NOKIA Bell Labs

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

FCC Certification Part 30 Test Report

Product Evaluated

AWEWA/B 5G n260 39GHz 8CC
AWEWA / AWEWB
FCC ID: 2AD8UAWEWAB01

Customer

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

Test Laboratory

Nokia Bell Labs
Nokia, Global Product Compliance Laboratory
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Date

July 20, 2021

Revisions

Date	Revision	Section	Change
7/14/2021	0		Initial Release
7/20/2021	1	1.0	FCC Test Site Designations

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Table of Contents

1. ATTESTATION OF TEST RESULTS

Equipment Under Test (EUT)	AWEWA/B 5G n260 39GHz 8CC - 2 Ext FA3WA Modules
Serial Number(s)	Radiated Emission AWEWB (DC) YK211800031, FA3WA YK2118000017 & YK2118000027 Radio Tests: AWEWB (DC) YK211800001, FA3WA YK2118000028 & YK2118000029 Frequency Stability Tests: AWEWA (AC) YK211800002, AWEWB (DC) YK211800015, FA3WA YK2118000033 & YK2118000034
FCC ID	2AD8UAWEWAB01
Model Name	ASMR Family – AWEWA (AC), AWEWB (DC)
Hardware Version	475170A AWEWA / 475171A AWEWB /
GPCL Project Number	2021-0072
Manufacturer	NOKIA SOLUTIONS AND NETWORKS OY?? KARAKAARI 7, FI-02610 ESPOO FINLAND
Test Requirement	• 47 CFR FCC Part 2 and Part 30 (Part 2.1047, 2.1055)
Test Standard(s)	• 47 CFR FCC Parts 2 and Part 30 • KDB 971168 D01 Power Meas License Digital Systems v03r01 April 9, 2018 • KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013 • KDB 842590 D01 Upper Microwave Flexible Use Service v01r01–April 2020 • Procedures on TRP Compliance for Out of Band and Spurious Emissions C63.26 mmWave JTG - Version # 1 July 14th, 2018
Reference(s)	• ANSI C63.26 (2015) • ANSI C63.4 (2014) • TR 14-1001, MMW Measurements with Harmonic Mixers (April-4-2014)
Test Date	June 4, 2021 – July 14, 2021
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, Obi Okorie
Lead Engineer	W. Steve Majkowski
Test Engineer (s)	W. Steve Majkowski, Mike Soli, Chris Polanco, Jaideep Yadav
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	ASMR – AWEWA (AC Pwr) AWEWB (DC Pwr) 5G AirScale 39 GHz mmWave Radio Head
Radio Type	Intentional Transceiver
Power Type	Both DC & AC
Modulation	QPSK, 16QAM, 64QAM, 256QAM
Operating Frequency Range	TDD Tx/Rx = 37 – 40.0 GHz, NR Band n260
Channel Bandwidth	1400 MHz
Max Radiated Power (EIRP)	52 dBm EIRP per polarizations; 55 dBm EIRP Total for the two polarizations.
Antenna Gain	23 dBi
Operating Mode	2x2 MIMO (2 duplex Tx/Rx Ports)
Software Version	5G19B
Hardware Version	475170A.X21 / AWEWA, 475171A X21 / AWEWB, 475002A.X21 / FA3WA
Antenna(s)	Refer to Section 3.2

3.2 EIRP/ PSD Compliance and Antenna Information.

The product incorporates integrated antennas. Externally mounted antennas cannot be attached to the unit or mounted remotely. The units integrated antennas are electronically steerable with a maximum gain of 23 dBi. There is a single antenna board assembly inside the product. This antenna assembly has two individually polarized antenna Tx/Rx modules. Each antenna Tx/Rx modules is an 8x12 matrix (96 elements each). One antenna Tx/Rx modules is vertically polarized, and the second antenna Tx/Rx modules is horizontally polarized. The antennas nominal RF drive level is 29 dBm. The 29 dBm RF power and 23 dBi gain results in a 52 dBm EIRP per assembly. The sum of the two 52 dBm EIRP beams results in a maximum EIRP of 55 dBm. Antenna Gain vs frequency is detailed in Exhibit 6 of the filing package.

3.3 Antenna Far Field Determination Distance

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

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

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

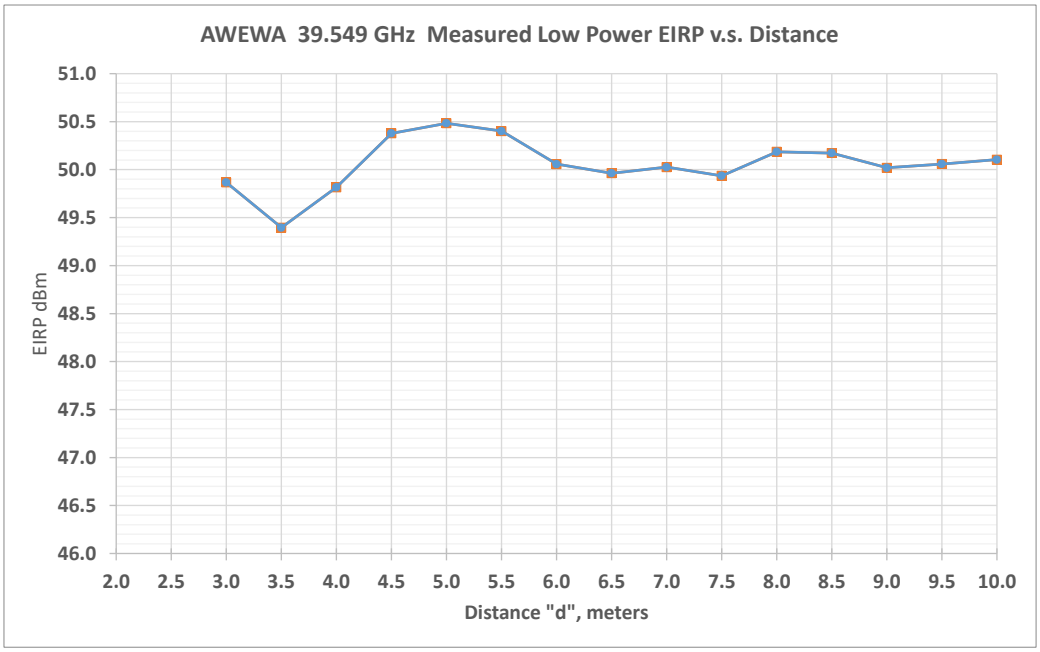
The individual polarization antenna array height is 135 mm and is 77 mm wide with a 155mm diagional. The diagional for both arrays is 301 mm.
At 40 GHz the individual array dimensions results in a minimum Fraunhofer far field distance, $d_{ff,}$ of 6.4 meters.
At 40 GHz the overall array dimensions results in a minimum Fraunhofer far field distance, $d_{ff,}$ of 24 meters.

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

Measurements for the Moongilan Test were performed at low power using a standard gain horn antenna In the horizontal polarization the determined boundary was 6.0 m.

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.



4. REQUIRED MEASUREMENTS AND RESULTS

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

Table 4.0a Required Certification Measurements

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

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

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

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

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

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

4.1 Section 2.1046 MEASUREMENT REQUIRED: RF POWER OUTPUT

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

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

The **Nokia AirScale 39 GHz Radio Unit (AWEWA/B), FCC ID: 2AD8UAWEWAB01**, is a LTE TDD Remote radio head can be configured for one to eight carrier operation. It is specified to provide a maximum power output of 52 dBm /158.5 W EIRP per transmit polarization for a sum total of 55 dBm /317W EIRP per unit. The product is designed for the 5G global market including operation per 47 CFR Part 30 rules for use in the USA authorized portions of 5G New Radio Band, n260, from 37 - 40 GHz.

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.

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 68 dB offset. An additional FSW transducer correction factor is used to ascertain the actual measured EIRP power. The calculation of path loss, cable loss and measurement antenna gain are listed in Table 4.1.1. below. The unit was configured to transmit at its maximum power.

The Channel Power function of the FSW spectrum analyzer was used to measure the maximum average Horizontal and Vertical EIRP at the 6.5m boundary distance. The measurements were performed for one through eight carriers at the left, center and right side of the 37 -40 GHz Band. For all measurements the a nominal 100 MHz bandwidth carrier with 5G-NR modulations was used. Channel power plots identify the individual carrier power, modulation and the total power.

Table 4.1.1 Corrections For Transmitter Power Measurements

Frequency	Free Space Path Loss, "PL"	Measurement Antenna Gain, "G1"	Measurement Cable Loss, "L1"	Total Offset Required PL -G1 + L1	FSW Measurement Offset	Required Final Correction
GHz	dB	dBi	dB	dB	dB	dB
35.00	79.58	23.96	12.84	68.46	68	0.460
35.50	79.70	23.52	13.03	69.21	68	1.214
36.00	79.83	24.27	13.20	68.75	68	0.754
36.50	79.95	23.28	13.35	70.01	68	2.015
37.00	80.06	24.42	13.39	69.04	68	1.040
37.50	80.18	23.27	13.39	70.29	68	2.293
38.00	80.30	24.29	13.45	69.45	68	1.455
38.50	80.41	23.18	13.54	70.76	68	2.762
39.00	80.52	23.65	13.73	70.60	68	2.604
39.50	80.63	23.03	13.76	71.36	68	3.358
40.00	80.74	23.00	13.79	71.53	68	3.530
40.50	80.85	23.35	13.84	71.34	68	3.343
41.00	80.96	23.22	13.98	71.72	68	3.717
41.50	81.06	23.28	14.14	71.93	68	3.927
42.00	81.17	23.39	14.23	72.01	68	4.014
42.50	81.27	23.81	14.36	71.81	68	3.815
43.00	81.37	23.55	15.30	73.11	68	5.114
43.50	81.47	23.60	16.14	74.01	68	6.008

4.1.1.1 RF Power Output Results

Power output measurements verified the expected performance of 52 dBm EIRP per polarization for a Total Power of 55 dBm. The maximum measured level was 53.33 dBm for a single polarization and 56.02 dBm total. This level is well within the maximum Part 30.202a limit of 75 dBm EIRP. Measurements were performed for each modulation.

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

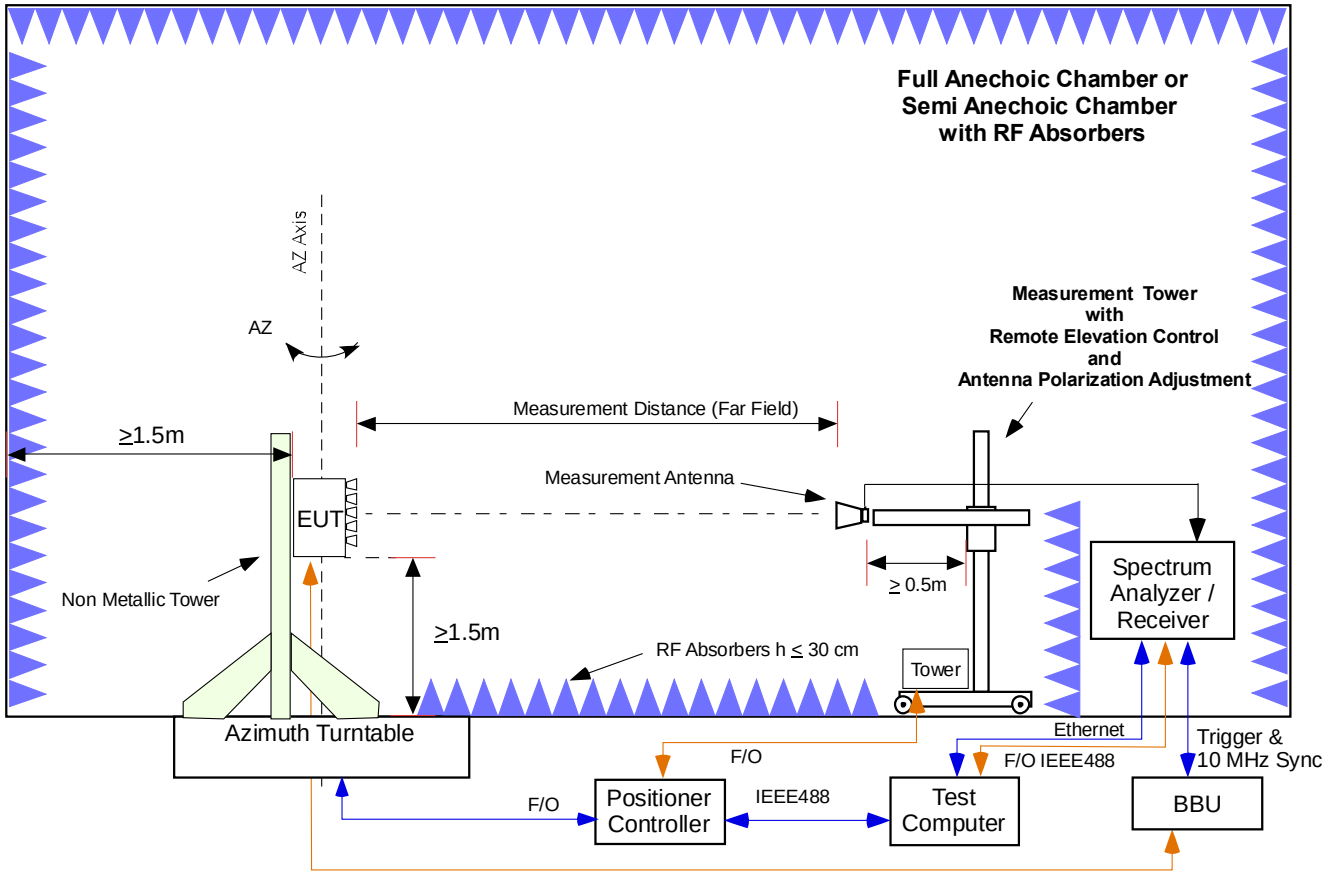
Table 4.1.1.1 – Channel Power Measurements (adjacent)

Location in Band	Channel Center Frequencies, GHz	# of carriers	Modulation	Horizontal Polarization Total Channel Power, EIRP	Vertical Polarization Total Channel Power, EIRP	Sum Total Channel Power EIRP
				dBm	dBm	dBm
Left	37.05	1	QPSK	52.20	52.76	55.50
Center	38.5476	1	64QAM	52.34	52.68	55.52
Right	39.94536	1	16QAM	52.02	52.40	55.22
Left	37.05000 37.14984	2	QPSK	52.76	53.24	56.02
Left	37.05000 37.14984 37.24968	3	QPSK	52.04	53.18	55.66
Left	37.05000 37.14984 37.24968 37.34952	4	QPSK	52.07	53.31	55.74
Left	37.05000 37.14984 37.24968 37.34952 37.44936	5	QPSK	52.06	53.23	55.69
Left	37.05000 37.14984 37.24968 37.34952 37.44936 37.5492	6	QPSK	52.14	52.87	55.53
Left	37.05000 37.14984 37.24968 37.34952 37.44936 37.54920 37.64904	7	QPSK	52.50	52.80	55.66
Left	37.05000 37.14984 37.24968 37.34952 37.44936 37.54920 37.64904 37.74888	8	QPSK	52.16	52.33	55.26
Center	39.01768 39.01768 39.01768 39.01768 39.01768 38.64744 38.74728 38.84712	8	64QAM	52.44	52.68	55.57
Right	39.24648 39.34632 39.44616 39.54600 39.64584 39.74568 39.84552 39.94536	8	16QAM	52.05	52.34	55.21

Table 4.1.1.2 – Channel Power Measurements (non-Contiguous Max IBW)

Location in Band	Channel Center Frequencies, GHz	# of carriers	Modulation	Horizontal Polarization Total Channel Power, EIRP	Vertical Polarization Total Channel Power, EIRP	Sum Total Channel Power EIRP
				dBm	dBm	dBm
Left	37050.00 37149.84 37249.68 37349.52 38048.40 38148.24 38248.08 38347.92	8	QPSK	52.08	52.19	55.15
Right	38647.44 38747.28 38847.12 38946.96 39645.84 39745.68 39845.52 39945.36	8	64QAM	52.07	53.34	55.76

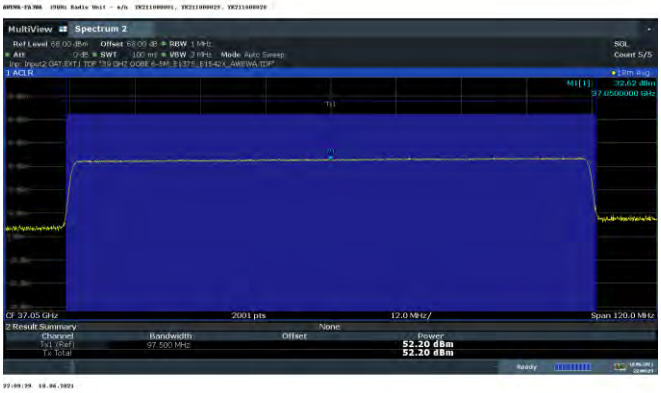
Figure 4.1.1 Test Set-Up for Measurement of Radio Transmitter Performance



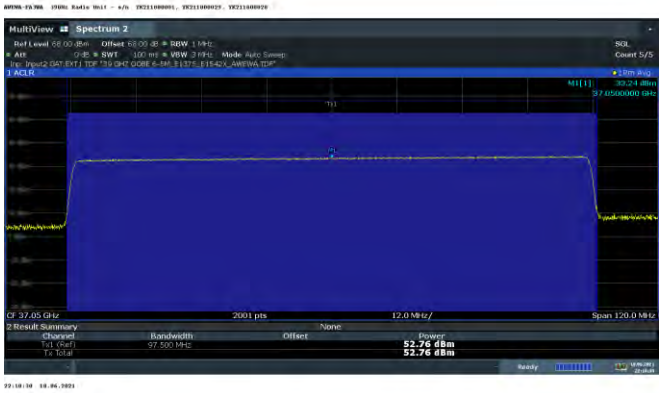
4.1.1.1.1 Channel Power Measurement Plots

Channel Power Measurements, 1 Carrier – QPSK - Left Side of Band

Horizontal

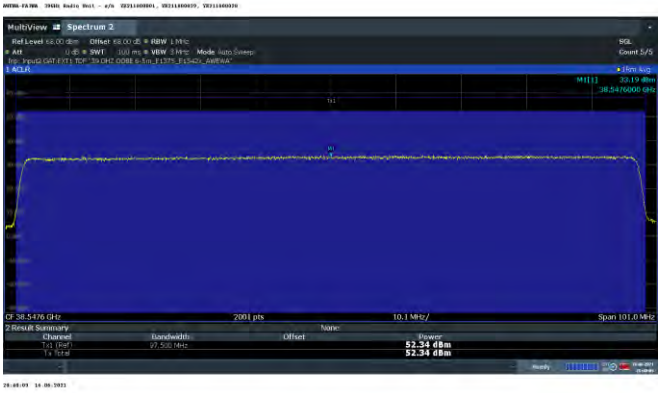


Vertical

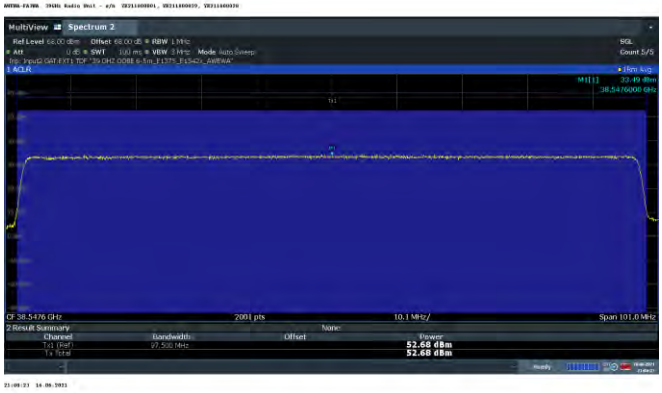


Channel Power Measurements, 1 Carrier – 64QAM – Middle of Band

Horizontal

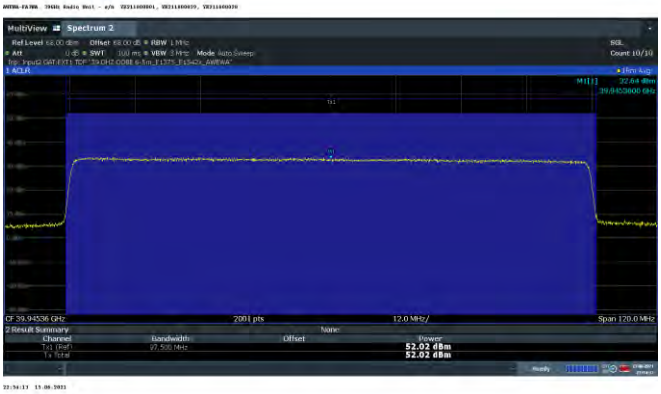


Vertical



Channel Power Measurements, 1 Carrier – 16QAM – Right Side of Band

Horizontal



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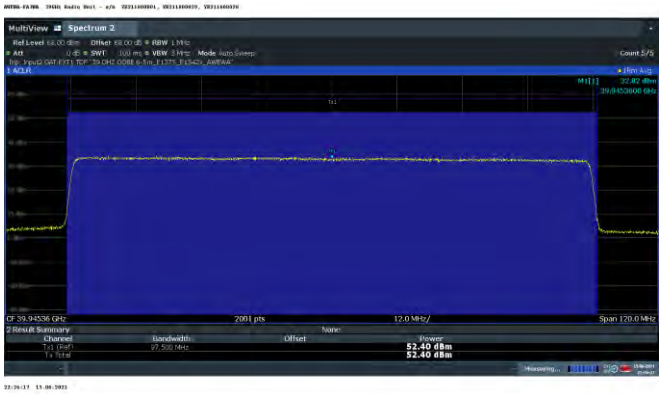
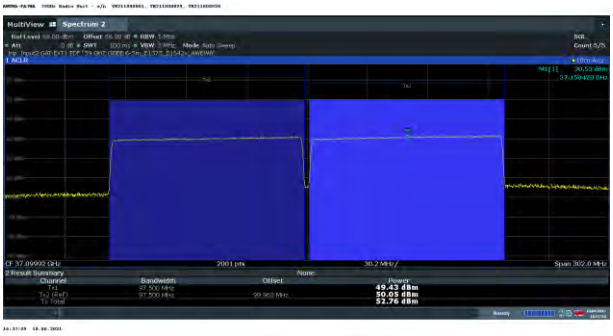


Channel Power Measurements, 2 Carrier –QPSK – Left Side of Band

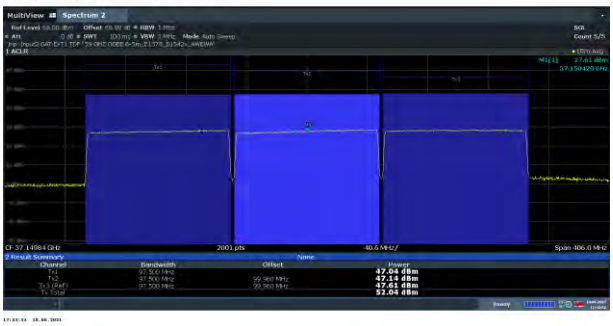
Horizontal



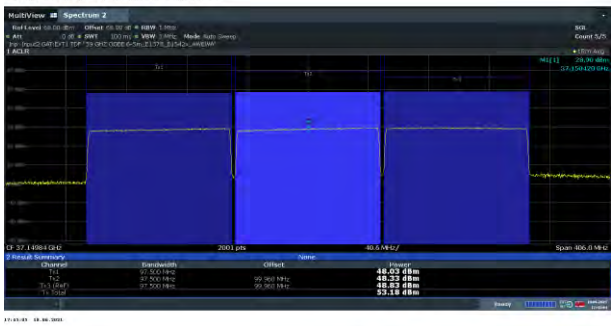
Vertical

Channel Power Measurements, 3 Carrier – QPSK – Left Side of Band

Horizontal

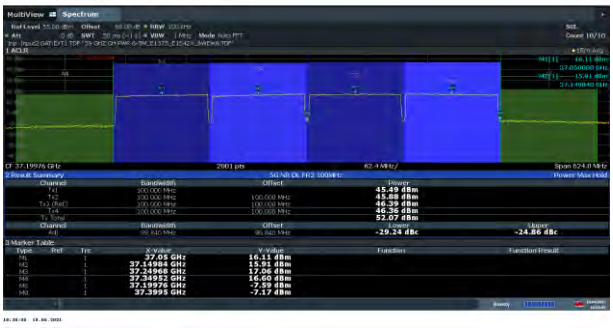


Vertical

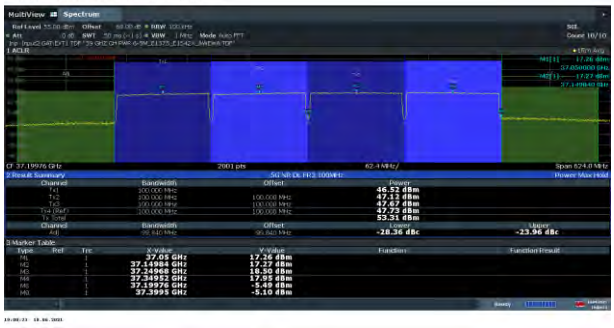


Channel Power Measurements, 4 Carrier – QPSK – Left Side of Band

Horizontal



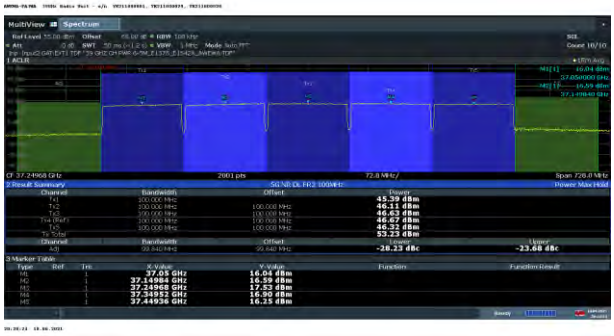
Vertical



Channel Power Measurements, 5 Carrier –QPSK – Left Side of Band

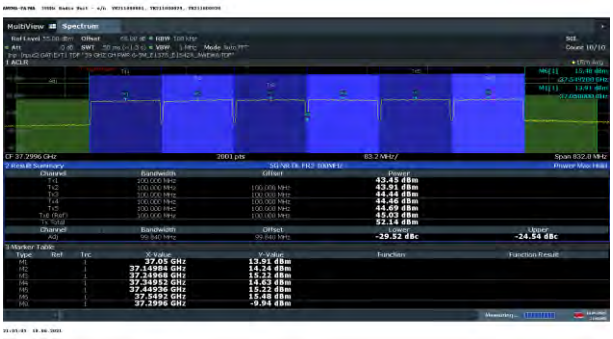
Horizontal

Vertical

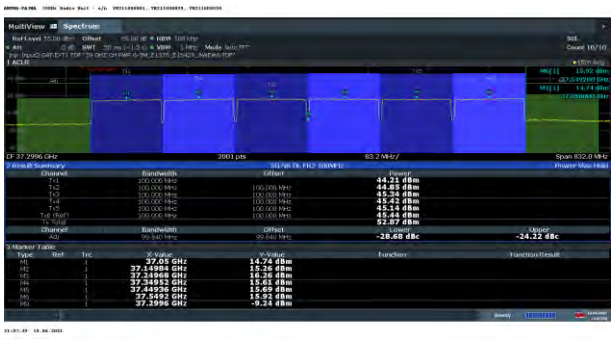


Channel Power Measurements, 6 Carrier – QPSK – Left Side of Band

Horizontal

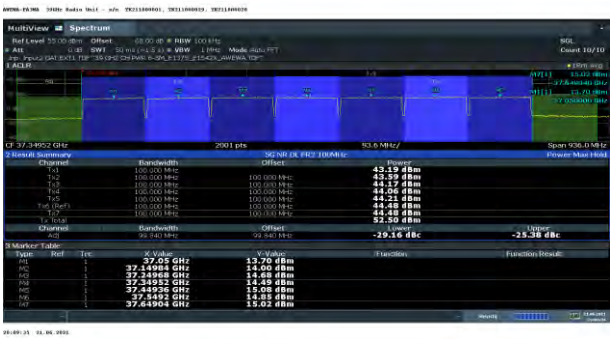


Vertical

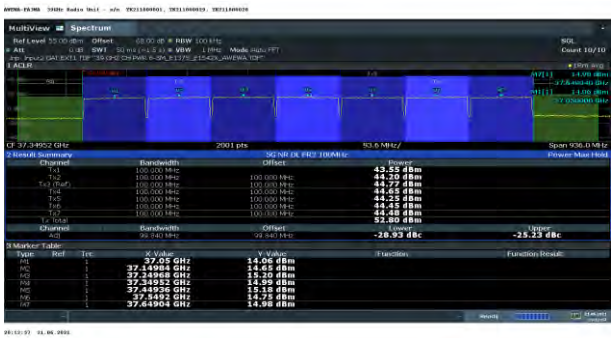


Channel Power Measurements, 7 Carrier – QPSK – Left Side of Band

Horizontal

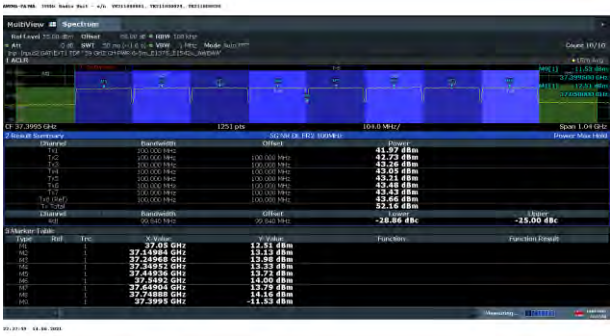


Vertical

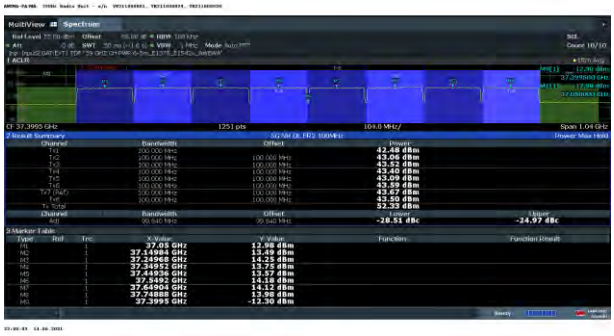


Channel Power Measurements, 8 Carrier –QPSK – Left Side of Band

Horizontal

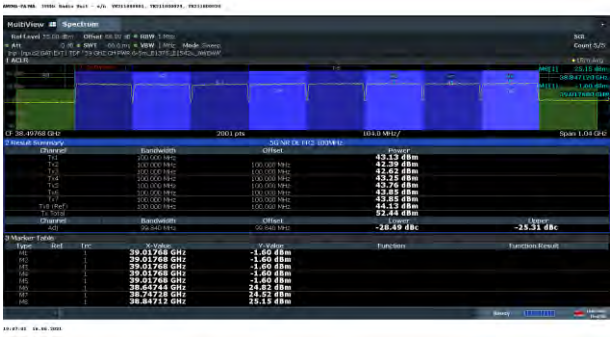


Vertical

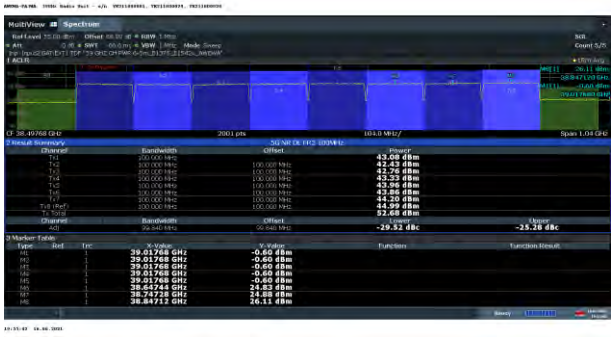


Channel Power Measurements, 8 Carrier – 64QAM – Center of Band

Horizontal

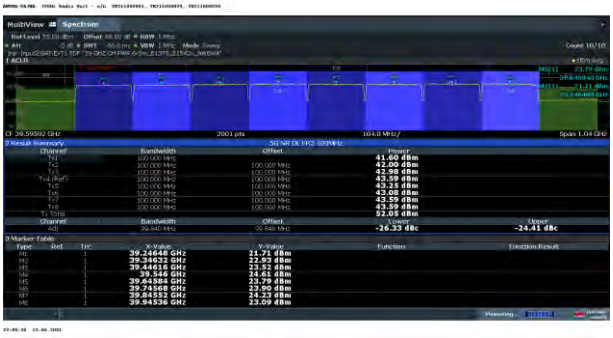


Vertical

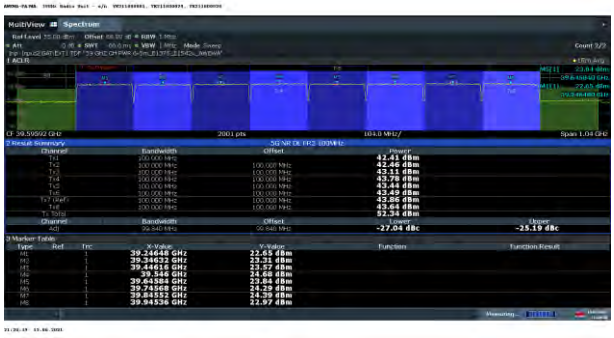


Channel Power Measurements, 8 Carrier – 16QAM – Right Side of Band

Horizontal



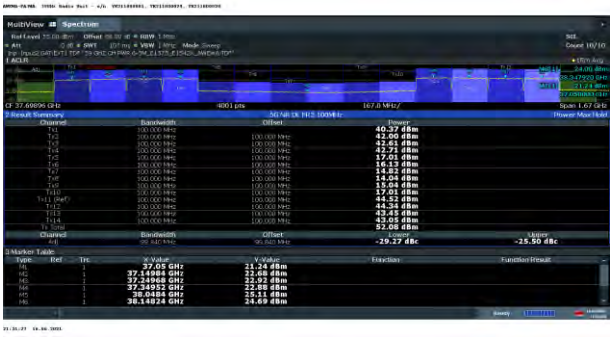
Vertical



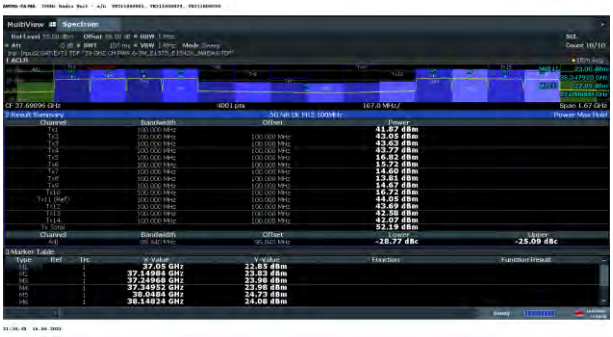
Non-Adjacent

Channel Power Measurements, 8 Carrier –QPSK – Left Side of Band

Horizontal

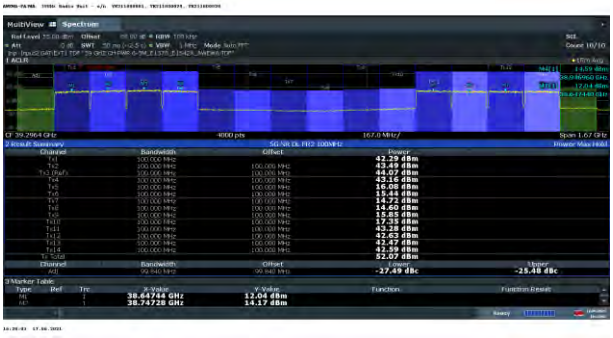


Vertical

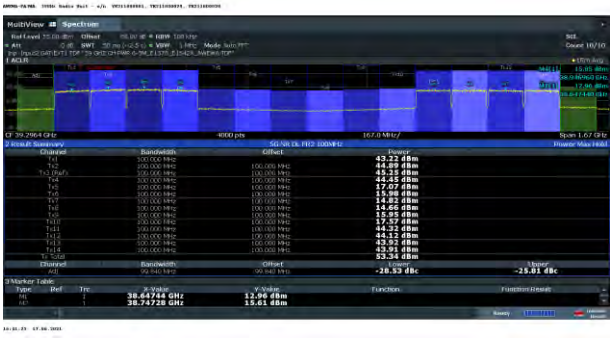


Channel Power Measurements, 8 Carrier – 64QAM – Right Side of Band

Horizontal



Vertical



4.2 Section 2.1047 MEASUREMENT REQUIRED: MODULATION CHARACTERISTICS

The **2AD8UAWEWAB01** supports the 5G New Radio Modulation Format based upon LTE TDD technologies. LTE utilizes Orthogonal Frequency Division Multiplexing (OFDM) which splits the carrier frequency bandwidth into many small subcarriers. Each individual subcarrier can be modulated with QPSK, 16QAM and 64QAM digital modulation formats.

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

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

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

4.2.1 Modulation Characteristics Measurement

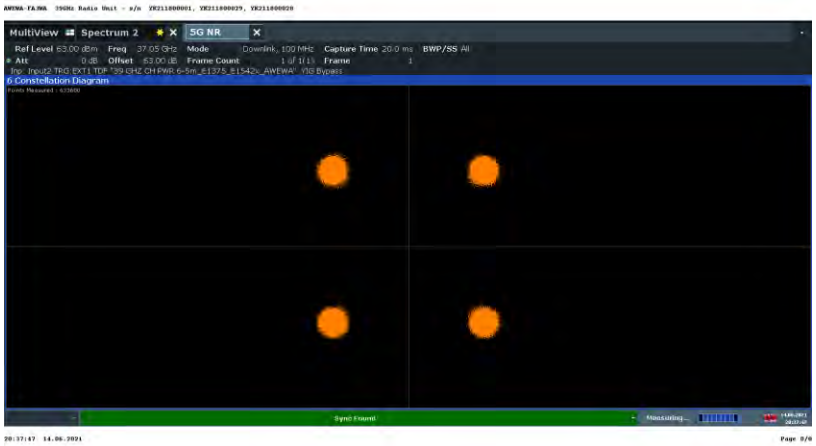
The measurements were performed at a distance of 6.5 m from the unit utilizing the test configuration in Figure 4.4.1 utilizing a Rohde & Schwarz FSW85 Signal analyzer with the 3GPP 5G-NR DL Measurement software option. Representative screen plots of the modulation measurement are attached below for all three of the subcarrier configurations and sample polarizations. .

