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TEST REPORT

FCC Test for PSR-78-8527
Certification

APPLICANT
ADRF KOREA, Inc.

REPORT NO.
HCT-RF-2012-FC042

DATE OF ISSUE
December 24, 2020

Tested by
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TEST REPORT

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PSR-78-8527

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Additional Model
–

Applicant	**ADRF KOREA, Inc.** 5-5, Mojeon-Ri, Backsa-Myun, Icheon-Citi, Kyunggi-Do, Korea
Eut Type Model Name	Repeater PSR-78-8527
FCC ID	N52-PSR-78-8527
Output Power	Downlink: 27 dBm / Uplink: 24 dBm
Date of Test	November 30, 2020~ December 17, 2020
FCC Rule Parts:	Part 2, Part 90

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

REVISION HISTORY

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

Revision No.	Date of Issue	Description
0	December 24, 2020	Initial Release

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance.

CONTENTS

1. GENERAL INFORMATION

1.1. APPLICANT INFORMATION

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

1.2. PRODUCT INFORMATION

EUT Type	Repeater
EUT Serial Number	P788527XXXXXX
Power Supply	Input: 110 Vac ~ 240 Vac / Output (DC): +27V, +6V, +3.8V
Frequency Range	Band Name: Uplink (MHz) / Downlink (MHz) FirstNet: 788 ~ 798 / 758 ~ 768 PS Narrowband: 799 ~ 805 / 769 ~ 775 SMR: 809 ~ 816 / 854 ~ 861
Tx Output Power	DL: 27 dBm / UL: 24 dBm
Antenna Peak Gain	Band Name / Uplink (Panel antenna) / Downlink (Omni antenna) FirstNet: 2.6 dBi / 15 dBi PS Narrowband: 2.6 dBi / 15 dBi SMR: 3.9 dBi / 16 dBi

1.3. TEST INFORMATION

FCC Rule Parts	Part 2, Part 90
Measurement Standards	KDB 935210 D05 v01r04, ANSI C63.26-2015
Test Location	HCT CO., LTD. 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

2. FACILITIES AND ACCREDITATIONS

2.1. FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA.

The site is constructed in conformance with the requirements of ANSI C63.4 (Version: 2014) and CISPR Publication 22.

Detailed description of test facility was submitted to the Commission and accepted dated April 02, 2018 (Registration Number: KR0032).

2.2. EQUIPMENT

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

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

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

3. TEST SPECIFICATIONS

3.1. STANDARDS

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

Description	Reference
AGC threshold	KDB 935210 D05 v01r04 3.2 KDB 935210 D05 v01r04 4.2
Out-of-band rejection	KDB 935210 D05 v01r04 3.3 KDB 935210 D05 v01r04 4.3
Occupied Bandwidth	§ 2.1049 § 90.219(e)(4)(ii)
Input-versus-output signal comparison	§ 90.210, § 90.219(e)(4)(iii)
Input/output power and amplifier/booster gain	§ 2.1046, § 90.219(e)(1), § 90.541, § 90.542, § 90.635
Noise figure	§ 90.219(e)(2)
Emission masks Out-of-band/out-of-block emissions and spurious emissions	§ 2.1051, § 90.219(e)(3), § 90.543
Spurious emissions radiated	§ 2.1053

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.

This EUT is supported power supply both of AC and DC. Test results are only attached worst cases.

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	Link	Frequency	Tested signals
FistNet	Uplink	(788 ~ 798) MHz	LTE 10MHz
	Downlink	(758 ~ 768) MHz	
PS Narrowband,	Uplink	(799 ~ 805) MHz	P25 Phase 1
	Downlink	(769 ~ 775) MHz	
SMR	Uplink	(809 ~ 816) MHz	P25 Phase 1
	Downlink	(854 ~ 861) MHz	

Below channels are not tested because it could consist of a combination of P25 Phase 1 signals.

Channelizing	P25 Phase 1 combinations	Bandwidth
12.5 kHz x n	n = 6 ~ 26	75 kHz ~ 325 kHz

The frequency stability measurement has been omitted in accordance with section 3.7 of KDB 935210 D05 v01r04.
: It can be confirmed through input-versus-output signal comparison test that EUT does not alter the input signal.

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	-0.054	800	0.037
650	0.080	850	0.116
700	-0.018	900	0.303
750	0.034	950	0.172

: Output Path

Correction factor table			
Frequency (MHz)	Factor (dB)	Frequency (MHz)	Factor (dB)
10	28.764	1 700	37.144
30	28.884	1 800	39.092
50	29.032	1 900	31.835
100	28.892	2 000	31.792
200	29.511	2 100	31.191
300	29.266	2 200	30.489
400	29.410	2 300	30.366
500	29.792	2 400	30.267
600	29.547	2 500	30.037
700	29.599	2 600	29.903
800	29.630	2 700	29.807
900	29.905	3 000	30.554
1 000	29.996	4 000	30.685
1 100	30.060	5 000	30.933
1 200	30.100	6 000	30.865
1 300	30.150	7 000	32.778
1 400	30.243	8 000	33.051
1 500	30.328	9 000	33.522
1 600	31.069	10 000	35.719

3.3. MEASUREMENTUNCERTAINTY

Description	Reference	Results
AGC threshold	-	±0.87 dB
Out-of-band rejection	-	±0.58 MHz
Occupied Bandwidth	OBW ≤ 25 kHz	±0.16 MHz
	OBW > 5 MHz	±0.58 MHz
Input-versus-output signal comparison		±0.87 dB
Input/output power and amplifier/booster gain	-	±0.87 dB
Out-of-band/out-of-block emissions and spurious emissions	-	±1.08 dB
Spurious emissions radiated	f ≤ 1 GHz	±4.80 dB
	f > 1 GHz	±6.07 dB

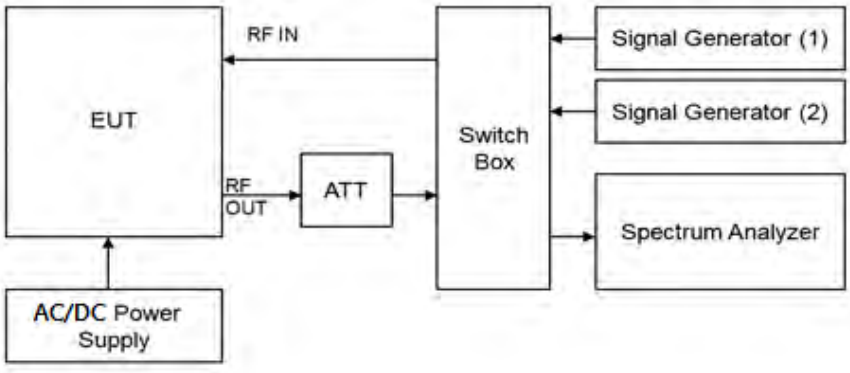
** Coverage factor k = 2, Confidence levels of 95 %*

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

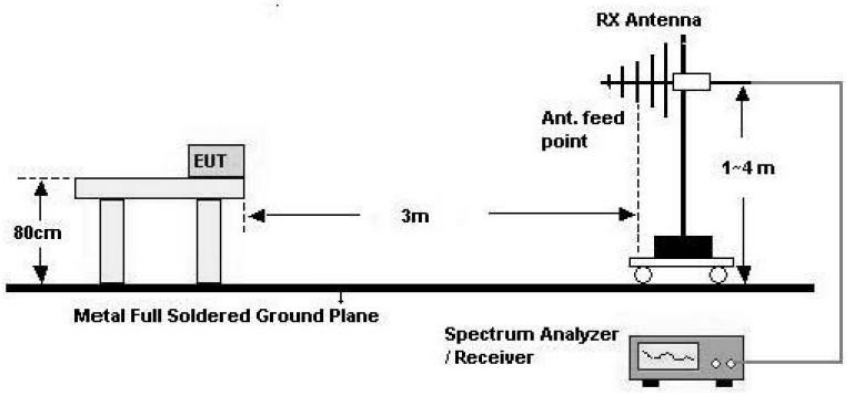
3.5. TEST DIAGRAMS

Conducted Test

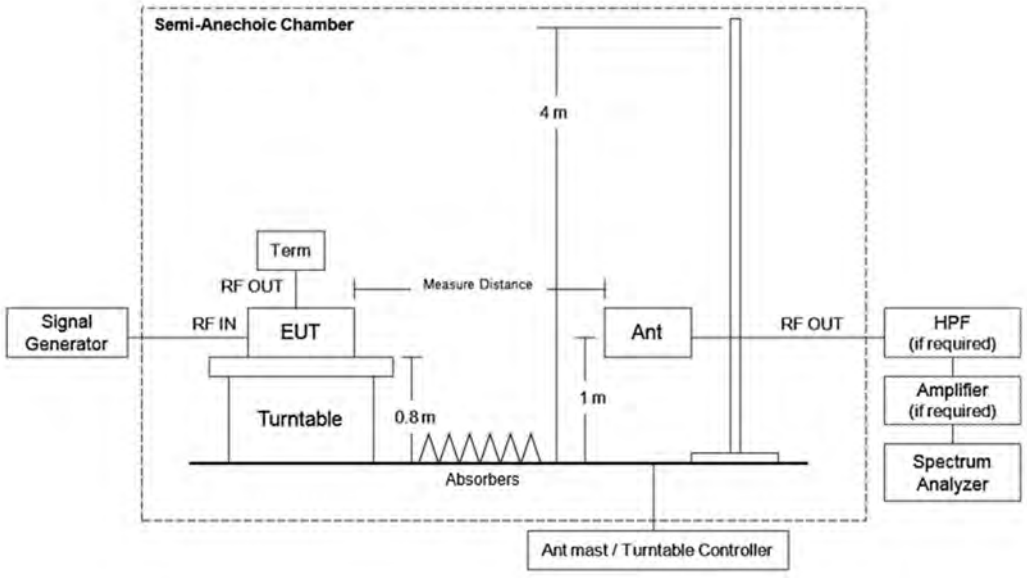


Radiated Test

30 MHz ~ 1 GHz



Above 1 GHz



4. TEST EQUIPMENTS

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Agilent	N9020A / MXA Signal Analyzer	08/06/2020	Annual	MY52440870
Agilent	N5182A / MXG Vector Signal Generator	08/26/2020	Annual	MY50140312
Agilent	N5182A / MXG Vector Signal Generator	12/02/2020	Annual	MY46240807
Weinschel Associates	WA93-30-33 / 30 dB Attenuator	04/09/2020	Annual	0202
KEITHLEY	S46 / Switch	N/A	N/A	1088024
KIKUSUI	PCR4000M / AC, DC Power Supply	10/14/2020	Annual	VM002269
Innco system	CO3000 / Controller(Antenna mast)	N/A	N/A	CO3000-4p
Innco system	MA4640/800-XP-EP / Antenna Position Tower	N/A	N/A	N/A
Audix	EM1000 / Controller	N/A	N/A	060520
Audix	Turn Table	N/A	N/A	N/A
TNM system	FBSM-01B / Amp & Filter Bank Switch Controller	N/A	N/A	N/A
Rohde & Schwarz	Loop Antenna	05/12/2020	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	08/02/2020	Biennial	01039
Schwarzbeck	BBHA 9120D / Horn Antenna	06/28/2020	Biennial	1300
Rohde & Schwarz	FSV / Spectrum Analyzer	05/13/2020	Annual	101055
TNM system	FBSM-05B / LNA1(1~18GHz)	01/21/2020	Annual	25540
Wainwright Instruments	WHKX10-900-1000-15000-40SS/ High Pass Filter	06/24/2020	Annual	5

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.

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.

Output power measurement in subclause 5.2.4.4.1 of ANSI C63.26

a) Set span to 2 × to 3 × the OBW.
b) Set RBW = 1% to 5% of the OBW.
c) Set VBW ≥ 3 × RBW.
d) Set number of measurement points in sweep ≥ 2 × span / RBW.
e) Sweep time: auto-couple

f) Detector = power averaging (rms).

g) If the EUT can be configured to transmit continuously, then set the trigger to free run.

h) Omit

i) Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over multiple symbols, it can be necessary to increase the number of traces to be averaged above 100 or, if using a manually configured sweep time, increase the sweep time.

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

Test Results:

Test Band	Link	Signal	Center Frequency (MHz)	AGC Threshold Level (dBm)	Output Level (dBm)
FistNet	Uplink	LTE 10 MHz	793.00	-61	23.98
	Downlink	LTE 10 MHz	763.00	-58	26.79
PS Narrowband	Uplink	P25 Phase 1	802.00	-61	24.18
	Downlink	P25 Phase 1	772.00	-58	26.56
SMR	Uplink	P25 Phase 1	812.50	-61	24.25
	Downlink	P25 Phase 1	857.50	-58	26.98

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.

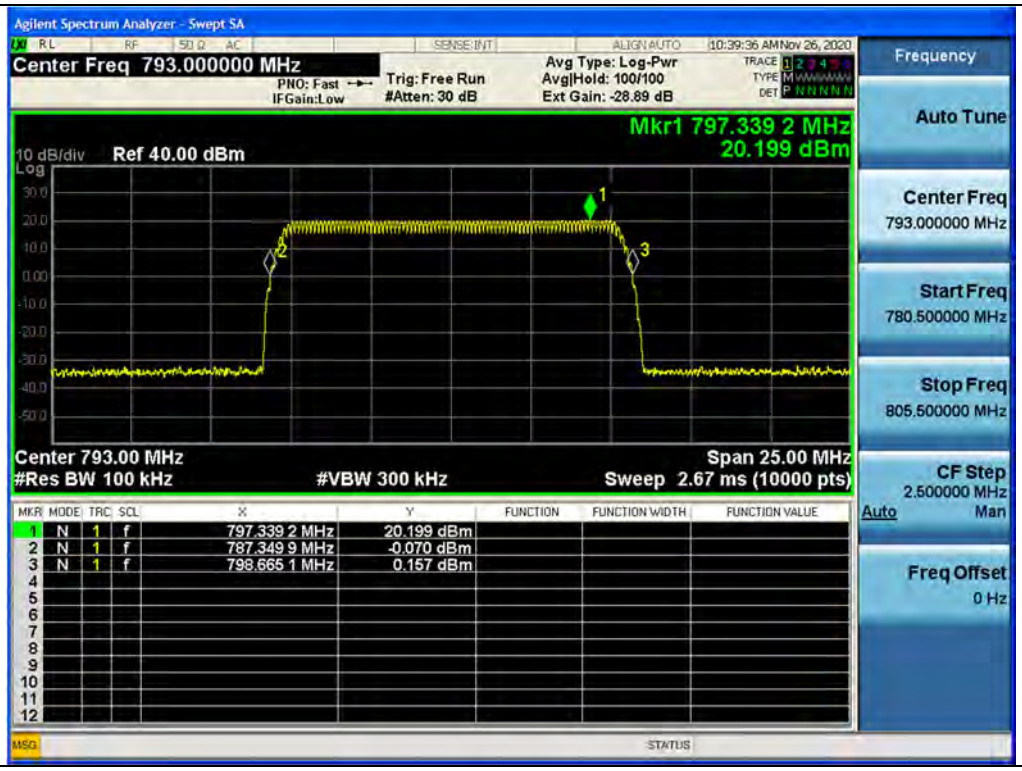
d) Set the RBW of the spectrum analyzer to between 1 % and 5 % of the manufacturer's rated passband, and VBW = 3 × RBW.

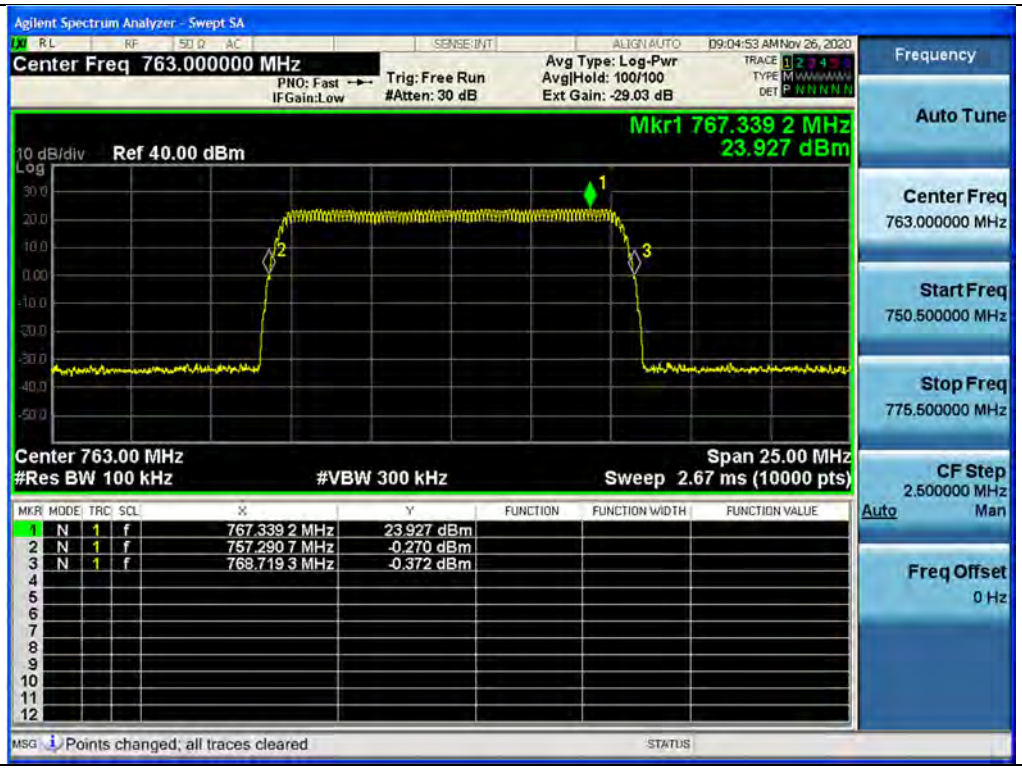
e) Set the detector to Peak and the trace to Max-Hold.

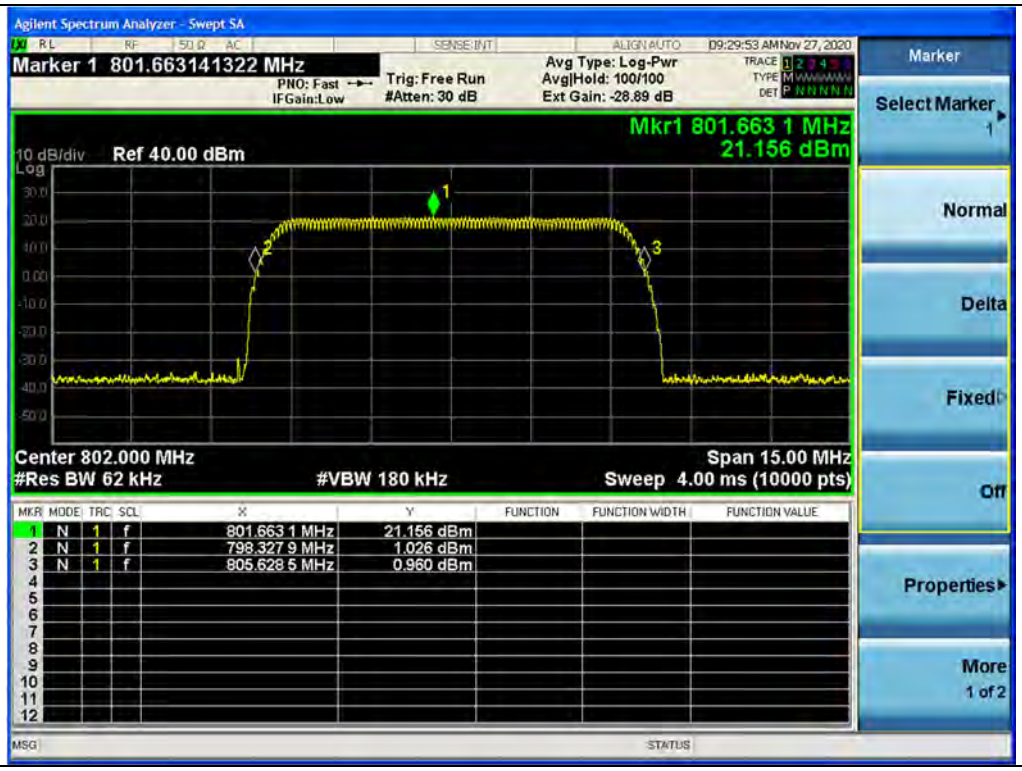
f) After the trace is completely filled, place a marker at the peak amplitude, which is designated as f_0, and with two additional markers (use the marker-delta method) at the 20 dB bandwidth (i.e., at the points where the level has fallen by 20 dB).

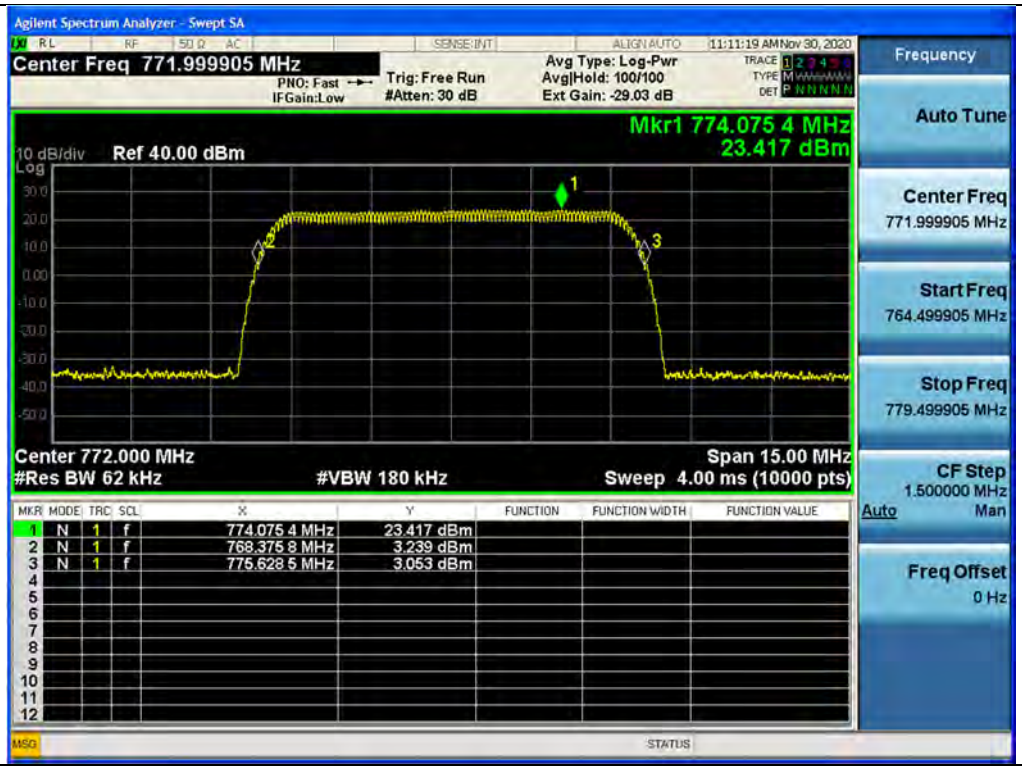
g) Capture the frequency response plot for inclusion in the test report.

