TEST REPORT

FCC Test for IT109B017CA
Certification

APPLICANT
DKK North America, Inc.

REPORT NO.
HCT-RF-2409-FC001-R1

DATE OF ISSUE
September 25, 2024

Tested by
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Applicant	**DKK North America, Inc.** 8105 Rasor Blvd, Suite 222, Plano, TX USA 75024
Product Name Model Name	700/800 2.5W Public Safety BDA IT109B017CA
FCC ID	2BKJD-IT109B017-UA
Output Power	Uplink: 27 dBm, Downlink: 34 dBm
Date of Test	July 10, 2024 ~ September 04, 2024
Location of Test	■ Permanent Testing Lab ☐ On Site Testing (Address: 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea)
Test Standard Used	CFR 47 Part 2, Part 90
Test Results	PASS
Manufacturer	**innertron** 301, Harmony-ro, Yeonsu-gu, Incheon City 22014 Korea

REVISION HISTORY

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

Revision No.	Date of Issue	Description
0	September 04, 2024	Initial Release
1	September 25, 2024	- Removed the content on signal combination configuration and multi-carrier in Section 3.2. - Changed "or" to "," in the 800 MHz band of the table for "Simultaneous Transmission Band Condition" in Section 3.2. - Revised the notes below the plots in Sections 5.2 and 5.6. - Revised the model name on page 1~2.

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	DKK North America, Inc.
Company Address	8105 Rasor Blvd, Suite 222, Plano, TX USA 75024

1.2. PRODUCT INFORMATION

EUT Type	700/800 2.5W Public Safety BDA		
EUT Serial Number	24IT08000000		
Power Supply	100-240 VAC, 50/60 Hz		
Frequency Range	Band Name	Uplink (MHz)	Downlink (MHz)
	Public Safety Narrowband	799 ~ 805	769 ~ 775
	NPSPAC	806 ~ 809	851 ~ 854
	B/ILT; SMR	809 ~ 816	854 ~ 861
	ESMR	817 ~ 824	862 ~ 869
Tx Output Power	Uplink: 27 dBm, Downlink: 34 dBm		
Antenna Peak Gain	Uplink: 9.0 dBi, Downlink: 3.5 dBi		

1.3. TEST INFORMATION

FCC Rule Parts	CFR 47 Part 90
Measurement Standards	KDB 935210 D05 v01r04, KDB 971168 D01 v03r01, ANSI C63.26-2015
Test Location	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea

2. FACILITIES AND ACCREDITATIONS

2.1. FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication22. Detailed description of test facility was submitted to the Commission and accepted dated March 11, 2024 (CAB identifier: KR0032).

2.2. EQUIPMENT

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

3. TEST SPECIFICATIONS

3.1. STANDARDS

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC CFR 47 Part 2, Part 90.

Description	Reference	Results
AGC threshold	KDB 935210 D05 v01r04 4.2	Compliant
Out-of-band rejection	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)	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)	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	Uplink (MHz)	Downlink (MHz)
Public Safety Narrowband	799 ~ 805	769 ~ 775
NPSPAC	806 ~ 809	851 ~ 854
B/ILT; SMR	809 ~ 816	854 ~ 861
ESMR	817 ~ 824	862 ~ 869

Simultaneous transmission band condition

700 MHz band	800 MHz band
Public Safety Narrowband	NPSPAC, 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	0.873	800	0.891
650	0.872	850	0.877
700	0.855	900	0.947
750	0.895	950	1.005

: Output Path

Correction factor table			
Frequency (MHz)	Factor (dB)	Frequency (MHz)	Factor (dB)
2	29.800	2 000	32.469
10	29.497	2 100	32.463
30	29.808	2 200	32.532
50	31.279	2 300	32.542
100	30.008	2 400	32.699
200	30.403	2 500	32.713
300	30.641	2 600	32.872
400	30.762	2 700	32.914
500	30.970	2 800	32.942
600	31.105	2 900	33.033
700	31.163	3 000	33.048
800	31.279	4 000	33.704
900	31.383	5 000	34.081
1 000	31.491	6 000	33.279
1 100	31.602	7 000	33.543
1 200	31.711	8 000	34.023
1 300	31.770	9 000	34.324
1 400	31.763	10 000	35.259
1 500	31.919	-	-
1 600	32.047	-	-
1 700	32.068	-	-
1 800	32.130	-	-
1 900	32.341	-	-

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

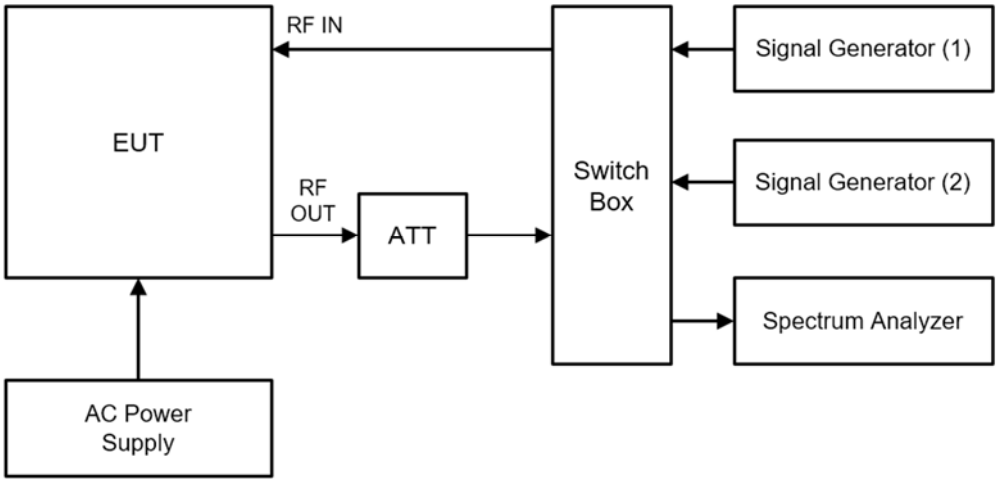
Coverage factor k = 2, Confidence levels of 95 %

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

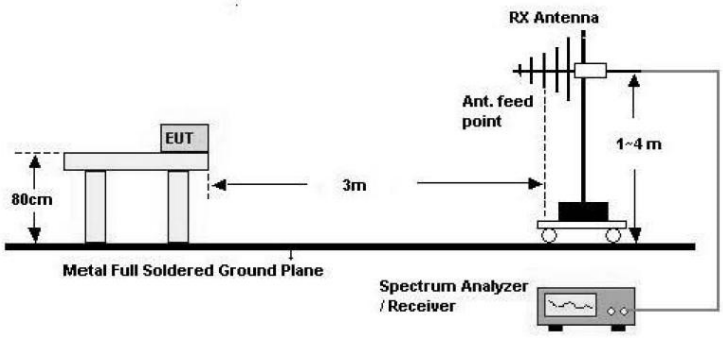
3.5. TEST DIAGRAMS

Conducted Test

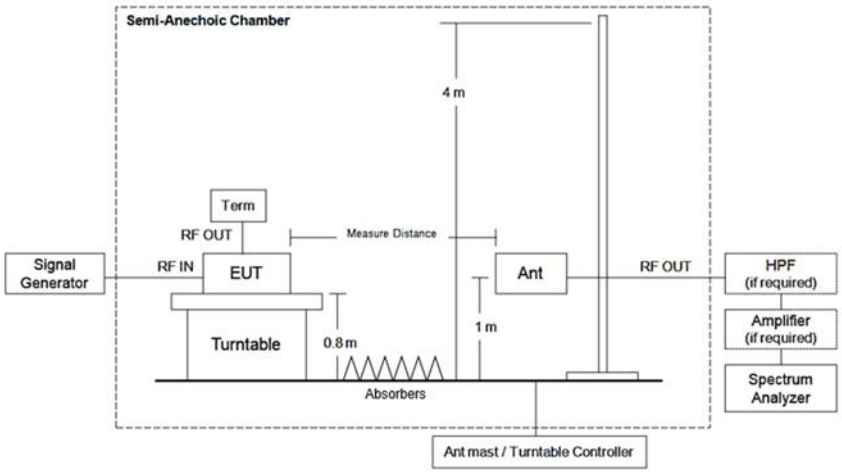


Radiated Test

30 MHz ~ 1 GHz

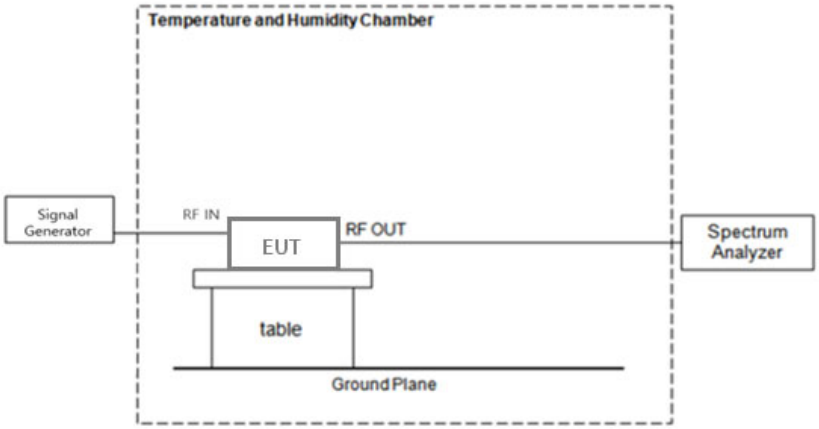


Above 1 GHz



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
MXA Signal Analyzer	N9030A	Keysight	MY52350879	04/05/2025	Annual
#MXG Vector Signal Generator	N5182A	Agilent	MY50141649	08/12/2025	Annual
#30 dB Attenuator	WA93-30-33	Weinschel Associates	0155	11/20/2024	Annual
AC Power Supply	PCR2000MA	KIKUSUI	ZL002530	12/29/2024	Annual
Switch	S46-SV11	KEITHLEY	1088025	N/A	N/A
#50Ω Termination	908A	H.P.	N/A	N/A	N/A
Temperature and Humidity Chamber	NY-THR18750	NANGYEAL	NY-200912201A	01/04/2025	Annual
Amp & Filter Bank Switch Controller	FBSM-01B	TNM system	TM20090002	N/A	N/A
Controller(Antenna Mast & Turn Table)	CO3000	Innco systems	CO3000/1251/48920320/P	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco systems	N/A	N/A	N/A
Turn Table	DS2000-S	Innco systems	N/A	N/A	N/A
Turn Table	N/A	Ets	N/A	N/A	N/A
Loop Antenna	FMZB 1513	Rohde & Schwarz	1513-333	03/07/2026	Biennial
Hybrid Antenna	VULB 9160-31	Schwarzbeck	9168-0895	03/09/2025	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	9120D-937	02/13/2025	Biennial
Horn Antenna	BBHA9170	Schwarzbeck	BBHA9170124	03/28/2025	Biennial
RF Switching System	FBSR-04C	TNM system	S4L1	04/11/2025	Annual
Low Noise Amplifier	TK-PA1840H	TESTEK	170011-L	10/20/2024	Annual

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

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 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)
Public Safety Narrowband	Uplink	P25 Phase 1	802.00	-56	27.01
	Downlink		772.00	-53	33.34
NPSPAC	Uplink		807.50	-56	27.02
	Downlink		852.50	-53	34.01
B/ILT; SMR	Uplink		812.50	-56	27.37
	Downlink		857.50	-53	34.81
ESMR	Uplink		820.50	-56	27.18
	Downlink		865.50	-53	33.00

5.2. OUT-OF-BAND REJECTION

Test Requirement:

KDB 935210 D05 v01r04

Out-of-band rejection required.

Test Procedures:

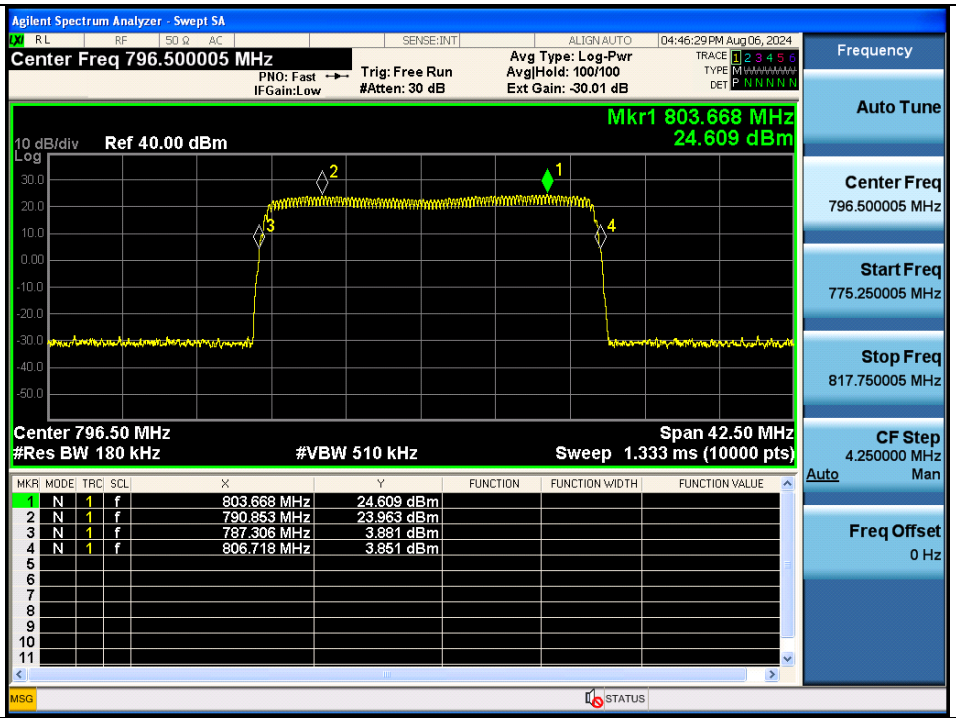
Measurements were in accordance with the test methods section 4.3 of KDB 935210 D05 v01r04.

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.

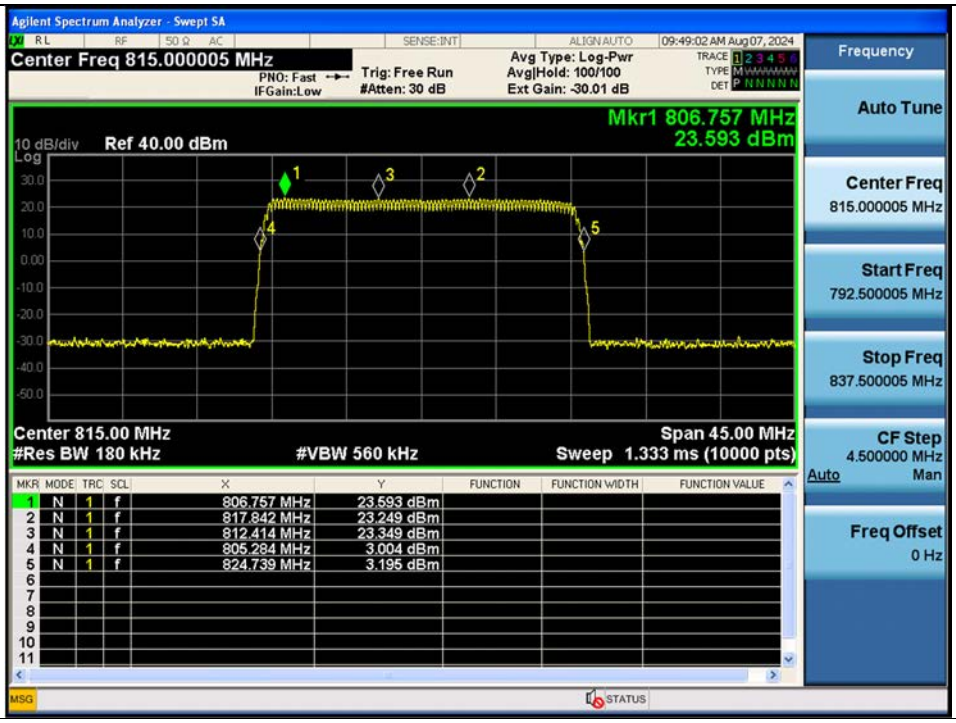
Test Results:

Public Safety Narrowband(799 ~ 805 MHz) / Uplink



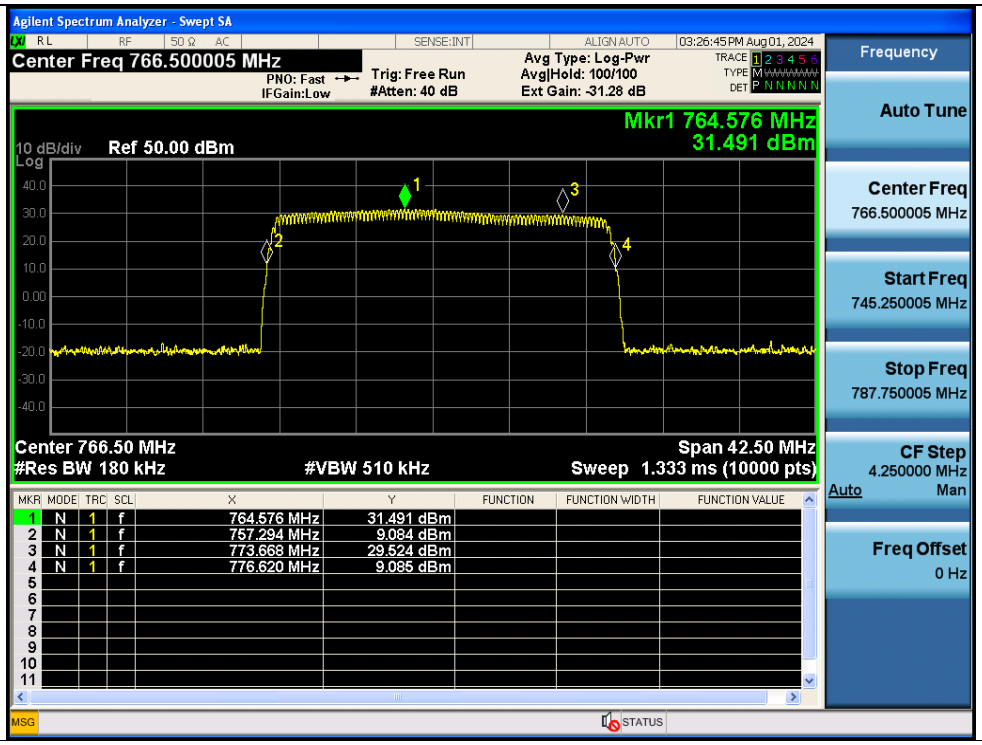
Note: The EUT is amplified over a frequency range of 788 ~ 806 MHz, but this test report uses the results for the frequency range of 799 ~ 805 MHz.

