Testing and Certification

TEST REPORT

FCC Test for CS45-727-827-A0
Certification

APPLICANT
Westell, Inc

REPORT NO.
HCT-RF-2404-FC051

DATE OF ISSUE
April 26, 2024

Tested by
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TEST REPORT

REPORT NO.
HCT-RF-2404-FC051

DATE OF ISSUE
April 26, 2024

Applicant	**Westell, Inc** 750 North Commons Drive, Aurora, IL 60504 USA
Product Name Model Name	DAS CS45-727-827-A0
FCC ID	CH8727827
Output Power	Uplink: 24 dBm, Downlink: 27 dBm
Date of Test	February 20, 2024 ~ April 23, 2024
Location of Test	■ Permanent Testing Lab ☐ On Site Testing (Address: 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea)
Test Standard Used	Part 2, Part 90
Test Results	PASS

REVISION HISTORY

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

Revision No.	Date of Issue	Description
0	April 26, 2024	Initial Release

Notice

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

CONTENTS

1. GENERAL INFORMATION

1.1. APPLICANT INFORMATION

Company Name	Westell, Inc
Company Address	750 North Commons Drive, Aurora, IL 60504 USA

1.2. PRODUCT INFORMATION

<table>
<tr><td>EUT Type</td><td colspan="3">DAS</td></tr>
<tr><td>EUT Serial Number</td><td colspan="3">23RF12000001</td></tr>
<tr><td>Power Supply</td><td colspan="3">+12 VDC</td></tr>
<tr><td rowspan="5">Frequency Range</td><td>Band Name</td><td>Uplink (MHz)</td><td>Downlink (MHz)</td></tr>
<tr><td>PS Narrowband</td><td>799 ~ 805</td><td>769 ~ 775</td></tr>
<tr><td>NPSPAC</td><td>806 ~ 809</td><td>851 ~ 854</td></tr>
<tr><td>B/ILT; SMR</td><td>809 ~ 816</td><td>854 ~ 861</td></tr>
<tr><td>ESMR</td><td>817 ~ 824</td><td>862 ~ 869</td></tr>
<tr><td>Tx Output Power</td><td colspan="3">Uplink: 24 dBm, Downlink: 27 dBm</td></tr>
<tr><td>Antenna Peak Gain</td><td colspan="3">Uplink: 11 dBi, Downlink: 3 dBi</td></tr>
</table>

1.3. TEST INFORMATION

FCC Rule Parts	Part 2, Part 90
Measurement Standards	KDB 935210 D05 v01r04, ANSI C63.26-2015
Test Location	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea

2. FACILITIES AND ACCREDITATIONS

2.1. FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA.
The site is constructed in conformance with the requirements of ANSI C63.4 (Version: 2014) and CISPR Publication 22.
Detailed description of test facility was submitted to the Commission and accepted dated March 11, 2024 (CAB identifier: KR0032).

2.2. EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.
Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

3. TEST SPECIFICATIONS

3.1. STANDARDS

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 2, Part 90.

Description	Reference	Results
AGC threshold	KDB 935210 D05 v01r04 3.2 KDB 935210 D05 v01r04 4.2	Compliant
Out-of-band rejection	KDB 935210 D05 v01r04 3.3 KDB 935210 D05 v01r04 4.3	Compliant
Occupied Bandwidth	§ 2.1049 § 90.209, § 90.219(e)(4)(ii)	Compliant
Input-versus-output signal comparison	§ 90.210, § 90.219(e)(4)(iii)	Compliant
Input/output power and amplifier/booster gain	§ 2.1046, § 90.219(e)(1), § 90.635	Compliant
Noise figure	§ 90.219(e)(2)	Compliant
Out-of-band/out-of-block emissions and spurious emissions	§ 2.1051, § 90.219(e)(3), § 90.543(f), § 90.691	Compliant
Spurious emissions radiated	§ 2.1053	Compliant
Frequency Stability	§ 90.213	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
PS Narrowband	CW, P25 Phase 1 (12.5 kHz)
NPSPAC	CW, P25 Phase 1 (12.5 kHz)
B/ILT; SMR	CW, P25 Phase 1 (12.5 kHz)
ESMR	GSM
	CDMA
	LTE

- Below channels are not tested because it could consist of a combination.

Channelizing	Combinations	Bandwidth
12.5 kHz x n	n = 6 ~ 12	75 kHz ~ 150 kHz

- After spot-checking of multi-carriers, we have attached the test results of 12 carriers as the worst case in this test report.

- Simultaneous transmission band condition

700 MHz band	800 MHz band
PS Narrowband	NPSPAC or B/ILT; SMR, ESMR

- 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	0.135	800	0.432
650	0.271	850	0.259
700	0.177	900	0.443
750	0.236	950	0.423

: Output Path

Correction factor table			
Frequency (MHz)	Factor (dB)	Frequency (MHz)	Factor (dB)
2	30.386	2 000	31.188
10	29.376	2 100	31.232
30	29.132	2 200	30.928
50	29.237	2 300	30.798
100	29.098	2 400	30.828
200	29.715	2 500	30.732
300	29.579	2 600	30.587
400	29.722	2 700	30.482
500	30.105	2 800	30.955
600	29.901	2 900	30.977
700	30.010	3 000	31.453
800	30.061	4 000	31.355
900	30.354	5 000	31.660
1 000	30.426	6 000	31.686
1 100	30.506	7 000	32.010
1 200	30.529	8 000	32.341
1 300	30.535	9 000	31.642
1 400	30.489	10 000	31.388
1 500	30.539	-	-
1 600	30.717	-	-
1 700	30.898	-	-
1 800	31.059	-	-
1 900	31.088	-	-

3.3. MEASUREMENTUNCERTAINTY

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

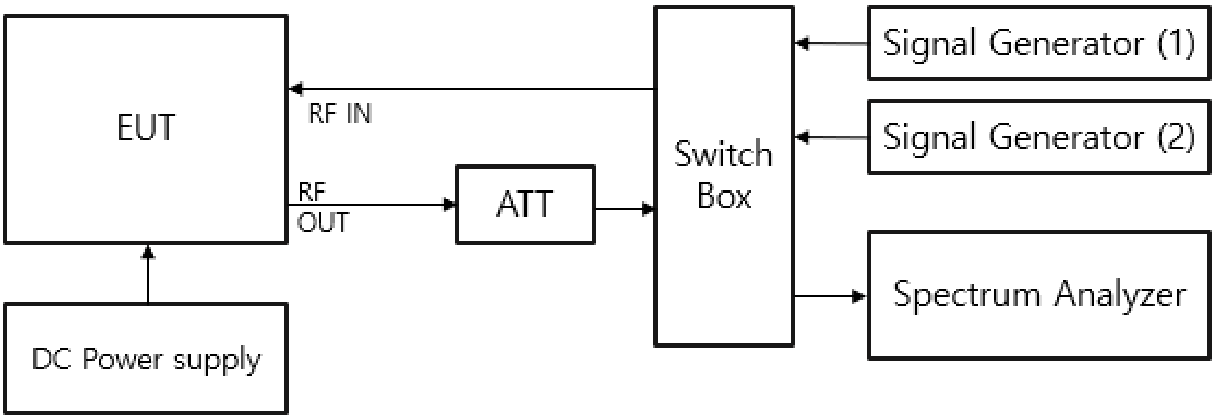
Coverage factor k = 2, Confidence levels of 95 %

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

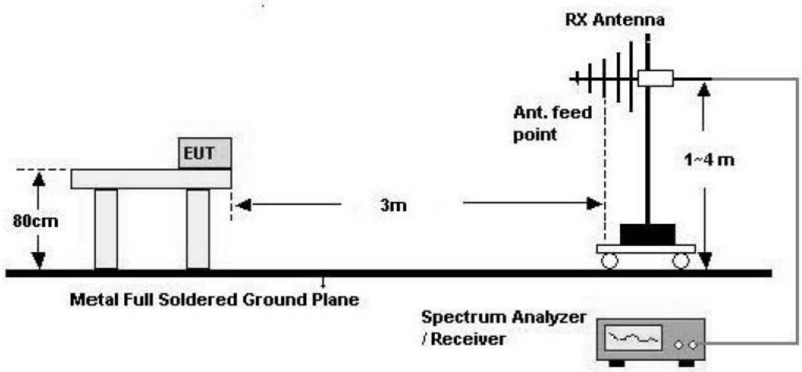
3.5. TEST DIAGRAMS

Conducted Test

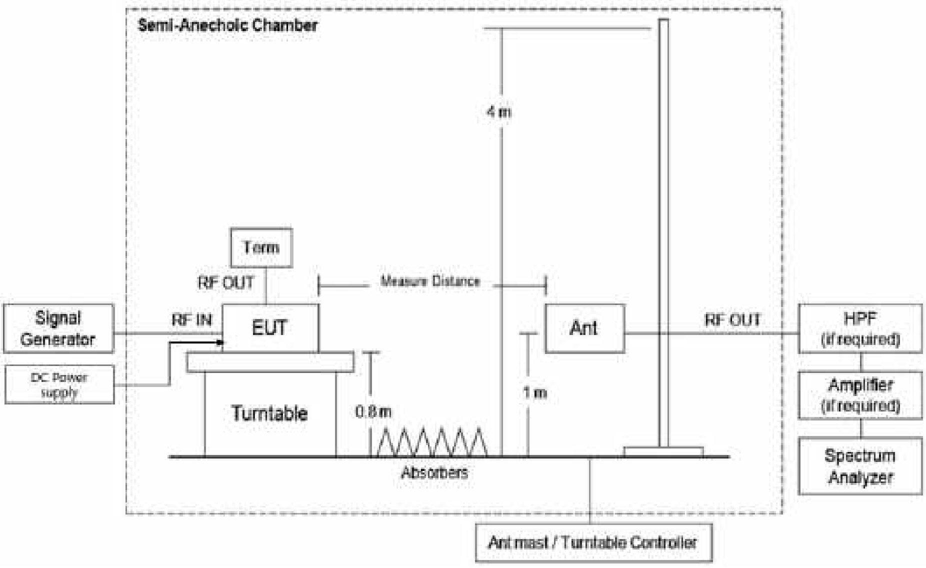


Radiated Test

30 MHz ~ 1 GHz

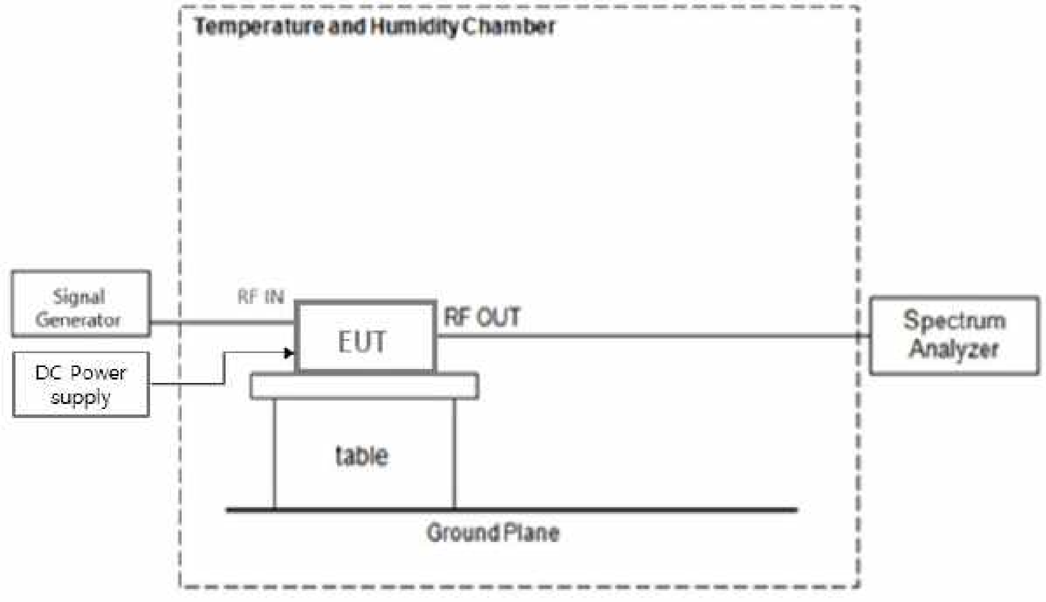


Above 1 GHz



Note: Measure distance for Above 1 GHz is 3 m.

Frequency Stability



4. TEST EQUIPMENTS

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
PXA Signal Analyzer	N9030A	Keysight	MY55410714	02/13/2025	Annual
MXG Vector Signal Generator	N5182A	Agilent	MY46240807	12/13/2024	Annual
MXG Vector Signal Generator	N5182A	Agilent	MY47070406	02/13/2025	Annual
30 dB Attenuator	WA93-30-33	Weinschel Associates	0184	11/24/2024	Annual
50Ω Termination	908A	H.P.	N/A	N/A	N/A
Switch	S46-SV11	KEITHLEY	1035126	N/A	N/A
Controller (Antenna Mast & Turn Table)	CO3000	Innco system	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 system	N/A	N/A	N/A
Turn Table	Turn Table	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	03/07/2026	Biennial
Trilog Super Broadband Antenna	VULB 9168	Schwarzbeck	9168-0895	08/16/2024	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	02296	05/18/2024	Biennial
Spectrum Analyzer	FSP40	Rohde & Schwarz	100843	10/30/2024	Annual
RF Switching System	FBSR-04C(LNA)	TNM system	S4L4	08/18/2024	Annual
High Pass Filter	WHKX10-900-1000-15000-40SS	Wainwright Instruments	16	08/01/2024	Annual

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.

Measurements were in accordance with the test methods section 4.2 of KDB 935210 D05 v01r04.

Testing at and above the AGC threshold will be required. The AGC threshold shall be determined by applying the procedure of 3.2, but with the signal generator configured to produce a test signal defined in Table 1, a CW input signal, or a digitally modulated signal, consistent with the discussion about signal types in 4.1.

Measurement were in accordance with the test methods in subclause 7.2.3.1 of ANSI C63.26.

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.
c) The signal generator must be set for CW operation.
d) While monitoring the output of the EUT, increase the input level until a 1 dB increase in the input signal no longer causes a 1 dB increase in the output signal.
e) This is the AGC threshold level of the EUT.

Test Results:

Test Band	Link	Signal	Center Frequency (MHz)	AGC Threshold Level (dBm)	Output Level (dBm)
PS Narrowband	Uplink	CW	802.00	-56	23.93
	Downlink		772.00	-63	26.73
NPSPAC	Uplink		807.50	-56	23.80
	Downlink		852.50	-63	26.99
B/ILT; SMR	Uplink		812.50	-56	23.81
	Downlink		857.50	-63	26.67
ESMR	Uplink	GSM	820.50	-56	23.79
		CDMA	820.50	-56	23.93
		LTE 5 MHz	820.50	-56	23.83
	Downlink	GSM	865.50	-63	26.78
		CDMA	865.50	-63	26.91
		LTE 5 MHz	865.50	-63	27.01

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.

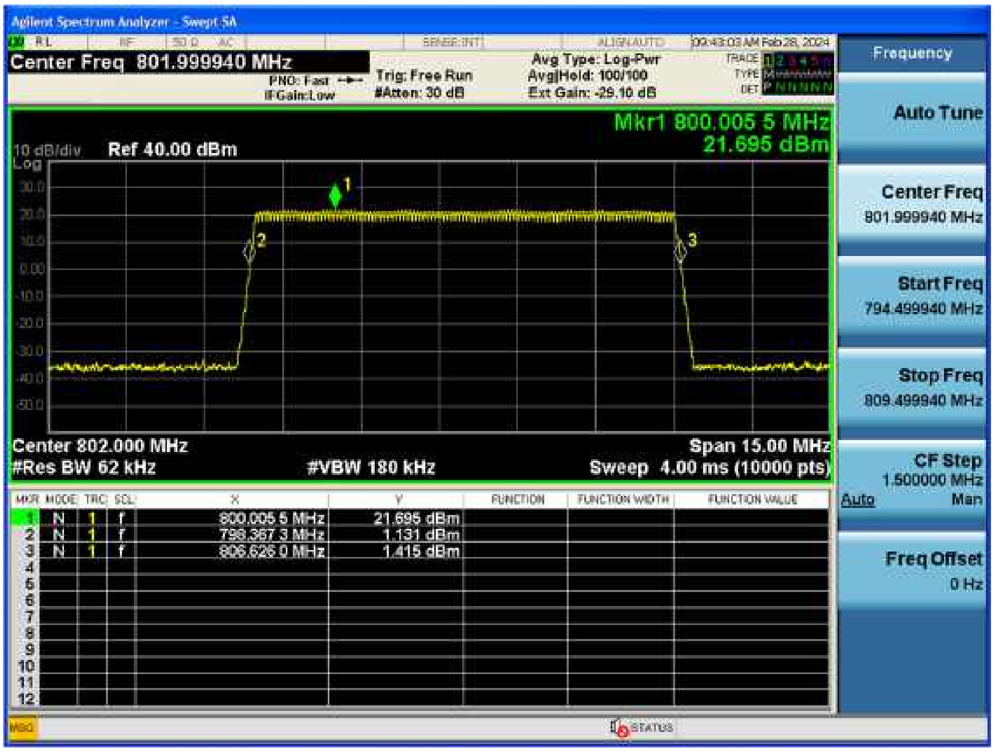
Measurements were in accordance with the test methods section 4.3 of KDB 935210 D05 v01r04.

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

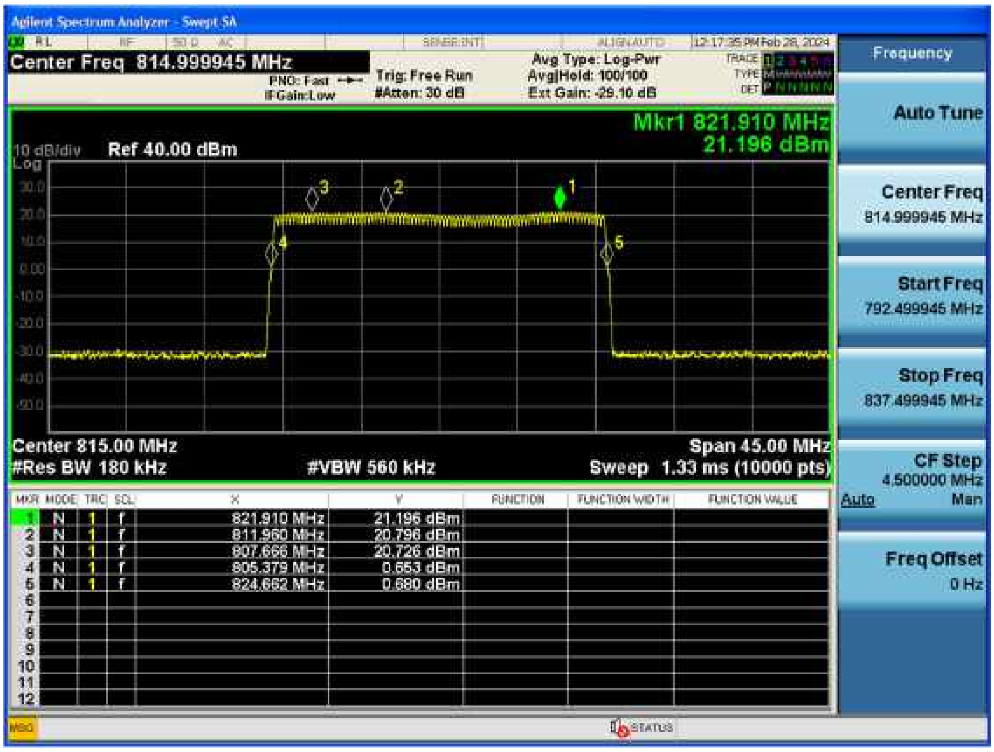
a) Connect a signal generator to the input of the EUT.
b) Configure a swept CW signal with the following parameters:
   1) Frequency range = ± 250 % of the manufacturer's specified pass band.
   2) The CW amplitude shall be 3 dB below the AGC threshold (see 4.2), and shall not activate the AGC threshold throughout the test.
   3) Dwell time = approximately 10 ms.
   4) Frequency step = 50 kHz.
c) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
d) Set the RBW of the spectrum analyzer to between 1 % and 5 % of the manufacturer's rated passband, and VBW = 3 × RBW.
e) Set the detector to Peak and the trace to Max-Hold.
f) After the trace is completely filled, place a marker at the peak amplitude, which is designated as f_0, and with two additional markers (use the marker-delta method) at the 20 dB bandwidth (i.e., at the points where the level has fallen by 20 dB).
g) Capture the frequency response plot for inclusion in the test report.

Test Results:

PS Narrowband / Uplink

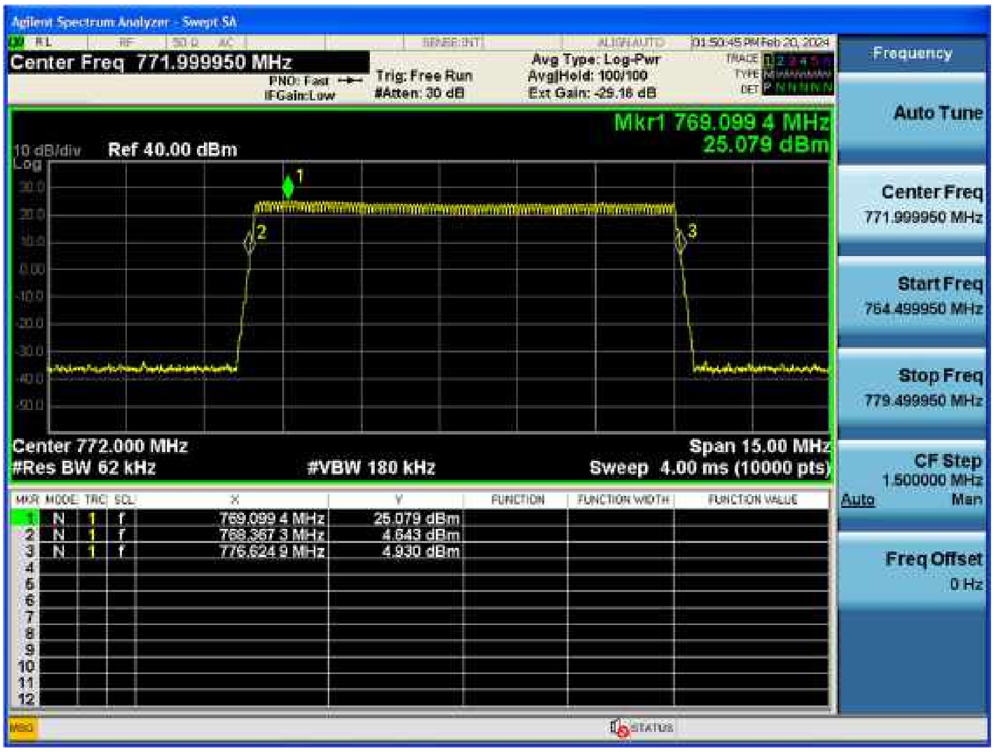


800 MHz (806 ~ 824) / Uplink

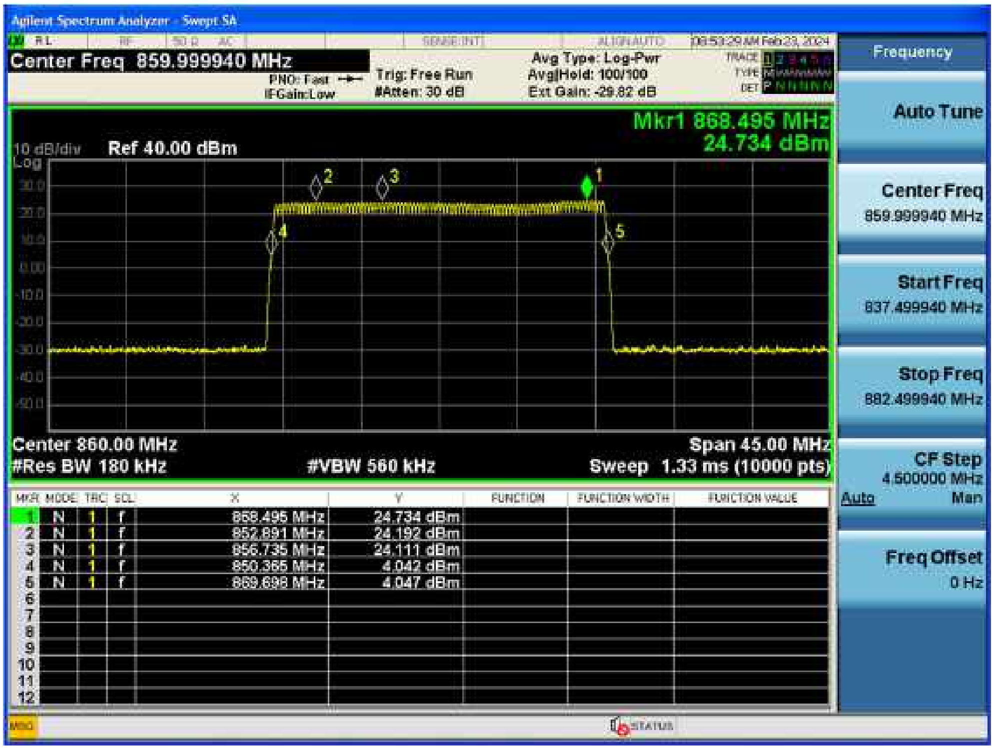


Note: The EUT amplifies the frequency range of 806 MHz ~ 824 MHz at once.

PS Narrowband / Downlink



800 MHz (851 ~ 869) / Downlink



Note: The EUT amplifies the frequency range of 851 MHz ~ 869 MHz at once.

5.3. OCCUPIED BANDWIDTH

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.

§ 90.209 Bandwidth limitations.

Table 1 to § 90.209(b)(5) - Standard Channel Spacing/Bandwidth

Frequency band (MHz)	Channel spacing (kHz)	Authorized bandwidth (kHz)
Below 25		
25-50	20	20
72-76	20	20
150-174	7.5	[1]20/11.25/6
216-220	6.25	20/11.25/6
220-222	5	4
406-512	6.25	20/11.25/6
806-809/851-854	12.5	20
809-817/854-862	12.5	20/11.25
817-824/862-869	25	20
896-901/935-940	12.5	13.6
902-928		
929-930	25	20
1427-1432	12.5	12.5
2450-2483.5		
Above 2500		

§ 90.219 Use of signal boosters.

(e) Device Specifications. In addition to the general rules for equipment certification in § 90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.

(4) A signal booster must be designed such that all signals that it retransmits meet the following requirements:

(ii) There is no change in the occupied bandwidth of the retransmitted signals.

Test Procedures:

Measurements were in accordance with the test methods section 5.4.4 of ANSI C63.26-2015.

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (typically a span of 1.5 × OBW is sufficient).

b) The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.
NOTE—Step a), step b), and step c) may require iteration to adjust within the specified tolerances.

d) Set the detection mode to peak, and the trace mode to max-hold.

e) Omit

f) The OBW shall be reported and plot(s) of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labeled. Tabular data can be reported in addition to the plot(s).

Test Results:

Tabular data of Input Occupied Bandwidth

Test Band	Link	Signal	No. of Carriers	Total BW (kHz)	Center Frequency (MHz)	99 % OBW (kHz)	26 dB OBW (kHz)
PS Narrowband	Uplink	P25 Phase 1	1	12.5	802.00	8.3258	10.954
			12	150	802.00	142.20	149.132
	Downlink		1	12.5	772.00	8.2561	10.836
			12	150	772.00	142.18	148.552
NPSPAC	Uplink		1	12.5	807.50	8.1288	10.847
			12	150	807.50	142.21	148.764
	Downlink		1	12.5	852.50	8.1900	10.942
			12	150	852.50	142.20	148.900
B/ILT; SMR	Uplink		1	12.5	812.50	8.1963	10.632
			12	150	812.50	142.13	148.703
	Downlink		1	12.5	857.50	8.2348	11.249
			12	150	857.50	142.17	148.700
ESMR	Uplink	GSM	-	-	820.50	243.75	310.999
		CDMA	-	-	820.50	1 257.9	1 397.765
		LTE 5 MHz	-	-	820.50	4 516.1	4 995.505
	Downlink	GSM	-	-	865.50	244.88	312.940
		CDMA	-	-	865.50	1 267.9	1 398.041
		LTE 5 MHz	-	-	865.50	4 576.3	5 070.410

Tabular data of Output Occupied Bandwidth

Test Band	Link	Signal	No. of Carriers	Total BW (kHz)	Center Frequency (MHz)	99 % OBW (kHz)	26 dB OBW (kHz)
PS Narrowband	Uplink	P25 Phase 1	1	12.5	802.00	8.3472	11.674
			12	150	802.00	142.13	148.703
	Downlink		1	12.5	772.00	8.3209	11.249
			12	150	772.00	142.17	148.597
NPSPAC	Uplink		1	12.5	807.50	8.1968	10.941
			12	150	807.50	142.14	148.692
	Downlink		1	12.5	852.50	8.3559	11.666
			12	150	852.50	142.16	148.145
B/ILT; SMR	Uplink		1	12.5	812.50	8.2066	11.262
			12	150	812.50	142.03	148.818
	Downlink		1	12.5	857.50	8.1986	11.199
			12	150	857.50	142.23	148.828
ESMR	Uplink	GSM	-	-	820.50	242.58	312.806
		CDMA	-	-	820.50	1 265.2	1 399.605
		LTE 5 MHz	-	-	820.50	4 500.9	4 993.749
	Downlink	GSM	-	-	865.50	245.57	311.870
		CDMA	-	-	865.50	1 263.9	1 397.401
		LTE 5 MHz	-	-	865.50	4 516.3	5 052.687

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

Test Band	Link	Signal	No. of Carriers	Total BW (kHz)	Center Frequency (MHz)	99 % OBW (kHz)	26 dB OBW (kHz)
PS Narrowband	Uplink	P25 Phase 1	1	12.5	802.00	8.1884	11.442
			12	150	802.00	142.10	148.606
	Downlink		1	12.5	772.00	8.2558	11.341
			12	150	772.00	142.20	148.933
NPSPAC	Uplink		1	12.5	807.50	8.2930	11.899
			12	150	807.50	142.10	148.674
	Downlink		1	12.5	852.50	8.2638	11.352
			12	150	852.50	142.11	148.851
B/ILT; SMR	Uplink		1	12.5	812.50	8.1580	11.009
			12	150	812.50	142.08	148.568
	Downlink		1	12.5	857.50	8.1517	11.373
			12	150	857.50	142.19	148.851
ESMR	Uplink	GSM	-	-	820.50	244.85	316.304
		CDMA	-	-	820.50	1 258.6	1 395.210
		LTE 5 MHz	-	-	820.50	4 509.0	5 026.184
	Downlink	GSM	-	-	865.50	242.00	314.206
		CDMA	-	-	865.50	1 262.9	1 398.562
		LTE 5 MHz	-	-	865.50	4 538.4	5 038.020

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

Test Band	Link	Signal	No. of Carriers	Total BW (kHz)	Center Frequency (MHz)	99 % OBW (kHz)	26 dB OBW (kHz)
PS Narrowband	Uplink	P25 Phase 1	1	12.5	802.00	8.3177	11.249
			12	150	802.00	142.17	148.626
	Downlink		1	12.5	772.00	8.1161	10.455
			12	150	772.00	142.12	148.553
NPSPAC	Uplink		1	12.5	807.50	8.3991	11.288
			12	150	807.50	142.08	148.695
	Downlink		1	12.5	852.50	8.3615	11.401
			12	150	852.50	142.23	149.188
B/ILT; SMR	Uplink		1	12.5	812.50	8.3150	11.030
			12	150	812.50	142.08	148.559
	Downlink		1	12.5	857.50	8.2700	11.648
			12	150	857.50	142.15	148.754
ESMR	Uplink	GSM	-	-	820.50	243.28	308.230
		CDMA	-	-	820.50	1 264.1	1 394.797
		LTE 5 MHz	-	-	820.50	4 511.0	5 026.489
	Downlink	GSM	-	-	865.50	245.37	307.777
		CDMA	-	-	865.50	1 260.5	1 391.034
		LTE 5 MHz	-	-	865.50	4 513.8	5 034.586

