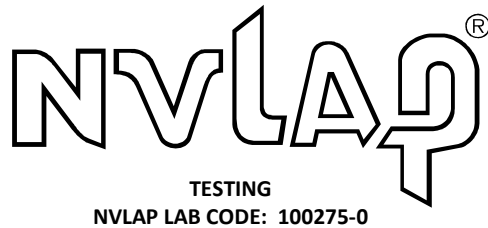




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Title 47 Code of Federal Regulations Test Report

Regulation:

FCC Part 15 Subpart E

Client:

Nokia Solutions and Networks Oy

Product Evaluated:

Nokia Flexi Zone Multiband Outdoor Micro Base Station (MBO)
FW2RMOM1 LAA RF Module Operating in Band 46B/C UNII-2
in FW2FIRC System (No-DFS)

GPCL Report Number:

TR-2019-0105-FCC15E RF Non-DFS

Date Issued:

November 5, 2019

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Date	Revision	Section	Change
11/5/2019	0		Initial Release


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1 SYSTEM INFORMATION AND REQUIREMENTS

Equipment Under Test (EUT):	Nokia Flexi Zone Multiband Outdoor Micro Base Station (MBO) LAA RF Module FW2RMOM1
FCC ID:	2AD8UFW2RMBOM1
Serial Number:	EB182110033
Model Name/Part No:	FW2RMBOM1/088774A.X22
Hardware Version:	474947A
Software Version:	FLF19
Operation Frequency Range	5250-5350 MHz (UNII-2a); 5470-5725 MHz (UNII-2c) E-UTRAN B46B/C
Type of Equipment:	Intentional Transceiver
Operation Mode	Master Device
FCC Part 15 Subpart B Sections 15.107 and 15.109 Class B	Passed
GPCL File Number(s):	2019-0105
Applicant & Manufacturer:	Nokia Solutions and Networks, OY 2000 W. Lucent Lane Naperville, IL 60563 USA
Test Requirement(s):	Title 47 CFR Parts 2 and 15E (Non-DFS)
Test Procedures/Methods Standards:	<ul style="list-style-type: none"> KDB 789033 D02, General U-NII Test Procedures New Rules, v02r01, December 2017 KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013 KDB 353028 D01, v01, Antenna Part 15 Transmitter, April 2017 ANSI C63.10 (2013) FCC-IC-OB - GPCL Power Measurement, Occupied Bandwidth & Modulation Test Procedure FCC-IC-SE - GPCL Spurious Emissions Test Procedure
Test Date(s):	July/October 2019
Type of Application	C2PC
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: 515091/US5302
Product Engineer(s):	Jeff Webb, Ron Remy
Lead Engineer:	Qin Yu
Test Engineer (s):	J. Yadav and G. Manuel
Test Results: The EUT 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.	

1.1 Introduction

This Conformity test report applies to the Nokia Flexi Zone Multiband Outdoor Micro Base Station (MBO) LAA RF Module FW2RMOM1 with FA2WA and FA2RA Antennas, 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 operating in UNII-2 (B46b/c) band in compliance with FCC Parts 2 and 15E measured in accordance with the procedures set out in Section 2.1033 (c) (14) of the Rules.

The Nokia Flexi Zone MBO is a small cell that consists of a common digital system module (host) and up to three LTE (Long Term Evolution) RF transceiver modules in various combinations. The MBO LAA RF module FW2RMBOM1, 1W, is a low power LTE RF transceiver. It has been FCC certified under FCC ID: 2AD8UFW2RMOM1 in UNII-3 bands for 1x20MHz and 2x20MHz carriers with FA2RD 474881A, FA2WA 473461A and FA2RA 473121A antennas. In B46 b/c (UNII-2), the following antennas are available:

LE-LAN/UNII Antenna Data from Manufacturers in B46b/c UNII-2 Band*

Ant No	Model Name	Antenna Type/ Size (mm)	Freq (MHz)	Tx/Rx Port	Max Avg Antenna Gain Over Two Ports (dBi)
1	FA2WA 473461A	Directional 380(L) × 290(W) × 190(D)	5150 ~ 5925	Tx/Rx 1/2	6
2	FA2RA 473121A	Omni-Directional, 235(L) × 51(D)	5150 ~ 5850	Tx/Rx 1/2	7.0**

*FA2RD 474881A antenna authorized for operating in B46d (UNII-3) band are not be available in B46b/c (UNII-2) band.

**The maximum antenna gain of FA2RA is 7.0 dBi in B46b/c (UNII-2) due to additional feedline.

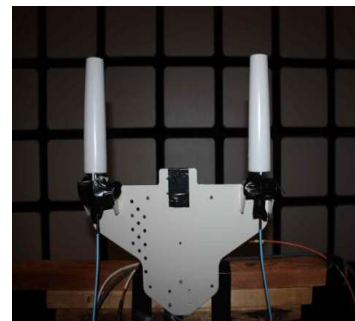
A Class II permissive change is needed for the EUT with FA2WA and FA2RA antennas operating in UNII-2 (Band 46b/c) due to new frequency spectrum.

1.3 EUT Details

1.3.1 Specifications

Specification Items	Description		
Radio Access Technology	LAA LTE		
Duplex Mode	TDD		
Operation Mode	Master Device, Point to Multipoint		
Modulation Type(s)	QPSK, 16QAM, 64QAM, 256QAM		
Operation Frequency Range	E-UTRAN Band 46: 5250-5350 MHz (UNII-2a); 5470-5725 MHz (UNII-2c)		
Tx and Rx Signal Bandwidths	20 MHz		
Number of Tx and Rx Paths	2TX/2RX		
MIMO	Yes		
Max Rated Conducted RF Power	FA2WA Direc Ant with Max Ave Gain = 6 dBi: 20.98 dBm (0.1253 W) total FA2RA Omni-Direc Ant with Max Gain = 7.0 dBi: 19.94 dBm (0.0986 W) total		
Max Rated EIRP Power	26.98 dBm (0.499 W) total		
Min Conducted Power	19.94 dBm (0.0986 W) total		
Transmit Power Control Function	NA for less than 500 mW		
Maxi. Number of Carriers per Port	1		
Maxi. Spacing between Carriers in Number of Carriers	N/A		
Deployment Environment	Outdoor		
Environment Temperature Range	-40 °C to +55 °C		
Power Source	Voltage Ranges (VAC)		
	Minimum	Nominal	Maximum
	90.0	110.0	264.0
Antenna	Refer to Section 1.3.3. No beamforming		

1.3.2 Photographs



1.3.3 Antennas, Accessories and Cable List

Currently, there are two available antennas of two types to be equipped for this EUT, MBO LAA RF Module operating in Band 46b/c, no beamforming.

Antennas	Part No	Description	Serial Number
FA2WA	473461A.101	Directional Antenna	YE182400119
FA2RA	473121A.X0	Omni-Directional Antenna	P8182400001

A Nokia system module for MBO, which provides baseband signals, the baseband processing, control and timing to the radio, was used for all required conducted and radiated testing. The EUT is unmodified and is commercially available. The above accessory device is unmodified and is commercially available per FCC requirement given in 2.1033(b)(8). The system module FW2FIRC for MBO B2/B66/LAA was used in this testing.

Cable	Ports	Description	Shielded/Non-shielded (Shield grounded one end/both ends)	Type of Signal and classification for immunity tests
FA2RA	Ant M from EUT	RF Cable	C568-141-02M Shielded and grounded both ends	RF
FA2RA	Ant D from EUT	RF Cable	C568-141-02M Shielded and grounded both ends	RF
AC Power	AC Input port	AC Power	Shield grounded one end, 3 wire, 300V 5A, P/N 996077A	AC Power
Ground Cable	Frame Ground	Frame Ground Connection, (Length = 2 meter, 1X50 mm2) Ground Reference Plane	1X50 mm2 Cable (Stranded)	Frame Ground Connection
Ground Cable	EUT Ground	EUT Ground Connection, (Length = 2 meter, 6AWG) – Ground Reference Plane	6 AWG Cable (Stranded)	EUT Ground Connection
Ethernet	EUT Port B	Ethernet	26 AWG CAT 6a Shielded and grounded both ends	Ethernet

Asset ID	Manufacturer	Type	Description	Model	Serial	Range used
AR-5 Cable Set	Megaphase	RF Cable	Set of 3 Cables 36", 72" and 278"	D230-N1N1	N/A	.150MHz-30MHz 30MHz-1000MHz 1GHz-18GHz
E513 kit	Megaphase	RF Cable	Set of 2 cables 36" and 144"		002 & 005	18GHz-26.5GHz
E520 kit	Micro-coax UTIFLEX	RF Cable	20"	UFB 142A-0-0200-200260		26.5GHz-40GHz
E520 kit	Micro-coax UTIFLEX	RF Cable	237"	UFB 142A-0-2370-200260		26.5GHz-40GHz

1.4 Test Requirements

Each required measurement is listed below:

47 CFR FCC Sections	Description of Tests	Test Required
15.403 (i) & 15.407(a)(2) & 15.215(c)	Emission Bandwidth (26dB Bandwidth)	Yes
15.407 (a)(2)(4)	Maximum Power Output	Yes
15.407 (a)(2)(5)	Peak Power Spectrum Density	Yes
15.407 (b)(2)(3)(5)(8)	Unwanted Out-of-Band Emissions	Yes
15.407 (b)(2)(3)(5-8), 15.209, 15.205 & 15.109	Unwanted Spurious Emissions	Yes
15.407(b)(6), 15.207 & 15.107	AC Power Line Conducted Emissions	Yes

1.4.1 Regulatory Requirements

FCC 2.1041(a) stated that for equipment operating under parts 15 and 18, the measurement procedures are specified in the rules governing the particular device for which certification is requested.

The tests in this report were performed for Unlicensed-National Information Infrastructure (UNII) Devices Operating in the 5250-5350 MHz and 5470-5725 MHz Bands in accordance with the non-DFS requirements of FCC CFR 47 Part 15 Subpart E.

The requirements are provided in the following:

- (1) Emission Bandwidth (FCC 15.403 (i), 15.407(a)(2), 15.215(c))

The emission bandwidth shall be determined by the 26dB bandwidth. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

In the case of intentional radiators operating under the provisions of Subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

- (2) Output Power and Power Spectrum Density Limits (FCC 15.407 (a)(2)(4)(5))

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In

addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum conducted output power must be measured with *rms* detector. Measurements of the maximum power spectral density in the 5.25-5.35 GHz and 5.47-5.725 GHz are made over a bandwidth of 1 MHz or the 26dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

(3) Unwanted Emission Limits (FCC 15.407 (b)(2)(3)(5-8)), 15.209 and 15.205 (a, b, c).

The peak emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

- i. For transmitters operating in the 5.25-5.35 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz.
- ii. For transmitters operating in the 5.47-5.725 GHz band: all emissions outside of the 5.47-5.725 GHz shall not exceed an EIRP of -27 dBm/MHz.
- iii. The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.
- iv. Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in Section 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in Section 15.207.
- v. The provisions of Section 15.205 apply to UNII intentional radiators, where the field strength of emissions appearing *within Section 15.205 restricted frequency bands* shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1GHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1GHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the *average* value of the measured emissions. The provisions in Section 15.35 apply to these measurements.
- vi. When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

Therefore,

- 1) the emissions from the UNII transmitter in the frequency spectrum up to the 10th harmonics are subject to the following requirements:
 - a. For emissions outside the restricted bands, per 15.407(b)(6-7), KDB789033 D02 II.G.2.a-c,
 - (i) $f < 1\text{GHz}$, the limits specified in 15.209 need to be met by QPK or PK;
 - (ii) $f > 1\text{GHz}$, the limits specified in 15.407 (b)(1-4) for UNII-1/2/3 need to be met by PK;

- b. For emissions in the restricted bands, per 15.407(b)(6-7), 15.205 (b), KDB 789033 D02 II.G.1.a-c,
 - (i) $f < 1\text{GHz}$, the limits specified in 15.209 need to be met by QPK or PK;
 - (ii) $f > 1\text{GHz}$, the limits specified in 15.209 need to be met by AVE and the limits specified in 15.407 (b)(1-4) for UNII-1/2/3 need to be met by PK
- 2) the emissions from the digital circuits of the EUT in the frequency spectrum up to the 5th harmonics are subject to the 15.109 limit.
- 3) the emissions from AC power lines in the frequency range of 150kHz and 30MHz are subject to the 15.107 and 15.207 limits.

Either radiated measurement with antenna in place or antenna-port conducted measurement plus cabinet emissions test with antenna terminated can be used.

The emissions of AC power lines have been evaluated in the original filing with EUT transmitting at the maximum power in UNII-3 band which has higher output power than that of UNII-2 carriers. The emissions were in compliance with the FCC 15.207 and 15.107 Class B requirements with over 4dB margin. Therefore, the evaluation of AC power lines emissions for UNII-2 band is waived.

Table 1.4.1 FCC Part 15.205 (a) Restricted Bands of Operation

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	Above 38.6
13.36 - 13.41			

- (4) Frequency Stability (FCC 15.407 (g), 15.215(c), KDB 789033 D02 Section II.A.3).

Section 15.407(g) stated that manufacturers of UNII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

Section 15.215(c) stated that in the case of intentional radiators operating under the provisions of Subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

KDB 789033 D02 Section II.A.3 stated that the grantee is responsible for ensuring that the EUT meets Section 15.407(g) requirements; however, the applications for equipment certification are *not* required to include test reports with explicit demonstration of compliance.

(5) Antennas to Be Tested (15.203, 15.204, KDB 353028 D01)

Section 15.204(c)(2) requires that compliance testing use the *actual* antennas to be certified with the part 15 intentional radiator. All devices (*e.g.*, radio card, module) must be tested with the antennas connected to the device.

Section 15.204(b) states that an approved “transmission system” must always be marketed as a complete system, *i.e.*, including the antenna.

KDB 353028 D01 Section III.A stated that when submitting test data for part 15 transmitters to be used with multiple antennas, the non-DFS testing for the highest gain of each type of antenna (*e.g.*, highest gain for each patch, yagi, grid, dish, monopole, etc.) was required. For systems that can operate at different power levels, test data with the highest output power must be submitted.

(6) Transmit Power Control (TPC) (15.407(h)(1))

U-NII devices operating in the 5.25-5.35 GHz and 5.47-5.725 GHz bands shall employ a TPC mechanism. The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30 dBm. A TPC mechanism is not required for systems with an EIRP of less than 500 mW.

1.5 Standards & Procedures

1.5.1 Standards

- Title 47 Code of Federal Regulations, Federal Communications Commission Part 2.
- Title 47 Code of Federal Regulations, Federal Communications Commission Part 15.

1.5.2 Procedures

1. FCC-IC-0B and FCC-IC-SE
2. ANSI C63.10, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices, 2013.
3. FCC KDB 789033 D02, Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices (Part 15, Subpart E), December 2017, v02r01.

4. FCC KDB 662911D01, Emissions Testing of Transmitters with Multiple Outputs in the Same Band, October 2013, v02r01.
5. FCC KDB 353028 D01, Basic Equipment Authorization Guidance for Antennas Used with Part 15 Intentional Radiators, April 2017, v01.

1.5.3 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.

Worst-Case Estimated Measurement Uncertainties

Standard, Method or Procedure	Condition	Frequency MHz	Expanded Uncertainty (k=2)
a. EMC Emissions, (e.g., ANSI C63.4, CISPR 11, 14, 32, etc., using ESHS 30, EMC-60, LISNs/AMNs and antennas)	Conducted Emissions	0.009 - 30	± 3.5dB
	Radiated Emissions (AR-8 Semi-Anechoic Chambers)	30 – 200 200 – 1000	±5.1 ~ ±5.4 dB ±4.3 ~ ±4.7 dB
	Radiated Emissions (OATS)	1000 – 18,000	±3.3 dB

Worst-Case Estimated Measurement Uncertainties

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

1.6 Executive Summary

Requirement	Description	Results
15.403 (i) & 15.407(a)(2) & 15.215(c)	Emission Bandwidth (26dB Bandwidth)	Yes
15.407 (a)(2)(4)	Maximum Power Output	Yes
15.407 (a)(2)(5)	Peak Power Spectrum Density	Yes
15.407 (b)(2)(3)(5)(8)	Unwanted Out-of-Band Emissions	Yes
15.407 (b)(2)(3)(5-8), 15.209, 15.205 & 15.109	Unwanted Spurious Emissions	Yes
15.407(b)(6), 15.207 & 15.107	AC Power Line Conducted Emissions	Yes

FCC Section 2.911(e) Certification of Technical Test Data

The technical test data presented in this report are accurate.

1.7 Test Configurations and Setup

All measurements need to be performed with the EUT transmitting at 100% duty cycle (at least 98% if required by the EUT for amplitude control purposes) at the following power control level. If continuous transmission (or at least 98% duty cycle) cannot be achieved due to hardware limitations (e.g., overheating), the EUT shall be operated at its maximum power control level, with the transmit duration as long as possible, and the duty cycle as high as possible.

Power Levels Tested for UNII-2a/2c with 1x20MHz

Per Port Power Setting for FA2WA Antennas #1 (Max Ave G^{\max} = 6 dBi)*	Per Port Power Setting for FA2RA Antennas #2 (Max Ave G^{\max} = 7.0 dBi)
18 dBm	17.0 dBm

*Maximum average antenna gain was based on the uncorrelated directional antenna gain calculated from two ports.

Various modulation types (Q/16QAM, 64QAM and 256QAM) and bandwidth modes (20MHz) were evaluated for the conducted and radiated tests, including RF power output, peak power spectrum density, emissions bandwidth and unwanted emissions.

The test setup diagrams are given below.

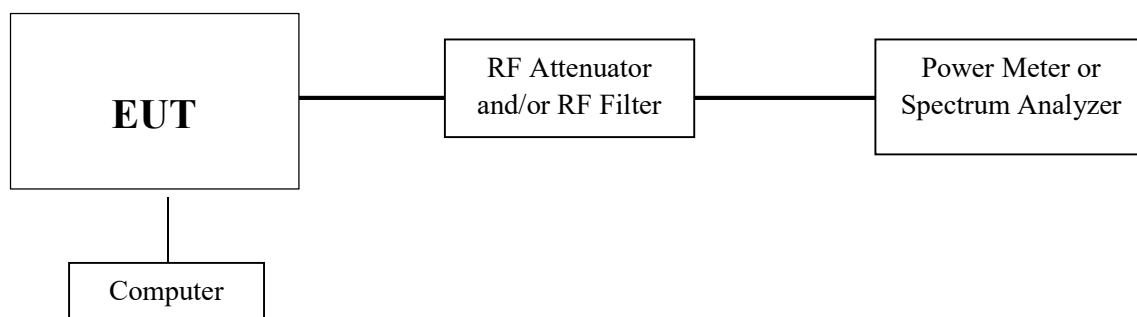


Figure 1.7.1 Setup Diagram of Conducted Test for RF Output Power, Power Spectrum Density and Occupied Bandwidth.