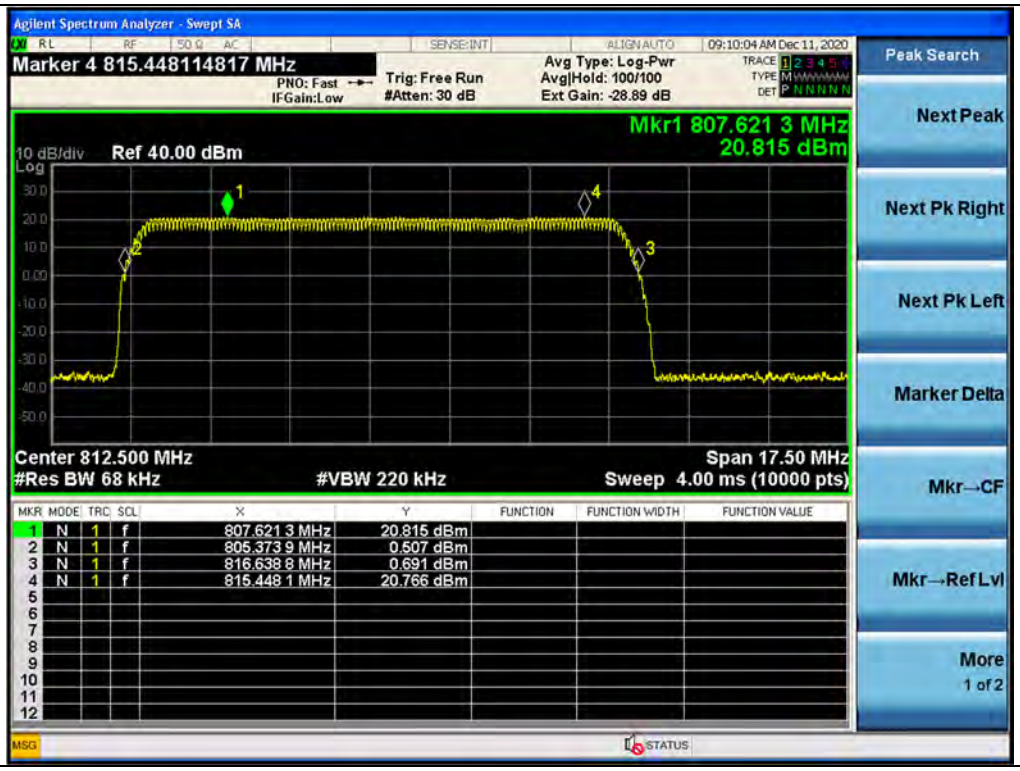
Test Results:

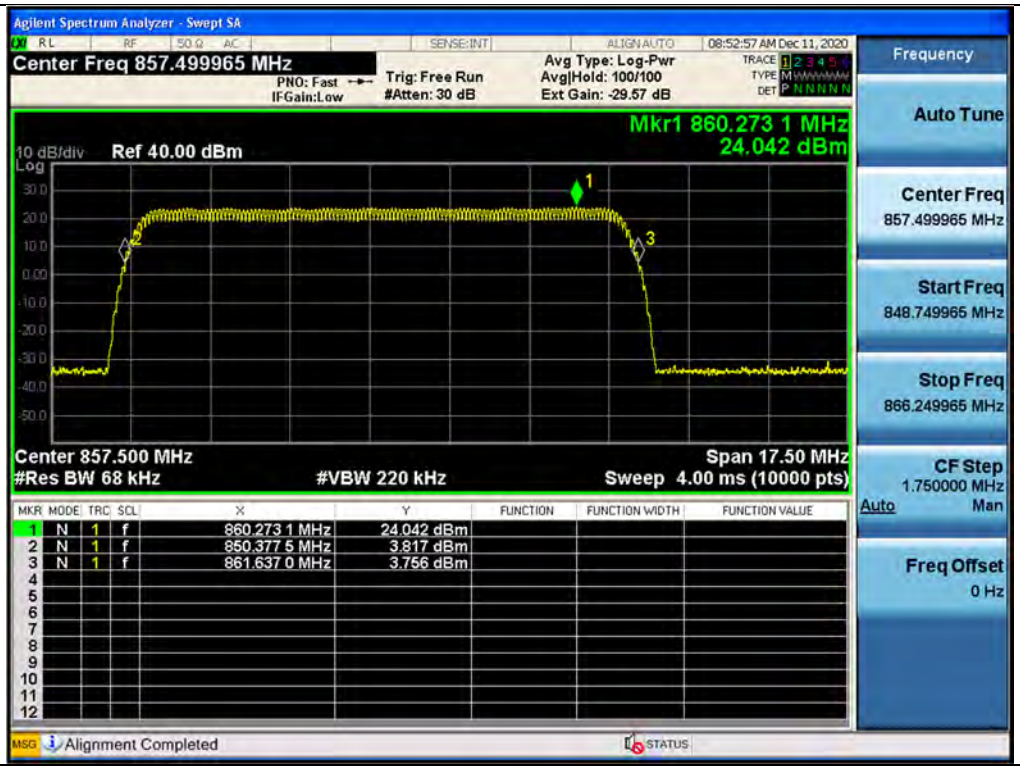
FistNet / Uplink


FistNet / Downlink


PS Narrowband / Uplink


PS Narrowband / Downlink


SMR / Uplink


SMR / Downlink


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.

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

OBW) is the positive frequency difference between the two markers. If the spectral envelope crosses the −26 dB down amplitude at multiple points, the lowest or highest frequency shall be selected as the frequencies that are the furthest removed from the center frequency at which the spectral envelope crosses the −26 dB down amplitude point.

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

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

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

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

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

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 Output Occupied Bandwidth

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (MHz)
FistNet	Uplink	LTE 10 MHz	793.00	9.0165
	Downlink	LTE 10 MHz	763.00	8.9868

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (kHz)
PS Narrowband	Uplink	P25 Phase 1	802.00	8.291
	Downlink	P25 Phase 1	772.00	8.235
SMR	Uplink	P25 Phase 1	812.50	8.186
	Downlink	P25 Phase 1	857.50	8.236

Tabular data of Input Occupied Bandwidth

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (MHz)
FistNet	Uplink	LTE 10 MHz	793.00	9.1784
	Downlink	LTE 10 MHz	763.00	9.0988

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (kHz)
PS Narrowband	Uplink	P25 Phase 1	802.00	8.225
	Downlink	P25 Phase 1	772.00	8.243
SMR	Uplink	P25 Phase 1	812.50	8.274
	Downlink	P25 Phase 1	857.50	8.279

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

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (MHz)
FistNet	Uplink	LTE 10 MHz	793.00	8.9944
	Downlink	LTE 10 MHz	763.00	9.0069

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (kHz)
PS Narrowband	Uplink	P25 Phase 1	802.00	8.205
	Downlink	P25 Phase 1	772.00	8.211
SMR	Uplink	P25 Phase 1	812.50	8.305
	Downlink	P25 Phase 1	857.50	8.034

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

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (MHz)
FistNet	Uplink	LTE 10 MHz	793.00	9.0494
	Downlink	LTE 10 MHz	763.00	9.0130

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (kHz)
PS Narrowband	Uplink	P25 Phase 1	802.00	8.334
	Downlink	P25 Phase 1	772.00	8.397
SMR	Uplink	P25 Phase 1	812.50	8.317
	Downlink	P25 Phase 1	857.50	8.230

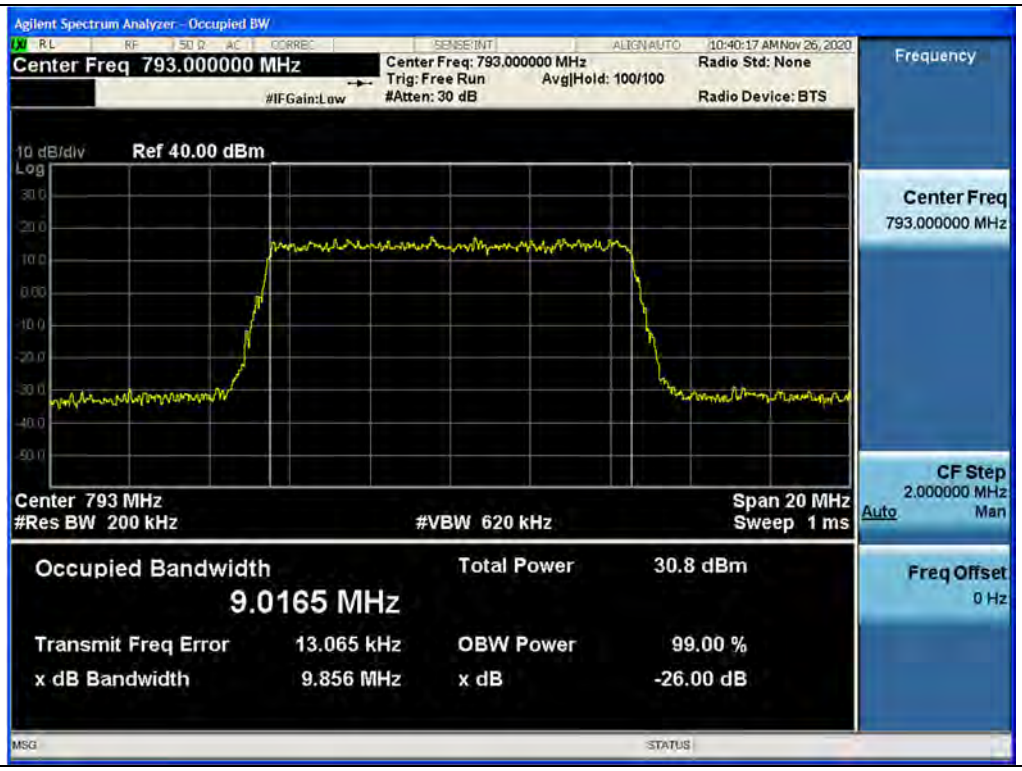
Measured Occupied Bandwidth Comparison

Test Band	Link	Signal	Variant of Input and output Occupied Bandwidth (%)	Variant of Input and 3 dB above the AGC threshold output Occupied Bandwidth (%)
FistNet	Uplink	LTE 10 MHz	-1.77	-0.61
	Downlink	LTE 10 MHz	-1.23	-0.07
PS Narrowband	Uplink	P25 Phase 1	-0.42	-3.42
	Downlink	P25 Phase 1	1.56	-3.26
SMR	Uplink	P25 Phase 1	2.25	-0.10
	Downlink	P25 Phase 1	0.66	-3.44

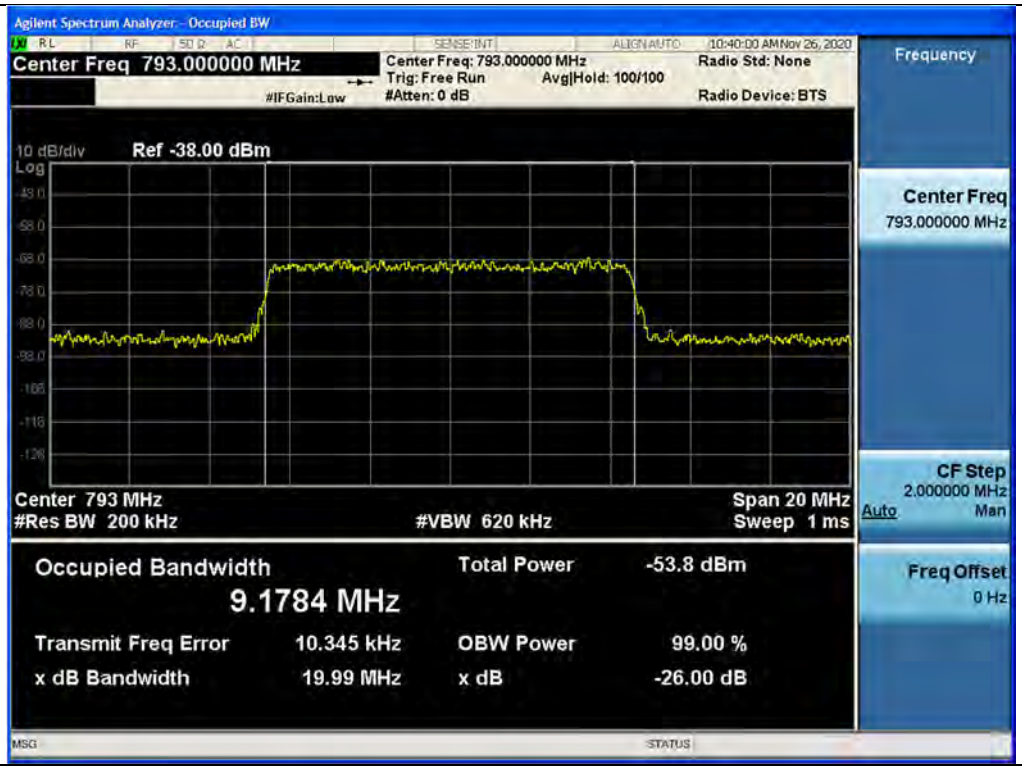
** Change in input-output OBW is less than ±5 %.*

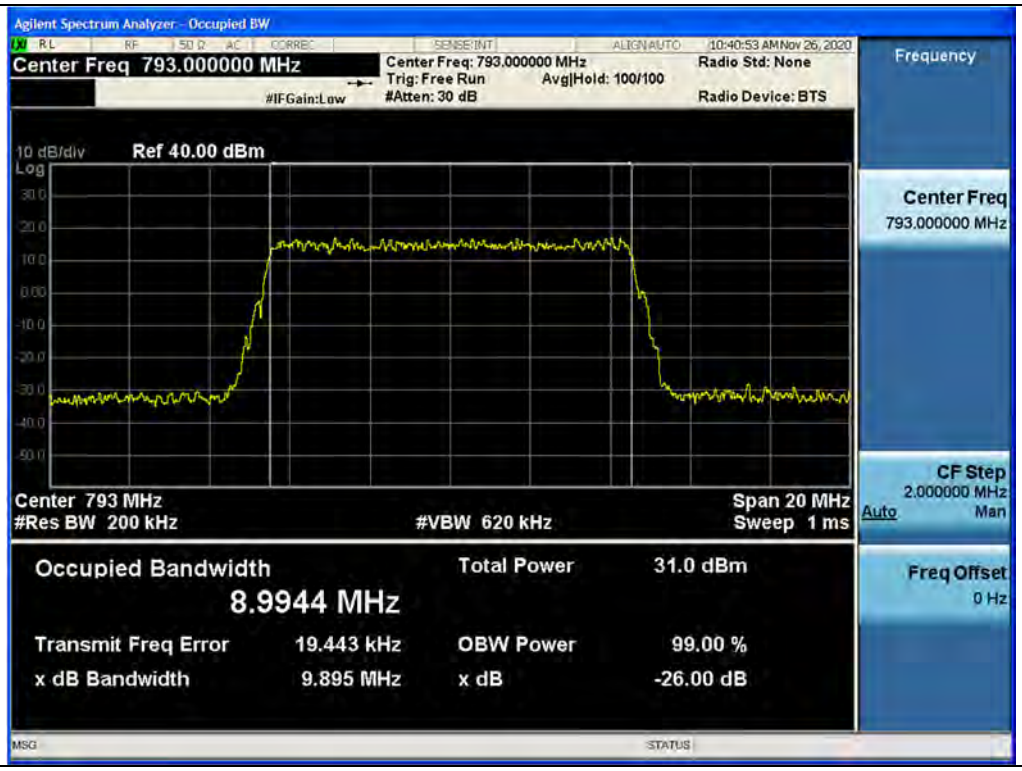
Plot data of Occupied Bandwidth

Output / FistNet / Uplink / LTE 10 MHz



Input / FistNet / Uplink / LTE 10 MHz



3 dB above the AGC threshold output / FistNet / Uplink / LTE 10 MHz


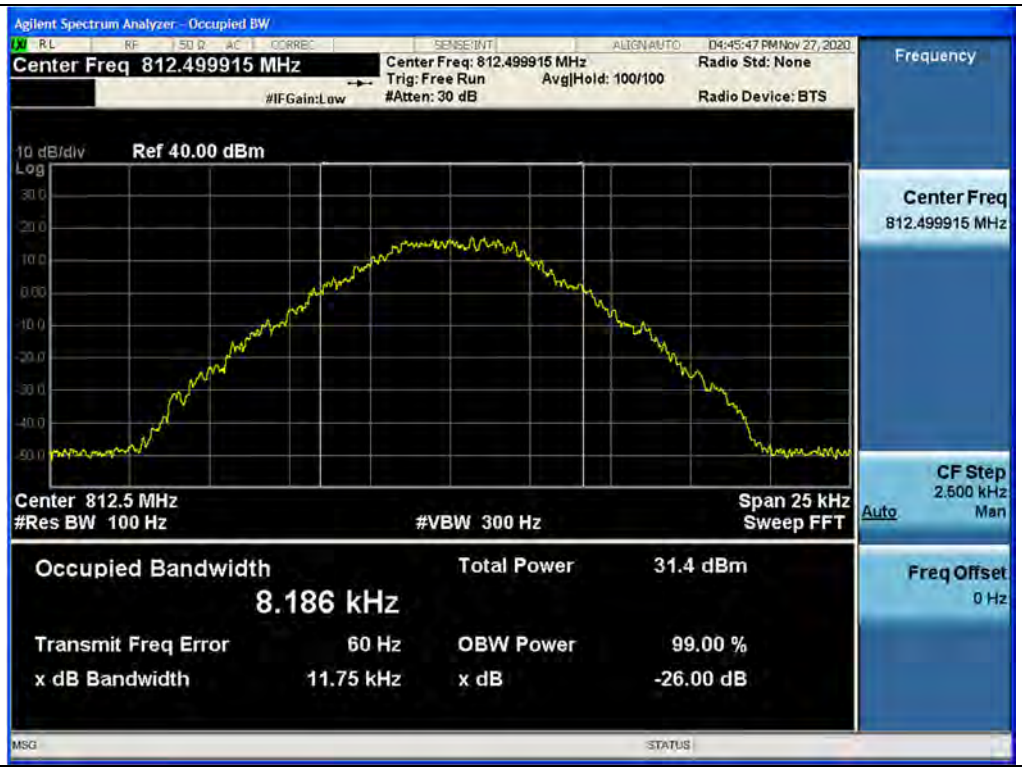
3 dB above the AGC threshold Input / FistNet / Uplink / LTE 10 MHz

