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TESTING
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Title 47 Code of Federal Regulations Test Report

Regulation:
Title 47 CFR FCC Part 96

Client:
NOKIA SOLUTIONS AND NETWORKS

Product Evaluated:
AEQM AirScale MAA 64T64R 192AE B48 32W

Report Number:
TR-2022-0078-FCC96

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Revisions

Date	Revision	Section	Change
8/15/2022	0		Initial Release
2/28/2023	1	2.1.1	Add more details on antenna gain calculation, max antenna gain and the worst case to be evaluated. Also Revised Table 2.1 by removing EUT capacity 26.99dBm (putting in the notes) and correcting typos.
		2.1.2	Revised Section 2.1.2 and Table 2.2 by adding data for more bandwidths
		2.3	Revised Section 2.3 by adding EIRP compliance tables for various operation modes

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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):	AEQM AirScale MAA 64T64R 192AE B48 32W
Serial Number:	Refer to Section 1.3.2
FCC ID:	VBNAEQM-02
Hardware Version:	Refer to Section 1.3.2
Software Version:	SBTS22R3
Frequency Range:	3550 - 3700 MHz
GPCL Project Number:	2022-0078
Manufacturer:	NOKIA SOLUTIONS AND NETWORKS OY KARAKAARI 7, FI-02610 ESPOO FINLAND
Applicant:	Nokia Solutions and Networks 3201 Olympus Blvd, Dallas, Texas USA 75019
Test Requirement(s):	Title 47 CFR Part96
Test Standards:	Refer to Section 1.5.1
Measurement Procedure(s):	Refer to Section 1.5.2
Test Date(s):	6/30/2022 – 7/19/2022 (Radio) 6/16/2022 – 6/29/2022 (Radiated Emission)
Test Performed By:	Nokia Global Product Compliance Laboratory 600-700 Mountain Ave. P.O. Box 636 Murray Hill, NJ 07974-0636 Site Registration Number: US5302
Product Engineer(s):	Ron Remy
Lead Engineer:	Steve Gordon
Test Engineer (s):	Jaideep Yadav, Greg Manuel, Mike Miller
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 the AEQM AirScale MAA 64T64R 192AE B48 32W, 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 Part 96 measured in accordance with the procedures set out in Section 2.1033 (c) (14) of the Rules.

This is a new Certification and this test report demonstrates compliance for the **AEQM AirScale MAA 64T64R 192AE B48 32W** product for 5G-NR bandwidths from 20MHz – 100MHz at maximum power of 563.6 W EIRP. The testing for the LTE operation is reported in a separate test report.

1.3 EUT Details

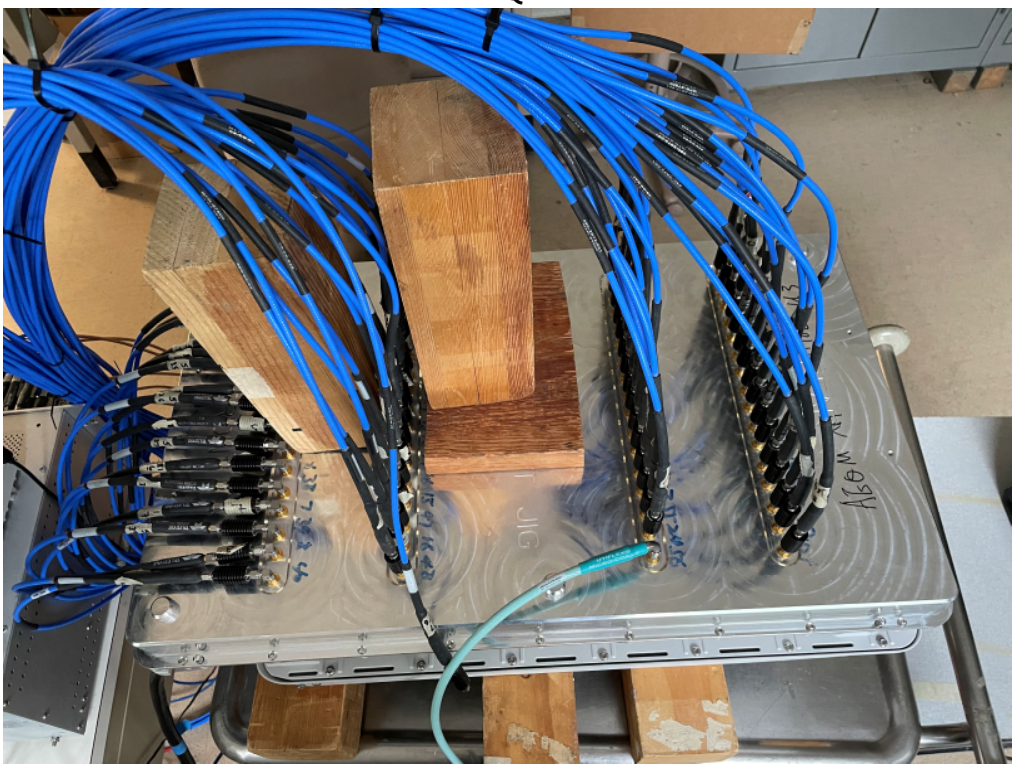
1.3.1 Specifications

Specification	3GPP/FCC NR/LTE compliant, TDD, NR
Frequency range	3550 - 3700 MHz
Max. supported modulation	QPSK, 16QAM, 64QAM and 256 QAM
Number of TX/RX paths	64T/64R and 32T32R
MIMO streams	16
Mode of operation	16-Beam 64T64R and 8-Beam 32T32R MIMO
Instantaneous bandwidth IBW	150 MHz
Occupied bandwidth OBW	100 MHz
Total average EIRP	69.5 dBm
Max. output power	0.5 W per TRX (32W total)
Antenna configuration	12, 8, 2 (±45° X-polarized)
Max. Antenna gain	24.5dBi
Horizontal beamwidth	15° (boresight)
Vertical beamwidth	6° (boresight)
Horizontal coverage angle	±45° (3 dB), ±60° (5 dB)
Vertical steering angle	±6°
Dimensions	750 mm (H) x 450 mm (W) x 240 mm (D)
Supply voltage / Connector type	DC -40.5 V … -57 V / 2 pole connector

1.3.2 Photographs

Serial Number

AEQM



1.4 Test Requirements

Each required measurement is listed below:

47 CFR FCC Sections	Description of Tests	Test Required
2.1046, 96.41 (b) 96.41(g)	RF Power Output (b) Power Limits, EIRP, PSD (g) Peak-to-Average Power Ratio	Yes
2.1047, 96.41(a)	Modulation Characteristics	Yes
2.1049, 96.41(e)(2)(3)	(a) Occupied Bandwidth (b) Out-of-Band Emissions	Yes
2.1051, 96.41(e)	Spurious Emissions at Antenna Terminals	Yes
2.1053, 96.41(e)(2)(3)	Field Strength of Spurious Radiation	Yes
2.1055, 96.41(e)(2)(3)	Measurement of Frequency Stability	Yes

1.5 Test Standards & Measurement Procedures

1.5.1 Test Standards

- Title 47 Code of Federal Regulations, Federal Communications Commission Part 2.
- Title 47 Code of Federal Regulations, Federal Communications Commission Part 96.
- KDB 940660 D01 Certification And Test Procedures For Citizens Broadband Radio Service Devices Authorized Under Part 96, v03, Oct 29, 2020
- KDB 971168 D01 Power Measurement License Digital Systems v03r01 April 9, 2018.
- KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013
- 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

1.5.2 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

1.6 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, 22, *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

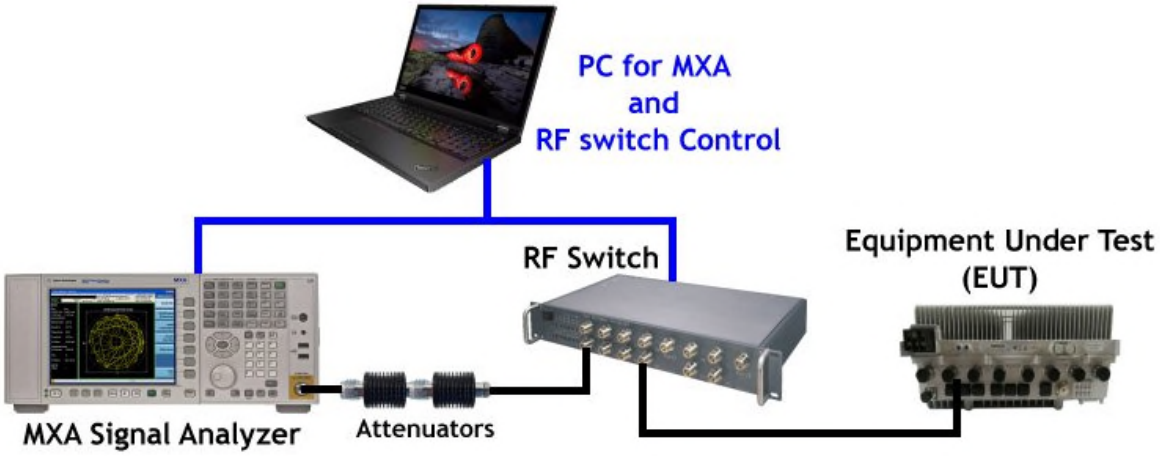
1.7 Executive Summary

Requirement 47 CFR FCC Parts 2 and 96	Description of Tests	Result
2.1046, 96.41 (b) 96.41(g)	RF Power Output (b) Power Limits, EIRP, PSD (g) Peak-to-Average Power Ratio	COMPLIES
2.1047, 96.41(a)	Modulation Characteristics	COMPLIES
2.1049, 96.41(e)(2)(3)	(a) Occupied Bandwidth (b) Out-of-Band Emissions	COMPLIES
2.1051, 96.41(e)	Spurious Emissions at Antenna Terminals	COMPLIES
2.1053, 96.41(e)	Field Strength of Spurious Radiation	COMPLIES
2.1055	Measurement of Frequency Stability	COMPLIES

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

1.8 Test Configurations

Test Setup for all Antenna Port Measurements



2. FCC Section 2.1046 - RF Power Output and Power Spectral Density

2.1 RF Power Output

2.1.1 Limits

The FCC Part 96.41 requirement for Category B CBSD is that the Output Power of the EUT shall not exceed 47 dBm/10MHz EIRP.

Directional Antenna Gain Calculation:

The EUT has 192 AE (antenna elements) for 64 ports operation and 96 AE for 32 ports operation where each antenna port has 3 AEs. The gain of each antenna is around 9.45 dBi.

a. Antenna Gain
    i. Antenna Gain for 64T64R = 27.5 dBi with 1 beam per polarization
    ii. Antenna Gain for 32T32R = 24.5 dBi with 1 beam per polarization
b. Antenna Gain for cross-polarization
    i. Antenna Gain for 2-Beam 64T64R = 24.5 dBi,
    ii. Antenna Gain for 2-Beam 32T32R = 21.5 dBi;
c. Multi-Beam Antenna Gain Reduction
    i. 16-Beam Reduction = 10*log(1/16) dB = -12.04
    ii. 8-Beam Reduction = 10*log(1/8) dB = -9.03
d. Effective Antenna Gain
    i. Effective Antenna Gain for 16-Beam 64T64R = 27.5 – 12.04 = 15.46 dBi
    ii. Effective Antenna Gain for 8-Beam 32T32R = 24.5 – 9.03 = 15.47 dBi

With cross-polarized antennas and 1 beam per polarization (two beams total), the maximum effective antenna gain is 24.5 dBi for 64T64R.

KDB 662911 D02 MIMO with Cross-Polarized Antenna specified that for Rules That Specify Radiated Limits, 1) if the transmitter output signals are completely uncorrelated, then each of the two EIRPs must individually be below the limit; 2) if one of the transmitter outputs is a 90-degree phase-shifted replica of the other and the phase centers of the two antennas are co-located (as would be the case when creating a circularly polarized transmission using linearly polarized antennas), then the each of the two EIRPs must individually be below the limit; 3) other than the above cases 1) and 2), the sum of the two EIRPs from two polarizations must be below the limit.

The EUT is capable of supporting MIMO Rank 2^+ transmission schemes where the output signals on two polarizations could be uncorrelated or have a 90-degree phase-shift, depending on the deployment scenario and channel conditions, and each of the two EIRPs must individually be below the 47dBm/10MHz EIRP limit. For compliance testing, the case that each of the two EIRPs is individually below the 47dBm/10MHz EIRP limit is worse than the case where the correlated signals are sent to two polarization chains and the sum of two EIRPs must be below the 47dBm/10MHz EIRP limit. The former allows for 3dB higher per port conducted output power and thus was evaluated to ensure the compliance. Some RF characteristics for the case that the sum of the EIRPs from two polarizations must be below the 47dBm/10MHz limit were evaluated as well and the data were saved in the project folder 2021-0067.

Table 2.1 RF Conducted Output Power Limits

Operation Modes	Effective Antenna Gain (dBi)	FCC 96.41 EIRP Limit (dBm/BW)	Total Conducted Output Power Limit (dBm/BW)**	Conducted Output Power Limit per Port (dBm/BW)
16-Beam 64T64R 10MHz	15.46	47	34.55	16.49
8-Beam 32T32R 10MHz	15.47	47	34.54	**19.49**
16-Beam 64T64R 20MHz	15.46	50.01	37.56	19.50
8-Beam 32T32R 20MHz	15.47	50.01	37.55	**22.50**
16-Beam 64T64R 10+20MHz or 30 MHZ	15.46	51.77	39.32	21.26
8-Beam 32T32R 10+20MHz or 30 MHz	15.47	51.77	39.31	**24.26**
16-Beam 64T64R 20+20MHz or 40 MHz	15.46	53.02	40.57	22.51
8-Beam 32T32R 20+20MHz or 40 MHz	15.47	53.02	40.56	**25.51**
16-Beam 64T64R 50 MHz	15.46	53.99	41.54	23.47
8-Beam 32T32R 50 MHz	15.47	53.99	41.53	**26.47**
16-Beam 64T64R 60 MHz	15.46	54.78	42.33	23.27
8-Beam 32T32R 60 MHz	15.47	54.78	42.32	**27.27***
16-Beam 64T64R 70 MHz	15.46	55.45	43.00	24.94
8-Beam 32T32R 70 MHz	15.47	55.45	42.99	**27.94***
16-Beam 64T64R 80 MHz	15.46	56.03	43.58	25.52
8-Beam 32T32R 80 MHz	15.47	56.03	43.57	**28.52***
16-Beam 64T64R 90 MHz	15.46	56.54	44.09	26.03
8-Beam 32T32R 90 MHz	15.47	56.54	44.08	**29.03***
16-Beam 64T64R 100 MHz	15.46	57.0	44.55	26.49
8-Beam 32T32R 100 MHz	15.47	57.0	44.54	**29.49***

* The maximum power per port for the product is capped at 0.5 W (26.99 dBm).

** The limits are based on the worst case where EIRP from each polarization is individually below the 47dBm/10MHz EIRP limit, where the total conducted output power or the power per port have the highest limits.

The limits for 8-Beam 32T32R modes are higher than that for 16-Beam 64T64R modes. Therefore, the maximum output power per port at the antenna ports for 8-Beam 32T32R modes was evaluated for NR technology and 20-100MHz carriers, which is the worst case.

2.1.2 Results

Power measurements of the TDD transmit signal were conducted with an MXA Signal analyzer per KDB 971168 D01 and ANSI C63.26. The applied signal from the AEQM, met the recommended characteristics as defined in 3GPP TS 36.141 V16.9.0 (2021-04) Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing (Release 14). The Channel power was measured when the product was set to provide the maximum rated power at the antenna transmitting terminals. The output power of the EUT was measured per ANSI C63.26 methods and procedures and the Channel Power Measurement feature of the MXA Analyzer for carriers of 20MHz -100MHz bandwidths.

The conducted output power was measured at all antenna ports first for a 100MHz carrier with TM3.1 NR at B, M and T positions. The Port 56 has the highest power and was used for conducted measurement.

The measured output power at antenna ports was presented in the table below. The Maximum Average RF Power Values are bolded in each configuration.

Table 2.2 RF Power Output Results (8-Beam 32T32R Modes, NR, Port 56)

Signal BW MHz	Test Model	Channel Frequency MHz	Channel Power per Port dBm/BW	Channel Power Limit per Port dBm/BW	Results
20	3.1	3560	**21.32**	22.50	Pass
	3.2	3625	21.12	22.50	Pass
	3.1a	3690	21.22	22.50	Pass
30	3.1	3565	23.19	24.26	Pass
	3.2	3625	23.05	24.26	Pass
	3.1a	3685	**23.34**	24.26	Pass
40	3.1	3670	24.45	25.51	Pass
	3.2	3625	24.33	25.51	Pass
	1.1	3680	**24.50**	25.51	Pass
50	3.1	3575	**25.61**	26.47	Pass
	3.2	3625	25.56	26.47	Pass
	3.1	3675	25.41	26.47	Pass
60	3.1	3580	26.28	27.27	Pass
	3.2	3625	26.34	27.27	Pass
	3.1a	3670	**26.37**	27.27	Pass
70	1.1	3585	**26.92**	27.94	Pass
	3.2	3625	26.83	27.94	Pass
	3.1a	3665	26.79	27.94	Pass
80	1.1	3590	**26.91**	28.52	Pass
	3.2	3625	26.84	28.52	Pass
	3.1a	3660	26.90	28.52	Pass
90	1.1	3595	**26.98**	29.03	Pass
	3.2	3625	26.93	29.03	Pass
	3.1a	3655	26.81	29.03	Pass
100	3.1	3600	26.77	29.49	Pass
	1.1	3625	**26.91**	29.49	Pass
	3.1a	3650	26.69	29.49	Pass

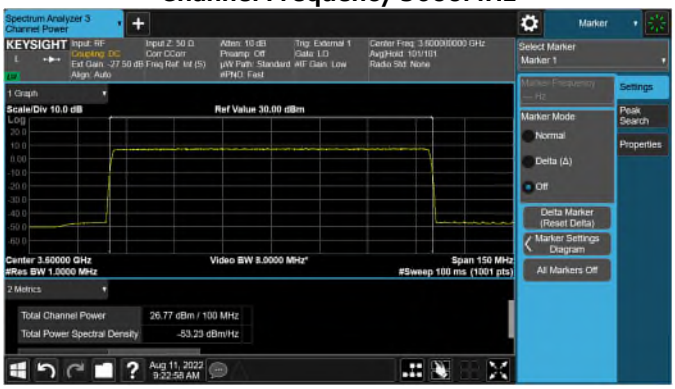
2.1.3 Maximum RF Conducted Output Power Plots

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

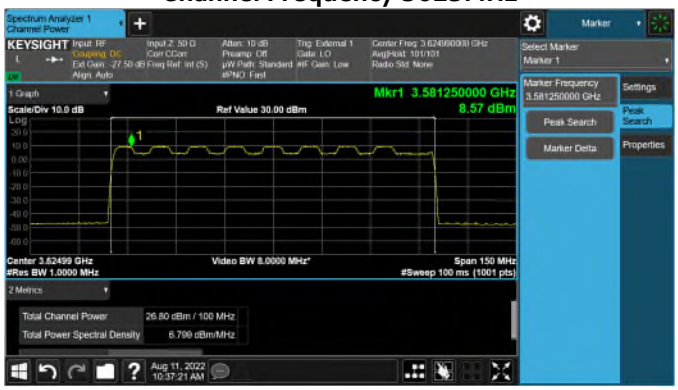
The plots for 100MHz channel are presented below.

Signal BW 100MHz (0.5W per Port)

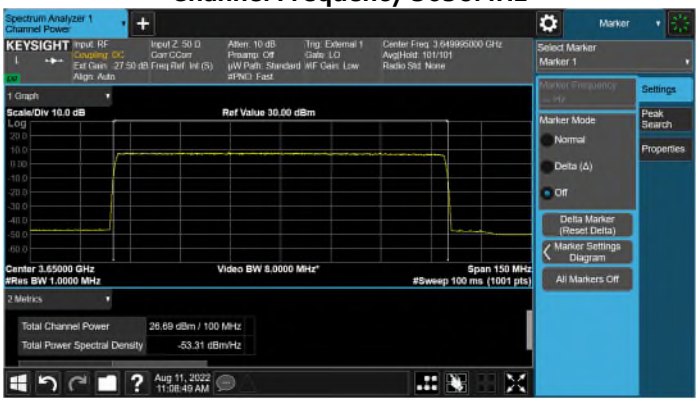
TM 3.1, 64QAM, TX56
Channel Frequency 3600MHz



TM 3.2, QPSK/16QAM, TX62
Channel Frequency 3625MHz



TM 3.1a, 256QAM, TX56
Channel Frequency 3650MHz



2.2 Power Spectral Density

2.2.1 Limits

The FCC Part 96.41 requirement for Category B CBSD is that the Power Spectral Density (PSD) of the EUT shall not exceed 37 dBm/MHz. The PSD per port limit was derived below.

Table 2.3 RF Conducted Power Spectrum Density Limits

Operation Modes	Effective Antenna Gain (dBi)	FCC 96.41 PSD Limit (dBm/MHz)	Total Conducted PSD Limit (dBm/MHz)	Conducted PSD Limit per Port (dBm/MHz)
16-Beam 64T64R	15.46	37	24.55	6.49
8-Beam 32T32R	15.47	37	24.54	**9.49**

Both the power and PSD limits for 8-Beam 32T32R modes are 3dB higher than that for 16-Beam 64T64R modes, Therefore, the output power at the antenna ports for 8-Beam 32T32R modes was evaluated only.

2.2.2 Results

The PSD of the EUT was measured per ANSI C63.26 methods and procedures and the PSD Measurement feature of the MXA Analyzer. The PSD was measured when the product was set to provide the maximum rated power at the antenna transmitting terminals. The signal bandwidths, modulations and transmit channels identified in Table below were evaluated. The measured power spectral density level was documented in the table below.

The Maximum Average PSD Values are bolded in each configuration.

