

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 US LLC

Product Evaluated:

AirScale MAA 64T64R 192AE B41 320W AEHC
Issue 2.0

Report Number:

TR-2020-0060-FCC2-27

Date Issued:

June 8, 2020

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 endorsement by NVLAP or any other 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.....	5
1.4 TEST REQUIREMENTS	7
1.5 STANDARDS & PROCEDURES	7
1.6 EXECUTIVE SUMMARY	9
1.7 TEST CONFIGURATION FOR ALL ANTENNA PORT MEASUREMENTS.	9
2. FCC SECTION 2.1046 - RF POWER OUTPUT	10
2.1 RF POWER OUTPUT	10
3. FCC SECTION 2.1047 - MODULATION CHARACTERISTICS	30
3.1 MODULATION CHARACTERISTICS	30
4. FCC SECTION 2.1049 - OCCUPIED BANDWIDTH/EDGE OF BAND EMISSIONS.....	37
4.1 OCCUPIED BANDWIDTH	37
4.2 EDGE OF BAND EMISSIONS	48
5. FCC SECTION 2.1051 - SPURIOUS EMISSIONS AT TRANSMIT ANTENNA PORT.....	57
5.1 MEASUREMENT OF SPURIOUS EMISSIONS AT TRANSMIT ANTENNA PORT.....	57
6. FCC SECTION 2.1053 - FIELD STRENGTH OF SPURIOUS RADIATION	78
6.1 SECTION 2.1053 FIELD STRENGTH OF SPURIOUS EMISSIONS	78
6.2 FIELD STRENGTH OF SPURIOUS EMISSIONS - LIMITS.....	78
7. FCC SECTION 2.1055 - MEASUREMENT OF FREQUENCY STABILITY	79
8. NVLAP CERTIFICATE OF ACCREDITATION	89

Revisions

Date	Revision	Section	Change
6/3/20	0		Initial Release
6/4/20	1		Page 4: FCC ID Update
6/8/20	2		Section 1.3.2: Remove Incorrect EUT Photos

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 federal government.

Prepared By:

Signed:



6/8/2020

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

Approved By:

Signed:



6/8/2020

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

Reviewed By:

Signed:



6/8/2020

Steve Gordon
EMC Engineer
NVLAP Signatory
steve.gordon@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 192AE B41 320W AEHC
Serial Number:	L1201606511
FCC ID:	VBNAEHC-01
Hardware Version:	475124B.X32
Software Version:	LTE: SBTS20A 5G: 5G19B
Frequency Range:	2496-2690 MHz
GPCL Project Number:	2020-0060
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):	5/14/2020 – 5/28/2020
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, <i>as tested</i> 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 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.

This report covers the following configurations for AEHC FCC Filing:

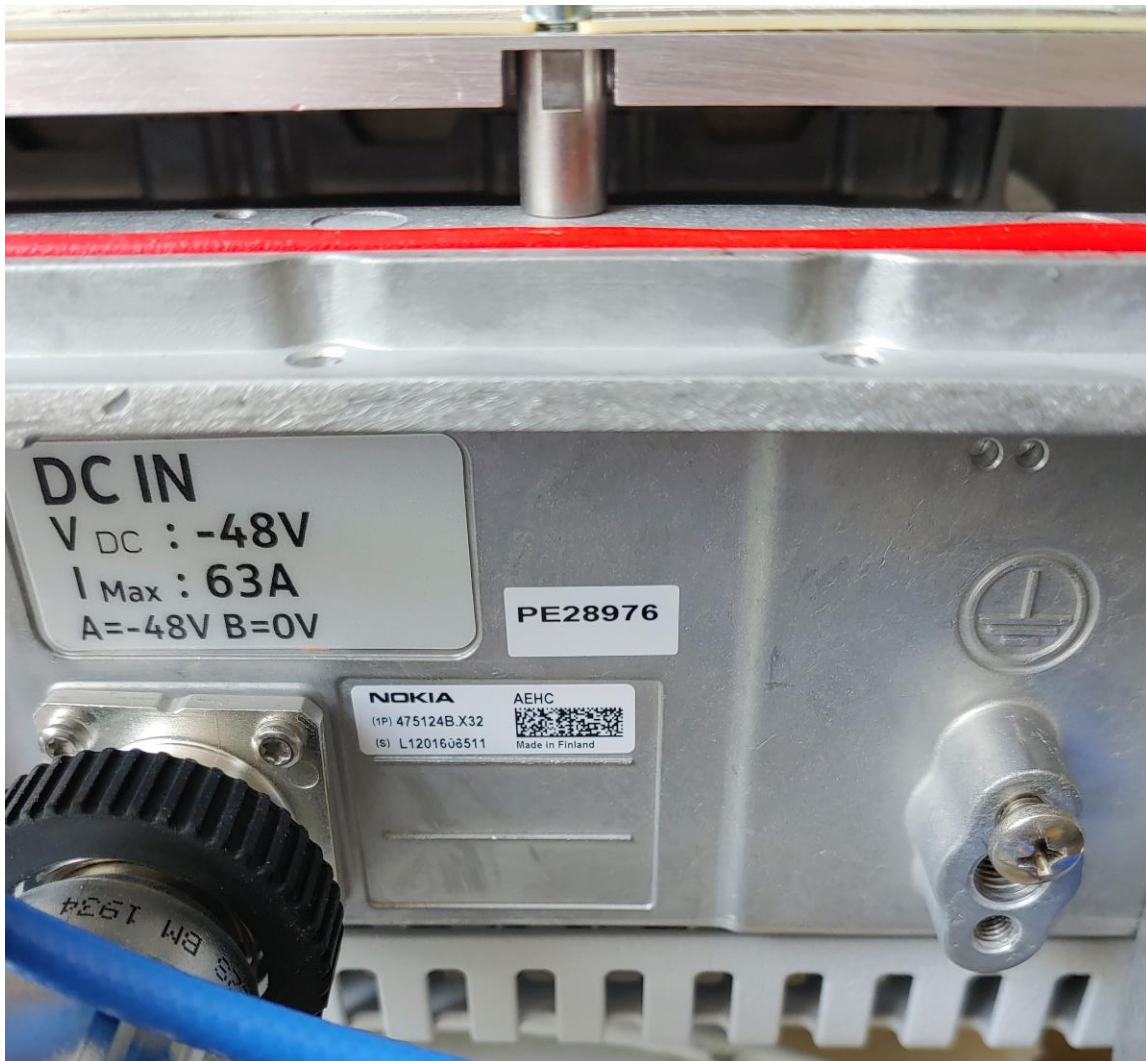
Radio Access Technology	BW (MHz)	Power W/MHz	Total TRX Output power/Port (dBm)	Total TRX Output power/Port (Watts)	Total (64 ports) power (W)
5G-NR	100	3.2	37.0	5.0	320
5G-NR	60	4	35.7	3.8	243.2
5G-NR	40	4	34.0	2.5	160
LTE	20	5	31.9	1.6	102.4

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	LTE 20MHz / 5G NR 40, 60, 100 MHz
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



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	Yes

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-OB 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, (<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

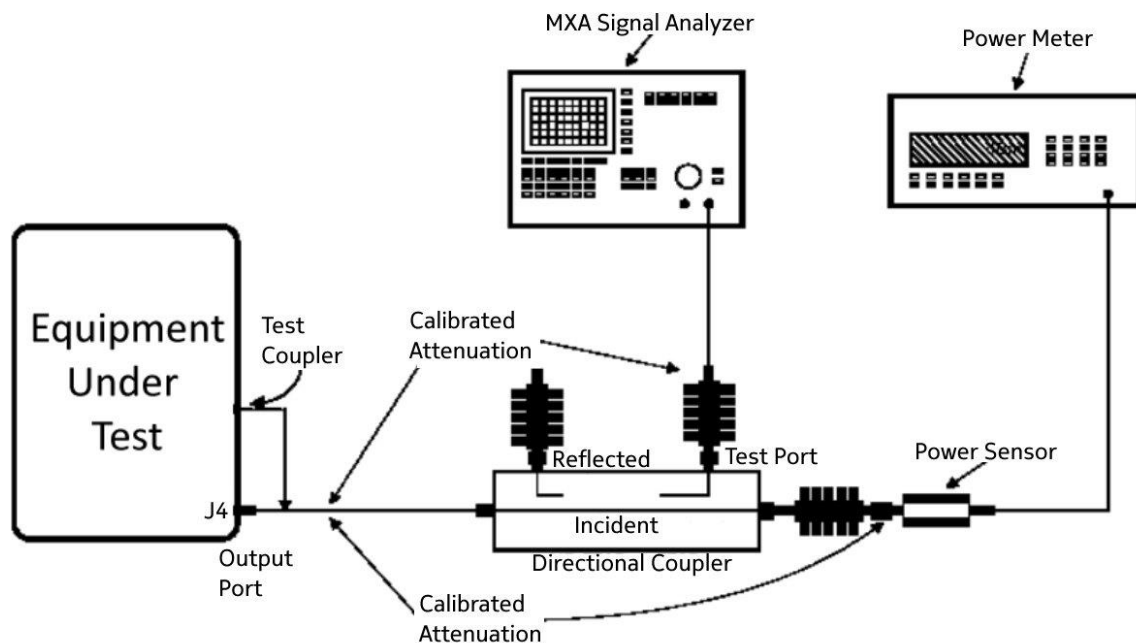
Antenna Port Test	Signal Bandwidth	Frequency Range	Expanded Uncertainty (k=2), Amplitude
Occupied Bandwidth, Edge of Band, Conducted Spurious Emissions	10 Hz 100 Hz 10 kHz to 1 MHz 1MHz	9 kHz to 20 MHz 20 MHz to 1 GHz 1 GHz to 10 GHz 10 GHz to 40 GHz:	1.78 dB
RF Power	10 Hz to 20 MHz	50 MHz to 18 GHz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

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. TX Port 6 was the port with the highest power output.

