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

AWEUC/D 5G AirScale 24 GHz mmWave Radio
AWEUC / AWEUD / FA3UB
FCC ID: 2AD8UASMR24FA3UB

Customer

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

Test Laboratory

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

Date: November 17, 2020

Revisions

Date	Revision	Section	Change
10/30/2020	0		Initial Release
11/04/2020	1	4.5	RE TX On Data added to 4.5.4
11/10/2020	2	4.5.3	Title corrections.
11/17/2020	3	4.5	RE TX On Data added to 4.5.4

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Table of Contents

1. ATTESTATION OF TEST RESULTS

Company Name	Nokia Solutions and Networks, OY 2000 Lucent Lane Naperville, Illinois 60563
FCC ID	2AD8UASMR24FA3UB
Product Name	AWEUC/D 5G AirScale 24 GHz mmWave Radio
Model Name	ASMR Family; AWEUC / AWEUD / FA3UB
Part No	475168A AWEUC / 475169A AWEUD / 475046A FA3UB
Serial Number(s)	Radiated Emission / Radio Tests: YK202700009, YK202900042, YK202900054 Frequency Stability Tests: AC YK202800019 , DC YK202800014
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)
Frequency Band	24.25-24.45 GHz and 24.75-25.25 GHz
Technology	5G NR mmW, LTE-TDD
Test Frequency Range	30 MHz – 100 GHz
Operation Mode(s)	2x 52dBm EIRP, 55 dBm EIRP Total. MIMO, 1 to 7 Carriers
Submission Type	Initial Product Certification
FCC Part 15 Subpart B	Compliance with Class B
Test Date	August 27, 2020 – October 8, 2020
Test Laboratory	Nokia Global Product Compliance Laboratory 600-700 Mountain Avenue, Rm 5B-108 Murray Hill, New Jersey 07974-0636 USA **NVLAP** Lab Code: 100275-0 FCC **Registration Number: 395774**

This is to certify that the above product has been evaluated and found to be in compliance with the Rules and Regulations set forth in the above standard(s). The data and the descriptions about the test setup, procedures and configuration presented in this report are accurate. The results of testing in this report apply only to the product/system which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Per the requirement of Section 2.911(d) Certification of Technical Test Data, I hereby certify that the technical test data are the results of tests either performed or supervised by me.

W. Steve Majkowski NCE
Member of Technical Staff
Nokia, Global Product Compliance Laboratory

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	AWEUC/D 5G AirScale 24 GHz mmWave Radio Head and Extension Modules
Radio Type	Intentional Transceiver
Power Type	Both DC & AC
Modulation	5G-NR LTE-TDD with QPSK, 16QAM, 64QAM,
Operating Frequency Range	TDD Tx/Rx = 24.25-24.45 GHz and 24.75 – 25.25 GHz. 24.25-24.45 GHz portion of the US n258 spectrum and one to five 97M5G7W carriers in the 24.75 – 25.25 GHz
Channel Bandwidth	1400 MHz,
Max Radiated Power (EIRP)	52 dBm EIRP per polarizations; 55 dBm EIRP Total for the two polarizations.
Antenna Gain	25 dBi
Operating Mode	2x2 MIMO (2 duplex Tx/Rx Ports)
Software Version	5G19B
Hardware Version	475168A.X21 / AWEUC, 475169A X21 / AWEUD, 475046A.X21 / FA3UB
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 25 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 27 dBm. The 27 dBm RF power and 25 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

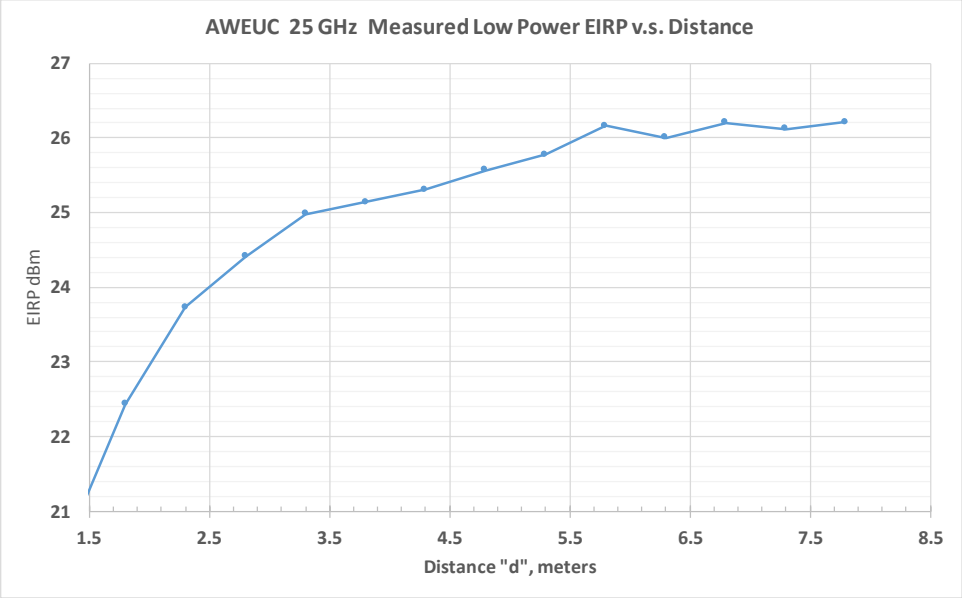
The individual polarization antenna array height is 100 mm and is 50 mm wide with a 112mm diagional. The diagional for both arrays is 250 mm.
At 25 GHz the individual array dimensions results in a minimum Fraunhofer far field distance, $d_{ff,}$ of 2.1 meters.
At 25 GHz the overall array dimensions results in a minimum Fraunhofer far field distance, $d_{ff,}$ of 10.4 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 5.7 m.

To eliminate any inconsistancy all Power, OBW and OOBE measurements were made at 5.7 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 (AEWF), FCC ID: 2AD8UASMR24FA3UB**, is a LTE TDD Remote radio head is configured for one to seven carrier operation. It is specified to provide a maximum power output of 52 dBm /158.5 W EIRP per transmit polarization for a sum total of 55 dBm /317W EIRP per unit. The product is designed for the 5G global market including operation per 47 CFR Part 30 rules for use in the USA authorized portions of 5G New Radio Band, n258, from 24.25-24.45 GHz and 24.75-25.25 GHz.

4.1.1 RF Power Output Measurement

The product was 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 5.7 m distance using a nominal 64 dB offset. An additional FSW transducer correction factor is used to ascertain the actual measured EIRP power. The calculation of path loss, cable loss and measurement antenna gain are listed in Table 4.1.1. below. The unit was configured to transmit at its maximum power.

The Channel Power function of the FSW spectrum analyzer was used to measure the maximum average Horizontal and Vertical EIRP at the 5.7m boundary distance. The measurements were performed for one and two carriers in the lower 24.25-24.45 GHz Block and one to five carriers in the upper 24.75-25.25 GHz Block for a nominal 100 MHz bandwidth carrier with 5G-NR. Channel power plots identify the individual carrier power, modulation and the total power.

Table 4.1.1 Corrections For Transmitter Power Measurements

Frequency	Free Space Path Loss, "PL"	Measurement Antenna Gain, "G1"	Measurement Cable Loss, "L1"	Total Offset Required PL -G1 + L1	FSW Measurement Offset	Required Final Correction
GHz	dB	dBi	dB	dB	dB	dB
22.0	74.41	23.70	11.39	62.10	64	-1.902
22.5	74.60	23.90	11.57	62.27	64	-1.728
23.0	74.79	23.85	11.75	62.70	64	-1.302
23.5	74.98	24.10	11.96	62.84	64	-1.161
24.0	75.16	24.25	12.09	63.00	64	-0.998
24.5	75.34	24.30	12.18	63.22	64	-0.775
25.0	75.52	24.38	12.23	63.37	64	-0.628
25.5	75.69	24.45	12.30	63.54	64	-0.461
26.0	75.86	24.65	12.40	63.61	64	-0.388
26.5	76.02	24.55	12.52	63.99	64	-0.009
27.0	76.19	24.65	12.64	64.18	64	0.179
27.5	76.35	24.75	12.75	64.34	64	0.344
28.0	76.50	24.85	12.83	64.48	64	0.481
28.5	76.66	24.75	12.93	64.83	64	0.831
29.0	76.81	25.00	13.01	64.82	64	0.821
29.5	76.96	24.95	13.14	65.14	64	1.142
30.0	77.10	25.10	13.26	65.26	64	1.258
30.5	77.25	25.00	13.43	65.67	64	1.673
31.0	77.39	25.13	13.60	65.86	64	1.860
31.5	77.53	25.00	13.80	66.33	64	2.329
32.0	77.66	25.25	13.96	66.37	64	2.374
32.5	77.80	25.12	14.09	66.77	64	2.766
33.0	77.93	25.20	14.18	66.91	64	2.914

4.1.1.1 RF Power Output Results

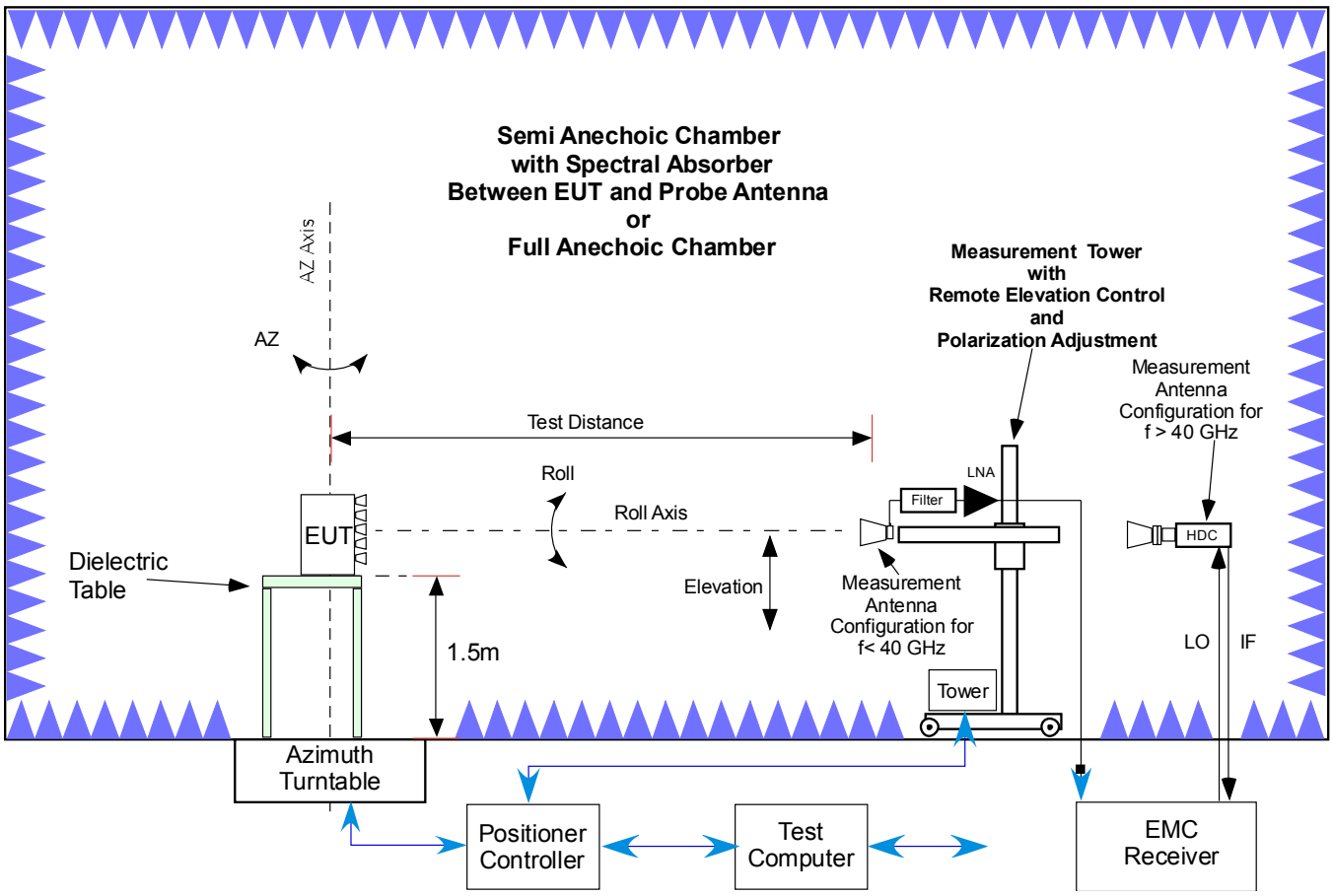
Power output measurements verified the expected performance of 52 dBm EIRP per polarization for a Total Power of 55 dBm. The maximum measured level was 52.62 dBm for a single polarization and 55.49 dBm total. This level is well within the maximum Part 30.202a limit of 75 dBm EIRP. Measurements were performed 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

Location in Band	Channel Center Frequencies, GHz	# of carriers	Modulation	Horizontal Polarization Total Channel Power, EIRP	Vertical Polarization Total Channel Power, EIRP	Sum Total Channel Power EIRP
				dBm	dBm	dBm
Left	24.3	**1**	**QPSK**	**52.33**	**52.83**	**55.60**
Center	24.74 (H) 24.8 (V)	**1**	**QPSK**	**52.64**	**52.33**	**55.50**
Right	25.14 (H) 25.13988 (V)	**1**	**64QAM**	**51.86**	**52.38**	**55.14**
Left	24.39996 24.3	**2**	**QPSK**	**51.65**	**52.62**	**55.17**
Right	24.99996 25.09992 25.19988	**3**	**16QAM**	**52.00**	**52.33**	**55.18**
Right	24.9 24.99996 25.09992 25.19988	**4**	**64QAM**	**52.04**	**52.24**	**55.15**
Right	24.80004 24.9 24.99996 25.09992 25.19988	**5**	**64QAM**	**52.50**	**52.46**	**55.49**
Right	24.39996 24.80004 24.9 24.99996 25.09992 25.19988	**6**	**64QAM**	**52.33**	**52.16**	**55.26**
Right	24.3 24.39996 24.80004 24.9 24.99996 25.09992 25.19988	**7**	**64QAM**	**52.1**	**52.46**	**55.29**

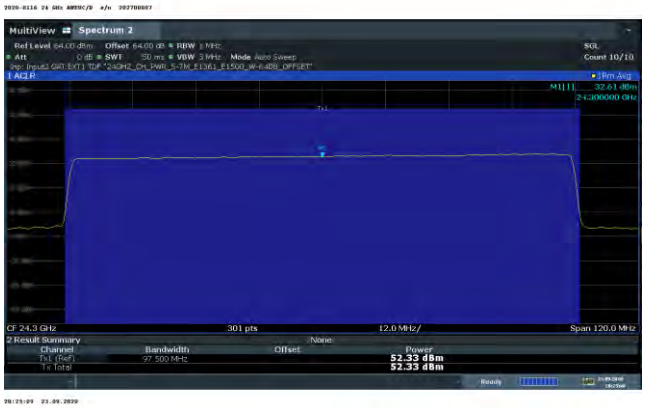
Figure 4.1.1 Test Set-Up for Measurement of Radio Transmitter Performance



4.1.1.1.1 Channel Power Measurement Plots

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

Horizontal

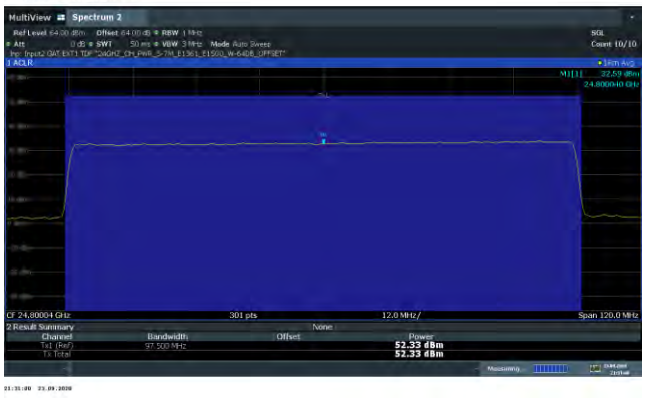


Vertical

Channel Power Measurements, 1 Carrier – QPSK – Middle of Band

Horizontal

Vertical



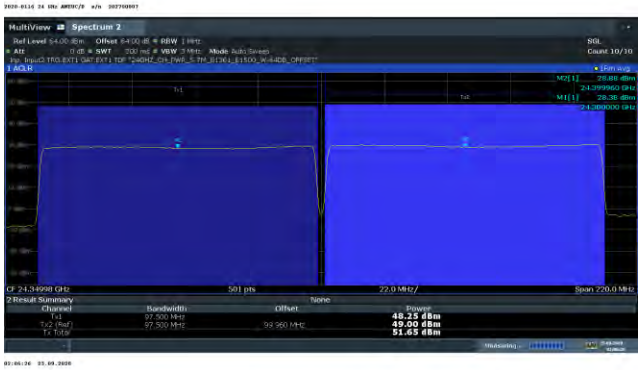
Channel Power Measurements, 1 Carrier – 64QAM – Right Side of Band

Horizontal

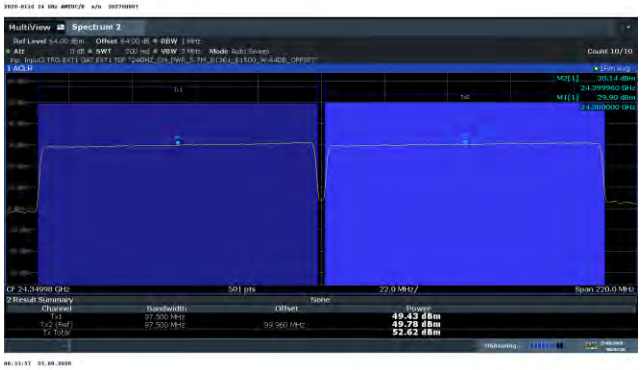
Vertical

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

Horizontal

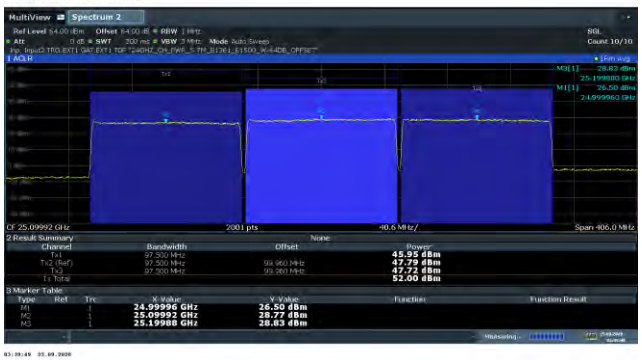


Vertical

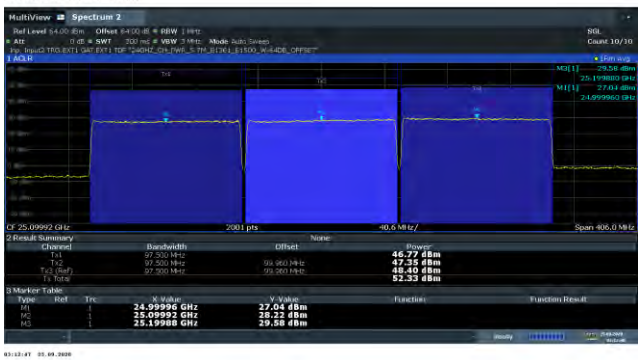


Channel Power Measurements, 3 Carrier – 64QAM – Right Side of Band

Horizontal



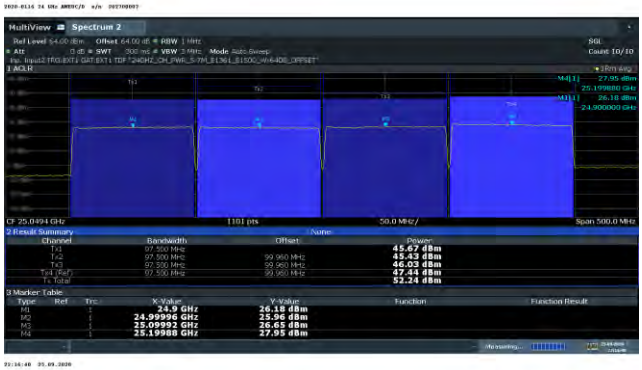
Vertical



Channel Power Measurements, 4 Carrier – 64QAM – Right Side of Band

Horizontal

Vertical



Channel Power Measurements, 5 Carrier –64QAM – Right Side of Band

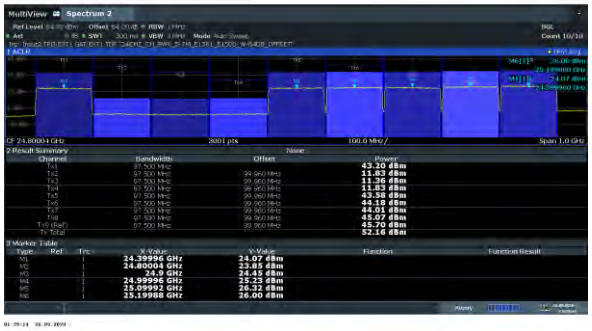
Horizontal

Vertical

Channel Power Measurements, 6 Carrier – 64QAM – Right Side of Band

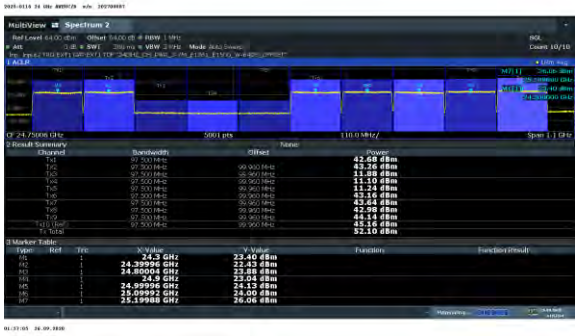
Horizontal

Vertical

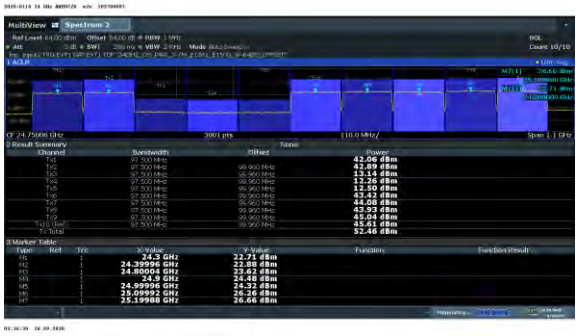


Channel Power Measurements, 7 Carrier – 64QAM – Right Side of Band

Horizontal



Vertical



4.2 Section 2.1047 MEASUREMENT REQUIRED: MODULATION CHARACTERISTICS

The **2AD8UASMR24FA3UB** 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

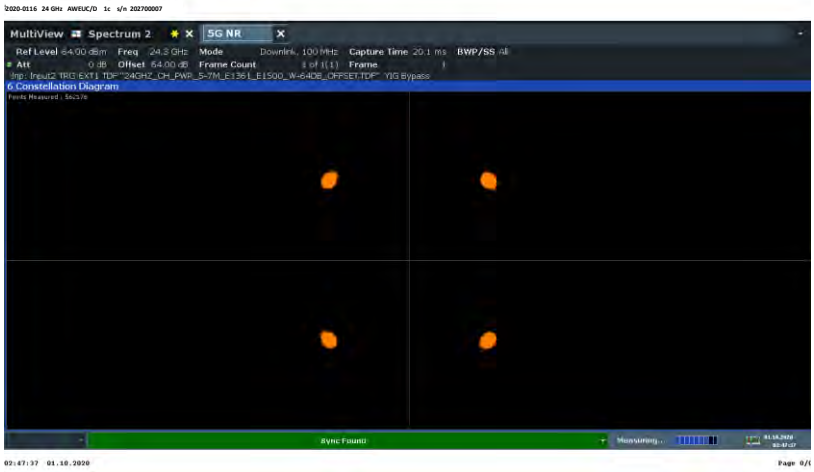
The measurements were performed at a distance of 5.7 m from the unit utilizing the test configuration in Figure 4.4.1 utilizing an Rohde & Schwarz FSW85 Signal analyzer with the 3GPP 5G-NR DL Measurement software option. Representative screen plots of the modulation measurement are attached below for all three of the subcarrier configurations and sample polarizations. Data was collected at left, center and right side of the n258 24 GHz frequency band.

4.2.2 Modulation Measurements Results:

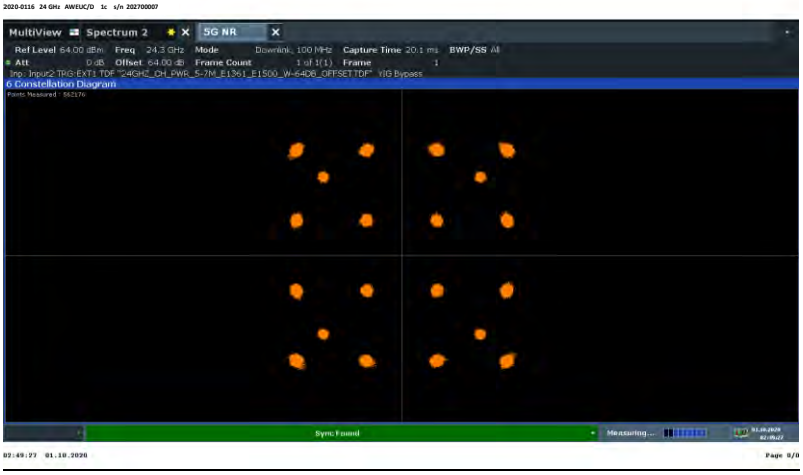
The typical measured modulation characteristics of the EUT are shown below:

Figure 4.2 Sample Modulation Results

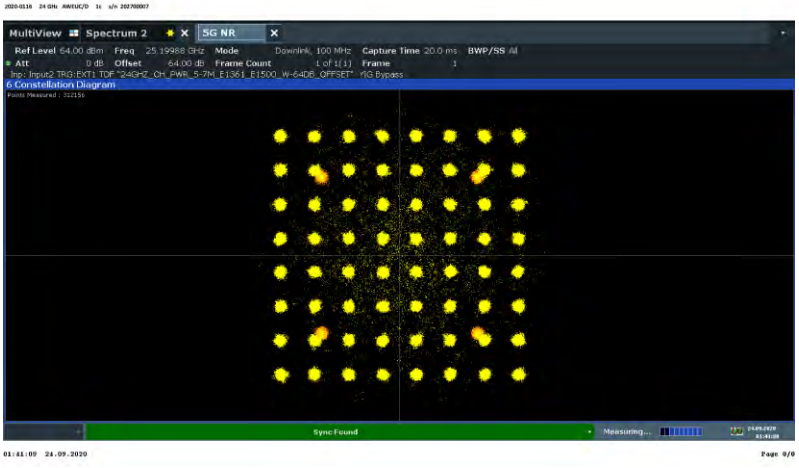
QPSK - Left - Vertical Polarization



16QAM - Left - Vertical Polarization



64QAM - Right – Horizontal Polarization



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

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

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

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

4.3.1 Results Occupied Bandwidth (Signal Bandwidth)

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

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

Location in Band	Carrier Frequencies (GHz)	Number of Carriers	Modulation	Horizontal Polarization Occupied Signal Bandwidth (MHz)	Vertical Polarization Occupied Signal Bandwidth (MHz)
Left	24.3	1	QPSK	94.309	94.28
Middle	24.80004	1	QPSK	94.33	94.242
Right	25.19988	1	64QAM	94.222	94.246
Left	24.3 To 24.39996	2	QPSK	194.96	194.637
Right	24.99996 To 25.19988	3	16QAM	291.961	292.303
Right	24.9 To 25.19988	4	64QAM	392.13	391.617
Right	24.80004 To 25.19988	5	64QAM	489.945	490.409

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)
Middle	24.800004	1	QPSK	-	95.305
Right	25.19988	1	64QAM	95.326	-

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)
Middle	24.80004	1	QPSK	-	96.955
Right	25.19988	1	64QAM	96.999	-
Left	24.3 To 24.39996	2	QPSK	194.644	194.549
Right	24.99996 To 25.19988	3	16QAM	292.645	293.207
Right	24.800004 To 25.19988	5	64QAM	490.165	490.706

4.3.1.1 Results - Occupied Bandwidth Carrier Aggregation

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

The overall signal bandwidth for 5 adjacent carriers is depicted in Figure 4.3.1.1. This is the maximum number of adjacent 97M5G7W carriers that can fit in the upper FCC authorized 24.75-25.25 GHz Band. The calculated assessment was that the 5 carrier aggregated bandwidth is 497.34 MHz which translates to an appropriate aggregated emissions designator of 498MG7W. The measurement of 5 adjacent carriers documented a measured maximum 5 carrier bandwidth of 491 MHz which is within the parameters of the selected Carrier Aggregation Emissions Designator.