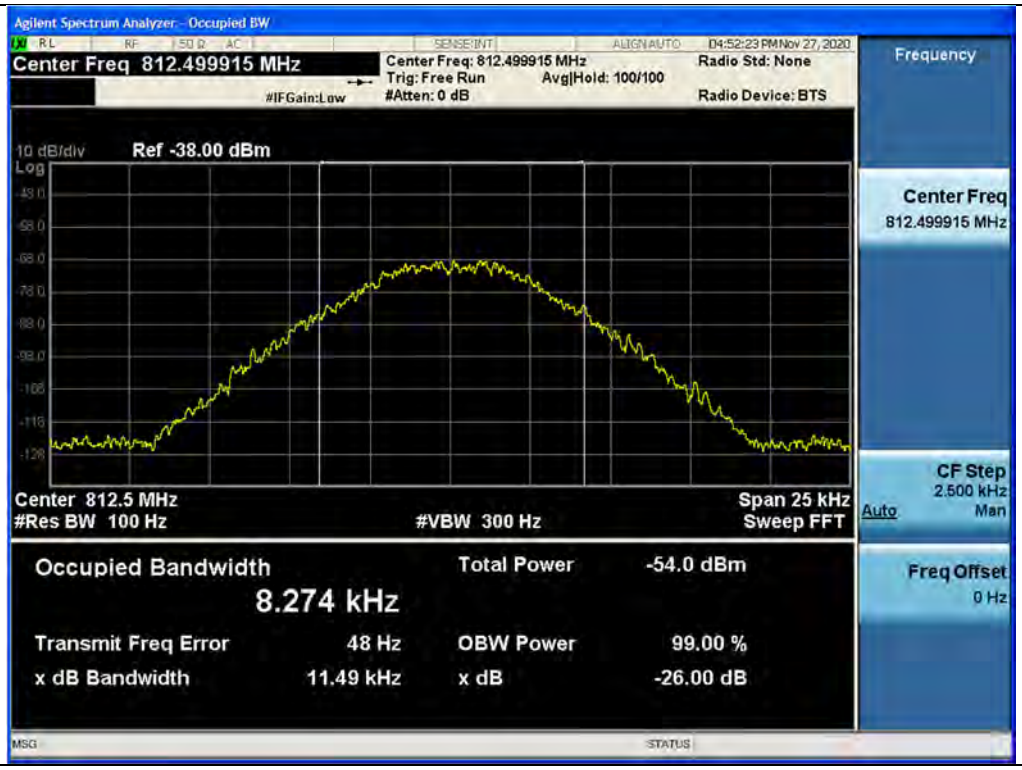

Output / PS Narrowband / Uplink / P25 Phase 1

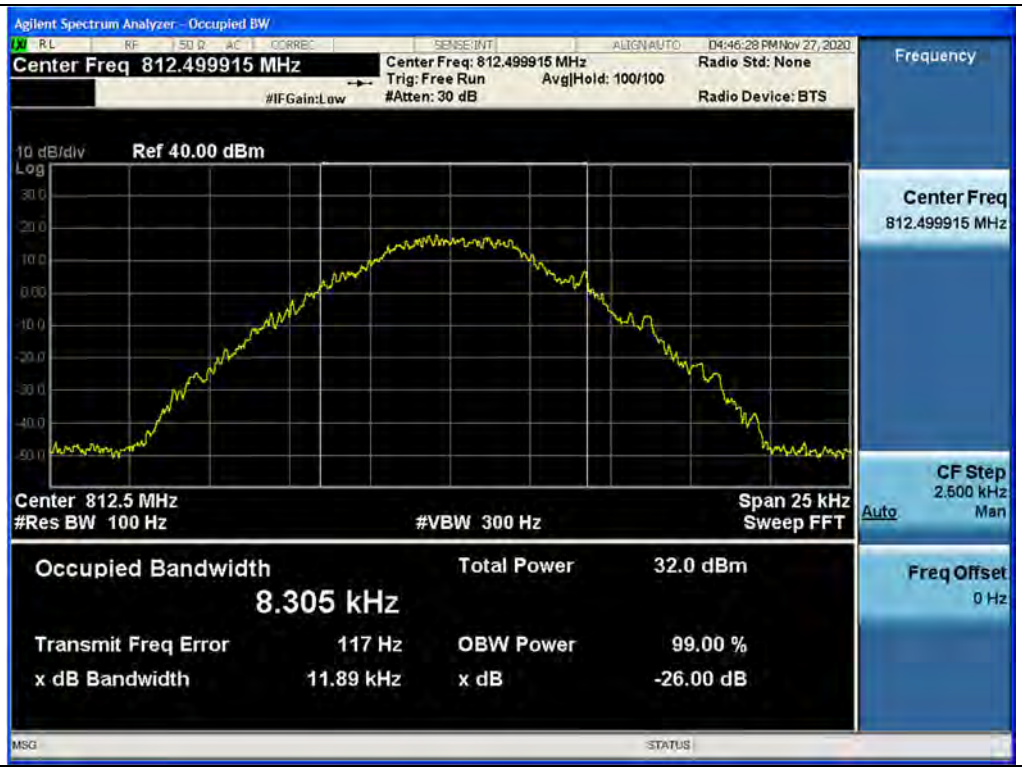

Input / PS Narrowband / Uplink / P25 Phase 1


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

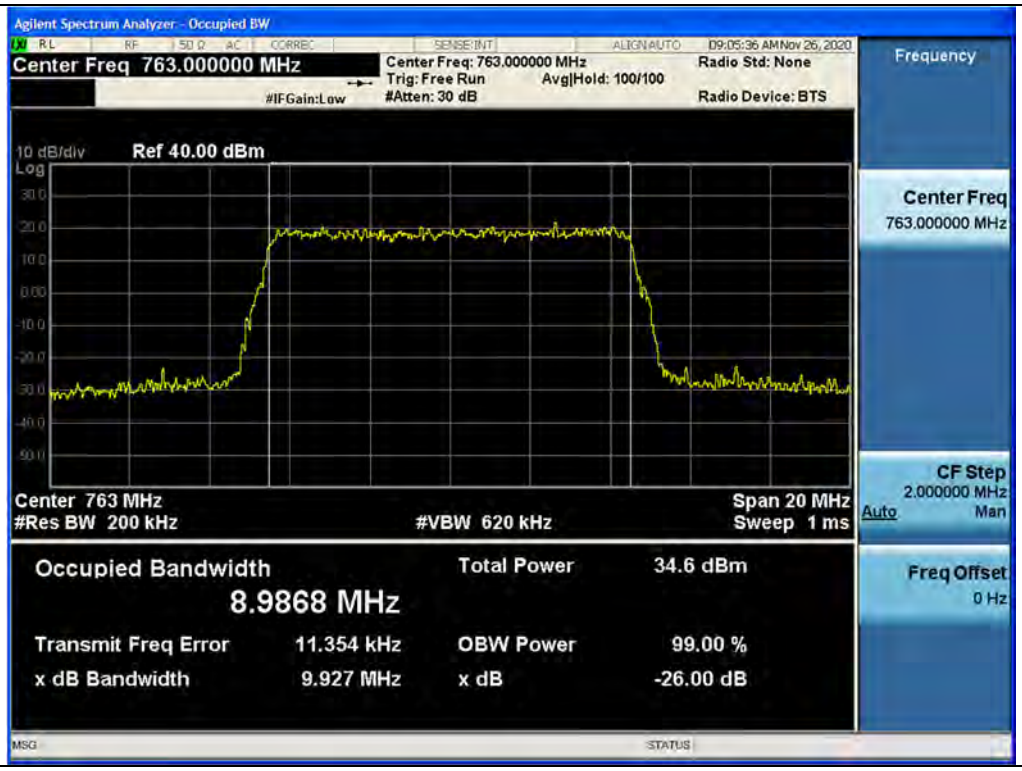

3 dB above the AGC threshold Input / PS Narrowband / Uplink / P25 Phase 1


Output / SMR / Uplink / P25 Phase 1


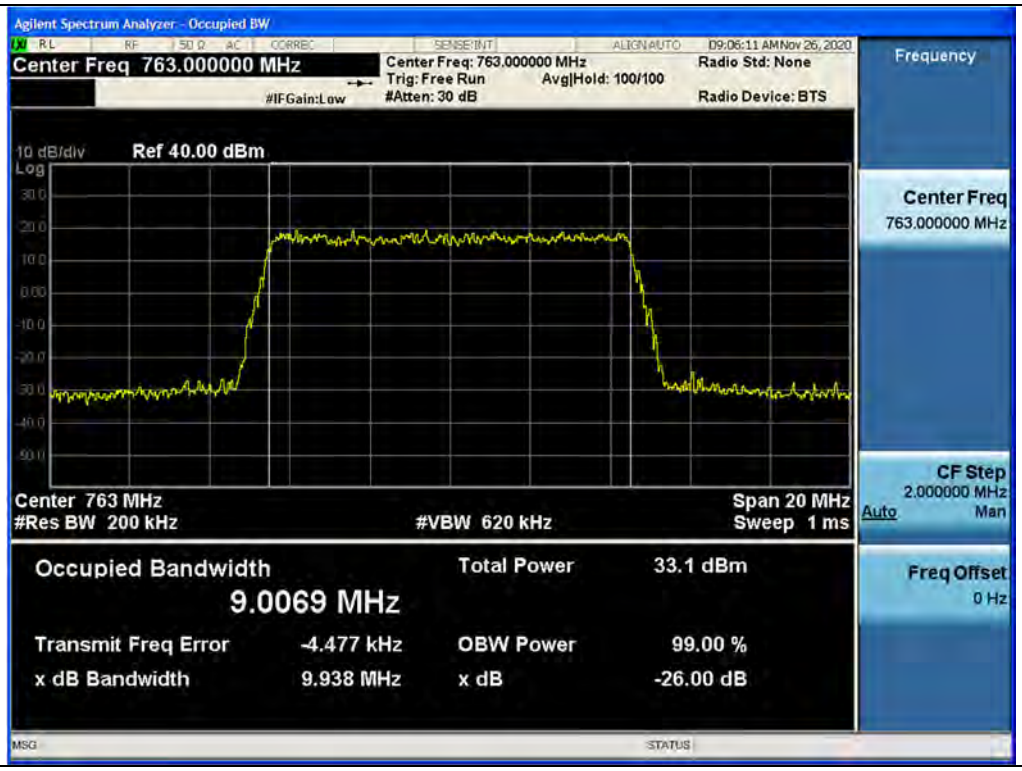
Input / SMR / Uplink / P25 Phase 1


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


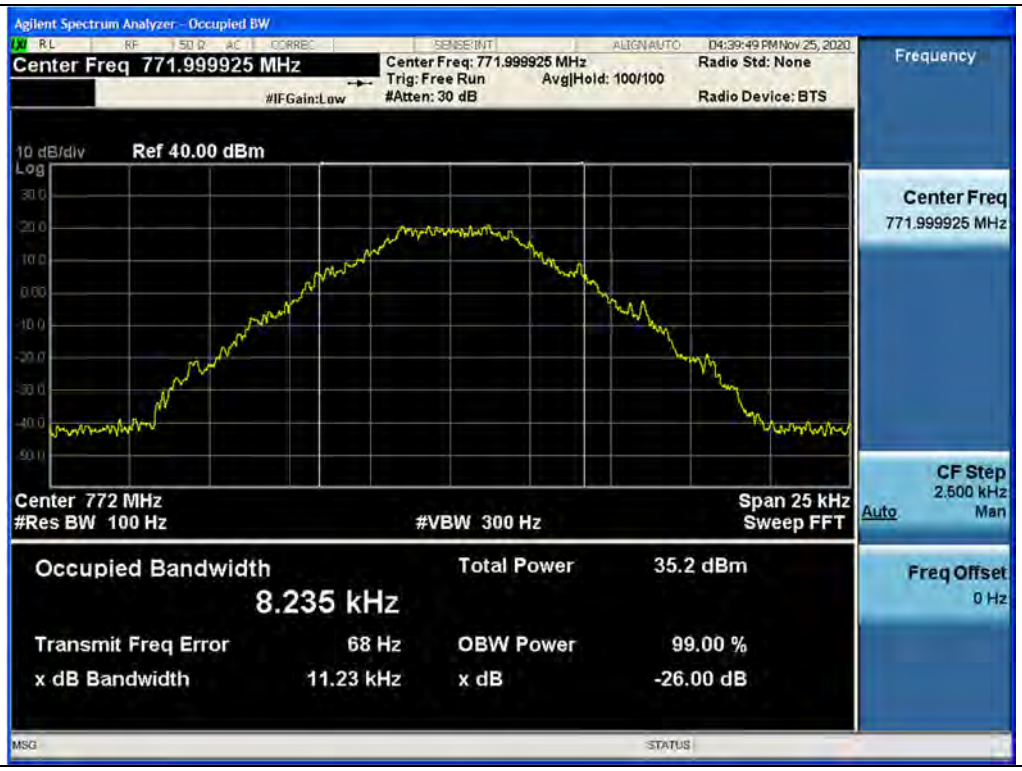
3 dB above the AGC threshold Input / SMR / Uplink / P25 Phase 1


Output / FistNet / Downlink / LTE 10 MHz


Input / FistNet / Downlink / LTE 10 MHz


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


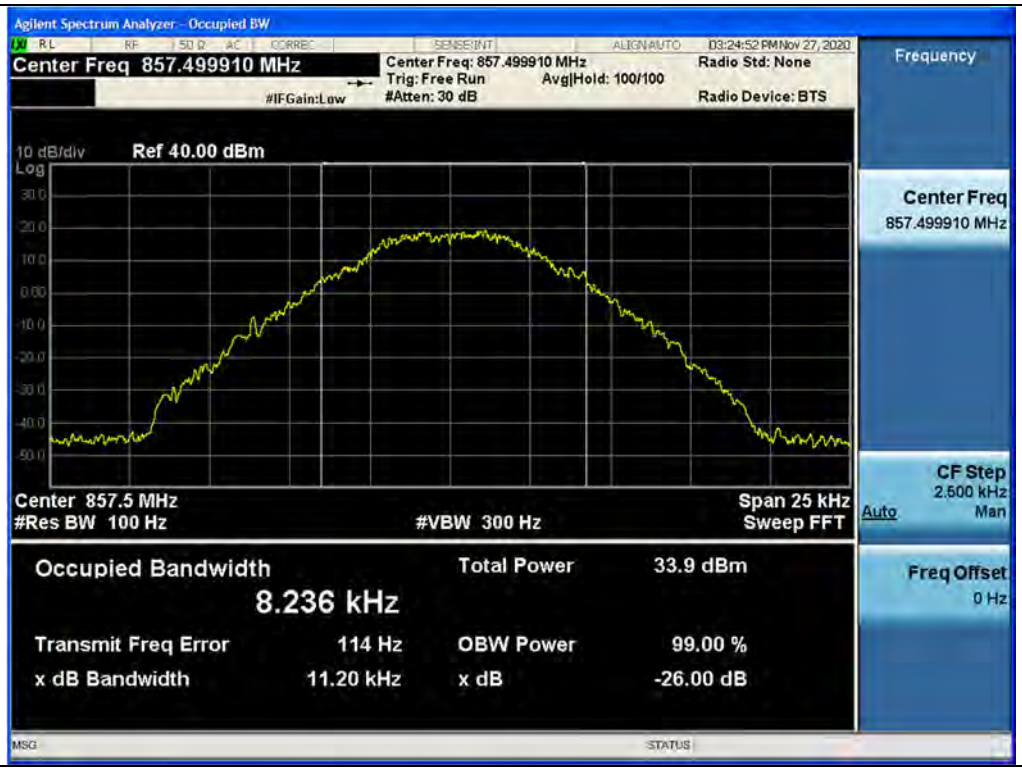
3 dB above the AGC threshold Input / FistNet / Downlink / LTE 10 MHz

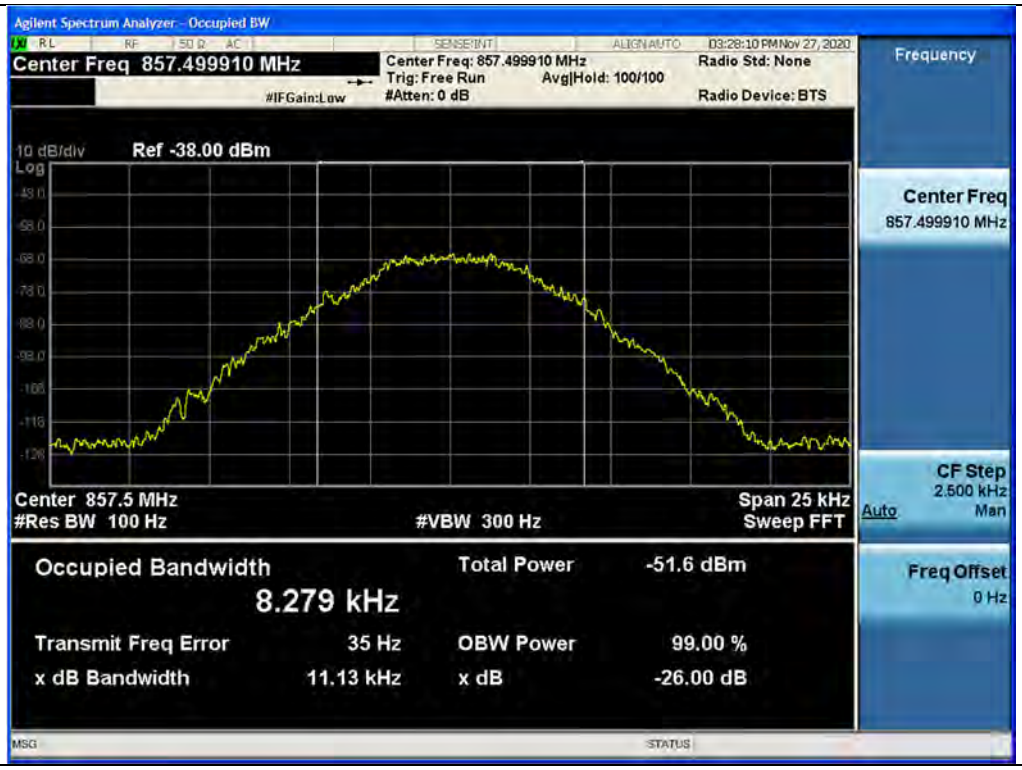

Output / PS Narrowband / Downlink / P25 Phase 1


Input / PS Narrowband / Downlink / P25 Phase 1


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


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


Output / SMR / Downlink / P25 Phase 1


Input / SMR / Downlink / P25 Phase 1


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


3 dB above the AGC threshold Input / SMR / 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 on 25 kilohertz bandwidth channels must meet the requirements of either Emission Mask B or G, whichever is applicable, while equipment designed to operate on 12.5 kilohertz bandwidth channels must meet the requirements of Emission Mask D. Equipment designed to operate on 25 kilohertz bandwidth channels may alternatively meet the Adjacent Channel Power limits of § 90.221.

(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 f_0 to 5.625 kHz removed from f_0: 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.

§ 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 v01r04.

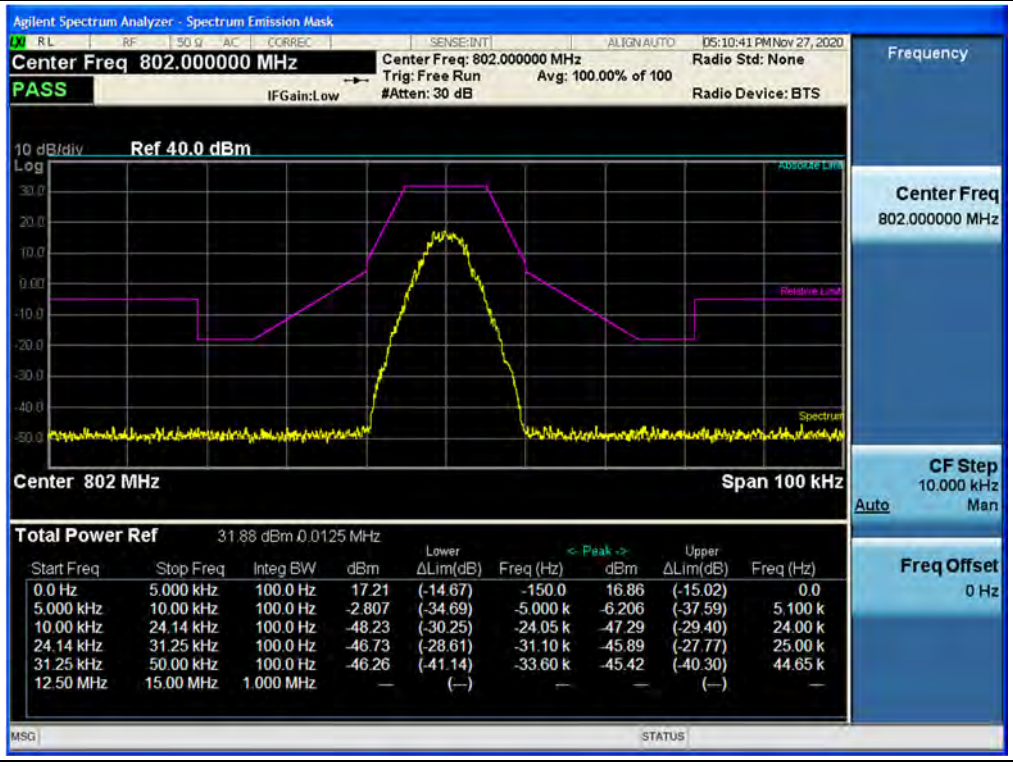
Compliance with the emission mask of the EUT output shall be measured for the public safety service signal types as specified in 4.1.

Refer to the applicable regulatory requirements (e.g., Section 90.210) for emission mask specifications.

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 (see Table 1).
c) Configure the signal level to be just below the AGC threshold (see results from 4.2).
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 × to 5 × 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 4.3.
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.

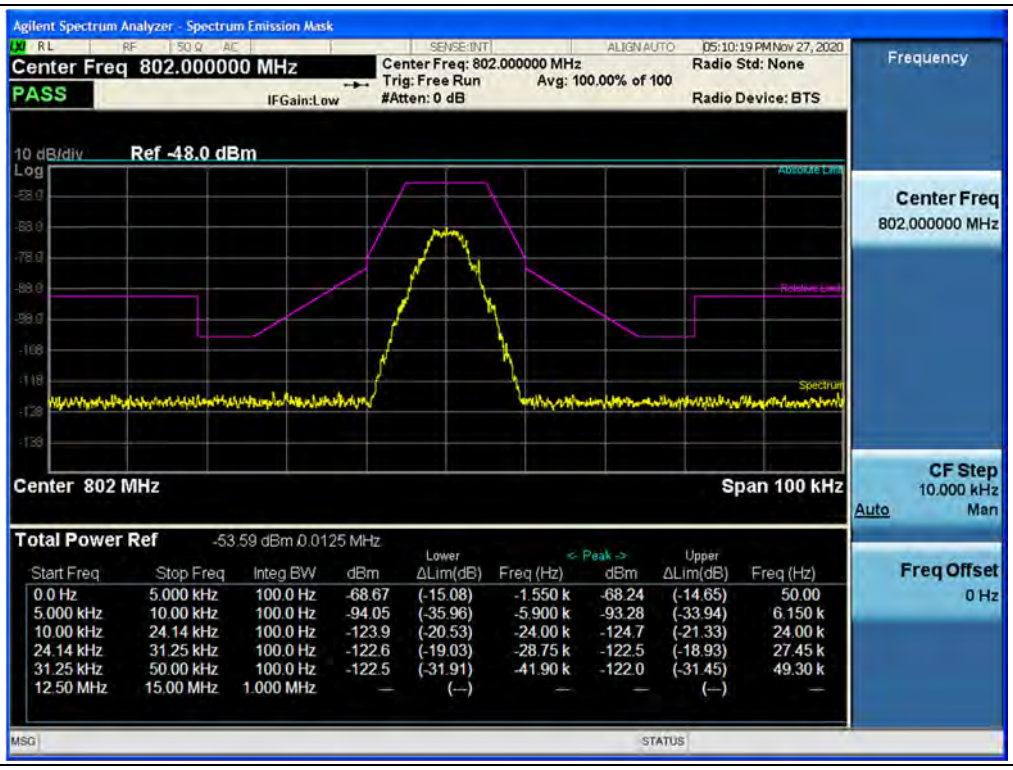
Plot data of Emission mask:

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



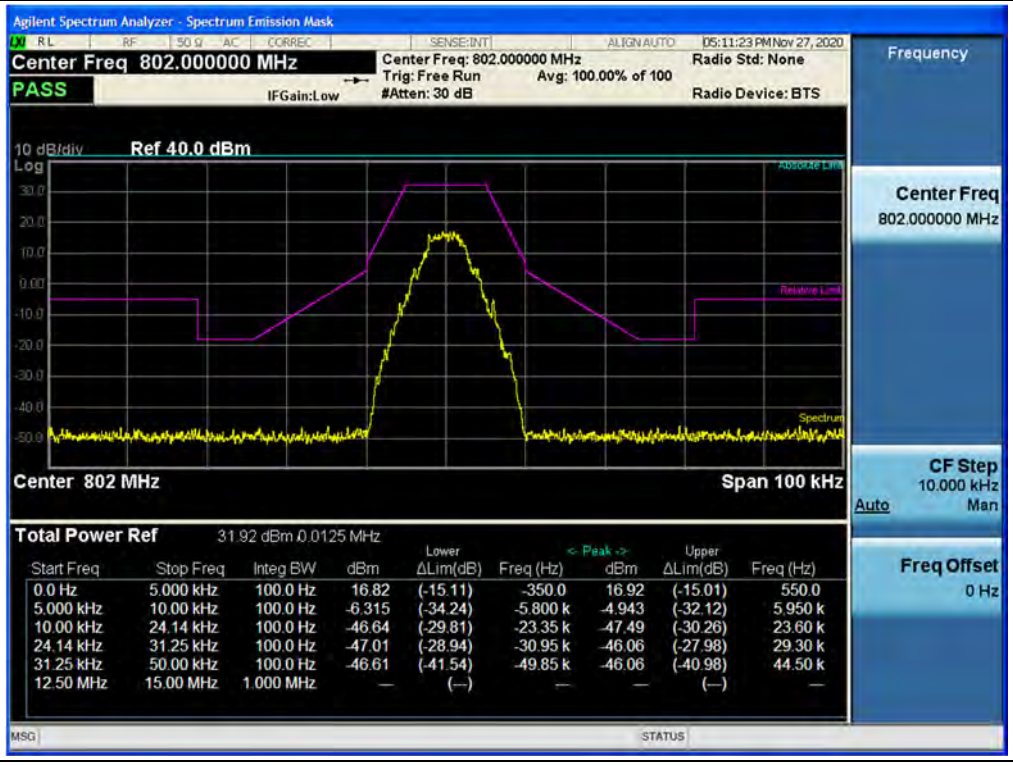
Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	Peak dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	5.000 kHz	100.0 Hz	17.21	(-14.67)	-150.0	16.86	(-15.02)	0.0
5.000 kHz	10.00 kHz	100.0 Hz	-2.807	(-34.69)	-5.000 k	-6.206	(-37.59)	5.100 k
10.00 kHz	24.14 kHz	100.0 Hz	-48.23	(-30.25)	-24.05 k	-47.29	(-29.40)	24.00 k
24.14 kHz	31.25 kHz	100.0 Hz	-46.73	(-28.61)	-31.10 k	-45.89	(-27.77)	25.00 k
31.25 kHz	50.00 kHz	100.0 Hz	-46.26	(-41.14)	-33.60 k	-45.42	(-40.30)	44.65 k
12.50 MHz	15.00 MHz	1.000 MHz	—	(---)	—	—	(---)	—

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

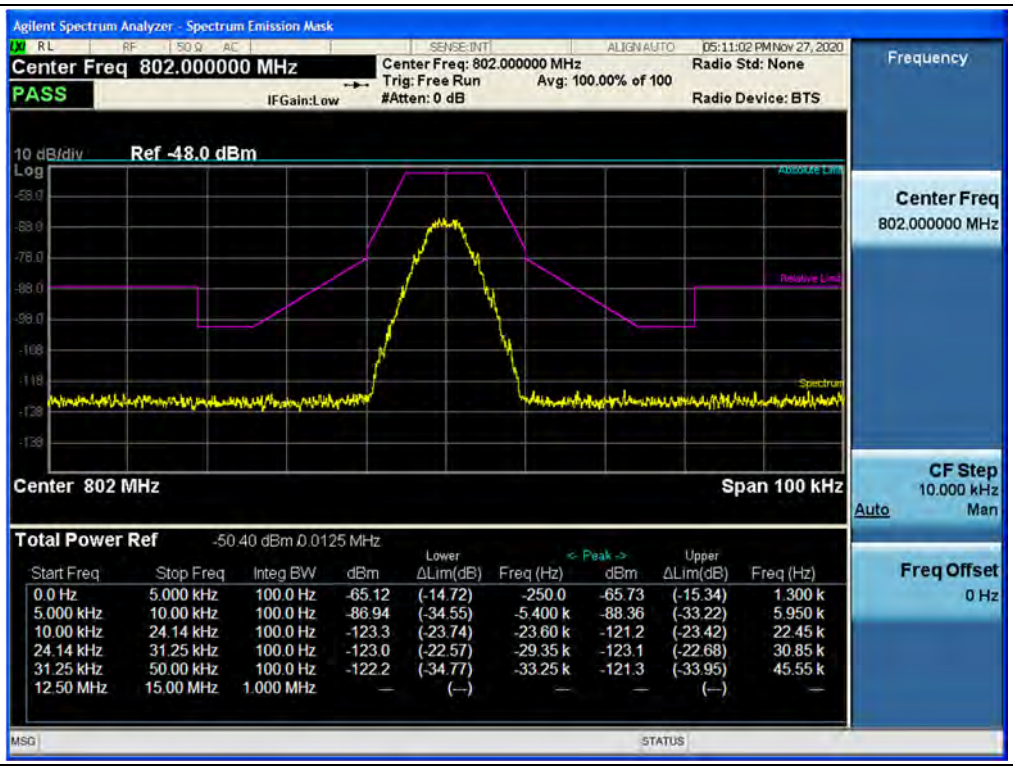


Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	Peak dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	5.000 kHz	100.0 Hz	-68.67	(-15.08)	-1.550 k	-68.24	(-14.65)	50.00
5.000 kHz	10.00 kHz	100.0 Hz	-94.05	(-35.96)	-5.900 k	-93.28	(-33.94)	6.150 k
10.00 kHz	24.14 kHz	100.0 Hz	-123.9	(-20.53)	-24.00 k	-124.7	(-21.33)	24.00 k
24.14 kHz	31.25 kHz	100.0 Hz	-122.6	(-19.03)	-28.75 k	-122.5	(-18.93)	27.45 k
31.25 kHz	50.00 kHz	100.0 Hz	-122.5	(-31.91)	-41.90 k	-122.0	(-31.45)	49.30 k
12.50 MHz	15.00 MHz	1.000 MHz	—	(---)	—	—	(---)	—

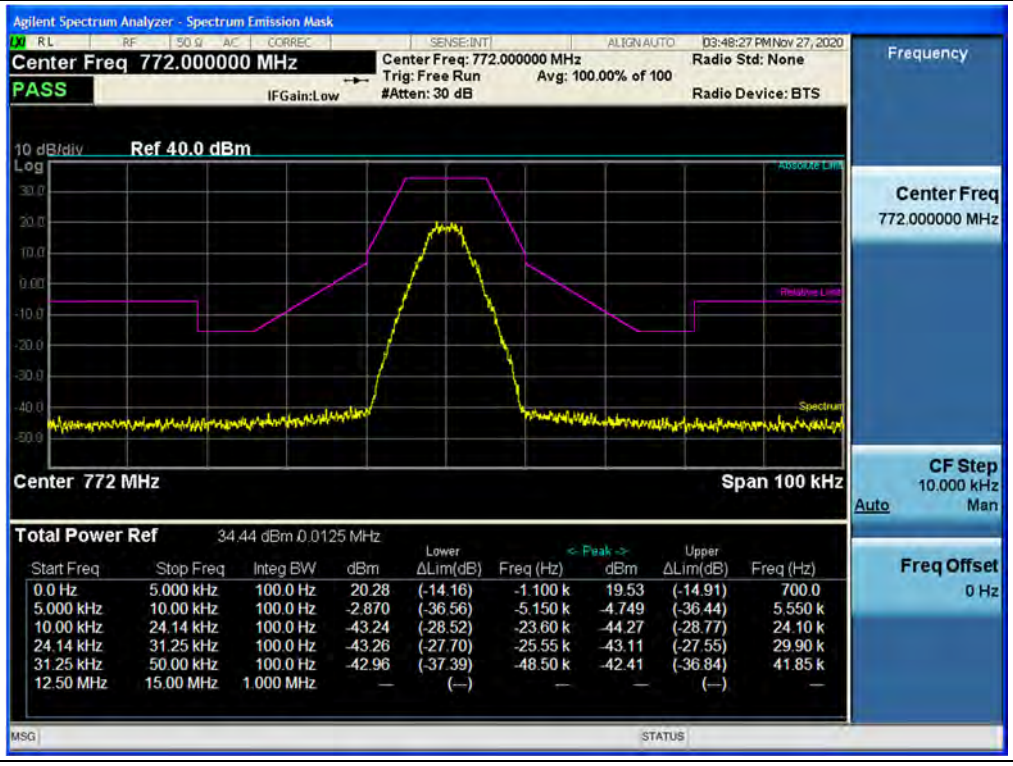
3 dB above the AGC threshold Output / PS Narrowband / P25 Phase 1 / Uplink / Mask C



