NOKIA Bell Labs

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

NVLAP®

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 320W AEHC Radio Unit

Report Number:
TR-2021-0006-FCC2-27

Date Issued:
February 24, 2021

This report shall not be reproduced, in whole or in part without the approval of Nokia Global Product Compliance Laboratory. This report must not be used by the recipient to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

Table of Contents

1. SYSTEM INFORMATION AND REQUIREMENTS 4

1.1 INTRODUCTION 5
1.2 PURPOSE AND SCOPE 5
1.3 EUT DETAILS 6
1.4 TEST REQUIREMENTS 8
1.5 EXECUTIVE SUMMARY 10
1.6 TEST CONFIGURATION FOR ALL ANTENNA PORT MEASUREMENTS. 10

2. FCC SECTION 2.1046 - RF POWER OUTPUT 11

2.1 RF POWER OUTPUT 11

3. FCC SECTION 2.1047 - MODULATION CHARACTERISTICS 27

3.1 MODULATION CHARACTERISTICS 27

4. FCC SECTION 2.1049 – OCCUPIED BANDWIDTH/EDGE OF BAND EMISSIONS 28

4.1 OCCUPIED BANDWIDTH 28
4.2 EDGE OF BAND EMISSIONS 34

5. FCC SECTION 2.1051 - SPURIOUS EMISSIONS AT TRANSMIT ANTENNA PORT 39

5.1 MEASUREMENT OF SPURIOUS EMISSIONS AT TRANSMIT ANTENNA PORT 39

6. FCC SECTION 2.1053 - FIELD STRENGTH OF SPURIOUS RADIATION 57

6.1 SECTION 2.1053 FIELD STRENGTH OF SPURIOUS EMISSIONS 57
6.2 FIELD STRENGTH OF SPURIOUS EMISSIONS - LIMITS 57

7. NVLAP CERTIFICATE OF ACCREDITATION 58

Revisions

Date	Revision	Section	Change
2/24/21	0		Initial Release

Nokia Global Product Compliance Laboratories is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP®) for specific services, listed on the Scope of Accreditation, for: Electromagnetic Compatibility and 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 Communiqué dated January 2009). NVLAP LAB CODE: 100275-0.

Nokia Global Product Compliance Laboratory represents to the client that the laboratory's accreditation or any of its calibration or test reports in no way constitutes or implies product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S Government.

Prepared By:

Signed: 2/24/2021

Ann Chang
Compliance Engineer
NVLAP Signatory
Ann.chang@nokia-bell-labs.com

Approved By:

Signed: 2/24/2021

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

Reviewed By:

Signed: 2/24/2021

Nilesh Patel
EMC Engineer
NVLAP Signatory
Nilesh.b.patel@nokia-bell-labs.com

1. System Information and Requirements

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

Equipment Under Test (EUT):	AirScale MAA 64T64R 320W AEHC Radio Unit
Serial Number:	L1203206453
FCC ID:	VBNAEHC-01
Hardware Version:	475124B.101
Software Version:	LTE: SBTS21A 5G: 5G20B
Frequency Range:	2496-2690 MHz
GPCL Project Number:	2021-0006
Manufacturer:	NOKIA SOLUTIONS AND NETWORKS OY KARAKAARI 7, FI-02610 ESPOO FINLAND
Applicant:	Nokia Solutions and Networks US LLC 3201 Olympus Blvd Dallas, Texas 75019 Steve Mitchell
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):	1/19/2021 – 2/8/2021
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 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 AirScale MAA 64T64R 192AE B41 320W AEHC, hereinafter referred to as the Equipment Under Test (EUT).

1.2 Purpose and Scope

The purpose of this document is to provide the testing data required for qualifying the EUT 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.

The original filing for this product was in GPCL project 2020-0060 for FCC ID: VBNAEHC-01 which includes 20 MHz LTE, 40, 60, 100 MHz 5G-NR. The second test program was to support a Class I change for the concurrent mode of operation with LTE/5G NR operation with 60 MHz 5G-NR and 1-3 Carriers of 20 MHz LTE and it was documented as part of the test report, TR-2020-0131-FCC15 AEHC 64T64R 320 W 4G & 5G FCC.

This testing is to support the following configurations:

Single Carrier configurations

- LTE: 10MHz (31 dBm - 1.25 W/port, 80 W Total)
- 5G-NR: 20 (32 dBm - 1.58 W/port, 100 W Total)
- 5G-NR 50 (35 dBm - 3.16 W/port, 200 W Total)
- 5G-NR 80 and 90MHz (37 dBm – 5.01 W/port, 320 W Total)

Multi Carrier contiguous/non-contiguous carrier configurations

- 5G-NR 20MHz + LTE 20MHz (1.5 W each for LTE and 5G-NR)
- 5G-NR 40MHz + LTE 20MHz (1.5 W – LTE, 3.2 W 5G-NR)
- 5G-NR 20MHz + LTE 20MHz + LTE 20MHz (3.2 W – LTE, 1.5 W 5G-NR)
- 5G-NR 40MHz + LTE 20MHz + LTE 20MHz (3.2 W – LTE, 1.5 W 5G-NR)
- 5G-NR 20MHz + LTE 20MHz + LTE 20MHz + LTE 20MHz (3.2 W – LTE, 1.5 W 5G-NR)
- 5G-NR 40MHz + LTE 20MHz + LTE 20MHz + LTE 20MHz (3.2 W – LTE, 1.5 W 5G-NR)

The combined power for all configurations does not exceed 320 W (37 dBm per port, 64 ports), and each individual carrier does not exceed the single carrier power listed on the FCC grant. Testing was conducted at maximum power.

No Frequency Stability testing was considered necessary for this test program since there were no changes to the basic frequency determining and stabilizing circuitry (including clock and data rates).

1.3 EUT Details

1.3.1 Specifications

Specification Items	Description
Radio Access Technology	LTE & 5G-NR
Duplex Mode	Time Division Duplex (TDD)
Modulation Type(s)	QPSK 16QAM 64QAM 256QAM
Operation Frequency Range	2496-2690 MHz
Channel Bandwidth	10MHz, 20MHz, 50MHz, 80MHz and 90MHz
Tx/Rx	64T64R
MIMO	Yes
Deployment Environment	Outdoor
Supply Voltage	-48.0 VDC
Max RF Output Power	320W (5W per TRX)

1.3.2 Photographs

Front

Rear

Left

Right

Top

Bottom

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*

* No Frequency Stability testing was considered necessary for this test program since there were no changes to the basic frequency determining and stabilizing circuitry (including clock and data rates. Standards & Procedures

1.4.1 Standards

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

1.4.2 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

1.4.3 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

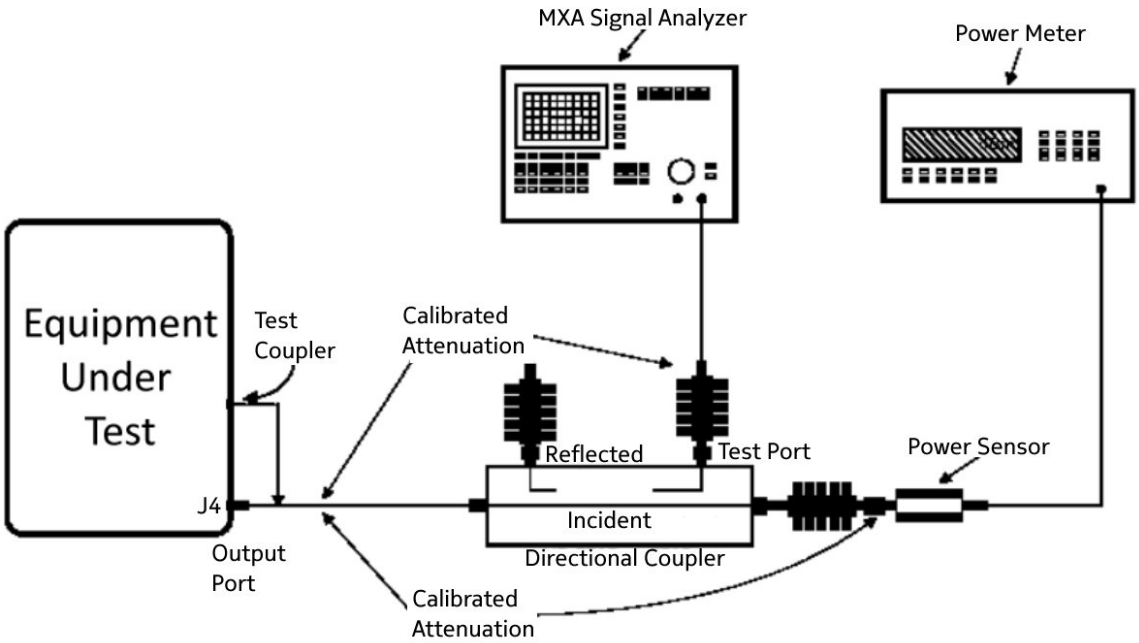
Antenna Port Test	Signal Bandwidth	Frequency Range	Expanded Uncertainty (k=2), Amplitude
Occupied Bandwidth, Edge of Band, Conducted Spurious Emissions	10 Hz 100 Hz 10 kHz to 1 MHz 1MHz	9 kHz to 20 MHz 20 MHz to 1 GHz 1 GHz to 10 GHz 10 GHz to 40 GHz:	1.78 dB
RF Power	10 Hz to 20 MHz	50 MHz to 18 GHz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

1.5 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	NT

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

1.6 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. The maximum output is bolded in each case.

