NOKIA Bell Labs

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TESTING
NVLAP LAB CODE: 100275-0

Title 47 Code of Federal Regulations Test Report

Regulation:
FCC Part 2 and 27

Client:
Nokia Solutions and Networks US LLC

Product Evaluated:
AirScale MAA 64T64R 128AE B41 120W AAHF

Report Number:
TR-2020-0101-FCC2-27

Date Issued:
August 18, 2020

Table of Contents

Revisions

Date	Revision	Section	Change
8/18/20	0		Initial Release

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1. System Information and Requirements

Report copies and other information not contained in this report are held by either the product engineer or in an identified file at the Global Product Compliance Laboratory in Murray-Hill, NJ.

Equipment Under Test (EUT):	AirScale MAA 64T64R 128AE B41 120W AAHF
Serial Number:	6Q183702544
FCC ID:	VBNAAHF-01
Hardware Version:	44715A.M01
Software Version:	SBTS20B
Frequency Range:	2496-2690 MHz
GPCL Project Number:	2020-0101
Manufacturer:	NOKIA SOLUTIONS AND NETWORKS OY KARAKAARI 7, FI-02610 ESPOO FINLAND
Test Requirement(s):	Title 47 CFR Parts 2 and 27
Test Standards:	• Title 47 CFR Parts 2 and 27 • 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) • ANSI C63.4 (2014)
Measurement Procedure(s):	• FCC-IC-OB - GPCL Occupied Bandwidth and Power Measurement Test Procedure 12-4-2017 • FCC-IC-SE - GPCL Spurious Emissions Test Procedure 12-4-2017
Test Date(s):	7/31/2020 – 8/3/2020
Test Performed By:	Nokia Global Product Compliance Laboratory 600-700 Mountain Ave. P.O. Box 636 Murray Hill, NJ 07974-0636
Product Engineer(s):	Ron Remy
Lead Engineer:	Steve Gordon
Test Engineer (s):	Jaideep Yadav
Test Results: The EUT, *as tested* met the above listed requirements. Report copies and other information not contained in this report are held by either the product engineer or in an identified file at the Global Product Compliance Laboratory in New Providence, NJ.	

1.1 Introduction

This Conformity test report applies to the AirScale MAA 64T64R 128AE B41 120W AAHF, hereinafter referred to as the Equipment Under Test (EUT).

1.2 Purpose and Scope

The purpose of this testing is to demonstrate compliance for the AirScale MAA 64T64R 128AE B41 120W AAHF. This Class II Permissive Change will be submitted to add a mode of operation for 40 W for 15 MHz Single Carrier LTE (64T64R) or 80 W for 15 +15 MHz Dual Carrier LTE (64T64R). These modes of operation have lower total maximum power (120 W) than was previously certified for this device.

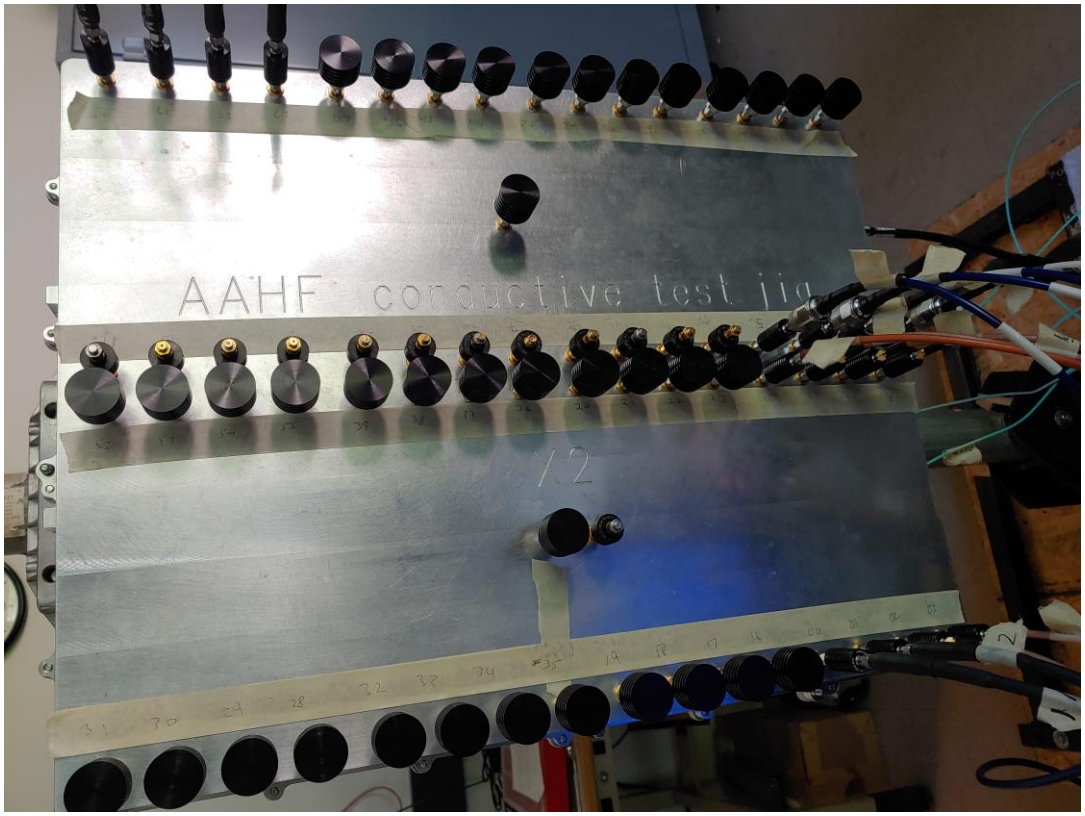
The purpose of this document is to provide the testing data required for qualifying the EUT in compliance with FCC Parts 2 and 27 measured in accordance with the procedures set out in Section 2.1033 (c) (14) of the Rules.

1.3 EUT Details

1.3.1 Specifications

Specification Items	Description
Radio Access Technology	E-UTRA
Duplex Mode	Frequency Division Duplex (FDD)
Modulation Type(s)	QPSK 16QAM 64QAM 256QAM
Operation Frequency Range	2496-2690 MHz
Channel Bandwidth	5, 10, 15, 20, 40, 60 MHz
Tx/Rx	64T64R or (2) x 32T32R
MIMO	2X or 4X
Deployment Environment	Outdoor
Supply Voltage	-48.0 VDC
Max RF Output Power	The total power for single carrier 15 MHz operation is 40 W (0.625 W/port x 64 ports) and for dual carrier 15 + 15 MHz operation at 80 W (1.25 W/port x 64 ports).

1.3.2 Photographs



1.4 Test Requirements

Each required measurement is listed below:

47 CFR FCC Sections	Description of Tests	Test Required
2.1046, 27.53	RF Power Output	Yes
2.1047, 27.53	Modulation Characteristics	Yes
2.1049, 27.53	(a) Occupied Bandwidth (b) Out-of-Band Emissions	Yes
2.1051, 27.53	Spurious Emissions at Antenna Terminals	Yes
2.1053, 27.53	Field Strength of Spurious Radiation	Yes
2.1055, 27.53	Frequency Stability	No

1.5 Standards & Procedures

1.5.1 Standards

- Title 47 Code of Federal Regulations, Federal Communications Commission Part 2.
- Title 47 Code of Federal Regulations, Federal Communications Commission Part 27.
- ANSI C63.26, American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services

1.5.2 Procedures

1. FCC-IC-0B and FCC-IC-SE

2. ANSI C63.4 (2014) entitled: “American National Standard for Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz”, American National Standards Institute, Institute of Electrical and Electronic Engineers, Inc., New York, NY 10017-2394, USA.

3. FCC KDB 971168 D01 Power Measurement License Digital Systems v03r01 April 9, 2018.
   FCC KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013

1.5.3 MEASUREMENT UNCERTAINTY

The results of the calculations to estimate uncertainties for the several test methods and standards are shown in the Table below. These are the worst-case values.