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



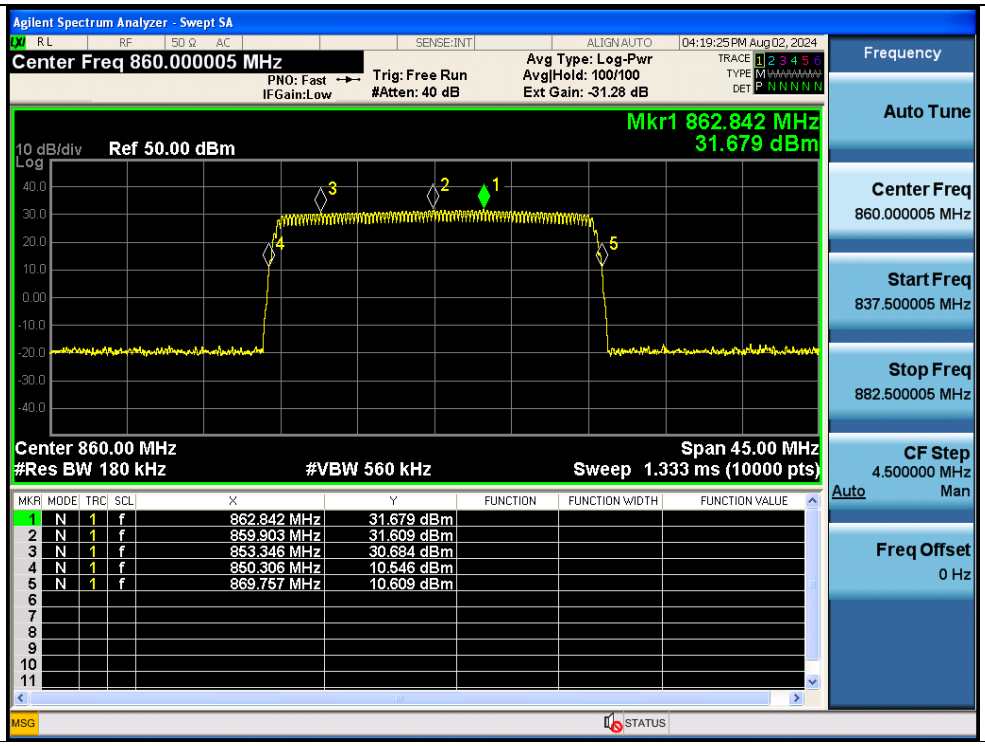
Note: The EUT is amplified over a frequency range of 806 ~ 824 MHz, but this test report uses the results for the frequency range of 806 ~ 809 MHz, 809 ~ 816 MHz, 817 ~ 824 MHz.

Public Safety Narrowband / Downlink



Note: The EUT is amplified over a frequency range of 758 ~ 776 MHz, but this test report uses the results for the frequency range of 769 ~ 775 MHz.

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



Note: The EUT is amplified over a frequency range of 851 ~ 869 MHz, but this test report uses the results for the frequency range of 851 ~ 854 MHz, 854 ~ 861 MHz, 862 ~ 869 MHz.

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	Center Frequency (MHz)	99 % OBW (kHz)	26 dB OBW (kHz)
Public Safety Narrowband	Uplink	P25 Phase 1	1	802.00	8.3500	11.10
	Downlink		1	772.00	8.2020	11.16
NPSPAC	Uplink		1	807.50	8.2280	10.44
	Downlink		1	852.50	8.2520	11.26
B/ILT; SMR	Uplink		1	812.50	8.3160	11.50
	Downlink		1	857.50	8.2950	10.75
ESMR	Uplink		1	820.50	8.0640	10.24
	Downlink		1	865.50	8.4740	11.70

Tabular data of Output Occupied Bandwidth

Test Band	Link	Signal	No. of Carriers	Center Frequency (MHz)	99 % OBW (kHz)	26 dB OBW (kHz)
Public Safety Narrowband	Uplink	P25 Phase 1	1	802.00	8.2850	10.78
	Downlink		1	772.00	8.2700	11.42
NPSPAC	Uplink		1	807.50	8.1090	10.28
	Downlink		1	852.50	8.2320	11.47
B/ILT; SMR	Uplink		1	812.50	8.3290	11.33
	Downlink		1	857.50	8.1870	10.84
ESMR	Uplink		1	820.50	8.2160	10.70
	Downlink		1	865.50	8.4680	11.45

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

Test Band	Link	Signal	No. of Carriers	Center Frequency (MHz)	99 % OBW (kHz)	26 dB OBW (kHz)
Public Safety Narrowband	Uplink	P25 Phase 1	1	802.00	8.1680	11.01
	Downlink		1	772.00	8.1510	10.13
NPSPAC	Uplink		1	807.50	8.2900	11.90
	Downlink		1	852.50	8.2700	11.58
B/ILT; SMR	Uplink		1	812.50	8.2240	11.28
	Downlink		1	857.50	8.1960	10.88
ESMR	Uplink		1	820.50	8.2340	10.73
	Downlink		1	865.50	8.5310	12.22

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

Test Band	Link	Signal	No. of Carriers	Center Frequency (MHz)	99 % OBW (kHz)	26 dB OBW (kHz)
Public Safety Narrowband	Uplink	P25 Phase 1	1	802.00	8.2170	11.39
	Downlink		1	772.00	8.2190	10.10
NPSPAC	Uplink		1	807.50	8.3370	11.85
	Downlink		1	852.50	8.2660	11.48
B/ILT; SMR	Uplink		1	812.50	8.2390	11.37
	Downlink		1	857.50	8.2400	10.92
ESMR	Uplink		1	820.50	8.1930	10.94
	Downlink		1	865.50	8.5030	12.31

Measured Occupied Bandwidth Comparison

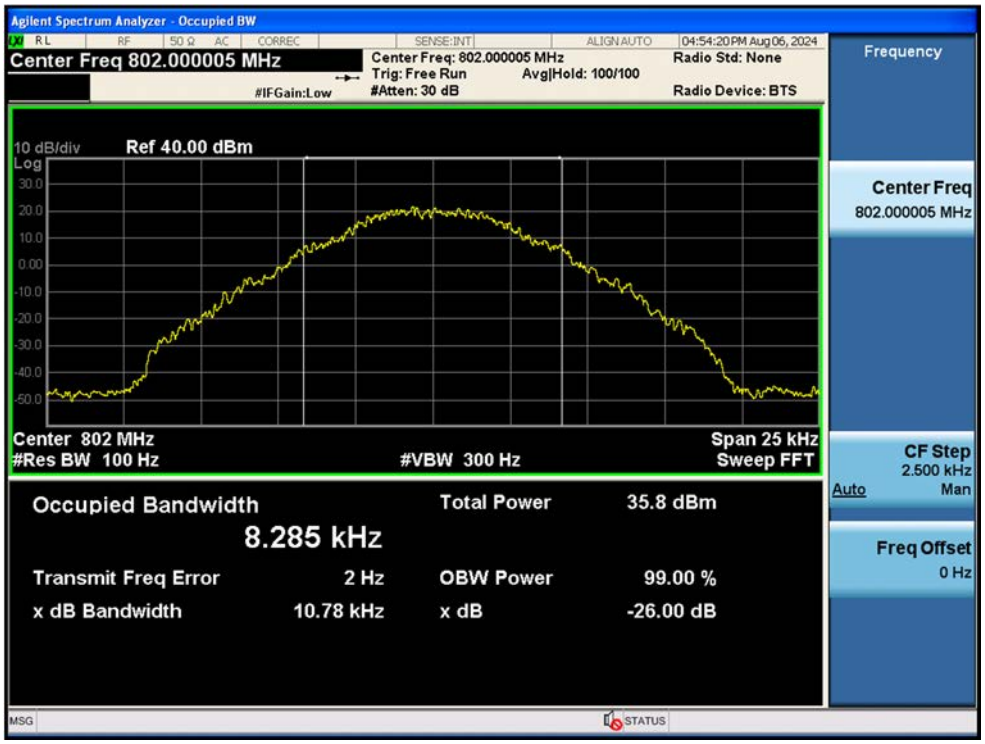
Test Band	Link	Signal	No. of Carriers	Variant of Input and output Occupied Bandwidth (%)	Variant of Input and 3 dB above the AGC threshold output Occupied Bandwidth (%)
Public Safety Narrowband	Uplink	P25 Phase 1	1	-2.88	3.45
	Downlink		1	2.33	-0.30
NPSPAC	Uplink		1	-1.53	-0.42
	Downlink		1	1.87	-0.86
B/ILT; SMR	Uplink		1	-1.48	0.80
	Downlink		1	0.84	0.37
ESMR	Uplink		1	4.49	1.96
	Downlink		1	-2.14	0.74

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

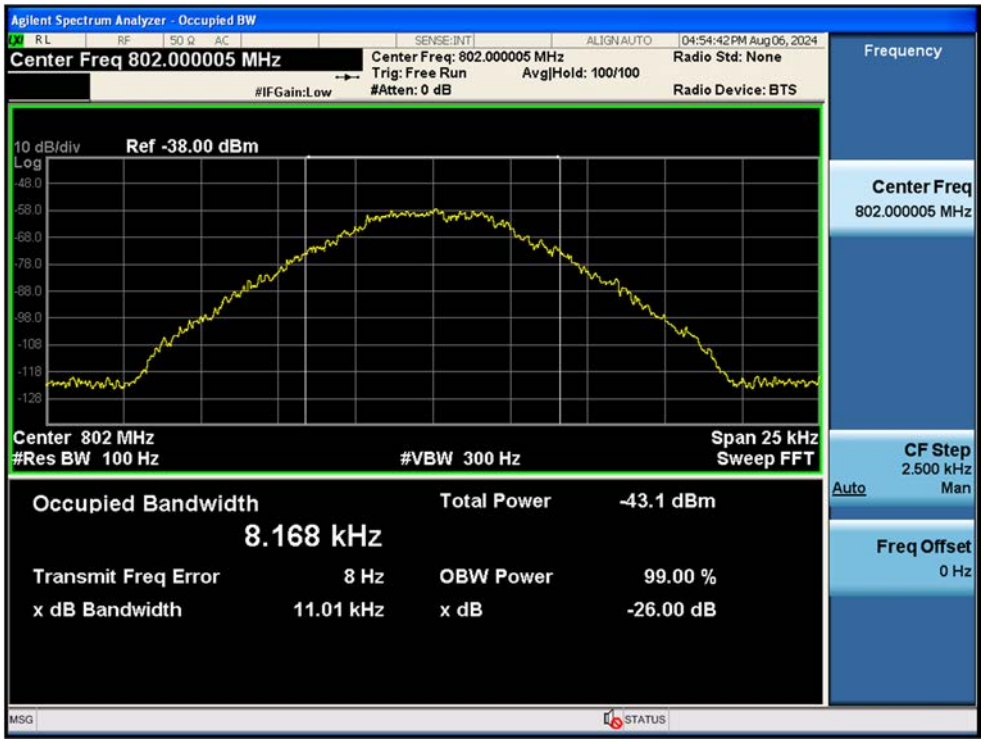
Plot data of Occupied Bandwidth

Input / Public Safety Narrowband / 1 Carrier / Uplink / P25 Phase 1

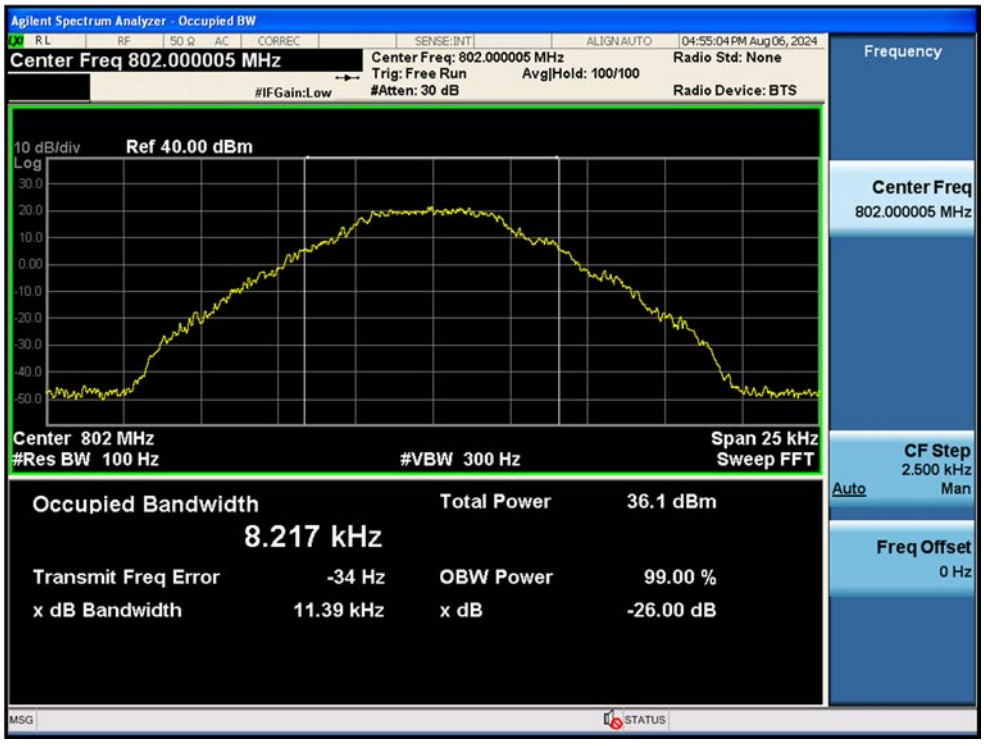
Output / Public Safety Narrowband / 1 Carrier / Uplink / P25 Phase 1



3 dB above the AGC threshold Input / Public Safety Narrowband / 1 Carrier / Uplink / P25 Phase 1

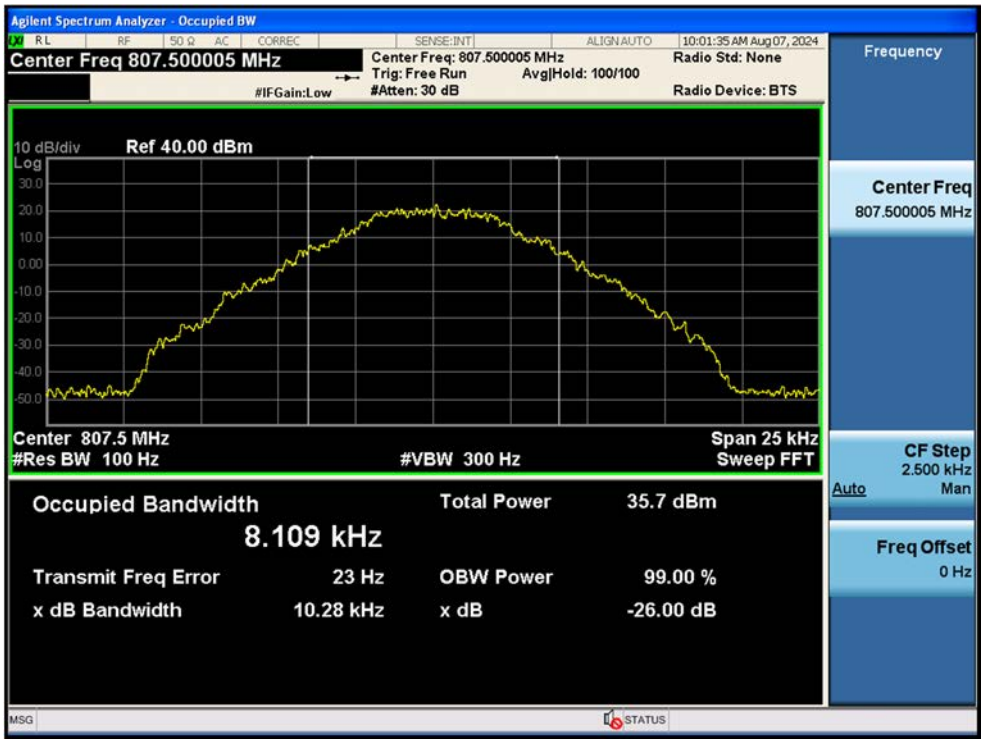


3 dB above the AGC threshold output / Public Safety Narrowband / 1 Carrier / Uplink / P25 Phase 1

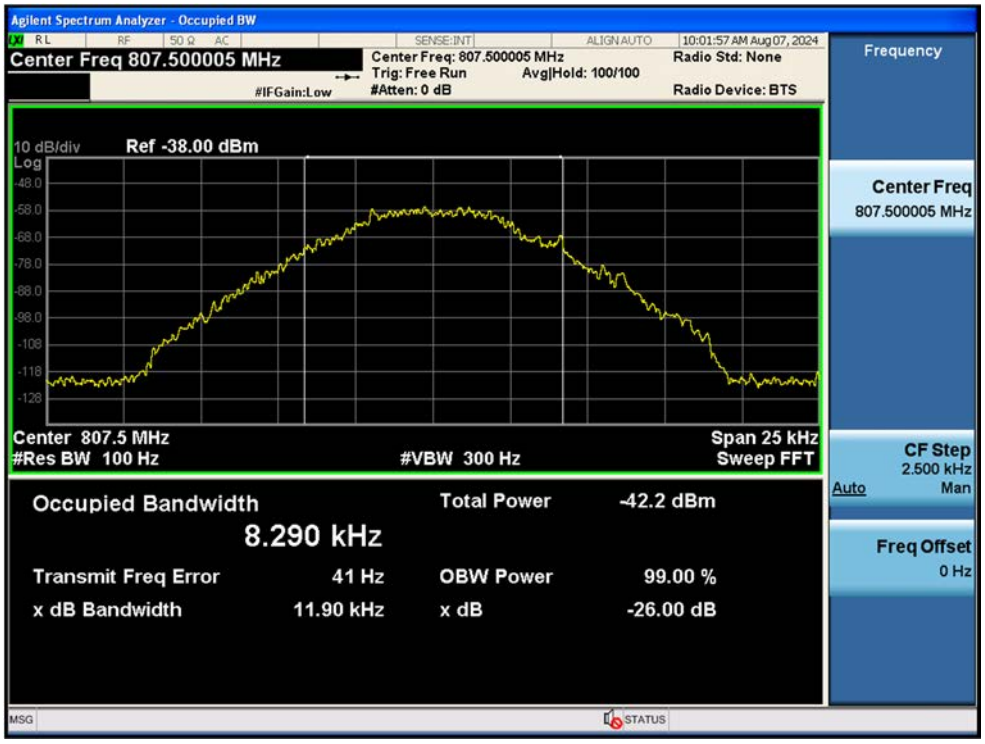


Input / NPSPAC / 1 Carrier / Uplink / P25 Phase 1

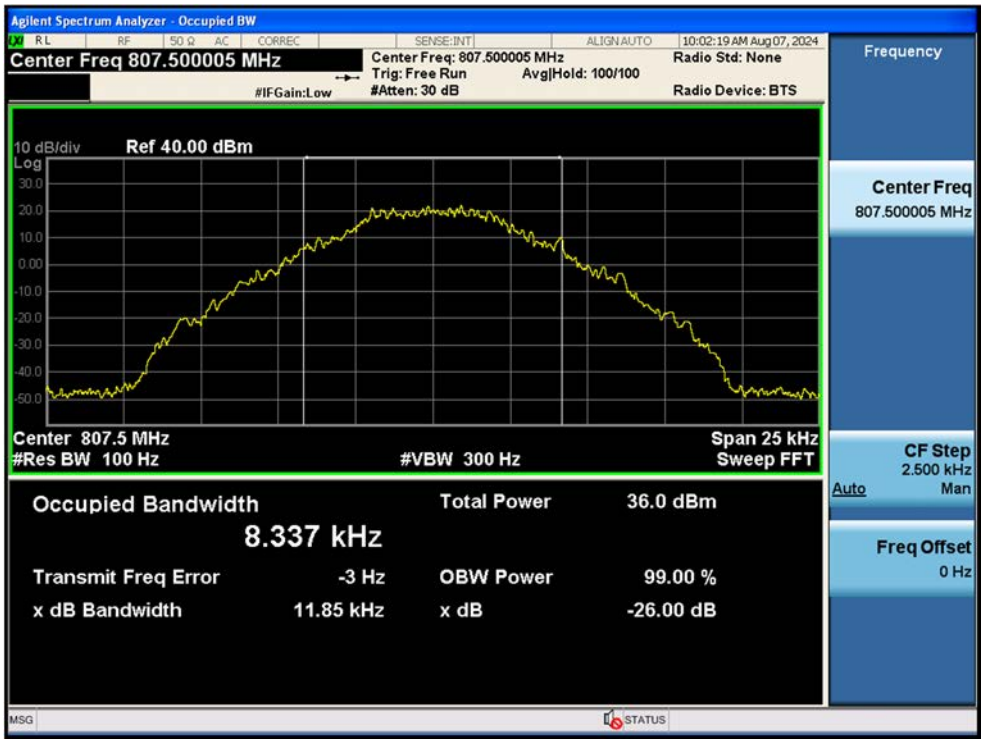
Output / NPSPAC / 1 Carrier / Uplink / P25 Phase 1



