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
Nokia AirScale 39 GHz Radio Unit (AEWF)
AEWF-01,
FCC ID: VBNAEWF-01

Customer
Nokia Solutions and Networks US LLC
6000 Connection Drive
Irving, Texas 75039 USA

Test Laboratory
Nokia Bell Labs
Nokia, Global Product Compliance Laboratory
600-700 Mountain Avenue, Rm 5B-108
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Date: December 26, 2018

Revisions

Date	Revision	Sections	Change
11/26/2018	0		Initial Release
12/13/2018	1	4.4.2	Text error removed
12/26/2018	2	4.3.7, 4.1.1, 4.5, 4.3.6.1	Worst case operation and Realized Gain correction.
12/26/2018	3	4.3.6.1	Realized Gain correction.

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Prepared By: W. Steve Majkowski NCE

12/26/2018

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12/26/2018

Technical Manager
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Nokia, Global Product Compliance Laboratory

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1. ATTESTATION OF TEST RESULTS

Company Name	**Nokia Solutions and Networks** 6000 Connection Drive Irving, Texas 75039 USA
FCC ID	**VBNAEWF-01**
Product Name	**AirScale 39 GHz Radio Unit (AEWF) Band 30** PRI20183530
Model Name	**AEWF**
Part No	474870A.X12,
Serial Number(s)	DC Models: L1183000461, L1183000452
Test Standard(s)	• 47 CFR FCC Parts 2 • KDB 971168 D01 Licensed DTS Guidance v03 April 9, 2018 • KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013 • 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)
Frequency Band	(Tx: 37 – 40.0 GHz), NR Band n260
Technology	5G-New Radio, LTE-TDD: 100M0G7W,
Test Frequency Range	30 MHz – 200 GHz
Operation Mode(s)	2x 54dBm EIRP, 57 dBm EIRP Total. MIMO
Submission Type	Initial Filing
FCC Part 15 Subpart B	Compliance with Class B
Test Date	August 25 to November 29, 2018
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	Compact Base Station LTE Module (2Tx, 2Rx), 2x2 MIMO
Radio Type	Intentional Transceiver
Power Type	115 VAC
Modulation	5G New Radio LTE-TDD with QPSK, 16QAM and 64QAM
Operating Frequency Range	TDD (Tx/Rx: 37.0-40.0 GHz),
Channel Bandwidth	100 MHz,
Max Radiated Power (EIRP)	54 dBm EIRP per polarizations; based upon 28 dBm Tx output. 57 dBm EIRP Total for the two polarizations.
Antenna Gain	29 dBi
Operating Mode	2x2 MIMO (2 duplex Tx/Rx Ports)
Software Version	FLF17SP
Hardware Version	474870A.X12
Antenna(s)	Refer to Section 3.2

The EUT supports the following carrier configurations:

Table 3.1.2 EUT Supported Configurations

Carrier Bandwidth (MHz)	Carriers per Path	MIMO Modes	Signal Type	Modulation
100	1	2x	LTE-TDD	QPSK, 16QAM & 64QAM

The as tested operating band consists of the following channels and spectrum:

Absolute Radio-Frequency Channel Number (**ARFCN**

Table 3.1.3 NRARFCN per 38.101-2, for n260 with 100 MHz Carriers

NRARFCN	TDD Center Reference Frequency (MHz)	Width of Channel (MHz)
2229999	37.050	100
2254166	38.500	100
2278332	39.949	100

3.1.1 NR-ARFCN Calculation

The computational relationship between the NR-ARFCN and the RF reference frequency (or carrier center frequency) F_{ref} in MHz for the downlink and uplink is defined by the following equation, where the values of F_{offset} and N_{offset} depend on the frequency range as given in the table below and N_{ref} is the NR-ARFCN.

$$F_{ref} = F_{offset} + \Delta F \, (N_{ref} - N_{offset}) \quad (1)$$

$$N_{ref} = N_{offset} + (F_{ref} - F_{offset}) / \Delta F \quad (2)$$

So for the Upper Microwave Flexible Use Services (UMFUS) band:

$$F_{ref} = 24250 + 0.06(\text{NRARFCN}-2016667) \quad \text{MHz}$$

For a NR-ARFCN =2229999 the F_{ref} is:

$$F_{ref} = 37.04992 \text{ GHz} \quad = 24250 + 0.06(2229999-2016667)$$

Table 3.1.1 NR-ARFCN Calculation Parameters for UMFUS

Frequency Range	ΔF	F_{offset} [MHz]	N_{offset}	Range of N_{ref}
24250 – 100000 MHz	0.06 MHz	24250 MHz	2016667	2016667 – 3279167

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 29 dBi. There are two antenna assembly boards inside the product. Each antenna assembly board is a pair of 16x16 matrix (a transmit matrix and a receive matrix with 256 elements each). One assembly board is vertically polarized and the second assembly board is horizontally polarized. The antennas RF drive level is 28 dBm. The 28 dBm RF power and 29 dBi gain results in a 54 dBm EIRP per assembly. The sum of the two 54 dBm EIRP beams results in a maximum EIRP of 57 dBm. Antenna Gain vs frequency is detailed in Exhibit 6 of the filing package.

3.3 Antenna Far Field Determination Distance

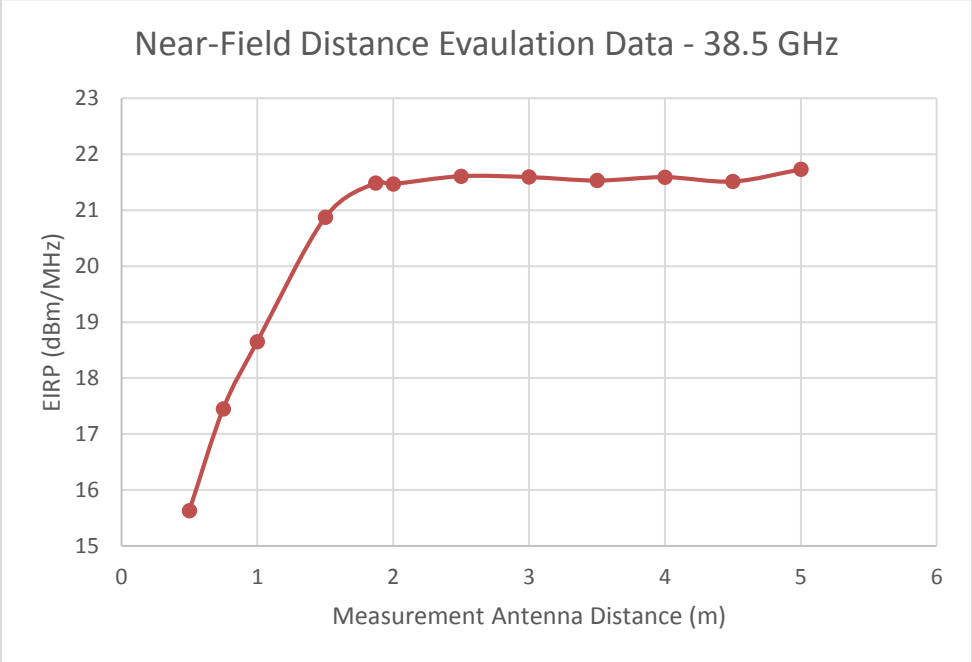
Calculations and low power measurements were performed to determine the far field boundary location for the antenna per the Fraunhofer distance calculated from

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

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 antenna patch height is 15 mm and 7.6 mm wide and the patches are 15 .
At 39 GHz the 15 cm dimension results in a far field distance d_{ff} of 5.85 meters.
At 39 GHz the 7.6 cm dimension results in a far field distance d_{ff} of 1.50 meters.

Measurements were performed at low power and using a small horn antenna
In horizontal polarization the determined boundary was 100 cm, which matches the horizontal dimension.
To eliminate any inconsistancy all power measurements were made at 5m.



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 Original 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. 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 • KDB 971168 D01 Licensed DTS Guidance v03 April 9, 2018 • KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013 • 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 and there is no antenna connection on the product. This test as implemented is therefore 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: VBNAEWF-01**, is a LTE TDD Remote radio head presently configured for single carrier operation. It is specified to provide a maximum power output of 54 dBm EIRP/500 W EIRP per transmit polarization for a sum total of 57 dBm EIRP /500W EIRP per unit. The product is designed for the 5G global market including operation per 47 CFR Part 30 rules for operation in the 5G New Radio Band n260 from 37 – 40 GHz.

4.1.1 RF Power Output Measurement

The product was configured for test as shown in Figure 4.1.1 below and allowed to warm up and stabilize per KDB 971168 D01 and ANSI C63.26.

Radiated Power measurements of the 5G New Radio transmit signal were conducted with an FSW Spectrum Analyzer per KDB 971168 D01. Measurements were performed at a 5 m distance using a nominal 70.12 dB offset. An additional correction is necessary to ascertain the actual measured EIRP power. See Note (i). 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 5m boundary distance. The worst case performance was measured while operating with 5GNR 64QAM modulation. The worst case measurements listed below were performed at the Left, Center and Right side of the 37-40 GHz frequency range for a 100 MHz bandwidth carrier with 5GNR 64QAM modulation.

Table 4.1.1 Corrections For Transmitter Power Measurements

Frequency	Free Space Path Loss, "PL"	Measurement Antenna Gain, "G1"	Measurement Cable Loss, "L1"	Total Offset Required PL -G1 + L1	FSW Measurement Offset	Required Final Correction
GHz	dB	dBi	dB	dB	dB	dB
35	77.3	24.83	15.11	67.58	70.12	-2.54
36	77.55	24.83	15.11	67.82	70.12	-2.3
37	**77.79**	24.95	15.11	67.94	70.12	**-2.18**
37.5	77.9	25	15.24	68.14	70.12	-1.98
38	78.02	25.1	15.37	68.29	70.12	-1.83
38.5	78.13	25.15	15.49	68.47	70.12	**-1.65**
39	78.24	25.15	15.67	68.76	70.12	-1.36
39.5	78.35	25.15	15.81	69.01	70.12	-1.11
40	78.46	25.17	15.85	69.14	70.12	**-0.98**
41	78.68	25.19	15.85	69.34	70.12	-0.78

4.1.1.1 RF Power Output Results

Power output measurements verified the expected performance of 54 dBm EIRP per polarization. The maximum measured level was 57.69 dBm. This level is well within the maximum Part 30.202a limit of 75 dBm EIRP. Measurements were performed for each polarization

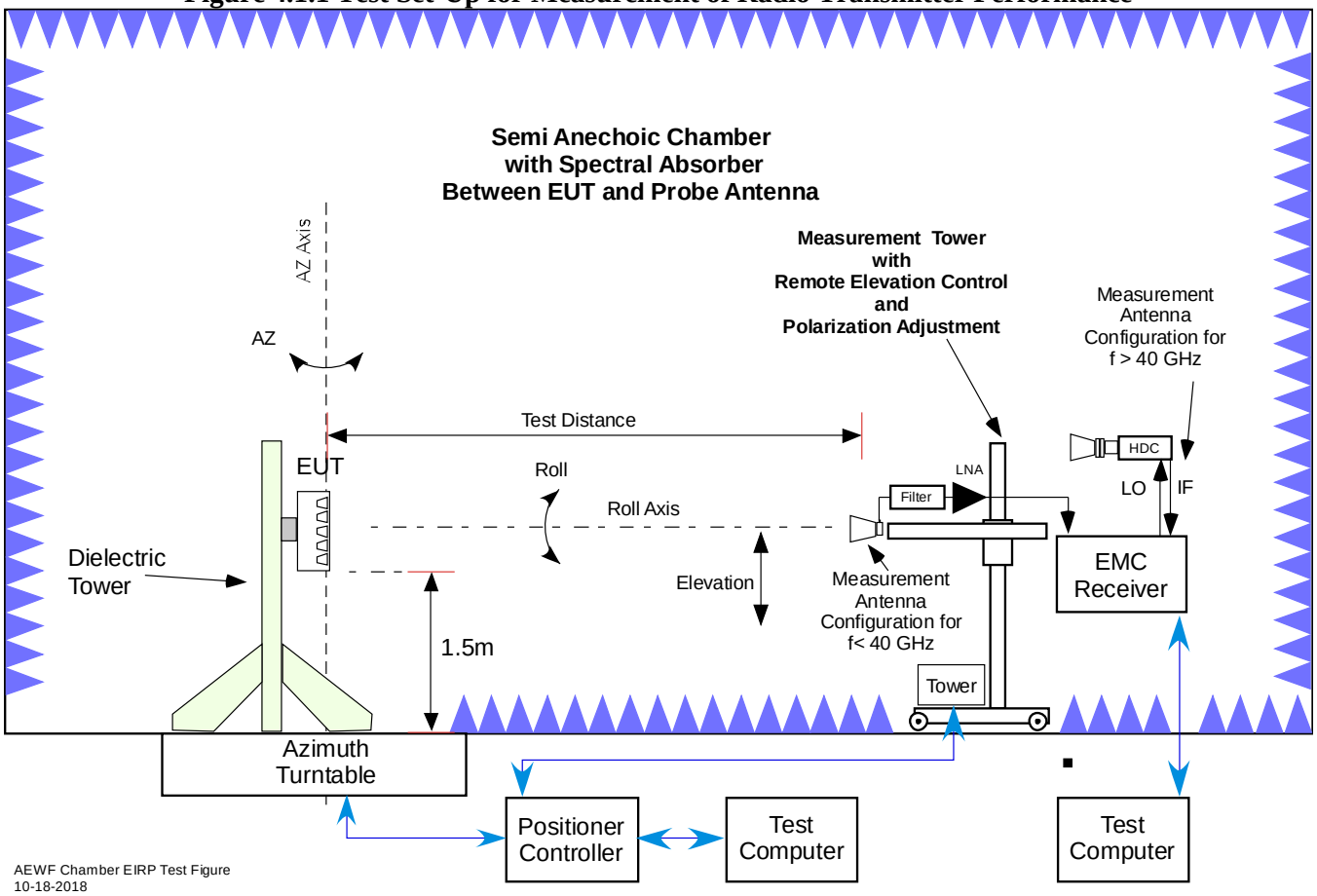
Table 4.1.1.1 RF Power Output Results

Frequency, GHz	Polarization	Raw Channel Power Measurement EIRP dBm	Correction, dB	Channel Power, EIRP dBm
37.05000	Horizontal	56.47	-2.18	54.29
38.50002	Horizontal	56.16	-1.65	54.51
39.94998	Horizontal	53.97	-0.98	52.99
37.05000	Vertical	57.69	-2.18	55.51
38.50002	Vertical	57.47	-1.65	55.82
39.94998	Vertical	54.19	-0.98	53.21

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

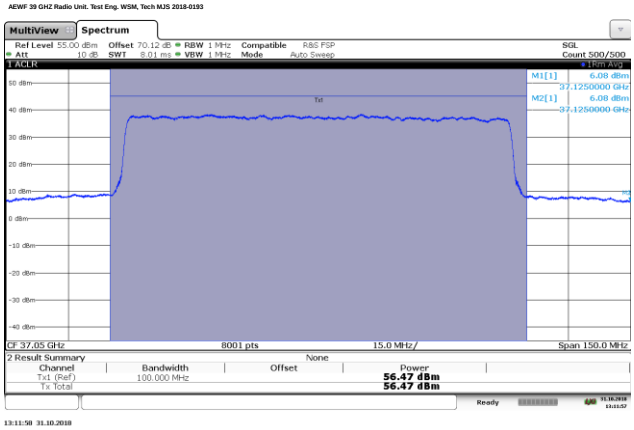
Note (i): We have multiple antennas available for measurement in this frequency range. The offset table was originally prepared for use with one serial number antenna. Measurements were actually performed with a second unit. The nominal 70.12 dB offset was originally supposed to have a $\pm$ 0.32 dB correction but the actual antenna required a -2.18 dB to -0.98 dB correction to the 70.12 dB offset over the 37-40 GHz frequency range. The tables above corrects that oversight.

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

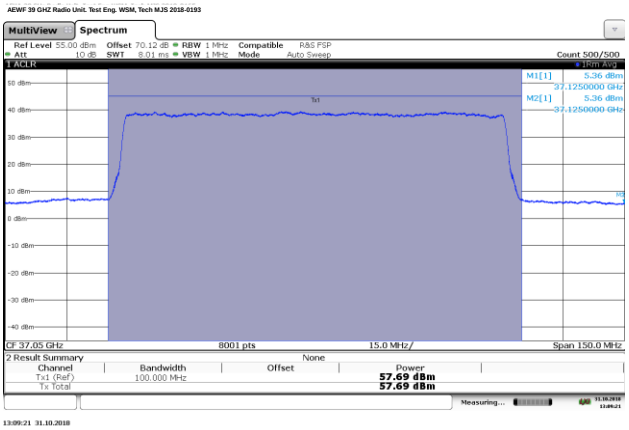


5m Channel Power Measurements.

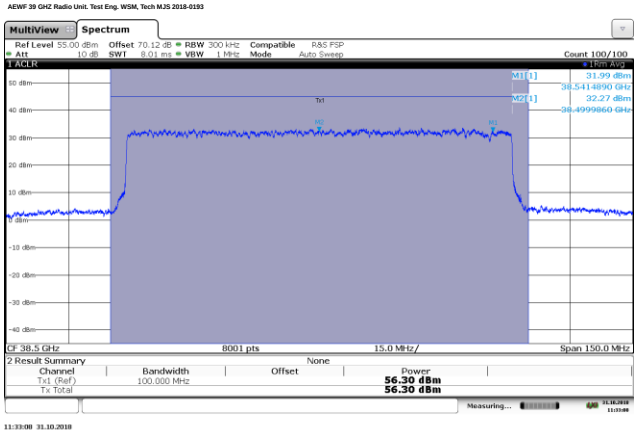
37.0500 GHz Horizontal



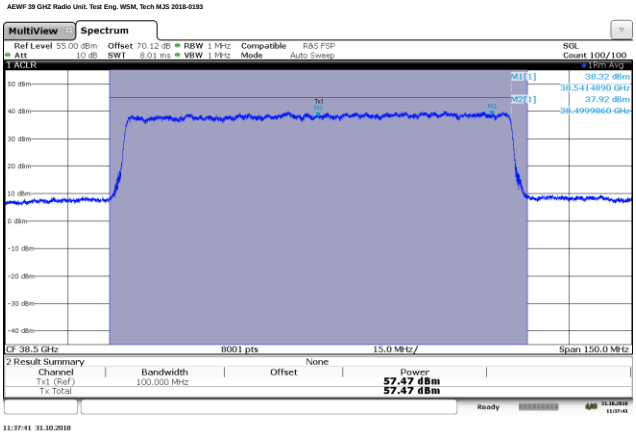
37.0500 GHz Vertical



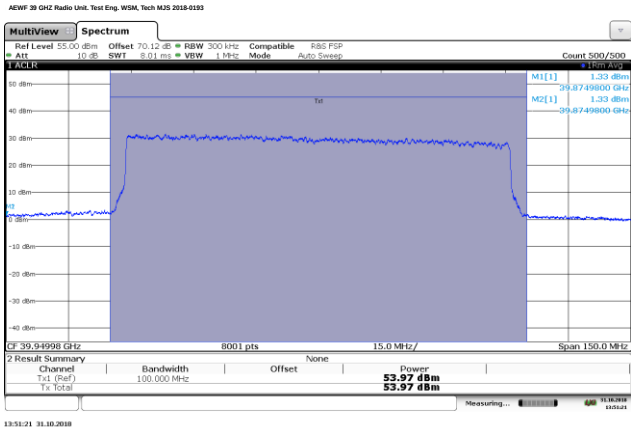
38.50002 GHz Horizontal



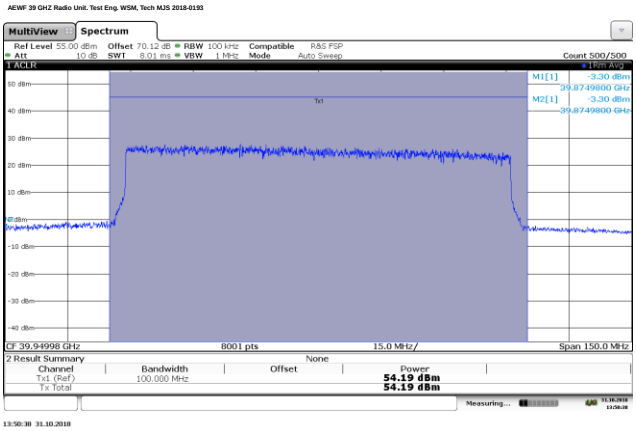
38.50002 GHz Vertical



39.9499 Horizontal



39.9499 GHz Vertical



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4.2 Section 2.1047 MEASUREMENT REQUIRED: MODULATION CHARACTERISTICS

The **VBNAEWF-01** 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 Release 16 is expected Q4 of 2018. This present evolutionary nature of 5G-NR prevents all of the nominal EVM measurements from being performed at this time. However, constellations were recorded to assess that the subcarrier configurations were achieved.

There are no FCC Limits for Modulation and all of the formats above look spectrally the same from a channel edge and regrowth standpoint. It is expected that greater fidelity will be available after test equipment is configurable with the final format of Release 16. A Class II change is planned for this unit for Multi-carrier operation and Release 16 should be testable at that time.

4.2.1 Modulation Characteristics Measurement

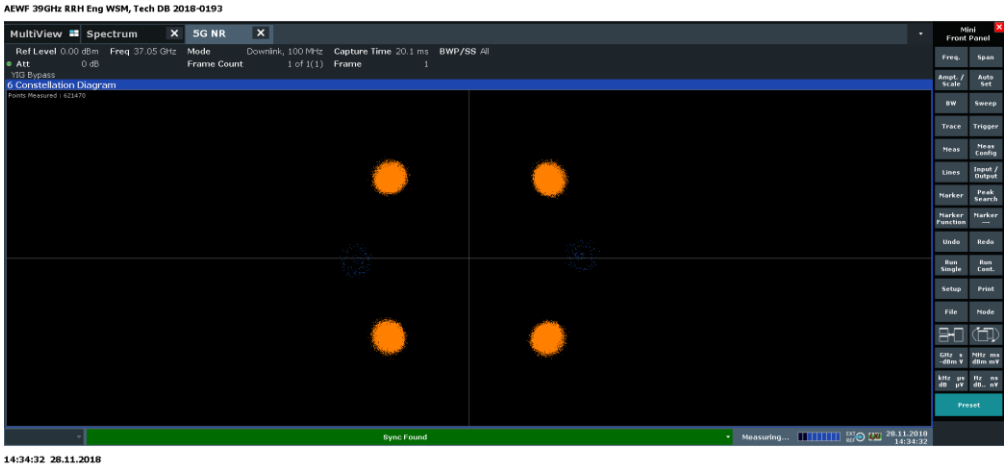
The measurements were performed at a distance of 4.5 m from the unit utilizing the test configuration in Figure 4.4.1 utilizing a Rohde & Schwartz FSW 67 GHz spectrum analyzer with the 3GPP 5G-NR DL Measurement software option. Representative screen plots of the modulation measurement are attached below for all three of the subcarrier configurations and sample polarizations. Data was collected at left, center and right side of the 37-40 GHz frequency band..