Tabular Data – LTE Channel RF Power

Carrier	TM	TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
1	3.1a	6	2506	20	256 QAM	32.01
1	1.1	6	2593	20	QPSK	32.20
1	3.1	6	2680	20	64 QAM	31.57
2	3.1	6	2506+2526	20	64 QAM	34.760
2	1.1	6	2506+2680	20	QPSK	34.565
2	3.1a	6	2660+2680	20	256 QAM	34.852
3	3.1a	6	2506+2526+2546	20	256 QAM	36.545
3	3.1	6	2506+2593+2680	20	64 QAM	36.379
3	1.1	6	2640+2660+2680	20	QPSK	36.659

Tabular Data – 5G 40MHz Signal BW RF Power

TM	TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
3.1a	6	2516	40	256 QAM	34.307
3.1	6	2593	40	64 QAM	34.303
3.2	6	2670	40	QPSK/16QAM	34.408

Tabular Data – 5G 60MHz Signal BW RF Power

TM	TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
3.1	6	2526	60	64 QAM	35.905
3.2	6	2593	60	QPSK/16QAM	35.968
3.1a	6	2660	60	256 QAM	36.078

Tabular Data – 5G 100MHz Signal BW RF Power

TX Port	Channel Power dBm		
	TM 3.1 64QAM Modulation 2546 MHz Channel Frequency 100 MHz Signal BW	TM 3.2 QPSK/16QAM Modulation 2593 MHz Channel Frequency 100 MHz Signal BW	TM 3.1a 256QAM Modulation 2640 MHz Channel Frequency 100 MHz Signal BW
1	37.107	36.906	36.910
2	36.982	36.821	36.848
3	36.975	36.786	36.838
4	36.928	36.738	36.733
5	36.903	36.739	36.745
6	36.974	36.951	36.929
7	36.864	36.749	36.756
8	36.846	36.632	36.681
9	36.837	36.654	36.730
10	37.036	36.941	36.940
11	36.848	36.527	36.611
12	38.068	37.903	37.941
13	36.928	36.758	36.829
14	37.021	36.849	36.853
15	36.842	36.620	36.702
16	37.025	36.818	36.896
17	36.914	36.673	36.815
18	36.820	36.532	36.707
19	36.857	36.553	36.761
20	36.726	36.454	36.694
21	36.772	36.501	36.724
22	37.038	36.772	36.901
23	36.926	36.724	36.856
24	36.669	36.360	36.526
25	36.905	36.661	36.841
26	36.725	36.442	36.717
27	36.610	36.370	36.600
28	37.919	37.661	37.898
29	36.850	36.546	36.716
30	36.871	36.636	36.823
31	36.896	36.611	36.734
32	36.828	36.568	36.711
33	37.454	37.349	37.367
34	36.965	36.764	36.773
35	37.113	36.995	36.982
36	36.666	36.552	36.579
37	37.055	36.891	36.970
38	36.785	36.587	36.679
39	37.199	37.070	37.082

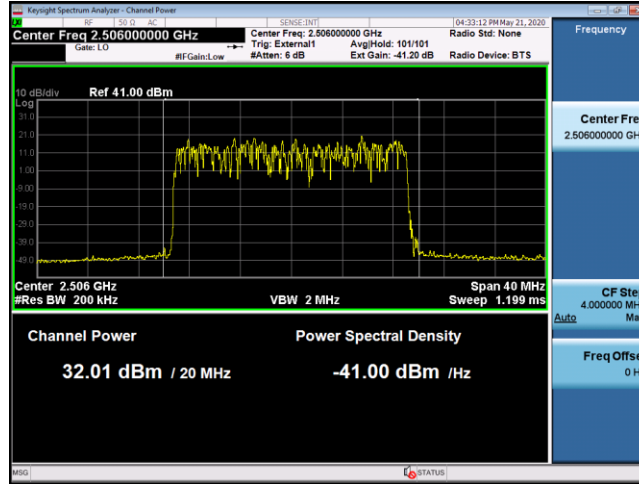
40	36.931	36.821	36.900
41	37.465	37.388	37.434
42	37.250	37.162	37.229
43	37.004	36.932	36.946
44	38.131	38.071	38.107
45	37.136	36.950	36.986
46	37.014	36.818	36.869
47	37.002	36.815	36.787
48	36.818	36.730	36.776
49	37.187	36.963	37.149
50	37.221	36.869	36.991
51	37.192	36.920	37.050
52	36.746	36.388	36.562
53	37.060	36.898	36.927
54	37.095	36.691	36.886
55	37.016	36.704	36.837
56	36.937	36.901	36.925
57	37.234	37.057	37.165
58	37.185	37.005	37.123
59	36.986	36.806	36.660
60	34.474	34.345	34.373
61	36.938	36.700	36.881
62	36.991	36.868	36.918
63	37.230	37.047	37.075
64	36.984	36.822	36.898

NOTE: For 100MHz, only the maximum TX44 plots are used in this report. The full suite of raw data resides at the MH, New Jersey location.

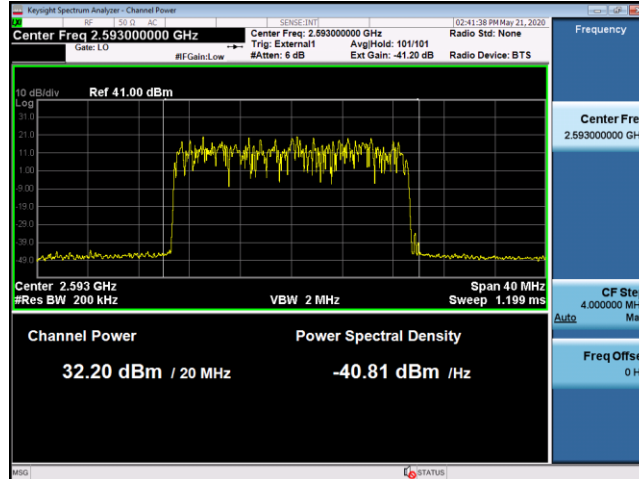
2.1.1 Channel RF Power - Plots

LTE 1C Data

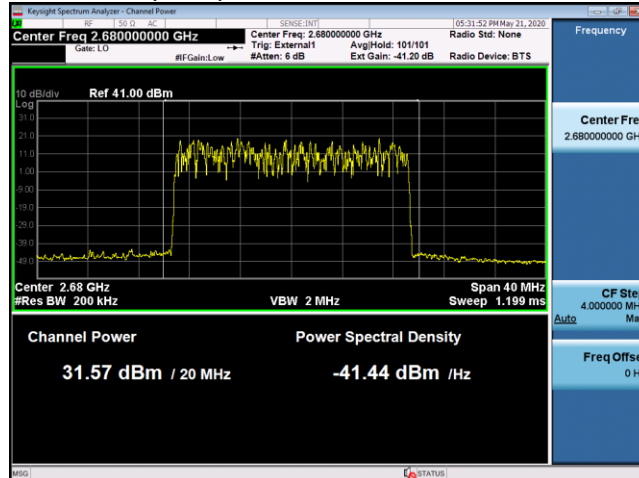
Channel Frequency 2506 MHz, Modulation 256QAM, TX6



Channel Frequency 2593 MHz, Modulation QPSK, TX6

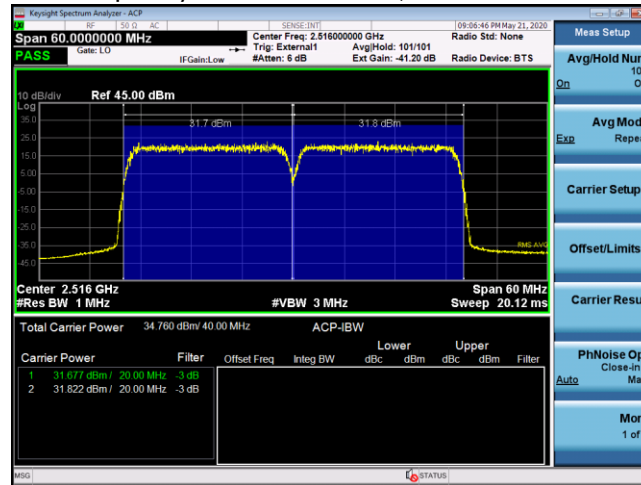


Channel Frequency 2680 MHz, Modulation 64QAM, TX6

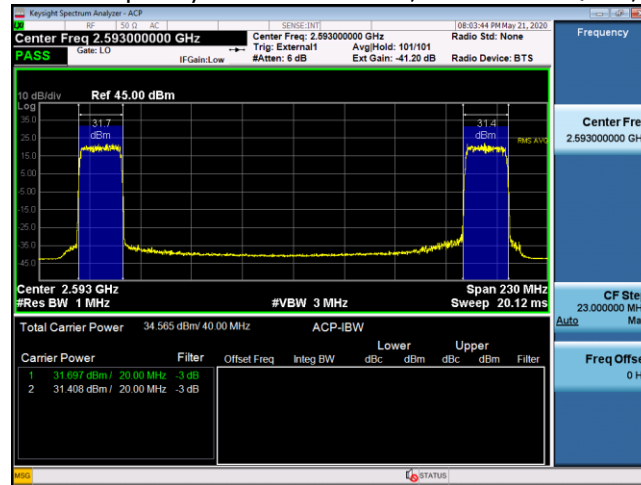


LTE 2C Data

Channel Frequency 2506+2526 MHz, Modulation 64QAM, TX6



Channel Frequency 2506+2680 MHz, Modulation QPSK, TX6

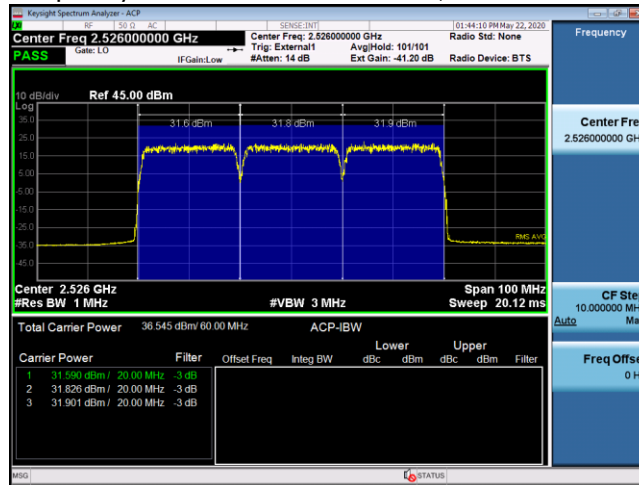


Channel Frequency 2660 + 2680 MHz, Modulation 256QAM, TX6

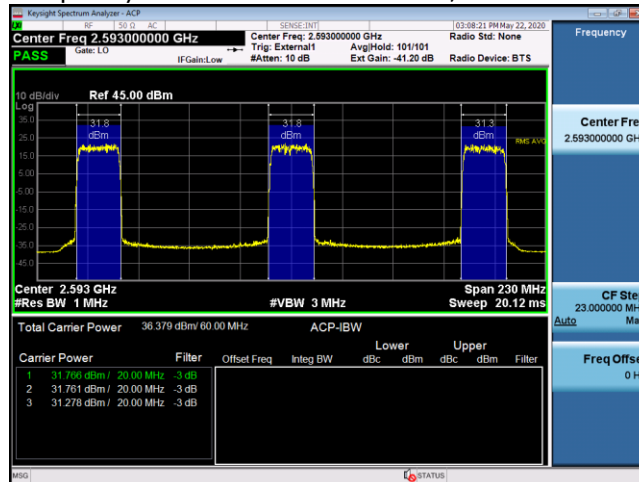


LTE 3C Data

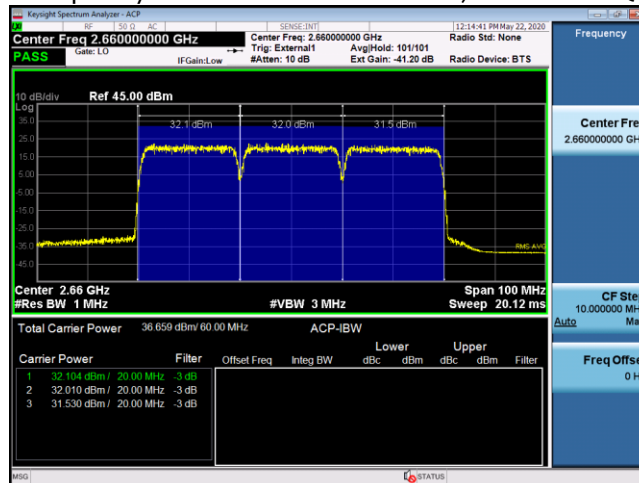
Channel Frequency 2506 + 2526 + 2546 MHz, Modulation 256QAM, TX6