Worst-Case Estimated Measurement Uncertainties

Standard, Method or Procedure	Condition	Frequency MHz	Expanded Uncertainty (k=2)
a. 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

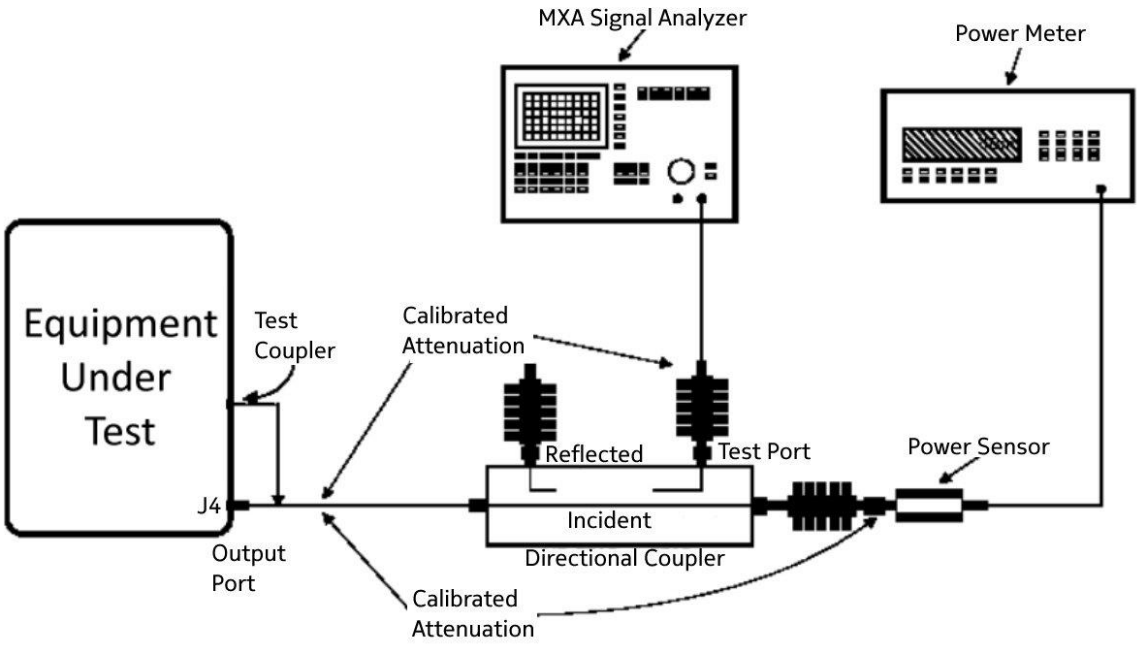
Antenna Port Test	Signal Bandwidth	Frequency Range	Expanded Uncertainty (k=2), Amplitude
Occupied Bandwidth, Edge of Band, Conducted Spurious Emissions	10 Hz 100 Hz 10 kHz to 1 MHz 1MHz	9 kHz to 20 MHz 20 MHz to 1 GHz 1 GHz to 10 GHz 10 GHz to 40 GHz:	1.78 dB
RF Power	10 Hz to 20 MHz	50 MHz to 18 GHz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

1.6 Executive Summary

Requirement	Description	Result
47 CFR FCC Parts 2 and 27		
2.1046, 27.53	RF Power Output Peak to Average Power Ratio	COMPLIES
2.1047, 27.53	Modulation Characteristics	COMPLIES
2.1049, 27.53	(a) Occupied Bandwidth (b) Edge of Band Emissions	COMPLIES
2.1051, 27.53	Spurious Emissions at Antenna Terminals	COMPLIES
2.1053, 27.53	Field Strength of Spurious Radiation	COMPLIES
2.1055, 27.53	Frequency Stability	N/A

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

1.7 Test Configuration for all Antenna Port Measurements.



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 configured for test as shown in section above and allowed to warm up and stabilize per KDB 971168 D01 and ANSI C63.26.

Power measurements were made with an MXA Signal Analyzer. Preliminary testing was performed on all Tx Ports which showed Port #1 to be the worst case

Tabular Data –Channel RF Power

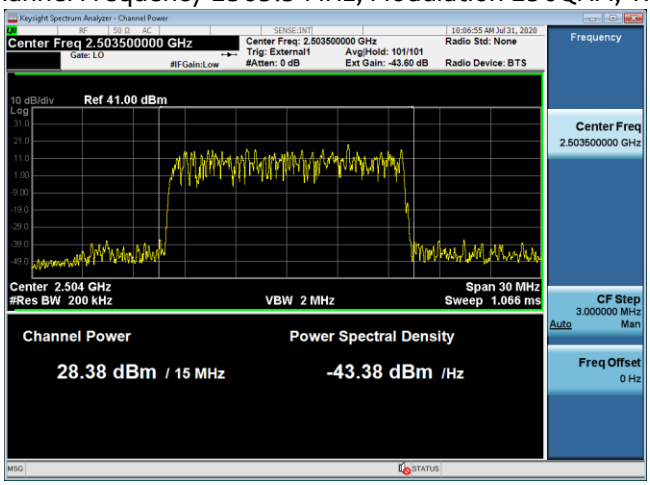
# of Carriers	Test Model	Worst case TX Port	Channel Frequency (MHz)	Signal BW (MHz)	Modulation	Channel Power (dBm/W)	Total Power 10 log(64)
1	3.1a	1	2503.5	15	256 QAM	28.38/0.689	44.10
1	3.2	1	2593	15	QPSK/16QAM	28.56/0.718	45.95
1	3.1	1	2682.5	15	64 QAM	28.08/0.643	41.15
2	3.1a	1	2503/2518	15	256 QAM	30.82/1.208	77.31
2	3.1a	1	2503/2548	15	256 QAM	31.10/1.288	82.43
2	3.2	1	2578/2593	15	QPSK/16QAM	31.75/1.496	95.74
2	3.1	1	2637/2682	15	64 QAM	31.42/1.387	88.77
2	3.1	1	2667/2682	15	64 QAM	31.32/1.355	86.72

The total power for single carrier 15 MHz operation is 40 W (0.625 W/port x 64 ports) and for dual carrier 15 + 15 MHz operation at 80 W (1.25 W/port x 64 ports).

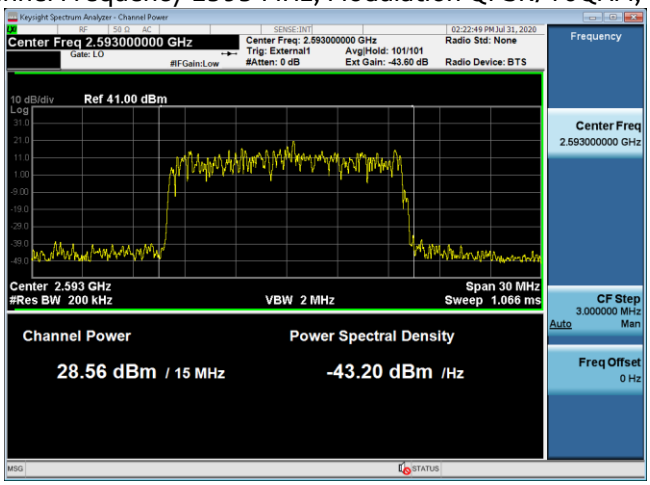
2.1.1 Channel RF Power - Plots

1C Data

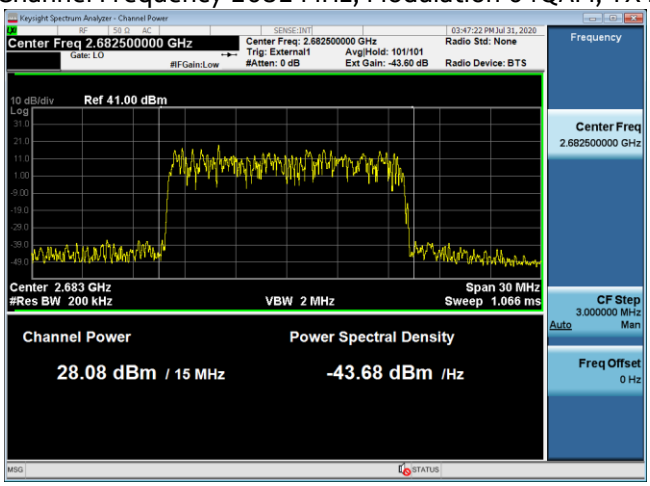
Channel Frequency 2503.5 MHz, Modulation 256QAM, TX1