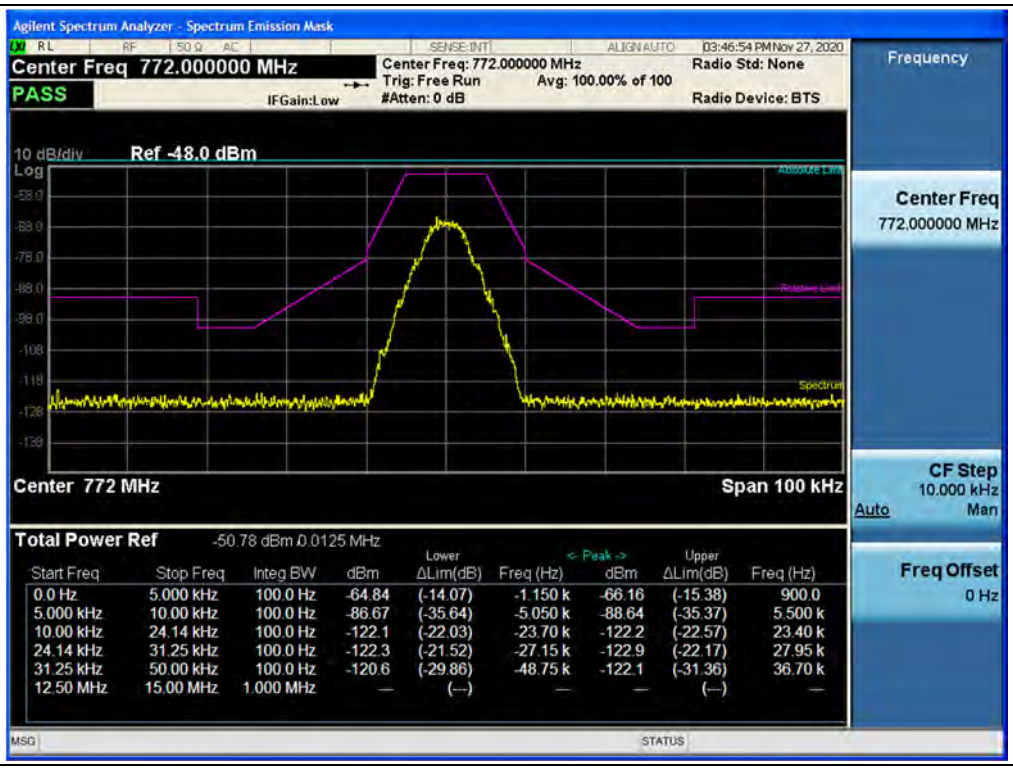
3 dB above the AGC threshold Input / PS Narrowband / P25 Phase 1 / Uplink / Mask C



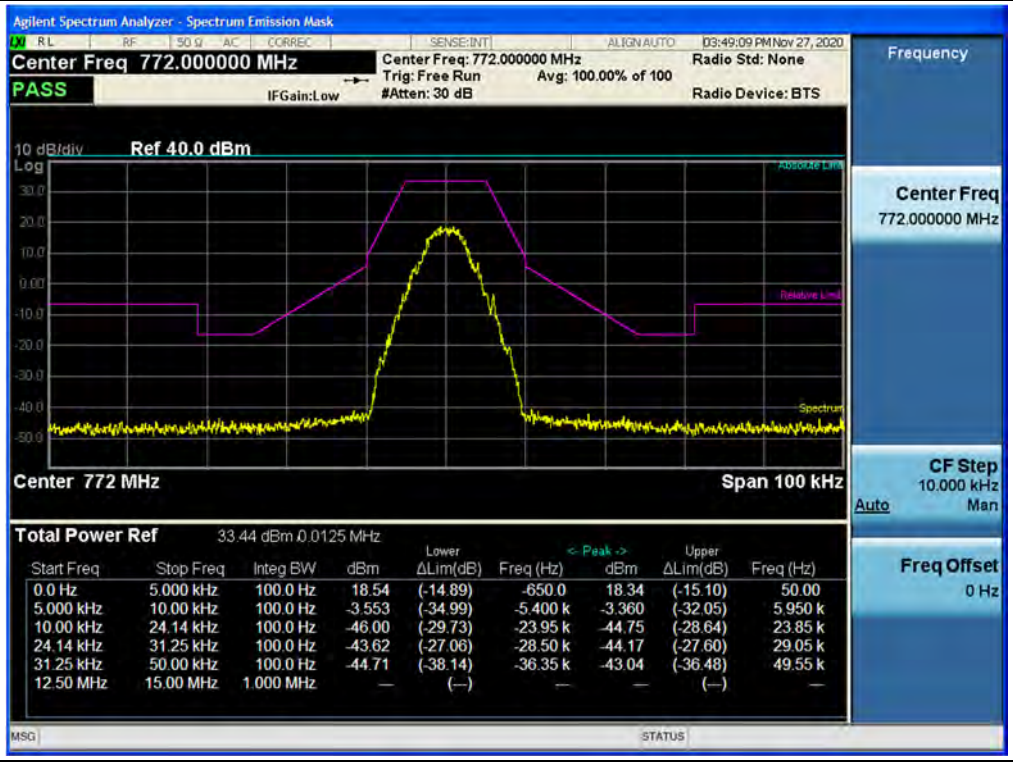
Output / PS Narrowband / P25 Phase 1 / Downlink / Mask C



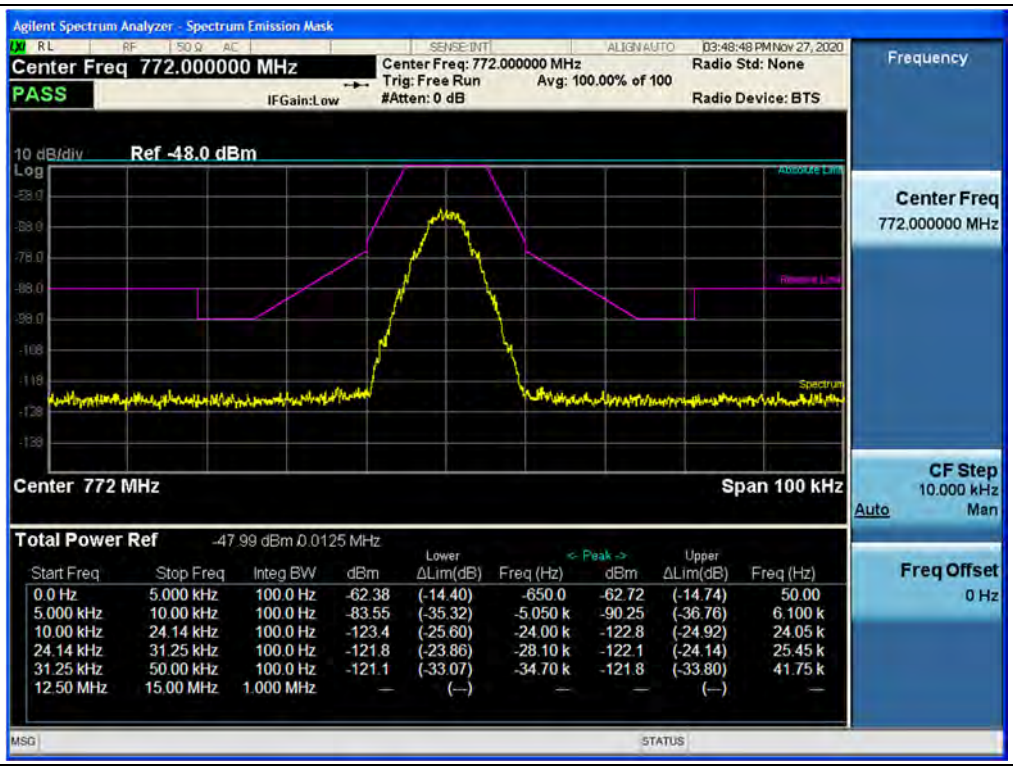
Input / PS Narrowband / P25 Phase 1 / Downlink / Mask C

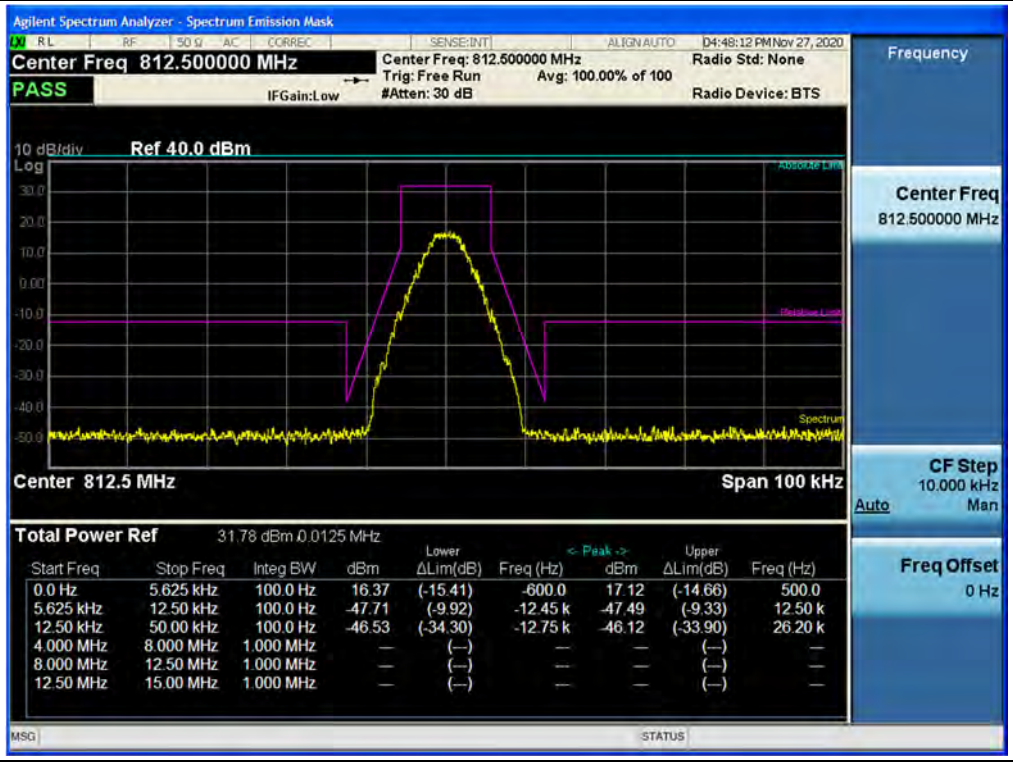


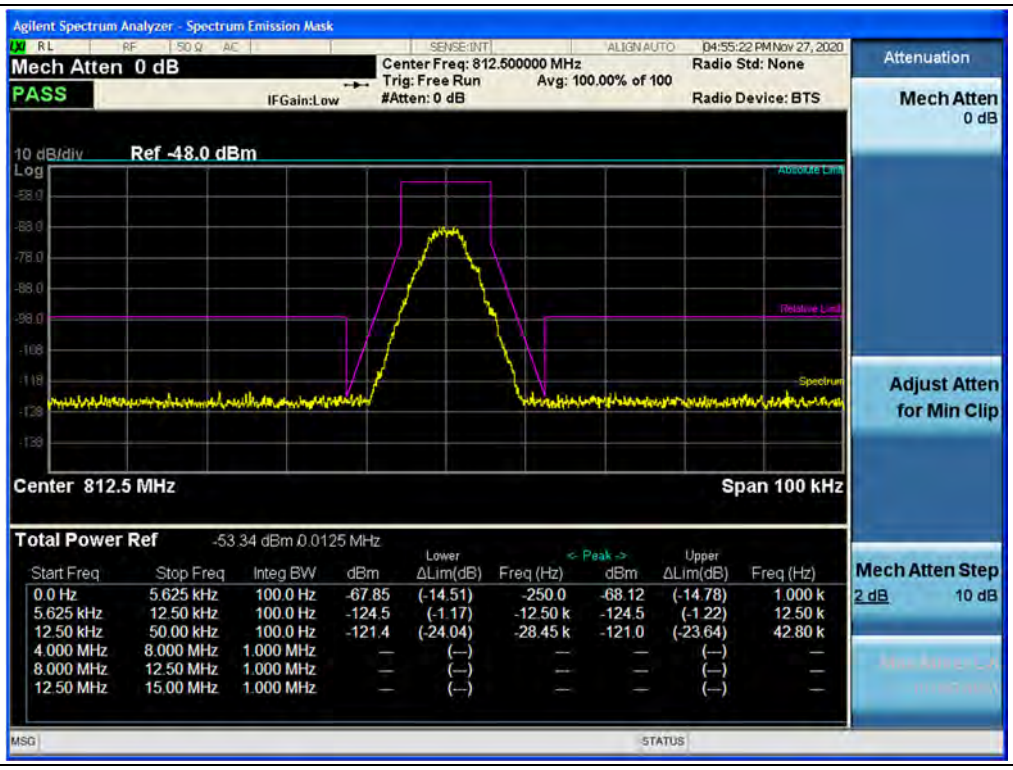
3 dB above the AGC threshold Output / PS Narrowband / P25 Phase 1 / Downlink / Mask C



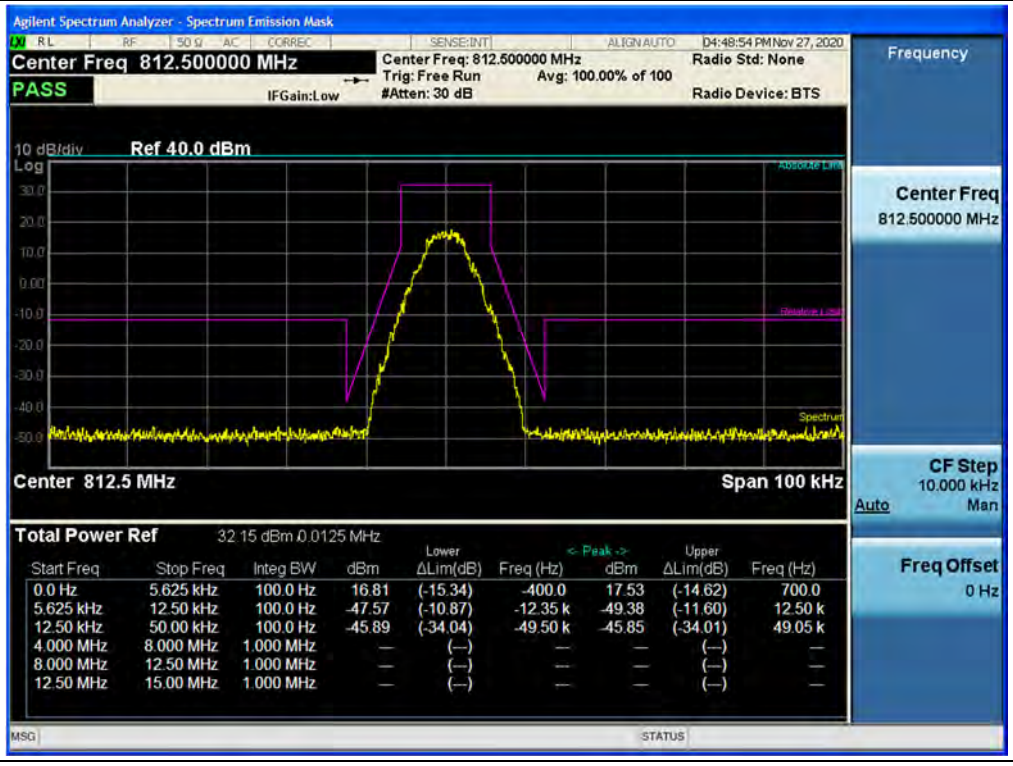
3 dB above the AGC threshold Input / PS Narrowband / P25 Phase 1 / Downlink / Mask C



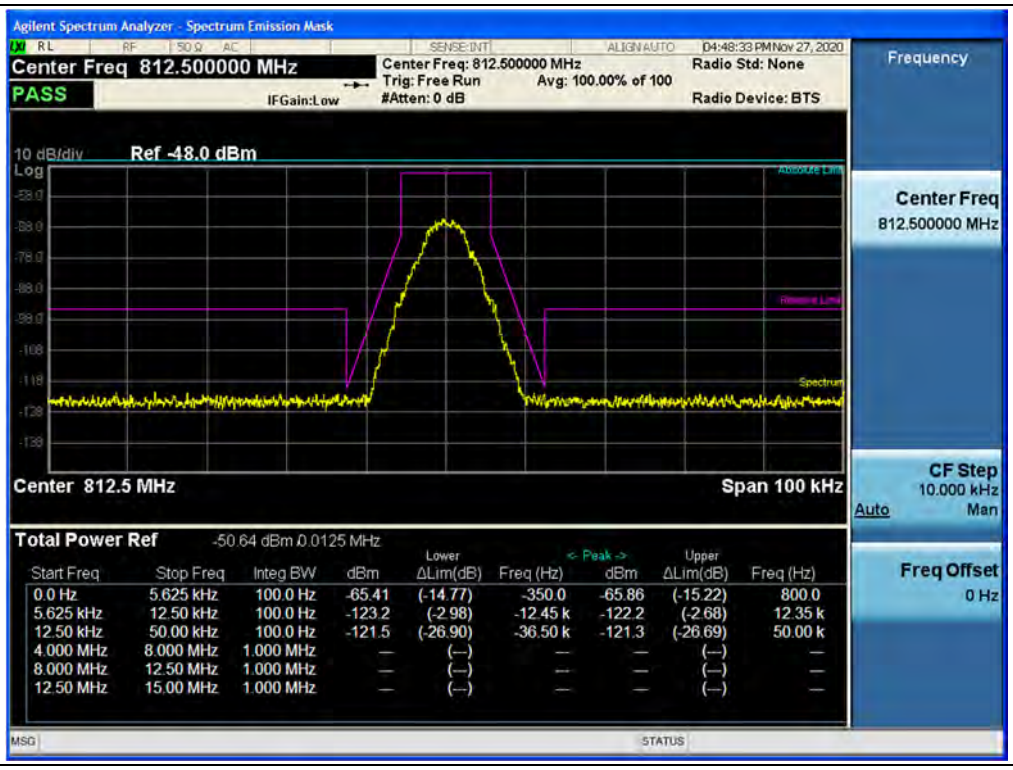
Output / SMR / P25 Phase 1 / Uplink / Mask D


Input / SMR / P25 Phase 1 / Uplink / Mask D


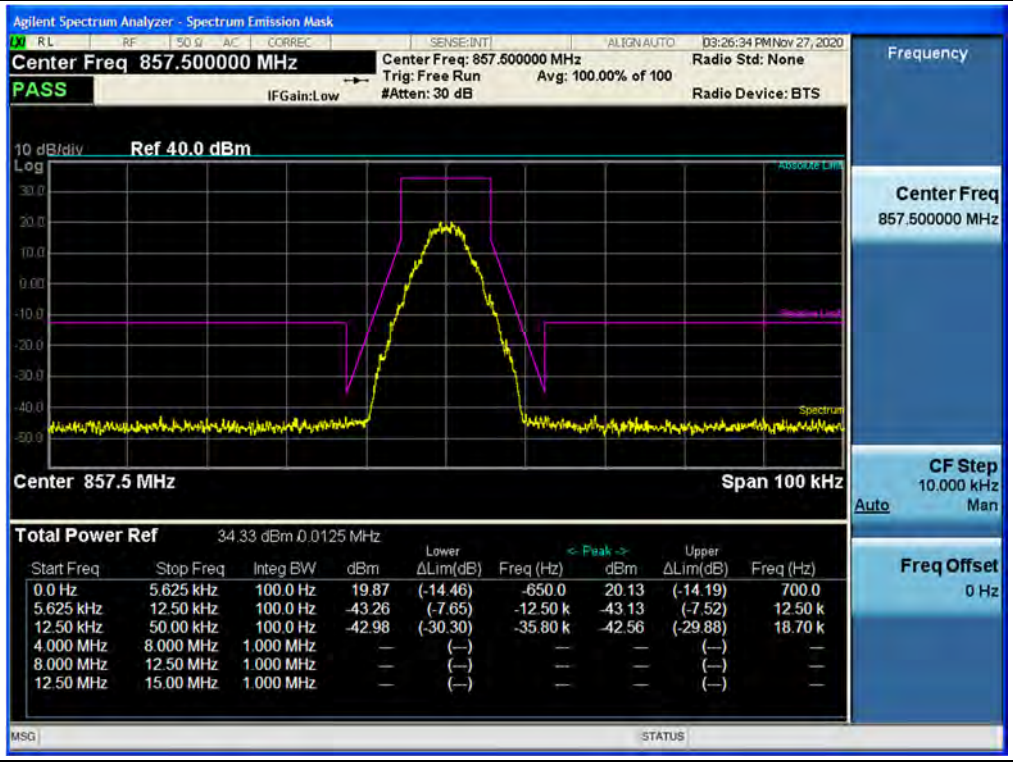
3 dB above the AGC threshold Output / SMR / P25 Phase 1 / Uplink / Mask D



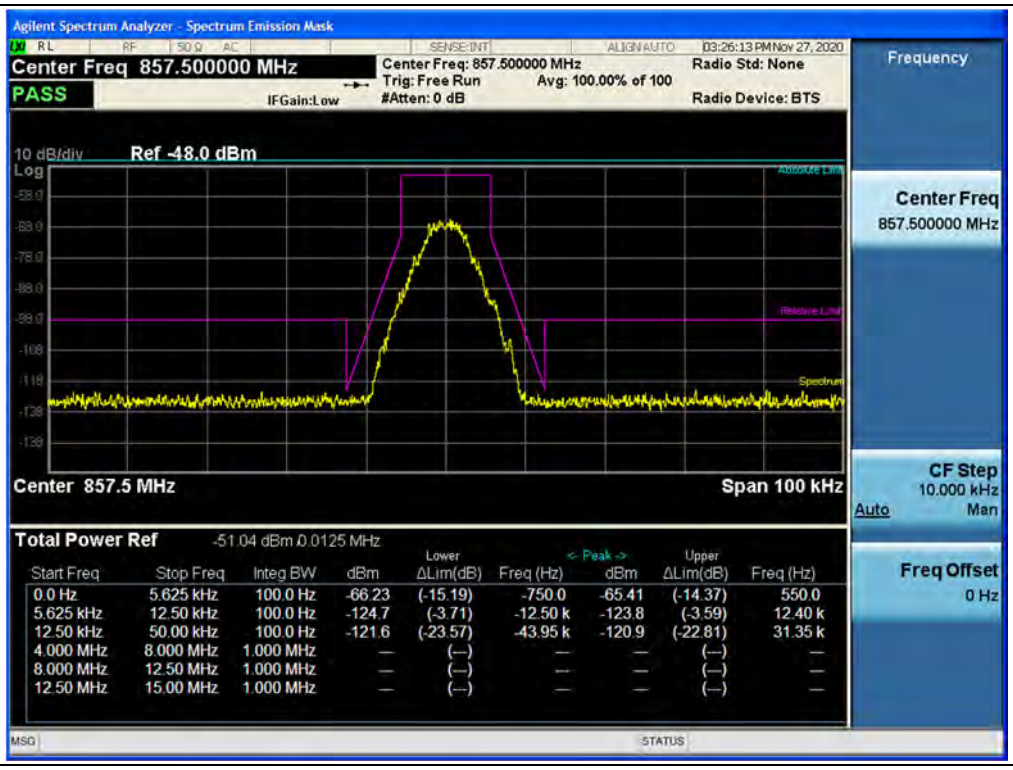
3 dB above the AGC threshold Input / SMR / P25 Phase 1 / Uplink / Mask D