4.2.2 Modulation Measurements Results:

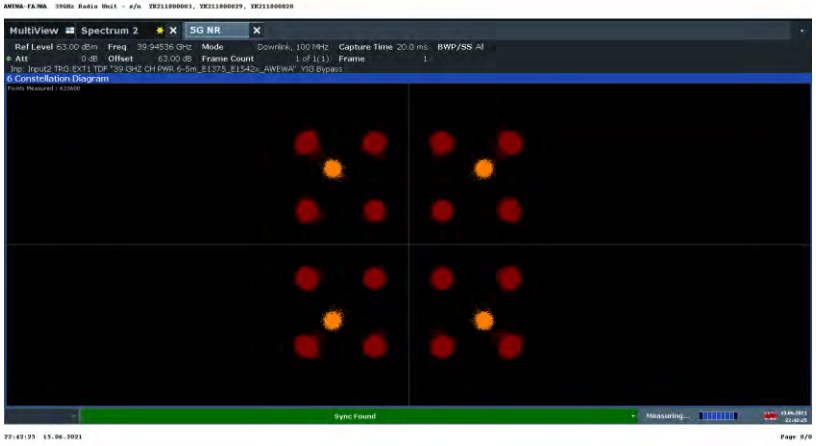
The typical measured modulation characteristics of the EUT are shown below:

Figure 4.2 Sample Modulation Results

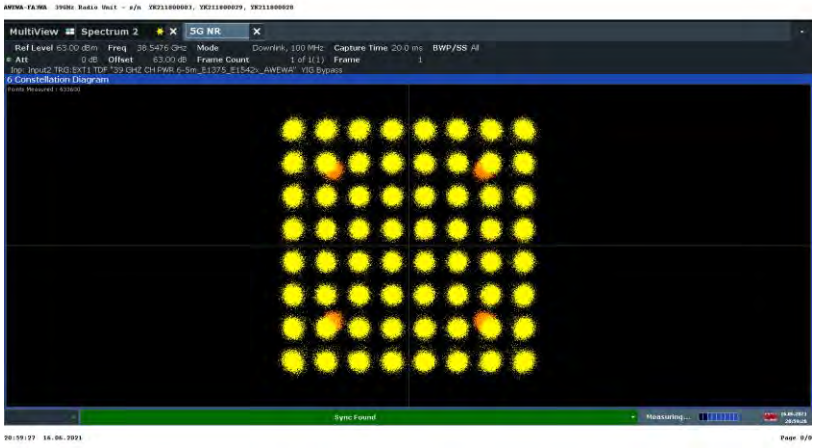
QPSK - Left - Vertical Polarization



16QAM - Right - Vertical Polarization



64QAM - Center – Horizontal Polarization



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

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

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

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

4.3.1 Results Occupied Bandwidth (Signal Bandwidth)

The measurements of 99% occupied bandwidth were performed with a Rohde & Schwartz FSW85 GHz spectrum analyzer. The measurements of the intended 100 MHz 5G-NR carrier indicated compliance with the 97M0G7D emission designator. Sample results are presented below and shows that the measured signals are within the parameters of the 97M0G7D emissions designator. Most of the multicarrier measurements were made with a carrier spacing of 99.84 MHz. Center of band data for the 99.96MHz carrier spacing is also separately reported for the 8 carrier configuration.

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

Location in Band	Carrier Frequencies (GHz)	Number of Carriers	Modulation	Horizontal Polarization Occupied Signal Bandwidth (MHz)	Vertical Polarization Occupied Signal Bandwidth (MHz)
Left	37.05	1	QPSK	94.179	94.159
Middle	38.5476	1	64QAM	94.136	94.182
Right	39.94536	1	16QAM	95.152	94.143
Left	37.05 37.14984	2	QPSK	193.090	192.968
Left	37.05000 37.14984 37.24968	3	QPSK	291.967	291.752
Left	37.05 To 37.34952	4	QPSK	390.776	390.660
Left	37.05 To 37.44936	5	QPSK	489.903	489.509
Left	37.05 To 37.5492	6	QPSK	588.669	588.522
Left	37.05 To 37.64904	7	QPSK	687.141	686.884
Left	37.05 To 37.74888	8 (adjacent)	QPSK	785.569	785.306
Middle	38.14824 To 38.84712	8 (adjacent)	16QAM	787.909	788.142
Right	39.24648 To 39.94536	8 (adjacent)	64QAM	785.105	786.224
Left	37.05 To 38.34792	8 (Non-adjacent)	QPSK	1381.773	1382.564
Right	38.64744 To 39.94536	8 (Non-adjacent)	64QAM	1383.649	1382.963

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

Location in Band	Carrier Frequencies (GHz)	Number of Carriers	Modulation	Horizontal Polarization Occupied Signal Bandwidth (MHz)	Vertical Polarization Occupied Signal Bandwidth (MHz)
Left	37.05	1	QPSK	95.198	95.180
Middle	38.5476	1	64QAM	95.119	95.178
Right	39.94536	1	16QAM	95.147	95.126
Left	37.05 37.14984	2	QPSK	193.649	193.456
Left	37.05000 37.14984 37.24968	3	QPSK	292.155	291.952
Left	37.05 To 37.34952	4	QPSK	390.882	390.839
Left	37.05 To 37.44936	5	QPSK	489.943	489.524
Left	37.05 To 37.5492	6	QPSK	588.793	588.647
Left	37.05 To 37.64904	7	QPSK	687.153	686.865
Left	37.05 To 37.74888	8 (adjacent)	QPSK	785.607	785.335
Middle	38.14824 To 38.84712	8 (adjacent)	16QAM	787.868	788.103
Right	39.24648 To 39.94536	8 (adjacent)	64QAM	785.079	785.591
Left	37.05 To 38.34792	8 (Non-adjacent)	QPSK	1381.844	1382.580
Right	38.64744 To 39.94536	8 (Non-adjacent)	64QAM	1383.430	1382.792

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

Location in Band	Carrier Frequencies (GHz)	Number of Carriers	Modulation	Horizontal Polarization Occupied Signal Bandwidth (MHz)	Vertical Polarization Occupied Signal Bandwidth (MHz)
Left	37.05	1	QPSK	96.841	96.808
Middle	38.5476	1	64QAM	96.642	96.719
Right	39.94536	1	16QAM	96.771	96.742
Left	37.05 37.14984	2	QPSK	194.768	194.489
Left	37.05000 37.14984 37.24968	3	QPSK	292.856	292.583
Left	37.05 To 37.34952	4	QPSK	391.357	391.299
Left	37.05 To 37.44936	5	QPSK	490.306	489.824
Left	37.05 To 37.5492	6	QPSK	589.099	588.854
Left	37.05 To 37.64904	7	QPSK	687.294	686.979
Left	37.05 To 37.74888	8 (adjacent)	QPSK	785.678	785.373
Middle	38.14824 To 38.84712	8 (adjacent)	16QAM	787.988	788.259
Right	39.24648 To 39.94536	8 (adjacent)	64QAM	785.223	785.709
Left	37.05 To 38.34792	8 (Non-adjacent)	QPSK	1381.869	1382.579
Right	38.64744 To 39.94536	8 (Non-adjacent)	64QAM	1383.440	1382.859
99.96 MHz Carrier Spacing					
Middle	38.14956 To 38.84928	8 (adjacent)	16QAM	788.912	788.937

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

Location in Band	Carrier Frequencies (GHz)	Number of Carriers	Modulation	Horizontal Polarization Occupied Signal Bandwidth (MHz)	Vertical Polarization Occupied Signal Bandwidth (MHz)
Left	37.05 To 37.74888	8 (adjacent)	QPSK	786.573	786.201
Middle	38.14824 To 38.84712	8 (adjacent)	16QAM	789.110-	789.396
Right	39.24648 To 39.94536	8 (adjacent)	64QAM	786.005	786.507
Left	37.05 To 38.34792	8 (Non-adjacent)	QPSK	1382.514	1383.166
Right	38.64744 To 39.94536	8 (Non-adjacent)	64QAM	1383.955	1383.295
99.96 MHz Carrier Spacing					
Middle	38.14956 To 38.84928	8 (adjacent)	16QAM	790.239-	790.357

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 **AWEWA/B** is thus defined as follows.

The N260 39 GHz Band can be assigned a total of 30 side by side carriers over the 37-40 GHz frequency range. The AWEWA/B can be operated anywhere within this 3 GHz wide band.

The AWEWA/B product can support up to eight carriers operating within its maximum instantaneous 1.4 GHz bandwidth. Additionally, we have evaluated carrier spacing configuration of 99.96 MHz and 99.84 MHz respectively. There was no difference identified for Power, radiated spurious or OOBE measurements with either spacing.

There is a 1% difference in the occupied signal bandwidth for eight aggregated carriers which was expected.

An example of the signal bandwidth for 4 adjacent carriers is depicted in Figure 4.3.1.1. The emissions designator for 2 thru seven is identical for either spacing. The eight carrier spacing using 99.84 MHz is 99.9% of the 99.96 spacing so a single emissions designator is appropriate.

The maximum calculated assessment for two through eight carriers using 99.96 and 99.84 channel spacings are identified below.

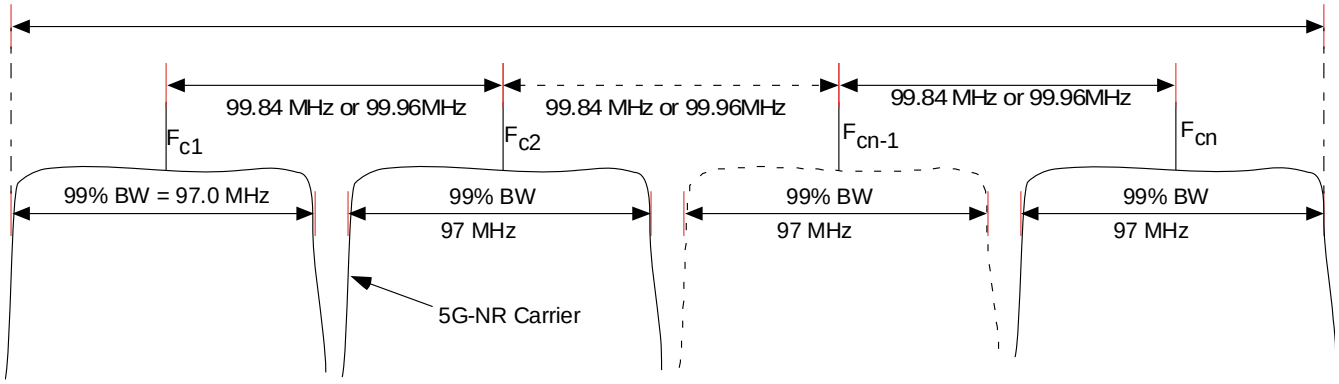
Two Carrier Aggregation Bandwidth = 1(99.96) + 97 MHz = 196.96 MHz = 197MG7W
Three Carrier Aggregation Bandwidth = 2(99.96) + 97 MHz = 296.92 MHz = 297MG7W
Four Carrier Aggregation Bandwidth = 3(99.96) + 97 MHz = 396.88 MHz = 397MG7W
Five Carrier Aggregation Bandwidth = 4(99.96) + 97 MHz = 496.84 MHz = 497MG7W
Six Carrier Aggregation Bandwidth = 5(99.96) + 97 MHz = 596.80 MHz = 597MG7W
Seven Carrier Aggregation Bandwidth = 6(99.96) + 97 MHz = 696.76 MHz = 697MG7W
Eight Carrier Aggregation Bandwidth = 7(99.96) + 97 MHz = 796.72 MHz = 797MG7W

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

Two Carrier Aggregation Bandwidth = 1(99.84) + 97 MHz = 196.84 MHz = 197MG7W
Three Carrier Aggregation Bandwidth = 2(99.84) + 97 MHz = 296.68 MHz = 297MG7W
Four Carrier Aggregation Bandwidth = 3(99.84) + 97 MHz = 396.52 MHz = 397MG7W
Five Carrier Aggregation Bandwidth = 4(99.84) + 97 MHz = 496.36 MHz = 497MG7W
Six Carrier Aggregation Bandwidth = 5(99.84) + 97 MHz = 596.20 MHz = 597MG7W
Seven Carrier Aggregation Bandwidth = 6(99.84) + 97 MHz = 696.04 MHz = 697MG7W
Eight Carrier Aggregation Bandwidth = 7(99.84) + 97 MHz = 795.88 MHz $\leq$ 797MG7W

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

Figure 4.3.1.1 Carrier Aggregation



Carrier Aggregation nx(97M0)
WSM 7-12-21

4.3.1.2 99% Signal Bandwidth Plots

1MHz RBW

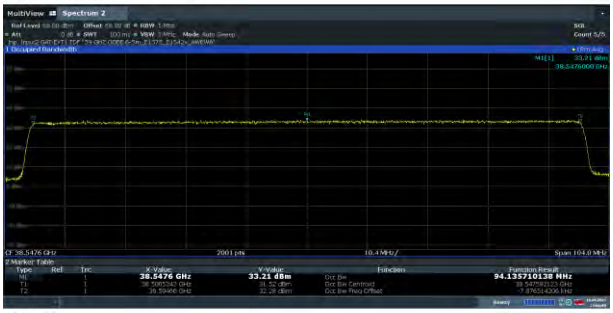
1 Carrier, Left, QPSK

Horizontal

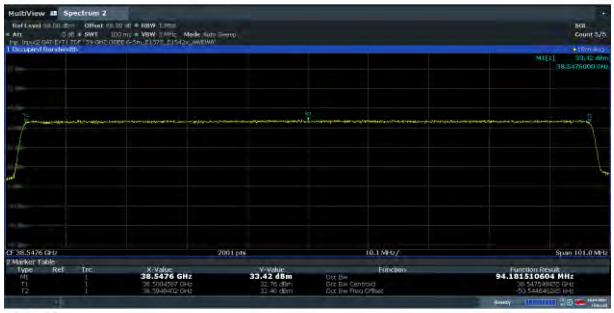
Vertical

1 Carrier, Middle, 64QAM

Horizontal

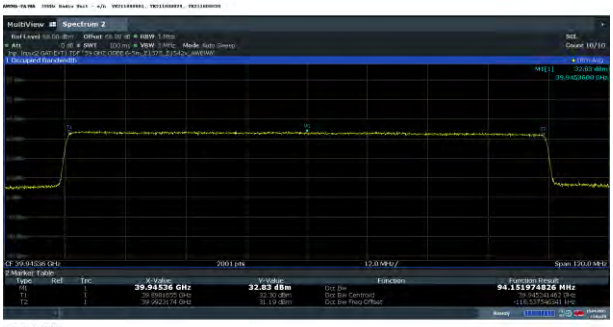


Vertical

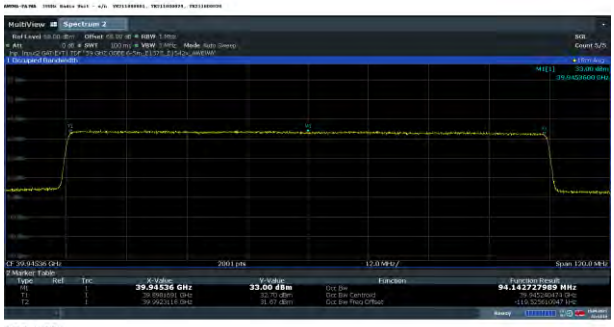


1 Carrier, Right, 16QAM

Horizontal



Vertical



2 Carrier, Left, QPSK

Horizontal

Vertical

3 Carrier, Left, QPSK

Horizontal

Vertical

4 Carrier, Left, QPSK

Horizontal

Vertical

5 Carrier, Left, QPSK

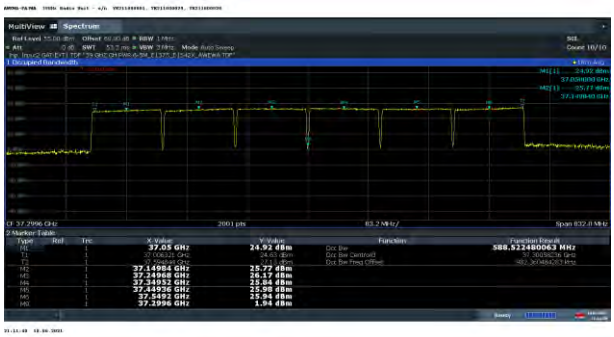
Horizontal

Vertical

6 Carrier, Left, QPSK

Horizontal

Vertical



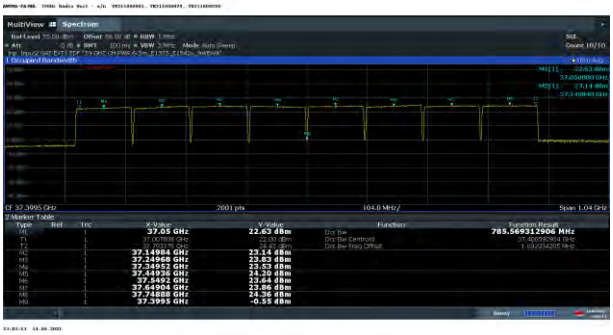
7 Carrier, Left, QPSK

Horizontal

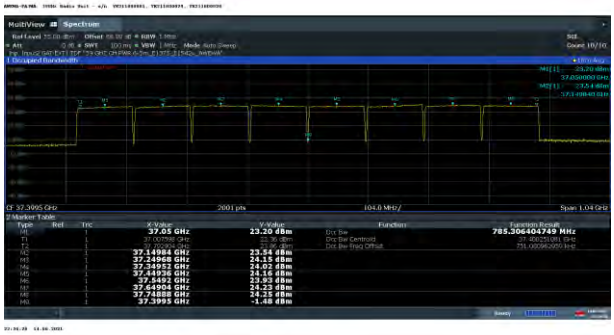
Vertical

8 Carrier Adjacent, Left, QPSK

Horizontal

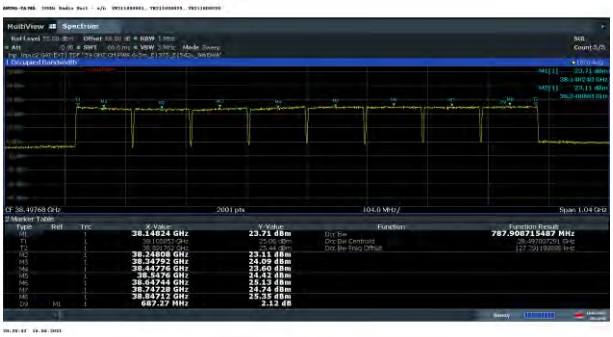


Vertical



8 Carrier Adjacent, Middle, 16QAM

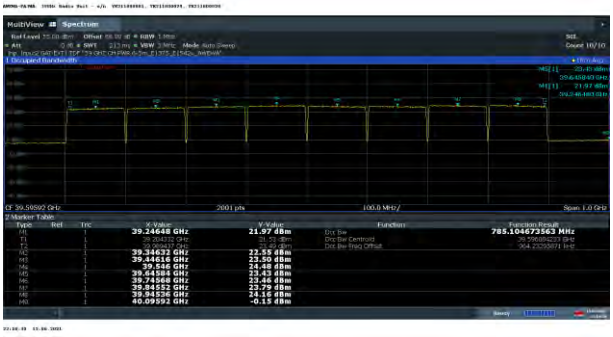
Horizontal



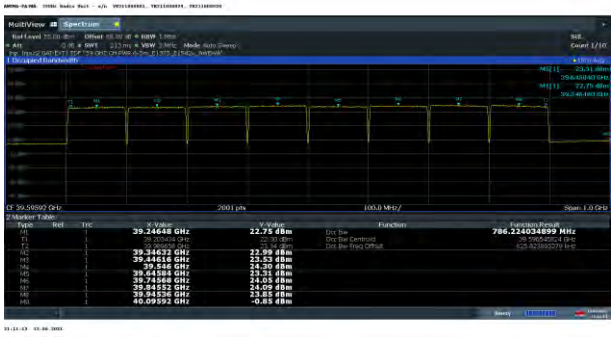
Vertical

8 Carrier Adjacent, Right, 64QAM

Horizontal



Vertical



8 Carrier Non-Adjacent, Left, QPSK

Horizontal

Vertical

8 Carrier Non-Adjacent, Right, 64QAM

Horizontal

Vertical

3MHz RBW

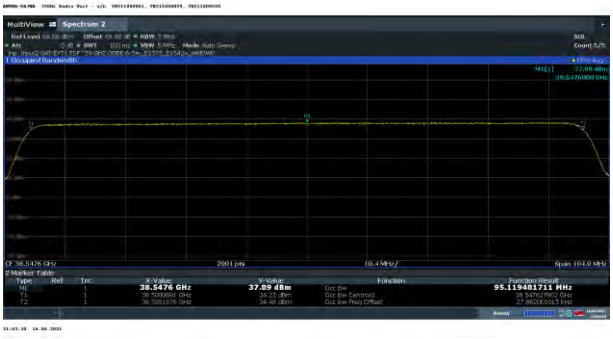
1 Carrier, Left, QPSK

Horizontal

Vertical

1 Carrier, Middle, 64QAM

Horizontal

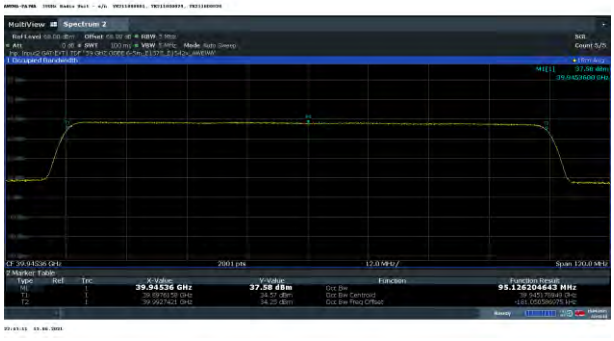


Vertical

1 Carrier, Right, 16QAM

Horizontal

Vertical



2 Carrier, Left, QPSK

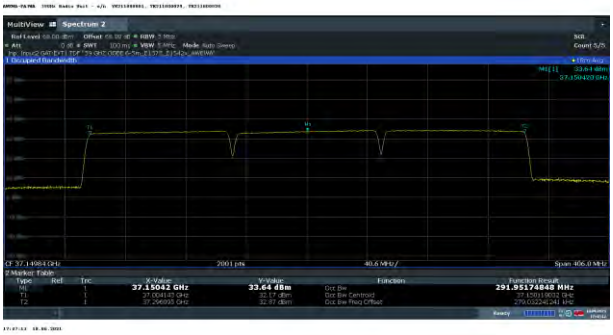
Horizontal

Vertical

3 Carrier, Left, QPSK

Horizontal

Vertical



4 Carrier, Left, QPSK

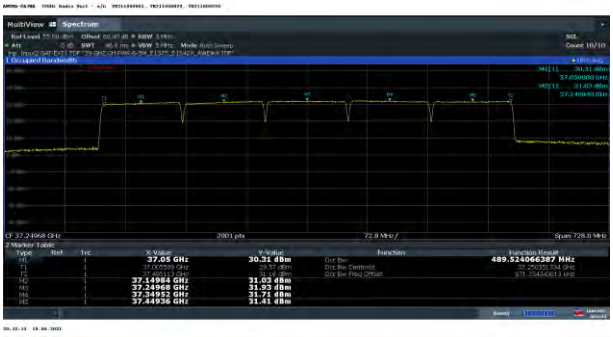
Horizontal

Vertical

5 Carrier, Left, QPSK

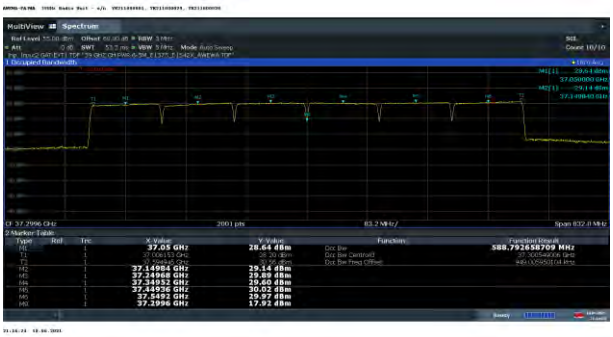
Horizontal

Vertical

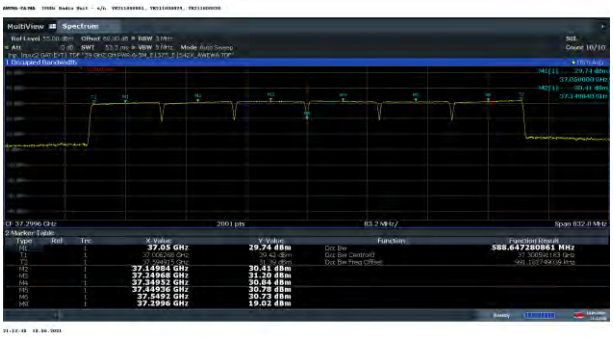


6 Carrier, Left, QPSK

Horizontal



Vertical



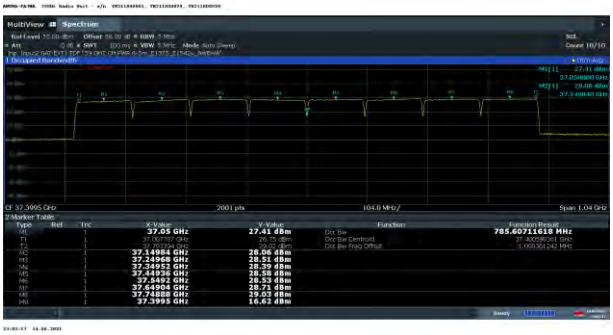
7 Carrier, Left, QPSK

Horizontal

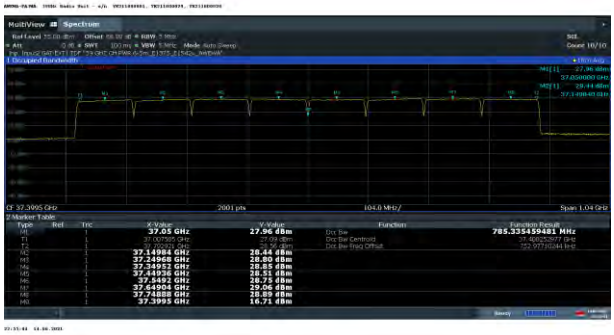
Vertical

8 Carrier Adjacent, Left, QPSK

Horizontal

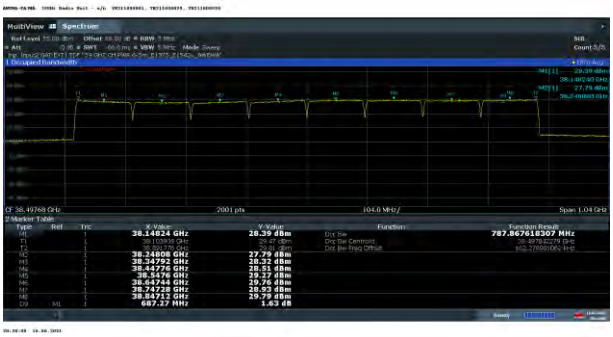


Vertical

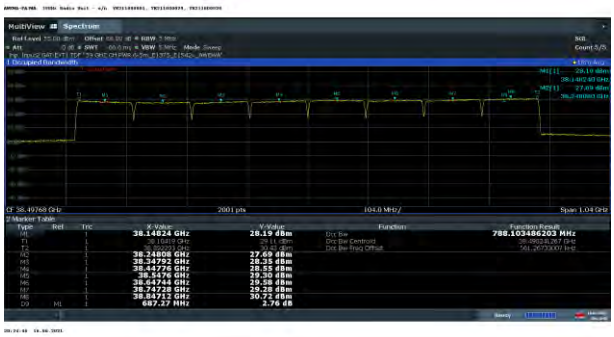


8 Carrier Adjacent, Middle, 16QAM

Horizontal

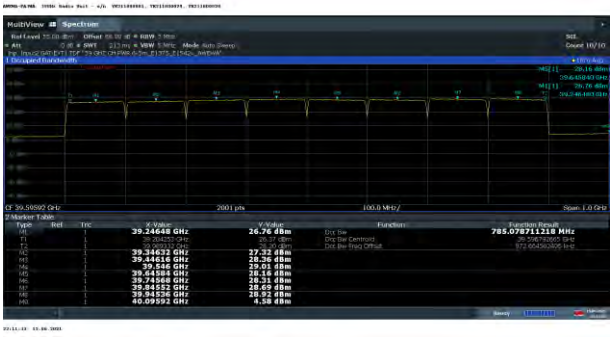


Vertical

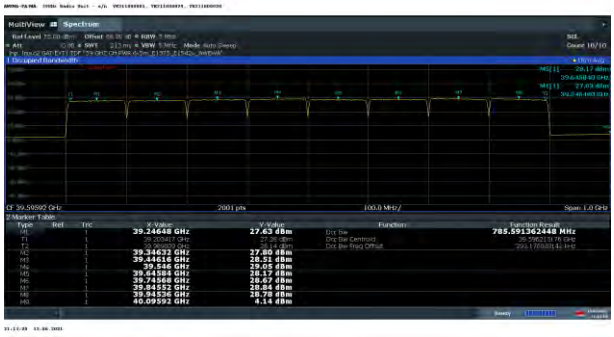


8 Carrier Adjacent, Right, 64QAM

Horizontal



Vertical



8 Carrier Non-Adjacent, Left, QPSK

Horizontal

Vertical

8 Carrier Non-Adjacent, Right, 64QAM

Horizontal

Vertical

5MHz RBW

1 Carrier, Left, QPSK

Horizontal

Vertical

1 Carrier, Middle, 64QAM

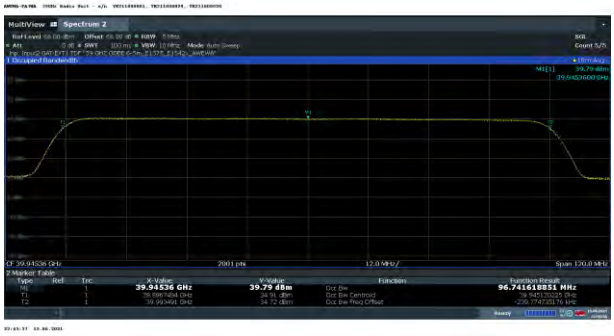
Horizontal

Vertical

1 Carrier, Right, 16QAM

Horizontal

Vertical



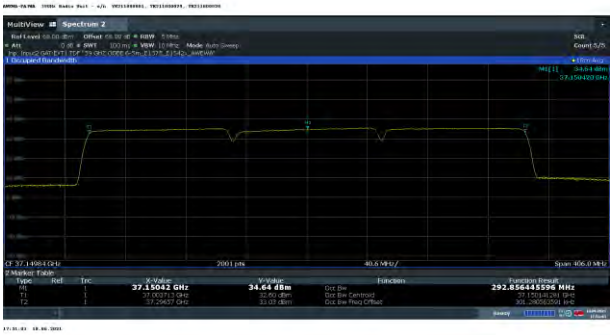
2 Carrier, Left, QPSK

Horizontal

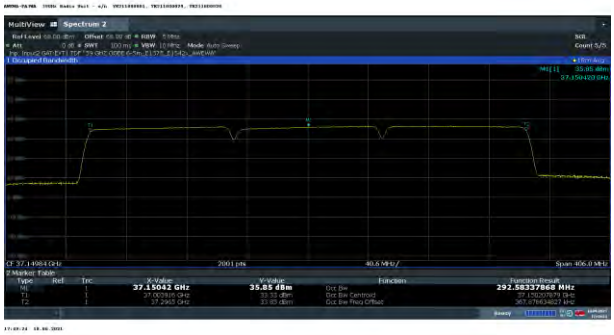
Vertical

3 Carrier, Left, QPSK

Horizontal



Vertical



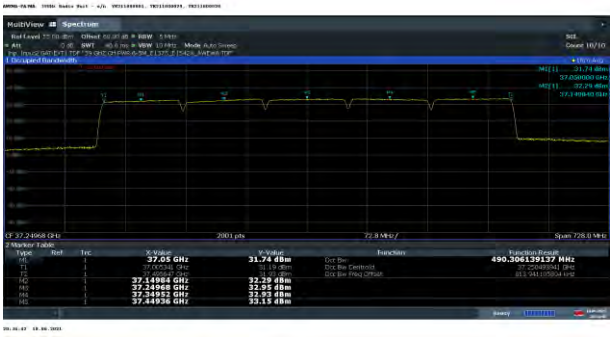
4 Carrier, Left, QPSK

Horizontal

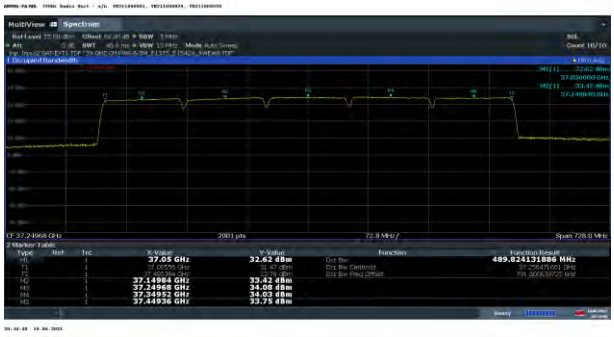
Vertical

5 Carrier, Left, QPSK

Horizontal

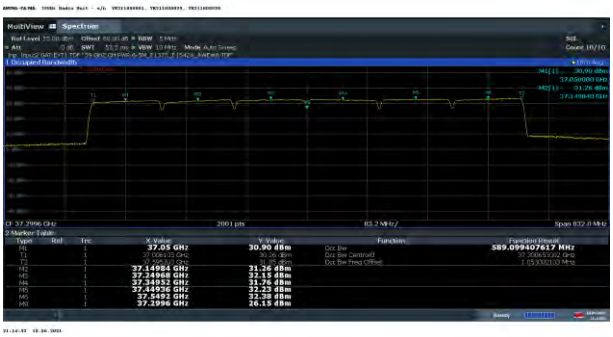


Vertical

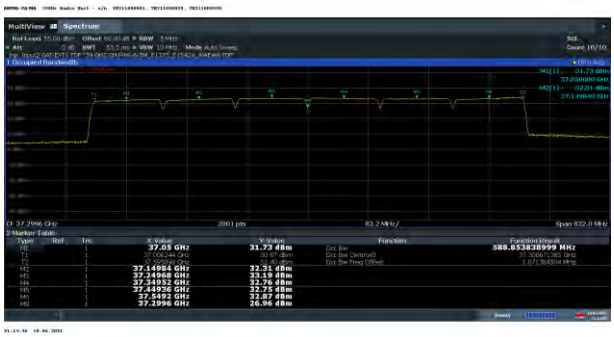


6 Carrier, Left, QPSK

Horizontal



Vertical



7 Carrier, Left, QPSK

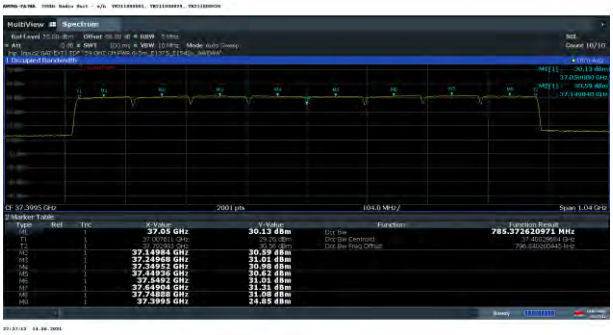
Horizontal

Vertical

8 Carrier Adjacent, Left, QPSK

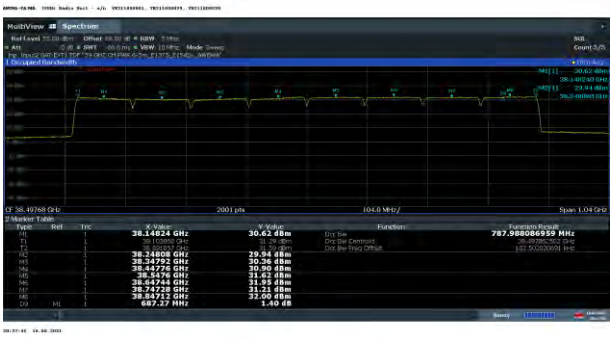
Horizontal

Vertical

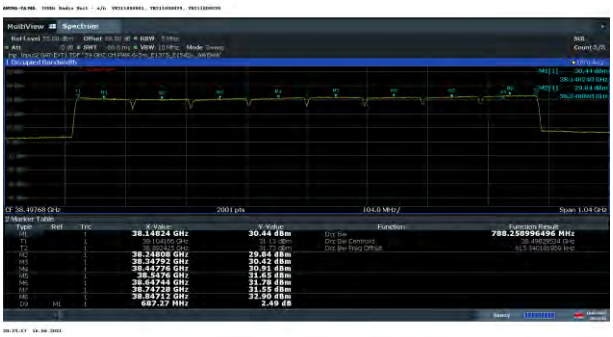


8 Carrier Adjacent, Middle, 16QAM

Horizontal

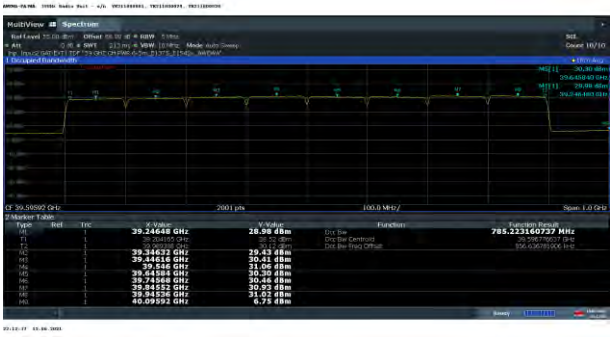


Vertical

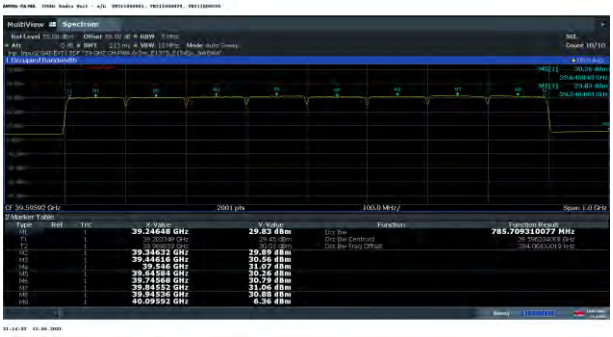


8 Carrier Adjacent, Right, 64QAM

Horizontal



Vertical



8 Carrier Non-Adjacent, Left, QPSK

Horizontal

Vertical

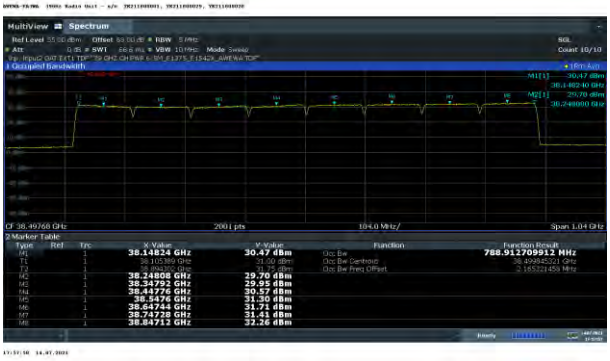
8 Carrier Non-Adjacent, Right, 64QAM

Horizontal

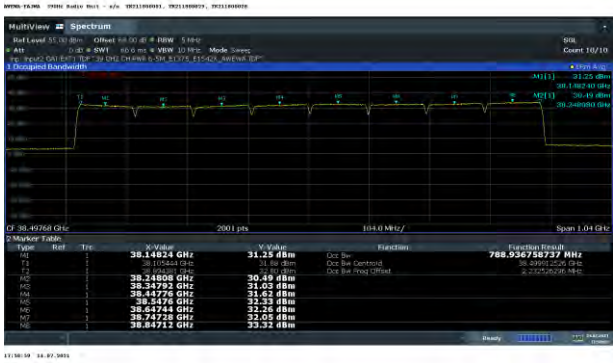
Vertical

8 Carrier Adjacent, Middle, 16QAM with 99.96 MHz channel spacing

Horizontal



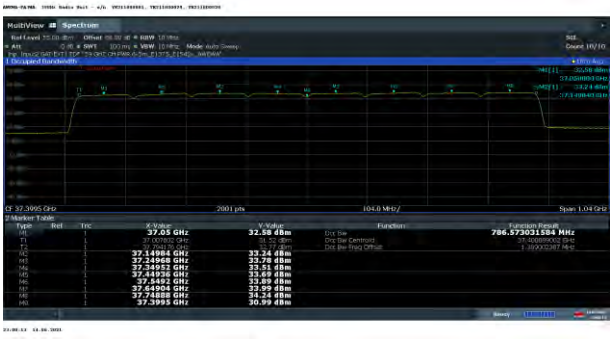
Vertical



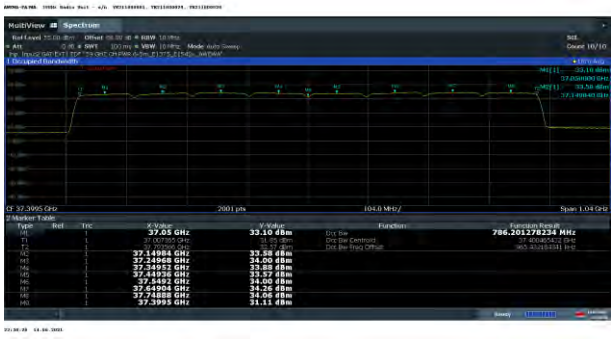
10MHz RBW

8 Carrier Adjacent, Left, QPSK

Horizontal



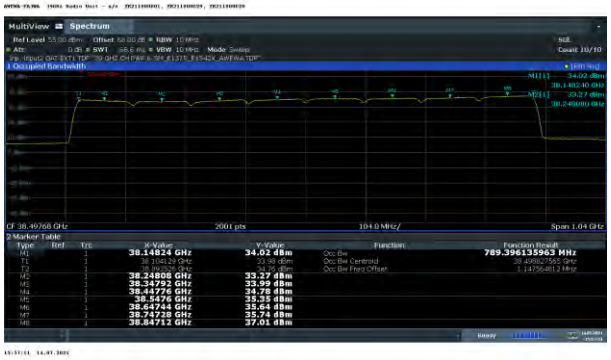
Vertical



8 Carrier Adjacent, Middle, 16QAM

Horizontal

Vertical



8 Carrier Adjacent, Right, 64QAM

Horizontal

Vertical

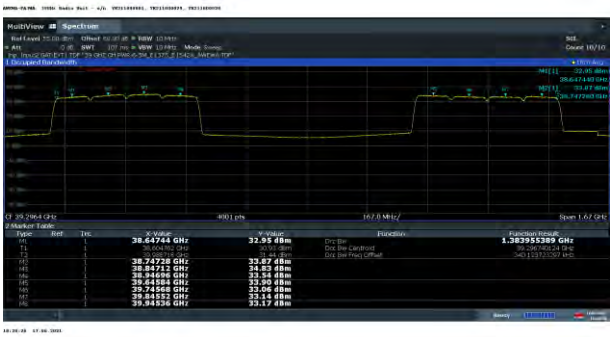
8 Carrier Non-Adjacent, Left, QPSK

Horizontal

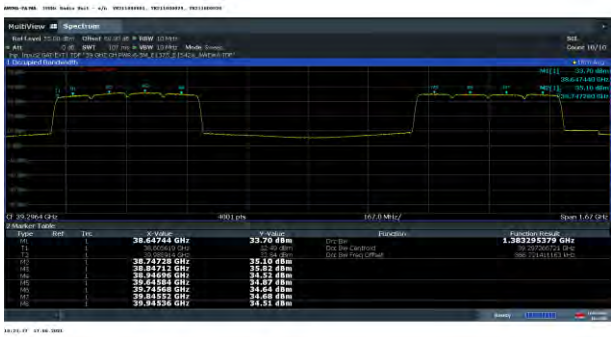
Vertical

8 Carrier Non-Adjacent, Right, 64QAM

Horizontal

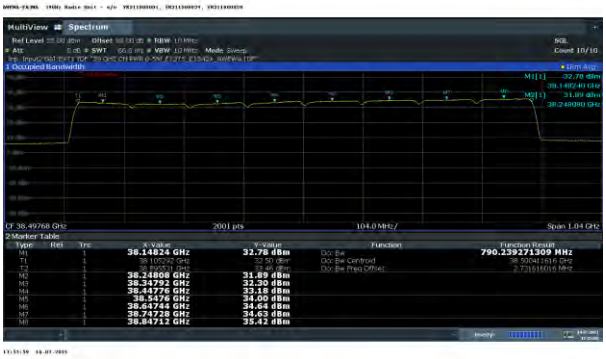


Vertical

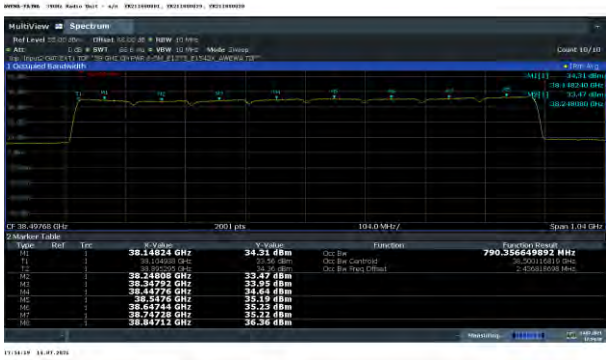


8 Carrier Adjacent, Middle, 16QAM with 99.96 MHz channel spacing

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 **2AD8UAWEWAB01 AWEWA/B 5G AirScale 39 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 eight carriers.

