HCT
Testing and Certification

TEST REPORT

FCC Test for HRDU_25_25_S
Certification

APPLICANT
SOLiD, Inc.

REPORT NO.
HCT-RF-2410-FC002-R2

DATE OF ISSUE
November 14, 2024

Tested by
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HCT-RF-2410-FC002-R2

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Applicant	**SOLiD, Inc.** 10, 9th Floor, SOLiD Space, Pangyoyeok-ro 220, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-400, South Korea
Product Name Model Name	HRDU HRDU_25_25_S
FCC ID	W6UNH2525S
Date of Test	August 14, 2024 ~ October 02, 2024
Location of Test	■ Permanent Testing Lab ☐ On Site Testing (Address: 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea)
Test Standard Used	CFR 47 Part 2, Part 27
Test Results	PASS

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	October 07, 2024	Initial Release
1	November 11, 2024	- Inserted #note below the table in Section 4. - Corrected the typo in the report number(HCT-RF-2301-FC003 → HCT-RF-2305-FC003) in note 2 of Section 3.1.
2	November 14, 2024	Revised #Note 2 in Section 3.1.

Notice

Content
Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance. The results shown in this test report only apply to the sample(s), as received, provided by the applicant, unless otherwise stated. The test results have only been applied with the test methods required by the standard(s). The laboratory is not accredited for the test results marked *. Information provided by the applicant is marked **. Test results provided by external providers are marked ***. When confirmation of authenticity of this test report is required, please contact www.hct.co.kr The test results in this test report are not associated with the ((KS Q) ISO/IEC 17025) accreditation by KOLAS (Korea Laboratory Accreditation Scheme) / A2LA (American Association for Laboratory Accreditation) that are under the ILAC (International Laboratory Accreditation Cooperation) Mutual Recognition Agreement (MRA).

CONTENTS

1. GENERAL INFORMATION

1.1. APPLICANT INFORMATION

Company Name	SOLiD, Inc.
Company Address	10, 9th Floor, SOLiD Space, Pangyoyeok-ro 220, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-400, South Korea

1.2. PRODUCT INFORMATION

EUT Type	HRDU
EUT Serial Number	RH400025S0001
Power Supply	AC 100~240 VAC DC -48 VDC
Frequency Range	Band Name: BRS&EBS Downlink (MHz): 2 496 ~ 2 690
Tx Output Power	43 dBm
Antenna Peak Gain	[Outdoor] SISO Antenna Gain: 12 dBi MIMO Antenna Gain: 15 dBi [Indoor] SISO Total Antenna Gain#: - 16 dBi MIMO Total Antenna Gain#: -13 dBi # Total Antenna Gain: Antenna Gian (dBi) + Cable Loss (dB)

1.3. TEST INFORMATION

FCC Rule Parts	CFR 47 Part 2, Part 27
Measurement Standards	KDB 935210 D05 v01r04, KDB 971168 D01 v03r01, ANSI C63.26-2015
Test Location	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea

2. FACILITIES AND ACCREDITATIONS

2.1. FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication22.

Detailed description of test facility was submitted to the Commission and accepted dated March 11, 2024 (CAB identifier: KR0032).

2.2. EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

3. TEST SPECIFICATIONS

3.1. STANDARDS

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC CFR 47 Part 2, Part 27

Description	Reference	Results
AGC threshold	KDB 935210 D05 v01r04 3.2	Compliant
Out-of-band rejection	KDB 935210 D05 v01r04 3.3	Compliant
Input-versus-output signal comparison	§ 2.1049	Compliant
Input/output power and amplifier/booster gain	2.1046, § 27.50 (h)	Compliant# note 1
Out-of-band/out-of-block emissions and spurious emissions	2.1051, § 27.53 (m)	Compliant# note 2
Spurious emissions radiated	2.1053, § 27.53 (m)	Compliant# note 2
Frequency Stability	§ 2.1055, § 27.54	Compliant

Note 1: This device is capable of SISO operation and 2x2 MIMO operation when configured in the Alliance HROU_4000 enclosure with the transmitter approved under FCC ID W6UNH2525M. Test data for MIMO operations are addressed in this report (FCC ID W6UNH2525S for Ant. 1, FCC ID W6UNH2525M for Ant. 2).

Note 2

: There are several scenarios of simultaneous emissions.
This report contains the results for Scenario No.1 in the table below.

- Scenarios of Simultaneous Emissions

Scenario No.	Band 1	Band 2
1	BRS&EBS	3.7 GHz Service
2	3.45 GHz Service	3.7 GHz Service

Number 2 and 3 in the table below are already certified. After spot-checking, conducted and radiated spurious emissions have been tested under the conditions of simultaneous emissions.

- Simultaneous Emission Bands and Certification Information

No.	Band	Model Name	FCC ID	Report No.
1	BRS&EBS	HRDU_25_25_S	W6UNH2525S	HCT-RF-2410-FC002-R2
		HRDU_25_25_M	W6UNH2525M	HCT-RF-2410-FC004-R2
2	3.45 GHz Service	HRDU_345	W6UNH345	HCT-RF-2301-FC001-R1
		HRDU_345_M	W6UNH345M	HCT-RF-2301-FC003-R1
3	3.7 GHz Service	HRDU_Cband_R	W6UNHCBANDR	HCT-RF-2305-FC001
		HRDU_Cband_M_R	W6UNHCBANDMR	HCT-RF-2305-FC003

3.2. ADDITIONAL DESCRIPTIONS ABOUT TEST

- Except for the following cases, EUT was tested under normal operating conditions.
  : Out-of-band rejection test requires maximum gain condition without AGC.

- The test was generally based on the method of KDB 935210 D05 v01r04 and only followed ANSI C63.26-2015 if there was no test method in KDB standard.

- EUT was tested with following modulated signals provide by applicant.

Band Name	Tested signals
BRS&EBS	LTE 5 MHz
	LTE 10 MHz
	LTE 15 MHz
	LTE 20 MHz
	5G NR 20 MHz
	5G NR 40 MHz
	5G NR 60 MHz
	5G NR 80 MHz
	5G NR 100 MHz

- The tests results included actual loss value for attenuator and cable combination as shown in the table below.
  : Input Path

Correction factor table			
Frequency (MHz)	Factor (dB)	Frequency (MHz)	Factor (dB)
1 900	1.127	2 350	1.395
1 950	1.319	2 400	1.318
2 000	1.151	2 450	1.423
2 050	1.204	2 500	2.000
2 100	1.358	2 550	1.323
2 150	1.298	2 600	1.500
2 200	1.260	2 650	2.700
2 250	1.339	2 700	3.000
2 300	1.364	-	-

: Output Path

Correction factor table			
Frequency (MHz)	Factor (dB)	Frequency (MHz)	Factor (dB)
2	29.486	11 000	34.094
10	29.496	12 000	34.795
30	29.418	13 000	34.793
50	29.459	14 000	34.828
100	29.633	15 000	34.820
200	29.809	16 000	35.738
300	30.040	17 000	35.607
400	30.126	18 000	36.466
500	30.243	19 000	36.813
600	30.289	20 000	36.582
700	30.325	21 000	36.947
800	30.439	19 000	36.813
900	30.609	20 000	36.582
1 000	30.656	21 000	36.947
2 000	31.121	22 000	38.645
3 000	31.601	23 000	38.147
4 000	32.067	24 000	38.223
5 000	32.966	25 000	38.611
6 000	32.398	26 000	37.904
7 000	32.858	27 000	-52.647
8 000	33.188	-	-
9 000	33.410	-	-
10 000	33.533	-	-

3.3. MEASUREMENTUNCERTAINTY

Description	Condition	Uncertainty
Radiated Disturbance	9 kHz ~ 30 MHz	4.36 dB
	30 MHz ~ 1 GHz	5.70 dB
	1 GHz ~ 18 GHz	5.52 dB
	18 GHz ~ 40 GHz	5.66 dB

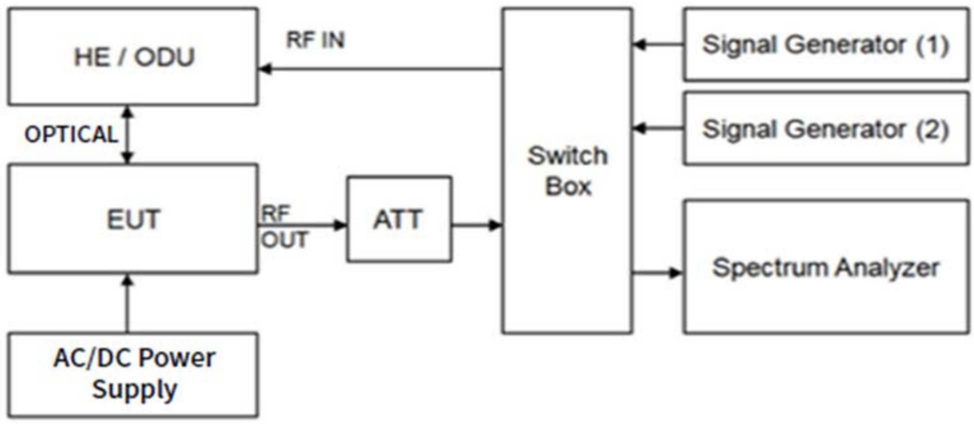
Note: Coverage factor *k* = 2, Confidence levels of 95 %

3.4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

Temperature	+15 °C to +35 °C
Relative humidity	30 % to 60 %
Air pressure	860 mbar to 1 060 mbar

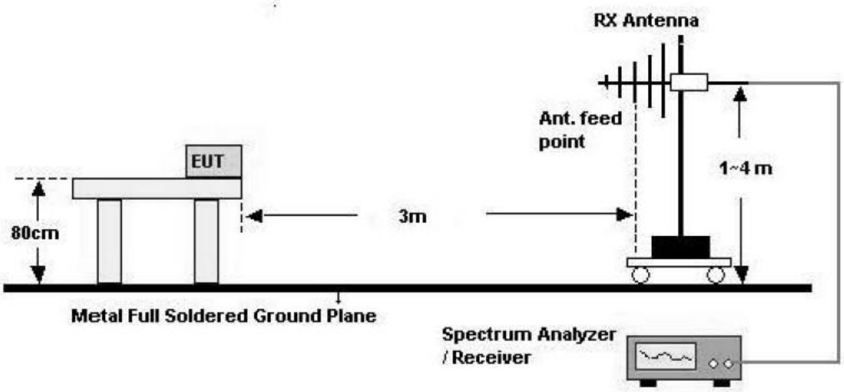
3.5. TEST DIAGRAMS

Conducted Test

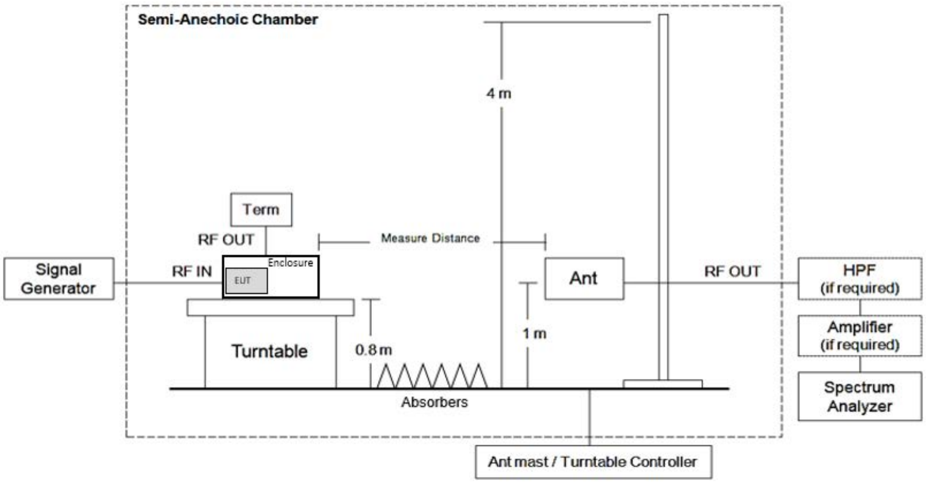


Radiated Test

30 MHz ~ 1 GHz



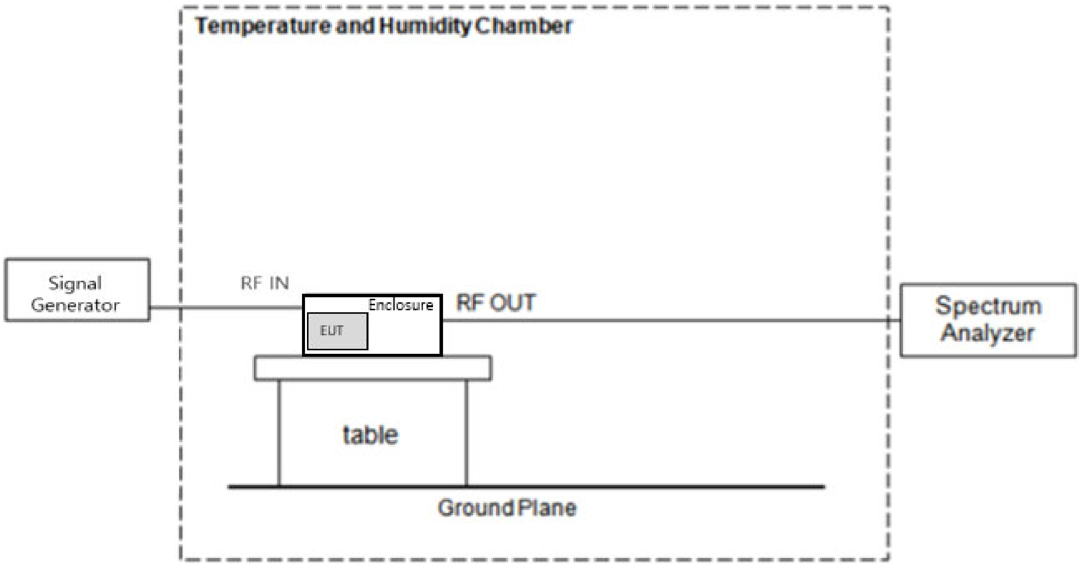
Above 1 GHz



※ EUT position is adopted by placement of floor-standing refer to section 5.5.2.3.2 of ANSI C63.26-2015

Note: Measure distance is 3 m.

Frequency Stability



4. TEST EQUIPMENTS

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
MXA Signal Analyzer	N9030A	Keysight	MY52350879	04/05/2025	Annual
PXA Signal Analyzer	N9030B	Keysight	MY55480110	08/19/2025	Annual
#MXG Vector Signal Generator	N5182A	Agilent	MY50141649	08/12/2025	Annual
Signal Generator	SMBV100A	Rohde & Schwarz	255727	08/22/2025	Annual
Vector Signal Generator	SMW200A	Rohde & Schwarz	109695	06/18/2025	Annual
#30 dB Attenuator	WA93-30-33	Weinschel Associates	0155	11/20/2024	Annual
#50Ω Termination	908A	H.P.	N/A	N/A	N/A
AC Power Supply	PCR2000MA	KIKUSUI	ZL002530	12/29/2024	Annual
DC Power Supply	EX 60-40	ODA	ODA-02-0923-01606	02/23/2025	Annual
Switch	S46-SV11	KEITHLEY	1088025	N/A	N/A
Temperature and Humidity Chamber	NY-THR18750	NANGYEAL	NY-200912201A	01/04/2025	Annual
Amp & Filter Bank Switch Controller	FBSM-01B	TNM system	TM20090002	N/A	N/A
Controller(Antenna Mast & Turn Table)	CO3000	Innco systems	CO3000/1251/48920320/P	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco systems	N/A	N/A	N/A
Turn Table	DS2000-S	Innco systems	N/A	N/A	N/A
Turn Table	N/A	Ets	N/A	N/A	N/A
Loop Antenna	FMZB 1513	Rohde & Schwarz	1513-333	03/07/2026	Biennial
TRILOG Broadband Antenna	VULB 9160-31	Schwarzbeck	3150	03/09/2025	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	9120D-937	02/13/2025	Biennial
Horn Antenna (15 GHz ~ 40 GHz)	BBHA9170	Schwarzbeck	BBHA9170124	03/28/2025	Biennial
RF Switching System	FBSR-04C	TNM system	S4L1	04/11/2025	Annual
Low Noise Amplifier	TK-PA1840H	TESTEK	170011-L	10/20/2024	Annual

#This equipment has been used to each port, but we only listed one equipment for simplicity.

<u>Note:</u>

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

5. TEST RESULT

5.1. AGC THRESHOLD

Test Requirement:

KDB 935210 D05 v01r04

Testing at and above the AGC threshold is required.

Test Procedures:

Measurements were in accordance with the test methods section 3.2 of KDB 935210 D05 v01r04.

In the case of fiber-optic distribution systems, the RF input port of the equipment under test (EUT) refers to the RF input of the supporting equipment RF to optical convertor; see also descriptions and diagrams for typical DAS System booster systems in KDB Publication 935210 D02

Devices intended to be directly connected to an RF source (donor port) only need to be evaluated for any over-the-air transmit paths.

a) Connect a signal generator to the input of the EUT.
b) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.
c) The signal generator should initially be configured to produce either of the required test signals.
d) Set the signal generator frequency to the center frequency of the EUT operating band.
e) While monitoring the output power of the EUT, measured using the methods of ANSI C63.26-2015 subclause 5.2.4.4.1, increase the input level until a 1 dB increase in the input signal power no longer causes a 1 dB increase in the output signal power.
f) Record this level as the AGC threshold level.
g) Repeat the procedure with the remaining test signal.

Output power measurement in subclause 5.2.4.4.1 of ANSI C63.26

a) Set span to 2 × to 3 × the OBW.
b) Set RBW = 1% to 5% of the OBW.
c) Set VBW ≥ 3 × RBW.
d) Set number of measurement points in sweep ≥ 2 × span / RBW.
e) Sweep time: auto-couple
f) Detector = power averaging (rms).
g) If the EUT can be configured to transmit continuously, then set the trigger to free run.
h) Omit
i) Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over multiple symbols, it can be necessary to increase the number of traces to

be averaged above 100 or, if using a manually configured sweep time, increase the sweep time.

j) Compute the power by integrating the spectrum across the OBW of the signal using the instrument's band or channel power measurement function, with the band/channel limits set equal to the OBW band edges. If the instrument does not have a band or channel power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

Test Results:

Test Band	Link	Signal	Center Frequency (MHz)	AGC Threshold Level (dBm)	Output Level (dBm)
BRS&EBS (Ant. 1)	Downlink	LTE 5 MHz	2 593.00	-20	42.75
		LTE 10 MHz	2 593.00	-20	42.89
		LTE 15 MHz	2 593.00	-20	42.78
		LTE 20 MHz	2 593.00	-20	42.56
		5G NR 20 MHz	2 593.00	-20	42.91
		5G NR 40 MHz	2 593.00	-20	42.99
		5G NR 60 MHz	2 593.00	-20	42.95
		5G NR 80 MHz	2 593.00	-20	42.92
		5G NR 100 MHz	2 593.00	-20	42.94

5.2. OUT-OF-BAND REJECTION

Test Requirement:

KDB 935210 D05 v01r04

Out-of-band rejection required.

Test Procedures:

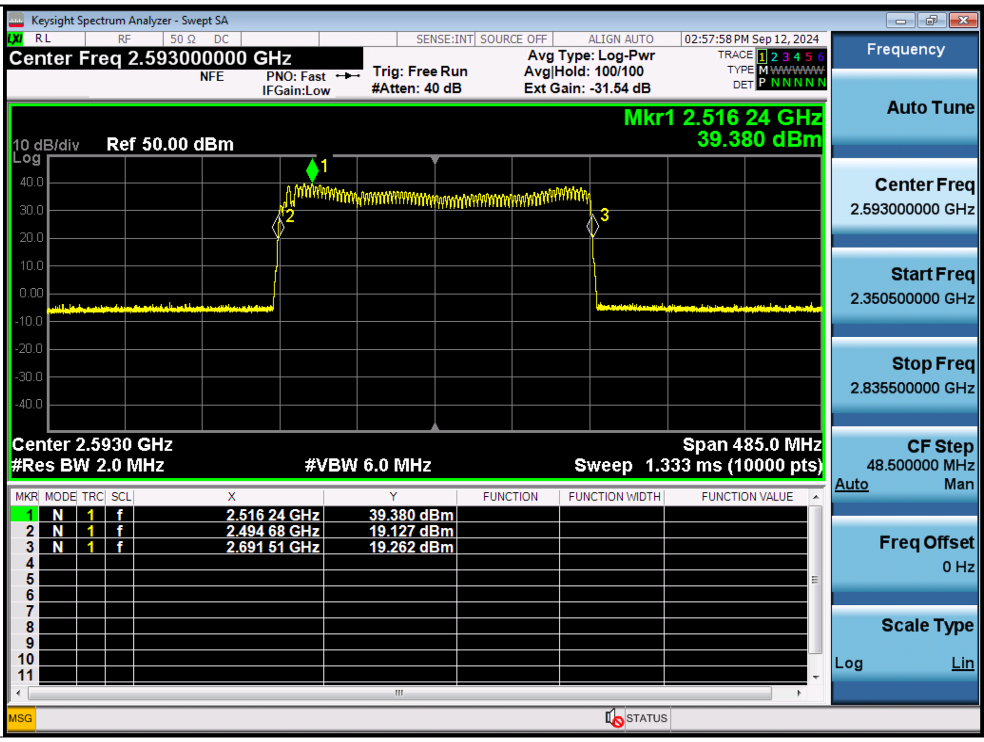
Measurements were in accordance with the test methods section 3.3 of KDB 935210 D05 v01r04.

A signal booster shall reject amplification of other signals outside of its passband. Adjust the internal gain control of the EUT (if so equipped) to the maximum gain for which equipment certification is sought.

a) Connect a signal generator to the input of the EUT.
b) Configure a swept CW signal with the following parameters:
    1) Frequency range = ±250 % of the passband, for each applicable CMRS band.
    2) Level = a sufficient level to affirm that the out-of-band rejection is > 20 dB above the noise floor and will not engage the AGC during the entire sweep.
    3) Dwell time = approximately 10 ms.
    4) Number of points = SPAN/(RBW/2).
c) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
d) Set the span of the spectrum analyzer to the same as the frequency range of the signal generator.
e) Set the resolution bandwidth (RBW) of the spectrum analyzer to be 1 % to 5 % of the EUT passband, and the video bandwidth (VBW) shall be set to ≥ 3 × RBW.
f) Set the detector to Peak Max-Hold and wait for the spectrum analyzer's spectral display to fill.
g) Place a marker to the peak of the frequency response and record this frequency as f_0.
h) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the −20 dB down amplitude, to determine the 20 dB bandwidth.
i) Capture the frequency response of the EUT.
j) Repeat for all frequency bands applicable for use by the EUT.

Test Results:

BRS&EBS / Downlink



5.3. INPUT-VERSUS-OUTPUT SIGNAL COMPARISON

Test Requirement:

§ 2.1049 Measurements required: Occupied bandwidth.

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 specified conditions of § 2.1049 (a) through (i) as applicable.

Test Procedures:

Measurements were in accordance with the test methods section 3.4 of KDB 935210 D05 v01r04.

A 26 dB bandwidth measurement shall be performed on the input signal and the output signal; alternatively, the 99% OBW can be measured and used. See KDB Publication 971168 [R8] for more information on measuring OBW.

a) Connect a signal generator to the input of the EUT.
b) Configure the signal generator to transmit the AWGN signal.
c) Configure the signal amplitude to be just below the AGC threshold level (see 3.2), but not more than 0.5 dB below.
d) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
e) Set the spectrum analyzer center frequency to the center frequency of the operational band under test. The span range of the spectrum analyzer shall be between 2 times to 5 times the emission bandwidth (EBW) or alternatively, the OBW.
f) The nominal RBW shall be in the range of 1 % to 5 % of the anticipated OBW, and the VBW shall be ≥ 3 × RBW.
g) Set the reference level of the instrument as required to preclude the signal from exceeding the maximum spectrum analyzer input mixer level for linear operation. In general, the peak of the spectral envelope must be more than [10 log (OBW / RBW)] below the reference level. Steps f) and g) may require iteration to enable adjustments within the specified tolerances.
h) The noise floor of the spectrum analyzer at the selected RBW shall be at least 36 dB below the reference level.
i) Set spectrum analyzer detection function to positive peak.
j) Set the trace mode to max hold.
k) Determine the reference value: Allow the trace to stabilize. Set the spectrum analyzer marker to the highest amplitude level of the displayed trace (this is the reference value) and record the associated frequency.
l) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the −26 dB down amplitude. The 26 dB EBW (alternatively OBW) is the positive frequency difference between the two markers. If the spectral envelope crosses the −26 dB down amplitude at multiple points, the lowest or highest frequency shall be selected as the frequencies that are the furthest removed from the center frequency at which the spectral envelope crosses the −26 dB down amplitude point.

m) Repeat steps e) to l) with the input signal connected directly to the spectrum analyzer (i.e., input signal measurement).

n) Compare the spectral plot of the input signal (determined from step m) to the output signal (determined from step l) to affirm that they are similar (in passband and rolloff characteristic features and relative spectral locations), and include plot(s) and descriptions in test report.

o) Repeat the procedure [steps e) to n)] with the input signal amplitude set to 3 dB above the AGC threshold.

p) Repeat steps e) to o) with the signal generator set to the narrowband signal.

q) Repeat steps e) to p) for all frequency bands authorized for use by the EUT.

Test Results:

Tabular data of Output Occupied Bandwidth

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (MHz)	26 dB OBW (MHz)
BRS&EBS (Ant. 1)	Downlink	LTE 5 MHz	2 593.00	4.4722	4.8237
		LTE 10 MHz	2 593.00	8.9580	9.7373
		LTE 15 MHz	2 593.00	13.408	14.497
		LTE 20 MHz	2 593.00	17.871	19.144
		5G NR 20 MHz	2 593.00	18.946	19.600
		5G NR 40 MHz	2 593.00	37.787	39.179
		5G NR 60 MHz	2 593.00	57.816	60.371
		5G NR 80 MHz	2 593.00	77.409	79.954
		5G NR 100 MHz	2 593.00	96.987	100.44

Tabular data of Input Occupied Bandwidth

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (MHz)	26 dB OBW (MHz)
BRS&EBS (Ant. 1)	Downlink	LTE 5 MHz	2 593.00	4.4771	4.7808
		LTE 10 MHz	2 593.00	8.9256	9.6735
		LTE 15 MHz	2 593.00	13.395	14.197
		LTE 20 MHz	2 593.00	17.858	18.979
		5G NR 20 MHz	2 593.00	18.822	19.567
		5G NR 40 MHz	2 593.00	37.812	39.173
		5G NR 60 MHz	2 593.00	57.859	60.068
		5G NR 80 MHz	2 593.00	77.562	79.905
		5G NR 100 MHz	2 593.00	96.909	100.35

Tabular data of 3 dB above the AGC threshold Output Occupied Bandwidth

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (MHz)	26 dB OBW (MHz)
BRS&EBS (Ant. 1)	Downlink	LTE 5 MHz	2 593.00	4.4764	4.8268
		LTE 10 MHz	2 593.00	8.9617	9.7754
		LTE 15 MHz	2 593.00	13.472	14.605
		LTE 20 MHz	2 593.00	17.840	19.154
		5G NR 20 MHz	2 593.00	18.923	19.621
		5G NR 40 MHz	2 593.00	37.816	39.191
		5G NR 60 MHz	2 593.00	57.858	60.371
		5G NR 80 MHz	2 593.00	77.394	79.992
		5G NR 100 MHz	2 593.00	97.057	100.50

Tabular data of 3 dB above the AGC threshold Input Occupied Bandwidth

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (MHz)	26 dB OBW (MHz)
BRS&EBS (Ant. 1)	Downlink	LTE 5 MHz	2 593.00	4.4810	4.7798
		LTE 10 MHz	2 593.00	8.9460	9.6637
		LTE 15 MHz	2 593.00	13.443	14.468
		LTE 20 MHz	2 593.00	17.881	19.147
		5G NR 20 MHz	2 593.00	18.840	19.565
		5G NR 40 MHz	2 593.00	37.792	39.152
		5G NR 60 MHz	2 593.00	57.848	60.147
		5G NR 80 MHz	2 593.00	77.314	79.989
		5G NR 100 MHz	2 593.00	97.035	100.42

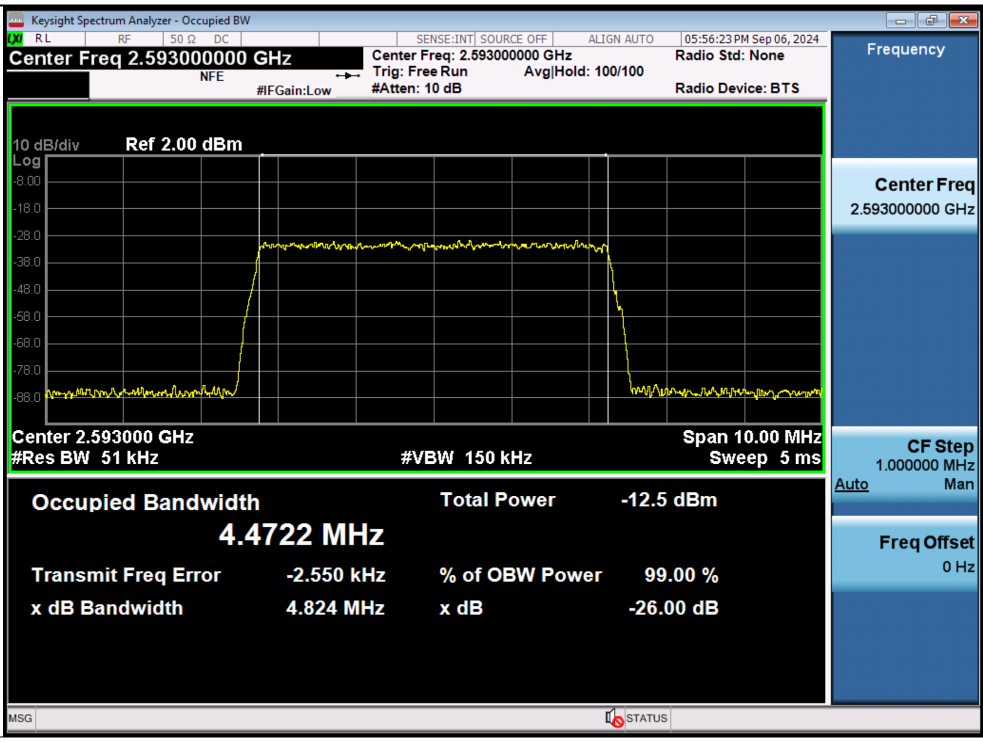
Measured Occupied Bandwidth Comparison

Test Band	Link	Signal	Variant of Input and Output Occupied Bandwidth (%)	Variant of Input and 3 dB above the AGC threshold Output Occupied Bandwidth (%)
BRS&EBS (Ant. 1)	Downlink	LTE 5 MHz	-0.891	-0.974
		LTE 10 MHz	-0.647	-1.136
		LTE 15 MHz	-2.069	-0.938
		LTE 20 MHz	-0.862	-0.037
		5G NR 20 MHz	-0.168	-0.285
		5G NR 40 MHz	-0.015	-0.100
		5G NR 60 MHz	-0.502	-0.371
		5G NR 80 MHz	-0.061	-0.004
		5G NR 100 MHz	-0.086	-0.086

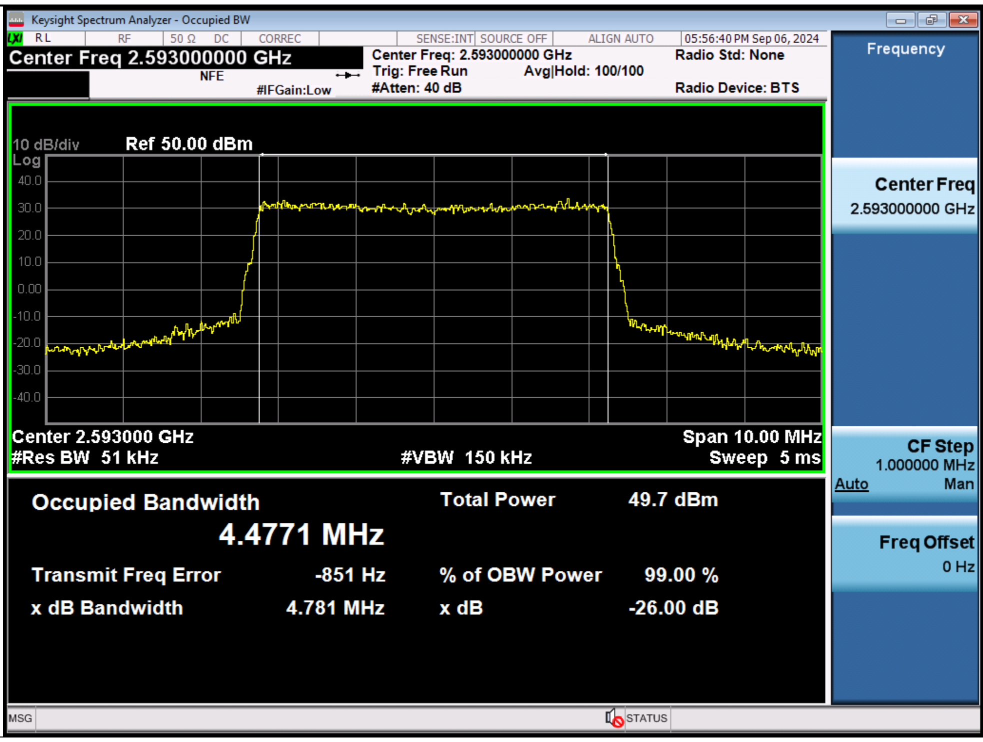
Note: *Change in input-output OBW is less than ±5 %*