2.1.1 Channel RF Power - Tables

1C – LTE 10MHz BW

Channel Power - LTE 10MHz					
Test Model 3.1 Modulation 64QAM Channel Frequency 2501MHz		Test Model 3.2 Modulation QPSK/16QAM Channel Frequency 2593MHz		Test Model 3.1a Modulation 256QAM Channel Frequency 2685MHz	
TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)
1	31.20	1	31.17	1	31.00
9	31.28	9	31.21	9	30.97
17	31.11	17	31.08	17	30.85
25	31.28	25	31.45	25	30.97
33	31.04	33	30.9	33	30.75
41	31.63	41	31.45	41	31.22
49	31.25	49	31.09	49	30.88
57	**31.92**	57	**31.65**	57	**31.42**

1C - 5G-NR 20MHz BW

Channel Power - 5G-NR 20MHz					
Test Model 3.1 Modulation 64QAM Channel Frequency 2506.02MHz		Test Model 3.2 Modulation QPSK/16QAM Channel Frequency 2593.02MHz		Test Model 3.1a Modulation 256QAM Channel Frequency 2679.99MHz	
TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)
1	31.83	1	31.79	1	31.88
9	31.91	9	31.88	9	31.92
17	31.99	17	31.88	17	31.95
25	31.73	25	31.68	25	31.68
33	31.62	33	31.55	33	31.67
41	31.99	41	31.89	41	31.96
49	31.84	49	31.79	49	31.85
57	**32.17**	57	**32.03**	57	**32.33**

1C - 5G-NR 50MHz BW

Channel Power - 5G-NR 50MHz					
Test Model 3.1 Modulation 64QAM Channel Frequency 2521.02MHz		Test Model 3.2 Modulation QPSK/16QAM Channel Frequency 2593.02MHz		Test Model 3.1a Modulation 256QAM Channel Frequency 2664.99MHz	
TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)
1	34.87	1	34.79	1	35.05
9	35.07	9	34.96	9	35.18
17	35.07	17	34.93	17	35.09
25	34.77	25	34.79	25	35.03
33	34.78	33	34.65	33	34.90
41	35.33	41	35.19	41	35.41
49	35.03	49	34.93	49	35.13
57	**35.58**	57	**35.37**	57	**35.58**

1C - 5G-NR 80MHz BW

Channel Power - 5G-NR 80MHz					
Test Model 3.1 Modulation 64QAM Channel Frequency 2536.02MHz		Test Model 3.2 Modulation QPSK/16QAM Channel Frequency 2593.02MHz		Test Model 3.1a Modulation 256QAM Channel Frequency 2649.99MHz	
TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)
1	36.94	1	37.04	1	37.12
9	37.14	9	37.11	9	37.18
17	36.93	17	36.87	17	36.93
25	36.93	25	36.90	25	36.92
33	36.85	33	36.78	33	36.84
41	37.15	41	37.12	41	**37.32**
49	37.13	49	37.08	49	37.09
57	**37.32**	57	**37.19**	57	37.27

1C - 5G-NR 90MHz BW

Channel Power - 5G-NR 90MHz					
Test Model 3.1 Modulation 64QAM Channel Frequency 2541MHz		Test Model 3.2 Modulation QPSK/16QAM Channel Frequency 2593.02MHz		Test Model 3.1a Modulation 256QAM Channel Frequency 2644.98MHz	
TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)
1	36.99	1	36.94	1	37.02
9	37.16	9	37.07	9	37.16
17	37.04	17	36.93	17	37.00
25	37.15	25	37.06	25	37.18
33	36.87	33	36.77	33	36.87
41	37.40	41	**37.26**	41	37.37
49	37.17	49	37.01	49	37.13
57	**37.49**	57	37.22	57	**37.40**

2C – 5G-NR 20MHz + LTE 20MHz BW

Channel Power - 5G-NR 20MHz + LTE 20MHz	
Test Model 3.2 Modulation QPSK/16QAM Channel Frequency 2506+2680MHz	
TX Port	(dBm)
1	31.78+32.46
9	31.82+32.71
17	31.81+32.42
25	31.75+32.41
33	31.61+32.39
41	32.10+32.94
49	31.74+32.64
57	**32.24+32.84**

2C LTE 20MHz + 5G-NR 40MHz BW

Channel Power - LTE 20MHz + 5G-NR 40MHz	
Test Model 3.1a Modulation 256QAM Channel Frequency 2506+2670MHz	
TX Port	(dBm)
1	31.93+34.27
9	31.93+34.27
17	32.00+34.35
25	31.84+34.27
33	31.84+34.26
41	31.84+34.26
49	31.85+34.27
57	**31.85+34.27**

3C 5G-NR 20MHz + LTE 20MHz + LTE 20MHz BW

Channel Power - 5G-NR 20MHz + LTE 20+20MHz	
Test Model 3.1 Modulation 64QAM Channel Frequency 2506.02+2660+2680MHz	
TX Port	(dBm)
1	31.89+34.59
9	31.72+34.41
17	**31.99+34.70**
25	31.87+34.57
33	31.84+34.60
41	31.89+34.60
49	31.86+34.60
57	31.84+34.60

3C LTE 20MHz + LTE 20MHz + 5G-NR 40MHz BW

Channel Power - LTE 20+20MHz + 5G-NR 40MHz	
Test Model 3.1 Modulation 64QAM Channel Frequency 2506+2526+2670MHz	
TX Port	(dBm)
1	34.75+33.14
9	34.85+33.39
17	34.65+32.95
25	34.66+33.04
33	34.63+33.03
41	35.13+33.60
49	34.81+33.34
57	**35.22+33.47**

4C 5G-NR 20MHz + LTE 20MHz + LTE 20MHz + LTE 20MHz BW

Channel Power - 5G-NR 20MHz + LTE 20+20+20MHz	
Test Model 3.1a Modulation 256QAM Channel Frequency 2506.02+2640+2660+2680MHz	
TX Port	(dBm)
1	31.93+35.68
9	31.92+35.67
17	**32.02+35.78**
25	31.91+35.67
33	31.92+35.68
41	31.92+35.67
49	31.91+35.67
57	31.91+35.66

4C LTE 20MHz + LTE 20MHz + LTE 20MHz + 5G-NR 40MHz BW

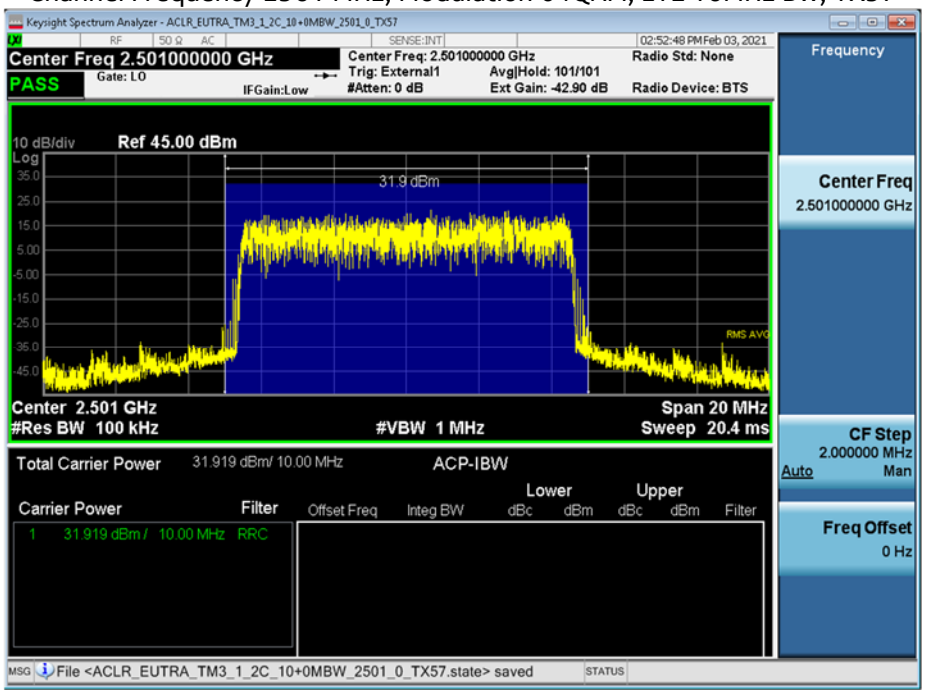
Channel Power - LTE 20+20+20MHz + 5G-NR 40MHz	
Test Model 3.1 Modulation 64QAM Channel Frequency 2506+2526+2546+2670MHz	
TX Port	(dBm)
1	35.64+31.64
9	35.75+31.89
17	35.64+31.54
25	37.01+30.77
33	35.50+31.50
41	35.99+32.08
49	37.42+30.67
57	**36.33+32.20**