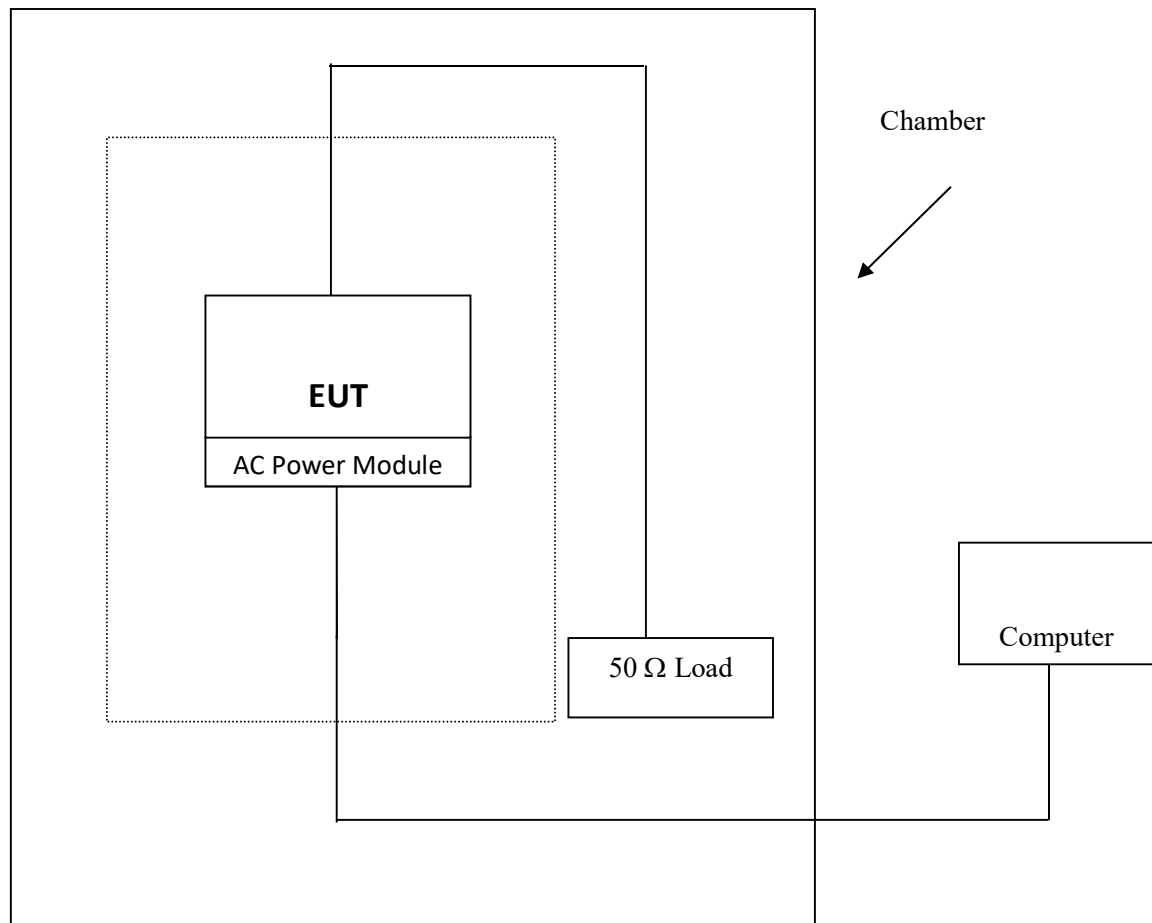


Figure 1.7.2 Setup Diagram of Radiated Test

1.8 UNII-2a/2c Band Channels

The channel 144 is a straddle channel. The power and PSD requirement in UNII-3 are less stringent than in UNII-2c. Therefore, the requirements in UNII-2 need to be used.

Table 1.8.1 5 GHz UNII-2 (5250-5350 MHz, 5470-5725 MHz) Frequency Channel Plan

Bands	Channel No (Nch)	Frequency	Channel Bandwidth	Frequency Bands
UNII-2a (B46b)	52	5260 MHz	20 MHz	5250-5350 MHz
	56	5280 MHz		
	60	5300 MHz		
	64	5320 MHz		
UNII-2c (B46c)	100	5500 MHz	20 MHz	5470-5725 MHz
	104	5520 MHz		
	108	5540 MHz		
	112	5560 MHz		
	116	5580 MHz		
	120	5600 MHz		
	124	5620 MHz		
	128	5640 MHz		
	132	5660 MHz		
	136	5680 MHz		
	140	5700 MHz		
	144	5720 MHz		

Table 1.8.2(a) 5 GHz UNII-2a (5250 -5350 MHz) Frequency Channels Used for Testing

Channel No.	Frequency	Bandwidth
52	5260 MHz	20 MHz
60	5300 MHz	
64	5320 MHz	

Table 1.8.2(b) 5GHz UNII-2c (5470 -5725MHz) Channels Used for Testing

Channel No.	Frequency	Bandwidth
100	5500 MHz	20 MHz
116	5580 MHz	
140	5700 MHz	
144	5720 MHz	

2 FCC 15.403 (I),15.407(A)(2) & 15.215(C) – EMISSION BANDWIDTH (26 DB BANDWIDTH)

The measurement requirements of the emission bandwidth were provided in Section 1.4.1.

The 26dB emission bandwidth was measured at the antenna port 1 for the low, middle and high channels listed in Section 1.8. The 26dB emission bandwidth was measured at the antenna port 2 at the selected channels as well as verification. The measurement follows the procedures given in KDB 789033 D02. The automatic bandwidth measurement function of the spectrum analyzer was utilized where the resolution bandwidth (RBW) is initially set to 1% of the bandwidth and the video bandwidth (VBW), that is 200kHz for 20MHz, the video bandwidth was set to 1MHz, and the peak detector with maximum hold and auto sweep was used. Then the maximum width of the emission that is 26 dB down from the maximum of the emission was measured and compared with the RBW setting of the analyzer. The RBW might be readjusted as needed until the RBW/EBW ration is approximately 1%.

The maximum conducted power levels at 18dBm/port were used for this measurement. The measured results are tabulated below. Three plots which have the widest emission bandwidth are provided below.

Table 4.4.1(a) 26dB Emissions Bandwidth for One-20MHz Carrier UNII-2 (18dBm/pt)

Bands (GHz)	Ch No	Carrier Freq (MHz)	Modulation	Port 1 (MHz)
5.25-5.35	52	5260	Q/16QAM	19.20
	56	5280	Q/16QAM	19.11
	64	5320	Q/16QAM	19.12
5.47-5.725	100	5500	Q/16QAM	19.25
			64QAM	19.26
			256QAM	19.44
	116	5580	Q/16QAM	19.30
			64QAM	18.96
			256QAM	19.16
	140	5700	Q/16QAM	19.26
			64QAM	19.31
			256QAM	19.32

The maximum 26dB emissions bandwidths of the EUT measured at its antenna transmitting terminals across the UNII-2 bands for various modulations are tabulated below.

Table 4.4.2 Maximum 26dB Emissions Bandwidth (EBW) Measured

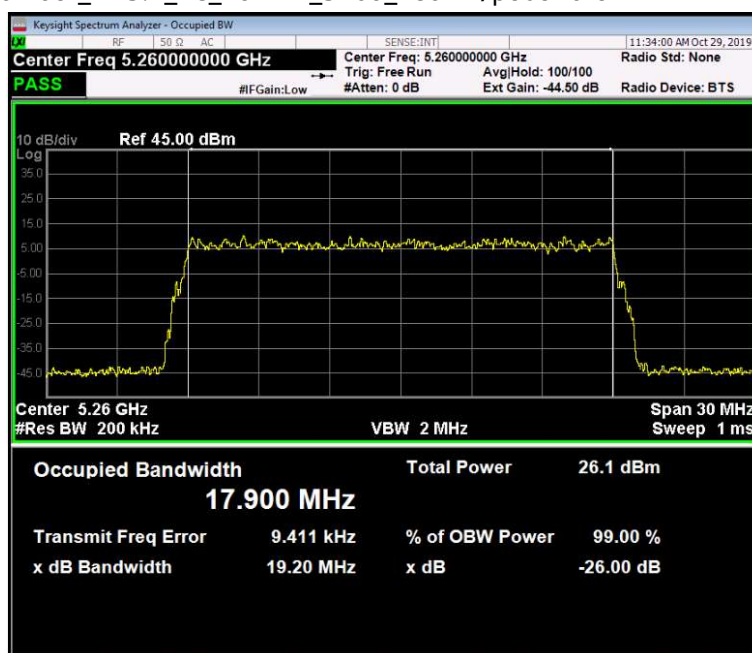
Bands (GHz)	Bandwidth	Max 26dB EBW	Test Limit	Test Results
UNII-2a (5.25-5.35)	1 x 20MHz	19.20 MHz	26dB EBW is within the Band	Pass
UNII-2c (5.470- 5.725)	1 x 20MHz	19.32 MHz	26dB EBW is within the Band	Pass

The maximum 26dB bandwidths measured are all less their nominal bandwidths. Therefore, any transmission that does not intentionally extend into the other bands, like straddle channels, is down 26 dB and met the requirements. The results and measurements are in full compliance with the Rules of the Commission.

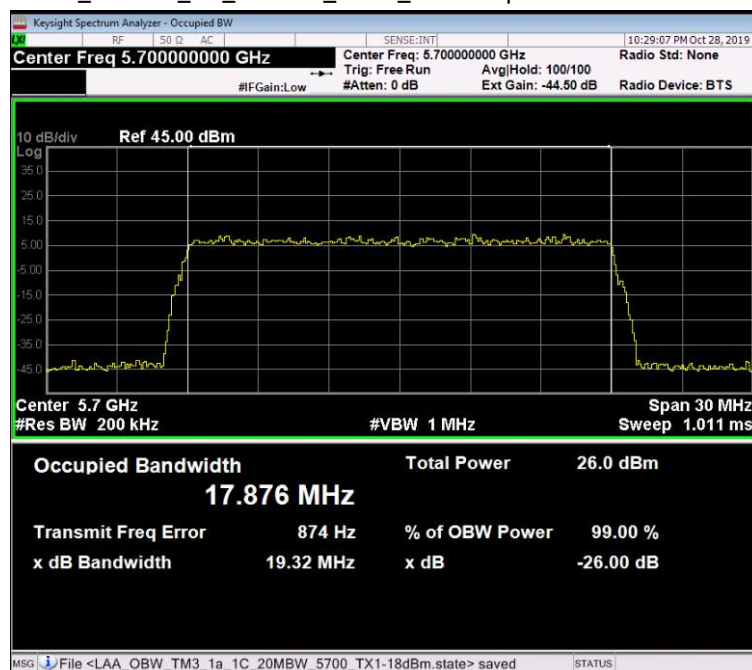
2.1 26 dB Emissions Bandwidth

NOTE: Only the plots with the maximum power levels measured are used in this report. The full suite of raw data resides at the MH, New Jersey location.

26 dB Emission Bandwidth_TM3.2_1C_20MBW_5260_18dBm/pt at Port 1



26 dB Emission Bandwidth_TM3.1a_1C_20MBW_5700_18dBm/pt at Port 1



3 FCC 15.407 (a)(2)(4) – MAXIMUM POWER OUTPUT

The maximum output power was measured at the both antenna ports for the channels listed in Table 1.8.2. The measurement follows the procedures given in KDB 789033 D02.

The limit is $\text{Min}\{250\text{mW} (24\text{dBm}), 11\text{dBm} + 10\log B\}$, where B is 26 dB emission bandwidth. The maximum conducted output power shall be reduced by the amount in dB that the antenna gain exceeds 6 dBi. The minimum 26dB emission bandwidth measured for 20MHz carrier is 18.96MHz. Therefore, the power limit for the antenna gain of 6dBi or below is 23.78dBm for 20 MHz carrier bandwidth.

For multiple antennas with equal transmit power but unequal gains, per KDB 662911 D01, the directional antenna gain of uncorrelated signals is equal to

$$\text{Directional Gain} = 10 \log \left[\frac{10^{G_1/10} + 10^{G_2/10} + \dots + 10^{G_N/10}}{N_{ANT}} \right] \text{dBi, and}$$

the directional antenna gain of correlated signals is equal to

$$\text{Directional Gain} = 10 \log \left[\frac{(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2}{N_{ANT}} \right] \text{dBi,}$$

where $G_1, G_2 \dots, G_N$ are antenna gains.

For the spatial multiplexing (SM) transmissions, like 802.11n MCS8-15, the EUT operates with two uncorrelated spatial data streams on two transmitting ports. Per KDB 662911 D01 (Section (F)(2)(e)), the directional antenna gain may be calculated by using either of the following methods:

- i. Directional Gain = $\text{Max}\{G_1, G_2 \dots, G_N\} + \text{Array Gain} = \text{Max}\{G_1, G_2 \dots, G_N\}$, where Array Gain = $10 \log (N_{ANT}/N_{SS}) = 0$
- ii. Calculate the directional gain by using the formula for uncorrelated signals provided above if each antenna is only fed by its own data stream.

For Cyclic Delay Diversity (CDD) transmissions, per KDB 662911 D01 (Section (F)(2)(f)), the directional antenna gain may be calculated by using either of the following methods:

- i. Directional Gain = $\text{Max}\{G_1, G_2 \dots, G_N\} + \text{Array Gain}$
 - a. For power measurements, Array Gain = 0 if $N_{ANT} \leq 4$;
 - b. For power spectrum density (PSD) measurement, Array Gain = $10 \log (N_{ANT}/N_{SS}) \text{dB}$, where N_{SS} is number of spatial streams and $N_{SS} = 1$ was suggested by the FCC for calculating the worst directional gain.
- ii. Calculate the directional gain by using the formula for correlated signals provided above.

The EUT does not have beamforming function and two signals are not correlated. Hence, for the power and PSD limits, the directional antenna gain was calculated by using the equation above

for uncorrelated signals. The limits for the combined maximum transmitting power and PSD are calculated and tabulated below.

Table 3.1. Transmitter Power and PSD Limits at Antenna Ports

Band	Antenna	Max Direc Gain for Spectral Density and Total Power (dBi)	Maxi Total PSD Limit (dBm/MHz)	Maxi Total Power/EIRP Limits w TPC (dBm)	Maxi Total Power/EIRP Limit w/o TPC (dBm) *
UNII-2	#1 FA2WA	6.0	11.0	24/30	21/27
	#2 FA2RA	7.0	10	23/30	20/27

* Without TPC, the maximum EIRP allowed is 500mW (26.99dBm).

The output power of the EUT was first verified by a power meter and then measured by a spectrum analyzer. The RBW and VBW were set to 1MHz and 3MHz, respectively. The RMS detector and trace average (≥ 100) were used. The output power was calculated by integrating the spectrum across the EBW of the carrier using the SA's band power measurement function with band limits set equal to the EBW band edges. The total combined output power was calculated by summing the measured output power in mW at the various antenna ports.

**Table 3.2 Maximum Mean Combined RF Power Output at Antenna Ports for 5GHz
1x20MHz Carrier at 18dBm/pt in UNII-2 for FA2WA Antenna #1 (6dBi)**

Bands (GHz)	Ch No/ Freq (MHz)	Modulation	Port 1 (dBm)	Port 2 (dBm)	Total Power (dBm)	Power Limit (dBm)	Test Results
Band 46b (5.25- 5.35)	52/5260	Q/16QAM	17.85	17.99	20.93	20.99	Pass
		64QAM	17.85	17.87	20.87	20.99	Pass
		256QAM	17.92	17.99	20.97	20.99	Pass
	56/5280	Q/16QAM	17.89	17.86	20.89	20.99	Pass
		256QAM	17.81	18.00	20.92	20.99	Pass
	64/5320	Q/16QAM	17.94	17.88	20.92	20.99	Pass
		256QAM	17.91	17.96	20.95	20.99	Pass
Band 46c (5.47- 5.725)	100/5500	Q/16QAM	17.96	17.97	20.98	20.99	Pass
		64QAM	17.86	17.86	20.87	20.99	Pass
		256QAM	17.91	17.83	20.88	20.99	Pass
	116/5580	Q/16QAM	17.97	17.89	20.94	20.99	Pass
		64QAM	17.83	17.94	20.90	20.99	Pass
		256QAM	17.92	17.99	20.97	20.99	Pass
	140/5700	Q/16QAM	17.98	17.88	20.94	20.99	Pass
		64QAM	18.01	17.86	20.95	20.99	Pass
		256QAM	18.00	17.79	20.91	20.99	Pass
	144/5720	Q/16QAM	17.90	17.82	20.87	20.99	Pass
		64QAM	17.95	17.85	20.91	20.99	Pass
		256QAM	17.90	18.01	20.97	20.99	Pass

**Table 3.3 Maximum Mean Combined RF Power Output at Antenna Ports for 5GHz
1x20MHz Carrier at 17dBm/pt in UNII-2 for FA2RA Antenna #2 (7.0dBi)**

Bands (GHz)	Ch No/ Freq (MHz)	Modulation	Port 1 (dBm)	Port 2 (dBm)	Total Pwr (dBm)	Pwr Limit (dBm)	Test Results
UNII-2a (5.25- 5.35)	52/5260	Q/16QAM	16.92	16.87	19.91	19.99	Pass
		256QAM	16.97	16.81	19.90	19.99	Pass
	64/5320	Q/16QAM	16.94	16.98	19.97	19.99	Pass
		64QAM	16.88	16.98	19.94	19.99	Pass
UNII-2c (5.47- 5.725)	100/5500	256QAM	16.85	16.89	19.88	19.99	Pass
		Q/16QAM	16.84	16.99	19.93	19.99	Pass
		64QAM	16.97	16.87	19.93	19.99	Pass
	116/5580	256QAM	17.00	16.82	19.92	19.99	Pass
		Q/16QAM	16.89	16.95	19.93	19.99	Pass
		64QAM	16.99	16.87	19.94	19.99	Pass
	120/5600	256QAM	16.92	16.87	19.91	19.99	Pass
		Q/16QAM	16.98	16.84	19.92	19.99	Pass
		64QAM	16.94	16.92	19.94	19.99	Pass
	136/5700	256QAM	16.85	16.89	19.88	19.99	Pass

As a result, the maximum total mean output powers at antenna ports measured are:

**Table 3.5(a) Maximum Total Mean Output Power Measured at Antenna Ports
for 1x20MHz Carriers**

Bands	Power (dBm) for FA2WA Antenna (6dBi)	Power (dBm) for FA2RA Antenna (7.0dBi)
UNII-2a (5.25-5.35 GHz)	20.93	19.97
UNII-2c (5.47-5.725 GHz)	20.98	19.94