Channel Frequency 2506 + 2593 + 2680 MHz, Modulation 64QAM, TX6

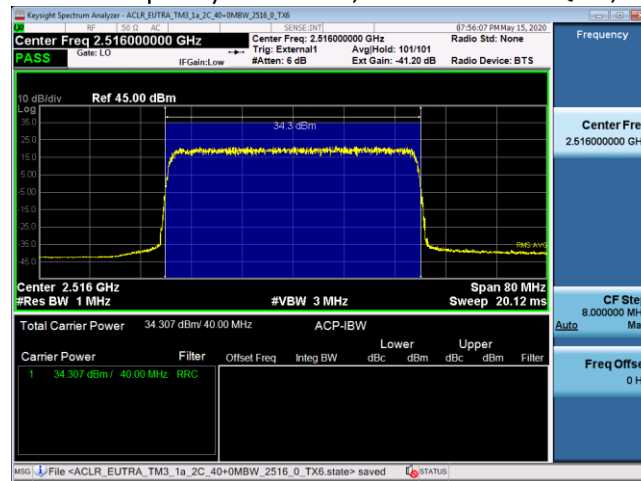


Channel Frequency 2640 + 2660 + 2680 MHz, Modulation QPSK, TX6

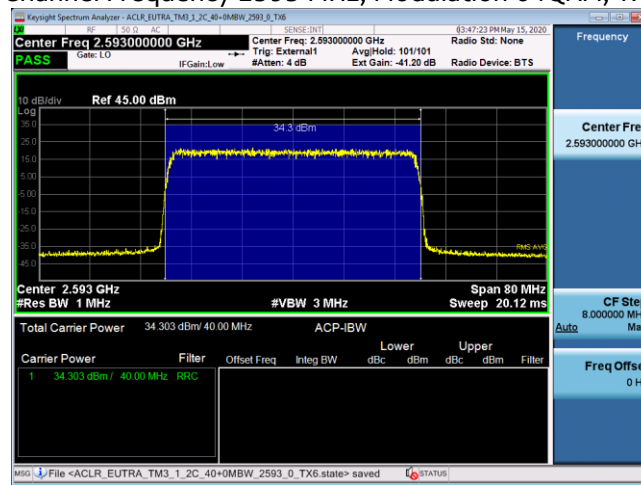


5G 40MHz

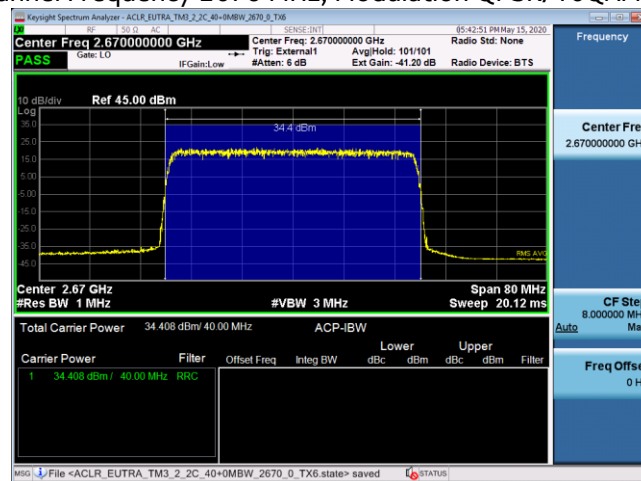
Channel Frequency 2516 MHz, Modulation 256QAM, TX6



Channel Frequency 2593 MHz, Modulation 64QAM, TX6

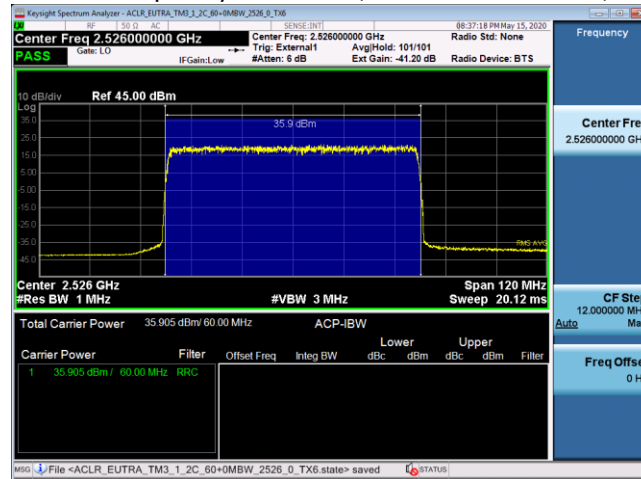


Channel Frequency 2670 MHz, Modulation QPSK/16QAM, TX6

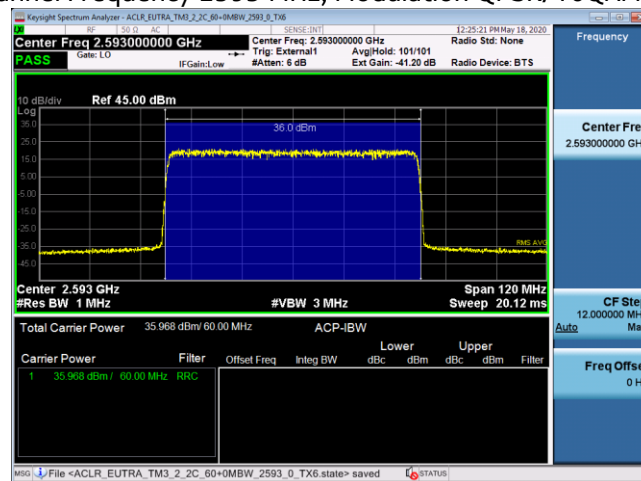


5G 60MHz

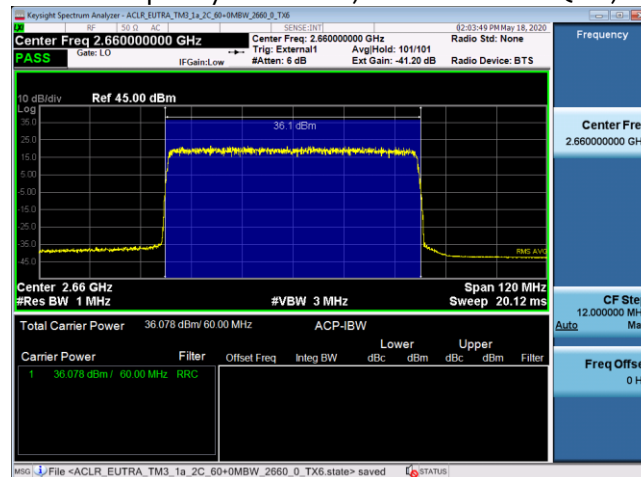
Channel Frequency 2526 MHz, Modulation 64QAM, TX6



Channel Frequency 2593 MHz, Modulation QPSK/16QAM, TX6

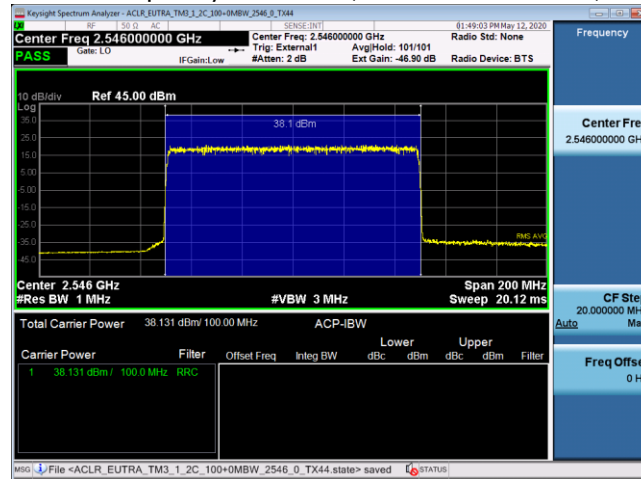


Channel Frequency 2660 MHz, Modulation 256QAM, TX6

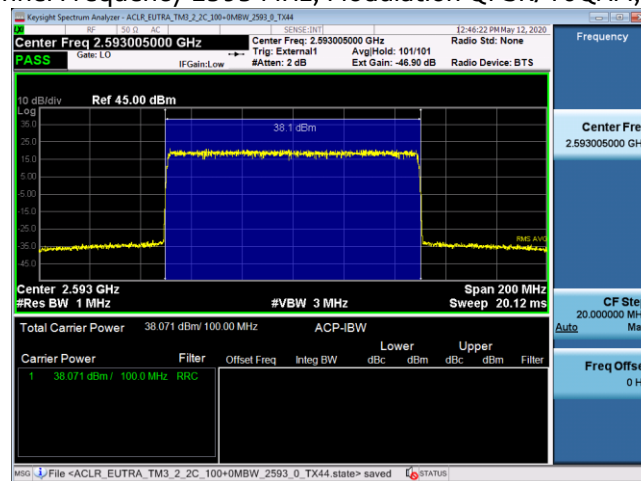


5G 100MHz

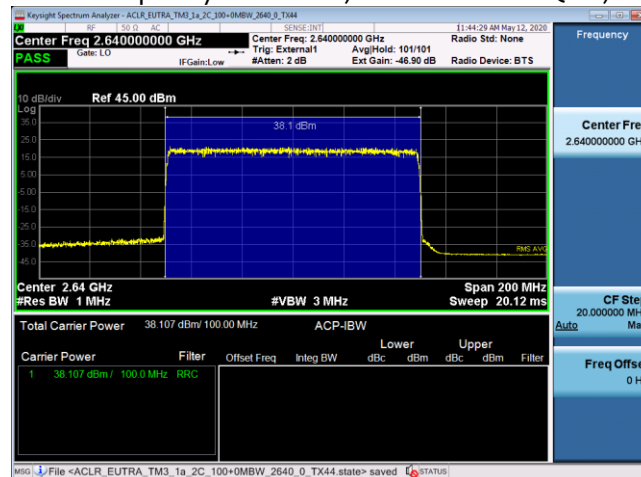
Channel Frequency 2546 MHz, Modulation 64QAM, TX44



