FSW-67 spectrum analyzer measurements examine the 30 MHz to 40 GHz range. The FSW based mmWave transmitter test system were used to provide measurement capability from 40 GHz to 100 GHz range.

4.5 Section 2.1053 MEASUREMENT REQUIRED: FIELD STRENGTH OF SPURIOUS RADIATION

The field strength measurements of radiated spurious emissions were made in FCC registered five and ten meter semi-anechoic chambers AR-4 and AR-8 , (FCC Registration Number: 395774) **NVLAP** Lab Code: 100275-0 and IC (Filing Number: 6933F-4 & 8) which are maintained by Nokia Bell Labs in Murray Hill, New Jersey.

The **2AD8UFA3UB01** (EUT) was configured in semi-anechoic chamber AR-4 in a manner simulating a normal field installation. The recommendations of ANSI C63.4–2014, C63.26-2015, KDB 842590 D01 and C63.26 mmWave JTG were followed for EUT testing setup and cabling. The EUT was configured to operate in a 5G-NR test model per the constraints identified in section 4.2. A photograph of this setup is in Exhibit 12 of the filing package.

The Extension Unit was configured into the full power forward beam transmit configuration as defined in Table 4.5.1. The unit was configured with the maximum transmit bandwidth of seven carriers for each polarization. The Vertical and Horizontal polarizations each transmitted 52 dBm EIRP, with the total transmit power of 55 dBm EIRP. The product in the below configurations was evaluated over the 30 MHz to 100 GHz frequency range as required.

Table 4.5.1 EUT Transmit Configuration

Test Configuration NRARFCN	FA3UB Tx Frequencies GHz	Transmit Active Polarization	Signal Bandwidth, MHz	Modulation	Total Power, dBm EIRP	Radiated Emissions Pass / Fail
2017499	24300.00	H & V	100	64QAM	55	Pass
2019163	24399.84					
2025833	24800.04					
2027497	24899.88					
2029161	24999.72					
2030825	25099.56					
2032489	25199.40					

4.5.1 Spurious Radiation and Radiated Emissions Requirements.

This product meets Part 15B, and Part 30.203 requirements. FCC Part 15 Class B require emissions to be below 54.5 dBuV/m at 3m. Part 30.203 requires emissions to be below the value generated by a conducted emission of -13 dBm. This is a standard value for wireless products typically defined as

-43+10LogP=-13 dBm.

The evaluation of emissions at the Edge of Band was detailed in Sections 4.3.7 and 4.3.8. Emissions removed from the transmit band were evaluated identically to other wireless products.

Measurements were performed in compliance with Section 2.1053, FCC publication 442401, the requirements detailed above and clause 5.5 of ANSI C63.26. For this case the evaluation of acceptable radiated field strength is as follows.

The calculated emission levels were found by:

Pmeas (dBm) + Cable Loss(dB) + Antenna Factor(dB) + 107 (dBμV/dBm) -Amplifier Gain (dB) = Field Strength (dBμV/m)

Title 47CFR section 30.203 and 2.1053 contains the requirements for the levels of spurious radiation as a function of the EIRP of the modulated carrier with 100 MHz of bandwidth. The reference level for the modulated carrier is calculated as the field produced by an isotropic radiator excited by the transmitter output power according to the following relation taken from Reference Data for Radio Engineers, page 27-7, 6th edition, IT&T Corp.

$$\mathbf{E = (120\pi P)^{1/2} = [(30*P)^{1/2}] / R}$$

$$\mathbf{20 \log (E*10^{6}) - (43 + 10 \log P) = 82.23\ dB\ \mu V/meter}$$

Where: E = Field Intensity in Volts/ meter R = Distance in meters = 3 m
P = Transmitted Power, Watts = 316.23 W

The field strength of radiated spurious emissions measured was determined by

E(dBμV/m) = V_{meas} (dBμV) + Cable Loss (dB) + Antenna Factor (dBi/m).

Field strength measurements of radiated spurious emissions were made in the semi-anechoic chamber, AR-4 as detailed above. The recommendations of ANSI C63.4 and ANSI C63.26 were followed for EUT testing setup, cabling, and measurement approach and procedures. All the measurement equipment used, including antennas, was calibrated in accordance with ISO 9001 process. The EUT setup diagram is given in the Figure 4.5. The minimum margins to the Part 30.203 limit is as measured in accordance with 2.1053. The test data follows.

4.5.2 Radiated Spurious Emissions Measurements: 40 GHz - 100 GHz

The radiated spurious emissions spectrum was investigated per 47CFR Section 2.1057(a)(1) for spurious emissions over the frequency range of 40 GHz to 100 GHz. The procedure and methodology followed the recommendations of ANSI C63.4–2014, C63.26-2015 and C63.26 mmWave JTG.

A Rohde & Schwarz FSW 67 was employed with external three port Harmonic Down Converters (HDC). The waveguide RF input converters provided coverage for 40-60 GHz (U), 60-90 GHz (E), and 90-140 GHz (F) bands. The HDC's were paired with 25 dB Standard Gain Horns. A 40 GHz waveguide high pass filter was utilized to limit the transmit carrier emissions from overloading the 40-60 GHz HDC.

Operation of the harmonic down converters utilizes a swept LO with a fixed IF frequency of 1.325 GHz. The IF cable loss for the 4m of cable was 1.03 dB and was corrected internally to the FSW along with the Conversion loss for the harmonic down converters. Additional external shielding of the HDC's was necessary to limit carrier energy from creating immunity issues with the measurements.

Cable loss compensation for the LO cable loss was necessary to enable scan heights from 1-3 meters. The experience of this test indicated that a 3m maximum test height with this product is adequate (0.5 m above the top of product). This allowed for a reduction of the test cables length and reduce IF images which occurred at multiples of the 1.325 GHz IF frequency.

Measurements were performed at the following distances:

mmWave Band	Frequency Range, GHz	Measurement distance meters
U	40-60	4
E	60-90	4
F	90-140	3

Operation was verified prior to testing by bore-sighting a mmWave signal generator or mmWave source module with an antenna identical to the measurement antenna at the test distance. The location of the maximum beams had previously been ascertained for both vertical and horizontal polarizations. The beam is narrow and radiated power is down 23 dB at just $\pm$ 12 degrees off center. All of the emissions and harmonics were found to be centered on the beam as well.

Based upon previous experience a continuous max hold (average detector) sweep of the product in elevation and azimuth was employed for full coverage scanning of the product. For these measurements in each band the scan was started at the beam peak location of 21 degrees azimuth, and a nominal elevations 172 cm for Vertical and Horizontal. The peak was first located for the most prominent emissions in the span. The elevation was then swept down to 1m and back up back to 3m and returned to the beam peak. The product was then rotated continuously to 360 degrees back to 0 degrees and back to 21 degrees. This method locates any emission and provides the maximum emissions but required operation without the analyzer internal noise reduction function. Peaks were noted using the marker function which were later formally measured with the required 1 MHz resolution bandwidth. Measurements for 40-100 GHz were performed this way for the 7 carrier transmit configuration.

4.5.2.1 Bandwidth Limits and Corrections: Radiated Measurements 40 GHz - 100 GHz

All corrections were made to the signal level as detailed below.

4.5.2.2 Resolution Bandwidth and # of Points:

For measurements above 40 GHz we performed final measurement scans with the required 1 MHz resolution bandwidth and preliminary scans with either a 10 MHz or 3 MHz resolution bandwidth.

Final measurements were performed so that the resolution bandwidth and span limitations of ANSI C63.26 were followed so that the number of measurement points > 2(Span/RBW).
Our FSW can processes 100,000 data points across the screen which allows for 50 GHz spans with a 1 MHz RBW. Multiple spans were therefore used when necessary to evaluate the peak spurious emissions detected.

4.5.2.3 Part 30 Limit:

The -13 dBm emissions limit was not adjusted in any way.

4.5.2.4 Emissions Corrections

The measured signal was corrected by the FSW for the harmonic downconverter (HDC) conversion loss. In addition, a correction consisting of the radiated path loss, the gain of the measurement antenna and a 1 dB IF cable loss (at 1.3 GHz) was applied. There was no correction applied for the product antenna gain as these measurements are outside the transmit frequency range.

$$\text{Emissions Correction} = \text{Path Loss} - \text{Antenna Gain} + \text{IF Cable loss (1dB)}$$

$$\text{Where Free Space Path Loss} = ((4\pi d)/\lambda))^2$$

Table 4.5.2.4 details the correction for the three bands.

Table 4.5.2.4a Radiated Emissions Corrections for 40-60 GHz at 4m

Frequency	λ	Measurement Distance, d	Path Loss	Measurement Antenna Gain	IF Cable Loss	Emissions Correction Total
GHz	m	m	dB	dB	dB	dB
40.0	0.0075	4	76.52	21.80	1.03	55.75
42.5	0.0071	4	77.05	22.20	1.03	55.87
45.0	0.0067	4	77.55	22.50	1.03	56.07
47.5	0.0063	4	78.02	22.70	1.03	56.34
50.0	0.0060	4	78.46	23.00	1.03	56.49
52.5	0.0057	4	78.89	23.30	1.03	56.61
55.0	0.0055	4	79.29	23.40	1.03	56.91
57.5	0.0052	4	79.68	23.60	1.03	57.10
60.0	0.0050	4	80.05	23.70	1.03	57.37

Table 4.5.2.4b Radiated Emissions Corrections for 60-90 GHz at 4m

Frequency	λ	Measurement Distance, d	Path Loss	Measurement Antenna Gain	IF Cable Loss	Emissions Correction Total
GHz	m	m	dB	dB	dB	dB
60.0	0.0050	4	80.05	21.80	1.03	59.276
65.0	0.0046	4	80.74	22.30	1.03	59.471
70.0	0.0043	4	81.38	22.70	1.03	59.715
75.0	0.0040	4	81.98	23.00	1.03	60.014
80.0	0.0038	4	82.54	23.40	1.03	60.175
85.0	0.0035	4	83.07	23.60	1.03	60.501
90.0	0.0033	4	83.57	23.80	1.03	60.798

Table 4.5.2.4c Radiated Emissions Corrections for 90-100 GHz at 3m

Frequency	λ	Measurement Distance, d	Path Loss	Measurement Antenna Gain	IF Cable Loss	Emissions Correction Total
GHz	m	m	dB	dB	dB	dB
90.0	0.003333	3	81.07	21.90	1.03	60.199
95.0	0.003158	3	81.54	22.30	1.03	60.269
100.0	0.003	3	81.98	22.60	1.03	60.414

4.5.3 Field Strength of Spurious Radiation Results:

This product meets Part 15B limits below 10 GHz and Part 30 Requirements. For the Title 47CFR section 30.203 and 2.1053 test, the field strength of any spurious radiation, measured at 3m, is required to be less than 82.23 dBμV/meter. Emissions equal to or less than 62.23 dBμV/meter are not reportable.

All other emissions below 40 GHz were below the Part 15 Class B limit.

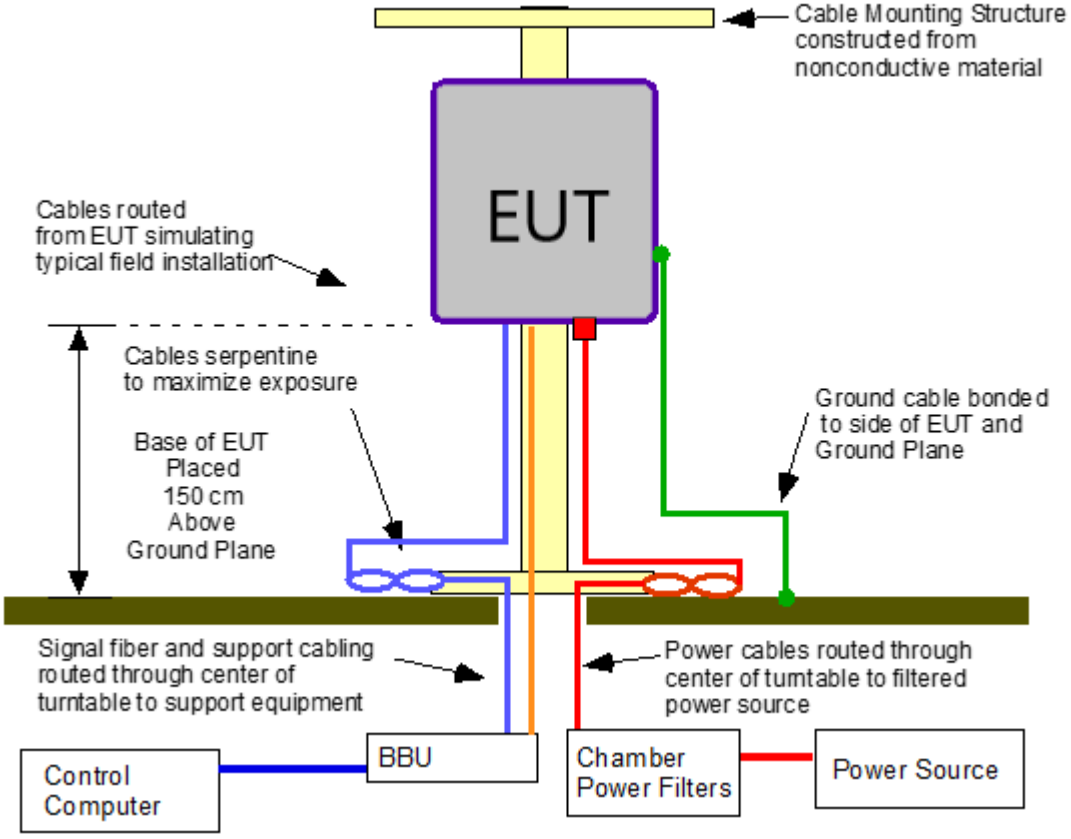
Presented results include the standard measurements from 30 MHz to 40 GHz followed by the four mmWave bands. The worst-case emissions are presented. The scans are performed with the required 1 MHz resolution bandwidth and sufficient number of points per ANSI C63.26 with markers at the frequencies of interest. The limit in the measurement is the conducted -13 dBm limit as specified in Part 30.203. Corrections to the emissions levels consisted of only the HDC conversion loss, the Free Space Path Loss and the gain of the measurement antenna as detailed in Table 4.5.2.4.

Over the out of band spectrum investigated from 30 MHz to 100 GHz, reportable spurious emissions were detected and determined to be compliant with the Part 30 limit.

This demonstrates that the **FA3UB 24 GHz ASMR mmWave Radio Extension Module FCC ID: 2AD8UFA3UB01**, the subject of this application, complies with FCC Part 15 Class B, and FCC Sections 2.1053, 30.203 and 2.1057 of the Rules.

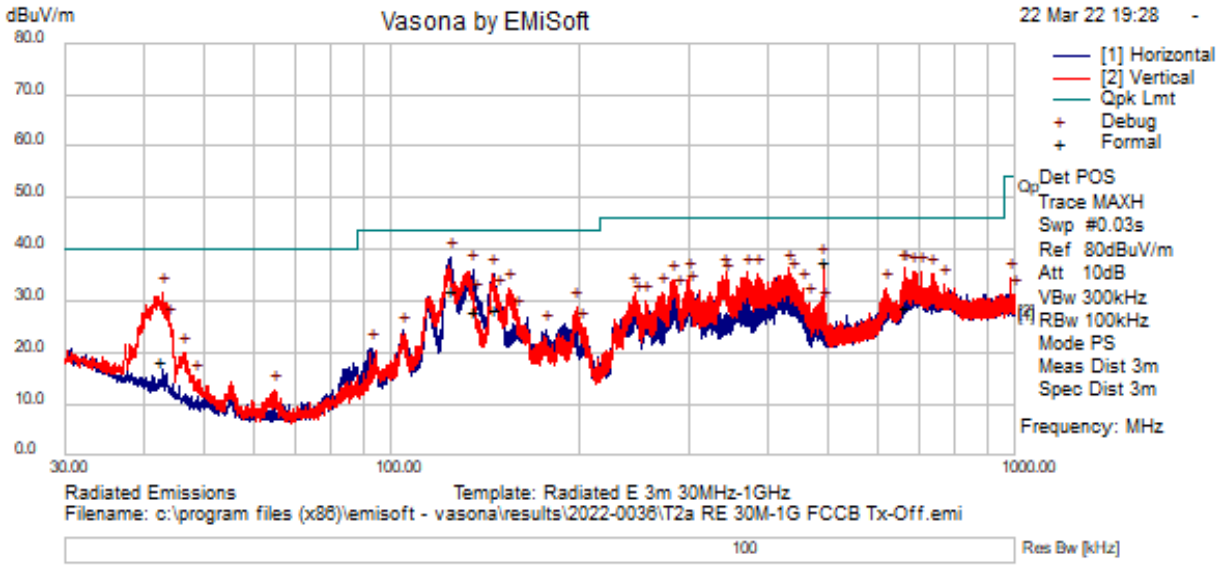
Photographs of the measurement setup are in the filing exhibits.

