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TESTING
NVLAP LAB CODE: 100275-0

FCC Certification Part 30 Test Report

Regulation:
FCC Part 30

Client:
NOKIA SOLUTIONS AND NETWORKS

Product Evaluated
AWKUC (AC) / AWKUD (DC) 24GHz

Report Number:
TR-2024-0001-FCC30

Date Issued:
April 17, 2024

Revisions

Date	Revision	Section	Change
3/14/2024	0		Initial Release
3/20/2024	1	1, 4.3.1, 5	Occupied Bandwidth, Appendix A
4/5/2024	2	1, 4, 4.1	Documented 3GPP Test Models.
4/17/2024	3	3.4, 4.1, 4.3, 4.5	Detailed 3GPP Test Models. Revised result tables. Revised titles.

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Table of Contents

1. ATTESTATION OF TEST RESULTS

Company Name	Nokia Solutions and Networks, OY
FCC ID	2AD8UAWKUCD01
Product Name	AWKUC (AC) / AWKUD (DC) 24GHz
Part No	Refer to Section 3.1
Serial Number(s)	Refer to Section 3.1
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 v01r02–April 2021 • 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) • ETSI TS 138 141-2 V15.17.0 5G; NR; Base Station (BS) conformance testing Part 2: Radiated conformance testing (2023-05)
Test Date	1/4/2024 – 3/19/2024
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)	Ron Remy
Lead Engineer	W. Steve Majkowski
Test Engineer (s)	W. Steve Majkowski, Mike Soli
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	AWKUC (AC) / AWKUD (DC) 24GHz
Radio Type	Intentional Transceiver
Power Type	Both DC & AC
Modulation	QPSK, 16QAM, 64QAM
Operating Frequency Range	24.25-24.45 and 24.75-25.25 GHz
Channel Bandwidth	100MHz
Max Radiated Power	69 dBm per unit per polarization 72 dBm Total per unit
Antenna Gain	30 dBi
Operating Mode	2x / 4x / 8x MIMO (2 duplex Tx/Rx Ports) each unit
Software Version	SBTS22R3
Hardware Version	DC Version: 476239A.X21 AC Version: 476240A.X21
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 that exceeds 30 dBi. There is a single antenna board assembly inside the product. This antenna assembly has polarized antenna Tx/Rx modules. The antennas nominal RF drive level is 39 dBm per polarization. The 39 dBm RF power and 30 dBi gain results in a 69 dBm EIRP per polarization. The sum of the two 69 dBm EIRP beams results in a maximum total EIRP of 72 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

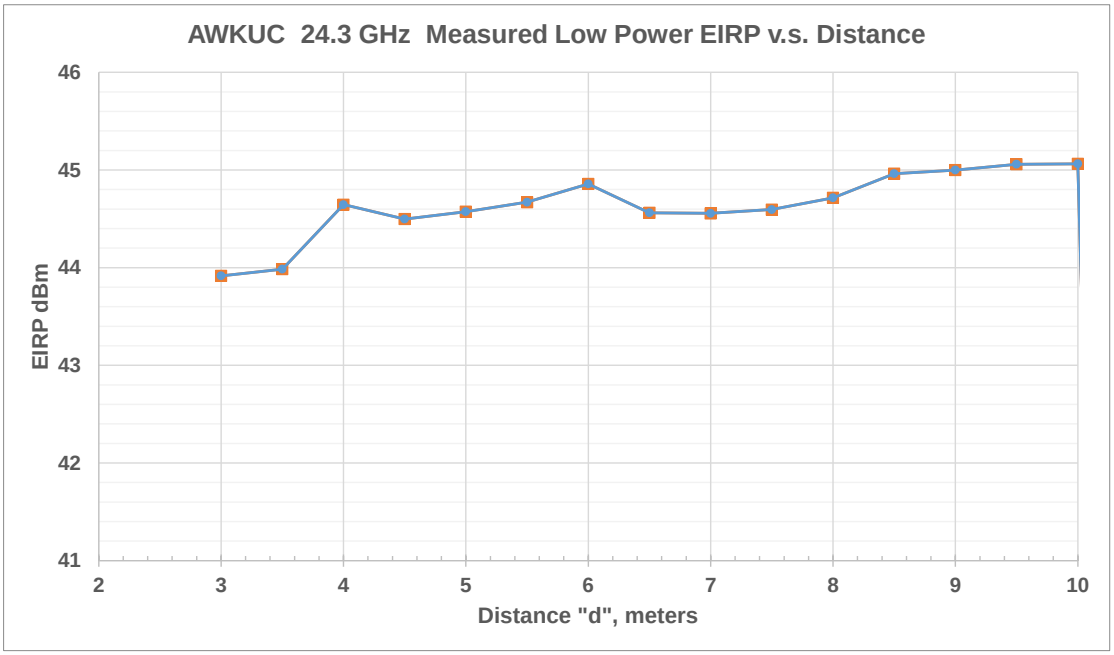
The individual polarization antenna array has a 20 cm diagional.
At 24.3 GHz the individual array dimensions results in a minimum Fraunhofer far field distance, $d_{ff,}$ of 6.47 meters.

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 power is constant and where it actually occurs for the specific product under test.

The Moongilan Test was performed at low power using a standard gain horn antenna. In the vertical polarization the reliable far field distance was determined to be at 6.5 m. The results are shown below.

To eliminate any inconsistancy all Power, OBW and OOBE measurements were made at 6.5 m.

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



3.4 Product Operational Configuration and RF Test Model

Three 3GPP Test Models for 5G New Radio (NR) in Frequency Range 2 (FR > 6GHz) were used in the performance of these tests. They are:

NR FR2 Test Model 1.1	Typically called NR-FR2-TM1.1 or **QPSK**
NR FR2 Test Model 3.1	Typically called NR-FR2-TM3.1 or **64QAM**
NR FR2 Test Model 3.1N	Typically called NR-FR2-TM3.1N which is **QPSK + 16QAM**

Testing was performed for the worst case conditions of single carrier Max power at left and right side of band as well as the maximum 7 carrier at the same total power. These endpoints were also tested with NR-FR2-TM3.1 / 64QAM. All the channel configurations of 1 through 7 carriers were tested.

47CFR Part 30 does not specify any Modulation requirements, however 3GPP has identified the appropriate worst case test model to use for specific tests. These are identified in in section 4.9.2 of TS 138 141-2 V15.17.0 (2023-05) Specifically the NR-FR2-TM1.1 or **QPSK**, which is identified within this document as **QPSK**, is the required 3GPP industry standard Test Model for

- Radiated transmit power
- BS output power
- Transmiter off radiated emissions
- Unwanted emissions
- Occupied bandwidth
- ACLR
- Time Alignment Error
- Operating band unwanted emissions
- Transmitter spurious emissions
- Receiver spurious emissions

The major fixed parameters of the transmit signal were:

Table 3.4-1 Transmit Signal Parameters

Number of Resource Blocks	66
Resource Blocks Bandwidth	1.44 MHz
Nominal Signal Bandwidth	100 MHz
Minimum Signal Bandwidth	94.05 MHz
Sub-Carrier Spacing	120 kHz

Specific physical channel parameters for NR-FR2-TM1.1 are defined in the table below.

Table 3.4-1 Specific Physical Channel Parameters for NR-FR2-TM1.1

Parameter	Value
Number of PRBs PDSCH $\eta_{RNTI} = 0$	N_{RB} - 3
Modulation of PDSCH $\eta_{RNTI} = 0$	QPSK
RB starting location of PDSCH $\eta_{RNTI} = 0$	3
Modulation of PDSCH $\eta_{RNTI} = 0$	QPSK
RB starting location of PDSCH $\eta_{RNTI} = 0$	0

There are four additional tables of other commom fixed parameters which are documented in Tables 4.9.2.2-1, 4.9.2.2-2, 4.9.2.2-3, 4.9.2.2-4. of TS 138 141-2 V15.17.0(2023-05). All other parameters, per 3GPP, are varied dynamically. The parameters for the three test models were hard fixed in the test software and were unchanged throughout all tests. Unless otherwise noted radiated spurious emissions measurements were performed with the product configured for a single 24.998GHz QPSK carrier at maximum power.

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 I 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 Product was configured with the appropriate 3GPP test models per TS 138 141-2 V15.17.0 (2023-05) section 4.2.2 as described in 3.4.

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 v01r02–April 2021 • 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) • ETSI TS 138 141-2 V15.17.0 (2023-05) 5G; NR; Base Station (BS) conformance testing Part 2: Radiated conformance testing

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 a measurement of the total radiated power in terms of the maximum EIRP radiated by the product.
The FCC requirements under Part 30 limits the average power of the sum of all antenna elements to an equivalent isotopically radiated power (EIRP) density of +75dBm/100 MHz.

The **Nokia AWKUC (AC) / AWKUD (DC) 24GHz Radio Unit FCC ID: 2AD8UAWKUCD01** is a 5G-NR Remote radio head that can be configured for one to eight carrier operation. It is specified to provide a maximum power output of 69 dBm /7943.3 W EIRP per transmit polarization for a sum total of 72 dBm /15849W 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, n260 in 37 – 40 GHz. In the US market operation will be limited to 7 carriers of operation.

4.1.1 RF Power Output Measurement

The product was configured for test as shown in Figure 4.1.1 below and allowed to warm up and stabilize per KDB 971168 D01 and ANSI C63.26. The Product was configured with the appropriate 3GPP test models per TS 138 141-2 V15.17.0 (2023-05) and as identified on the results tables..
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 6.5 m distance using a nominal 64 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.

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

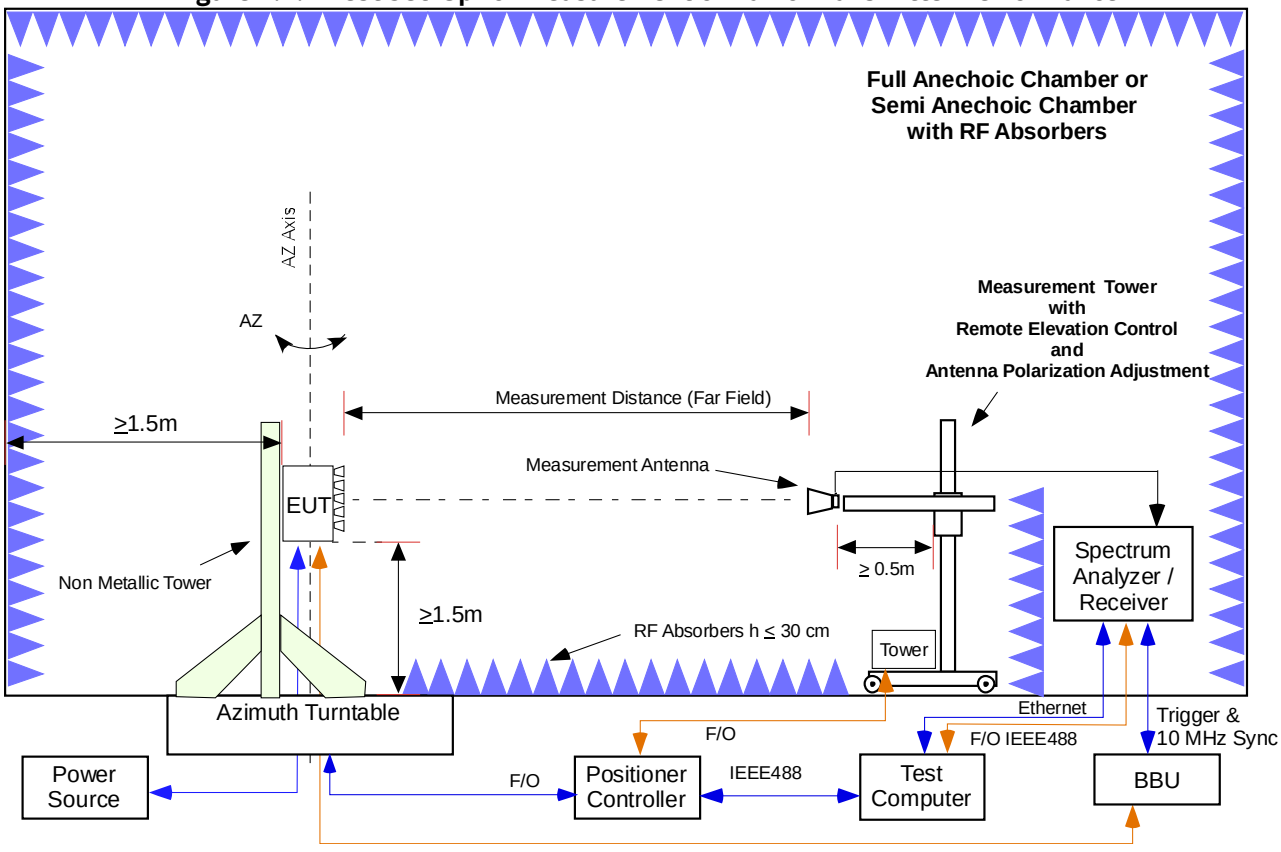


Table 4.1.1 Corrections For Transmitter Power Measurements

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	75.55	23.70	31.82	83.67	83	0.671
22.50	75.74	23.90	32.05	83.89	83	0.893
23.00	75.93	23.85	32.37	84.45	83	1.451
23.50	76.12	24.10	32.36	84.39	83	1.386
24.00	76.30	24.25	32.40	84.46	83	1.455
24.50	76.48	24.30	32.61	84.79	83	1.790
25.00	76.66	24.38	32.73	85.01	83	2.006
25.50	76.83	24.45	32.89	85.28	83	2.276
26.00	77.00	24.65	33.05	85.40	83	2.399
26.50	77.16	24.55	33.26	85.87	83	2.872
27.00	77.33	24.65	33.31	85.98	83	2.983
27.50	77.49	24.75	33.44	86.17	83	3.174
28.00	77.64	24.85	33.64	86.43	83	3.431
28.50	77.80	24.75	33.82	86.86	83	3.862
29.00	77.95	25.00	33.90	86.85	83	3.846
29.50	78.10	24.95	34.05	87.20	83	4.198
30.00	78.24	25.10	34.16	87.30	83	4.298
30.50	78.39	25.00	34.48	87.87	83	4.868
31.00	78.53	25.13	34.49	87.89	83	4.891
31.50	78.67	25.00	34.68	88.34	83	5.344
32.00	78.80	25.25	34.82	88.37	83	5.372
32.50	78.94	25.12	34.96	88.78	83	5.777
33.00	79.07	25.20	34.96	88.83	83	5.826

4.1.1.1 RF Power Output Results

Power output measurements verified the expected performance of 69 dBm EIRP per polarization for a Total Power of 72 dBm. The maximum measured level was 69.73 dBm for a single polarization and 72.26 dBm total. This level is well within the maximum Part 30.202(a) limit of 75 dBm EIRP.
The measured performance was in full compliance with the Rules of the Commission. The data plots and table are detailed below.

Table 4.1.1.1 – Channel Power Measurements

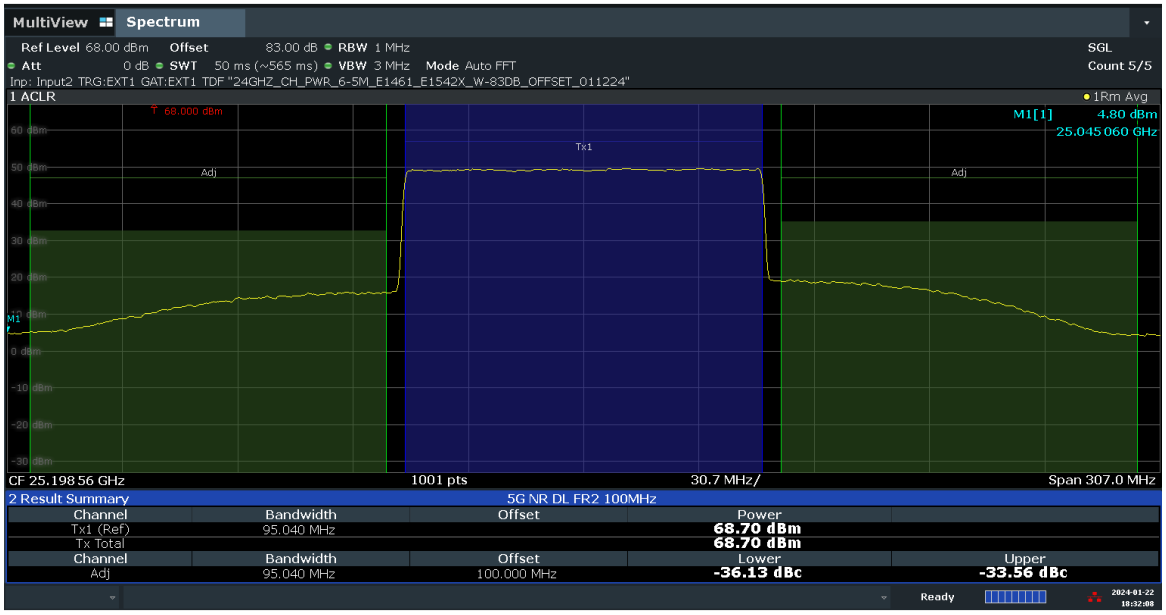
Channel Center Frequencies, GHz	# of carriers	Modulation	Horizontal Polarization Total Channel Power, EIRP	Vertical Polarization Total Channel Power, EIRP	Sum Total Channel Power EIRP	Margin to Part 30.202a Limit
			dBm	dBm	dBm	dB
24.7992	1	QPSK	68.16	67.85	71.02	3.98
24.99888	1	QPSK	68.80	68.75	71.79	3.21
24.7992	1	QPSK	68.70	69.73	**72.26**	**2.74**
24.3 24.3984 24.7992 24.89904 24.99888 25.09872 25.19856	7	QPSK	68.58	68.01	**71.31**	3.69

4.1.1.1.1 Channel Power Measurement Plots

Single Carrier 24.7992GHz

Horizontal

2024-0001 24 GHz AWKUC s/n YK234200054



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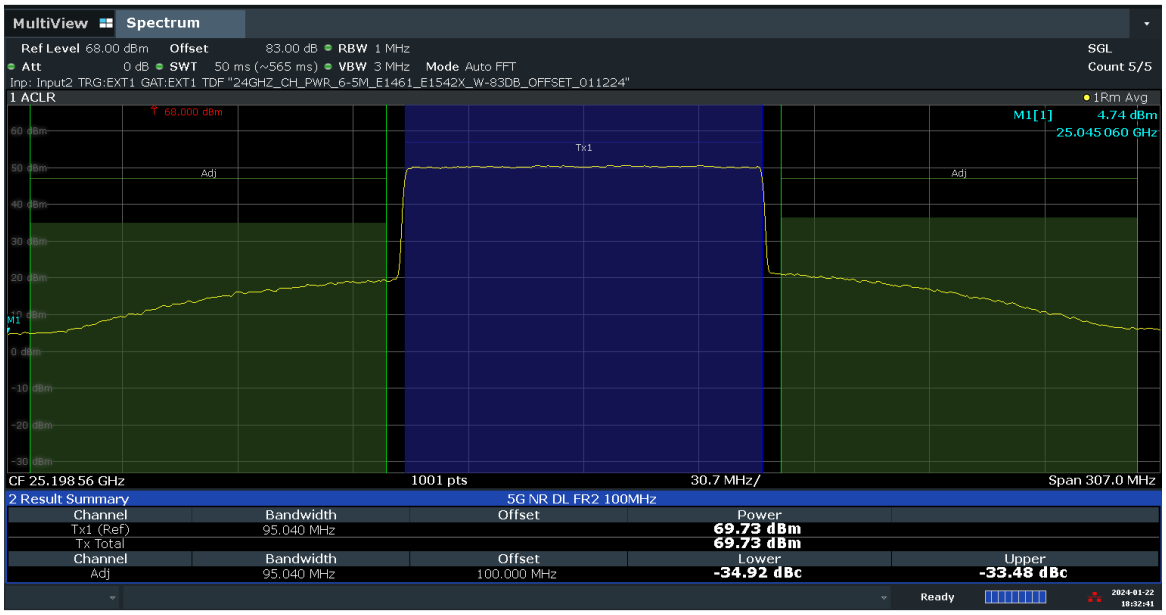
Vertical

