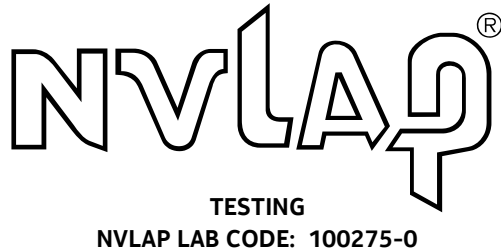


Global Product Compliance Laboratory
600-700 Mountain Avenue
Room 5B-108
Murray Hill, New Jersey 07974-0636 USA



Title 47 Code of Federal Regulations Test Report

Regulation:
FCC Part 2 and 27

Client:
NOKIA SOLUTIONS AND NETWORKS, OY

Product Evaluated:
AWHHF Airscale Micro RRH 4T4R 5G n41 4x20W

Report Number:
TR-2023-0073-FCC2-27

Date Issued:
June 20, 2023

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Revisions

Date	Revision	Section	Change
06/20/2023	0		Initial Release

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Prepared By:

Signed:

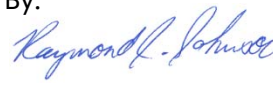


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1. System Information and Requirements

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):	AWHHF Airscale Micro RRH 4T4R 5G n41 4x20W
Serial Number:	Refer to Section 1.3.2
FCC ID:	2AD8UAWHHF01
Hardware Version:	Refer to Section 1.3.2
Software Version:	SBS23R3
Frequency Range:	2496-2690 MHz
GPCL Project Number:	2023-0073
Applicant:	NOKIA SOLUTIONS AND NETWORKS, OY Lee Klippenborg 2000 W. Lucent Lane, Naperville, Illinois 60563 United States
Test Requirement(s):	Title 47 CFR Parts 2 and 27
Test Standards:	See Section 1.5.1
Measurement Procedure(s):	See Section 1.5.2
Test Date(s):	4/27/2023 – 6/6/2023
Test Performed By:	Nokia Global Product Compliance Laboratory 600-700 Mountain Ave. P.O. Box 636 Murray Hill, NJ 07974-0636 Test Site Number: US5302
Product Engineer(s):	Ron Remy
Lead Engineer:	Nilesh Patel
Test Engineer (s):	Nilesh Patel
Test Results: The EUT, <i>as tested</i> 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 **AWHHF Airscale Micro RRH 4T4R 5G n41 4x20W**, 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.

This report covers the Class II Permissive change to add 10 MHz 5G-NR Emission Designator and 10 MHz multi carrier modes of operation to the existing Grant. The AWHHF product is certified under FCC ID: 2AD8UAWHHF01.

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	5G-NR & LTE
Duplex Mode	Time Division Duplex (TDD)
Modulation Type(s)	QPSK, 16QAM, 64QAM, 256QAM
Operation Frequency Range	2496-2690 MHz
Channel Bandwidth	Single Carrier – 10 MHz (5G-NR) Multicarrier – 10 + 10 MHz (5G-NR)
Number of Tx Ports per Unit	4
MIMO	Yes
Deployment Environment	Outdoor
Supply Voltage	-48.0 VDC

