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

TESTING
NVLAP LAB CODE: 100275-0

Title 47 Code of Federal Regulations Test Report

Regulation:
Title 47 CFR FCC Part 27

Client:
NOKIA SOLUTIONS AND NETWORKS, OY

Product Evaluated:
Nokia Drone Networks Electric Drone with P638893 RF Module

Report Number:
TR-2023-0050-FCC27

Date Issued:
October 31, 2023

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Revisions

Date	Revision	Section	Change
	0		Initial Release

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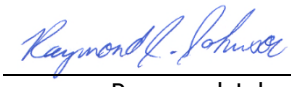
Prepared By:

Signed:  10/31/2023

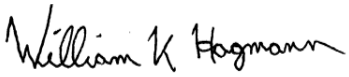
Qin Yu
Compliance Engineer
q.yu@nokia-bell-labs.com

Approved By:

Signed:  10/31/2023

Raymond Johnson
Technical Manager
NVLAP Signatory
ray.johnson@nokia-bell-labs.com

Reviewed By:

Signed:  10/31/2023

William K. Hagmann
Technical Manager
william.hagmann@nokia-bell-labs.com

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 with P638893 RF Module
Model Name(s):	NDN Electric Drone P591013 with P638893 (LTE & NR) & P632592 (wifi) RF Modules, NDN Dual Gimbal P591015
Serial Number:	L1220703735 (NDN Electirc Drone, RE), L1220705351 (NDN Electirc Drone, Conducted), MPY23CH2B001719 & P1Y22G91D000267 (P638893 RF modules)
FCC ID:	2BC99NDNUAV1
Hardware Version:	P591013
Software Version:	ndn-flight controller: 22.12.1; ndn-jetson-utilities: 23.03.0; ndn-services: 23.03.1
Frequency Bands:	663-3980 MHz in the following bands (the lowest band b71/n71, the highest band n77): WCDMA: II/IV/V. LTE: FDD Band: b2, b4, b7, b12, b13, b14, b17, b25, b26, b30, b66; TDD Band: b38, b41, b42, b43, b48*, b71; NR: FDD Band: n2, n7, n12, n13, n14, n25, n26, n30, n66; TDD Band: n38, n41, n48*, n70, n71, n77, n78. b71/n71: UL 663-698 MHz, DL 617-652MHz; n77: 3450-3980MHz
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 Parts 24E, 27, 90 and 96
Test Standards:	Refer to Section 1.6.1
Measurement Procedure(s):	Refer to Section 1.6.2
Test Date(s):	May 2023 – July 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):	Petri Sinisalo
Lead Engineer:	Qin Yu
Test Engineer (s):	Jaideep Yadav, N. Albrecht, Steve Gordon
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.	

*For ground operation only.

1.1 Introduction

This Conformity test report applies to **Nokia Drone Networks Electric Drone with P638893 RF 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

Nokia Drone Networks (NDN) comprises a NDN Electric Drone and a NDN Docking Station. The NDN Electric Drone is an Unmanned Aircraft System (UAS) which creates value to customers by providing airborne missions, such as terrain mapping, area monitoring, gas measurement and structure inspection etc.

The NDN electric drone P591013 is equipped with two RF modules P638893 and one WiFi module P632592 for communication. RF modules P638893 supports both LTE and 5G NR technologies. P632592 RF Module supports WiFi 801.11 b/g/n. Two RF modules P638893 will not transmit simultaneously on the same channel. The NDN Docking Station provides a platform for drone's taking off, landing and charging.

1.3.1 Specifications

Specification Items	Description
Product	NDN Electric Drone with P638893 RF Module
Radio Type	Intentional Transceiver
Power Type	Drone: Rechargeable Li-ion Battery 25.2 VDC/20 A
Modulation	LTE: QPSK, 16QAM, 64QAM, 256QAM 5G: DFT-s-Pi/2-BPSK, DFT-s-QPSK, DFT-s-16QAM, DFT-s-64QAM, DFT-s-256QAM. CP-QPSK, CP-16QAM, CP-64QAM, CP-256QAM
Operating Frequency Range	663-3980 MHz in the following bands (the lowest band b71/n71, the highest band n77): LTE: FDD Band: b2, b4, b7, b12, b13, b14, b17, b25, b26, b30, b66; TDD Band: b38, b41, b42, b43, b48*, b71; NR: FDD Band: n1, n2, n7, n12, n13, n14, n25, n26, n30, n66; TDD Band: n38, n41, n48*, n70, n71, n77, n78. b71/n71: UL 663-698 MHz, DL 617-652MHz; n77: 3450-3980MHz
Channel Bandwidth	LTE: 5/10/15/20MHz NR: 10/15/20/30/40/50/60/70/80/90/100MHz
Maximum Rated Conducted Power	Class 3: 23dBm ± 1dB (0.158W ~ 0.251W) Class 2 HPUE: 26dBm ± 1dB (0.316 ~ 0.501W) in B38/B41/B42/B43 and n38/n41/n77/n78 bands.
Maximum EIRP	30.9dBm
Operating Mode	UL: 2T4R, 2T for HPUE bands only
Software Version	ndn-flight controller: 22.12.1; ndn-jetson-utilities: 23.03.0; ndn-services: 23.03.1
Hardware Version	P591013
Antenna(s)	Refer to Section 1.3.2

*For ground operation only.

The maximum rated output power levels of P638893 are:

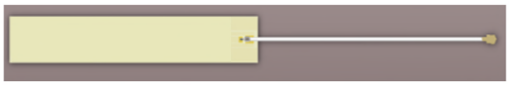
Mode	Frequency	Maximum Output Power Conducted (dBm)	Minimum Conducted Power (dBm)
LTE	LTE bands	23 dBm ±1 dB (Class 3)	< -40 dBm
	LTE HPUE bands (b38/b41/b42/b43)	26 dBm ±1 dB (Class 2)	< -40 dBm
5G NR	5G NR bands	23 dBm ±1 dB (Class 3)	< -40 dBm
	5G NR HPUE bands (n38/n41/n77/n78)	26 dBm ±1 dB (Class 2)	< -40 dBm

1.3.2 Antenna Information

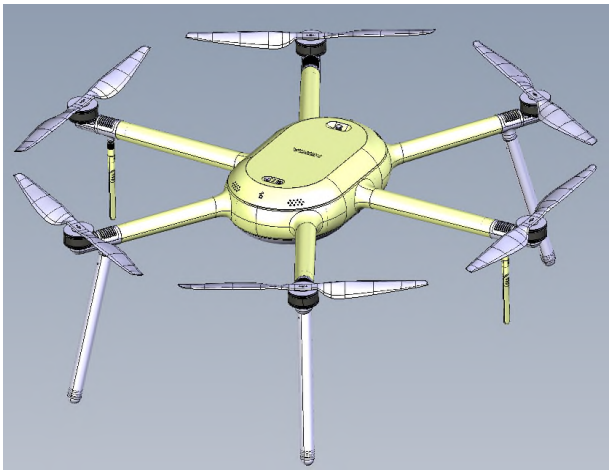
The EUT is equipped with the following eight antennas:

- two External Paddle Antennas P567162 (ANT0, Port 0): 650MHz-4200MHz with peak gain +3.0 ~ +5.0dBi,

- six Internal Antennas P601003 (ANT1, ANT2 & ANT3, Ports 1, 2,3): 617MHz-4400MHz with peak gain -1.7 ~ +3.7dBi.



1.3.3 Photographs



1.4 Test Requirements

The RF module P638893 was FCC certified on 8/1/2022 and 8/31/2022 (C2PC) as a single-modular transmitter in the frequency range of 663-3980 MHz in compliance with FCC Parts 22, 24, 27, 90 and 96 rules. It supports both LTE and 5G NR technologies in multiple bands with multiple bandwidths. The antennas used in the original certification tests had peak antenna gain between -6.1~2.87 dBi.

Now two P638893 RF radio modules are installed in the NDN Electric Drone, see Section 1.3.3. The EUT has eight new antennas with higher antenna gains in the bands certified. See Section 1.3.2. The comparison of antenna peak gains in each band is given below.

The comparison of antenna peak gains in each band for the antennas tested with P638893 as a single-modular transmitter and the antenns installed on the EUT is given below:

Table 1.4.1 Antenna Maximum Gain Information for P638893 Module LTE/NR

Bands	Frequency Range (MHz)	Max Peak Ant Gain Tested for P638893 SA Module (dBi)	Max Peak Gain Int Ant P601003 (dBi)	Max Peak Gain Ext Ant P567162(dBi)
B2, n2	1850 -1910	0.91	2.7	4.0
B25, n25	1850 -1915	0.25	2.7	4.0
b4	1710 -1755	1.47	2.7	4.0
b66, n66	1710-1780	1.47	2.7	4.0
b5, n5	824 - 849	2.68	1.7	3.0
b7, n7	2500 - 2570	0.55	3.7	4.0
b12, n12	699 - 716	-0.2	1.7	3.0
b13, n13	777 - 787	1.54	1.7	3.0
b14, n14	788 - 798	2.42	1.7	3.0
B17	704 - 716, 703 - 748	-0.2	1.7	3.0
b26. n26	814 - 849	2.87	1.7	3.0
B30, n30	2305 - 2315	-5.7	3.6	4.0
b38, n38	2570 - 2620	-0.23	3.7	4.0
b41, n41	2496 - 2690	0.78	3.7	4.0
b42	3400 - 3600	-6.1	3.6	5.0
b43	3600 - 3800	-6.1	3.6	5.0
b48, n48	3550 - 3700	-6.1	3.6	5.0
n70	1695 - 1710	1.3	2.7	1.8*
b71, n71	663 - 698	1.22	-1.7	3.0
n77	3450 - 3550, 3700 - 3980	-6.1	3300-3800: 3.6 & 3800-4400: 2.7	3400-3800: 5.0 & 3800-4400: 3.4*
n78	3450-3550, 3700-3800	-6.1	3.6	5.0

*Measured in Nokia Bell labs with antenna installed on Drone

Some bands are not permitted for airborn operations:

Table 1.4.2 Bands with Restrictions for Airborn Operations and Aeronautical Service

Bands	Freq Range UL (MHz)	Freq Range DL (MHz)	Certified UL Freq Range	FCC Rule Parts	Operation Restricted?
b2, n2	1850-1910	1930-1990	1850-1910	Part 24E	N
b25, n25	1850-1915	1930-1995	1850-1915	Part 24E	N
b4	1710-1755	2110-2155	1710-1755	Part 27	N
b66, n66	1710-1780	2110-2200	1710-1780	Part 27	N
b5, n5	824 - 849	869-894	824-849	Part 22	No Airborne (22.925)
b7, n7	2500 ~ 2570	2620-2690	2500-2570	Part 27	No Aeronautical
b12, n12	699 ~716	729-746	699-716	Part 27	N
b13, n13	777 ~ 787	746-756	777-787	Part 27	N
b14, n14	788-798	758-768	788-798	Part 90R	N*
B17	704-716	734-746	704-716	Part 27	N
b26, n26	814-824	859-869	814-824	Part 90	N
b26, n26	824-849	869-894	824-849	Part 22H	No Airborne (22.925)
B30, n30	2305-2315	2350-2360	2305-2315	Part 27	2305-2310 - No Aeronautical
B38, n38	2570-2620	2570-2620	2570-2620	Part 27	No Aeronautical
b41, n41	2496 ~ 2690	2496-2690	2496 ~ 2690	Part 27	No Aeronautical
B42	3400 ~ 3600	3400-3600	3450-3550	Part 27	No Aeronautical
B43	3600 ~ 3800	3600 ~ 3800	3700-3800	Part 27	No Aeronautical
b48, n48	3550 - 3700	3550 - 3700	3550-3700	Part 96	No Airborne (96.39)
n70	1695 ~ 1710	1995 – 2020	1695~1710	Part 27	No Aeronautical
b71, n71	663 ~ 698	617 – 652	663 - 698	Part 27	N
n77	3300 ~ 4200	3300 – 4200	3450-3550, 3700-3980	Part 27	No Aeronautical
n78	3300-3800	3300-3800	3450-3550, 3700-3800	Part 27	No Aeronautical

*Below 1500ft (458m) for narrowband channels only. The EUT flight height is limited to 500ft (153m) in the US.

Most of RF tests required for P638893 RF module certification were conducted and measured at the antenna ports, except the radiated emissions test. The impact from the new antennas used on EUT with different antennas gains is mainly on the radiated emissions test data and EIRP power compliance. The lower the antenna gains, the higher the conducted power outputs allowed for the same EIRP power limit. **The RF conducted tests and data presented in the original certification RF test reports are still valid** and are the worst cases for the bands with low EIRP limits. Therefore, only the following selected bands and requirements were evaluated at the antenna ports in this report for verification purpose, where b71/n71 and n77 represent the lowest and highest frequency bands certified in 663-3980MHz and n77, and b41/n41 and n77 bands have higher conducted power output capacity (Class 2):

Table 1.4.3 Bands Evaluated

Position in Certified Freq Range 663-3980MHz	Bands	Frequency (UL/DL) (MHz)	Maxi Ant Gain Δ (Host Ant – Ant Tested for RF Module)	Maximum Rated Power*
Low	b71/n71	663-698MHz /617-652MHz	1.78	23 dBm
Middle	b66/n66	1710–1780MHz/2110–2200MHz	5.47	23 dBm
Middle	b30/n30	2310–2315MHz/2355–2360MHz	9.7	23 dBm
Middle	b41/n41	2496–2690MHz	3.22	26 dBm
High	n77	3450-3550, 3700-3980MHz	11.1	26 dBm

*±1 dB

The evaluation of NDN Electric Drone with P632592 WiFi module and the EMC tests of Nokia Drone System which consists of NDN Electric Drone with P638893 RF Module and P632592 WiFi module and NDN Docking Station are provided in two other separate reports.

Only the following requirements at the selected bands (Table 1.4.3) and channels were evaluated in this report for verification purpose:

Table 1.4.4 Tests Evlauated for FCC Part 27 Requirements

47 CFR FCC Rules	Description of Tests	Tests Performed
2.1046	RF Power Output, EIRP, Peak-to-Average Power Ratio (PAR)	Yes
2.1047	Modulation Characteristics	Yes
2.1049	Occupied Bandwidth	Yes
2.1051	Out-of-Band Emissions	Yes
2.1051	Spurious Emissions at Antenna Terminals	Yes
2.1053, FCC 15 Class B	Field Strength of Spurious Radiation	Yes
FCC 15.111, 15.109, 15.33	Receiver Spurious Emissions	Yes
2.1055	Measurement of Frequency Stability	No

1.5 Band Carrier Frequencies

Table 1.5.1 Channels to Be Tested

Position in Certified Freq Range 663-3980 MHz	Bands	Frequency (UL/DL) (MHz)	Carrier Freq (UL/DL) (MHz)	Bandwidth (MHz)	Position	Maximum Rated Power Output* (dBm)
Low	b71/n71	663-698/617-652	673/627	20	B	23
			649.5/695.5	5	T	
			647/693	10	T	
Middle	b66/n66	1710–1780/ 2110–2200	2112.5/1712.5	5	B	23
			2120/1720	20	B	
			2130/1730	40	B	
			1775/2195	10	T	
			1770/2190	20	T	
			1760/2180	40	T	
Middle	b30/n30	2305–2315MHz/ 2350–2360MHz	2312.5/2357.5	5	T	23
Middle	b41/n41	2496–2690MHz	2498.5/2498.5	5	B	26
			2506/2506	20	B	
			2680/2680	20	T	
			2640/2640	100	T	
High	n77	3450-3550, 3700-3980	3550/3550	100	B	26
			3975/3975	10	T	

*For HPUE band (b41/n41 and n77), 2TX is supported and for non-HPUE bands (b71/n71, b66/n66 and b30/n30), only one Tx.

1.6 Test Standards & Measurement Procedures

1.6.1 Test Standards

- Title 47 Code of Federal Regulations, Federal Communications Commission Parts 2, 22, 24, 27, 90, 96.
- 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.
- FCC KDB 971168 D01 Power Measurement License Digital Systems v03r01 April 9, 2018.
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013.
- FCC KDB 662911 D02 MIMO with Cross-Polarized Antenna (October 25, 2011) - MIMO with Cross-Polarized Antenna.
- FCC KDB 662911 D03 MIMO with Cross-Polarized Antenna (October 13, 2020) - Provision to Allow Measurement of Directional Gain of Multi-Antenna Systems for Compliance Verification.
- ANSI C63.26-2015, American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services.
- ANSI C63.4-2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- ANSI C63.10-2020, American Nation Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- ANSI/TIA/EIA-603-E (2016) - Commercial Mobile Services (FCC Licensed Radio Service Equipment) in 47 CFR FCC Parts 22 (cellular), 24, 27, 90 and 96.

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

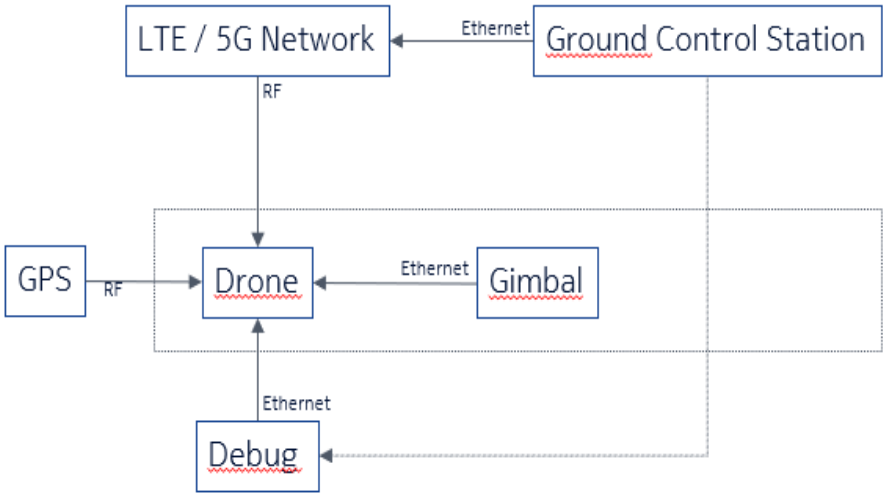
Antenna Port Test	Signal Bandwidth	Frequency Range	Expanded Uncertainty (k=2), Amplitude
Occupied Bandwidth, Edge of Band, Conducted Spurious Emissions	10 Hz 100 Hz 10 kHz to 1 MHz 1MHz	9 kHz to 20 MHz 20 MHz to 1 GHz 1 GHz to 10 GHz 10 GHz to 40 GHz:	1.78 dB
RF Power	10 Hz to 20 MHz	50 MHz to 18 GHz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

1.8 Executive Summary

Requirement 47 CFR FCC Parts 2 and 27	Description of Tests	Result
2.1046, 27.50(a)(c)(d)(h)(i)(j)(k)	RF Power Output, PSD	COMPLIES
27.50(d)(5), 27.50(j)(4), 27.50(k)(4)	Peak to Average Power Ratio (PAR)	COMPLIES
2.1047	Modulation Characteristics	COMPLIES
2.1049, 27.53	Occupied Bandwidth	COMPLIES
2.1051, 27.53(a)(g)(h) (i)(m)	Out-of-Band Emissions	COMPLIES
2.1051, 27.53(a)(g)(h) (i)(m)	Spurious Emissions at Antenna Terminals	COMPLIES
2.1053, 27.53(a)(g)(h) (i)(m)	Field Strength of Spurious Radiation	COMPLIES
FCC Part 15 Class B: 15.107, 15.109, 15.111, 15.33	EMI Power Line Conducted & Radiated Emissions, Rx Emissions[3]	COMPLIES
2.1055	Measurement of Frequency Stability	NT

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).