Channel Frequency 2593 MHz, Modulation QPSK/16QAM, TX44



Channel Frequency 2640 MHz, Modulation 256QAM, TX44

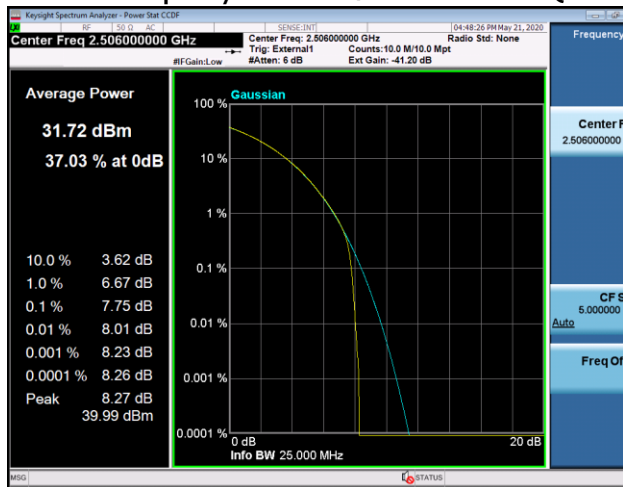


2.1.2 Peak-to-Average Power Ratio (PAPR) – Plots

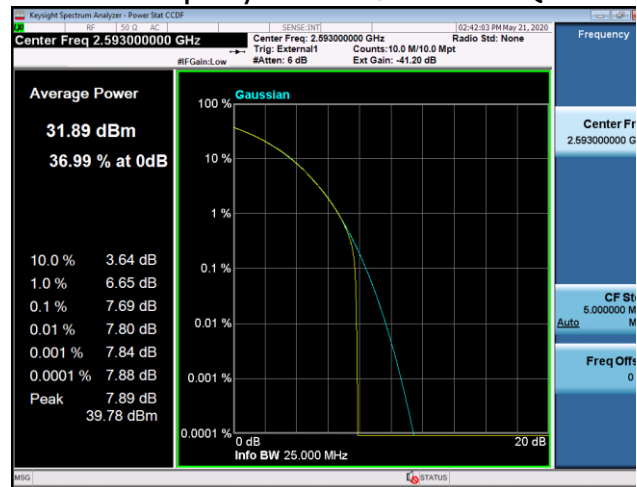
The Peak-to-Average Power Ratio (PAPR) was evaluated per KDB 971168 for 20MHz, 40MHz, 60 MHz and 100 MHz bandwidths. The PAPR values of all carriers measured are below 13dB.

LTE 1C Data

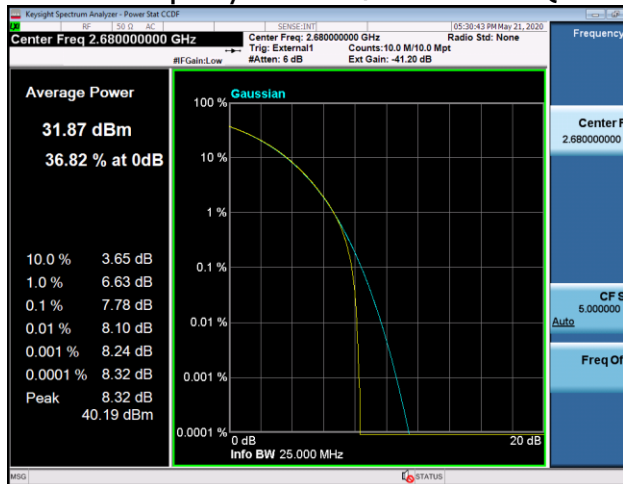
Channel Frequency 2506 MHz / Modulation 256QAM



Channel Frequency 2593 MHz / Modulation QPSK

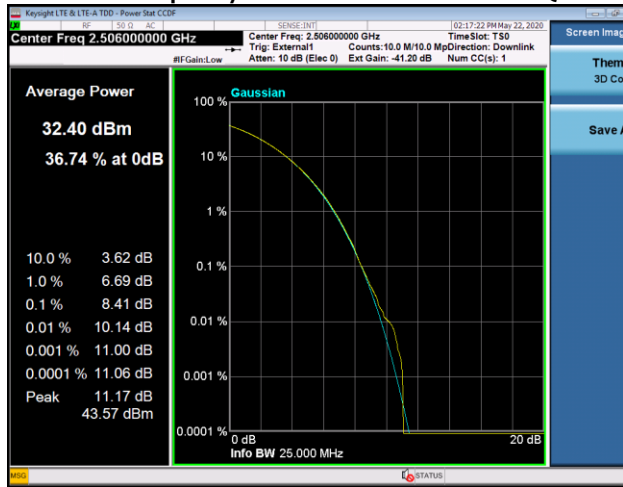


Channel Frequency 2680 MHz / Modulation 64QAM

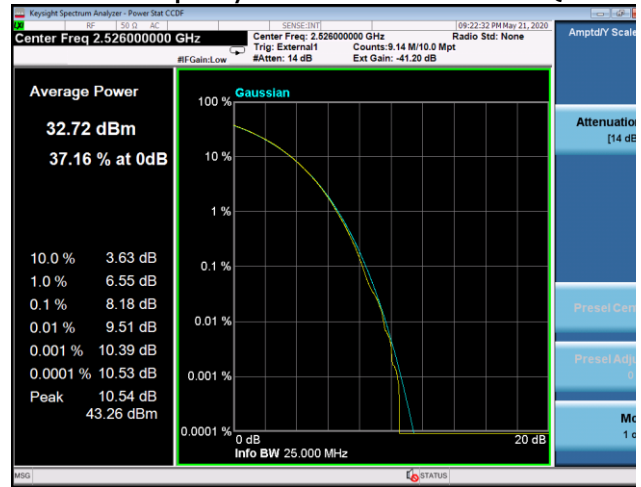


LTE 2C Data

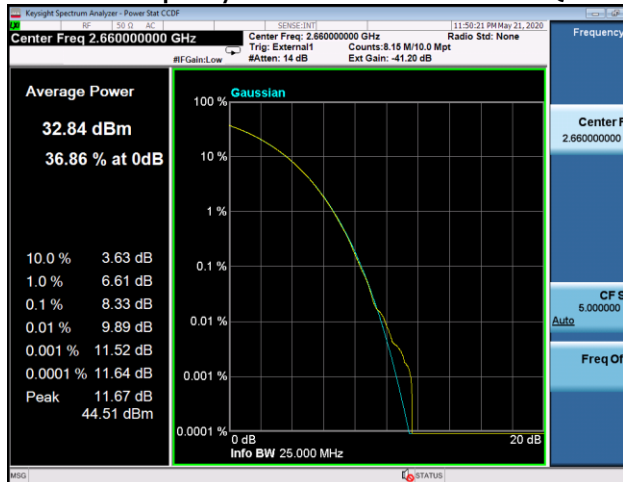
Channel Frequency 2506 MHz / Modulation 64QAM



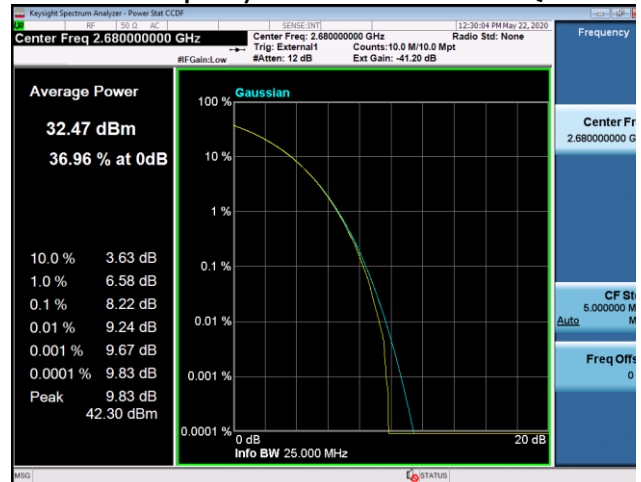
Channel Frequency 2526 MHz / Modulation 64QAM



Channel Frequency 2660 MHz / Modulation 256QAM

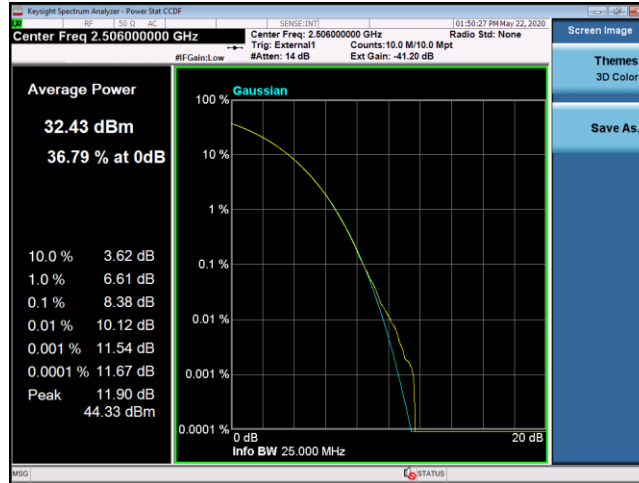


Channel Frequency 2680 MHz / Modulation QPSK

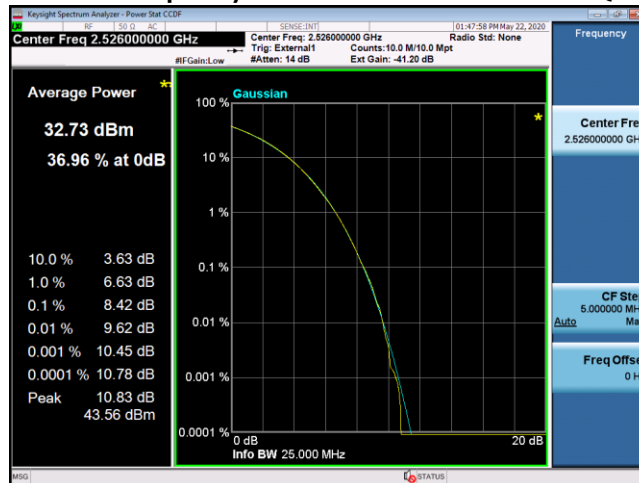


LTE 3C Data

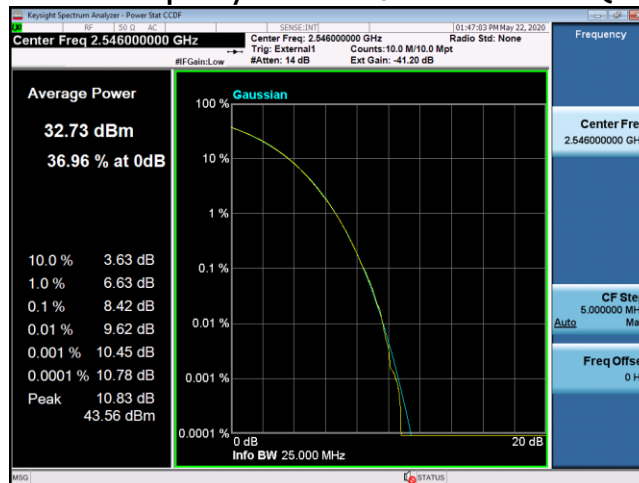
Channel Frequency 2506 MHz / Modulation 256QAM