Figure 4.5 Radiated Emissions Product Setup



4.5.4 Transmitter Measurements of Radiated Spurious Emissions

T2a Radiated Emissions 30MHz-1GHz Tx-Off



Test Information

Results Title	Radiated Emissions 3m 30MHz-1GHz
File Name	T2a RE 30M-1G FCCB Tx-Off.emi
Test Laboratory	MH-AR4, 15.7%RH, 23.8C, 994hPa
Test Engineer	WSM / MJS
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	ASMR 24 Main + 24 Extensions (FA3UB) - New FCC Filing for Ext. Main Unit SN-AH211500018, Extension 1SN-AH212200012, Extension 2 SN-AH212200010, PN-475168A.104, PN-475046A.104**. Tx-Off**.
Configuration	AR4 - Powered by 120VAC, AWEUC-D and FA3UB Extension Module (475001A) FSW67-E1260, PA-E813, LPF-E980, BiLog Ant-E766, RE 30MHz - 1GHz FCC Part 15. Cable set-AR4.Internal Attenuation 10dB Preview RBW Default; Formal RBW Default.
Date	2022-03-22 19:28:04

Formal Data

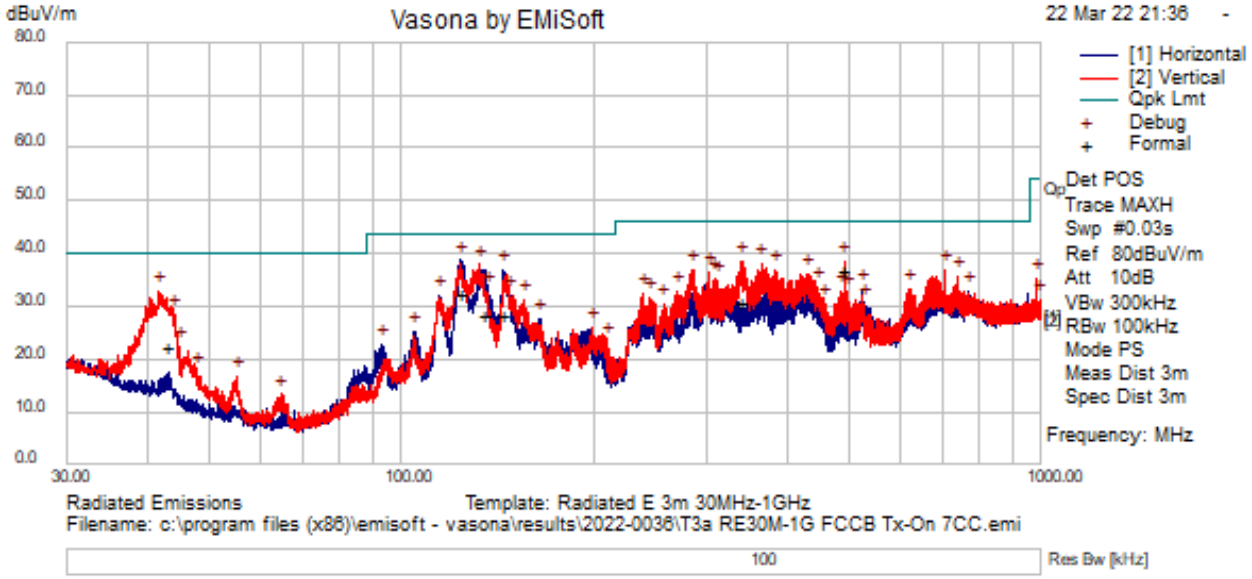
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
491.517	44.92	2.54	-9.65	37.81	QuasiMax	V	158	345	46.00	-8.19	Pass	
123.784	40.52	1.43	-10.02	31.92	QuasiMax	H	130	169	43.50	-11.58	Pass	
145.590	36.25	1.54	-9.43	28.36	QuasiMax	V	300	261	43.50	-15.14	Pass	
134.937	36.08	1.49	-9.64	27.93	QuasiMax	H	115	348	43.50	-15.57	Pass	
662.831	29.38	2.85	-3.34	28.89	QuasiMax	V	105	4	46.00	-17.11	Pass	
42.380	33.63	0.90	-15.95	18.58	QuasiMax	V	141	143	40.00	-21.42	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
124.510333	46.84	1.43	-9.92	38.36	Debug	H	175	180	43.50	-5.14	Pass	
134.986333	44.10	1.49	-9.64	35.95	Debug	H	100	352	43.50	-7.55	Pass	
145.527	43.12	1.54	-9.43	35.23	Debug	V	300	270	43.50	-8.27	Pass	
42.998	46.93	0.91	-16.24	31.60	Debug	V	100	135	40.00	-8.40	Pass	
491.493667	44.36	2.54	-9.66	37.25	Debug	V	100	352	46.00	-8.75	Pass	
662.763333	36.76	2.85	-3.35	36.26	Debug	V	100	0	46.00	-9.74	Pass	
433.843333	44.51	2.41	-10.68	36.24	Debug	V	200	315	46.00	-9.76	Pass	
666.029	36.07	2.86	-3.01	35.91	Debug	V	100	0	46.00	-10.09	Pass	
706.542667	34.20	2.92	-1.32	35.80	Debug	V	100	0	46.00	-10.20	Pass	
685.817	34.45	2.89	-1.60	35.73	Debug	V	100	352	46.00	-10.27	Pass	
371.892667	44.93	2.25	-11.72	35.46	Debug	V	100	45	46.00	-10.54	Pass	
343.342333	45.79	2.16	-12.53	35.42	Debug	V	100	352	46.00	-10.58	Pass	
735.416333	34.69	2.96	-2.31	35.34	Debug	V	100	0	46.00	-10.66	Pass	
386.669	44.19	2.29	-11.37	35.11	Debug	V	200	352	46.00	-10.89	Pass	
154.289333	40.78	1.59	-10.04	32.32	Debug	V	100	225	43.50	-11.18	Pass	
440.471667	42.78	2.43	-10.68	34.53	Debug	V	200	315	46.00	-11.47	Pass	
300.048	45.40	2.02	-12.96	34.46	Debug	V	100	315	46.00	-11.54	Pass	
282.749667	45.41	1.98	-13.30	34.10	Debug	V	100	315	46.00	-11.90	Pass	
346.090667	44.30	2.17	-12.53	33.95	Debug	V	100	0	46.00	-12.05	Pass	
148.469333	39.17	1.56	-9.38	31.36	Debug	V	300	270	43.50	-12.14	Pass	
768.008333	32.07	2.99	-1.92	33.14	Debug	H	100	45	46.00	-12.86	Pass	
137.185	38.71	1.50	-9.59	30.62	Debug	H	100	135	43.50	-12.88	Pass	
458.416667	40.39	2.47	-10.46	32.40	Debug	V	200	315	46.00	-13.60	Pass	
621.635333	33.41	2.79	-3.95	32.24	Debug	V	100	352	46.00	-13.76	Pass	
301.923333	43.00	2.03	-12.93	32.10	Debug	V	100	315	46.00	-13.90	Pass	
245.049	41.94	1.90	-12.10	31.74	Debug	V	100	45	46.00	-14.26	Pass	
44.259	41.49	0.91	-16.80	25.60	Debug	V	100	90	40.00	-14.40	Pass	
271.788667	42.82	1.96	-13.20	31.59	Debug	V	100	352	46.00	-14.41	Pass	
198.198	42.26	1.77	-15.39	28.64	Debug	V	100	90	43.50	-14.86	Pass	
288.537333	42.27	2.00	-13.18	31.09	Debug	V	100	315	46.00	-14.91	Pass	
255.945333	40.05	1.92	-11.88	30.10	Debug	V	100	225	46.00	-15.90	Pass	
248.767333	39.49	1.91	-11.54	29.86	Debug	V	100	225	46.00	-16.14	Pass	
159.139333	36.53	1.61	-10.81	27.33	Debug	V	100	0	43.50	-16.17	Pass	
467.373	37.26	2.49	-10.24	29.51	Debug	V	100	45	46.00	-16.49	Pass	
493.983333	35.75	2.55	-9.59	28.70	Debug	V	100	352	46.00	-17.30	Pass	
202.627667	38.60	1.78	-15.52	24.87	Debug	V	100	45	43.50	-18.63	Pass	
176.728667	36.07	1.69	-13.33	24.43	Debug	H	100	225	43.50	-19.07	Pass	
104.593	35.97	1.30	-13.12	24.16	Debug	H	175	352	43.50	-19.34	Pass	
983.025	33.37	3.32	-2.23	34.47	Debug	V	100	352	54.00	-19.53	Pass	
46.587	36.61	0.92	-17.72	19.82	Debug	V	100	270	40.00	-20.18	Pass	
999.127	30.02	3.36	-2.08	31.30	Debug	V	100	315	54.00	-22.70	Pass	
93.147	35.50	1.22	-15.96	20.76	Debug	H	175	352	43.50	-22.74	Pass	
48.785667	32.19	0.93	-18.51	14.62	Debug	V	100	180	40.00	-25.38	Pass	
64.920	32.39	0.99	-20.89	12.49	Debug	V	200	225	40.00	-27.51	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

T3a Radiated Emissions 3m 30MHz – 1GHz 7 Carrier Tx-On



Test Information

Results Title	Radiated Emissions 3m 30MHz-1GHz
File Name	T3a RE30M-1G FCCB Tx-On 7CC.emi
Test Laboratory	MH-AR4, 15.7%RH, 23.8C, 994hPa
Test Engineer	WSM / MJS
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	ASMR 24 Main + 24 Extension (FA3UB) - New FCC Filing for Ext. Main Unit SN-AH211500018 , Extension 1SN-AH212200012, Extension 2 SN-AH212200010, PN-475168A.104 , PN-475046A.104 . Tx -On 7CC - 64QAM.
Configuration	AR4 - Powered by 120VAC, AWEUC-D and FA3UB Extension Module (475001A) FSW67-E1260, PA-E813, LPF-E980, BiLog Ant-E766, RE 30MHz - 1GHz FCC Part 15. Cable set-AR4.Internal Attenuation 10dB Preview RBW Default; Formal RBW Default.
Date	2022-03-22 21:36:47

Formal Data

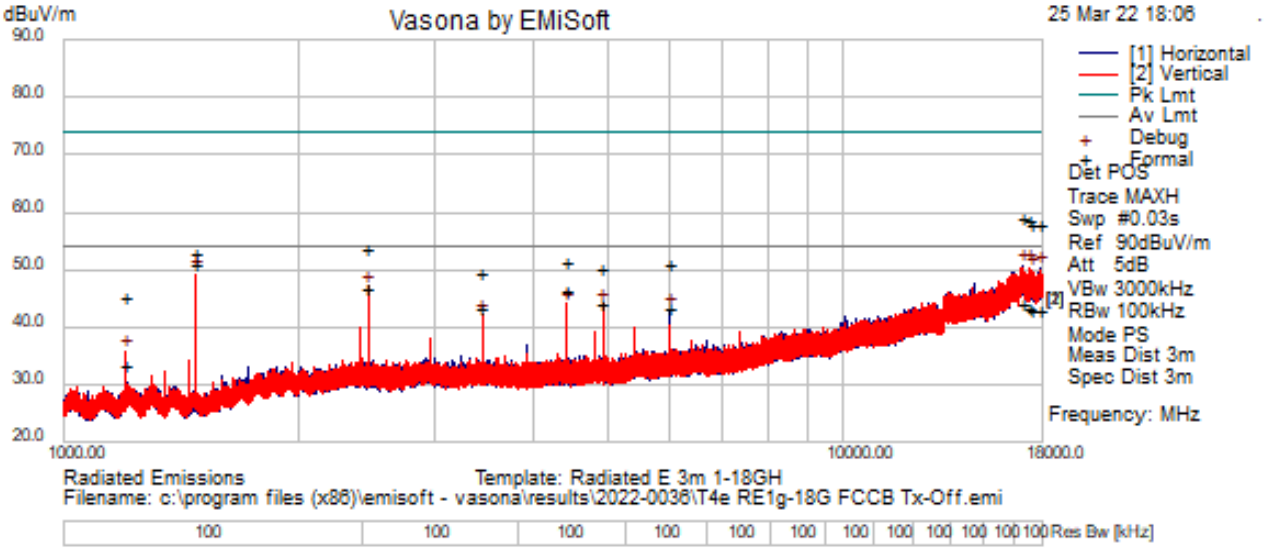
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
491.519	43.91	2.54	-9.65	36.80	QuasiMax	V	105	41	46.00	-9.20	Pass	
124.107	41.20	1.43	-9.98	32.65	QuasiMax	H	122	162	43.50	-10.85	Pass	
144.524667	36.52	1.54	-9.45	28.61	QuasiMax	H	279	6	43.50	-14.89	Pass	
134.514	36.76	1.49	-9.64	28.60	QuasiMax	V	174	178	43.50	-14.90	Pass	
339.379	41.43	2.15	-12.53	31.05	QuasiMax	V	103	347	46.00	-14.95	Pass	
43.215	37.76	0.91	-16.34	22.34	QuasiMax	V	114	105	40.00	-17.66	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
123.669667	47.28	1.43	-10.04	38.67	Debug	H	100	180	43.50	-4.83	Pass	
132.496667	46.05	1.48	-9.69	37.84	Debug	V	200	352	43.50	-5.66	Pass	
144.524667	44.59	1.54	-9.45	36.68	Debug	H	275	0	43.50	-6.82	Pass	
41.834	47.51	0.90	-15.70	32.71	Debug	V	100	90	40.00	-7.29	Pass	
491.493667	45.75	2.54	-9.66	38.64	Debug	V	100	352	46.00	-7.36	Pass	
340.206	48.91	2.15	-12.53	38.53	Debug	V	100	352	46.00	-7.47	Pass	
365.005667	47.68	2.23	-11.97	37.94	Debug	V	200	352	46.00	-8.06	Pass	
706.542667	35.39	2.92	-1.32	36.99	Debug	V	100	0	46.00	-9.01	Pass	
284.851333	48.07	1.99	-13.26	36.80	Debug	V	100	315	46.00	-9.20	Pass	
383.338667	45.85	2.28	-11.44	36.69	Debug	V	100	0	46.00	-9.31	Pass	
302.473	47.50	2.03	-12.92	36.61	Debug	V	100	315	46.00	-9.39	Pass	
432.194333	44.40	2.41	-10.68	36.13	Debug	V	200	315	46.00	-9.87	Pass	
742.432667	34.99	2.96	-2.34	35.62	Debug	V	100	0	46.00	-10.38	Pass	
136.667667	40.83	1.50	-9.60	32.73	Debug	H	100	352	43.50	-10.77	Pass	
308.842667	45.91	2.05	-12.81	35.15	Debug	V	100	352	46.00	-10.85	Pass	
312.043667	45.43	2.06	-12.75	34.74	Debug	V	100	352	46.00	-11.26	Pass	
148.081333	39.92	1.56	-9.38	32.09	Debug	H	275	0	43.50	-11.41	Pass	
114.713333	42.01	1.37	-11.42	31.96	Debug	H	175	180	43.50	-11.54	Pass	
44.226667	44.13	0.91	-16.79	28.26	Debug	V	100	45	40.00	-11.74	Pass	
155.291667	39.78	1.59	-10.20	31.17	Debug	V	100	180	43.50	-12.33	Pass	
446.194667	41.82	2.44	-10.68	33.58	Debug	V	200	315	46.00	-12.42	Pass	
620.730	34.65	2.78	-4.08	33.36	Debug	V	200	352	46.00	-12.64	Pass	
526.219667	39.57	2.61	-9.01	33.18	Debug	H	100	315	46.00	-12.82	Pass	
767.976	31.93	2.99	-1.93	33.00	Debug	H	100	180	46.00	-13.00	Pass	
487.290333	40.14	2.53	-9.76	32.91	Debug	V	100	90	46.00	-13.09	Pass	
269.396	43.79	1.96	-13.00	32.74	Debug	V	100	315	46.00	-13.26	Pass	
497.895667	39.58	2.56	-9.50	32.64	Debug	V	100	352	46.00	-13.36	Pass	
238.614667	43.44	1.88	-13.08	32.24	Debug	V	100	270	46.00	-13.76	Pass	
244.628667	42.02	1.90	-12.16	31.76	Debug	V	100	270	46.00	-14.24	Pass	
256.721333	40.57	1.93	-11.94	30.55	Debug	V	100	270	46.00	-15.45	Pass	
528.709333	36.80	2.62	-8.94	30.48	Debug	H	175	352	46.00	-15.52	Pass	
457.382	38.45	2.47	-10.49	30.42	Debug	V	200	315	46.00	-15.58	Pass	
164.248	37.39	1.63	-11.59	27.44	Debug	H	100	0	43.50	-16.06	Pass	
44.970333	38.61	0.92	-17.11	22.42	Debug	V	200	270	40.00	-17.58	Pass	
198.230333	39.53	1.77	-15.39	25.91	Debug	V	200	270	43.50	-17.59	Pass	
104.269667	37.02	1.30	-13.17	25.15	Debug	H	175	352	43.50	-18.35	Pass	
983.057333	34.15	3.32	-2.23	35.24	Debug	V	100	315	54.00	-18.76	Pass	
209.353	36.76	1.80	-15.44	23.13	Debug	V	100	225	43.50	-20.37	Pass	
93.405667	37.40	1.22	-15.88	22.74	Debug	H	175	352	43.50	-20.76	Pass	
47.815667	34.76	0.93	-18.16	17.52	Debug	V	100	352	40.00	-22.48	Pass	
994.826667	30.12	3.35	-2.12	31.35	Debug	H	175	135	54.00	-22.65	Pass	
55.317	35.73	0.96	-19.93	16.76	Debug	V	200	90	40.00	-23.24	Pass	
64.823	33.15	0.99	-20.88	13.26	Debug	V	200	270	40.00	-26.74	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

