

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

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TESTING NVLAP LAB CODE: 100275-0

RF Transmitter Certification Test Report (FCC ID: VBNAAHC-01)

Regulation: FCC Part 2 and 27

<u>Client:</u> Nokia Mobility

Product Evaluated: AirScale MAA 64T64R 128AE B41 120W AAHC mMIMO Full Band

> Report Number: TR-2018-0080-FCC2-27

> > Date Issued: July 16, 2018

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Revisions

Date	Revision	Section	Change
07/06/2018	Initial		
07/16/2018	1	All	All except data plots.

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7/16/2018

Equipment Under Test (EUT):	AirScale MAA 64T64R 128AE B41 120W AAHC					
Serial Number:	(1P) – 474155A.102					
	(Q) – 6Q180712583					
FCC ID:	VBNAAHC-01					
Cell Name / Number	GPCL Project Number:2018-0080					
Company:	NOKIA SOLUTIONS AND NETWORKS					
	6000 Connection Drive					
	Irving, TX 75039 USA					
Manufacturer:	NOKIA SOLUTIONS AND NETWORKS					
Test Requirement(s):	47 CFR FCC Part 2 and Part 27					
Measurement Procedure(s):	ANSI C63.26-2015					
	FCC KDB 971168 D01, v03r01, April 2018					
	FCC KDB 662911 D01, v02r01, October 2013					
Frequency Band	2496 - 2690MHz					
Nominal Total Transmit Power	120W for all ports					
Maximum Antenna Gain	23.4 dBi					
Minimum Antenna Beamwidth	9.2 degrees vertical, 12.7 degrees horizontal					
Test Date(s):	May/June 2018					
Test Performed By:	Nokia					
	Global Product Compliance Laboratory					
	600-700 Mountain Ave.					
	P.O. Box 636					
	Murray Hill, NJ 07974-0636					
	FCC Registration No/Designation No: 328881/US5302					
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1. System Information and Requirements

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Product Engineer(s):	Ron Remy
Lead Engineer	Steve Majkowski
Test Engineer (s):	Jaideep Yadav, Eugene Mitchell, Mike Soli

Test Results: The AAHC mMIMO - Full Band, *as tested* met the above listed requirements. Report copies and other information not contained in this report are held by either the product engineer or in an identified file at the Global Product Compliance Laboratory in New Providence, NJ.

FCC Section 2.911(e) Certification of Technical Test Data

The technical test data presented in this report are accurate.

1.1 Introduction

This Conformity Assessment Report applies to the AAHC mMIMO - Full Band, 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 Description

Nokia AirScale massive MIMO Adaptive Antenna deploys 64 transmit and 64 receive streams and 16-layer Massive MIMO. It incorporates Carrier Aggregation with broad range of customized variants to deliver up to five times more network capacity, high peak downlink throughput, significantly improved uplink, and greater coverage.

The use of Massive MIMO also enhances conventional beamforming, giving wider coverage and better indoor penetration.

With Massive MIMO, operators now have a powerful new tool to boost capacity using their existing spectrum.

1.3.1 Test Requirements

47 CFR FCC Sections	Description of Tests	Test Required
2.1046	RF Power Output	Yes
2.1047	Modulation Characteristics	Yes
2.1049 27.53(m)	(a) Occupied Bandwidth (b) Out-of-Band Emissions	Yes Yes
2.1051 27.53(m)	Spurious Emissions at Antenna Terminals	Yes
2.1053 27.53(m)	Field Strength of Spurious Radiation	Yes
2.1055 27.54	Measurement of Frequency Stability	Yes

Each required measurement is listed below:

1.4 Reference Documents, Test Specifications & Procedures

A list of the applicable documents is provided herein.

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
- 2. ANSI C63.4 (2014), American National Standard for Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz.
- 3. ANSI C63.26-2015, American Nation Standard for Compliance Testing of Transmitters Used in Licensed Radio Services.
- 4. FCC KDB 971168 D01, Measurement Guidance for Certification of Licensed Digital Transmitters, April 2018, v03r01.
- 5. FCC KDB 662911D01, Emissions Testing of Transmitters with Multiple Outputs in the Same Band, October 2013, v02r01.

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.

S	tandard, Method or Procedure	Condition	Frequency MHz	Expanded Uncertainty (k=2)
a.	Classical Emissions, (e.g., ANSI	Conducted Emissions	0.009 - 30	±3.5 dB
	C63.4, CISPR 11, 14, 22, etc.,	Radiated Emissions	30 MHz – 200MHz	±5.4 dB
	using ESHS 30,	(AR-8 Semi-Anechoic	200 MHz – 1000 MHz	±4.7 dB
		Chamber)	1 GHz - 18 GHz	±3.3 dB

Worst-Case Estimated Measurement Uncertainties

Antenna Port Test	Expanded Uncertainty (k=2), Amplitude
RF Power	± 1.4 dB
Occupied Bandwidth	± 2.2 dB
Conducted Spurious Emissions	± 2.8 dB

1.5 Executive Summary

Requirement	Description	Result
47 CFR FCC Parts 2 and 27		
2.1046	RF Power Output	
27.50(n), (i)	Peak to Average Power Ratio	COMPLIES
2.1047	Modulation Characteristics CC	
2.1049	Occupied Bandwidth	
	(a) Emissions Signal Bandwidth	COMPLIES
	(b) Occupied Bandwidth/ Edge of Band Emissions	
2.1051	Spurious Emissions at Antenna Terminals	COMPLIES
2.1053	Field Strength of Spurious Radiation	COMPLIES
2.1055	Measurement of Frequency Stability	COMPLIES

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

2. FCC Section 2.1046 - RF Power Output

2.1 RF Power Output Requirements

Per 47CFR 27.50(h)... The following power limits shall apply in the BRS and EBS:

(1) *Main, booster and base stations.* (i) The maximum EIRP of a main, booster or base station shall not exceed 33 dBW + $10\log(X/Y)$ dBW, where X is the actual channel width in MHz and Y is either 6 MHz if prior to transition or the station is in the MBS following transition or 5.5 MHz if the station is in the LBS and UBS following transition, except as provided in paragraph (h)(1)(ii) of this section.

(ii) If a main or booster station sectorizes or otherwise uses one or more transmitting antennas with a nonomnidirectional horizontal plane radiation pattern, the maximum EIRP in dBW in a given direction shall be determined by the following formula: EIRP = 33 dBW + 10 log(X/Y) dBW + 10 log(360/beamwidth) dBW, where X is the actual channel width in MHz, Y is either (i) 6 MHz if prior to transition or the station is in the MBS following transition or (ii) 5.5 MHz if the station is in the LBS and UBS following transition, and beamwidth is the total horizontal plane beamwidth of the individual transmitting antenna for the station or any sector measured at the halfpower points.

The required Total Transmit Port power limits are derived from the EIRP Limits as follows:

From 27.50(h)(ii) ... and given a minimum beamwidth of 9.2 degrees and an antenna gain of 23.4 dBi:

EIRP Limit = 33 dBW + 10 LOG (20/6) dBW + 10 LOG (360/9.2) dBW

EIRP Limit = 33+ 5.23 + 15.93 = 54.15 dBW EIRP

therefore:

54.15 dBW EIRP – 23.4 dBi antenna gain = 30.75 dBW = Total Power limit at Antenna Port = 1188 Watts

The maximum power output is rated at 120W so the product clearly meets this criteria.

2.2 **RF Power Output Measurement**

This test is a measurement of the total RF power level transmitted at the antenna-transmitting terminal (J4), as shown in the accompanying test set-up diagram in paragraph 2.2.1.

Before the testing was started, the Base Station was given a sufficient "warm-up" period as required.

Power measurements were made using the Channel Power measurement feature of the Keysight MXA Signal Analyzer. Corrections for path loss were applied by using the worst case path attenuation for the frequency range of interest. These values were applied and are offset on the display. All parameters were adjusted based upon the designated signal bandwidth and measurement resolution bandwidth per transmit signal.

Power was measured on every port for all carrier configurations to determine the maximum power output.

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

2.2.1 RF Antenna Port Measurement Setup

The Test Setup depicted in the diagram below was used for the Measurement of RF Power, Modulation, PAR, Occupied Bandwidth, Edge of Band and Conducted Spurious Emissions



2.3 RF Power Data

RF Channel Power was measured for the Single, Dual and Three Carrier configurations.

2.3.1 RF Channel Power - Single Carrier (1C)

Channel Power, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM1.2, 2593 MHz.

Center Freq 2.5 Gate: LC	593000000 GH	HZ Gain:Low	Center Fr Trig: Free #Atten: 8	req: 2.59300 e Run dB	0000 GHz Avg Hold Ext Gain:	ALIGN AUTO 10/10 -41.90 dB	08:25:25 Radio Sto Radio De	AM May 09, 2018 d: None wice: BTS	Frequency
10 dB/div Rei	130.00 dBm	hla yapan.	myymy	/mtV/wy	gange af	nyimpili	VAN I		Center Freq 2.59300000 GHz
Center 2.593 GH	12 2		VBV	V 2.4 MH	2		Spa	an 25 MHz eep 1 ms	CF Step 2.500000 MHz
Channel Po 28.2	ower 5 dBm / 2	0 MHz		Power	Spectr 44.76	al Dens dBm	iity /Hz		<u>Auto</u> Man Freq Offset 0 Hz
972						TANS	0	_	

Ch Power, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.1, 2506 MHz.





Ch Power, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.1, 2680 MHz.

Ch Power, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.1A, 2593 MHz.



2.3.2 RF Channel Power - Dual Carrier (2C)

Channel Power, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1, 2506 and 2526 MHz, Port 56.



Channel Power, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.2, 2660 and 2680 MHz, Port 56.



Channel Power, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1A, 2593 and 2613 MHz, Port 56.



Channel Power, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1, 2506 and 2546 MHz, Port 56.

Center Freq: 2.52600000 GHz Center Freq: 2.52600000 GHz Gate: LO Gate: LO	Channo 3(el Pow 0.68 c	iBm / e	60 MHz		Power -4	Spectr 17.10	al Dens dBm	ity /Hz			Freq Offset 0 Hz
Center Freq: 2.52600000 GHz Center Freq: 2.52600000 GHz Gate: LO Center Freq: 2.52600000 GHz Gate: LO Center Freq: 2.52600000 GHz Freq: Estemail Auguledic 2020 Ext Gain: -41.90 dB Radio Std: None Freq: Balo Std	Center 2.5 #Res BW 2	26 GHz 200 kHz			VBV	V 2 MHz			Swe	Spa ep	n 90 MHz 2.733 ms	CF Step 9.000000 MHz Auto Man
Center Freq: 2.52600000 GHz Gate: LO Gate: L	20.0 30,0 40,0 60.0	maradar			der an	lheillanen			500	441	Nachrinael	
Center Freq 2.526000000 GHz Center Freq: 2.52600000 GHz Radio Std: None Gate: LO GAT	100 100 000		pland the let	al William			platella	ntiutrat	4			Center Freq 2.526000000 GHz
Center Freq 2.526000000 GHz Center Freq: 222600000 GHz Radio Std: None Gate: L0 Gate: L0 If Galet.Low #Atten: 0 dB Ext Gain: -41.90 dB Radio Device: BTS	10 dB/div	Ref 30	.00 dBm						_			
RE 50 02 AC SENSE:EXT ALIGN AUTO 02:04:35 PM May 21, 2018	Center Fre	Gate: LO	000000 G	Gain:Low	Center Fr Trig: Exte #Atten: 0	eq: 2.526000 ernal1 dB	000 GHz Avg Hold Ext Gain:	: 20/20 -41.90 dB	Radio Radio	Dev	MMay 21, 2018 None rice: BTS	Frequency

Channel Power, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1A, 2593 and 2633 MHz, Port 56.



Channel Power, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.2, 2640 and 2680 MHz, Port 56.



2.3.3 RF Channel Power - Triple Carrier (3C)

Channel Power, AAHC mMIMO-Full Band, B41, 3C, 33dBm, 60MBW, TM3.1A, 2506, 2526 & 2546 MHz, Port 12



Channel Power, AAHC mMIMO-Full Band, B41, 3C, 33dBm, 60MBW, TM3.1A, 2593, 2613 & 2633 MHz, Port 12.



Channel Power, AAHC mMIMO - Full Band, B41, 3C, 33dBm, 60MBW, TM3.2, 2640, 2660 and 2680 MHz, Port 12.



2.4 Peak-to-Average Power Ratio (PAPR) 47CFR 27.50

This measurement of the Peak-to-Average Power Ratio (PAPR) was performed using the Complementary Cumulative Distribution Function (CCDF) feature of a Keysight MXA Signal Analyzer. All the measured values were below the required 13dB limit at the required 0.1 percent of the time.

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

2.4.1 PAPR - Single Carrier (1C)



PAR, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM1.2, 2593 MHz.

PAR, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.2, 2680 MHz.





PAR, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.1A, 2506 MHz.









2.4.2 PAPR - Dual Carrier (2C)









PAR, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1, 2506 and 2526 MHz, Port 56.







PAR, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1A, 25506 and 2546 MHz, Port 56.



PAR, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1, 2593 and 2633 MHz, Port 56.







PAR, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.2, 2593 and 2633 MHz, Port 56.



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2.4.3 PAPR - Triple Carrier (3C)

PAR, AAHC mMIMO - Full Band, B41, 3C, 33dBm, 60MBW, TM3.2, 2506, 2526 and 2646 MHz, Port 12.