Channel Frequency 2526 MHz / Modulation 256QAM

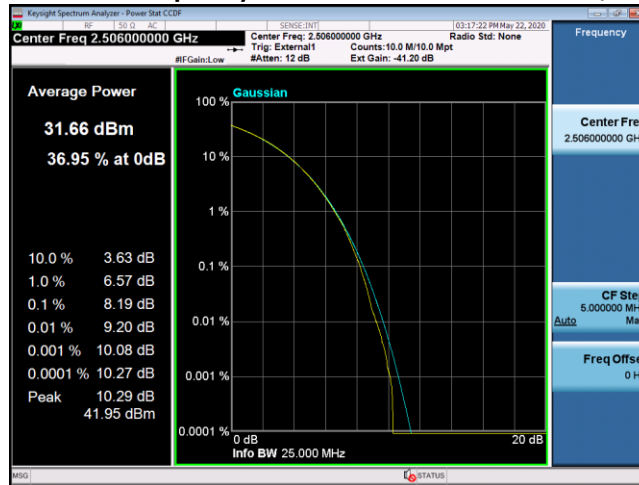


Channel Frequency 2546 MHz / Modulation 256QAM

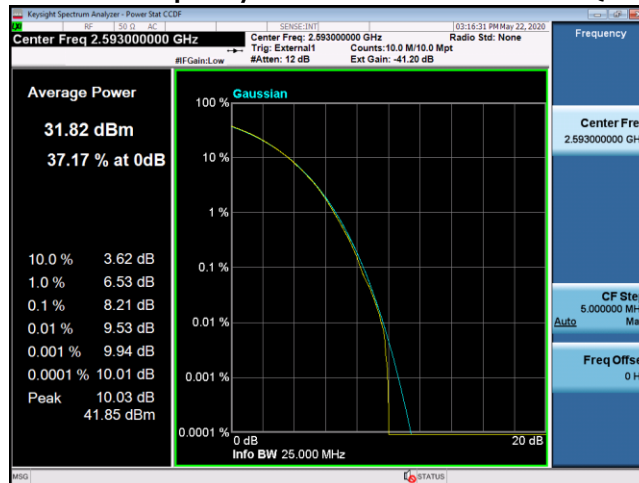


LTE 3C Data

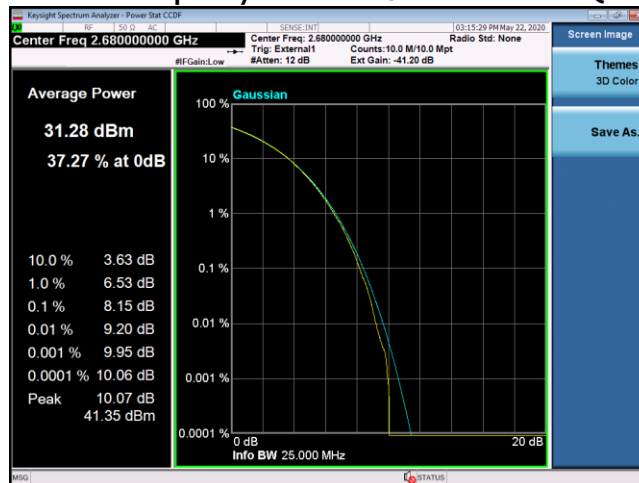
Channel Frequency 2506 MHz / Modulation 64QAM



Channel Frequency 2593 MHz / Modulation 64QAM

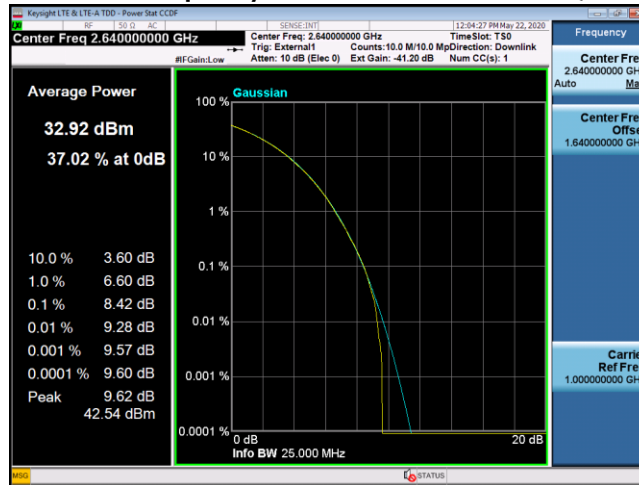


Channel Frequency 2680 MHz / Modulation 64QAM

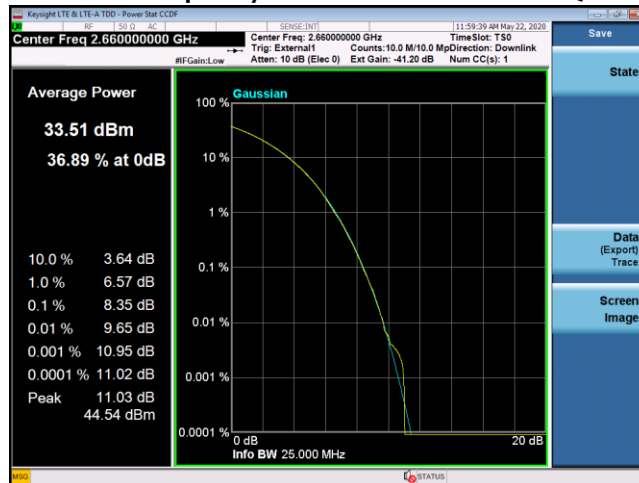


LTE 3C Data

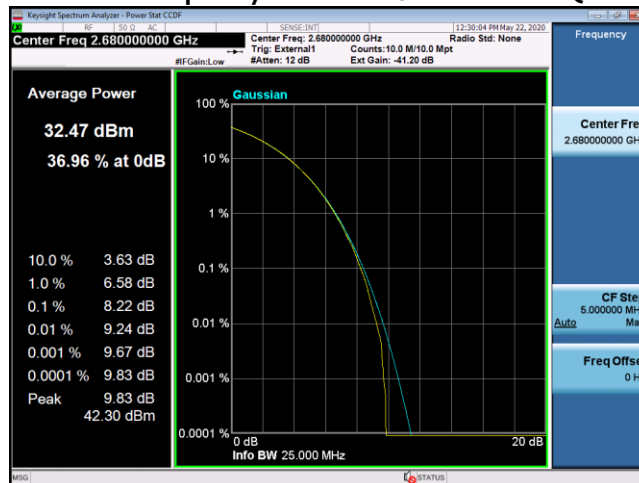
Channel Frequency 2640 MHz / Modulation QPSK