Table 2.4 Power Spectral Density Results (8-Beam 32T32R Modes)

Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	PSD Limit dBm/MHz	PSD dBm/MHz	PSD Results Pass/Fail
3.1	64QAM	56	3560	20	9.5	8.275	Pass
1.1	QPSK	56	3625	20	9.5	8.139	Pass
1.1	QPSK	56	3690	20	9.5	8.101	Pass
1.1	QPSK	56	3565	30	9.5	**8.416**	Pass
1.1	QPSK	56	3625	30	9.5	8.472	Pass
1.1	QPSK	56	3570	40	9.5	**8.339**	Pass
1.1	QPSK	56	3625	40	9.5	8.391	Pass
1.1	QPSK	56	3625	50	9.5	**8.617**	Pass
1.1	QPSK	56	3675	50	9.5	8.230	Pass
1.1	QPSK	56	3580	60	9.5	8.428	Pass
3.2	QPSK/16QAM	56	3625	60	9.5	**8.524**	Pass
1.1	QPSK	56	3670	60	9.5	8.430	Pass
1.1	QPSK	56	3585	70	9.5	**8.465**	Pass
1.1	QPSK	56	3625	70	9.5	8.438	Pass
1.1	QPSK	56	3665	70	9.5	8.048	Pass
1.1	QPSK	56	3590	80	9.5	**7.883**	Pass
3.1	64QAM	56	3625	80	9.5	7.851	Pass
1.1	QPSK	56	3660	80	9.5	7.755	Pass

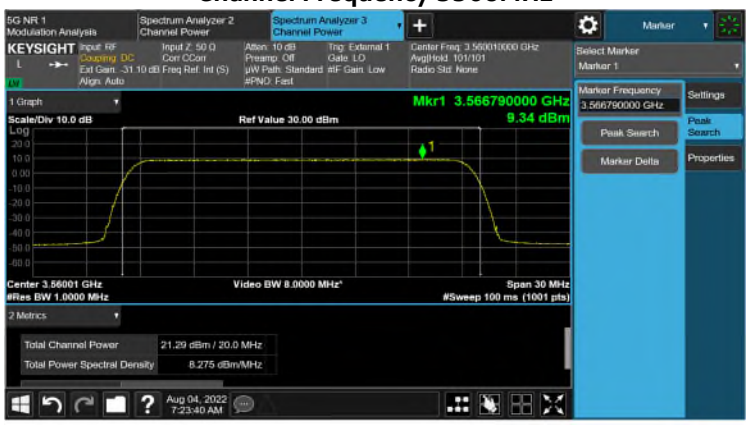
Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	PSD Limit dBm/MHz	PSD dBm/MHz	PSD Results Pass/Fail
1.1	QPSK	56	3595	90	9.5	**7.433**	Pass
3.2	QPSK/16QAM	56	3625	90	9.5	7.400	Pass
1.1	QPSK	56	3655	90	9.5	7.336	Pass
1.1	QPSK	56	3600	100	9.5	**7.489**	Pass
1.1	QPSK	56	3625	100	9.5	6.913	Pass
1.1	QPSK	56	3650	100	9.5	6.769	Pass

2.2.3 Maximum Conducted PSD Plots

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

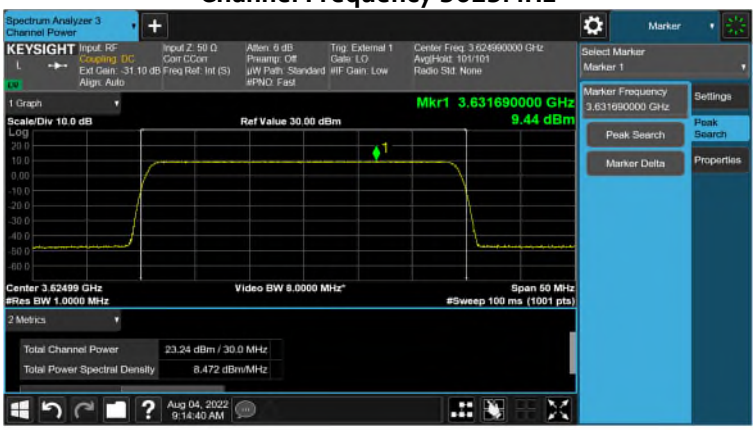
Mode 8-Beam 32T32R

20MHz BW, TM1.1
Channel Frequency 3560MHz

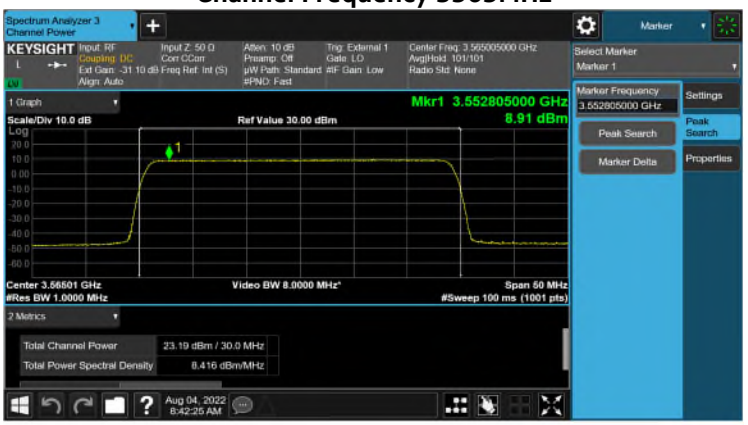


20MHz BW, TM1.1
Channel Frequency 3625MHz

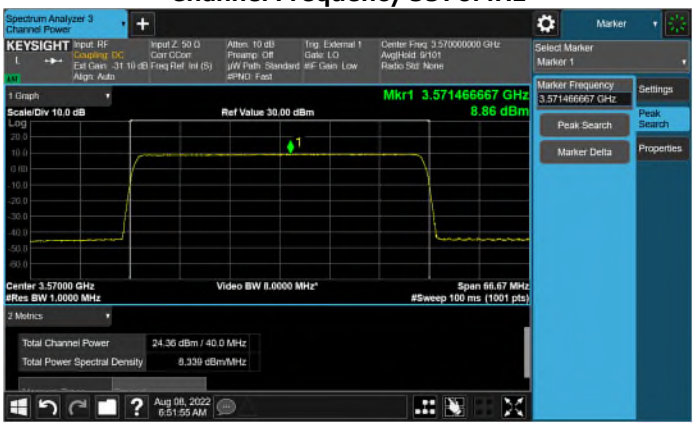
30MHz BW, TM1.1
Channel Frequency 3625MHz



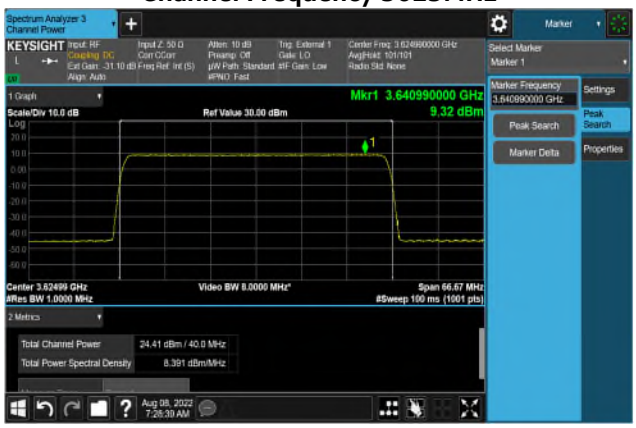
30MHz BW, TM1.1
Channel Frequency 3565MHz



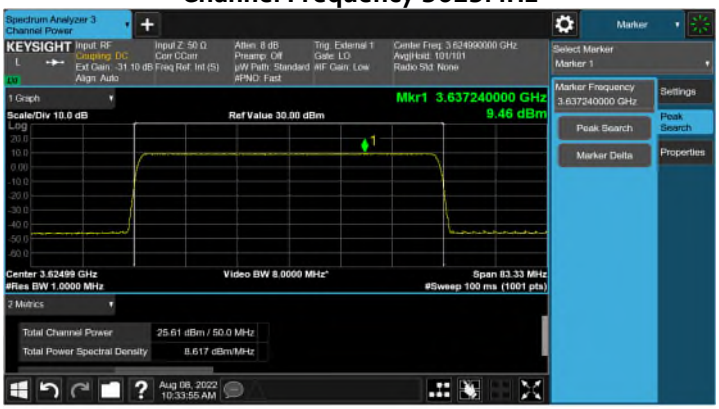
40MHz BW, TM1.1
Channel Frequency 3570MHz



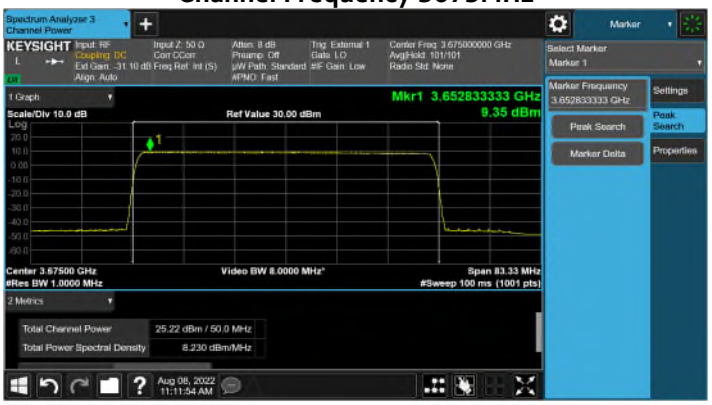
40MHz BW, TM1.1
Channel Frequency 3625MHz



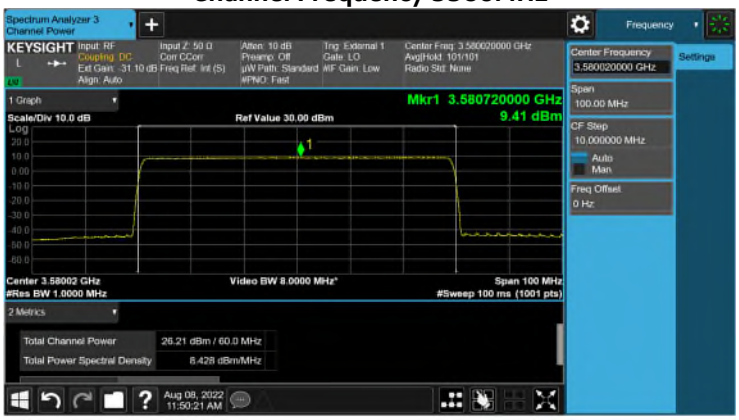
50MHz BW, TM1.1
Channel Frequency 3625MHz



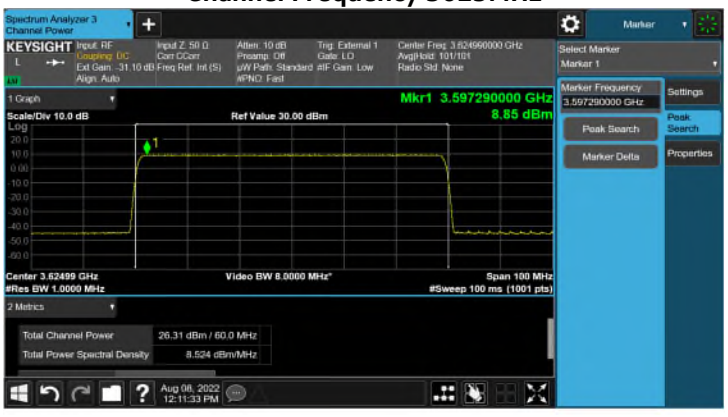
50MHz BW, TM1.1
Channel Frequency 3675MHz



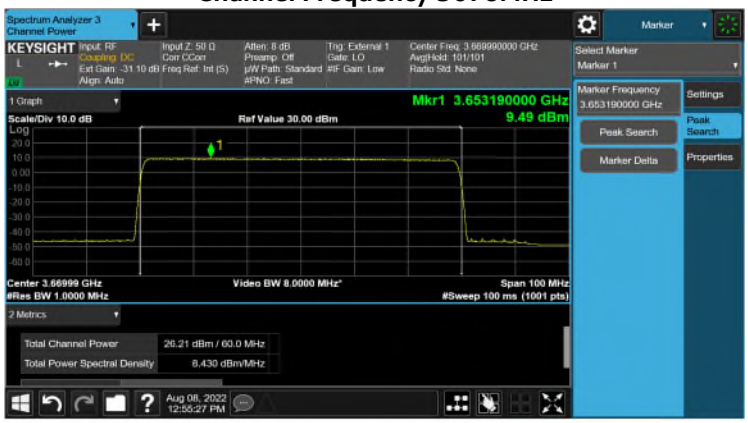
60MHz BW, TM1.1
Channel Frequency 3580MHz



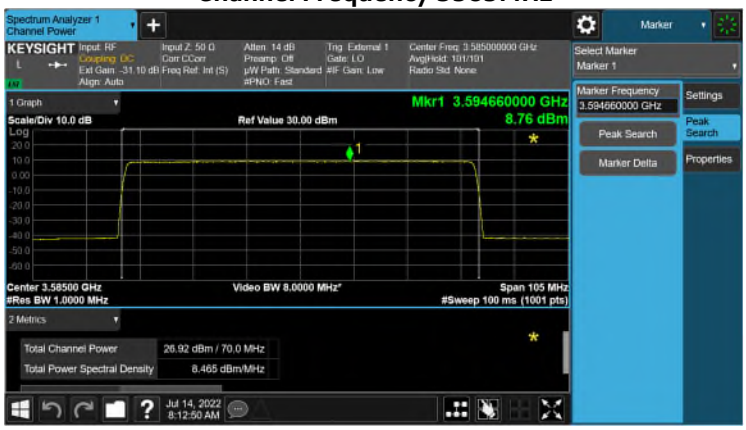
60MHz BW, TM3.2
Channel Frequency 3625MHz



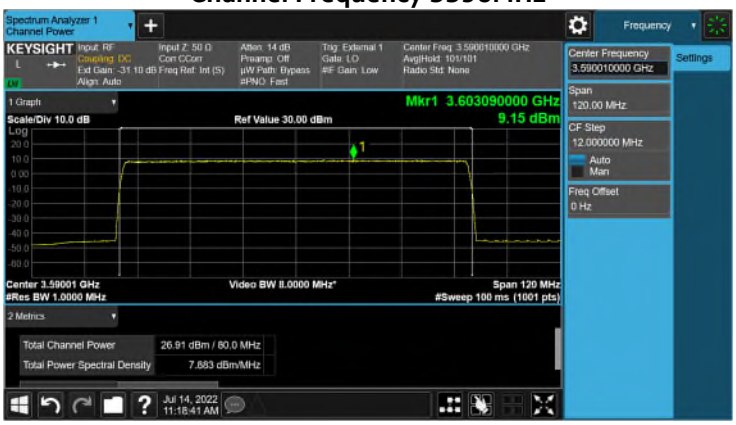
60MHz BW, TM1.1
Channel Frequency 3670MHz



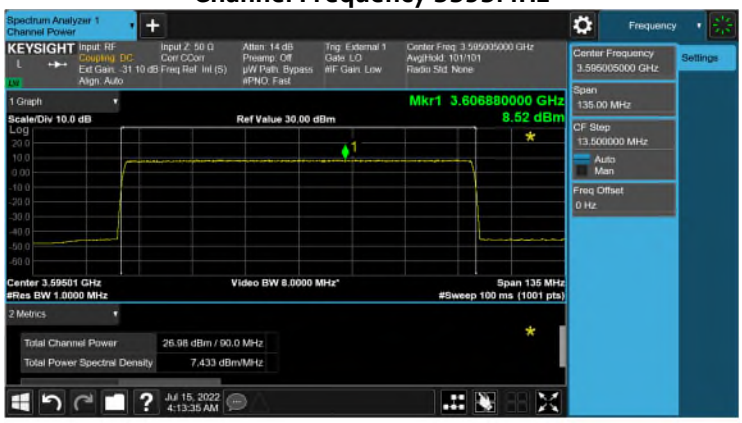
70MHz BW, TM1.1
Channel Frequency 3585MHz



80MHz BW, TM1.1
Channel Frequency 3590MHz



90MHz BW, TM1.1
Channel Frequency 3595MHz



100MHz BW, TM1.1
Channel Frequency 3600MHz

2.3 EIRP Compliance

As stated above, the EUT supports two operation modes:

1) 16-Beam 64T64R with cross polarization (32 ports and 8 streams each polarization) and
2) 8-Beam 32T32R with cross polarization (16 ports and 4 streams each polarization),

where MIMO Rank 2^+ transmission schemes are supported for each operation mode. As a result, it results in two scenarios for EIRP compliance for each operation mode: A) when the output signals on two polarizations are uncorrelated or have a 90-degree phase-shift, depending on the deployment scenario and channel conditions, then each of the two EIRPs must individually be below the 47dBm/10MHz EIRP limit**,** B) when the correlated signals are sent to two polarization chains, then the sum of two EIRPs must be below the 47dBm/10MHz EIRP limit. The case 2A (the case A with 8-Beam 32T32R mode) allows for highest per port conducted output power and was thus evaluated at the antenna port in Section 2.1 to ensure the compliance.

Table 2.5 presented the maximum EIRP values for the following four cases or configurations:

1A: 16-Beam 64T64R CP, each EIRP below 47dBm/10MHz EIRP limit,
1B: 16-Beam 64T64R CP, sum of both EIRPs below 47dBm/10MHz EIRP limit,
2A: 8-Beam 32T32R CP, each EIRP below 47dBm/10MHz EIRP limit,
2B: 8-Beam 32T32R CP, sum of both EIRPs below 47dBm/10MHz EIRP limit.

Table 2.5(a) Maximum EIRP for 32T32R 8 Beam CP Configuration 2A

Bandwidth (MHz)	Maxi Cond Power per Port dBm**	Maxi Cond Power per Port Allowed dBm*	Maxi EIRP dBm	Maxi EIRP W	FCC Limit 96.41 dBm EIRP	FCC Limit 96.41 W EIRP	Margin (dB)
20	21.32	22.50	48.83	76.4	50.01	100.24	1.18
30	23.34	24.26	50.85	121.7	51.77	150.36	0.92
40	24.50	25.51	52.01	158.9	53.02	200.47	1.01
50	25.61	26.48	53.12	205.17	53.99	250.59	0.87
60	26.37	26.99	53.88	244.41	54.78	300.71	0.90
70	26.92	26.99	54.43	277.41	55.45	350.83	1.02
80	26.91	26.99	54.42	276.77	56.03	400.95	1.61
90	26.98	26.99	54.49	281.3	56.54	451.07	2.05
100	26.91	26.99	54.42	276.77	57.00	501.19	2.58

*per FCC limit or EUT restriction. ** From Table 2.2.

Table 2.5(b) Maximum EIRP for 32T32R 8 Beam CP Configuration 2B

Bandwidth (MHz)	Maxi Cond Power per Port dBm**	Maxi Cond Power per Port Allowed dBm*	Maxi EIRP dBm	Maxi EIRP W	FCC Limit 96.41 dBm EIRP	FCC Limit 96.41 W EIRP	Margin (dB)
20	19.4	19.49	49.92	98.2	50.01	100.24	0.09
30	21.2	21.25	51.72	148.6	51.77	150.36	0.05
40	22.4	22.50	52.92	196.0	53.02	200.47	0.1
50	23.4	23.47	53.92	246.7	53.99	250.59	0.07
60	24.2	24.26	54.72	296.6	54.78	300.71	0.06
70	24.9	24.93	55.42	348.5	55.45	350.83	0.03
80	25.5	25.51	56.02	400.1	56.03	400.95	0.01
90	26.0	26.02	56.52	448.9	56.54	451.07	0.02
100	26.45	26.48	56.97	498.0	57.00	501.19	0.03

* per FCC limit. ** The power per port was reduced from 2A.

Table 2.5(c) Maximum EIRP for 64T64R 16 Beam CP Configurations 1A

Bandwidth (MHz)	Maxi Cond Power per Port dBm**	Maxi Cond Power per Port Allowed dBm*	Maxi EIRP dBm	Maxi EIRP W	FCC Limit 96.41 dBm EIRP	FCC Limit 96.41 W EIRP	Margin (dB)
20	19.4	19.49	49.91	98.0	50.01	100.24	0.1
30	21.2	21.25	51.71	148.3	51.77	150.36	0.06
40	22.4	22.50	52.91	195.5	53.02	200.47	0.11
50	23.4	23.47	53.91	246.1	53.99	250.59	0.08
60	24.2	24.26	54.71	295.9	54.78	300.71	0.07
70	24.9	24.93	55.41	347.7	55.45	350.83	0.04
80	25.5	25.51	56.01	399.2	56.03	400.95	0.02
90	26.0	26.02	56.51	447.8	56.54	451.07	0.03
100	26.45	26.48	56.96	496.8	57.00	501.19	0.04

* per FCC limit. ** The power per port was reduced from 2A.

Table 2.5(d) Maximum EIRP for 64T64R 16 Beam CP Configurations 1B

Bandwidth (MHz)	Maxi Cond Power per Port dBm**	Maxi Cond Power per Port Allowed dBm*	Maxi EIRP dBm	Maxi EIRP W	FCC Limit 96.41 dBm EIRP	FCC Limit 96.41 W EIRP	Margin (dB)
20	16.4	16.48	49.92	98.2	50.01	100.24	0.09
30	18.2	18.24	51.72	148.7	51.77	150.36	0.05
40	19.4	19.49	52.92	196.0	53.02	200.47	0.1
50	20.4	20.46	53.92	246.7	53.99	250.59	0.07
60	21.2	21.25	54.72	296.6	54.78	300.71	0.06
70	21.9	21.92	55.42	348.5	55.45	350.83	0.03
80	22.5	22.50	56.02	400.1	56.03	400.95	0.01
90	23.0	23.01	56.52	448.9	56.54	451.07	0.02
100	23.45	23.47	56.97	497.9	57.00	501.19	0.03

* per FCC limit. ** The power per port was reduced from 2A.

The sample calculation for the maximum EIRP for 2A as follows,

The maximum Conducted Output Power per port = 26.98 dBm
The maximum Conducted Output Power per polarization = 26.98 + 10 x *log* (16) = 39.02 dBm
The maximum EIRP per polarization = 39.02 + 15.47 = 54.491 dBm.

The sample calculation for the maximum EIRP for 2B as follows,

The maximum Conducted Output Power per port = 26.0dBm
The maximum Conducted Output Power per polarization = 26.0 + 10 x *log* (32) = 41.05 dBm
The maximum EIRP per polarization = 41.05 + 15.47 = 56.52 dBm.

The sample calculation for the maximum EIRP for 1A as follows,

The maximum Conducted Output Power per port = 26.0dBm
The maximum Conducted Output Power per polarization = 26.0 + 10 x *log* (32) = 41.05 dBm
The maximum EIRP per polarization = 41.05 + 15.46 = 56.51 dBm.

The sample calculation for the maximum EIRP for 1B as follows,

The maximum Conducted Output Power per port = 23.0dBm
The maximum Conducted Output Power per polarization = 23.0 + 10 x *log* (64) = 41.06 dBm
The maximum EIRP per polarization = 41.06 + 15.46 = 56.52 dBm.

The lower EIRPs in Table 2.5(a) for configuration 2A was mainly due to the restriction from power capacity per port of EUT.

Table 2.5(e) Maximum EIRP for Configurations 64T64R 16 Beam CP 1A/1B and 32T32R 8 Beam CP 2A/2B

Bandwidth (MHz)	Configurations	Maxi EIRP dBm	Maxi EIRP W	FCC Limit 96.41 dBm EIRP	FCC Limit 96.41 W EIRP	Results
20	1B, 2B	49.92	98.2	50.01	100.24	Pass
30	1B, 2B	51.72	148.6	51.77	150.36	Pass
40	1B, 2B	52.92	196.0	53.02	200.47	Pass
50	1B, 2B	53.92	246.7	53.99	250.59	Pass
60	1B, 2B	54.72	296.6	54.78	300.71	Pass
70	1B, 2B	55.42	348.5	55.45	350.83	Pass
80	1B, 2B	56.02	400.1	56.03	400.95	Pass
90	1B, 2B	56.52	448.9	56.54	451.07	Pass
100	1B, 2B	56.97	498.0	57.00	501.19	Pass

2.4 Peak-to-Average Power Ratio (PAPR)

The Peak-to-Average Power Ratio (PAPR) was evaluated per ANSI C63.26 for 8-Beam 32T32R with 5, 10, 10+20, and 20+20 MHz bandwidth. The PAPR values of all carriers measured are below 13dB.