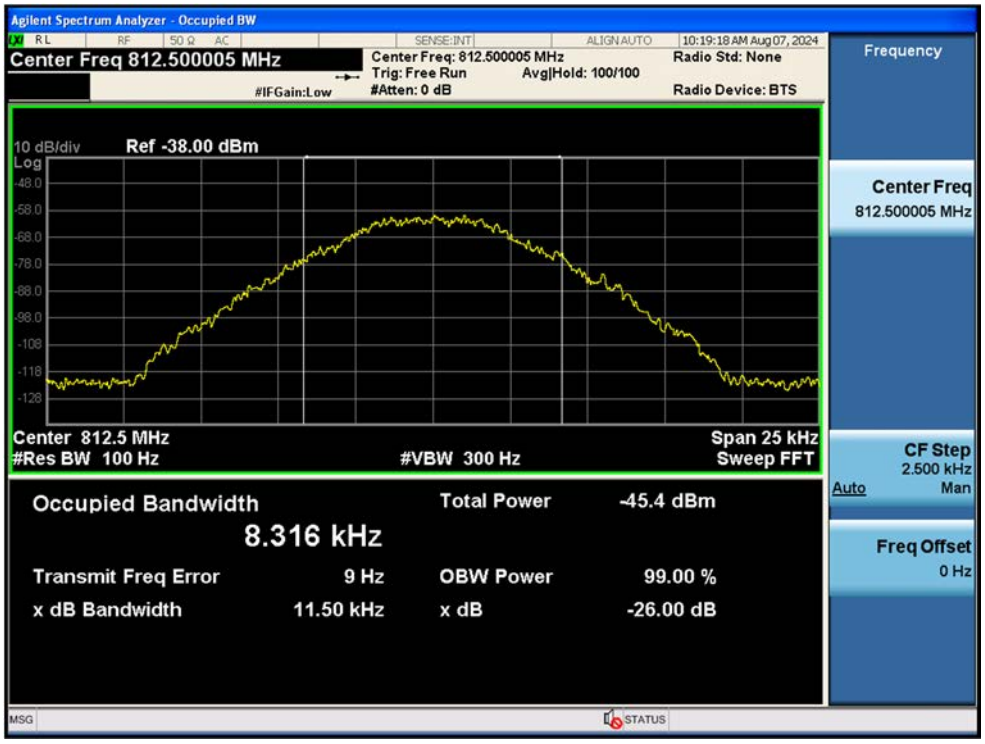
3 dB above the AGC threshold Input / NPSPAC / 1 Carrier / Uplink / P25 Phase 1



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



Input / B/ILT; SMR / 1 Carrier / Uplink / P25 Phase 1

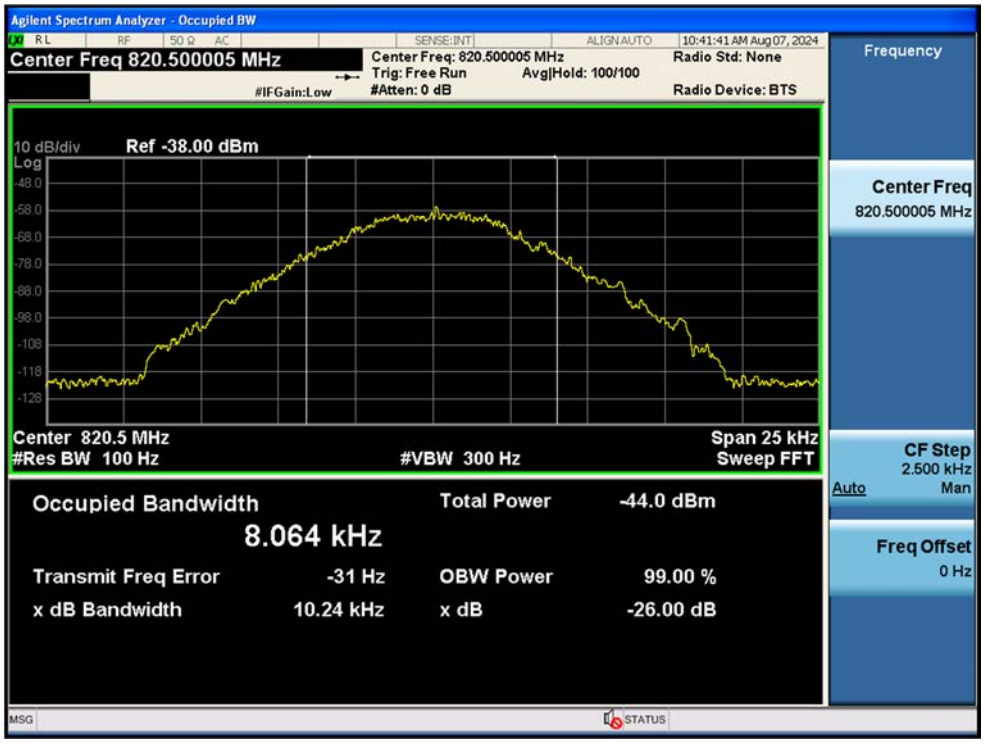


Output / B/ILT; SMR / 1 Carrier / Uplink / P25 Phase 1

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

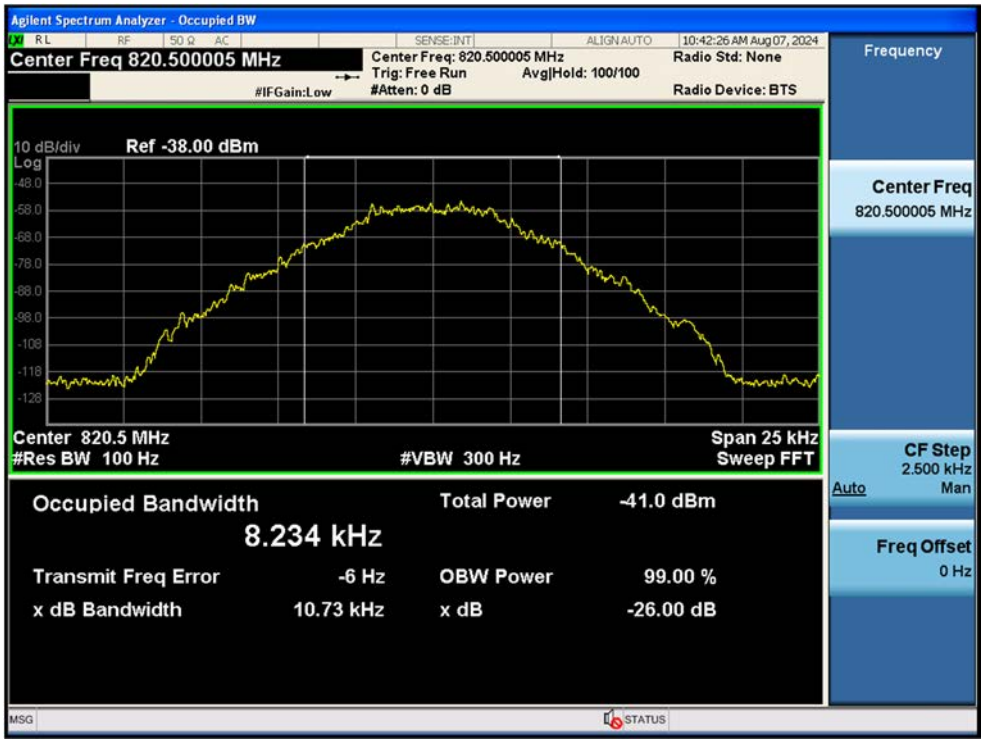
3 dB above the AGC threshold output / B/ILT; SMR / 1 Carrier / Uplink / P25 Phase 1

Input / ESMR / 1 Carrier / Uplink / P25 Phase 1

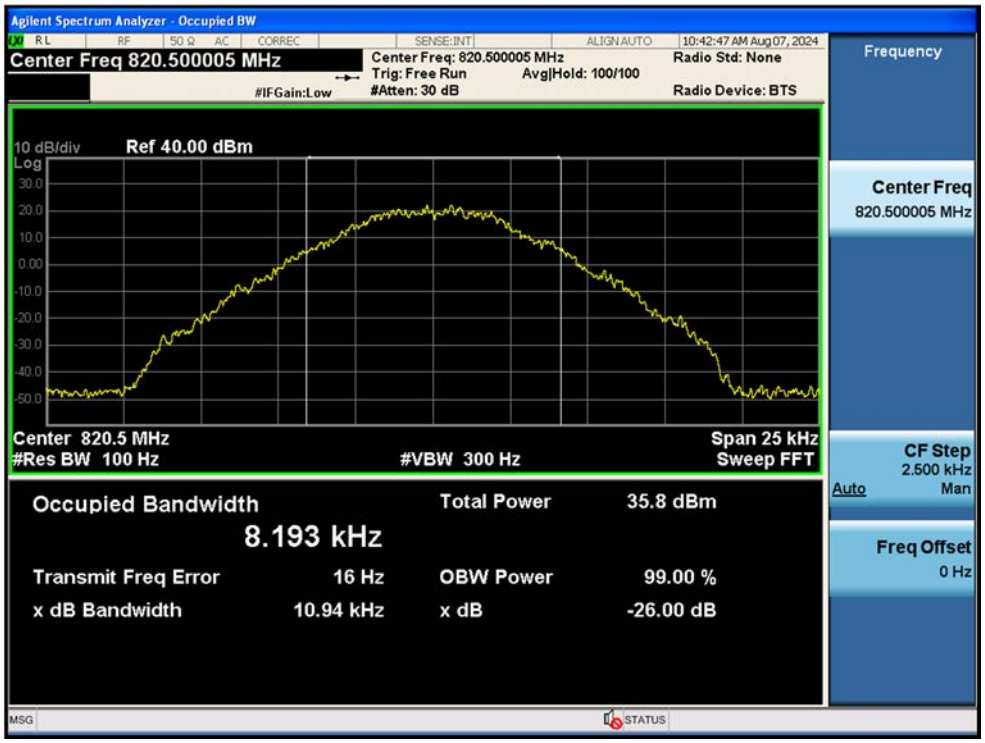


Output / ESMR / 1 Carrier / Uplink / P25 Phase 1

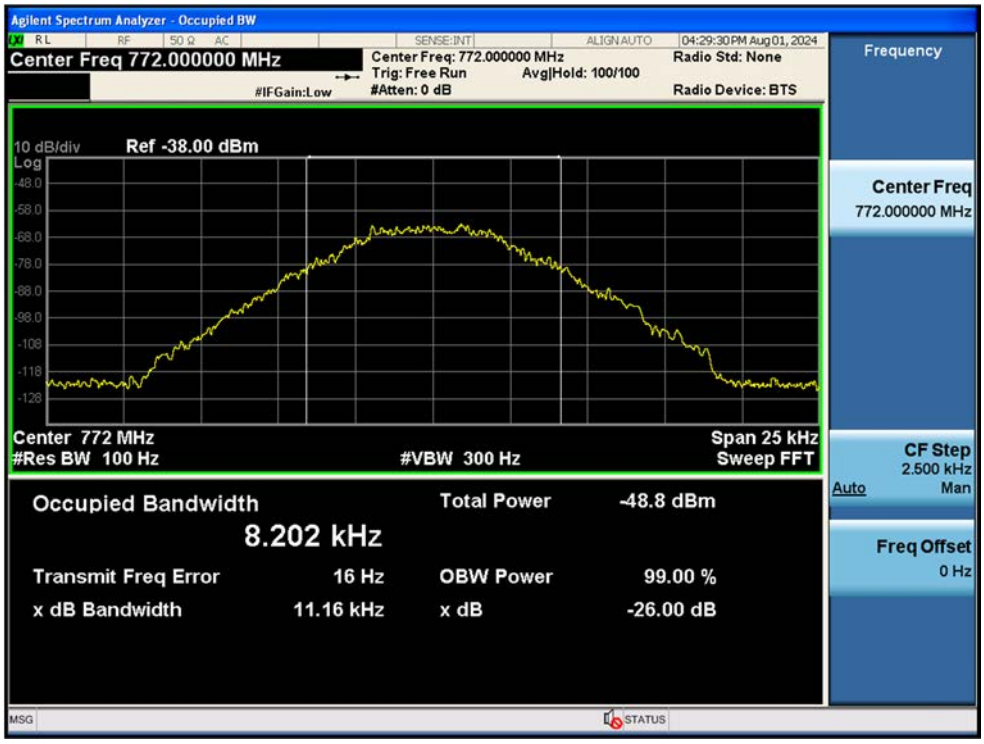
3 dB above the AGC threshold Input / ESMR / 1 Carrier / Uplink / P25 Phase 1



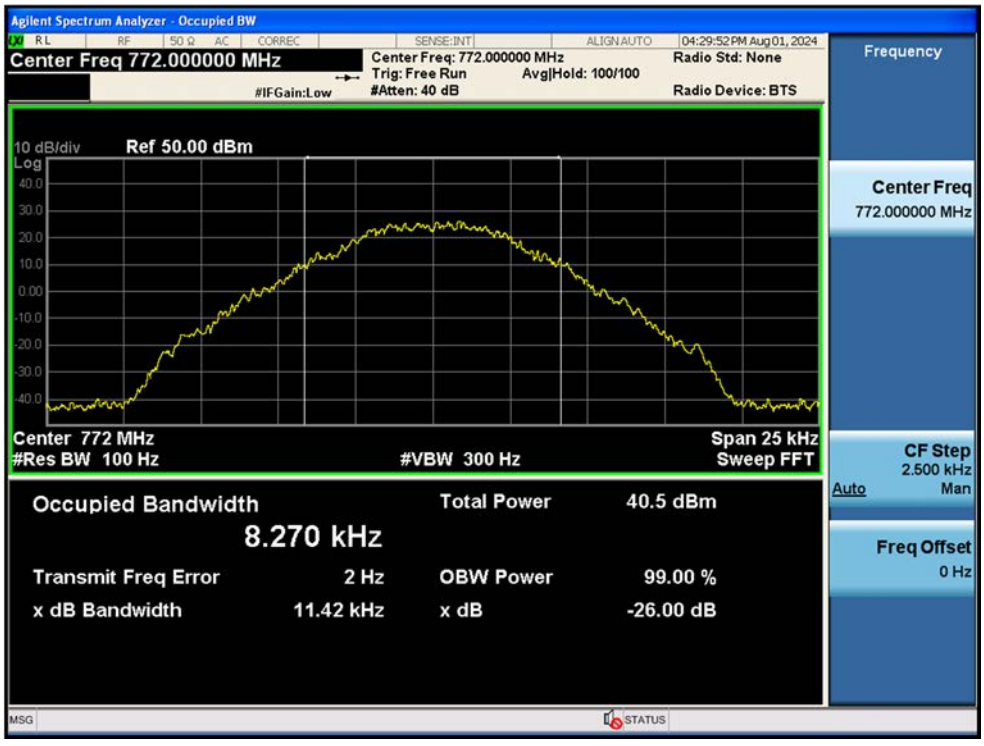
3 dB above the AGC threshold output / ESMR / 1 Carrier / Uplink / P25 Phase 1



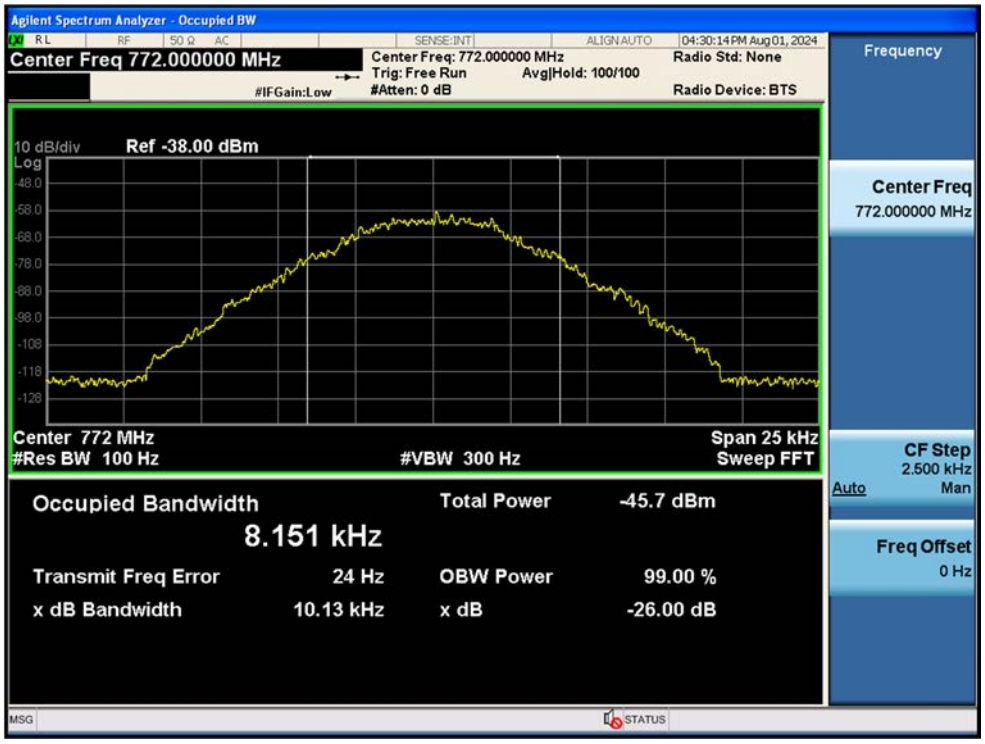
Input / Public Safety Narrowband / 1 Carrier / Downlink / P25 Phase 1



Output / Public Safety Narrowband / 1 Carrier / Downlink / P25 Phase 1

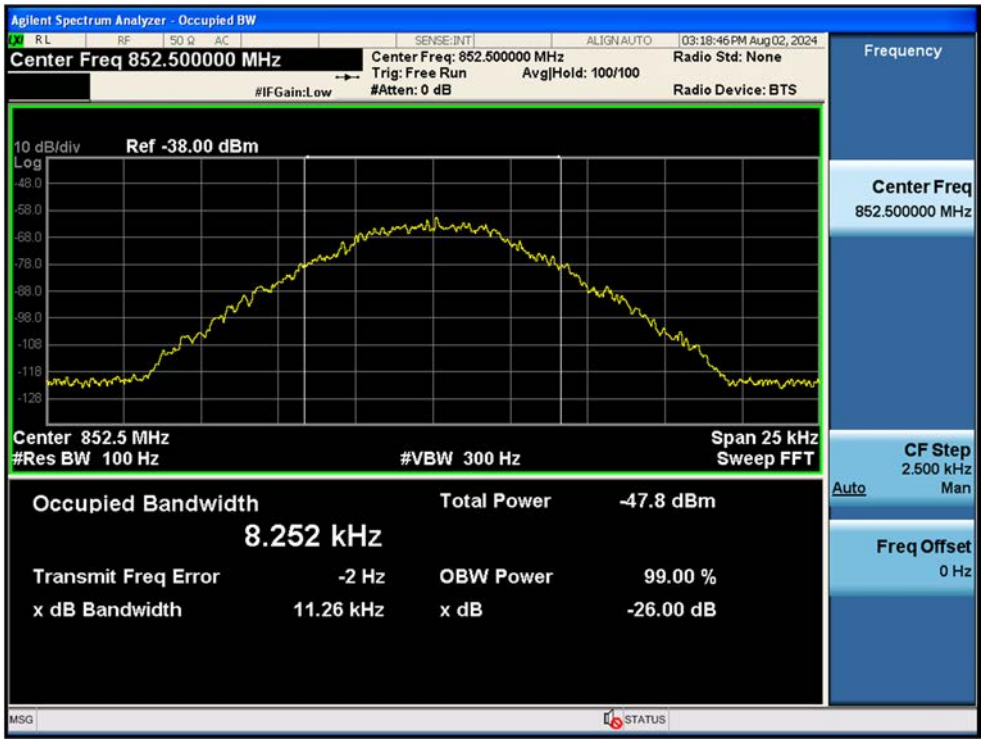


3 dB above the AGC threshold Input / Public Safety Narrowband / 1 Carrier / Downlink / P25 Phase 1