1.3.2 Photographs

Front View



Rear View



Left View



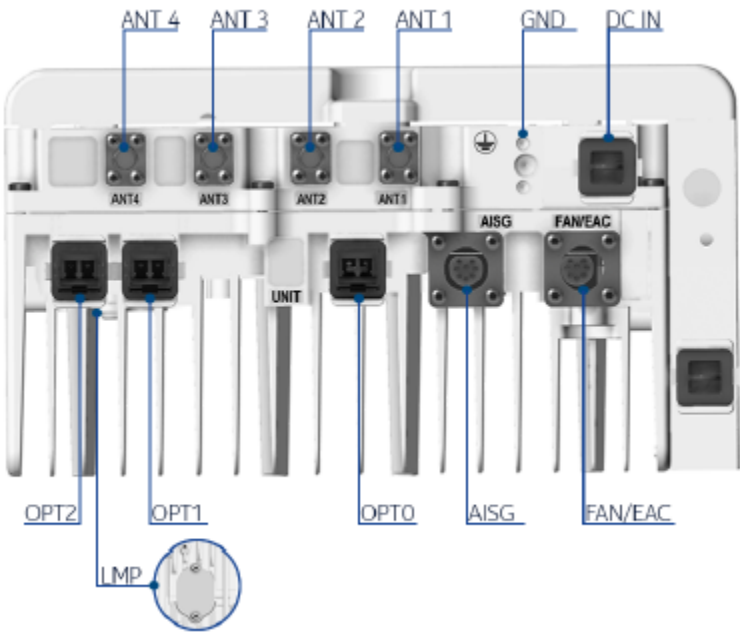
Right View




Top View



Bottom View



Interface	Label on the HW	Number of interfaces	Connector type	Additional info
Power Connector	DC IN	1	DC OCTIS Plug Kit	Hot insert not supported
Antenna connector	ANT	4	NEX 10	-
External Alarm Connection/Fan	EAC/FAN	1	CIRC 8F IP67 Flange	Two external alarms supported
Optical interface	OPT	3	OCTIS Plug Kit SFP/SFP+	9.8 Gbps, CPRI
Ethernet	RJ	1	RJ45	-
Grounding		1	M8 or dual M5 screws	-
AISG connector	AISG	1	8-pin circular	-
Local Management Port (LMP)	-	1	2x20-pin female header	-

Serial Number



Power Information



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

¹ 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).

1.5 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 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.

1.5.2 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.

1.5.3 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, (<i>e.g.</i> , ANSI C63.4, CISPR 11, 14, 22, <i>etc.</i> , 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

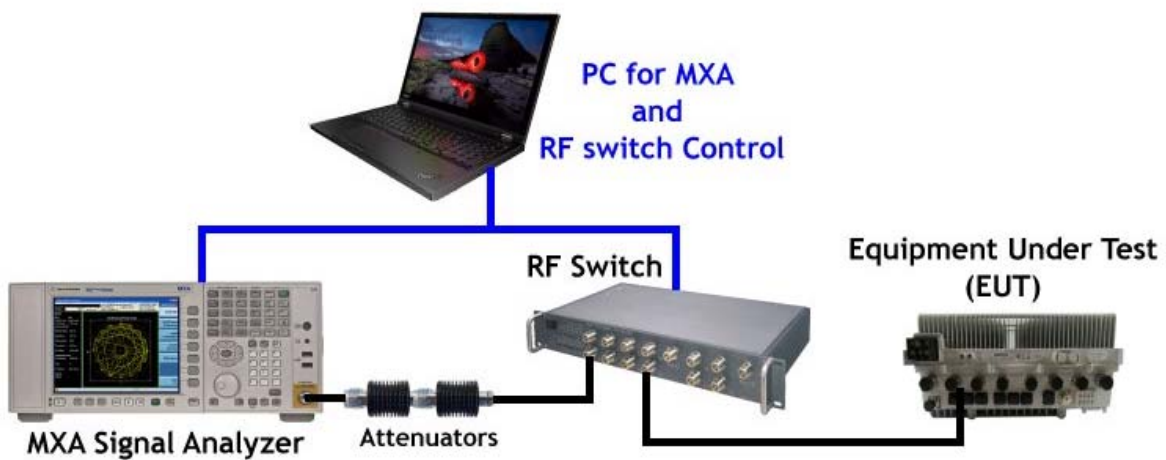
1.6 Executive Summary

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

1.8 Test Setup for all Measurement at Antenna Ports



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 the 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.

Tabular Data – Channel RF Power (5G-NR)

Channel Frequency MHz	Signal BW MHz	Modulation	TX Port	Channel Power dBm
2501	10	64QAM	8	40.99
			9	41.05
			10	40.88
			11	40.89
2592	10	QPSK/16QAM	8	41.28
			9	41.49
			10	41.22
			11	41.37
2685	10	256QAM	8	41.57
			9	41.53
			10	41.31
			11	41.59

Tabular Data – Channel RF Power 2-Carrier (5G-NR)