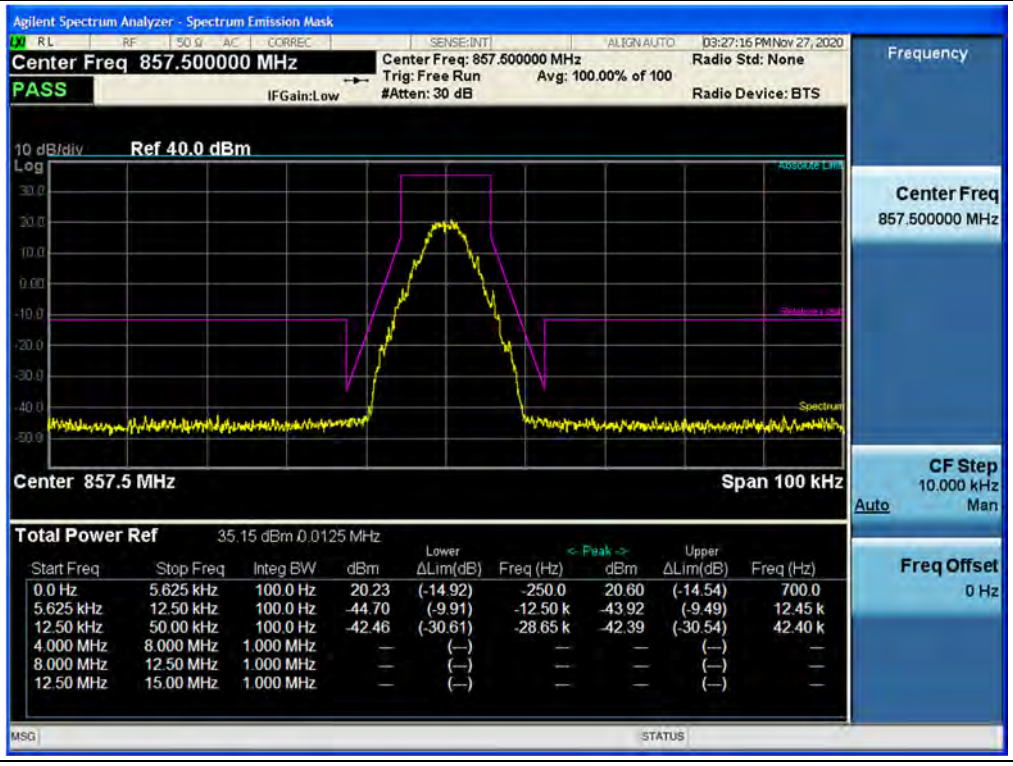
Output / SMR / P25 Phase 1 / Downlink / Mask D



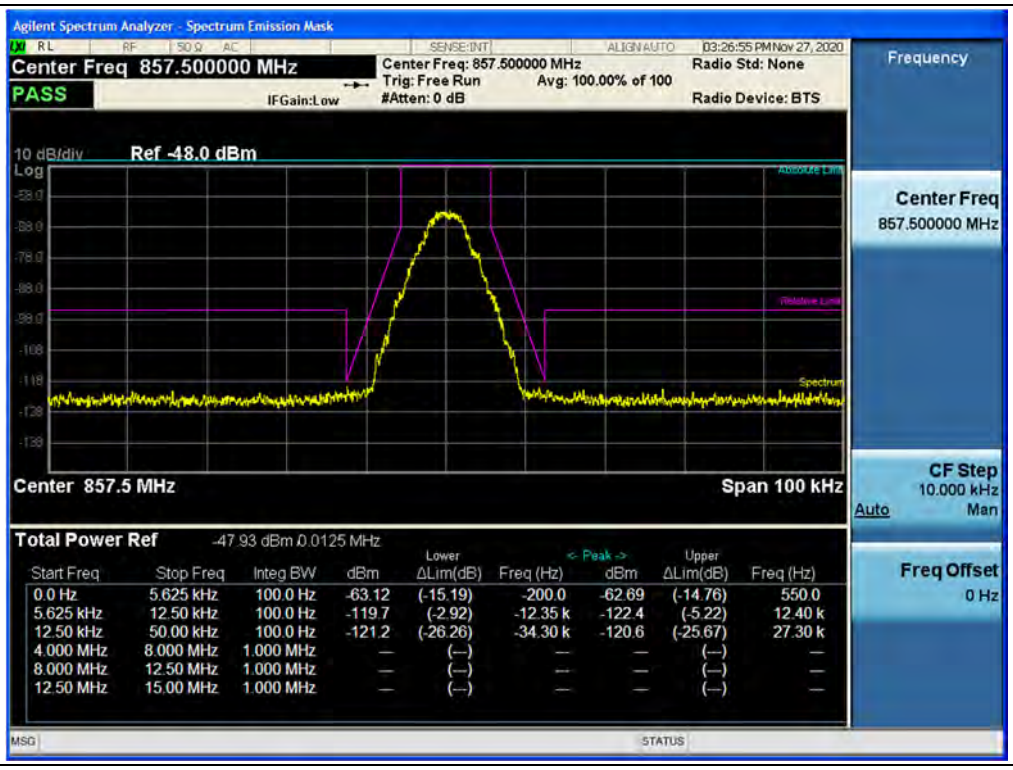
Input / SMR / P25 Phase 1 / Downlink / Mask D



3 dB above the AGC threshold Output / SMR / P25 Phase 1 / Downlink / Mask D



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



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.

§ 90.541 Transmitting power and antenna height limits.

The transmitting power and antenna height of base, mobile, portable and control stations operating in the 769-775 MHz and 799-805 MHz frequency bands must not exceed the maximum limits in this section. Power limits are listed in effective radiated power (ERP).

(a) The transmitting power and antenna height of base stations must not exceed the limits given in paragraph (a) of § 90.635.

§ 90.542 Broadband transmitting power limits.

(a) The following power limits apply to the 758-768/788-798 MHz band:

(1) Fixed and base stations transmitting a signal in the 758-768 MHz band with an emission bandwidth of 1 MHz or less must not exceed an ERP of 1000 watts and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts ERP in accordance with Table 1 of this section.

(2) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal in the 758-768 MHz band with an emission bandwidth of 1 MHz or less must not exceed an ERP of 2000 watts and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts ERP in accordance with Table 2 of this section.

(3) Fixed and base stations transmitting a signal in the 758-768 MHz band with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP accordance with Table 3 of this section.

(4) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal in the 758-768 MHz band with an emission bandwidth greater than 1 MHz must not exceed an ERP of 2000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts/MHz ERP in accordance with Table 4 of this section.

(5) Licensees of fixed or base stations transmitting a signal in the 758-768 MHz band at an ERP greater than 1000 watts must comply with the provisions set forth in paragraph (b) of this section.

(6) Control stations and mobile stations transmitting in the 758-768 MHz band and the 788-798 MHz band are limited to 30 watts ERP.

(7) Portable stations (hand-held devices) transmitting in the 758-768 MHz band and the 788-798 MHz band are limited to 3 watts ERP.

(8) For transmissions in the 758-768 MHz and 788-798 MHz bands, licensees may employ equipment operating in compliance with either of the following measurement techniques:

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

(ii) A Commission-approved average power technique.

Table 1 to § 90.542(a)—Permissible Power and Antenna Heights for Base and Fixed Stations in the 758-768 MHz Band Transmitting a Signal With an Emission Bandwidth of 1 MHz or Less

Antenna height (AAT) in meters (feet)	Effective radiated power (ERP) (watts)
Above 1372 (4500)	65
Above 1220 (4000) To 1372 (4500)	70
Above 1067 (3500) To 1220 (4000)	75
Above 915 (3000) To 1067 (3500)	100
Above 763 (2500) To 915 (3000)	140
Above 610 (2000) To 763 (2500)	200
Above 458 (1500) To 610 (2000)	350
Above 305 (1000) To 458 (1500)	600
Up to 305 (1000)	1000

Table 2 to § 90.542(a)—Permissible Power and Antenna Heights for Base and Fixed Stations in the 758-768 MHz Band Transmitting a Signal With an Emission Bandwidth of 1 MHz or Less

Antenna height (AAT) in meters (feet)	Effective radiated power (ERP) (watts)
Above 1372 (4500)	130
Above 1220 (4000) To 1372 (4500)	140
Above 1067 (3500) To 1220 (4000)	150
Above 915 (3000) To 1067 (3500)	200
Above 763 (2500) To 915 (3000)	280
Above 610 (2000) To 763 (2500)	400
Above 458 (1500) To 610 (2000)	700
Above 305 (1000) To 458 (1500)	1200
Up to 305 (1000)	2000

Table 3 to § 90.542(a)—Permissible Power and Antenna Heights for Base and Fixed Stations in the 758-768 MHz Band Transmitting a Signal With an Emission Bandwidth Greater Than 1 MHz

Antenna height (AAT) in meters (feet)	Effective radiated power (ERP) per MHz (watts/MHz)
Above 1372 (4500)	65
Above 1220 (4000) To 1372 (4500)	70
Above 1067 (3500) To 1220 (4000)	75
Above 915 (3000) To 1067 (3500)	100
Above 763 (2500) To 915 (3000)	140
Above 610 (2000) To 763 (2500)	200
Above 458 (1500) To 610 (2000)	350
Above 305 (1000) To 458 (1500)	600
Up to 305 (1000)	1000

Table 4 to § 90.542(a)—Permissible Power and Antenna Heights for Base and Fixed Stations in the 758-768 MHz Band Transmitting a Signal With an Emission Bandwidth Greater Than 1 MHz

Antenna height (AAT) in meters (feet)	Effective radiated power (ERP) per MHz (watts/MHz)
Above 1372 (4500)	130
Above 1220 (4000) To 1372 (4500)	140
Above 1067 (3500) To 1220 (4000)	150
Above 915 (3000) To 1067 (3500)	200
Above 763 (2500) To 915 (3000)	280
Above 610 (2000) To 763 (2500)	400
Above 458 (1500) To 610 (2000)	700
Above 305 (1000) To 458 (1500)	1200
Up to 305 (1000)	2000

(b) For base and fixed stations operating in the 758-768 MHz band in accordance with the provisions of paragraph (a)(5) of this section, the power flux density that would be produced by such stations through a combination of antenna height and vertical gain pattern must not exceed 3000 microwatts per square meter on the ground over the area extending to 1 km from the base of the antenna mounting structure.

§ 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.

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.

a) 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.
b) 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 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 uplink ERP is calculated including the cable loss value declared by the manufacturer.

ex) ERP = Uplink Max Power + Ant. Peak Gain – Cable Loss

= 25 dBm + (16 dBi – 2.15 dB) – 2dB = 36.85 dBm

Test Results:

Tabular data of Input / Output Power and Gain

Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)
FistNet	Uplink	LTE 10 MHz	793.00	-61.04	23.52	84.56
	Downlink	LTE 10 MHz	763.00	-58.36	27.15	85.51
PS Narrowband	Uplink	P25 Phase 1	801.66	-60.71	24.25	84.96
	Downlink	P25 Phase 1	774.08	-58.05	26.55	84.60
SMR	Uplink	P25 Phase 1	815.45	-61.21	23.77	84.98
	Downlink	P25 Phase 1	860.27	-58.07	27.05	85.12

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

Test Band	Link	Signal	f_0 Frequency (MHz)	+3 dB Input Power (dBm)	+3 dB Output Power (dBm)
FistNet	Uplink	LTE 10 MHz	793.00	-58.00	23.66
	Downlink	LTE 10 MHz	763.00	-55.34	26.73

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.

$$F_{sys} = \frac{N_o}{kT_oBG}$$

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)	kT_0B (dBm/MHz)	Measured Value (dBm)	Noise Figure (dB)
PS Narrowband	Uplink	-60.71	24.25	84.96	-114	-37.39	-8.35
	Downlink	-58.05	26.55	84.60	-114	-21.73	7.67
SMR	Uplink	-61.21	23.77	84.98	-114	-36.46	-7.44
	Downlink	-58.07	27.05	85.12	-114	-21.80	7.08

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.

Transmitters designed to operate in 769-775 MHz and 799-805 MHz frequency bands must meet the emission limitations in paragraphs (a) through (d) of this section. Class A and Class B signal boosters retransmitting signals in the 769-775 MHz and 799-805 MHz frequency bands are exempt from the limits listed in paragraph (a) of this section when simultaneously retransmitting multiple signals and instead shall be subject to the limit listed in paragraph (c) of this section when operating in this manner. Transmitters operating in 758-768 MHz and 788-798 MHz bands must meet the emission limitations in (e) of this section.

(c) Out-of-band emission limit. On any frequency outside of the frequency ranges covered by the ACP tables in this section, the power of any emission must be reduced below the mean output power (P) by at least 43 + 10log (P) dB measured in a 100 kHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.

(e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations.

(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

(4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands

immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

(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.

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.

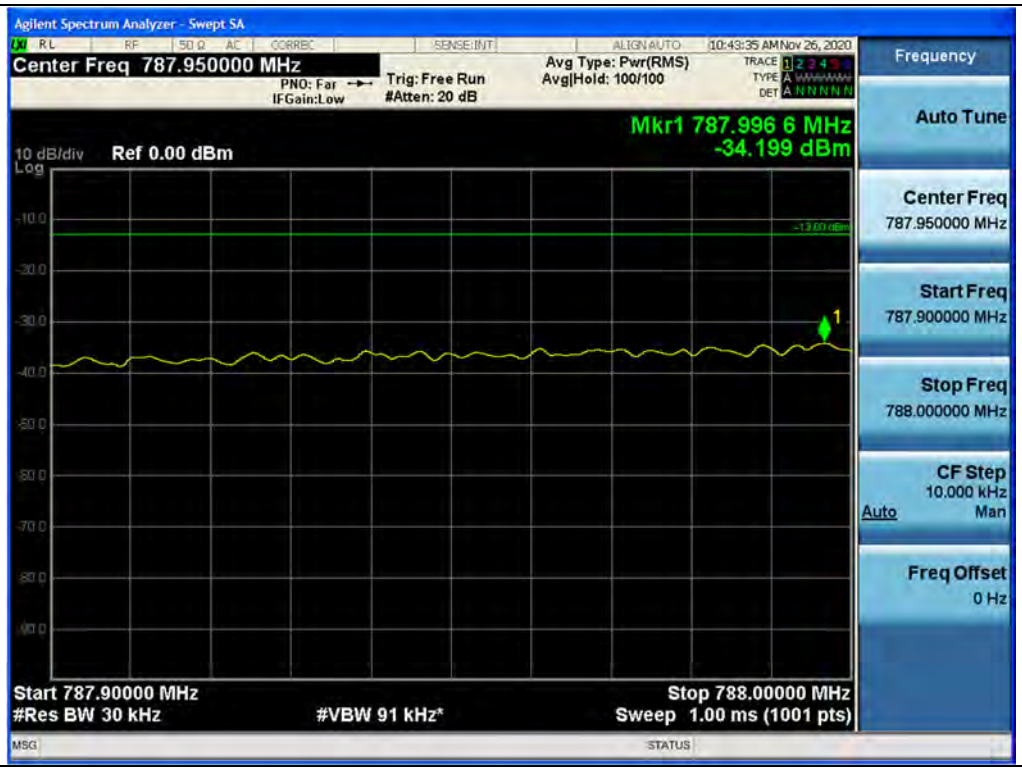
4.7.2 Out-of-band/out-of-block emissions conducted measurements
a) Connect a signal generator to the input of the EUT.
b) If the signal generator is not capable of producing two independent modulated carriers simultaneously, then two discrete signal generators can be connected, with an appropriate combining 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.

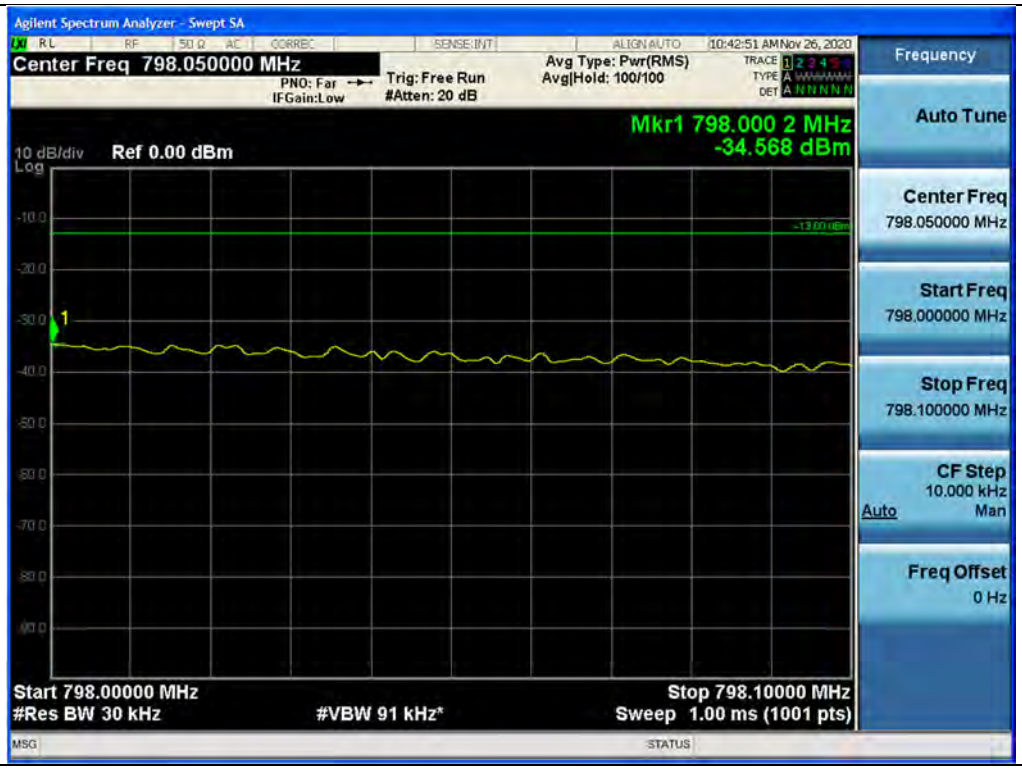
4.7.3 EUT spurious emissions conducted measurements
a) Connect a signal generator to the input of the EUT.
b) Configure the signal generator to produce a CW signal.
c) Set the frequency of the CW signal to the center channel of the EUT passband.
d) Set the output power level so that the resultant signal 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.)

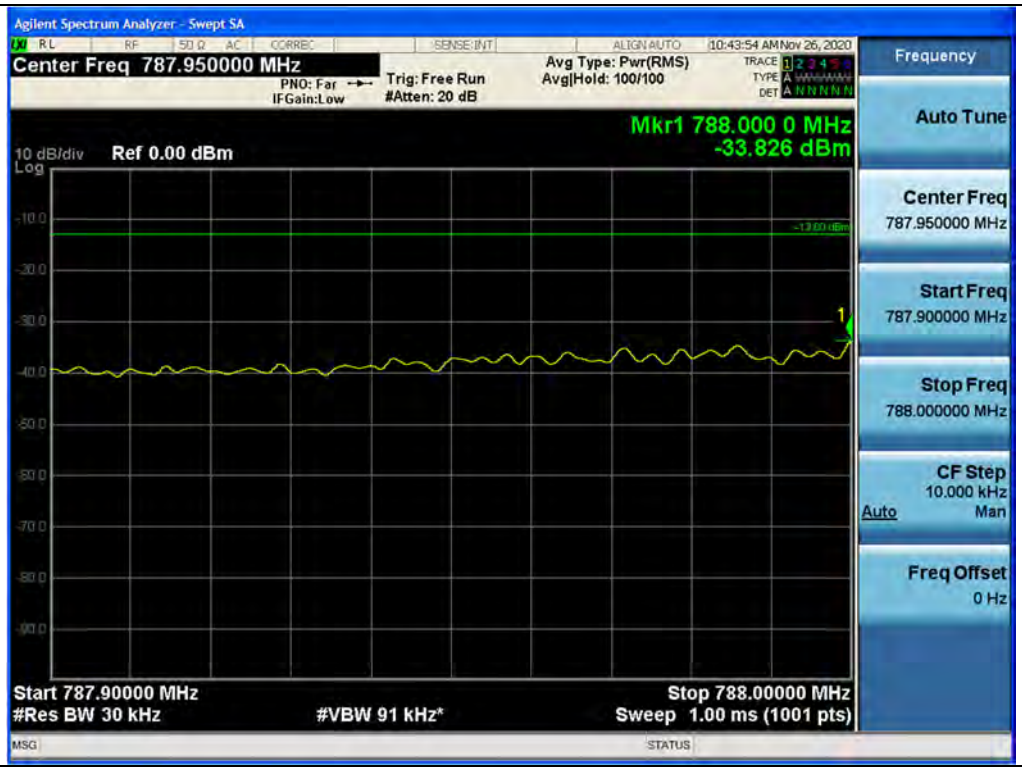
l) Capture a plot for inclusion in the test report.
m) Repeat steps c) to l) for each authorized frequency band/block of operation.

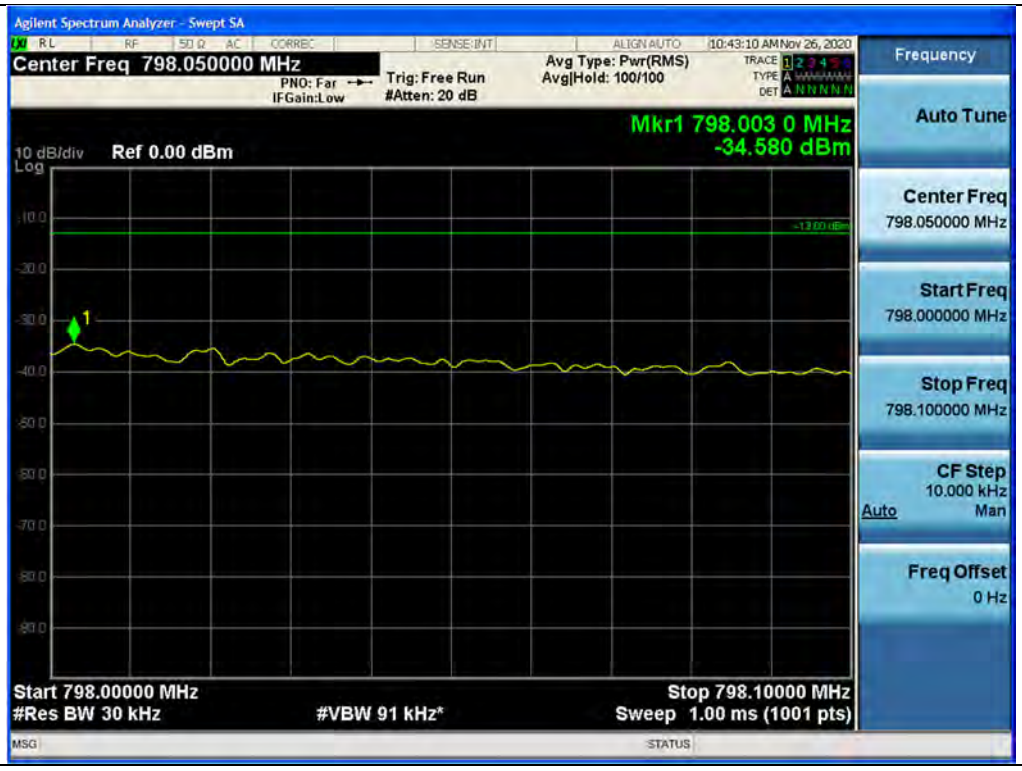
Note: In 9 kHz-150 kHz and 150 kHz-30 MHz for FirstNet bands, RBW was reduced to 1 % and 10 % of the reference bandwidth for measuring unwanted emission level (typically, 1 MHz if the authorized frequency band is above 1 GHz) and power was integrated.(1% = +20 dB, 10% = +10 dB)

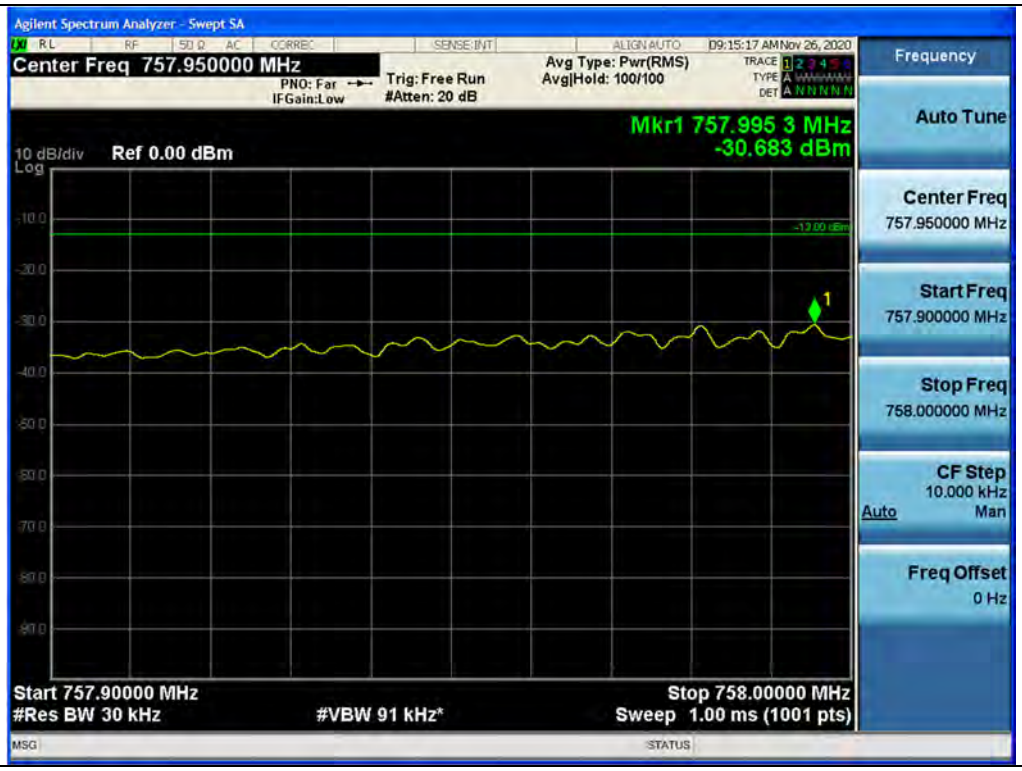
Plot data of Out-of-band/out-of-block emissions