Plot data of Occupied Bandwidth

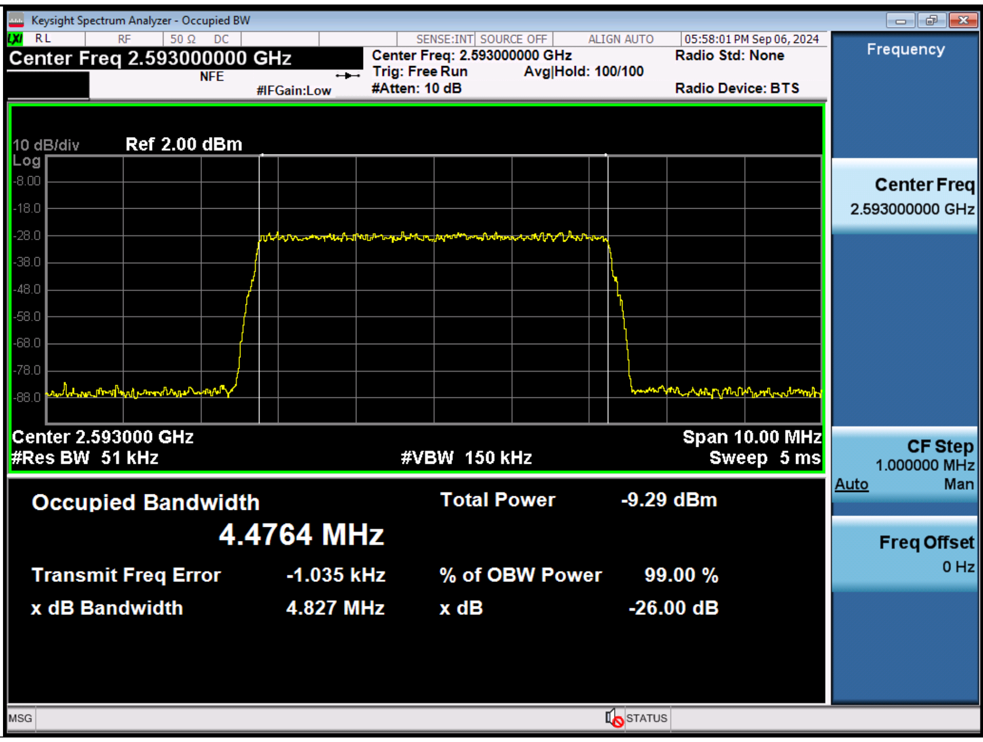
Output / BRS&EBS / Downlink / LTE 5 MHz



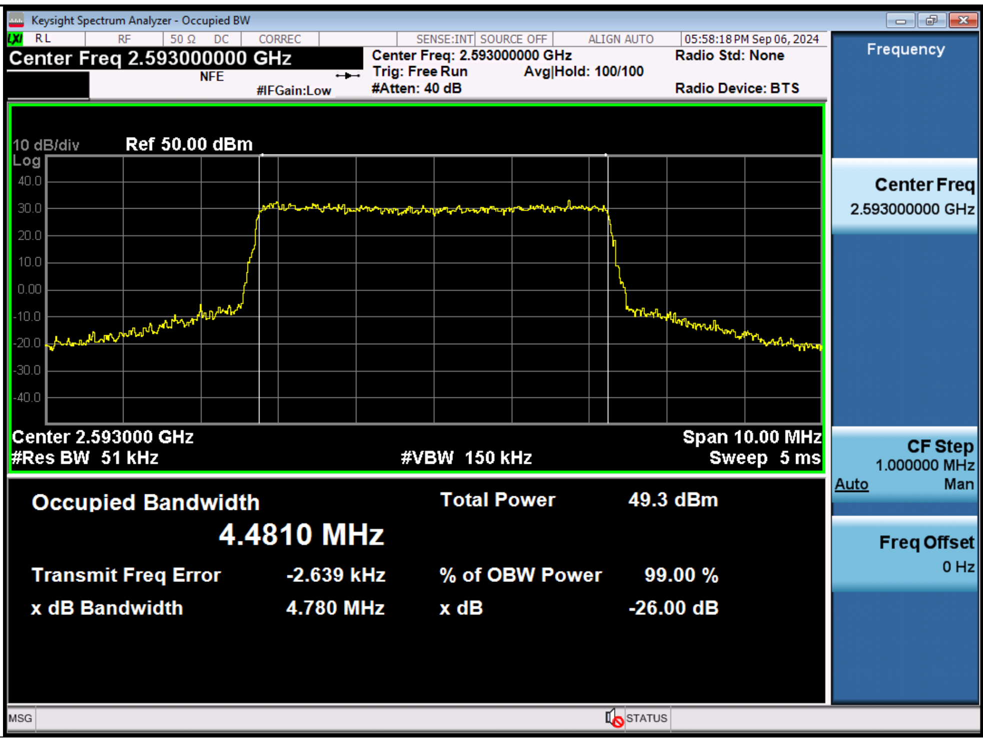
Input / BRS&EBS / Downlink / LTE 5 MHz



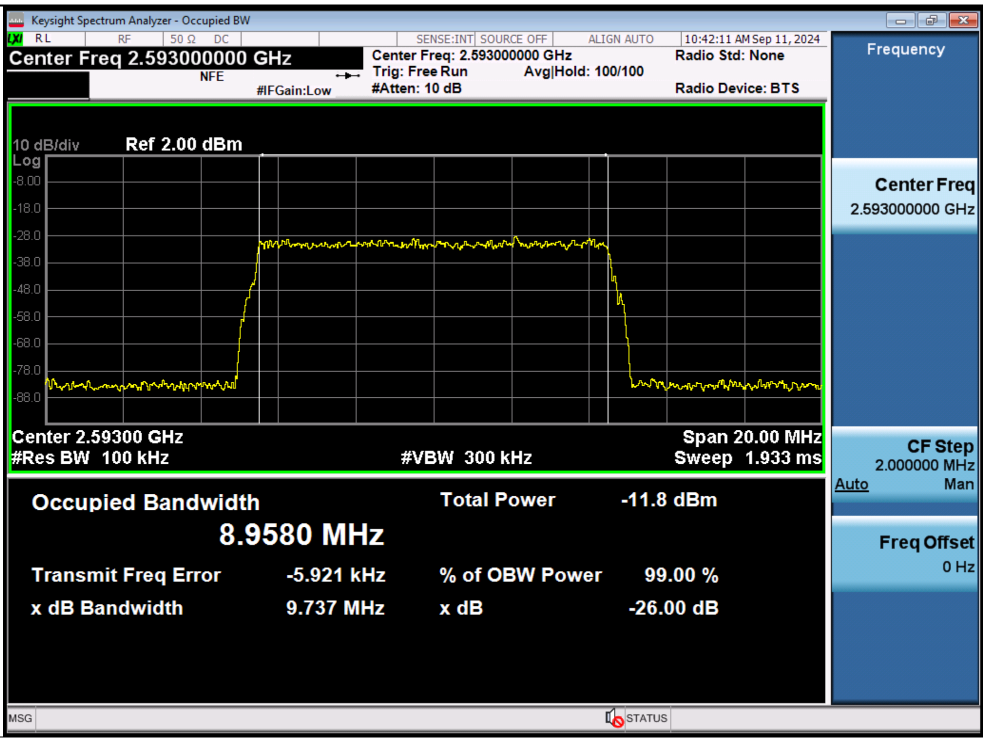
3 dB above the AGC threshold output / BRS&EBS / Downlink / LTE 5 MHz



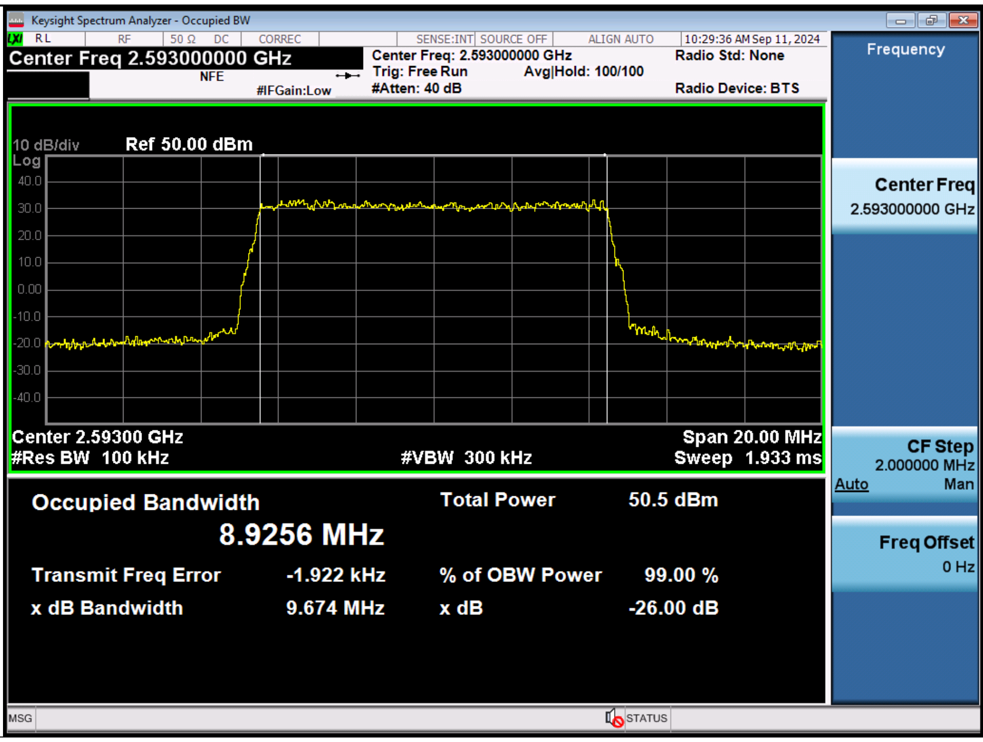
3 dB above the AGC threshold Input / BRS&EBS / Downlink / LTE 5 MHz



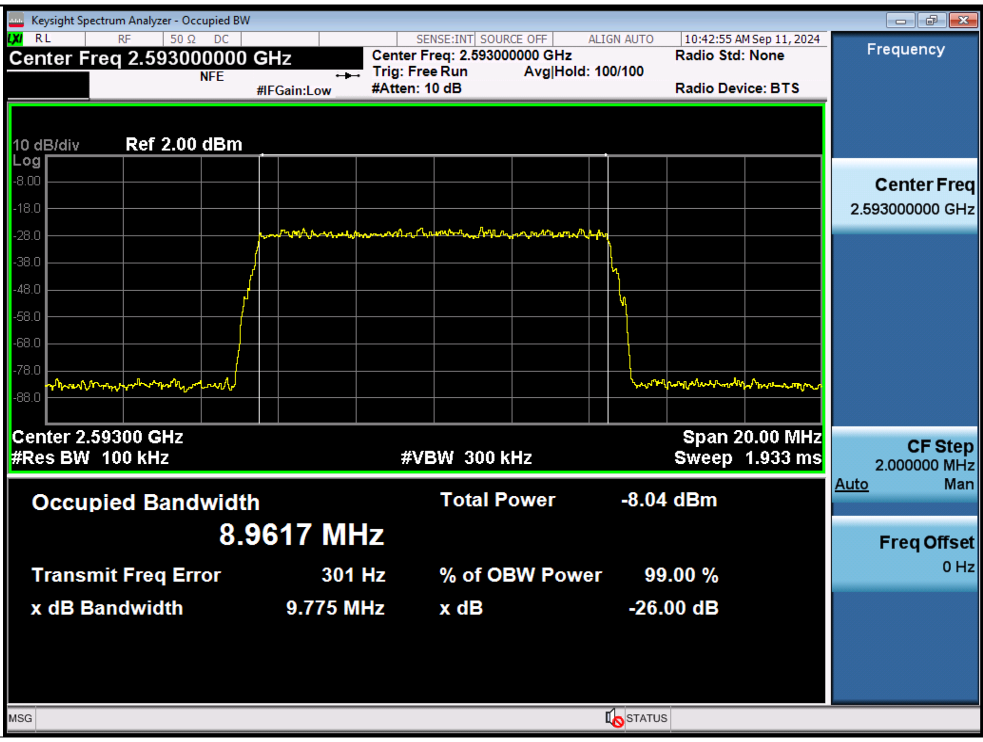
Output / BRS&EBS / Downlink / LTE 10 MHz



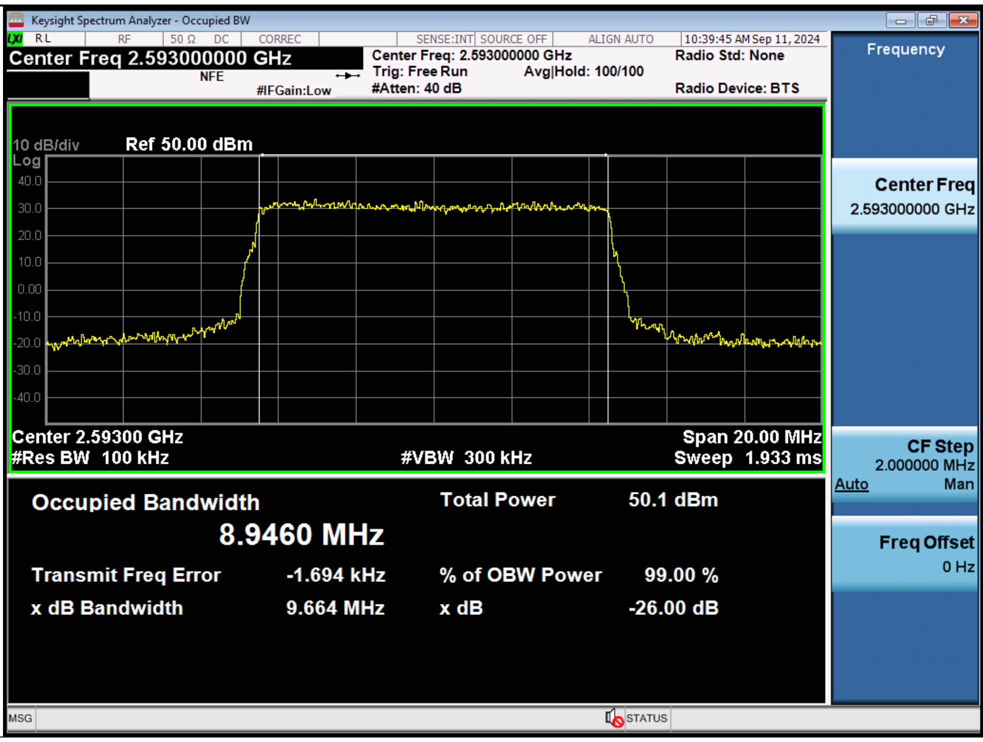
Input / BRS&EBS / Downlink / LTE 10 MHz



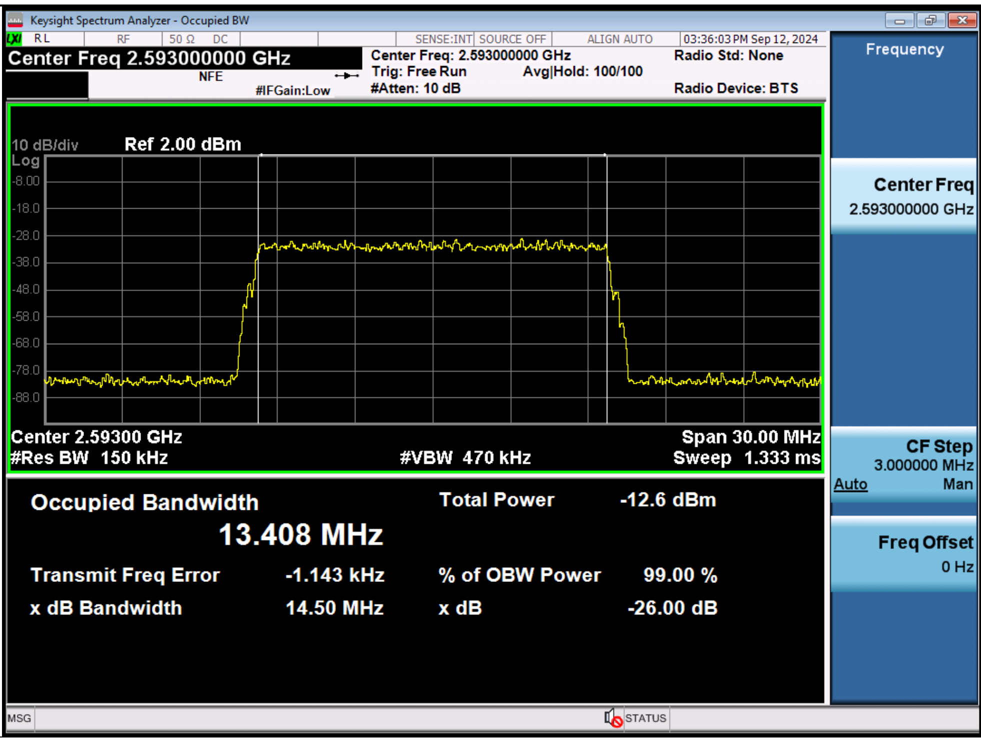
3 dB above the AGC threshold output / BRS&EBS / Downlink / LTE 10 MHz



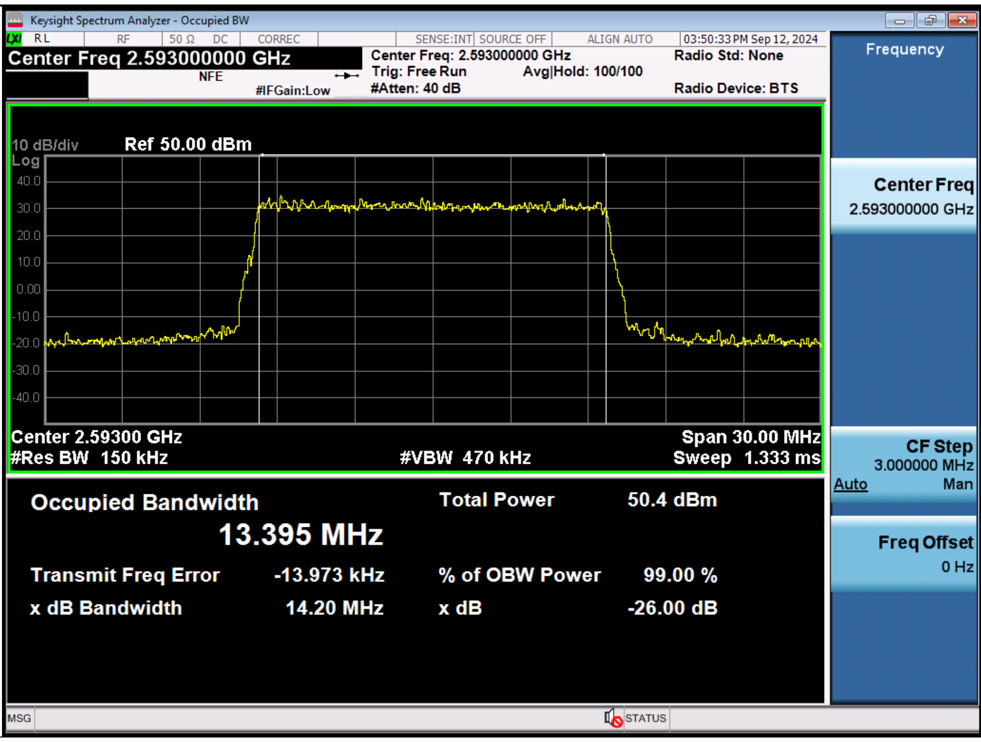
3 dB above the AGC threshold Input / BRS&EBS / Downlink / LTE 10 MHz

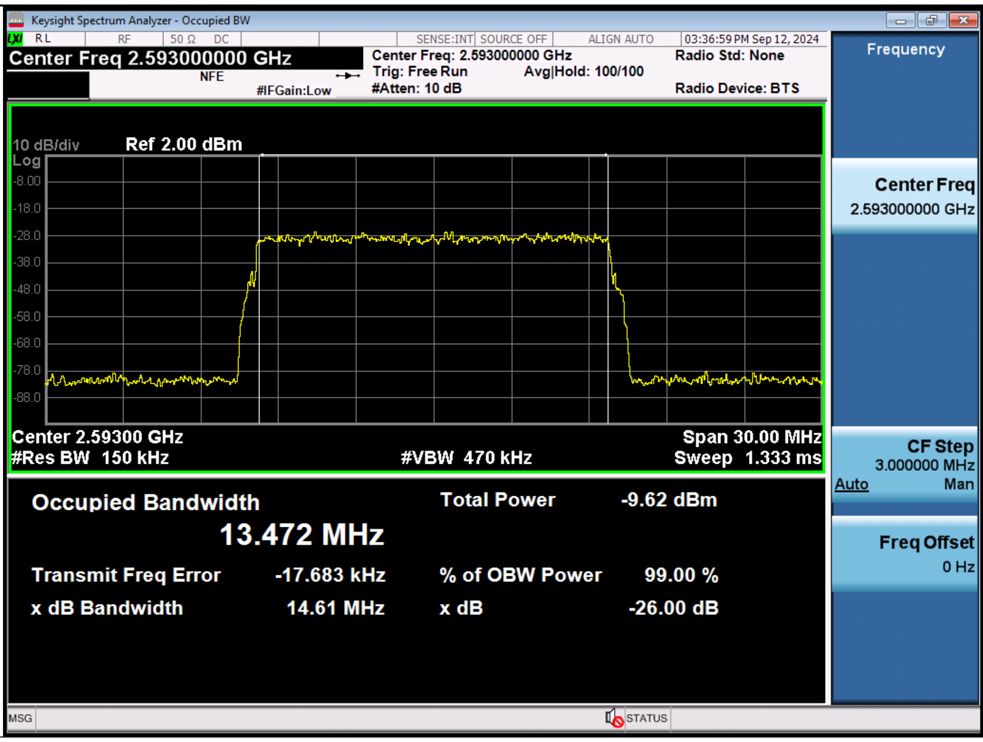


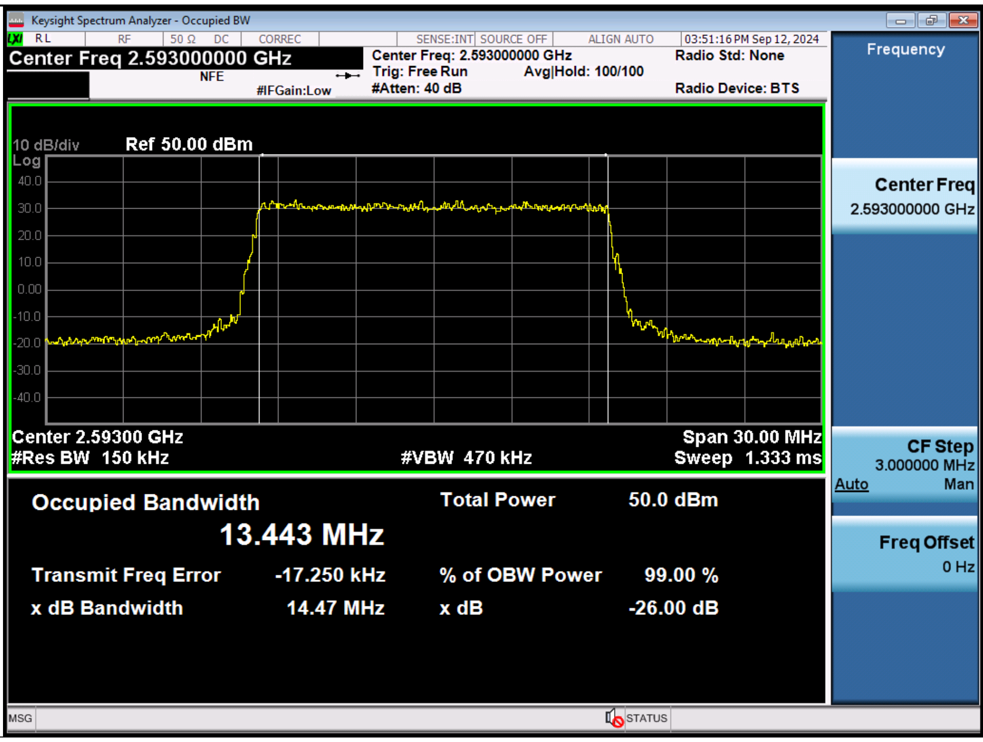
Output / BRS&EBS / Downlink / LTE 15 MHz



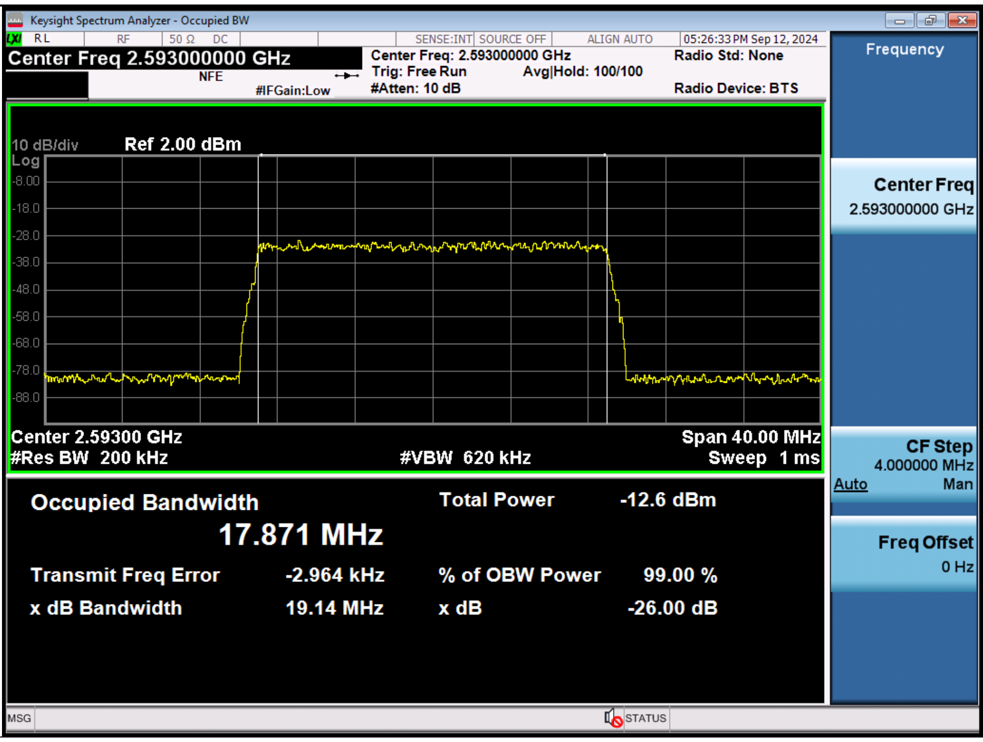
Input / BRS&EBS / Downlink / LTE 15 MHz



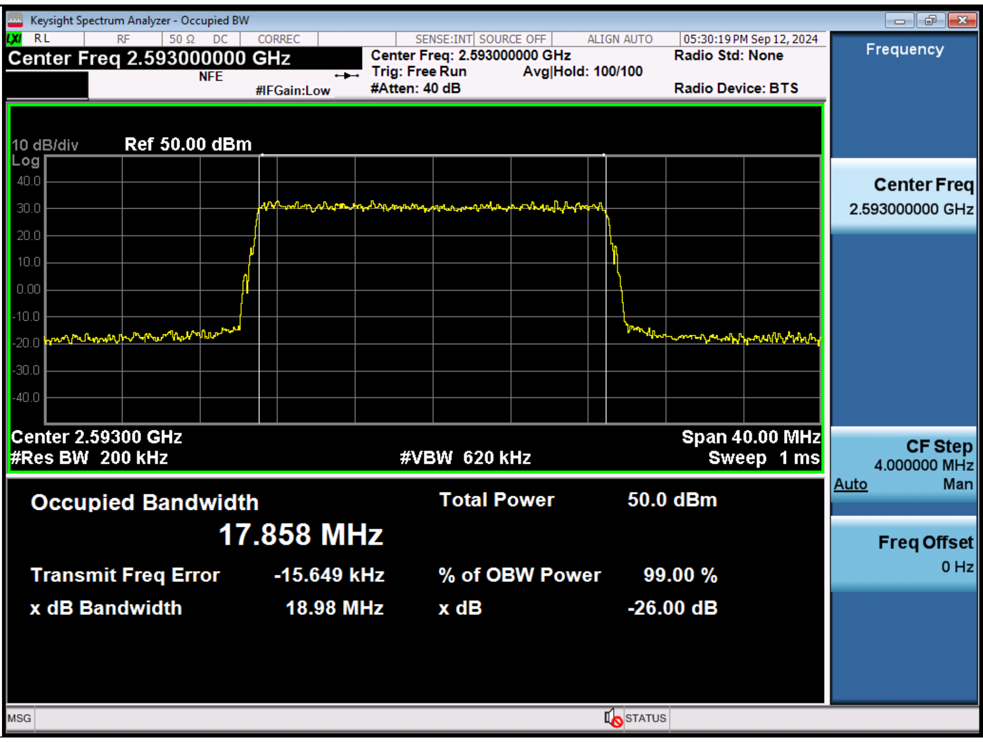
3 dB above the AGC threshold output / BRS&EBS / Downlink / LTE 15 MHz


3 dB above the AGC threshold Input / BRS&EBS / Downlink / LTE 15 MHz


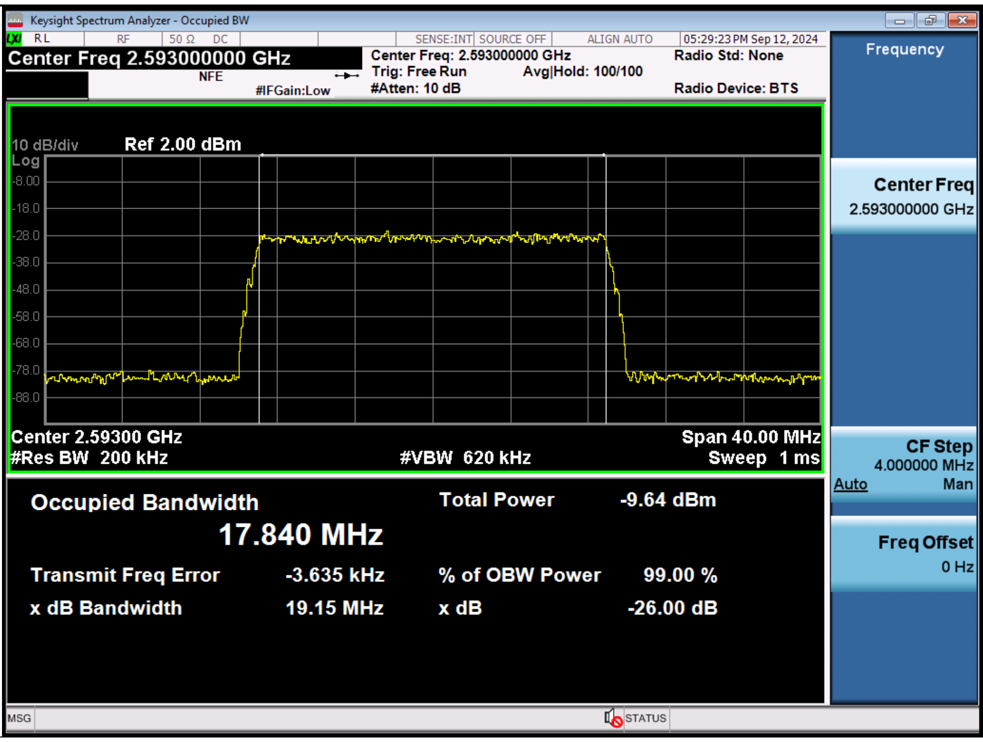
Output / BRS&EBS / Downlink / LTE 20 MHz



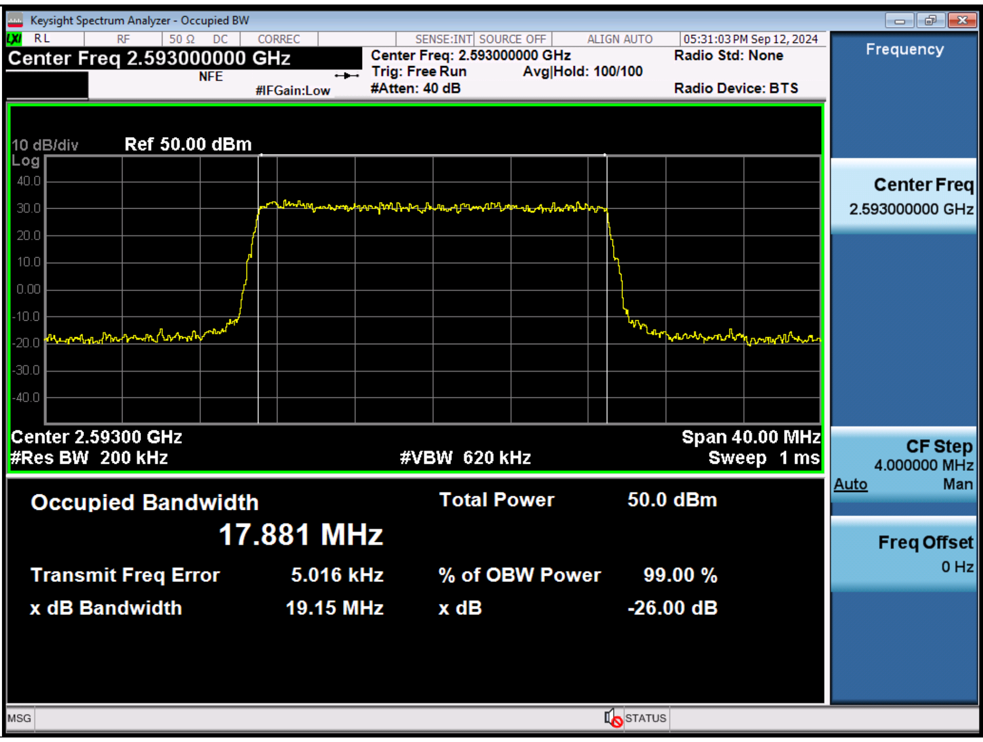
Input / BRS&EBS / Downlink / LTE 20 MHz



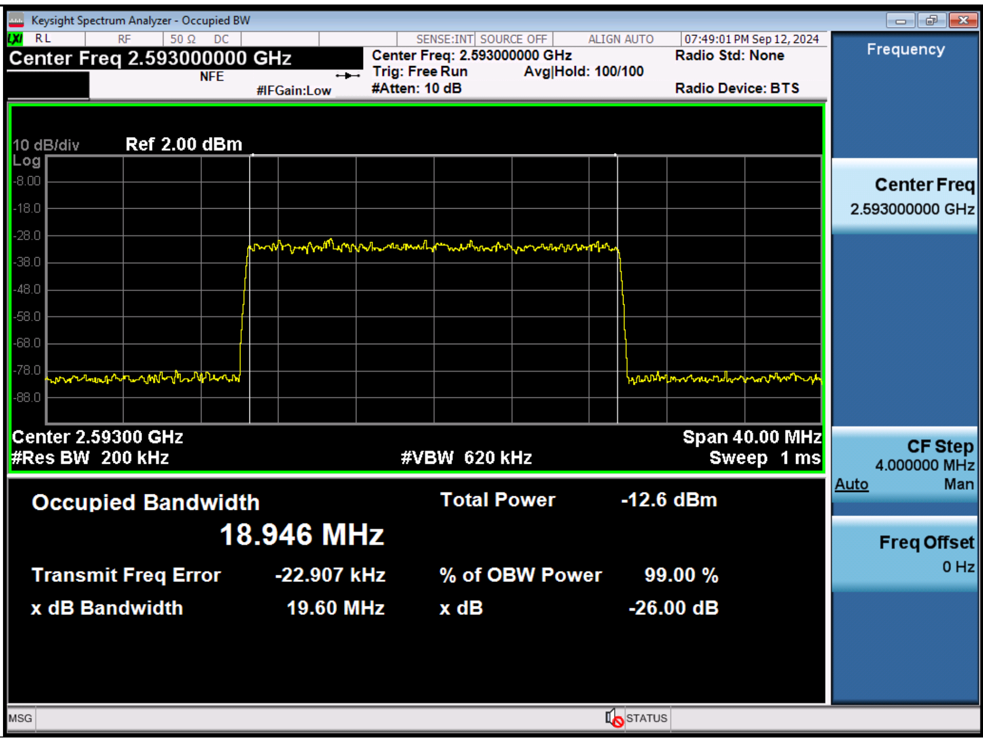
3 dB above the AGC threshold output / BRS&EBS / Downlink / LTE 20 MHz



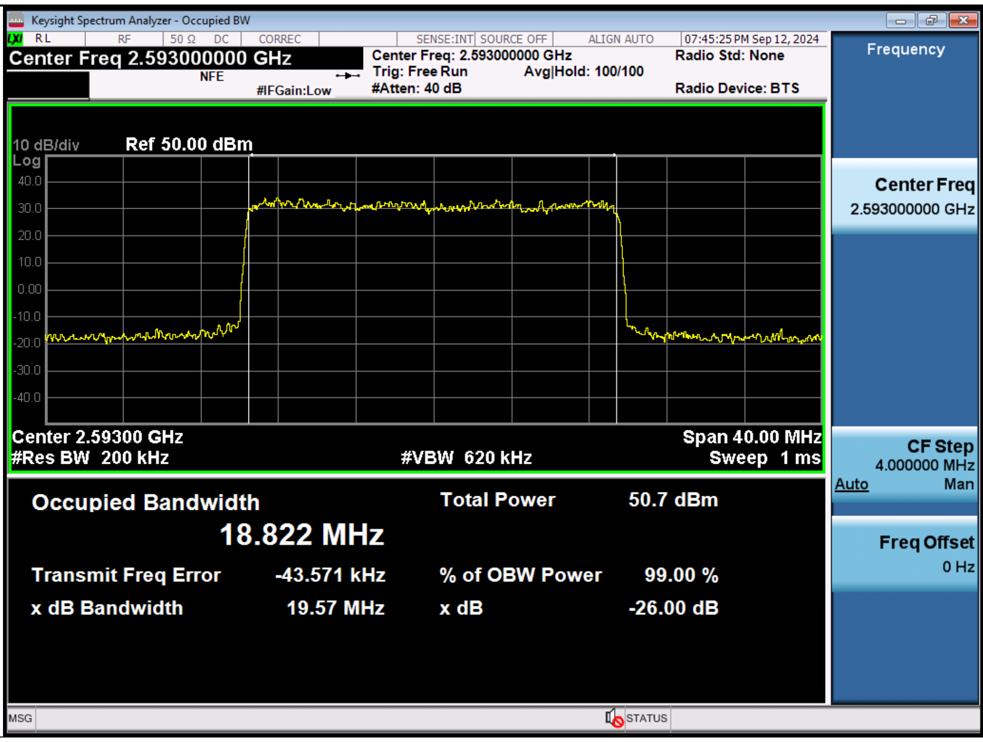
3 dB above the AGC threshold Input / BRS&EBS / Downlink / LTE 20 MHz