2024-0001 24 GHz AWKUC s/n YK234200054



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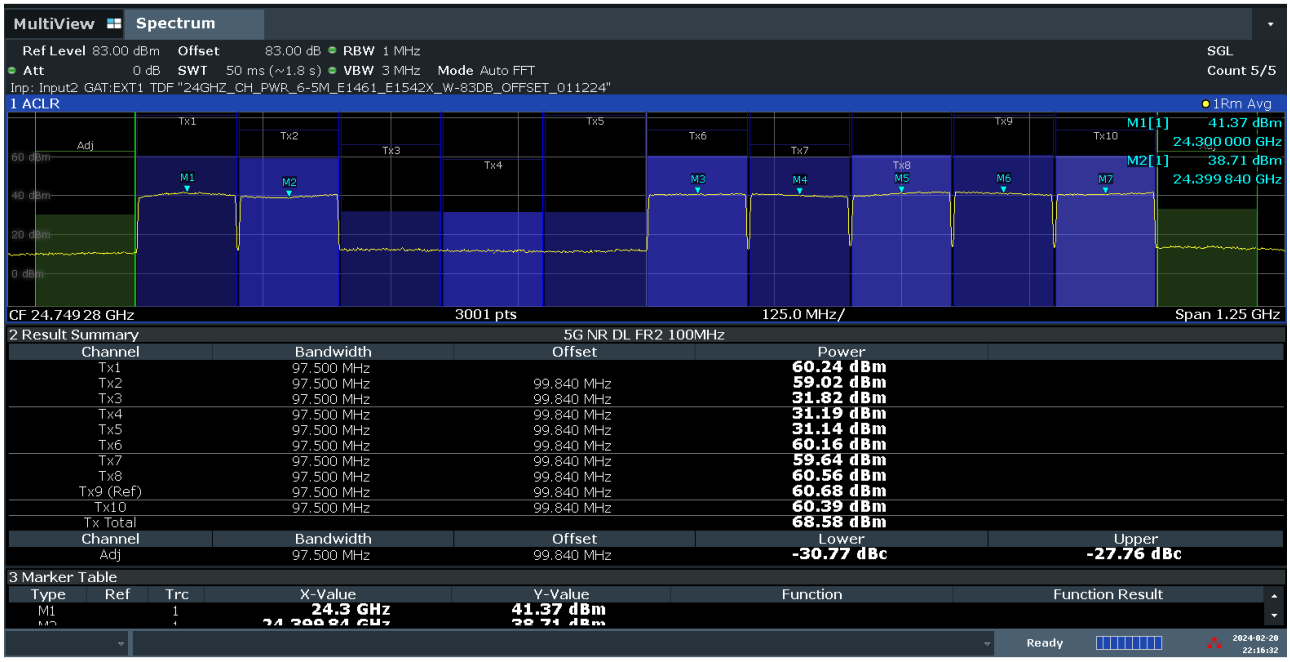
Seven Carrier 24.7992GHz

Horizontal

2024-0001 24 GHz AWKUD S/N YK234300009



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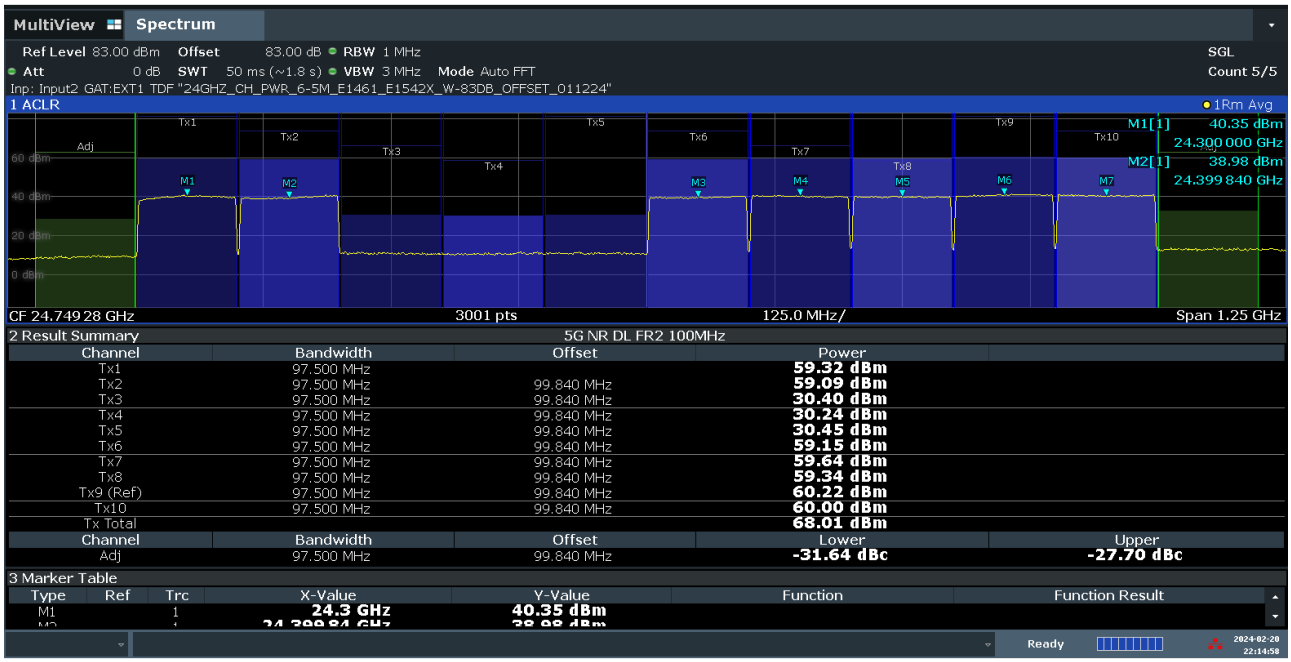
Vertical

2024-0001 24 GHz AWKUD S/N YK234300009



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4.2 Section 2.1047 MEASUREMENT REQUIRED: MODULATION CHARACTERISTICS

AWKUC (AC) / AWKUD (DC) 24GHz supports the 5G New Radio Modulation. Each individual subcarrier can be modulated with QPSK, 16QAM and 64QAM digital modulation formats.

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

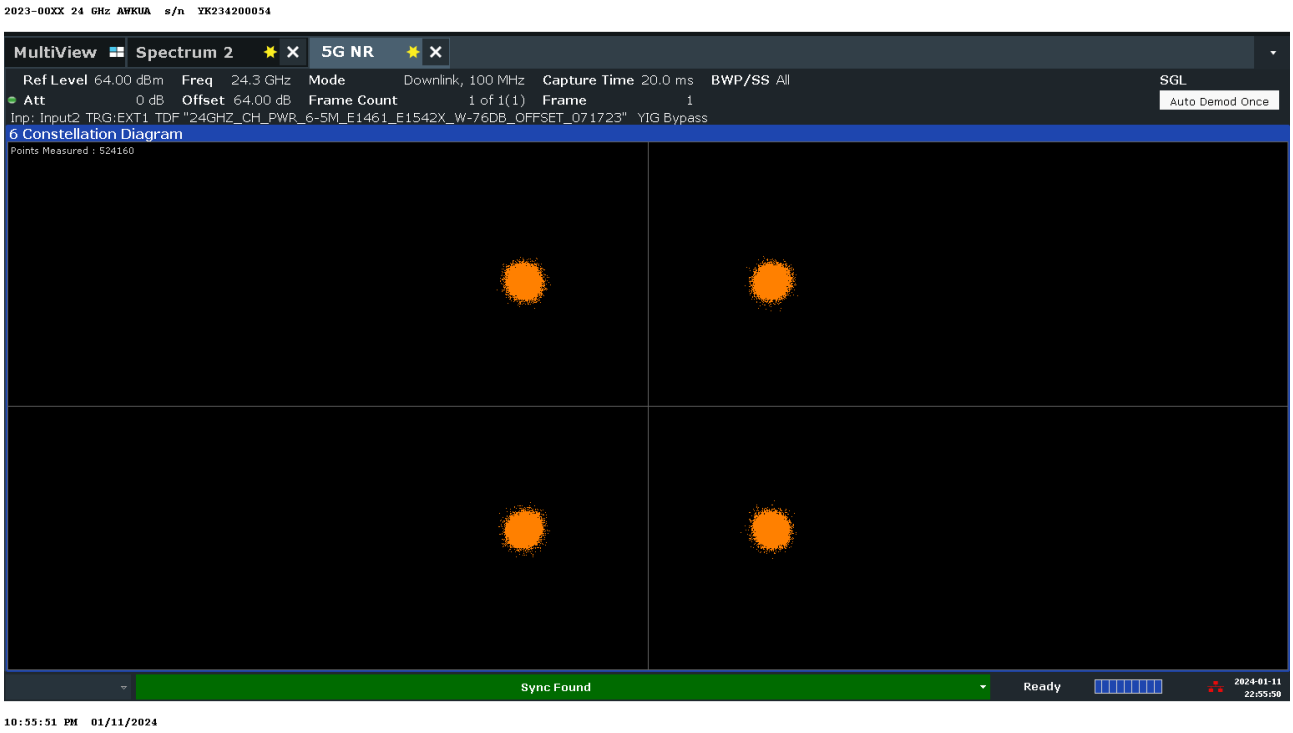
The measurements were performed at a distance of 6.5 m from the unit utilizing the test configuration in Figure 4.4.1 utilizing an Rohde & Schwarz FSW85 Signal analyzer with the 3GPP 5G-NR DL Measurement software option. Representative screen plots of the modulation measurement are attached below for all three of the subcarrier configurations and sample polarizations. Data was collected at left, center and right side of the n258 24GHz frequency band.

4.2.2 Modulation Measurements Results:

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

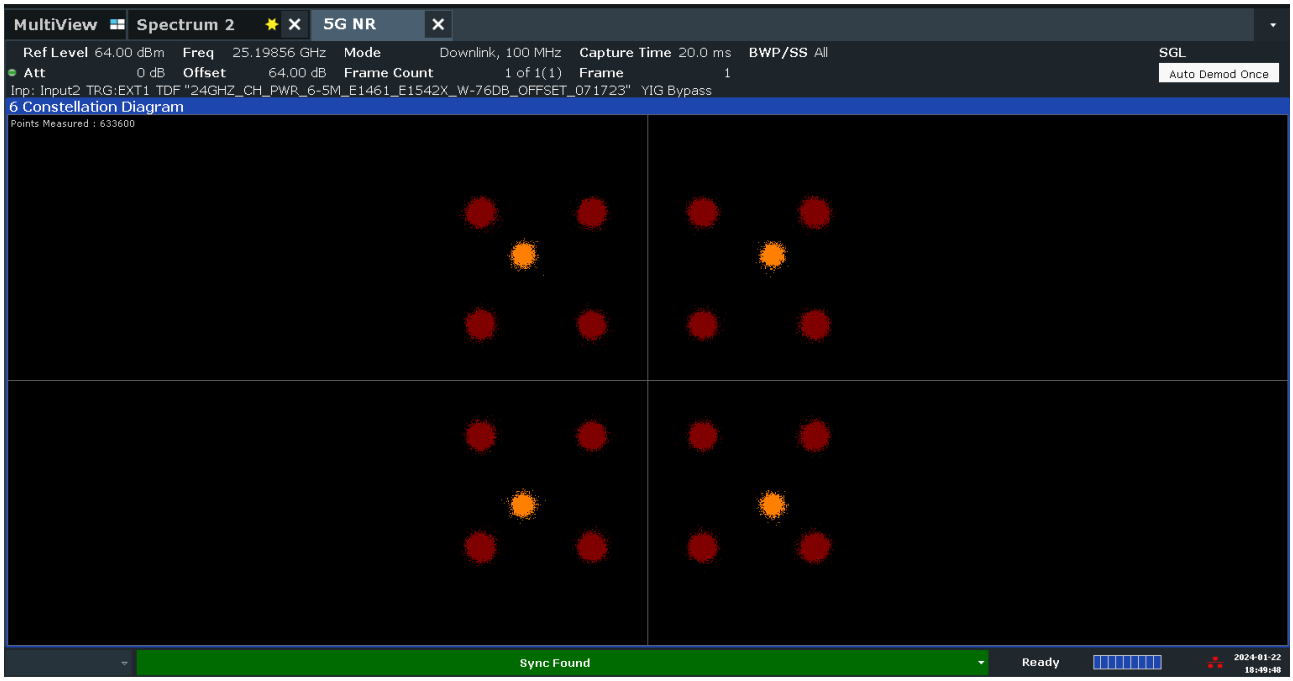
Figure 4.2 Sample Modulation Results

QPSK



16QAM

2023-00XX 24 GHz AWKUA s/n YK234200054



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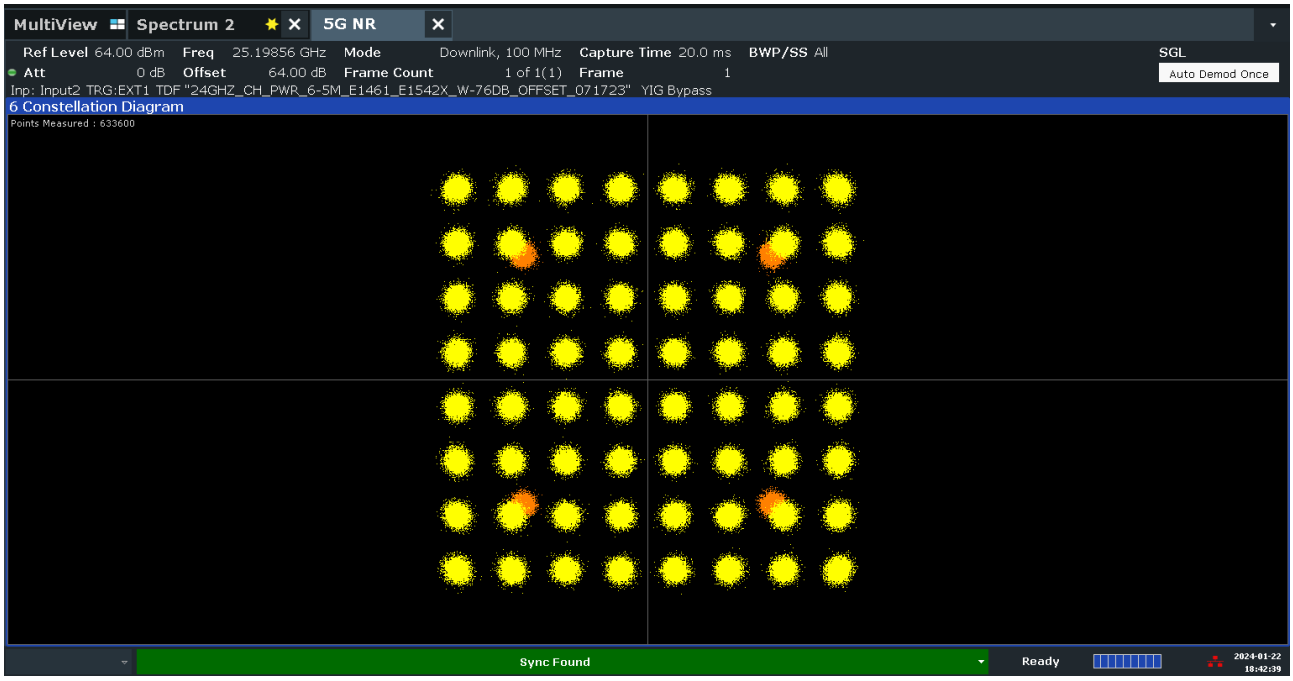
64QAM

2023-00XX 24 GHz AWKUA s/n YK234200054



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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 that is 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 bandwidth of the 100 MHz 5G-NR carrier measured is less than 97.5MHz for the AWKUC/D in the US n258 band. Both are within the authorized band and are less than the bandwidth used in the emission designator.

Table 4.3.1-1 – Occupied Bandwidth 1MHz RBW

Carrier Frequencies (GHz)	Number of Carriers	Modulation	Horizontal Polarization Occupied Signal Bandwidth (MHz)	Vertical Polarization Occupied Signal Bandwidth (MHz)
24.3	1	QPSK	93.93	93.85

Table 4.3.1-2 – Occupied Bandwidth 5MHz & 10 MHz RBW

Carrier Frequencies (GHz)	Number of Carriers	Modulation	Horizontal Polarization Occupied Signal Bandwidth (MHz)		Vertical Polarization Occupied Signal Bandwidth (MHz)	
			5 MHz RBW	10 MHz RBW	5 MHz RBW	10 MHz RBW
24.7992 24.89904	2	64QAM	194.30	197.95	194.52	198.40
24.7992 24.89904 24.99888	3	64QAM	292.91	296.24	293.01	296.38
24.7992 24.89904 24.99888 25.09872	4	64QAM	390.88	393.63	391.17	393.65
24.7992 24.89904 24.99888 25.09872 25.19856	5	64QAM	489.58	491.65	489.68	491.60

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 **AWEUC/D** 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 maximum bandwidth of 97.5 MHz, are spaced on centers that are either 99.96 MHz or 99.84 MHz apart. These carriers do not overlap and their spacing is determined by the carriers preference.

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 491 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

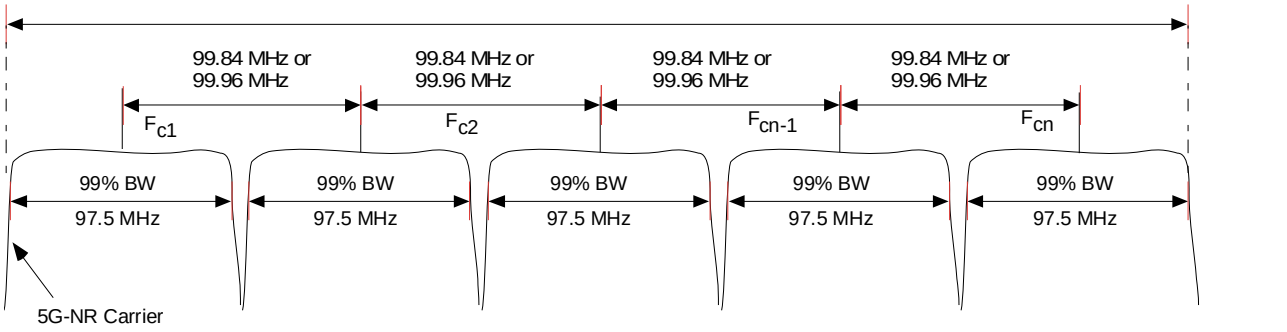
The calculated assessment for two through eight carriers are identified below.

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

A comparison of the maximum difference of the Aggregation Bandwidth for the 99.96 MHz carrier spacing vs the 99.84 MHz carrier spacing is as follows.
Maximum Carrier Aggregation Bandwidth (99.96MHz)= 4(99.96) + 97.5MHz = 497.34 MHz = 498MG7W
Maximum Carrier Aggregation Bandwidth (99.84MHz)= 4(99.84) + 97.5MHz = 496.86 MHz < 498MG7W

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

Figure 4.3.1.1 Carrier Aggregation



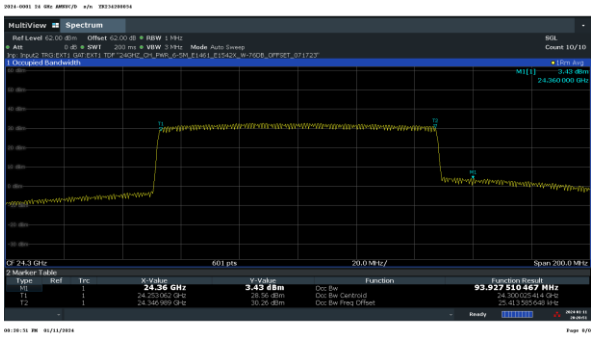
Carrier Aggregation 5x(97M5)@99.84 spacing
WSM 6-04-22

The Maximum Carrier Aggregation Bandwidth = 4(99.96) + 97.5MHz = 497.34 MHz

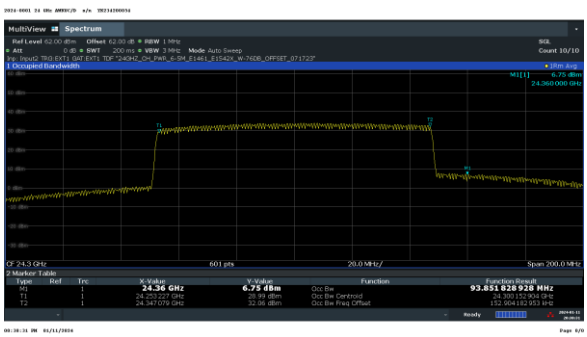
4.3.1.2 99% Signal Bandwidth Sample Plots

One carrier

Horizontal

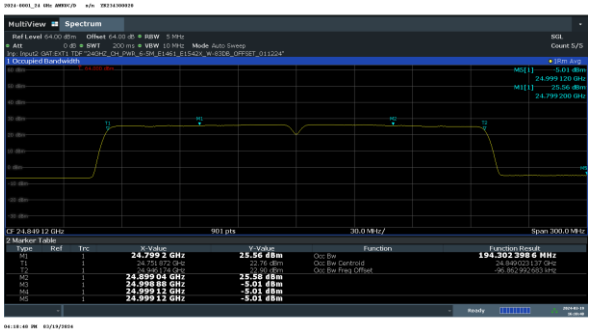


Vertical

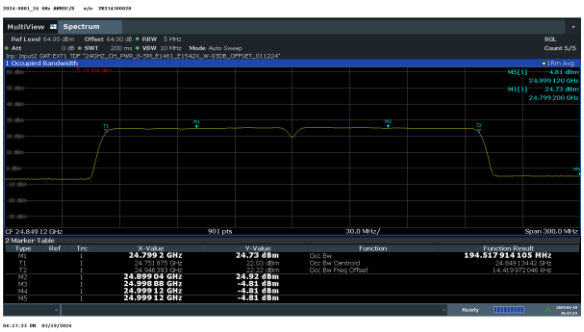


Two Carrier

Horizontal

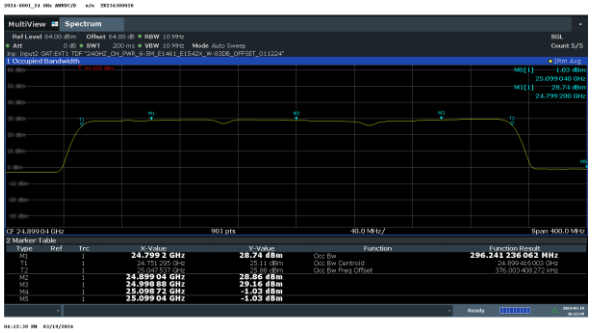


Vertical

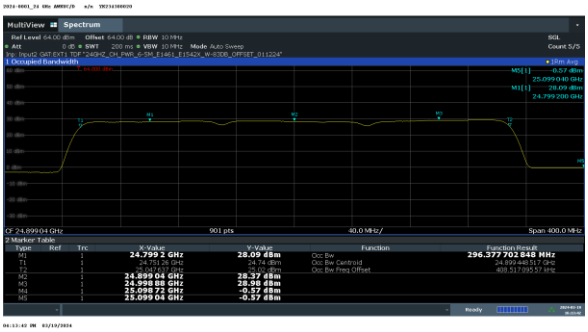


Three Carrier

Horizontal



Vertical

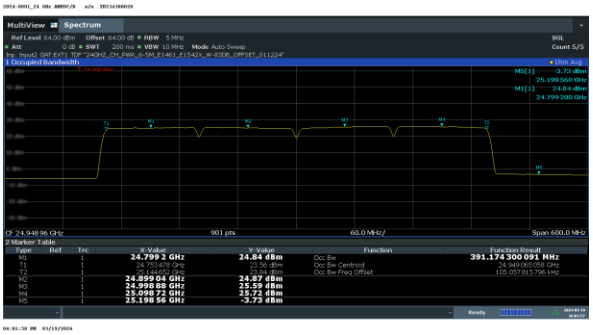


99% Signal Bandwidth Plots *continued*

Four Carrier

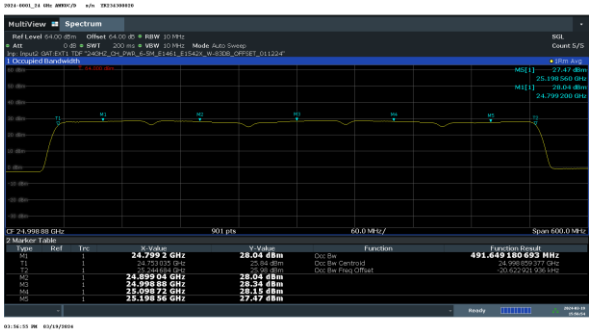
Horizontal

Vertical

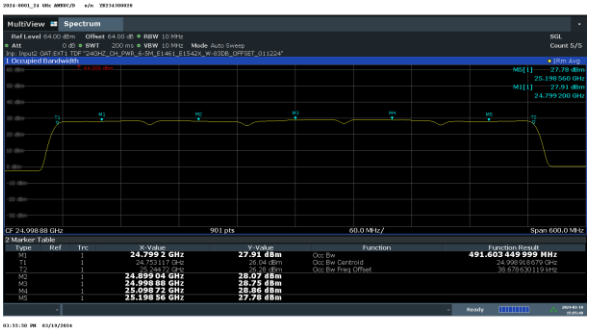


Five Carrier

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 **2AD8UAWKUCD01 AWKUC/D 5G AirScale 24 GHz mmWave Radio** Unit 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 5.7m boundary 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 for both vertical and horizontal polarizations were performed at 6.5m.