Channel Frequency 2660 MHz / Modulation QPSK

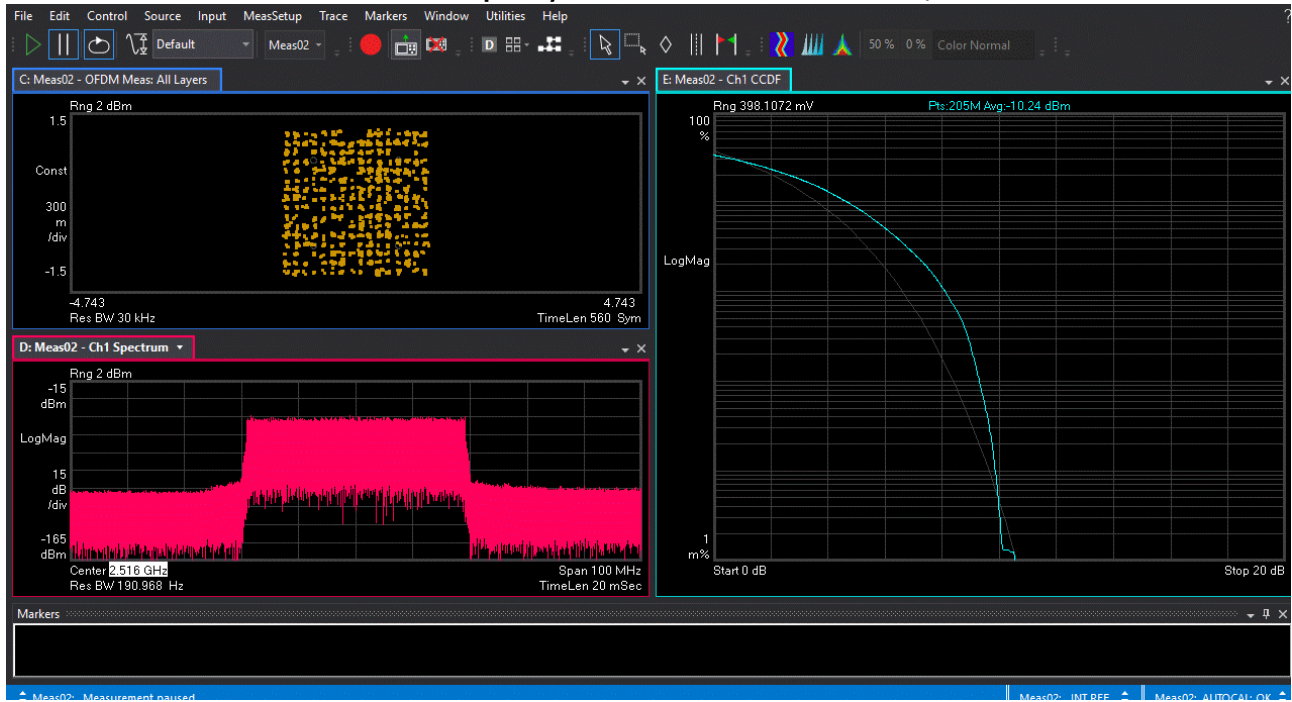


Channel Frequency 2680 MHz / Modulation QPSK

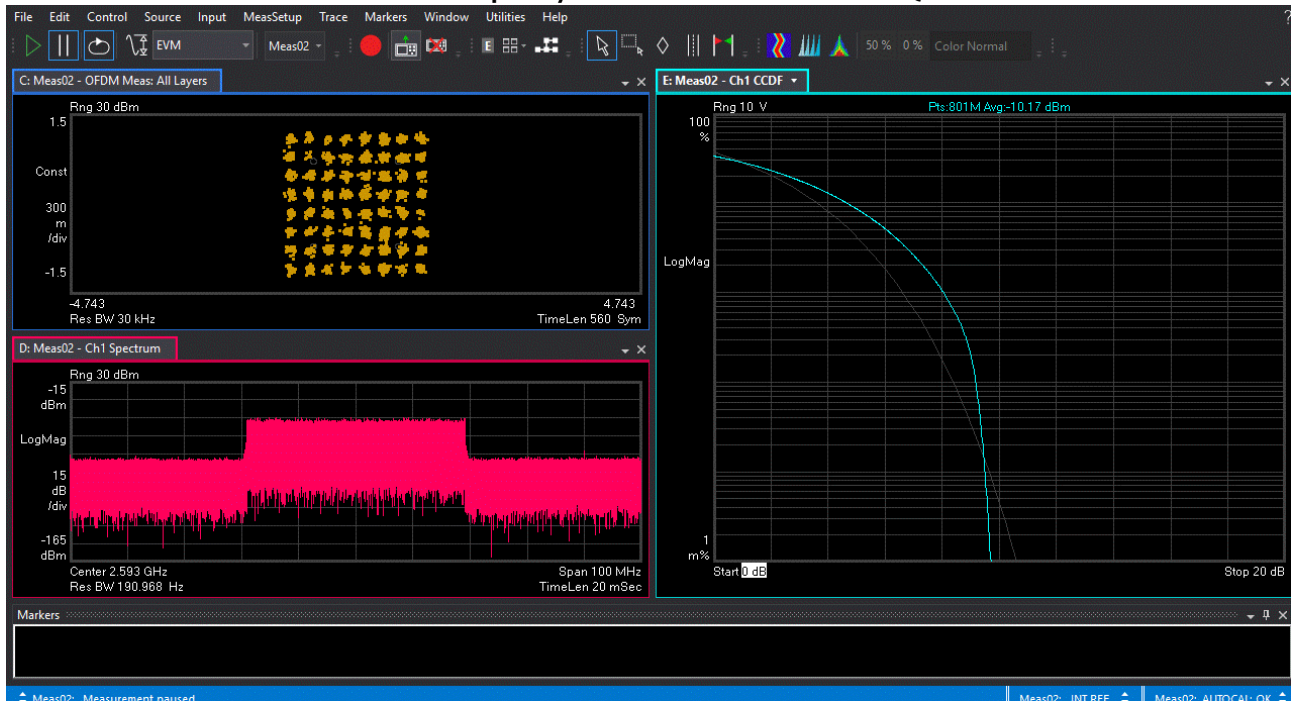


5G 40MHz Data

Channel Frequency 2516 MHz / Modulation 256QAM

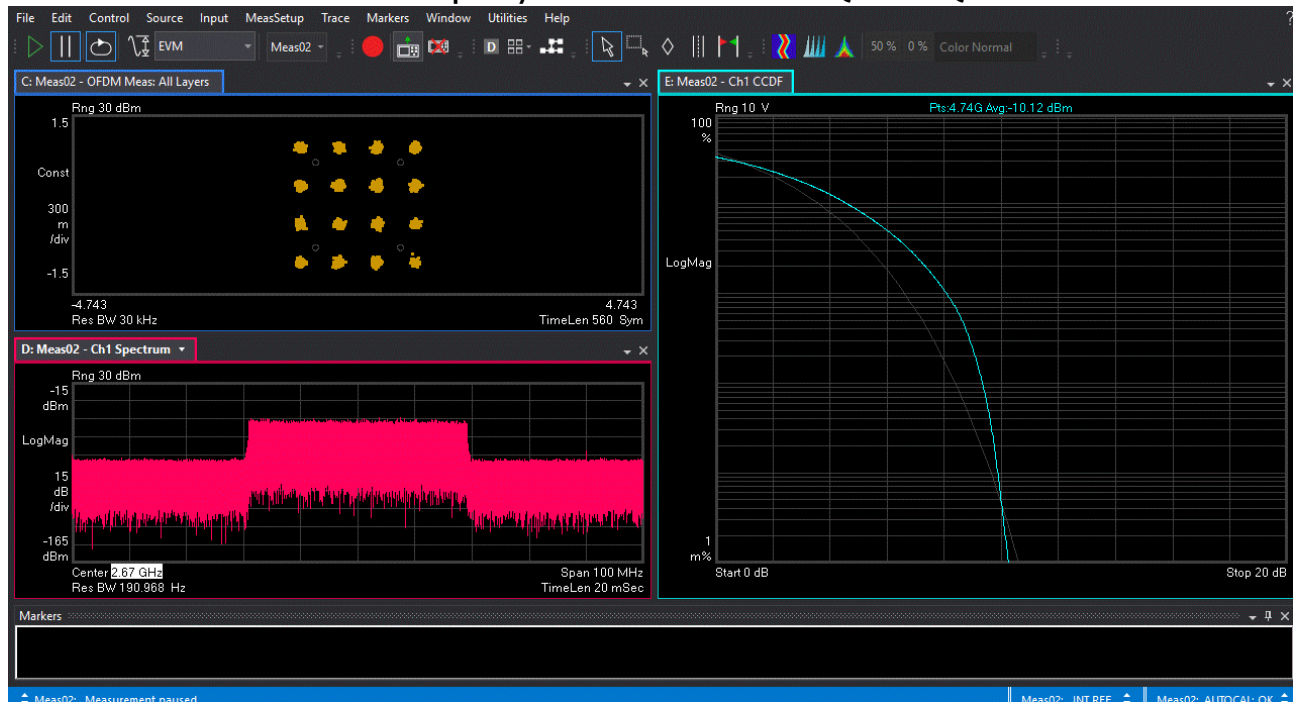


Channel Frequency 2593 MHz / Modulation 64QAM



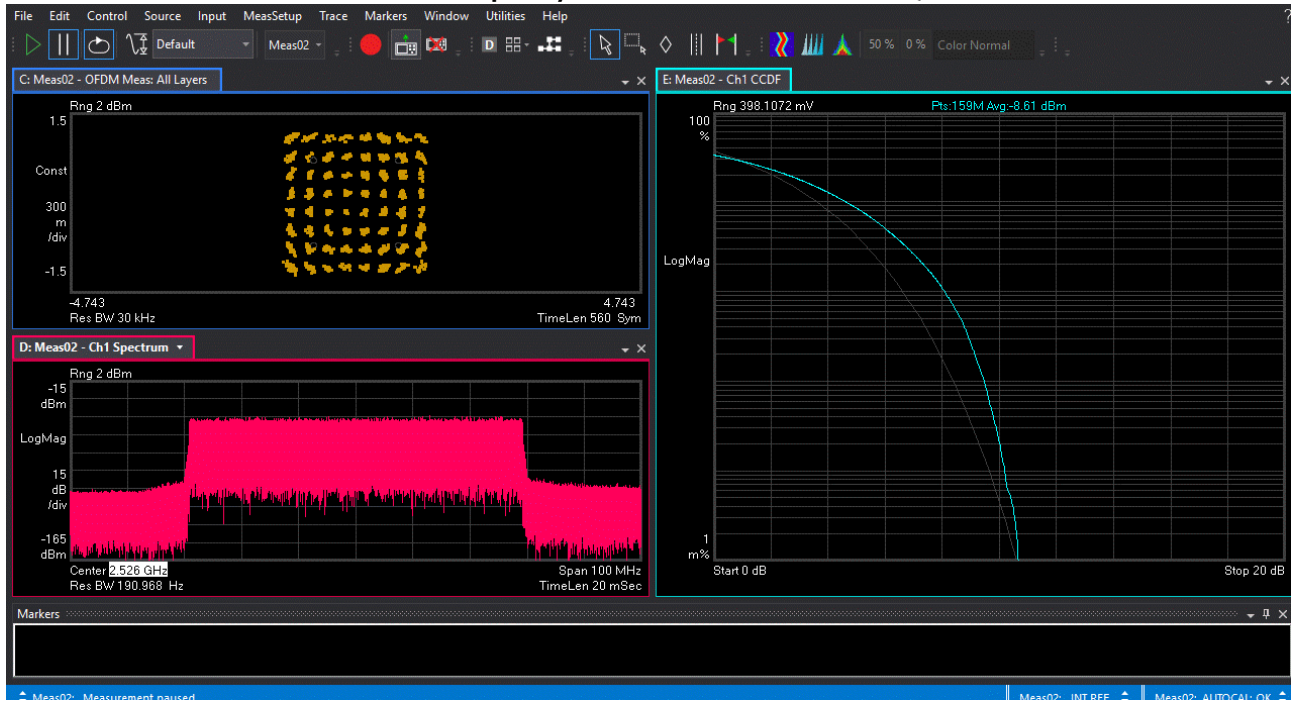
5G 40MHz Data

Channel Frequency 2670 MHz / Modulation QPSK/16QAM