The OOBE evaluation is used to measure the maximum average spurious levels outside the transmit band as measured at the 6.5m boundary distance. The measurements were performed for one carrier which is the maximum spectral density carrier at the left, center and right side of band, two thru eight carriers at the left side of band and eight carriers at the left, center and right side of band. Additionally, the eight carrier non adjacent configurations spaced across the maximum instantaneous bandwidth of 1.4 GHz were evaluated at left side and right side of the band.

For each configuration channel power and modulation were verified prior to other measurements. The measurement process meets the requirements of ANSI C63.26 and ISO17025. The test setup was as shown in Figure 4.1.1. Measurements were performed in the far field at 6.5m for both vertical and horizontal polarizations.

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

These sheets contain data for multiple mixed carrier configurations for Left Edge, Center and Right Edge of the 39 GHz Part 30 Upper Microwave Flexible Use Service spectrum.

4.3.3 Requirements 39 GHz Emissions Limits

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

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

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

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

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

In order to address the limit as imposed for the requirement in 47CFR 96.41 we evaluated emissions per the requirements in ANSI C63.26 and per KDB 940660 D01 Part 30 CBRS Equipment.

The average detector function was used for all MXA measurements and the Peak detector function were used for EMC receiver measurements.

4.3.4 Measurement Offset and MIMO

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

4.3.5 Mask Parameters

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

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

Frequency	Part 30 Limit
GHz	dBm
35.00	-13
36.00	-13
36.92	-13
36.92	-5
37.00	-5
37.00	57
40.00	57
40.00	-5
40.08	-5
40.08	-13
43.00	-13

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 35 GHz;

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

Total Required Adjustment (@35 GHz) **=** 50.32 dB = 79.58 dB -23.96dBi + 12.84dB – 18.14 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 AWEUA product gain. The measurements were made using a flat offset of 44 dB with a transducer correction identified below.

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

Frequency	Free Space Path Loss, PL	Measurement Antenna Gain, "G"	Measurement Cable Loss, "L"	PL-G1+L1	AEWF Antenna Gain, IEEE	Total Required Adjustment	FSW Offset	Transducer Correction Factor
GHz	dB	dBi	dB	dB	dBi	dB	dB	dB
35.00	79.58	23.96	12.84	68.46	18.14	50.32	44	6.324
35.50	79.70	23.52	13.03	69.21	20.05	49.16	44	5.162
36.00	79.83	24.27	13.20	68.75	21.97	46.78	44	2.784
36.50	79.95	23.28	13.35	70.01	22.81	47.20	44	3.203
37.00	80.06	24.42	13.39	69.04	23.65	45.39	44	1.387
37.50	80.18	23.27	13.39	70.29	23.82	46.47	44	2.469
38.00	80.30	24.29	13.45	69.45	23.99	45.46	44	1.461
38.50	80.41	23.18	13.54	70.76	24.11	46.65	44	2.653
39.00	80.52	23.65	13.73	70.60	24.22	46.38	44	2.382
39.50	80.63	23.03	13.76	71.36	24.10	47.26	44	3.256
40.00	80.74	23.00	13.79	71.53	23.98	47.55	44	3.547
40.50	80.85	23.35	13.84	71.34	23.91	47.43	44	3.433
41.00	80.96	23.22	13.98	71.72	23.84	47.88	44	3.880
41.50	81.06	23.28	14.14	71.93	23.20	48.73	44	4.731
42.00	81.17	23.39	14.23	72.01	22.56	49.46	44	5.459
42.50	81.27	23.81	14.36	71.81	21.52	50.29	44	6.290
43.00	81.37	23.55	15.30	73.11	20.49	52.62	44	8.620
43.50	81.47	23.60	16.14	74.01	18.55	55.46	44	11.462

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 in compliance with the procedure and requirements of ANSI C63.26. The test set-up diagram in Figure 4.1.1 was used. Testing was performed for the 100 MHz carrier configurations at the left side, and right side of the Part 30 Band. All of the Edge of Band measurements were performed at the specified 1 MHz resolution bandwidths. Adjustment factors were as described in Section 4.3.6 above.

4.3.7.1 Initial Results - Edge of Band Measurements

The initial Occupied Bandwidth and Edge-of-Band emissions measurements identified a single significant Out Of Band Emissions (OOBE). This emission was identified as a single LO narrowband spurious signal at 40.6489 GHz. Multiple transmit configurations were evaluated to determine the worst case operating configuration for generating the maximum spurious signal at 40.6489 GHz. Multiple scans confirmed that the maximum signal was generated by a single full power QPSK carrier at the Left side of the band.

The OOBE measurements determined that the 40.6489 GHz signal maximum value was 8.39 dBm when not adjusted for the AWEUA's Transmit Antenna gain. Per KDB 842590 D01 guidance these emissions needed to be evaluated using the Total Radiated Power methodology.

4.3.8 Total Radiated Power Evaluation of Out Of Band Emissions

Per KDB 842590 D01 the use of product array gain to reference the radiated spurious to the conducted transmit signal is not valid at greater than 10% of signal bandwidth outside the band. For reference, if the gain was allowable for the 40.6489 GHz spur it would result in a final value of -15.52 dBm which is 2.52 dB of margin to the limit. Without the consideration for transmit antenna gain the OOBE measurements determined that the 40.6489 GHz signals maximum value was 8.39 dBm and needed to be evaluated for Total Radiated Power.

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

Two Cut and Three cut TRP evaluations were performed at a measurement distance of 4m per KDB 842590 D01. We used our ISO 17025 accredited Radiated Emissions measurement process software with updated software drivers for control of the FSW85 analyzer and modifications for data export. Measurements were performed every 4 degrees. For cuts one and two the maximum beam height was180 cm. For Cut 3 the height was 170 cm. The first cut was performed with the receive antenna Vertically polarized and the second cut was performed with the receive antenna Horizontally polarized. The product under test has two arrays (H&V) which are at the same height and their peak beam is also at the same height but about 1 degrees apart in azimuth. There was no attempt to duplicate the data cuts as it would not result in any change in average value. The sweeps were performed with the following settings as follows:

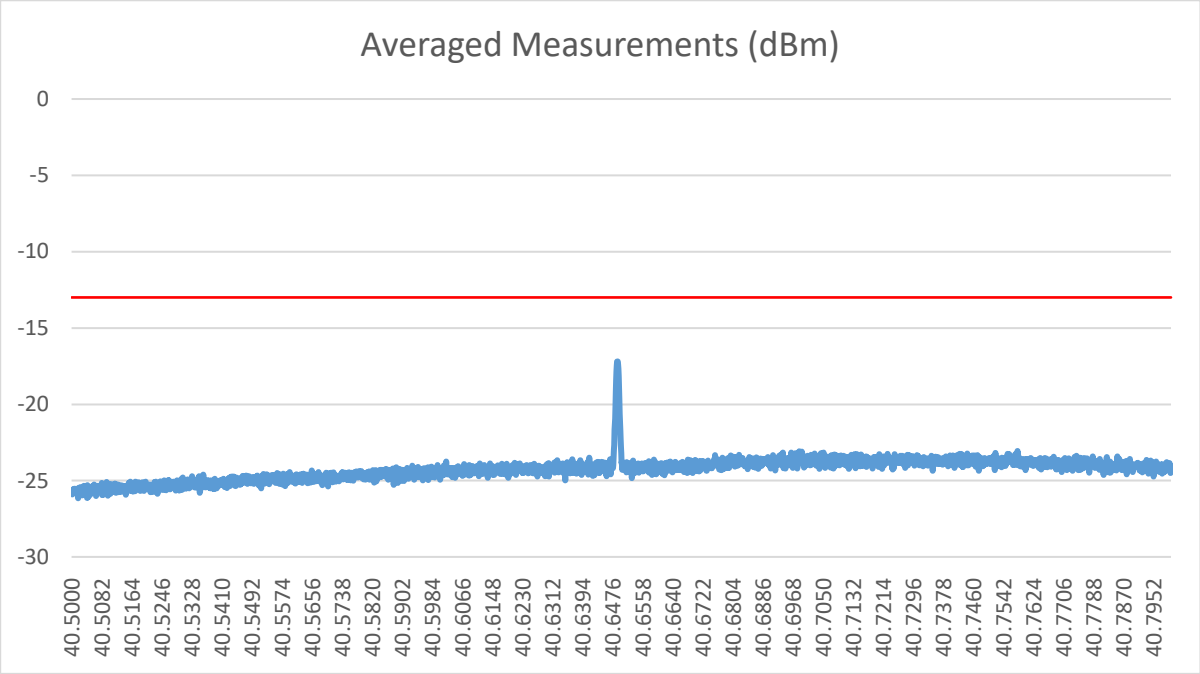
	Spur #1
Frequency range:	40.5 GHz to 40.8 GHz
Resolution Bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector:	RMS
Trace averaging Factor	120
Number of points	3001
Turntable step size	4 degrees
Three cut correction factor	1.5 dB

4.3.8.1 Total Radiated Power Results

The net result for the Spur was a maximum corrected TRP value of -17.654 dBm at 40.6492 GHz. Which demonstrates 4.654 dB margin to the -13 dBm limit. This emission is reportable.

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

TRP Data Plot for 40.5-40.8 GHz



4.3.8.2 Out Of Band Emissions Results

The Out Of Band Emissions plots for the tested configurations of one through eight carriers operation are below. These Occupied Bandwidth and Edge-of-Band emissions measurements were made as a radiated measurement at the verified far field measurement distance of 6.5m. The plots show compliance to the Part 30 FCC limit for the n260 Band for all signals except the single narrowband local oscillator spurious at 40.6489 GHz. This spur was evaluated for compliance using the three cut TRP method and found to be compliant.
The out-of-band emissions plots attached below document that all the emissions are compliant.

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

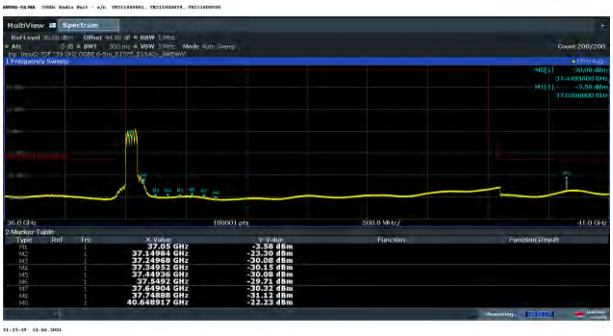
Table 4.3.7.1 Results - Occupied Bandwidth-Edge of Block Emissions/ OOBE

Center Frequencies of Edge Channels, GHz	Location	Number of Carriers	Modulation	Polarization	Occupied Bandwidth Edge of Block / OOBE Compliance
37.05	Left Side of Lower Band	1	QPSK	Horizontal	Compliant
				Vertical	Compliant
38.14824	Middle of Overall Band	1	64QAM	Horizontal	Compliant
				Vertical	Compliant
39.24648	Right Side of Upper Band	1	16QAM	Horizontal	Compliant
				Vertical	Compliant
37.05 37.14984	Left Side of Band	2 adjacent	QPSK	Horizontal	Compliant
				Vertical	Compliant
37.05 37.24968	Left Side of Band	3 adjacent	QPSK	Horizontal	Compliant
				Vertical	Compliant
37.05 38.34792	Left side + Middle of Band	2 adjacent + 1 non-adjacent	QPSK	Horizontal	Compliant
				Vertical	Compliant
37.05 37.34952	Left Side of Band	4 adjacent	QPSK	Horizontal	Compliant
				Vertical	Compliant
37.05 37.44936	Left Side of Band	5 adjacent	QPSK	Horizontal	Compliant
				Vertical	Compliant
37.05 37.5492	Left Side of Band	6 adjacent	QPSK	Horizontal	Compliant
				Vertical	Compliant
37.05 37.5492	Left Side of Band (Entire Lower Band)	7 adjacent	QPSK	Horizontal	Compliant
				Vertical	Compliant
37.05 37.74888	Left Side of Lower Band	8 adjacent	QPSK	Horizontal	Compliant
				Vertical	Compliant
38.14824 38.84712	Middle of Overall Band	8 adjacent	16QAM	Horizontal	Compliant
				Vertical	Compliant
39.24648 39.94536	Right Side of Upper Band	8 adjacent	64QAM	Horizontal	Compliant
				Vertical	Compliant
37.05 38.34792	Left Side + Middle	4 adjacent + 4 adjacent	QPSK	Horizontal	Compliant
				Vertical	Compliant
38.64744 39.94536	Middle + Right Side	4 adjacent + 4 adjacent	64QAM	Horizontal	Compliant
				Vertical	Compliant

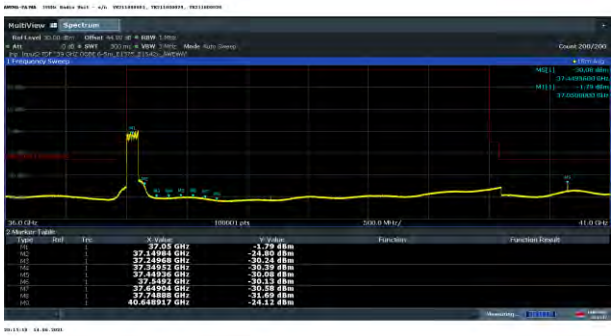
4.3.8.2.1 Occupied Bandwidth Edge of Band Plots

1 Carrier – QPSK / Left

OOBE/EoB – Horizontal Polarization



OOBE/EoB – Vertical Polarization



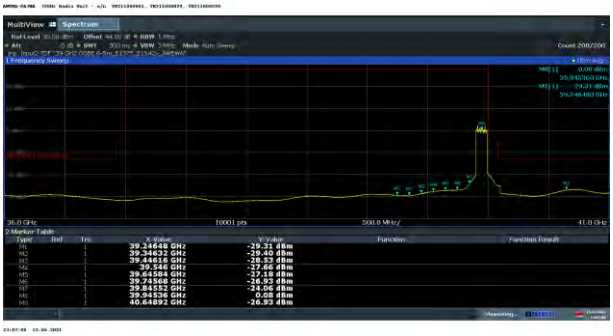
1 Carrier – 64QAM / Middle

OOBE/EoB – Horizontal Polarization

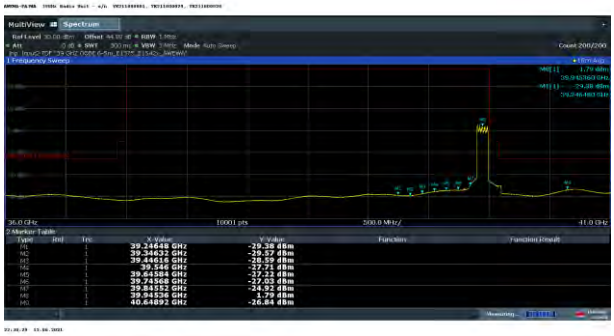
OOBE/EoB – Vertical Polarization

1 Carrier – 16QAM / Right

OOBE/EoB – Horizontal Polarization

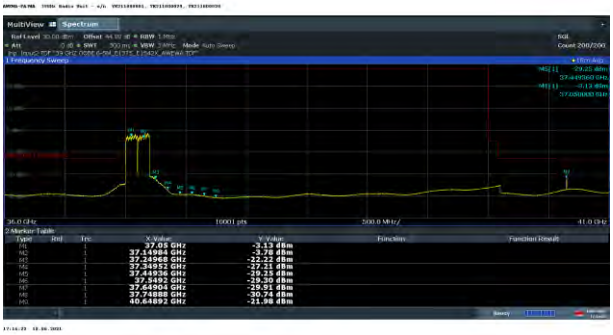


OOBE/EoB – Vertical Polarization

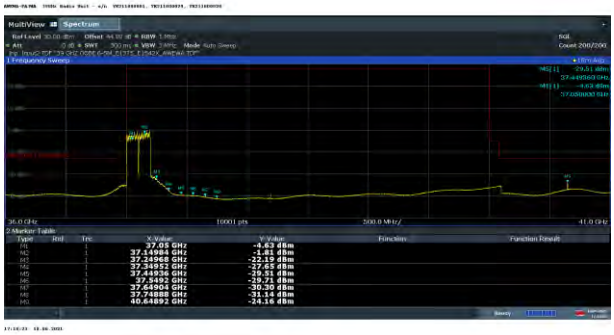


2 Carrier – QPSK / Left

OOBE/EoB – Horizontal Polarization

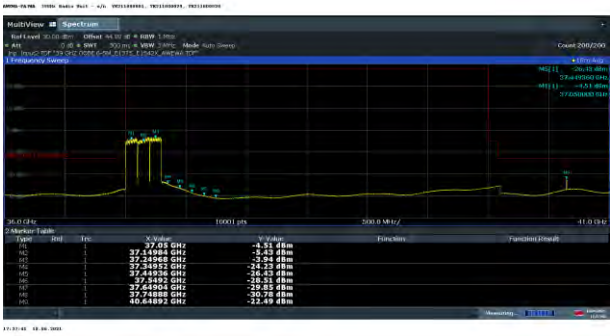


OOBE/EoB – Vertical Polarization

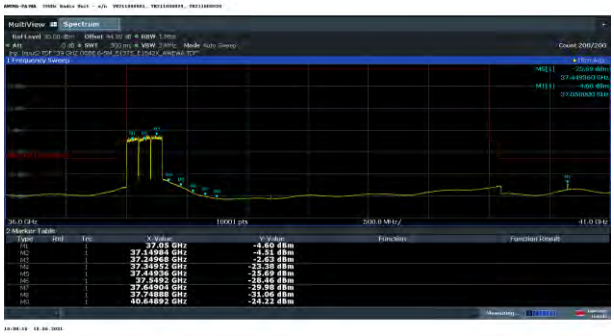


3 Carrier – QPSK / Left

OOBE/EoB – Horizontal Polarization



OOBE/EoB – Vertical Polarization



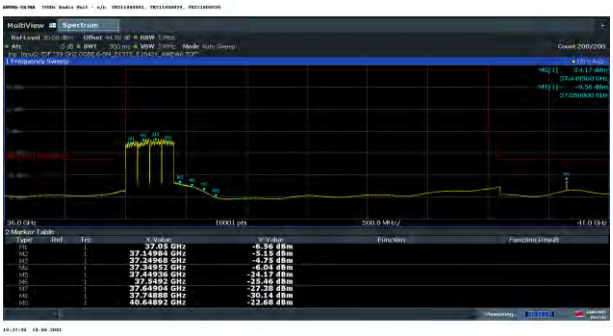
3 Carrier (non-adjacent)– QPSK / Left + Middle

OOBE/EoB – Horizontal Polarization

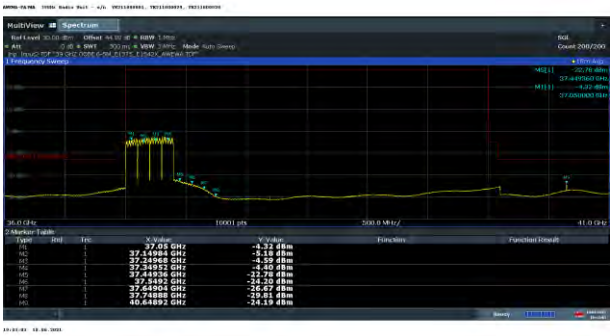
OOBE/EoB – Vertical Polarization

4 Carrier – QPSK / Left

OOBE/EoB – Horizontal Polarization

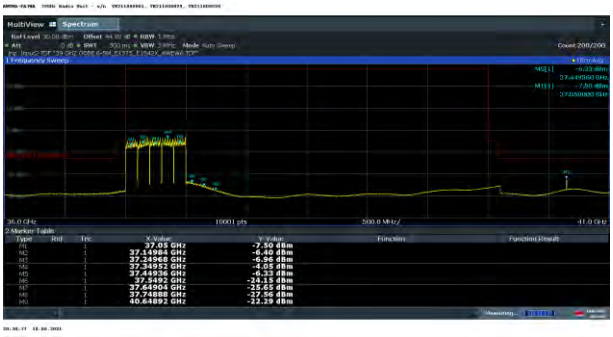


OOBE/EoB – Vertical Polarization

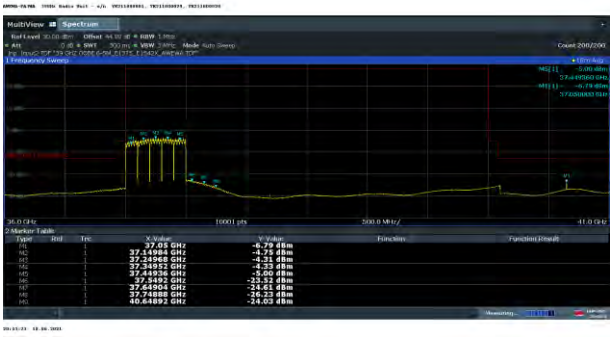


5 Carrier – QPSK / Left

OOBE/EoB – Horizontal Polarization

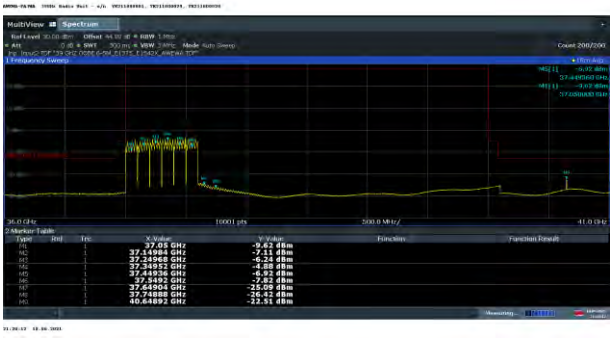


OOBE/EoB – Vertical Polarization

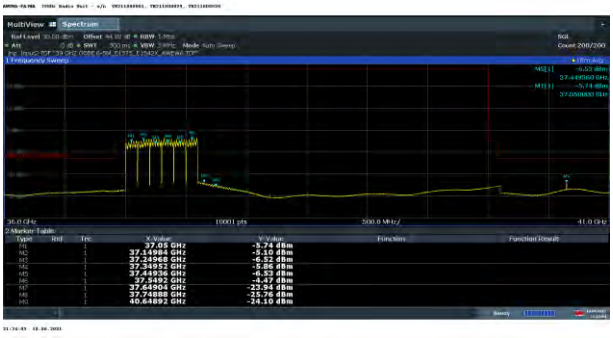


6 Carrier – QPSK / Left

OOBE/EoB – Horizontal Polarization

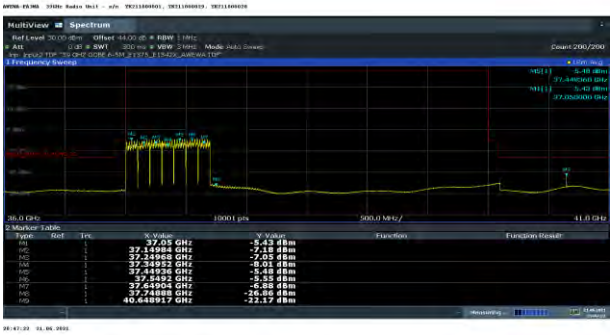


OOBE/EoB – Vertical Polarization



7 Carrier – QPSK / Left

OOBE/EoB – Horizontal Polarization



OOBE/EoB – Vertical Polarization

8 Carrier (non-adjacent) – QPSK / Left + Middle

OOBE/EoB – Horizontal Polarization

OOBE/EoB – Vertical Polarization

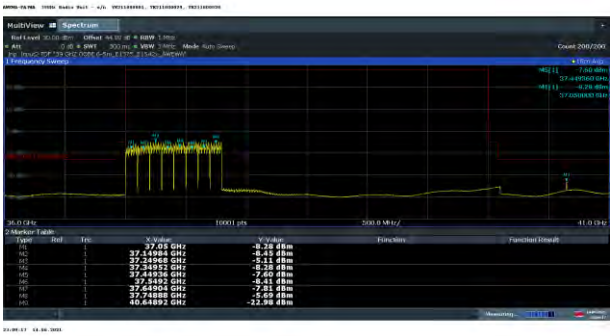
8 Carrier (non-adjacent) – 64QAM / Middle + Right

OOBE/EoB – Horizontal Polarization

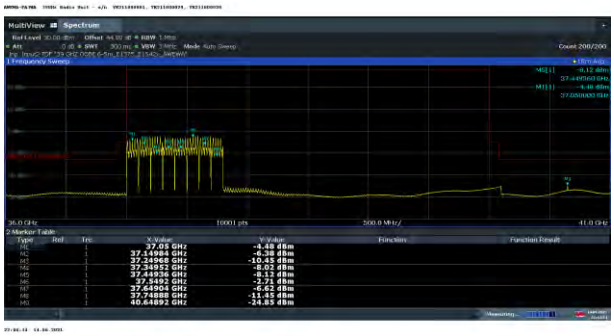
OOBE/EoB – Vertical Polarization

8 Carrier – QPSK / Left

OOBE/EoB – Horizontal Polarization



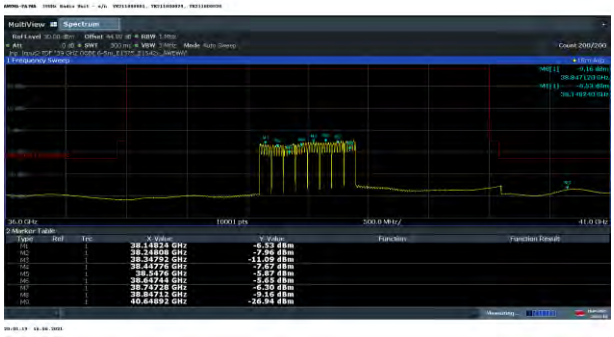
OOBE/EoB – Vertical Polarization



8 Carrier – 16QAM / Middle

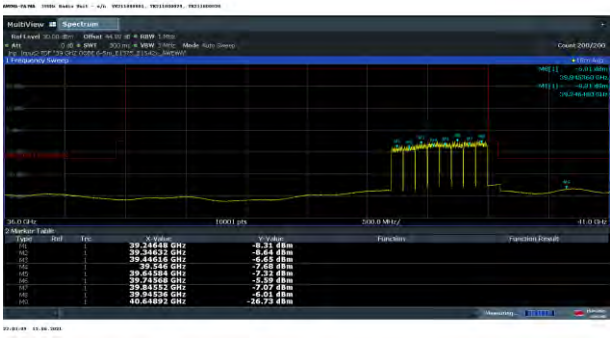
OOBE/EoB – Horizontal Polarization

OOBE/EoB – Vertical Polarization

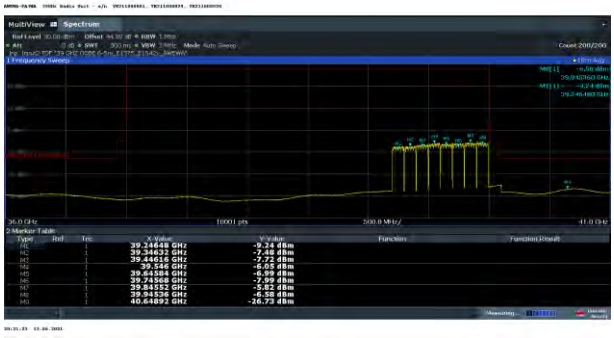


8 Carrier – 64QAM / Right

OOBE/EoB – Horizontal Polarization



OOBE/EoB – Vertical Polarization



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

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

4.4.1 Section 2.1051 Spurious Emissions at Antenna Terminals

Spurious Emissions were investigated per 47CFR Section 2.1057(a)(1) over the frequency range of 30 MHz to 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) (a) The conductive power or the total radiated power of any emission outside a licensee's frequency block shall be -13 dBm/MHz or lower. However, in the bands immediately outside and adjacent to the licensee's frequency block, having a bandwidth equal to 10 percent of the channel bandwidth, the conductive power or the total radiated power of any emission shall be -5 dBm/MHz or lower.

4.4.3 Results

Since there is no antenna terminal, all measurements were performed as radiated measurements and standard radiated emissions. The Edge of Band emissions, presented in Section 4.3.7 and the Total Radiated Power (TRP) evaluation in 4.3.8 document the OOBE compliance for the 36-41 GHz frequency range which is around the Transmit ranges of 37 - 40 GHz. Those measurements are appropriate as the products antenna gain is documented over the same ranges. There was one significant emission detected and was shown to be compliant in Section 4.3.8.1. There were no other emissions detected in these ranges within 20 dB of the limit.

The standard radiated emissions are documented in Section 4.5 "*Section 2.1053 Measurement Required: Field Strength of Spurious Radiation*". The test configuration is shown in Figure 4.4.1 documents the test set up used for the measurements. Measurements in Section 4.5

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 were used to provide measurement capability from 40 GHz to 220 GHz range.

4.5 Section 2.1053 MEASUREMENT REQUIRED: FIELD STRENGTH OF SPURIOUS RADIATION

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

The **2AD8UAWEWAB01** (EUT) was configured in semi-anechoic chamber AR-8 in a manner simulating a normal field installation. The product's field installation hardware was used to mount the Base Unit and Two Extension Modules to a wooden pole with the bottom of the product 1.5m above the turntable ground plane. The recommendations of ANSI C63.4–2014, C63.26-2015, KDB 842590 D01 and C63.26 mmWave JTG were followed for EUT testing setup and cabling. The EUT was configured to operate in a 5G-NR test model per the constraints identified in section 4.2. A photograph of this setup is in Exhibit 12 of the filing package.

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

Table 4.5.1 EUT Transmit Configuration

Test Configuration NRARFCN	AWEWA/B Tx Frequencies GHz	Transmit Active Polarization	Signal Bandwidth, MHz	Modulation	Total Power, dBm EIRP	Radiated Emissions Pass / Fail
2229999	37.05000	H & V	100	QPSK	55	Pass
2266607 2268271 2269935 2271599 2273263 2274927 2276591 2278255	39.24648 39.34632 39.44616 39.54600 39.64584 39.74568 39.84552 39.94536	H & V	100	64QAM	55	Pass

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

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

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:

$$\text{Pmeas (dBm)} + \text{Cable Loss(dB)} + \text{Antenna Factor(dB)} + 107\ (\text{dB}\mu\text{V/dBm}) - \text{Amplifier Gain (dB)} = \text{Field Strength (dB}\mu\text{V/m)}$$

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

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

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

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

The field strength of radiated spurious emissions measured was determined by

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

Field strength measurements of radiated spurious emissions were made in the 5m semi-anechoic chamber, AR-4 as detailed above. The recommendations of ANSI C63.4 and ANSI C63.26 were followed for EUT testing setup, cabling, and measurement approach and procedures. All the measurement equipment used, including antennas, was calibrated in accordance with ISO 9001 process. The EUT setup diagram is given in the Figure 4.5. The minimum margins to the Part 30.203 limit is as measured in accordance with 2.1053. The test data follows.

4.5.2 Radiated Spurious Emissions Measurements: 40 GHz - 100 GHz

The radiated spurious emissions spectrum was investigated per 47CFR Section 2.1057(a)(1) for spurious emissions over the frequency range of 40 GHz to 200 GHz. The procedure and methodology followed the recommendations of ANSI C63.4–2014, C63.26-2015 and C63.26 mmWave JTG.

A Rohde & Schwarz FSW 67 was employed with external three port Harmonic Down Converters (HDC). The waveguide RF input converters provided coverage for 40-60 GHz (U), 60-90 GHz (E), 90-140 GHz (F) and 140-220 GHz (G) bands. The HDC's were paired with 25 dB Standard Gain Horns. A 40 GHz waveguide high pass filter was utilized to limit the transmit carrier emissions from overloading the 40-60 GHz HDC.

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

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

Measurements were performed at the following distances:

mmWave Band	Frequency Range, GHz	Measurement distance meters
U	40-60	4
E	60-90	4
F	90-140	3
G	140-220	3

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

Based upon previous experience a continuous max hold (average detector) sweep of the product in elevation and azimuth was employed for full coverage scanning of the product. For these measurements in each band the scan was started at the beam peak location of 21 degrees azimuth, and a nominal elevations 172 cm for Vertical and Horizontal. The peak was first located for the most prominent emissions in the span. The elevation was then swept down to 1m and back up back to 3m and returned to the beam peak. The product was then rotated continuously to 360 degrees back to 0 degrees and back to 21 degrees. This method locates any emission and provides the maximum emissions but required operation without the analyzer internal noise reduction function. Peaks were noted using the marker function which were later formally measured with the required 1 MHz resolution bandwidth. Measurements for 40-200 GHz were performed this way for the 1 carrier and the 8 carrier transmit configurations.

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

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

4.5.2.2 Resolution Bandwidth and # of Points:

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

Final measurements were performed so that the resolution bandwidth and span limitations of ANSI C63.26 were followed so that the number of measurement points > 2(Span/RBW).
Our FSW 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 Corrections

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

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

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

Table 4.5.2.4 details the correction for the three bands.

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

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

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

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

Table 4.5.2.4c Radiated Emissions Corrections for 90-100GHz 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
130.0	0.0023	3	84.26	24.18	1.03	61.113
135.0	0.0022	3	84.59	24.35	1.03	61.271
140.0	0.0021	3	84.91	24.50	1.03	61.437

Table 4.5.2.4d Radiated Emissions Corrections for 140-200GHz at 3m.