Table 2.4 Peak to Average Power Ratio (8-Beam 32T32R)

Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	PAR at 0.1% Limit - 13 dB
3.1	64QAM	56	3560	20	7.83
3.1	64QAM	56	3560	20	7.82
3.2	QPSK/16QAM	56	3625	20	**7.98**
3.1a	256QAM	56	3690	20	7.88
3.1	64QAM	56	3565	30	7.84
3.2	QPSK/16QAM	56	3625	30	**7.96**
3.1a	256QAM	56	3685	30	7.93
3.1	64QAM	56	3570	40	7.82
3.2	QPSK/16QAM	56	3625	40	7.92
3.1a	256QAM	56	3680	40	**7.97**
3.1	64QAM	56	3575	50	7.88
3.1	64QAM	56	3575	50	7.87
3.2	QPSK/16QAM	56	3625	50	**7.99**
3.1	64QAM	56	3675	50	7.99
3.1	64QAM	56	3580	60	8.00
3.2	QPSK/16QAM	56	3625	60	**8.14**
3.1a	256QAM	56	3670	60	8.11
3.1	64QAM	56	3585	70	**7.97**
3.2	QPSK/16QAM	56	3625	70	7.97
3.1a	256QAM	56	3665	70	7.97
3.1	64QAM	56	3590	80	**8.00**
3.2	QPSK/16QAM	56	3625	80	7.91
3.1a	256QAM	56	3660	80	7.99
3.1	64QAM	56	3595	90	**7.98**
3.2	QPSK/16QAM	56	3625	90	7.91
3.1a	256QAM	56	3655	90	7.95
3.1	64QAM	56	3600	100	8.09
3.2	QPSK/16QAM	56	3625	100	**8.50**
3.1a	256QAM	56	3650	100	8.05

Mode 8-Beam 32T32R, TX56

20MHz BW, TM3.2
Channel Frequency 3625MHz

30MHz BW, TM3.2
Channel Frequency 3625MHz

40MHz BW, TM3.1a
Channel Frequency 3680MHz

50MHz BW, TM3.2
Channel Frequency 3625MHz

60MHz BW, TM3.2
Channel Frequency 3625MHz

70MHz BW, TM3.1
Channel Frequency 3585MHz

80MHz BW, TM3.1
Channel Frequency 3590MHz

90MHz BW, TM3.1
Channel Frequency 3600MHz

100MHz BW, TM3.2
Channel Frequency 3625MHz

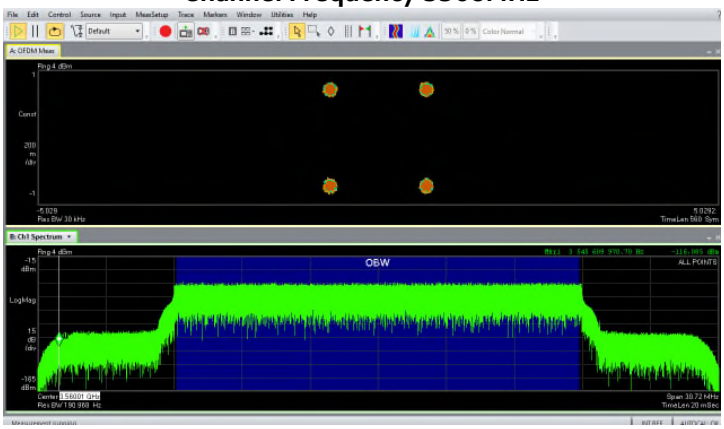
3. FCC Section 2.1047 - Modulation Characteristics

3.1 Modulation Characteristics

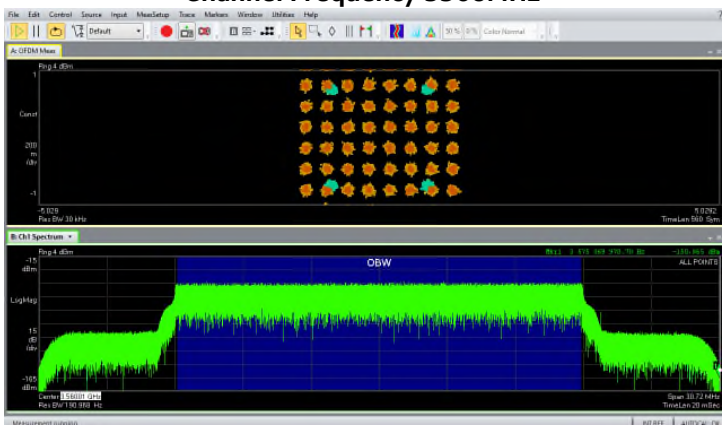
The RF signal at the antenna port was demodulated and verified for correctness of the modulation signal used before each test was performed.

3.1.1 Modulation Characteristics – Plots

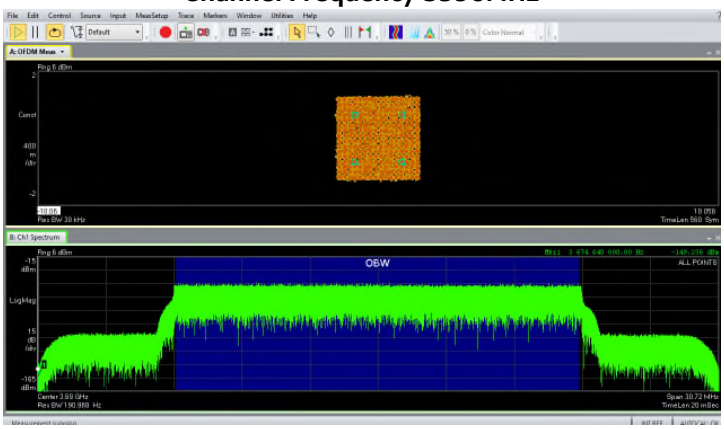
Modulation QPSK TM1.1
Channel Frequency 3560MHz



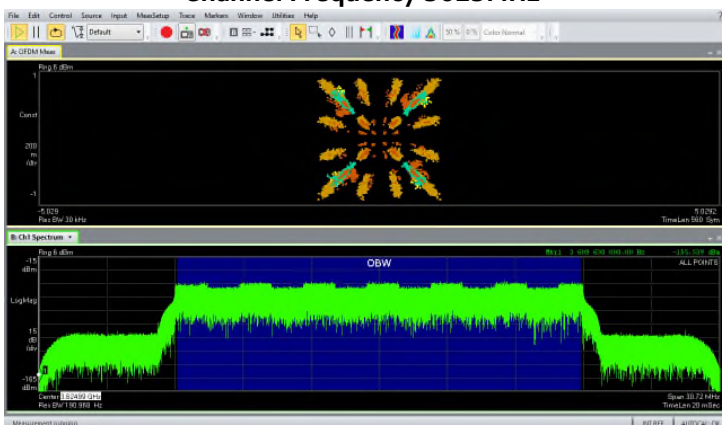
Modulation 64QAM TM3.1
Channel Frequency 3560MHz



Modulation 256QAM TM3.1a
Channel Frequency 3590MHz



Modulation QPSK/16QAM TM3.2
Channel Frequency 3625MHz



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.

Part 96.41e(3) specified that the fundamental emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

The transmitted signal occupied bandwidth was measured using a Keysight MXA Signal Analyzer. All emissions were within the parameters as required. The 8-Beam 32T32R modes have higher conducted RF output power per port, therefore, 8-Beam 32T32R modes were used for occupied bandwidth and band edge emissions evaluations.

Table 4.1 AEQM 99% Occupied Bandwidth (8-Beam 32T32R)

Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Occupied BW MHz
3.1	64QAM	56	3560	20	18.15
3.2	QPSK/16QAM	56	3625	20	18.16
3.1a	256QAM	56	3690	20	**18.19**
3.1	64QAM	56	3565	30	**28.04**
3.2	QPSK/16QAM	56	3625	30	27.86
3.1a	256QAM	56	3685	30	27.84
3.1	64QAM	56	3570	40	37.48
3.2	QPSK/16QAM	56	3625	40	**37.73**
3.1a	256QAM	56	3680	40	37.47
3.1	64QAM	56	3575	50	**47.65**
3.2	QPSK/16QAM	56	3625	50	47.56
3.1	64QAM	56	3675	50	47.49
3.1	64QAM	56	3580	60	57.49
3.2	QPSK/16QAM	56	3625	60	**57.70**
3.1a	256QAM	56	3670	60	57.39
3.1	64QAM	56	3585	70	67.08
3.2	QPSK/16QAM	56	3625	70	**67.73**
3.1a	256QAM	56	3665	70	67.48
3.1	64QAM	56	3590	80	76.67
3.2	QPSK/16QAM	56	3625	80	**77.36**
3.1a	256QAM	56	3660	80	77.19
3.1	64QAM	56	3595	90	**87.57**
3.2	QPSK/16QAM	56	3625	90	87.20
3.1a	256QAM	56	3655	90	87.17
3.1	64QAM	56	3600	100	**97.36**

Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Occupied BW MHz
3.2	QPSK/16QAM	56	3625	100	96.97
3.1a	256QAM	56	3650	100	97.20

Table 4.2 AEQM 26dB Emission Bandwidth (8-Beam 32T32R)

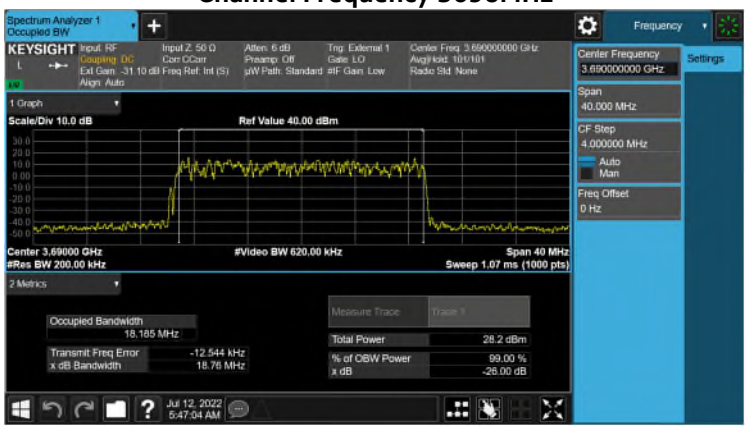
Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Occupied BW MHz
3.1	64QAM	56	3560	20	18.71
3.2	QPSK/16QAM	56	3625	20	18.71
3.1a	256QAM	56	3690	20	**18.75**
3.1	64QAM	56	3565	30	28.85
3.2	QPSK/16QAM	56	3625	30	**28.94**
3.1a	256QAM	56	3685	30	28.68
3.1	64QAM	56	3570	40	39.01
3.2	QPSK/16QAM	56	3625	40	39.35
3.1a	256QAM	56	3680	40	**39.39**
3.1	64QAM	56	3575	50	**48.91**
3.2	QPSK/16QAM	56	3625	50	48.77
3.1	64QAM	56	3675	50	48.89
3.1	64QAM	56	3580	60	59.49
3.2	QPSK/16QAM	56	3625	60	59.41
3.1a	256QAM	56	3670	60	**59.61**
3.1	64QAM	56	3585	70	69.33
3.2	QPSK/16QAM	56	3625	70	**69.43**
3.1a	256QAM	56	3665	70	69.38
3.1	64QAM	56	3590	80	79.55
3.2	QPSK/16QAM	56	3625	80	**80.26**
3.1a	256QAM	56	3660	80	79.57
3.1	64QAM	56	3595	90	89.94
3.2	QPSK/16QAM	56	3625	90	**90.04**
3.1a	256QAM	56	3655	90	89.85
3.1	64QAM	56	3600	100	**100.0**
3.2	QPSK/16QAM	56	3625	100	100.0
3.1a	256QAM	56	3650	100	100.0

4.1.1 Occupied Bandwidth – Plots

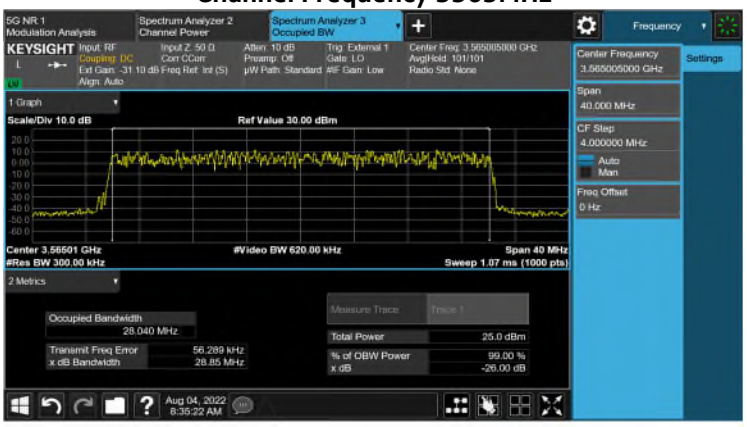
NOTE: Only the plots which give the widest bandwidth for each configuration evaluated are used in this report. The full suite of raw data resides at the MH, New Jersey location.

4.1.1.1 99% Occupied Bandwidth Plots

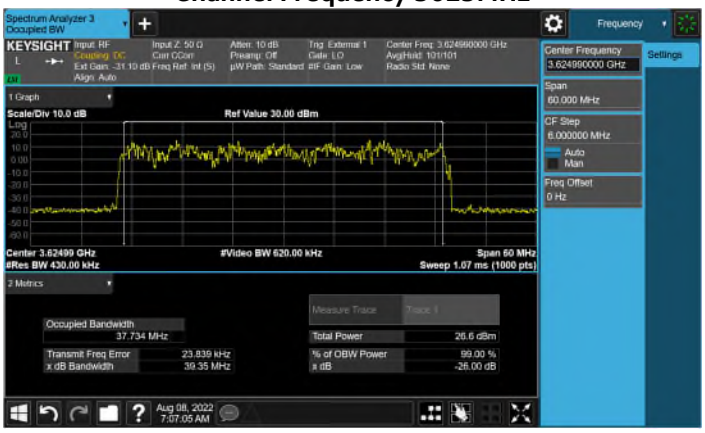
20MHz BW, TM3.1a
Channel Frequency 3690MHz



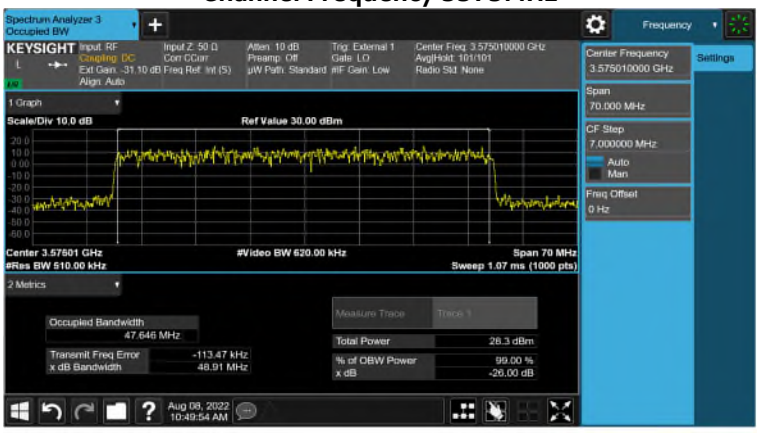
30MHz BW, TM3.1
Channel Frequency 3565MHz



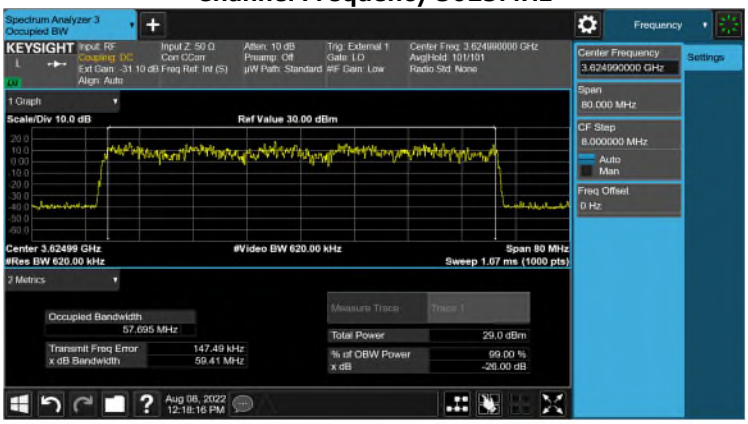
40MHz BW, TM3.2
Channel Frequency 3625MHz



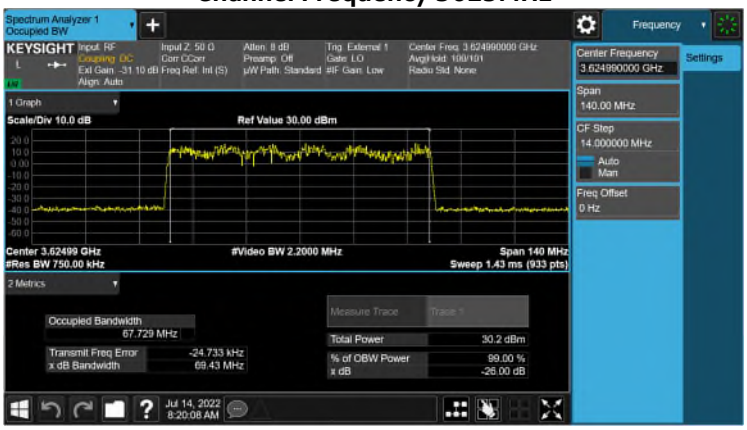
50MHz BW, TM3.1
Channel Frequency 3575MHz



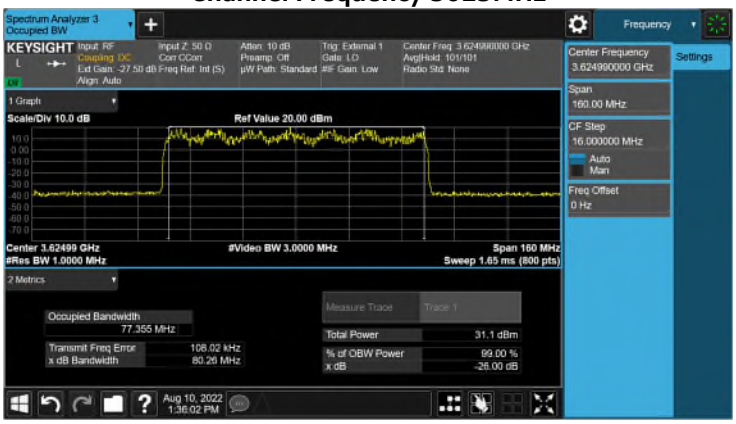
60MHz BW, TM3.1
Channel Frequency 3625MHz



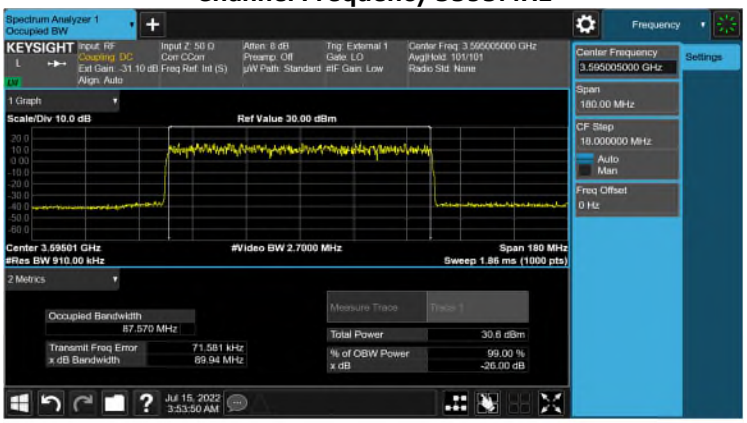
70MHz BW, TM3.2
Channel Frequency 3625MHz



80MHz BW, TM3.2
Channel Frequency 3625MHz



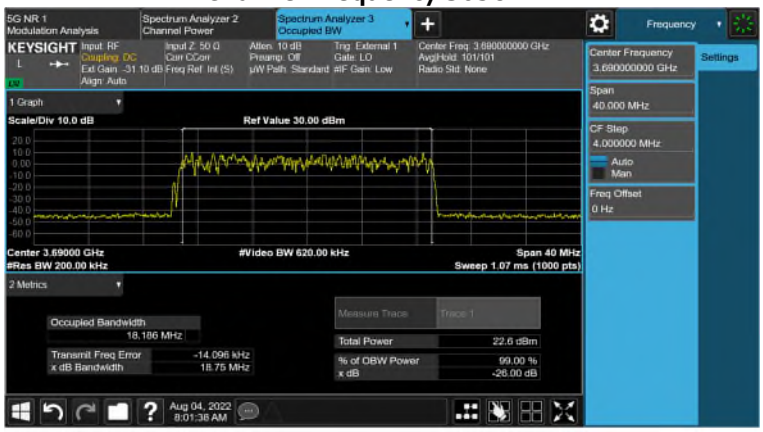
90MHz BW, TM3.1
Channel Frequency 3595MHz



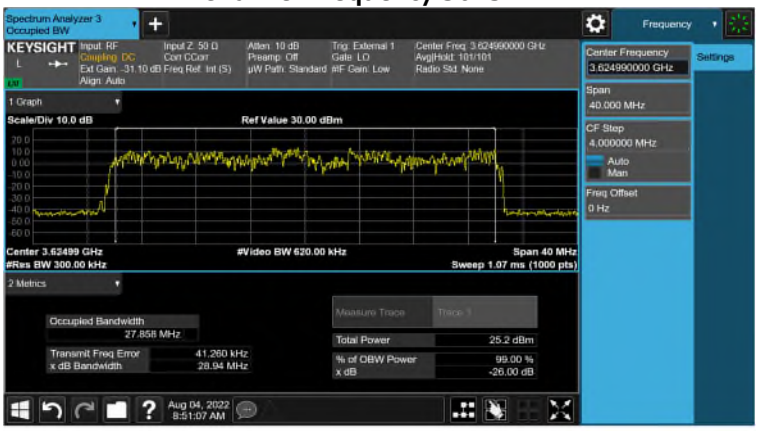
100MHz BW, TM3.1
Channel Frequency 3600MHz