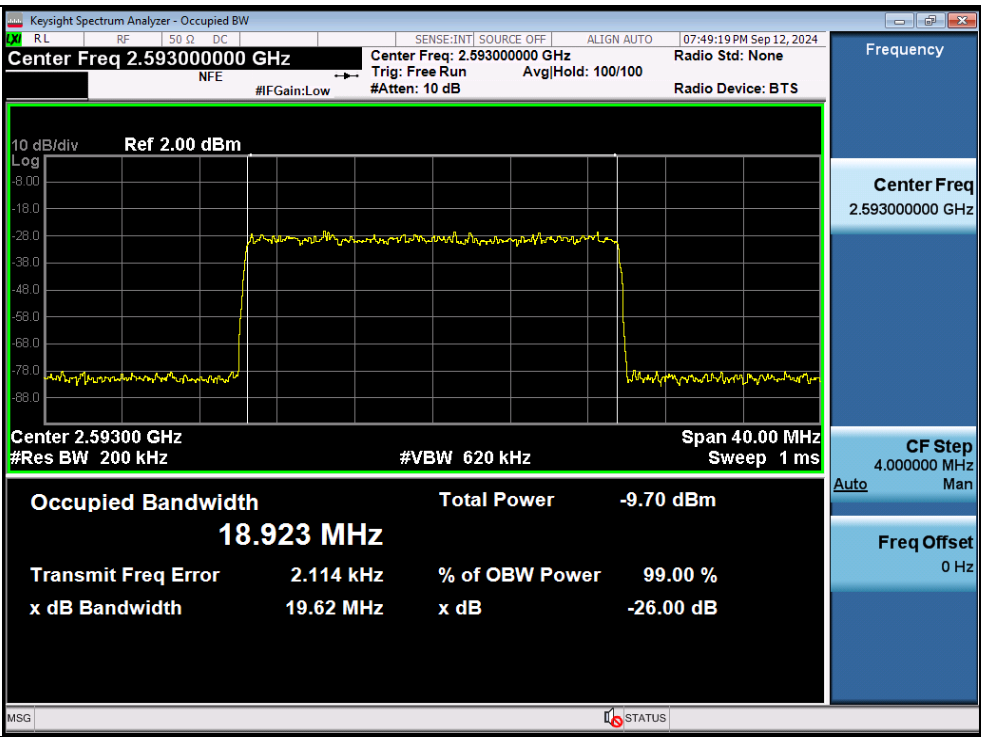
Output / BRS&EBS / Downlink / 5G NR 20 MHz



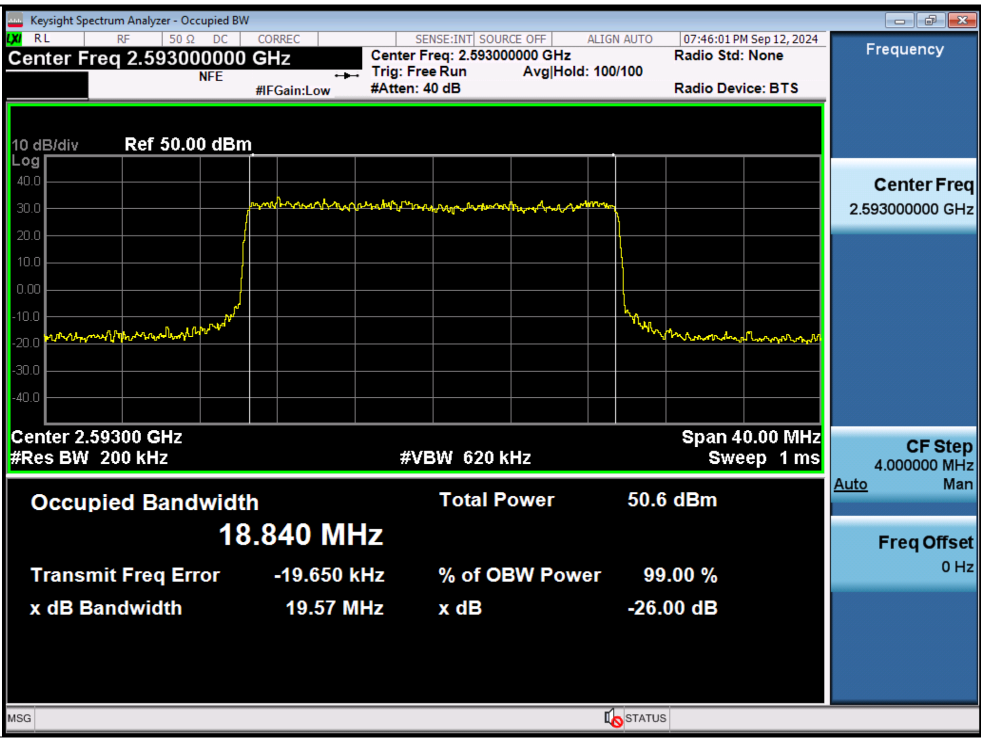
Input / BRS&EBS / Downlink / 5G NR 20 MHz



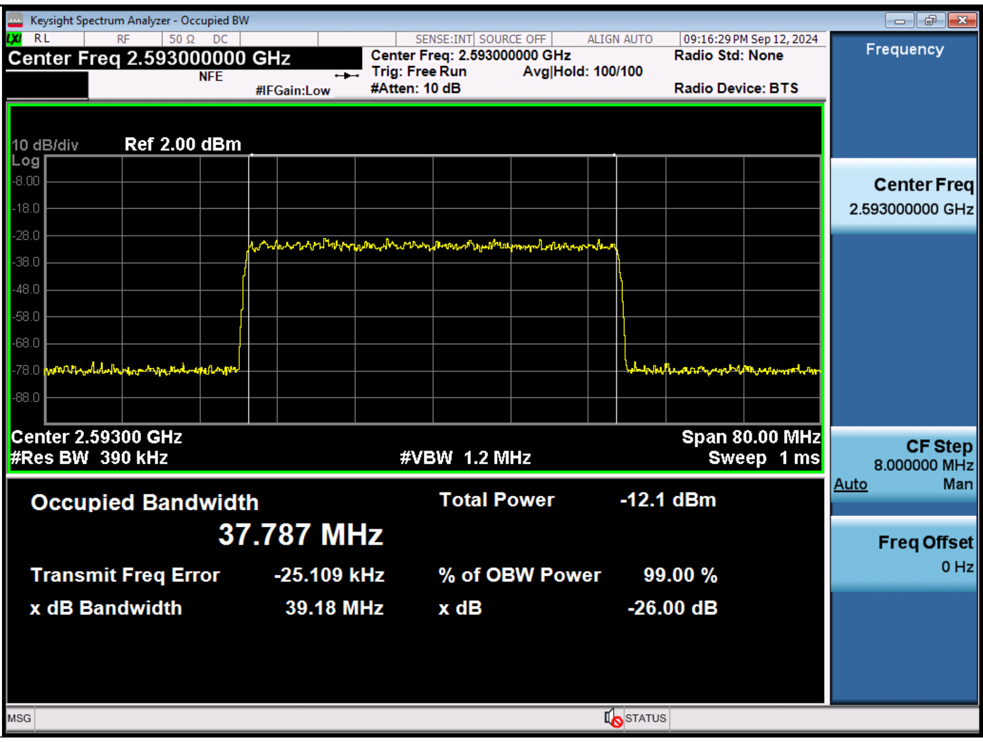
3 dB above the AGC threshold output / BRS&EBS / Downlink / 5G NR 20 MHz



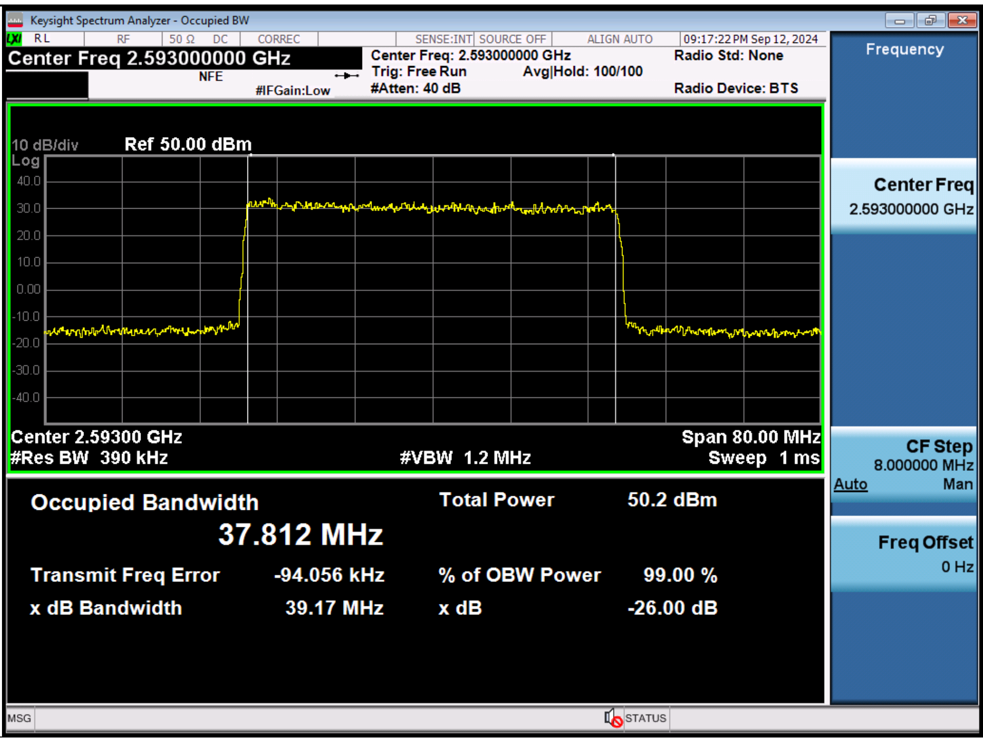
3 dB above the AGC threshold Input / BRS&EBS / Downlink / 5G NR 20 MHz



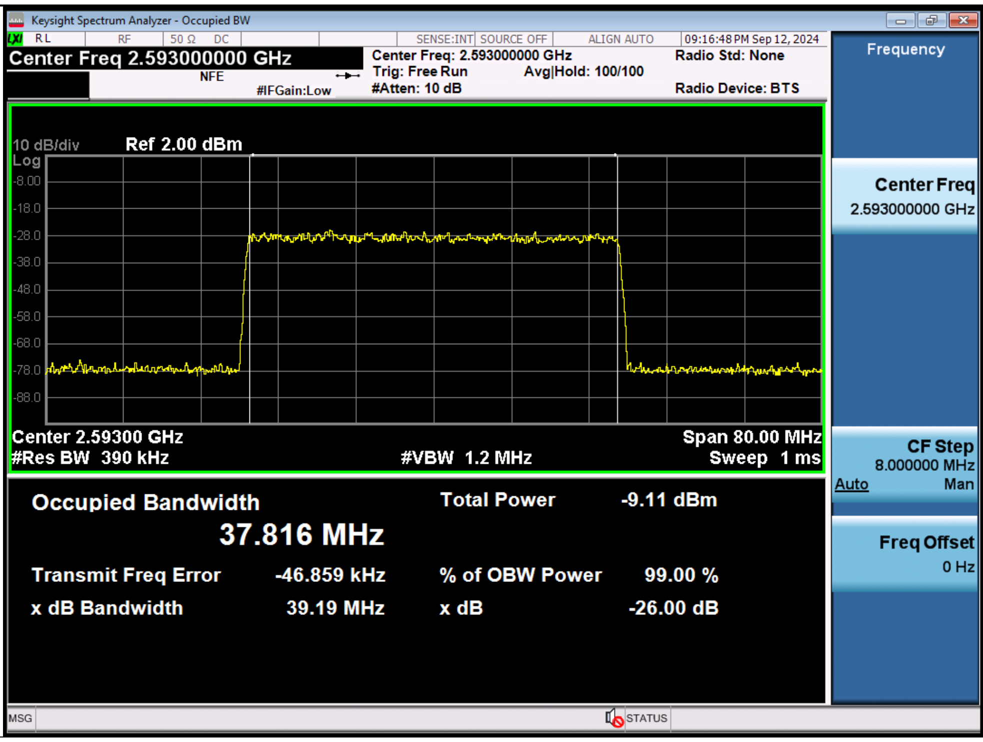
Output / BRS&EBS / Downlink / 5G NR 40 MHz



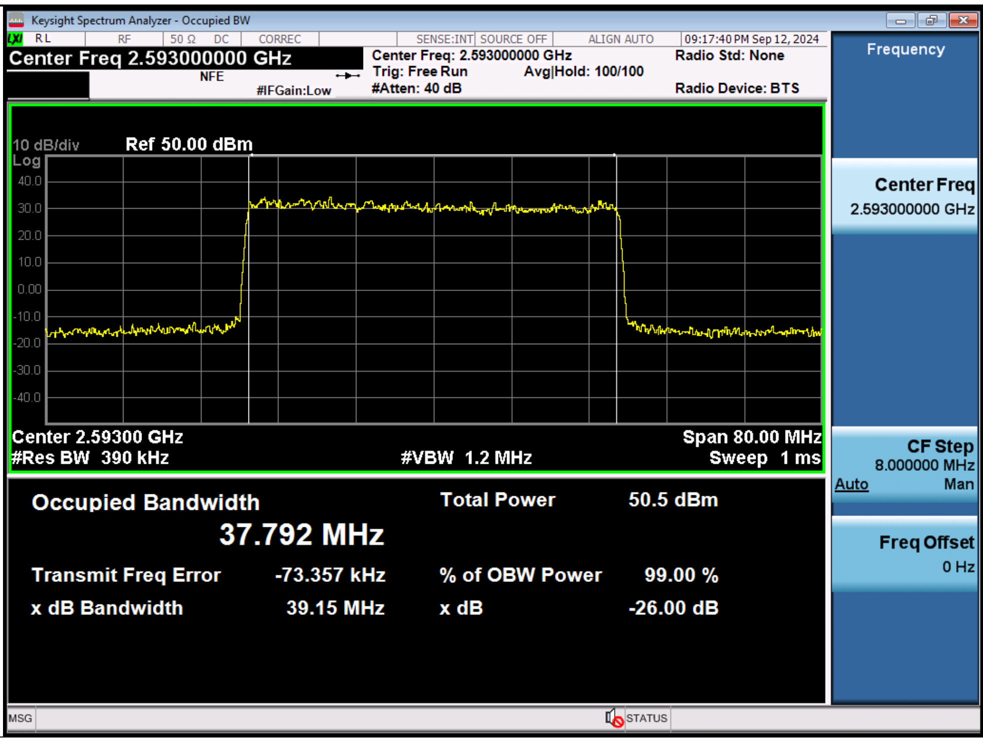
Input / BRS&EBS / Downlink / 5G NR 40 MHz



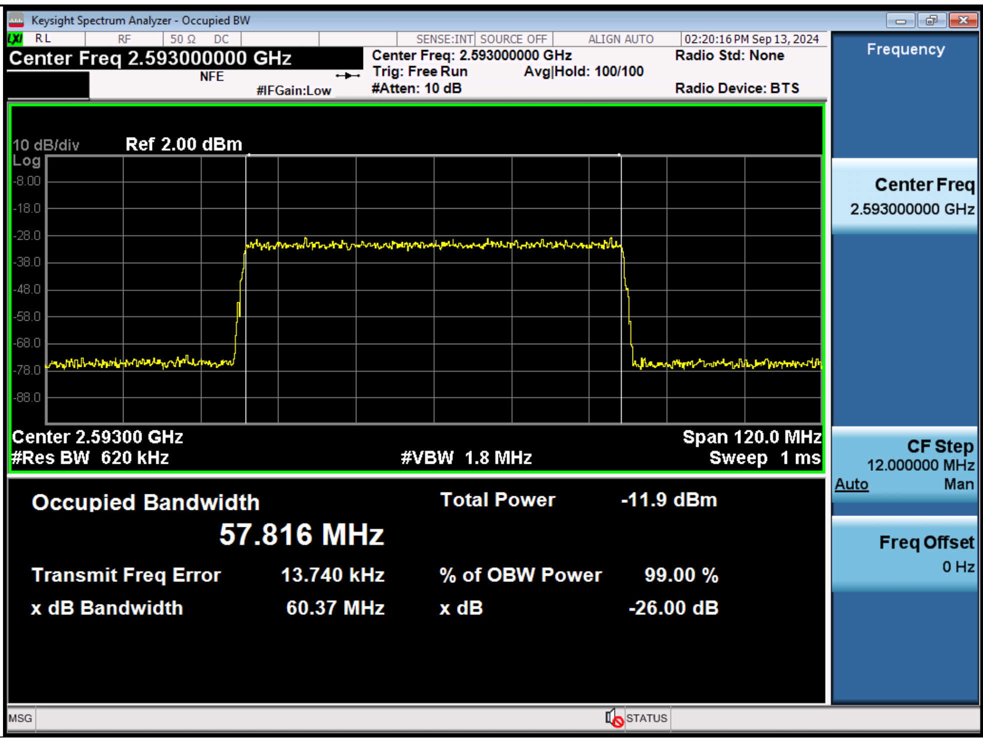
3 dB above the AGC threshold output / BRS&EBS / Downlink / 5G NR 40 MHz



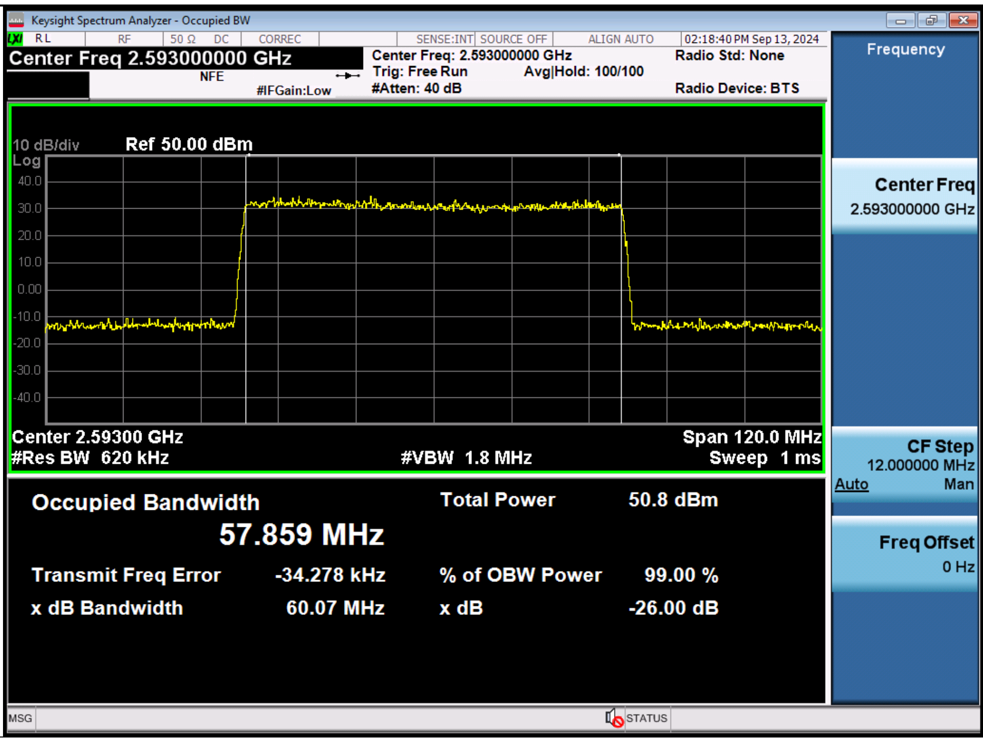
3 dB above the AGC threshold Input / BRS&EBS / Downlink / 5G NR 40 MHz



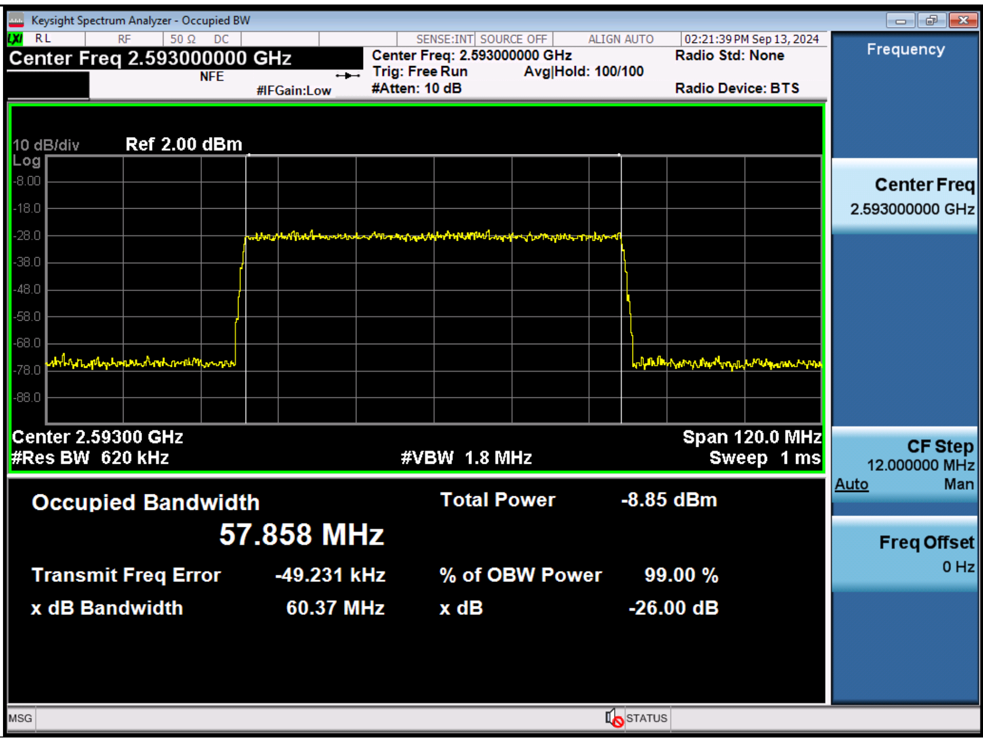
Output / BRS&EBS / Downlink / 5G NR 60 MHz



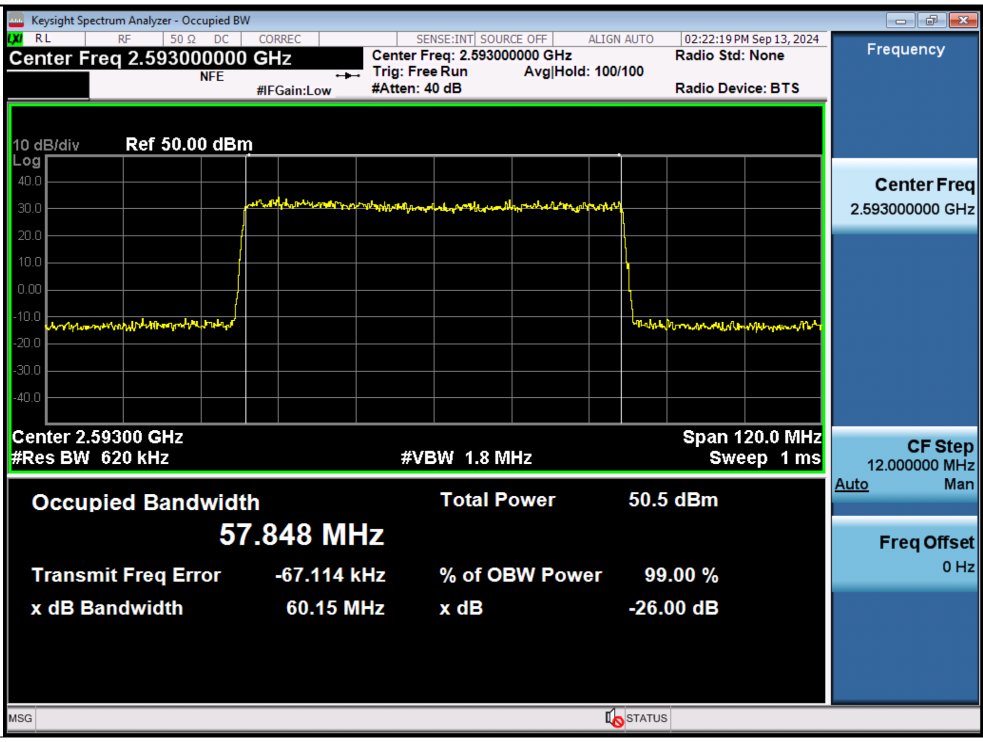
Input / BRS&EBS / Downlink / 5G NR 60 MHz



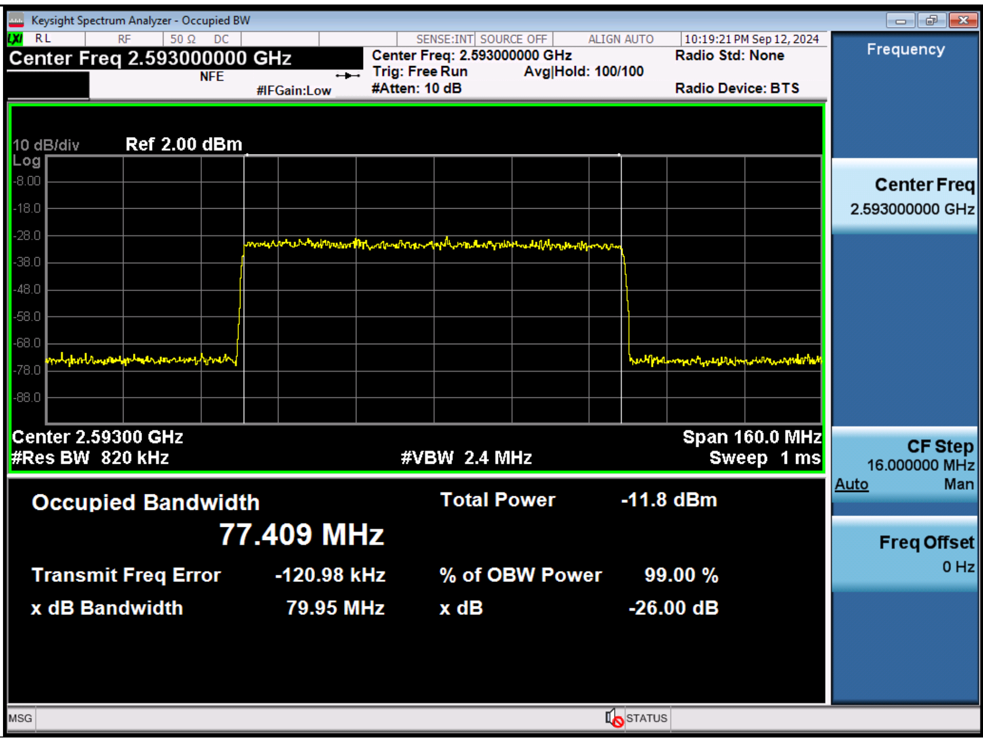
3 dB above the AGC threshold output / BRS&EBS / Downlink / 5G NR 60 MHz



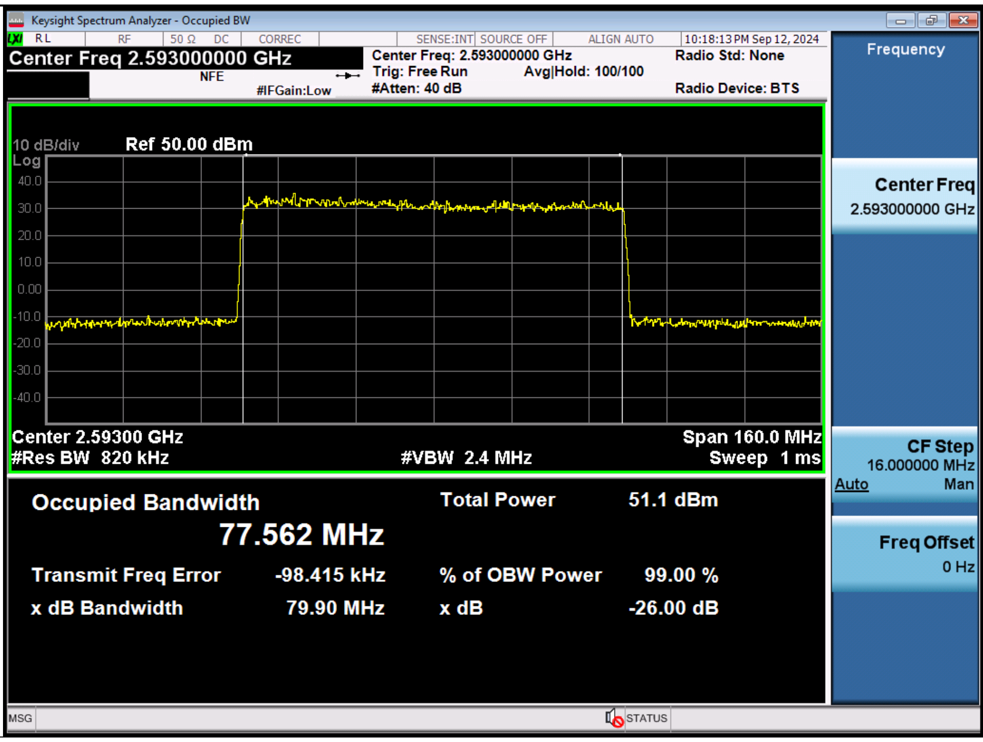
3 dB above the AGC threshold Input / BRS&EBS / Downlink / 5G NR 60 MHz

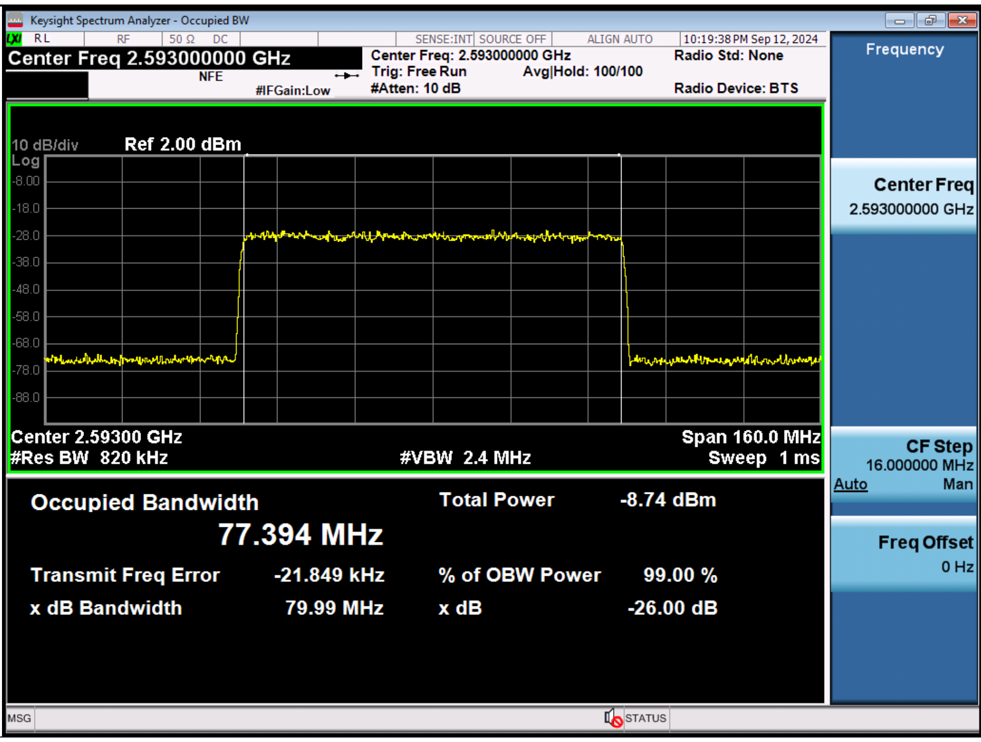


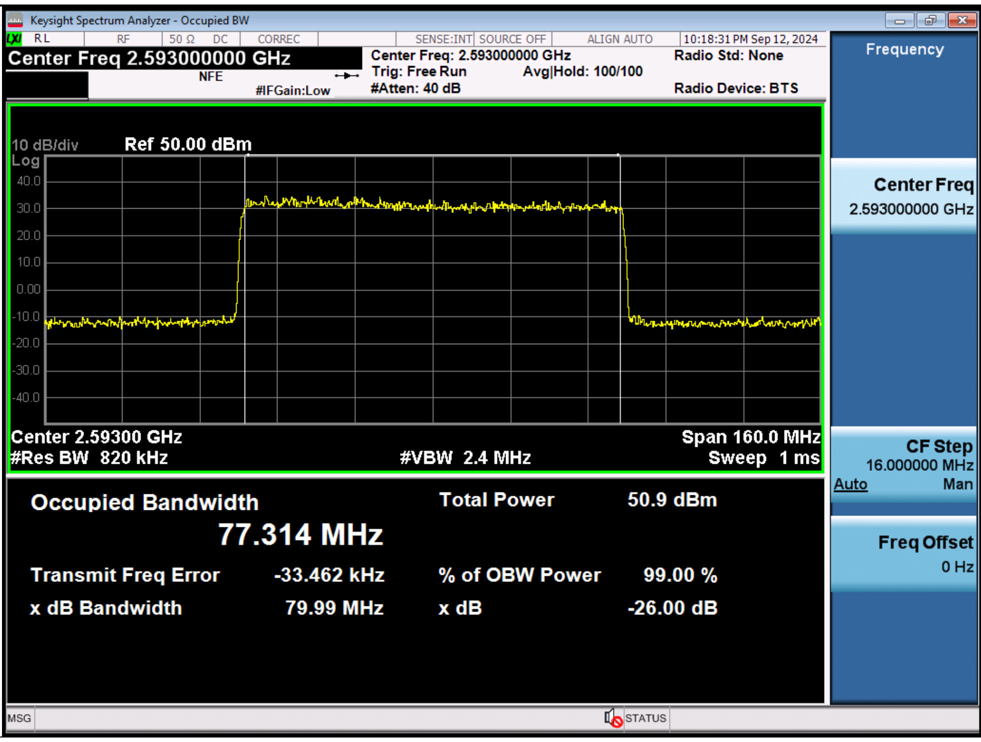
Output / BRS&EBS / Downlink / 5G NR 80 MHz



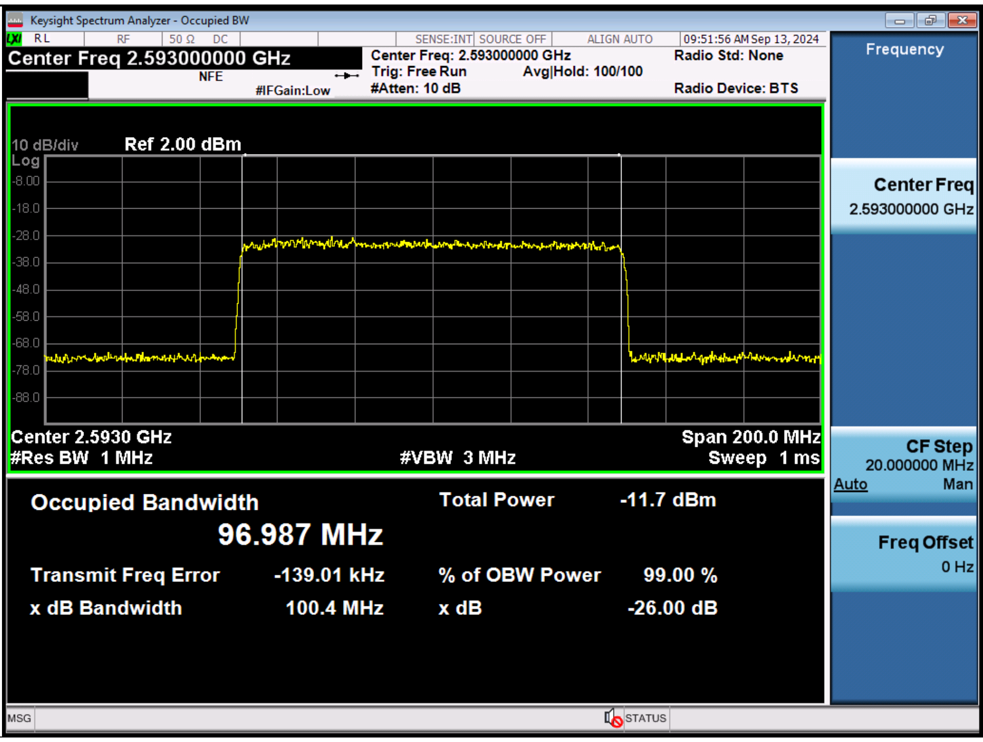
Input / BRS&EBS / Downlink / 5G NR 80 MHz