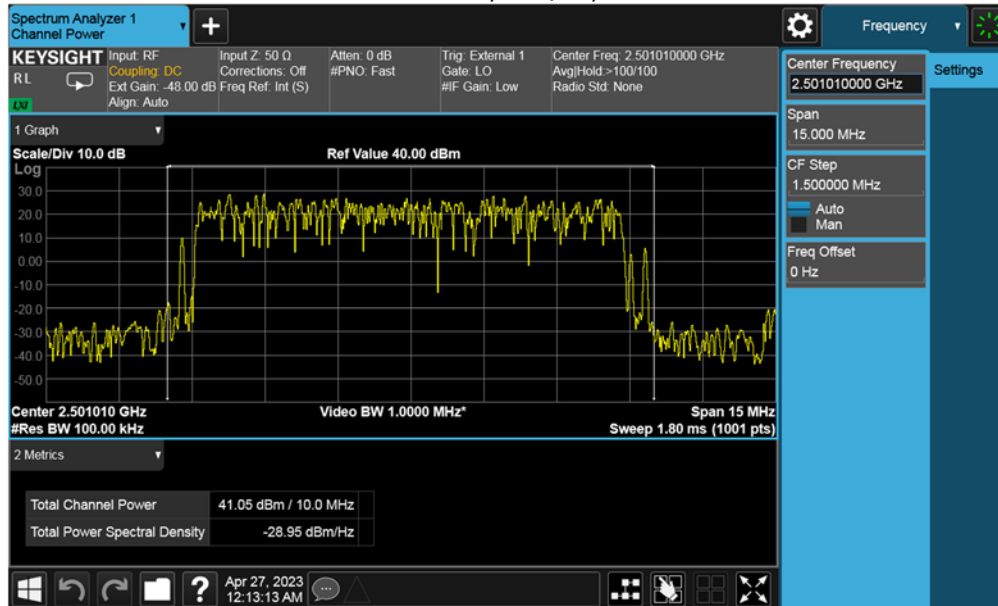
Channel Frequency MHz	Signal BW MHz	Modulation	TX Port	Channel Power dBm
2501 + 2510	10 + 10	QPSK/16QAM	8	41.15
			9	41.70
			10	41.20
			11	41.01
2535 + 2685	10 + 10	256QAM	8	41.38
			9	41.11
			10	41.02
			11	41.32
2588 + 2597	10 + 10	QPSK/16QAM	8	41.14
			9	41.70
			10	41.00
			11	41.14
2675 + 2684	10 + 10	256QAM	8	41.26
			9	40.99
			10	41.00
			11	41.15

2.2 Channel RF Power – Plots

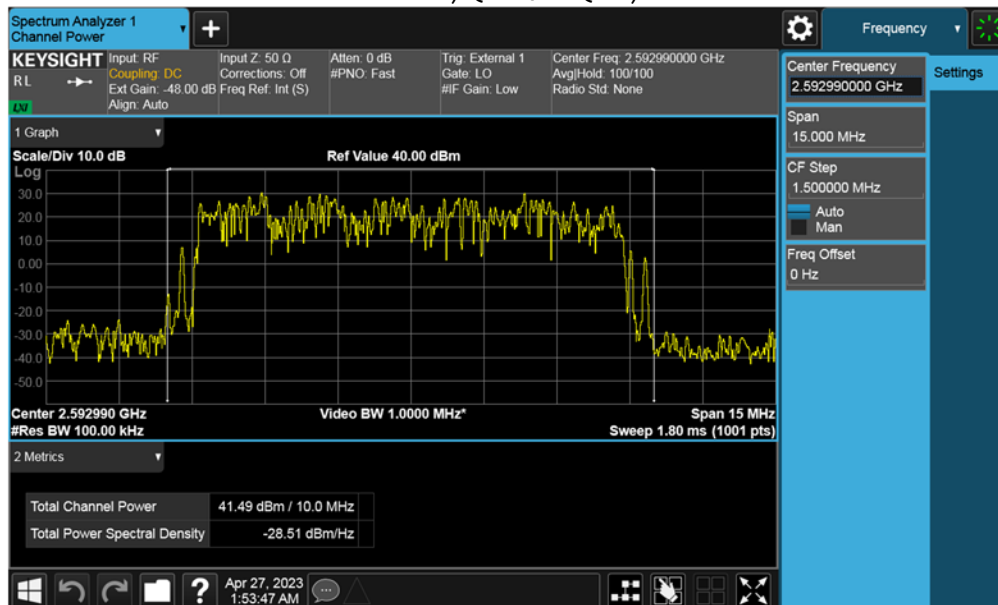
NOTE: Only a sample of the plots are used in this report. The full suite of raw data resides at the MH, New Jersey location.