Channel Frequency 2593 MHz, Modulation QPSK/16QAM, TX1

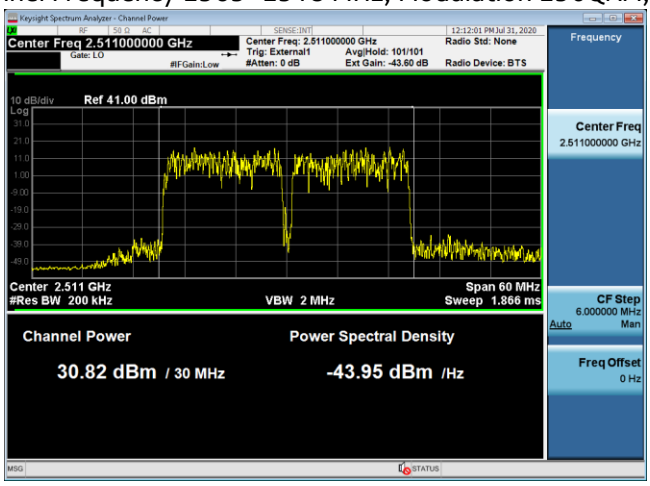


Channel Frequency 2682 MHz, Modulation 64QAM, TX1

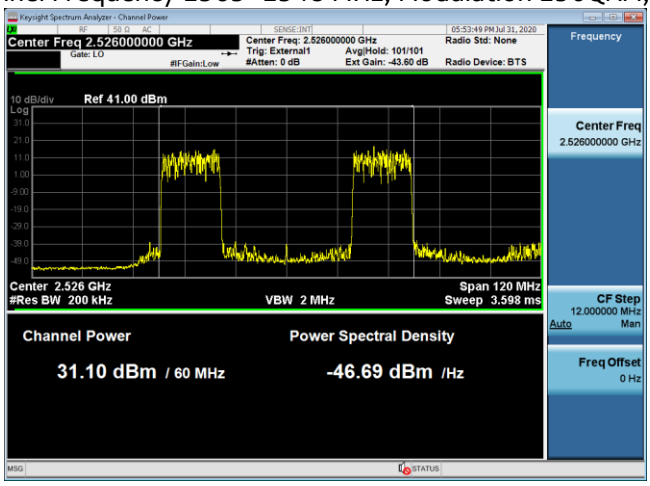


2C Data

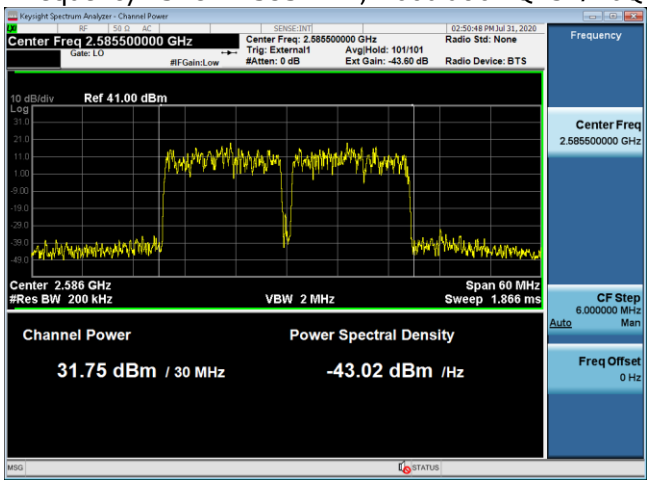
Channel Frequency 2503+2518 MHz, Modulation 256QAM, TX1



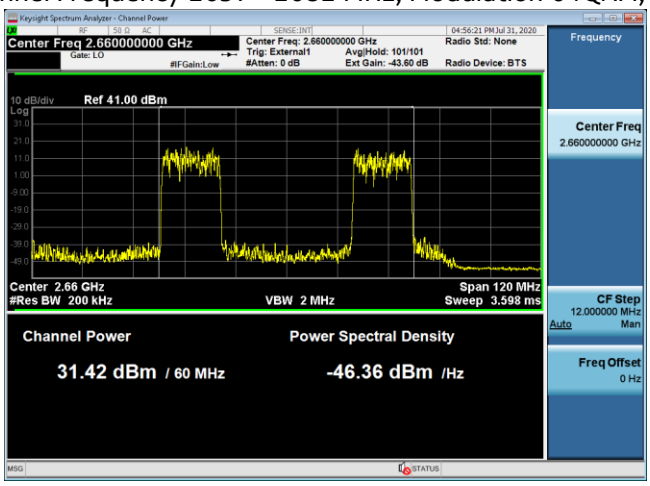
Channel Frequency 2503+2548 MHz, Modulation 256QAM, TX1



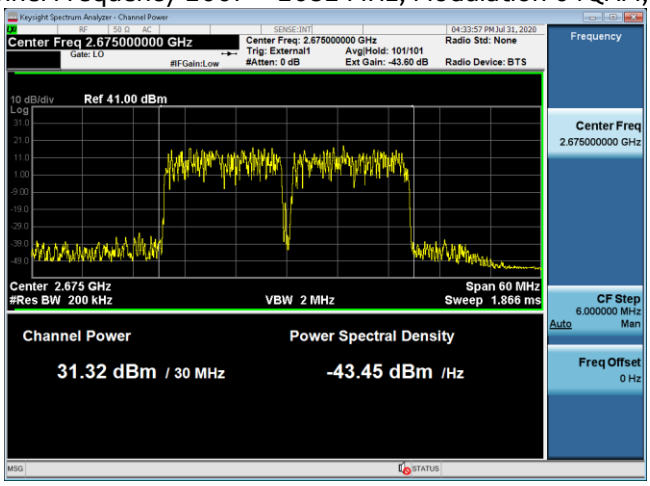
Channel Frequency 2578 + 2593 MHz, Modulation QPSK/16QAM, TX1



Channel Frequency 2637+ 2682 MHz, Modulation 64QAM, TX1



Channel Frequency 2667 + 2682 MHz, Modulation 64QAM, TX1



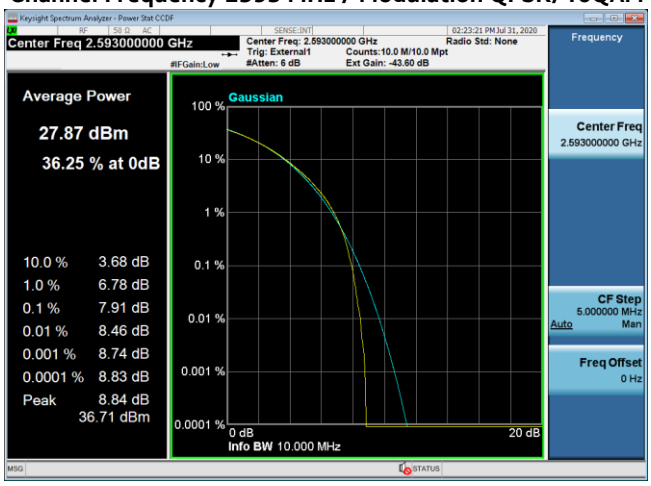
2.1.2 Peak-to-Average Power Ratio (PAPR) – Plots

The Peak-to-Average Power Ratio (PAPR) was evaluated per KDB 971168 for 10MHz bandwidths. The PAPR values of all carriers measured are below 13dB.

