

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

TESTING NVLAP LAB CODE: 100275-0

# **FCC Test Report**

Regulation: FCC Part 2 and 27

Client: Nokia Mobile Networks

Product Evaluated: AAHE - Small Band 10 MHz

Report Number: TR-2018-0226-FCC2-27

> Date Issued: January 03, 2019

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#### Revisions

Date	Revision	Section	Change
1/03/2019	0		Initial Release

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1/03/2019

1/03/2019

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aynon .

1/03/2019

Raymond Johnson Technical Manager

PUBLIC

# **1.** System Information and Requirements

Equipment Under Test (EUT):	AAHE - Small Band 10 MHz
Equipment Under Test (EUT).	FCCID: VBNAAHE-01
Serial Number:	6Q184012463
Cell Name / Number	GPCL Project Number: 2018-0226
	NOKIA SOLUTIONS AND NETWORKS OY
Company:	KARAPORTTI 3, FI-02610 ESPOO
	FINLAND
Manufacturer:	NOKIA SOLUTIONS AND NETWORKS OY
Test Requirement(s):	47 CFR FCC Part 2 and 27
Test Standards	47 CFR FCC Parts 2 and 27
	KDB 971168 D01 Power Measurement License Digital Systems
	v03r01 April 9, 2018.
	KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013
Measurement Procedure(s):	FCC-IC-OB - GPCL Occupied Bandwidth and Power Measurement Test
	Procedure 12-4-2017
	FCC-IC-SE - GPCL Spurious Emissions Test Procedure 12-4-2017
Reference(s):	• ANSI C63.26 (2015)
	• ANSI C63.4 (2014)
Test Date(s):	July 30 - October 05, 2018
Test Performed By:	Nokia
·	Global Product Compliance Laboratory
	600-700 Mountain Ave.
	P.O. Box 636
	Murray Hill, NJ 07974-0636
Nokia Global Product Compliance Laborate	ries is accredited by the National Voluntary Laboratory Accreditation Program
	Scope of Accreditation, for: Electromagnetic Compatibility and Telecommunications.
	ith the recognized International Standard ISO/IEC 17025:2005. This accreditation
	ed scope and the operation of a laboratory quality management system (refer to joint
ISO-ILAC-IAF Communiqué dated January 20	
Product Engineer(s):	Ron Remy
Lead Engineer	Steve Gordon
Test Engineer (s):	Jaideep Yadav, Eugene Mitchell, Mike Soli
	) MHz, as tested met the above listed requirements. Report copies and other
	e held by either the product engineer or in an identified file at the Global
Product Compliance Laboratory in New P	rovidence. NJ.

### **1.1 Introduction**

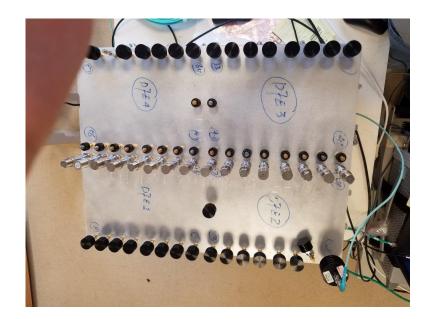
This Conformity test report applies to the AAHE - Small Band 10 MHz, hereinafter referred to as the Equipment Under Test (EUT).

#### **1.2 Purpose and Scope**

The purpose of this document is to provide the testing data required for qualifying the EUT in compliance with FCC Parts 2 and 27 measured in accordance with the procedures set out in Section 2.1033 (c) (14) of the Rules.

#### **1.3 EUT Details**

The EUT was tested for Class II Permissive change to add a new low channel frequency (2628.8 MHz), new 10 MHz single carrier bandwidth, and 20+10 MHz multiple carrier operation to the existing Grant. Multi Carrier operation is restricted to placement of carriers within a bandwidth of 60 MHz.





### **1.3.1** Test Requirements

Each required measurement is listed below:

47 CFR FCC Sections	Description of Tests	Test Required
2.1046	RF Power Output	Yes
2.1047	Modulation Characteristics	Yes
2.1049	<ul><li>(a) Occupied Bandwidth</li><li>(b) Out-of-Band Emissions</li></ul>	Yes
2.1051	Spurious Emissions at Antenna Terminals	Yes
2.1053	Field Strength of Spurious Radiation	Yes

### **1.4 Reference Documents, Test Specifications & Procedures**

A list of the applicable documents is provided in Section 1.0.

### **1.4.1 Test Specifications**

- Title 47 Code of Federal Regulations, Federal Communications Commission Part 2.
- Title 47 Code of Federal Regulations, Federal Communications Commission Part 27.

## **1.4.2 Procedures**

- 1. FCC-IC-0B and FCC-IC-SE
- ANSI C63.4 (2014) entitled: "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz", American National Standards Institute, Institute of Electrical and Electronic Engineers, Inc., New York, NY 10017-2394, USA.
- 3. FCC KDB 971168 D01 Power Measurement License Digital Systems v03r01 April 9, 2018. FCC KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013

#### **1.4.3 MEASUREMENT UNCERTAINTY**

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

	Standard, Method or Procedure	Condition	Frequency MHz	Expanded Uncertainty (k=2)
a.	Classical Emissions, ( <i>e.g.</i> , ANSI C63.4, CISPR 11, 14, 22, <i>etc.</i> , using ESHS 30,		0.009 - 30	±3.5 dB
		Radiated Emissions (AR-6 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	±5.1 dB ±5.1 dB ±4.7 dB ±4.7 dB ±3.3 dB

#### **Worst-Case Estimated Measurement Uncertainties**

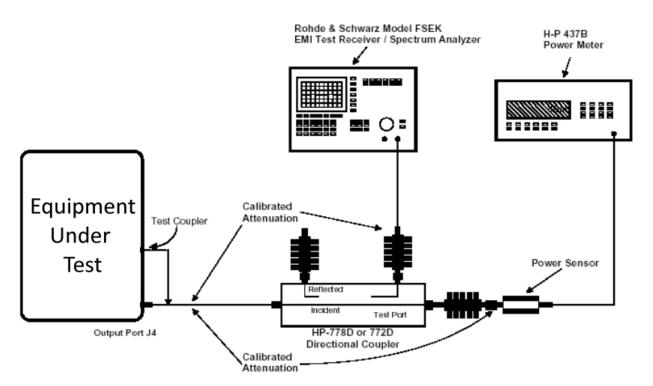
Antenna Port Test	Signal Bandwidth	Frequency Range	Expanded Uncertainty (k=2), Amplitude
	10 Hz	9 kHz to 20 MHz	
Occupied Bandwidth, Edge of Band,	100 Hz	20 MHz to 1 GHz	1.78 dB
Conducted Spurious Emissions	10 kHz to 1 MHz	1 GHz to 10 GHz	1.78 dB
	1MHz	10 GHz to 40 GHz:	
RF Power	10 Hz to 20 MHz	50 MHz to 18 GHz	0.5 dB

### **1.5 Executive Summary**

Requirement	Description	Result
47 CFR FCC Parts 2 and 27		
2.1046	RF Power Output Peak to Average Power Ratio	COMPLIES
2.1047	Modulation Characteristics	COMPLIES
2.1049	Occupied Bandwidth	COMPLIES
	(a) Emissions Signal Bandwidth	
	(b) Occupied Bandwidth/ Edge of Band Emissions	
2.1051	Spurious Emissions at Antenna Terminals	COMPLIES
2.1053	Field Strength of Spurious Radiation	COMPLIES

- 1. **COMPLIES -** Passed all applicable tests.
- 2. N/A Not Applicable.
- 3. **NT** Not Tested.