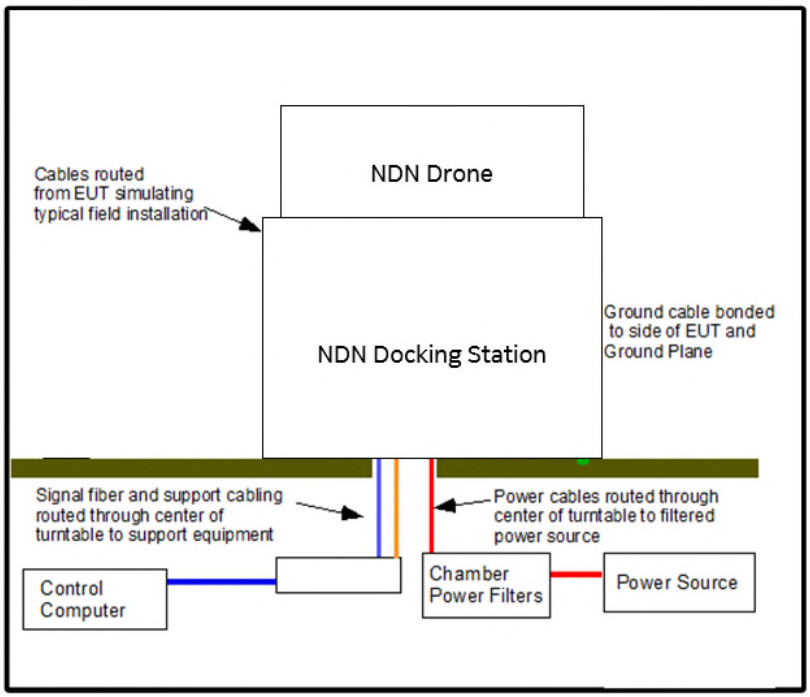
1.9 Test Configurations and Setup



EUT with NDN docking has three Test Modes, where Idle Mode and Flight Mode were used for enclosure radiated and EMC testing:

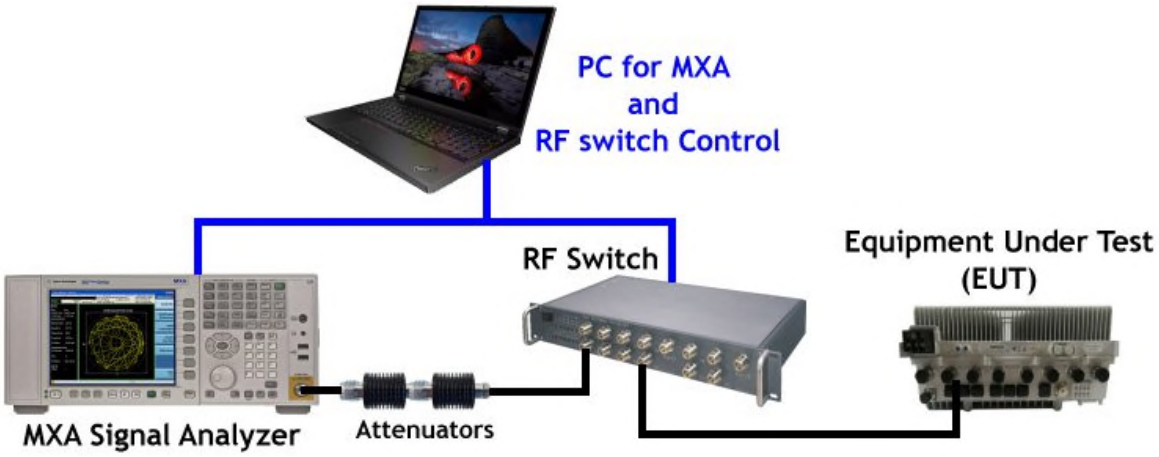
- Mode 1: Maintenance Mode
  - Connection via Debug adapter, no dependency on LTE/5G
  - Gimbal connection optional
  - Power supply connection (docking adapter) optional
- Mode 2: Idle Mode
  - Connected via LTE/5G to ground control station
  - Gimbal connected
  - Power supply connection via docking station adapter - connected
- Mode 3: Flight Mode (ready to fly)
  - Connected via LTE/5G to ground control station
  - Gimbal connected
  - Power supply connection via docking station adapter connection - **not** connected
  - Motors spinning

Test Setup for Radiated Measurements

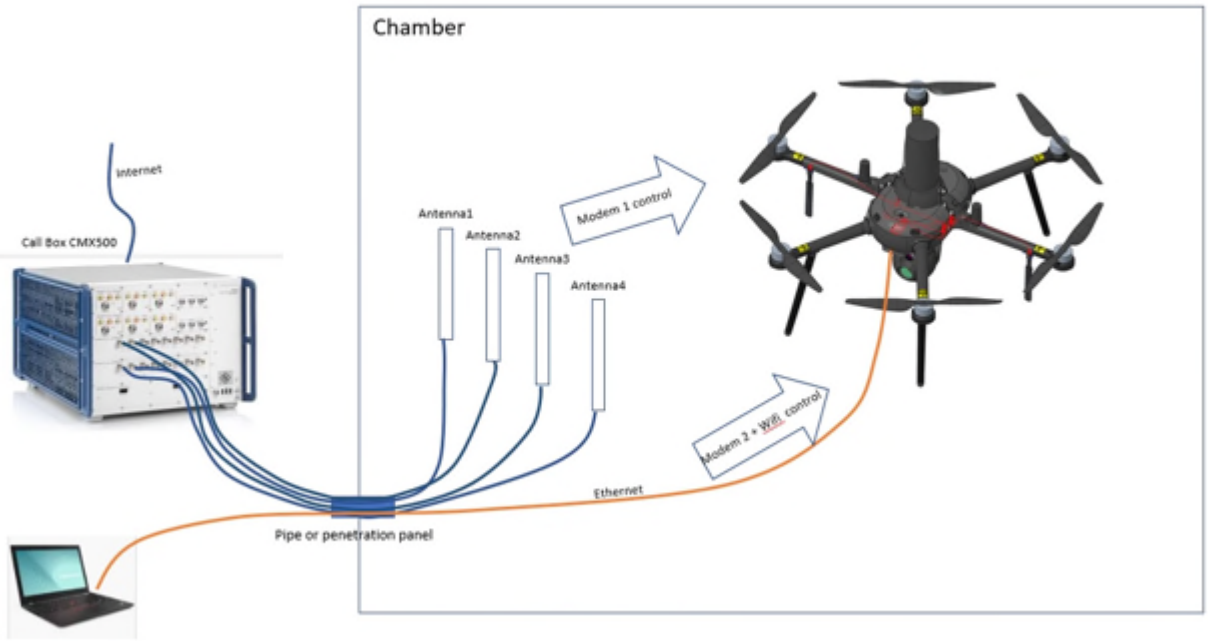


*NDN Docking Station is installed only in EMC related radiated compliance tests.

Test Setup for all Antenna Port Measurements



Radiated Test



2. FCC Section 2.1046 - RF Power Output

2.1 RF Power Output

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

The conducted output power levels tested in this report were based on the maximum power (conducted and EIRP) tested for P638893 modular original approval. The real power output in the field will be reduced based on the antennas used and the maximum EIRP limit.

2.1.1 RF Power Output Measurements

Power measurements of the LTE and NR transmit signal were conducted with an MXA Signal analyzer per KDB 971168 D01 using the gated RF Channel Power Function. The output power of both P638893 modules have been measured.

2.1.2 RF Power Output Results

The Port 0 is connected to Antenna 0, external antenna P567162 (dBi) and Port 2 is connected to Antenna 2, internal antenna P601003 (dBi), see Section 1.3.3.

The antennas installed in NDN Drone have higher antenna gains than that used in the P638893 original SA single module certification tests in most bands. The RF conducted power was evaluated at a reduced level for all bands to make their EIRP values comparable to that in original tests. The maximum HPUE rated power supported including MIMO power were also measured in b41/n41 and n77 bands.

Table 2.1.1a - RF Power - b71/n71 Module 1

Channel Power - 20 MHz				Channel Power - 20 MHz				Channel Power - 5 MHz				Channel Power - 10 MHz			
LTE, Test Model 3.1a 256QAM Channel Freq UL 673 MHz				NR, DFT-s-64QAM, 15k, Channel Freq UL 673 MHz				NR, DFT-s-QPSK, 15k, Channel Freq UL 695.5 MHz				NR, DFT-s-16QAM, 15k, Channel Freq UL 693 MHz			
Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)
0	18.77	3.0	21.77	0	**19.57**	3.0	**22.57**	0	19.35	3.0	22.35	0	18.90	3.0	21.90

Table 2.1.1b - RF Power - b71/n71 Module 2

Channel Power - 20 MHz				Channel Power - 20 MHz				Channel Power - 5 MHz				Channel Power - 10 MHz			
LTE, Test Model 3.1a 256QAM Channel Freq UL 673 MHz				NR, DFT-s-64QAM, 15k, Channel Freq UL 673 MHz				NR, DFT-s-QPSK, 15k, Channel Freq UL 695.5 MHz				NR, DFT-s-16QAM, 15k, Channel Freq UL 693 MHz			
Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)
0	18.71	3.0	21.71	0	19.41	3.0	22.41	0	19.32	3.0	22.32	0	18.85	3.0	21.85

Table 2.1.2a1 – RF Power – b66/n66 Module 1

Channel Power – 5 MHz				Channel Power – 20 MHz				Channel Power – 5 MHz				Channel Power – 20 MHz			
LTE, Test Model 3.2 QPSK Channel Freq UL 1712.5 MHz				LTE, Test Model 3.1a 256QAM Channel Freq UL 1770 MHz				NR, DFT-s-QPSK, 15k, Channel Freq UL 1712.5 MHz				NR, DFT-s-64QAM, 15k, Channel Freq UL 1720 MHz			
Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)
0	19.14	4.0	23.14	0	18.98	4.0	22.98	0	19.31	4.0	23.31	0	**19.36**	4.0	**23.36**

Table 2.1.2b1 – RF Power – b66/n66 Module 2

Channel Power – 5 MHz				Channel Power – 20 MHz				Channel Power – 5 MHz				Channel Power – 20 MHz			
LTE, Test Model 3.2 QPSK Channel Freq UL 1712.5 MHz				LTE, Test Model 3.1a 256QAM Channel Freq UL 1770 MHz				NR, DFT-s-QPSK, 15k, Channel Freq UL 1712.5 MHz				NR, DFT-s-64QAM, 15k, Channel Freq UL 1720 MHz			
Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)
0	19.1	4.0	23.1	0	18.91	4.0	22.91	0	19.13	4.0	23.13	0	19.11	4.0	23.11

Table 2.1.2a2 – RF Power – b66/n66 Module 1

Channel Power – 40 MHz				Channel Power – 10 MHz				Channel Power – 40 MHz			
NR, DFT-s-256QAM, 15k Channel Freq UL 1730 MHz				NR, DFT-s-16QAM, 15k Channel Freq UL 1775 MHz				NR, DFT-s-QPSK, 15k, Channel Freq UL 1760 MHz			
Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)
0	17.58	4.0	21.58	0	18.82	4.0	22.82	0	17.76	4.0	21.76

Table 2.1.2b2 – RF Power – b66/n66 Module 2

Channel Power – 40 MHz				Channel Power – 10 MHz				Channel Power – 40 MHz			
NR, DFT-s-256QAM, 15k Channel Freq UL 1730 MHz				NR, DFT-s-16QAM, 15k Channel Freq UL 1775 MHz				NR, DFT-s-QPSK, 15k, Channel Freq UL 1760 MHz			
Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)
0	17.78	4.0	21.78	0	18.73	4.0	22.73	0	17.58	4.0	21.58

Table 2.1.3a – RF Power – b30/n30 Module 1

Channel Power – 5 MHz			
LTE, 64QAM, 15k, Channel Freq UL 2312.5 MHz			
Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)
0	17.28	4.0	21.28

Table 2.1.3b – RF Power – b30/n30 Module 2

Channel Power – 5 MHz			
LTE, 64QAM, 15k, Channel Freq UL 2312.5 MHz			
Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)
0	**17.39**	4.0	**21.39**

Table 2.1.4a – RF Power – b41/n41 Module 1 at 21dBm

Channel Power – 5 MHz				Channel Power – 20 MHz				Channel Power – 20 MHz				Channel Power – 100 MHz			
LTE, Test Model 3.2 QPSK Channel Freq UL 2498.5 MHz				LTE, Test Model 3.1a 256QAM Channel Freq UL 2640MHz				NR, DFT-s-QPSK, 30k, Channel Freq UL 2506 MHz				NR, DFT-s-256QAM, 30k, Channel Freq UL 2640 MHz			
Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)
0	21.10	4.0	25.1	0	21.18	4.0	25.18	0	21.26	4.0	25.26	0	19.6	4.0	23.6

Table 2.1.4b – RF Power – b41/n41 Module 2 at 21dBm

Channel Power – 5 MHz				Channel Power – 20 MHz				Channel Power – 20 MHz				Channel Power – 100 MHz			
LTE, Test Model 3.2 QPSK Channel Freq UL 2498.5 MHz				LTE, Test Model 3.1a 256QAM Channel Freq UL 2640MHz				NR, DFT-s-QPSK, 30k, Channel Freq UL 2506 MHz				NR, DFT-s-256QAM, 30k, Channel Freq UL 2640 MHz			
Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)
0	**21.28**	4.0	**25.28**	0	21.09	4.0	25.09	0	21.19	4.0	25.19	0	19.5	4.0	23.5

Table 2.1.4c – RF Power – b41/n41 Module 2, at Rated Power 26dBm, non-MIMO

Channel Power – 5 MHz			
LTE, Test Model 3.2 QPSK Channel Freq UL 2498.5 MHz			
Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)
0	**26.06**	**4.0**	**30.06**

Table 2.1.4d – RF Power – b41/n41 Module 2, at Rated Power 26dBm, MIMO

Channel Power – 20 MHz									
NR, DFT-s-QPSK, 30k, Channel Freq UL 2506 MHz									
Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Total Power (dBm)	Total EIRP (dBm)
0	24.01	4.0	28.01	2	24.02	3.7	27.72	27.03	30.88

Table 2.1.5a – RF Power – n77 Module 1, non-MIMO

Channel Power – 10 MHz			
NR, DFT-s-256QAM, 30k, Channel Freq UL 3975 MHz			
Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)
2	**20.91**	2.7	**23.61**

Table 2.1.5b – RF Power – n77 Module 2, non-MIMO

Channel Power – 10 MHz			
NR, DFT-s-256QAM, 30k, Channel Freq UL 3975 MHz			
Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)
2	**20.73**	2.7	**23.43**

Table 2.1.5c – RF Power – n77 Module 2, MIMO

Channel Power – 100 MHz									
NR, DFT-s-256QAM, 30k, Channel Freq UL 3500 MHz									
Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Port	Pwr (dBm)	Ant (dBi)	EIRP (dBm)	Total Power (dBm)	Total EIRP (dBm)
0	18.52	5.0	**23.52**	2	18.75	3.6	**22.35**	**21.65**	**25.98**

Table 2.1.6 – Maximum RF Power Output of Two RF P638893 Modules Measured With Reduced Power Setting and non-MIMO

Position in 663-3980 MHz	Bands Freq (UL/DL) (MHz)	Radio Access Tech	Carrier Freq (UL/DL) (MHz)	Bandwidth (MHz)	Modulation	Posi	Maxi Power Output (dBm)	Maxi EIRP (dBm)
Low	b71/n71 663-698/ 617-652	LTE	673/627	20	256QAM	B	18.77	21.8
		NR	673/627	20	DFT-s-64QAM	B	19.57	22.6
			695.5/649.5	5	DFT-s-QPSK	T	19.35	22.4
			693/647	10	DFT-s-16QAM	T	18.90	21.9
Middle	b66/n66 1710–1780	LTE	1712.5/2112.5	5	QPSK	B	19.14	23.1
			1770/2190	20	256QAM	T	18.98	23.0
		NR	1712.5/2112.5	5	DFT-s-QPSK	B	19.31	23.3
			1720/2120	20	DFT-s-64QAM	B	19.36	23.4
			1730/2130	40	DFT-s-QPSK	B	17.78	21.8
			1775/2195	10	DFT-s-16QAM	T	18.82	22.8
			1760/2180	40	DFT-s 256QAM	T	17.76	21.8
Middle	b30/n30 2310–2315	LTE	2312.5/2357.5	5	64QAM		17.39	21.4
Middle	b41/n41 2496–2690	LTE	2498.5/2498.5	5	QPSK	B	**21.28**	**25.3**
			2640/2640	20	256QAM	T	21.18	25.2
		NR	2506/2506	20	DFT-s-QPSK	B	**21.26**	**25.3**
			2640/2640	100	DFT-s-256QAM	T	19.6	23.6
High	n77 3450-3550 3700-3980	NR	3500/3500	100	DFT-s-256QAM	B	20.73	23.4
			3975/3975	10	DFT-S-QPSK	T	20.91	23.6

Table 2.1.7 – Maximum RF Power Output of Two RF P638893 Modules Measured in NDN (Reduced Power Setting) vs SA Module by Vendor – non-MIMO