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

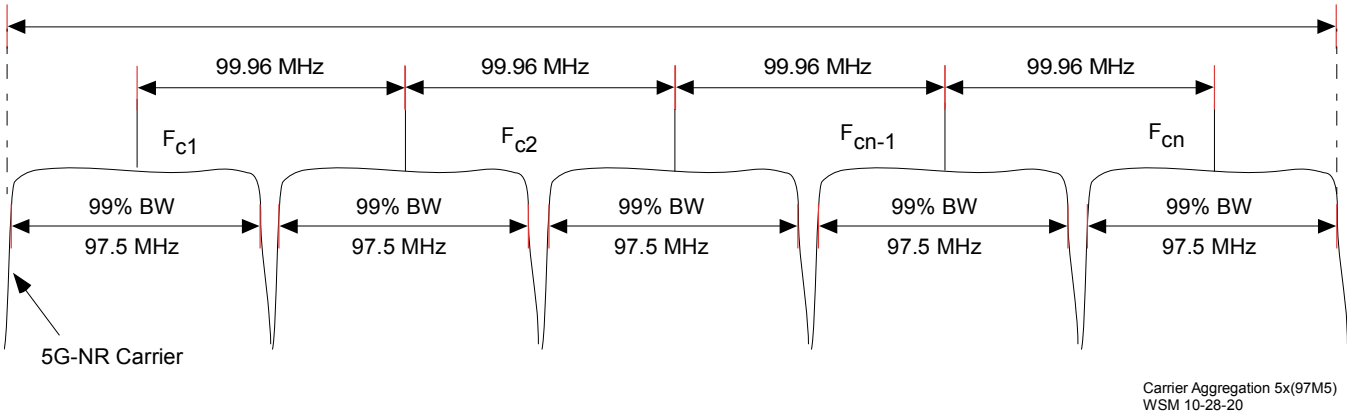
So considered separately, the two carrier configuration produces an aggregated bandwidth of:
99.96 MHz + 97.5 MHz = 197.46 MHz which indicates a 198MG7W Emissions Designator

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

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

Figure 4.3.1.1 Carrier Aggregation

Maximum Carrier Aggregation Bandwidth = 4(99.96) + 97.5MHz = 497.34 MHz = 498MG7W



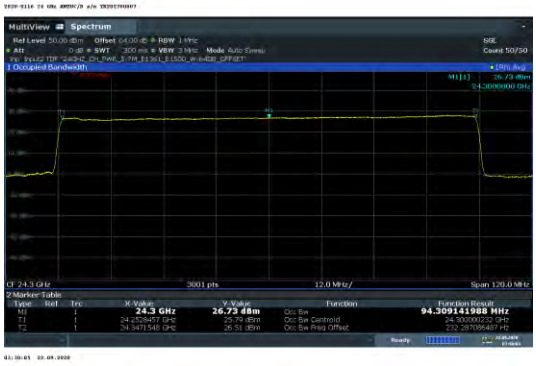
Carrier Aggregation 5x(97M5)
WSM 10-28-20

4.3.1.2 99% Signal Bandwidth 10 MHz RBW Plots

1MHz RBW

1 Carrier, Left, QPSK

Horizontal

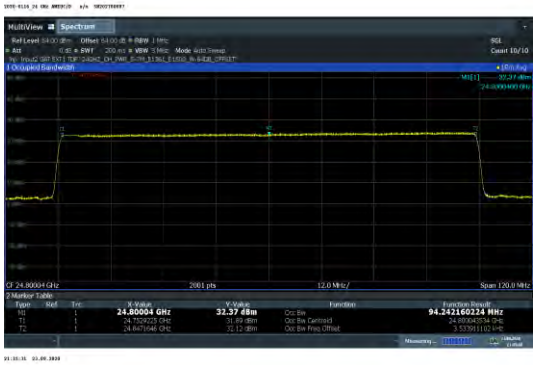


Vertical

1 Carrier, Middle, QPSK

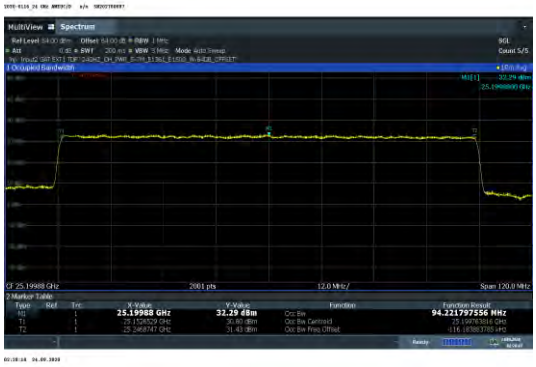
Horizontal

Vertical



1 Carrier, Right, 64QAM

Horizontal



Vertical

2 Carrier, Left, QPSK

Horizontal

Vertical

3 Carrier, Right, 16QAM

Horizontal

Vertical

4 Carrier, Right, 64QAM

Horizontal

Vertical

5 Carrier, Right, 64QAM

Horizontal

Vertical

6 Carrier, Right, 64QAM

Horizontal

Vertical

7 Carrier, Right, 64QAM

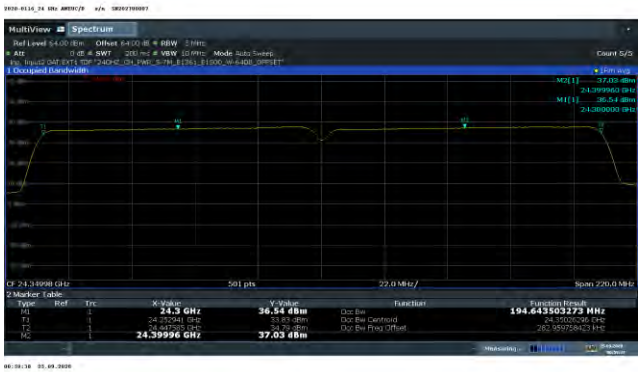
Horizontal

Vertical

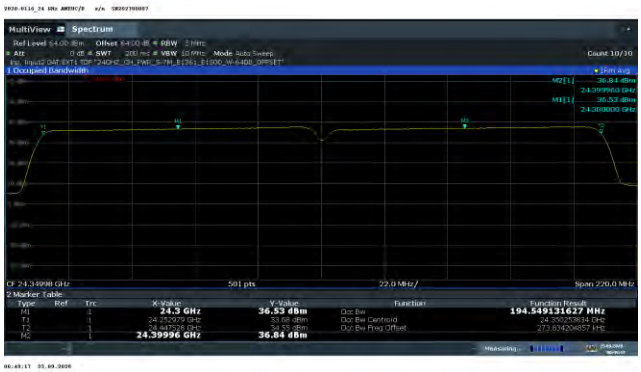
5MHz RBW

2 Carrier, Left, QPSK

Horizontal



Vertical



3 Carrier, Right, 16QAM

Horizontal

Vertical

5 Carrier, Right, 64QAM

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 **2AD8UASMR24FA3UB AWEUC/D 5G AirScale 24 GHz mmWave Radio** Unit presently supports nominal 100 MHz bandwidth 5G-New Radio LTE TDD technologies. The Out Of Band evaluation addresses operation with one through seven carriers.

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

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

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

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

4.3.3 Requirements 24 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. Mask Edge Offsets = ½ the measurement Resolution Bandwidth were not used.

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

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

4.3.6 Measurement Path Adjustments

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

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

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

Total Required Adjustment (@25 GHz) = 37.84 dB = 77.52 dB -24.8dBi + 12.23dB – 25.53 dBi

This adjustment was only used for the OOBE/EoB frequency range. Table 4.3.6 below lists the offset correction factors used for the measurement distance of 5.7m including the AWEUA product gain. The measurements were made using a flat offset of 42 dB with a transducer correction identified below.

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

Frequency	Free Space Path Loss, PL	Measurement Antenna Gain, "G"	Measurement Cable Loss, "L"	PL-G1+L1	AEWF Antenna Gain, IEEE	Total Required Adjustment	FSW Offset	Transducer Correction Factor
GHz	dB	dBi	dB	dB	dBi	dB	dB	dB
22.0	74.41	23.70	11.39	62.10	24.77	37.33	42	-4.672
22.5	74.60	23.90	11.57	62.27	24.90	37.38	42	-4.624
23.0	74.79	23.85	11.75	62.70	25.02	37.67	42	-4.326
23.5	74.98	24.10	11.96	62.84	25.15	37.69	42	-4.313
24.0	75.16	24.25	12.09	63.00	25.28	37.72	42	-4.278
24.5	75.34	24.30	12.18	63.22	25.41	37.82	42	-4.182
25.0	75.52	24.38	12.23	63.37	25.53	37.84	42	-4.163
25.5	75.69	24.45	12.30	63.54	25.72	37.82	42	-4.179
26.0	75.86	24.65	12.40	63.61	25.90	37.71	42	-4.290
26.5	76.02	24.55	12.52	63.99	26.16	37.83	42	-4.174
27.0	76.19	24.65	12.64	64.18	26.43	37.75	42	-4.249
27.5	76.35	24.75	12.75	64.34	26.72	37.62	42	-4.379
28.0	76.50	24.85	12.83	64.48	27.02	37.46	42	-4.537
28.5	76.66	24.75	12.93	64.83	27.41	37.42	42	-4.577
29.0	76.81	25.00	13.01	64.82	27.80	37.02	42	-4.979
29.5	76.96	24.95	13.14	65.14	27.41	37.73	42	-4.266
30.0	77.10	25.10	13.26	65.26	27.02	38.24	42	-3.758
30.5	77.25	25.00	13.43	65.67	25.06	40.62	42	-1.384
31.0	77.39	25.13	13.60	65.86	23.10	42.76	42	0.761
31.5	77.53	25.00	13.80	66.33	23.87	42.46	42	0.456
32.0	77.66	25.25	13.96	66.37	24.65	41.73	42	-0.274
32.5	77.80	25.12	14.09	66.77	24.75	42.02	42	0.021
33.0	77.93	25.20	14.18	66.91	24.84	42.07	42	0.073

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 5.7m. 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 emissions was identified as a single narrowband spurious signal at 27.8993 GHz. Radiated spurious tests of multiple transmit configurations operating in the right side block also identified a spurious signal at 25.491675 GHz. Multiple scans confirmed that both signals are radiated by the array primary beam in both polarizations.

Multiple transmit configurations were examined to determine the worst case operational configurations. The worst case configurations for the first spur was determined to be a single carrier with vertical polarization at 24.3 GHz with QPSK modulation. The OOBE measurements determined that the 27.8993 GHz signal maximum value was 5.03 dBm when not adjusted for the AWEUA's Transmit Antenna gain.

The second spurs had a narrow margin of 0.05 dB with an amplitude was 82.18 dBμV/m/MHz at 25.491675 GHz. This configuration at full power was five carriers in the right side block with QPSK modulation. Per KDB 842590 D01 guidance these emissions needed to be evaluated using the Total Radiated Power methodology.

4.3.8 Total Radiated Power Evaluation of Out Of Band Emissions

Per KDB 842590 D01 the use of product array gain to reference the radiated spurious to the conducted transmit signal is not valid at greater than 10% of signal bandwidth outside the band. For reference, if the gain was allowable for the 27.89 GHz spur it would result in a final value of -14.77 dBm which is 1.77 dB of margin to the limit. Without the consideration for transmit antenna gain the OOBE measurements determined that the 27.8993 GHz signals maximum value was 5.03 dBm. It was expected that the second spur would be far lower.

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

The Two Cut TRP evaluations were performed at 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 at the maximum beam height of 169 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 2 degrees apart in azmiuth. 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	**Spur # 2**
Frequency range:	27.85 GHz to 27.95 GHz	25.25 GHz to -27.00 GHz
Resolution Bandwidth:	1 MHz	1 MHz
Video bandwidth:	3 MHz	3 MHz
Detector:	RMS	RMS
Trace averaging Factor	120	120
Number of points	3001	6001
Turntable step size	4 degrees	4 degrees
Two cut correction factor	2 dB	2 dB

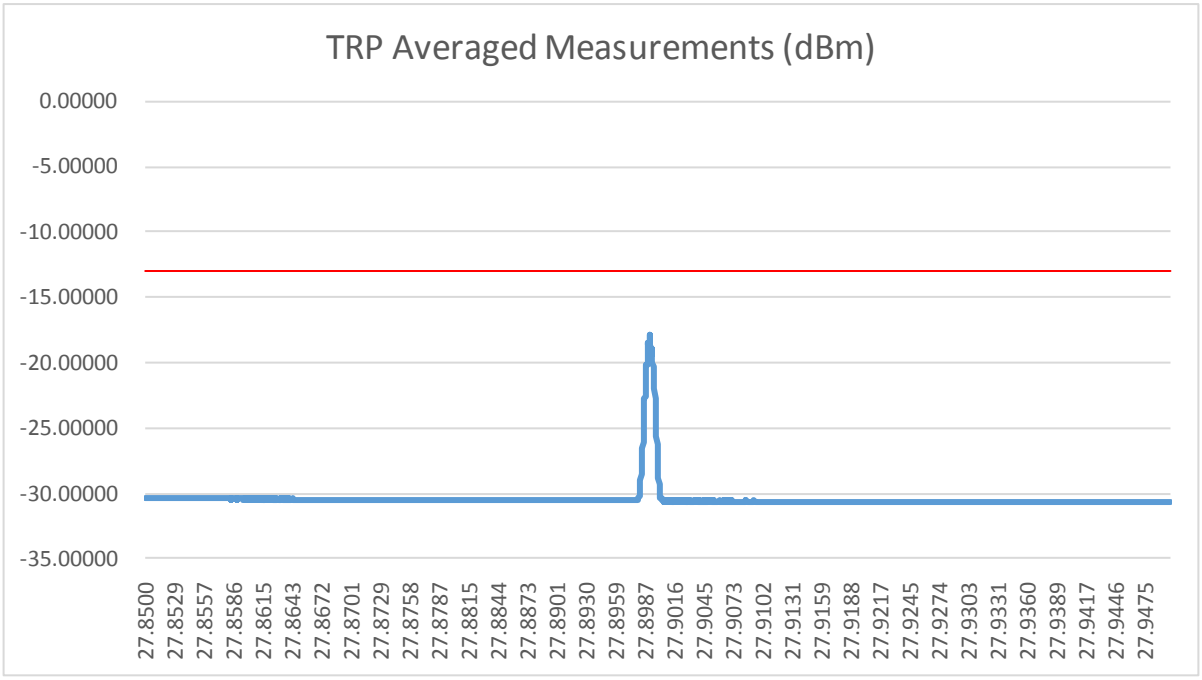
4.3.8.1 Total Radiated Power Results

The net result for Spur #1 was a maximum corrected TRP value of -16.309 dBm at 27.8993 GHz. Which demonstrates 3.309 dB margin to the -13 dBm limit. This emission is reportable.

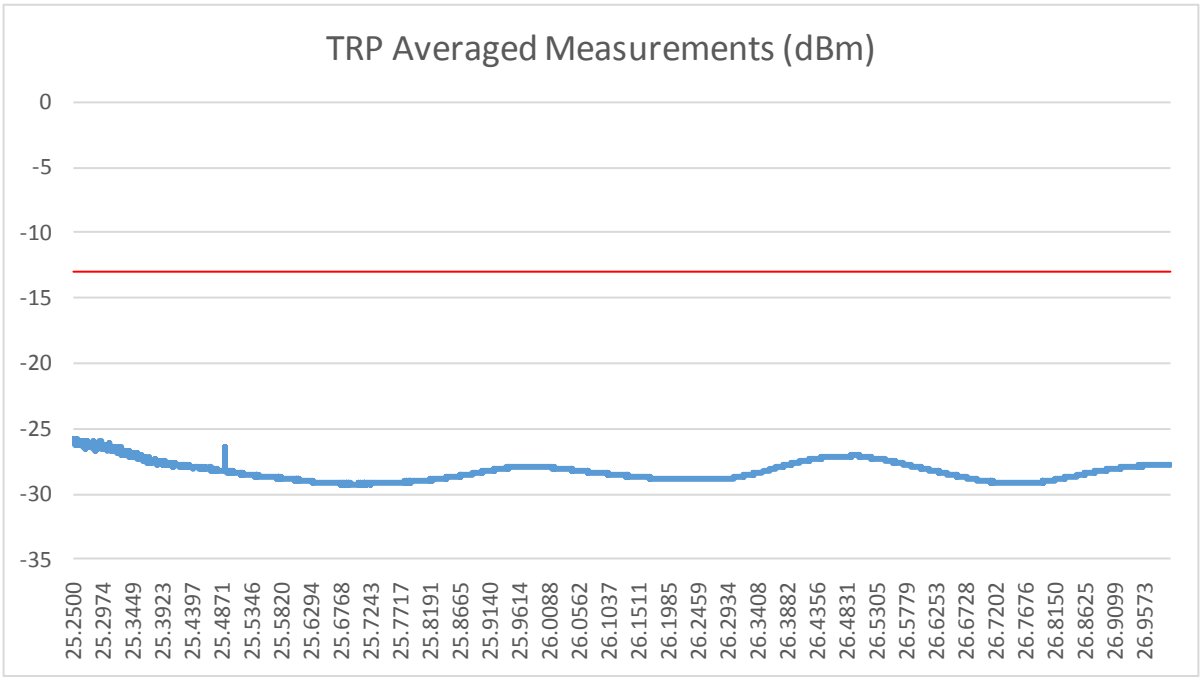
The net result for Spur #2 was a maximum corrected TRP value of -26.85 dBm at 25.4913 GHz. Which demonstrates 13.85 dB margin to the -13 dBm limit.

A third cut would have resulted in greater margin as it would point the beam upwards and would have only increased the margin as at 90 degrees from the beam there is no signal present. The plots of the Two Cut Average TRP measurements over frequency are plotted below.

27.5 - 28.5GHz



25.25-27.00GHz



4.3.8.2 Out Of Band Emissions Results

The Out Of Band Emissions plots for the tested configurations of one through seven carriers operation are below. These Occupied Bandwidth and Edge-of-Band emissions measurements were made as a radiated measurement at a distance of 5.7m. The plots clearly show easy compliance to the Part 30 FCC n258 Band for all signals except the single narrowband local oscillator spurious at 27.8993 GHz and the small spur at 25.4913 GHz. Both spurs were evaluated for compliance using the two cut TRP method and found to be compliant.
From the out-of-band emissions plots attached below, it can be seen that all the emissions are compliant.

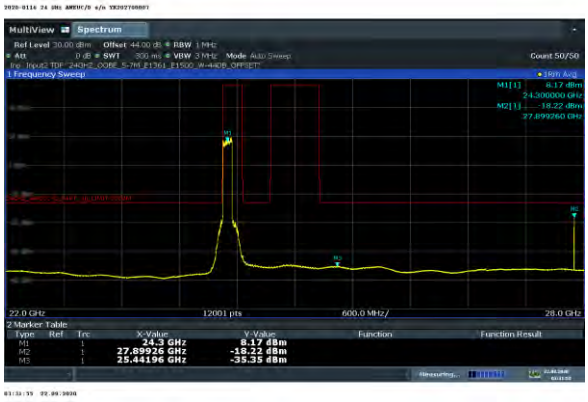
The measurement results of the occupied bandwidth and the out-of-band emissions as documented in the plots and Table 4.3.6.1 demonstrate the full compliance with the Rules of the Commission for the operating band.

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

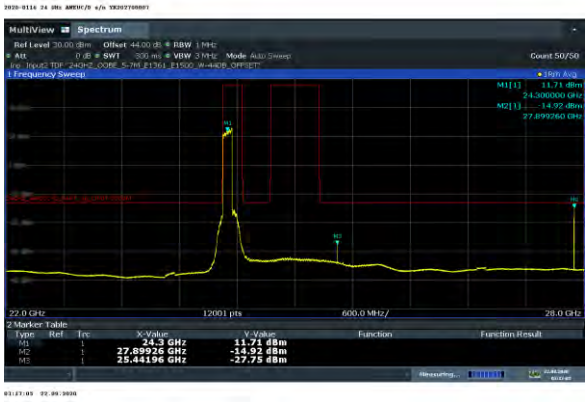
Center Frequencies of Edge Channels, GHz	Location	Number of Carriers	Modulation	Polarization	Occupied Bandwidth Edge of Block / OOBE Compliance
24.3	Left Side of Lower Band	1	QPSK	Horizontal	Compliant
				Vertical	Compliant
24.3	Middle of Overall Band	1	QPSK	Horizontal	Compliant
				Vertical	Compliant
25.19988	Right Side of Upper Band	1	64QAM	Horizontal	Compliant
				Vertical	Compliant
24.3 24.39996	Left Side of Band (Entire Lower Band)	2 adjacent	QPSK	Horizontal	Compliant
				Vertical	Compliant
24.99996 25.19988	Right Side of Upper Band	3 adjacent	16QAM	Horizontal	Compliant
				Vertical	Compliant
24.9 25.19988	Right Side of Upper Band	4 adjacent	64QAM	Horizontal	Compliant
				Vertical	Compliant
24.80004 25.19988	Right Side of Band (Entire Upper Band)	5 adjacent	64QAM	Horizontal	Compliant
				Vertical	Compliant
24.39996 25.19988	Entire Right Side of Band + 1 Lower Band	5 adjacent + 1 non-adjacent	64QAM	Horizontal	Compliant
				Vertical	Compliant
24.3 25.19988	Full Band, 2 Lower Channels + 5 Upper Channels	5 adjacent +2 non-adjacent	64QAM	Horizontal	Compliant
				Vertical	Compliant

4.3.8.2.1 Occupied Bandwidth Edge of Band Plots

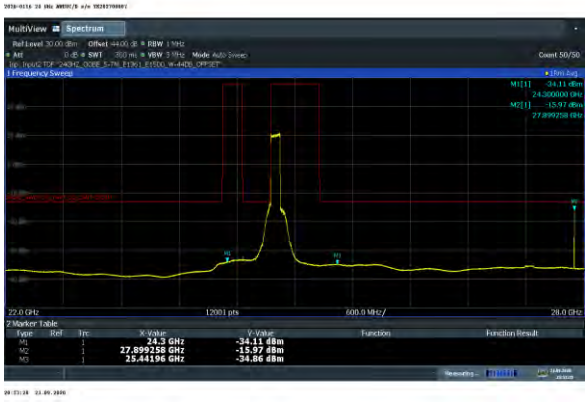
1 Carrier – QPSK / Left
OOBE/EoB – Horizontal Polarization



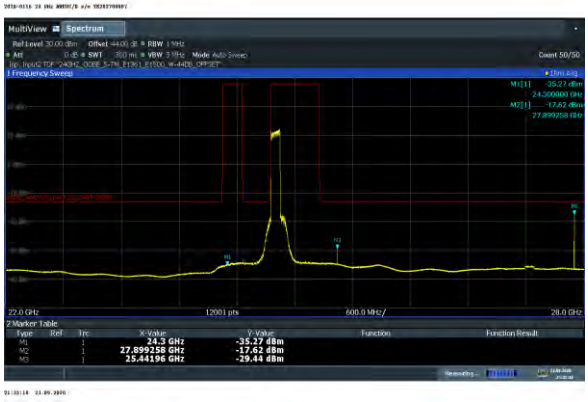
OOBE/EoB – Vertical Polarization



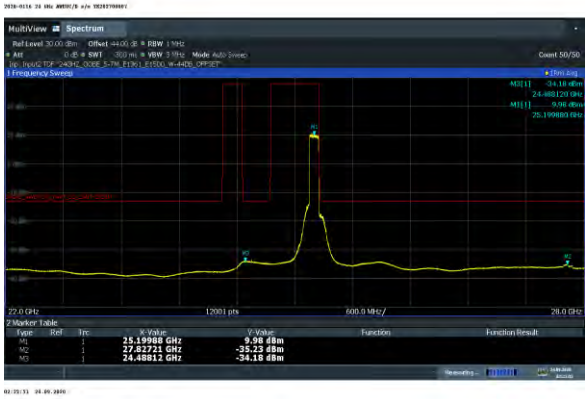
1 Carrier – QPSK / Middle
OOBE/EoB – Horizontal Polarization



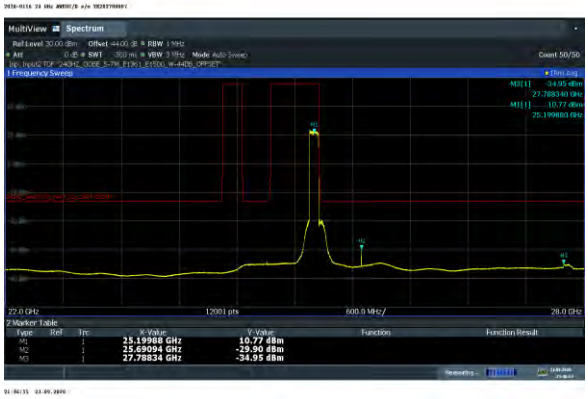
OOBE/EoB – Vertical Polarization



1 Carrier – 64 QAM / Right
OOBE/EoB – Horizontal Polarization

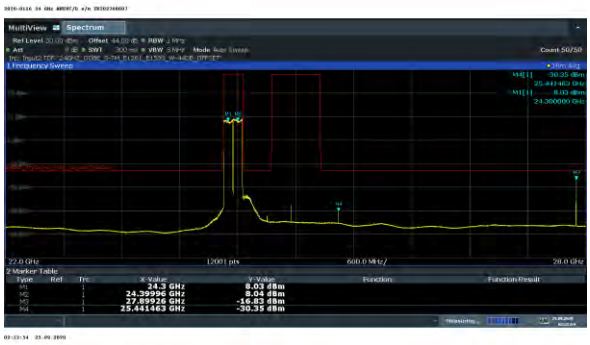


OOBE/EoB – Vertical Polarization



2 Carrier – QPSK / Left

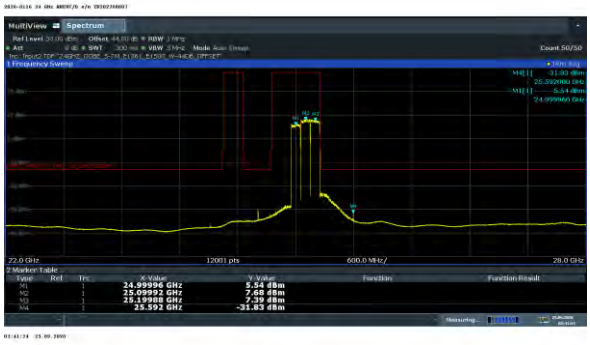
OOBE/EoB – Horizontal Polarization



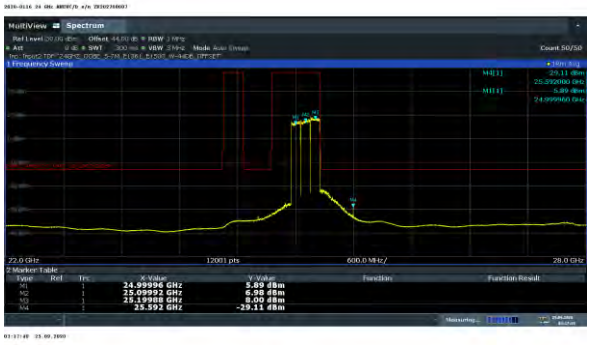
OOBE/EoB – Vertical Polarization

3 Carrier – 16QAM / Right

OOBE/EoB – Horizontal Polarization



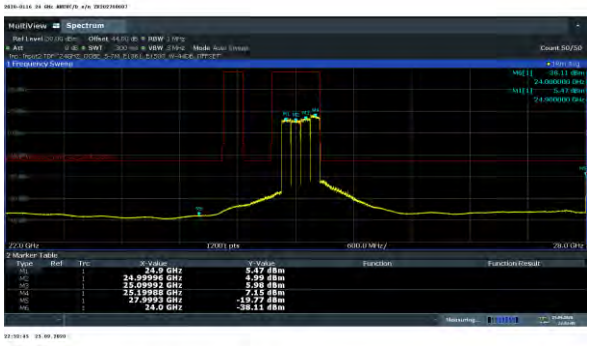
OOBE/EoB – Vertical Polarization



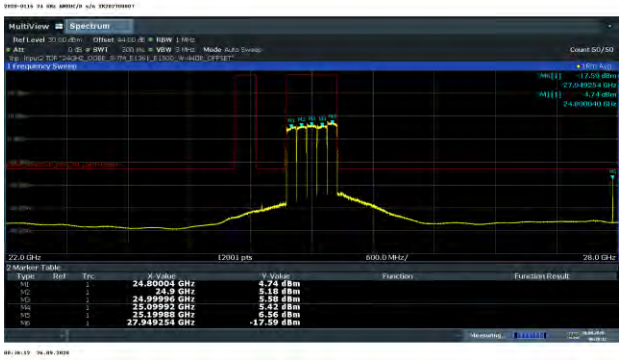
4 Carrier – 64QAM / Right

OOBE/EoB – Horizontal Polarization

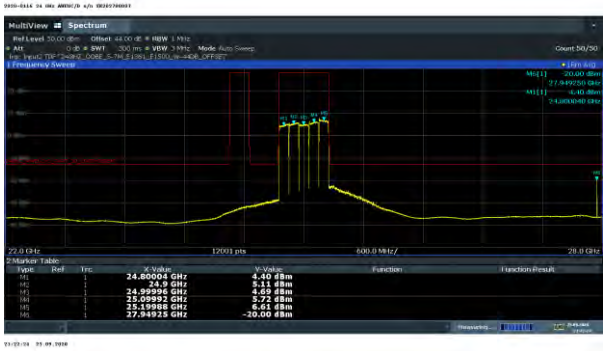
OOBE/EoB – Vertical Polarization



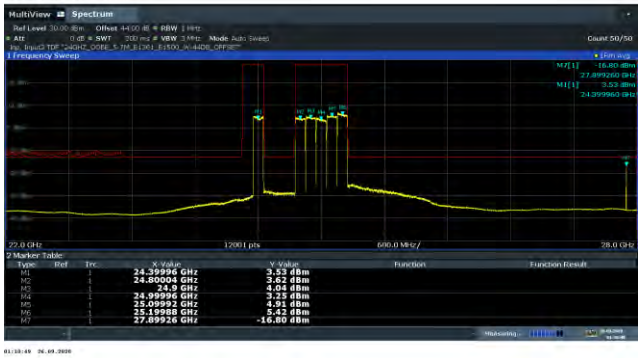
5 Carrier – 64QAM / Right
OOBE/EoB – Horizontal Polarization



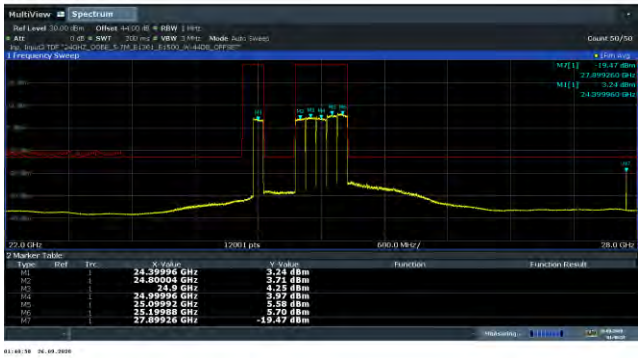
OOBE/EoB – Vertical Polarization



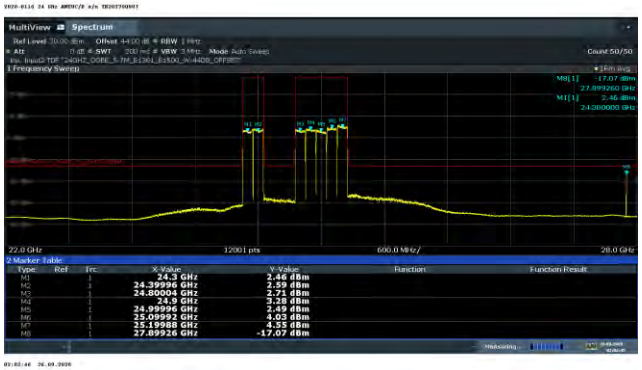
6 Carrier – 64QAM / Right
OOBE/EoB – Horizontal Polarization



OOBE/EoB – Vertical Polarization



7 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 100 GHz as specified in 2.1057(a)(2).

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

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 22- 33 GHz frequency range which is around the Transmit ranges of 24.25-24.45 GHz and 24.75-25.25 GHz. Those measurements are appropriate as the products antenna gain is documented over the same ranges. There was one significant emission detected and was shown to be compliant in Section 4.3.8.1. There were no other emissions detected in these ranges within 20 dB of the limit.