### **1.6** Test Configuration for all Antenna Port Measurements.



# 2. FCC Section 2.1046 - RF Power Output

### 2.1 RF Power Output

This test is a measurement of the total RF power level transmitted at the antenna-transmitting terminal. The product was configured for test as shown in section 1.6 above and allowed to warm up and stabilize per KDB 971168 D01 and ANSI C63.26.

Power measurements were made with a broadband Power Meter in the average mode. Before the testing was started, the Base Station was given a sufficient "warm-up" period as required.

NOTE: Only a sample of all the plots taken have been used in this report. The full suite of raw data resides at the MH, New Jersey location.

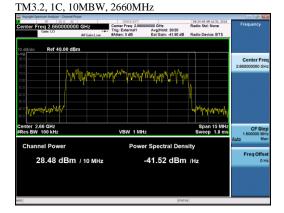
Modulation	Signal BW		
	MHz	Channel Frequency	Channel Power
		MHz	dBm
QPSK+16QAM	10	2633.8	28.34
		2635	29.05
		2660	28.48
		2685	28.63
64QAM	10	2633.8	28.34
		2635	28.30
		2660	27.99
		2685	28.25
256QAM	10	2633.8	29.05
		2635	28.11
		2660	28.73
		2685	29.01
QPSK+16QAM	20	2638.8	27.78
256QAM	20	2680.0	27.80
QPSK+16QAM	10+20 Contiguous	2634+2649	31.41
	ç	2665+2685	30.23
QPSK+16QAM	10+20 Non-Contiguous	2633.88+2678.8	31.13

|--|

### 2.1.1 Channel RF Power - Plots.

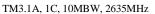
#### TM3.1, 1C, 10MBW, 2633.8MHz

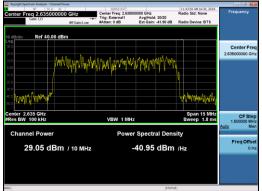
Cherrer Freq 2.633500000 OHz Britain Error Station Conference 3.8300000 OHz Britain Error Station Conference 3.830000 OH Britain Error Statio	Keysight Spectrum Analyzer - Chann	el Power			08:00:48 AM Jul 31, 2018	- 6 -
Channel Power Power Spectral Density	Center Freq 2.633800	1	Center Freq: 2.633 Trig: External1	Avg Hold: 20/20	Radio Std: None	Frequency
Channel Power Power Spectral Density		dBm				
channel Power Power Spectral Density	x0	אוייייע אין אין אין אין	alahaansaad	whereast, Wind Prot		Center Free 2.633800000 GH;
enter 2.034 GHz Res BW 100 kHz Channel Power Power Spectral Density FreqOffse	0.0	á volá fladis. Ji	te le âtre de de a	and other at the		
Res BW 100 kHz VBW 1 MHz Sweep 1.8 ms LCP 306 Channel Power Power Spectral Density Freq Offse	oo Wanina wali					
Channel Power Power Spectral Density			VBW 1 MH	z	Span 15 MHz Sweep 1.8 ms	CF Step 1.500000 MHa Auto Mar
	Channel Power		Powe	er Spectral Dens	sity	
	28.34 dBi	m / 10 MHz		-41.66 dBm	/Hz	Freq Offset 0 Hz
	60			STATE	8	



#### TM3.2, 10+20MBW, 2665/2680MHz

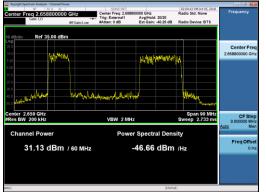
Keysight Spectrum Analyzer - Chann	el Power				- 4
Center Freq 2.675000 Gete: L0	AC 000 GHz #FGain:Low	Center Freq: 2.6750 Trig: External1 #Atten: 6 dB	00000 GHz Avg Hold: 20/20 Ext Gain: -40.20 dB	Radio Std: None Radio Device: BTS	Frequency
10 dB/div Ref 35.00	dBm				
15.0 5.00	hannya	Manager	Windhamash	M	Center Fre 2.675000000 GH
5.00		V.14			
25.0 25.0 45.0 plants/mark/2004/2				harring	
Center 2.675 GHz		VBW 2 MH		Span 45 MHz Sweep 1.4 ms	CF Ste
Channel Power			r Spectral Den		4.500000 Mi Auto Mi
30.23 dB	m / 30 MHz		44.54 dBm	I /Hz	Freq Offs 01
NG			STAT	US	



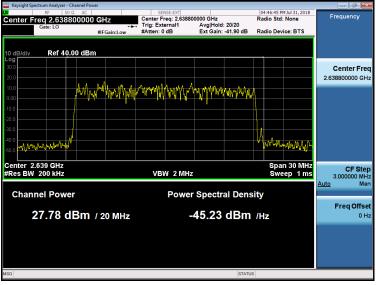


enter Freq 2.68500		Center Freq: 2.6850 Trig: External1 #Atten: 0 dB	00000 GHz Avg Hold: 20/20 Ext Gain: -41.90 dB	Radio Device: BTS	Frequency
dB/div Ref 40.00	dBm				
0	MMMM	www.way	n yyn yr yr yr	ų	Center Fre 2.685000000 GH
				Maria and	
enter 2.685 GHz Res BW 100 kHz		VBW 1 MH:	2	Span 15 MHz Sweep 1.8 ms	CF Ste 1.50000 MH
Channel Power		Powe	r Spectral Dens	sity	<u>Auto</u> Ma
28.63 dE	5 <b>m</b> / 10 MHz		-41.37 dBm	/Hz	Freq Offs 0 F