4.2.2 Modulation Measurements Results:

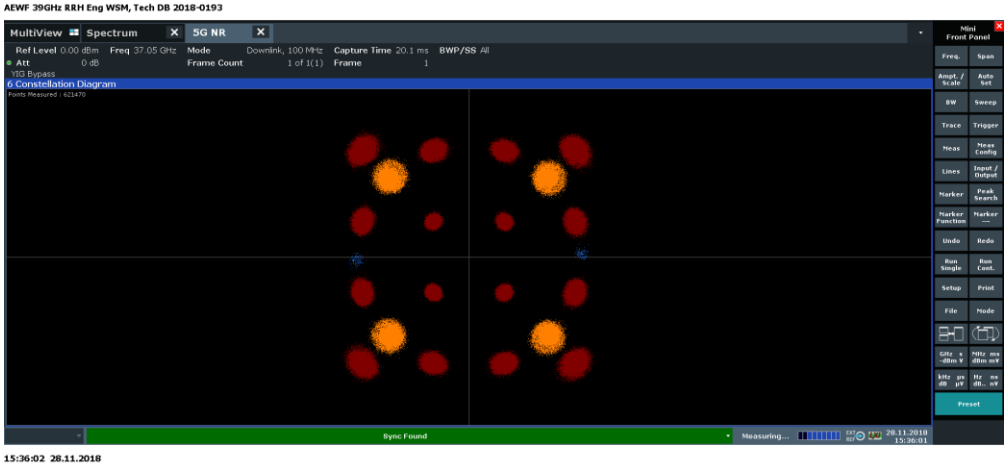
The typical measured modulation characteristics of the EUT are shown below:

Figure 4.2 Modulation Results

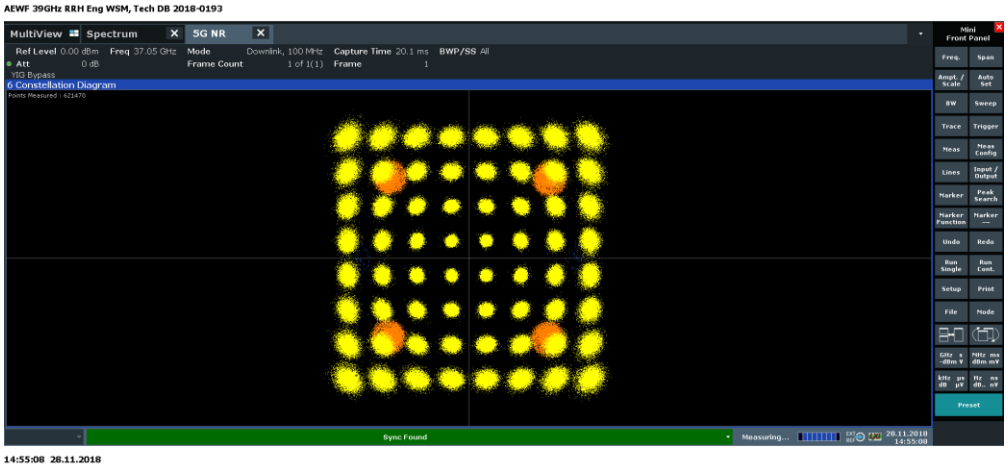
QPSK 37.05 GHz Vertical Polarization



16QAM 37.05 GHz Vertical Polarization

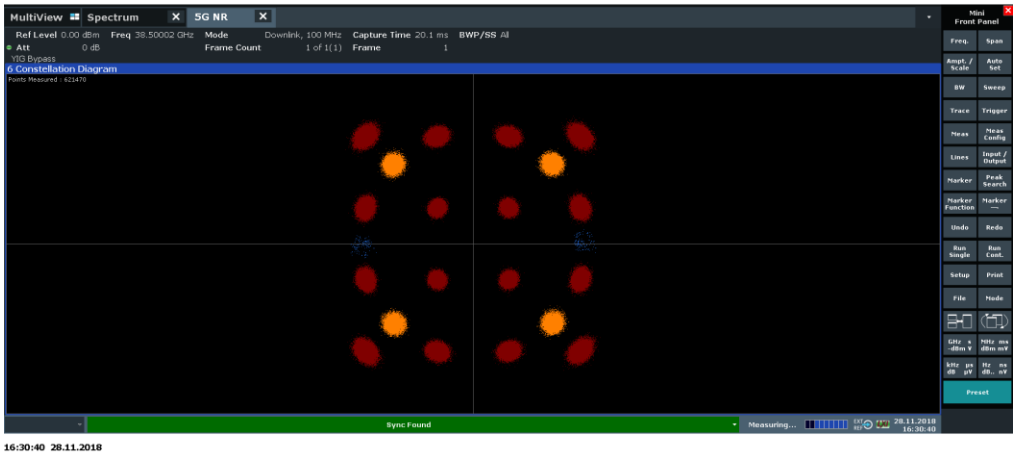


64QAM 37.05 GHz Vertical Polarization

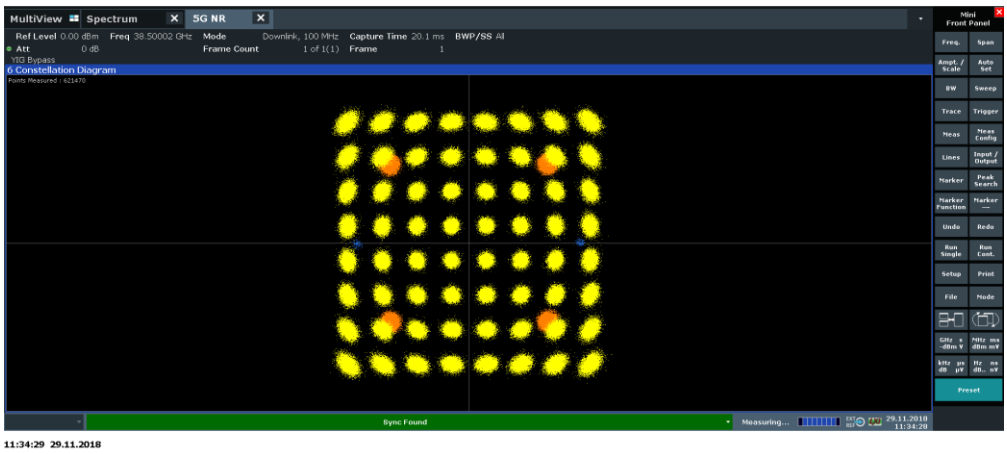


QPSK 38.50002 GHz Horizontal Polarization

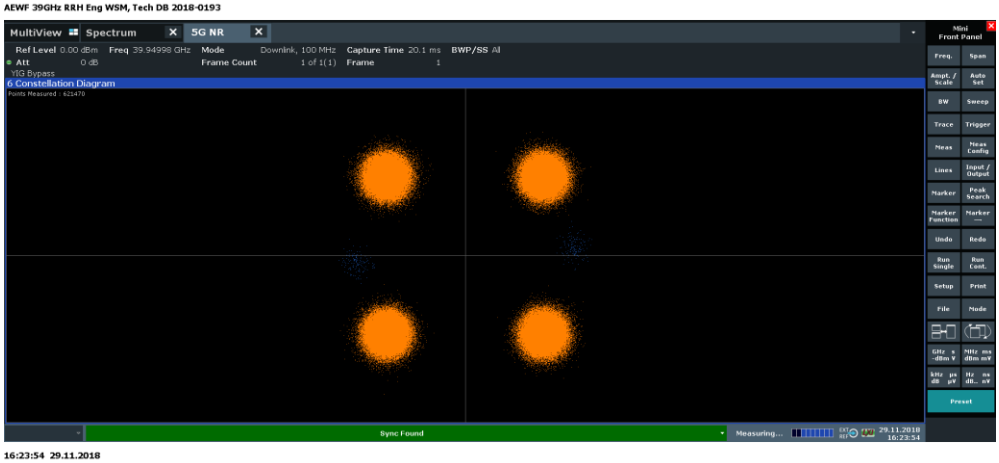
16QAM 38.50002 GHz Horizontal Polarization



64QAM 38.50002 GHz Horizontal Polarization

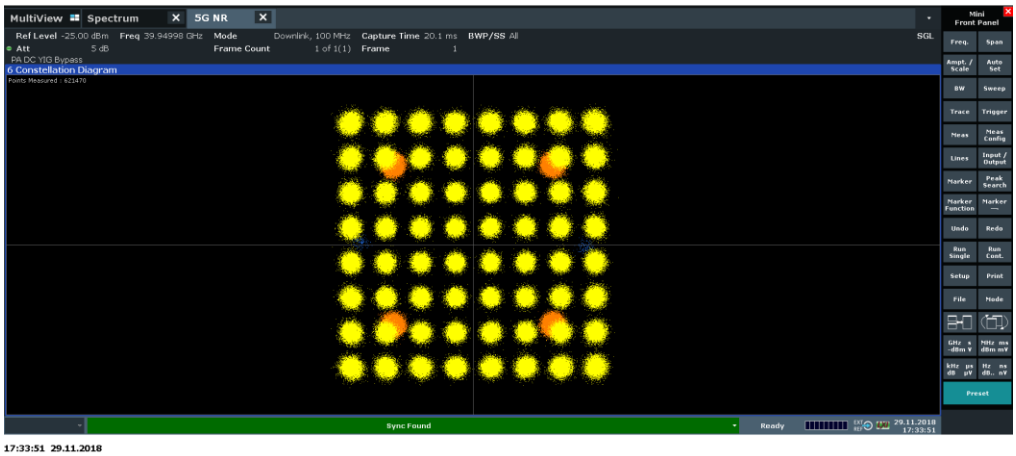


QPSK 39.94998 GHz Vertical Polarization



16QAM 39.94998 GHz Vertical Polarization

64QAM 39.94998 GHz Vertical 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).

For this test the occupied bandwidth (OBW) is defined 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.

Per KDB 971168 D01 v03, 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 per Subclause 5.4.4 of ANSI C63.26-2015 and when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment is operated.

The requirements defined in Subclause 5.4.4 of ANSI C63.26-2015 were developed for conducted measurements. However all of the measurements performed herein were performed as radiated measurements. The use of max hold and a peak detector were not used as the internal noise reduction functionality was required to make the measurement. A 500 sweep average using an average detector process was used with resolution bandwidths of 1, 3 & 5 MHz.

4.3.1 Results Occupied Bandwidth (Signal Bandwidth)

The measurements of 99% occupied bandwidth were performed with a Rohde & Schwartz FSW 67 GHz spectrum analyzer. The measurements of the intended 100 MHz 5G-NR carrier indicated compliance for the 100M0G7D emission designator. The results are presented below and shows that the measured signals are within the parameters of the 100M0G7D emissions designator.

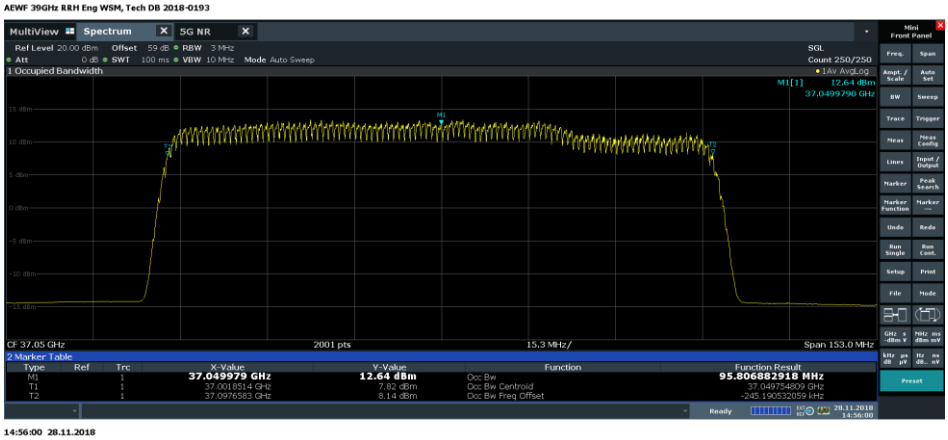
Table 4.3.1 Occupied Bandwidth Results

Frequency, GHz	Resolution Bandwidth, MHz	Modulation	Occupied Bandwidth, MHz
37.05	3	QPSK	95.9
37.05	3	16QAM	95.9
37.05	3	64QAM	95.9
38.5	5	QPSK	97.3
38.5	3	QPSK	95.3
38.5	1	16QAM	95.1
38.5	3	64QAM	95.2
39.94998	3	QPSK	99
39.94998	5	QPSK	**99.8**
39.94998	3	16QAM	96.3
39.94998	3	64QAM	96.9

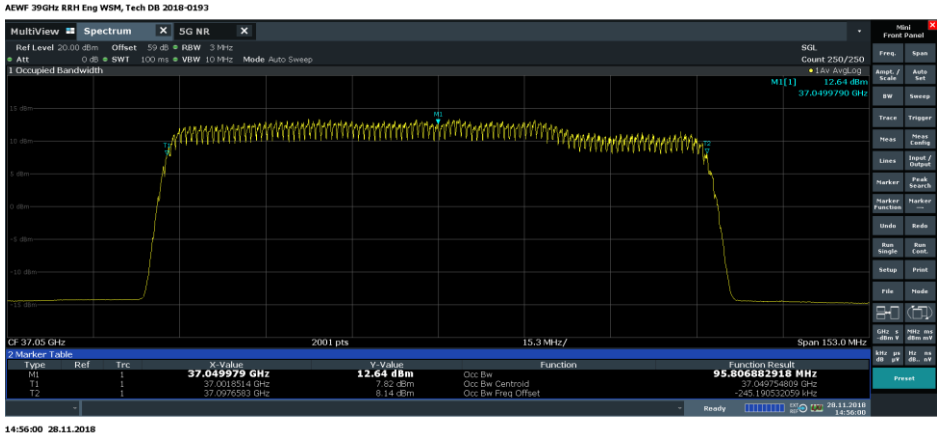
Figure 4.3.1- Occupied Bandwidth - Typical Signal Bandwidth

99% Signal Bandwidth 100 MHz 37.05 GHz QPSK

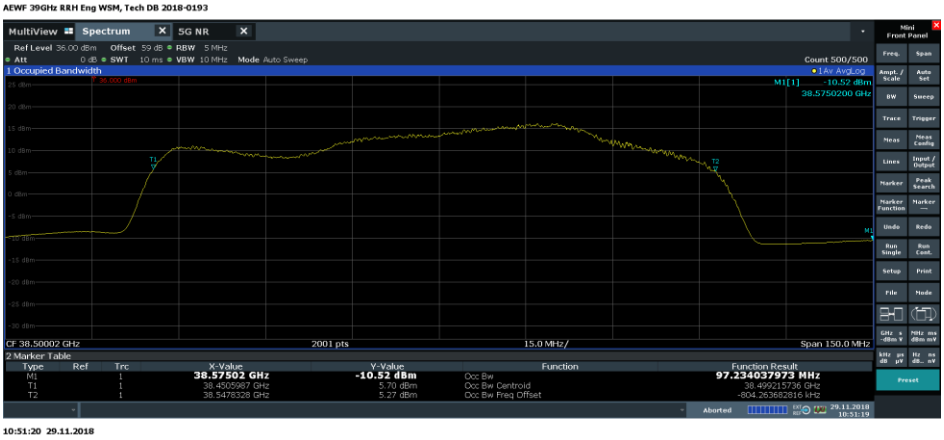
99% Signal Bandwidth 100 MHz 37.05 GHz 16QAM



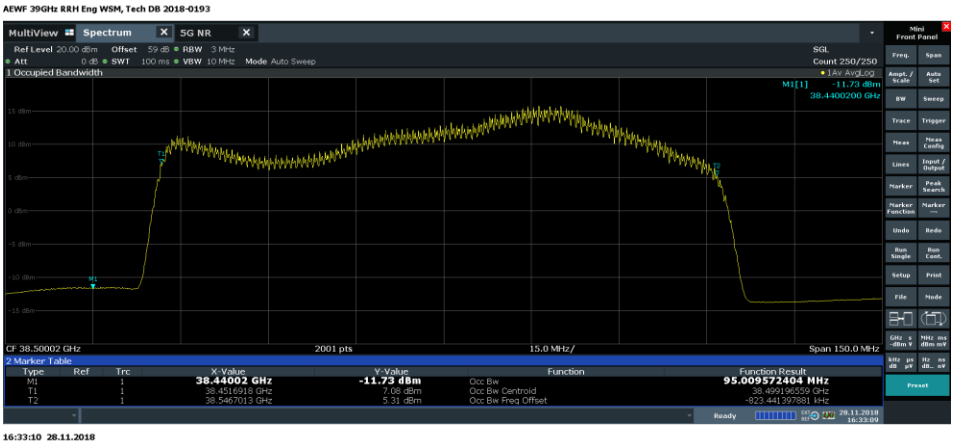
99% Signal Bandwidth 100 MHz 37.05 GHz 64QAM



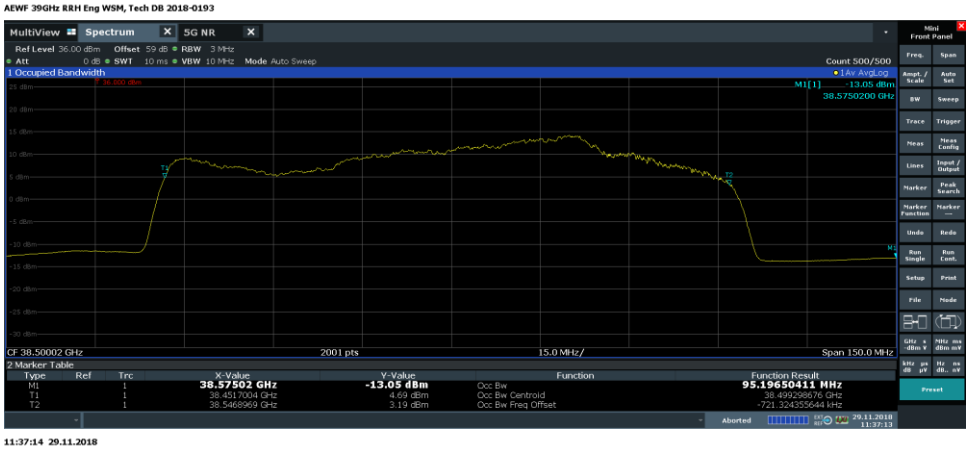
99% Signal Bandwidth 100 MHz 38.50002 GHz QPSK



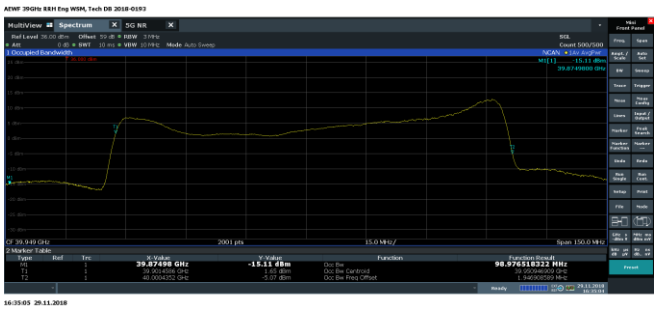
99% Signal Bandwidth 100 MHz 38.50002 GHz 16QAM

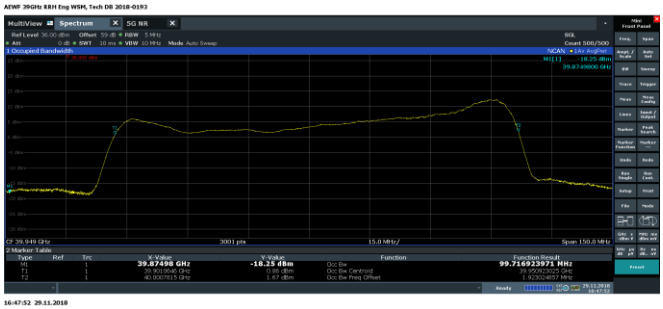


99% Signal Bandwidth 100 MHz 38.50002 GHz 64QAM

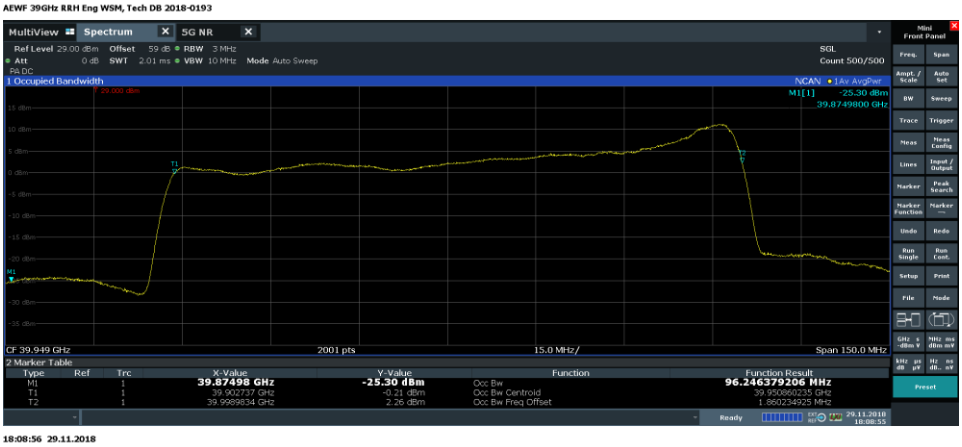


99% Signal Bandwidth 100 MHz 39.94998 GHz QPSK

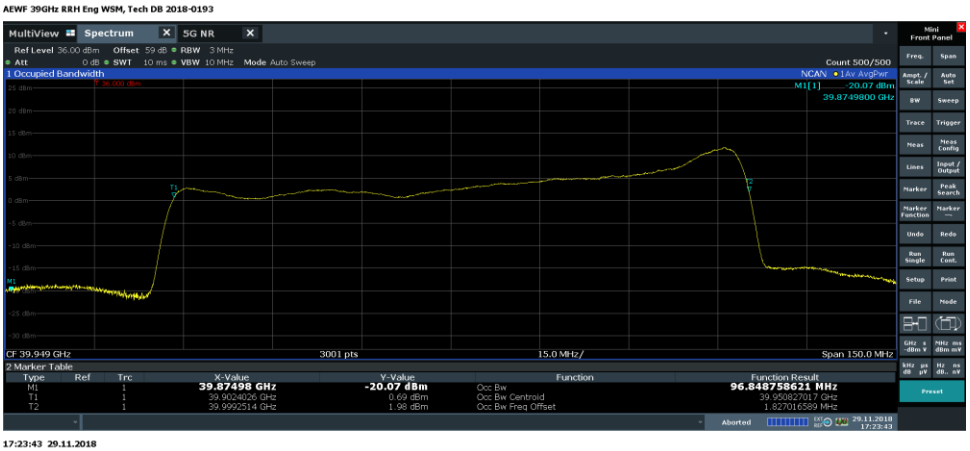




99% Signal Bandwidth 100 MHz 39.94998 GHz 16QAM



99% Signal Bandwidth 100 MHz 39.94998 GHz 64QAM



4.3.2 Occupied Bandwidth-Edge of Band Emissions

Classical Occupied Bandwidth – Edge of Block Emissions is an evaluation of the transmit carrier compliance with edge of band requirements and characterizes Out-Of-Band Emissions (OOBE). This measurement documents the product's ability to maintain compliance with FCC Parts 2 and Part 30.203 limitations on emissions outside the band of operation. There are no internal blocks divisions.

The **VBNAEWF-01** 39 GHz Radio Unit presently supports a single 5G-New Radio LTE TDD technology carrier. This evaluation addresses 2x2 MIMO operation with 100 MHz carriers. In each test configuration the carriers were configured at the left side and right side of the Part 30 band as appropriate. All power measurements were performed prior to other measurements. Power was set to the total per polarization maximum. The measurements are described below.

The occupied bandwidth of each of the signals identified in Table 4.3.6.1 was measured using a Rohde & Schwarz FSW Spectrum analyzer, a remote PC based instrumentation controller and the same calibrated RF attenuation path used for channel 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 m for both vertical and horizontal polarizations.

Plots are provided using the triggered functionality of the test analyzer and demonstrate compliance with edge of band limits. These sheets contain data for single carrier configurations for "Left Edge of Block", and "Right Edge of Block" across the Part 30 Upper Microwave Flexible Use Service spectrum.

4.3.3 Requirements 39 GHz Emissions Limits

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

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

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

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

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

In order to address the limit as imposed for the requirement in 47CFR 30.203 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 with multiple sweep averaging for all 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
35.00	-13
36.00	-13
36.99	-13
36.99	-5
37.00	-5
37.00	57
40.00	57
40.00	-5
40.01	-5
40.01	-13
41.00	-13
42.00	-13

4.3.6 Measurement Path Adjustments

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

Sample calculation: The sample calculation below is the formula and the correction for 37 GHz; Adjustment = Free Space Path Loss - Measurement Antenna Gain + Cable Loss - Product Antenna Gain.

Total Required Adjustment (@37 GHz) = 40.50 dB = 77.79 dB -23.25dBi + 15.11dB - 29.15 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 5m including the AEWF product gain. The measurements were made using a flat offset of 40.49 dB and 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"	Cable Loss, "L"	PL-G+L	AEWF Antenna Gain, IEEE	Total Required Adjustment	FSW Offset	Transducer Correction Factor
GHz	dB	dBi	dB	dB	dBi	dB	dB	dB
35.0	77.30	23.25	15.11	69.16	28.70	40.46	40.49	-0.03
36.0	77.55	23.25	15.11	69.41	28.93	40.48	40.49	-0.01
37.0	77.79	23.25	15.11	69.65	29.15	40.5	40.49	0.01
37.5	77.90	23.40	15.24	69.74	29.26	40.48	40.49	-0.01
38.0	78.02	23.45	15.37	69.94	29.38	40.56	40.49	0.07
38.5	78.13	23.60	15.49	70.02	29.49	40.53	40.49	0.04
39.0	78.24	23.60	15.67	70.31	29.60	40.71	40.49	0.22
39.5	78.35	23.60	15.81	70.56	29.70	40.86	40.49	0.37
40.0	78.46	23.70	15.85	70.61	29.80	40.81	40.49	0.32
41.0	78.68	23.70	15.85	70.83	30.00	40.83	40.49	0.34

4.3.6.1 AEWF Antenna Gain Correction Adjustments

The out of band offsets identified in 4.3.6.1 used the IEEE gain of the AEWF product. FCC KDB publication 662911 provides a method to over-estimate the directional gain of an antenna system in

order to derive radiated power from measured transmit (conducted) power. The result would be an over estimated radiated power. Conversely, deriving conducted power from measured radiated power, by subtracting IEEE gain from radiated power will yield the best case calculation of conducted power. The below table documents the difference between the IEEE Gain and realized gain of the AEWF product. The difference is the required minimum margin to determine compliance from the measurement plots.

Table 4.3.6.1 Comparison of IEEE and Realized Antenna Gain

Frequency	AEWF Antenna Gain, Realized	AEWF Antenna Gain, IEEE	Realized vs IEEE Gain
GHz	dBi	dBi	dB
36.0	27.80	28.93	1.13
37.0	28.80	29.15	0.35
37.5	29.10	29.26	0.16
38.0	29.30	29.38	0.08
38.5	29.40	29.49	0.09
39.0	29.50	29.60	0.10
39.5	29.40	29.70	0.30
40.0	29.35	29.80	0.45
41.0	29.00	30.00	1.00

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 4.5m. The measurements were performed with an FSW spectrum analyzer in compliance with the procedure and requirements of ANSI C63.26. The test set-up diagram in Figure 4.1.1 was used. Testing was performed for the 100 MHz carrier configurations at the left side, and right side of the Part 30 Band. All of the Edge of Band measurements were performed at the specified 1 MHz resolution bandwidths. The worst case performance was measured while operating with 5GNR 64QAM modulation. Adjustment factors were as described in Section 4.3.6 above.

4.3.7.1 Results - Occupied Bandwidth-Edge of Block Emissions

The occupied bandwidth plots for operation at the left side, center and the right side of the band for the 100 MHz signal bandwidth are below. The mask accurately depicts the limits for the Part 30 NAR Band to determine compliance with FCC requirements. From the out-of-band emissions plots attached below, it can be seen that all the emissions are under the required emission masks. The mask limits include the appropriate considerations for operation.

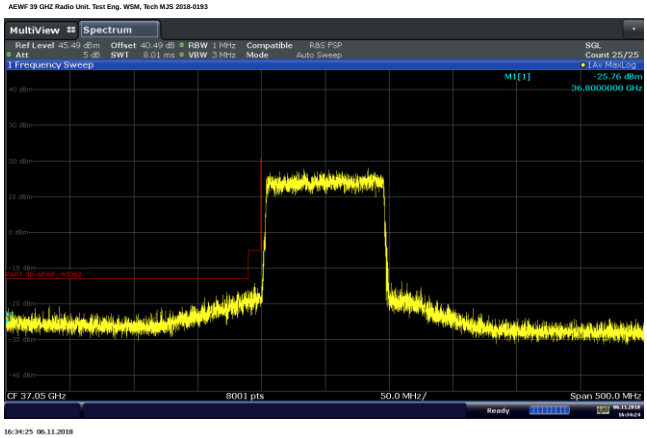
The measurement results of the occupied bandwidth and the out-of-band emissions as documented in the plots and Table 4.3.7.1 demonstrate the full compliance with the Rules of the Commission for the operating band.

Table 4.3.7.1 Results - Occupied Bandwidth-Edge of Block Emissions

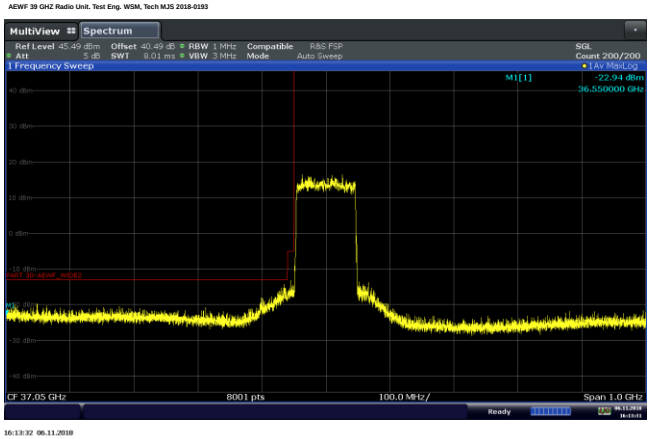
Frequency, GHz	Location	Polarization	OOBE Compliance
37.05000	Left Side of Band	Horizontal	Compliant
39.94998	Right Side of Band	Horizontal	Compliant
37.05000	Left Side of Band	Vertical	Compliant
39.94998	Right Side of Band	Vertical	Compliant

Figure 4.3.5 - Occupied Bandwidth - OOBE/EoB Band Charts E

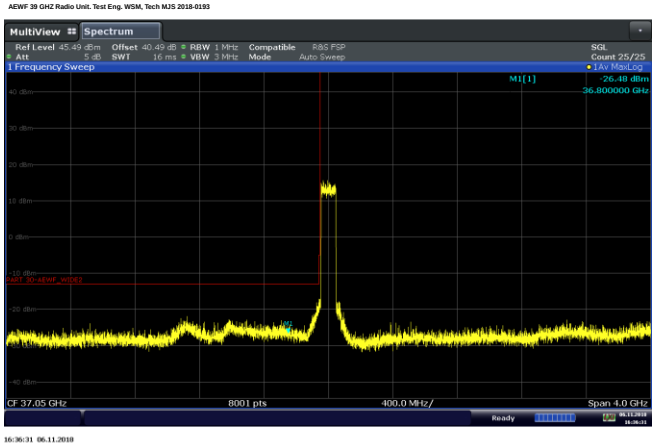
OOBE/EoB – V - 64QAM - 37.05GHz.