The standard radiated emissions are documented in Section 4.5 "*Section 2.1053 Measurement Required: Field Strength of Spurious Radiation*". The test configuration is shown in Figure 4.4.1 documents the test set up used for the measurements. 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 ESU-40 spectrum analyzer measurements examine the 30 MHz to 40 GHz range. The FSW based mmWave transmitter test system provides measurement capability from 40 GHz to 200 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.

he **2AD8UASMR24FA3UB** (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 base station was configured into the full power forward beam transmit configuration as defined in Table 4.5.1. The base unit was configured with the maximum transmit bandwidth of seven carriers for each polarization. The Vertical and Horizontal polarizations each transmitted 52 dBm EIRP, with the total transmit power of 55 dBm EIRP. The product in the below configurations was evaluated over the 30 MHz to 100 GHz frequency range as required.

Table 4.5.1 EUT Transmit Configuration

Test Configuration NRARFCN	AWEUC/D Tx Reference Frequencies GHz	Transmit Active Polarization	Signal Bandwidth, MHz	Modulation	Total Power, dBm EIRP	Radiated Emissions Pass / Fail
2017499	24.30000	H & V	100	16QAM	55	Pass
2019165	24.39996					
2025833	24.80004					
2027499	24.90000					
2029165	24.99996					
2030831	25.09992					
2032497	25.19988					

4.5.1 Spurious Radiation and Radiated Emissions Requirements.

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

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

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

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

The calculated emission levels were found by:

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

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.

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

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

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

The field strength of radiated spurious emissions measured was determined by

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

Field strength measurements of radiated spurious emissions were made in the 10m semi-anechoic chamber, AR-8 as detailed above. The recommendations of ANSI C63.4 and ANSI C63.26 were followed for EUT testing setup, cabling, and measurement approach and procedures. All the measurement equipment used, including antennas, was calibrated in accordance with ISO 9001 process. The EUT setup diagram is given in the Figure 4.5. The minimum margins to the Part 30.203 limit is as measured in accordance with 2.1053. The test data follows.

4.5.2 Radiated Spurious Emissions Measurements: 40 GHz - 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 extremely narrow and radiated power is down 19 dB at just ± 7 degrees off center. All of the emissions and harmonics were found to be centered on the beam as well.

Based upon previous experience a continuous max hold (average detector) sweep of the product in elevation and azimuth was employed for full coverage scanning of the product. For these measurements in each band the scan was started at the beam peak location of 350 degrees azimuth, and nominal elevations 169-170 cm for Vertical and 168-169 cm for Horizontal. The peak was first located for the most prominent emissions in the span. The elevation was then swept down to 1m and back up back to 3m and returned to the beam peak. The product was then rotated continuously to 360 degrees back to 0 degrees and back to 350 degrees. This method locates any emission and provides the maximum emissions but required operation without the analyzer internal noise reduction function. Peaks were noted using the marker function which were later formally measured with the required 1 MHz resolution bandwidth. Measurements for 40-100 GHz were performed this way.

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 27899.198 MHz. This signal was addressed in section 4.3.7 and 4.3.8. This signal also was compliant during normal radiated emissions testing. The minimum margin was 3.309 dB using a Two Cut TRP evaluation and 0.75 dB with a standard Radiated emissions evaluation.

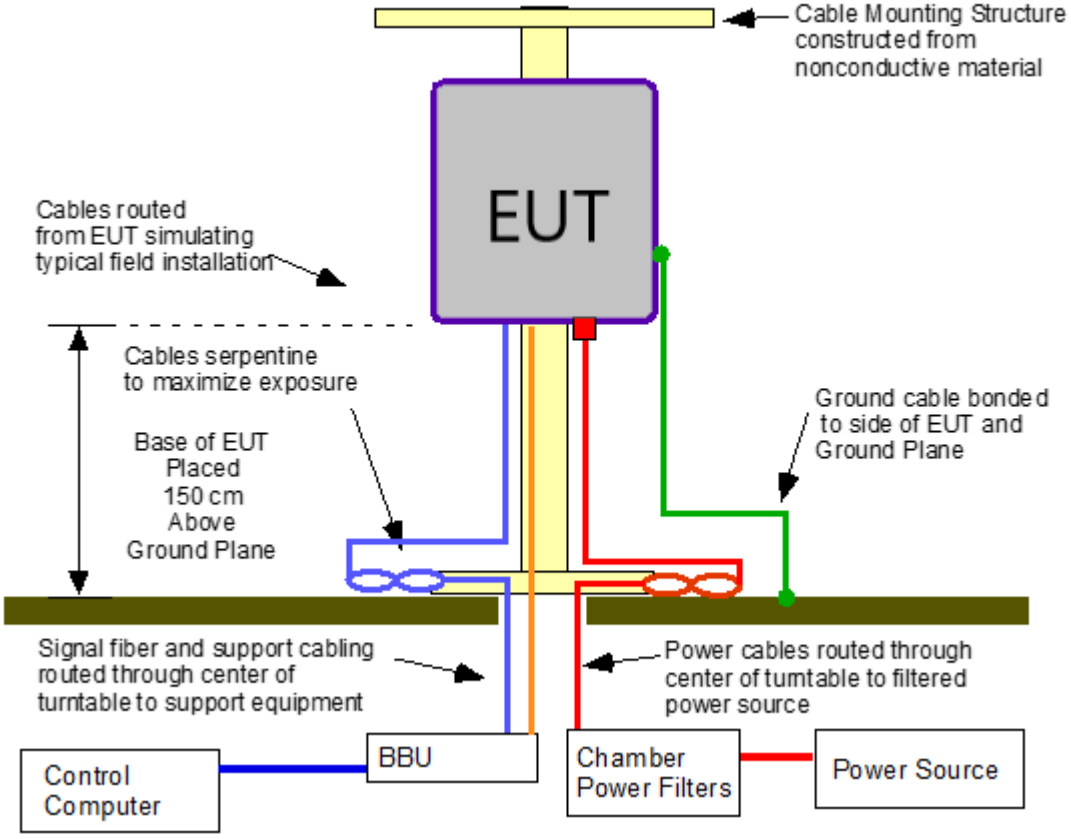
All other emissions below 40 GHz were below the Part 15 Class B limit.

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

Over the out of band spectrum investigated from 30 MHz to 100 GHz, reportable spurious emissions were detected and determined to be compliant with the Part 30 limit. The minimum margin, measured in the vertical polarization, was 2.52 dB at 60.5525 GHz. Additionally, from 30 MHz to 40 GHz all non-transmitter emissions were a minimum of 0.75 dB below the Part 15 Class B limit.

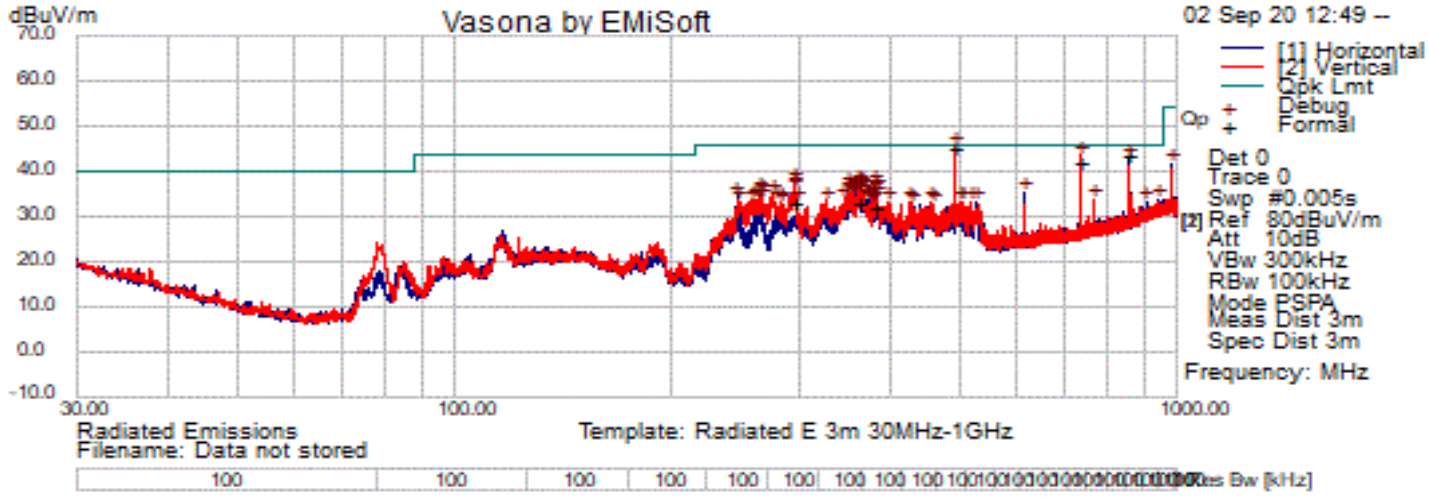
This demonstrates that the **AWEUC/D 5G AirScale 24 GHz mmWave Radio FCC ID: 2AD8UASMR24FA3UB**, the subject of this application, complies with FCC Part 15 Class B, and FCC Sections 2.1053, 30.203 and 2.1057 of the Rules.
Photographs of the measurement setup are in the filing exhibits.

Figure 4.5 Radiated Emissions Product Setup



4.5.4 Transmitter Measurements of Radiated Spurious Emissions

T8 Radiated Emissions 30MHz - 1GHz Tx-On AC Powered



Test Information

Results Title	Radiated Emissions 3m 30MHz-1GHz
File Name	t8 re30m-1g fccb 7c tx-on.emi
Test Laboratory	Global Product Compliance Lab
Test Engineer	CP
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless
EUT Details	Powered by 120VAC, AWEUC/D MAIN UNIT-SN202700007 // Extender 1 SN202900042, Extender 2 SN202900043, 7C @24.30G, 24.399.96G, 24.80004G, 24900G, 24.99996G, 25.09992G and 25.19988G Main Unit connected to AM2 and AM3. TX on
Configuration	Powered by -48VDC, Tested to FCC Class B, RE 30MHz-1GHz, @ 3-Meters, ESI E908, Preview RBW Default; Formal RBW Default. Int. Att. 10dB, PA E813, LPF E908, BiLog E601. LMI Board disconnected, Grounds back on.
Date	2020-09-02 12:49:36

Formal Data

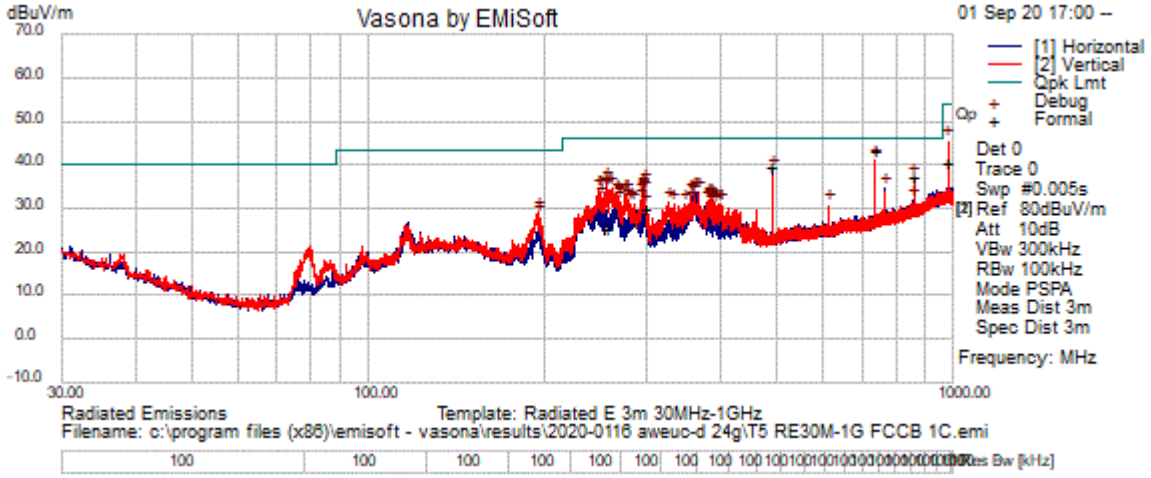
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
491.531062	51.80	3.02	-9.54	45.28	QuasiMax	V	167	50	46.00	-0.72	Pass	
860.140281	44.03	4.14	-4.63	43.54	QuasiMax	H	188	105	46.00	-2.46	Pass	
737.302605	44.93	3.59	-6.25	42.26	QuasiMax	V	245	238	46.00	-3.74	Pass	
294.240481	44.63	2.26	-13.77	33.13	QuasiMax	V	135	308	46.00	-12.87	Pass	
362.440882	42.69	2.65	-12.41	32.93	QuasiMax	H	176	315	46.00	-13.07	Pass	
382.160321	40.84	2.75	-11.61	31.98	QuasiMax	V	106	55	46.00	-14.02	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
491.531062	51.94	3.02	-9.54	45.42	Debug	V	160	45	46.00	-0.58	Pass	
737.302605	46.16	3.59	-6.25	43.49	Debug	V	260	225	46.00	-2.51	Pass	
860.140281	43.38	4.14	-4.63	42.89	Debug	H	202	90	46.00	-3.11	Pass	
294.240481	48.88	2.26	-13.77	37.38	Debug	V	102	315	46.00	-8.62	Pass	
382.160321	45.97	2.75	-11.61	37.11	Debug	V	102	45	46.00	-8.89	Pass	
362.440882	46.84	2.65	-12.41	37.08	Debug	H	202	315	46.00	-8.92	Pass	
363.691383	46.27	2.65	-12.35	36.57	Debug	V	102	90	46.00	-9.43	Pass	
294.529058	48.07	2.26	-13.76	36.57	Debug	V	102	315	46.00	-9.43	Pass	
349.551102	46.86	2.58	-13.02	36.42	Debug	V	102	0	46.00	-9.58	Pass	
366.192385	45.95	2.67	-12.23	36.39	Debug	V	102	90	46.00	-9.61	Pass	
365.230461	45.86	2.66	-12.28	36.25	Debug	V	102	90	46.00	-9.75	Pass	
383.218437	44.88	2.76	-11.58	36.05	Debug	V	102	45	46.00	-9.95	Pass	
354.937876	46.15	2.61	-12.77	35.98	Debug	V	102	0	46.00	-10.02	Pass	
367.635271	45.46	2.68	-12.16	35.98	Debug	V	102	90	46.00	-10.02	Pass	
369.559118	45.13	2.69	-12.07	35.74	Debug	H	102	225	46.00	-10.26	Pass	
295.875752	47.20	2.27	-13.75	35.71	Debug	V	102	315	46.00	-10.29	Pass	
358.496994	45.52	2.63	-12.60	35.54	Debug	H	202	315	46.00	-10.46	Pass	
614.368737	39.78	3.31	-7.68	35.41	Debug	H	202	180	46.00	-10.59	Pass	
350.032064	45.81	2.58	-13.02	35.37	Debug	V	102	0	46.00	-10.63	Pass	
265.382766	45.94	2.16	-12.77	35.33	Debug	V	160	45	46.00	-10.67	Pass	
382.92986	44.11	2.76	-11.59	35.27	Debug	V	102	45	46.00	-10.73	Pass	
348.973948	45.72	2.57	-13.03	35.27	Debug	V	102	0	46.00	-10.73	Pass	
266.056112	45.69	2.16	-12.85	35.00	Debug	V	160	45	46.00	-11.00	Pass	
275.386774	46.59	2.20	-13.92	34.87	Debug	V	102	315	46.00	-11.13	Pass	
369.366733	44.14	2.68	-12.08	34.75	Debug	H	102	225	46.00	-11.25	Pass	
351.859719	44.99	2.59	-12.92	34.65	Debug	H	102	225	46.00	-11.35	Pass	
245.759519	44.05	2.08	-11.59	34.54	Debug	H	102	45	46.00	-11.46	Pass	
384.468938	43.00	2.76	-11.54	34.22	Debug	V	102	45	46.00	-11.78	Pass	
356.476954	44.30	2.62	-12.70	34.21	Debug	H	102	225	46.00	-11.79	Pass	
379.370741	43.16	2.74	-11.69	34.21	Debug	V	102	45	46.00	-11.79	Pass	
943.731463	32.32	4.76	-3.28	33.80	Debug	H	202	135	46.00	-12.20	Pass	
369.943888	43.15	2.69	-12.05	33.78	Debug	V	102	0	46.00	-12.22	Pass	
259.418838	43.67	2.14	-12.03	33.78	Debug	V	102	315	46.00	-12.22	Pass	
983.074148	39.36	5.03	-2.63	41.76	Debug	H	102	135	54.00	-12.24	Pass	
263.843687	44.13	2.15	-12.58	33.71	Debug	V	160	45	46.00	-12.29	Pass	
261.631263	43.86	2.14	-12.30	33.70	Debug	V	160	45	46.00	-12.30	Pass	
345.703407	44.17	2.56	-13.07	33.66	Debug	V	160	90	46.00	-12.34	Pass	
767.987976	35.77	3.62	-5.76	33.64	Debug	V	160	225	46.00	-12.36	Pass	
267.498998	44.49	2.17	-13.02	33.63	Debug	V	160	225	46.00	-12.37	Pass	
258.745491	43.30	2.13	-11.94	33.49	Debug	V	102	315	46.00	-12.51	Pass	
373.310621	42.61	2.71	-11.89	33.42	Debug	H	202	315	46.00	-12.58	Pass	
327.330661	44.21	2.45	-13.29	33.37	Debug	V	160	315	46.00	-12.63	Pass	
528.084168	38.88	3.10	-8.75	33.24	Debug	H	102	135	46.00	-12.76	Pass	
247.490982	42.42	2.09	-11.28	33.23	Debug	V	160	180	46.00	-12.77	Pass	
456.132265	40.68	2.95	-10.41	33.22	Debug	V	160	45	46.00	-12.78	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.

T5a Radiated Emissions 30MHz - 1GHz Tx-Off DC Powered



Test Information

Results Title	Radiated Emissions 3M 30MHz-1GHz
File Name	T5a RE30M-1G FCCB 1C.emi
Test Laboratory	Global Product Compliance Lab
Test Engineer	MJS
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless
EUT Details	Powered by 120VAC, AWEUC/D MAIN UNIT-SN202700007 – AM2-SN202900042, AM3 SN202900043, 1C @24.30GHz, **Main Unit connected to AM2, AM3**.
Configuration	Powered by -48VDC, Tested to FCC Class B, RE 30MHz-1GHz, @ 3-Meters, ESI E908, Preview RBW Default; Formal RBW Default. Int. Att. 10dB, PA E813, LPF E908, BiLog E601. LMI Board disconnected, Grounds back on.
Date	2020-09-01 17:01:52

Formal Data

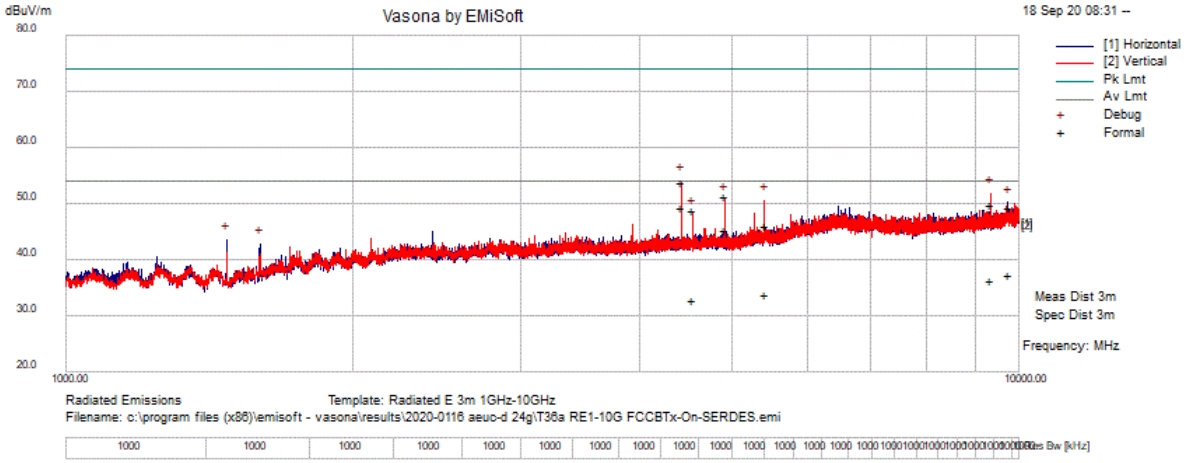
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
737.290	46.03	3.59	-6.25	43.36	QuasiMax	H	144	277	46.00	-2.64	Pass	
491.526	46.17	3.02	-9.54	39.64	QuasiMax	H	105	257	46.00	-6.36	Pass	
860.155	37.94	4.14	-4.63	37.45	QuasiMax	H	109	226	46.00	-8.55	Pass	
983.049	38.45	5.03	-2.63	40.85	QuasiMax	V	120	287	54.00	-13.15	Pass	
297.222445	41.71	2.27	-13.74	30.24	QuasiMax	V	134	304	46.00	-15.76	Pass	
255.955912	34.71	2.12	-11.59	25.24	QuasiMax	V	270	81	46.00	-20.76	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
737.398798	43.80	3.59	-6.25	41.13	Debug	H	102	270	46.00	-4.87	Pass	
491.627255	45.30	3.02	-9.54	38.78	Debug	H	102	315	46.00	-7.22	Pass	
983.170341	42.98	5.03	-2.62	45.38	Debug	V	160	270	54.00	-8.62	Pass	
860.236473	37.34	4.14	-4.63	36.85	Debug	H	102	225	46.00	-9.15	Pass	
255.955912	45.27	2.12	-11.59	35.80	Debug	V	102	90	46.00	-10.20	Pass	
297.222445	46.95	2.27	-13.74	35.48	Debug	V	102	315	46.00	-10.52	Pass	
261.53507	44.80	2.14	-12.29	34.65	Debug	V	102	270	46.00	-11.35	Pass	
768.084168	36.63	3.62	-5.76	34.50	Debug	H	202	315	46.00	-11.50	Pass	
294.817635	45.93	2.26	-13.76	34.43	Debug	V	102	315	46.00	-11.57	Pass	
259.034068	44.19	2.14	-11.98	34.34	Debug	V	102	270	46.00	-11.66	Pass	
255.186373	43.70	2.12	-11.49	34.33	Debug	V	102	90	46.00	-11.67	Pass	
248.741483	42.93	2.10	-11.05	33.98	Debug	V	160	90	46.00	-12.02	Pass	
295.39479	45.40	2.26	-13.76	33.91	Debug	V	102	315	46.00	-12.09	Pass	
256.340681	43.42	2.12	-11.64	33.91	Debug	V	102	90	46.00	-12.09	Pass	
247.779559	43.03	2.09	-11.22	33.90	Debug	V	160	90	46.00	-12.10	Pass	
249.703407	42.63	2.10	-10.88	33.85	Debug	V	160	90	46.00	-12.15	Pass	
298.376754	45.23	2.27	-13.73	33.77	Debug	V	102	315	46.00	-12.23	Pass	
361.57515	43.55	2.64	-12.45	33.75	Debug	H	202	315	46.00	-12.25	Pass	
295.202405	45.07	2.26	-13.76	33.58	Debug	V	102	315	46.00	-12.42	Pass	
368.693387	42.91	2.68	-12.11	33.48	Debug	V	160	45	46.00	-12.52	Pass	
365.807615	43.04	2.67	-12.25	33.46	Debug	H	202	315	46.00	-12.54	Pass	
363.306613	43.17	2.65	-12.37	33.45	Debug	H	202	315	46.00	-12.55	Pass	
265.95992	44.03	2.16	-12.84	33.35	Debug	V	160	45	46.00	-12.65	Pass	
294.336673	44.85	2.26	-13.76	33.34	Debug	V	102	315	46.00	-12.66	Pass	
277.599198	45.02	2.20	-13.90	33.32	Debug	V	102	315	46.00	-12.68	Pass	
277.887776	44.87	2.20	-13.90	33.17	Debug	V	102	315	46.00	-12.83	Pass	
274.905812	44.80	2.19	-13.91	33.08	Debug	V	102	315	46.00	-12.92	Pass	
357.53507	42.93	2.62	-12.65	32.91	Debug	V	260	180	46.00	-13.09	Pass	
360.420842	42.43	2.64	-12.51	32.56	Debug	H	202	315	46.00	-13.44	Pass	
267.883768	43.46	2.17	-13.07	32.56	Debug	V	160	45	46.00	-13.44	Pass	
251.43487	41.26	2.11	-11.01	32.35	Debug	V	160	135	46.00	-13.65	Pass	
268.749499	43.18	2.17	-13.18	32.17	Debug	V	160	225	46.00	-13.83	Pass	
385.527054	40.89	2.77	-11.51	32.14	Debug	V	102	45	46.00	-13.86	Pass	
382.352705	40.84	2.75	-11.60	31.99	Debug	V	260	180	46.00	-14.01	Pass	
853.887776	32.35	4.09	-4.70	31.74	Debug	H	360	0	46.00	-14.26	Pass	
388.893788	40.37	2.79	-11.42	31.74	Debug	V	360	180	46.00	-14.26	Pass	
278.46493	43.39	2.21	-13.89	31.70	Debug	V	102	315	46.00	-14.30	Pass	
293.567134	43.21	2.26	-13.77	31.70	Debug	V	102	315	46.00	-14.30	Pass	
383.699399	40.41	2.76	-11.57	31.60	Debug	V	102	45	46.00	-14.40	Pass	
327.811623	42.34	2.45	-13.28	31.51	Debug	V	102	270	46.00	-14.49	Pass	
390.529058	39.98	2.79	-11.37	31.40	Debug	V	360	180	46.00	-14.60	Pass	
195.450902	42.15	1.86	-15.20	28.81	Debug	V	102	225	43.50	-14.69	Pass	
360.709419	41.13	2.64	-12.49	31.28	Debug	H	202	315	46.00	-14.72	Pass	
358.304609	41.23	2.63	-12.61	31.25	Debug	V	260	180	46.00	-14.75	Pass	
269.61523	42.33	2.17	-13.28	31.23	Debug	V	160	225	46.00	-14.77	Pass	
381.198397	40.05	2.75	-11.64	31.16	Debug	V	260	180	46.00	-14.84	Pass	
281.158317	42.71	2.22	-13.87	31.06	Debug	V	102	315	46.00	-14.94	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.

T36a Radiated Emissions 1GHz - 10GHz Tx-On



Test Information

Results Title	Radiated Emissions 3m 1GHz-10GHz
File Name	T36a RE1-10G FCCB Tx-On-SERDES.emi
Test Laboratory	Global Product Compliance Lab AR9
Test Engineer	MJS / CP
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless
EUT Details	AR9- GPCL 2020-0116 - AWEUC/D - Powered by 120VAC, AWEUC/D Main Unit -AM1-SNYK202700036 // AM2-SNYK202900057, AM3-SNYK202900059, 1C - Tx On. Changed extension cables with new and Modified cables from Naperville, all clocks turned off, commands to lower SERDES drive.
Configuration	Tested to FCC Part 15b, RE 1G-10GHz, @ 3-Meters, Preview RBW 1M; Formal RBW Default. Int. Att. 0dB, PA-HP E1356, LPF-E1475, ESI-E908, 3117 DR Horn Antenna E1073.
Date	2020-09-18 08:32:35

Formal Data

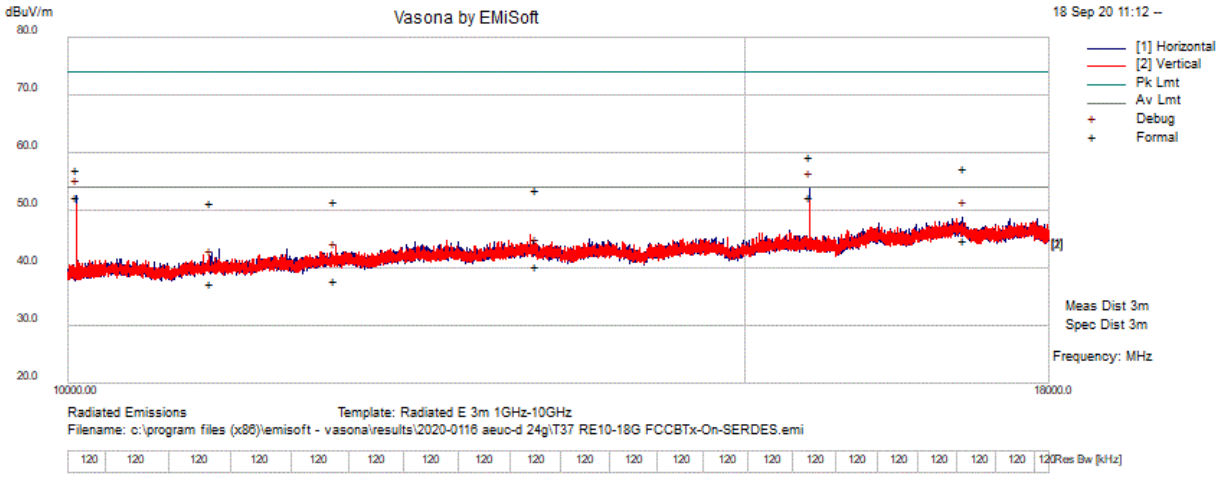
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
4423.964329	46.10	5.95	-2.65	49.40	AvgMax	V	146	23	54.00	-4.60	Pass	
4915.054048	41.61	6.36	-2.51	45.46	AvgMax	V	136	181	54.00	-8.54	Pass	
9749.59523	28.07	9.32	-0.17	37.22	AvgMax	H	357	322	54.00	-16.78	Pass	
9339.684008	27.84	9.08	-0.56	36.37	AvgMax	V	147	60	54.00	-17.63	Pass	
4423.964329	50.64	5.95	-2.65	53.94	PeakMax	V	146	23	74.00	-20.06	Pass	
5407.751263	28.89	7.02	-2.12	33.79	AvgMax	V	146	78	54.00	-20.21	Pass	
4546.937695	29.30	6.05	-2.57	32.78	AvgMax	V	138	49	54.00	-21.22	Pass	
4915.054048	47.55	6.36	-2.51	51.40	PeakMax	V	136	181	74.00	-22.60	Pass	
9339.684008	41.19	9.08	-0.56	49.72	PeakMax	V	147	60	74.00	-24.28	Pass	
9749.59523	40.32	9.32	-0.17	49.47	PeakMax	H	357	322	74.00	-24.53	Pass	
4546.937695	45.28	6.05	-2.57	48.76	PeakMax	V	138	49	74.00	-25.24	Pass	
5407.751263	41.19	7.02	-2.12	46.10	PeakMax	V	146	78	74.00	-27.90	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
4423.964329	50.77	5.95	-2.65	54.07	Debug	V	101	45	54.00	0.07	Fail	
9339.684008	43.23	9.08	-0.56	51.76	Debug	V	101	0	54.00	-2.24	Pass	
4915.054048	46.76	6.36	-2.51	50.61	Debug	V	101	180	54.00	-3.39	Pass	
5407.751263	45.64	7.02	-2.12	50.54	Debug	V	101	135	54.00	-3.46	Pass	
9749.59523	40.99	9.32	-0.17	50.14	Debug	H	101	225	54.00	-3.86	Pass	
4546.937695	44.67	6.05	-2.57	48.15	Debug	V	101	45	54.00	-5.85	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.