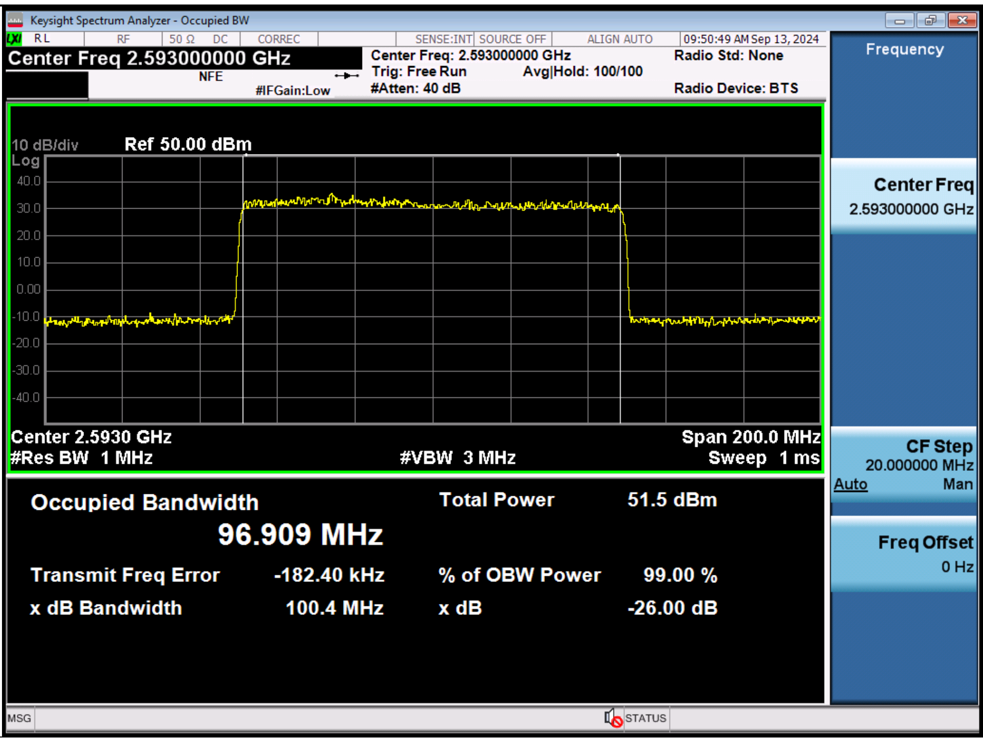
3 dB above the AGC threshold output / BRS&EBS / Downlink / 5G NR 80 MHz


3 dB above the AGC threshold Input / BRS&EBS / Downlink / 5G NR 80 MHz


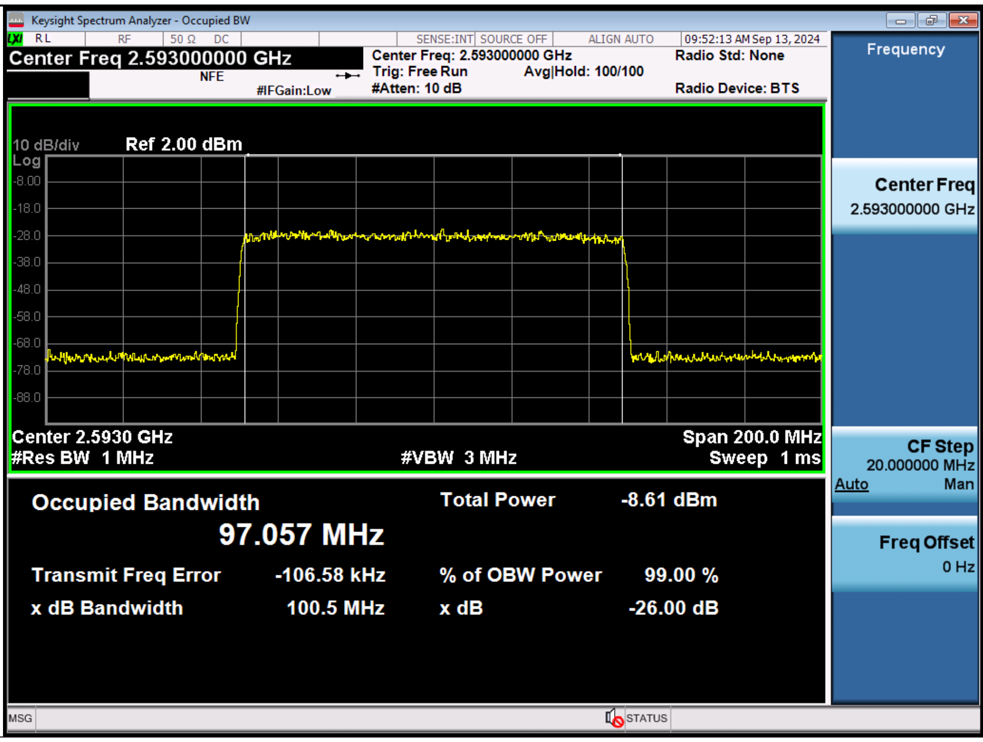
Output / BRS&EBS / Downlink / 5G NR 100 MHz



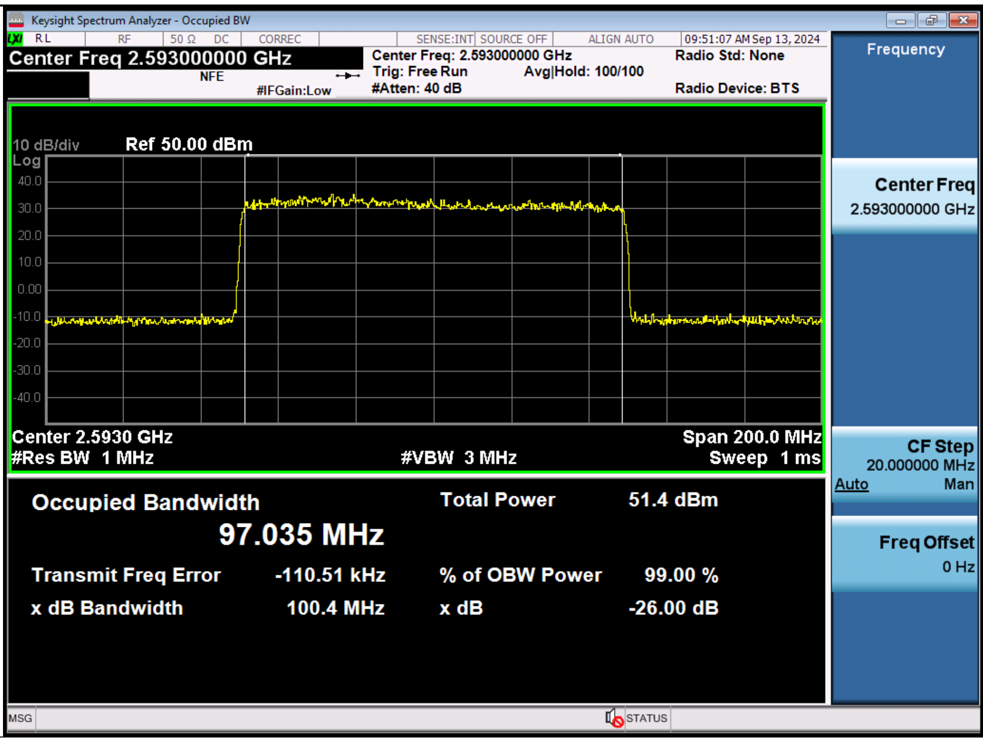
Input / BRS&EBS / Downlink / 5G NR 100 MHz



3 dB above the AGC threshold output / BRS&EBS / Downlink / 5G NR 100 MHz



3 dB above the AGC threshold Input / BRS&EBS / Downlink / 5G NR 100 MHz



5.4. INPUT/OUTPUT POWER AND AMPLIFIER/BOOSTER GAIN

Test Requirement:

§ 2.1046 Measurements required: RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

(b) For single sideband, independent sideband, and single channel, controlled carrier radiotelephone transmitters the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and applicable in § 2.1046 (b) (1-5). In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

§ 27.50 Power limits and duty cycle.

(h) The following power limits shall apply in the BRS and EBS:

(1) Main, booster and base stations.

(i) The maximum EIRP of a main, booster or base station shall not exceed 33 dBW + 10log(X/Y) dBW, where X is the actual channel width in MHz and Y is either 6 MHz if prior to transition or the station is in the MBS following transition or 5.5 MHz if the station is in the LBS and UBS following transition, except as provided in paragraph (h)(1)(ii) of this section.

(ii) If a main or booster station sectorizes or otherwise uses one or more transmitting antennas with a non-omnidirectional horizontal plane radiation pattern, the maximum EIRP in dBW in a given direction shall be determined by the following formula: EIRP = 33 dBW + 10 log(X/Y) dBW + 10 log(360/beamwidth) dBW, where X is the actual channel width in MHz, Y is either (i) 6 MHz if prior to transition or the station is in the MBS following transition or (ii) 5.5 MHz if the station is in the LBS and UBS following transition, and beamwidth is the total horizontal plane beamwidth of the individual transmitting antenna for the station or any sector measured at the half-power points.

Test Procedures:

Measurements were in accordance with the test methods section 3.5 of KDB 935210 D05 v01r04.

Adjust the internal gain control of the EUT to the maximum gain for which the equipment certification is being sought. Any EUT attenuation settings shall be set to their minimum value.

Input power levels (uplink and downlink) should be set to maximum input ratings while confirming that the device is not capable of operating in saturation (non-linear mode) at the rated input levels, including during the performance of the input/output power measurements.

3.5.2 Measuring the EUT mean input and output power

a) Connect a signal generator to the input of the EUT.
b) Configure to generate the test signal.
c) The frequency of the signal generator shall be set to the frequency f_0 as determined from out-of-band rejection test.
d) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.
e) Set the signal generator output power to a level that produces an EUT output level that is just below the AGC threshold, but not more than 0.5 dB below.
f) Measure and record the output power of the EUT; use ANSI C63.26-2015 subclause 5.2.4.4.1, for power measurement.
g) Remove the EUT from the measurement setup. Using the same signal generator settings, repeat the power measurement at the signal generator port, which was used as the input signal to the EUT, and record as the input power. EUT gain may be calculated as described in 3.5.5.
h) Repeat steps f) and g) with input signal amplitude set to 3 dB above the AGC threshold level.
i) Repeat steps e) to h) with the narrowband test signal.
j) Repeat steps e) to i) for all frequency bands authorized for use by the EUT.

3.5.5 Calculating amplifier, repeater, or industrial booster gain

After the input and output power levels have been measured as described in the preceding subclauses, the gain of the EUT can be determined from:

$$\text{Gain (dB)} = \text{output power (dBm)} - \text{input power (dBm)}.$$

Report the gain for each authorized operating frequency band, and each test signal stimulus.

Note:

If f_0 that determined from out-of-band test is smaller or greater than difference of test signal's center frequency and operation band block, test is performed at the lowest or the highest frequency that test signals can be passed.

Test Results:

[Outdoor] Tabular data of Input / Output Power and Gain

Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)	Ant. Gain (dBi)	E.I.R.P. (dBm)	Limit (dBm)
BRS&EBS (Ant. 1)	Downlink	LTE 5 MHz	2 516.24	-20.03	42.94	62.97	12.00	54.94	63.00
		LTE 10 MHz	2 516.24	-20.03	43.07	63.10	12.00	55.07	63.00
		LTE 15 MHz	2 516.24	-20.00	42.90	62.90	12.00	54.90	63.01
		LTE 20 MHz	2 516.24	-20.05	42.97	63.02	12.00	54.97	63.01
		5G NR 20 MHz	2 516.24	-19.98	43.00	62.98	12.00	55.00	63.01
		5G NR 40 MHz	2 516.24	-20.08	43.18	63.26	12.00	55.18	63.01
		5G NR 60 MHz	2 526.00	-20.03	43.19	63.22	12.00	55.19	63.02
		5G NR 80 MHz	2 536.00	-20.00	43.06	63.06	12.00	55.06	63.03
		5G NR 100 MHz	2 546.00	-20.04	43.22	63.26	12.00	55.22	63.04

[Outdoor] Tabular data of 3 dB above AGC threshold Input / Output Power and Gain

Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)	Ant. Gain (dBi)	E.I.R.P. (dBm)	Limit (dBm)
BRS&EBS (Ant. 1)	Downlink	LTE 5 MHz	2 516.24	-16.98	42.87	59.85	12.00	54.87	63.00
		LTE 10 MHz	2 516.24	-17.04	42.95	59.99	12.00	54.95	63.00
		LTE 15 MHz	2 516.24	-17.03	43.02	60.05	12.00	55.02	63.01
		LTE 20 MHz	2 516.24	-17.05	43.09	60.12	12.00	55.09	63.01
		5G NR 20 MHz	2 516.24	-17.04	43.35	60.39	12.00	55.35	63.01
		5G NR 40 MHz	2 516.24	-17.04	43.19	60.23	12.00	55.19	63.01
		5G NR 60 MHz	2 526.00	-17.00	43.23	60.23	12.00	55.23	63.02
		5G NR 80 MHz	2 536.00	-16.99	42.95	59.94	12.00	54.95	63.03
		5G NR 100 MHz	2 546.00	-17.04	43.03	60.07	12.00	55.03	63.04

Note:

- E.I.R.P.(dBm/MHz) = Output Power(dBm) + Ant. Gain(dBi)
- Sample Calculation(Limit):

  33 dBW + 10log(X/Y) (where X is the actual channel width in MHz and Y is either 6 MHz)

  if X = 5 MHz,

  = 33 dBW + 10log(5/6)

  = 1995.26 W + 0.83 W = 1996.09 W = 63 dBm

[Outdoor] MIMO(Ant. 1 + Ant. 2) Tabular data of Input / Output Power and Gain

Test Band	Link	Signal	Output Power (dBm)	Directional Gain (dBi)	E.I.R.P. (dBm)	Limit (dBm)
BRS&EBS (Ant. 1 + Ant. 2)	Downlink	LTE 5 MHz	45.98	15.00	60.98	63.00
		LTE 10 MHz	46.15	15.00	61.15	63.00
		LTE 15 MHz	46.02	15.00	61.02	63.01
		LTE 20 MHz	46.02	15.00	61.02	63.01
		5G NR 20 MHz	46.12	15.00	61.12	63.01
		5G NR 40 MHz	46.30	15.00	61.30	63.01
		5G NR 60 MHz	46.16	15.00	61.16	63.02
		5G NR 80 MHz	46.22	15.00	61.22	63.03
		5G NR 100 MHz	46.26	15.00	61.26	63.04

[Outdoor] MIMO(Ant. 1 + Ant. 2) Tabular data of 3 dB above AGC threshold Input / Output Power and Gain

Test Band	Link	Signal	Output Power (dBm)	Directional Gain (dBi)	E.I.R.P. (dBm)	Limit (dBm)
BRS&EBS (Ant. 1 + Ant. 2)	Downlink	LTE 5 MHz	46.00	15.00	61.00	63.00
		LTE 10 MHz	46.09	15.00	61.09	63.00
		LTE 15 MHz	46.10	15.00	61.10	63.01
		LTE 20 MHz	46.22	15.00	61.22	63.01
		5G NR 20 MHz	46.26	15.00	61.26	63.01
		5G NR 40 MHz	46.11	15.00	61.11	63.01
		5G NR 60 MHz	46.12	15.00	61.12	63.02
		5G NR 80 MHz	46.11	15.00	61.11	63.03
		5G NR 100 MHz	46.16	15.00	61.16	63.04

Note:

- E.I.R.P.(dBm/MHz) = Output Power(dBm) + Ant. Gain(dBi)
- Sample Calculation(Limit):
  33 dBW + 10log(X/Y) (where X is the actual channel width in MHz and Y is either 6 MHz)
  if X = 5 MHz,
  = 33 dBW + 10log(5/6)
  = 1995.26 W + 0.83 W = 1996.09 W = 63 dBm

[Indoor] Tabular data of Input / Output Power and Gain

Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)	Ant. Gain (dBi)	E.I.R.P. (dBm)	Limit (dBm)
BRS&EBS (Ant. 1)	Downlink	LTE 5 MHz	2 516.24	-20.03	42.94	62.97	-16.00	26.94	63.00
		LTE 10 MHz	2 516.24	-20.03	43.07	63.10	-16.00	27.07	63.00
		LTE 15 MHz	2 516.24	-20.00	42.90	62.90	-16.00	26.90	63.01
		LTE 20 MHz	2 516.24	-20.05	42.97	63.02	-16.00	26.97	63.01
		5G NR 20 MHz	2 516.24	-19.98	43.00	62.98	-16.00	27.00	63.01
		5G NR 40 MHz	2 516.24	-20.08	43.18	63.26	-16.00	27.18	63.01
		5G NR 60 MHz	2 526.00	-20.03	43.19	63.22	-16.00	27.19	63.02
		5G NR 80 MHz	2 536.00	-20.00	43.06	63.06	-16.00	27.06	63.03
		5G NR 100 MHz	2 546.00	-20.04	43.22	63.26	-16.00	27.22	63.04

[Indoor] Tabular data of 3 dB above AGC threshold Input / Output Power and Gain

Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)	Ant. Gain (dBi)	E.I.R.P. (dBm)	Limit (dBm)
BRS&EBS (Ant. 1)	Downlink	LTE 5 MHz	2 516.24	-16.98	42.87	59.85	-16.00	26.87	63.00
		LTE 10 MHz	2 516.24	-17.04	42.95	59.99	-16.00	26.95	63.00
		LTE 15 MHz	2 516.24	-17.03	43.02	60.05	-16.00	27.02	63.01
		LTE 20 MHz	2 516.24	-17.05	43.09	60.12	-16.00	27.09	63.01
		5G NR 20 MHz	2 516.24	-17.04	43.35	60.39	-16.00	27.35	63.01
		5G NR 40 MHz	2 516.24	-17.04	43.19	60.23	-16.00	27.19	63.01
		5G NR 60 MHz	2 526.00	-17.00	43.23	60.23	-16.00	27.23	63.02
		5G NR 80 MHz	2 536.00	-16.99	42.95	59.94	-16.00	26.95	63.03
		5G NR 100 MHz	2 546.00	-17.04	43.03	60.07	-16.00	27.03	63.04

Note:

- E.I.R.P.(dBm/MHz) = Output Power(dBm) + Ant. Gain(dBi)
- Sample Calculation(Limit):
  33 dBW + 10log(X/Y) (where X is the actual channel width in MHz and Y is either 6 MHz)
  if X = 5 MHz,
  = 33 dBW + 10log(5/6)
  = 1995.26 W + 0.83 W = 1996.09 W = 63 dBm

[Indoor] MIMO(Ant. 1 + Ant. 2) Tabular data of Input / Output Power and Gain

Test Band	Link	Signal	Output Power (dBm)	Directional Gain (dBi)	E.I.R.P. (dBm)	Limit (dBm)
BRS&EBS (Ant. 1 + Ant. 2)	Downlink	LTE 5 MHz	45.98	-13.00	32.98	63.00
		LTE 10 MHz	46.15	-13.00	33.15	63.00
		LTE 15 MHz	46.02	-13.00	33.02	63.01
		LTE 20 MHz	46.02	-13.00	33.02	63.01
		5G NR 20 MHz	46.12	-13.00	33.12	63.01
		5G NR 40 MHz	46.30	-13.00	33.30	63.01
		5G NR 60 MHz	46.16	-13.00	33.16	63.02
		5G NR 80 MHz	46.22	-13.00	33.22	63.03
		5G NR 100 MHz	46.26	-13.00	33.26	63.04

[Indoor] MIMO(Ant. 1 + Ant. 2) Tabular data of 3 dB above AGC threshold Input / Output Power and Gain

Test Band	Link	Signal	Output Power (dBm)	Directional Gain (dBi)	E.I.R.P. (dBm)	Limit (dBm)
BRS&EBS (Ant. 1 + Ant. 2)	Downlink	LTE 5 MHz	46.00	-13.00	33.00	63.00
		LTE 10 MHz	46.09	-13.00	33.09	63.00
		LTE 15 MHz	46.10	-13.00	33.10	63.01
		LTE 20 MHz	46.22	-13.00	33.22	63.01
		5G NR 20 MHz	46.26	-13.00	33.26	63.01
		5G NR 40 MHz	46.11	-13.00	33.11	63.01
		5G NR 60 MHz	46.12	-13.00	33.12	63.02
		5G NR 80 MHz	46.11	-13.00	33.11	63.03
		5G NR 100 MHz	46.16	-13.00	33.16	63.04

Note:

- E.I.R.P.(dBm/MHz) = Output Power(dBm) + Ant. Gain(dBi)
- Sample Calculation(Limit):

  33 dBW + 10log(X/Y) (where X is the actual channel width in MHz and Y is either 6 MHz)

  if X = 5 MHz,

  = 33 dBW + 10log(5/6)

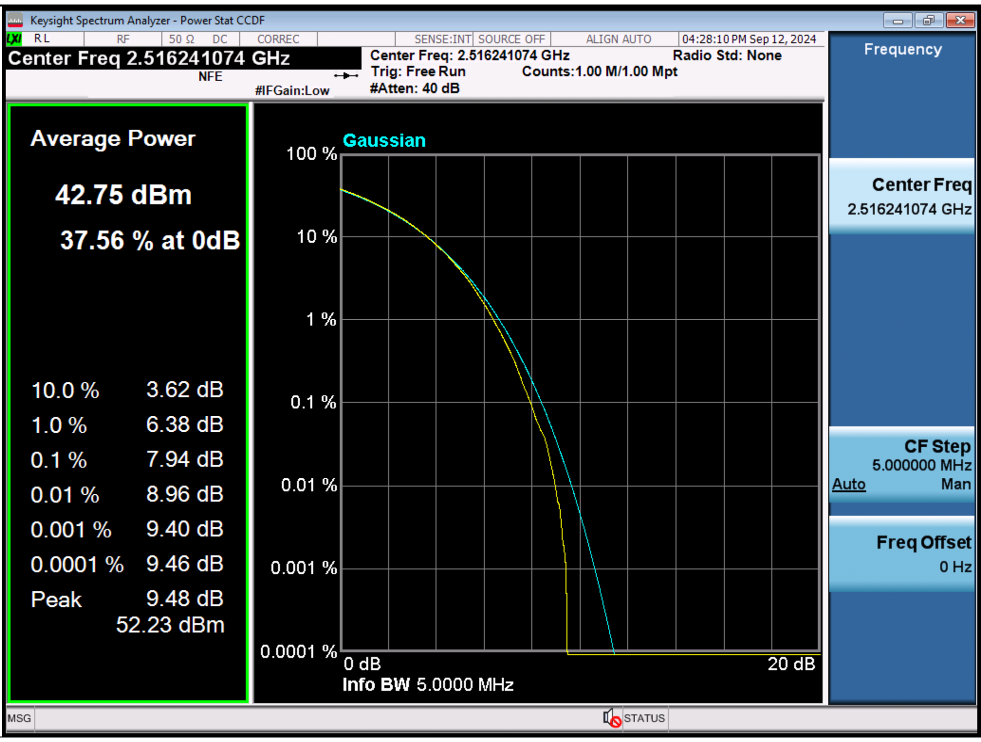
  = 1995.26 W + 0.83 W = 1996.09 W = 63 dBm

Tabular data of PAPR

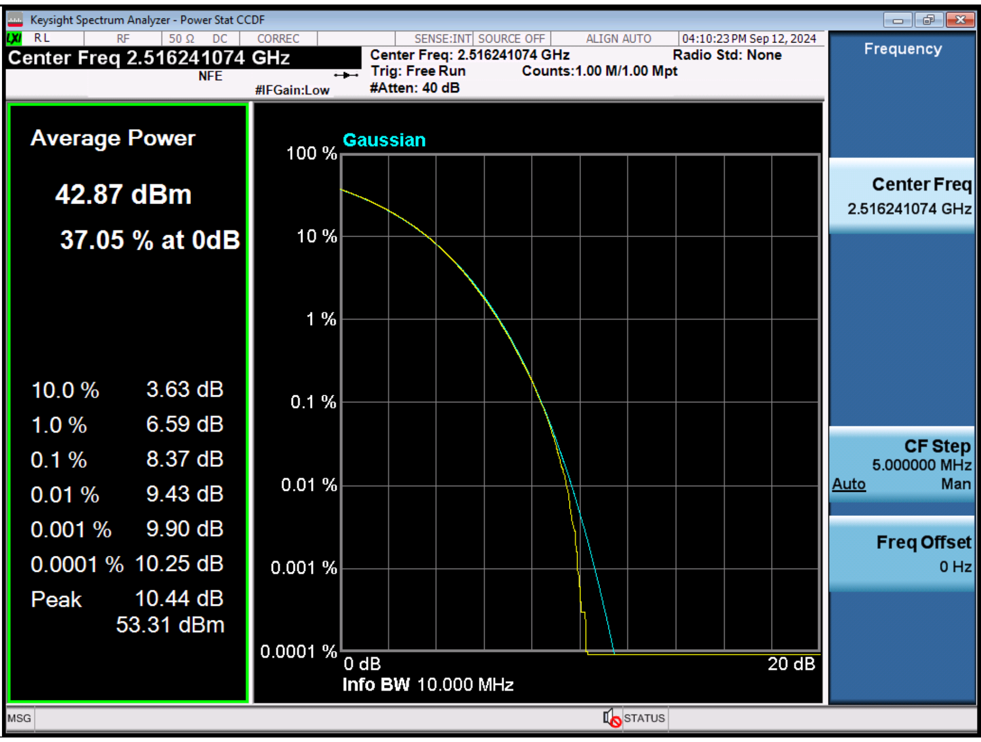
Test Band	Link	Signal	f_0 Frequency (MHz)	0.1 % PAPR (dB)
BRS&EBS (Ant. 1)	Downlink	LTE 5 MHz	2 516.24	7.94
		LTE 10 MHz	2 516.24	8.37
		LTE 15 MHz	2 516.24	8.25
		LTE 20 MHz	2 516.24	8.23
		5G NR 20 MHz	2 516.24	8.46
		5G NR 40 MHz	2 516.24	8.45
		5G NR 60 MHz	2 526.00	8.28
		5G NR 80 MHz	2 536.00	8.52
		5G NR 100 MHz	2 546.00	8.46

Plot data of PAPR

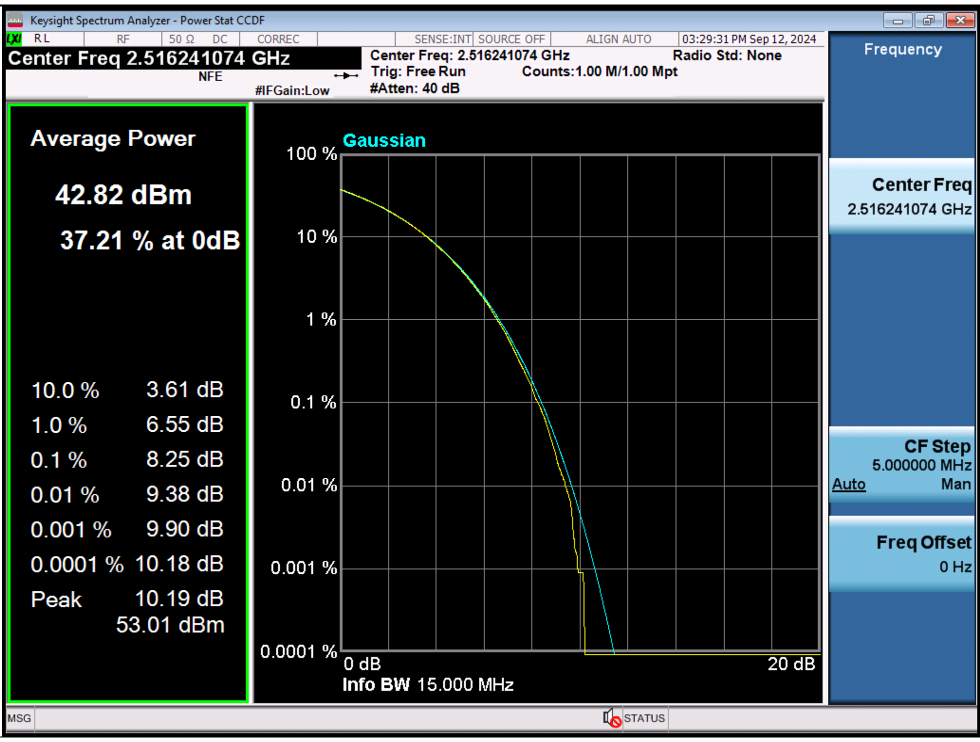
PAPR / BRS&EBS / Downlink / LTE 5 MHz



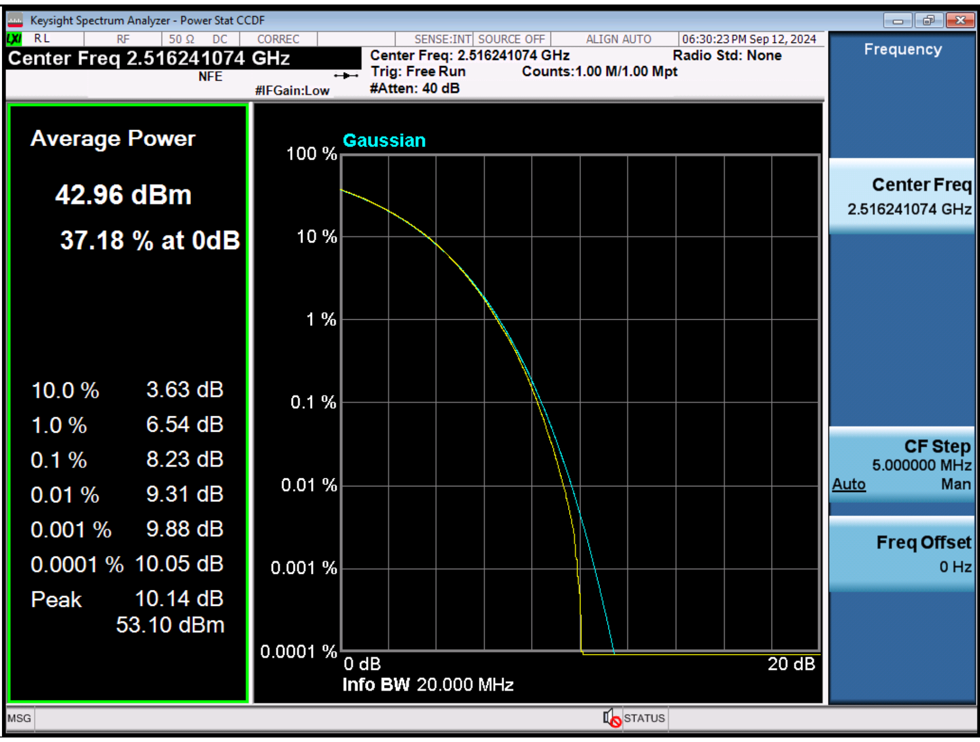
PAPR / BRS&EBS / Downlink / LTE 10 MHz



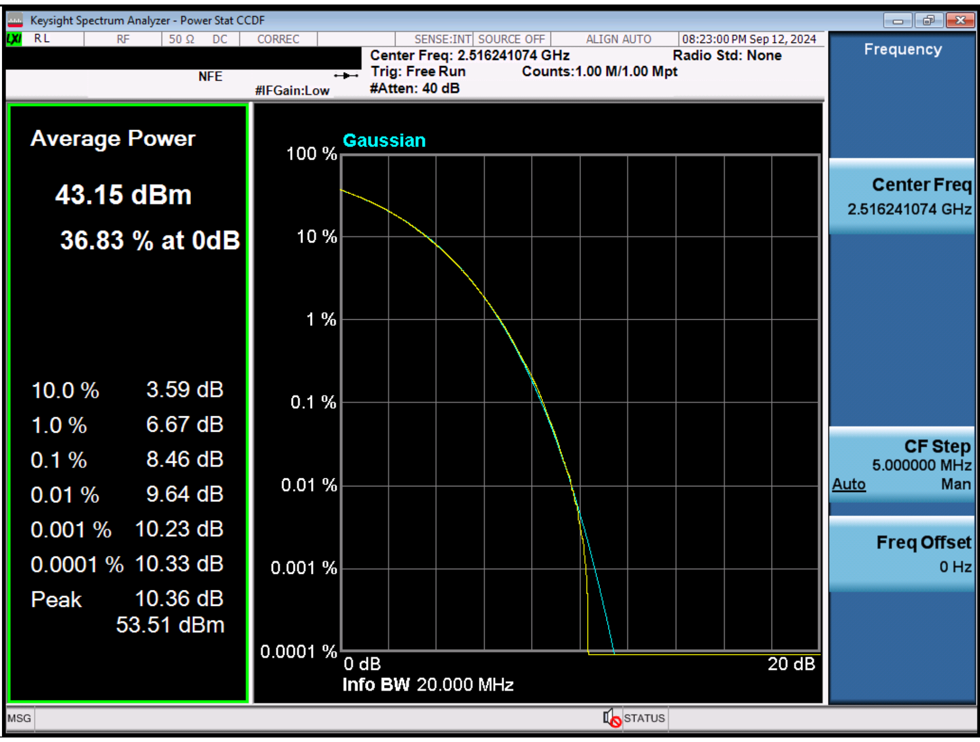
PAPR / BRS&EBS / Downlink / LTE 15 MHz



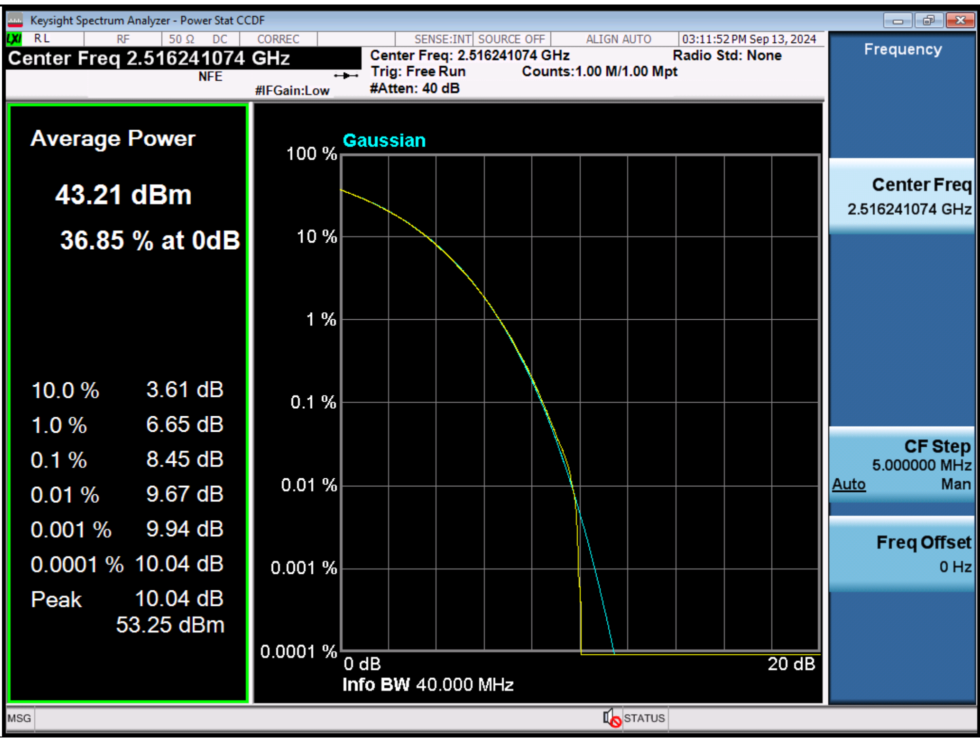
PAPR / BRS&EBS / Downlink / LTE 20 MHz



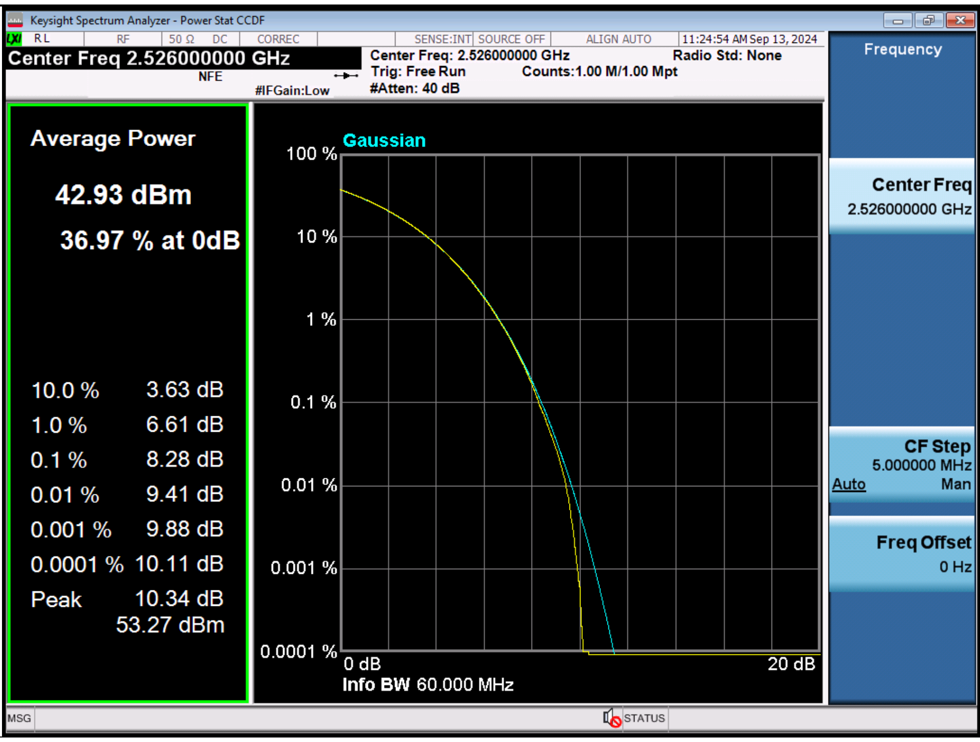
PAPR / BRS&EBS / Downlink / 5G NR 20 MHz