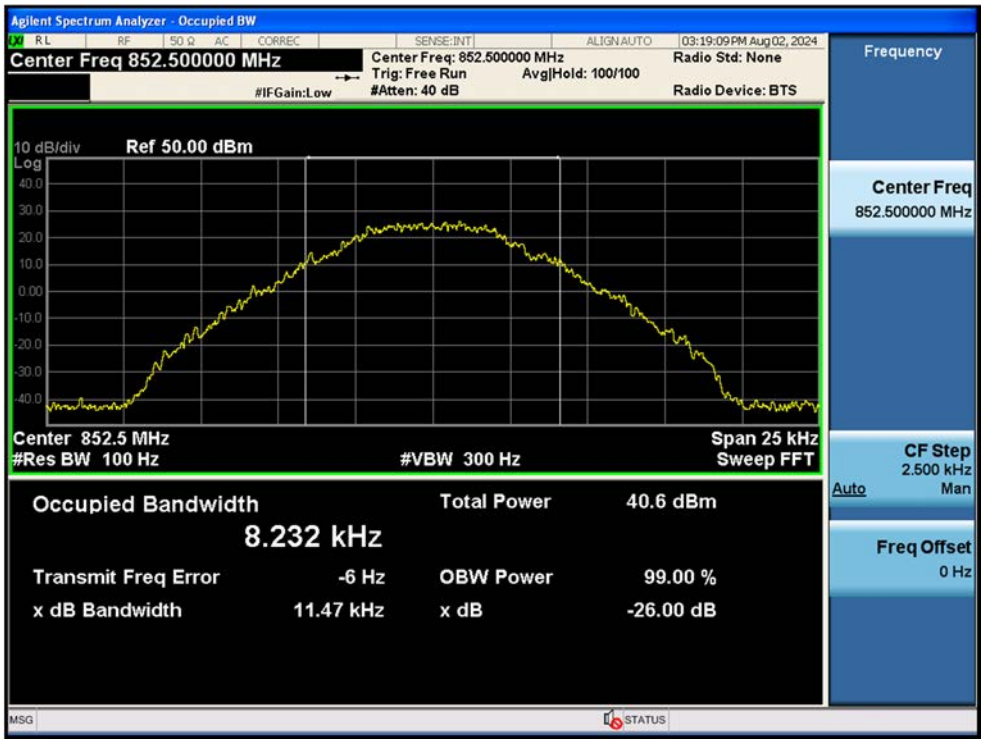


3 dB above the AGC threshold output / Public Safety Narrowband / 1 Carrier / Downlink / P25 Phase 1

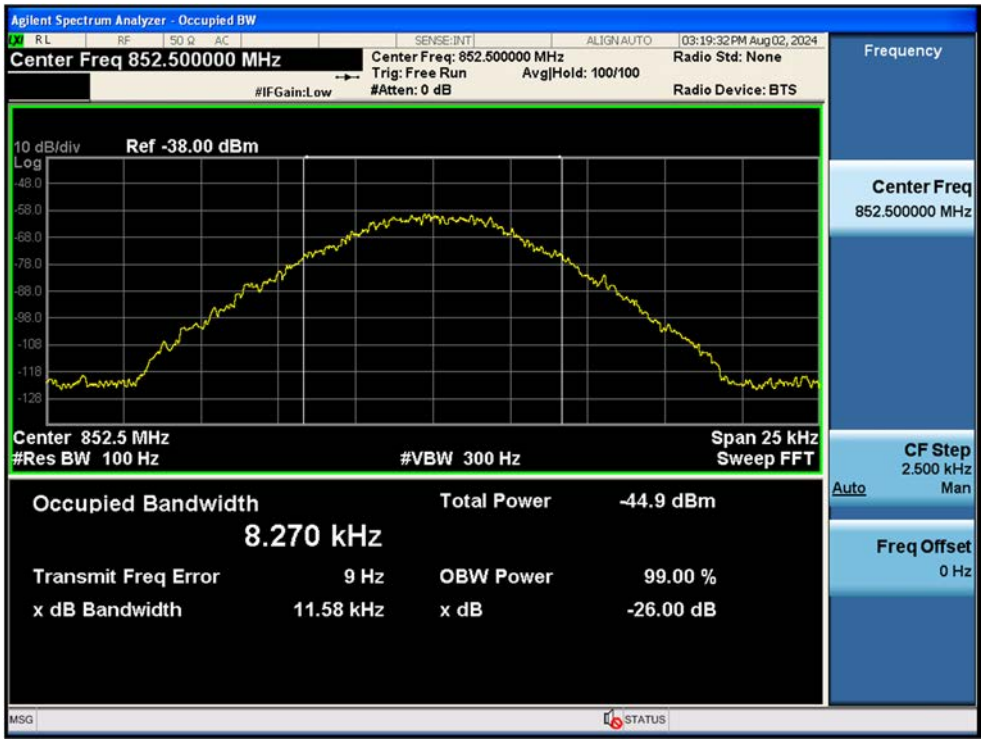
Input / NPSPAC / 1 Carrier / Downlink / P25 Phase 1



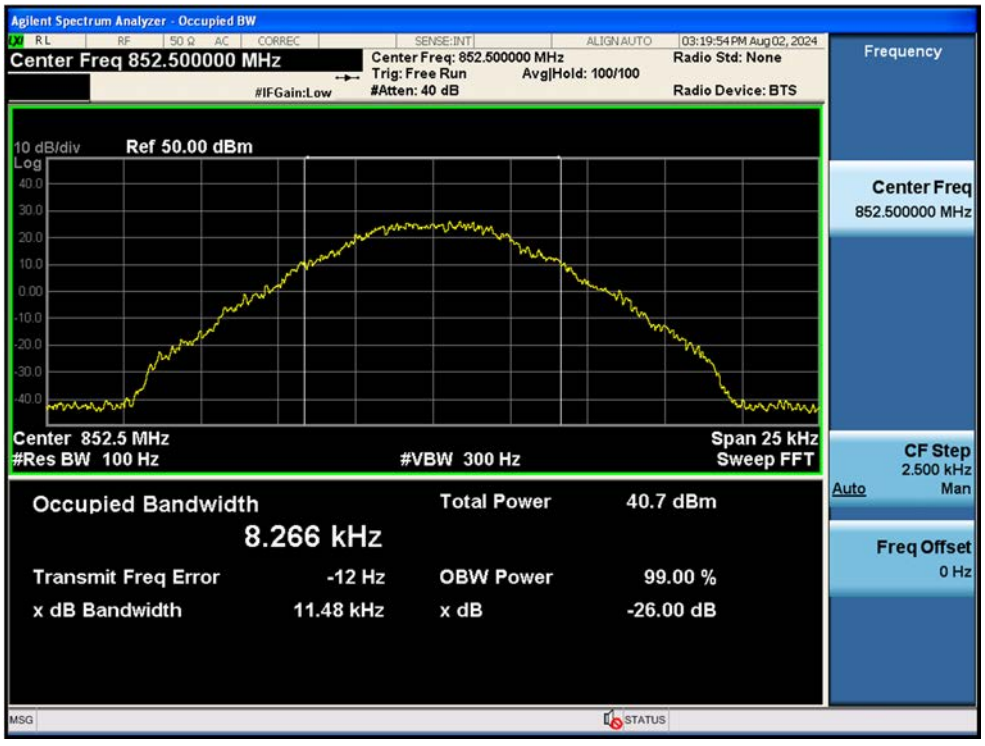
Output / NPSPAC / 1 Carrier / Downlink / P25 Phase 1



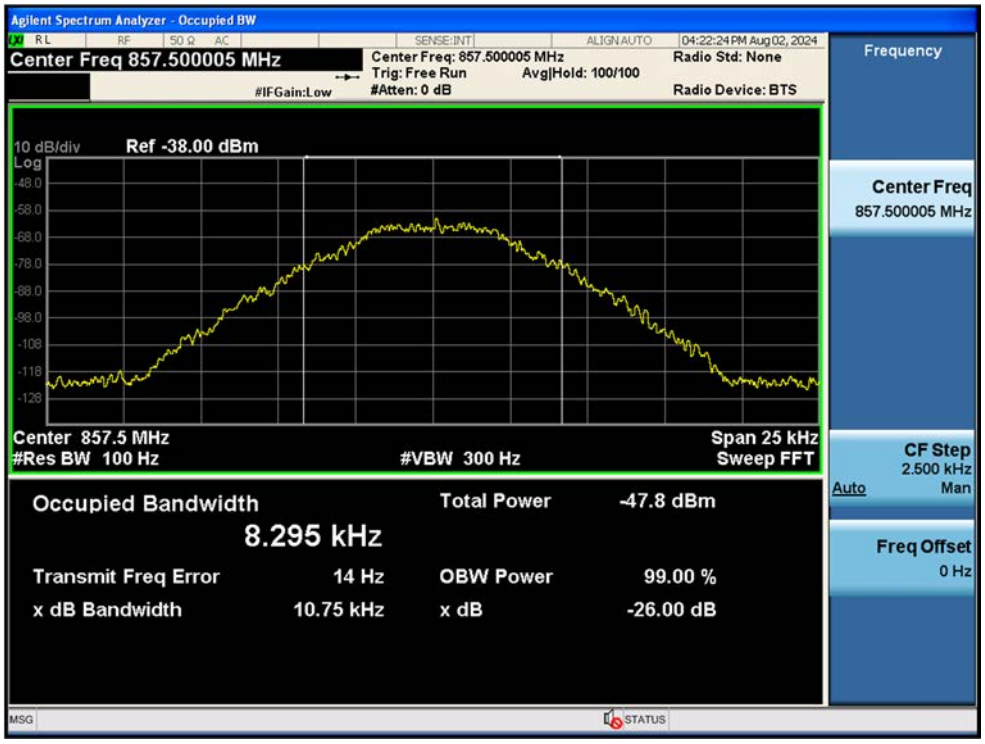
3 dB above the AGC threshold Input / NPSPAC / 1 Carrier / Downlink / P25 Phase 1



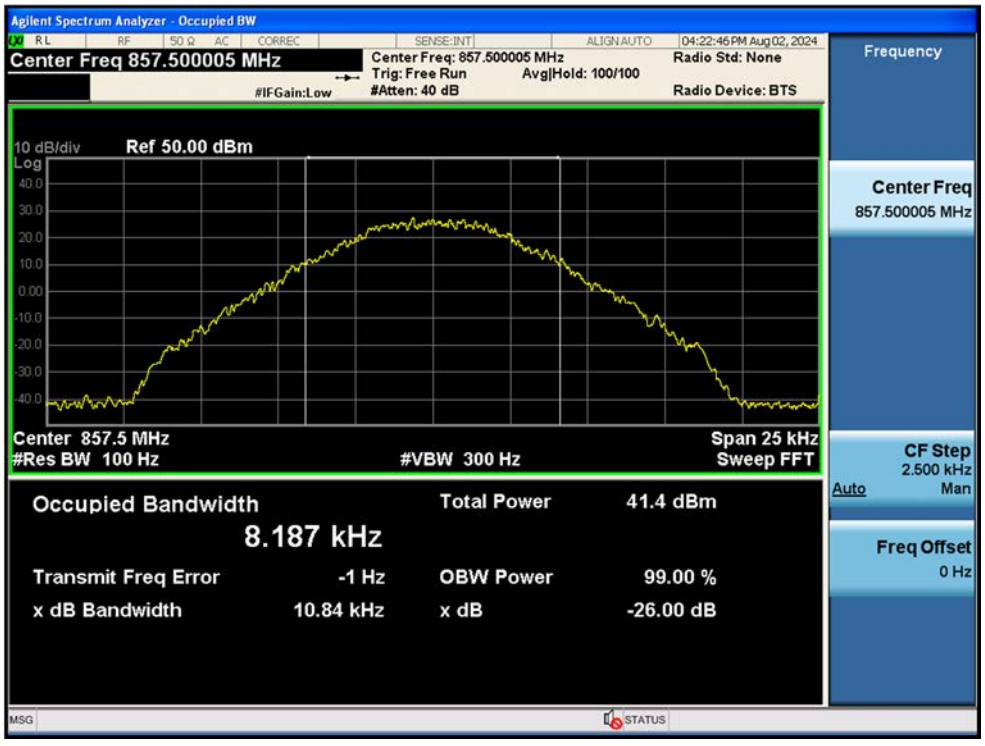
3 dB above the AGC threshold output / NPSPAC / 1 Carrier / Downlink / P25 Phase 1



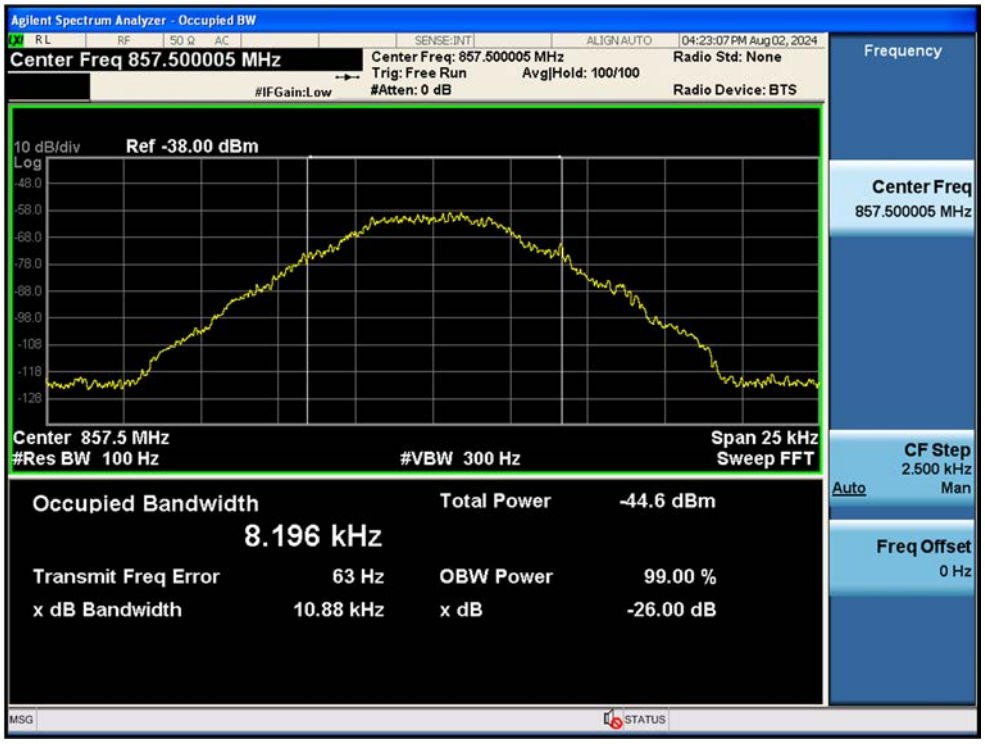
Input / B/ILT; SMR / 1 Carrier / Downlink / P25 Phase 1



Output / B/ILT; SMR / 1 Carrier / Downlink / P25 Phase 1

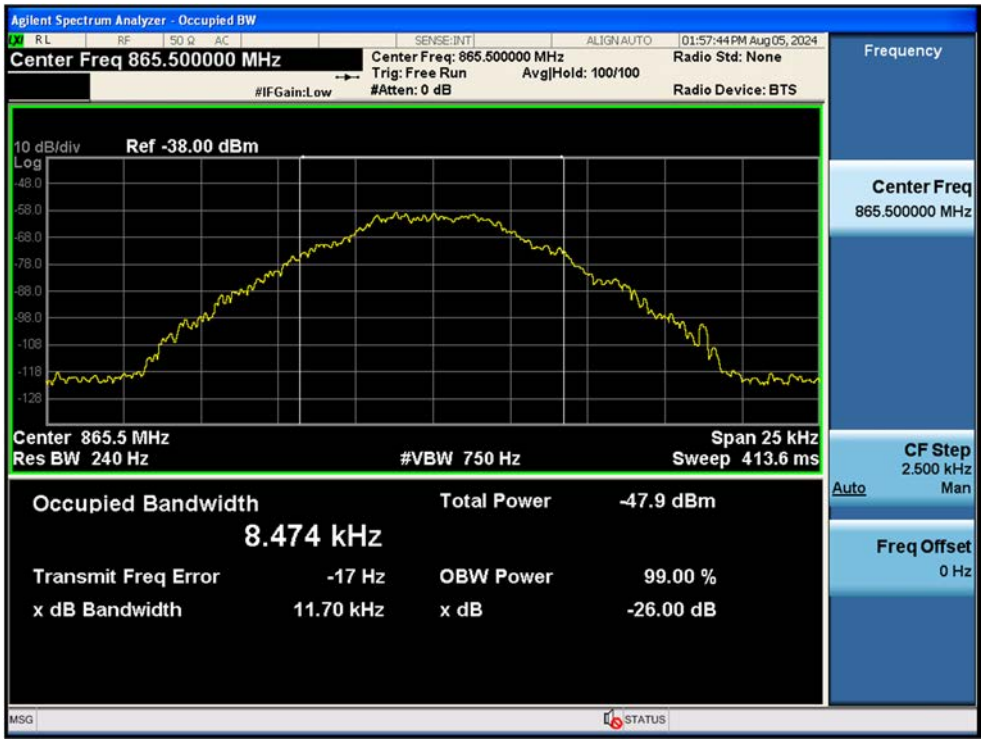


3 dB above the AGC threshold Input / B/ILT; SMR / 1 Carrier / Downlink / P25 Phase 1

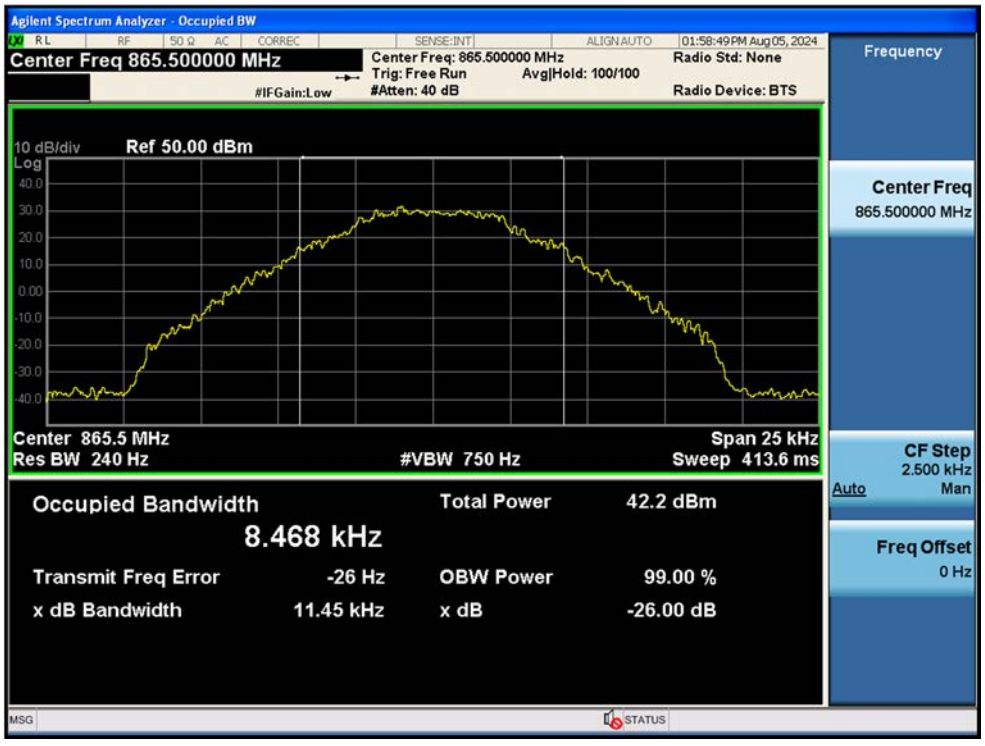


3 dB above the AGC threshold output / B/ILT; SMR / 1 Carrier / Downlink / P25 Phase 1