2.2.1 1-Carrier, 10MHz BW

2501 MHz, 64QAM, TX9



2592 MHz, QPSK/16QAM, TX9

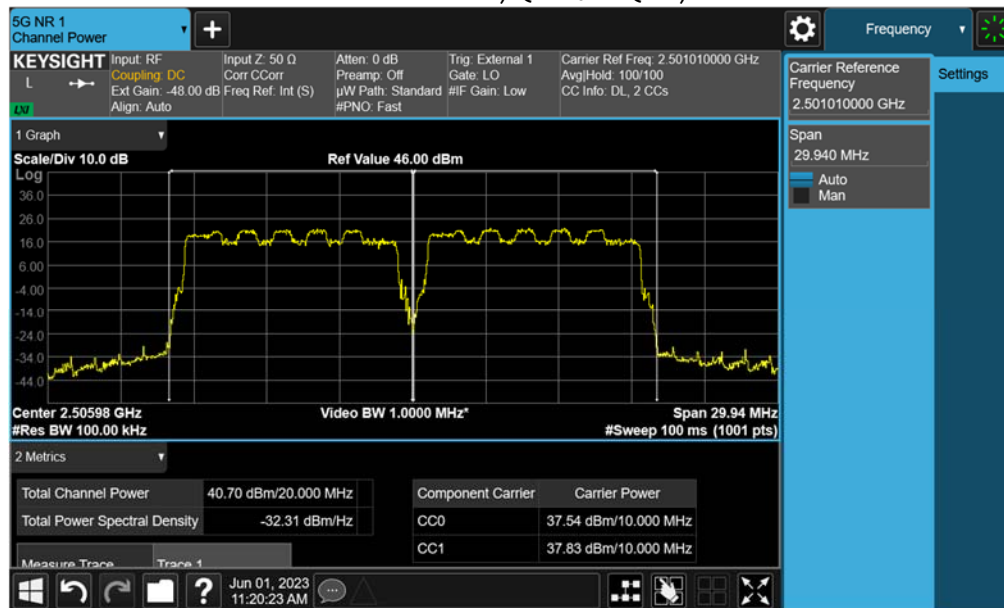


2685 MHz, 256QAM, TX11

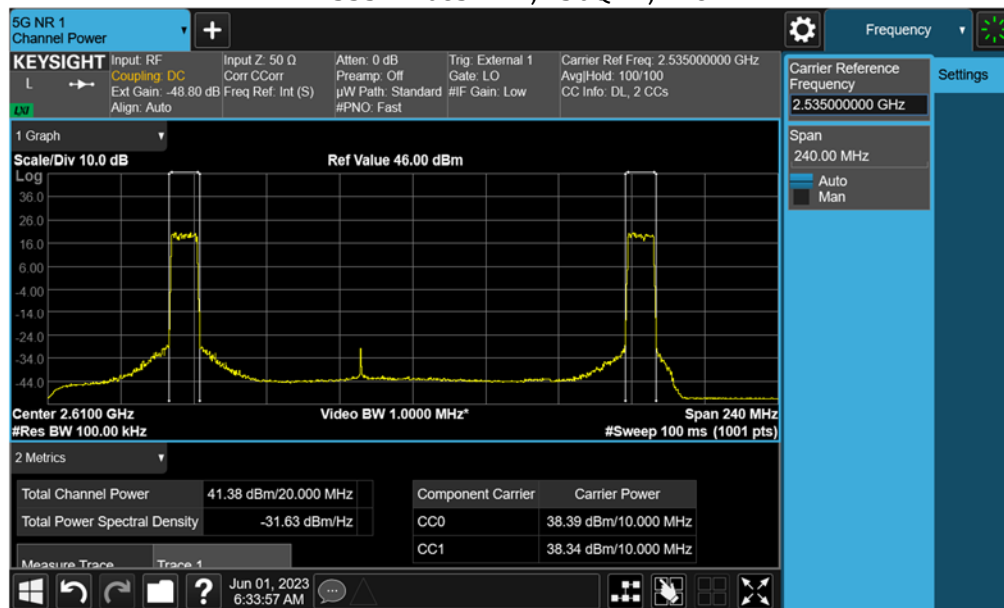


2.2.2 2-Carrier, 10 + 10MHz BW

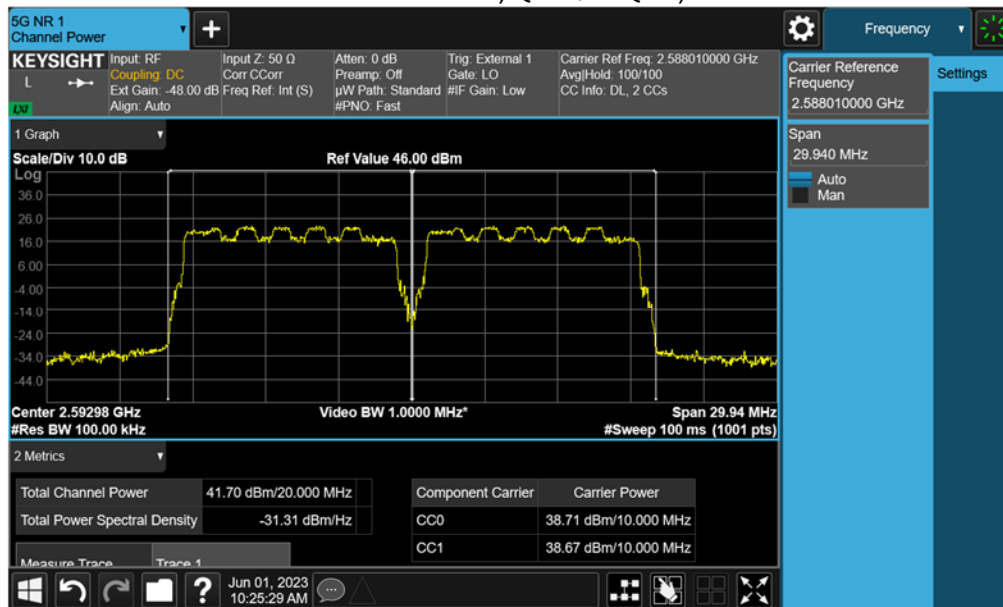
2501 + 2510 MHz, QPSK/16QAM, TX9



