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TEST REPORT

FCC Test for ADXV
Class II Permissive Change

APPLICANT
ADRF KOREA, Inc.

REPORT NO.
HCT-RF-2302-FC003

DATE OF ISSUE
February 9, 2023

Tested by
Sang Su Lee

Technical Manager
Jong Seok Lee

HCT CO., LTD.
BongJai Huh / CEO

HCT CO., LTD.
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si,
Gyeonggi-do, 17383 KOREA
Tel. +82 31 634 6300 Fax. +82 31 645 6401

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TEST REPORT

FCC Test for ADXV

REPORT NO.
HCT-RF-2302-FC003

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Additional Model
-

Applicant	**ADRF KOREA, Inc.** 5-5, Mojeon-Ri, Backsa-Myun, Icheon-Citi, Kyunggi-Do, Korea
Eut Type Model Name	DAS ADXV
FCC ID	N52-ADXV
Output Power	33 dBm (Lower 700 MHz, Upper 700 MHz, ESMR, Cellular), 37 dBm (Broadband PCS, AWS)
Date of Test	December 7, 2022 ~ January 27, 2023
FCC Rule Parts:	CFR 47 Part 2, Part 22, Part 24, Part 27, Part 90

The result shown in this test report refer only to the sample(s) tested unless otherwise stated.
This test results were applied only to the test methods required by the standard.

REVISION HISTORY

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

Revision No.	Date of Issue	Description
0	February 09, 2023	Initial Release

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.

If this report is required to confirmation of authenticity, please contact to www.hct.co.kr

CONTENTS

1. GENERAL INFORMATION

1.1. APPLICANT INFORMATION

Company Name	ADRF KOREA, Inc.
Company Address	5-5, Mojeon-Ri, Backsa-Myun, Icheon-Citi, Kyunggi-Do, Korea

1.2. PRODUCT INFORMATION

EUT Type	DAS
EUT Serial Number	ADXVR337F23XXXX / ADXVR33S8C23XXXX / ADXVR37P23XXXX / ADXVR37A23XXXX
Power Supply	100-130 VAC or 210~240 VAC, 50/60 Hz
Frequency Range	Band Name / Downlink (MHz) Lower 700 MHz / 728 ~ 746 Upper 700 MHz / 746 ~ 757 ESMR / 862 ~ 869 Cellular / 869 ~ 894 Broadband PCS / 1 930 ~ 1 995 AWS / 2 110 ~ 2 180
Tx Output Power	33 dBm (Lower 700 MHz, Upper 700 MHz, ESMR, Cellular), 37 dBm (Broadband PCS, AWS)
Antenna Peak Gain	Maximum Directional Peak Gain: 13.4 dBi

1.3. TEST INFORMATION

FCC Rule Parts	47 CFR Part 2, Part 22, Part 24, Part 27, Part 90
Measurement Standards	KDB 935210 D05 v01r04, ANSI C63.26-2015, KDB 971168 D01 v03r01
Test Location	HCT CO., LTD. 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. 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 Publication 22.

Detailed description of test facility was submitted to the Commission and accepted dated April 02, 2018 (Registration Number: 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 Part 2 and Part 22, Part 24, Part 27, Part 90.

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, § 22.913 (a), (d), § 24.232 (a), (d), § 27.50 (b), (c), (d), § 90.635	Compliant
Out-of-band/out-of-block emissions and spurious emissions	§ 2.1051, § 22.917, § 24.238, § 27.53 (c), (f), (g), (h), § 90.691,	Compliant
Spurious emissions radiated	§ 2.1053	Compliant
Frequency Stability	§ 2.1055	Compliant

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
Lower 700 MHz	LTE 10 MHz
	5G NR 10 MHz
Upper 700 MHz	LTE 10 MHz
	5G NR 10 MHz
ESMR	5G NR 5 MHz
Cellular	5G NR 20 MHz
Broadband PCS	5G NR 60 MHz
AWS	5G NR 60 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)
600	0.631	1 400	1.195
650	0.777	1 500	1.289
700	0.714	1 600	1.424
750	0.770	1 700	1.560
800	0.721	1 800	1.650
850	0.836	1 900	1.685
900	1.049	2 000	1.893
950	0.954	2 100	1.959
1 000	1.111	2 200	1.635
1 100	1.101	2 300	1.467
1 200	1.166		
1 300	1.198		

: Output Path

Correction factor table			
Frequency (MHz)	Factor (dB)	Frequency (MHz)	Factor (dB)
2	30.547	6 500	32.871
10	29.555	7 000	33.234
20	29.558	7 500	33.204
30	29.333	8 000	33.782
40	29.439	8 500	33.348
50	29.473	9 000	33.272
100	29.320	9 500	33.142
200	30.001	10 000	33.195
300	29.871	11 000	34.278
400	30.017	12 000	34.561
500	30.454	13 000	34.791
600	30.178	14 000	34.920
700	30.269	15 000	35.375
800	30.339	16 000	35.724
900	30.622	17 000	36.466
1 000	30.716	18 000	36.622
1 200	30.859	19 000	36.510
1 400	30.848	20 000	37.091
1 600	31.089	21 000	37.383
1 800	31.461	22 000	39.794
2 000	31.535	23 000	38.790
2 500	31.142	24 000	39.754
3 000	31.686	25 000	39.684
3 500	31.859	26 000	38.648
4 000	31.917	26 500	42.920
4 500	32.340	-	-
5 000	32.424	-	-
5 500	32.372	-	-
6 000	32.630	-	-

3.3. MEASUREMENTUNCERTAINTY

Description	Condition	Uncertainty
Radiated Disturbance	9 kHz ~ 30 MHz	± 4.14 dB
	30 MHz ~ 1 GHz	± 5.82 dB
	1 GHz ~ 18 GHz	± 5.74 dB
	18 GHz ~ 40 GHz	± 5.76 dB

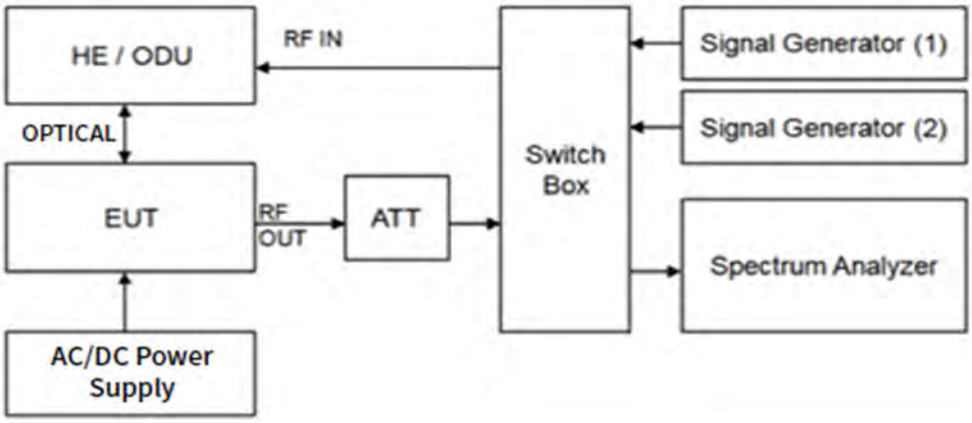
* Coverage factor k = 2, Confidence levels of 95 %

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

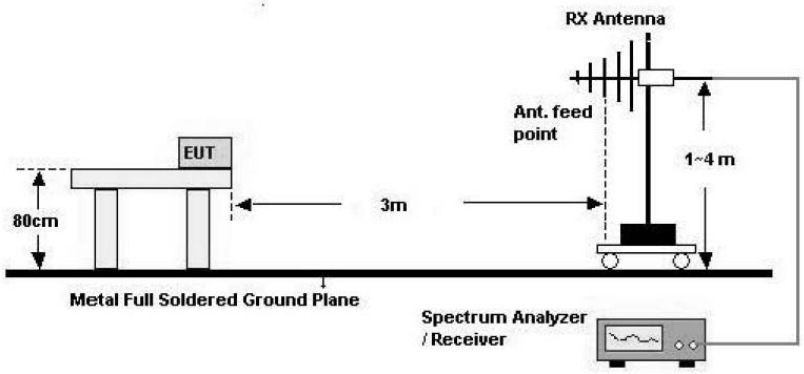
3.5. TEST DIAGRAMS

Conducted Test

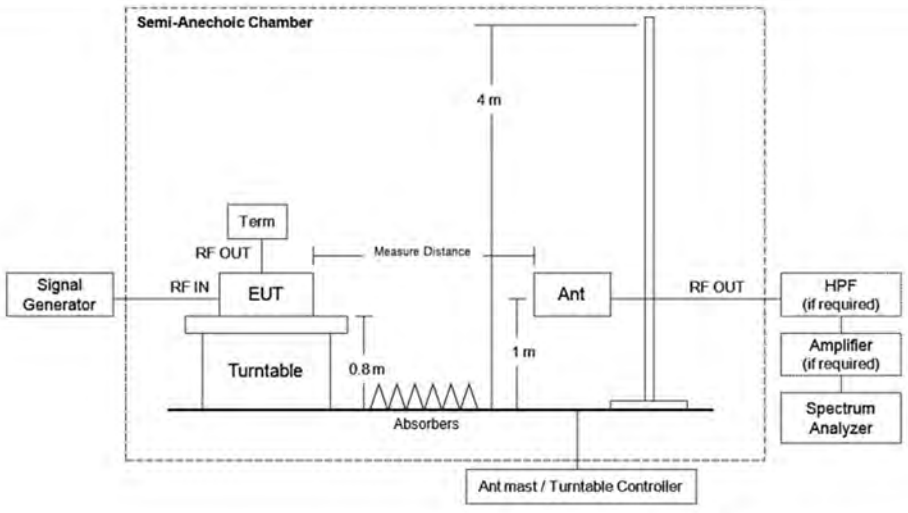


Radiated Test

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

4. TEST EQUIPMENTS

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
MXA Signal Analyzer	N9020A	Keysight	MY46471250	07/22/2023	Annual
PXA Signal Analyzer	N9030A	Keysight	MY55410714	02/14/2023	Annual
MXG Vector Signal Generator	N5182A	Agilent	MY50140312	08/18/2023	Annual
MXG Vector Signal Generator	N5182A	Agilent	MY50141649	08/16/2023	Annual
MXG Vector Signal Generator	N5182A	Agilent	MY46240807	12/23/2023	Annual
MXG Vector Signal Generator	N5182A	Agilent	MY46240523	12/06/2023	Annual
30 dB Attenuator	WA93-30-33	Weinschel Associates	0190	03/28/2023	Annual
*30 dB Attenuator	67-30-33	API Weinschel, Inc.	CL4336	05/03/2023	Annual
*50Ω Termination	908A	H.P.	N/A	N/A	N/A
AC Power Supply	PCR2000MA	KIKUSUI	ZL002530	12/28/2023	Annual
Switch	S46-SV11	KEITHLEY	1035126	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 system	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
Amp & Filter Bank Switch Controller	FBSM-01B	TNM system	TM20090002	N/A	N/A
Loop Antenna	FMZB 1513	Schwarzbeck	1513-333	03/17/2024	Biennial
Trilog Super Broadband Antenna	VULB 9168	Schwarzbeck	9168-0895	08/16/2024	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	02296	05/18/2024	Biennial
Horn Antenna	BBHA 9170	Schwarzbeck	BBHA9170342	09/29/2024	Biennial
Thru(0.1 ~ 18 GHz) + LNA(0.1 ~ 18 GHz)	FBSR-04C	TNM system	N/A	08/23/2023	Annual
HPF(3 ~ 18 GHz) + LNA(0.1 ~ 18 GHz)	FBSR-04C	TNM system	N/A	08/23/2023	Annual
Low Noise Amplifier	LLAU1183540Q	LTC Microwave	100	08/23/2023	Annual
Low Noise Amplifier	TK-PA1840H	TESTEK	170011-L	10/24/2023	Annual
High Pass Filter	WHKX10-900-1000-15000-40SS	Wainwright Instruments	16	08/02/2023	Annual
High Pass Filter	WHKX12-2805-3000-18000-40SS	Wainwright Instruments	45	08/23/2023	Annual

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

Note:

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 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)
Lower 700 MHz	Downlink	LTE 10 MHz	737.00	-15	32.71
		5G NR 10 MHz	737.00	-15	32.81
Upper 700 MHz	Downlink	LTE 10 MHz	751.50	0	32.69
		5G NR 10 MHz	751.50	0	32.65
ESMR	Downlink	5G NR 5 MHz	865.50	0	32.76
Cellular	Downlink	5G NR 20 MHz	881.50	0	32.88
AWS	Downlink	5G NR 20 MHz	2 145.00	-15	36.65
PCS	Downlink	5G NR 20 MHz	1 962.50	0	36.70

5.2. OUT-OF-BAND REJECTION

Test Requirement:

KDB 935210 D05 v01r04

Out-of-band rejection required.

Test Procedures:

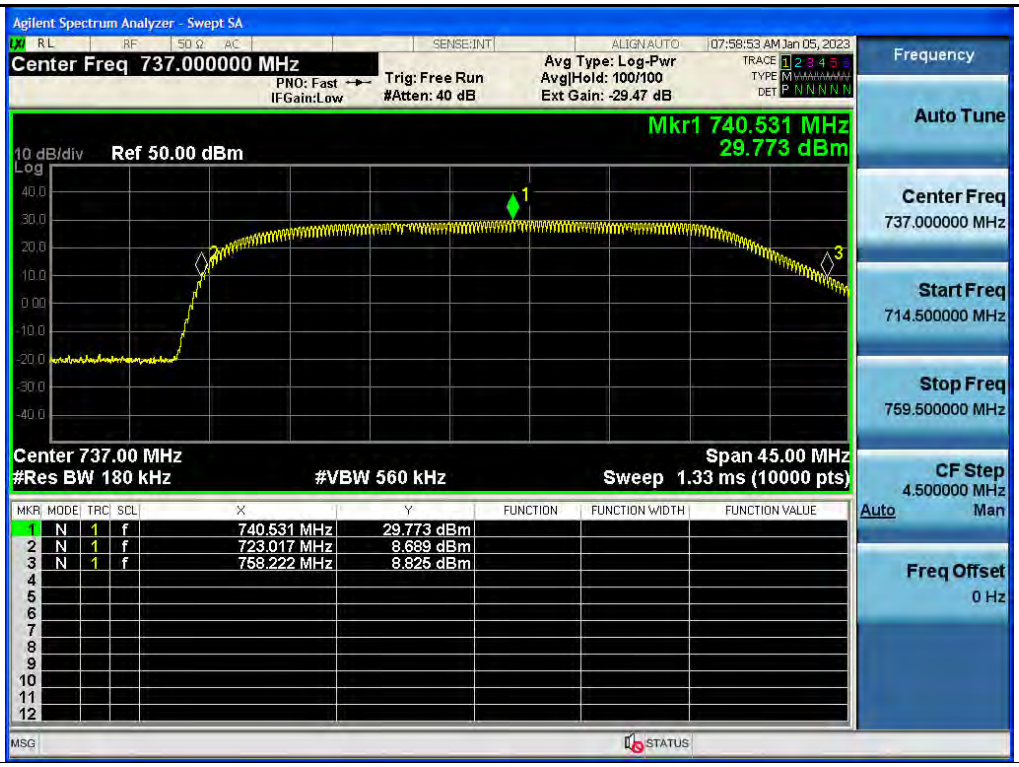
Measurements were in accordance with the test methods section 3.3 of KDB 935210 D05 v01r04.

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.

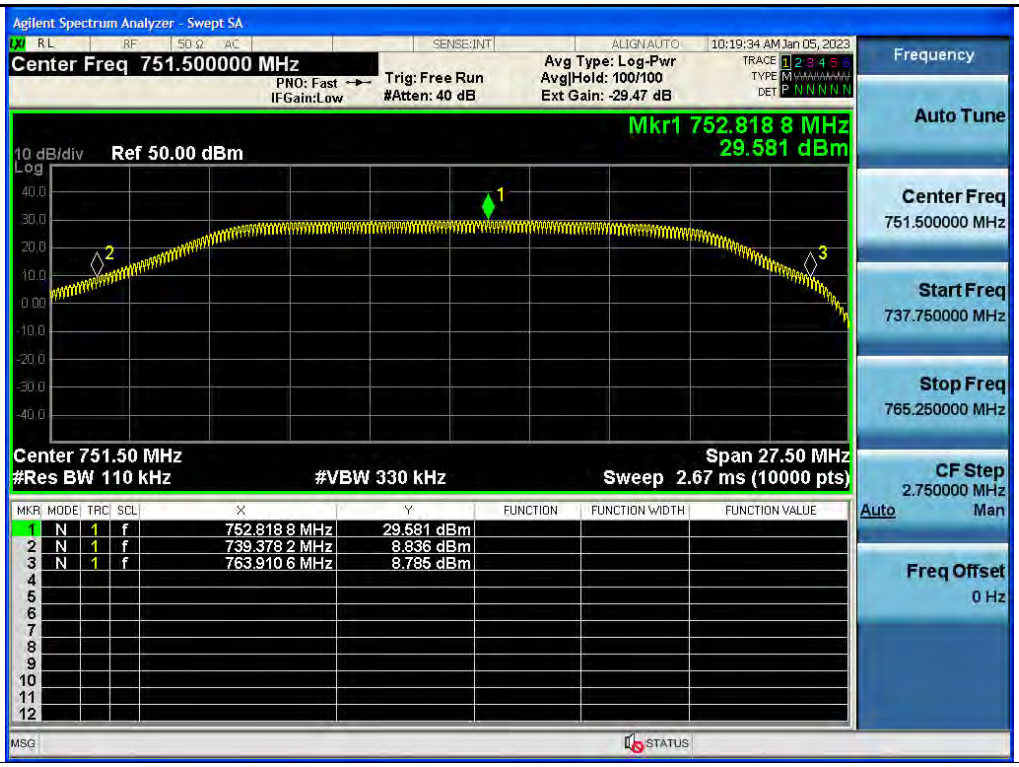
a) Connect a signal generator to the input of the EUT.
b) Configure a swept CW signal with the following parameters:
   1) Frequency range = ±250 % of the passband, for each applicable CMRS band.
   2) Level = a sufficient level to affirm that the out-of-band rejection is > 20 dB above the noise floor 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:

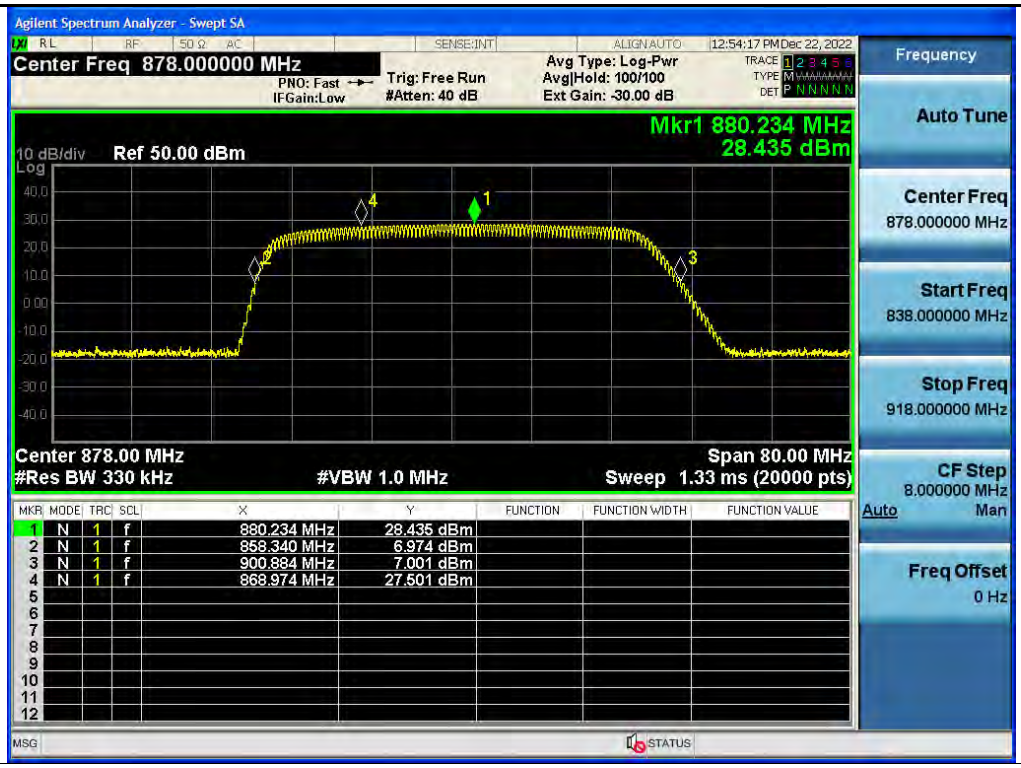
Lower 700 MHz / Downlink



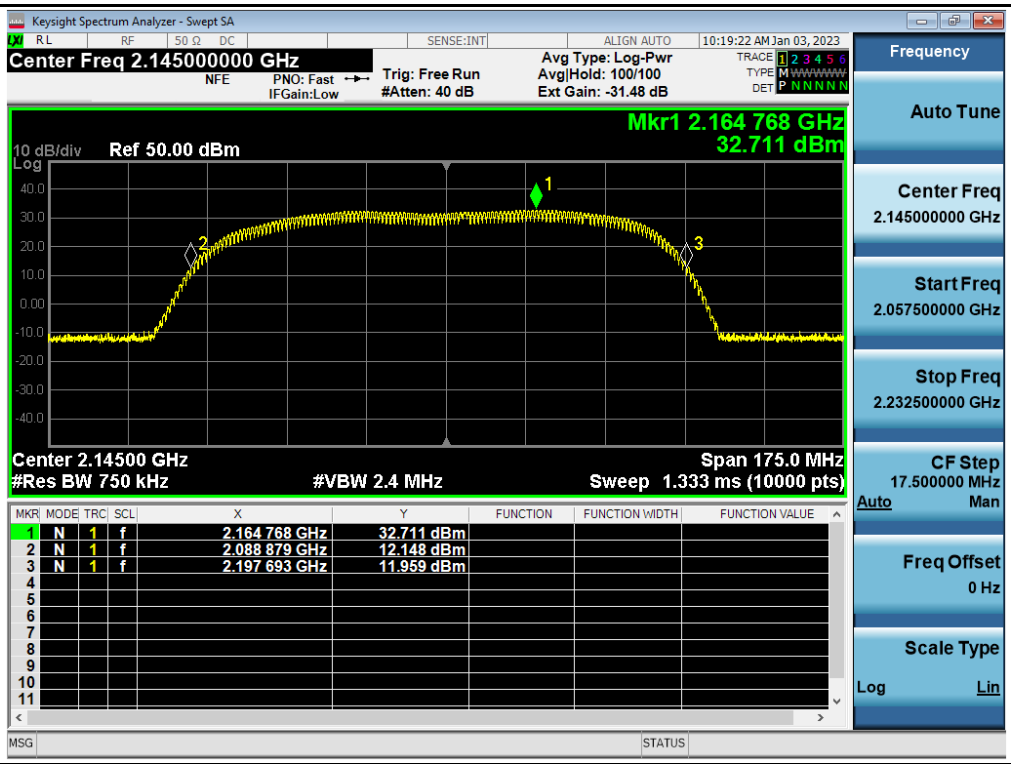
Upper 700 MHz / Downlink



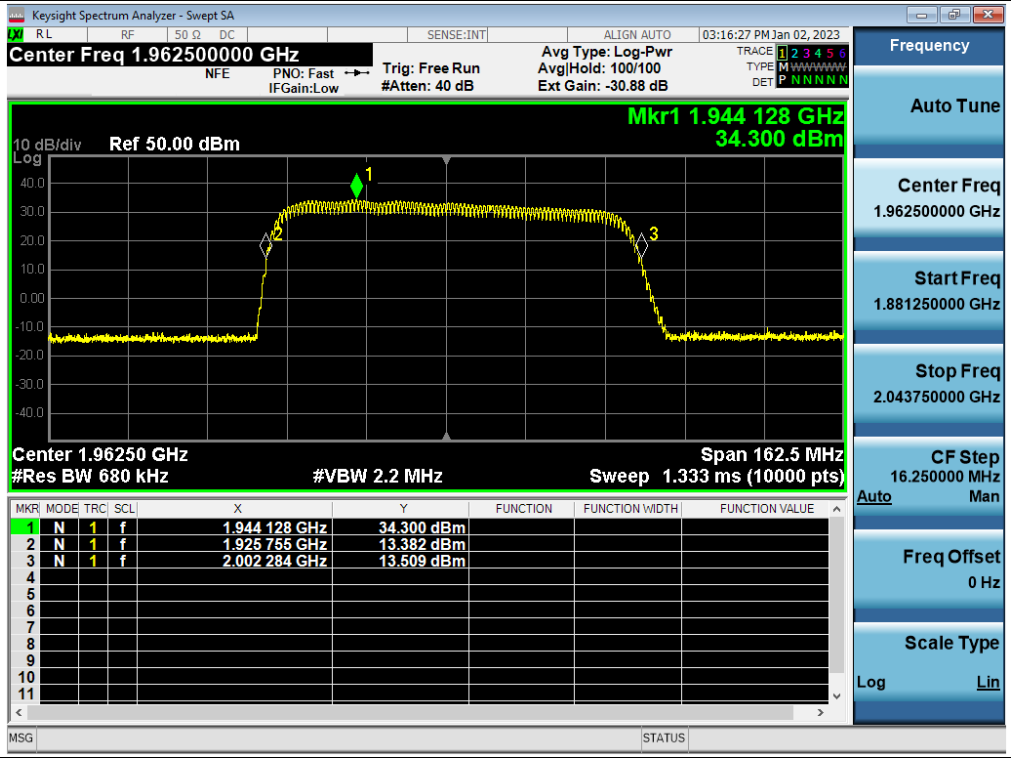
ESMR + Cellular / Downlink



AWS / Downlink



PCS / 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)
Lower 700 MHz	Downlink	LTE 10 MHz	737.00	9.0258	9.920
		5G NR 10 MHz	737.00	8.6130	9.481
Upper 700 MHz	Downlink	LTE 10 MHz	751.50	9.0005	9.972
		5G NR 10 MHz	751.50	8.6319	9.416
ESMR	Downlink	5G NR 5 MHz	865.50	4.5103	4.917
Cellular	Downlink	5G NR 20 MHz	881.50	18.222	19.377
AWS	Downlink	5G NR 60 MHz	2 145.00	57.903	60.842
PCS	Downlink	5G NR 60 MHz	1 962.50	57.825	60.850

Tabular data of Input Occupied Bandwidth

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (MHz)	26 dB OBW (MHz)
Lower 700 MHz	Downlink	LTE 10 MHz	737.00	9.0118	9.917
		5G NR 10 MHz	737.00	8.6081	9.444
Upper 700 MHz	Downlink	LTE 10 MHz	751.50	8.9989	9.974
		5G NR 10 MHz	751.50	8.6324	9.421
ESMR	Downlink	5G NR 5 MHz	865.50	4.5196	4.930
Cellular	Downlink	5G NR 20 MHz	881.50	18.260	19.395
AWS	Downlink	5G NR 60 MHz	2 145.00	57.956	60.837
PCS	Downlink	5G NR 60 MHz	1 962.50	57.855	60.893

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)
Lower 700 MHz	Downlink	LTE 10 MHz	737.00	9.0035	9.918
		5G NR 10 MHz	737.00	8.6307	9.458
Upper 700 MHz	Downlink	LTE 10 MHz	751.50	8.9978	9.914
		5G NR 10 MHz	751.50	8.6067	9.460
ESMR	Downlink	5G NR 5 MHz	865.50	4.5069	4.942
Cellular	Downlink	5G NR 20 MHz	881.50	18.232	19.412
AWS	Downlink	5G NR 60 MHz	2 145.00	57.970	60.929
PCS	Downlink	5G NR 60 MHz	1 962.50	57.723	60.891

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)
Lower 700 MHz	Downlink	LTE 10 MHz	737.00	9.0079	9.910
		5G NR 10 MHz	737.00	8.6475	9.491
Upper 700 MHz	Downlink	LTE 10 MHz	751.50	8.9853	9.909
		5G NR 10 MHz	751.50	8.6176	9.467
ESMR	Downlink	5G NR 5 MHz	865.50	4.5113	4.916
Cellular	Downlink	5G NR 20 MHz	881.50	18.256	19.406
AWS	Downlink	5G NR 60 MHz	2 145.00	58.055	60.883
PCS	Downlink	5G NR 60 MHz	1 962.50	57.875	60.900

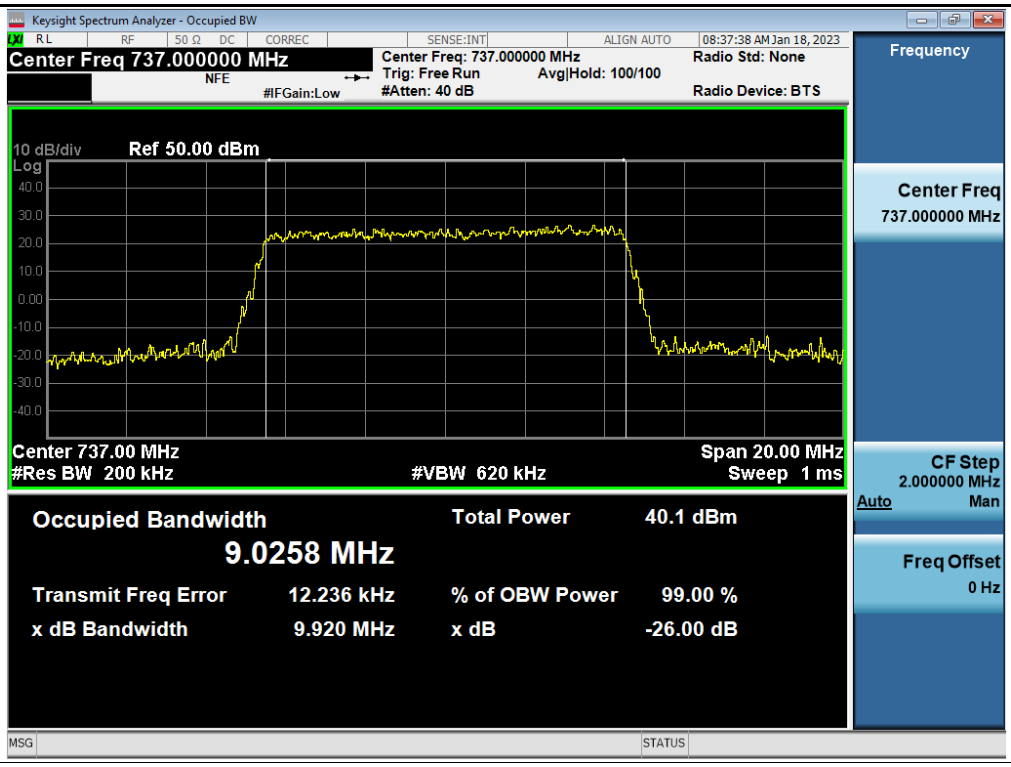
Measured Occupied Bandwidth Comparison

Test Band	Link	Signal	Variant of Input and output Occupied Bandwidth (%)	Variant of Input and 3 dB above the AGC threshold output Occupied Bandwidth (%)
Lower 700 MHz	Downlink	LTE 10 MHz	0.030	0.081
		5G NR 10 MHz	0.392	-0.348
Upper 700 MHz	Downlink	LTE 10 MHz	-0.020	0.050
		5G NR 10 MHz	-0.053	-0.074
ESMR	Downlink	5G NR 5 MHz	-0.264	0.529
Cellular	Downlink	5G NR 20 MHz	-0.093	0.031
AWS	Downlink	5G NR 60 MHz	0.008	0.076
PCS	Downlink	5G NR 60 MHz	-0.071	-0.015

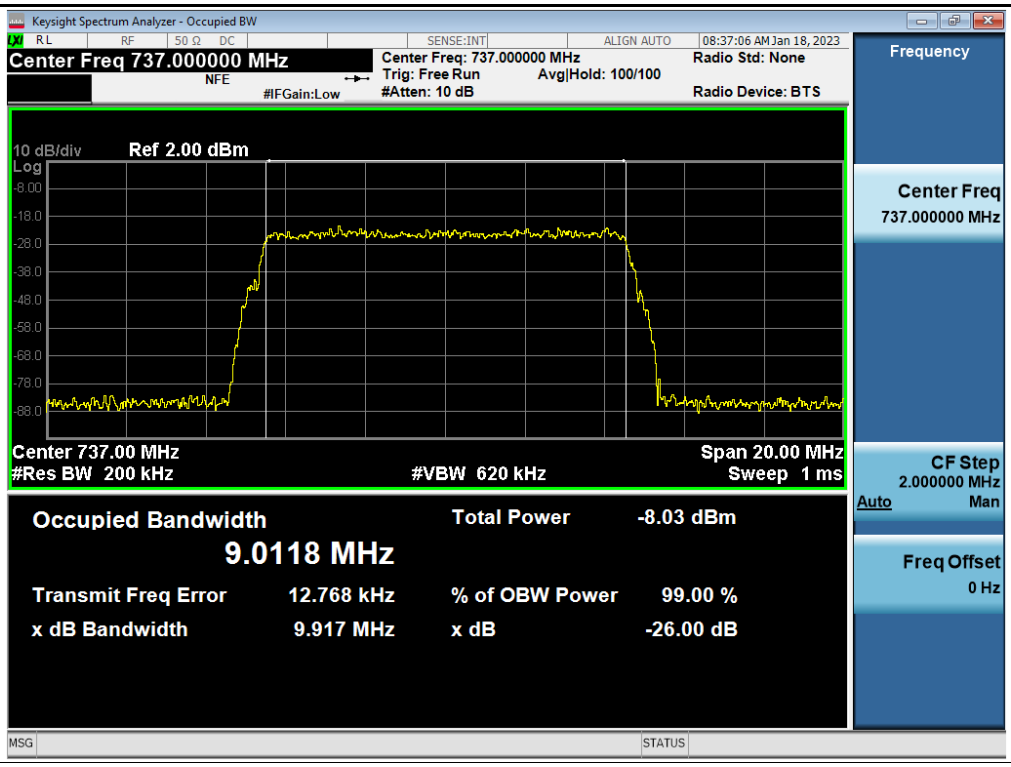
** Change in input-output OBW is less than ±5 %.*

Plot data of Occupied Bandwidth

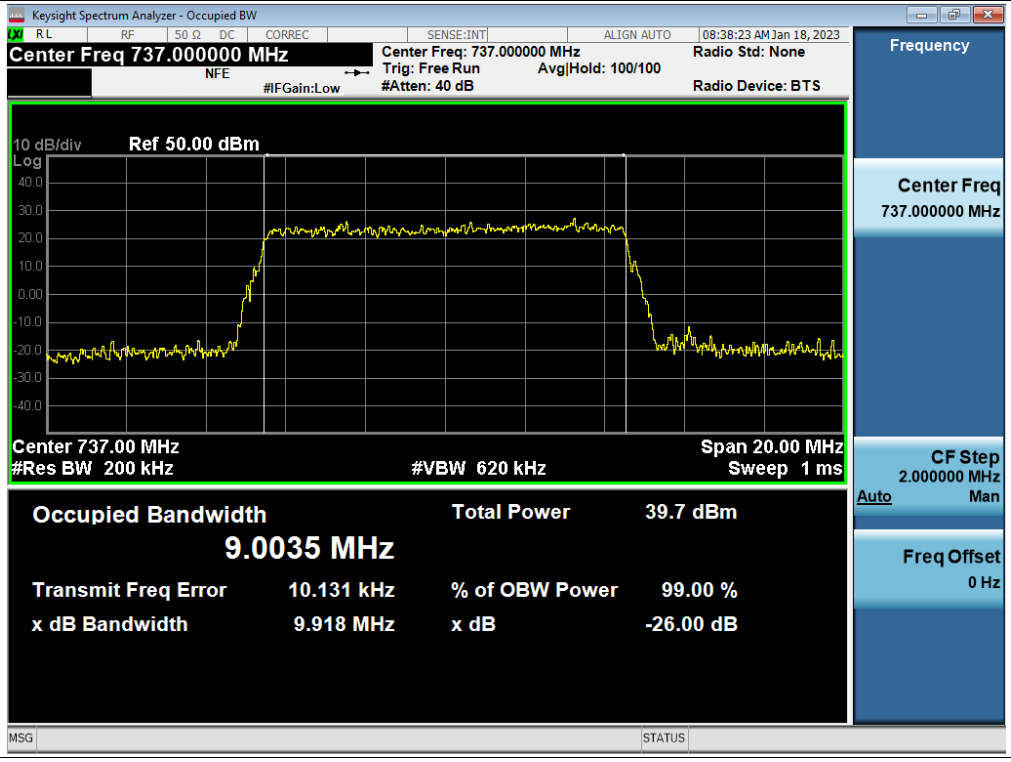
Output / Lower 700 MHz / Downlink / LTE 10 MHz