T4e Radiated Emissions 3m 1GHz – 18GHz Tx-Off



Test Information

Results Title	Radiated Emissions 3m 1-18GHz
File Name	T4e RE1g-18G FCCB Tx-Off.emi
Test Laboratory	MH-AR4, 30%RH, 22.8C, 994hPa
Test Engineer	MJS / WSM
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	ASMR 24 Main + 24 Extension (FA3UB) - New FCC Filing for Ext. Main Unit SN-AH211500018 , Extension 1SN-AH212200012, Extension 2 SN-AH212200010, PN-475168A.104 , PN-475046A.104 . Tx -Off
Configuration	AR4 - Powered by 120VAC, AWEUC-D and FA3UB Extension Module (475001A) FSW67-E1260, PA-E1166, LPF-E1475, Horn Ant-E1074, RE 1GHz - 18GHz FCC Part 15. Cable set-AR4.Internal Attenuation 5dB Preview RBW Default; Formal RBW 1M.
Date	2022-03-25 18:06:16

Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
1474.536223	59.07	2.60	-10.65	51.03	AvgMax	V	155	63	54.00	-2.97	Pass	
2457.585	49.04	3.16	-5.53	46.67	AvgMax	V	122	263	54.00	-7.33	Pass	
4423.694	46.06	4.17	-3.72	46.51	AvgMax	V	99	29	54.00	-7.49	Pass	
4915.222	43.06	4.53	-3.27	44.32	AvgMax	V	107	83	54.00	-9.68	Pass	
17025.853	27.44	10.04	6.52	44.00	AvgMax	H	257	68	54.00	-10.00	Pass	
3440.673	44.41	3.74	-4.66	43.49	AvgMax	V	99	325	54.00	-10.51	Pass	
5999.982	40.22	5.26	-2.02	43.46	AvgMax	H	149	30	54.00	-10.54	Pass	
17383.089	27.44	10.08	5.77	43.29	AvgMax	V	136	0	54.00	-10.71	Pass	
17530.989	27.44	10.23	5.53	43.21	AvgMax	V	163	112	54.00	-10.79	Pass	
17979.081	27.30	10.25	5.59	43.14	AvgMax	V	252	143	54.00	-10.86	Pass	
17025.853	42.43	10.04	6.52	58.99	PeakMax	H	257	68	74.00	-15.01	Pass	

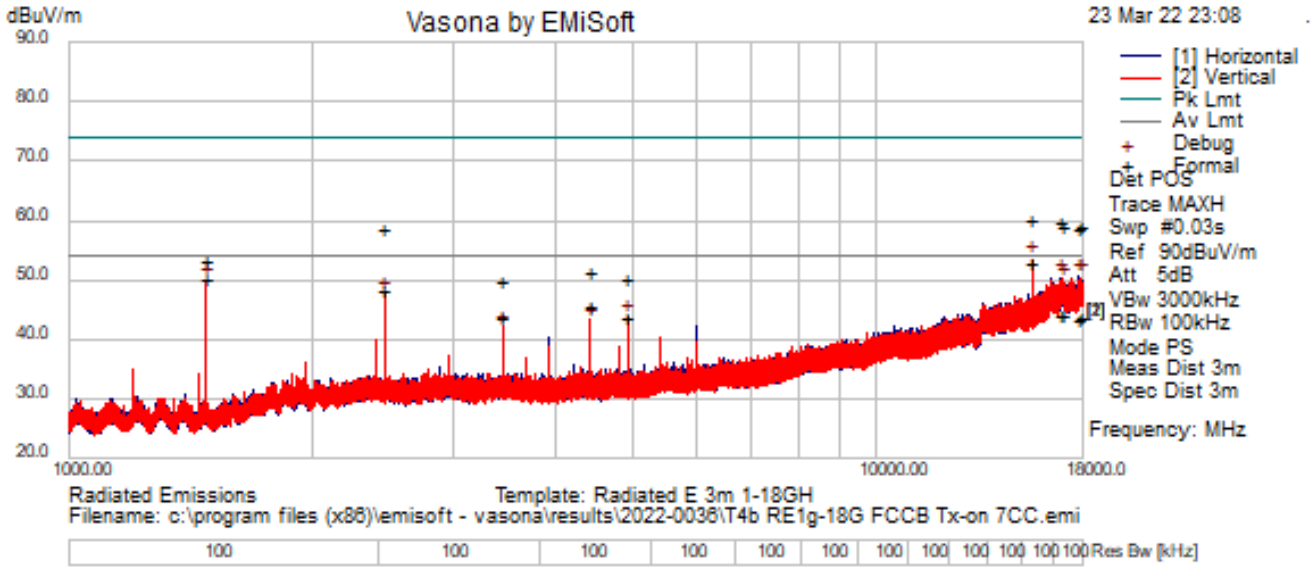
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
17383.089	42.81	10.08	5.77	58.66	PeakMax	V	136	0	74.00	-15.34	Pass	
17530.989	42.33	10.23	5.53	58.09	PeakMax	V	163	112	74.00	-15.91	Pass	
17979.081	42.11	10.25	5.59	57.95	PeakMax	V	252	143	74.00	-16.05	Pass	
2457.585	56.20	3.16	-5.53	53.83	PeakMax	V	122	263	74.00	-20.17	Pass	
1199.977	42.17	2.42	-11.26	33.34	AvgMax	V	101	347	54.00	-20.66	Pass	
1474.536223	61.02	2.60	-10.65	52.98	PeakMax	V	155	63	74.00	-21.02	Pass	
4423.694	51.12	4.17	-3.72	51.58	PeakMax	V	99	29	74.00	-22.42	Pass	
5999.982	47.90	5.26	-2.02	51.15	PeakMax	H	149	30	74.00	-22.85	Pass	
4915.222	49.00	4.53	-3.27	50.26	PeakMax	V	107	83	74.00	-23.74	Pass	
3440.673	50.59	3.74	-4.66	49.67	PeakMax	V	99	325	74.00	-24.33	Pass	
1199.977	54.15	2.42	-11.26	45.31	PeakMax	V	101	347	74.00	-28.69	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
17025.853	33.91	10.04	6.52	50.47	Debug	H	300	176	54.00	-3.53	Pass	
17383.089	34.51	10.08	5.77	50.37	Debug	V	200	110	54.00	-3.63	Pass	
17979.081	33.92	10.25	5.59	49.76	Debug	V	300	308	54.00	-4.24	Pass	
17530.989	33.65	10.23	5.53	49.41	Debug	V	100	132	54.00	-4.59	Pass	
1474.536223	57.25	2.60	-10.65	49.21	Debug	V	100	66	54.00	-4.79	Pass	
2457.585	48.93	3.16	-5.53	46.56	Debug	V	100	65	54.00	-7.44	Pass	
3440.673	42.40	3.74	-4.66	41.48	Debug	V	100	65	54.00	-12.52	Pass	
4423.694	43.04	4.17	-3.72	43.50	Debug	V	100	65	54.00	-10.50	Pass	
4915.222	42.03	4.53	-3.27	43.29	Debug	V	100	65	54.00	-10.71	Pass	
5999.982	39.33	5.26	-2.02	42.58	Debug	H	100	65	54.00	-11.42	Pass	
1199.977	44.35	2.42	-11.26	35.51	Debug	V	100	65	54.00	-18.49	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

T4b Radiated Emissions 3m 1GHz – 18GHz TX-On



Test Information

Results Title	Radiated Emissions 3m 1-18GHz
File Name	T4b RE1g-18G FCCB Tx-on 7CC.emi
Test Laboratory	MH-AR4, 30%RH, 22.8C, 994hPa
Test Engineer	MJS / WSM
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	ASMR 24 Main + 24 Extension (FA3UB) - New FCC Filing for Ext. Main Unit SN-AH211500018 , Extension 1SN-AH212200012, Extension 2 SN-AH212200010, PN-475168A.104 , PN-475046A.104 . Tx -On 7CC - 64QAM.
Configuration	AR4 - Powered by 120VAC, AWEUC-D and FA3UB Extension Module (475001A) FSW67-E1260, PA-E1166, LPF-E1475, Horn Ant-E1074, RE 1GHz - 18GHz FCC Part 15. Cable set-AR4.Internal Attenuation 5dB Preview RBW Default; Formal RBW 1M.
Date	2022-03-23 23:08:52

Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
15596.106	40.33	9.80	2.88	53.01	AvgMax	V	100	306	54.00	-0.99	Pass	
1474.561	58.53	2.60	-10.65	50.48	AvgMax	V	157	61	54.00	-3.52	Pass	
2457.608	50.58	3.16	-5.53	48.21	AvgMax	V	120	263	54.00	-5.79	Pass	
4423.680	45.27	4.17	-3.72	45.73	AvgMax	V	101	28	54.00	-8.27	Pass	
16961.158	27.76	10.01	6.44	44.21	AvgMax	H	118	355	54.00	-9.79	Pass	
17071.516	27.49	10.09	6.43	44.00	AvgMax	V	298	352	54.00	-10.00	Pass	
3440.643	44.76	3.74	-4.66	43.83	AvgMax	V	104	325	54.00	-10.17	Pass	
4915.203	42.45	4.53	-3.27	43.71	AvgMax	V	119	162	54.00	-10.29	Pass	
17942.483	27.84	10.20	5.59	43.63	AvgMax	V	253	352	54.00	-10.37	Pass	
17860.553	27.85	10.13	5.58	43.55	AvgMax	H	142	355	54.00	-10.45	Pass	
15596.106	47.69	9.80	2.88	60.37	PeakMax	V	100	306	74.00	-13.63	Pass	

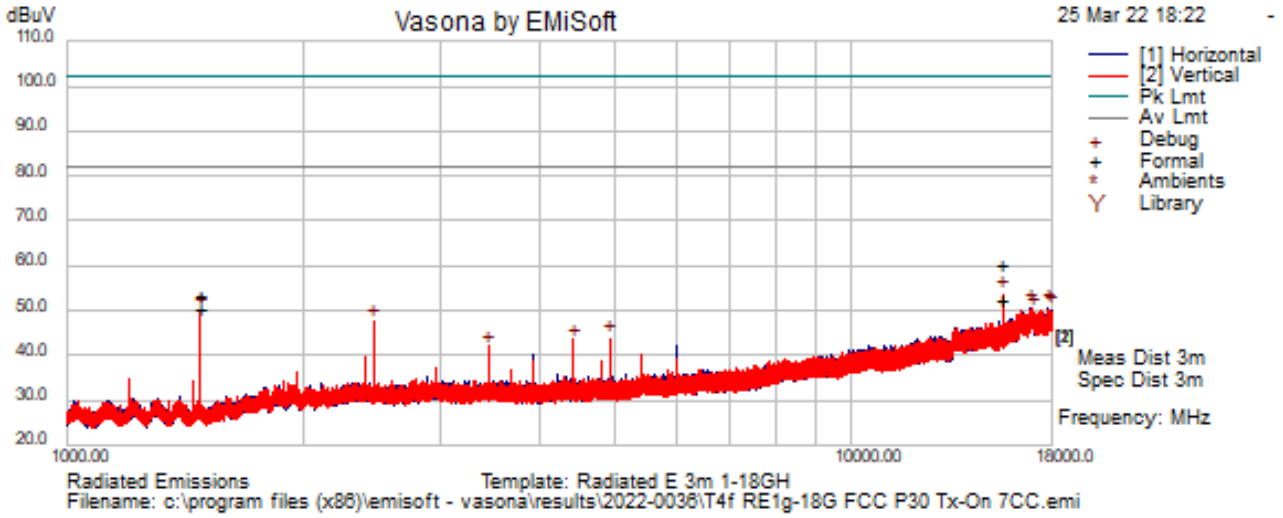
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
16961.158	43.35	10.01	6.44	59.81	PeakMax	H	118	355	74.00	-14.19	Pass	
17942.483	43.39	10.20	5.59	59.18	PeakMax	V	253	352	74.00	-14.82	Pass	
17071.516	42.50	10.09	6.43	59.02	PeakMax	V	298	352	74.00	-14.98	Pass	
2457.608	61.12	3.16	-5.53	58.75	PeakMax	V	120	263	74.00	-15.25	Pass	
17860.553	42.90	10.13	5.58	58.60	PeakMax	H	142	355	74.00	-15.40	Pass	
1474.561	61.36	2.60	-10.65	53.31	PeakMax	V	157	61	74.00	-20.69	Pass	
4423.680	51.05	4.17	-3.72	51.50	PeakMax	V	101	28	74.00	-22.50	Pass	
4915.203	48.94	4.53	-3.27	50.20	PeakMax	V	119	162	74.00	-23.80	Pass	
3440.643	50.75	3.74	-4.66	49.83	PeakMax	V	104	325	74.00	-24.17	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
15596.106	40.68	9.80	2.88	53.35	Debug	V	100	308	54.00	-0.65	Pass	
17860.553	34.79	10.13	5.58	50.50	Debug	H	100	110	54.00	-3.50	Pass	
16961.158	33.93	10.01	6.44	50.39	Debug	H	300	198	54.00	-3.61	Pass	
17942.483	34.35	10.20	5.59	50.14	Debug	V	100	66	54.00	-3.86	Pass	
17071.516	33.21	10.09	6.43	49.72	Debug	V	300	88	54.00	-4.28	Pass	
2457.555	49.76	3.16	-5.53	47.39	Debug	V	99	330	54.00	-6.61	Pass	
3440.671	42.23	3.74	-4.66	41.31	Debug	V	99	330	54.00	-12.69	Pass	
4915.210	42.25	4.53	-3.27	43.51	Debug	V	100	330	54.00	-10.49	Pass	
4423.686	42.12	4.17	-3.72	42.58	Debug	V	100	330	54.00	-11.42	Pass	
1474.519	57.59	2.60	-10.65	49.55	Debug	V	100	330	54.00	-4.45	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