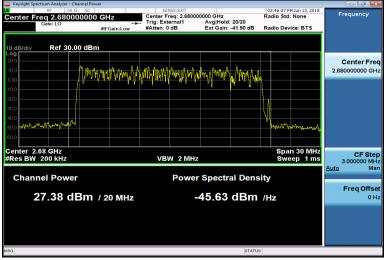
#### TM3.2, 10+20MBW, 2633.8/2678.8MHz



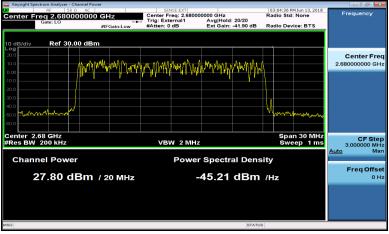
#### TM3.2, 1C, 20MBW, 2638.8 MHz



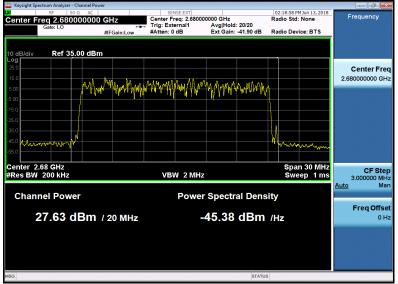
#### TM3.1, 1C, 20MBW, 2680 MHz



#### TM3.1A, 1C, 20MBW, 2680 MHz



#### TM3.2, 1C, 20MBW, 2680 MHz



### **3.** FCC Section 2.1047 - Modulation Characteristics

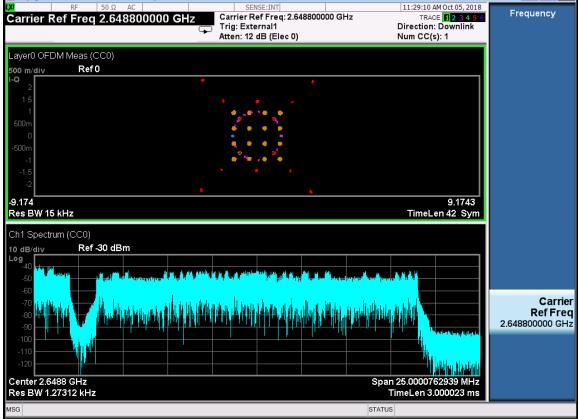
### **3.1 Modulation Characteristics**

The RF signal at the antenna port was demodulated and verified for correctness of the modulation signal used before each test was performed. For these products the operation with QPSK, 16QAM, 64QAM and 256QAM modulation was evaluated and verified.

NOTE: Only a sample of all the data taken have been used in this report. The full suite of raw data resides at the MH, New Jersey location.

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# 4. FCC Section 2.1049 – Occupied Bandwidth

### 4.1 Occupied Bandwidth

#### In 47CFR 2.1049 the FCC requires:

"The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable."

This required measurement is the 99% Occupied Bandwidth, also called the designated signal bandwidth and needs to be within the parameters of the products specified emissions designator. The -26 dB bandwidth values were also recorded.

During these measurements it is customary to evaluate the Edge of Band emissions at block/band edges.

The transmitted signal occupied bandwidth was measured using a Keysight MXA Signal Analyzer. All emissions were within the parameters as previously filed. Sample Charts are below.

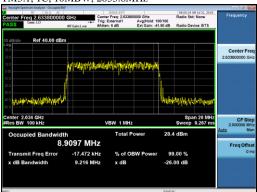
Modulation	Signal BW		
1010uululoit	MHz	Channel Frequency	OBW
		MHz	MHz
QPSK+16QAM	10	2633.8	8.9251
	Γ	2635	8.9280
	T	2660	8.9300
		2685	8.8988
64QAM	10	2633.8	8.9097
	Γ	2635	8.9102
	T	2660	8.9110
	T	2685	8.9090
256QAM	10	2633.8	8.9271
	T	2635	8.9280
	T	2660	8.9298
		2685	8.9298
QPSK+16QAM	20	2638.8	
			17.734
QPSK+16QAM	20	2680.0	
			17.751
QPSK+16QAM	10+20 Contiguous	2634+2649	28.008
-		2665+2685	27.997
QPSK+16QAM	10+20 Non-Contiguous	2633.88+2678.8	8.8730+17.740

Tabular Data - Occupied Bandwidth

### 4.1.1 Occupied Bandwidth – Plots.

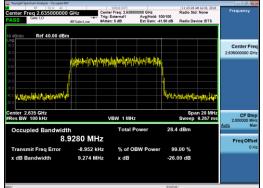
#### TM3.1A, 1C, 10MBW, 2685MHz

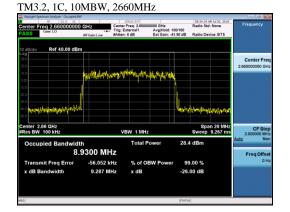
Keysight Spectrum Analyzer - Occupied	BM				- 6 -
Center Freq 2.68500000 Gate: L0	0 GHz	Center Freq: 2.685 Trig: External1 #Atten: 6 dB	000000 GHz Avg Hold: 100/100 Ext Gain: -41.90 dB	Radio Std: None Radio Device: BTS	Frequency
10 dB/div Ref 40.00 dE	3m				
20.0					Center Free 2.685000000 GHz
10.0	<b>ANNIA N</b>	h de la caracteria	har an		
20.0					
*** <b>\_\</b>	4		N <sub>gh1</sub>	hatanan dalaman Malan	
Center 2.685 GHz #Res BW 100 kHz		VBW 1 MH	z	Span 20 MHz Sweep 9.267 ms	CF Step 2.000000 MHz
Occupied Bandwig			Power 28	.2 dBm	Auto Man
පි Transmit Freg Error	.9298 M		BW Power S	9.00 %	Freq Offset 0 Hz
x dB Bandwidth	9.276			5.00 dB	
80			STAT	16	



TM3.1, 1C, 10MBW, 2633.8MHz

#### TM3.1A, 1C, 10MBW, 2635MHz





Keysight Spectrum Analyzer - Occupi File 50 Ω Enter Freq 2.6388000 Gene: L0 Gene: L0	000 GHz	SDISE:DIT Center Freq: 2.6388 Trig: External1	Avg Hold: 100/100	04:46:22 PH3al 31, 2018 Radio Std: None	Frequency
dB/div Ref 40.00 e	and damatow	#Atten: 6 dB	Ext Gain: -41.90 dB	Radio Device: BTS	
0.0	nalamanana	ula da Muzza	nadalista stadante		Center Fre 2.638800000 GH
	eallthiche all hi	n ath ath ath ath	and a hold of the		
and the second second				Madericania	
enter 2.639 GHz Res BW 100 kHz		VBW 1 MH	z	Span 30 MHz Sweep 3.6 ms	CF Ste 3.000000 MH
Occupied Bandw	<sup>idth</sup> 17.734 MH	Total I	Power 28.	5 dBm	Auto Ma Freq Offse
Transmit Freq Error x dB Bandwidth	-62.899 kH 18.19 MH			9.00 % .00 dB	0 H