2.1.2 Channel RF 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.

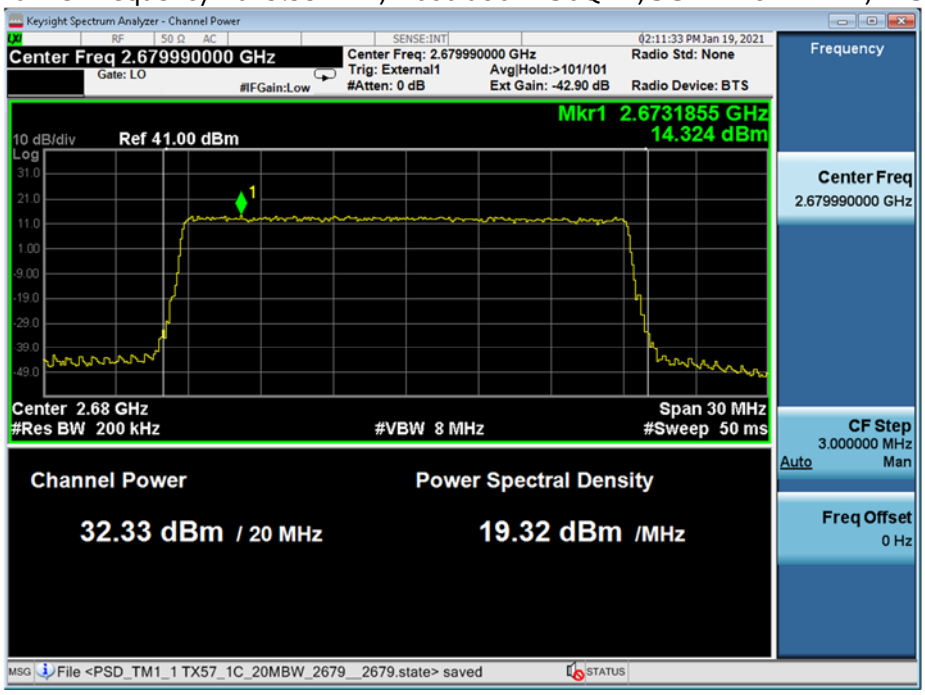
1C Data (LTE)

Channel Frequency 2501 MHz, Modulation 64QAM, LTE 10MHz BW, TX57

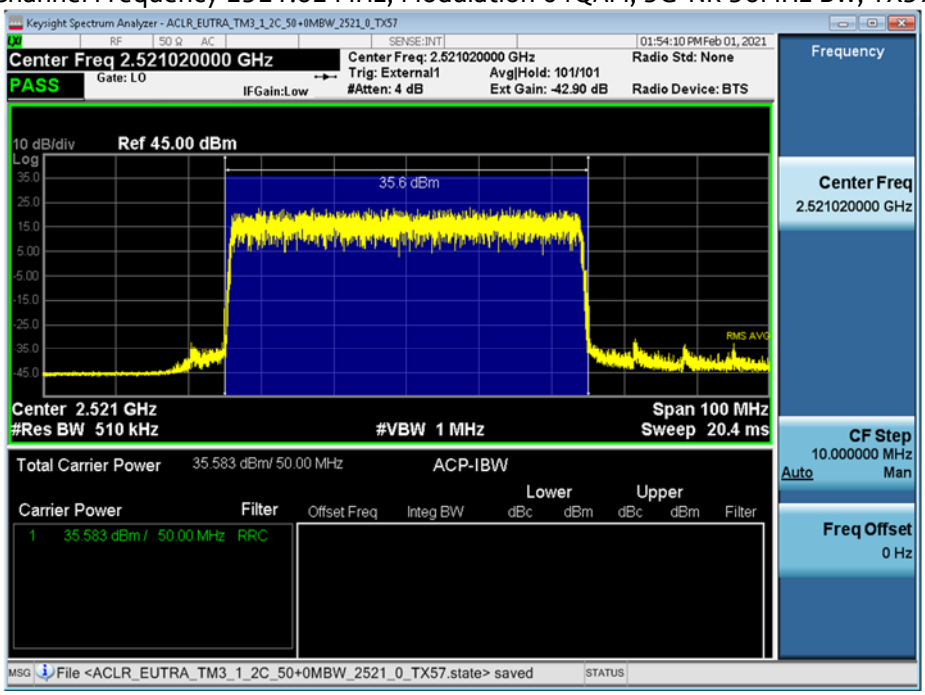


1C Data (5G-NR)

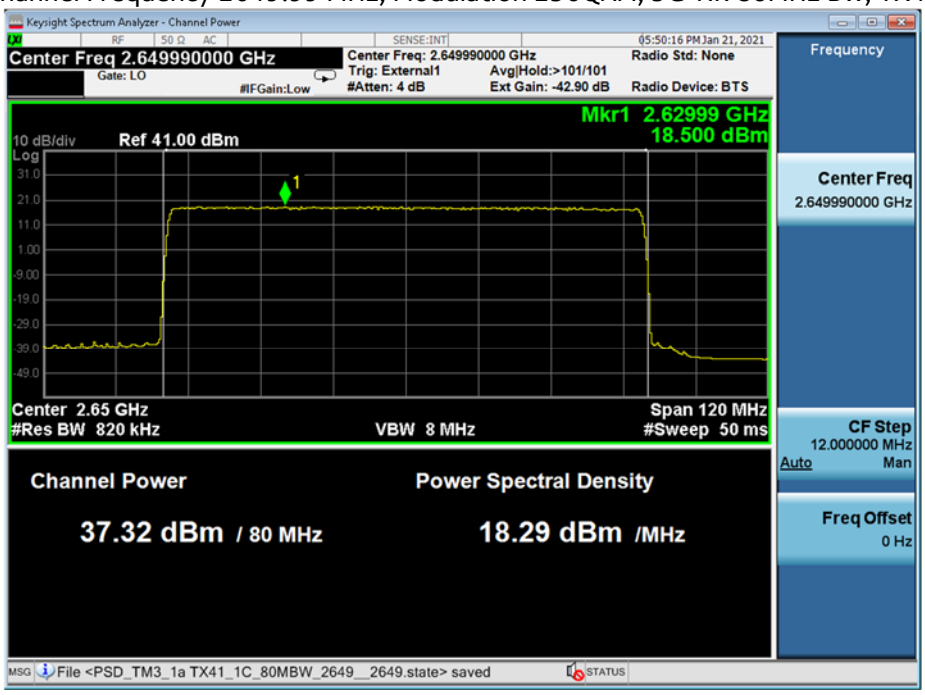
Channel Frequency 2679.99 MHz, Modulation 256QAM, 5G-NR 20MHz BW, TX57