Measured Occupied Bandwidth Comparison

Test Band	Link	Signal	No. of Carriers	Total BW (kHz)	Variant of Input and Output Occupied Bandwidth (%)	Variant of 3 dB above the AGC threshold Input and Output Occupied Bandwidth (%)
PS Narrowband	Uplink	P25 Phase 1	1	12.5	6.573	-1.687
			12	150	-0.288	0.013
	Downlink		1	12.5	3.811	-7.812
			12	150	0.030	-0.255
NPSPAC	Uplink		1	12.5	0.867	-5.135
			12	150	-0.048	0.014
	Downlink		1	12.5	6.617	0.432
			12	150	-0.507	0.226
B/ILT; SMR	Uplink		1	12.5	5.926	0.191
			12	150	0.077	-0.006
	Downlink		1	12.5	-0.444	2.418
			12	150	0.086	-0.065
ESMR	Uplink	GSM	-	-	0.581	-2.553
		CDMA	-	-	0.132	-0.030
		LTE 5 MHz	-	-	-0.035	0.006
	Downlink	GSM	-	-	-0.342	-2.046
		CDMA	-	-	-0.046	-0.538
		LTE 5 MHz	-	-	-0.350	-0.068

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

Plot data of Occupied Bandwidth

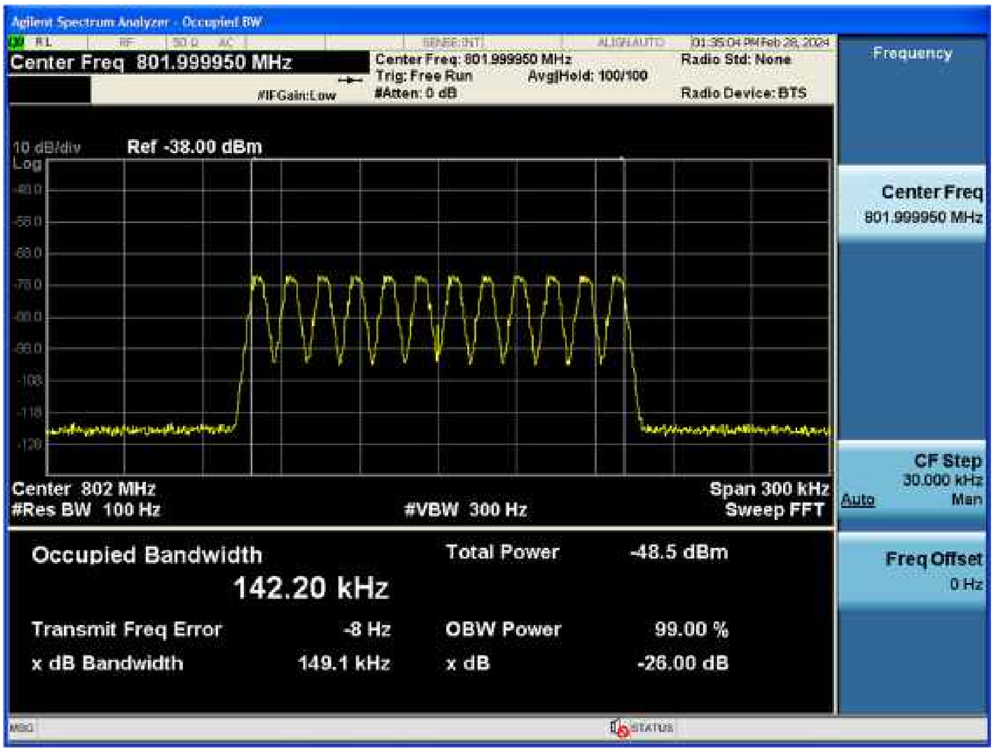
Input / PS Narrowband / Uplink / P25 Phase 1 / 12.5 kHz

Output / PS Narrowband / Uplink / P25 Phase 1 / 12.5 kHz

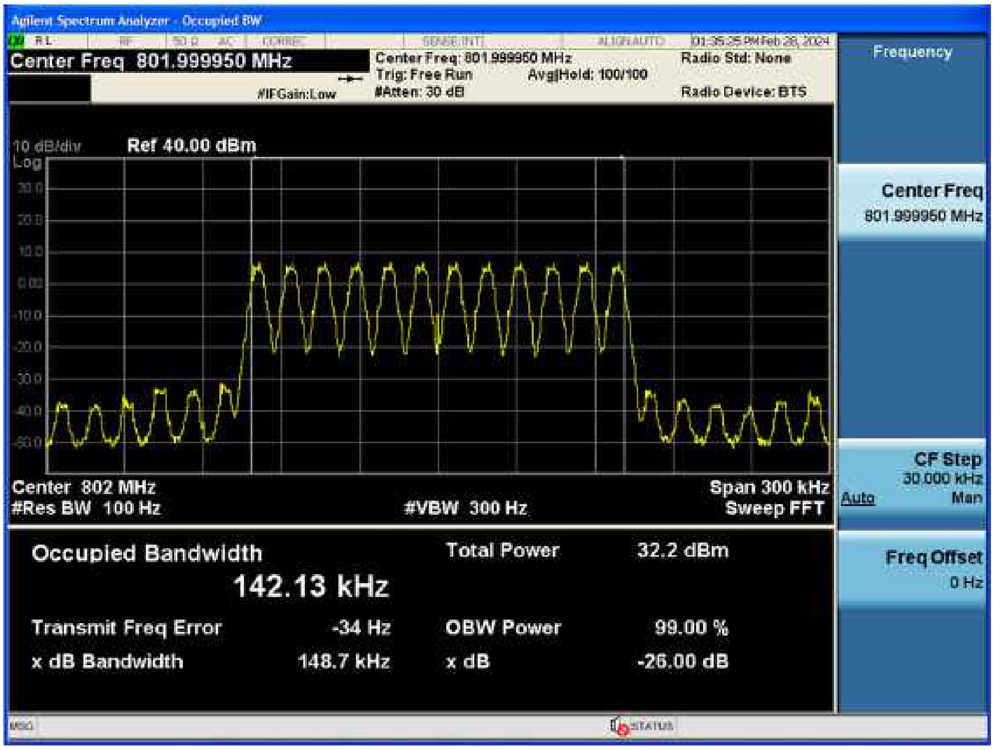
3 dB above the AGC threshold Input / PS Narrowband / Uplink / P25 Phase 1 / 12.5 kHz

3 dB above the AGC threshold output / PS Narrowband / Uplink / P25 Phase 1 / 12.5 kHz

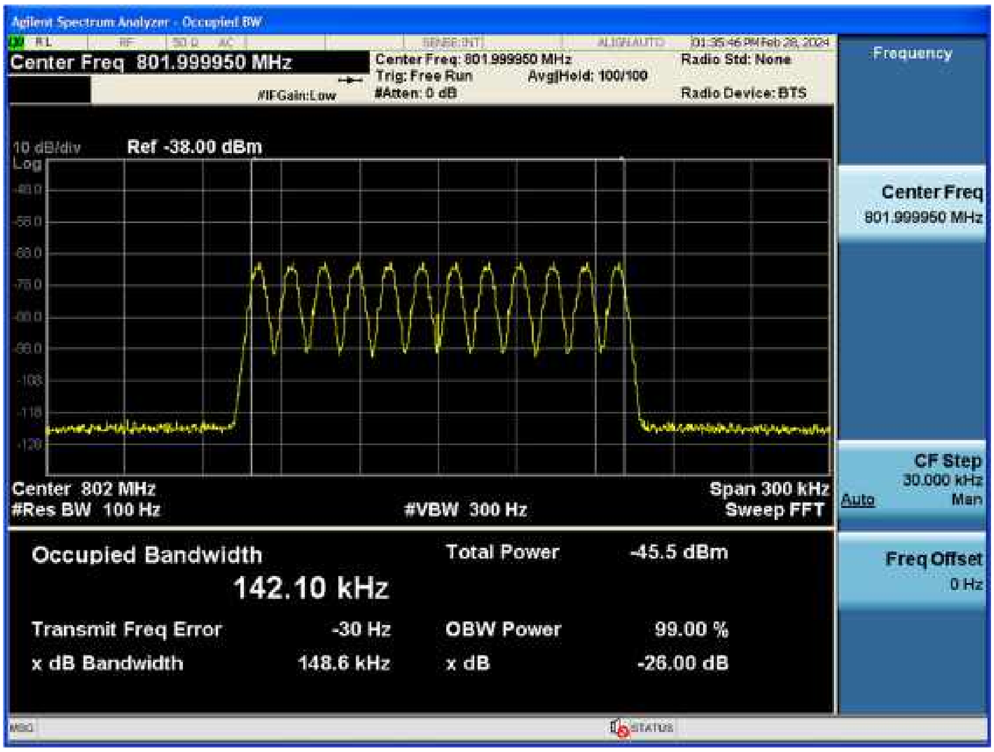
Input / PS Narrowband / Uplink / P25 Phase 1 / 150 kHz



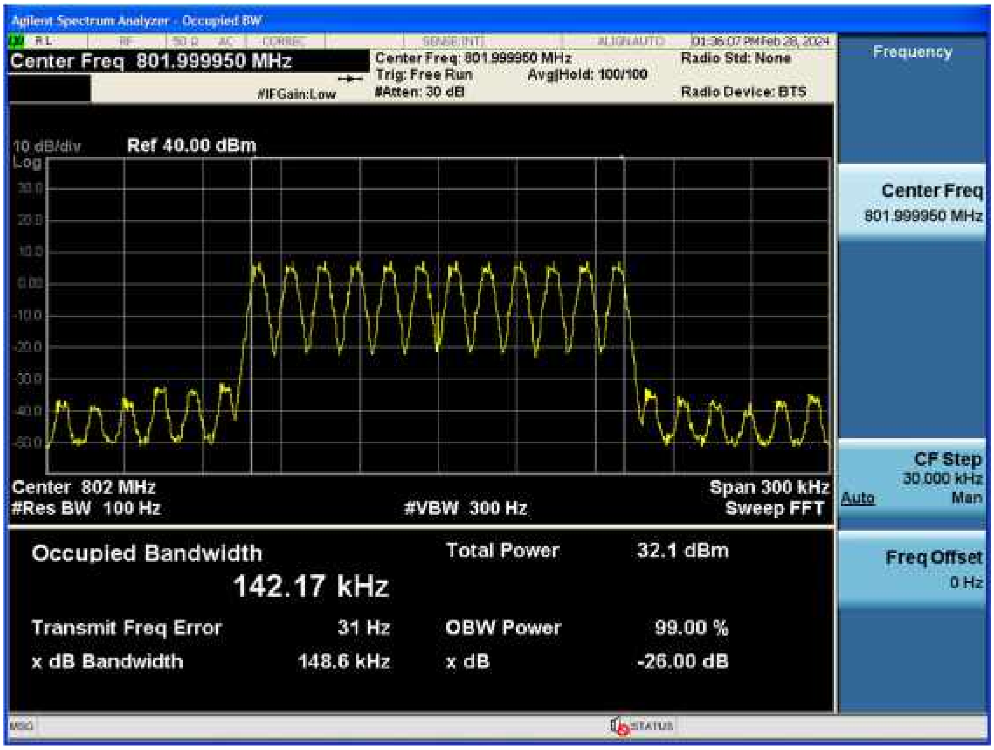
Output / PS Narrowband / Uplink / P25 Phase 1 / 150 kHz



3 dB above the AGC threshold Input / PS Narrowband / Uplink / P25 Phase 1 / 150 kHz



3 dB above the AGC threshold output / PS Narrowband / Uplink / P25 Phase 1 / 150 kHz



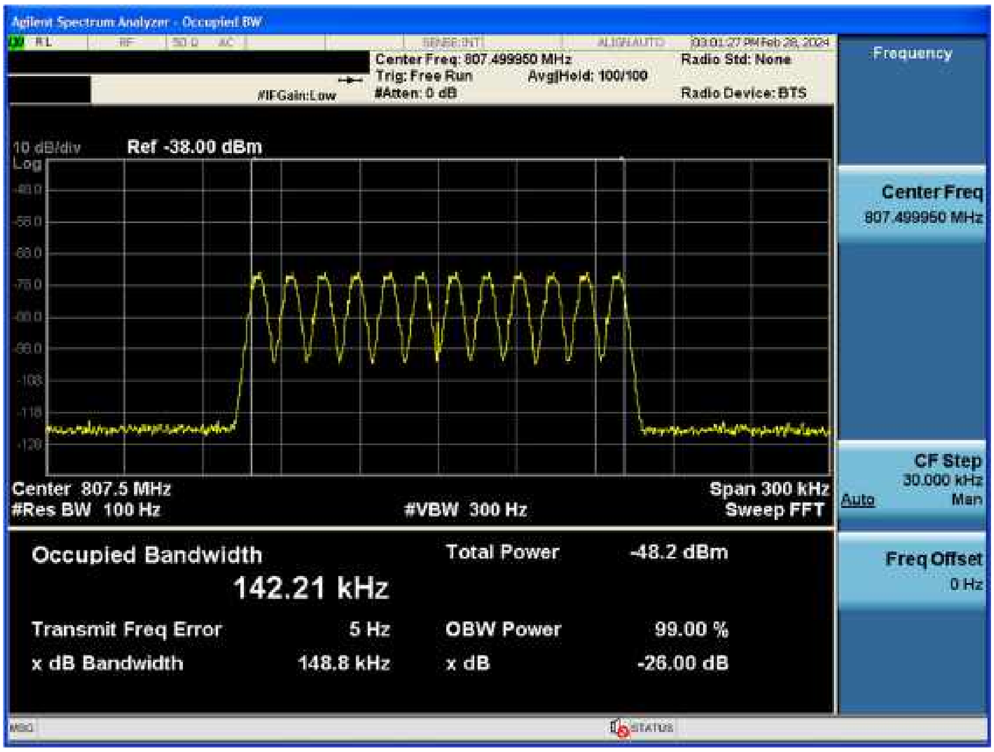
Input / NPSPAC / Uplink / P25 Phase 1 / 12.5 kHz

Output / NPSPAC / Uplink / P25 Phase 1 / 12.5 kHz

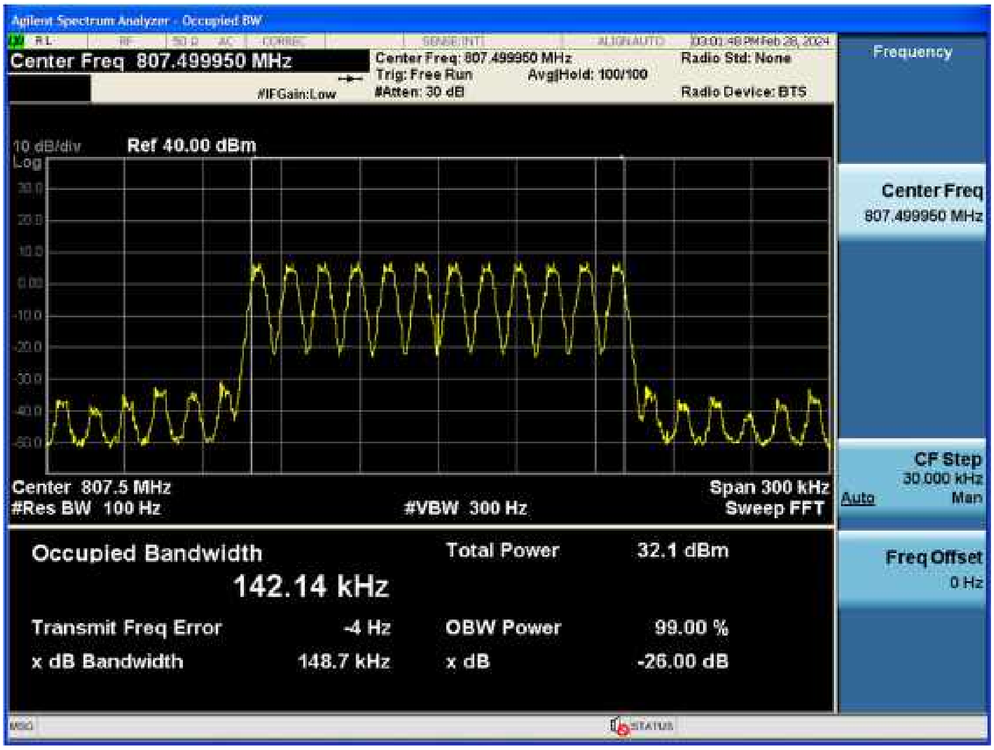
3 dB above the AGC threshold Input / NPSPAC / Uplink / P25 Phase 1 / 12.5 kHz

3 dB above the AGC threshold output / NPSPAC / Uplink / P25 Phase 1 / 12.5 kHz

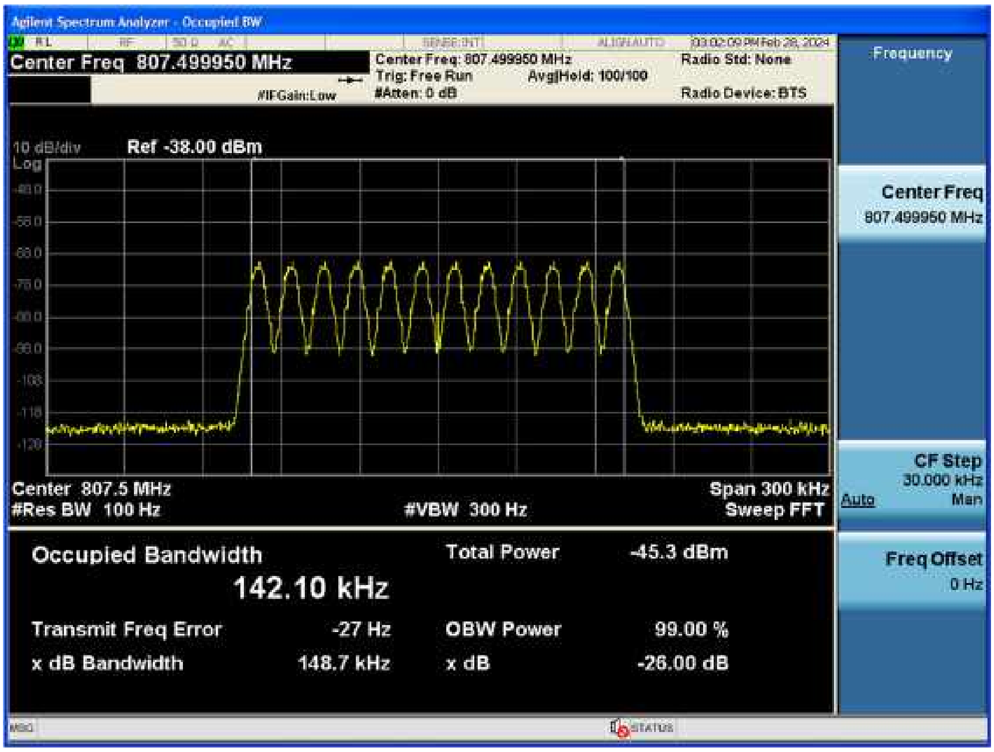
Input / NPSPAC / Uplink / P25 Phase 1 / 150 kHz



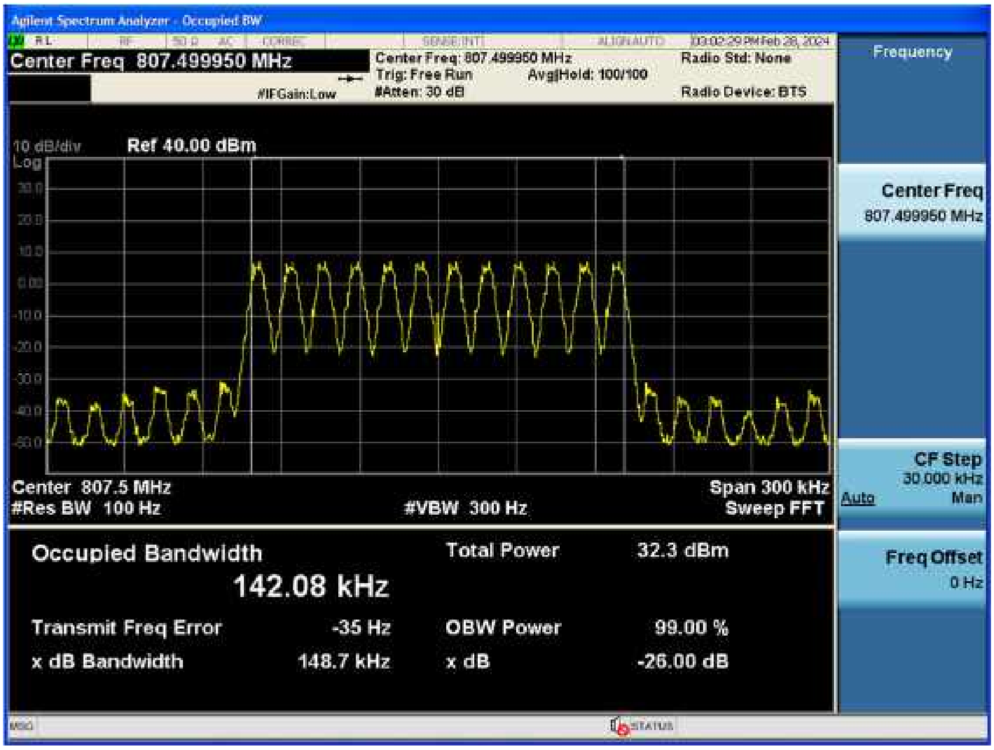
Output / NPSPAC / Uplink / P25 Phase 1 / 150 kHz



3 dB above the AGC threshold Input / NPSPAC / Uplink / P25 Phase 1 / 150 kHz



3 dB above the AGC threshold output / NPSPAC / Uplink / P25 Phase 1 / 150 kHz



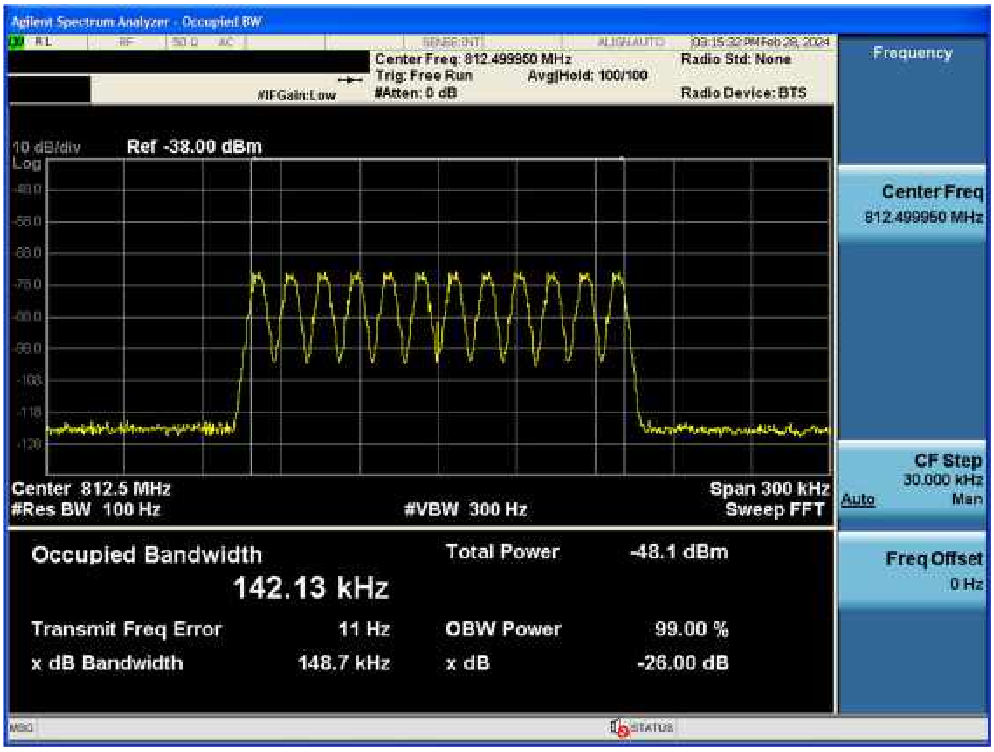
Input / B/ILT; SMR / Uplink / P25 Phase 1 / 12.5 kHz

Output / B/ILT; SMR / Uplink / P25 Phase 1 / 12.5 kHz

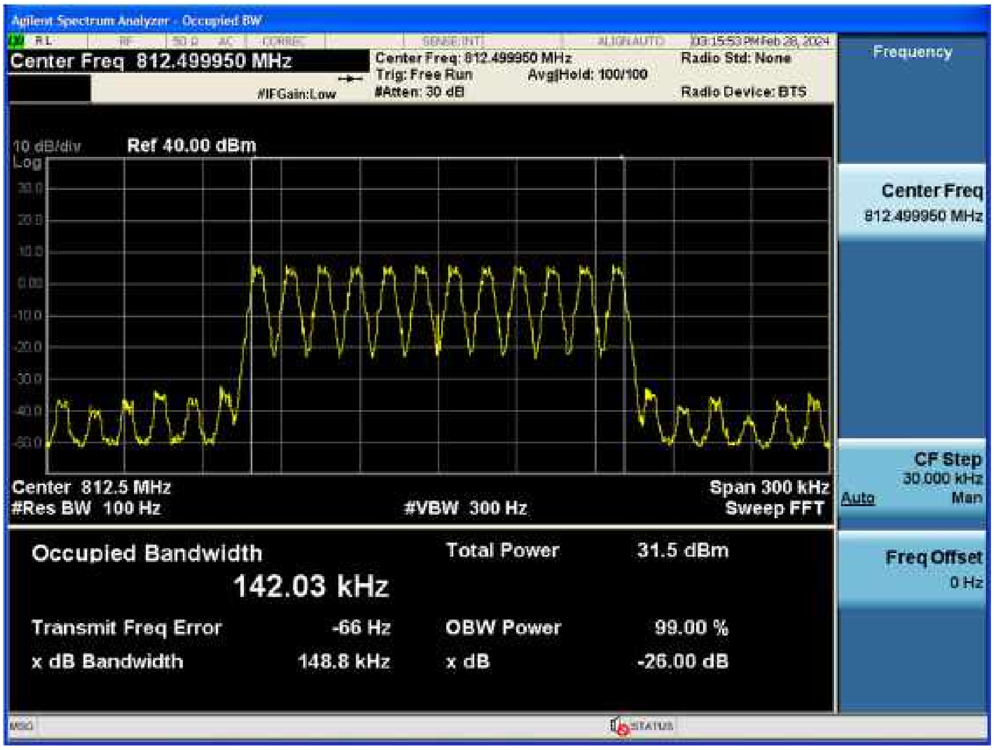
3 dB above the AGC threshold Input / B/ILT; SMR / Uplink / P25 Phase 1 / 12.5 kHz

3 dB above the AGC threshold output / B/ILT; SMR / Uplink / P25 Phase 1 / 12.5 kHz

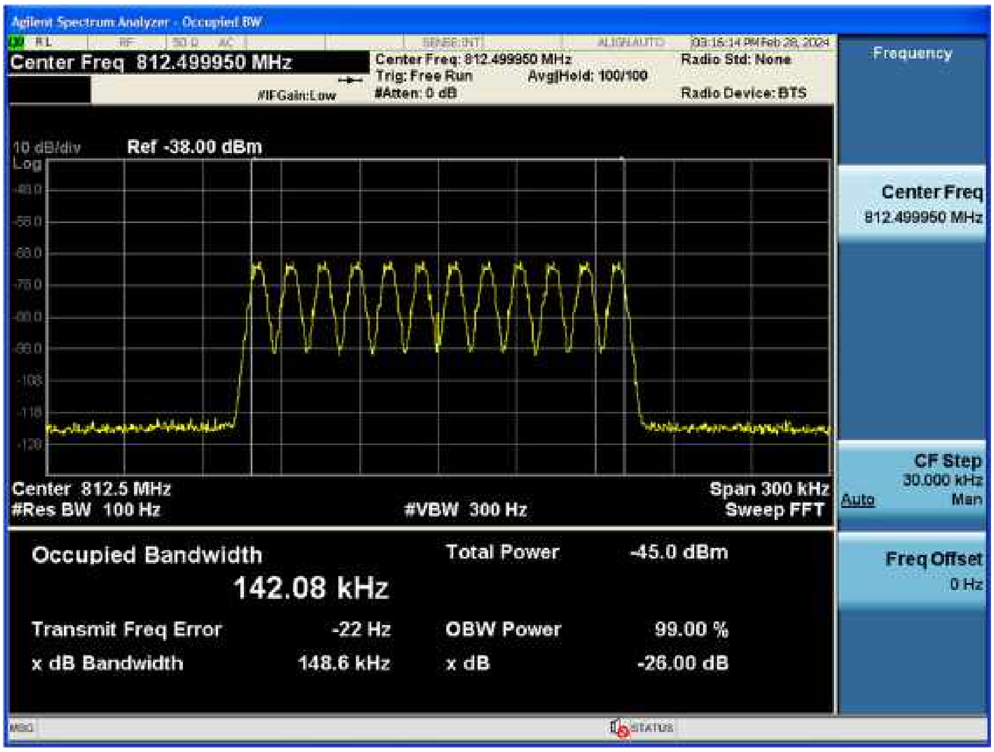
Input / B/ILT; SMR / Uplink / P25 Phase 1 / 150 kHz



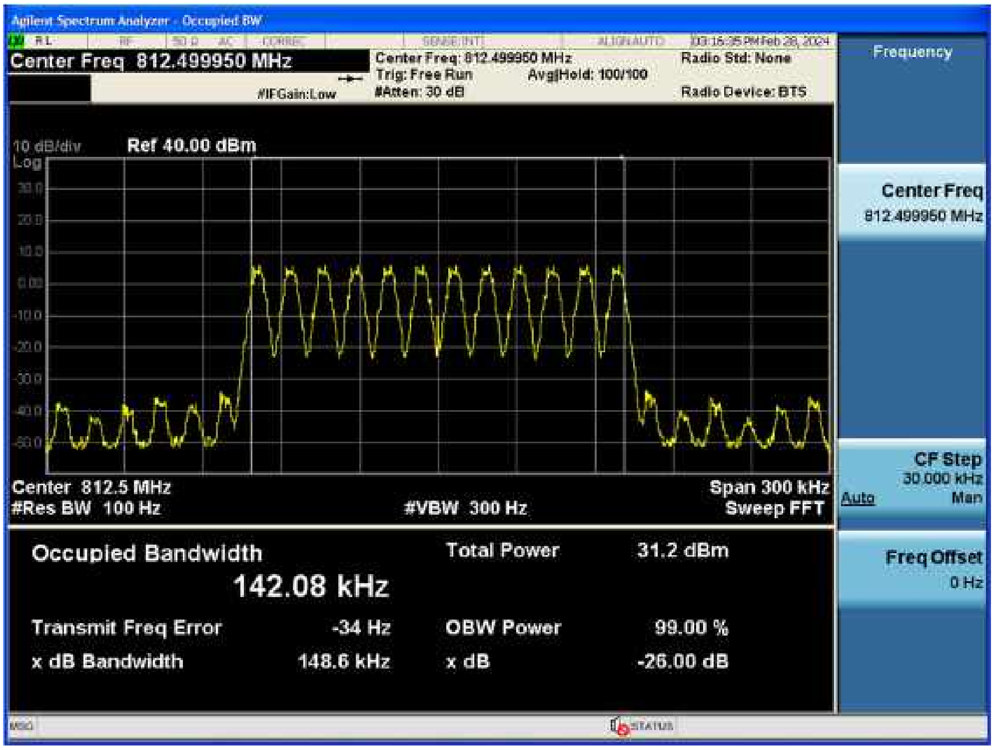
Output / B/ILT; SMR / Uplink / P25 Phase 1 / 150 kHz



3 dB above the AGC threshold Input / B/ILT; SMR / Uplink / P25 Phase 1 / 150 kHz



3 dB above the AGC threshold output / B/ILT; SMR / Uplink / P25 Phase 1 / 150 kHz