PAR, AAHC mMIMO - Full Band, B41, 3C, 33dBm, 60MBW, TM3.1A, 2593, 2613 and 2633 MHz, Port 12.





PAR, AAHC mMIMO - Full Band, B41, 3C, 33dBm, 60MBW, TM3.1A, 2506, 2526 and 2546 MHz, Port 12.



Average Power	NFGaintlow #Atten: 8 dB Ext Gain: -40,10 dB	
27.90 dBm 38.56 % at 0dB	10 %	Center Free 2.546000000 GH
	1 %	
10.0 % 3.64 dB 1.0 % 5.97 dB	0.1 %	
0.1 % 7.14 dB 0.01 % 7.89 dB	0.01 %	CF Stej 25,00000 MH <u>Auto</u> Mar
0.001 % 8.48 dB 0.0001 % 8.90 dB Peak 8.92 dB	0.001 %	Freq Offse 0 H
36.82 dBm	0.0001 % 0 dB Info BW 25.000 MHz	20 dB

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 has been used in this report. The full suite of raw data resides at the MH, New Jersey location.

3.1.1 Modulation - Single Carrier (1C)

AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.1, 2506 MHz.



AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.1, 2593 MHz.



AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.1A, 2680 MHz.



AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM1.2, 2680 MHz.



AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM1.2, 2593 MHz.



3.1.2 Modulation - Dual Carrier (2C)

AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1, 2506 and 2526 MHz, Port 56.



AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.2, 2660 and 2680 MHz, Port 56.



AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1A, 2593 and 2613 MHz, Port 56.

Keysight LTE & LTE-A TDD - Modulation Analysis			Keysight LTE & LTE-A TDD - Modulation Analysis		
Carrier Ref Freq 2.593000000 GHz Garrier Ref Freq 2.593000000 GHz Trig:	SEMEELENT ALIGN AUTO 11:40:15 AM May 18, 2018 or Ref Freq: 2.593000000 GHz TRACE D2 4.4 Free Run Direction: Downlink n: 8 dB Num CC(s); 1	Frequency	Carrier Ref Freq 2.613000000 GHz Carrier Ref Areq 2.613000000 GHz Carrier Carr	SDBEEXT ALIGN BUTO 11:40:32 AM May 18, 2018 ier Ref Freq: 2.613000000 GHz TRACE 10:40:32 AM May 18, 2018 Free Run Direction: Downlink 10:40:32 AM May 18, 2018 an: 10 dB Num CC(s): 1 10:40:32 AM May 18, 2018	Frequency
Layer OFEPM Mees (CC0) poo maty Ref0 10 10 10 10 10 10 10 10 10 1	Layer® Enror Vector Spectrum (CC0) to very Ref 3 % 10 10 10 10 10 10 10 10 10 10		LayerO CFCM Mees (CC0) don many Ref0 10 10 10 10 10 10 10 10 10 1	Lever0 Error Vector Spectrum (CC0)	
Ch1 Spectrum (CC0) to dia div. Ref. 30 dBm 20 20 20 20 20 20 20 20 20 20 20 20 20	Ch1 Error Summary (CC0) = 40.017 %rms at EVM Fk = 10.90 % at Deta EVM = 47.707 %rms -36FP-Steffed QPSK EIM = 51.01 %rms -36FP-Steffed QPSK EIM = 58.70 %rms -36FP-Steffed QPSK EIM = 58.70 %rms -36FP-Steffed QPSK EIM = 58.70 %rms Charael Powel = 13.08 dBm RS TV Powel (Avg) = 44.655 dBm RS TV Powel (Avg) = 43.655 dBm RS TV Powel (Avg) = 13.655 dBm RS TV Powel (Avg) = 13.655 dBm RS TV Construct (Avg) = 13.855 dBm RS TV Construct (Avg) = 13.857 dBm	Carrier Ref Freq 2.59300000 GHz	Ch1 Spectrum (CC0) 50 mildio: Ref -30 dBm Log 0 0 0 0 0 0 0 0 0 0 0 0 0	Ch1 Error Summary (CC0) = 40.245 Neme at EVM Fix = 40.245 Neme at at EVM Fix = 40.245 Neme at at EVM Fix = 40.245 Neme at at EVM Fix = 40.245 Neme at EVM Fix = 40.245 Neme at EVM Fix = 30.674-defined 160.0M EVM = = = 51.144 Neme EVM Fix = 14.000 Neme Fix = 13.021 dbm Fix Neme EVM Fix Neme EVM Fix = <td>Carrier Ref Freq 2.61300000 GHz</td>	Carrier Ref Freq 2.61300000 GHz
MSG	STATUS		MSG	STATUS	

3.1.3 Modulation - Triple Carrier (3C)

AAHC mMIMO - Full Band, B41, 3C, 33dBm, 60MBW, TM3.1, 2593, 2613 and 2633 MHz, Port 12.





AAHC mMIMO - Full Band, B41, 3C, 33dBm, 60MBW, TM3.2, 2593, 2613 and 2633 MHz, Port 12.





AAHC mMIMO - Full Band, B41, 3C, 33dBm, 60MBW, TM3.1A, 2506, 2526 and 2546 MHz, Port 12.



Keysight LTE & LTE-A TDD - Modulation Analysis					
Carrier Ref Freq 2.526000000 GHz Car Trig	rier Ref Freq: 2.526000000 GHz g: External1 ten: 6 dB	nk	Frequency		
Layer0 CFEDM Mass (CC0) Box mater Ref 0 500 500 500 500 500 500 500 5	Layer0 Error Vector Spectrum 20 Surgiv Ref 0 % 10 10 10 10 10 10 10 10 10 10 10 10 10	(CC0)	Stop 600 carr	fier	
Ch1 Spectrum (CCO) 19 dBalay Ref 30 dBm Log 40 50 bar Millions an eine bef etb (b) cott (b) ett	Ch1 Error Summary (CC0) EVM EVM Pk Data EVM - 3GPP-delined QPSK EVM	= 40.969 = 111 11 = 48.770 = 51.585	%brms at % at %orms %orms		
	- 3GPP-defined 16CAM EVM - 3GPP-defined 64QAM EVM RS EVM Channel Power RS Tx, Power (Avg) OFDM Sym Tx, Power RS Rx, Power (Avg) OFDM Str.	= = 17.054 = -13.40 = -45.73 = -14.92 = -45.73	%rms 7 dBm dBm 9 dBm dBm		Carrie Ref Fre 2.526000000 GH
160	the second se	— 14 Miles			



4. FCC Section 2.1049 – Occupied Bandwidth

4.1 Occupied Bandwidth –(Signal Bandwidth OBW - Si)

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 measure the required Edge of Band emissions at the channel and block/band edges.

The product was measured to determine the Occupied Signal Bandwidth per Part 2.1049 when tested per ANSI C63.26, KDB 971168 D01, v03r01, and KDB 662911 D01, v02r01.

The RF output from the EAC port to spectrum analyzer was reduced (to an amplitude usable by the signal analyzer) by using a calibrated attenuator/ test coupler. Measurements were performed using a Keysight MXA Signal Analyzer.

Corrections for path loss were applied by using the worst case path attenuation for the frequency range of interest. These values were applied and are offset on the display. All parameters were adjusted based upon the designated signal bandwidth and measurement resolution bandwidth per transmit signal.

Specific Emissions Signal bandwidths were recorded for the one, two and three carrier configurations.

Sample Charts are below.

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

4.1.1 Signal Bandwidth OBW - Single Carrier (1C)



26dB and 99%, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM1.2, 2593 MHz.

26dB and 99%, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.1, 2593 MHz.



26dB and 99%, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.1A, 2506 MHz.



26dB and 99%, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.2, 2680 MHz.

 Keysight Spectrum 	п Алијузи - Оссирне	1 BAA						
ME S0 2 AC Center Freq 2.680000000 GHz Gate: L0 #FGain:Low			SENSE EXT ALIG Center Freq: 2.68000000 GHz Trig: External Avg Hold: 10/ #Atten: 6 dB Ext Gain: -41		AUTO [04:01:57 PM Radio Std: 100 0 dB Radio Devi	None ce: BTS	Frequency	
10 dB/div	Ref 30.00 d	Bm						
200 10.0	Monstand	athan portably and	and a second state of the	where water	hallman		Center Freq 2.680000000 GHz	
-10.00 -10.00 -20.0								
-30,0 -40,0)							
60.0								
Center 2.68 #Res BW 10	GHZ 0 kHZ		VBW 1 MHz		Spar Sweep	11.6 ms	CF Step 2.500000 MHz	
Occupie	d Bandwi	dth 17.756 MH	Total F	ower	28.1 dBm		Freq Offset	
Transmit x dB Ban	Freq Error dwidth	-56.799 k 18.64 M	Hz % of O Hz x dB	BW Power	99.00 % -26.00 dB		0 Hz	
NSG					STATUS	_	-	

4.1.2 Signal Bandwidth OBW - Dual Carrier (2C)

26dB and 99%, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1, 2506 and 2526 MHz, Port 56.



Keysight Spect	trum Analyzer - Oci	upred BW								-		5 8
Center Freq 2.526000000 GHz Gate: LO			Z Sain:Low	Center Freq: 2.52600 Trig: Free Run #Atten: 0 dB		00000 GHz Avg Hold Ext Gain:	ALIGN AUTO 0000 GHz Avg Hold: 100/100 Ext Gain: -41.90 dB		11:52:56 AM May 21, 2018 Radio Std: None Radio Device: BTS		Frequ	непсу
10 dB/div	Ref 31.0	0 dBm						_	-			
21.0 51.0 5.00	in hat which	en de la competencia de la competen Competencia de la competencia de la compe	i Malihun	the test	philipp	y wirst hill	n-laytati	uhatika tika	N.j.M		Cer 2.52600	oooo GHz
-800 -190 -290												
39.0 W 43.0										M		
Center 2.5 Res BW 1	526 GHz 80 kHz	VBW 1.8 MHz					Span 20 MHz Sweep 2.867 ms			CF Ste 2 000000 M	CF Step	
Occupied Bandwidth				Total Power 28				28.2 dBm			<u>Auto</u> M	
Transm x dB Ba	nit Freq Err Andwidth	17.8 or	-3.798 H 18.75 M	Hz Hz	% of Ol x dB	BW Pow	er 99 -26.	0.00 % 00 dB			Fre	o Hz
MSG							STAR	5				

26dB and 99%, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1A, 2593 and 2613 MHz, Port 56.



📥 Keysight S	pectrum Analyzer - Oc	cupied BW								
Center F	RF 50.52, AC Center Freq 2.613000000 GHz PASS Gate: L0 #FGein:Low			Center Fr Trig: Ext #Atten: 6	SENSE:EXT ALIGN Center Freq: 2.613000000 GHz Trig: External Avg Hold: 100/ #Atten: 6 dB Ext Gain: -41.90			Radio Sto	Frequency	
10 dB/div	Ref 30.0	0 dBm							_	
0.02 10.0 0.00	an a	eputrophyk	4tallefterty	in the physical states of the physical state	ulypychy	Marine (I)	nanderstation	tijente of	ertelen.	Center Freq 2.613000000 GHz
20.0 -3070 -4010										
-00.0 -60.0									00.84	
Center 2.613 GHz #Res BW 100 kHz				VB	VBW 1 MHz			Spa Sweep	CF Step 2.000000 MHz	
Occu	pied Band	width	11 M	17	Total P	ower	27.9	dBm		
Trans x dB I	mit Freq En Bandwidth	ror	-65.738 H 18.54 M	Hz	% of OI x dB	BW Pow	er 99 -26.	0.00 % 00 dB		Freq Offset 0 Hz
MSG							STATU	\$		
26dB and 99%, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.2, 2660 and 2680 MHz, Port 56.



STATUS

Keysight Spectrum Analyzer - Occupied B	W.					000
Center Freq 2.680000000	HFGain:Low	SEASE EXT Center Freq: 2.68000 Trig: Free Run #Atten: 0 dB	ALIGH AUT 0000 GHz Avg Hold: 100/100 Ext Gain: -41.90 dE	Radio Std: Nor Radio Device: I	22, 2018 •• BTS	Frequency
10 dB/div Ref 31.00 dB/ Log 210	n	Alter da à Alada a	tute to take our d	the trade	E	Center Freq 2.68000000 GHz
1 00	ana da na manine a	a hadadh a a dhad	e ni ni fili	anai Whaterica I	l l	
-39.0 -39.0 -49.0					W	
Center 2.68 GHz Res BW 180 kHz		VBW 1.8 MH	IZ	Span 20 Sweep 2.80) MHz 57 ms	CF Step 2.000000 MHz
Occupied Bandwid	th 7.845 MH	Total P Z	ower 27	.8 dBm	-	Freq Offset
Transmit Freq Error x dB Bandwidth	-8.263 kH 18.53 MH	lz % of Ol Iz x dB	3W Power 9	99.00 % 6.00 dB		0 Hz
ATEX			ATE	R/5		

26dB and 99%, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1, 2506 and 2546 MHz, Port 56.