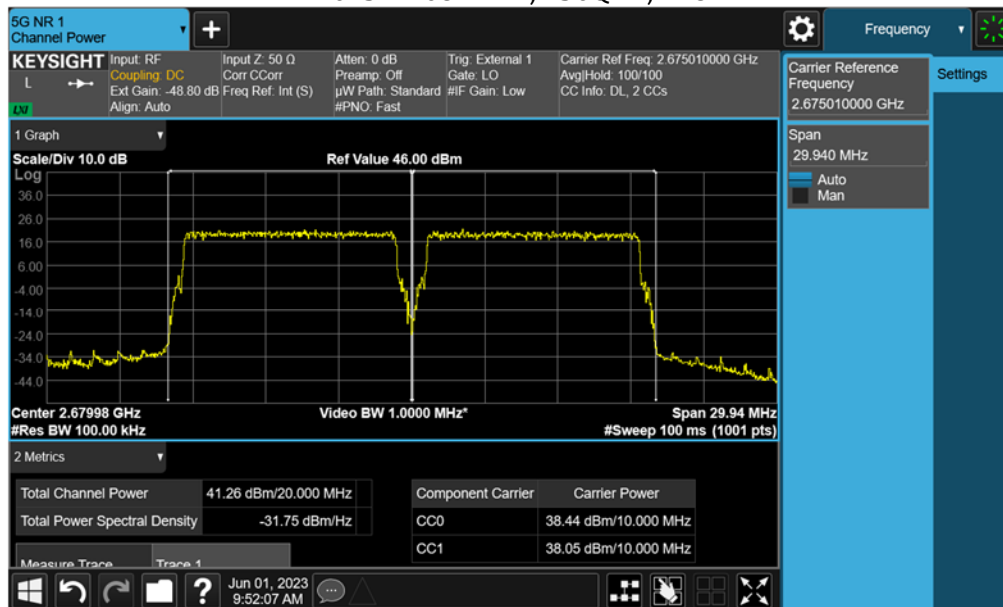
2535 + 2685 MHz, 256QAM, TX8



2588 + 2597 MHz, QPSK/16QAM, TX9



2675 + 2684 MHz, 256QAM, TX8



2.3 Peak-to-Average Power Ratio (PAPR)

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

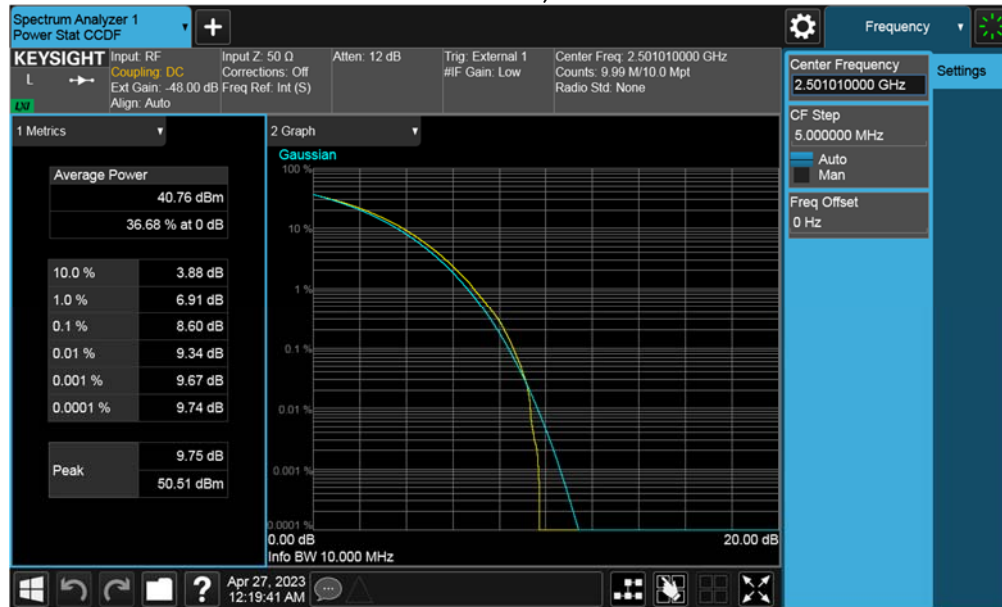
Tabular Data – PAPR (5G-NR)

# of Carrier	Signal BW MHz	Modulation	TX Port	Channel Frequency MHz	PAR at 0.1% Limit - 13 dB
1	10	64QAM	9	2501	8.60
1	10	QPSK/16QAM	9	2592	8.58
1	10	256QAM	11	2685	8.68
2	10 + 10	QPSK/16QAM	10	2501 + 2510	8.80
2	10 + 10	256QAM	8	2535 + 2685	8.54 + 8.56
2	10 + 10	QPSK/16QAM	9	2588 + 2597	8.75
2	10 + 10	256QAM	8	2675 + 2684	8.73