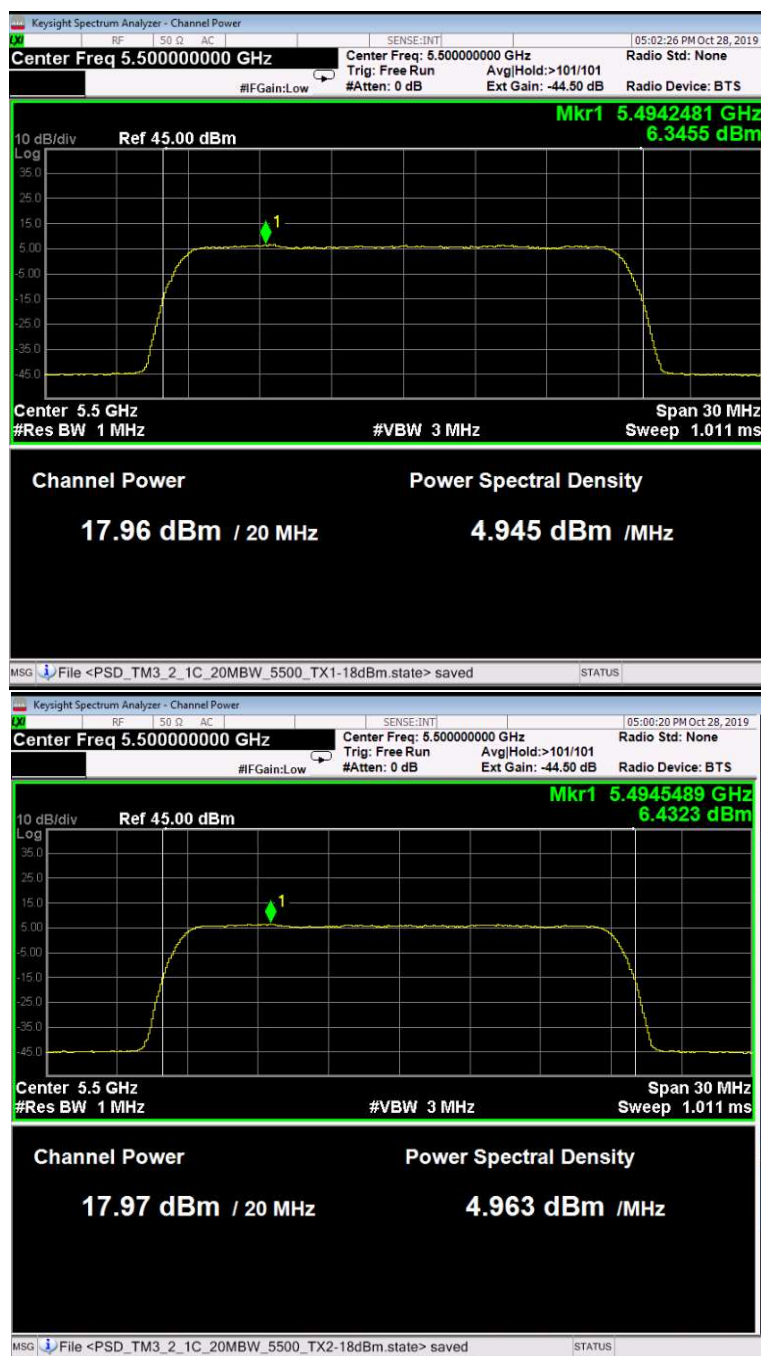
For UNII-2a and UNII-2c bands, the maximum total output power measured for the EUT equipped with the antennas RA2WA and FA2RA are all below the FCC required limits and are in full compliance with the Rules of the Commission. The maximum output power is less than 500mW. Therefore, TPC is not required.

The measurement results for the conducted output power at both ports and the plots which show the maximum output power are provided below.

3.1 Channel RF Power – Plots Antenna #1 FA2WA (6dBi)

NOTE: Only the plots with the maximum power levels measured are used in this report. The full suite of raw data resides at the MH, New Jersey location.

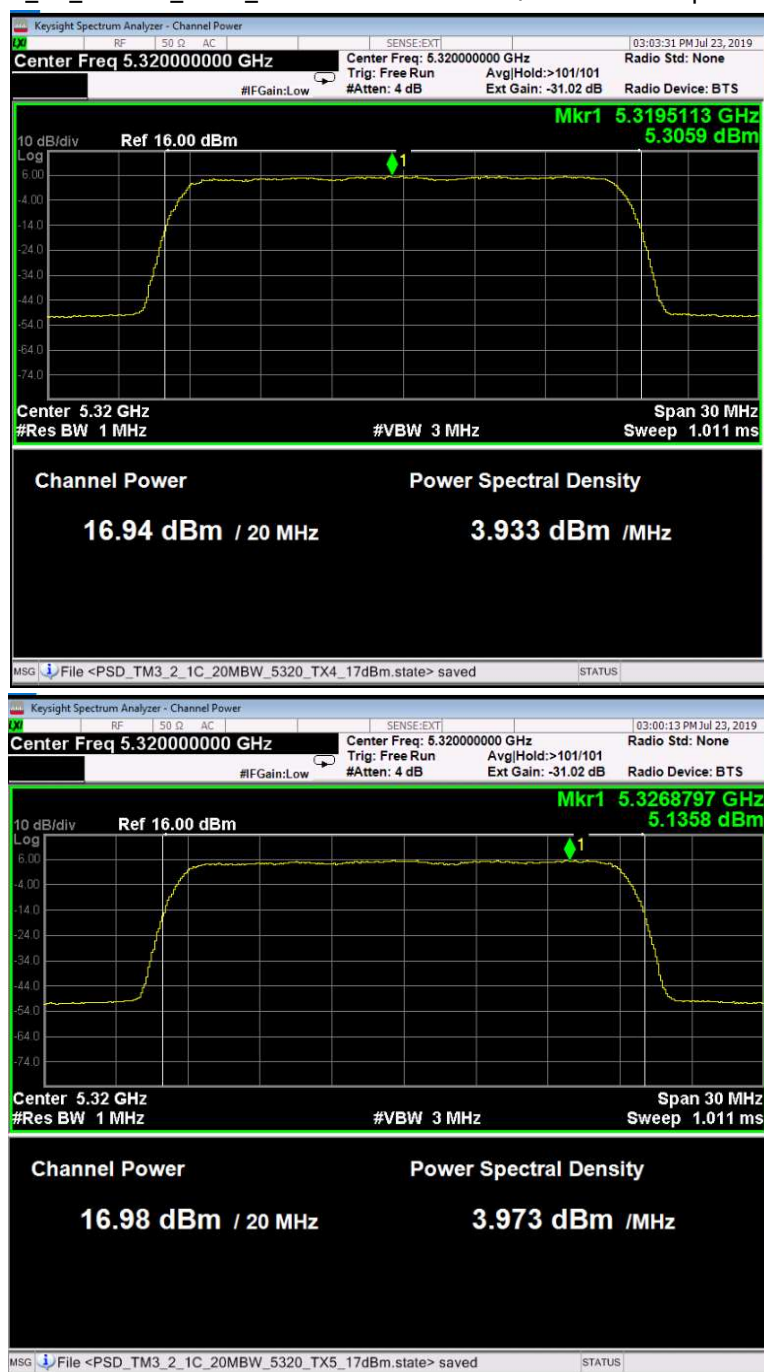
Output Power_TM3.2_1C_20MBW_5500_18dBm at Ports 1 & 2 (Combined Output Power 20.98 dBm)



3.2 Channel RF Power – Plots Antenna #2 FA2RA (7.0dBi)

NOTE: Only the plots with the maximum power levels measured are used in this report. The full suite of raw data resides at the MH, New Jersey location.

Output Power_TM3.2_1C_20MBW_5320_17dBm at Ports 1 & 2 (Combined Output Power 19.97 dBm)



4 FCC 15.407 (a)(2)(5) – PEAK POWER SPECTRUM DENSITY

The peak power spectrum density (PPSD) measures the maximum value of the time average of the PSD measured during a period of continuous transmission.

The PPSD limits calculated were provided in Table 3.1. The PPSD was measured at the both antenna ports for the channels listed in Section 1.8 for various modulations. The measurement follows the procedures given in ANSI C63.10.

The PSD was measured by a spectrum analyzer. The RBW and VBW were set to 1MHz and 3MHz, respectively. The RMS detector and trace average (≥ 100) were used. The PPSD can be found by using either the peak search function on the instrument to find the peak of the spectrum or the spectrum analyzer's PSD function.

Normally, the total PPSD was calculated by the PPSD measured at the port which usually has higher PPSD based on the measurement for output power plus 3dB for two ports. When the margin is slim, the PPSD measurement was performed at both ports to obtain the combined PPSD value, where the total PPSD was obtained by summing the PPSD measured at both antenna ports.

**Table 4.1 Maximum Mean Combined PPSD at Antenna Ports for 5GHz
1x20MHz Carrier at 18dBm/pt in UNII-2 for FA2WA Antenna #1 (6dBi)**

Bands (GHz)	Ch No/ Freq (MHz)	Modulation	Port 1 (dBm/ MHz)	Port 2 (dBm/ MHz)	Total PPSD (dBm /MHz)	PPSD Limit (dBm /MHz)	Test Results
Band 46b (5.25-5.35)	52/5260	Q/16QAM	6.0636	6.0765	9.080	11	Pass
		64QAM	5.5831	5.5764	8.590	11	Pass
		254QAM	5.4254	6.2110	8.846	11	Pass
	56/5280	Q/16QAM	6.1908	6.3463	9.280	11	Pass
		256QAM	5.5861	5.9427	8.778	11	Pass
	64/5320	Q/16QAM	6.3174	6.1888	9.264	11	Pass
25QAM		5.6709	5.9629	8.830	11	Pass	
Band 46c (5.47-5.725)	100/5500	Q/16QAM	6.3455	6.4323	9.399	11	Pass
		64QAM	5.5120	5.8028	8.670	11	Pass
		256QAM	5.3872	5.7548	8.585	11	Pass
	116/5580	Q/16QAM	6.5787	6.1124	9.362	11	Pass
		64QAM	5.9837	6.3145	9.163	11	Pass
		256QAM	5.4442	5.8304	8.652	11	Pass
	140/5700	Q/16QAM	6.1115	6.4299	9.284	11	Pass
		64QAM	5.6789	6.5288	9.135	11	Pass
		256QAM	5.9904	5.9703	8.991	11	Pass
	144/5720	Q/16QAM	6.0133	6.0751	9.055	11	Pass
		64QAM	5.8093	5.4489	8.643	11	Pass
		256QAM	5.6724	5.9879	8.843	11	Pass

The measurement results are given above. The total PPSD measured are all below the FCC required limits.

Table 4.2 Maximum Total PPSD Measured at Antenna Ports for FA2WA (6dBi) 18dBm/pt

Bands	20MHz FA2WA #1 (dBm/MHz)
UNII-2a (5.25-5.35 GHz)	9.28
UNII-2c (5.47-5.725 GHz)	9.40

For the EUT with FA2WA antenna at 18dBm/pt, the PPSD at antenna ports measured has more than 1.6dB margin. Therefore, the measurement of the PPSD of the EUT with FA2RA antenna 17dBm/pt can be waived.

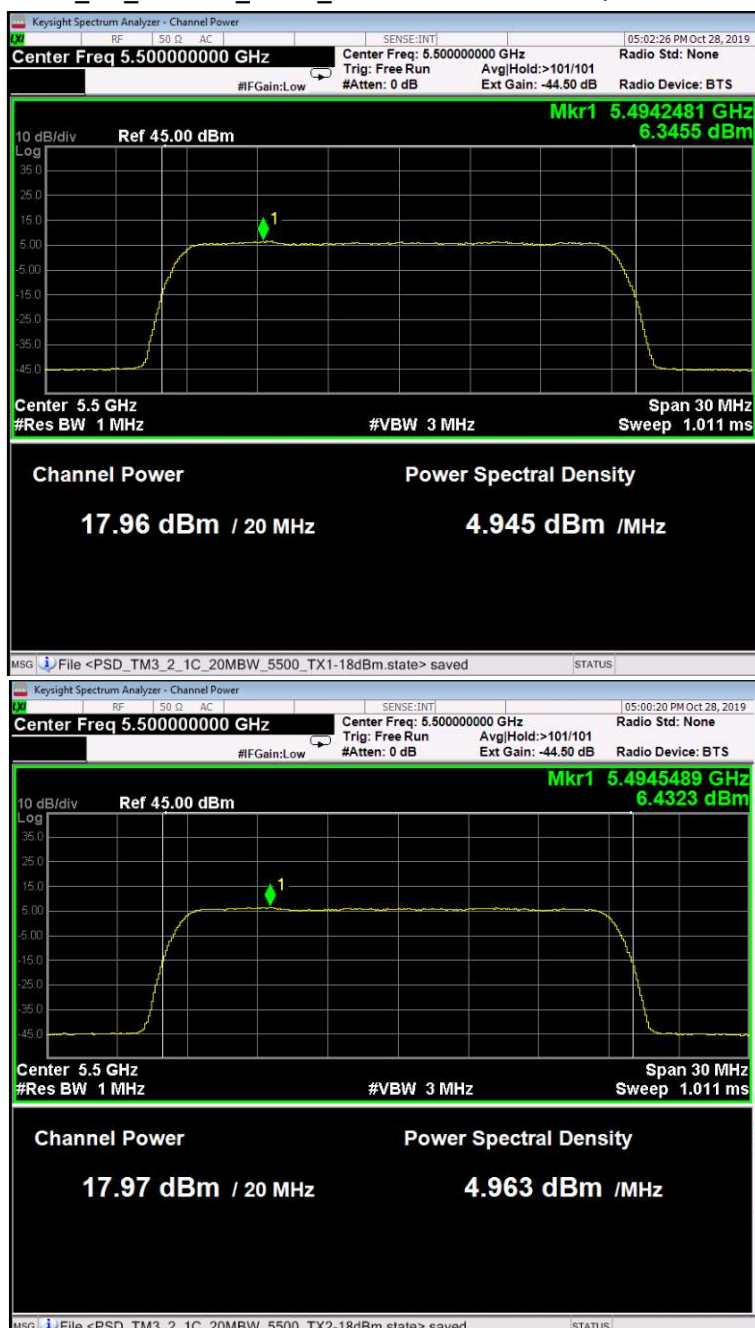
The PPSD plots which have the smallest margin for 1x20MHz carriers with 18dBm/port are provided in Figures below.

The combined PPSD of the EUT at its antenna transmitting terminals across the UNII-2a and UNII-2c bands are all below FCC required limits and are in full compliance with the Rules of the Commission.

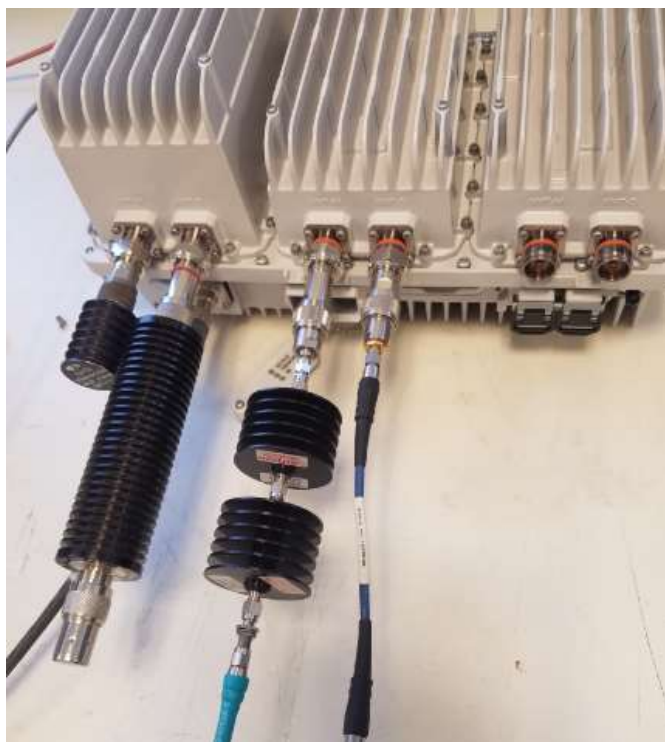
4.1 Peak Power Spectrum Density – Plots Antenna #1 FA2WA (6 dBi)

NOTE: Only the plots with the maximum power levels measured are used in this report. The full suite of raw data resides at the MH, New Jersey location.

Conducted PPSD_TM3.2_1C_20MBW_5500_18dBm at Ports 1&2 (Combined PPSD 9.4 dBm/MHz)



Photograph



Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due	Calibration Type
E831	Agilent Technologies	MXA Signal Analyzer	20Hz-26.5GHz	N9020A	MY48011791	2018-02-15	2020-02-15	Requires Calibration
E896	Agilent Technologies	Network Analyzer	10 MHz - 40 GHz	N5230C	MY49000897	2019-01-31	2021-01-31	Requires Calibration
T053	Krohn-Hite	Dual Filter		3202	1155			
E1022	Weinschel	Attenuator	10dB DC-18GHz 25W	46-10-34-LIM	BN3118			Calibration Not Required, Must Be Verified
E1214	Weinschel	Attenuator	20dB 150watt	66-20-34	BQ8163	2018-12-16	2020-12-16	Requires Calibration
E1154	Weinschel	Attenuator	30dB 25W 0.05GHz-26GHz	74-30-12	1065			Calibration Not Required, Must Be Verified

5 FCC 15.407 (b)(2)(3)(5)(8) – UNWANTED OUT-OF-BAND EMISSIONS

The out-of-band emissions provided in this section are the unwanted emissions outside the band, but near the band edges. The unwanted emissions at the frequencies away from the band edges were provided in the next section.

5.1 Unwanted Out-of-Band Emissions Limits

The requirements of the out-of-band emissions are provided in Section 1.4.1. Per KDB 789033 D02 guidance II.G.3.b, “The unwanted emission limits in both the restricted and non-restricted bands are based on radiated measurements; however, as an alternative, antenna-port conducted measurements in conjunction with cabinet emissions tests will be permitted to demonstrate compliance.”

The radiated out-of-band emissions were evaluated per ANSI C63.10 measurement guidance for the EUT equipped with the omni-directional antenna #2 FA2FA which has the highest antenna gain among all omni-directional antennas and the directional antenna #2 FA2WA which has the maximum output power and the highest gain among all directional antennas, respectively. The carriers transmitted at the maximum power levels allowed per FCC and ISD requirements with 1x20MHz configuration at the low, middle and high channels with various modulations, respectively.

Per KDB 789033 D02, for the radiated measurement, the field strength limit is obtained from the EIRP limit by

$$EIRP = \frac{\sqrt{E \times d}}{30},$$

where

- E is the field strength in V/m;
- d is the measurement distance in m;
- EIRP is the equivalent isotropically radiated power in W.

Therefore, with E in,

$$E \text{ (dB}\mu\text{V/m)} = EIRP(\text{dBm}) - 20 * \log(d) + 104.77.$$

At 3m with EIRP = - 27dBm, E = 68.2 dBμV/m.