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 antenna 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 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 (100 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	75.0
24.45	75.0
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	75.0
24.75	75.0
25.25	75.0
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/attenuator Loss - Product Antenna Gain.

Total Required Adjustment (@25 GHz) **=** 54.25 dB = 76.66 dB -24.38dBi + 32.73dB – 30.756 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 6.5m including the AWKUC/D product gain. The measurements were made using a flat offset of 54 dB with a transducer correction identified below.

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 6.5m. The measurements were made using a flat offset 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+ 20 dB attenuator Loss, "L"	PL-G+L	AWKUC/D Antenna Gain, IEEE	Total Required Adjustment	FSW Offset	Transducer Correction Factor
GHz	dB	dBi	dB	dB	dBi	dB	dB	dB
22.00	75.55	23.70	31.82	83.67	27.189	56.48	54	2.482
22.50	75.74	23.90	32.05	83.89	27.981	55.91	54	1.912
23.00	75.93	23.85	32.37	84.45	28.772	55.68	54	1.679
23.50	76.12	24.10	32.36	84.39	29.360	55.03	54	1.026
24.00	76.30	24.25	32.40	84.46	29.947	54.51	54	0.509
24.50	76.48	24.30	32.61	84.79	30.351	54.44	54	0.439
25.00	76.66	24.38	32.73	85.01	30.756	54.25	54	0.250
25.50	76.83	24.45	32.89	85.28	30.929	54.35	54	0.347
26.00	77.00	24.65	33.05	85.40	31.101	54.30	54	0.298
26.50	77.16	24.55	33.26	85.87	31.248	54.62	54	0.624
27.00	77.33	24.65	33.31	85.98	31.394	54.59	54	0.590
27.50	77.49	24.75	33.44	86.17	31.401	54.77	54	0.773
28.00	77.64	24.85	33.64	86.43	31.408	55.02	54	1.023
28.50	77.80	24.75	33.82	86.86	29.398	57.46	54	3.464
29.00	77.95	25.00	33.90	86.85	27.387	59.46	54	5.459
29.50	78.10	24.95	34.05	87.20	19.459	67.74	54	13.739
30.00	78.24	25.10	34.16	87.30	11.532	75.77	54	21.767
30.50	78.39	25.00	34.48	87.87	17.389	70.48	54	16.479
31.00	78.53	25.13	34.49	87.89	23.246	64.65	54	10.645
31.50	78.67	25.00	34.68	88.34	24.512	63.83	54	9.832
32.00	78.80	25.25	34.82	88.37	25.779	62.59	54	8.593
32.50	78.94	25.12	34.96	88.78	26.161	62.62	54	8.616
33.00	79.07	25.20	34.96	88.83	26.544	62.28	54	8.282

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 6.5m. The measurements were performed with an FSW spectrum analyzer and in compliance with the procedure and requirements of ANSI C63.26. The test set-up diagram in Figure 4.1.1 was used. All testing was performed with 100 MHz carriers. Testing was performed for the one and two carrier configuration at the left side of the n258 Band and the five 100 MHz carrier configuration at the upper band of the n258 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 EIRP Results and Edge of Band Measurements

KDB 842590 D01 Section 4.4.2.1 allows an "early exit", an alternative approach to TRP (or conducted power) measurement. In other words, it is acceptable to perform maximum EIRP measurements, over the required frequency range, and compare the measurements to the limit to verify compliance. If the measured EIRP levels are below the TRP limit the early exit condition is met and the device is compliant. If the device does not meet the emission limit at one or some frequencies, then TRP measurements need be performed only at those frequencies.

EIRP measurements need to be performed using linearly polarized antenna. Both horizontal and vertical polarizations are measured separately and not summed. The highest amplitude signal measured from horizontal or vertical polarization is used for determining compliance to the unwanted emission limit.
The out-of-band emissions were measured for n258 bands in vertical and horizontal polarizations.

From the radiated measurement in the 40 GHz to 125 GHz presented in Section 4.5, the worst "in beam" EIRP emission is at 90.144 GHz with an amplitude at -16.98 dBm/MHz. It is 3.98 dB below the TRP limit before averaging. From the field strength measurement in the 27 GHz to 40 GHz range the worst emission is at 27.635483 GHz with a margin of 2.04 dB (pk) and 7.53 dB (avg). These results are tabulated in Section 4.5 of this document on page 46.

Table 4.3.7.1 Results - Spurious Emissions 40-125GHz

Number of Carriers	Modulation	Frequency of measured OOBE, GHz	Measured Value Vertical Polarization	Vertical Margin to Part 30.203(a) limit of -13 dBm	Measured Value Horizontal Polarization	Horizontal Margin to Part 30.203(a) limit of -13 dBm	Occupied Bandwidth Edge of Block / OOBE Compliance
7	QPSK	49.99137	-33.24	20.24	-33.29	20.29	Compliant
7	QPSK	60.00025	-27.71	14.71	-27.95	14.95	Compliant
7	QPSK	72.37274	-25.46	12.46	-34.44	21.44	Compliant
7	QPSK	90.14472	-17.48	4.48	-16.98	**3.98**	Compliant

The maximum EIRP emissions from both vertical and horizontal polarizations are below the TRP limits with a minimum margin of 3.98 dB. Therefore, the early exit condition was met and the EUT is compliant.

4.3.7.2 Out Of Band Emissions Results

The worst case Out Of Band Emissions plots for the tested configurations are shown below. These Occupied Bandwidth and Edge-of-Band emissions measurements were made as a radiated measurement at the verified far field measurement distance of 6.5m.

The measurement results of the out-of-band emissions are documented in Table 4.3.7.2 below.
For n258 24 GHz band, the worst emission was identified at 25.441GHz with a level at -22.60dBm/MHz.

The measurement results of the out-of-band emissions as documented in the plots demonstrate the full compliance with the Rules of the Commission for the operating bands.

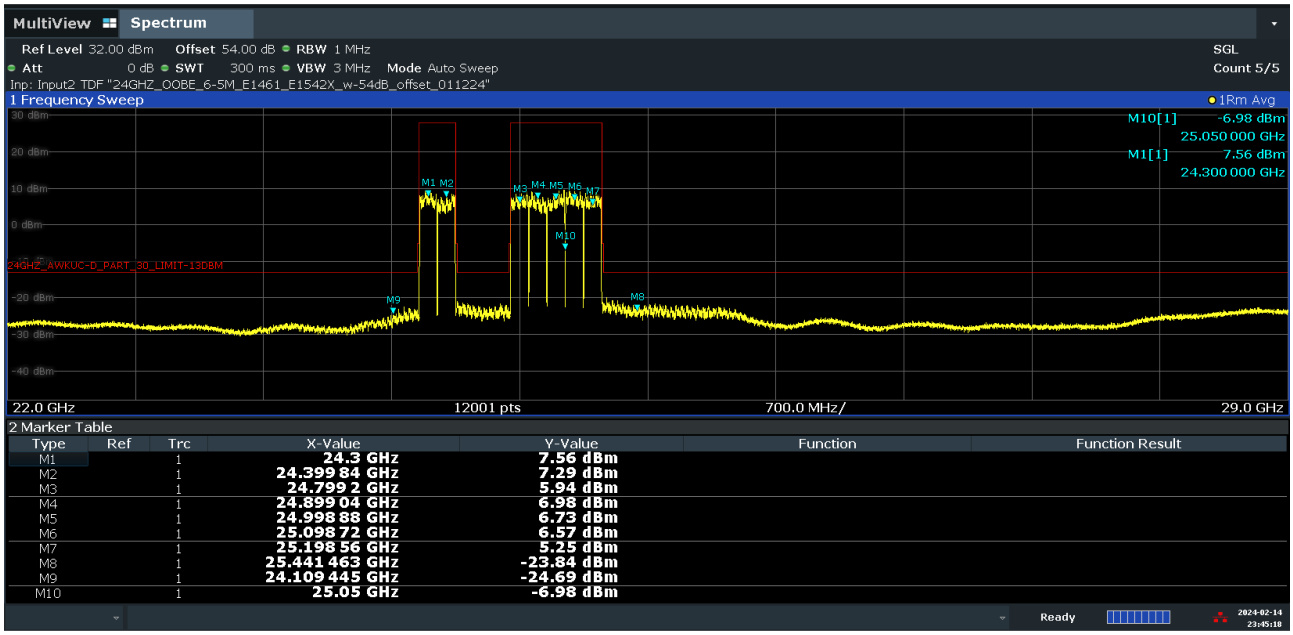
Table 4.3.7.2 Results -Edge of Block Emissions/ Out Of Band Emissions (OOBE)

Number of Carriers	Modulation	Frequency of measured OOBE, GHz	Measured Value Vertical Polarization	Margin to Part 30.203 limit of -13 dBm	Measured Value Horizontal Polarization	Margin to Part 30.203 limit of -13 dBm	Occupied Bandwidth Edge of Block / OOBE Compliance
7	QPSK	24.109445	-27.22	14.22	-23.84	10.84	Compliant
7	QPSK	25.441463	-22.60	**9.60**	-24.69	11.69	Compliant
1	QPSK	24.109445	-33.05	20.05	-33.80	20.80	Compliant
1	QPSK	25.441463	-32.01	19.01	-31.80	18.80	Compliant

4.3.7.2.1 Occupied Bandwidth Edge of Band Plots

7 Carrier Configuration QPSK
Horizontal

2024-0001 24 GHz AWKUD s/n YK234300009



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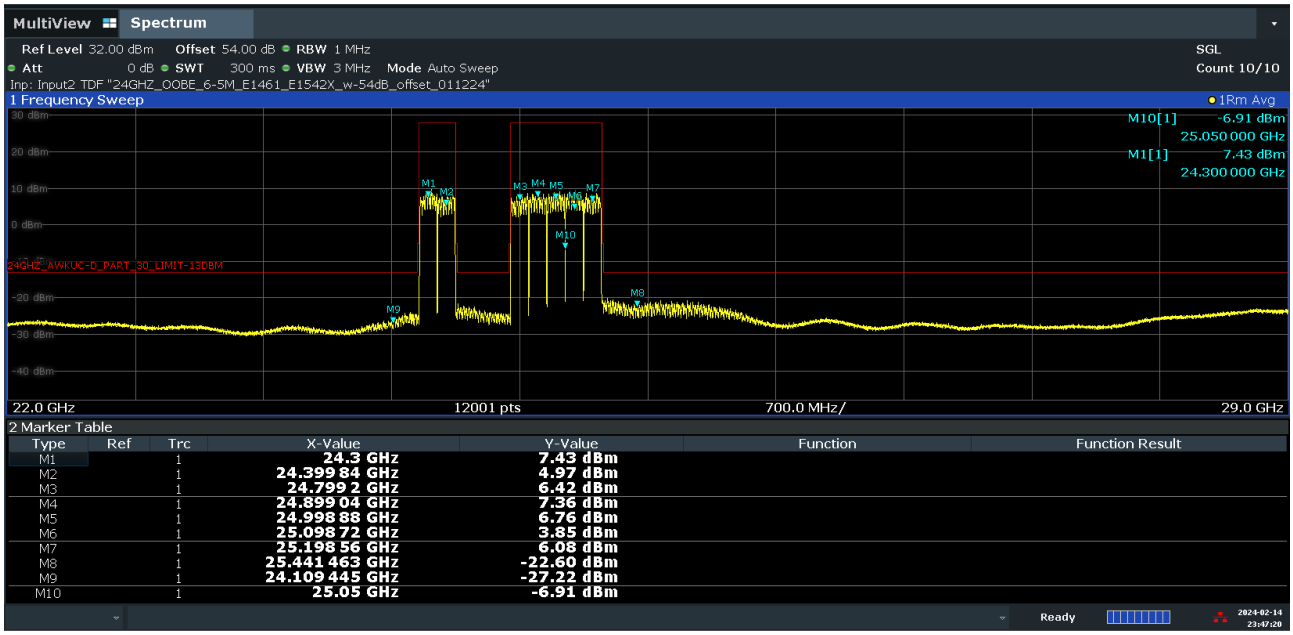
Vertical

2024-0001 24 GHz AWKUD s/n YK234300009



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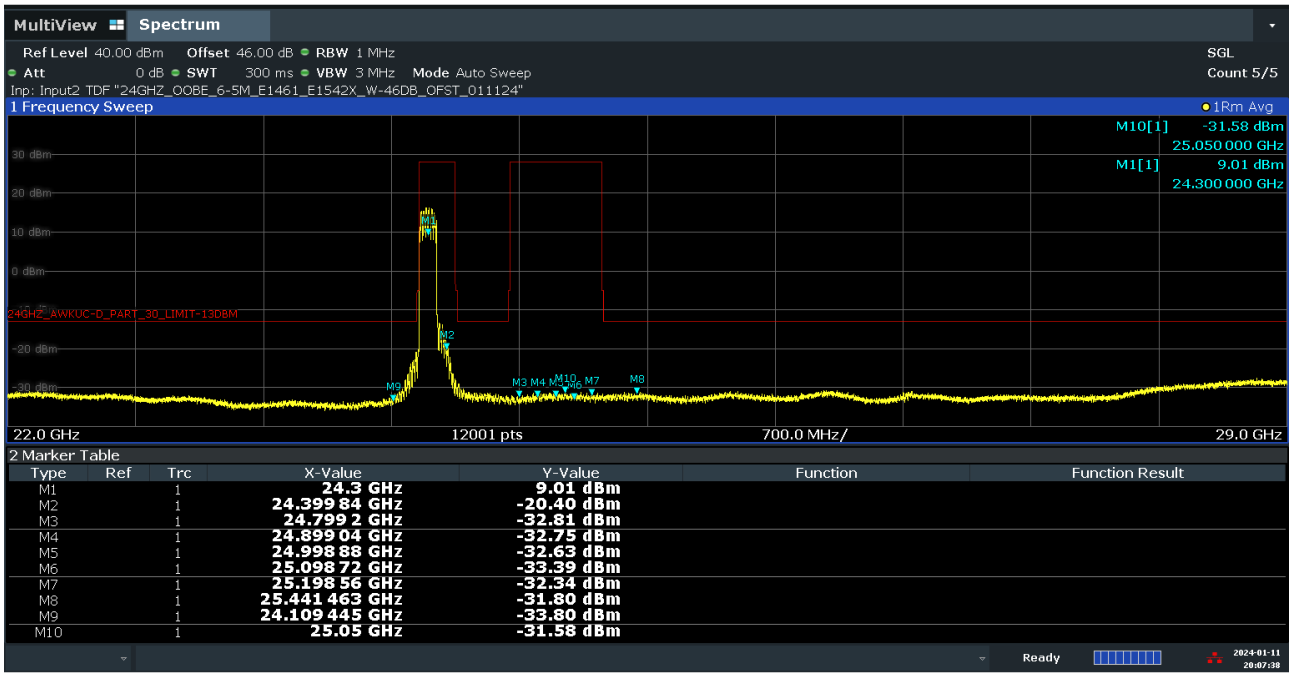
1 Carrier Configuration QPSK
Horizontal

2024-0001 24 GHz AWKUC/D s/n YK234200054



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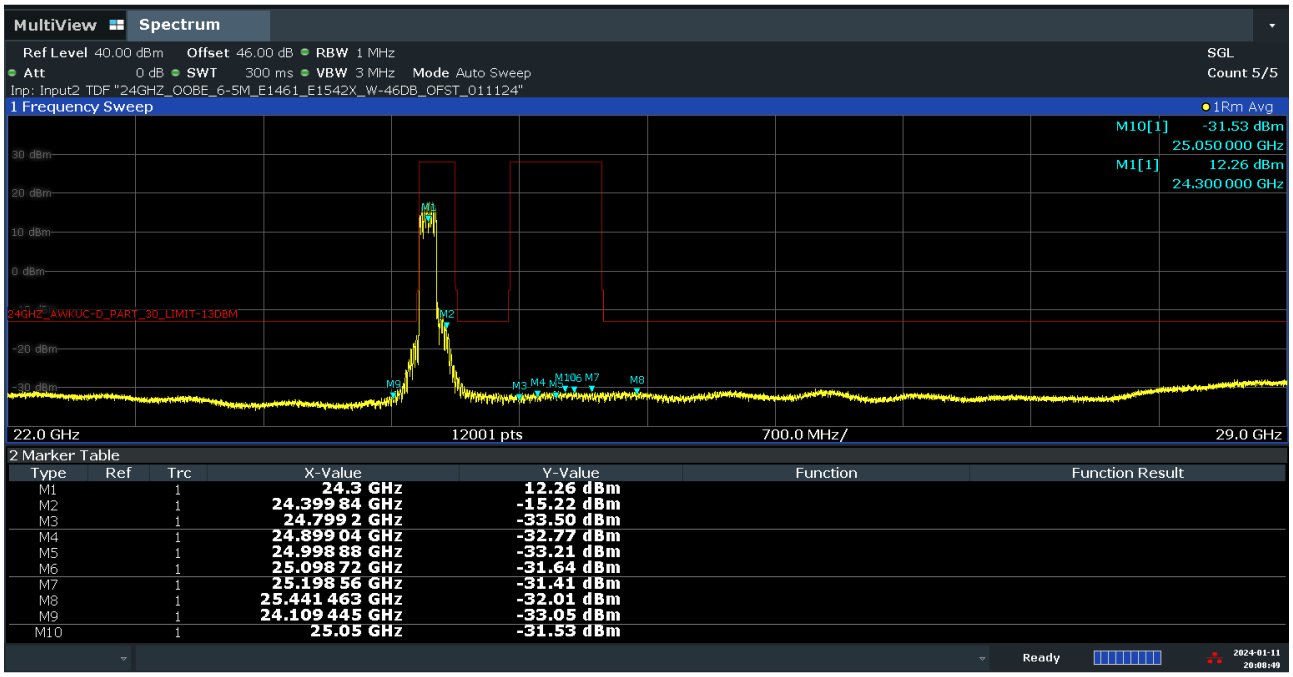
Vertical

2024-0001 24 GHz AWKUC/D s/n YK234200054



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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 200 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:

(3) If the equipment operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower.

(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:

47CFR 30.203 (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 emissions near the band edges are presented in 4.3.7 and are in compliance with the requirements.

The standard radiated emissions are documented in Section 4.5 "Section 2.1053 Measurement Required: Field Strength of Spurious Radiation".

The measurements 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 ESW-44 spectrum analyzer measurements examine the 30 MHz to 40 GHz range. The FSW based mmWave transmitter test system was used to provide measurement capability from 40 GHz to 125 GHz.

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 meter semi-anechoic chamber AR-4 (FCC Registration Number: 395774) **NVLAP** Lab Code: 100275-0 and IC (Filing Number: 6933F-4 & 8) which is maintained by Nokia Bell Labs in Murray Hill, New Jersey.