👝 Keysight Sp	ectrum Analyzer - Oc	cupied BW.								
Center F	RF 50 12 req 2.54600 Gate: LO	₩C 00000 GH #IF	lz Gain:Low	Center Fr Trig: Ext #Atten: 6	req: 2.54600 ernal1 i dB	0000 GHz Avg Hold Ext Gain:	4116N AUTO : 100/100 -41.90 dB	Radio Std	MMay 21, 2011 I: None vice: BTS	Frequency
10 dB/div	Ref 30.0	0 dBm			_		_			
20 0 10.5 0.00	a hakake ng kata	an tradition	hur have the	-the all the	****	tapalita	Ah.MY Jaanti	a Alaraka Marika	Wepla	Center Freq 2.546000000 GHz
-10.0 (20.0 (30/0										
40.0 60.0 60.0									1	
Center 2 #Res BW	2.546 GHz 100 kHz			VB	W 1 MHz			Spa Sweep	n 20 MHz 9.267 ms	CF Step 2.000000 MHz
Occu	pied Band	width		. –	Total P	ower	28.2	2 dBm		Auto Man
Trans x dB E	mit Freq En Bandwidth	17.8 ror	-35.480 I 18.54 M	HZ KHZ IHZ	% of Of x dB	BW Pow	er 99 -26.	9.00 % 00 dB		Freq Offset 0 Hz
Msa							STATU	s		

26dB and 99%, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1A, 2593 and 2633 MHz, Port 56.



Keysight S	pectrum Analyzer - Oci	cupied BW									
Center F	req 2.63300 Gate: LO	40 10000 GH #IF	dain:Low	Center Fr Trig: Ext #Atten: 6	req: 2.63300 ernal1 dB	0000 GHz Avg Hold Ext Gain:	413N AUTO 100/100 -41.90 dB	Radio De	PMMay 18, 2 d: None vice: BTS	018	Frequency
10 dB/div	Ref 30.0	0 dBm									_
20 0 10 0 0 00	analiyyyyyyyyyyyy	(quintyri)d	4tall/petro	附柳柳	malerare	ale the state of the	endige-serve	hymned	WWW.		Center Freq 2.633000000 GHz
20.0 -3010 -4010										Į.	
90.0 40.0	1 699 6 45							0.0	20 80		
#Res BW	/ 100 kHz			VB	W 1 MHz			Sweep	9.267 n	ns	CF Step 2.000000 MHz
Occu	ipied Band	width 17.8	13 M	Ηz	Total P	ower	27.1	7 dBm		-	Freq Offset
Trans x dB I	mit Freq Err Bandwidth	or	-66.009 18.54 N	(Hz IHz	% of Of x dB	BW Powe	ər 99 -26.	9.00 % .00 dB			0 Hz
Msa							STATU	s			

26dB and 99%, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.2, 2640 and 2680 MHz, Port 56.



📥 Keysight S	pectrum Analyzer - Oc	cupied BW									
Center I PASS	Freq 2.64000 Gate: L0	AC 00000 GH #F	HZ Gain:Low	Center Fr Trig: Ext #Atten: 6	nse ext] req: 2.64000 ernal1 i dB	0000 GHz Avg Hold Ext Gain:	411GN AUTO : 100/100 -41.90 dB	Radio Std Radio Der	M May 22 I: None vice: BT	, 2018 S	Frequency
10 dB/div	Ref 30.0	0 dBm					_				
0.00 10.0 0.00	approxistion and an	Mananahah	authorization	ntu (Vonje)	ellipmakan	and and a second	thurse the population	Munitipali	NIHA V		Center Freq 2.640000000 GHz
20.0 3010 40.0										 叫	
-50.0 -60.0									- 20		
#Res BV	V 100 kHz			VB	W 1 MHz			Sweep	9.267	ms	CF Step 2.000000 MHz
Occu	ipied Band	width	86 MI	Ηz	Total P	ower	28.1	dBm			Auto Man
Trans x dB	smit Freq En Bandwidth	ror	-77.437 18.39 N	(Hz IHz	% of OI x dB	BW Powe	er 99 -26.	0.00 % 00 dB			0 Hz
MSG							STATU	5			

4.1.3 Signal Bandwidth OBW - Triple Carrier (3C)

26dB and 99%, AAHC mMIMO - Full Band, B41, 3C, 33dBm, 60MBW, TM3.1, 2593, 2613 and 2633 MHz, Port 12.

Center Freq 2.61300000 GHz Center Freq 2.613000000 GHz Radio Std: None Gate: L0 #F Gate: Low Augithol:>100100 Augithol:>100100 Radio Std: None 10 dB16iv Ref 30.00 dBm Log Freq Freq 2.613000000 GHz Radio Device: BTS	Every Experiment Section 2 (1254-32 PM and 2, 2016) Every Experiment Section	lency
200 200 200 200 200 200 200 200 200 200	Center Freq 2.613000000 GHz 2.013000000 GHz 2.013000000 GHz 2.01300000 GHZ 2.0130000 GHZ 2.01300000 GHZ 2.01300000 GHZ 2.01300000 GHZ 2.01300000 GHZ 2.01300000 GHZ 2.0130000 GHZ 2.01300000 GHZ 2.0130000 GHZ 2.0130000 GHZ 2.0130000 GHZ 2.0130000 GHZ 2.0130000 GHZ 2.0130000 GHZ 2.0130000 GHZ 2.0130000 GHZ 2.013000 GHZ 2.0130000 GHZ 2.013000 GHZ 2.01000 GHZ 2.010000 GHZ 2.01000 GHZ 2.01000000 GHZ 2.0100000000000000000000000000000000000	i ter Freq 0000 GHz
Center 2.613 GHz Span 100 MHz Res BW 910 kHz Sweep 1 ms	iz CF Step 1000000000000000000000000000000000000	CF Step
Occupied Bandwidth Total Power 31.6 dBm	Auto Man Occupied Bandwidth Total Power 27.0 dBm	Man
57.863 MHz	Freq Offset 17.883 MHz	offset
Transmit Freq Error -20.289 kHz % of OBW Power 99.00 % x dB Bandwidth 59.75 MHz x dB -26.00 dB	x dB Bandwidth 18.54 MHz x dB -26.00 dB	
Angi Status	MSG STATUS	
Konjust Sustainer Andyne: Occupied BW IstAct Strill Ist254.59 PM Jan 01, 2015 Center Frag 2:653000000 GHz Center Frag 2:653000000 GHz Radio Std: Hone PASS Gale: L0 If Gale: L0 Affen: 6 dB Ext Gale: 42.00 dB Radio Device: BTS 10 dB/div Ref 30.00 dBm File Ref 30.00 dBm Ref 30.00 dBm Ref 30.00 dBm	8 Frequency Center Freq 2.613000000 GHz Center Freq 2.613000000 GHz Radio Std: None Frequency PASS Gate: L0 etc.finit.cw Attain: 6 dB Ext Gain: -42.00 dB Radio Device: BTS 10 dB/dV Ref 30.00 dBm Conter Freq 2.6130000000 GHz Conter Freq 2.6130000000 GHz Radio Std: None	lency
rea ano ano ano ano ano ano ano an	Center Freq 2.63300000 GHz 2.63300000 GHZ 2.6330000 GHZ 2.6330000 GHZ 2.6330000 GHZ 2.6330000 GHZ 2.6330000 GHZ 2.6330000 GHZ 2.6330000 GHZ 2.6330000 GHZ 2.630000 GHZ 2.630000 GHZ 2.630000 GHZ 2.630000 GHZ 2.630000 GHZ 2.630000 GHZ 2.630000 GHZ 2.63000 GHZ 2.63000 GHZ 2.63000 GHZ 2.63000 GHZ 2.63000 GHZ 2.6300 GH	iter Freq 0000 GHz
Center 2.633 GHZ Span 20 MHz Span 20 MHz #Res BW 100 kHz VBW 1 MHz Sweep 9.267 ms	Z CF Step 2 2000000 MHz XBW 1 MHz Sweep 9.267 ms 2000	CF Step
Occupied Bandwidth Total Power 27.0 dBm	Auto Man Occupied Bandwidth Total Power 26.9 dBm	Man
17.883 MHz Transmit Freq Error - 32.982 kHz % of OBW Power 99.00 % x dB Bandwidth 18.54 MHz x dB -26.00 dB	Freq Offset 17.887 MHz 0 Hz Transmit Freq Error -31.058 kHz % of OBW Power 99.00 % x dB Bendwidth 18.54 MHz x dB -26.00 dB	e q Offset 0 Hz
NSQ STATUS	Meg StAtus	

26dB and 99%, AAHC mMIMO - Full Band, B41, 3C, 33dBm, 60MBW, TM3.1A, 2593, 2613 and 2633 MHz, Port 12.

Keysight Spectrum Analyzer - Occupied BW	- Lice Keynight Spectrum Analyze - Occupied BW	
Center Freq 2,813000000 GHz Center Freq 25100000 GHz Radio Srd: None Gate: L0 Freq Run AvgHold-1010 BFGainLow RAtten: 0 dB Ext Gain: 42.00 dB Radio Device: BTS	Prequency Center Freq 26150000000 GHz Center Freq 261500000 0Hz Radio Std: Norw Frequency Center Freq 261500000 0Hz Radio Std: Norw Frequency Center Freq 261500000 0Hz Radio Device: BTS Std: Norw Frequency	
10 dB/div Ref 30.00 dBm	10 dB/div Ref 30.00 dBm	
an in the set of the s	Center Freq 2.613000000 GHz 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	Freq GHz
60.0		
Center 2.613 GHz Span 100 MH: Res BW 910 kHz VBW 8 MHz Sweep 1 ms	Hz CF Step #Res BW 100 kHz VBW 1 MHz Sweep 9.267 ms 2.00000	Step
Occupied Bandwidth Total Power 31.7 dBm	Auto Man Occupied Bandwidth Total Power 26.8 dBm Auto	Man
57.793 MHz	Freq Offset 17.846 MHz Freq O	ffset
Transmit Freq Error 58.730 kHz % of OBW Power 99.00 %	0 Hz Transmit Freq Error -51.350 kHz % of OBW Power 99.00 %	0 Hz
x dB Bandwidth 59.79 MHz x dB -26.00 dB	x dB Bandwidth 18.54 MHz x dB -26.00 dB	
MSG STATUS	IISO STATUS	
📕 Keysight Spectrum Analyzer - Occupied BW	📼 🐼 🖬 keysight Spectrum Analyze - Occupied BW	
Center Freq 2,593000000 GHz Generation State Press 2,593000000 GHz Center Freq 2,593000000 GHz Trig: External1 Avgihold: 100/100	Frequency Center Freq 2833000000 GHz Center Freq 2833000000 GHz Radio Std: None Frequency Center Std: None Trig: External Avgitabid: 100/100	1
#FGain:Low #Atten: 6 dB Ext Gain: 42.00 dB Radio Device: BTS	PASS #FGain:Low #Atten: 6 dB Ext Gain: 42.00 dB Radio Device: BTS	
10 dB/div Ref 30.00 dBm	10 dB/div Ref 30.00 dBm	
	Center Freq	Freq
acco hear for the first of the second state of the		GHZ
- 00 J ^{MA}		
200		
Center 2.593 GHz Span 20 MHz Span 20 MHz VBW 1 MHz Sween 9.267 ms	Hz CF Step Center 2.633 GHz Span 20 MHz CF Step #Res BW 100 kHz VBW 1 MHz Sweep 9.267 ms	Step
Occupied Bandwidth Total Power 26.9 dBm	Auto Man Occupied Bandwidth Total Power 26.9 dBm	Man
17.838 MHz	Free Offset 17.824 MHz	ffset
Transmit Freq Error -54.486 kHz % of OBW Power 99.00 %	DHz Transmit Freq Error -61.624 kHz % of OBW Power 99.00 %	0 Hz
x dB Bandwidth 18.54 MHz x dB -26.00 dB	x dB Bandwidth 18.54 MHz x dB -26.00 dB	
NSG INTATIN		
01000		

26dB and 99%, AAHC mMIMO - Full Band, B41, 3C, 33dBm, 60MBW, TM3.2, 2640, 2660 and 2680 MHz, Port 12.

