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TESTING
NVLAP LAB CODE: 100275-0

Title 47 Code of Federal Regulations Test Report

Regulation:
Title 47 CFR FCC Part 15C

Client:
NOKIA SOLUTIONS AND NETWORKS, OY

Product Evaluated:
Nokia Drone Networks Electric Drone with P632592 WiFi RF Module

Report Number:
TR-2023-0050-FCC15C

Date Issued:
October 31, 2023

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Revisions

Date	Revision	Section	Change
	0		Initial Release

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1. System Information and 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 Murray-Hill, NJ.

Equipment Under Test (EUT):	NDN Electric Drone P591013 with P632592 RF Module
Model Name(s):	NDN Electric Drone P591013 with P638893 & P632592 RF Modules, NDN Dual Gimbal P591015
Serial Number:	L1220703735 (NDN Electirc Drone, RE), L1220705351 (NDN Electirc Drone, Conducted), 2022DP6085 (P632592 WiFi Module)
FCC ID:	2BC99NDNUAV1
Hardware Version:	P632592
Software Version:	ndn-flight controller: 22.12.1; ndn-jetson-utilities: 23.03.0; ndn-services: 23.03.1
Frequency Bands:	2400-2483.5MHz WiFi: 20MHz 2412-2462MHz and 40MHz 2422-2452MHz; BT: 2402-2480MHz
GPCL Project Number:	2023-0050
Manufacturer:	Nokia Solutions and Networks, OY Karakaari 7, FI-02610 Espoo Finland
Applicant:	Nokia of America Corp 3201 Olympus Blvd Dallas, TX 75019
Test Requirement(s):	Title 47 CFR Part 15 Subpart C
Test Standards:	Refer to Section 1.6.1
Measurement Procedure(s):	Refer to Section 1.6.2
Test Date(s):	May 2023 – June 2023
Test Performed By:	Nokia Global Product Compliance Laboratory 600-700 Mountain Ave. P.O. Box 636 Murray Hill, NJ 07974-0636 Test Site Number: US5302
Product Engineer(s):	P. Sinisalo, J. Vuorio
Lead Engineer:	Q. Yu
Test Engineer (s):	J. Yadav, N. Albrecht, M. Soli
Test Results: The EUT, *as tested* met the above listed Test Requirements. The decision rule employed is binary (Pass/Fail) based on the measured values without accounting for Measurement Uncertainty or any Guard Band. The measured values obtained during testing were compared to a value given in the referenced regulation or normative standard. 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 **Nokia Drone Networks Electric Drone with P632592 RF WiFi Module**, hereinafter referred to as the Equipment Under Test (EUT).

1.2 Purpose and Scope

This document is to provide the testing data required for qualifying the EUT in compliance with FCC applicable rules measured in accordance with the procedures set out in Section 2.1033 (c) (17) of the Rules.

1.3 EUT Details

The Nokia Drone Networks (NDN) Electric Drone P591013 is equipped with two RF modules P638893 and one RF module P632592 for communication. The P632592 RF module supports 2.4GHz DTS (Digital Transmission Systems) with 802.11b/g/n Technologies and Bluetooth with Frequency Hopping Spread Spectrum (FHSS). RF modules P638893 supports both LTE and 5G NR technologies.

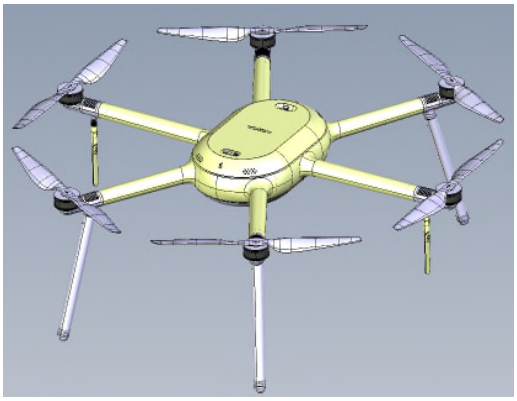
1.3.1 Specifications

Specification Items	**Description**
Product	NDN Electric Drone with P632592 RF Module
Radio Type	Intentional Transceiver
Power Type	Drone: Rechargeable Li-ion Battery 25.2 VDC/20 A
Modulation	WiFi: 802.11b: DSSS 802.11g/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) BT LE: FHSS: GFSK, π/4 DQPSK, 8DPSK
Operating Frequency Range	2400-2483.5MHz WiFi: 20MHz 2412-2462MHz and 40MHz 2422-2452MHz; BT: 2402-2480MHz
Channel Bandwidth	WiFi: 802.11b: 20 MHz 802.11g: 20 MHz 802.11n: 20/40 MHz
Maximum Conducted Power	WiFi: 0.071W (18.52 dBm); BT: 0.00687W (8.37dBm)
Operating Mode	1T1R
Antenna(s)	Refer to Section 1.3.2

1.3.2 Antenna Information.

The EUT has an integrated PCB antenna with a maximum antenna gain of 4.54 dBi.

1.3.3 Photographs



1.4 Test Requirements

The WiFi module P632592 has been FCC certified by the vendor on 2/28/2022 for 2.4 GHz Bluetooth and 2.4GHz DTS, respectively, as a single-modular transmitter in the frequency range of 2400-2483.5MHz in compliance with FCC Part 15 Subpart C rules. It supports 802.11b/g/n technologies with 20/40MHz bandwidths.

One P632592 WiFi module is installed in the NDN Electric Drone. The P632592 module has an integrated PCB antenna. See Section 1.3.2. There are no changes in P632592 WiFi module and its antenna. Therefore, the RF test results required and evaluated at the antenna ports in its original certification tests of P632592 module as a SA modular are still valid, except the radiated and EMC related tests due to the new host environment.

Only the following requirements at the selected channels were evaluated at the antenna ports for 2.4GHs DTS with a power level of 18.52dBm listed on FCC certificate in this report for verification purpose:

Table 1.4.1 Test Evaluated for FCC Part 15C 2.4GHz DTS Requirements

Description of Tests	47 CFR FCC Rules	Measurement Procedures	Test Required
Tx Maximum Output Power	15.247(b)(3)(4) & (c)(2)	ANSI C63.10 Section 11.9	Yes
Power Spectrum Density	15.247(e)	ANSI C63.10 Section 11.10	Yes
6 dB bandwidth Measurement (DTS BW)	15.247(a)(2)	ANSI C63.10 Section 11.8	Yes
Unwanted Out-of-Band Emissions in Non-Restricted Frequency Band	15.247(d)	ANSI C63.10 11.11	Yes
Unwanted Emissions in Non-Restricted Frequency Band	15.247(d), 15.33(a)	ANSI C63.10 11.11	Yes
Unwanted Emissions in Restricted Frequency Band	15.247(d), 15.209, 15.205	ANSI C63.10 11.12	Yes

The Electromagnetic Compatibility (EMC) test report identifies the final EMC tests performed on Nokia Drone system which consists of NDN Electric Drone with P632592 Wifi module, P638893 RF Module and NDN Docking Station.

1.5 Band Carrier Frequencies

Table 1.5.1 2.4GHz Frequency Channel Plan (FCC)

Channel No.	Freq (MHz)
1	2412
2	2417
3	2422
4	2427
5	2432
6	2437
7	2442
8	2447
9	2452
10	2457
11	2462

Table 1.5.2 2.4GHz Frequency Channels Tested for FCC Requirements

Channel No.	Freq (MHz)	Channel Bandwidth
1 (Low)	2412	20MHz
6 (Mid)	2437	
11 (High)	2462	
3 (1-5) (Low)	2422	40MHz
9 (7-11) (High)	2452	

1.6 Test Standards & Measurement Procedures

1.6.1 Test Standards

- Title 47 Code of Federal Regulations, Federal Communications Commission Parts 2, 15.
- FCC KDB 558074 D01 Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of The FCC Rules, v02, April 2, 2019.
- FCC KDB 996369 D01 Transmitter Module Equipment Authorization Guide, v03, October 24, 2023.
- FCC KDB 996369 D02 Frequently Asked Questions and Answers about Modules, v02, October 24, 2023.
- FCC KDB 996369 D04 Modular Transmitter Integration Guide — Guidance For Host Product Manufacturers v02, October 13, 2020.
- ANSI C63.10-2020, American Nation Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

1.6.2 Measurement Procedures

- FCC-IC-OB - GPCL Power Measurement, Occupied Bandwidth & Modulation Test Procedure 6-20-2019
- FCC-IC-SE - GPCL Spurious Emissions Test Procedure 6-20-2019

1.7 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. Classical Emissions, (*e.g.*, ANSI C63.4, CISPR 11, 14, 32, *etc.*, using ESHS 30,	Conducted Emissions	0.009 - 30	±3.5 dB
	Radiated Emissions (AR-6 Semi-Anechoic Chamber)	30 MHz – 200MHz H 30 MHz – 200 MHz V 200 MHz – 1000 MHz H 200 MHz – 1000 MHz V 1 GHz - 18 GHz	±5.1 dB ±5.1 dB ±4.7 dB ±4.7 dB ±3.3 dB

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

1.8 Executive Summary

Requirement 47 CFR FCC Parts 15 Subpart C	**Description of Tests**	**Result**
15.247(b)(3)(4) & (c)(2)	Tx Maximum Output Power	COMPLIES
15.247(e)	Power Spectrum Density	COMPLIES
15.247(a)(2)	6 dB bandwidth Measurement (DTS BW)	COMPLIES
15.247(d)	Unwanted Out-of-Band Emissions in Non-Restricted Frequency Band	COMPLIES
15.247(d), 15.33(a)	Unwanted Emissions in Non-Restricted Frequency Band	COMPLIES
15.247(d), 15.209, 15.205	Unwanted Emissions in Restricted Frequency Band	COMPLIES
15.215(c)	Measurement of Frequency Stability	NT
FCC Part 15B: 15.107, 15.109, 15.111, 15.33	EMI Power Line Conducted & Radiated Emissions, Rx Emissions[3]	COMPLIES

1. **COMPLIES -** Passed all applicable tests.
2. **NT –** Not Tested.
3. FCC Part 15B test results were presented in FCC EMC report (TR-2023-0050-FCC15B).