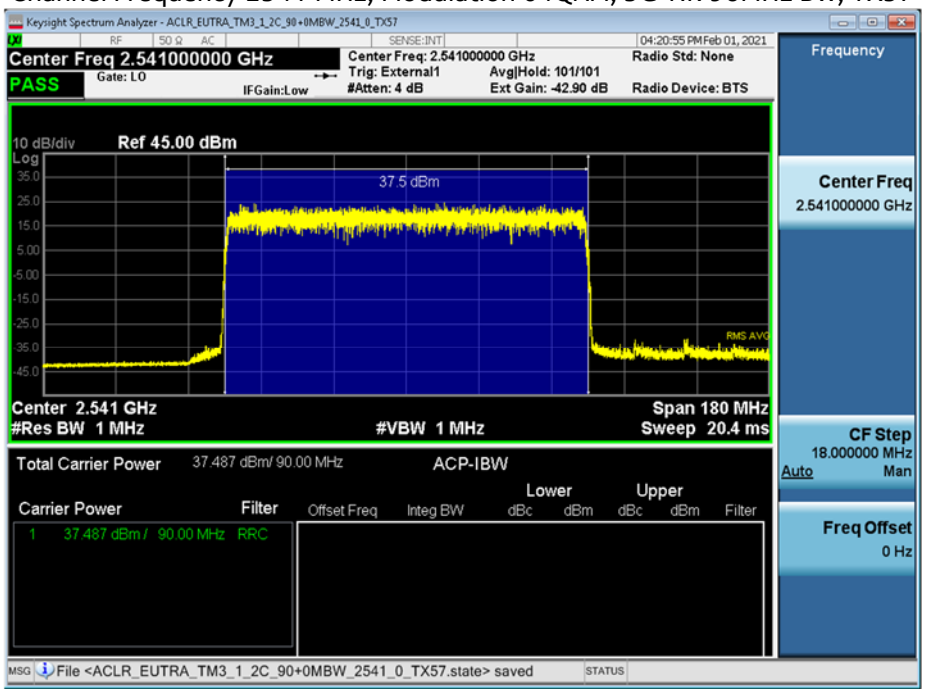
Channel Frequency 2521.02 MHz, Modulation 64QAM, 5G-NR 50MHz BW, TX57



Channel Frequency 2649.99 MHz, Modulation 256QAM, 5G-NR 80MHz BW, TX41

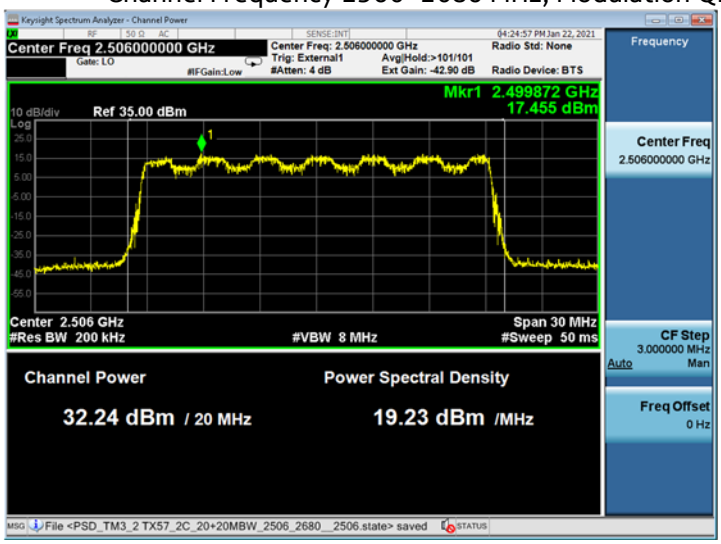


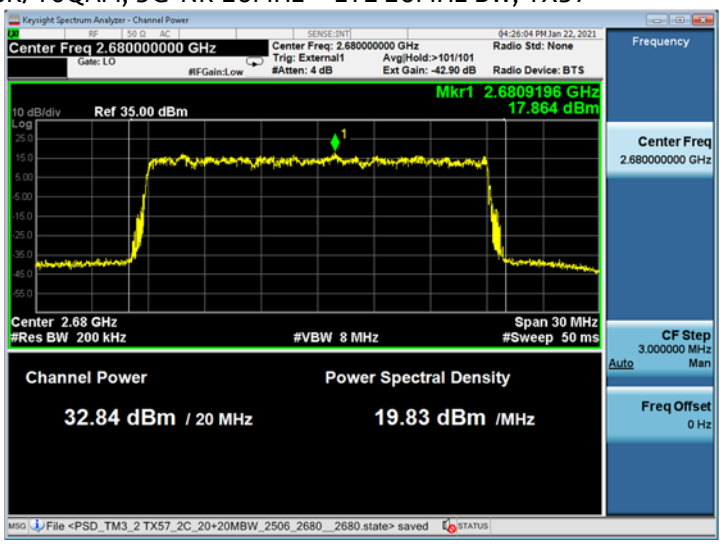
Channel Frequency 2541 MHz, Modulation 64QAM, 5G-NR 90MHz BW, TX57



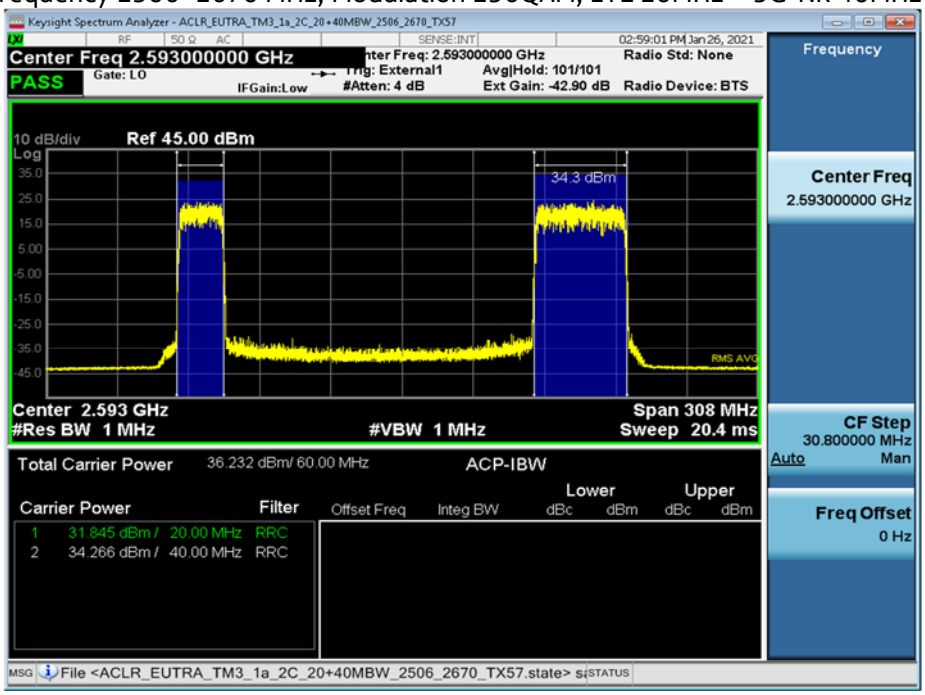
2C Data

Channel Frequency 2506+2680 MHz, Modulation QPSK/16QAM, 5G-NR 20MHz + LTE 20MHz BW, TX57



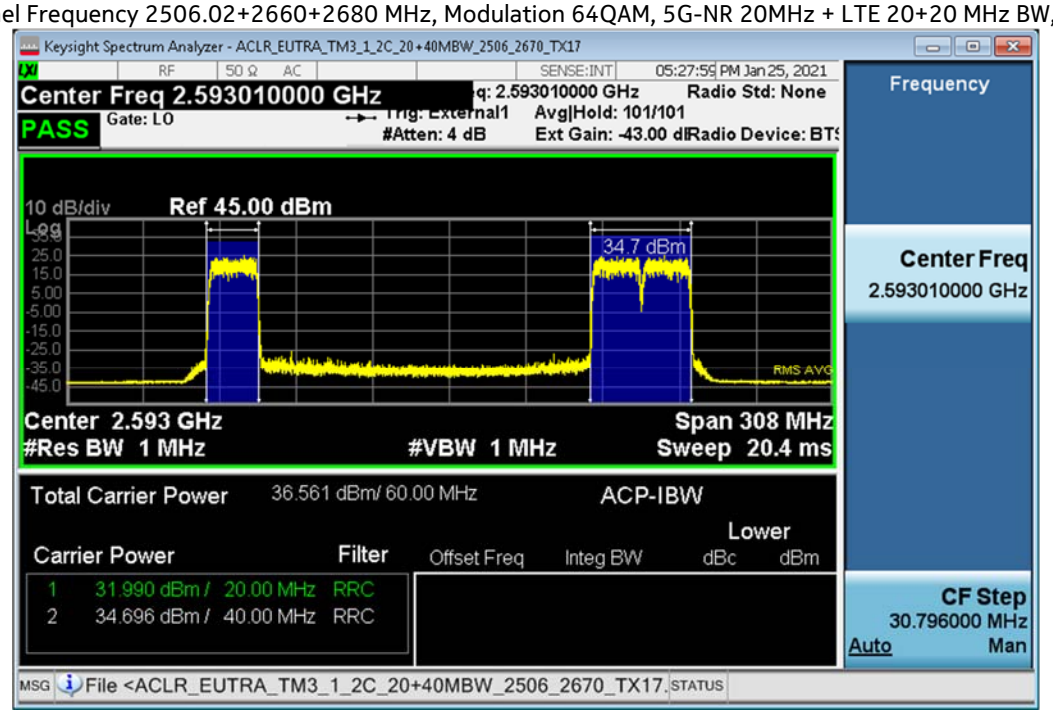


Channel Frequency 2506+2670 MHz, Modulation 256QAM, LTE 20MHz + 5G-NR 40MHz BW, TX57