Center Freq 2.660000000 GHz Center Freq 2.56000000 GHz Center Freq 2.560000000 GHz Center Freq 2.56000	uency
BHGaint.ow #Attent 0 00 Ext Gaint 40,10 00 Radio Device. D S	
10 dB/dy Ref 33.00 dBm 20 20 20 20 20 20 20 20 20 20	n ter Freq 00000 GHz
S70 S70 Center 2.66 GHz Span 100 MHz Center 2.66 GHz Span 100 MHz Res BW 910 kHz VBW 8 MHz Sweep 1 ms Sweep 1 ms 100 00000 MHz Res BW 180 kHz VBW 1.8 MHz Sweep 2.867 ms	CF Step
Occupied Bandwidth Total Power 32.0 dBm Auto Man 57.491 MHz 57.491 MHz 0 Ccupied Bandwidth Total Power 27.1 dBm Transmit Freq Error 132.80 kHz % of OBW Power 99.00 % 17.857 MHz 17.857 MHz x dB Bandwidth 59.53 MHz x dB -26.00 dB 7 ansmit Freq Error -2.589 kHz % of OBW Power 99.00 %	Man eq Offset 0 Hz
MSG STATUS MSG STATUS	
Crypteld Spectrum Analyzer - Occupied BW Strold EXT Strol	uency nter Freq
	00000 GHz
Center 2.88 GHz Span 20 MHz CF Step Center 2.88 GHz Span 20 MHz Span 20 MHz Res BW 180 kHz VBW 1.8 MHz Sweep 2.867 ms 200000 MHz Sweep 2.867 ms 2000000 MHz Sweep 2.867 ms 200000 MHz Sweep 2.867 ms 200	CF Step
Occupied Bandwidth Total Power 27.0 dBm Auto Man Occupied Bandwidth Total Power 26.9 dBm Auto 17.862 MHz 17.866 MHz 17.866 MHz 17.866 MHz 17.866 MHz 17.866 MHz Freq Offset 17.866 MHz 17.866 MHz Freq Offset 17.866 MHz Freq Offset 17.866 MHz 18.76 MHz x dB 26.00 dB	Man eq Offset 0 Hz
MSG STATUS MSG STATUS	_

4.2 Occupied Bandwidth/ Edge of Band Emissions (OBW-Edge of Band)

The Occupied Bandwidth / Edge of Band emissions of the EUT at the external antenna connector (EAC) were measured to determine compliance with the limits of Part 27.53 when tested per ANSI C63.26, KDB 971168 D01, v03r01, and KDB 662911 D01, v02r01. The RF output from the EAC port to spectrum analyzer was reduced (to an amplitude usable by the signal analyzer) by using a calibrated attenuator/ test coupler. Measurements were performed using a Keysight MXA Signal Analyzer. The Block edge requirements as specified in 47CFR 27.53 were followed and are listed in Table 4.2 below:

Carrier	Power	Signal Bandwidth	OBW Measurement RBW	Signal Referen	Offset ce level	"n" x MIMO	MIMO Factor	1st M⊦	1st MHz limit		the 1st ₋imit
w	dBm	MHz	MHz	dBc	dBm	integer	dB	dBm	dBc	dBm	dBc
1.875	32.73	20	0.1	-23.01	9.72	64	18.06	-34.07	-66.80	-41.06	-73.79
1.875	32.73	20	0.2	-20.00	12.73	64	18.06	-31.06	-63.79	-38.05	-70.78
1.875	32.73	20	1	-13.01	19.72	64	18.06	-24.07	-56.80	-31.06	-63.79

Table 4.2 Mask values for OBW and Conducted Spurious measurements at various measurement bandwidths

Corrections for path loss were applied by using the worst case path attenuation for the frequency range of interest. These values were applied and are offset on the display. All parameters were 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 mask values requirements as specified in 47CFR 27.53 were followed. These include the 10LOG(N) correction equal to 18.06 dB for 64x MIMO.

The Top of Mask corresponds to the set rated power level as confirmed by the RF Channel power. This allows confirmation that the measured trace is properly calibrated to the mask.

All emissions were within the parameters as required by Part 27.53 for compliance. Sample Charts are below

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

4.2.1 OBW-Edge of Band - Single Carrier (1C)

Unwanted Emissions, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM1.2, 2593 MHz.



Unwanted Emissions, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.1, 2593 MHz.



Unwanted Emissions, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.1, 2680 MHz.



Unwanted Emissions, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.1, 2506 MHz.



Unwanted Emissions, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.1A, 2593 MHz.



Unwanted Emissions, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.1A, 2506 MHz.



Unwanted Emissions, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.2, 2506 MHz.



Unwanted Emissions, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.1A, 2680 MHz.

	RF 50.0 A	0		SENSE:EXT		ALIGN A	VJTO 08:35	:38 AM May 10, 2018	Fraguanau
enter Fred	2.6800000 tte: L0	00 GHz	Ce Tri	nter Freq: 2. g: External1 tten: 0 dB	680000000 GH Avg: 1 Ext G:	z 00.00% of ain: -41.90	25 dB Radio	Std: None Device: BTS	Frequency
	Def 20.0 dB								
od aerain	Ref 28.0 dE	an.						TERUVALOVI	
8.0		1 A A			and chards	1.1			Center Fre
cii		MANNA	NAME	BANAPINA	新日本市	WANK .		_	2.68000000 GH
10. ———			- An sheet	1112 11	- HIM - I - I	1.140			
.0						h			
2.0									
.0.									
2.0		1				1		Absolute Link	
						N		Spectrum	
2,0									
enter 2.68	GHz						Sp	an 40.2 MHz	CF Ste 4.020000 MH
otal Power	Ref 27.9	3 dBm / 30	MHz						Auto Ma
				Lower		Peak ->	Upper	2	Freq Offse
Start Freq	Stop Freq	Integ BW	dBm	ALIM(dB)	Freq (HZ)	dBm	ALIM(dB)	Freq (HZ)	0.6
10.10 MHz	11.10 MHz	200.0 KHZ	-42.16	(-11.06)	-10.44 M	-42.92	(-11.82)	10.85 M	
15.10 MHz	20.10 MHz	200.0 KHZ	-46.83	(-8,74)	-11:50 M	-47.70	(-9,61)	15 10 M F	
10.10 MHz	20.10 MHz	200:0 KHZ	-47.03	(-8.94)	-10.28 M	-50.13	(-12.04)	15.10 M F	
8 000 MHz	12 50 MHz	1.000 MHz		()			()		
12 50 MHz	15.00 MHz	1 000 MHz		()			()		
12 50 MHz	15.00 MHz	1 000 MHz		()			()		

Unwanted Emissions, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM3.2, 2680 MHz.



4.2.2 OBW-Edge of Band - Dual Carrier (2C)

Unwanted Emissions, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1, 2506 & 2526 MHz, Port 56.



Unwanted Emissions, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1A, 2593 and 2613 MHz, Port 56.



Unwanted Emissions, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.2, 2660 and 2680 MHz, Port 56.



Unwanted Emissions, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.2, 2640 and 2680 MHz, Port 56.



Unwanted Emissions, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1A, 2593 and 2633 MHz, Port 56.

SS	ate: LO	IFGain:	Low #A	tten: 0 dB	Ext Ga	in: -41.90 d	dB Radio	Device: BTS	
dB/dív	Ref 31.0 dB	im		_					
n o	NIWIN	WW	MN,		/w	un anti-	in the second		Center Fre 2.613000000 GF
0									
0			in the	hidden and	vianni ¹			Absolute Line Spectrum	
nter 2.61	3 GHz Ref 30 56	6 dBm / 6	0 MHz				Sp	an 80.2 MHz	CF Ste 8.020000 MH Auto Mi
nter 2.61	3 GHz Ref 30.56 Stop Freq	6 dBm /6	0 MHz	Lower ALim(dB)	Freq (Hz)	² eak ≫ dBm	Sp Upper ALim(dB)	an 80.2 MHz Freg (Hz)	CF Ste 8.020000 Mi Auto Mi Freq Offs
nter 2.61 tal Power	3 GHz Ref .30.56 Stop Freq 31.10 MHz	6 dBm / 6 Integ BW 200.0 kHz	0 MHz dBm -38.28	Lower ∆Lim(dB) (-7.18)	<- Freq (Hz) -30.67 M	⁹ eak ⇒ dBm -38.25	Sp Upper ALim(dB) (-7.15)	an 80.2 MHz Freq (Hz) 30.38 M	CF Sto B.020000 MI <u>Auto</u> M Freq Offs 0 1
nter 2.61 tal Power start Freq 30.10 MHz 31.10 MHz	3 GHz 30 56 Stop Freq 31.10 MHz 35.10 MHz	6 dBm / 6 Integ BW 200.0 kHz 200.0 kHz	0 MHz dBm -38.28 -43.59	Lower ∆Lim(dB) (-7.18) (-5.50)	Freq (Hz) -30.67 M -33.62 M	² eak ≫ dBm -38.25 -44.16	Upper ΔLim(dB) (-7.15) (-6.07)	an 80.2 MHz Freq (Hz) 30.38 M 31.18 M	CF Str B.020000 M Auto M Freq Offs 0
tal Power start Freq 80.10 MHz 31.10 MHz 35.10 MHz	3 GHz Ref 30.54 Stop Freq 31.10 MHz 35.10 MHz 40.10 MHz	6 dBm / 6 Integ BW 200.0 kHz 200.0 kHz 200.0 kHz	0 MHz dBm -38.28 -43.59 -44.00	Lower ΔLim(dB) (-7.18) (-5.50) (-5.91)	<- Freq (Hz) -30.67 M -33.62 M -39.42 M	eak ⇒ dBm -38.25 -44.16 -44.66	Upper ΔLim(dB) (-7.15) (-6.07) (-6.57)	an 80.2 MHz Freq (Hz) 30.38 M 2 31.18 M 37.70 M	CF St 8.020000 M Auto N Freq Offs 0
tal Power tal Power Start Freq 30.10 MHz 31.10 MHz 35.10 MHz 4.000 MHz	3 GHz Stop Freq 31.10 MHz 35.10 MHz 40.10 MHz 8.000 MHz	6 dBm / 6 Integ BW 200.0 kHz 200.0 kHz 200.0 kHz 1.000 MHz	0 MHz dBm -38.28 -43.59 -44.00	Lower ΔLim(dB) (-7.18) (-5.50) (-5.91) ()	 Freq (Hz) -30.67 M -33.62 M -39.42 M 	Peak ⇒ dBm -38.25 -44.16 -44.66	Upper ΔLim(dB) (-7.15) (-6.07) (-6.57) ()	an 80.2 MHz Freq (Hz) 30.38 M 31.18 M 37.70 M	CF St B.020000 M Auto N Freq Offs 0
tal Power start Freq 30.10 MHz 31.10 MHz 35.10 MHz 4.000 MHz 3.000 MHz	3 GHz Stop Freq 31.10 MHz 35.10 MHz 40.00 MHz 12.50 MHz	6 dBm / 6 Integ BW 200.0 kHz 200.0 kHz 200.0 kHz 200.0 kHz 1.000 MHz 1.000 MHz	0 MHz dBm -38.28 -43.59 -44.00 	Lower ΔLim(dB) (-7.18) (-5.50) (-5.91) () ()	Freq (Hz) -30.67 M -33.62 M -39.42 M	2eak ⇒ dBm -38.25 -44.16 -44.66 	Upper <u>ALim(dB)</u> (-7.15) (-6.07) (-6.57) (-) (-)	an 80.2 MHz Freq (Hz) 30.38 M 31.18 M 37.70 M	CF St B.020000 M Auto N Freq Offs 0

Unwanted Emissions, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1, 2506 and 2546 MHz, Port 56.

and a second second		00.011-		SENSEEXI	25000000 01	ALIGN ACT	0 02:02: Dadie	18 PM May 21, 2018	Frequency
Ga	2.5260000 ate: LO	IFGain:Lo	W #A	ig: External1 tten: 0 dB	Avg: 10 Ext Ga	0.00% of 25 n: -41.90 dB	Radio	Device: BTS	
101.11									
g Sland	Ref 51.0 dE							Transie and	
σ									Center Fre
0	Alderent di	all have fi that	6		Mint	an a third like	Auto		2.526000000 GH
30			<u> </u>		Internet		et katalant		
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á									
ń.									
	Г							Absolute Land	
	1		Sec. sugar	Dental Jack	لم والم عام			Spectrum	
0			- north	a la compara de compara	and the second second			ľ	
.0									
	6 011-						0		
							sp	an 80.2 MHZ	CF Ster
anter 2.32	0 GHZ								
enter 2.52	Def								8.020000 MH
otal Power	Ref 30.7	0 dBm / 60	MHz						8.020000 MH Auto Ma
otal Power	Ref 30.7	0 dBm / 60	MHz	Lower	c.F	eak⇒	Upper		8.020000 MH <u>Auto</u> Ma
otal Power	Ref 30.7	0 dBm / 60 Integ BW	MHz dBm	Lower	⊊Freq (Hz)	eak.⇒ dBm 2	Upper \Lim(dB)	Freq (Hz)	B.020000 MH Auto Ma Freq Offse
Start Freq 30.10 MHz	Ref 30.7 Stop Freq 31.10 MHz	0 dBm / 60 Integ BW 200.0 kHz	MHz dBm -42.47	Lower ∆Lim(dB) (-11.46)	- F Freq (Hz) -30.13 M	eak ⇒ dBm _2 -37.53	Upper ALim(dB) (-6.52)	Freq (Hz) 30.55 M 🕑	B.020000 MF Auto Ma Freq Offs 0 F
Start Freq 30.10 MHz 31.10 MHz	Ref 30.70 Stop Freq 31.10 MHz 35.10 MHz	0 dBm / 60 Integ BW 200.0 kHz 200.0 kHz	MHz dBm -42.47 -46.50	Lower ΔLim(dB) (-11.46) (-8.50)	- Freq (Hz) -30.13 M -31.22 M	eak → dBm 2 -37.53 -43.68	Upper ΔLim(dB) (-6.52) (-5.68)	Freq (Hz) 30.55 M 32.18 M	B.020000 MF Auto Ma Freq Offsi 0 F
Start Freq 30.10 MHz 31.10 MHz 35.10 MHz	Ref 30.7 Stop Freq 31.10 MHz 35.10 MHz 40.10 MHz	0 dBm / 60 Integ BW 200.0 kHz 200.0 kHz 200.0 kHz	MHz dBm -42.47 -46.50 -48.73	Lower ΔLim(dB) (-11.46) (-8.50) (-10.73)	- Freq (Hz) -30.13 M -31.22 M -35.10 M	eak ⇒ dBm 2 -37.53 -43.68 -44.73	Upper <u>Lim(dB)</u> (-6.52) (-5.68) (-6.73)	Freq (Hz) 30.55 M 4 32.18 M 35.66 M =	B.020000 MF Auto Mr Freq Offs 0 F
Start Freq 30.10 MHz 31.10 MHz 35.10 MHz 4.000 MHz	Ref 30.7 Stop Freq 31.10 MHz 35.10 MHz 40.10 MHz 8.000 MHz	0 dBm / 60 Integ BW 200.0 kHz 200.0 kHz 200.0 kHz 1.000 MHz	MHz dBm -42.47 -46.50 -48.73 	Lower ΔLim(dB) (-11.46) (-8.50) (-10.73) ()	- Freq (Hz) -30.13 M -31.22 M -35.10 M	eak ⇒ dBm 2 -37.53 -43.68 -44.73	Upper ALim(dB) (-6.52) (-5.68) (-6.73) ()	Freq (Hz) 30.55 M = 32.18 M 35.66 M =	B.020000 Mi <u>Auto</u> Mi Freq Offs 0 i
Start Freq 30.10 MHz 31.10 MHz 35.10 MHz 4.000 MHz 8.000 MHz	Ref 30.7/ Stop Freq 31.10 MHz 35.10 MHz 40.10 MHz 8 000 MHz 12.50 MHz	0 dBm / 60 Integ BW 200.0 kHz 200.0 kHz 200.0 kHz 1.000 MHz 1.000 MHz	MHz dBm -42.47 -46.50 -48.73 	Lower ∆Lim(dB) (-11.48) (-8.50) (-10.73) () ()	-30.13 M -30.13 M -31.22 M -35.10 M	eak ⇒ dBm 2 -37.53 -43.68 -44.73	Upper ALim(dB) (-6.52) (-5.68) (-6.73) () ()	Freq (Hz) 30.55 M 32.18 M 35.66 M	B.020000 MF Auto Mr Freq Offs 0 F
Start Freq 30.10 MHz 31.10 MHz 35.10 MHz 4.000 MHz 8.000 MHz 12.50 MHz	Ref 30.70 Stop Freq 31.10 MHz 35.10 MHz 40.10 MHz 8.000 MHz 12.50 MHz 15.00 MHz 15.00 MHz	0 dBm / 60 Integ BW 200.0 kHz 200.0 kHz 200.0 kHz 1.000 MHz 1.000 MHz 1.000 MHz	MHz 48m 42.47 46.50 48.73 	Lower ΔLim(dB) (-11.46) (-8.50) (-10.73) () () ()		eak ⇒ dBm 2 -37.53 -43.68 -44.73 	Upper LLim(dB) (-6.52) (-5.68) (-6.73) () () ()	Freq (Hz) 30.55 M 32.18 M 35.66 M	B.020000 MF Auto Mr Freq Offs 0 F