1.9 Test Configurations and Setup

The RF performance of the WiFi module installed in the host are to be verified for the following worst test cases:

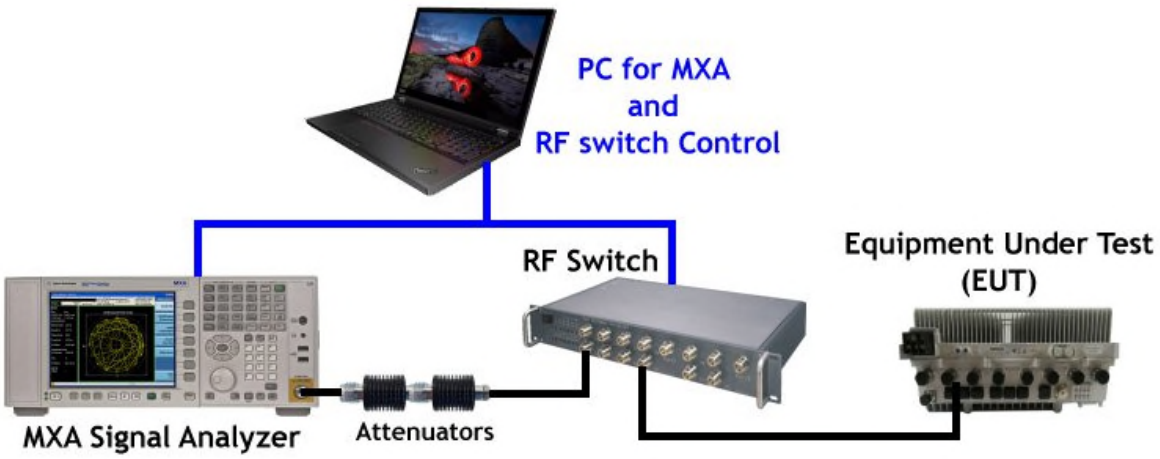
Table 1.9.1 Test Cases (Tx Power of UE = 18.52dBm)

Ch No/Freq (MHz)	Mode	Modulation	Bandwidth (MHz)	Data Rate (Mbps)*
2412	.11b - 1Tx	DSSS	22	1
	.11g - 1Tx	OFDM/CDD	20	6
	HT20-1Tx-1S	OFDM/CDD	20	MCS0
2437	.11b - 1Tx	DSSS	22	1
	.11g - 1Tx	OFDM/CDD	20	6
	HT20-1Tx-1S	OFDM/CDD	20	MCS0
2462	.11b - 1Tx	DSSS	22	1
	.11g - 1Tx	OFDM/CDD	20	6
	HT20-1Tx-1S	OFDM/CDD	20	MCS0
2422	HT40-1Tx-1S	OFDM/CDD	40	MCS0
2452	HT40-1Tx-1S	OFDM/CDD	40	MCS0

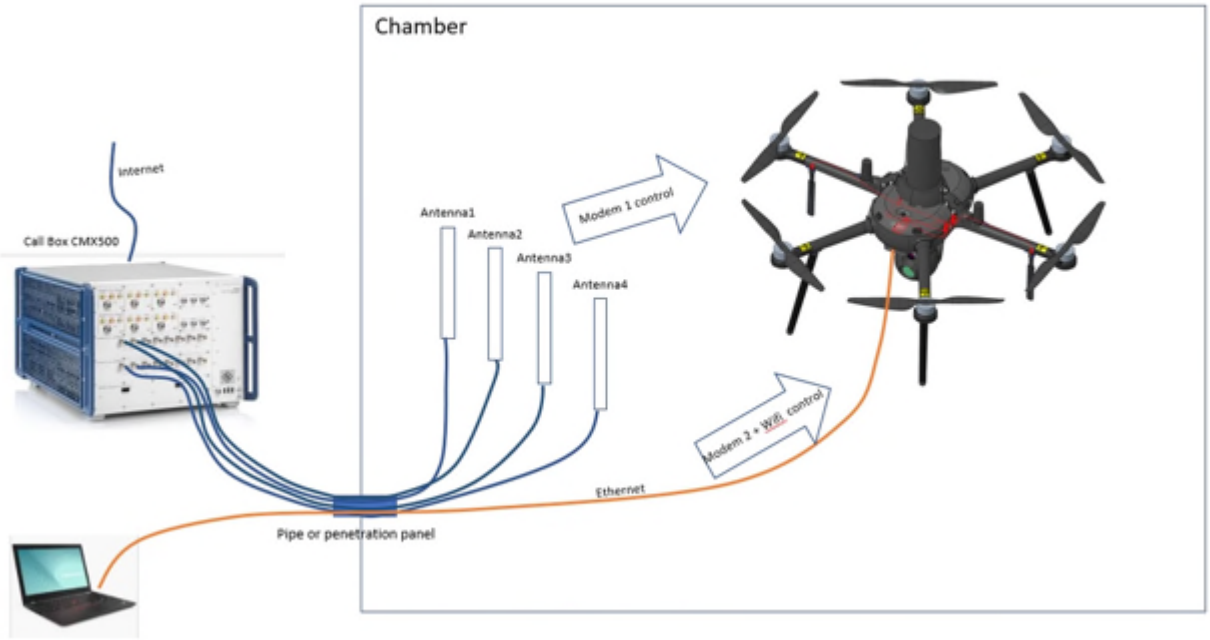
*Worst case for producing the highest output power.

The test setup diagrams are given below.

Test Setup for all Antenna Port Measurements



Radiated Test



2. FCC Section 15.247(b)(c) - RF Power Output

This test is a measurement of the total maximum RF power level transmitted at the antenna-transmitting terminals. The product was allowed to warm up and stabilize per ANSI C63.10.

The maximum conducted output power, which was supported and certified for the module, was measured at the antenna port(s) with the configurations and power levels given in Section 1.9. The measurement follows the procedures given in KDB 558074.

2.1 Limits

The 15.247(b)(c) specified the RF power output limit:

15.247(b)(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

15.247(b)(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

15.247(c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(iii) Fixed, point-to-point operation, as used in paragraphs (c)(1)(i) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

(2) In addition to the provisions in paragraphs (b)(1), (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams, simultaneously or

sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(i) Different information must be transmitted to each receiver.

(ii) If the transmitter employs an antenna system that emits multiple directional beams but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, *i.e.*, the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:

(A) The directional gain shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

(B) A lower value for the directional gain than that calculated in paragraph (c)(2)(ii)(A) of this section will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beamforming.

(iii) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the power limit specified in paragraph (c)(2)(ii) of this section. If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limit specified in paragraph (c)(2)(ii) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (c)(2)(ii) of this section by more than 8 dB.

(iv) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (c)(1) of this section.

The EUT has one antenna port and the maximum antenna gain is less than 6dBi. Therefore, the Maximum Conducted Average Output Power, i.e., the total transmit power delivered to all antennas and antenna elements averaged across all symbols is limited to 1W (30dBm) for the EUT.

2.2 Results

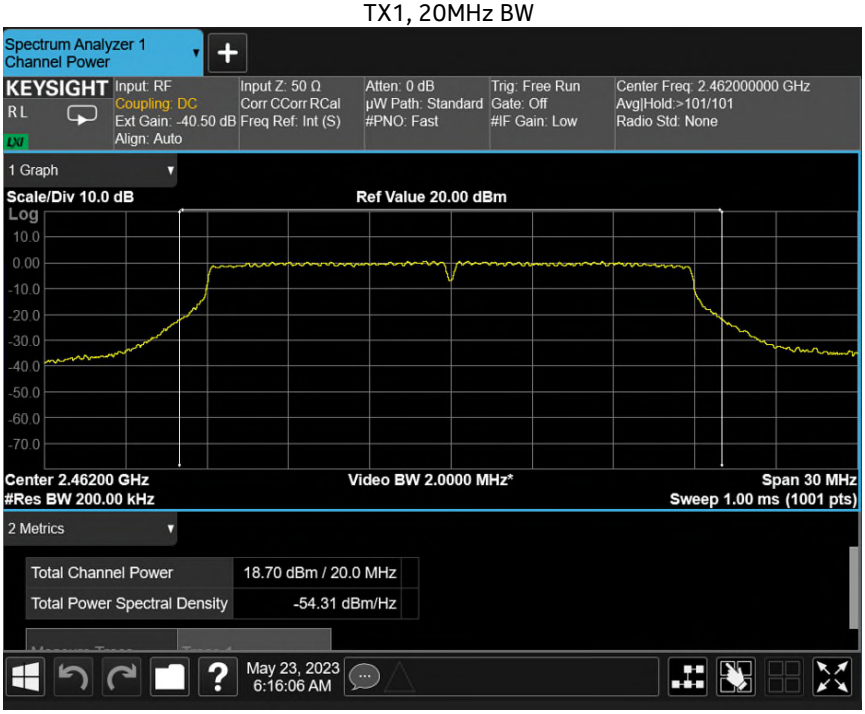
Power measurements of the LTE and NR transmit signal were conducted with an MXA Signal analyzer per KDB 558074 D01 using the gated RF Channel Power Function. The duty cycle is 100%.,