#### TM3.2, 1C, 20MBW, 2680.0 MHz

Keysight Spectrum Analyzer - Occupied	BW				
Center Freq 2.68000000 PASS Gate: LO		SENSE EXT Center Freq: 2,6800 Trig: External1 IAtten: 6 dB	00000 GHz Avg Hold: 100/100 Ext Gain: -41.90 dB	Contract Con	Frequency
10 dB/div Ref 30.00 dE	Im				
200 100 000	and the second second	ويويوا لبالما والمحمر والم	www.	River Ma	Center Freq 2.68000000 GHz
-20.0					
-30.0					
-50.0					
Center 2.68 GHz #Res BW 100 kHz		VBW 1 MH	z	Span 25 MHz Sweep 11.6 ms	2.500000 MH
Occupied Bandwig		Total F	Power 27	.9 dBm	<u>Auto</u> Mar
	7.751 MHz		BW Power S	99.00 %	Freq Offset 0 Ha
Transmit Freq Error x dB Bandwidth	-53.140 KH 18.64 MH			99.00 % 6.00 dB	
60			STA	TUS	

Keysight Spectrum Analyzer - Occupied B RF 50 Q AC	SW .	SENSE:INT		6	2:09:26 PM Oct 05, 2018	- 6
enter Freq 2.63380000 ASS Gate: LO		enter Freq: 2.6338 rig: External1 Atten: 6 dB	00000 GHz Avg Hold: 10 Ext Gain: -40	R:	dio Std: None dio Device: BTS	Frequency
0 dB/div Ref 40.00 dB	m					
0.0	water	も 例 <sup>例例</sup> 例の の 前	Hadanta hata			Center Fred 2.633800000 GH
00 0.0 0.0		in a stra				
aa aa aa aa ahaa ahaa ahaa ahaa ahaa ah				Witness	unioritan	
enter 2.634 GHz Res BW 100 kHz		VBW 1 MH	z	S	Span 20 MHz veep 9.267 ms	CF Step 2.000000 MH
Occupied Bandwid	th	Total F	Power	28.2 d	Зm	Auto Mar
8	.8730 MHz					Freq Offse
Transmit Freq Error	-26.798 kHz	% of O	BW Power	99.00	%	0 H
x dB Bandwidth	9.270 MHz	x dB		-26.00	dB	
2				STATUS		

#### TM3.2, 10+20MBW, 2633.8/2678.8MHz

enter Freq 2.6788000	00 GHz	SENSE:INT Center Freq: 2.678	800000 GHz	02:09:38 PM Oct 05, 2018 Radio Std: None	Frequency
ASS Gate: LO	#IFGain:Low	#Atten: 6 dB	Avg Hold: 100/100 Ext Gain: -40.20 d		
dB/div Ref 40.00 c	Bm				
<b>99</b> 0.0					Center Fre
0.0					2.678800000 GH
0.0	ALLANK SAMO	Will With Mind	hade have the defe	L.R	
	white we want	trie Al M. Marke	an stated	Pri I	
10					
10				and and a	
Unorth western with				" I'm Wayney	
enter 2.679 GHz				Span 30 MHz	
Res BW 100 kHz		VBW 1 MH	z	Sweep 3.6 ms	CF Ste 3.000000 M
Occupied Bandw	dth	Total	Power 2	8.0 dBm	Auto M
	17.740 M			0.0 GBM	
	17.740 W	ΠZ			Freq Offs
Transmit Freq Error	-69.191	kHz % of C	BW Power	99.00 %	01
x dB Bandwidth	18.19 M	lHz xdB	-7	26.00 dB	

#### TM3.2, 10+20MBW, 2665/2680MHz

	RF 50 Ω AC				08:19:51 AM Oct 03, 2018	
Center Fre	eq 2.67500000 Gate: L0	IO GHz	Center Freq: 2.6750 Trig: External1 #Atten: 6 dB	Avg Hold: 100/100 Ext Gain: -40.20 dB	Radio Std: None Radio Device: BTS	Frequency
0 dB/div	Ref 35.00 dE	łm				
80 60	Us as De	Mint. Arts				Center Free 2.675000000 GHz
.00 .00	ALAONAS.	A PRESSED	while an and the second s	hander fin der	1 Alexandre	
5.0						
5.0 <b>Verteiji</b> en	le-pet	W			Non the Contraction	
enter 2.6 Res BW			VBW 1 MHz		Span 40 MHz Sweep 4.8 ms	CF Step 4.000000 MH
Occup	ied Bandwid		Total P	ower 30.	0 dBm	Auto Mar
Transm	2 it Freq Error	7.997 MH- -376.81 ki	-	BW Power 9	9.00 %	Freq Offse 0 H
	ndwidth	28.74 MI			.00 dB	
				STAT	6	

### 4.2 Occupied Bandwidth/ Edge of band Emissions

The Edge of Band emissions of the EUT at the external antenna connector (EAC) were measured using a Keysight MXA Signal Analyzer. The RF power level was continuously measured using a RF broadband power meter. The RF output from the EAC port to spectrum analyzer was reduced (to an amplitude usable by the spectrum analyzer) by using a calibrated attenuator and test coupler. The path attenuation was offset on the display and the signal for single carrier was adjusted to the corrected RF power level for the resolution bandwidth used for the transmit signal. All mask values were adjusted based upon the designated signal bandwidth and measurement bandwidths. The Top of Mask corresponds to the set rated power level as confirmed by the RF power meter.

### 4.2.1 Occupied Bandwidth Results.

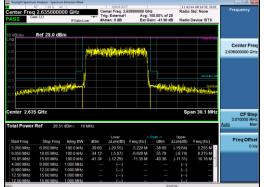
The Occupied Bandwidth was measured for all three modulations, at each signal bandwidth and at left center and right side of band. The mask on the plots meet the Block Edge requirements as specified in 47CFR 27.53.

All of the measurements met the requirements of Part 27.53 when measured per Part 2.1049.

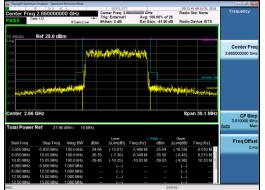
NOTE: Only a sample of all the data taken have been used in this report. The full suite of data resides at the MH, New Jersey location.