4.2.3 OBW-Edge of Band - Triple Carrier (3C)

Unwanted Emissions, AAHC mMIMO - Full Band, B41, 3C, 33dBm, 60MBW, TM3.1A, 2593, 2613 and 2633 MHz, Port 12.



Unwanted Emissions, AAHC mMIMO - Full Band, B41, 3C, 33dBm, 60MBW, TM3.2, 2593, 2613 and 2633 MHz, Port 12.

Center Free PASS	q 2.6130000 ate: LO	C 100 GHz IFGain:Lo	Ce Tri w #A	sense ext nter Freq: 2. g: External1 tten: 2 dB	613000000 GH Avg: 1 Ext Ga	z 00.00% of ain: -40.10	25 dB Radio	116 AM Jun 04, 2018 Std: None Device: BTS	Frequency
10 dB/div	Ref 33.0 dE	ßm						Frankline card	
230 130	Wingenst	a dat fan fran all fan	h MANN	homespecture	ingen pin	r philips M	applements		Center Freq 2.613000000 GHz
7.00			Ŷ.		Y				
17 0									
27.0								ADAGHARLANA	
0.0	4							9	
27.0									· · · · · · · · · · · · · · · · · · ·
3/ J									
Center 2.61	13 GHz r Ref 32.1	7 dBm / 60	MHz				5	Span 80 MHz	CF Step 8.000000 MHz Auto Man
Start Freq	Stop Freq	Integ BW	dBm	Lower ALim(dB)	Freq (Hz)	Peak -≫ dBm	Upper ALim(dB)	Freg (Hz)	Freq Offset
30.10 MHz	31.10 MHz	200.0 kHz	-38.75	(-7.65)	-31.00 M	-39.08	(-7.98)	31.08 M	0 H3
31.10 MHz	35.00 MHz	1.000 MHz	-31.66	(-0.56)	-31.78 M	-31.98	(-0.88)	31.69 M	
35.00 MHz	40.00 MHz	1.000 MHz	-31.40	(-0.30)	-38.10 M	-31.77	(-0.67)	39.58 M	
4.000 MHz	8.000 MHz	1.000 MHz							
8.000 MHz	12.50 MHz	1.000 MHz		()			()	-	
12.50 MHz	15.00 MHz	1.000 MHz		()			()		
MHZ	15.00 MHz	1000 MHz		()			()		

Unwanted Emissions, AAHC mMIMO - Full Band, B41, 3C, 33dBm, 60MBW, TM3.2, 2640, 2660 and 2680 MHz, Port 12. 2s sweep time



Unwanted Emissions, AAHC mMIMO - Full Band, B41, 3C, 33dBm, 60MBW, TM3.2, 2506, 2526 and 2546 MHz, Port 12. 1s sweep time.

Keysight Spect	rum Analyzer - Spectru	m Emission Mask		1					
Center Fr PASS	eq 2.526000 Gate: L0	000 GHz IFGain:Le		enter Freq: 2. rig: External1 Atten: 0 dB	526000000 GH Avg: 1 Ext G:	z 100.00% of 25 ain: -40.10 dE	Radio 8 8 Radio	Std: None Device: BTS	Frequency
0 dB/div	Ref 33.0 d	Bm						- REPURE TO	
23.0 13.0 3.00 7.00	MANYA	ymyyyth	ia myyy	al a change a	nterent pop	havan/m	an (-141		Center Free 2,526000000 GH
7.5 7.6 7.8			V		V			Absolute Lity	
enter 2.3	526 GHz er Ref 31.	94 dBm / 60	MHz				Sp	an 80.2 MHz	CF Ste 8.020000 MH Auto Ma
Start Freq	Stop Freq	Integ BW	dBm	Lower <u>ALim(dB)</u>	Freq (Hz)	Peak.⊸ dBm _/	Upper Lim(dB)	Freq (Hz)	FregOffse
30.10 MHz	31.10 MHz	200.0 kHz	-40.46	(-9.36)	-30.66 M	-39.14	(-8.04)	31.03 M	0 H
31.10 MHz	35.10 MHz	200.0 kHz	-40,98	(-2.89)	-32.52 M	-38.92	(-0.83)	33.40 M	
35.10 MHz	40.10 MHz	200.0 kHz	-43.05	(-4.96)	-35.10 M	-40.53	(-2.44)	39.75 M	
4.000 MHz	8.000 MHz	1.000 MHz		()			()		
8.000 MHz	12.50 MHz	1.000 MHz		()			()		
12.50 MHz	15.00 MHz	1.000 MHz		()			()	-	-
10						STA	tus		

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

5.1 Measurement of Spurious Emissions at Transmit Antenna Port

The Spurious Emissions at the transmit-antenna terminals of the EUT (EAC) were measured to determine compliance with the limits of Part 27.53 when tested per ANSI C63.26, KDB 971168 D01, v03r01, and KDB 662911 D01, v02r01. The RF output from the EAC port to spectrum analyzer was reduced (to an amplitude usable by the signal analyzer) by using a calibrated attenuator/ test coupler. Measurements above 10 GHz incorporated a high pass filter to reduce path loss. Measurements were performed using a Keysight MXA Signal Analyzer. The Spurious Emissions requirements as specified in 47CFR 27.53 were followed. These include the 10LOG(N) correction equal to 18.06 dB for 64x MIMO.

The applicable per port limits are as follows

Corrections for path loss were applied by using the worst case path attenuation for the frequency range of interest. These values were applied and are offset on the display. All parameters were adjusted to the corrected RF power level for the resolution bandwidth used for the transmit signal.

The measured spurious emission levels were plotted for the frequency range of 10 MHz to 26.5 GHz. Data below documents performance up to 26.5 GHz.

All emissions were within the parameters as required by Part 27.53 for compliance. Sample Charts are below

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

5.1.1 Antenna Port Spurious Emissions - Single Carrier (1C)

Spurious Emissions, AAHC mMIMO - Full Band, B41, 1C, 28dBm, 20MBW, TM1.1, 2593 MHz.





Center F	req 2.593	0000000 GHz	Center Freq: 2.5	93000000 GHz	Radio Std: None	Range Table
PASS	-	IFGair	Low #Atten: 4 dB	Ext Gain: -43.90 dB	Radio Device: BTS	Range
10 dB/div	Ref 2	8.00 dBm				<u>90</u> 00
100 100						Start Freq 2.491000000 GHz
12.0 12.0 12.0						Stop Freq 2.578000000 GHz
420 511 470						Res BW 1.0000 MHz Auto Man
Start 2.4	91 GHz				Stop 2.578 GHz	Video BW
Spur	Range	Frequency	Amplitude	Limit	1 Limit	Auto Man
						Filter Type Gaussian
						More 1 of 3
14675				-TATA	1	-

Keysight Spec	thum Analyzes Spurroun i	missions				AR (2) OF AM R	-	519 4
Stop Fred PASS	2.695000000	GHz IFGain:Low	Center Freq Trig: Free R #Atten: 4 dt	2.593000000 GHz un Avg/Hold: Ext Gain:	100/100 43.90 dB	Radio Std: None Radio Device: BTS	Ran	ge Table Range
10 dB/div	Ref 28.00 dE	m					QD	D
100 100 600							2.608	Start Freq 000000 GHz
-12.0 -12.0 							2.695	Stop Freq 000000 GHz
-420 -51.1 -57.0							Auto	Res BW 1.0000 MHz Mat
Start 2.60	8 GHz					Stop 2.695 GHz		Video BW
Spur	Range Freq	uency	Amplitude	Limit	4	Limit	Auto	Marr
							F	Gaussian
								More 1 ef 3
No Se	ours have been four	d			STATE		-	





5.1.2 Antenna Port Spurious Emissions - Dual Carrier (2C)

Spurious Emissions, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1, 2593 and 2613 MHz, Port 56.



Keysight Spectrum Analyzes	Spanous Emissions				- 914 - 4
Center Freq 2.603	000000 GHz IFGain:Low	Center Freq: 2.60300 Trig: External1 #Atten: 0 dB	00000 GHz AvgiHold: 100/100 Ext Gain: -28.60 dB	Radio Std: None Radio Device: BTS	Range Table Range
10 dB/div Ref 31	.00 dBm				QD 007
21.0					Start Freq 10.000000000 GHz
100 100 19.0 19.0					Stop Freq 27.000000000 GHz
20 D 49 D 40 C					Res BW 1.0000 MHz Auto Man
Start 10 GHz				Stop 27 GHz	Video BW 3.0000 MHz
Spur Range	Frequency A	mplitude	Limit 4	1 Limit	Auto Man
					Filter Type Gaussian
					More 1 of 3
Vec LINo Spurs have be	sen found		STATE	6	

Spurious Emissions, AAHC mMIMO - Full Band, B41, 2C, 31dBm, 40MBW, TM3.1A, 2506 and 2546 MHz, Port 56.



Center F	req 2.5260	00000 GHz	Center Freq: 2.52	6000000 GHz	Radio Std: None	Range Table
PASS		IFGain:Los	#Atten: 4 dB	Ext Gain: -42.00	dB Radio Device: BT	s Range
vib/Bb 01	Ref 31.	00 dBm				<u>Qo</u> off
21.0 (1.9						Start Freq 1.000000000 GHz
9 co 19.0 -29.0						Stop Freq 2.491000000 GHz
49.0 49.0						Res BW 1.0000 MHz Auto Man
Start 1 G	Hz				Stop 2.491 C	Hz Video BW
Spur	Range	Frequency	Amplitude	Limit	Δ Limit	Auto Man
						Filter Type Gaussian
						More 1 of 3
MEG				-	TATUS	



Keysight Spect	nim Anklyzer =	Spanitus Emissions	-						0 0
Center Fre	q 2.526	000000 GH	ain:Low	Center Freq: 2.5260 Trig: External1 #Atten: 0 dB	00000 GHz Avg Hold: Ext Gain:	100/100 -43.90 dB	Radio Std: None Radio Device: BTS	Ra	nge Table Range
10 dB/div	Ref 31	.00 dBm					5.4150 GHz -42.230 dBm	Qn	or
210 110								2.69	Start Freq 5000000 GHz
-) cn -19.0 -29.0								10.00	Stop Freq
40 0 68 0								Auto	Res BW 1.0000 MHz Man
Start 2.695	GHz						Stop 10 GHz	Auto	Video BW 3.0000 MHz Man
Spur	Range	Frequency	Am	plitude	Limit		S Limit	,	filter Type Gaussian
									More 1 of 3
wsa 🜙 No Spi	urs have be	en found				STATU	5		

Keysight Spectrum Anal	28 Spontous Emissions				le-14
Center Freq 2.5	26000000 GHz	Center Freq: Trig: External #Atten: 0 dB	2.525000000 GHz 11 Avg Hold: 100/10 Ext Gain: -28.60	Radio Std: Non 00 dB Radio Device E	Range Table
to devalue Ref	31.00 dBm	112.00			On Of
210 110					Start Freq 10.000000000 GHz
9 m2 19.0					Stop Freq 27 00000000 GHz
29 D 49 D 40 C					Res BW 1 0000 MHz Auto Man
Start 10 GHz				Stop 27	GHz Video BW 3.0000 MHz
Spur Rang	e Frequency	Amplitude	Limit	Δ Limit	Auto Man
					Filter Type Gaussian
					More 1 of 3

5.1.3 Antenna Port Spurious Emissions - Triple Carrier (3C)

Spurious Emissions, AAHC mMIMO - Full Band, B41, 3C, 33dBm, 60MBW, TM3.2, 2506, 2526 and 2546 MHz, Port 12.