Table 5.1 FCC 15.407E UNII-2 Out-of-Band Radiated Emission limits

Band (GHz)	Freq Investigated (GHz)	Emission Limits		Detector	RBW (MHz)
		Freq Range (GHz)	Limit (dBm/MHz)		
5.25-5.35	5.10-5.40	5.10 - 5.15 & 5.35 - 5.40	54/68.2	ave/pk	1
5.47-5.725	5.40-5.8 (w/o Ch 144)	5.40 - 5.46	54/68.2	ave/pk	1
		5.46 - 5.47 & 5.725 - 5.8	68.2	pk	
	5.40-5.90 (with Ch 144)	5.40 - 5.46	54/68.2	ave/pk	
		5.46-5.47 & 5.85-5.9	68.2	pk	

The recommendations of ANSI C63.10 were followed for the EUT testing setup and cabling. The test setup diagram was given in Section 1.7. The emissions were maximized by rotating the turntable 360° and moving the receiving antenna height to scan and capture the emissions from the EUT.

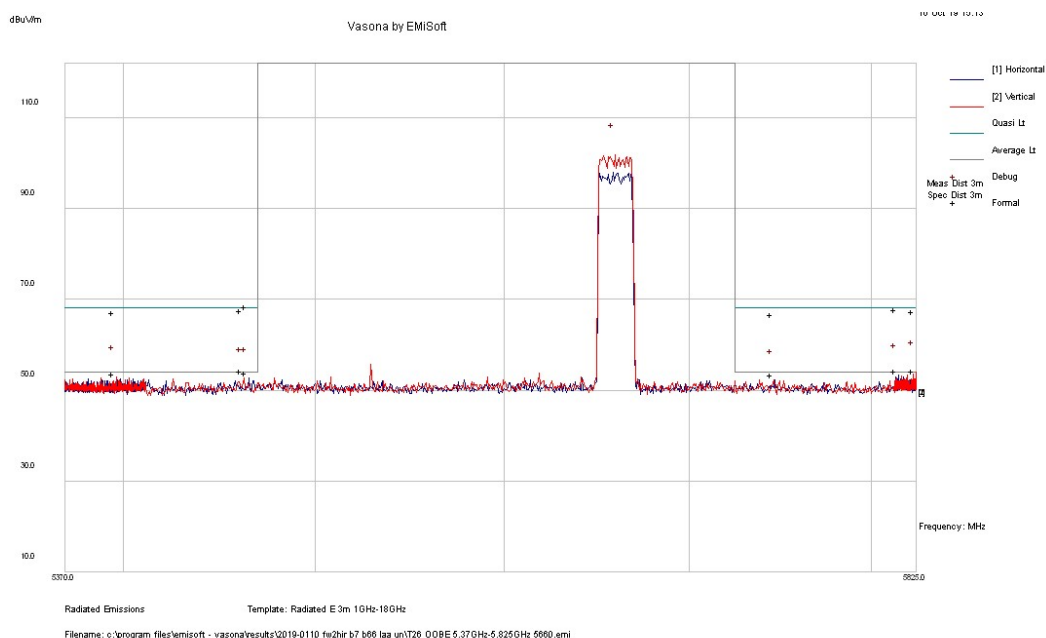
For the EUT equipped with FA2WA, the radiated out-of-band emissions were measured with 1x20MHz configuration at the low, middle and high channels in the UNII-2a and UNII-2c bands with various modulations and maximum power. For the EUT equipped with FA2RA antenna, the out-of-band emissions were measured with 1x20MHz configuration at the channel 5260 MHz with Q/16QAM modulation and at the low, middle and high channels in the UNII-2c band with various modulations and maximum power. The unwanted radiated out-of-band emissions measured are all below the average and/or peak limits required in both the restricted and non-restricted bands. The restricted bands are provided in Table 1.4.1.

Hence, the unwanted radiated out-of-band emissions measured with the EUT transmitting in the UNII-2a and UNII-2c bands are all below FCC required limits for the EUT equipped with either omni-directional antenna or directional antenna, respectively, and are in full compliance with the regulatory requirements.

The out-of-band emissions plots which give the minimum emission margin evaluated for each antenna equipped for 1x20MHz carrier were shown below.

5.2 Radiated Out-of-Band Emissions – Plots FA2WA Antenna #1

NOTES: 1) Only the emissions plots which give the minimum emission margin evaluated for 1x20MHz carrier were used in this report. The full suite of raw data resides at the MH, New Jersey location. 2) “NA” (Not Applicable) in the tables of Formal Data below was due to the fact that only the unwanted emissions in the restricted band above 1GHz are subject to the average 54 dBuV/m limit per FCC 15.205 and 15.209.



Results Title: Radiated E 3m 1GHz-18GHz
File Name: c:\program files\emisoft - vasona\results\2019-0110 fw2hir b7 b66 laa un\T26 OOBE 5.37GHz-5.825GHz 5660.emi
Test Laboratory: GPCL AR5-MH 25C, 42%RH, 991mB
Test Engineer: GM
Test Software: Vasona by EMISoft, version 2.161
Equipment: Nokia
EUT Details: 2019-0110. FW2HIR B7/B66 LAA UNII-2 wDFS -IC with FA2WA; 5660MHz 1 Carrier; 20dBm per port; ETM3.1, 20MHz BW; 120V AC.
Configuration: RE 10GHz-18GHz ESI E954, Peak RBW=100KHz, VBW=3MHz, Formal RBW 1MHz, VBW 3MHz, Int. Att. 0dB, PA E447, Horn Ant E1073, 19dB (E175, E176, E177)
Date: 2019-10-16 15:13:17

FORMAL DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5814.79	26.93	23.88	-3.12	47.69	AvgMax	H	152	346	54	-6.31	Pass	NA
5462.58	27.3	23.81	-3.44	47.67	AvgMax	V	205	336	54	-6.33	Pass	NA
5465.11	41.48	23.81	-3.44	61.85	Peak	H	274	162	68.2	-6.35	Pass	
5824.67	26.86	23.88	-3.11	47.63	AvgMax	V	279	16	54	-6.37	Pass	NA
5465.11	26.88	23.81	-3.44	47.25	AvgMax	H	274	162	54	-6.75	Pass	NA
5814.79	40.51	23.88	-3.12	61.27	Peak	H	152	346	68.2	-6.93	Pass	
5396.44	26.76	23.79	-3.5	47.05	AvgMax	V	218	360	54	-6.95	Pass	
5746.68	26.22	23.87	-3.18	46.91	AvgMax	H	369	29	54	-7.09	Pass	NA
5462.58	40.51	23.81	-3.44	60.87	Peak	V	205	336	68.2	-7.33	Pass	
5824.67	40.02	23.88	-3.11	60.79	Peak	V	279	16	68.2	-7.41	Pass	
5396.44	40.23	23.79	-3.5	60.52	Peak	V	218	360	68.2	-7.68	Pass	
5746.68	39.51	23.87	-3.18	60.2	Peak	H	369	29	68.2	-8	Pass	

PREVIEW DATA

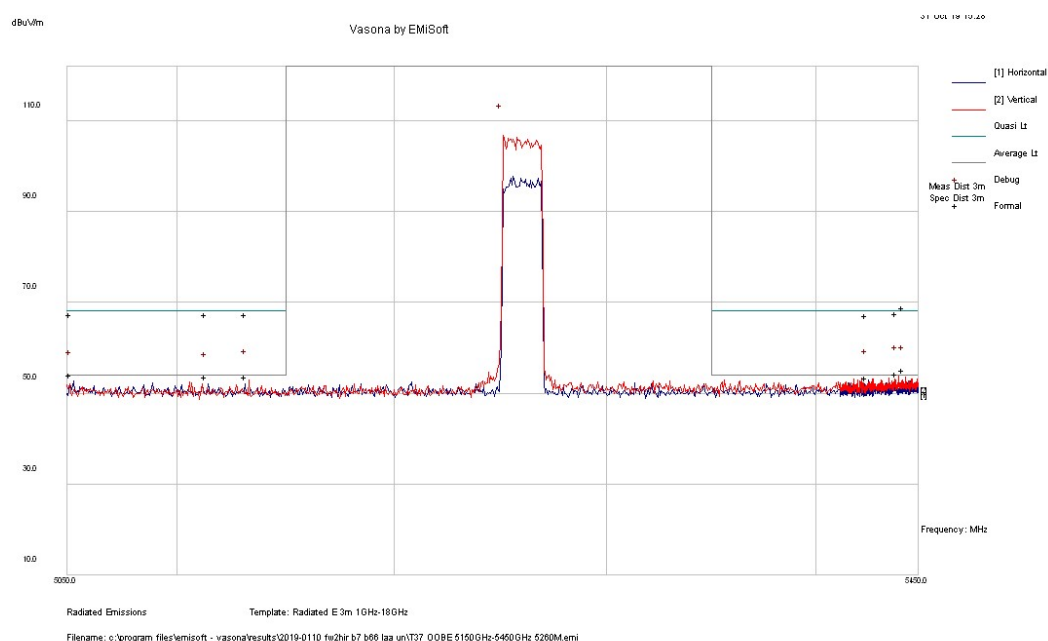
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5824.67	33.33	23.88	-3.11	54.1	Preview	V	202	135	54	0.1	Fail	
5814.79	32.6	23.88	-3.12	53.36	Debug	H	99	322	54	-0.64	Pass	
5396.44	32.71	23.79	-3.5	53	Debug	V	99	322	54	-1	Pass	
5465.11	32.26	23.81	-3.44	52.63	Debug	H	99	322	54	-1.37	Pass	
5462.58	32.14	23.81	-3.44	52.51	Debug	V	99	322	54	-1.49	Pass	
5746.68	31.43	23.87	-3.18	52.11	Debug	H	99	322	54	-1.89	Pass	
5659.87	81.27	23.85	-3.26	101.86	Preview	V	102	0	122	-20.14	Pass	

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

5.3 Radiated Out-of-Band Emissions – Plots FA2RA Antenna #2

NOTES: 1) Only the emissions plots which give the minimum emission margin evaluated for 1x20MHz carrier were used in this report. The full suite of raw data resides at the MH, New Jersey location. 2) “NA” (Not Applicable) in the tables of Formal Data below was due to the fact that only the unwanted emissions in the restricted band above 1GHz are subject to the average 54 dBuV/m limit per FCC 15.205 and 15.209.

Out-of-Band_TM3.2_1C_20MBW_5260_17dBm



Results Title: Radiated E 3m 1GHz-18GHz
File Name: c:\program files\emisoft - vasona\results\2019-0110 fw2hir b7 b66 laa un\T37 OOBE 5150MHz-5450MHz 5260M.emi
Test Laboratory: GPCL AR5-MH 23C, 52%RH, 991mB
Test Engineer: GM
Test Software: Vasona by EMISoft, version 2.161
Equipment: Nokia
EUT Details: 2019-0110. FW2HIR B7/B66 LAA UNII-2 wDFS -IC with FA2RA; 5260MHz 1 Carrier; 17 dBm per port; ETM3.2, 20MHz BW; 120V AC.
Configuration: RE , OOBE 5150MHz-5450MHz Peak RBW=100KHz, VBW=3MHz, Formal RBW=1MHz, VBW=3MHz, Int. Att. 0dB, ESU E954, 17dB per port, 19dB (E175,176,177), Ant E1073, Pre-Amp e447
Date: 2019-10-31 15:28:38

FORMAL DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5443.81	28.14	23.8	-3.46	48.49	AvgMax	V	163	300	54	-5.51	Pass	
5443.81	41.88	23.8	-3.46	62.23	Peak	V	163	300	68.2	-5.97	Pass	

FORMAL DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5440.38	27.38	23.8	-3.46	47.72	AvgMax	V	108	106	54	-6.28	Pass	
5052.9	27.6	23.71	-3.83	47.48	AvgMax	H	189	76	54	-6.52	Pass	
5114.36	27.08	23.73	-3.77	47.04	AvgMax	H	135	314	54	-6.96	Pass	
5132.9	27.03	23.73	-3.75	47.01	AvgMax	V	165	168	54	-6.99	Pass	
5425.68	26.49	23.8	-3.48	46.81	AvgMax	H	182	289	54	-7.19	Pass	
5440.38	40.53	23.8	-3.46	60.87	Peak	V	108	106	68.2	-7.33	Pass	
5132.9	40.88	23.73	-3.75	60.86	Peak	V	165	168	68.2	-7.34	Pass	
5052.9	40.92	23.71	-3.83	60.8	Peak	H	189	76	68.2	-7.4	Pass	
5114.36	40.7	23.73	-3.77	60.66	Peak	H	135	314	68.2	-7.54	Pass	
5425.68	40.17	23.8	-3.48	60.49	Peak	H	182	289	68.2	-7.71	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
5440.38	33.41	23.8	-3.46	53.75	Debug	V	100	322	54	-0.25	Pass	
5443.81	33.29	23.8	-3.46	53.63	Debug	V	100	322	54	-0.37	Pass	
5132.9	32.88	23.73	-3.75	52.86	Debug	V	100	322	54	-1.14	Pass	
5425.68	32.54	23.8	-3.48	52.86	Debug	H	100	322	54	-1.14	Pass	
5052.9	32.78	23.71	-3.83	52.66	Debug	H	100	322	54	-1.34	Pass	
5114.36	32.12	23.73	-3.77	52.08	Debug	H	100	322	54	-1.92	Pass	
5251.18	86.75	23.76	-3.64	106.87	Preview	V	102	180	122	-15.13	Pass	

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

6 FCC 15.407 (b)(2)(3)(5-8), 15.209 , 15.205 & 15.109 – Unwanted Spurious Emissions

The requirements of the unwanted emissions are provided in Section 1.4.1. Per ANSI C63.10 12.7.4.2 guidance, the unwanted emission limits in both the restricted and non-restricted bands are based on radiated measurements; however, as an alternative, antenna-port conducted measurements in conjunction with cabinet emissions tests will be permitted to demonstrate compliance.

6.1 Unwanted Radiated Spurious Emissions Limits

The Limits of FCC 15.109 Class B, 15.209 and 15.407 were given in the tables below, where the conversion between the EIRP and electrical field strength was given in the above section. The FCC 15.109 Class B limits are identical to the 15.209 limits between 30MHz and 30GHz for the EUT operating in UNII bands.

Table 6.1. FCC 15.109 Class B and 15.209 Radiated Emissions Limits

Frequency (MHz)	Field Strength at 3m (dB uV/m)		RBW (kHz)	Detector
	FCC 15.109 Class B	FCC 15.209		
10 - 30		49.5	9	QP
30 - 88	40	40	120	QP
88 - 216	43.5	43.5		
216 - 230	46	46		
230 - 960	46	46		
960 - 1000	54	54		
1000 - 3000	54	54	1000	Ave.
	74	74		Peak
> 3000 - $5f_c$	54	54	1000	Ave.
	74	74		Peak
$5f_c$ - $10f_c$ / 40GHz		54	1000	Ave.
		74		Peak

The combined radiated limits of RSS-GEN Table 5, RSS-247, ICES-003/FCC 15.109 Class B and FCC 15.209 were given in Table below.

Table 6.2. Combined Worst Radiated Emission Limits per 15.407 UNII-1/2/3, 15.209 and 15.109 at 3m**

Frequency (MHz)	E (dBuV/m)*	RBW (kHz)	Detector
30 - 88	40/63.7	120kHz	QP/Peak
88 - 216	43.5/63.7		
216 - 960	46/63.7		
960 - 1000	54/63.7		
1G - 40G in Restricted Bands*	54/68.2	1000	Ave/Peak
1G - 40G in Non-Restricted Bands*	68.2	1000	Peak

* The restricted bands of operation specified in FCC 15.205(a) were provided in Section 1.4.1. For a failing signal, need to check if it is from the transmitter. If not, it needs to meet ICES-003/15.109 Class B.

** Per KDB 789033 D02, the ground reflection 4.7dB was included for frequencies below 1GHz when converting between EIRP and E per KDB. If no 4.7dB, the limit is 59 dBuV/m.

The emissions were investigated from 30MHz to 40GHz. The emissions near the band edges were provided in the above section.

The radiated spurious emissions were evaluated for the EUT equipped with the directional antenna #1 FA2WA, which has the maximum output power and the highest gain among all directional antennas, in the frequency range of 30MHz-40GHz with 1x20MHz carrier at the channel 5700MHz with 64QAM modulation and in the frequency range of 30MHz-18GHz with 1x20MHz carrier at the channel 5260MHz with Q/16QAM modulation, respectively. The radiated spurious emissions were evaluated for the EUT equipped with the omni-directional antenna #2 FA2RA, which has the highest gain among all omni-directional antennas, in the frequency range of 1-18GHz with 1x20MHz carrier at the channel 5500MHz with 64QAM modulation.

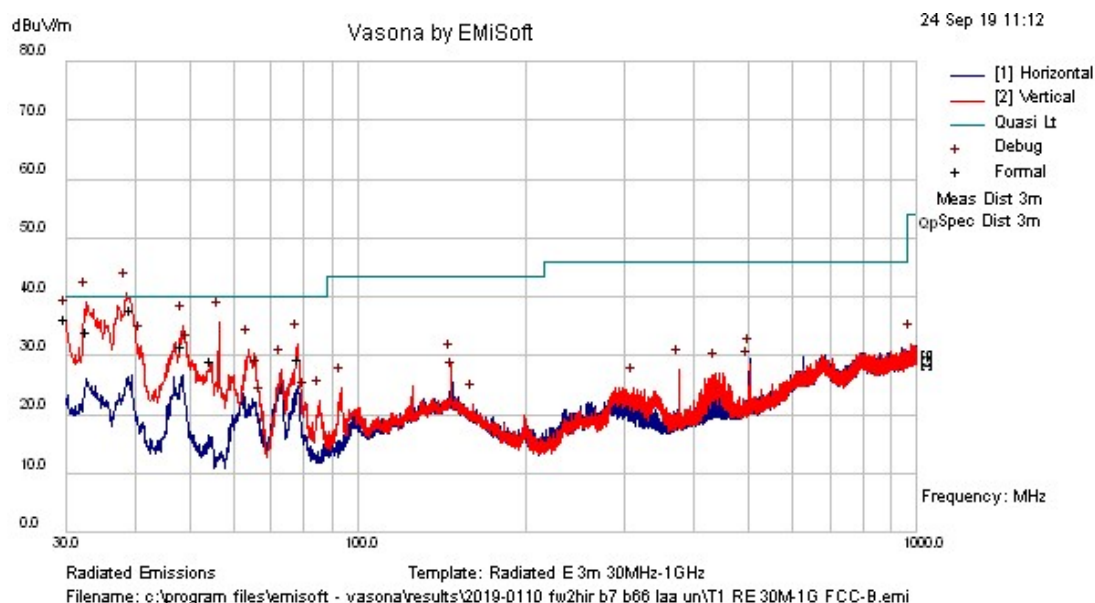
The recommendations of ANSI C63.10 were followed for EUT testing setup and cabling. The measurement guidance given in KDB 789033 D02 was followed. The test setup diagram was given in Section 1.7. The emissions were maximized by rotating the turntable 360° and moving the receiving antenna height to scan and capture the emissions from the EUT.