T4f Radiated Emissions 3m 1GHz – 18GHz 7CC TX-On



Test Information

Results Title	Radiated Emissions 3m 1-18GHz
File Name	T4f RE1g-18G FCC P30 Tx-On 7CC.emi
Test Laboratory	MH-AR4, 30%RH, 22.8C, 994hPa
Test Engineer	MJS / WSM
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	ASMR 24 Main + 24 Extension (FA3UB) - New FCC Filing for Ext. Main Unit SN-AH211500018 , Extension 1SN-AH212200012, Extension 2 SN-AH212200010, PN-475168A.104 , PN-475046A.104 . Tx -On 7CC - 64QAM.
Configuration	AR4 - Powered by 120VAC, AWEUC-D and FA3UB Extension Module (475001A) FSW67-E1260, PA-E1166, LPF-E1475, Horn Ant-E1074, RE 1GHz - 18GHz FCC Part 15. Cable set-AR4.Internal Attenuation 5dB Preview RBW Default; Formal RBW 1M.
Date	2022-03-25 18:22:03

Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
15596.106	39.97	9.80	2.88	52.65	AvgMax	V	108	94	82.23	-29.58	Pass	
1474.561	58.64	2.60	-10.65	50.60	AvgMax	V	158	58	82.23	-31.63	Pass	
15596.106	47.62	9.80	2.88	60.30	PeakMax	V	108	94	102.23	-41.93	Pass	
1474.561	61.48	2.60	-10.65	53.43	PeakMax	V	158	58	102.23	-48.80	Pass	

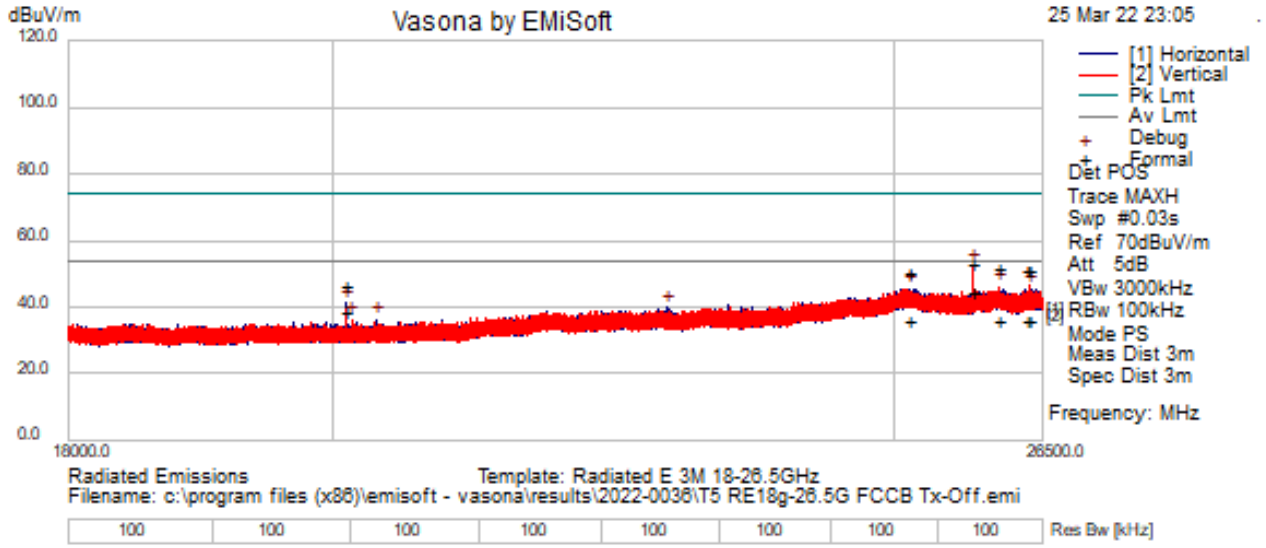
Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
15596.106	40.68	9.80	2.88	53.35	Debug	V	100	308	82.23	-28.88	Pass	
17860.553	34.79	10.13	5.58	50.50	Debug	H	100	110	82.23	-31.73	Pass	
16961.158	33.93	10.01	6.44	50.39	Debug	H	300	198	82.23	-31.84	Pass	

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
17942.483	34.35	10.20	5.59	50.14	Debug	V	100	66	82.23	-32.09	Pass	
17071.516	33.21	10.09	6.43	49.72	Debug	V	300	88	82.23	-32.51	Pass	
2457.555	49.76	3.16	-5.53	47.39	Debug	V	99	330	82.23	-34.84	Pass	
3440.671	42.23	3.74	-4.66	41.31	Debug	V	99	330	82.23	-40.92	Pass	
4915.210	42.25	4.53	-3.27	43.51	Debug	V	100	330	82.23	-38.72	Pass	
4423.686	42.12	4.17	-3.72	42.58	Debug	V	100	330	82.23	-39.65	Pass	
1474.519	57.59	2.60	-10.65	49.55	Debug	V	100	330	82.23	-32.68	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

T5 Radiated Emissions 3m 18GHz – 26.5GHz TX-Off



Test Information

Results Title	Radiated Emissions 3M 18-26.5GHz
File Name	T5 RE18g-26.5G FCCB Tx-Off.emi
Test Laboratory	MH-AR4, 30%RH, 22.8C, 994hPa
Test Engineer	MJS / WSM
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	ASMR 24 Main + 24 Extension (FA3UB) - New FCC Filing for Ext. Main Unit SN-AH211500018 , Extension 1SN-AH212200012, Extension 2 SN-AH212200010, PN-475168A.104 , PN-475046A.104 . Tx -On 7CC - 64QAM.
Configuration	AR4 - Powered by 120VAC, AWEUC-D and FA3UB Extension Module (475001A) FSW67-E1260, PA-E1525, No Filter, Horn Ant-E1452, RE 18GHz - 26.5GHz FCC Part 15. Cable set-E1501 + E1502, .Internal Attenuation 5dB Preview RBW 100k; Formal RBW 1M.
Date	2022-03-25 23:05:48

Formal Data

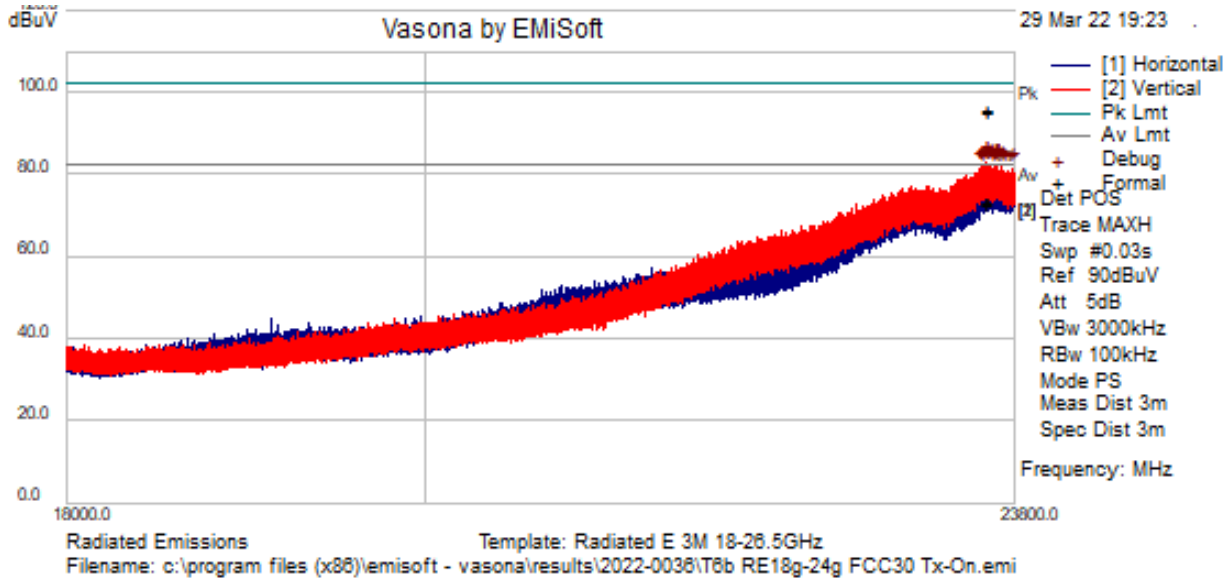
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
25781.245	34.45	13.43	-3.20	44.68	AvgMax	V	118	54	54.00	-9.32	Pass	
20101.124	35.91	11.82	-9.23	38.50	AvgMax	H	175	277	54.00	-15.50	Pass	
26052.332	25.95	13.49	-3.13	36.32	AvgMax	V	172	177	54.00	-17.68	Pass	
26384.434	25.94	13.59	-3.22	36.31	AvgMax	H	194	43	54.00	-17.69	Pass	
26364.849	25.90	13.58	-3.22	36.26	AvgMax	V	174	325	54.00	-17.74	Pass	
25144.745	25.93	13.31	-3.21	36.03	AvgMax	H	199	26	54.00	-17.97	Pass	
25781.245	43.22	13.43	-3.20	53.45	PeakMax	V	118	54	74.00	-20.55	Pass	
26052.332	41.42	13.49	-3.13	51.79	PeakMax	V	172	177	74.00	-22.21	Pass	
26364.849	41.12	13.58	-3.22	51.48	PeakMax	V	174	325	74.00	-22.52	Pass	
26384.434	40.93	13.59	-3.22	51.30	PeakMax	H	194	43	74.00	-22.70	Pass	
25144.745	40.70	13.31	-3.21	50.80	PeakMax	H	199	26	74.00	-23.20	Pass	
20101.124	44.17	11.82	-9.23	46.77	PeakMax	H	175	277	74.00	-27.23	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
25781.218	41.99	13.43	-3.20	52.21	Debug	V	150	44	54.00	-1.79	Pass	
26364.849	36.38	13.58	-3.22	46.74	Debug	V	150	264	54.00	-7.26	Pass	
26052.332	35.51	13.49	-3.13	45.88	Debug	V	150	66	54.00	-8.12	Pass	
25144.745	35.48	13.31	-3.21	45.58	Debug	H	150	88	54.00	-8.42	Pass	
26384.434	34.86	13.59	-3.22	45.23	Debug	H	150	220	54.00	-8.77	Pass	
20101.129	38.51	11.82	-9.23	41.11	Debug	H	150	286	54.00	-12.89	Pass	
22828.141	32.95	12.69	-5.93	39.71	Debug	H	150	132	54.00	-14.29	Pass	
20142.779	33.51	11.84	-9.19	36.16	Debug	V	150	198	54.00	-17.84	Pass	
20344.300	33.28	11.91	-9.05	36.13	Debug	H	150	176	54.00	-17.87	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

T6b Radiated Emissions 3m 18GHz – 23.8GHz 7CC TX-On



Test Information

Results Title	Radiated Emissions 3M 18-26.5GHz
File Name	T6b RE18g-23.8g FCC30 Tx-On.emi
Test Laboratory	MH-AR4, 30%RH, 22.8C, 994hPa
Test Engineer	MJS
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	ASMR 24 Main + 24 Extension (FA3UB) - New FCC Filing for Ext. Main Unit SN-AH211500018 , Extension 1SN-AH212200012, Extension 2 SN-AH212200010, PN-475168A.104 , PN-475046A.104 . Tx -On 7CC - 64QAM.
Configuration	AR4 - Powered by 120VAC, AWEUC-D and FA3UB Extension Module (475001A) FSW67-E1260, PA-E1525, LPF-Filter-E1499, Horn Ant-E1452, RE 18GHz - 23.8GHz FCC Part 30. Cable set-E1501 + E1502, .Internal Attenuation 5dB Preview RBW 100k; Formal RBW 1M.
Date	2022-03-29 19:23:40

Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
23605.338	67.59	32.86	-4.69	95.75	PeakMax	V	166	181	102.23	-6.48	Pass	
23595.381	67.45	32.53	-4.70	95.28	PeakMax	V	168	182	102.23	-6.95	Pass	
23595.381	45.63	32.53	-4.70	73.46	AvgMax	V	168	182	82.23	-8.77	Pass	
23605.338	44.78	32.86	-4.69	72.94	AvgMax	V	166	181	82.23	-9.29	Pass	

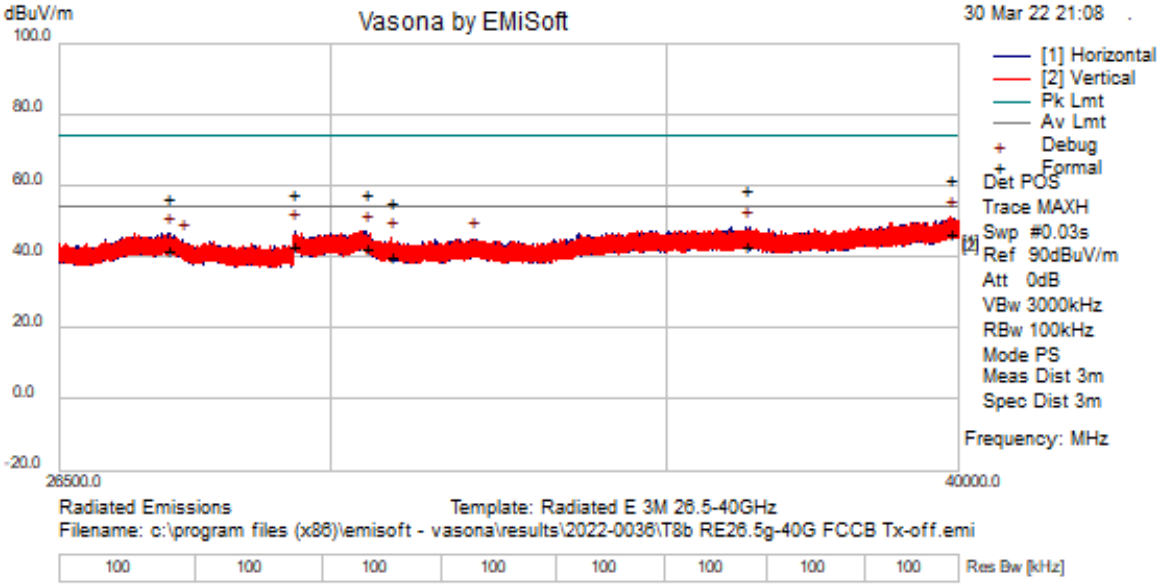
Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
23595.381	55.02	32.53	-4.70	82.86	Debug	V	175	198	82.23	0.63	Fail	
23605.338	54.46	32.86	-4.69	82.62	Debug	V	175	198	82.23	0.39	Fail	
23680.858	51.63	35.36	-4.70	82.29	Debug	V	175	198	82.23	0.06	Fail	
23671.989	51.91	35.07	-4.70	82.28	Debug	V	175	198	82.23	0.05	Fail	