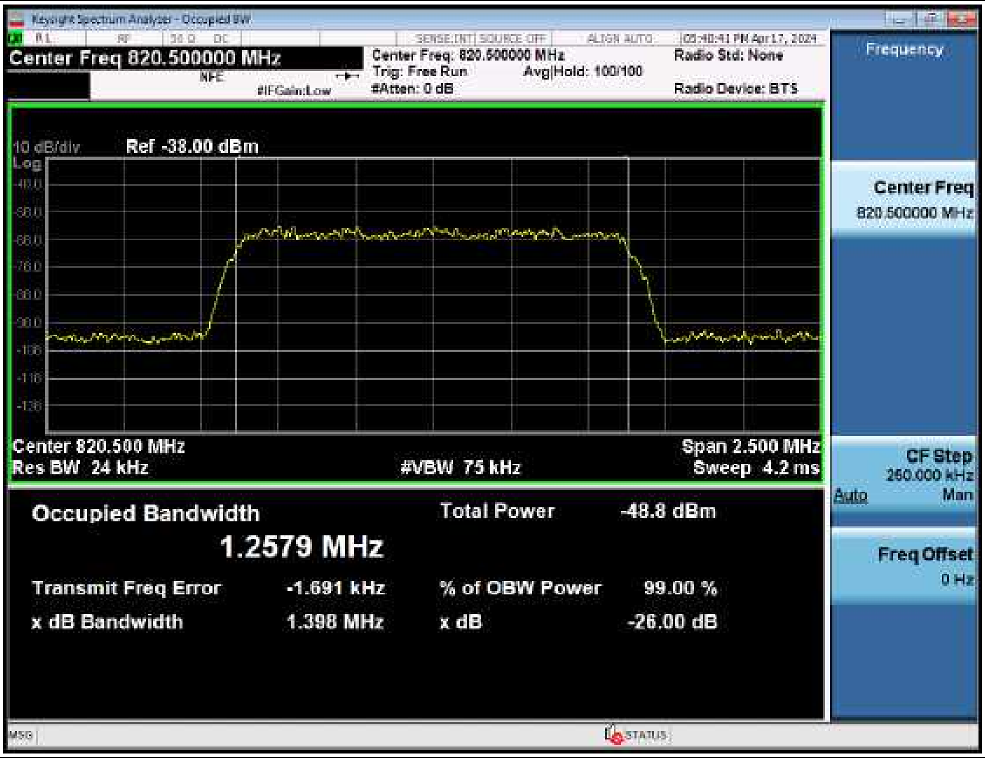
Input / ESMR / Uplink / GSM

Output / ESMR / Uplink / GSM

3 dB above the AGC threshold Input / ESMR / Uplink / GSM

3 dB above the AGC threshold output / ESMR / Uplink / GSM

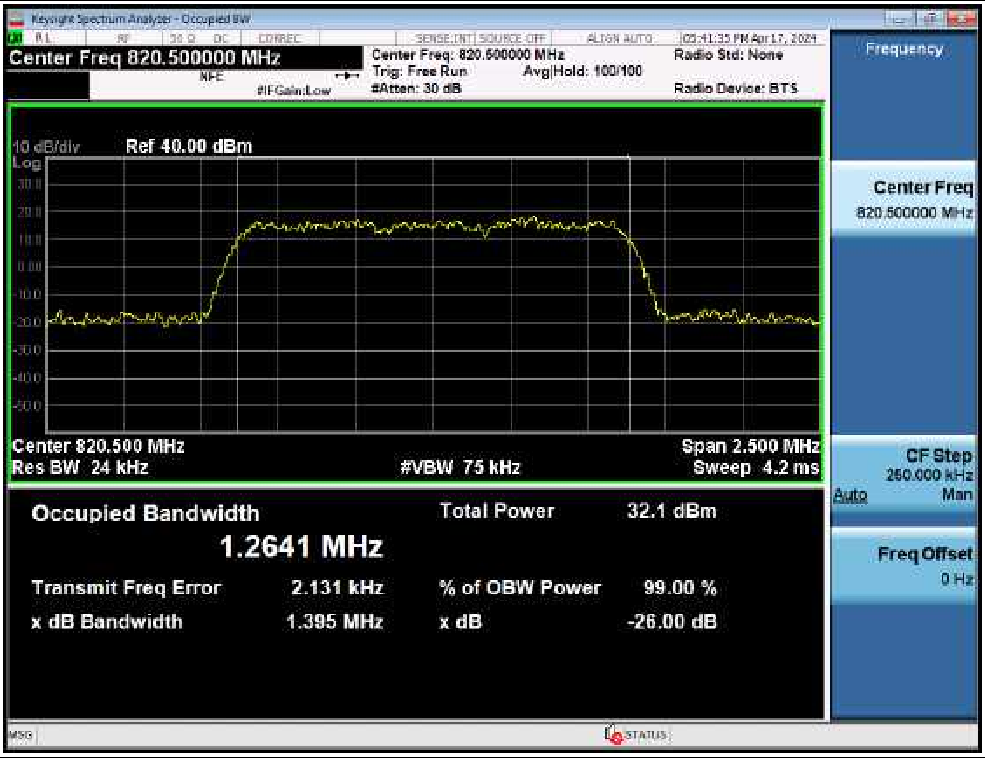
Input / ESMR / Uplink / CDMA



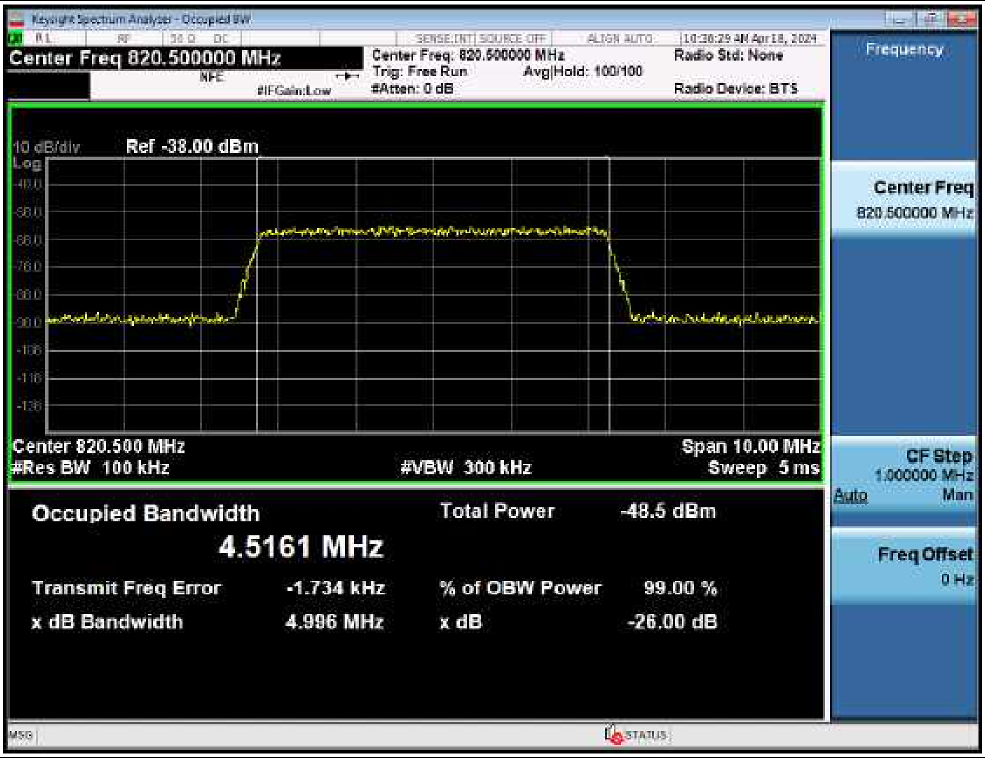
Output / ESMR / Uplink / CDMA

3 dB above the AGC threshold Input / ESMR / Uplink / CDMA

3 dB above the AGC threshold output / ESMR / Uplink / CDMA



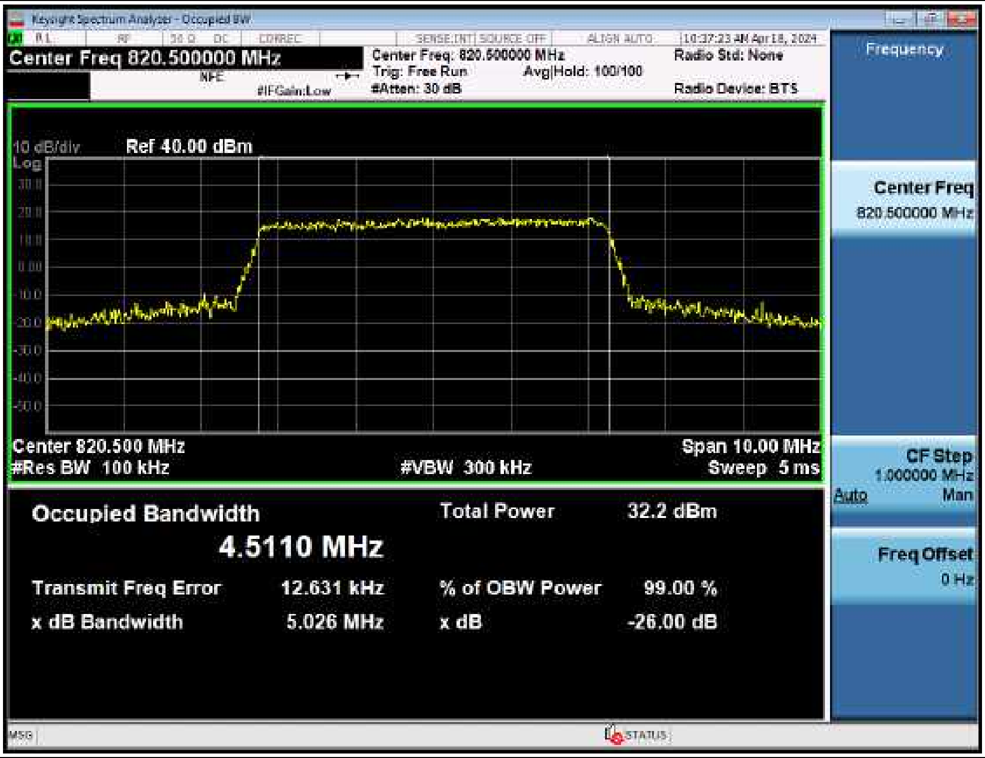
Input / ESMR / Uplink / LTE 5 MHz



Output / ESMR / Uplink / LTE 5 MHz

3 dB above the AGC threshold Input / ESMR / Uplink / LTE 5 MHz

3 dB above the AGC threshold output / ESMR / Uplink / LTE 5 MHz



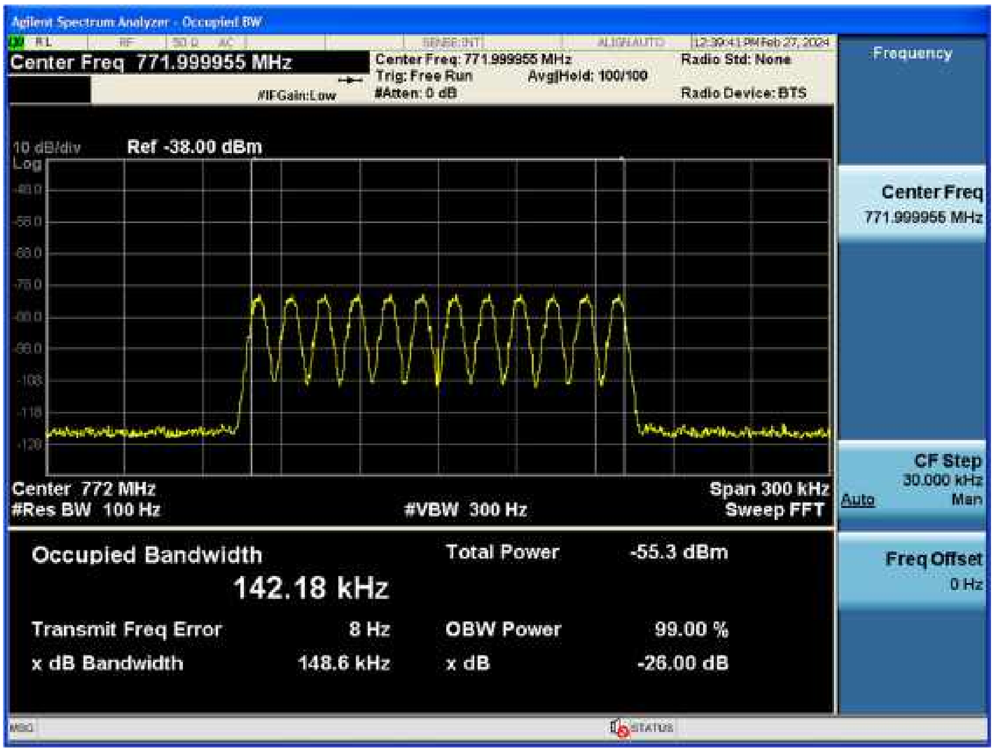
Input / PS Narrowband / Downlink / P25 Phase 1 / 12.5 kHz

Output / PS Narrowband / Downlink / P25 Phase 1 / 12.5 kHz

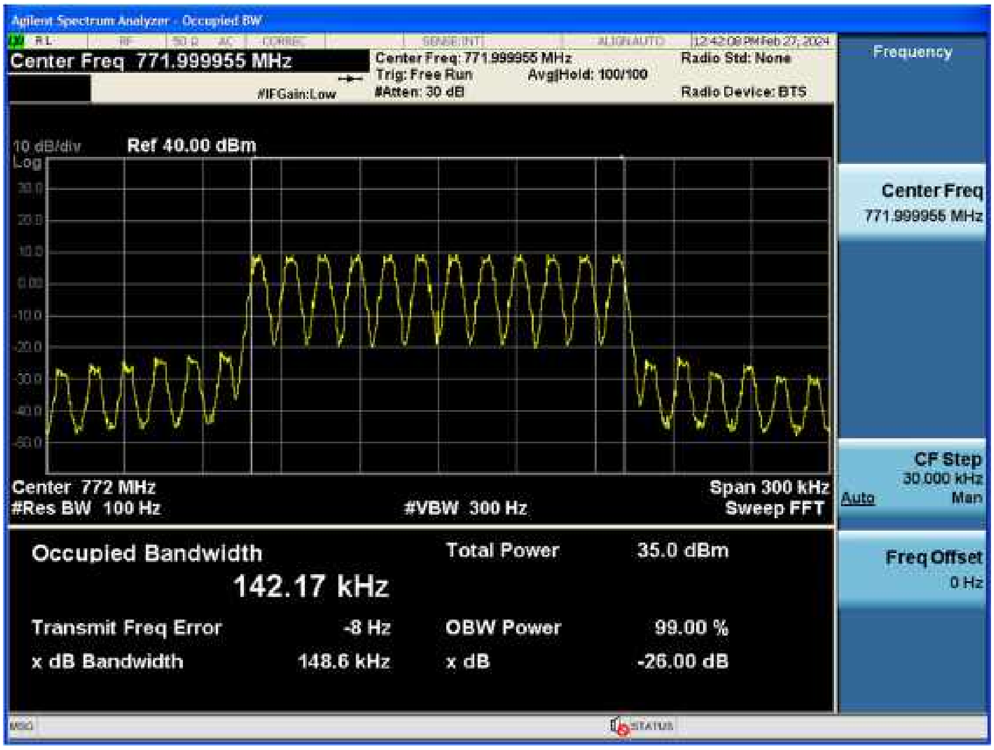
3 dB above the AGC threshold Input / PS Narrowband / Downlink / P25 Phase 1 / 12.5 kHz

3 dB above the AGC threshold output / PS Narrowband / Downlink / P25 Phase 1 / 12.5 kHz

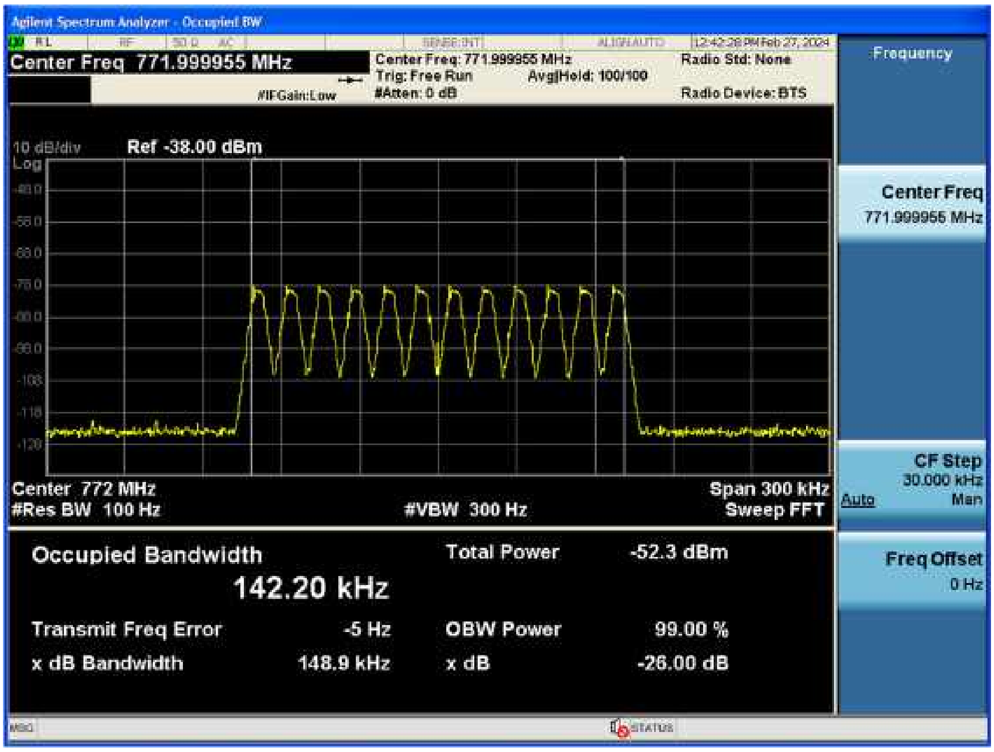
Input / PS Narrowband / Downlink / P25 Phase 1 / 150 kHz



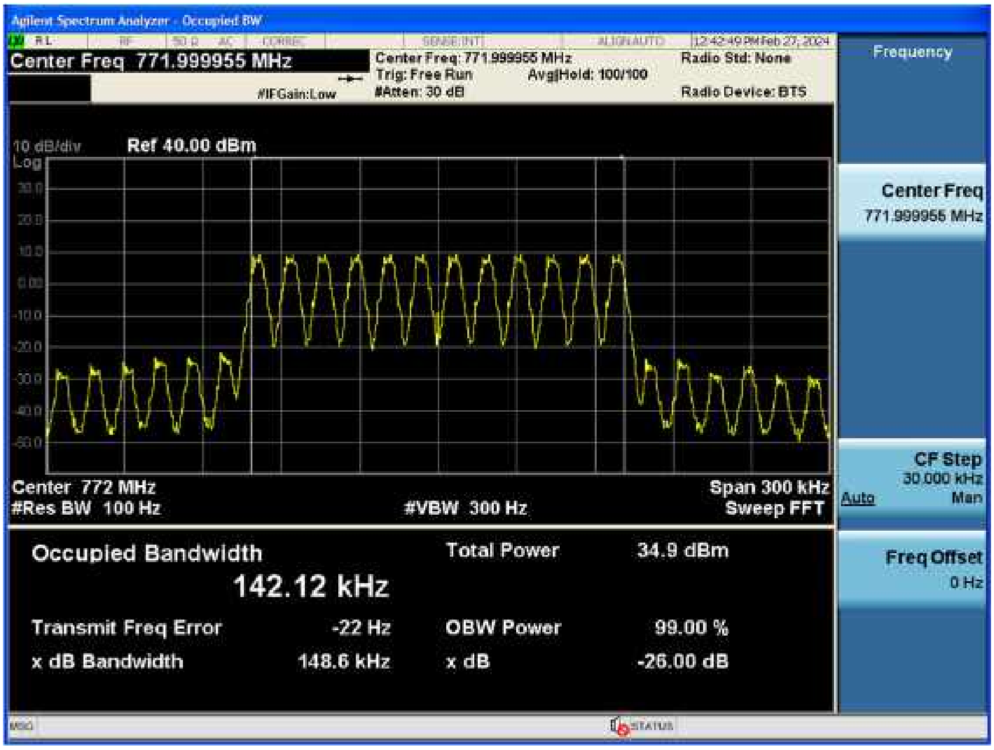
Output / PS Narrowband / Downlink / P25 Phase 1 / 150 kHz



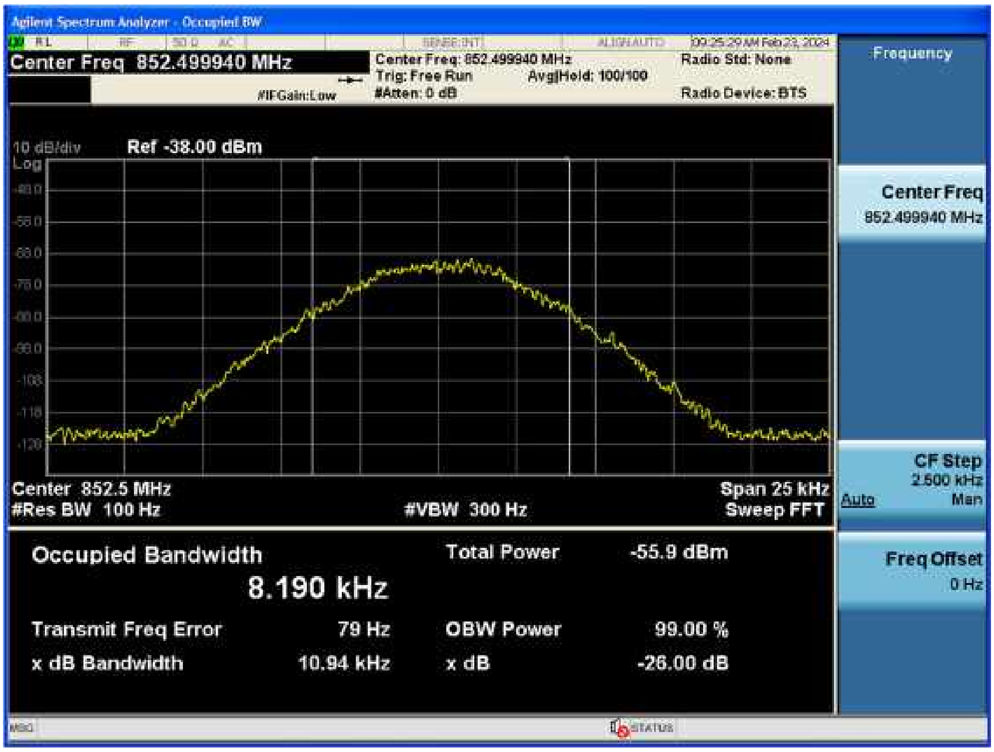
3 dB above the AGC threshold Input / PS Narrowband / Downlink / P25 Phase 1 / 150 kHz



3 dB above the AGC threshold output / PS Narrowband / Downlink / P25 Phase 1 / 150 kHz



Input / NPSPAC / Downlink / P25 Phase 1 / 12.5 kHz

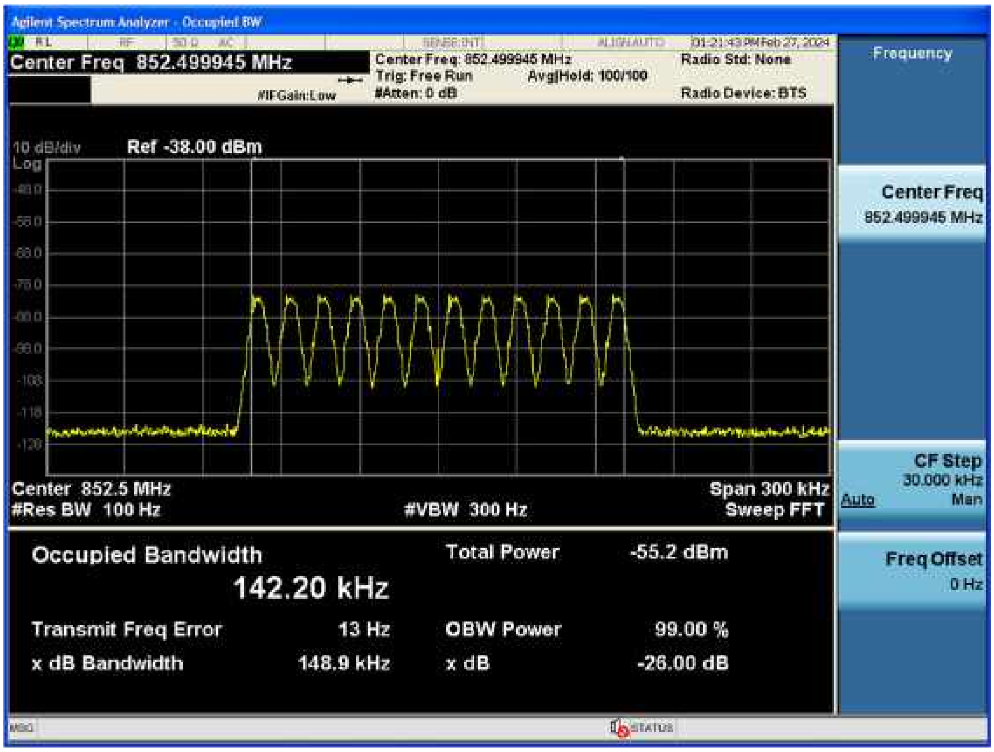


Output / NPSPAC / Downlink / P25 Phase 1 / 12.5 kHz

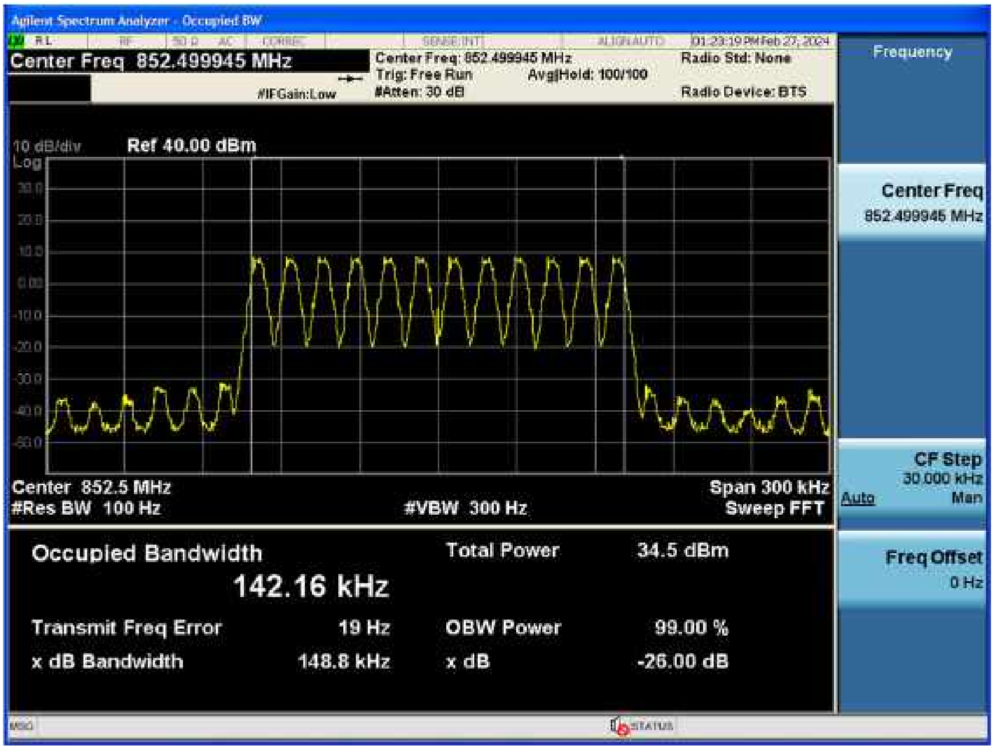
3 dB above the AGC threshold Input / NPSPAC / Downlink / P25 Phase 1 / 12.5 kHz

3 dB above the AGC threshold output / NPSPAC / Downlink / P25 Phase 1 / 12.5 kHz

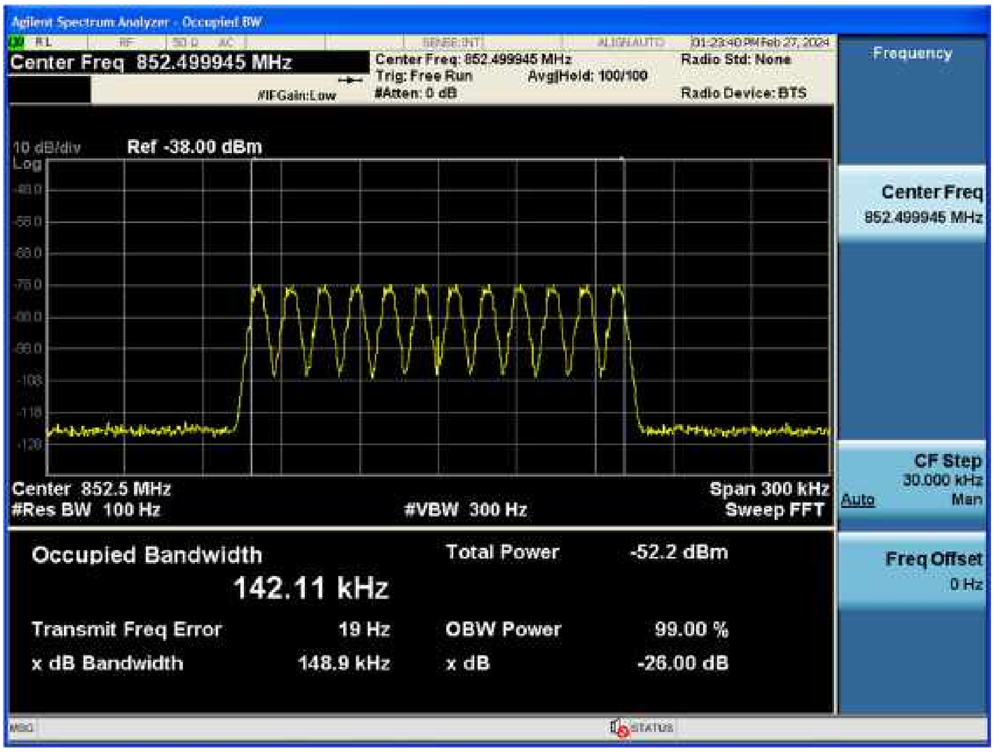
Input / NPSPAC / Downlink / P25 Phase 1 / 150 kHz



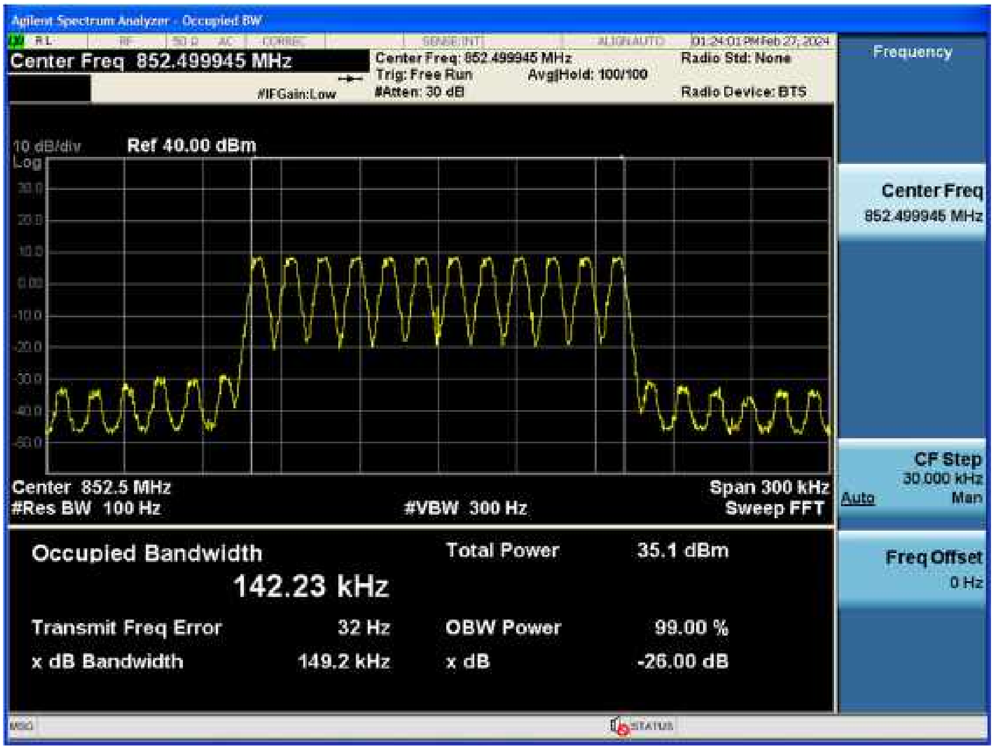
Output / NPSPAC / Downlink / P25 Phase 1 / 150 kHz