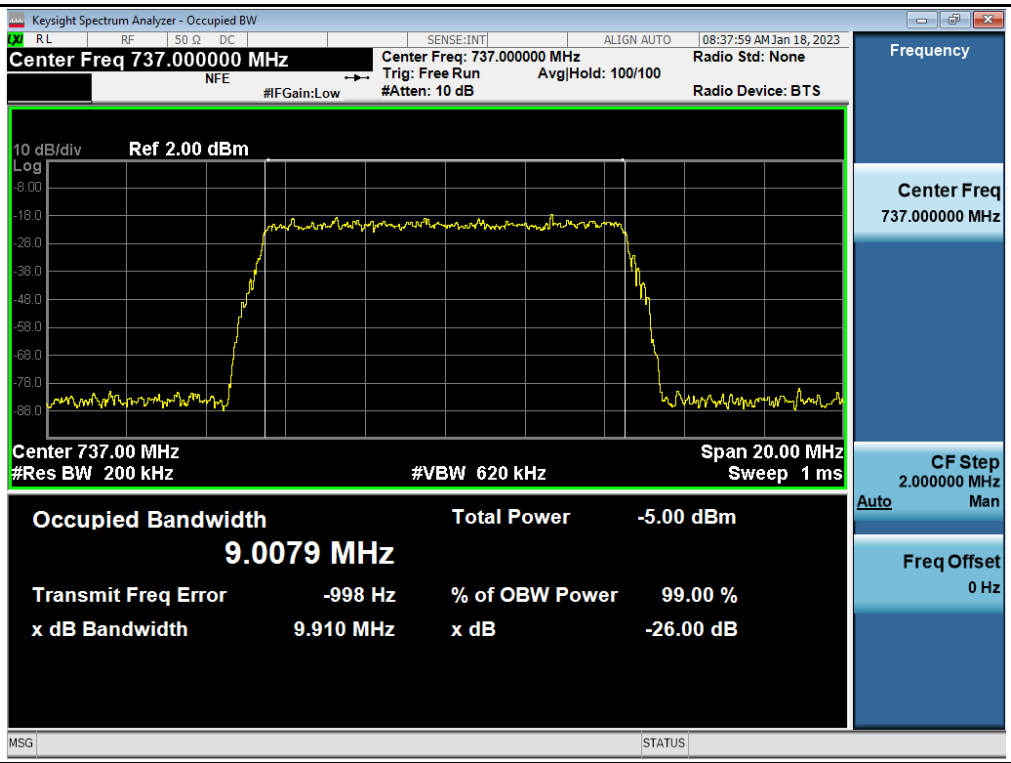
Input / Lower 700 MHz / Downlink / LTE 10 MHz



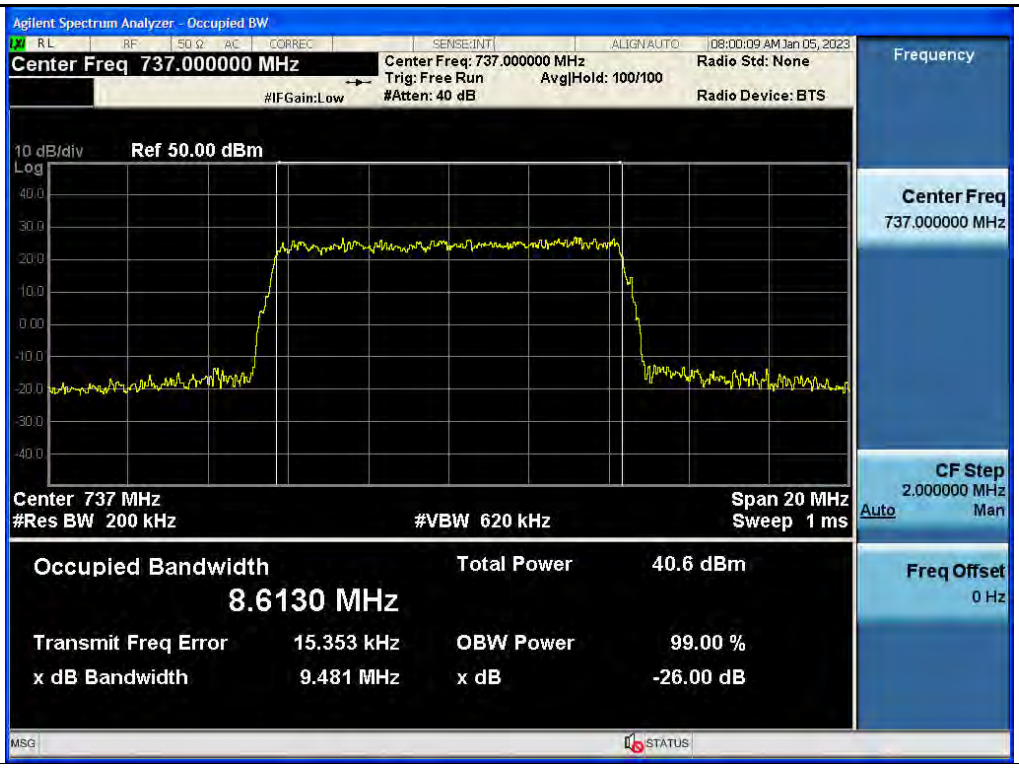
3 dB above the AGC threshold output / Lower 700 MHz / Downlink / LTE 10 MHz



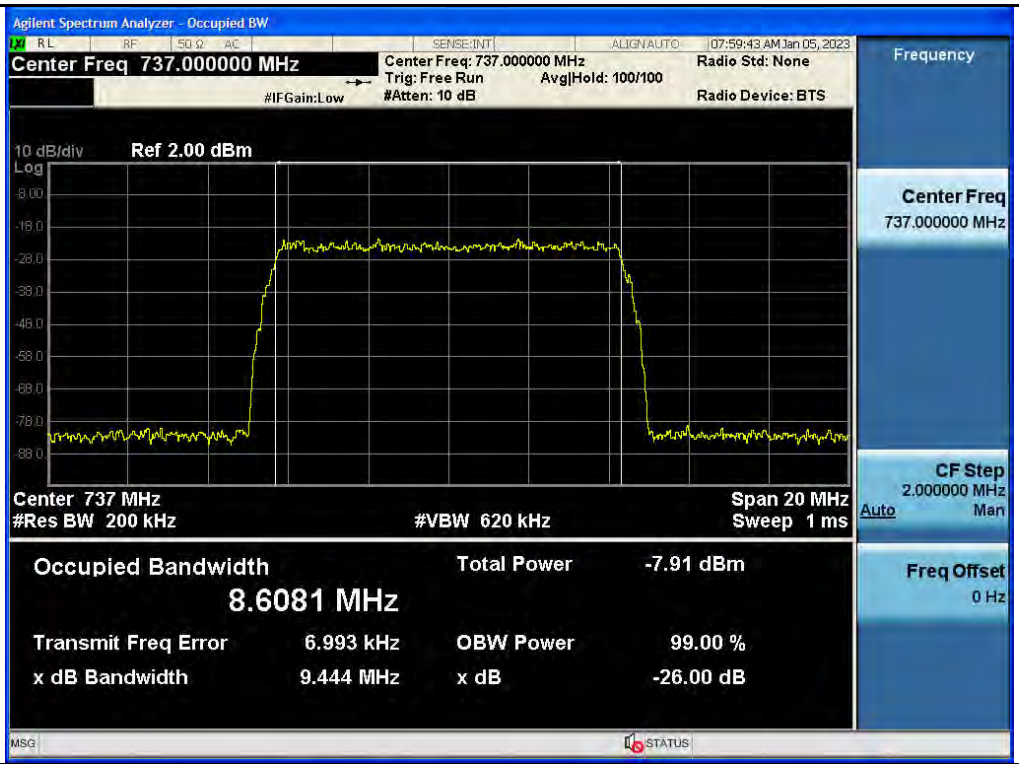
3 dB above the AGC threshold Input / Lower 700 MHz / Downlink / LTE 10 MHz



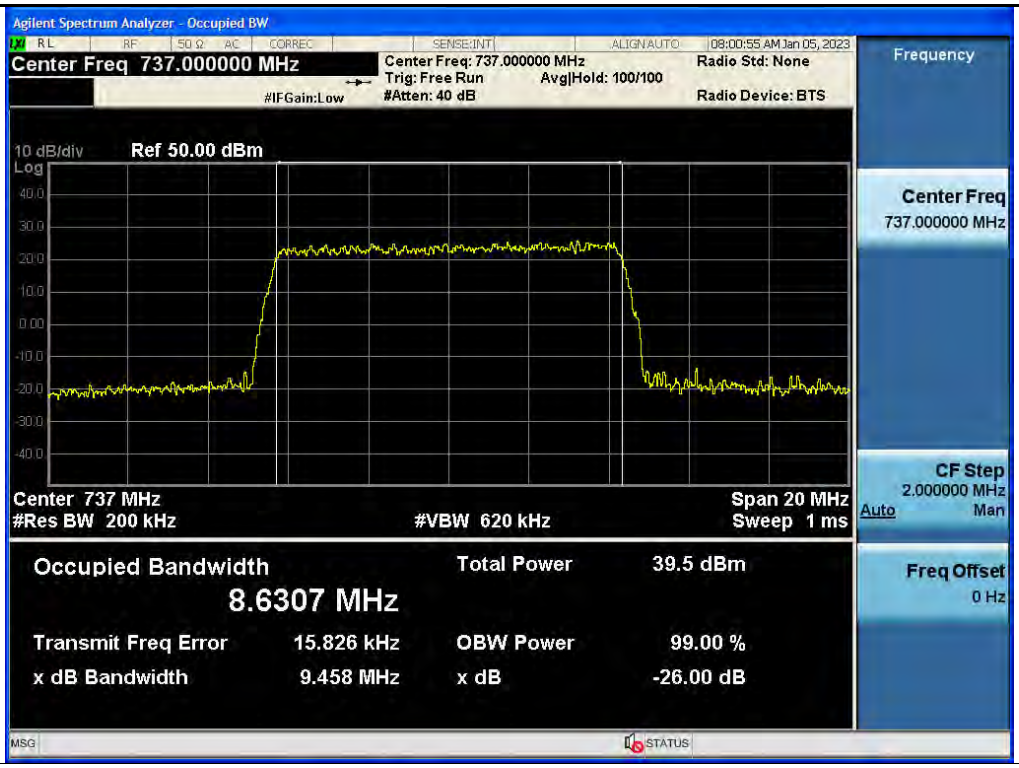
Output / Lower 700 MHz / Downlink / 5G NR 10 MHz



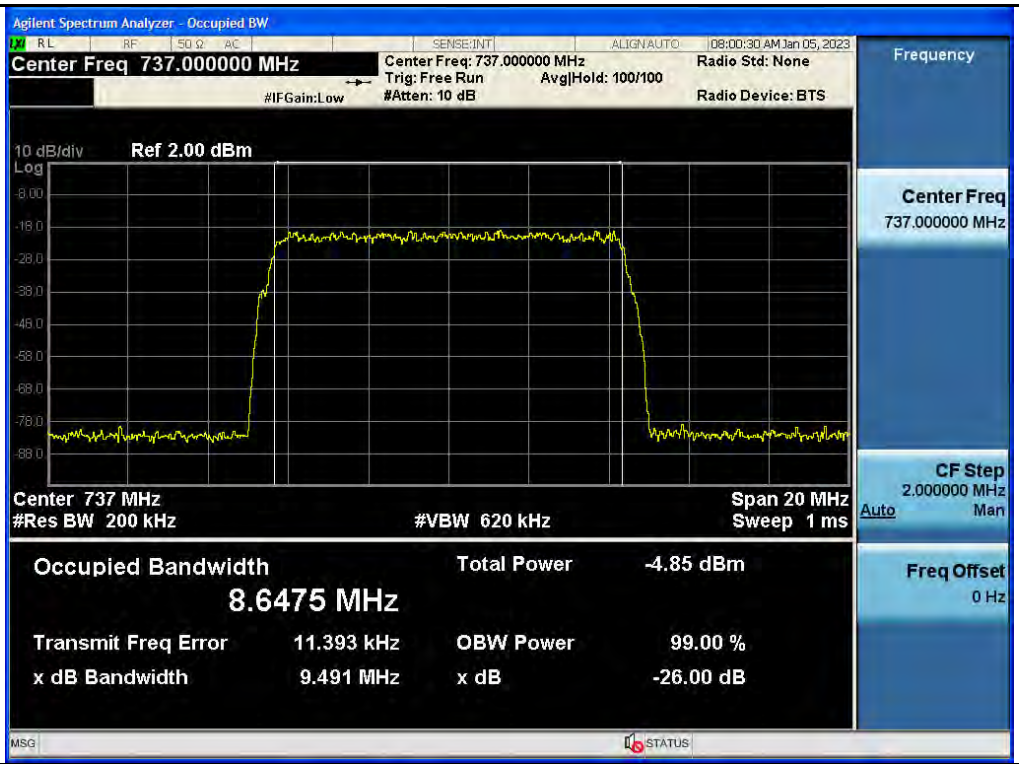
Input / Lower 700 MHz / Downlink / 5G NR 10 MHz



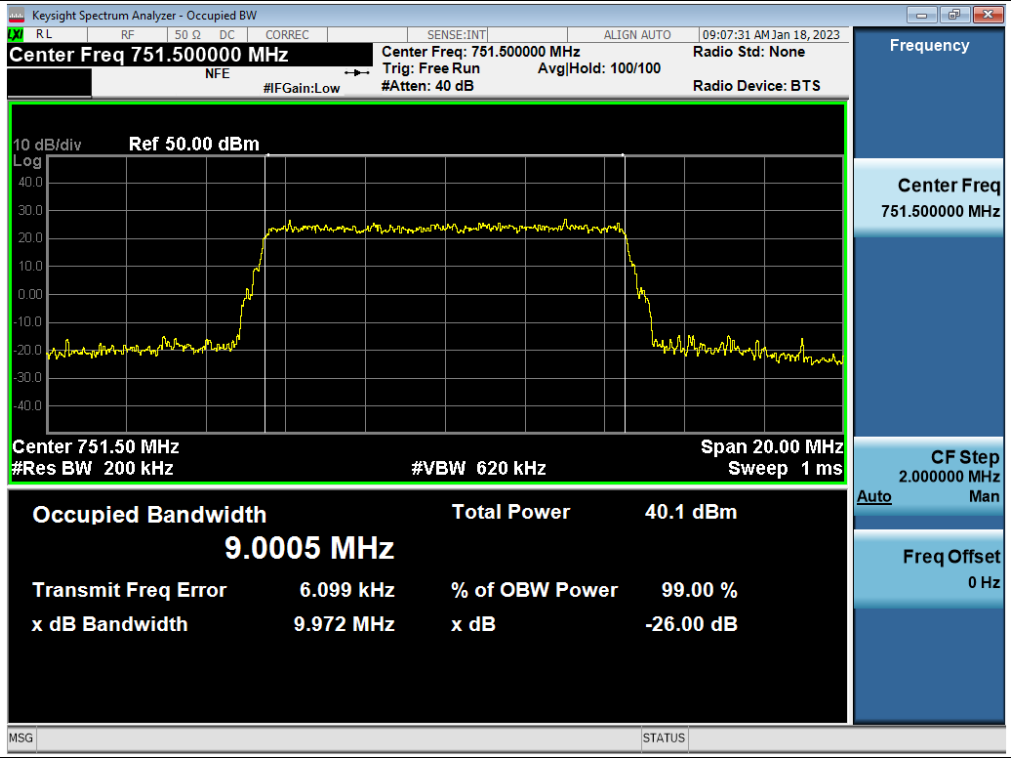
3 dB above the AGC threshold output / Lower 700 MHz / Downlink / 5G NR 10 MHz



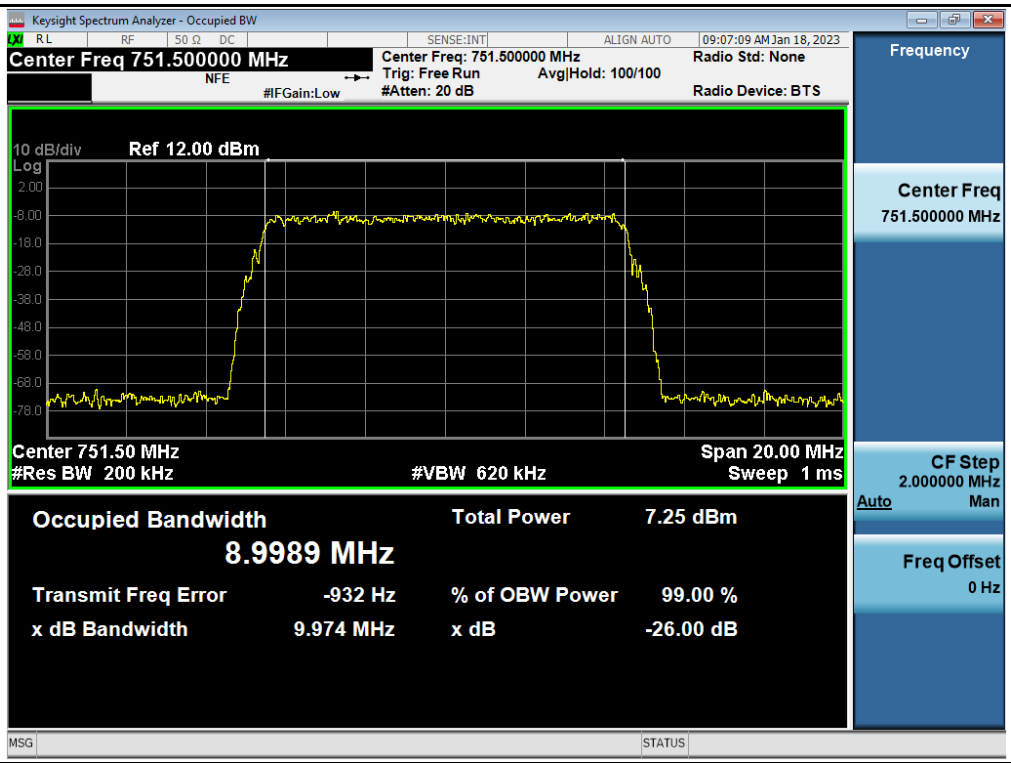
3 dB above the AGC threshold Input / Lower 700 MHz / Downlink / 5G NR 10 MHz



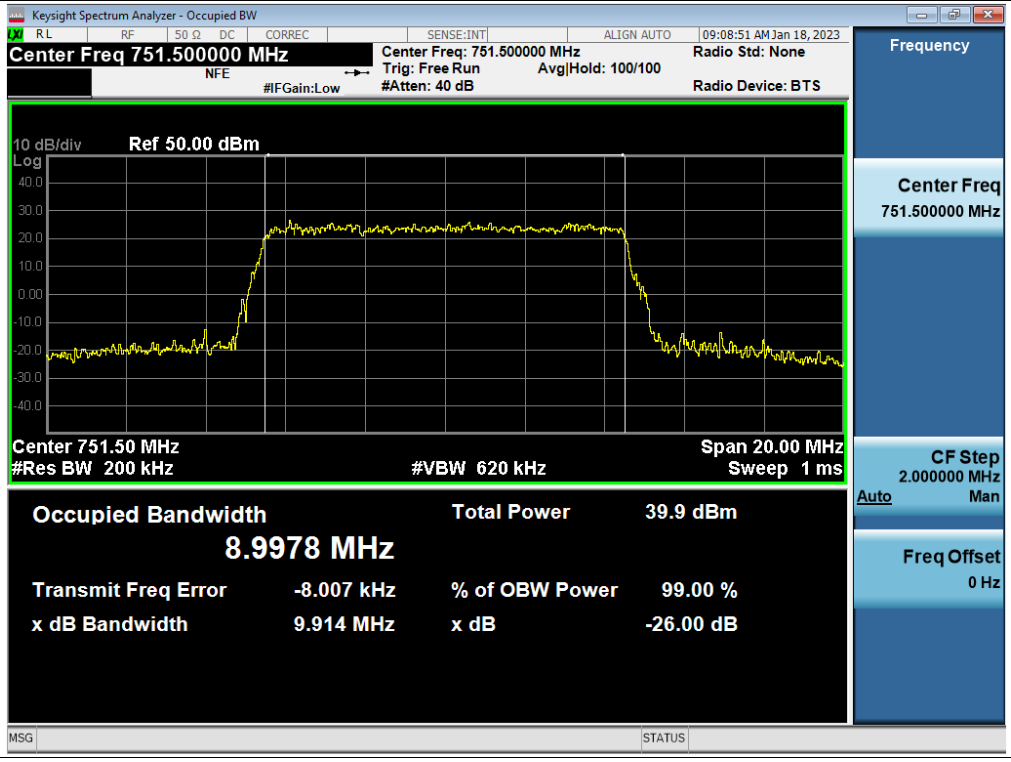
Output / Upper 700 MHz / Downlink / LTE 10 MHz



Input / Upper 700 MHz / Downlink / LTE 10 MHz



3 dB above the AGC threshold output / Upper 700 MHz / Downlink / LTE 10 MHz



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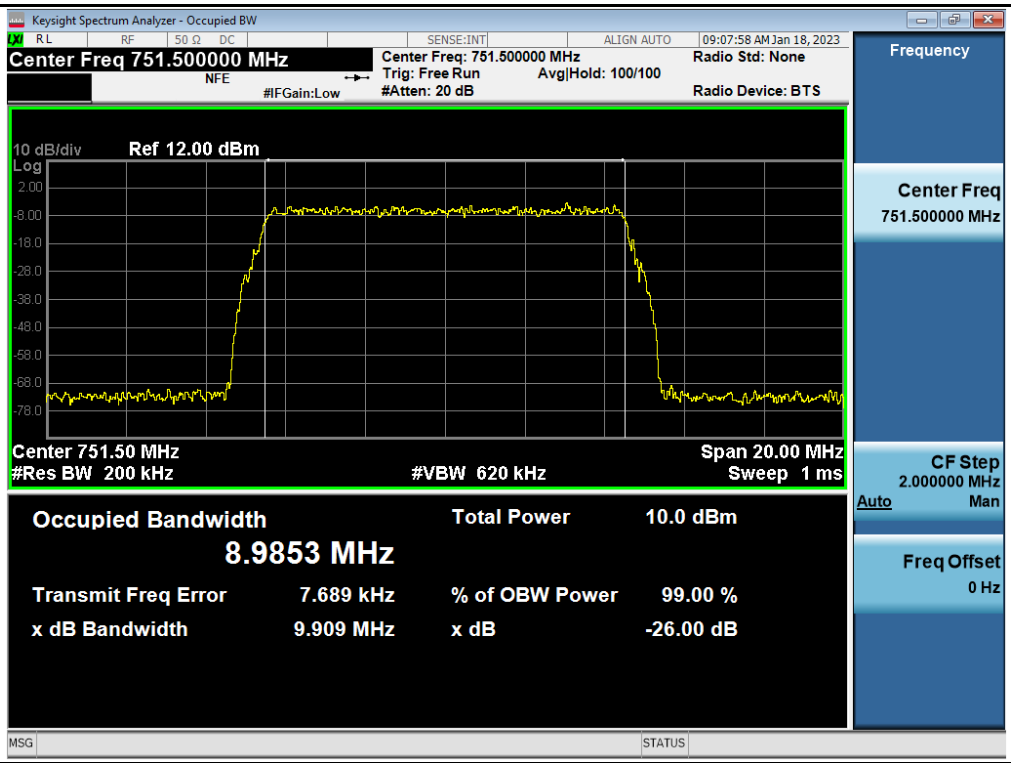
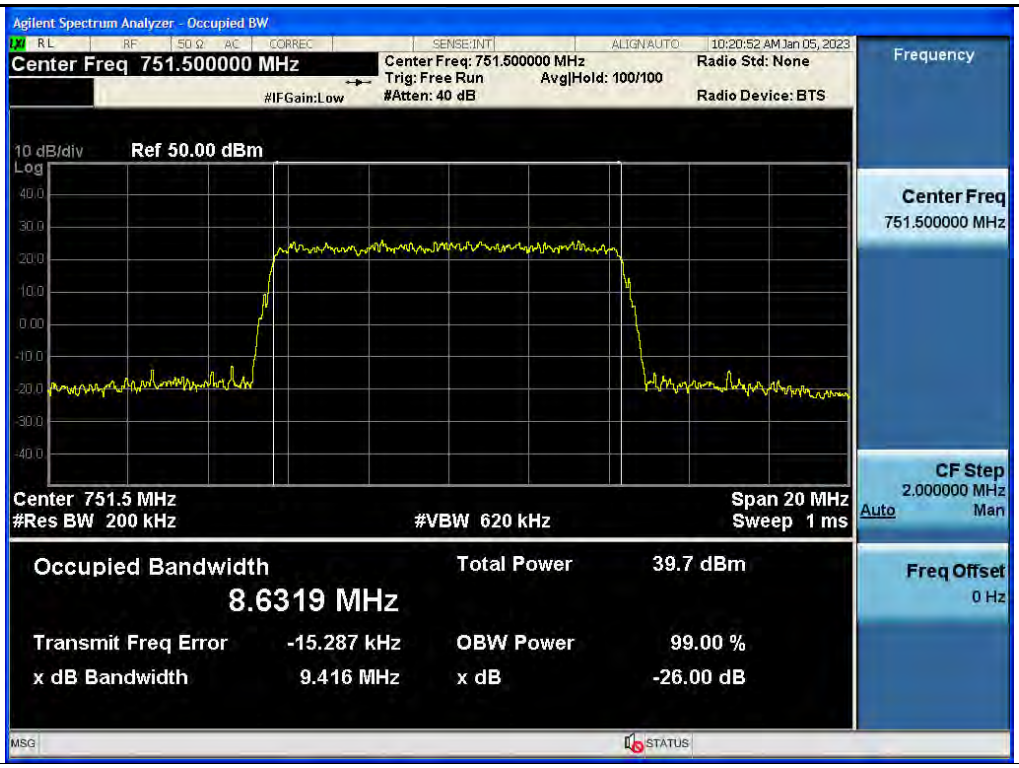
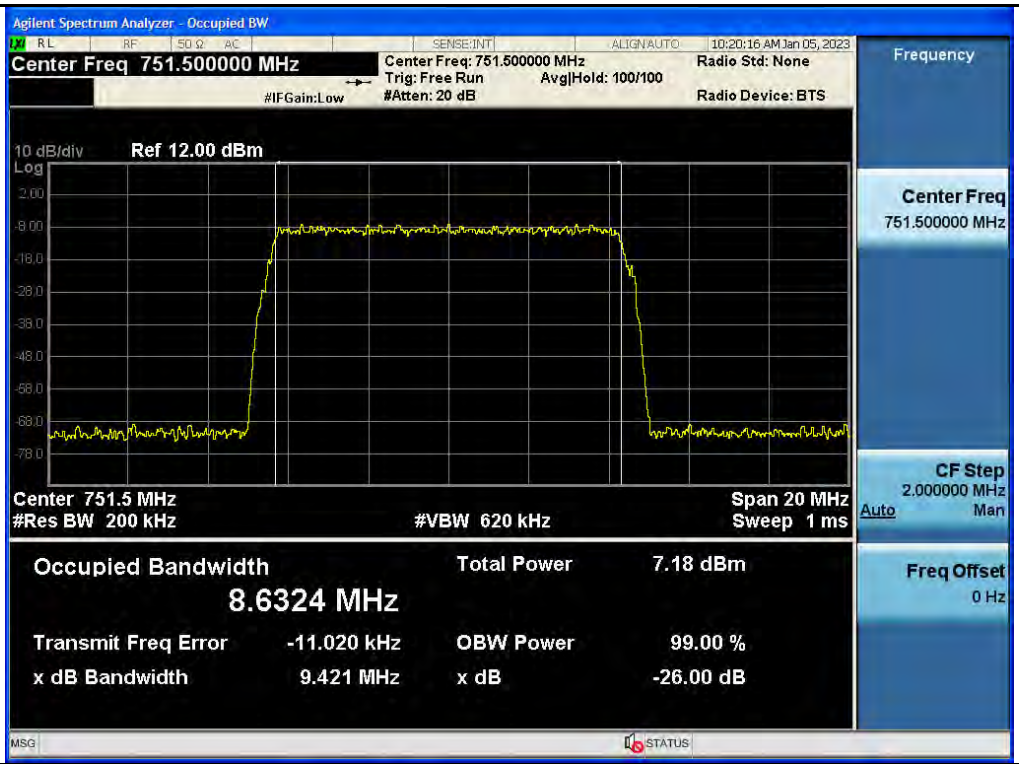


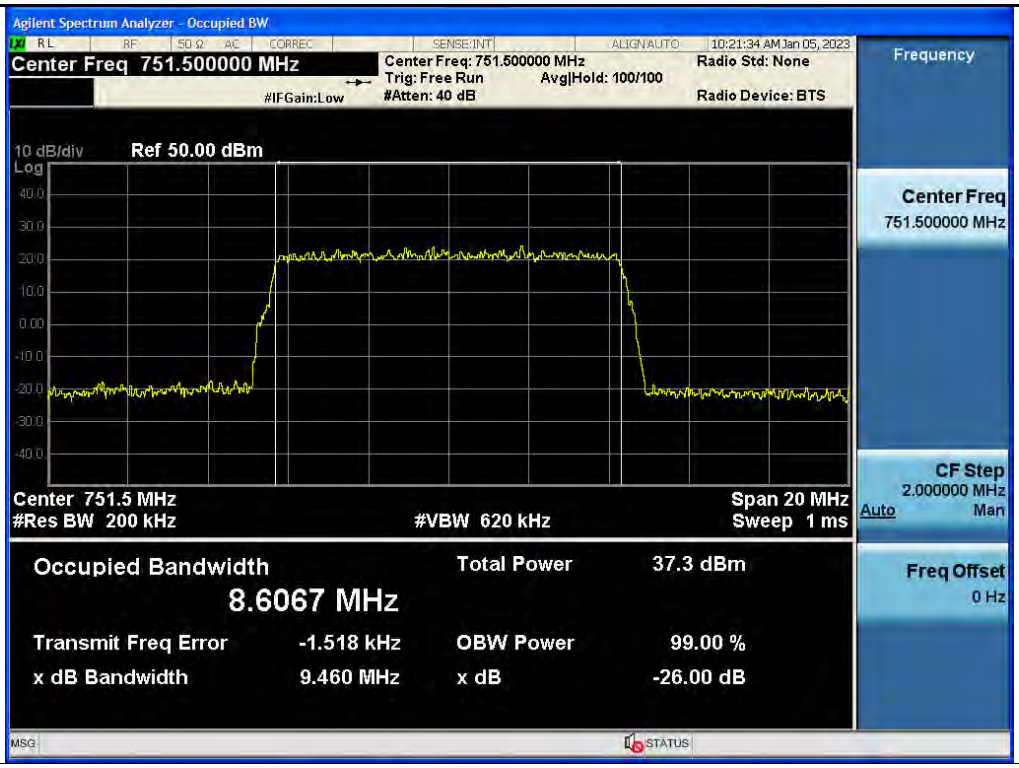
Output / Upper 700 MHz / Downlink / 5G NR 10 MHz



Input / Upper 700 MHz / Downlink / 5G NR 10 MHz



3 dB above the AGC threshold output / Upper 700 MHz / Downlink / 5G NR 10 MHz



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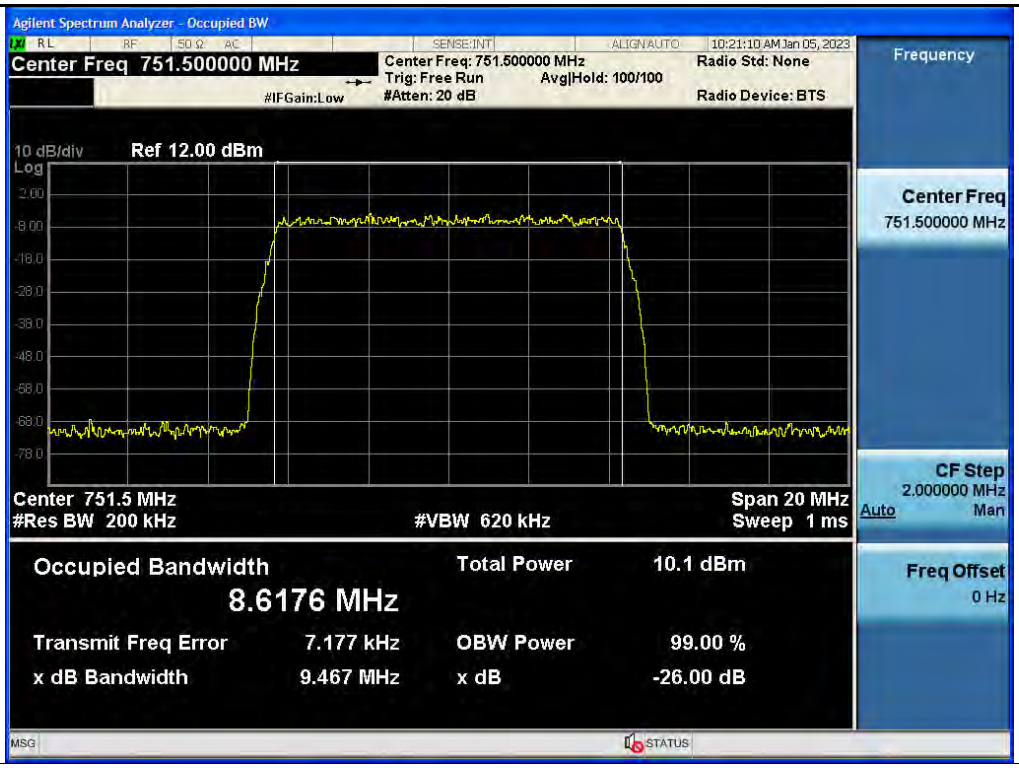
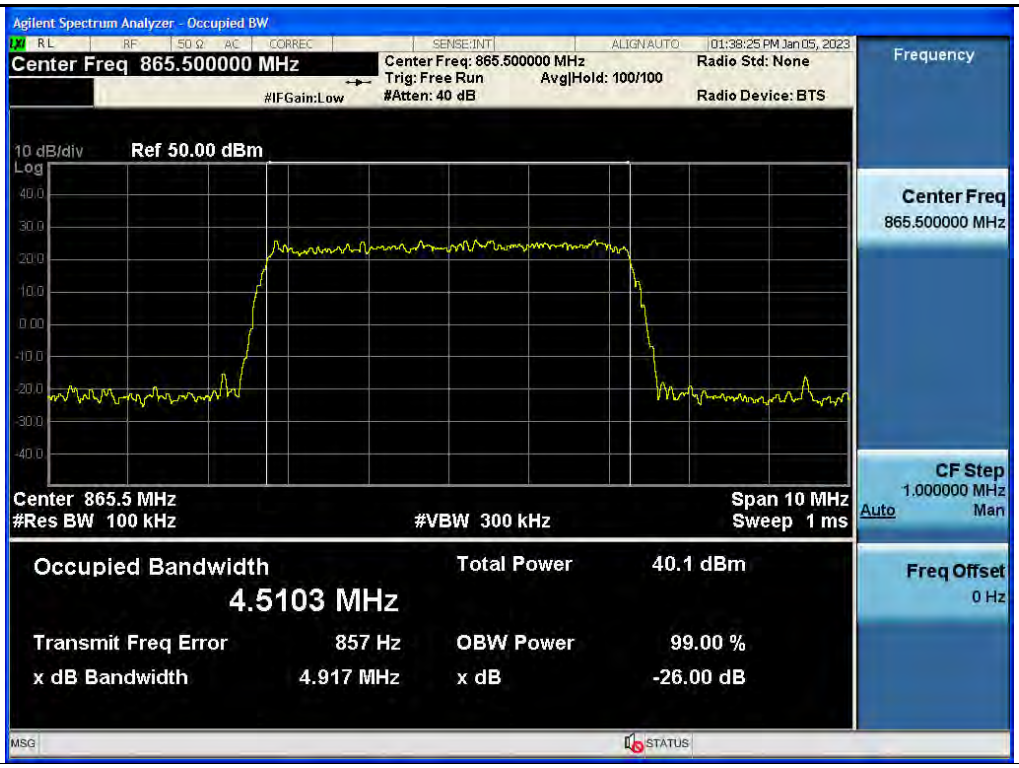
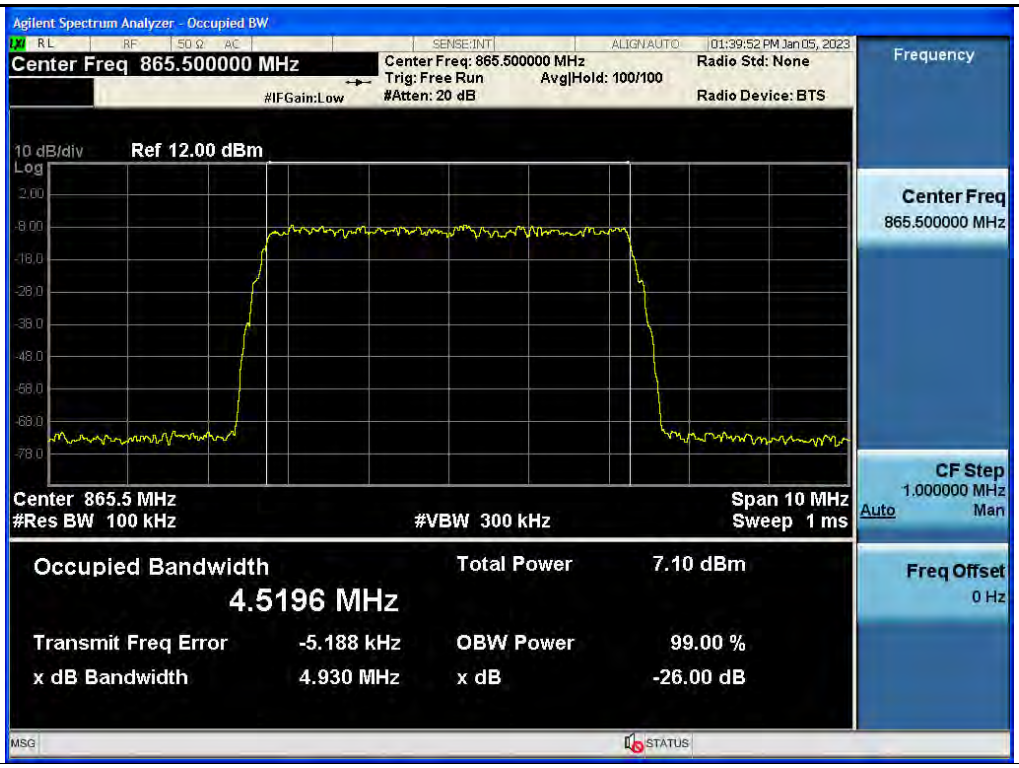