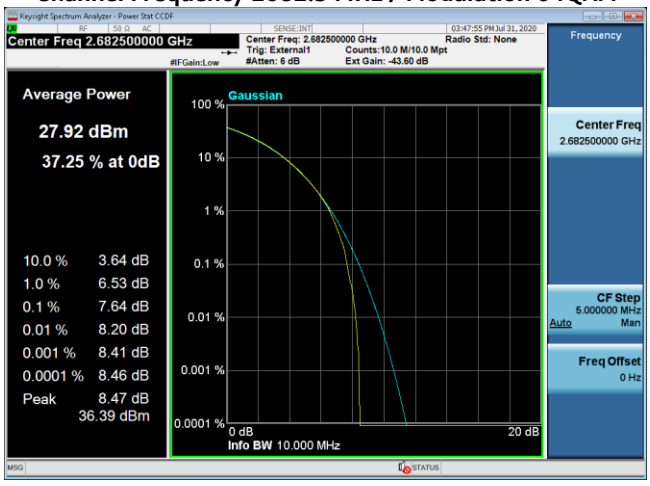
1C Data

Channel Frequency 2503.5 MHz / Modulation 256QAM

Channel Frequency 2593 MHz / Modulation QPSK/16QAM

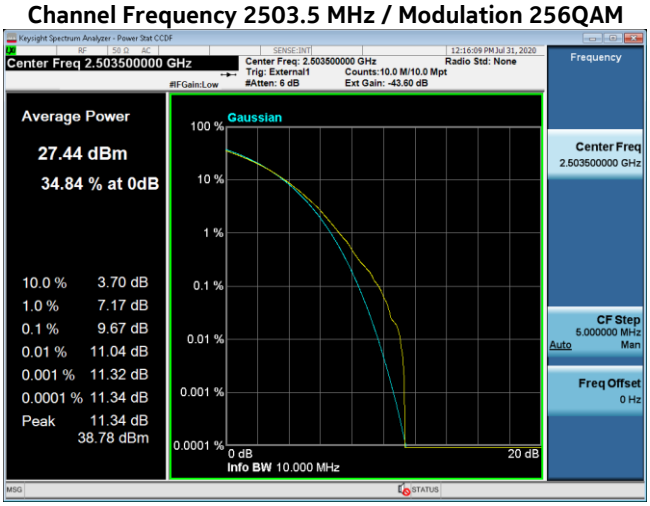


Channel Frequency 2682.5 MHz / Modulation 64QAM

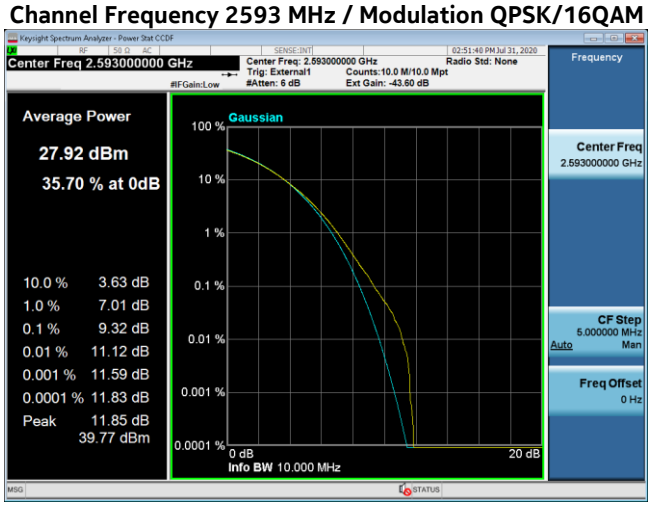


2C Data

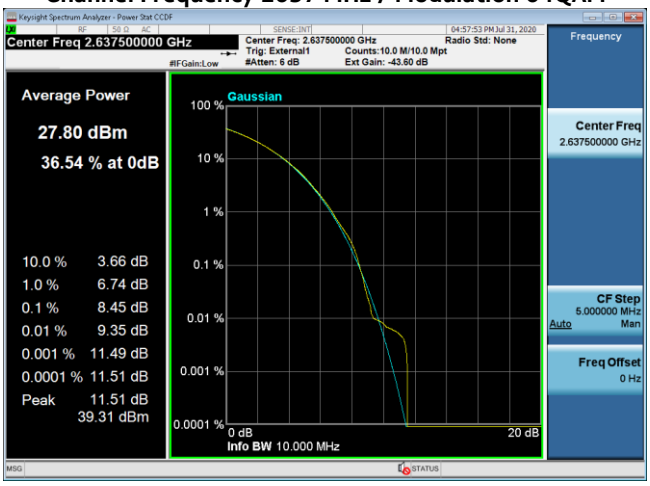
Channel Frequency 2503.5 MHz / Modulation 256QAM



Channel Frequency 2593 MHz / Modulation QPSK/16QAM



Channel Frequency 2637 MHz / Modulation 64QAM



3. FCC Section 2.1047 - Modulation Characteristics

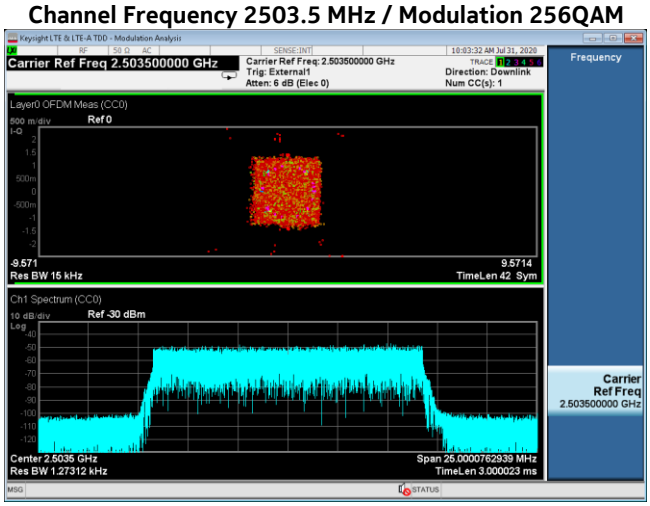
3.1 Modulation Characteristics

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

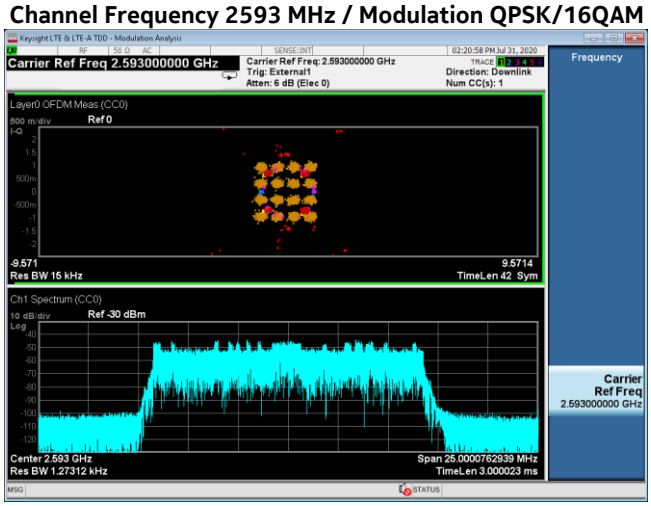
3.1.1 Modulation Characteristics – Plots

1C Data

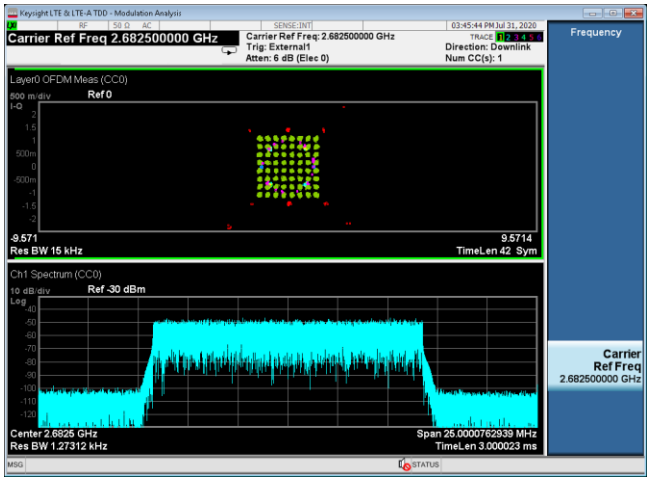
Channel Frequency 2503.5 MHz / Modulation 256QAM