Table 2.1 Maximum Mean RF Power Output at Antenna Ports for 2.4GHz DTS Carriers

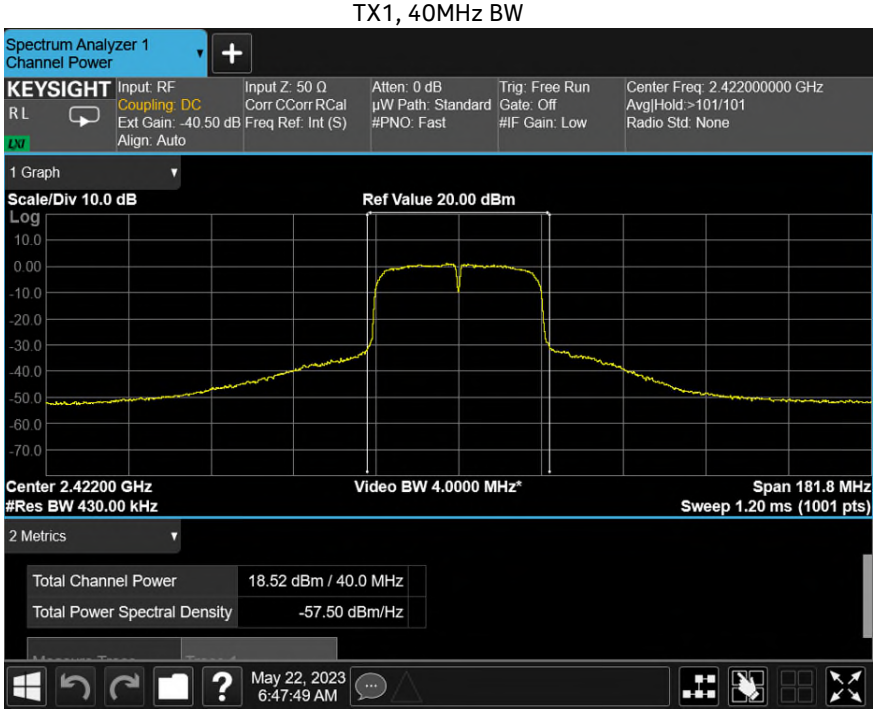
Bandwidth (MHz)	Ch No/ Freq (MHz)	Mode	Modulation	Data Rate (Mbps)	Power Measured (dBm)	Total Power Limit (dBm)	Results
20	2412	.11b - 1Tx	DSSS	1	18.69	30	Pass
		.11g - 2Tx	OFDM/CDD	6	18.61	30	Pass
		HT20-2Tx-1S	OFDM/CDD	MCS0	18.54	30	Pass
	2437	.11b - 1Tx	DSSS	1	18.53	30	Pass
		.11g - 2Tx	OFDM/CDD	6	18.69	30	Pass
		HT20-2Tx-1S	OFDM/CDD	MCS0	18.69	30	Pass
	2462	.11b - 1Tx	DSSS	1	18.47	30	Pass
		.11g - 2Tx	OFDM/CDD	6	18.47	30	Pass
		HT20-2Tx-1S	OFDM/CDD	MCS0	**18.70**	30	Pass
40	2422	HT40-1Tx-1S	OFDM/CDD	MCS0	**18.52**	30	Pass
	2452	HT40-1Tx-1S	OFDM/CDD	MCS0	18.26	30	Pass

2.2.1 Maximum RF Conducted Output Power Plots

RF Power - 1C LTE 18.70dBm
802.11n OFDM/CDD MCS0
Channel Frequency 2462 MHz
TX1, 20MHz BW



RF Power - 1C 5G-NR 18.52dBm
802.11n OFDM/CDD MCS0
Channel Frequency 2422 MHz
TX1, 40MHz BW



3. FCC Section 15.247(e) - 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.

3.1 Limits

FCC 15.247(e) specified that for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

The PPSD must be less than 8 dBm in any 3 kHz band segment within the DTS bandwidth during any time interval of continuous transmission. The peak conducted PSD shall be reduced by the amount in dB that the antenna gain exceeds 6 dBi.

Per KDB 558074 guidance, the same method as used to determine the conducted output power shall be used to determine the power spectral density (*i.e.,* if maximum peak conducted output power was measured then the peak PSD procedure shall be used and if maximum average conducted output power was measured then the average PSD procedure shall be used).

3.2 Results

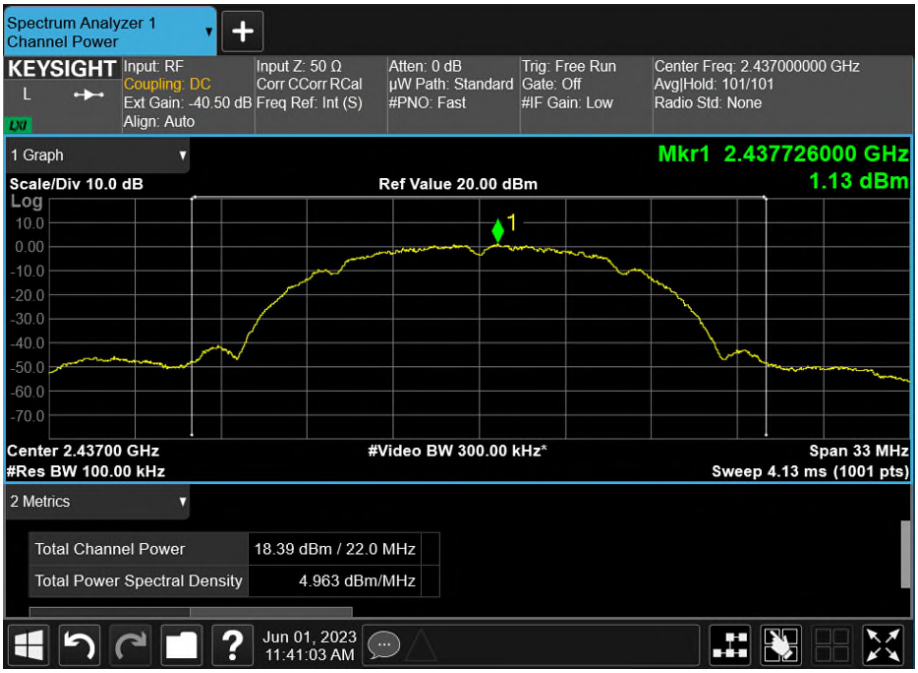
The PSD was measured at the antenna terminal with the configurations and power levels given in Table 1.9.1 for the middle channel. The measurement follows the procedures given in KDB 558074.

Table 3.1 PPSD Measured at Antenna Port for 2.4GHz DTS Carrier (Power Setting 18.5dBm)

Ch No/ Freq (MHz)	Mode	Modulation	Data Rate (Mbps)	BW (MHz)	PPSD Measured (dBm/100kHz)	PPSD Limit (dBm/3kHz)	Compliance
2437	.11b - 1Tx	DSSS	1	20	1.13	8.00	Yes
	.11g - 2Tx	OFDM/CDD	6		-1.60	8.00	Yes
	HT20-2Tx-1S	OFDM/CDD	MCS0		-1.81	8.00	Yes

3.2.1 Power Spectrum Density Plots

5G-NR 18.5 dBm
802.11b 1Mbps, DSSS
Channel Frequency 2437 MHz
20 MHz BW



4. FCC Section 15.247(a)(2) – Occupied Bandwidth

4.1 Limits

FCC 15.247(a)(2) specified that systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

4.2 Results

The 6dB DTS bandwidth was measured at the antenna port with the configurations and power levels given in Table 1.9.1 for the middle channel. The measurement follows the procedures given in KDB 558074. The automatic bandwidth measurement function of the spectrum analyzer, the X dB bandwidth mode, was utilized with X set to 6 dB, where the resolution bandwidth (RBW) is set to 100kHz and the video bandwidth (VBW) is set to 300kHz, and the peak detector with maximum hold and auto sweep was used.

The 6dB DTS bandwidth measured was in the range of 8.318-17.68 MHz for 20MHz carriers. The measured results are tabluated below. The plot which has the smallest emissions bandwidth are provided below.

Table 4.1 6dB Occupied Bandwidth

BW (MHz)	Ch No/ Freq (MHz)	Mode	Modulation	Data Rate (Mbps)	Power Setting (dBm)	6dB BW Measured (MHz)	6dB BW Limit	Compliance
20	2412	.11b - 1Tx	DSSS	1	18.52	8.318		Yes
	2437	.11g - 1Tx	OFDM/CDD	6		16.36	500kHz	Yes
	2462	HT20-1Tx-1S	OFDM/CDD	MCS0		17.68		Yes

4.2.1 6dB Occupied Bandwidth – Plots

Center Frequency 2412 MHz, 20MHz BW, 802.11b DSSS

5. FCC Section 15.247(d) – Out of Band Emissions in Non-Restricted Frequency Band

5.1 Limits

FCC 15.247(d) specified that in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a).

In other words, the out-of-band emissions in the non-restricted band must be 20dBc/100kHz below the maximum in-band peak PSD if the maximum peak conducted output power is used or 30dBc/100kHz below the maximum in-band average PSD if the maximum average conducted output power is used.

5.2 Results

The out-of-band emissions were measured per the measurement procedures provided by KDB 558074 guidance.

The maximum in-band PSD was measured first as the reference level, where RBW = 100 kHz, VBW = 300 kHz, span = 1.5 x DTS channel bandwidth and either RMS detector with average trace were used or peak detector. The maximum in-band PSD was determined by the peak search function. Then the limit line is 30dB below the maximum in-band RMS PSD value or 20dB below the maximum in-band peak value.

The out-of-band emissions at antenna terminals were investigated for the following configurations with the maximum power output. Over the required frequency spectrum investigated for the EUT, the measurement results demonstrate that the subject of the application is in full compliance with the Rules of the Commission.

The Edge of Band emissions of the EUT at the external antenna connector (EAC) were measured using a Keysight MXA Signal Analyzer. The RF power level was continuously measured using a RF broadband power meter. The RF output from the EAC port to signal analyzer was reduced (to an amplitude usable by the signal analyzer) by using a calibrated attenuator and test coupler. The path attenuation was offset on the display and the signal for the carrier was adjusted to the corrected RF power level for the resolution bandwidth used for the transmit signal.

The minimum margin is 2.4 dB for 20MHz carriers and 2.2dB for 40MHz carriers. The worst margin is near 2400MHz band edge. The plots of the band edge emissions with the minimum margins are provided below.