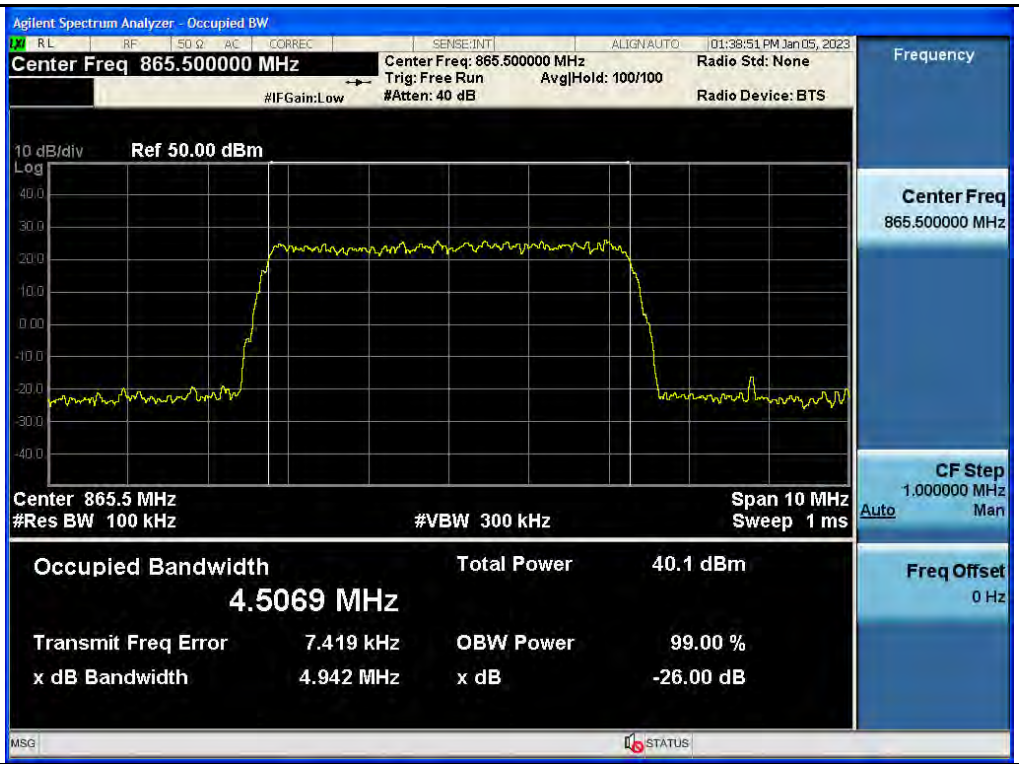
Output / ESMR / Downlink / 5G NR 5 MHz



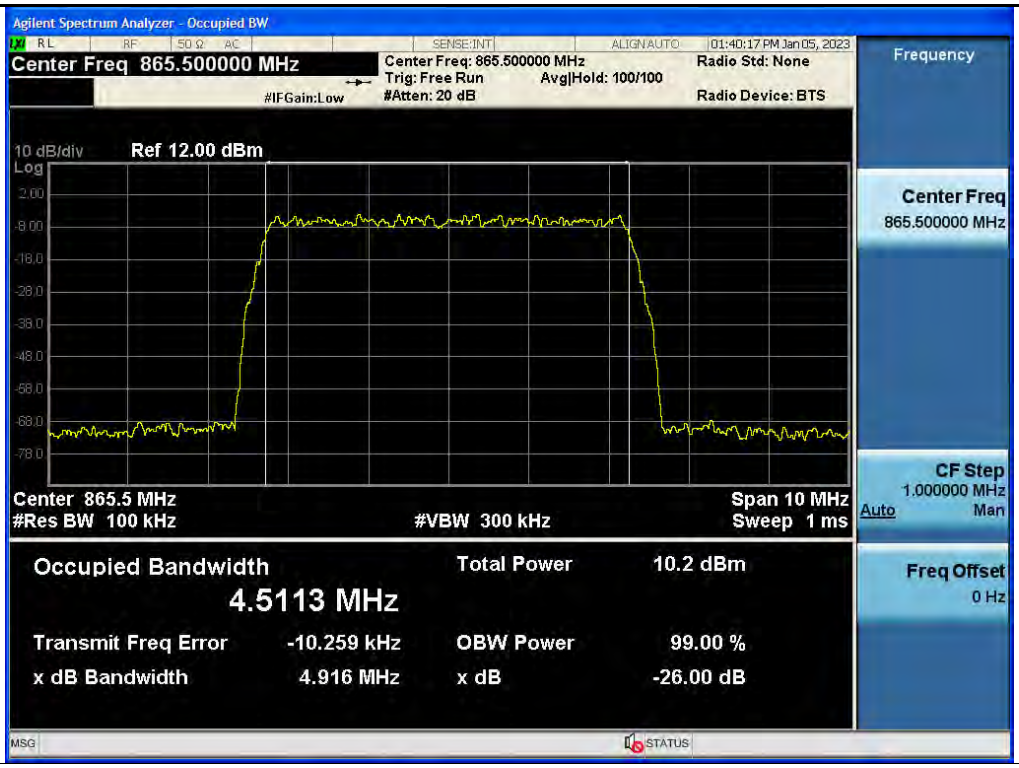
Input / ESMR / Downlink / 5G NR 5 MHz



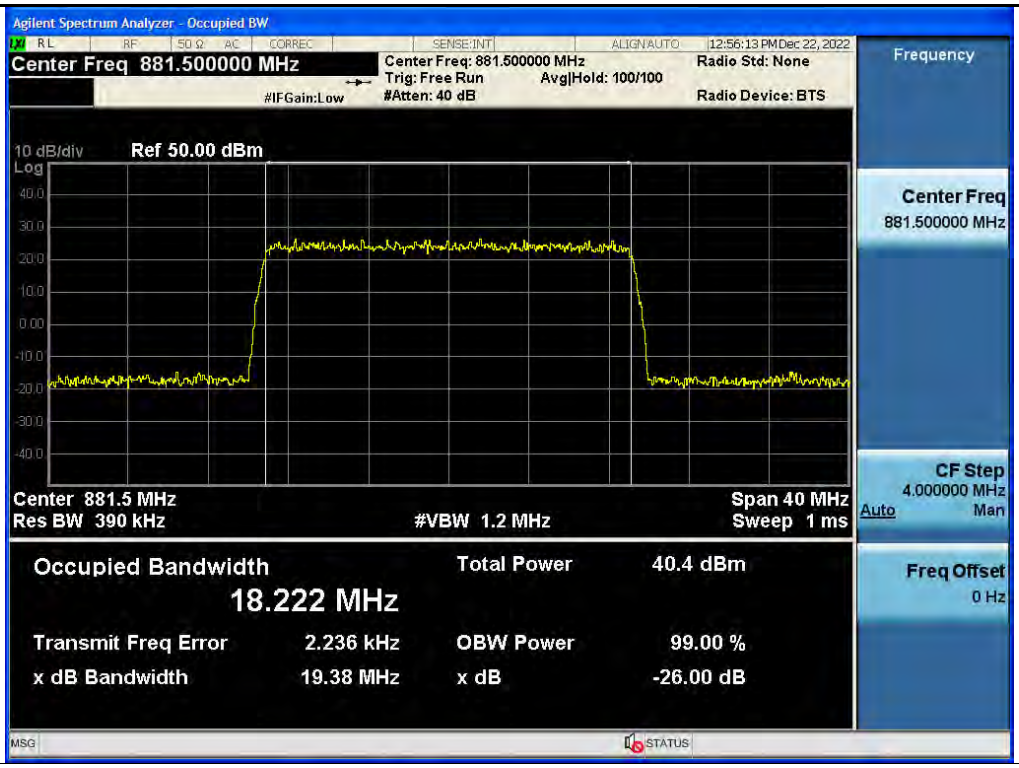
3 dB above the AGC threshold output / ESMR / Downlink / 5G NR 5 MHz



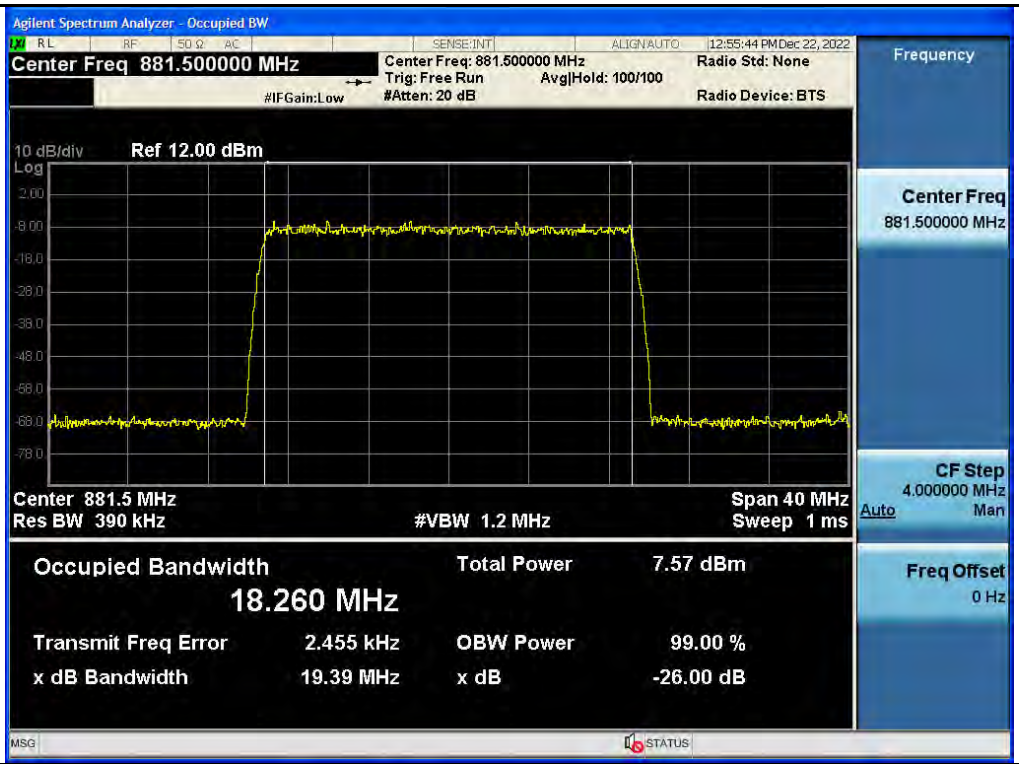
3 dB above the AGC threshold Input / ESMR / Downlink / 5G NR 5 MHz



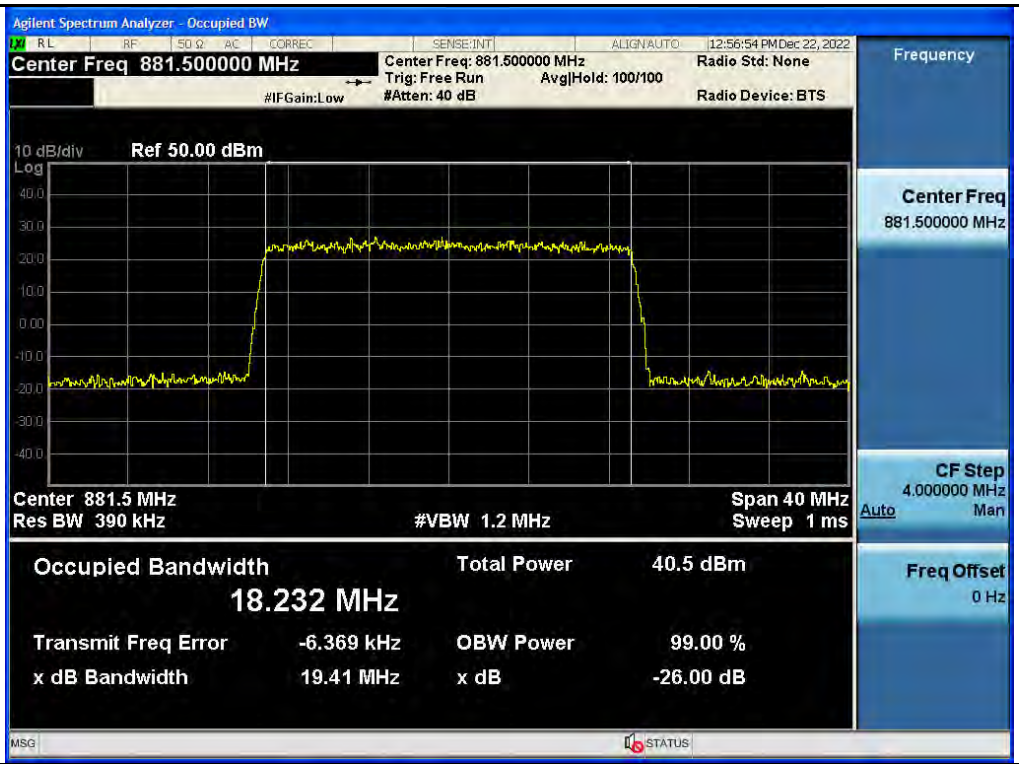
Output / Cellular / Downlink / 5G NR 20 MHz



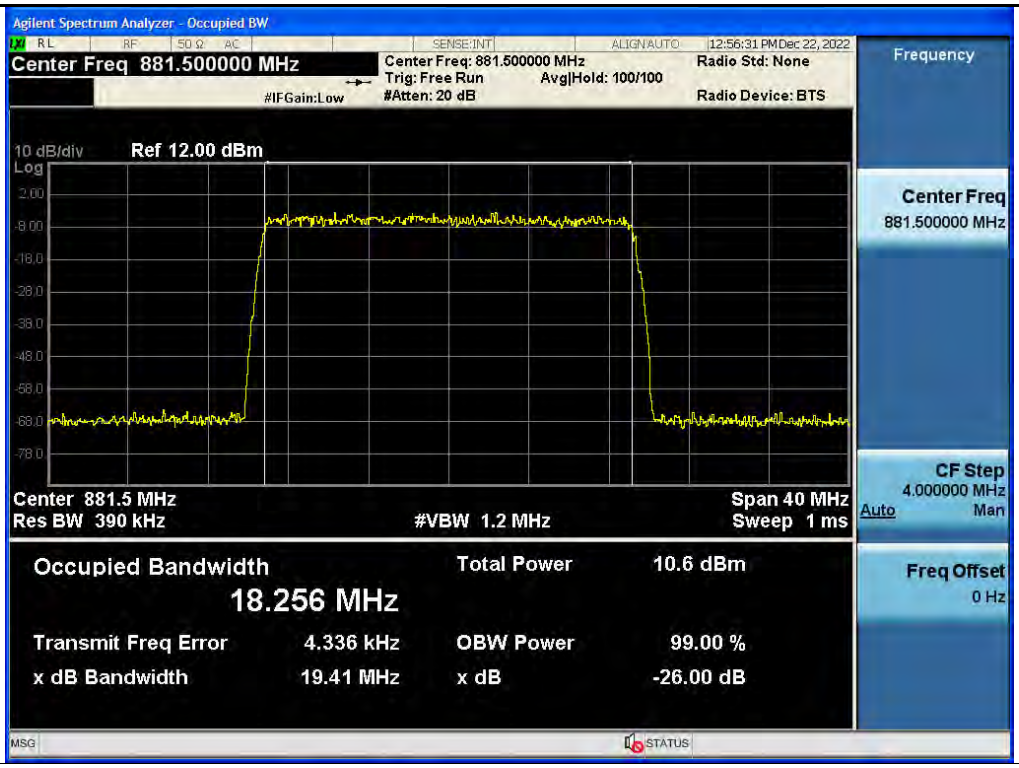
Input / Cellular / Downlink / 5G NR 20 MHz



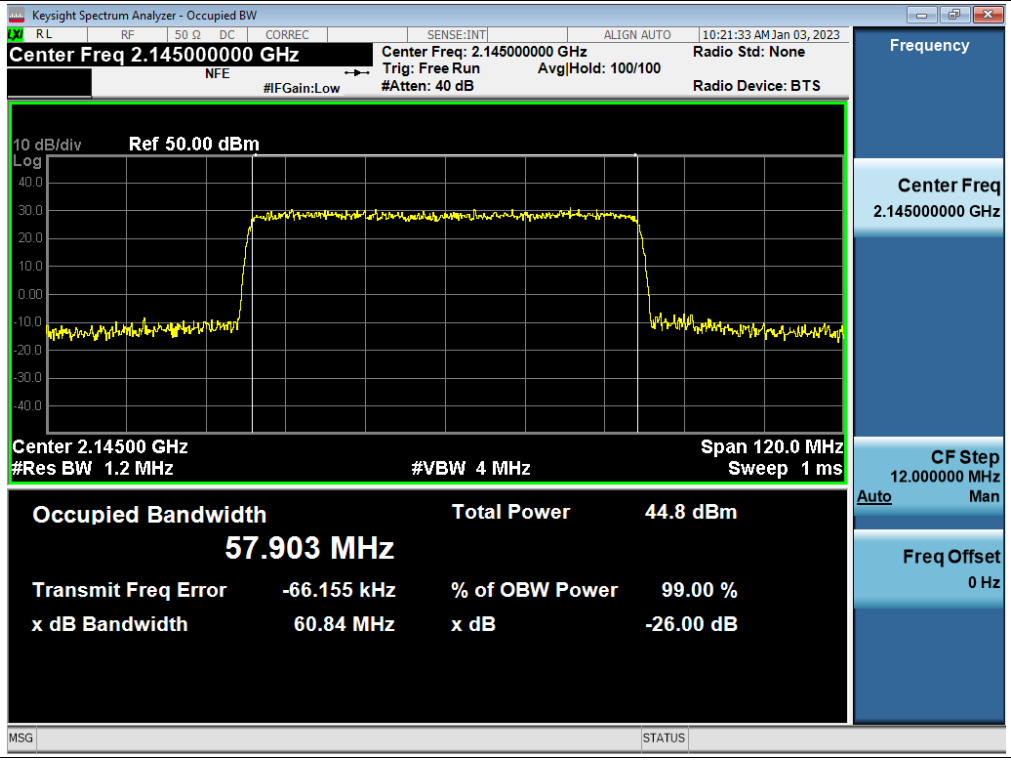
3 dB above the AGC threshold output / Cellular / Downlink / 5G NR 20 MHz



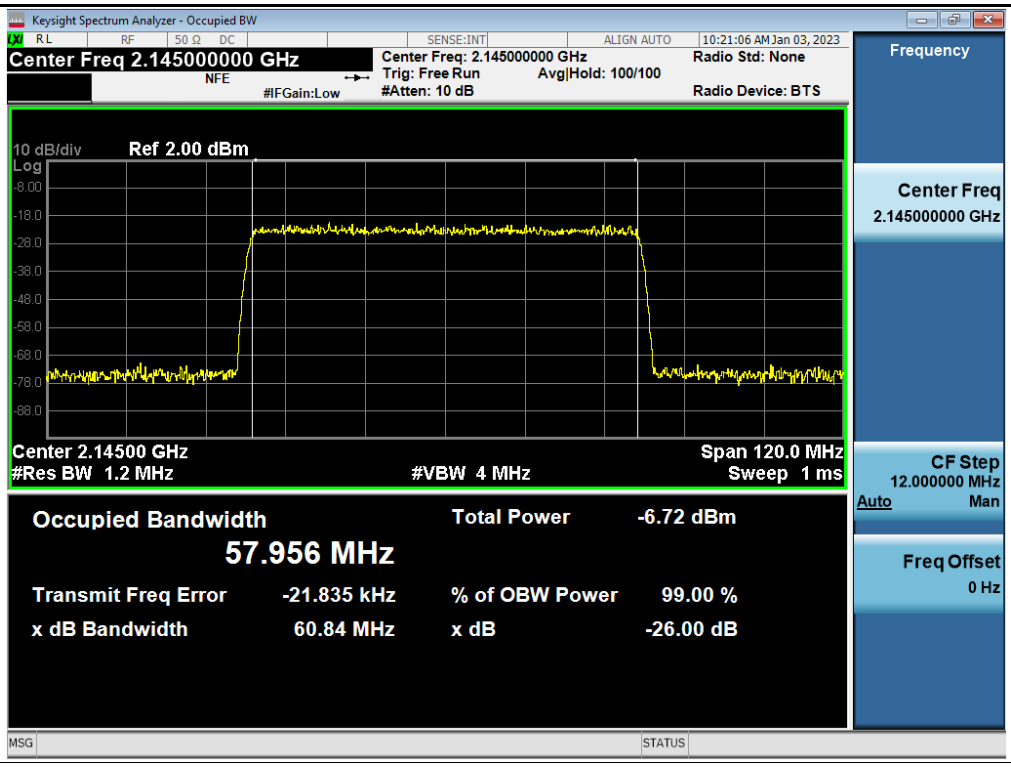
3 dB above the AGC threshold Input / Cellular / Downlink / 5G NR 20 MHz



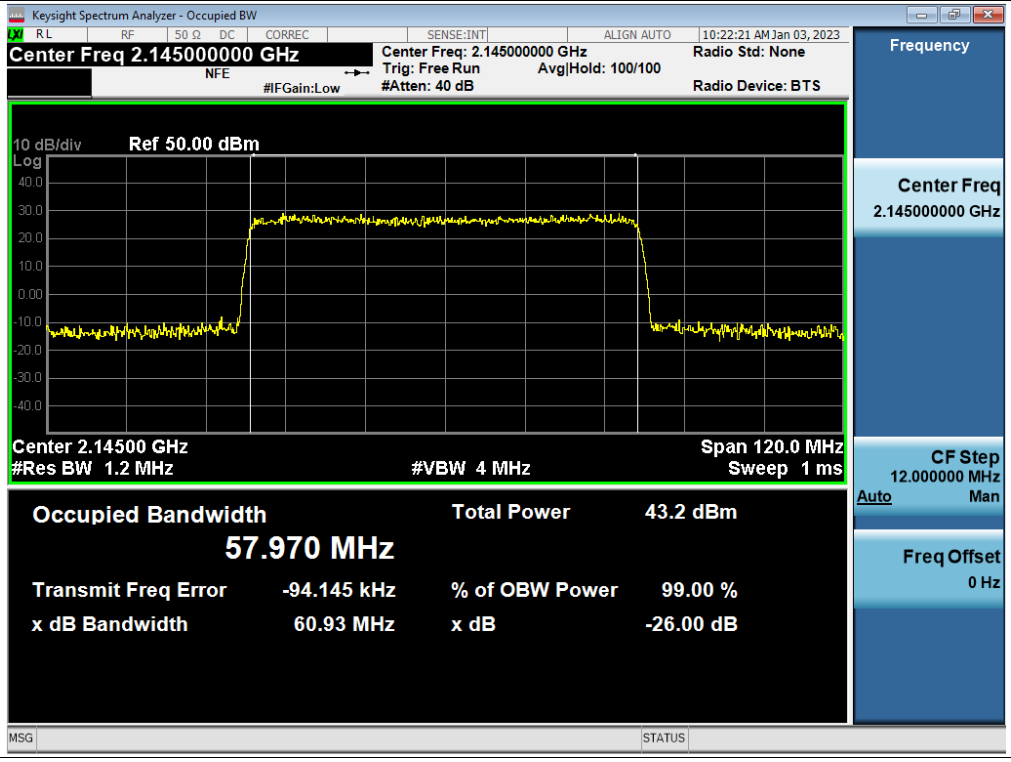
Output / AWS / Downlink / 5G NR 60 MHz



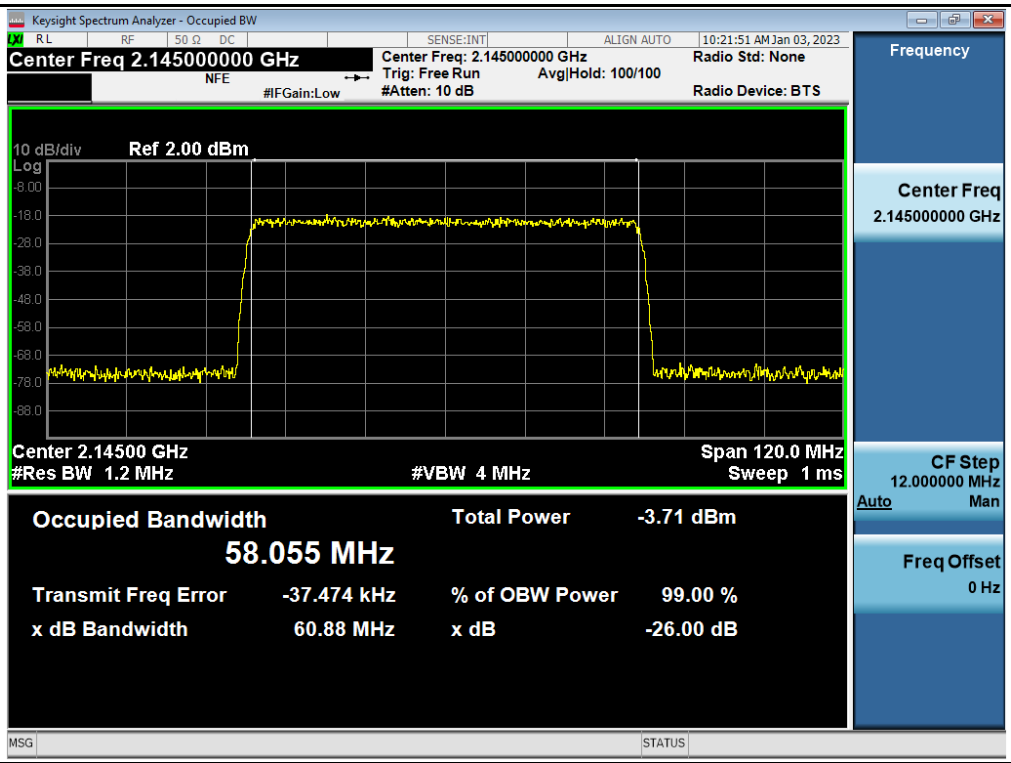
Input / AWS / Downlink / 5G NR 60 MHz



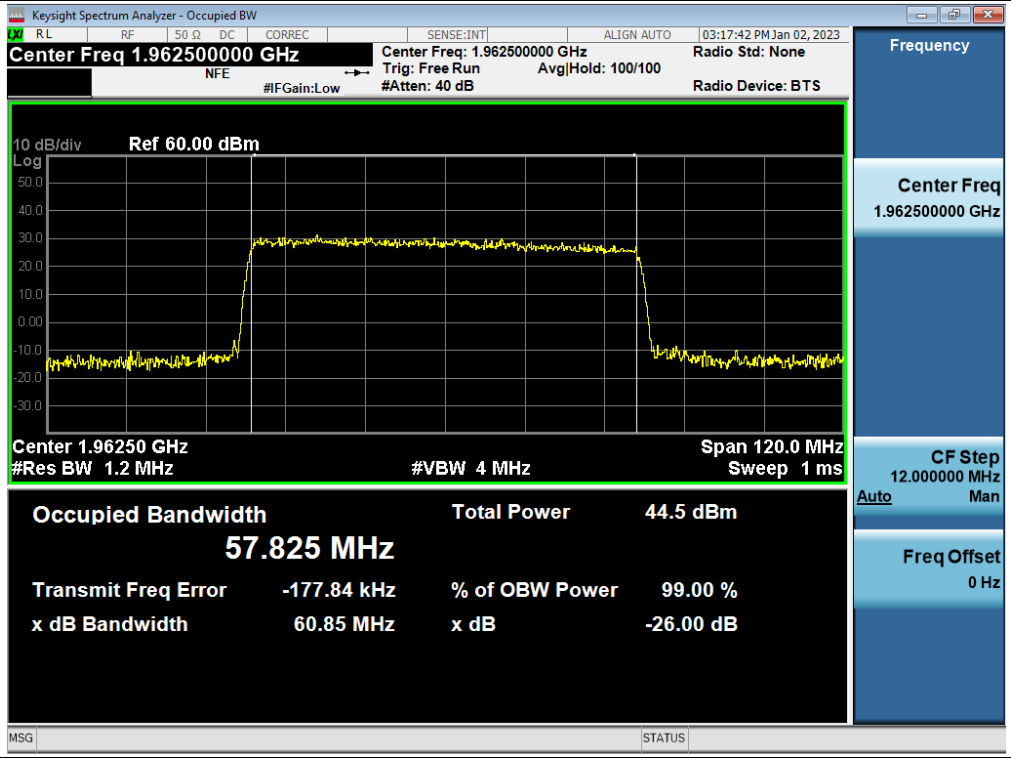
3 dB above the AGC threshold output / AWS / Downlink / 5G NR 60 MHz



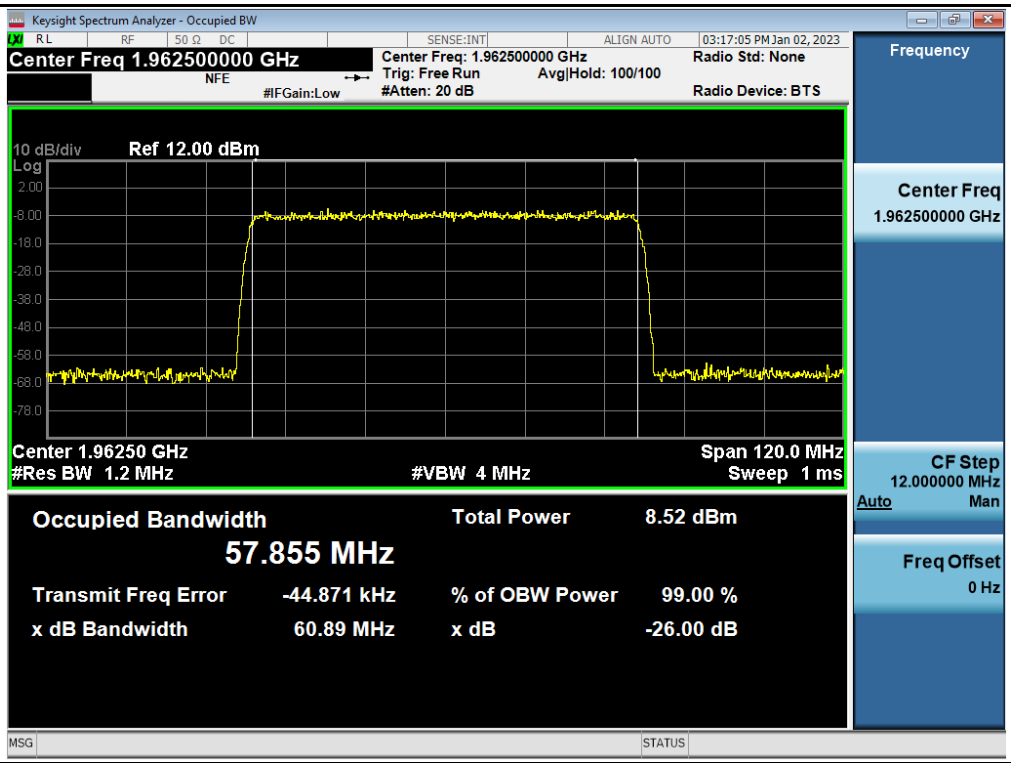
3 dB above the AGC threshold Input / AWS / Downlink / 5G NR 60 MHz



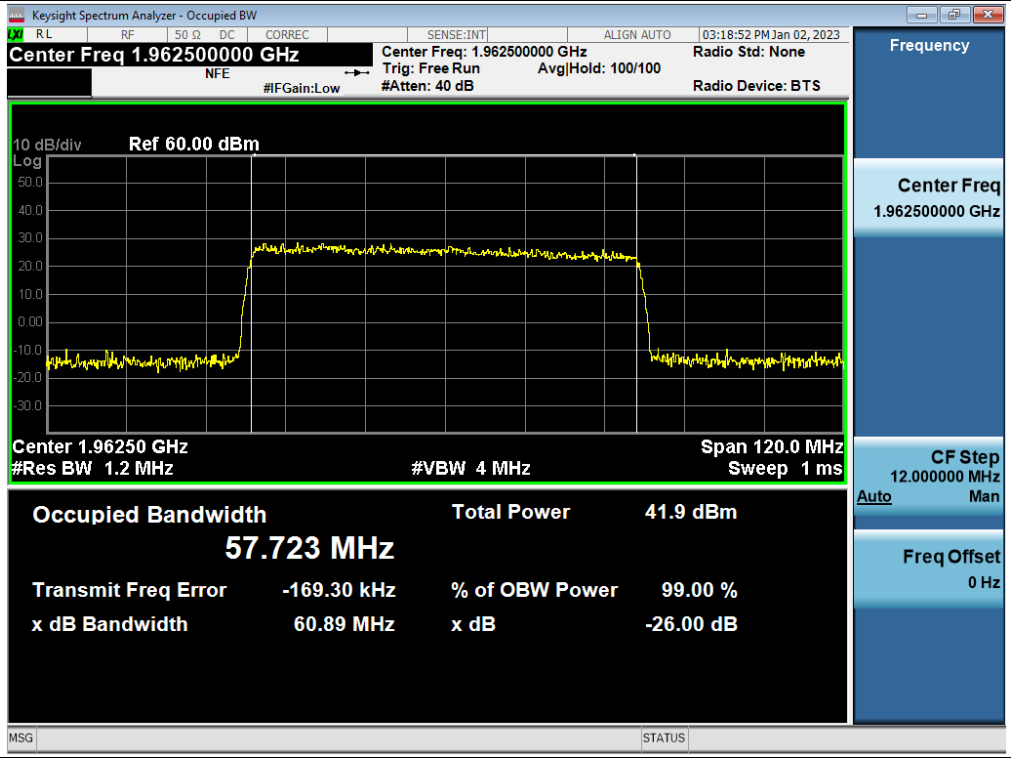
Output / PCS / Downlink / 5G NR 60 MHz



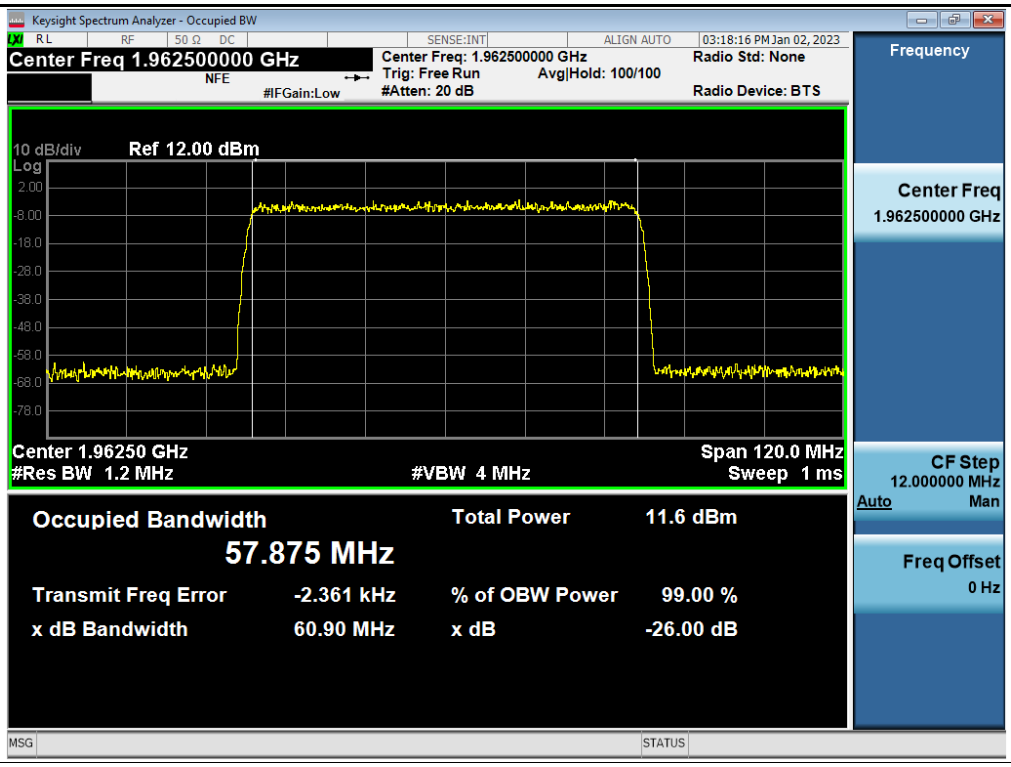
Input / PCS / Downlink / 5G NR 60 MHz



3 dB above the AGC threshold output / PCS / Downlink / 5G NR 60 MHz



3 dB above the AGC threshold Input / PCS / Downlink / 5G NR 60 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.