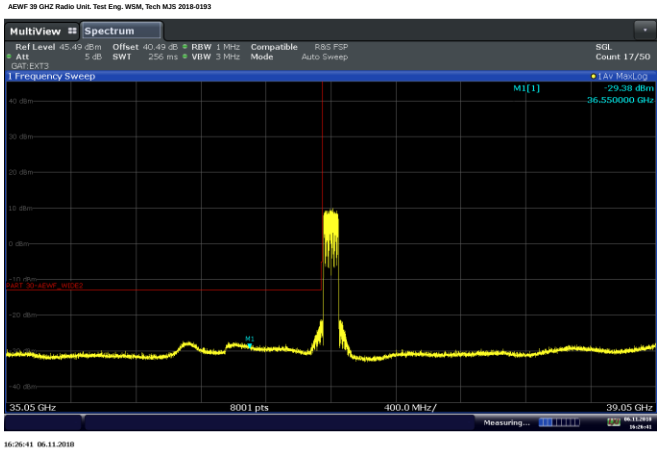
OOBE/EoB – H - 64QAM - 37.05GHz



OOBE/EoB – V - 64QAM - 37.05GHz.

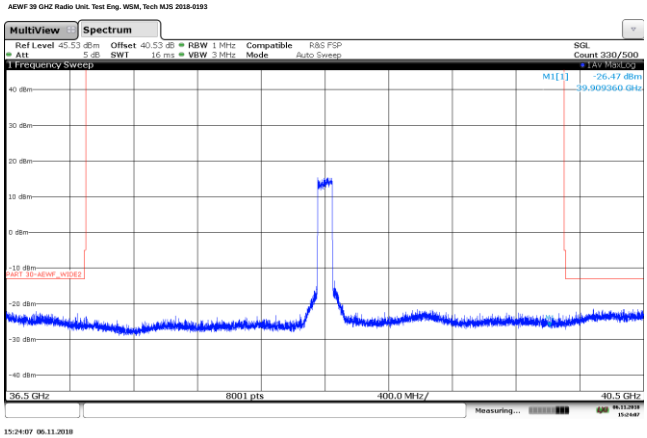


OOBE/EoB – H - 64QAM - 37.05GHz

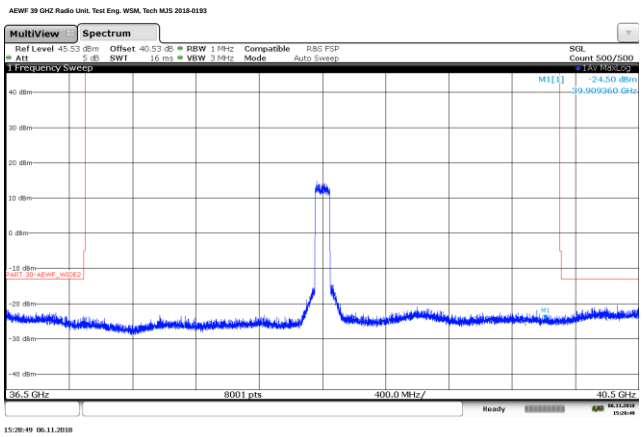


35.05 GHz to 39.05 GHz

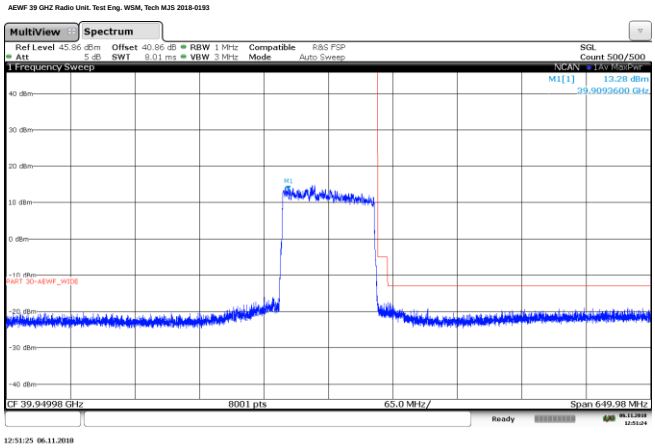
OOBE/EoB – V - 64QAM - 38.50002 GHz.



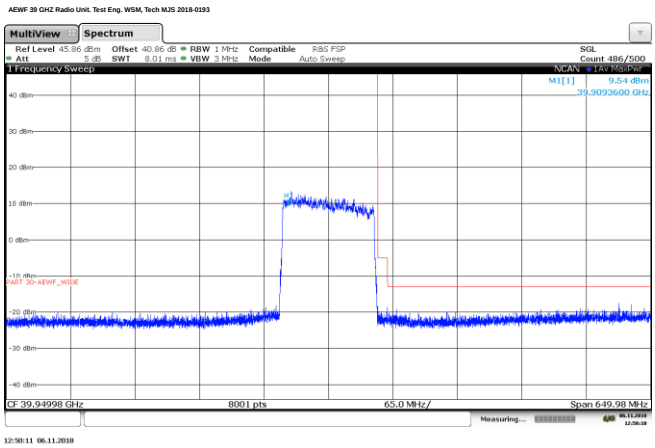
OOBE/EoB – H - 64QAM - 38.50002 GHz



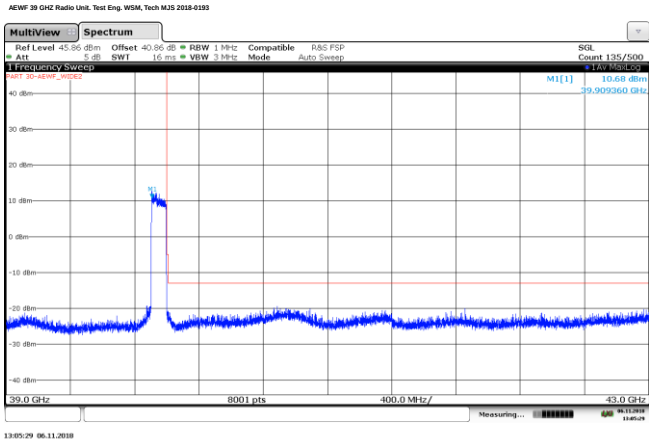
OOBE/EoB – V - 64QAM – 39.94998 GHz.



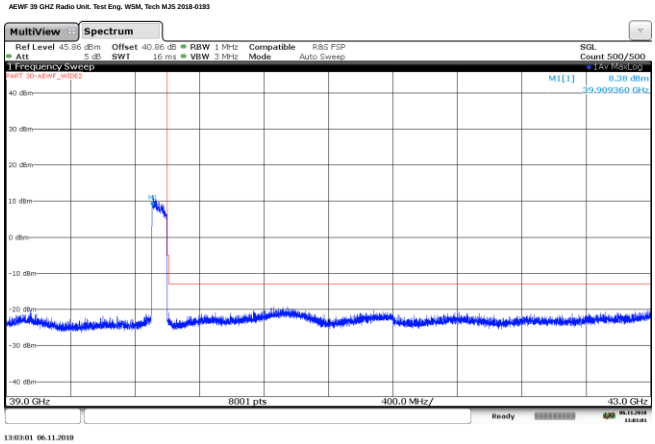
OOBE/EoB – H - 64QAM - 39.94998 GHz



OOBE/EoB – V - 64QAM – 39.94998 GHz.



OOBE/EoB – H - 64QAM - 39.94998 GHz



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

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

4.4.1 Section 2.1051 Spurious Emissions at Antenna Terminals

Spurious Emissions were investigated per 47CFR Section 2.1057(a)(1) over the frequency range of 30 MHz to 200 GHz as specified in 2.1057(a)(3).

2.1057(a)(3) If the equipment operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower.

The 5G NR 64QAM modulation is the highest data rate configuration for the product at this time. Preliminary tests also identified operation using 5G NR 64QAM modulation as both the highest power and the highest spurious emissions configuration. These form our basis as technical rational using this configuration as specified in 5.1.2.2 of ANSI C63.26.

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.

For a 100 MHz carrier, the limit for the 1st 10 MHz outside the band is -5 dBm MHz and -13 dBm/MHz for all emissions beyond the 1st 10 MHz. As this was a radiated EIRP measurement no MIMO adjustment was used.

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 4.3.7.1, document the 35 - 37 GHz and 40 - 43 GHz ranges. Those measurements are appropriate as the products antenna gain is documented over the same ranges. There were no emissions detected in these ranges.

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

The measurements were performed in compliance with ANSI C63.26, 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 ESIB-40 spectrum analyzer measurements examine the 30 MHz to 40 GHz range. The FSW based mmWave transmitter test system overlaps the transmit band for 37-40 GHz and extends the frequency range to examine the 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 a FCC registered ten meter semi-anechoic chamber AR-8, (FCC Registration Number: 395774) **NVLAP** Lab Code: 100275-0 and IC (Filing Number: 6933F-8) which is maintained by Nokia Bell Labs in Murray Hill, New Jersey. The **VBNAEWF-01** (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 product 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 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 to transmit two 54 dBm EIRP 100 MHz bandwidth 5G-NR carriers, one Vertical and one Horizontal polarization, with the total transmit power of 57 dBm EIRP. The worst case performance was measured while operating with 5GNR 64QAM modulation. This configuration provides the highest power spectral density transmit signal and highest data rate for the product. The product utilizing the configurations below was evaluated over the 30 MHz to 200 GHz frequency range as required.

Table 4.5.1 EUT Configurations

Test Configuration NRARFCN	AEWF Tx Reference Frequencies GHz	Transmit Active Polarization	Signal Bandwidth, MHz	Modulation	Total Power, dBm EIRP	Radiated Emissions Pass / Fail
2229999 2254166 2278332	37.05000 38.50002 39.94998	H & V	100	QPSK & 64QAM	57	Pass

4.5.1 Spurious Radiation and Radiated Emissions Requirements Below 40 GHz.

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

-43+10LogP=-13 dBm.

The emissions at the Edge of Band were adjusted by the 29 dBi gain of the transmit antenna as the product is designed to operate globally over the 37 to 40 GHz frequency band. 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 and clause 5.5 of ANSI C63.26. For this case the evaluation of acceptable radiated field strength is as follows.

The calculated emission levels were found by:

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

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

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

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

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

The field strength of radiated spurious emissions measured was determined by

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

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 - 200 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 23 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	5
E	60-90	6
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 $\pm$ 7 degrees off center. All of the emissions and harmonics were found to be centered on the beam as well.

Based upon previous experience a continuous max hold (average detector) sweep of the product in elevation and azimuth was employed for full coverage scanning of the product. For these measurements in each band the scan was started at the beam peak location of 345 degrees azimuth, and nominal elevations 171-179 cm for Vertical and 154-158 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 345 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 all four bands were performed this way.

4.5.2.1 Bandwidth Limits and Corrections: Radiated Measurements 40 GHz - 200 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 $\geq$ 2(Span/RBW).
Our FSW was limited to 8001 data points across the screen. (software update will increase this in the future). Multiple spans were therefore used to evaluate the peak spurious emissions detected. The assessment of out of beam spurious was performed with a 10 MHz RBW.

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, and the measurement antenna gain was applied as a fixed offset + a transducer factor. There was no adjustment applied for the product antenna gain as these measurements are outside the transmit frequency range.

Emissions Correction = Path Loss - Antenna Gain

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

Table 4.5.2.4 details the corrections for the three bands.

Table 4.5.2.4a Radiated Emissions Corrections for 40-60 GHz at 5m .

Frequency	λ	Measurement Distance, d	Path Loss	Rx Antenna Gain	Total	Offset	Transducer Factor
GHz	m	m	dB	dB	dB	dB	dB
40.0	0.007500	5	78.46	21.80	56.66	57.45	-0.79
42.5	0.007059	5	78.99	22.20	56.79	57.45	-0.66
45.0	0.006667	5	79.49	22.50	56.99	57.45	-0.46
47.5	0.006316	5	79.96	22.70	57.26	57.45	-0.19
50.0	0.006000	5	80.40	23.00	57.40	57.45	-0.05
52.5	0.005714	5	80.82	23.30	57.52	57.45	0.07
55.0	0.005455	5	81.23	23.40	57.83	57.45	0.38
57.5	0.005217	5	81.61	23.60	58.01	57.45	0.56
60.0	0.005000	5	81.98	23.70	58.28	57.45	0.83

Table 4.5.2.4b Radiated Emissions Corrections for 60-90 GHz at 3m.

Frequency	λ	Measurement Distance, d	Path Loss	Rx Antenna Gain	Total	Offset	Transducer Factor
GHz	m	m	dB	dB	dB	dB	dB
60.0	0.005000	6	83.57	21.80	61.77	62.50	-0.73
65.0	0.004615	6	84.26	22.30	61.96	62.50	-0.54
70.0	0.004286	6	84.91	22.70	62.21	62.50	-0.29
75.0	0.004000	6	85.51	23.00	62.51	62.50	0.01
80.0	0.003750	6	86.07	23.40	62.67	62.50	0.17
85.0	0.003529	6	86.59	23.60	62.99	62.50	0.49
90.0	0.003333	6	87.09	23.80	63.29	62.50	0.79

Table 4.5.2.4c Radiated Emissions Corrections for 90-140GHz at 3m.

Frequency	λ	Measurement Distance, d	Path Loss	Rx Antenna Gain	Total	Offset	Transducer Factor
GHz	m	m	dB	dB	dB	dB	dB
90.0	0.003333	3	81.07	21.90	59.17	59.79	-0.62
95.0	0.003158	3	81.54	22.20	59.34	59.79	-0.45
100.0	0.003000	3	81.98	22.60	59.38	59.79	-0.41
105.0	0.002857	3	82.41	23.00	59.41	59.79	-0.38
110.0	0.002727	3	82.81	23.30	59.51	59.79	-0.28
115.0	0.002609	3	83.20	23.63	59.57	59.79	-0.22
120.0	0.002500	3	83.57	23.83	59.74	59.79	-0.05
125.0	0.002400	3	83.92	24.00	59.92	59.79	0.13
130.0	0.002308	3	84.26	24.20	60.06	59.79	0.27
135.0	0.002222	3	84.59	24.40	60.19	59.79	0.40
140.0	0.002143	3	84.91	24.50	60.41	59.79	0.62

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	Tranducer Factor
GHz	m	m	dB	dB	dB	dB	dB
140.0	0.002143	3	84.91	23.40	61.51	**62.76**	**-1.25**
145.0	0.002069	3	85.21	23.65	61.56	**62.76**	**-1.20**
150.0	0.002000	3	85.51	23.90	61.61	**62.76**	**-1.15**
155.0	0.001935	3	85.79	24.15	61.64	**62.76**	**-1.12**
160.0	0.001875	3	86.07	24.30	61.77	**62.76**	**-0.99**
165.0	0.001818	3	86.33	24.55	61.78	**62.76**	**-0.98**
170.0	0.001765	3	86.59	24.70	61.89	**62.76**	**-0.87**
175.0	0.001714	3	86.84	24.95	61.89	**62.76**	**-0.87**
180.0	0.001667	3	87.09	25.10	61.99	**62.76**	**-0.77**
185.0	0.001622	3	87.33	25.25	62.08	**62.76**	**-0.68**
190.0	0.001579	3	87.56	25.40	62.16	**62.76**	**-0.60**
195.0	0.001538	3	87.78	25.55	62.23	**62.76**	**-0.53**
200.0	0.001500	3	88.00	25.70	62.30	**62.76**	**-0.46**

4.5.3 Field Strength of Spurious Radiation Results:

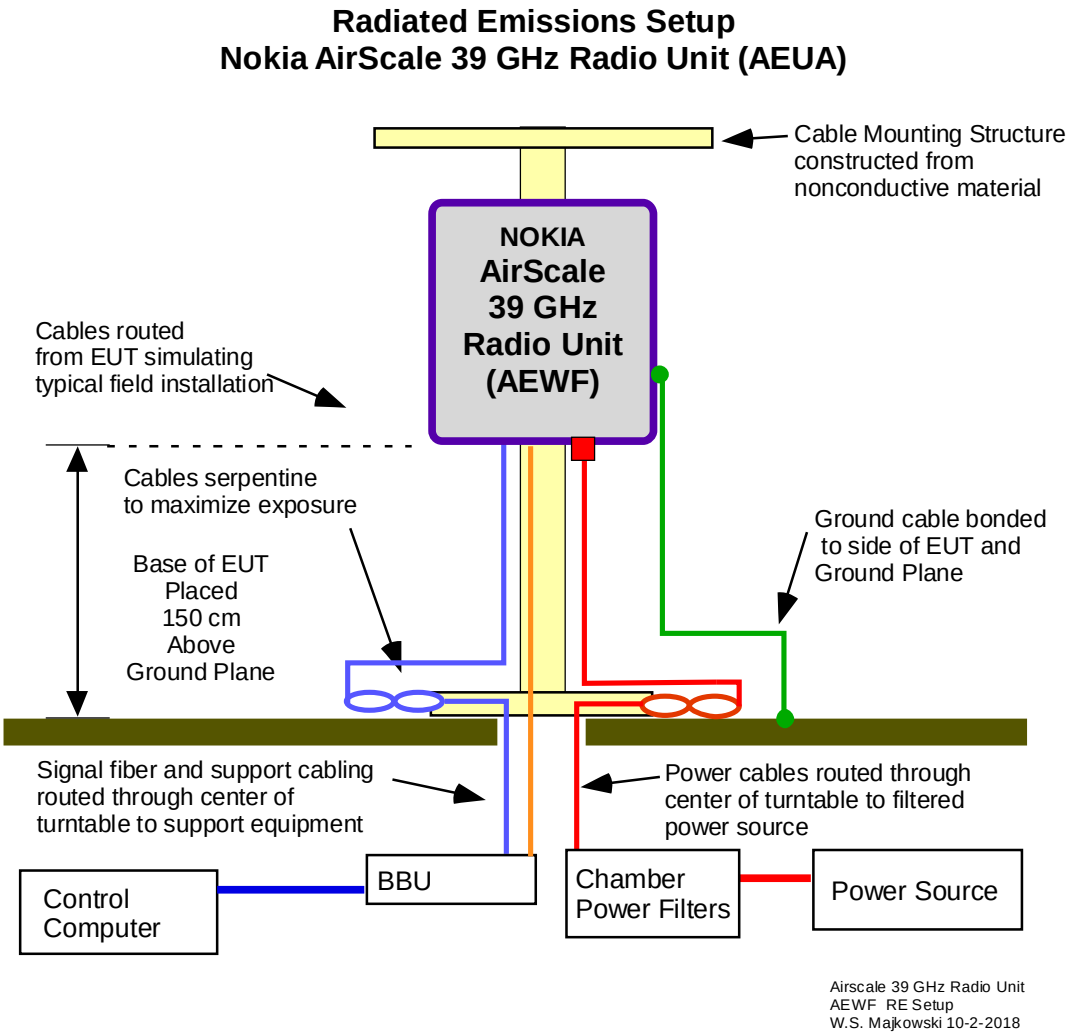
This product meets Part 15B limits below 10 GHz and Part 30 Requirements. For the Title 47CFR section 30.203 and 2.1053 test, the field strength of any spurious radiation, measured at 3m, is required to be less than 82.23 dBμV/meter. Emissions equal to or less than 62.23 dBμV/meter are not reportable.

Presented results include the standard measurements from 30 MHz to 40 GHz followed by the three mmWave bands. The max hold pre-scans were measured with a 10 MHz resolution bandwidth. These show the detectable signals measured across the band with the -13dBm limit *unadjusted* for the measurement bandwidth. These are followed by 4 GHz wide spans with the required 1 MHz resolution bandwidth with markers at the frequencies of interest. The limit in both sets of measurements is the conducted -13 dBm limit as specified in Part 30.203. Corrections to the emissions levels consisted of only the HDC conversion loss, the Free Space Path Loss and the gain of the measurement antenna as detailed in Table 4.5.2.4.

Over the out of band spectrum investigated from 30 MHz to 200 GHz, reportable spurious emissions were detected and determined to be compliant with the Part 30 limit. The minimum margin, measured in the vertical polarization, was 6.29 dB at 90.0155 GHz. Additionally, from 30 MHz to 10 GHz all emissions were a minimum of 5.96 dB below the Part 15 Class B limit of 54.5 dBμV/m. This demonstrates that the **AirScale 39 GHz Radio Unit (AEWF) Band 30, FCC ID: VBNAEWF-01**, 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.

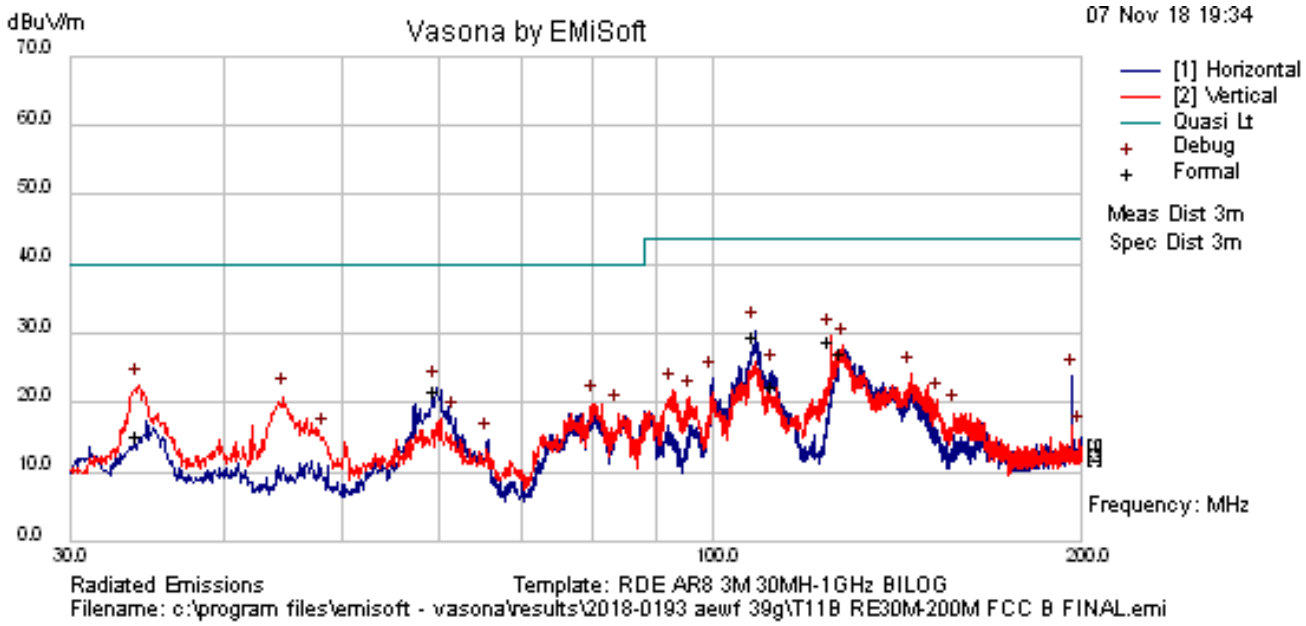
Photographs of the measurement setup are in the filing exhibits.