Frequency	λ	Measurement Distance, d	Path Loss	Rx Antenna Gain	Total	Offset	Transducer Factor
GHz	m	m	dB	dB	dB	dB	dB
140.0	0.002143	3	84.91	23.40	61.51	62.07	-0.56
145.0	0.002069	3	85.21	23.65	61.56	62.07	-0.51
150.0	0.002000	3	85.51	23.90	61.61	62.07	-0.46
155.0	0.001935	3	85.79	24.15	61.64	62.07	-0.43
160.0	0.001875	3	86.07	24.30	61.77	62.07	-0.30
165.0	0.001818	3	86.33	24.55	61.78	62.07	-0.29
170.0	0.001765	3	86.59	24.70	61.89	62.07	-0.18
175.0	0.001714	3	86.84	24.95	61.89	62.07	-0.18
180.0	0.001667	3	87.09	25.10	61.99	62.07	-0.08
185.0	0.001622	3	87.33	25.25	62.08	62.07	0.01
190.0	0.001579	3	87.56	25.40	62.16	62.07	0.09
195.0	0.001538	3	87.78	25.55	62.23	62.07	0.16
200.0	0.001500	3	88.00	25.70	62.30	62.07	0.23

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.

There was a single reportable emission at 40.6489 GHz. This signal was addressed in section 4.3.7 and 4.3.8. This signal also was compliant during normal radiated emissions testing. The TRP measured spurious signal level of -17.654 dBm at 40.6492 GHz demonstrates a 4.654 dB margin to the -13 dBm limit.

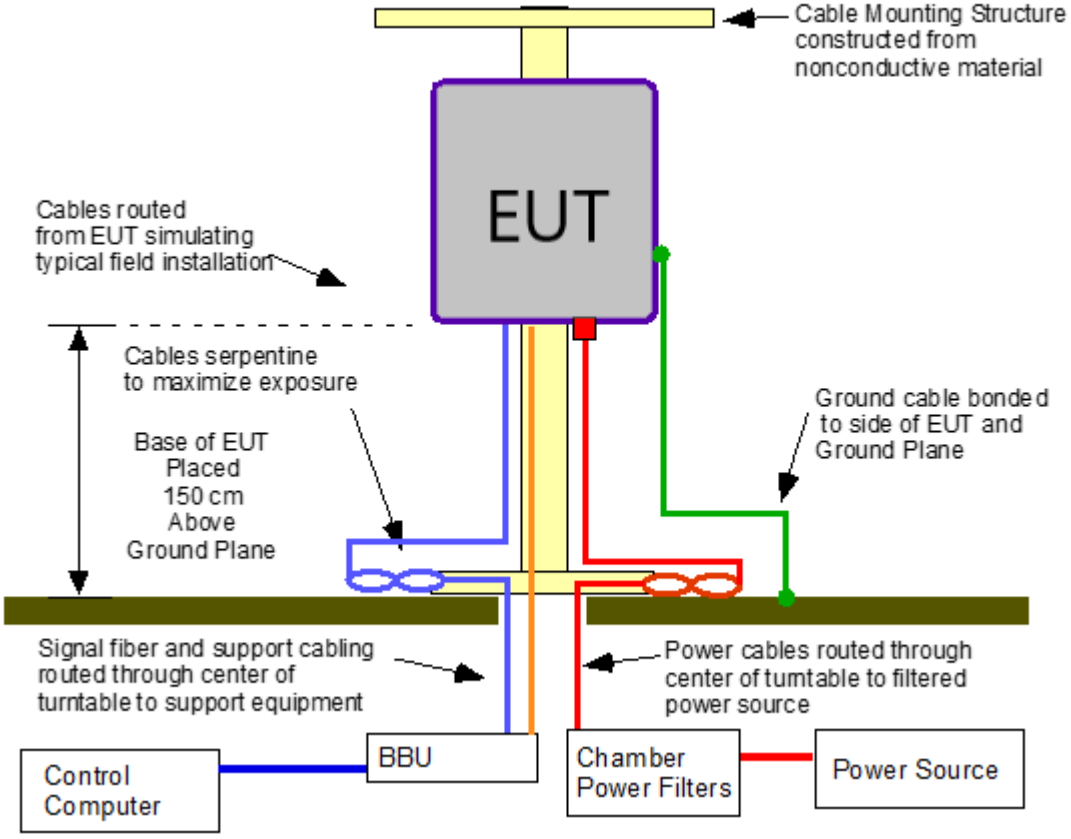
All other emissions below 40 GHz were below the Part 15 Class B limit.

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

Over the out of band spectrum investigated from 30 MHz to 200 GHz, reportable spurious emissions were detected and determined to be compliant with the Part 30 limit. The minimum margin, measured in the horizontal polarization, was **3.07 dB at 128.98436 GHz**. Additionally, from 30 MHz to 40 GHz all non-transmitter emissions were a minimum of 1.61 dB below the Part 15 Class B limit.

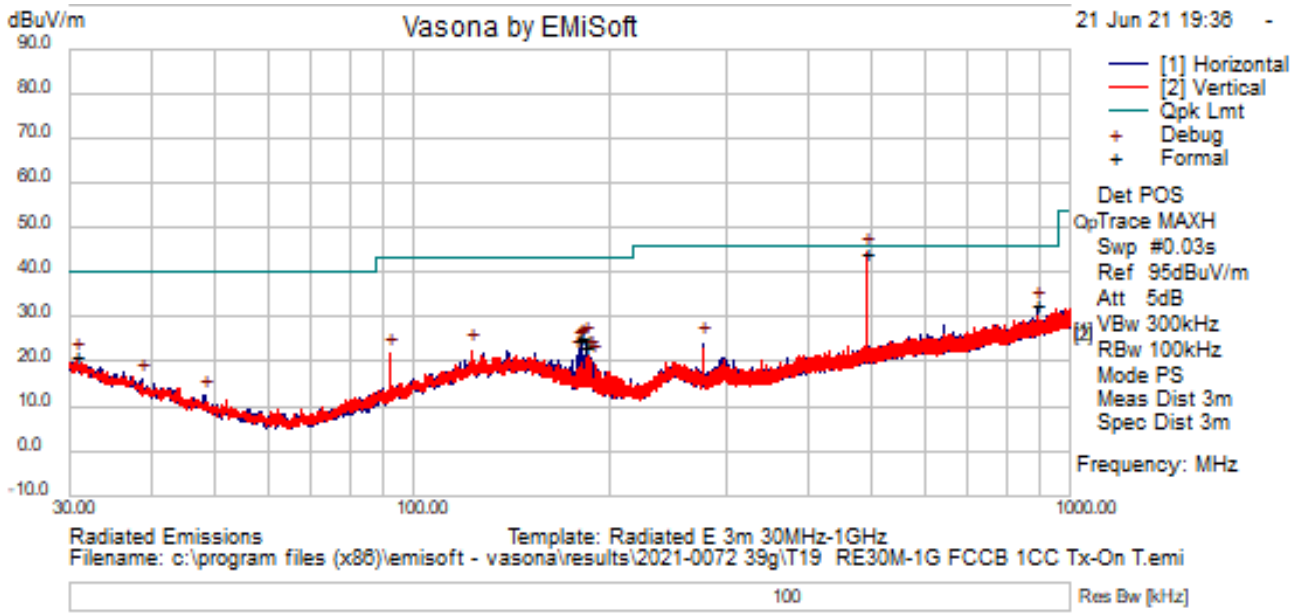
This demonstrates that the **AWEWA/B 5G AirScale 39 GHz mmWave Radio FCC ID: 2AD8UAWEWAB01**, the subject of this application, complies with FCC Part 15 Class B, and FCC Sections 2.1053, 30.203 and 2.1057 of the Rules.
Photographs of the measurement setup are in the filing exhibits.

Figure 4.5 Radiated Emissions Product Setup



4.5.4 Transmitter Measurements of Radiated Spurious Emissions

T19 Radiated Emissions 3m 30MHz-1GHz 1CC TX-On Top Part 15B



Test Information

Results Title	Radiated Emissions 3m 30MHz-1GHz
File Name	T19 RE30M-1G FCCB 1CC Tx-On T.emi
Test Laboratory	MH-AR4, 52.4%RH, 20.6C, 997hPa
Test Engineer	MJS
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	AR4-2021-0072, 39GHz ASMR - SN-AM1-YK211800017, AM2-YK211800027, AM3-YK211800031, Main Unit - 1CC Top-39.94884G-Tx-On.
Configuration	Powered by -48Vdc Tested to FCC Part 15b, RE 30MHz-15GHz, @ 3-Meters, BiLog Antenna E601, LPF-E980, Preamp-E813, FSW67-E1260, Cables AR4 set. Internal attenuation 0dB, Previews RBW Default; Formals RBW Default.
Date	2021-06-21 19:36:36

Formal Data

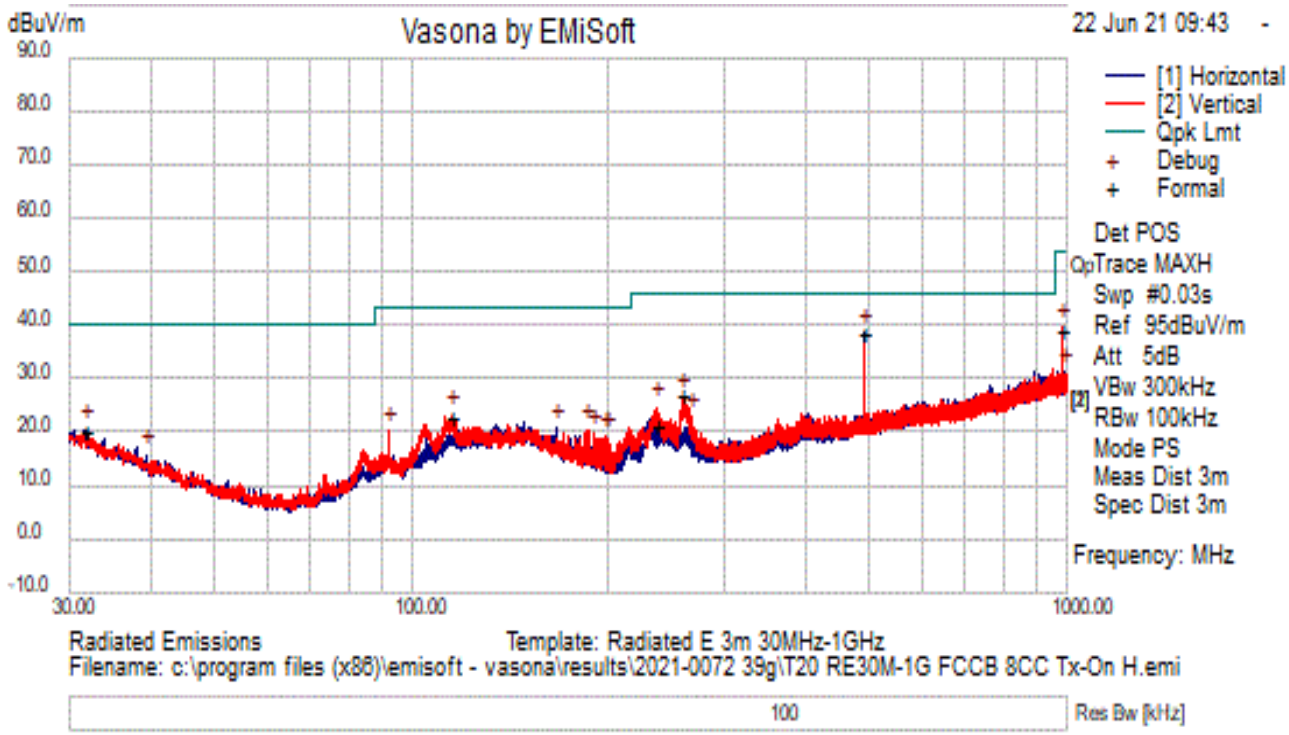
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
491.518	51.06	3.02	-9.69	44.39	QuasiMax	V	231	135	46.00	-1.61	Pass	
890.875	32.97	4.37	-4.16	33.18	QuasiMax	H	110	101	46.00	-12.82	Pass	
181.108	38.06	1.80	-13.99	25.87	QuasiMax	H	117	189	43.50	-17.63	Pass	
179.086	37.27	1.79	-13.78	25.28	QuasiMax	H	121	218	43.50	-18.22	Pass	
30.711333	30.11	0.80	-9.35	21.57	QuasiMax	V	136	161	40.00	-18.43	Pass	
183.227667	35.87	1.81	-14.21	23.47	QuasiMax	H	105	212	43.50	-20.03	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
491.493667	51.10	3.02	-9.69	44.42	Debug	V	250	135	46.00	-1.58	Pass	
890.875	32.08	4.37	-4.16	32.29	Debug	H	175	180	46.00	-13.71	Pass	
183.227667	36.43	1.81	-14.21	24.03	Debug	H	100	225	43.50	-19.47	Pass	
30.711333	28.89	0.80	-9.35	20.34	Debug	V	250	315	40.00	-19.66	Pass	
181.223	35.99	1.80	-14.01	23.79	Debug	H	100	225	43.50	-19.71	Pass	
179.186	35.02	1.79	-13.79	23.02	Debug	H	100	225	43.50	-20.48	Pass	
122.861333	31.31	1.50	-10.25	22.55	Debug	V	250	352	43.50	-20.95	Pass	
92.144667	36.32	1.30	-15.87	21.75	Debug	V	100	315	43.50	-21.75	Pass	
276.477	36.05	2.20	-14.15	24.11	Debug	H	250	90	46.00	-21.89	Pass	
185.167667	33.82	1.82	-14.41	21.23	Debug	V	100	135	43.50	-22.27	Pass	
177.149	32.99	1.79	-13.58	21.20	Debug	H	100	225	43.50	-22.30	Pass	
187.237	33.69	1.83	-14.62	20.90	Debug	H	100	0	43.50	-22.60	Pass	
188.174667	32.69	1.83	-14.71	19.81	Debug	H	100	0	43.50	-23.69	Pass	
38.697667	28.88	0.89	-13.68	16.09	Debug	H	325	45	40.00	-23.91	Pass	
48.203667	29.26	0.98	-17.87	12.37	Debug	H	250	45	40.00	-27.63	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.

T20 Radiated Emissions 3m 30MHz-1GHz 8CC TX-On Top Part 15B



Test Information

Results Title	Radiated Emissions 3m 30MHz-1GHz
File Name	T20 RE30M-1G FCCB 8CC Tx-On H.emi
Test Laboratory	MH-AR4, 52.4%RH, 20.6C, 997hPa
Test Engineer	MJS/CP
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	AR4-2021-0072, 39GHz ASMR - SN-AM1-YK211800007, AM2-YK211800027, AM3-YK211800031, Main Unit - 8CC High -Tx-On.
Configuration	Powered by 120V/60Hz AC. Tested to FCC Part 15b, RE 30MHz-15GHz, @ 3-Meters, Bilog Antenna E601, LPF-E980, Preamp-E813, FSW67-E1260, Cables AR4 set. Internal attenuation 5dB, Previews RBW Default; Formals RBW Default.
Date	2021-06-22 10:26:40

Formal Data

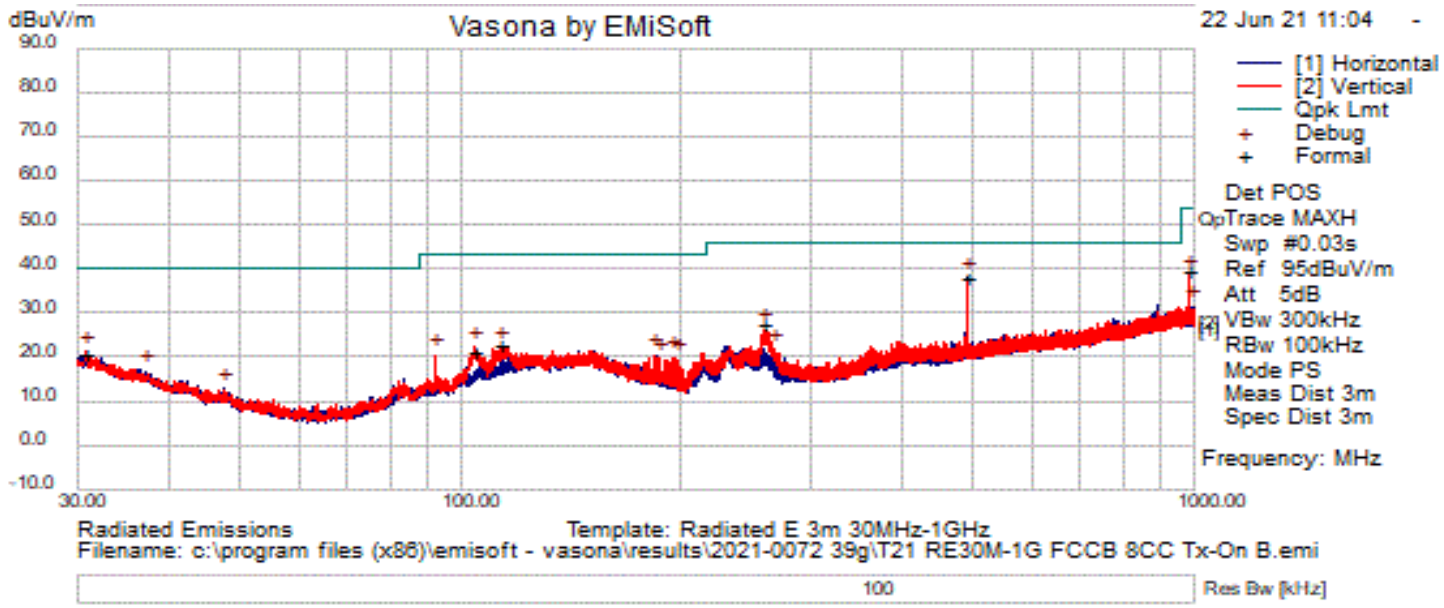
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
491.513	45.36	3.02	-9.69	38.69	QuasiMax	H	104	347	46.00	-7.31	Pass	
983.006	36.88	5.03	-2.80	39.11	QuasiMax	V	184	16	54.00	-14.89	Pass	
259.987	37.27	2.14	-12.33	27.08	QuasiMax	V	208	60	46.00	-18.92	Pass	
31.875333	29.38	0.81	-10.02	20.17	QuasiMax	H	137	84	40.00	-19.83	Pass	
115.036667	32.71	1.45	-11.43	22.73	QuasiMax	V	272	135	43.50	-20.77	Pass	
236.707	33.03	2.05	-13.49	21.59	QuasiMax	V	228	152	46.00	-24.41	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
491.493667	45.33	3.02	-9.69	38.65	Debug	H	100	352	46.00	-7.35	Pass	
983.025	37.46	5.03	-2.80	39.69	Debug	V	100	0	54.00	-14.31	Pass	
31.875333	29.63	0.81	-10.02	20.42	Debug	H	175	45	40.00	-19.58	Pass	
259.987	36.55	2.14	-12.33	26.36	Debug	V	175	45	46.00	-19.64	Pass	
115.036667	33.07	1.45	-11.43	23.09	Debug	V	250	135	43.50	-20.41	Pass	
236.707	35.98	2.05	-13.49	24.54	Debug	V	250	45	46.00	-21.46	Pass	
166.446667	31.08	1.74	-11.98	20.84	Debug	H	100	45	43.50	-22.66	Pass	
994.762	28.85	5.11	-2.64	31.32	Debug	H	100	270	54.00	-22.68	Pass	
185.070667	32.97	1.82	-14.40	20.39	Debug	V	175	0	43.50	-23.11	Pass	
267.294333	33.70	2.17	-13.23	22.64	Debug	V	175	45	46.00	-23.36	Pass	
92.144667	34.68	1.30	-15.87	20.11	Debug	H	175	270	43.50	-23.39	Pass	
189.112333	32.70	1.84	-14.80	19.74	Debug	V	100	352	43.50	-23.76	Pass	
39.279667	28.75	0.90	-13.97	15.67	Debug	H	325	352	40.00	-24.33	Pass	
197.195667	32.79	1.87	-15.59	19.07	Debug	V	175	45	43.50	-24.43	Pass	
199.200333	32.83	1.88	-15.78	18.93	Debug	V	175	0	43.50	-24.57	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.

T21 Radiated Emissions 3m 30MHz-1GHz 8CC TX-On Bottom (Adjacent) Part 15B



Test Information

Results Title	Radiated Emissions 3m 30MHz-1GHz
File Name	T21 RE30M-1G FCCB 8CC Tx-On B.emi
Test Laboratory	MH-AR4, 52.4%RH, 20.6C, 997hPa
Test Engineer	MJS/CP
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	AR4-2021-0072, 39GHz ASMR - SN-AM1-YK211800007, AM2-YK211800027, AM3-YK211800031, Main Unit - 8CC Bottom -Tx-On.
Configuration	Powered by 120V/60Hz AC. Tested to FCC Part 15b, RE 30MHz-15GHz, @ 3-Meters, Bilog Antenna E601, LPF-E980, Preamp-E813, FSW67-E1260, Cables AR4 set. Internal attenuation 5dB, Previews RBW Default; Formals RBW Default.
Date	2021-06-22 11:51:22

Formal Data

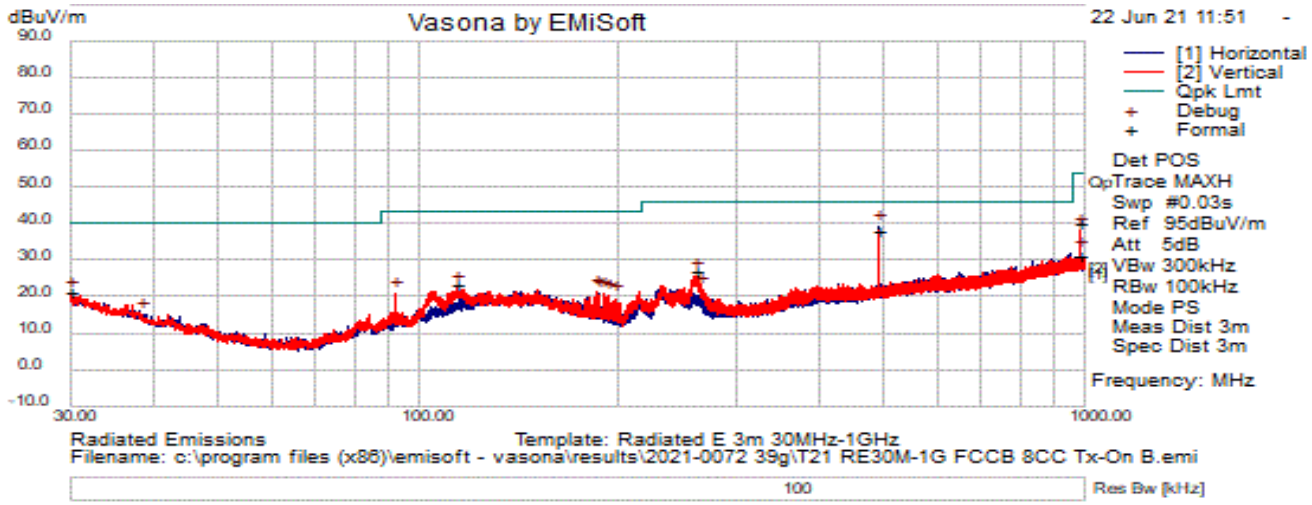
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
491.493667	45.10	3.02	-9.69	38.43	QuasiMax	H	104	339	46.00	-7.57	Pass	
983.025	37.63	5.03	-2.80	39.86	QuasiMax	V	105	27	54.00	-14.14	Pass	
259.469667	37.73	2.14	-12.27	27.60	QuasiMax	V	170	38	46.00	-18.40	Pass	
30.808333	29.35	0.80	-9.40	20.75	QuasiMax	V	208	139	40.00	-19.25	Pass	
113.775667	33.22	1.44	-11.63	23.04	QuasiMax	V	300	96	43.50	-20.46	Pass	
104.140333	33.13	1.37	-13.21	21.29	QuasiMax	V	291	318	43.50	-22.21	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
491.493667	44.50	3.02	-9.69	37.83	Debug	H	100	352	46.00	-8.17	Pass	
983.025	36.44	5.03	-2.80	38.67	Debug	V	100	352	54.00	-15.33	Pass	
30.808333	29.70	0.80	-9.40	21.10	Debug	V	325	135	40.00	-18.90	Pass	
259.469667	36.36	2.14	-12.27	26.23	Debug	V	175	45	46.00	-19.77	Pass	
113.775667	32.46	1.44	-11.63	22.27	Debug	V	250	135	43.50	-21.23	Pass	
104.140333	34.02	1.37	-13.21	22.18	Debug	V	250	352	43.50	-21.32	Pass	
994.180	29.00	5.10	-2.65	31.45	Debug	H	100	45	54.00	-22.55	Pass	
92.144667	34.96	1.30	-15.87	20.39	Debug	V	100	352	43.50	-23.11	Pass	
183.098333	32.73	1.81	-14.20	20.34	Debug	V	100	0	43.50	-23.16	Pass	
37.242667	28.75	0.87	-12.93	16.69	Debug	H	250	270	40.00	-23.31	Pass	
195.158667	33.39	1.86	-15.39	19.86	Debug	V	175	0	43.50	-23.64	Pass	
187.140	32.51	1.83	-14.61	19.73	Debug	V	100	0	43.50	-23.77	Pass	
197.195667	33.12	1.87	-15.59	19.40	Debug	V	175	352	43.50	-24.10	Pass	
267.779333	32.58	2.17	-13.29	21.46	Debug	V	175	90	46.00	-24.54	Pass	
47.589333	29.46	0.97	-17.64	12.79	Debug	H	250	270	40.00	-27.21	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.

T22 Radiated Emissions 3m 30MHz-1GHz 8CC TX-On Bottom (Non-Adjacent)



Test Information

Results Title	Radiated Emissions 3m 30MHz-1GHz
File Name	T22 RE30M-1G FCCB 8CC Tx-On B.emi
Test Laboratory	MH-AR4, 52.4%RH, 20.6C, 997hPa
Test Engineer	MJS/CP
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	AR4-2021-0072, 39GHz ASMR - SN-AM1-YK211800007, AM2-YK211800027, AM3-YK211800031, Main Unit - 8CC Bottom Non Contig-Tx-On.
Configuration	Powered by 120V/60Hz AC. Tested to FCC Part 15b, RE 30MHz-15GHz, @ 3-Meters, Bilog Antenna E601, LPF-E980, Preamp-E813, FSW67-E1260, Cables AR4 set. Internal attenuation 5dB, Previews RBW Default; Formals RBW Default.
Date	2021-06-22 13:36:09

Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
491.493667	45.03	3.02	-9.69	38.35	QuasiMax	H	104	349	46.00	-7.65	Pass	
983.025	37.82	5.03	-2.80	40.05	QuasiMax	V	132	16	54.00	-13.95	Pass	
260.504333	37.62	2.14	-12.40	27.36	QuasiMax	V	180	54	46.00	-18.64	Pass	
30.097	29.35	0.79	-8.98	21.17	QuasiMax	H	204	272	40.00	-18.83	Pass	
114.551667	33.55	1.45	-11.51	23.48	QuasiMax	V	300	161	43.50	-20.02	Pass	
984.156667	28.94	5.03	-2.78	31.19	QuasiMax	V	145	85	54.00	-22.81	Pass	

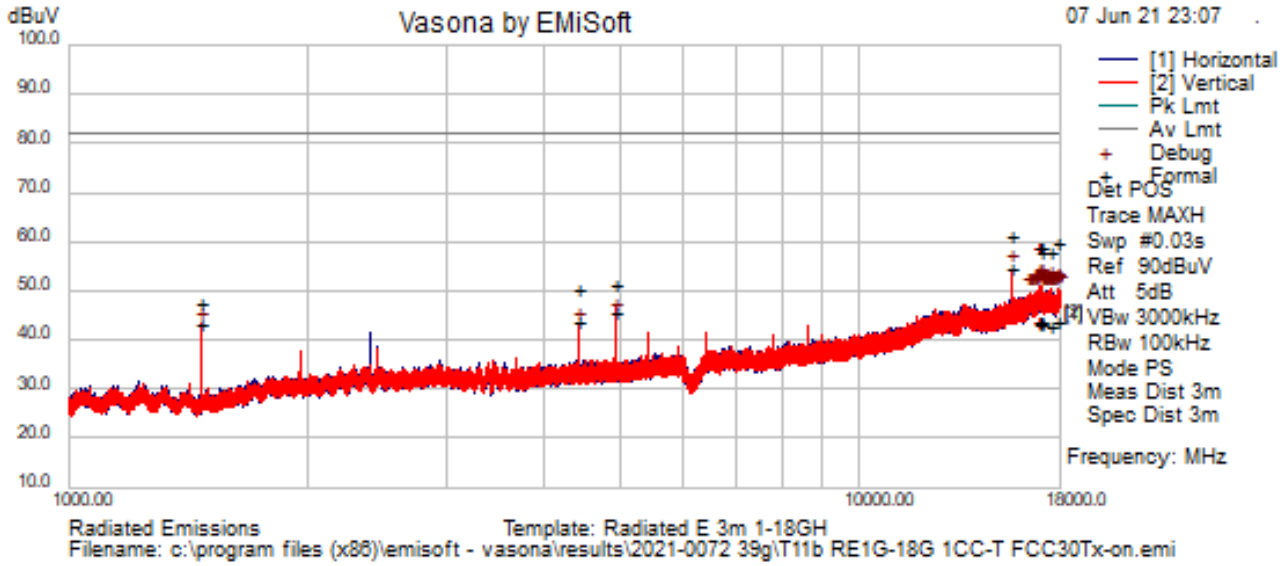
Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
491.493667	45.55	3.02	-9.69	38.88	Debug	H	100	352	46.00	-7.12	Pass	
983.025	35.92	5.03	-2.80	38.15	Debug	V	100	352	54.00	-15.85	Pass	
30.097	28.73	0.79	-8.98	20.54	Debug	H	325	352	40.00	-19.46	Pass	
260.504333	35.97	2.14	-12.40	25.72	Debug	V	175	45	46.00	-20.28	Pass	
114.551667	32.30	1.45	-11.51	22.23	Debug	V	250	180	43.50	-21.27	Pass	
984.156667	29.44	5.03	-2.78	31.69	Debug	V	100	225	54.00	-22.31	Pass	

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
185.135333	33.72	1.82	-14.41	21.13	Debug	V	175	352	43.50	-22.37	Pass	
189.177	33.82	1.84	-14.81	20.85	Debug	V	175	0	43.50	-22.65	Pass	
92.144667	35.41	1.30	-15.87	20.84	Debug	V	100	352	43.50	-22.66	Pass	
187.172333	33.56	1.83	-14.61	20.78	Debug	H	100	180	43.50	-22.72	Pass	
193.186333	33.60	1.85	-15.20	20.25	Debug	V	175	0	43.50	-23.25	Pass	
197.195667	33.00	1.87	-15.59	19.28	Debug	V	175	0	43.50	-24.22	Pass	
266.647667	32.72	2.16	-13.15	21.73	Debug	V	175	45	46.00	-24.27	Pass	
38.374333	27.64	0.89	-13.52	15.01	Debug	V	325	352	40.00	-24.99	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.

T11b Radiated Emissions 3m 1GHz – 18GHz 1CC TX-On Top



Test Information

Results Title	Radiated Emissions 3m 1-18GHz
File Name	T11b RE1G-18G 1CC-T FCC30 Tx-on.emi
Test Laboratory	MH-AR4, 49.2%RH, 20.6C, 997hPa
Test Engineer	MJS
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	AR4-2021-0072, 39GHz ASMR - SN-AM1-YK211800017, AM2-YK211800027, AM3-YK211800031, Main Unit - 1CC Top-Tx-On
Configuration	Powered by -48Vdc Tested to FCC Part 30, RE 1GHz-18GHz, @ 3-Meters, Horn Antenna E1074, LPF-E1476, Preamp-E447, FSW67-E1260, Cables E1503 and E1504. Internal attenuation 5dB, Previews RBW 100K; Formals RBW 1M / 3M.
Date	2021-06-07 23:07:04

Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
15603.850	40.73	12.18	2.05	54.95	AvgMax	H	106	58	82.23	-27.28	Pass	
4915.258	43.49	6.45	-3.88	46.06	AvgMax	V	157	3	82.23	-36.17	Pass	
4423.676	42.25	5.89	-4.16	43.98	AvgMax	V	187	50	82.23	-38.25	Pass	
16925.600	26.91	12.37	4.71	43.98	AvgMax	V	188	209	82.23	-38.25	Pass	
17010.246	26.63	12.39	4.87	43.90	AvgMax	V	262	231	82.23	-38.33	Pass	
16952.658	26.70	12.38	4.77	43.85	AvgMax	V	133	115	82.23	-38.38	Pass	
16990.979	26.58	12.39	4.87	43.84	AvgMax	V	257	343	82.23	-38.39	Pass	
17921.163	26.74	12.91	4.15	43.80	AvgMax	V	183	190	82.23	-38.43	Pass	
16967.746	26.54	12.38	4.81	43.73	AvgMax	V	172	352	82.23	-38.50	Pass	
17025.688	26.48	12.40	4.85	43.72	AvgMax	V	114	179	82.23	-38.51	Pass	
16982.975	26.46	12.39	4.85	43.70	AvgMax	V	104	122	82.23	-38.53	Pass	
1474.549	51.53	3.19	-11.38	43.35	AvgMax	V	111	52	82.23	-38.88	Pass	
17103.463	26.19	12.41	4.73	43.33	AvgMax	H	178	7	82.23	-38.90	Pass	
17576.629	26.37	12.56	4.13	43.07	AvgMax	V	133	145	82.23	-39.16	Pass	

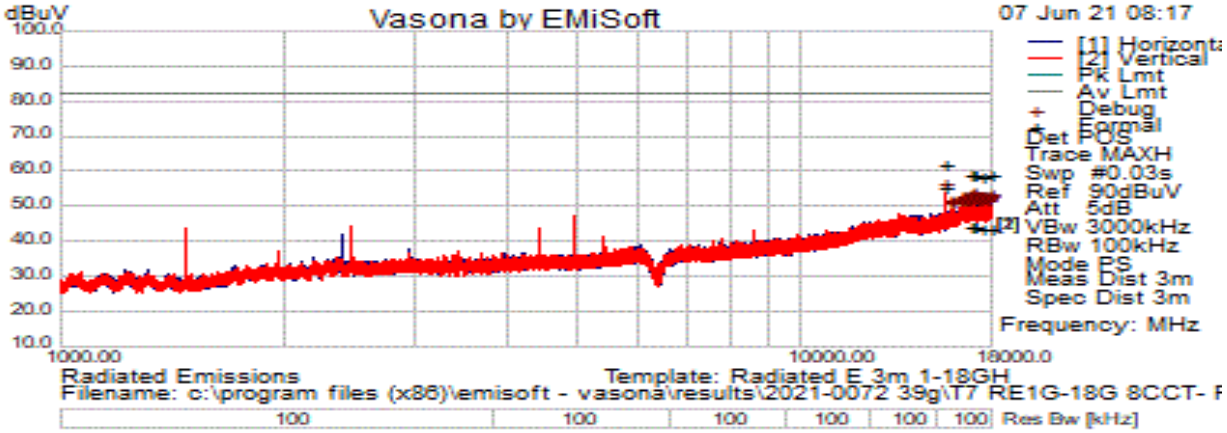
Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
15603.850	39.75	12.18	2.05	53.98	Debug	H	100	90	82.23	-28.25	Pass	
17025.688	33.84	12.40	4.85	51.08	Debug	V	250	150	82.23	-31.15	Pass	
16990.979	33.82	12.39	4.87	51.07	Debug	V	100	300	82.23	-31.16	Pass	
16967.746	33.61	12.38	4.81	50.80	Debug	V	100	180	82.23	-31.43	Pass	
17576.629	33.87	12.56	4.13	50.56	Debug	V	325	210	82.23	-31.67	Pass	
17010.246	33.17	12.39	4.87	50.44	Debug	V	325	90	82.23	-31.79	Pass	
17103.463	33.27	12.41	4.73	50.41	Debug	H	325	60	82.23	-31.82	Pass	
17921.163	33.28	12.91	4.15	50.34	Debug	V	100	60	82.23	-31.89	Pass	
16925.600	33.27	12.37	4.71	50.34	Debug	V	250	300	82.23	-31.89	Pass	
16952.658	33.13	12.38	4.77	50.28	Debug	V	250	30	82.23	-31.95	Pass	
16982.975	32.97	12.39	4.85	50.20	Debug	V	100	150	82.23	-32.03	Pass	
17853.800	33.20	12.84	4.14	50.19	Debug	H	250	210	82.23	-32.04	Pass	
17027.883	32.91	12.40	4.85	50.15	Debug	V	250	0	82.23	-32.08	Pass	
17089.721	32.97	12.41	4.75	50.13	Debug	V	250	270	82.23	-32.10	Pass	
16998.488	32.82	12.39	4.89	50.10	Debug	V	100	30	82.23	-32.13	Pass	
17317.096	33.22	12.45	4.41	50.07	Debug	H	100	240	82.23	-32.16	Pass	
17998.796	32.86	12.99	4.15	50.00	Debug	V	175	120	82.23	-32.23	Pass	
17470.521	33.33	12.48	4.17	49.98	Debug	V	250	270	82.23	-32.25	Pass	
16871.696	33.03	12.35	4.57	49.94	Debug	V	325	300	82.23	-32.29	Pass	
17942.908	32.81	12.94	4.15	49.89	Debug	V	100	30	82.23	-32.34	Pass	
17364.908	33.10	12.46	4.33	49.89	Debug	H	250	90	82.23	-32.34	Pass	
17510.542	33.25	12.49	4.13	49.88	Debug	H	175	330	82.23	-32.35	Pass	
17845.017	32.88	12.84	4.14	49.86	Debug	H	175	270	82.23	-32.37	Pass	
17872.925	32.84	12.86	4.15	49.85	Debug	V	175	270	82.23	-32.38	Pass	
17506.575	33.20	12.49	4.13	49.82	Debug	V	325	0	82.23	-32.41	Pass	
17430.288	33.09	12.47	4.24	49.80	Debug	V	250	300	82.23	-32.43	Pass	
17439.638	33.10	12.47	4.22	49.80	Debug	H	250	270	82.23	-32.43	Pass	
17040.279	32.56	12.40	4.83	49.78	Debug	H	175	30	82.23	-32.45	Pass	
17170.683	32.68	12.42	4.63	49.73	Debug	H	100	210	82.23	-32.50	Pass	
17836.163	32.74	12.83	4.14	49.71	Debug	H	175	330	82.23	-32.52	Pass	
16887.633	32.73	12.35	4.61	49.69	Debug	V	325	210	82.23	-32.54	Pass	
17083.700	32.51	12.41	4.76	49.68	Debug	V	250	150	82.23	-32.55	Pass	
17176.067	32.61	12.42	4.62	49.65	Debug	V	325	150	82.23	-32.58	Pass	
16687.033	33.21	12.28	4.11	49.59	Debug	V	250	210	82.23	-32.64	Pass	
17541.992	32.90	12.52	4.13	49.56	Debug	V	325	30	82.23	-32.67	Pass	
17487.308	32.93	12.48	4.15	49.56	Debug	V	175	0	82.23	-32.67	Pass	
16531.767	33.62	12.22	3.71	49.56	Debug	V	325	150	82.23	-32.67	Pass	
17276.650	32.60	12.44	4.47	49.51	Debug	V	100	0	82.23	-32.72	Pass	
17584.633	32.71	12.57	4.13	49.41	Debug	H	250	120	82.23	-32.82	Pass	
17201.567	32.40	12.43	4.58	49.41	Debug	V	325	330	82.23	-32.82	Pass	
17277.288	32.49	12.44	4.47	49.40	Debug	H	100	90	82.23	-32.83	Pass	
17610.275	32.66	12.60	4.14	49.39	Debug	H	325	0	82.23	-32.84	Pass	
17602.696	32.66	12.59	4.13	49.39	Debug	H	100	150	82.23	-32.84	Pass	
16507.046	33.51	12.21	3.65	49.37	Debug	H	250	210	82.23	-32.86	Pass	
17415.413	32.65	12.47	4.26	49.37	Debug	H	250	0	82.23	-32.86	Pass	
17565.792	32.64	12.55	4.13	49.33	Debug	H	325	270	82.23	-32.90	Pass	
16839.750	32.48	12.33	4.49	49.31	Debug	H	250	240	82.23	-32.92	Pass	
17518.050	32.67	12.50	4.13	49.30	Debug	H	100	0	82.23	-32.93	Pass	
17180.317	32.25	12.42	4.61	49.29	Debug	V	325	30	82.23	-32.94	Pass	
16438.125	33.56	12.23	3.46	49.25	Debug	H	325	270	82.23	-32.98	Pass	

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
16507.825	33.37	12.21	3.65	49.23	Debug	H	325	90	82.23	-33.00	Pass	
17283.308	32.33	12.44	4.46	49.23	Debug	V	100	90	82.23	-33.00	Pass	
17763.629	32.33	12.75	4.14	49.22	Debug	H	100	60	82.23	-33.01	Pass	
17230.892	32.25	12.43	4.54	49.22	Debug	V	325	60	82.23	-33.01	Pass	
17093.617	32.06	12.41	4.75	49.22	Debug	H	175	150	82.23	-33.01	Pass	
17796.425	32.27	12.79	4.14	49.20	Debug	V	250	180	82.23	-33.03	Pass	
16478.571	33.41	12.22	3.57	49.20	Debug	H	250	210	82.23	-33.03	Pass	
16625.479	32.96	12.26	3.95	49.17	Debug	V	250	120	82.23	-33.06	Pass	
16775.929	32.52	12.31	4.33	49.16	Debug	V	325	180	82.23	-33.07	Pass	
16724.575	32.65	12.29	4.20	49.15	Debug	V	250	150	82.23	-33.08	Pass	
1474.549	50.31	3.19	-11.38	42.13	Debug	V	100	330	82.23	-40.10	Pass	
4915.258	41.73	6.45	-3.88	44.30	Debug	V	0	330	82.23	-37.93	Pass	
4423.676	40.73	5.89	-4.16	42.46	Debug	V	0	330	82.23	-39.77	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.