Bands Freq (UL) (MHz)	Radio Access Tech	Carrier Freq (UL) (MHz)	BW (MHz)	Modulation	Posi	Maxi Pwr Output (dBm)	Maxi EIRP (dBm)	Vendor Maxi Pwr Output (dBm)	Vendor Maxi EIRP (dBm)
b71/n71 663-698	LTE	673	20	256QAM	B	18.77	21.8	19.96	21.18
	NR	673	20	DFT-s-64QAM	B	19.57	22.6	21.88	23.1
		695.5	5	DFT-s-QPSK	T	19.35	22.4	23.13	24.35
		693	10	DFT-s-16QAM	T	18.90	21.9	22.27	23.49
b66/n66 1710–1780	LTE	1712.5	5	QPSK	B	19.14	23.1	23.62	25.09
		1770	20	256QAM	T	18.98	23.0	19.66	21.13
	NR	1712.5	5	DFT-s-QPSK	B	19.31	23.3	23.64	25.11
		1720	20	DFT-s-64QAM	B	19.36	23.4	21.79	23.26
		1730	40	DFT-s-QPSK	B	17.78	21.8	24.06	25.53
		1775	10	DFT-s-16QAM	T	18.82	22.8	22.42	23.89
		1760	40	DFT-s 256QAM	T	17.76	21.8	20.42	21.89
b30/n30 2310–2315	LTE	2312.5	5	64QAM		17.39	21.4	21.72	16.02
b41/n41 2496–2690	LTE	2498.5	5	QPSK	B	**21.28**	**25.3**	27.04	27.82
		2640	20	256QAM	T	21.18	25.2	22.18	22.96
	NR	2506	20	DFT-s-QPSK	B	**21.26**	**25.3**	25.69	26.47
		2640	100	DFT-s-256QAM	T	19.6	23.6	22.12	22.9
n77 3450-3550 3700-3980	NR	3500	100	DFT-s-256QAM	B	20.73	23.4	24.46	18.56
		3975	10	DFT-s-QPSK	T	20.91	23.6	24.24	18.14

Table 2.1.8 – Maximum RF Rated Power Outputs (26dBm) Measured in NDN vs SA Module by Vendor, LTE, Non-MIMO, HPUE

Bands Freq (UL) (MHz)	Carrier Freq (UL) (MHz)	BW (MHz)	Modulation	Posi	Maxi Power Output (dBm)	Maxi EIRP (dBm)	Vendor Maxi Power Output (dBm)	Vendor Maxi EIRP (dBm)
b41/n41 2496–2690	2498.5	5	QPSK	B	26.06	30.06	27.04	27.82

Table 2.1.9 – Maximum RF Power Outputs Measured in NDN vs SA Module by Vendor, NR and 2Tx MIMO

Bands Freq (UL) (MHz)	Carrier Freq (UL) (MHz)	BW (MHz)	Modulation	Posi	Total Maxi Power Output (dBm)	Total Maxi EIRP (dBm)	Vendor Total Maxi Power Output (dBm)	Vendor Total Maxi EIRP (dBm)
b41/n41 2496–2690	2506	20	CP-QPSK	B	27.03	30.88	23.55	24.33
n77 3450-3550	3500	100	CP-256QAM	B	21.65	25.98	19.1	13.1

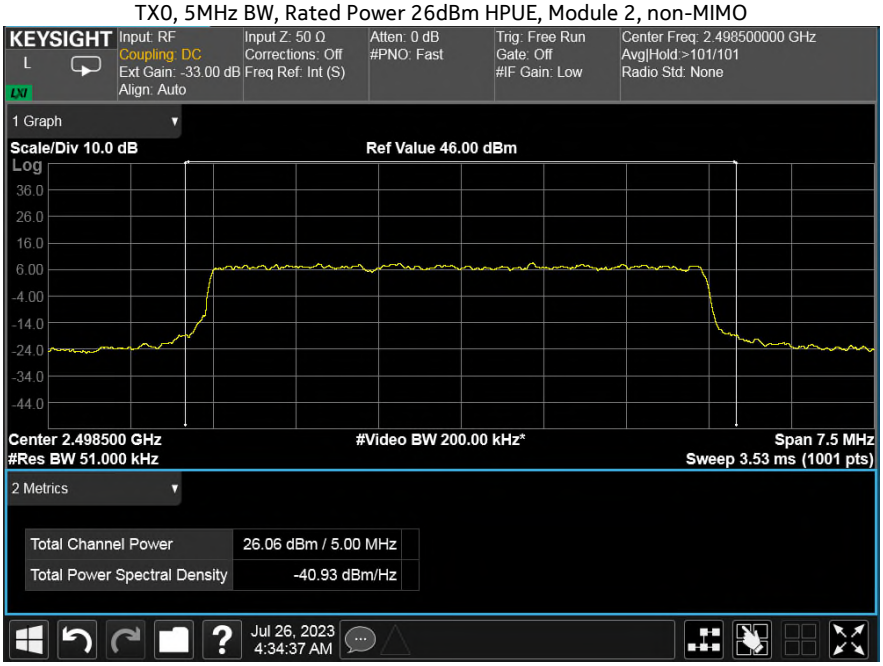
The HPUE RF conducted power measured for b41/n41 (MIMO and non-MIMO) is very close to the maximum rated power 26dBm. The EIRP limit for b41/n41 band is 33dBm. The EIRP limit for n77 band is 30dBm. The test results verified the maximum HPUE power output supported by RF P638893 module.

2.1.3 Maximum RF Conducted Output Power Plots

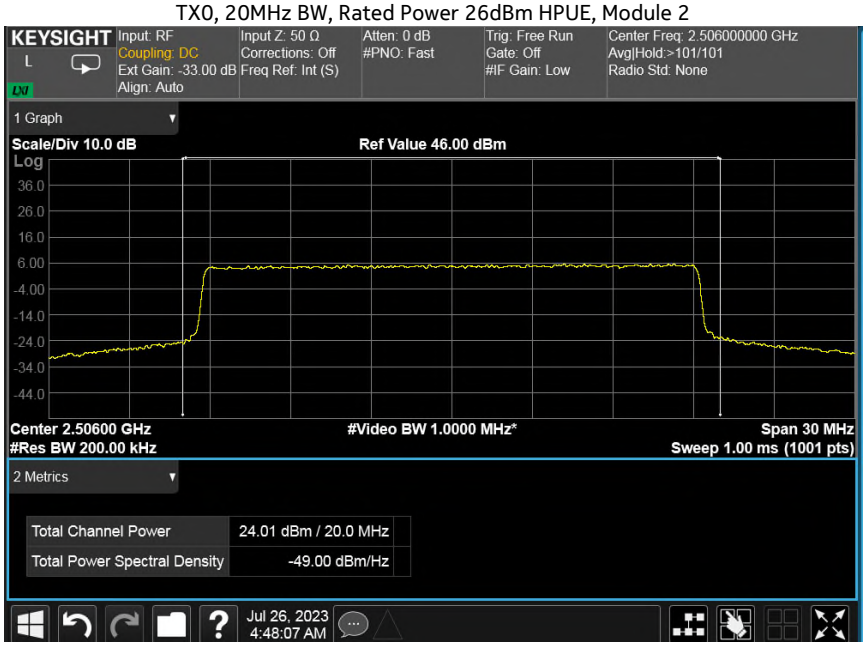
NOTE: Only plots with highest power in LTE and NR technologies supported are used in this report. The full suite of raw data resides at the MH, New Jersey location.

RF Power – 1C LTE

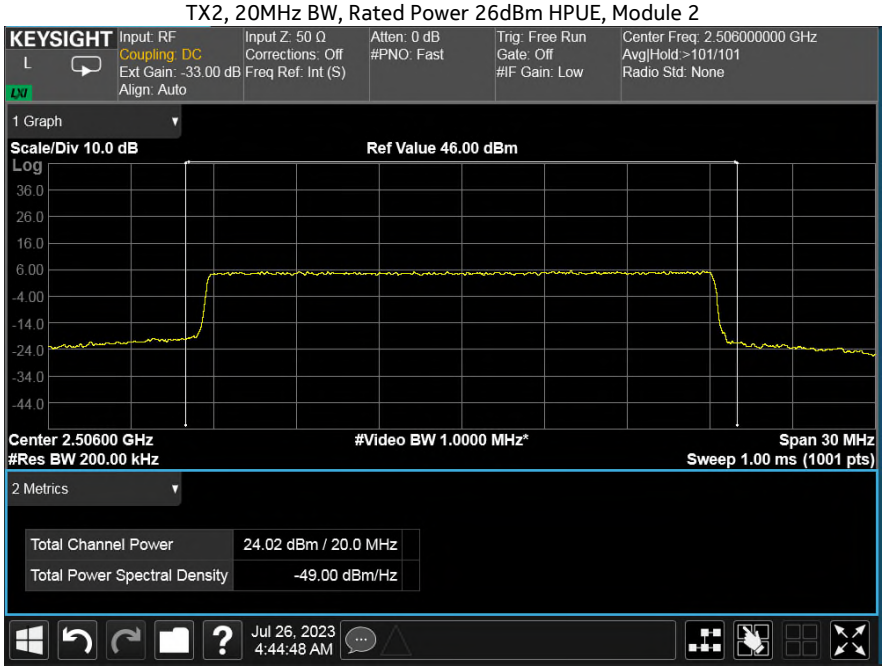
Modulation Test Model 3.2 QPSK
Channel Frequency 2498.5 MHz, b41
TX0, 5MHz BW, Rated Power 26dBm HPUE, Module 2, non-MIMO



RF Power – 1C 5G-NR MIMO
DFT-s-QPSK, 30K
Channel Frequency 2506 MHz, n41
TX0, 20MHz BW, Rated Power 26dBm HPUE, Module 2



RF Power – 1C 5G-NR MIMO
DFT-s-QPSK, 30K
Channel Frequency 2506 MHz, n41
TX2, 20MHz BW, Rated Power 26dBm HPUE, Module 2



2.2 EIRP Compliance

Two P638893 cannot transmit on the same channel simultaneously. Compliance with the EIRP (Effective Isotopically Radiated Power) requirements is on each individual module only and is tabulated in Table 2.2 below.

In the event the maximum antenna gains minus installation pathloss (cabling loss) are higher, the product Output Power Setting must be reduced in order to stay within the EIRP limits for the band.

Table 2.2.1a EIRP Compliance with External Antenna P567162 (Higher Antenna Gain), Non- MIMO

Position in 663-3980 MHz	Bands	Freq UL/DL (MHz)	Max Output Power (dBm)	Maximum EIRP (dBm)	Limit EIRP (dBm)	Compliance Pass/Fail
Low	b71/n71	663-698/ 617-652	19.57	22.6	32.6	Pass
Middle	b66/n66	1710–1780/2110–2200	19.36	23.4	30	Pass
Middle	b30/n30	2310–2315/2355–2360	17.39	21.4	24	Pass
Middle	b41/n41	2496–2690	26.06	30.06	33	Pass
High	n77	3450-3550, 3700-3980	20.91	23.6	30	Pass

Table 2.2.1b EIRP Compliance with One External Antennas P567162 and One Internal Antennas P601003 with 2Tx MIMO

Bands	Freq UL/DL (MHz)	Maxi Total Output Power (dBm)	Maximum EIRP (dBm)	Limit EIRP (dBm)	Compliance Pass/Fail
b41/n41	2496–2690	27.03	30.88	33	Pass
n77	3450-3550, 3700-3980	21.65	25.98	30	Pass

Table 2.2.2a EIRP Data Comparison Between NDN Drone and SA Module, Non-MIMO

Position in 663-3980 MHz	Bands	Freq UL/DL (MHz)	Maximum EIRP (dBm)	Vendor Maximum EIRP (dBm)	Δ (dB)
Low	b71/n71	663-698/ 617-652	22.6	23.1	-0.5
Middle	b66/n66	2110–2200/1710–1780	23.4	23.3	0.1
Middle	b30/n30	2310–2315/2355–2360	21.4	16.0	5.4
Middle	b41/n41	2496–2690	25.3/30.06*	27.1	-1.8/2.96
High	n77	3450-3550, 3700-3980	23.6	18.1	5.5

*Lower power setting and maximum HPUE power setting.

Table 2.2.2b EIRP Comparison with 2Tx MIMO

Position in 663-3980 MHz	Bands	Freq UL/DL (MHz)	Maximum EIRP (dBm)	Vendor Maximum EIRP (dBm)	Compliance Pass/Fail
Middle	b41/n41	2496–2690	30.88	28.7	2.18
High	n77	3450-3550, 3700-3980	25.98	27.2	-1.22

2.2.1 Maximum Antenna Gain Allowed

The maximum allowed antenna gains given on the FCC grant of P638893 as a single module were calculated based on 1) the difference between the maximum rated power for each band plus +2dB tolerance and the EIRP/ERP limit for each band (add 3dB for B38/n38. B41/n41, n77 and n78 which support MIMO), and 2) the power level restriction for a minimum safety distance of 20cm, which ever is lower. See the table below for the calculations.

Table 2.2.3 Maximum Antenna Gain Allowed on P638893 SA Module Certificate

Bands	Freq Range UL (MHz)	Maxi Rated Power (dBm)	Tolerance +T ***	MIMO (dB)	P_{max} = Maxi Rated Cond Power +T + MIMO (dBm)	EIRP Limit (dBm)	Maxi Ant Gain Allowed ($EIRP_{Lim}$ - P_{max}) (dBi)	Maxi Ant Gain Allowed on Grant (dBi)
b2, n2	1850-1910	23	2	0	25	33	8	8
b25, n25	1850-1915	23	2	0	25	33	8	8
b4	1710-1755	23	2	0	25	30	5	5
b66, n66	1710-1780	23	2	0	25	30	5	5
b7, n7	2500 ~ 2570	23	2	0	25	33	8	8
b12, n12	699 ~716	23	2	0	25	36.92	11.92	8.7*
b13, n13	777 ~ 787	23	2	0	25	36.92	11.92	9.16*
b14, n14	788-798	23	2	0	25	36.92	11.92	9.23*
B17	704-716	23	2	0	25	36.92	11.92	8.74*
b26, n26	814-824	23	2	0	25	40.6	15.6	9.36*
b30, n30	2305-2315	23	2	0	25	23.98	-1.02	-1.02
b38, n38	2570-2620	26	2	3	28	33.0	5	5
b41, n41	2496 ~ 2690	26	2	3	28	33.0	5	5
b42	3400 ~ 3600	26	2	3	28	30.0	2	2
b43	3600 ~ 3800	26	2	3	28	30.0	2	2
b48, n48	3550-3700	23	2	0	25	23.0**	-2	-2
n70	1695 ~ 1710	23	2	0	25	30	5	5
b71, n71	663 ~ 698	23	2	0	25	36.92	11.92	8.48*
n77	3300 ~ 3980	26	2	3	28	30	2	2
n78	3300-3800	26	2	3	28	30	2	2

* Maximum antenna gain allowed was reduced for the FCC grant of P638893 RF Module for a minimum safety distance of 20cm. ** for 10MHz

*** ±1dB in RF module P638893 specification.

NDN Electric Drone certainly does not need to maintain a minimum safety distance at 20cm. Therefore, the maximum allowed antenna gain data on the FCC grant of P638893 as a single module are no longer valid. The maximum allowed antenna gain for NDN Drone should be based on the value ($EIRP_{Lim}$ - P_{max}), where the maximum rated power, extra tolerance +2dB and MIMO have been taken into consideration.

Table 2.2.4 Maximum Antenna Gain Allowed for NDN Drone P591013

Bands	Freq Range UL (MHz)	NDN Maxi Conducted Power (dBm)	NDN Maxi Ant Gain Used (dBi)	EIRP Limit (dBm)	EIRP Limit - NDN Maxi Conducted Pwr (dB)	Maxi Ant Gain Allowed for NDN Drone (dBi)
b2, n2	1850-1910	24.86	4.0	33	8.14	8.0
b25, n25	1850-1915	25.00	4.0	33	8.00	8.0
b4	1710-1755	24.98	4.0	30	5.02	5.0
b66, n66	1710-1780	24.96	4.0	30	5.04	5.0
b7, n7	2500 ~ 2570	24.96	4.0	33	8.04	8.0
b12, n12	699 ~716	24.89	3.0	36.92	12.03	11.92
b13, n13	777 ~ 787	24.61	3.0	36.92	12.31	11.92
b14, n14	788-798	24.79	3.0	36.92	12.13	11.92
B17	704-716	24.97	3.0	36.92	11.95	11.92
b26, n26	814-824	24.96	3.0	40.6	15.64	15.6
b30, n30	2305-2315	19.48	4.0	23.98	4.5	4.0
b38, n38	2570-2620	25.99	4.0	33.0	7.01	5.0
b41, n41	2496 ~ 2690	27.04	4.0	33.0	5.96	5.0
b42	3400 ~ 3600	23.02	5.0	30.0	6.98	5.0
b43	3600 ~ 3800	22.85	5.0	30.0	7.15	5.0
b48, n48	3550-3700	17.53	5.0	23.0*	5.47	5.0
n70	1695 ~ 1710	23.77	2.7	30	6.23	5.0
b71, n71	663 ~ 698	24.98	3.0	36.92	11.94	11.92
n77	3300 ~ 3980	23.02	5.0	30	6.98	5
n78	3300-3800	22.85	5.0	30	7.15	5

2.3 Peak-to-Average Power Ratio (PAPR)

The Peak-to-Average Power Ratio (PAPR) of the EUT was measured per KDB 971168 D01 using the Power Complementary Cumulative Distribution Function (CCDF) feature of the MXA Analyzer. The PAPR measurements are tabulated in Table 2.3.1.

Often it is expected that the transmitter's peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission. The limits are specified in FCC Part 27.50(d)(5), 27.50(j)(4), 27.50(k)(4). The PAPR values for each measured configuration are given in Table 2.3.1.

2.3.1 Peak-to-Average Power Ratio Results

The maximum Peak-to-Average Power Ratio (PAPR) of the EUT measured at its antenna transmitting terminals was measured to be 8.37dB maximum, which is in full compliance with the requirement to not exceed 13 dB as specified by the FCC. The representative data sets exact values are listed in the table below.

Table 2.3.1 Peak to Average Power Ratio (Port 0)

Position in 663-3980 MHz	Bands Freq (UL/DL) (MHz)	Tech	Carrier Freq (UL/DL) (MHz)	BW (MHz)	Modem	Modulation	PAR at 0.1% (dB)	PAR at 0.1% Limit
Low	b71/n71 663-698/617-652	LTE	673/627	20	M1	256QAM	6.78	13
Middle	b66/n66 1710–1780/2110–2200	LTE	1712.5/2112.5	5	M1	QPSK	5.65	13
Middle	b30/n30 2310–2315/2355–2360	LTE	2312.5/2357.5	5	M1	64QAM	6.59	13
Middle	b41/n41 2496–2690	LTE	2498.5/2498.5	5	M2	QPSK	5.34	13
Middle	b41/n41 2496–2690	NR	2640/2640	100	M1	DFT-s-256QAM	**8.37**	13
High	n77 3450-3550, 3700-3980	NR	3975/3975	10	M1	DFT-s-256QAM	6.87	13

2.3.2 Peak-to-Average Power Ratio Plots

The plot with the maximum PAPR is presented below.

5G-NR
Modulation DFT-s-256QAM
Channel Frequency 2640 MHz, n41, 100 MHz BW

3. FCC Section 2.1047 – Modulation Characteristics

3.1 Modulation Characteristics

The RF signal at the antenna port was demodulated and verified for correctness of the modulation signal used before each test was performed.