Table 5.1 Out-of-Band Emissions Measured at Antenna Port for 2.4GHz DTS Carriers

Bandwidth (MHz)	Ch No/ Freq (MHz)	Mode	Modulation	Data Rate (Mbps)
20	2412	.11b - 1Tx	DSSS	1
		.11g - 2Tx	OFDM/CDD	6
		HT20-2Tx-1S	OFDM/CDD	MCS0
	2437	.11b - 1Tx	DSSS	1
		.11g - 2Tx	OFDM/CDD	6
		HT20-2Tx-1S	OFDM/CDD	MCS0
	2462	.11b - 1Tx	DSSS	1
		.11g - 2Tx	OFDM/CDD	6
		HT20-2Tx-1S	OFDM/CDD	MCS0
40	2422	HT40-1Tx-1S	OFDM/CDD	MCS0
	2452	HT40-1Tx-1S	OFDM/CDD	MCS0

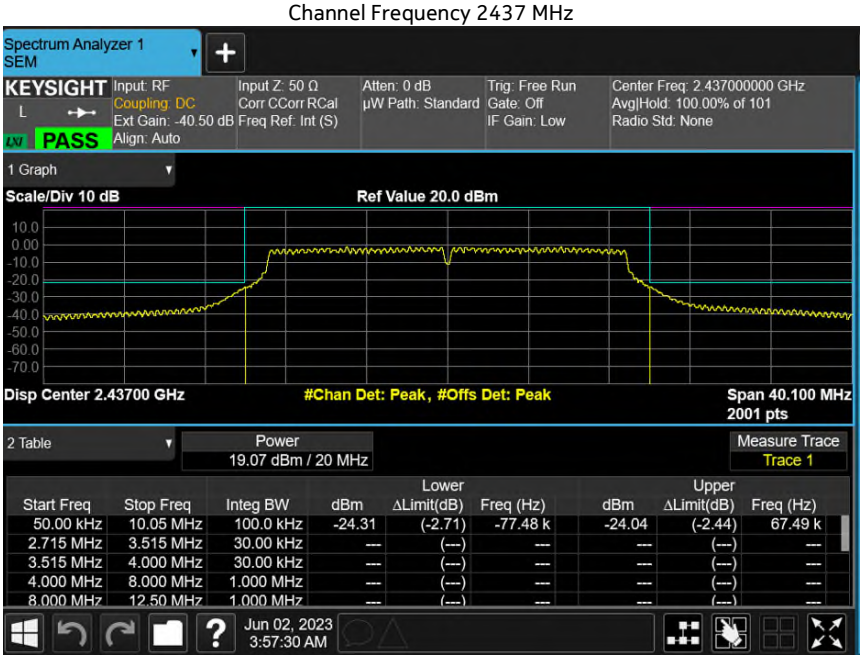
5.2.1 Edge of Band Emissions Plots

The minimum margin is 2.2dB. The out-of-band emissions measured met the FCC requirements.

Edge of Band Emission – 20MHz

802.11n OFDM/CDD, MCS0

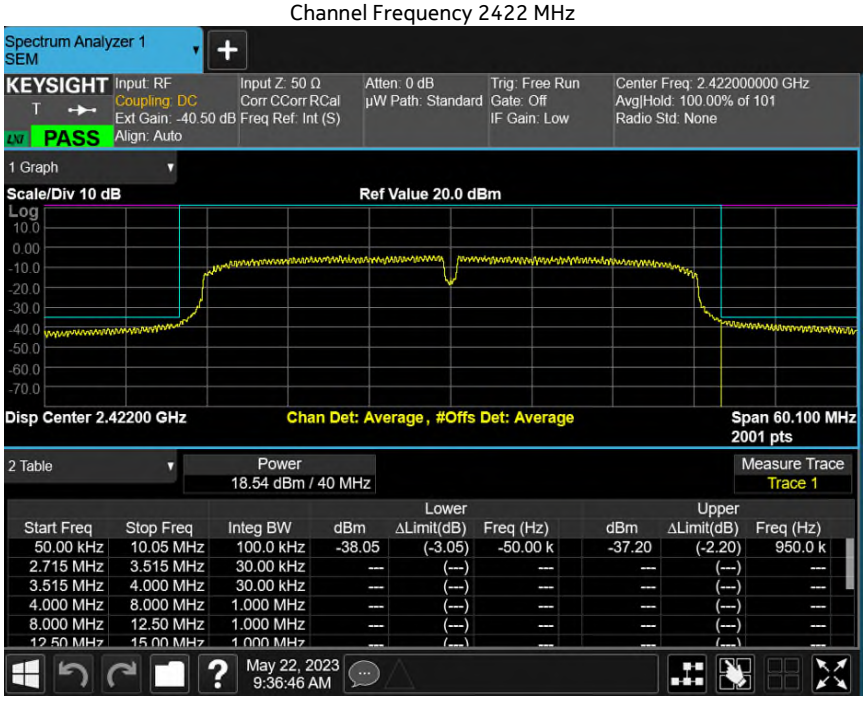
Channel Frequency 2437 MHz



Edge of Band Emission – 40MHz

802.11n OFDM/CDD, MCS0

Channel Frequency 2422 MHz



6. FCC Sections 15.247(d), 15.209 & 15.205 - Spurious Emissions at Transmit Antenna Port

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

6.1 Spurious Emissions in Non-Restricted Frequency Band at Transmit Antenna Port

6.1.1 Limits

As specified in Section 5.1, the spurious emissions in the non-restricted band must be 20dBc/100kHz below the maximum in-band peak PSD if the maximum conducted output power is measured with peak detector or 30dBc/100kHz below the maximum in-band average PSD if the maximum conducted output power is measured with average detector. The measurement can be either conducted or radiated.

6.1.2 Results

Spurious Emissions were investigated over the frequency range of 30 MHz to 25 GHz (the 10th harmonic of the carrier frequency) at the antenna terminals by using the conducted approach for the configurations listed in the following table. The measurement method was specified in ANSI C63.10 Section 11.11 and KDB 558074. The maximum in-band PSD was measured first as the *reference level*, where RBW = 100 kHz, VBW = 300 kHz, span = 1.5 x DTS channel bandwidth and RMS detector with average trace and maximum hold were used. The maximum in-band PSD was determined by the peak search function. Then the limit line is 30dB below the maximum in-band PSD value (reference level). Per ANSI C63.10 Section 11.11, *the channel found to contain the maximum PSD level can be used to establish the reference level*.

The spurious emissions have been evaluated at the following configurations:

Table 6.1.1 Spurious Emissions in the Non-Restricted Bands Measured at Antenna Port for 2.4GHz DTS Carriers

Bandwidth (MHz)	Ch No/ Freq (MHz)	Mode	Modulation	Data Rate (Mbps)
20	2412	.11b - 1Tx	DSSS	1
		.11g - 2Tx	OFDM/CDD	6
	2437	HT20-2Tx-1S	OFDM/CDD	MCS0
	2462	.11b - 1Tx	DSSS	1
		.11g - 2Tx	OFDM/CDD	6
40	2422	HT40-1Tx-1S	OFDM/CDD	MCS0
	2452	HT40-1Tx-1S	OFDM/CDD	MCS0

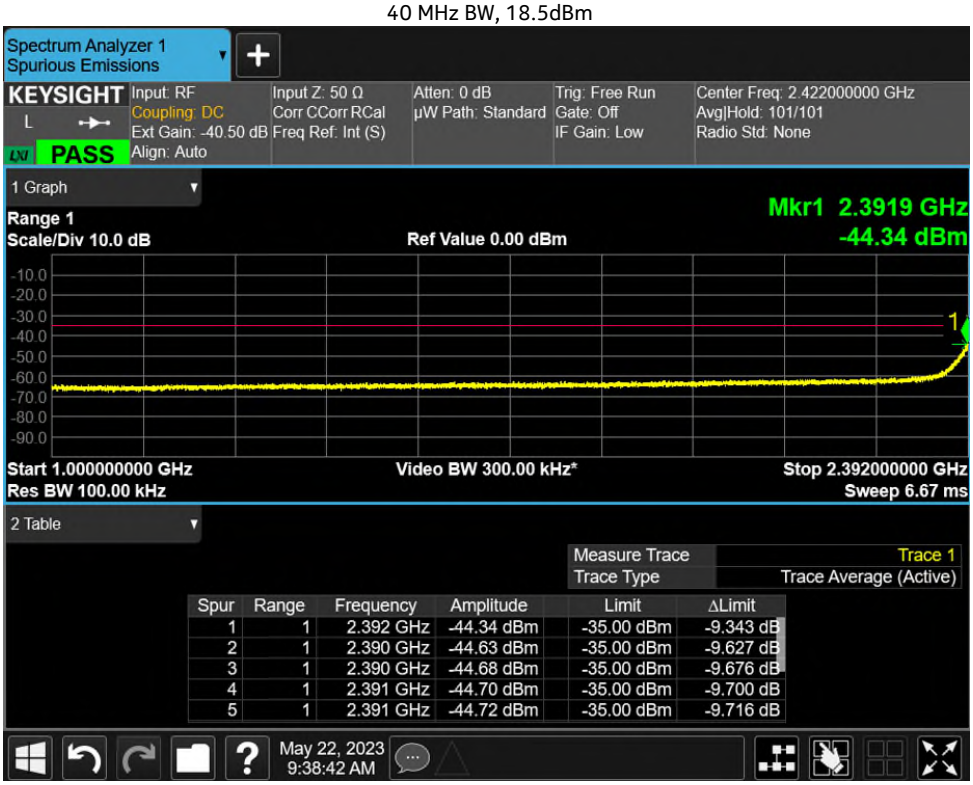
A low intermod broadband RF attenuator was used to reduce the transceiver's amplitude to a level usable by the spectrum analyzer. The test configuration is shown in Section 1.9 which documents the test set up used for the measurements. In this set up the complete RF test path was calibrated over the 30 MHz-25 GHz range. The measurement was performed in compliance with ANSI C63.10 and our ISO17025 process.

6.1.2.1 Spurious Emissions in Non-Restricted Bands Plots

NOTE: Only plots with lowest margin in each frequency range are used in this report. The full suite of raw data resides at the MH, New Jersey location.

The spurious emissions in the frequency range of 30MHz-1GHz and 10GHz- 25GHz have margins larger than 20dB for spurious emissions limits in the non-restricted bands and are not reportable. Therefore, only the spurious emissions in the frequency range of 1-10GHz are provided below.