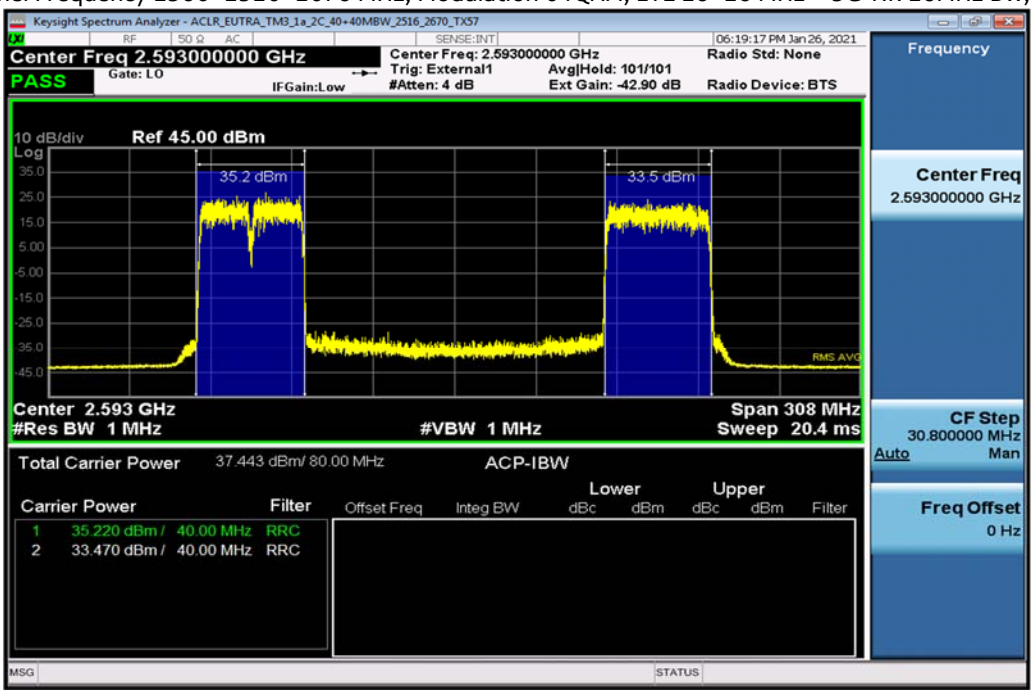


3C Data

Channel Frequency 2506.02+2660+2680 MHz, Modulation 64QAM, 5G-NR 20MHz + LTE 20+20 MHz BW, TX17

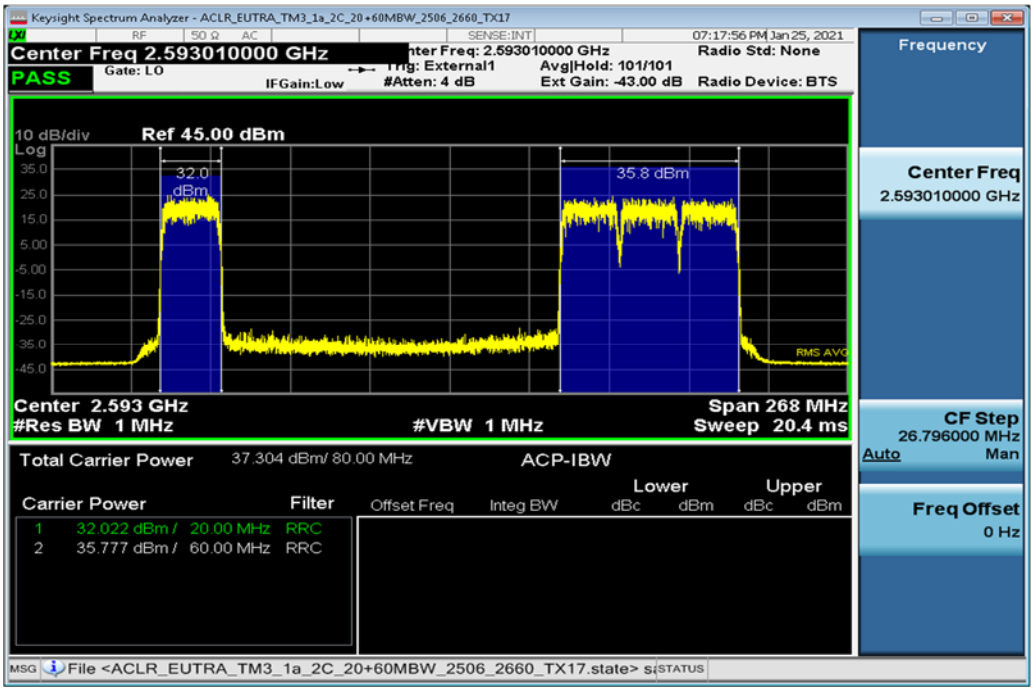


Channel Frequency 2506+2526+2670 MHz, Modulation 64QAM, LTE 20+20 MHz + 5G-NR 20MHz BW, TX57

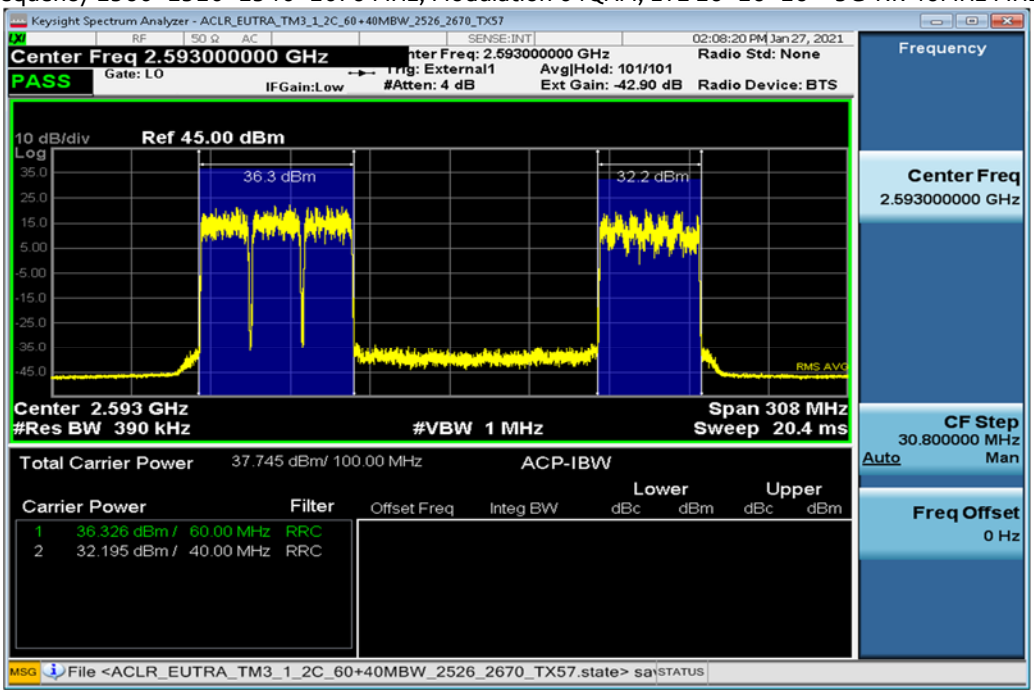


4C Data

Channel Frequency 2506.02+2640+2660+2680 MHz, Modulation 256QAM, 5G-NR 20MHz + LTE 20+20+20 MHz BW, TX17



Channel Frequency 2506+2526+2546+2670 MHz, Modulation 64QAM, LTE 20+20+20 + 5G-NR 40MHz MHz BW, TX57