The unwanted radiated spurious emissions measured for the EUT, which operated in UNII-2a/2c bands and was equipped with the directional antenna #1 FA2WA and the omni-directional antenna #2 FA2RA, respectively, met the FCC 15.407 and 15.209 requirements for intentional radiators and the FCC 15.109 Class B requirements for unintentional radiators. The plots in each frequency range evaluated for each antenna were provided below.

6.2 Radiated Spurious Emissions – Plots FA2WA Antenna #1

NOTES: 1) Only the emissions plots which give the minimum emission margin evaluated for 1x20MHz carrier were used in this report. The full suite of raw data resides at the MH, New Jersey location. 2) "NA" (Not Applicable) in the tables of Formal Data below was due to the fact that only the unwanted emissions in the restricted band above 1GHz are subject to the average 54 dBuV/m limit per FCC 15.205 and 15.209.

Spurious_TM3.2_1C_20MBW_5260, 30MHz-1GHz



Results Title: Radiated E 3m 30MHz-1GHz
File Name: c:\program files\emisoft - vasona\results\2019-0110 fw2hir b7 b66 laa un\T1 RE 30M-1G FCC-B.emi
Test Laboratory: GPCL AR5-MH 24C, 50%RH, 991mB
Test Engineer: GM
Test Software: Vasona by EMISoft, version 2.161
Equipment: Nokia
EUT Details: 2019-0111. FW2HIR B7/B66 LAA UNII-2 wDFS -IC with FA2WA; 5260 MHz 1 Carrier; 21dBm; ETM3.2; 120V AC.
Configuration: RE 30M-1GHz. ESI E704, RBW=100kHz, VBW=300kHz, Int. Att. 10dB, PA E507, Bilog E602.
Date: 2019-09-24 11:15:28

FORMAL DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
39.367	47.84	0.63	-14.2	34.27	Quasi Max	V	107	17	40	-5.73	Pass	
30.097	41.4	0.61	-9.29	32.72	Quasi Max	V	114	320	40	-7.28	Pass	
32.852	40.67	0.62	-10.8	30.53	Quasi Max	V	157	56	40	-9.47	Pass	
48.757	45.8	0.64	-18.4	28.02	Quasi Max	V	210	110	40	-11.98	Pass	
78.661	44.18	0.77	-19.3	25.67	Quasi Max	V	113	11	40	-14.33	Pass	
54.778	45.12	0.66	-20.3	25.45	Quasi Max	V	160	119	40	-14.55	Pass	

PREVIEW DATA

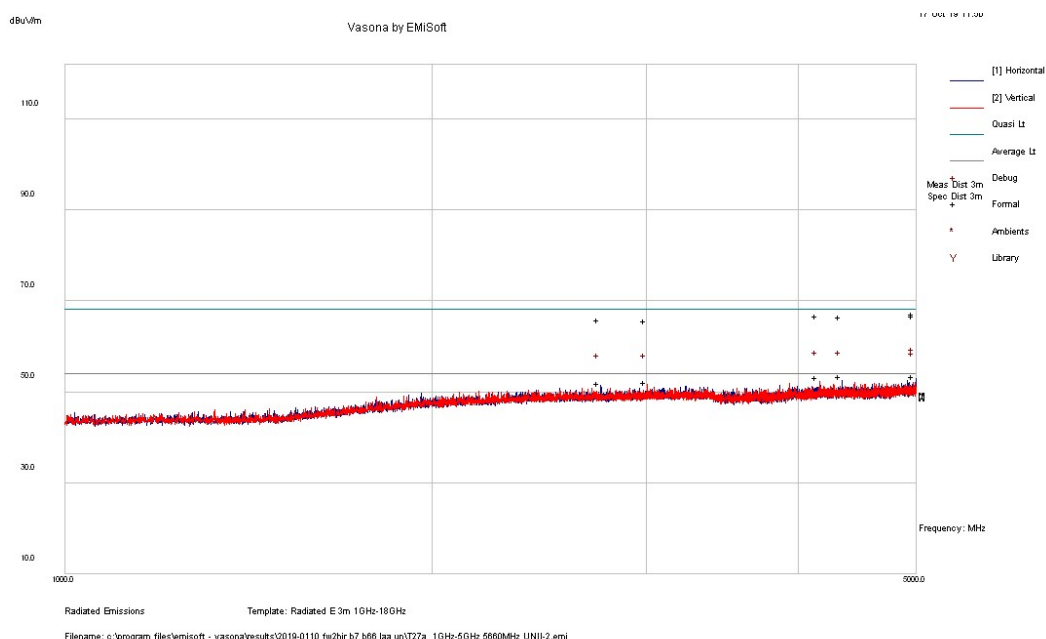
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
38.5611	53.94	0.62	-13.8	40.79	Preview	V	102	45	40	0.79	Fail	
32.5972	49.18	0.61	-10.6	39.17	Preview	V	102	90	40	-0.83	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
30.0962	44.54	0.61	-9.29	35.87	Preview	V	102	315	40	-4.13	Pass	
56.4529	55.59	0.67	-20.7	35.57	Preview	V	380	45	40	-4.43	Pass	
48.7575	52.87	0.64	-18.4	35.09	Preview	V	102	90	40	-4.91	Pass	
77.9038	50.59	0.77	-19.5	31.9	Preview	V	102	45	40	-8.1	Pass	
40.9659	46.01	0.63	-15	31.64	Preview	V	102	180	40	-8.36	Pass	
63.8597	52.09	0.7	-21.6	31.18	Preview	V	102	270	40	-8.82	Pass	
49.9118	48.49	0.64	-18.9	30.26	Preview	V	102	0	40	-9.74	Pass	
72.998	47.61	0.74	-20.6	27.79	Preview	V	102	90	40	-12.21	Pass	
66.1683	46.55	0.71	-21.6	25.71	Preview	V	102	225	40	-14.29	Pass	
147.259	36.76	1.1	-9.31	28.55	Preview	V	280	270	43.5	-14.95	Pass	
502.208	37.14	1.78	-9.52	29.39	Preview	H	202	225	46	-16.61	Pass	
85.3106	39.56	0.81	-17.9	22.48	Preview	V	102	90	40	-17.52	Pass	
80.6934	40.03	0.78	-18.8	21.99	Preview	V	102	45	40	-18.01	Pass	
147.547	33.59	1.1	-9.3	25.39	Preview	H	380	135	43.5	-18.11	Pass	
374.946	37.59	1.62	-11.6	27.64	Preview	V	180	0	46	-18.36	Pass	
499.9	35.28	1.77	-9.59	27.46	Preview	H	202	225	46	-18.54	Pass	
436.317	36.13	1.7	-10.7	27.15	Preview	V	102	45	46	-18.85	Pass	
67.2265	41.88	0.71	-21.5	21.14	Preview	V	102	225	40	-18.86	Pass	
93.487	39.67	0.85	-15.9	24.58	Preview	V	102	90	43.5	-18.92	Pass	
311.555	34.75	1.53	-11.7	24.6	Preview	V	180	0	46	-21.4	Pass	
160.629	31.66	1.15	-10.9	21.91	Preview	V	102	45	43.5	-21.59	Pass	
978.265	31.47	2.78	-2.16	32.09	Preview	V	180	270	54	-21.91	Pass	

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

Spurious_TM3.1_1C_20MBW_5700 1-5GHz



Results Title: Radiated E 3m 1GHz-18GHz
File Name: c:\program files\emisoft - vasona\results\2019-0110 fw2hir b7 b66 laa un\T27 1GHz-5GHz 5700MHz UNII-2.emi
Test Laboratory: GPCL AR5-MH 23C, 37%RH, 976mB
Test Engineer: GM
Test Software: Vasona by EMISoft, version 2.161
Equipment: Nokia
EUT Details: 2019-0110. FW2HIR B7/B66 LAA UNII-2 wDFS -IC with FA2WA; 5700MHz 1 Carrier; 20dBm per port; ETM3.1, 20MHz BW; 120V AC.
Configuration: RE 1GHz-5GHz ESI E954, Peak RBW=100KHz, VBW=3MHz, Formal RBW 1MHz, VBW 3MHz, Int. Att. 0dB, PA E447, Horn Ant E1073, 19dB (E175, E176, E177)
Date: 2019-10-17 15:10:54

FORMAL DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
4988.27	27.06	23.69	-3.89	46.86	AvgMax	V	134	214	54	-7.14	Pass	
4992.49	26.99	23.69	-3.89	46.79	AvgMax	H	114	176	54	-7.21	Pass	
4344.86	27.79	23.18	-4.26	46.72	AvgMax	H	130	0	54	-7.28	Pass	
4161.63	27.93	23.03	-4.43	46.52	AvgMax	V	235	302	54	-7.48	Pass	
4992.49	40.82	23.69	-3.89	60.63	Peak	H	114	176	68.2	-7.57	Pass	
4161.63	41.58	23.03	-4.43	60.17	Peak	V	235	302	68.2	-8.03	Pass	
4988.27	40.24	23.69	-3.89	60.05	Peak	V	134	214	68.2	-8.15	Pass	
4344.86	41.01	23.18	-4.26	59.93	Peak	H	130	0	68.2	-8.27	Pass	
3008.57	28.97	22.39	-5.84	45.53	AvgMax	V	147	122	54	-8.47	Pass	NA
2754.06	28.97	22.26	-5.92	45.31	AvgMax	H	137	339	54	-8.69	Pass	
2754.06	42.86	22.26	-5.92	59.2	Peak	H	137	339	68.2	-9	Pass	

FORMAL DATA

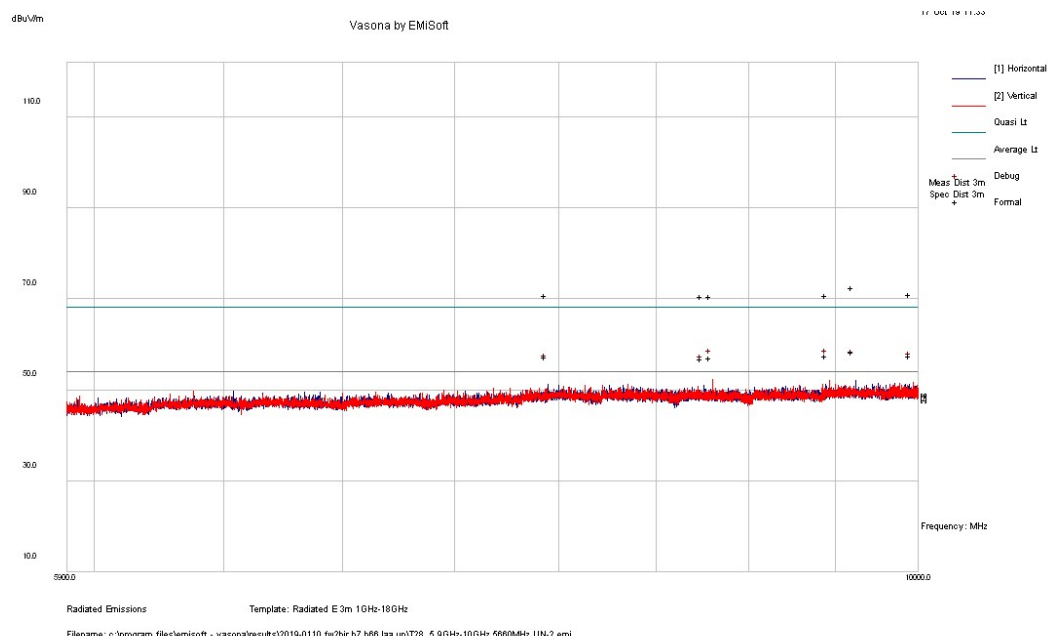
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
3008.57	42.56	22.39	-5.84	59.11	Peak	V	147	122	68.2	-9.09	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
4992.49	33.04	23.69	-3.89	52.84	Preview	H	102	180	54	-1.16	Pass	
4344.86	33.34	23.18	-4.26	52.27	Debug	H	100	214	54	-1.73	Pass	
4161.63	33.6	23.03	-4.43	52.19	Debug	V	100	214	54	-1.81	Pass	
4988.27	32.15	23.69	-3.89	51.95	Debug	V	100	214	54	-2.05	Pass	
3008.57	35.03	22.39	-5.84	51.59	Debug	V	100	214	54	-2.41	Pass	
2754.06	35.1	22.26	-5.92	51.44	Debug	H	100	214	54	-2.56	Pass	

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

Spurious_TM3.1_1C_20MBW_5700 5.9-10GHz



Results Title: Radiated E 3m 1GHz-18GHz
File Name: c:\program files\emisoft - vasona\results\2019-0110 fw2hir b7 b66 laa un\T28a 5.9GHz-10GHz 5700MHz UN-2.emi
Test Laboratory: GPCL AR5-MH 23C, 37%RH, 976mB
Test Engineer: GM
Test Software: Vasona by EMISoft, version 2.161
Equipment: Nokia
EUT Details: 2019-0110. FW2HIR B7/B66 LAA UNII-2 wDFS -IC with FA2WA; 5700MHz 1 Carrier; 20dBm per port; ETM3.1, 20MHz BW; 120V AC.
Configuration: RE 5.9GHz-10GHz ESI E954, Peak RBW=30KHz, VBW=3MHz, Formal RBW 1MHz, VBW 3MHz, Int. Att. 0dB, PA E447, Horn Ant E1073, 19dB (E175, E176, E177)
Date: 2019-10-17 15:03:48

FORMAL DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
9616.59	28.16	25.85	-2.28	51.74	AvgMax	H	235	122	54	-2.26	Pass	NA
9616.59	42.23	25.85	-2.28	65.81	Peak	H	235	122	68.2	-2.39	Pass	
9462.32	27.42	25.91	-2.37	50.96	AvgMax	H	380	80	54	-3.04	Pass	
9965.22	27.14	25.73	-2.03	50.84	Average	H	167	92	54	-3.16	Pass	NA
7950.61	27.76	25.68	-2.73	50.71	AvgMax	H	272	159	54	-3.29	Pass	NA
8804.8	27.11	26.02	-2.61	50.51	AvgMax	V	249	136	54	-3.49	Pass	NA
8755.95	26.96	26	-2.63	50.33	Average	H	234	321	54	-3.67	Pass	NA
9965.22	40.73	25.73	-2.03	64.43	Peak	H	171	98	68.2	-3.77	Pass	
9462.32	40.76	25.91	-2.37	64.3	Peak	H	384	73	68.2	-3.9	Pass	
7950.61	41.18	25.68	-2.73	64.12	Peak	H	272	159	68.2	-4.08	Pass	
8804.8	40.5	26.02	-2.61	63.9	Peak	V	249	136	68.2	-4.3	Pass	

FORMAL DATA

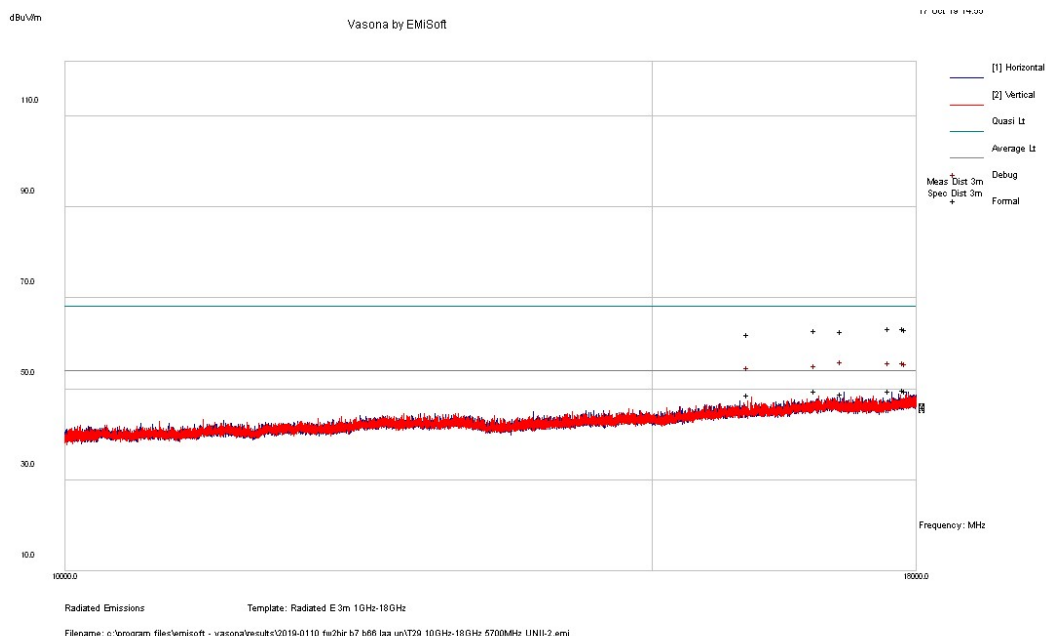
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
8755.95	40.53	26	-2.63	63.9	Peak	H	234	321	68.2	-4.3	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
8804.8	28.79	26.02	-2.61	52.19	Preview	V	202	135	54	-1.81	Pass	
9462.32	28.54	25.91	-2.37	52.08	Debug	H	100	321	54	-1.92	Pass	
9616.59	28.4	25.85	-2.28	51.98	Debug	H	100	321	54	-2.02	Pass	
9965.22	27.83	25.73	-2.03	51.53	Debug	H	100	321	54	-2.47	Pass	
7950.61	28.21	25.68	-2.73	51.15	Debug	H	100	321	54	-2.85	Pass	
8755.95	27.59	26	-2.63	50.96	Debug	H	100	321	54	-3.04	Pass	

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

Spurious_TM3.1_1C_20MBW_5700 10-18GHz



Results Title: Radiated E 3m 1GHz-18GHz
File Name: c:\program files\emisoft - vasona\results\2019-0110 fw2hir b7 b66 laa un\T29 10GHz-18GHz 5700MHz UNII-2.emi
Test Laboratory: GPCL AR5-MH 23C, 37%RH, 976mB
Test Engineer: GM

Test Software: Vasona by EMISoft, version 2.161
Equipment: Nokia
EUT Details: 2019-0110. FW2HIR B7/B66 LAA UNII-2 wDFS -IC with FA2WA; 5700MHz 1 Carrier; 20dBm per port; ETM3.1, 20MHz BW; 120V AC.
Configuration: RE 10GHz-18GHz ESI E954, Peak RBW=100KHz, VBW=3MHz, Formal RBW 1MHz, VBW 3MHz, Int. Att. 0dB, PA E447, Horn Ant E1073, HPF E1212
Date: 2019-10-17 14:55:18