Center Fr	eq 2.526	5000000 G	Hz	Center Free	q: 2.526000	000 GHz	ALION AUTO	Radio St	M Jun (8, 2018 d: None	Ra	inge Table
PASS		4	FGain:Low	#Atten: 4 d	nai1 B	Avg Hold Ext Gain:	-42.00 dB	Radio De	evice: BTS		Range
to dB/div	Ref 3	3.00 dBm								On	on
210 210 100										1.00	Start Freq
7 00 17.0 -37.0										2.49	Stop Freq
37 D 47 O 57 D										Auto	Res BW 1.0000 MHz Man
Start 1 GH	Hz							Stop	2.495 GHz		Video BW
Spur	Range	Frequen	cy Al	mplitude		Limit		Limit		Auto	Man
											Filter Type Gaussian
											More 1 of 3
En.							STATE			_	_

							Shranora suezanaz	ection Analyzes	a dividue sh
ige Table	Ione Ra	Radio Std: N	1001400	5000000 GHz	Center Freq: 2		000000 GHz	req 2.526	nter F
Rang	BTS	Radio Device	42.00 dB	Ext Gain: -4	#Atten: 6 dB	in:Low	IFGair		ASS
	Qn						.00 dBm	Ref 3	dB/div
Start Fre	*								9
5000000 GH	2.55								0
Ston Fre									00
0000000 GH	2.65								0
Res Bi 200,00 kH	Auto	MANAMAA	Viivyy			ANYTYTY	mathilian	nutrativita a	nviv
Res Bi 200.00 kF Ma Video Bi	Auto	Stop 2.	Viinau	NUTVICTI	trenom WW	ANTROPON	nnnillinn	56 GHz	art 2.5
Res Br 200.00 kF Ma Video Br 1.0000 MF	Auto	Stop 2.	WINYNW 2	Limit	piitude	ANTIVITÀ	frequency	56 GHz Range	art 2.5
Res Bi 200.00 kF Ma Video Bi 1.0000 MF Ma	Auto	Stop 2. A Limit	1/10/1000 2 n -2	Limit -38.10 dBm	plitude 05 dBm	ANTONION Ant -41.	Frequency 2.571 GHz	56 GHz Range	art 2.5 Spur
Res Bi 200,00 kF Ma Video Bi 1.0000 MF Ma	Auto	Stop 2. Δ Limit 2.950 dB 3.026 dB	1//////// n -2. n -3.	Limit -38.10 dBm -38.10 dBm	plitude 05 dBm 13 dBm	ANTIVITÀ An -41. -41.	Frequency 2.571 GHz 2.591 GHz	56 GHz Range 1 1	art 2.5 Spur 1 2
Res Bi 200.00 ki Ma Video Bi 1.0000 Mi Ma litter Type Gaussian	Auto	Stop 2. A Limit 2.950 dB 0.026 dB 1.308 dB	2 n -2 n -3 n -3	Limit -38.10 dBm -38.10 dBm -38.10 dBm	plitude D5 dBm 13 dBm 41 dBm	ANTINIA An -41. -41. -41.	Frequency 2.571 GHz 2.591 GHz 2.633 GHz	56 GHz Range 1 1	art 2.5 Spur 1 2 3
Res Bi 200.00 ki Ma Video Bi 1.0000 Mi Ma litter Type Gaussian	Auto 69 GHZ	Stop 2. A Limit 1950 dB 1,026 dB 1,308 dB 1,401 dB	4 n -2 n -3 n -3 n -3	Limit -38.10 dBm -38.10 dBm -38.10 dBm -38.10 dBm -38.10 dBm	plitude 05 dBm 13 dBm 41 dBm 50 dBm	Am 41. -41. -41. -41.	Frequency 2.571 GHz 2.533 GHz 2.633 GHz 2.634 GHz	Range 1 1 1 1	art 2.5 Spur 1 2 3 4
Res Bi 200.00 kF Ma Video Bi 1.0000 MF Ma liter Type Gaussian	69 GHz	Stop 2. A Limit 1,950 dB 1,026 dB 1,308 dB 1,401 dB 1,708 dB	2 n -2 n -3 n -3 n -3 n -3 n -3	Limit -38.10 dBm -38.10 dBm -38.10 dBm -38.10 dBm -38.10 dBm	plitude 05 dBm 13 dBm 41 dBm 50 dBm 81 dBm	Ann 41. -41. -41. -41. -41. -41.	Frequency 2.571 GHz 2.691 GHz 2.633 GHz 2.634 GHz 2.595 GHz	Range 1 1 1 1 1	art 2.5 Spur 1 2 3 4 5
Res Bi 200.00 ki Ma Video B 1.0000 ki Ma Gaussian Gaussian	Auto	Stop 2. Δ Limit 2950 dB 1026 dB 1.308 dB 1.401 dB 1.708 dB 1.707 dB	2 n -2 n -3 n -3 n -3 n -3 n -3 n -3 n -3	Limit -38.10 dBm -38.10 dBm -38.10 dBm -38.10 dBm -38.10 dBm -38.10 dBm	plitude D5 dBm 13 dBm 11 dBm 21 dBm 81 dBm 87 dBm	Annovi (1) 41. 41. 41. 41. 41. 41. 41.	Frequency 2.571 GHz 2.591 GHz 2.633 GHz 2.595 GHz 2.595 GHz 2.593 GHz	S6 GHz Range 1 1 1 1 1 1	art 2.5 Spur 1 2 3 4 5 6

SS	The start of	Trig: External1	Avg Hold: 100/100	Radio Std: None	Pano
dB/div Ref 33.0	0 dBm	W BAtten: 200	Ext Gain: 43.90 de	Radio Device: B13	Qn D
				*	Start Fre 2.690000000 GH
					Stop Fre 10.00000000 GH
					Res BV 1.0000 MH Auto Ma
art 2.69 GHz				Stop 10 GH	Video B
Spur Range	Frequency	Amplitude	Limit	ΔLimit 🔸	Auto Ma
					Filter Type Gaussian
					Moi 1 ef



6. FCC Section 2.1053 and Part 15.109

6.1 Section 2.1053 Field Strength of Spurious Emissions

Field strength measurements of radiated spurious emissions were made in a 10m Semi-Anechoic Chamber 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 328881).

The spectrum from 30 MHz to the tenth harmonic of the carrier, as high as 27 GHz depending upon the product, 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 have sufficient margin below the specification limit, the use of field strength measurements for compliance determination is acceptable. For this case the evaluation of acceptable radiated field strength is as follows.

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, 4th edition, IT&T Corp.

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

20 log (E*10⁶) – (43 + 10 log P) = 82.23 dBµV/meter

Where:E = Field Intensity in Volts/meterP = Transmitted Power in WattsR = Measurement distance in meters = 3 m

The non-report compliance limit is 62.23 dB μ V/m for 64x64 MIMO The FCC Part 15 Class B limit is 54 dB μ V/m above 1GHz.

The calculated emission levels were found by:

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

6.2 Field Strength of Spurious Emissions 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 μ V/meter @ 3m. Emissions equal to or less than 64.2 dB μ 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 27 GHz), no spurious emissions above the limits were detected. A representative set of measurement scans are included below.



Radiated Emissions Template: RDE AR8 3M 30MH-1GHz BILOG Filename: c:\program files\emisoft - vasona\results\2018-0080 aaho mmimo - full band\T1 RE30M-200M FCC B 10M.emi

Results Title:	RDE AR8 3M 30MH-200 MHz BILOG
File Name:	c:\program files\emisoft - vasona\results\2018-0080 AAHC mmimo - full band\T1 RE30M-200M FCC B 10M.emi
Test Laboratory:	AR8 MH GPCL 21C, 38% RH 1000mB
Test Engineer:	2LW / YL
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia
EUT Details:	AAHC mMIMO - Full Band
Configuration:	Powered by -48VDC, 20 Amps, Tx-2593MHz, 256QAM, 1C, 28dBm per port. All ports transmitting. Radiated Emissions FCC Part 15, RE 30MHz-
	200MHz, Bicon Antenna E051, 6dB pad-E1130, Sonoma Preamp E813, ESI-E936.
Date:	2018-05-17 19:20:49

FORMAL DATA

Freq.	Raw	Cable	Factor	Level	Emission	Pol	Ht	Az	Limit	Margin	Pass	
MHz	dBuV	dB	dB	dBuV/m	Туре	H/V	cm	deg	dBuV/m	dB	/Fail	Comments
133.305	40.38	6.97	-19.3	28.06	Quasi Max	V	112	288	33	-4.94	Pass	
137.176	34.78	6.99	-19.2	22.59	Quasi Max	V	126	276	33	-10.41	Pass	
145.766	31.4	7.02	-19.2	19.22	Quasi Max	V	100	219	33	-13.78	Pass	
74.344	32.22	6.67	-24	14.88	Quasi Max	V	162	180	29.5	-14.62	Pass	
199.962	23.71	7.21	-17.8	13.14	Quasi Max	Н	100	248	33	-19.86	Pass	
54.4329	22.71	6.53	-22	7.23	Quasi Max	Н	338	148	29.5	-22.27	Pass	

PREVIEW DATA

Freq.	Raw	Cable	Factor	Level	Emission	Pol	Ht	Az	Limit	Margin	Pass	
MHz	dBuV	dB	dB	dBuV/m	Туре	H/V	cm	deg	dBuV/m	dB	/Fail	Comments
133.407	43.05	6.97	-19.3	30.74	Preview	V	100	270	33	-2.26	Pass	
137.158	39.74	6.99	-19.2	27.55	Preview	V	100	270	33	-5.45	Pass	
74.3447	37.44	6.67	-24	20.1	Preview	V	185	180	29.5	-9.4	Pass	
145.816	35.45	7.02	-19.2	23.27	Preview	V	100	270	33	-9.73	Pass	
199.583	33.83	7.21	-17.8	23.24	Preview	Н	385	180	33	-9.76	Pass	
54.4329	34.44	6.53	-22	18.96	Preview	Н	385	0	29.5	-10.54	Pass	
56.7415	33.95	6.55	-22.4	18.13	Preview	Н	385	0	29.5	-11.37	Pass	



Τ2 **Radiated Emissions** 200M-1 GHz 1C FCC Class B dBu∿/m

Template: RDE AR8 3M 30MH-1GHz BILOG Radiated Emissions Filename: c:/program files/emisoft - vasona/vesults/2018-0080 aaho mmimo - full band/T2_RE200M-1G_FCC_B_10M.emi

Results Title:	RDE AR8 3M 200 MHz-1GHz BILOG
File Name:	c:\program files\emisoft - vasona\results\2018-0080 AAHC mmimo - full band\T2 RE200M-1G FCC B 10M.emi
Test Laboratory:	AR8 MH GPCL 21C, 38% RH 1000mB
Test Engineer:	STW / JT
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia
EUT Details:	AAHC mMIMO - Full Band
Configuration:	Powered by -48VDC, 20 Amps, Tx-2593MHz, 256QAM, 1C, 28dBm per port. All ports transmitting. Radiated Emissions FCC Part 15, RE 200MHz-
	1GHz, 6dB pad E1130, Log-Periodic E061, Sonoma Preamp E813, ESI-E936.
Date:	2018-05-17 21:39:40

FORMAL DATA

Freq.	Raw	Cable	Factor	Level	Emission	Pol	Ht	Az	Limit	Margin	Pass	
MHz	dBuV	dB	dB	dBuV/m	Туре	H/V	cm	deg	dBuV/m	dB	/Fail	Comments
868.73	23.8	9.1	-8.37	24.53	Quasi Max	V	200	192	35.6	-11.07	Pass	
639.945	23.52	8.16	-11.6	20.12	Quasi Max	V	305	289	35.6	-15.48	Pass	
998.978	23.8	9.44	-6.21	27.04	Quasi Max	Н	110	261	43.5	-16.46	Pass	
568.37	23.32	7.92	-12.9	18.37	Quasi Max	V	261	69	35.6	-17.23	Pass	
328.1	26.23	7.61	-17.2	16.66	Quasi Max	V	115	280	35.6	-18.94	Pass	
221.344	22.82	7.29	-20.4	9.73	Quasi Max	V	233	117	35.6	-25.87	Pass	

PREVIEW DATA

Freq.	Raw	Cable	Factor	Level	Emission	Pol	Ht	Az	Limit	Margin	Pass	
MHz	dBuV	dB	dB	dBuV/m	Туре	H/V	cm	deg	dBuV/m	dB	/Fail	Comments
868.73	29.51	9.1	-8.37	30.24	Debug	V	100	317	35.6	-5.36	Pass	
998.978	31.56	9.44	-6.21	34.79	Preview	Н	385	225	43.5	-8.71	Pass	
639.945	29.48	8.16	-11.6	26.08	Debug	V	100	317	35.6	-9.52	Pass	
568.37	30.03	7.92	-12.9	25.07	Debug	V	100	317	35.6	-10.53	Pass	
328.1	34.05	7.61	-17.2	24.48	Preview	V	385	270	35.6	-11.12	Pass	
221.344	30.53	7.29	-20.4	17.44	Debug	V	100	317	35.6	-18.16	Pass	