Figure 4.5 Radiated Emissions Product Setup



4.5.4 Transmitter Measurements of Radiated Spurious Emissions

T11B2 Radiated Emissions 30M-200 MHz FCC Class B DC Powered



Results Title:	RDE AR8 3M 30MH-1GHz BILOG
File Name:	c:\program files\emisoft - vasona\results\2018-0193 aewf 39g\T11B RE30M-200M FCC B FINAL.emi
Test Laboratory:	AR8 MH 24.6 C, 42.% RH 1006mB
Test Engineer:	MJS / WSM
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia Wireless
EUT Details:	AEWA 39G Radio Unit, Transmitting Center Frequency@38.5GHz, power 54.4dBm with 1C. SN-L1183000461 / IP-474870A.X12. HDMI cable disconnected at the EUT.
Configuration:	Powered by -48Vdc, Tested to FCC Class B, RE 30M- 200MHz, @ 3-Meters, ESI- E907, Bicon Antenna E051, Preamp-E494, PCS-LPF-E980. Internal attenuation 10dB, Preview BW (100 kHz RBW/ 300 KHz VBW); Formal default.
Date:	2018-11-07 19:34:07

Formal Data

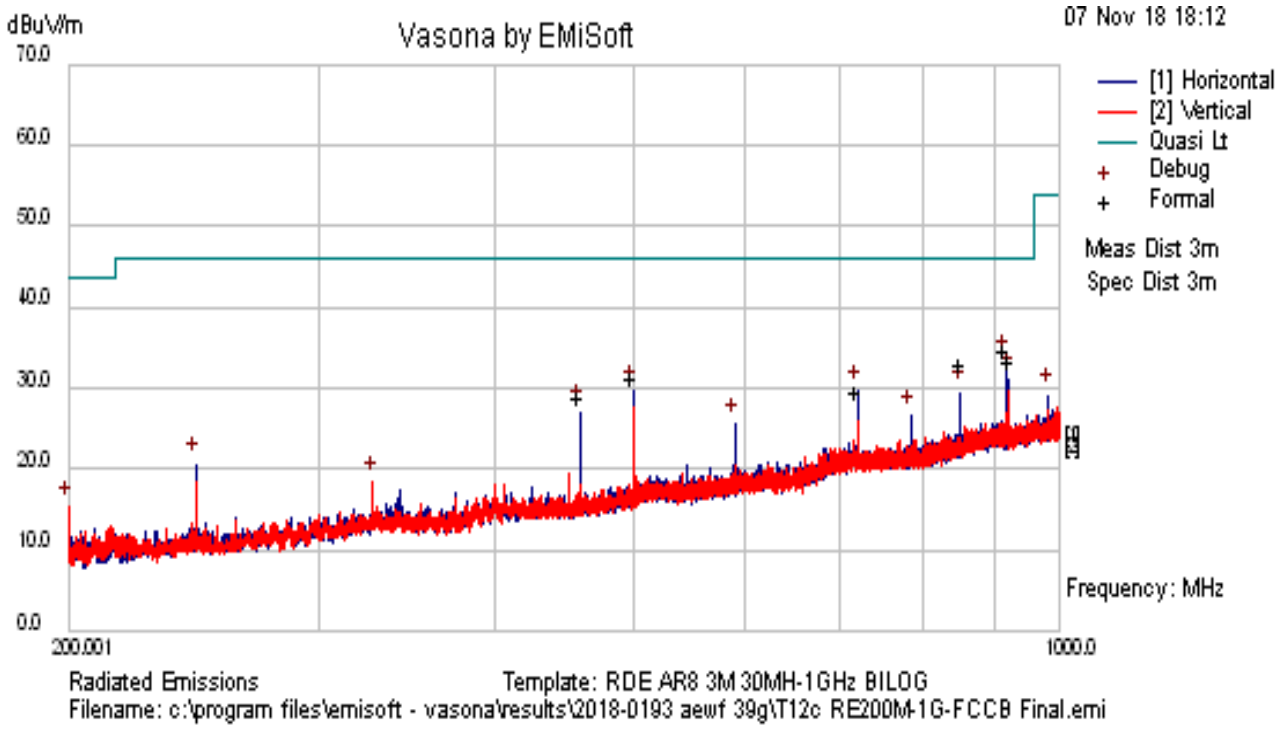
Frequency. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht. cm	Az. Deg.	Limit dBuV/m	Margin dB	Pass /Fail	Comments
108.372	47.52	1.16	-21.9	26.78	Quasi Max	H	135	185	43.5	-16.72	Pass	
125.038	44.87	1.23	-20.1	26	Quasi Max	V	247	310	43.5	-17.5	Pass	
127.844	43	1.24	-19.9	24.31	Quasi Max	V	237	309	43.5	-19.19	Pass	
59.629	40.85	0.87	-22.9	18.82	Quasi Max	H	165	189	40	-21.18	Pass	
112.148	39.94	1.17	-21.4	19.71	Quasi Max	H	161	200	43.5	-23.79	Pass	
34.068	30.75	0.78	-18.9	12.59	Quasi Max	V	203	349	40	-27.41	Pass	

Preview Data

Frequency. 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
108.397	51.19	1.16	-21.9	30.45	Preview	H	100	180	43.5	-13.05	Pass	
125.038	48.49	1.23	-20.1	29.62	Preview	V	200	315	43.5	-13.88	Pass	
127.924	46.8	1.24	-19.9	28.11	Preview	V	200	315	43.5	-15.39	Pass	
34.1363	40.52	0.78	-19	22.35	Preview	V	100	225	40	-17.65	Pass	
59.6273	44.08	0.87	-22.9	22.04	Preview	H	200	180	40	-17.96	Pass	
112.148	44.74	1.17	-21.4	24.51	Preview	H	100	180	43.5	-18.99	Pass	
44.8136	40.75	0.78	-20.6	20.89	Preview	V	100	270	40	-19.11	Pass	
145.142	42.23	1.3	-19.5	24.03	Preview	V	200	270	43.5	-19.47	Pass	
196.665	40.58	1.44	-18.1	23.88	Preview	H	100	0	43.5	-19.62	Pass	
100.028	45.44	1.12	-23	23.55	Preview	H	200	0	43.5	-19.95	Pass	
80.02	43.91	1.01	-25	19.89	Preview	V	100	225	40	-20.11	Pass	
83.9639	42.42	1.03	-25	18.51	Preview	V	100	270	40	-21.49	Pass	
92.7174	44.55	1.08	-24	21.65	Preview	V	100	270	43.5	-21.85	Pass	
61.8397	40.08	0.88	-23.3	17.64	Preview	H	200	180	40	-22.36	Pass	
95.988	43.2	1.1	-23.6	20.73	Preview	V	300	270	43.5	-22.77	Pass	
152.838	38.71	1.32	-19.6	20.47	Preview	V	200	270	43.5	-23.03	Pass	
48.2766	35.53	0.78	-21.3	15.05	Preview	V	200	270	40	-24.95	Pass	
157.647	36.88	1.34	-19.7	18.53	Preview	V	200	135	43.5	-24.97	Pass	
65.6874	37.75	0.91	-24	14.69	Preview	H	200	0	40	-25.31	Pass	
200	32.13	1.45	-18.1	15.5	Preview	H	100	225	43.5	-28	Pass	

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

T12c Radiated Emissions 200MHz-1GHz FCC Class B DC powered



Results Title:	RDE AR8 3M 30MH-1GHz BILOG
File Name:	c:\program files\emisoft - vasona\results\2018-0193 AEWF 39g\T12c RE200M-1G-FCCB Final.emi
Test Laboratory:	AR8 MH 24.6 C, 42.% RH 1006mB
Test Engineer:	MJS / WSM
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia Wireless
EUT Details:	AEWA 39G Radio Unit, Transmitting Center Frequency@38.5GHz, power 54.4dBm with 1C. SN-L1183000461 / IP-474870A.X12. HDMI cable disconnected at the EUT.
Configuration:	Powered by -48Vdc, Tested to FCC Class B, RE 200M-1 GHz, @ 3-Meters, ESI- E907, Log-Periodic Antenna E061, Preamp-E494, PCS-LPF-E980. Internal attenuation 10dB, Preview BW (100 kHz RBW/ 300 KHz VBW); Formal default.
Date:	2018-11-07 18:12:58

Formal Data

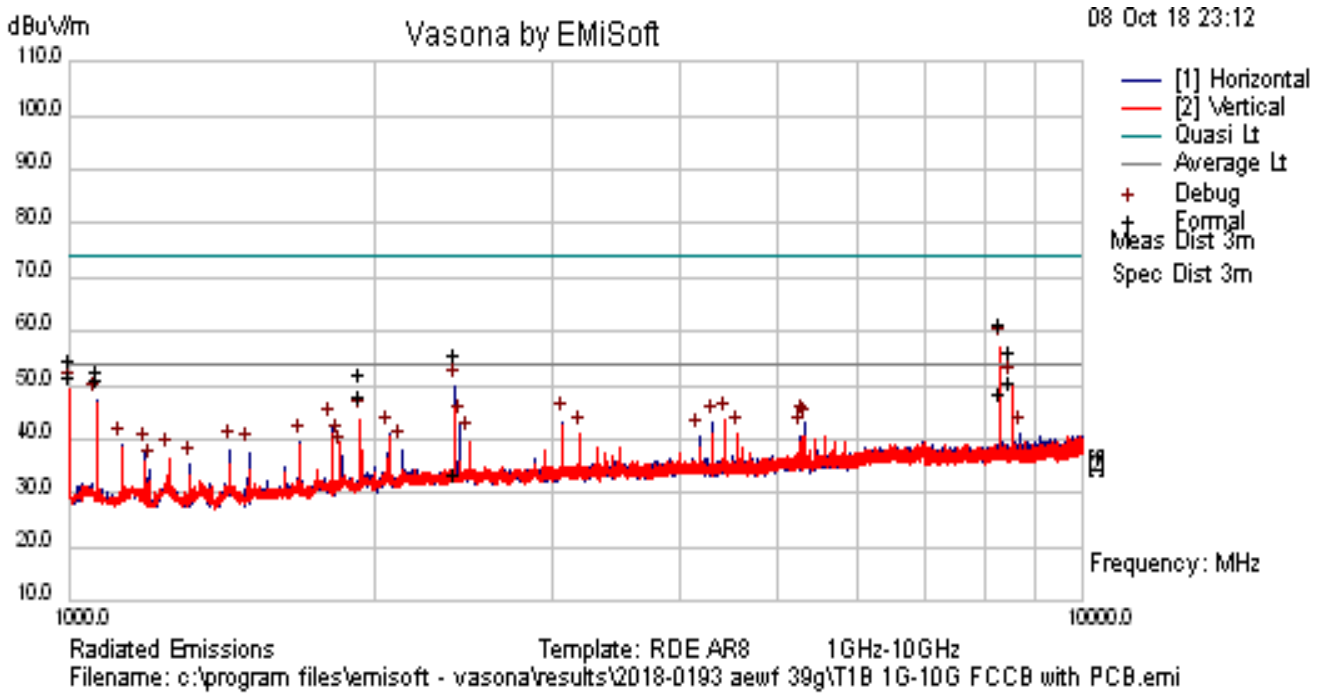
Frequency MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht. cm	Az. Deg.	Limit dBuV/m	Margin dB	Pass /Fail	Comments
917.517	36.63	2.91	-7.63	31.9	Quasi Max	H	101	5	46	-14.1	Pass	
921.597	35.22	2.91	-7.59	30.54	Quasi Max	H	100	67	46	-15.46	Pass	
851.95	36.14	2.84	-8.94	30.04	Quasi Peak	H	237	13	46	-15.96	Pass	
500.014	40.56	2.22	-14.1	28.64	Quasi Max	H	174	121	46	-17.36	Pass	
720.884	34.56	2.62	-10.4	26.84	Quasi Max	H	172	344	46	-19.16	Pass	
458.756	38.82	2.16	-15	25.95	Quasi Max	H	100	347	46	-20.05	Pass	

Preview Data

Frequency. 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
921.607	35.81	2.91	-7.59	31.13	Preview	H	100	0	46	-14.87	Pass	
720.95	37.35	2.62	-10.4	29.63	Preview	H	180	0	46	-16.37	Pass	
500.092	41.51	2.22	-14.1	29.59	Preview	H	100	135	46	-16.41	Pass	
851.964	35.47	2.84	-8.94	29.37	Preview	H	180	0	46	-16.63	Pass	
458.826	39.96	2.16	-15	27.09	Preview	H	100	315	46	-18.91	Pass	
786.457	34.16	2.75	-10.4	26.54	Preview	H	100	0	46	-19.46	Pass	
589.84	35.95	2.34	-12.8	25.49	Preview	H	180	0	46	-20.51	Pass	
983.17	32.92	2.97	-6.84	29.05	Preview	H	100	0	54	-24.95	Pass	
245.76	38.54	1.63	-19.6	20.57	Preview	H	280	90	46	-25.43	Pass	
327.715	33.6	1.89	-17.1	18.42	Preview	V	100	45	46	-27.58	Pass	
200.001	33.63	1.45	-19.8	15.3	Preview	H	100	225	43.5	-28.2	Pass	

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

T1B Radiated Emissions 1GHz—10GHz FCC B_ & Part 30



Results Title:	RDE AR8 1GHz-10GHz
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Test Laboratory:	AR8 MH 24.6 C, 42.% RH 1006mB
Test Engineer:	MJS
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia Wireless
EUT Details:	AEWA 39G Radio Unit, Transmitting Center Frequency@38.5GHz, power 54.4dBm with 1C. SN-L1183000461 / IP-474870A.X12
Configuration:	Powered by -48Vdc, Tested to FCC Class B, RE 1 G-10 GHz, @ 3-Meters, Antenna E1073, Preamp-E447, Low Pass Filter E1361. Internal attenuation 0dB, Preview BW (100 kHz RBW/ 3000 KHz VBW); Formal BW (1MHz RBW).
Date:	2018-10-08 23:12:07

Formal Data

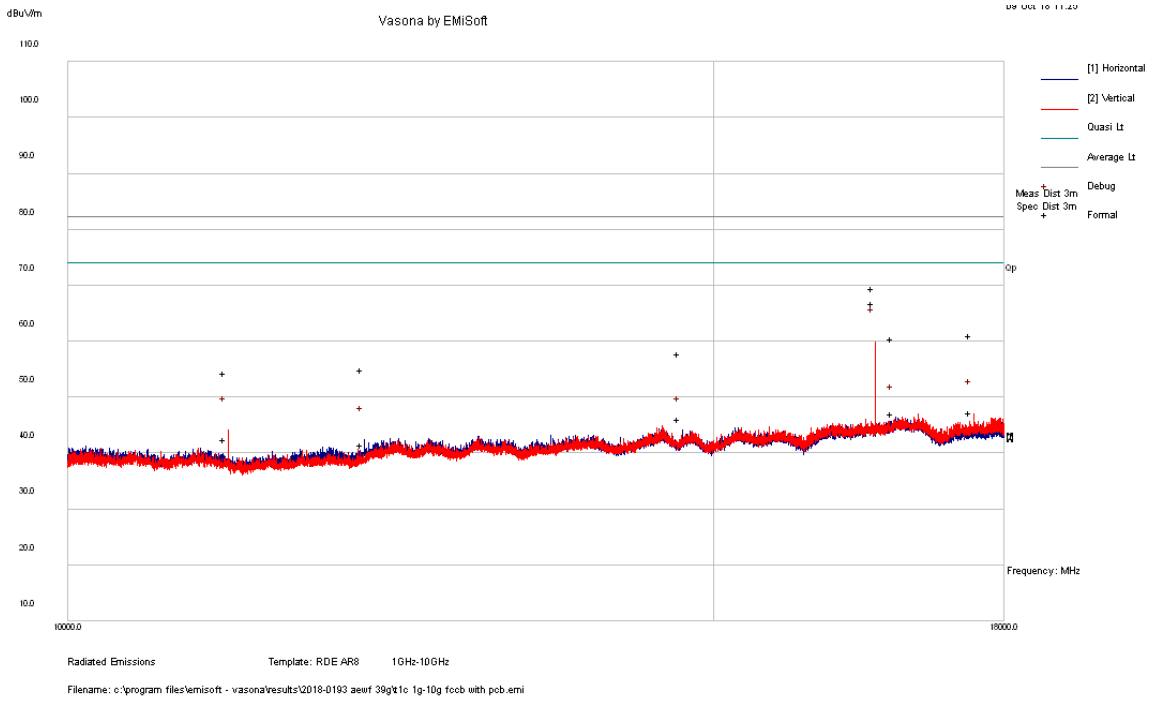
Frequency. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht. cm	Az. Deg.	Limit dBuV/m	Margin dB	Pass /Fail	Comments
1000	57.57	3.08	-12.6	48.04	Average	V	187	224	54	**-5.96**	Pass	
1062.5	56.8	3.1	-12.4	47.52	Average	H	204	205	54	-6.48	Pass	
8519.24	41.36	8.39	-2.77	46.97	Average	V	100	27	54	-7.03	Pass	
8301.61	39.24	8.14	-2.77	44.62	Average	V	183	345	54	-9.38	Pass	
1937.49	48.96	3.26	-8.01	44.2	Average	H	100	151	54	-9.8	Pass	
8301.61	52.23	8.14	-2.77	57.61	Peak	V	182	345	74	-16.39	Pass	
8519.24	46.85	8.39	-2.77	52.46	Peak	V	100	27	74	-21.54	Pass	
2401.94	54.93	3.46	-6.45	51.95	Peak	H	298	72	74	-22.05	Pass	
1000	60.38	3.08	-12.6	50.85	Peak	V	187	224	74	-23.15	Pass	
2401.94	32.83	3.46	-6.45	29.84	Average	H	298	72	54	-24.16	Pass	
1062.5	58.54	3.1	-12.4	49.26	Peak	H	204	205	74	-24.74	Pass	
1937.49	53.1	3.26	-8.01	48.35	Peak	H	100	151	74	-25.65	Pass	

Preview Data

Frequency. 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
8301.24	51.91	8.14	-2.77	57.29	Preview	V	190	0	54	3.29	Fail	
8519.06	44.34	8.39	-2.77	49.96	Preview	V	100	88	54	-4.04	Pass	
2402.54	52.69	3.46	-6.45	49.71	Preview	H	200	66	54	-4.29	Pass	
1000	58.77	3.08	-12.6	49.24	Preview	V	190	264	54	-4.76	Pass	
1061.89	56.31	3.1	-12.4	47.02	Preview	H	200	132	54	-6.98	Pass	
1937.17	48.54	3.26	-8.01	43.79	Preview	H	200	110	54	-10.21	Pass	
4437.63	42.71	5.02	-4.31	43.42	Preview	V	100	44	54	-10.58	Pass	
3062.42	44.95	4.12	-5.99	43.08	Preview	H	100	132	54	-10.92	Pass	
2425.85	45.93	3.47	-6.39	43.02	Preview	H	100	44	54	-10.98	Pass	
5308.09	40.72	5.88	-3.63	42.97	Preview	H	100	22	54	-11.03	Pass	
4312.24	42.26	4.98	-4.39	42.85	Preview	H	200	286	54	-11.15	Pass	
1811.78	47.77	3.24	-8.81	42.2	Preview	H	200	110	54	-11.8	Pass	
5324.16	39.82	5.9	-3.62	42.09	Preview	H	100	176	54	-11.91	Pass	
8682.22	35.06	8.53	-2.7	40.89	Preview	H	100	330	54	-13.11	Pass	
2062.55	45	3.3	-7.43	40.86	Preview	H	200	286	54	-13.14	Pass	
4563.01	39.95	5.12	-4.22	40.85	Preview	V	100	44	54	-13.15	Pass	
3187.8	42.41	4.27	-5.84	40.83	Preview	H	200	154	54	-13.17	Pass	
5269.51	38.55	5.85	-3.66	40.74	Preview	H	100	66	54	-13.26	Pass	
4187.66	39.93	4.93	-4.47	40.4	Preview	H	200	110	54	-13.6	Pass	
2479.7	42.41	3.5	-6.25	39.66	Preview	H	100	88	54	-14.34	Pass	
1688.01	45.78	3.22	-9.65	39.35	Preview	H	200	220	54	-14.65	Pass	
1843.13	44.59	3.24	-8.6	39.23	Preview	V	100	88	54	-14.77	Pass	
1124.58	47.83	3.11	-12.2	38.78	Preview	H	300	176	54	-15.22	Pass	
1437.24	46.03	3.17	-11.2	37.99	Preview	H	100	220	54	-16.01	Pass	
2125.25	41.89	3.33	-7.24	37.98	Preview	H	100	198	54	-16.02	Pass	
1187.27	46.67	3.12	-12	37.85	Preview	H	390	198	54	-16.15	Pass	
1499.93	45.34	3.19	-11.1	37.48	Preview	H	300	220	54	-16.52	Pass	
1854.38	42.39	3.24	-8.53	37.1	Preview	H	200	0	54	-16.9	Pass	
1249.97	45.15	3.14	-11.8	36.54	Preview	H	100	154	54	-17.46	Pass	
1312.66	43.66	3.15	-11.6	35.25	Preview	H	200	220	54	-18.75	Pass	
1200.13	43.13	3.13	-11.9	34.35	Preview	H	100	154	54	-19.65	Pass	

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

T1C Radiated Emissions 10GHz—18 GHz FCC Part 15B_ & Part 30



Results Title:	RDE AR8 10GHz-18GHz
File Name:	c:\program files\emisoft - vasona\results\2018-0193 AEWF 39g\T1C 1G-10G FCCB with PCB.emi
Test Laboratory:	AR8 MH 24.6 C, 42.% RH 1006mB
Test Engineer:	MJS
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia Wireless
EUT Details:	AEWA 39G Radio Unit, Transmitting Center Frequency @38.5GHz, power 54.4dBm with 1C. SN-L1183000461 / IP-474870A.X12
Configuration:	Powered by -48Vdc, Tested to FCC Class B, RE 10 G-18 GHz, @ 3-Meters, Antenna E1073, Preamp-E447, Low Pass Filter E1361. Internal attenuation 0dB, Preview BW (100 kHz RBW/ 3000 KHz VBW); Formal BW (1MHz RBW).
Date:	2018-10-09 11:25:22

Formal Data

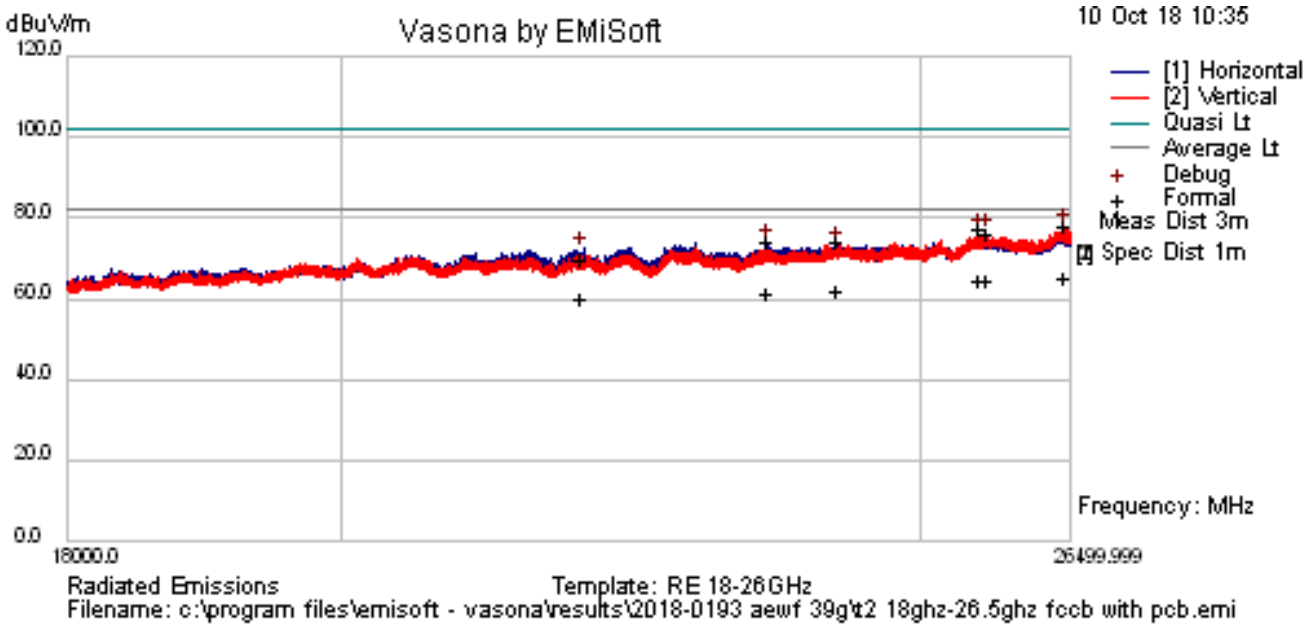
Frequency. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht. cm	Az. Deg.	Limit dBuV/m	Margin dB	Pass /Fail	Comments
16603.4	43.3	13.45	4.05	60.81	Average	V	210	359	82.23	-21.42	Pass	
16603.4	46.09	13.45	4.05	63.6	Peak	V	210	359	74	-10.4	Pass	
17656.9	22.39	14.42	4.52	41.32	Average	V	387	216	82.23	-40.91	Pass	
16809.1	23.02	13.64	4.47	41.13	Average	H	169	124	82.23	-41.1	Pass	
14705.6	25.87	12.1	2.29	40.27	Average	H	238	318	82.23	-41.96	Pass	
11059	26.58	10.31	-0.25	36.64	Average	V	137	44	82.23	-45.59	Pass	
12047.5	24.78	10.61	0.17	35.56	Average	H	271	259	82.23	-46.67	Pass	
17656.9	36.18	14.42	4.52	55.12	Peak	V	387	216	74	-18.88	Pass	
16809.1	36.41	13.64	4.47	54.52	Peak	H	169	124	74	-19.48	Pass	
14705.6	37.46	12.1	2.29	51.86	Peak	H	238	318	74	-22.14	Pass	
12047.5	38.28	10.61	0.17	49.07	Peak	H	271	259	74	-24.93	Pass	
11059	38.28	10.31	-0.25	48.35	Peak	V	137	44	74	-25.65	Pass	

Preview Data

Frequency. 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
16603.4	42.4	13.45	4.05	59.9	Debug	V	100	352	82.23	-22.33	Pass	
17656.9	28.08	14.42	4.52	47.02	Debug	V	290	110	82.23	-35.21	Pass	
11059	34	10.31	-0.25	44.06	Debug	V	100	22	82.23	-38.17	Pass	
14705.6	29.62	12.1	2.29	44.02	Debug	H	100	256	82.23	-38.21	Pass	
16809.1	28.01	13.64	4.47	46.12	Debug	H	100	256	82.23	-36.11	Pass	
12047.5	31.46	10.61	0.17	42.24	Debug	H	100	256	82.23	-39.99	Pass	

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

T2 RE 18G-26.5GHz FCC Part 15 Class B & Part 30



Results Title:	RE 18-26GHz
File Name:	c:\program files\emisoft - vasona\results\2018-0193 AEWF 39g\T2 18GHz-26.5GHz fccb with pcb.emi
Test Laboratory:	AR8 MH 24.6 C, 42.% RH 1006mB
Test Engineer:	MJS / WSM / GM
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia Wireless
EUT Details:	AEWA 39G Radio Unit, Transmitting Center Frequency @38.5GHz, power 54.4dBm with 1C. SN-L1183000461 / IP-474870A.X12
Configuration:	Powered by -48Vdc, Tested to FCC Class B, RE 18 G-26.5 GHz, @ 3-Meters, ESI E907, Antenna E513, Preamp-E447, Low Pass Filter E1361. Internal attenuation 0dB, Preview BW (1 MHz RBW/ 3000 KHz VBW); Formal BW (1MHz RBW).
Date:	2018-10-10 10:22:20

Formal Data

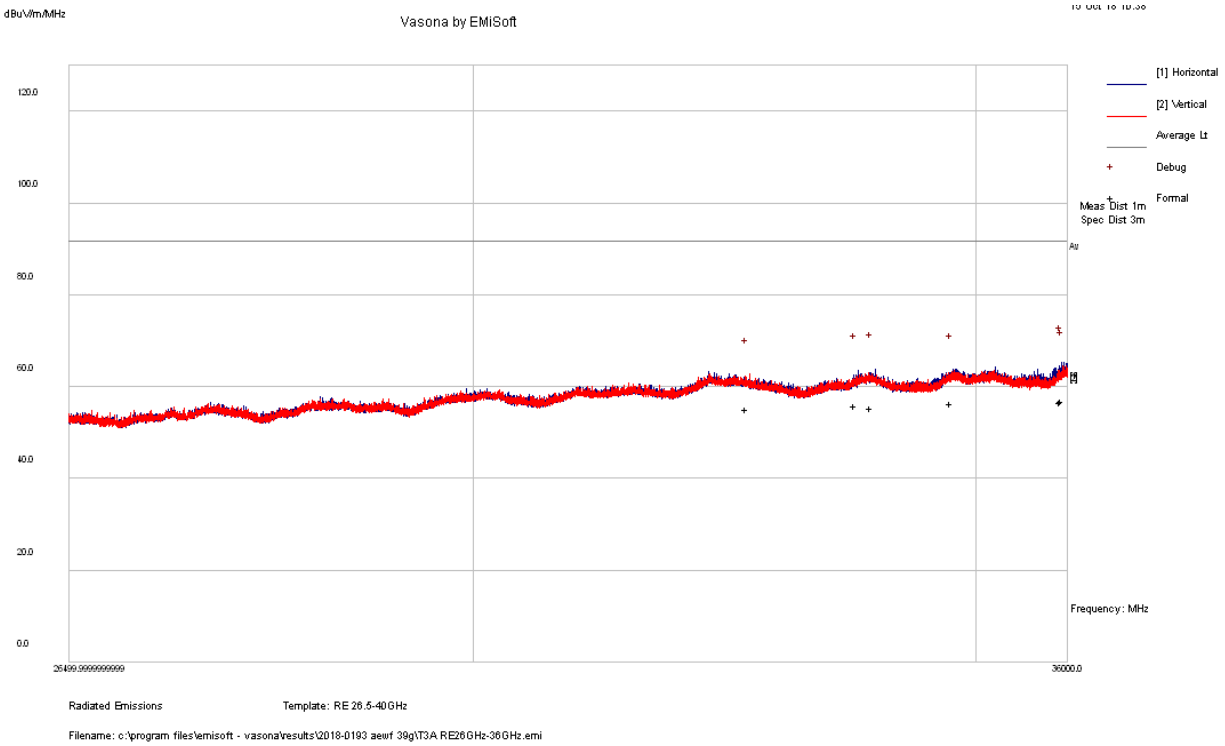
Frequency. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht. cm	Az. Deg.	Limit dBuV/m	Margin dB	Pass /Fail	Comments
26452.1	26.98	12.17	21.76	60.91	Average	V	119	299	82.23	-21.32	Pass	
25603.5	28.95	11.42	20.14	60.52	Average	H	265	342	82.23	-21.71	Pass	
25672	28.59	11.44	20.2	60.24	Average	V	136	213	82.23	-21.99	Pass	
24242.9	27.95	11.24	18.4	57.58	Average	V	150	94	82.23	-24.65	Pass	
23576.4	27.6	11.02	18.47	57.09	Average	H	176	339	82.23	-25.14	Pass	
21959.7	26.98	10.5	18.5	55.98	Average	H	232	331	82.23	-26.25	Pass	
26452.1	39.87	12.17	21.76	73.8	Peak	V	119	299	102.23	-28.43	Pass	
25603.5	41.8	11.42	20.14	73.36	Peak	H	265	342	102.23	-28.87	Pass	
25672	40.23	11.44	20.2	71.87	Peak	V	136	213	102.23	-30.36	Pass	
23576.4	40.44	11.02	18.47	69.93	Peak	H	176	339	102.23	-32.3	Pass	
24242.9	40.08	11.24	18.4	69.72	Peak	V	150	94	102.23	-32.51	Pass	