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

$$-43+10\text{Log}P=-13 \text{ dBm.}$$

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.

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

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

Where: E = Field Intensity in Volts/ meter R = Distance in meters = 3 m
P = Transmitted Power, Watts = 53300 W

The field strength of radiated spurious emissions measured was determined by

$$E(\text{dB}\mu\text{V/m}) = V_{meas}(\text{dB}\mu\text{V}) + \text{Cable Loss (dB)} + \text{Antenna Factor (dBi/m)}.$$

Field strength measurements of radiated spurious emissions were made in the 10m semi-anechoic chamber, AR-8 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 - 125 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 125 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 85 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 90-125 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	90-125	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 extremely narrow and radiated power is down 19 dB at just $\pm$ 7 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 350 degrees azimuth, and nominal elevations 173 cm for both 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 350 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 40-125 GHz were performed this way.

4.5.2.1 Bandwidth Limits and Corrections: Radiated Measurements 40 GHz - 125 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 was upgraded from the original filing and now 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 Correction Factors

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.

Emissions Correction = Path Loss - Antenna Gain + IF Cable loss (1dB)
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 90-125GHz 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	0.0033	3	81.07	21.90	1.03	60.199
95.0	0.0032	3	81.54	22.30	1.03	60.269
100.0	0.0030	3	81.98	22.60	1.03	60.414
105.0	0.0029	3	82.41	22.95	1.03	60.488
110.0	0.0027	3	82.81	23.30	1.03	60.542
115.0	0.0026	3	83.20	23.60	1.03	60.628
120.0	0.0025	3	83.57	23.85	1.03	60.748
125.0	0.0024	3	83.92	24.05	1.03	60.902

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.

Presented results include the standard measurements from 30 MHz to 40 GHz followed by the three 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 product was configured for single 24.998GHz QPSK carrier at maximum power. 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 125 GHz, reportable spurious emissions were detected and determined to be compliant with the Part 30 limit.

From the radiated measurement in the 40 GHz to 125 GHz presented in Section 4.5, the worst "in beam" EIRP emission is at 90.041 GHz with an amplitude at -16.98 dBm/MHz. It is 3.98 dB below the TRP limit before averaging. From the field strength measurement in the 27 GHz to 40 GHz range presented in Section 4.5, the worst emission is at 27.635483 GHz with a margin of 2.04 dB (pk) and 7.53 dB (avg).

Table 4.5.3 Results - Spurious Emissions 40-125GHz

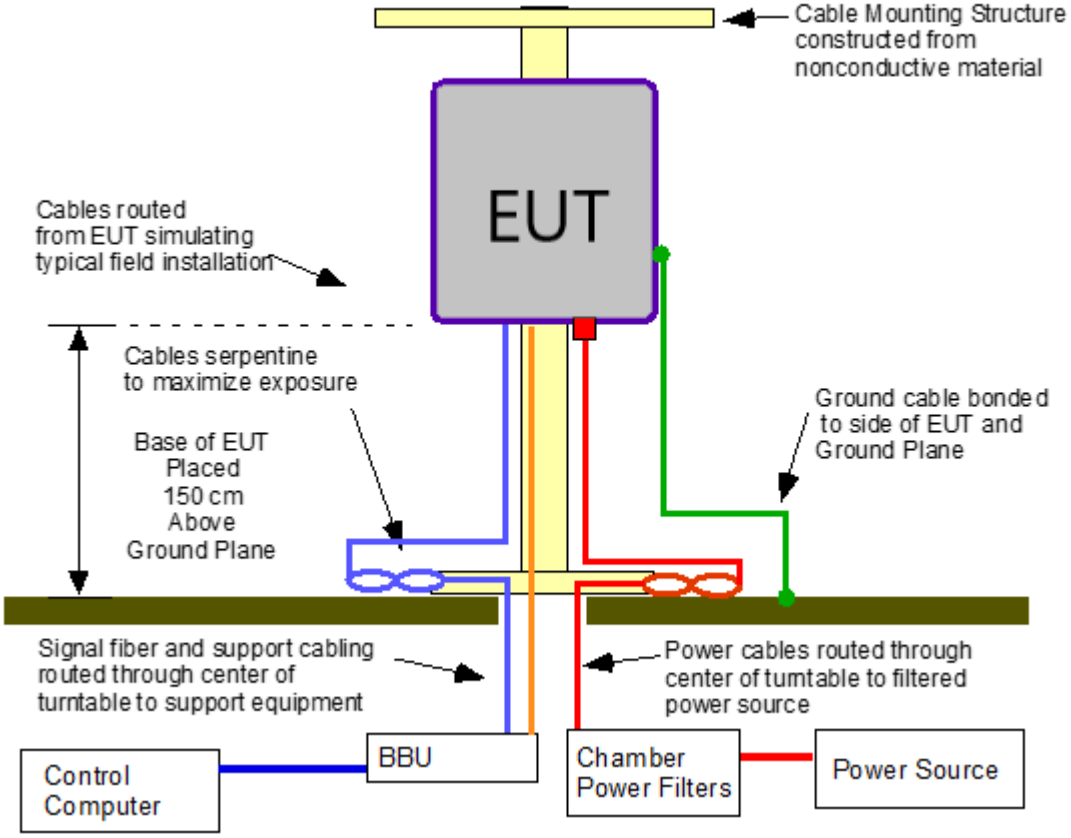
Number of Carriers	Modulation	Frequency of measured OOBE, GHz	Measured Value Vertical Polarization	Margin to Part 30.203 limit of -13 dBm	Measured Value Horizontal Polarization	Margin to Part 30.203 limit of -13 dBm	Occupied Bandwidth Edge of Block / OOBE Compliance
7	QPSK	49.99137	-33.24	20.24	-33.29	20.29	Compliant
7	QPSK	60.00025	-27.71	14.71	-27.95	14.95	Compliant
7	QPSK	72.37274	-25.46	12.46	-34.44	21.44	Compliant
7	QPSK	90.14472	-17.48	4.48	-16.98	**3.98**	Compliant

The maximum EIRP emissions from both vertical and horizontal polarizations are below the TRP limits with a minimum margin of 3.98 dB. Therefore, the early exit condition was met and the EUT is compliant.
The minimum margin, measured in the horizontal polarization, was 2.06 dB (pk) 7.29 dB (Avg) at 27.635483 GHz. Additionally, from 30 MHz to 40 GHz all non-transmitter emissions were a minimum of 4.7 dB below the Part 15 Class B limit.

This demonstrates that **AWKUC (AC) / AWKUD (DC) 24GHz Radio FCC ID: 2AD8UAWKUCD01,** 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.

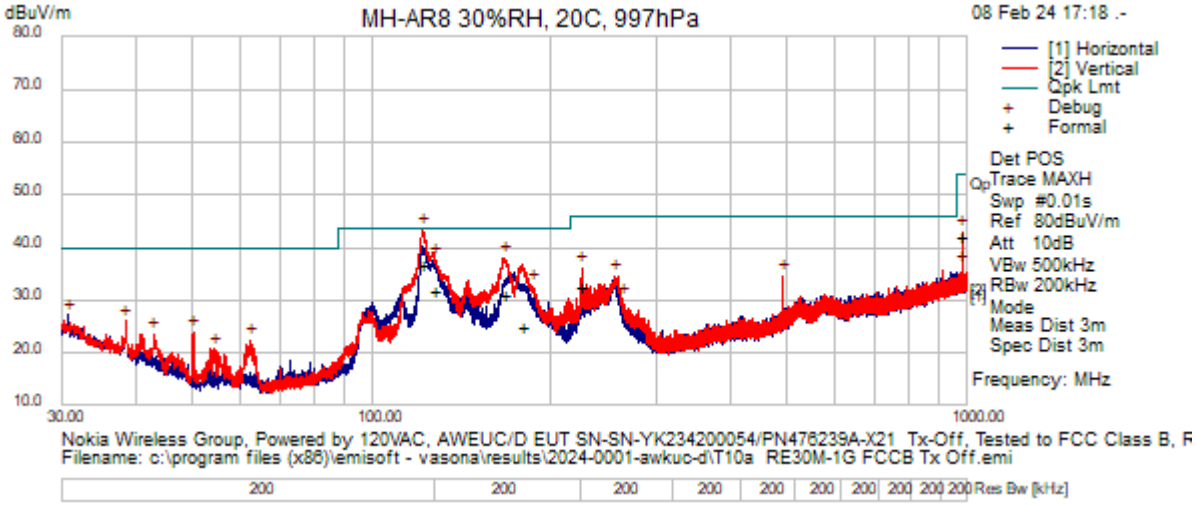
Photographs of the measurement setup are in the filing exhibits.

Figure 4.5 Radiated Emissions Product Setup



4.5.4 Transmitter Measurements of Radiated Spurious Emissions

T10a Radiated Emissions 3m 30MHz -1GHz FCC Part 15B (AC)



Test Information

Results Title	RE30M-1G Bilog 3M
File Name	T10a RE30M-1G FCCB Tx Off.emi
Test Laboratory	MH-AR8 30%RH, 20C, 997hPa
Test Engineer	MJS/NB
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	Powered by 120VAC, AWKUC EUT SN-SN-YK234200054/PN476239A-X21 Tx-Off
Configuration	Tested to FCC Class B, RE 30M-1GHz, @ 3-Meters, Preview RBW 120k; Formal RBW Default. Int. Att. 10dB, PA-E812, LPF-E1268, ESU40-E954, Bilog Antenna E758. AR8 cable set. Ground on.
Date	2024-02-08 17:18:31

Formal Data

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
121.468	46.35	1.34	-10.83	36.86	QuasiMax	V	263	232	43.50	-6.64	Pass	
127.9215	40.62	1.35	-10.17	31.79	QuasiMax	V	242	242	43.50	-11.71	Pass	
983.031	42.39	3.35	-3.59	42.16	QuasiMax	V	261	127	54.00	-11.84	Pass	
166.967	42.13	1.38	-12.37	31.13	QuasiMax	V	105	275	43.50	-12.37	Pass	
225.365	47.43	1.50	-16.11	32.82	QuasiMax	V	133	280	46.00	-13.18	Pass	
179.511	37.96	1.39	-14.16	25.19	QuasiMax	V	270	220	43.50	-18.31	Pass	

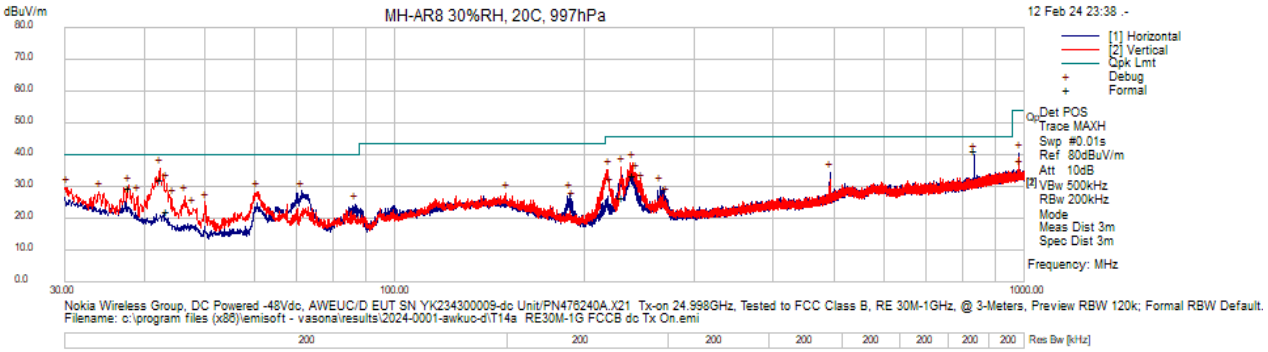
Preview Data

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
121.665	52.67	1.34	-10.80	43.21	Debug	V	250	225	43.50	-0.29	Pass	
166.867	48.98	1.38	-12.36	38.01	Debug	V	103	270	43.50	-5.49	Pass	
127.9215	46.50	1.35	-10.17	37.68	Debug	V	175	225	43.50	-5.82	Pass	
225.455	50.72	1.50	-16.09	36.13	Debug	V	103	270	46.00	-9.87	Pass	
185.8305	46.12	1.41	-14.81	32.71	Debug	V	250	270	43.50	-10.79	Pass	

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
983.0735	43.03	3.35	-3.59	42.80	Debug	V	250	135	54.00	-11.20	Pass	
256.5435	44.89	1.57	-12.03	34.43	Debug	V	325	135	46.00	-11.57	Pass	
491.5745	41.61	2.11	-9.29	34.42	Debug	V	175	0	46.00	-11.58	Pass	
30.9215	35.65	1.79	-10.30	27.14	Debug	H	103	225	40.00	-12.86	Pass	
38.4875	38.74	1.55	-14.32	25.97	Debug	V	103	180	40.00	-14.03	Pass	
263.770	41.51	1.59	-12.93	30.18	Debug	V	250	135	46.00	-15.82	Pass	
50.0305	41.79	1.35	-19.28	23.86	Debug	V	103	315	40.00	-16.14	Pass	
42.901	38.59	1.46	-16.44	23.61	Debug	V	103	90	40.00	-16.39	Pass	
62.3495	42.48	1.29	-21.50	22.27	Debug	V	103	0	40.00	-17.73	Pass	
983.3645	36.21	3.35	-3.58	35.98	Debug	V	103	225	54.00	-18.02	Pass	
54.444	39.66	1.31	-20.30	20.67	Debug	V	103	0	40.00	-19.33	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.

T14a Radiated Emissions 3m 30MHz -1GHz FCC Part 15B (DC)



Test Information

Results Title	Radiated Emissions 30M-1G Bilog 3M
File Name	T14a RE30M-1G FCCB dc Tx On.emi
Test Laboratory	MH-AR8 30%RH, 20C, 997hPa
Test Engineer	MJS/NB
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	DC Powered -48Vdc, AWKUD EUT SN YK234300009-dc Unit/PN476240A.X21 Tx-on 24.998GHz
Configuration	Tested to FCC Class B, RE 30M-1GHz, @ 3-Meters, Preview RBW 120k; Formal RBW Default. Int. Att. 10dB, PA-E812, LPF-E1268, ESU40-E954, Bilog Antenna E758. AR8 cable set. Ground on. Tx-On 24.998GHz. Middle, QPSK
Date	2024-02-12 23:38:32

Formal Data

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
833.463125	44.64	3.28	-6.18	41.73	QuasiMax	H	312	25	46.00	-4.27	Pass	
42.313	47.14	1.47	-16.17	32.44	QuasiMax	V	126	91	40.00	-7.56	Pass	
37.833	42.40	1.57	-13.99	29.98	QuasiMax	V	105	178	40.00	-10.02	Pass	
238.660	45.80	1.54	-13.39	33.95	QuasiMax	V	128	268	46.00	-12.05	Pass	
43.45875	37.60	1.45	-16.69	22.36	QuasiMax	V	112	99	40.00	-17.64	Pass	
229.410	40.35	1.51	-15.27	26.60	QuasiMax	V	153	300	46.00	-19.40	Pass	

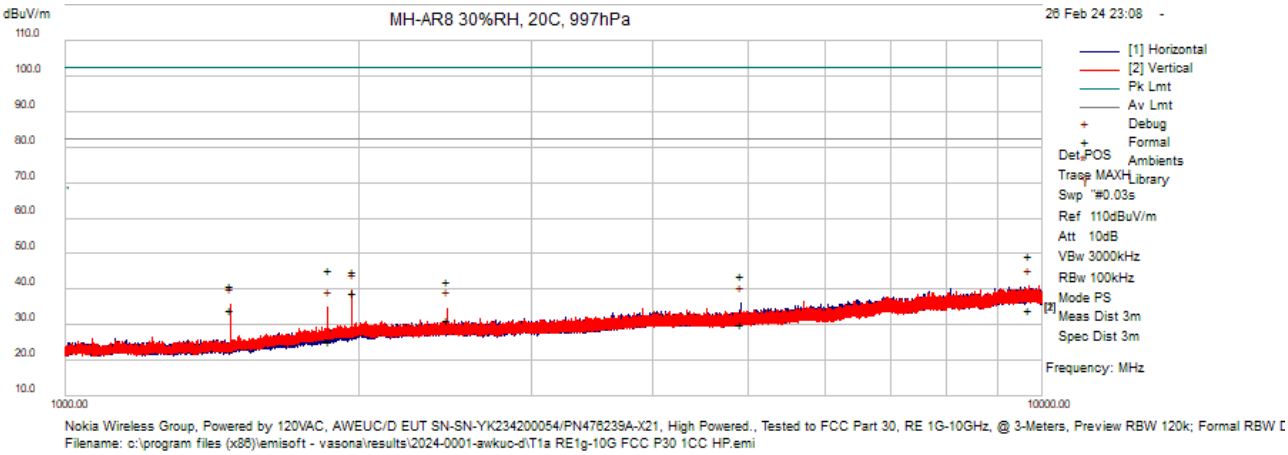
Preview Data

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
42.3675	50.57	1.47	-16.20	35.84	Debug	V	103	135	40.00	-4.16	Pass	
833.463125	43.11	3.28	-6.18	40.20	Debug	H	103	135	46.00	-5.80	Pass	
238.67125	49.59	1.54	-13.39	37.74	Debug	V	103	270	46.00	-8.26	Pass	
43.45875	46.20	1.45	-16.69	30.96	Debug	V	103	135	40.00	-9.04	Pass	
229.335	50.24	1.51	-15.28	36.47	Debug	V	175	270	46.00	-9.53	Pass	
37.820625	42.87	1.57	-13.98	30.46	Debug	V	103	180	40.00	-9.54	Pass	
30.12125	37.88	1.81	-9.84	29.86	Debug	V	103	135	40.00	-10.14	Pass	
218.483125	50.05	1.47	-16.19	35.33	Debug	V	250	270	46.00	-10.67	Pass	
71.164375	48.75	1.31	-21.35	28.71	Debug	H	253	270	40.00	-11.29	Pass	
491.538125	41.70	2.11	-9.29	34.51	Debug	H	178	90	46.00	-11.49	Pass	
60.373125	48.68	1.27	-21.48	28.48	Debug	V	103	90	40.00	-11.52	Pass	
33.940625	38.70	1.69	-11.93	28.46	Debug	V	103	180	40.00	-11.54	Pass	

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
242.6725	45.34	1.54	-12.60	34.29	Debug	V	103	225	46.00	-11.71	Pass	
46.429375	43.69	1.40	-17.94	27.15	Debug	V	103	45	40.00	-12.85	Pass	
39.09375	40.09	1.54	-14.63	27.01	Debug	V	103	135	40.00	-12.99	Pass	
983.085625	40.87	3.35	-3.59	40.64	Debug	H	178	180	54.00	-13.36	Pass	
44.368125	42.12	1.43	-17.10	26.46	Debug	V	103	45	40.00	-13.54	Pass	
50.066875	43.17	1.35	-19.29	25.23	Debug	V	103	135	40.00	-14.77	Pass	
246.67375	41.38	1.55	-11.82	31.11	Debug	V	103	270	46.00	-14.89	Pass	
189.8075	41.88	1.42	-15.21	28.09	Debug	H	103	90	43.50	-15.41	Pass	
150.40125	36.06	1.36	-9.46	27.97	Debug	V	103	315	43.50	-15.53	Pass	
86.5025	41.34	1.32	-18.25	24.41	Debug	H	178	90	40.00	-15.59	Pass	
264.315625	41.72	1.60	-13.00	30.32	Debug	H	178	0	46.00	-15.68	Pass	
219.816875	44.61	1.48	-16.19	29.90	Debug	V	175	225	46.00	-16.10	Pass	
47.82375	40.48	1.38	-18.47	23.39	Debug	V	103	90	40.00	-16.61	Pass	
191.62625	39.47	1.42	-15.39	25.50	Debug	H	103	90	43.50	-18.00	Pass	
984.904375	35.57	3.35	-3.55	35.36	Debug	H	178	315	54.00	-18.64	Pass	
269.8325	38.78	1.62	-13.67	26.72	Debug	H	178	0	46.00	-19.28	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.