3 dB above the AGC threshold Input / NPSPAC / Downlink / P25 Phase 1 / 150 kHz



3 dB above the AGC threshold output / NPSPAC / Downlink / P25 Phase 1 / 150 kHz



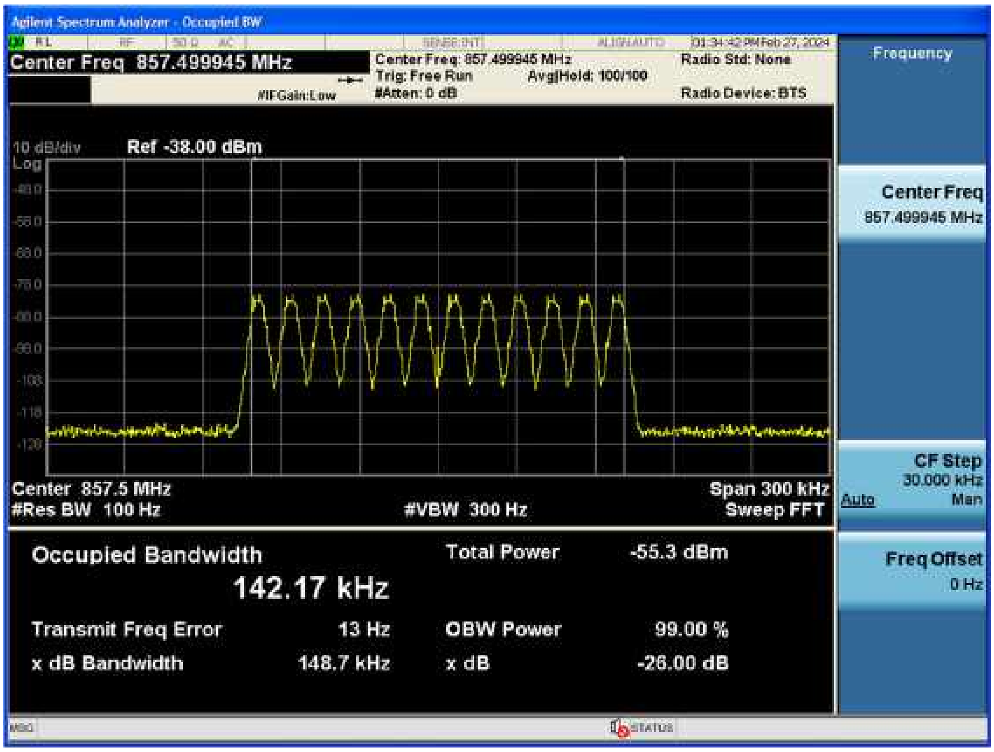
Input / B/ILT; SMR / Downlink / P25 Phase 1 / 12.5 kHz

Output / B/ILT; SMR / Downlink / P25 Phase 1 / 12.5 kHz

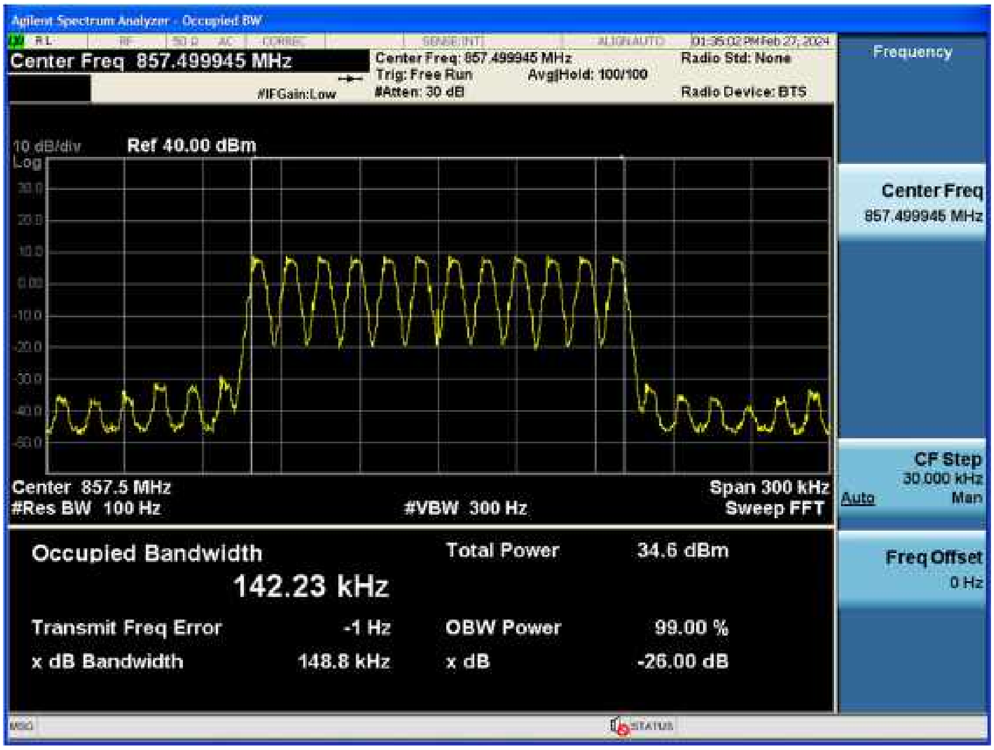
3 dB above the AGC threshold Input / B/ILT; SMR / Downlink / P25 Phase 1 / 12.5 kHz

3 dB above the AGC threshold output / B/ILT; SMR / Downlink / P25 Phase 1 / 12.5 kHz

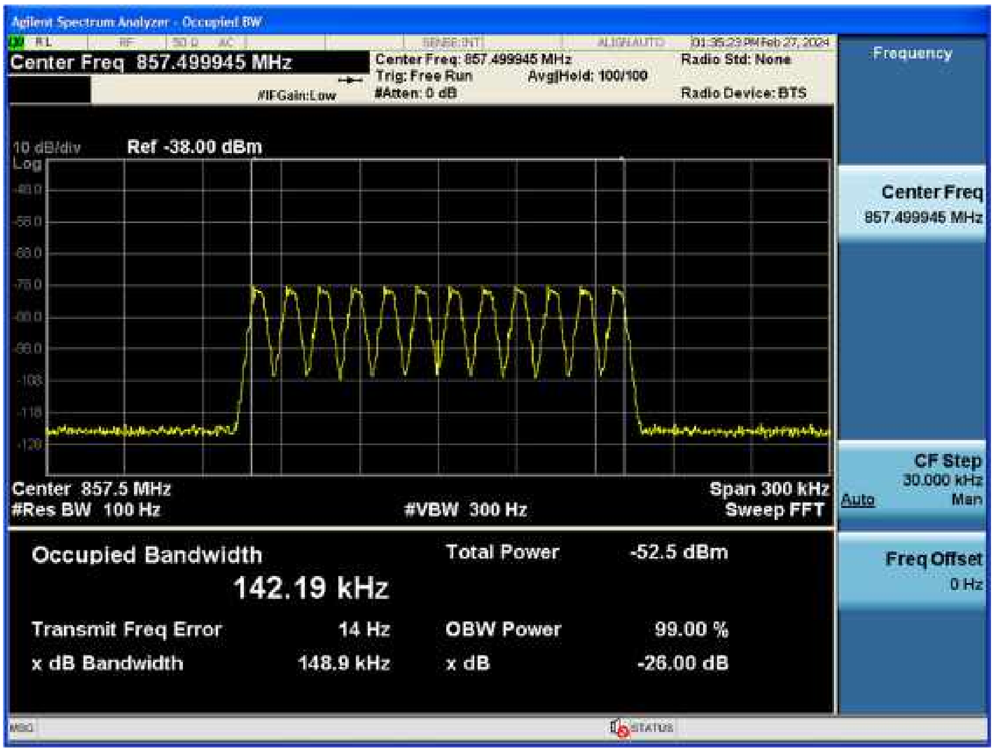
Input / B/ILT; SMR / Downlink / P25 Phase 1 / 150 kHz



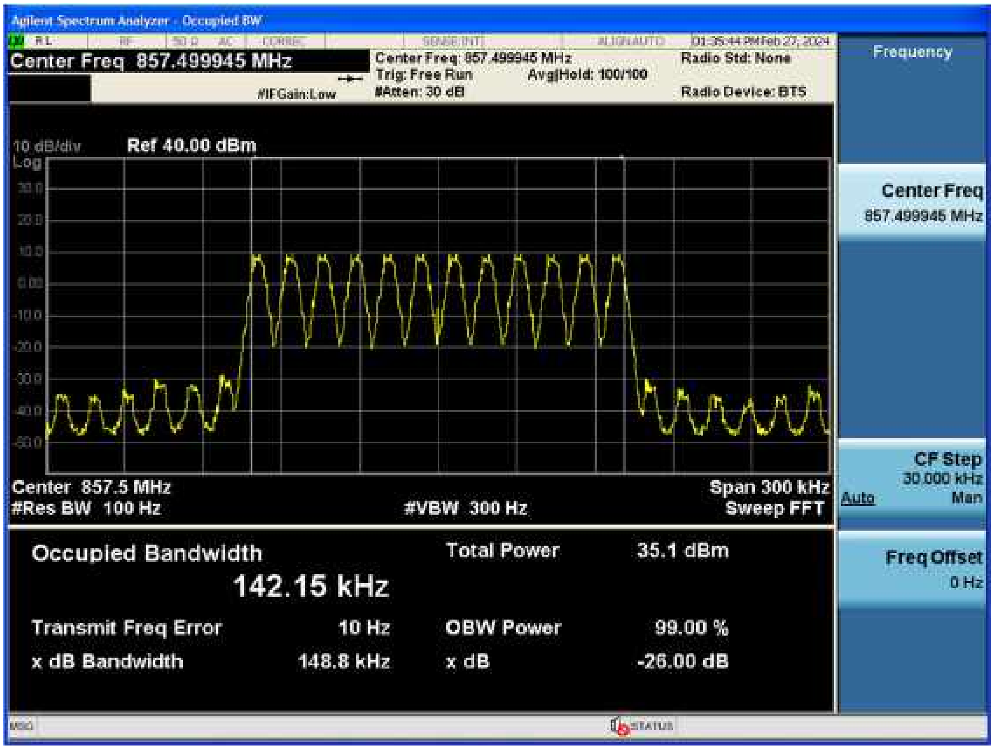
Output / B/ILT; SMR / Downlink / P25 Phase 1 / 150 kHz



3 dB above the AGC threshold Input / B/ILT; SMR / Downlink / P25 Phase 1 / 150 kHz

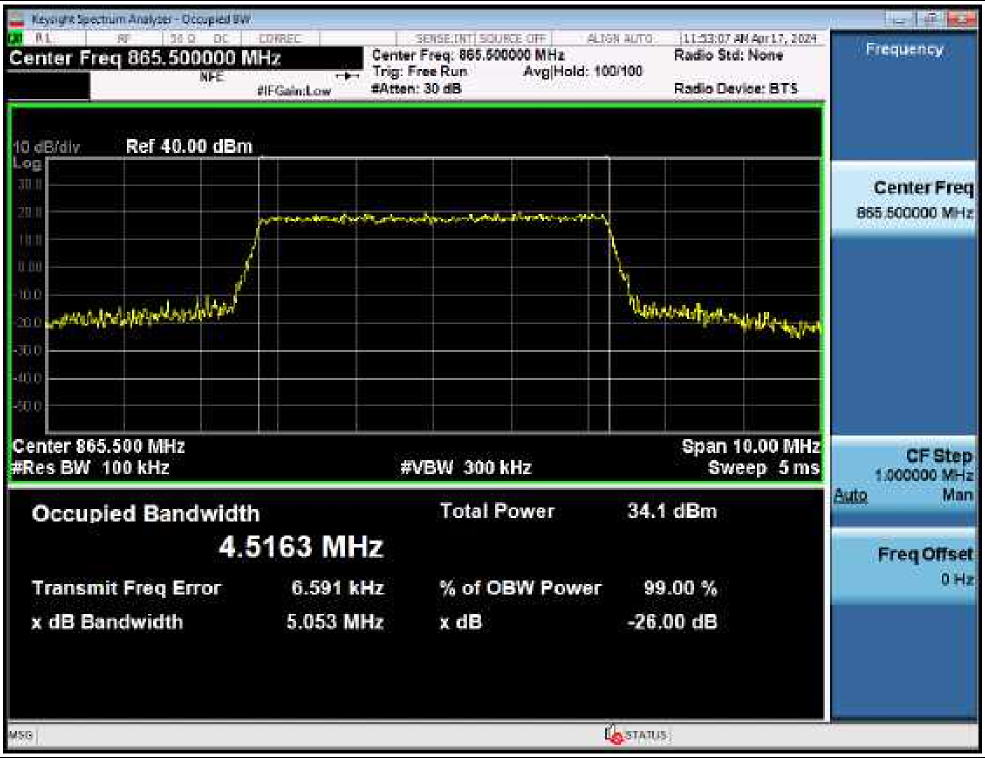


3 dB above the AGC threshold output / B/ILT; SMR / Downlink / P25 Phase 1 / 150 kHz

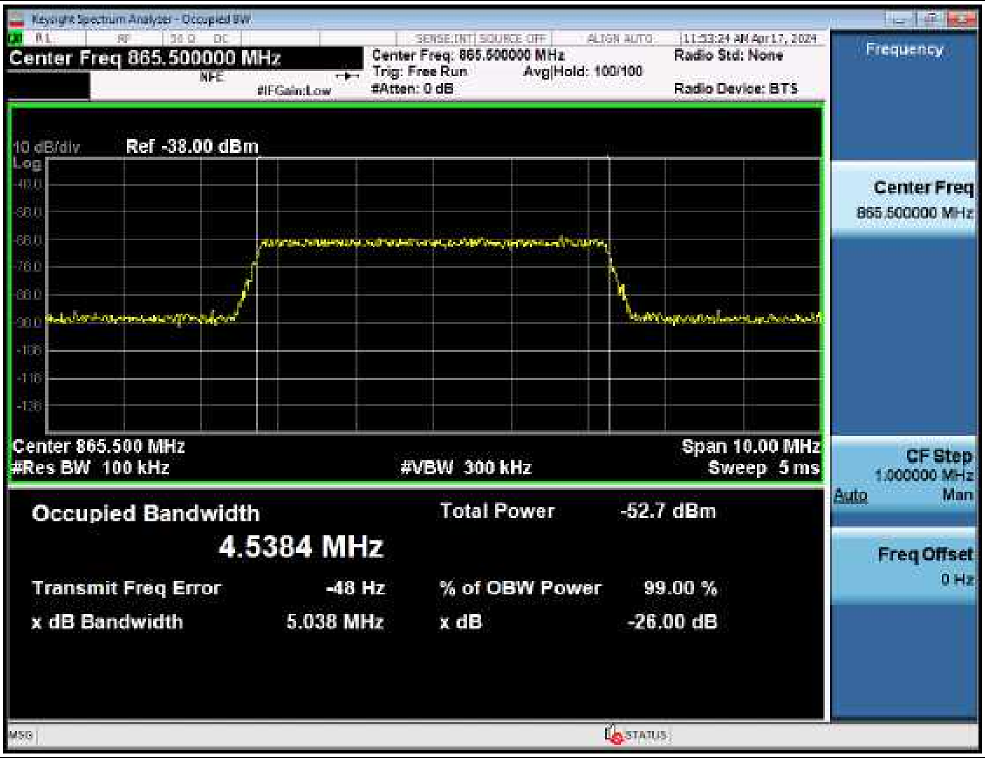


Input / ESMR / Downlink / GSM

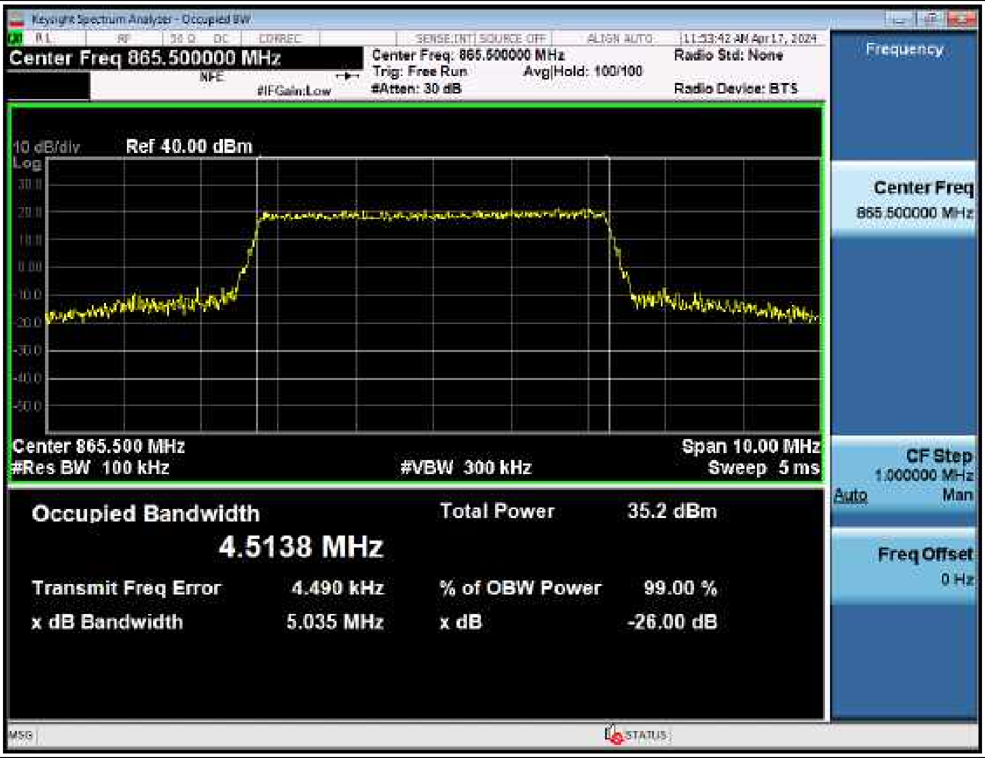
Output / ESMR / Downlink / GSM



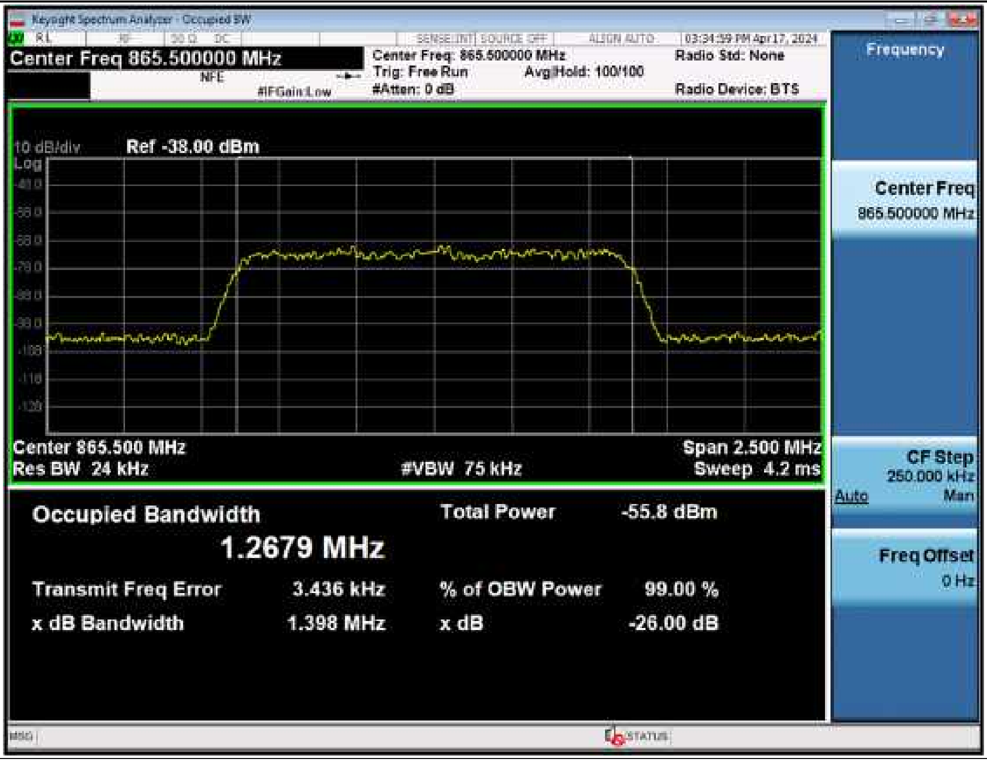
3 dB above the AGC threshold Input / ESMR / Downlink / GSM



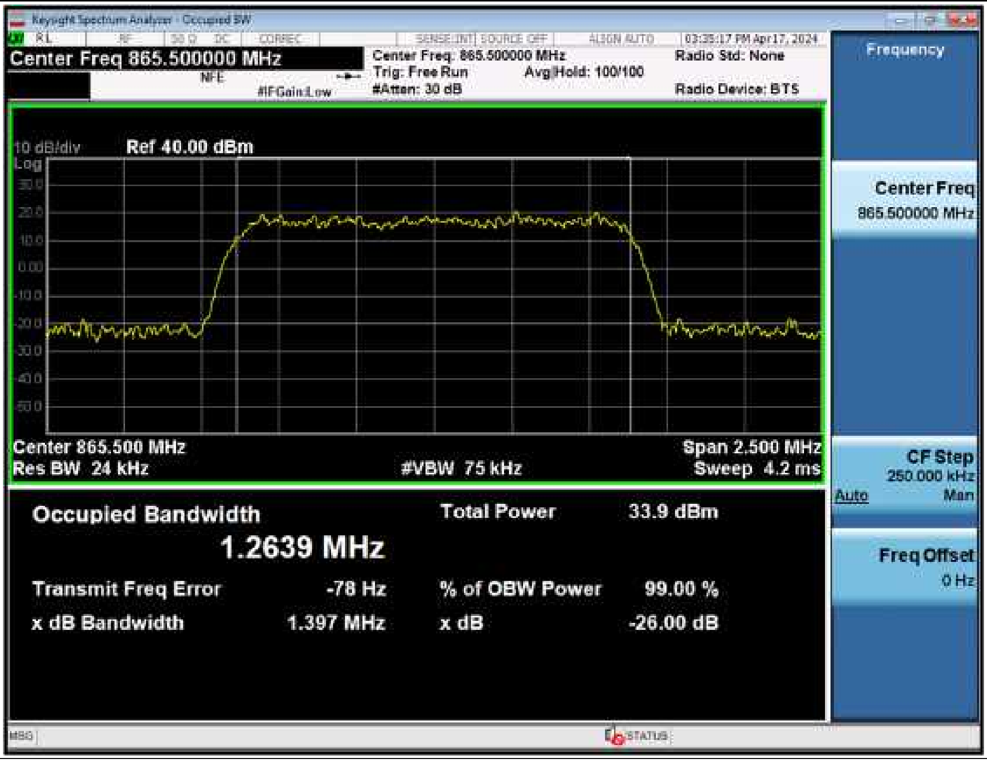
3 dB above the AGC threshold output / ESMR / Downlink / GSM



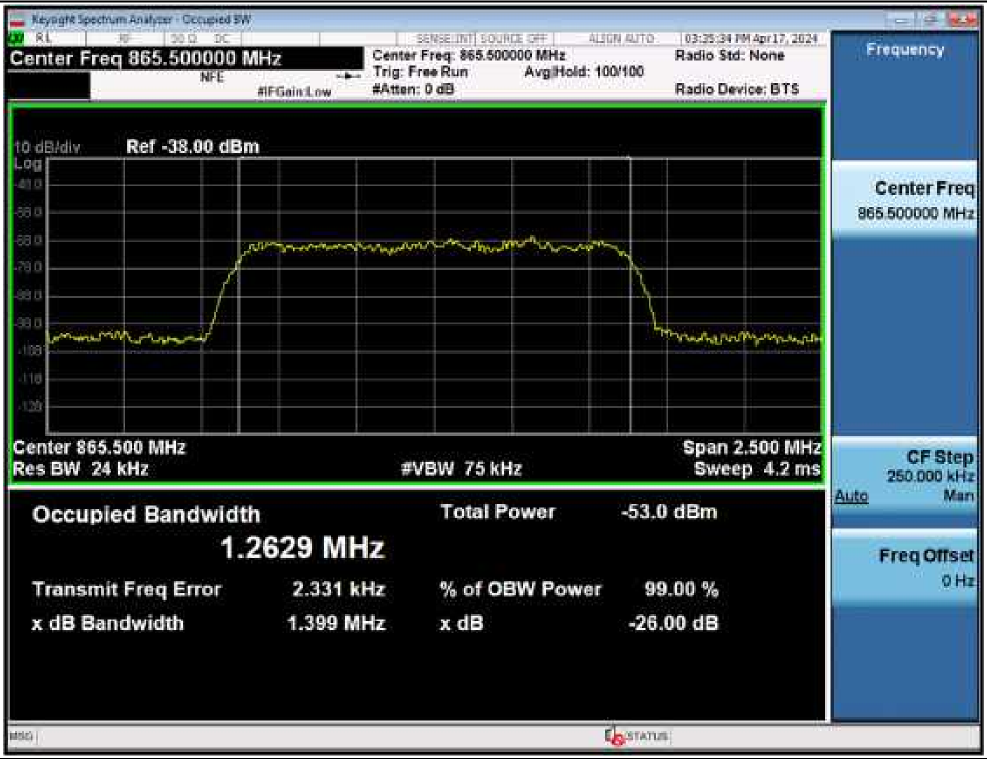
Input / ESMR / Downlink / CDMA



Output / ESMR / Downlink / CDMA



3 dB above the AGC threshold Input / ESMR / Downlink / CDMA



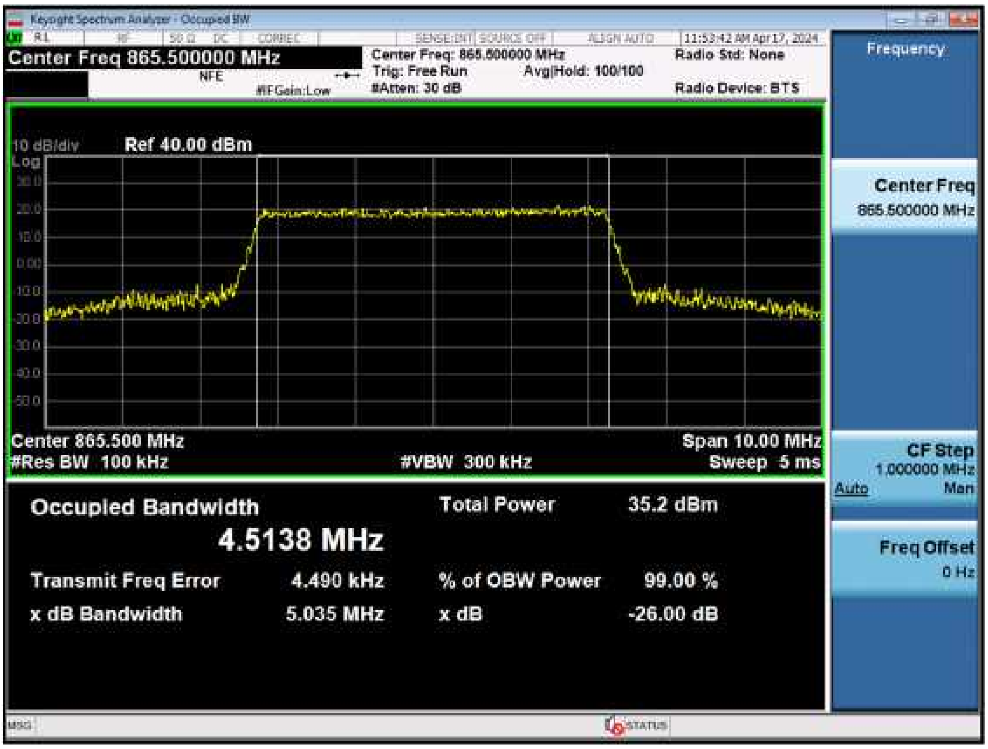
3 dB above the AGC threshold output / ESMR / Downlink / CDMA

Input / ESMR / Downlink / LTE 5 MHz

Output / ESMR / Downlink / LTE 5 MHz

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

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



5.4. INPUT-VERSUS-OUTPUT SIGNAL COMPARISON

Test Requirement:

§ 90.210 Emission masks.

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (o) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating under this part.

Applicable Emission Masks

Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
Below 25	A or B	A or C
25-50	B	C
72-76	B	C
150-174	B, D, or E	C, D or E
150 paging only	B	C
220-222	F	F
421-512	B, D, or E	C, D, or E
450 paging only	B	G
806-809/851-854	B	H
809-824/854-869[#]	B, D	D, G
896-901/935-940	I	J
902-928	K	K
929 ~ 930	B	G
4940-4990 MHz	L or M	L or M
5850-5925		
All other bands	B	C

[#] Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.

(c) Emission Mask C. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz, but not more than 10 kHz: At least 83 log (fd/5) dB;

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least 29 log (fd2/11) dB or 50 dB, whichever is the lesser attenuation;

(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

(4) In the 1427-1432 MHz band, licensees are encouraged to take all reasonable steps to ensure that unwanted emissions power does not exceed the following levels in the 1400-1427 MHz band:

(i) For stations of point-to-point systems in the fixed service: −45 dBW/27 MHz.

(ii) For stations in the mobile service: −60 dBW/27 MHz.

(d) Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(fd−2.88 kHz) dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

(h) Emission Mask H. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of 4 kHz or less: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 4 kHz, but no more than 8.5 kHz: At least 107 log (fd/4) dB;

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 8.5 kHz, but no more than 15 kHz: At least 40.5 log (fd/1.16) dB;

(4) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 15 kHz, but no more than 25 kHz: At least 116 log (fd/6.1) dB;

(5) On any frequency removed from the center of the authorized bandwidth by more than 25 kHz: At least 43 + 10 log (P) dB.

§ 90.219 Use of signal boosters.

(e) Device Specifications. In addition to the general rules for equipment certification in § 90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.

(4) A signal booster must be designed such that all signals that it retransmits meet the following requirements:

(iii) The retransmitted signals continue to meet the unwanted emissions limits of § 90.210 applicable to the corresponding received signals (assuming that these received signals meet the applicable unwanted emissions limits by a reasonable margin).

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.