# 4.2.2 Edge of band Emissions - Plots.





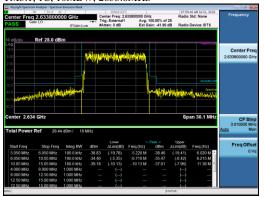
TM3.2, 1C, 10MBW, 2660MHz



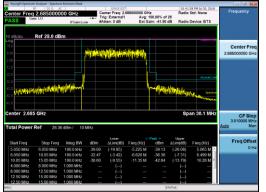
TM3.2, 1C, 20MBW, 2638.8MHz



TM3.1, 1C, 10MBW, 2633.8MHz





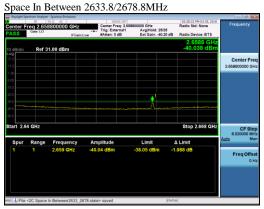


#### TM3.2, 1C, 20MBW, 2680.0MHz

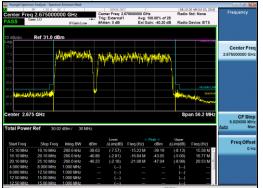
Keysight spectru	m Analyzer - Spectrum	n Ernission Mask							
	RF 50.0 Al			SENSE:EXT	580000000 GH			58 PN Jun 13, 2018 Std: None	Frequency
	2.6800000	00 GHz		nter Freq: 2) g: External1		z 00.00% of		Std: None	,,
ASS	ate: LO	IFGain:Lo		tten: 0 dB		in: -41.90		Device: BTS	
						_			
dB/div	Ref 28.0 dB	m							
<b>9</b>								000000000000	
		R. Male	م لية المدا	Add in the	A ALL ALL	4 .			Center Free
.00		- Martin	10H 10 H	Presentation of the	and the state				2.68000000 GH:
			100	1. I. I. I.	and the second	1.1.1			
2.0									
20						1			
2.0									
20									
2.0		14						Absolute Linit	
2.0		w l				1			
2.0								Spectrum	
2.0									
enter 2.68							Sp	an 40.2 MHz	CF Step 4.020000 MH
otal Power	Ref 27.91	IdBm / 301	MHz						Auto Mar
				Lower		Peak ->	Upper	Freg (Hz)	Freq Offse
Start Fred	Stop Fred	Integ BW	dBm						
Start Freq	Stop Freq	Integ BW	dBm 45.62	ΔLim(dB)	Freq (Hz)	dBm 45.52			0 H
10.10 MHz	11.10 MHz	200.0 kHz	-45.63	(-14.53)	-10.20 M		(-14.43)	10.10 M ^	0 H
10.10 MHz 11.10 MHz	11.10 MHz 15.10 MHz	200.0 kHz 200.0 kHz	-45.63 -45.90	(-14.53) (-7.81)	-10.20 M -14.02 M	-45.53 -46.88	(-14.43) (-8.79)	10.10 M ^ 11.67 M	он
10.10 MHz 11.10 MHz 15.10 MHz	11.10 MHz 15.10 MHz 20.10 MHz	200.0 kHz 200.0 kHz 200.0 kHz	-45.63 -45.90 -46.28	(-14.53) (-7.81) (-8.19)	-10.20 M -14.02 M -15.86 M		(-14.43) (-8.79) (-13.13)	10.10 M ^	он
10.10 MHz 11.10 MHz 15.10 MHz 4.000 MHz	11.10 MHz 15.10 MHz 20.10 MHz 8.000 MHz	200.0 kHz 200.0 kHz 200.0 kHz 1.000 MHz	-45.63 -45.90 -46.28	(-14.53) (-7.81) (-8.19) ()	-10.20 M -14.02 M -15.86 M	-45.53 -46.88 -51.22	(-14.43) (-8.79) (-13.13) ()	10.10 M ^ 11.67 M	он
10.10 MHz 11.10 MHz 15.10 MHz 4.000 MHz 8.000 MHz	11.10 MHz 15.10 MHz 20.10 MHz 8.000 MHz 12.50 MHz	200.0 kHz 200.0 kHz 200.0 kHz 1.000 MHz 1.000 MHz	-45.63 -45.90 -46.28 	(-14.53) (-7.81) (-8.19) () ()	-10.20 M -14.02 M -15.86 M	-45.53 -46.88	(-14.43) (-8.79) (-13.13) () ()	10.10 M ^ 11.67 M	0 H
10.10 MHz 11.10 MHz 15.10 MHz 4.000 MHz 8.000 MHz 12.50 MHz	11.10 MHz 15.10 MHz 20.10 MHz 8.000 MHz 12.50 MHz 15.00 MHz	200.0 kHz 200.0 kHz 200.0 kHz 1.000 MHz 1.000 MHz 1.000 MHz	-45.63 -45.90 -46.28	(-14.53) (-7.81) (-8.19) ()	-10.20 M -14.02 M -15.86 M	-45.53 -46.88 -51.22	(-14.43) (-8.79) (-13.13) ()	10.10 M ^ 11.67 M	0 H
10.10 MHz 11.10 MHz 15.10 MHz 4.000 MHz 8.000 MHz	11.10 MHz 15.10 MHz 20.10 MHz 8.000 MHz 12.50 MHz	200.0 kHz 200.0 kHz 200.0 kHz 1.000 MHz 1.000 MHz	-45.63 -45.90 -46.28 	(-14.53) (-7.81) (-8.19) () ()	-10.20 M -14.02 M -15.86 M	-45.53 -46.88 -51.22 	(-14.43) (-8.79) (-13.13) () ()	10.10 M ^ 11.67 M	01

 Openet Program
 Opene Program
 Openet Program
 Openet P

TM3.2, 2C, 10+20MBW, 2633.8/2678.8MHz Space



TM3.2, 10+20MBW, 2665/2680MHz



# 5. FCC Section 2.1051 - Spurious Emissions at Transmit Antenna Port

#### 5.1 Measurement of Spurious Emissions at Transmit Antenna Port

Spurious Emissions at the transmit-antenna terminals were investigated over the frequency range of 10 MHz to beyond the 10th harmonic of the specific transmit band. For this band of operation, the measurements were performed up to 27 GHz. Measurements were made using a Keysight MXA Signal Analyzer. The RF output from the transmitter was reduced (to an amplitude usable by the receivers) using calibrated attenuators. The RF power level was continuously monitored via a coupled RF Power Meter.

The required emission limitation is specified as appropriate in 27.53. The measured spurious emission levels were plotted for the frequency range as specified in 2.1057. There were no reportable emissions. Data below documents performance up to 27 GHz.

NOTE: Only a sample of all the data taken have been used in this report. The full suite of raw data resides at the MH, New Jersey location.