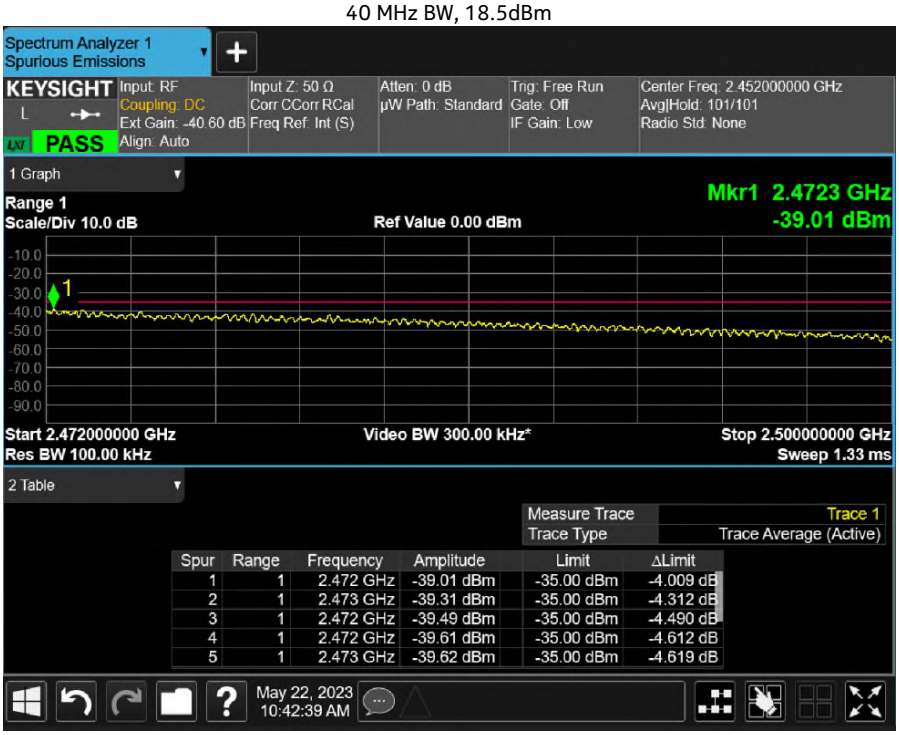
Spurious Emissions 1- 2.392GHz
802.11n 1Mbps, OFDM/CDD MCS0
Channel Frequency 2422 MHz
40 MHz BW, 18.5dBm



Spur	Range	Frequency	Amplitude	Limit	ΔLimit
1	1	2.392 GHz	-44.34 dBm	-35.00 dBm	-9.343 dB
2	1	2.390 GHz	-44.63 dBm	-35.00 dBm	-9.627 dB
3	1	2.390 GHz	-44.68 dBm	-35.00 dBm	-9.676 dB
4	1	2.391 GHz	-44.70 dBm	-35.00 dBm	-9.700 dB
5	1	2.391 GHz	-44.72 dBm	-35.00 dBm	-9.716 dB

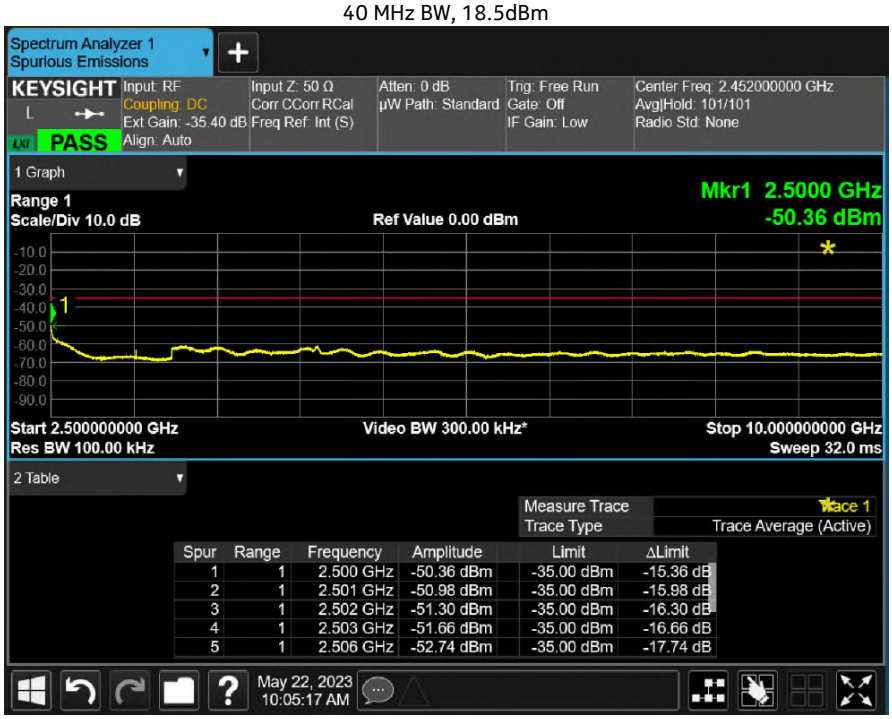
Spurious Emissions 2.472 - 2.5GHz

802.11n 1Mbps, OFDM/CDD MCS0
Channel Frequency 2452 MHz
40 MHz BW, 18.5dBm



Spurious Emissions 2.5 - 10GHz

802.11n 1Mbps, OFDM/CDD MCS0
Channel Frequency , 2452 MHz
40 MHz BW, 18.5dBm



6.2 Spurious Emissions in Restricted Frequency Bands at Transmit Antenna Port

6.2.1 Limits

FCC Part 15.247(d) stated that attenuation below the general limits specified in 15.209(a) is not required. Radiated emissions which fall in the restricted bands, as defined in 15.205(a), must comply with the radiated emission limits specified in 15.209(a).

The restricted bands are given in FCC Part 15.205.

Table 6.2.1 FCC 15.205 Restricted Bands of Operation

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]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	([2])
13.36 - 13.41			

The spurious emissions in restrict frequency bands in compliance with 15.209 limits are generally evaluated by radiated test. However, the conducted measurement in determining the compliance with 15.209 is acceptable per ANSI C63.10 Sections 11.12.1 and 11.12.2.2.

The conversion between EIRP in dBm and electric field E in dBμV/m at 3m is:

$$E\,(dB\mu V/m) = EIRP\ (dBm) + 95.26.$$

For an ideal dipole at 3m,

$$P\,(\text{dBm}) = E\,(dB\mu V/m) - 95.26.$$

Per ANSI C63.10 Section 11.12.2.2 General Procedure for Conducted Measurements in Restricted-Bands, it recommended adding the appropriate maximum ground reflection factor to the EIRP before converting it to E: 6 dB for frequency ≤ 30 MHz; 4.7 dB for frequency between 30 MHz and 1000 MHz, inclusive, and 0 dB for frequency > 1000MHz when using the conducted approach.

Table 6.2.2 FCC Part 15.209 Radiated and Converted Conducted Emissions Limits

Frequency (MHz)	E Limit at 3m (dBµV/m)	Converted Conducted Power Limit (dBm)	RBW (kHz)	Detector
1.705 - 30	29.54	-71.72 (-65.72-6)	10	QP
30 - 88	40	-59.96 (-55.26-4.7)	120	QP
88 - 216	43.52	-56.44 (-51.74-4.7)		
216 - 960	46.02	-53.94 (-49.24-4.7)		
960 - 1000	53.98	-45.98 (-41.28-4.7)		
Above 1000	53.98	-41.28	1000	Ave

The spurious emissions at the antenna terminal in the restricted bands were investigated for the following configurations over the frequency range of 30M-25GHz:

Table 6.2.3 Spurious Emissions in the Restricted Bands Evaluated at Antenna Port for 2.4GHz DTS Carriers

Bandwidth (MHz)	Ch No/ Freq (MHz)	Mode	Modulation	Data Rate (Mbps)
20	2412	.11b - 1Tx	DSSS	1
		.11g - 2Tx	OFDM/CDD	6
	2437	HT20-2Tx-1S	OFDM/CDD	MCS0
	2462	.11b - 1Tx	DSSS	1
		.11g - 2Tx	OFDM/CDD	6
40	2422	HT40-1Tx-1S	OFDM/CDD	MCS0
	2452	HT40-1Tx-1S	OFDM/CDD	MCS0

6.2.2 Results

The conducted spurious emissions over the frequency range of 30MHz-1GHz and 2.5-25GHz were investigated for the EUT. The spurious emissions in the restricted bands in the frequency range of 30MHz – 1GHz and 2.5GHz-25GHz are in compliance with 15.209 limits. The spurious emissions in the frequency range of 1-2.5GHz were evaluated by the radiated emissions in Section 7.1.

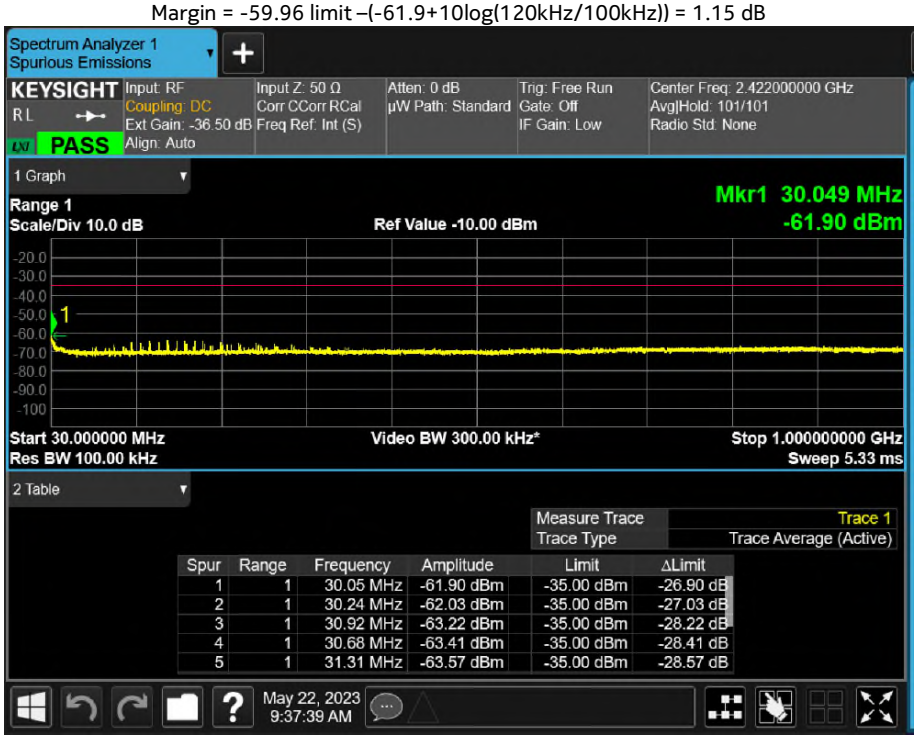
6.2.2.1 Spurious Emissions in Restricted Bands Plots 30 MHz -1 1 GHz & 2.5-25 GHz

NOTE: Only plots with lowest margin in each frequency range are used in this report. The full suite of raw data resides at the MH, New Jersey location.