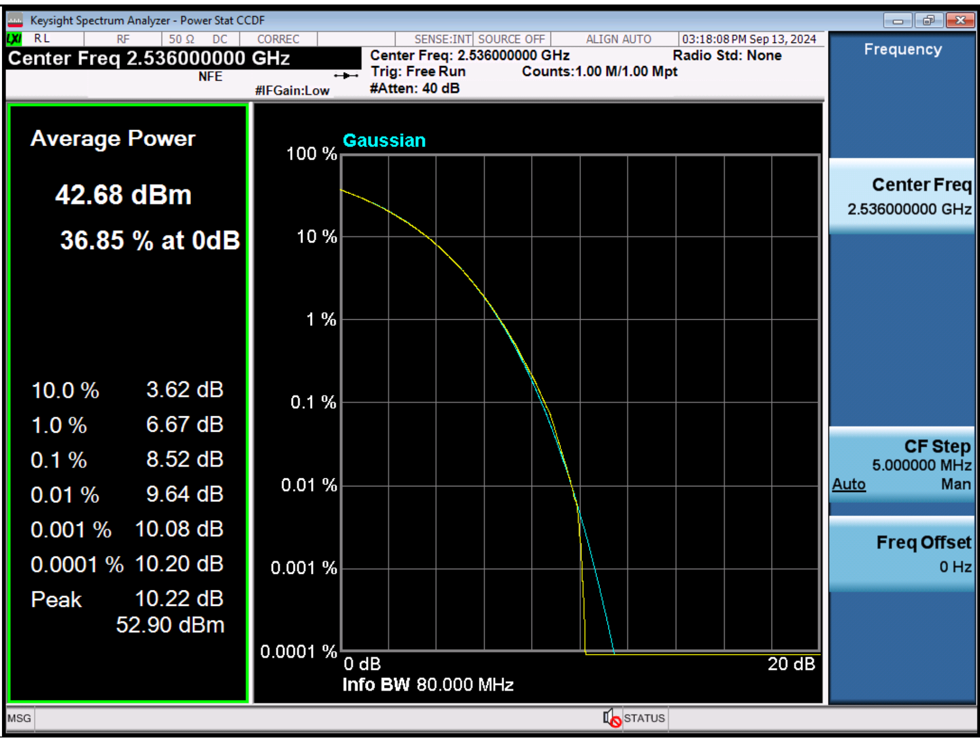
PAPR / BRS&EBS / Downlink / 5G NR 40 MHz



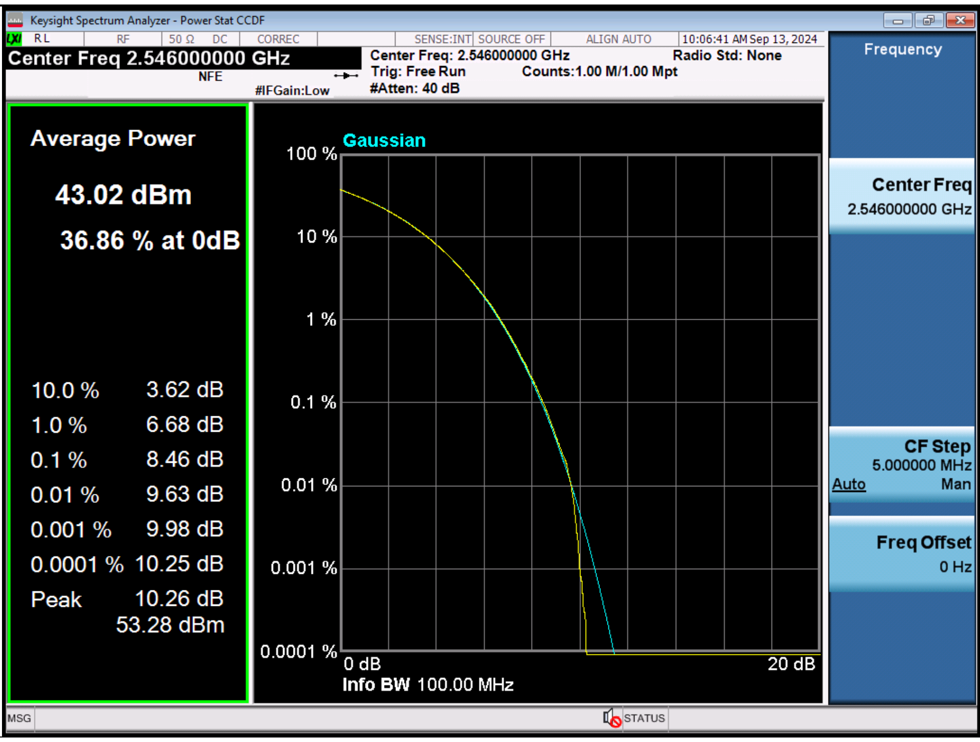
PAPR / BRS&EBS / Downlink / 5G NR 60 MHz



PAPR / BRS&EBS / Downlink / 5G NR 80 MHz



PAPR / BRS&EBS / Downlink / 5G NR 100 MHz



5.5. OUT-OF-BAND/OUT-OF-BLOCK EMISSIONS AND SPURIOUS EMISSIONS

Test Requirements:

§ 2.1051 Measurements required: Spurious emissions at antenna terminals:

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 27.53 Emission limits.

(m) For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts in accordance with the standards below. If a licensee has multiple contiguous channels, out-of-band emissions shall be measured from the upper and lower edges of the contiguous channels.

(2) For digital base stations, the attenuation shall be not less than 43 + 10 log (P) dB, unless a documented interference complaint is received from an adjacent channel licensee with an overlapping Geographic Service Area. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS No. 1 on the same terms and conditions as adjacent channel BRS or EBS licensees. Provided that a documented interference complaint cannot be mutually resolved between the parties prior to the applicable deadline, then the following additional attenuation requirements shall apply:

(i) If a pre-existing base station suffers harmful interference from emissions caused by a new or modified base station located 1.5 km or more away, within 24 hours of the receipt of a documented interference complaint the licensee of the new or modified base station must attenuate its emissions by at least 67 +10 log (P) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block and shall immediately notify the complaining licensee upon implementation of the additional attenuation. No later than 60 days after the implementation of such additional attenuation, the licensee of the complaining base station must attenuate its base station emissions by at least 67 +10 log (P) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block of the new or modified base station.

(ii) If a pre-existing base station suffers harmful interference from emissions caused by a new or modified base station located less than 1.5 km away, within 24 hours of receipt of a documented interference complaint the licensee of the new or modified base station must attenuate its emissions by at least 67 +10 log (P)－20 log (Dkm/1.5) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block of the complaining licensee, or if both base stations are co-located, limit its undesired signal level at the pre-existing base station receiver(s) to no more than －107 dBm measured in a 5.5 megahertz bandwidth and shall immediately notify the complaining licensee upon such reduction in the undesired signal level. No later than 60 days after such reduction in the undesired signal level, the complaining licensee must attenuate its base station emissions by at least 67 +10 log (P) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block of the new or modified base station.

(iii) If a new or modified base station suffers harmful interference from emissions caused by a pre-existing base station located 1.5 km or more away, within 60 days of receipt of a documented interference complaint the licensee of each base station must attenuate its base station emissions by at least 67 +10 log (P) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block of the other licensee.

(iv) If a new or modified base station suffers harmful interference from emissions caused by a pre-existing base station located less than 1.5 km away, within 60 days of receipt of a documented interference complaint: (a) The licensee of the new or modified base station must attenuate its OOBE by at least 67 +10 log (P)−20 log (Dkm/1.5) measured 3 megahertz above or below, from the channel edge of its frequency block of the other licensee, or if the base stations are co-located, limit its undesired signal level at the other base station receiver(s) to no more than −107 dBm measured in a 5.5-megahertz bandwidth; and (b) the licensee causing the interference must attenuate its emissions by at least 67 +10 log (P) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block of the new or modified base station.

(v) For all fixed digital user stations, the attenuation factor shall be not less than 43 +10 log (P) dB at the channel edge.

(6) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed; for mobile digital stations, in the 1 megahertz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least two percent may be employed, except when the 1 megahertz band is 2495-2496 MHz, in which case a resolution bandwidth of at least one percent 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 required measurement bandwidth (i.e. 1 megahertz or 1 percent of emission bandwidth, as specified; or 1 megahertz or 2 percent for mobile digital stations, except in the band 2495-2496 MHz). The 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. With respect to television operations, measurements must be made of the separate visual and aural operating powers at sufficiently frequent intervals to ensure compliance with the rules.

Test Procedures:

Measurements were in accordance with the test methods section 3.6 of KDB 935210 D05 v01r04 and Section 5.7.2 of ANSI C63.26.

KDB 935210 D05 v01r04

3.6 Measuring out-of-band/out-of-block (including intermodulation) emissions and spurious emissions

3.6.1 General

Spurious emissions shall be measured using a single test signal sequentially tuned to the low, middle, and high channels or frequencies within each authorized frequency band of operation.

Out-of-band/out-of-block emissions (including intermodulation products) shall be measured under each of the following two stimulus conditions:

a) two adjacent test signals sequentially tuned to the lower and upper frequency band/block edges;
b) a single test signal, sequentially tuned to the lowest and highest frequencies or channels within the frequency band/block under examination.

NOTE—Single-channel boosters that cannot accommodate two simultaneous signals within the passband may be excluded from the test stipulated in step a).

3.6.2 Out-of-band/out-of-block emissions conducted measurements

a) Connect a signal generator to the input of the EUT.
   If the signal generator is not capable of generating two modulated carriers simultaneously, then two discrete signal generators can be connected with an appropriate combining network to support this two-signal test.
b) Set the signal generator to produce two AWGN signals as previously described.
c) Set the center frequencies such that the AWGN signals occupy adjacent channels, as defined by industry standards such as 3GPP or 3GPP2, at the upper edge of the frequency band or block under test.
d) Set the composite power levels such that the input signal is just below the AGC threshold, but not more than 0.5 dB below. The composite power can be measured using the procedures provided in KDB Publication 971168, but it will be necessary to expand the power integration bandwidth so as to include both of the transmit channels.
e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.
f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band.
g) Set the VBW = 3 × RBW.
h) Set the detector to power averaging (rms) detector.
i) Set the Sweep time = auto-couple.
j) Set the spectrum analyzer start frequency to the upper block edge frequency, and the stop frequency to the upper block edge frequency plus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively.
k) Trace average at least 100 traces in power averaging (rms) mode.
l) Use the marker function to find the maximum power level.
m) Capture the spectrum analyzer trace of the power level for inclusion in the test report.

n) Repeat steps k) to m) with the composite input power level set to 3 dB above the AGC threshold.
o) Reset the frequencies of the input signals to the lower edge of the frequency block or band under test.
p) Reset the spectrum analyzer start frequency to the lower block edge frequency minus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively, and the stop frequency to the lower band or block edge frequency.
q) Repeat steps k) to n).
r) Repeat steps a) to q) with the signal generator configured for a single test signal tuned as close as possible to the block edges.
s) Repeat steps a) to r) with the narrowband test signal.
t) Repeat steps a) to s) for all authorized frequency bands or blocks used by the EUT.

3.6.3 Spurious emissions conducted measurements

a) Connect a signal generator to the input of the EUT.
b) Set the signal generator to produce the broadband test signal as previously described.
c) Set the center frequency of the test signal to the lowest available channel within the frequency band or block.
d) Set the EUT input power to a level that is just below the AGC threshold, but not more than 0.5 dB below.
e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.
f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band of operation.
g) Set the VBW ≥ 3 × RBW.
h) Set the Sweep time = auto-couple.
i) Set the spectrum analyzer start frequency to the lowest RF signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 1 MHz.
The number of measurement points in each sweep must be ≥ (2 × span/RBW), which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.
j) Select the power averaging (rms) detector function.
k) Trace average at least 10 traces in power averaging (rms) mode.
l) Use the peak marker function to identify the highest amplitude level over each measured frequency range. Record the frequency and amplitude and capture a plot for inclusion in the test report.
m) Reset the spectrum analyzer start frequency to the upper band/block edge frequency plus 1 MHz, and the spectrum analyzer stop frequency to 10 times the highest frequency of the fundamental emission. The number of measurement points in each sweep must be ≥ (2 × span/RBW), which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.
n) Trace average at least 10 traces in power averaging (rms) mode.
o) Use the peak marker function to identify the highest amplitude level over each of the measured frequency ranges. Record the frequency and amplitude and capture a plot for inclusion in the test report; also provide

tabular data, if required.

p) Repeat steps i) to o) with the input test signals firstly tuned to a middle band/block frequency/channel, and then tuned to a high band/block frequency/channel.

q) Repeat steps b) to p) with the narrowband test signal.

r) Repeat steps b) to q) for all authorized frequency bands/blocks used by the EUT.

ANSI C63.26.

5.7.2 Basic guidelines for unwanted emissions conducted measurements

a) For improvement of the accuracy in the measurement of the average power of a noise-like emission, a RBW narrower than the specified reference bandwidth can be used (generally limited to no less than 1% of the OBW), provided that a subsequent integration is performed over the full required measurement bandwidth. This integration should be performed using the spectrum analyzer's channel power, adjacent channel power, or band power functions. When using the integration method at the channel/block/band edge, the starting frequency of the integration shall be centered at one-half of the RBW away from the band/channel/block edge.

Note:

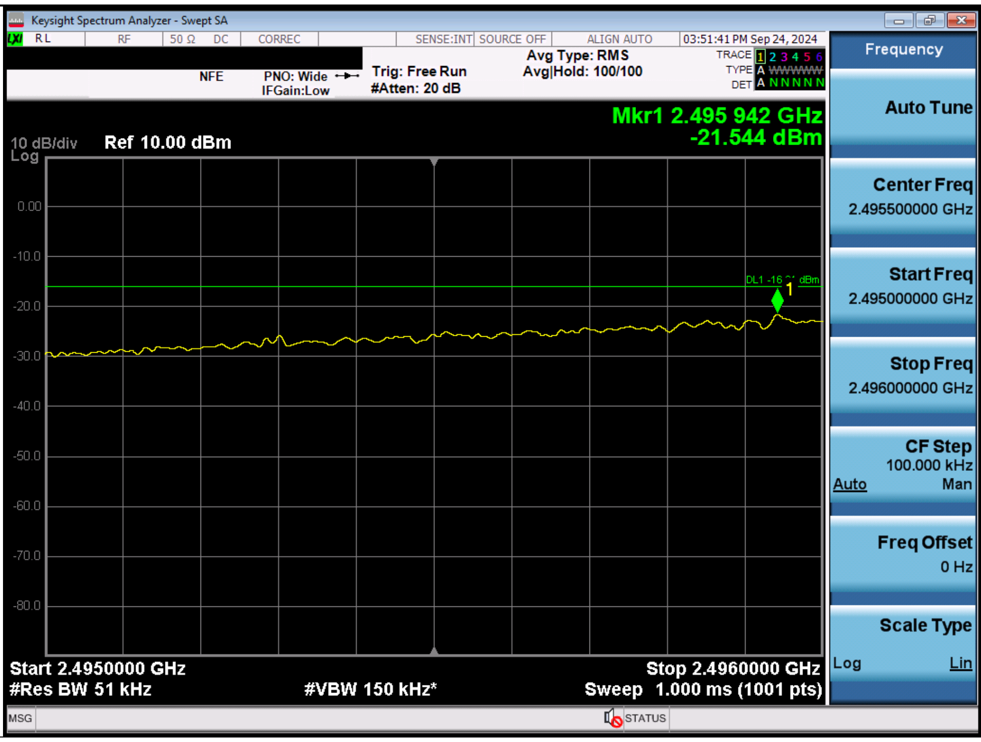
1. In some bands, RBW was reduced to 0.1 %, 1 %, and 10 % of the reference bandwidth for measuring out-of-band and unwanted spurious emissions level, so the limit lines were compensated according to section 5.7.2 of ANSI C63.26-2015.

Reduced RBW	0.1 %	1 %	10 %
Limit line compensation	-30 dB	-20 dB	-10 dB

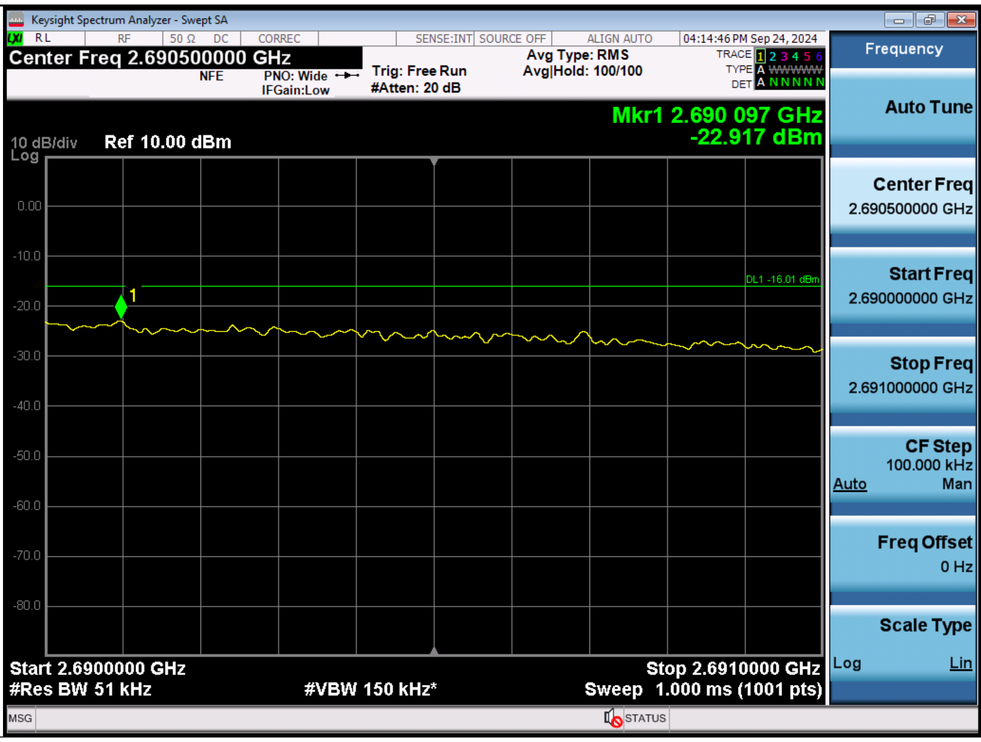
2. Some measurements used the integration method according to Section 5.7.2 of ANSI C63.26.
3. We applied MIMO Limit Values because they are the worst according to KDB 662911 D01 v02r01.
   - 2Tx MIMO correction: 10 log(NANT)=10 log(2)=3.01 dB // -13 dBm – 10 log(2) = -16.01 dBm
4. 2Tx summation values of out-of-band/out-of-block and spurious emissions have a margin of more than 1.5 dB compared to the limit.

Test Results: Plot data of Out-of-band/out-of-block emissions

Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / LTE 5 MHz / Lower



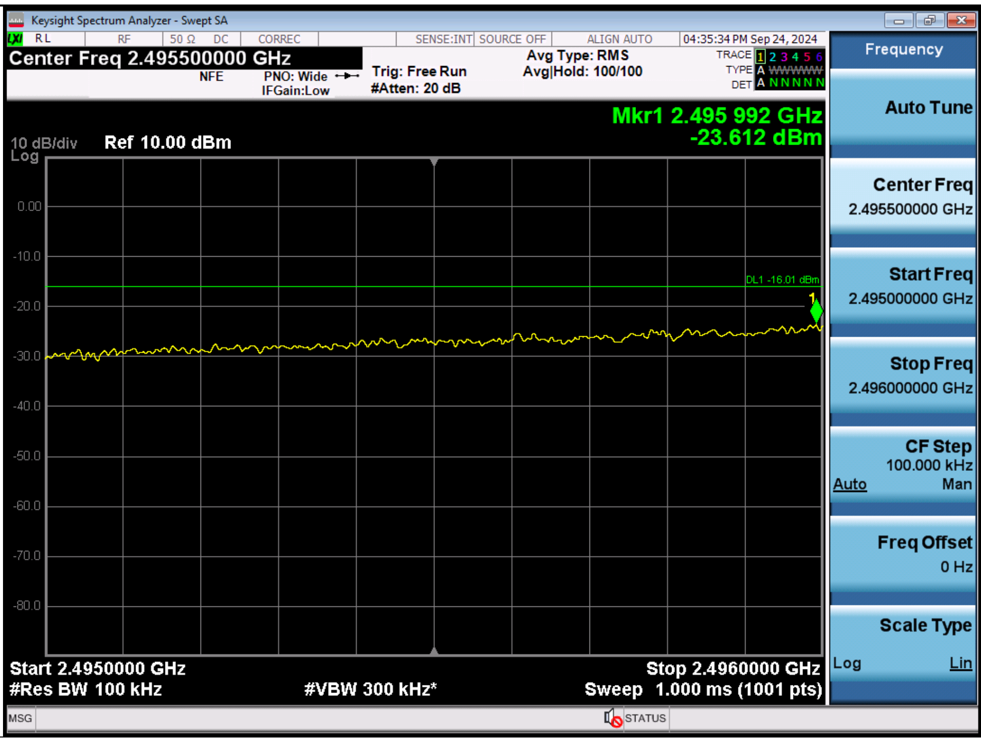
Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / LTE 5 MHz / Upper



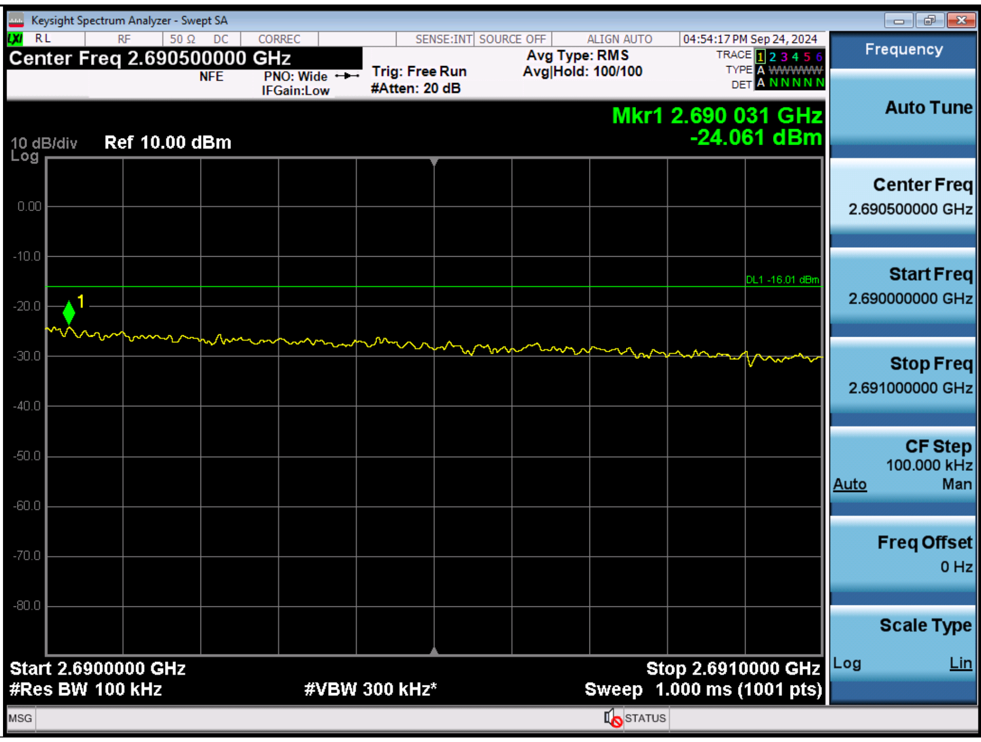
3 dB above Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / LTE 5 MHz / Lower

3 dB above Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / LTE 5 MHz / Upper

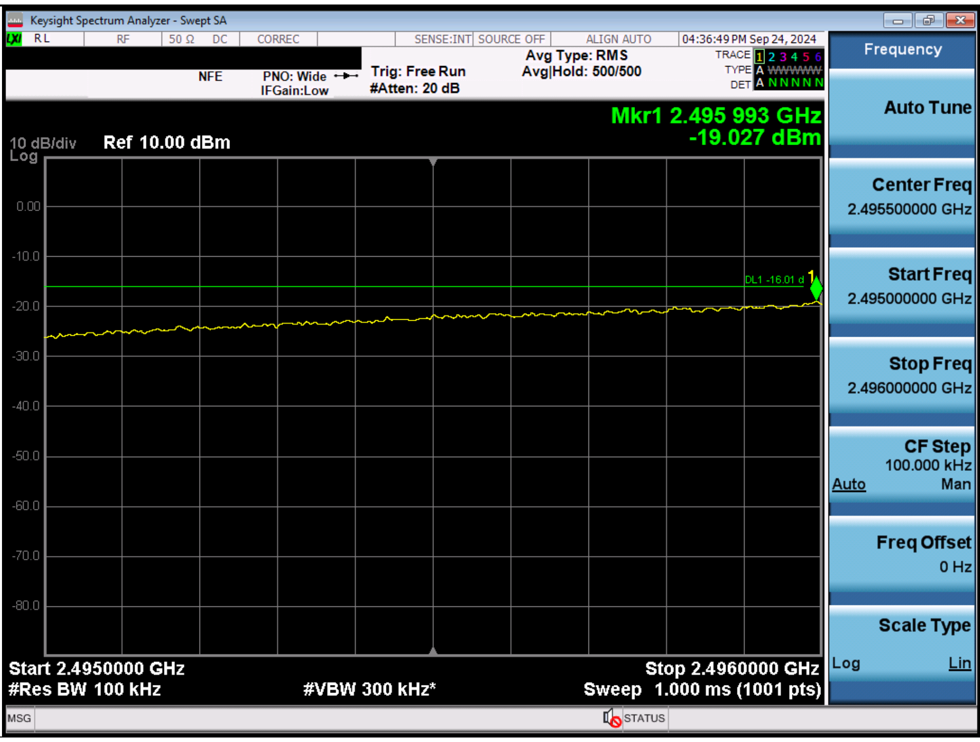
Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / LTE 10 MHz / Lower



Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / LTE 10 MHz / Upper

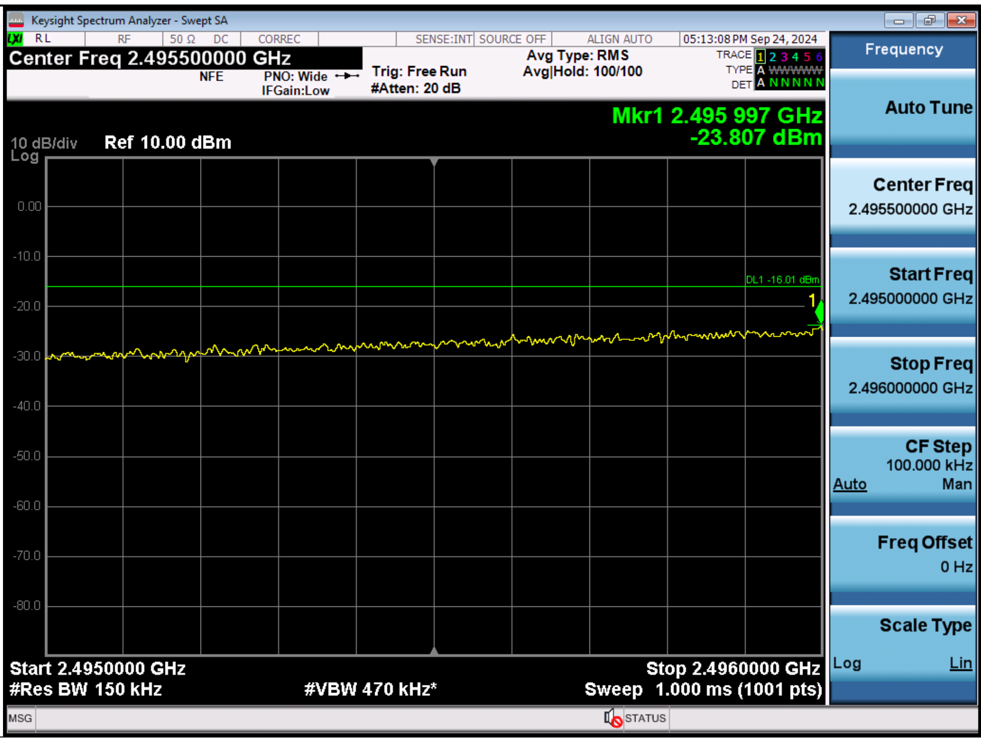


3 dB above Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / LTE 10 MHz / Lower

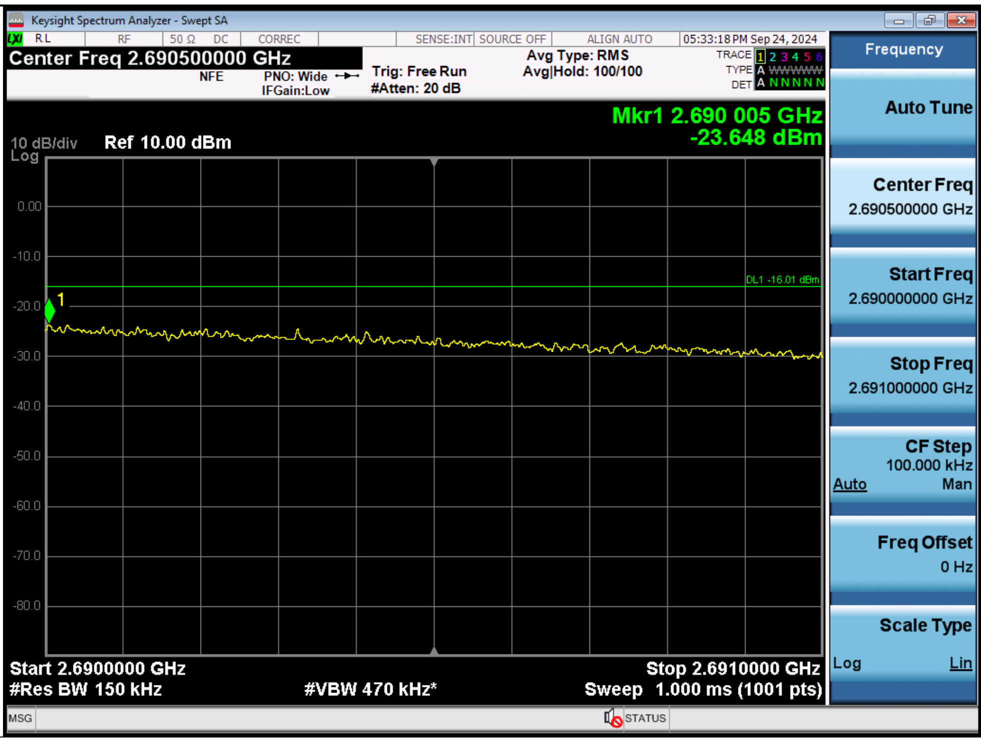


3 dB above Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / LTE 10 MHz / Upper

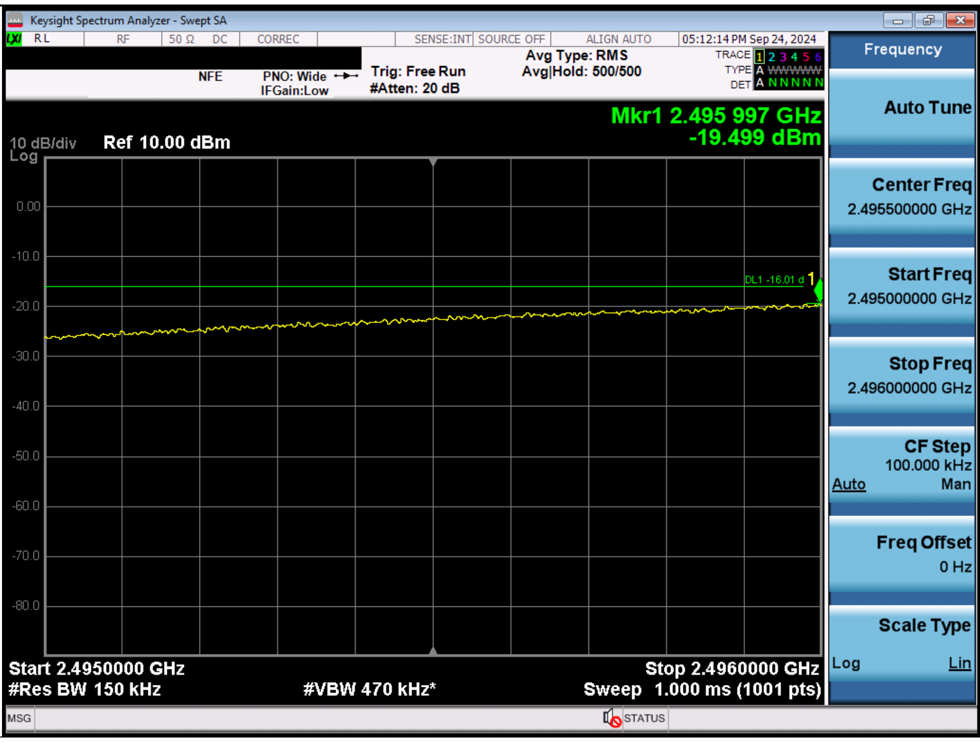
Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / LTE 15 MHz / Lower