4.1.1.2 26 dB Emission Bandwidth Plots

20MHz BW, TM3.1a
Channel Frequency 3690MHz

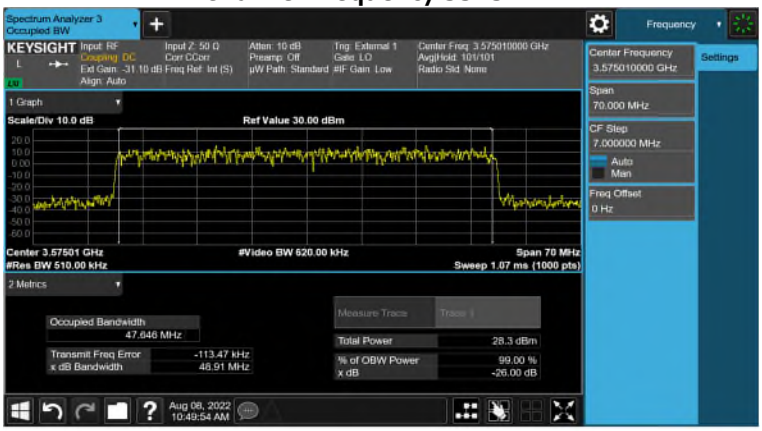


30MHz BW, TM3.2
Channel Frequency 3625MHz

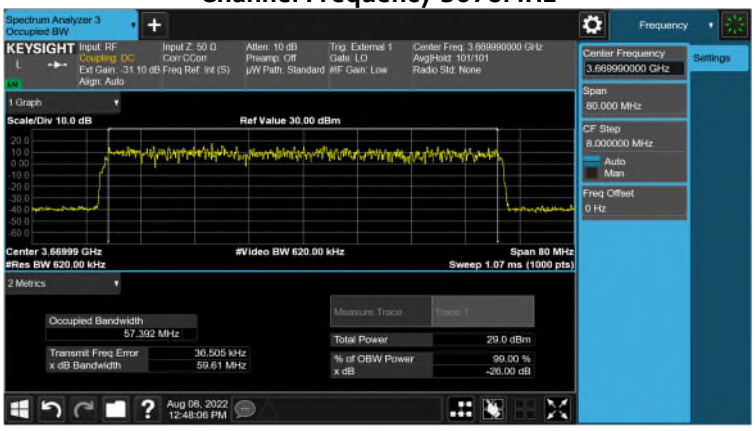


40MHz BW, TM3.1a
Channel Frequency 3680MHz

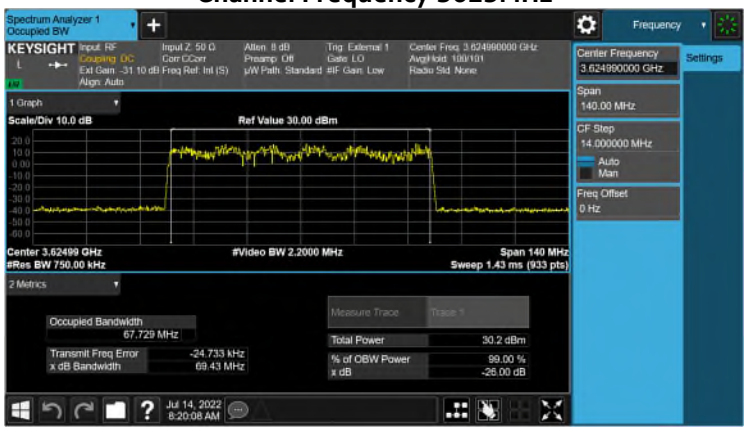
50MHz BW, TM3.1
Channel Frequency 3575MHz



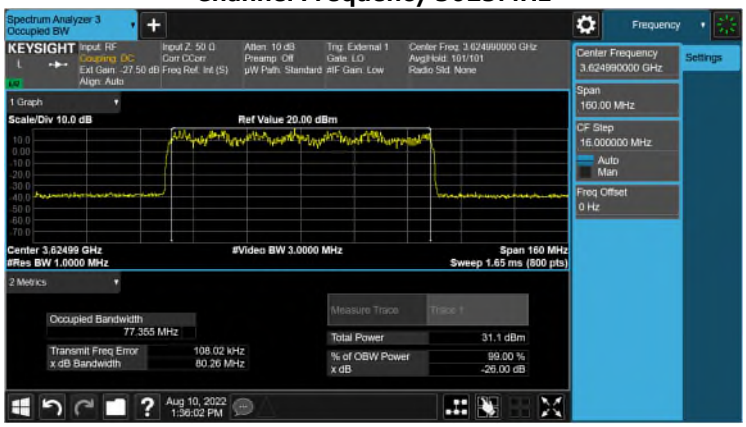
60MHz BW, TM3.1a
Channel Frequency 3670MHz



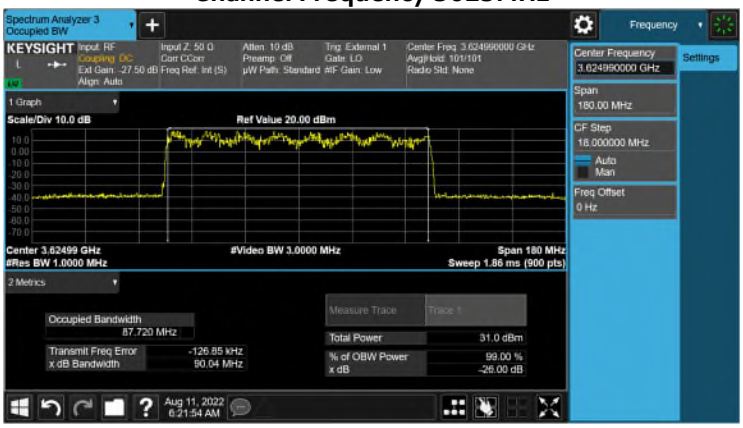
70MHz BW, TM3.2
Channel Frequency 3625MHz



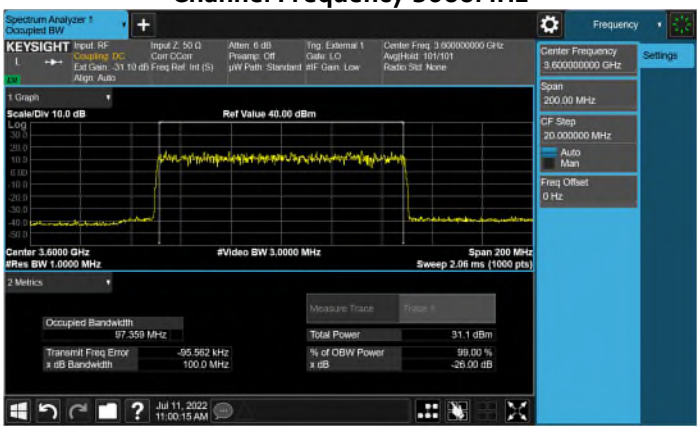
80MHz BW, TM3.2
Channel Frequency 3625MHz



90MHz BW, TM3.2
Channel Frequency 3625MHz



100MHz BW, TM3.1
Channel Frequency 3600MHz



4.2 Edge of band Emissions

47CFR 96.41 (e)(1) (i) and KDB 940660 D01 Section 3.2 (b)(6) specified that the limits for the emissions outside the fundamental are as follows.

- within 0 MHz to 10 MHz above and below the assigned channel $\leqslant$ −13 dBm/MHz,
- greater than 10 MHz above and below the assigned channel $\leqslant$ −25 dBm/MHz,
- any emission below 3530 MHz and above 3720 MHz $\leqslant$ −40 dBm/MHz.

47CFR 96.41 (e)(3) and KDB 940660 D01 Section 3.2 (b)(6) specified stated that (i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 Megahertz band immediately outside and adjacent to the licensee's authorized frequency channel, a resolution bandwidth of no less than one percent of the fundamental emission bandwidth may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full reference bandwidth (*i.e.,* 1 MHz or 1 percent of emission bandwidth, as specified). The fundamental emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. (ii) When measuring unwanted emissions to demonstrate compliance with the limits, the CBSD and End User Device nominal carrier frequency/channel shall be adjusted as close to the licensee's authorized frequency block edges, both upper and lower, as the design permits. (iii) Compliance with emission limits shall be demonstrated using either average (RMS)-detected or peak-detected power measurement techniques.

KDB 940660 D01 Section 3.2 (b)(6) specified that measurements must be performed for low, mid, and high channels. It is acceptable to apply the procedures in Section 5.7 of ANSI C63.26-2015. When antenna-port conducted measurements are performed to demonstrate compliance to the applicable unwanted emission limits (Section 2.1051), a separate radiated measurement is required to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation (Section 2.1053). The Section 96.41(e) limits generally also apply to radiated unwanted emissions.

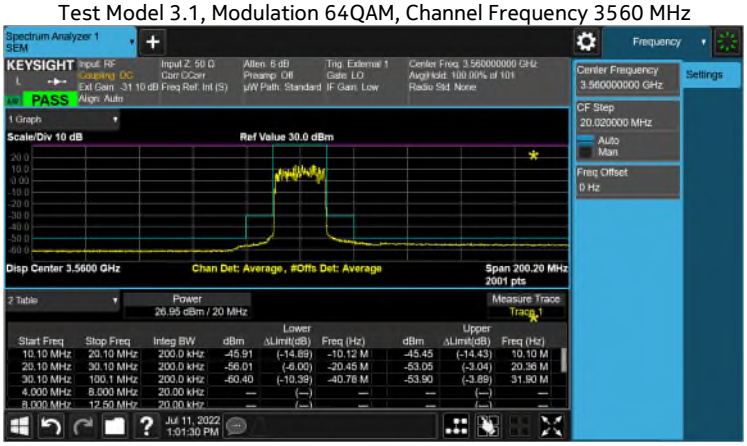
The Edge of Band emissions of the EUT at the external antenna connector (EAC) were measured using a Keysight MXA Signal Analyzer. The RF power level was continuously measured using a RF broadband power meter. The RF output from the EAC port to signal analyzer was reduced (to an amplitude usable by the 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. The Top of Mask corresponds to the set rated power level as confirmed by the RF power meter.

4.2.1 Edge of Band Emissions - Plots.

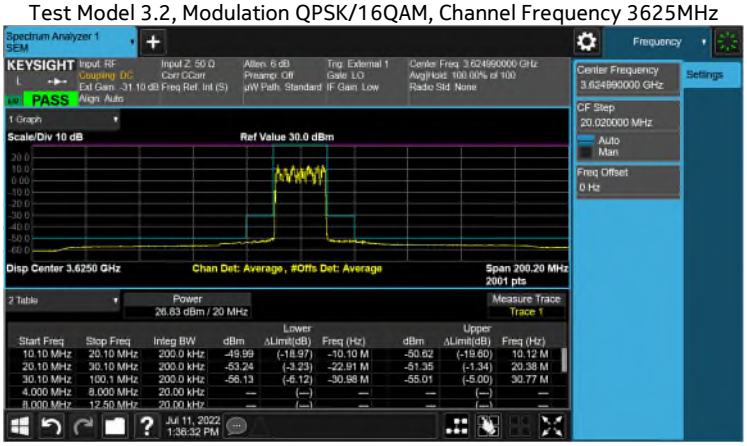
All of the measurements met the requirements of Part 96.41(e)(1) and KDB 940660 D01 Section 3.2 (b)(6) when measured per Part 2.1049.

Single Carrier - 8-Beam 32T32R 20 MHz, TX56

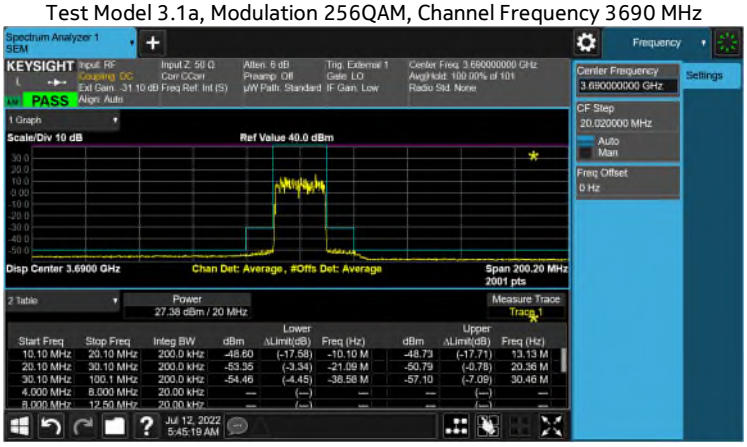
Test Model 3.1, Modulation 64QAM, Channel Frequency 3560 MHz



Test Model 3.2, Modulation QPSK/16QAM, Channel Frequency 3625MHz

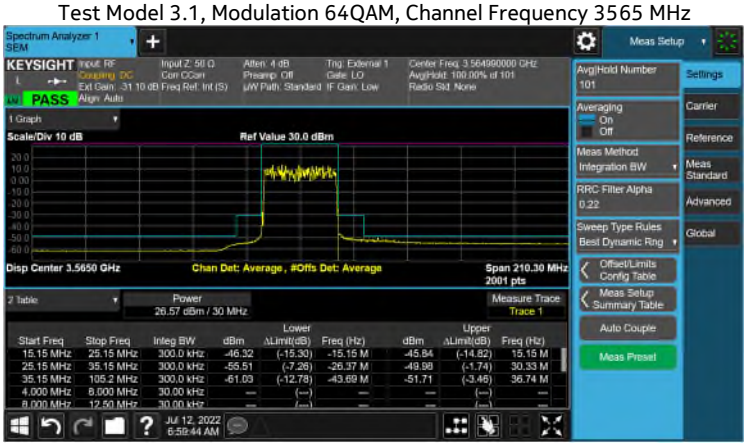


Test Model 3.1a, Modulation 256QAM, Channel Frequency 3690 MHz

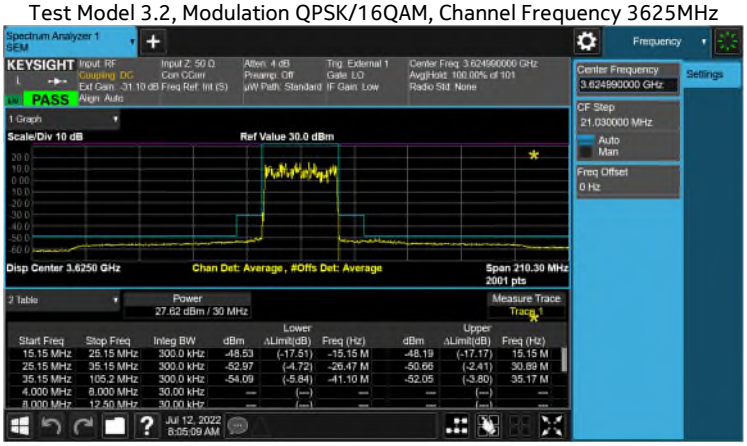


Single Carrier - 8-Beam 32T32R 30 MHz, TX56

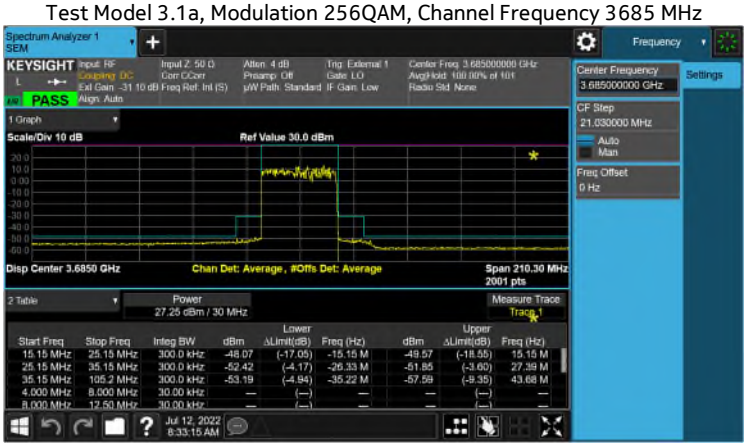
Test Model 3.1, Modulation 64QAM, Channel Frequency 3565 MHz



Test Model 3.2, Modulation QPSK/16QAM, Channel Frequency 3625MHz

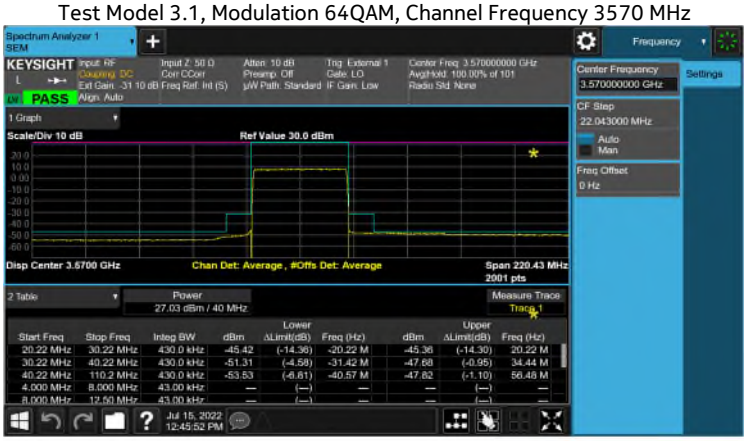


Test Model 3.1a, Modulation 256QAM, Channel Frequency 3685 MHz

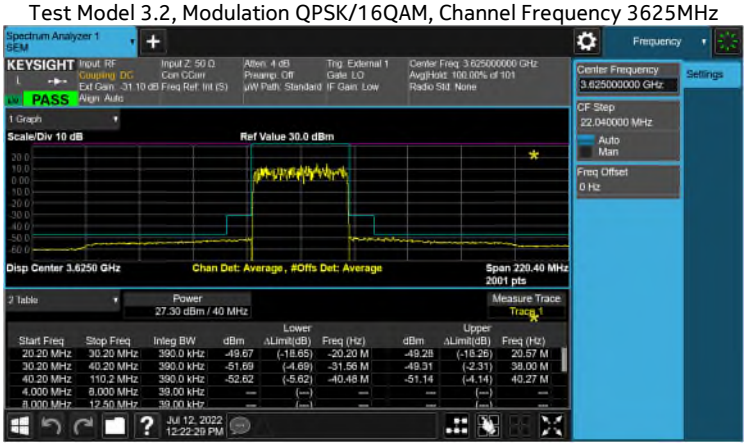


Single Carrier - 8-Beam 32T32R 40 MHz, TX56

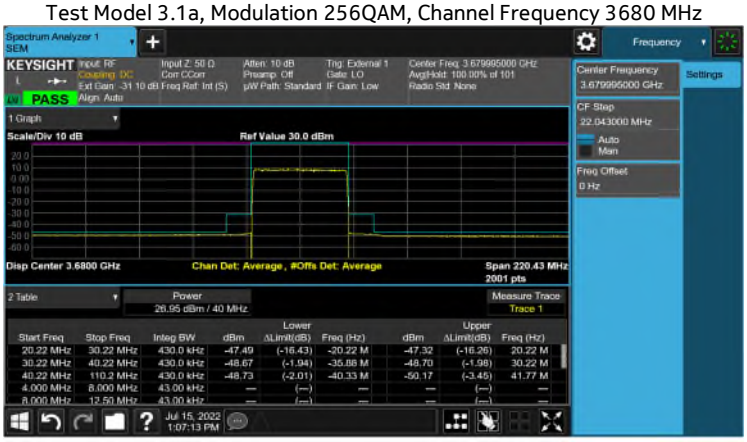
Test Model 3.1, Modulation 64QAM, Channel Frequency 3570 MHz



Test Model 3.2, Modulation QPSK/16QAM, Channel Frequency 3625MHz

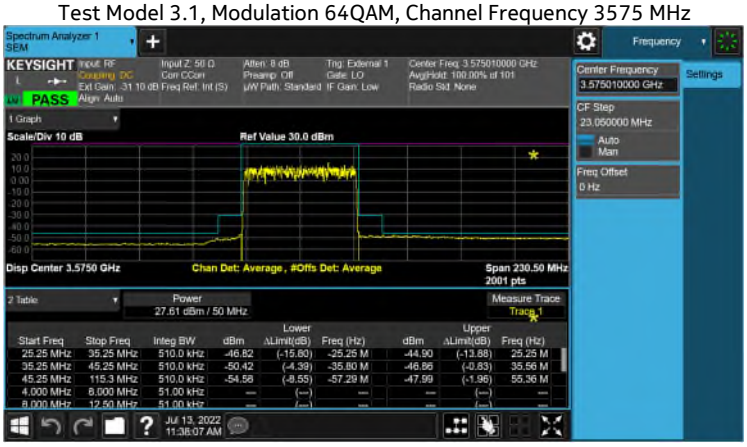


Test Model 3.1a, Modulation 256QAM, Channel Frequency 3680 MHz

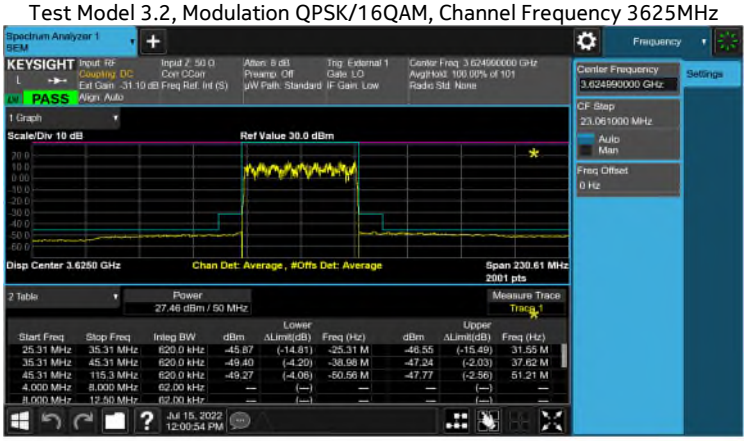


Single Carrier - 8-Beam 32T32R 50 MHz, TX56

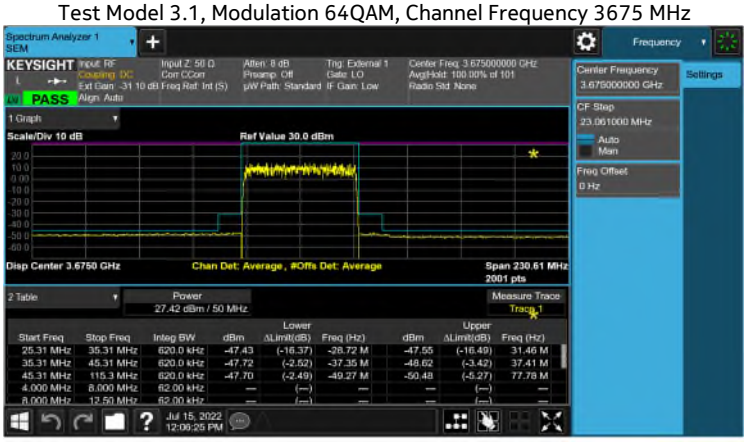
Test Model 3.1, Modulation 64QAM, Channel Frequency 3575 MHz