### 5.1.1 Plots – Spurious Emissions at Tx Port

### TM3.1, 1C, 10MBW, 2635MHz



Center F		00 AC 0000000 GHz IFGaint	Center Fre Trig: Exter		Radi 25/25	0 Std: None	Ra	nge Table Rang
10 dB/div	Ref 10	0.00 dBm				2.6240 GHz 3.560 dBm	<u>On</u>	
0.00 10.0 20.0							1.00	Start Fr
30.0 40.0 50.0						'	2.62	Stop Fr 5000000 G
60.0 70.0 80.0							Auto	Res 8 1.0000 M
Start 1 G	Hz				SI	op 2.625 GHz		Video E 3.0000 M
Spur 1	Range 1	Frequency 2.624 GHz	Amplitude -33.56 dBm	Limit -31.10 dB	∆ Lim m -2.460 (		Auto F	ilter Typ Gaussia
								Mo 1 o
sa 🤳 File -	<spurious_1< td=""><td>000_to_2625.state</td><td>&gt; saved</td><td></td><td>STATUS</td><td></td><td></td><td></td></spurious_1<>	000_to_2625.state	> saved		STATUS			

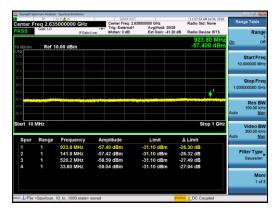
📕 Keysight Spe		- Spurious Emission	1								
Sweep Ti	me 1.00	ms		Center Fre	se por eq: 2.63500	0000 GHz AvgiHold:	25/25	Radio Sto	M 3ul 30, 2018 I: None	Ra	nge Table
PASS	Gate: LO	IF	Sain:Low	#Atten: 0		Ext Gain:		Radio De	vice: BTS		Range
10 dB/div	Ref 1	0.00 dBm						2.6 -34.5	450 GHz 60 dBm	<u>On</u>	1 Off
Log 0.00 -10.0 -20.0										2.64	Start Freq 5000000 GHz
-30.0 -40.0 -50.0			~~~~							2.69	Stop Freq 0000000 GHz
-50.0 -70.0 -80.0										Auto	Res BW 1.0000 MHz Man
Start 2.64	15 GHz								2.69 GHz	Auto	Video BW 3.0000 MHz Man
Spur	Range	Frequenc		nplitude		Limit		1 Limit		Auto	
1		2.645 GHz	-34.	.56 dBm		31.10 dBn	n -3	.460 dB		1	Gaussian
											More 1 of 3
MSG 🥠 File •	Spurious_	2645_to_2690.	state> saved	i .			STATU	6			

Keysight Spe		- Spurious Emissi	DMS							_	🕞 🖗 🛃
Center F		5000000 (	Hz	Center F	v6E:EXT reg: 2.63500	0000 GHz		Radio Std	M 3ul 30, 2018	Ra	inge Table
PASS	Gate: LO		FGain:Low	#Atten: 0	ernal1 dB	Avg Hold Ext Gain:		Radio De	vice: BTS		Range
10 dB/div	Ref 1	0.00 dBm						2.69 -41.8	910 GHz 40 dBm	<u>On</u>	OF
-10.0										2.65	Start Free
-30.0 1 -40.0 -50.0										10.00	Stop Free
40.0 -70.0 -80.0										Auto	Res BW 1.0000 MH: Mar
Start 2.6	9 GHz							Sto	p 10 GHz		Video BV 3.0000 MH
Spur	Range	Frequer	cy A	mplitude		Limit		Limit		Auto	Mar
1	1	2.691 G	lz -4	1.84 dBm		31.10 dBr	m -1	0.74 dB		'	Filter Type Gaussian
											More 1 of 3
M60							STATU	5		_	



#### Global Product Compliance Laboratory Report No.: TR-2018-0226-FCC2-27 Product: AAHE - Small Band 10 MHz

#### TM3.1A, 1C, 10MBW, 2660MHz





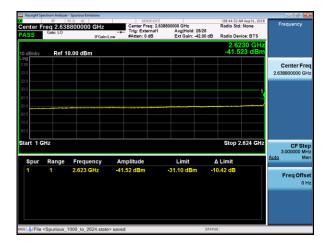
	RF 5	- Spurious Emissions io Ω AC	SENSES			M Jul 30, 2018		nge Table
Center F PASS	Gate: LO	5000000 GHz IFGain:	Trig: Externa	2.635000000 GHz al1 Avg Hold: 25/ Ext Gain: -42/			Rai	nge Table Range
10 dB/div	Ref 1	0.00 dBm			2.67 -39.8	'00 GHz 17 dBm	<u>On</u>	1
Log 0.00 -10.0 -20.0							2.67	Start Freq 0000000 GHz
30.0 • <b>1</b> 40.0 • 50.0							2.69	Stop Freq 0000000 GHz
-60.0 -70.0 -80.0							Auto	Res BW 1.0000 MHz <u>Man</u>
Start 2.6	7 GHz				Stop	2.69 GHz		Video BW 3.0000 MHz
Spur	Range	Frequency	Amplitude	Limit	∆ Limit		Auto	Man
1		2.670 GHz	-39.82 dBm	-31.10 dBm	-8.717 dB		F	Gaussian
								More 1 of 3
MSG 🜙 File ·	<spurious_7< td=""><td>670_to_2690.state</td><td>e&gt; saved</td><td></td><td>STATUS</td><td></td><td></td><td></td></spurious_7<>	670_to_2690.state	e> saved		STATUS			

📕 Keysight Sj		Spurious Ernissions					- # <b>-</b>
		00 AC 0000000 GHz	Trig: Extern	2.66000000 GHz hal1 AvgiHold: 2	Radio St	PM3ul 30, 2018 d: None	Frequency
PASS	Gale. LO	IFGain:	Low #Atten: 0 d	B Ext Gain: -2	8.60 dB Radio D	vice: BTS	
10 dB/div	Ref 2	3.00 dBm					
18.0							Center Freq
6.00							2.660000000 GHz
-2.00							
-12.8							
32.0							
-42.0							
-52.0							
Start 10	GHz				St	op 27 GHz	CF Step 359.000000 MHz
Spur	Range	Frequency	Amplitude	Limit	∆ Limit		<u>Auto</u> Man
1	1	25.66 GHz	-40.91 dBm	-31.10 dBm	-9.807 dB		Freq Offset
							0 Hz
MSG					STATUS		