T7 Radiated Emissions 3m 1GHz – 18GHz 8CC TX-On Top



Test Information

Results Title	Radiated Emissions 3m 1-18GHz
File Name	T7 RE1G-18G 8CCT- FCC-P30.emi
Test Laboratory	MH-AR4, 49.2%RH, 20.6C, 997hPa
Test Engineer	MJS/CP
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	AR4-2021-0072, 39GHz ASMR - SN-AM1-YK211800017, AM2-YK211800027, AM3-YK211800031, 8CC Top-TX-On.
Configuration	Powered by -48Vdc Tested to FCC Part30, RE 1GHz-18GHz, @ 3-Meters, Horn Antenna E1074, LPF-E1476, Preamp-E447, FSW67-E1260, Cables E1503 and E1504. Internal attenuation 0dB, Previews RBW 100K; Formals RBW 1M / 3M.
Date	2021-06-07 09:01:20

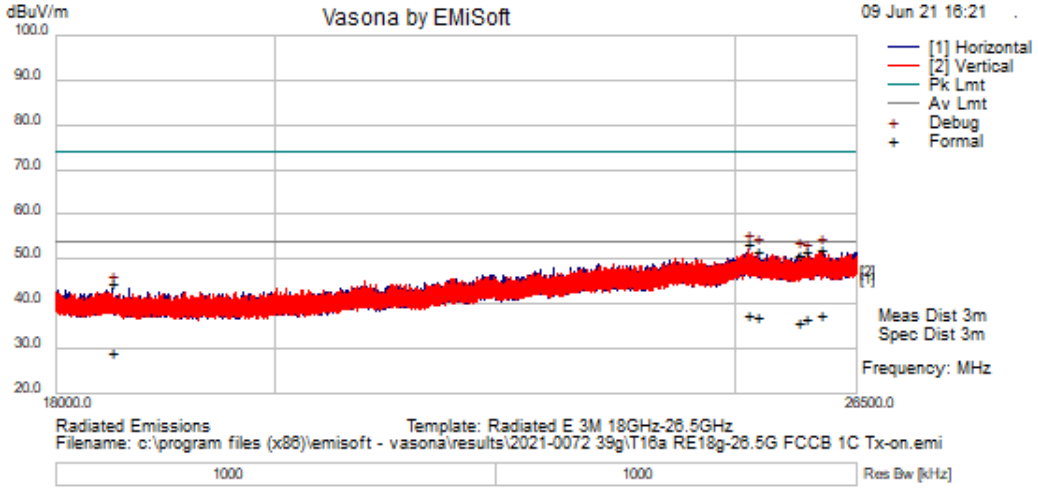
Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
15603.756	41.45	12.18	2.05	55.68	AvgMax	V	143	166	82.23	-26.55	Pass	
16999.078	26.71	12.39	4.89	43.99	AvgMax	V	210	173	82.23	-38.24	Pass	
16943.450	26.84	12.37	4.75	43.97	AvgMax	V	216	256	82.23	-38.26	Pass	
16996.245	26.65	12.39	4.88	43.92	AvgMax	H	120	314	82.23	-38.31	Pass	
17969.306	26.74	12.96	4.15	43.85	AvgMax	H	176	30	82.23	-38.38	Pass	
17523.245	26.67	12.51	4.13	43.30	AvgMax	H	306	302	82.23	-38.93	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
15603.756	39.74	12.18	2.05	53.97	Debug	V	175	300	82.23	-28.26	Pass	
16999.078	34.35	12.39	4.89	51.63	Debug	V	175	300	82.23	-30.60	Pass	
16996.245	33.95	12.39	4.88	51.22	Debug	H	100	270	82.23	-31.01	Pass	
16943.450	33.81	12.37	4.75	50.93	Debug	V	325	270	82.23	-31.30	Pass	
17969.306	33.63	12.96	4.15	50.74	Debug	H	175	120	82.23	-31.49	Pass	
17523.245	33.95	12.51	4.13	50.59	Debug	H	175	240	82.23	-31.64	Pass	
17895.450	33.46	12.89	4.15	50.49	Debug	V	250	60	82.23	-31.74	Pass	
17056.689	33.28	12.40	4.80	50.48	Debug	V	250	90	82.23	-31.75	Pass	

T16a Radiated Emissions 3m 18GHz – 26.5GHz 1CC TX-On Top



Test Information

Results Title	Radiated Emissions 3M 18GHz-26.5GHz
File Name	T16a RE18g-26.5G FCCB 1CC-Top Tx-on_Main.emi
Test Laboratory	MH-AR4, 49.2%RH, 20.6C, 997hPa
Test Engineer	JY
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	AR4-2021-0072, 39GHz ASMR - SN-AM1-YK211800017, AM2-YK211800027, AM3-YK211800031, **Main Unit** - 1CC Top-Tx-On.
Configuration	Powered by -48Vdc Tested to FCC Part 15b, RE 18GHz-26.5GHz, @ 3-Meters, Horn Antenna E1452, LPF-E1516, Preamp-E447, FSW67-E1260, Cables E1501 and E1502. Internal attenuation 0dB, Previews RBW 100K; Formals RBW 1M / 3M.
Date	2021-06-09 16:21:37

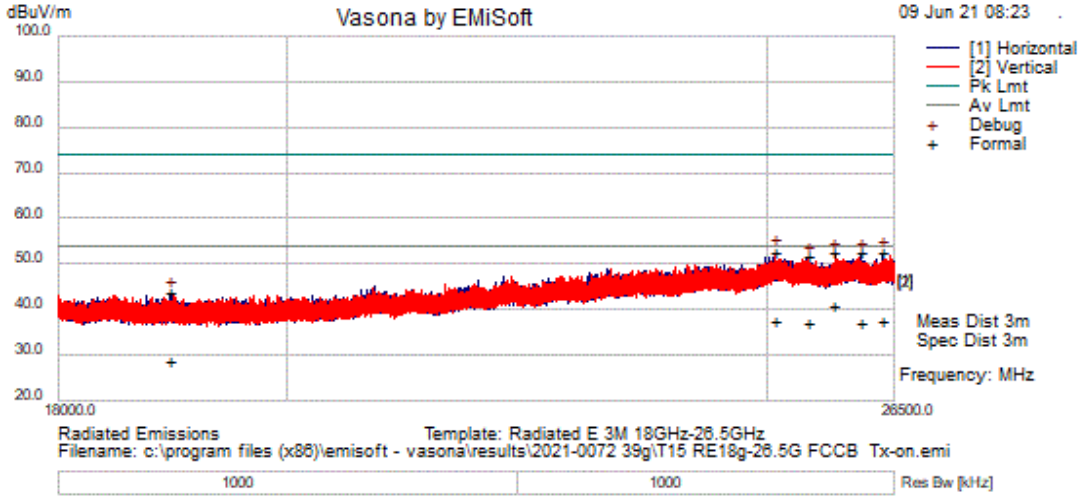
Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
25152.608	26.74	14.25	-3.21	37.78	AvgMax	V	304	192	54.00	-16.22	Pass	
26048.791	26.19	14.43	-3.12	37.49	AvgMax	V	323	342	54.00	-16.51	Pass	
25258.163	25.94	14.32	-3.30	36.96	AvgMax	V	307	147	54.00	-17.04	Pass	
25876.385	25.56	14.42	-3.10	36.88	AvgMax	V	244	282	54.00	-17.12	Pass	
25767.744	24.90	14.40	-3.23	36.08	AvgMax	H	127	91	54.00	-17.92	Pass	
18491.017	25.74	11.88	-8.58	29.05	AvgMax	H	320	91	54.00	-24.95	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
25152.608	41.20	14.25	-3.21	52.24	Debug	V	175	44	54.00	-1.76	Pass	
26048.791	40.17	14.43	-3.12	51.47	Debug	V	325	352	54.00	-2.53	Pass	
25258.163	40.45	14.32	-3.30	51.47	Debug	V	99	352	54.00	-2.53	Pass	
25767.744	39.64	14.40	-3.23	50.82	Debug	H	99	352	54.00	-3.18	Pass	
25876.385	39.14	14.42	-3.10	50.45	Debug	V	99	352	54.00	-3.55	Pass	
18491.017	40.07	11.88	-8.58	43.38	Debug	H	100	286	54.00	-10.62	Pass	

T15a Radiated Emissions 3m 18GHz – 26.5GHz 8CC TX-On Top



Test Information

Results Title	Radiated Emissions 3M 18GHz-26.5GHz
File Name	T15a RE18g-26.5G FCCB Tx-on.emi
Test Laboratory	MH-AR4, 49.2%RH, 20.6C, 997hPa
Test Engineer	MJS / JY
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	AR4-2021-0072, 39GHz ASMR - SN-AM1-YK211800017, AM2-YK211800027, AM3-YK211800031, Main Unit - 1CC Top-Tx-On.
Configuration	Powered by -48Vdc Tested to FCC Part 15b, RE 18GHz-26.5GHz, @ 3-Meters, Horn Antenna E1452, LPF-E1516, Preamp-E447, FSW67-E1260, Cables E1501 and E1502. Internal attenuation 0dB, Previews RBW 100K; Formals RBW 1M / 3M.
Date	2021-06-09 08:47:54

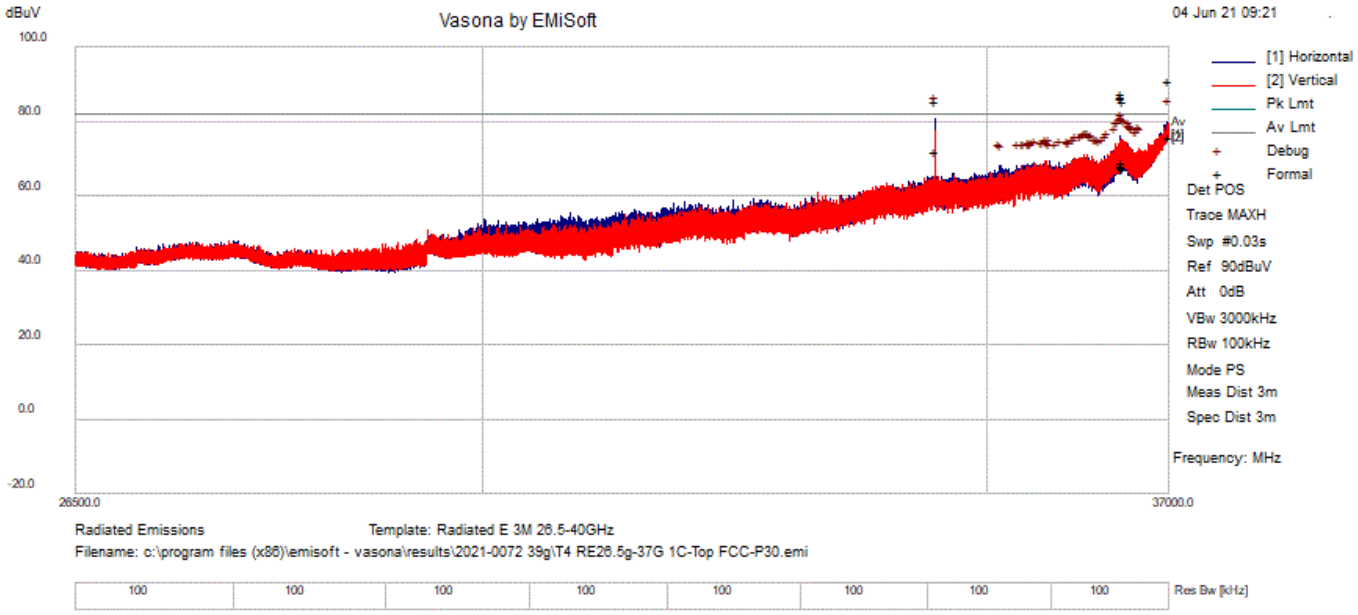
Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
25781.203	29.58	14.41	-3.20	40.78	AvgMax	V	161	56	54.00	-13.22	Pass	
25087.016	26.57	14.19	-3.25	37.51	AvgMax	H	155	304	54.00	-16.49	Pass	
26365.132	26.15	14.48	-3.22	37.41	AvgMax	H	158	133	54.00	-16.59	Pass	
25464.139	26.29	14.35	-3.53	37.11	AvgMax	V	244	62	54.00	-16.89	Pass	
26106.588	25.84	14.42	-3.18	37.09	AvgMax	H	303	71	54.00	-16.91	Pass	
18957.950	25.84	11.91	-8.91	28.84	AvgMax	H	230	65	54.00	-25.16	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
18957.950	40.17	11.91	-8.91	43.17	Debug	H	250	308	54.00	-10.83	Pass	
25087.016	41.39	14.19	-3.25	52.33	Debug	H	100	22	54.00	-1.67	Pass	
25464.139	39.77	14.35	-3.53	50.59	Debug	V	100	352	54.00	-3.41	Pass	
25781.203	40.21	14.41	-3.20	51.42	Debug	V	100	352	54.00	-2.58	Pass	
26106.588	40.43	14.42	-3.18	51.67	Debug	H	100	352	54.00	-2.33	Pass	
26365.132	40.89	14.48	-3.22	52.15	Debug	H	100	352	54.00	-1.85	Pass	

T4 Radiated Emissions 3m 26.5GHz – 37GHz 1CC TX-On Top



Test Information

Results Title	Radiated Emissions 3m 26.5-37GHz
File Name	T4 RE26.5g-37G 1C-Top FCC-P30.emi
Test Laboratory	MH-AR4, 49.2%RH, 20.6C, 997hPa
Test Engineer	MJS / WSM
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	AR4-2021-0072, 39GHz ASMR - SN-AM1-YK211800017, AM2-YK211800027, AM3-YK211800031, Tx-On 1CC.
Configuration	Powered by -48Vdc Tested to FCCB, RE 26.5G-37Hz, @ 3-Meters, Horn Antenna E1373, Preamp-E1525, FSW67-E1260, and HPF-Filter E1516, Cables E1501 and E1502. Internal attenuation 5dB, Previews RBW 1M; Formals RBW 1M / 3M.
Date	2021-06-04 09:22:48

Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail	Comments
36976.856	30.43	48.66	-2.98	76.11	AvgMax	H	165	27	82.23	-6.12	Pass	
34447.352	56.16	16.95	-1.06	72.05	AvgMax	H	169	23	82.23	-10.18	Pass	
36455.488	39.94	31.40	-2.05	69.29	AvgMax	H	175	28	82.23	-12.94	Pass	
36465.113	39.00	31.68	-2.06	68.62	AvgMax	V	179	19	82.23	-13.61	Pass	
36456.931	38.74	31.44	-2.05	68.13	AvgMax	V	167	24	82.23	-14.10	Pass	
36476.006	37.62	31.99	-2.06	67.54	AvgMax	V	168	28	82.23	-14.69	Pass	

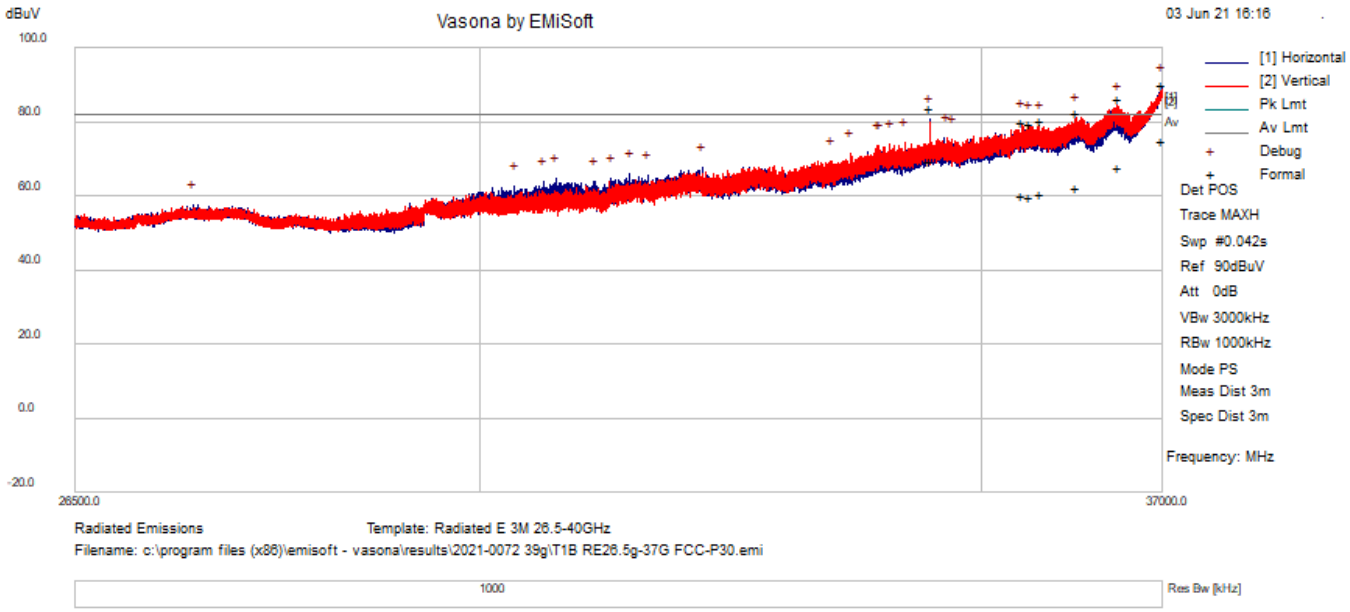
Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail	Comments
34447.319	64.99	16.95	-1.06	80.88	Debug	H	175	22	82.23	-1.35	Pass	
36976.856	34.35	48.66	-2.98	80.03	Debug	H	175	22	82.23	-2.20	Pass	
36455.488	46.69	31.40	-2.05	76.04	Debug	H	175	22	82.23	-6.19	Pass	

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail	Comments
36465.113	45.57	31.68	-2.06	75.18	Debug	V	175	22	82.23	-7.05	Pass	
36456.931	45.63	31.44	-2.05	75.02	Debug	V	175	22	82.23	-7.21	Pass	
36476.006	45.01	31.99	-2.06	74.94	Debug	V	175	22	82.23	-7.29	Pass	
36497.006	43.91	32.59	-2.08	74.41	Debug	V	175	22	82.23	-7.82	Pass	
36428.888	45.54	30.64	-2.03	74.16	Debug	V	175	22	82.23	-8.07	Pass	
36401.850	46.25	29.86	-2.00	74.10	Debug	V	175	22	82.23	-8.13	Pass	
36539.663	42.40	33.84	-2.16	74.08	Debug	H	175	22	82.23	-8.15	Pass	
36543.950	41.61	33.97	-2.17	73.41	Debug	V	175	22	82.23	-8.82	Pass	
36556.638	41.23	34.34	-2.19	73.38	Debug	V	175	22	82.23	-8.85	Pass	
36568.844	40.43	34.70	-2.21	72.91	Debug	V	175	22	82.23	-9.32	Pass	
36656.825	37.76	37.36	-2.43	72.70	Debug	V	175	22	82.23	-9.53	Pass	
36581.750	39.75	35.08	-2.24	72.59	Debug	H	175	22	82.23	-9.64	Pass	
36385.444	44.88	29.41	-2.01	72.28	Debug	V	175	22	82.23	-9.95	Pass	
36667.500	37.01	37.69	-2.46	72.24	Debug	V	175	22	82.23	-9.99	Pass	
36631.844	37.49	36.59	-2.36	71.72	Debug	V	175	22	82.23	-10.51	Pass	
36620.381	37.65	36.24	-2.33	71.57	Debug	V	175	22	82.23	-10.66	Pass	
36081.294	51.36	22.15	-2.35	71.16	Debug	V	175	22	82.23	-11.07	Pass	
36055.788	51.56	21.78	-2.35	70.99	Debug	V	175	22	82.23	-11.24	Pass	
36307.350	45.77	27.26	-2.07	70.97	Debug	V	175	22	82.23	-11.26	Pass	
36086.281	51.07	22.22	-2.35	70.94	Debug	H	175	22	82.23	-11.29	Pass	
36041.963	51.68	21.57	-2.34	70.91	Debug	V	175	22	82.23	-11.32	Pass	
36131.213	49.95	23.08	-2.33	70.70	Debug	V	175	22	82.23	-11.53	Pass	
36280.619	46.04	26.57	-2.11	70.50	Debug	H	175	22	82.23	-11.73	Pass	
36000.400	51.69	20.96	-2.34	70.32	Debug	V	175	22	82.23	-11.91	Pass	
36011.600	51.52	21.13	-2.34	70.31	Debug	V	175	22	82.23	-11.92	Pass	
36101.988	50.19	22.47	-2.35	70.31	Debug	H	175	22	82.23	-11.92	Pass	
35953.806	51.89	20.51	-2.24	70.17	Debug	V	175	22	82.23	-12.06	Pass	
36241.025	46.29	25.56	-2.18	69.68	Debug	V	175	22	82.23	-12.55	Pass	
36154.181	48.41	23.56	-2.30	69.67	Debug	V	175	22	82.23	-12.56	Pass	
35931.538	51.56	20.30	-2.19	69.67	Debug	H	175	22	82.23	-12.56	Pass	
35630.144	52.03	19.03	-1.48	69.58	Debug	V	175	22	82.23	-12.65	Pass	
36195.350	47.30	24.42	-2.26	69.46	Debug	V	175	22	82.23	-12.77	Pass	
36185.288	47.50	24.21	-2.27	69.44	Debug	V	175	22	82.23	-12.79	Pass	
35918.281	51.43	20.17	-2.16	69.44	Debug	V	175	22	82.23	-12.79	Pass	
35665.144	51.83	19.08	-1.55	69.36	Debug	H	175	22	82.23	-12.87	Pass	
35783.663	51.68	19.36	-1.86	69.18	Debug	H	175	22	82.23	-13.05	Pass	
35624.631	51.58	19.02	-1.46	69.13	Debug	H	175	22	82.23	-13.10	Pass	
35866.481	51.35	19.80	-2.05	69.10	Debug	V	175	22	82.23	-13.13	Pass	
35508.125	51.65	18.74	-1.38	69.02	Debug	H	175	22	82.23	-13.21	Pass	
36215.694	46.23	24.92	-2.23	68.92	Debug	V	175	22	82.23	-13.31	Pass	
35483.713	51.51	18.68	-1.39	68.79	Debug	H	175	22	82.23	-13.44	Pass	
35875.844	50.99	19.85	-2.07	68.77	Debug	V	175	22	82.23	-13.46	Pass	
35884.681	50.95	19.90	-2.09	68.76	Debug	H	175	22	82.23	-13.47	Pass	
35598.163	51.06	18.97	-1.41	68.62	Debug	H	175	22	82.23	-13.61	Pass	
35438.388	51.50	18.55	-1.44	68.61	Debug	H	175	22	82.23	-13.62	Pass	
35572.175	51.08	18.91	-1.40	68.59	Debug	V	175	22	82.23	-13.64	Pass	
35646.288	50.97	19.05	-1.51	68.52	Debug	V	175	22	82.23	-13.71	Pass	
35452.081	51.20	18.59	-1.42	68.36	Debug	H	175	22	82.23	-13.87	Pass	
35389.169	51.43	18.40	-1.48	68.34	Debug	H	175	22	82.23	-13.89	Pass	
35434.756	51.20	18.53	-1.44	68.30	Debug	H	175	22	82.23	-13.93	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.

T1B Radiated Emissions 3m 26.5GHz – 37GHz 8CC TX-On Top



Test Information

Results Title	Radiated Emissions 3m 26.5-37 GHz
File Name	T1B RE26.5g-37G FCC-P30.emi
Test Laboratory	MH-AR4, 49.2%RH, 20.6C, 997hPa
Test Engineer	MJS / WSM
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	AR4-2021-0072, 39GHz ASMR - SN-AM1-YK211800017, AM2-YK211800027, AM3-YK211800031, Tx-On 8CC-Top Main Panel.
Configuration	Powered by -48Vdc, Tested to FCC Part 30, RE 26.5G-37GHz, @ 3-Meters, Horn Antenna E1373, Preamp-E1525, FSW67-E1260, and LPF-Filter E1516. Cables E1501 and E1502. Internal attenuation 0dB, Previews RBW 1M; Formals RBW 1M / 3M.
Date	2021-06-03 16:16:27

Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
36991.950	29.03	49.28	-2.98	75.34	AvgMax	H	154	132	82.23	-6.89	Pass	
34447.477	53.99	16.96	-1.06	69.89	AvgMax	H	172	28	82.23	-12.34	Pass	
36491.450	37.74	32.43	-2.08	68.09	AvgMax	V	190	19	82.23	-14.14	Pass	
36025.250	43.50	21.33	-2.34	62.49	AvgMax	V	169	16	82.23	-19.74	Pass	
35624.850	43.37	19.02	-1.46	60.93	AvgMax	V	184	25	82.23	-21.30	Pass	
35427.100	43.24	18.51	-1.45	60.31	AvgMax	V	169	20	82.23	-21.92	Pass	
35509.350	42.48	18.75	-1.38	59.84	AvgMax	V	188	18	82.23	-22.39	Pass	

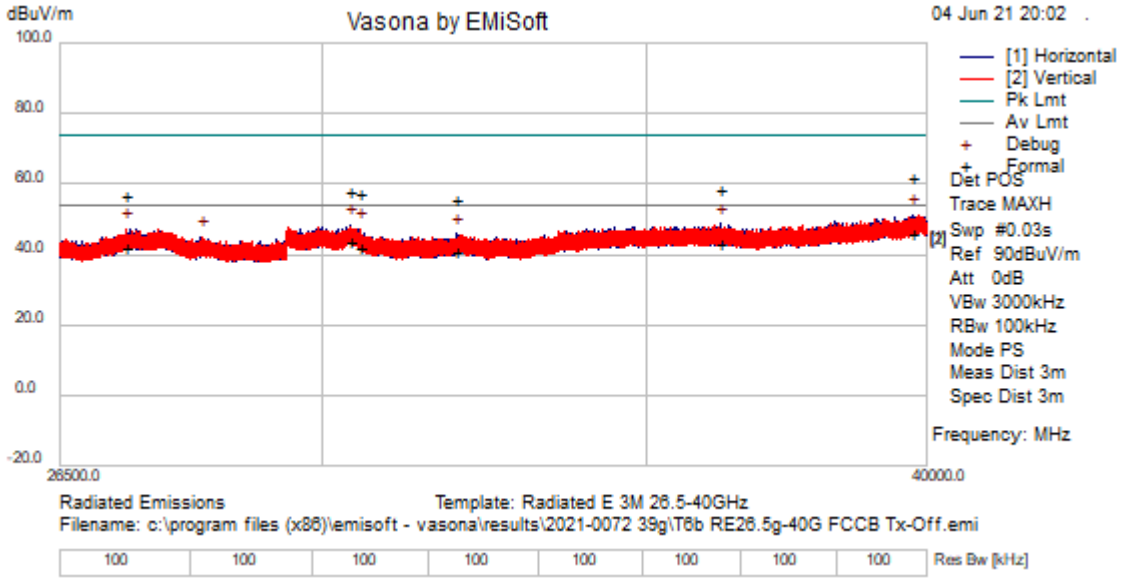
Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
36991.950	42.86	49.28	-2.98	89.17	Debug	H	100	44	82.23	6.94	Fail	
36491.450	54.07	32.43	-2.08	84.42	Debug	V	175	22	82.23	2.19	Fail	
36025.250	62.28	21.33	-2.34	81.26	Debug	V	175	22	82.23	-0.97	Pass	

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
34447.450	64.79	16.96	-1.06	80.69	Debug	H	175	22	82.23	-1.54	Pass	
35427.100	62.33	18.51	-1.45	79.40	Debug	V	175	22	82.23	-2.83	Pass	
35509.350	61.90	18.75	-1.38	79.27	Debug	V	175	22	82.23	-2.96	Pass	
35624.850	61.61	19.02	-1.46	79.16	Debug	V	175	22	82.23	-3.07	Pass	
34625.950	59.96	16.92	-1.08	75.80	Debug	V	175	22	82.23	-6.43	Pass	
34683.700	59.68	16.94	-1.07	75.55	Debug	V	175	22	82.23	-6.68	Pass	
34185.300	58.23	17.21	-1.08	74.35	Debug	V	175	22	82.23	-7.88	Pass	
34026.400	57.89	17.25	-0.97	74.17	Debug	V	175	22	82.23	-8.06	Pass	
33896.900	57.50	16.99	-0.83	73.65	Debug	V	175	22	82.23	-8.58	Pass	
33915.800	57.41	17.03	-0.85	73.59	Debug	V	175	22	82.23	-8.64	Pass	
33615.850	55.90	16.48	-0.69	71.68	Debug	V	175	22	82.23	-10.55	Pass	
33423.350	54.19	16.19	-0.79	69.60	Debug	V	175	22	82.23	-12.63	Pass	
32124.150	51.91	16.17	-0.36	67.72	Debug	H	175	22	82.23	-14.51	Pass	
31420.300	50.77	15.69	-0.41	66.04	Debug	H	175	22	82.23	-16.19	Pass	
31588.650	50.48	15.88	-0.79	65.56	Debug	H	175	22	82.23	-16.67	Pass	
31238.650	49.36	15.58	-0.04	64.91	Debug	H	175	22	82.23	-17.32	Pass	
30711.550	50.06	15.30	-0.57	64.79	Debug	H	175	22	82.23	-17.44	Pass	
31076.600	48.71	15.46	-0.09	64.08	Debug	H	175	22	82.23	-18.15	Pass	
30592.900	48.94	15.29	-0.36	63.86	Debug	H	175	22	82.23	-18.37	Pass	
30324.800	47.15	15.20	0.33	62.68	Debug	H	175	22	82.23	-19.55	Pass	
27474.750	43.17	14.53	-0.06	57.64	Debug	H	100	132	82.23	-24.59	Pass	

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

T6b Radiated Emissions 3m 26.5GHz – 40GHz TX-Off Part 15B



Test Information

Results Title	Radiated Emissions 3M 26.5-40GHz
File Name	T6b RE26.5g-40G FCCB Tx-Off.emi
Test Laboratory	MH-AR4, 49.2%RH, 20.6C, 997hPa
Test Engineer	MJS
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	AR4-2021-0072, 39GHz ASMR - SN-AM1-YK211800017, AM2-YK211800027, AM3-YK211800031, TX-OFF.
Configuration	Powered by -48Vdc Tested to FCC Part 15 Class B, RE 26.5GHz-40GHz, @ 3-Meters, Horn Antenna E1373, Preamp-E1525, FSW67-E1260, Cables E1501 and E1502. Internal attenuation 0dB, Previews RBW 100K; Formals RBW 1M / 3M.
Date	2021-06-04 20:02:54

Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
39736.806	30.25	17.17	-1.27	46.14	AvgMax	H	214	352	54.00	-7.86	Pass	
30405.775	28.84	14.66	0.20	43.70	AvgMax	H	318	231	54.00	-10.30	Pass	
36286.488	29.45	16.24	-2.10	43.60	AvgMax	H	201	194	54.00	-10.40	Pass	
27337.450	28.16	13.85	0.00	42.02	AvgMax	V	164	171	54.00	-11.98	Pass	
30567.213	27.55	14.71	-0.30	41.96	AvgMax	V	103	65	54.00	-12.04	Pass	
39736.806	46.06	17.17	-1.27	61.96	PeakMax	H	214	352	74.00	-12.04	Pass	
32004.006	25.94	15.34	-0.26	41.02	AvgMax	H	170	237	54.00	-12.98	Pass	
36286.488	44.50	16.24	-2.10	58.65	PeakMax	H	201	194	74.00	-15.35	Pass	
30405.775	43.48	14.66	0.20	58.33	PeakMax	H	318	231	74.00	-15.67	Pass	
30567.213	43.00	14.71	-0.30	57.41	PeakMax	V	103	65	74.00	-16.59	Pass	
27337.450	43.12	13.85	0.00	56.97	PeakMax	V	164	171	74.00	-17.03	Pass	
32004.006	40.81	15.34	-0.26	55.89	PeakMax	H	170	237	74.00	-18.11	Pass	

Preview Data

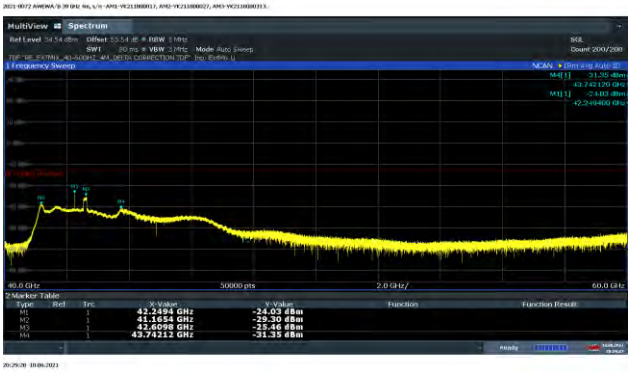
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
39736.806	35.43	17.17	-1.27	51.32	Debug	H	175	110	54.00	-2.68	Pass	
36286.488	34.41	16.24	-2.10	48.56	Debug	H	175	198	54.00	-5.44	Pass	
30405.775	33.56	14.66	0.20	48.41	Debug	H	175	88	54.00	-5.59	Pass	
27337.450	33.35	13.85	0.00	47.20	Debug	V	175	176	54.00	-6.80	Pass	
30567.213	32.59	14.71	-0.30	47.00	Debug	V	175	330	54.00	-7.00	Pass	
32004.006	30.72	15.34	-0.26	45.80	Debug	H	175	0	54.00	-8.20	Pass	
28351.806	30.76	14.10	0.10	44.96	Debug	V	175	286	54.00	-9.04	Pass	

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

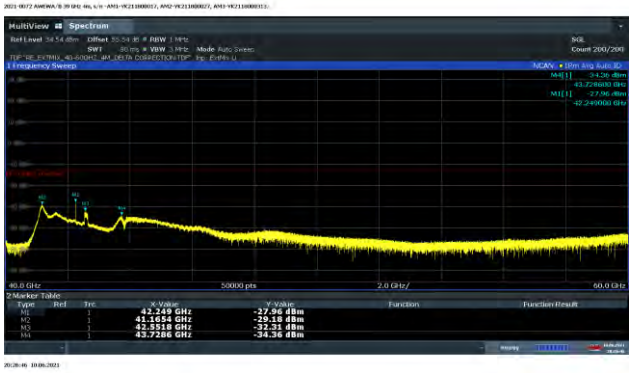
Maximum Measured Radiated Emissions -U Band 40GHz-60GHz **FCC B Part 30**

1CC

Vertical Polarization - 1 MHz RBW

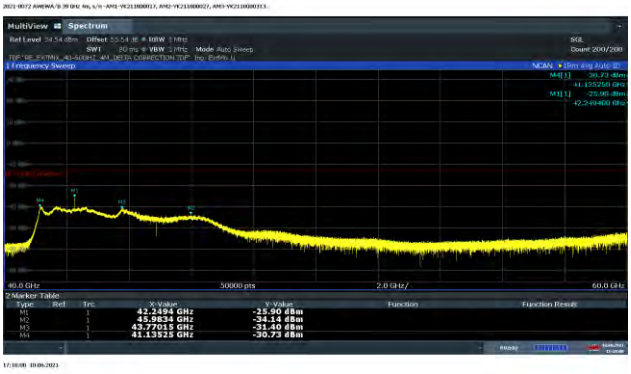


Horizontal Polarization - 1 MHz RBW

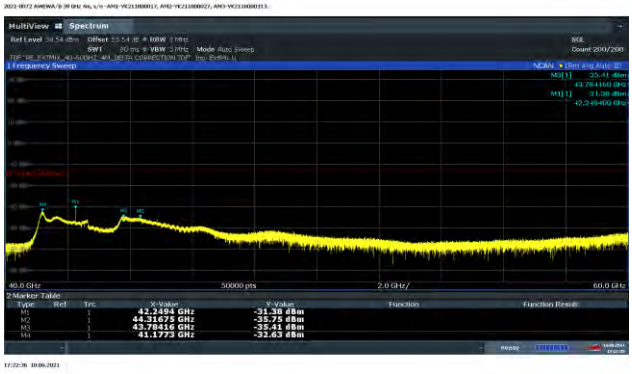


8CC

Vertical Polarization - 1 MHz RBW



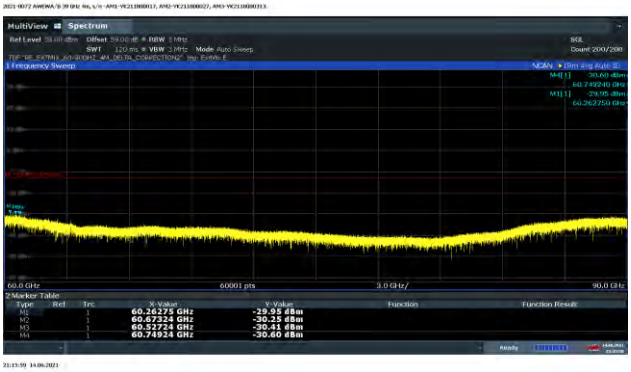
Horizontal Polarization - 1 MHz RBW



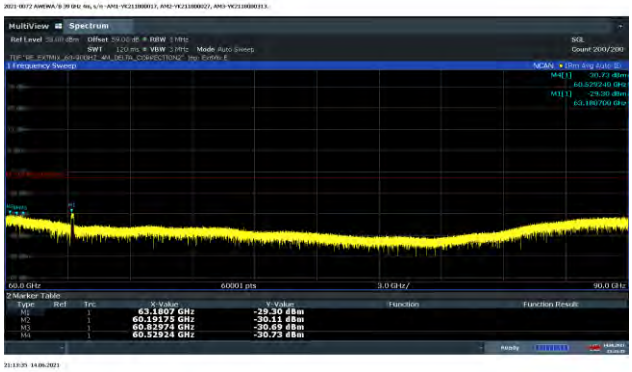
Maximum Measured Radiated Emissions -U Band 60GHz-90GHz FCC B Part 30