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
23629.698	53.27	33.67	-4.70	82.25	Debug	V	175	198	82.23	0.02	Pass	
23678.708	51.61	35.29	-4.70	82.20	Debug	V	175	198	82.23	-0.03	Pass	
23659.471	52.11	34.65	-4.70	82.06	Debug	V	175	198	82.23	-0.17	Pass	
23676.363	51.46	35.21	-4.70	81.97	Debug	V	175	198	82.23	-0.26	Pass	
23591.659	54.20	32.41	-4.70	81.91	Debug	V	175	198	82.23	-0.32	Pass	
23585.352	54.37	32.20	-4.70	81.87	Debug	V	175	198	82.23	-0.36	Pass	
23570.779	54.81	31.71	-4.70	81.82	Debug	V	175	198	82.23	-0.41	Pass	
23654.831	51.99	34.50	-4.70	81.79	Debug	V	175	198	82.23	-0.44	Pass	
23588.808	54.18	32.31	-4.70	81.79	Debug	V	175	198	82.23	-0.44	Pass	
23633.951	52.65	33.81	-4.70	81.76	Debug	V	175	198	82.23	-0.47	Pass	
23624.574	52.90	33.50	-4.69	81.70	Debug	V	175	198	82.23	-0.53	Pass	
23706.693	50.15	36.21	-4.69	81.66	Debug	V	175	198	82.23	-0.57	Pass	
23578.174	54.29	31.96	-4.70	81.55	Debug	V	175	198	82.23	-0.68	Pass	
23569.353	54.44	31.67	-4.70	81.40	Debug	V	175	198	82.23	-0.83	Pass	
23600.432	53.38	32.70	-4.69	81.38	Debug	V	175	198	82.23	-0.85	Pass	
23637.842	52.09	33.94	-4.70	81.33	Debug	V	175	198	82.23	-0.90	Pass	
23660.123	51.33	34.67	-4.70	81.31	Debug	V	175	198	82.23	-0.92	Pass	
23641.418	51.93	34.05	-4.70	81.29	Debug	V	175	198	82.23	-0.94	Pass	
23601.302	53.24	32.73	-4.69	81.27	Debug	V	175	198	82.23	-0.96	Pass	
23783.736	47.15	38.75	-4.66	81.25	Debug	V	175	198	82.23	-0.98	Pass	
23564.037	54.43	31.49	-4.70	81.22	Debug	V	175	198	82.23	-1.01	Pass	
23607.658	52.92	32.94	-4.69	81.16	Debug	V	175	198	82.23	-1.07	Pass	
23554.974	54.67	31.19	-4.71	81.15	Debug	V	175	198	82.23	-1.08	Pass	
23553.814	54.68	31.15	-4.71	81.12	Debug	V	175	198	82.23	-1.11	Pass	
23711.043	49.45	36.36	-4.69	81.11	Debug	V	175	198	82.23	-1.12	Pass	
23558.962	54.39	31.32	-4.70	81.00	Debug	V	175	198	82.23	-1.23	Pass	
23661.404	50.96	34.72	-4.70	80.98	Debug	V	175	198	82.23	-1.25	Pass	
23715.731	49.13	36.51	-4.69	80.95	Debug	V	175	198	82.23	-1.28	Pass	
23664.498	50.76	34.82	-4.70	80.88	Debug	V	175	198	82.23	-1.35	Pass	
23644.125	51.35	34.14	-4.70	80.80	Debug	V	175	198	82.23	-1.43	Pass	
23572.302	53.74	31.76	-4.70	80.80	Debug	V	175	198	82.23	-1.43	Pass	
23775.060	46.93	38.47	-4.66	80.73	Debug	V	175	198	82.23	-1.50	Pass	
23749.468	47.76	37.62	-4.68	80.70	Debug	V	175	198	82.23	-1.53	Pass	
23682.212	49.96	35.40	-4.70	80.66	Debug	V	175	198	82.23	-1.57	Pass	
23688.374	49.67	35.61	-4.70	80.58	Debug	V	175	198	82.23	-1.65	Pass	
23724.721	48.46	36.81	-4.69	80.58	Debug	V	175	198	82.23	-1.65	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

T8b Radiated Emissions 3m 26.5GHz – 40GHz TX-Off



Test Information

Results Title	Radiated Emissions 3M 26.5-40GHz
File Name	T8b RE26.5g-40G FCCB Tx-off.emi
Test Laboratory	MH-AR4, 30%RH, 22.8C, 994hPa
Test Engineer	MJS
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	ASMR 24 Main + 24 Extensions (FA3UB) - New FCC Filing for Ext. Main Unit SN-AH211500018, Extension 1SN-AH212200012, Extension 2 SN-AH212200010, PN-475168A.104, PN-475046A.104. Tx -On 7CC - 64QAM.
Configuration	AR4 - Powered by 120VAC, AWEUC-D and FA3UB Extension Module (475001A) FSW67-E1260, PA-E1525, No-Filters, Horn Ant-E1375, RE 26.5GHz - 40GHz FCC Part 30. Cable set-E1501 + E1502, .Internal Attenuation 0dB Preview RBW 100k; Formal RBW 1M.
Date	2022-03-30 21:08:18

Formal Data

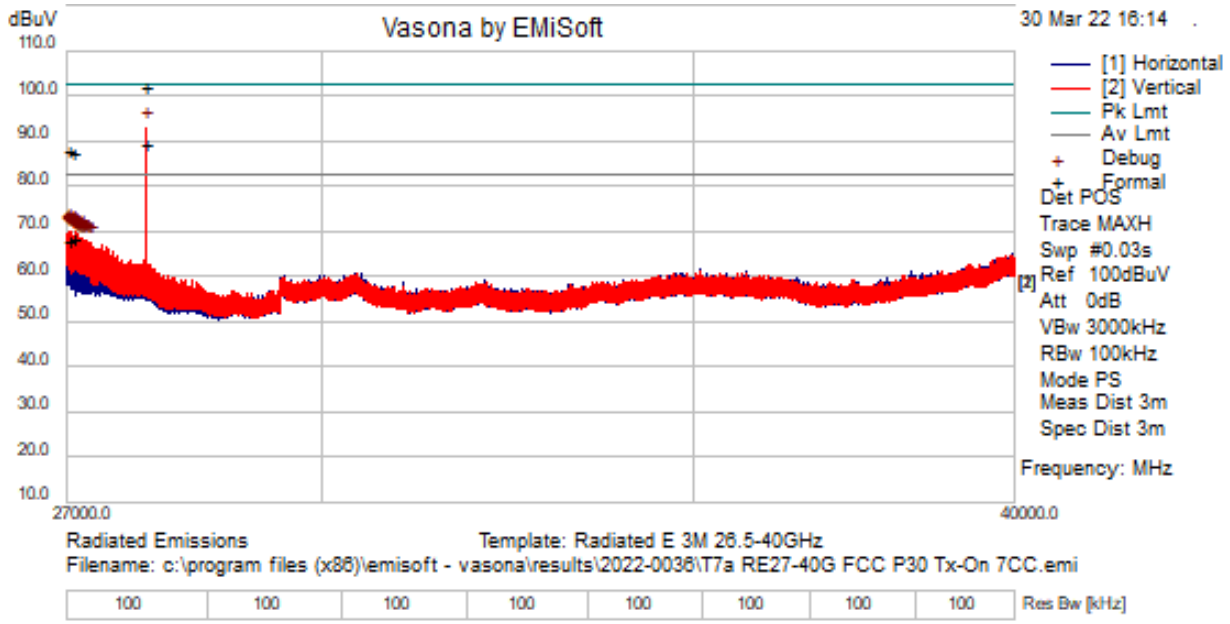
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
39849.306	30.46	17.17	-1.17	46.46	AvgMax	V	208	69	54.00	-7.54	Pass	
36296.781	29.13	16.25	-2.01	43.37	AvgMax	H	134	0	54.00	-10.63	Pass	
29504.875	28.31	14.38	0.24	42.93	AvgMax	H	121	80	54.00	-11.07	Pass	
30483.288	28.00	14.68	-0.05	42.63	AvgMax	H	138	335	54.00	-11.37	Pass	
27849.944	27.96	13.98	-0.10	41.84	AvgMax	H	128	340	54.00	-12.16	Pass	
39849.306	45.84	17.17	-1.17	61.84	PeakMax	V	208	69	74.00	-12.16	Pass	
30843.400	25.78	14.81	-0.49	40.10	AvgMax	V	270	355	54.00	-13.90	Pass	
36296.781	44.43	16.25	-2.01	58.67	PeakMax	H	134	0	74.00	-15.33	Pass	
30483.288	43.25	14.68	-0.05	57.88	PeakMax	H	138	335	74.00	-16.12	Pass	
29504.875	43.24	14.38	0.24	57.85	PeakMax	H	121	80	74.00	-16.15	Pass	
27849.944	42.79	13.98	-0.10	56.67	PeakMax	H	128	340	74.00	-17.33	Pass	
30843.400	41.02	14.81	-0.49	55.35	PeakMax	V	270	355	74.00	-18.65	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
39849.306	34.98	17.17	-1.17	50.98	Debug	V	165	66	54.00	-3.02	Pass	
36296.781	34.03	16.25	-2.01	48.27	Debug	H	165	22	54.00	-5.73	Pass	
29504.875	32.66	14.38	0.24	47.28	Debug	H	165	264	54.00	-6.72	Pass	
30483.288	32.42	14.68	-0.05	47.05	Debug	H	165	330	54.00	-6.95	Pass	
27849.944	32.59	13.98	-0.10	46.47	Debug	H	165	242	54.00	-7.53	Pass	
30843.400	30.72	14.81	-0.49	45.05	Debug	V	165	132	54.00	-8.95	Pass	
32029.881	29.80	15.34	-0.22	44.92	Debug	H	165	242	54.00	-9.08	Pass	
28037.031	30.61	14.02	-0.05	44.58	Debug	H	165	22	54.00	-9.42	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

T7a Radiated Emissions 3m 27GHz – 40GHz TX-On



Test Information

Results Title	Radiated Emissions 3M 26.5-40GHz
File Name	T7a RE27-40G FCC P30 Tx-On 7CC.emi
Test Laboratory	MH-AR4, 30%RH, 22.8C, 994hPa
Test Engineer	MJS
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	ASMR 24 Main + 24 Extension (FA3UB) - New FCC Filing for Ext. Main Unit SN-AH211500018 , Extension 1SN-AH212200012, Extension 2 SN-AH212200010, PN-475168A.104 , PN-475046A.104 . Tx -On 7CC - 64QAM.
Configuration	AR4 - Powered by 120VAC, AWEUC-D and FA3UB Extension Module (475001A) FSW67-E1260, PA-E1525, HPF-Filters-E1472 and E1473, Horn Ant-E1375, RE 27GHz - 40GHz FCC Part 30. Cable set-E1501 + E1502, .Internal Attenuation 5dB Preview RBW 100k; Formal RBW 1M.
Date	2022-03-30 16:14:12

Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
27899.196	63.42	15.99	10.09	89.50	AvgMax	V	172	184	82.23	7.27	Fail	
27899.196	76.24	15.99	10.09	102.32	PeakMax	V	172	184	102.23	0.09	Fail	
27087.317	41.66	16.57	10.03	68.26	AvgMax	V	165	188	82.23	-13.97	Pass	
27035.479	41.36	16.85	10.00	68.22	AvgMax	V	172	188	82.23	-14.01	Pass	
27035.479	60.91	16.85	10.00	87.77	PeakMax	V	172	188	102.23	-14.46	Pass	
27087.317	61.10	16.57	10.03	87.70	PeakMax	V	165	188	102.23	-14.53	Pass	

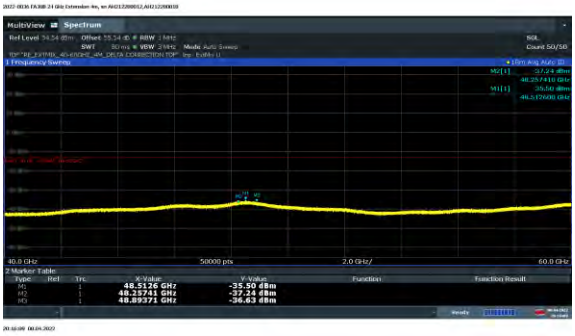
Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
27899.167	66.48	15.99	10.09	92.57	Debug	V	175	176	82.23	10.34	Fail	
27035.479	43.11	16.85	10.00	69.97	Debug	V	175	176	82.23	-12.26	Pass	
27087.317	43.19	16.57	10.03	69.79	Debug	V	175	176	82.23	-12.44	Pass	
27023.346	42.64	16.92	10.00	69.56	Debug	V	175	176	82.23	-12.67	Pass	
27086.829	42.93	16.58	10.02	69.54	Debug	V	175	176	82.23	-12.69	Pass	
27004.550	42.46	17.02	9.99	69.47	Debug	V	175	176	82.23	-12.76	Pass	
27104.921	42.83	16.48	10.03	69.34	Debug	V	175	176	82.23	-12.89	Pass	
27006.175	42.33	17.01	9.99	69.33	Debug	V	175	176	82.23	-12.90	Pass	
27037.375	42.46	16.84	10.01	69.31	Debug	V	175	176	82.23	-12.92	Pass	
27111.908	42.63	16.44	10.04	69.11	Debug	V	175	176	82.23	-13.12	Pass	
27054.221	42.23	16.75	10.01	68.99	Debug	V	175	176	82.23	-13.24	Pass	
27062.671	42.22	16.71	10.02	68.94	Debug	V	175	176	82.23	-13.29	Pass	
27029.033	41.80	16.89	10.00	68.69	Debug	V	175	176	82.23	-13.54	Pass	
27047.125	41.71	16.79	10.01	68.51	Debug	V	175	176	82.23	-13.72	Pass	
27110.338	41.92	16.45	10.04	68.40	Debug	V	175	176	82.23	-13.83	Pass	
27167.321	42.17	16.14	10.08	68.39	Debug	V	175	176	82.23	-13.84	Pass	
27115.321	41.87	16.42	10.04	68.34	Debug	V	175	176	82.23	-13.89	Pass	
27167.808	42.01	16.14	10.08	68.23	Debug	V	175	176	82.23	-14.00	Pass	
27142.567	41.81	16.28	10.06	68.15	Debug	V	175	176	82.23	-14.08	Pass	
27069.496	41.41	16.67	10.02	68.10	Debug	V	175	176	82.23	-14.13	Pass	
27084.446	41.47	16.59	10.02	68.08	Debug	V	175	176	82.23	-14.15	Pass	
27096.471	41.52	16.52	10.03	68.07	Debug	V	175	176	82.23	-14.16	Pass	
27109.038	41.57	16.46	10.04	68.06	Debug	V	175	176	82.23	-14.17	Pass	
27075.183	41.34	16.64	10.02	68.00	Debug	V	175	176	82.23	-14.23	Pass	
27150.475	41.68	16.23	10.07	67.98	Debug	V	175	176	82.23	-14.25	Pass	
27172.575	41.66	16.11	10.08	67.86	Debug	V	175	176	82.23	-14.37	Pass	
27228.692	41.88	15.81	10.13	67.82	Debug	V	175	176	82.23	-14.41	Pass	
27190.450	41.70	16.02	10.09	67.81	Debug	V	175	176	82.23	-14.42	Pass	
27129.079	41.32	16.35	10.05	67.72	Debug	V	175	176	82.23	-14.51	Pass	
27091.000	41.14	16.55	10.03	67.72	Debug	V	175	176	82.23	-14.51	Pass	
27229.504	41.75	15.81	10.13	67.69	Debug	V	175	176	82.23	-14.54	Pass	
27156.108	41.34	16.20	10.07	67.61	Debug	V	175	176	82.23	-14.62	Pass	
27118.842	41.06	16.40	10.04	67.51	Debug	V	175	176	82.23	-14.72	Pass	
27200.146	41.44	15.97	10.10	67.50	Debug	V	175	176	82.23	-14.73	Pass	
27170.192	41.17	16.13	10.08	67.37	Debug	V	175	176	82.23	-14.86	Pass	
27137.096	40.97	16.31	10.06	67.33	Debug	V	175	176	82.23	-14.90	Pass	
27209.300	41.28	15.92	10.11	67.31	Debug	V	175	176	82.23	-14.92	Pass	
27278.796	41.29	15.72	10.18	67.20	Debug	V	175	176	82.23	-15.03	Pass	
27252.850	41.33	15.70	10.15	67.19	Debug	V	175	176	82.23	-15.04	Pass	
27246.621	41.19	15.72	10.15	67.05	Debug	V	175	176	82.23	-15.18	Pass	