Preview Data

Frequency. 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
26452.1	43	12.17	21.76	76.93	Preview	V	100	308	82.23	-5.3	Pass	
25603.5	44.04	11.42	20.14	75.6	Debug	H	100	27	82.23	-6.63	Pass	
25672	43.65	11.44	20.2	75.29	Debug	V	100	27	82.23	-6.94	Pass	
23576.4	43.6	11.02	18.47	73.09	Debug	H	100	27	82.23	-9.14	Pass	
24242.9	42.93	11.24	18.4	72.56	Debug	V	100	27	82.23	-9.67	Pass	
21959.7	42.08	10.5	18.5	71.08	Debug	H	100	27	82.23	-11.15	Pass	

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

T3A Radiated Emissions 26.5 GHz - 36 GHz Part 15 Class B and Part 30



Results Title:	RE 26.5-40GHz
File Name:	c:\program files\emisoft - vasona\results\2018-0193 AEWF 39g\T3A RE26GHz-36GHz.emi
Test Laboratory:	AR8 MH 24.6 C, 42.% RH 1006mB
Test Engineer:	MJS / WSM / GM
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia Wireless
EUT Details:	AEWA 39G Radio Unit, Transmitting Center Frequency @38.5G, power 54.4dBm with 1C. SN-L1183000461 / IP-474870A.X12
Configuration:	Powered by -48Vdc, Tested to FCC Class B, RE 26.5 G-36.0 GHz, @ 1-Meter, ESI-1G E907, Antenna E526, Low Pass Filter E1361. Internal attenuation 0dB, Preview BW (1 MHz RBW/ 3000 KHz VBW); Formal BW (1MHz RBW).
Date:	2018-10-15 10:30:10

FORMAL DATA

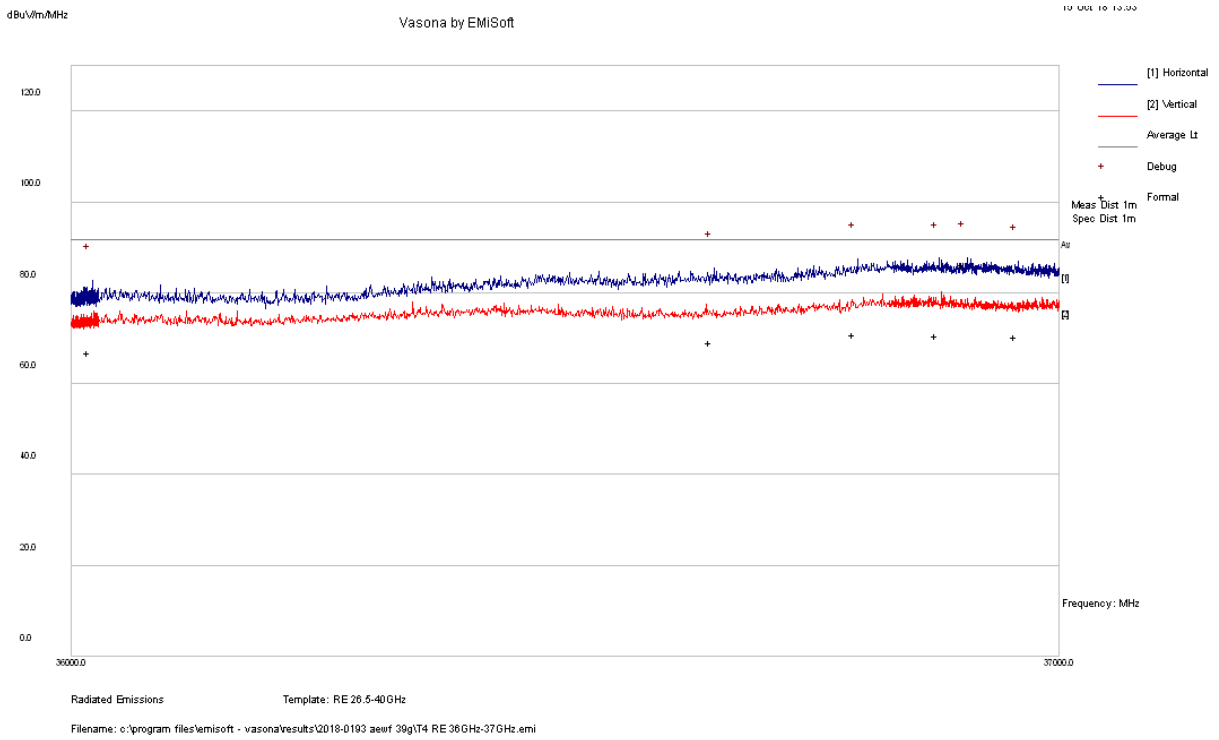
Frequency. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht. cm	Az. Deg.	Limit dBuV/m	Margin dB	Pass /Fail	Comments
35978.3	28.94	2.42	17.75	49.11	AvgMax	V	123	76	91.7	-42.66	Pass	
35961.7	28.94	2.42	17.71	49.07	AvgMax	H	190	150	91.7	-42.7	Pass	
34768.9	30.67	2.45	15.5	48.62	AvgMax	V	123	265	91.7	-43.15	Pass	
33763.4	31.28	2.02	14.8	48.1	AvgMax	H	164	31	91.7	-43.67	Pass	
33932.2	30.8	2.03	14.92	47.75	AvgMax	H	206	195	91.7	-44.02	Pass	
32658.2	30.92	2.07	14.52	47.51	AvgMax	V	246	198	91.7	-44.26	Pass	

PREVIEW DATA

Frequency. 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
35961.7	45.25	2.42	17.71	65.38	Debug	H	200	352	91.7	-26.39	Pass	
35978.3	44.35	2.42	17.75	64.52	Debug	V	100	245	91.7	-27.25	Pass	
33932.2	46.87	2.03	14.92	63.82	Debug	H	100	245	91.7	-27.95	Pass	
34768.9	45.68	2.45	15.5	63.63	Debug	V	100	245	91.7	-28.14	Pass	
33763.4	46.74	2.02	14.8	63.56	Debug	H	100	245	91.7	-28.21	Pass	
32658.2	45.95	2.07	14.52	62.54	Debug	V	100	245	91.7	-29.23	Pass	

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

T4 Radiated Emissions 36 GHz - 37 GHz FCC Part 15 B &Part 30.



Results Title:	RE 26.5-40GHz
File Name:	c:\program files\emisoft - vasona\results\2018-0193 AEWF 39g\T4 RE 36GHz-37GHz.emi
Test Laboratory:	AR8 MH 24.6 C, 42.% RH 1006mB
Test Engineer:	MJS / WSM / GM
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia Wireless
EUT Details:	AEWA 39G Radio Unit, Transmitting @38.5G, power 54.4dBm with 1C. SN-L1183000461 / IP-474870A.X12
Configuration:	Powered by -48Vdc, Tested to FCC Class B, RE 36.0 G-37.0 GHz, @ 1-Meter, ESI-1G E907, Antenna E526, Low Pass Filter E1361. Internal attenuation 0dB, Preview BW (1 MHz RBW/ 3000 KHz VBW); Formal BW (1MHz RBW).
Date:	2018-10-15 13:53:16

FORMAL DATA

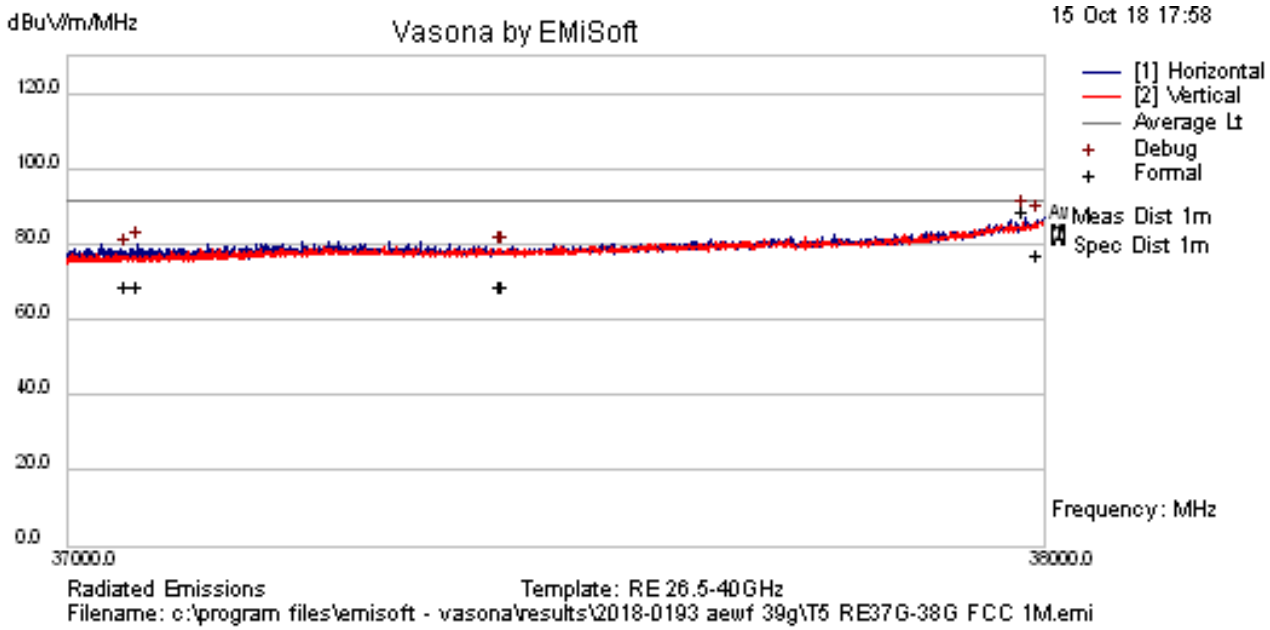
Frequency. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht. cm	Az. Deg.	Limit dBuV/m	Margin dB	Pass /Fail	Comments
36905.4	46.32	3.69	28.63	78.64	AvgMax	H	162	361	91.7	-13.13	Pass	
36793.5	30.88	3.88	28.51	63.27	AvgMax	H	100	145	91.7	-28.5	Pass	
36876.9	30.54	3.74	28.6	62.88	AvgMax	H	169	185	91.7	-28.89	Pass	
36958.2	30.28	3.59	28.69	62.56	AvgMax	H	197	267	91.7	-29.21	Pass	
36647.3	29.3	3.78	28.35	61.42	AvgMax	H	100	31	91.7	-30.35	Pass	
36021	29.34	2.45	27.39	59.18	AvgMax	H	110	267	91.7	-32.59	Pass	

PREVIEW DATA

Frequency. 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
36905.4	55.48	3.69	28.63	87.8	Preview	H	150	0	91.7	-3.97	Pass	
36793.5	55.11	3.88	28.51	87.5	Debug	H	100	360	91.7	-4.27	Pass	
36876.9	55.13	3.74	28.6	87.46	Debug	H	100	360	91.7	-4.31	Pass	
36958.2	54.71	3.59	28.69	86.99	Debug	H	100	360	91.7	-4.78	Pass	
36647.3	53.33	3.78	28.35	85.46	Debug	H	100	360	91.7	-6.31	Pass	
36021	52.94	2.45	27.39	82.78	Debug	H	100	360	91.7	-8.99	Pass	

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

T5 Radiated Emissions 37 G - 38 GHz FCC Part 15 B &Part 30.



Results Title:	RE 26.5-40GHz
File Name:	c:\program files\emisoft - vasona\results\2018-0193 AEWF 39g\T5 RE37G-38G FCC 1M.emi
Test Laboratory:	AR8 MH 24.6 C, 42.% RH 1006mB
Test Engineer:	MJS / WSM / GM
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia Wireless
EUT Details:	AEWA 39G Radio Unit, Transmitting Center Frequency@38.5GHz, power 54.4dBm with 1C. SN-L1183000461 / IP-474870A.X12
Configuration:	Powered by -48Vdc, Tested to FCC Class B, RE 37.0 G-38.0 GHz, @ 1-Meter, ESI-1G E907, Antenna E526, Low Pass Filter E1361. Internal attenuation 10dB, Preview BW (100 kHz RBW/ 3000 KHz VBW); Formal BW (1MHz RBW).
Date:	2018-10-15 17:58:34

FORMAL DATA

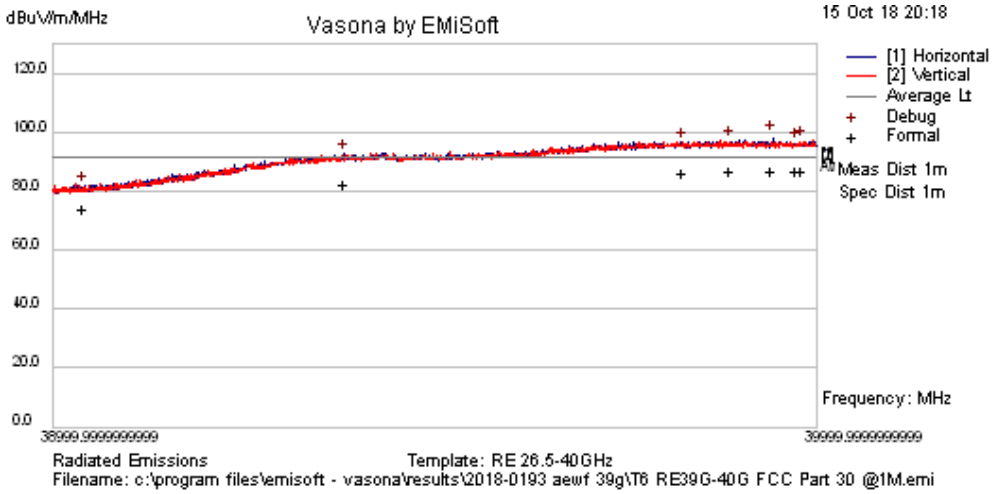
Frequency. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht. cm	Az. Deg.	Limit dBuV/m	Margin dB	Pass /Fail	Comments
37978.6	47.63	7.81	28.11	83.55	AvgMax	H	164	361	91.77	-8.22	Pass	
37994.4	36.08	7.97	28.1	72.15	AvgMax	V	277	244	91.77	-19.62	Pass	
37443.2	32.53	2.99	28.41	63.93	AvgMax	V	146	24	91.77	-27.84	Pass	
37059.3	31.89	3.32	28.69	63.9	AvgMax	V	286	244	91.77	-27.87	Pass	
37440.2	32.43	2.99	28.41	63.83	AvgMax	H	278	203	91.77	-27.94	Pass	
37071.6	31.71	3.27	28.68	63.66	AvgMax	H	184	36	91.77	-28.11	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
37978.6	50.99	7.81	28.11	86.91	Preview	H	100	220	91.77	-4.86	Pass	
37994.4	49.61	7.97	28.1	85.69	Debug	V	100	361	91.77	-6.08	Pass	
37443.2	46.08	2.99	28.41	77.48	Debug	V	100	361	91.77	-14.29	Pass	
37059.3	44.43	3.32	28.69	76.43	Debug	V	100	361	91.77	-15.34	Pass	
37440.2	46.23	2.99	28.41	77.63	Debug	H	100	361	91.77	-14.14	Pass	
37071.6	46.81	3.27	28.68	78.76	Debug	H	100	361	91.77	-13.01	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.

T6 Radiated Emissions 39 GHz-40GHz FCC 15B & Part 30



Results Title:	RE 39-40GHz
File Name:	c:\program files\emisoft - vasona\results\2018-0193 aewf 39g\T6 RE39G-40G FCC Part 30 @1M.emi
Test Laboratory:	AR8 MH 24.6 C, 42.% RH 1006mB
Test Engineer:	MJS / WSM / GM
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia Wireless
EUT Details:	AEWA 39G Radio Unit, Transmitting Center Frequency@38.5GHz, power 54.4dBm with 1C. SN-L1183000461 / IP-474870A.X12
Configuration:	Powered by -48Vdc, Tested to FCC Class B, RE 39.0 G-40.0 GHz, @ 1-Meter, ESI-1G E907, Antenna E526, Low Pass Filter E1361. Internal attenuation 10dB, Preview BW (100 kHz RBW/ 3000 KHz VBW); Formal BW (1MHz RBW).
Date:	2018-10-15 20:18:34

Formal Data

Frequency. 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
39972.2	32.04	21.57	28.4	82.01	Average	H	275	99	91.77	-9.76	Pass	
39979.8	31.89	21.58	28.41	81.89	Average	V	168	257	91.77	-9.88	Pass	
39941.7	32.04	21.52	28.32	81.88	Average	H	118	33	91.77	-9.89	Pass	
39884.7	32.11	21.42	28.19	81.72	Average	V	229	107	91.77	-10.05	Pass	
39822.2	32.15	21.31	28.05	81.5	Average	H	290	246	91.77	-10.27	Pass	
39380	33.47	16.52	27.26	77.25	Average	V	286	30	91.77	-14.52	Pass	
39038.5	32.6	9.06	27.19	68.85	Average	V	158	35	91.77	-22.92	Pass	

Preview Data

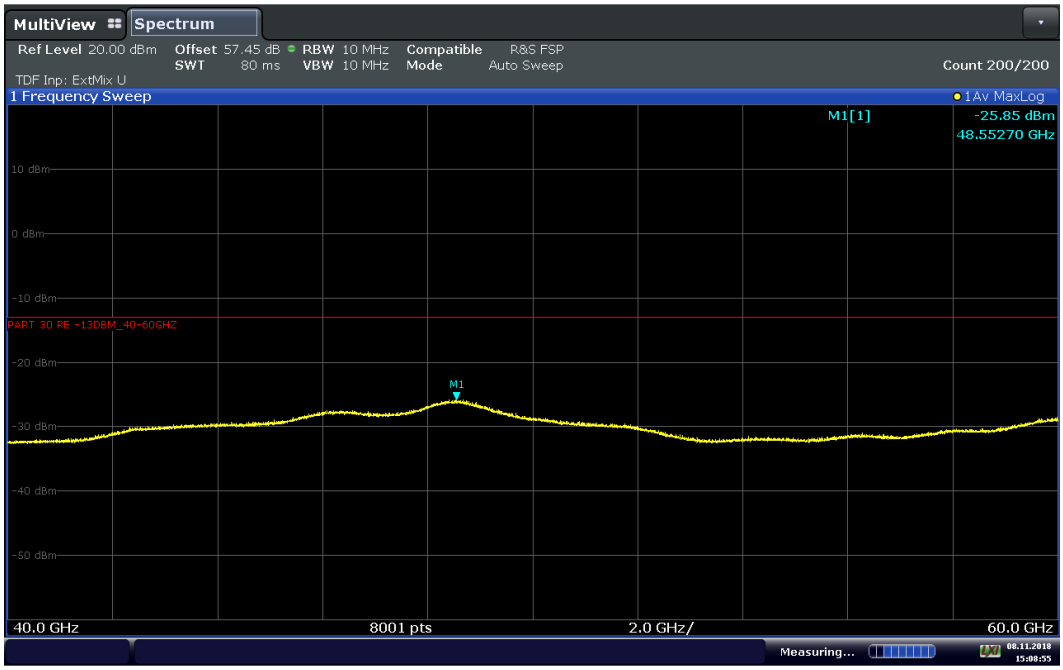
Frequency. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht. cm	Az. Deg.	Limit dBuV/m	Margin dB	Pass /Fail	Comments
39941.7	48.01	21.52	28.32	97.85	Preview	H	250	22	91.77	6.08	Fail	
39380	47.62	16.52	27.26	91.4	Debug	V	100	360	91.77	-0.37	Pass	
39038.5	44.24	9.06	27.19	80.49	Debug	V	100	360	91.77	-11.28	Pass	
39979.8	46.27	21.58	28.41	96.27	Debug	V	158	35	91.77	4.5	Fail	
39884.7	46.31	21.42	28.19	95.92	Debug	V	158	35	91.77	4.15	Fail	
39822.2	45.95	21.31	28.05	95.3	Debug	H	158	35	91.77	3.53	Fail	
39972.2	45.48	21.57	28.4	95.45	Debug	H	158	35	91.77	3.68	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.

Peak Search Radiated Emissions -U Band 40GHz-60GHz at 5m FCC B Part 30

Vertical Polarization - 10 MHz RBW - Max Hold 0-360 degree Azimuth; 1-3m Elevation

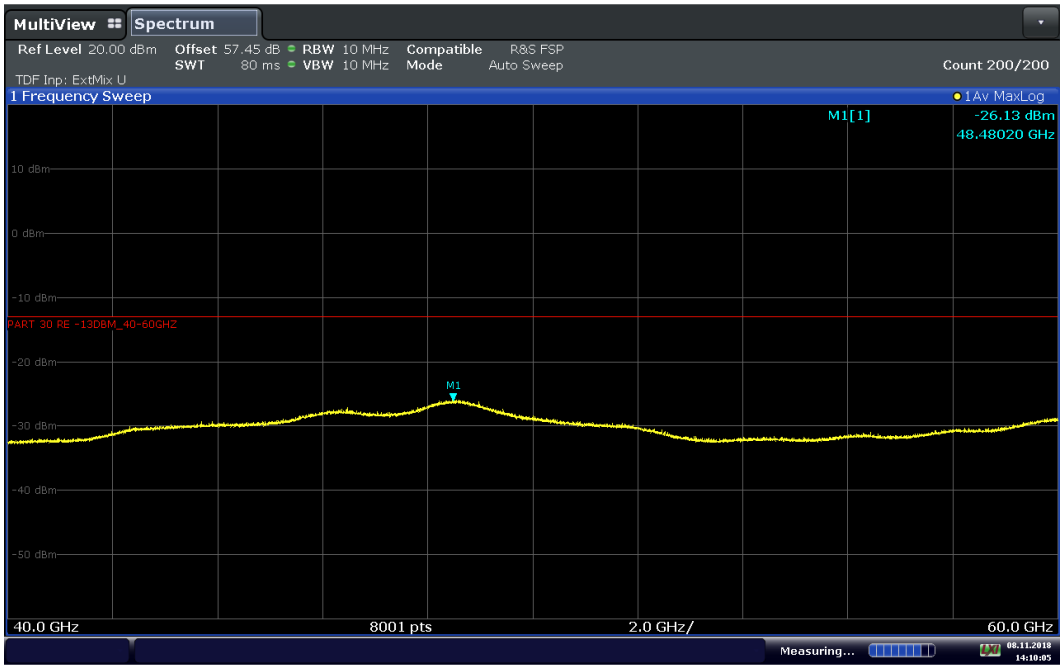
AEWF 39 GHz Radio Unit. Test Eng WSM, Tech MJS 2018-0193



15:08:55 08.11.2018

Horizontal Polarization - 10 MHz RBW - Max Hold 0-360 degree Azimuth; 1-3m Elevation

AEWF 39 GHz Radio Unit. Test Eng WSM, Tech MJS 2018-0193

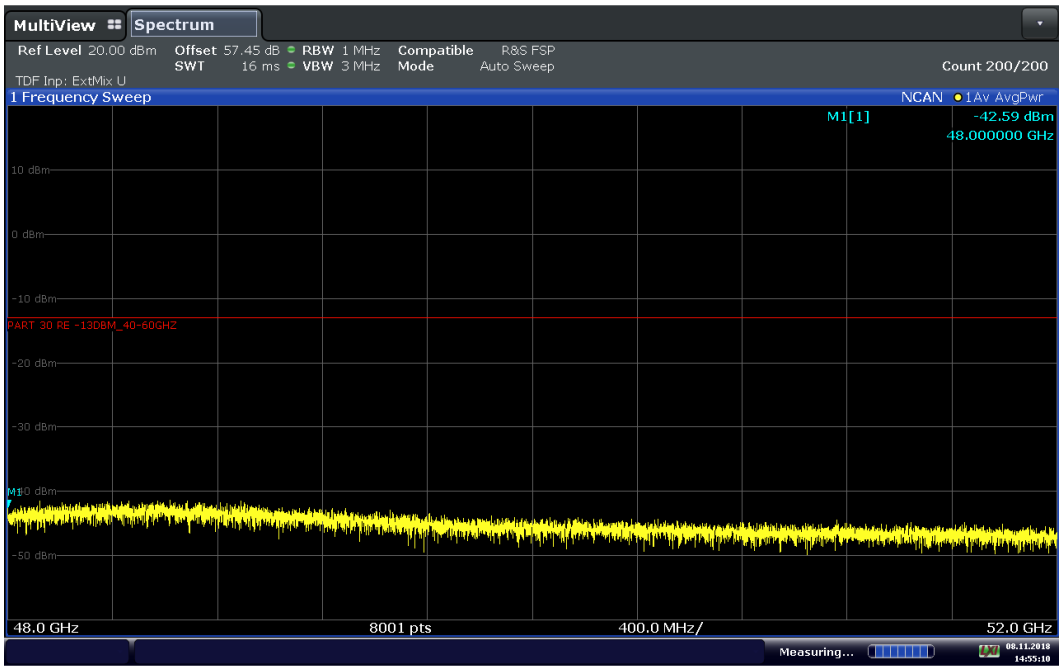


14:10:06 08.11.2018

Maximum Radiated Emissions -U Band 40GHz-60GHz at 5m FCC B Part 30

Vertical Polarization - 1 MHz RBW - 345 degree Azimuth; 1.71m Elevation

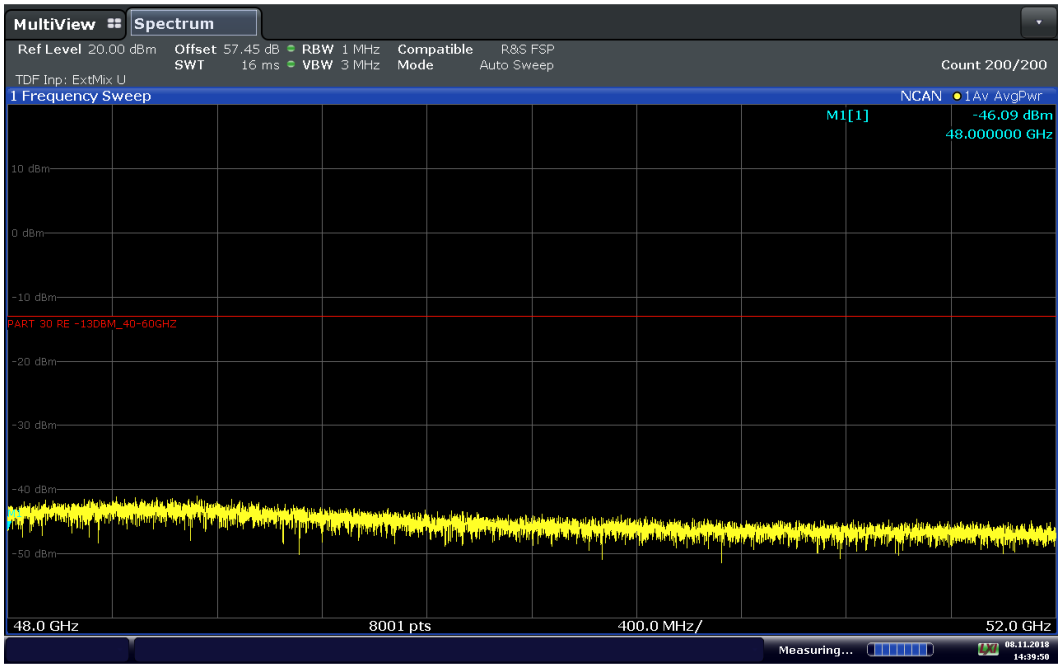
AEWF 39 GHz Radio Unit. Test Eng WSM, Tech MJS 2018-0193