1CC

Vertical Polarization - 1 MHz RBW

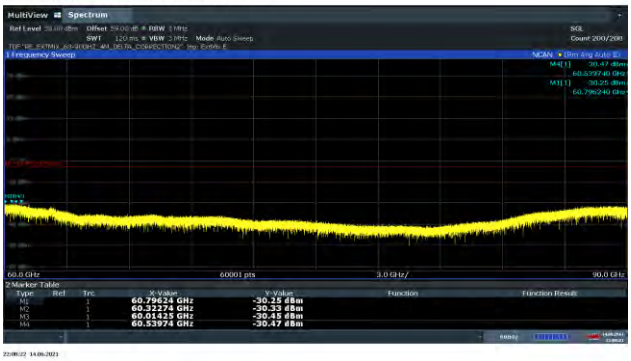


Horizontal Polarization - 1 MHz RBW

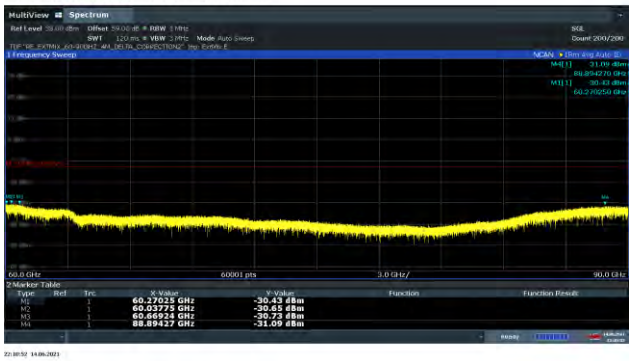


8CC

Vertical Polarization - 1 MHz RBW



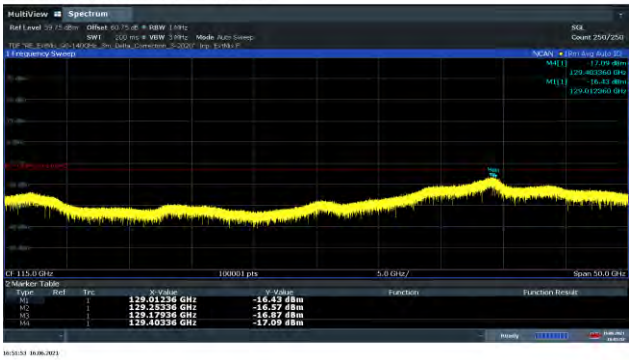
Horizontal Polarization - 1 MHz RBW



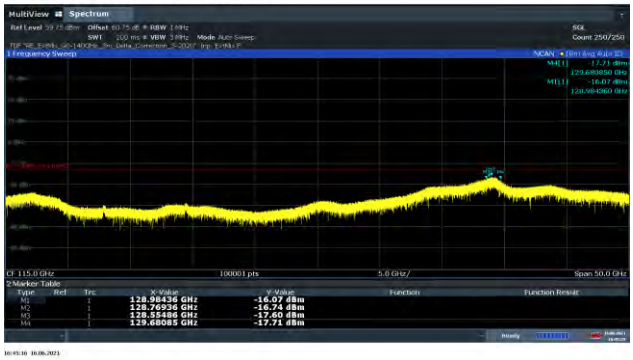
Maximum Measured Radiated Emissions -U Band 90GHz-140GHz FCC B Part 30

1CC

Vertical Polarization - 1 MHz RBW

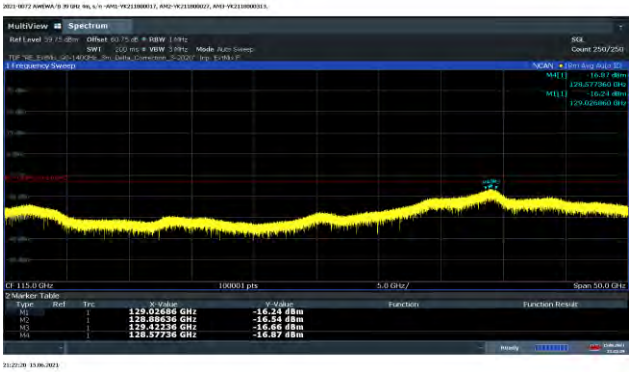


Horizontal Polarization - 1 MHz RBW

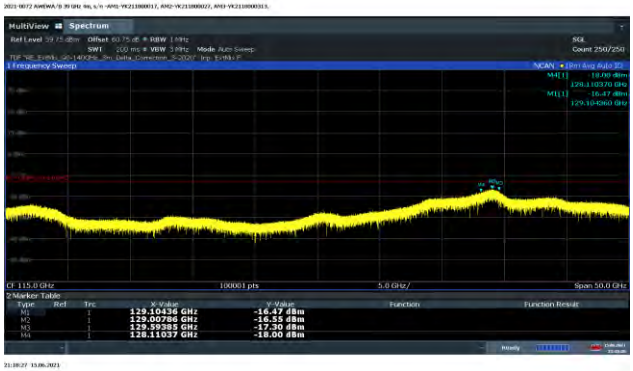


8CC

Vertical Polarization - 1 MHz RBW



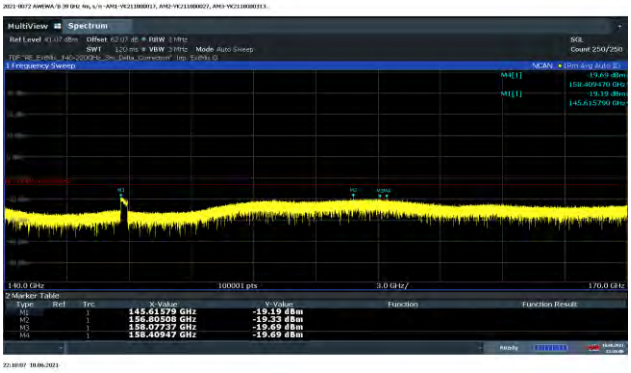
Horizontal Polarization - 1 MHz RBW



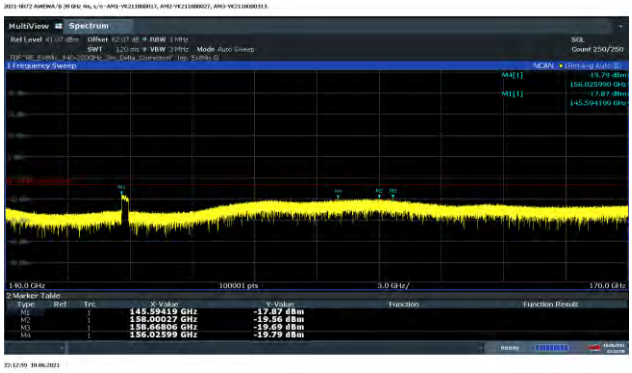
Maximum Measured Radiated Emissions -U Band 140GHz-170GHz FCC B Part 30

1CC

Vertical Polarization - 1 MHz RBW

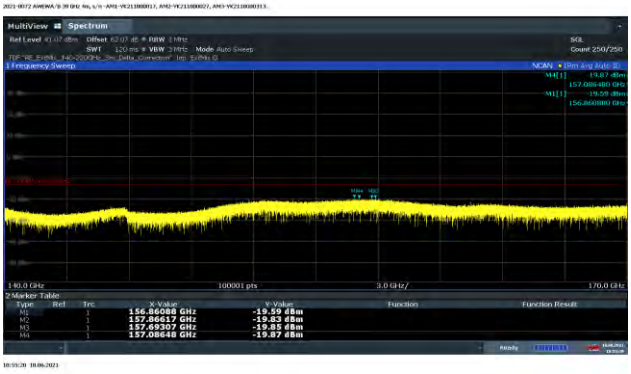


Horizontal Polarization - 1 MHz RBW

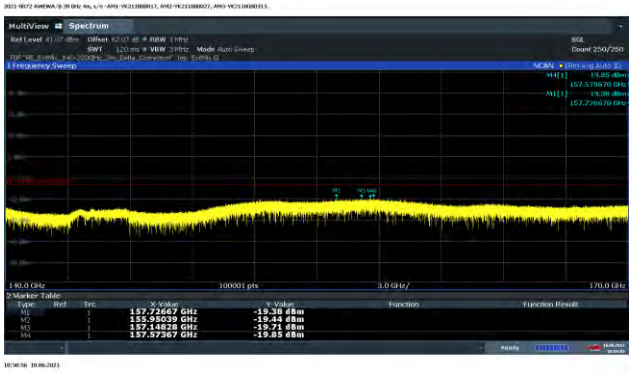


8CC

Vertical Polarization - 1 MHz RBW



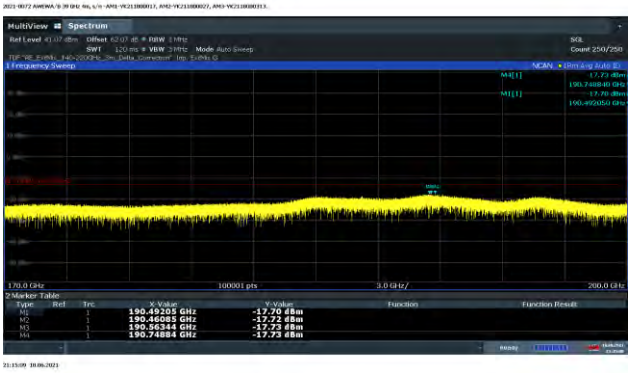
Horizontal Polarization - 1 MHz RBW



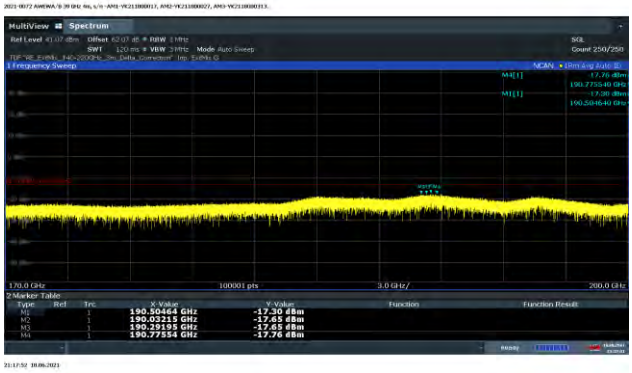
Maximum Measured Radiated Emissions -U Band 170GHz-200GHz FCC B Part 30

1CC

Vertical Polarization - 1 MHz RBW

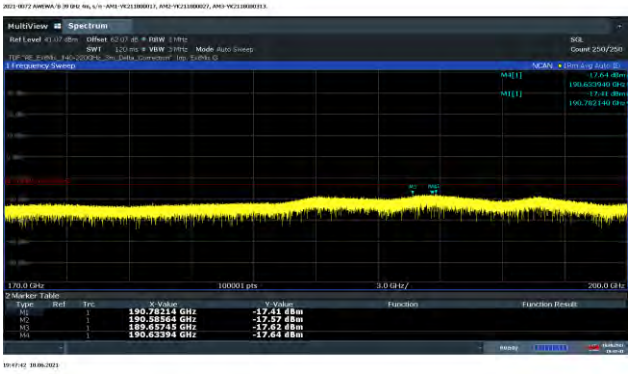


Horizontal Polarization - 1 MHz RBW

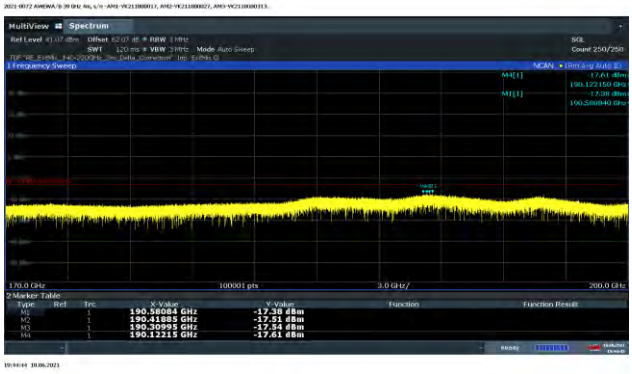


8CC

Vertical Polarization - 1 MHz RBW



Horizontal Polarization - 1 MHz RBW



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: AWEWA, 39GHz ASMR (CF = 38,447.76MHz). Two Extension Modules (FA3WA) were connected to the AWEWA. Testing was performed from 06/21/2021 through 06/22/2021 on the radio, which was located in the T-16 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 A: AC Unit Under Test

Series	Vendor	Serial Number	Model
AWEWA	Nokia	YK211800002	475170A.X31
FA3WA	Nokia	YK211800033	475002A.X31
FA3WA	Nokia	YK211800034	475002A.X31

Note: A fan was not installed on the radio during testing.
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 then cabling it to an MXA signal analyzer. A maximum deviation of 33.868 Hz was recorded which demonstrates compliance with the established design criteria of +/-1922.4 Hz (±0.05ppm).

4.6.2 Frequency Stability Results DC Model:

Frequency Stability testing was completed on: AWEWB, 39GHz ASMR (CF = 38,447.76MHz). Two Extension Modules (FA3WA) were connected to the AWEWA. Testing was performed from 06/23/2021 through 06/24/2021 on the radio, which was located in the T-16 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 B: DC Unit Under Test

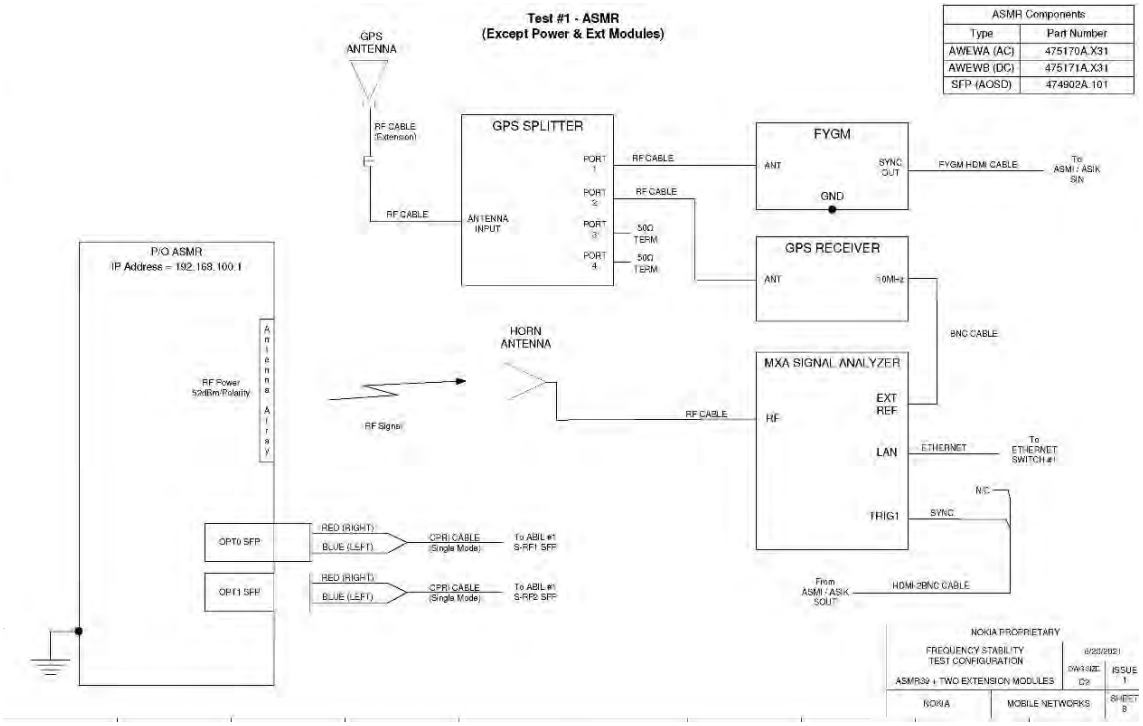
Series	Vendor	Serial Number	Com Code #
AWEWB	**Nokia**	**YK211800015**	**475171A.X31**
FA3WA	**Nokia**	**YK211800033**	**475002A.X31**
FA3WA	**Nokia**	**YK211800034**	**475002A.X31**

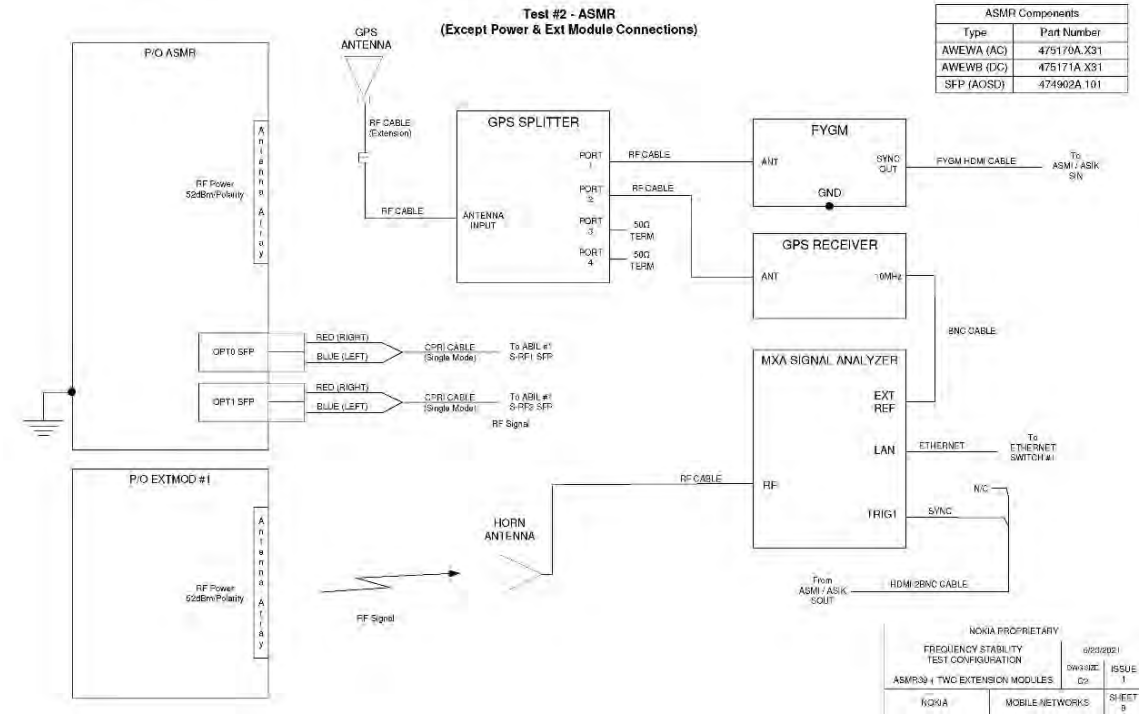
Note: A fan was not installed on the radio during testing.
The temperatures to which the UUT were subjected ranged from a high temperature of +50ºC system ambient to a low temperature of -30ºC system ambient with measurements recorded at 10C increments.

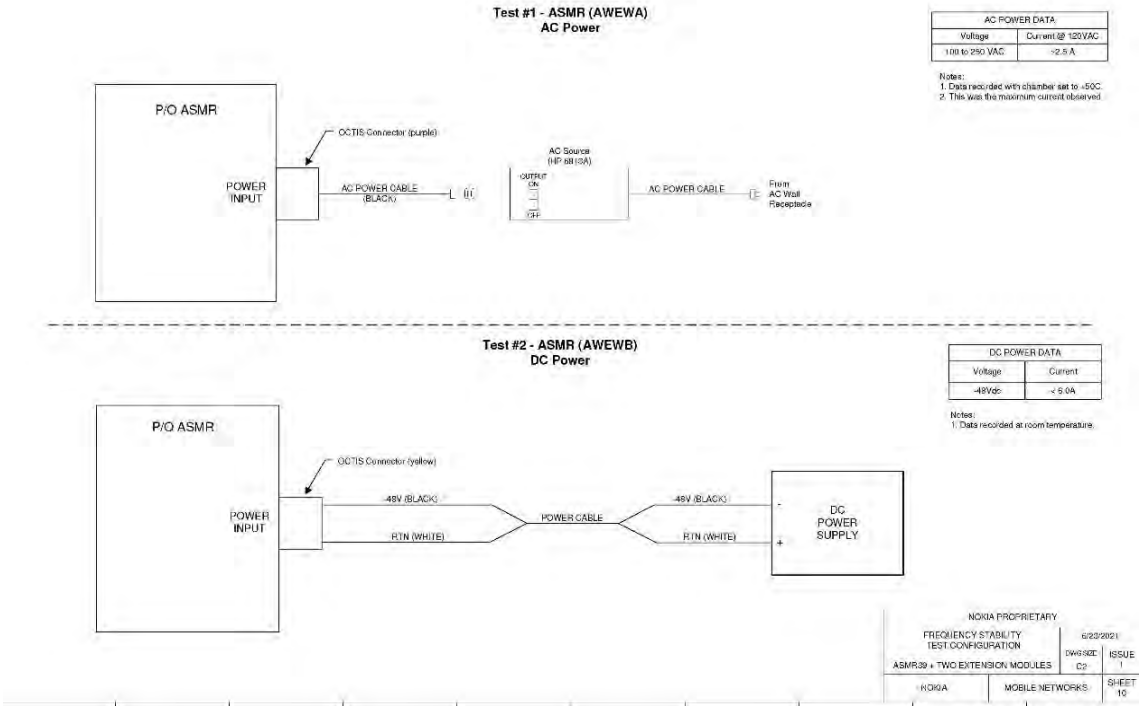
Transmit frequency error measures the deviation between the actual transmit frequency and the assigned frequency. The transmit frequency error in this case was measured by capturing the transmitted signal using a receiving antenna and then cabling it to an MXA signal analyzer. A maximum deviation of 34.980 Hz was recorded which demonstrates compliance with the established design criteria of +/-1922.4 Hz (±0.05ppm).

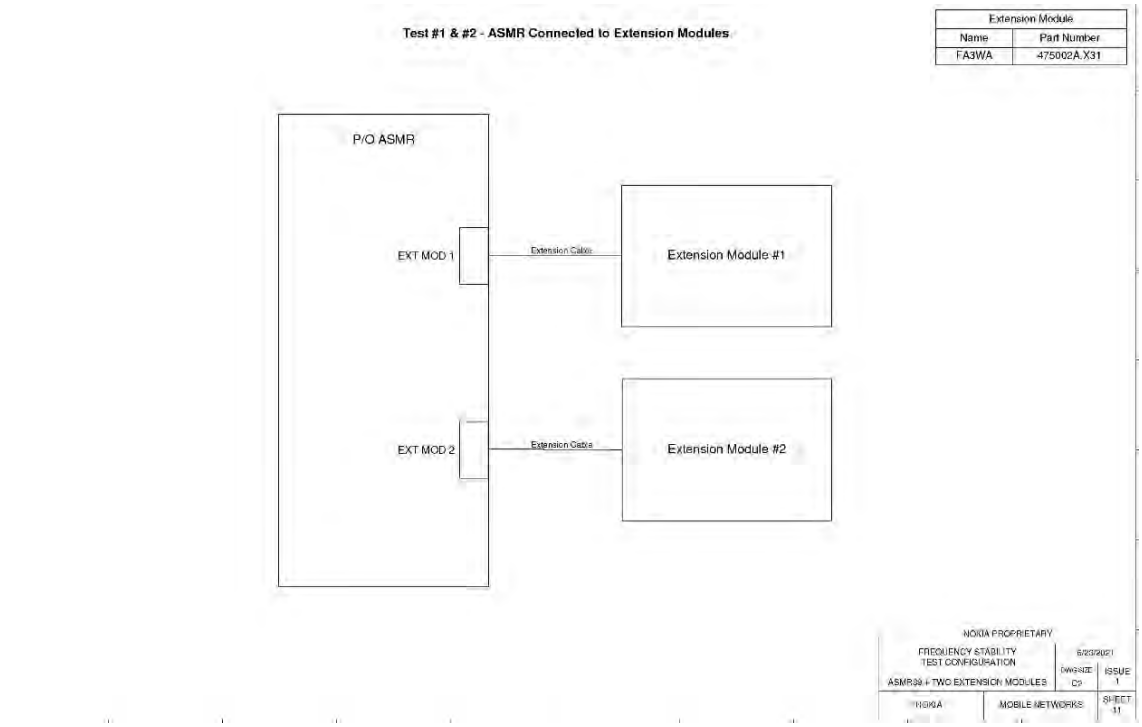
FIGURE 4.6.1: Frequency Stability Test Block Diagram

FIGURE 1: TEST BLOCK DIAGRAM






Test #1 - ASMR (AWEWA)
AC Power
AC POWER DATA
Voltage
Current @ 120VAC
100 to 250 VAC
<2.5 A
Notes:
1. Data recorded with chamber set to +50C.
2. This was the maximum current observed.
P/O ASMR
OCTIS Connector (purple)
POWER INPUT
AC POWER CABLE (BLACK)
AC Source (HP 6813A)
OUTPUT ON OFF
AC POWER CABLE
From AC Wall Receptacle
Test #2 - ASMR (AWEWB)
DC Power
DC POWER DATA
Voltage
Current
-48Vdc
< 5.0A
Notes:
1. Data recorded at room temperature.
P/O ASMR
OCTIS Connector (yellow)
POWER INPUT
48V (BLACK)
RTN (WHITE)
POWER CABLE
48V (BLACK)
RTN (WHITE)
DC POWER SUPPLY
NOKIA PROPRIETARY
FREQUENCY STABILITY TEST CONFIGURATION
6/23/2021
ASMR39 + TWO EXTENSION MODULES
DWG SIZE C2
ISSUE 1
NOKIA
MOBILE NETWORKS
SHEET 10


Test #1 & #2 - ASMR Connected to Extension Modules
Extension Module
Name
Part Number
FA3WA
475002A.X31
P/O ASMR
EXT MOD 1
Extension Cable
Extension Module #1
EXT MOD 2
Extension Cable
Extension Module #2
NOKIA PROPRIETARY
FREQUENCY STABILITY TEST CONFIGURATION
6/23/2021
ASMR39 + TWO EXTENSION MODULES
DWG SIZE C2
ISSUE 1
NOKIA
MOBILE NETWORKS
SHEET 11

AWEWA + FA3UA - AC Version

Frequency Block Tested: 39 GHz RADIO (CF = 38,447.76MHz)
Baseline Measurement at +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**13.111**
0.5	**0.78801**
1.0	**10.795**
1.5	**12.861**
2.0	**14.655**
2.5	**6.6406**
3.0	**12.787**
FCC SPECIFICATION	**+/-1922.4Hz (±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	**-3.2418**
0.5	**13.115**
1.0	**-8.0514**
1.5	**10.144**
2.0	**-0.4928**
2.5	**14.392**
3.0	**5.8396**
FCC SPECIFICATION	**+/-1922.4Hz (±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	**15.695**
0.5	**3.3412**
1.0	**10.168**
1.5	**-3.8514**
2.0	**-9.1557**
2.5	**5.6470**
3.0	**20.858**
FCC SPECIFICATION	**+/-1922.4Hz (±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	**4.7404**
0.5	**12.430**
1.0	**4.3301**
1.5	**-11.230**
2.0	**-7.7532**
2.5	**12.445**
3.0	**5.9113**
FCC SPECIFICATION	**+/-1922.4Hz (±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	**8.3116**
0.5	**4.5011**
1.0	**17.955**
1.5	**1.5506**
2.0	**-6.1657**
2.5	**14.027**
3.0	**-1.2359**
FCC SPECIFICATION	**+/-1922.4Hz (±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	**5.8857**
0.5	**12.715**
1.0	**1.8021**
1.5	**-6.3238**
2.0	**19.839**
2.5	**10.521**
3.0	**-0.83318**
FCC SPECIFICATION	**+/-1922.4Hz (±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	16.681
0.5	4.5097
1.0	-0.7665
1.5	5.2510
2.0	18.751
2.5	4.6458
3.0	-4.2273
FCC SPECIFICATION	+/-1922.4Hz (±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	13.002
0.5	-2.2340
1.0	8.7299
1.5	-7.2664
2.0	9.4134
2.5	19.129
3.0	6.2202
FCC SPECIFICATION	+/-1922.4Hz (±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	5.1157
0.5	13.770
1.0	1.8577
1.5	6.8028
2.0	5.6239
2.5	9.0679
3.0	14.552
FCC SPECIFICATION	+/-1922.4Hz (±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	**11.200**
0.5	**2.6812**
1.0	**-5.3370**
1.5	**3.8333**
2.0	**-2.3281**
2.5	**10.248**
3.0	**7.2584**
FCC SPECIFICATION	**+/-1922.4Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Upon return to +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**14.080**
0.5	**13.318**
1.0	**25.566**
1.5	**8.1983**
2.0	**10.559**
2.5	**-4.8542**
3.0	**11.513**
FCC SPECIFICATION	**+/-1922.4Hz (±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	**13.018**
0.5	**-4.5630**
1.0	**5.6430**
1.5	**20.375**
2.0	**8.4732**
2.5	**15.843**
3.0	**33.868**
FCC SPECIFICATION	**+/-1922.4Hz (±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	**8.1775**
0.5	**-0.5158**
1.0	**18.759**
1.5	**9.9124**
2.0	**2.6433**
2.5	**5.0576**
3.0	**-2.0275**
FCC SPECIFICATION	**+/-1922.4Hz (±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	**7.5559**
0.5	**12.249**
1.0	**8.2609**
1.5	**-0.9278**
2.0	**11.600**
2.5	**1.0150**
3.0	**4.9411**
FCC SPECIFICATION	**+/-1922.4Hz (±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	**6.4640**
0.5	**-0.8967**
1.0	**5.1581**
1.5	**12.431**
2.0	**-9.4260**
2.5	**3.2700**
3.0	**-6.0713**
FCC SPECIFICATION	**+/-1922.4Hz (±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	**7.0284**
0.5	**12.990**
1.0	**-3.7400**
1.5	**6.4070**
2.0	**1.0252**
2.5	**9.4424**
3.0	**11.359**
FCC SPECIFICATION	**+/-1922.4Hz (±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	**6.2074**
0.5	**1.4952**
1.0	**17.105**
1.5	**10.991**
2.0	**25.165**
2.5	**6.6824**
3.0	**3.8268**
FCC SPECIFICATION	**+/-1922.4Hz (±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	**9.8699**
0.5	**3.7053**
1.0	**1.3225**
1.5	**11.222**
2.0	**0.6512**
2.5	**17.392**
3.0	**2.3274**
FCC SPECIFICATION	**+/-1922.4Hz (±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	**14.030**
0.5	**5.1072**
1.0	**1.3910**
1.5	**12.270**
2.0	**3.0453**
2.5	**5.3259**
3.0	**-0.6639**
FCC SPECIFICATION	**+/-1922.4Hz (±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	**-3.9776**
0.5	**13.600**
1.0	**19.753**
1.5	**6.3323**
2.0	**4.3180**
2.5	**-2.3764**
3.0	**9.8002**
FCC SPECIFICATION	**+/-1922.4Hz (±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	**-0.0482**
0.5	**19.662**
1.0	**2.2966**
1.5	**8.1748**
2.0	**-2.0069**
2.5	**15.993**
3.0	**-1.5567**
FCC SPECIFICATION	**+/-1922.4Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

AWEWB + FA3WA - DC Version

Baseline Measurement at +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**5.3717**
0.5	**9.1716**
1.0	**-6.2743**
1.5	**7.7106**
2.0	**-0.1346**
2.5	**5.7867**
3.0	**-3.7020**
FCC SPECIFICATION	**38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +50°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**2.7994**
0.5	**13.860**
1.0	**-3.7563**
1.5	**-10.063**
2.0	**5.3310**
2.5	**-7.8576**
3.0	**11.628**
FCC SPECIFICATION	**38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +40°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**4.9815**
0.5	**11.152**
1.0	**-0.18084**
1.5	**5.7859**
2.0	**18.643**
2.5	**22.894**
3.0	**-3.0847**
FCC SPECIFICATION	**38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**2.9555**
0.5	**-3.7904**
1.0	**14.497**
1.5	**5.1026**
2.0	**16.990**
2.5	**11.386**
3.0	**3.9316**
FCC SPECIFICATION	**38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**7.9572**
0.5	**2.0672**
1.0	**-3.2580**
1.5	**19.936**
2.0	**5.8211**
2.5	**7.1661**
3.0	**3.9313**
FCC SPECIFICATION	**38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**6.5647**
0.5	**10.176**
1.0	**0.1091**
1.5	**9.6805**
2.0	**6.8924**
2.5	**-1.5072**
3.0	**12.604**
FCC SPECIFICATION	**38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at 0°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	19.993
0.5	9.3070
1.0	1.3352
1.5	-2.2986
2.0	9.0385
2.5	-4.7677
3.0	-3.0167
FCC SPECIFICATION	38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz
FCC RESULT	PASS

Transmit Frequency Deviation at -10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	5.1961
0.5	0.61847
1.0	15.476
1.5	8.1087
2.0	14.949
2.5	12.804
3.0	-8.8906
FCC SPECIFICATION	38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz
FCC RESULT	PASS

Transmit Frequency Deviation at -20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-1.9848
0.5	14.175
1.0	6.2946
1.5	15.101
2.0	-4.8754
2.5	6.0201
3.0	-2.8523
FCC SPECIFICATION	38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz
FCC RESULT	PASS

Transmit Frequency Deviation at -30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**19.852**
0.5	**34.980**
1.0	**8.2369**
1.5	**2.8516**
2.0	**-7.1159**
2.5	**12.406**
3.0	**3.3541**
FCC SPECIFICATION	**38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz**
FCC RESULT	**PASS**

Upon return to +25°C.

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-7.1416**
0.5	**5.6805**
1.0	**1.6613**
1.5	**-7.2289**
2.0	**0.55693**
2.5	**12.828**
3.0	**2.2910**
FCC SPECIFICATION	**38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 103% of Nominal Voltage, -49.44VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-3.2775**
0.5	**8.3858**
1.0	**-0.5131**
1.5	**4.0309**
2.0	**12.369**
2.5	**11.200**
3.0	**2.8653**
FCC SPECIFICATION	**38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 106% of Nominal Voltage, -50.88VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**22.487**
0.5	**10.983**
1.0	**2.4532**
1.5	**9.8378**
2.0	**3.5910**
2.5	**10.508**
3.0	**4.6842**
FCC SPECIFICATION	**38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 109% of Nominal Voltage, -52.32VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**4.6812**
0.5	**6.7634**
1.0	**1.9768**
1.5	**-5.6610**
2.0	**18.270**
2.5	**4.8324**
3.0	**-2.4254**
FCC SPECIFICATION	**38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 112% of Nominal Voltage, -53.76VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**4.4481**
0.5	**9.0950**
1.0	**-7.1927**
1.5	**14.007**
2.0	**-2.0294**
2.5	**14.618**
3.0	**5.0757**
FCC SPECIFICATION	**38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 115% of Nominal Voltage, -55.20VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	8.3026
0.5	14.010
1.0	2.2780
1.5	14.137
2.0	23.107
2.5	5.8085
3.0	-4.0131
FCC SPECIFICATION	38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48.0VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-9.9890
0.5	10.407
1.0	-4.7079
1.5	2.2624
2.0	10.187
2.5	1.3859
3.0	4.1272
FCC SPECIFICATION	38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -3% of Nominal Voltage, -46.56VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	10.171
0.5	0.56579
1.0	13.813
1.5	-1.7037
2.0	-6.7878
2.5	-13.105
3.0	8.0425
FCC SPECIFICATION	38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -6% of Nominal Voltage, -45.12VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-3.4635
0.5	16.086
1.0	-1.8561
1.5	2.6651
2.0	8.6077
2.5	-4.2673
3.0	12.419
FCC SPECIFICATION	38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -9% of Nominal Voltage, -43.68VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	10.350
0.5	-4.3117
1.0	16.768
1.5	7.2068
2.0	-0.6209
2.5	7.5892
3.0	17.007
FCC SPECIFICATION	38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -12% of Nominal Voltage, -42.24VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-3.5629
0.5	1.4070
1.0	-3.5125
1.5	2.2096
2.0	-14.592
2.5	7.0721
3.0	15.479
FCC SPECIFICATION	38,447.76MHz (±0.05ppm) ±0.05ppm = ±1922.45Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -15% of Nominal Voltage, -40.80VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**10.906**
0.5	**15.003**
1.0	**-0.7521**
1.5	**7.2081**
2.0	**15.326**
2.5	**2.5654**
3.0	**-1.9956**
FCC SPECIFICATION	**38,447.76MHz (±0.05ppm)** **±0.05ppm = ±1922.45Hz**
FCC RESULT	**PASS**

4.7 List of Test Equipment

4.7.1 List of Radio Measurements Test Equipment

The following equipment was used for the measurement of Radio parameters and Radiated Emissions.