The limits displayed in the plots are for non-restricted bands. The minimum margin for the restricted bands in each frequency range was recalculated with the limit for the restricted bands.

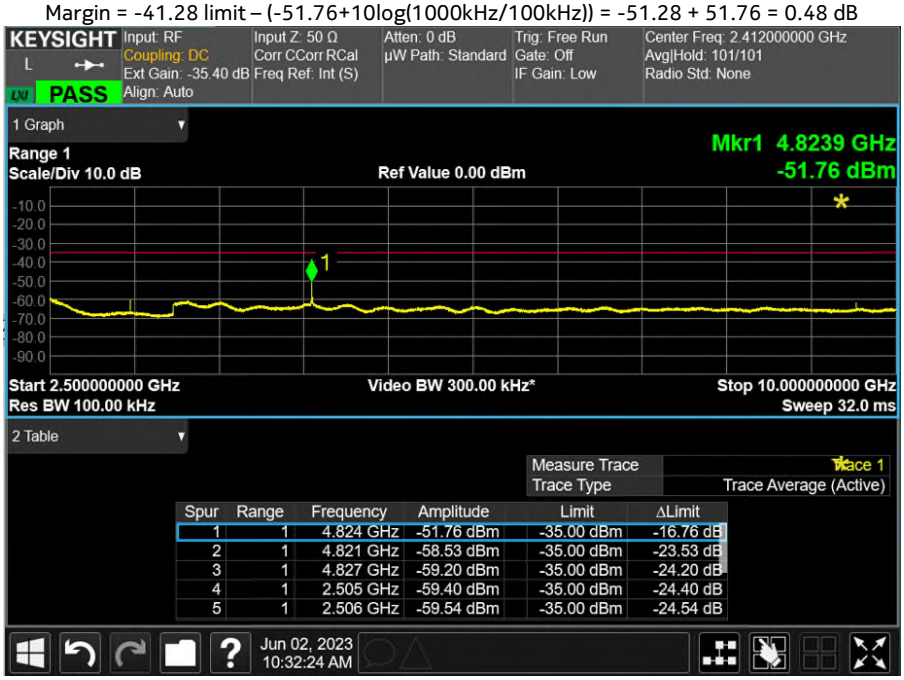
Spurious Emissions 30M - 1GHz

802.11n 1Mbps, OFDM/CDD MCS0
Channel Frequency 2422 MHz, 40 MHz BW, 18.5 dBm
Margin = -59.96 limit –(-61.9+10log(120kHz/100kHz)) = 1.15 dB

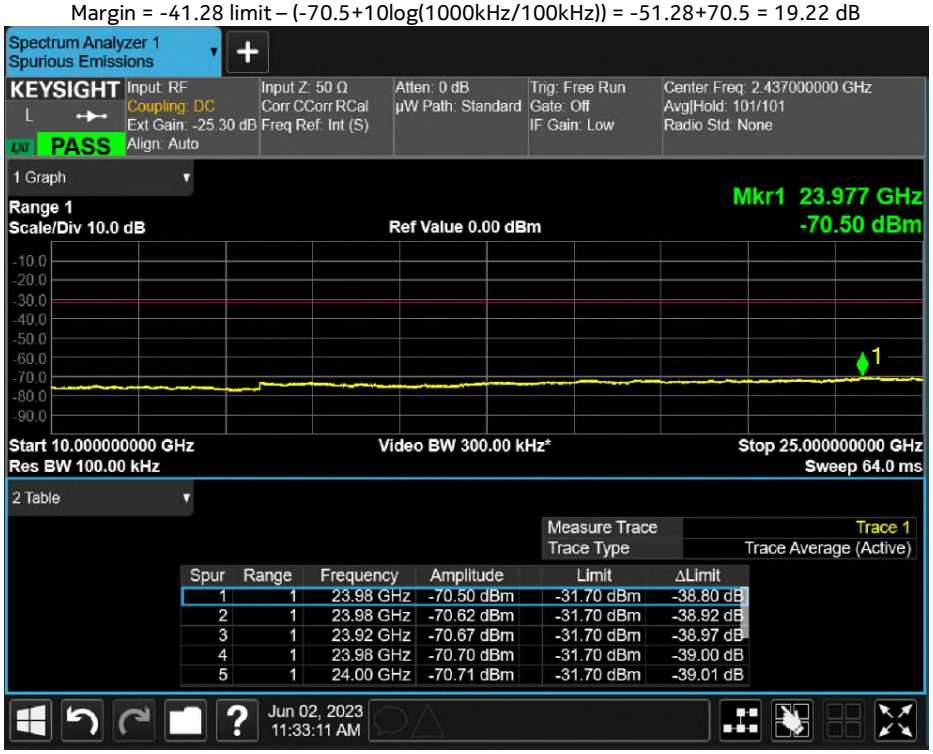


Spurious Emissions 2.5 G – 10 GHz

802.11b 1Mbps, DSSS
Channel Frequency 2412 MHz, 20 MHz BW, 18.5 dBm
Margin = -41.28 limit – (-51.76+10log(1000kHz/100kHz)) = -51.28 + 51.76 = 0.48 dB



Spurious Emissions 10 G – 25 GHz
802.11g 1Mbps, OFDM/CDD MCS0
Channel Frequency 2437 MHz, 20 MHz BW, 18.5dBm
Margin = -41.28 limit – (-70.5+10log(1000kHz/100kHz)) = -51.28+70.5 = 19.22 dB



7. Sections 15.209 & 15.205 - Field Strength of Spurious Radiation in Restricted Bands 1-2.5 GHz

The field strength measurements of radiated spurious emissions were made in an FCC registered 10-meter semi-anechoic chamber AR-8, (FCC Registration Number: 395774) **NVLAP** Lab Code: 100275-0 and IC (Filing Number: 6933F-8) which is maintained by Nokia Bell Labs in Murray Hill, New Jersey.

7.1 Spurious Radiation and Radiated Emissions Requirements

As stated in Section 6.2, FCC Part 15.247(d) specified that attenuation below the general limits specified in 15.209(a) is not required. Only radiated emissions which fall in the restricted bands, as defined in 15.205(a), must comply with the radiated emission limits specified in 15.209(a).

Therefore, the WiFi transmitter needs to meet Parts 15.209 and 15.205 requirements. The FCC 15.209 does not apply to the carriers of licensed transmitters. The limits of Part 15.209 in the frequency range of 30MHz above are same as that of FCC Part 15.109 Class B requirements.

The spurious emissions in the restricted bands in the frequency range of 30MHz – 1GHz and 2.5GHz-25GHz have been evaluated in Section 6.2 by the conducted approach at the antenna terminal and have

demonstrated in compliance with 15.209 limits. Therefore, only the radiated spurious emissions in the frequency range of 1-2.5GHz were evaluated by the radiated measurement for 15.209 compliance.

Part 15.209 limits are given in Table 7.1.1 and the restricted bands are given in Table 6.2.1.

Table 7.1.1 FCC Part 15.209 Radiated Emissions Limits

Frequency (MHz)	E Limit at 3m (dBμV/m)	RBW (kHz)	Detector
1.705 - 30	29.54	10	QP
30 - 88	40	120	QP
88 - 216	43.52		
216 - 960	46.02		
960 - 1000	53.98		
Above 1000	53.98	1000	Ave

The NDN Electric Drone equipped with two P638893 modules and one WiFi module were investigated for unwanted radiated emissions per FCC Parts 15B, 15C and 27 for the following configurations. Here only FCC Part 15C compliance in the frequency range of 1-2.5GHz is addressed.

Table 7.1.2 Configurations Evaluated for FCC Part 15C Transmitter Unwanted Radiated Spurious Emission

Test	Configurations	Carrier Freq UL/DL (MHz)	Bandwidth (MHz)	Modulation	Freq Range Invested
1a-2	Module 1: n71, 20M/B NR, 15kHz	673/627	20	CP-64QAM	1 - 2.5GHz
	Module 2: b66, 5M/B LTE	1712.5/2112.5	5	QPSK	
	WiFi 2412, 11b, 20M, 1Mps	2412	22	DSSS	
1b-2	Module 1: n30, 5M/B NR, 15kHz;	2312.5	5	DFS-s-QPSK	1 - 2.5GHz
	Module 2: n66, 40M/B NR, 15kHz	1730/2130	40	DFS-s-256QAM	
	WiFi: 2437,11g, QPSK, 6Mps, 20M	2437	20	QPSK	
1d-2	Module 1: n77 100M/T NR 30kHz	3950	100	CP-256QAM	1 - 2.5GHz
	Module 2: b41 5M/B LTE	2498.5	5	QPSK	
	WiFi: 2452, HT40, 64QAM, MCS0	2452	40	64QAM	

The field strength of radiated spurious emissions measured was determined by

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

Field strength measurements of radiated spurious emissions were made in the 10m semi-anechoic chamber, AR-8 as detailed above. The recommendations of ANSI C63.10, especially Section 11.12.1 Radiated Emission Measurements, were followed for EUT testing setup, cabling, and measurement approach and procedures. All the measurement equipment used, including antennas, was calibrated in accordance with ISO 9001 process. The EUT setup diagram is given in section 1.9.