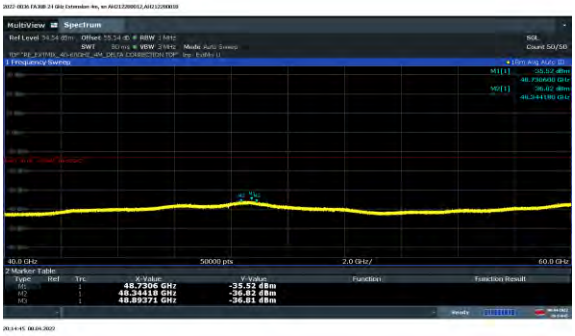
Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

Maximum Measured Radiated Emissions -U Band 40GHz-60GHz FCC B Part 30

Horizontal Polarization - 1 MHz RBW (50 deg)

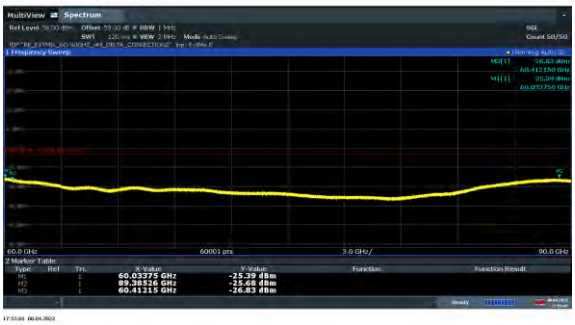


Vertical Polarization - 1 MHz RBW (50 deg)

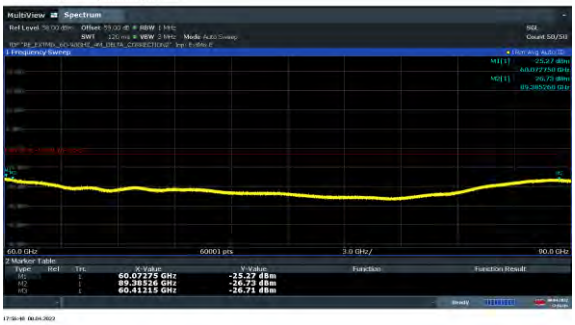


Maximum Measured Radiated Emissions -U Band 60GHz-90GHz FCC B Part 30

Horizontal Polarization - 1 MHz RBW (50 deg)

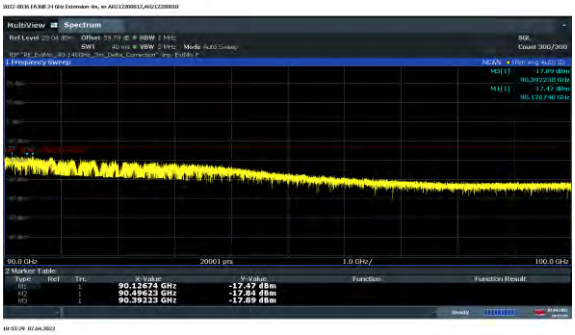


Vertical Polarization - 1 MHz RBW (50 deg)

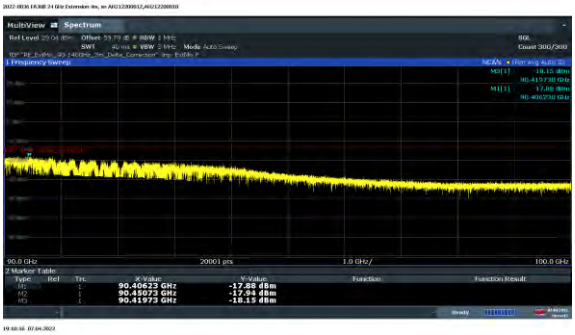


Maximum Measured Radiated Emissions -U Band 90GHz-100GHz FCC B Part 30

Horizontal Polarization - 1 MHz RBW (50 deg)



Vertical Polarization - 1 MHz RBW (50 deg)



4.6 Section 2.1055 MEASUREMENT OF FREQUENCY STABILITY

This measurement evaluates the frequency difference between the actual transmit carrier frequency and the specified transmit frequency assignment. Only the portion of the transmitter system containing the frequency determining and stabilizing circuitry need be put in an environmental chamber and subjected to the temperature variation test per FCC Section 2.1055 and RSS-133. The unit which provides baseband signals, such as BBU (baseband unit), can be located outside the chamber if it is a separated unit.

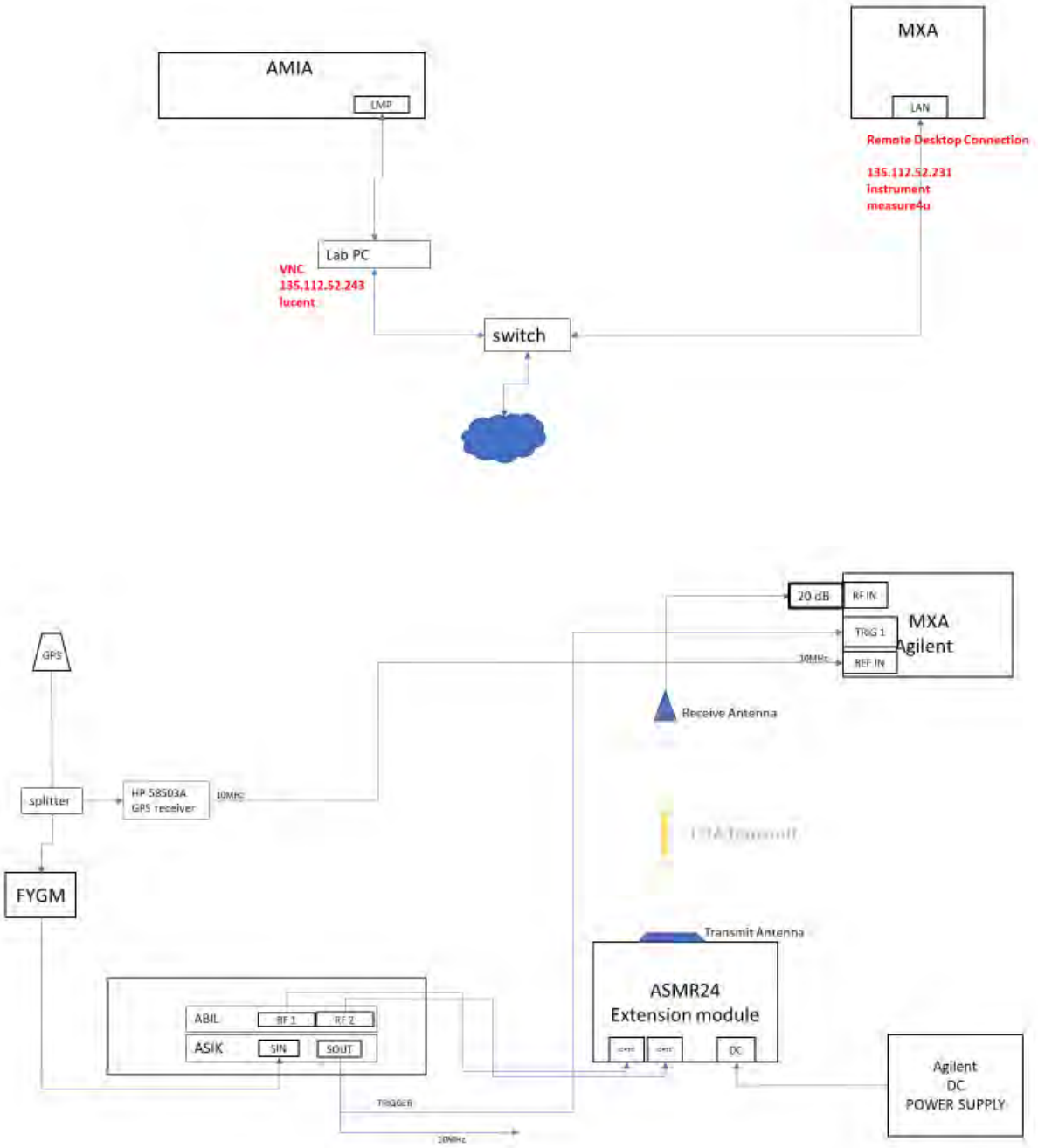
The temperatures to which the UUT were subjected ranged from a high temperature of +50°C system ambient to a low temperature of -30°C system ambient with measurements recorded at 10°C increments.

Transmit frequency error measures the deviation between the actual transmit frequency and the assigned frequency. The transmit frequency error in this case was measured by capturing the transmitted signal using a receiving antenna and then cabling it to an MXA signal analyzer. The system level frequency stability testing resulted in compliance with established design criteria.

4.6.1 Frequency Stability Results AC Model:

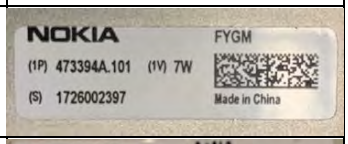
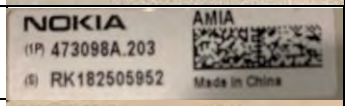
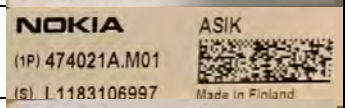
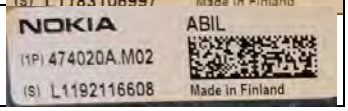
Frequency Stability testing was completed on: ASMR 24 Main and 24 Extension (FA3UB) (CF = 24,899MHz). Testing was performed from 5/4/2022 through 5/6/2022 on the radio, which was located in the T-13 Thermal chamber of the Global Product Compliance Laboratory (GPCL) test facility located in Building 4, Room 4-280, Murray Hill, NJ, by Joe Bordonaro from GPCL.

FIGURE 4.6.1: Frequency Stability Test Block Diagram



Serial Number (AWEUD Unit)

Serial Number (FA3UB Unit)

Hardware	Part number	Serial number	
FYGM	473394A.101	1726002397	
AMIA	473098A.203	RK182505952	
ASIK	474021A.M02	L1183106997	
ABIL	474020A.M02	L1192115508	

Frequency Block Tested: *ASMR24 Extension (CF = 24899.040MHz)*

1. (a)Set the power supply to nominal Voltage. (b) Record the frequency at ~25°C. (c)Raise EUT operating temperature to 50°C. (d)Record the frequency difference. (e) Repeat step (d) at each 10°C step down to -30°C. Result will be 10 readings and take temperature readings to establish thermal stability at each point.

Baseline Measurement at +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-4.8554
0.5	3.3368
1.0	156.53 mHz
1.5	1.0495
2.0	-3.7178
2.5	1.1593
3.0	-6.2064
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at +50°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	3.1433
0.5	-2.0725
1.0	-2.2212
1.5	805.72 mHz
2.0	-1.1984
2.5	3.0167
3.0	1.0204
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at +40°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	6.1961
0.5	-2.3414
1.0	-4.0954
1.5	2.4365
2.0	-2.0755
2.5	-6.7856
3.0	4.5985
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at +30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	4.0361
0.5	-4.9559
1.0	1.1329
1.5	-3.5118
2.0	-2.3741
2.5	5.1310
3.0	-1.9608
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at +20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	1.6383
0.5	-3.1200
1.0	760.8 mHz
1.5	2.2903
2.0	-1.1944
2.5	3.9797
3.0	-4.0262
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at +10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-3.3114
0.5	5.5878
1.0	-3.2678
1.5	-1.3880
2.0	546.13 mHz
2.5	1.1273
3.0	3.8304
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at 0°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	1.5581
0.5	3.3213
1.0	-3.3671
1.5	4.0748
2.0	247.8 mHz
2.5	-7.2418
3.0	1.4155
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at -10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	2.82622
0.5	3.9707
1.0	-3.2357
1.5	4.0748
2.0	-247.8 mHz
2.5	-7.2418
3.0	1.4155
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at -20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-4.7739
0.5	-8.0644
1.0	552.33 mHz
1.5	-4.5034
2.0	2.7911
2.5	1.6050
3.0	3.0625
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at -30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	1.4877
0.5	-6.6963
1.0	4.0015
1.5	-1.2220
2.0	1.9301
2.5	2.6793
3.0	2.0732
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Upon return to +25°C.

2. At ambient, vary voltage to +15% and -15% of nominal VAC and record frequency difference. Result will be 12 readings for each voltage (nominal, ~+ 3%, ~+6%, ~+9%, ~+12%, +15%, and nominal, ~- 3%, ~-6%, ~-9%, ~-12%, -15%).

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-2.0368
0.5	1.3404
1.0	1.0012
1.5	970.53 mHz
2.0	4.7207
2.5	-2.5335
3.0	1.8752
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at 103% of Nominal Voltage, -49.44VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
-8.7786	2.3702
-7.8625	3.4004
-9.4527	-1.6223
-9.0073	2.7235
-8.9239	-2.0901
-8.0889	3.2505
-9.1828	495.38 mHz
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at 106% of Nominal Voltage, -50.88VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	2.8456
0.5	-1.2398
1.0	3.8132
1.5	1.0856
2.0	-2.4104
2.5	-3.9070
3.0	1.6004
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at 109% of Nominal Voltage, -52.32VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	3.5765
0.5	4.3402
1.0	-1.1557
1.5	2.6981
2.0	3.6474
2.5	1.5863
3.0	-4.8321
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at 112% of Nominal Voltage, -53.76VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	2.8729
0.5	3.1017
1.0	-1.3406
1.5	4.3427
2.0	1.5463
2.5	3.6492
3.0	-418.3 mHz
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at 115% of Nominal Voltage, -55.20VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-1.0234
0.5	-4.4869
1.0	1.5734
1.5	1.2111
2.0	-1.2863
2.5	2.6303
3.0	-4.0389
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48.0VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-2.6954
0.5	-1.4080
1.0	-3.0613
1.5	2.2419
2.0	5.4943
2.5	4.0539
3.0	1.3370
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at -3% of Nominal Voltage, -46.56VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	5.2004
0.5	1.7218
1.0	4.3373
1.5	-5.6798
2.0	693.27 mHz
2.5	-1.2589
3.0	637.56 mHz
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at -6% of Nominal Voltage, -45.12VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	2.5582
0.5	-1.5944
1.0	-3.6296
1.5	-1.1946
2.0	3.6750
2.5	-2.9574
3.0	3.9237
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at -9% of Nominal Voltage, -43.68VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-2.7304
0.5	-3.4404
1.0	-801.5 mHz
1.5	3.6887
2.0	1.2733
2.5	6.5423
3.0	1.8665
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at -12% of Nominal Voltage, -42.24VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-790.3 mHz
0.5	-1.6841
1.0	1.2285
1.5	4.4705
2.0	3.1387
2.5	1.5239
3.0	2.5141
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at -15% of Nominal Voltage, -40.80VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	4.3895
0.5	1.9127
1.0	-2.4540
1.5	3.7077
2.0	1.1994
2.5	1.6629
3.0	4.0741
SPECIFICATION	24899.040 MHz (±0.05ppm) ±0.05ppm = ± 1245 Hz
RESULT	PASS

Thermal Chamber Profile Plot

4.7 List of Test Equipment

4.7.1 List of Radio Measurements Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due	Calibration Type	Status
E1461	A-Info	Horn Antenna	Pyramidal standard gain horn antenna 22 - 33 GHz WR34 25dB	LB-34-25-C2-KF	J202026030	Factory, - in Service 2020-03-04	2023-03-04	RC	Active
E1384	Rohde & Schwarz	Spectrum Analyzer	2 Hz to 85 GHz	FSW85	101537	2020-08-25	2022-08-25	RC	Active
E485	Kikusui	Power Supply	0-55VDC,120 Amps	PAD 55-120L	DL000416	CNR	CNR	CNR	Active
E772	Sunol Sciences Corp	Modular Controller	Tower / Turntable Controller	SC104V	060107-1	CNR	CNR	CNR	Active
E1255	ETS Lindgren	Controller	Multi-Device Controller	2090	00078509	CNR	CNR	CNR	Active
E1150	Extech	Data Logger	Pressure Humidity Temp Data Logger	SD700	Q752767	2021-01-11	2023-01-11	RC	Active