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
E1373	A-Info	Horn Antenna	26.5-40GHz WR28 25 dB	LB-28-25-C2-KF	J202062735	2018-12-05	2021-12-05
E1375	A-Info	Horn Antenna	26.5-40GHz WR28 25 dB	LB-28-25-C2-KF	J202023249	2020-7-27	2022-7-27
E1384	Rohde & Schwarz	Spectrum Analyzer	2 Hz to 85 GHz	FSW85	101537	2020-08-25	2022-08-25
E483	Kikusui	Power Supply	DC 55 Volts 120 Amps	PAD 55-120L	DM000112	CNR	CNR
E772	Sunol Sciences Corp	Modular Controller	Tower / Turntable Controller	SC104V	060107-1	CNR	CNR
E1255	ETS Lindgren	Controller	Multi-Device Controller	2090	00078509	CNR	CNR
E1150	Extech	Data Logger	Pressure Humidity Temp Data Logger	SD700	Q752767	2021-01-11	2023-01-11

CNR: Calibration Not Required
CNR-V: Calibration Not Required, Must Be Verified
SPV: System Performance Verified

4.7.2 List of Radiated Emissions Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
E601	A.H. Systems Inc.	Bilogical Antenna	25 - 2000 MHz	SAS-521-2	408	2019-12-03	2021-12-03
E1074	ETS Lindgren	Horn Antenna	Double-Ridged Waveguide Horn 1-18 GHz	3117	00135194	2019-05-01	2021-08-01
E1373	A-Info	Horn Antenna	26.5-40GHz WR28 25 dB	LB-28-25-C2-KF	J202062735	2018-12-05	2021-12-05
E1452	A-Info	Horn Antenna	18 to 26.5 GHz WR42 25 dB	LB-42-25-C2-KF	J202066361	2020-08-11	2022-08-11
E1260	Rohde & Schwarz	Spectrum Analyzer	2 Hz-67 GHz	FSW67	104007	2020-08-21	2022-08-21
E447	Hewlett Packard	Pre-Amplifier	Preamplifier 1-26.5 GHz	8449B	3008A01384	2020-08-31	2022-08-31
E813	Sonoma Instrument Co.	Amplifier	9kHz-1GHz	310N	186750	2020-10-20	2022-10-20
E1525	A.H. Systems Inc.	Pre-Amplifier	18 GHz-40 GHz, 37 dB	PAM-1840VH	186	2020-11-30	2022-11-30
E980	Trilithic	Filter, Low Pass	PCS	10LC1790-3-AA	PCS-LPF-12	CNR-V	CNR-V

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
E1516	Reactel, Inc.	Filter, Low Pass	1 - 34 GHz, 2.0 dB	11LS-X34GK11	SN20-01	2021-03-15	2022-03-15
E1476	Reactel, Inc.	Filter, Low Pass	DC - 20 GHz	11LS-X20GS11	SN20-01	2020-09-15	2021-09-15
E1119	Extech	Data Logger	Pressure Humidity Temp data logger	SD700	Q668960	2021-01-11	2023-01-11
E483	Kikusui	Power Supply	DC 55 Volts 120 Amps	PAD 55-120L	DM000112	CNR	CNR
E588	Sunol Sciences Corp	System Controller	Tower / Turntable Controller	SC99V	32802-1	CNR	CNR
E1308	Rohde & Schwarz	Harmonic Mixer	Down Converter 90-140GHz	FS-Z140	101008	2017-04-06, - in Service 2018-07-01	SPV
E1311	Rohde & Schwarz	Harmonic Mixer	Down Converter 40-60GHz	FS-Z60	100977	2017-12-21, - in Service 2018-07-01	SPV
E1312	Rohde & Schwarz	Harmonic Mixer	Down Converter 60-90GHz	FS-Z90	101719	2017-08-09 -in Service 2018-07-01	SPV
E1313	Rohde & Schwarz	Harmonic Mixer	Down Converter, 140-220GHz	FS-Z220	100960	2017-12-21, - in Service 2018-07-01	SPV
E1315	RS Microwave Company, Inc.	Microwave Filter	40 GHz High Pass Filter	P/N 60733A	007	CNR-V	CNR-V
E1323	Mi-Wave Millimeter Wave Products, Inc.	Horn Antenna	G-band pyramidal horn antenna 25dB 140 - 220 GHz	261G-25/387		2017-12-21, - in Service 2018-07-01	SPV
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	SPV
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	SPV
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	SPV

CNR: Calibration Not Required
CNR-V: Calibration Not Required, Must Be Verified
SPV: System Performance Verified

Note* - This is a brand-new factory calibrated equipment. Keysight Liberty Labs who does the 17025-calibration was closed due to Covid-19. Prior to testing, a verification test of this equipment was performed in house with a17025 calibrated network analyzer and the factory calibration was verified.

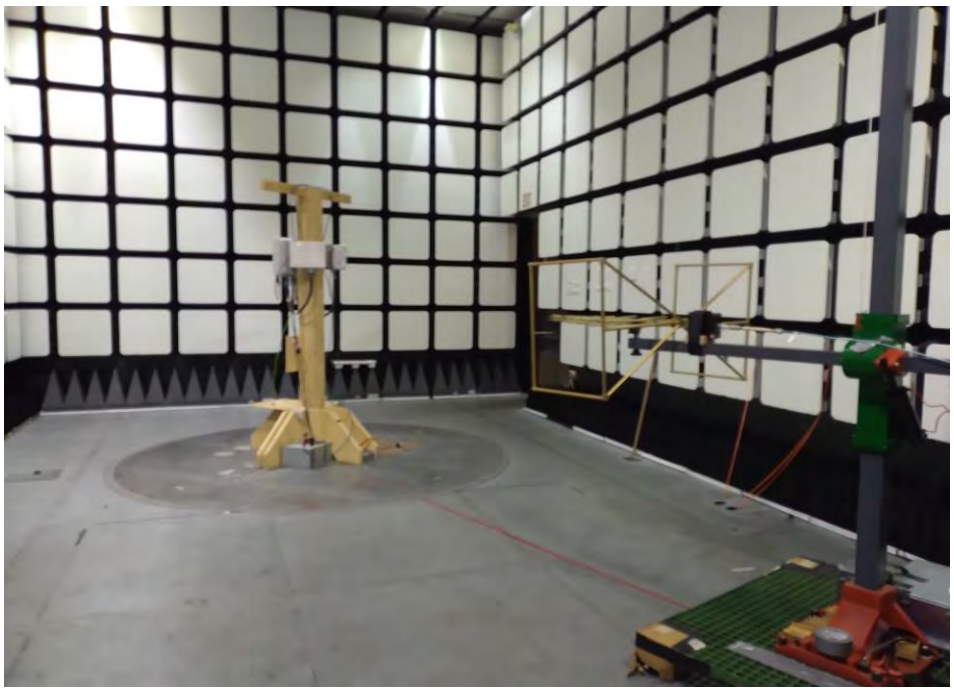
4.7.3 List of Frequency Stability Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
TH514-T16	Envirotronics	Controller		Envirotronics SPPCM	SP000637	2021-06-08	2023-06-08
TH-T16	Envirotronics	Thermal Chamber		N/A	3015243	N/A	N/A
TH149	Fluke	Multimeter	Digital Multimeter	87III	7519030337	2019-07-22	2021-07-22
EIH74	KeySight Technologies	EMI Receiver	MXA Signal Analyzer	N9020B	MY57120303	2020-12-21	2022-12-21
TH288	Yokogawa	Data Acquisition Unit	Recorder	MV2048-2-4-2-1-1D	S5JC04071	2021-02-25	2023-02-25
N/A	HP	Power Supply	AC Source	6813A	3524A-00321	N/A	N/A
N/A	Agilent	Power Supply	DC Source	N5767At	US13N5074M	N/A	N/A

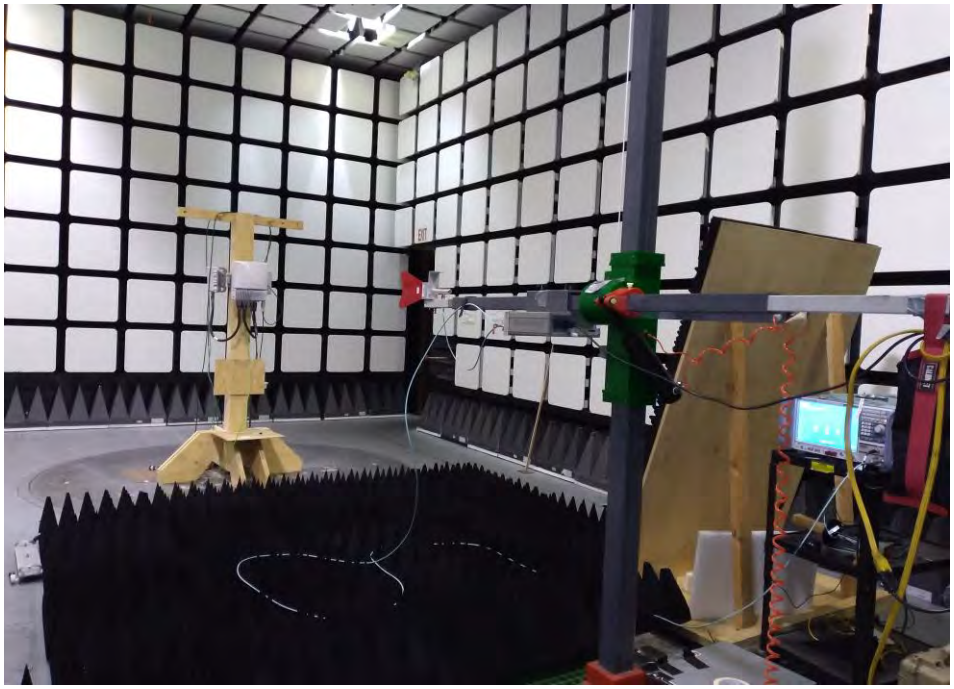
4.8 PHOTOGRAPHS OF THE TEST SETUPS

Radio Measurements and Radiated Emissions Test

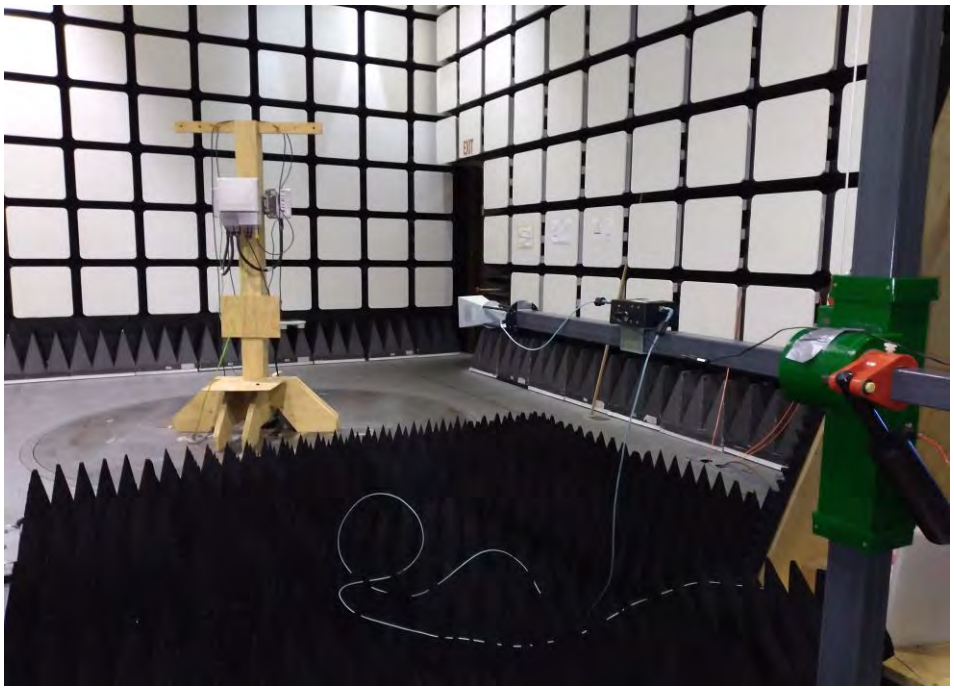
30 MHz-1 GHz



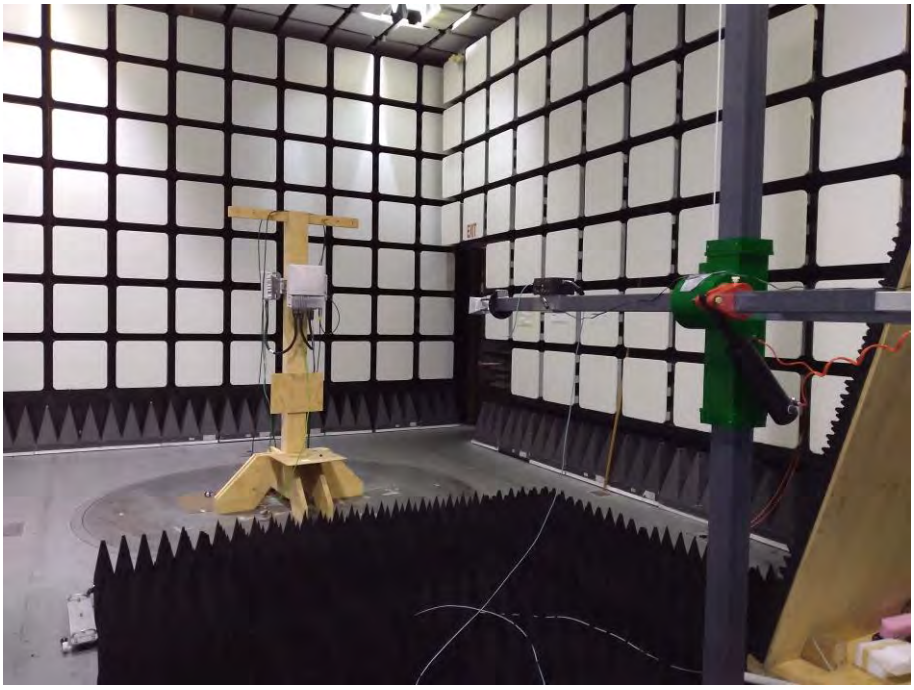
1 GHz – 18 GHz



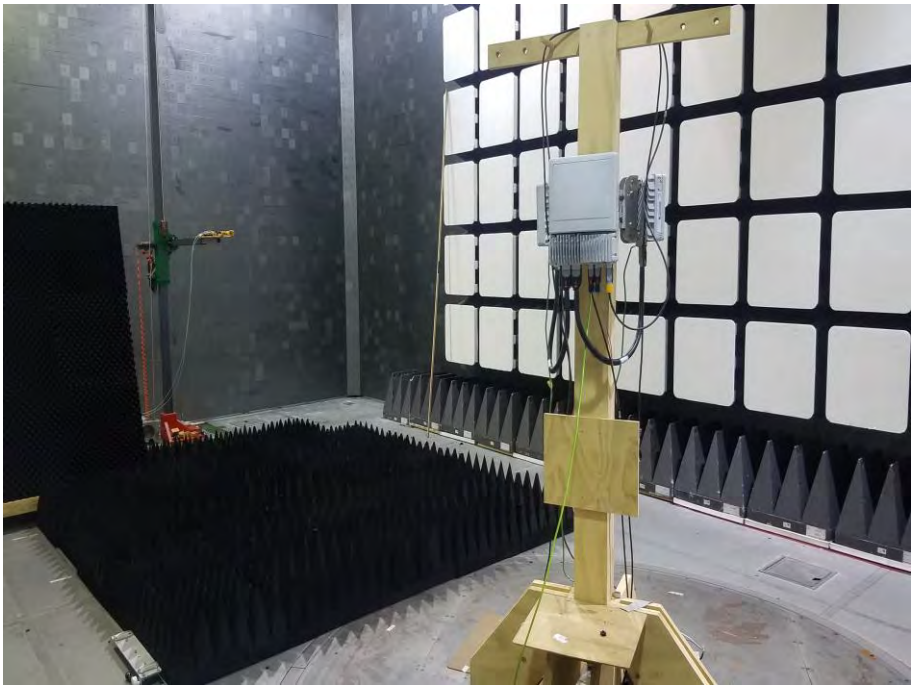
18GHz-26.5GHz



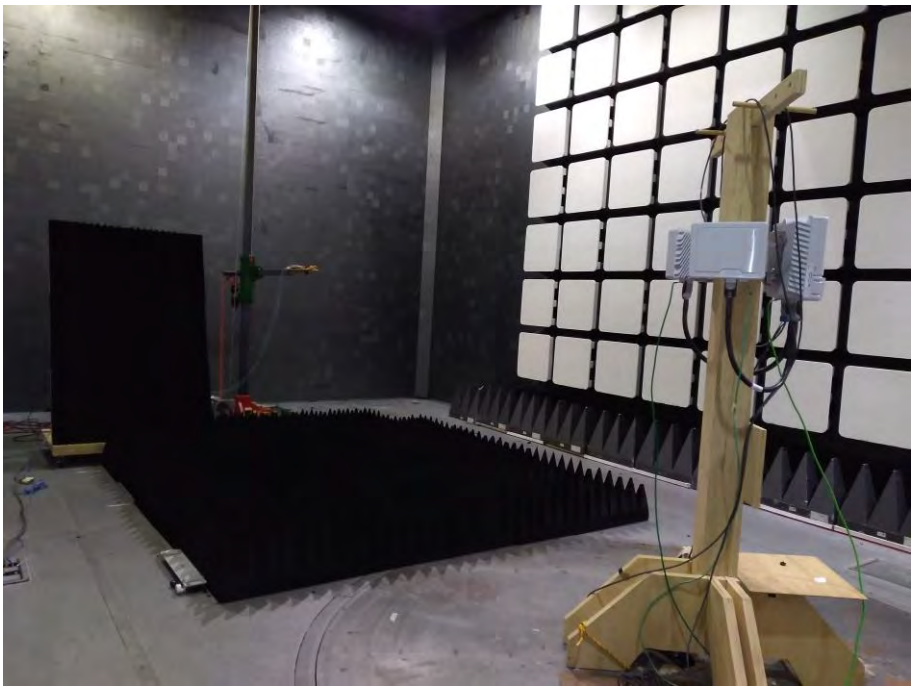
26.5GHz-40 GHz



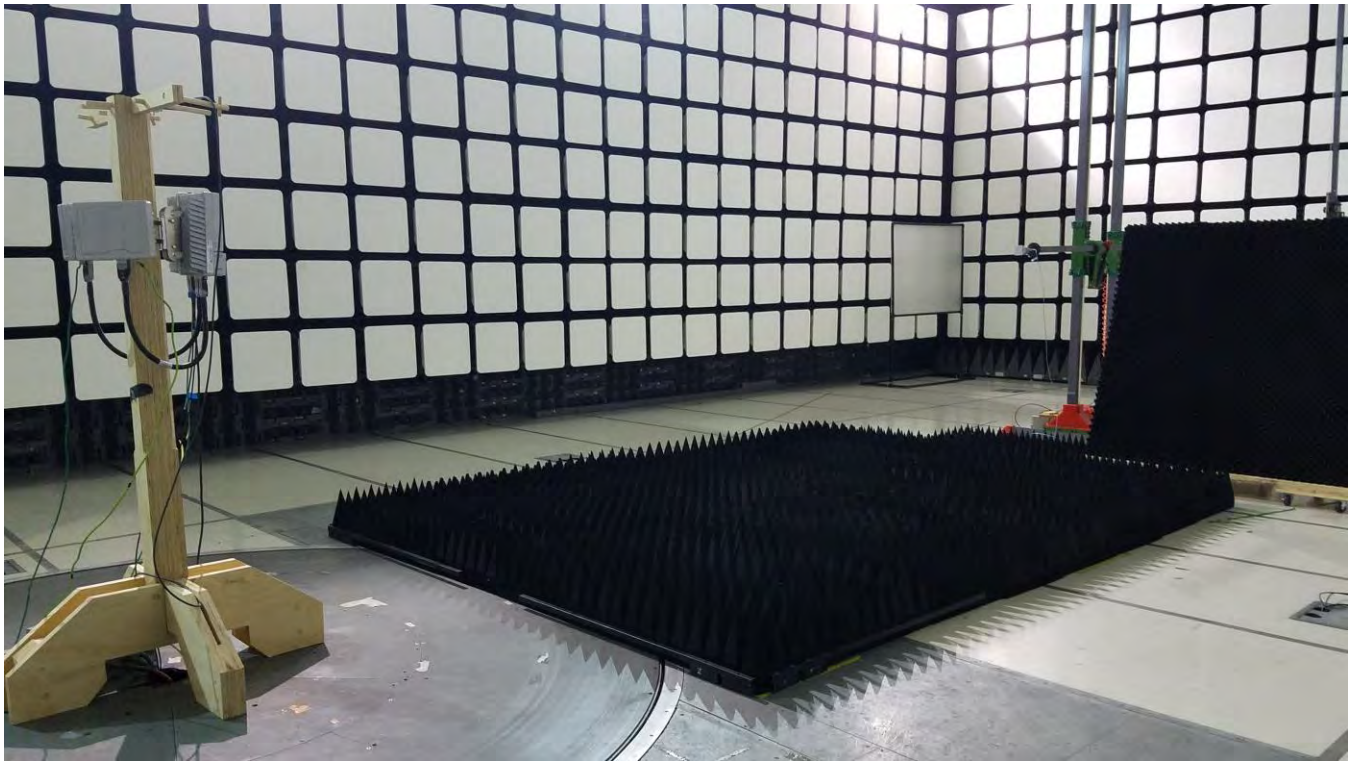
40GHz-60 GHz



60GHz-90 GHz

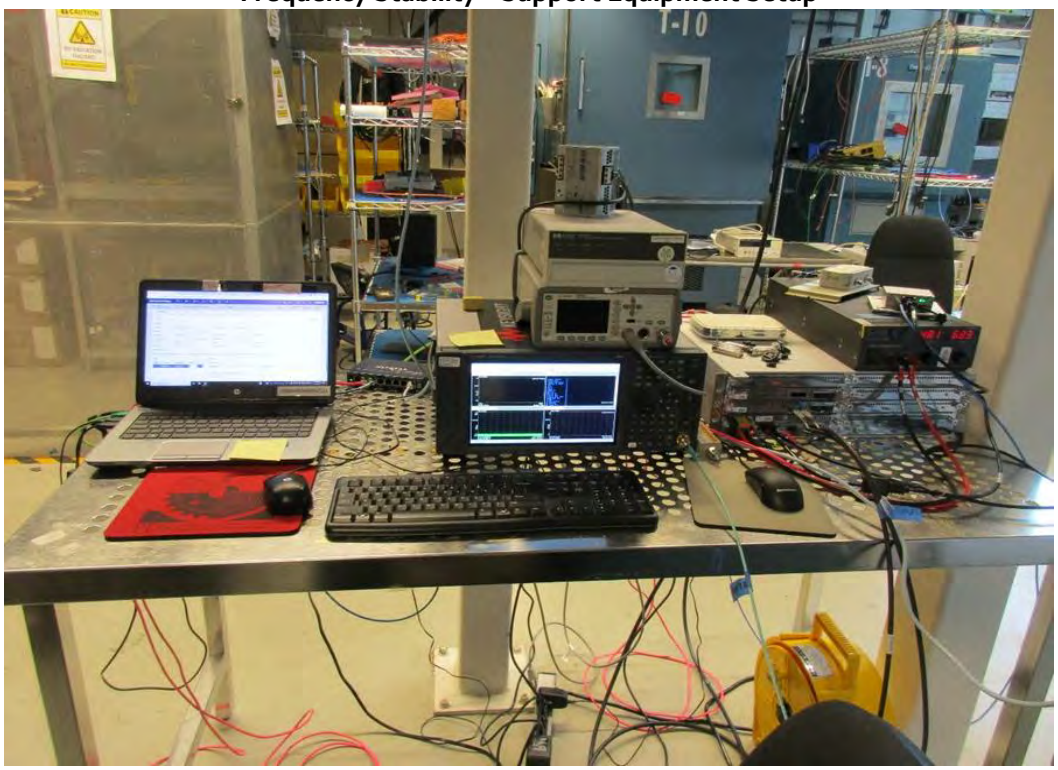


Radio Testing



Frequency Stability Test - in thermal chamber

Frequency Stability - Support Equipment Setup



4.9 FACILITIES AND ACCREDITATION

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

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

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

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

and is as listed in the Table below.

OET Accredited Test Firm Scope List

Test Firm: Nokia, Global Product Compliance Lab

Scope	FCC Rule Parts	Maximum Assessed Frequency, MHz	Status	Expiration Date	Recognition Date
Unintentional Radiators	FCC Part15, Subpart B	40000	Approved	9/30/2020	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®

ilac-MRA

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).

2020-09-25 through 2021-09-30
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.

Radiometer Physics
A Rohde & Schwarz Company

Calibration Certificate
Kalibrierschein

Certificate Number 24-0060-100977-01
Zertifikatsnummer

Unit Data

Item
Gegenstand
Harmonic Mixer, 40 GHz to 60 GHz

Manufacturer
Hersteller
RPG

Type
Typ
RPG FS-Z60

Material Number
Materialnummer
1048.0171.02

Serial Number
Seriennummer
100977

Asset Number
Inventarnummer

Order Data

Customer
Auftraggeber

Order Number
Bestellnummer

Date of Receipt
Eingangsdatum

Performance

Place and Date of Calibration
Ort und Datum der Kalibrierung
Meckenheim, 2017-12-21

Scope of Calibration
Umfang der Kalibrierung
Standard Calibration

Statement of Compliance (Incoming)
Konformitätsaussage (Anlieferung)
New device

Statement of Compliance (Outgoing)
Konformitätsaussage (Auslieferung)
All measured values are within the data sheet specifications.

Extend of Calibration Documents
Umfang des Kalibrierdokuments
2 pages Calibration Certificate
5 pages Outgoing Results

This calibration certificate documents, that the named item is tested and measured against defined specifications. Measurement results are located usually in the corresponding interval with a probability of approx. 95% (coverage factor k = 2). Calibration is performed with test equipment and standards directly or indirectly traceable by means of approved calibration techniques to the PTB/DKD or other national/international standards, which realize the physical units of measurement according to the International System of Units (SI). In all cases where no standards are available, measurements are referenced to standards of the R&S laboratories. Principles and methods of calibration correspond with EN ISO/IEC 17025. This calibration certificate may not be reproduced other than in full. Calibration certificates without signatures are not valid. The user is obliged to have the object recalibrated at appropriate intervals.

Dieser Kalibrierschein dokumentiert, dass der genannte Gegenstand nach festgelegten Vorgaben geprüft und gemessen wurde. Die Messwerte lagen im Regelfall mit einer Wahrscheinlichkeit von annähernd 95% im zugeordneten Werteintervall (Erweiterte Messunsicherheit mit k = 2). Die Kalibrierung erfolgte mit Messmitteln und Normalen, die direkt oder indirekt durch Ableitung mittels anerkannter Kalibriertechniken rückgeführt sind auf Normale der PTB/DKD oder anderer nationaler/internationaler Standards zur Darstellung der physikalischen Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI). Wenn keine Normale existieren, erfolgt die Rückführung auf Bezugsnormale der R&S-Laboratorien. Grundsätze und Verfahren der Kalibrierung beziehen sich auf EN ISO/IEC 17025. Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Kalibrierscheine ohne Unterschriften sind ungültig. Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

Radiometer Physics GmbH; Meckenheim

Date of Issue
Ausstellungsdatum
2017-12-21

Head of Laboratory
Laborleitung
Schulze

Person Responsible
Bearbeiter
Wildfang

Radiometer Physics GmbH ● Werner-von-Siemens-Str. 4 ● 53340 Meckenheim ● Telephone national: 02225/99981-0 international: 0049 2225-99981-0
Fax: 02225/99981-99 ● Managing Director: Achim Walber, Dr. Thomas Rose ● Company's Place of Business: Meckenheim
Commercial Register No.: Bonn, HRB 10291 ● VAT Identification No.: DE 123 377 395

Calibration Method
Kalibrieranweisung

RPG-PAQA-TN-2014-002

Relative Humidity **20 % - 80 %**
Relative Luftfeuchte

Ambient Temperature
Umgebungstemperatur

(23 $^{+7}_{-3}$) °C

Working standards used (having a significant effect on the accuracy)
Verwendete Gebrauchsnormale (mit signifikantem Einfluss auf die Genauigkeit)

Item Gegenstand	**Type** Typ	**Serial Number** Seriennummer	**Calibration Certificate Number** Kalibrierscheinnummer	**Cal. Due** Kalibr. bis
Vector Network Analyzer	R&S® ZVA67	101097	20-300432406	2020-07-21
Powersensor	R&S® NRP-Z55	140093	20-300426315	2018-05-17
Powersensor	R&S® NRP-Z57	101423	20-541799	2019-04-27

UGB1 **A compliance statement may be possible where a confidence level of less than 95 % is acceptable.**
Die Bestätigung der Konformität ist möglich, sofern ein Grad des Vertrauens von weniger als 95 % akzeptabel ist.

UGB2 **A non-compliance statement may be possible where a confidence level of less than 95 % is acceptable.**
Die Bestätigung der Nicht-Konformität ist möglich, sofern ein Grad des Vertrauens von weniger als 95 % akzeptabel ist.

Ref.: ILAC-G8:03/2009 'Guidelines on the Reporting of Compliance with Specification'.

Notes
Anmerkungen

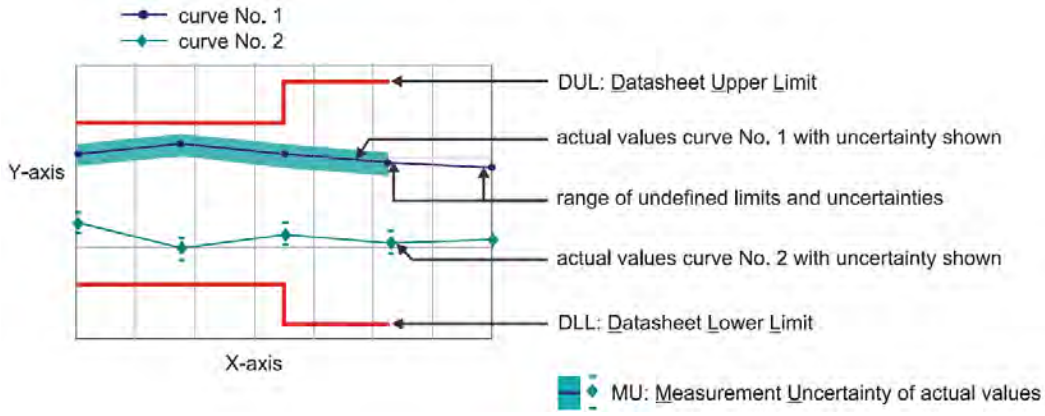
If the new product is stored under the climate conditions as specified in the data sheet upon delivery, the product's accuracy is not significantly affected within 12 month after its calibration in our factory. In this case, the recommended calibration interval starts on the date when the product is actually put into operation.

Outgoing Results

The following abbreviations may be used in this document

{a}	No measurement uncertainty stated because the errors always add together. So it is sure that a measurement result evaluated as "PASS" is pass.
{b}	The measurement uncertainty depends on the measurement result. The stated measurement uncertainty is valid for the close area around the specification. Measurement results outside the close area have a higher measurement uncertainty but are within the specification.
{c}	Functional test, therefore no measurement uncertainty is stated.
{d}	Typical value, refer to performance test.
{e}	The measurement uncertainty is taken into account when setting the measuring system.
DL or DT	Data Limit for symmetrical tolerance limits
DLL	Datasheet Lower Limit
DUL	Datasheet Upper Limit
MU	Measurement Uncertainty
MLL or MLV	Measurement Uncertainty Lower Value
MUL or MUV	Measurement Uncertainty Upper Value
Nom.	Nominal Value
Dev.	Deviation
MErr.	Measurement Error
Act.	Actual Value
UGB	Uncertainty Guard Band: Measuring uncertainty violates the data (spec.) limit.
UGB1	Measurement results marked as UGB1 show conformity with a probability of >50 %and <95 %.
UGB2	Measurement results marked as UGB2 show non-conformity with a probability of >50 %and <95 %.
DU	Datasheet Uncertainty

Explanation of charts

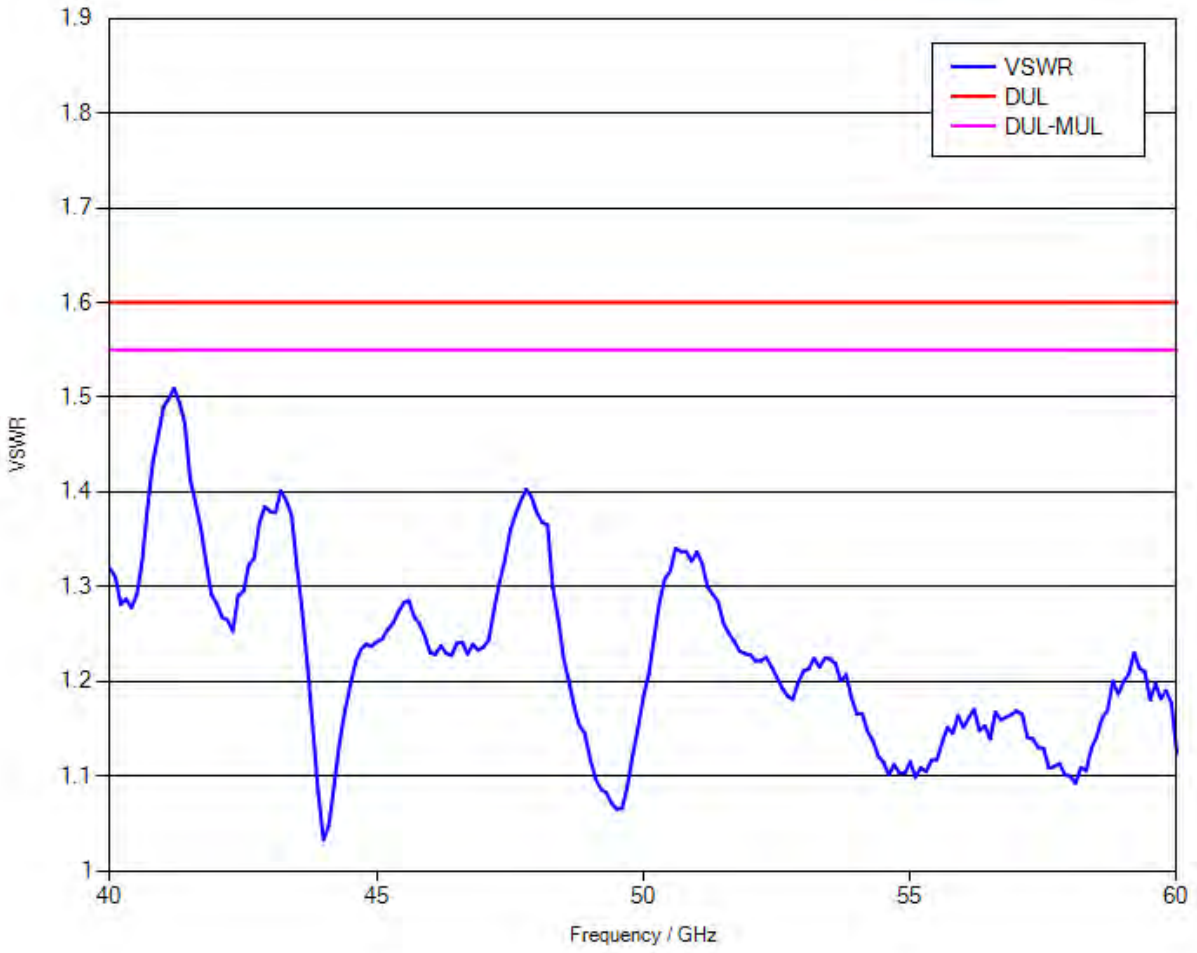


Software used for measurement

Item Type	Version	Remark
Measurement Studio Professional Edition	2013	
MixerCertification	7_07	

1.1 RF Input – VSWR

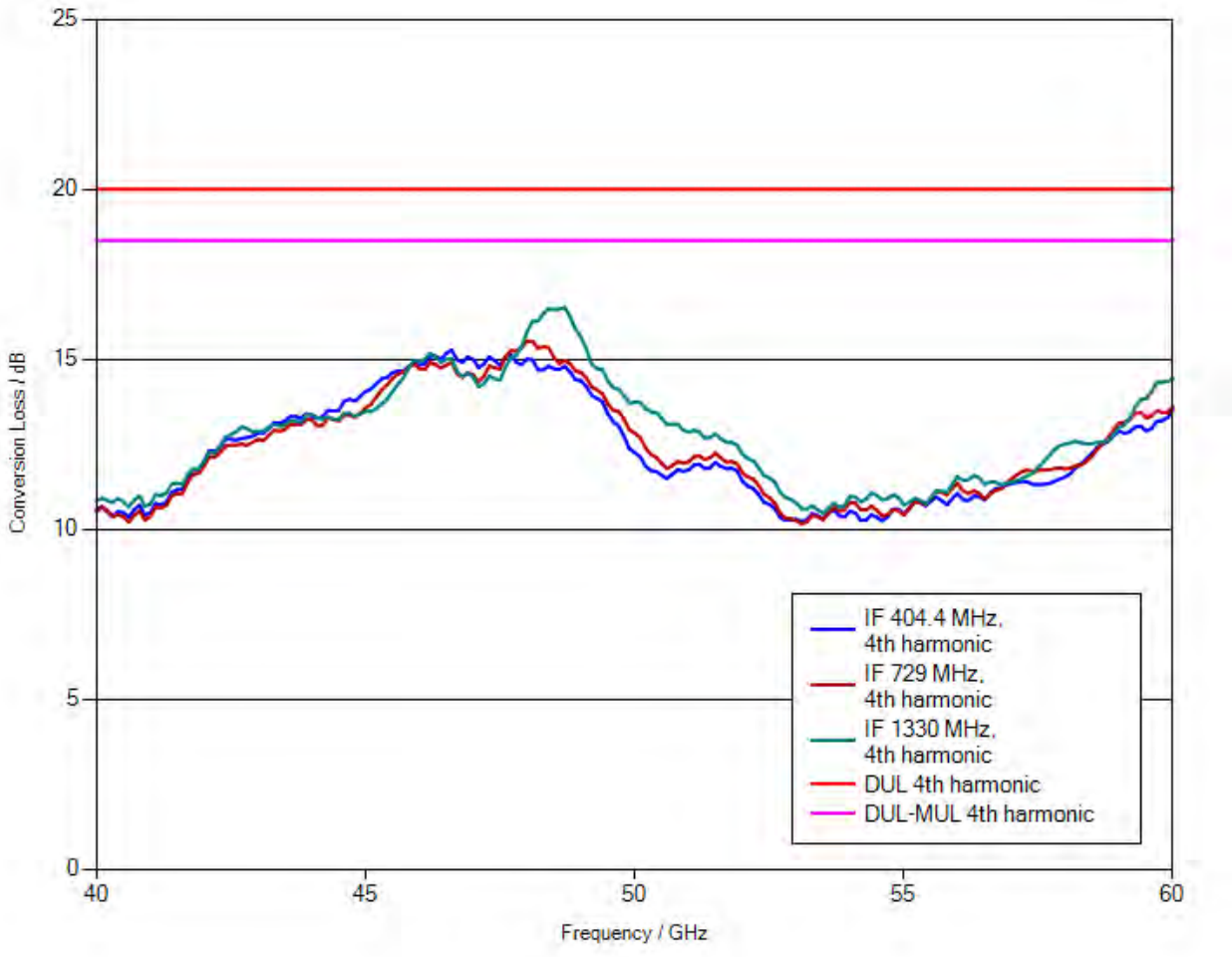
Measurement uncertainty: 0.05 (VSWR)



1.2 Conversion loss

LO level +13 dBm nominal
Bias 0 A

Measurement uncertainty: 1.5 dB



Note: Numeric calibration data can be found attached to the PDF file of the calibration certificate. Click the "paper clip" symbol to display the file.

The file has been renamed for safety reasons.
When downloading the file onto your PC, please delete the ".file" extension and unzip the data.