The spectrum from 30MHz to 25GHz, the tenth harmonic of the carrier, was searched for spurious radiation. Measurements were made using both horizontally and vertically polarized broadband antennas. The radiated emissions of the EUT for FCC Part 27 compliance and FCC Part 15 Subpart B EMC compliance (unintentional radiator) are presented in Part 27 RF report and Part 15B EMC report, respectively. In this section, only the compliance in the restricted bands in the frequency range of 1-2.5GHz with FCC Part 15.209 requirement is

presented. The emissions caused by licensed Part 27 carriers are subject to the unwanted emissions limits of Part 27, see TR-2023-0050-FCC27.

7.2 Field Strength of Spurious Radiation Results 1-2.5 GHz

The radiated emissions of the EUT in the frequency range of 1GHz-2.5GHz meets Part 15.209 and Part 15.205 Requirements.

NOTE: Only plots with lowest margin in each frequency range are used in this report. The full suite of raw data resides at the MH, New Jersey location.

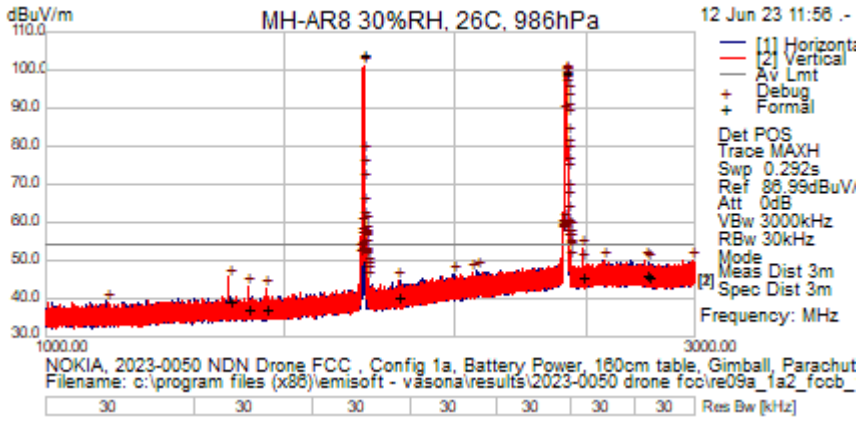
Per Table 6.2.1, the restricted bands in 1-2.5GHz are 960-1240, 1300-1427, 1435-1626.5, 1645.5-1646.5, 1660-1710, 1718.8-1722.2, 2200-2300, 2310-2390, 2483.5-2500 MHz.

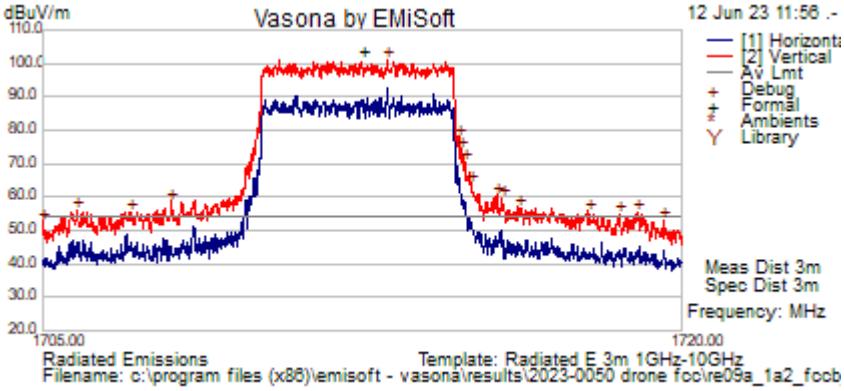
Table 7.2.1 Carrier Frequencies in Configurations Evaluated for FCC Part 15C Transmitter Unwanted Radiated Spurious Emission

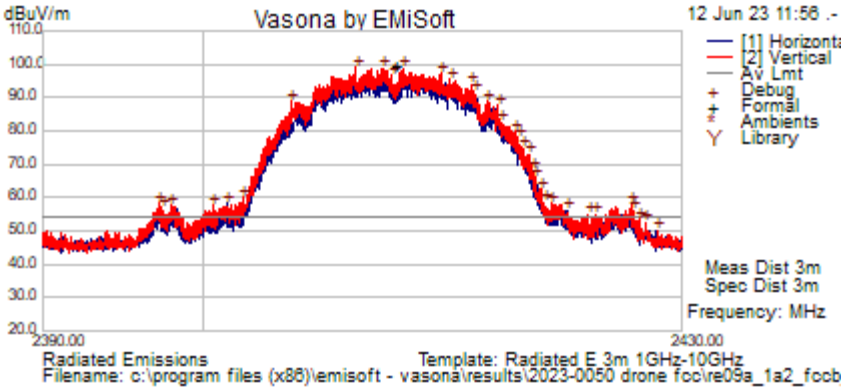
Test	Configurations	Carrier Freq UL (MHz)	Bandwidth (MHz)	Nearby (±10 MHz) Restricted Bands in 1-2.5 GHz (MHz)
1a-2	Module 1: n71, 20M/B NR, 15kHz	663-683	20	
	Module 2: b66, 5M/B LTE	1710-1715	5	1660-1710, 1718.8-1722.2
	WiFi 2412, 11b, 20M, 1Mps	2401-2413	22	2310-2390
1b-2	Module 1: n30, 5M/B NR, 15kHz	2310-2315	5	2310-2390
	Module 2: n66, 40M/B NR, 15kHz	1710-1750	40	1660-1710, 1718.8-1722.2
	WiFi: 2437,11g, QPSK, 6Mps, 20M	2427-2447	20	
1d-2	Module 1: n77 100M/T NR 30kHz	3900-4000	100	
	Module 2: b41 5M/B LTE	2496-2501	5	2483.5-2500
	WiFi: 2452, HT40, 64QAM, MCS0	2421-2461	40	

7.2.1 Transmitter Measurements of Radiated Spurious Emissions Plots

RE 1GHz – 3GHz 1a-2 RE09, Carriers: 663-683 MHz, 1710-1715 MHz and 2401-2413MHz







Test Information

Results Title	Radiated E 3m 1GHz-10GHz
File Name	re09a_1a2_fccb_1g_3g_form.emi
Test Laboratory	MH-AR8 30%RH, 26C, 986hPa
Test Engineer	NPA
Test Software	Vasona by EMISoft, version 6.061
Equipment	NOKIA
EUT Details	2023-0050 NDN Drone FCC , Config 1a, Battery Power, 160cm table, Gimbal, Parachute, GPS Livesky
Configuration	Radiated Emissions 1GHz - 3GHz, FCC Part 15 Class B Limit, 3m Measurement distance, Rcvr E1218 MXE, Ant E1074, No Preamp, No pad, 7 step, RBW 30KHz preview, RBW 1MHz Formal,
Date	2023-06-12 11:56:51

Formal Data

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
1712.500	71.42	3.29	29.52	104.23	AvgMax	V	278	188	54.00	50.23	Authorized	TxCarrier
2412.000	63.29	4.07	32.30	99.66	AvgMax	V	199	302	54.00	45.66	Authorized	Wifi
2759.600	9.02	4.47	32.64	46.12	AvgMax	V	234	30	54.00	-7.88	Pass	
2771.972	8.39	4.46	32.65	45.50	AvgMax	H	104	63	54.00	-8.50	Pass	
2480.066	8.93	4.15	32.41	45.49	AvgMax	V	221	343	54.00	-8.51	Pass	
1815.029	6.87	3.38	30.28	40.53	AvgMax	V	363	117	54.00	-13.47	Pass	
1364.002	8.97	2.86	27.66	39.49	AvgMax	V	131	331	54.00	-14.51	Pass	
1407.994	6.52	2.90	27.70	37.13	AvgMax	V	248	193	54.00	-16.87	Pass	
1451.993	6.21	2.94	27.74	36.89	AvgMax	V	387	205	54.00	-17.11	Pass	