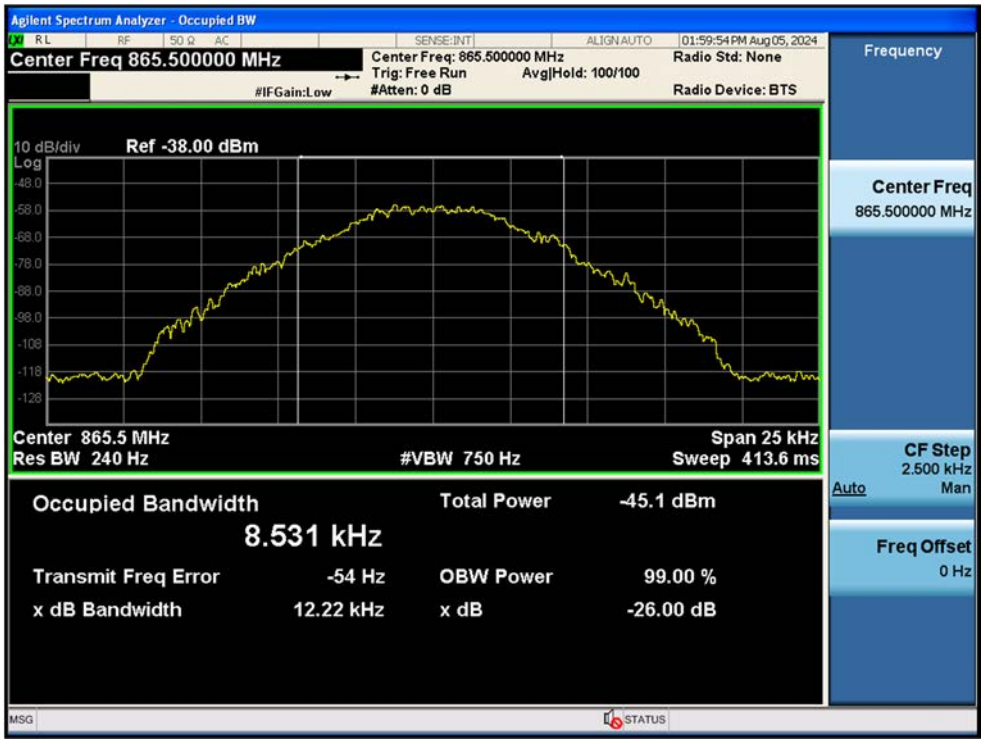
Input / ESMR / 1 Carrier / Downlink / P25 Phase 1



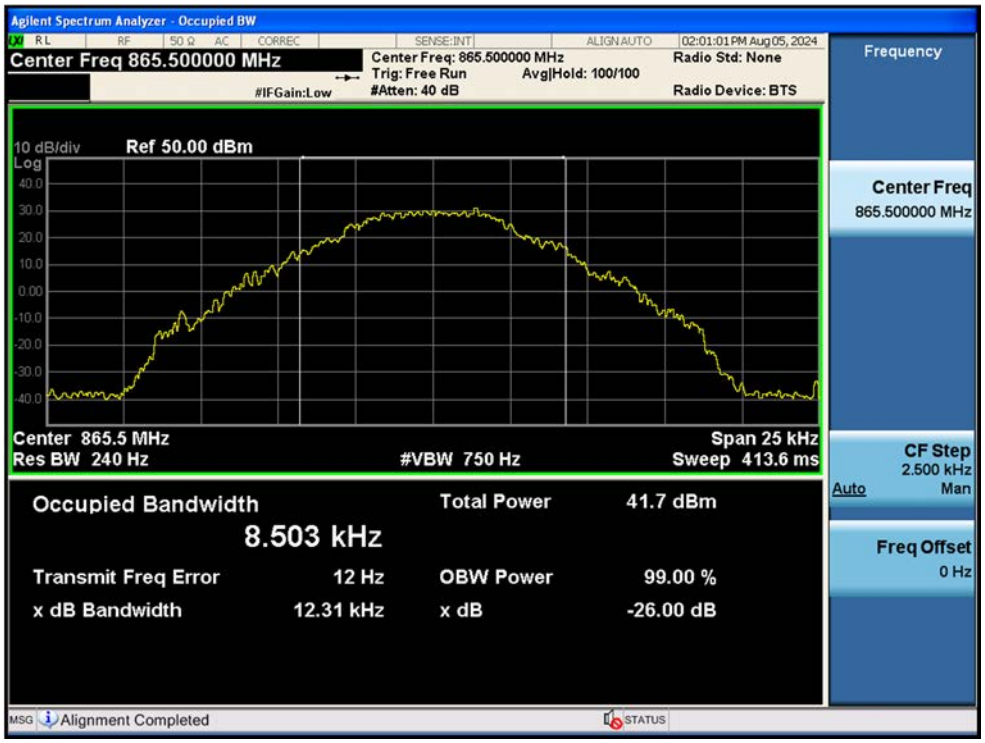
Output / ESMR / 1 Carrier / Downlink / P25 Phase 1



3 dB above the AGC threshold Input / ESMR / 1 Carrier / Downlink / P25 Phase 1



3 dB above the AGC threshold output / ESMR / 1 Carrier / Downlink / P25 Phase 1



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).

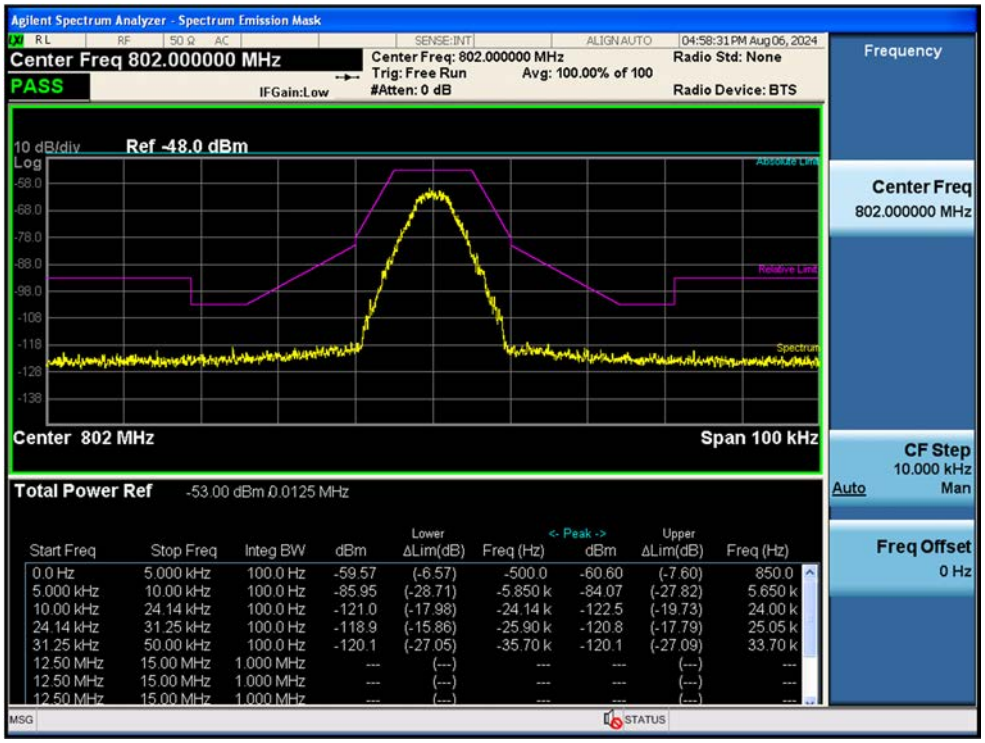
Test Procedures:

Measurements were in accordance with the test methods section 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.

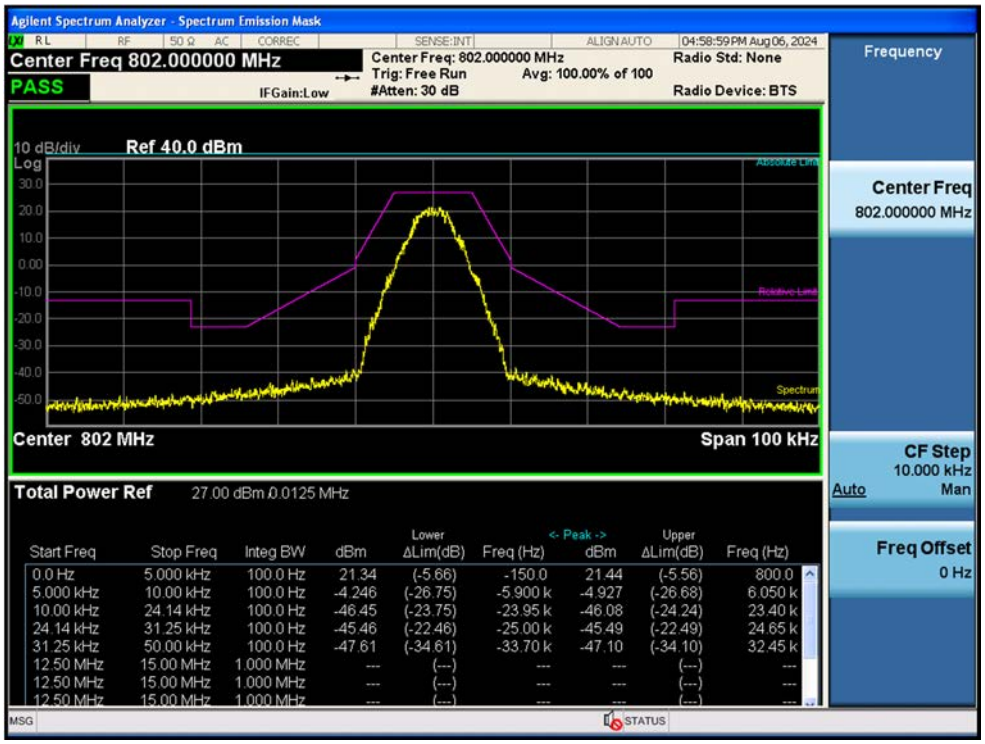
Plot data of Emission mask

Input / Public Safety Narrowband / 1 Carrier / Uplink / Mask C



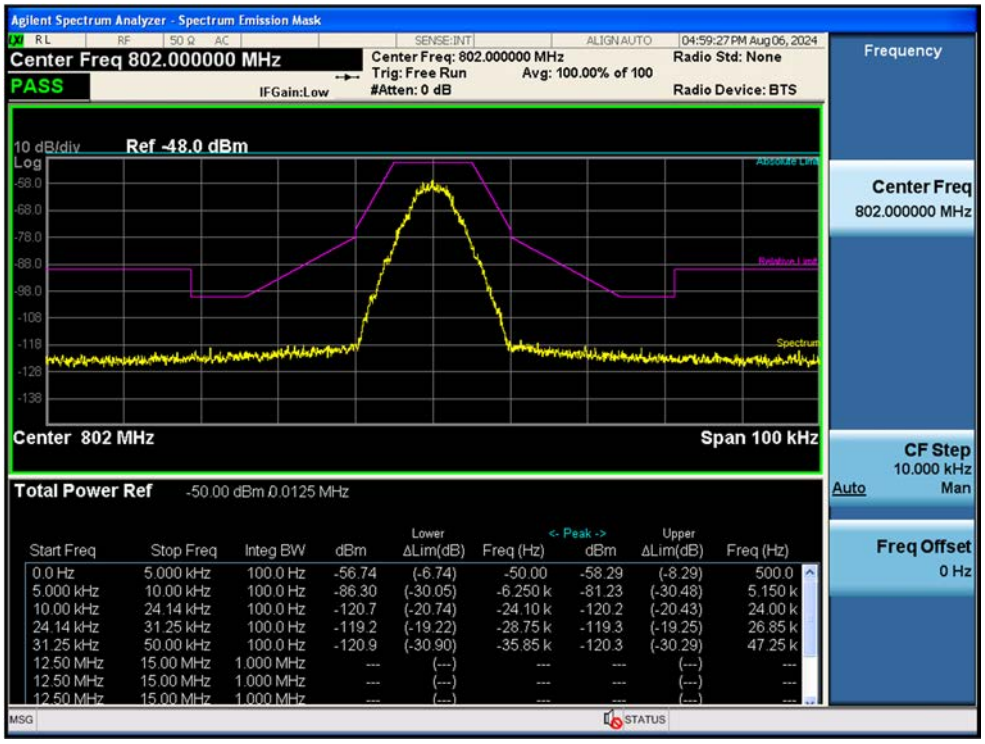
Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	5.000 kHz	100.0 Hz	-59.57	(-6.57)	-500.0	-60.60	(-7.60)	850.0
5.000 kHz	10.00 kHz	100.0 Hz	-85.95	(-28.71)	-5.850 k	-84.07	(-27.82)	5.650 k
10.00 kHz	24.14 kHz	100.0 Hz	-121.0	(-17.98)	-24.14 k	-122.5	(-19.73)	24.00 k
24.14 kHz	31.25 kHz	100.0 Hz	-118.9	(-15.86)	-25.90 k	-120.8	(-17.79)	25.05 k
31.25 kHz	50.00 kHz	100.0 Hz	-120.1	(-27.05)	-35.70 k	-120.1	(-27.09)	33.70 k
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

Output / Public Safety Narrowband / 1 Carrier / Uplink / Mask C

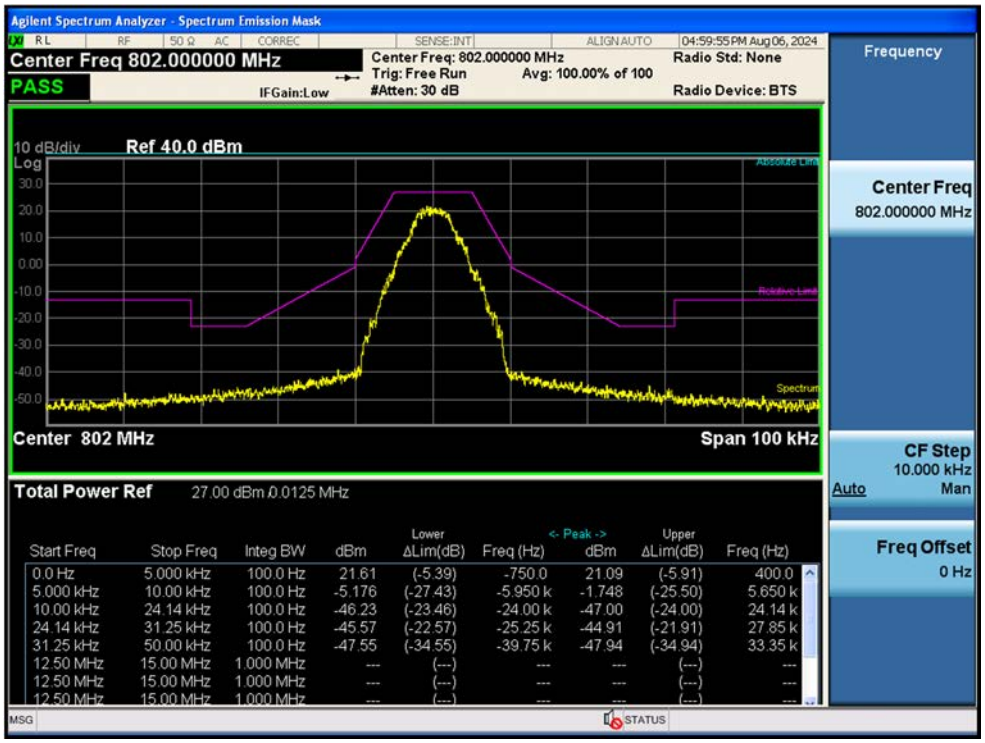


Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	5.000 kHz	100.0 Hz	21.34	(-5.66)	-150.0	21.44	(-5.56)	800.0
5.000 kHz	10.00 kHz	100.0 Hz	-4.246	(-26.75)	-5.900 k	-4.927	(-26.68)	6.050 k
10.00 kHz	24.14 kHz	100.0 Hz	-46.45	(-23.75)	-23.95 k	-46.08	(-24.24)	23.40 k
24.14 kHz	31.25 kHz	100.0 Hz	-45.46	(-22.46)	-25.00 k	-45.49	(-22.49)	24.65 k
31.25 kHz	50.00 kHz	100.0 Hz	-47.61	(-34.61)	-33.70 k	-47.10	(-34.10)	32.45 k
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

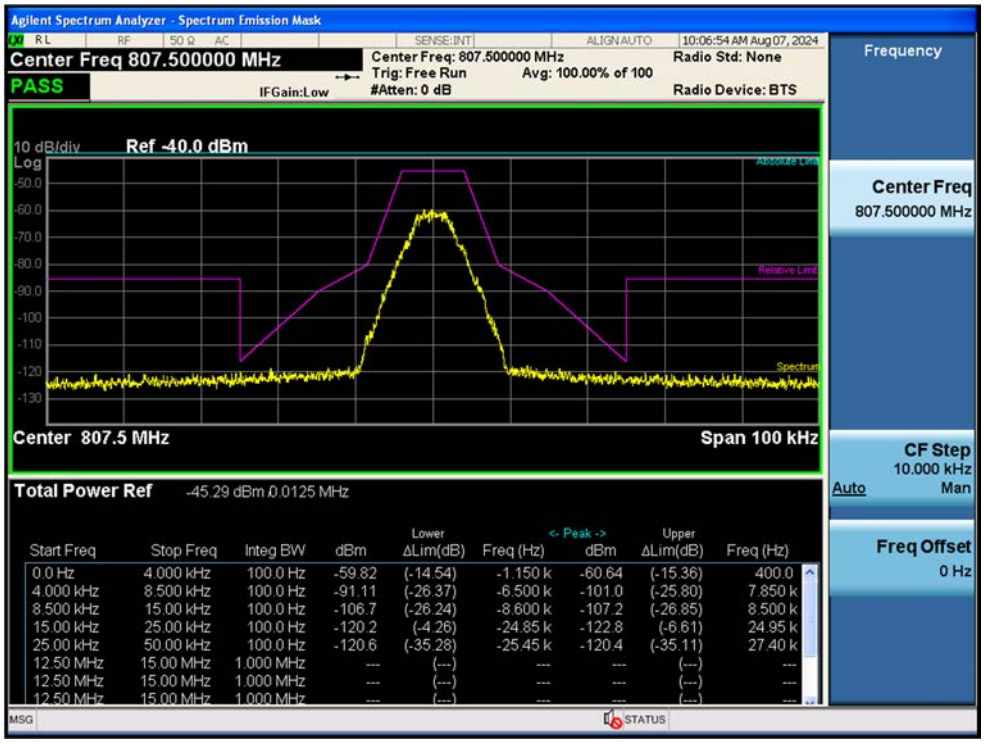
3 dB above the AGC threshold Input / Public Safety Narrowband / 1 Carrier / Uplink / Mask C