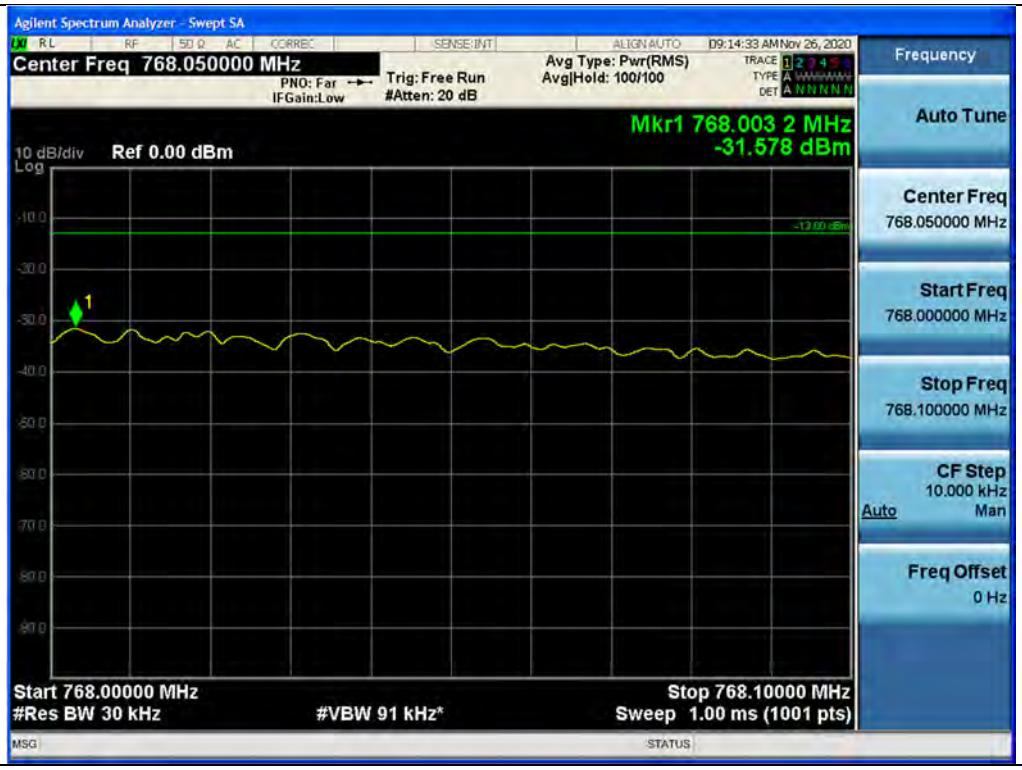
Out-of-band (single test signals) / FistNet / Uplink / LTE 10 MHz / Lower


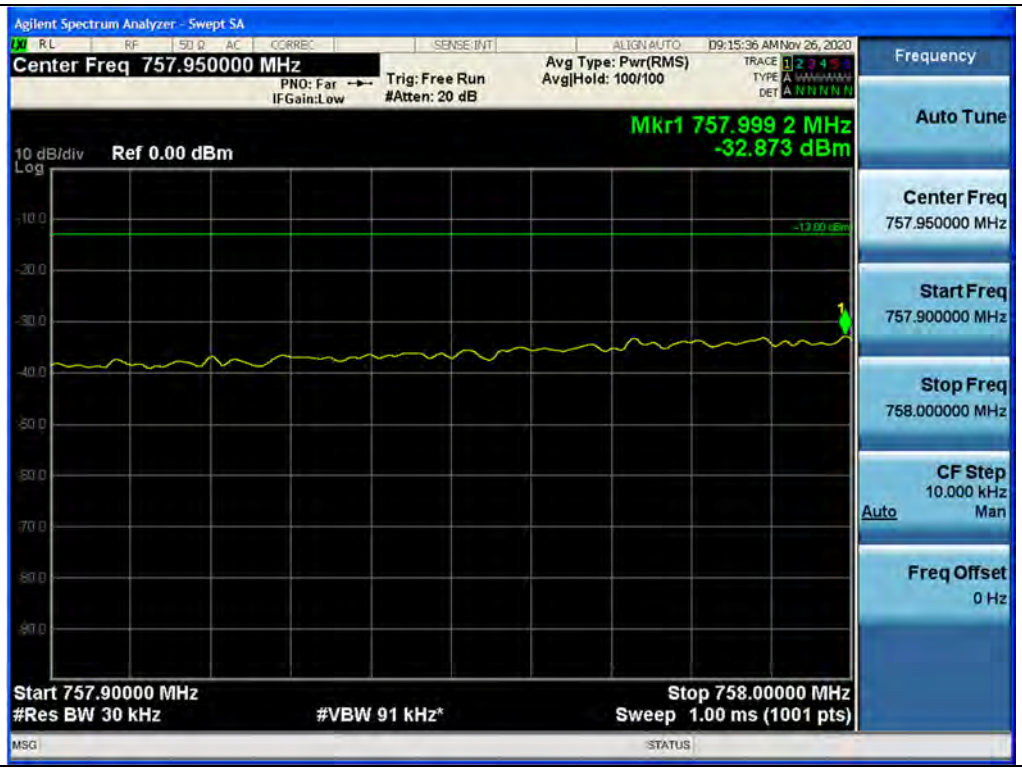
Out-of-band (single test signals) / FistNet / Uplink / LTE 10 MHz / Upper


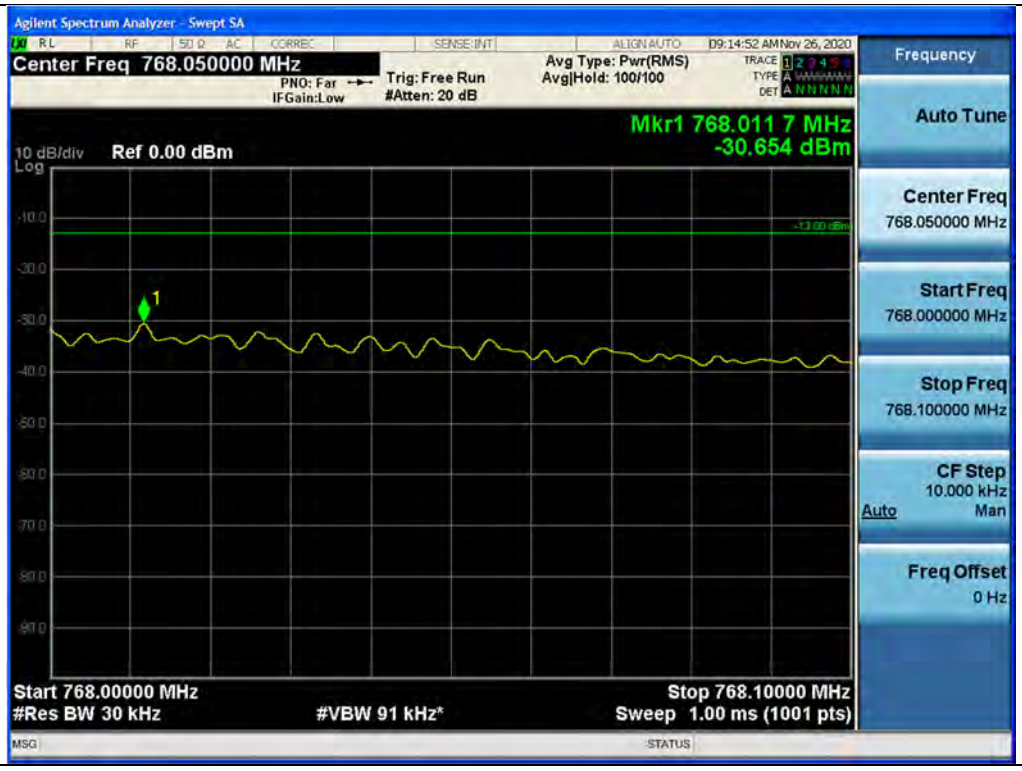
+3 dB above Out-of-band (single test signals) / FistNet / Uplink / LTE 10 MHz / Lower


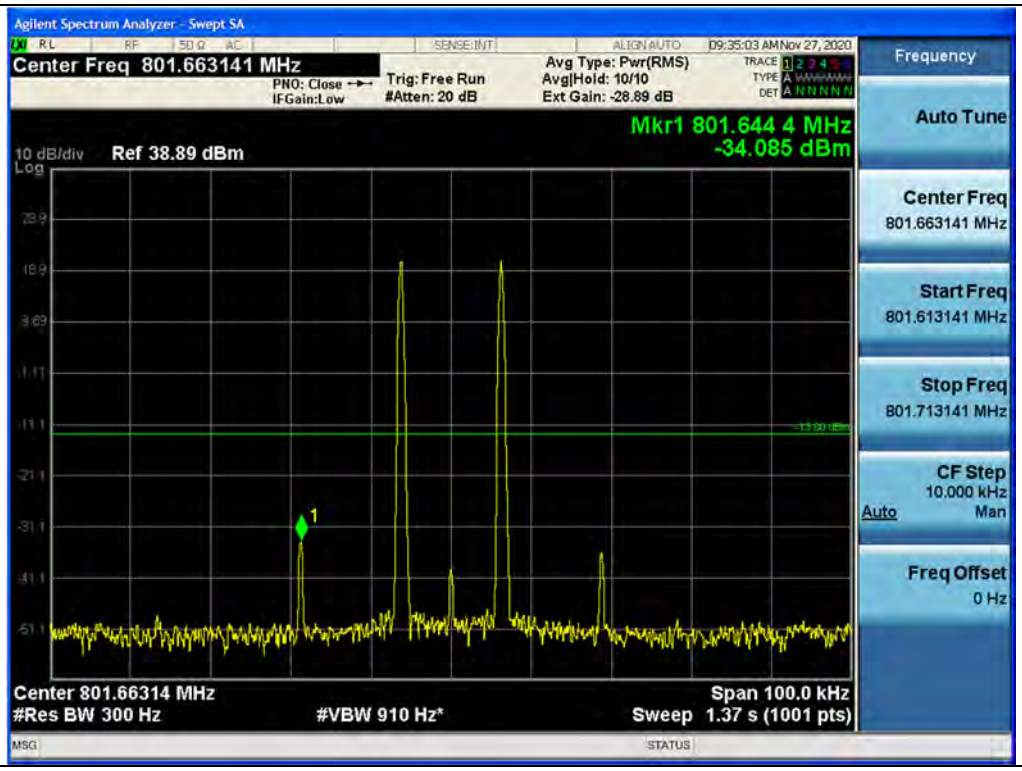
+3 dB above Out-of-band (single test signals) / FistNet / Uplink / LTE 10 MHz / Upper


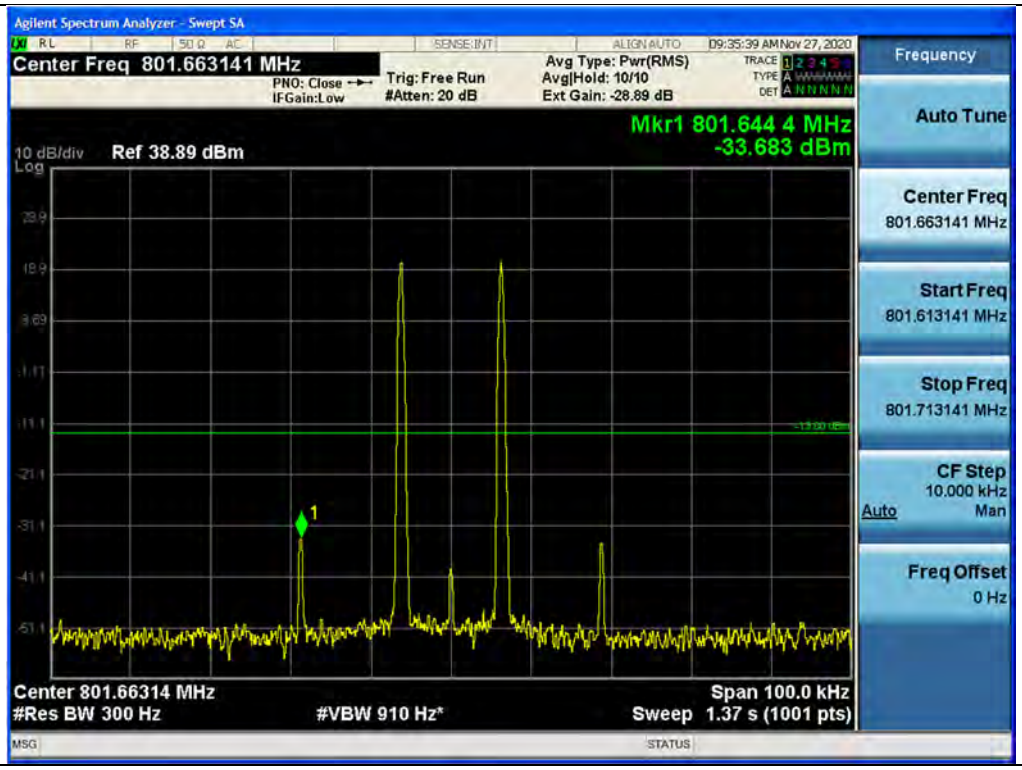
Out-of-band (single test signals) / FistNet / Downlink / LTE 10 MHz / Lower


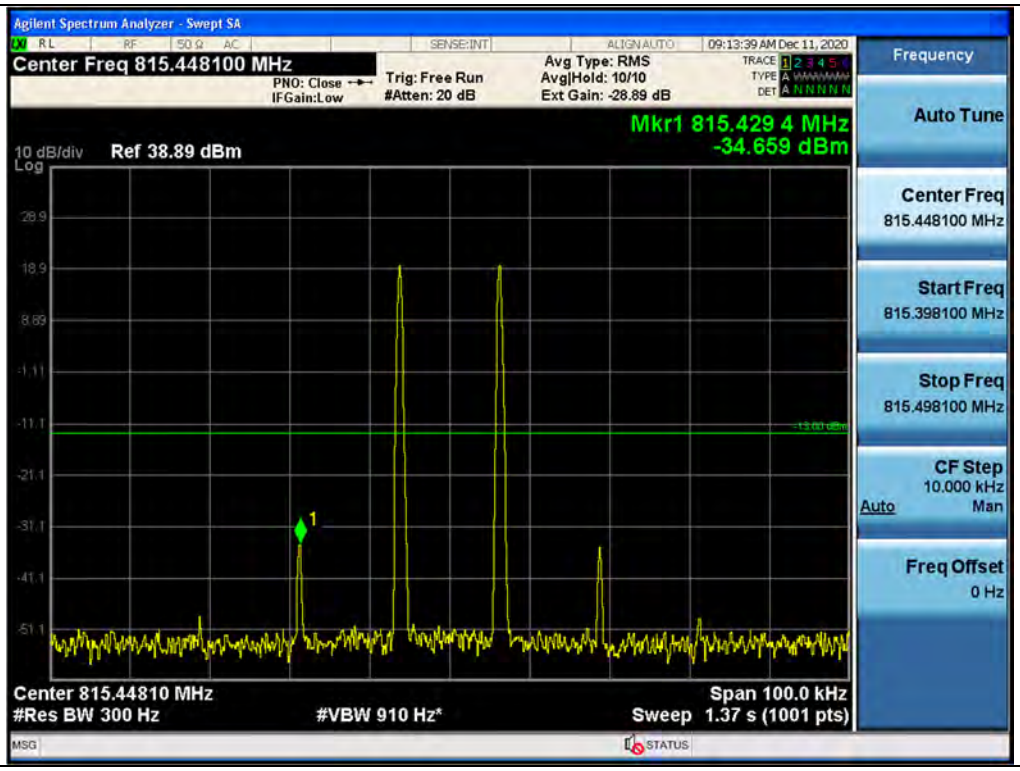
Out-of-band (single test signals) / FistNet / Downlink / LTE 10 MHz / Upper


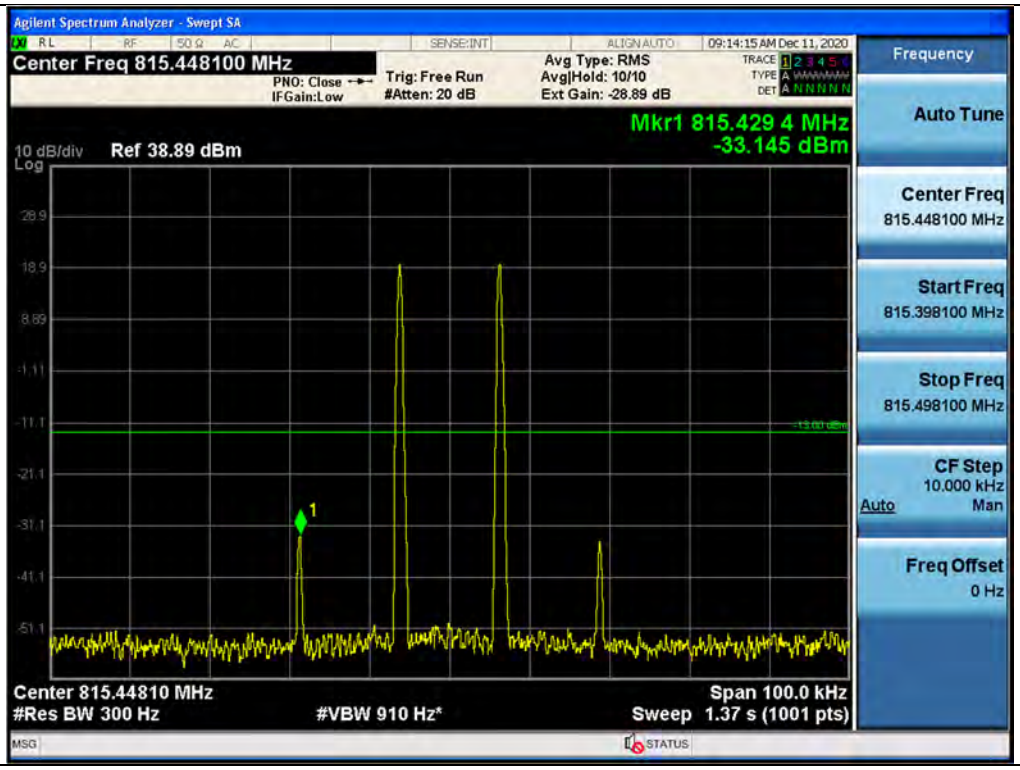
+3 dB above Out-of-band (single test signals) / FistNet / Downlink / LTE 10 MHz / Lower


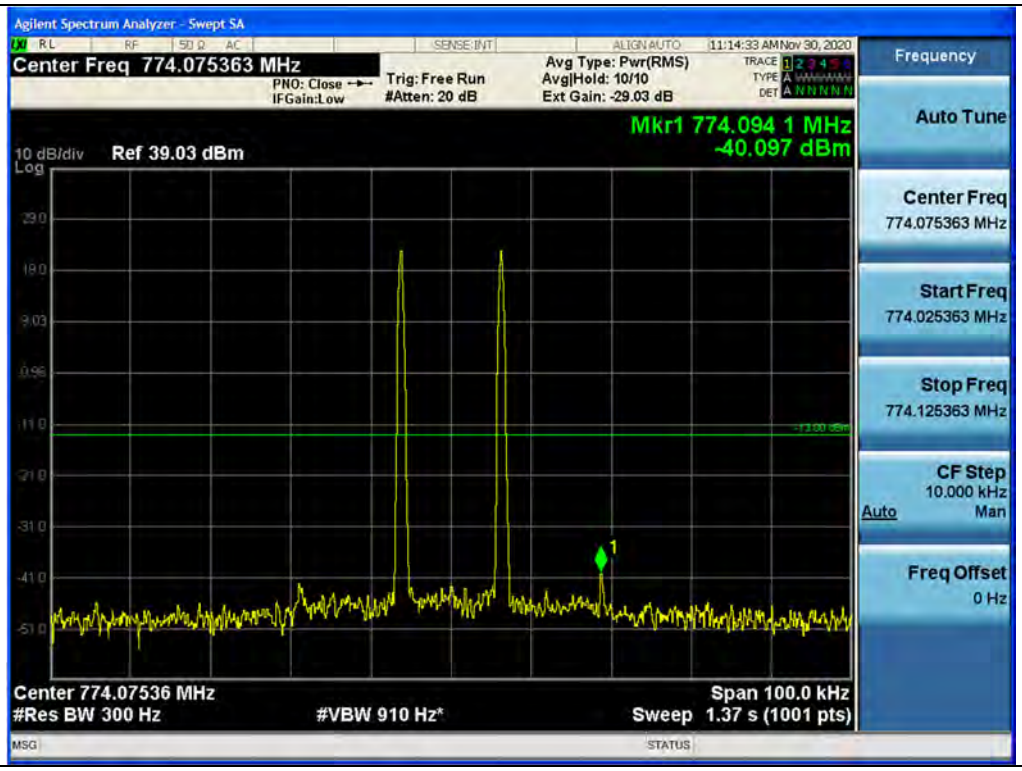
+3 dB above Out-of-band (single test signals) / FistNet / Downlink / LTE 10 MHz / Upper


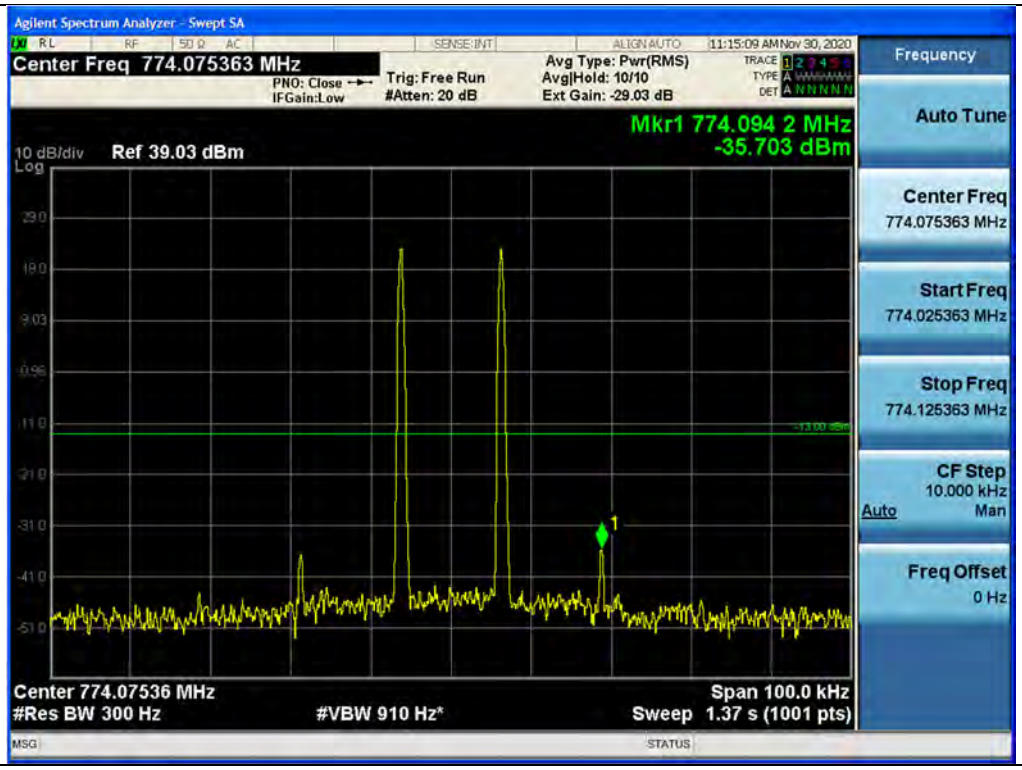
Out-of-band (two adjacent test signals) / PS Narrowband / Uplink