Test Model 3.2, Modulation QPSK/16QAM, Channel Frequency 3625MHz

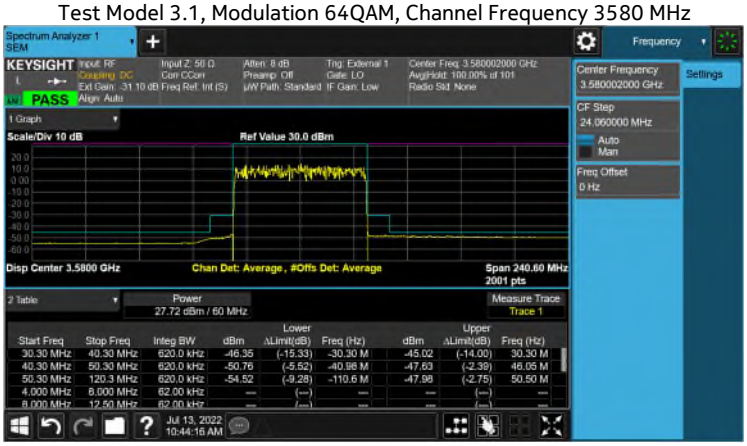


Test Model 3.1, Modulation 64QAM, Channel Frequency 3675 MHz

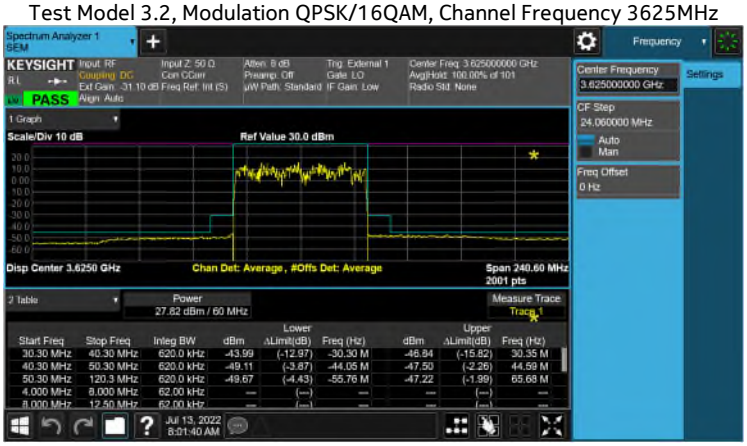


Single Carrier - 8-Beam 32T32R 60 MHz, TX56

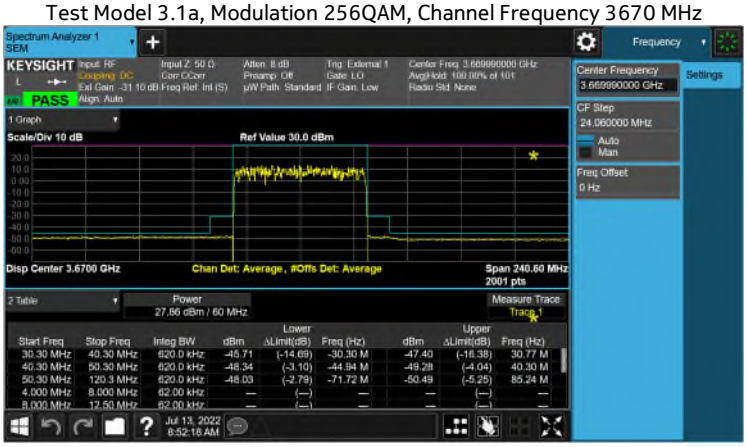
Test Model 3.1, Modulation 64QAM, Channel Frequency 3580 MHz



Test Model 3.2, Modulation QPSK/16QAM, Channel Frequency 3625MHz

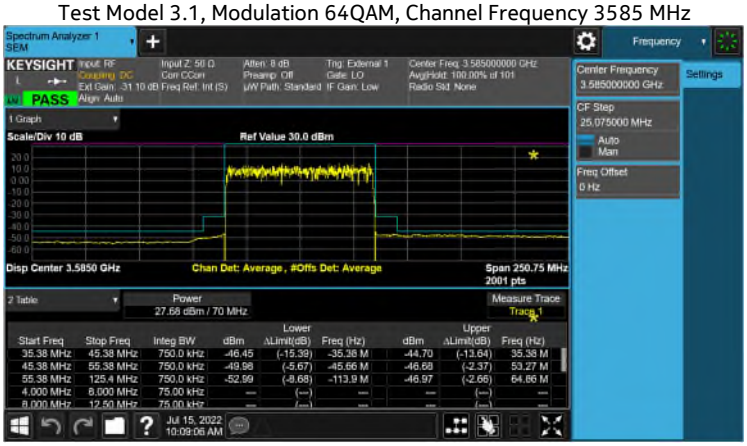


Test Model 3.1a, Modulation 256QAM, Channel Frequency 3670 MHz

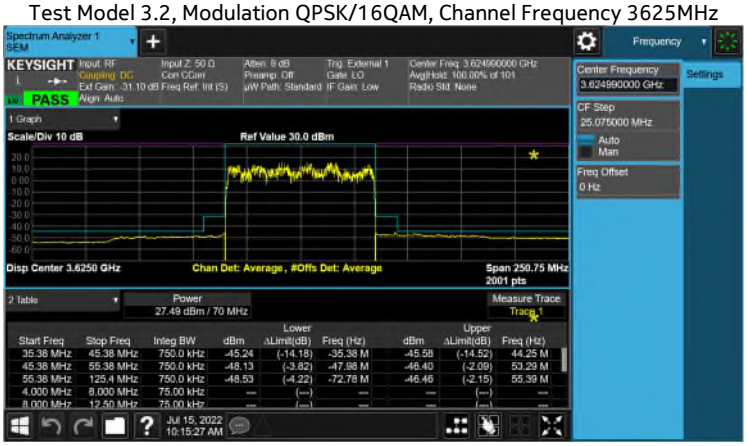


Single Carrier - 8-Beam 32T32R 70 MHz, TX56

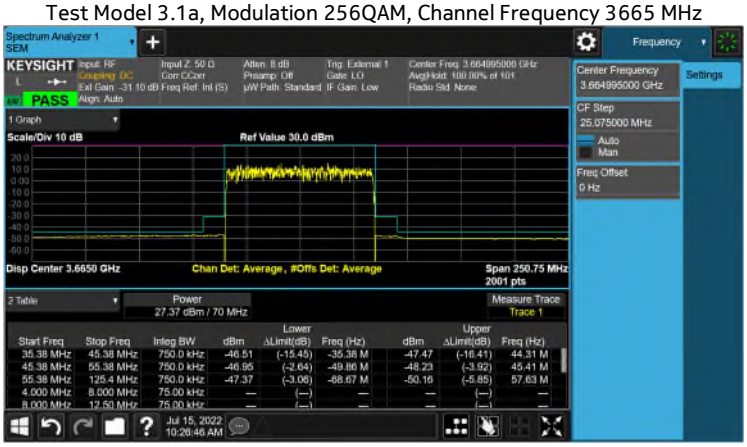
Test Model 3.1, Modulation 64QAM, Channel Frequency 3585 MHz



Test Model 3.2, Modulation QPSK/16QAM, Channel Frequency 3625MHz

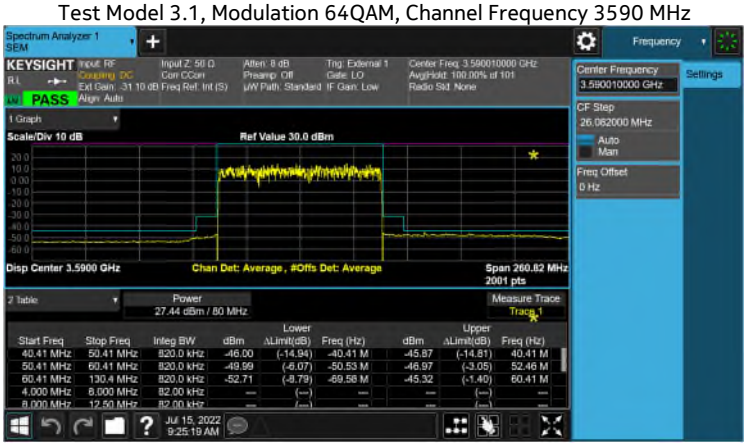


Test Model 3.1a, Modulation 256QAM, Channel Frequency 3665 MHz

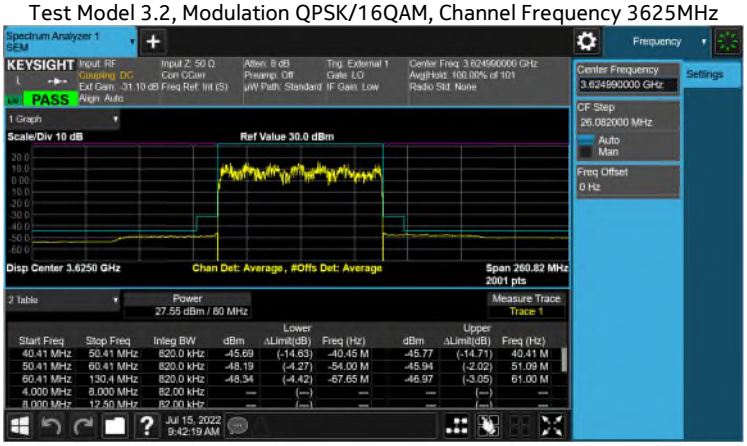


Single Carrier - 8-Beam 32T32R 80 MHz, TX56

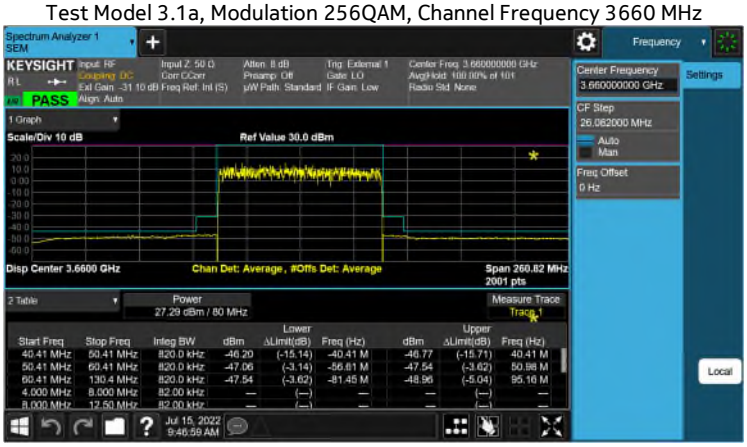
Test Model 3.1, Modulation 64QAM, Channel Frequency 3590 MHz



Test Model 3.2, Modulation QPSK/16QAM, Channel Frequency 3625MHz

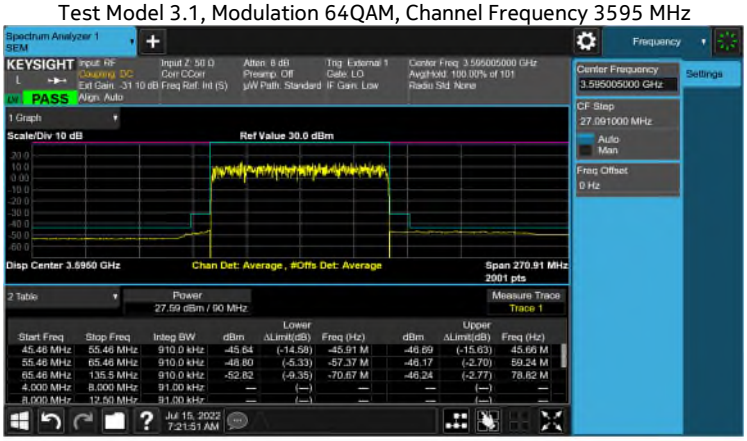


Test Model 3.1a, Modulation 256QAM, Channel Frequency 3660 MHz

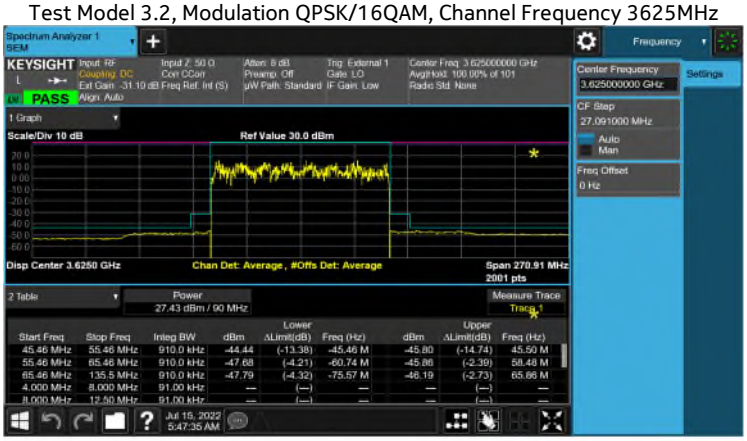


Single Carrier - 8-Beam 32T32R 90 MHz, TX56

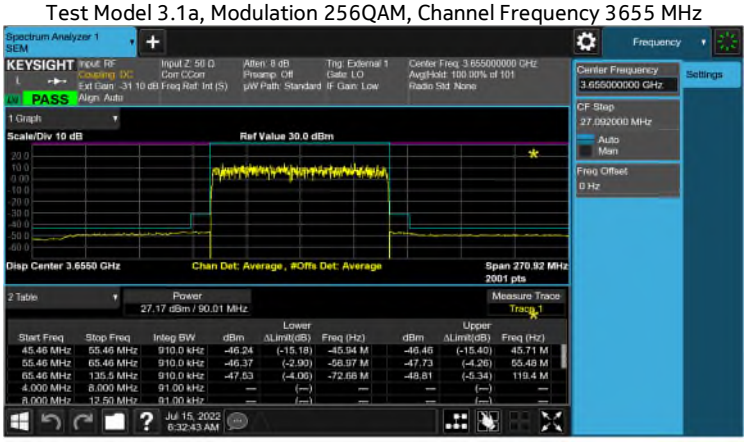
Test Model 3.1, Modulation 64QAM, Channel Frequency 3595 MHz



Test Model 3.2, Modulation QPSK/16QAM, Channel Frequency 3625MHz

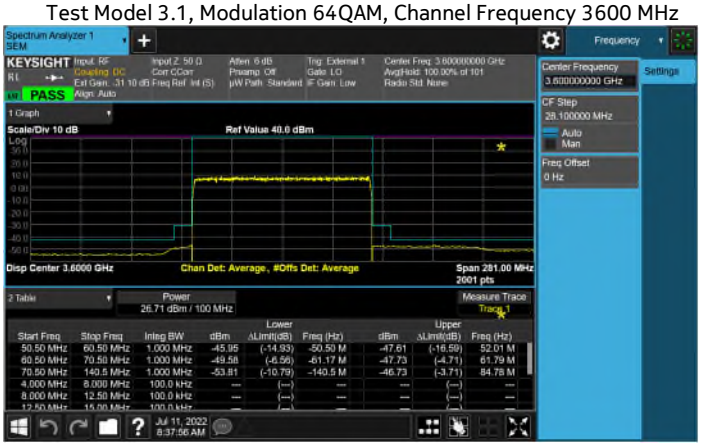


Test Model 3.1a, Modulation 256QAM, Channel Frequency 3655 MHz

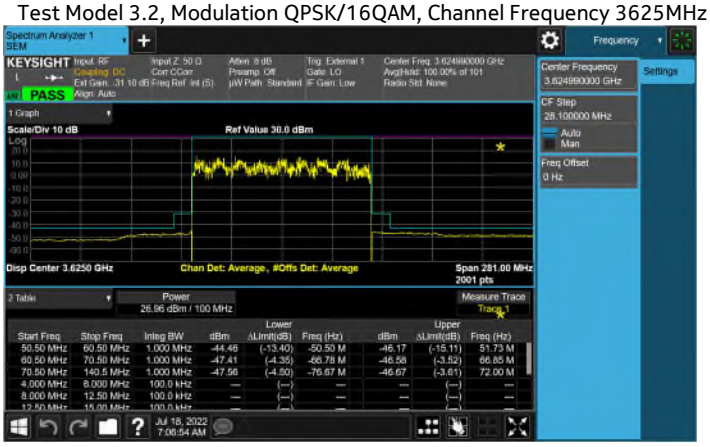


Single Carrier - 8-Beam 32T32R 100 MHz, TX56

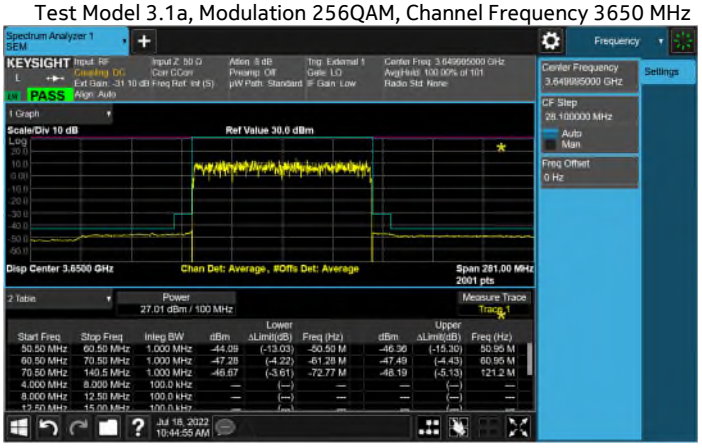
Test Model 3.1, Modulation 64QAM, Channel Frequency 3600 MHz



Test Model 3.2, Modulation QPSK/16QAM, Channel Frequency 3625MHz



Test Model 3.1a, Modulation 256QAM, Channel Frequency 3650 MHz



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 9 KHz to 38 GHz which is beyond the 10th harmonic of the carrier frequency. A test coupler and/or attenuator 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 spurious measurements were made using a PC based automated test system which controls either a MXA Signal Analyzer or a Rohde & Schwarz ESU-40 Test Receiver/ Spectrum 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 required emission limitation specified in **47CFR 96.41 (e)** was applied to these tests. Based upon the criterion given in Section 96 of the Code, the required emission limit for emissions outside a licensee's frequency block is:

47CFR 96.41 (e)(2) Additional protection levels. Notwithstanding paragraph (d)(1) of this section, the conducted power of any emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz. In order to account for the spectral adding of identical signals from the primary and diversity ports, per KDB 662911 D01 Multiple Transmitter Output v01r01, the level needs be adjusted by 10LOG(n) where n= number of outputs.

The adjustment for n=64 → 10LOG (64) = 18.06 dB

Therefore, the limit for emissions >1 MHz outside a licensee's frequency block when measured with a RBW of 1 MHz is:

-40 dBm – 18.06 dB = -58.06 dBm for 64x MIMO

5.2 Spurious Emissions at Antenna Terminals Results

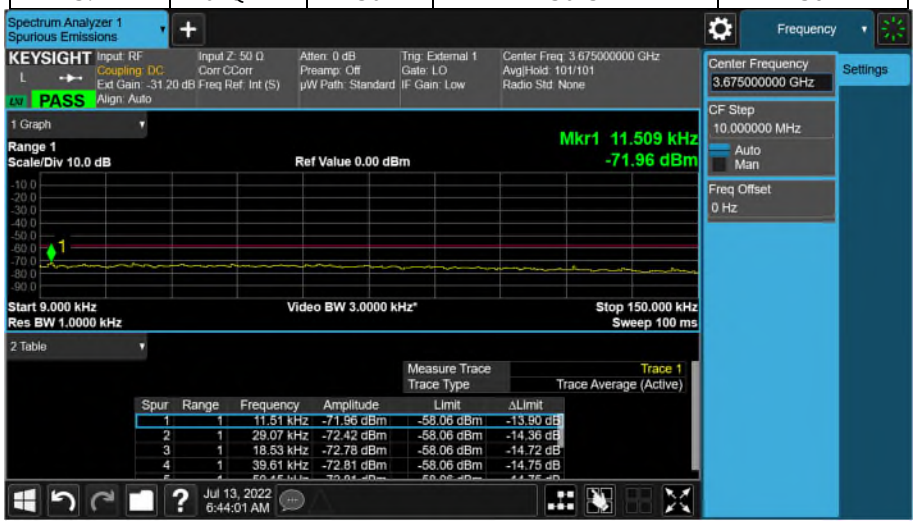
NOTE: Only plots with lowest margin in each frequency range are used in this report. The full suite of raw data resides at the MH, New Jersey location.

Tabular Data – Spurious Emissions at Antenna Terminals

Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Conducted Spurious Emissions Results Pass/ Fail
3.1	64QAM	56	3560	20	Pass
3.1	64QAM	56	3560	20	Pass
3.2	QPSK/16QAM	56	3625	20	Pass
3.1a	256QAM	56	3690	20	Pass
3.1	64QAM	56	3565	30	Pass
3.2	QPSK/16QAM	56	3625	30	Pass
3.1a	256QAM	56	3685	30	Pass
3.1	64QAM	56	3570	40	Pass
3.2	QPSK/16QAM	56	3625	40	Pass
3.1a	256QAM	56	3680	40	Pass
3.1	64QAM	56	3575	50	Pass
3.2	QPSK/16QAM	56	3625	50	Pass
3.1	64QAM	56	3675	50	Pass
3.1	64QAM	56	3580	60	Pass
3.2	QPSK/16QAM	56	3625	60	Pass
3.1a	256QAM	56	3670	60	Pass
3.1	64QAM	56	3585	70	Pass
3.2	QPSK/16QAM	56	3625	70	Pass
3.1a	256QAM	56	3665	70	Pass
3.1	64QAM	56	3590	80	Pass
3.2	QPSK/16QAM	56	3625	80	Pass
3.1a	256QAM	56	3660	80	Pass
3.1	64QAM	56	3595	90	Pass
3.2	QPSK/16QAM	56	3625	90	Pass
3.1a	256QAM	56	3655	90	Pass
3.1	64QAM	56	3600	100	Pass
3.2	QPSK/16QAM	56	3625	100	Pass
3.1a	256QAM	56	3650	100	Pass

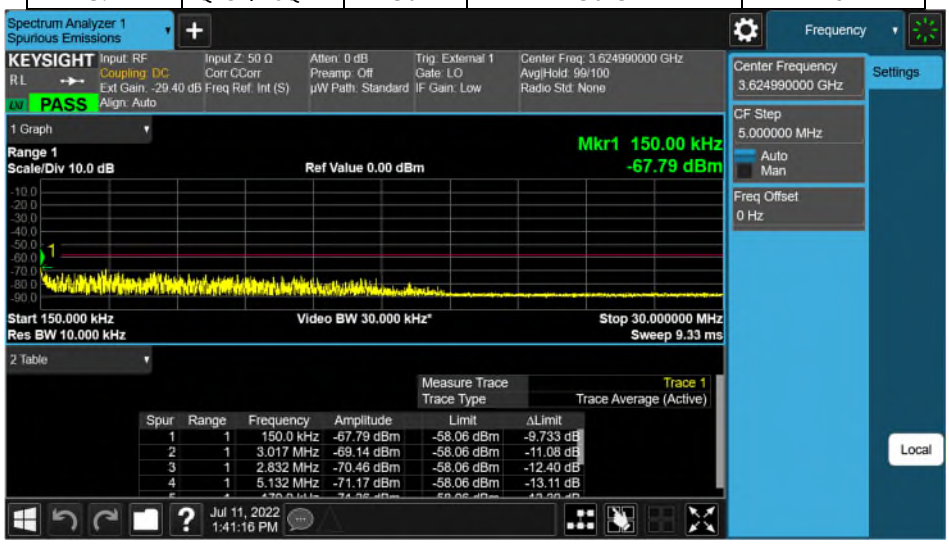
9KHz – 150kHz

Test Model	Modulation	TX Port	Channel Frequency (MHz)	Signal BW (MHz)
3.1	64QAM	56	3675	50