Filename: c:\program files\emisoft - vasona\results\2018-0080 aahc mmimo - full band\T4 RE1GHz-4.5GHz FCC B.emi

Results Title:	RDE AR8 1GHz-4.5 GHz
File Name:	c:\program files\emisoft - vasona\results\2018-0080 aahc mmimo - full band\T4a RE1GHz-4.5GHz FCC B Tilt.emi
Test Laboratory:	AR8 MH GPCL 23C, 53% RH 1000mB
Test Engineer:	GM
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia
EUT Details:	AAHC mMIMO - Full Band
Configuration:	Powered by -48VDC, 20 Amps, Tx-2593MHz, 256QAM, 1C, 28dBm per port. All ports transmitting. Radiated Emissions FCC Part 15, RE 1GHz-4.5GHz,
	Horn Antenna E1073, HPF-HP Preamp E376, ESI-1G-E936. Preview RBW: 30kHz / 1M Formals. VBW: 1 MHz. 0dB internal Attenuation
Date:	2018-05-18 15:39:54

FORMAL DATA

Freq.	Raw	Cable	Factor	Level	Emission	Pol	Ht	Az	Limit	Margin	Pass	
MHz	dBuV	dB	dB	dBuV/m	Туре	H/V	cm	deg	dBuV/m	dB	/Fail	Comments
2949.13	37.02	9.41	-1.28	45.15	AvgMax	Н	355	254	54	-8.85	Pass	42.6 Degrees
2949.14	35.98	9.41	-1.28	44.11	AvgMax	V	247	156	54	-9.89	Pass	42.6 Degrees
2949.13	47.17	9.41	-1.28	55.29	Quasi Max	Н	355	254	74	-18.71	Pass	42.6 Degrees
2949.14	46.16	9.41	-1.28	54.28	Quasi Max	V	247	156	74	-19.72	Pass	42.6 Degrees

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
2949.15	39.52	9.41	-1.28	47.64	Debug	Н	395	225	54	-6.36	Pass	
2949.08	38.98	9.41	-1.28	47.1	Debug	V	100	317	54	-6.9	Pass	



T3a Radiated Emissions

4.5GHz -18GHz

FCC B

Filename: o:/program files/emisoft - vasona/results/2018-0080 aaho mmimo - full band/t3a re 4.5GHz -18GHz foo b.emi

Results Title:	RDE AR8 1GHz-10GHz
File Name:	c:\program files\emisoft - vasona\results\2018-0080 aahc mmimo - full band\t3a re 4.5GHz -18GHz fcc b.emi
Test Laboratory:	AR8 MH GPCL 21C, 38% RH 1000mB
Test Engineer:	JY/GM
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia
EUT Details:	AAHC mMIMO - Full Band
Configuration:	Powered by -48VDC, 20 Amps, Tx-2593MHz, 256QAM, 1C, 28dBm per port. All ports transmitting. Radiated Emissions FCC Part 15, RE 4.5GHz-
	18GHz, Horn Antenna E1073, HPF-HP Preamp E376, ESI-1G-E936. Preview RBW: 30kHz / 1M Formals. VBW: 1 MHz. 0dB internal Attenuation
Date:	2018-05-18 12:21:08

FORMAL DATA

Freq.	Raw	Cable	Factor	Level	Emission	Pol	Ht	Az	Limit	Margin	Pass	
MHz	dBuV	dB	dB	dBuV/m	Туре	H/V	cm	deg	dBuV/m	dB	/Fail	Comments
5898.28	36.8	5.85	1.9	44.55	AvgMax	V	103	176	54	-9.45	Pass	14.2 Degrees
5898.24	31.89	5.85	1.9	39.65	AvgMax	V	220	180	54	-14.35	Pass	42.6 Degrees
5898.28	45.15	5.85	1.9	52.91	Quasi Max	V	103	176	74	-21.09	Pass	14.2 Degrees
5898.24	43.82	5.85	1.9	51.58	Quasi Max	V	220	180	74	-22.42	Pass	42.6 Degrees

PREVIEW DATA

PREVIEW DA	PREVIEW DATA											
Freq.	Raw	Cable	Factor	Level	Emission	Pol	Ht	Az	Limit	Margin	Pass	
MHz	dBuV	dB	dB	dBuV/m	Туре	H/V	cm	deg	dBuV/m	dB	/Fail	Comments
5898.04	35.61	5.85	1.9	43.37	Preview	V	100	154	54	-10.63	Pass	



Radiated Emissions Template: RE 18-266Hz Filename: o:\program files\emisoft - vasona\results\2018-0080 aaho mmimo - full band\T5 RE 186Hz-26.56Hz FCC B.emi

Results Title:	RE 18-26GHz
File Name:	c:\program files\emisoft - vasona\results\2018-0080 aahc mmimo - full band\T5 RE 18GHz-26.5GHz FCC B.emi
Test Laboratory:	AR8 MH GPCL 23C, 53% RH 1000mB
Test Engineer:	GM
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia
EUT Details:	AAHC mMIMO - Full Band
Configuration:	Powered by -48VDC, 20 Amps, Tx-2593MHz, 256QAM, 1C, 28dBm per port. All ports transmitting. Radiated Emissions FCC Part 15, RE 18GHz- 26.5GHz, Horn Antenna E1073, HP Preamp E376, ESI-1G-E936. Preview RBW: 1MHz VBw 3MHzFormals. VBW: RBW 1MHz VBW 3 MHz. 0dB internal Attenuation
Date:	2018-05-21 09:18:29

FORMAL DATA

Freq.	Raw	Cable	Factor	Level	Emission	Pol	Ht	Az	Limit	Margin	Pass	
MHz	dBuV	dB	dB	dBuV/m	Туре	H/V	cm	deg	dBuV/m	dB	/Fail	Comments
26343.3	26.65	10.32	21.09	58.05	AvgMax	Н	111	56	63.5	-5.45	Pass	
25990.5	26.91	10.19	20.47	57.58	AvgMax	Н	125	68	63.5	-5.92	Pass	
26187.7	26.44	10.26	20.82	57.53	AvgMax	Н	133	0	63.5	-5.97	Pass	
26427.7	25.95	10.35	21.23	57.52	AvgMax	V	115	181	63.5	-5.98	Pass	
25929.8	26.98	10.17	20.31	57.46	AvgMax	Н	117	35	63.5	-6.04	Pass	
26068	26.37	10.22	20.62	57.21	AvgMax	V	128	75	63.5	-6.29	Pass	
25906.5	26.71	10.16	20.25	57.12	AvgMax	V	100	52	63.5	-6.38	Pass	
25788.3	26.78	10.12	19.92	56.83	AvgMax	V	118	66	63.5	-6.67	Pass	
26427.7	39.35	10.35	21.23	70.92	Quasi Max	V	115	181	83.5	-12.58	Pass	
25906.5	40.46	10.16	20.25	70.87	Quasi Max	V	100	52	83.5	-12.63	Pass	
25990.5	40.19	10.19	20.47	70.86	Quasi Max	Н	125	68	83.5	-12.64	Pass	
26343.3	39.35	10.32	21.09	70.75	Quasi Max	Н	111	56	83.5	-12.75	Pass	
25929.8	39.93	10.17	20.31	70.41	Quasi Max	Н	117	35	83.5	-13.09	Pass	
25788.3	40.33	10.12	19.92	70.37	Quasi Max	V	118	66	83.5	-13.13	Pass	
26068	39.35	10.22	20.62	70.19	Quasi Max	V	128	75	83.5	-13.31	Pass	
26187.7	38.79	10.26	20.82	69.88	Quasi Max	Н	133	0	83.5	-13.62	Pass	

PREVIEW DATA

Freq.	Raw	Cable	Factor	Level	Emission	Pol	Ht	Az	Limit	Margin	Pass	
MHz	dBuV	dB	dB	dBuV/m	Туре	H/V	cm	deg	dBuV/m	dB	/Fail	Comments
26342.9	32.33	10.32	21.08	63.73	Preview	Н	100	330	63.5	0.23	Fail	
26427.7	31.6	10.35	21.23	63.17	Debug	V	100	354	63.5	-0.33	Pass	
26068	32.17	10.22	20.62	63.01	Debug	V	100	354	63.5	-0.49	Pass	
25906.5	32.59	10.16	20.25	63	Debug	V	100	354	63.5	-0.5	Pass	
26187.7	31.89	10.26	20.82	62.97	Debug	Н	100	354	63.5	-0.53	Pass	
25929.8	32.48	10.17	20.31	62.96	Debug	Н	100	354	63.5	-0.54	Pass	
25990.5	32.2	10.19	20.47	62.87	Debug	Н	100	354	63.5	-0.63	Pass	
25788 3	32 77	10 12	19 92	62.82	Debug	V	100	354	63.5	-0.68	Pass	

T7 Radiated Emissions 26.5G-30GHz FCC Class B limits



Radiated Emissions Template: RE 26.5-40 GHz

Filename: c:\program files\emisoft - vasona\results\2018-0080 aaho mmimo - full band\T7 RE26.5-30G 3C FCC B.emi

Results Title:	RE 26.5-30GHz
File Name:	c:\program files\emisoft - vasona\results\2018-0080 AAHC mMimo - full band\T7 RE26.5-30G 3C FCC B.emi
Test Laboratory:	AR8 MH GPCL 23C, 53% RH 1000mB
Test Engineer:	YL SLM
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia
EUT Details:	AAHC mMIMO - Full Band
Configuration:	Powered by -48VDC, 20 Amps, Tx-2640MHz, 256QAM, 2660-256QAM, 2680-64QAM. 3C, 31.8dBm per port. All ports transmitting. Radiated
-	Emissions FCC Part 15, RE 26.5GHz-30GHz, Horn Antenna E526, ESI-40G-E936. Preview RBW: 1MHz VBw 3M, Formals. VBW: RBW 1MHz VBW 3 MHz.
	0dB internal Attenuation
Date:	2018-05-24 20:33:51

FORMAL DATA

Freq.	Raw	Cable	Factor	Level	Emission	Pol	Ht	Az	Limit	Margin	Pass	
MHz	dBuV	dB	dB	dBuV/m	Туре	H/V	cm	deg	dBuV/m	dB	/Fail	Comments
29996.1	31.97	0	22.74	54.71	Average	V	100	314	63.5	-8.79	Pass	
29921.9	31.82	0	22.64	54.46	Average	Н	112	275	63.5	-9.04	Pass	
29657.7	31.36	0	22.28	53.64	Average	Н	100	187	63.5	-9.86	Pass	
29996.1	45.42	0	22.74	68.17	Peak	V	100	314	83.5	-15.33	Pass	
29921.9	44.38	0	22.64	67.02	Peak	Н	112	275	83.5	-16.48	Pass	
29657.7	43.98	0	22.28	66.26	Peak	Н	100	187	83.5	-17.24	Pass	

PREVIEW DATA

Freq.	Raw	Cable	Factor	Level	Emission	Pol	Ht	Az	Limit	Margin	Pass	
MHz	dBuV	dB	dB	dBuV/m	Туре	H/V	cm	deg	dBuV/m	dB	/Fail	Comments
29996.1	37.98	0	22.74	60.73	Preview	V	200	22	63.5	-2.77	Pass	
28171.3	33.43	0	20.59	54.02	Debug	V	100	354	63.5	-9.48	Pass	
26656.6	35.04	0	19.2	54.24	Debug	V	100	354	63.5	-9.26	Pass	
28956.1	34.23	0	21.55	55.78	Debug	V	100	354	63.5	-7.72	Pass	
29657.7	34.54	0	22.28	56.82	Debug	Н	100	354	63.5	-6.68	Pass	
29921.9	34.8	0	22.64	57.44	Debug	Н	100	354	63.5	-6.06	Pass	

7. FCC Section 2.1055 Frequency Stability

7.1 Section 2.1055 Measurement of Frequency Stability

This measurement evaluates the frequency difference between the actual transmit carrier frequency and the specified transmit frequency assignment. Only the portion of the transmitter system containing the frequency determining and stabilizing circuitry need be put in an environmental chamber and subjected to the temperature variation test per FCC Section 2.1055 and RSS-133. The unit which provides baseband signals, such as BBU (baseband unit), can be located outside the chamber if it is a separated unit.

7.1.1 Frequency Stability Test Article and Configuration

The unit under test is identified as follows: AirScale MAA 64T64R 128AE B41 120W AAHC , PN (1P) 474155A.102, SN: 6Q180712583 - FCC ID: VBNAAHC-01

7.1.2 Frequency Stability Test

Frequency Stability Testing was performed on the Nokia AAHC AirScale MAA 64T64R 2600 B41 120W, PN: 474155A.102, SN: 6Q180712580., FCC ID: VBNAAHC-01.

The testing was performed on the B41 AAHC from 06/07/2018 through 06/09/2018. The product was configured per Figure 6.1.2 and tested in the T-11 Thermal chamber of the GPCL test facility located in Bldg. 4, Room 4-280, Murray Hill, NJ. Testing was witnessed by Joe Bordonaro from GPCL. The UUT was subjected to a range of temperature from ambient to +50°C to -30°C and back to ambient. Frequency Stability performance was verified by measuring Frequency Tolerance at EAC using an MXA Signal Analyzer. Frequency Tolerance is a measurement of the difference between the actual transmit frequency and the assigned frequency (2593MHz). The system level Frequency Stability testing of the UUT yielded results in compliance with established design criteria.