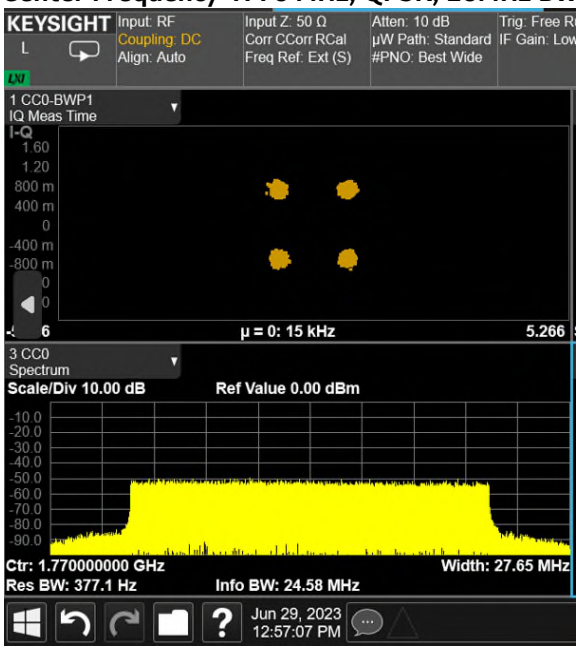
The following modulations have been selectively checked:

Bands	Modulations	Carrier (MHz)	Bandwidth (MHz)
B71/n71 663-698MHz (UL), 617-652MHz (DL)	256QAM LTE	668/623	10
	DFT-s-QPSK NR 15kHz	668/623	10
B66/n66 1710–1780MHz (UL), 2110–2200MHz (DL)	QPSK LTE	1770/2190	20
	256QAM LTE	1770/2190	20
	DFT-s-16QAM NR 15k	1770/2190	20
	DFT-s-64QAM NR 15k	1770/2190	20
	DFT-s 256QAM NR 15k	1770/2190	20

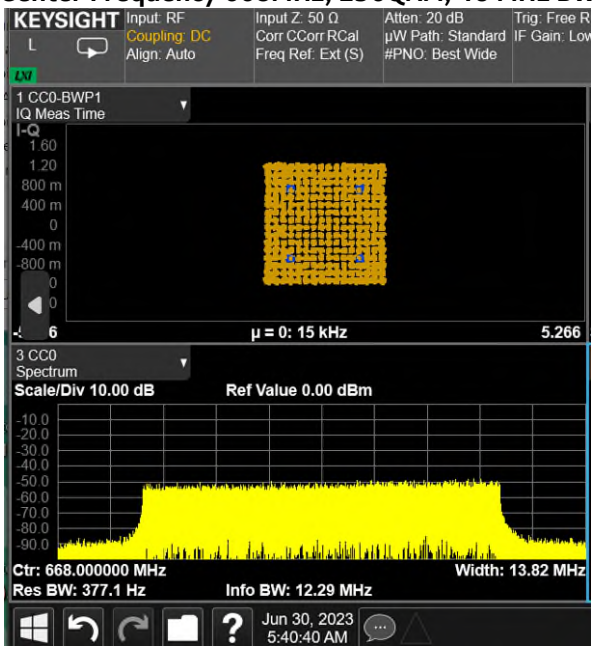
3.1.1 Modulation Characteristics – Plots

Modulation LTE

Center Frequency 1770 MHz, QPSK, 20MHz BW

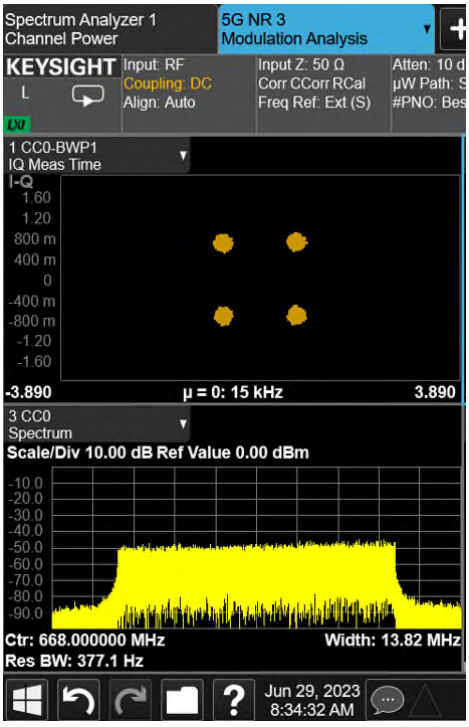


Center Frequency 668MHz, 256QAM, 10 MHz BW

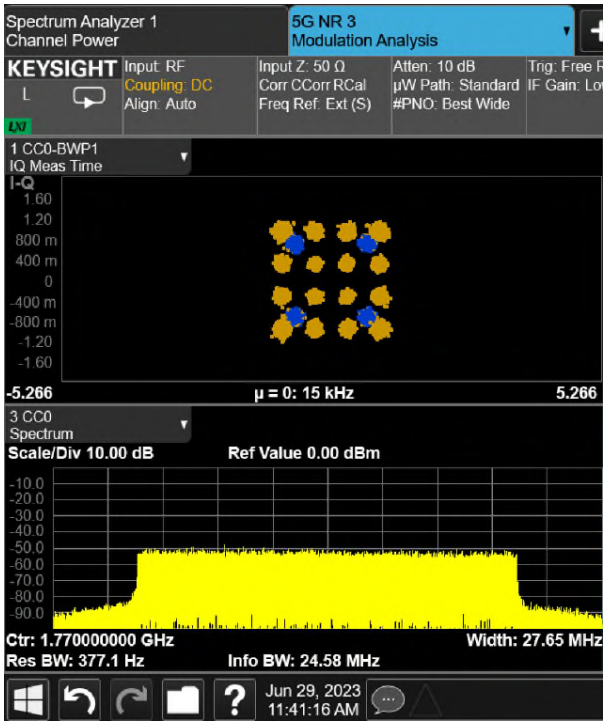


Modulation NR

Center Frequency 668 MHz, DFT-s-QPSK NR 15kHz, 10MHz BW

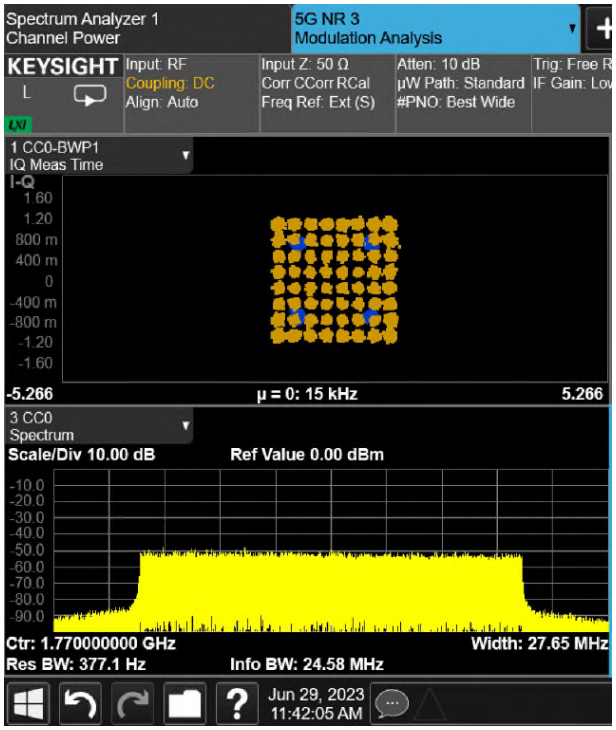


Center Frequency 1770MHz, DFT-s-16QAM NR 15k, 20 MHz BW

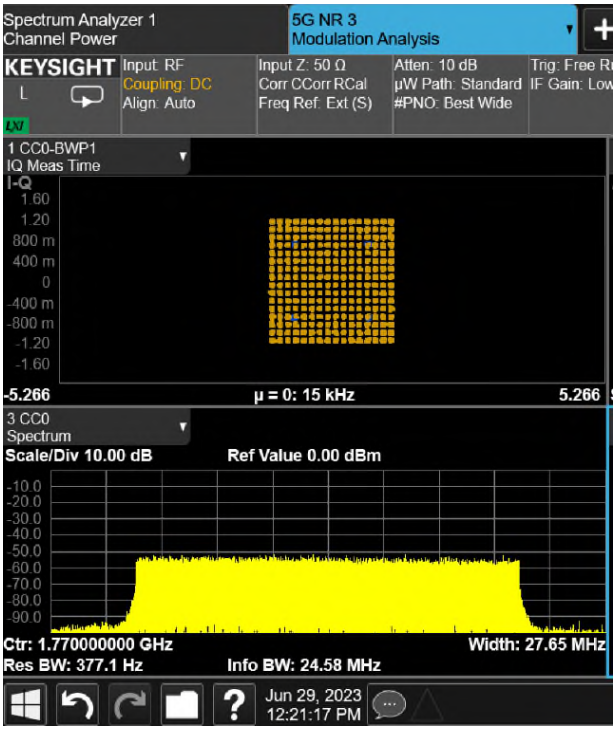


Modulation NR

Center Frequency 1770MHz, DFT-s-64QAM,15k, 20 MHz BW



Center Frequency 1770MHz, DFT-s 256QAM, 15k, 20 MHz BW



4. FCC Section 2.1049 – Occupied Bandwidth/Edge of Band Emissions

4.1 Occupied Bandwidth

In 47CFR 2.1049 the FCC requires:

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

This required measurement is the 99% Occupied Bandwidth, also called the designated signal bandwidth and needs to be within the parameters of the products specified emissions designator. During these measurements it is customary to evaluate the Edge of Band emissions at block/band edges.

The transmitted signal occupied bandwidth was measured using a Keysight MXA Signal Analyzer. All emissions were within the parameters as required.

4.1.1 Occupied Bandwidth Results

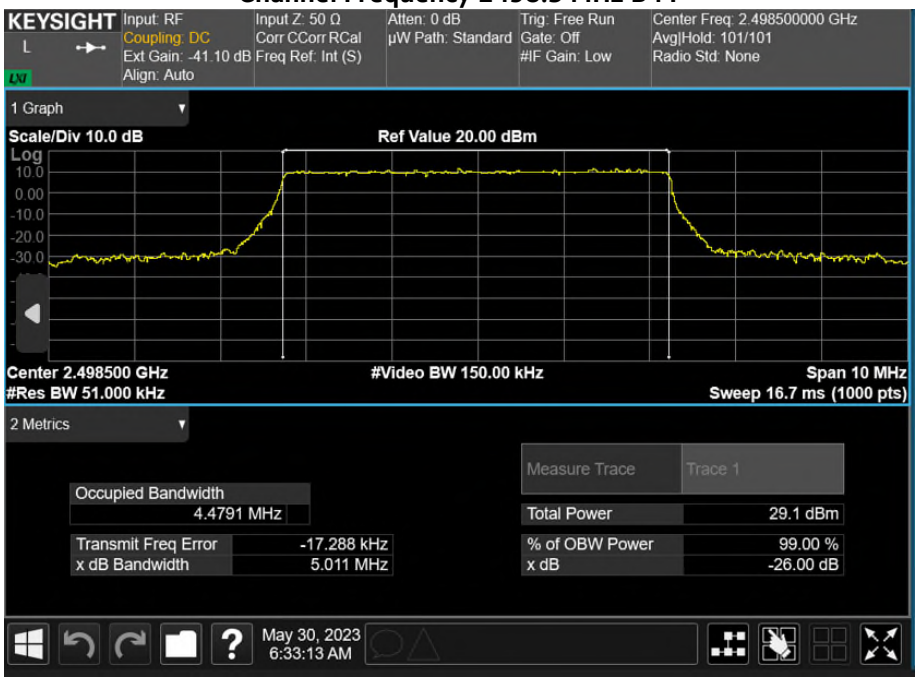
The 99% occupied bandwidth and -26 dB relative bandwidth were measured with an Agilent/Keysight MXA signal analyzer for the emission designators. The results are tabulated in Table 4.1.1 and example plots are in section 4.1. 2.

Table 4.1.1 Occupied Bandwidth (Port 0)

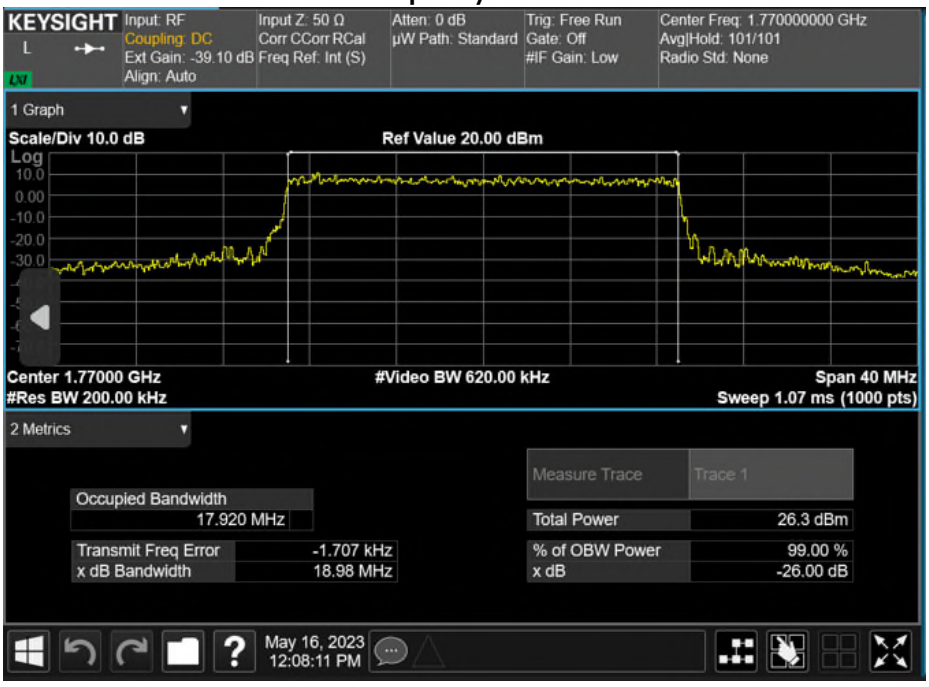
Posi in 663-3980 MHz	Bands Freq (UL/DL) (MHz)	Radio Access Tech	Carrier Freq (UL/DL) (MHz)	Bandwidth (MHz)	Modulation	Posi	99% Occupied BW MHz	26dB BW MHz
Low	b71/n71 663-698/ 617-652	LTE	673/627	20	256QAM	B	17.77	18.46
		NR	673/627	20	DFT-s-64QAM 15k	B	18.17	19.32
			695.5/649.5	5	DFT-s-QPSK 15k	T	**4.48**	5.15
			693/647	10	DFT-s-16QAM 15k	T	8.95	10.10
Middle	b66/n66 1710–1780/ 2110–2200	LTE	1712.5/2112.5	5	QPSK	B	4.48	4.96
			1770/2190	20	256QAM	T	**17.92**	18.98
		NR	1712.5/2112.5	5	DFT-s-QPSK 15k	B	4.47	4.92
			1720/2120	20	DFT-s-64QAM 15k	B	**18.90**	20.25
			1730/2130	40	DFT-s-QPSK 15k	B	37.47	38.99
			1775/2195	10	DFT-s-16QAM 15k	T	8.61	9.82
			1760/2180	40	DFT-s 256QAM 15k	T	**37.89**	39.67
Middle	b30/n30 2310–2315/ 2355–2360	LTE	2312.5/2357.5	5	64QAM		4.47	4.87
		NR	2312.5/2357.5	5	DFT-s-Pi/2-BPSK		4.48	5.09
Middle	b41/n41 2496–2690 MHz	LTE	2498.5/2498.5	5	QPSK	B	**4.48**	5.01
			2640/2640	20	256QAM	M	17.88	19.18
		NR	2506/2506	20	DFT-s-QPSK, 30K	B	18.24	19.66
			2640/2640	100	DFT-s-256QAM, 30K	T	**97.36**	100.8
High	n77 3450-3550, 3700-3980	NR	3975/3975	10	DFT-s-QPSK, 30kHz	T	**8.95**	10.24

4.1.1.1 Occupied Bandwidth – Plots

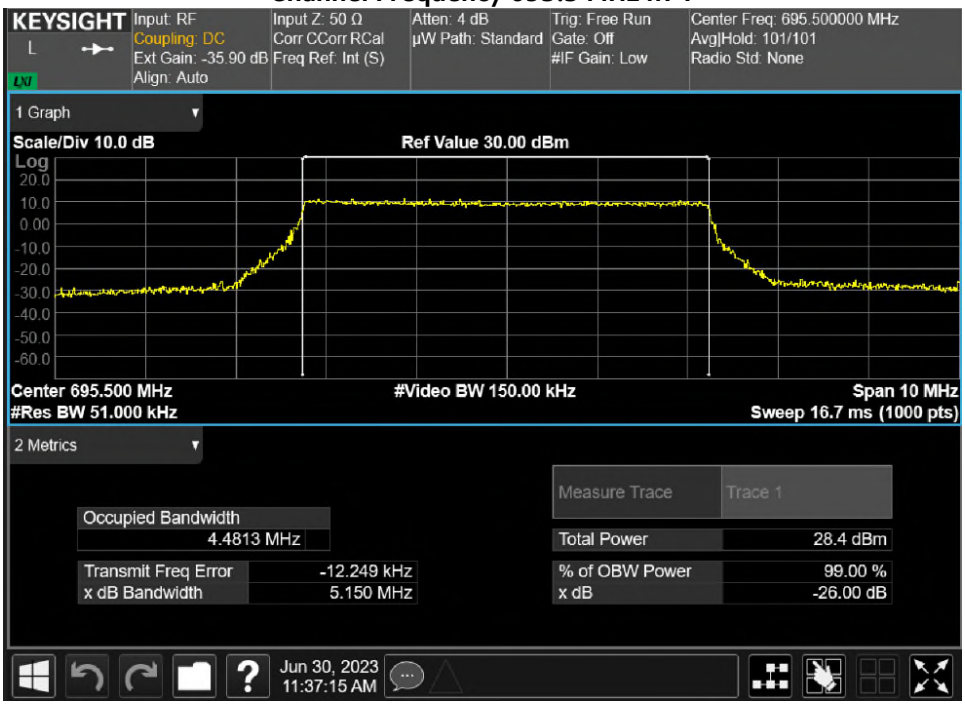
1C – LTE 5MHz
Modulation QPSK
Channel Frequency 2498.5 MHz B41