1.3 Frequency response within 1 GHz

	DUL	Actual (worst case)	Evaluation
IF = 404.4 MHz, 4th harmonic	4 dB	2.02 dB	PASS
IF = 729 MHz, 4th harmonic	4 dB	1.78 dB	PASS
IF = 1330 MHz, 4th harmonic	4 dB	2.35 dB	PASS

ROHDE&SCHWARZ

Calibration Certificate
Kalibrierschein

Certificate Number 24-0090-101719-01
Zertifikatsnummer

Unit Data

Item
Gegenstand
Harmonic Mixer, 60 GHz to 90 GHz

Manufacturer
Hersteller
ROHDE & SCHWARZ

Type
Typ
R&S® FS-Z90

Material Number
Materialnummer
1048.0371.02

Serial Number
Seriennummer
101719

Asset Number
Inventarnummer

Order Data

Customer
Auftraggeber

Order Number
Bestellnummer

Date of Receipt
Eingangsdatum

Performance

Place and Date of Calibration
Ort und Datum der Kalibrierung
Meckenheim, 2017-08-09

Scope of Calibration
Umfang der Kalibrierung
Standard Calibration

Statement of Compliance (Incoming)
Konformitätsaussage (Anlieferung)
New device

Statement of Compliance (Outgoing)
Konformitätsaussage (Auslieferung)
All measured values are within the data sheet specifications.

Extend of Calibration Documents
Umfang des Kalibrierdokuments
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Radiometer Physics GmbH; Meckenheim

Date of Issue
Ausstellungsdatum
2017-08-11

Head of Laboratory
Laborleitung
Ceru

Person Responsible
Bearbeiter
Heinze

Vers2010-05-05/
RPG2014-02-28

Radiometer Physics GmbH ● Werner-von-Siemens-Str. 4 ● 53340 Meckenheim ● Telephone national: 02225/99981-0 international: 0049 2225-99981-0
Fax: 02225/99981-99 ● Managing Director: Achim Walber, Dr. Thomas Rose ● Company's Place of Business: Meckenheim
Commercial Register No.: Bonn, HRB 10291 ● VAT Identification No.: DE 123 377 395

Calibration Method
Kalibrieranweisung

RPG-PAQA-TN-2014-002

Relative Humidity **20 % - 80 %**
Relative Luftfeuchte

Ambient Temperature
Umgebungstemperatur

(23 $^{+7}_{-3}$) °C

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Powersensor	R&S® NRP-Z55	140093	20-300426315	2018-05-17
Powersensor	R&S® NRP-Z58	101063	20-611482	2018-07-21
Calibration kit	WR12	E10001	RPG-PAQA-TN-2014-005	2019-02-01

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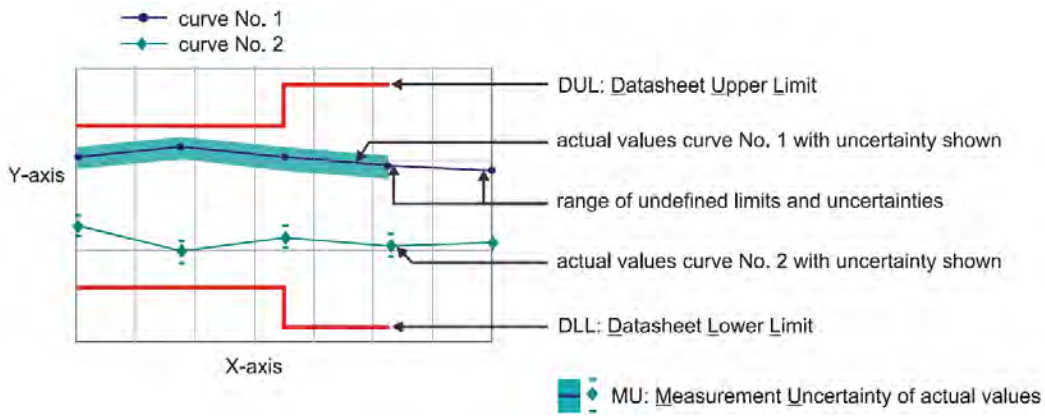
Explanation of charts

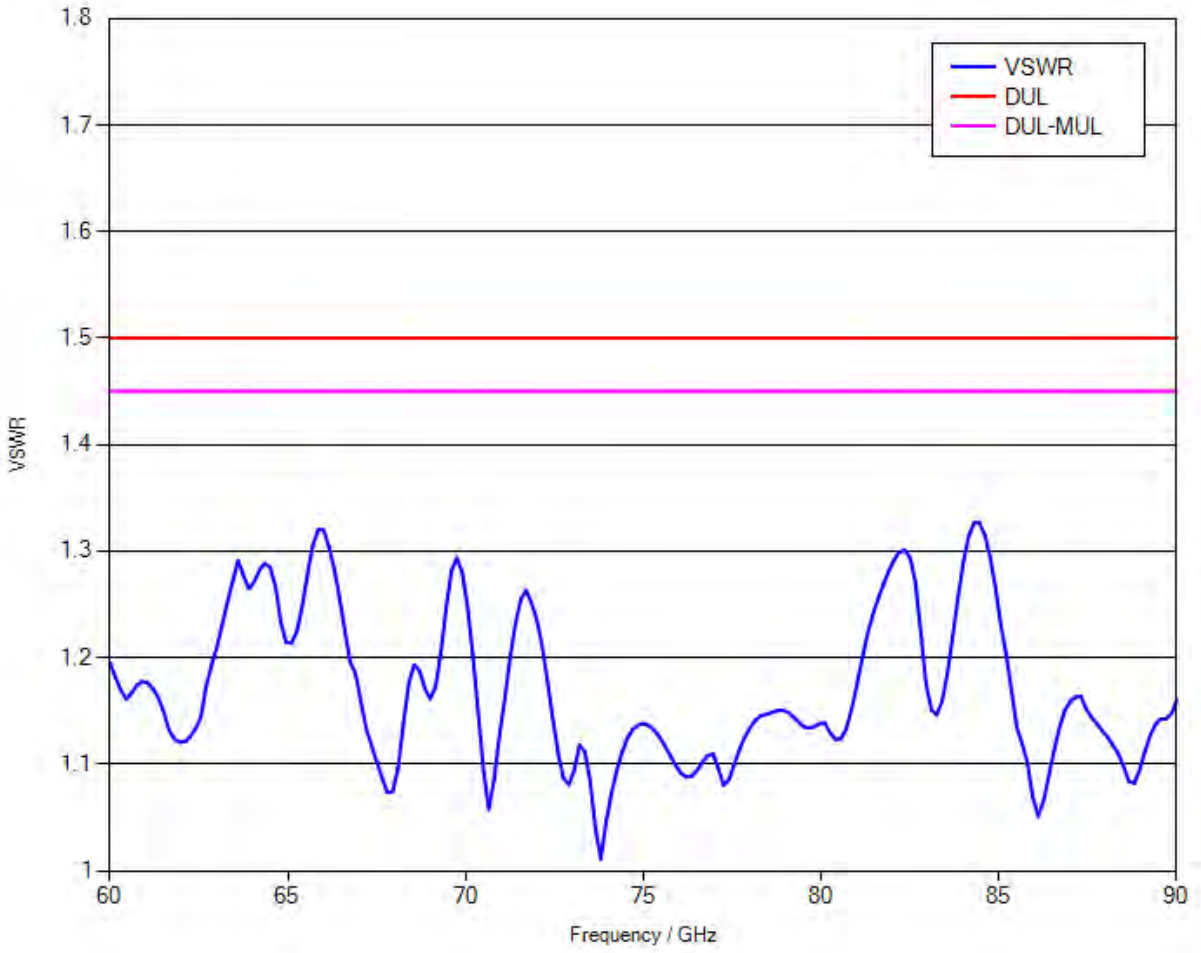


Software used for measurement

Item Type	Version	Remark
Measurement Studio Professional Edition	2013	
MixerCertification	only	

1.1 RF Input – VSWR

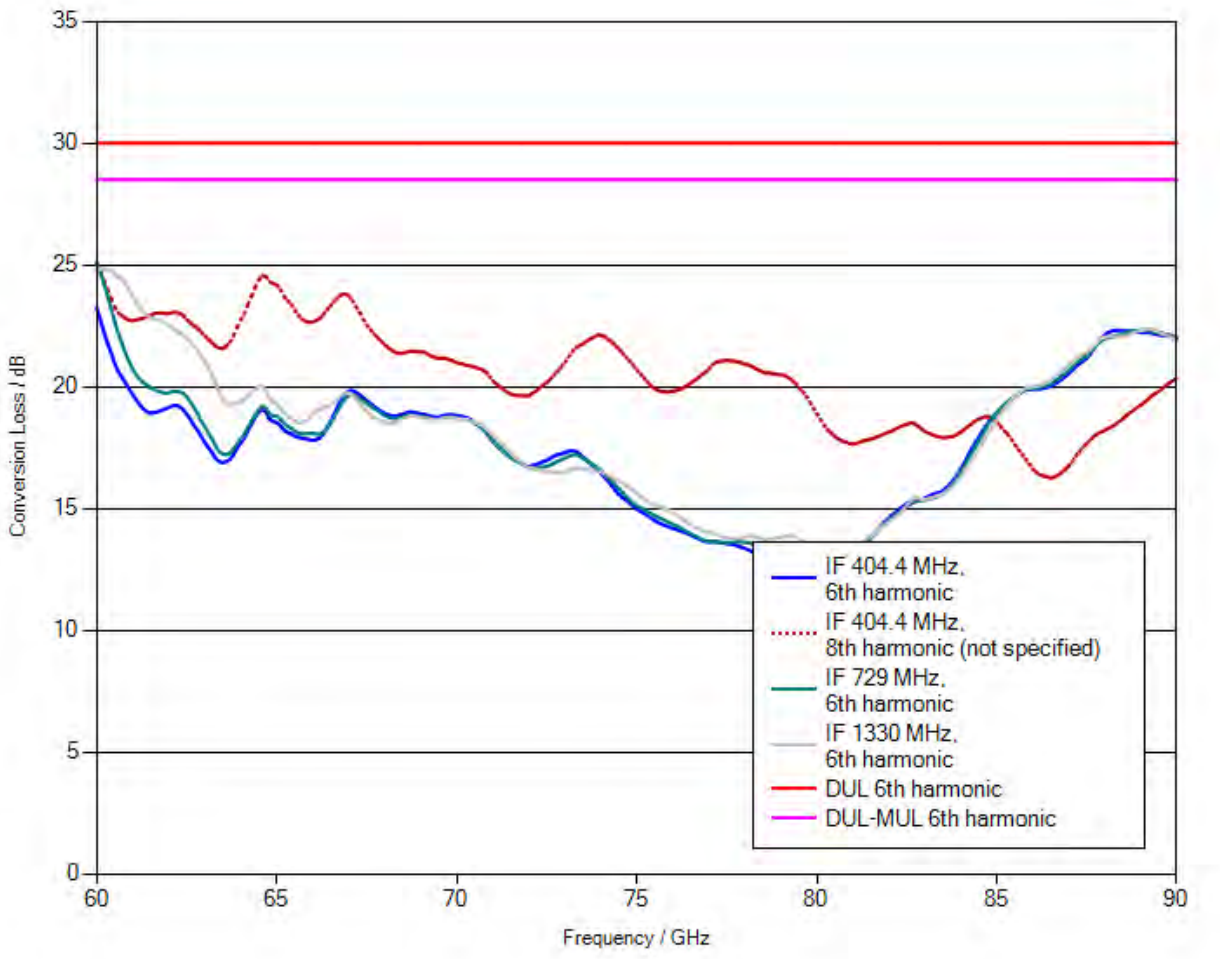
Measurement uncertainty: 0.05 (VSWR)



1.2 Conversion loss

LO level +14 dBm nominal
Bias 0 A

Measurement uncertainty: 1.5 dB



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The file has been renamed for safety reasons.
When downloading the file onto your PC, please delete the ".file" extension and unzip the data.

1.3 Frequency response within 1 GHz

	DUL	Actual (worst case)	Evaluation
IF = 404.4 MHz, 6th harmonic	6 dB	3.33 dB	PASS
IF = 404.4 MHz, 8th harmonic	not specified	2.73 dB	not specified
IF = 729 MHz, 6th harmonic	6 dB	4.12 dB	PASS
IF = 1330 MHz, 6th harmonic	6 dB	2.32 dB	PASS

Radiometer Physics
A Rohde & Schwarz Company

Calibration Certificate
Kalibrierschein

Certificate Number 24-0140-101008-01
Zertifikatsnummer

Unit Data

Item
Gegenstand
Harmonic Mixer, 90 GHz to 140 GHz

Manufacturer
Hersteller
RPG

Type
Typ
RPG FS-Z140

Material Number
Materialnummer
3622.0708.02

Serial Number
Seriennummer
101008

Asset Number
Inventarnummer

Order Data

Customer
Auftraggeber

Order Number
Bestellnummer

Date of Receipt
Eingangsdatum

Performance

Place and Date of Calibration
Ort und Datum der Kalibrierung
Meckenheim, 2017-04-06

Scope of Calibration
Umfang der Kalibrierung
Standard Calibration

Statement of Compliance (Incoming)
Konformitätsaussage (Anlieferung)
New device

Statement of Compliance (Outgoing)
Konformitätsaussage (Auslieferung)
All measured values are within the data sheet specifications.

Extend of Calibration Documents
Umfang des Kalibrierdokuments
2 pages Calibration Certificate
5 pages Outgoing Results

This calibration certificate documents, that the named item is tested and measured against defined specifications. Measurement results are located usually in the corresponding interval with a probability of approx. 95% (coverage factor k = 2). Calibration is performed with test equipment and standards directly or indirectly traceable by means of approved calibration techniques to the PTB/DKD or other national/international standards, which realize the physical units of measurement according to the International System of Units (SI). In all cases where no standards are available, measurements are referenced to standards of the R&S laboratories. Principles and methods of calibration correspond with EN ISO/IEC 17025. This calibration certificate may not be reproduced other than in full. Calibration certificates without signatures are not valid. The user is obliged to have the object recalibrated at appropriate intervals.

Dieser Kalibrierschein dokumentiert, dass der genannte Gegenstand nach festgelegten Vorgaben geprüft und gemessen wurde. Die Messwerte lagen im Regelfall mit einer Wahrscheinlichkeit von annähernd 95% im zugeordneten Werteintervall (Erweiterte Messunsicherheit mit k = 2). Die Kalibrierung erfolgte mit Messmitteln und Normalen, die direkt oder indirekt durch Ableitung mittels anerkannter Kalibriertechniken rückgeführt sind auf Normale der PTB/DKD oder anderer nationaler/internationaler Standards zur Darstellung der physikalischen Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI). Wenn keine Normale existieren, erfolgt die Rückführung auf Bezugsnormale der R&S-Laboratorien. Grundsätze und Verfahren der Kalibrierung beziehen sich auf EN ISO/IEC 17025. Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Kalibrierscheine ohne Unterschriften sind ungültig. Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

Radiometer Physics GmbH; Meckenheim

Date of Issue
Ausstellungsdatum
2017-04-07

Head of Laboratory
Laborleitung
Ceru

Person Responsible
Bearbeiter
Heinze

Vers2010-05-05/
RPG2014-02-28

Radiometer Physics GmbH ● Werner-von-Siemens-Str. 4 ● 53340 Meckenheim ● Telephone national: 02225/99981-0 international: 0049 2225-99981-0
Fax: 02225/99981-99 ● Managing Director: Achim Walber, Dr. Thomas Rose ● Company's Place of Business: Meckenheim
Commercial Register No.: Bonn, HRB 10291 ● VAT Identification No.: DE 123 377 395

Calibration Method
Kalibrieranweisung

RPG-PAQA-TN-2014-002

Relative Humidity **20 % - 80 %**
Relative Luftfeuchte

Ambient Temperature
Umgebungstemperatur

(23 $^{+7}_{-3}$) °C

Working standards used (having a significant effect on the accuracy)
Verwendete Gebrauchsnormale (mit signifikantem Einfluss auf die Genauigkeit)

Item Gegenstand	**Type** Typ	**Serial Number** Seriennummer	**Calibration Certificate Number** Kalibrierscheinnummer	**Cal. Due** Kalibr. bis
Vector Network Analyzer	R&S® ZVA67	101097	10-300319061	2017-08-06
Powersensor	R&S® NRP-Z55	140093	20-541556	2017-05-12

UGB1 **A compliance statement may be possible where a confidence level of less than 95 % is acceptable.**
Die Bestätigung der Konformität ist möglich, sofern ein Grad des Vertrauens von weniger als 95 % akzeptabel ist.

UGB2 **A non-compliance statement may be possible where a confidence level of less than 95 % is acceptable.**
Die Bestätigung der Nicht-Konformität ist möglich, sofern ein Grad des Vertrauens von weniger als 95 % akzeptabel ist.

Ref.: ILAC-G8:03/2009 'Guidelines on the Reporting of Compliance with Specification'.

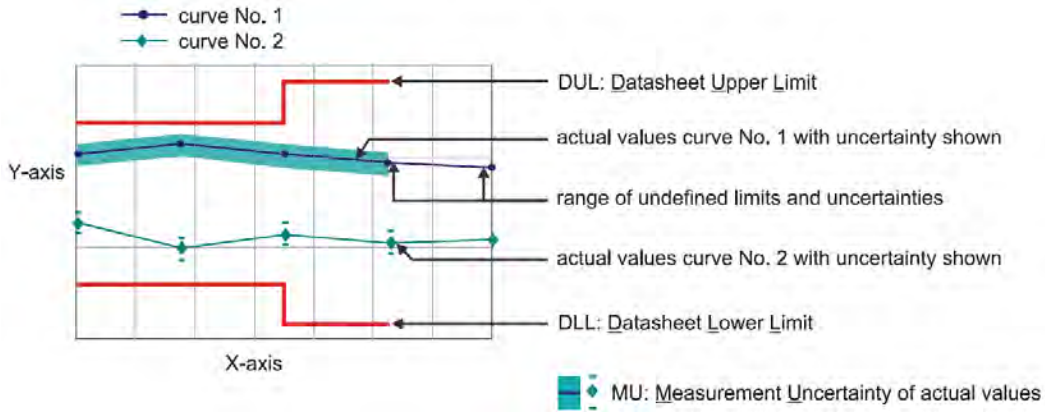
Notes
Anmerkungen

Outgoing Results

The following abbreviations may be used in this document

{a}	No measurement uncertainty stated because the errors always add together. So it is sure that a measurement result evaluated as "PASS" is pass.
{b}	The measurement uncertainty depends on the measurement result. The stated measurement uncertainty is valid for the close area around the specification. Measurement results outside the close area have a higher measurement uncertainty but are within the specification.
{c}	Functional test, therefore no measurement uncertainty is stated.
{d}	Typical value, refer to performance test.
{e}	The measurement uncertainty is taken into account when setting the measuring system.
DL or DT	Data Limit for symmetrical tolerance limits
DLL	Datasheet Lower Limit
DUL	Datasheet Upper Limit
MU	Measurement Uncertainty
MLL or MLV	Measurement Uncertainty Lower Value
MUL or MUV	Measurement Uncertainty Upper Value
Nom.	Nominal Value
Dev.	Deviation
MErr.	Measurement Error
Act.	Actual Value
UGB	Uncertainty Guard Band: Measuring uncertainty violates the data (spec.) limit.
UGB1	Measurement results marked as UGB1 show conformity with a probability of >50 %and <95 %.
UGB2	Measurement results marked as UGB2 show non-conformity with a probability of >50 %and <95 %.
DU	Datasheet Uncertainty

Explanation of charts

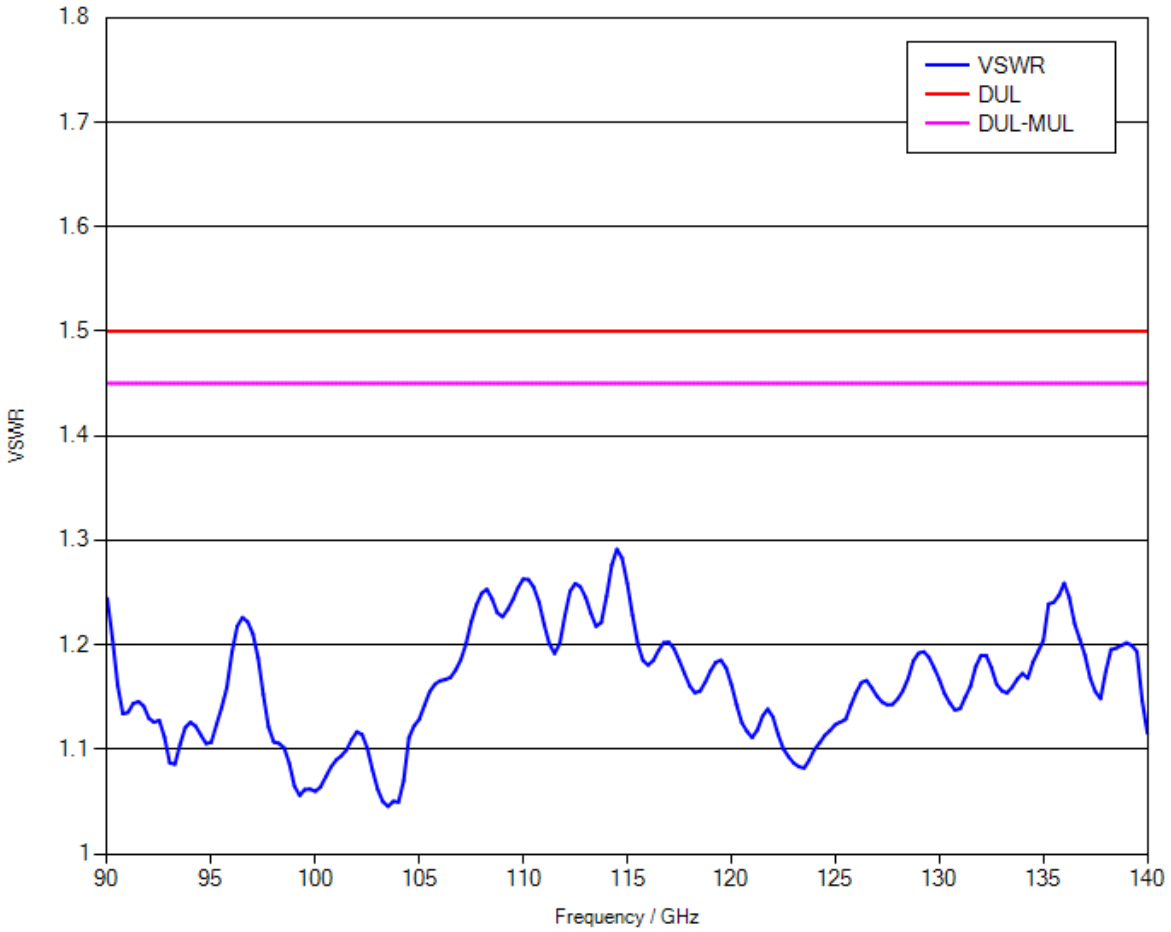


Software used for measurement

Item Type	Version	Remark
Measurement Studio Professional Edition	2013	
MixerCertification	7_04	

1.1 RF Input – VSWR

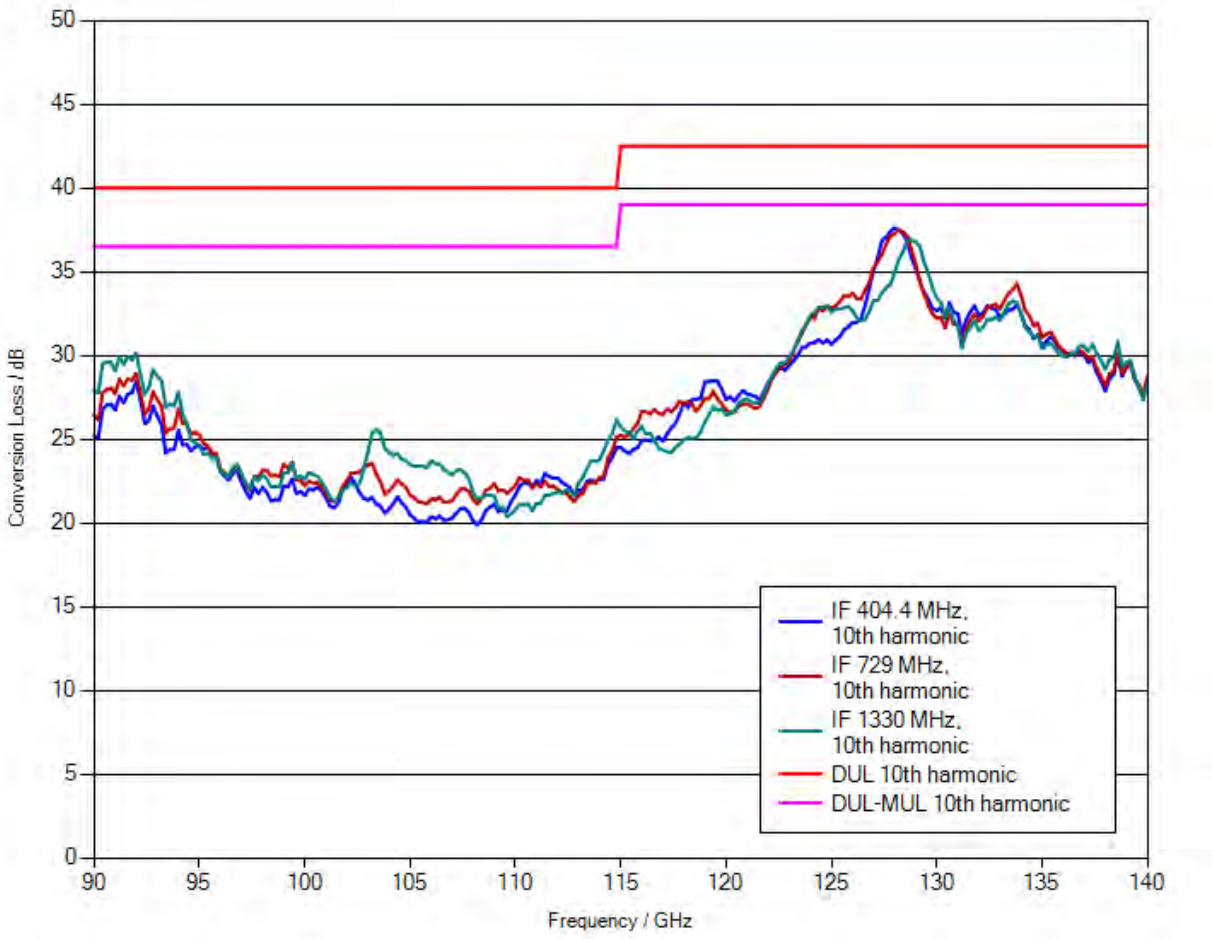
Measurement uncertainty: 0.05 (VSWR)



1.2 Conversion loss

LO level +14 dBm nominal
Bias 0 A

Measurement uncertainty: 3.5 dB



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1.3 Frequency response within 1 GHz

	DUL	Actual (worst case)	Evaluation
IF = 404.4 MHz, 10th harmonic	6 dB	3.86 dB	PASS
IF = 729 MHz, 10th harmonic	6 dB	3.48 dB	PASS
IF = 1330 MHz, 10th harmonic	6 dB	3.19 dB	PASS

Radiometer Physics
A Rohde & Schwarz Company

Calibration Certificate
Kalibrierschein

Certificate Number 24-0220-100960-01
Zertifikatsnummer

Unit Data

Item
Gegenstand
Harmonic Mixer, 140 GHz to 220 GHz

Manufacturer
Hersteller
RPG

Type
Typ
RPG FS-Z220

Material Number
Materialnummer
3593.3250.02

Serial Number
Seriennummer
100960

Asset Number
Inventarnummer

Order Data

Customer
Auftraggeber

Order Number
Bestellnummer

Date of Receipt
Eingangsdatum

Performance

Place and Date of Calibration
Ort und Datum der Kalibrierung
Meckenheim, 2018-01-17

Scope of Calibration
Umfang der Kalibrierung
Standard Calibration

Statement of Compliance (Incoming)
Konformitätsaussage (Anlieferung)
New device

Statement of Compliance (Outgoing)
Konformitätsaussage (Auslieferung)
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Extend of Calibration Documents
Umfang des Kalibrierdokuments
2 pages Calibration Certificate
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Radiometer Physics GmbH; Meckenheim

Date of Issue
Ausstellungsdatum
2018-01-19

Head of Laboratory
Laborleitung
Ceru

Person Responsible
Bearbeiter
Dick

Radiometer Physics GmbH ● Werner-von-Siemens-Str. 4 ● 53340 Meckenheim ● Telephone national: 02225/99981-0 international: 0049 2225-99981-0
Fax: 02225/99981-99 ● Managing Director: Achim Walber, Dr. Thomas Rose ● Company's Place of Business: Meckenheim
Commercial Register No.: Bonn, HRB 10291 ● VAT Identification No.: DE 123 377 395

Calibration Method
Kalibrieranweisung

RPG-PAQA-TN-2014-002

Relative Humidity **20 % - 80 %**
Relative Luftfeuchte

Ambient Temperature
Umgebungstemperatur

(23 $^{+7}_{-3}$) °C

Working standards used (having a significant effect on the accuracy)
Verwendete Gebrauchsnormale (mit signifikantem Einfluss auf die Genauigkeit)

Item Gegenstand	**Type** Typ	**Serial Number** Seriennummer	**Calibration Certificate Number** Kalibrierscheinnummer	**Cal. Due** Kalibr. bis
Vector Network Analyzer	R&S® ZVA67	101097	20-300432406	2020-07-21
Powersensor	R&S® NRP-Z55	140093	20-300426315	2018-05-17

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Die Bestätigung der Konformität ist möglich, sofern ein Grad des Vertrauens von weniger als 95 % akzeptabel ist.

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Ref.: ILAC-G8:03/2009 'Guidelines on the Reporting of Compliance with Specification'.

Notes
Anmerkungen

If the new product is stored under the climate conditions as specified in the data sheet upon delivery, the product's accuracy is not significantly affected within 12 month after its calibration in our factory. In this case, the recommended calibration interval starts on the date when the product is actually put into operation.

Outgoing Results

The following abbreviations may be used in this document

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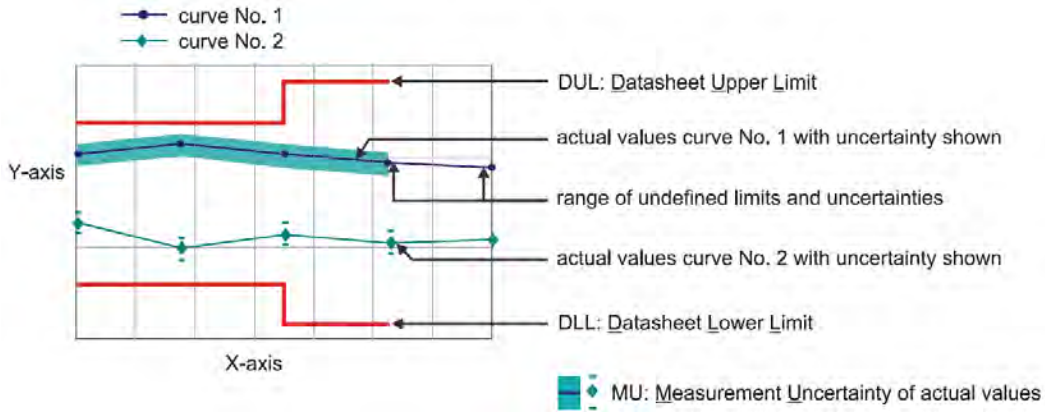

Software used for measurement

Item Type	Version	Remark
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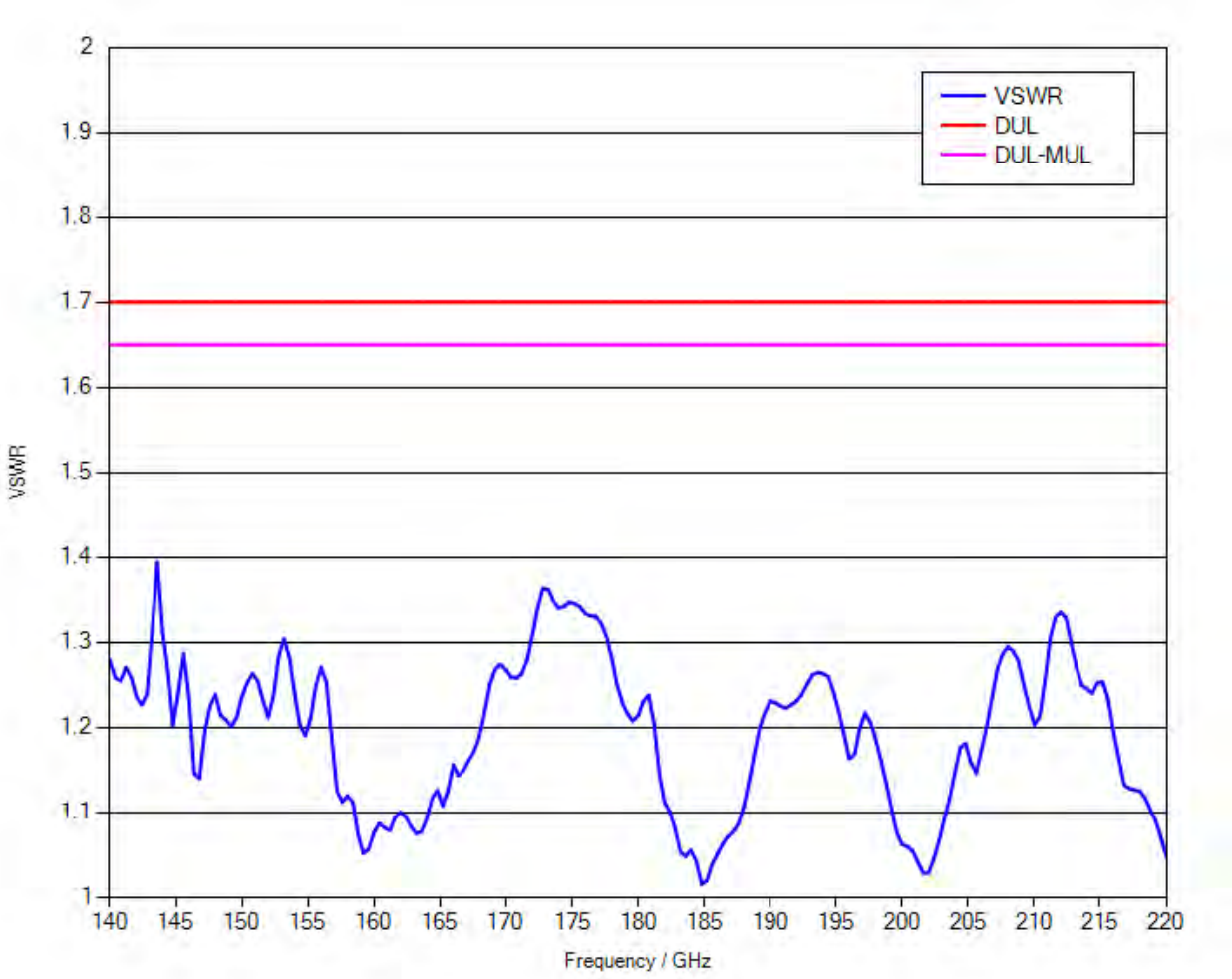
MixerCertification	7_08	

1.1 RF Input – VSWR

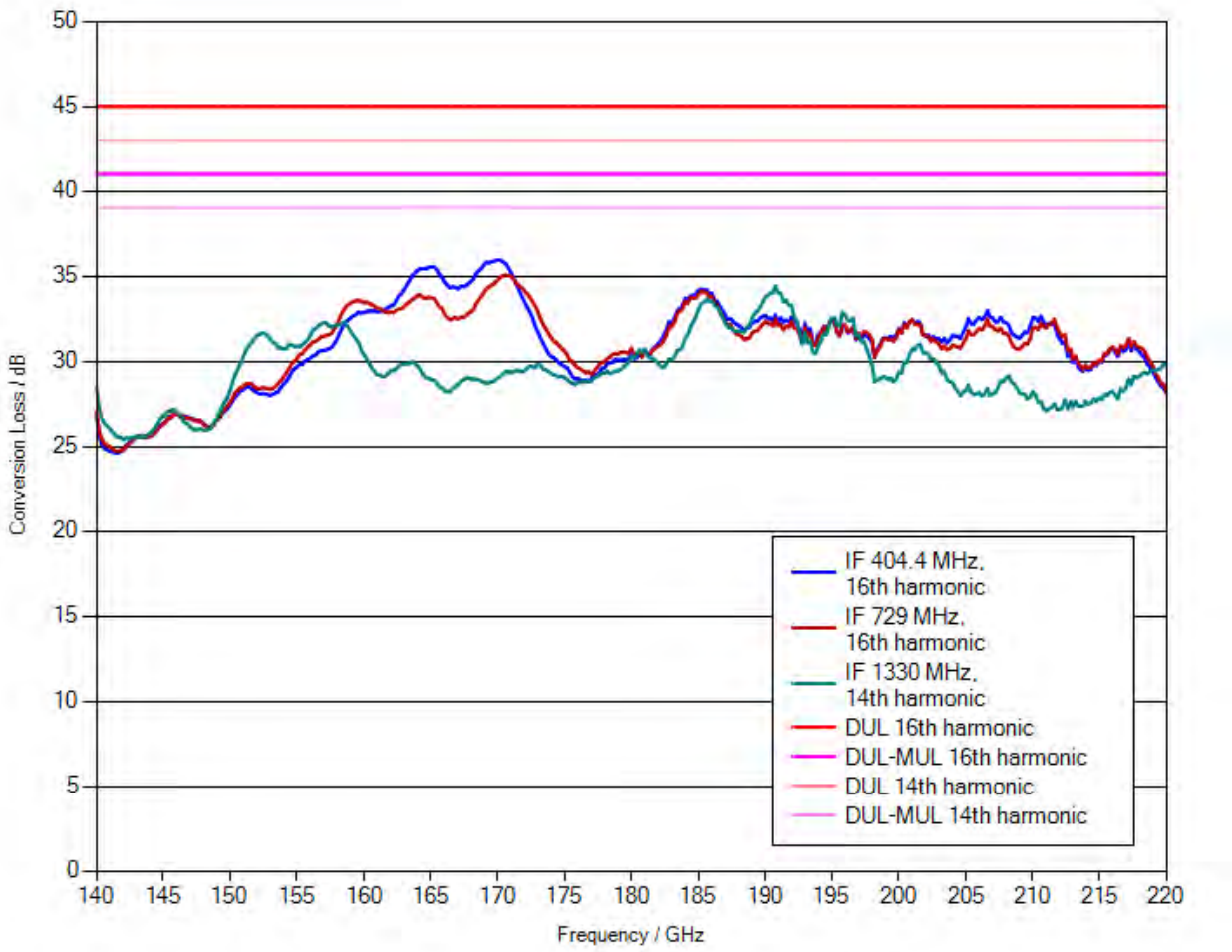
Measurement uncertainty: 0.05 (VSWR)



1.2 Conversion loss

LO level +13 dBm nominal
Bias 0 A

Measurement uncertainty: 4 dB



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1.3 Frequency response within 1 GHz

	DUL	Actual (worst case)	Evaluation
IF = 404.4 MHz, 16th harmonic	6 dB	2.1 dB	PASS
IF = 729 MHz, 16th harmonic	6 dB	2.05 dB	PASS
IF = 1330 MHz, 14th harmonic	6 dB	2.48 dB	PASS