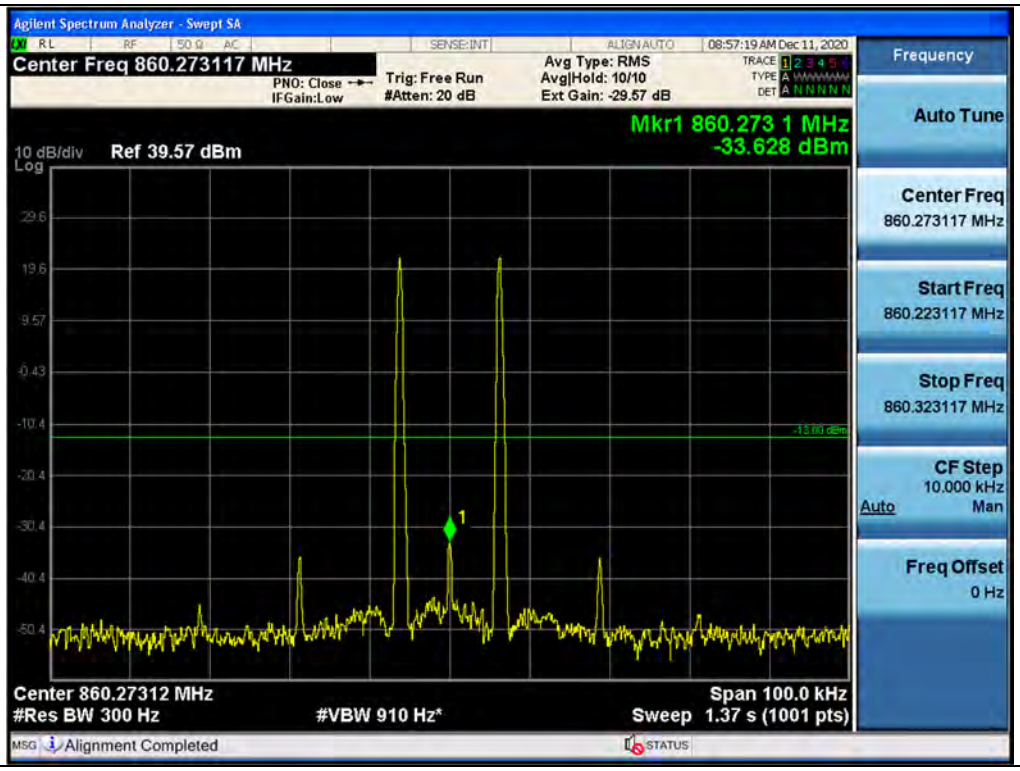
+3 dB above Out-of-band (two adjacent test signals) / PS Narrowband / Uplink


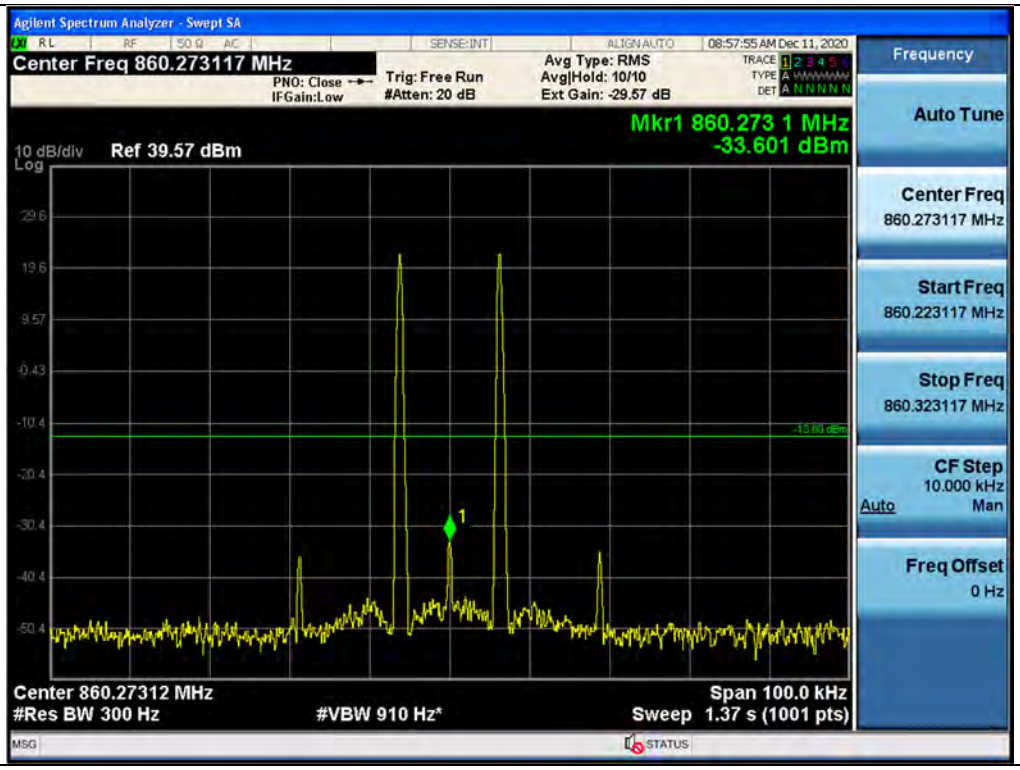
Out-of-band (two adjacent test signals) / SMR / Uplink


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


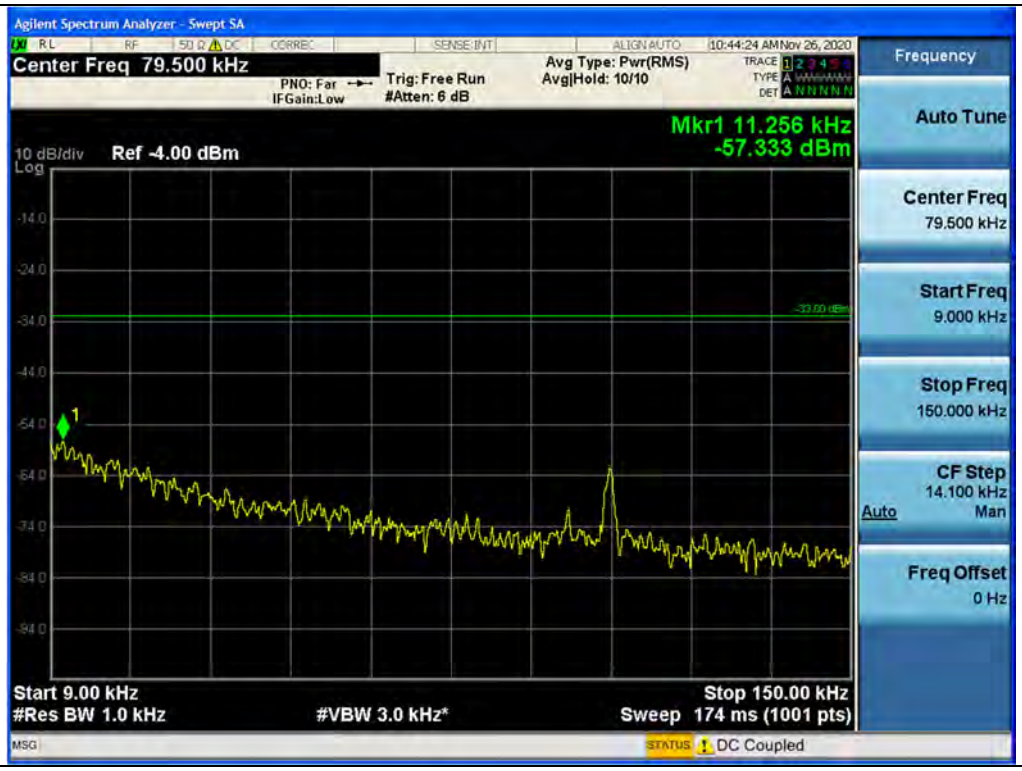
Out-of-band (two adjacent test signals) / PS Narrowband / Downlink


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


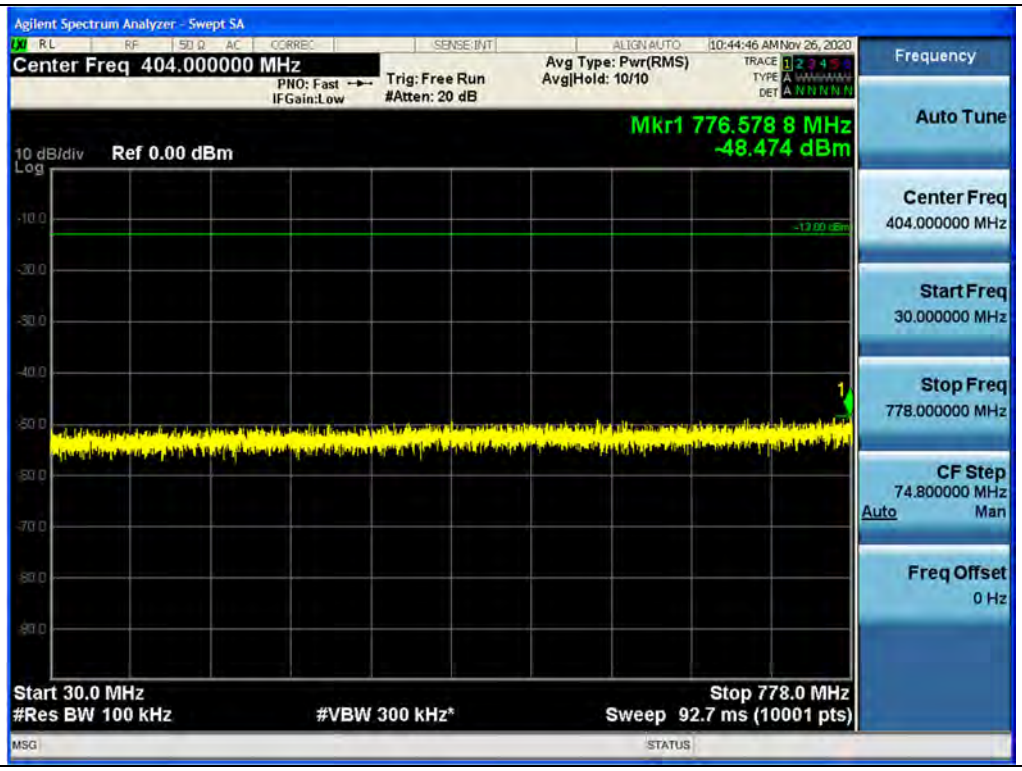
Out-of-band (two adjacent test signals) / SMR / Downlink


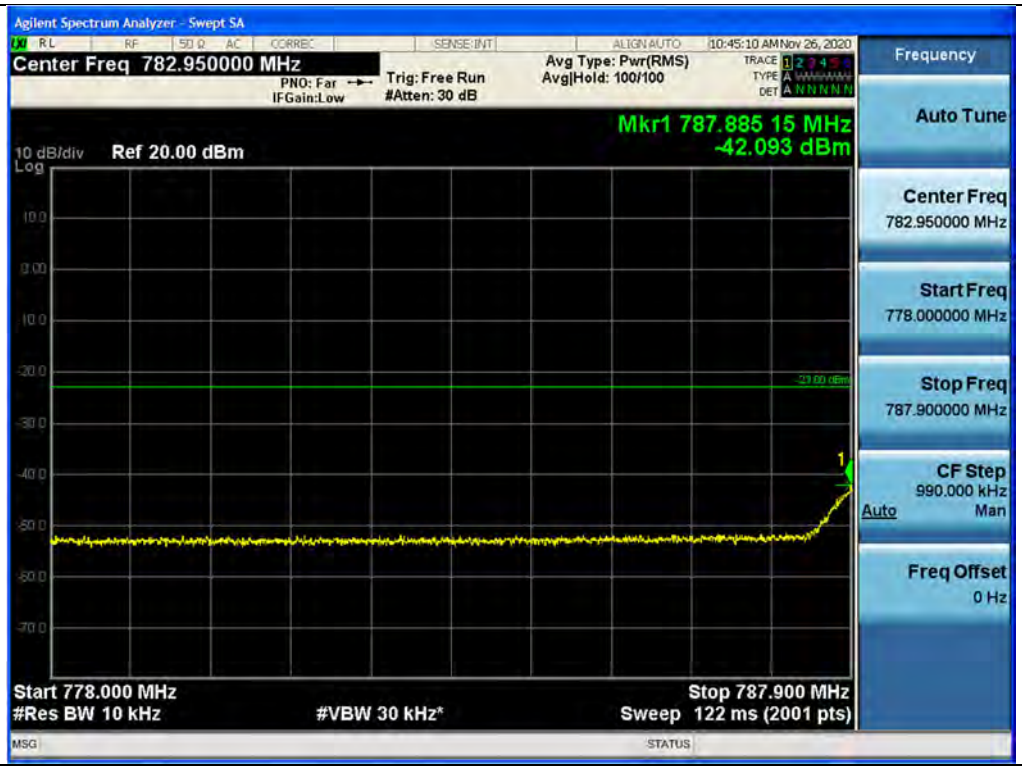
+3 dB above Out-of-band (two adjacent test signals) / SMR / Downlink


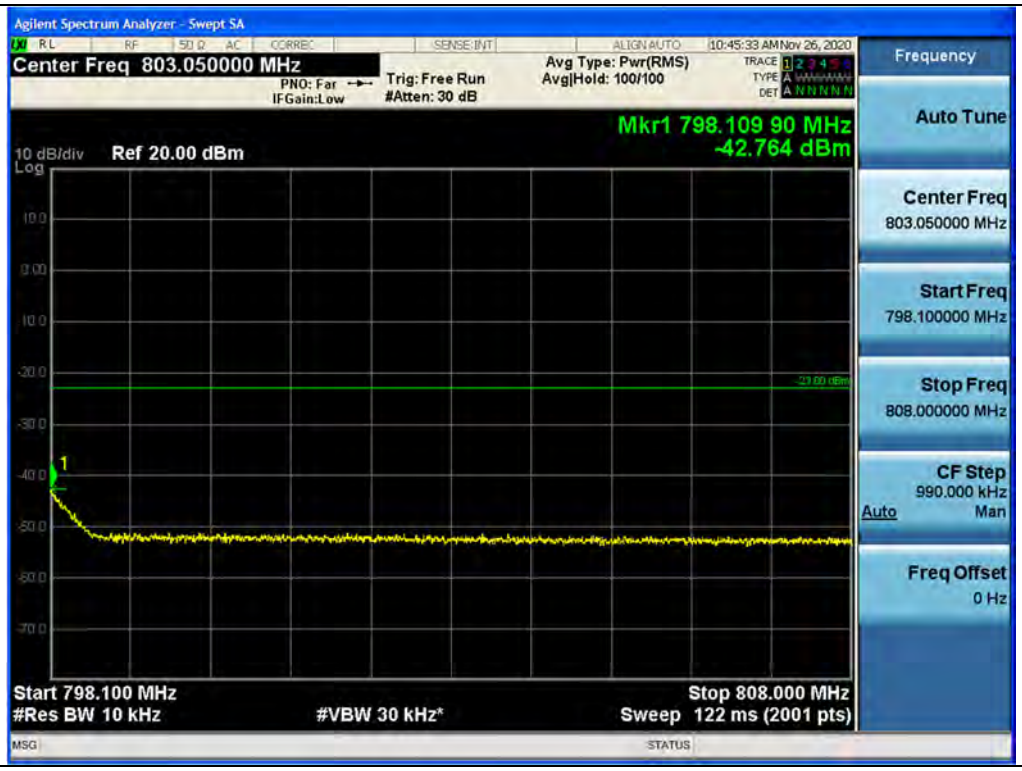
Plot data of Spurious Emissions

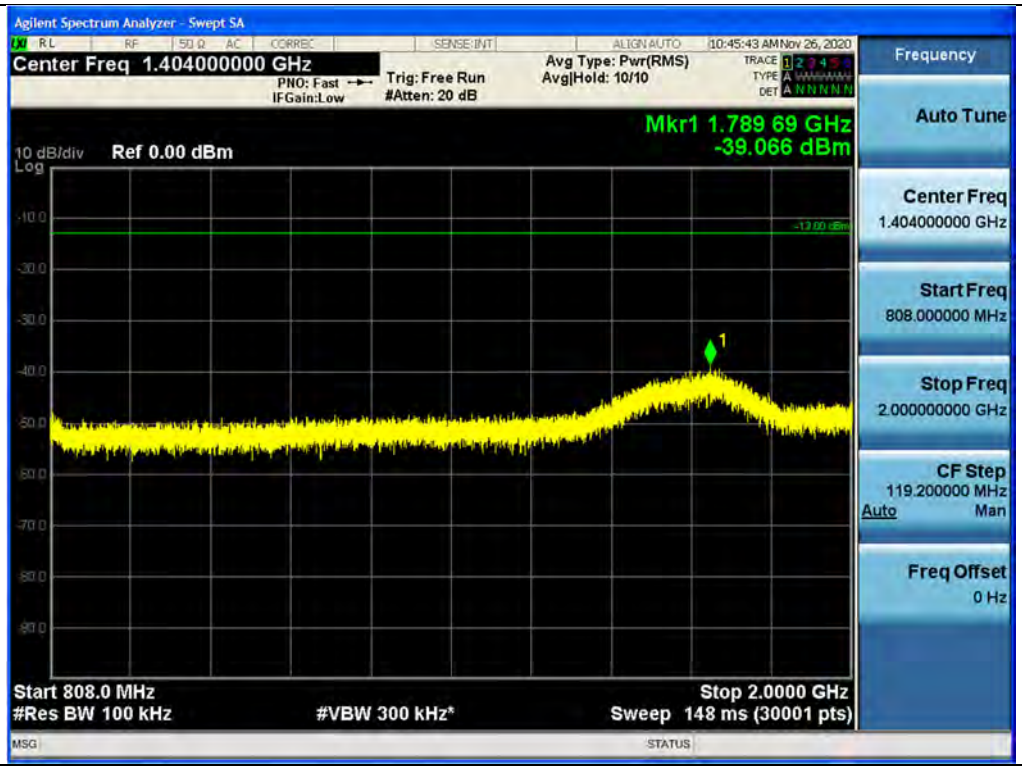
Spurious / FistNet / Uplink / LTE 10 MHz / Middle / 9 kHz ~ 150 kHz


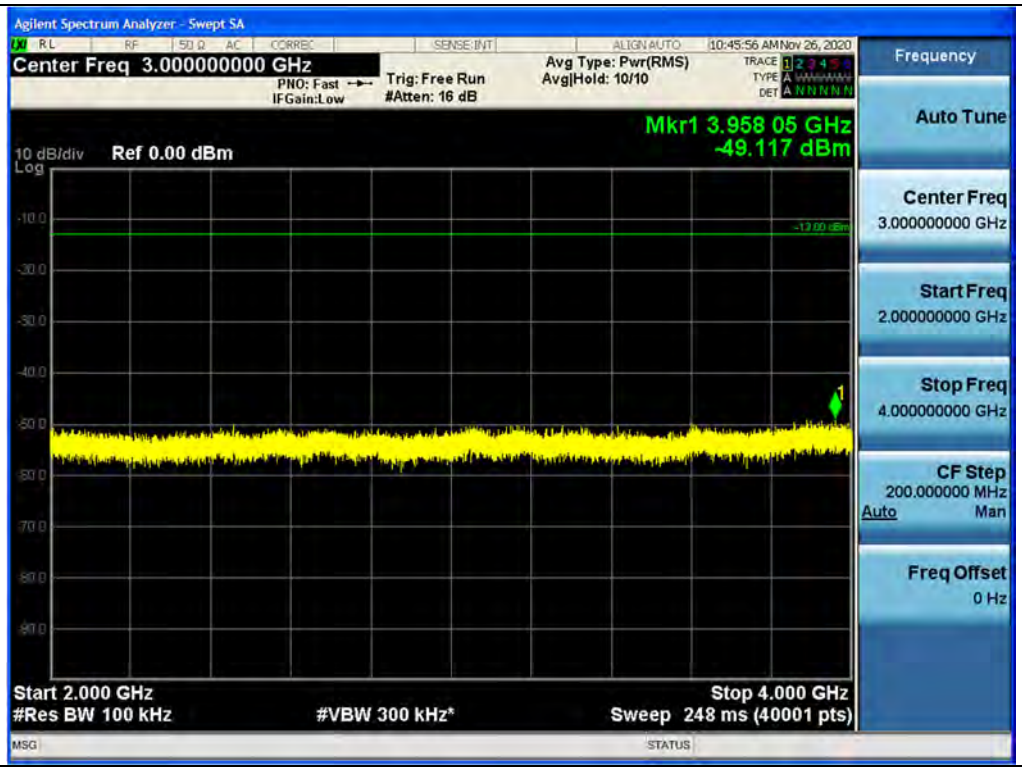
Spurious / FistNet / Uplink / LTE 10 MHz / Middle / 150 kHz ~ 30 MHz

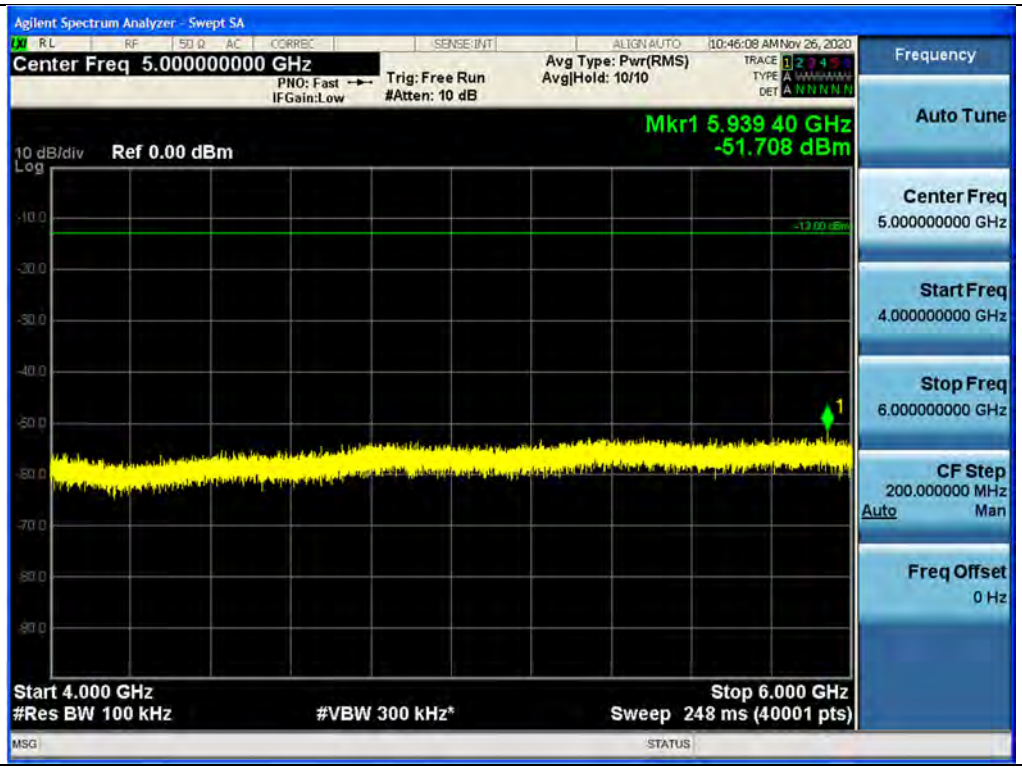

Spurious / FistNet / Uplink / LTE 10 MHz / Middle / 30 MHz ~ Low Edge - 10 MHz


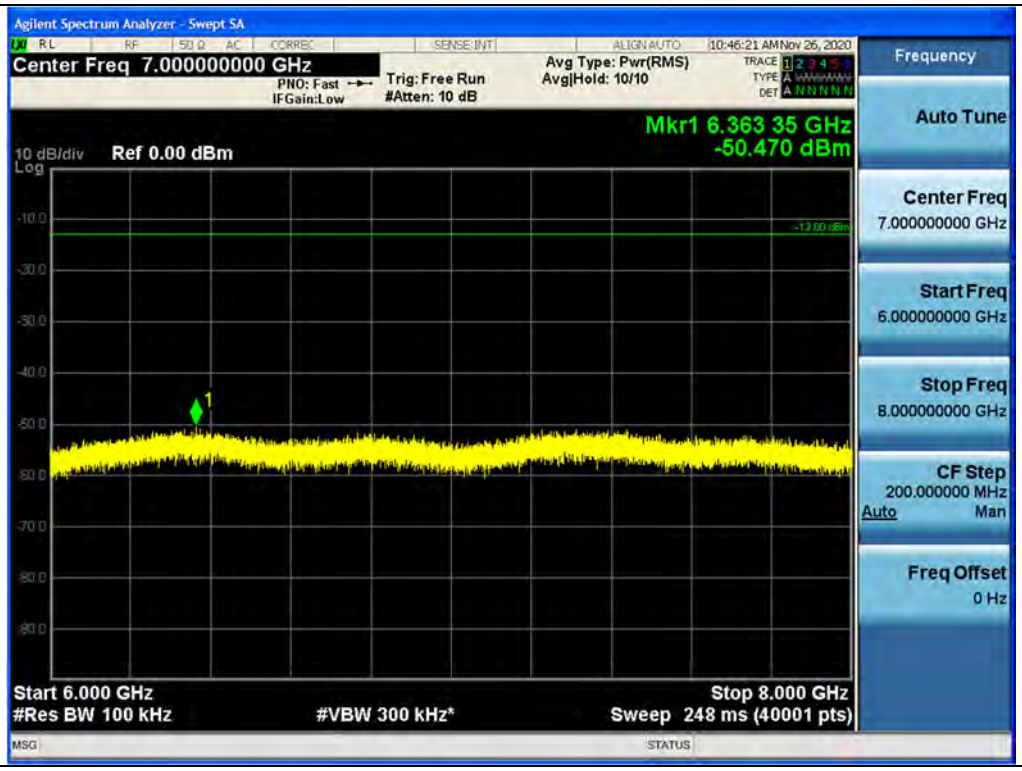
Spurious / FistNet / Uplink / LTE 10 MHz / Low / Low Edge - 10 MHz ~ Low Edge – 100 kHz