§ 22.913 Effective radiated power limits.

Licensees in the Cellular Radiotelephone Service are subject to the effective radiated power (ERP) limits and other requirements in this Section. See also § 22.169.

(a) Maximum ERP. The ERP of transmitters in the Cellular Radiotelephone Service must not exceed the limits in this section.

(1) Except as described in paragraphs (a)(2), (3), and (4) of this section, the ERP of base stations and repeaters must not exceed—

(i) 500 watts per emission; or

(ii) 400 watts/MHz (PSD) per sector.

(d) Power measurement. Measurement of the ERP of Cellular base transmitters and repeaters must be made using an average power measurement technique. The peak-to-average ratio (PAR) of the transmission must not exceed 13 dB. Power measurements for base transmitters and repeaters must be made in accordance with either of the following:

(1) A Commission-approved average power technique (see FCC Laboratory's Knowledge Database); or

(2) For purposes of this section, peak transmit power must be measured over an interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

§ 24.232 Power and antenna height limits.

(a)(1) Base stations with an emission bandwidth of 1 MHz or less are limited to 1640 watts equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph (b) below.

(2) Base stations with an emission bandwidth greater than 1 MHz are limited to 1640 watts/MHz equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph (b) below.

(3) Base station antenna heights may exceed 300 meters HAAT with a corresponding reduction in power; *see* Tables 1 and 2 of this section.

(4) The service area boundary limit and microwave protection criteria specified in § § 24.236 and 24.237 apply.

Table 1—Reduced Power for Base Station Antenna Heights Over 300 Meters, With Emission Bandwidth of 1 MHz or Less

HAAT in meters	Maximum EIRP watts
≤300	1640
≤500	1070
≤1000	490
≤1500	270
≤2000	160

Table 2—Reduced Power for Base Station Antenna Heights Over 300 Meters, With Emission Bandwidth Greater Than 1 MHz

HAAT in meters	Maximum EIRP watts/MHz
≤300	1640
≤500	1070
≤1000	490
≤1500	270
≤2000	160

(b)(1) Base stations that are located in counties with population densities of 100 persons or fewer per square mile, based upon the most recently available population statistics from the Bureau of the Census, with an emission bandwidth of 1 MHz or less are limited to 3280 watts equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT.

(2) Base stations that are located in counties with population densities of 100 persons or fewer per square mile, based upon the most recently available population statistics from the Bureau of the Census, with an emission bandwidth greater than 1 MHz are limited to 3280 watts/MHz equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT.

(3) Base station antenna heights may exceed 300 meters HAAT with a corresponding reduction in power; *see* Tables 3 and 4 of this section.

(4) The service area boundary limit and microwave protection criteria specified in § § 24.236 and 24.237 apply.

(5) Operation under this paragraph (b) at power limits greater than permitted under paragraph (a) of this section must be coordinated in advance with all broadband PCS licensees authorized to operate on adjacent frequency

blocks within 120 kilometers (75 miles) of the base station and is limited to base stations located more than 120 kilometers (75 miles) from the Canadian border and more than 75 kilometers (45 miles) from the Mexican border.

Table 3—Reduced Power for Base Station Antenna Heights Over 300 Meters, With Emission Bandwidth of 1 MHz or Less

HAAT in meters	Maximum EIRP watts
≤300	3280
≤500	2140
≤1000	980
≤1500	540
≤2000	320

Table 4—Reduced Power for Base Station Antenna Heights Over 300 Meters, With Emission Bandwidth Greater Than 1 MHz

HAAT in meters	Maximum EIRP watts/MHz
≤300	3280
≤500	2140
≤1000	980
≤1500	540
≤2000	320

(c) Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

(d) Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of § 24.51. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

(e) Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, *etc.*, so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

§ 27.50 Power limits and duty cycle.

(b) The following power and antenna height limits apply to transmitters operating in the 746-758 MHz, 775-788 MHz and 805-806 MHz bands:

(1) Fixed and base stations transmitting a signal in the 757-758 and 775-776 MHz bands must not exceed an effective radiated power (ERP) of 1000 watts and an antenna height of 305 m height above average terrain (HAAT), except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts ERP in accordance with Table 1 of this section.

(4) Fixed and base stations transmitting a signal in the 746-757 MHz and 776-787 MHz bands with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP in accordance with Table 3 of this section.

(5) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal in the 746-757 MHz and 776-787 MHz bands with an emission bandwidth greater than 1 MHz must not exceed an ERP of 2000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts/MHz ERP in accordance with Table 4 of this section.

(c) The following power and antenna height requirements apply to stations transmitting in the 600 MHz band and the 698-746 MHz band:

(3) Fixed and base stations transmitting a signal with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP in accordance with Table 3 of this section;

(4) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal with an emission bandwidth greater than 1 MHz must not exceed an ERP of 2000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts/MHz ERP in accordance with Table 4 of this section;

(5) Licensees, except for licensees operating in the 600 MHz downlink band, seeking to operate a fixed or base station located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal at an ERP greater than 1000 watts must:

(i) Coordinate in advance with all licensees authorized to operate in the 698-758 MHz, 775-788, and 805-806 MHz bands within 120 kilometers (75 miles) of the base or fixed station;

(ii) coordinate in advance with all regional planning committees, as identified in § 90.527 of this chapter, with jurisdiction within 120 kilometers (75 miles) of the base or fixed station.

(d) The following power and antenna height requirements apply to stations transmitting in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:

(1) The power of each fixed or base station transmitting in the 1995-2000 MHz, 2110-2155 MHz, 2155-2180 MHz or 2180-2200 MHz band and located in any county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, is limited to:

(i) An equivalent isotropically radiated power (EIRP) of 3280 watts when transmitting with an emission bandwidth of 1 MHz or less;

(ii) An EIRP of 3280 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

(2) The power of each fixed or base station transmitting in the 1995-2000 MHz, the 2110-2155 MHz 2155-2180 MHz band, or 2180-2200 MHz band and situated in any geographic location other than that described in paragraph (d)(1) of this section is limited to:

(i) An equivalent isotropically radiated power (EIRP) of 1640 watts when transmitting with an emission bandwidth of 1 MHz or less;

(ii) An EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

(3) A licensee operating a base or fixed station in the 2110-2155 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must coordinate such operations in advance with all Government and non-Government satellite entities in the 2025-2110 MHz band. A licensee operating a base or fixed station in the 2110-2180 MHz band utilizing power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with the following licensees authorized to operate within 120 kilometers (75 miles) of the base or fixed station operating in this band: All Broadband Radio Service (BRS) licensees authorized under this part in the 2155-2160 MHz band and all advanced wireless services (AWS) licensees authorized to operate on adjacent frequency blocks in the 2110-2180 MHz band.

(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP. Fixed stations operating in the 1710-1755 MHz band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in these bands must employ a means for limiting power to the minimum necessary for successful communications.

(5) Equipment employed must be authorized in accordance with the provisions of § 24.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

(6) Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

(7) Fixed, mobile, and portable (hand-held) stations operating in the 2000-2020 MHz band are limited to 2 watts EIRP, except that the total power of any portion of an emission that falls within the 2000-2005 MHz band may not exceed 5 milliwatts. A licensee of AWS-4 authority may enter into private operator-to-operator agreements with all 1995-2000 MHz licensees to operate in 2000-2005 MHz at power levels above 5 milliwatts EIRP; except the total power of the AWS-4 mobile emissions may not exceed 2 watts EIRP.

(8) A licensee operating a base or fixed station in the 2180-2200 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with all AWS licensees authorized to operate on adjacent frequency blocks in the 2180-2200 MHz band.

(9) Fixed, mobile and portable (hand-held) stations operating in the 1915-1920 MHz band are limited to 300 milliwatts EIRP.

(10) A licensee operating a base or fixed station in the 1995-2000 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with all PCS G Block licensees authorized to operate on adjacent frequency blocks in the 1990-1995 MHz band within 120 kilometers of the base or fixed station operating in this band.

§ 90.635 Limitations on power and antenna height

(a) The effective radiated power and antenna height for base stations may not exceed 1 kilowatt (30 dBw) and 304 m. (1,000 ft.) above average terrain (AAT), respectively, or the equivalent thereof as determined from the Table. These are maximum values, and applicants will be required to justify power levels and antenna heights requested.

(b) The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw).

Table—Equivalent Power and Antenna Heights for Base Stations in the 851-869 MHz and 935-940 MHz Bands Which Have a Requirement for a 32 km (20 mi) Service Area Radius

Antenna height (ATT) meters (feet)	Effective radiated power (watts)
Above 1,372 (4,500)	65
Above 1,220 (4,000) to 1,372 (4,500)	70
Above 1,067 (3,500) to 1,220 (4,000)	75
Above 915 (3,000) to 1,067 (3,500)	100
Above 763 (2,500) to 915 (3,000)	140
Above 610 (2,000) to 763 (2,500)	200
Above 458 (1,500) to 610 (2,000)	350
Above 305 (1,000) to 458 (1,500)	600
Up to 305 (1,000)	1,000

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:

Gain (dB) = output power (dBm) − input power (dBm).

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

Note:

1. 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.
2. E.I.R.P. (W/MHz) is calculated from Output Power (W) divided by Channel Bandwidth (MHz).

Test Results:

Tabular data of Input / Output Power and Gain

Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)	E.R.P.		
							(dBm)	(W/MHz)	(W)
Lower 700 MHz	Downlink	LTE 10 MHz	740.53	-15.28	32.80	48.08	44.05	2.54	25.41
		5G NR 10 MHz	740.53	-15.08	33.04	48.12	44.29	2.68	26.84
Upper 700 MHz	Downlink	LTE 10 MHz	752.00	-0.18	32.97	33.15	44.22	2.64	26.39
		5G NR 10 MHz	752.00	0.01	32.72	32.71	43.97	2.49	24.93
ESMR	Downlink	5G NR 5 MHz	866.50	-0.14	32.89	33.03	44.14	5.19	25.94
Cellular	Downlink	5G NR 20 MHz	880.23	0.07	32.91	32.84	44.16	1.30	26.08
Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)	E.I.R.P.		
							(dBm)	(W/MHz)	(W)
AWS	Downlink	5G NR 60 MHz	2 150.00	-14.95	36.72	51.67	50.12	1.71	102.80
PCS	Downlink	5G NR 60 MHz	1 960.00	0.32	36.82	36.50	50.22	1.75	105.20

*E.I.R.P.(dBm) = Output Power(dBm) + Ant. Gain(dBi), Ant. Gain = 13.4 dBi

*E.R.P(dBm) = E.I.R.P.(dBm) - 2.15(dB)

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

Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)	E.R.P.		
							(dBm)	(W/MHz)	(W)
Lower 700 MHz	Downlink	LTE 10 MHz	740.53	-12.28	32.77	45.05	44.02	2.53	25.26
		5G NR 10 MHz	740.53	-12.03	33.03	45.06	44.28	2.68	26.76
Upper 700 MHz	Downlink	LTE 10 MHz	752.00	2.74	32.92	30.18	44.17	2.61	26.11
		5G NR 10 MHz	752.00	3.05	32.56	29.51	43.81	2.40	24.04
ESMR	Downlink	5G NR 5 MHz	866.50	2.93	32.92	29.99	44.17	5.23	26.13
Cellular	Downlink	5G NR 20 MHz	880.23	3.09	33.00	29.91	44.25	1.33	26.60
Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)	E.I.R.P.		
							(dBm)	(W/MHz)	(W)
AWS	Downlink	5G NR 60 MHz	2 150.00	-11.99	36.66	48.65	50.06	1.69	101.32
PCS	Downlink	5G NR 60 MHz	1 960.00	3.33	36.69	33.36	50.09	1.70	102.09

*E.I.R.P.(dBm) = Output Power(dBm) + Ant. Gain(dBi), Ant. Gain = 13.4 dBi

*E.R.P(dBm) = E.I.R.P.(dBm) - 2.15(dB)

Tabular data of PSD

Test Band	Link	Signal	f_0 Frequency (MHz)	Output PSD (dBm/MHz)	Ant. Gain (dBi)	E.R.P. (dBm/MHz)	Calculated (W/MHz)
Lower 700 MHz	Downlink	LTE 10 MHz	740.53	24.525	13.4	35.775	3.780
		5G NR 10 MHz	740.53	24.957	13.4	36.207	4.175
Upper 700 MHz	Downlink	LTE 10 MHz	752.00	24.500	13.4	35.750	3.758
		5G NR 10 MHz	752.00	24.444	13.4	35.694	3.710
ESMR	Downlink	5G NR 5 MHz	866.50	27.391	13.4	38.641	7.313
Cellular	Downlink	5G NR 20 MHz	880.23	21.450	13.4	32.700	1.862
Test Band	Link	Signal	f_0 Frequency (MHz)	Output PSD (dBm/MHz)	Ant. Gain (dBi)	E.I.R.P. (dBm/MHz)	Calculated (W/MHz)
AWS	Downlink	5G NR 60 MHz	2 150.00	20.482	13.4	33.882	2.445
PCS	Downlink	5G NR 60 MHz	1 960.00	21.171	13.4	34.571	2.865

*E.I.R.P.(dBm/MHz) = Output PSD(dBm/MHz) + Ant. Gain(dBi)
*E.R.P(dBm/MHz) = E.I.R.P.(dBm/MHz) - 2.15(dB)

Tabular data of 3 dB above AGC threshold PSD

Test Band	Link	Signal	f_0 Frequency (MHz)	Output PSD (dBm/MHz)	Ant. Gain (dBi)	E.R.P. (dBm/MHz)	Calculated (W/MHz)
Lower 700 MHz	Downlink	LTE 10 MHz	740.53	24.540	13.4	35.790	3.794
		5G NR 10 MHz	740.53	25.140	13.4	36.390	4.355
Upper 700 MHz	Downlink	LTE 10 MHz	752.00	24.603	13.4	35.853	3.849
		5G NR 10 MHz	752.00	24.678	13.4	35.928	3.915
ESMR	Downlink	5G NR 5 MHz	866.50	27.621	13.4	38.871	7.710
Cellular	Downlink	5G NR 20 MHz	880.23	21.428	13.4	32.678	1.853
Test Band	Link	Signal	f_0 Frequency (MHz)	Output PSD (dBm/MHz)	Ant. Gain (dBi)	E.I.R.P. (dBm/MHz)	Calculated (W/MHz)
AWS	Downlink	5G NR 60 MHz	2 150.00	20.342	13.4	33.742	2.367
PCS	Downlink	5G NR 60 MHz	1 960.00	21.054	13.4	34.454	2.788

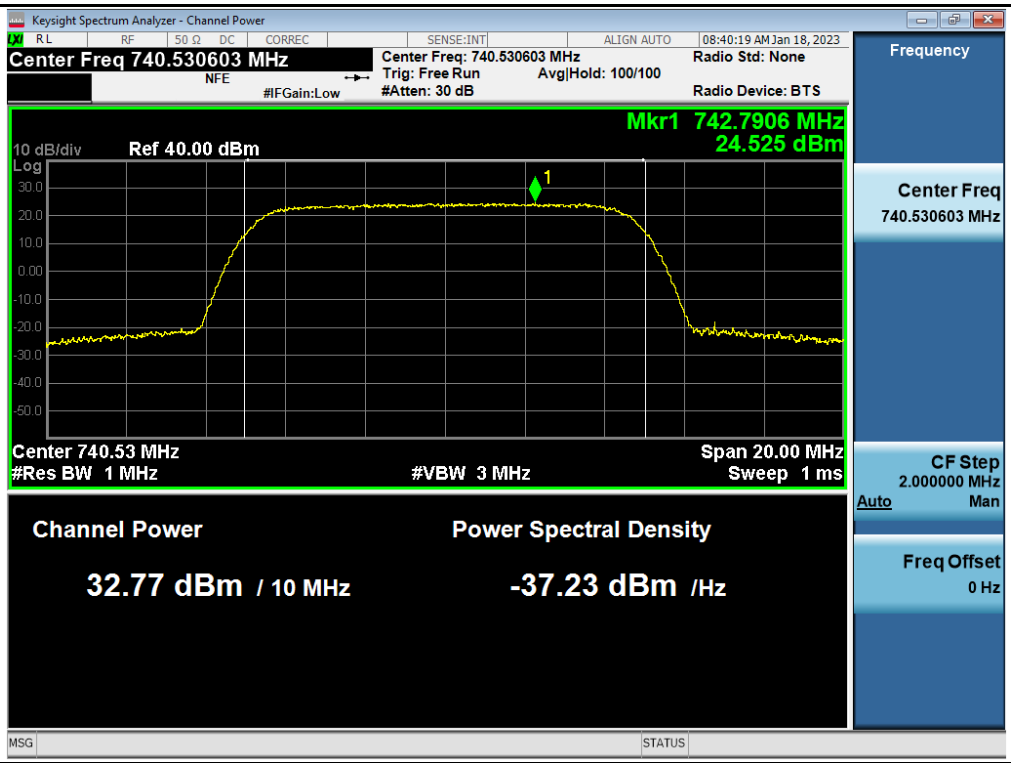
*E.I.R.P.(dBm/MHz) = Output PSD(dBm/MHz) + Ant. Gain(dBi)
*E.R.P(dBm/MHz) = E.I.R.P.(dBm/MHz) - 2.15(dB)

Tabular data of PAPR

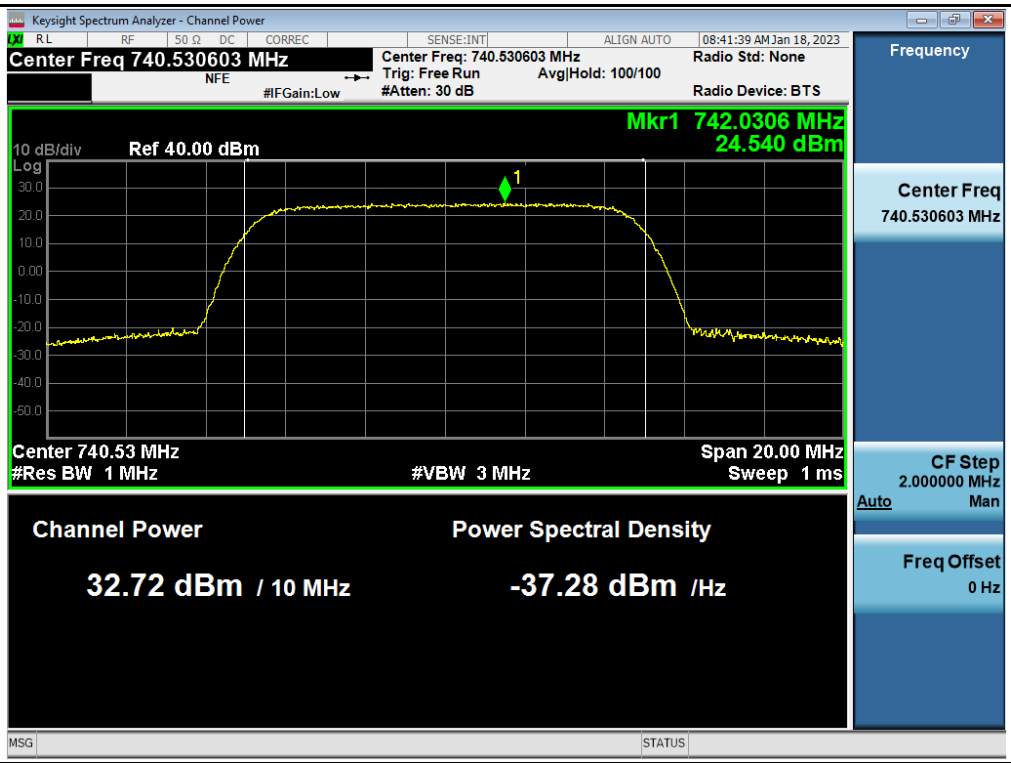
Test Band	Link	Signal	f_0 Frequency (MHz)	0.1 % PAPR (dB)
Lower 700 MHz	Downlink	LTE 10 MHz	740.53	8.27
		5G NR 10 MHz	740.53	8.25
Upper 700 MHz	Downlink	LTE 10 MHz	752.00	8.22
		5G NR 10 MHz	752.00	8.24
ESMR	Downlink	5G NR 5 MHz	866.50	8.33
Cellular	Downlink	5G NR 20 MHz	880.23	8.37
AWS	Downlink	5G NR 60 MHz	2 150.00	8.27
PCS	Downlink	5G NR 60 MHz	1 960.00	8.27

Plot data of PSD

PSD / Lower 700 MHz / Downlink / LTE 10 MHz



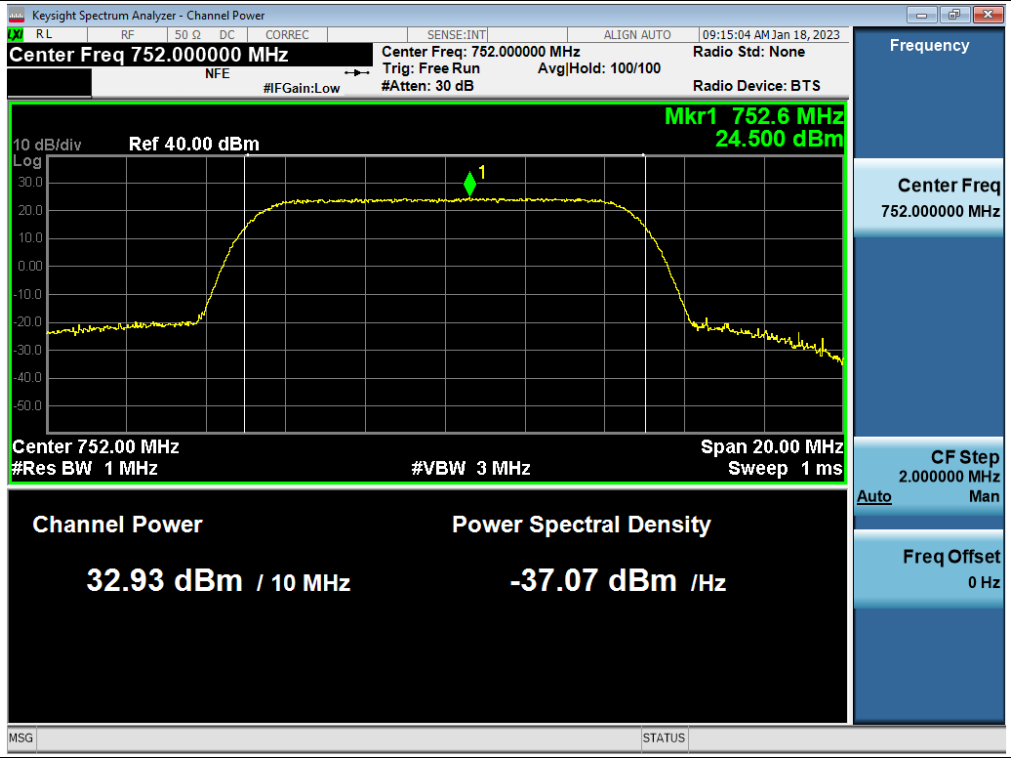
3 dB above the AGC threshold PSD / Lower 700 MHz / Downlink / LTE 10 MHz



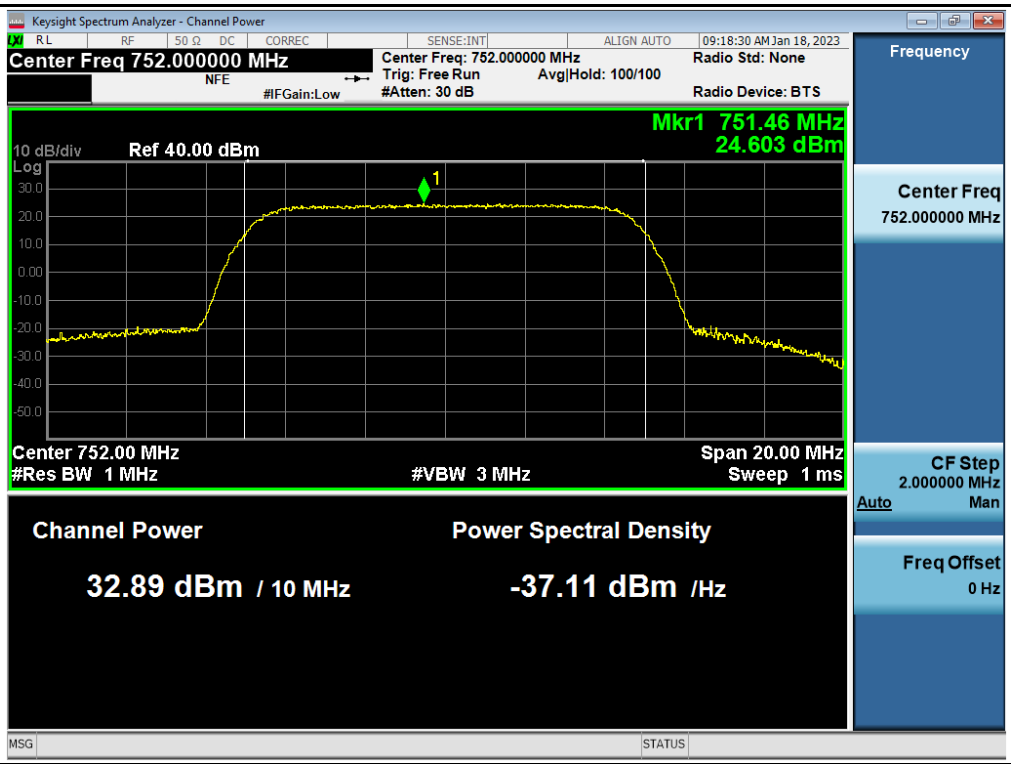
PSD / Lower 700 MHz / Downlink / 5G NR 10 MHz

3 dB above the AGC threshold PSD / Lower 700 MHz / Downlink / 5G NR 10 MHz

PSD / Upper 700 MHz / Downlink / LTE 10 MHz

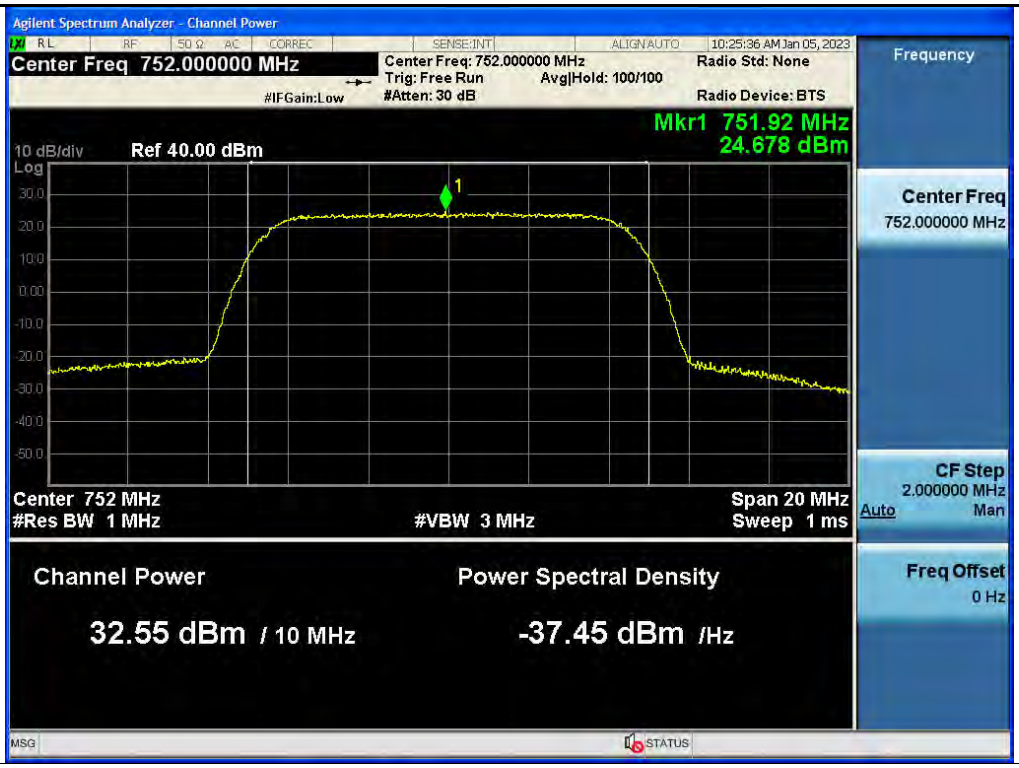


3 dB above the AGC threshold PSD / Upper 700 MHz / Downlink / LTE 10 MHz



PSD / Upper 700 MHz / Downlink / 5G NR 10 MHz

3 dB above the AGC threshold PSD / Upper 700 MHz / Downlink / 5G NR 10 MHz

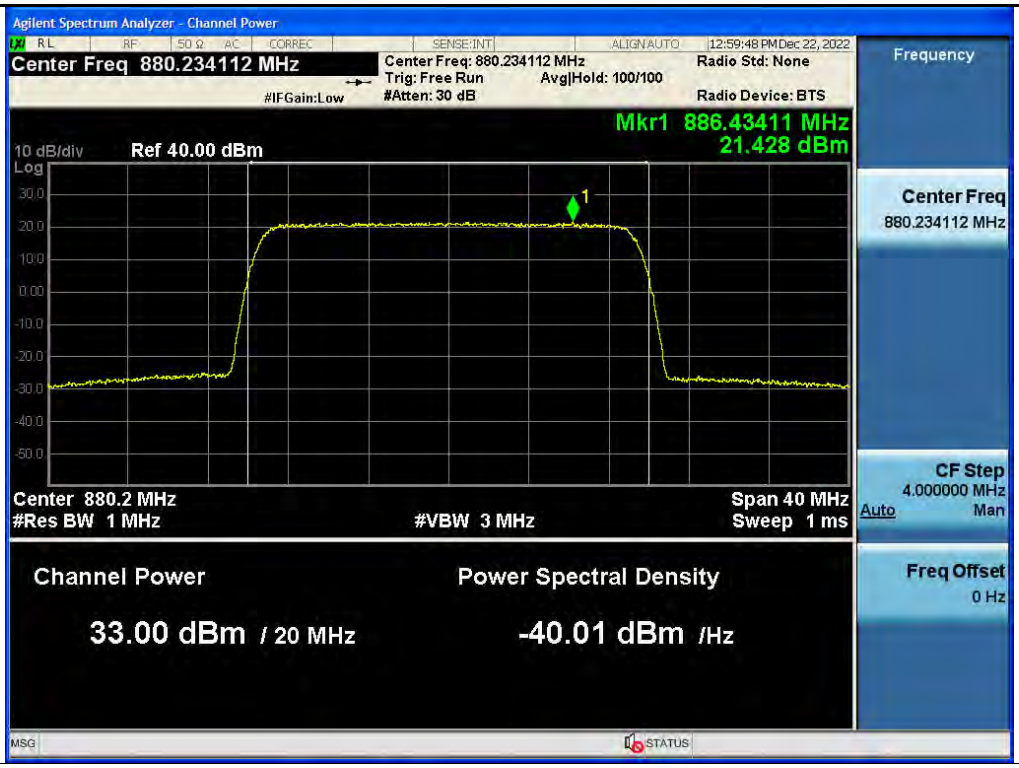


PSD / ESMR / Downlink / 5G NR 5 MHz

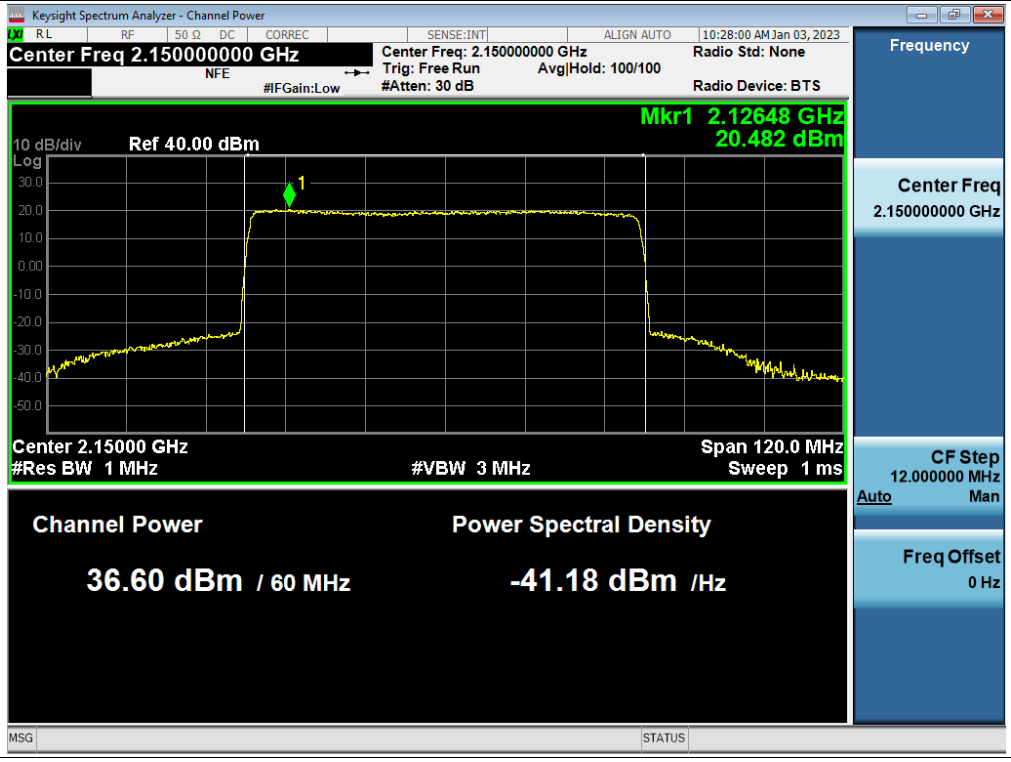
3 dB above the AGC threshold PSD / ESMR / Downlink / 5G NR 5 MHz

PSD / Cellular / Downlink / 5G NR 20 MHz

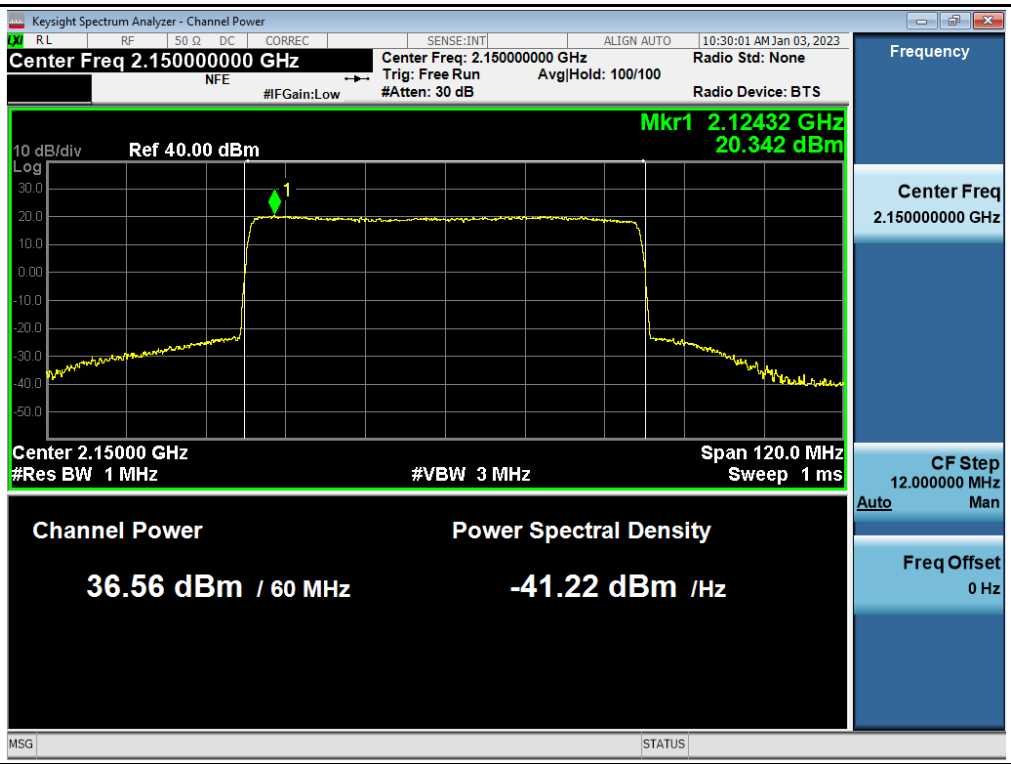
3 dB above the AGC threshold PSD / Cellular / Downlink / 5G NR 20 MHz