14:55:11 08.11.2018

Horizontal Polarization - 1 MHz RBW - 345 degree Azimuth; 1.45m Elevation

AEWF 39 GHz Radio Unit. Test Eng WSM, Tech MJS 2018-0193

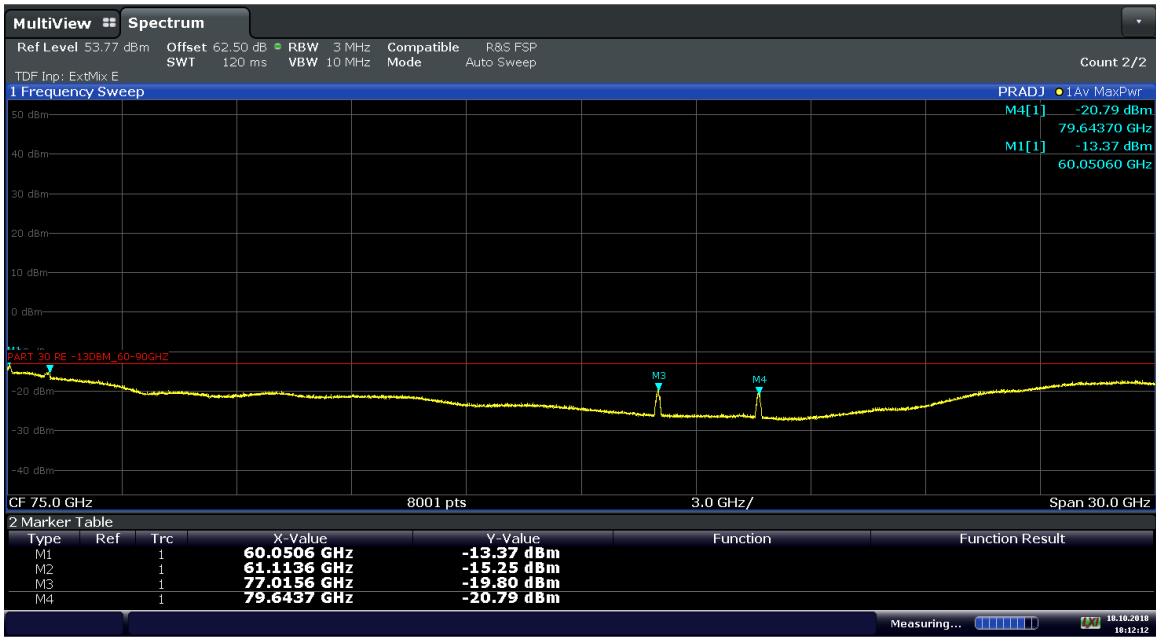


14:39:51 08.11.2018

Peak Search Maximum Radiated Emissions -E Band 60GHz-90GHz at 6m

Vertical Polarization - 3 MHz RBW- Max Hold 0-360 degree Azimuth; 1-3m Elevation

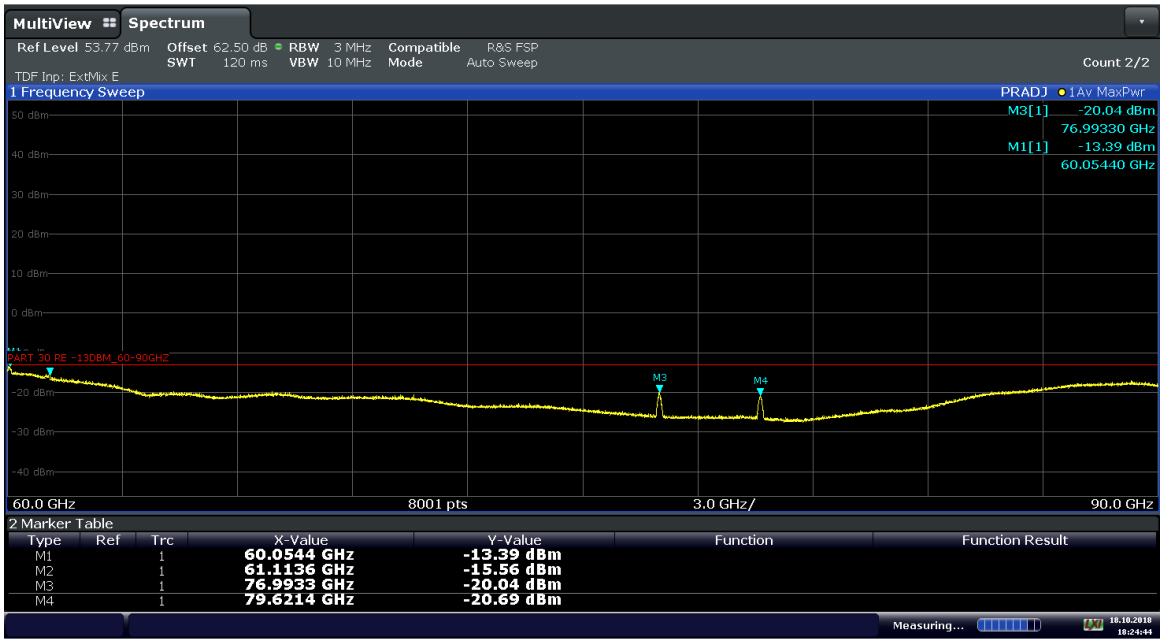
AEWF 39 GHz Radio Unit. Test Eng WSM, Tech MJS 2018-0193



18:12:13 18.10.2018

Horizontal Polarization - 3 MHz RBW- Max Hold 0-360 degree Azimuth; 1-3m Elevation

AEWF 39 GHz Radio Unit. Test Eng WSM, Tech MJS 2018-0193



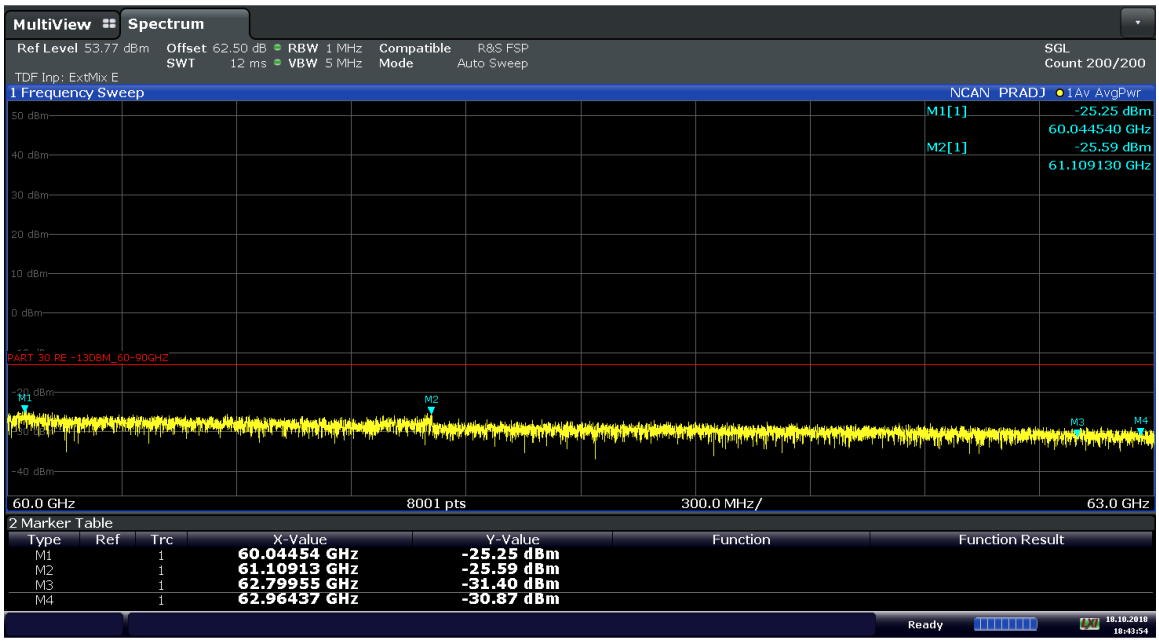
18:24:44 18.10.2018

Maximum Radiated Emissions -E Band 60GHz-90GHz - at 6m 1 MHz RBW

Vertical Polarization - 1 MHz RBW - 345 degree Azimuth; 1.86m Elevation

Vertical 60-63 GHz

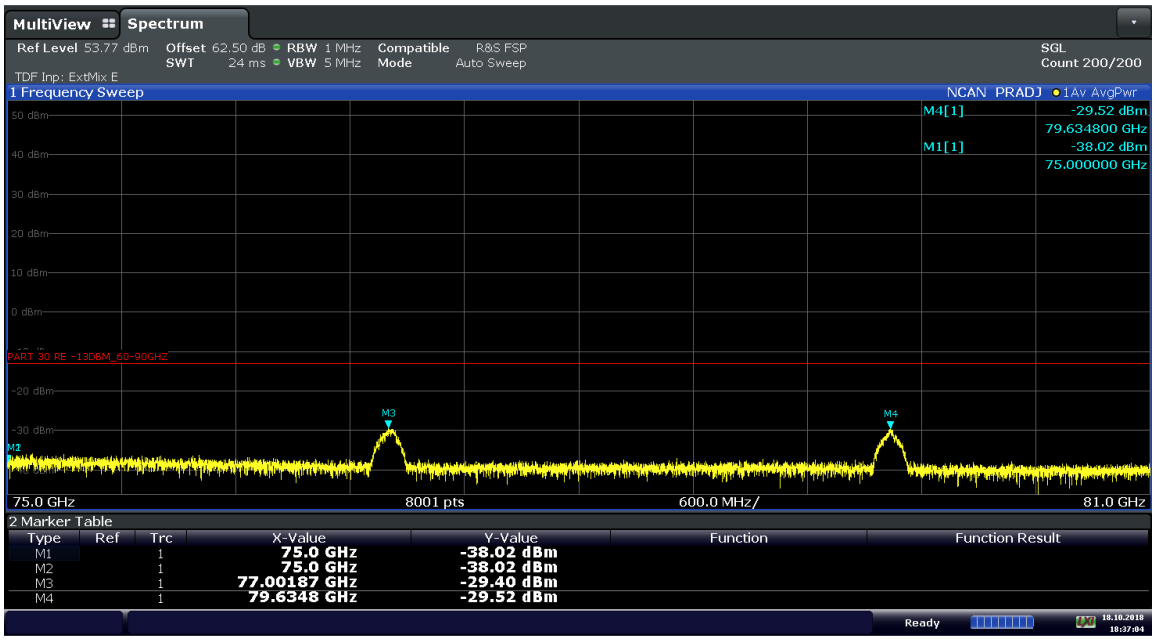
AEWF 39 GHz Radio Unit. Test Eng WSM, Tech MJS 2018-0193



18:43:55 18.10.2018

Vertical 75-81 GHz

AEWF 39 GHz Radio Unit. Test Eng WSM, Tech MJS 2018-0193

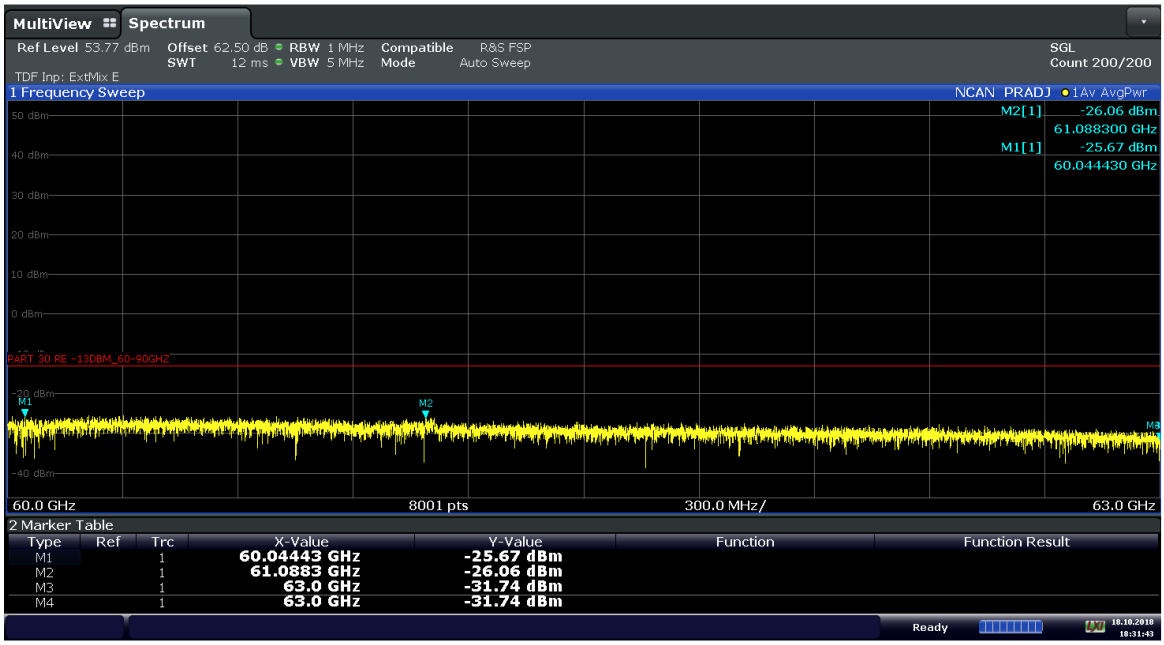


18:37:04 18.10.2018

Horizontal Polarization -1 MHz RBW - 345 degree Azimuth; 1.45m Elevation

Horizontal 60-63 GHz

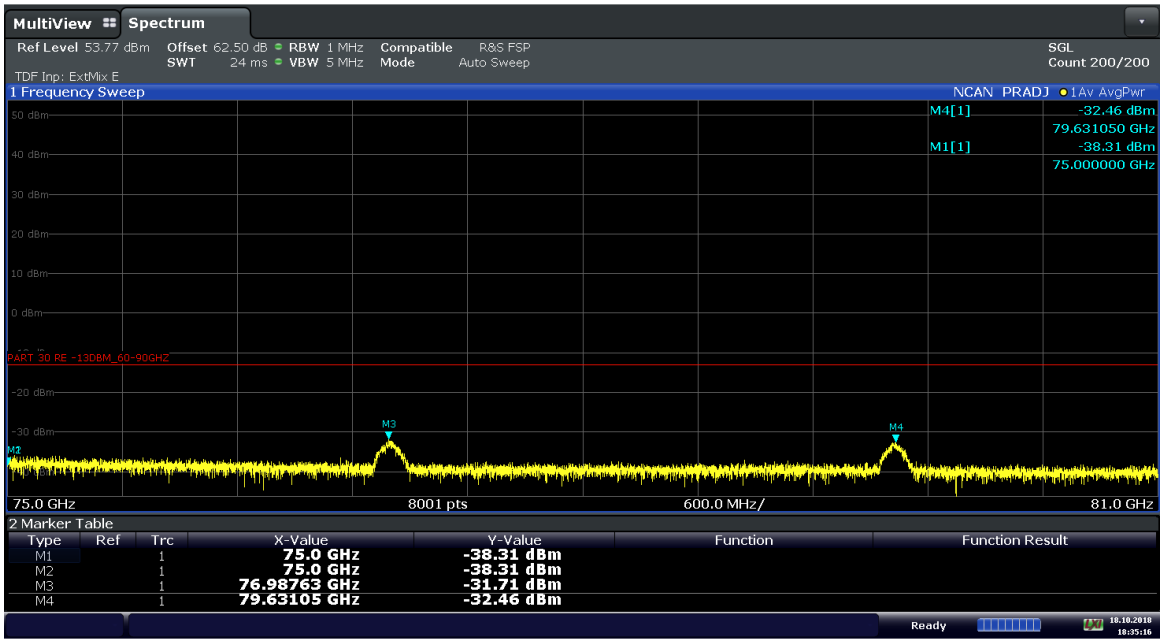
AEWF 39 GHz Radio Unit. Test Eng WSM, Tech MJS 2018-0193



18:31:44 18.10.2018

Horizontal 75-81 GHz

AEWF 39 GHz Radio Unit. Test Eng WSM, Tech MJS 2018-0193



18:35:17 18.10.2018

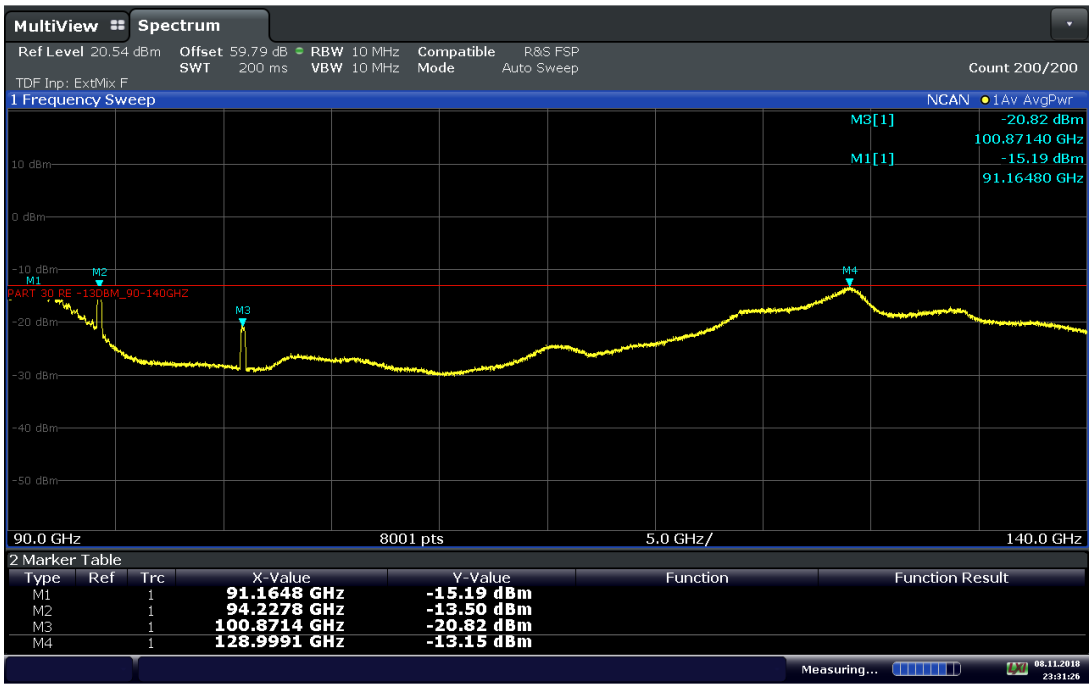
Peak Search Radiated Emissions F Band 90GHz-140GHz - at 3m 10 MHz RBW Vertical Polarization - 10 MHz RBW - Max Hold 0-360 degree Azimuth; 1-3m Elevation

AEWF 39 GHz Radio Unit. Test Eng WSM, Tech MJS 2018-0193

23:33:46 08.11.2018

Horizontal Polarization - 10 MHz RBW - Max Hold 0-360 degree Azimuth; 1-3m Elevation

AEWF 39 GHz Radio Unit. Test Eng WSM, Tech MJS 2018-0193



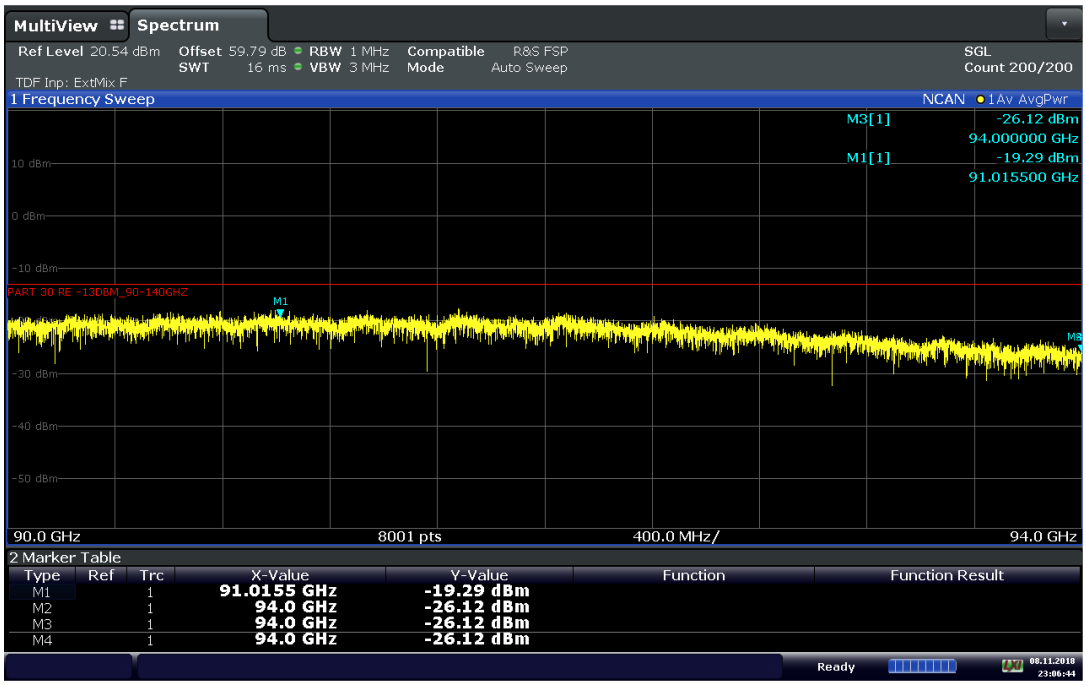
23:31:26 08.11.2018

Maximum Radiated Emissions -F Band 90GHz-140GHz 1MHz RBW

Vertical Polarization 1 MHz RBW - 345 degree Azimuth; 1.71m Elevation

Vertical – 90-94 GHz

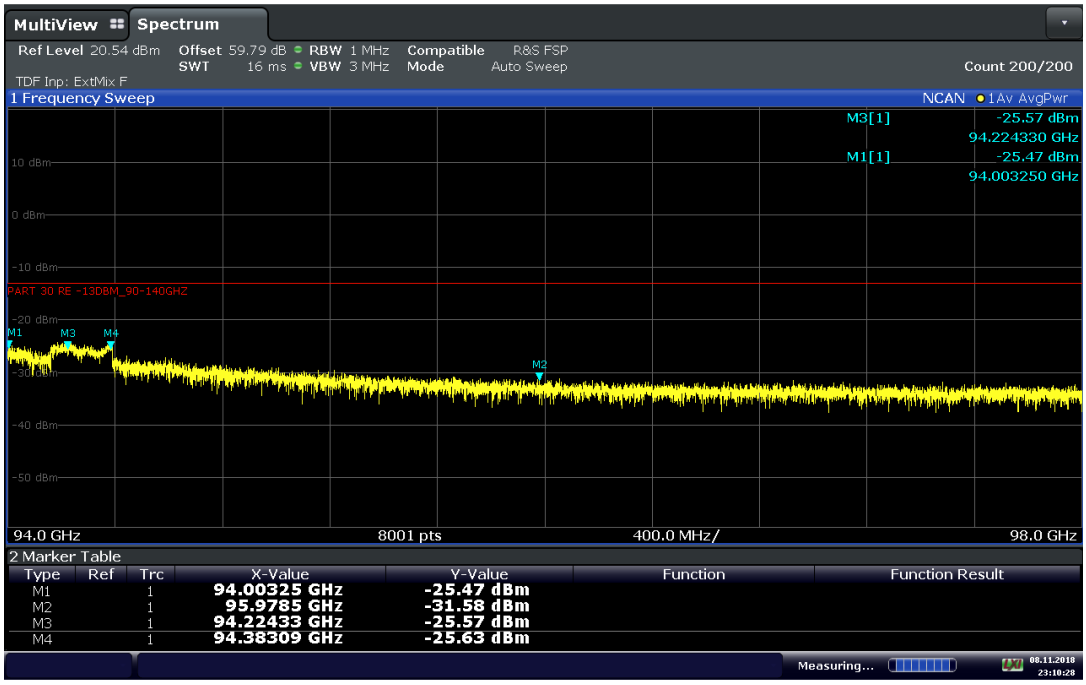
AEWF 39 GHZ Radio Unit. Test Eng. WSM, Tech MJS 2018-0193