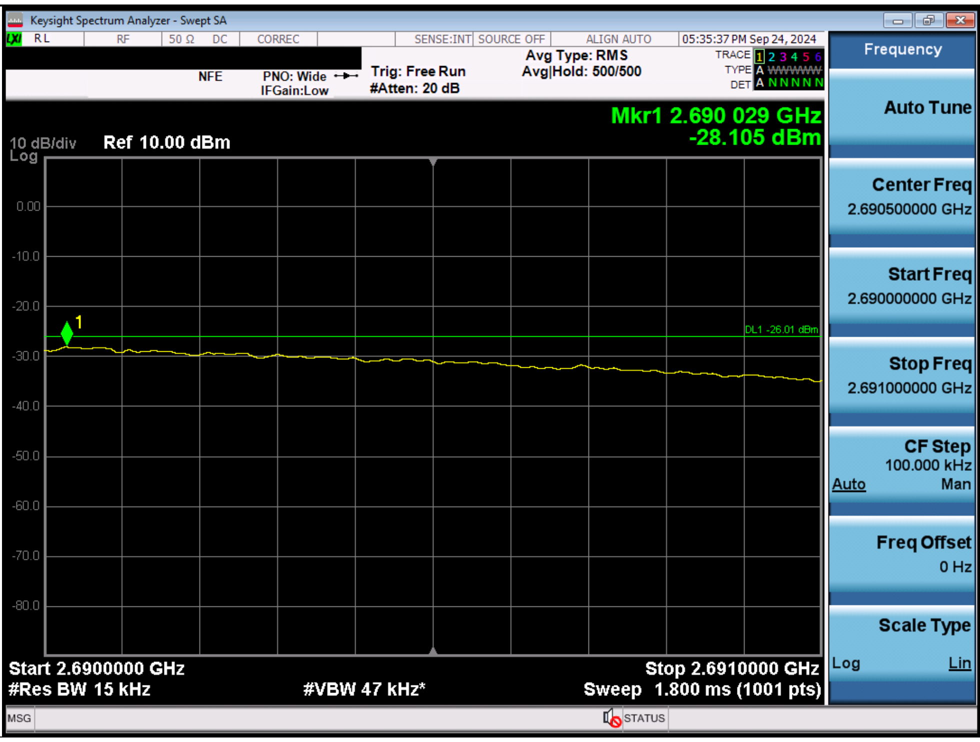
Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / LTE 15 MHz / Upper



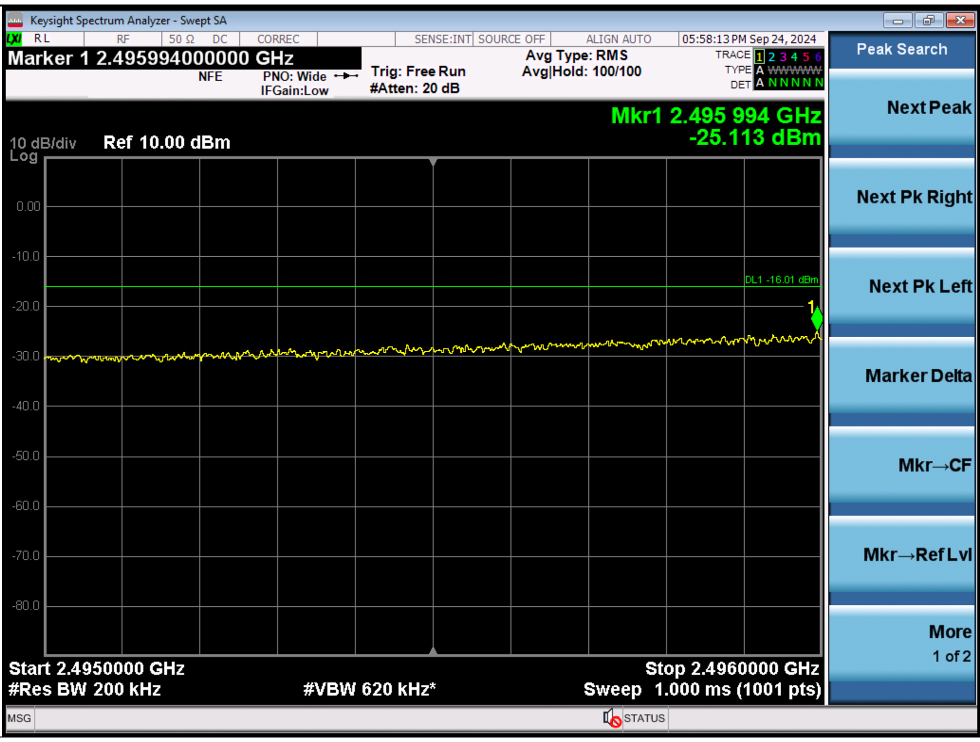
3 dB above Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / LTE 15 MHz / Lower



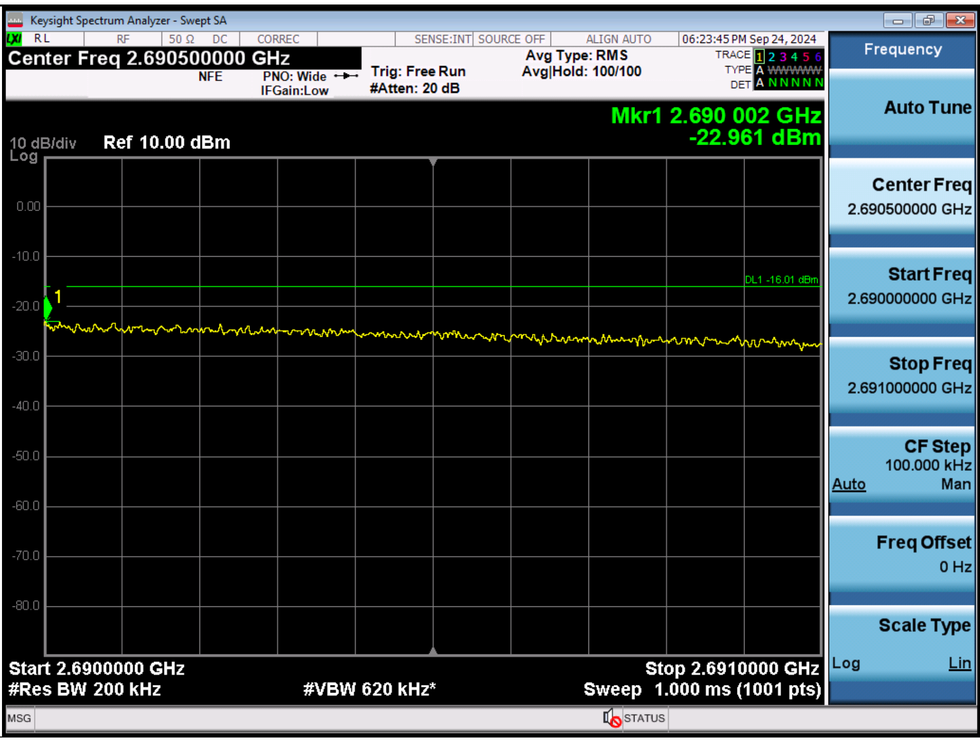
3 dB above Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / LTE 15 MHz / Upper



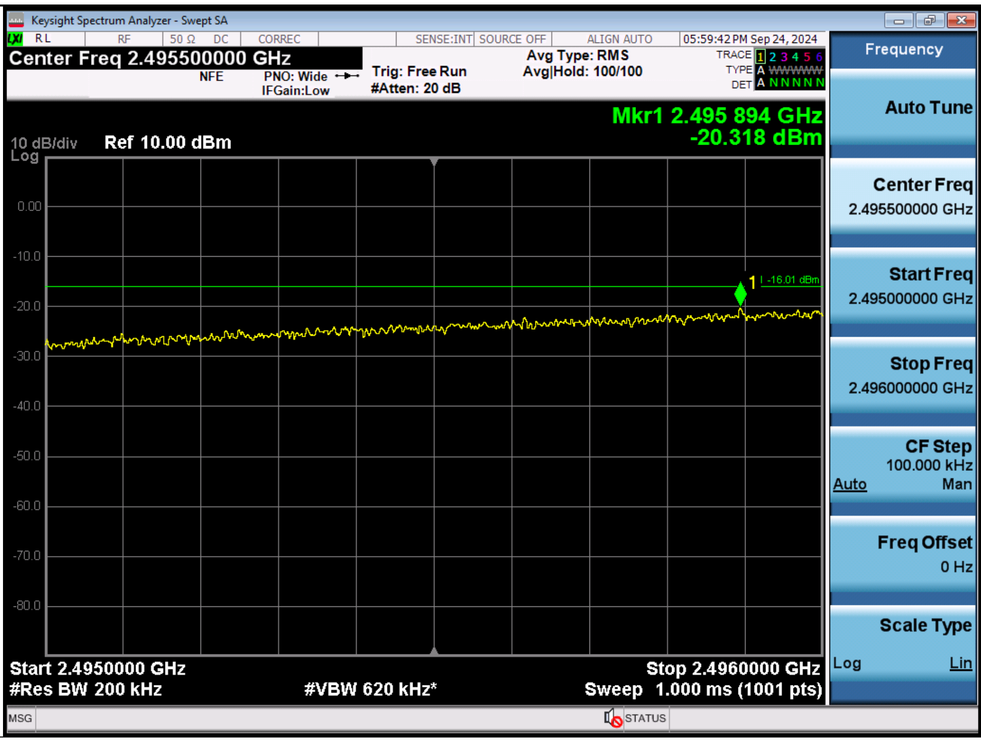
Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / LTE 20 MHz / Lower



Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / LTE 20 MHz / Upper

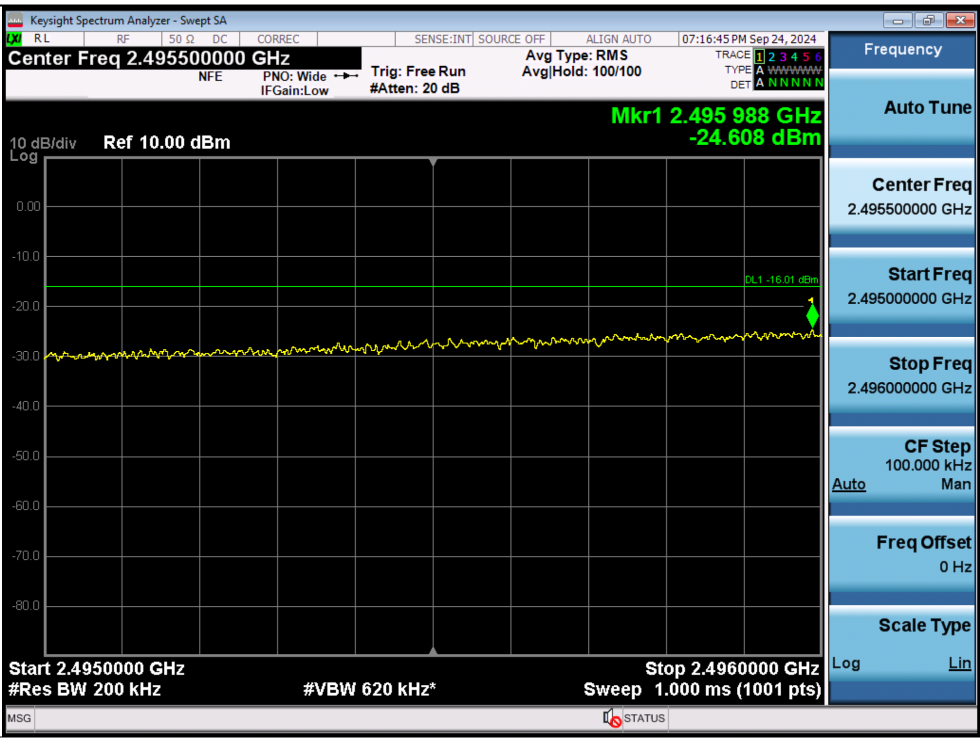


3 dB above Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / LTE 20 MHz / Lower

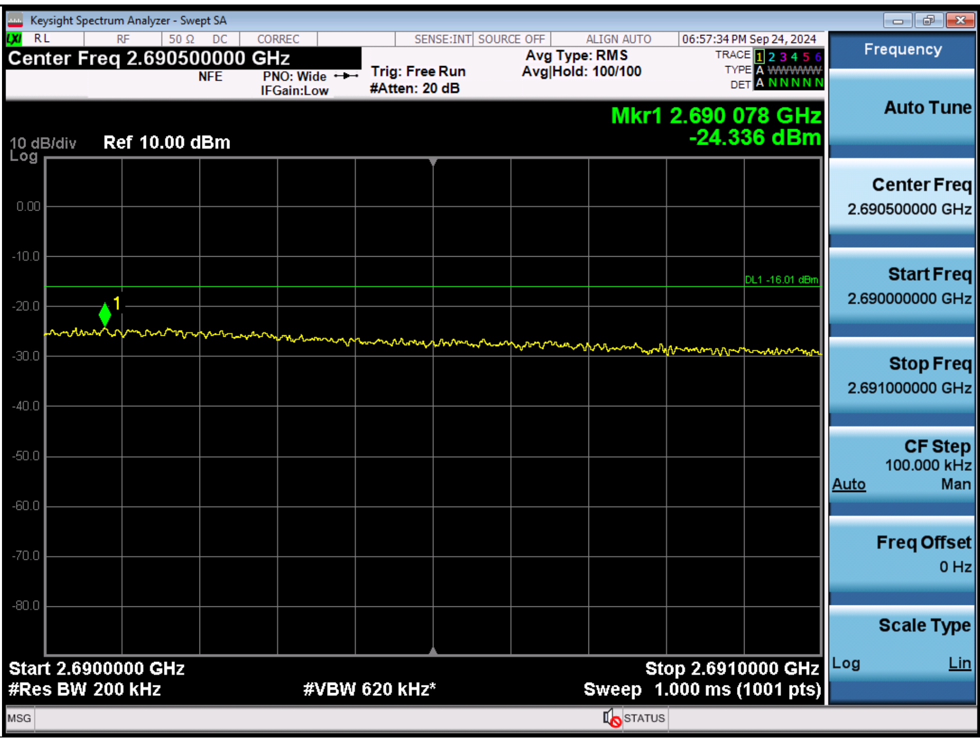


3 dB above Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / LTE 20 MHz / Upper

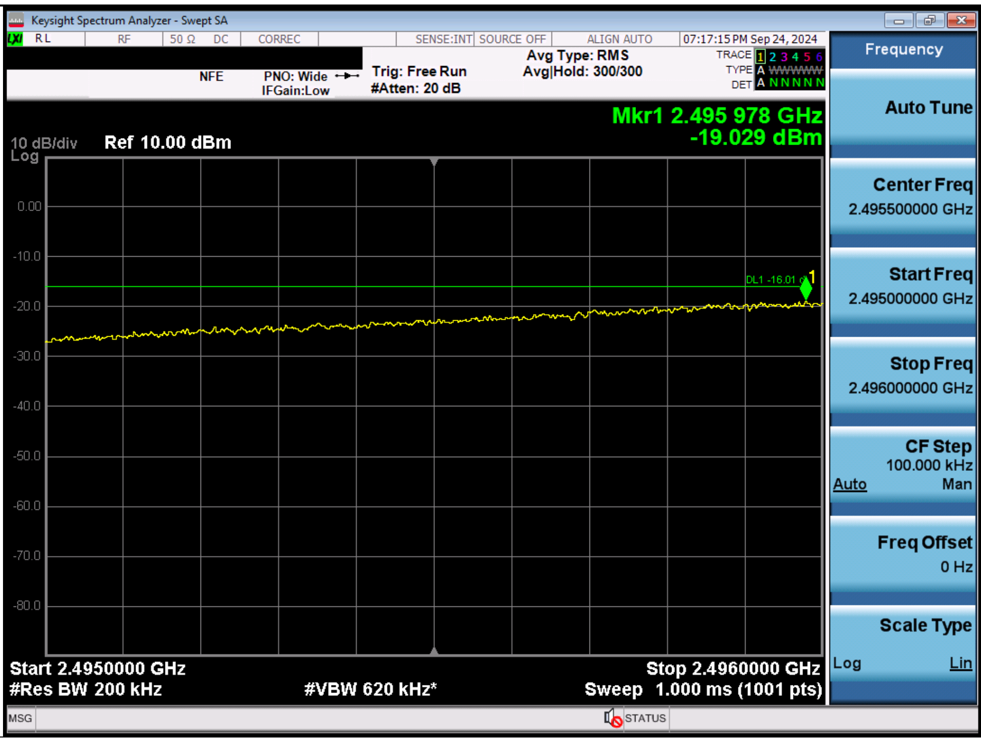
Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / 5G NR 20 MHz / Lower



Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / 5G NR 20 MHz / Upper

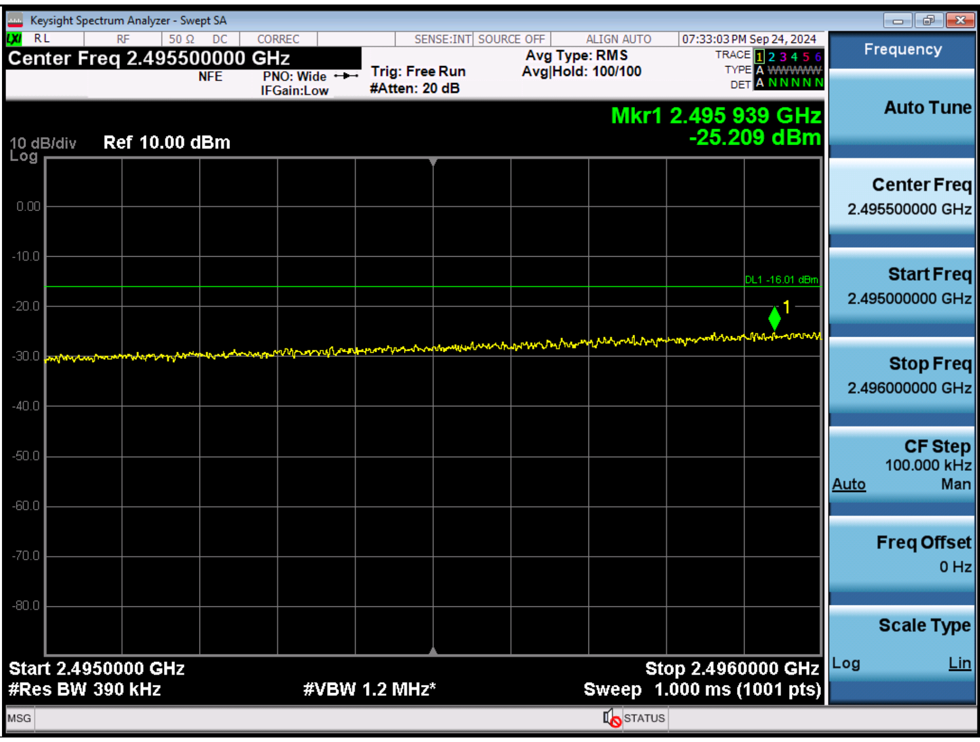


3 dB above Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / 5G NR 20 MHz / Lower

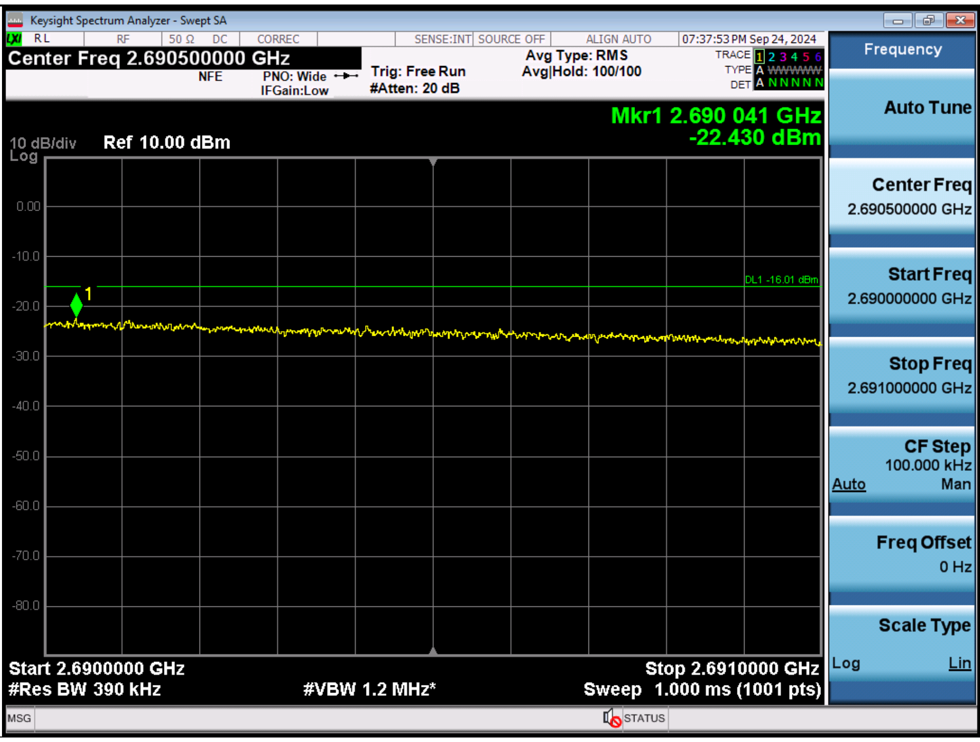


3 dB above Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / 5G NR 20 MHz / Upper

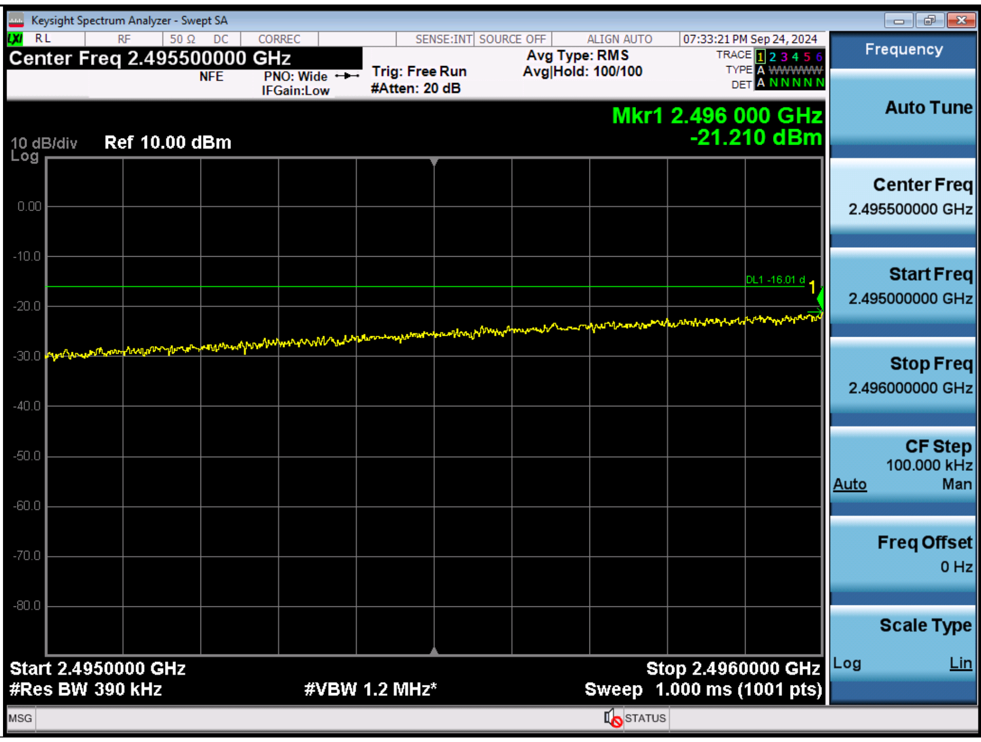
Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / 5G NR 40 MHz / Lower



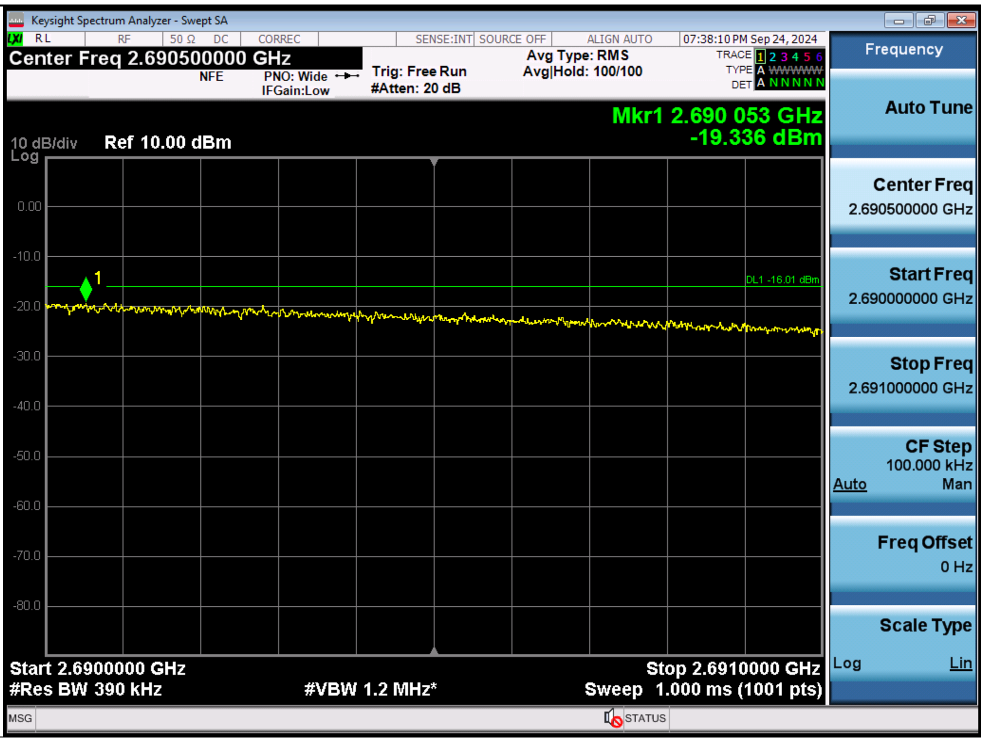
Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / 5G NR 40 MHz / Upper



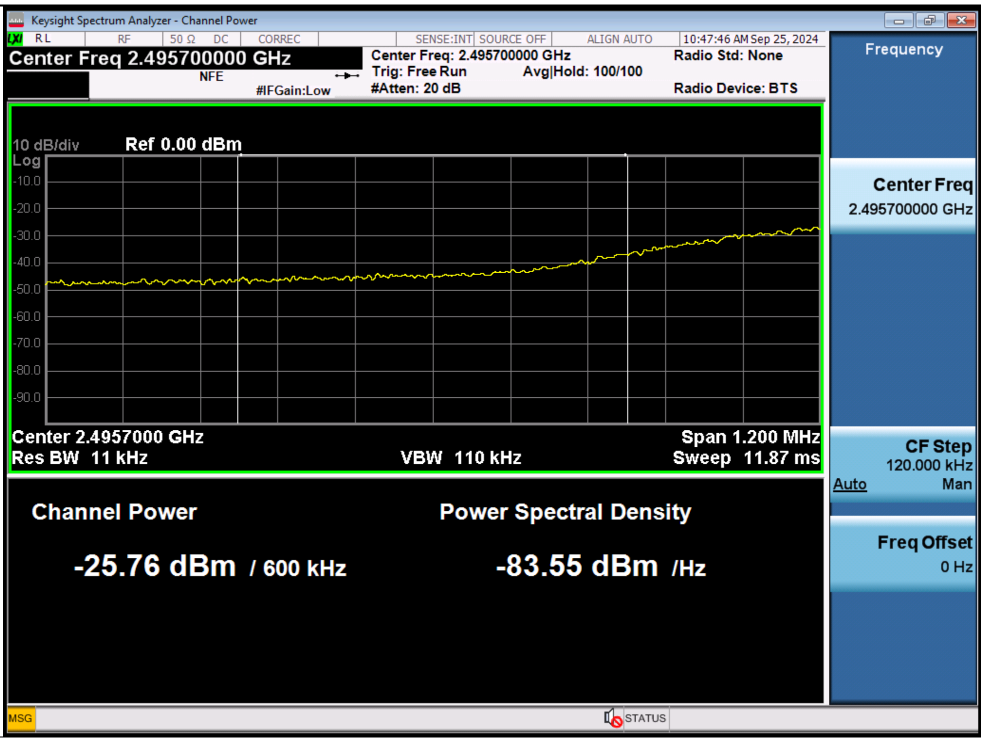
3 dB above Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / 5G NR 40 MHz / Lower



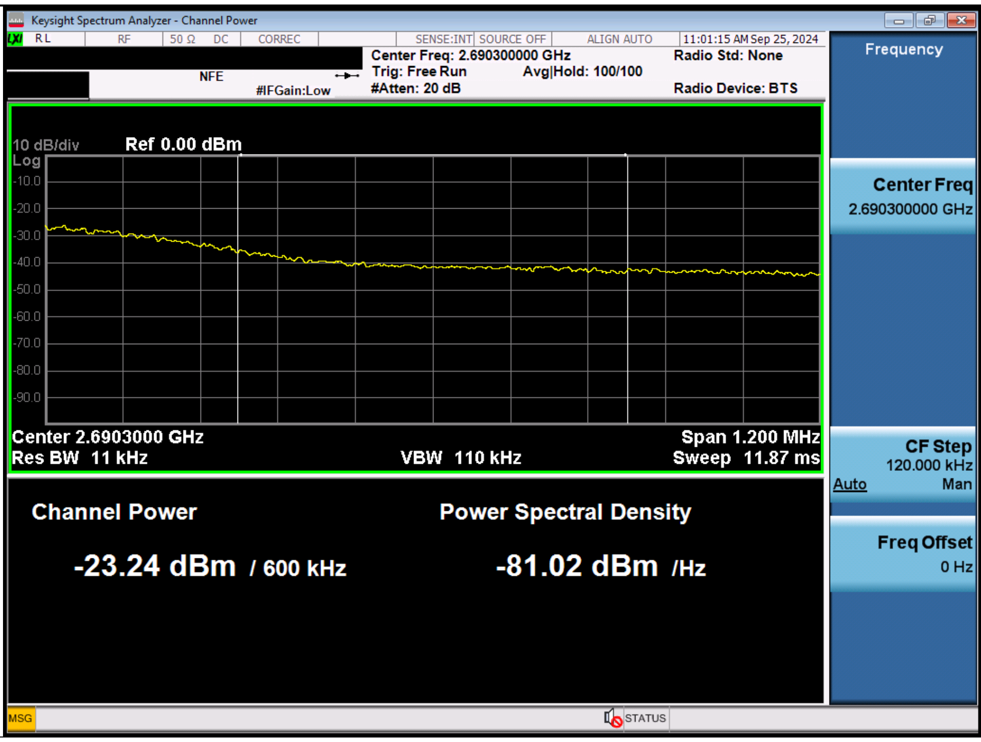
3 dB above Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / 5G NR 40 MHz / Upper



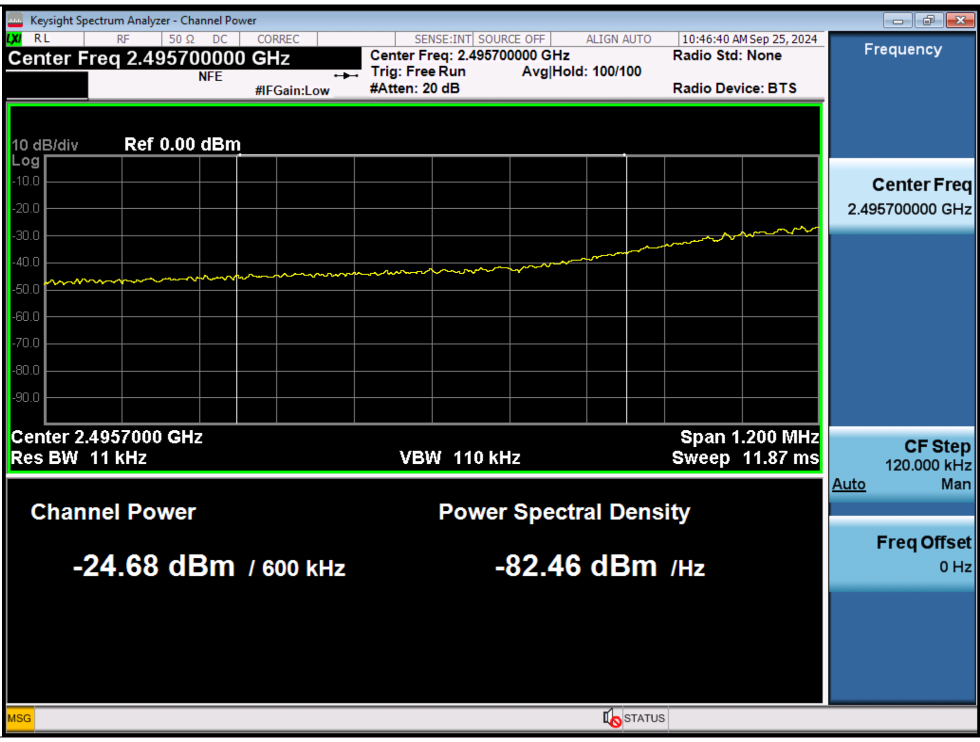
Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / 5G NR 60 MHz / Lower



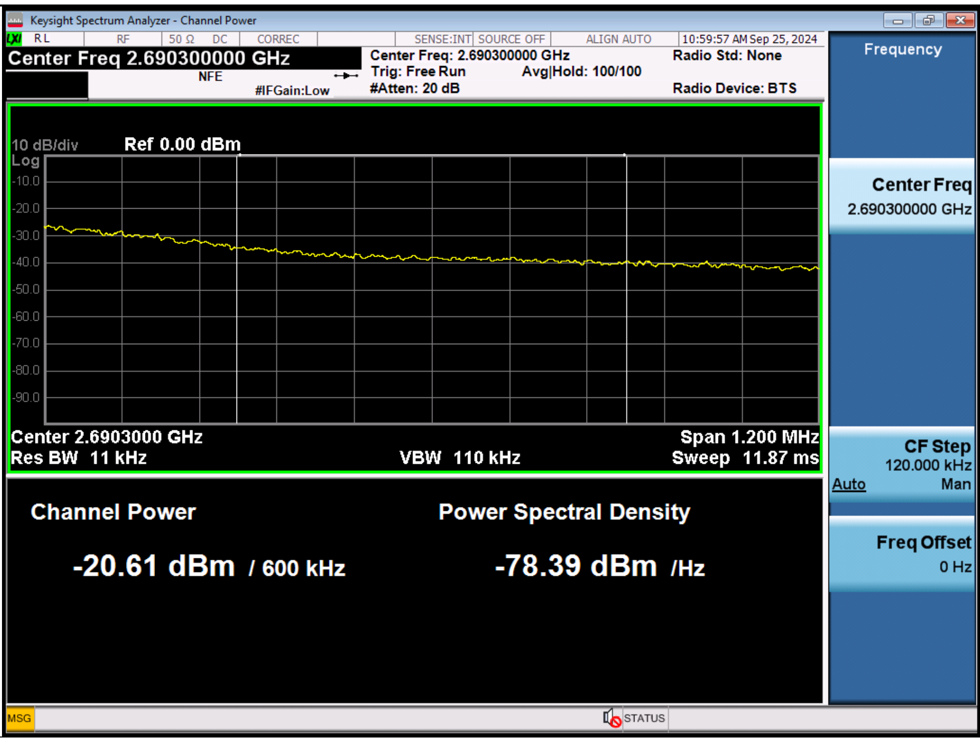
Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / 5G NR 60 MHz / Upper