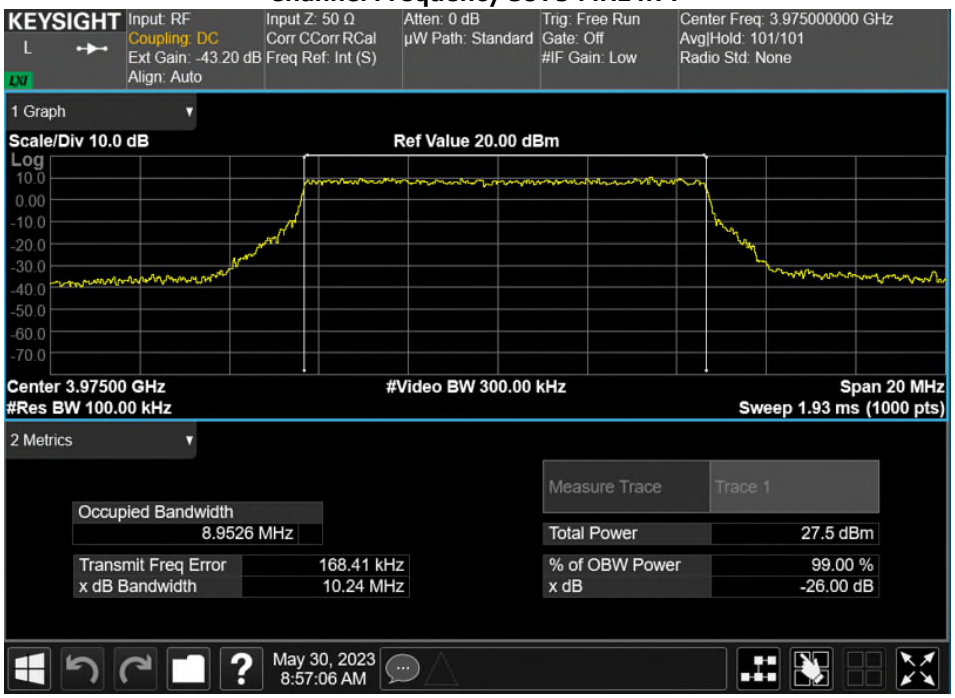
1C – LTE 20MHz
Modulation 256QAM
Channel Frequency 1770 MHz B66



1C – NR 5MHz
Modulation DFT-s-QPSK, 15kHz
Channel Frequency 695.5 MHz n71



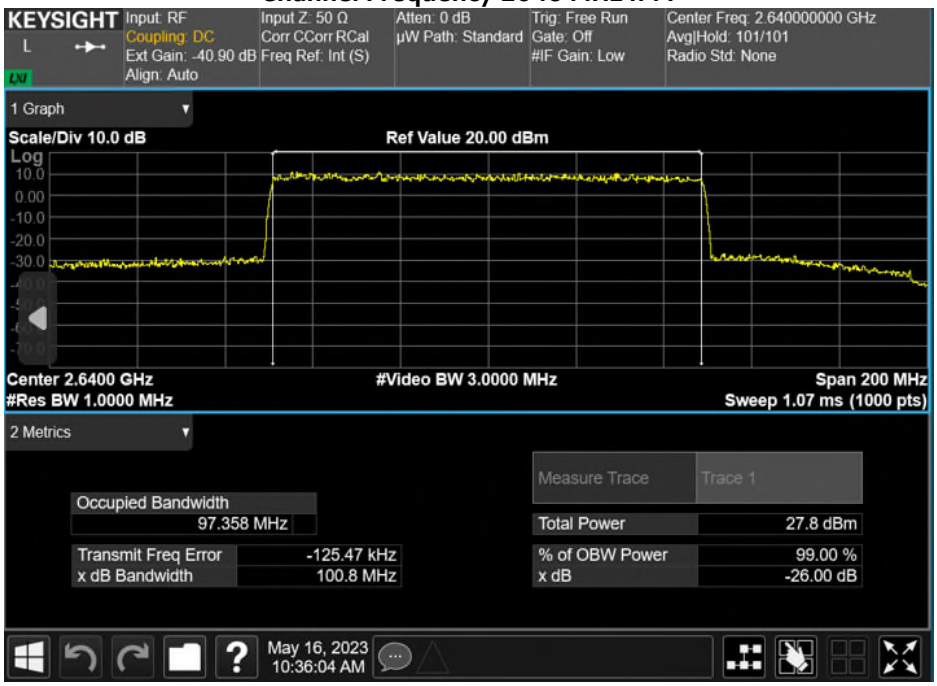
1C – NR 10MHz
Modulation DFT-s-QPSK, 30kHz
Channel Frequency 3975 MHz n77



1C – NR 20MHz
Modulation DFT-s-64QAM, 15kHz
Channel Frequency 1720 MHz n66

1C – NR 40MHz
Modulation DFT-s 256QAM, 15k
Channel Frequency 1760 MHz n66

1C – NR 100MHz
Modulation DFT-s-256QAM, 30kHz
Channel Frequency 2640 MHz n41



4.2 Edge of Band Emissions

47CFR 27.53 has specified that the unwanted emission limits for b71/n71, b66/n66, b30/n30, b41/n41 and n77 which are provided below:

Table 4.2.1 Tx Unwanted Emission Limits for Carriers Tested without MIMO

Bands	Freq UL/DL (MHz)	FCC Rules	Emission Limit Per Port with MIMO & RBW
b71/n71	663-698/ 617-652	27.53(g)	• 0~100kHz: -13dBm/30kHz • >100kHz: -13dBm/100kHz
b66/n66	1710–1780/ 2110–2200	27.53(h)(1)(3)	• 0~1MHz: -13dBm/1% BW (26dB), • >1MHz: -13dBm/1MHz
b30/n30	2310–2315/ 2355–2360	27.53(a)(4)(5)	• 2309-2310, 2315-2316: -13dBm/50kHz • 2300-2309, 2316-2320, 2345-2365: -13dBm/MHz • 2296-2300, 2320-2324, 2341-2345: -25dBm/MHz • 2292-2296, 2324-2328, 2337-2341: -31dBm/MHz; • 2288-2292, 2328-2337: -37dBm/MHz; • < 2288, > 2365: -40dBm/MHz
b41/n41	2496–2690	27.53(m)(4)(6)	• 0~1MHz: -10dBm/2% BW(26dB) (if it is 2495-2496: 1%) • 1~5MHz: -10dBm/MHz, • 5~XMHz: -13dBm/MHz • >XMHz: -25dBm/MHz • 2490.5~2496: at least -13dBm/MHz • < 2490.5: at least -25dBm/MHz For BW=5MHz, X= 6 For BW > 6MHz, X= BW
n77	3700-3980	27.53(i)(2)	• 0~1MHz: -13dBm/1% BW(26dB) or 350kHz • 1~5MHz: -13dBm/500kHz • >5MHz: -13dBm/1MHz
	3450-3550	27.53(n)(2)	• 0~1MHz: -13dBm/min {1% BW(26dB) or 200kHz} • 1~5MHz: -13dBm/500kHz • >5MHz: -13dBm/1MHz

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. All mask values were adjusted based upon the designated signal bandwidth and measurement bandwidths.

Table 4.2.2 Emission Masks for Carriers Tested without MIMO

Bands	Freq UL (MHz)	FCC Rules	Bandwidth (MHz)	Emission Mask (Per Port)
b71/n71	663-698	27.53(g)	5/10/20	• 0~100kHz: -13dBm/30kHz • >100kHz: -18.22dBm/30kHz
b66/n66	1710–1780	27.53(h)(1)(3)	5	• 0~1MHz: -13dBm/50kHz, • >1MHz: -26dBm/50kHz
			10	• 0~1MHz: -13dBm/100kHz, • >1MHz: -23dBm/100kHz
			20	• 0~1MHz: -13dBm/200kHz, • >1MHz: -20dBm/200kHz
			40	• 0~1MHz: -13dBm/400kHz, • >1MHz: -17dBm/400kHz
b30/n30	2310–2315	27.53(a)(4)(5)	5	• 2309-2310, 2315-2316: -13dBm/50kHz • 2300-2309, 2316-2320, 2345-2365: -26dBm/50kHz • 2296-2300, 2320-2324, 2341-2345: -38dBm/50kHz • 2292-2296, 2324-2328, 2337-2341: -44dBm/50kHz • 2288-2292, 2328-2337: -50dBm/50kHz
b41/n41	2496–2690	27.53(m)(4)(6)	5@ 2498.5M (2496-2501)	• 2495-2496, 2501-2502: -10dBm/100kHz • 2490~2495: -23dBm/100kHz, • 2502-2506: -20dBm/100kHz • 2506-2507: -23dBm/100kHz • >2507, < 2490: -35dBm/100kHz
			20@2506M (2496-2516)	• 2495-2496, 2516-2517: -10dBm/400kHz • 2490.5-2495: -17dBm/400kHz • 2517-2521: -14dBm/400kHz, • 2521-2536: -17dBm/400kHz • >2536: -29dBm/400kHz • < 2490.5: -29dBm/400kHz
			20@2680M or @2640M	• 0~1MHz: -10dBm/400kHz • 1~5MHz: -14dBm/400kHz, • 5~20MHz: -17dBm/400kHz • >20MHz: -29dBm/400kHz
			100 @2640M	• 2585-2590, 2690-2695: -10dBm/MHz • 2490-2585, 2695-2790: -13dBm/MHz • >2790MHz: -25dBm/MHz • < 2490: -25dBm/MHz
n77	3700-3980	27.53(i)(2)	10	0~1MHz: -13dBm/100kHz 1~5MHz: -20dBm/100kHz >5MHz: -23dBm/100kHz
			100	0~1MHz: -11.45dBm/500kHz 1~5MHz: -13dBm/500kHz >5MHz: -16dBm/500kHz Or 0~1MHz: -13dBm/350kHz 1~5MHz: -14.55dBm/350kHz >5MHz: -17.56dBm/350kHz
	3450-3550	27.53(n)(2)	100	0~1MHz: -13dBm/200kHz 1~5MHz: -17dBm/200kHz >5MHz: -20dBm/200kHz

4.2.1 Edge of Band Emissions Results

The out-of-band emissions at antenna terminals were investigated for the following configurations with the power output levels presented in Section 2.1.2. Over the required frequency spectrum investigated for the EUT, no failed out-of-block spurious emissions were detected. The measurement results demonstrate that the subject of the application is in full compliance with the Rules of the Commission.

Table 4.2.3 Conducted Tx Out-of-Band Emissions Tested (Tx Port = 0)

Position in 663-3980 MHz	Bands Freq (UL/DL) (MHz)	Radio Access Technology	Carrier Freq (UL/DL) (MHz)	Bandwidth (MHz)	Modulation	Posi	Results (Margin) (dB)
		LTE	673/627	20	256QAM	B	25.6
	b71/n71		673/627	20	DFT-s-64QAM	B	21.83
Low	663-698/	NR	695.5/649.5	5	DFT-s-QPSK	T	13.34
	617-652		693/647	10	DFT-s-16QAM	T	15.04
		LTE	1712.5/2112.5	5	QPSK	B	12.47
	b66/n66		1770/2190	20	256QAM	T	18.12
Middle	1710–1780/		1712.5/2112.5	5	DFT-s-QPSK	B	11.53
	2110–2200	NR	1720/2120	20	DFT-s-64QAM	B	12.56
			1730/2130	40	DFT-s-QPSK	B	23.33
			1775/2195	10	DFT-s-16QAM	T	16.74
			1760/2180	40	DFT-s 256QAM	T	**20.62**
Middle	b30/n30 2310–2315/	LTE	2312.5/2357.5	5	64QAM		**10.49**
	2355–2360	NR	2312.5/2357.5	5	DFT-s-Pi/2-BPSK		12.09
	b41/n41	LTE	2498.5/2498.5	5	QPSK	B	15.65
Middle	2496–2690MHz		2640/2640	20	256QAM	M	18.36
		NR	2506/2506	20	DFT-s-QPSK	B	**14.0/11.0***
			2640/2640	100	DFT-s-256QAM	T	25.15/22.15*
High	n77 3450-3550,	NR	3500/3500	100	DFT-s-256QAM	B	**14.76/11.76***
	3700-3980		3975/3975	10	DFT-s-QPSK	T	**8.11/5.11***

*Margin for 2Tx MIMO.

4.2.1.1 Edge of Band Emissions Plots

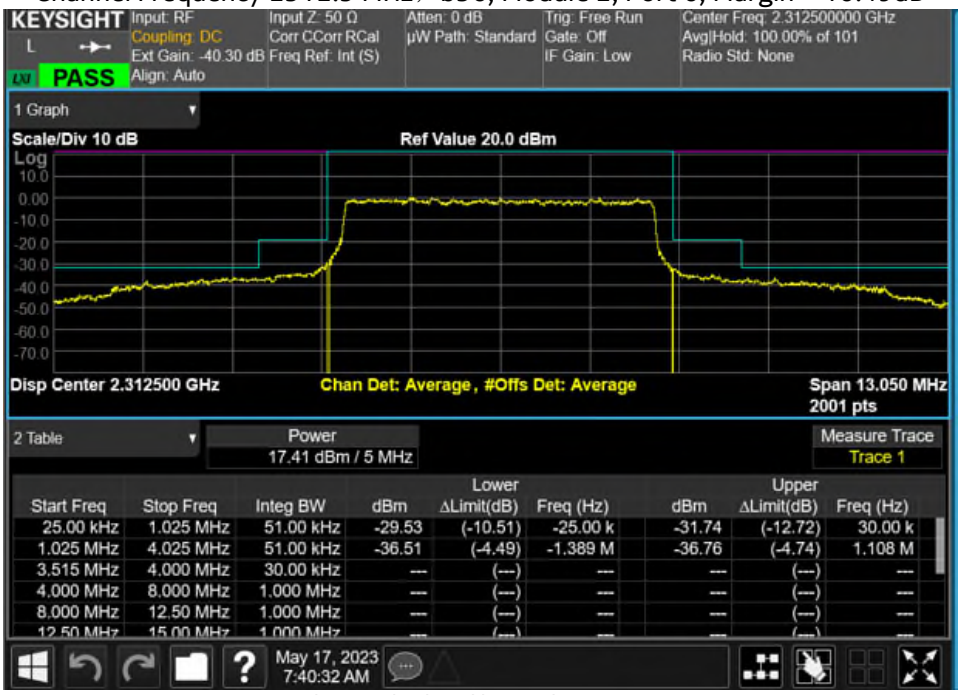
The minimum margin is 5.11dB. All of the measured data met the FCC Part 27 requirements.

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

Edge of Band Emission - 1C 5MHz

LTE, Modulation 64QAM

Channel Frequency 2312.5 MHz，b30, Module 2, Port 0, Margin = 10.49dB

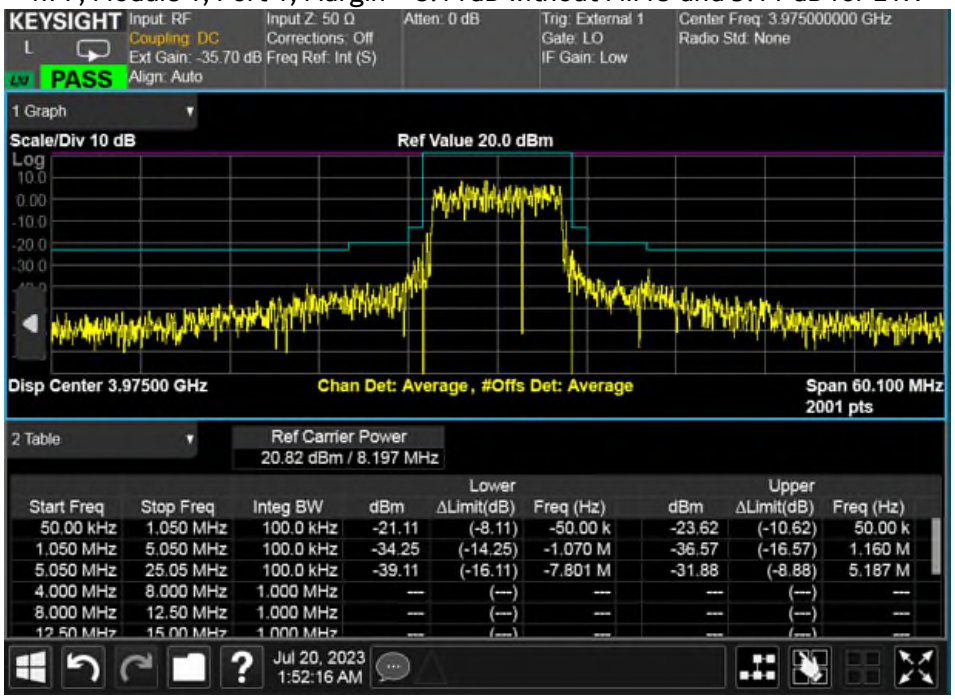


*Limits displayed have 6dB margin.

Edge of Band Emission - 1C 10MHz

NR, Modulation DFT-s-QPSK, Channel Frequency 3975 MHz

n77, Module 1, Port 1, Margin = 8.11dB without MIMO and 5.11 dB for 2TX



*Limits displayed is for non-MIMO

Edge of Band Emission - 1C 20MHz

NR, Modulation DFT-s-QPSK, 30K

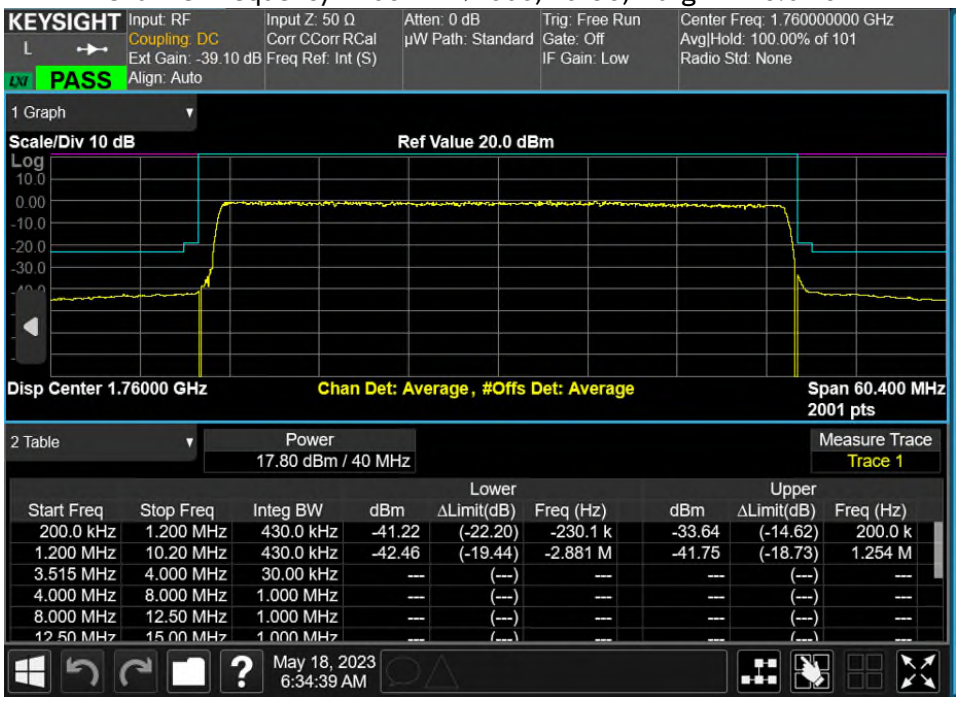
Channel Frequency 2506 MHz，n41, Module 1 Port 0, Margin = 14.0 dB and 11.0 for 2Tx MIMO

*Limits displayed have 6dB margin for non-MOMO and 3 dB for 2Tx MIMO.