FIGURE 7.1.2 Frequency Stability Test Set-Up

7.1.3 Frequency Stability Test process

- 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.

Upon return to +25°C.

f) At ambient, vary voltage to +15% and -15% of nominal 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%).

7.1.4 Frequency Stability Results:

The worst case Frequency Stability over temperature and voltage was **+9.064 Hz which is 0.0035 ppm**. This is within the +/- 0.05ppm desired performance required for LTE operation under 3GPP and FCC requirements.

7.1.5 Frequency Stability Data:

The frequency data below documents performance of the AAHC AirScale MAA 64T64R 128AE B41 120W RRH When operated at a center frequency of 2593 MHz.

Process Step:

(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.

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC				
Time	Transmit Carrier Deviation			
(minutes)	(Hz)			
0	2.409			
0.5	3.117			
1.0	1.930			
1.5	6.592			
2.0	1.123			
2.5	5.250			
3.0	1.881			
FCC SPECIFICATION	±2593 MHz (±0.05ppm)			
	±0.05ppm = ±129.65 Hz			
FCC RESULT	PASS			

Baseline Measurement at +25°C

Transmit Frequency Deviation at +50°C at 100% of Nominal Voltage, -48VDC				
Time	Transmit Carrier Deviation			
(minutes)	(Hz)			
0	1.449			
0.5	5.553			
1.0	7.301			
1.5	3.047			
2.0	1.828			
2.5	4.291			
3.0	2.422			
FCC SPECIFICATION	±2593 MHz (±0.05ppm)			
	±0.05ppm = ±129.65 Hz			
FCC RESULT	PASS			

Transmit Frequency Deviation at +40°C at 100% of Nominal Voltage, -48VDC				
Time	Transmit Carrier Deviation			
(minutes)	(Hz)			
0	4.010			
0.5	1.175			
1.0	6.299			
1.5	8.468			
2.0	1.542			
2.5	1.263			
3.0	4.997			
FCC SPECIFICATION	±2593 MHz (±0.05ppm)			
	±0.05ppm = ±129.65 Hz			
FCC RESULT	PASS			

Transmit Frequency Deviation at +30°C at 100% of Nominal Voltage, -48VDC				
Time	Transmit Carrier Deviation			
(minutes)	(Hz)			
0	8.141			
0.5	8.575			
1.0	3.620			
1.5	1.604			
2.0	1.878			
2.5	5.194			
3.0	3.522			
FCC SPECIFICATION	±2593 MHz (±0.05ppm)			
	±0.05ppm = ±129.65 Hz			
FCC RESULT	PASS			

Transmit Frequency Deviation at +20°C at 100% of Nominal Voltage, -48VDC				
Time	Transmit Carrier Deviation			
(minutes)	(Hz)			
0	0.897			
0.5	2.934			
1.0	5.816			
1.5	1.603			
2.0	3.019			
2.5	2.547			
3.0	1.149			
FCC SPECIFICATION	±2593 MHz (±0.05ppm)			
	± 0.05 ppm = ± 129.65 Hz			
FCC RESULT	PASS			

Transmit Frequency Deviation at +10°C at 100% of Nominal Voltage, -48VDC				
Time	Transmit Carrier Deviation			
(minutes)	(Hz)			
0	2.374			
0.5	5.430			
1.0	4.816			
1.5	0.703			
2.0	2.964			
2.5	1.375			
3.0	2.166			
FCC SPECIFICATION	±2593 MHz (±0.05ppm)			
	±0.05ppm = ±129.65 Hz			
FCC RESULT	PASS			

Transmit Frequency Deviation at 0°C at 100% of Nominal Voltage, -48VDC				
Time	Transmit Carrier Deviation			
(minutes)	(Hz)			
0	6.421			
0.5	4.534			
1.0	2.919			
1.5	2.941			
2.0	1.516			
2.5	3.820			
3.0	1.203			
FCC SPECIFICATION	±2593 MHz (±0.05ppm)			
	±0.05ppm = ±129.65 Hz			
FCC RESULT	PASS			

Transmit Frequency Deviation at -10°C at 100% of Nominal Voltage, -48VDC				
Time	Transmit Carrier Deviation			
(minutes)	(Hz)			
0	1.154			
0.5	3.976			
1.0	1.770			
1.5	0.308			
2.0	4.477			
2.5	2.293			
3.0	5.416			
FCC SPECIFICATION	±2593 MHz (±0.05ppm)			
	± 0.05 ppm = ± 129.65 Hz			
FCC RESULT	PASS			

Transmit Frequency Deviation at -20°C at 100% of Nominal Voltage, -48VDC	
Time	Transmit Carrier Deviation
(minutes)	(Hz)
0	9.064
0.5	3.095
1.0	1.593
1.5	2.309
2.0	4.847
2.5	1.632
3.0	3.758
FCC SPECIFICATION	±2593 MHz (±0.05ppm)
	±0.05ppm = ±129.65 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at -30°C at 100% of Nominal Voltage, -48VDC	
Time	Transmit Carrier Deviation
(minutes)	(Hz)
0	3.058
0.5	7.782
1.0	6.168
1.5	1.801
2.0	3.419
2.5	2.851
3.0	1.335
FCC SPECIFICATION	±2593 MHz (±0.05ppm)
	±0.05ppm = ±129.65 Hz
FCC RESULT	PASS

Upon return to +25°C.

 At ambient, vary voltage to +15% and -15% of nominal 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	Transmit Carrier Deviation
(minutes)	(Hz)
0	1.902
0.5	5.736
1.0	3.831
1.5	5.008
2.0	2.679
2.5	1.953
3.0	4.501
FCC SPECIFICATION	±2593 MHz (±0.05ppm)
	±0.05ppm = ±129.65 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 103% of Nominal Voltage, -49.44VDC	
Time	Transmit Carrier Deviation
(minutes)	(Hz)
0	1.663
0.5	4.601
1.0	1.449
1.5	3.692
2.0	5.554
2.5	2.726
3.0	1.806
FCC SPECIFICATION	±2593 MHz (±0.05ppm)
	±0.05ppm = ±129.65 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 106% of Nominal Voltage, -50.88VDC	
Time	Transmit Carrier Deviation
(minutes)	(Hz)
0	2.843
0.5	6.305
1.0	4.072
1.5	1.704
2.0	2.935
2.5	1.016
3.0	5.523
FCC SPECIFICATION	±2593 MHz (±0.05ppm)
	±0.05ppm = ±129.65 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 109% of Nominal Voltage, -52.32VDC	
Time	Transmit Carrier Deviation
(minutes)	(Hz)
0	2.765
0.5	1.262
1.0	5.121
1.5	3.320
2.0	1.039
2.5	5.068
3.0	4.140
FCC SPECIFICATION	±2593 MHz (±0.05ppm)
	±0.05ppm = ±129.65 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 112% of Nominal Voltage, -53.76VDC	
Time	Transmit Carrier Deviation
(minutes)	(Hz)
0	6.261
0.5	1.430
1.0	4.552
1.5	3.988
2.0	2.801
2.5	5.113
3.0	4.006
FCC SPECIFICATION	±2593 MHz (±0.05ppm)
	±0.05ppm = ±129.65 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 115% of Nominal Voltage, -55.20VDC	
Time	Transmit Carrier Deviation
(minutes)	(Hz)
0	2.931
0.5	1.636
1.0	3.570
1.5	4.252
2.0	5.360
2.5	1.557
3.0	3.162
FCC SPECIFICATION	±2593 MHz (±0.05ppm)
	±0.05ppm = ±129.65 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48.0VDC	
Time	Transmit Carrier Deviation
(minutes)	(Hz)
0	3.301
0.5	4.181
1.0	1.547
1.5	2.202
2.0	1.786
2.5	3.022
3.0	4.407
FCC SPECIFICATION	±2593 MHz (±0.05ppm)
	±0.05ppm = ±129.65 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -3% of Nominal Voltage, -46.56VDC	
Time	Transmit Carrier Deviation
(minutes)	(Hz)
0	2.391
0.5	5.057
1.0	2.908
1.5	1.705
2.0	3.203
2.5	5.726
3.0	4.611
FCC SPECIFICATION	±2593 MHz (±0.05ppm)
	±0.05ppm = ±129.65 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -6% of Nominal Voltage, -45.12VDC	
Time	Transmit Carrier Deviation
(minutes)	(Hz)
0	3.531
0.5	2.367
1.0	5.932
1.5	4.106
2.0	1.347
2.5	3.092
3.0	6.463
FCC SPECIFICATION	±2593 MHz (±0.05ppm)
	±0.05ppm = ±129.65 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -9% of Nominal Voltage, -43.68VDC	
Time	Transmit Carrier Deviation
(minutes)	(Hz)
0	2.957
0.5	4.601
1.0	7.966
1.5	3.252
2.0	1.536
2.5	5.411
3.0	2.527
FCC SPECIFICATION	±2593 MHz (±0.05ppm)
	\pm 0.05ppm = \pm 129.65 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -12% of Nominal Voltage, -42.24VDC	
Time	Transmit Carrier Deviation
(minutes)	(Hz)
0	4.911
0.5	3.486
1.0	6.461
1.5	1.117
2.0	6.247
2.5	4.295
3.0	1.268
FCC SPECIFICATION	±2593 MHz (±0.05ppm)
	±0.05ppm = ±129.65 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -15% of Nominal Voltage, -40.80VDC	
Time	Transmit Carrier Deviation
(minutes)	(Hz)
0	5.309
0.5	1.837
1.0	7.032
1.5	6.197
2.0	1.917
2.5	4.582
3.0	6.096
FCC SPECIFICATION	±2593 MHz (±0.05ppm)
	±0.05ppm = ±129.65 Hz
FCC RESULT	PASS
8. Test Equipment and Test Set-up Photographs

8.1 Test Set-up Photographs

The Test Setup photographs are supplied in the filing documents as a separate exhibit

8.2 Antenna Port Test Equipment

The following Test Equipment was used to perform Antenna Port testing.

Manufacturer	Туре	Description	Model	Serial	Calibration Date	Calibration Due	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			Calibration Not Required, Must Be Verified	Active
Weinschel	Attenuator	10dB 25Watt 0.05GHz - 26GHz	74-10-12	1068			Calibration Not Required, Must Be Verified	Active
Weinschel	Attenuator	30dB 25W 0.05GHz-26GHz	74-30-12	1065			Calibration Not Required, Must Be Verified	Active

8.3 Radiated Emissions Test Equipment

The following Test Equipment was used to perform Radiated Emissions testing

Manufacturer	Туре	Description	Model	Serial	Calibration Date	Calibration Due	Calibration Type	Status
ETS Lindgren	Horn Antenna	Double-Ridged Waveguide Horn 1-18 GHz	3117	00135198	2017-06-09	2019-06-09	Requires Calibration	Active
ETS Lindgren	Multi-Device Controller		2090	00078509			Calibration Not Required	Active
Hewlett Packard	HP-IB Extender		37204	3212U31136			Calibration Not Required	Active
Hewlett Packard	HP-IB Extender		37204A	3212U27554			Calibration Not Required	Active
Hewlett Packard	Pre-Amplifier	Preamplifier 1-26.5 GHz	8449B	3008A01270	2018-01-17	2019-01-17	Requires Calibration	Active
RLC Electronics Inc	High Pass Filter	2.5GHz to 26GHz High Pass Filter	F-19391	1440-001			Calibration Not Required, Must Be Verified	Active
A.H. Systems Inc.	Horn Antenna	Ridged Horn 26.5 GHz - 40 GHz	SAS-200/573	137	2017-10-04	2019-10-04	Requires Calibration	Active
EMC Test Systems	Horn Antenna	Double Ridged Horn 18- 40 GHz	3116	2539	2017-06-16	2019-06-16	Requires Calibration	Active
ЕМСО	Biconical Antenna		3109	2187	2016-12-01	2018-12-01	Requires Calibration	Active
ЕМСО	Log Periodic Antenna		3146	2082	2017-05-24	2019-05-24	Requires Calibration	Active
Rohde & Schwarz	Test Receiver	EMI (20Hz to 40 GHz)-150 +30dBM	ESIB40	100119	2017-11-06	2019-11-06	Requires Calibration	Active
Sonoma Instrument Co.	Amplifier	9kHz-1GHz	310N	186750	2016-07-27	2018-07-27	Requires Calibration	Active
Weinschel	Attenuator	6dB	2/6	CD2545	2017-03-03	2019-03-03	Requires Calibration	Active

8.4 Frequency Stability Test Equipment

The following Test Equipment was used to perform Frequency Stability testing.

Manufacturer	Instrument Type	Model	Serial Number	Cal Date	Cal Due Date
Agilent	MXA Signal Analyzer	N9020A	MY49060086	12/07/2016	12/07/2018
Agilent	Power Meter	E4419B	MY40511034	01/10/2018	01/10/2020
Agilent	Power Sensor	E9301A	MY52280001	02/08/2017	02/08/2019
Agilent	MY52280001	E9301A	MY52280011	02/08/2017	02/08/2019
Hewlett Packard	Multimeter	HP 971A	JP35001820	06/08/2017	06/08/2019
Yokogawa	Thermal Logger	MV2000	12W942552	06/02/2017	06/02/2019
Symmetricon	GPS Receiver	58503B	KR93200773	No Cal Req.	No Cal Req.
TDK-Lambda	Power supply	GEN60-85-3P208	13N5112J	No Cal Req.	No Cal Req.

9. NVLAP Certificate of Accreditation