### TM 3.2, 1C, 20MBW, 2638.8MHz

enter F		50 9▲ 00 3800000 GHz IFGain:	Trig: External	.638800000 GHz		Frequency
0 dB/div	Ref 1	0.00 dBm			802.59 -57.430 d	
						Center Freq 2.638800000 GHz
0.0						
0.0 0.0 0.0						
tart 10	MHz				Stop 1	GHz CF Step 3,000000 MHz
Spur	Range	Frequency	Amplitude	Limit	∆ Limit	Auto Man
1 2	1 1	802.6 MHz 953.4 MHz	-57.43 dBm -57.60 dBm	-31.10 dBm -31.10 dBm	-26.33 dB -26.50 dB	Freq Offset
4	1	660.8 MHz	-57.98 dBm	-31.10 dBm	-26.88 dB	0 Hz
3	1	507.7 MHz	-58.16 dBm	-31.10 dBm	-27.06 dB	
		507.7 MHz 174.6 MHz 413.7 MHz	-58.16 dBm -58.30 dBm -58.63 dBm	-31.10 dBm -31.10 dBm -31.10 dBm	-27.06 dB -27.20 dB -27.53 dB	



enter F ASS	RF 50 Ω AC req 2.638800000 GHz Gate: LO IFGain:Low		Center Freq: Trig: Externa			Aug 01, 2018 None	Rar	nge Table Rang
) dB/div	Ref 1	0.00 dBm			2.65 -39.0	30 GHz 79 dBm	<u>On</u>	01
•g .00 1.0 1.0							2.653	Start Free
1.0 <b>1</b> 1.0 1.0							2.690	Stop Fre
0.0 0.0 0.0							Auto	Res BV 1.0000 MH <u>Ma</u>
tart 2.6	53 GHz				Stop	2.69 GHz		Video BV 3.0000 MH
Spur	Range	Frequency	Amplitude	Limit	Δ Limit		Auto	Ma
1		2.653 GHz	-39.08 dBm	-31.10 dBm	-7.979 dB		F	<b>ilter Type</b> Gaussian
								Mor 1 of

Keysight Spe		- Spurious Emissions					
enter Fi	Gate: LO	50 Ω AC B800000 GHz IFGain: 0.00 dBm	Center Fre Trig: Exter		Radio Str 15/25 13.90 dB Radio De 2.6	AM Aug 01, 2018 d: None wice: BTS 905 GHz 295 dBm	Frequency
							Center Free 2.638800000 GH
0.0 0.0 0.0							
tart 2.69						op 10 GHz	CF Ste 3.000000 MH Auto Ma
Spur 1	Range 1	Frequency 2.691 GHz	Amplitude -42.29 dBm	Limit -31.10 dBm	∆ Limit -11.19 dB		Freq Offse
s 🕹 File •	Spurious_2	2690_to_10000.stat	ie> saved		STATUS		



#### TM 3.2, 1C, 20MBW, 2680.0MHz

Keysight Spect		- Spurious Emissions		1	NSE:EXT			0.000	PMJun 13, 2018	_	6
Center Fre		000000 GH		Center F	reg: 2.6800	00000 GHz AvgHold		Radio St		Ra	nge Table
PASS		IFC	iain:Low	#Atten: 0	dB	Ext Gain:		Radio D	evice: BTS		Range
10 dB/div	Ref 10	0.00 dBm								<u>On</u>	1 Off
-10.0 -20.0										10	Start Freq 0.000000 MHz
30.0 40.0 50.0										1.00	Stop Freq 0000000 GHz
60.0 70.0 80.0										Auto	Res BW 100.00 kHa Mar
Start 10 M	IHz							s	top 1 GHz		Video BV 300.00 kH
Spur	Range	Frequency	/ A	mplitude		Limit	1	Limit		Auto	<u>Mar</u>
										F	Filter Type Gaussian
											More 1 of 3
sg 🜙 No Sp	urs have b	een found					STATU	S			



Center Freq 2.68000	AC 100000 GHz IFGain:Lo	Center Fr Trig: Exte		z	02:33:35 P Radio Std	M Jun 13, 2018	Ra	nge Table
				Center Freq: 2.68000000 GHz				age rable
		w watten: u		fold: 100/100 ain: -43.90 dB	Radio Dev	ice: BTS		Range
							On	1 Off
10 dB/div Ref 28.00	0 dBm							_
18.0								Start Freq
8.00							2.69	2000000 GHz
-2.00								
-12.0								Stop Freq
-22.0							10.00	0000000 GHz
-32.0								
-52.0								Res BW
-62.0							Auto	1.0000 MHz Man
Start 2.692 GHz					Sto	p 10 GHz		Video BW 3.0000 MHz
Spur Range F	requency	Amplitude	Lim	it .	∆ Limit		Auto	Man
							F	Gaussian
								More 1 of 3
MSG				STAT				