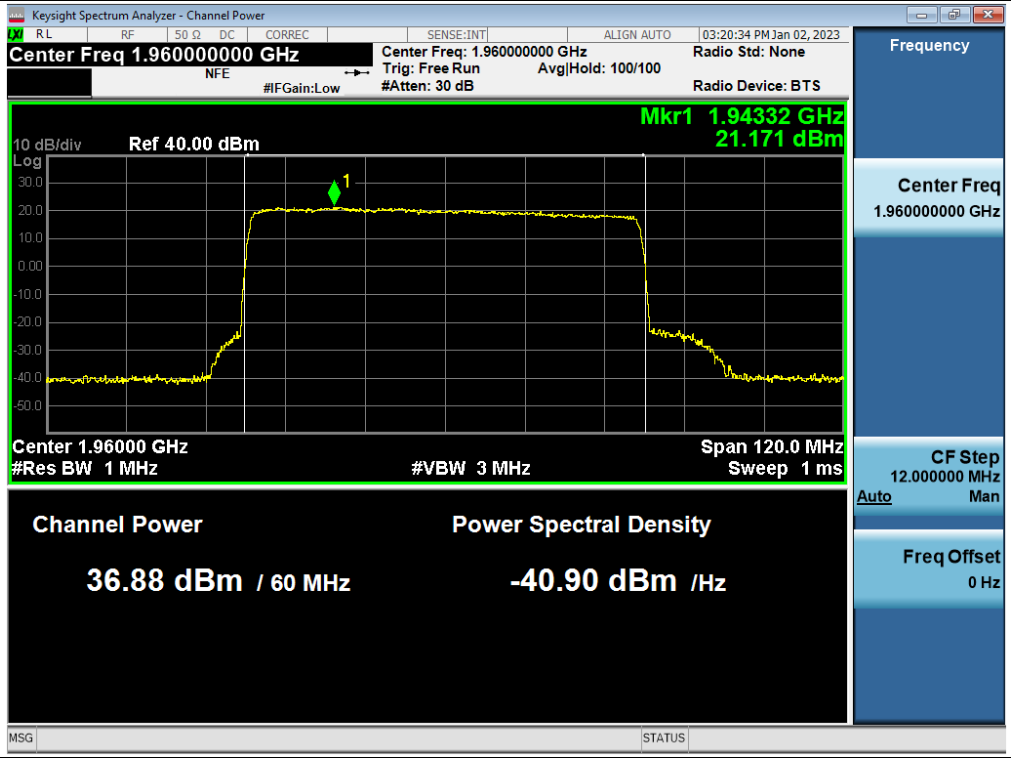
PSD / AWS / Downlink / 5G NR 60 MHz



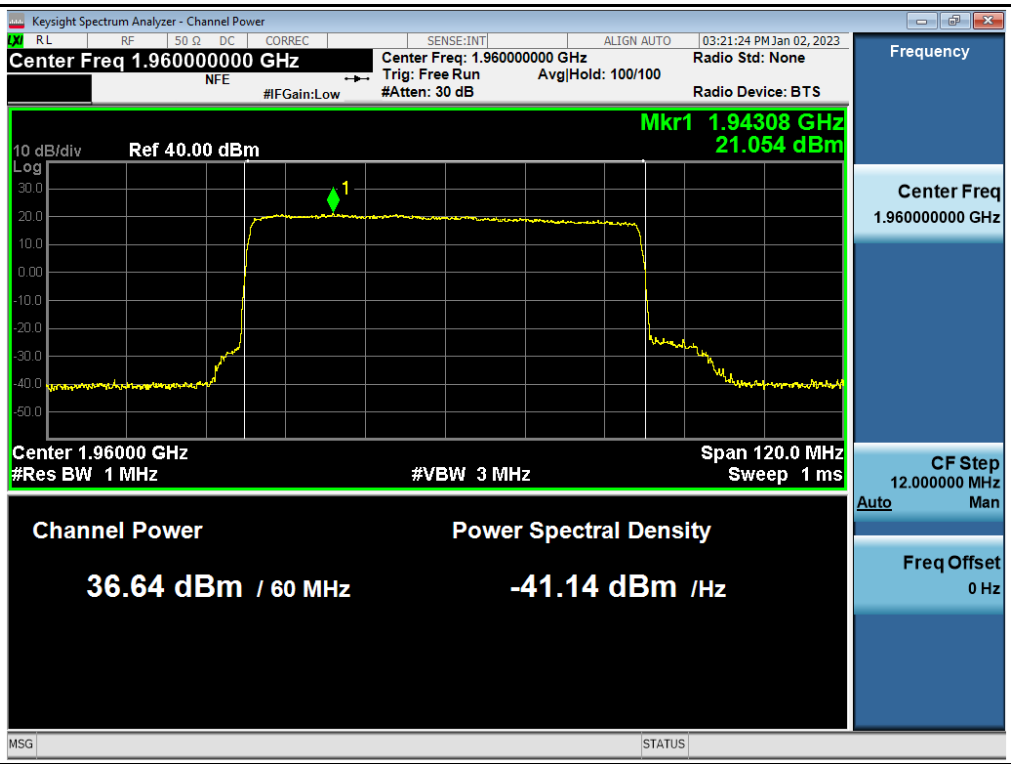
3 dB above the AGC threshold PSD / AWS / Downlink / 5G NR 60 MHz



PSD / PCS / Downlink / 5G NR 60 MHz

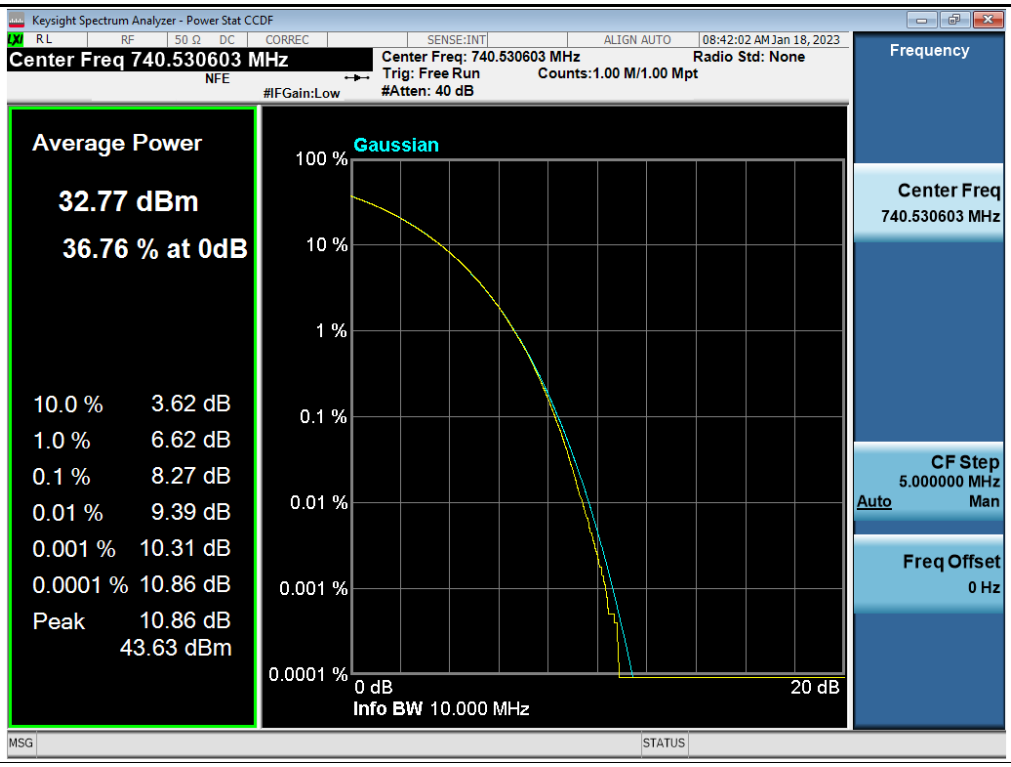


3 dB above the AGC threshold PSD / PCS / Downlink / 5G NR 60 MHz

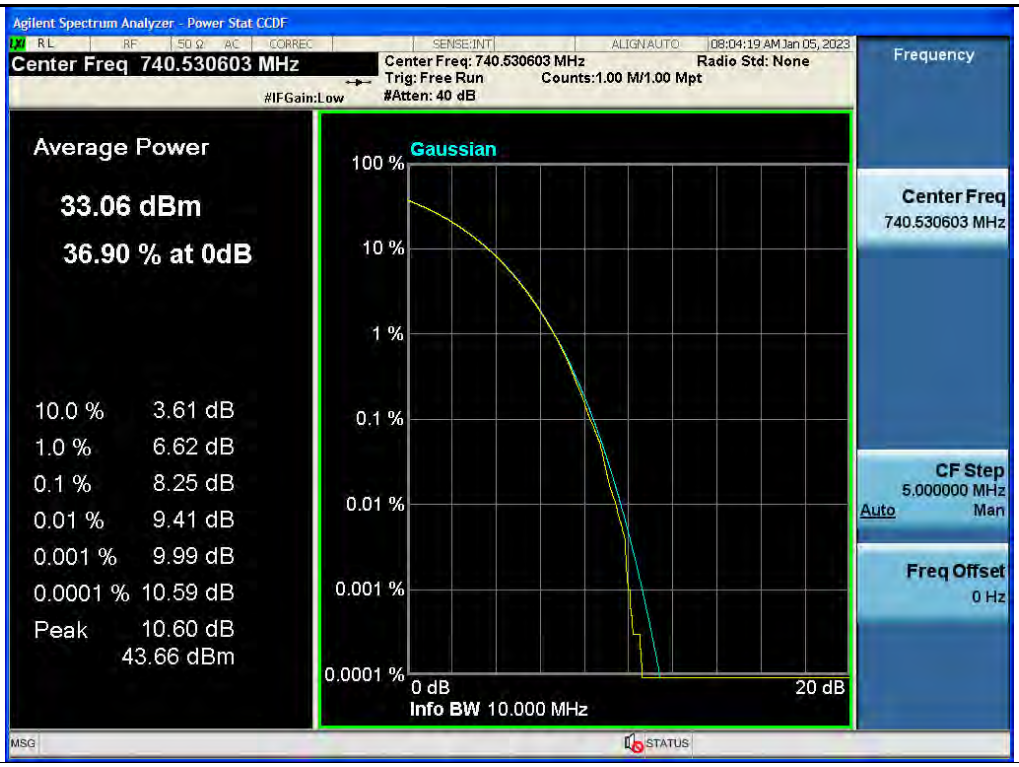


Plot data of PAPR

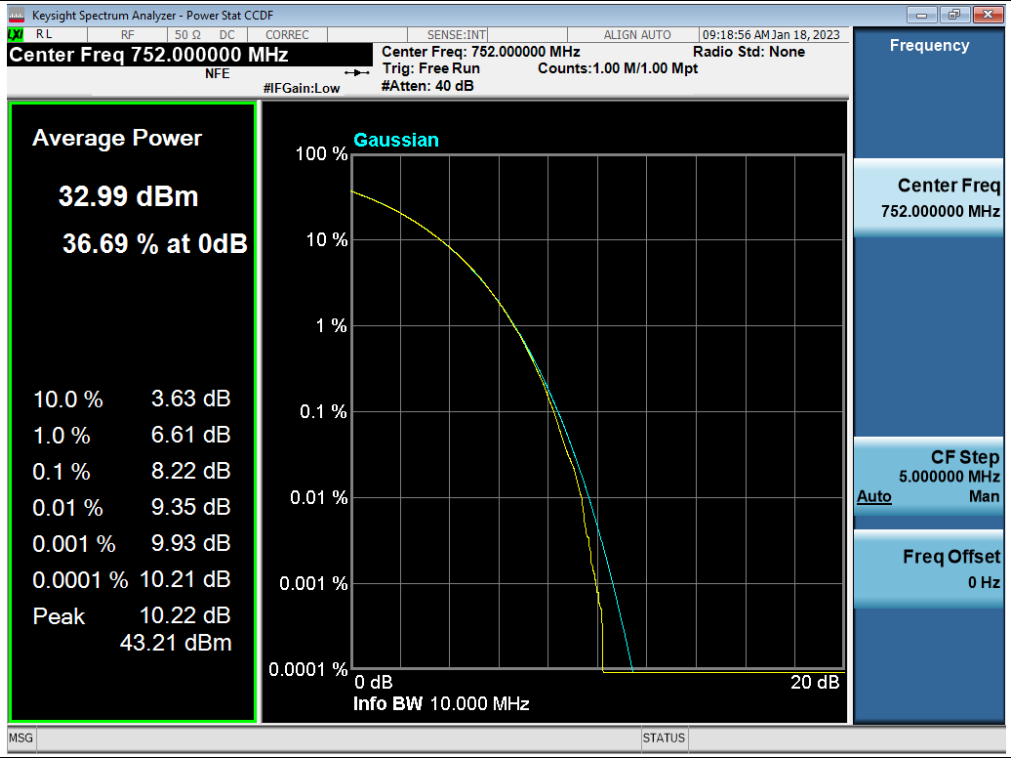
PAPR / Lower 700 MHz / Downlink / LTE 10 MHz



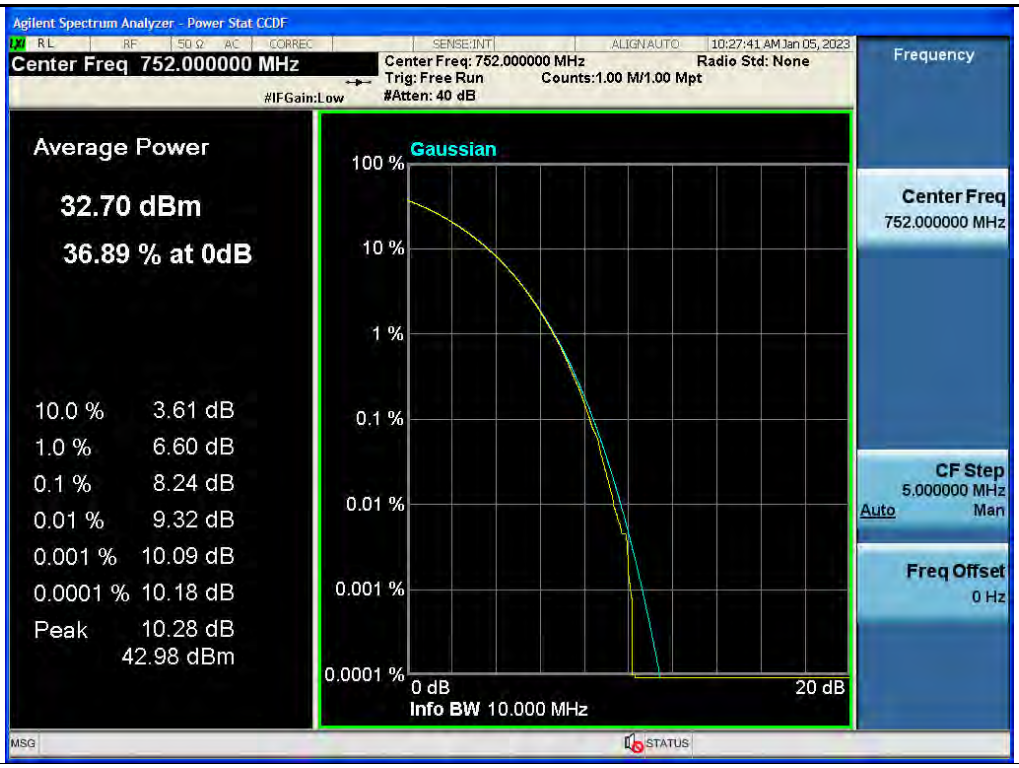
PAPR / Lower 700 MHz / Downlink / 5G NR 10 MHz



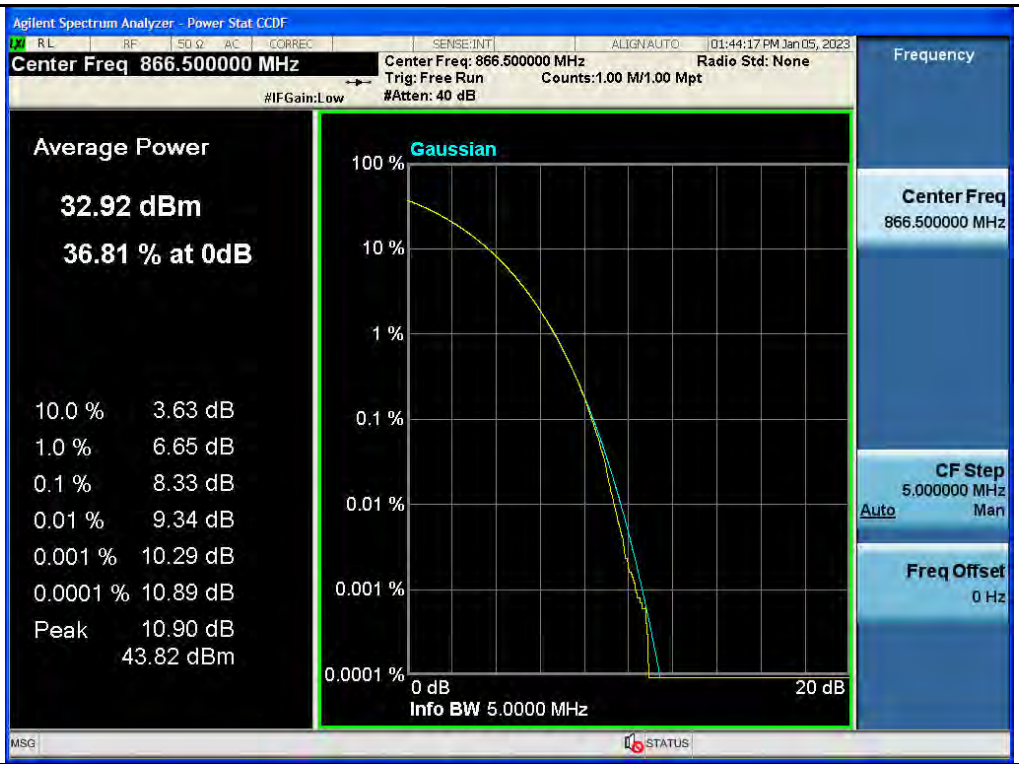
PAPR / Upper 700 MHz / Downlink / LTE 10 MHz



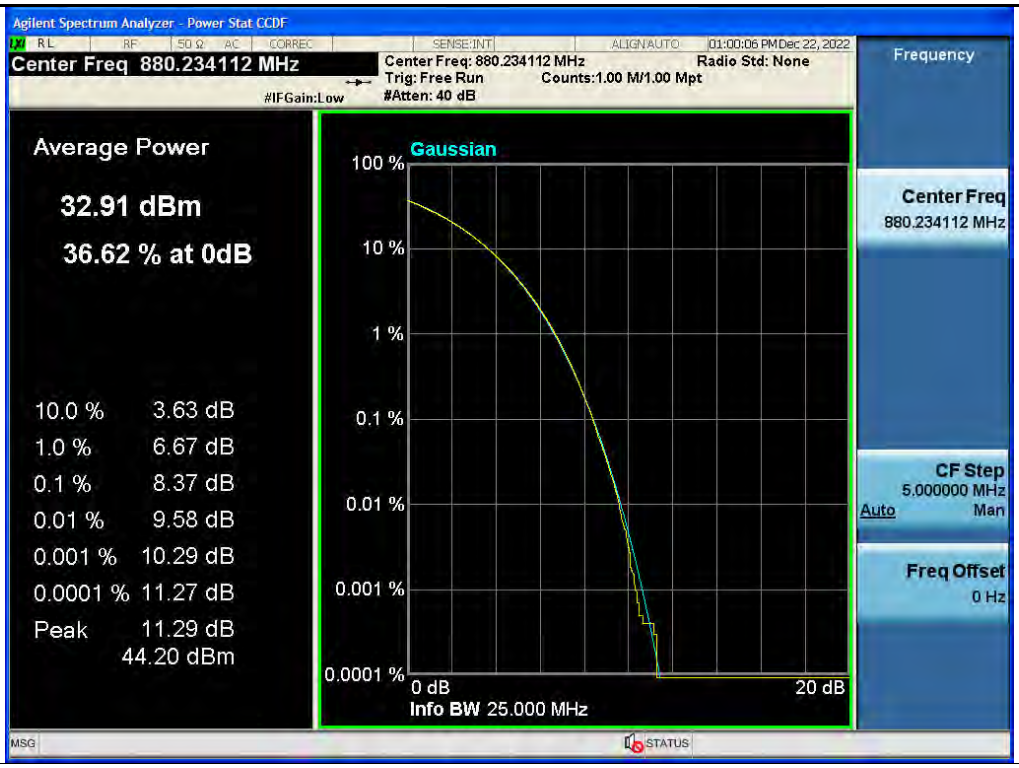
PAPR / Upper 700 MHz / Downlink / 5G NR 10 MHz



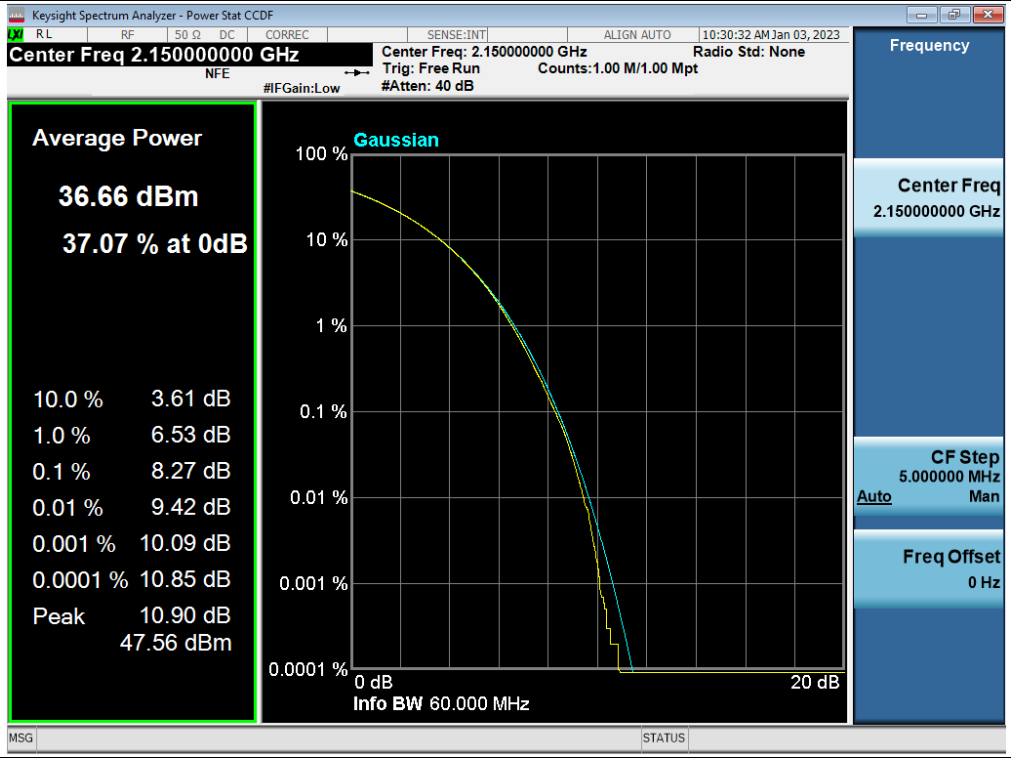
PAPR / ESMR / Downlink / 5G NR 5 MHz



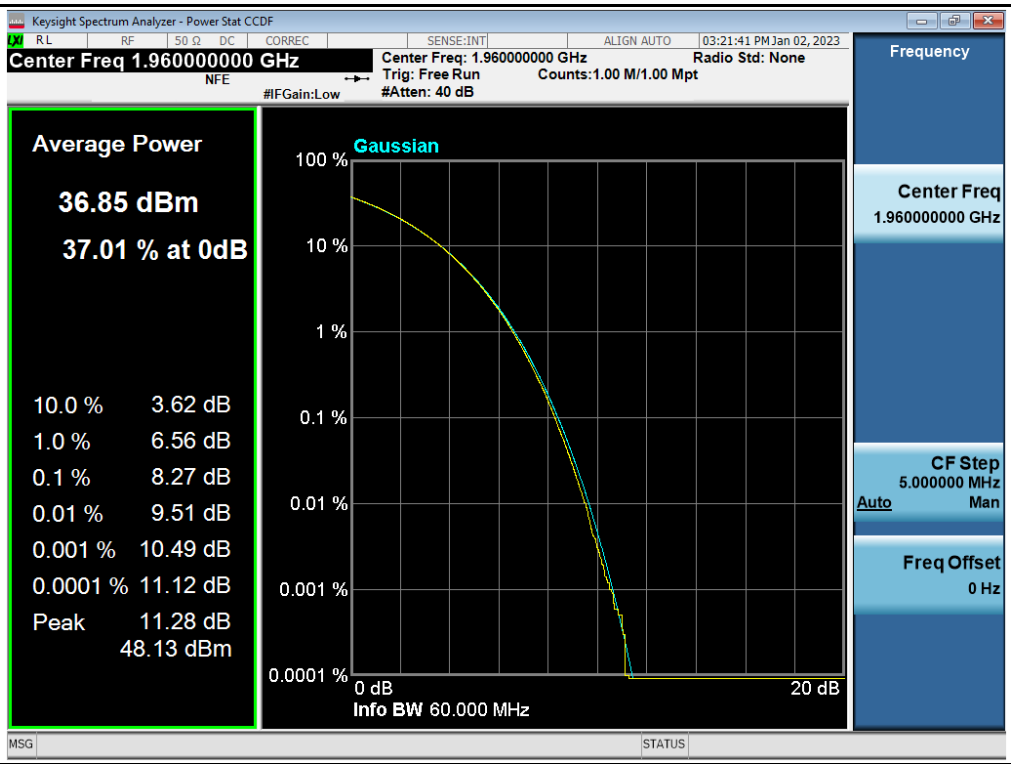
PAPR / Cellular / Downlink / 5G NR 20 MHz



PAPR / AWS / Downlink / 5G NR 60 MHz



PAPR / PCS / Downlink / 5G NR 60 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.

§ 22.917 Emission limitations for cellular equipment.

The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone Service.

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

(b) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a reference bandwidth as follows:

(1) In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. 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. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy, provided that the measured power is integrated over the full required reference bandwidth (i.e., 100 kHz or 1 percent of emission bandwidth, as specified). 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.

(2) In the spectrum above 1 GHz, instrumentation should employ a reference bandwidth of 1 MHz.

(c) Alternative out of band emission limit. Licensees in this service may establish an alternative out of band emission limit to be used at specified band edge(s) in specified geographical areas, in lieu of that set forth in this section, pursuant to a private contractual arrangement of all affected licensees and applicants. In this event, each party to such contract shall maintain a copy of the contract in their station files and disclose it to prospective assignees or transferees and, upon request, to the FCC.

(d) Interference caused by out of band emissions. If any emission from a transmitter operating in this service results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

§ 24.238 Emission limitations for Broadband PCS equipment.

The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.

(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

(b) *Measurement procedure.* Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz 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. 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 MHz or 1 percent of emission bandwidth, as specified). 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.

(c) *Alternative out of band emission limit.* Licensees in this service may establish an alternative out of band emission limit to be used at specified band edge(s) in specified geographical areas, in lieu of that set forth in this section, pursuant to a private contractual arrangement of all affected licensees and applicants. In this event, each party to such contract shall maintain a copy of the contract in their station files and disclose it to prospective assignees or transferees and, upon request, to the FCC.

(d) *Interference caused by out of band emissions.* If any emission from a transmitter operating in this service results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

§ 27.53 Emission limits.

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of

measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

(h) AWS emission limits

(1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

(2) Additional protection levels. Notwithstanding the foregoing paragraph (h)(1) of this section:

(i) Operations in the 2180-2200 MHz band are subject to the out-of-band emission requirements set forth in § 27.1134 for the protection of federal government operations operating in the 2200-2290 MHz band.

(ii) For operations in the 2000-2020 MHz band, the power of any emissions below 2000 MHz shall be attenuated below the transmitter power (P) in watts by at least 70 + 10 log10(P) dB.

(iii) For operations in the 1915-1920 MHz band, the power of any emission between 1930-1995 MHz shall be attenuated below the transmitter power (P) in watts by at least 70 + 10 log10(P) dB.

(iv) For operations in the 1995-2000 MHz band, the power of any emission between 2005-2020 MHz shall be attenuated below the transmitter power (P) in watts by at least 70 + 10 log10(P) dB.

(3) Measurement procedure.

(i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. 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.

(ii) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges, both upper and lower, as the design permits.

(iii) The measurements of emission power can be expressed in peak or average values, provided they are

expressed in the same parameters as the transmitter power.

(4) Private agreements.

(i) For AWS operations in the 2000-2020 MHz and 2180-2200 MHz bands, to the extent a licensee establishes unified operations across the AWS blocks, that licensee may choose not to observe the emission limit specified in paragraph (h)(1), above, strictly between its adjacent block licenses in a geographic area, so long as it complies with other Commission rules and is not adversely affecting the operations of other parties by virtue of exceeding the emission limit.

(ii) For AWS operations in the 2000-2020 MHz band, a licensee may enter into private agreements with all licensees operating between 1995 and 2000 MHz to allow the 70 + 10 log10(P) dB limit to be exceeded within the 1995-2000 MHz band.

(iii) An AWS licensee who is a party to a private agreement described in this section (4) must maintain a copy of the agreement in its station files and disclose it, upon request, to prospective AWS assignees, transferees, or spectrum lessees and to the Commission.

§ 90.691 Emission mask requirements for EA-based systems

(a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10\text{Log}_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

(b) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

Test Procedures:

Measurements were in accordance with the test methods section 3.6 of KDB 935210 D05 v01r04.

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.

Note

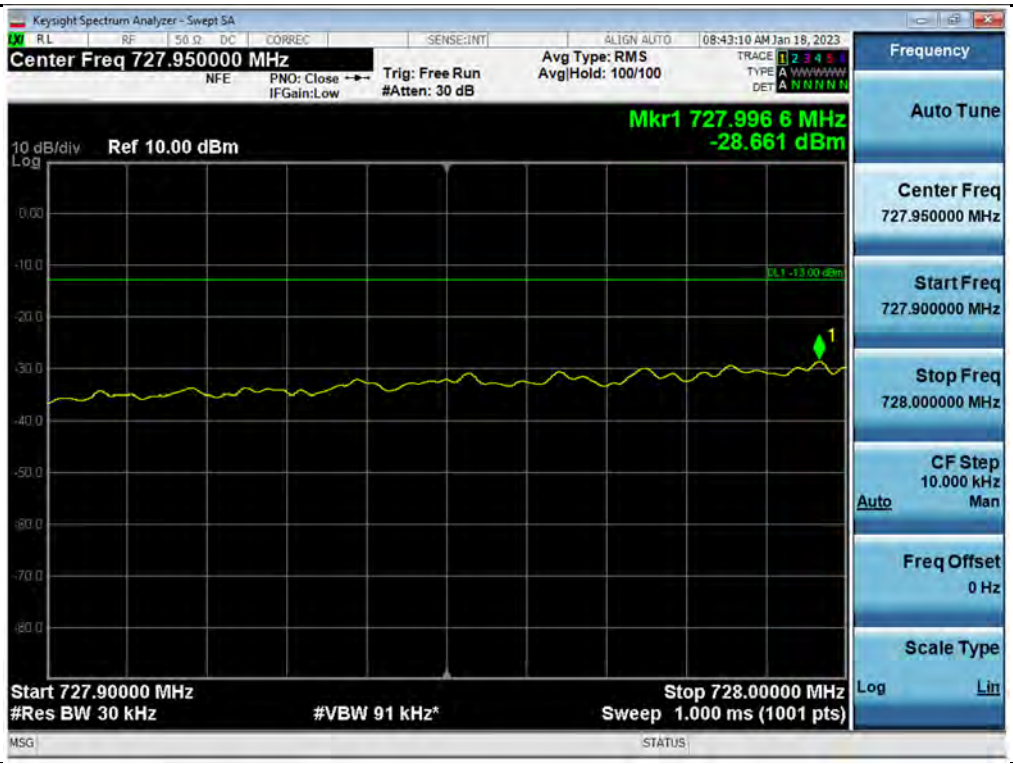
1. In 9 kHz-150 kHz, 150 kHz-30 MHz bands, and from edge to edge±10 MHz, narrow RBW was applied, so correction factor was used according to section 5.7.2 of ANSI C63.26-2015

Band	9 kHz ~ 150 kHz Correction	150 kHz ~ 30 MHz Correction	From Edge to Edge±10 MHz Correction
Below 1 GHz (Ref. RBW: 100 kHz)	20 dB	10 dB	10 dB
Above 1 GHz (Ref. RBW: 1 MHz)	30 dB	20 dB	10 dB

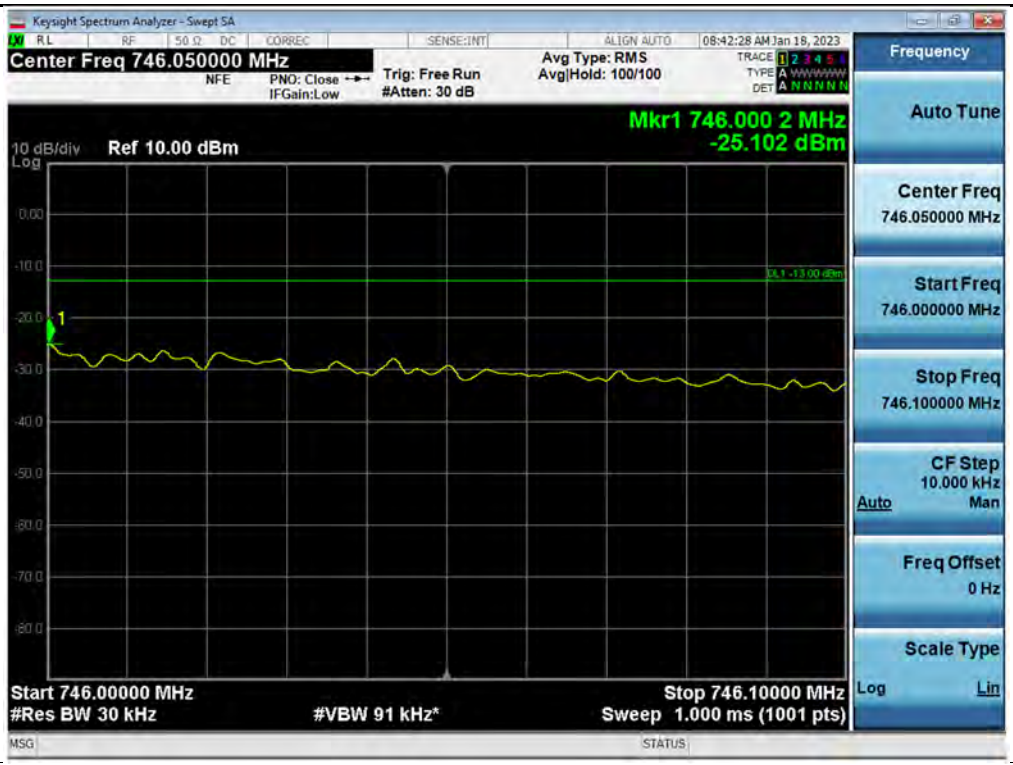
2. Measurement bandwidth specified in the applicable rule section for the supported frequency band.