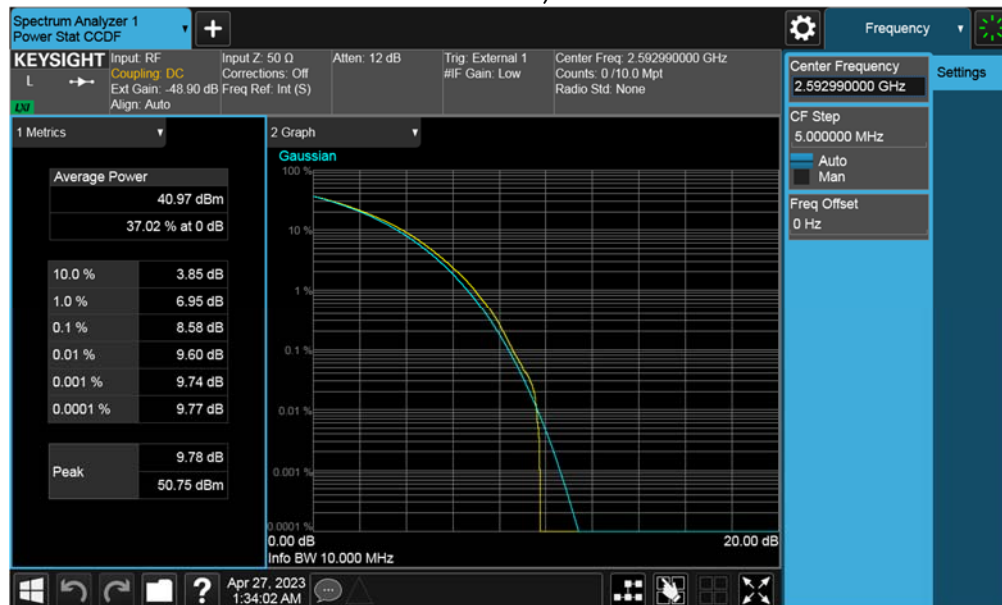
2.3.1 Peak-to-Average Power Ratio Plots

2.3.1.1 1 Carrier, 10 MHz BW

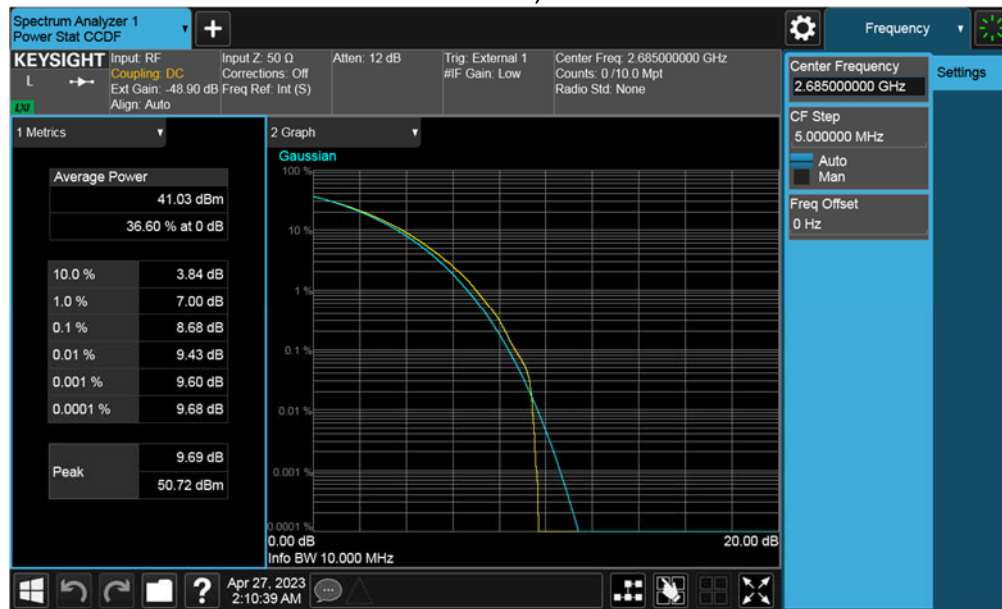
2501 MHz, TX9



2592 MHz, TX9

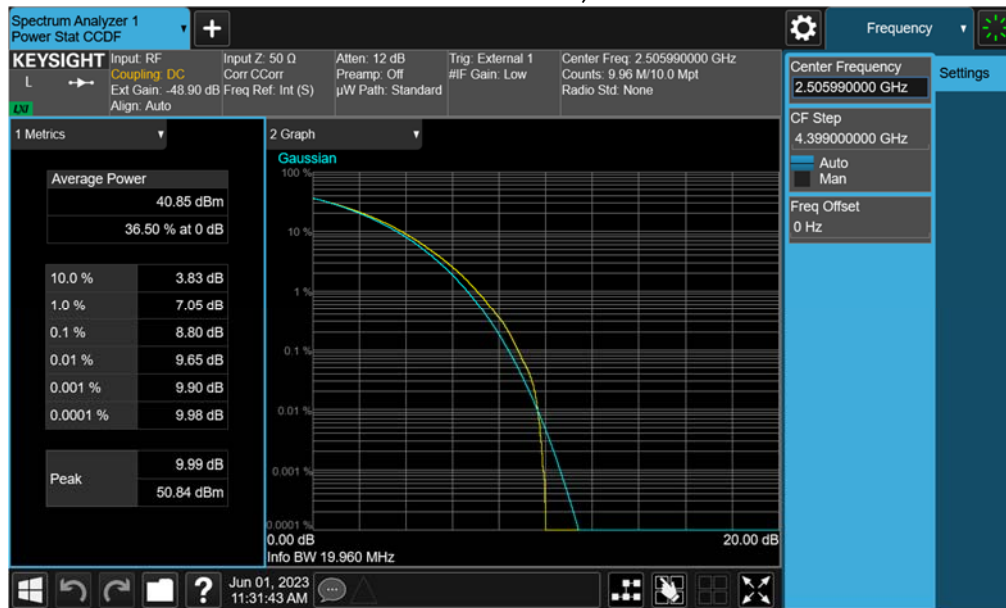