FORMAL DATA

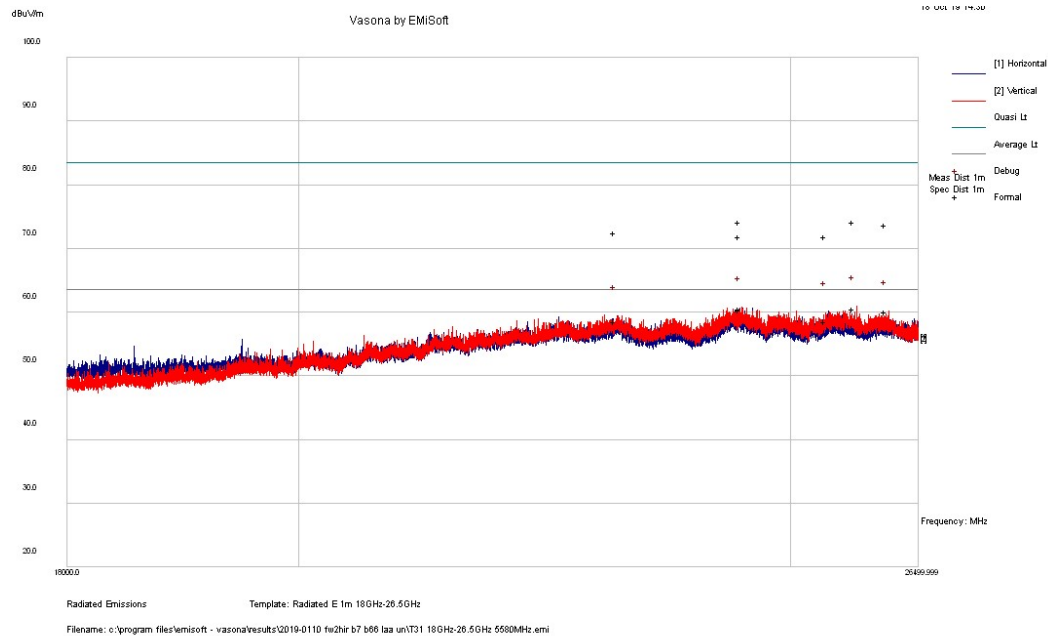
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
17878.7	27.73	10.63	4.71	43.07	Average	H	221	195	54	-10.93	Pass	
17700.4	27.88	10.54	4.48	42.9	AvgMax	H	189	310	54	-11.1	Pass	
16822.9	28.24	10.18	4.45	42.87	AvgMax	V	304	78	54	-11.13	Pass	NA
17898.9	27.49	10.63	4.74	42.87	AvgMax	V	340	276	54	-11.13	Pass	
17878.7	41.38	10.63	4.71	56.72	Peak	H	226	188	68.2	-11.48	Pass	
17700.4	41.56	10.54	4.48	56.58	Peak	H	189	310	68.2	-11.62	Pass	
17125.1	27.43	10.28	4.66	42.37	AvgMax	H	172	0	54	-11.63	Pass	NA
17898.9	41.01	10.63	4.74	56.38	Peak	V	340	276	68.2	-11.82	Pass	
16822.9	41.69	10.18	4.45	56.32	Peak	V	304	78	68.2	-11.88	Pass	
16058.1	29.48	9.99	2.64	42.12	AvgMax	V	221	149	54	-11.88	Pass	
17125.1	41.05	10.28	4.66	55.99	Peak	H	172	0	68.2	-12.21	Pass	
16058.1	42.78	9.99	2.64	55.42	Peak	V	221	149	68.2	-12.78	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
17125.1	34.45	10.28	4.66	49.39	Preview	H	290	315	54	-4.61	Pass	
17878.7	33.94	10.63	4.71	49.28	Debug	H	100	322	54	-4.72	Pass	
17700.4	34.1	10.54	4.48	49.13	Debug	H	100	322	54	-4.87	Pass	
17898.9	33.53	10.63	4.74	48.9	Debug	V	100	322	54	-5.1	Pass	
16822.9	33.83	10.18	4.45	48.46	Debug	V	100	322	54	-5.54	Pass	
16058.1	35.49	9.99	2.64	48.13	Debug	V	100	322	54	-5.87	Pass	

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

Spurious_TM3.1_1C_20MBW_5700 18-26.5GHz



Results Title: Radiated E 1m 18GHz-26.5GHz
File Name: c:\program files\emisoft - vasona\results\2019-0110 fw2hir b7 b66 laa un\T31 18GHz-26.5GHz 5580MHz.emi
Test Laboratory: GPCL AR5-MH 24C, 31%RH, 993mB
Test Engineer: GM
Test Software: Vasona by EMISoft, version 2.161
Equipment: Nokia
EUT Details: 2019-0110. FW2HIR B7/B66 LAA UNII-2 wDFS -IC with FA2WA; 5700MHz 1 Carrier; 20dBm per port; ETM3.1, 20MHz BW; 120V AC.
Configuration: RE 18GHz-26.5GHz ESI E954, Peak RBW=100KHz, VBW=3MHz, Formal RBW 1MHz, VBW 3MHz, Int. Att. 0dB, PA E447, Horn Ant E513, HPF E1212
Date: 2019-10-18 14:30:14

FORMAL DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
25766.2	27.49	17.61	10.64	55.75	AvgMax	V	168	124	63.5	-7.75	Pass	NA
24458.9	28.82	17.88	9.04	55.75	Average	V	130	134	63.5	-7.75	Pass	NA
24462.8	28.67	17.88	9.05	55.59	Average	H	183	210	63.5	-7.91	Pass	NA
26144.1	26.98	17.11	11.26	55.35	AvgMax	V	147	232	63.5	-8.15	Pass	NA
25437.8	25.92	17.59	10.38	53.88	AvgMax	H	110	286	63.5	-9.62	Pass	NA
23112.4	26.95	17.93	8.99	53.87	Average	H	127	303	63.5	-9.63	Pass	
25766.2	41.2	17.61	10.64	69.46	Peak	V	168	124	83.5	-14.04	Pass	
24458.9	42.45	17.88	9.04	69.38	Peak	V	134	140	83.5	-14.12	Pass	
26144.1	40.64	17.11	11.26	69.01	Peak	V	147	232	83.5	-14.49	Pass	
23112.4	40.78	17.93	8.99	67.7	Peak	H	127	303	83.5	-15.8	Pass	

FORMAL DATA

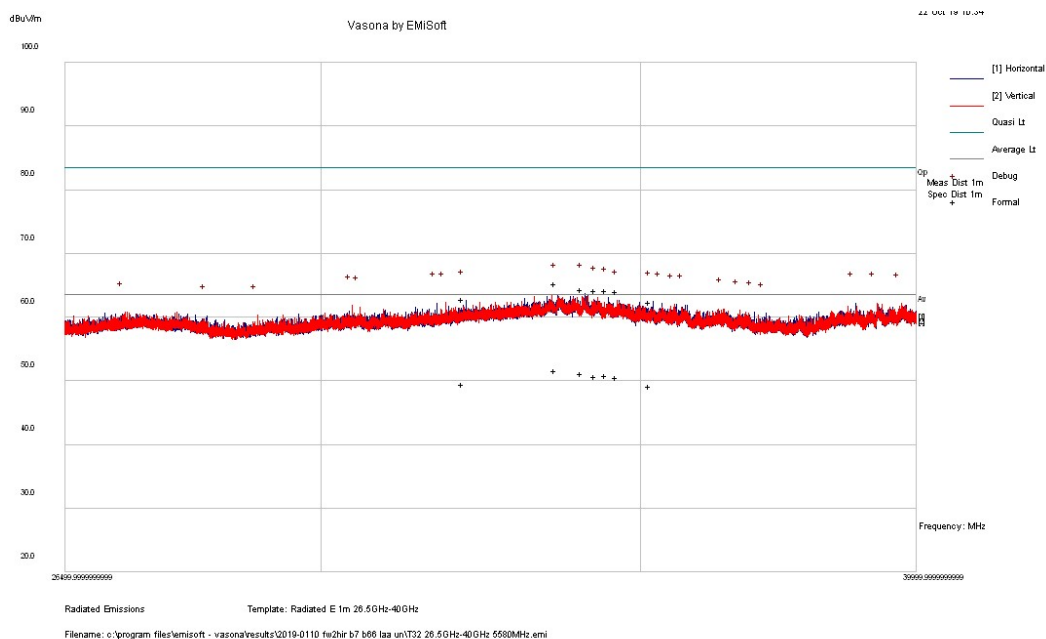
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
25437.8	39.12	17.59	10.38	67.08	Peak	H	110	286	83.5	-16.42	Pass	
24462.8	40.15	17.88	9.05	67.07	Peak	H	183	209	83.5	-16.43	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
25766.2	32.63	17.61	10.64	60.89	Preview	V	200	22	63.5	-2.61	Pass	
24458.9	33.85	17.88	9.04	60.77	Debug	V	100	358	63.5	-2.73	Pass	
24462.8	33.71	17.88	9.05	60.64	Debug	H	100	358	63.5	-2.86	Pass	
26144.1	31.77	17.11	11.26	60.14	Debug	V	100	358	63.5	-3.36	Pass	
25437.8	32.05	17.59	10.38	60.01	Debug	H	100	358	63.5	-3.49	Pass	
23112.4	32.37	17.93	8.99	59.29	Debug	H	100	358	63.5	-4.21	Pass	

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

Spurious_TM3.1_1C_20MBW_5700 26.5-40GHz



Results Title: Radiated E 1m 26.5GHz-40GHz
File Name: c:\program files\emisoft - vasona\results\2019-0110 fw2hir b7 b66 laa un\T32 26.5GHz-40GHz 5580MHz.emi
Test Laboratory: GPCL AR5-MH 24C, 31%RH, 993mB

Test Engineer: GM
Test Software: Vasona by EMISoft, version 2.161
Equipment: Nokia
EUT Details: 2019-0110. FW2HIR B7/B66 LAA UNII-2 wDFS -IC with FA2WA; 5700MHz 1 Carrier; 20dBm per port; ETM3.1, 20MHz BW; 120V AC.
Configuration: RE 26.5GHz-40GHz ESI E954, Peak RBW=1MHz, VBW=3MHz, Formal RBW 1MHz, VBW 3MHz, Int. Att. 0dB, PA E1387, Horn Ant E520, HPF E1376
Date: 2019-10-22 10:34:26

FORMAL DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
33630	36.14	13.06	-2.29	46.9	AvgMax	H	123	138	63.5	-16.6	Pass	NA
34069.6	35.92	13.13	-2.66	46.39	AvgMax	H	159	142	63.5	-17.11	Pass	NA
34466.7	36.6	13.15	-3.67	46.08	AvgMax	H	133	112	63.5	-17.42	Pass	NA
34289.9	36.07	13.14	-3.22	46	AvgMax	V	130	52	63.5	-17.5	Pass	NA
34648.3	36.67	13.19	-4.05	45.81	AvgMax	H	172	282	63.5	-17.69	Pass	NA
32166.4	34.77	12.64	-2.61	44.8	AvgMax	H	194	0	63.5	-18.7	Pass	NA
35210.9	36.26	13.29	-5.06	44.49	AvgMax	H	189	26	63.5	-19.01	Pass	NA
33630	49.76	13.06	-2.29	60.53	Peak	H	123	138	83.5	-22.97	Pass	
34069.6	49.18	13.13	-2.66	59.65	Peak	H	163	135	83.5	-23.85	Pass	
34289.9	49.52	13.14	-3.22	59.44	Peak	V	130	52	83.5	-24.06	Pass	
34466.7	49.92	13.15	-3.67	59.41	Peak	H	163	149	83.5	-24.09	Pass	
34648.3	50.15	13.19	-4.05	59.29	Peak	H	172	282	83.5	-24.21	Pass	
32166.4	48.11	12.64	-2.61	58.14	Peak	H	194	0	83.5	-25.36	Pass	
35210.9	49.45	13.29	-5.06	57.69	Peak	H	189	26	83.5	-25.81	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
34069.6	53.16	13.13	-2.66	63.63	Preview	H	102	75	63.5	0.13	Fail	
33630	52.82	13.06	-2.29	63.58	Preview	H	102	345	63.5	0.08	Fail	
34289.9	53.21	13.14	-3.22	63.14	Preview	V	200	75	63.5	-0.36	Pass	
34466.7	53.57	13.15	-3.67	63.05	Preview	H	102	120	63.5	-0.45	Pass	
34648.3	53.45	13.19	-4.05	62.6	Preview	H	102	75	63.5	-0.9	Pass	
32166.4	52.52	12.64	-2.61	62.55	Preview	H	102	240	63.5	-0.95	Pass	
35210.9	54.21	13.29	-5.06	62.44	Preview	H	102	30	63.5	-1.06	Pass	
31858.5	52.51	12.53	-2.77	62.27	Preview	V	102	315	63.5	-1.23	Pass	
38835.8	56.36	14	-8.13	62.23	Preview	H	102	210	63.5	-1.27	Pass	
35372.5	54.24	13.3	-5.31	62.22	Preview	H	102	315	63.5	-1.28	Pass	
39240.1	55.87	14.05	-7.7	62.22	Preview	V	200	30	63.5	-1.28	Pass	
31723.5	52.59	12.49	-2.86	62.21	Preview	H	200	180	63.5	-1.29	Pass	
39702.7	55.17	14.13	-7.17	62.14	Preview	V	102	150	63.5	-1.36	Pass	
35588.7	54.33	13.31	-5.67	61.97	Preview	V	102	352	63.5	-1.53	Pass	
35763.1	54.55	13.34	-6.01	61.88	Preview	H	102	345	63.5	-1.62	Pass	
30449.5	53.08	12.44	-3.72	61.81	Preview	V	200	75	63.5	-1.69	Pass	
30568.5	52.79	12.44	-3.63	61.6	Preview	V	200	135	63.5	-1.9	Pass	
36438.3	54.94	13.41	-7.05	61.3	Preview	V	200	345	63.5	-2.2	Pass	
36727.6	55.14	13.48	-7.55	61.07	Preview	V	102	255	63.5	-2.43	Pass	

PREVIEW DATA

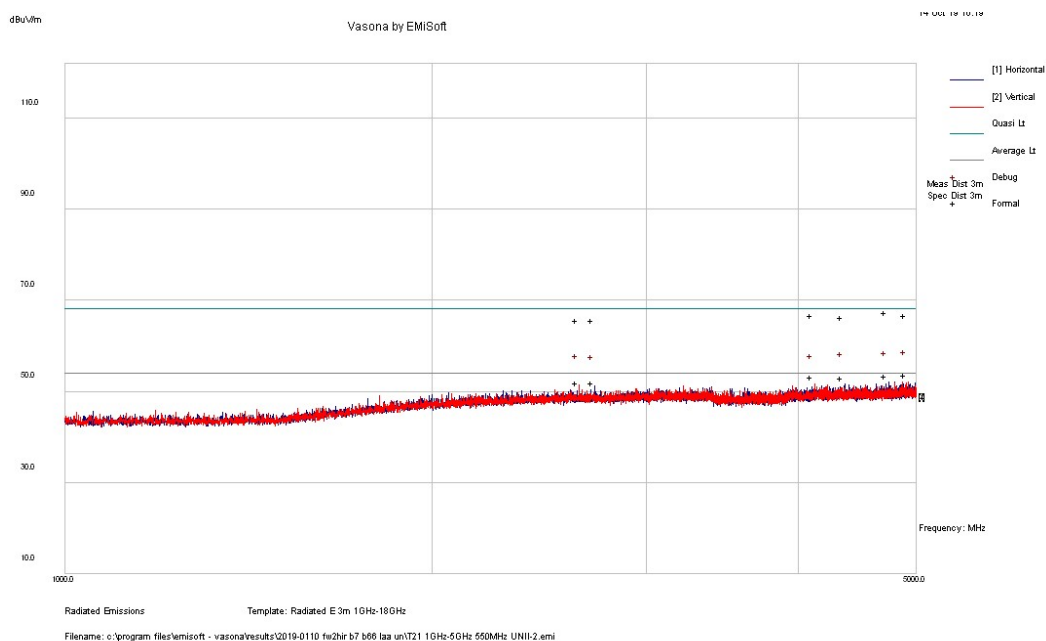
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
36981.6	55.28	13.56	-8.02	60.81	Preview	H	102	240	63.5	-2.69	Pass	
27280.4	52.72	11.79	-3.75	60.76	Preview	V	102	105	63.5	-2.74	Pass	
37189	55.12	13.6	-8.14	60.57	Preview	H	200	345	63.5	-2.93	Pass	
29092	52.1	11.96	-3.79	60.27	Preview	V	102	30	63.5	-3.23	Pass	
28392	52.22	11.7	-3.73	60.19	Preview	H	102	105	63.5	-3.31	Pass	

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

6.3 Radiated Spurious Emissions – Plots FA2RA Antenna #2

NOTES: 1) The full suite of raw data resides at the MH, New Jersey location. 2) “NA” (Not Applicable) in the tables of Formal Data below was due to the fact that only the unwanted emissions in the restricted band above 1GHz are subject to the average 54 dBuV/m limit per FCC 15.205 and 15.209.