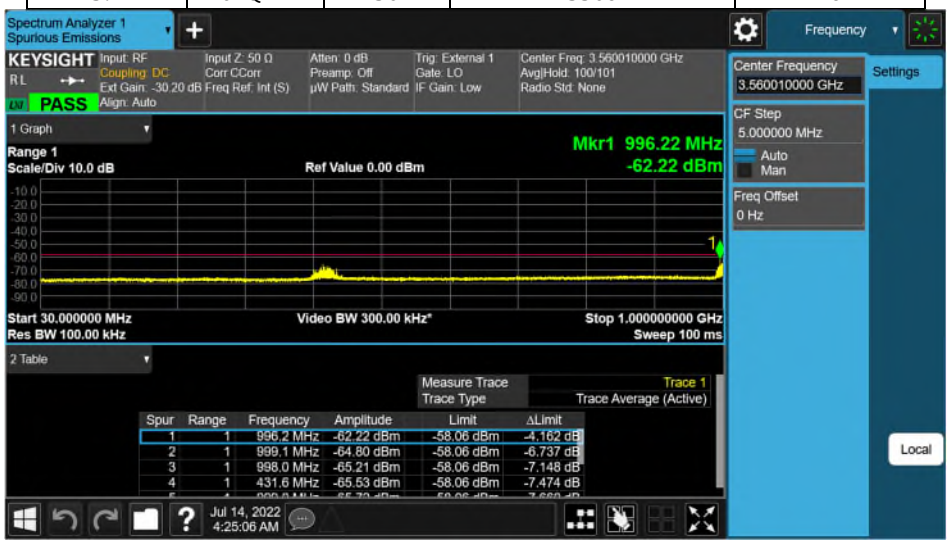
150kHz – 30MHz

Test Model	Modulation	TX Port	Channel Frequency (MHz)	Signal BW (MHz)
3.2	QPSK/16QAM	56	3625	20



30MHz – 1GHz

Test Model	Modulation	TX Port	Channel Frequency (MHz)	Signal BW (MHz)
3.1	64QAM	56	3560	20



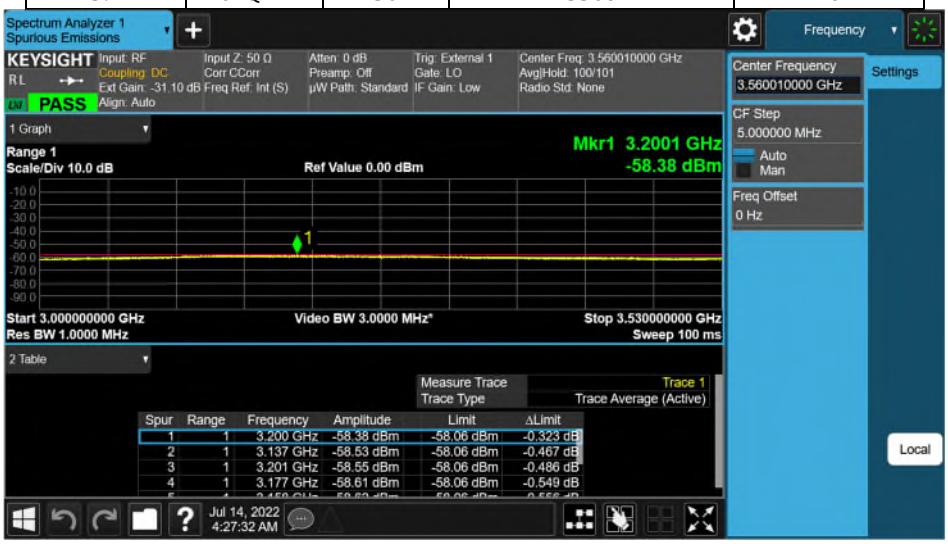
1GHz – 3GHz

Test Model	Modulation	TX Port	Channel Frequency (MHz)	Signal BW (MHz)
3.2	QPSK/16QAM	56	3625	20

Test Model	Modulation	TX Port	Channel Frequency (MHz)	Signal BW (MHz)
3.1	64QAM	56	3590.01	80

3GHz – 3.53GHz

Test Model	Modulation	TX Port	Channel Frequency (MHz)	Signal BW (MHz)
3.1	64QAM	56	3560	20

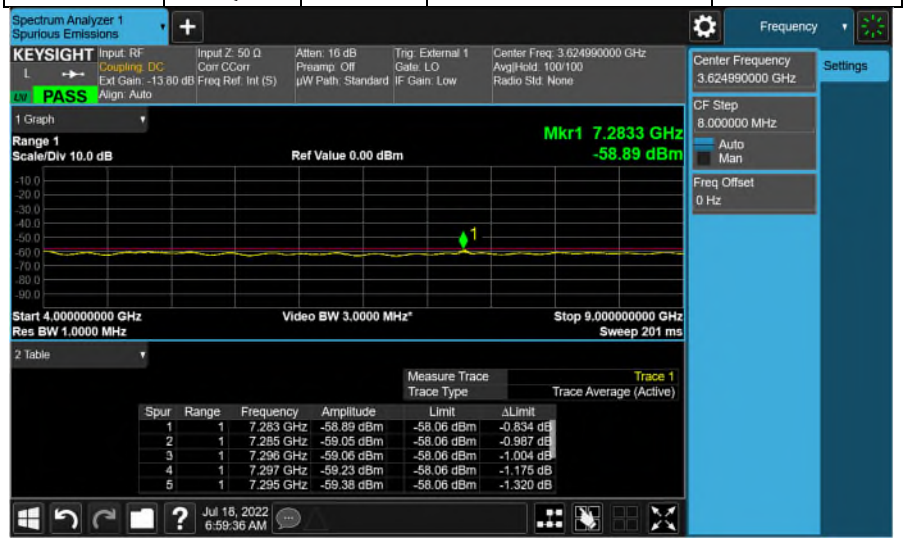


3.72GHz – 4GHz

Test Model	Modulation	TX Port	Channel Frequency (MHz)	Signal BW (MHz)
3.2	QPSK/16QAM	56	3625	80

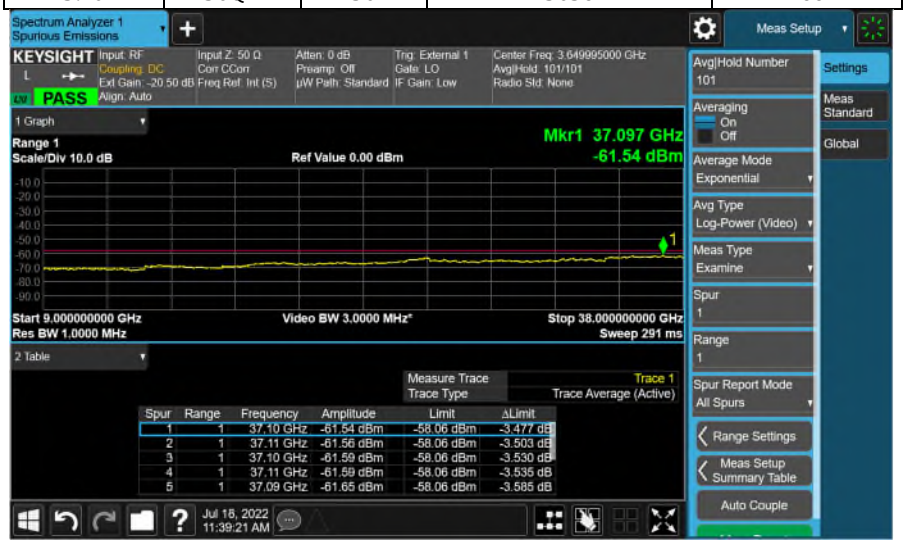
4GHz – 9GHz

Test Model	Modulation	TX Port	Channel Frequency (MHz)	Signal BW (MHz)
3.1	64QAM	56	3600	100



9GHz – 38GHz

Test Model	Modulation	TX Port	Channel Frequency (MHz)	Signal BW (MHz)
3.1a	256QAM	56	3650	100



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 3-meter semi-anechoic chamber AR-5, (FCC Registration Number: 395774) **NVLAP** Lab Code: 100275-0 and IC (Filing Number: 6933F-5) which is maintained by Nokia Bell Labs in Murray Hill, New Jersey.

6.1 Spurious Radiation and Radiated Emissions Requirements.

This product meets Parts 2,15 and 96 requirements. FCC Part 15 Class B require emissions to be below 54.5 dBuV/m at 3m.

47CFR 96.41 (e)(1) (i) and KDB 940660 D01 Section 3.2 (b)(6) specified that the limits for the emissions outside the fundamental are as follows.

- within 0 MHz to 10 MHz above and below the assigned channel $\leqslant$ −13 dBm/MHz,
- greater than 10 MHz above and below the assigned channel $\leqslant$ −25 dBm/MHz,
- any emission below 3530 MHz and above 3720 MHz $\leqslant$ −40 dBm/MHz.

Title 47CFR section 2.1053 contains the requirements for the levels of spurious radiation as a function of the EIRP of the unmodulated carrier. The reference level for the unmodulated carrier is calculated as the field produced by an isotropic radiator excited by the transmitter output power according to the following relation taken from Reference Data for Radio Engineers, page 27-7, 6th edition, IT&T Corp.

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

Where: E = Field Intensity in Volts/ meter R = Distance in meters = 3 m
P = Emission Power in Watts

Hence,

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

For EIRP = -13dBm/MHz, E = 82.2 dBµV/m,
For EIRP = -25dBm/MHz, E = 70.2 dBµV/m,
For EIRP = -40dBm/MHz, E = 55.2 dBµV/m.

The field strength of radiated spurious emissions measured was determined by

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

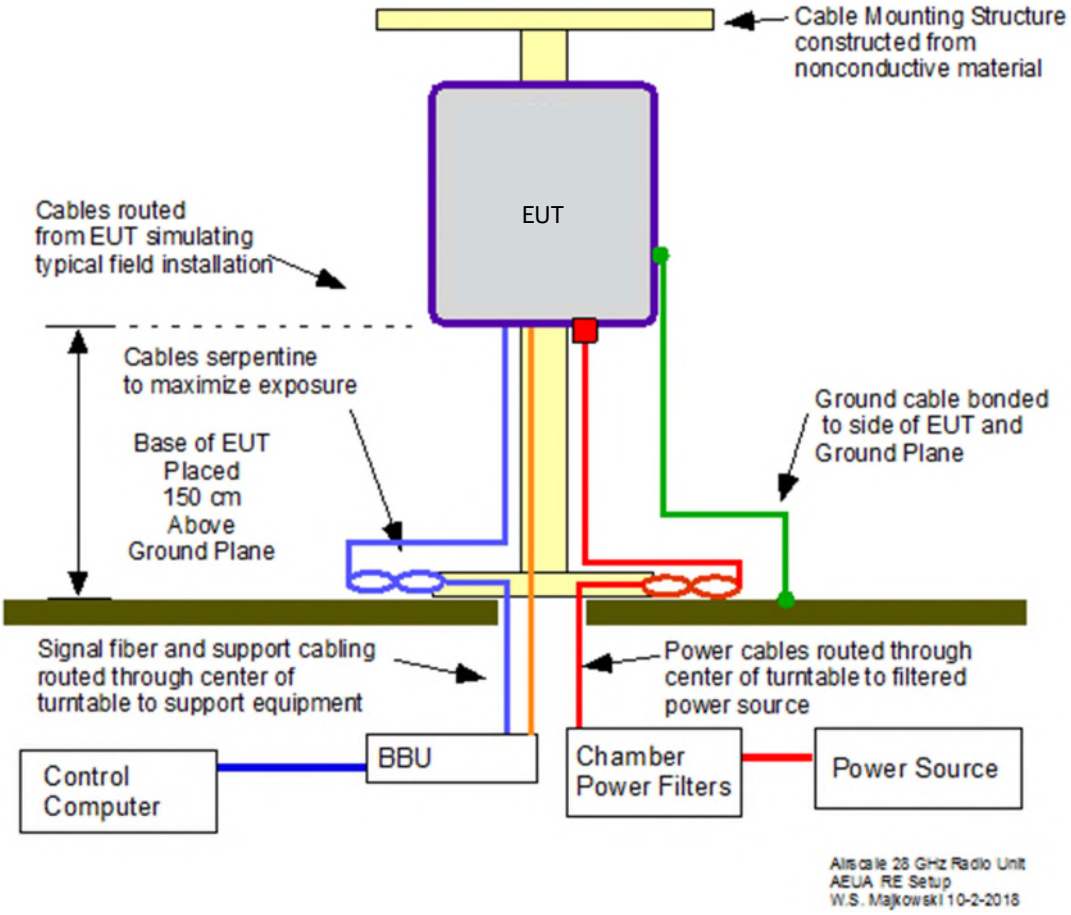
Field strength measurements of radiated spurious emissions were made in the 3m semi-anechoic chamber, AR-6 as detailed above. The recommendations of ANSI C63.4 and ANSI C63.26 were followed for EUT testing setup, cabling, and measurement approach and procedures. All the measurement equipment used, including antennas, was calibrated in accordance with ISO 9001 process. The EUT setup diagram is given in the Figure 4.5.

Below 18GHz, FCC Part 15 Class B limit 54.5 dBuV/m was used which is worse than FCC Part 96 limit. Above 18GHz, the limit 55.2 dBuV/m was used.

6.2 Field Strength of Spurious Radiation Results:

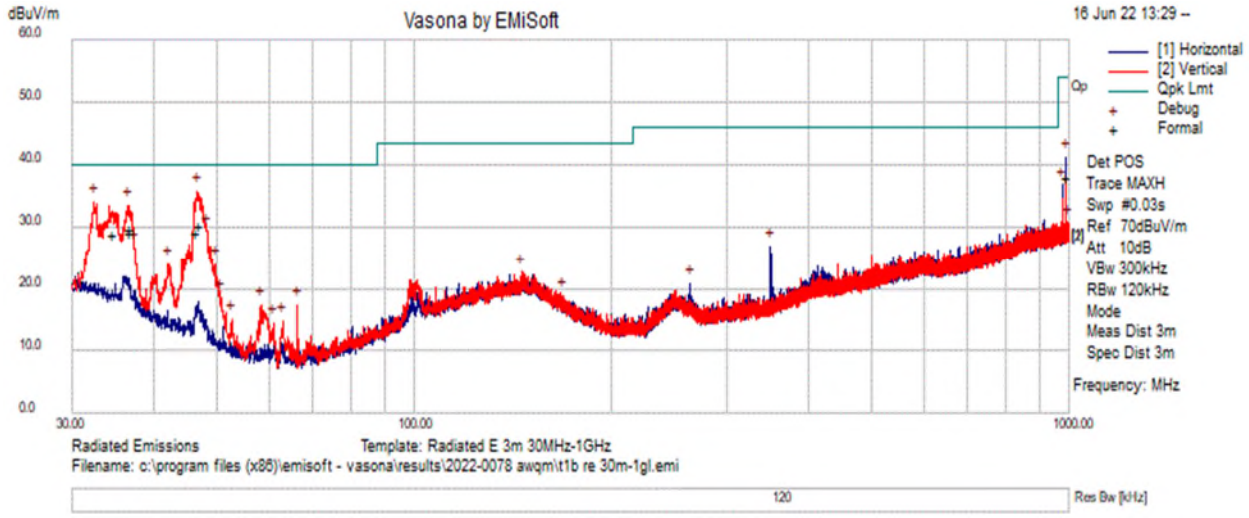
This product meets Part 96 Requirements. For the Title 47CFR section 96.41(e) and 2.1053 test, the field strength of any spurious radiation, measured at 3m, is required to be less than 55.2dBµV/meter. The minimum reportable emission is -16.16 dB.

Radiated Emission Setup



6.3 Transmitter Measurements of Radiated Spurious Emissions Plots

RE 30MHz – 1GHz



Test Information

Results Title	Radiated E 3m 30MHz-1GHz
File Name	t4f re30m-1g fcc b final.emi
Test Laboratory	MH-AR5, 49%RH, 23C, 1002mB
Test Engineer	GM / MGM
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia
EUT Details	2022-0078 Airscale Micro RRH AEQM M48 DSS - FCC & ISED; 3600MHz, DDS, 27dBm/Port
Configuration	FCC Part 15 Class B RE 30MHz-1GHz, 3 meter distance. 0dB Int Attn, RBW: 120KHz, VBW: 300KHz. ESW E1511, PA E814, Bilog Ant E602, Cable Set AR5 1-1
Date	2022-06-16 13:30:18

Formal Data

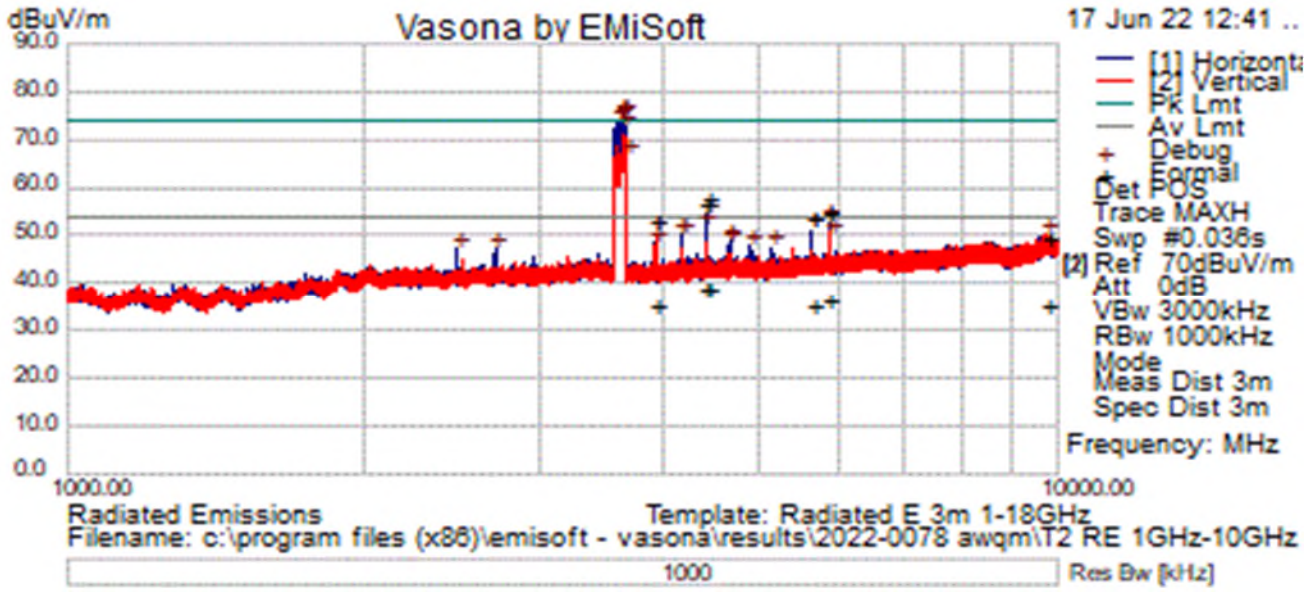
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail	Comments
46.944	46.23	0.68	-16.76	30.15	QuasiMax	V	128	315	40.00	-9.85	Pass	
36.845	41.13	0.72	-12.19	29.66	QuasiMax	V	109	308	40.00	-10.34	Pass	
36.836	40.67	0.72	-12.18	29.21	QuasiMax	V	127	163	40.00	-10.79	Pass	
46.331	44.85	0.68	-16.51	29.03	QuasiMax	V	109	37	40.00	-10.97	Pass	
34.707	39.36	0.73	-11.13	28.97	QuasiMax	V	119	119	40.00	-11.03	Pass	
990.720	37.89	2.83	-2.69	38.03	QuasiMax	H	143	308	54.00	-15.97	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail	Comments
46.716333	51.75	0.68	-16.67	35.76	Debug	V	100	0	40.00	-4.24	Pass	
32.392667	43.16	0.75	-9.96	33.94	Debug	V	100	225	40.00	-6.06	Pass	
36.499	44.63	0.73	-12.02	33.34	Debug	V	100	0	40.00	-6.66	Pass	
48.268333	45.85	0.68	-17.29	29.24	Debug	V	100	315	40.00	-10.76	Pass	
990.752667	40.90	2.83	-2.69	41.04	Debug	H	100	315	54.00	-12.96	Pass	
37.436667	38.24	0.72	-12.47	26.49	Debug	V	100	225	40.00	-13.51	Pass	
42.060333	37.94	0.70	-14.64	23.99	Debug	V	100	225	40.00	-16.01	Pass	
49.658667	41.05	0.67	-17.83	23.89	Debug	V	100	45	40.00	-16.11	Pass	
975.394333	36.64	2.79	-2.78	36.65	Debug	H	100	315	54.00	-17.35	Pass	
350.326333	38.33	1.55	-13.16	26.72	Debug	H	185	90	46.00	-19.28	Pass	
145.721	30.39	1.21	-8.95	22.65	Debug	V	300	135	43.50	-20.85	Pass	
50.725667	35.98	0.68	-18.24	18.41	Debug	V	100	135	40.00	-21.59	Pass	
58.356333	37.48	0.74	-20.81	17.41	Debug	V	200	90	40.00	-22.59	Pass	
66.342667	37.87	0.80	-21.36	17.31	Debug	V	100	225	40.00	-22.69	Pass	
994.050667	30.46	2.84	-2.67	30.63	Debug	V	385	225	54.00	-23.37	Pass	
168.839333	29.60	1.28	-12.18	18.70	Debug	V	300	0	43.50	-24.80	Pass	
52.698	33.30	0.69	-19.00	14.99	Debug	V	100	315	40.00	-25.01	Pass	
263.996333	32.56	1.49	-13.19	20.86	Debug	H	185	45	46.00	-25.14	Pass	
63.012333	35.47	0.77	-21.43	14.81	Debug	V	100	135	40.00	-25.19	Pass	
60.943	34.97	0.76	-21.31	14.41	Debug	V	100	225	40.00	-25.59	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 1GHz – 10GHz



Test Information

Results Title	Radiated E 3m 1-18GHz
File Name	T2 RE 1GHz-10GHz FCC B.emi
Test Laboratory	MH-AR5, 52%RH, 24C, 989mB
Test Engineer	GM
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia
EUT Details	2022-0078 Airscale Micro RRH AEQM M48 DSS - FCC & ISED; 3600MHz, DDS, 27dBm/Port
Configuration	FCC Part 15 Class B RE 1GHz-10GHz, 3 meter distance. 0dB Int Attn, RBW: 1MHz, VBW: 3MHz. ESW E1511, PA E1356, Horn Ant E1074, Cable Set AR5 Direct Cable
Date	2022-06-17 12:59:20