T1a Radiated Emissions 3m 1GHz -10GHz FCC Part 30 (AC)



Test Information

Results Title	Radiated Emissions 3m 1GHz-10GHz
File Name	T1a RE1g-10G FCC Part 30 1CC HP.emi
Test Laboratory	MH-AR8 30%RH, 20C, 997hPa
Test Engineer	MJS/NB
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	Powered by 120VAC, AWKUC EUT SN-SN-YK234200054/PN476239A-X21, High Powered.
Configuration	Tested to FCC Part 30, RE 1G-10GHz, @ 3-Meters, Preview RBW 120k; Formal RBW Default. Int. Att. 10dB, PA-E1602, LPF-E1475, FSW67L, 3117 DR Horn Antenna E1073. Grounds on. Tx-On 24.998GHz. Middle, QPSK
Date	2024-02-26 23:08:24

Formal Data

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
1966.085	47.01	2.34	-10.12	39.24	AvgMax	V	274	63	82.23	-42.99	Pass	
9692.550	31.60	5.30	-2.66	34.24	AvgMax	V	267	54	82.23	-47.99	Pass	
1474.563	45.99	2.15	-13.91	34.23	AvgMax	V	226	89	82.23	-48.00	Pass	
2457.602	39.13	2.52	-9.95	31.70	AvgMax	V	252	63	82.23	-50.53	Pass	
4915.174	35.06	3.39	-8.31	30.15	AvgMax	V	219	75	82.23	-52.08	Pass	
9692.550	46.90	5.30	-2.66	49.54	PeakMax	V	267	54	102.23	-52.69	Pass	
1855.100	54.00	2.30	-10.92	45.39	PeakMax	V	222	355	102.23	-56.84	Pass	
1855.100	33.98	2.30	-10.92	25.36	AvgMax	V	222	355	82.23	-56.87	Pass	
1966.085	53.01	2.34	-10.12	45.24	PeakMax	V	274	63	102.23	-56.99	Pass	
4915.174	49.02	3.39	-8.31	44.11	PeakMax	V	219	75	102.23	-58.12	Pass	
2457.602	49.93	2.52	-9.95	42.50	PeakMax	V	252	63	102.23	-59.73	Pass	
1474.563	52.87	2.15	-13.91	41.10	PeakMax	V	226	89	102.23	-61.13	Pass	

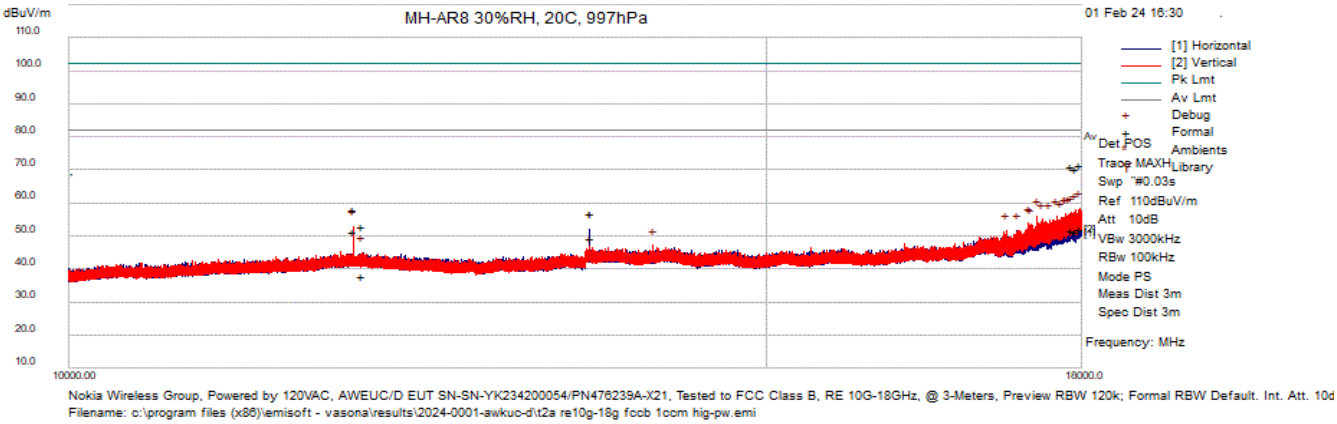
Preview Data

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
9692.550	38.25	5.30	-2.66	40.89	Debug	V	251	220	82.23	-41.34	Pass	

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
1966.050	47.52	2.34	-10.12	39.75	Debug	V	103	44	82.23	-42.48	Pass	
1474.550	47.46	2.15	-13.91	35.70	Debug	V	176	88	82.23	-46.53	Pass	
1855.100	43.49	2.30	-10.92	34.87	Debug	V	251	286	82.23	-47.36	Pass	
2457.600	42.10	2.52	-9.95	34.67	Debug	V	251	66	82.23	-47.56	Pass	
4915.174	40.88	3.39	-8.31	35.97	Debug	V	175	87	82.23	-46.26	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.

T2b Radiated Emissions 3m 10GHz -18GHz FCC Part 30 (AC)



Test Information

Results Title	Radiated Emissions 3m 1GHz-10GHz
File Name	T2b RE10G-18G FCC-P30 1M High-Pwr.emi
Test Laboratory	MH-AR8 30%RH, 20C, 997hPa
Test Engineer	MJS/WSM
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	Powered by 120VAC, AWKUC EUT SN-SN-YK234200054/PN476239A-X21
Configuration	Tested to FCC Part 30, RE 10G-18GHz, @ 3-Meters, Preview RBW 120k; Formal RBW Default. Int. Att. 10dB, PA-E1602, LPF-E1475, FSW67-E1260, 3117 DR Horn Antenna E1073. Grounds on. Tx-On 24.998GHz. Middle, QPSK
Date	2024-02-01 19:37:42

Formal Data

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
17986.222	42.03	7.79	2.35	52.17	AvgMax	V	186	272	82.23	-30.06	Pass	
17892.578	41.74	7.69	2.36	51.78	AvgMax	V	194	270	82.23	-30.45	Pass	
11796.481	44.43	6.21	0.93	51.57	AvgMax	V	167	253	82.23	-30.66	Pass	
17986.222	61.35	7.79	2.35	71.49	PeakMax	V	186	272	102.23	-30.74	Pass	
17939.778	41.38	7.73	2.36	51.47	AvgMax	V	201	269	82.23	-30.76	Pass	
17892.578	61.02	7.69	2.36	71.06	PeakMax	V	194	270	102.23	-31.17	Pass	
17939.778	60.36	7.73	2.36	70.45	PeakMax	V	201	269	102.23	-31.78	Pass	
13532.982	42.27	6.62	0.43	49.32	AvgMax	H	187	238	82.23	-32.91	Pass	
11796.481	50.81	6.21	0.93	57.95	PeakMax	V	167	253	102.23	-44.28	Pass	
11858.044	30.51	6.16	1.10	37.77	AvgMax	V	181	239	82.23	-44.46	Pass	
13532.982	49.83	6.62	0.43	56.88	PeakMax	H	187	238	102.23	-45.35	Pass	
11858.044	45.65	6.16	1.10	52.91	PeakMax	V	181	239	102.23	-49.32	Pass	

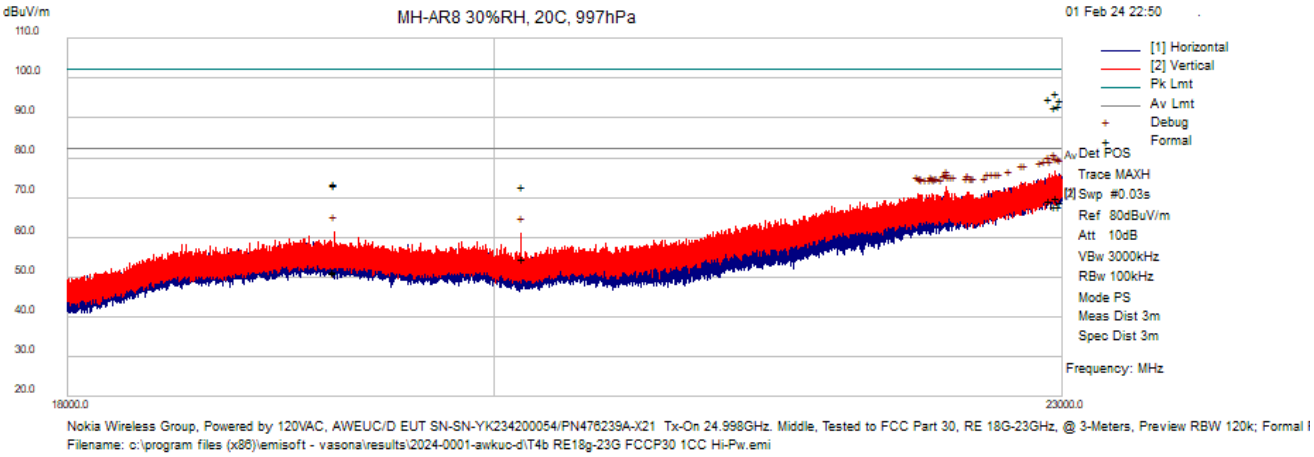
Preview Data

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
17986.222	48.26	7.79	2.35	58.40	Debug	V	176	264	82.23	-23.83	Pass	
17939.778	47.74	7.73	2.36	57.83	Debug	V	176	264	82.23	-24.40	Pass	
17892.578	46.97	7.69	2.36	57.02	Debug	V	176	264	82.23	-25.21	Pass	

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
17830.000	46.47	7.73	2.36	56.56	Debug	V	176	264	82.23	-25.67	Pass	
17836.222	46.40	7.72	2.36	56.49	Debug	V	176	264	82.23	-25.74	Pass	
17866.756	46.35	7.70	2.36	56.42	Debug	V	176	264	82.23	-25.81	Pass	
17745.867	45.85	7.65	2.37	55.87	Debug	V	176	264	82.23	-26.36	Pass	
17545.733	46.06	7.43	2.38	55.87	Debug	V	176	264	82.23	-26.36	Pass	
17787.822	45.28	7.73	2.36	55.37	Debug	V	176	264	82.23	-26.86	Pass	
17597.778	45.16	7.52	2.37	55.05	Debug	V	176	264	82.23	-27.18	Pass	
17667.467	44.91	7.56	2.37	54.84	Debug	V	176	264	82.23	-27.39	Pass	
17460.578	43.93	7.49	2.40	53.82	Debug	V	176	264	82.23	-28.41	Pass	
17482.889	43.63	7.42	2.39	53.43	Debug	V	176	264	82.23	-28.80	Pass	
11796.444	45.64	6.21	0.93	52.78	Debug	V	176	286	82.23	-29.45	Pass	
13533.156	45.06	6.62	0.43	52.11	Debug	H	178	330	82.23	-30.12	Pass	
17234.489	41.84	7.44	2.49	51.77	Debug	V	176	264	82.23	-30.46	Pass	
17341.556	41.68	7.64	2.44	51.76	Debug	H	178	264	82.23	-30.47	Pass	
14038.489	39.87	6.61	0.67	47.15	Debug	V	326	308	82.23	-35.08	Pass	
11858.044	37.80	6.16	1.10	45.06	Debug	V	103	264	82.23	-37.17	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 18GHz -23GHz FCC Part 30 (AC)



Test Information

Results Title	Radiated Emissions 3m 18-26.5GHz
File Name	T4b RE18g-23G FCC P30 1CC High-Pwr.emi
Test Laboratory	MH-AR8 30%RH, 20C, 997hPa
Test Engineer	MJS/NB
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	Powered by 120VAC, AWKUC EUT SN-SN-YK234200054/PN476239A-X21, Tx-On 24.998GHz. Middle, QPSK
Configuration	Tested to FCC Part 30, RE 18G-23GHz, @ 3-Meters, Preview RBW 120k; Formal RBW Default. Int. Att. 10dB, PA-E1602, LPF-E1498 + E1599, FSW67-E1260, A-INFO Horn Antenna E1451. Cables E1610 and E1611, Ground on.
Date	2024-02-01 22:50:09

Formal Data

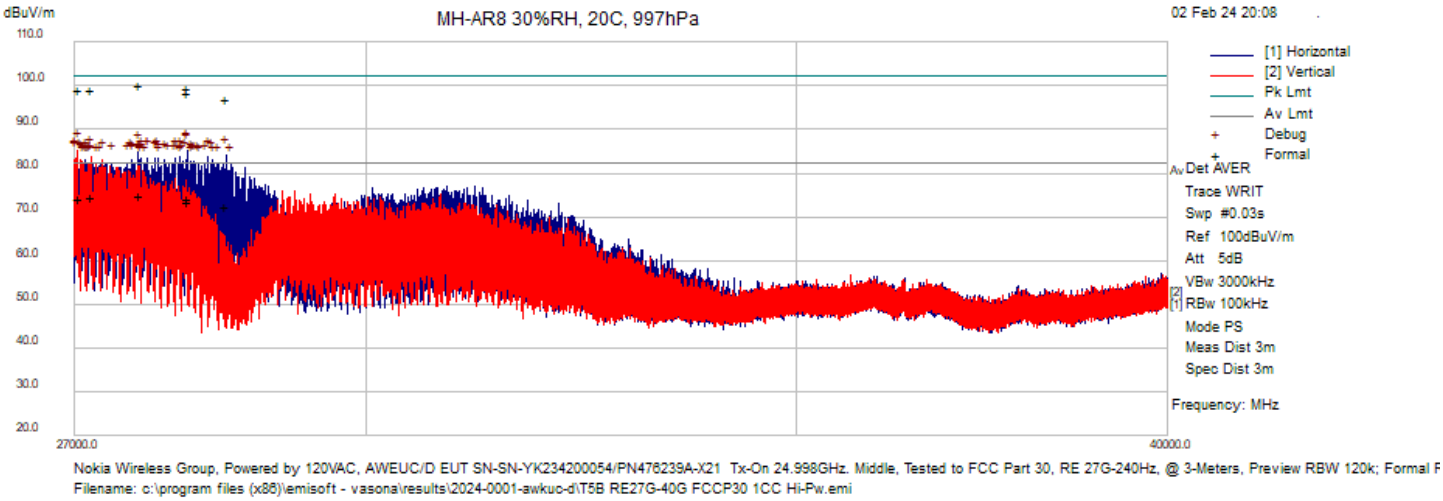
Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
22966.708	91.51	19.54	-14.55	96.49	PeakMax	V	174	266	102.23	-5.74	Pass	
22925.000	90.65	19.10	-14.65	95.10	PeakMax	V	177	266	102.23	-7.13	Pass	
22990.417	89.27	19.78	-14.50	94.56	PeakMax	V	166	264	102.23	-7.67	Pass	
22984.042	87.88	19.72	-14.51	93.08	PeakMax	H	166	263	102.23	-9.15	Pass	
22959.417	87.96	19.46	-14.57	92.85	PeakMax	V	178	263	102.23	-9.38	Pass	
22966.708	65.12	19.54	-14.55	70.11	AvgMax	V	174	266	82.23	-12.12	Pass	
22925.000	64.98	19.10	-14.65	69.43	AvgMax	V	177	266	82.23	-12.80	Pass	
22990.417	63.74	19.78	-14.50	69.03	AvgMax	V	166	264	82.23	-13.20	Pass	
22984.042	62.78	19.72	-14.51	67.99	AvgMax	H	166	263	82.23	-14.24	Pass	
22959.417	62.94	19.46	-14.57	67.83	AvgMax	V	178	263	82.23	-14.40	Pass	
20133.594	59.90	12.88	-17.90	54.88	AvgMax	V	182	262	82.23	-27.35	Pass	
19225.189	79.23	12.43	-18.21	73.45	PeakMax	V	174	262	102.23	-28.78	Pass	
19225.189	79.07	12.43	-18.21	73.29	PeakMax	V	169	262	102.23	-28.94	Pass	
20133.594	78.09	12.88	-17.90	73.07	PeakMax	V	182	262	102.23	-29.16	Pass	
19225.189	57.18	12.43	-18.21	51.39	AvgMax	V	174	262	82.23	-30.84	Pass	
19225.189	56.90	12.43	-18.21	51.12	AvgMax	V	169	262	82.23	-31.11	Pass	

Preview Data

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
22959.417	71.70	19.46	-14.57	76.59	Debug	V	175	264	82.23	-5.64	Pass	
22925.000	71.48	19.10	-14.65	75.93	Debug	V	175	264	82.23	-6.30	Pass	
22984.042	70.62	19.72	-14.51	75.83	Debug	H	178	264	82.23	-6.40	Pass	
22966.708	70.77	19.54	-14.55	75.75	Debug	V	175	264	82.23	-6.48	Pass	
22990.417	70.17	19.78	-14.50	75.45	Debug	V	175	264	82.23	-6.78	Pass	
22932.833	70.32	19.18	-14.63	74.88	Debug	H	178	264	82.23	-7.35	Pass	
22903.208	70.66	18.88	-14.70	74.84	Debug	H	178	264	82.23	-7.39	Pass	
22878.000	70.82	18.61	-14.76	74.67	Debug	V	175	264	82.23	-7.56	Pass	
22792.125	71.02	17.72	-14.96	73.78	Debug	H	178	264	82.23	-8.45	Pass	
22773.083	71.22	17.52	-15.00	73.74	Debug	V	175	264	82.23	-8.49	Pass	
22356.583	74.03	14.41	-15.81	72.62	Debug	V	175	264	82.23	-9.61	Pass	
22706.083	70.77	16.81	-15.16	72.42	Debug	H	178	264	82.23	-9.81	Pass	
22631.500	71.14	16.03	-15.34	71.83	Debug	V	175	264	82.23	-10.40	Pass	
22585.208	71.56	15.54	-15.45	71.65	Debug	H	178	264	82.23	-10.58	Pass	
22646.750	70.76	16.19	-15.30	71.65	Debug	H	178	264	82.23	-10.58	Pass	
22610.292	71.22	15.80	-15.39	71.63	Debug	H	178	264	82.23	-10.60	Pass	
22359.167	73.02	14.41	-15.81	71.62	Debug	V	175	264	82.23	-10.61	Pass	
22476.500	72.55	14.60	-15.68	71.48	Debug	V	175	264	82.23	-10.75	Pass	
22473.958	72.45	14.59	-15.68	71.36	Debug	V	175	264	82.23	-10.87	Pass	
22345.208	72.69	14.39	-15.83	71.25	Debug	V	175	264	82.23	-10.98	Pass	
22363.458	72.56	14.42	-15.81	71.17	Debug	V	175	264	82.23	-11.06	Pass	
22272.708	72.74	14.27	-15.91	71.10	Debug	V	175	264	82.23	-11.13	Pass	
22399.083	72.35	14.47	-15.76	71.06	Debug	V	175	264	82.23	-11.17	Pass	
22383.792	72.36	14.45	-15.78	71.02	Debug	V	175	264	82.23	-11.21	Pass	
22196.750	72.78	14.15	-16.00	70.93	Debug	V	175	264	82.23	-11.30	Pass	
22566.458	70.94	15.34	-15.49	70.79	Debug	V	175	264	82.23	-11.44	Pass	
22502.292	71.74	14.66	-15.64	70.75	Debug	V	175	264	82.23	-11.48	Pass	
22305.583	72.29	14.32	-15.87	70.74	Debug	V	175	264	82.23	-11.49	Pass	
22298.542	72.25	14.31	-15.88	70.68	Debug	V	175	264	82.23	-11.55	Pass	
22496.042	71.68	14.63	-15.65	70.66	Debug	V	175	264	82.23	-11.57	Pass	
22280.208	72.27	14.28	-15.90	70.65	Debug	V	175	264	82.23	-11.58	Pass	
22463.042	71.74	14.58	-15.69	70.62	Debug	V	175	264	82.23	-11.61	Pass	
22220.500	72.41	14.19	-15.97	70.62	Debug	V	175	264	82.23	-11.61	Pass	
22208.292	72.38	14.17	-15.99	70.56	Debug	V	175	264	82.23	-11.67	Pass	
22488.333	71.58	14.62	-15.66	70.53	Debug	V	175	264	82.23	-11.70	Pass	
22217.458	72.32	14.18	-15.98	70.52	Debug	V	175	264	82.23	-11.71	Pass	
22262.625	72.19	14.25	-15.92	70.52	Debug	V	175	264	82.23	-11.71	Pass	
22243.250	72.21	14.22	-15.95	70.48	Debug	V	175	264	82.23	-11.75	Pass	
22285.542	72.05	14.29	-15.90	70.44	Debug	V	175	264	82.23	-11.79	Pass	
22322.958	71.91	14.35	-15.85	70.41	Debug	V	175	264	82.23	-11.82	Pass	
20133.621	65.80	12.88	-17.90	60.78	Debug	V	170	272	82.23	-21.45	Pass	
19225.189	66.78	12.43	-18.21	61.00	Debug	V	170	272	82.23	-21.23	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.