T37 Radiated Emissions 10GHz - 18GHz Tx-On



Test Information

Results Title	Radiated Emissions 3m 1GHz-10GHz
File Name	T37 RE10-18G FCCBTx-On-SERDES.emi
Test Laboratory	Global Product Compliance Lab
Test Engineer	MJS / CP
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless
EUT Details	AR9- GPCL 2020-0116 - AWEUC/D - Powered by 120VAC, AWEUC/D Main Unit -AM1-SNYK202700036 // AM2-SNYK202900057, AM3-SNYK202900059, 7C - Tx On. Changed extension cables with new and Modified cables from Naperville, all clocks turned off, commands to lower SERDES drive.
Configuration	Tested to FCC Part 15b, RE 10G-18GHz, @ 3-Meters, Preview RBW 120k; Formal RBW Default. Int. Att. 0dB, PA-HP E1356, LPF-E1475, ESI-E908, 3117 DR Horn Antenna E1073.
Date	2020-09-18 11:13:16

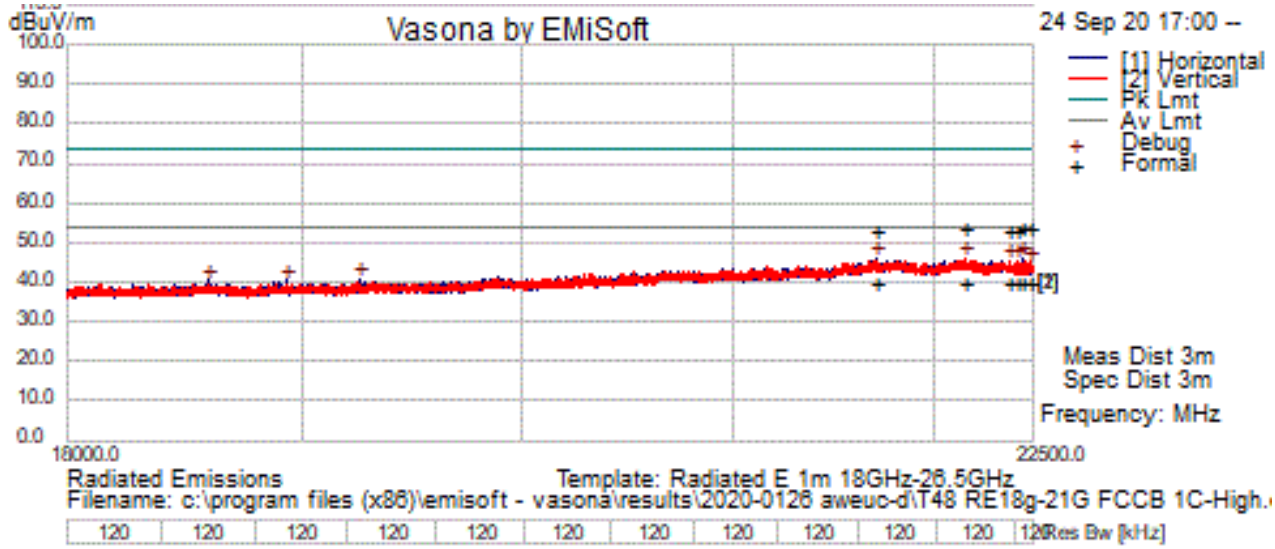
Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
10050.413	42.72	9.53	0.18	52.43	AvgMax	H	201	118	54.00	-1.57	Pass	
15596.055	36.48	11.56	4.36	52.40	AvgMax	H	198	179	54.00	-1.60	Pass	
17095.044	25.26	12.33	7.14	44.73	AvgMax	H	250	245	54.00	-9.27	Pass	
13228.473	24.94	10.92	4.40	40.26	AvgMax	H	337	20	54.00	-13.74	Pass	
15596.055	43.54	11.56	4.36	59.46	PeakMax	H	198	179	74.00	-14.54	Pass	
11723.336	25.57	10.39	1.89	37.85	AvgMax	H	108	42	54.00	-16.15	Pass	
10883.266	26.09	10.08	1.26	37.43	AvgMax	H	225	317	54.00	-16.57	Pass	
17095.044	37.86	12.33	7.14	57.33	PeakMax	H	250	245	74.00	-16.67	Pass	
10050.413	47.42	9.53	0.18	57.13	PeakMax	H	201	118	74.00	-16.87	Pass	
13228.473	38.23	10.92	4.40	53.55	PeakMax	H	337	20	74.00	-20.45	Pass	
11723.336	39.38	10.39	1.89	51.66	PeakMax	H	108	42	74.00	-22.34	Pass	
10883.266	39.94	10.08	1.26	51.28	PeakMax	H	225	317	74.00	-22.72	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
15596.055	37.86	11.56	4.36	53.79	Debug	H	200	180	54.00	-0.21	Pass	
10050.413	42.75	9.53	0.18	52.46	Debug	H	200	90	54.00	-1.54	Pass	
17095.044	29.35	12.33	7.14	48.81	Debug	H	101	315	54.00	-5.19	Pass	
13228.473	26.87	10.92	4.40	42.19	Debug	H	100	350	54.00	-11.81	Pass	
11723.336	29.19	10.39	1.89	41.47	Debug	H	100	350	54.00	-12.53	Pass	
10883.266	29.00	10.08	1.26	40.34	Debug	H	100	350	54.00	-13.66	Pass	

T48a Radiated Emissions 18GHz – 22.5GHz Tx-On



Test Information

Results Title	Radiated Emissions 1m 18GHz-22.5GHz
File Name	T48a RE18g-21G FCCB 1C-High.emi
Test Laboratory	AR9, 28%RH, 23C, 998hPa.
Test Engineer	MJS / CP
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless
EUT Details	2020-0126 - AWEUC/D - Powered by 120VAC, AWEUC/D Main Unit -AM1-YK202700009 // AM2-YK202900051, AM3-YK202900054, New ASMR HW (main and expansions units); 1C-TM1.1_High (25199.88MHz)- Tx On. New ASMR HW (main and expansions units). Modified extension cables from Naperville. Test Clocks off. Clock cleaners set for 500mV. Serdes Command used.
Configuration	Tested to FCC Part 15b, RE 18G-22.5GHz, @ 3-Meters, Preview RBW 120k; Formal RBW Default. Int. Att. 0dB, PA-Key Sight E1388, LPF-E1499, ESI-E908, A-Info Horn Antenna E1453.
Date	2020-09-24 17:18:27

Formal Data

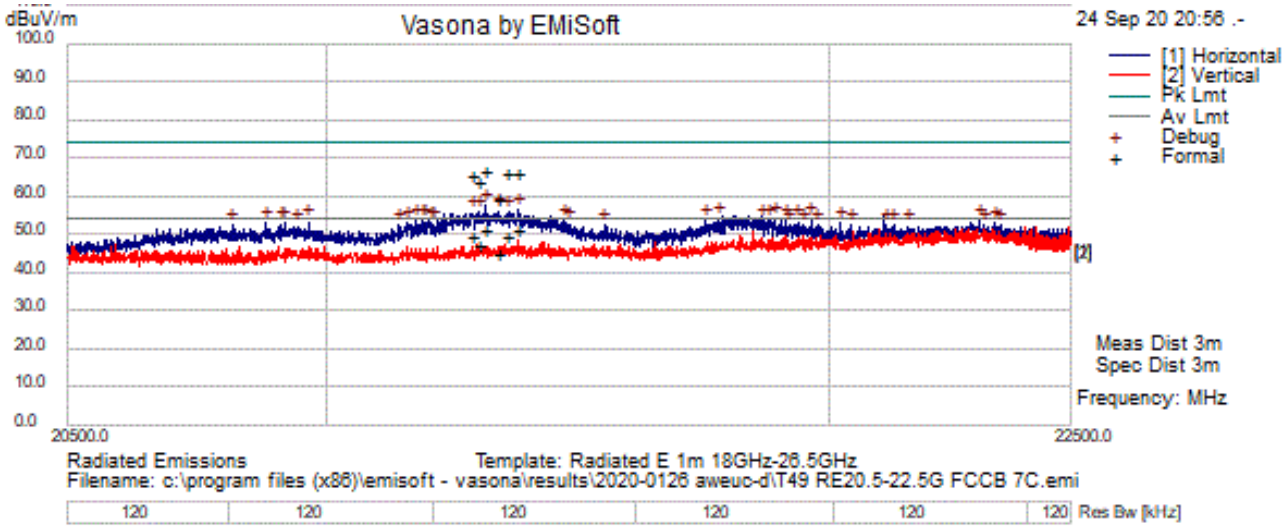
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
22449.785	19.40	14.36	6.30	40.06	AvgMax	H	191	112	54.00	-13.94	Pass	
21704.472	19.55	13.84	6.58	39.97	AvgMax	H	212	157	54.00	-14.03	Pass	
22493.988	19.24	14.41	6.28	39.93	AvgMax	V	116	116	54.00	-14.07	Pass	
22155.375	19.40	14.05	6.47	39.92	AvgMax	V	191	117	54.00	-14.08	Pass	
22423.440	19.24	14.33	6.32	39.89	AvgMax	V	148	266	54.00	-14.11	Pass	
22377.209	19.24	14.29	6.34	39.87	AvgMax	V	101	129	54.00	-14.13	Pass	
22493.988	33.13	14.41	6.28	53.81	PeakMax	V	116	116	74.00	-20.19	Pass	
22449.785	33.13	14.36	6.30	53.79	PeakMax	H	191	112	74.00	-20.21	Pass	
22155.375	33.13	14.05	6.47	53.65	PeakMax	V	191	117	74.00	-20.35	Pass	
22423.440	32.72	14.33	6.32	53.37	PeakMax	V	148	266	74.00	-20.63	Pass	
22377.209	32.72	14.29	6.34	53.35	PeakMax	V	101	129	74.00	-20.65	Pass	
21704.472	32.72	13.84	6.58	53.14	PeakMax	H	212	157	74.00	-20.86	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
22155.375	25.73	14.05	6.47	46.25	Debug	V	250	350	54.00	-7.75	Pass	
21704.472	25.78	13.84	6.58	46.19	Debug	H	250	264	54.00	-7.81	Pass	
22449.785	25.28	14.36	6.30	45.94	Debug	H	100	22	54.00	-8.06	Pass	
22377.209	24.89	14.29	6.34	45.52	Debug	V	150	330	54.00	-8.48	Pass	
22423.440	24.76	14.33	6.32	45.41	Debug	V	250	176	54.00	-8.59	Pass	
22493.988	24.48	14.41	6.28	45.17	Debug	V	150	66	54.00	-8.83	Pass	
19257.061	22.70	13.00	4.98	40.68	Debug	H	100	286	54.00	-13.32	Pass	
18937.973	22.78	12.68	5.07	40.53	Debug	H	250	0	54.00	-13.47	Pass	
18599.596	22.98	12.40	5.04	40.42	Debug	H	200	110	54.00	-13.58	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.

T49B Radiated Emissions 20.5GHz – 22.5GHz Tx-On



Test Information

Results Title	Radiated Emissions 1m 20.5GHz-22.5GHz
File Name	T49B RE20.5-22.5G FCCB 7C.emi
Test Laboratory	AR9, 28%RH, 23C, 998hPa.
Test Engineer	MJS / CP
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless
EUT Details	2020-0126 - AWEUC/D - Powered by 120VAC, AWEUC/D Main Unit -AM1-YK202700009 // AM2-YK202900051, AM3-YK202900054, New ASMR HW (main and expansions units); 7C-TM1.1_Tx On. New ASMR HW (main and expansions units). Modified extension cables from Naperville. Test Clocks off. Clock cleaners set for 500mV. Serdes Command used.
Configuration	Tested to FCC Part 15b, RE 20.5G-22.5GHz, @ 3-Meters, Preview RBW 100k; Formal RBW Default. Int. Att. 0dB, PA-KeySight E1388, LPF-E1499, ESI-E908, A-Info Horn Antenna E1453.
Date	2020-09-24 20:59:16

Formal Data

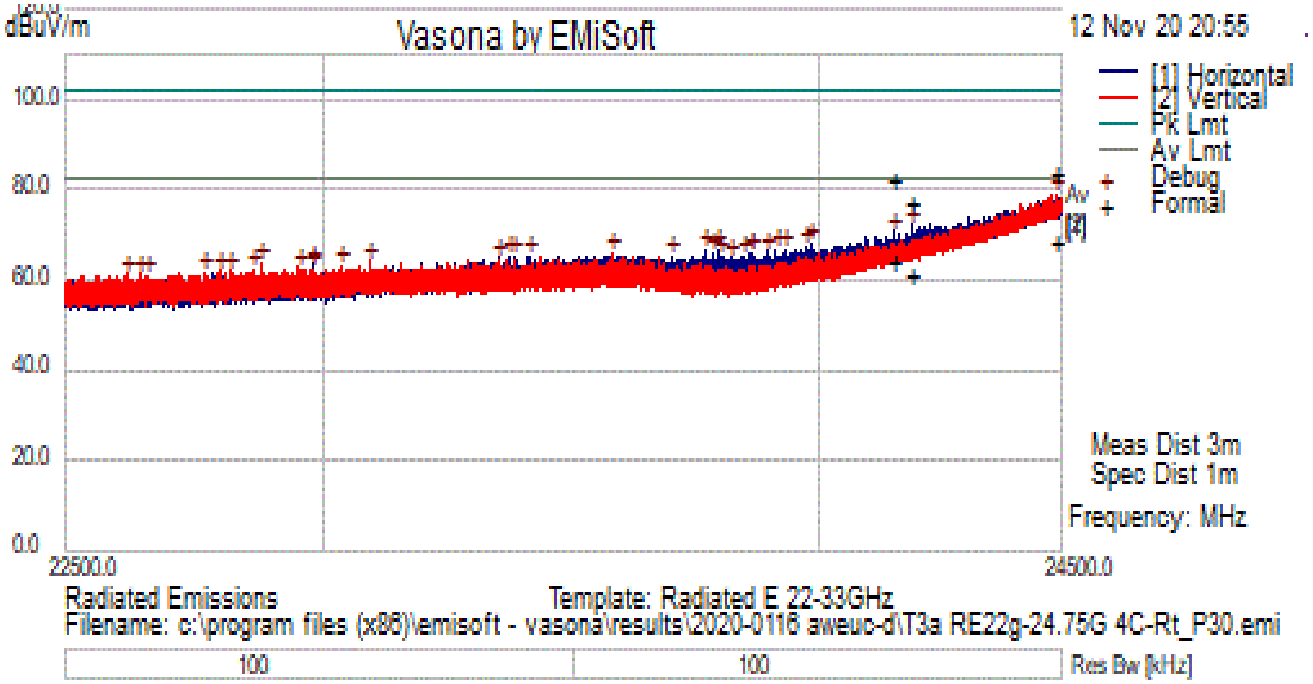
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
21310.636	30.96	13.81	6.35	51.12	AvgMax	H	191	29	54.00	-2.88	Pass	
21375.739	30.88	13.81	6.43	51.12	AvgMax	H	192	32	54.00	-2.88	Pass	
21284.112	29.49	13.81	6.31	49.62	AvgMax	H	193	32	54.00	-4.38	Pass	
21356.450	29.25	13.81	6.41	49.47	AvgMax	H	178	23	54.00	-4.53	Pass	
21298.580	27.48	13.81	6.33	47.63	AvgMax	H	190	38	54.00	-6.37	Pass	
21336.356	24.94	13.81	6.38	45.14	AvgMax	H	192	72	54.00	-8.86	Pass	
21310.636	46.39	13.81	6.35	66.55	PeakMax	H	191	29	74.00	-7.45	Pass	
21375.739	46.14	13.81	6.43	66.39	PeakMax	H	192	32	74.00	-7.61	Pass	
21356.450	45.77	13.81	6.41	65.99	PeakMax	H	178	23	74.00	-8.01	Pass	
21284.112	45.29	13.81	6.31	65.42	PeakMax	H	193	32	74.00	-8.58	Pass	
21298.580	43.93	13.81	6.33	64.08	PeakMax	H	190	38	74.00	-9.92	Pass	
21336.356	39.38	13.81	6.38	59.58	PeakMax	H	192	72	74.00	-14.42	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
21310.636	37.46	13.81	6.35	57.62	Debug	H	200	22	54.00	3.62	Fail	
21375.739	36.12	13.81	6.43	56.36	Debug	H	200	22	54.00	2.36	Fail	
21336.356	35.87	13.81	6.38	56.07	Debug	H	200	22	54.00	2.07	Fail	
21298.580	35.77	13.81	6.33	55.92	Debug	H	200	22	54.00	1.92	Fail	
21356.450	35.57	13.81	6.41	55.79	Debug	H	200	22	54.00	1.79	Fail	
21284.112	35.29	13.81	6.31	55.42	Debug	H	200	22	54.00	1.42	Fail	
21890.942	33.54	13.87	6.56	53.97	Debug	H	200	22	54.00	-0.03	Pass	
21776.809	33.47	13.85	6.57	53.89	Debug	H	200	22	54.00	-0.11	Pass	
21964.083	33.27	13.88	6.56	53.71	Debug	H	200	22	54.00	-0.29	Pass	
21878.082	33.20	13.87	6.56	53.64	Debug	H	200	22	54.00	-0.36	Pass	
21186.055	33.60	13.82	6.19	53.61	Debug	H	200	22	54.00	-0.39	Pass	
22312.105	33.01	14.22	6.38	53.61	Debug	H	200	22	54.00	-0.39	Pass	
21751.090	33.16	13.85	6.57	53.58	Debug	H	200	22	54.00	-0.42	Pass	
21174.803	33.39	13.82	6.17	53.39	Debug	H	200	22	54.00	-0.61	Pass	
21866.025	32.89	13.87	6.57	53.32	Debug	H	200	22	54.00	-0.68	Pass	
21912.643	32.84	13.87	6.56	53.28	Debug	H	200	22	54.00	-0.72	Pass	
21467.367	32.91	13.81	6.55	53.27	Debug	H	200	22	54.00	-0.73	Pass	
21937.559	32.71	13.88	6.56	53.15	Debug	H	200	22	54.00	-0.85	Pass	
20962.613	33.39	13.83	5.92	53.14	Debug	H	200	22	54.00	-0.86	Pass	
21192.485	33.09	13.82	6.20	53.11	Debug	H	200	22	54.00	-0.89	Pass	
22342.648	32.46	14.25	6.36	53.07	Debug	H	200	22	54.00	-0.93	Pass	
20879.827	33.40	13.82	5.85	53.07	Debug	H	200	22	54.00	-0.93	Pass	
21204.541	33.01	13.82	6.21	53.04	Debug	H	200	22	54.00	-0.96	Pass	
22024.364	32.52	13.91	6.54	52.98	Debug	H	200	22	54.00	-1.02	Pass	
21157.120	32.97	13.82	6.15	52.94	Debug	H	200	22	54.00	-1.06	Pass	
20916.800	33.01	13.82	5.88	52.71	Debug	H	200	22	54.00	-1.29	Pass	
21209.364	32.64	13.82	6.22	52.67	Debug	H	200	22	54.00	-1.33	Pass	
21475.404	32.26	13.81	6.56	52.62	Debug	H	200	22	54.00	-1.38	Pass	
20910.370	32.84	13.82	5.87	52.53	Debug	H	200	22	54.00	-1.47	Pass	
21948.811	32.08	13.88	6.56	52.52	Debug	H	200	22	54.00	-1.48	Pass	
21919.877	32.08	13.87	6.56	52.52	Debug	H	200	22	54.00	-1.48	Pass	
22353.900	31.89	14.26	6.36	52.51	Debug	H	200	22	54.00	-1.49	Pass	
22319.339	31.89	14.23	6.38	52.49	Debug	H	200	22	54.00	-1.51	Pass	
22118.402	31.93	14.01	6.49	52.43	Debug	H	200	22	54.00	-1.57	Pass	
21547.741	32.01	13.81	6.59	52.41	Debug	H	200	22	54.00	-1.59	Pass	
21141.045	32.39	13.82	6.13	52.34	Debug	H	200	22	54.00	-1.66	Pass	
22047.672	31.87	13.94	6.53	52.34	Debug	H	200	22	54.00	-1.66	Pass	
20815.527	32.66	13.82	5.79	52.27	Debug	H	200	22	54.00	-1.73	Pass	
22134.477	31.70	14.03	6.48	52.21	Debug	H	200	22	54.00	-1.79	Pass	
21977.746	31.76	13.88	6.56	52.20	Debug	H	200	22	54.00	-1.80	Pass	
20941.716	32.38	13.83	5.90	52.10	Debug	H	200	22	54.00	-1.90	Pass	
22163.412	31.57	14.06	6.46	52.09	Debug	H	200	22	54.00	-1.91	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.

T4 Radiated Emissions 22GHz-24.75GHz Part 30 0-315 Degrees Azimuth



Test Information

Results Title	Radiated Emissions - 22GHz-24.75GHz - Part 30 0-315 Degrees Azimuth
File Name	T4 RE22g-24.75G _P30_0-315.emi
Test Laboratory	MH-AR8 33%RH, 21C, 992hPa
Test Engineer	MJS / WSM
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	, 24 GHz AWEUC/D SN-AM2-YK202700009, AM2-YK202900051, AM3-YK202900054, Tx-On 4C-Right- 16QAM-Contiguous Channel, Production extension cables, all clocks turned off, commands to lower SERDES drive.
Configuration	Powered by -48Vdc, Tested to FCC Part 30, RE 22G-24.75GHz, @ 3-Meters, A-Info Horn E1461, Preamp-E1469, FSW85-E1384, and LPF-Filter E1498. Cables E1501, E1502. Internal attenuation 0dB, Preview RBW 1M; Formal RBW 1M.
Date	2020-11-12 22:27:14

Formal Data

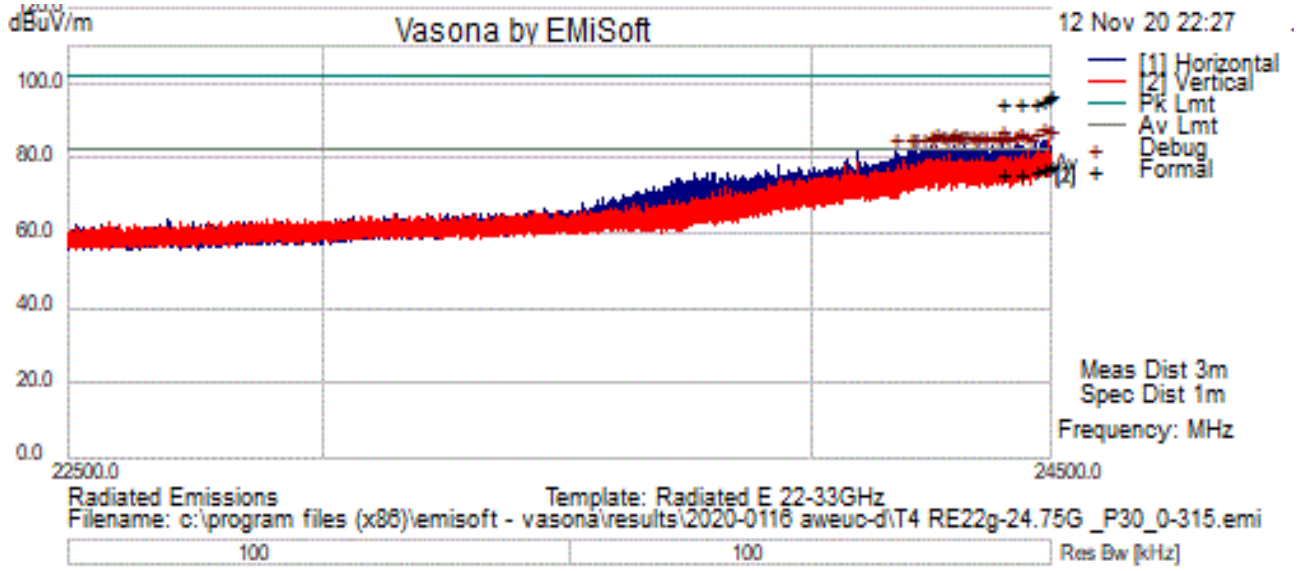
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail	Comments
24492.000	21.01	41.17	6.55	68.74	AvgMax	V	173	6	82.23	-13.49	Pass	
24151.933	26.89	31.95	5.74	64.58	AvgMax	H	181	7	82.23	-17.65	Pass	
24191.500	22.97	33.03	5.76	61.76	AvgMax	H	198	16	82.23	-20.47	Pass	
24492.000	35.89	41.17	6.55	83.61	PeakMax	V	173	6	102.23	-18.62	Pass	
24151.933	44.88	31.95	5.74	82.57	PeakMax	H	181	7	102.23	-19.66	Pass	
24191.500	38.90	33.03	5.76	77.69	PeakMax	H	198	16	102.23	-24.54	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
24492.000	31.18	41.17	6.55	78.91	Debug	V	175		45	82.23	-3.32	Pass	
24191.500	33.21	33.03	5.76	72.00	Debug	H	175		0	82.23	-10.23	Pass	
24151.933	33.10	31.95	5.74	70.79	Debug	H	175		0	82.23	-11.44	Pass	
23980.767	34.90	27.43	5.71	68.05	Debug	H	175		0	82.23	-14.18	Pass	
23970.767	34.30	27.25	5.71	67.26	Debug	H	175		0	82.23	-14.97	Pass	
23929.400	34.64	26.47	5.71	66.83	Debug	H	175		0	82.23	-15.40	Pass	
23791.667	37.27	23.89	5.63	66.79	Debug	H	175		0	82.23	-15.44	Pass	
23911.133	34.73	26.13	5.71	66.57	Debug	H	175		0	82.23	-15.66	Pass	
23764.933	37.48	23.39	5.61	66.48	Debug	H	175		0	82.23	-15.75	Pass	
23891.033	34.92	25.76	5.71	66.38	Debug	H	175		0	82.23	-15.85	Pass	
23858.633	35.29	25.15	5.68	66.12	Debug	H	175		0	82.23	-16.11	Pass	
23782.967	36.66	23.73	5.62	66.01	Debug	H	175		0	82.23	-16.22	Pass	
23862.767	35.08	25.23	5.68	65.99	Debug	H	175		0	82.23	-16.24	Pass	
23577.000	40.53	19.83	5.42	65.78	Debug	V	175		0	82.23	-16.45	Pass	
23413.733	42.28	17.72	5.27	65.27	Debug	H	175		0	82.23	-16.96	Pass	
23798.467	35.57	24.02	5.63	65.22	Debug	H	175		0	82.23	-17.01	Pass	
23845.433	34.63	24.90	5.67	65.20	Debug	H	175		0	82.23	-17.03	Pass	
23700.133	37.38	22.16	5.56	65.11	Debug	H	175		0	82.23	-17.12	Pass	
23382.200	42.31	17.49	5.27	65.06	Debug	H	225		315	82.23	-17.17	Pass	
23371.067	42.34	17.41	5.27	65.02	Debug	H	175		315	82.23	-17.21	Pass	
23348.367	42.39	17.24	5.28	64.91	Debug	H	225		315	82.23	-17.32	Pass	
23820.133	34.71	24.43	5.65	64.79	Debug	H	175		0	82.23	-17.44	Pass	
23092.333	43.53	15.31	5.22	64.06	Debug	V	175		0	82.23	-18.17	Pass	
22881.933	44.51	14.42	4.62	63.55	Debug	V	175		0	82.23	-18.68	Pass	
22981.733	43.85	14.58	5.00	63.43	Debug	H	175		315	82.23	-18.80	Pass	
23039.533	43.10	14.91	5.13	63.14	Debug	V	175		0	82.23	-19.09	Pass	
22954.100	43.31	14.53	4.89	62.74	Debug	V	175		0	82.23	-19.49	Pass	
22866.067	43.50	14.40	4.56	62.46	Debug	V	175		0	82.23	-19.77	Pass	
22982.433	42.85	14.58	5.00	62.43	Debug	V	175		0	82.23	-19.80	Pass	
22819.733	43.36	14.33	4.38	62.07	Debug	V	175		0	82.23	-20.16	Pass	
22799.267	43.25	14.29	4.30	61.85	Debug	V	175		0	82.23	-20.38	Pass	
22768.600	43.20	14.25	4.21	61.66	Debug	V	225		0	82.23	-20.57	Pass	
22642.600	43.27	14.05	3.97	61.29	Debug	V	175		0	82.23	-20.94	Pass	
22619.967	43.30	14.01	3.95	61.27	Debug	V	175		0	82.23	-20.96	Pass	
22660.867	42.73	14.08	3.98	60.80	Debug	H	175		0	82.23	-21.43	Pass	

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

T5 Radiated Emissions 22GHz-24.75GHz Pt-30_ 315-360 Degrees Azimuth



Test Information

Results Title	**Radiated Emissions - 22GHz-24.75GHz - Part-30 315-360 Degrees Azimuth**
File Name	T5 RE22g-24.75G _P30_315-360.emi
Test Laboratory	MH-AR8 33%RH, 21C, 992hPa
Test Engineer	MJS / WSM
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	24 GHz AWEUC/D SN-AM2-YK202700009, AM2-YK202900051, AM3-YK202900054, Tx-On 4C-Right- 16QAM-Contiguous Channel, Production extension cables, all clocks turned off, commands to lower SERDES drive.
Configuration	Powered by -48Vdc, Tested to FCC Part 30, RE 22G-24.75GHz, @ 3-Meters, A-Info Horn E1461, Preamp-E1469, FSW85-E1384, and LPF-Filter E1498. Cables E1501, E1502. Internal attenuation 0dB, Preview RBW 1M; Formal RBW 1M.
Date	2020-11-12 23:48:11