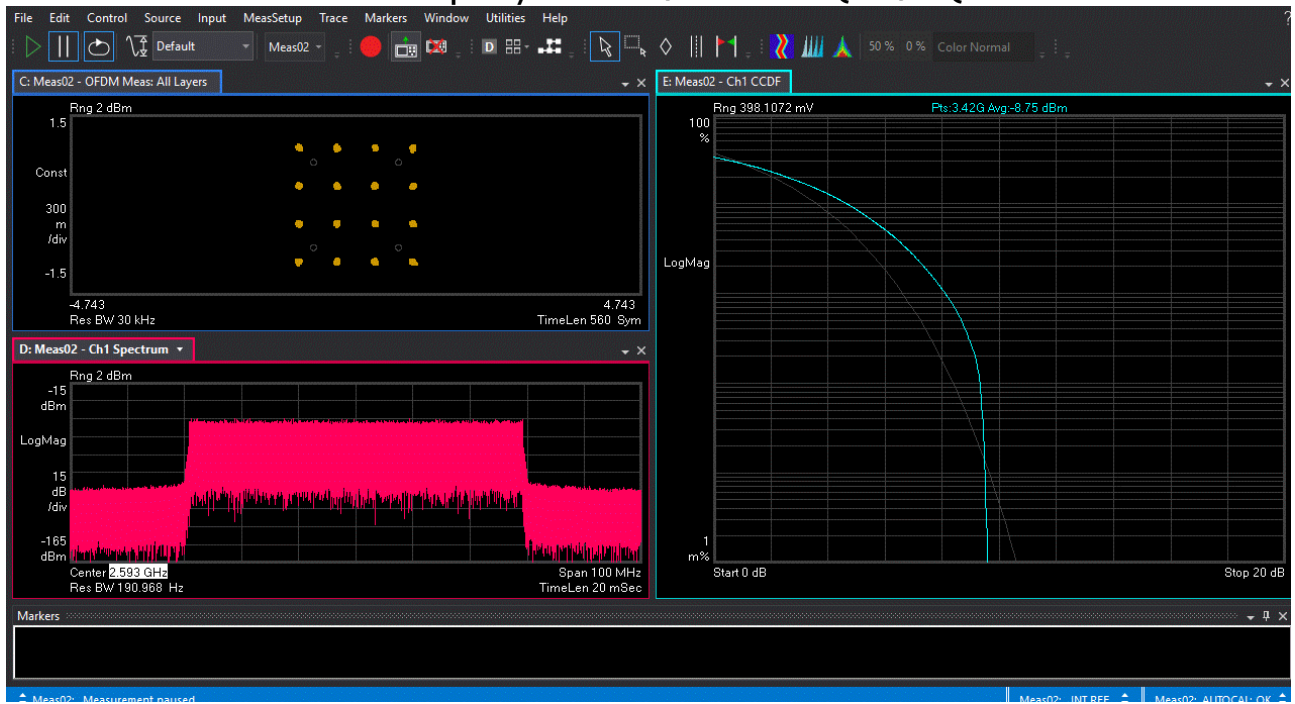


5G 60MHz Data

Channel Frequency 2526 MHz / Modulation 64QAM

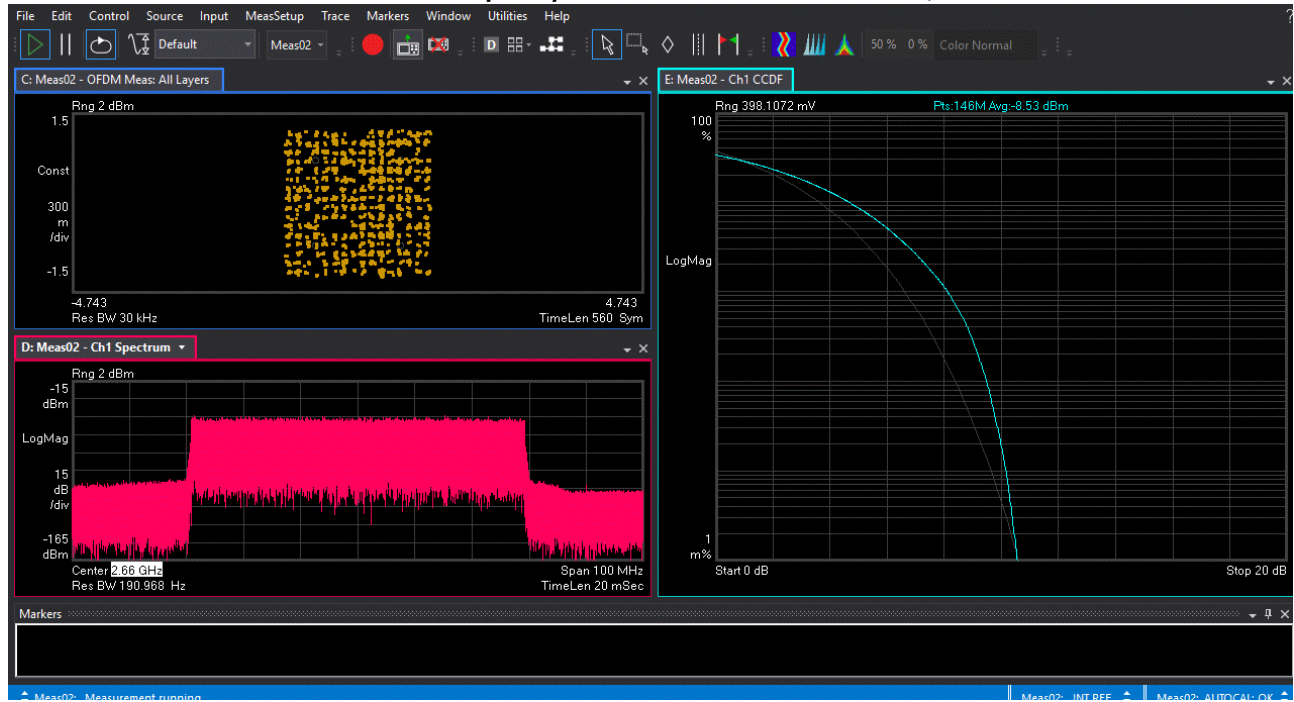


Channel Frequency 2593 MHz / Modulation QPSK/16QAM



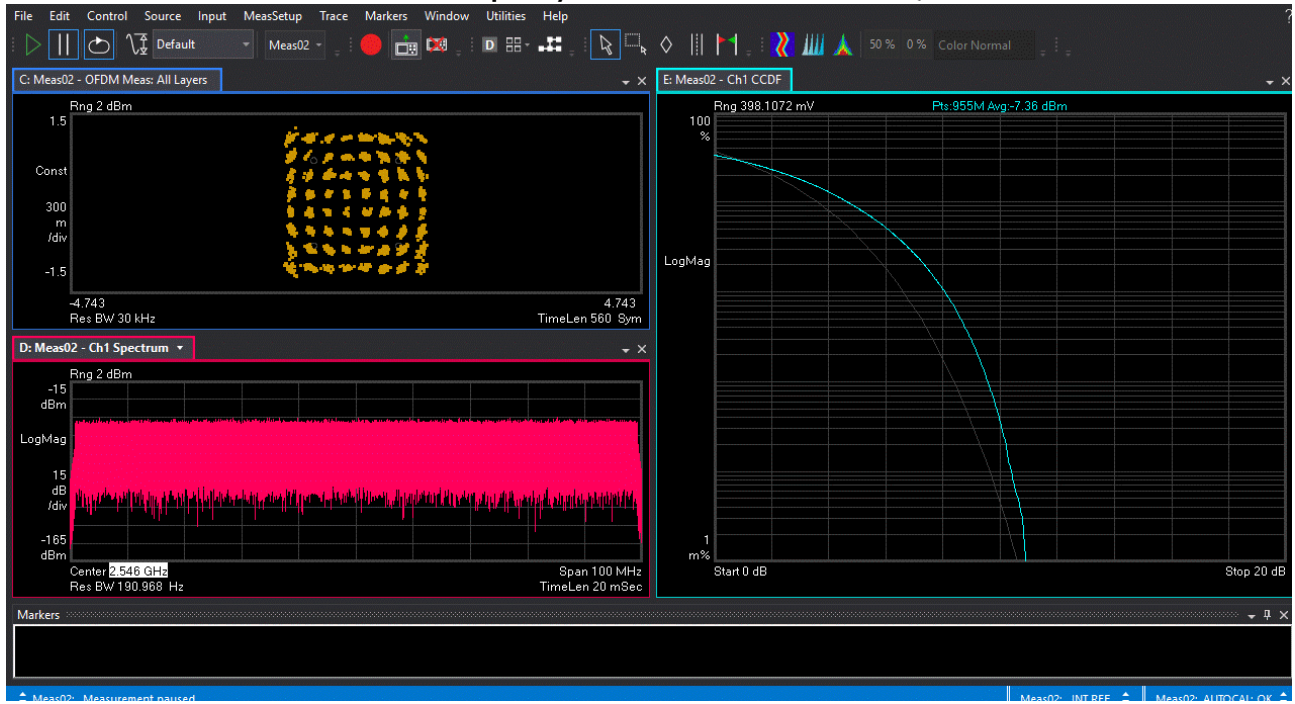
5G 60MHz Data

Channel Frequency 2660 MHz / Modulation 256QAM

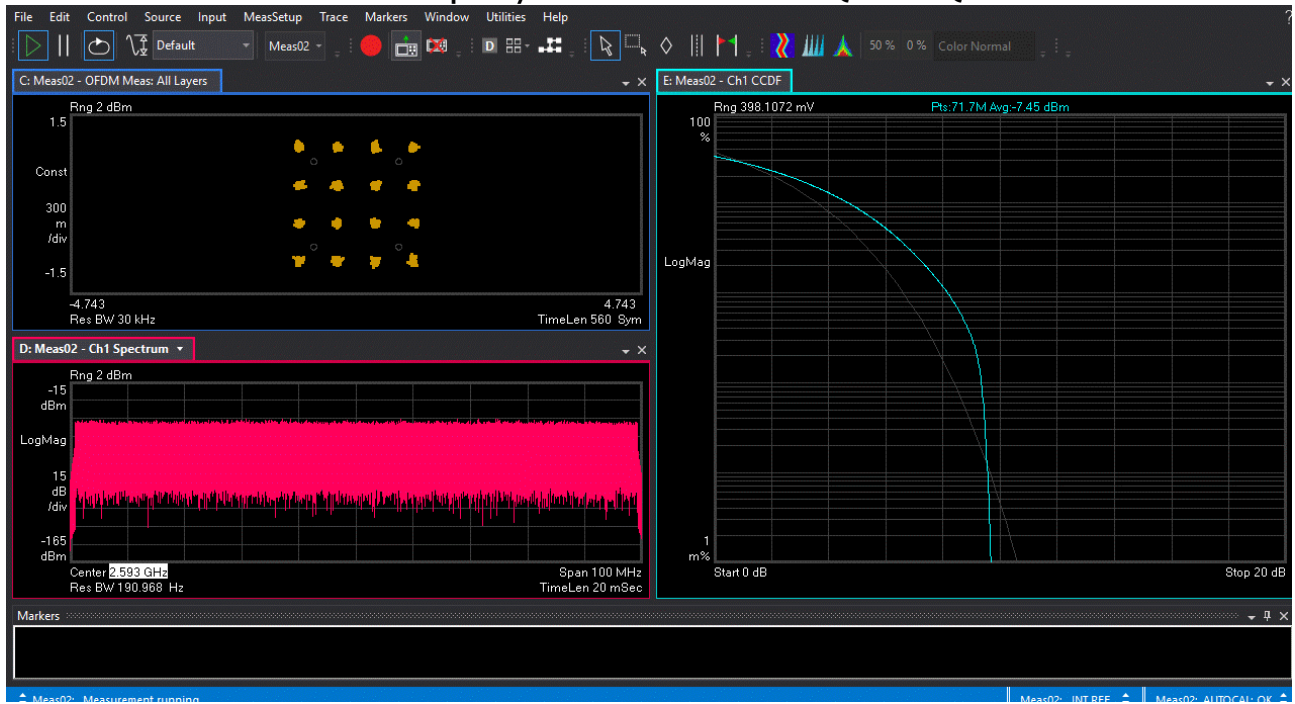


5G 100MHz Data

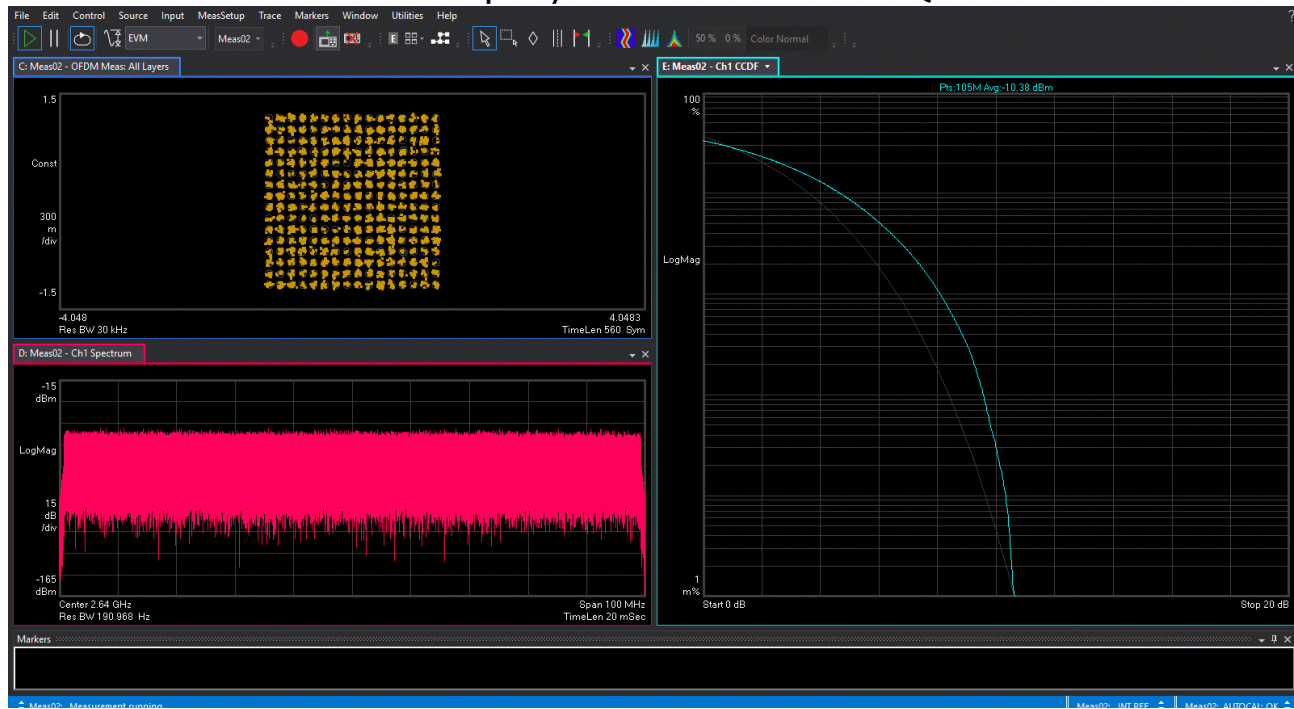
Channel Frequency 2546 MHz / Modulation 64QAM