T5B Radiated Emissions 3m 27GHz -40GHz FCC Part 30 (AC)



Test Information

Results Title	Radiated Emissions 3m 26.5GHz-40GHz
File Name	T5B RE27G-40G FCC-P30 1CC High-Pwr.emi
Test Laboratory	MH-AR8 30%RH, 20C, 997hPa
Test Engineer	MJS/NB
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	Powered by 120VAC, AWKUC EUT SN-SN-YK234200054/PN476239A-X21, Tx-On 24.998GHz. Middle, QPSK
Configuration	Tested to FCC Part 30, RE 27G-240Hz, @ 3-Meters, Preview RBW 120k; Formal RBW Default. Int. Att. 5dB, PA-E1601, LPF-E1472 + E1473, FSW67-E1260, 3116 Horn Antenna E1526. Cables E1610 and E1611, Ground on.
Date	2024-02-02 20:08:23

Formal Data

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
27635.483	87.45	14.96	-2.24	100.17	PeakMax	H	163	268	102.23	-2.06	Pass	
28124.392	86.89	14.79	-2.05	99.64	PeakMax	H	167	268	102.23	-2.59	Pass	
27168.838	86.78	15.16	-2.63	99.31	PeakMax	V	167	269	102.23	-2.92	Pass	
27041.871	86.17	15.86	-2.75	99.29	PeakMax	V	176	271	102.23	-2.94	Pass	
28125.583	85.93	14.79	-2.05	98.67	PeakMax	H	171	269	102.23	-3.56	Pass	
28524.467	84.58	14.51	-2.15	96.94	PeakMax	H	156	266	102.23	-5.29	Pass	
27635.483	62.28	14.96	-2.24	75.00	AvgMax	H	163	268	82.23	-7.23	Pass	
27168.838	62.09	15.16	-2.63	74.62	AvgMax	V	167	269	82.23	-7.61	Pass	
27041.871	61.25	15.86	-2.75	74.37	AvgMax	V	176	271	82.23	-7.86	Pass	
28124.392	61.48	14.79	-2.05	74.22	AvgMax	H	167	268	82.23	-8.01	Pass	
28125.583	60.86	14.79	-2.05	73.60	AvgMax	H	171	269	82.23	-8.63	Pass	
28524.467	60.23	14.51	-2.15	72.59	AvgMax	H	156	266	82.23	-9.64	Pass	

Preview Data

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
28124.392	72.56	14.79	-2.05	85.31	Debug	H	178	264	82.23	3.08	Fail	
27041.871	72.13	15.86	-2.75	85.25	Debug	V	178	264	82.23	3.02	Fail	
27635.483	72.26	14.96	-2.24	84.97	Debug	H	178	264	82.23	2.74	Fail	
28125.583	72.05	14.79	-2.05	84.79	Debug	H	178	264	82.23	2.56	Fail	
28524.467	71.63	14.51	-2.15	83.99	Debug	H	178	264	82.23	1.76	Fail	
27168.838	71.20	15.16	-2.63	83.72	Debug	V	178	264	82.23	1.49	Fail	
28337.267	71.25	14.58	-2.15	83.69	Debug	H	178	264	82.23	1.46	Fail	
28051.917	70.74	14.89	-2.01	83.62	Debug	H	178	264	82.23	1.39	Fail	
28009.342	70.61	14.94	-1.99	83.56	Debug	H	178	264	82.23	1.33	Fail	
27667.225	70.79	14.97	-2.22	83.54	Debug	H	178	264	82.23	1.31	Fail	
27826.313	70.58	15.00	-2.11	83.47	Debug	H	178	264	82.23	1.24	Fail	
27725.238	70.63	15.00	-2.18	83.45	Debug	H	178	264	82.23	1.22	Fail	
27019.067	70.21	15.99	-2.77	83.43	Debug	V	178	264	82.23	1.20	Fail	
27730.492	70.55	15.00	-2.17	83.38	Debug	H	178	264	82.23	1.15	Fail	
27802.588	70.36	15.00	-2.12	83.24	Debug	H	178	264	82.23	1.01	Fail	
27115.646	70.46	15.45	-2.68	83.23	Debug	H	178	264	82.23	1.00	Fail	
27284.429	71.02	14.74	-2.53	83.22	Debug	V	178	264	82.23	0.99	Fail	
28376.917	70.80	14.56	-2.17	83.20	Debug	H	178	264	82.23	0.97	Fail	
27063.971	70.17	15.74	-2.73	83.19	Debug	V	178	264	82.23	0.96	Fail	
28113.775	70.42	14.80	-2.04	83.18	Debug	H	178	264	82.23	0.95	Fail	
27563.713	70.41	14.92	-2.29	83.05	Debug	H	178	264	82.23	0.82	Fail	
27013.650	69.75	16.02	-2.77	83.00	Debug	V	178	264	82.23	0.77	Fail	
27646.154	70.21	14.96	-2.23	82.94	Debug	H	178	264	82.23	0.71	Fail	
27900.358	69.96	14.98	-2.05	82.88	Debug	H	178	264	82.23	0.65	Fail	
27571.188	70.08	14.93	-2.29	82.72	Debug	H	178	264	82.23	0.49	Fail	
28163.283	69.99	14.74	-2.06	82.66	Debug	H	178	264	82.23	0.43	Fail	
27651.300	69.92	14.97	-2.23	82.66	Debug	H	178	264	82.23	0.43	Fail	
27081.792	69.72	15.64	-2.71	82.65	Debug	V	178	264	82.23	0.42	Fail	
27663.379	69.89	14.97	-2.22	82.64	Debug	H	178	264	82.23	0.41	Fail	
27840.775	69.73	14.99	-2.10	82.63	Debug	H	178	264	82.23	0.40	Fail	
28199.358	70.01	14.69	-2.08	82.62	Debug	H	178	264	82.23	0.39	Fail	
27653.900	69.83	14.97	-2.23	82.57	Debug	H	178	264	82.23	0.34	Fail	
28076.129	69.71	14.85	-2.02	82.54	Debug	H	178	264	82.23	0.31	Fail	
28181.700	69.83	14.71	-2.07	82.47	Debug	H	178	264	82.23	0.24	Fail	
28303.683	69.98	14.60	-2.13	82.45	Debug	H	178	264	82.23	0.22	Fail	
27375.754	70.06	14.80	-2.45	82.41	Debug	H	178	264	82.23	0.18	Fail	
28029.329	69.49	14.92	-2.00	82.40	Debug	H	178	264	82.23	0.17	Fail	
28233.592	69.85	14.64	-2.10	82.40	Debug	H	178	264	82.23	0.17	Fail	
27582.888	69.73	14.93	-2.28	82.39	Debug	H	178	264	82.23	0.16	Fail	
27102.213	69.55	15.53	-2.69	82.38	Debug	H	178	264	82.23	0.15	Fail	
27530.617	69.78	14.91	-2.32	82.38	Debug	H	178	264	82.23	0.15	Fail	
27936.813	69.41	14.97	-2.03	82.36	Debug	H	178	264	82.23	0.13	Fail	
27168.025	69.80	15.16	-2.63	82.33	Debug	H	178	264	82.23	0.10	Fail	
27992.821	69.32	14.96	-1.99	82.29	Debug	H	178	264	82.23	0.06	Fail	
27161.308	69.72	15.20	-2.64	82.29	Debug	H	178	264	82.23	0.06	Fail	
27257.725	70.11	14.72	-2.55	82.27	Debug	H	178	264	82.23	0.04	Fail	
28246.646	69.74	14.62	-2.10	82.26	Debug	H	178	264	82.23	0.03	Pass	
27114.292	69.47	15.46	-2.68	82.25	Debug	H	178	264	82.23	0.02	Pass	
27224.358	69.95	14.85	-2.58	82.22	Debug	V	178	264	82.23	-0.01	Pass	
28063.671	69.34	14.87	-2.02	82.19	Debug	H	178	264	82.23	-0.04	Pass	
28567.908	69.69	14.52	-2.02	82.19	Debug	H	178	264	82.23	-0.04	Pass	
27834.817	69.28	14.99	-2.10	82.17	Debug	H	178	264	82.23	-0.06	Pass	
27660.725	69.41	14.97	-2.22	82.16	Debug	H	178	264	82.23	-0.07	Pass	
27135.742	69.46	15.34	-2.66	82.14	Debug	V	178	264	82.23	-0.09	Pass	
28438.938	69.79	14.54	-2.20	82.13	Debug	H	178	264	82.23	-0.10	Pass	

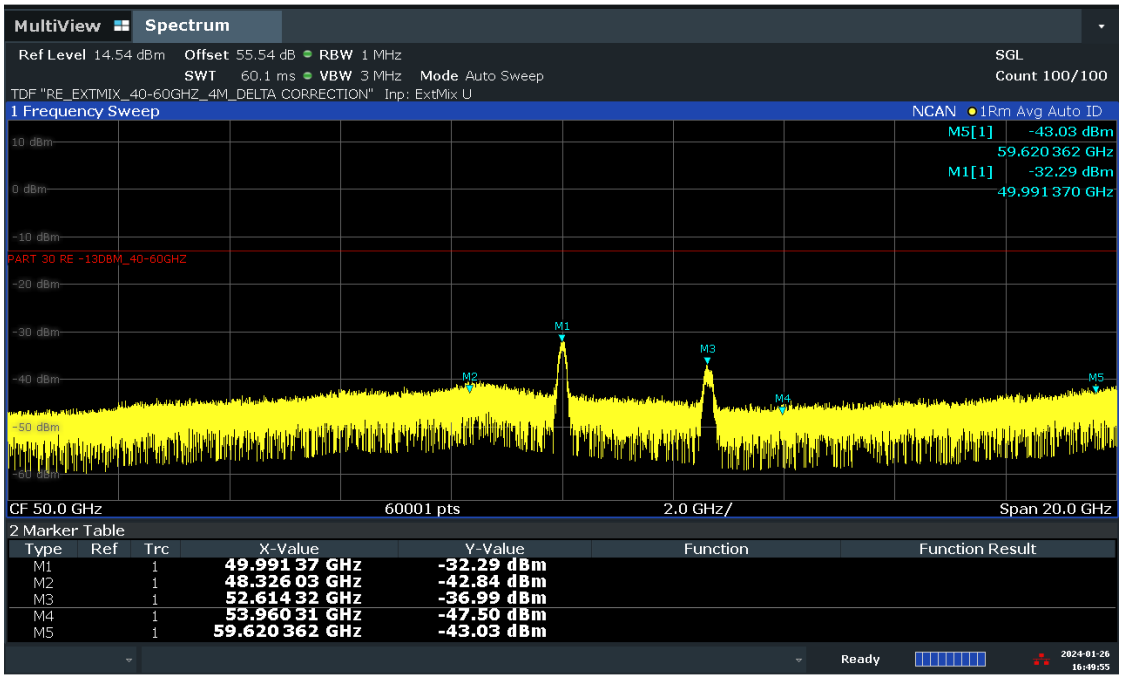
Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
27708.825	69.32	14.99	-2.19	82.12	Debug	H	178	264	82.23	-0.11	Pass	
27094.954	69.23	15.57	-2.70	82.10	Debug	V	178	264	82.23	-0.13	Pass	
28171.192	69.44	14.73	-2.07	82.09	Debug	H	178	264	82.23	-0.14	Pass	
27150.150	69.48	15.26	-2.65	82.09	Debug	V	178	264	82.23	-0.14	Pass	
28394.738	69.70	14.56	-2.18	82.07	Debug	H	178	264	82.23	-0.16	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 Part 30

Horizontal

2024-0001 AWKUC 24GHz 4m, s/n YK234200054



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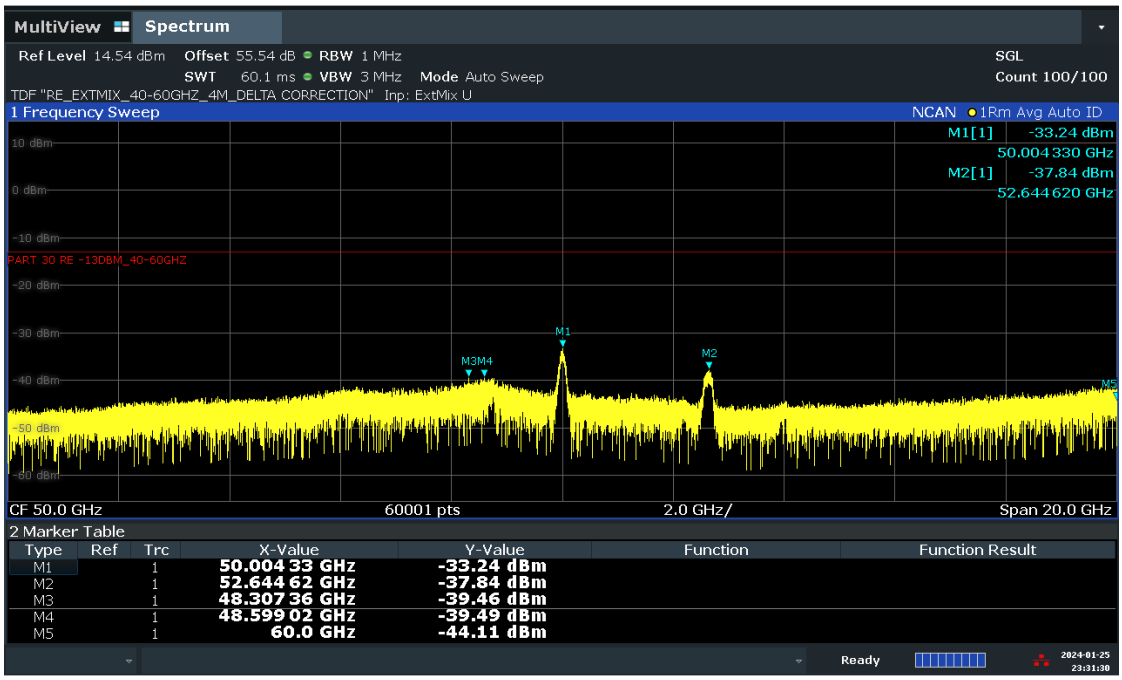
Vertical

2024-0001 AWKUC 24GHz 4m, s/n YK234200054

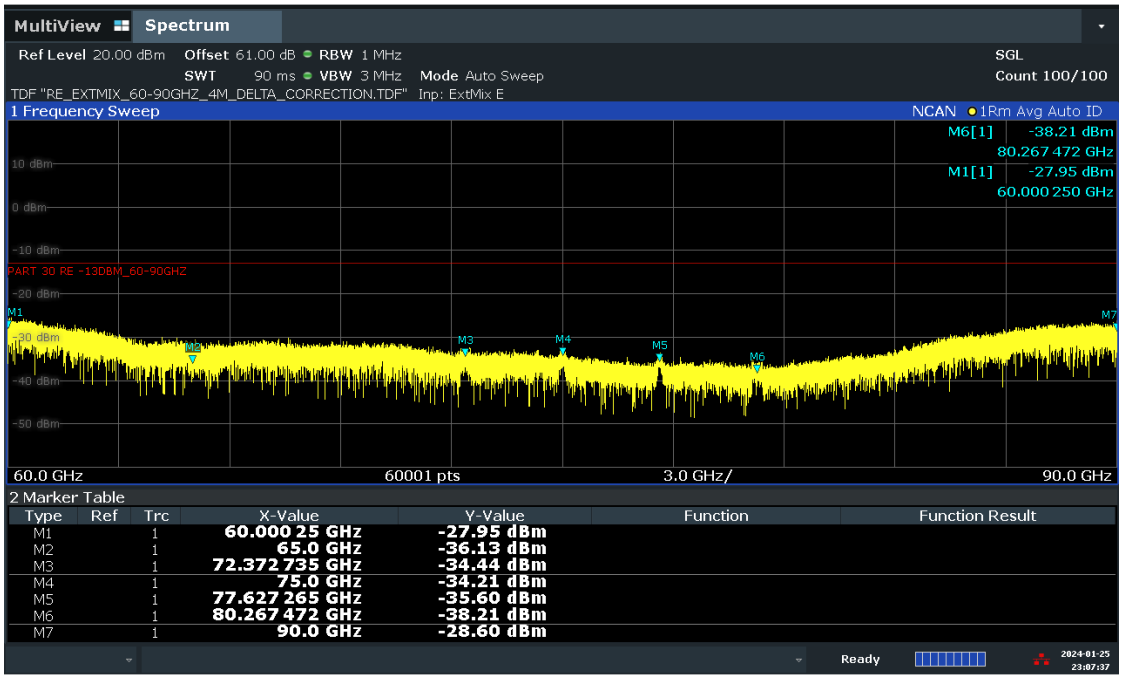


11:31:30 PM 01/25/2024

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

Horizontal

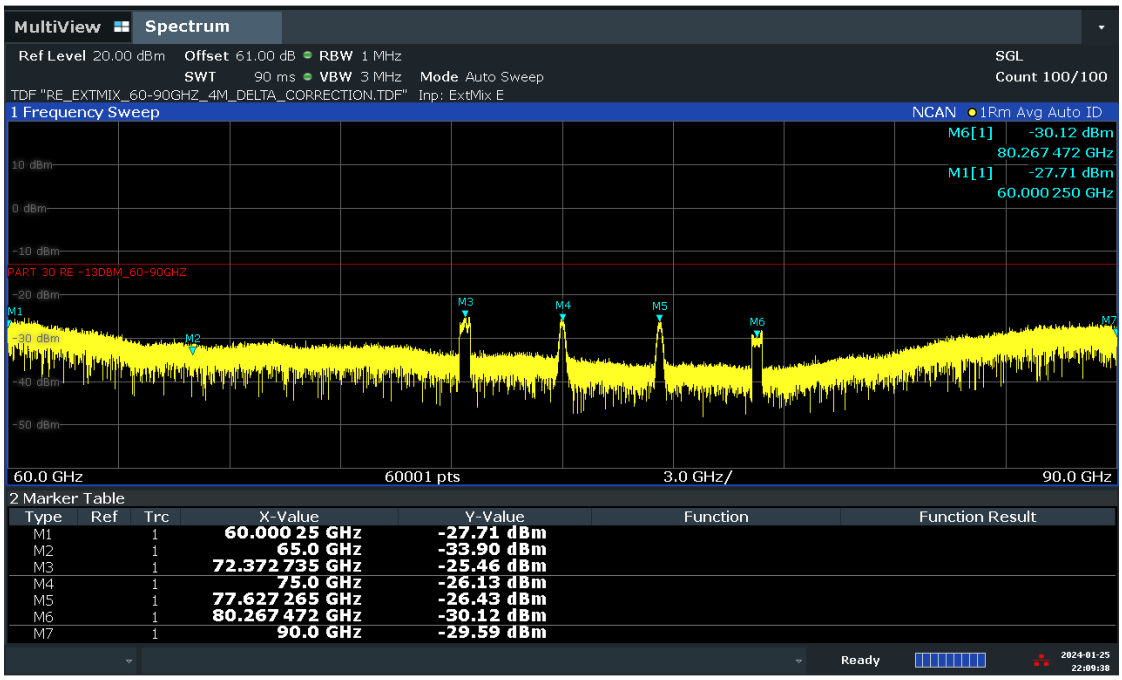
2024-0001 AWKUC 24GHz 4m, s/n YK234200054



11:07:37 PM 01/25/2024

Vertical

2024-0001 AWKUC 24GHz 4m, s/n YK234200054

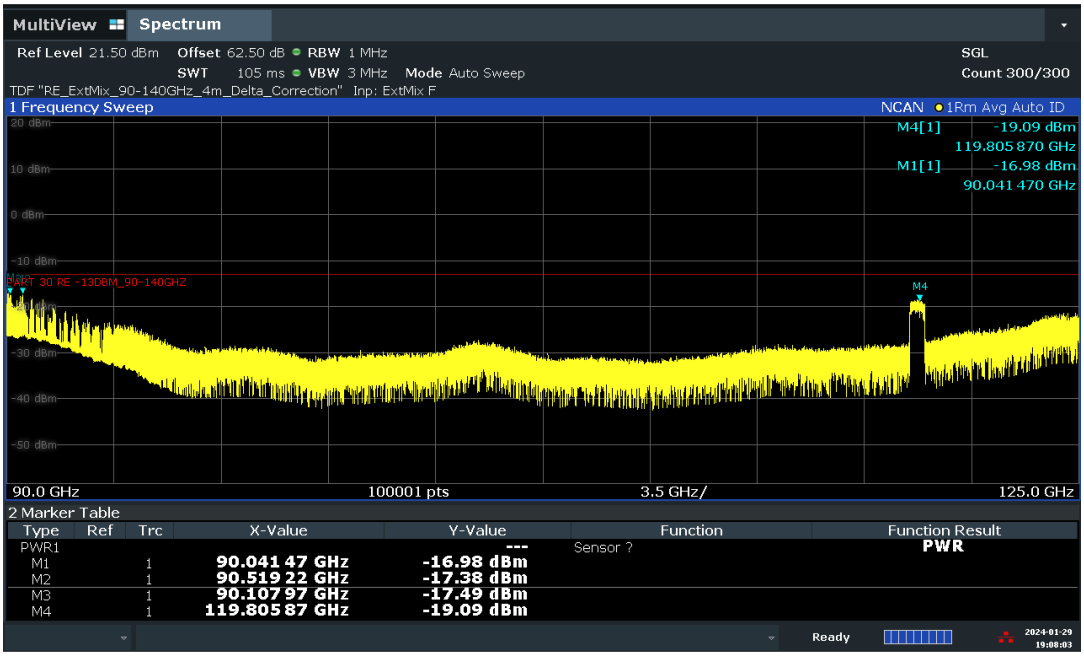


10:09:39 PM 01/25/2024

Maximum Measured Radiated Emissions -U Band 90GHz-125GHz FCC Part 30

Horizontal

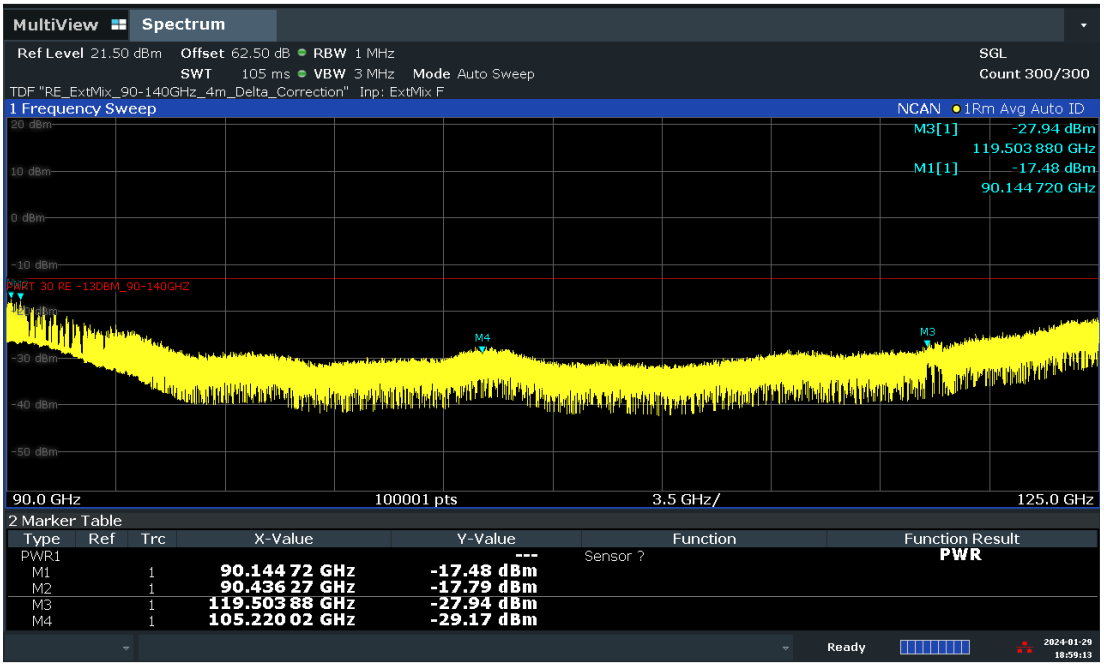
2024-0001 AWKUC 24GHz 4m, s/n YK234200054



07:08:04 PM 01/29/2024

Vertical

2024-0001 AWKUC 24GHz 4m, s/n YK234200054



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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.