	RF	- Spurious Emissi 50 Ω AC 00000000 C	GHz	Center Fr Trig: Ext	ernal1	00000 GHz Avg Hold: 1	00/100	Radio St		Ra	inge Table
435			IFGain:Lo	#Atten: 0	dB	Ext Gain: -2	8.60 dB	Radio D	evice: BTS	T I	Rang
dB/div	Ref 2	8.00 dBm								<u>On</u>	0
<b>9</b> 3.0											Start Free
										10.00	10000000 GH
0 0										-	
.0										27.00	Stop Fre 10000000 GH
.0											
0									~~~~		Res B
	~~~	~								Auto	1.0000 MF
art 10 G	Hz							SI	op 27 GHz		
											Video B 3.0000 Mi
Spur	Range	Frequer	су	Amplitude		Limit	4	∆ Limit		Auto	Ma
										F	Filter Type
											Gaussian
											Mo 1 of
No Sp	urs have b	been found					STATU	S			

11:43:42 AM Oct 05, 2018

### TM 3.2, 2C, 10+20MBW, 2633.8/2648.8MHz



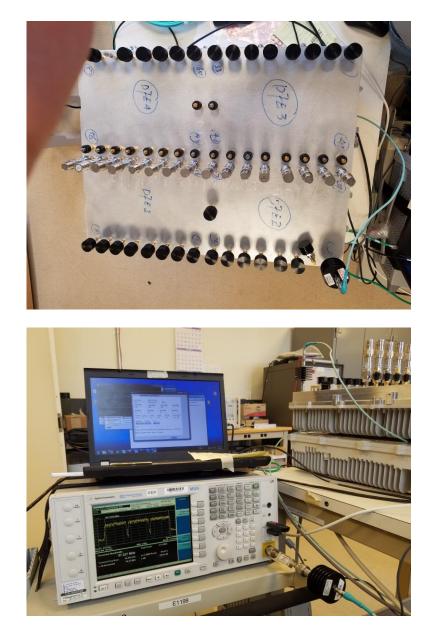


📕 Keysight Sp	ectrum Analyzer	- Spurious Emissions					
	req 2.64	3800000 GHz	Center Freq Trig: Extern	: 2.643800000 GHz	Radio St	AH Oct 05, 2018 td: None	Frequency
PASS		IFGain:				evice: BTS	
10 dB/div	Ref 0	.00 dBm				6666 GHz 354 dBm	
-10.0 -20.0 -30.0							Center Freq 2.643800000 GHz
-40.0 -50.0						ſ <b>~~~~</b>	
-60.0 -70.0 -80.0							
30.0							
Start 2.6	04 GHZ				510	p 2.69 GHz	CF Step 2.000000 MHz Auto Man
Spur	Range	Frequency	Amplitude	Limit	∆ Limit		Auto man
1		2.667 GHz	-40.35 dBm	-31.10 dBm			E
2		2.672 GHz	-41.26 dBm	-31.10 dBm			Freq Offset 0 Hz
3		2.664 GHz	-41.77 dBm	-31.10 dBm			0 Hz
4		2.677 GHz	-41.89 dBm	-31.10 dBm			
5		2.682 GHz	-42.72 dBm	-31.10 dBm			
6		2.687 GHz	-43.81 dBm	-31.10 dBm	-12.71 dB		

 Operation
 Addition
 Addition

Center F PASS	req 2.643	3806000 GHz IFGain:	Trig: Externa	2.643806000 GHz al1 Avg Hold: 25/25 Ext Gain: -42.50		
10 dB/div	Ref 0	.00 dBm			2.692 -41.220	5 GHz ) dBm
-10.0						Center Freq 2.643806000 GHz
40.0						
-60.0						
Start 2.6					04-7	10 GHz
						10 GHZ CF Step 2.000000 MHz Auto Man
Spur	Range	Frequency	Amplitude	Limit	∆ Limit	
1 2	1	2.693 GHz 4.783 GHz	-41.22 dBm -45.95 dBm	-31.10 dBm -31.10 dBm	-10.12 dB -14.85 dB	Freq Offset
3		9.533 GHz	-46.95 dBm	-31.10 dBm	-15.85 dB	0 Hz
V90					STATUS	

# Photographs



### **Test Equipment**

Manufacturer	Туре	Description	Model	Serial	<b>Calibration Date</b>	<b>Calibration Due</b>	Calibration Type	Status
Agilent Technologies	MXA Signal Analyzer	20Hz-26.5GHz	N9020A	MY48011791	2018-02-15	2020-02-15	Requires Calibration	Active
Hewlett Packard	High Pass Filter	3.5 GHz	84300-80038	006	N/A	N/A	CNR, Must Be Verified	Active
Weinschel	Attenuator	10dB 25Watt 0.05GHz - 26GHz	74-10-12	1068	N/A	N/A	CNR, Must Be Verified	Active
Weinschel	Attenuator	30dB 25W 0.05GHz-26GHz	74-30-12	1065	N/A	N/A	CNR, Must Be Verified	Active
	Agilent Technologies Hewlett Packard Weinschel	Agilent Technologies MXA Signal Analyzer Hewlett Packard High Pass Filter Weinschel Attenuator	Agilent Technologies     MXA Signal Analyzer     20Hz-26.5GHz       Hewlett Packard     High Pass Filter     3.5 GHz       Weinschel     Attenuator     10dB 25Watt 0.05GHz - 26GHz	Agilent Technologies         MXA Signal Analyzer         20Hz-26.5GHz         N9020A           Hewlett Packard         High Pass Filter         3.5 GHz         84300-80038           Weinschel         Attenuator         10dB 25Watt 0.05GHz - 26GHz         74-10-12	Agilent Technologies     MXA Signal Analyzer     20Hz-26.5GHz     N9020A     MY48011791       Hewlett Packard     High Pass Filter     3.5 GHz     84300-80038     006       Weinschel     Attenuator     10dB 25Watt 0.05GHz - 26GHz     74-10-12     1068	Agilent Technologies         MXA Signal Analyzer         20Hz-26.5GHz         N9020A         MY48011791         2018-02-15           Hewlett Packard         High Pass Filter         3.5 GHz         84300-80038         006         N/A           Weinschel         Attenuator         10dB 25Watt 0.05GHz - 26GHz         74-10-12         1068         N/A	Agilent Technologies         MXA Signal Analyzer         20Hz-26.5GHz         N9020A         MY48011791         2018-02-15         2020-02-15           Hewlett Packard         High Pass Filter         3.5 GHz         84300-80038         006         N/A         N/A           Weinschel         Attenuator         10dB 25Watt 0.05GHz - 26GHz         74-10-12         1068         N/A         N/A	Agilent Technologies         MXA Signal Analyzer         20Hz-26.5GHz         N9020A         MY48011791         2018-02-15         2020-02-15         Requires Calibration           Hewlett Packard         High Pass Filter         3.5 GHz         84300-80038         006         N/A         N/A         CNR, Must Be Verified           Weinschel         Attenuator         10dB 25Watt 0.05GHz - 26GHz         74-10-12         1068         N/A         N/A         CNR, Must Be Verified

CNR = Calibration Not Required

#### Laboratory conditions:

Humidity: 24.9 % Temperature: 23.8 degrees C Barometric Pressure: 994.0 h Pa

# 6. FCC Section 2.1053

### 6.1 Section 2.1053 Field Strength of Spurious Emissions

Field strength measurements of radiated spurious emissions were made in 3m Semi-Anechoic Chambers the of Global Product Compliance Laboratories of Nokia Bell Labs in Murray Hill NJ. A complete description and full measurement data for the site is on file with the Commission (FCC File 515091).

The spectrum from 30 MHz to beyond the tenth harmonic of the carrier, 27 GHz, was searched for spurious radiation. Measurements were made using both horizontally and vertically polarized broadband antennas. Per FCC regulations, the comparison of out of band spurious emissions directly to the limit is appropriately made using the substitution method. However, when the emissions are more than 20 dB below the specification limit, the use of field strength measurements for compliance determination is acceptable and those emissions are considered not reportable (Section 2.1053 and the FCC Interpretive database for 2.1053). For this case the evaluation of acceptable radiated field strength is as follows.

### 6.2 Field Strength of Spurious Emissions - Limits

Sections 2.1053 and 27.53 contain the requirements for the levels of spurious radiation as a function of the level of the unmodulated carrier. The reference level for the unmodulated carrier is calculated as the field produced by an ideal dipole excited by the transmitter output power according to the following relation taken from Reference Data for Radio Engineers, page 676, 4<sup>th</sup> edition, IT&T Corp.

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

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

Where:

E = Field Intensity in Volts/meter P = Transmitted Power in Watts R = Measurement distance in meters = 3 m

The Part 27 Limit is 82.23 dBuV/m at 3m and 91.77 dBuV/m at 1m The Part 27 non-report level is 62.23 dBuV/m at 3m.

The calculated emission levels were found by:

Measured level (dB $\mu$ V) + Cable Loss(dB)+Antenna Factor(dB) = Field Strength (dB $\mu$ V/m)

**RESULTS**:

For compliance with 47CFR Parts 2 and 27, the field strength of any spurious radiation, measured at 3m, is required to be less than 82.23 dB $\mu$ V/meter (82.23 @ 3m). Emissions equal to or less than 62.23 dB $\mu$ V/meter at 3m are not reportable and may be verified using field strength measurements and broadband antennas. Over the out of band spectrum investigated from 30 MHz to beyond the tenth harmonic of the carrier (up to 27GHz), no reportable spurious emissions were detected.

## 7. NVLAP Certificate of Accreditation