Channel Frequency 2593 MHz / Modulation QPSK/16QAM



5G 100MHz Data Channel Frequency 2640 MHz / Modulation 256QAM



3. FCC Section 2.1047 - Modulation Characteristics

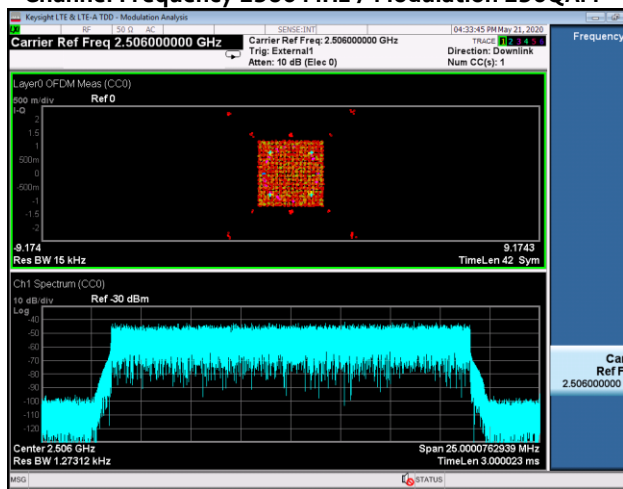
3.1 Modulation Characteristics

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

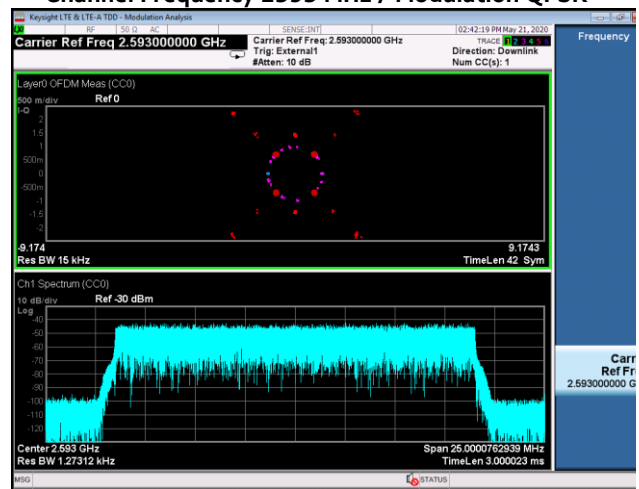
3.1.1 Modulation Characteristics – Plots

LTE 1C Data

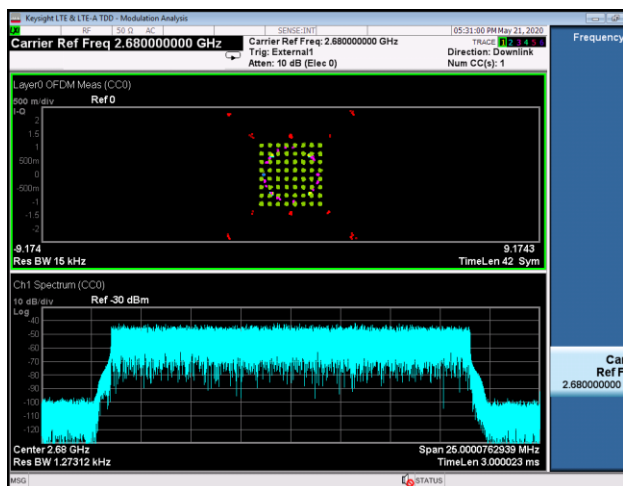
Channel Frequency 2506 MHz / Modulation 256QAM



Channel Frequency 2593 MHz / Modulation QPSK

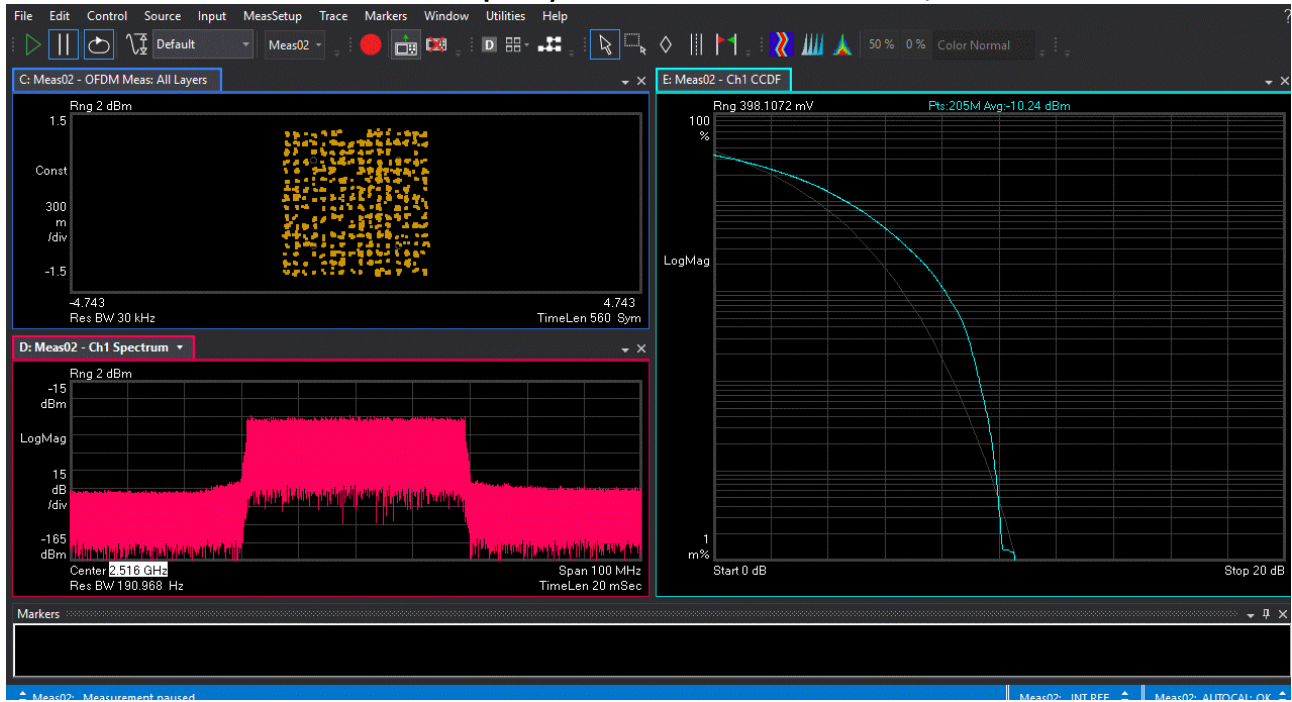


Channel Frequency 2680 MHz / Modulation 64QAM

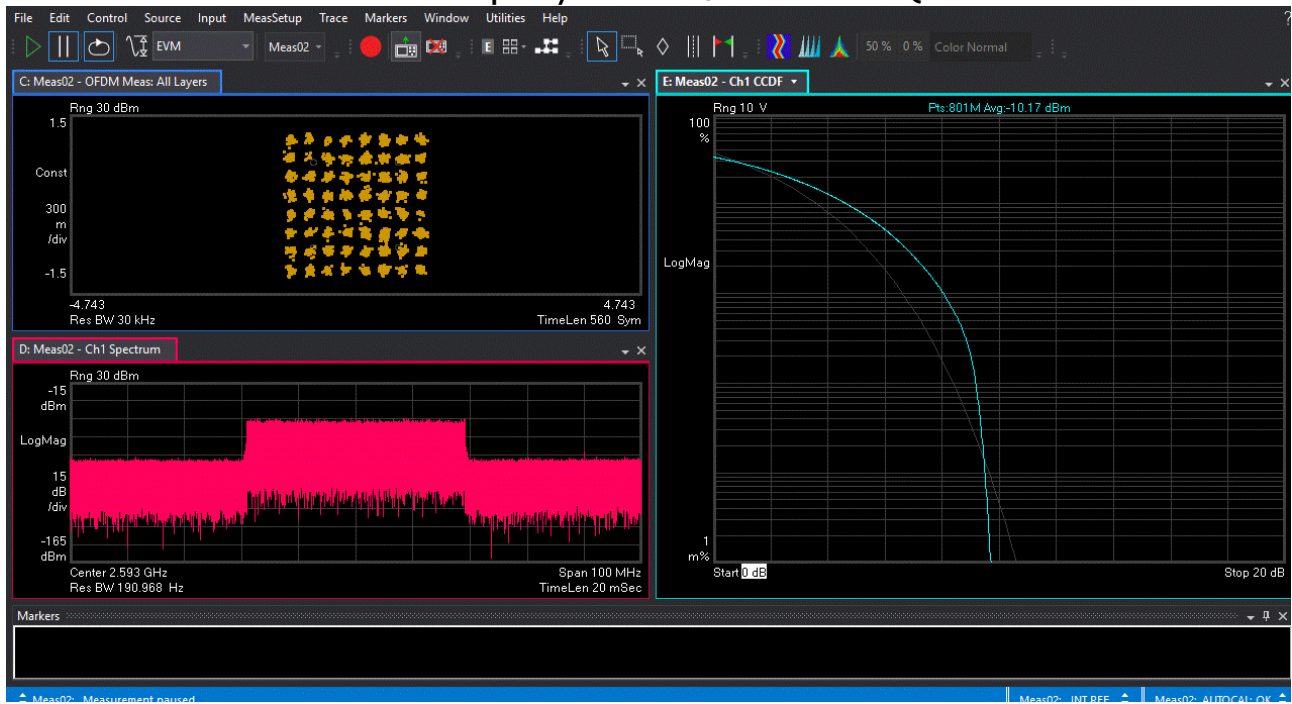


5G 40MHz Data

Channel Frequency 2516 MHz / Modulation 256QAM



Channel Frequency 2593 MHz / Modulation 64QAM



5G 40MHz Data

Channel Frequency 2670 MHz / Modulation QPSK/16QAM