4.6.1 Frequency Stability Results AC Model:

Frequency Stability testing was completed on: AWKUC, 24GHz Radio (CF = 24300 MHz). Testing was performed from 02/22/2024 through 02/23/2024 on the radio, which was located in the T-14 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

Table 1: Unit Under Test

Series	Vendor	Serial Number	Comcode
AWKUC	Nokia	YK234200054	476239A.X21

The temperatures to which the UUT were subjected ranged from a high temperature of +50ºC system ambient to a low temperature of -30ºC system ambient with measurements recorded at 10C 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 a MXA signal analyzer. The system level frequency stability testing resulted in a worst case deviation of **42.58 Hz** which is within the compliance with established design criteria of 1215 Hz.

4.6.2 Frequency Stability Results DC Model:

Frequency Stability testing was completed on: AWKUD, 24GHz Radio (CF = 24799.2 MHz). Testing was performed from 02/27/2024 through 02/28/2024 on the radio, which was located in the T-14 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.

Table 2: Unit Under Test

Series	Vendor	Serial Number	Model #
AWKUD	Nokia	YK2343000009	476240A.X21

The temperatures to which the UUT were subjected ranged from a high temperature of +50ºC system ambient to a low temperature of -30ºC system ambient with measurements recorded at 10C 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 a MXA signal analyzer. The system level frequency stability testing resulted in a worst case deviation of **55.31 Hz** which is within the compliance with established design criteria of 1215 Hz.

AC Model

Baseline Measurement at +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-20.19**
0.5	**-40.32**
1.0	**14.11**
1.5	**25.95**
2.0	**-38.56**
2.5	**-18.55**
3.0	**14.21**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +50°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-12.73**
0.5	**22.76**
1.0	**27.98**
1.5	**16.87**
2.0	**-27.43**
2.5	**11.10**
3.0	**23.59**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +40°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-25.74**
0.5	**16.20**
1.0	**14.22**
1.5	**15.31**
2.0	**-28.04**
2.5	**20.36**
3.0	**14.66**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +30°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-25.90**
0.5	**21.11**
1.0	**-19.22**
1.5	**-13.97**
2.0	**10.16**
2.5	**21.83**
3.0	**23.29**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +20°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**14.44**
0.5	**-23.70**
1.0	**-19.65**
1.5	**-27.77**
2.0	**9.07**
2.5	**-17.25**
3.0	**30.96**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +10°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	**15.09**
0.5	**35.51**
1.0	**21.49**
1.5	**-18.02**
2.0	**-15.59**
2.5	**-20.69**
3.0	**16.43**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at 0°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**19.73**
0.5	**30.38**
1.0	**27.42**
1.5	**23.58**
2.0	**40.01**
2.5	**33.64**
3.0	**-19.67**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at -10°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-23.14**
0.5	**11.88**
1.0	**29.17**
1.5	**42.58**
2.0	**13.76**
2.5	**-18.49**
3.0	**27.57**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at -20°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-13.19**
0.5	**16.30**
1.0	**10.89**
1.5	**-14.65**
2.0	**-23.10**
2.5	**-9.62**
3.0	**22.40**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at -30°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-25.54**
0.5	**11.51**
1.0	**30.87**
1.5	**22.64**
2.0	**-18.09**
2.5	**21.50**
3.0	**26.51**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Return to +25°C.

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-25.71**
0.5	**16.59**
1.0	**23.83**
1.5	**11.02**
2.0	**18.24**
2.5	**-22.23**
3.0	**16.42**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at +15% of Nominal Voltage, 138.0VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-25.65**
0.5	**-15.02**
1.0	**34.27**
1.5	**15.09**
2.0	**40.10**
2.5	**17.70**
3.0	**-8.20**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at +12% of Nominal Voltage, 134.40VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-29.49**
0.5	**-10.45**
1.0	**-16.12**
1.5	**26.64**
2.0	**19.91**
2.5	**12.54**
3.0	**22.82**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at +9% of Nominal Voltage, 130.80VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-18.83**
0.5	**16.27**
1.0	**27.37**
1.5	**9.20**
2.0	**-17.03**
2.5	**-23.82**
3.0	**-10.04**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at +6% of Nominal Voltage, 127.20VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-24.30**
0.5	**15.17**
1.0	**-14.85**
1.5	**23.09**
2.0	**18.23**
2.5	**16.49**
3.0	**18.94**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at +3% of Nominal Voltage, 123.60VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**21.40**
0.5	**9.14**
1.0	**25.03**
1.5	**16.94**
2.0	**-30.72**
2.5	**-16.95**
3.0	**29.91**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

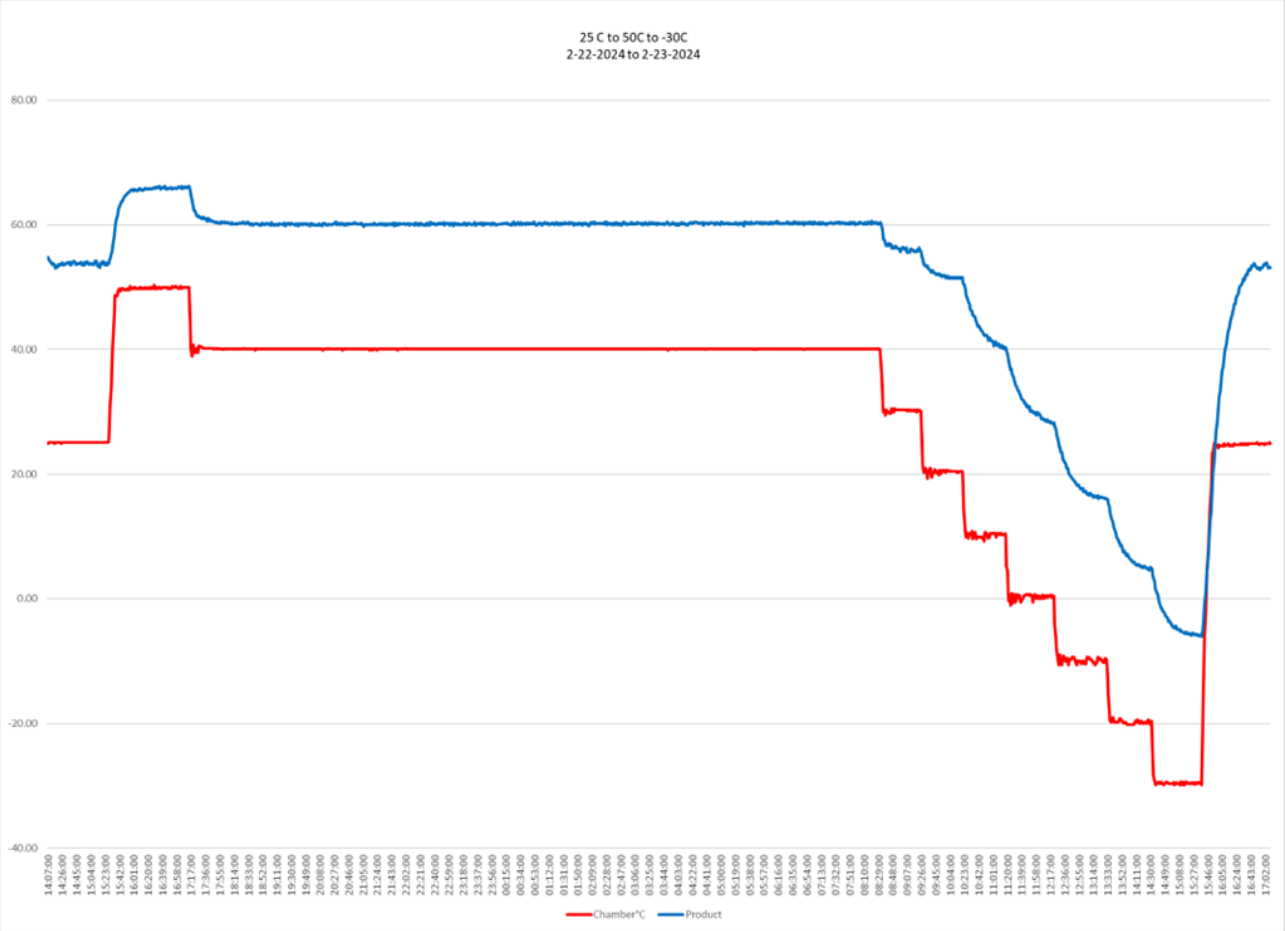
Transmit Frequency Deviation at +25°C at -3% of Nominal Voltage, 116.40VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**27.91**
0.5	**-11.51**
1.0	**-13.02**
1.5	**18.99**
2.0	**24.96**
2.5	**-16.72**
3.0	**-17.63**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at -6% of Nominal Voltage, 112.80VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**10.82**
0.5	**-13.31**
1.0	**-20.95**
1.5	**-29.81**
2.0	**27.06**
2.5	**9.10**
3.0	**-24.87**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at -9% of Nominal Voltage, 109.20VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-12.08**
0.5	**10.69**
1.0	**10.88**
1.5	**28.84**
2.0	**30.38**
2.5	**-13.15**
3.0	**21.48**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at -12% of Nominal Voltage, 105.60VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**39.85**
0.5	**32.00**
1.0	**12.61**
1.5	**-10.62**
2.0	**27.57**
2.5	**11.89**
3.0	**-29.76**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at -15% of Nominal Voltage, 102.0VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-21.30**
0.5	**-13.63**
1.0	**22.63**
1.5	**34.38**
2.0	**-27.58**
2.5	**24.44**
3.0	**11.04**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**


25 C to 50C to -30C
2-22-2024 to 2-23-2024
80.00
60.00
40.00
20.00
0.00
-20.00
-40.00
Chamber°C
Product

DC Model

Baseline Measurement at +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**30.15**
0.5	**26.28**
1.0	**-17.18**
1.5	**19.79**
2.0	**26.12**
2.5	**-31.13**
3.0	**15.86**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +50°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**10.66**
0.5	**19.09**
1.0	**-32.40**
1.5	**35.65**
2.0	**31.48**
2.5	**38.06**
3.0	**-27.16**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +40°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**24.83**
0.5	**-14.75**
1.0	**20.16**
1.5	**27.16**
2.0	**-23.11**
2.5	**-26.99**
3.0	**15.30**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-20.48**
0.5	**45.97**
1.0	**-22.71**
1.5	**33.95**
2.0	**28.92**
2.5	**-27.81**
3.0	**31.89**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**24.44**
0.5	**-29.76**
1.0	**18.10**
1.5	**28.13**
2.0	**-22.63**
2.5	**39.94**
3.0	**-35.65**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**27.12**
0.5	**37.96**
1.0	**39.46**
1.5	**45.79**
2.0	**17.69**
2.5	**31.13**
3.0	**28.50**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at 0°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**49.68**
0.5	**38.40**
1.0	**52.07**
1.5	**55.31**
2.0	**24.67**
2.5	**54.15**
3.0	**28.35**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at -10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**40.10**
0.5	**18.93**
1.0	**27.46**
1.5	**-26.50**
2.0	**52.94**
2.5	**46.97**
3.0	**23.44**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at -20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**26.29**
0.5	**50.15**
1.0	**-8.70**
1.5	**27.16**
2.0	**45.08**
2.5	**22.04**
3.0	**37.27**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at -30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**51.27**
0.5	**42.64**
1.0	**39.14**
1.5	**40.21**
2.0	**19.60**
2.5	**43.26**
3.0	**52.08**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

return to +25°C, Voltage Veriation

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-10.86**
0.5	**18.88**
1.0	**24.47**
1.5	**-31.09**
2.0	**-12.53**
2.5	**13.30**
3.0	**-19.90**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 103% of Nominal Voltage, -49.44VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**34.46**
0.5	**-25.56**
1.0	**-39.79**
1.5	**20.74**
2.0	**18.98**
2.5	**-26.98**
3.0	**31.41**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 106% of Nominal Voltage, -50.88VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**14.73**
0.5	**-23.89**
1.0	**22.52**
1.5	**16.42**
2.0	**22.92**
2.5	**24.91**
3.0	**10.98**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 109% of Nominal Voltage, -52.32VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**12.17**
0.5	**25.52**
1.0	**23.35**
1.5	**11.71**
2.0	**-21.24**
2.5	**-29.78**
3.0	**16.48**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 112% of Nominal Voltage, -53.76VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**17.77**
0.5	**-16.82**
1.0	**48.94**
1.5	**24.50**
2.0	**17.98**
2.5	**-17.70**
3.0	**-18.53**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 115% of Nominal Voltage, -55.20VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**10.51**
0.5	**25.95**
1.0	**19.25**
1.5	**26.85**
2.0	**9.48**
2.5	**12.41**
3.0	**25.32**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48.0VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**14.22**
0.5	**-10.65**
1.0	**-19.88**
1.5	**-24.46**
2.0	**20.23**
2.5	**12.88**
3.0	**-25.08**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

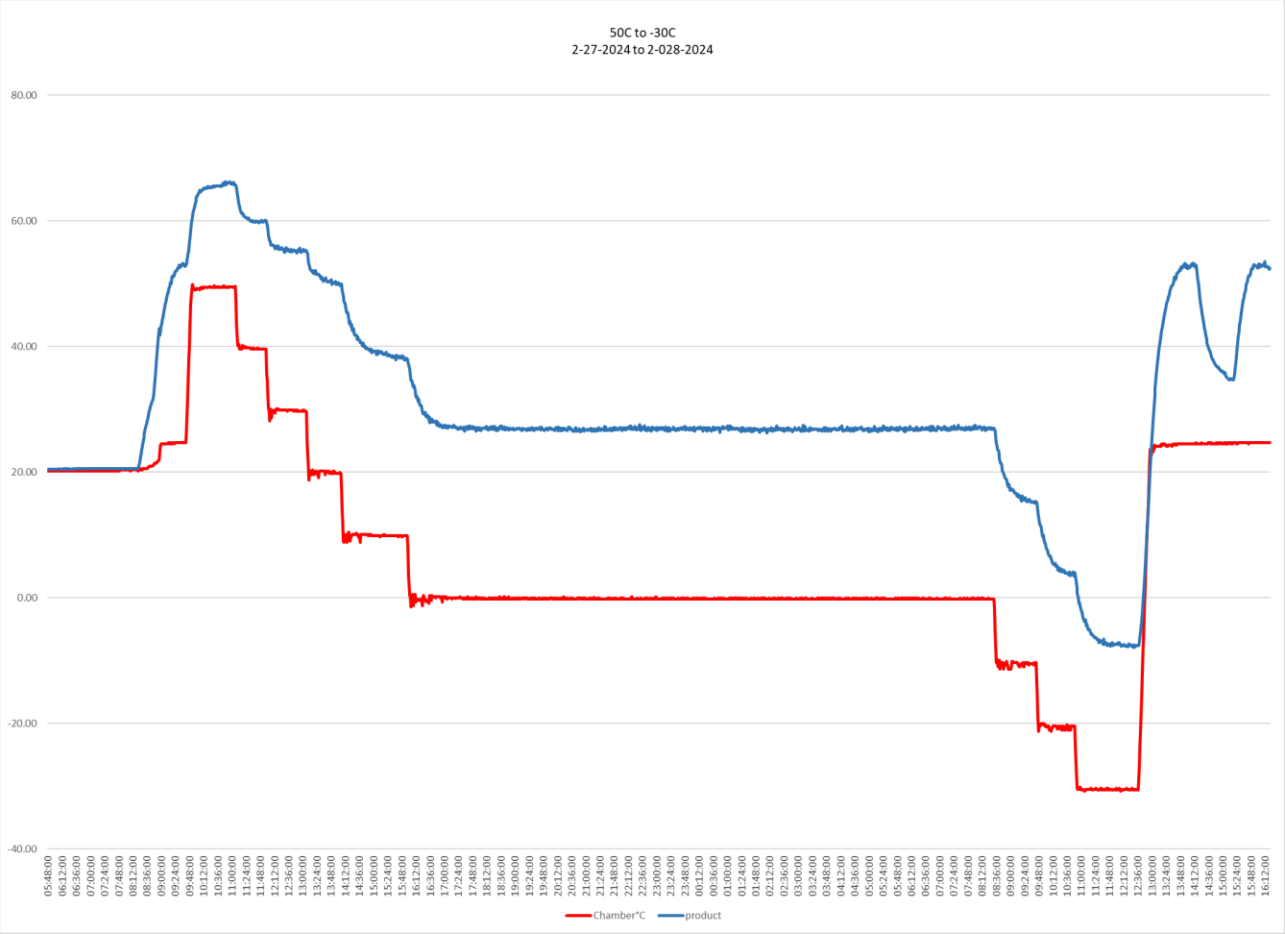
Transmit Frequency Deviation at +25°C at -3% of Nominal Voltage, -46.56VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-35.21**
0.5	**19.82**
1.0	**22.80**
1.5	**-23.64**
2.0	**-10.02**
2.5	**15.98**
3.0	**21.99**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -6% of Nominal Voltage, -45.12VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**38.06**
0.5	**16.57**
1.0	**11.56**
1.5	**-20.35**
2.0	**25.16**
2.5	**21.27**
3.0	**38.70**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -9% of Nominal Voltage, -43.68VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**20.12**
0.5	**14.27**
1.0	**26.53**
1.5	**33.01**
2.0	**-25.66**
2.5	**42.48**
3.0	**36.02**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -12% of Nominal Voltage, -42.24VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**23.90**
0.5	**17.53**
1.0	**34.67.**
1.5	**-15.24**
2.0	**13.76**
2.5	**-22.45**
3.0	**-28.14**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -15% of Nominal Voltage, -40.80VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**39.19**
0.5	**28.55**
1.0	**42.71**
1.5	**33.46**
2.0	**-23.68**
2.5	**20.44**
3.0	**38.42**
FCC SPECIFICATION	**1239.96 Hz (±0.05ppm)** **±0.05ppm = ±Hz**
FCC RESULT	**PASS**



4.7 List of Test Equipment

4.7.1 List of Radio Measurements and Radiated Emissions Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
E1451	A-Info	Horn Antenna	18 to 26.5 GHz WR42 25 dB	LB-42-25-C2-KF	J202066360	2023-01-10	2025-01-10
E1461	A-Info	Horn Antenna	22 - 33 GHz WR34 25dB	LB-34-25-C2-KF	J202026030	2022-01-25	2024-07-25
E1601	A.H. Systems	Pre-Amplifier	18 - 42 GHz	PAM-1842	102	2022-12-12	2024-12-12
E1602	A.H. Systems	Pre-Amplifier	20 MHz - 18 GHz, 1 Watt Input limiter	PAM-0118P	620	2023-03-06	2025-03-06
E1526	ETS Lindgren	Horn Antenna	Double Ridged Horn 10-40 GHz	3116C	0227821	2022-07-08	2024-07-08
E1073	ETS Lindgren	Horn Antenna	Double-Ridged Waveguide 1-18 GHz	3117	00135198	2023-06-06	2025-06-06
E1575	Lenovo	Computer - Laptop	GPCL Lab Laptop	T530	R-2429R9RTNFD	CNR	CNR
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
E1498	Reactel, Inc.	Filter, Low Pass	DC - 22 GHz, 1 dB	11LS-X22-6GK11	20-01	CNR-V	CNR-V
E1499	Reactel, Inc.	Filter, Low Pass	DC - 22 GHz, 1 dB	11LS-X22-6GK11	20-02	CNR-V	CNR-V
E1617	Reactel, Inc.	Filter, Band Pass	23.7 GHz to 24 GHz, EESS Bandpass filters	6CO-23.7G-X400K11	23-01	CNR-V	CNR-V
E1618	Reactel, Inc.	Filter, Band Pass	23.7 GHz to 24 GHz, EESS Bandpass filters	6CO-23.7G-X400K11	23-02	CNR-V	CNR-V
E1311	Rohde & Schwarz	Harmonic Mixer	40 GHz to 60 GHz	FS-Z60	100977	2021-10-06	2024-10-06
E1308	Rohde & Schwarz	Harmonic Mixer	90-140 GHz	FS-Z140	101008	2021-10-07	2024-10-07
E1312	Rohde & Schwarz	Harmonic Mixer	60 - 90 GHz	FS-Z90	101719	2021-09-28	2024-09-28
E1260	Rohde & Schwarz	Spectrum Analyzer	2 Hz – 67 GHz	FSW67	104007	2023-01-13	2025-01-13
E1384	Rohde & Schwarz	Spectrum Analyzer	2 Hz to 90 GHz	FSW85	101537	2023-01-26	2025-01-26
E1330	Sage Millimeter, Inc.	Horn Antenna	U-band pyramidal 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 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 horn antenna - 90 to 140 GHz	SAR-2309-08-S2	14853-02	Factory, - in Service 2018-07-01	CNR-V
E1524	Traceable	Data Logger	Barometric Humidity Temp Data Logger	6453	200665968	2023-06-23	2025-06-23