Channel Frequency 2593 MHz / Modulation QPSK/16QAM

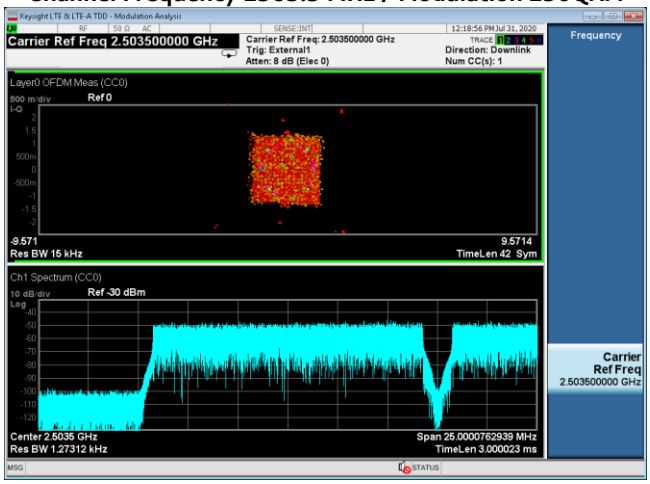


Channel Frequency 2682.5 MHz / Modulation 64QAM

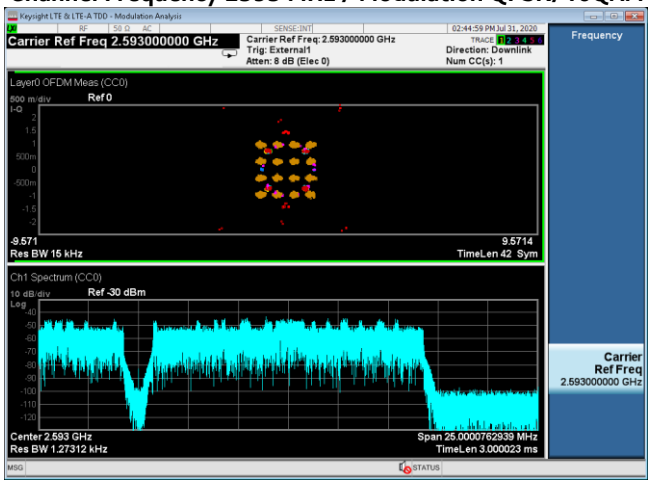


2C Data

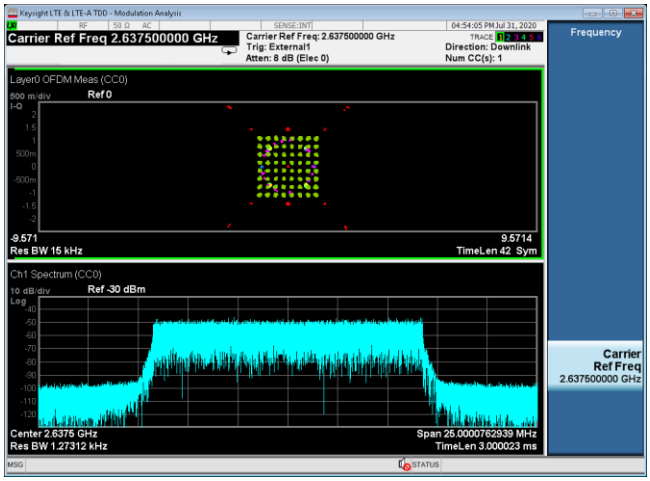
Channel Frequency 2503.5 MHz / Modulation 256QAM



Channel Frequency 2593 MHz / Modulation QPSK/16QAM



Channel Frequency 2680 MHz / Modulation 64QAM



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.

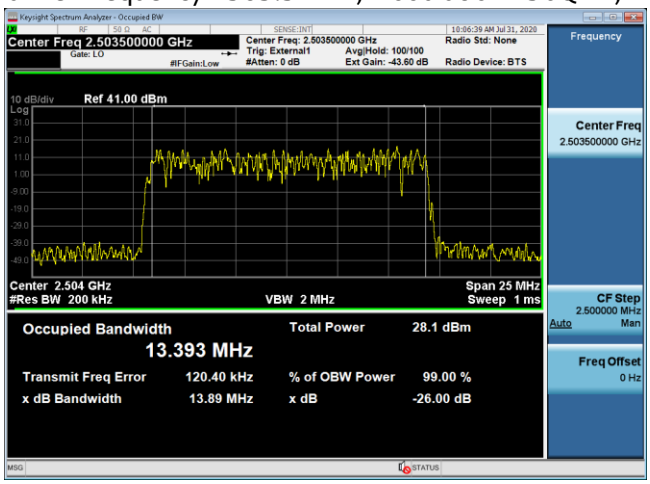
Tabular Data – Occupied Bandwidth

# of Carriers	Test Model	TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Occupied BW MHz
1	3.1a	1	2503.5	15	256QAM	13.393
	3.2	1	2593	15	QPSK/16QAM	13.314
	3.1	1	2682.5	15	64QAM	13.228

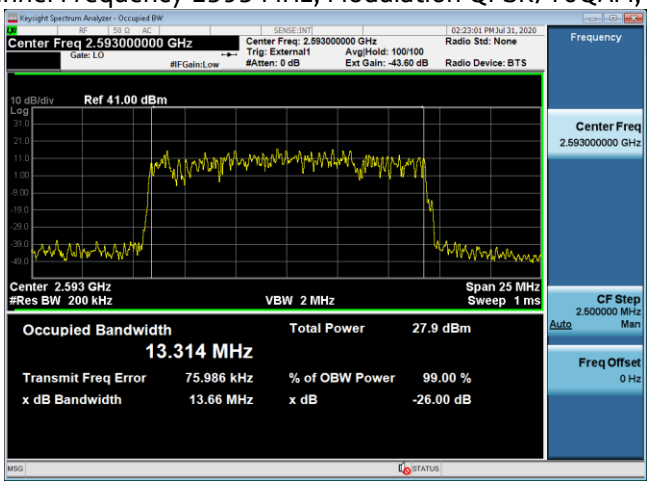
4.1.1 Occupied Bandwidth – Plots

1C Data

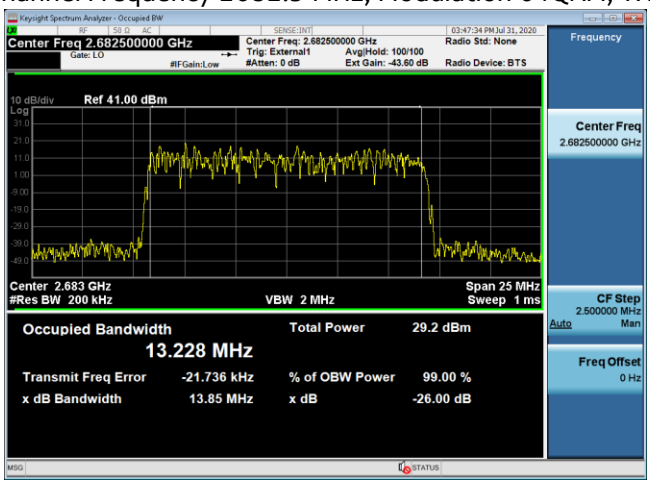
Channel Frequency 2503.5 MHz, Modulation 256QAM, TX1



Channel Frequency 2593 MHz, Modulation QPSK/16QAM, TX1



Channel Frequency 2682.5 MHz, Modulation 64QAM, TX1



4.2 Edge of band Emissions

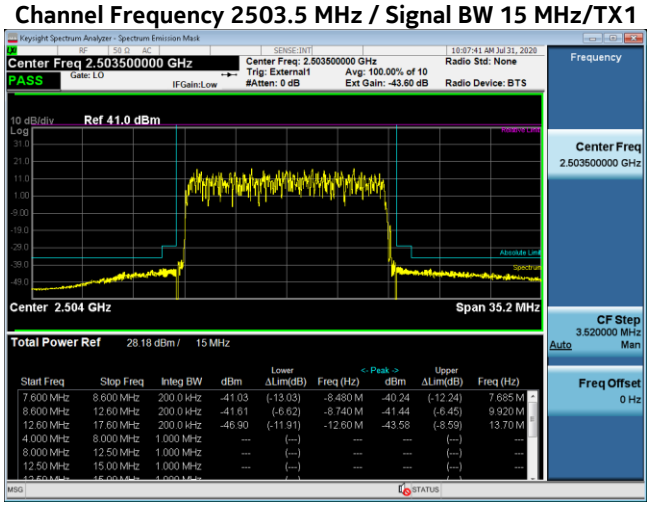
The Edge of Band emissions of the EUT at the external antenna connector (EAC) were measured using a Keysight MXA Signal Analyzer. The RF power level was continuously measured using a RF broadband power meter. The RF output from the EAC port to signal analyzer was reduced (to an amplitude usable by the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

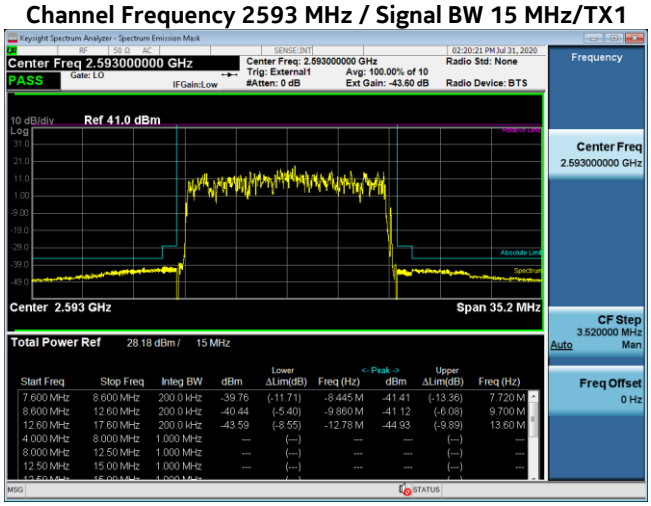
All of the measurements met the requirements of Part 27.53 when measured per Part 2.1049. The limit is derived using the 10 Log (n) rule for limits with n=64