Spurious_TM3.2_1C_20MBW_5500_19.5dBm, 1-5GHz



Results Title: Radiated E 3m 1GHz-18GHz
File Name: c:\program files\emisoft - vasona\results\2019-0110 fw2hir b7 b66 laa un\T21 1GHz-5GHz 550MHz UNII-2.emi
Test Laboratory: GPCL AR5-MH 23C, 44%RH, 999mB
Test Engineer: GM
Test Software: Vasona by EMISoft, version 2.161

Equipment: Nokia
EUT Details: 2019-0110. FW2HIR B7/B66 LAA UNII-2 wDFS -IC with FA2RA; 5500MHz 1 Carrier; 19.5dB Total; ETM3.2, 20MHz BW; 120V AC.
Configuration: RE 1GHz-5GHz ESI E954, Peak RBW=100KHz, VBW=3MHz, Formal RBW 1MHz, VBW 3MHz, Int. Att. 0dB, PA E447, Horn Ant E1073, 19dB (E175,176,177)
Date: 2019-10-14 16:19:47

FORMAL DATA

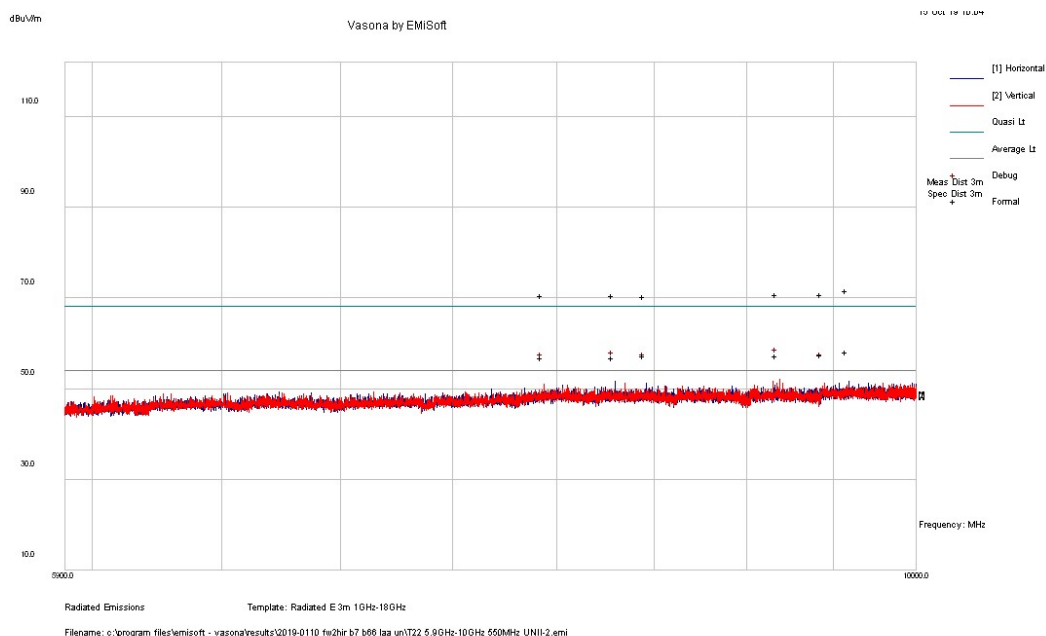
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
4920.55	27.3	23.64	-3.92	47.02	AvgMax	V	268	40	54	-6.98	Pass	
4743.51	27.25	23.51	-4	46.76	AvgMax	H	215	219	54	-7.24	Pass	
4743.51	41.34	23.51	-4	60.85	Peak	H	215	219	68.2	-7.35	Pass	
4124.96	28.08	22.99	-4.47	46.6	AvgMax	V	337	242	54	-7.4	Pass	
4366.67	27.51	23.2	-4.24	46.48	AvgMax	H	364	51	54	-7.52	Pass	
4920.55	40.42	23.64	-3.92	60.14	Peak	V	268	40	68.2	-8.06	Pass	
4124.96	41.6	22.99	-4.47	60.12	Peak	V	337	242	68.2	-8.08	Pass	
4366.67	40.76	23.2	-4.24	59.72	Peak	H	364	51	68.2	-8.48	Pass	
2723.81	29.07	22.24	-5.93	45.38	AvgMax	H	262	127	54	-8.62	Pass	
2643.47	29.03	22.2	-5.96	45.27	AvgMax	V	103	242	54	-8.73	Pass	NA
2643.47	42.73	22.2	-5.96	58.97	Peak	V	100	243	68.2	-9.23	Pass	
2723.81	42.65	22.24	-5.93	58.96	Peak	H	262	127	68.2	-9.24	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
4920.55	32.43	23.64	-3.92	52.16	Preview	V	102	45	54	-1.84	Pass	
4743.51	32.55	23.51	-4	52.06	Debug	H	100	318	54	-1.94	Pass	
4366.67	32.76	23.2	-4.24	51.73	Debug	H	100	318	54	-2.27	Pass	
4124.96	32.88	22.99	-4.47	51.4	Debug	V	100	318	54	-2.6	Pass	
2643.47	35.05	22.2	-5.96	51.29	Debug	V	100	318	54	-2.71	Pass	
2723.81	34.84	22.24	-5.93	51.15	Debug	H	100	318	54	-2.85	Pass	

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

Spurious_TM3.2_1C_20MBW_5500_19.5dBm, 6-10GHz



Results Title: Radiated E 3m 1GHz-18GHz
File Name: c:\program files\emisoft - vasona\results\2019-0110 fw2hir b7 b66 laa un\T22 5.9GHz-10GHz 550MHz UNII-2.emi
Test Laboratory: GPCL AR5-MH 23C, 44%RH, 999mB
Test Engineer: GM
Test Software: Vasona by EMISoft, version 2.161
Equipment: Nokia
EUT Details: 2019-0110. FW2HIR B7/B66 LAA UNII-2 wDFS -IC with FA2RA; 5500MHz 1 Carrier; 19.5dB Total; ETM3.2, 20MHz BW; 120V AC.
Configuration: RE 5.9GHz-10GHz ESI E954, Peak RBW=30KHz, VBW=3MHz, Formal RBW 1MHz, VBW 3MHz, Int. Att. 0dB, PA E447, Horn Ant E1073, 19dB (E175,176,177)
Date: 2019-10-15 10:04:53

FORMAL DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
9590.22	28.04	25.86	-2.29	51.6	AvgMax	H	232	97	54	-2.4	Pass	NA
9443.73	27.38	25.92	-2.38	50.92	AvgMax	V	325	208	54	-3.08	Pass	
9590.22	41.51	25.86	-2.29	65.08	Peak	H	232	97	68.2	-3.12	Pass	
9185.3	27.05	26.01	-2.46	50.6	AvgMax	V	237	174	54	-3.4	Pass	
8458.38	27.4	25.9	-2.72	50.58	AvgMax	H	343	32	54	-3.42	Pass	
8298.33	27.2	25.85	-2.73	50.31	AvgMax	H	185	242	54	-3.69	Pass	
7941.59	27.27	25.66	-2.73	50.21	AvgMax	V	382	224	54	-3.79	Pass	NA
9443.73	40.75	25.92	-2.38	64.29	Peak	V	325	208	68.2	-3.91	Pass	
9185.3	40.56	26.01	-2.46	64.11	Peak	V	237	174	68.2	-4.09	Pass	
8298.33	40.9	25.85	-2.73	64.01	Peak	H	185	242	68.2	-4.19	Pass	

FORMAL DATA

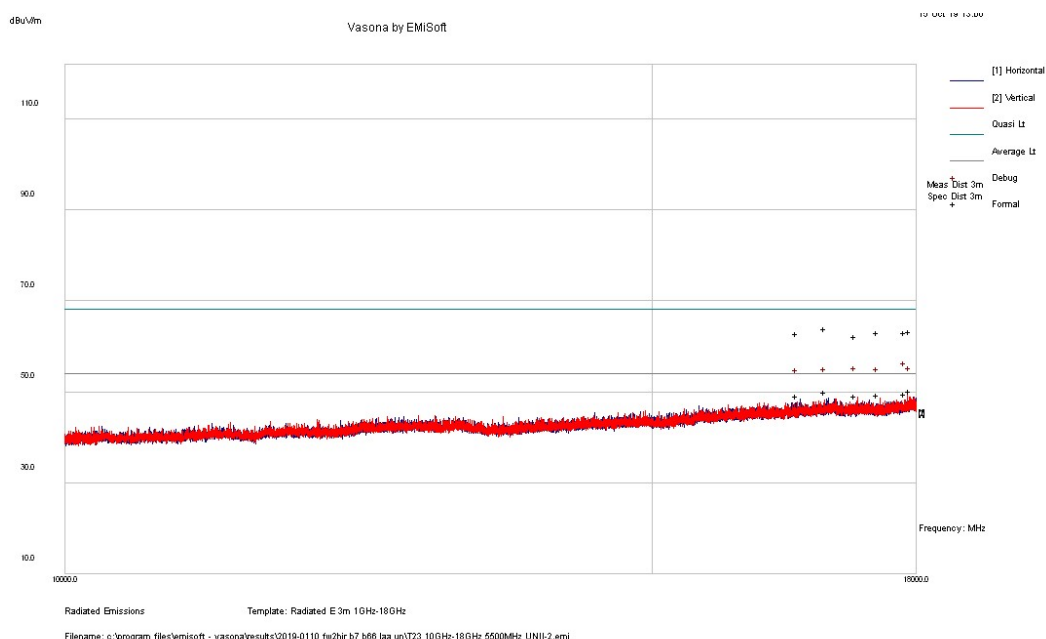
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
7941.59	40.99	25.66	-2.73	63.92	Peak	V	382	224	68.2	-4.28	Pass	
8458.38	40.64	25.9	-2.72	63.82	Peak	H	343	32	68.2	-4.38	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
9185.3	28.62	26.01	-2.46	52.17	Preview	V	202	180	54	-1.83	Pass	
8298.33	28.48	25.85	-2.73	51.6	Debug	H	100	229	54	-2.4	Pass	
9590.22	28.01	25.86	-2.29	51.58	Debug	H	100	229	54	-2.42	Pass	
9443.73	27.66	25.92	-2.38	51.2	Debug	V	100	229	54	-2.8	Pass	
8458.38	27.85	25.9	-2.72	51.03	Debug	H	100	229	54	-2.97	Pass	
7941.59	28.07	25.66	-2.73	51	Debug	V	100	229	54	-3	Pass	

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

Spurious_TM3.2_1C_20MBW_5500_19.5dBm, 10-18GHz



Results Title: Radiated E 3m 10Hz-18GHz
File Name: c:\program files\emisoft - vasona\results\2019-0110 fw2hir b7 b66 laa un\T23 10GHz-18GHz 5500MHz UNII-2.emi
Test Laboratory: GPCL AR5-MH 23C, 37%RH, 1004mB
Test Engineer: GM
Test Software: Vasona by EMISoft, version 2.161
Equipment: Nokia
EUT Details: 2019-0110. FW2HIR B7/B66 LAA UNII-2 wDFS -IC with FA2RA; 5500MHz 1 Carrier; 19.5dB Total; ETM3.2, 20MHz BW; 120V AC.
Configuration: RE 10GHz-18GHz ESI E954, Peak RBW=100KHz, VBW=3MHz, Formal RBW 1MHz, VBW 3MHz, Int. Att. 0dB, PA E447, Horn Ant E1073, HPF E1212
Date: 2019-10-15 13:06:26

FORMAL DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
17957	28.03	10.66	4.81	43.5	AvgMax	H	306	360	54	-10.5	Pass	
16937.4	28.47	10.21	4.68	43.35	AvgMax	H	290	344	54	-10.65	Pass	NA
16937.4	42.36	10.21	4.68	57.25	Peak	H	290	344	68.2	-10.95	Pass	
17889.2	27.65	10.63	4.73	43.01	Average	V	380	212	54	-10.99	Pass	
17557.6	27.89	10.48	4.3	42.66	AvgMax	V	324	121	54	-11.34	Pass	NA
17286.4	27.8	10.35	4.47	42.62	AvgMax	V	330	354	54	-11.38	Pass	NA
16606.4	28.41	10.13	4.01	42.55	AvgMax	H	117	173	54	-11.45	Pass	NA
17957	41.14	10.66	4.81	56.61	Peak	H	302	360	68.2	-11.59	Pass	
17889.2	41.17	10.63	4.73	56.53	Peak	V	376	205	68.2	-11.67	Pass	
17557.6	41.67	10.48	4.3	56.44	Peak	V	324	121	68.2	-11.76	Pass	
16606.4	42.16	10.13	4.01	56.29	Peak	H	117	173	68.2	-11.91	Pass	

FORMAL DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
17286.4	40.87	10.35	4.47	55.7	Peak	V	330	354	68.2	-12.5	Pass	

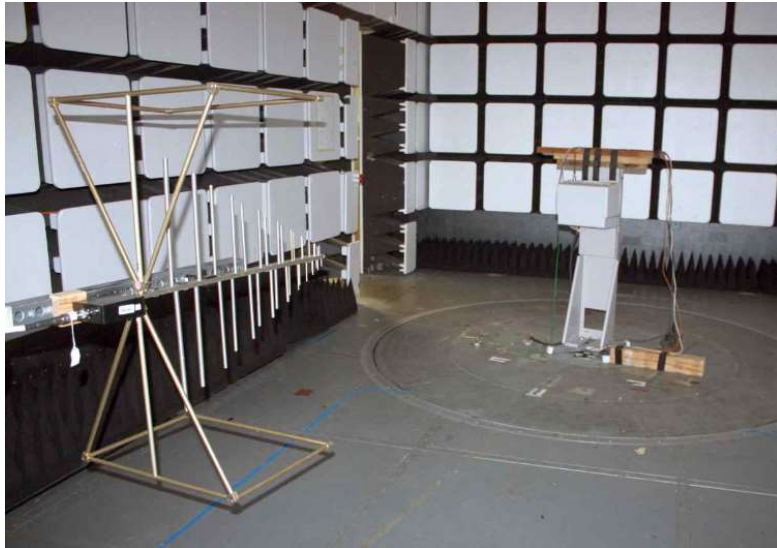
**PREVIEW
DATA**

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail	Comments
17889.2	34.4	10.63	4.73	49.76	Preview	V	102	315	54	-4.24	Pass	
17957	33.31	10.66	4.81	48.79	Debug	H	100	321	54	-5.21	Pass	
17286.4	33.92	10.35	4.47	48.74	Debug	V	100	321	54	-5.26	Pass	
16937.4	33.71	10.21	4.68	48.6	Debug	H	100	321	54	-5.4	Pass	
17557.6	33.7	10.48	4.3	48.48	Debug	V	100	321	54	-5.52	Pass	
16606.4	34.18	10.13	4.01	48.32	Debug	H	100	321	54	-5.68	Pass	

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

Photographs

FA2WA:



FA2RA:



Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due	Calibration Type
E520	EMC Test Systems	Horn Antenna	Double Ridged Horn 18-40 GHz	3116	2537	2018-08-09	2020-08-09	Requires Calibration
E513	EMC Test Systems	Horn Antenna	Double Ridged Horn 18-40 GHz	3116	2539	2019-08-26	2021-08-26	Requires Calibration
E1073	ETS Lindgren	Horn Antenna	Double-Ridged Waveguide Horn 1-18 GHz	3117	00135198	2019-08-22	2021-08-22	Requires Calibration
E447	Hewlett Packard	Pre-Amplifier	Preamplifier 1-26.5 GHz	8449B	3008A01384	2018-04-10	2020-04-10	Requires Calibration
E1387	Miteq	Pre-Amplifier	18 GHz-40 GHz, 45dBm	TTA1840-35-HG	2034	2018-08-08	2020-08-08	Requires Calibration
E1212	RLC Electronics Inc	High Pass Filter	High Pass Filter 10-30 GHz	F-19414	1444002			Calibration Not Required, Must Be Verified
E1376	Reactel, Inc.	High Pass Filter	18 to 40 GHz	7HSX-18G/40G-K11	18-11			Calibration Not Required, Must Be Verified
E954	Rohde & Schwarz	Test Receiver	EMI 20Hz - 40GHz - 155 dBm +30 dBm	ESU40	100246	2018-09-11	2020-09-11	Requires Calibration

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due	Calibration Type
E602	A.H. Systems Inc.	Biological Antenna	25 - 2000 MHz	SAS-521-2	410	2019-02-11	2021-02-11	Requires Calibration
E1119	Extech	Data Logger	Pressure Humidity Temp data logger	SD700	Q668960	2018-12-10	2020-12-10	Requires Calibration
E507	Sonoma Instrument Co.	Amplifier	9KHz-1GHz	310	185794	2018-08-14	2020-08-14	Requires Calibration
E177	Weinschel	Attenuator	10 dB, 18GHz 2 watt	2-10	BC0304	2018-06-26	2020-06-26	Requires Calibration
E175	Weinschel	Attenuator	3 dB, 2 Watt	2-3	BC0243	2018-05-23	2020-05-23	Requires Calibration
E176	Weinschel	Attenuator	6 dB, 2 Watt DC-12.5 GHz	2-6	BC0255	2018-06-29	2020-06-29	Requires Calibration

7 FCC 15.407 (b)(6), 15.207 & 15.107 – AC Power Line Conducted Emissions

The requirements for AC Power Line conducted emissions are provided in Section 1.4.1 and provided in Table below.

Table 7.1. AC Power Line Conducted Emissions Limits
(RSS-GEN Table 4, ICES-003/FCC 15.107 Class B, and 15.207)

Frequency (MHz)	Conducted Limit (dBµV)		RBW
	Quasi-Peak	Average	
0.15 – 0.5	66 – 56*	56 – 46*	9 kHz
0.5 – 5.0	56	46	
5.0 – 30.0	60	50	

*Decreases with the logarithm of the frequency.

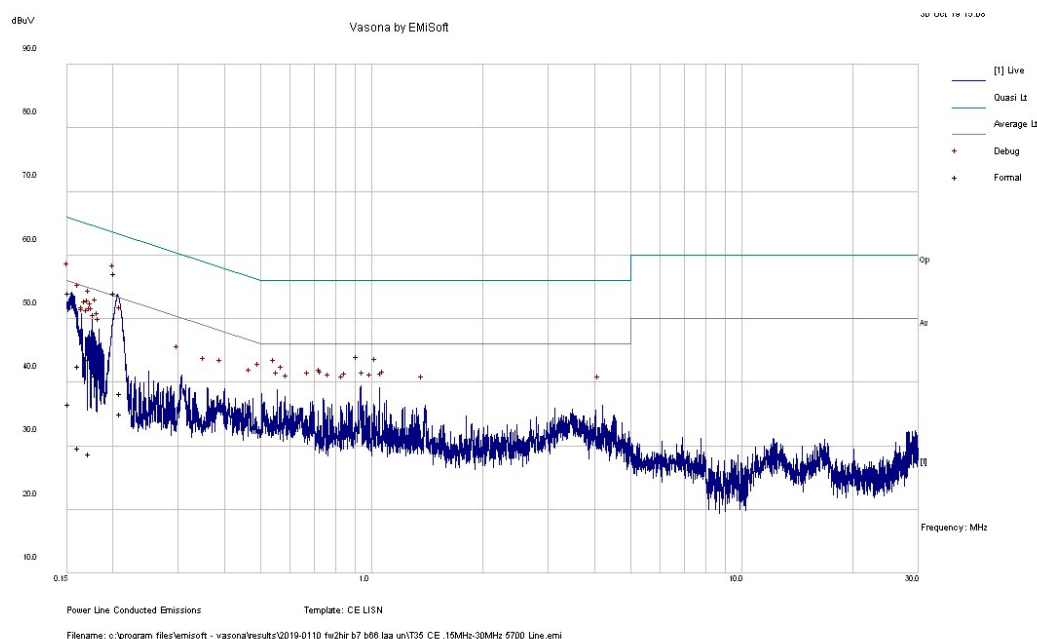
The AC power line conducted emissions of the EUT with FA2WA antenna which has the highest power output were evaluated with one 1x20MHz Q/16QAM carrier transmitting at 5700MHz at the maximum power level, 18dBm, at both ports.

The recommendations of ANSI C63.10 were followed for EUT testing setup and cabling.

The conducted emissions were measured at both AC power leads. The AC power line conducted emissions measured in the frequency spectrum 150kHz to 30MHz were all below the above requirements. The EUT is in full compliance with the regulatory requirements for both intentional radiators and unintentional radiators.