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

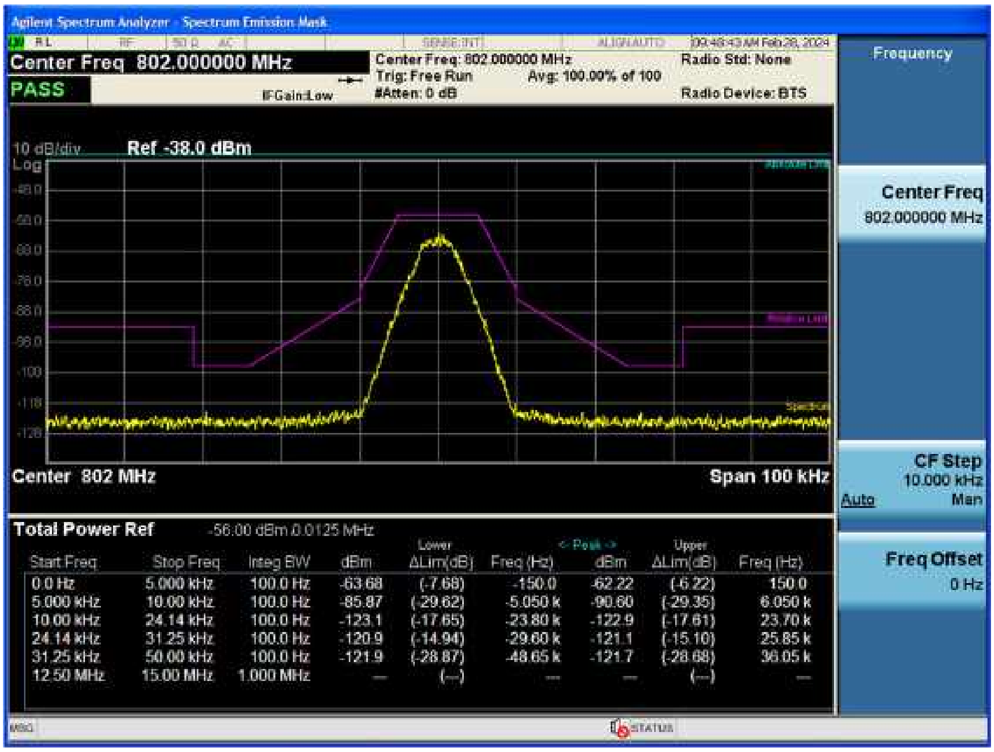
Measurements were in accordance with the test methods section 4.4 of KDB 935210 D05 v01r03.

a) Connect a signal generator to the input of the EUT.
b) Configure the signal generator to transmit the appropriate test signal associated with the public safety emission designation.
c) Configure the signal level to be just below the AGC threshold.
d) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.
e) Set the spectrum analyzer center frequency to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be between 2 times to 5 times the EBW (or OBW).
f) The nominal RBW shall be 300 Hz for 16K0F3E, and 100 Hz for all other emissions types.
g) Set the reference level of the spectrum analyzer to accommodate the maximum input amplitude level, i.e., the level at f_0 per Out-of-band rejection test.
h) Set spectrum analyzer detection mode to peak, and trace mode to max hold.
i) Allow the trace to fully stabilize.
j) Confirm that the signal is contained within the appropriate emissions mask.
k) Use the marker function to determine the maximum emission level and record the associated frequency.
l) Capture the emissions mask plot for inclusion in the test report (output signal spectra).
m) Measure the EUT input signal power (signal generator output signal) directly from the signal generator using power measurement guidance provided in KDB Publication 971168 [R8] (input signal spectra).
n) Compare the spectral plot of the output signal (determined in step k), to the input signal (determined in step l) to affirm they are similar (in passband and rolloff characteristic features and relative spectral locations).
o) Repeat steps d) to n) with the input signal amplitude set 3 dB above the AGC threshold.
p) Repeat steps b) to o) for all authorized operational bands and emissions types (see applicable regulatory specifications, e.g., Section 90.210).
q) Include all accumulated spectral plots depicting EUT input signal and EUT output signal in the test report, and note any observed dissimilarities.

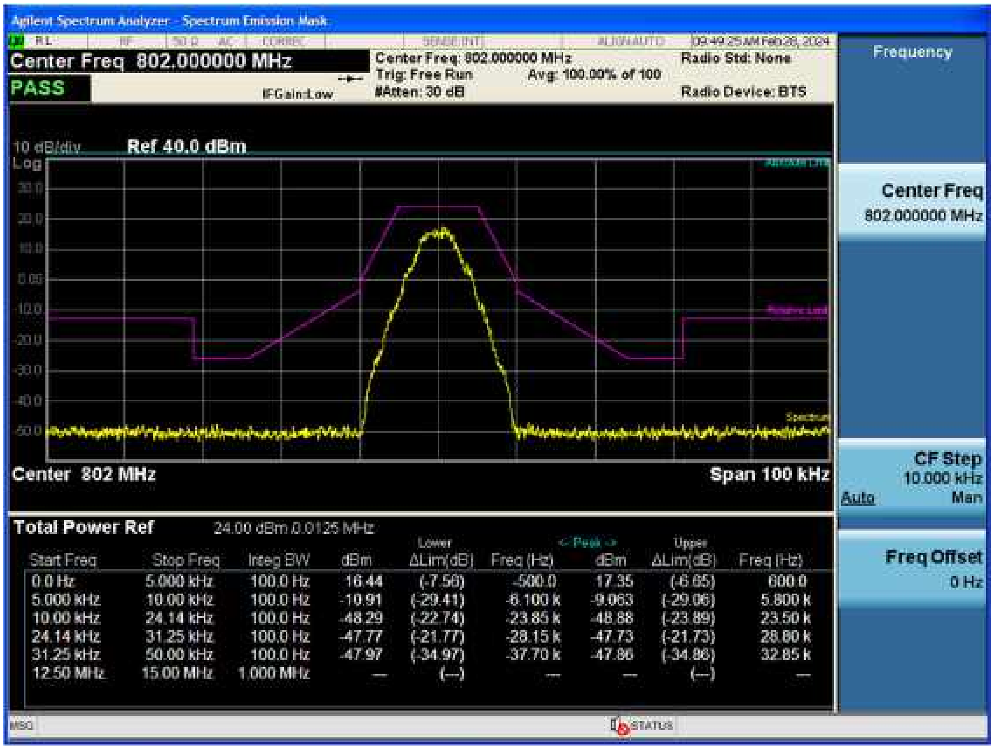
Note: Please refer to section 5.3 for the results of the ESMR band. This section contains only emission mask results.

Plot data of Emission mask

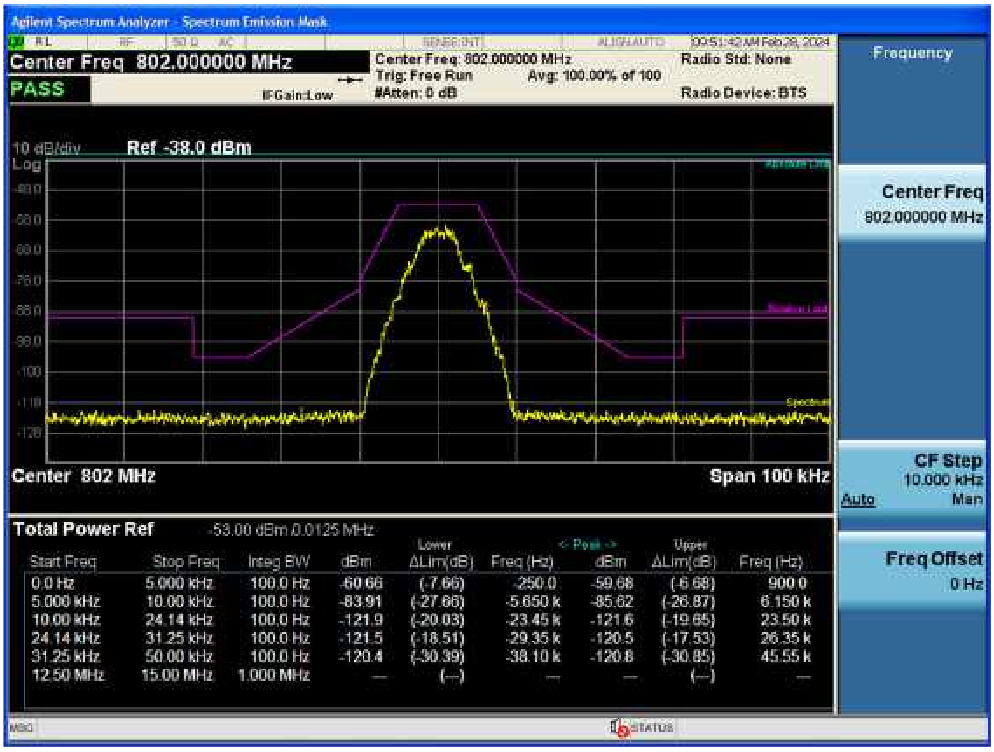
Input / PS Narrowband / Uplink / P25 Phase 1 / Mask C



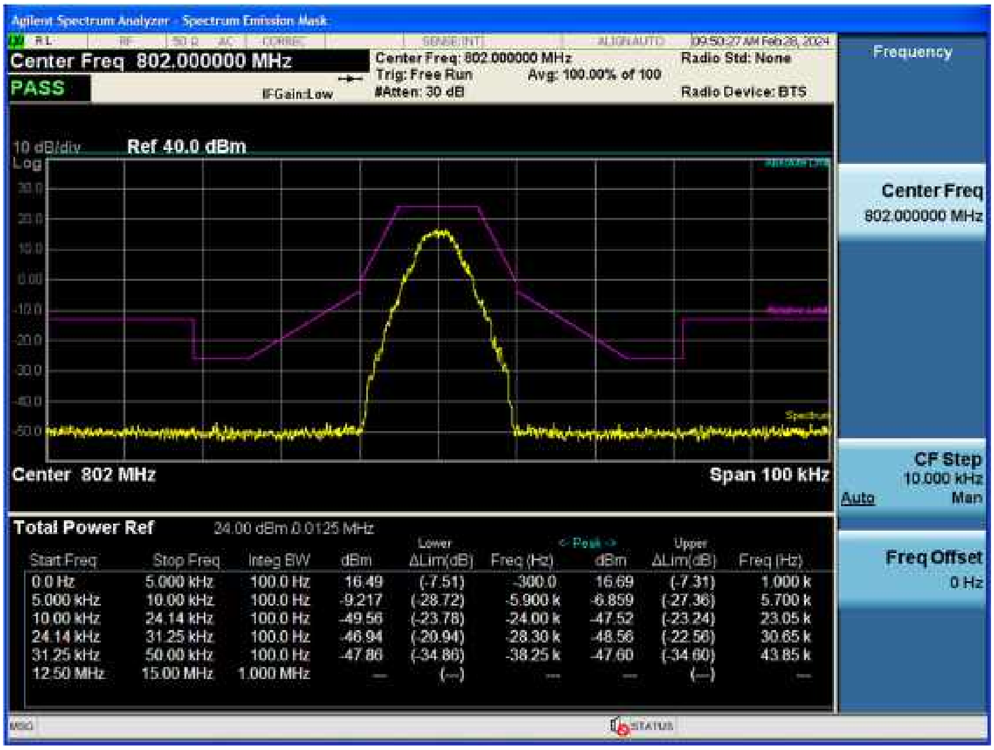
Output / PS Narrowband / Uplink / P25 Phase 1 / Mask C



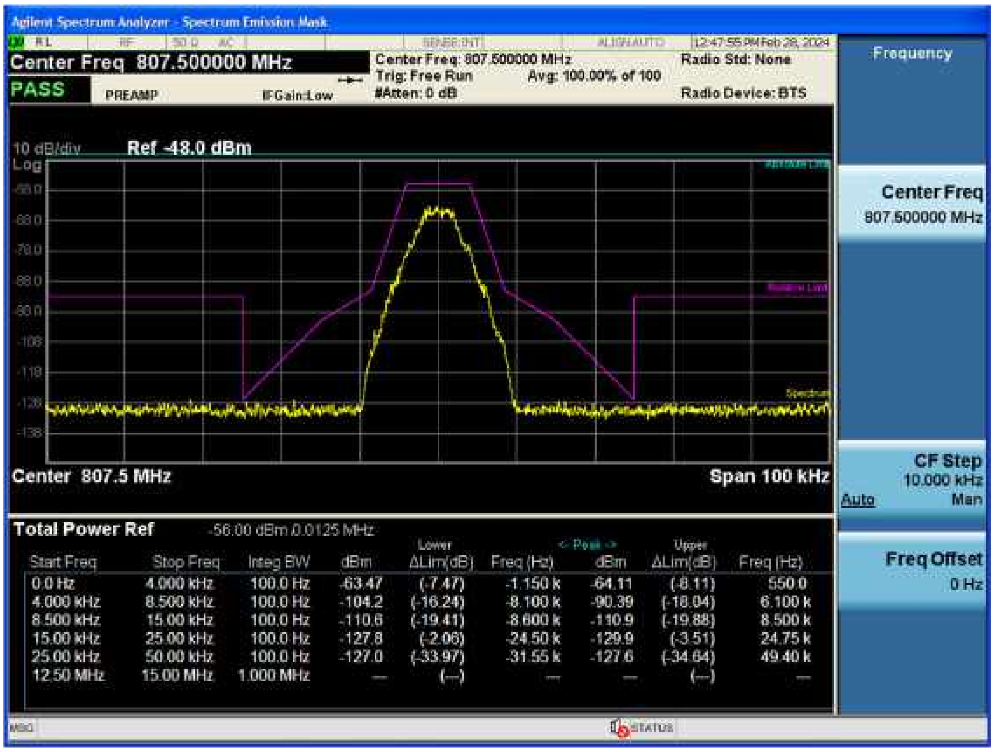
3 dB above the AGC threshold Input / PS Narrowband / Uplink / P25 Phase 1 / Mask C



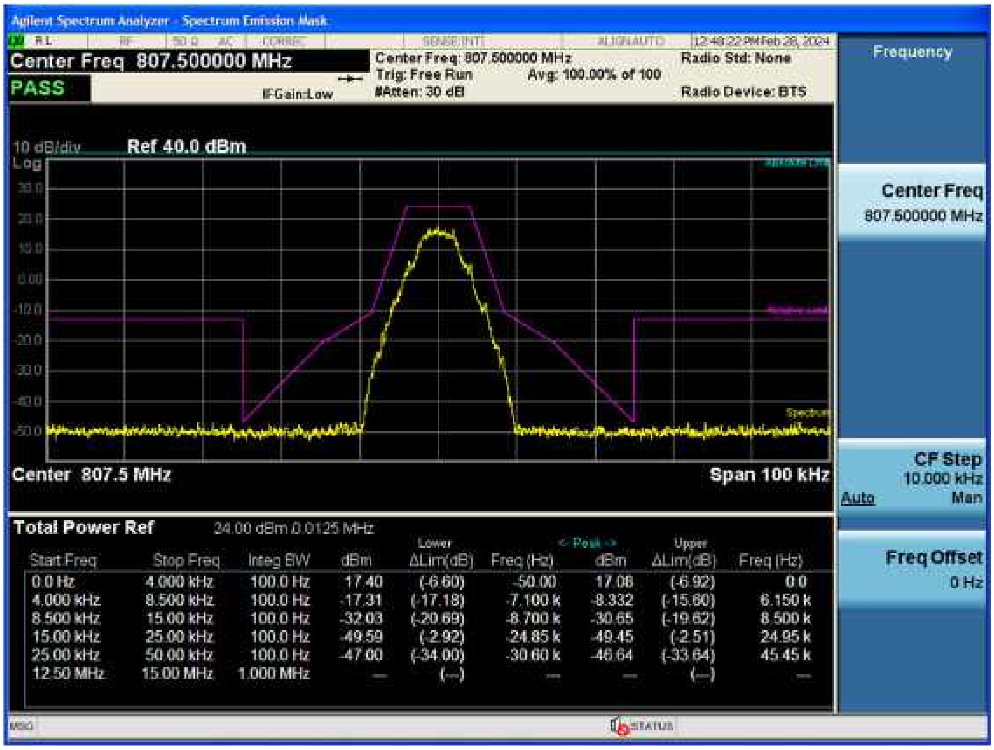
3 dB above the AGC threshold output / PS Narrowband / Uplink / P25 Phase 1 / Mask C



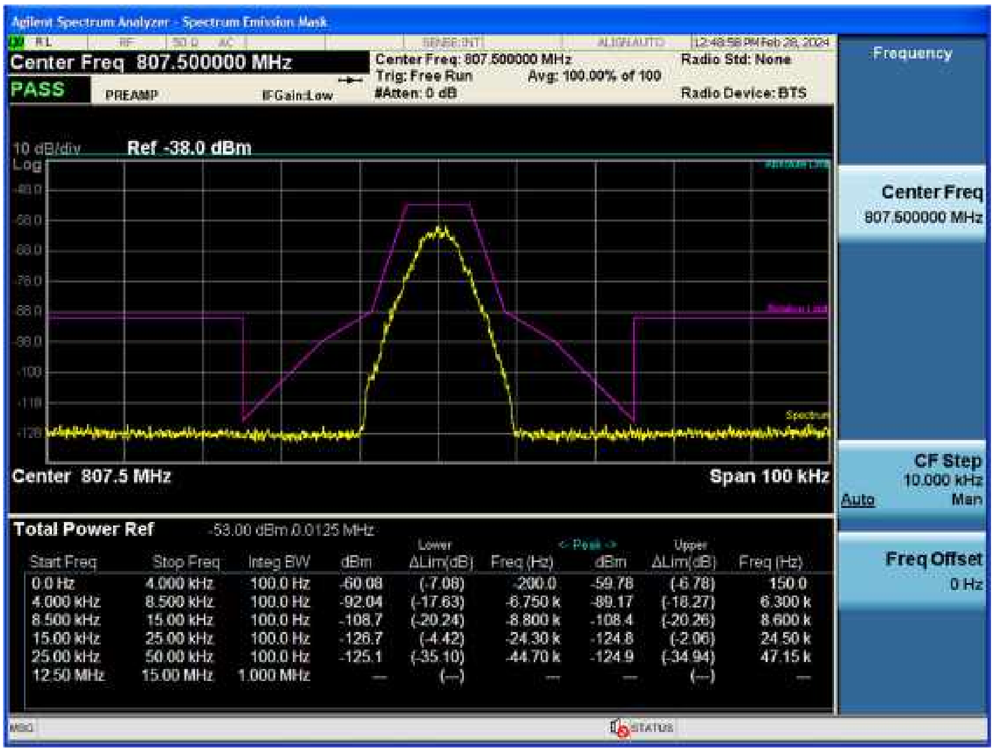
Input / NPSPAC / Uplink / P25 Phase 1 / Mask H



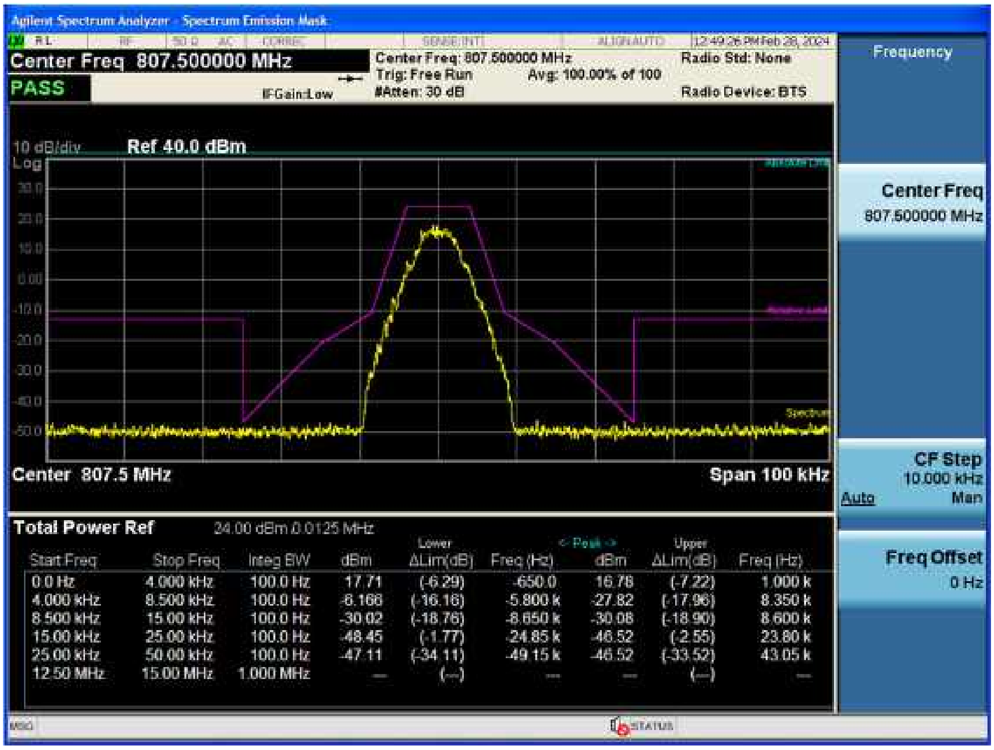
Output / NPSPAC / Uplink / P25 Phase 1 / Mask H



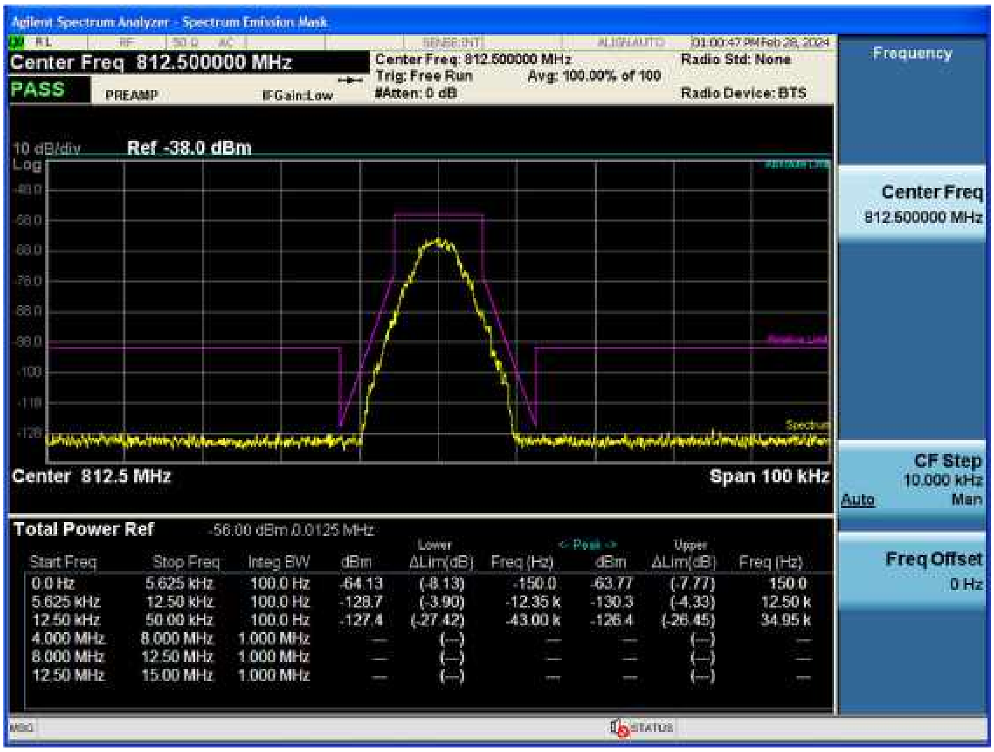
3 dB above the AGC threshold Input / NPSPAC / Uplink / P25 Phase 1 / Mask H



3 dB above the AGC threshold output / NPSPAC / Uplink / 12.5 kHz / Mask H

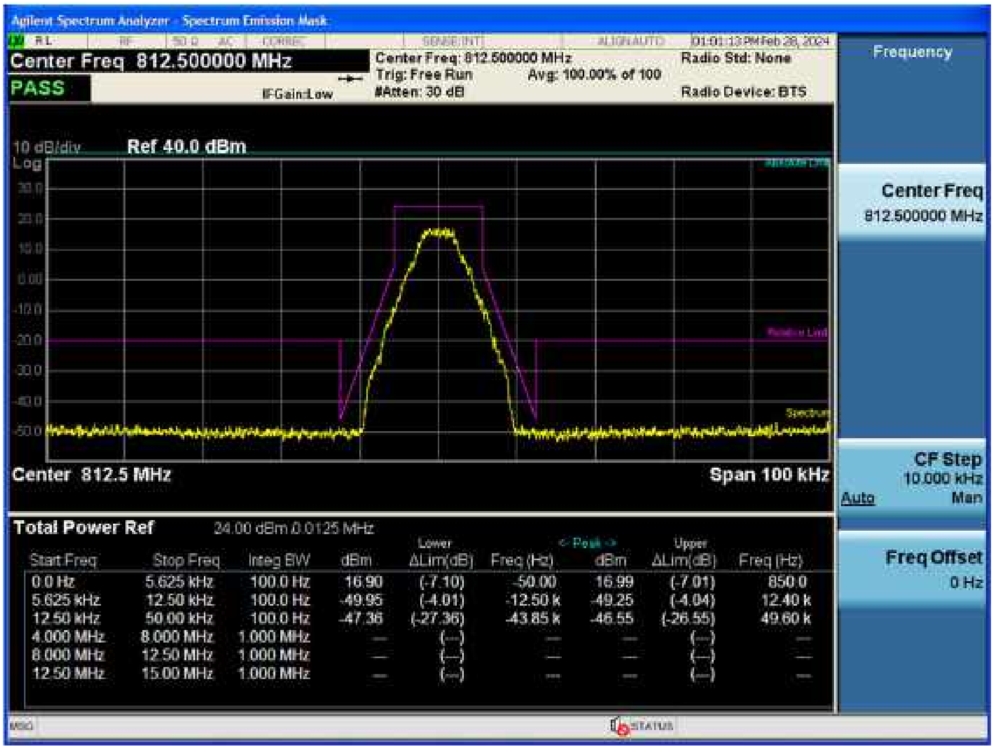


Input / B/ILT; SMR / Uplink / P25 Phase 1 / Mask D



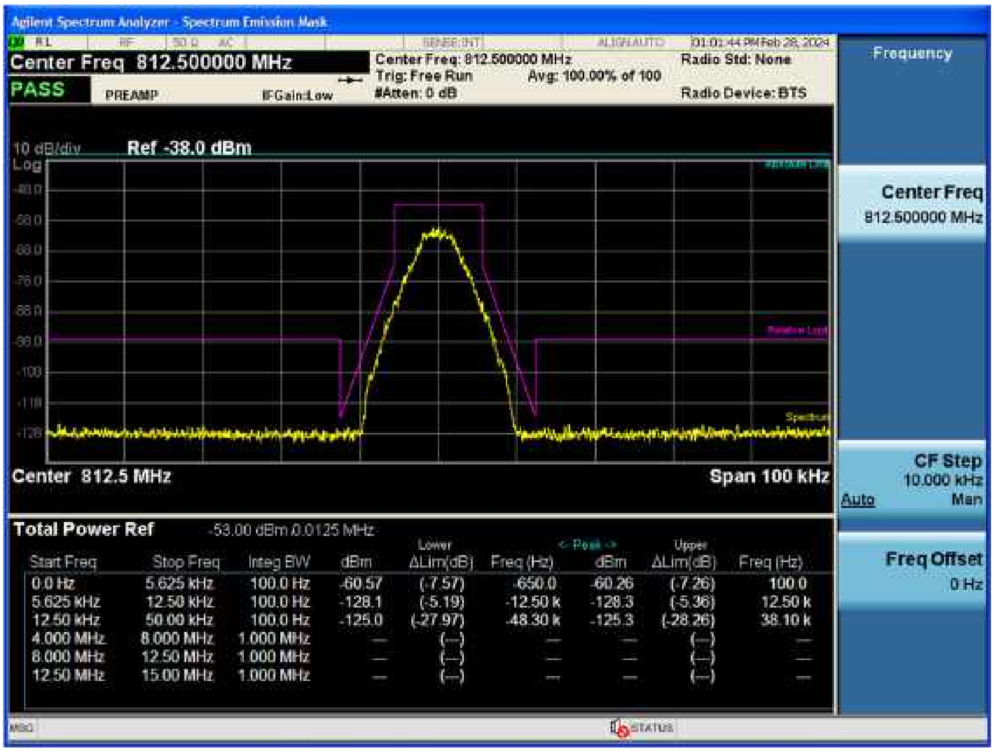
Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Freq (Hz)	dBm	Upper ΔLim(dB)	Freq (Hz)
0.0 Hz	5.625 kHz	100.0 Hz	-64.13	(-8.13)	-150.0	-63.77	(-7.77)	150.0
5.625 kHz	12.50 kHz	100.0 Hz	-128.7	(-3.90)	-12.35 k	-130.3	(-4.33)	12.50 k
12.50 kHz	50.00 kHz	100.0 Hz	-127.4	(-27.42)	-43.00 k	-126.4	(-26.45)	34.95 k
4.000 MHz	8.000 MHz	1.000 MHz	---	(---)	---	---	(---)	---
8.000 MHz	12.50 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

Output / B/ILT; SMR / Uplink / P25 Phase 1 / Mask D

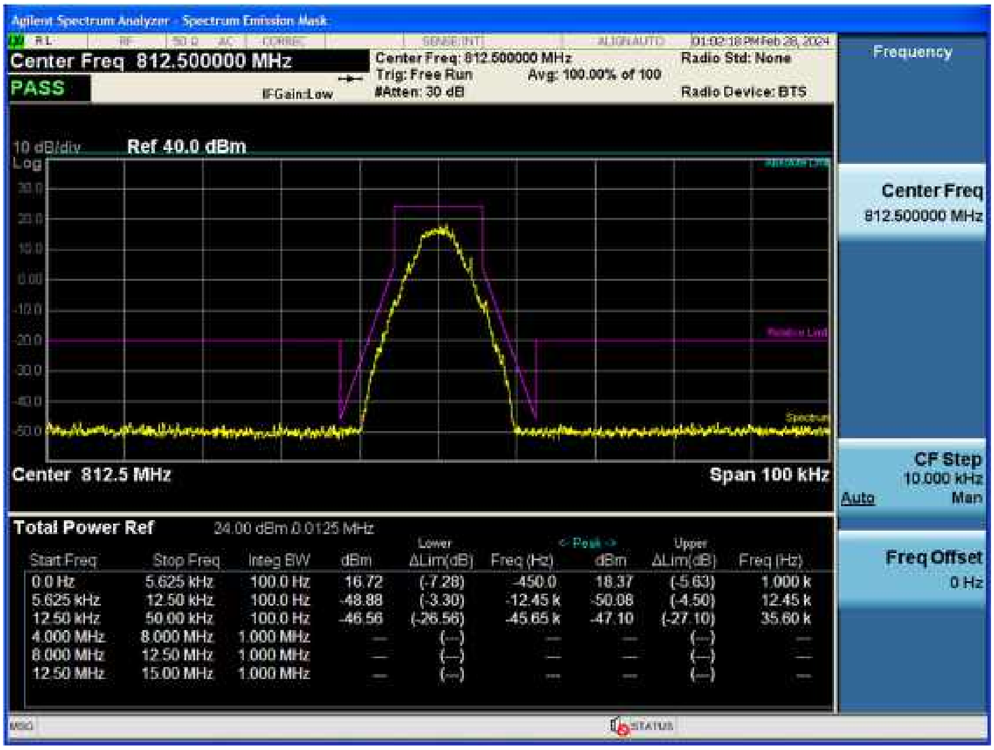


Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Freq (Hz)	dBm	Upper ΔLim(dB)	Freq (Hz)
0.0 Hz	5.625 kHz	100.0 Hz	16.90	(-7.10)	-50.00	16.99	(-7.01)	850.0
5.625 kHz	12.50 kHz	100.0 Hz	-49.95	(-4.01)	-12.50 k	-49.25	(-4.04)	12.40 k
12.50 kHz	50.00 kHz	100.0 Hz	-47.36	(-27.36)	-43.85 k	-46.55	(-26.55)	49.60 k
4.000 MHz	8.000 MHz	1.000 MHz	---	(---)	---	---	(---)	---
8.000 MHz	12.50 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