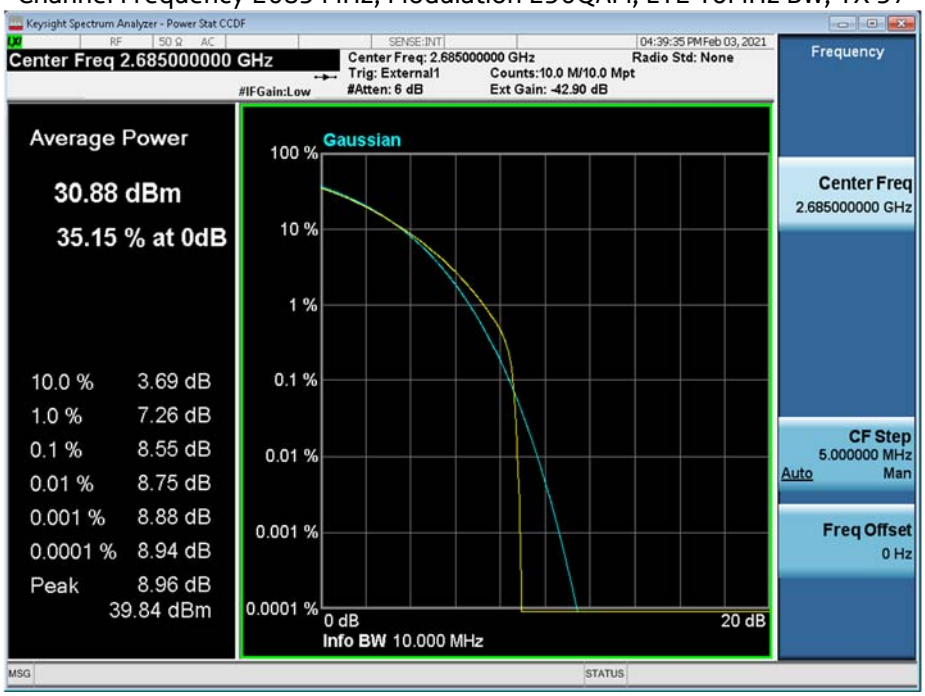


2.1.3 Peak-to-Average Power Ratio (PAPR) – Plots

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

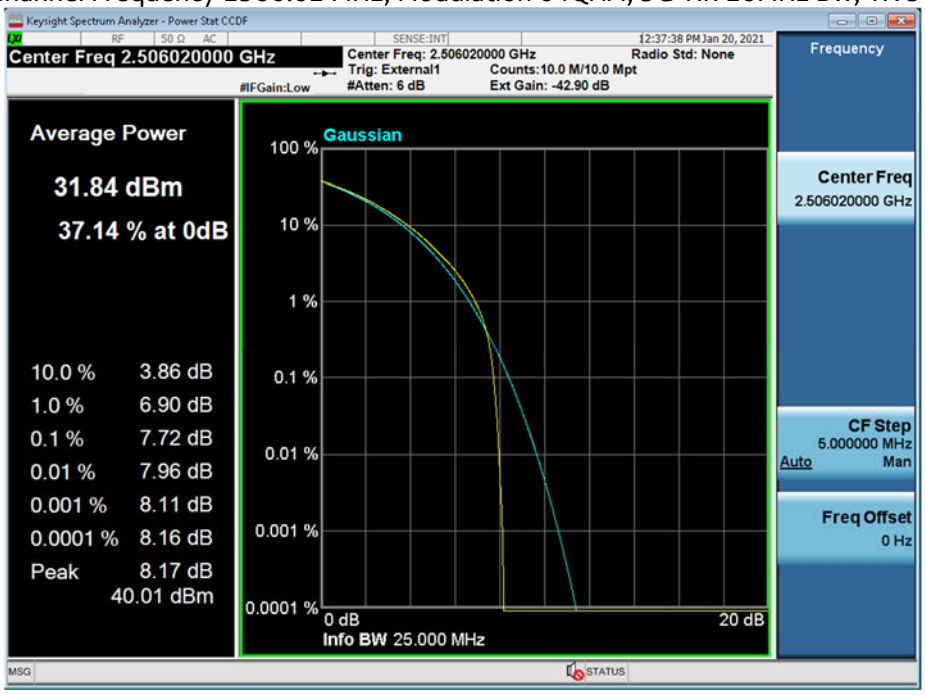
1C Data (LTE)

Channel Frequency 2685 MHz, Modulation 256QAM, LTE 10MHz BW, TX 57

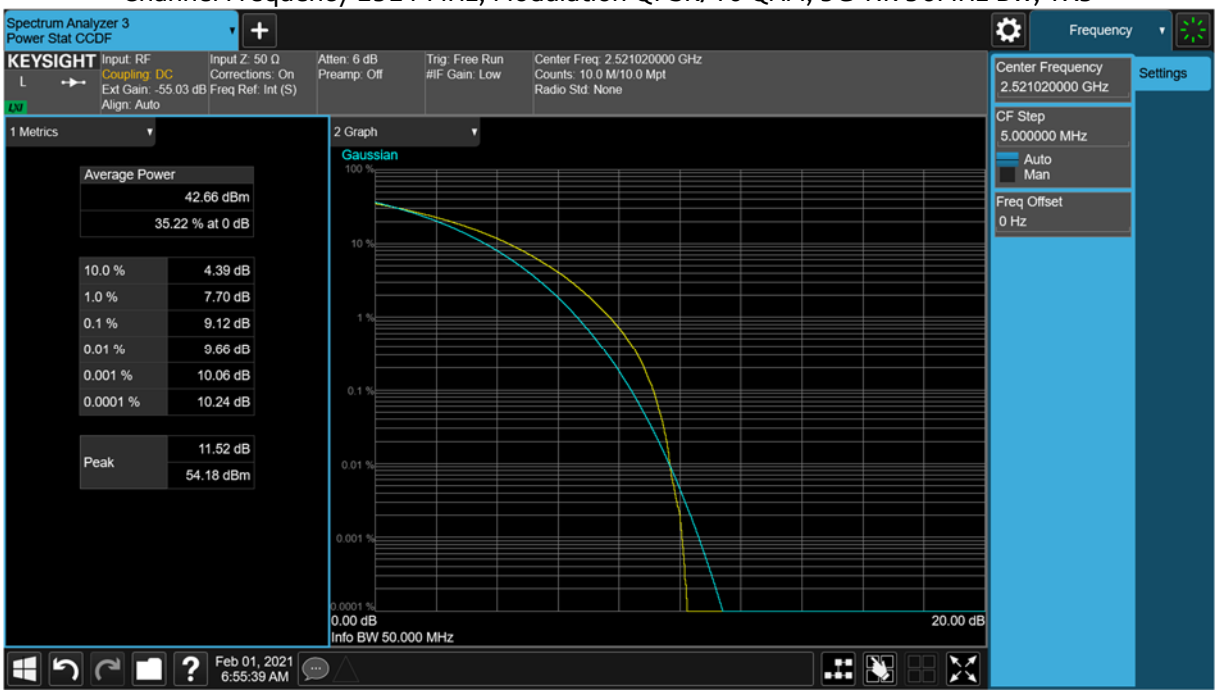


1C Data (5G-NR)

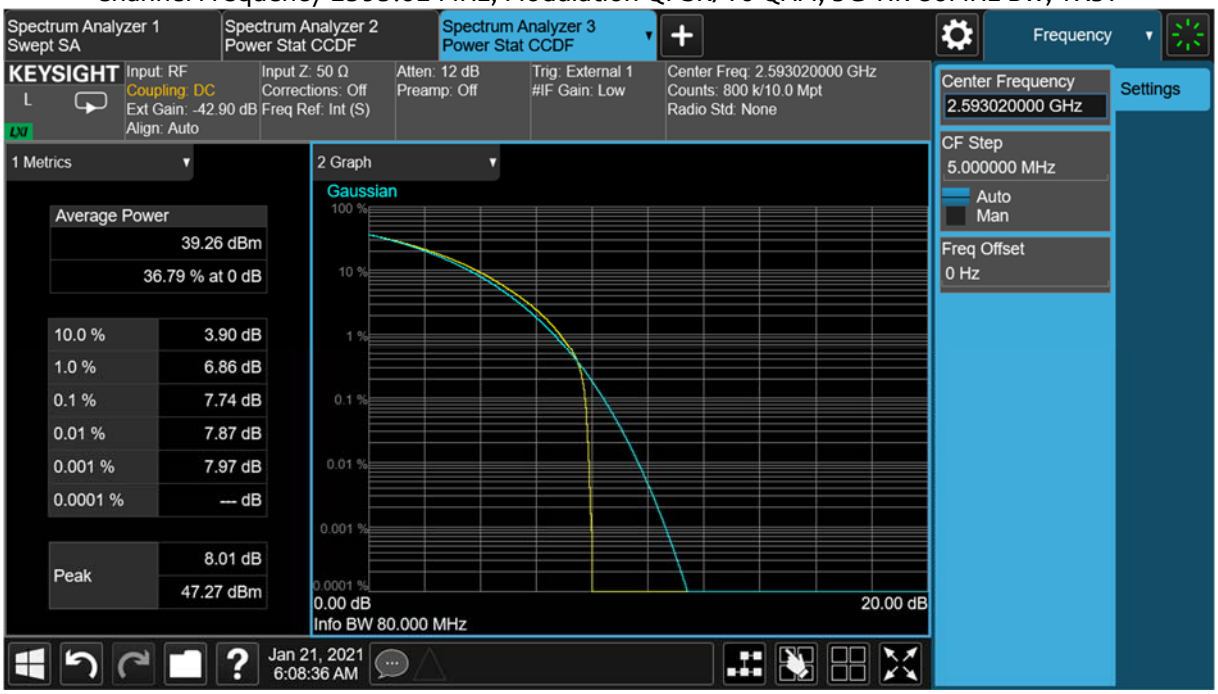
Channel Frequency 2506.02 MHz, Modulation 64QAM, 5G-NR 20MHz BW, TX 57