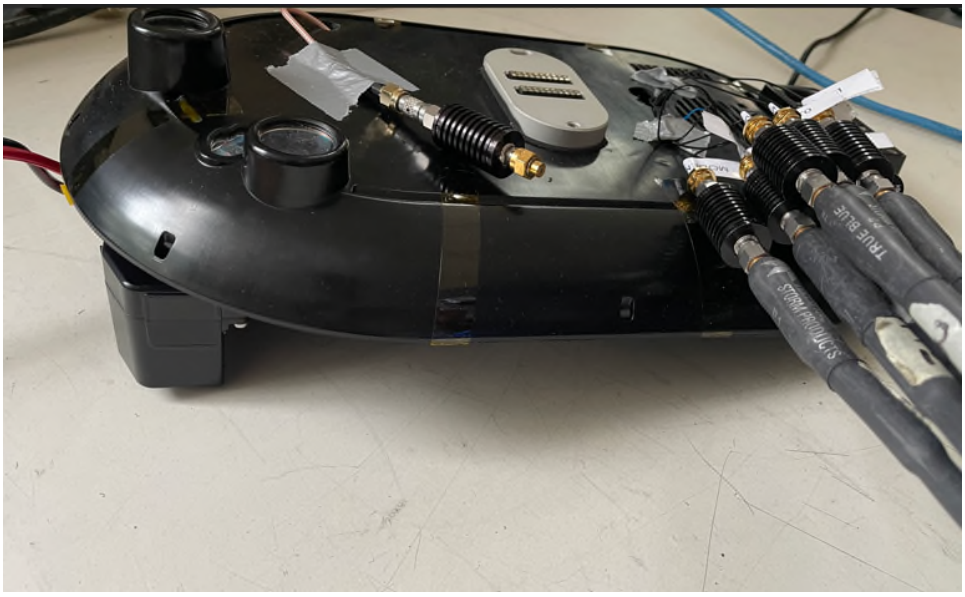
Preview Data

Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
1713.076477	68.32	3.29	29.52	101.13	Debug	V	303	225	54.00	47.13	Fail	
2409.513876	62.60	4.07	32.30	98.97	Debug	V	203	45	54.00	44.97	Fail	
2411.247208	62.44	4.07	32.30	98.81	Debug	V	203	45	54.00	44.81	Fail	
2412.466254	62.23	4.07	32.30	98.61	Debug	V	103	180	54.00	44.61	Fail	
2419.685295	41.57	4.08	32.31	77.97	Debug	V	203	45	54.00	23.97	Fail	
1715.03838	31.43	3.29	29.54	64.25	Debug	V	303	90	54.00	10.25	Fail	
1715.647903	27.86	3.29	29.54	60.69	Debug	V	203	225	54.00	6.69	Fail	
1708.009816	26.18	3.28	29.48	58.94	Debug	V	203	225	54.00	4.94	Fail	
2397.247222	21.97	4.06	32.28	58.30	Debug	V	203	45	54.00	4.30	Fail	
2401.456741	21.81	4.06	32.28	58.16	Debug	H	203	45	54.00	4.16	Fail	
2426.790049	21.50	4.09	32.33	57.92	Debug	V	203	45	54.00	3.92	Fail	
2398.009126	21.23	4.06	32.28	57.57	Debug	V	203	45	54.00	3.57	Fail	
2400.599599	21.16	4.06	32.28	57.50	Debug	V	203	45	54.00	3.50	Fail	
2397.428174	20.81	4.06	32.28	57.14	Debug	V	203	45	54.00	3.14	Fail	
1716.152665	24.09	3.29	29.55	56.93	Debug	V	303	90	54.00	2.93	Fail	
1705.809818	23.46	3.28	29.47	56.21	Debug	V	103	45	54.00	2.21	Fail	
2426.904335	19.66	4.09	32.33	56.08	Debug	V	203	45	54.00	2.08	Fail	
2422.809101	19.63	4.08	32.32	56.04	Debug	H	203	45	54.00	2.04	Fail	
1717.800282	22.97	3.29	29.56	55.82	Debug	V	203	225	54.00	1.82	Fail	
1707.057436	22.85	3.28	29.48	55.60	Debug	V	103	45	54.00	1.60	Fail	
1718.962186	22.57	3.29	29.57	55.42	Debug	V	203	225	54.00	1.42	Fail	
2424.104338	18.47	4.09	32.32	54.87	Debug	V	203	45	54.00	0.87	Fail	
2427.275763	17.00	4.09	32.33	53.42	Debug	V	203	45	54.00	-0.58	Pass	
1719.562185	20.42	3.29	29.57	53.28	Debug	V	203	225	54.00	-0.72	Pass	
2479.990176	16.44	4.15	32.41	53.00	Debug	V	203	0	54.00	-1.00	Pass	
1705.000295	20.00	3.28	29.46	52.74	Debug	V	303	90	54.00	-1.26	Pass	
2427.685287	16.16	4.09	32.33	52.58	Debug	V	103	180	54.00	-1.42	Pass	
1703.505058	19.25	3.28	29.45	51.98	Debug	V	103	225	54.00	-2.02	Pass	
1720.27647	18.20	3.29	29.58	51.07	Debug	V	103	135	54.00	-2.93	Pass	
2987.161918	12.84	4.47	32.80	50.11	Debug	V	303	330	54.00	-3.89	Pass	
2428.399572	13.65	4.09	32.33	50.07	Debug	H	203	45	54.00	-3.93	Pass	
1721.009803	16.99	3.29	29.58	49.87	Debug	V	203	225	54.00	-4.13	Pass	
2759.60024	12.74	4.47	32.64	49.85	Debug	V	303	225	54.00	-4.15	Pass	
2480.066367	12.96	4.15	32.41	49.52	Debug	V	203	0	54.00	-4.48	Pass	

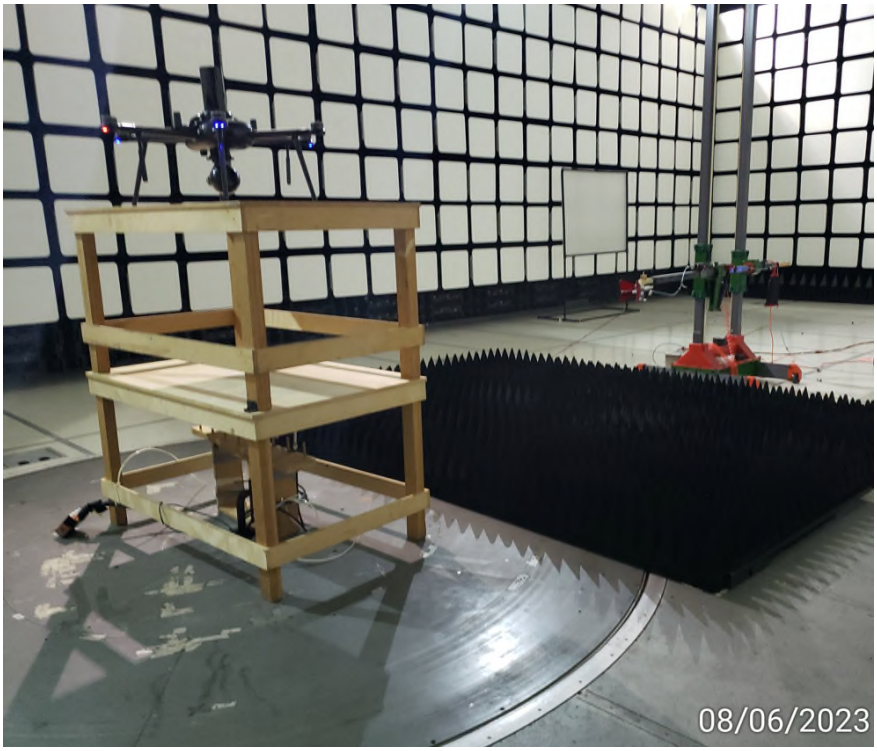
Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in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

8. Photographs

Radio Test



Radiated Emission Test



9. Test Equipment

Radio Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
E896	Agilent Technologies	Network Analyzer	10 MHz - 40 GHz, PNA-L Microwave Network Analyzer	N5230C	MY49000897	2023-02-08	2025-02-08
E1579	KeySight Technologies	MXA Signal Analyzer	10 Hz - 50 GHz	N9021B	MY60080199	2021-11-30	2023-11-30
E1344	Macom	Attenuator	3 dB, DC - 4 GHz, 2 watt	2082-6171-03	N/A	CNR-V	CNR-V
E1212	RLC Electronics Inc	Filter, High Pass	10 - 30 GHz, 2W, 5dB	F-19414	1444002	CNR-V	CNR-V
E1587	Reactel, Inc.	Filter, High Pass	6 - 24 GHz	11HS-6G/24G-K11	20-02	CNR-V	CNR-V
E1156	Weinschel	Attenuator	10dB 0.05GHz-26GHz 25W	74-10-12	1069	CNR-V	CNR-V
E1155	Weinschel	Attenuator	10dB 25Watt 0.05GHz - 26GHz	74-10-12	1068	CNR-V	CNR-V
E1154	Weinschel	Attenuator	30dB 25W 0.05GHz-26GHz	74-30-12	1065	CNR-V	CNR-V
		Attenuator	30dB 10W Dc-6GHz	P/N:ZSJ30-10RS-6TA		CNR-V	CNR-V
	Micro Coax Utiflex	RF Cable	MFR-64639-228872-001	UF142A-000400-200-2G0	MFR-64639-228872-001	CNR-V	CNR-V
	Mini Circuit	Test System	Modular Test System	ZTS-8SP8T-63	02203170006	CNR	CNR
	Mini Circuit	Test System	Modular Test System	RCM-202	02110200002	CNR	CNR

CNR: Calibration Not Required
CNR-V: Calibration Not Required, Must Be Verified

Radiated Emission Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
E758	A.H. Systems	Bilogical Ant	25 - 2000 MHz	SAS-521-2	458	2022-03-01	2024-03-01
E1600	A.H. Systems	Pre-Amplifier	18 - 42 GHz	PAM-1842	101	2023-01-10	2025-01-10
E1602	A.H. Systems	Pre-Amplifier	20 MHz - 18 GHz, 1 Watt Input limiter	PAM-0118P	620	2023-03-06	2025-03-06
E1597	Com Power	Site Source	1 - 40 GHz, 1000 MHz Step	CGO-51000	26050093	N/A	N/A
E1527	ETS Lindgren	Horn Ant	Double Ridged Horn 18-40 GHz	3116C	00227823	2023-01-10	2025-01-10
E1074	ETS Lindgren	Horn Ant	Double-Ridged Waveguide Horn 1-18 GHz	3117	00135194	2021-08-03	2023-08-03
E1321	Extech	Data Logger	Barometric Pressure/Humidity/Temperature Datalogger	SD700	A075782	2023-01-11	2025-01-11
E1218	KeySight Technologies	EMI Receiver	MXE EMI Receiver 44 GHz	N9038A	MY54130037	2021-12-29	2023-12-29
E1611	Micro-Coax	Cable	1-43.5 GHz, 2.92mm armored, 237 inch	UFB142A-Q-2370-2002G0	924906-001	N/A	N/A
E1610	Micro-Coax	Cable	1-43.5 GHz, 2.92mm, 36 inch	UFB142A-Q-0360-2002G0	924800-001	N/A	N/A
E1213	RLC Electronics	Filter, High Pass	10 - 30 GHz, 2W, 5dB	F-19414	1444001	N/A	N/A
E1480	Reactel	Filter, High Pass	DC - 4.3 GHz	11HS-X4.3GS11	SN20-02	N/A	N/A
E812	Sonoma Instrument	Amplifier	9kHz-1GHz	310N	186744	2022-11-28	2024-11-28

CNR-V: Calibration Not Required, Must Be Verified
CNR: Calibration Not Required

10. NVLAP Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

ilac-MRA

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 100275-0

Nokia, Global Product Compliance Lab
Murray Hill, NJ

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2022-09-28 through 2023-09-30
Effective Dates

DEPARTMENT OF COMMERCE · UNITED STATES OF AMERICA

For the National Voluntary Laboratory Accreditation Program