7.1 AC Power Line Conducted Emissions – Plot with FA2WA Antenna

Conducted Emissions on AC Main Power Lead L1



Results Title: CE LISN
File Name: c:\program files\emisoft - vasona\results\2019-0110 fw2hir b7 b66 laa un\T35 CE .15MHz-30MHz 5700 Line.emi
Test Laboratory: GPCL AR5-MH 23C, 46%RH, 1007mB
Test Engineer: GM
Test Software: Vasona by EMISoft, version 2.161
Equipment: Nokia
EUT Details: 2019-0110. FW2HIR B7/B66 LAA UNII-2 wDFS -IC with FA2WA; 5700MHz 1 Carrier; 18dB per port; ETM3.2, 20MHz BW; 120V AC.
Configuration: CE 150KHz-30MHz, Peak RBW=10KHz, VBW=30KHz, Formal RBW=10KHz, VBW=30KHz, Int. Att. 10dB, ESU E954, 20dB pad E1114, Ant E620, Line under test: Line
Date: 2019-10-30 15:08:38

FORMAL DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV)	Emission Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail	Comments
0.206	29.79	19.65	-0.07	49.37	Average	Line	53.37	-4	Pass	
0.206	32.79	19.65	-0.07	52.37	Quasi Peak	Line	63.37	-11	Pass	
0.155	29.84	19.63	-0.09	49.37	Quasi Peak	Line	65.73	-16.36	Pass	
0.184	16.78	19.64	-0.08	36.34	Average	Line	54.3	-17.96	Pass	
0.214	10.76	19.65	-0.07	30.34	Average	Line	53.05	-22.71	Pass	
0.155	12.39	19.63	-0.09	31.92	Average	Line	55.73	-23.81	Pass	
0.176	19.38	19.64	-0.08	38.93	Quasi Peak	Line	64.67	-25.74	Pass	

FORMAL DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV)	Emission Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail	Comments
0.165	18.34	19.63	-0.09	37.88	Quasi Peak	Line	65.21	-27.33	Pass	
0.184	16.78	19.64	-0.08	36.34	Quasi Peak	Line	64.3	-27.96	Pass	
0.214	13.89	19.65	-0.07	33.48	Quasi Peak	Line	63.05	-29.57	Pass	
0.165	5.35	19.63	-0.09	24.89	Average	Line	55.21	-30.32	Pass	
0.176	4.46	19.64	-0.08	24.01	Average	Line	54.67	-30.66	Pass	

PREVIEW DATA

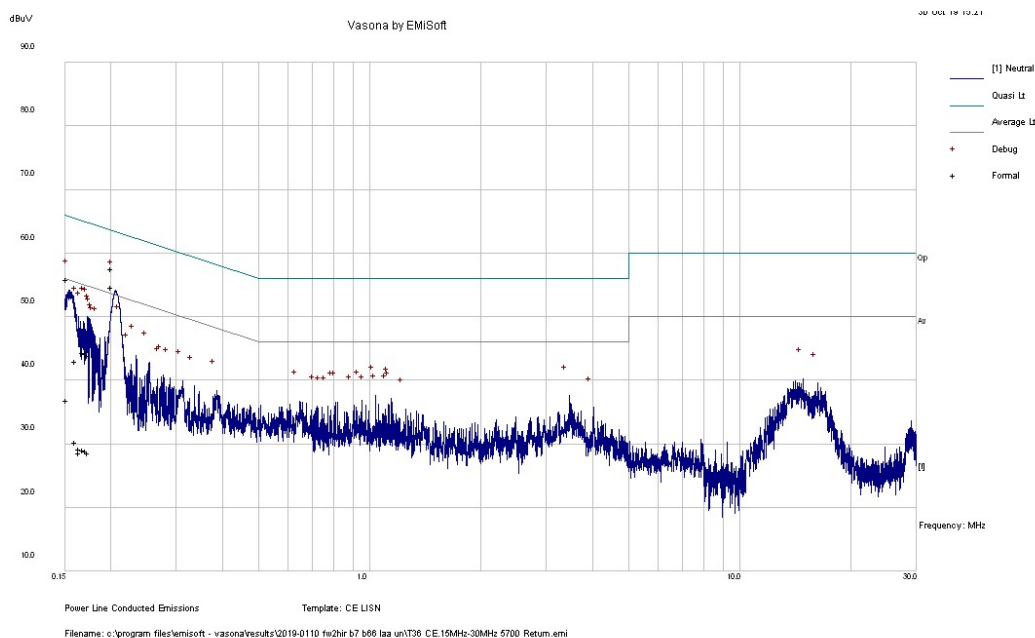
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV)	Emission Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail	Comments
0.205	34.21	19.65	-0.07	53.79	Preview	Line	53.41	0.39	Fail	
0.15442	34.58	19.63	-0.1	54.11	Preview	Line	55.76	-1.65	Pass	
0.16433	31.19	19.63	-0.09	50.73	Preview	Line	55.24	-4.51	Pass	
0.17574	30.31	19.64	-0.08	49.86	Preview	Line	54.68	-4.82	Pass	
0.21385	27.56	19.65	-0.07	47.14	Preview	Line	53.05	-5.91	Pass	
0.1834	28.79	19.64	-0.08	48.35	Preview	Line	54.33	-5.98	Pass	
0.17481	28.63	19.64	-0.09	48.18	Preview	Line	54.73	-6.55	Pass	
0.93282	19.67	19.78	-0.04	39.41	Preview	Line	46	-6.59	Pass	
0.17215	28.5	19.64	-0.09	48.04	Preview	Line	54.86	-6.81	Pass	
0.17785	28.22	19.64	-0.08	47.77	Preview	Line	54.59	-6.81	Pass	
1.04769	19.35	19.79	-0.04	39.1	Preview	Line	46	-6.9	Pass	
0.55539	19.21	19.74	-0.05	38.9	Preview	Line	46	-7.1	Pass	
0.1791	27.49	19.64	-0.08	47.04	Preview	Line	54.53	-7.48	Pass	
0.17692	27.46	19.64	-0.08	47.01	Preview	Line	54.63	-7.62	Pass	
0.50513	18.6	19.73	-0.05	38.28	Preview	Line	46	-7.72	Pass	
0.1683	27.58	19.63	-0.09	47.12	Preview	Line	55.04	-7.92	Pass	
0.18564	26.63	19.64	-0.08	46.2	Preview	Line	54.23	-8.03	Pass	
0.17362	27.15	19.64	-0.09	46.7	Preview	Line	54.79	-8.08	Pass	
0.16914	27.37	19.63	-0.09	46.92	Preview	Line	55	-8.08	Pass	
0.58308	18.13	19.74	-0.04	37.83	Preview	Line	46	-8.17	Pass	
0.1816	26.32	19.64	-0.08	45.88	Preview	Line	54.41	-8.53	Pass	
0.73949	17.66	19.76	-0.04	37.38	Preview	Line	46	-8.62	Pass	
0.18699	25.75	19.64	-0.08	45.31	Preview	Line	54.17	-8.85	Pass	
0.39923	19.31	19.71	-0.05	38.97	Preview	Line	47.87	-8.9	Pass	
0.74256	17.37	19.76	-0.04	37.09	Preview	Line	46	-8.91	Pass	
1.0959	17.33	19.8	-0.04	37.09	Preview	Line	46	-8.91	Pass	
0.47744	17.75	19.72	-0.05	37.42	Preview	Line	46.38	-8.96	Pass	
0.3059	21.44	19.68	-0.06	41.06	Preview	Line	50.08	-9.02	Pass	
0.56718	17.28	19.74	-0.05	36.98	Preview	Line	46	-9.02	Pass	
0.69026	17.25	19.75	-0.04	36.97	Preview	Line	46	-9.03	Pass	
0.96667	17.21	19.78	-0.04	36.95	Preview	Line	46	-9.05	Pass	
0.86615	17.04	19.77	-0.04	36.78	Preview	Line	46	-9.22	Pass	
1.08256	16.99	19.79	-0.04	36.74	Preview	Line	46	-9.26	Pass	
1.01385	16.84	19.79	-0.04	36.59	Preview	Line	46	-9.41	Pass	
0.78	16.84	19.77	-0.04	36.57	Preview	Line	46	-9.43	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV)	Emission Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail	Comments
0.60154	16.76	19.74	-0.04	36.46	Preview	Line	46	-9.54	Pass	
0.36	19.53	19.7	-0.05	39.18	Preview	Line	48.73	-9.55	Pass	
4.18923	16.5	19.93	-0.06	36.37	Preview	Line	46	-9.63	Pass	
0.85282	16.61	19.77	-0.04	36.35	Preview	Line	46	-9.65	Pass	
1.39846	16.54	19.82	-0.04	36.32	Preview	Line	46	-9.68	Pass	

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

Conducted Emissions on AC Main Lead L2



Results Title: CE LISN
File Name: c:\program files\emisoft - vasona\results\2019-0110 fw2hir b7 b66 laa un\T36 CE.15MHz-30MHz 5700 Return.emi
Test Laboratory: GPCL AR5-MH 23C, 46%RH, 1007mB
Test Engineer: GM
Test Software: Vasona by EMISoft, version 2.161
Equipment: Nokia
EUT Details: 2019-0110. FW2HIR B7/B66 LAA UNII-2 wDFS -IC with FA2WA; 5700MHz 1 Carrier; 18dB per port; ETM3.2, 20MHz BW; 120V AC.
Configuration: CE 150KHz-30MHz, Peak RBW=10KHz, VBW=30KHz, Formal RBW=10KHz, VBW=30KHz, Int. Att. 10dB, ESU E954, 20dB pad E1114, Ant E620, Line under test: Return
Date: 2019-10-30 15:21:15

FORMAL DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV)	Emission Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail	Comments
0.205	30.34	19.65	-0.07	49.92	Average	Return	53.41	-3.49	Pass	
0.205	33.32	19.65	-0.07	52.9	Quasi Peak	Return	63.41	-10.5	Pass	
0.15495	31.59	19.63	-0.09	51.13	Quasi Peak	Return	65.73	-14.6	Pass	
0.15495	12.67	19.63	-0.09	32.2	Average	Return	55.73	-23.53	Pass	
0.17224	20.12	19.64	-0.09	39.67	Quasi Peak	Return	64.85	-25.18	Pass	
0.17471	19.9	19.64	-0.09	39.45	Quasi Peak	Return	64.73	-25.28	Pass	
0.17696	19.59	19.64	-0.08	39.14	Quasi Peak	Return	64.63	-25.49	Pass	
0.16333	18.78	19.63	-0.09	38.32	Quasi Peak	Return	65.29	-26.97	Pass	
0.16333	6.05	19.63	-0.09	25.59	Average	Return	55.29	-29.7	Pass	
0.16821	5	19.63	-0.09	24.54	Average	Return	55.05	-30.51	Pass	
0.17224	4.77	19.64	-0.09	24.31	Average	Return	54.85	-30.54	Pass	
0.17471	4.57	19.64	-0.09	24.13	Average	Return	54.73	-30.61	Pass	
0.17696	4.33	19.64	-0.08	23.89	Average	Return	54.63	-30.74	Pass	
0.16821	4.34	19.63	-0.09	23.89	Quasi Peak	Return	65.05	-41.16	Pass	

PREVIEW DATA

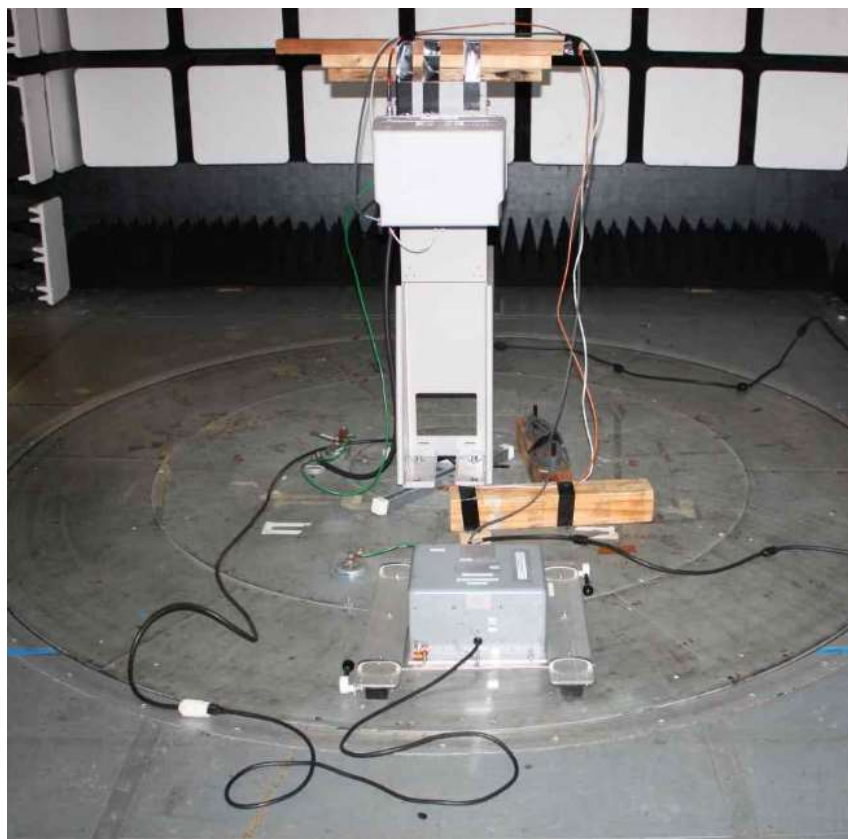
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV)	Emission Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail	Comments
0.20494	34.51	19.65	-0.07	54.09	Preview	Return	53.41	0.68	Fail	
0.15495	34.68	19.63	-0.09	54.22	Preview	Return	55.73	-1.51	Pass	
0.17224	30.45	19.64	-0.09	49.99	Preview	Return	54.85	-4.86	Pass	
0.17471	30.17	19.64	-0.09	49.72	Preview	Return	54.73	-5.01	Pass	
0.16333	30.46	19.63	-0.09	50	Preview	Return	55.29	-5.29	Pass	
0.17696	29.21	19.64	-0.08	48.76	Preview	Return	54.63	-5.87	Pass	
0.16821	29.63	19.63	-0.09	49.18	Preview	Return	55.05	-5.87	Pass	
0.21378	27.47	19.65	-0.07	47.05	Preview	Return	53.06	-6.01	Pass	
0.17782	28.7	19.64	-0.08	48.26	Preview	Return	54.59	-6.33	Pass	
0.17997	27.7	19.64	-0.08	47.26	Preview	Return	54.49	-7.23	Pass	
0.18622	27.14	19.64	-0.08	46.7	Preview	Return	54.2	-7.5	Pass	
0.18128	27.32	19.64	-0.08	46.88	Preview	Return	54.43	-7.55	Pass	
0.23397	24.29	19.66	-0.07	43.88	Preview	Return	52.31	-8.42	Pass	
3.45897	17.68	19.91	-0.05	37.55	Preview	Return	46	-8.45	Pass	
1.03846	17.78	19.79	-0.04	37.53	Preview	Return	46	-8.47	Pass	
0.25346	23.27	19.67	-0.07	42.87	Preview	Return	51.64	-8.77	Pass	
1.14	17.46	19.8	-0.04	37.22	Preview	Return	46	-8.78	Pass	
0.95128	17.06	19.78	-0.04	36.8	Preview	Return	46	-9.2	Pass	
0.64462	16.99	19.75	-0.04	36.7	Preview	Return	46	-9.3	Pass	
0.80667	16.86	19.77	-0.04	36.59	Preview	Return	46	-9.41	Pass	
0.81795	16.8	19.77	-0.04	36.53	Preview	Return	46	-9.47	Pass	
1.14718	16.77	19.8	-0.04	36.53	Preview	Return	46	-9.47	Pass	
14.8436	20.39	20.09	-0.23	40.25	Preview	Return	50	-9.75	Pass	
0.3859	18.71	19.7	-0.05	38.37	Preview	Return	48.15	-9.78	Pass	
1.12462	16.46	19.8	-0.04	36.22	Preview	Return	46	-9.78	Pass	
1.05385	16.46	19.79	-0.04	36.21	Preview	Return	46	-9.79	Pass	
0.9759	16.3	19.78	-0.04	36.04	Preview	Return	46	-9.96	Pass	

PREVIEW DATA

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV)	Emission Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail	Comments
0.90513	16.28	19.78	-0.04	36.02	Preview	Return	46	-9.98	Pass	
0.31256	20.28	19.69	-0.06	39.91	Preview	Return	49.9	-9.99	Pass	
0.71846	16.26	19.76	-0.04	35.98	Preview	Return	46	-10.02	Pass	
0.22615	22.93	19.66	-0.07	42.52	Preview	Return	52.59	-10.07	Pass	
0.27731	21.16	19.68	-0.06	40.77	Preview	Return	50.9	-10.13	Pass	
0.77128	16.14	19.76	-0.04	35.86	Preview	Return	46	-10.14	Pass	
0.74359	16.1	19.76	-0.04	35.82	Preview	Return	46	-10.18	Pass	
0.33564	19.46	19.69	-0.05	39.1	Preview	Return	49.31	-10.21	Pass	
0.28859	20.72	19.68	-0.06	40.34	Preview	Return	50.56	-10.23	Pass	
4.01692	15.83	19.93	-0.06	35.7	Preview	Return	46	-10.3	Pass	
16.2549	19.72	20.1	-0.26	39.56	Preview	Return	50	-10.44	Pass	
1.24872	15.76	19.81	-0.04	35.53	Preview	Return	46	-10.47	Pass	
0.27385	20.85	19.68	-0.07	40.46	Preview	Return	51	-10.54	Pass	

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

Photographs



Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due	Calibration Type
E1119	Extech	Data Logger	Pressure Humidity Temp data logger	SD700	Q668960	2018-12-10	2020-12-10	Requires Calibration
E1184	Extech	Micro-Ohmmeter	Miliohm Meter	380460	H273544	2019-08-06	2021-08-06	Requires Calibration
E284	Hewlett Packard	Signal Generator	Synthesized 9kHz-4GHz	8648D	3613A00296	2019-09-26	2021-09-26	Requires Calibration
E954	Rohde & Schwarz	Test Receiver	EMI 20Hz - 40GHz - 155 dBm +30 dBm	ESU40	100246	2018-09-11	2020-09-11	Requires Calibration
E590	Solar Electronics	LISN	50uH 0.25 uF	9348-50-R-24-BNC	018810	2019-04-23	2020-04-23	Requires Calibration
E1114	Weinschel	Attenuator	20dB 25W DC-18GHz	46-20-34	CB3197	2017-12-04	2019-12-04	Requires Calibration

8 TEST FACILITIES

All measurement facilities used to collect the measurement data under normal condition are located at 600-700 Mountain Avenue, Murray Hill, New Jersey 07974-0636 USA. The field strength measurements of radiated spurious emissions are made in an FCC and IC registered semi-anechoic chamber AR5 (FCC Site Registration Number: 515091, IC Filing Number: 6933F-5). The sites were constructed and are continuously in conformance with the requirements of ANSI C63.4 and CISPR Publication 32.

Nokia Global Product Compliance Laboratory is accredited with the US Department of Commerce National Institute of Standards and Technology's National Voluntary Laboratory Accreditation Program (NVLAP) for satisfactory compliance with criteria established in Title 15, Part 7 Code of Federal Regulations for offering test services for selected test methods in Electromagnetic Compatibility; Voluntary Control Council for Interference (VCCI), Japan; Australian Communications and Media Authority (ACMA). The laboratory is ISO 9001:2008 Certified.