RC: Requires Calibration CNR: Calibration Not Required
Test Dates 04/26/2022 – 05/06/2022

4.7.2 List of Radiated Emissions Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
E766	A.H. Systems Inc.	Bilogical Antenna	25 - 2000 MHz	SAS-521-2	457	2021-05-18	2023-05-18
E1525	A.H. Systems Inc.	Pre-Amplifier	18 GHz-40 GHz, 37 dB	PAM-1840VH	186	2020-11-30	2022-11-30
E1166	Agilent Technologies	Pre-Amplifier	Pre-Amplifier 1-26.5GHz	8449B	3008A01740	2021-01-12	2023-01-12
E813	Sonoma Instrument Co.	Amplifier	9kHz-1GHz	310N	186750	2020-10-20	2022-10-20
E1188	Extech	Data Logger	Barometric Pressure/ Humidity/Temp Logger	SD700	Q774046	2020-11-12	2022-11-12
E1074	ETS Lindgren	Horn Antenna	Double-Ridged Waveguide Horn 1-18 GHz	3117	00135194	2021-08-03	2023-08-03
E1527	ETS Lindgren	Horn Antenna	Double Ridged Horn 10-40 GHz	3116C	00227823	2020-08-13	2022-08-13
E980	Trilithic	Filter, Low Pass	PCS	10LC1790-3-AA	PCS-LPF-12	CNR	CNR
E1475	Reactel, Inc.	Filter, Low Pass	DC - 20 GHz	11LS-X20GS11	SN20-02	CNR-V	CNR-V
E1472	Reactel, Inc.	Filter, High Pass	1 - 27 GHz, 2dB	11HS-X27G-K11	SN20-02	CNR-V	CNR-V
E1473	Reactel, Inc.	Filter, High Pass	DC - 27 GHz	11HS-X27G-K11	SN20-02	CNR-V	CNR-V
E1452	A-Info	Horn Antenna	18 to 26.5 GHz WR42 25 dB	LB-42-25-C2-KF	J202066361	2020-07-24	2023-07-24
E1375	A-Info	Horn Antenna	26.5-40GHz WR28 25 dB	LB-28-25-C2-KF	J202023249	2020-07-27	2022-07-27
E1260	Rohde & Schwarz	Spectrum Analyzer	2 Hz – 67 GHz	FSW67	104007	2020-08-21	2022-08-21
E1308	Rohde & Schwarz	Harmonic Mixer	90-140 GHz	FS-Z140	101008	2021-10-29	2024-10-29
E1311	Rohde & Schwarz	Harmonic Mixer	40 - 60 GHz	FS-Z60	100977	2021-10-06	2024-10-06
E1312	Rohde & Schwarz	Harmonic Mixer	60 - 90 GHz	FS-Z90	101719	2021-09-28	2024-09-28
E1315	RS Microwave Company, Inc.	Filter, precision waveguide	DC - 40 GHz, 20W, 2.5dB	P/N 60733A	007	Factory, - in Service 2018-07-01	CNR-V
E1330	Sage Millimeter, Inc.	Horn Antenna	U-band pyramidal standard gain horn antenna - 40 to 60 GHz	SAR-2309-19-S2	14853-01	Factory, - in Service 2018-07-01	CNR-V
E1332	Sage Millimeter, Inc.	Horn Antenna	E-band pyramidal standard gain horn antenna - 60 to 90 GHz.	SAR-2309-12-S2	14853-01	Factory, - in Service 2018-07-01	CNR-V
E1335	Sage Millimeter, Inc.	Horn Antenna	F-band pyramidal standard gain horn antenna - 90 to 140 GHz	SAR-2309-08-S2	14853-02	Factory, - in Service 2018-07-01	CNR-V

CNR: Calibration Not Required CNR-V: Calibration Not Required, Must Be Verified Test Dates: 3/22/2022 – 3/30/2022.

4.7.3 List of Frequency Stability Test Equipment

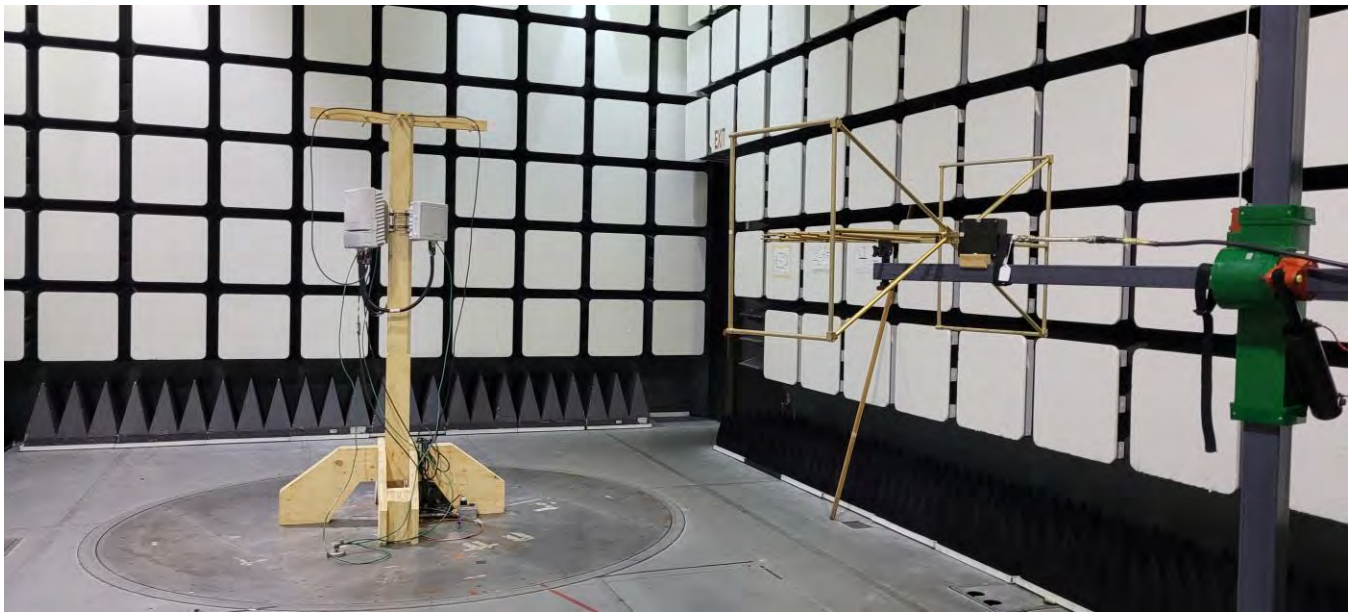
Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
TH534-T13	Envirotronics	Controller		SPPCM	SP001313	2021-06-08	2023-06-08
TH-T13	Envirotronics	Thermal Chamber		N/A	10005126	2020-09-19	2022-09-19
TH069	Extech	Data Logger	Barometric Pressure/Humidity/Temperature	SD700	Q690305	2021-07-20	2023-07-20
TH054	Yokogawa	Recorder	MVAdvanced portable paperless recorder	MV2048	S5JC04076	2021-02-25	2023-02-25
MY57431033	KeySight Technologies	MXA Signal Analyzer	N9020B	MY57431033	2020-07-08	2022-07-08	MY57431033