Formal Data

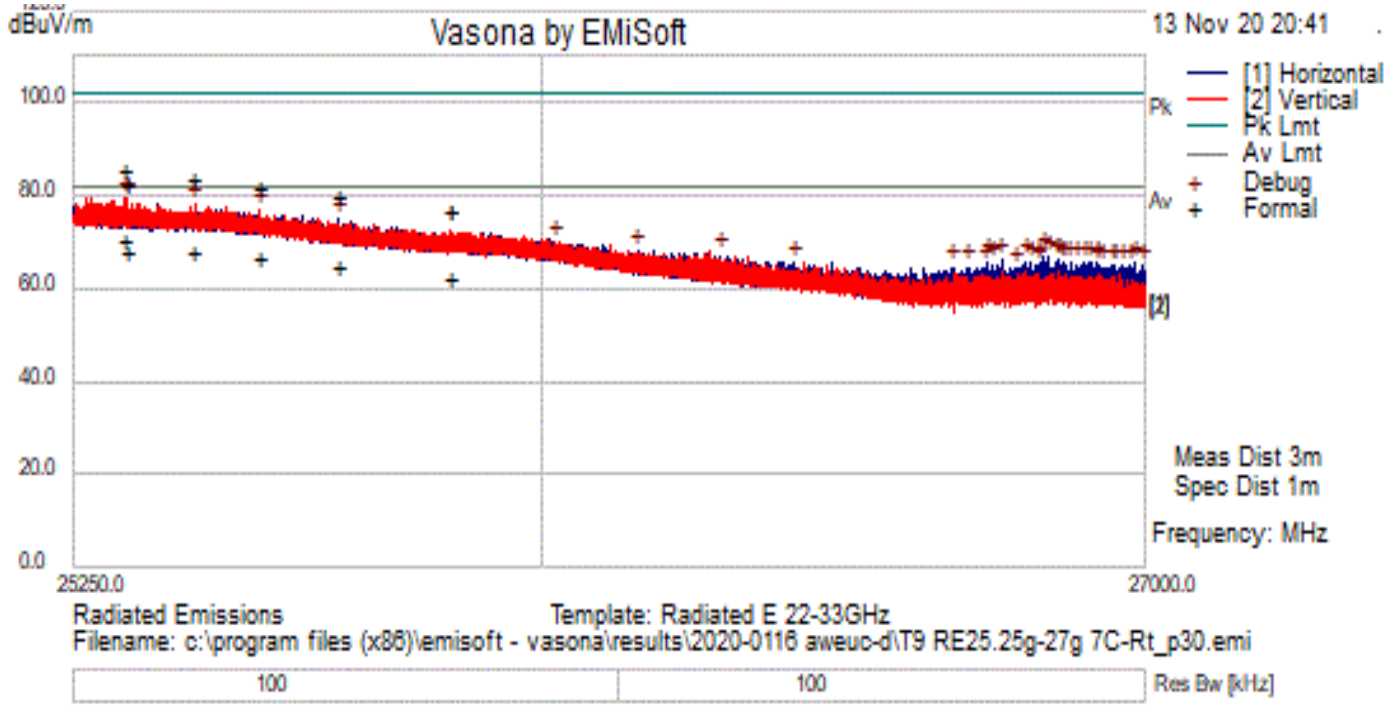
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
24499.433	30.11	41.37	6.57	78.05	AvgMax	H	175	340	82.23	-4.18	Pass	
24497.100	29.82	41.31	6.57	77.69	AvgMax	H	188	342	82.23	-4.54	Pass	
24486.400	29.78	41.02	6.54	77.34	AvgMax	H	162	340	82.23	-4.89	Pass	
24469.700	29.31	40.57	6.50	76.38	AvgMax	H	178	337	82.23	-5.85	Pass	
24399.133	31.26	38.67	6.32	76.25	AvgMax	H	160	339	82.23	-5.98	Pass	
24434.200	30.20	39.61	6.41	76.22	AvgMax	H	186	342	82.23	-6.01	Pass	
24499.433	49.21	41.37	6.57	97.15	PeakMax	H	175	340	102.23	-5.08	Pass	
24497.100	48.26	41.31	6.57	96.13	PeakMax	H	188	342	102.23	-6.10	Pass	
24486.400	48.22	41.02	6.54	95.78	PeakMax	H	162	340	102.23	-6.45	Pass	
24399.133	49.87	38.67	6.32	94.86	PeakMax	H	160	339	102.23	-7.37	Pass	
24469.700	47.69	40.57	6.50	94.76	PeakMax	H	178	337	102.23	-7.47	Pass	
24434.200	48.50	39.61	6.41	94.52	PeakMax	H	186	342	102.23	-7.71	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
24486.400	37.44	41.02	6.54	84.99	Debug	H	175	345	82.23	2.76	Fail	
24497.100	36.61	41.31	6.57	84.49	Debug	H	175	345	82.23	2.26	Fail	
24499.433	36.51	41.37	6.57	84.45	Debug	H	175	345	82.23	2.22	Fail	
24399.133	39.08	38.67	6.32	84.06	Debug	H	175	345	82.23	1.83	Fail	
24434.200	37.85	39.61	6.41	83.87	Debug	H	175	345	82.23	1.64	Fail	
24469.700	36.63	40.57	6.50	83.70	Debug	H	175	345	82.23	1.47	Fail	
24296.300	41.46	35.88	6.07	83.41	Debug	H	175	345	82.23	1.18	Fail	
24257.767	42.60	34.84	5.95	83.39	Debug	H	175	345	82.23	1.16	Fail	
24438.233	37.21	39.72	6.42	83.35	Debug	H	175	345	82.23	1.12	Fail	
24379.933	38.61	38.15	6.27	83.03	Debug	H	175	345	82.23	0.80	Fail	
24423.900	37.29	39.34	6.38	83.01	Debug	H	175	345	82.23	0.78	Fail	
24319.333	40.31	36.51	6.13	82.95	Debug	H	175	345	82.23	0.72	Fail	
24246.767	42.47	34.54	5.91	82.92	Debug	H	175	345	82.23	0.69	Fail	
24448.233	36.42	39.99	6.44	82.86	Debug	H	175	345	82.23	0.63	Fail	
24325.933	40.01	36.69	6.15	82.84	Debug	H	175	345	82.23	0.61	Fail	
24269.900	41.66	35.17	5.99	82.82	Debug	H	175	345	82.23	0.59	Fail	
24306.833	40.52	36.17	6.10	82.79	Debug	H	175	345	82.23	0.56	Fail	
24274.900	41.43	35.30	6.00	82.74	Debug	H	175	345	82.23	0.51	Fail	
24350.333	39.14	37.35	6.20	82.69	Debug	H	175	345	82.23	0.46	Fail	
24403.533	37.49	38.79	6.33	82.61	Debug	H	175	345	82.23	0.38	Fail	
24393.433	37.76	38.51	6.31	82.58	Debug	H	175	345	82.23	0.35	Fail	
24293.433	40.70	35.80	6.06	82.57	Debug	H	175	345	82.23	0.34	Fail	
24361.067	38.68	37.64	6.23	82.55	Debug	H	175	345	82.23	0.32	Fail	
24315.067	39.98	36.39	6.12	82.49	Debug	H	175	345	82.23	0.26	Fail	
24427.867	36.66	39.44	6.39	82.49	Debug	H	175	345	82.23	0.26	Fail	
24333.500	39.41	36.89	6.16	82.47	Debug	H	175	345	82.23	0.24	Fail	
24346.300	38.95	37.24	6.19	82.38	Debug	H	175	345	82.23	0.15	Fail	
24458.633	35.62	40.27	6.47	82.36	Debug	H	175	345	82.23	0.13	Fail	
24279.367	40.89	35.42	6.02	82.33	Debug	H	175	345	82.23	0.10	Fail	
24408.633	37.07	38.92	6.34	82.33	Debug	H	175	345	82.23	0.10	Fail	
24341.100	39.05	37.10	6.18	82.32	Debug	H	175	345	82.23	0.09	Fail	
24206.867	43.06	33.45	5.79	82.29	Debug	H	175	345	82.23	0.06	Fail	
24175.400	43.95	32.59	5.75	82.29	Debug	H	175	345	82.23	0.06	Fail	
24361.767	38.39	37.66	6.23	82.28	Debug	H	175	345	82.23	0.05	Fail	
24389.400	37.48	38.40	6.30	82.18	Debug	H	175	345	82.23	-0.05	Pass	
24230.333	42.15	34.09	5.86	82.11	Debug	H	175	345	82.23	-0.12	Pass	
24211.000	42.74	33.56	5.80	82.10	Debug	H	175	345	82.23	-0.13	Pass	
24299.833	40.02	35.98	6.08	82.08	Debug	H	175	345	82.23	-0.15	Pass	
24253.567	41.40	34.72	5.94	82.06	Debug	H	175	345	82.23	-0.17	Pass	
24216.133	42.52	33.70	5.82	82.04	Debug	H	175	345	82.23	-0.19	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.

T10 Radiated Emissions - 25.25GHz-27GHz - Part 30 0-315 Degrees Azimuth



Test Information

Results Title	T10 Radiated Emissions 25.25GHz-27GHz _Part 30_0-315 Degrees Azimuth
File Name	T10 RE25.25g-27G 5C_P30_0-315.emi
Test Laboratory	MH-AR8 33%RH, 21C, 992hPa
Test Engineer	MJS / WSM
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	, 24 GHz AWEUC/D SN-AM2-YK202700009, AM2-YK202900051, AM3-YK202900054, Tx-On 5C-Right-16QAM-Contiguous Channel, Production extension cables, all clocks turned off, commands to lower SERDES drive.
Configuration	Powered by -48Vdc, Tested to FCC Part 30, RE 25.25G-27.0GHz, @ 3-Meters, A-Info Horn E1461, Preamp-E1469, FSW85-E1384, and LPF-Filter E1473. Cables E1501, E1502. Internal attenuation 0dB, Preview RBW 1M; Formal RBW 1M.
Date	2020-11-13 22:01:03

Formal Data

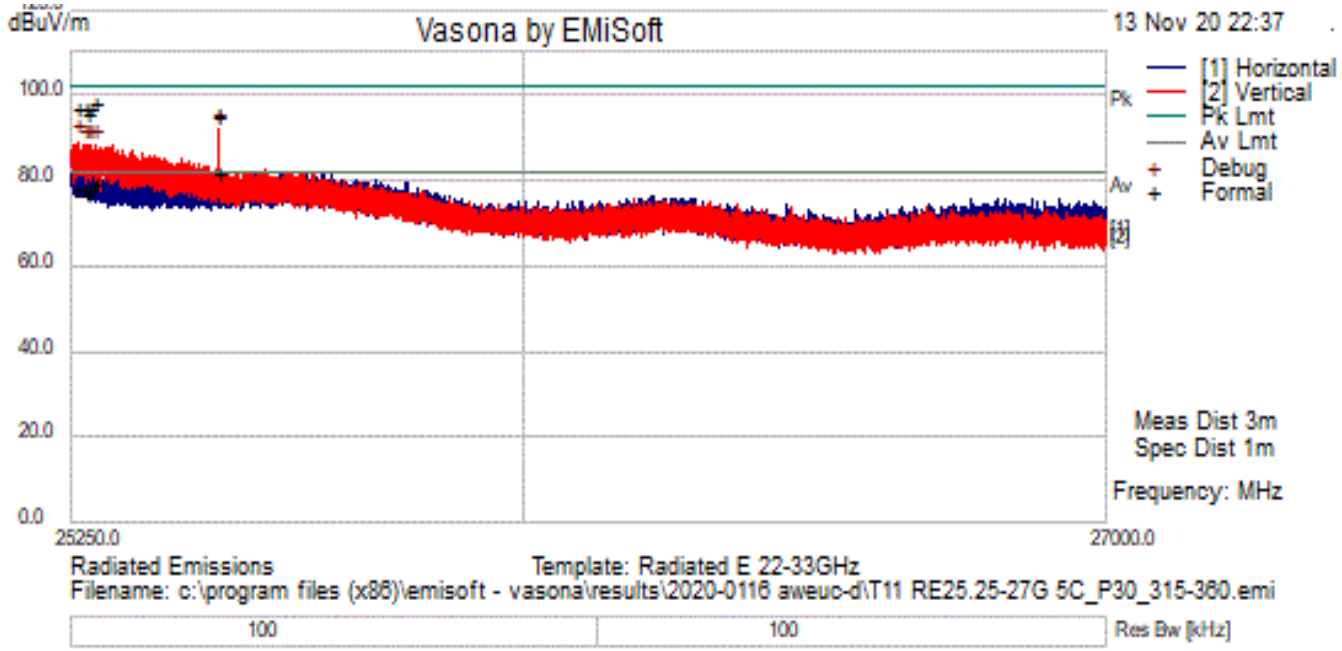
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
25328.138	23.22	40.25	6.95	70.42	AvgMax	V	180	22	82.23	-11.81	Pass	
25440.575	21.80	39.08	7.22	68.10	AvgMax	V	195	292	82.23	-14.13	Pass	
25334.554	20.75	40.18	6.97	67.90	AvgMax	V	217	276	82.23	-14.33	Pass	
25542.892	21.76	37.85	7.49	67.11	AvgMax	V	217	16	82.23	-15.12	Pass	
25669.008	21.22	36.05	7.79	65.05	AvgMax	H	224	11	82.23	-17.18	Pass	
25852.846	20.97	33.53	7.78	62.28	AvgMax	V	219	154	82.23	-19.95	Pass	
25328.138	38.89	40.25	6.95	86.10	PeakMax	V	180	22	102.23	-16.13	Pass	
25440.575	37.54	39.08	7.22	83.84	PeakMax	V	195	292	102.23	-18.39	Pass	
25334.554	35.68	40.18	6.97	82.83	PeakMax	V	217	276	102.23	-19.40	Pass	
25542.892	36.87	37.85	7.49	82.22	PeakMax	V	217	16	102.23	-20.01	Pass	
25669.008	36.42	36.05	7.79	80.25	PeakMax	H	224	11	102.23	-21.98	Pass	
25852.846	35.87	33.53	7.78	77.18	PeakMax	V	219	154	102.23	-25.05	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
25328.138	32.36	40.25	6.95	79.56	Debug	V	175	0	82.23	-2.67	Pass	
25334.554	32.21	40.18	6.97	79.36	Debug	V	175	0	82.23	-2.87	Pass	
25440.575	31.94	39.08	7.22	78.25	Debug	V	175	0	82.23	-3.98	Pass	
25542.892	31.59	37.85	7.49	76.94	Debug	V	125	45	82.23	-5.29	Pass	
25669.008	31.11	36.05	7.79	74.94	Debug	H	175	0	82.23	-7.29	Pass	
25852.846	31.40	33.53	7.78	72.71	Debug	V	175	0	82.23	-9.52	Pass	
26019.650	31.01	31.22	7.63	69.86	Debug	V	175	90	82.23	-12.37	Pass	
26155.683	31.70	28.75	7.68	68.13	Debug	H	175	315	82.23	-14.10	Pass	
26292.388	32.93	26.28	7.81	67.03	Debug	H	175	0	82.23	-15.20	Pass	
26829.054	41.80	17.52	7.69	67.01	Debug	H	175	0	82.23	-15.22	Pass	
26838.067	41.55	17.42	7.69	66.66	Debug	H	175	0	82.23	-15.57	Pass	
26758.558	40.32	18.23	7.73	66.29	Debug	H	175	0	82.23	-15.94	Pass	
26853.963	40.94	17.26	7.69	65.89	Debug	H	175	0	82.23	-16.34	Pass	
26800.325	40.37	17.81	7.69	65.86	Debug	H	175	0	82.23	-16.37	Pass	
26852.358	40.84	17.28	7.69	65.81	Debug	H	175	0	82.23	-16.42	Pass	
26735.925	39.46	18.57	7.76	65.79	Debug	H	175	0	82.23	-16.44	Pass	
26411.738	33.60	24.15	7.97	65.73	Debug	H	175	0	82.23	-16.50	Pass	
26874.146	40.89	17.06	7.69	65.64	Debug	H	175	0	82.23	-16.59	Pass	
26861.167	40.72	17.19	7.69	65.60	Debug	H	175	0	82.23	-16.63	Pass	
26897.625	41.08	16.82	7.69	65.59	Debug	H	175	0	82.23	-16.64	Pass	
26983.696	41.78	15.95	7.86	65.59	Debug	H	175	0	82.23	-16.64	Pass	
26864.725	40.69	17.15	7.69	65.53	Debug	H	175	0	82.23	-16.70	Pass	
26918.508	41.13	16.61	7.72	65.46	Debug	H	175	0	82.23	-16.77	Pass	
26807.850	40.02	17.73	7.69	65.44	Debug	H	175	0	82.23	-16.79	Pass	
26908.271	41.00	16.71	7.70	65.41	Debug	H	175	0	82.23	-16.82	Pass	
26822.696	40.10	17.58	7.69	65.37	Debug	H	175	0	82.23	-16.86	Pass	
26742.575	38.98	18.45	7.75	65.18	Debug	H	175	0	82.23	-17.05	Pass	
26885.958	40.55	16.94	7.69	65.18	Debug	H	175	0	82.23	-17.05	Pass	
26975.238	41.19	16.04	7.84	65.07	Debug	H	175	0	82.23	-17.16	Pass	
26943.592	40.80	16.36	7.77	64.93	Debug	H	175	0	82.23	-17.30	Pass	
26962.200	40.95	16.17	7.81	64.93	Debug	H	175	0	82.23	-17.30	Pass	
26819.925	39.62	17.61	7.69	64.91	Debug	H	175	0	82.23	-17.32	Pass	
26995.188	41.16	15.83	7.88	64.88	Debug	H	175	0	82.23	-17.35	Pass	
26920.054	40.54	16.59	7.73	64.86	Debug	H	175	0	82.23	-17.37	Pass	
26949.863	40.77	16.29	7.79	64.85	Debug	H	175	0	82.23	-17.38	Pass	
26676.308	37.16	19.62	7.83	64.60	Debug	H	175	0	82.23	-17.63	Pass	
26927.783	40.34	16.52	7.74	64.60	Debug	H	175	0	82.23	-17.63	Pass	
26700.546	37.54	19.19	7.80	64.53	Debug	H	175	0	82.23	-17.70	Pass	
26729.654	38.09	18.68	7.77	64.53	Debug	H	175	0	82.23	-17.70	Pass	
26780.608	38.73	18.01	7.71	64.44	Debug	H	175	0	82.23	-17.79	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.

T11 Radiated Emissions 25.25GHz-27GHz Part 30 315-360 Degrees Azimuth



Test Information

Results Title	Radiated E 22-33GHz
File Name	T11aRE25.25-27G 5C_P30_315-360.emi
Test Laboratory	MH-AR8 33%RH, 21C, 992hPa
Test Engineer	MJS / WSM
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless Group
EUT Details	, 24 GHz AWEUC/D SN-AM2-YK202700009, AM2-YK202900051, AM3-YK202900054, Tx-On 5C-Right-16QAM-Contiguous Channel, Production extension cables, all clocks turned off, commands to lower SERDES drive.
Configuration	Powered by -48Vdc, Tested to FCC Part 30, RE 25.25G-27.0GHz, @ 3-Meters, A-Info Horn E1461, Preamp-E1469, FSW85-E1384, and LPF-Filter E1473. Cables E1501, E1502. Internal attenuation 0dB, Preview RBW 1M; Formal RBW 1M.
Date	2020-11-13 22:45:56

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
25491.675	36.28	38.55	7.36	82.18	AvgMax	V	180	337	**82.23**	**-0.05**	**Pass**	TRP Test Performed
25261.083	30.73	40.95	6.82	78.49	AvgMax	V	165	347	82.23	-3.74	Pass	
25271.408	30.71	40.84	6.84	78.39	AvgMax	V	182	338	82.23	-3.84	Pass	
25290.396	31.98	40.64	6.87	79.49	AvgMax	V	173	342	82.23	-2.74	Pass	
25280.683	30.64	40.74	6.85	78.24	AvgMax	V	196	342	82.23	-3.99	Pass	
25276.017	29.55	40.79	6.84	77.19	AvgMax	V	188	337	82.23	-5.04	Pass	
25491.675	49.43	38.55	7.36	95.34	PeakMax	V	180	337	102.23	-6.89	Pass	
25261.083	49.20	40.95	6.82	96.96	PeakMax	V	165	347	102.23	-5.27	Pass	
25271.408	49.39	40.84	6.84	97.07	PeakMax	V	182	338	102.23	-5.16	Pass	
25290.396	50.91	40.64	6.87	98.43	PeakMax	V	173	342	102.23	-3.80	Pass	
25280.683	49.37	40.74	6.85	96.96	PeakMax	V	196	342	102.23	-5.27	Pass	
25276.017	48.04	40.79	6.84	95.67	PeakMax	V	188	337	102.23	-6.56	Pass	

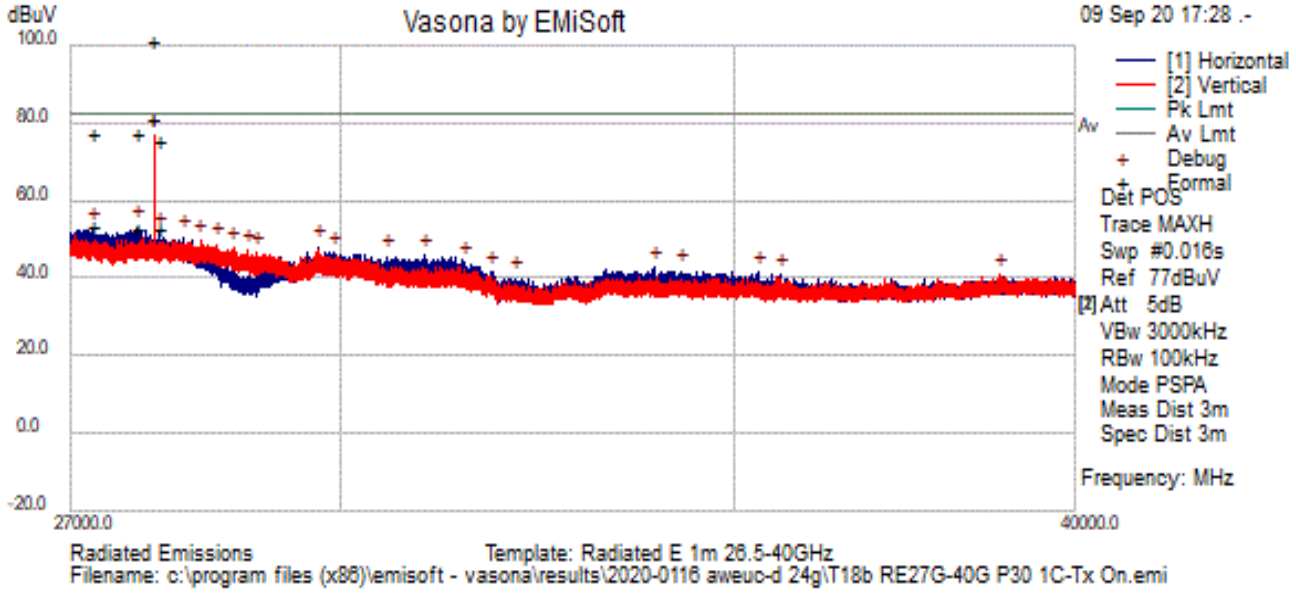
Note: A TRP test was performed on the spur at 25491.675 MHz

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
25491.675	45.87	38.55	7.36	91.78	Debug	V	175	345	82.23	9.55	Fail	
25261.083	41.30	40.95	6.82	89.06	Debug	V	175	345	82.23	6.83	Fail	
25271.408	40.68	40.84	6.84	88.36	Debug	V	175	345	82.23	6.13	Fail	
25290.396	40.83	40.64	6.87	88.34	Debug	V	175	345	82.23	6.11	Fail	
25280.683	40.73	40.74	6.85	88.33	Debug	V	175	345	82.23	6.10	Fail	
25276.017	40.57	40.79	6.84	88.20	Debug	V	175	345	82.23	5.97	Fail	

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.

T18C Radiated Emissions 27-40.0 GHz Tx-On



Test Information

Results Title	Radiated Emissions 1m 27-40GHz
File Name	T18c RE27G-40G P30 1C-Tx On.emi
Test Laboratory	Global Product Compliance Lab
Test Engineer	MJS / CP
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless
EUT Details	Powered by 120VAC, AWEUC/D Main Unit -AM1-SN202700007 // AM2-SN202900042, AM3-SN202900043, 1C - TX On. New feeding cables.
Configuration	Tested to FCC Part 30, RE 27.0G-40GHz, @ 3-Meters, Preview RBW 100k; Formal RBW 1M. Int. Att. 5dB, Internal preamp on, PA-AH E1469, HPF-E1472, FSW67L, A-Info Horn Antenna E1374. LMI Board disconnected, Grounds back on. Added three ferrites on AH preamp ports.
Date	2020-09-09 17:31:45

Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
27899.199	66.99	14.79	-0.30	81.48	AvgMax	V	183	17	82.23	-0.75	Pass	
27248.219	38.41	14.76	0.38	53.55	AvgMax	H	186	14	82.23	-28.68	Pass	
27717.031	38.74	14.79	-0.42	53.11	AvgMax	H	194	14	82.23	-29.12	Pass	
27954.281	38.22	14.79	-0.18	52.83	AvgMax	H	181	14	82.23	-29.40	Pass	

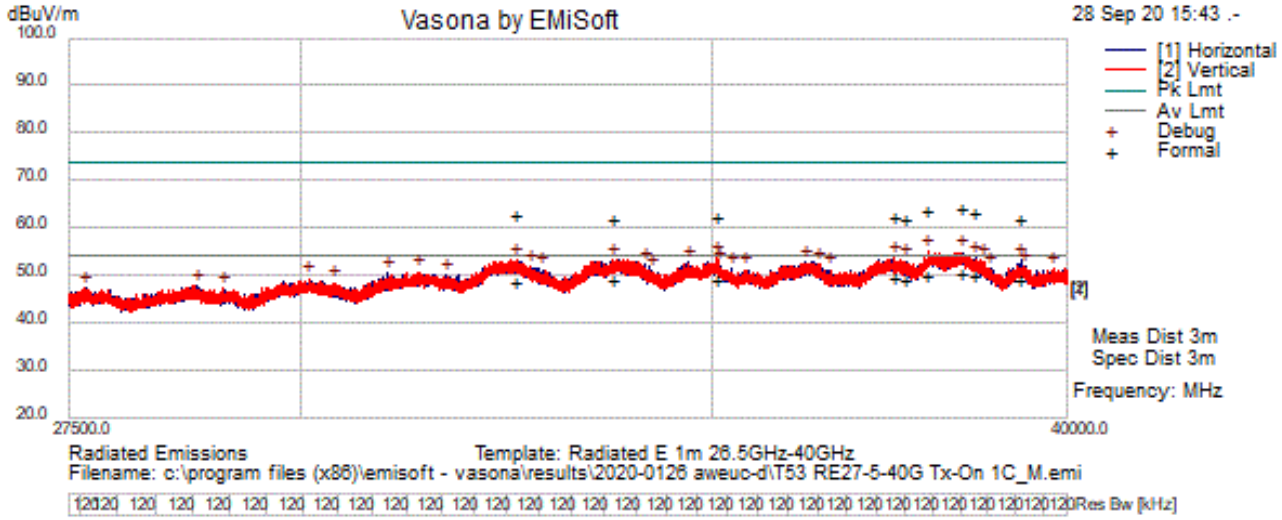
Note: A TRP test was performed on the spur at 27899.199 MHz

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
27899.031	62.34	14.79	-0.30	76.83	Debug	V	150	352	82.23	-5.40	Pass	
27717.031	38.73	14.79	-0.42	53.11	Debug	H	150	0	82.23	-29.12	Pass	
27248.219	37.47	14.76	0.38	52.61	Debug	H	150	0	82.23	-29.62	Pass	
27954.281	36.95	14.79	-0.18	51.55	Debug	H	150	0	82.23	-30.68	Pass	
28221.188	35.82	14.72	-0.03	50.51	Debug	H	150	0	82.23	-31.72	Pass	
28410.094	34.80	14.72	-0.12	49.40	Debug	V	150	45	82.23	-32.83	Pass	
28591.281	34.11	14.77	-0.25	48.64	Debug	V	150	0	82.23	-33.59	Pass	
29758.844	32.67	15.38	-0.11	47.95	Debug	H	150	45	82.23	-34.28	Pass	
28781.813	33.04	14.87	-0.27	47.64	Debug	V	150	0	82.23	-34.59	Pass	
28939.031	32.23	15.03	-0.30	46.96	Debug	V	150	0	82.23	-35.27	Pass	
29928.250	30.97	15.34	0.10	46.41	Debug	H	150	45	82.23	-35.82	Pass	
29050.750	31.62	15.13	-0.34	46.41	Debug	V	150	0	82.23	-35.82	Pass	
31017.406	29.75	15.60	0.28	45.62	Debug	H	150	45	82.23	-36.61	Pass	
30567.688	30.13	15.39	0.00	45.52	Debug	H	150	45	82.23	-36.71	Pass	
31509.781	27.55	15.87	0.52	43.94	Debug	H	150	45	82.23	-38.29	Pass	
33945.250	25.93	17.06	-0.27	42.72	Debug	H	150	0	82.23	-39.51	Pass	
34283.656	24.97	16.93	-0.13	41.76	Debug	H	150	352	82.23	-40.47	Pass	
31834.375	24.96	16.00	0.54	41.49	Debug	H	150	45	82.23	-40.74	Pass	
35347.625	24.77	16.79	-0.09	41.46	Debug	H	150	352	82.23	-40.77	Pass	
35638.094	24.06	16.69	0.01	40.76	Debug	H	150	352	82.23	-41.47	Pass	
38845.438	24.08	17.83	-1.25	40.66	Debug	V	150	270	82.23	-41.57	Pass	
32139.875	23.38	16.13	0.28	39.79	Debug	H	150	0	82.23	-42.44	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.