23:06:45 08.11.2018

Vertical – 94-98 GHz

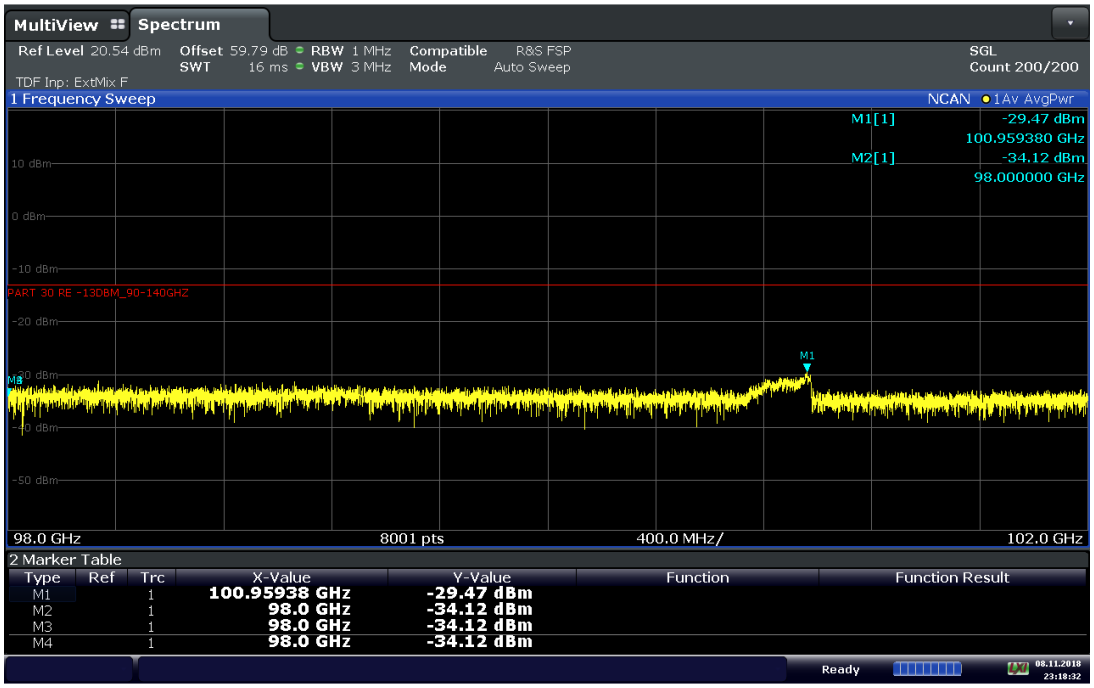
AEWF 39 GHZ Radio Unit. Test Eng. WSM, Tech MJS 2018-0193



23:10:28 08.11.2018

Vertical – 98-102 GHz

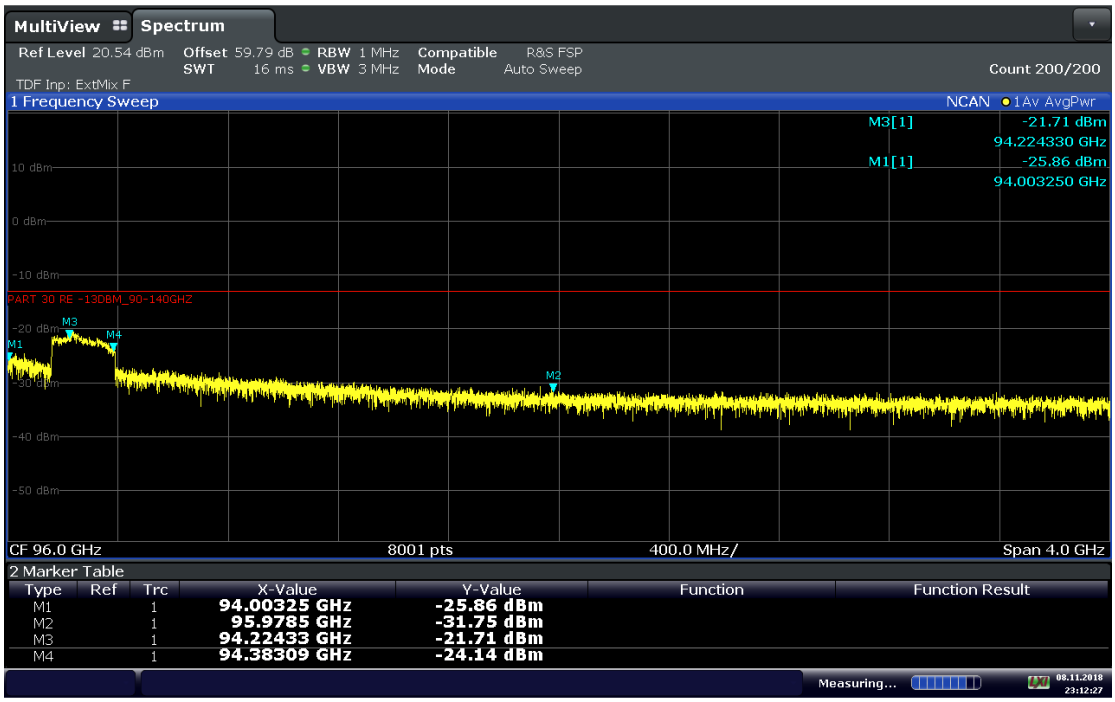
AEWF 39 GHZ Radio Unit. Test Eng. WSM, Tech MJS 2018-0193



23:18:33 08.11.2018

Horizontal Polarization - 1 MHz RBW- 345 degree Azimuth; 1.58m Elevation
Horizontal – 94-98 GHz

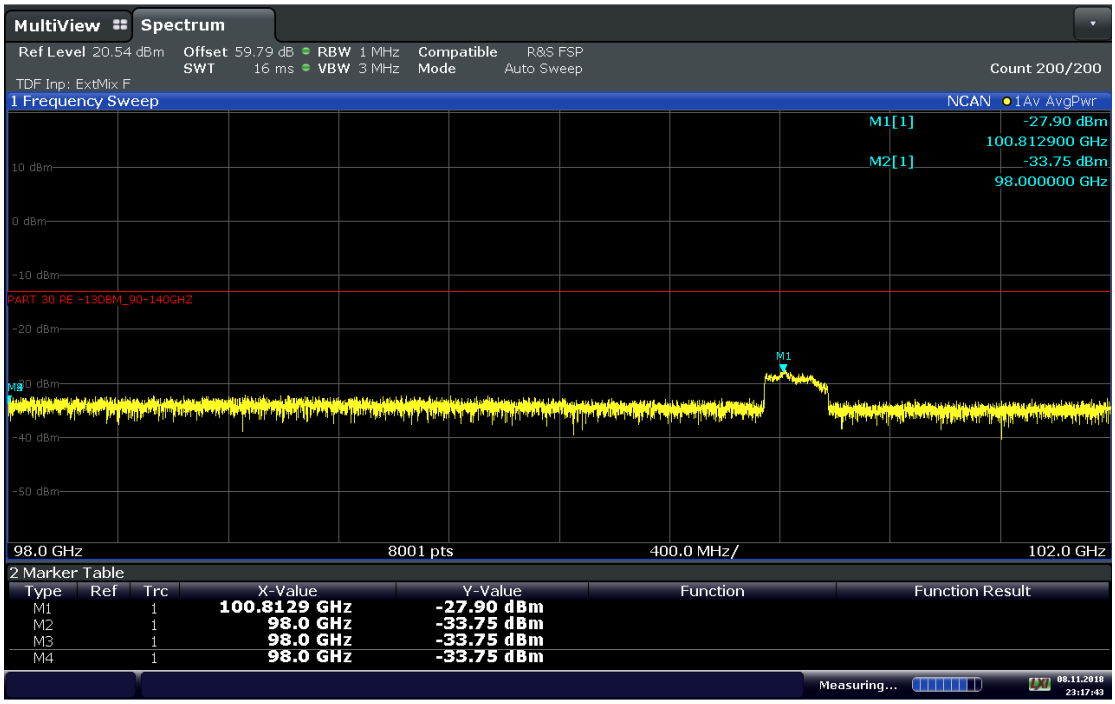
AEWF 39 GHZ Radio Unit. Test Eng. WSM, Tech MJS 2018-0193



23:12:28 08.11.2018

Horizontal – 98-102 GHz

AEWF 39 GHZ Radio Unit. Test Eng. WSM, Tech MJS 2018-0193



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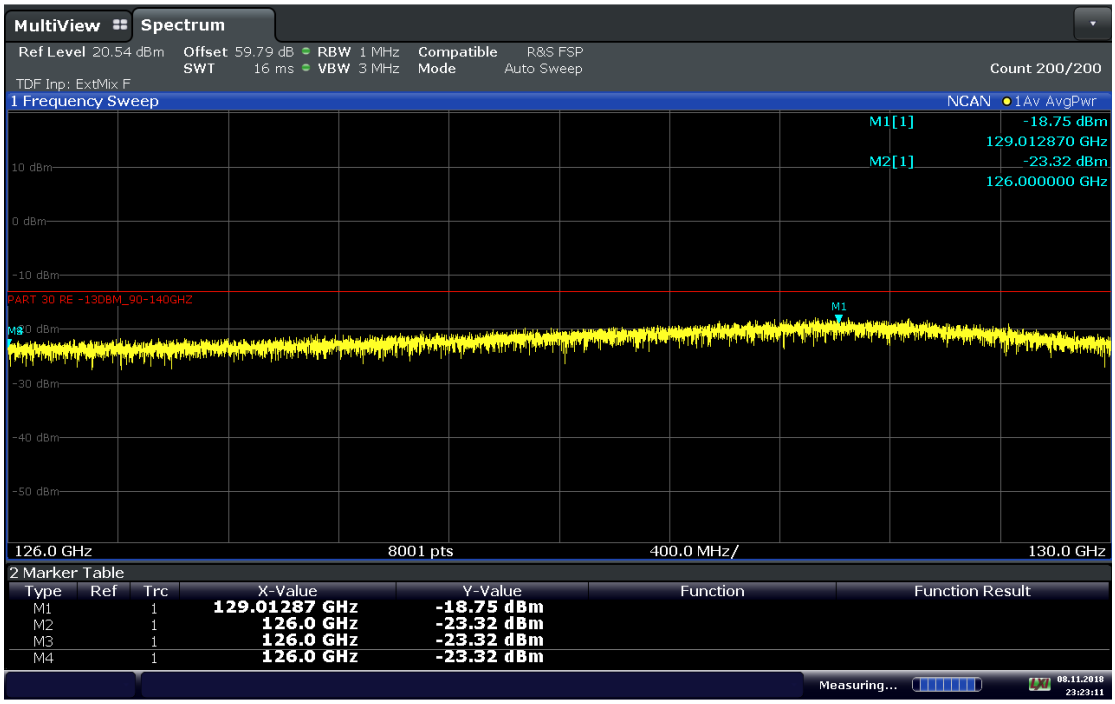
Horizontal – 98-102 GHz

AEWF 39 GHZ Radio Unit. Test Eng. WSM, Tech MJS 2018-0193

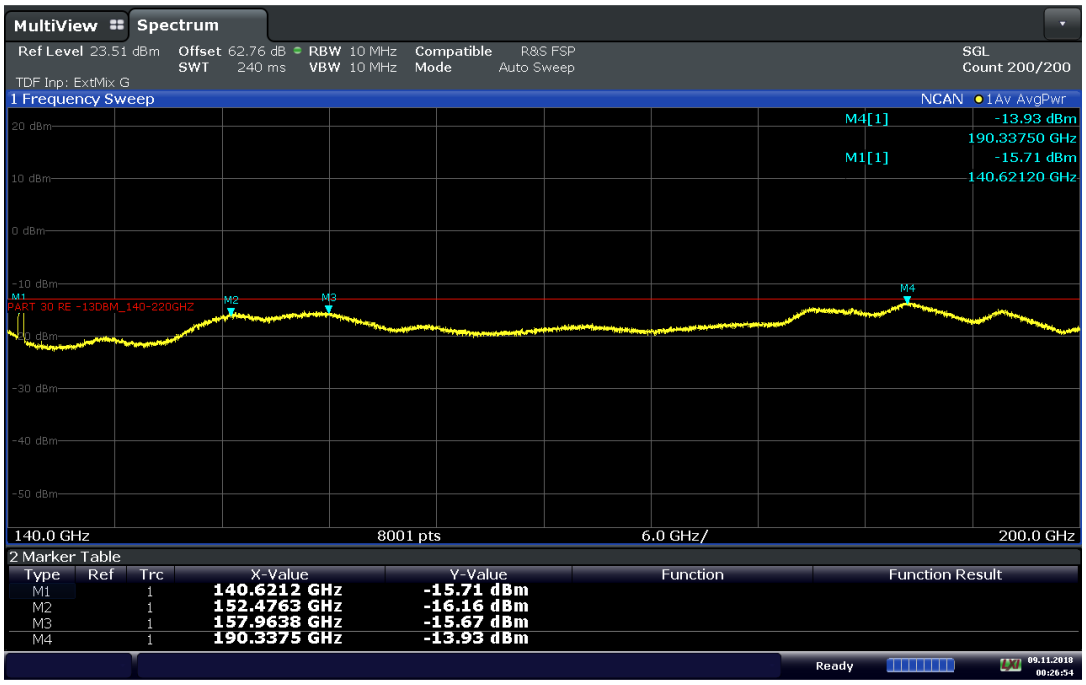


23:23:12 08.11.2018

Peak Search Radiated Emissions -G Band 140 - 200GHz - at 3m 10 MHz RBW

Vertical Polarization - 10 MHz RBW - Max Hold 0-360 degree Azimuth; 1-3m Elevation

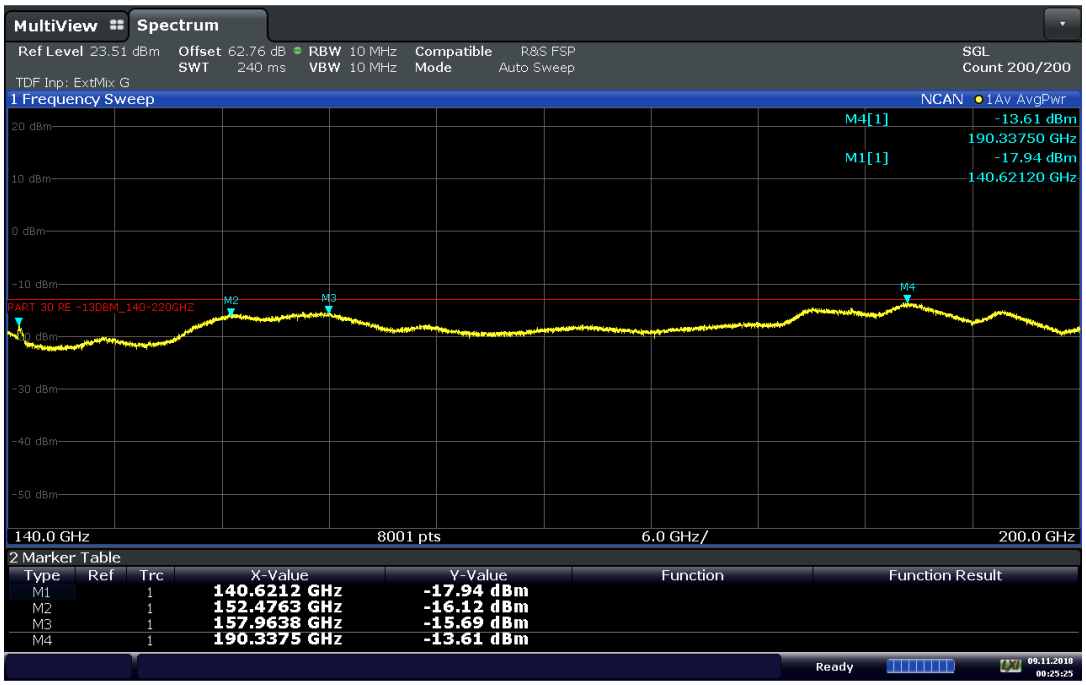
AEWF 39 GHZ Radio Unit. Test Eng. WSM, Tech MJS 2018-0193



00:26:54 09.11.2018

Horizontal Polarization - 10 MHz RBW - Max Hold 0-360 degree Azimuth; 1-3m Elevation

AEWF 39 GHZ Radio Unit. Test Eng. WSM, Tech MJS 2018-0193



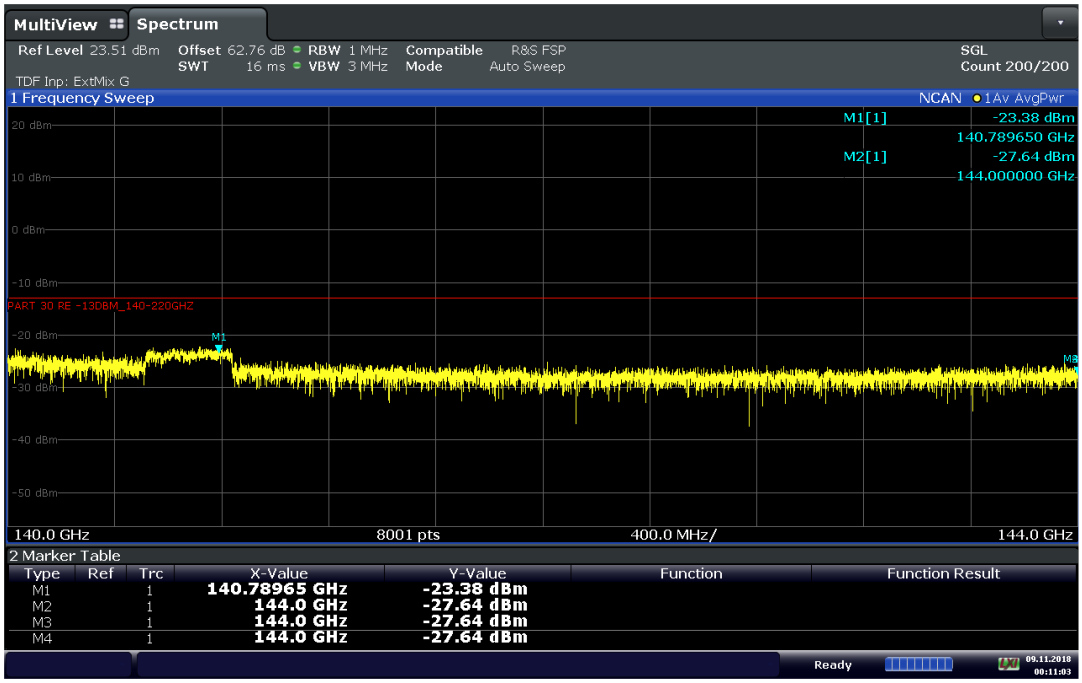
00:25:25 09.11.2018

Maximum Radiated Emissions - G Band 140 - 200GHz - at 3m 1 MHz RBW

Vertical Polarization - 1 MHz RBW - 345 degree Azimuth; 1.79m Elevation

Vertical – 140-144 GHz

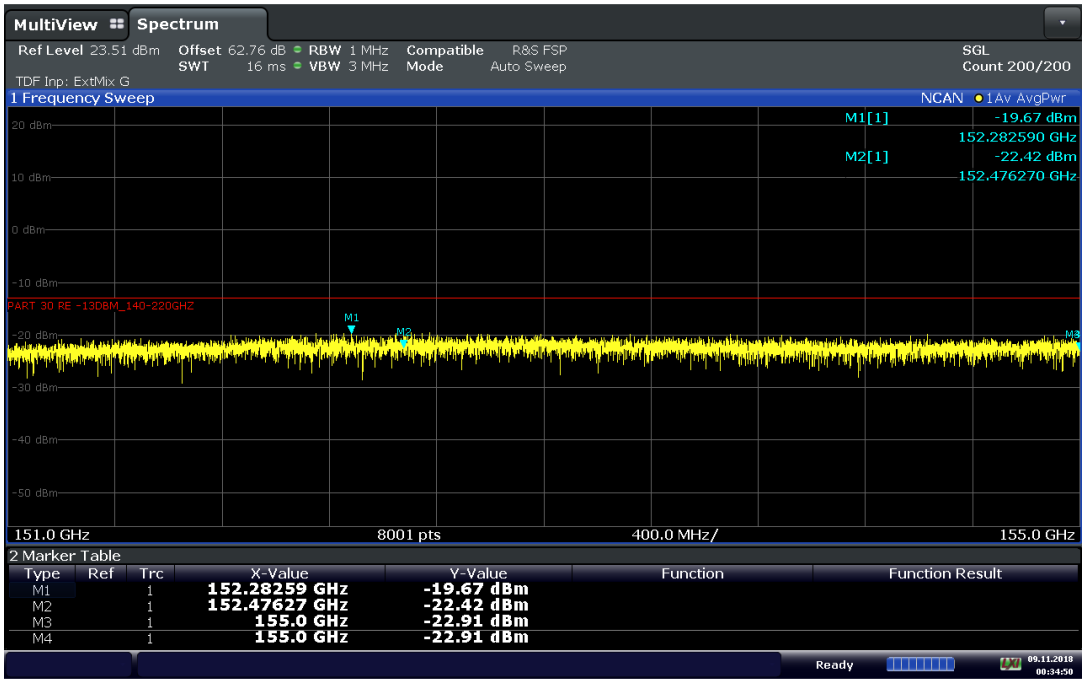
AEWF 39 GHZ Radio Unit. Test Eng. WSM, Tech MJS 2018-0193



00:11:03 09.11.2018

Vertical – 151-155 GHz

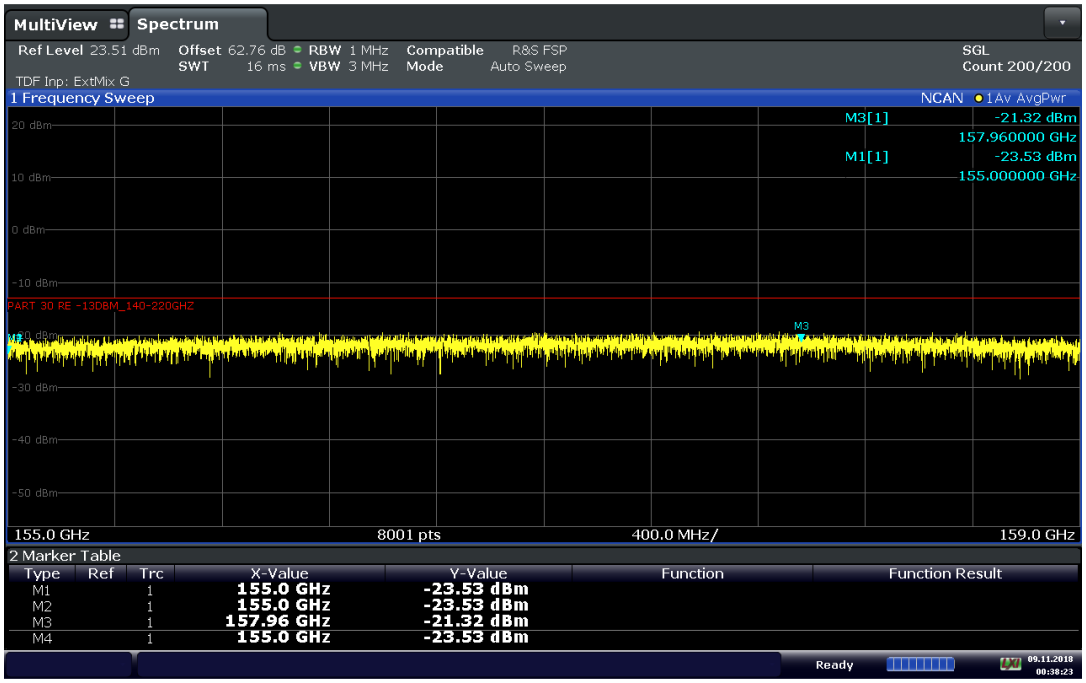
AEWF 39 GHZ Radio Unit. Test Eng. WSM, Tech MJS 2018-0193



00:34:50 09.11.2018

Vertical – 155-159 GHz

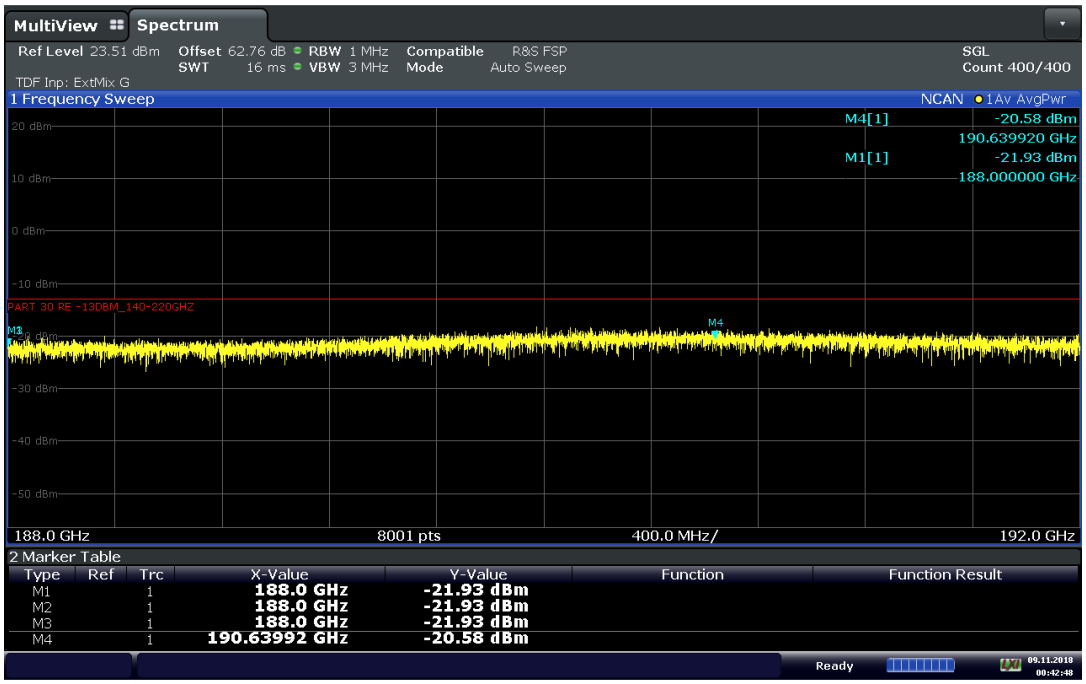
AEWF 39 GHZ Radio Unit. Test Eng. WSM, Tech MJS 2018-0193