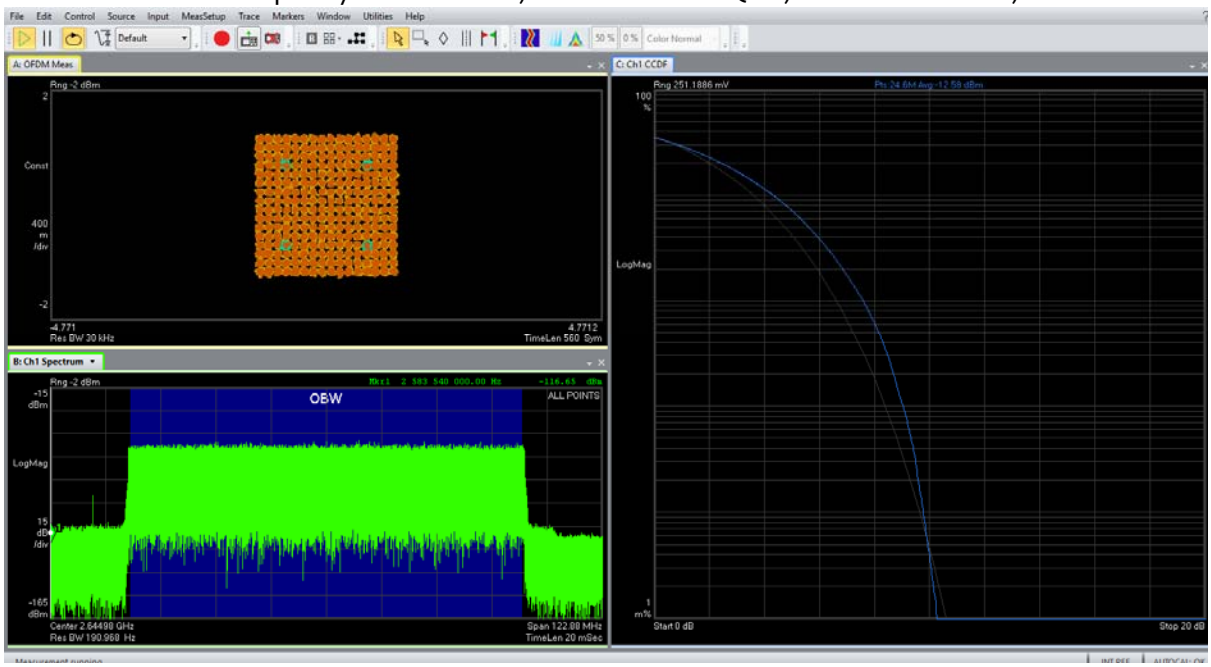
Channel Frequency 2521 MHz, Modulation QPSK/16 QAM, 5G-NR 50MHz BW, TX3



Channel Frequency 2593.02 MHz, Modulation QPSK/16 QAM, 5G-NR 80MHz BW, TX57

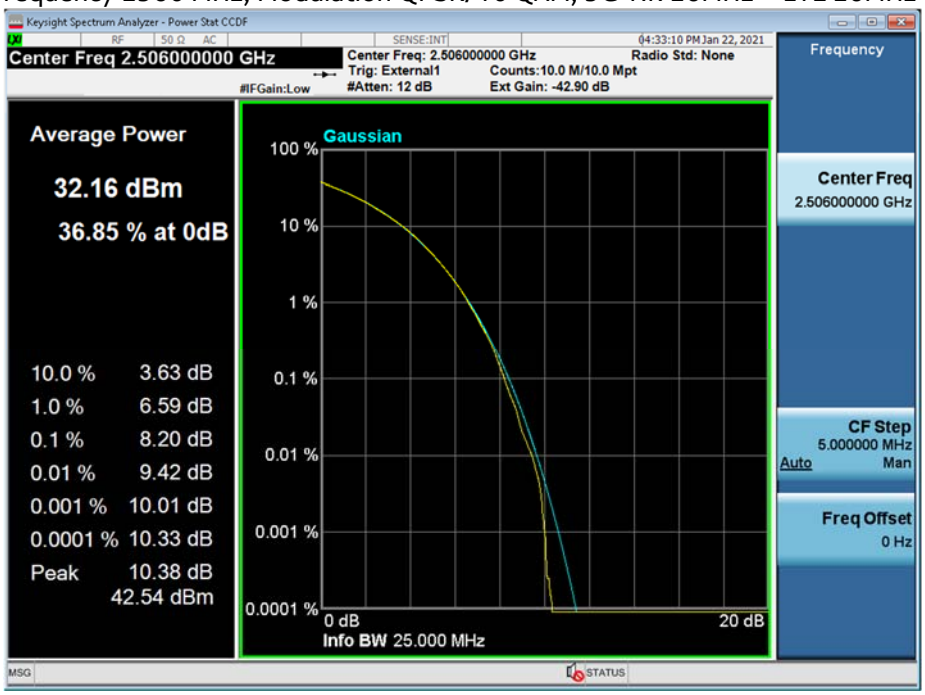


Channel Frequency 2644.98 MHz, Modulation 256 QAM, 5G-NR 90MHz BW, TX57

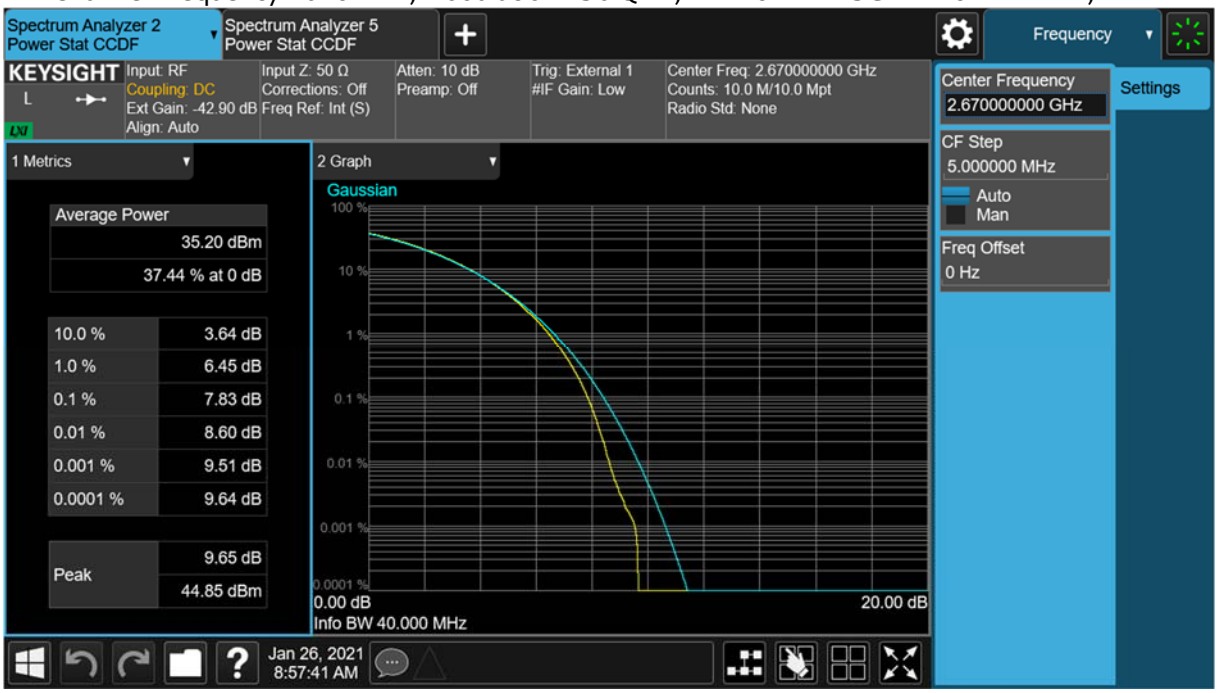


2C Data

Channel Frequency 2506 MHz, Modulation QPSK/16 QAM, 5G-NR 20MHz + LTE 20MHz BW, TX41