1C Data

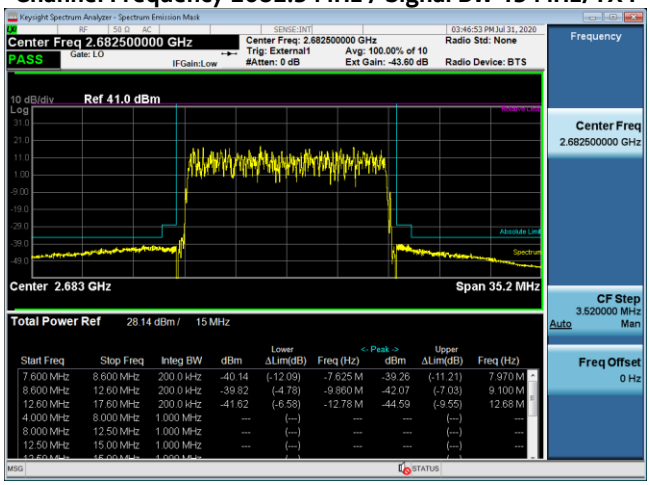
Channel Frequency 2503.5 MHz / Signal BW 15 MHz/TX1



Channel Frequency 2593 MHz / Signal BW 15 MHz/TX1

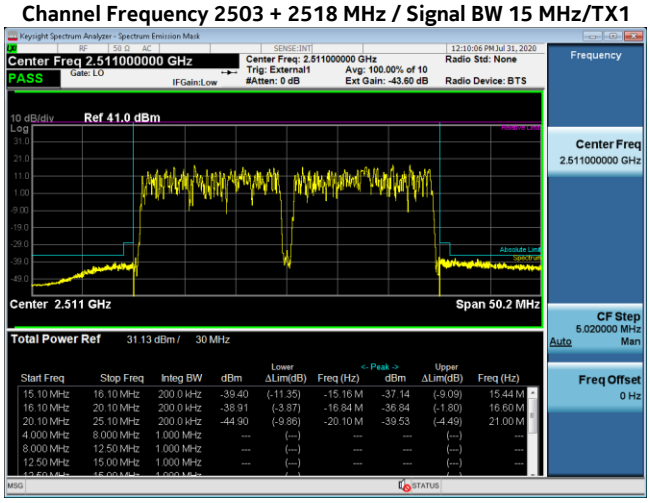


Channel Frequency 2682.5 MHz / Signal BW 15 MHz/TX1

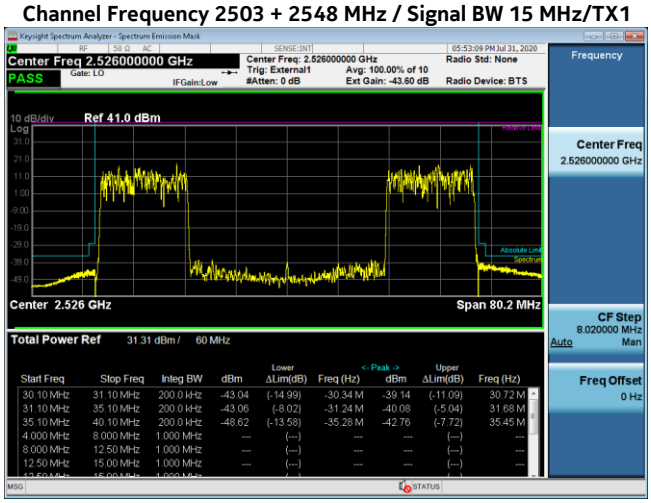


2C Data

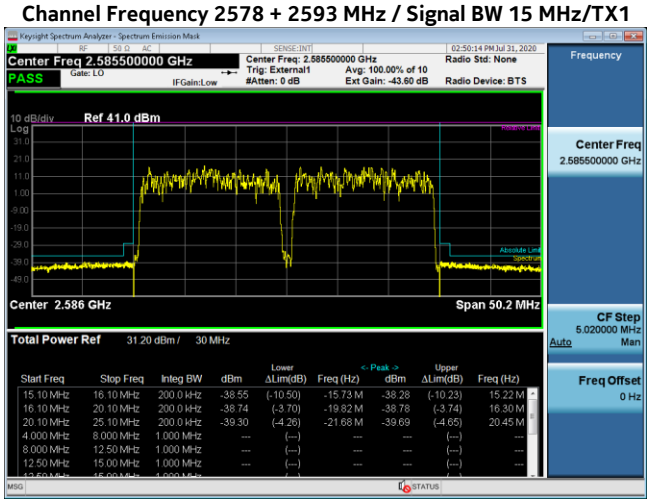
Channel Frequency 2503 + 2518 MHz / Signal BW 15 MHz/TX1



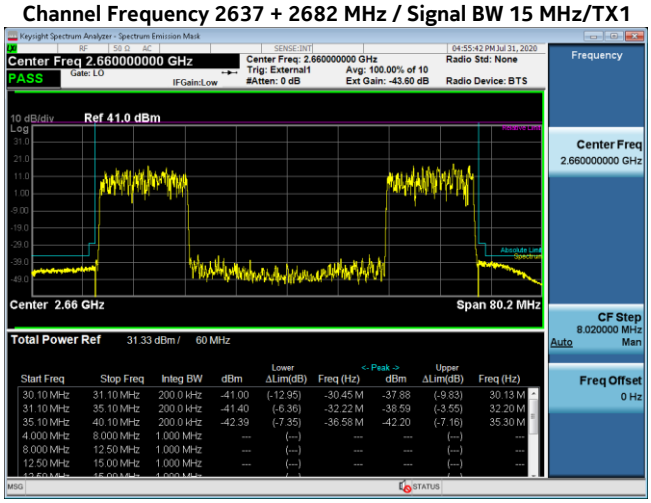
Channel Frequency 2503 + 2548 MHz / Signal BW 15 MHz/TX1



Channel Frequency 2578 + 2593 MHz / Signal BW 15 MHz/TX1



Channel Frequency 2637 + 2682 MHz / Signal BW 15 MHz/TX1



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

5.1 Measurement of Spurious Emissions at Transmit Antenna Port

Spurious Emissions at the transmit-antenna terminals were investigated over the frequency range of 10 MHz to beyond the 10th harmonic of the specific transmit band. Carrier Bandwidth is exempt. For this band of operation, the measurements were performed up to 10 GHz. Measurements were made using a Keysight MXA Signal Analyzer. The RF output from the transmitter was reduced (to an amplitude usable by the receivers) using calibrated attenuators. The RF power level was continuously monitored via a coupled RF Power Meter.

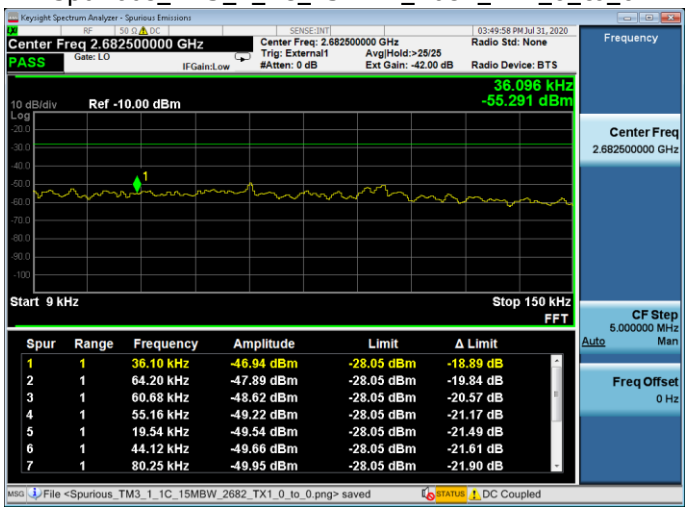
The required emission limitation is specified as appropriate in 27.53. The measured spurious emission levels were plotted for the frequency range as specified in 2.1057. There were no reportable emissions. Data below documents performance up to 27 GHz. The limit is derived using the 10 Log (n) rule for limits with n=64

5.1.1 Spurious Emissions at Tx Port - Plots

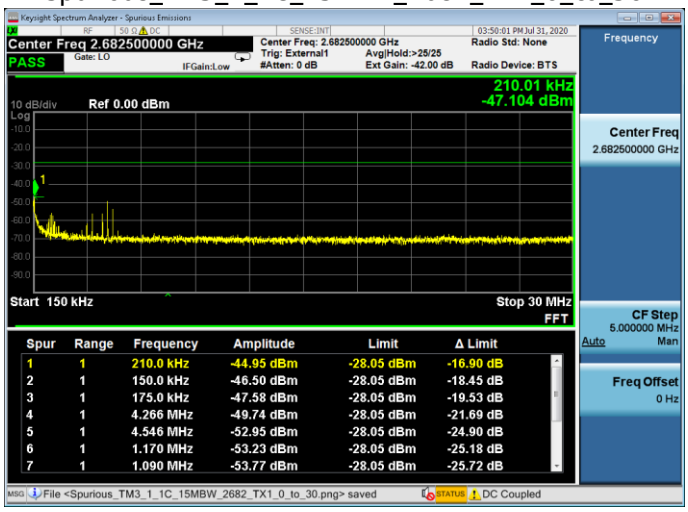
NOTE: Only a sample of the plots are used in this report. The full suite of raw data resides at the MH, New Jersey location.