Edge of Band Emission - 1C 40MHz

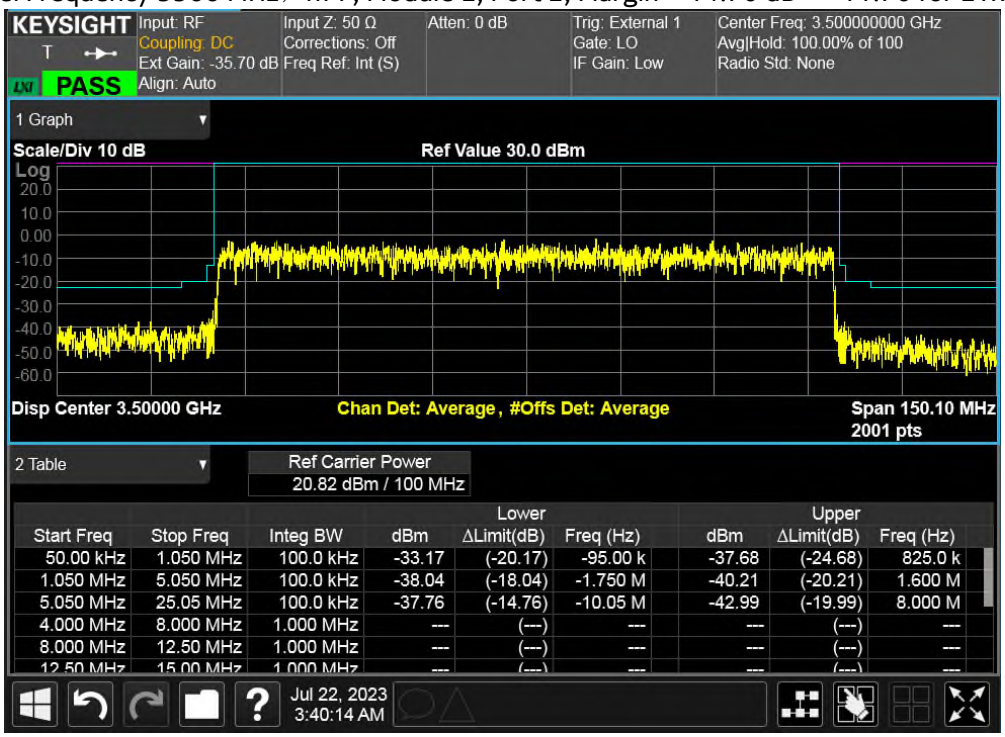
NR, Modulation DFT-s 256QAM 15k

Channel Frequency 1760 MHz，b66, Port 0, Margin = 20.62 dB



*Limits displayed have 6dB margin.

Edge of Band Emission - 1C 100MHz
NR, Modulation DFT-s-256QAM, 30K
Channel Frequency 3500 MHz，n77, Module 2, Port 2, Margin = 14.76 dB => 11.76 for 2Tx MIMO



*Limit in the frequency offset range < 1MHz is -16dBm/100kHz for non-MOMO.

5. FCC Section 2.1051 - 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 Edge-of-Band emissions.

5.1 Section 2.1051 Spurious Emissions at Antenna Terminals

Spurious Emissions at the antenna terminals were investigated per 47CFR Section 2.1057(a)(1) over the frequency range of 30 MHz to 40 GHz which is beyond the 10th harmonic of the carrier frequency. A test coupler which incorporates 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 Sections 1.5 and 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-40 GHz range.

The spurious measurements were made using an MXA Signal Analyzer. These measurements are performed in compliance with ANSI C63.26 and our ISO17025 process. The measurement meets the ANSI C63.26 requirements in paragraphs 5.2.4.4.1 and 5.7 which requires that the number of points in the sweep be > 2 × Span/RBW. The MXA signal analyzer measurements examine the 30 MHz to 40 GHz range.

Measurements were performed for all of the test configurations in Table 5.3.1 and these matches the test configurations used for Occupied Bandwidth /Edge of Band Emissions, RF Power and modulation.

5.2 Required Limit

The required emission limitation specified in 47CFR 27.53 was applied to these tests.

The transmitter unwanted emission limits were given in Section 4.2 and the spurious emissions limits are presented below.

Table 5.2.1 Tx Unwanted Spurious Emission Limits non-MIMO

Bands	Freq UL/DL (MHz)	FCC Rules	Spurious Emission Limit Per Port & RBW
b71/n71	663-698/617-652	27.53(g)	-13dBm/100kHz
b66/n66	1710–1780/2110–2200	27.53(h)(1)(3)	-13dBm/1MHz
b30/n30	2310–2315/2355–2360	27.53(a)(4)(5)	• 2345-2365: -13dBm/MHz • 2341-2345: -25dBm/MHz • 2292-2296, 2324-2328, 2337-2341: -31dBm/MHz • 2288-2292, 2328-2337: -37dBm/MHz • < 2288, > 2365: -40dBm/MHz
b41/n41	2496–2690	27.53(m)(4)(6)	-25dBm/MHz
n77	3700-3980	27.53(i)(2)	-13dBm/1MHz
	3450-3550	27.53(n)(2)	-13dBm/1MHz

5.3 Spurious Emissions at Antenna Terminals Results

The spurious emissions at antenna terminals were investigated for the following configurations. 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.

Table 5.3.1: Conducted Tx Spurious Emissions at Antenna Terminals (Tx Port = 0, Module 1)

Position in 663-3980 MHz	Bands Freq (UL/DL) (MHz)	Radio Access Tech	Carrier Freq (UL) (MHz)	BW (MHz)	Modulation	Posi	Compliance
Low	b71/n71 663-698/ 617-652	LTE	673	20	256QAM	B	Yes
		NR	673	20	DFT-s-64QAM 15k		Yes
			693	10	DFT-s-16QAM 15k	T	Yes
Middle	b66/n66 1710–1780/ 2110–2200	LTE	1712.5	5	QPSK	B	Yes
			1770	20	16QAM	T	Yes
		NR	1720	20	DFT-s-64QAM 15k	B	Yes
			1760	40	DFT-s-256QAM 15k	T	Yes
Middle	b30/n30 2310–2315/2355–2360	LTE	2312.5	5	64QAM		Yes
		NR	2312.5/2357.5	5	DFT-s-QPSK		Yes
Middle	b41/n41 2496–2690MHz	LTE	2498.5/2498.5	5	QPSK	B	Yes
High	n77 3450-3550, 3700-3980	NR	3975/3975	10	DFT-S-QPSK, 30K	T	Yes

5.3.1 Spurious Emissions Plots

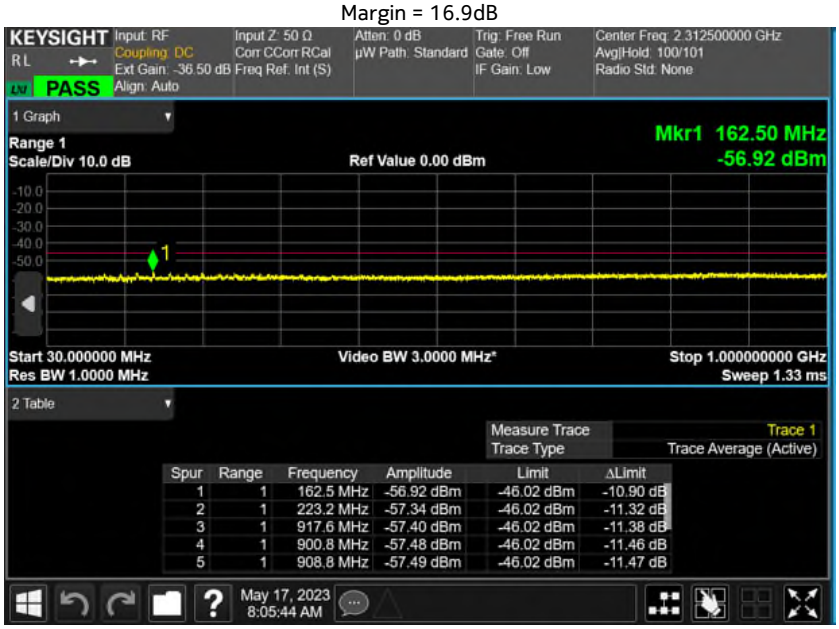
NOTE: Only plots with lowest margin in each frequency range are used in this report. The full suite of raw data resides at the MH, New Jersey location.

The unwanted emissions near the band edges were provided in Section 4.2.

30MHz – 1GHz

# of Carriers	Band	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Radio Access Technology
1	B30	64QAM	0	2312.5	5	LTE

Margin = 16.9dB

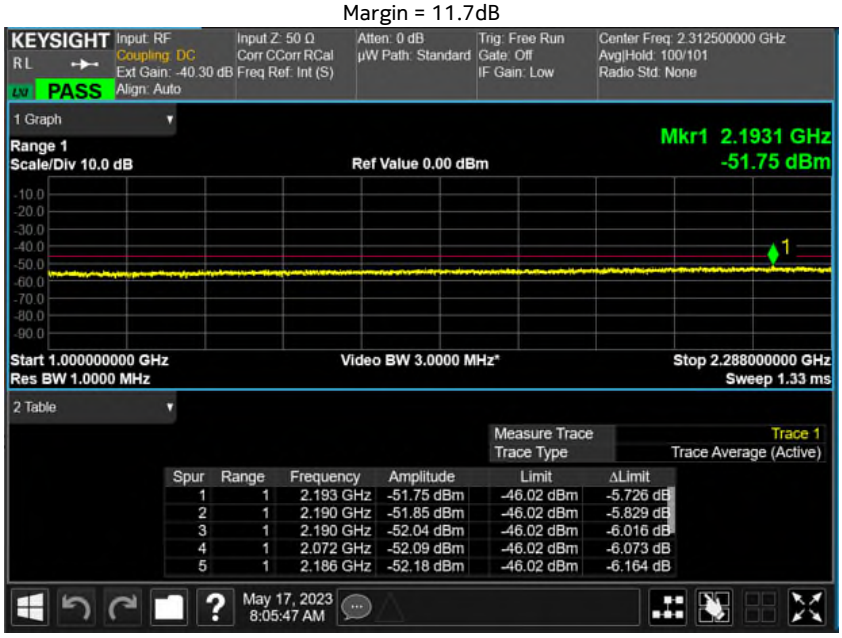


*Limit is -40dBm/1MHz non-MIMO

1GHz – 1.79GHz

# of Carriers	Band	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Radio Access Technology
1	B30	64QAM	0	2312.5	5	LTE

Margin = 11.7dB

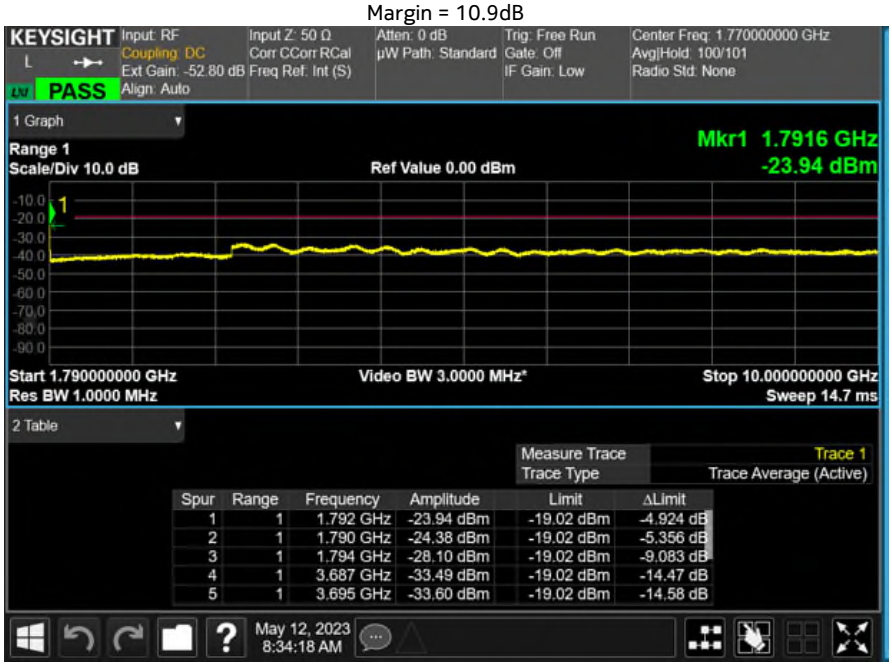


*Limit is -40dBm/1MHz non-MIMO

1.79GHz – 2.507GHz

# of Carriers	Band	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Radio Access Technology
1	B66	16QAM	0	1770	20	LTE

Margin = 10.9dB

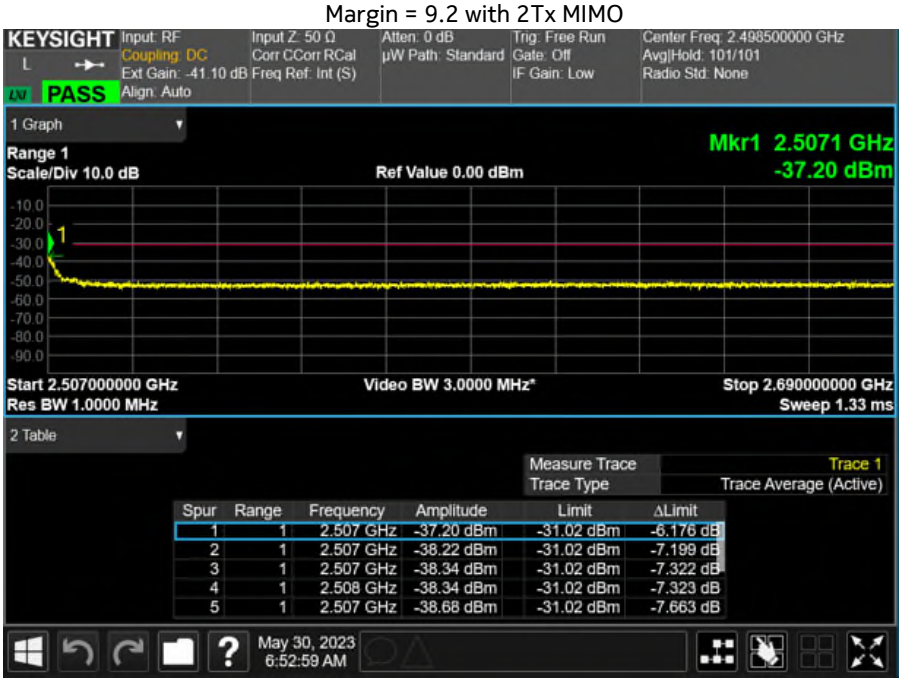


*Limit is -13dBm/1MHz non-MIMO

2.507GHz – 2.69GHz

# of Carriers	Band	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Radio Access Technology
1	B41	QPSK	0	2498.5	5	LTE

Margin = 9.2 with 2Tx MIMO

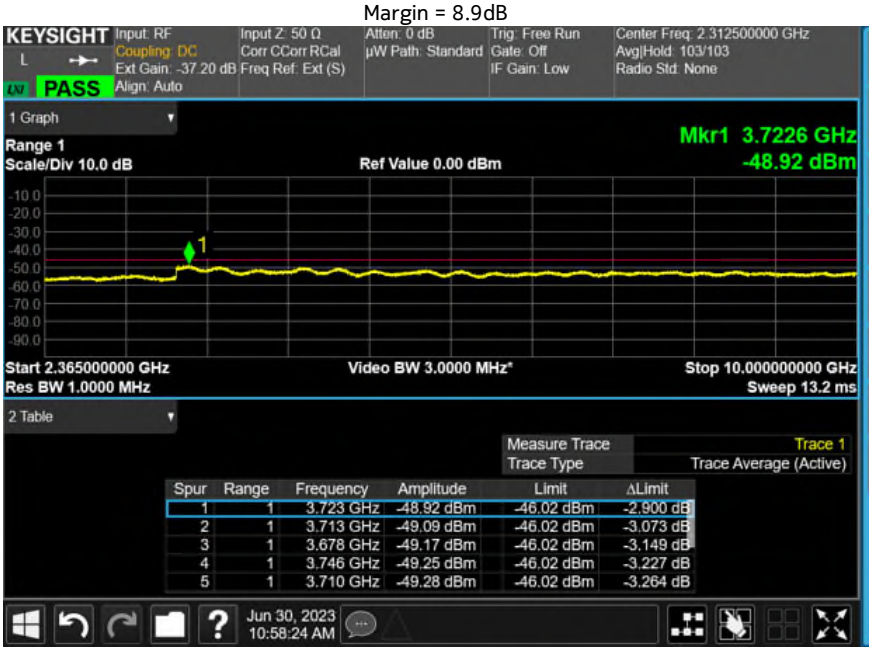


*Limit is -28dBm/1MHz with 2Tx MIMO

2.69GHz – 10GHz

# of Carriers	Band	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Radio Access Technology
1	n30	DFT-s- QPSK	0	2312.5	5	NR

Margin = 8.9dB

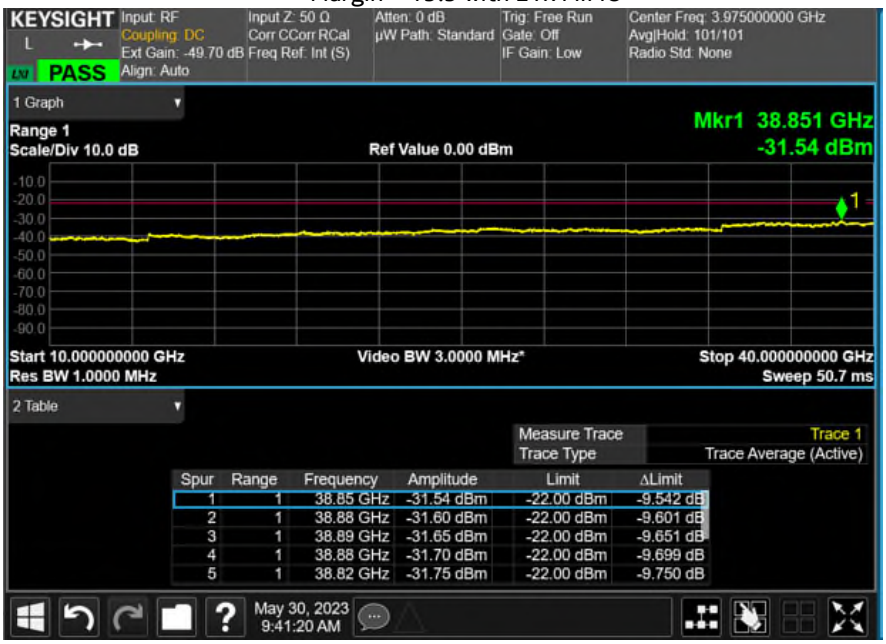


*Limit is -40dBm/1MHz without MIMO

10GHz – 40GHz

# of Carriers	Band	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Radio Access Technology
1	N77	DFT-s-256QAM	0	3975	20	NR

Margin = 15.5 with 2Tx MIMO



*Limit is -16dBm/1MHz with 2Tx MIMO

6. Section 2.1053 - Measurement Required: Field Strength of Spurious Radiation

The field strength measurements of radiated spurious emissions were made in a 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.