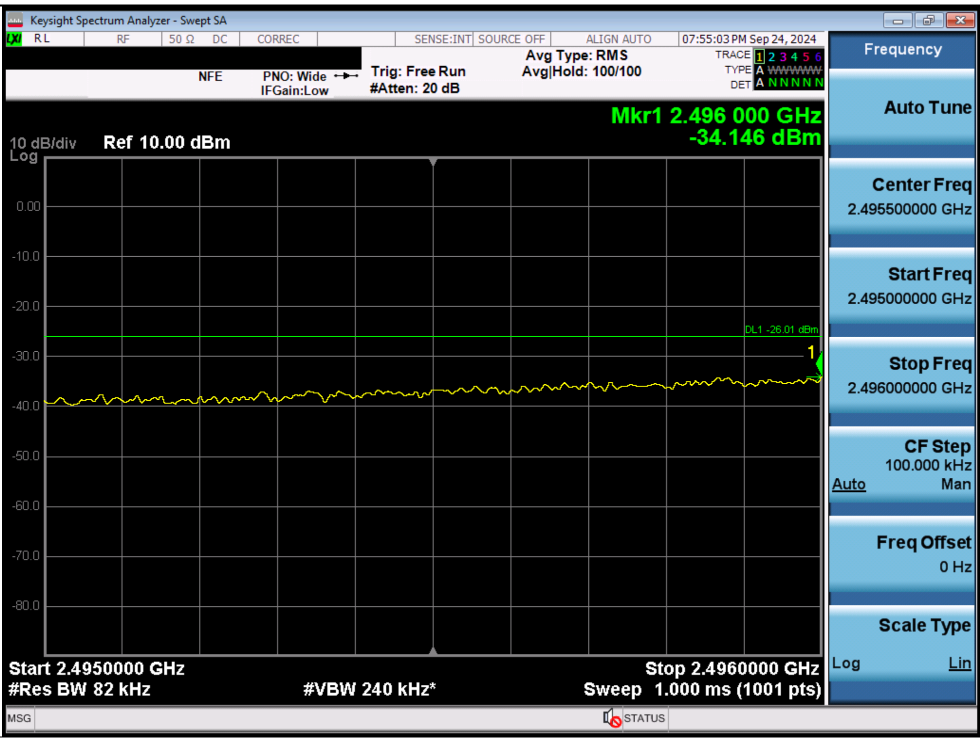
3 dB above Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / 5G NR 60 MHz / Lower



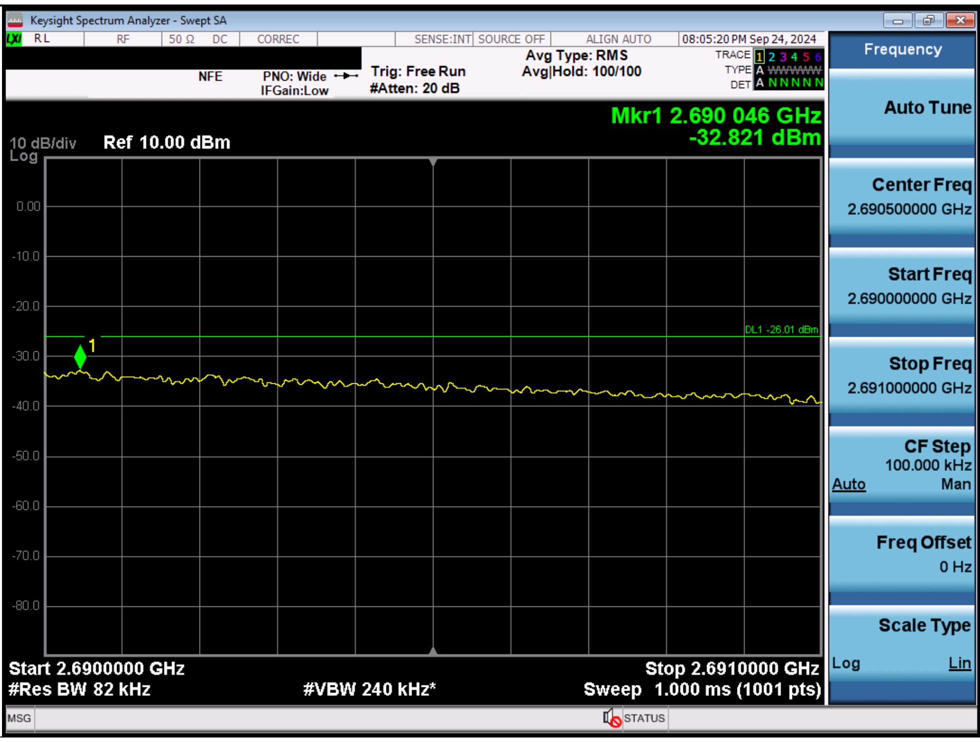
3 dB above Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / 5G NR 60 MHz / Upper



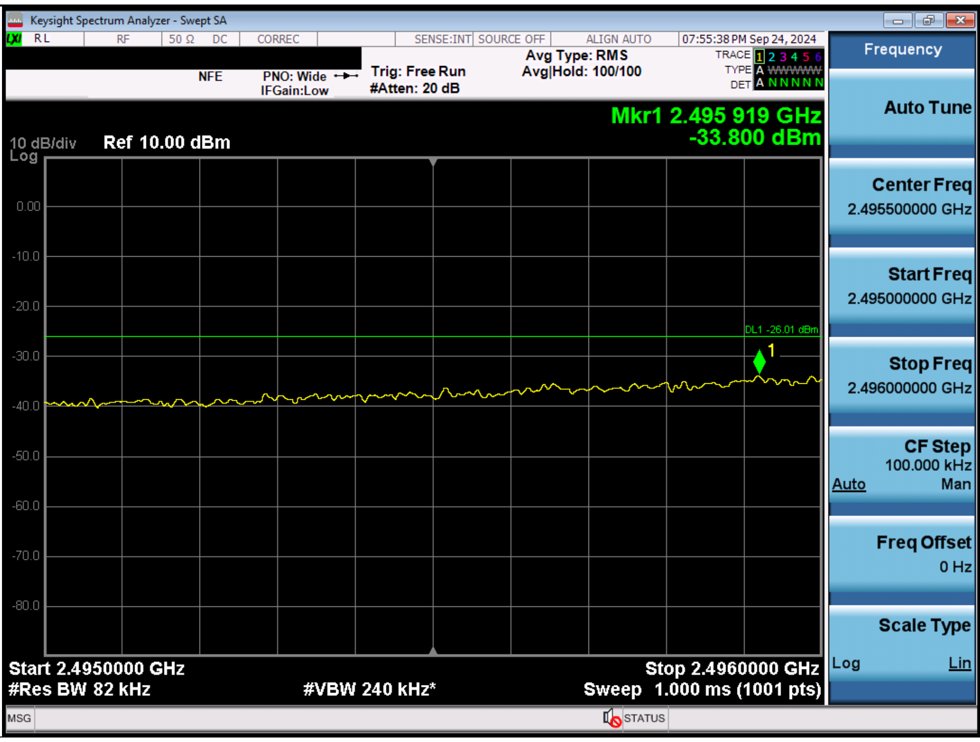
Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / 5G NR 80 MHz / Lower



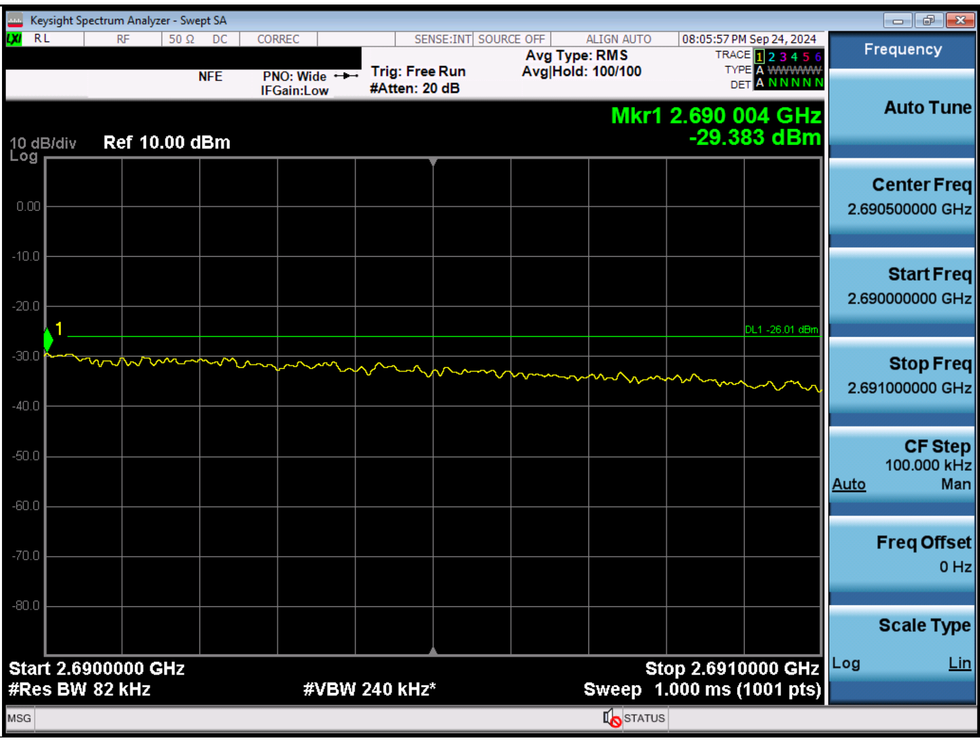
Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / 5G NR 80 MHz / Upper

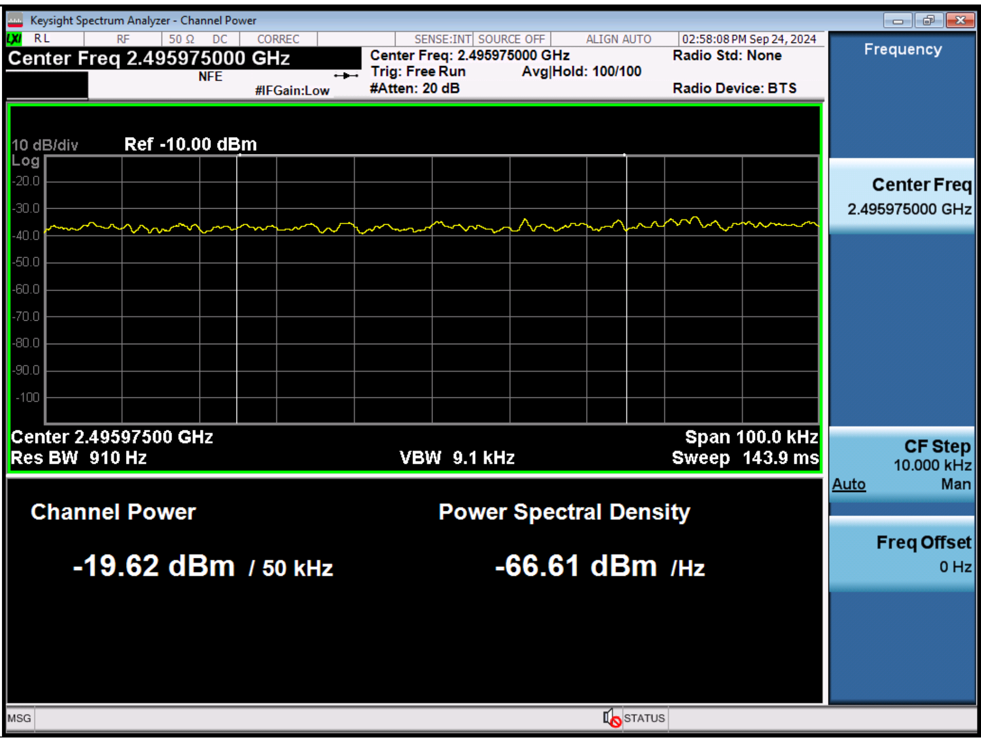


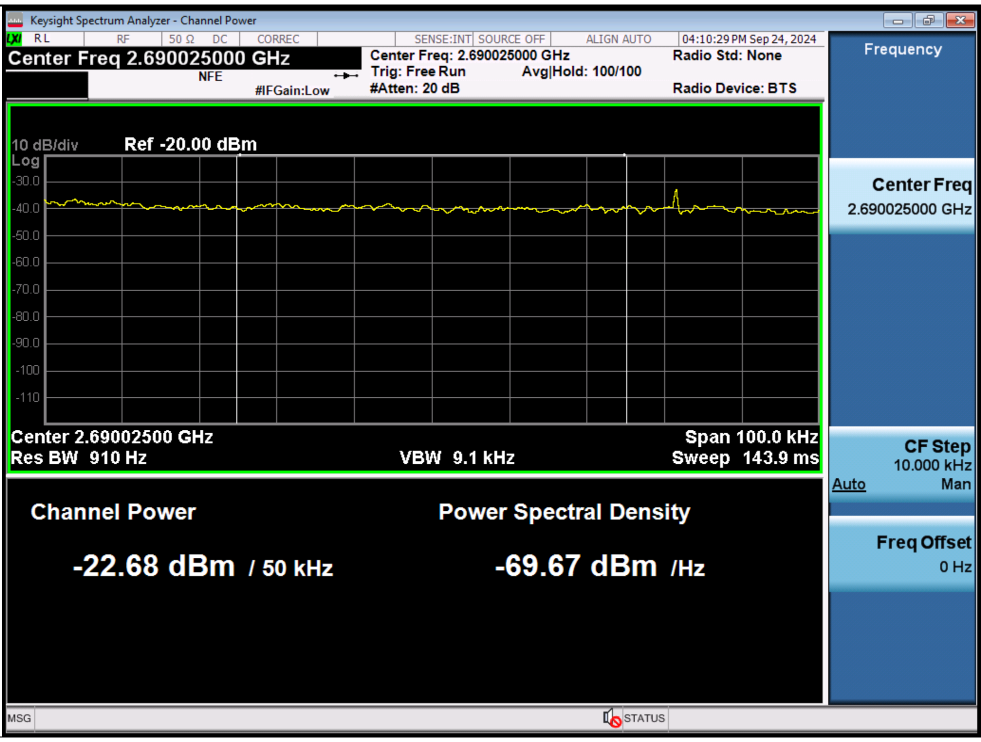
3 dB above Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / 5G NR 80 MHz / Lower



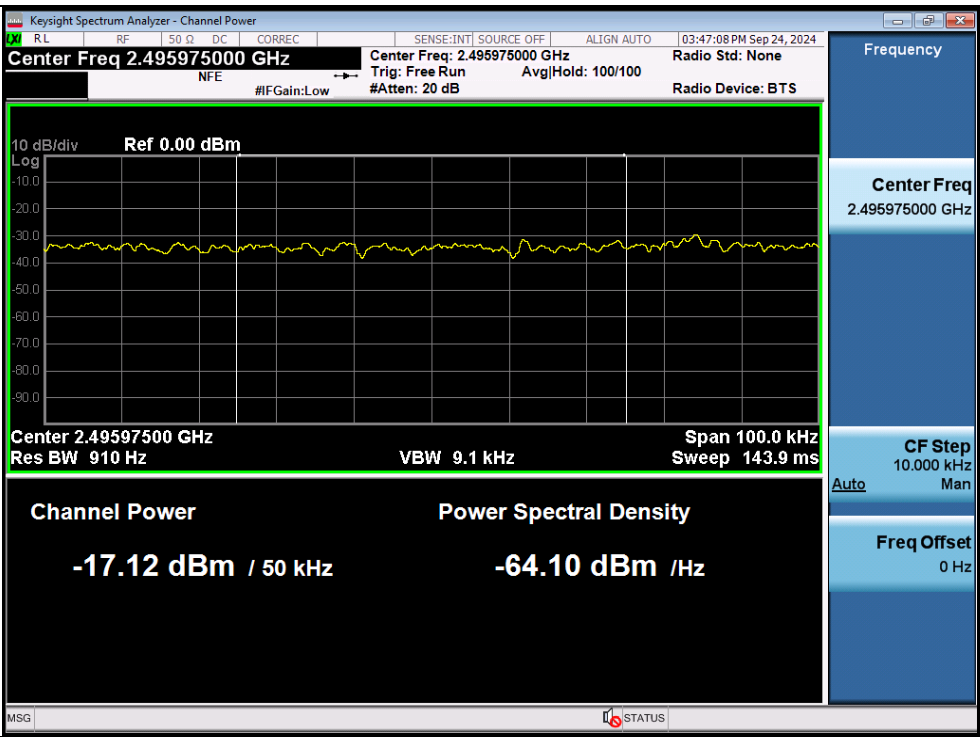
3 dB above Out-of-band (two adjacent test signals) / BRS&EBS / Downlink / 5G NR 80 MHz / Upper



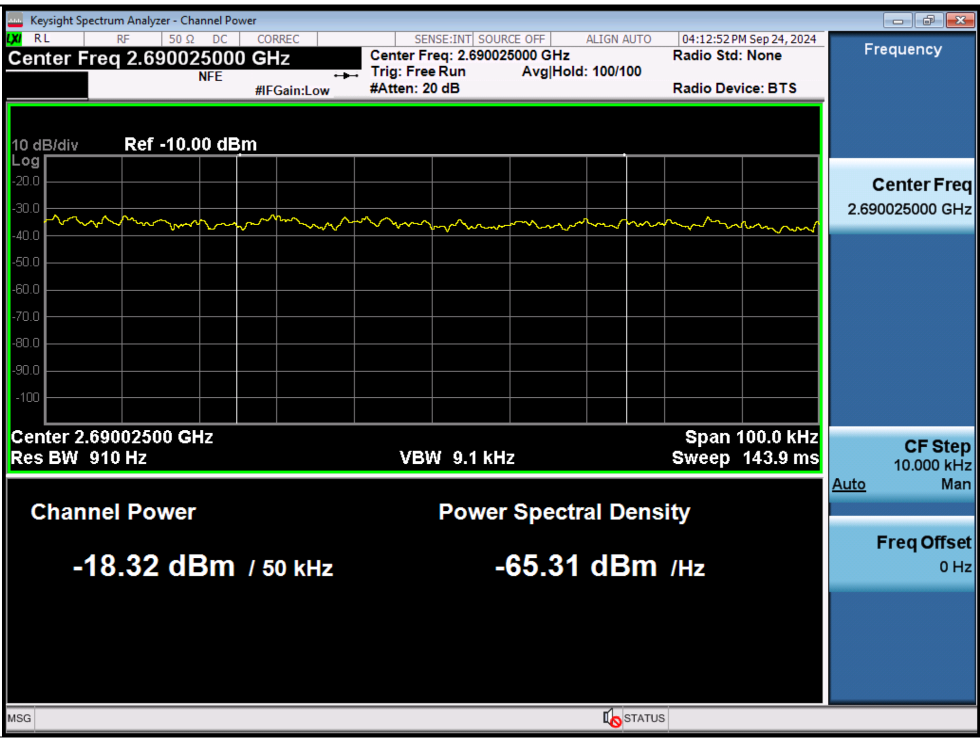
Out-of-band (single test signal) / BRS&EBS / Downlink / LTE 5 MHz / Lower


Out-of-band (single test signal) / BRS&EBS / Downlink / LTE 5 MHz / Upper


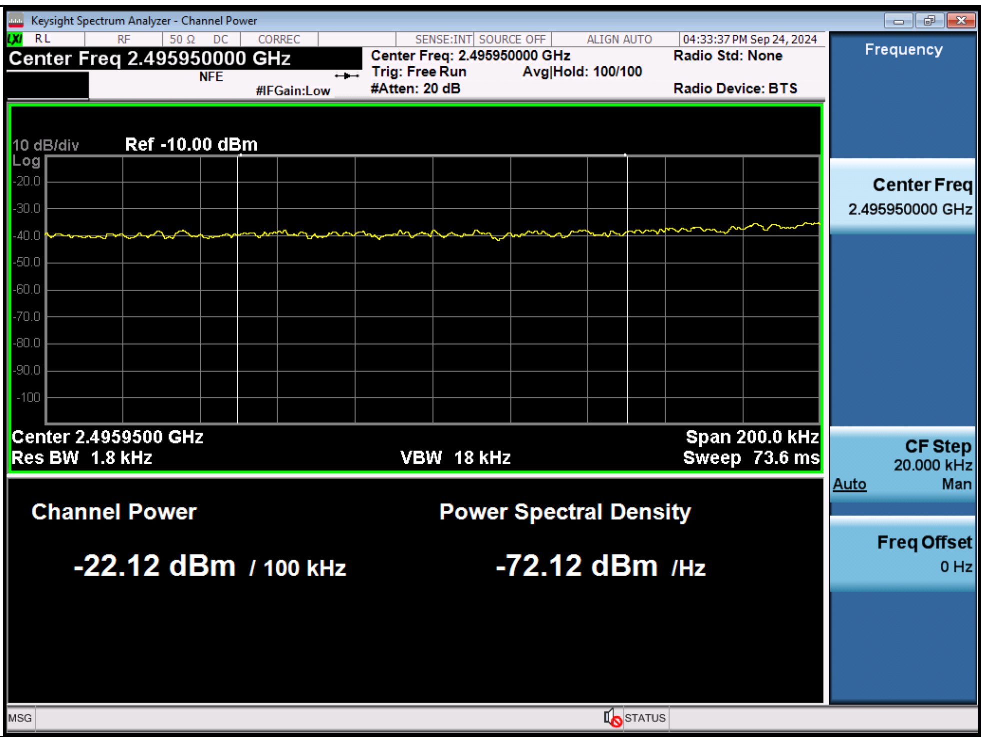
+3 dB above Out-of-band (single test signal) / BRS&EBS / Downlink / LTE 5 MHz / Lower



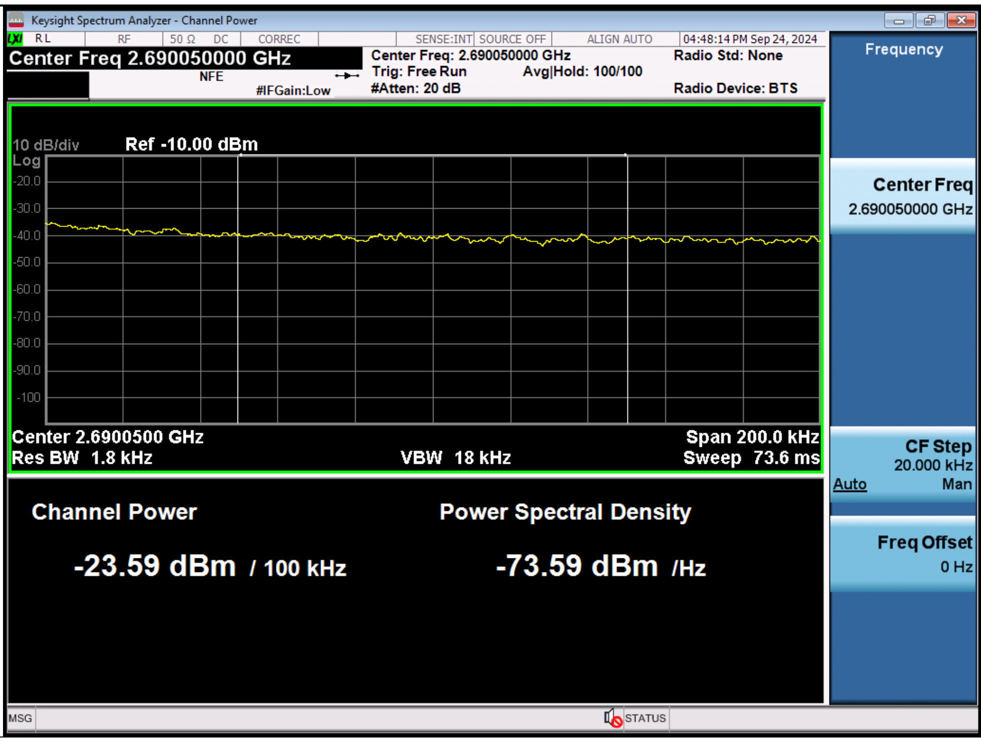
+3 dB above Out-of-band (single test signal) / BRS&EBS / Downlink / LTE 5 MHz / Upper



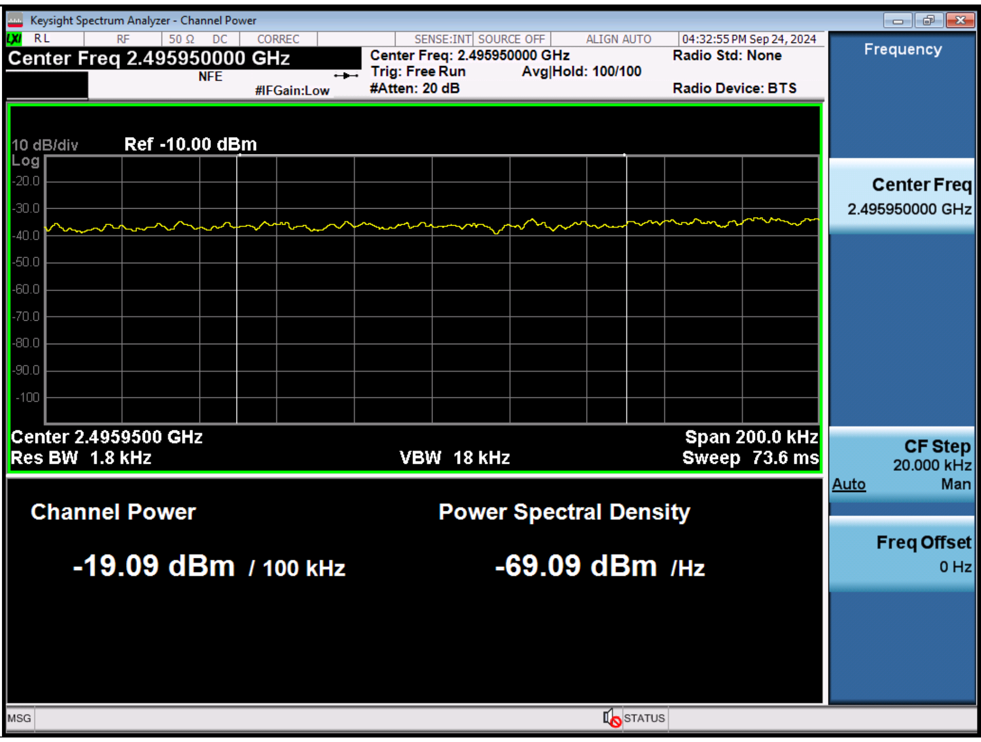
Out-of-band (single test signal) / BRS&EBS / Downlink / LTE 10 MHz / Lower



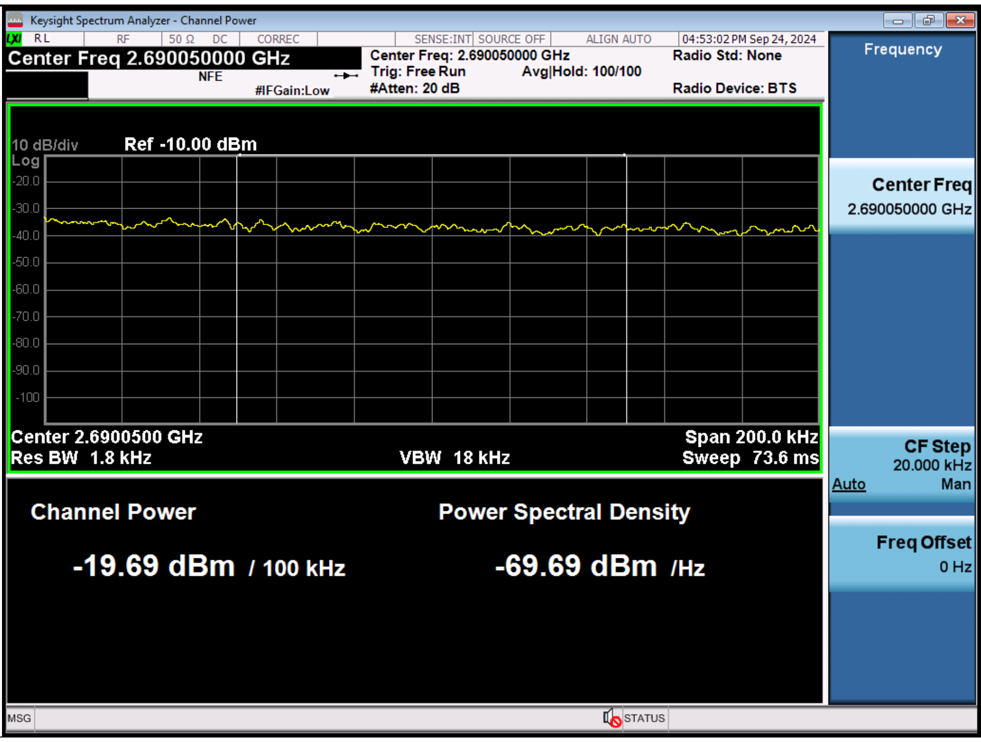
Out-of-band (single test signal) / BRS&EBS / Downlink / LTE 10 MHz / Upper



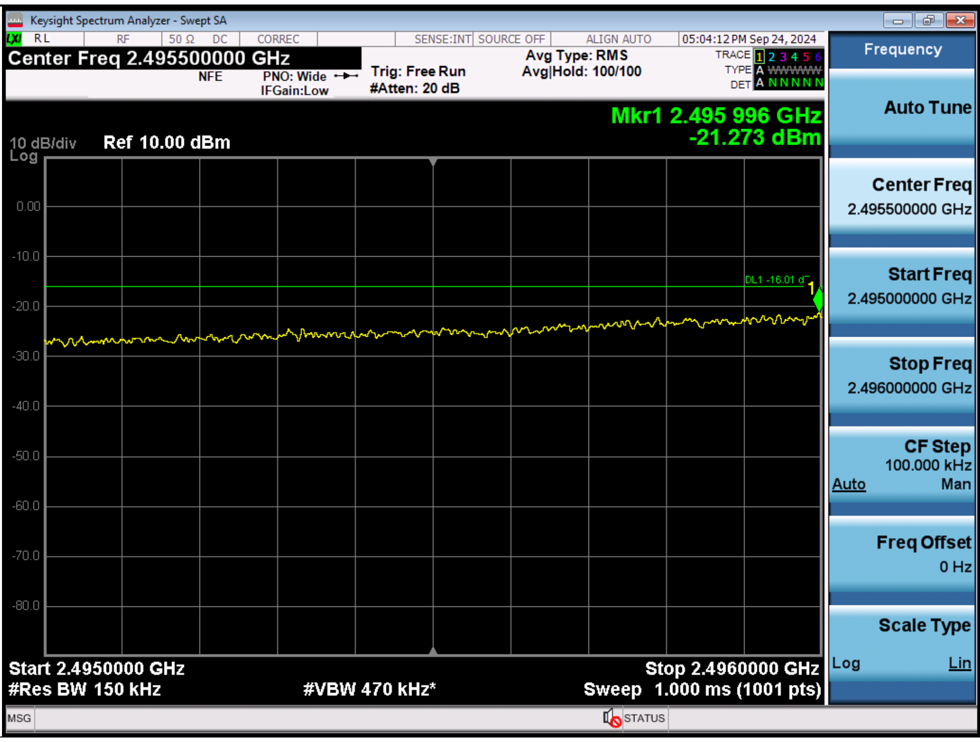
+3 dB above Out-of-band (single test signal) / BRS&EBS / Downlink / LTE 10 MHz / Lower



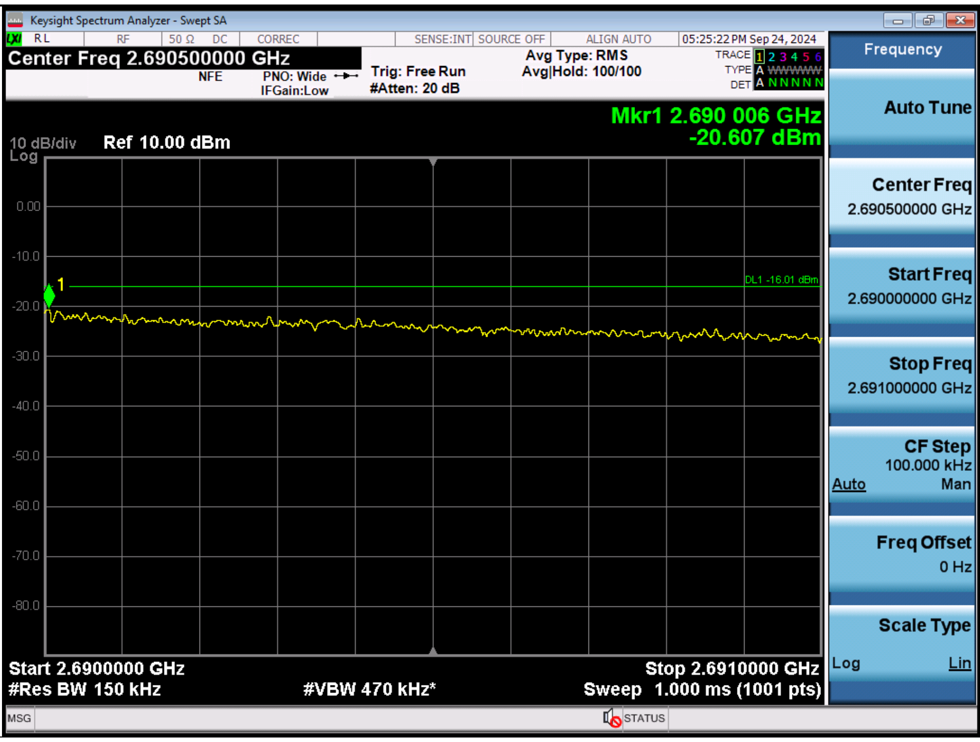
+3 dB above Out-of-band (single test signal) / BRS&EBS / Downlink / LTE 10 MHz / Upper



Out-of-band (single test signal) / BRS&EBS / Downlink / LTE 15 MHz / Lower

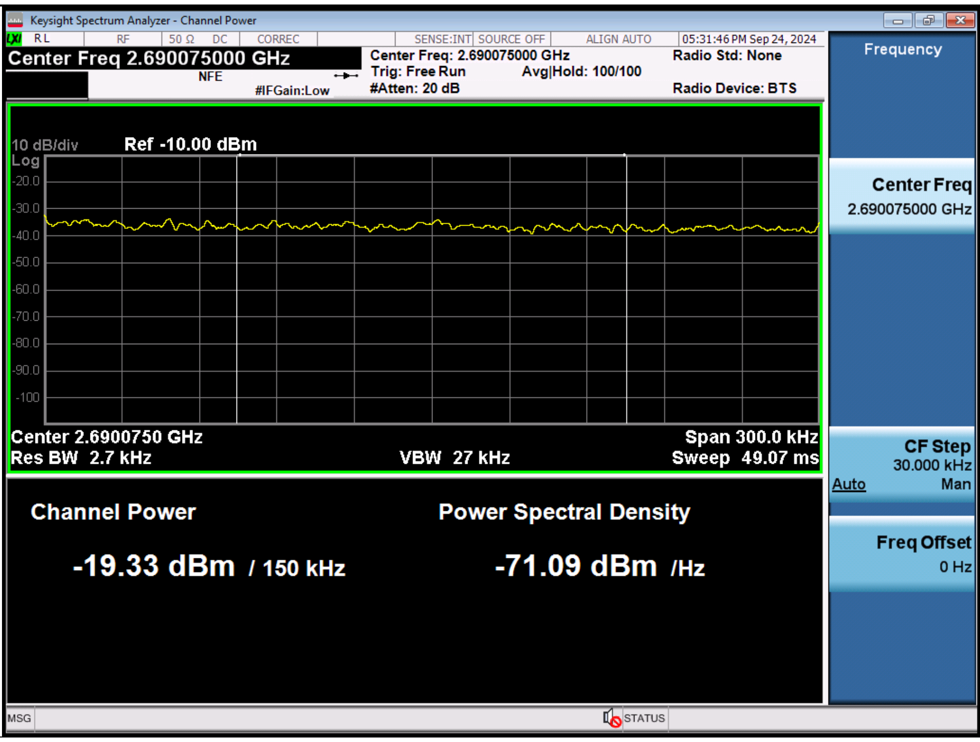


Out-of-band (single test signal) / BRS&EBS / Downlink / LTE 15 MHz / Upper

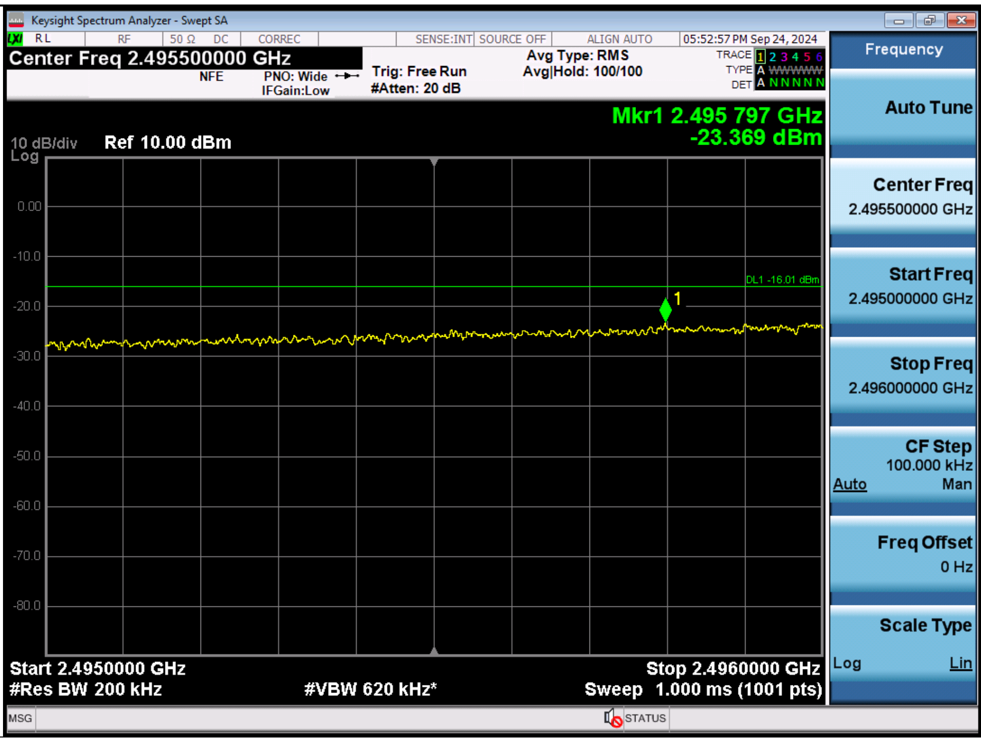


+3 dB above Out-of-band (single test signal) / BRS&EBS / Downlink / LTE 15 MHz / Lower