T16 Radiated Emissions 27-40.0 GHz Tx-On



Test Information

Results Title	Radiated Emissions 1m 26.5GHz-40GHz
File Name	T53a RE27-5-40G Tx-On 1C_High.emi
Test Laboratory	MH-AR9, 28%RH, 23C, 998hPa.
Test Engineer	MJS / CP
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia Wireless
EUT Details	2020-0126 - AWEUC/D - Powered by 120VAC, AWEUC/D Main Unit -AM1-YK202700009 // AM2-YK202900051, AM3-YK202900054, New ASMR HW (main and expansions units); 1C-TM1.1_Tx On_25.19988GHz_High. New ASMR HW (main and expansions units). Modified extension cables from Naperville. Test Clocks off. Clock cleaners set for 500mV. Serdes Command used.
Configuration	Tested to FCC Part 15b, RE 27.5G-40GHz, @ 3-Meters, Preview RBW 100k; Formal RBW Default. Int. Att. 0dB, PA-AH E1469, HPF-E1473, ESI-E908, A-Info Horn Antenna E1373.
Date	2020-09-28 16:00:18

Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
38459.694	33.53	17.93	-0.72	50.74	AvgMax	H	266	205	54.00	-3.26	Pass	
38655.004	33.32	17.95	-0.92	50.35	AvgMax	H	236	246	54.00	-3.65	Pass	
37967.800	33.00	17.62	-0.45	50.17	AvgMax	V	160	189	54.00	-3.83	Pass	
37489.570	32.83	17.23	-0.57	49.49	AvgMax	V	110	52	54.00	-4.51	Pass	
33720.798	32.53	17.04	-0.30	49.28	AvgMax	V	236	317	54.00	-4.72	Pass	
37649.516	32.32	17.36	-0.59	49.10	AvgMax	V	280	106	54.00	-4.90	Pass	
39322.115	32.04	17.93	-0.89	49.08	AvgMax	H	100	254	54.00	-4.92	Pass	
35068.683	32.73	16.61	-0.28	49.07	AvgMax	V	161	332	54.00	-4.93	Pass	
32529.645	32.36	16.07	0.45	48.88	AvgMax	V	137	296	54.00	-5.12	Pass	
38459.694	47.01	17.93	-0.72	64.22	PeakMax	H	266	205	74.00	-9.78	Pass	
37967.800	46.76	17.62	-0.45	63.94	PeakMax	V	160	189	74.00	-10.06	Pass	
38655.004	46.14	17.95	-0.92	63.18	PeakMax	H	236	246	74.00	-10.82	Pass	
32529.645	46.39	16.07	0.45	62.91	PeakMax	V	137	296	74.00	-11.09	Pass	
35068.683	46.26	16.61	-0.28	62.60	PeakMax	V	161	332	74.00	-11.40	Pass	
37489.570	45.77	17.23	-0.57	62.43	PeakMax	V	110	52	74.00	-11.57	Pass	
33720.798	45.41	17.04	-0.30	62.15	PeakMax	V	236	317	74.00	-11.85	Pass	
37649.516	45.29	17.36	-0.59	62.06	PeakMax	V	280	106	74.00	-11.94	Pass	
39322.115	44.92	17.93	-0.89	61.96	PeakMax	H	100	254	74.00	-12.04	Pass	

Preview Data

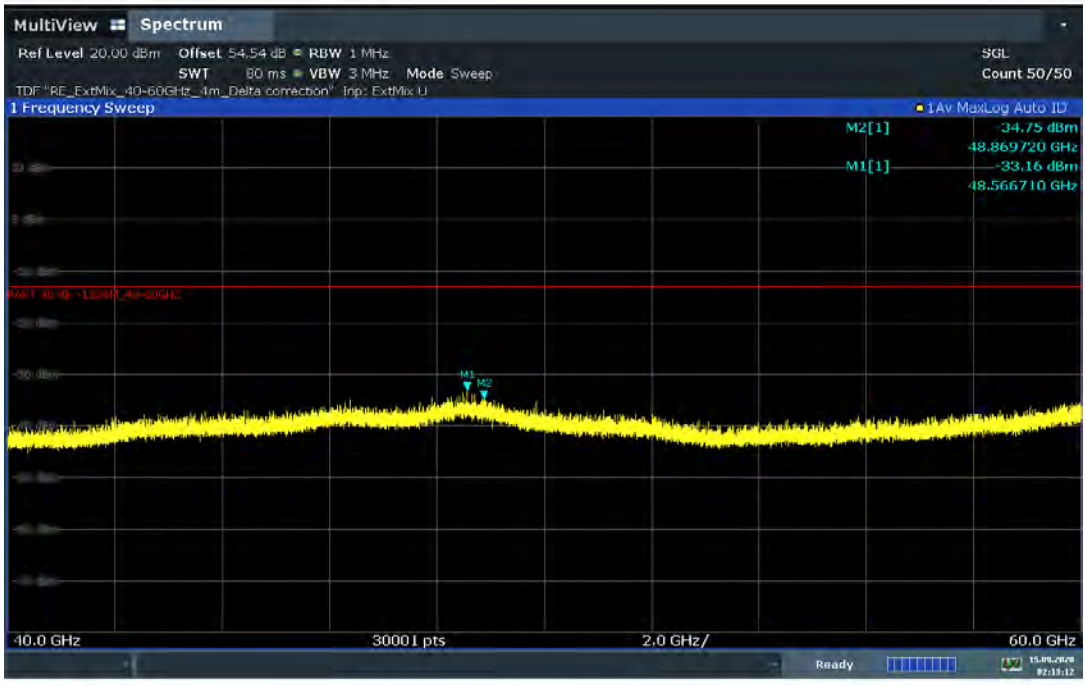
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
37967.800	37.84	17.62	-0.45	55.01	Debug	V	100	286	54.00	1.01	Fail	
38459.694	37.63	17.93	-0.72	54.85	Debug	H	300	110	54.00	0.85	Fail	
38655.004	36.70	17.95	-0.92	53.73	Debug	H	300	330	54.00	-0.27	Pass	
37489.570	36.98	17.23	-0.57	53.64	Debug	V	200	154	54.00	-0.36	Pass	
35068.683	37.26	16.61	-0.28	53.60	Debug	V	300	132	54.00	-0.40	Pass	
33720.798	36.52	17.04	-0.30	53.26	Debug	V	100	44	54.00	-0.74	Pass	
39322.115	36.14	17.93	-0.89	53.17	Debug	H	300	176	54.00	-0.83	Pass	
32529.645	36.57	16.07	0.45	53.09	Debug	V	300	176	54.00	-0.91	Pass	
37649.516	36.24	17.36	-0.59	53.02	Debug	V	100	110	54.00	-0.98	Pass	
38760.295	36.19	17.96	-1.14	53.00	Debug	V	300	264	54.00	-1.00	Pass	
36254.211	35.39	17.53	-0.02	52.89	Debug	H	200	0	54.00	-1.11	Pass	
34705.389	36.44	16.71	-0.38	52.78	Debug	H	300	88	54.00	-1.22	Pass	
36455.147	35.03	17.55	-0.15	52.43	Debug	V	100	308	54.00	-1.57	Pass	
35104.048	35.88	16.63	-0.27	52.24	Debug	V	300	132	54.00	-1.76	Pass	
34133.925	35.22	17.17	-0.21	52.18	Debug	H	300	154	54.00	-1.82	Pass	
39359.891	34.85	17.93	-0.92	51.87	Debug	V	300	350	54.00	-2.13	Pass	
32701.647	35.28	16.09	0.34	51.71	Debug	V	100	264	54.00	-2.29	Pass	
35266.405	34.93	16.73	-0.16	51.50	Debug	H	200	176	54.00	-2.50	Pass	
38845.492	34.73	17.97	-1.28	51.41	Debug	H	100	22	54.00	-2.59	Pass	
39797.422	34.98	18.10	-1.76	51.32	Debug	V	200	308	54.00	-2.68	Pass	
35458.501	34.36	16.92	-0.09	51.19	Debug	V	200	44	54.00	-2.81	Pass	
32852.751	34.92	16.14	0.10	51.16	Debug	H	300	220	54.00	-2.84	Pass	
36603.841	33.92	17.50	-0.33	51.09	Debug	V	300	264	54.00	-2.91	Pass	
34225.552	33.91	17.08	-0.18	50.81	Debug	H	100	220	54.00	-3.19	Pass	
31360.192	34.55	15.74	0.33	50.62	Debug	V	300	22	54.00	-3.38	Pass	
31001.721	34.45	15.66	0.22	50.33	Debug	H	100	44	54.00	-3.67	Pass	
31684.102	33.64	15.86	0.52	50.03	Debug	H	300	132	54.00	-3.97	Pass	
30084.645	33.53	15.57	0.16	49.27	Debug	V	200	198	54.00	-4.73	Pass	
30379.620	32.65	15.67	0.03	48.34	Debug	V	300	176	54.00	-5.66	Pass	
28845.266	33.13	14.95	-0.25	47.84	Debug	H	300	350	54.00	-6.16	Pass	
27660.542	32.39	15.14	-0.30	47.24	Debug	V	100	132	54.00	-6.76	Pass	
29139.438	32.38	15.10	-0.34	47.15	Debug	V	200	44	54.00	-6.85	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

Vertical Polarization - 1 MHz RBW

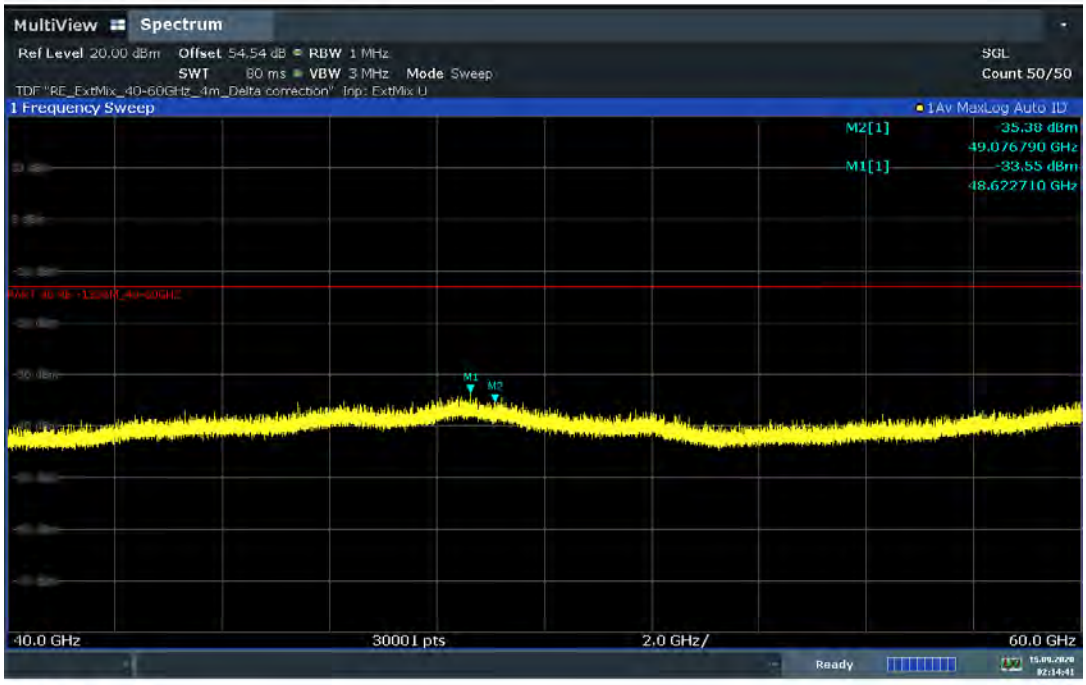
2020-0116 AWEUC-D 1C SN: 202700007, 202400254, 2024002259



02:13:12 15.09.2020

Horizontal Polarization - 1 MHz RBW

2020-0116 AWEUC-D 1C SN: 202700007, 202400254, 2024002259

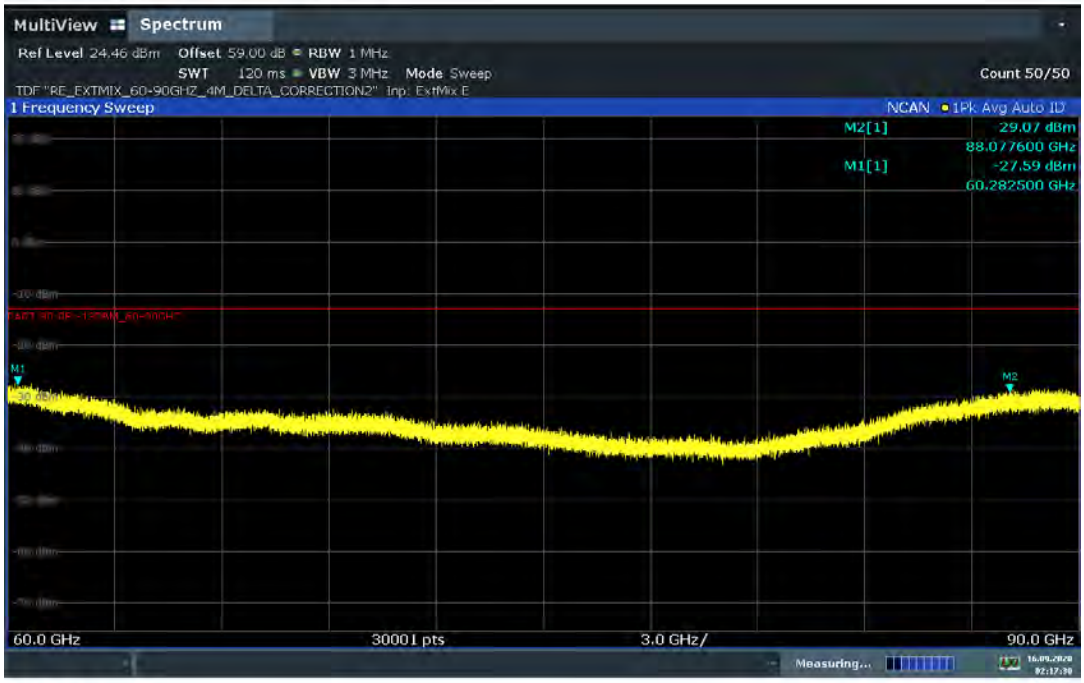


02:14:41 15.09.2020

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

Vertical Polarization - 1 MHz RBW

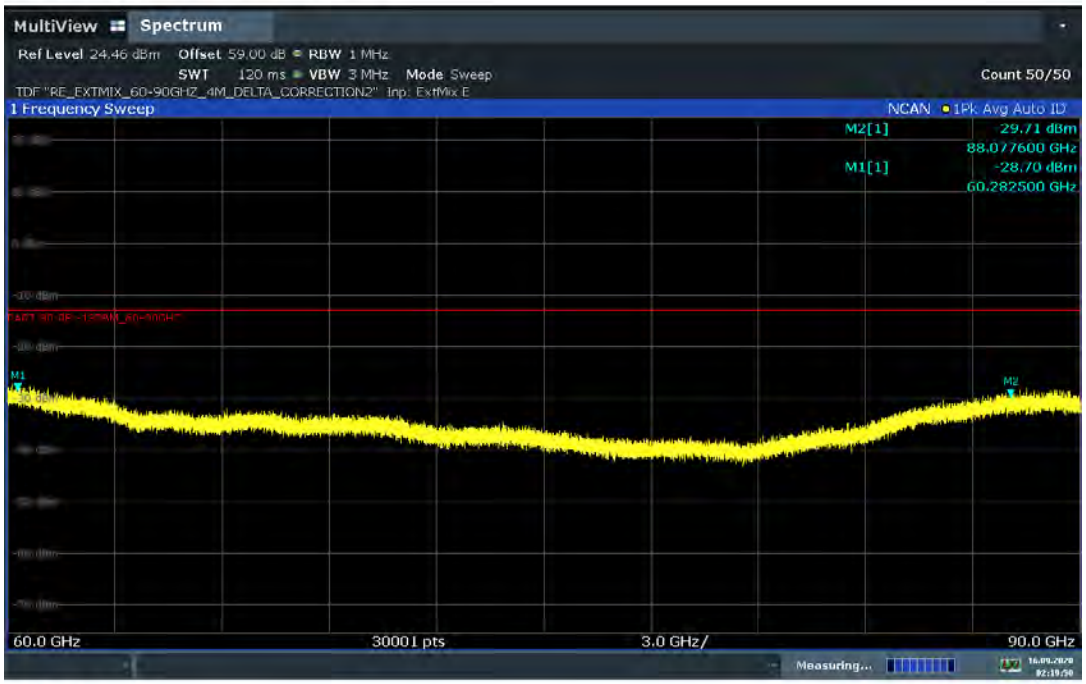
2020-0116 AWEUC-D 1C SN: 202700007, 202400254, 2024002259



02:17:31 16.09.2020

Horizontal Polarization - 1 MHz RBW

2020-0116 AWEUC-D 1C SN: 202700007, 202400254, 2024002259

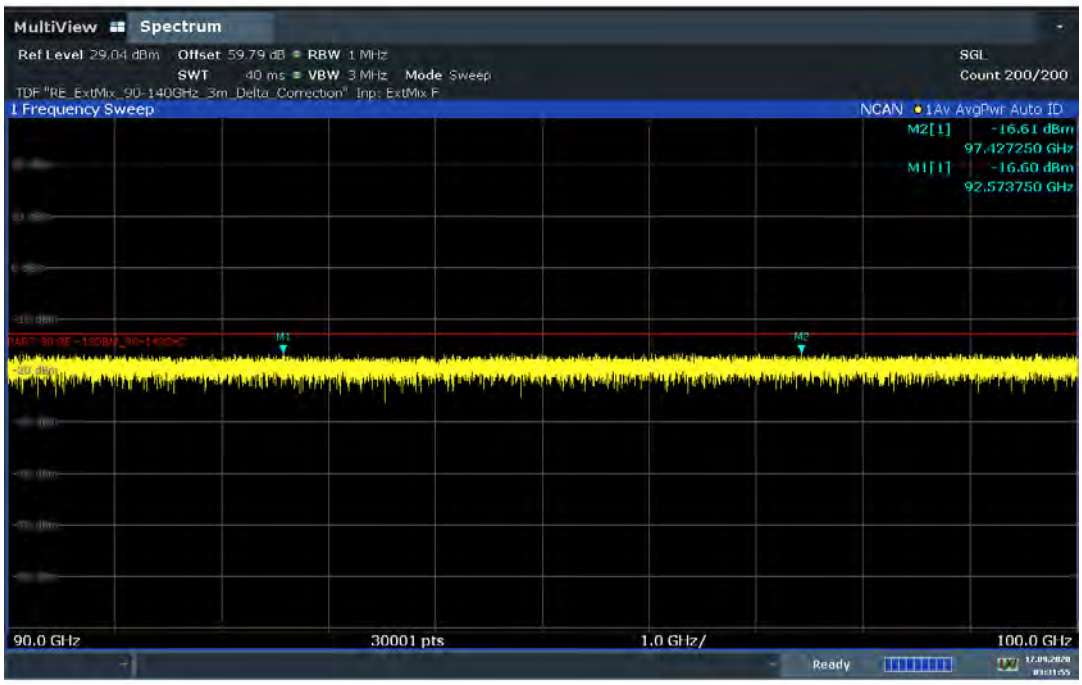


02:19:51 16.09.2020

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

Vertical Polarization - 1 MHz RBW

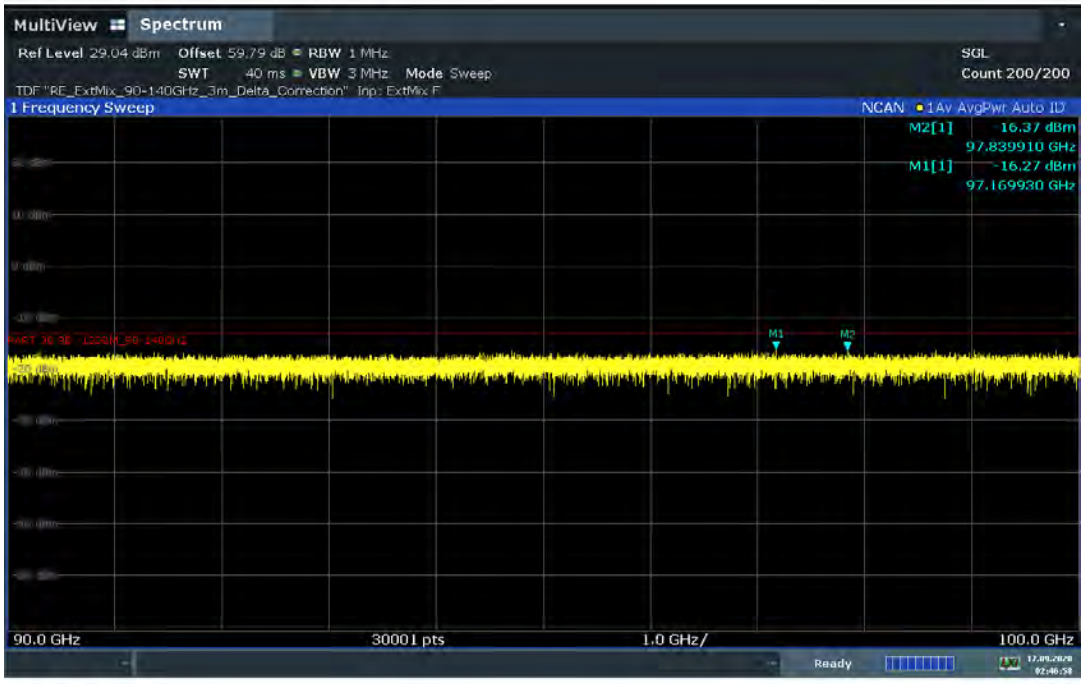
2020-0116 AWEUC-D 1C SN: 202700007, 202400254, 2024002259



03:31:56 17.09.2020

Horizontal Polarization - 1 MHz RBW

2020-0116 AWEUC-D 1C SN: 202700007, 202400254, 2024002259



02:46:58 17.09.2020

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: AWEUC, 24GHz ASMR (CF = 24,300 MHz). Two Extension Modules (FA3UB) were connected to the AWEUC, but were not transmitting. Testing was performed from 09/16/2020 through 09/17/2020 on the radio, which was located in the T-6 Thermal chamber of the Global Product Compliance Laboratory (GPCL) test facility located in Building 4, Room 4-280, Murray Hill, NJ, by Joe Bordonaro from GPCL

Table 1: Unit Under Test

Series	Vendor	Serial Number	Comcode
ASMR	Nokia	YK202800019	475168.X21

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 a MXA signal analyzer. The system level frequency stability testing resulted in a worst case deviation of **1112.0 Hz** which is within the compliance with established design criteria of 1215 Hz.

4.6.2 Frequency Stability Results DC Model:

Frequency Stability testing was completed on: AWEUD, 24GHz ASMR (CF = 24,300 MHz). Two Extension Modules (FA3UB) were connected to the AWEUD, but were not transmitting. Testing was performed from 09/16/2020 through 09/17/2020 on the radio, which was located in the T-6 Thermal chamber of the Global Product Compliance Laboratory (GPCL) test facility located in Building 4, Room 4-280, Murray Hill, NJ, by Joe Bordonaro from GPCL.

Table 2: Unit Under Test

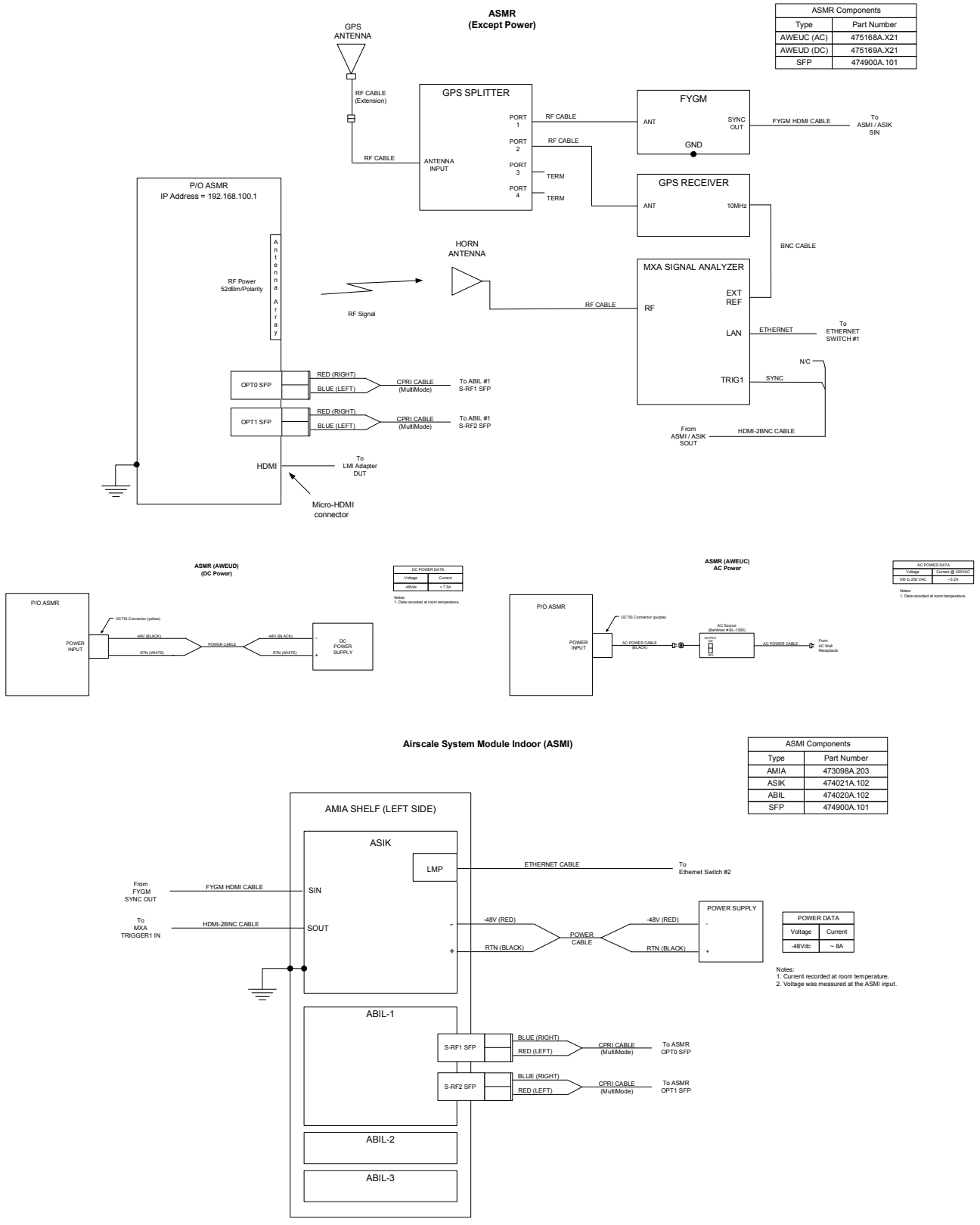
Series	Vendor	Serial Number	Model #
ASMR	Nokia	YK202800014	475169.X21

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 a MXA signal analyzer. The system level frequency stability testing resulted in a worst case deviation of **994.96 Hz** which is within the compliance with established design criteria of 1215 Hz.

FIGURE 4.6.1: Frequency Stability Test Block Diagram



AWEUC + FA3UB - AC Version

Frequency Block Tested: ***24 GHz RADIO (CF = 24,300.000 MHz)***

Baseline Measurement at +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+125.20**
0.5	**-765.92**
1.0	**-350.21**
1.5	**+484.96**
2.0	**-815.64**
2.5	**+107.88**
3.0	**+313.03**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +50°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-84.895**
0.5	**-602.50**
1.0	**+128.37**
1.5	**-417.66**
2.0	**+567.16**
2.5	**-398.20**
3.0	**+700.71**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +40°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+305.55**
0.5	**+518.41**
1.0	**-469.71**
1.5	**+296.95**
2.0	**-369.04**
2.5	**-500.66**
3.0	**+322.72**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +30°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-495.22**
0.5	**+579.87**
1.0	**-500.05**
1.5	**+237.04**
2.0	**+786.57**
2.5	**-722.29**
3.0	**+176.07**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +20°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+715.13**
0.5	**-329.90**
1.0	**+966.20**
1.5	**-455.43**
2.0	**-280.05**
2.5	**+999.83**
3.0	**-725.48**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +10°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	**-679.66**
0.5	**-761.04**
1.0	**-802.44**
1.5	**-108.62**
2.0	**-970.99**
2.5	**-373.88**
3.0	**-575.00**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at 0°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-314.50**
0.5	**-1088.0**
1.0	**+212.95**
1.5	**-1047.0**
2.0	**-841.47**
2.5	**+140.54**
3.0	**-1028.0**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at -10°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-914.44**
0.5	**-233.57**
1.0	**-560.27**
1.5	**1034.0**
2.0	**-266.94**
2.5	**-1112.0**
3.0	**-611.34**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at -20°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-466.50**
0.5	**-777.98**
1.0	**1104.0**
1.5	**-789.90**
2.0	**--300.80**
2.5	**-1048.0**
3.0	**-995.20**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at -30°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-806.16**
0.5	**-679.36**
1.0	**-638.96**
1.5	**+395.94**
2.0	**-794.80**
2.5	**-406.53**
3.0	**+559.37**
FCC SPECIFICATION	**1215 Hz (±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	**-240.60**
0.5	**+517.65**
1.0	**+175.58**
1.5	**-571.44**
2.0	**-245.19**
2.5	**-810.34**
3.0	**+467.32**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at +15% of Nominal Voltage, 138.0VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+123.08**
0.5	**-381.07**
1.0	**+198.44**
1.5	**-759.02**
2.0	**-200.81**
2.5	**+450.06**
3.0	**-198.62**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at +12% of Nominal Voltage, 134.40VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+324.24**
0.5	**-211.14**
1.0	**+734.19**
1.5	**+116.06**
2.0	**-415.79**
2.5	**-620.59**
3.0	**-847.88**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at +9% of Nominal Voltage, 130.80VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-249.27**
0.5	**+807.46**
1.0	**-445.40**
1.5	**+103.03**
2.0	**+80.020**
2.5	**-401.85**
3.0	**+839.68**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at +6% of Nominal Voltage, 127.20VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-635.85**
0.5	**+88.288**
1.0	**-319.14**
1.5	**+429.89**
2.0	**-111.37**
2.5	**-582.86**
3.0	**+370.04**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at +3% of Nominal Voltage, 123.60VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-531.85**
0.5	**+201.38**
1.0	**-419.65**
1.5	**+125.85**
2.0	**-85.033**
2.5	**+323.63**
3.0	**+512.03**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at -3% of Nominal Voltage, 116.40VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-749.97**
0.5	**+583.69**
1.0	**+14.101**
1.5	**-695.73**
2.0	**+138.52**
2.5	**-99.785**
3.0	**+686.40**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at -6% of Nominal Voltage, 112.80VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-749.97**
0.5	**+583.69**
1.0	**-14.101**
1.5	**-695.73**
2.0	**-126.35**
2.5	**+432.73**
3.0	**-520.95**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at -9% of Nominal Voltage, 109.20VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+492.59**
0.5	**-662.48**
1.0	**-312.65**
1.5	**+634.31**
2.0	**-351.25**
2.5	**-31.712**
3.0	**-787.48**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at -12% of Nominal Voltage, 105.60VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+122.85**
0.5	**+742.18**
1.0	**-220.42**
1.5	**-510.07**
2.0	**-410.05**
2.5	**+301.05**
3.0	**+627.30**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at -15% of Nominal Voltage, 102.0VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+308.05**
0.5	**-364.63**
1.0	**-685.95**
1.5	**+327.13**
2.0	**-852.08**
2.5	**+802.49**
3.0	**-228.86**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