CNR: Calibration Not Required
CNR-V: Calibration Not Required, Must Be Verified
Test Date: 1/4/2024 – 2/6/2024

4.7.2 List of Frequency Stability Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
TH536-T14	Envirotronics	Controller	Controller	SPPCM	SP001513	2023-03-23	2025-03-23
TH-T14	Thermotron	Thermal Chamber	Thermal Chamber	N/A	28431	Calibration Not Required	
TH090	Yokogawa	Data Logger	10 Channel Paperless Recorder	GP10	S5V108472	2023-07-25	2025-07-25
TH073	Fluke	DMM	Digital Multimeter	87V	25910080	2022-02-24	2024-03-24
Customer provided Equipment	KeySight Technologies	EMI Receiver	MXA EMI Receiver	N9020B	MY59050106	2022-10-22	2024-10-22
TH069	Extech	Data Logger	Barometric Pressure/Humidity/Temperature	SD700	Q690305	2023-07-24	2025-07-24

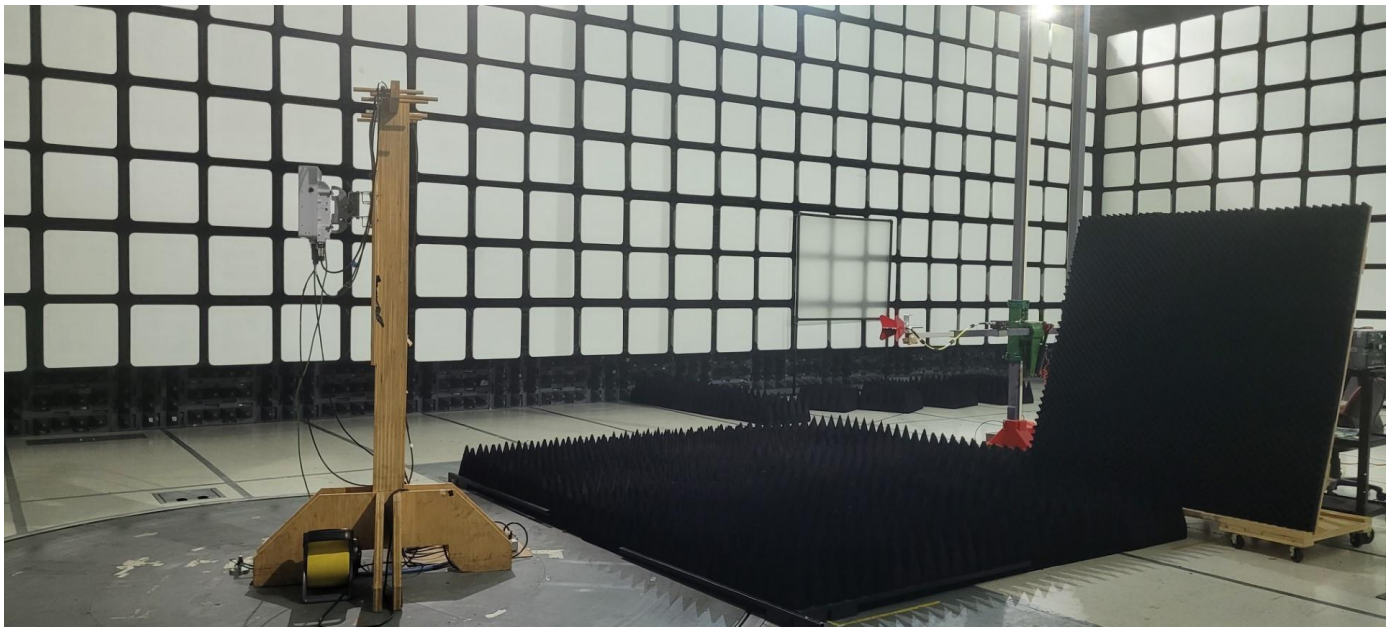
Test Date: 2/22/2024 – 2/28/2024

4.8 PHOTOGRAPHS OF THE TEST SETUPS

Radiated Emissions and Radio Measurements Test Photos

30 MHz-1 GHz AR-4

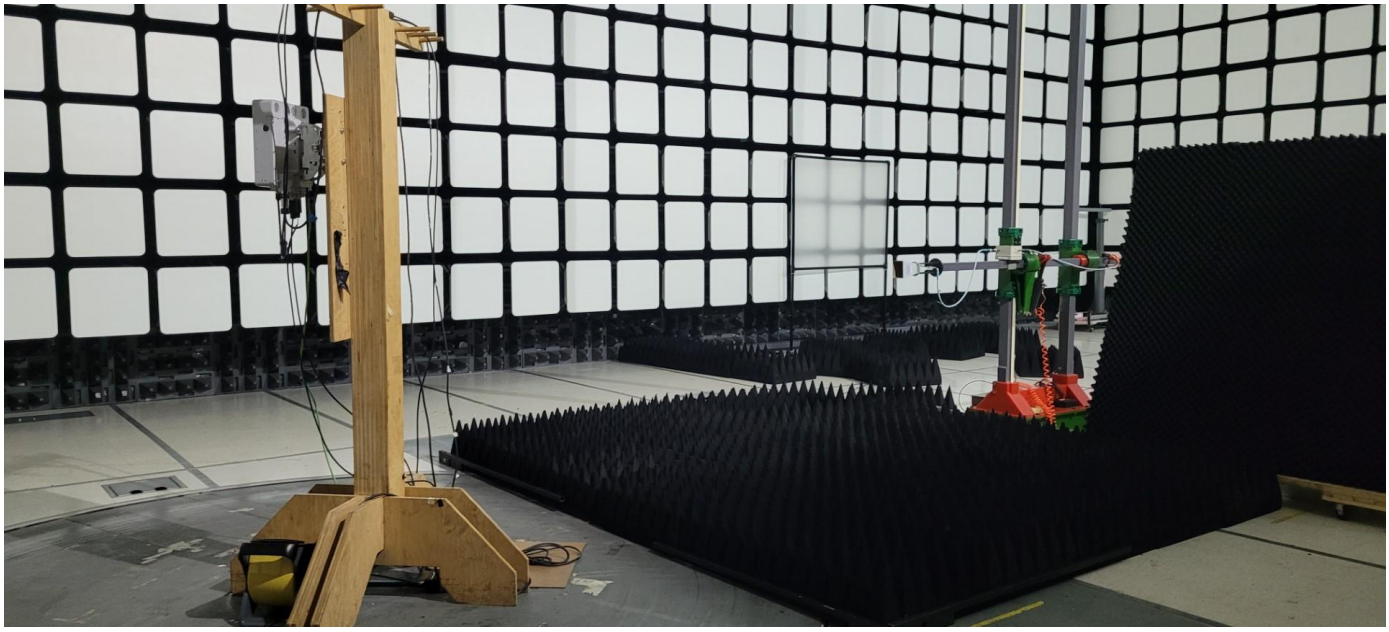
1 GHz – 18 GHz AR-4



1GHz-18 GHz AR-9

Exhibit 12 - Test Setup Photographs –*continued*

18GHz-26.5GHz AR-8



26.5GHz-40 GHz AR-8

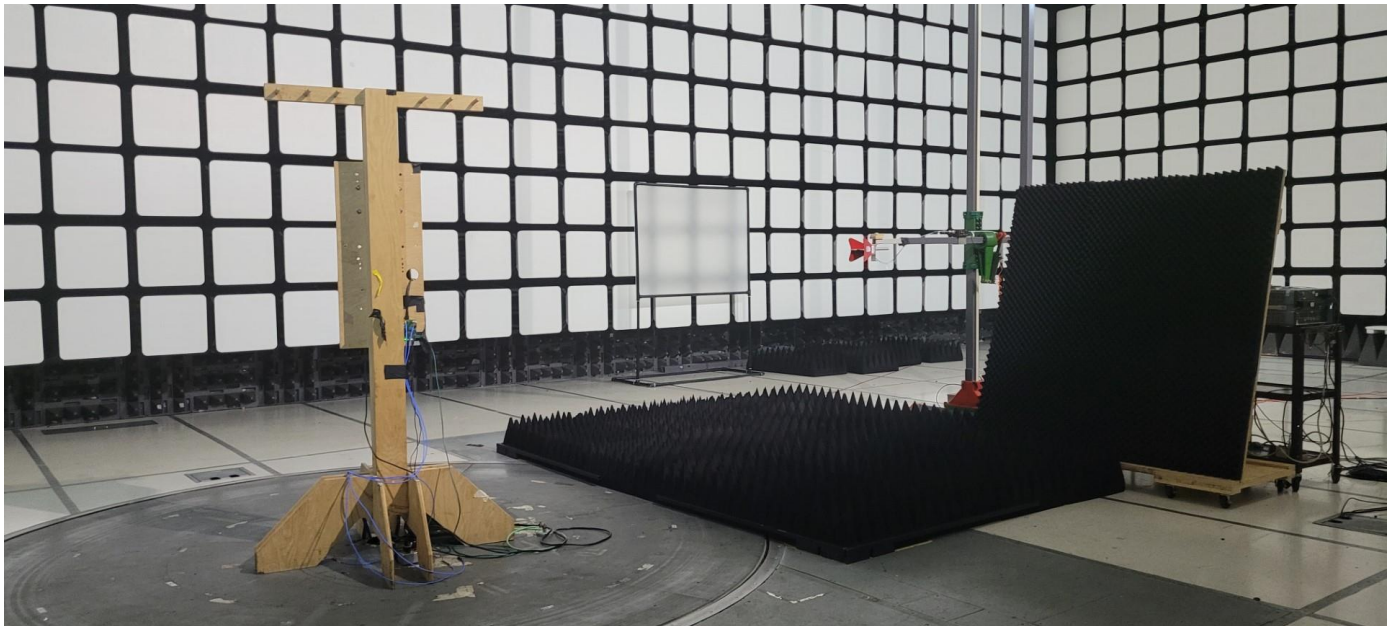
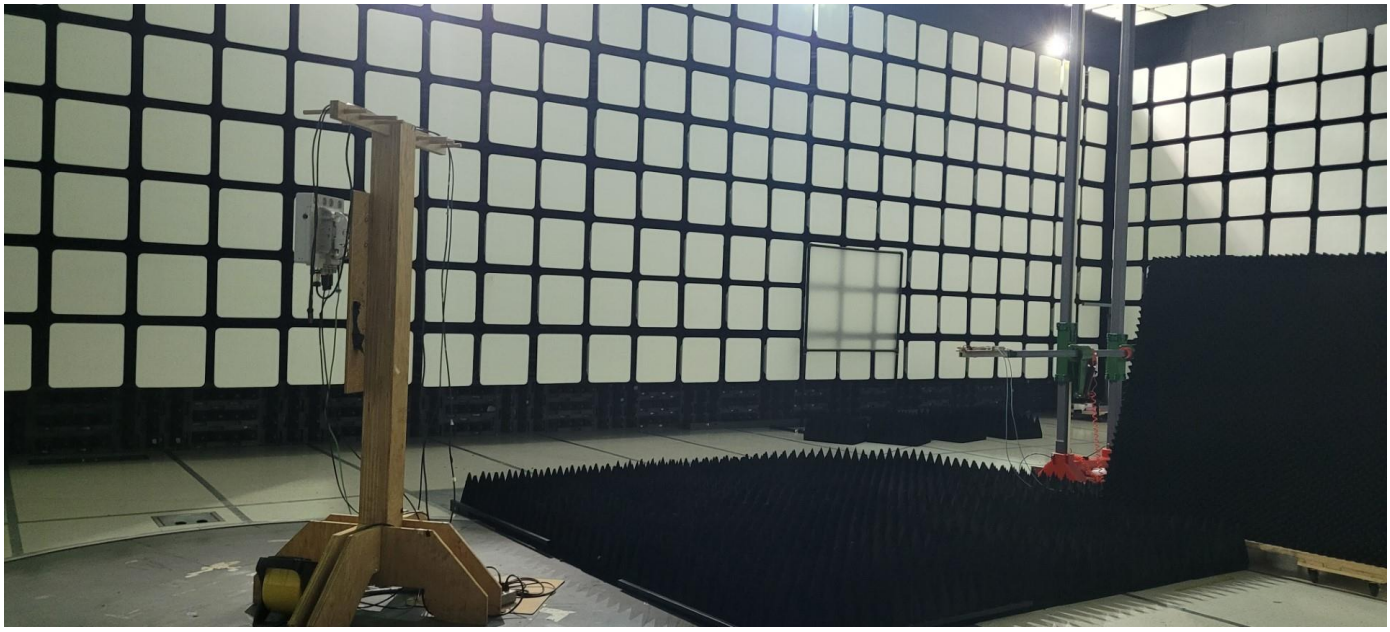


Exhibit 12 – Test Setup Photographs - *continued*

40GHz-100 GHz AR-8



Radio Testing 22-33 GHz at 6.5m in AR-8

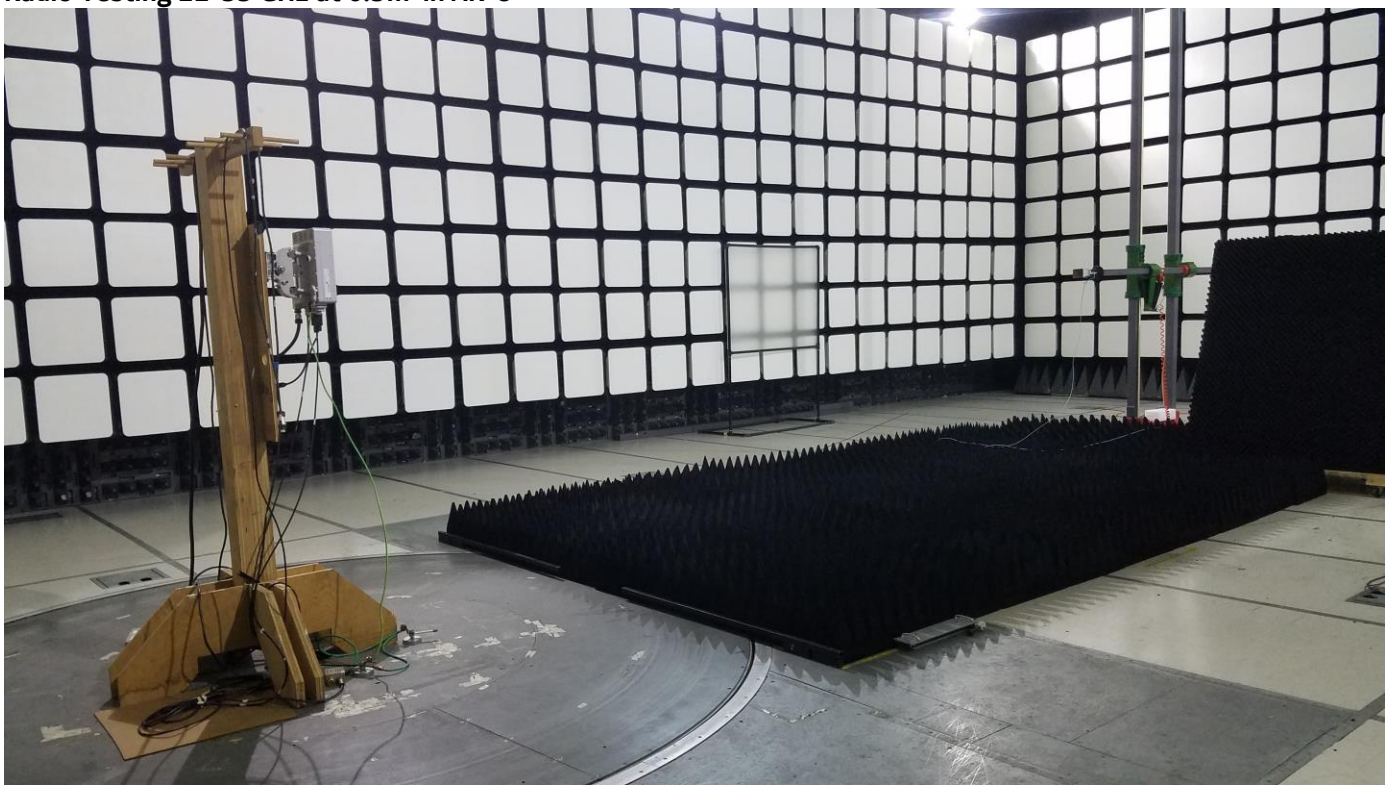


Exhibit 12 – Test Setup Photographs - *continued*

Radio and Radiated Emissions Test Support Equipment Setup

AR-8 Testing Control Room

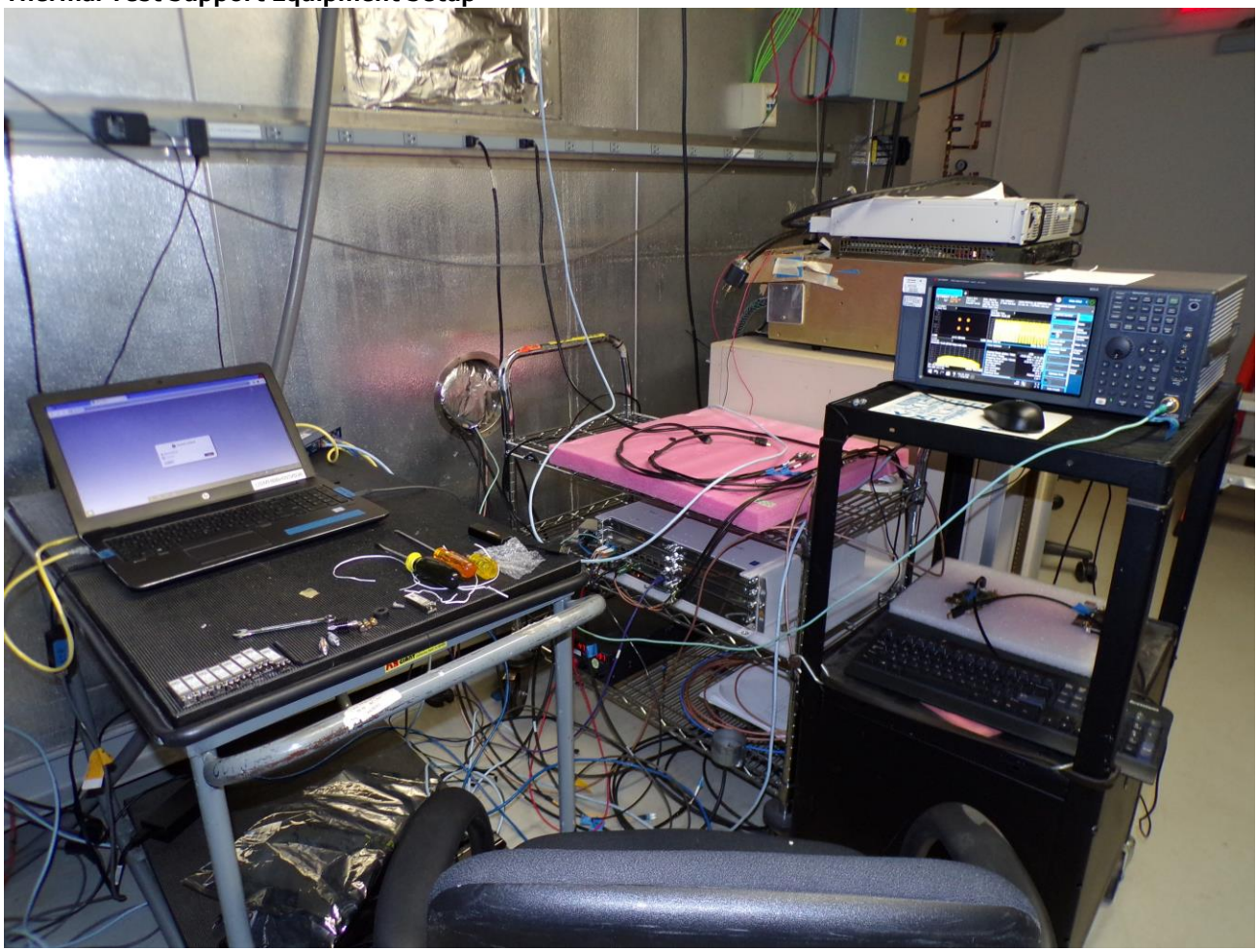
Exhibit 12 - Test Setup Photographs –*continued*

Frequency Stability Tests

2AD8UAWKUCD01 with Horn Measurement Antenna in the Thermal Chamber

Exhibit 12 - Test Setup Photographs –*continued*

Thermal Test 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-8, (FCC Registration Number: 395774) **NVLAP** Lab Code: 100275-0 and IC (Filing Number:6933F-8) 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	9/30/2020	7/6/2017
Intentional Radiators	FCC Part 15 Subpart C	40000	Approved	9/30/2020	6/5/2018
U-NII without DFS Intentional Radiators	FCC Part 15, Subpart E	40000	Approved	9/30/2020	6/5/2018
U-NII with DFS Intentional Radiators	FCC Part 15, Subpart E	40000	Approved	9/30/2020	6/5/2018
Commercial Mobile Services	Part 22 (cellular), Part 24, Part 25 (below 3 GHz), Part 27	40000	Approved	9/30/2020	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	9/30/2020	6/5/2018
Citizens Broadband Radio Services	Part 30	40000	Approved	9/30/2020	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	9/30/2020	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).

2023-09-07 through 2024-09-30
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.