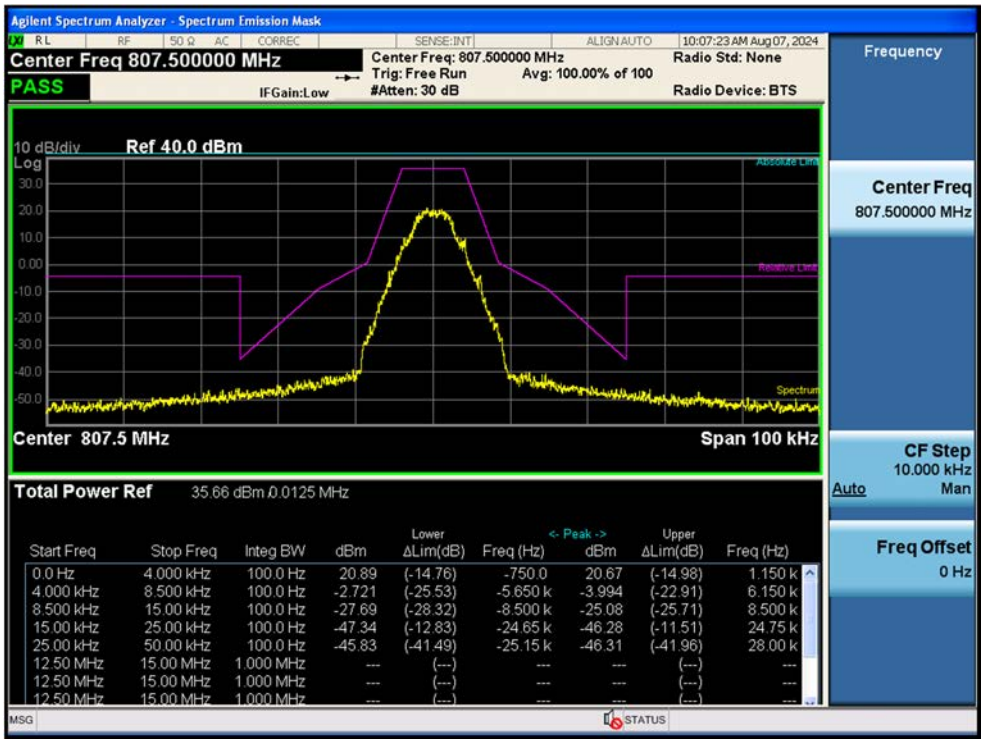
3 dB above the AGC threshold output / Public Safety Narrowband / 1 Carrier / Uplink / Mask C



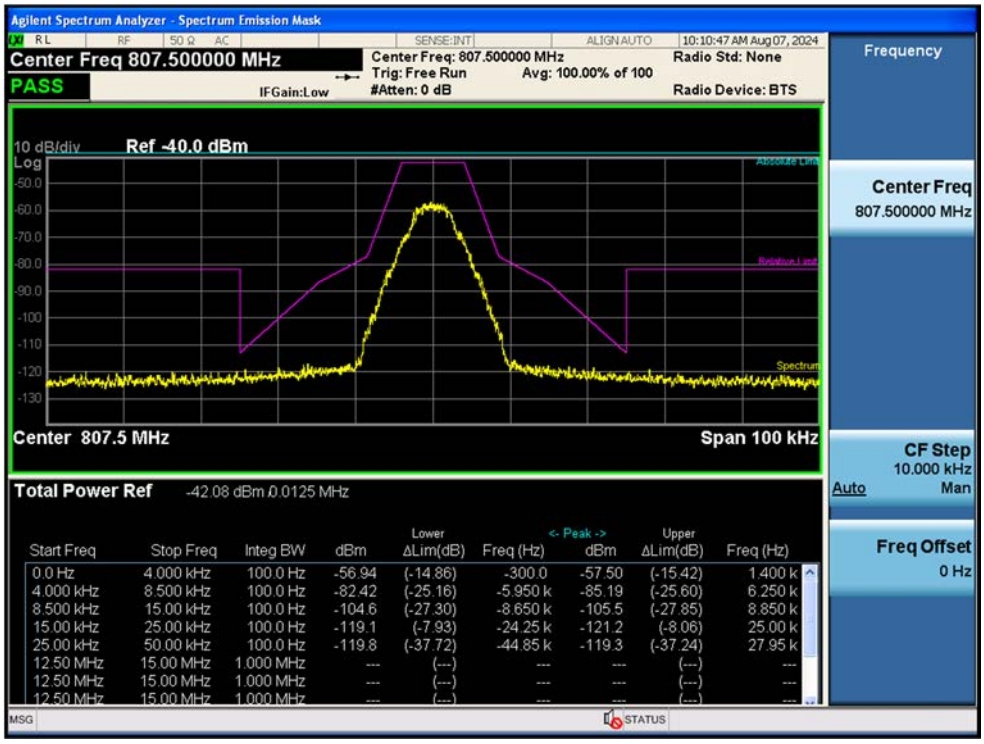
Input / NPSPAC / 1 Carrier / Uplink / Mask H



Output / NPSPAC / 1 Carrier / Uplink / Mask H

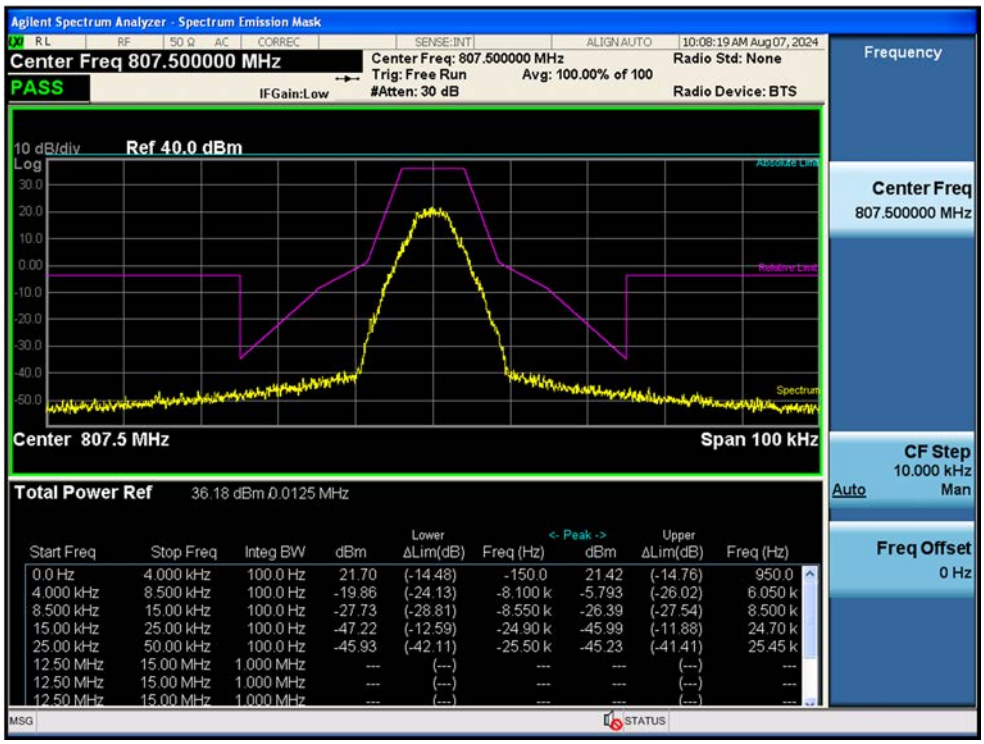


3 dB above the AGC threshold Input / NPSPAC / 1 Carrier / Uplink / Mask H



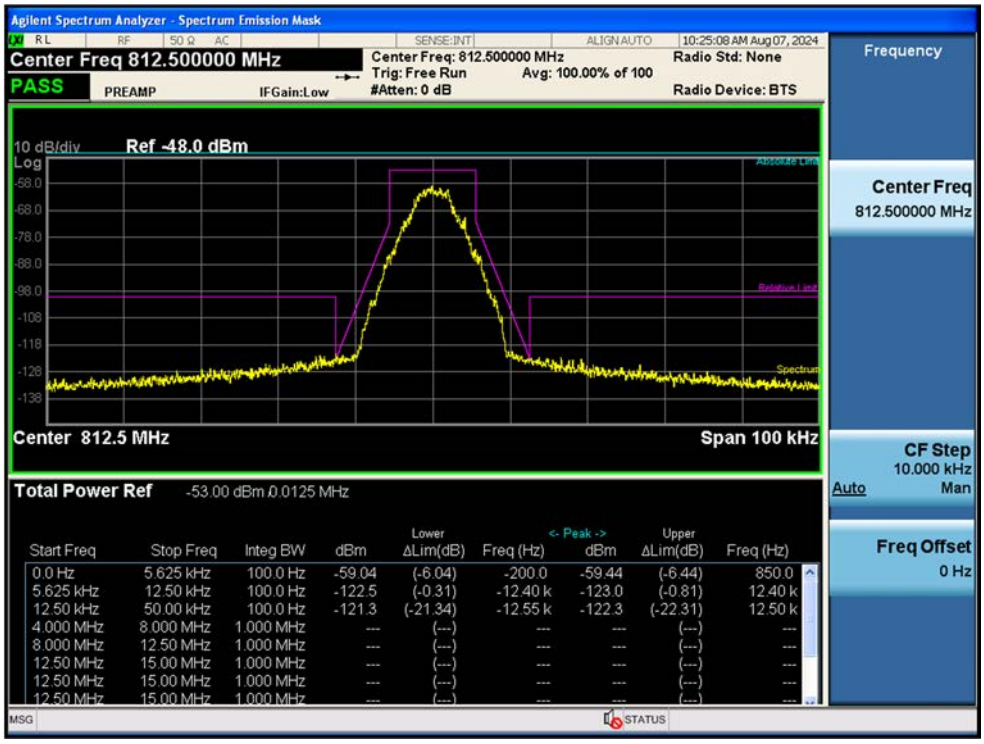
Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	4.000 kHz	100.0 Hz	-56.94	(-14.86)	-300.0	-57.50	(-15.42)	1.400 k
4.000 kHz	8.500 kHz	100.0 Hz	-82.42	(-25.16)	-5.950 k	-85.19	(-25.60)	6.250 k
8.500 kHz	15.00 kHz	100.0 Hz	-104.6	(-27.30)	-8.650 k	-105.5	(-27.85)	8.850 k
15.00 kHz	25.00 kHz	100.0 Hz	-119.1	(-7.93)	-24.25 k	-121.2	(-8.06)	25.00 k
25.00 kHz	50.00 kHz	100.0 Hz	-119.8	(-37.72)	-44.85 k	-119.3	(-37.24)	27.95 k
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

3 dB above the AGC threshold output / NPSPAC / 1 Carrier / Uplink / Mask H

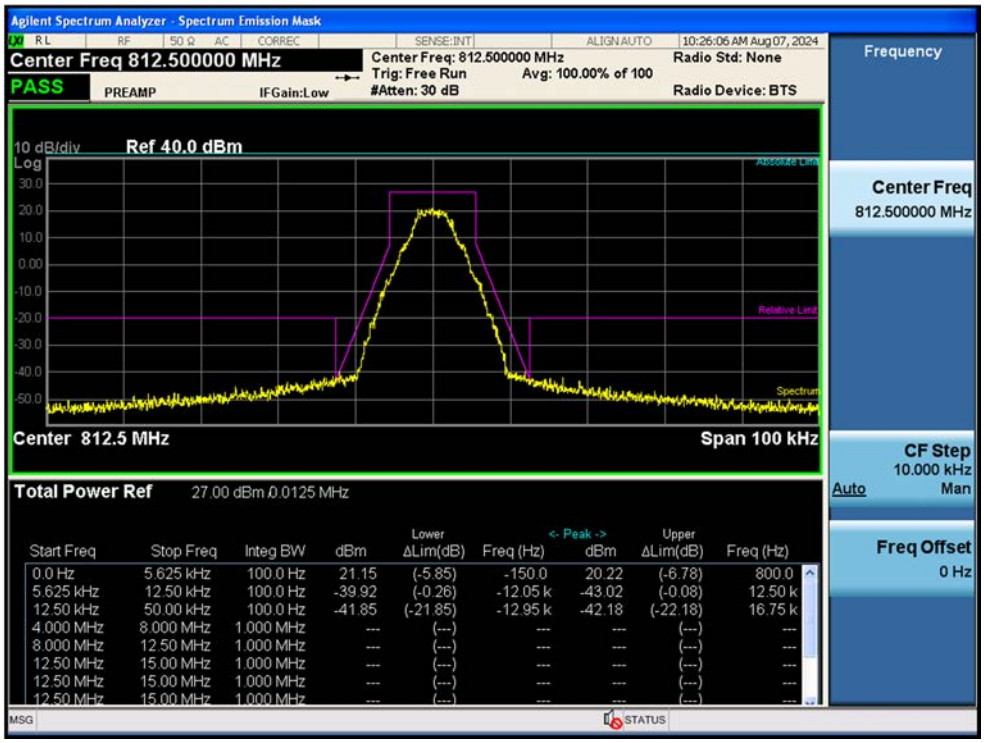


Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	4.000 kHz	100.0 Hz	21.70	(-14.48)	-150.0	21.42	(-14.76)	950.0
4.000 kHz	8.500 kHz	100.0 Hz	-19.86	(-24.13)	-8.100 k	-5.793	(-26.02)	6.050 k
8.500 kHz	15.00 kHz	100.0 Hz	-27.73	(-28.81)	-8.550 k	-26.39	(-27.54)	8.500 k
15.00 kHz	25.00 kHz	100.0 Hz	-47.22	(-12.59)	-24.90 k	-45.99	(-11.88)	24.70 k
25.00 kHz	50.00 kHz	100.0 Hz	-45.93	(-42.11)	-25.50 k	-45.23	(-41.41)	25.45 k
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

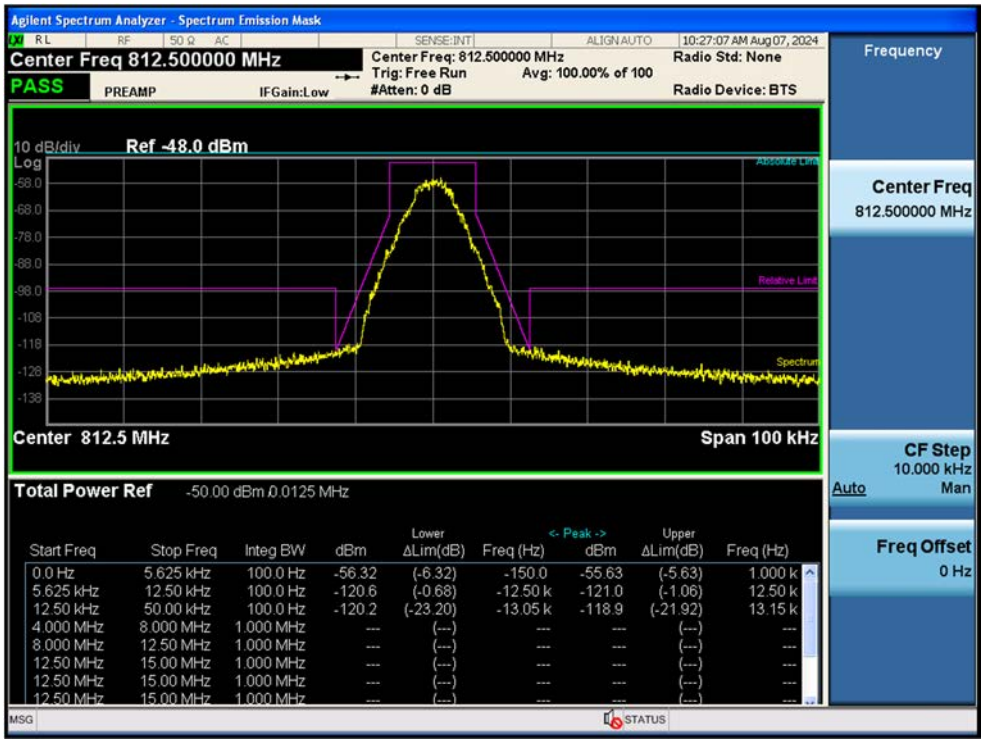
Input / B/ILT; SMR / 1 Carrier / Uplink / Mask D



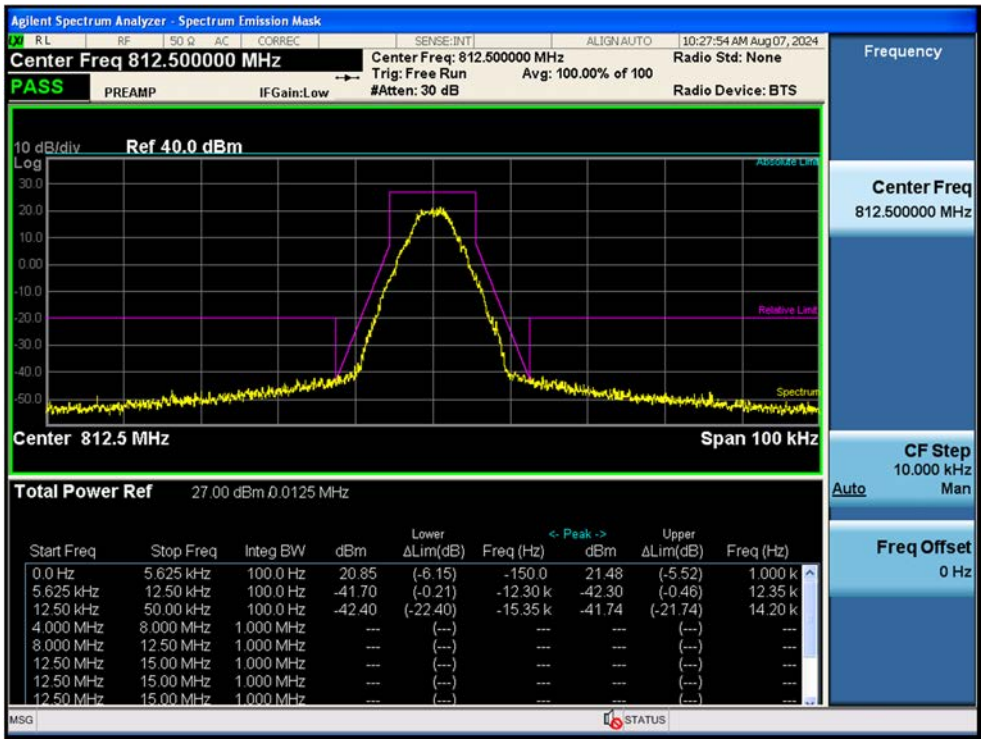
Output / B/ILT; SMR / 1 Carrier / Uplink / Mask D



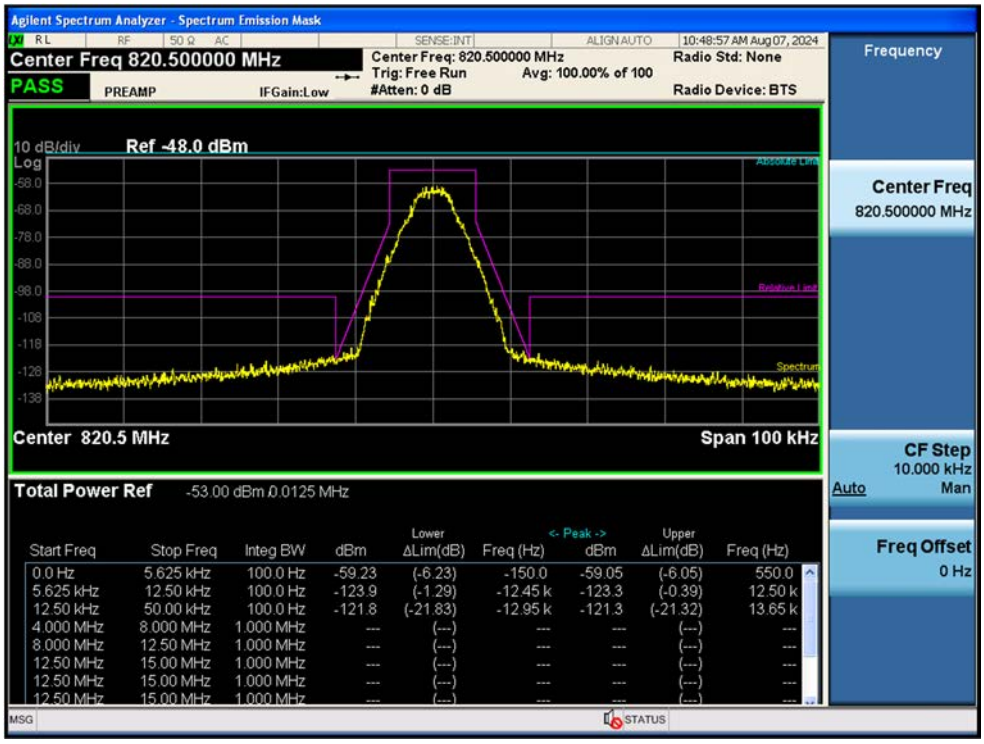
3 dB above the AGC threshold Input / B/ILT; SMR / 1 Carrier / Uplink / Mask D