6.1 Spurious Radiation and Radiated Emissions Requirements

This product needs to meet Parts 2 and 27 requirements.

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

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

$$E\ (dB\mu V/m) = EIRP\ (dBm) -20 \log d\ (m) + 104.77,$$

where:
E = Field Intensity in Volts/meter EIRP = Transmitted Power in Watts
R = Measurement distance in meters

At 3m,

$$E\ (dB\mu V/m) = EIRP\ (dBm) + 95.23.$$

The Emission limits are given in Table 5.2.1 and the converted E limits are given below.

Table 6.1.1 Tx Unwanted Spurious Emission Limits

Bands	Freq UL (MHz)	FCC Rules	Emission Limit & RBW	E Limit (dBµV/m) & RBW
b71/n71	663-698	27.53(g)	-13dBm/100kHz	82.2/100kHz
b66/n66	1710–1780	27.53(h)(1)(3)	-13dBm/1MHz	82.2/MHz
b30/n30	2310–2315	27.53(a)(4)(5)	• 2345-2365: -13dBm/MHz • 2341-2345: -25dBm/MHz • 2292-2296, 2324-2328, 2337-2341: -31dBm/MHz • 2288-2292, 2328-2337: -37dBm/MHz • < 2288, > 2365: -40dBm/MHz	• 2345-2365: 82.2/MHz • 2341-2345: 70.2/MHz • 2292-2296, 2324-2328, 2337-2341: 64.2/MHz • 2288-2292, 2328-2337: -58.2/MHz • < 2288, > 2365: 55.2/MHz
b41/n41	2496–2690	27.53(m)(4)(6)	-25dBm/MHz	70.2/MHz
n77	3700-3980	27.53(i)(2)	-13dBm/1MHz	82.2/MHz
	3450-3550	27.53(n)(2)	-13dBm/1MHz	82.2/MHz

The field strength of radiated spurious emissions measured was determined by

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

The non-reportable level is 20dB below. The FCC Part 15 Class B limit is 54 dBμV/m above 1GHz. The FCC Part 15 Class B requirement is more stringent.

The EUT with two P638893 modules and its eight antennas and one WiFi module were investigated for FCC Part 27 and Part 15 for the following configurations.

Table 6.1.2 Configurations Evaluated for FCC Part 27 Tx Unwanted Spurious Emission

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

Table 6.1.3 Tx Unwanted Spurious Emission Limits Set for Testing

Test	Configurations	Carrier Freq (MHz)	Bandwidth (MHz)	Freq Range	Lowest E Limits
1a-1	Mod 1: n71, B, NR, 15kHz	673/627	20	30M-18GHz	82.2dBμV/m Ave RBW 1 MHz
	Mod 2: b66, B, LTE	1712.5/2112.5	5		
	WiFi 2412, 11b, 1Mps	2412	22		
1b-1	Mod 1: n30, B, NR, 15kHz;	2312.5	5	30M – 24GHz	55.2dBμV/m Ave RBW 1 MHz
	Mod 2: n66, B, NR, 15kHz	1730/2130	40		
	WiFi: 2437,11g, 6Mps	2437	20		
1d-1	Mod 1: n77, T, NR 30kHz	3950	100	30M-40GHz	70.2dBμV/m Ave RBW 1 MHz
	Mod 2: b41, B, LTE	2498.5	5		
	WiFi: 2452, HT40, MCS0	2452	40		

Field strength measurements of radiated spurious emissions were made in the 10m semi-anechoic chamber, AR-8 as detailed above. The recommendations of ANSI C63.4 and ANSI C63.26 were followed for EUT testing setup, cabling, and measurement approach and procedures. All the measurement equipment used, including antennas, was calibrated in accordance with ISO 9001 process. The EUT setup diagram is given in section 1.9.

The spectrum from 30MHz to 40GHz, 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 15 Subpart C compliance (intentional radiator) and FCC Part 15 Subpart B EMC compliance (unintentional radiator) are presented in Part 15C and part 15B EMC reports, respectively.

Per FCC regulations, the comparison of the emissions directly to the limit is appropriately made using the substitution method. However, both FCC and ANSI C63.26 accept using the field strength radiated measurement for limits specified in power without requiring substitution method for a licensed Tx.

6.2 Field Strength of Spurious Radiation Results

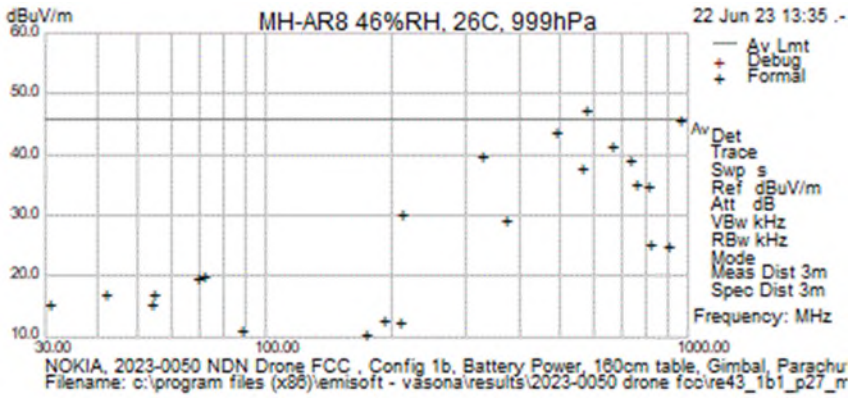
For all the configurations evaluated (see Table 6.1.2), this product meets Part 27 Requirements tabulated in Table 6.1.1.

Over the frequency spectrum investigated from 18 GHz to 40GHz, no reportable spurious emissions were detected. Hence, only the emissions plots in the frequency range of 30MHz -18GHz were presented below.

6.2.1 Transmitter Measurements of Radiated Spurious Emissions 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.

RE 30MHz – 1GHz 1b1 RE43



Test Information

Results Title	RE30M-1G BiLOG 3M
File Name	re43a_1b1_p27_mot_30m_1g_form.emi
Test Laboratory	MH-AR8 46%RH, 26C, 999hPa
Test Engineer	NPA
Test Software	Vasona by EMISoft, version 6.061
Equipment	NOKIA
EUT Details	2023-0050 NDN Drone FCC , Config 1b, Battery Power, 160cm table, Gimbal, Parachute, GPS Livesky, motors running 1235ms
Configuration	Radiated Emissions 30MHz - 1GHz, FCC Part 27 Limit, 3m Measurement distance, offset, Rcvr E1218 MXE, Ant E758, preamp E812, PCS-LPF-E1268, RBW 120KHz Preview and Formal
Date	2023-06-22 13:41:05

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
572.007	49.80	4.72	-6.94	47.58	AvgMax	V	108	274	46.00	1.58	Fail	*Pass
960.022	44.10	5.77	-3.95	45.92	AvgMax	H	231	310	46.00	-0.08	Pass	
483.997	49.74	3.65	-9.68	43.71	AvgMax	H	140	43	46.00	-2.29	Pass	
659.999	43.21	5.59	-7.22	41.57	AvgMax	V	213	10	46.00	-4.43	Pass	
322.968	50.58	2.46	-13.09	39.95	AvgMax	V	104	278	46.00	-6.05	Pass	
730.938	40.44	5.87	-7.20	39.11	AvgMax	V	115	324	46.00	-6.89	Pass	
560.978	41.05	4.59	-7.76	37.88	AvgMax	V	113	251	46.00	-8.12	Pass	
747.965	36.19	5.96	-6.94	35.21	AvgMax	V	214	354	46.00	-10.79	Pass	
798.966	35.63	6.24	-6.83	35.04	AvgMax	V	147	20	46.00	-10.96	Pass	
210.517	44.65	1.99	-16.19	30.46	AvgMax	V	309	267	46.00	-15.54	Pass	
370.874	38.68	2.66	-11.94	29.39	AvgMax	V	160	313	46.00	-16.61	Pass	
811.626	25.86	6.27	-6.60	25.53	AvgMax	V	111	10	46.00	-20.47	Pass	
892.524	23.73	6.29	-5.02	25.00	AvgMax	V	178	31	46.00	-21.00	Pass	
71.403	39.85	1.50	-21.31	20.05	AvgMax	V	157	139	46.00	-25.95	Pass	
68.628	39.72	1.50	-21.56	19.65	AvgMax	V	102	54	46.00	-26.35	Pass	

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
41.781	31.38	1.64	-15.92	17.09	AvgMax	V	157	50	46.00	-28.91	Pass	
53.823	35.67	1.48	-20.16	16.98	AvgMax	V	114	35	46.00	-29.02	Pass	
30.534	23.51	1.94	-10.08	15.38	AvgMax	V	123	6	46.00	-30.62	Pass	
53.462	33.94	1.48	-20.08	15.34	AvgMax	V	136	182	46.00	-30.66	Pass	
190.082	26.04	1.92	-15.23	12.72	AvgMax	H	387	300	46.00	-33.28	Pass	
206.314	26.70	1.97	-16.19	12.48	AvgMax	V	259	254	46.00	-33.52	Pass	
86.955	27.92	1.55	-18.15	11.32	AvgMax	V	102	333	46.00	-34.68	Pass	
172.734	21.94	1.87	-13.32	10.48	AvgMax	V	106	293	46.00	-35.52	Pass	

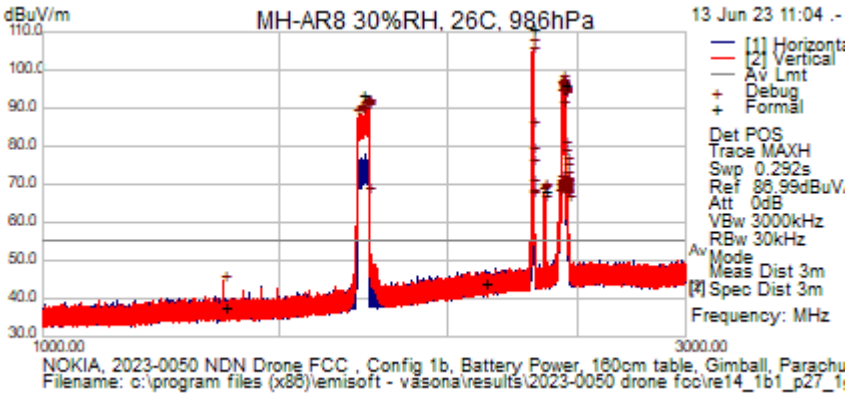
Preview Data

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
.00000	0.00	0.00	0.00	0.00	Preview		0	0	0.00	0.00	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.

*In the above plot, the limit used was adjusted with RBW differences: 10log(1MHz/120kHz) = 9.2dB. The zoom-in evaluation of the 572MHz signal showed it was a narrowband signal. The emissions level of 572MHz signal with 1MHz RBW and average detector was close to the emissions level with 120kHz RBW. Therefore, the emissions at 572MHz is below the limit of 55.2dBµV/m/MHz.

RE 1GHz – 3GHz, 1b1 RE14



Test Information

Results Title	Radiated E 3m 1GHz-10GHz
File Name	re14_1b1_p27_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 1b, Battery Power, 160cm table, Gimbal, Parachute, GPS Livesky, motors idle
Configuration	Radiated Emissions 1GHz - 3GHz, FCC Part 27 Limit, 3m Measurement distance, Rcvr E1218 MXE, Ant E1074, No Preamp, No pad, 7 step, RBW 30KHz preview, RBW 1MHz Formal,
Date	2023-06-13 11:04:32

Formal Data

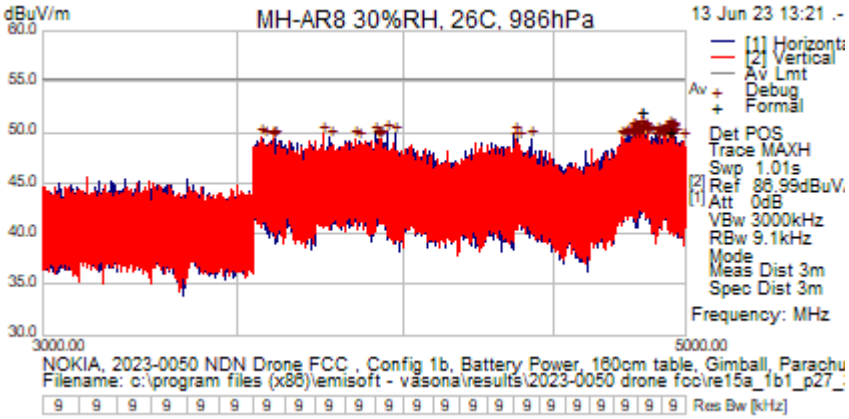
Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2311.992	74.96	4.00	32.13	111.09	AvgMax	V	108	17	55.20	55.89	Authorized	B30
2441.350	59.67	4.11	32.35	96.12	AvgMax	V	105	184	55.20	40.92	Authorized	Wifi
1730.000	60.72	3.30	29.65	93.67	AvgMax	V	235	223	55.20	38.47	Authorized	B66
2358.000	32.02	4.02	32.21	68.25	AvgMax	V	205	161	55.20	13.05	Authorized	n30
2130.000	8.26	3.78	31.80	43.85	AvgMax	V	115	318	55.20	-11.35	Pass	n66
1363.993	7.33	2.86	27.66	37.86	AvgMax	V	109	211	55.20	-17.34	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
2445.485328	42.86	4.11	32.36	79.33	Debug	V	203	45	55.20	24.13	Fail	
2315.123494	38.05	4.00	32.14	74.19	Debug	V	103	330	55.20	18.99	Fail	
2447.18057	34.62	4.11	32.36	71.09	Debug	V	103	180	55.20	15.89	Fail	
2425.742431	33.90	4.09	32.32	70.31	Debug	V	203	45	55.20	15.11	Fail	
2448.218668	33.27	4.11	32.36	69.75	Debug	V	103	180	55.20	14.55	Fail	
2447.590095	33.18	4.11	32.36	69.65	Debug	H	203	45	55.20	14.45	Fail	
2449.790101	32.81	4.12	32.36	69.29	Debug	V	103	180	55.20	14.09	Fail	
2450.113911	32.66	4.12	32.36	69.14	Debug	V	103	180	55.20	13.94	Fail	
2448.81867	32.64	4.11	32.36	69.11	Debug	V	103	180	55.20	13.91	Fail	
2424.732909	32.58	4.09	32.32	68.99	Debug	H	203	45	55.20	13.79	Fail	
2315.31397	32.80	4.00	32.14	68.94	Debug	V	103	330	55.20	13.74	Fail	
2425.094813	32.45	4.09	32.32	68.86	Debug	V	203	45	55.20	13.66	Fail	
2449.152004	32.31	4.11	32.36	68.79	Debug	V	203	45	55.20	13.59	Fail	
2424.456718	32.19	4.09	32.32	68.60	Debug	H	203	45	55.20	13.40	Fail	
2425.342432	31.79	4.09	32.32	68.20	Debug	H	203	45	55.20	13.00	Fail	
2358.875832	31.67	4.02	32.21	67.91	Debug	V	203	90	55.20	12.71	Fail	
2452.856775	31.39	4.12	32.37	67.88	Debug	V	103	180	55.20	12.68	Fail	
2422.351959	31.43	4.08	32.32	67.83	Debug	V	203	45	55.20	12.63	Fail	
2451.323438	31.34	4.12	32.37	67.83	Debug	V	103	180	55.20	12.63	Fail	
2424.161481	31.36	4.09	32.32	67.77	Debug	H	203	45	55.20	12.57	Fail	
2449.456767	30.98	4.11	32.36	67.46	Debug	V	103	180	55.20	12.26	Fail	
2357.61869	31.16	4.02	32.21	67.39	Debug	V	203	90	55.20	12.19	Fail	
2421.342436	30.91	4.08	32.32	67.31	Debug	V	203	45	55.20	12.11	Fail	
2451.971059	30.50	4.12	32.37	66.99	Debug	V	103	180	55.20	11.79	Fail	
2355.43774	30.66	4.02	32.21	66.89	Debug	V	203	90	55.20	11.69	Fail	
2421.656721	30.39	4.08	32.32	66.79	Debug	V	203	45	55.20	11.59	Fail	
2421.085293	30.31	4.08	32.32	66.71	Debug	V	203	45	55.20	11.51	Fail	
2450.399626	30.10	4.12	32.36	66.58	Debug	V	103	180	55.20	11.38	Fail	
2451.67582	29.91	4.12	32.37	66.39	Debug	V	103	180	55.20	11.19	Fail	
2315.761589	30.25	4.00	32.14	66.39	Debug	V	203	90	55.20	11.19	Fail	
2308.418739	30.05	4.00	32.13	66.17	Debug	V	103	330	55.20	10.97	Fail	
2451.075818	29.63	4.12	32.37	66.11	Debug	V	103	180	55.20	10.91	Fail	
2452.618679	29.56	4.12	32.37	66.04	Debug	V	103	180	55.20	10.84	Fail	
2359.590117	28.81	4.02	32.21	65.05	Debug	V	203	0	55.20	9.85	Fail	
2455.1044	28.35	4.12	32.37	64.84	Debug	V	103	180	55.20	9.64	Fail	
1363.983	13.32	2.86	27.66	43.85	Debug	V	105	331	55.20	-11.35	Pass	
2130.334	5.78	3.78	31.81	41.37	Debug	V	105	331	55.20	-13.83	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.