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

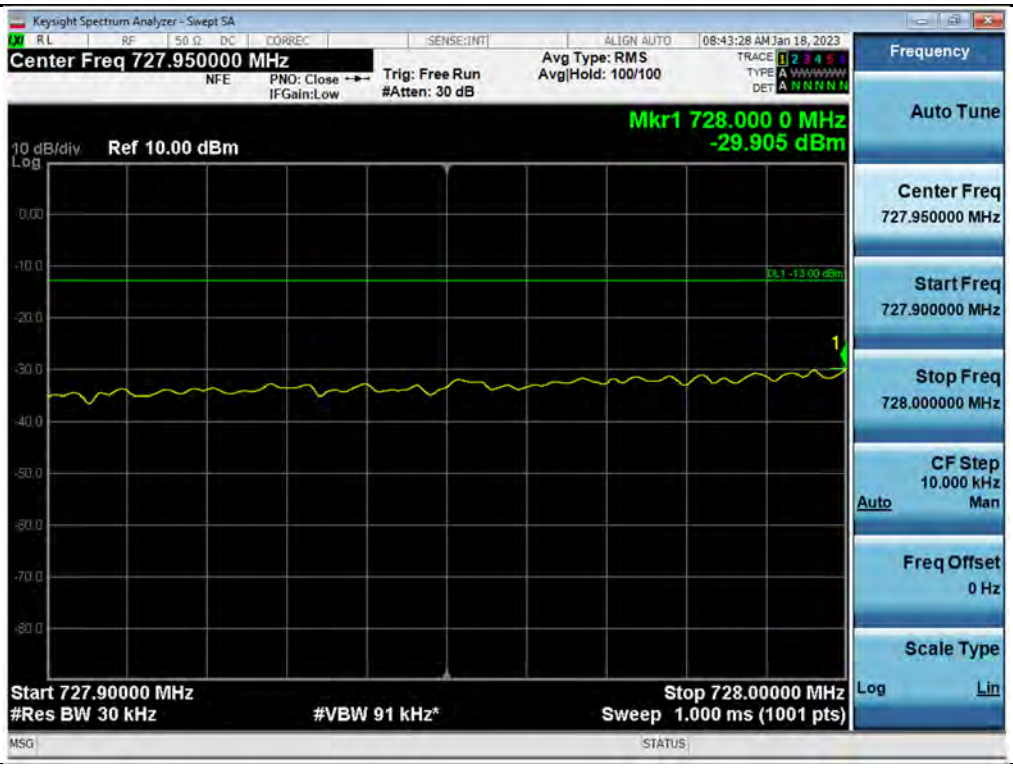
Out-of-band (single test signal) / Lower 700 MHz / Downlink / LTE 10 MHz / Lower



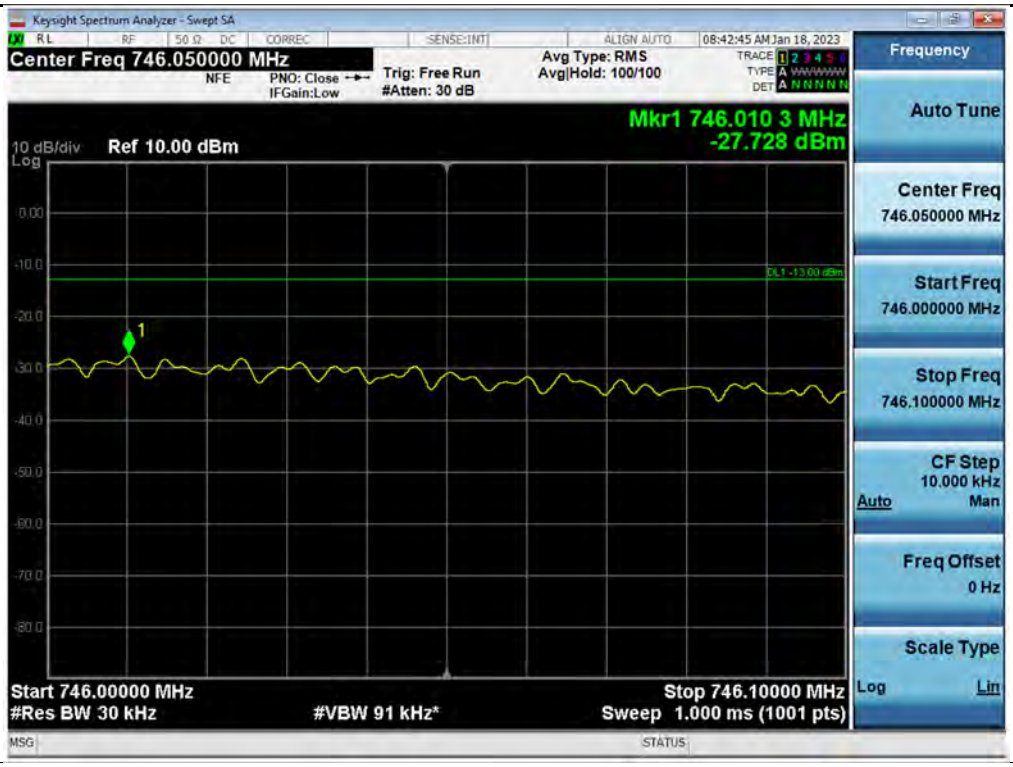
Out-of-band (single test signal) / Lower 700 MHz / Downlink / LTE 10 MHz / Upper



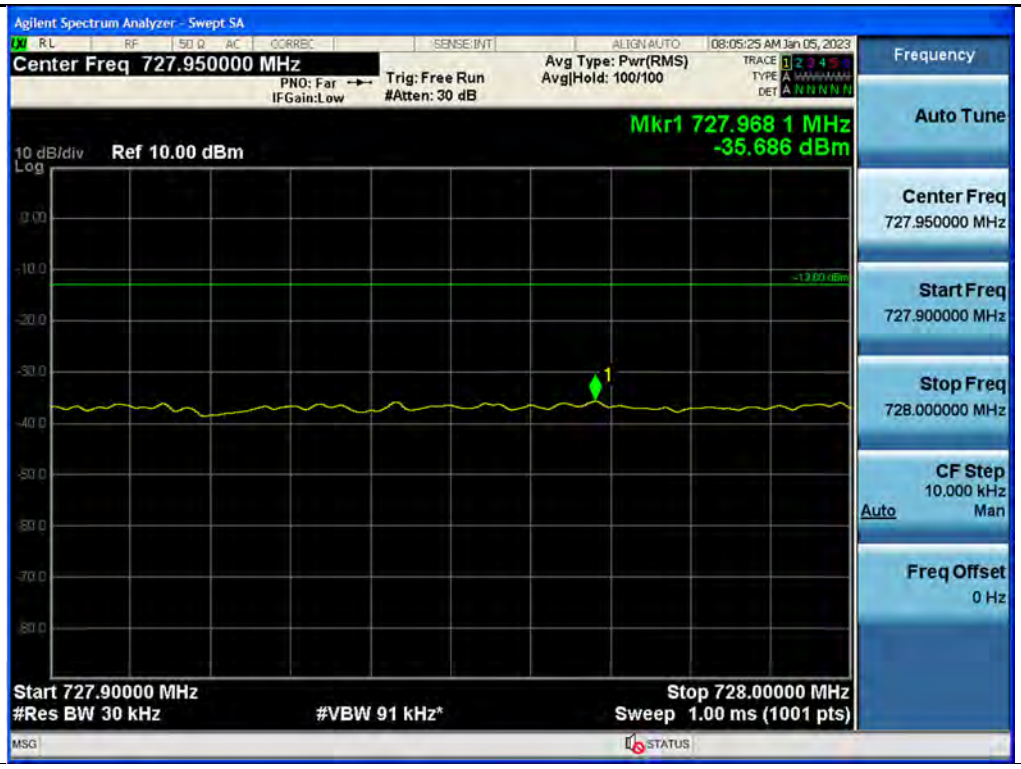
+3 dB above Out-of-band (single test signal) / Lower 700 MHz / Downlink / LTE 10 MHz / Lower



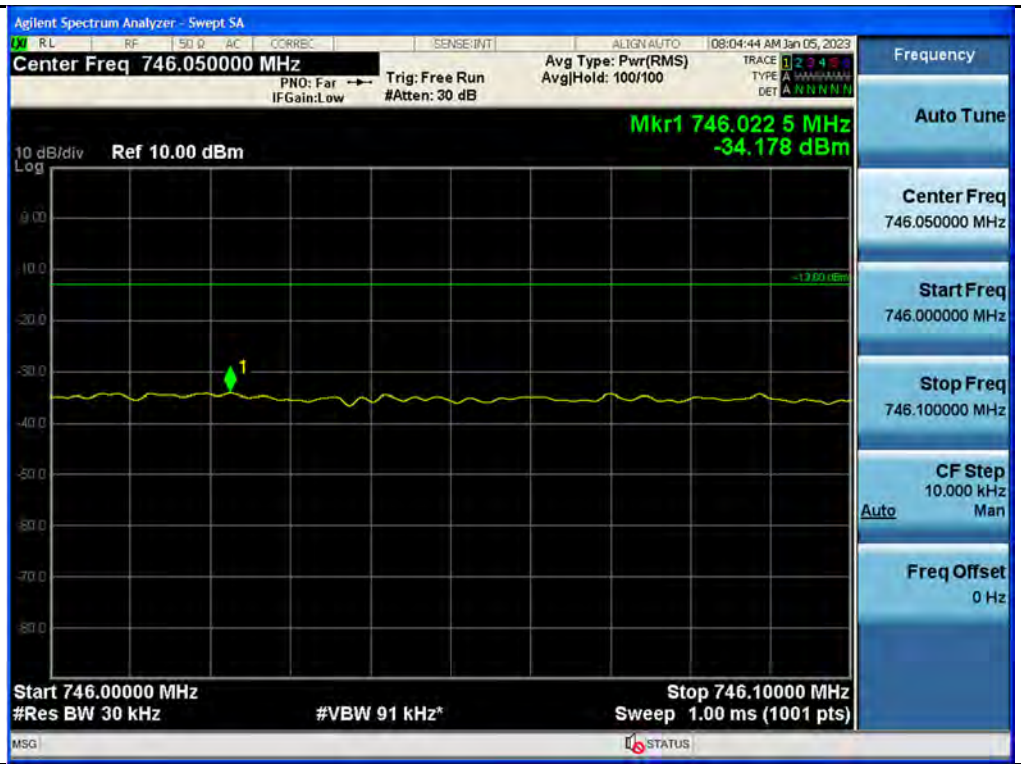
+3 dB above Out-of-band (single test signal) / Lower 700 MHz / Downlink / LTE 10 MHz / Upper



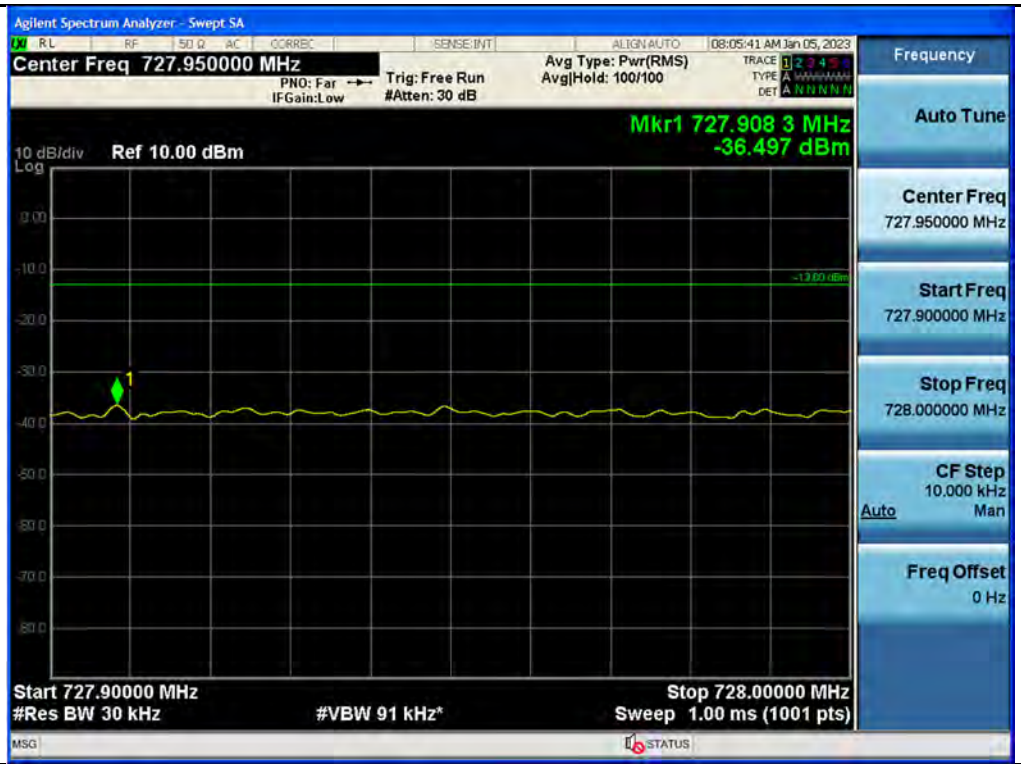
Out-of-band (single test signal) / Lower 700 MHz / Downlink / 5G NR 10 MHz / Lower



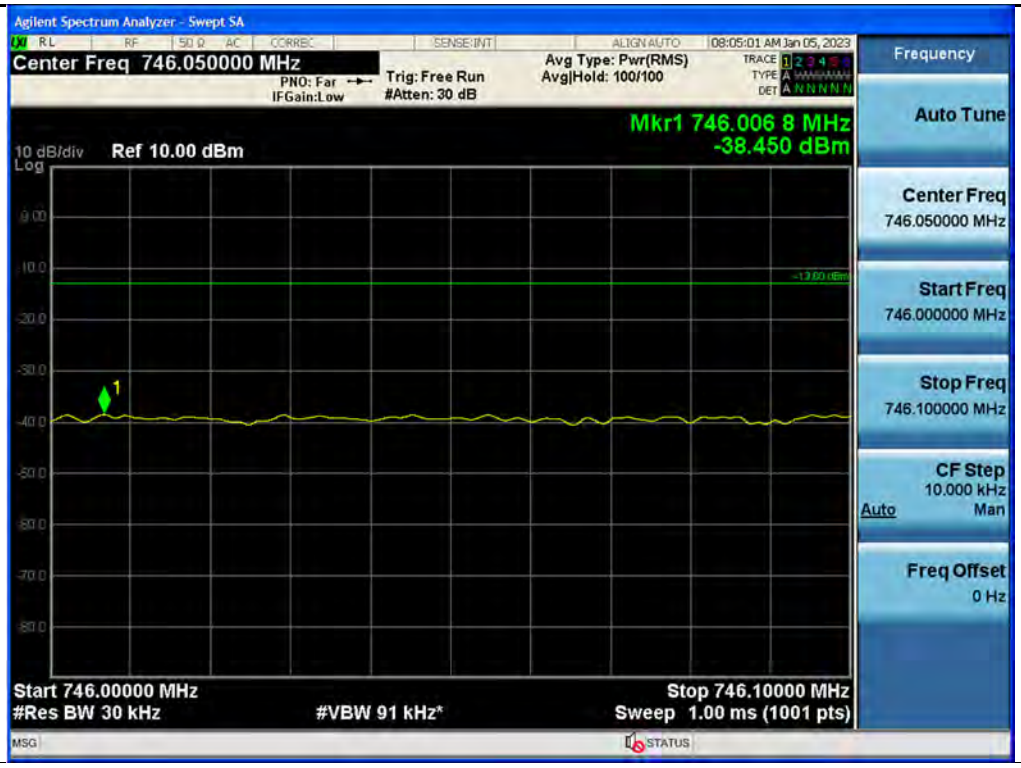
Out-of-band (single test signal) / Lower 700 MHz / Downlink / 5G NR 10 MHz / Upper



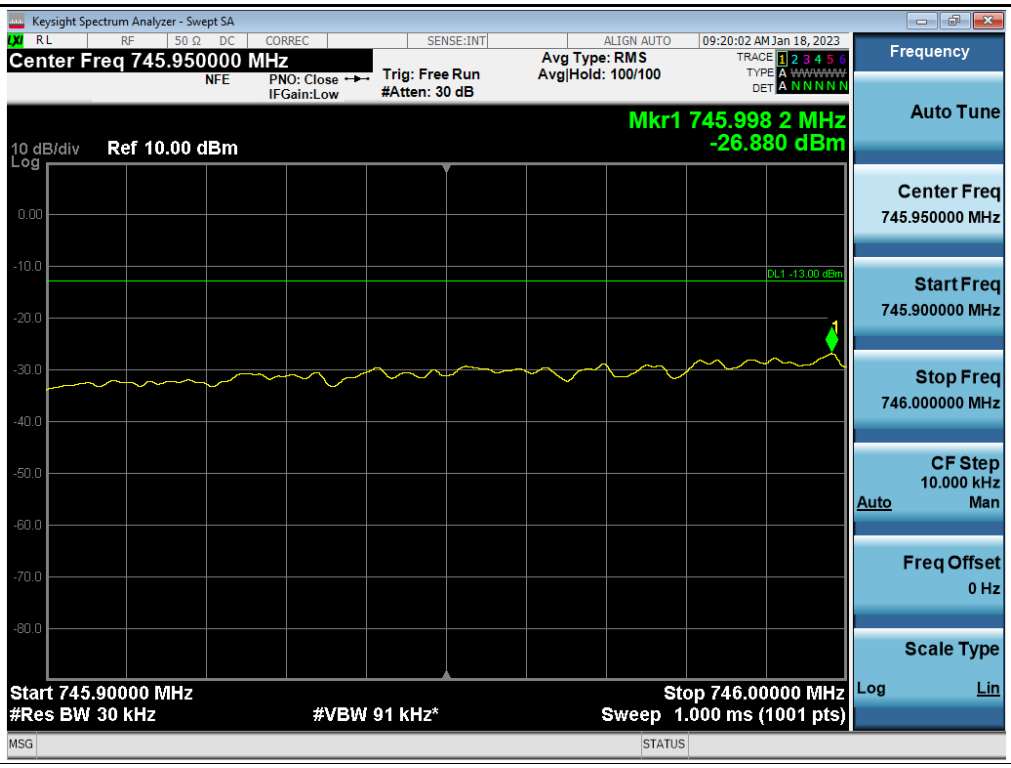
+3 dB above Out-of-band (single test signal) / Lower 700 MHz / Downlink / 5G NR 10 MHz / Lower



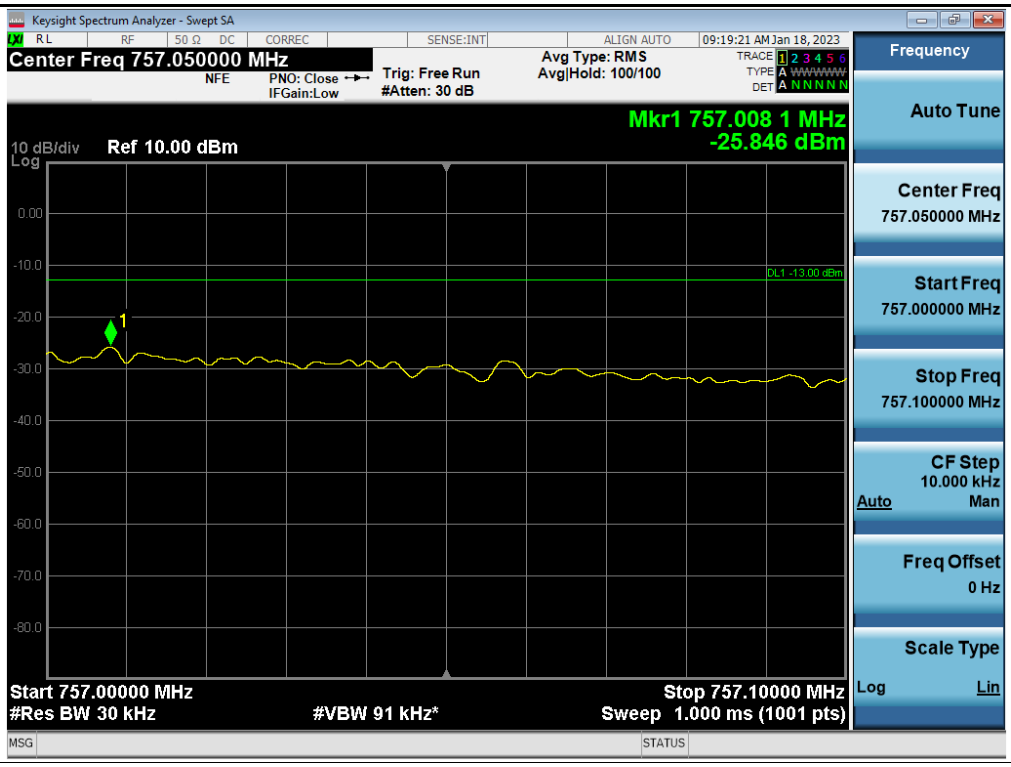
+3 dB above Out-of-band (single test signal) / Lower 700 MHz / Downlink / 5G NR 10 MHz / Upper



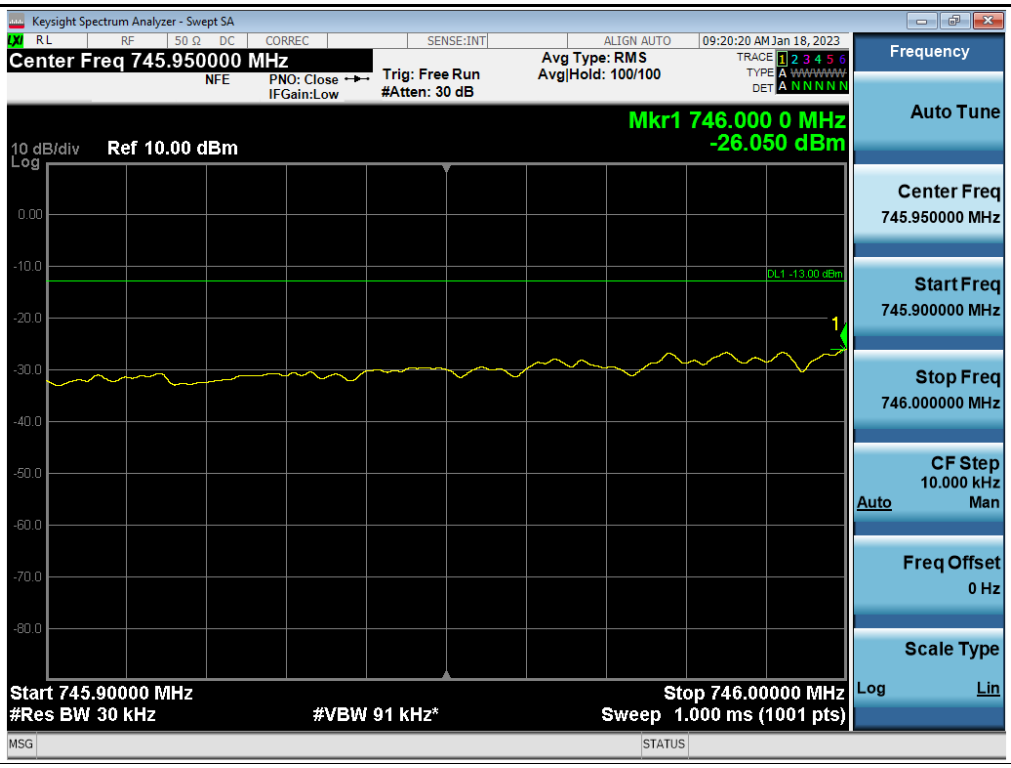
Out-of-band (single test signal) / Upper 700 MHz / Downlink / LTE 10 MHz / Lower



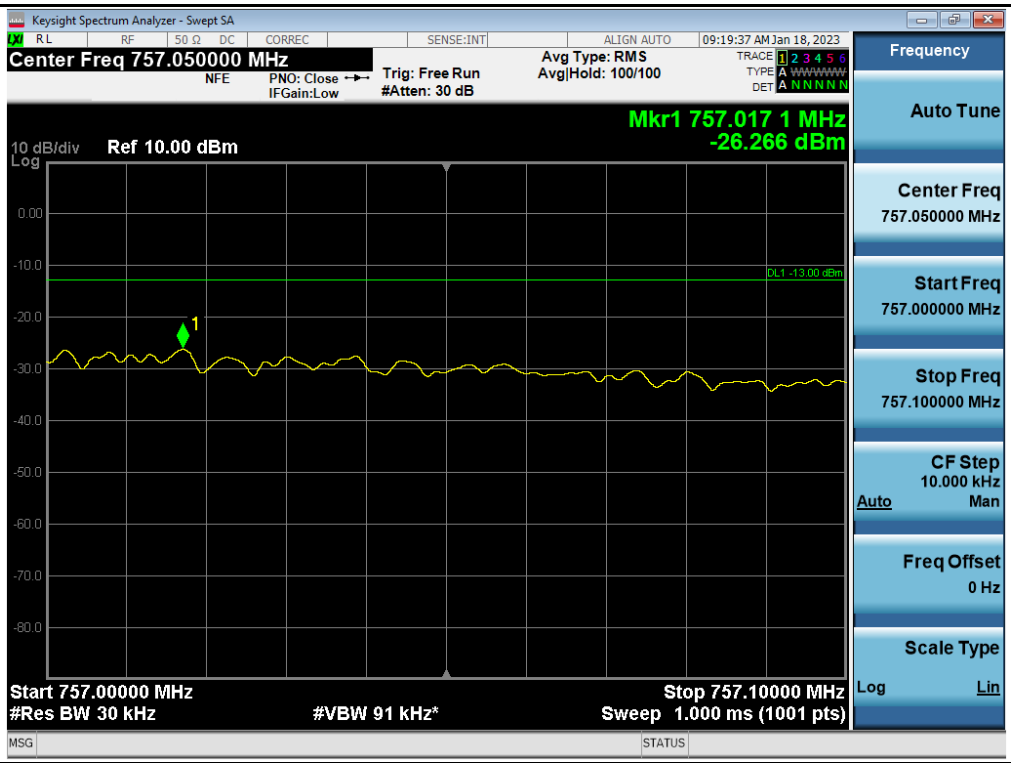
Out-of-band (single test signal) / Upper 700 MHz / Downlink / LTE 10 MHz / Upper



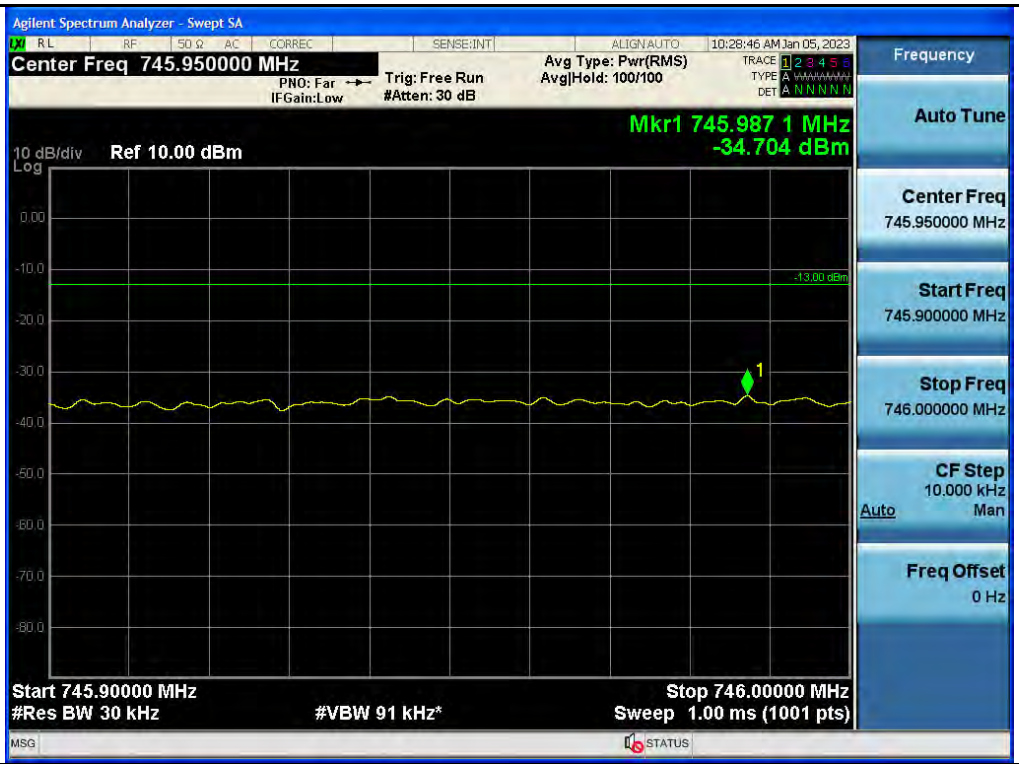
+3 dB above Out-of-band (single test signal) / Upper 700 MHz / Downlink / LTE 10 MHz / Lower



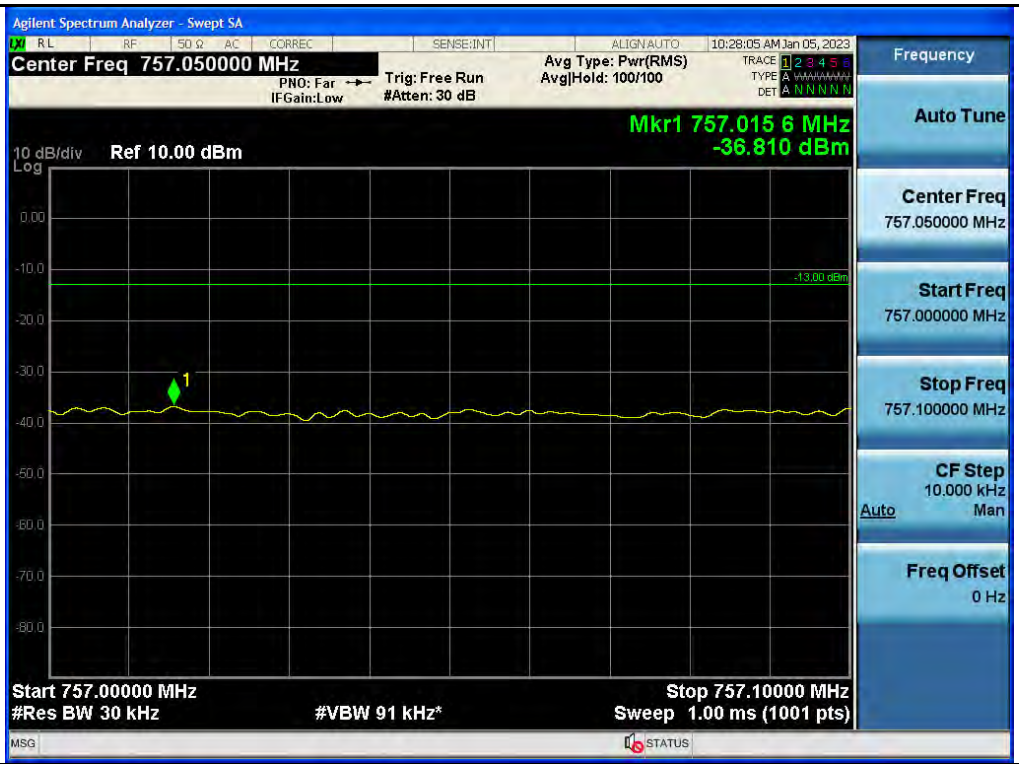
+3 dB above Out-of-band (single test signal) / Upper 700 MHz / Downlink / LTE 10 MHz / Upper



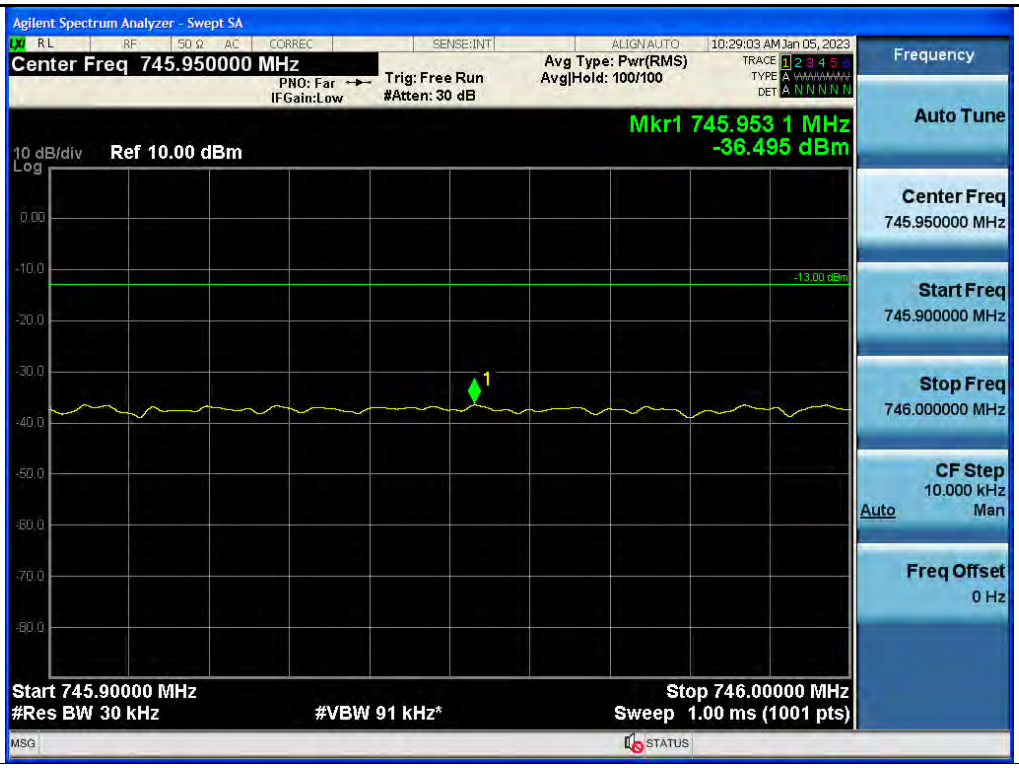
Out-of-band (single test signal) / Upper 700 MHz / Downlink / 5G NR 10 MHz / Lower



Out-of-band (single test signal) / Upper 700 MHz / Downlink / 5G NR 10 MHz / Upper



+3 dB above Out-of-band (single test signal) / Upper 700 MHz / Downlink / 5G NR 10 MHz / Lower



+3 dB above Out-of-band (single test signal) / Upper 700 MHz / Downlink / 5G NR 10 MHz / Upper

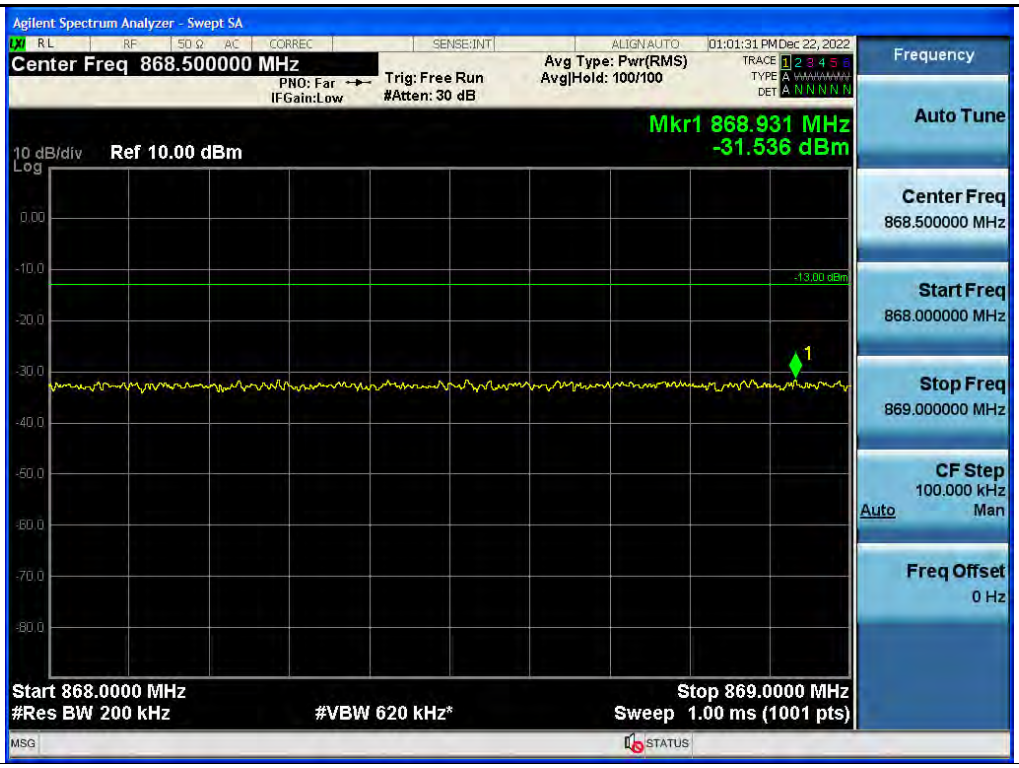
Out-of-band (single test signal) / ESMR / Downlink / 5G NR 5 MHz / Lower