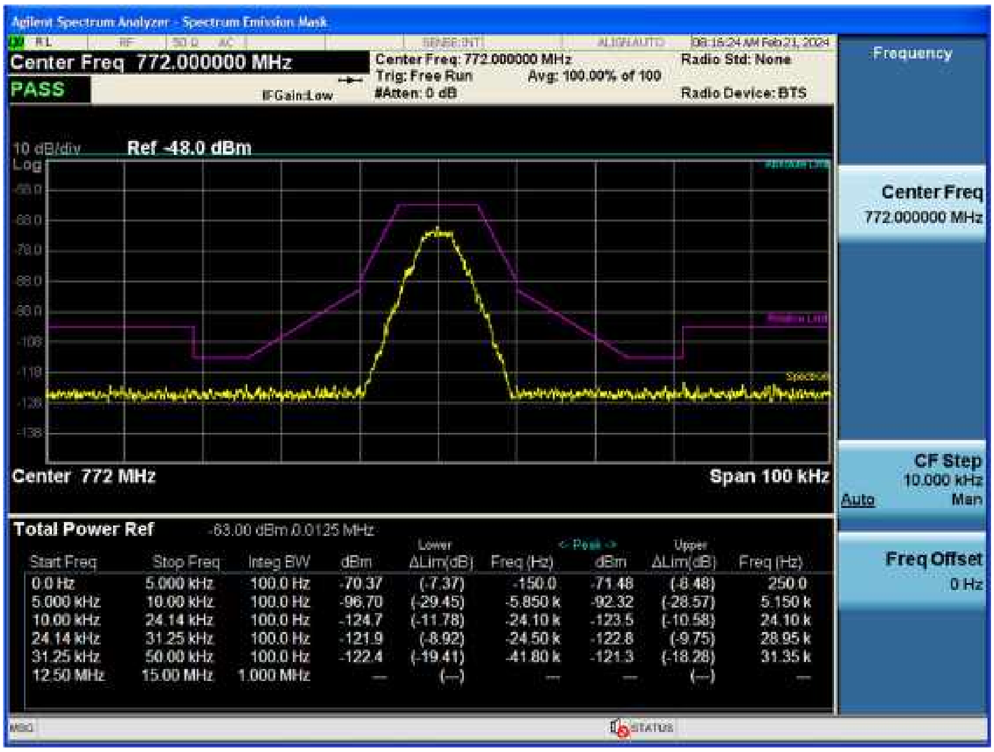
3 dB above the AGC threshold Input / B/ILT; SMR / Uplink / P25 Phase 1 / Mask D



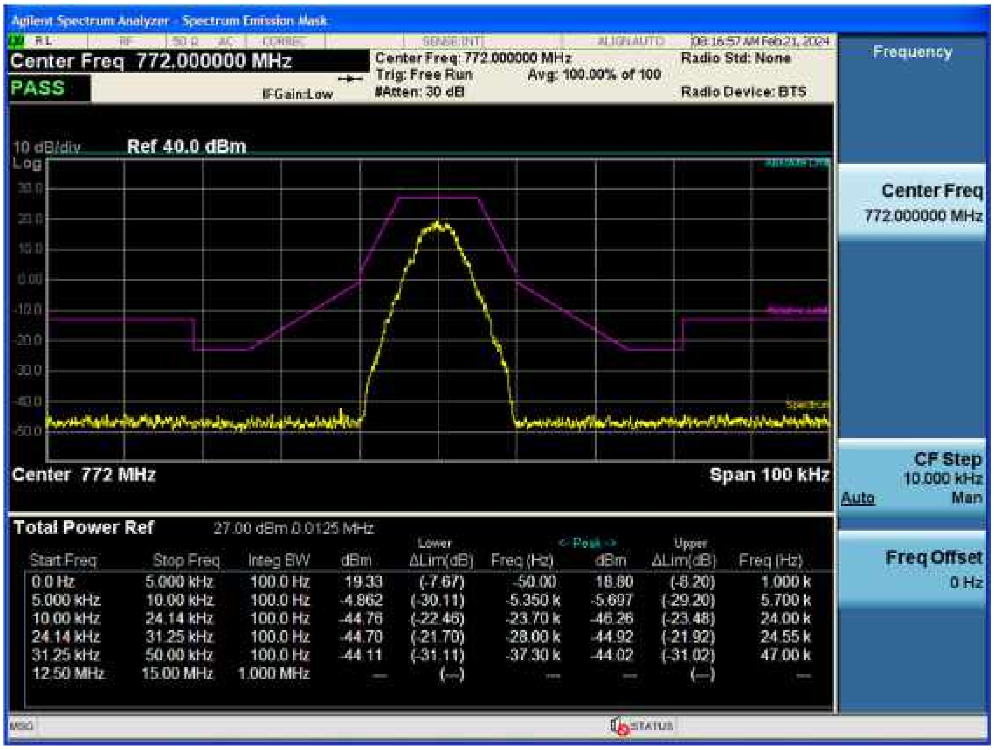
3 dB above the AGC threshold output / B/ILT; SMR / Uplink / P25 Phase 1 / Mask D



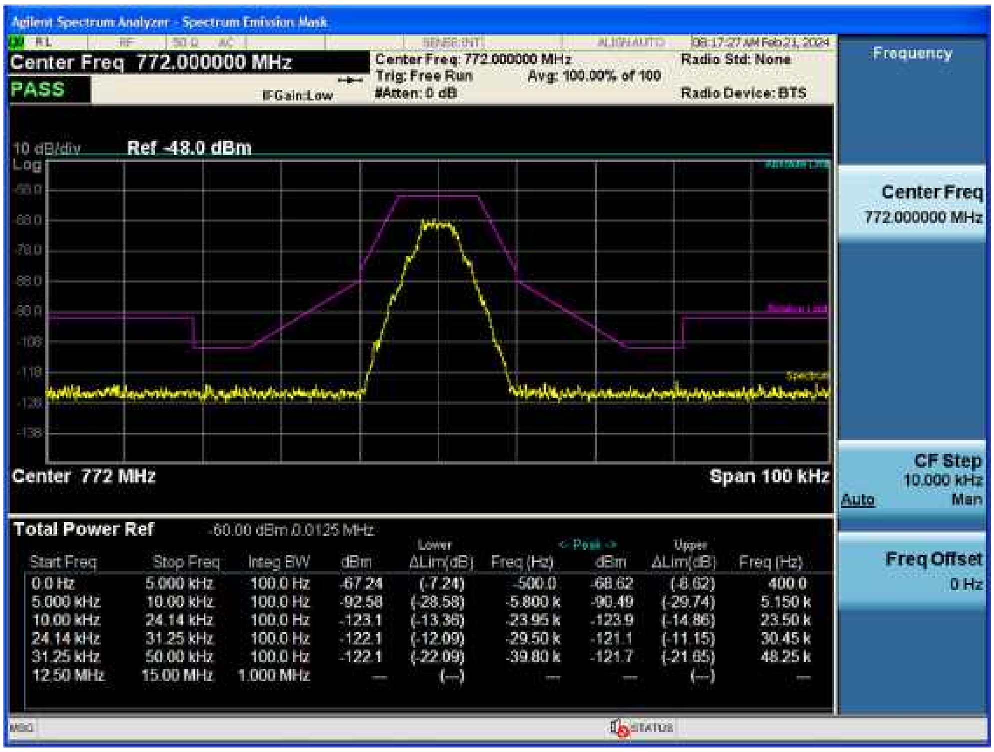
Input / PS Narrowband / Downlink / P25 Phase 1 / Mask C



Output / PS Narrowband / Downlink / P25 Phase 1 / Mask C

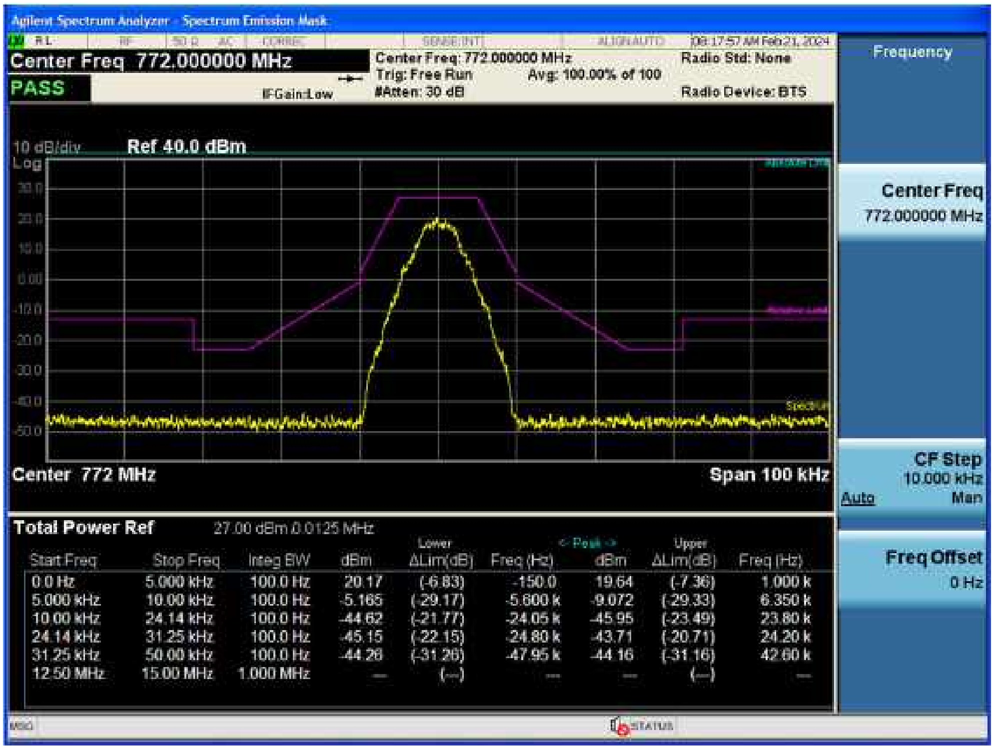


3 dB above the AGC threshold Input / PS Narrowband / Downlink / P25 Phase 1 / Mask C



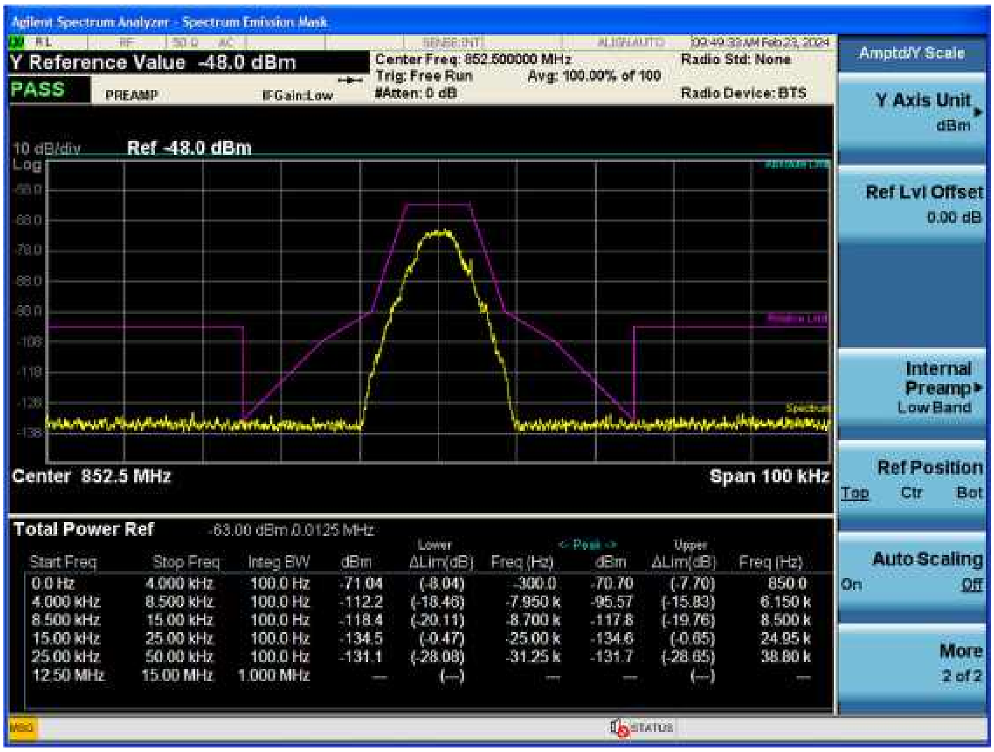
Start Freq	Stop Freq	Integ BW	Lower dBm	Lower ΔLim(dB)	Lower Freq (Hz)	Upper dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	5.000 kHz	100.0 Hz	-67.24	(-7.24)	-500.0	-68.62	(-8.62)	400.0
5.000 kHz	10.00 kHz	100.0 Hz	-92.58	(-28.58)	-5.800 k	-90.49	(-29.74)	5.150 k
10.00 kHz	24.14 kHz	100.0 Hz	-123.1	(-13.36)	-23.95 k	-123.9	(-14.86)	23.50 k
24.14 kHz	31.25 kHz	100.0 Hz	-122.1	(-12.09)	-29.50 k	-121.1	(-11.15)	30.45 k
31.25 kHz	50.00 kHz	100.0 Hz	-122.1	(-22.09)	-39.80 k	-121.7	(-21.65)	48.25 k
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

3 dB above the AGC threshold output / PS Narrowband / Downlink / P25 Phase 1 / Mask C

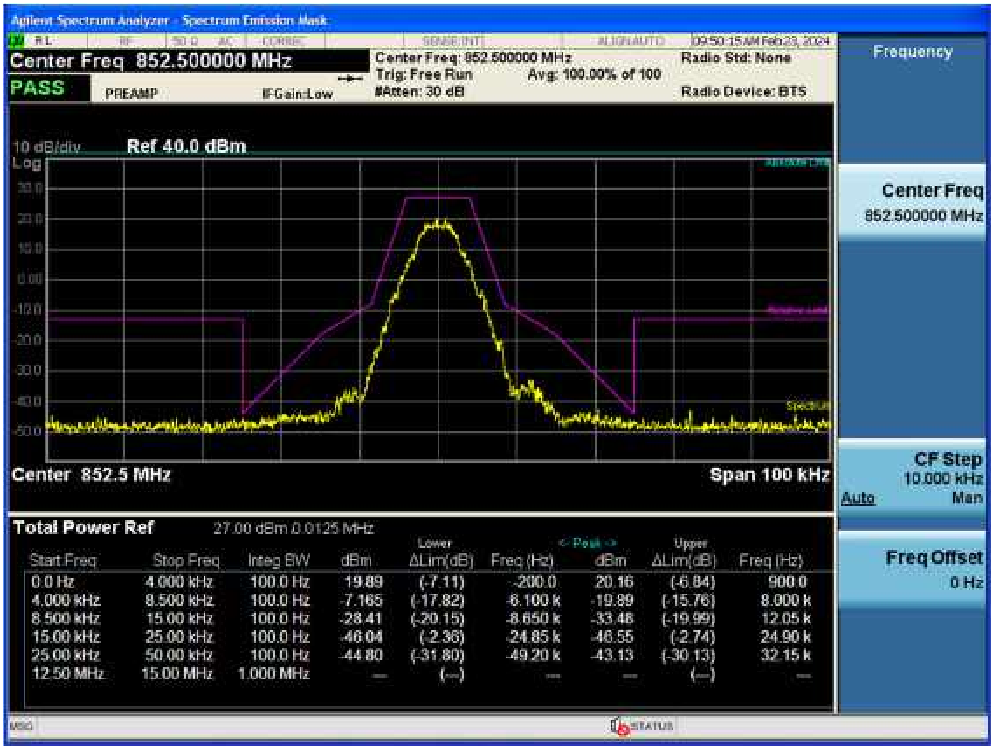


Start Freq	Stop Freq	Integ BW	Lower dBm	Lower ΔLim(dB)	Lower Freq (Hz)	Upper dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	5.000 kHz	100.0 Hz	20.17	(-6.83)	-150.0	19.64	(-7.36)	1.000 k
5.000 kHz	10.00 kHz	100.0 Hz	-5.165	(-29.17)	-5.600 k	-9.072	(-29.33)	6.350 k
10.00 kHz	24.14 kHz	100.0 Hz	-44.62	(-21.77)	-24.05 k	-45.95	(-23.49)	23.80 k
24.14 kHz	31.25 kHz	100.0 Hz	-45.15	(-22.15)	-24.80 k	-43.71	(-20.71)	24.20 k
31.25 kHz	50.00 kHz	100.0 Hz	-44.26	(-31.26)	-47.95 k	-44.16	(-31.16)	42.60 k
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

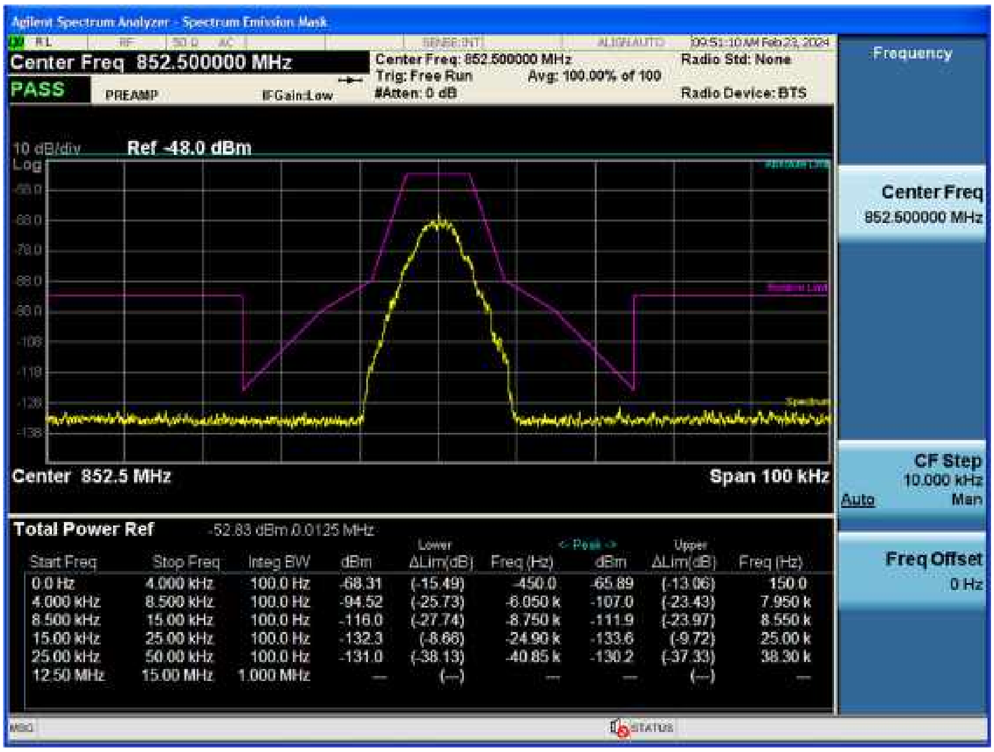
Input / NPSPAC / Downlink / P25 Phase 1 / Mask H



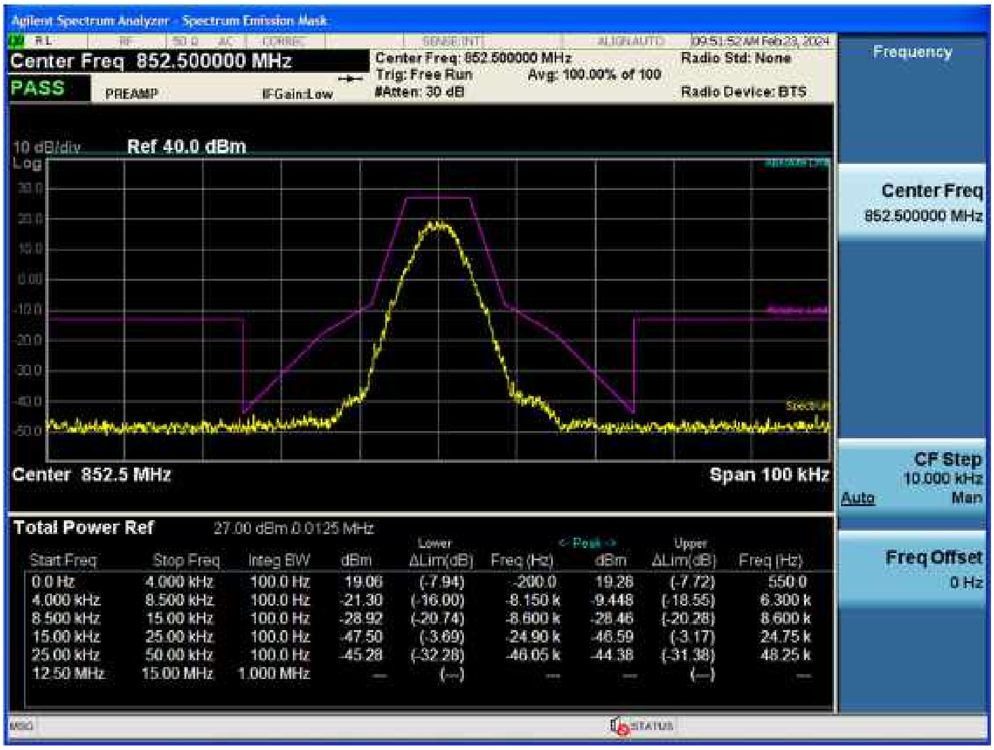
Output / NPSPAC / Downlink / P25 Phase 1 / Mask H



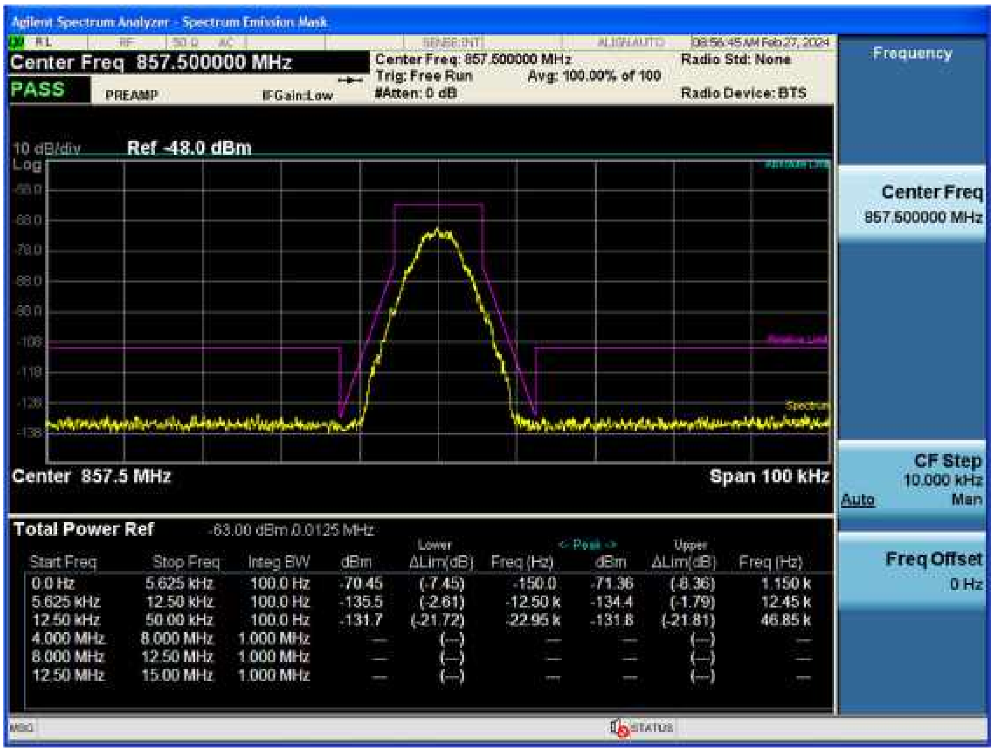
3 dB above the AGC threshold Input / NPSPAC / Downlink / P25 Phase 1 / Mask H



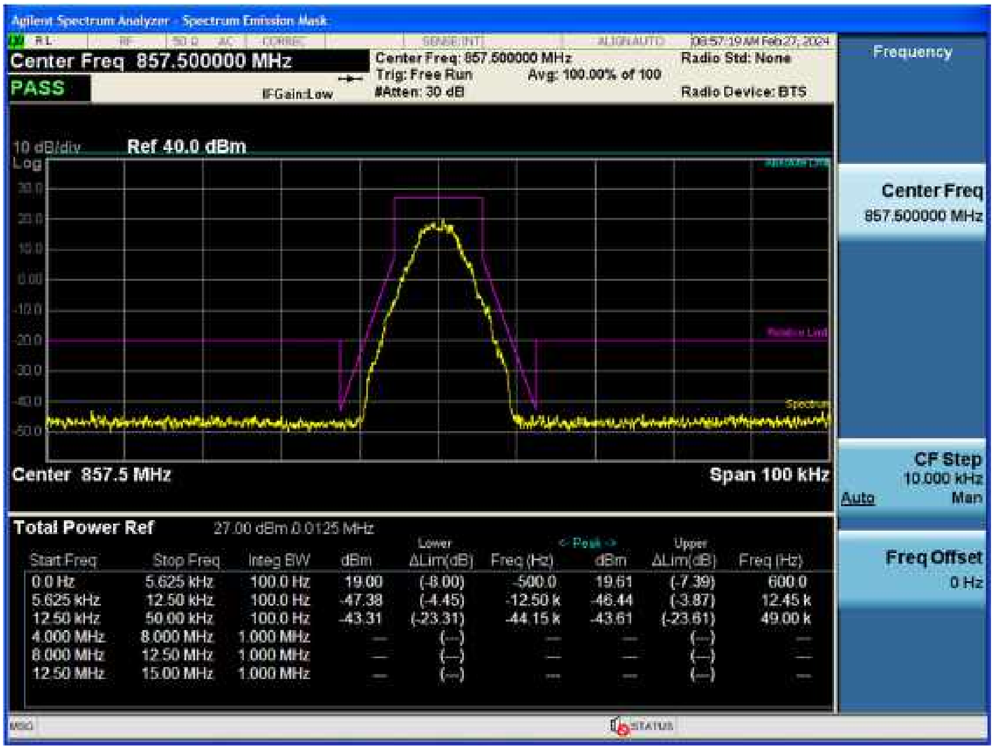
3 dB above the AGC threshold output / NPSPAC / Downlink / P25 Phase 1 / Mask H



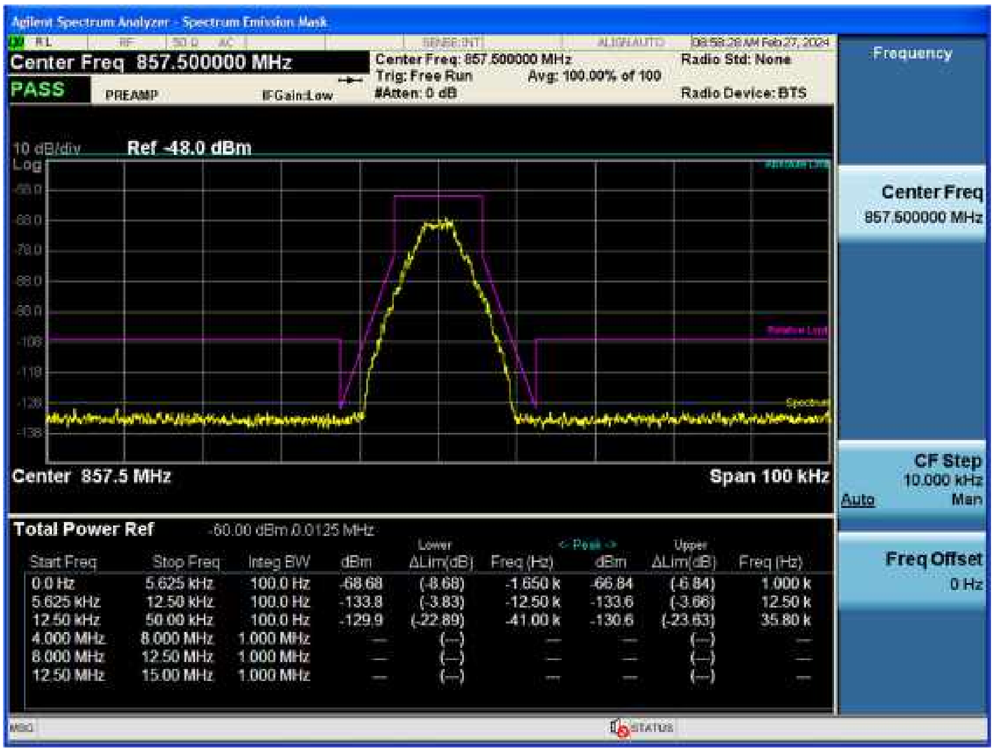
Input / B/ILT; SMR / Downlink / P25 Phase 1 / Mask D



Output / B/ILT; SMR / Downlink / P25 Phase 1 / Mask D

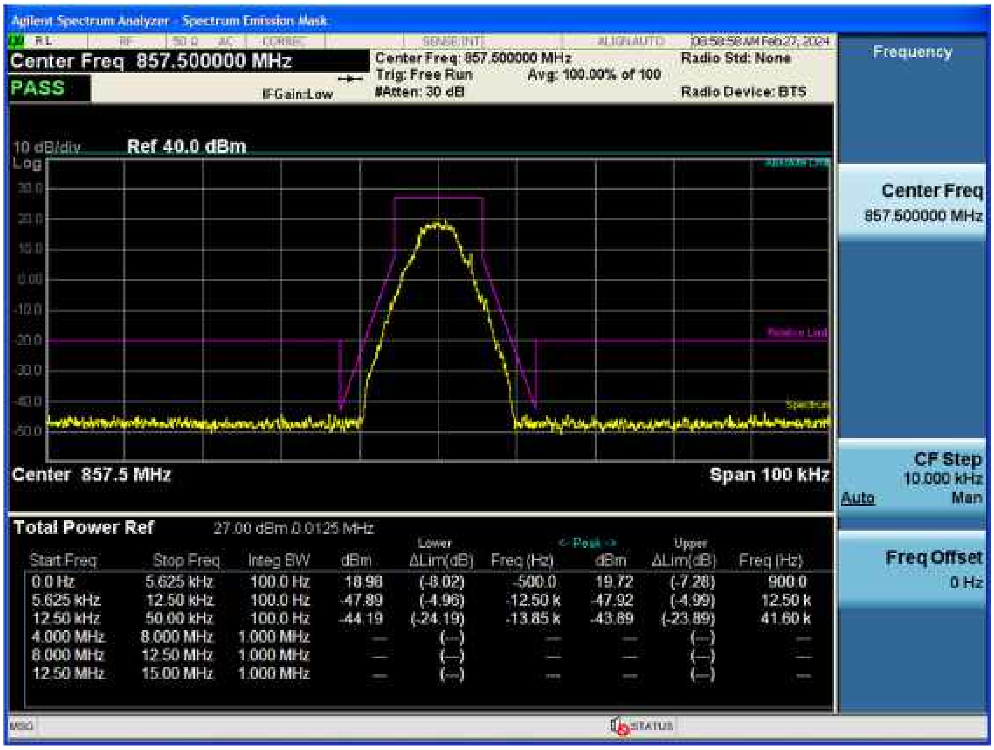


3 dB above the AGC threshold Input / B/ILT; SMR / Downlink / P25 Phase 1 / Mask D



Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Freq (Hz)	dBm	Upper ΔLim(dB)	Freq (Hz)
0.0 Hz	5.625 kHz	100.0 Hz	-68.68	(-8.68)	-1.650 k	-66.84	(-6.84)	1.000 k
5.625 kHz	12.50 kHz	100.0 Hz	-133.8	(-3.83)	-12.50 k	-133.6	(-3.66)	12.50 k
12.50 kHz	50.00 kHz	100.0 Hz	-129.9	(-22.89)	-41.00 k	-130.6	(-23.63)	35.80 k
4.000 MHz	8.000 MHz	1.000 MHz	---	(---)	---	---	(---)	---
8.000 MHz	12.50 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

3 dB above the AGC threshold output / B/ILT; SMR / Downlink / P25 Phase 1 / Mask D



Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Freq (Hz)	dBm	Upper ΔLim(dB)	Freq (Hz)
0.0 Hz	5.625 kHz	100.0 Hz	18.98	(-8.02)	-500.0	19.72	(-7.28)	900.0
5.625 kHz	12.50 kHz	100.0 Hz	-47.89	(-4.96)	-12.50 k	-47.92	(-4.99)	12.50 k
12.50 kHz	50.00 kHz	100.0 Hz	-44.19	(-24.19)	-13.85 k	-43.89	(-23.89)	41.60 k
4.000 MHz	8.000 MHz	1.000 MHz	---	(---)	---	---	(---)	---
8.000 MHz	12.50 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

5.5 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.

§ 90.219 Use of signal boosters.

(e) Device Specifications. In addition to the general rules for equipment certification in § 90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.
  (1) The output power capability of a signal booster must be designed for deployments providing a radiated power not exceeding 5 Watts ERP for each retransmitted channel.

§ 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.

Measurements were in accordance with the test methods section 4.5 of KDB 935210 D05 v01r04.