00:38:23 09.11.2018

Vertical – 188-192 GHz

AEWF 39 GHZ Radio Unit. Test Eng. WSM, Tech MJS 2018-0193

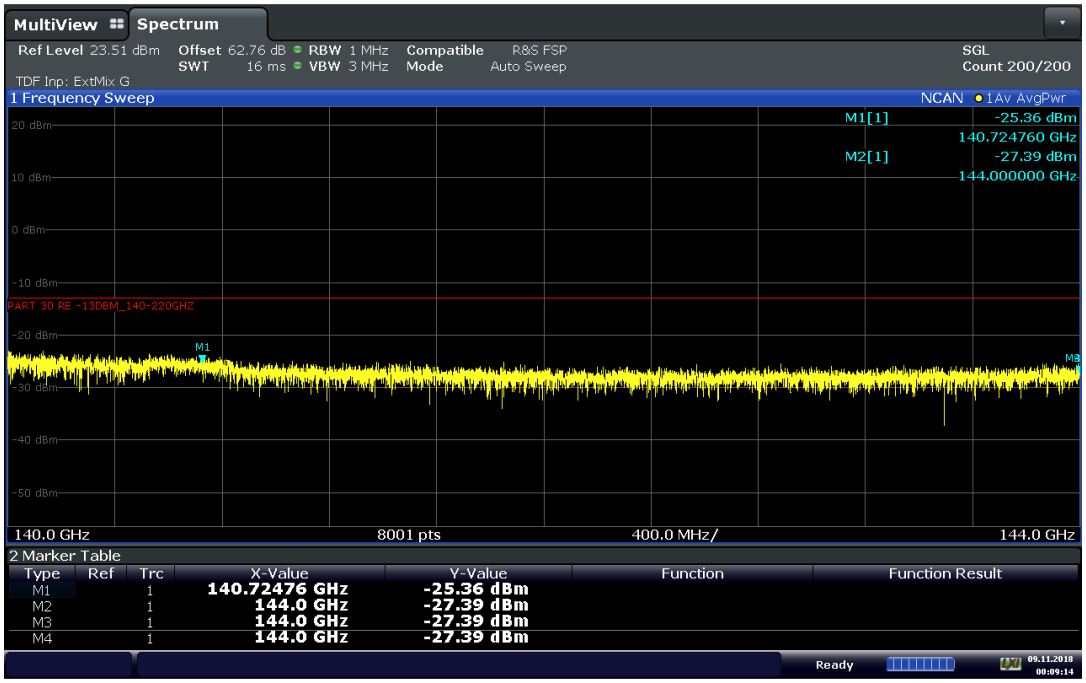


00:42:49 09.11.2018

Horizontal Polarization - 1 MHz RBW- 345 degree Azimuth; 1.54m Elevation - at 3m

Horizontal – 140-144 GHz

AEWF 39 GHZ Radio Unit. Test Eng. WSM, Tech MJS 2018-0193



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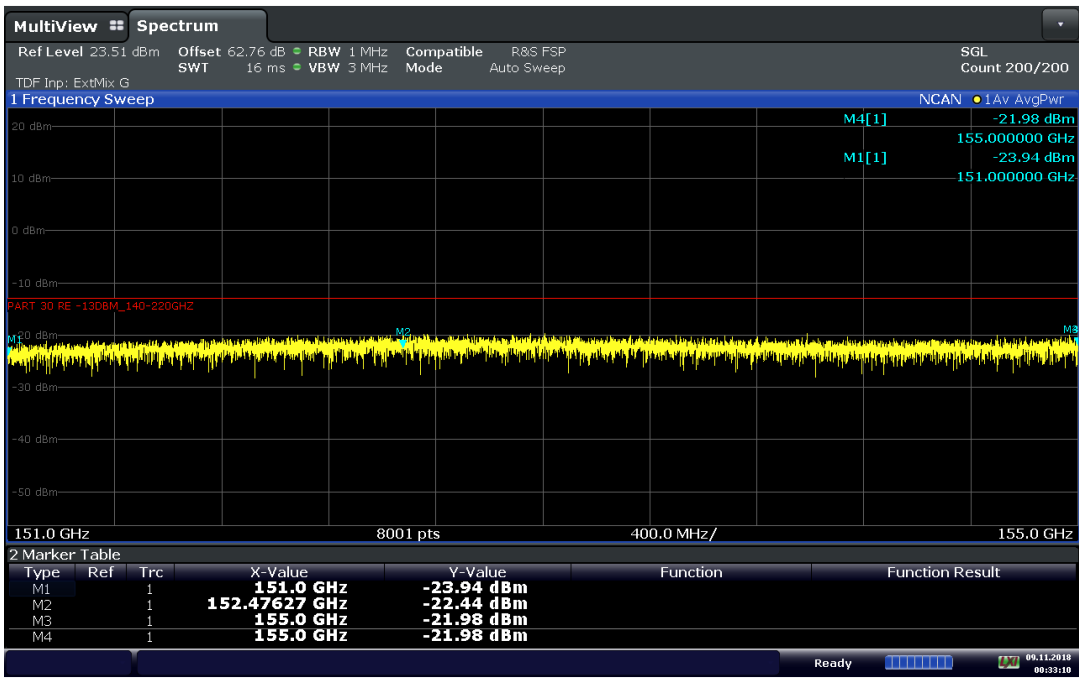
Horizontal – 151-155 GHz

AEWF 39 GHZ Radio Unit. Test Eng. WSM, Tech MJS 2018-0193



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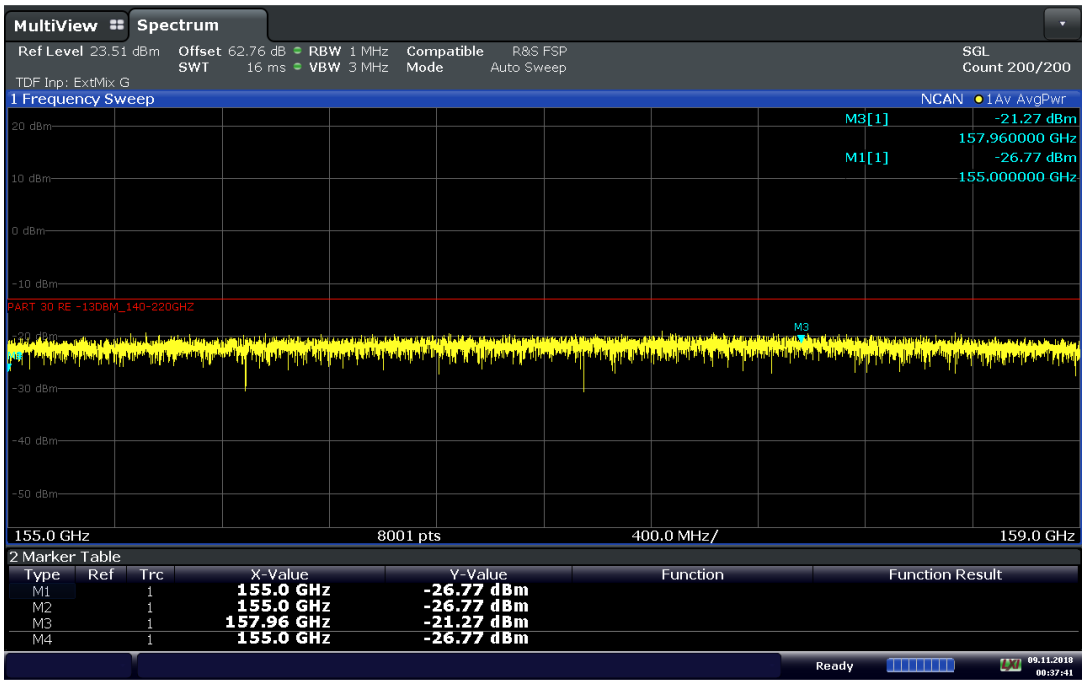
Horizontal – 155-159 GHz

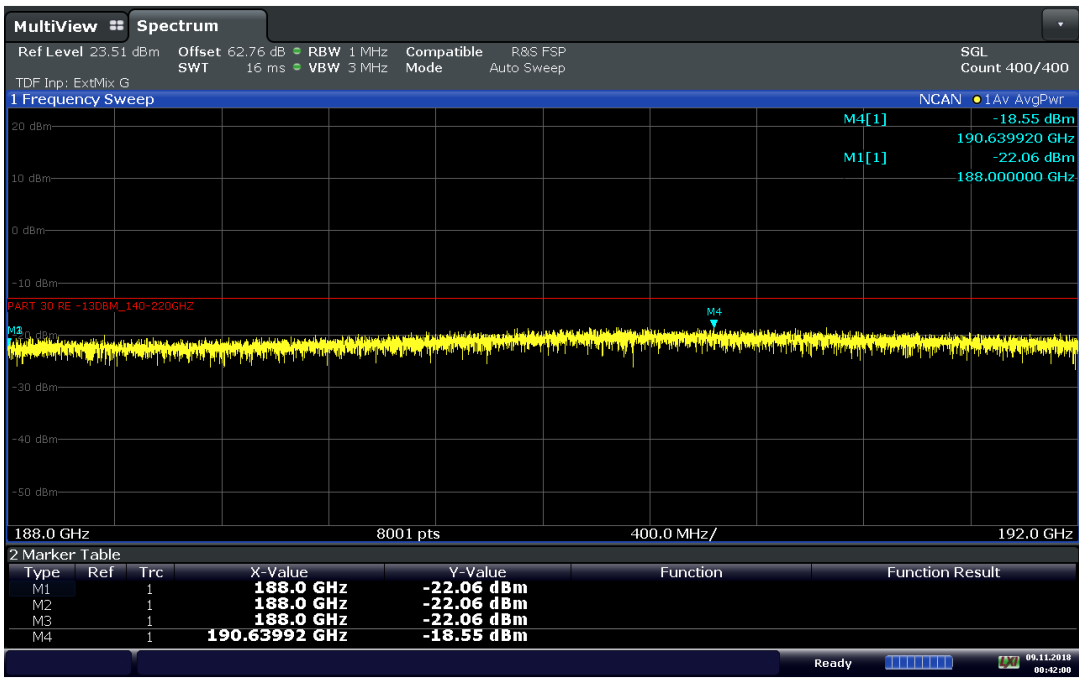
AEWF 39 GHZ Radio Unit. Test Eng. WSM, Tech MJS 2018-0193



00:37:42 09.11.2018

Horizontal – 188-192 GHz

AEWF 39 GHZ Radio Unit. Test Eng. WSM, Tech MJS 2018-0193



00:42:00 09.11.2018

4.6 Section 2.1055 MEASUREMENT REQUIRED: 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 Test Article and Configuration

The unit under test is identified as follows:

Series	Vendor	Serial Number	Comcode	Version
AEWF	Nokia	L1182710698	474864A.X21	DC
AEWF	Nokia	L1182902829	474214A.101	AC

4.6.2 Frequency Stability Test

Frequency Stability Testing was performed on the **Nokia AirScale 39 GHz Radio Unit (AEWF) FCC ID: VBNAEWF-01**. The **AEWF** is a 39 GHz RRH with a center frequency of 38.3553 MHz. The testing was performed on the DC powered AEWF 39 GHz RRH from 11/07/2018 through 11/08/2018. The product was configured with the external fan option per Figure 4.6.2 and tested in the T-14 Thermal chamber of the GPCL test facility located in Building 4, Room 4-278, Murray Hill, NJ. Testing was witnessed by Joe Bordonaro from GPCL. The UUT was subjected to a range of temperature from ambient to +50ºC to -30ºC and back to ambient. The transmit frequency error in this case was measured by capturing the transmitted signal using a receiving antenna and then cabling it to an MXA signal analyzer. Frequency Tolerance is a measurement of the difference between the actual transmit frequency and the assigned frequency (38.3553 GHz). The system level Frequency Stability testing of the UUT yielded results in compliance with established design criteria.

4.6.3 Frequency Stability Test Equipment

Type	Model	Vendor	Serial Number	Cal Due Date
Temperature Logger	MV2000	Yokogawa	SSH103438	9/12/2019
MXA	N9020B	Keysight	MY57431033	8/02/2019
DC Power Supply	GEN60-85	TDK/Lambda	9809175	N/A
AC Source	BL 1350	Behlman	-	N/A

4.6.4 Frequency Stability Test process

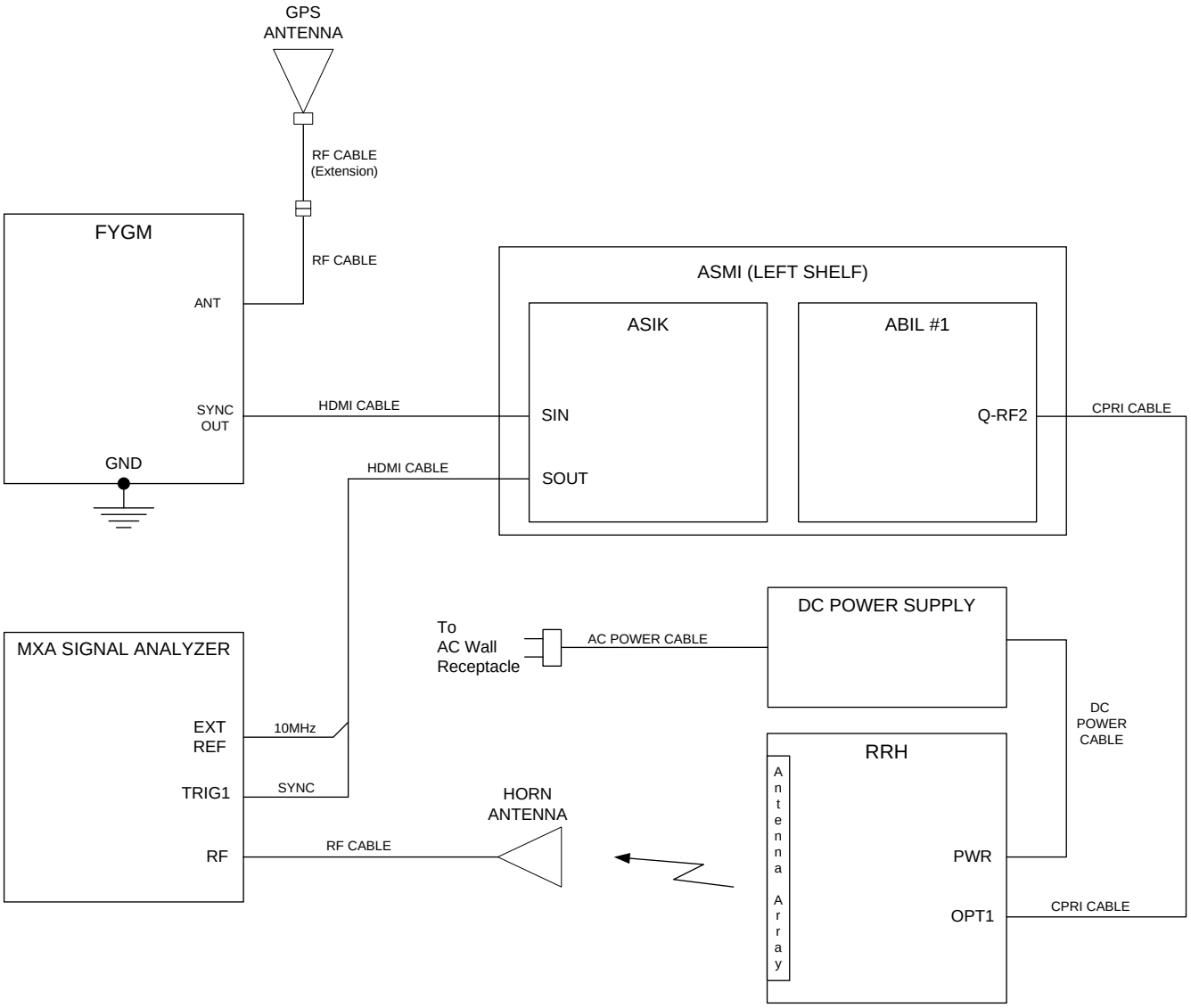
Set the power supply to nominal Voltage. (b) Record the frequency at ~25°C. (c)Raise EUT operating temperature to 50°C. (d)Record the frequency difference. (e) Repeat step (d) at each 10°C step down to -30°C. Result will be 10 readings and take temperature readings to establish thermal stability at each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

4.6.5 Frequency Stability Results:

The worst case Frequency Stability over temperature and voltage for the DC Product was **-916.3 Hz** which is **-0.0239 ppm.**
This performance is within the +/- 0.05ppm desired performance required for LTE operation.

FIGURE 4.6.2: Frequency Stability Test Set-Up

DC Power



4.6.6 Frequency Stability Test Photos

Photographs of the Frequency Stability test setups are in the Test Photos Section.

4.6.7 Frequency Stability Data:

Frequency Block Tested: *PRI20184090 – AEWF 39GHz RRH (CF = 38,355.3MHz)*

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

Baseline Measurement at +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-21.0**
0.5	**-147.5**
1.0	**118.1**
1.5	**83.5**
2.0	**-44.7**
2.5	**96.4**
3.0	**-54.4**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm); ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +50°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**89.6**
0.5	**-56.1**
1.0	**82.5**
1.5	**73.8**
2.0	**-83.0**
2.5	**97.3**
3.0	**-58.6**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +40°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-42.6**
0.5	**117.0**
1.0	**-51.4**
1.5	**152.4**
2.0	**-47.1**
2.5	**64.9**
3.0	**-50.0**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**93.7**
0.5	**-59.6**
1.0	**-35.8**
1.5	**72.5**
2.0	**-49.7**
2.5	**71.8**
3.0	**-37.7**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**109.5**
0.5	**-48.6**
1.0	**110.1**
1.5	**-49.6**
2.0	**116.3**
2.5	**-97.3**
3.0	**93.1**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-53.8**
0.5	**30.8**
1.0	**82.7**
1.5	**107.6**
2.0	**-45.2**
2.5	**73.1**
3.0	**-51.4**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at 0°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-38.3**
0.5	**90.2**
1.0	**-55.7**
1.5	**-48.5**
2.0	**90.05**
2.5	**93.8**
3.0	**-55.1**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at -10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-53.9**
0.5	**85.7**
1.0	**-47.7**
1.5	**95.7**
2.0	**78.1**
2.5	**-31.7**
3.0	**96.1**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at -20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**108.1**
0.5	**-46.9**
1.0	**103.4**
1.5	**-57.2**
2.0	**-48.9**
2.5	**80.1**
3.0	**97.2**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at -30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-37.4**
0.5	**86.6**
1.0	**-54.9**
1.5	**48.8**
2.0	**-54.0**
2.5	**89.1**
3.0	**-81.1**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Upon return to +25°C.

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

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**88.0**
0.5	**-55.3**
1.0	**12.6**
1.5	**1.8**
2.0	**-66.5**
2.5	**34.7**
3.0	**48.6**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 103% of Nominal Voltage, -49.44VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-30.1**
0.5	**84.8**
1.0	**-22.5**
1.5	**-58.8**
2.0	**61.0**
2.5	**-7.3**
3.0	**32.8**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 106% of Nominal Voltage, -50.88VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-32.6**
0.5	**-6.3**
1.0	**669.2**
1.5	**-25.2**
2.0	**-59.5**
2.5	**-4.3**
3.0	**7.2**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm) ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 109% of Nominal Voltage, -52.32VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**59.3**
0.5	**99.5**
1.0	**-46.5**
1.5	**57.9**
2.0	**-35.6**
2.5	**20.4**
3.0	**-45.2**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 112% of Nominal Voltage, -53.76VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**20.6**
0.5	**-29.8**
1.0	**-27.2**
1.5	**22.3**
2.0	**-34.3**
2.5	**-35.4**
3.0	**59.3**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 115% of Nominal Voltage, -55.20VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-28.6**
0.5	**-42.3**
1.0	**730.5**
1.5	**-57.1**
2.0	**66.2**
2.5	**-24.5**
3.0	**72.8**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48.0VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-27.2**
0.5	**77.1**
1.0	**-14.3**
1.5	**81.7**
2.0	**-33.5**
2.5	**-19.2**
3.0	**102.2**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -3% of Nominal Voltage, -46.56VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-23.9**
0.5	**-25.6**
1.0	**-29.8**
1.5	**-54.0**
2.0	**82.4**
2.5	**36.5**
3.0	**-23.8**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -6% of Nominal Voltage, -45.12VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**75.2**
0.5	**53.8**
1.0	**-33.8**
1.5	**89.7**
2.0	**-30.3**
2.5	**-25.4**
3.0	**-27.6**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -9% of Nominal Voltage, -43.68VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**12.9**
0.5	**-13.3**
1.0	**-37.6**
1.5	**84.4**
2.0	**-72.4**
2.5	**6.4**
3.0	**-11.6**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -12% of Nominal Voltage, -42.24VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-29.4**
0.5	**-16.4**
1.0	**12.2**
1.5	**41.9**
2.0	**-34.6**
2.5	**-24.8**
3.0	**62.4**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -15% of Nominal Voltage, -40.80VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-8.2**
0.5	**97.4**
1.0	**-916.3**
1.5	**96.8**
2.0	**-20.9**
2.5	**85.2**
3.0	**-33.9**
FCC SPECIFICATION	**38,355.3MHz (±0.05ppm), ±0.05ppm = ±1917Hz**
FCC RESULT	**PASS**

4.7 List of Test Equipment

4.7.1 List of Radiated Emissions Test Equipment

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

Asset ID	Manufacturer	Type	Description	Model	Serial	Cal Date	Cal Due	Cal Type
E051	EMCO	Biconical Antenna	30 MHz - 200 MHz	3109	2187	12/1/2016	12/1/2018	Requires Calibration
E061	EMCO	Log Periodic Antenna	200 MHz - 1000 MHz	3146	2082	5/24/2017	5/24/2019	Requires Calibration
E447	Hewlett Packard	Pre-Amplifier	Preamplifier 1-26.5 GHz	8449B	3008A01384	4/10/2018	4/10/2020	Requires Calibration
E479	Hewlett Packard	HP-IB Extender		37204	3212U31137			Calibration Not Required
E481	Hewlett Packard	HP-IB Extender		37204	3212U31136			Calibration Not Required
E485	Kikusui	Power Supply	DC 55 Volts 120 Amps	PAD 55-120L	DL000416			Verification
E494	Sonoma Instrument Co.	Amplifier	9kHz-1GHz	310N	185785	1/9/2018	1/9/2020	Requires Calibration
E889	Weinschel	Attenuator	6 dB DC-18GHz 5 Watt	43137	BX3438	5/23/2018	5/23/2020	Requires Calibration
E907	Rohde & Schwarz	Test Receiver	EMI (20Hz to 40 GHz)-	ESIB40	100101	4/17/2018	4/17/2020	Requires Calibration
E949	Agilent Technologies	Power Sensor	-35 - +20 dBm 50 MHz -18 GHz	N1921A	MY45242502	4/2/2018	4/2/2020	Requires Calibration
E950	Agilent Technologies	Power Meter	P-Series	N1911A	MY45101984	3/29/2018	3/29/2020	Requires Calibration
E964	Rohde & Schwarz	Test Receiver	EMI 20Hz - 40GHz	ESU40	100247	12/5/2016	12/5/2018	Requires Calibration
E980	Trilithic	Low Pass Filter	PCS	10LC1790-3-AA	PCS-LPF-12			Verification
E1073	ETS Lindgren	Horn Antenna	Double-Ridged Waveguide Horn 1-18 GHz	3117	135198	6/9/2017	6/9/2019	Requires Calibration
E1089	Weinschel	Attenuator	10dB 25W DC-18GHz	46-10-34	CB5229	6/26/2018	6/26/2020	Requires Calibration
E1120	Extech	Data Logger	Pressure Humidity Temp Data Logger	SD700	Q673552	10/26/2016	10/26/2018	Requires Calibration
E1166	Agilent Technologies	Amplifier	Pre-Amplifier 1-26.5GHz	8449B	3008A01740	2/25/2016	8/25/2018	Requires Calibration
E1255	ETS Lindgren	Multi-Device Controller		2090	78509			Calibration Not Required
E1260	Rohde & Schwarz	Spectrum Analyzer	2 Hz- 67 GHz	FSW67	104007	2/12/2018	2/12/2020	Requires Calibration

Asset ID	Manufacturer	Type	Description	Model	Serial	Cal Date	Cal Due	Cal Type
E1264	KeySight Technologies	Signal Generator		E8257D	MY53402943	8/28/2017	8/28/2019	Requires Calibration
E1308	Rohde & Schwarz	Harmonic Mixer	Down Converter 90-140GHz	FS-Z140	101008			Factory
E1311	Rohde & Schwarz	Harmonic Mixer	Down Converter, 40-60GHz	FS-Z60	100977			Factory
E1312	Rohde & Schwarz	Harmonic Mixer	Down Converter, 60-90GHz	FS-Z90	101719			Factory
E1313	Rohde & Schwarz	Harmonic Mixer	Down Converter, 140-220GHz	FS-Z220	100960			Factory
E1315	RS Microwave Company, Inc.	Microwave Filter	37 GHz High Pass Filter	P/N 60733A	7	10/6/2018	11/6/2019	Verification
E1323	Mi-Wave (Millmeter Wave Products, Inc.)	Horn Antenna	140 – 220 GHz	261G-25/387				Factory
E1328	A-Info	Horn Antenna	26.5-40GHz WR28 25dB	LB-28-25-C2-KF	J202023250	10/16/2018	10/16/2021	
E1330	Sage Millimeter, Inc.	Horn Antenna	U-band pyramidal horn antenna - 40 to 60 GHz	SAR-2309-19-S2	14853-01	4/17/2018		Factory
E1332	Sage Millimeter, Inc.	Horn Antenna	E-band pyramidal horn antenna - 60 to 90 GHz.	SAR-2309-12-S2	14853-01	4/17/2018		Factory
E1335	Sage Millimeter, Inc.	Horn Antenna	F-band pyramidal horn antenna - 90 to 140 GHz	SAR-2309-08-S2	14853-02	4/17/2018		Factory
E1338	KeySight Technologies	MXA Signal Analyzer	10 Hz - 44 GHz	N9020B	MY57430927	9/13/2018	9/13/2020	Requires Calibration
E1340	Sage Millimeter, Inc.	Horn Antenna	Pyramidal horn antenna - 26.5 to 40 GHz, 25 dB gain	SAR-2507-28-S2	15309-01	4/17/2018		Factory
E1363	A-Info	Horn Antenna	26.5-40GHz WR28 dB	LB-28-25-C2-KF	J202062675	10/16/2018	10/16/2021	Requires Calibration

4.8 PHOTOGRAPHS OF THE TEST SETUPS

Response:

The photographs of the test setups for the **AirScale 39 GHz Radio Unit (AEWF) Band 30, FCC ID: VBNAEWF-01** are provided in the Filing exhibits.

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 three meter semi-anechoic chamber AR-8, (FCC Registration Number: 395774) **NVLAP** Lab Code: 100275-0 and IC (Filing Number: 6933F-8) which is maintained by Nokia Bell Labs in Murray Hill, New Jersey. The sites were constructed and are continuously in conformance with the requirements of ANSI C63.4 and CISPR Publication 22.

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

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

and is as listed in the Table below.

OET Accredited Test Firm Scope List

Test Firm: Nokia, Global Product Compliance Lab

Scope	FCC Rule Parts	Maximum Assessed Frequency, MHz	Status	Expiration Date	Recognition Date
Unintentional Radiators	FCC Part15, Subpart B	40000	Approved	9/30/2018	7/6/2017
Intentional Radiators	FCC Part 15 Subpart C	40000	Approved	9/30/2018	6/5/2018
U-NII without DFS Intentional Radiators	FCC Part 15, Subpart E	40000	Approved	9/30/2018	6/5/2018
U-NII with DFS Intentional Radiators	FCC Part 15, Subpart E	40000	Approved	9/30/2018	6/5/2018
Commercial Mobile Services	Part 22 (cellular), Part 24, Part 25 (below 3 GHz), Part 27	40000	Approved	9/30/2018	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	9/30/2018	6/5/2018
Citizens Broadband Radio Services	Part 96	40000	Approved	9/30/2018	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	9/30/2018	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®

Certificate of Accreditation to ISO/IEC 17025:2005

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 17025:2005. 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).

2017-08-17 through 2018-09-30
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.