1C Data

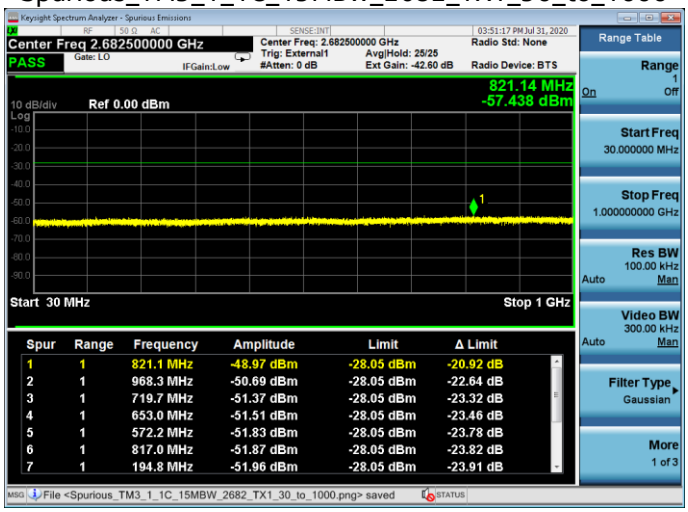
Spurious_TM3_1_1C_15MBW_2682_TX1_0_to_0



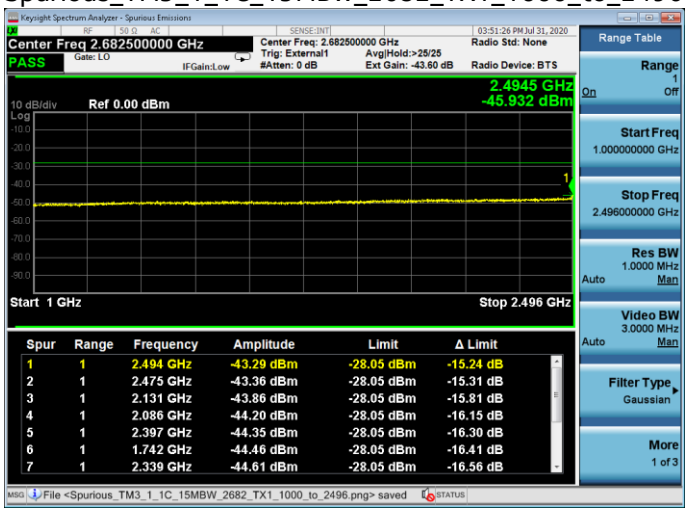
Spurious_TM3_1_1C_15MBW_2682_TX1_0_to_30



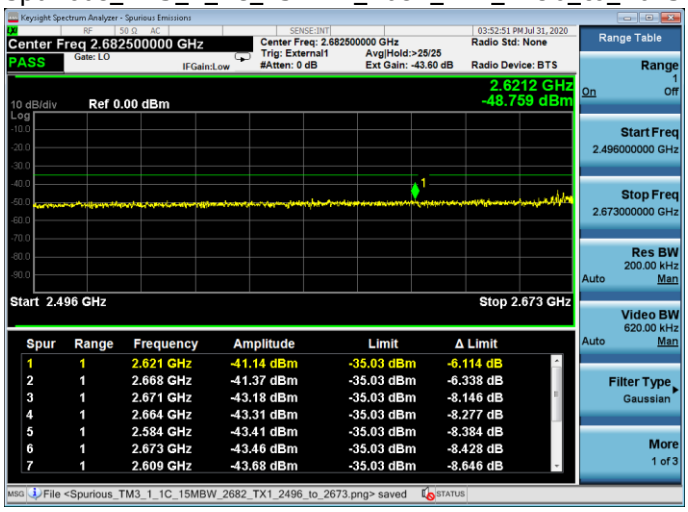
Spurious_TM3_1_1C_15MBW_2682_TX1_30_to_1000



Spurious_TM3_1_1C_15MBW_2682_TX1_1000_to_2496



Spurious_TM3_1_1C_15MBW_2682_TX1_2496_to_2673



Spurious_TM3_1_1C_15MBW_2682_TX1_2700_to_10000

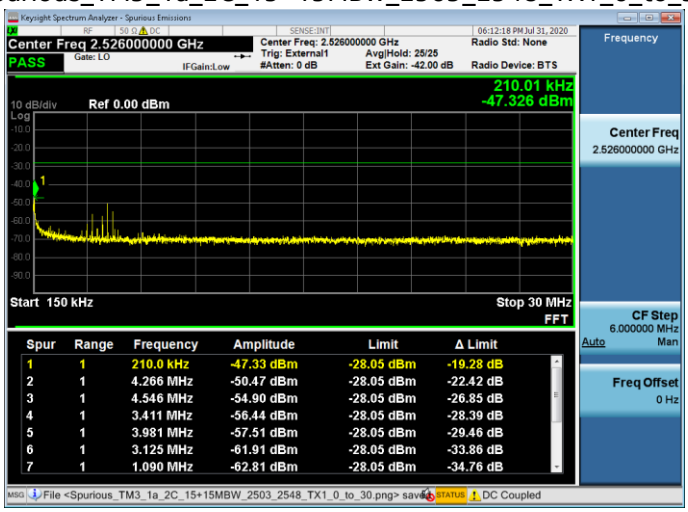
Spurious_TM3_1_1C_15MBW_2682_TX1_10000_to_15000

Spurious_TM3_1_1C_15MBW_2682_TX1_15000_to_27000

2C Data

Spurious_TM3_1a_2C_15+15MBW_2503_2548_TX1_0_to_0

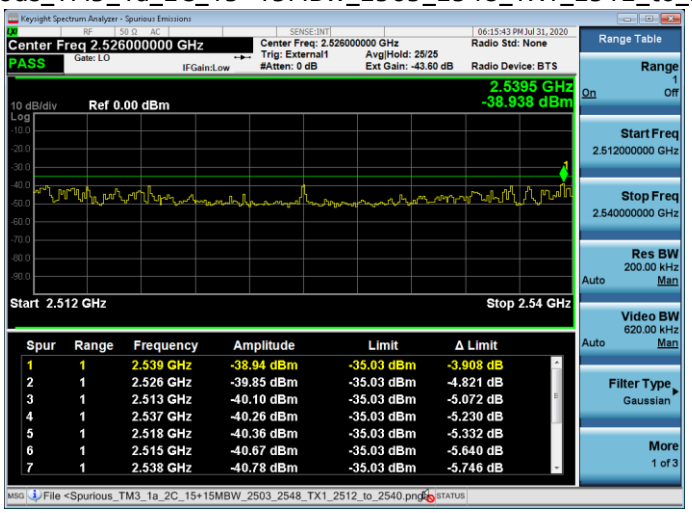
Spurious_TM3_1a_2C_15+15MBW_2503_2548_TX1_0_to_30