2685 MHz, TX11

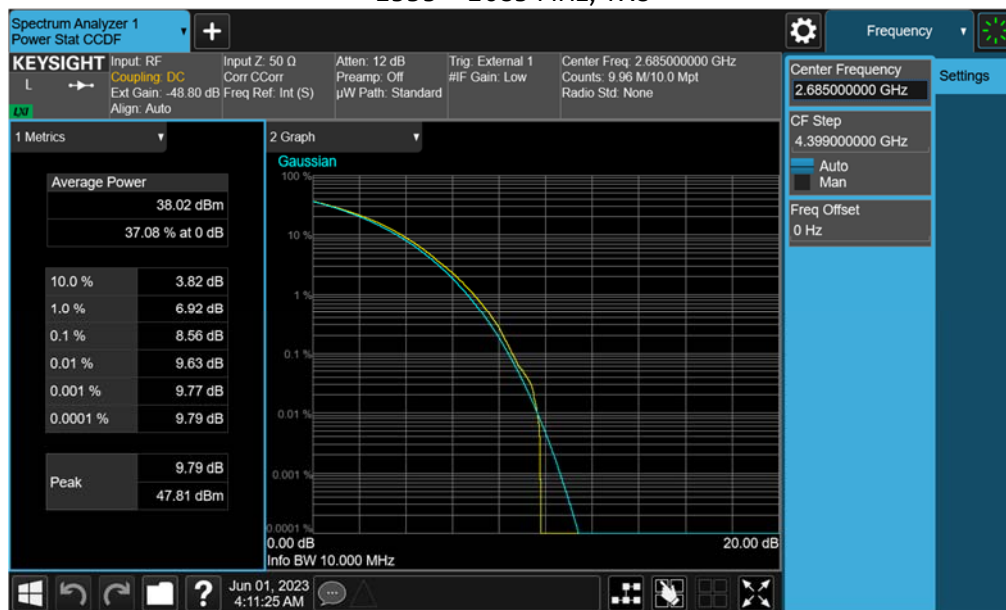


2.3.1.2 2 Carrier, 10 + 10 MHz

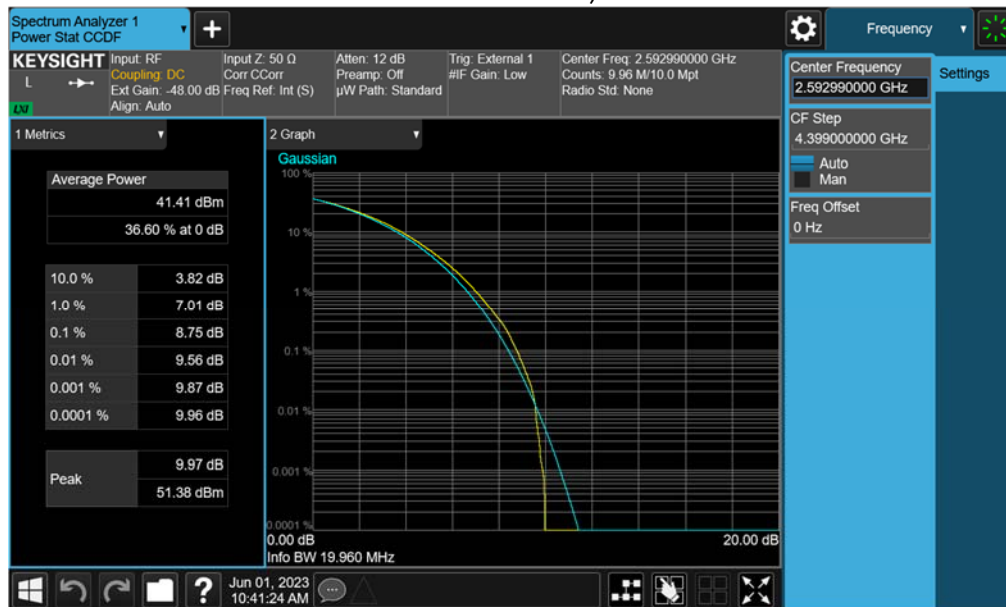
2501 + 2510 MHz, TX10



2535 + 2685 MHz, TX8



2588 + 2597 MHz, TX9



2675 + 2684 MHz, TX8