Formal Data

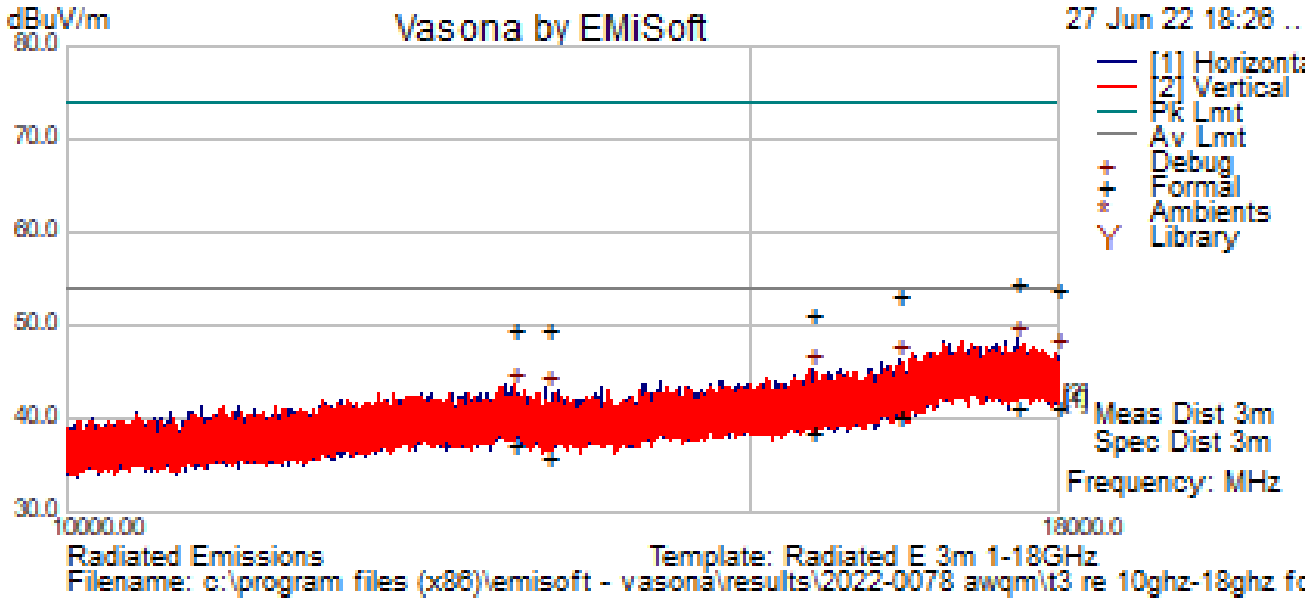
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail	Comments
4431.323	38.47	3.81	-3.23	39.04	AvgMax	H	188	73	54.00	-14.96	Pass	
4416.250	38.14	3.80	-3.25	38.69	AvgMax	H	118	68	54.00	-15.31	Pass	
4431.323	57.12	3.81	-3.23	57.69	PeakMax	H	188	73	74.00	-16.31	Pass	
4416.250	56.27	3.80	-3.25	56.82	PeakMax	H	118	68	74.00	-17.18	Pass	
5890.530	34.25	4.47	-2.02	36.71	AvgMax	H	184	326	54.00	-17.29	Pass	
5660.080	33.52	4.38	-2.25	35.64	AvgMax	H	269	26	54.00	-18.36	Pass	
9756.100	30.90	5.67	-0.95	35.63	AvgMax	V	379	334	54.00	-18.37	Pass	
3939.937	35.73	3.53	-3.66	35.60	AvgMax	V	328	5	54.00	-18.40	Pass	
5890.530	52.37	4.47	-2.02	54.82	PeakMax	H	184	326	74.00	-19.18	Pass	
5660.080	51.90	4.38	-2.25	54.03	PeakMax	H	269	26	74.00	-19.97	Pass	
3939.937	53.20	3.53	-3.66	53.07	PeakMax	V	328	5	74.00	-20.93	Pass	
9756.100	44.71	5.67	-0.95	49.44	PeakMax	V	379	334	74.00	-24.56	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail	Comments
3652.300	75.72	3.35	-3.91	75.16	Debug	H	185	45	54.00	21.16	Fail	
3632.200	75.19	3.34	-3.93	74.60	Debug	H	185	45	54.00	20.60	Fail	
3624.100	74.91	3.34	-3.94	74.30	Debug	H	185	45	54.00	20.30	Fail	
3595.600	74.31	3.32	-3.97	73.66	Debug	H	185	45	54.00	19.66	Fail	
3667.900	73.30	3.36	-3.90	72.77	Debug	H	185	45	54.00	18.77	Fail	
3674.200	67.33	3.37	-3.89	66.81	Debug	H	185	45	54.00	12.81	Fail	
4431.323	53.68	3.81	-3.23	54.26	NoTune	H	185	90	54.00	0.26	Fail	
5890.600	50.31	4.47	-2.02	52.77	Debug	H	185	270	54.00	-1.23	Pass	
4416.100	51.14	3.80	-3.25	51.69	Debug	H	185	90	54.00	-2.31	Pass	
5660.200	48.82	4.38	-2.25	50.95	Debug	H	185	270	54.00	-3.05	Pass	
3939.700	50.36	3.53	-3.66	50.23	Debug	V	300	0	54.00	-3.77	Pass	
9756.100	45.41	5.67	-0.95	50.13	Debug	V	300	225	54.00	-3.87	Pass	
4170.400	49.82	3.66	-3.45	50.03	Debug	H	185	270	54.00	-3.97	Pass	
4185.700	49.79	3.67	-3.44	50.02	Debug	H	100	270	54.00	-3.98	Pass	
5905.900	47.23	4.47	-2.00	49.71	Debug	V	200	315	54.00	-4.29	Pass	
4676.800	48.09	3.94	-3.09	48.94	Debug	H	185	45	54.00	-5.06	Pass	
3924.400	48.48	3.52	-3.67	48.33	Debug	H	285	225	54.00	-5.67	Pass	
4661.800	47.00	3.93	-3.10	47.84	Debug	H	185	90	54.00	-6.16	Pass	
4907.800	46.52	4.05	-2.98	47.60	Debug	H	185	90	54.00	-6.40	Pass	
5152.900	46.18	4.17	-2.77	47.57	Debug	H	185	45	54.00	-6.43	Pass	
2479.600	49.70	2.61	-5.14	47.18	Debug	H	185	315	54.00	-6.82	Pass	
2711.200	49.22	2.75	-4.93	47.04	Debug	H	385	315	54.00	-6.96	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



Test Information

Results Title	Radiated E 3m 1-18GHz
File Name	T3 RE 10GHz-18GHz FCC B.emi
Test Laboratory	MH-AR5, 52%RH, 24C, 989mB
Test Engineer	GM/MGM
Test Software	Vasona by EMISoft, version 6.093
Equipment	Nokia
EUT Details	2022-0078 Airscale Micro RRH AEQM M48 DSS - FCC & ISED; 3600MHz, DDS, 27dBm/Port
Configuration	FCC Part 15 Class B RE 10GHz-18GHz, 3 meter distance. 0dB Int Attn, RBW: 120kHz, VBW: 500kHz. MXE E1281, PA E1356, Horn Ant E1074, Cable Set AR5 Direct Cable
Date	2022-06-27 17:57:29

Formal Data

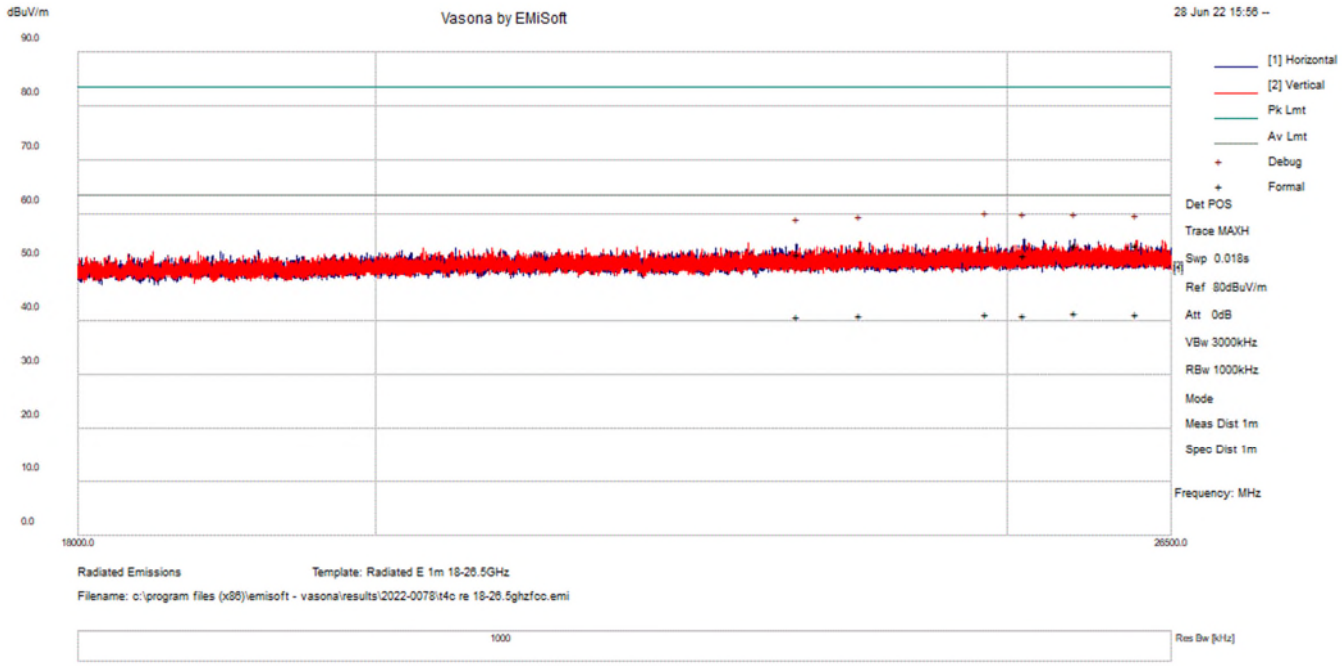
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/Fail	Comments
17970.622	38.75	8.33	7.05	54.14	PeakMax	V	385	279	74.00	-19.86	Pass	
17564.711	39.54	8.24	6.87	54.65	PeakMax	H	375	345	74.00	-19.35	Pass	
16371.200	39.91	7.95	5.47	53.33	PeakMax	H	385	304	74.00	-20.67	Pass	
15548.984	39.87	7.73	3.59	51.19	PeakMax	H	125	140	74.00	-22.81	Pass	
13032.934	38.59	6.98	4.00	49.57	PeakMax	V	115	123	74.00	-24.43	Pass	
13294.445	38.71	7.05	3.84	49.60	PeakMax	H	252	84	74.00	-24.40	Pass	
17970.622	25.77	8.33	7.05	41.16	AvgMax	V	385	279	54.00	-12.84	Pass	
17564.711	26.08	8.24	6.87	41.19	AvgMax	H	375	345	54.00	-12.81	Pass	
16371.200	26.96	7.95	5.47	40.38	AvgMax	H	385	304	54.00	-13.62	Pass	
15548.984	27.27	7.73	3.59	38.59	AvgMax	H	125	140	54.00	-15.41	Pass	
13032.934	26.34	6.98	4.00	37.32	AvgMax	V	115	123	54.00	-16.68	Pass	
13294.445	25.15	7.05	3.84	36.04	AvgMax	H	252	84	54.00	-17.96	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail	Comments
17564.711	33.48	8.24	6.87	48.59	Debug	H	380	135	54.00	-5.41	Pass	
17970.622	31.71	8.33	7.05	47.09	Debug	V	300	270	54.00	-6.91	Pass	
16371.200	33.04	7.95	5.47	46.47	Debug	H	100	45	54.00	-7.53	Pass	
15548.984	34.10	7.73	3.59	45.42	Debug	H	100	317	54.00	-8.58	Pass	
13032.934	32.61	6.98	4.00	43.59	Debug	V	100	225	54.00	-10.41	Pass	
13294.445	32.28	7.05	3.84	43.17	Debug	H	180	0	54.00	-10.83	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 18GHz – 26.5GHz



Test Information

Results Title	Radiated E 1m 18-26.5GHz
File Name	t4c re 18-26.5ghzfcc.emi
Test Laboratory	MH-Bldg.5
Test Engineer	GM
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia
EUT Details	2022-0078 Airscale Micro RRH AEQM M48 DSS - FCC & ISED; 3600MHz, DDS, 27dBm/Port
Configuration	FCC Part 15 Class B RE 18GHz-26.5GHz, 1 meter distance. 0dB Int Attn, RBW: 1MHz, VBW: 3MHz. MXE E1281, PA E1387, Horn Ant E1527, Cable Set E1528+E1529
Date	2022-06-28 15:57:06

Formal Data

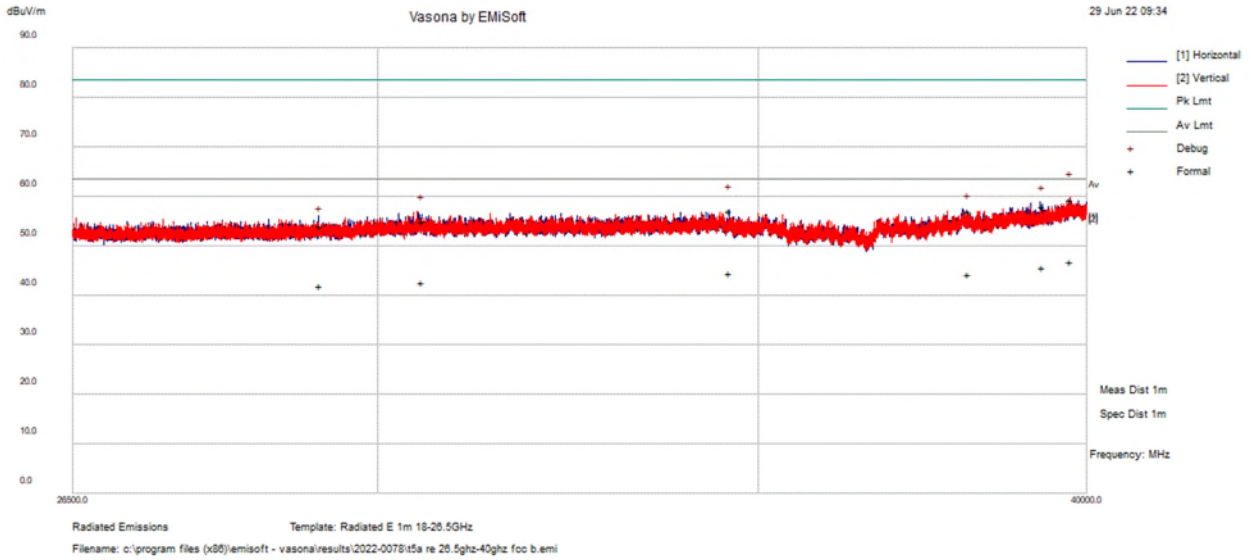
Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail	Comments
25613.038	34.69	12.40	-5.56	41.53	AvgMax	H	154	199	63.50	-21.97	Pass	
24824.083	35.33	12.06	-6.05	41.34	AvgMax	V	175	23	63.50	-22.16	Pass	
26172.410	33.98	12.45	-5.21	41.23	AvgMax	V	134	347	63.50	-22.27	Pass	
25153.596	34.74	12.22	-5.93	41.03	AvgMax	H	155	356	63.50	-22.47	Pass	
23737.449	35.66	11.70	-6.40	40.96	AvgMax	V	173	46	63.50	-22.54	Pass	
23215.331	35.97	11.59	-6.66	40.91	AvgMax	H	107	216	63.50	-22.59	Pass	
26172.410	46.90	12.45	-5.21	54.14	PeakMax	V	134	347	83.50	-29.36	Pass	
25613.038	47.24	12.40	-5.56	54.08	PeakMax	H	154	199	83.50	-29.42	Pass	
24824.083	47.43	12.06	-6.05	53.44	PeakMax	V	175	23	83.50	-30.06	Pass	
23737.449	48.08	11.70	-6.40	53.39	PeakMax	V	173	46	83.50	-30.11	Pass	
23215.331	47.53	11.59	-6.66	52.46	PeakMax	H	107	216	83.50	-31.04	Pass	
25153.596	45.97	12.22	-5.93	52.26	PeakMax	H	155	356	83.50	-31.24	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail	Comments
24824.083	49.18	12.06	-6.05	55.19	Debug	V	100	308	63.50	-8.31	Pass	
25613.038	48.22	12.40	-5.56	55.06	Debug	H	100	354	63.50	-8.44	Pass	
25153.596	48.75	12.22	-5.93	55.04	Debug	H	100	354	63.50	-8.46	Pass	
26172.410	47.47	12.45	-5.21	54.71	Debug	V	100	354	63.50	-8.79	Pass	
23737.449	49.34	11.70	-6.40	54.64	Debug	V	100	354	63.50	-8.86	Pass	
23215.331	49.10	11.59	-6.66	54.03	Debug	H	100	354	63.50	-9.47	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 26.5 GHz – 40 GHz



Test Information

Results Title	Radiated E 1m 18-26.5GHz
File Name	t5b re 26.5ghz-40ghz fcc b.emi
Test Laboratory	MH-Bldg.5
Test Engineer	GM
Test Software	Vasona by EMISoft, version 6.061
Equipment	Nokia
EUT Details	2022-0078 Airscale Micro RRH AEQM M48 DSS - FCC & ISED; 3600MHz, DDS, 27dBm/Port
Configuration	FCC Part 15 Class B RE 18GHz-26.5GHz, 1 meter distance. 0dB Int Attn, RBW: 1MHz, VBW: 3MHz. MXE E1218, PA E1387, Horn Ant E1527, Cable Set E1528+E1529
Date	2022-06-29 09:39:37

Formal Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail	Comments
39737.200	37.31	15.45	-6.00	46.76	AvgMax	V	150	64	63.50	-16.74	Pass	
39298.048	37.65	15.33	-7.36	45.61	AvgMax	V	107	175	63.50	-17.89	Pass	
34596.400	36.17	14.08	-5.67	44.58	AvgMax	H	189	203	63.50	-18.92	Pass	
38118.758	38.48	15.06	-9.18	44.36	AvgMax	V	146	164	63.50	-19.14	Pass	
30538.303	33.18	13.53	-4.05	42.66	AvgMax	V	102	131	63.50	-20.84	Pass	
29294.569	33.38	13.15	-4.48	42.05	AvgMax	V	155	9	63.50	-21.45	Pass	
39737.200	49.94	15.45	-6.00	59.39	PeakMax	V	150	64	83.50	-24.11	Pass	
39298.048	50.06	15.33	-7.36	58.02	PeakMax	V	107	175	83.50	-25.48	Pass	
34596.400	48.70	14.08	-5.67	57.11	PeakMax	H	189	203	83.50	-26.39	Pass	
38118.758	51.17	15.06	-9.18	57.05	PeakMax	V	146	164	83.50	-26.45	Pass	
30538.303	45.40	13.53	-4.05	54.89	PeakMax	V	102	131	83.50	-28.61	Pass	
29294.569	45.29	13.15	-4.48	53.95	PeakMax	V	155	9	83.50	-29.55	Pass	

Preview Data

Freq. (MHz)	Raw (dBuV)	Cable (dB)	Factor (dB)	Level (dBuV/m)	Emission Type	Pol (H/V)	Ht (cm)	Az (deg)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail	Comments
39737.200	50.31	15.45	-6.00	59.76	Debug	V	100	55	63.50	-3.74	Pass	
34596.400	48.63	14.08	-5.67	57.03	Debug	H	160	66	63.50	-6.47	Pass	
39298.048	49.02	15.33	-7.36	56.98	Debug	V	100	354	63.50	-6.52	Pass	
38118.758	49.41	15.06	-9.18	55.29	Debug	V	100	354	63.50	-8.21	Pass	
30538.303	45.43	13.53	-4.05	54.91	Debug	V	100	354	63.50	-8.59	Pass	
29294.569	44.11	13.15	-4.48	52.77	Debug	V	100	354	63.50	-10.73	Pass	

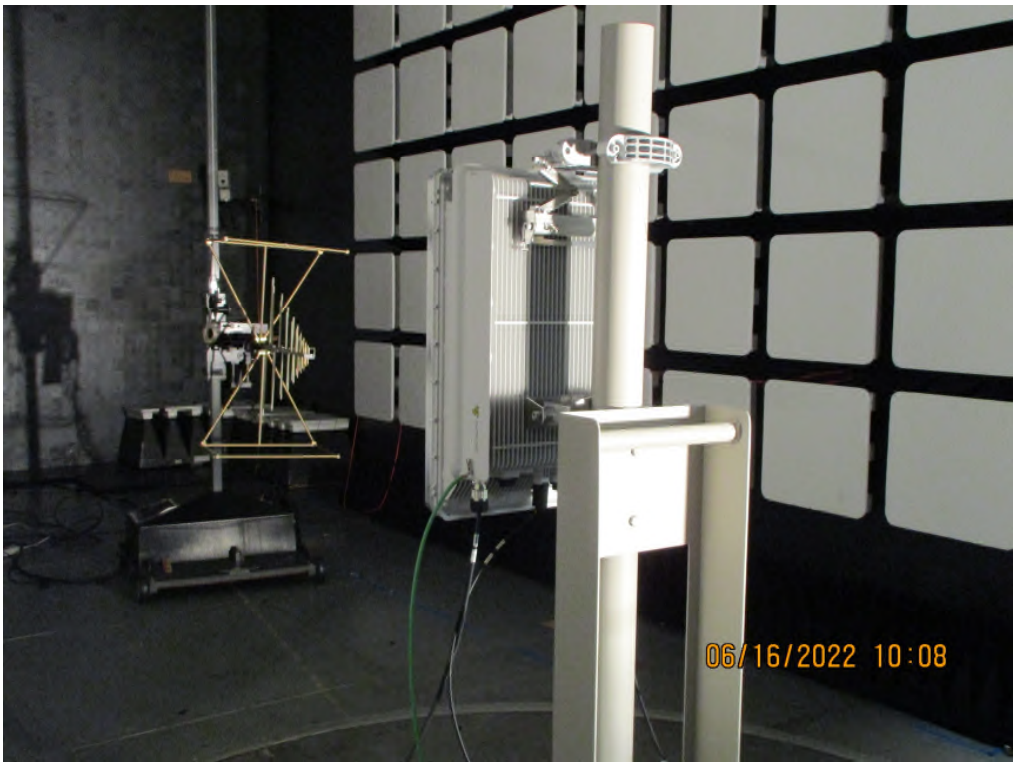
Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in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