AWEUD + FA3UB - DC Version

Frequency Block Tested: *24 GHz RADIO (CF = 24,300.000 MHz)*

Baseline Measurement at +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-351.60
0.5	-471.80
1.0	+70.343
1.5	-762.80
2.0	+202.24
2.5	+50.152
3.0	-445.11
FCC SPECIFICATION	1215 Hz (±0.05ppm) ±0.05ppm = ±Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +50°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-522.10
0.5	+237.23
1.0	-408.65
1.5	-794.52
2.0	-194.84
2.5	+198.62
3.0	-446.71
FCC SPECIFICATION	1215 Hz (±0.05ppm) ±0.05ppm = ±Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +40°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	+18.088
0.5	-320.59
1.0	+253.70
1.5	-663.81
2.0	+230.27
2.5	-799.07
3.0	-230.19
FCC SPECIFICATION	1215 Hz (±0.05ppm) ±0.05ppm = ±Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-202.75**
0.5	**-684.52**
1.0	**+175.73**
1.5	**-786.66**
2.0	**+51.608**
2.5	**-289.20**
3.0	**-955.83**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-541.32**
0.5	**+129.30**
1.0	**-680.27**
1.5	**+7.8511**
2.0	**-643.59**
2.5	**+141.56**
3.0	**-518.51**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+322.68**
0.5	**-802.41**
1.0	**+166.86**
1.5	**-400.19**
2.0	**+867.74**
2.5	**-730.36**
3.0	**-450.91**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at 0°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-211.52**
0.5	**+167.72**
1.0	**-769.24**
1.5	**+207.44**
2.0	**-680.59**
2.5	**+103.89**
3.0	**-714.80**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at -10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-134.75**
0.5	**-608.24**
1.0	**-446.28**
1.5	**-575.08**
2.0	**+301.00**
2.5	**-208.21**
3.0	**-903.13**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at -20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-242.08**
0.5	**-540.17**
1.0	**-96.224**
1.5	**-444.72**
2.0	**-521.53**
2.5	**-400.30**
3.0	**-518.29**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at -30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-771.66**
0.5	**-330.25**
1.0	**-520.20**
1.5	**-85.768**
2.0	**-36.544**
2.5	**-547.25**
3.0	**-603.70**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
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	**+256.44**
0.5	**-672.62**
1.0	**+96.587**
1.5	**-664.89**
2.0	**+805.97**
2.5	**+258.37**
3.0	**-381.75**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 103% of Nominal Voltage, -49.44VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-282.71**
0.5	**-354.76**
1.0	**+45.300**
1.5	**-751.68**
2.0	**-487.05**
2.5	**-303.85**
3.0	**+179.68**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 106% of Nominal Voltage, -50.88VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-255.70**
0.5	**-305.87**
1.0	**+198.92**
1.5	**-454.95**
2.0	**+145.64**
2.5	**-338.07**
3.0	**-565.77**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 109% of Nominal Voltage, -52.32VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-45.214**
0.5	**+286.44**
1.0	**-549.48**
1.5	**-958.31**
2.0	**-661.22**
2.5	**+802.66**
3.0	**+266.62**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 112% of Nominal Voltage, -53.76VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-468.19**
0.5	**-406.41**
1.0	**-173.49**
1.5	**-725.41**
2.0	**-244.48**
2.5	**+59.880**
3.0	**-812.20**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 115% of Nominal Voltage, -55.20VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-664.55**
0.5	**-293.24**
1.0	**-715.44**
1.5	**+676.34**
2.0	**-284.70**
2.5	**-803.55**
3.0	**-140.05**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48.0VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+885.17**
0.5	**-525.64**
1.0	**-292.82**
1.5	**-507.01**
2.0	**-145.26**
2.5	**-813.01**
3.0	**+502.96**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -3% of Nominal Voltage, -46.56VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-306.56**
0.5	**+238.15**
1.0	**-669.55**
1.5	**+142.52**
2.0	**-326.19**
2.5	**-407.59**
3.0	**-720.03**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -6% of Nominal Voltage, -45.12VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-667.87**
0.5	**-365.72**
1.0	**+994.96**
1.5	**-207.38**
2.0	**-462.73**
2.5	**-514.14**
3.0	**-524.50**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -9% of Nominal Voltage, -43.68VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-760.11**
0.5	**-195.47**
1.0	**-410.28**
1.5	**-788.07**
2.0	**-210.95**
2.5	**+301.16**
3.0	**-458.75**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -12% of Nominal Voltage, -42.24VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-365.98**
0.5	**-578.96**
1.0	**-61.558**
1.5	**-682.88**
2.0	**+347.43**
2.5	**-838.05**
3.0	**-366.06**
FCC SPECIFICATION	**1215 Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -15% of Nominal Voltage, -40.80VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+241.43**
0.5	**-609.85**
1.0	**-382.80**
1.5	**-410.49**
2.0	**-291.90**
2.5	**+211.37**
3.0	**-203.90**
FCC SPECIFICATION	**1215 Hz (±0.05ppm)** **±0.05ppm = ±Hz**
FCC RESULT	**PASS**

4.7 List of Test Equipment

4.7.1 List of Radio Measurements and Radiated Emissions Test Equipment

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
E1451	A-Info	Horn Antenna	18 to 26.5 GHz WR42 25 dB	LB-42-25-C2-KF	J202066360	2020-03-23	2020-08-23
E1461	A-Info	Horn Antenna	22-33 GHz WR34 25dB	LB-34-25-C2-KF	J202026030	2020-08-27	Factory
E1373	A-Info	Horn Antenna	26.5-40GHz WR28 25 dB	LB-28-25-C2-KF	J202062735	2018-12-05	2021-12-05
E1374	A-Info	Horn Antenna	26.5-40GHz WR28 25 dB	LB-28-25-C2-KF	J202062736	2018-12-05	2021-12-05
E1074	ETS Lindgren	Horn Antenna	Double-Ridged Horn 1-18 GHz	3117	00135194	2019-05-01	2021-05-01
E601	A.H. Systems Inc.	Bilogical Antenna	25 - 2000 MHz	SAS-521-2	408	2019-12-03	2021-12-03
E766	A.H. Systems Inc.	Bilogical Antenna	25 - 2000 MHz	SAS-521-2	457	2019-02-13	2021-02-13
E954	Rohde & Schwarz	EMI Test Receiver	20Hz - 40GHz	ESU40	100246	2020-08-03	2022-08-03
E908	Rohde & Schwarz	EMI Test Receiver	20Hz - 40 GHz-	ESIB40	100100	2020-04-17	2022-04-17
E1260	Rohde & Schwarz	Spectrum Analyzer	2 Hz-67 GHz	FSW67	104007	2020-08-21	2022-08-21
E1384	Rohde & Schwarz	Spectrum Analyzer	2 Hz to 85 GHz	FSW85	101537	2020-08-25	2022-08-25
E1470L	Rohde & Schwarz	Spectrum Analyzer	2 Hz to 67 GHz	FSW67	101461	2020-06-04	2022-06-04
E1511	Rohde & Schwarz	EMI Test Receiver	2 Hz-44 GHz	ESW44	101965	2020-08-05	2020-11-05
E1469	A.H. Systems Inc.	Pre-Amplifier	18 GHz-40 GHz, 37 dB	PAM-1840VH	185	2020-06-04	Factory + V
E447	Hewlett Packard	Pre-Amplifier	Preamplifier 1-26.5 GHz	8449B	3008A01384	2020-08-31	2022-08-31
E1356	Hewlett Packard	Pre-Amplifier	Pre-Amplifier 1-26.5GHz	8449B	3008A01353	2020-10-21	2022-10-21
E1388	KeySight Technologies	Pre-Amplifier	0.5GHz -18GHz, 15dbM	87405C	MY55380142	2018-12-13	2020-12-13
E1472	Reactel, Inc.	Filter, High Pass	27 GHz High Pass	11HS-X27G-K11	SN20-02	CNR-V	CNR-V
E1473	Reactel, Inc.	Filter, High Pass	27 GHz High Pass	11HS-X27G-K11	SN20-01	CNR-V	CNR-V
E1498	Reactel, Inc.	Filter, Low Pass	DC - 22 GHz, 1 dB	11LS-X22-6GK11	20-01	CNR-V	CNR-V

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
E1499	Reactel, Inc.	Filter, Low Pass	1 - 22 GHz	11LS-X22-6GK11	20-02	CNR-V	CNR-V
E772	Sunol Sciences Corp	Modular Controller	Tower / Turntable Controller	SC104V	060107-1	CNR	CNR
E489	EMC Test Systems	Controller	Multi-Device Controller	2090	0004-1507	CNR	CNR
E1255	ETS Lindgren	Controller	Multi-Device Controller	2090	00078509	CNR	CNR
E588	Sunol Sciences Corp	System Controller	Tower / Turntable Controller	SC99V	32802-1	CNR	CNR
E812	Sonoma Instrument Co.	Amplifier	9kHz-1GHz	310N	186744	2020-10-20	2022-10-20
E494	Sonoma Instrument Co.	Amplifier	9kHz-1GHz	310N	185785	2020-03-04	2022-03-04
E980	Trilithic	Low Pass Filter	PCS 0.01-2 GHz	10LC1790-3-AA	PCS-LPF-12	CNR-V	CNR-V
E1150	Extech	Data Logger	Pressure Humidity Temp Data Logger	SD700	Q752767	2019-01-16	2021-01-16
E1315	RS Microwave Company, Inc.	Microwave Filter	40 GHz High Pass Filter	P/N 60733A	007	CNR-V	CNR-V
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
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
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

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.

4.7.2 List of Frequency Stability Test Equipment

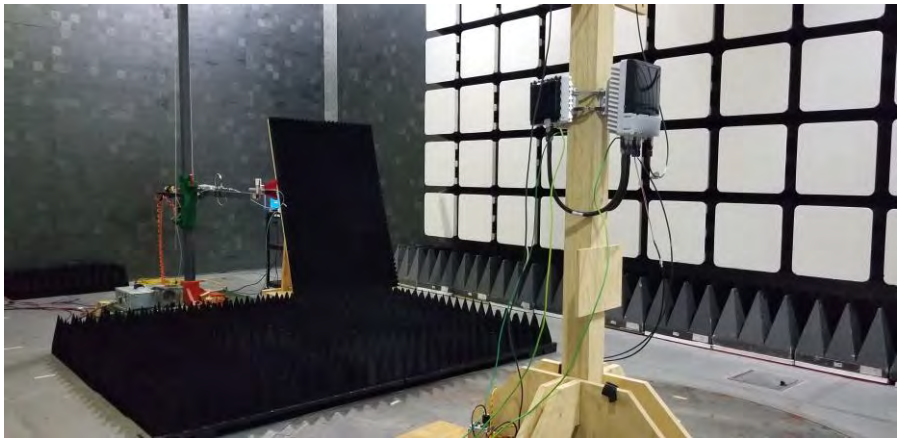
Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
MY57431033	KeySight Technologies	MXA	MXA Signal Analyzer	N9020B	MY57431033	2020-07-08	2022-07-08
TH530-T06	Thermotron	Controller	Thermal Chamber Controller	Thermotron 7800	8E62408	2019-09-18	2021-09-18
TH-T06	Thermotron	Thermal Chamber	Thermal Chamber	N/A	28972	2019-09-13	2021-09-13
TH070	Vaisala	Transmitter	Humidity and Temperature	HMT330	J3330109	2019-12-04	2021-12-04
TH085	Yokogawa	Recorder		GP20	S5PB04190	2020-02-25	2022-02-25
TH073	Fluke	Multimeter	Digital	87V	25910080	2020-02-25	2022-02-25
N/A	XHR	Power Supply	DC Source	60-18	53519	N/A	N/A
N/A	Behlman	Power Supply	AC Source	BL 1350	04824	N/A	N/A

4.8 PHOTOGRAPHS OF THE TEST SETUPS

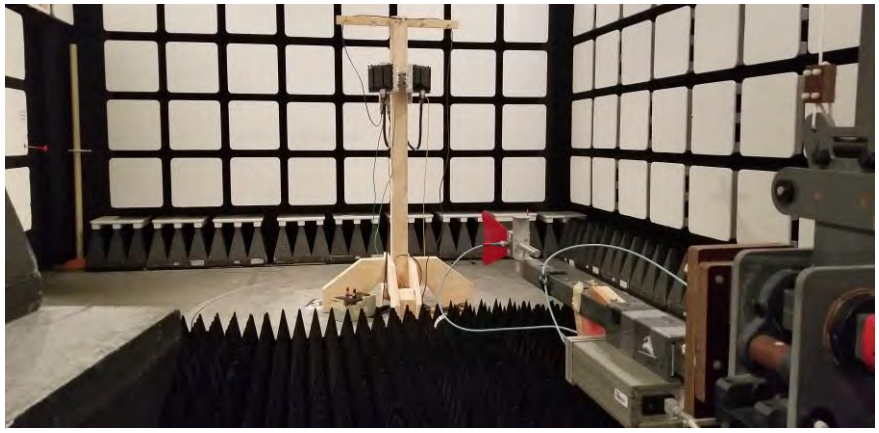
Radio Measurements and Radiated Emissions Test

30 MHz-1 GHz AR-4

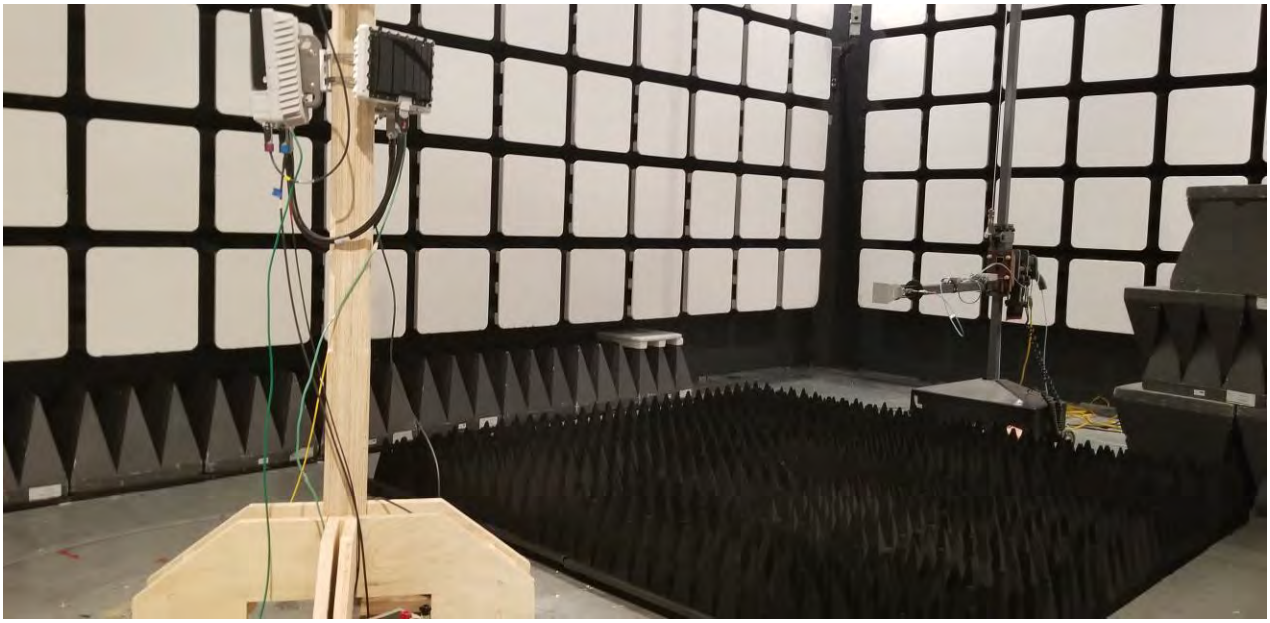
1 GHz – 18 GHz AR-4



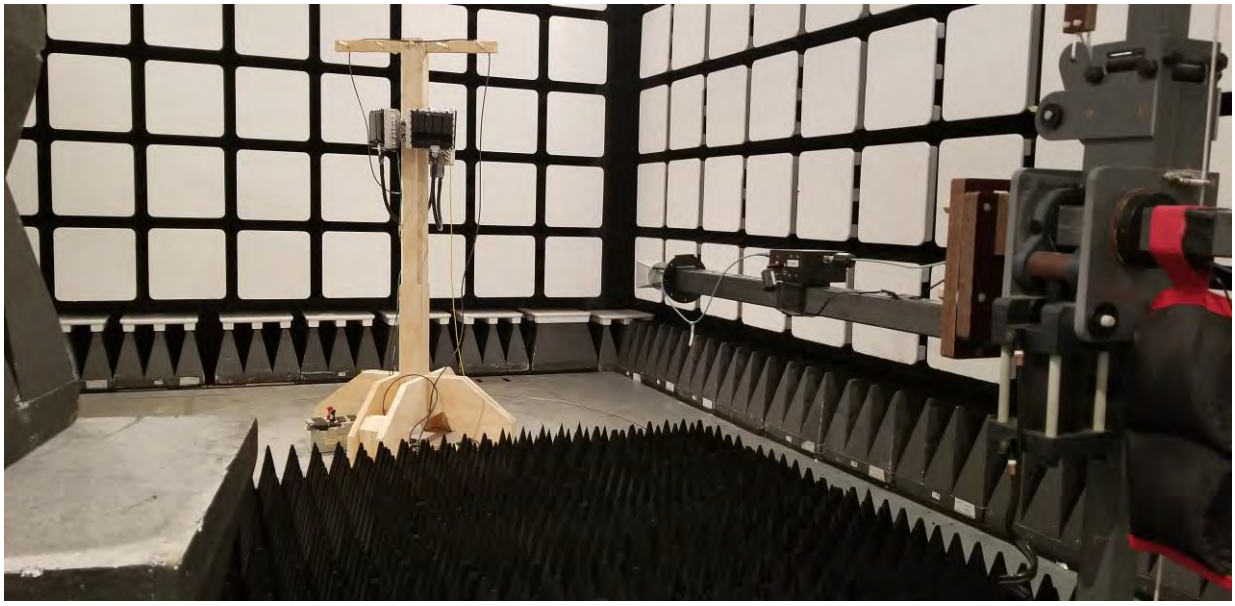
1GHz-18 GHz AR-9



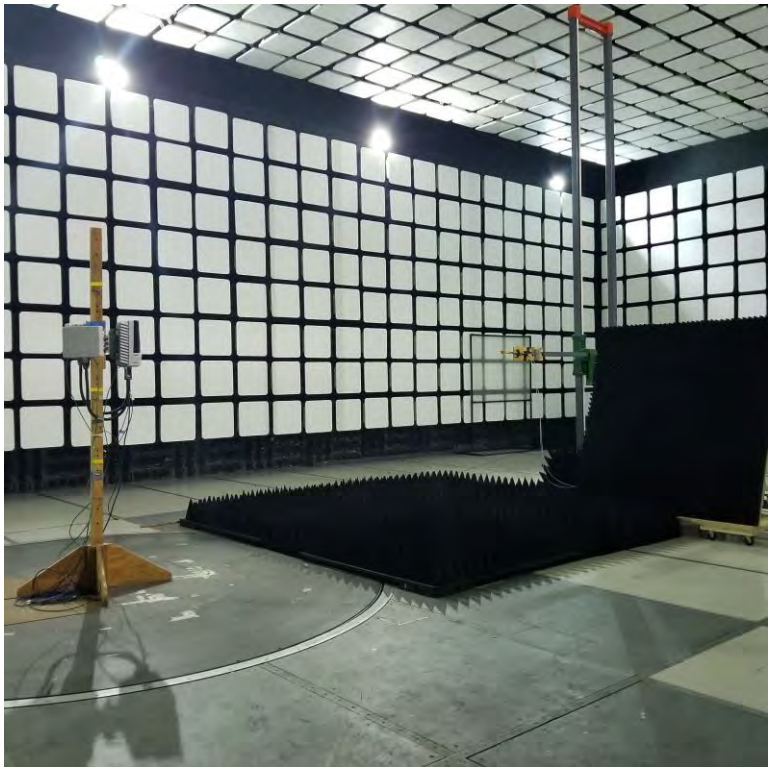
18GHz-22.5GHz AR-9



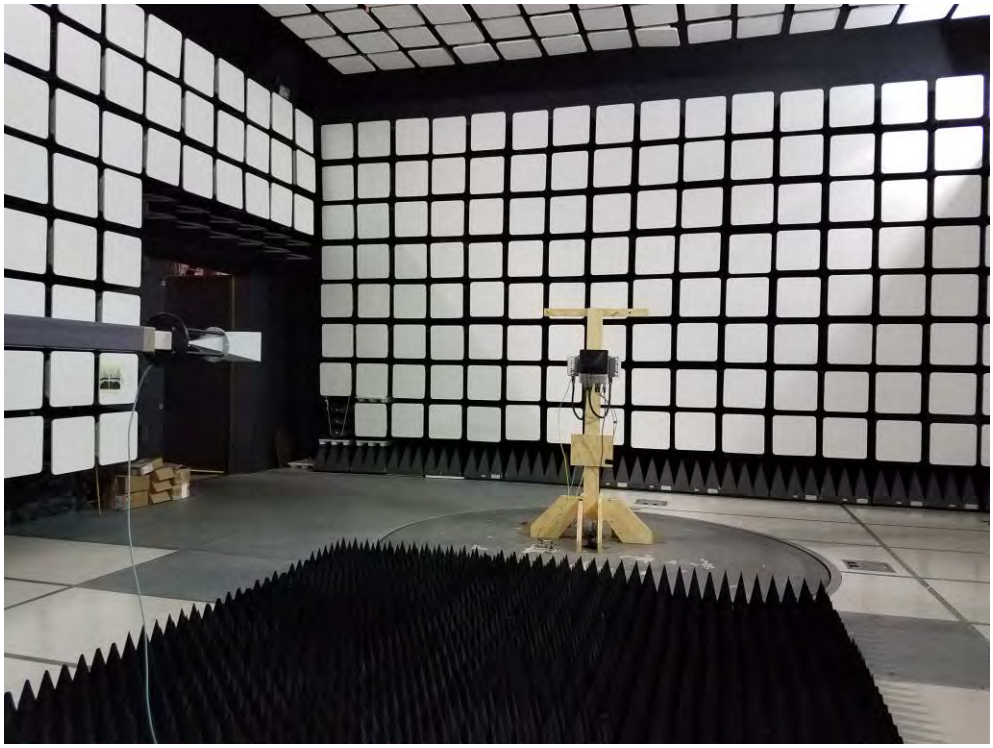
26.5GHz-40 GHz AR-9



40GHz-100 GHz AR-8



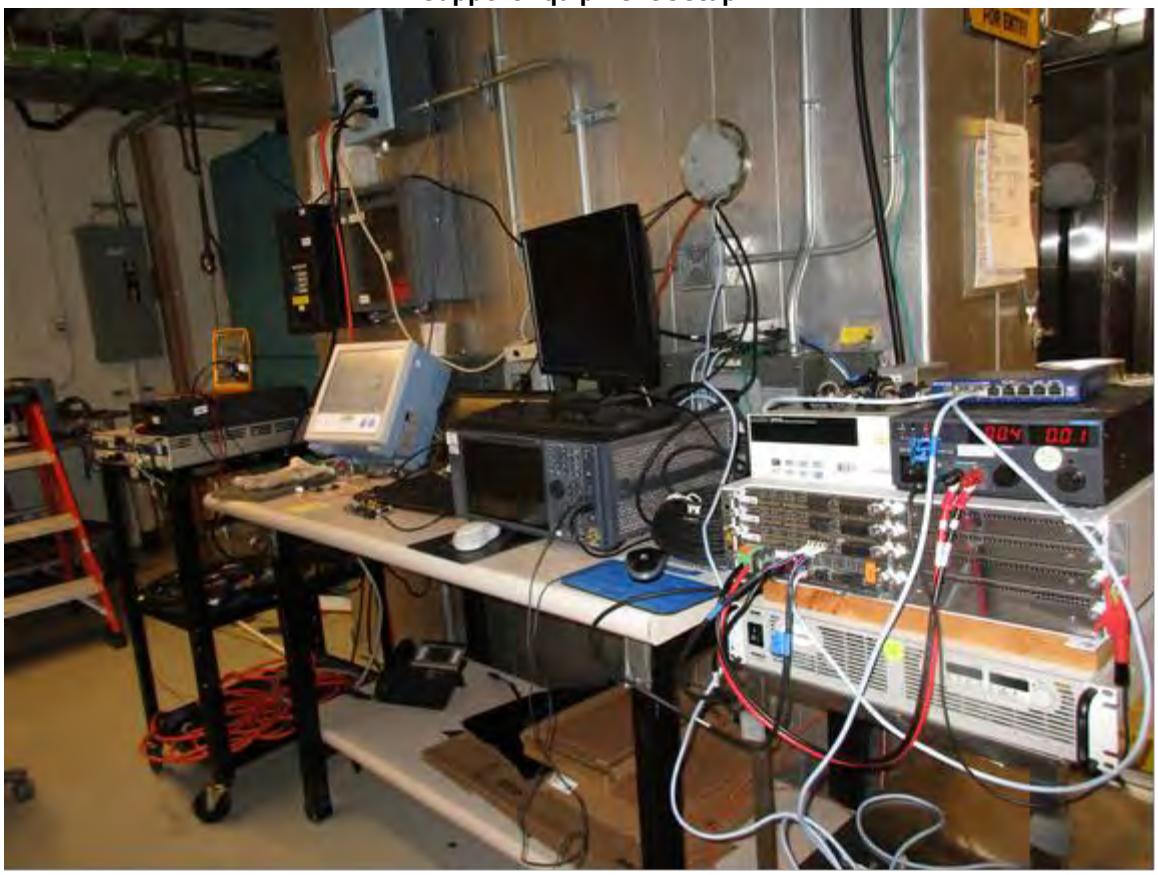
Radio Testing AR-8



2AD8U24FA3UB in thermal chamber

Horn Antenna (outside of thermal chamber)

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

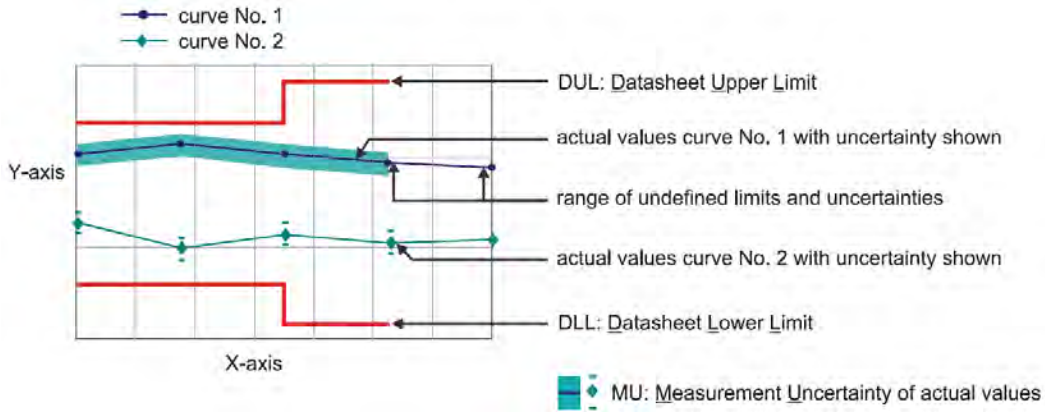
If the new product is stored under the climate conditions as specified in the data sheet upon delivery, the product's accuracy is not significantly affected within 12 month after its calibration in our factory. In this case, the recommended calibration interval starts on the date when the product is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

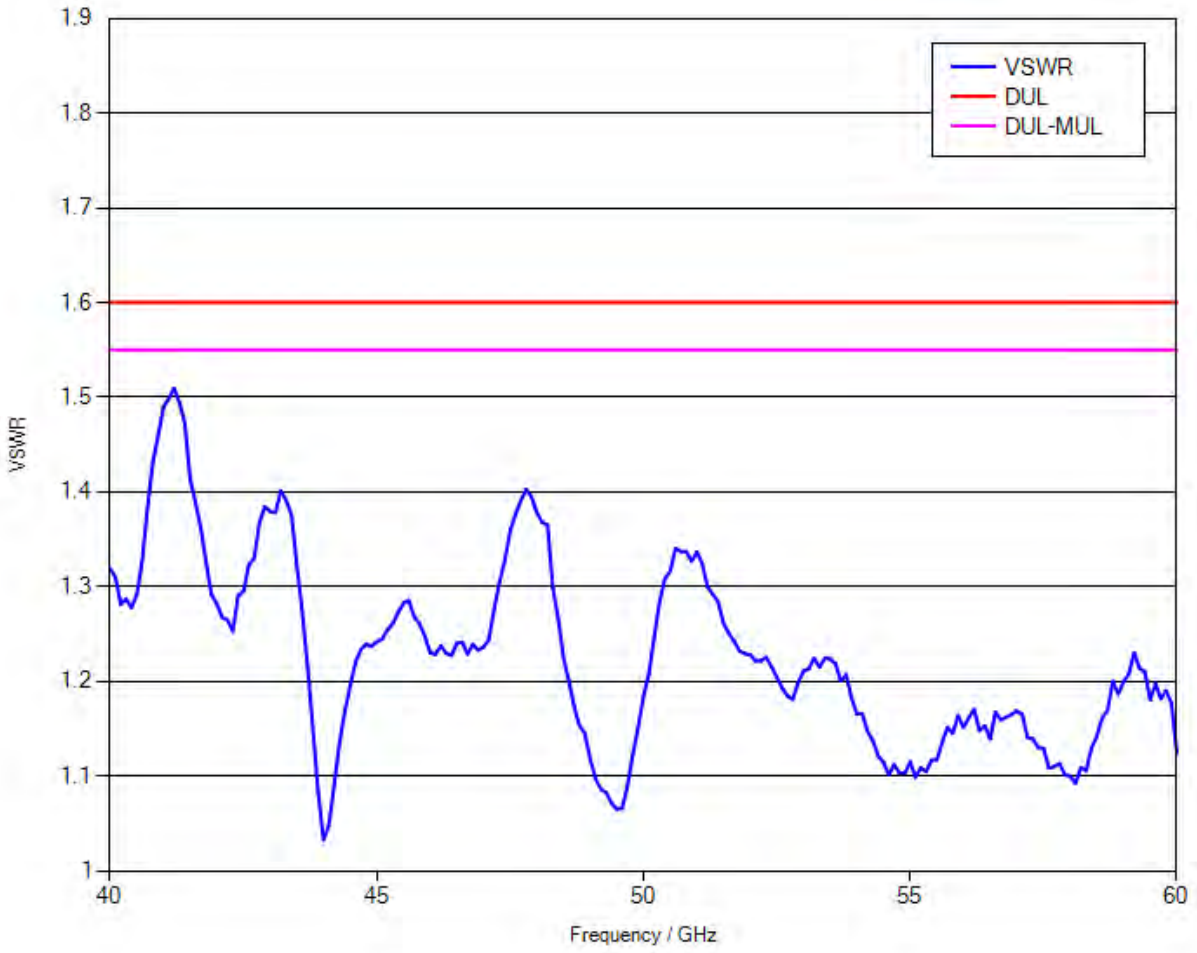


Software used for measurement

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

1.1 RF Input – VSWR

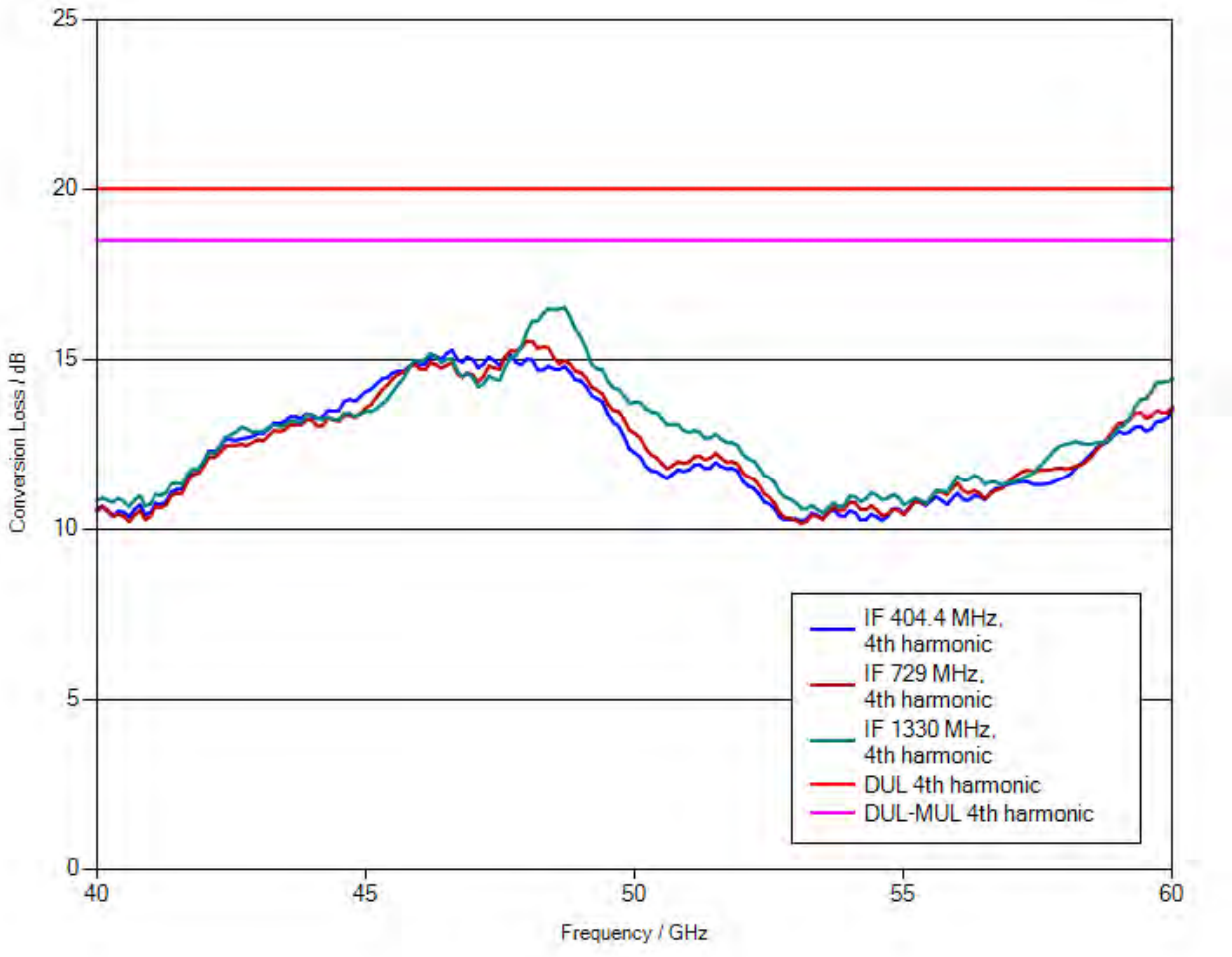
Measurement uncertainty: 0.05 (VSWR)