4.5.2 Measuring input and output power levels for determining amplifier/booster gain
Apply the same guidance as in 3.5.2 to measure the maximum input and output power levels necessary for computing the mean EUT gain, but with the following modifications:

a) Configure the signal generator for CW operation, instead of AWGN,
b) Select the spectrum analyzer positive peak detector, instead of the power averaging (rms) detector,
c) Activate the max hold function, instead of the trace averaging function,
d) Use in conjunction with the guidance in 4.5.3.

4.5.3 Power measurement Method 1: using a spectrum or signal analyzer

a) Set the span to at least 1 MHz.
b) Set the RBW 100 kHz.
c) Set the VBW to ≥ 3 × RBW.
d) Set the detector to PEAK with the trace to MAX HOLD.
e) Place a marker on the peak of the signal, and record the value as the maximum power.
f) Repeat step e) but with the EUT in place.
g) EUT gain may be calculated as described in 4.5.5.

4.5.5 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 rejection 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. The ERP is calculated as follows.
   ex) ERP = Uplink Output Power + Ant. Peak Gain(dBi → dBd)
   = 24.16 dBm + 8.85 dBd (11 dBi – 2.15 dB) = 33.01 dBm
   ERP = Downlink Output Power + Ant. Peak Gain(dBi → dBd)
   = 27.00 dBm + 0.85 dBd (3 dBi – 2.15 dB) = 27.85 dBm

Test Results:

Tabular data of Input / Output Power and Gain

Test Band	Link	Signal	No. of Carriers	Total BW	f_0 Frequency	Input Power	Output Power	Gain	E.R.P.	
				(kHz)	(MHz)	(dBm)		(dB)	(dBm)	(W)
PS Narrowband	Uplink	CW	1	12.5	800.01	-55.95	24.16	80.11	33.010	2.000
			12	150	800.01	-56.09	23.96	80.05	32.810	1.910
	Downlink		1	12.5	769.10	-62.90	26.97	89.87	27.820	0.605
			12	150	769.10	-63.30	26.97	90.27	27.820	0.605
NPSPAC	Uplink		1	12.5	807.67	-55.93	23.90	79.83	32.750	1.884
			12	150	807.67	-55.85	23.95	79.80	32.800	1.905
	Downlink		1	12.5	852.89	-62.78	27.00	89.78	27.850	0.610
			12	150	852.89	-62.95	26.93	89.88	27.780	0.600
B/ILT; SMR	Uplink		1	12.5	811.96	-55.73	24.01	79.74	32.860	1.932
			12	150	811.96	-55.85	23.98	79.83	32.830	1.919
	Downlink		1	12.5	856.74	-62.89	26.92	89.81	27.770	0.598
			12	150	856.74	-63.08	26.75	89.83	27.600	0.575
ESMR	Uplink	GSM	-	-	821.91	-56.11	23.96	80.07	32.810	1.910
		CDMA	-	-	821.91	-56.17	24.18	80.35	33.030	2.009
		LTE 5 MHz	-	-	821.50	-55.97	23.83	79.80	32.680	1.854
	Downlink	GSM	-	-	868.50	-63.07	27.05	90.12	27.900	0.617
		CDMA	-	-	868.38	-62.91	27.14	90.05	27.990	0.630
		LTE 5 MHz	-	-	866.50	-63.04	27.07	90.11	27.920	0.619

Antenna Peak Gain: 11 dBi(Uplink), 3 dBi(Downlink)

5.6. NOISE FIGURE

Test Requirements:

§ 90.219 Use of signal boosters.

(e) Device Specifications. In addition to the general rules for equipment certification in § 90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.

(2) The noise figure of a signal booster must not exceed 9 dB in either direction.

Test Procedures:

Measurements were in accordance with Agilent Application Note 57-1, 'The Direct Noise Measurement Method".

The output power of the device is measured with an input termination at a temperature of approximately 290K. If the gain of the device and noise bandwidth of the measurement system is known, the noise factor can be determined.

$$F_{sys} = \frac{N_0}{kT_0BG}$$

F_{sys} = System Noise Factor
N_0 = Output Noise Power
k = Boltzmann's Constant
T_0 = Standard Noise Temperature (290K)
B = Noise Bandwidth
G = Gain

'kT_0B' calculation result for 1 MHz noise bandwidth is -114 dBm/MHz.
'Gain' value can be obtained from the test performed previously.

For measure the 'output noise power', perform the following procedure.

a) Remove a signal generator from the input port of EUT then terminate it.
b) Turn off the AGC function in EUT.
c) Connect a spectrum analyzer to output port of EUT.
d) Set the RBW 1 MHz. and set the VBW to ≥ 3 × RBW.
e) Measure the maximum output noise power for EUT pass band.

After the measurement, calculate the noise figure according to the following formular.

Noise Figure = Noise Output Power - kT0B - Gain

Test Results:

Test Band	Link	Input Power (dBm)	Output Power (dBm)	Gain (dB)	kT0B (dBm/MHz)	Measured Value (dBm)	Noise Figure (dB)
PS Narrowband	Uplink	-55.95	24.16	80.11	-114	-25.78	8.11
	Downlink	-62.90	26.97	89.87	-114	-17.88	6.25
NPSPAC	Uplink	-55.93	23.90	79.83	-114	-28.51	5.66
	Downlink	-62.78	27.00	89.78	-114	-17.43	6.79
B/ILT; SMR	Uplink	-55.73	24.01	79.74	-114	-28.16	6.10
	Downlink	-63.08	26.92	90.00	-114	-17.38	6.63

Plot data of Noise Figure

Noise Figure / PS Narrowband / Uplink

Noise Figure / 800 MHz(NPSPAC, B/ILT; SMR) / Uplink

Note: The EUT amplifies the frequency range of 806 MHz ~ 824 MHz at once, but the testing was performed only for the frequency range of 806 MHz ~ 816 MHz. The result of marker 1 is irrelevant.

Noise Figure / PS Narrowband / Downlink

Noise Figure / 800 MHz(NPSPAC, B/ILT; SMR) / Downlink

Note: The EUT amplifies the frequency range of 851 MHz ~ 869 MHz at once, but the testing was performed only for the frequency range of 851 MHz ~ 861 MHz. The result of marker 1 is irrelevant.

5.7. 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.

§ 90.219 Use of signal boosters.

(e) Device Specifications. In addition to the general rules for equipment certification in § 90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.

  (3) Spurious emissions from a signal booster must not exceed −13 dBm within any 100 kHz measurement bandwidth.

§ 90.543 Emission limitations.

(f) For operations in the 758–775 MHz and 788–805 MHz bands, all emissions including harmonics 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.

§ 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 + 10Log10(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.

Measurements were in accordance with the test methods section 4.7 of KDB 935210 D05 v01r04.

Spurious emissions shall be measured using a single test signal sequentially tuned to frequencies within each authorized frequency band of operation.
Intermodulation products shall be measured using two CW signals with all available channel spacing with the center between these channels being equal to the center frequency f_0 as determined from Out-of-band rejection test.

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

a) Connect a signal generator to the input of the EUT.

b) If the signal generator is not capable of producing two independent modulated carriers simultaneously, then two discrete signal generators can be connected, with an appropriate combining network to support the two-signal test.

c) Configure the two signal generators to produce CW on frequencies spaced consistent with f_0, with amplitude levels set to just below the AGC threshold.

d) Connect a spectrum analyzer to the EUT output.

e) Set the span to 100 kHz.

f) Set RBW = 300 Hz with VBW ≥ 3 × RBW.

g) Set the detector to power averaging (rms).

h) Place a marker on highest intermodulation product amplitude.

i) Capture the plot for inclusion in the test report.

j) Repeat steps c) to h) with the composite input power level set to 3 dB above the AGC threshold.

k) Repeat steps b) to i) for all operational bands.

4.7.3 EUT spurious emissions conducted measurements

a) Connect a signal generator to the input of the EUT.

b) Configure the signal generator to produce a CW signal.

c) Set the frequency of the CW signal to the center channel of the EUT passband.

d) Set the output power level so that the resultant signal is just below the AGC threshold.

e) Connect a spectrum analyzer to the output of the EUT, using appropriate attenuation as necessary.

f) Set the RBW = 100 kHz. (i.e., for 30 MHz to 1 GHz PLMRS and/or PSRS booster devices)

g) Set the VBW = 3 × RBW.

h) Set the Sweep time = auto-couple.

i) Set the detector to PEAK.

j) Set the spectrum analyzer start frequency to 30 MHz (or the lowest radio frequency signal generated in the EUT, without going below 9 kHz if the EUT has additional internal clock frequencies), and the stop frequency to 10 times the highest allowable frequency of the EUT passband.

k) Select MAX HOLD, and use the marker peak function to find the highest emission(s) outside the passband. (This could be either at a frequency lesser or greater than the passband frequencies.)

l) Capture a plot for inclusion in the test report.

m) Repeat steps c) to l) for each authorized frequency band/block of operation.

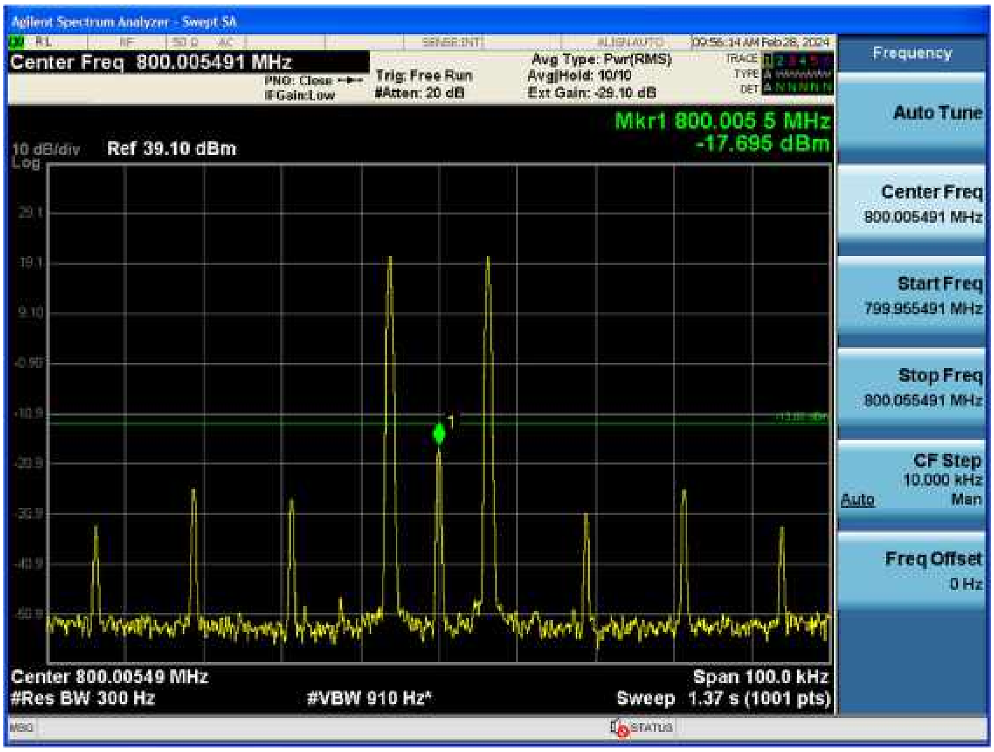
Note: In some bands, RBW was reduced to 0.1 %, 1 %, and 10 % of the reference bandwidth for measuring out-of-band and unwanted spurious emissions level, so the limit lines were compensated according to section 5.7.2 of ANSI C63.26-2015.

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

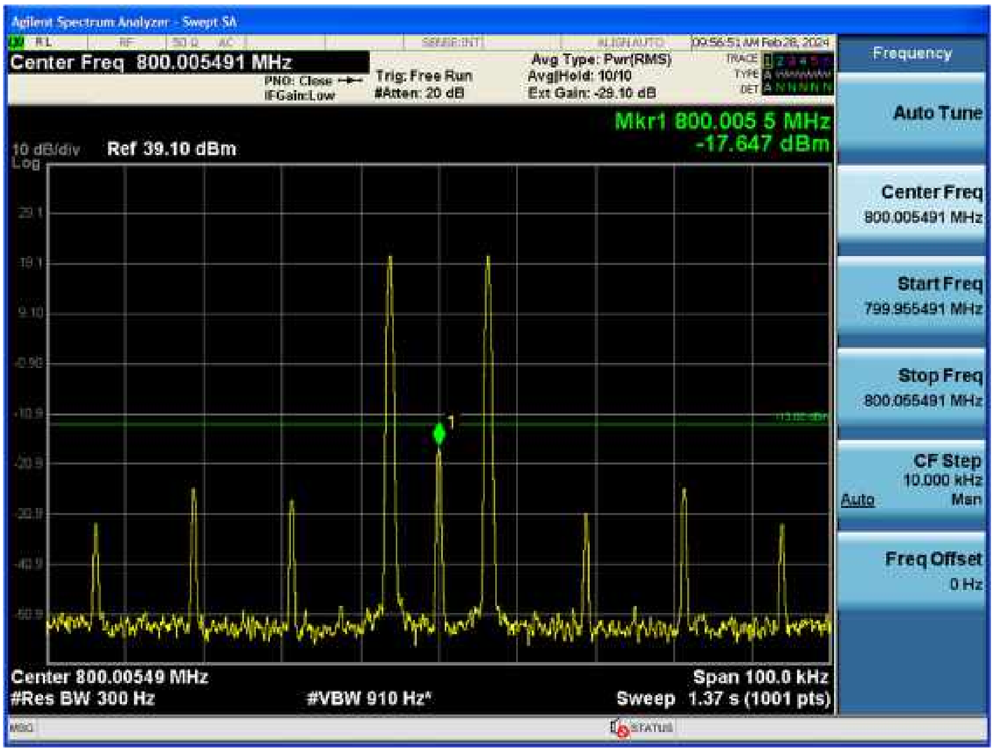
Test Results

Plot data of Out-of-band/out-of-block emissions

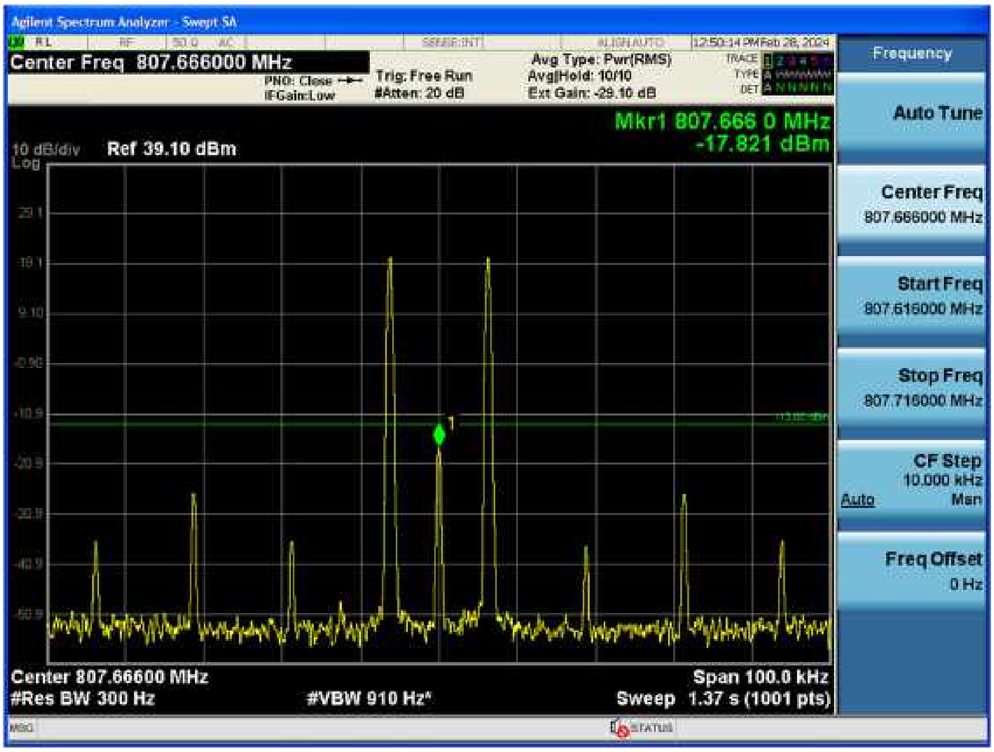
Out-of-band (two adjacent test signals) / PS Narrowband / Uplink



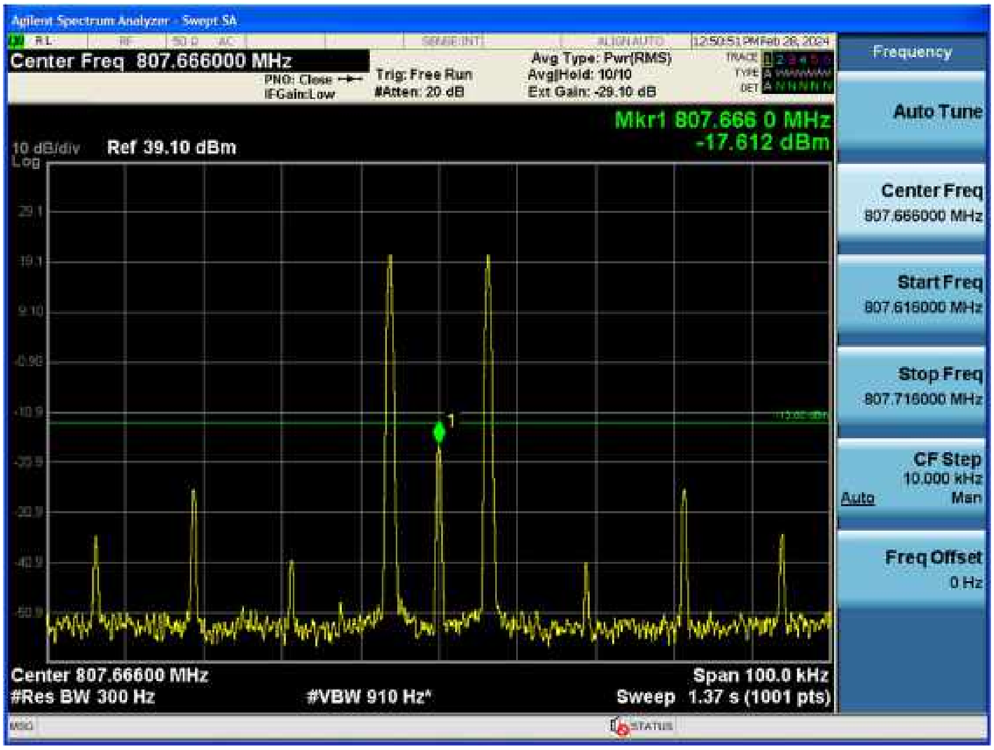
+3 dB above Out-of-band (two adjacent test signals) / PS Narrowband / Uplink



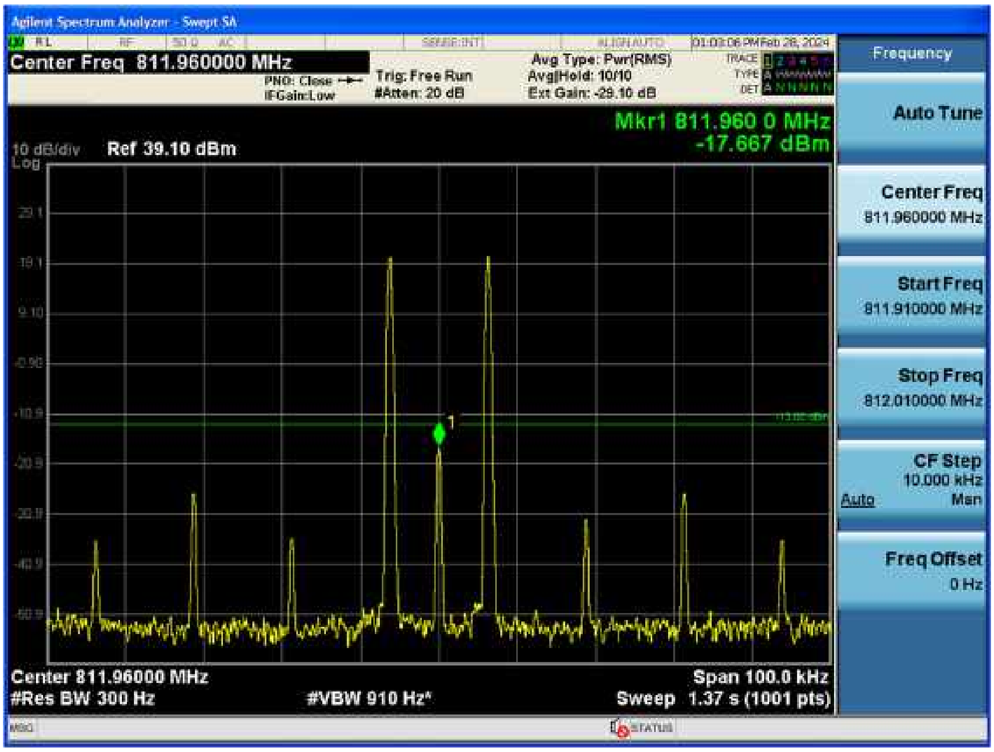
Out-of-band (two adjacent test signals) / NPSPAC / Uplink



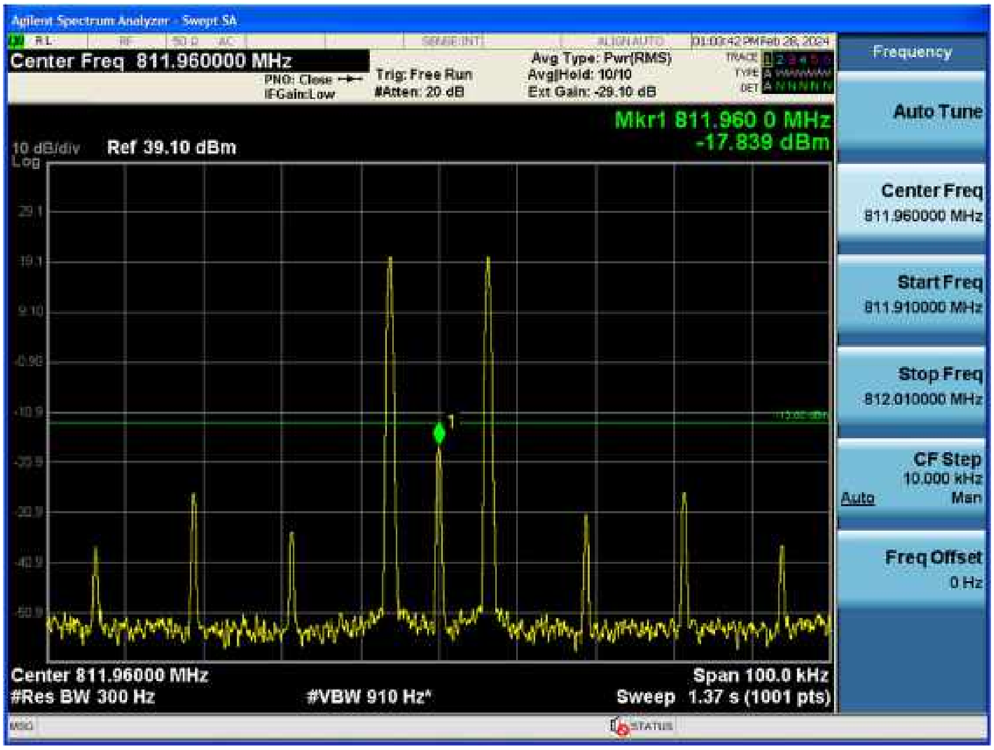
+3 dB above Out-of-band (two adjacent test signals) / NPSPAC / Uplink



Out-of-band (two adjacent test signals) / B/ILT; SMR / Uplink



+3 dB above Out-of-band (two adjacent test signals) / B/ILT; SMR / Uplink



Out-of-band (two adjacent test signals) / ESMR / Uplink / GSM / Lower

Out-of-band (two adjacent test signals) / ESMR / Uplink / GSM / Upper

+3 dB above Out-of-band (two adjacent test signals) / ESMR / Uplink / GSM / Lower

+3 dB above Out-of-band (two adjacent test signals) / ESMR / Uplink / GSM / Upper

Out-of-band (two adjacent test signals) / ESMR / Uplink / CDMA / Lower

Out-of-band (two adjacent test signals) / ESMR / Uplink / CDMA / Upper

+3 dB above Out-of-band (two adjacent test signals) / ESMR / Uplink / CDMA / Lower

+3 dB above Out-of-band (two adjacent test signals) / ESMR / Uplink / CDMA / Upper

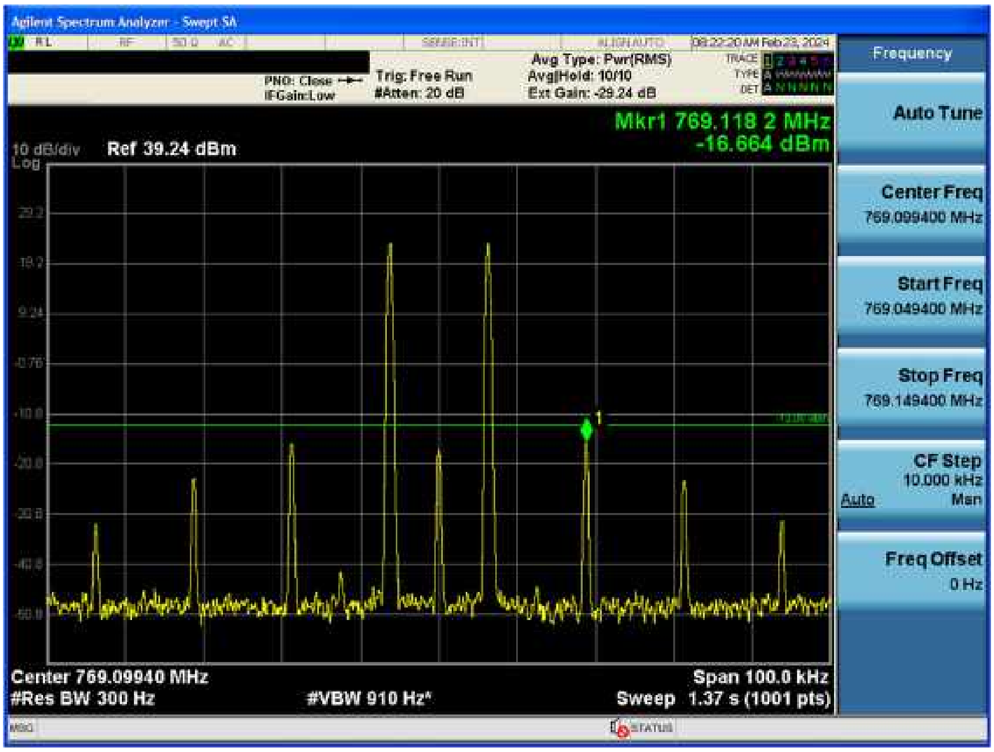
Out-of-band (two adjacent test signals) / ESMR / Uplink / LTE 5 MHz / Lower

Out-of-band (two adjacent test signals) / ESMR / Uplink / LTE 5 MHz / Upper

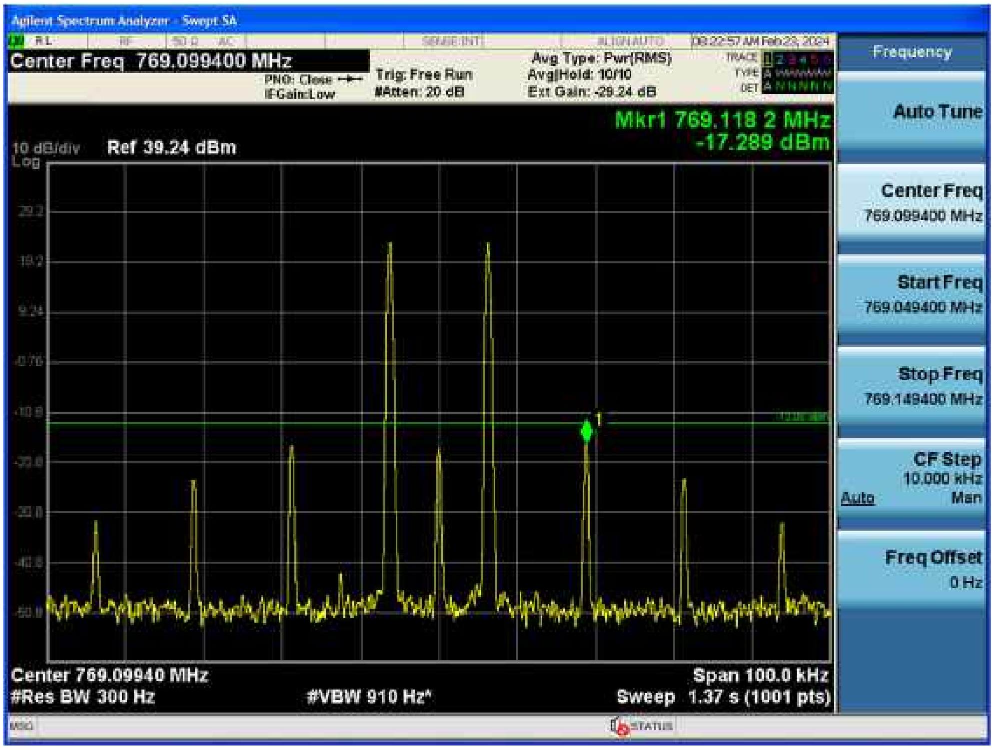
+3 dB above Out-of-band (two adjacent test signals) / ESMR / Uplink / LTE 5 MHz / Lower

+3 dB above Out-of-band (two adjacent test signals) / ESMR / Uplink / LTE 5 MHz / Upper

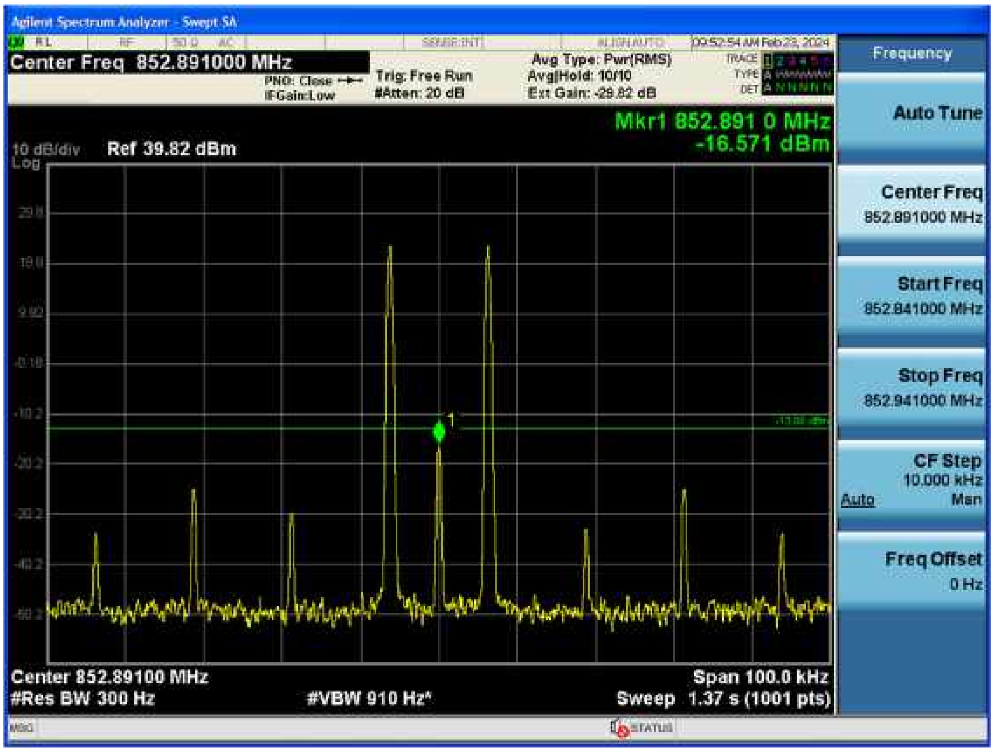
Out-of-band (two adjacent test signals) / PS Narrowband / Downlink