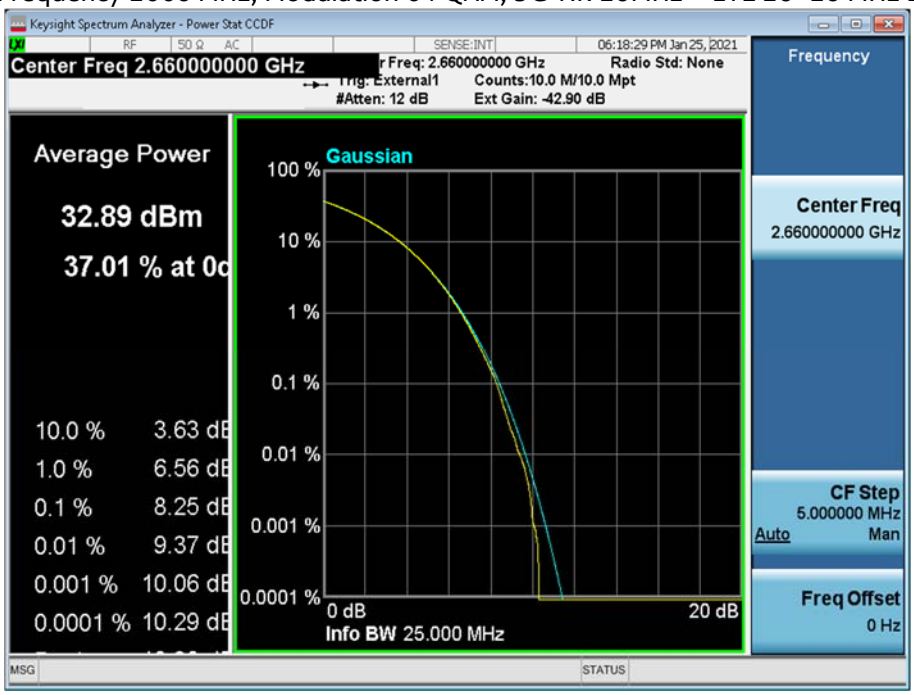


Channel Frequency 2670 MHz, Modulation 256 QAM, LTE 20MHz + 5G-NR 40MHz + BW, TX17

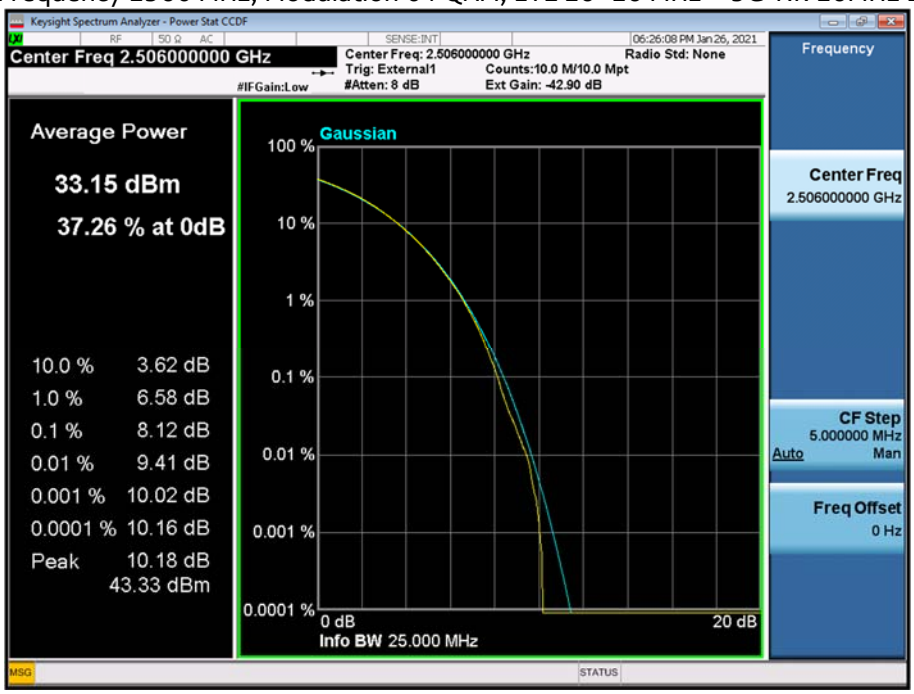


3C Data

Channel Frequency 2660 MHz, Modulation 64 QAM, 5G-NR 20MHz + LTE 20+20 MHz BW, TX17

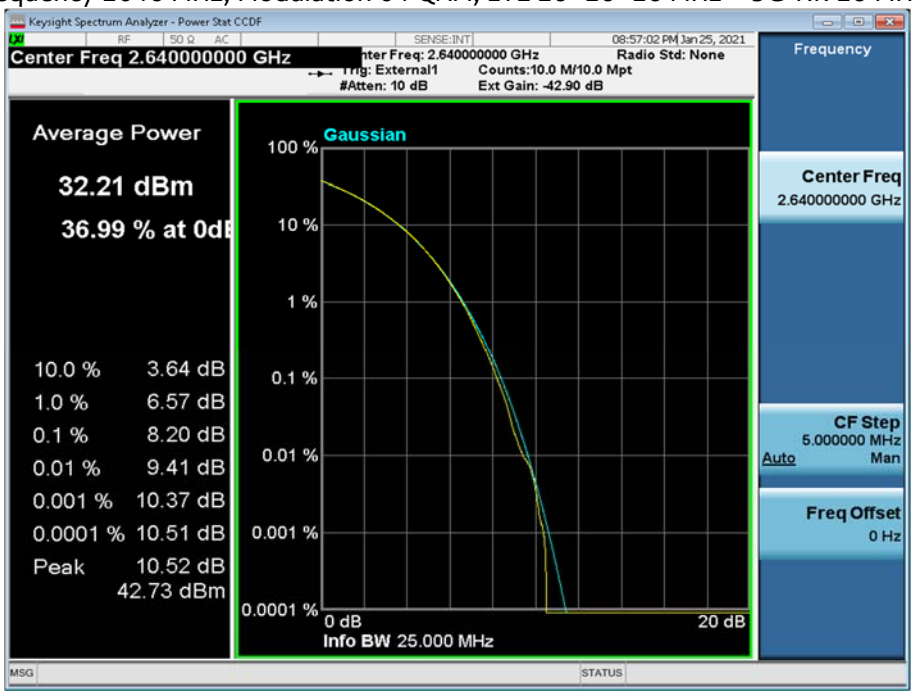
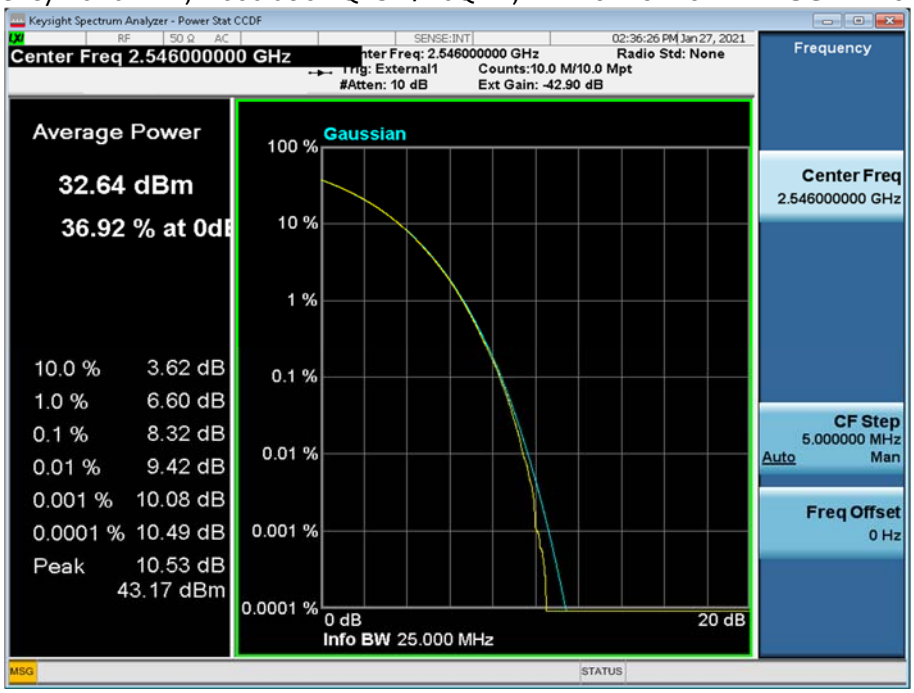


Channel Frequency 2506 MHz, Modulation 64 QAM, LTE 20+20 MHz + 5G-NR 20MHz BW, TX57



4C Data

Channel Frequency 2640 MHz, Modulation 64 QAM, LTE 20+20+20 MHz + 5G-NR 20 MHz BW, TX33



Channel Frequency 2646 MHz, Modulation QPSK /16QAM, LTE 20+20+20 MHz + 5G-NR 40 MHz BW, TX49