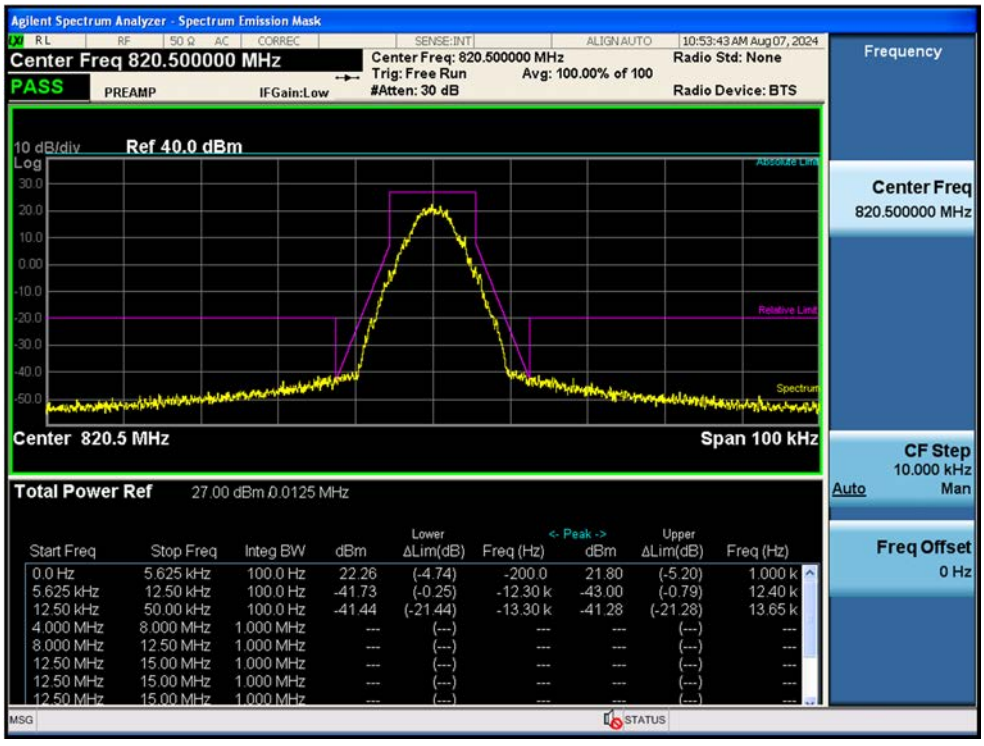
3 dB above the AGC threshold output / B/ILT; SMR / 1 Carrier / Uplink / Mask D



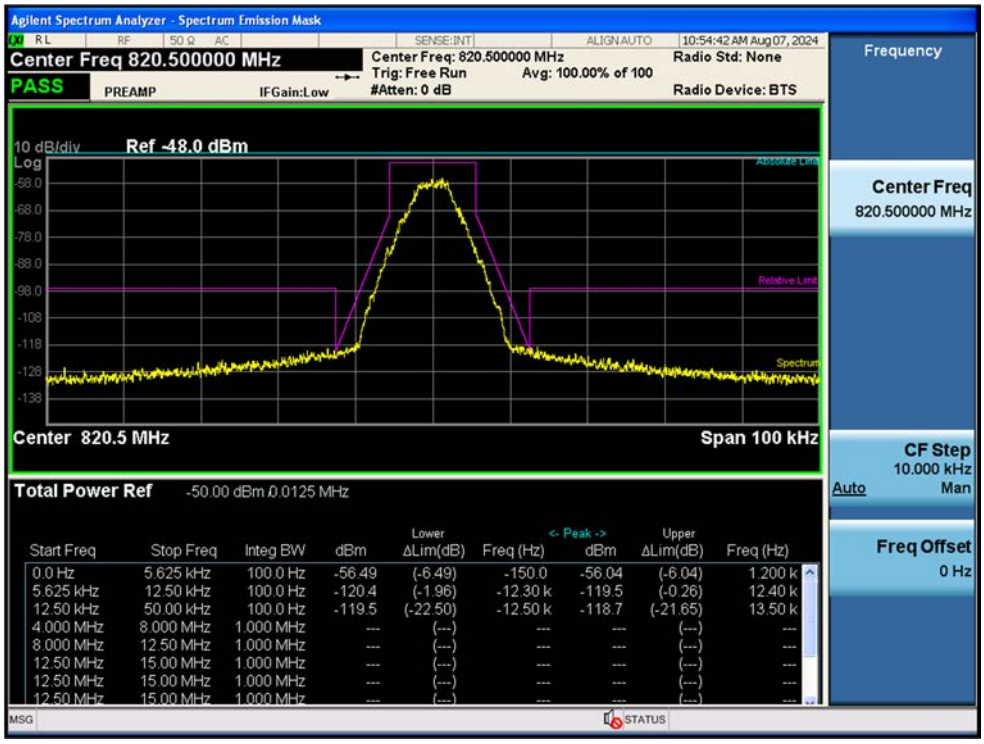
Input / ESMR / 1 Carrier / Uplink / Mask D



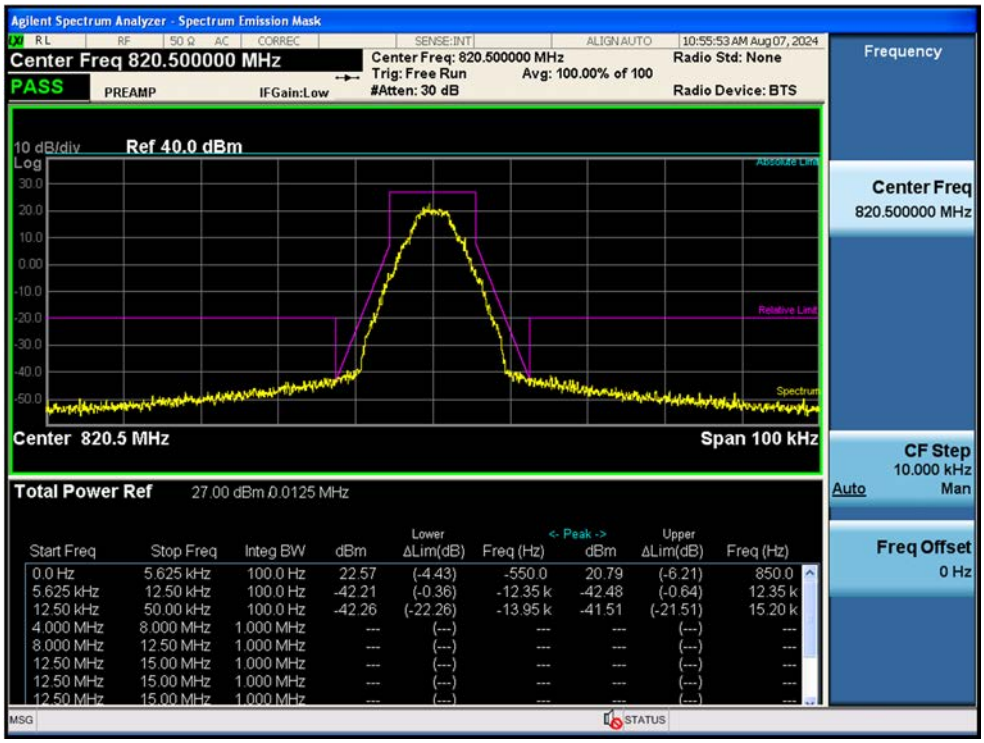
Output / ESMR / 1 Carrier / Uplink / Mask D



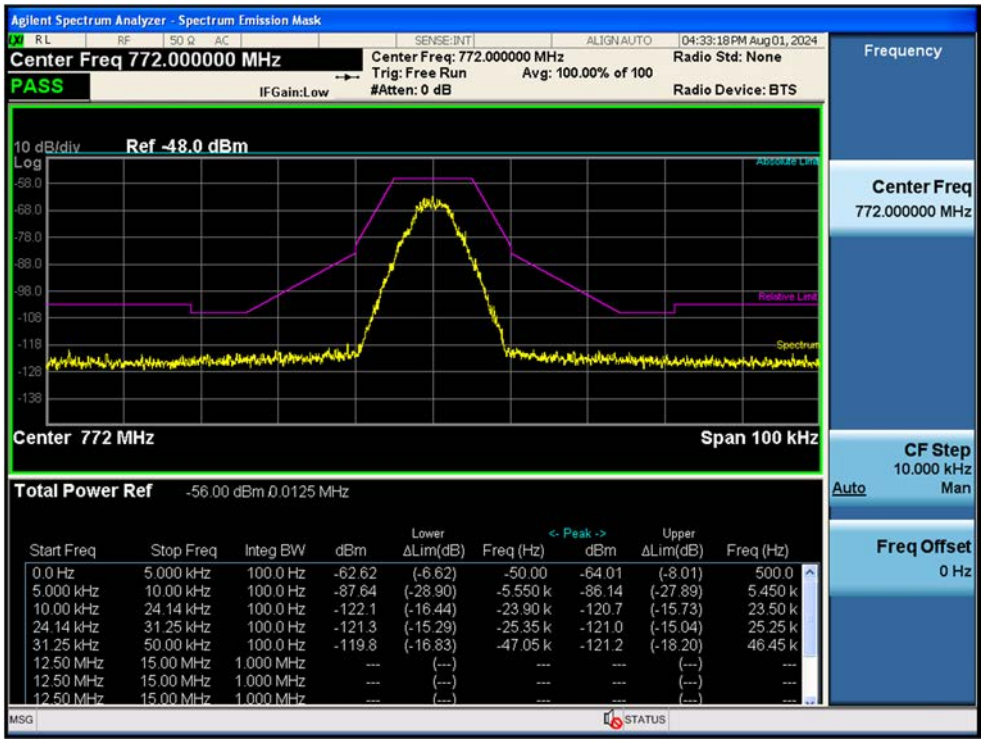
3 dB above the AGC threshold Input / ESMR / 1 Carrier / Uplink / Mask D



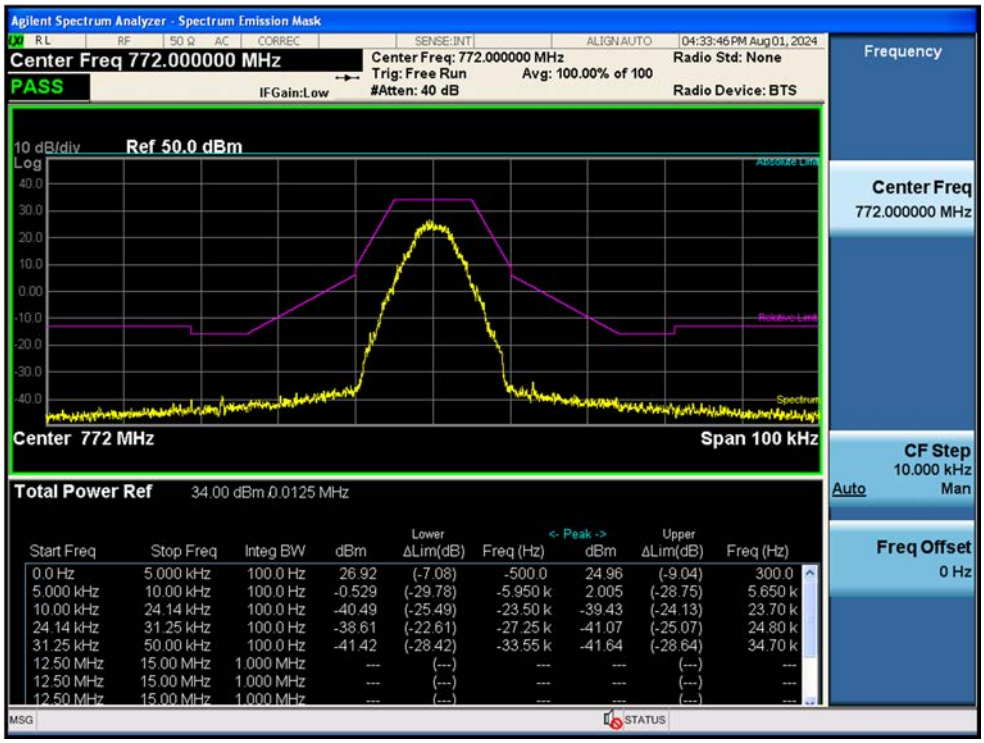
3 dB above the AGC threshold output / ESMR / 1 Carrier / Uplink / Mask D



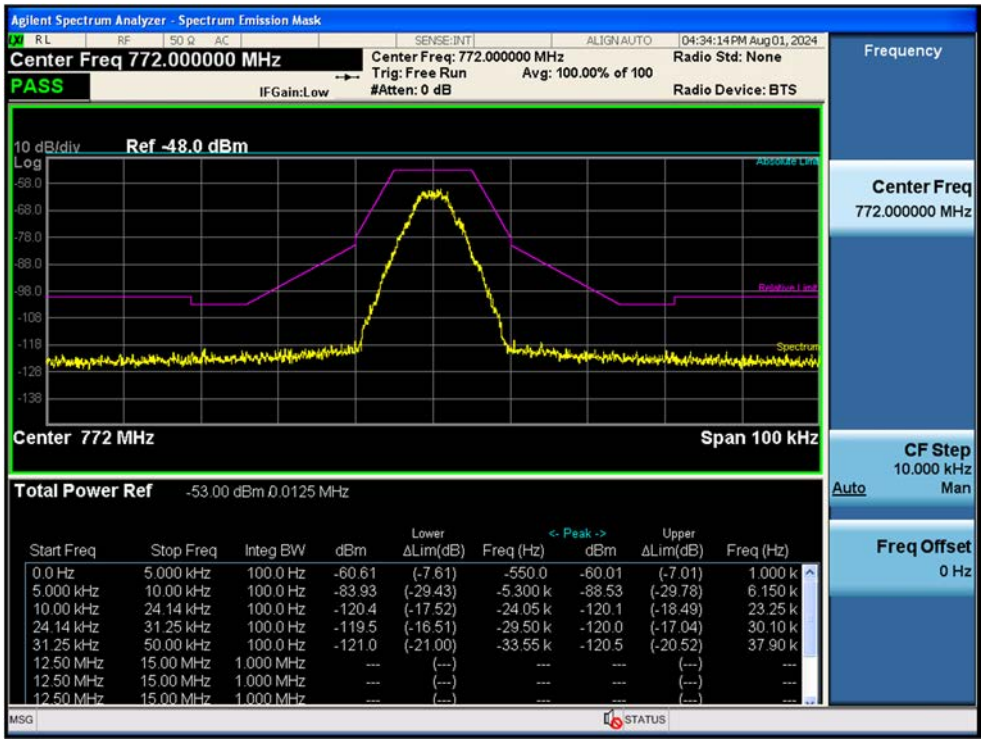
Input / Public Safety Narrowband / 1 Carrier / Downlink / Mask C



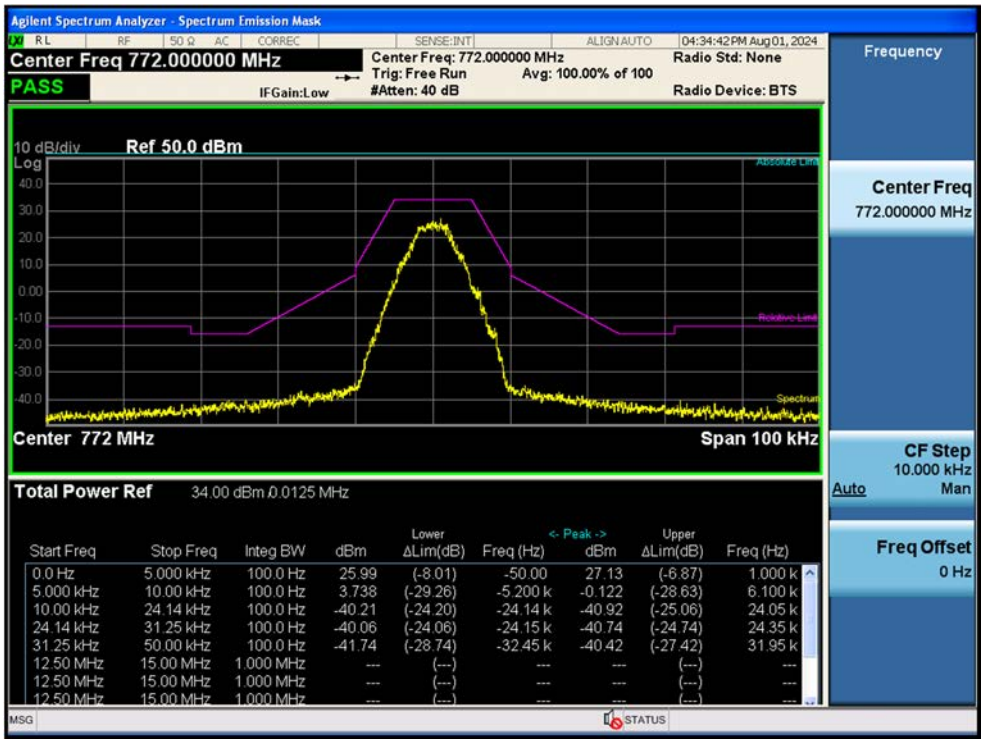
Output / Public Safety Narrowband / 1 Carrier / Downlink / Mask C



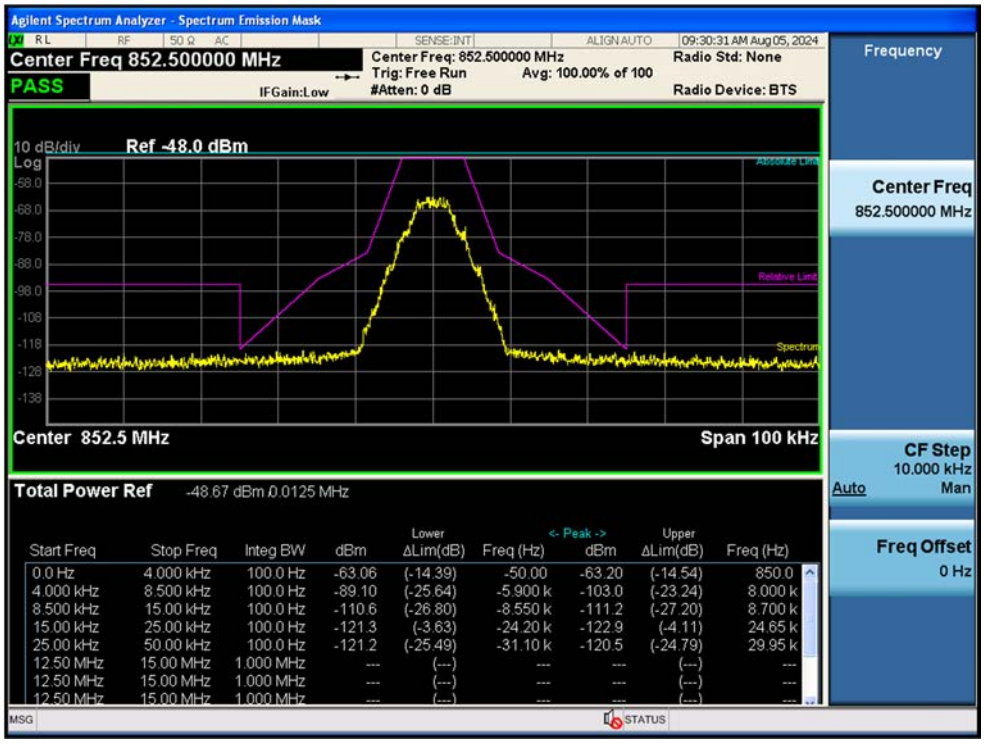
3 dB above the AGC threshold Input / Public Safety Narrowband / 1 Carrier / Downlink / Mask C