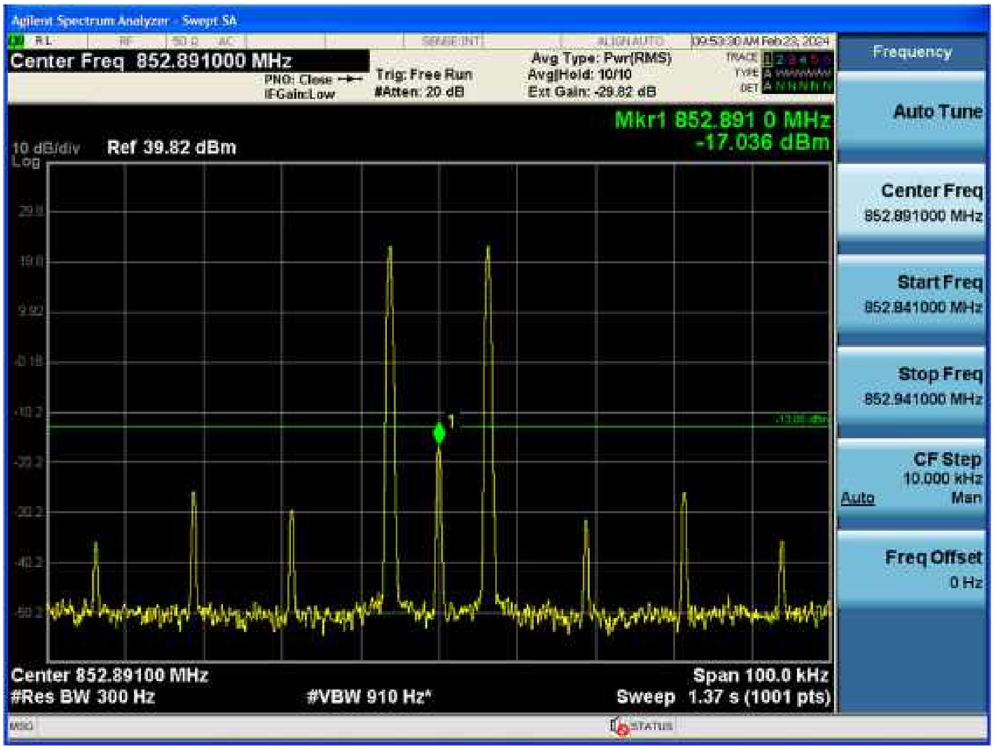
+3 dB above Out-of-band (two adjacent test signals) / PS Narrowband / Downlink



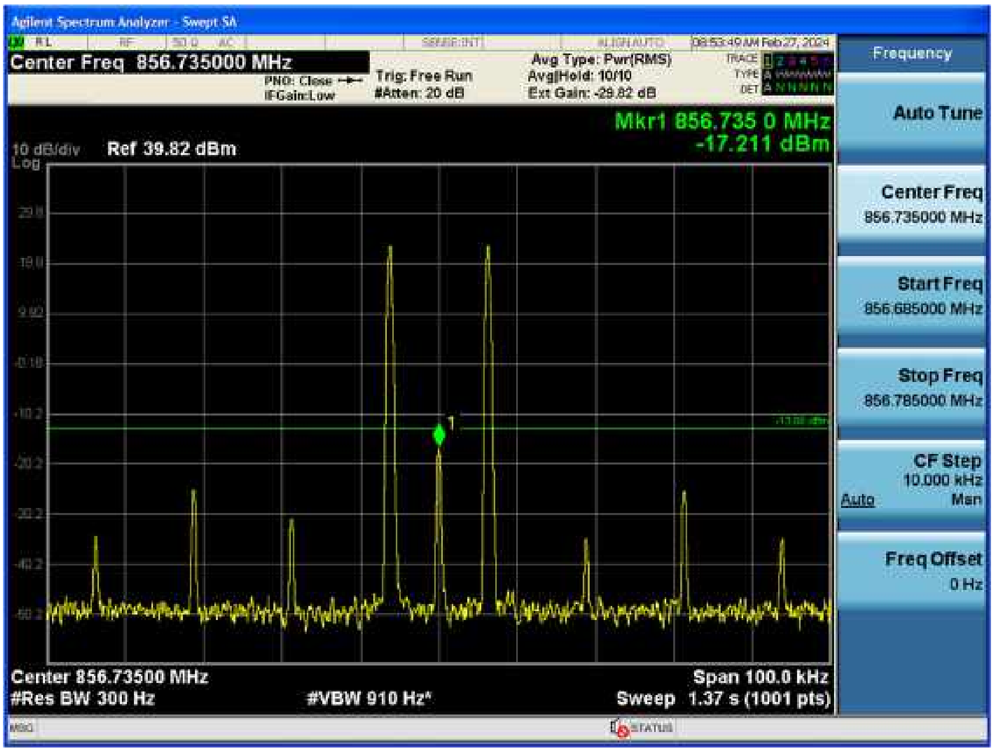
Out-of-band (two adjacent test signals) / NPSPAC / Downlink



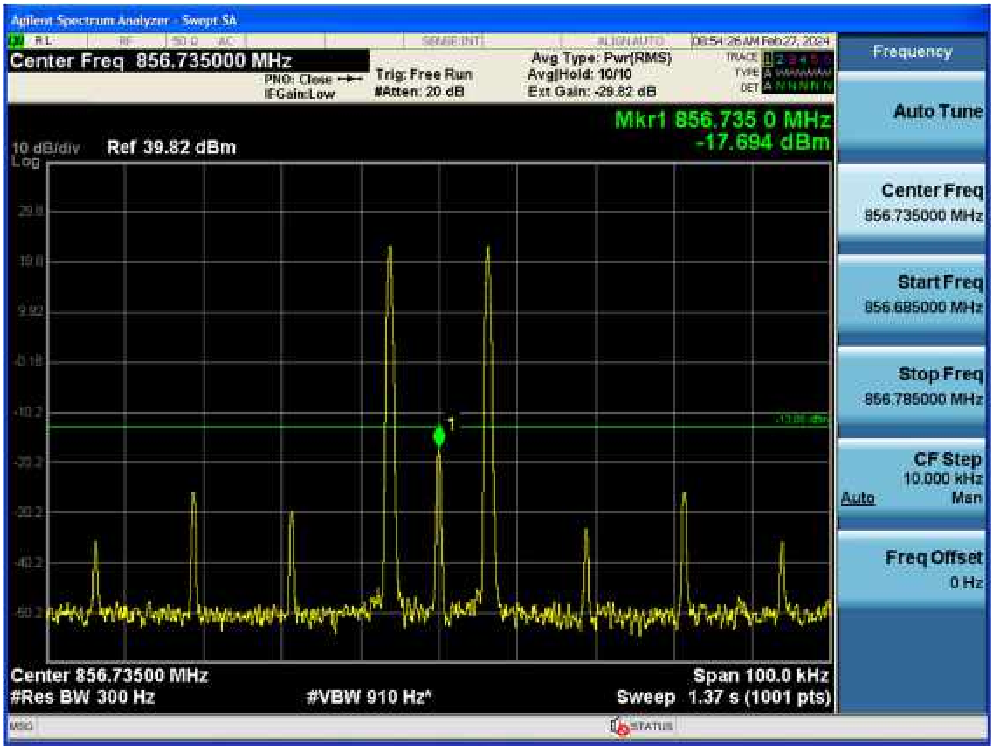
+3 dB above Out-of-band (two adjacent test signals) / NPSPAC / Downlink



Out-of-band (two adjacent test signals) / B/ILT; SMR / Downlink



+3 dB above Out-of-band (two adjacent test signals) / B/ILT; SMR / Downlink



Out-of-band (two adjacent test signals) / ESMR / Downlink / GSM / Lower

Out-of-band (two adjacent test signals) / ESMR / Downlink / GSM / Upper

+3 dB above Out-of-band (two adjacent test signals) / ESMR / Downlink / GSM / Lower

+3 dB above Out-of-band (two adjacent test signals) / ESMR / Downlink / GSM / Upper

Out-of-band (two adjacent test signals) / ESMR / Downlink / CDMA / Lower

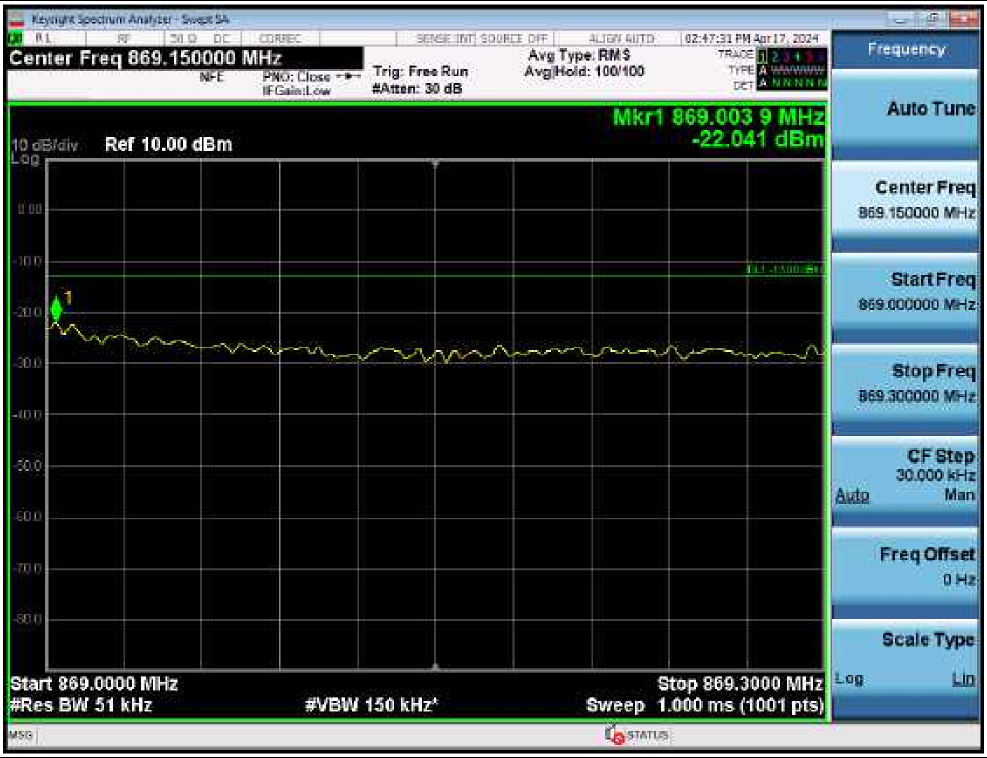
Out-of-band (two adjacent test signals) / ESMR / Downlink / CDMA / Upper

+3 dB above Out-of-band (two adjacent test signals) / ESMR / Downlink / CDMA / Lower

+3 dB above Out-of-band (two adjacent test signals) / ESMR / Downlink / CDMA / Upper

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

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



+3 dB above Out-of-band (two adjacent test signals) / ESMR / Downlink / LTE 5 MHz / Lower

+3 dB above Out-of-band (two adjacent test signals) / ESMR / Downlink / LTE 5 MHz / Upper

Out-of-band (single test signal) / ESMR / Uplink / GSM / Lower

Out-of-band (single test signal) / ESMR / Uplink / GSM / Upper

+3 dB above Out-of-band (single test signal) / ESMR / Uplink / GSM / Lower

+3 dB above Out-of-band (single test signal) / ESMR / Uplink / GSM / Upper

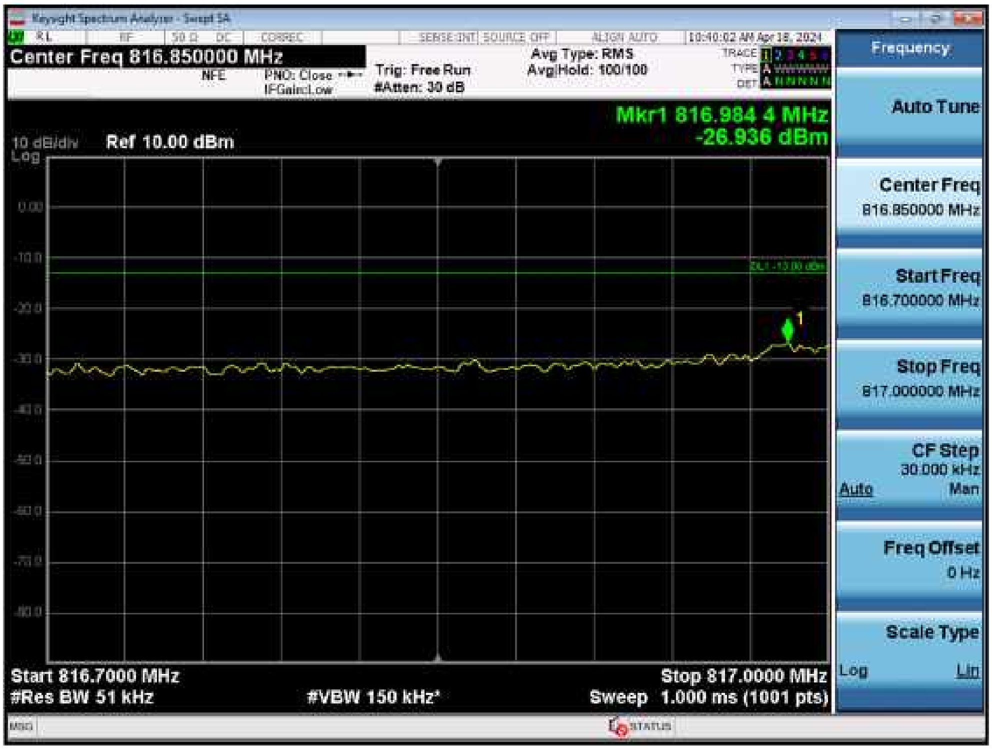
Out-of-band (single test signal) / ESMR / Uplink / CDMA / Lower

Out-of-band (single test signal) / ESMR / Uplink / CDMA / Upper

+3 dB above Out-of-band (single test signal) / ESMR / Uplink / CDMA / Lower

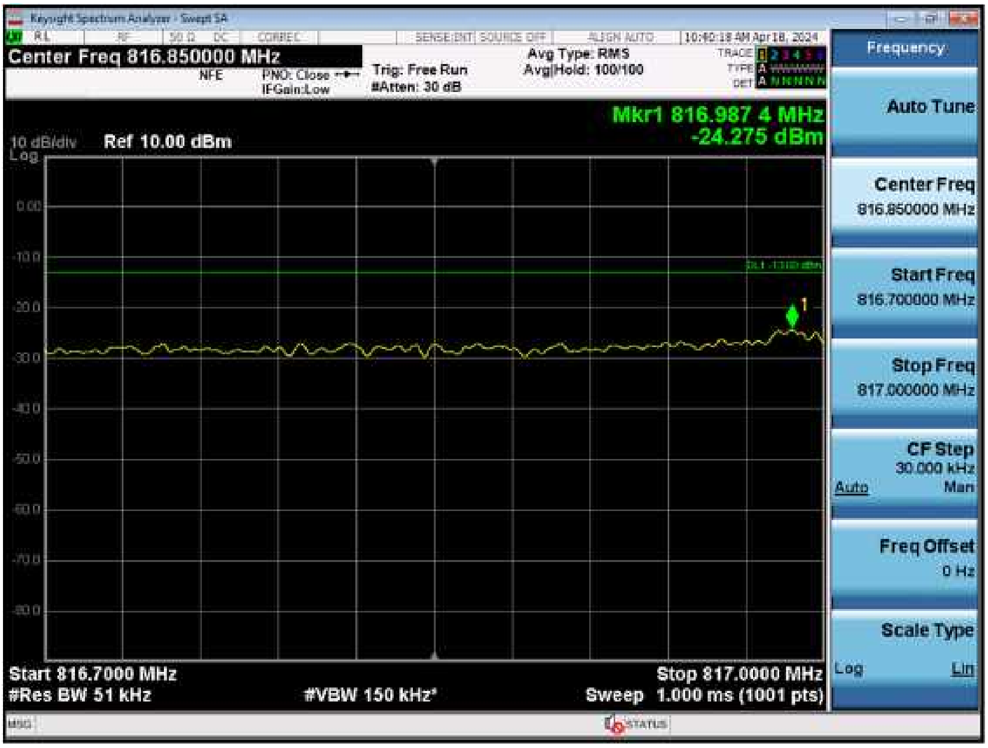
+3 dB above Out-of-band (single test signal) / ESMR / Uplink / CDMA / Upper

Out-of-band (single test signal) / ESMR / Uplink / LTE 5 MHz / Lower

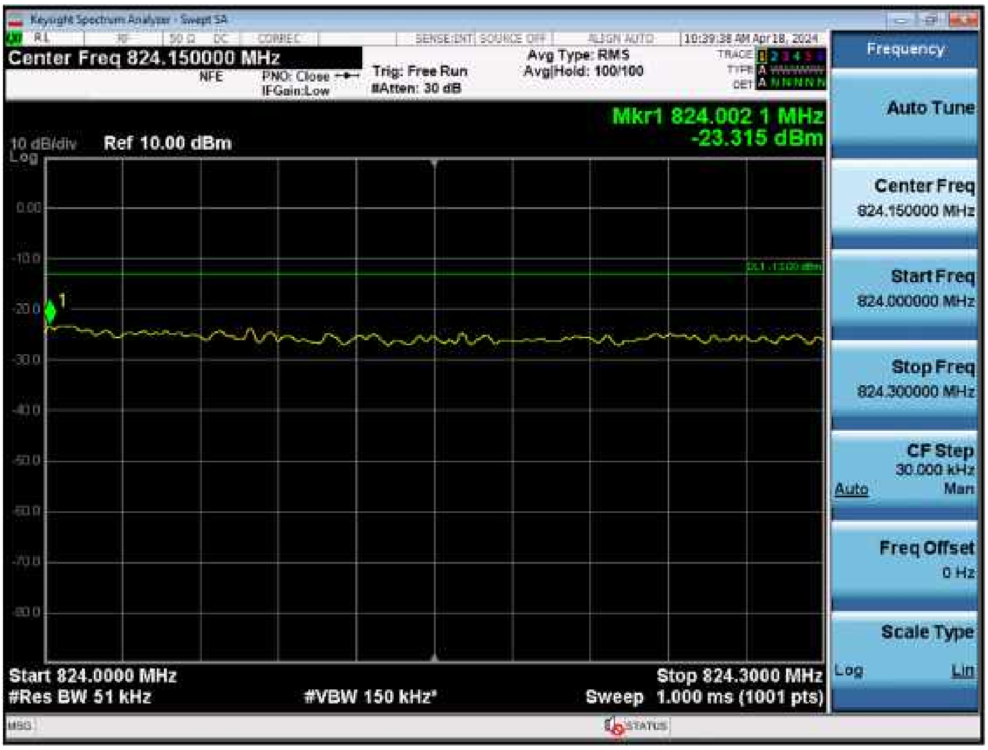


Out-of-band (single test signal) / ESMR / Uplink / LTE 5 MHz / Upper

+3 dB above Out-of-band (single test signal) / ESMR / Uplink / LTE 5 MHz / Lower



+3 dB above Out-of-band (single test signal) / ESMR / Uplink / LTE 5 MHz / Upper



Out-of-band (single test signal) / ESMR / Downlink / GSM / Lower

Out-of-band (single test signal) / ESMR / Downlink / GSM / Upper

+3 dB above Out-of-band (single test signal) / ESMR / Downlink / GSM / Lower

+3 dB above Out-of-band (single test signal) / ESMR / Downlink / GSM / Upper

Out-of-band (single test signal) / ESMR / Downlink / CDMA / Lower

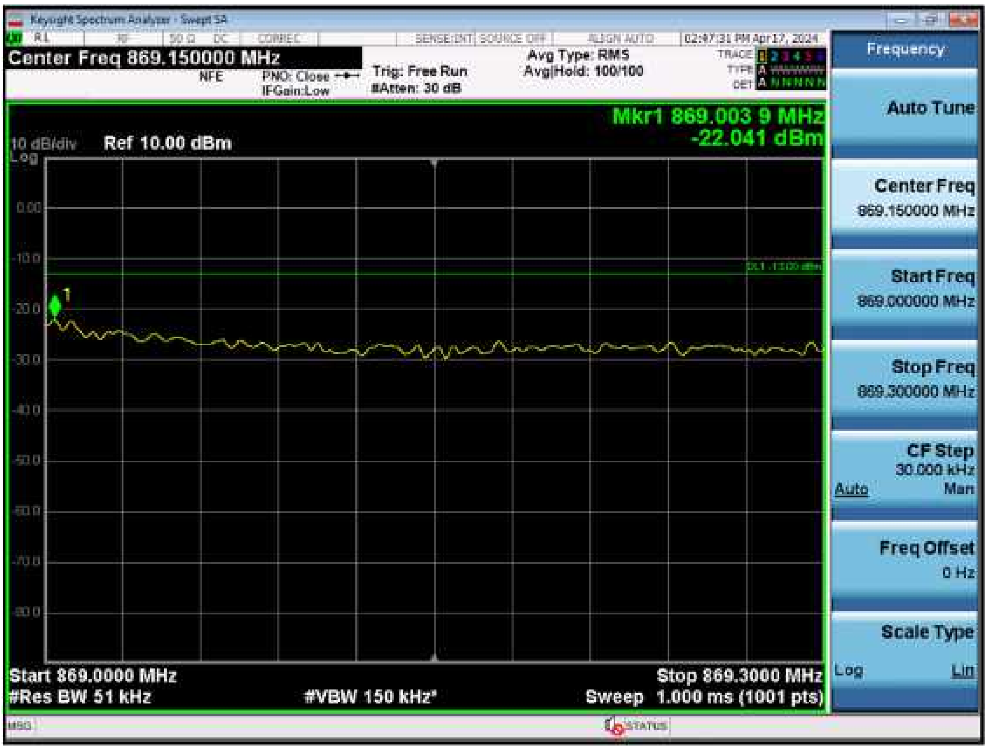
Out-of-band (single test signal) / ESMR / Downlink / CDMA / Upper

+3 dB above Out-of-band (single test signal) / ESMR / Downlink / CDMA / Lower

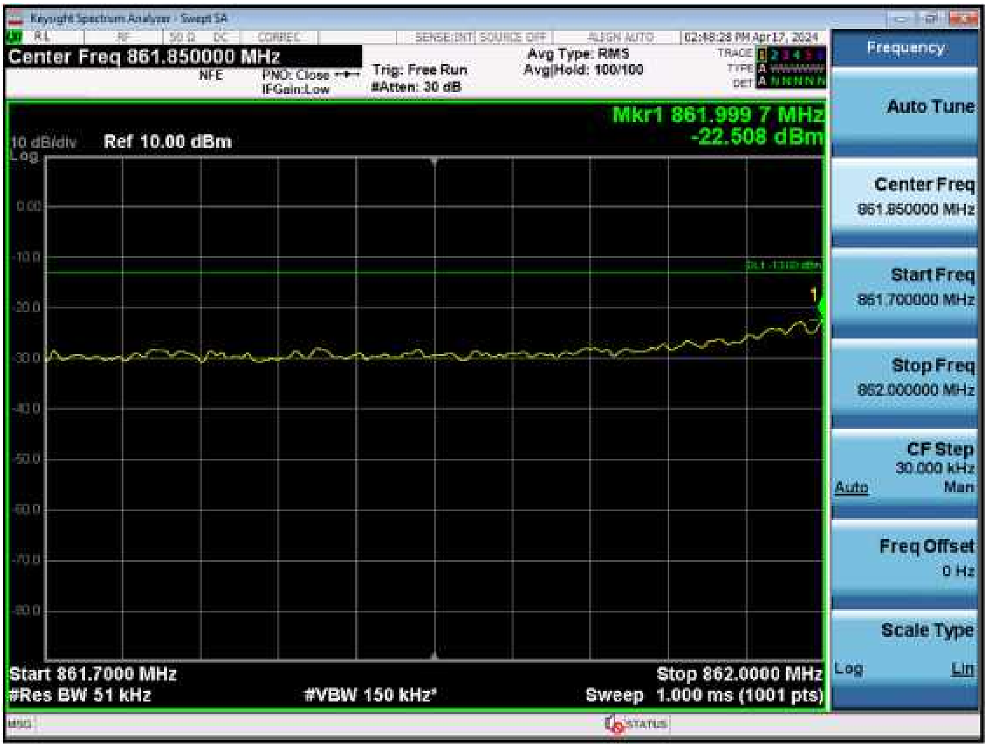
+3 dB above Out-of-band (single test signal) / ESMR / Downlink / CDMA / Upper

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

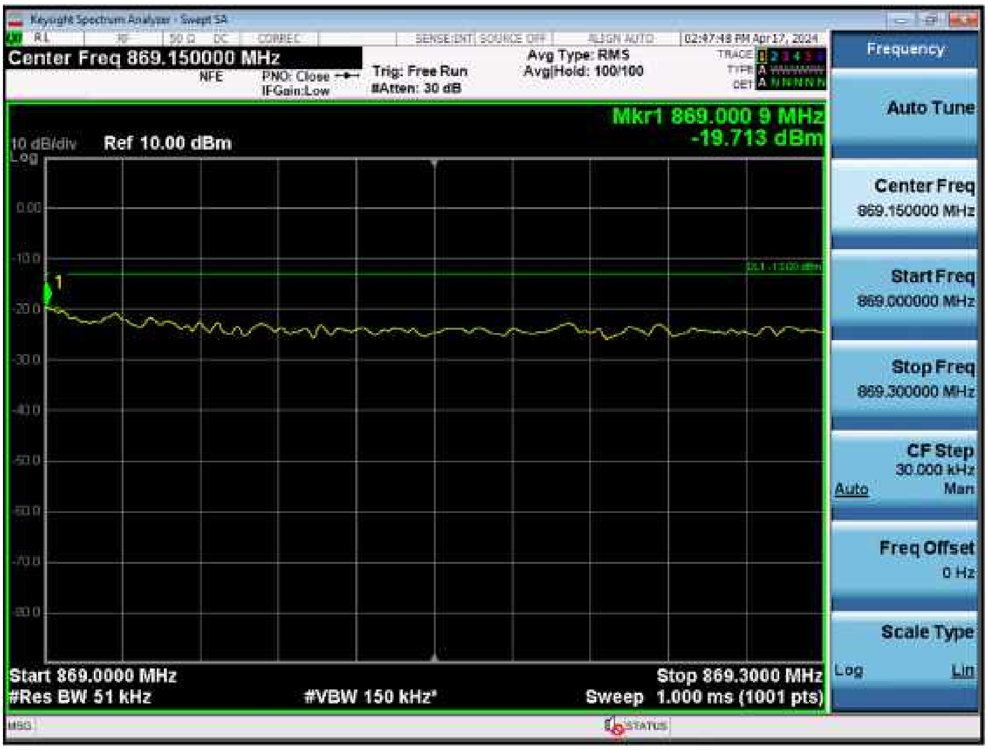
Out-of-band (single test signal) / ESMR / Downlink / LTE 5 MHz / Upper



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

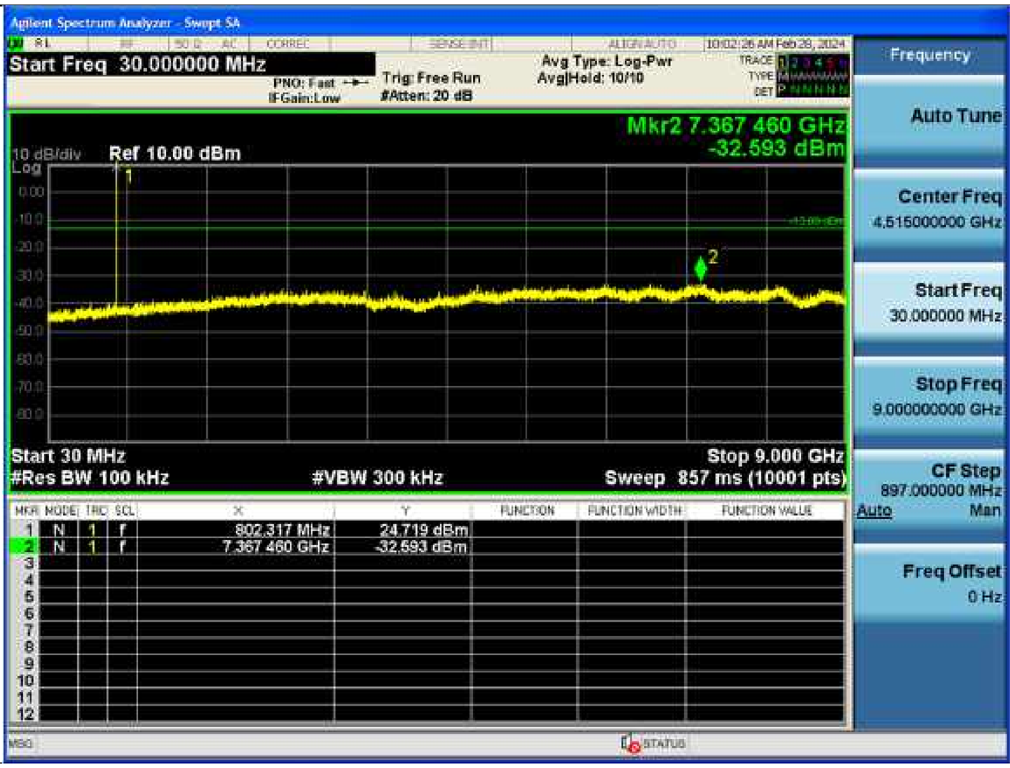


+3 dB above Out-of-band (single test signal) / ESMR / Downlink / LTE 5 MHz / Upper

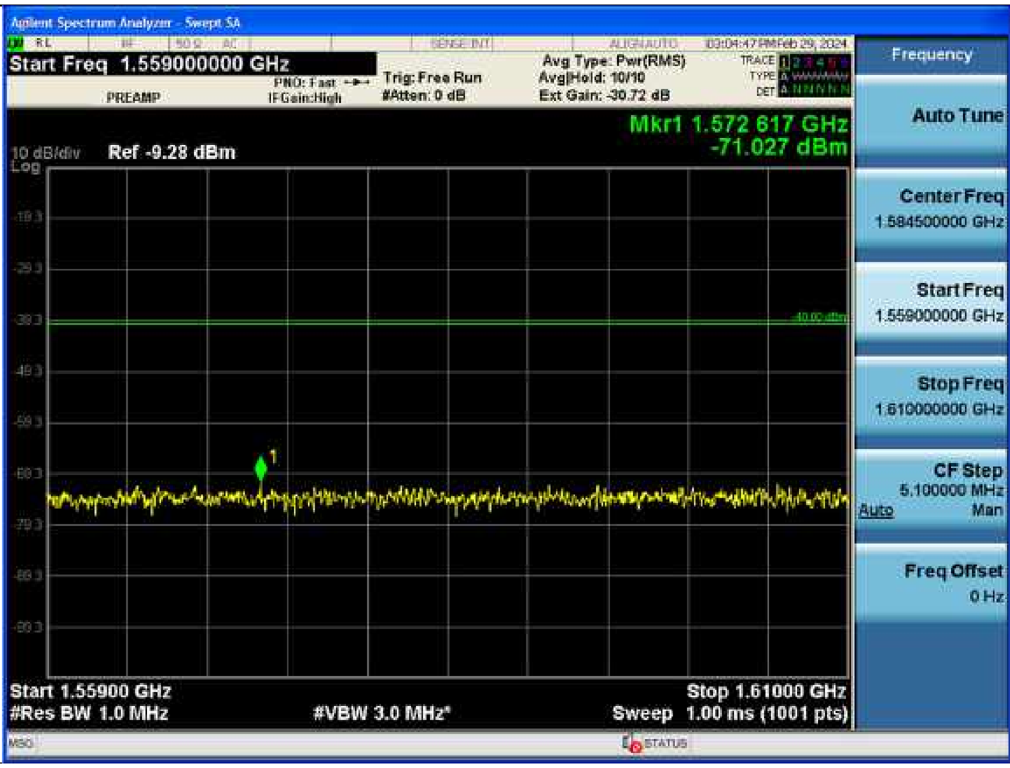


Plot data of Spurious Emissions

Spurious / PS Narrowband / Uplink



Spurious / PS Narrowband / Uplink / 1 Carrier / Additional 1559 MHz ~ 1610 MHz



Measured Level + Ant. Gain = -71.027 dBm + 11 dBi = -60.027 dBm(E.I.R.P.) complies with the limit 27.53(f).