Test Dates: 5/4/2022 – 5/6/2022

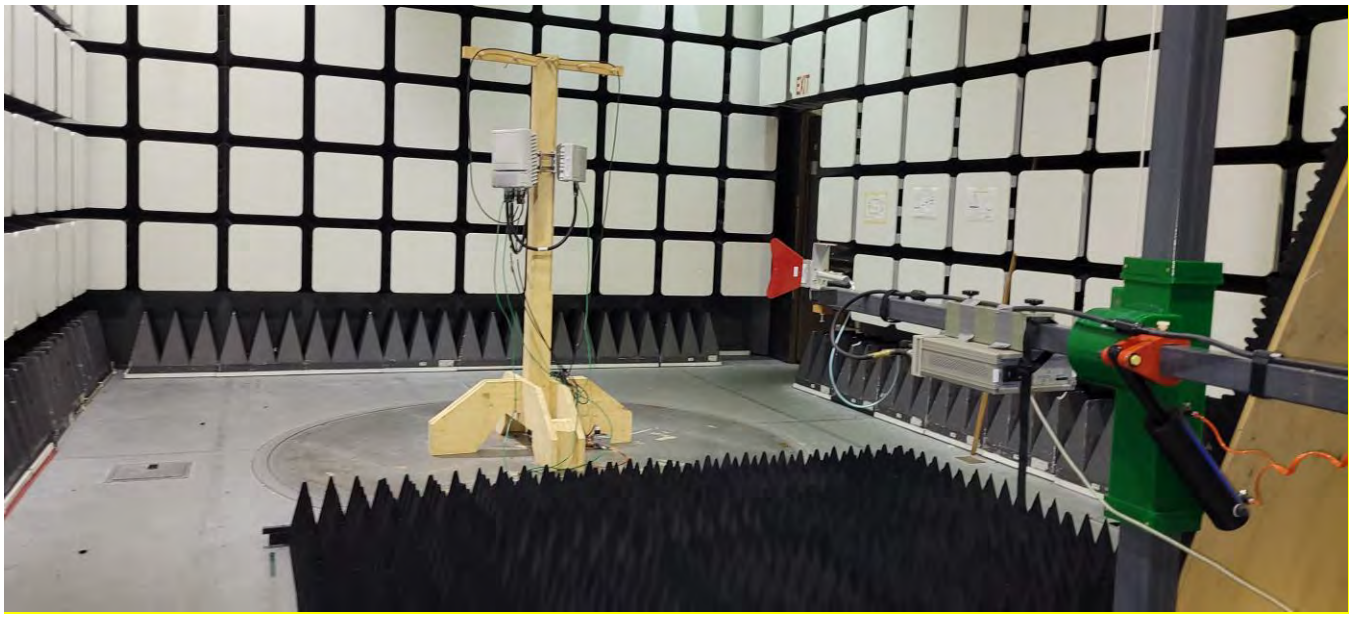
4.8 PHOTOGRAPHS OF THE TEST SETUPS

Radiated Emissions Test

30 MHz-1 GHz

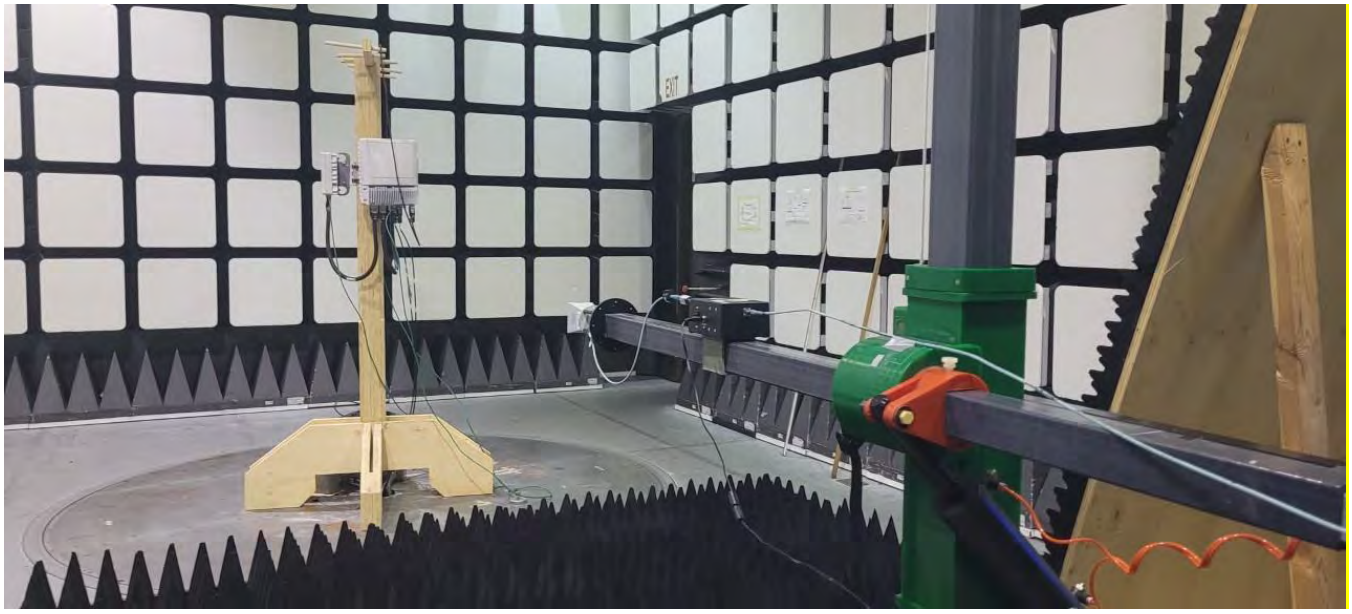


1 GHz – 18 GHz



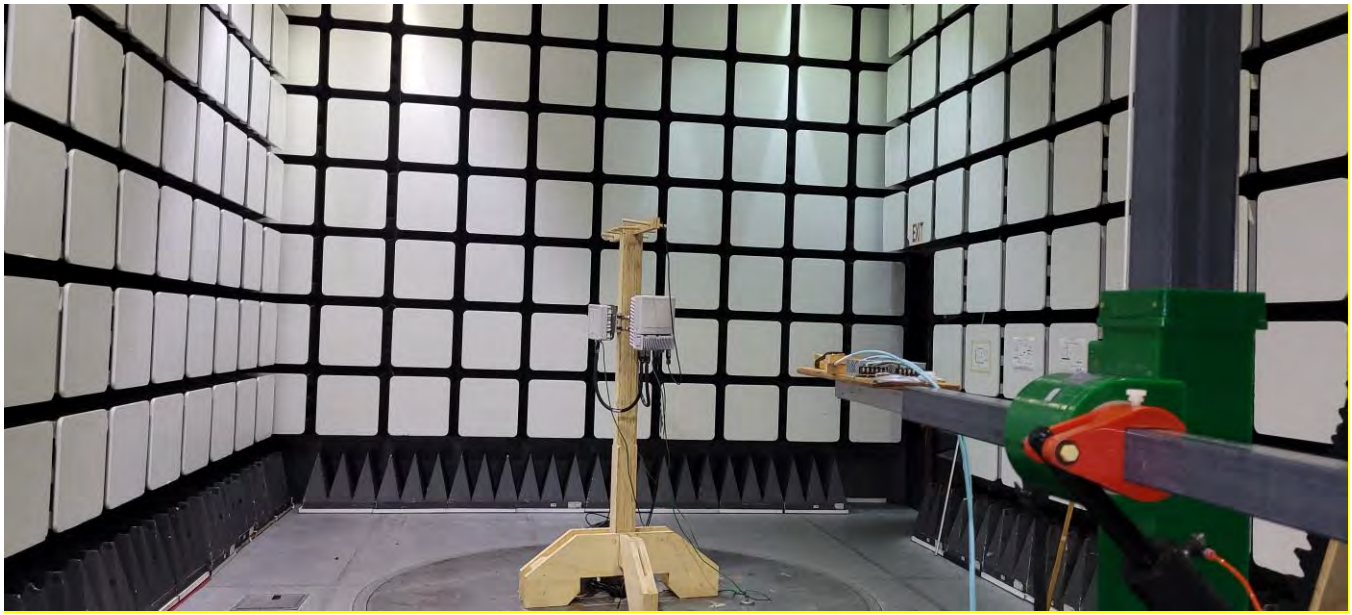
18GHz-26.5GHz

26.5GHz-40 GHz

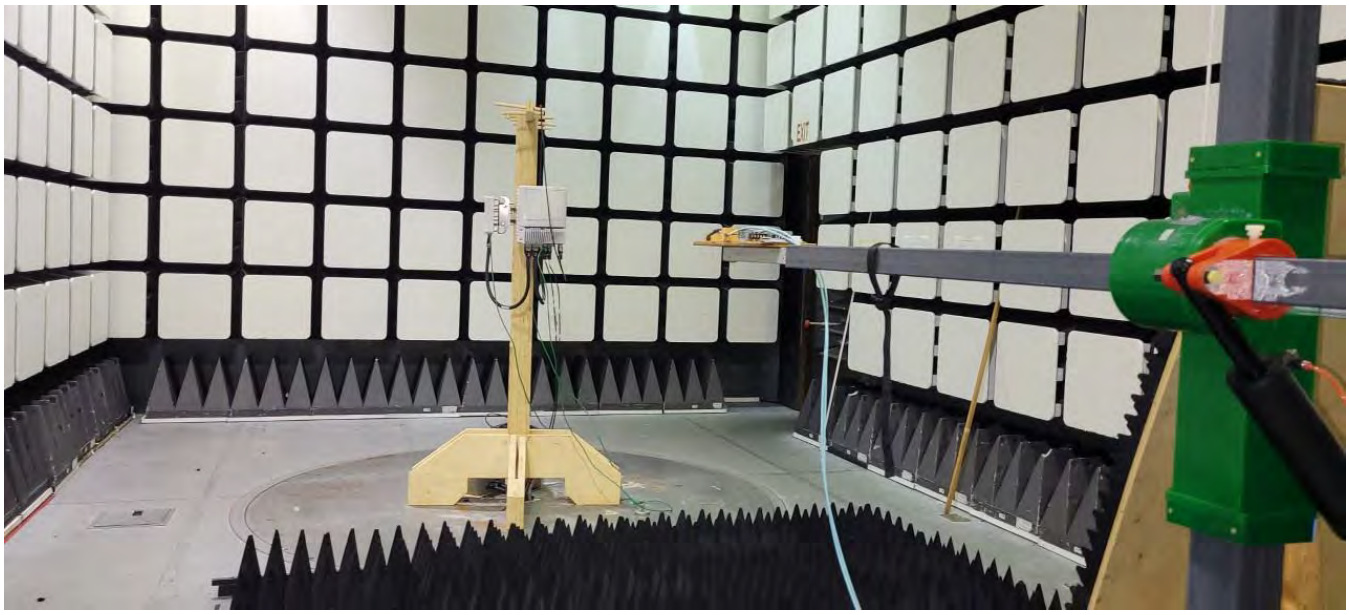


40GHz-60 GHz

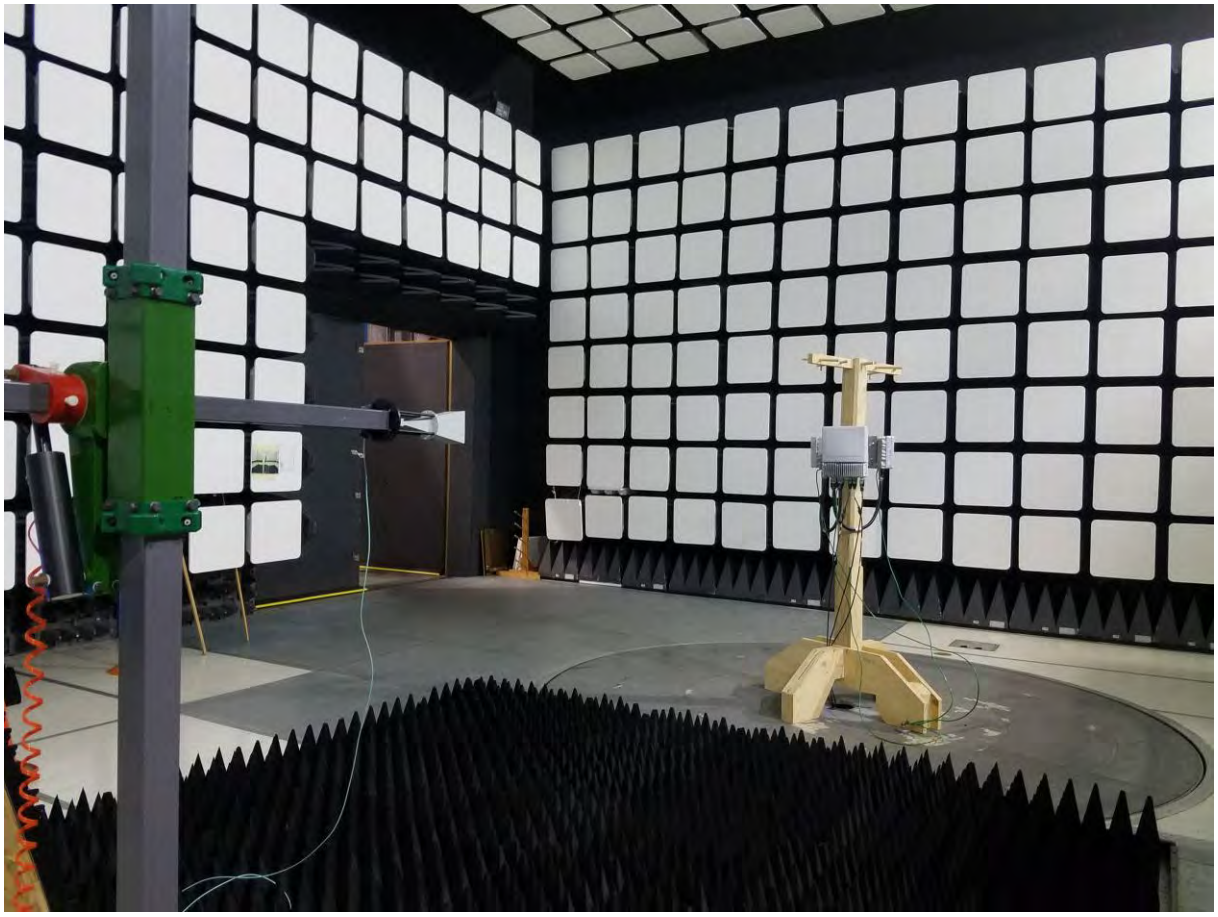
60GHz-90 GHz



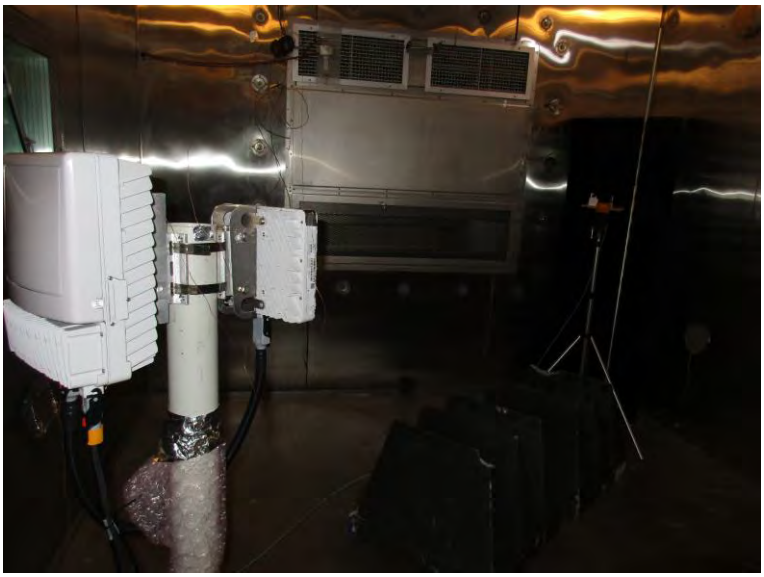
90GHz-140 GHz

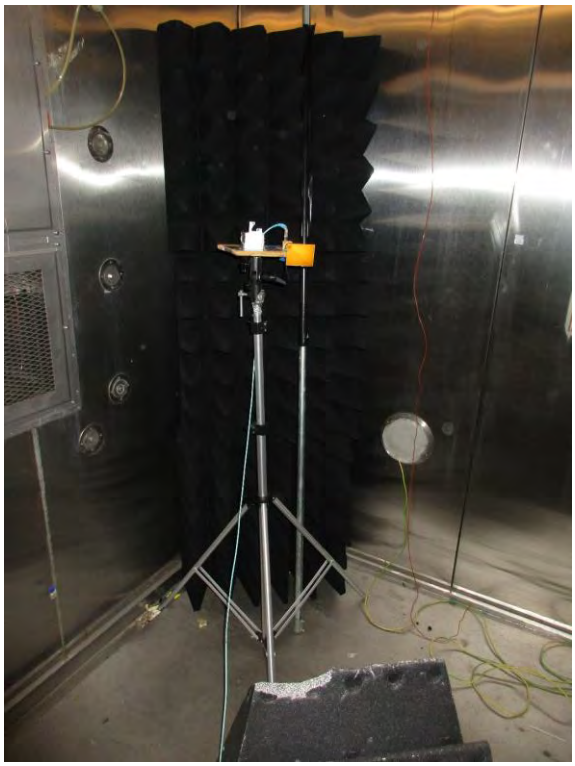


Radio Testing

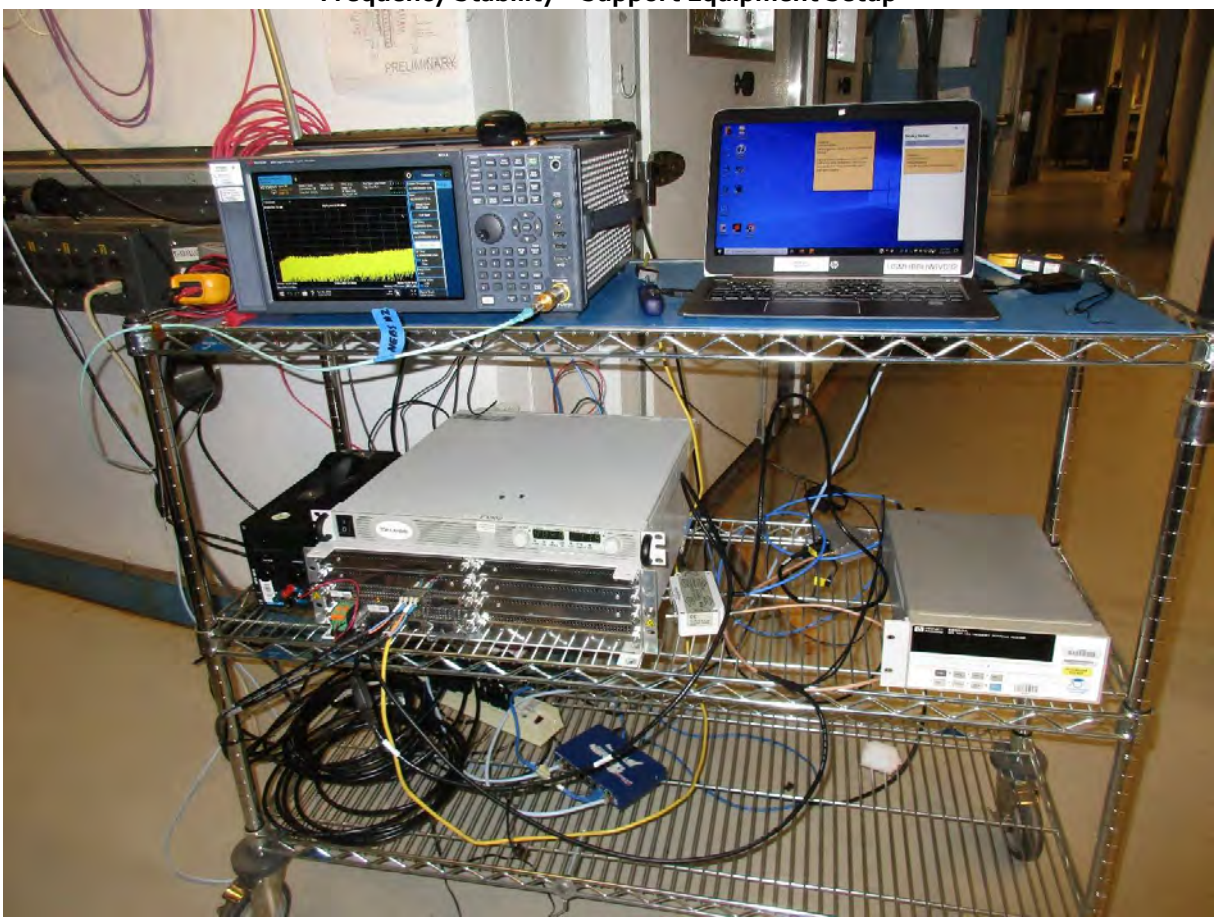


Frequency Stability Test - in thermal chamber





Frequency Stability - Support Equipment Setup



4.9 FACILITIES AND ACCREDITATION

Measurement facilities at Nokia, Global Product Compliance Laboratory (GPCL) a member of the Nokia family of companies, was used to collect the measurement data in the test report. The laboratory, which is part of Nokia Bell Labs, is located at 600-700 Mountain Avenue, Murray Hill, New Jersey 07974-0636 USA.

The field strength measurements of radiated spurious emissions were made in a FCC registered five meter semi-anechoic chamber AR-4, (FCC Registration Number: 395774) **NVLAP** Lab Code: 100275-0 and IC (Filing Number: 6933F-5) which is maintained by Nokia Bell Labs in Murray Hill, New Jersey. The sites were constructed and are continuously in conformance with the requirements of ANSI C63.4 and CISPR Publication 22.

Nokia Global Product Compliance Laboratory FCC OET Accredited Test Firm Scope List is accessible at:

https://apps.fcc.gov/oetcf/eas/reports/ViewTestFirmAccredScopes.cfm?calledFromFrame=N&RequestTimeout=500&regnum_specified=N&test_firm_id=7007

and is as listed in the Table below.

OET Accredited Test Firm Scope List

Test Firm: Nokia, Global Product Compliance Lab

Scope	FCC Rule Parts	Maximum Assessed Frequency, MHz	Status	Expiration Date	Recognition Date
Unintentional Radiators	FCC Part15, Subpart B	40000	Approved	9/30/2022	7/6/2017
Intentional Radiators	FCC Part 15 Subpart C	40000	Approved	9/30/2022	6/5/2018
U-NII without DFS Intentional Radiators	FCC Part 15, Subpart E	40000	Approved	9/30/2022	6/5/2018
U-NII with DFS Intentional Radiators	FCC Part 15, Subpart E	40000	Approved	9/30/2022	6/5/2018
Commercial Mobile Services	Part 22 (cellular), Part 24, Part 25 (below 3 GHz), Part 27	40000	Approved	9/30/2022	6/5/2018
General Mobile Radio Services	Part 22 (non-cellular), Part 90 (below 3 GHz), Part 95 (below 3 GHz), Part 97 (below 3 GHz), Part 101 (below 3 GHz)	40000	Approved	9/30/2022	6/5/2018
Citizens Broadband Radio Services	Part 30	40000	Approved	9/30/2022	7/6/2017
Microwave and Millimeter Bands Radio Services	Part 25, Part30, Part 74, Part 90 (90M DSRC, Y, Z), Part 95 (M & L), Part 101	200000	Approved	9/30/2022	7/6/2017

Nokia Global Product Compliance Laboratory is accredited with the US Department of Commerce National Institute of Standards and Technology's National Voluntary Laboratory Accreditation Program (NVLAP) for satisfactory compliance with criteria established in Title 15, Part 7 Code of Federal Regulations for offering test services for selected test methods in Electromagnetic Compatibility; Voluntary Control Council for Interference (VCCI), Japan; Australian Communications and Media Authority (ACMA). The laboratory is ISO 9001:2008 Certified.

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

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Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 100275-0

Nokia, Global Product Compliance Lab
Murray Hill, NJ

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2021-09-24 through 2022-09-30
Effective Dates

DEPARTMENT OF COMMERCE · UNITED STATES OF AMERICA

For the National Voluntary Laboratory Accreditation Program

5. APPENDIX A - CALIBRATION CERTIFICATES.

The attached Calibration certificates represent the Harmonic Downconverters used in this testing.