RE 3GHz – 5GHz, 1b1 RE15



Test Information

Results Title	Radiated E 3m 1GHz-10GHz
File Name	re15a_1b1_p27_3g_5g_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 1b, Battery Power, 160cm table, Gimbal, Parachute, GPS Livesky, motors idle
Configuration	Radiated Emissions 3GHz - 5GHz, FCC Part 27 Limit, 3m Measurement distance, Rcvr E1218 MXE, Ant E1074, No Preamp, No pad, 22 step, RBW 9KHz preview, RBW 1MHz Formal,
Date	2023-06-13 13:21:41

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
4825.606235	12.46	5.68	34.01	52.15	AvgMax	H	305	134	55.20	-3.05	Pass	Noise Floor
4829.518352	12.40	5.69	34.02	52.11	AvgMax	V	303	91	55.20	-3.09	Pass	
4936.433397	10.26	5.85	34.10	50.21	AvgMax	V	101	331	55.20	-4.99	Pass	

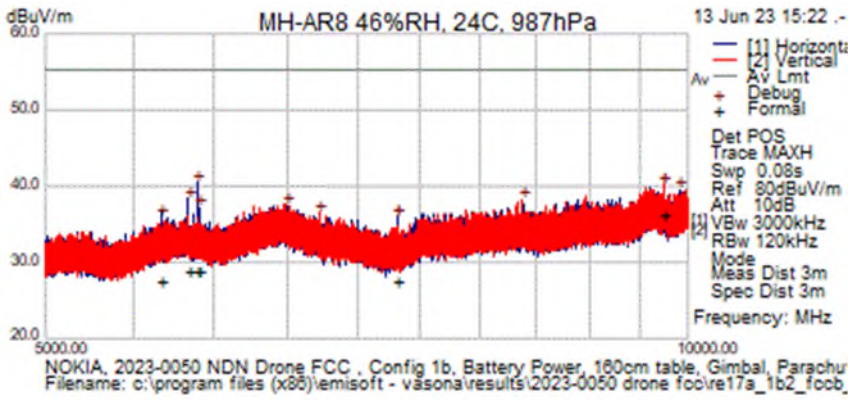
Preview Data

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
4829.518352	10.74	5.69	34.02	50.44	Debug	V	303	90	55.20	-4.76	Pass	
4936.433397	10.43	5.85	34.10	50.38	Debug	V	103	330	55.20	-4.82	Pass	
4825.606235	10.62	5.68	34.01	50.31	Debug	H	303	135	55.20	-4.89	Pass	
4944.557631	10.30	5.86	34.11	50.27	Debug	V	303	135	55.20	-4.93	Pass	
4797.427475	10.59	5.64	33.99	50.22	Debug	V	103	45	55.20	-4.98	Pass	
4838.872888	10.49	5.70	34.02	50.21	Debug	V	303	45	55.20	-4.99	Pass	
4951.633382	10.20	5.87	34.11	50.18	Debug	V	103	0	55.20	-5.02	Pass	
4798.103232	10.51	5.64	33.99	50.14	Debug	V	103	90	55.20	-5.06	Pass	
3946.733387	11.81	5.14	33.14	50.09	Debug	H	103	270	55.20	-5.11	Pass	
4817.400183	10.41	5.67	34.01	50.09	Debug	H	303	225	55.20	-5.11	Pass	
4921.045534	10.16	5.83	34.09	50.07	Debug	H	103	270	55.20	-5.13	Pass	
4954.318228	10.07	5.87	34.11	50.06	Debug	H	103	225	55.20	-5.14	Pass	
4804.085044	10.39	5.65	34.00	50.04	Debug	H	103	330	55.20	-5.16	Pass	
4924.227349	10.10	5.83	34.09	50.02	Debug	V	103	315	55.20	-5.18	Pass	
4801.61838	10.33	5.64	34.00	49.96	Debug	H	103	90	55.20	-5.24	Pass	
4808.936555	10.28	5.65	34.00	49.94	Debug	H	103	225	55.20	-5.26	Pass	
4832.21835	10.20	5.69	34.02	49.91	Debug	H	103	45	55.20	-5.29	Pass	
4885.412236	10.06	5.77	34.06	49.90	Debug	H	103	45	55.20	-5.30	Pass	

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
4812.92443	10.21	5.66	34.00	49.87	Debug	V	303	180	55.20	-5.33	Pass	
4811.339583	10.20	5.66	34.00	49.86	Debug	V	303	225	55.20	-5.34	Pass	
3907.751607	11.59	5.11	33.14	49.85	Debug	H	303	225	55.20	-5.35	Pass	
4805.157771	10.19	5.65	34.00	49.84	Debug	H	103	330	55.20	-5.36	Pass	
4855.95469	10.07	5.73	34.04	49.83	Debug	V	303	0	55.20	-5.37	Pass	
3968.945486	11.53	5.15	33.15	49.83	Debug	H	103	270	55.20	-5.37	Pass	
3751.024491	11.72	5.00	33.11	49.83	Debug	V	303	180	55.20	-5.37	Pass	
4937.57885	9.85	5.85	34.10	49.81	Debug	V	103	45	55.20	-5.39	Pass	
4841.503189	10.06	5.71	34.03	49.79	Debug	V	103	135	55.20	-5.41	Pass	
4363.905697	10.74	5.43	33.60	49.77	Debug	H	103	225	55.20	-5.43	Pass	
4814.975943	10.08	5.66	34.01	49.75	Debug	H	103	225	55.20	-5.45	Pass	
4919.139475	9.80	5.83	34.09	49.71	Debug	V	303	0	55.20	-5.49	Pass	
4816.639577	10.01	5.67	34.01	49.68	Debug	H	303	180	55.20	-5.52	Pass	
4787.803243	10.05	5.62	33.98	49.66	Debug	H	103	180	55.20	-5.54	Pass	
4773.351742	10.07	5.60	33.97	49.65	Debug	H	103	330	55.20	-5.55	Pass	
4849.451666	9.90	5.72	34.03	49.65	Debug	H	103	225	55.20	-5.55	Pass	
4897.524345	9.79	5.79	34.07	49.65	Debug	V	103	180	55.20	-5.55	Pass	
4845.200155	9.90	5.71	34.03	49.64	Debug	H	303	90	55.20	-5.56	Pass	
3569.421643	11.74	4.82	33.07	49.63	Debug	V	103	225	55.20	-5.57	Pass	
4938.633395	9.61	5.86	34.10	49.57	Debug	V	303	315	55.20	-5.63	Pass	
4959.251556	9.57	5.87	34.12	49.56	Debug	H	303	135	55.20	-5.64	Pass	
4817.721394	9.87	5.67	34.01	49.55	Debug	V	303	330	55.20	-5.65	Pass	
4851.027422	9.80	5.72	34.03	49.55	Debug	H	103	330	55.20	-5.65	Pass	
4951.00611	9.53	5.87	34.11	49.52	Debug	V	303	315	55.20	-5.68	Pass	
4853.675904	9.75	5.72	34.04	49.51	Debug	V	303	45	55.20	-5.69	Pass	
4865.003165	9.73	5.74	34.04	49.51	Debug	H	303	315	55.20	-5.69	Pass	
4792.545662	9.87	5.63	33.99	49.49	Debug	H	303	135	55.20	-5.71	Pass	
4798.875959	9.85	5.64	33.99	49.48	Debug	H	303	0	55.20	-5.72	Pass	
4752.718429	9.89	5.60	33.96	49.45	Debug	V	303	315	55.20	-5.75	Pass	
4810.563826	9.78	5.66	34.00	49.44	Debug	V	303	135	55.20	-5.76	Pass	
4894.839499	9.59	5.79	34.07	49.44	Debug	H	103	270	55.20	-5.76	Pass	
3770.530533	11.31	5.01	33.11	49.43	Debug	H	303	180	55.20	-5.77	Pass	
3602.470095	11.50	4.85	33.08	49.43	Debug	V	303	180	55.20	-5.77	Pass	
4940.657635	9.46	5.86	34.10	49.42	Debug	V	303	270	55.20	-5.78	Pass	
4935.639458	9.46	5.85	34.10	49.41	Debug	H	303	330	55.20	-5.79	Pass	
4929.778858	9.47	5.84	34.09	49.41	Debug	H	103	0	55.20	-5.79	Pass	
3845.491064	11.20	5.07	33.13	49.40	Debug	V	303	0	55.20	-5.80	Pass	
3909.827363	11.14	5.12	33.14	49.40	Debug	H	103	225	55.20	-5.80	Pass	
3916.812204	11.12	5.12	33.14	49.38	Debug	H	303	225	55.20	-5.82	Pass	
4789.563847	9.76	5.62	33.99	49.37	Debug	V	103	135	55.20	-5.83	Pass	
3610.157966	11.43	4.86	33.08	49.37	Debug	H	103	0	55.20	-5.83	Pass	
3926.981891	11.08	5.13	33.14	49.35	Debug	V	103	45	55.20	-5.85	Pass	
4762.403268	9.78	5.60	33.96	49.35	Debug	H	303	315	55.20	-5.85	Pass	
4911.703119	9.44	5.81	34.08	49.34	Debug	H	103	90	55.20	-5.86	Pass	
4905.269792	9.45	5.80	34.08	49.33	Debug	H	103	315	55.20	-5.87	Pass	
3577.394362	11.43	4.82	33.07	49.33	Debug	H	103	135	55.20	-5.87	Pass	
4423.511698	10.11	5.54	33.67	49.31	Debug	H	103	45	55.20	-5.89	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.

RE 5GHz – 10GHz, 1b1 RE18



Test Information

Results Title	Radiated E 3m 1GHz-18GHz
File Name	re18_1b1_p27_5g_10g_form.emi
Test Laboratory	MH-AR8 46%RH, 24C, 987hPa
Test Engineer	NPA
Test Software	Vasona by EMISoft, version 6.061
Equipment	NOKIA
EUT Details	2023-0050 NDN Drone FCC , Config 1b, Battery Power, 160cm table, Gimbal, Parachute, GPS Livesky, motors idle
Configuration	Radiated Emissions 5GHz - 10GHz, FCC Part 27, 3m Measurement distance, Rcvr E1218 MXE, Ant E1074, Preamp E1602, HPF E1480 (4GHz), RBW 120KHz preview, RBW 1MHz Formal,
Date	2023-06-13 15:26:33

Formal Data

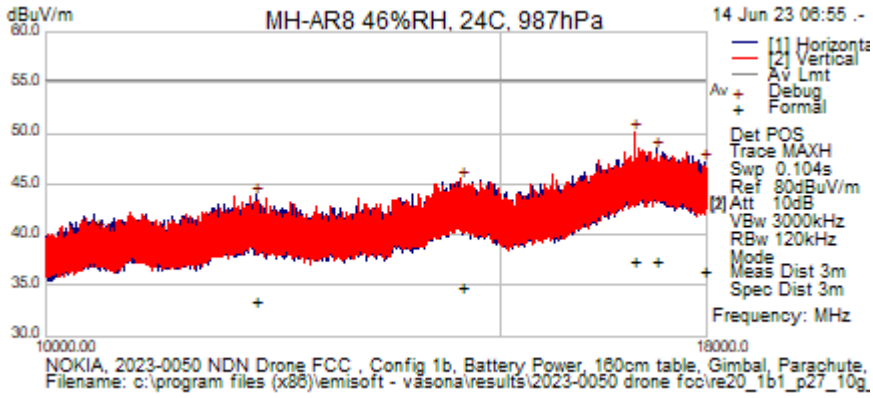
Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
9751.086	31.68	9.97	-5.50	36.15	AvgMax	V	105	354	55.20	-19.05	Pass	Noise Floor
5834.667	30.64	7.36	-9.03	28.97	AvgMax	H	301	179	55.20	-26.23	Pass	
5905.625	30.33	7.61	-8.99	28.95	AvgMax	H	301	179	55.20	-26.25	Pass	
5889.625	30.28	7.55	-9.00	28.84	AvgMax	H	301	181	55.20	-26.36	Pass	
5670.539	29.52	7.16	-9.13	27.56	AvgMax	V	104	354	55.20	-27.64	Pass	
7310.923	26.79	8.62	-7.88	27.53	AvgMax	V	106	354	55.20	-27.67	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
5889.625	41.81	7.55	-9.00	40.36	Debug	H	303	180	55.20	-14.84	Pass	
9751.083333	35.72	9.97	-5.50	40.19	Debug	V	190	352	55.20	-15.01	Pass	
9909.958333	34.53	10.26	-5.27	39.52	Debug	H	390	315	55.20	-15.68	Pass	
5834.666667	40.02	7.36	-9.03	38.35	Debug	H	303	180	55.20	-16.85	Pass	
8370.333333	36.59	8.89	-7.27	38.21	Debug	V	390	225	55.20	-16.99	Pass	
6485.708333	37.03	8.64	-8.12	37.56	Debug	V	390	352	55.20	-17.64	Pass	
5905.625	38.44	7.61	-8.99	37.06	Debug	H	303	180	55.20	-18.14	Pass	
6719.708333	36.36	8.23	-8.13	36.46	Debug	V	390	352	55.20	-18.74	Pass	
7310.916667	35.19	8.62	-7.88	35.92	Debug	H	103	0	55.20	-19.28	Pass	
5670.539	37.80	7.16	-9.13	35.84	Debug	V	104	353	55.20	-19.36	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.

RE 10GHz – 18GHz, 1b1 RE20



Test Information

Results Title	Radiated E 3m 1GHz-18GHz
File Name	re20_1b1_p27_10g_18g_form.emi
Test Laboratory	MH-AR8 46%RH, 24C, 987hPa
Test Engineer	NPA
Test Software	Vasona by EMISoft, version 6.061
Equipment	NOKIA
EUT Details	2023-0050 NDN Drone FCC , Config 1b, Battery Power, 160cm table, Gimbal, Parachute, GPS Livesky, motors idle
Configuration	Radiated Emissions 10GHz - 18GHz, FCC Part 27 Limit, 3m Measurement distance, Rcvr E1218 MXE, Ant E1074, Preamp E1602, HPF E1480 (4GHz), RBW 120KHz preview, RBW 1MHz Formal,
Date	2023-06-14 06:55:15

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
17218.987	23.94	13.51	-0.06	37.39	AvgMax	H	370	349	55.20	-17.81	Pass	Noise
16893.379	23.73	13.51	0.12	37.36	AvgMax	V	294	70	55.20	-17.84	Pass	Floor
17970.560	23.58	13.45	-0.64	36.39	AvgMax	H	152	327	55.20	-18.81	Pass	
14466.453	24.17	13.22	-2.52	34.87	AvgMax	V	126	102	55.20	-20.33	Pass	
12055.040	24.30	11.03	-1.86	33.47	AvgMax	H	336	24	55.20	-21.73	Pass	

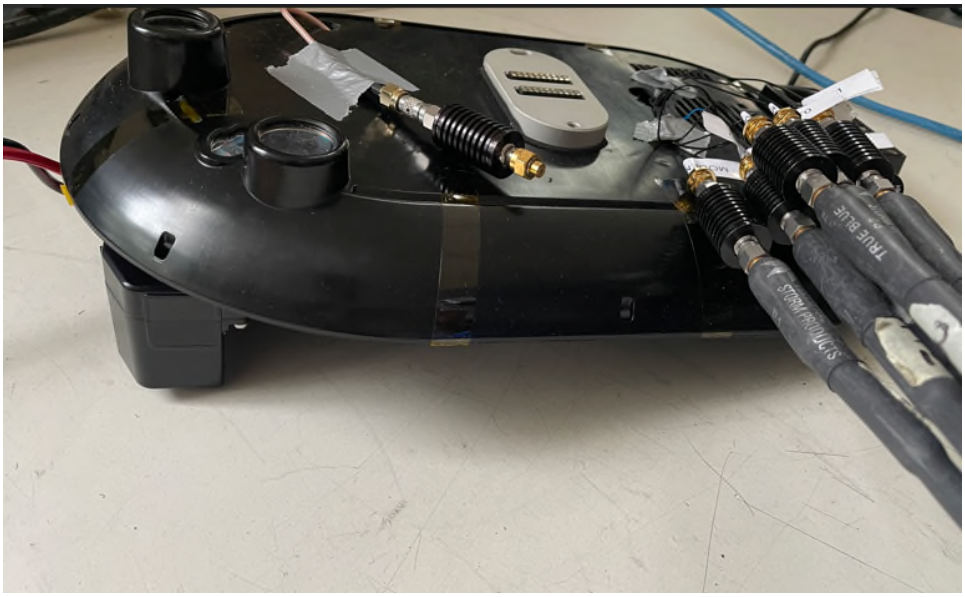
Preview Data

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
16895.093	36.56	13.51	0.13	50.20	Debug	V	390	352	55.20	-5.00	Pass	
17218.987	35.05	13.51	-0.06	48.50	Debug	H	390	264	55.20	-6.70	Pass	
17970.560	34.40	13.45	-0.64	47.21	Debug	H	303	264	55.20	-7.99	Pass	
14466.453	34.80	13.22	-2.52	45.50	Debug	V	190	220	55.20	-9.70	Pass	
12055.040	34.76	11.03	-1.86	43.94	Debug	H	303	176	55.20	-11.26	Pass	
10456.846	33.32	10.99	-4.02	40.29	Debug	V	104	353	55.20	-14.91	Pass	

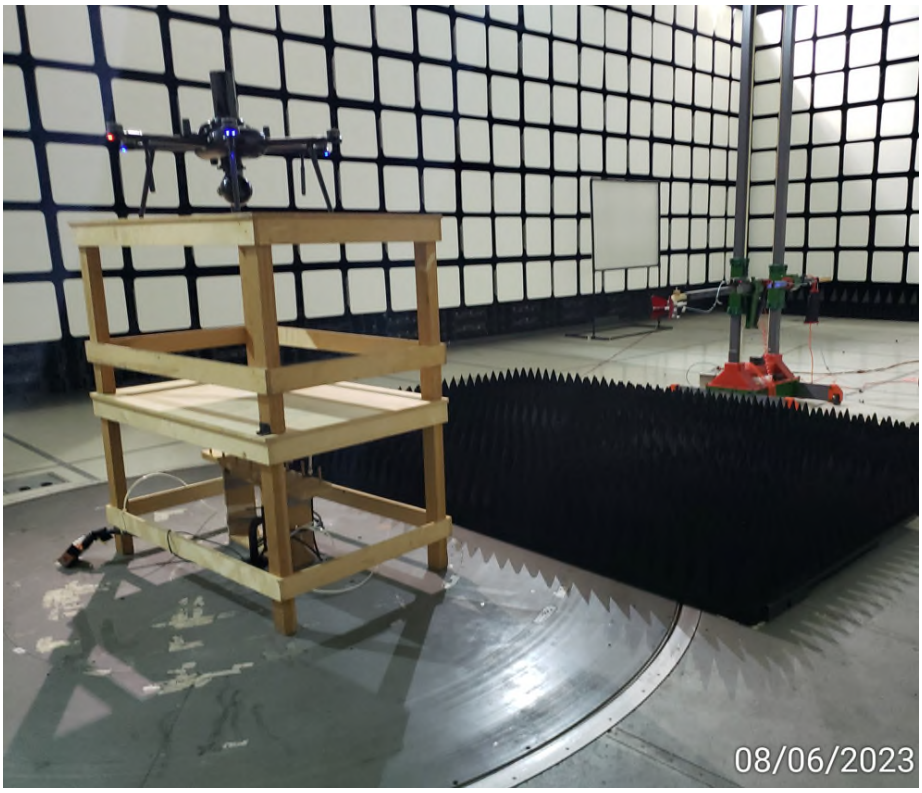
Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in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

7. Photographs

Radio Test



Radiated Emission Test



8. 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

9. 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