Spurious_TM3_1a_2C_15+15MBW_2503_2548_TX1_30_to_1000

Spurious_TM3_1a_2C_15+15MBW_2503_2548_TX1_1000_to_2486

Spurious_TM3_1a_2C_15+15MBW_2503_2548_TX1_2512_to_2540

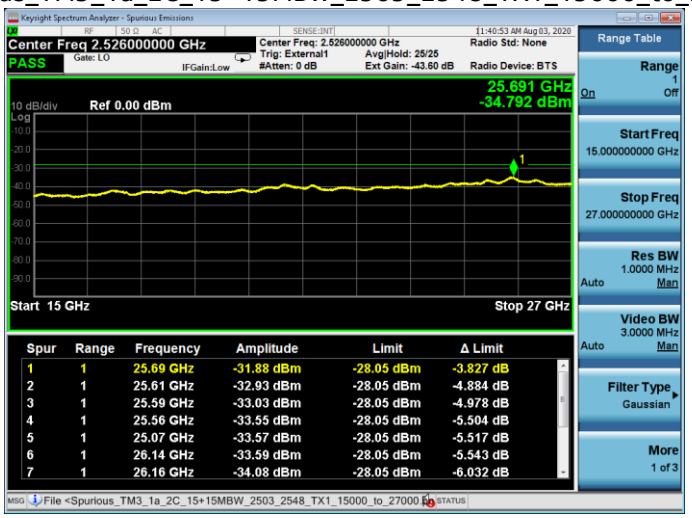


Spurious_TM3_1a_2C_15+15MBW_2503_2548_TX1_2556_to_2690

Spurious_TM3_1a_2C_15+15MBW_2503_2548_TX1_2690_to_10000

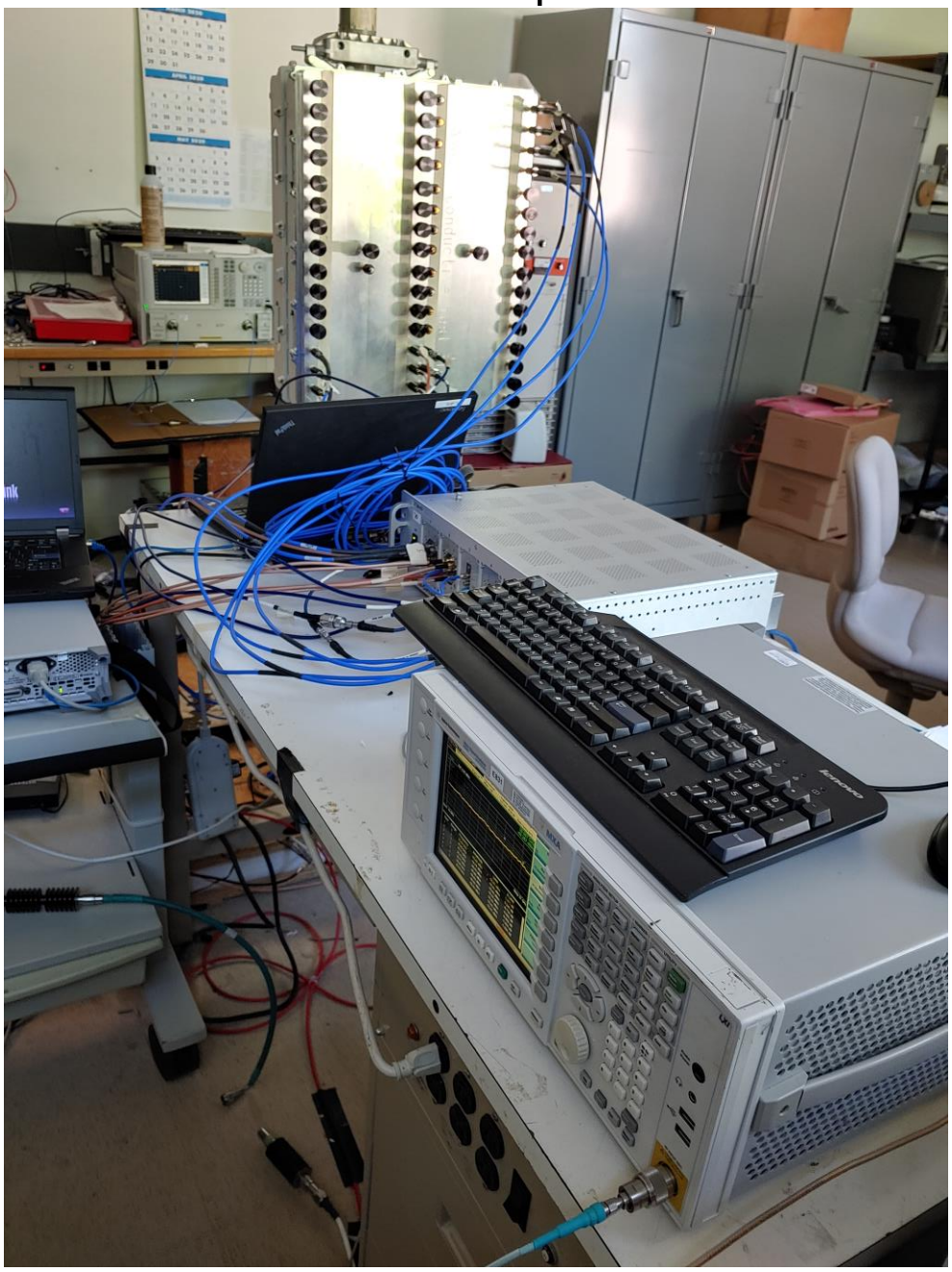
Spurious_TM3_1a_2C_15+15MBW_2503_2548_TX1_10000_to_15000

Spurious_TM3_1a_2C_15+15MBW_2503_2548_TX1_15000_to_27000



Photographs

Test Setup



Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
E831	Agilent Technologies	MXA Signal Analyzer	20Hz-26.5GHz	N9020A	MY48011791	2020-06-16	2022-06-16
E1156	Weinschel	Attenuator	10dB 0.05GHz-26GHz 25W	74-10-12	1069	CNR-V	CNR-V

Customer provided Equipment

Manufacturer	Type	Description	Model	Calibration Date	Calibration Due
Weinschel	Attenuator	30dB/10Watts DC-6GHz	P/NZSJ30-10RS-6TA	CNR-V	CNR-V

CNR: Calibration Not Required
CNR-V: Calibration Not Required, must be Verified

6. FCC Section 2.1053 - Field strength of spurious radiation

6.1 Section 2.1053 Field Strength of Spurious Emissions

Field strength measurements of radiated spurious emissions were made in an FCC registered 3m Semi-Anechoic Chamber which is maintained by Nokia Bell Labs in Murray Hill, New Jersey. A complete description and full measurement data for the site is on file with the Commission (Site Registration Number: 515091).

The spectrum from 30 MHz to beyond the tenth harmonic of the carrier, 10 GHz, was searched for spurious radiation. Measurements were made using both horizontally and vertically polarized broadband antennas. Per FCC regulations, the comparison of out of band spurious emissions directly to the limit is appropriately made using the substitution method. However, when the emissions are more than 20 dB below the specification limit, the use of field strength measurements for compliance determination is acceptable and those emissions are considered not reportable (Section 2.1053 and the FCC Interpretive database for 2.1053). For this case the evaluation of acceptable radiated field strength is as follows.

6.2 Field Strength of Spurious Emissions - Limits

Sections 2.1053 and 27.53 contain the requirements for the levels of spurious radiation as a function of the level of the unmodulated carrier. The reference level for the unmodulated carrier is calculated as the field produced by an ideal dipole excited by the transmitter output power according to the following relation taken from Reference Data for Radio Engineers, page 676, 4th edition, IT&T Corp.

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

$$20 \log (E*10^6) – (43 + 10 \log P) = 82.23 \text{ dB}\mu\text{V/meter}$$

Where:
E = Field Intensity in Volts/meter P = Transmitted Power in Watts
R = Measurement distance in meters = 3 m

The Part 27 Limit is 82.23 dBuV/m at 3m and 91.77 dBuV/m at 1m
The Part 27 non-report level is 62.23 dBuV/m at 3m.

The calculated emission levels were found by:

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

RESULTS:

For compliance with 47CFR Parts 2 and 27, the field strength of any spurious radiation, measured at 3m, is required to be less than 82.23 dBμV/meter (82.23 @ 3m). Emissions equal to or less than 62.23 dBμV/meter at 3m are not reportable and may be verified using field strength measurements and broadband antennas. Over the out of band spectrum investigated from 30 MHz to beyond the tenth harmonic of the carrier (up to 10 GHz), no reportable spurious emissions were detected.

7. NVLAP Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

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 17025:2005. 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).

2019-09-20 through 2020-09-30
Effective Dates

DEPARTMENT OF COMMERCE * UNITED STATES OF AMERICA *

For the National Voluntary Laboratory Accreditation Program