Out-of-band (single test signal) / ESMR / Downlink / 5G NR 5 MHz / Upper

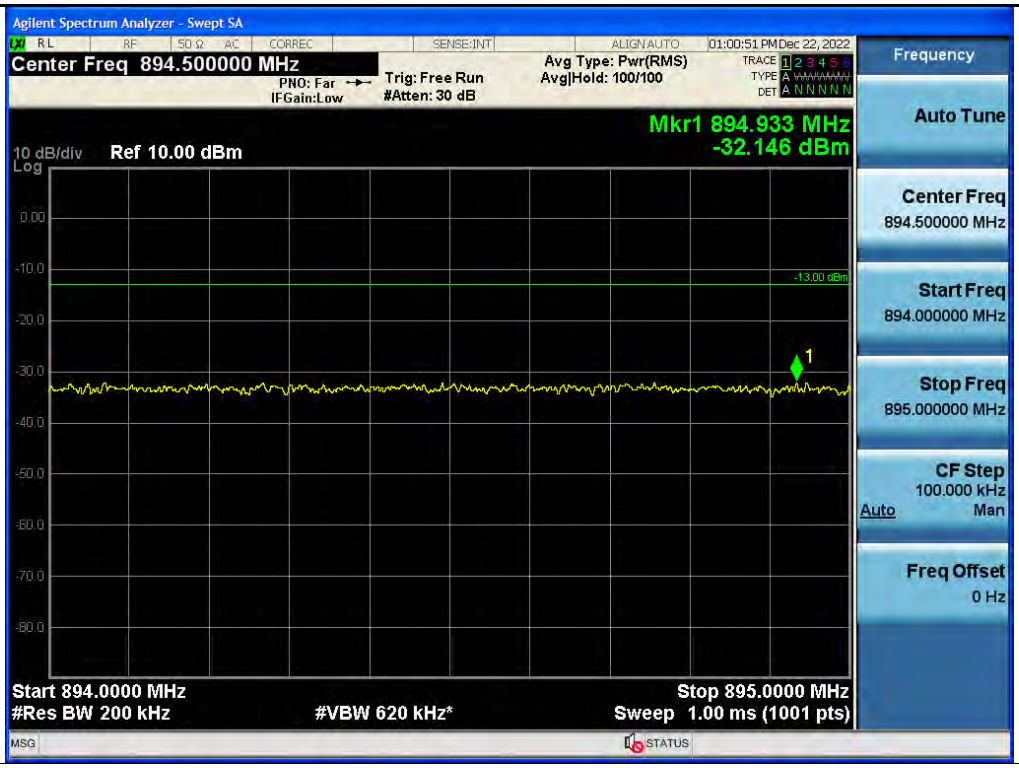
+3 dB above Out-of-band (single test signal) / ESMR / Downlink / 5G NR 5 MHz / Lower

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

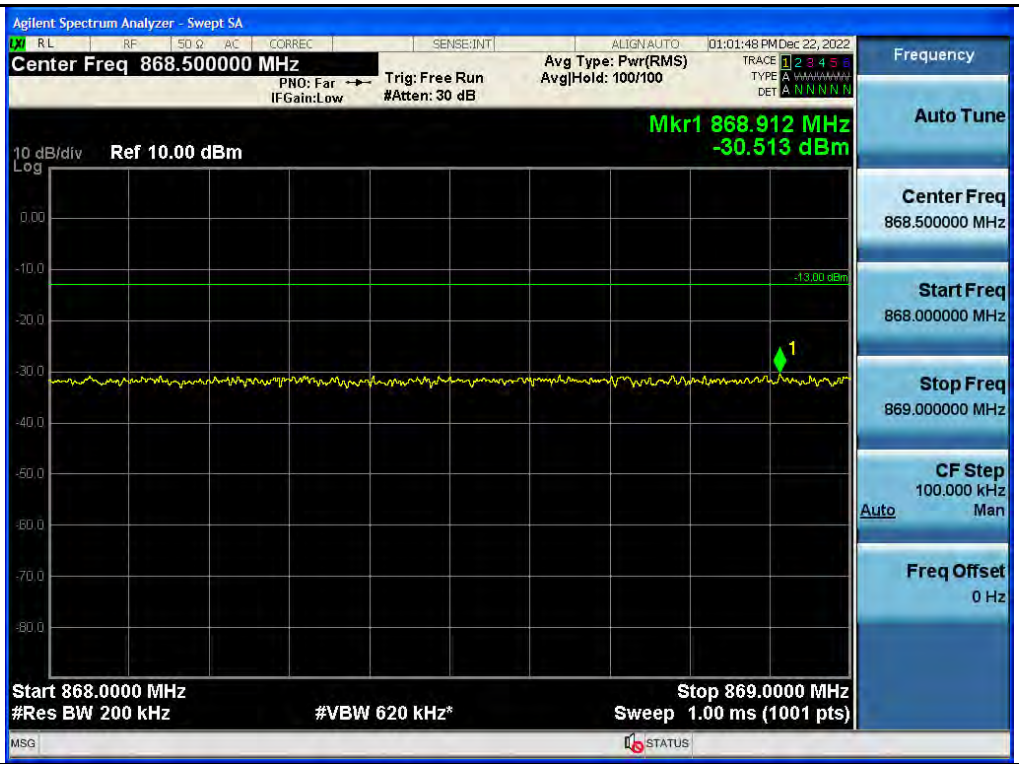
Out-of-band (single test signal) / Cellular / Downlink / 5G NR 20 MHz / Lower



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

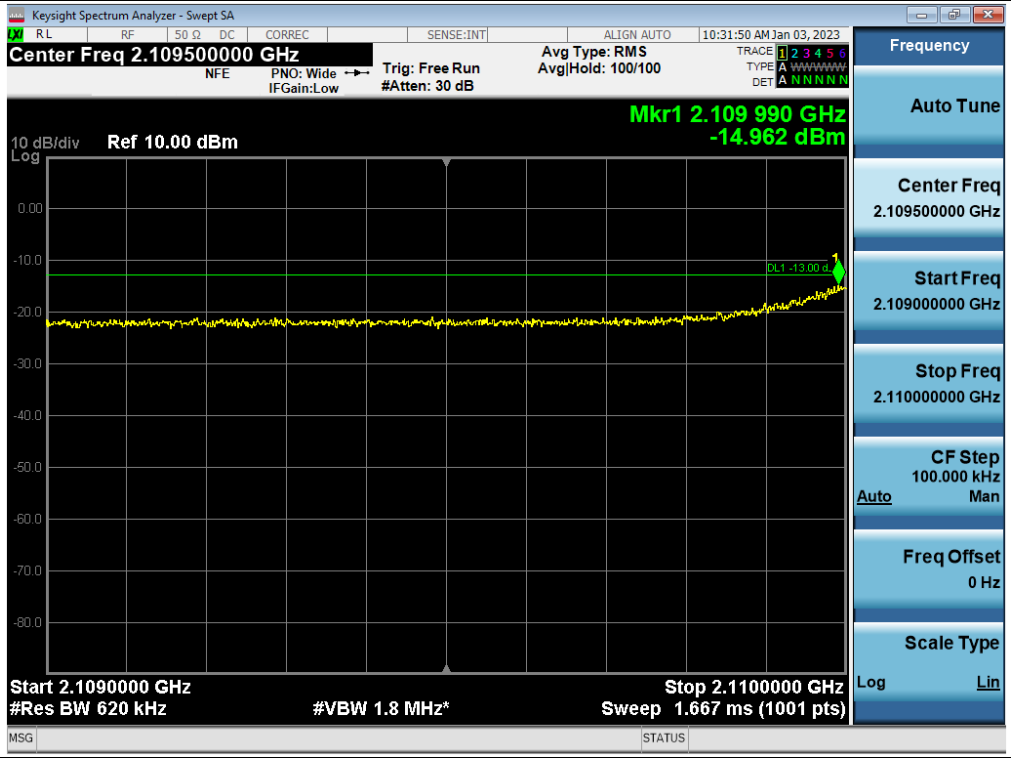


+3 dB above Out-of-band (single test signal) / Cellular / Downlink / 5G NR 20 MHz / Lower

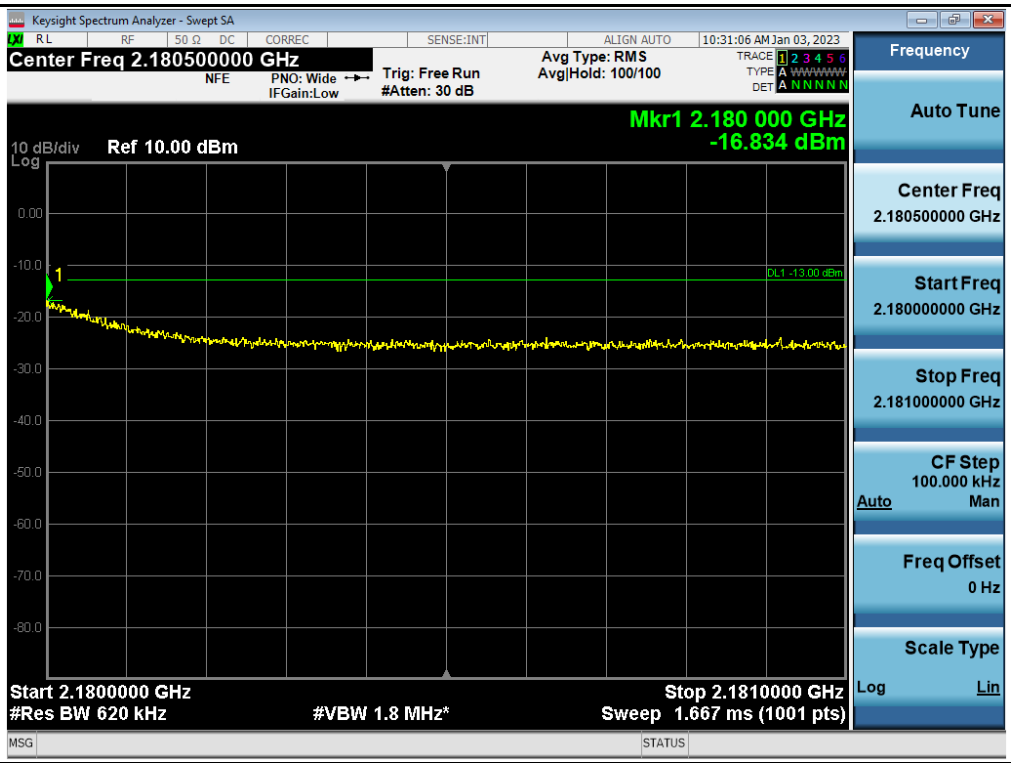


+3 dB above Out-of-band (single test signal) / Cellular / Downlink / 5G NR 20 MHz / Upper

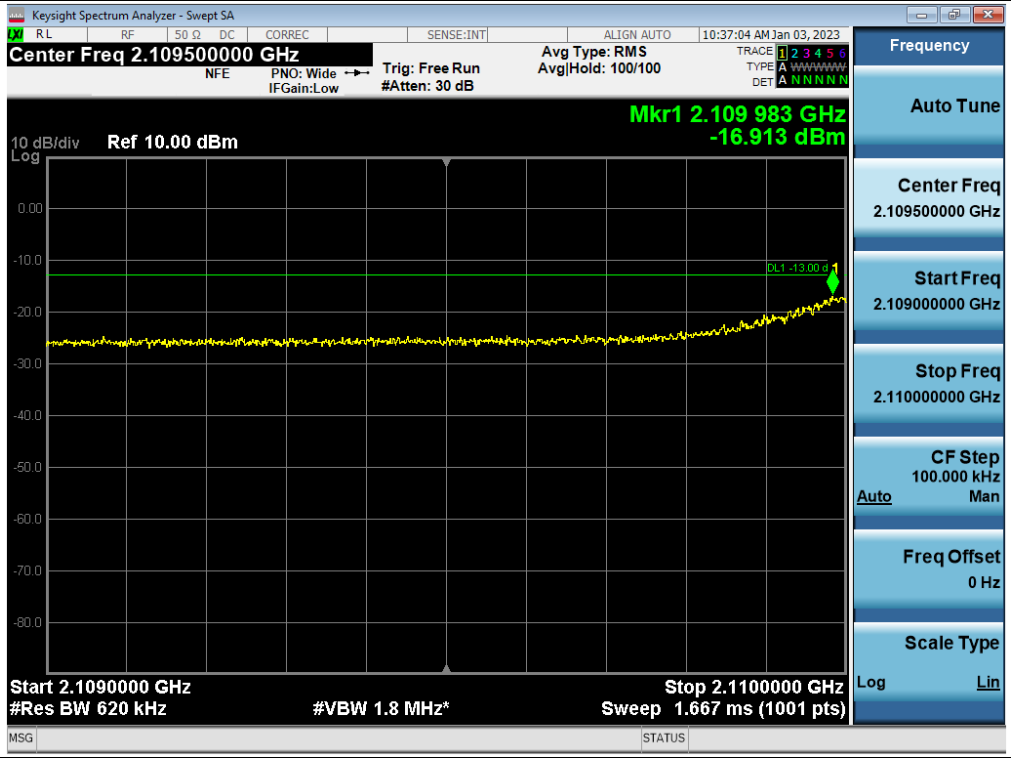
Out-of-band (single test signal) / AWS / Downlink / 5G NR 60 MHz / Lower



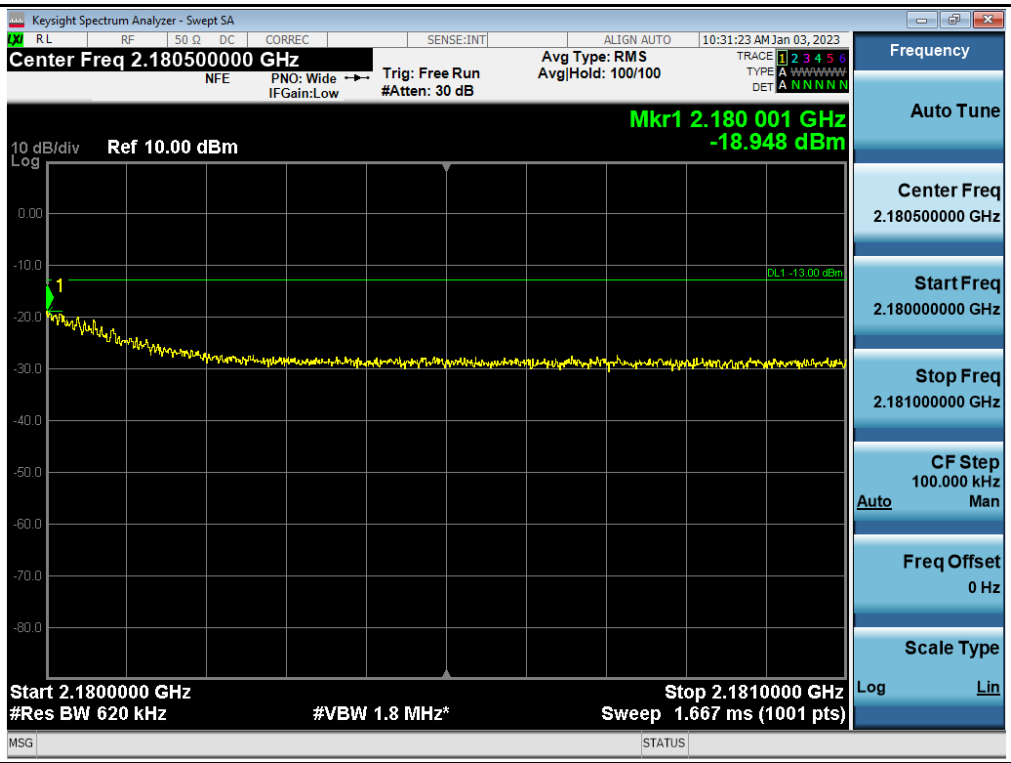
Out-of-band (single test signal) / AWS / Downlink / 5G NR 60 MHz / Upper



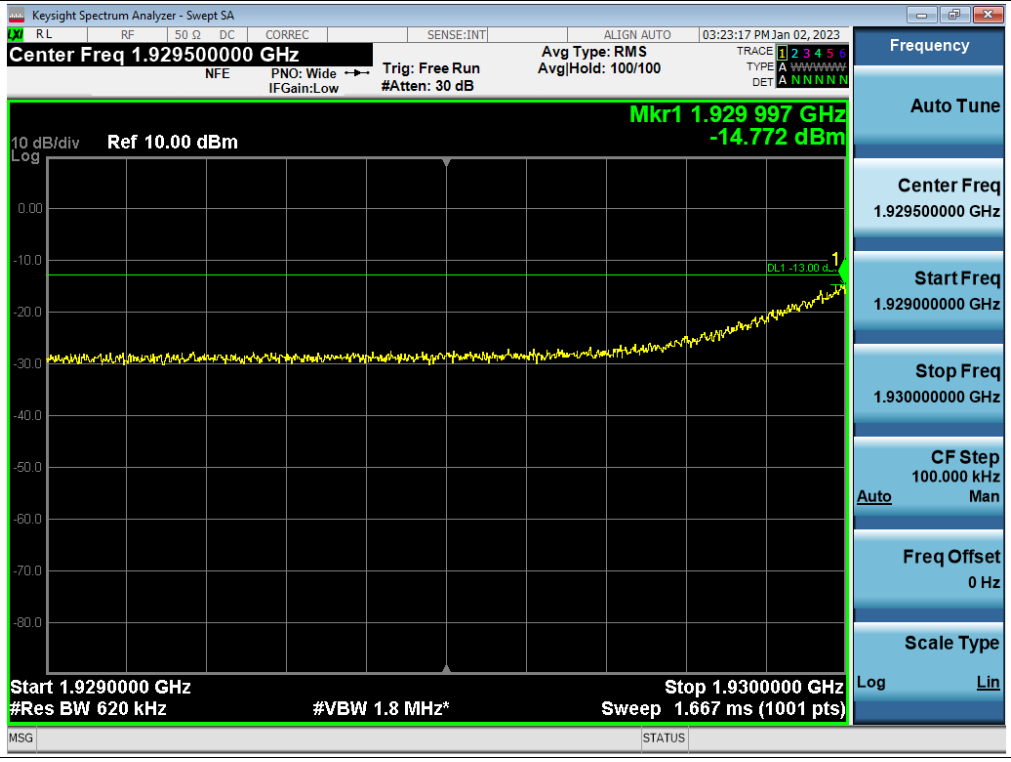
+3 dB above Out-of-band (single test signal) / AWS / Downlink / 5G NR 60 MHz / Lower



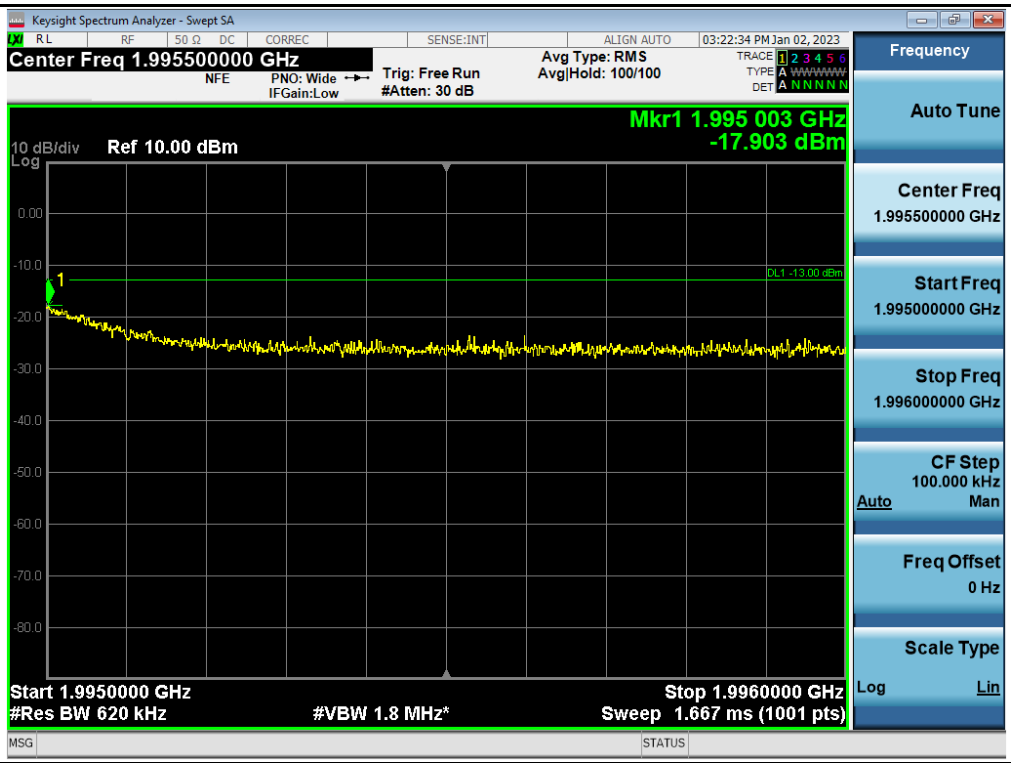
+3 dB above Out-of-band (single test signal) / AWS / Downlink / 5G NR 60 MHz / Upper



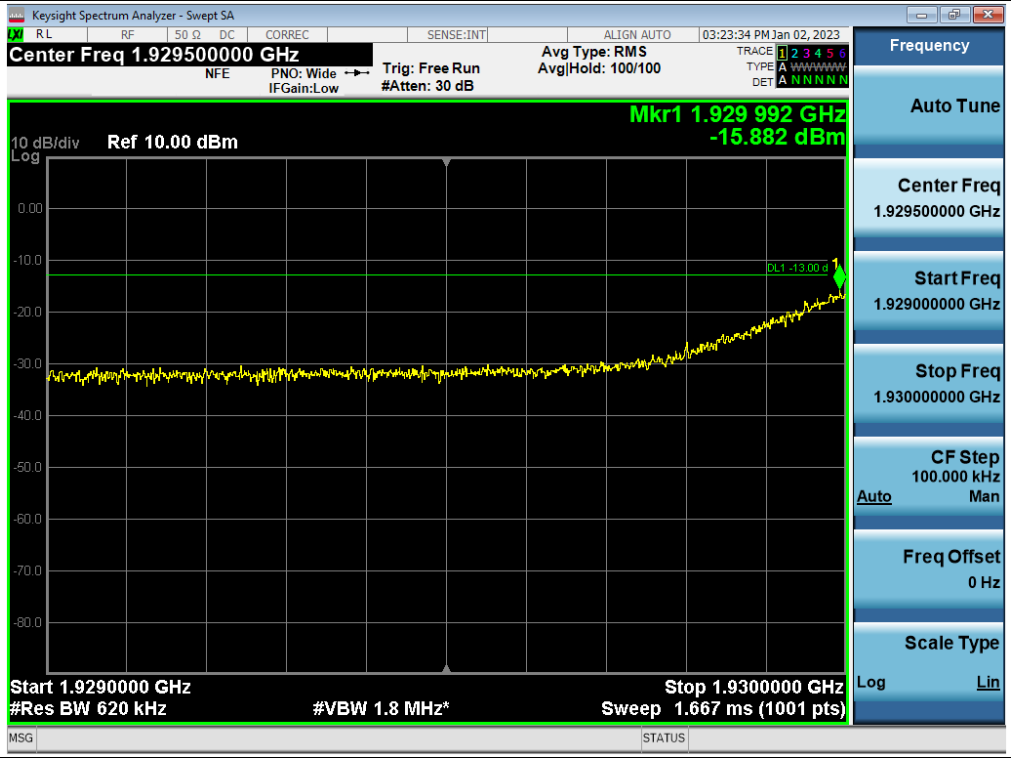
Out-of-band (single test signal) / PCS / Downlink / 5G NR 60 MHz / Lower



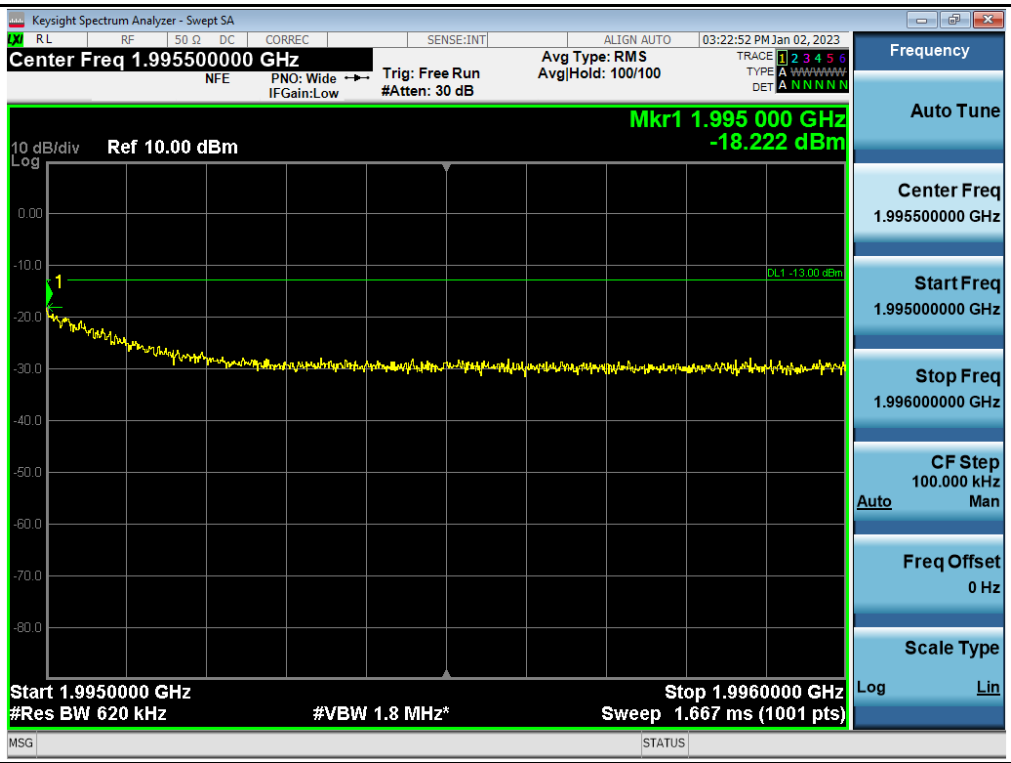
Out-of-band (single test signal) / PCS / Downlink / 5G NR 60 MHz / Upper



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

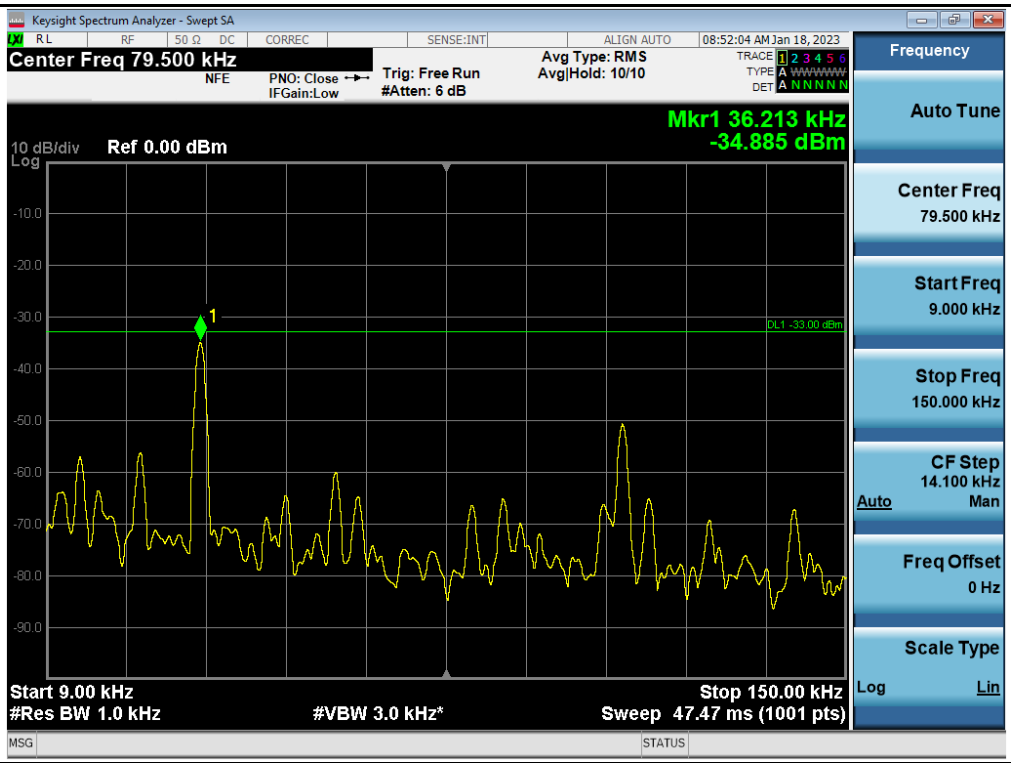


+3 dB above Out-of-band (single test signal) / PCS / Downlink / 5G NR 60 MHz / Upper

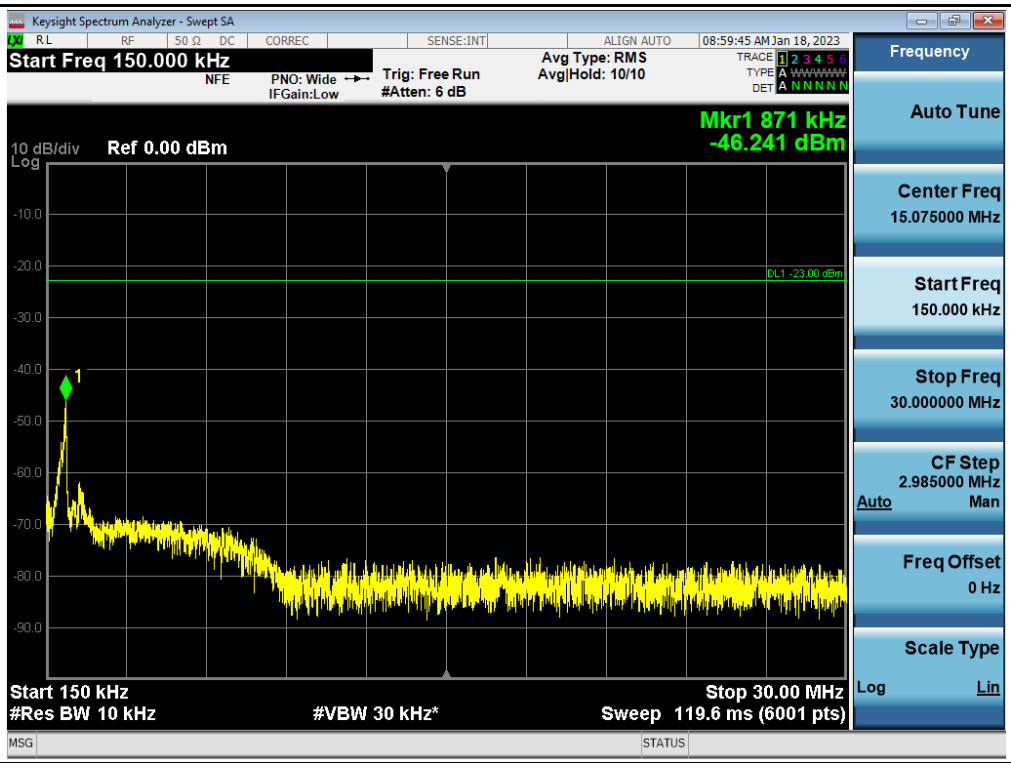


Plot data of Spurious Emissions

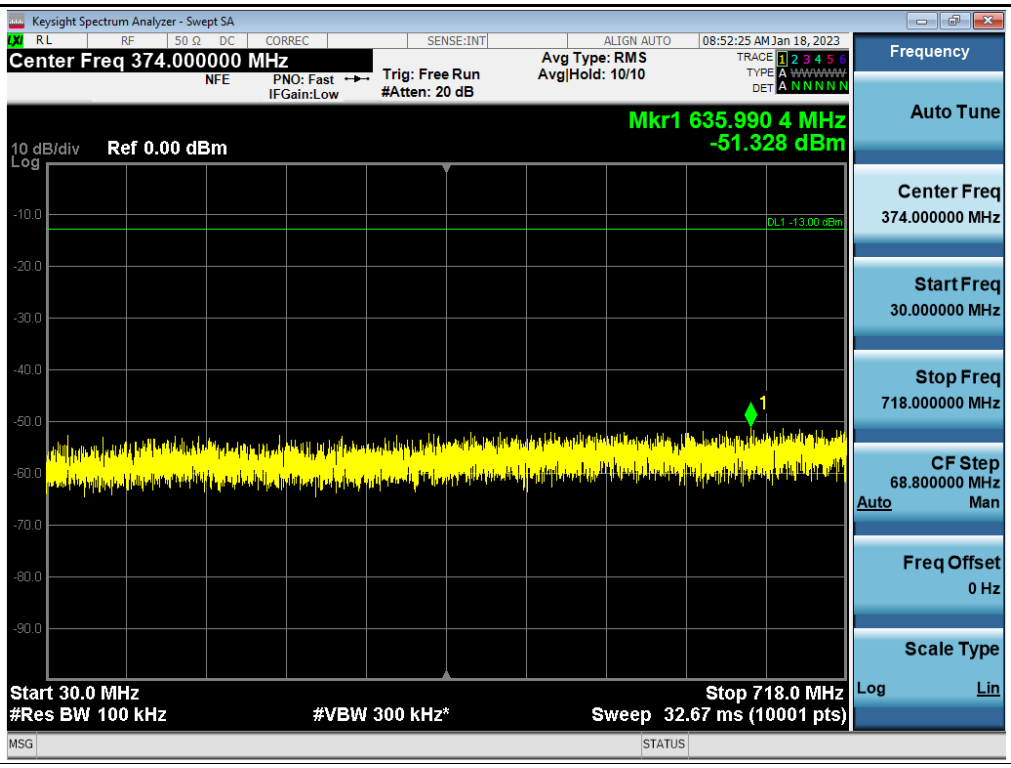
Spurious / Lower 700 MHz / Downlink / LTE 10 MHz / Middle / 9 kHz ~ 150 kHz



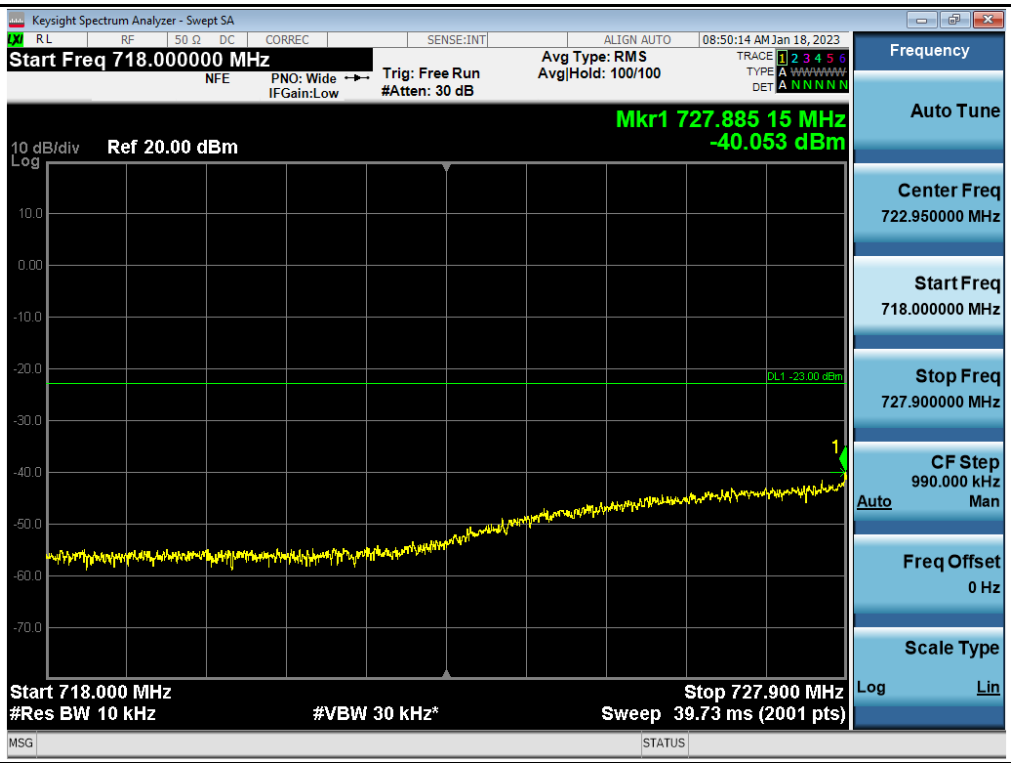
Spurious / Lower 700 MHz / Downlink / LTE 10 MHz / High / 150 kHz ~ 30 MHz