Photographs

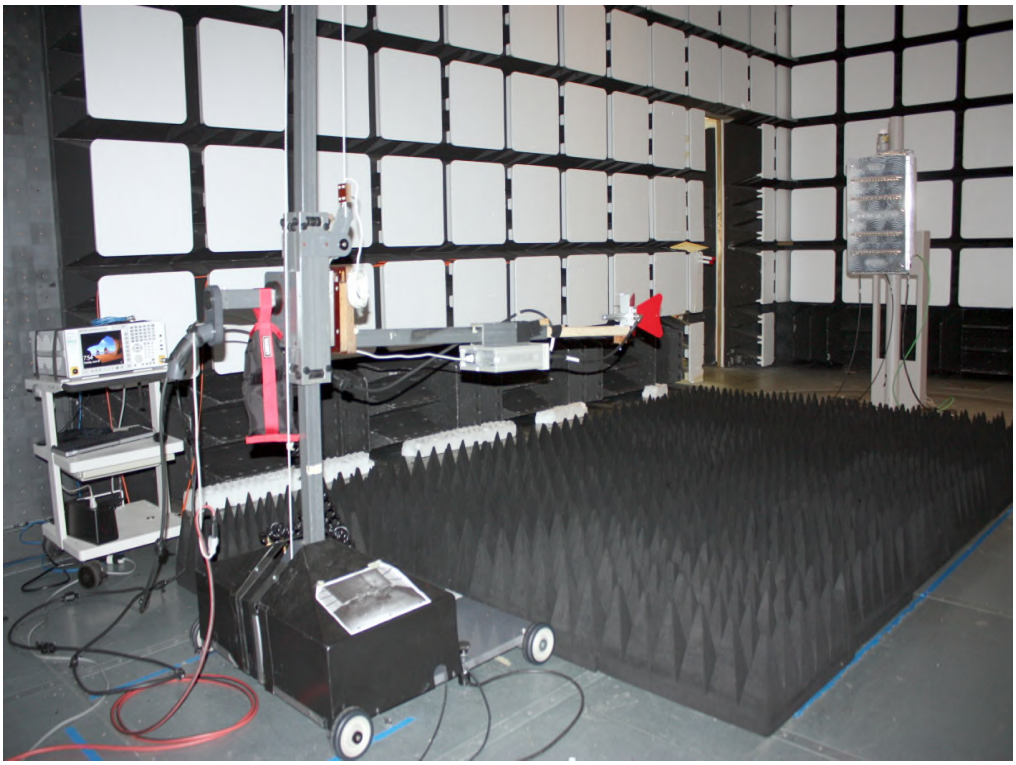
Radio Test

Radiated Emission Test

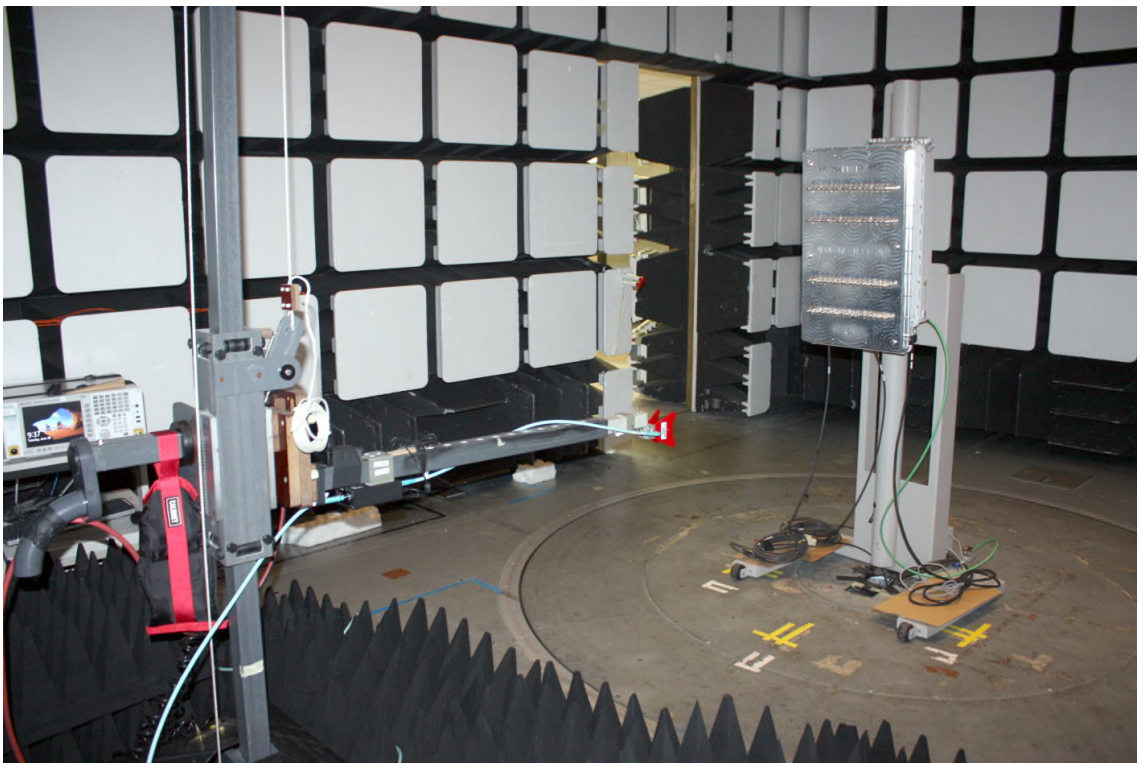
30MHz- 1GHz



1GHz-18GHz



18GHz – 40GHz



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	N5230C	MY49000897	2021-03-03	2023-03-03
E1338	KeySight Technologies	MXA Signal Analyzer		N9020B	MY57430927	2021-01-07	2023-01-07
E1212	RLC Electronics Inc	Filter, High Pass	10 - 30 GHz, 2W, 5dB	F-19414	1444002	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
E1480	Reactel, Inc.	Filter, High Pass	DC - 4.3 GHz	11HS-X4.3GS11	SN20-02	CNR-V	CNR-V
	CF-1-0005A	Notch filter			2018260003	NA	NA
	Utiflex Micro-coax	RF Cable		MFR6 64639 858616-001	UFB142A-Q-0760-2002G0	NA	NA

CNR-V: Calibration Not Required, Must Be Verified

Test Dates: 6/30/2022 – 7/19/2022

Radiated Emission Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
E602	A.H. Systems Inc.	Bilogical Antenna	25 - 2000 MHz	SAS-521-2	410	2021-09-21	2023-09-21
E1527	ETS Lindgren	Horn Antenna	Double Ridged Horn 10-40 GHz	3116C	00227823	2020-08-13	2022-08-13
E1188	Extech	Data Logger	Barometric Preasure/Humd/Temp Logger	SD700	Q774046	2020-11-12	2022-11-12
E1218	KeySight Technologies	EMI Receiver	MXE EMI Receiver 44 GHz	N9038A	MY54130037	2021-12-29	2023-12-29
E1511	Rohde & Schwarz	Test Receiver	EMI Test Receiver 2 Hz - 44 GHz	ESW44	101965	2021-04-07	2023-04-07
E1529	Micro-Coax	Cable	1-40 GHz, 2.92 (m)+2.92 (m), 237 inch., armor, 90 degree bent	UFB142A-0-2370-2002G0	SFC235841	CNR-V	CNR-V
E1528	Micro-Coax	Cable	1-40 GHz, 2.92 (m)+2.92 (m), 36 inch., armor, 90 degree bent	UFB142A-Q-0360-2002GO	SFC235840	CNR-V	CNR-V
E1387	Miteq	Pre-Amplifier	18 GHz-40 GHz, 45dBm	TTA1840-35-HG	2034	2020-08-28	2022-08-28
E814	Sonoma Instrument Co.	Amplifier	9kHz-1GHz	310N	186747	2020-09-23	2022-09-23
E1074	ETS Lindgren	Horn Antenna	Double-Ridged Waveguide Horn 1-18 GHz	3117	00135194	2021-08-03	2023-08-03
E1356	Hewlett Packard	Pre-Amplifier	Pre-Amplifier 1-26.5GHz	8449B	3008A01353	2020-10-21	2022-10-21

CNR-V: Calibration Not Required, Must Be Verified

Test Dates: 6/16/2022 – 6/29/2022

7. FCC Section 2.1055 - Measurement of Frequency Stability

Frequency Stability testing was completed on AEQM Unit with Center Frequency 3560 MHz. Testing was performed from 6/4/2021 – 6/7/2021, which was located in the T-6 Thermal chamber of the Global Product Compliance Laboratory (GPCL) test facility located in Building 4, Room 4-280, Murray Hill, NJ, by Joe Bordonaro from GPCL.

The temperatures to which the UUT were subjected ranged from a high temperature of +50°C system ambient to a low temperature of -30ºC system ambient with measurements recorded at +20°C, +50°C, and -30°C.

Frequency Stability performance was verified by measuring Frequency Tolerance using an MXA Signal Analyzer. Frequency Tolerance is a measurement of the difference between the actual transmit frequency and the assigned frequency (3560 MHz).

Frequency Block Tested: ***AEQM (CF = 3560MHz)***

Baseline Measurement at +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+3.8750**
0.5	**-13.902**
1.0	**+1.8302**
1.5	**-3.8023**
2.0	**+3.4776**
2.5	**-6.7544**
3.0	**-1.9865**
FCC SPECIFICATION	**3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +50°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-10.750**
0.5	**+14.759**
1.0	**-0.69670**
1.5	**-4.5439**
2.0	**+6.7892**
2.5	**+2.4771**
3.0	**+4.4456**
FCC SPECIFICATION	**3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +40°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	+0.24684
0.5	-1.6141
1.0	+0.59917
1.5	-12.505
2.0	+4.8579
2.5	-8.3321
3.0	-1.2769
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	+4.1848
0.5	+16.636
1.0	-6.1450
1.5	+6.6178
2.0	+4.6371
2.5	-10.283
3.0	+4.9190
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	+3.4777
0.5	-3.0568
1.0	+4.3705
1.5	-0.16530
2.0	-10.218
2.5	-0.82249
3.0	-4.7172
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	+12.347
0.5	+1.4347
1.0	-17.583
1.5	+3.5924
2.0	10.104
2.5	+2.0754
3.0	-6.3512
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Transmit Frequency Deviation at 0°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	+6.1104
0.5	-1.7525
1.0	-7.8115
1.5	+13.826
2.0	-14.378
2.5	+6.6687
3.0	-2.0080
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Transmit Frequency Deviation at -10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-5.2349
0.5	+9.9507
1.0	+3.7016
1.5	+1.2450
2.0	+4.8887
2.5	-3.3121
3.0	+13.657
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Transmit Frequency Deviation at -20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	+7.5858
0.5	+2.5196
1.0	-1.6503
1.5	-19.487
2.0	+4.7748
2.5	-8.2757
3.0	-+3.2537
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Transmit Frequency Deviation at -30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	+0.26955
0.5	+2.8445
1.0	-1.3958
1.5	-7.6142
2.0	+6.4045
2.5	+4.5395
3.0	-4.8253
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Upon return to +25°C.

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-4.4163
0.5	+6.9856
1.0	+3.5827
1.5	+6.7737
2.0	-1.5648
2.5	+ 6.0202
3.0	-4.4824
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 103% of Nominal Voltage, -49.44VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-1.1464
0.5	+9.8085
1.0	+19.991
1.5	+5.3323
2.0	+0.48917
2.5	+13.545
3.0	-9.5809
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 106% of Nominal Voltage, -50.88VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-2.4299
0.5	+1.5974
1.0	-0.79784
1.5	-5.1383
2.0	+3.4425
2.5	-3.4280
3.0	+5.5968
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 109% of Nominal Voltage, -52.32VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	+9.7076
0.5	+3.6390
1.0	-3.7666
1.5	+10.642
2.0	-2.5427
2.5	-0.48523
3.0	-10.696
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 112% of Nominal Voltage, -53.76VDC

Time (minutes)	Transmit Carrier Deviation (Hz)
0	+4.2895
0.5	-1.8626
1.0	+13.894
1.5	-2.8591
2.0	+5.8917
2.5	+10.770
3.0	-6.5248
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 115% of Nominal Voltage, -55.20VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	+2.6357
0.5	-5.4152
1.0	-0.59246
1.5	+3.2770
2.0	-9.0774
2.5	+2.6013
3.0	+15.475
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48.0VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	+3.3582
0.5	-2.2634
1.0	+6.6301
1.5	-0.55364
2.0	-6.9080
2.5	-11.393
3.0	+5.8138
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	

Transmit Frequency Deviation at +25°C at -3% of Nominal Voltage, -46.56VDC

Time (minutes)	Transmit Carrier Deviation (Hz)
0	+9.5083
0.5	+13.494
1.0	-0.41294
1.5	-6.7902
2.0	+4.6328
2.5	+2.0616
3.0	+4.9448
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -6% of Nominal Voltage, -45.12VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-17.856
0.5	+2.7755
1.0	-6.8828
1.5	+7.2832
2.0	+4.2438
2.5	+4.7231
3.0	+5.3656
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

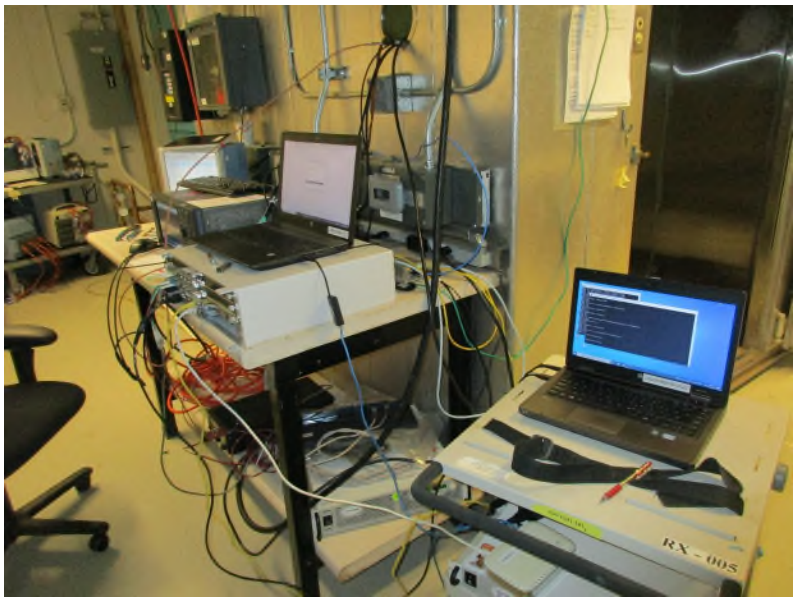
Transmit Frequency Deviation at +25°C at -9% of Nominal Voltage, -43.68VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	+0.86277
0.5	-3.9744
1.0	+6.7785
1.5	+3.6722
2.0	-2.6485
2.5	+6.2182
3.0	+12.340
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -12% of Nominal Voltage, -42.24VDC

Time (minutes)	Transmit Carrier Deviation (Hz)
0	-6.4749
0.5	-2.9890
1.0	+8.6116
1.5	+3.8308
2.0	-4.4166
2.5	-3.7443
3.0	-18.172
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -15% of Nominal Voltage, -40.80VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-0.89076
0.5	-3.5690
1.0	+6.9530
1.5	+3.8680
2.0	-7.8853
2.5	+2.3236
3.0	+9.0061
FCC SPECIFICATION	3560 MHz (±0.05ppm) ±0.05ppm = ± 178Hz
FCC RESULT	PASS

Photographs

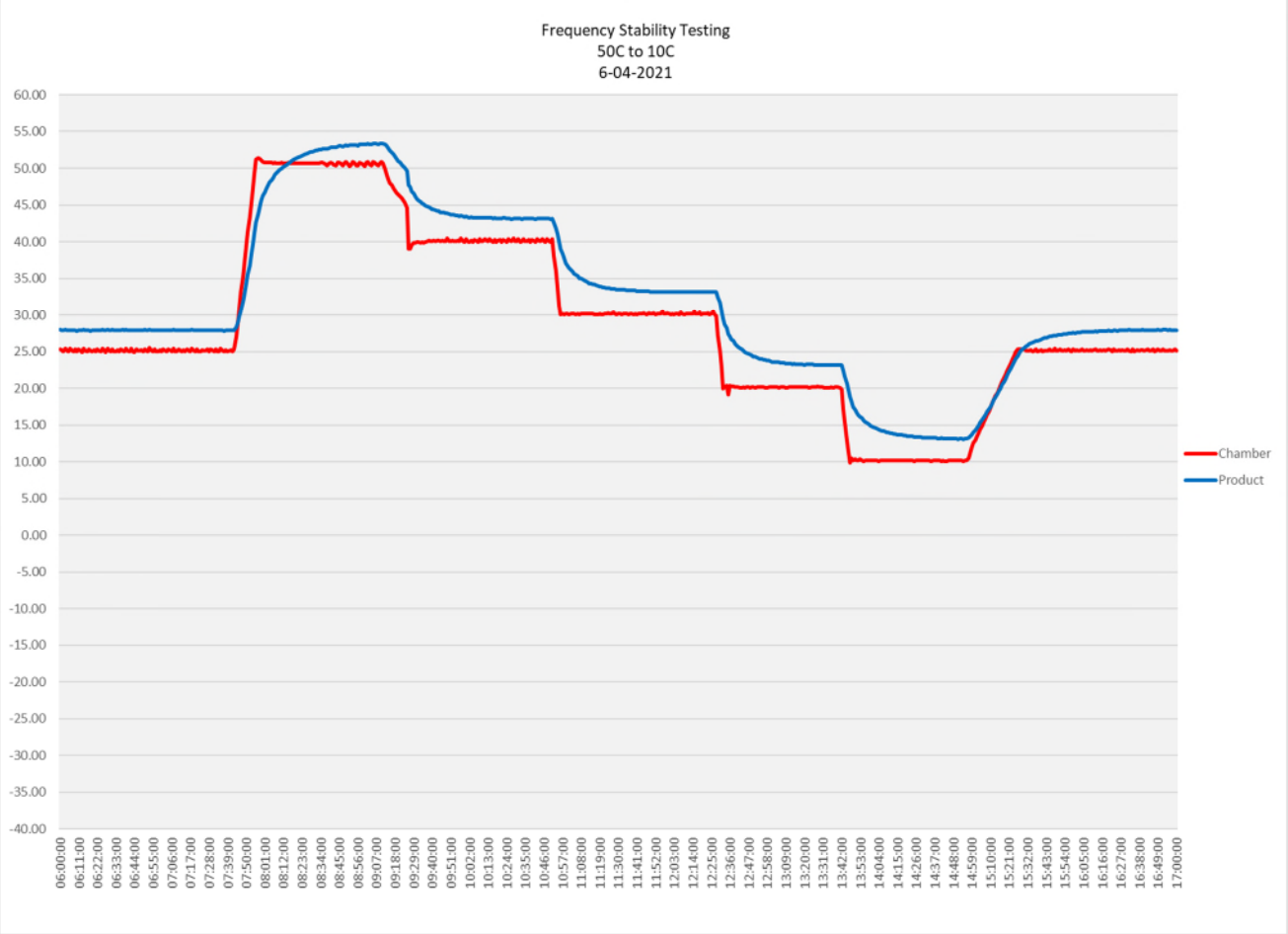


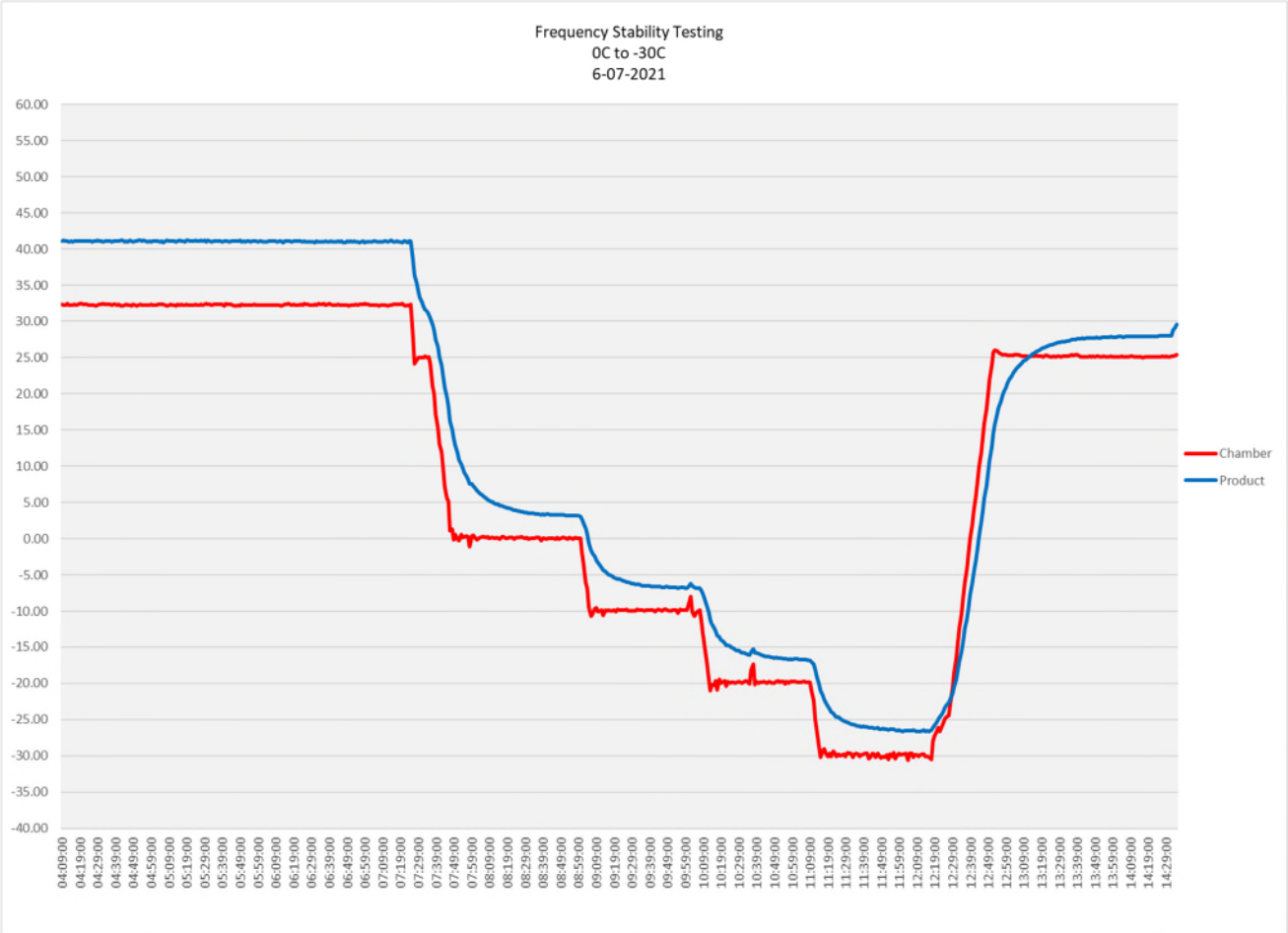
Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
E1338	KeySight Technologies	MXA Signal Analyzer		N9020B	MY57120303	2020-12-21	2022-12-21
TH530-T06	Thermotron	Controller		Thermotron 7800	8E62408	2019-09-18	2021-09-18
TH-T06	Thermotron	Thermal Chamber		N/A	28972	2019-09-13	2021-09-13
TH070	Vaisala	Transmitter	Humidity and Temperature	HMT330	J3330109	2019-12-04	2021-12-04
TH085	Yokogawa	Recorder		GP20	S5PB04190	2020-02-25	2022-02-25
TH149	Fluke	Multimeter	Digital Multimeter	87III	7519030337	2019-07-22	2021-07-22
N/A	TDK Lambda	Power Supply	DC Source	GEN 60-85-3P208	13N5110J	CNR	CNR

CNR – Calibration Not Required

Chamber Plots




Frequency Stability Testing
0C to -30C
6-07-2021
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
-20.00
-25.00
-30.00
-35.00
-40.00
Chamber
Product

8. NVLAP Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology

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).

2021-09-24 through 2022-09-30
Effective Dates

For the National Voluntary Laboratory Accreditation Program