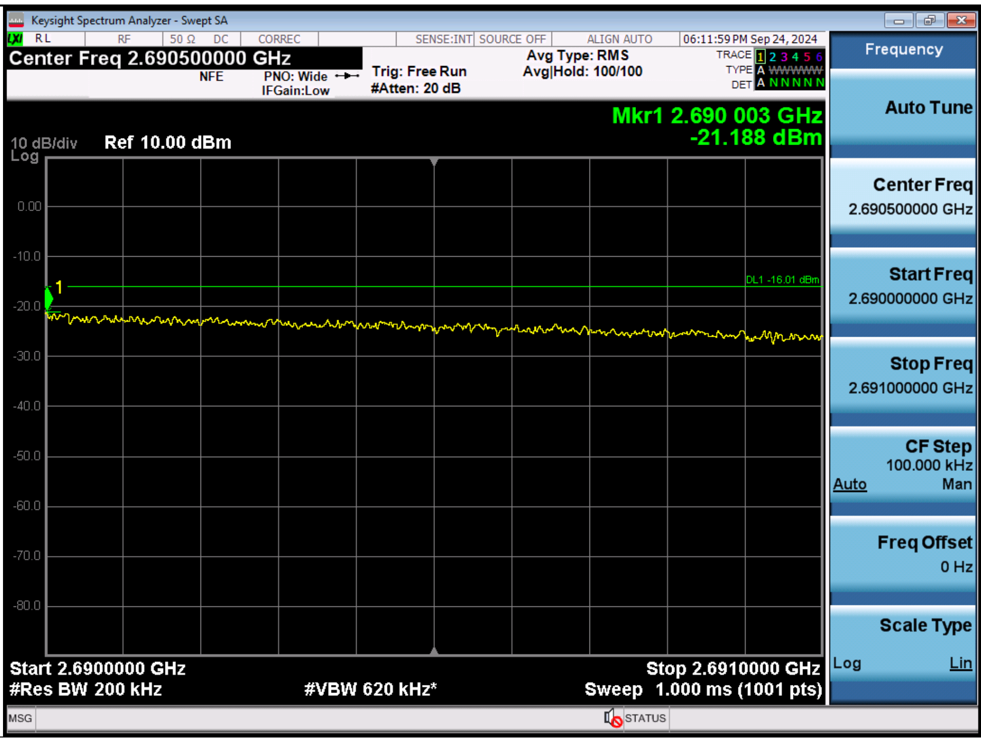
+3 dB above Out-of-band (single test signal) / BRS&EBS / Downlink / LTE 15 MHz / Upper



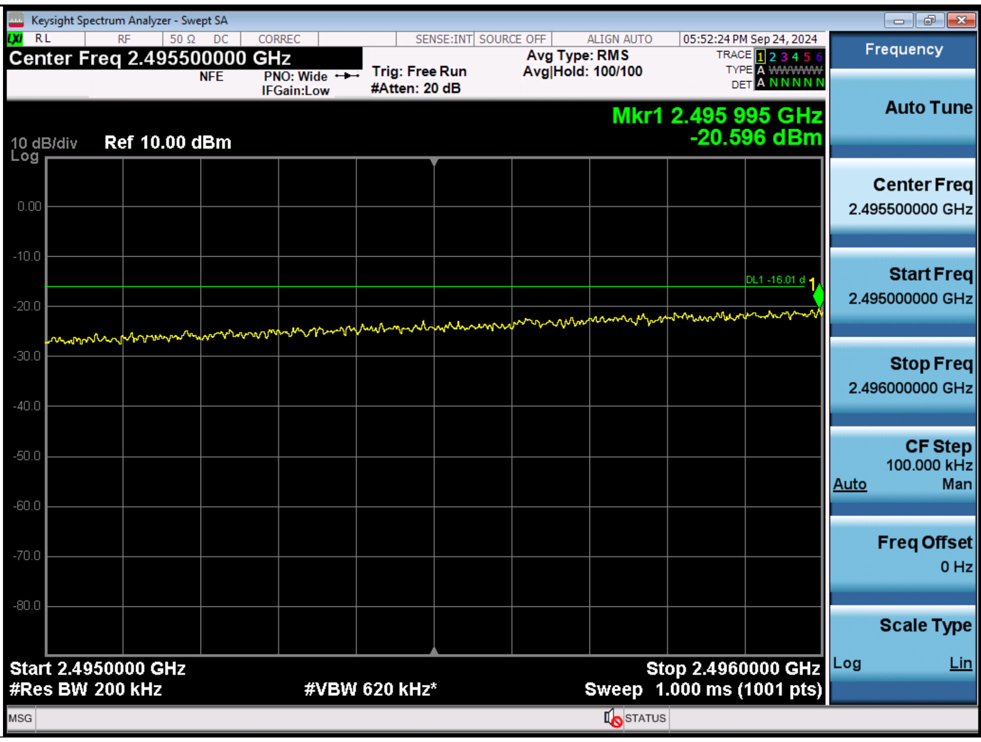
Out-of-band (single test signal) / BRS&EBS / Downlink / LTE 20 MHz / Lower



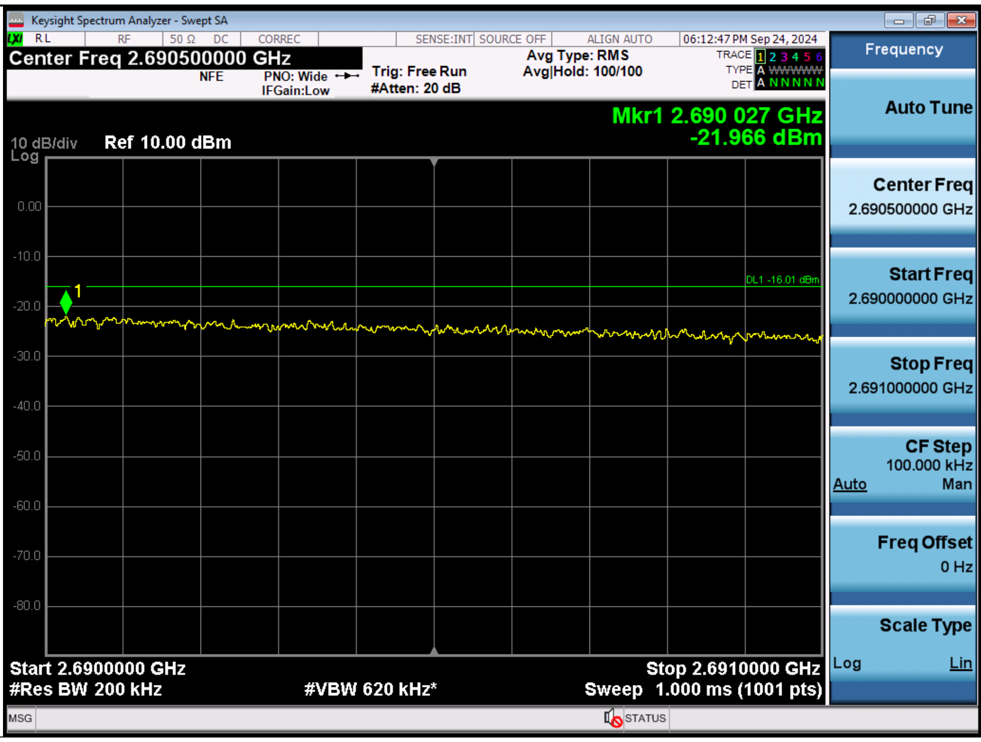
Out-of-band (single test signal) / BRS&EBS / Downlink / LTE 20 MHz / Upper



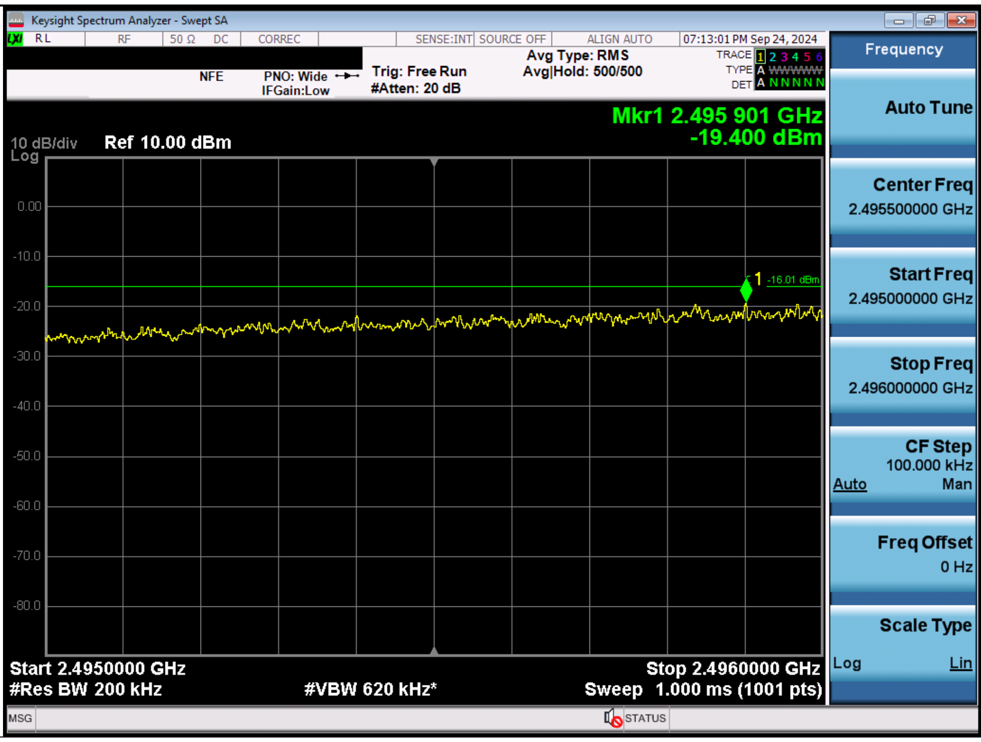
+3 dB above Out-of-band (single test signal) / BRS&EBS / Downlink / LTE 20 MHz / Lower



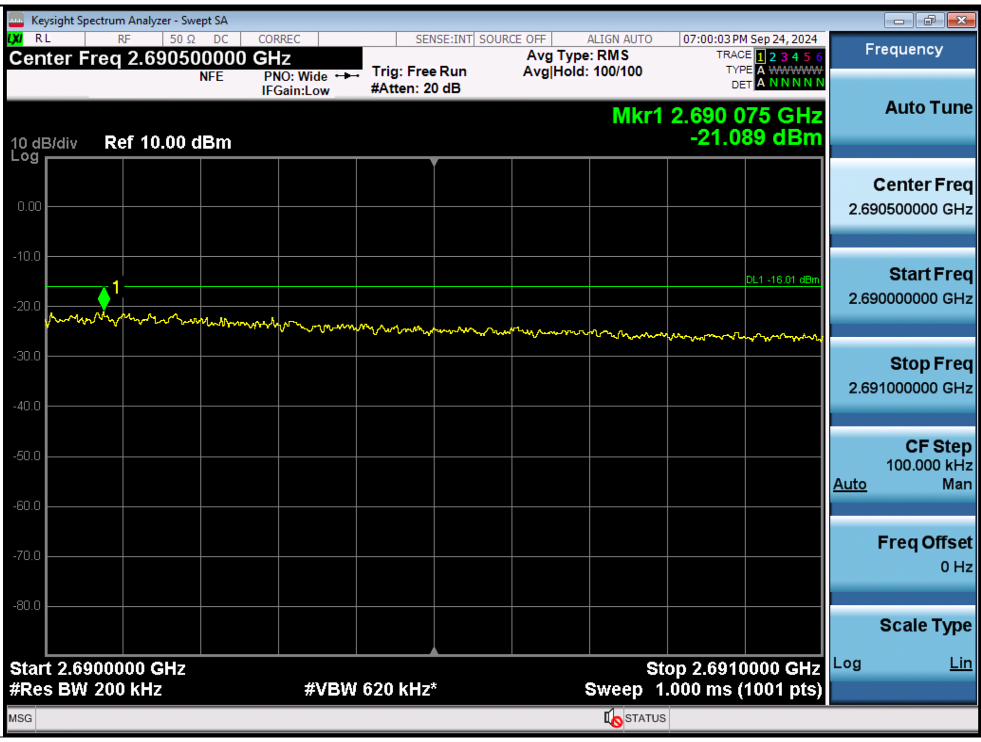
+3 dB above Out-of-band (single test signal) / BRS&EBS / Downlink / LTE 20 MHz / Upper



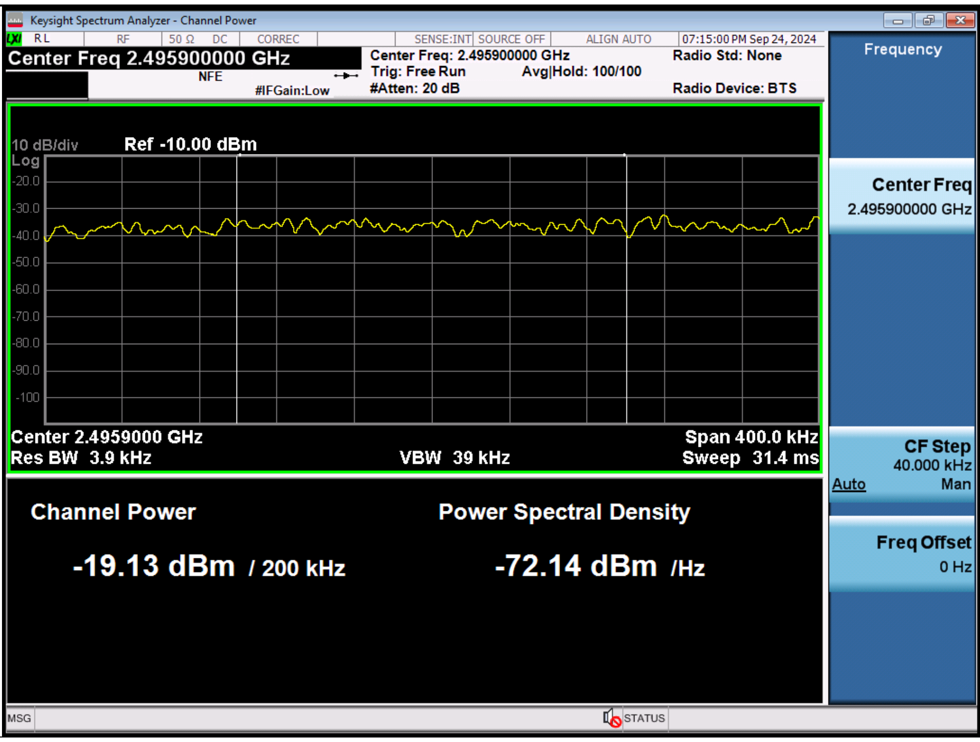
Out-of-band (single test signal) / BRS&EBS / Downlink / 5G NR 20 MHz / Lower



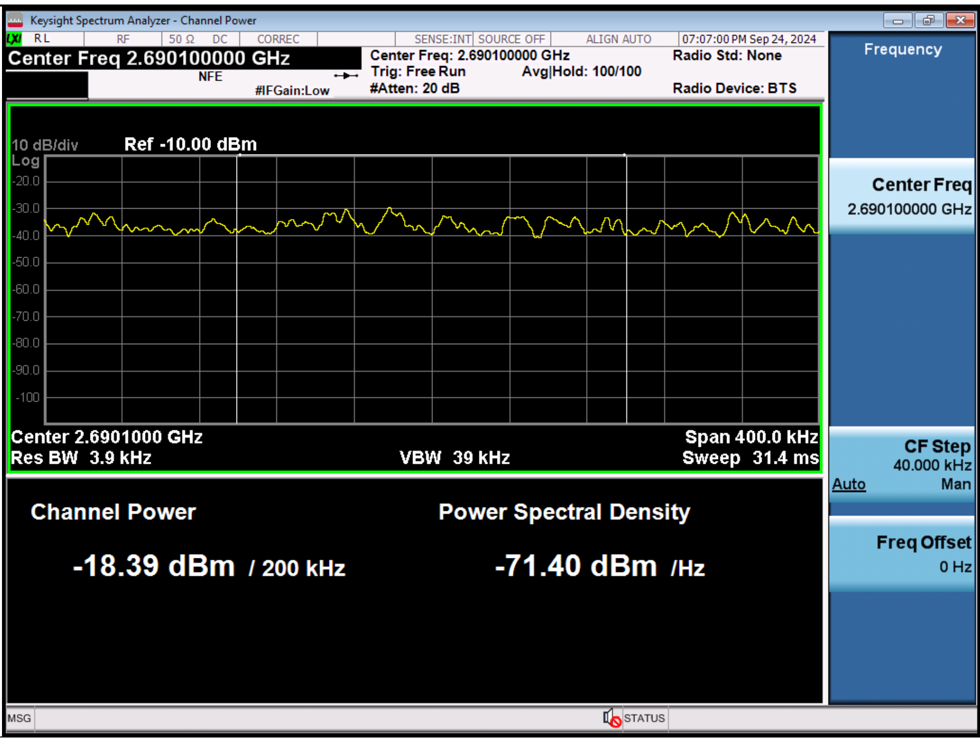
Out-of-band (single test signal) / BRS&EBS / Downlink / 5G NR 20 MHz / Upper



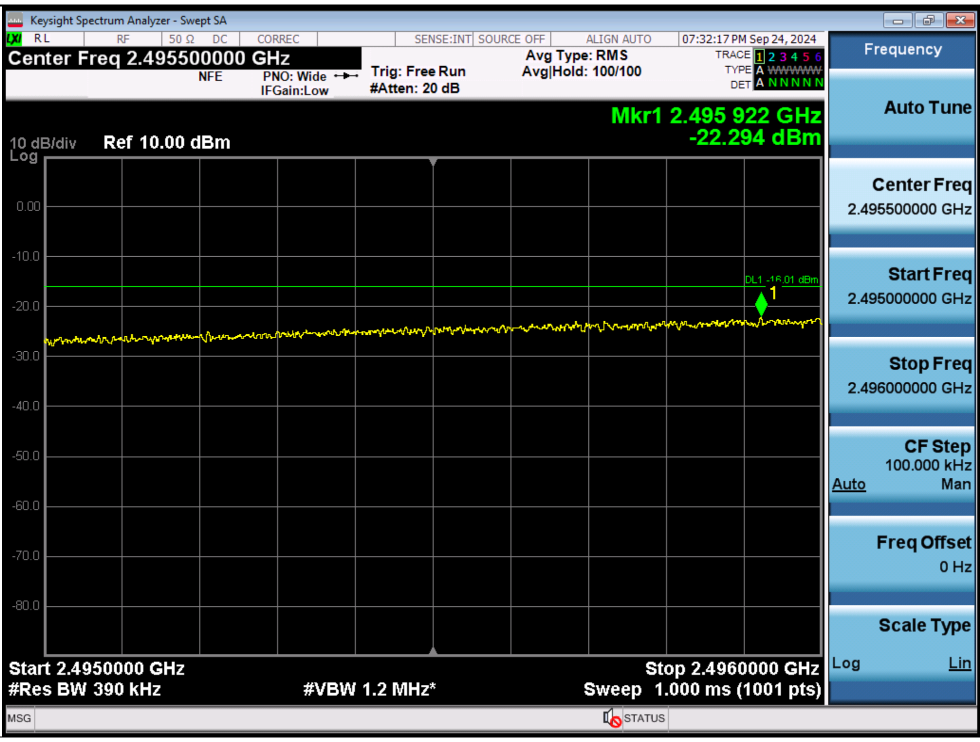
+3 dB above Out-of-band (single test signal) / BRS&EBS / Downlink / 5G NR 20 MHz / Lower



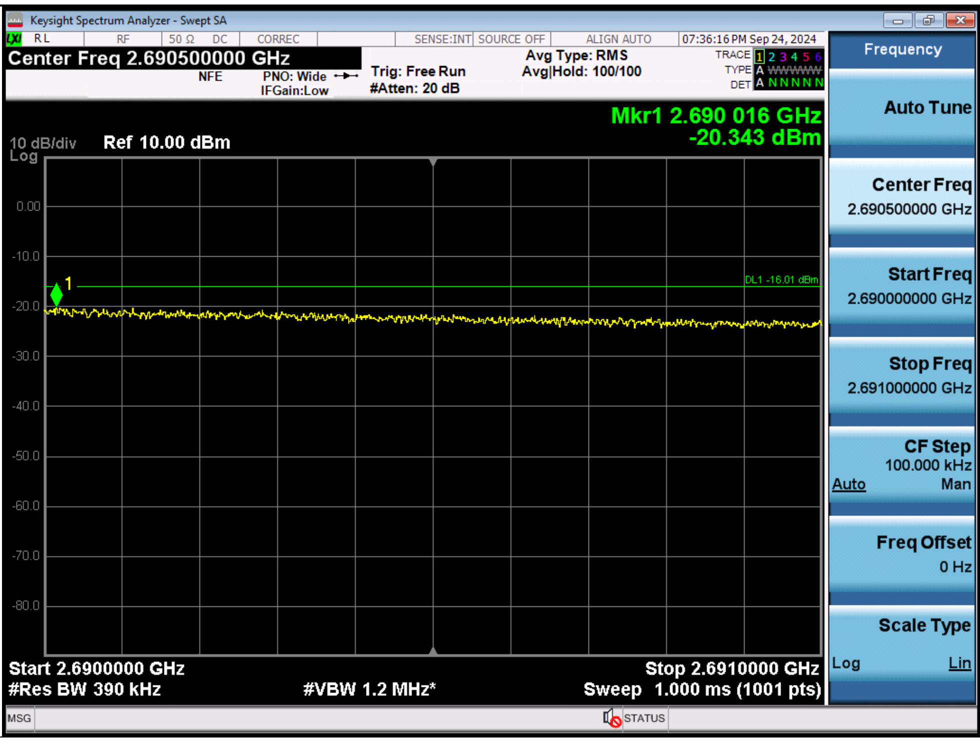
+3 dB above Out-of-band (single test signal) / BRS&EBS / Downlink / 5G NR 20 MHz / Upper



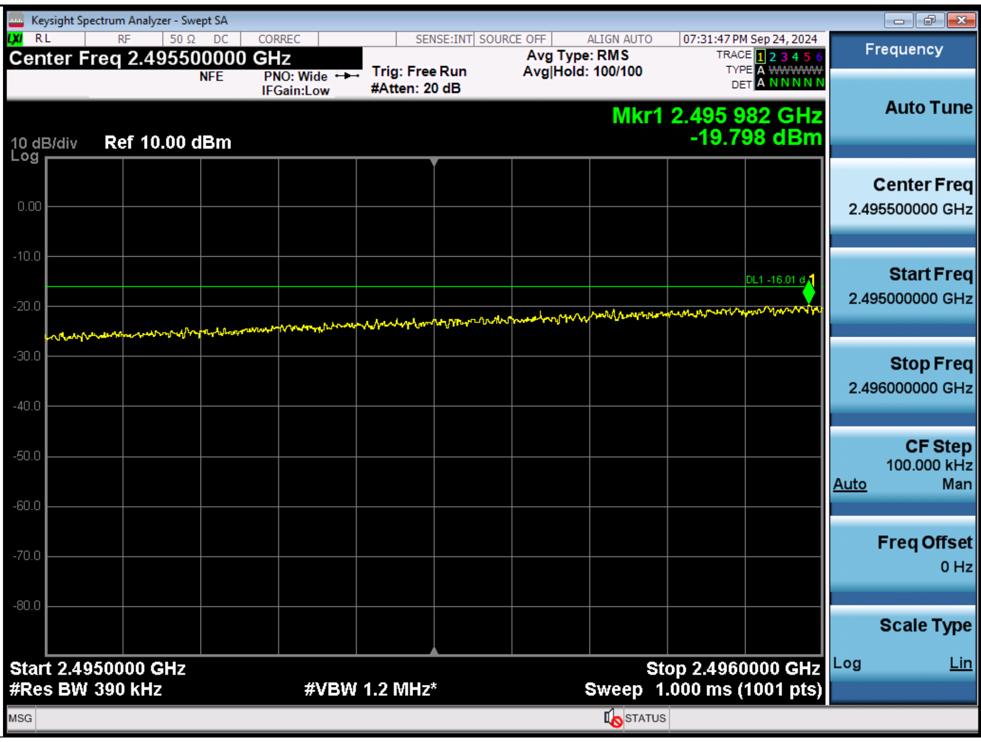
Out-of-band (single test signal) / BRS&EBS / Downlink / 5G NR 40 MHz / Lower



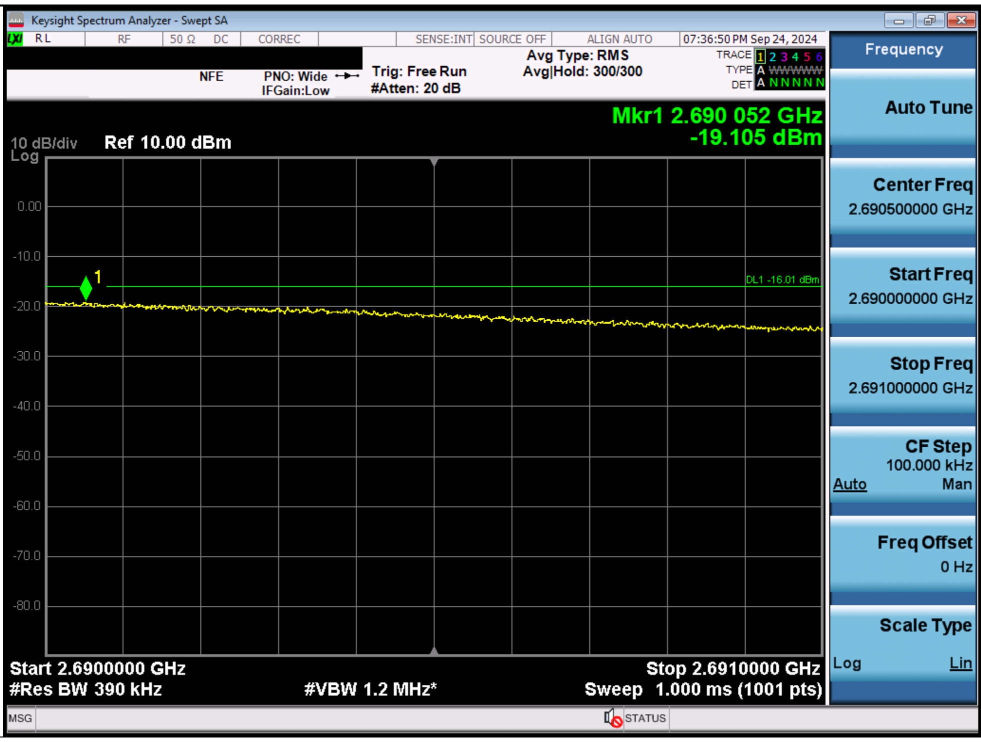
Out-of-band (single test signal) / BRS&EBS / Downlink / 5G NR 40 MHz / Upper



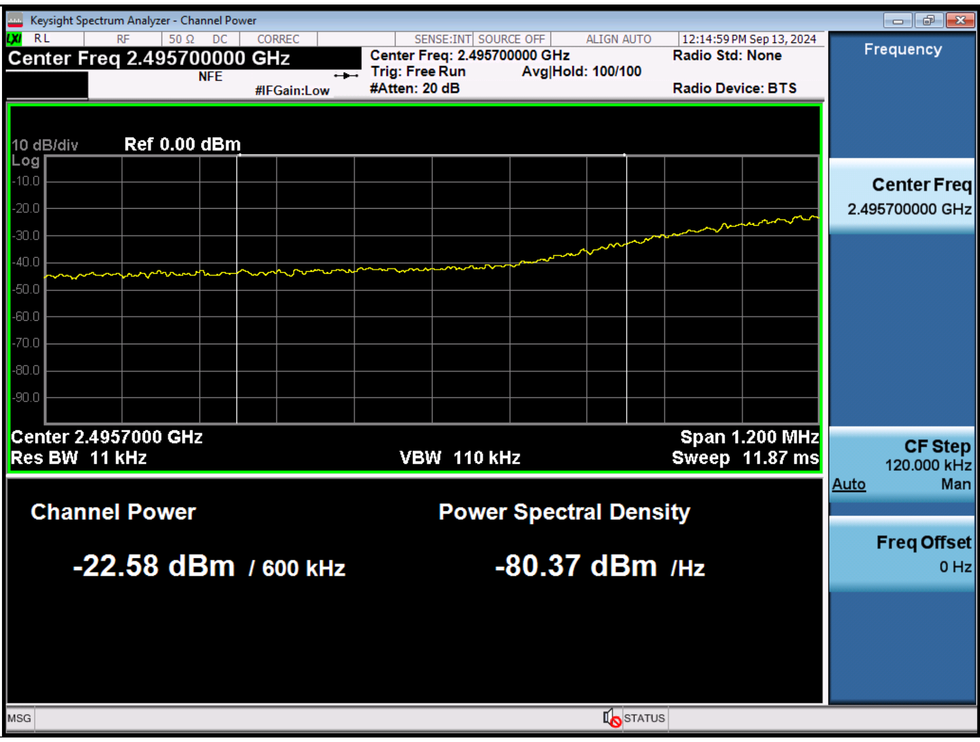
+3 dB above Out-of-band (single test signal) / BRS&EBS / Downlink / 5G NR 40 MHz / Lower



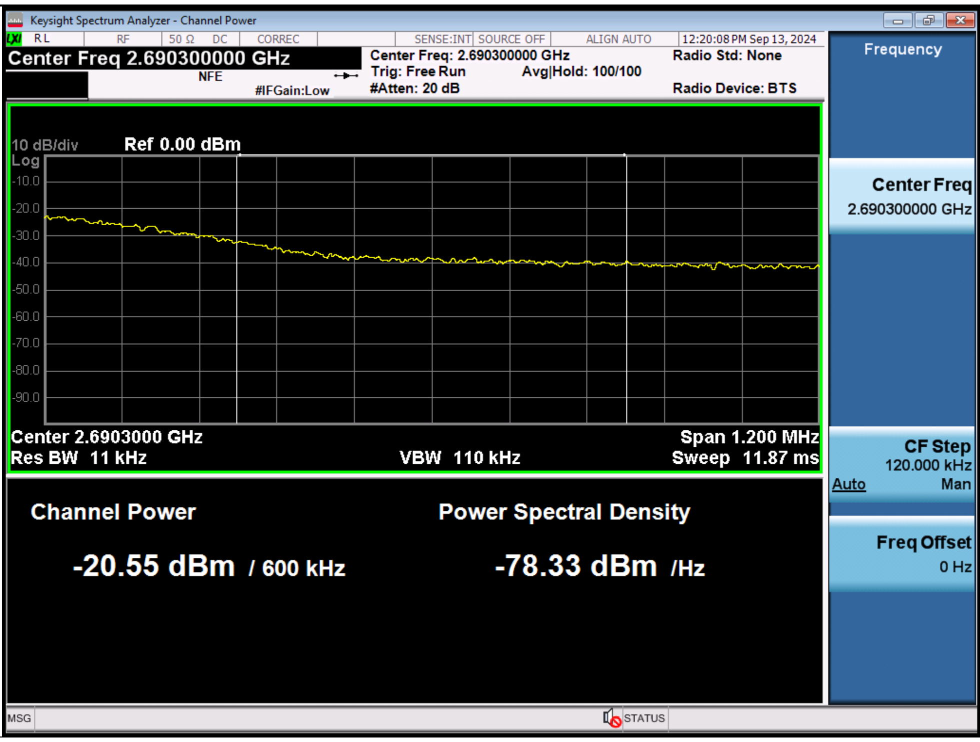
+3 dB above Out-of-band (single test signal) / BRS&EBS / Downlink / 5G NR 40 MHz / Upper



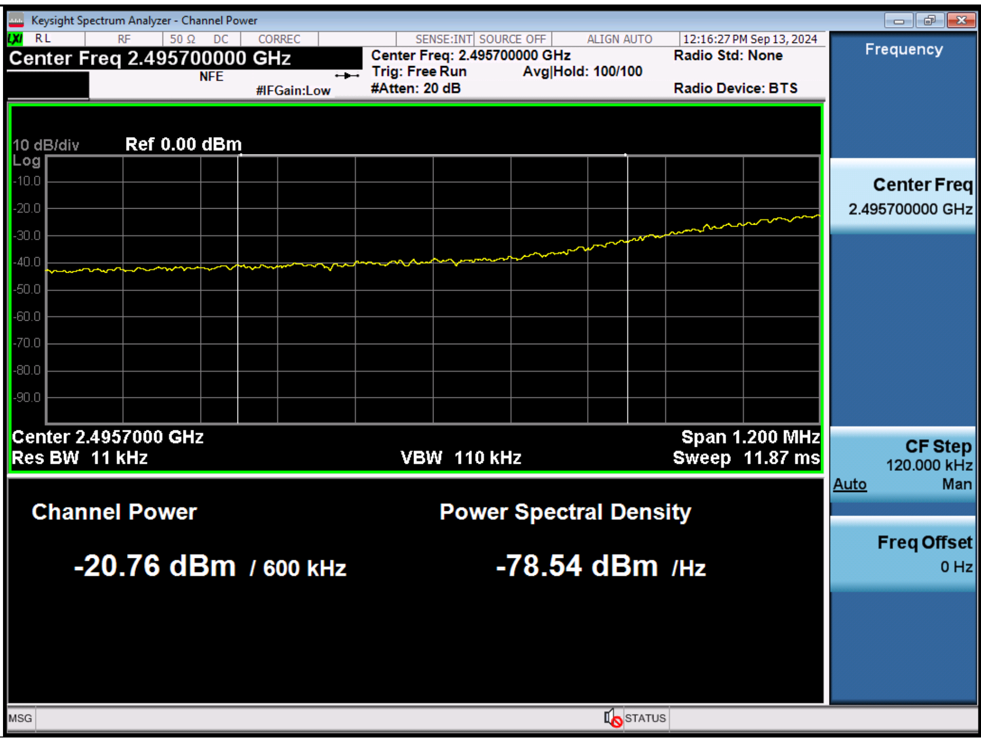
Out-of-band (single test signal) / BRS&EBS / Downlink / 5G NR 60 MHz / Lower



Out-of-band (single test signal) / BRS&EBS / Downlink / 5G NR 60 MHz / Upper



+3 dB above Out-of-band (single test signal) / BRS&EBS / Downlink / 5G NR 60 MHz / Lower



+3 dB above Out-of-band (single test signal) / BRS&EBS / Downlink / 5G NR 60 MHz / Upper