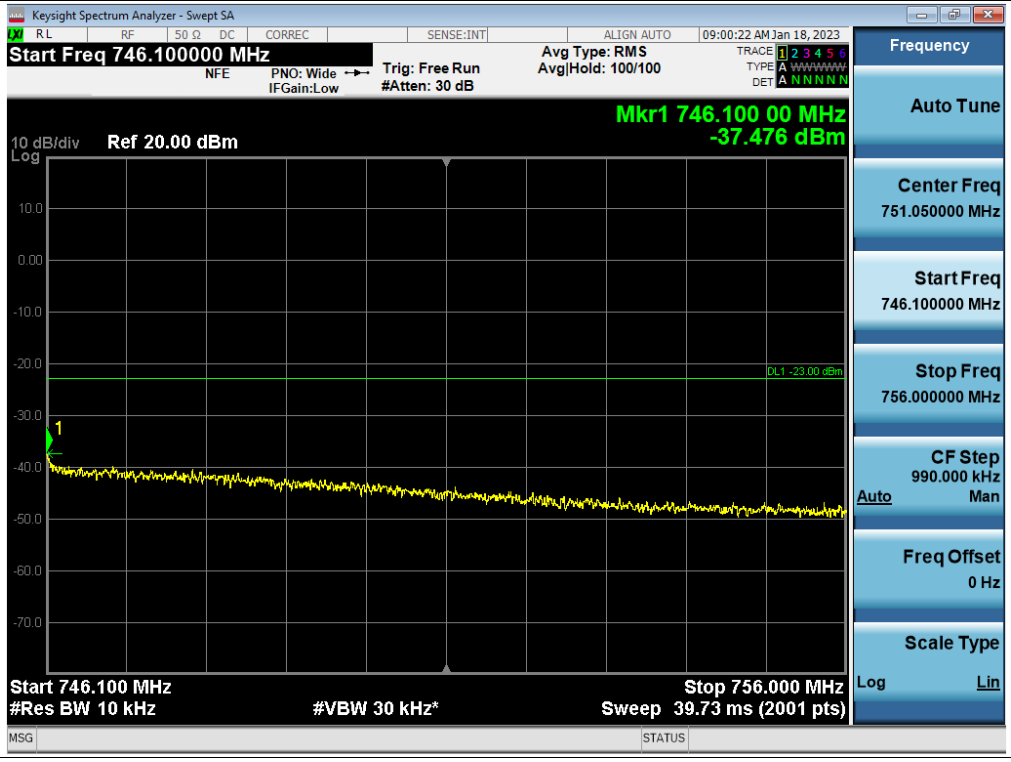
Spurious / Lower 700 MHz / Downlink / LTE 10 MHz / Middle / 30 MHz ~ Low Edge – 10 MHz



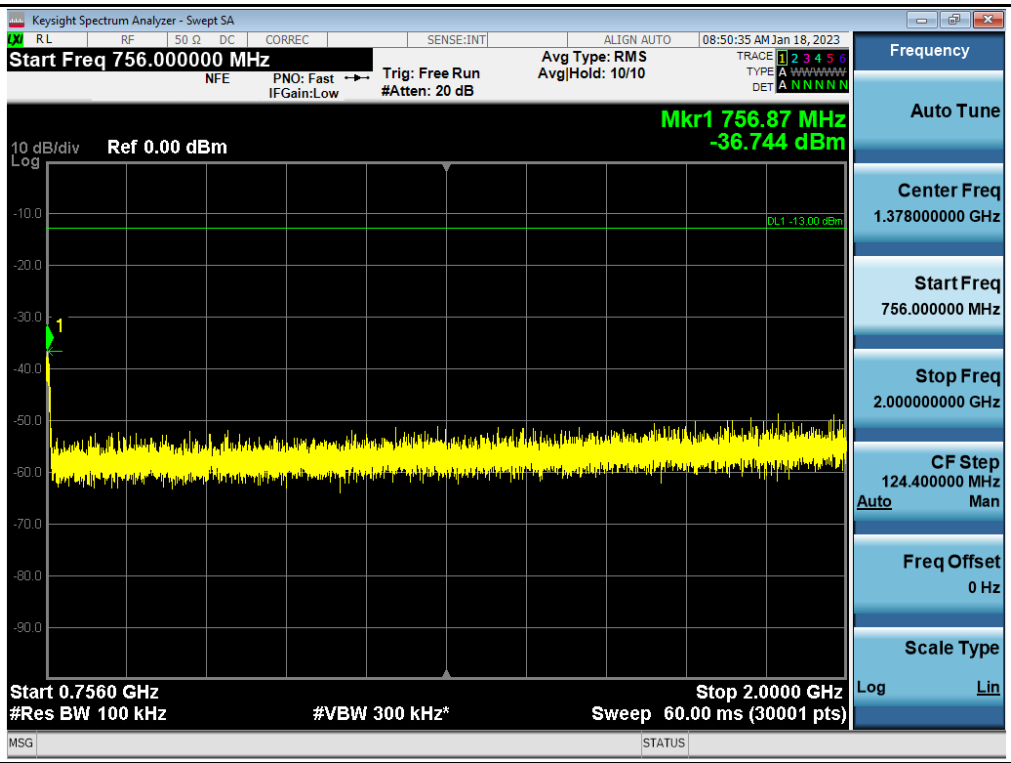
Spurious / Lower 700 MHz / Downlink / LTE 10 MHz / Low / Low Edge – 10 MHz ~ Low Edge



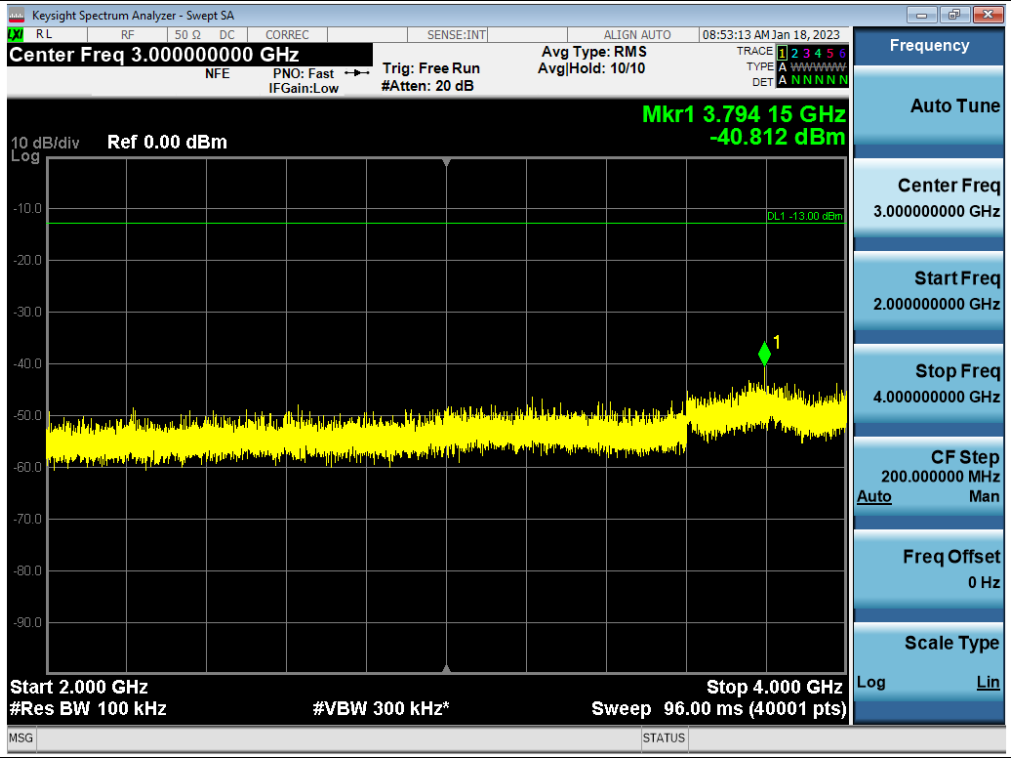
Spurious / Lower 700 MHz / Downlink / LTE 10 MHz / High / High Edge ~ High Edge + 10 MHz



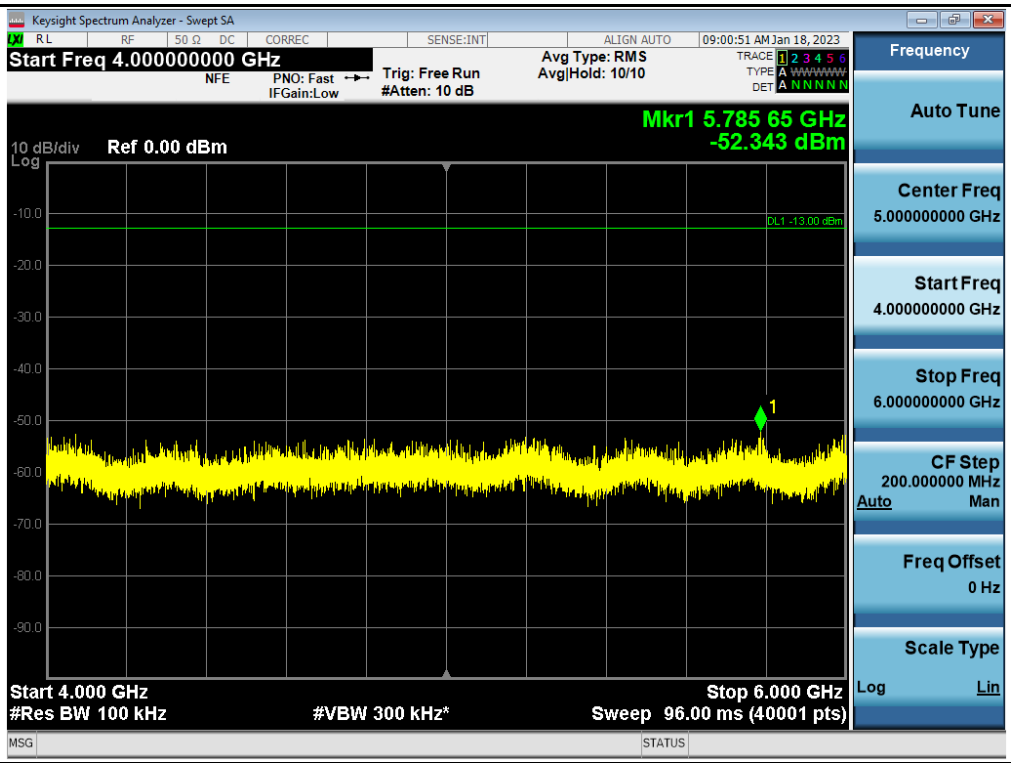
Spurious / Lower 700 MHz / Downlink / LTE 10 MHz / Low / High Edge + 10 MHz ~ 2 GHz



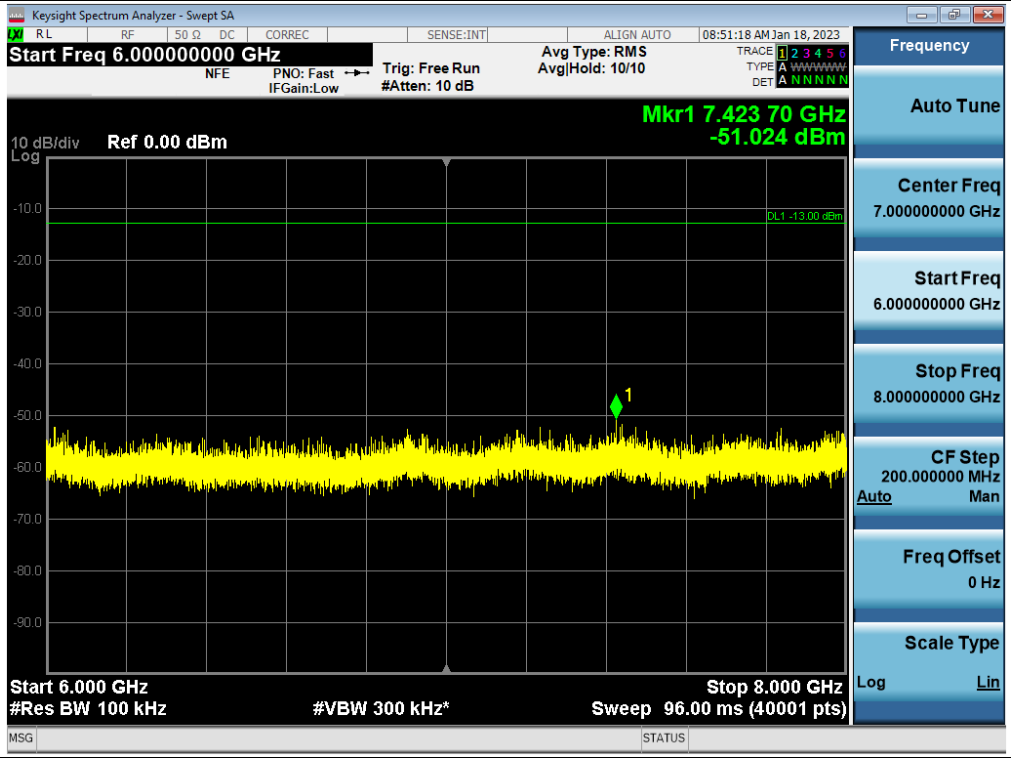
Spurious / Lower 700 MHz / Downlink / LTE 10 MHz / Middle / 2 GHz ~ 4 GHz



Spurious / Lower 700 MHz / Downlink / LTE 10 MHz / High / 4 GHz ~ 6 GHz

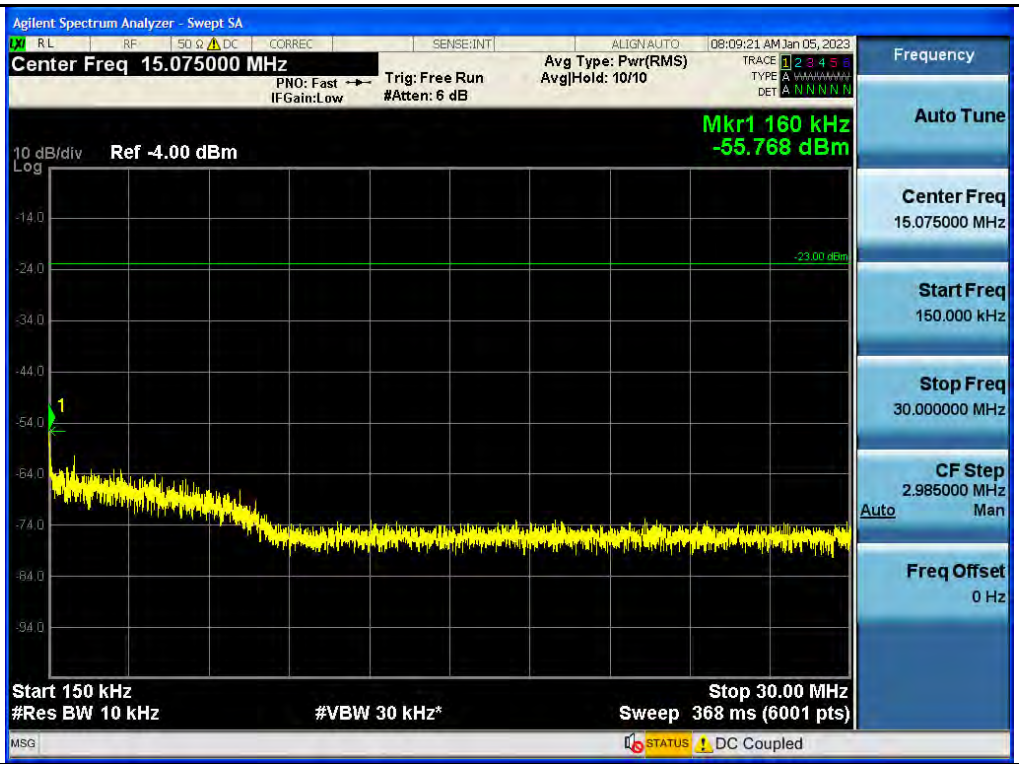


Spurious / Lower 700 MHz / Downlink / LTE 10 MHz / Low / 6 GHz ~ 8 GHz

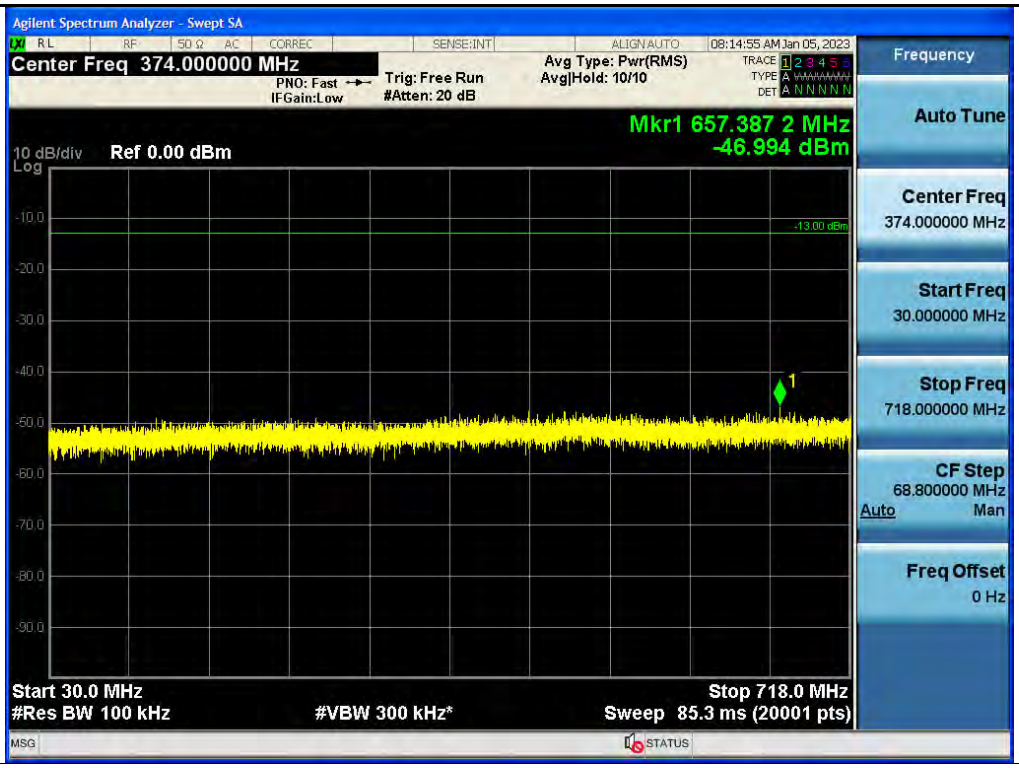


Spurious / Lower 700 MHz / Downlink / 5G NR 10 MHz / High / 9 kHz ~ 150 kHz

Spurious / Lower 700 MHz / Downlink / 5G NR 10 MHz / Middle / 150 kHz ~ 30 MHz



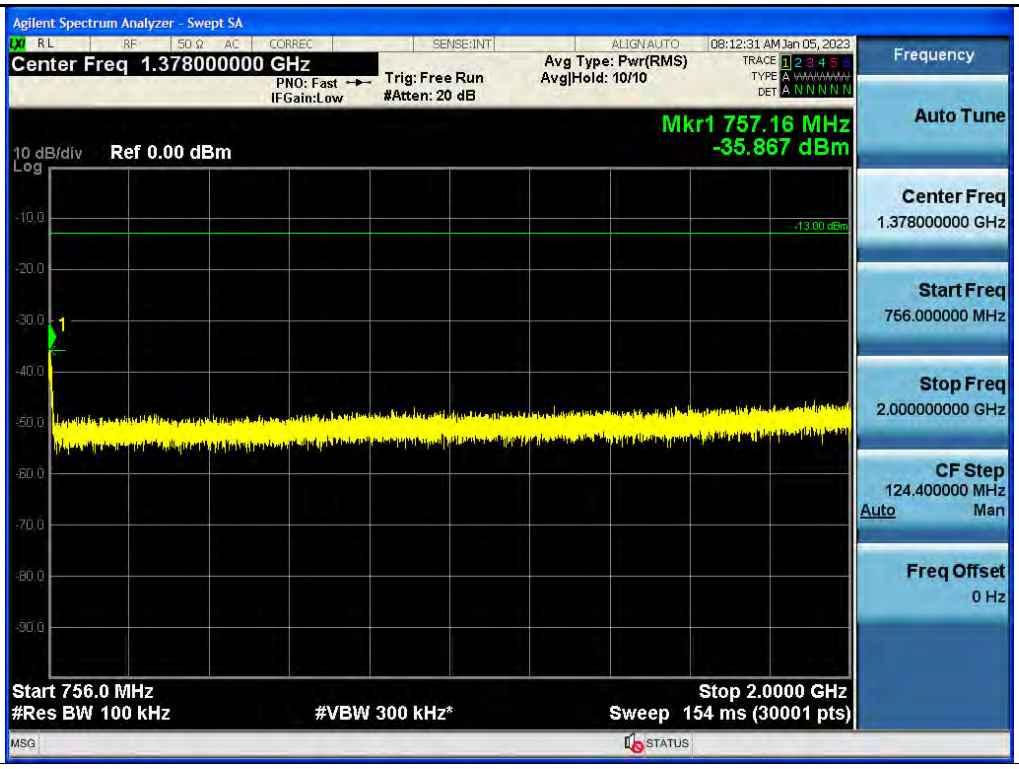
Spurious / Lower 700 MHz / Downlink / 5G NR 10 MHz / Low / 30 MHz ~ Low Edge – 10 MHz



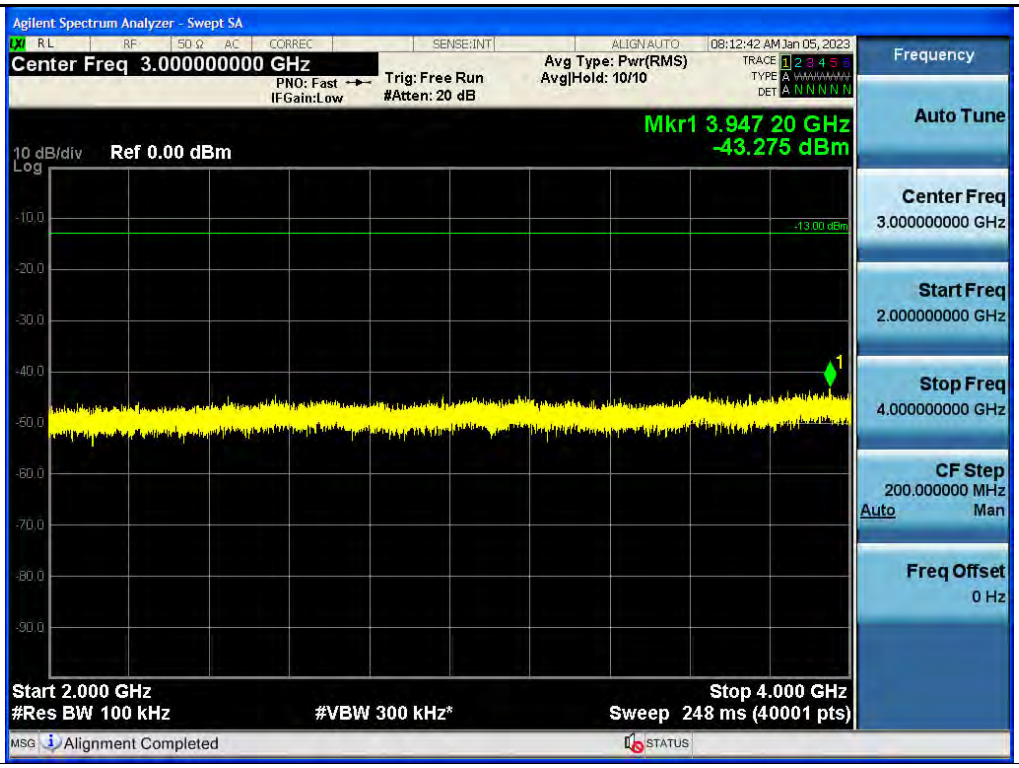
Spurious / Lower 700 MHz / Downlink / 5G NR 10 MHz / Low / Low Edge – 10 MHz ~ Low Edge

Spurious / Lower 700 MHz / Downlink / 5G NR 10 MHz / High / High Edge ~ High Edge + 10 MHz

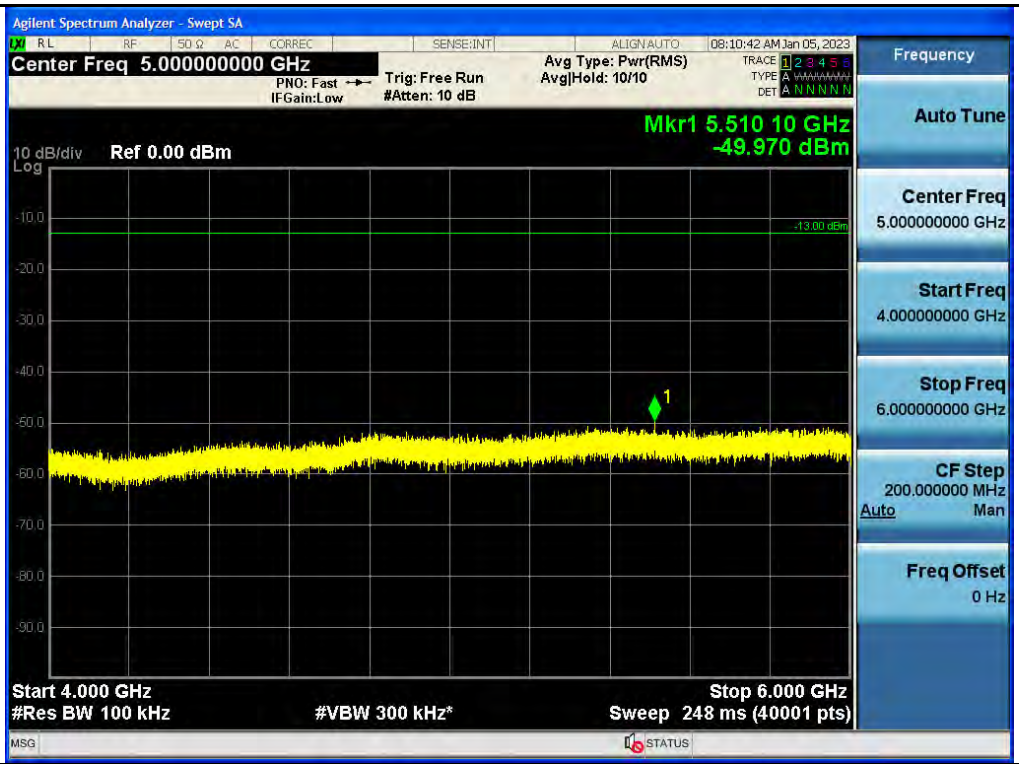
Spurious / Lower 700 MHz / Downlink / 5G NR 10 MHz / High / High Edge + 10 MHz ~ 2 GHz



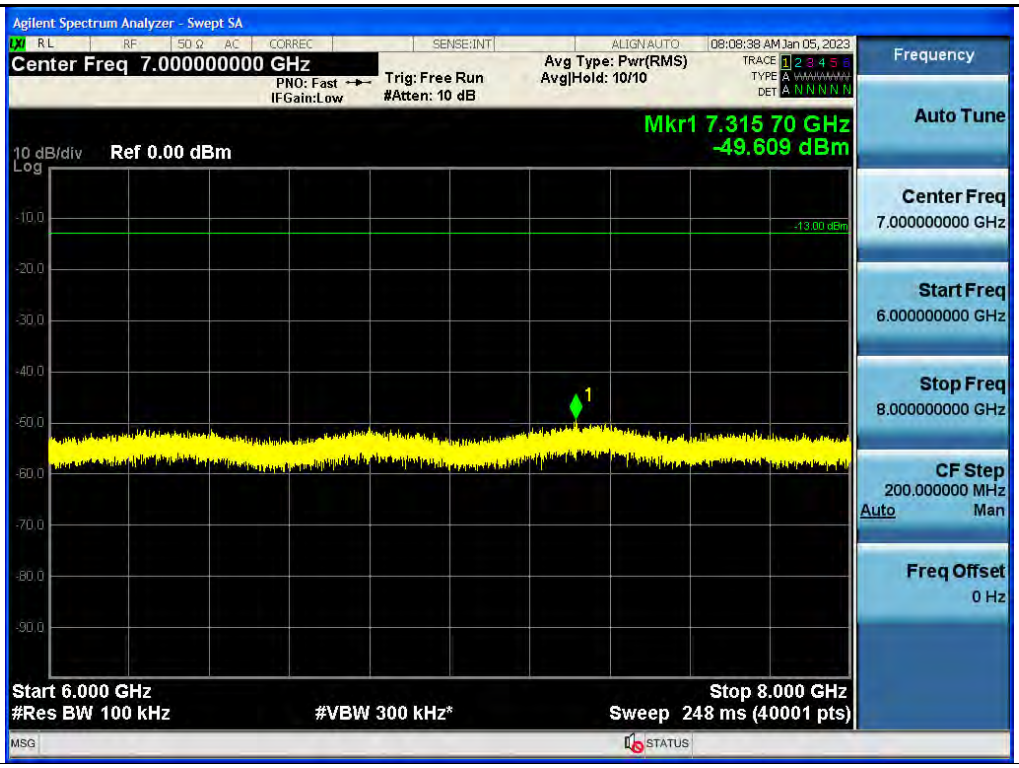
Spurious / Lower 700 MHz / Downlink / 5G NR 10 MHz / High / 2 GHz ~ 4 GHz



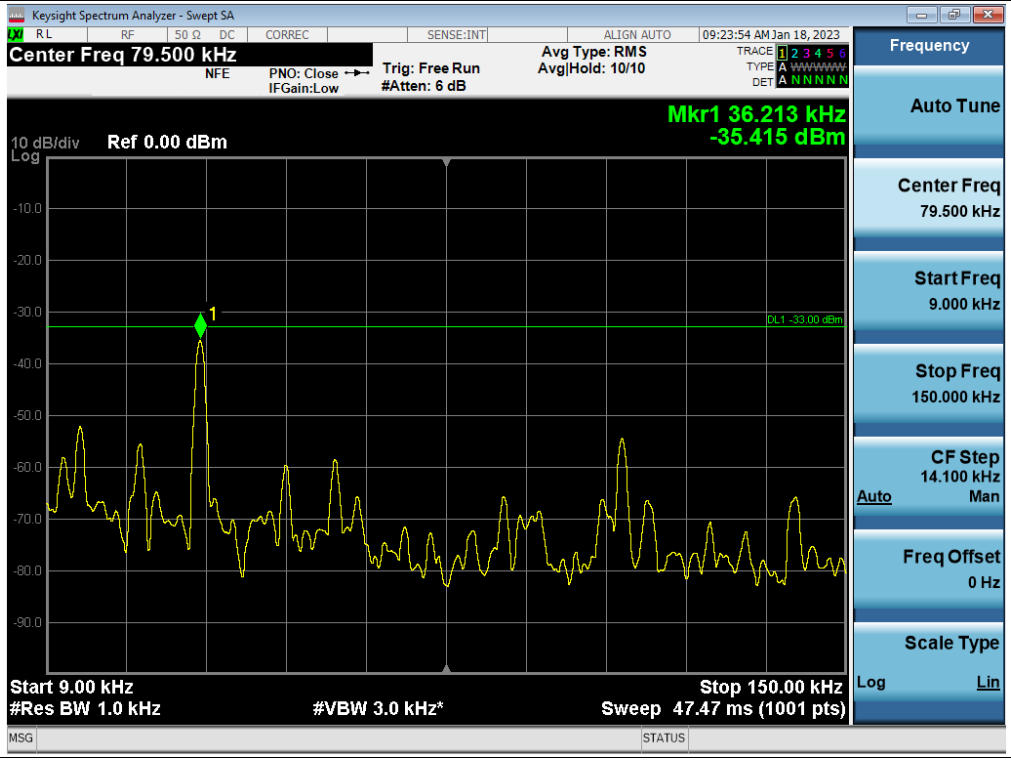
Spurious / Lower 700 MHz / Downlink / 5G NR 10 MHz / Middle / 4 GHz ~ 6 GHz



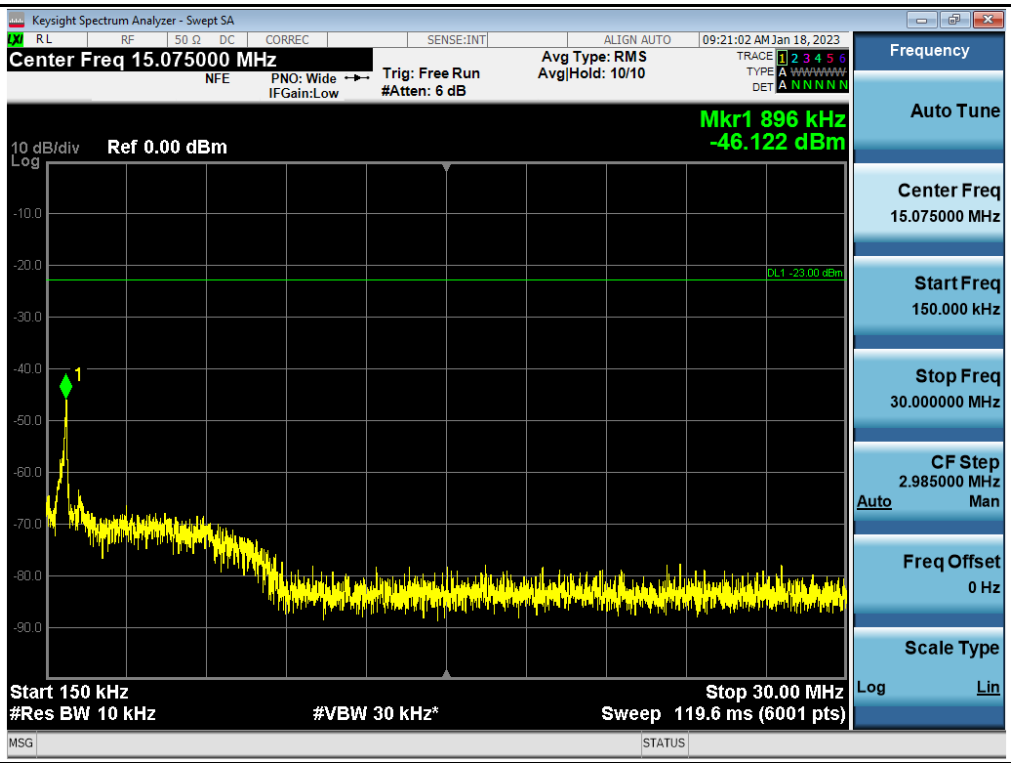
Spurious / Lower 700 MHz / Downlink / 5G NR 10 MHz / Low / 6 GHz ~ 8 GHz



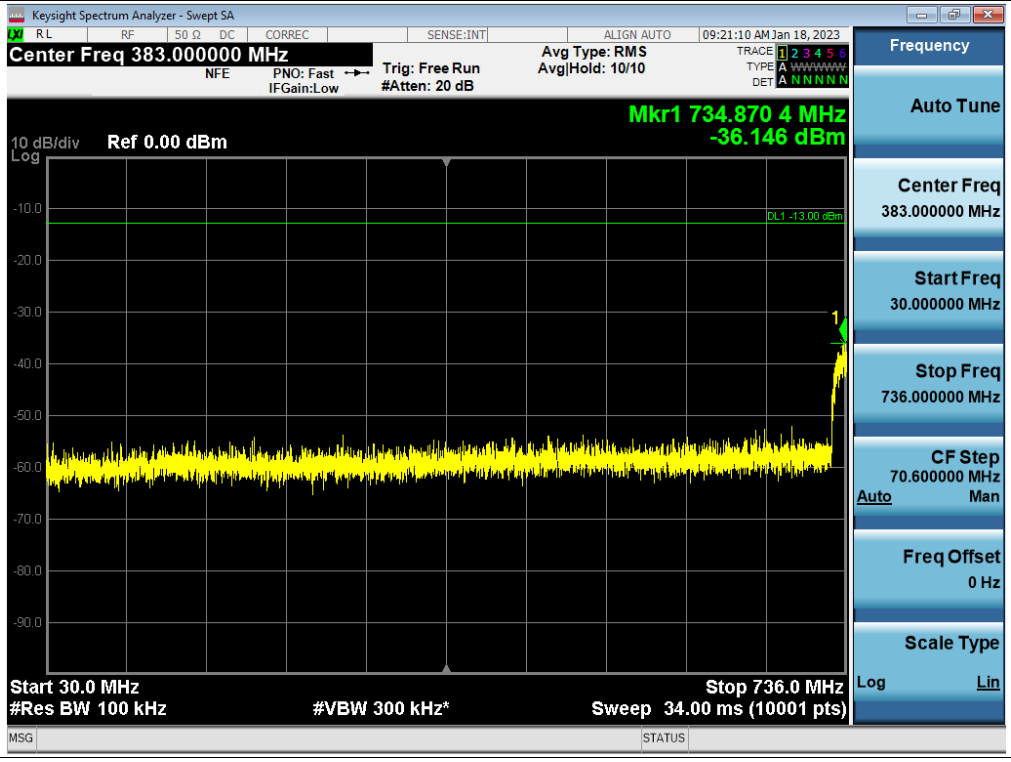
Spurious / Upper 700 MHz / Downlink / LTE 10 MHz / Middle / 9 kHz ~ 150 kHz



Spurious / Upper 700 MHz / Downlink / LTE 10 MHz / Low / 150 kHz ~ 30 MHz



Spurious / Upper 700 MHz / Downlink / LTE 10 MHz / Low / 30 MHz ~ Low Edge – 10 MHz



Spurious / Upper 700 MHz / Downlink / LTE 10 MHz / Low / Low Edge – 10 MHz ~ Low Edge