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
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
2017-08-11

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

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-Z58	101063	20-611482	2018-07-21
Calibration kit	WR12	E10001	RPG-PAQA-TN-2014-005	2019-02-01

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

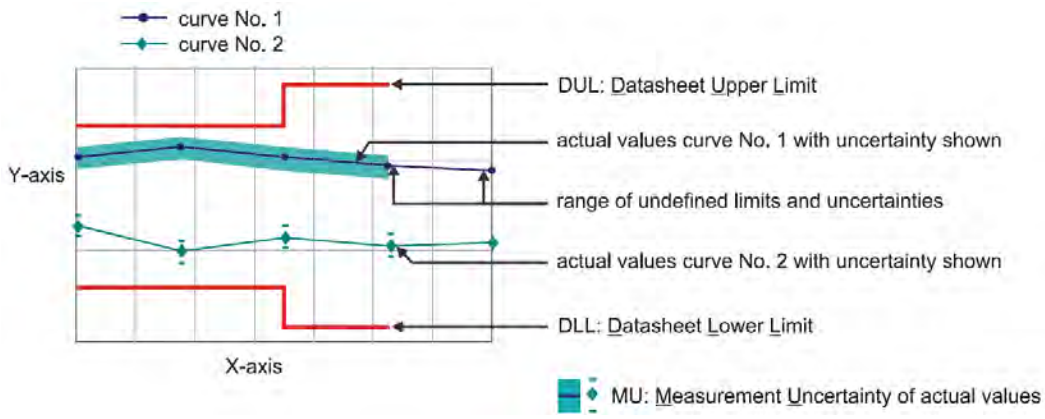
If the new product is stored under the climate conditions as specified in the data sheet upon delivery, the product's accuracy is not significantly affected within 12 month after its calibration in our factory. In this case, the recommended calibration interval starts on the date when the product is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

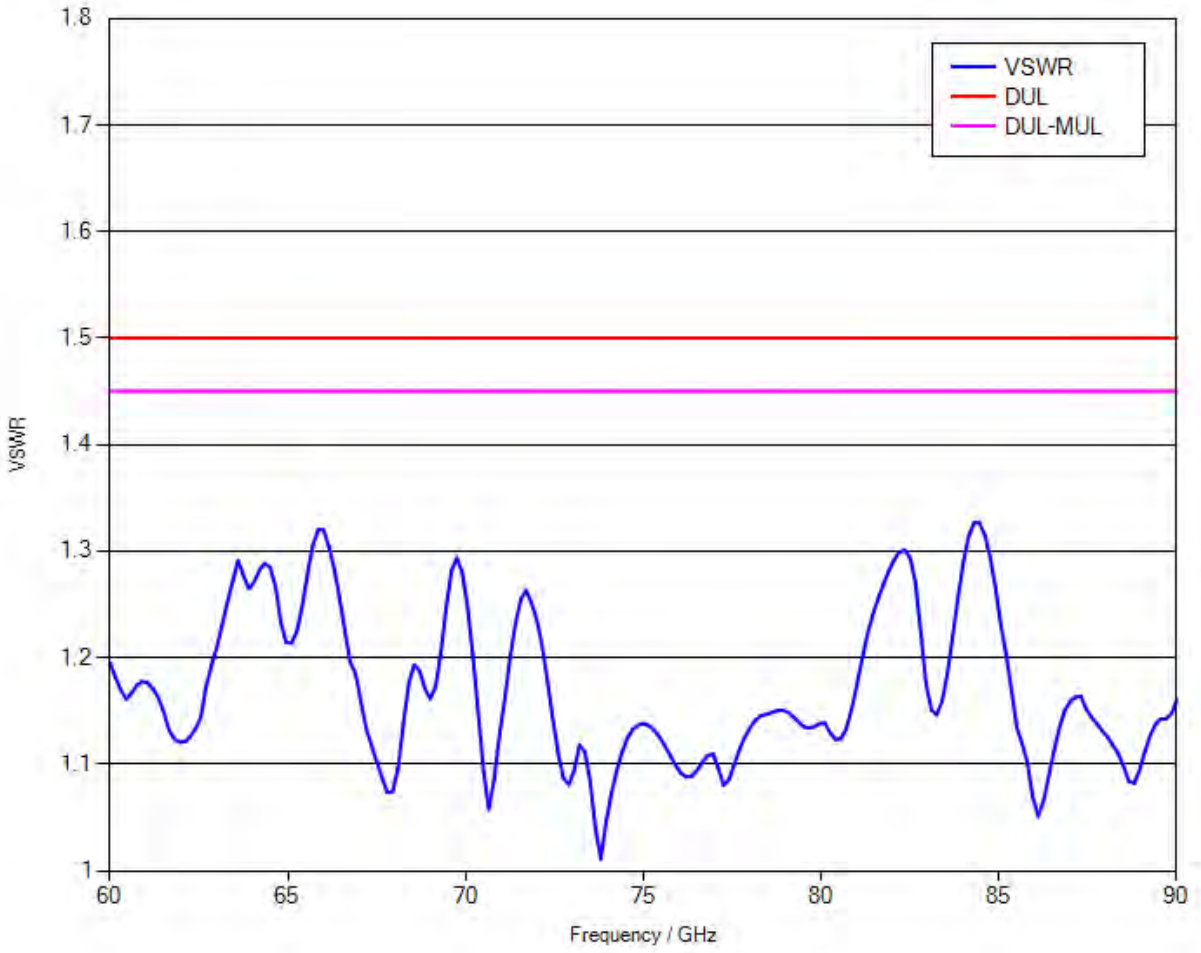


Software used for measurement

Item Type	Version	Remark
Measurement Studio Professional Edition	2013	
MixerCertification	only	

1.1 RF Input – VSWR

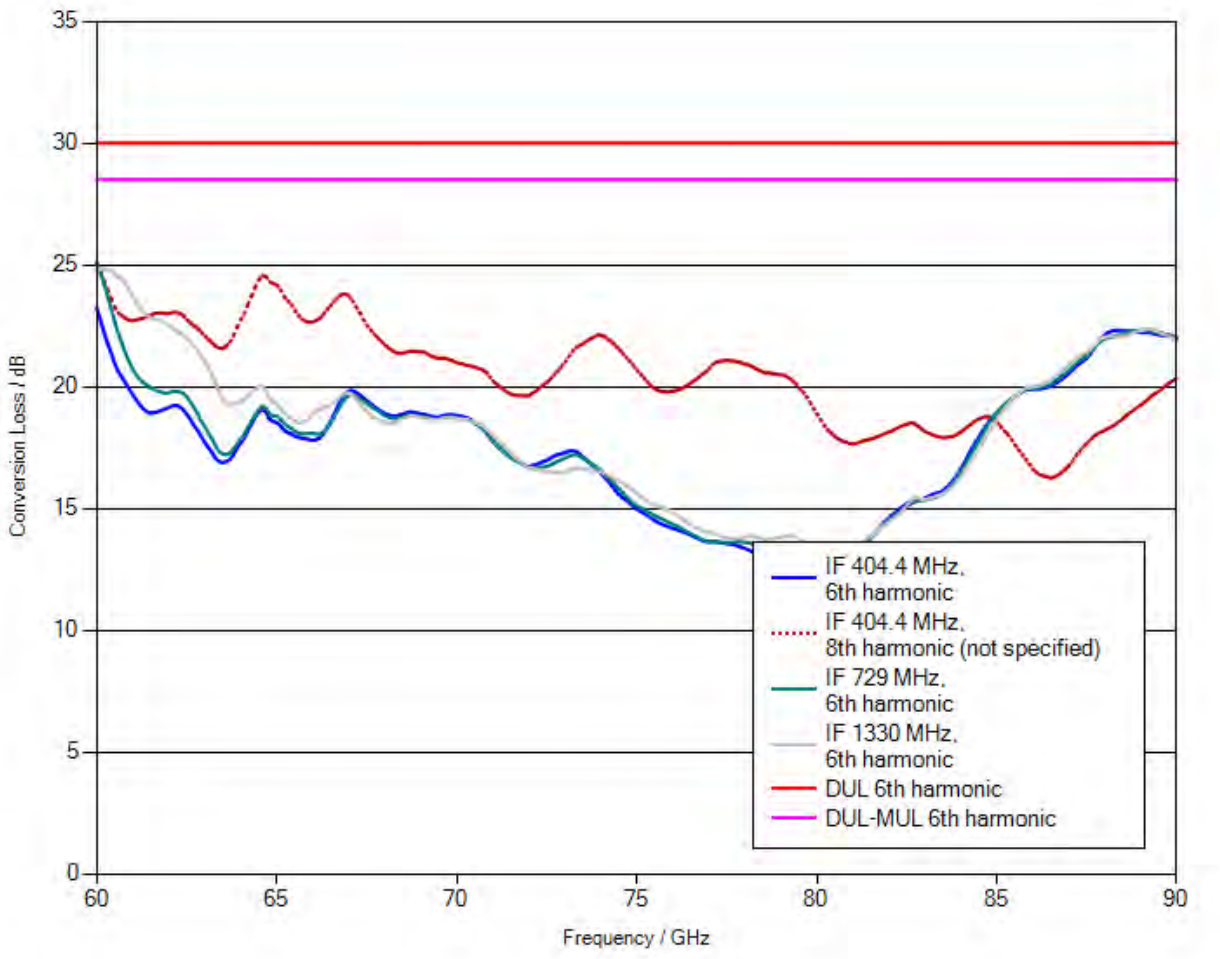
Measurement uncertainty: 0.05 (VSWR)



1.2 Conversion loss

LO level +14 dBm nominal
Bias 0 A

Measurement uncertainty: 1.5 dB



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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

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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.
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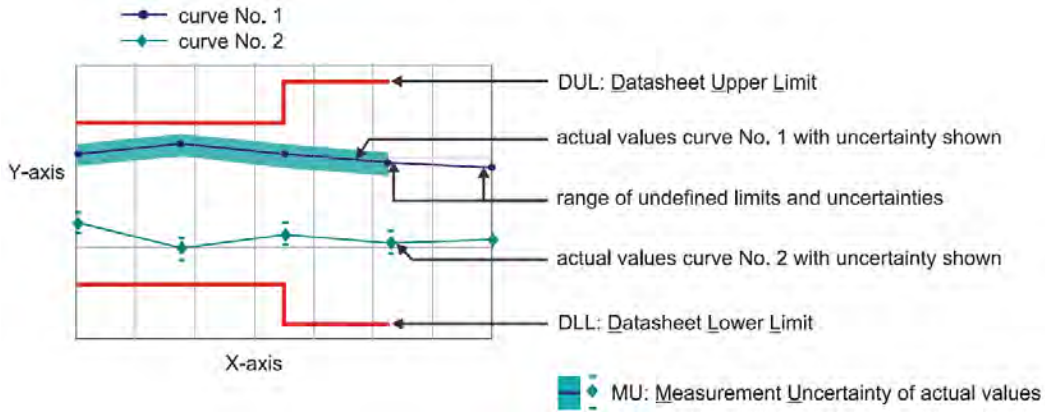
{e}	The measurement uncertainty is taken into account when setting the measuring system.
DL or DT	Data Limit for symmetrical tolerance limits
DLL	Datasheet Lower Limit
DUL	Datasheet Upper Limit
MU	Measurement Uncertainty
MLL or MLV	Measurement Uncertainty Lower Value
MUL or MUV	Measurement Uncertainty 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

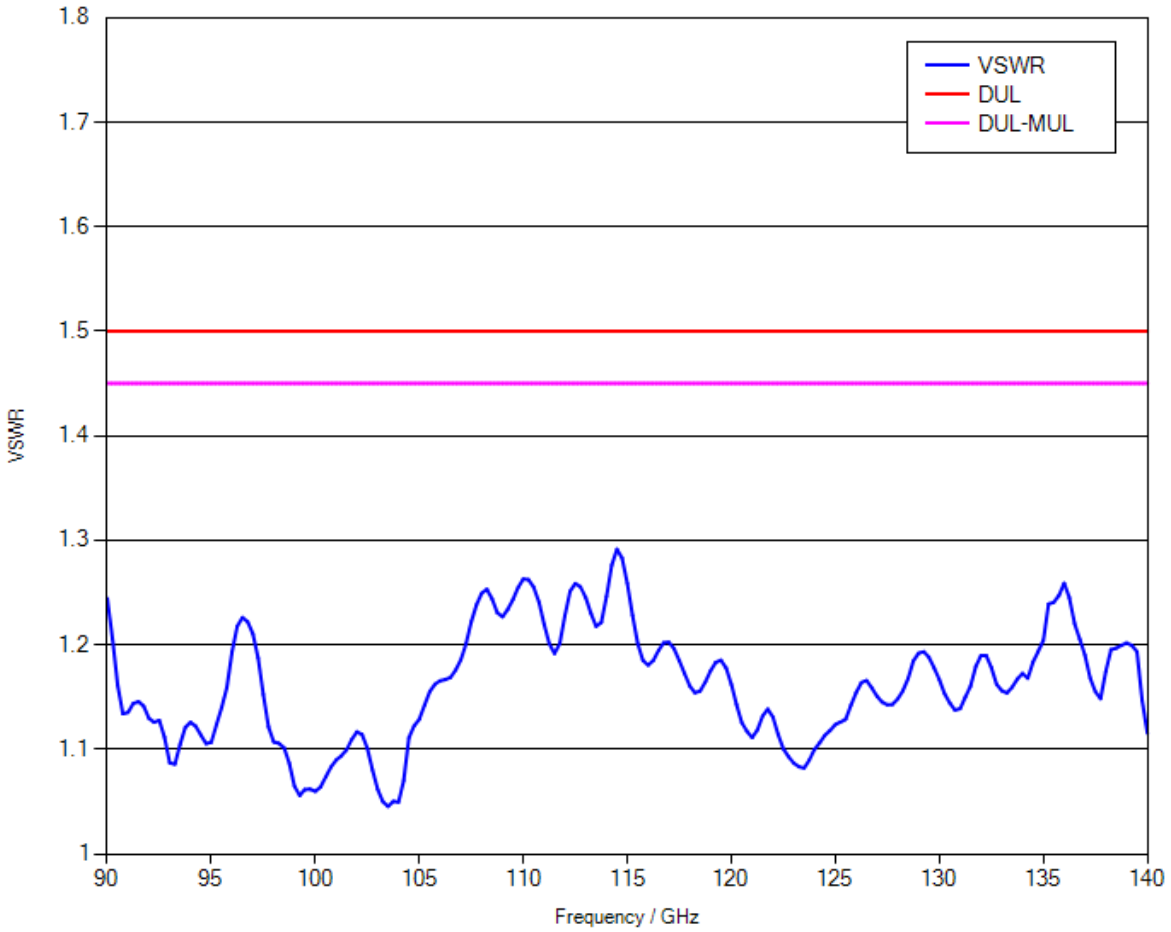


Software used for measurement

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

1.1 RF Input – VSWR

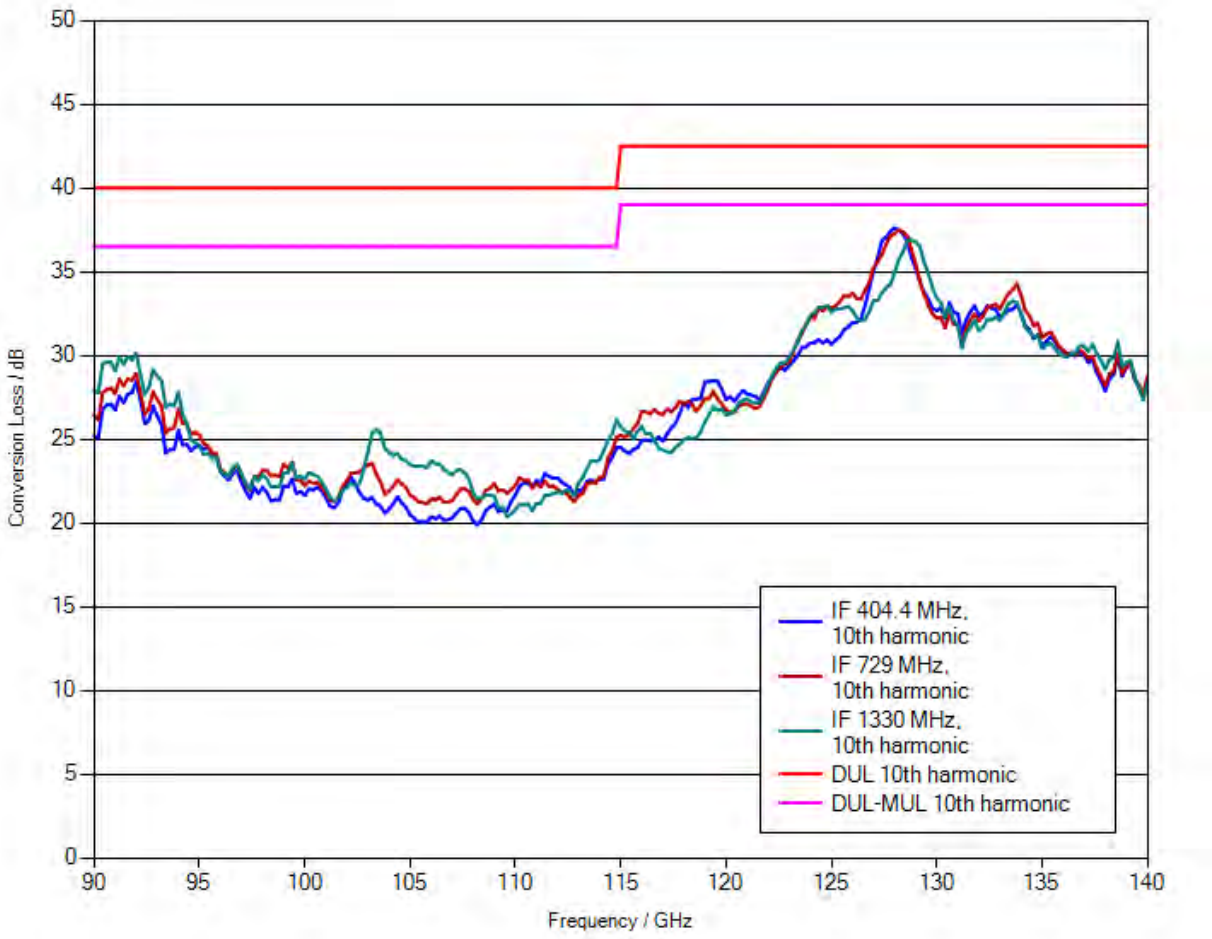
Measurement uncertainty: 0.05 (VSWR)



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)
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.

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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

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.
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DLL	Datasheet Lower Limit
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MU	Measurement Uncertainty
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MUL or MUV	Measurement Uncertainty Upper Value
Nom.	Nominal Value
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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 %.
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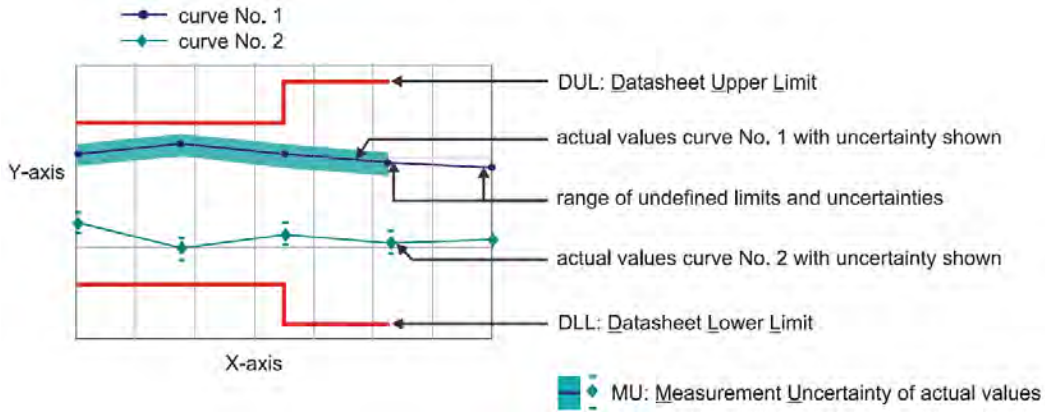
DU	Datasheet Uncertainty

Explanation of charts

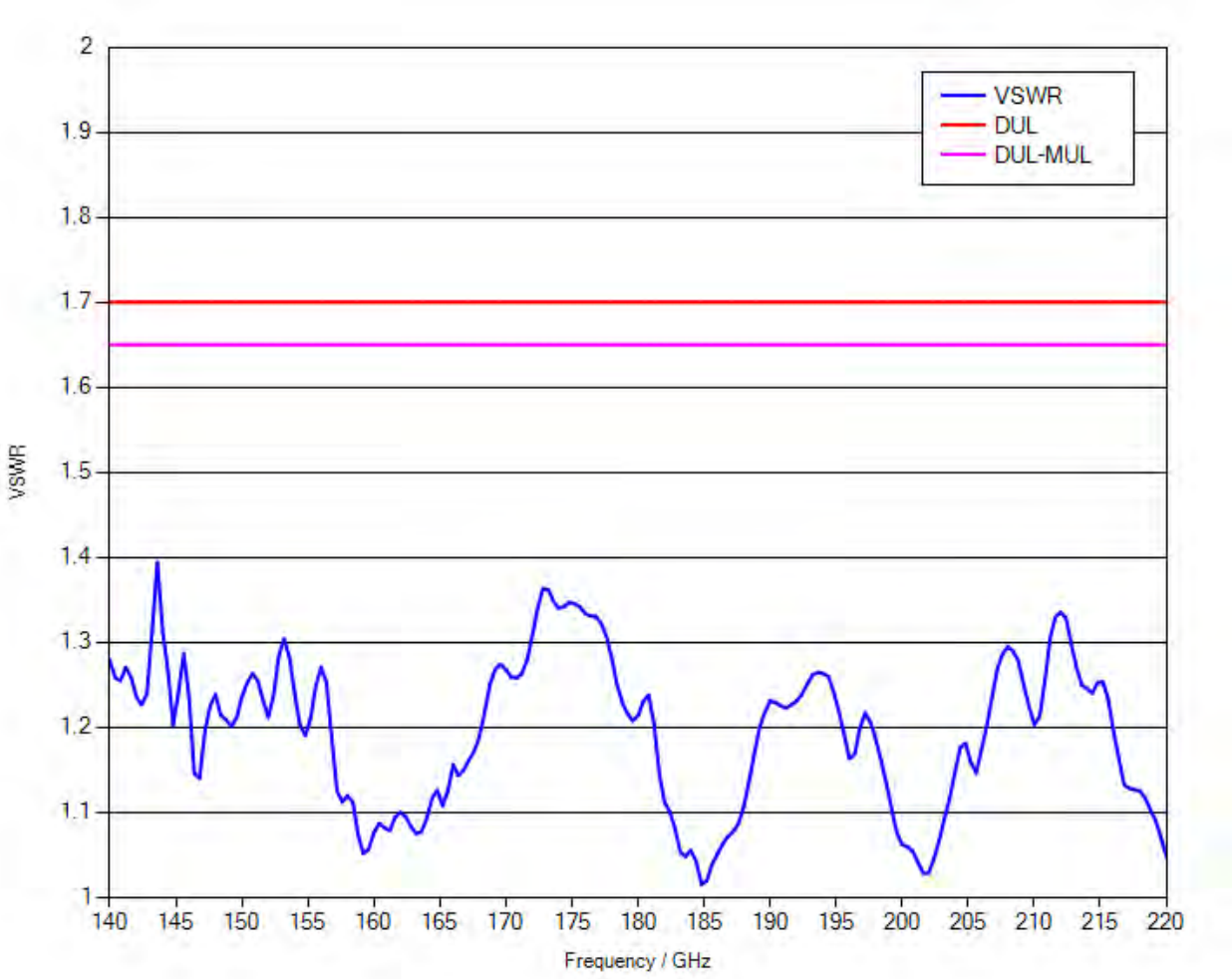


Software used for measurement

Item Type	Version	Remark
Measurement Studio Professional Edition	2013	
MixerCertification	7_08	

1.1 RF Input – VSWR

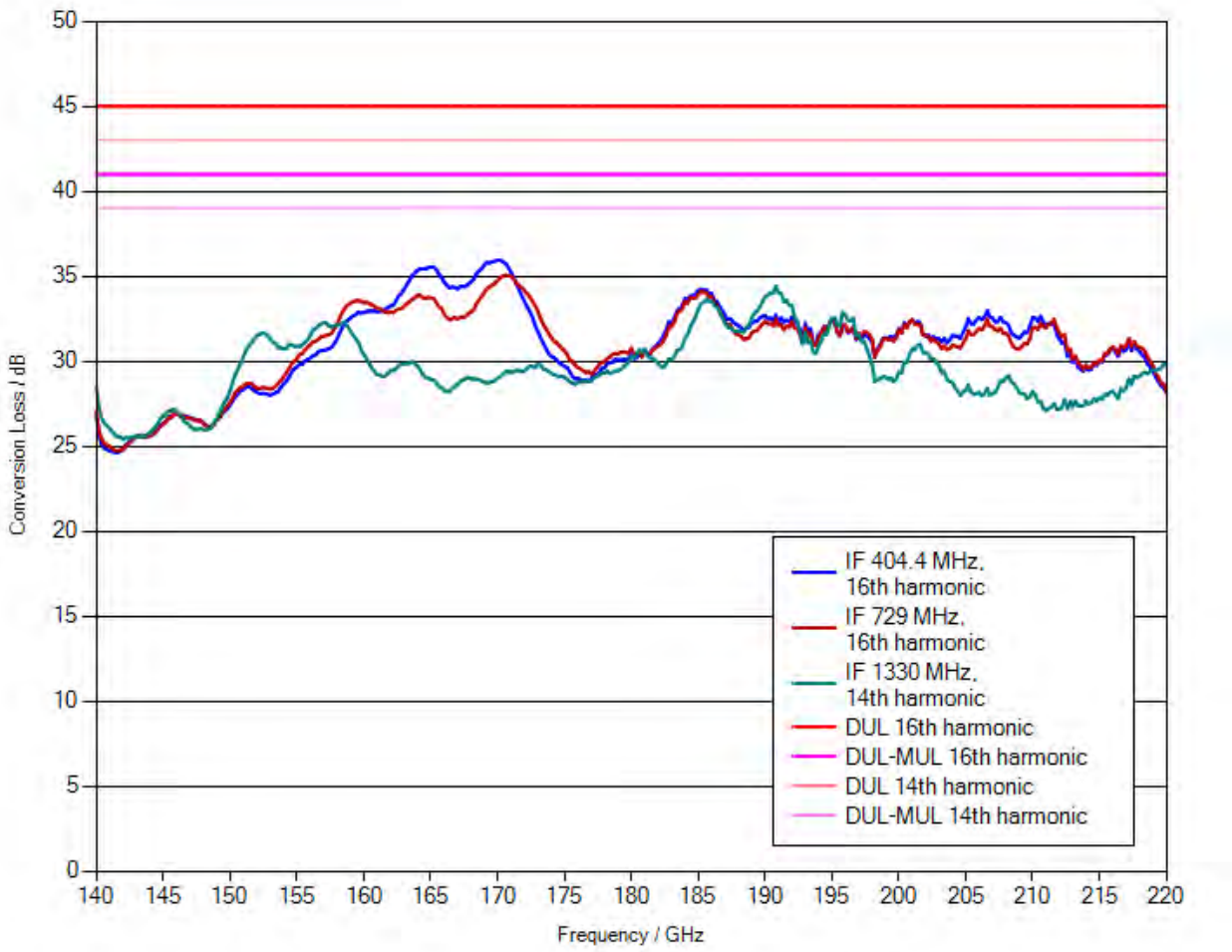
Measurement uncertainty: 0.05 (VSWR)



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