3 dB above the AGC threshold output / Public Safety Narrowband / 1 Carrier / Downlink / Mask C

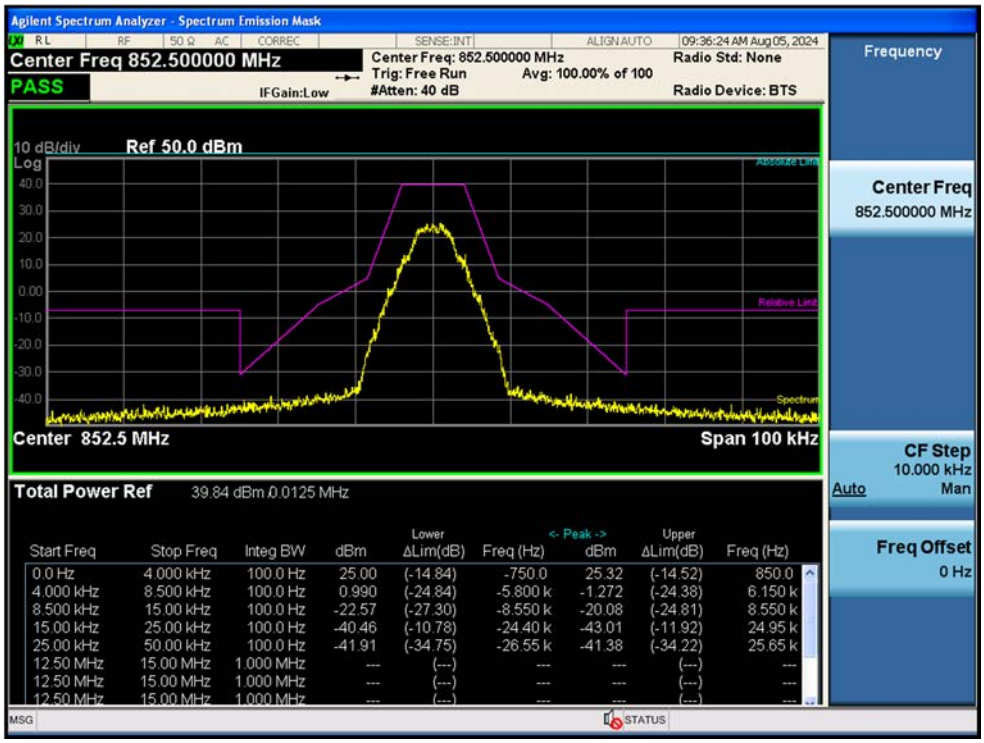


Input / NPSPAC / 1 Carrier / Downlink / Mask H



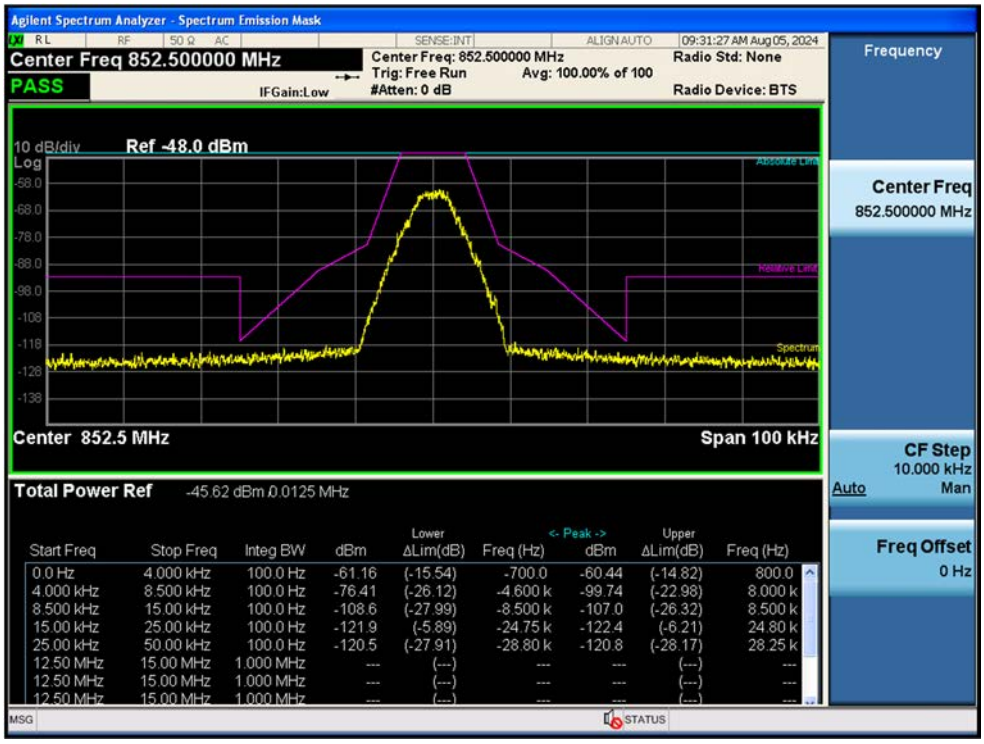
Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	4.000 kHz	100.0 Hz	-63.06	(-14.39)	-50.00	-63.20	(-14.54)	850.0
4.000 kHz	8.500 kHz	100.0 Hz	-89.10	(-25.64)	-5.900 k	-103.0	(-23.24)	8.000 k
8.500 kHz	15.00 kHz	100.0 Hz	-110.6	(-26.80)	-8.550 k	-111.2	(-27.20)	8.700 k
15.00 kHz	25.00 kHz	100.0 Hz	-121.3	(-3.63)	-24.20 k	-122.9	(-4.11)	24.65 k
25.00 kHz	50.00 kHz	100.0 Hz	-121.2	(-25.49)	-31.10 k	-120.5	(-24.79)	29.95 k
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

Output / NPSPAC / 1 Carrier / Downlink / Mask H

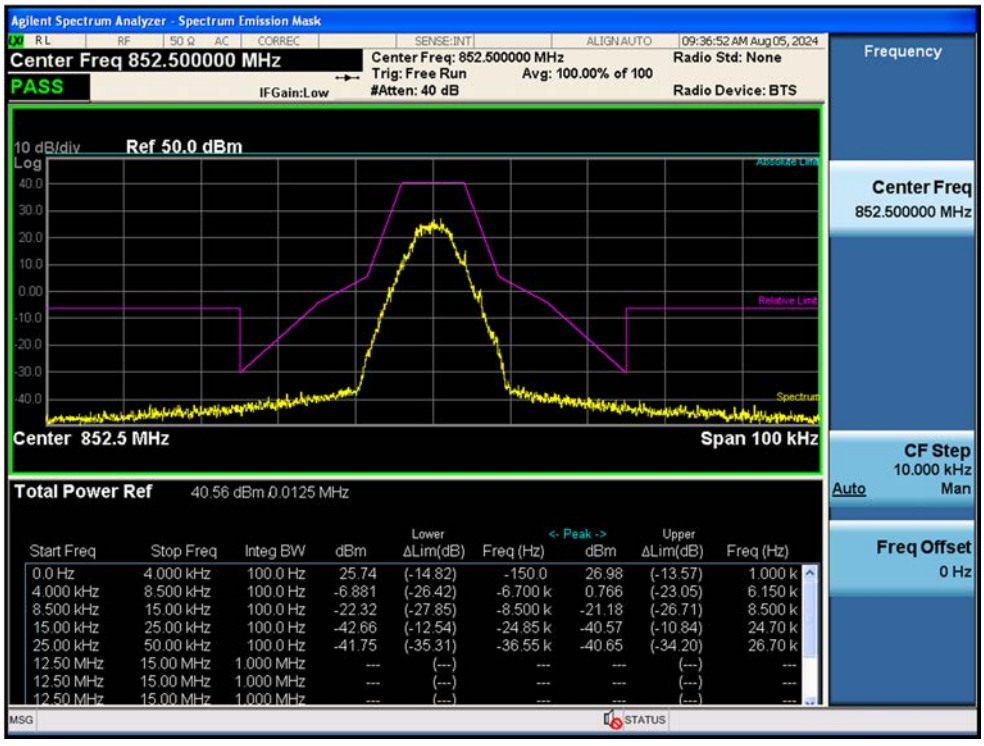


Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	4.000 kHz	100.0 Hz	25.00	(-14.84)	-750.0	25.32	(-14.52)	850.0
4.000 kHz	8.500 kHz	100.0 Hz	0.990	(-24.84)	-5.800 k	-1.272	(-24.38)	6.150 k
8.500 kHz	15.00 kHz	100.0 Hz	-22.57	(-27.30)	-8.550 k	-20.08	(-24.81)	8.550 k
15.00 kHz	25.00 kHz	100.0 Hz	-40.46	(-10.78)	-24.40 k	-43.01	(-11.92)	24.95 k
25.00 kHz	50.00 kHz	100.0 Hz	-41.91	(-34.75)	-26.55 k	-41.38	(-34.22)	25.65 k
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

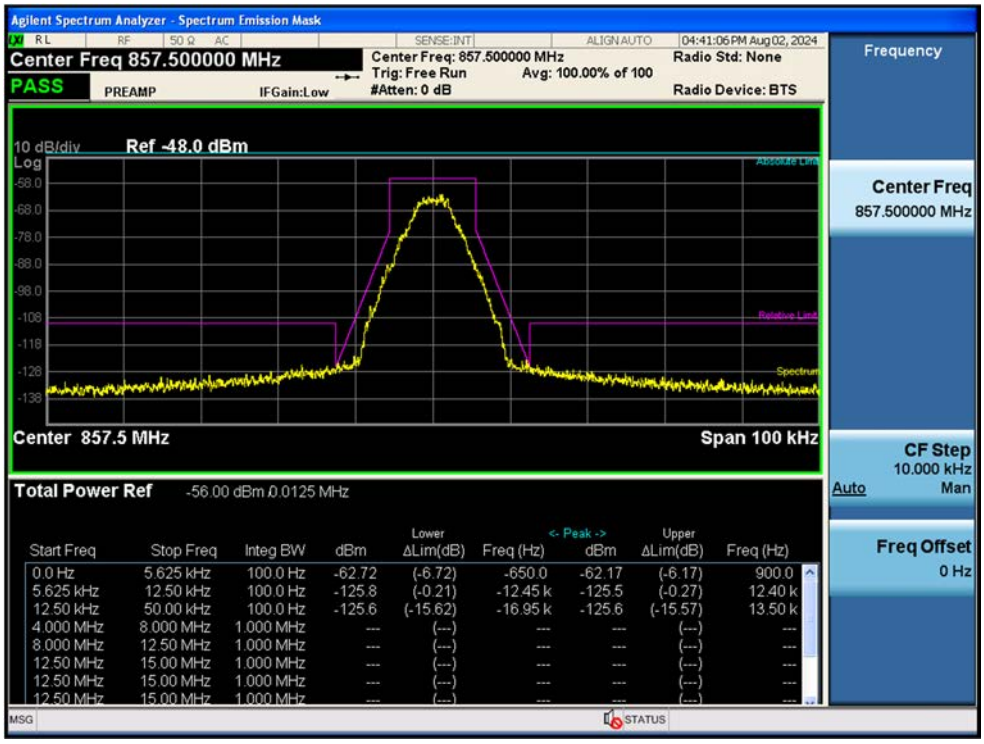
3 dB above the AGC threshold Input / NPSPAC / 1 Carrier / Downlink / Mask H



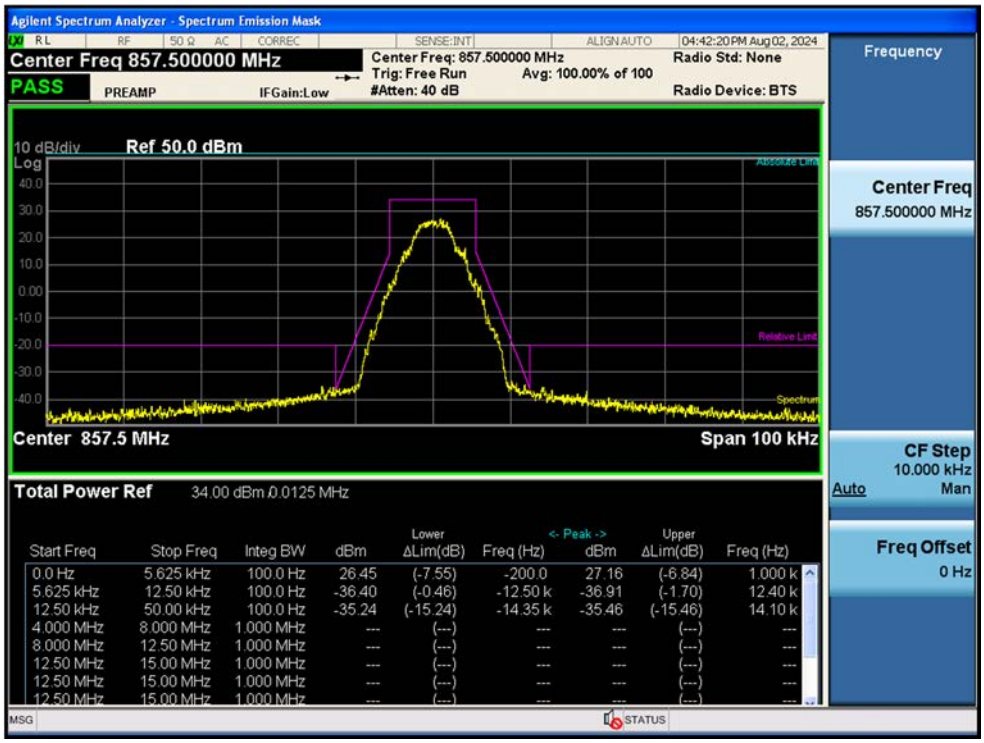
3 dB above the AGC threshold output / NPSPAC / 1 Carrier / Downlink / Mask H



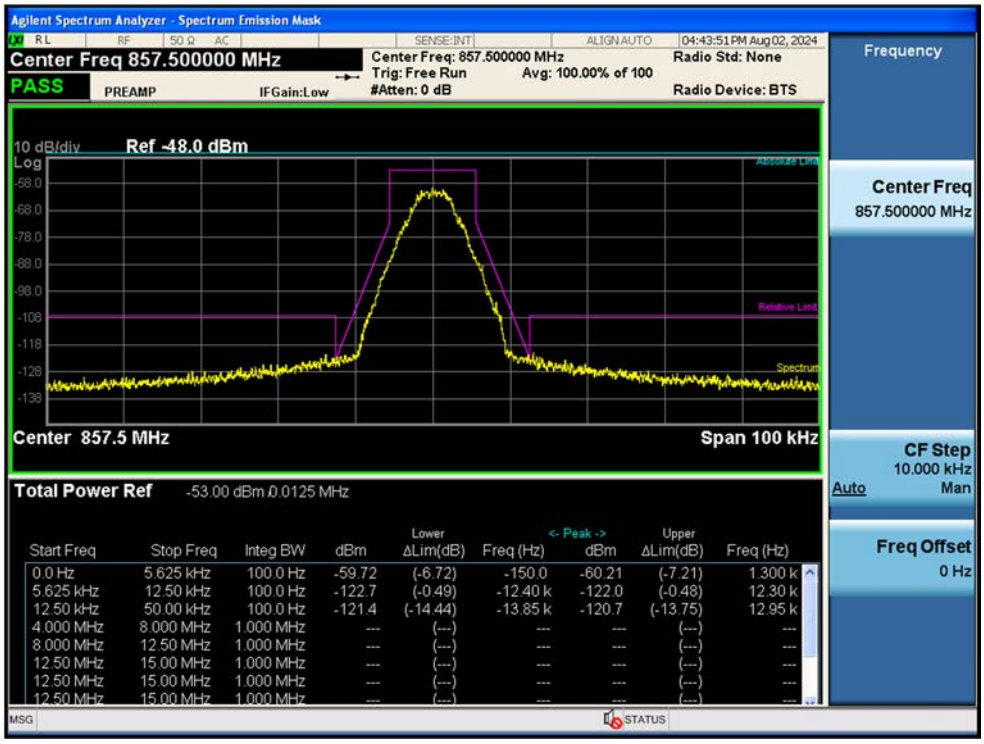
Input / B/ILT; SMR / 1 Carrier / Downlink / Mask D



Output / B/ILT; SMR / 1 Carrier / Downlink / Mask D

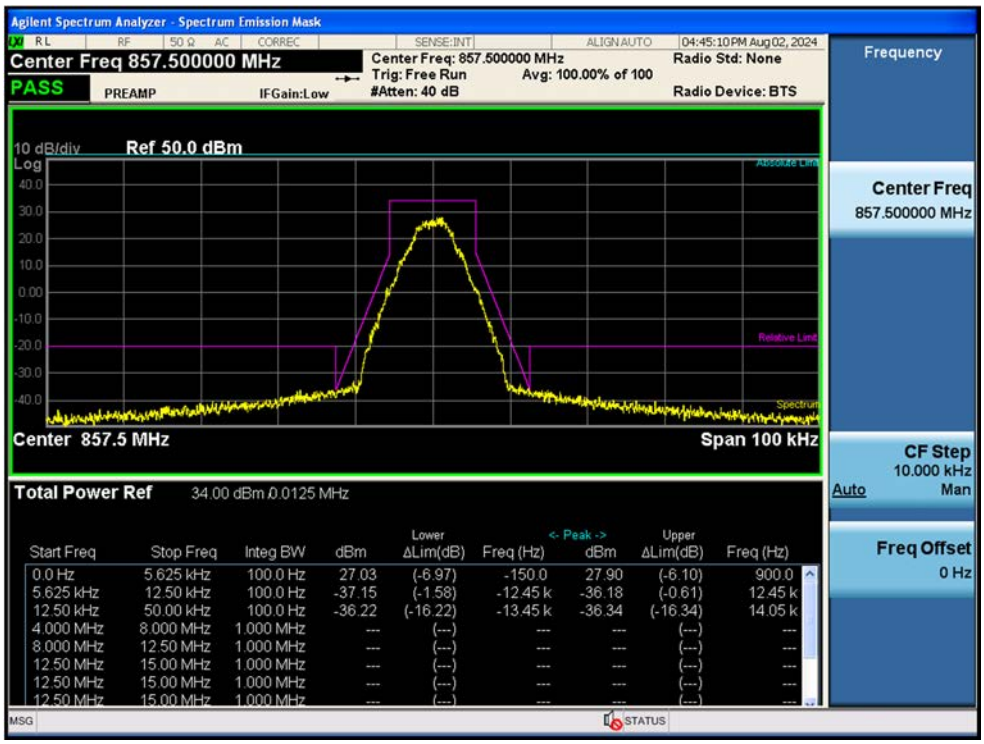


3 dB above the AGC threshold Input / B/ILT; SMR / 1 Carrier / Downlink / Mask D



Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	5.625 kHz	100.0 Hz	-59.72	(-6.72)	-150.0	-60.21	(-7.21)	1.300 k
5.625 kHz	12.50 kHz	100.0 Hz	-122.7	(-0.49)	-12.40 k	-122.0	(-0.48)	12.30 k
12.50 kHz	50.00 kHz	100.0 Hz	-121.4	(-14.44)	-13.85 k	-120.7	(-13.75)	12.95 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	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

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



Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	5.625 kHz	100.0 Hz	27.03	(-6.97)	-150.0	27.90	(-6.10)	900.0
5.625 kHz	12.50 kHz	100.0 Hz	-37.15	(-1.58)	-12.45 k	-36.18	(-0.61)	12.45 k
12.50 kHz	50.00 kHz	100.0 Hz	-36.22	(-16.22)	-13.45 k	-36.34	(-16.34)	14.05 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	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---