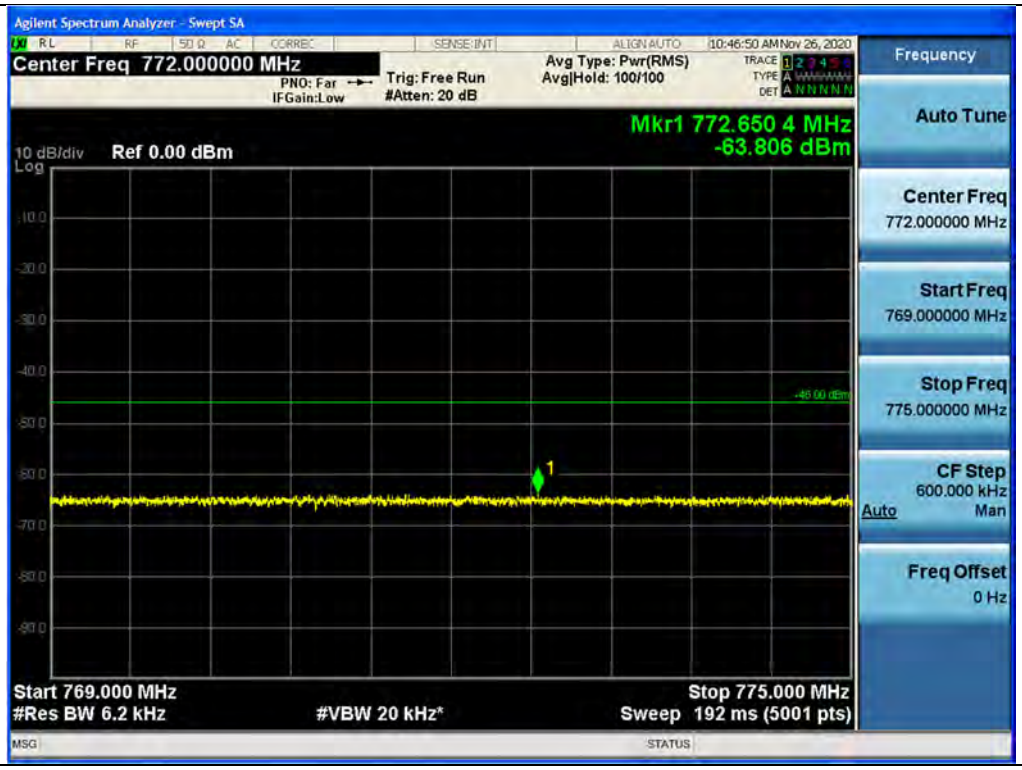
Spurious / FistNet / Uplink / LTE 10 MHz / High / High Edge + 100 kHz ~ High Edge + 10 MHz


Spurious / FistNet / Uplink / LTE 10 MHz / Low / High Edge + 10 MHz ~ 2 GHz


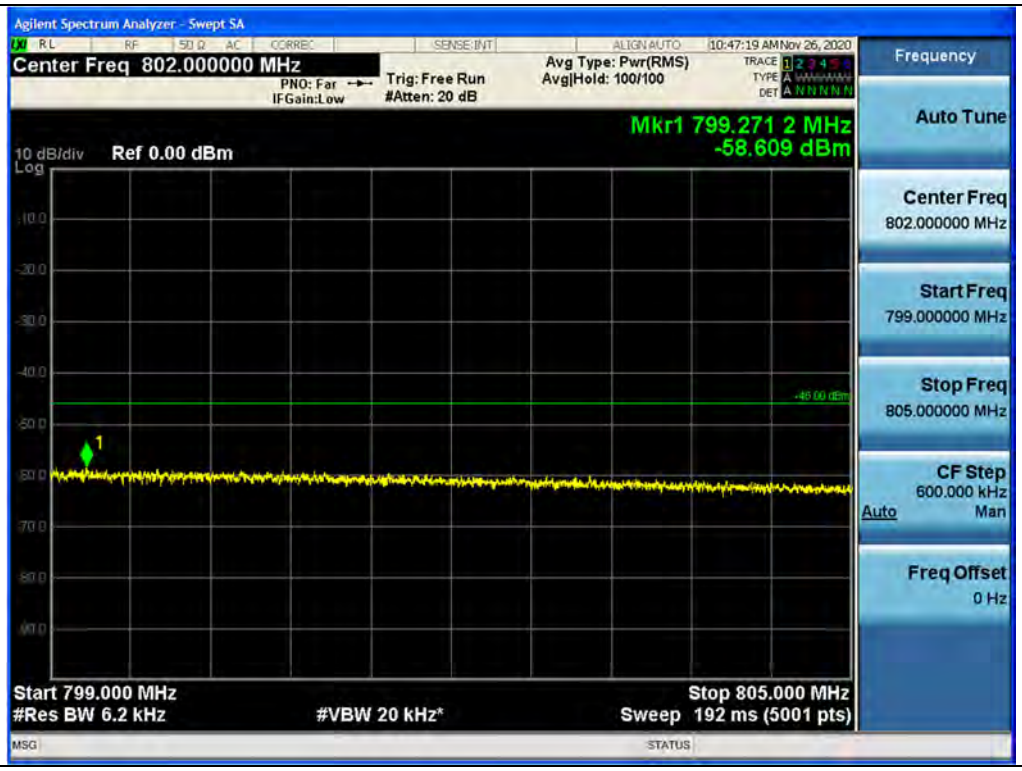
Spurious / FistNet / Uplink / LTE 10 MHz / Middle / 2 GHz ~ 4 GHz


Spurious / FistNet / Uplink / LTE 10 MHz / High / 4 GHz ~ 6 GHz


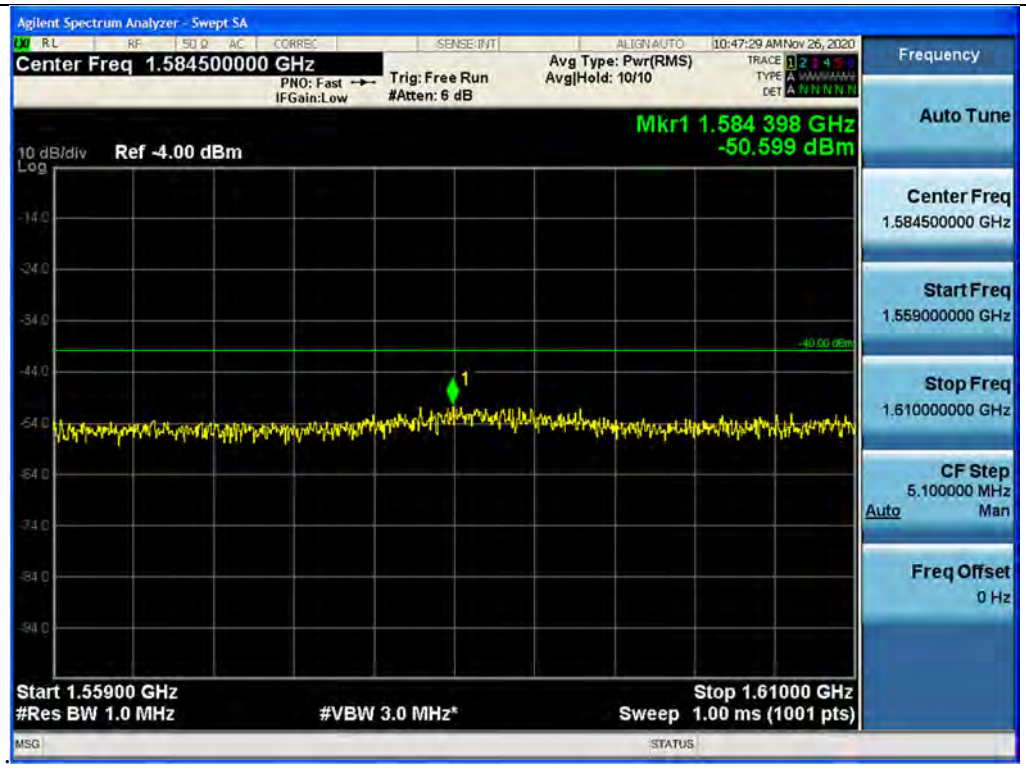
Spurious / FistNet / Uplink / LTE 10 MHz / High / 6 GHz ~ 8 GHz


Spurious / FistNet / Uplink / LTE 10 MHz / High / 769 ~ 775 MHz


Spurious / FistNet / Uplink / LTE 10 MHz / High / 799 ~ 805 MHz

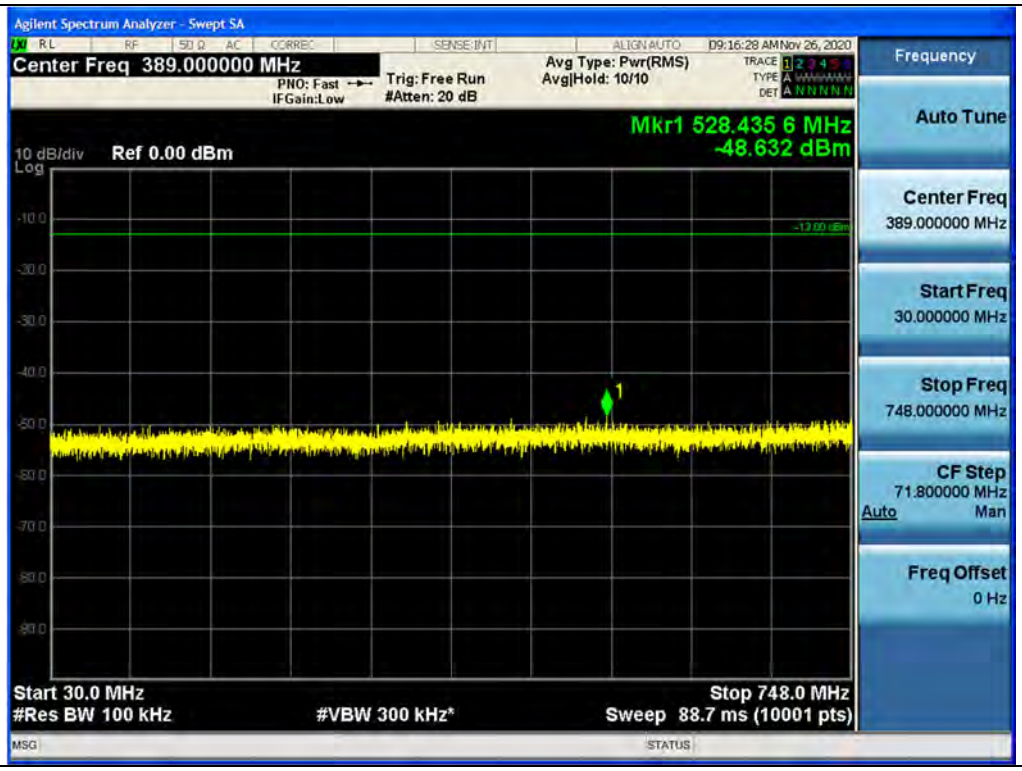


Spurious / FistNet / Uplink / LTE 10 MHz / High / 1559 ~ 1610 MHz (RBW 1 MHz)



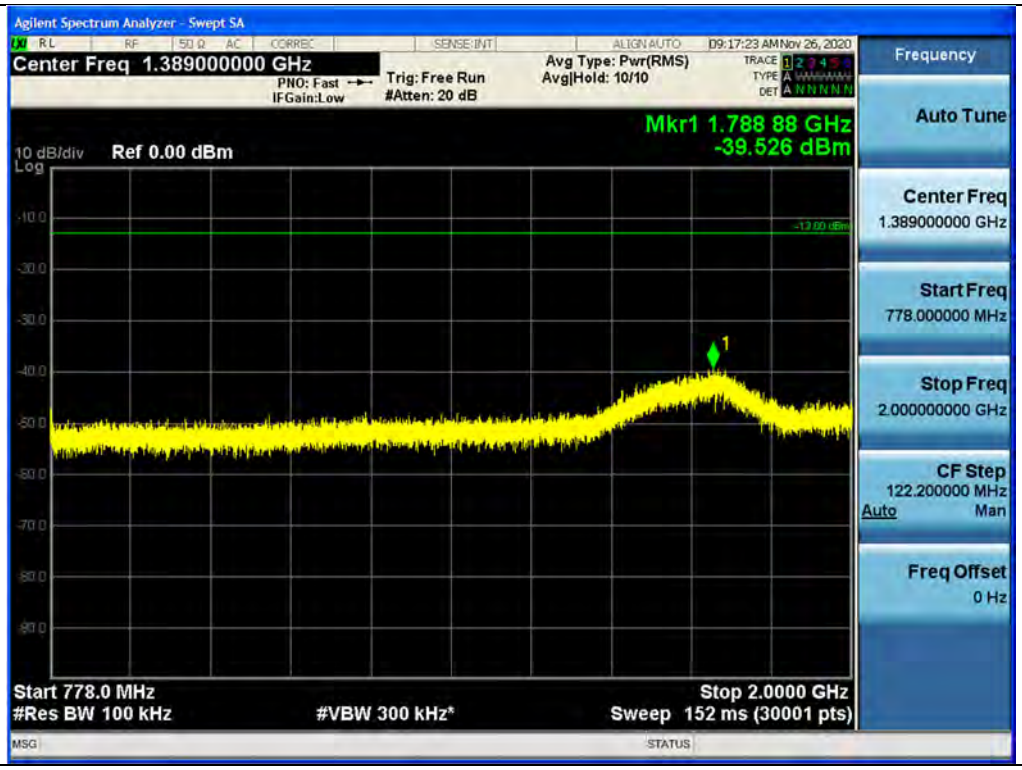
Spurious / FistNet / Downlink / LTE 10 MHz / Middle / 9 kHz ~ 150 kHz

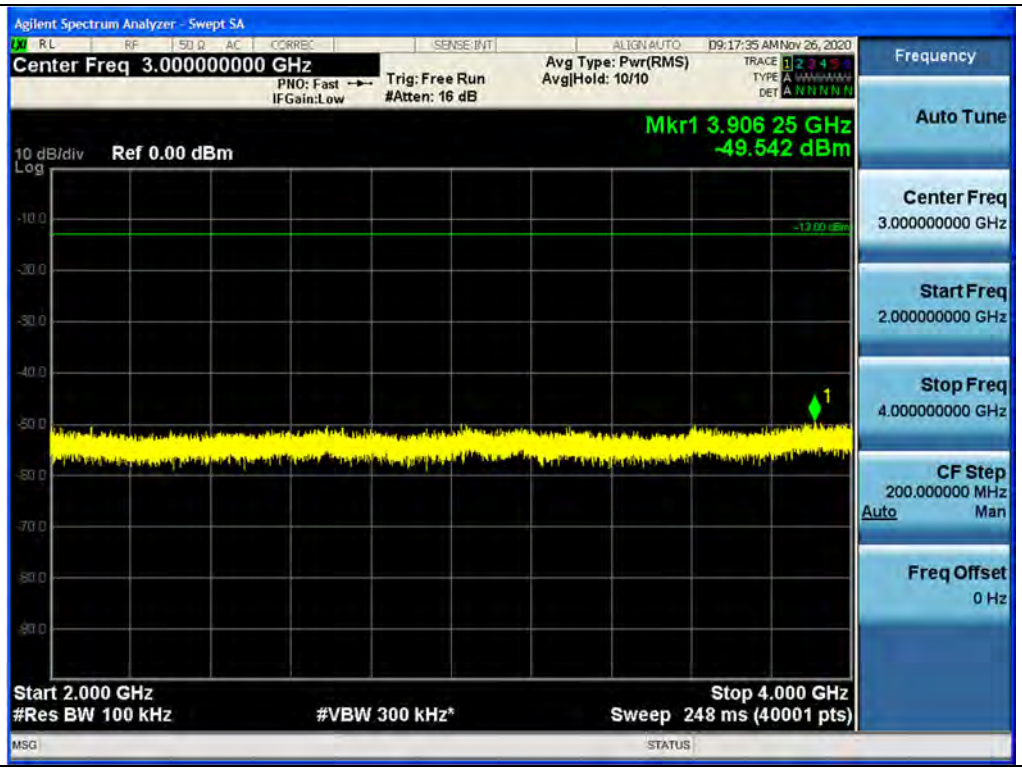

Spurious / FistNet / Downlink / LTE 10 MHz / Low / 150 kHz ~ 30 MHz

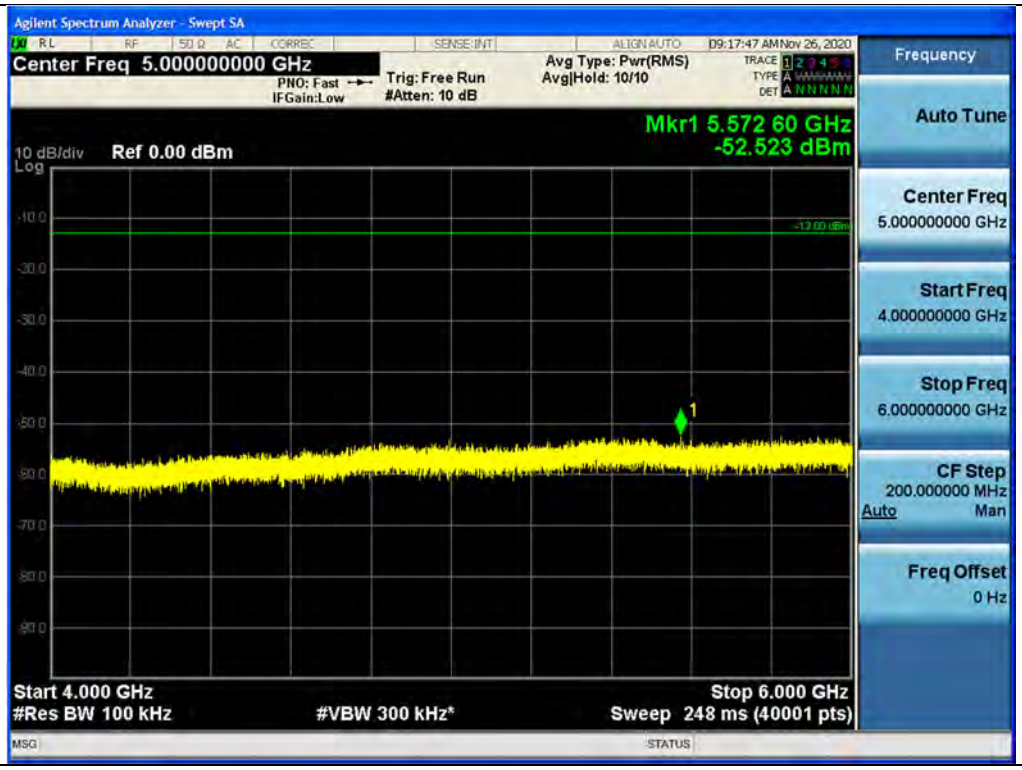

Spurious / FistNet / Downlink / LTE 10 MHz / Low / 30 MHz ~ Low Edge - 10 MHz


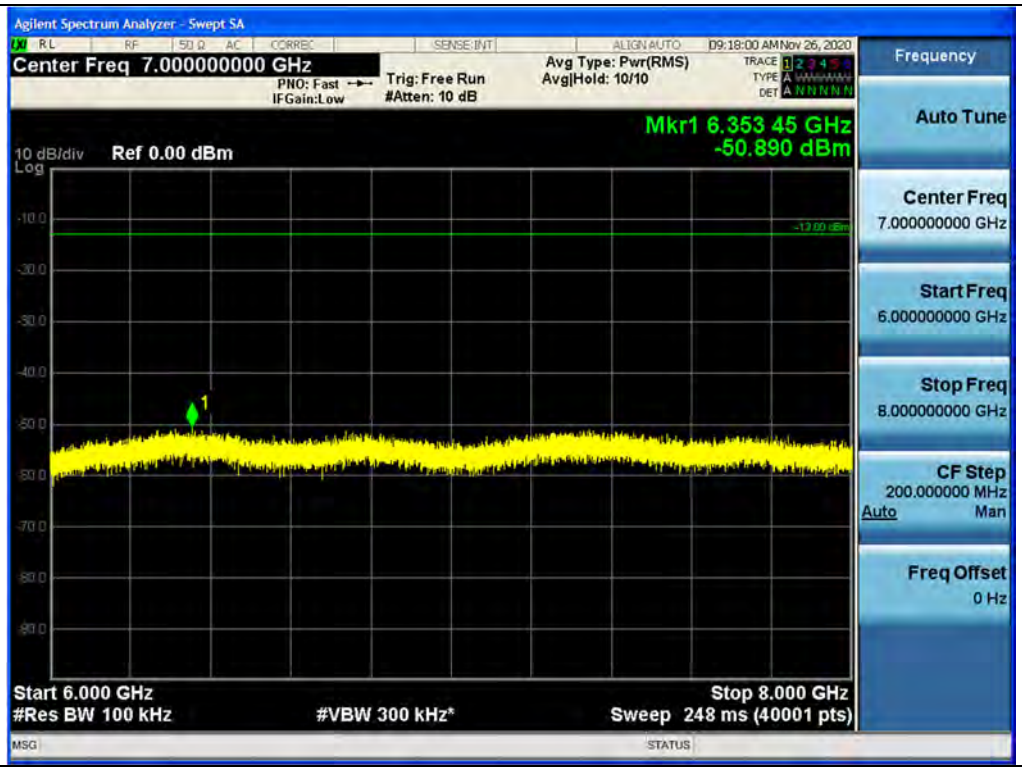
Spurious / FistNet / Downlink / LTE 10 MHz / Low / Low Edge - 10 MHz ~ Low Edge – 100 kHz


Spurious / FistNet / Downlink / LTE 10 MHz / High / High Edge + 100 kHz ~ High Edge + 10 MHz

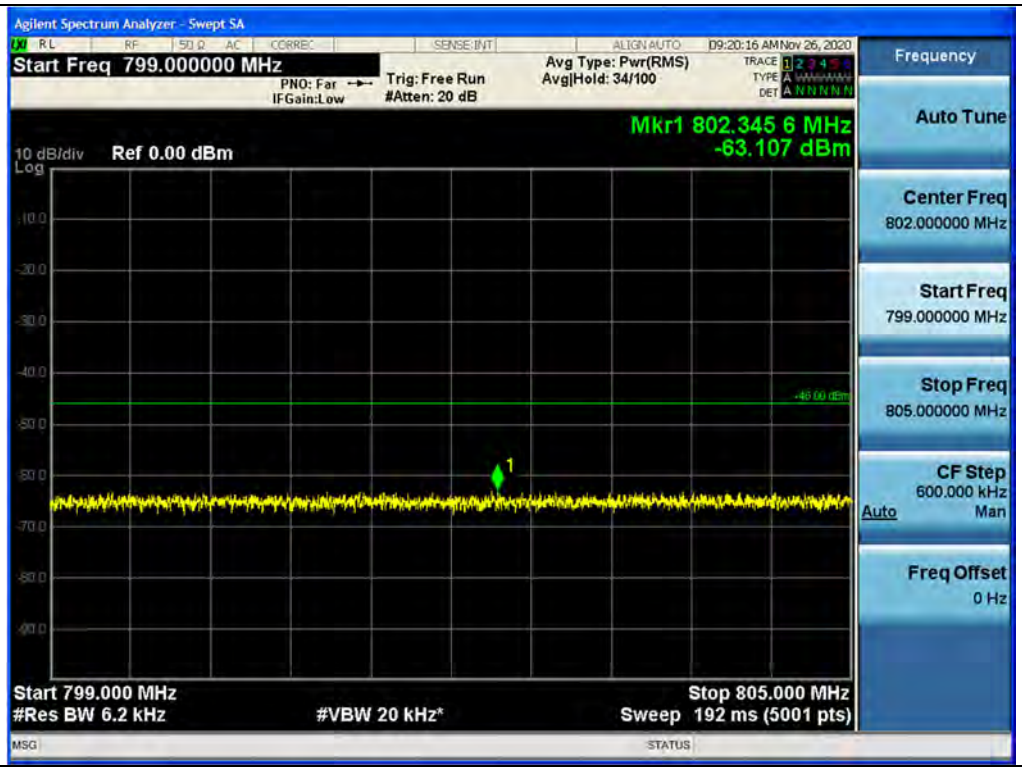

Spurious / FistNet / Downlink / LTE 10 MHz / High / High Edge + 10 MHz ~ 2 GHz


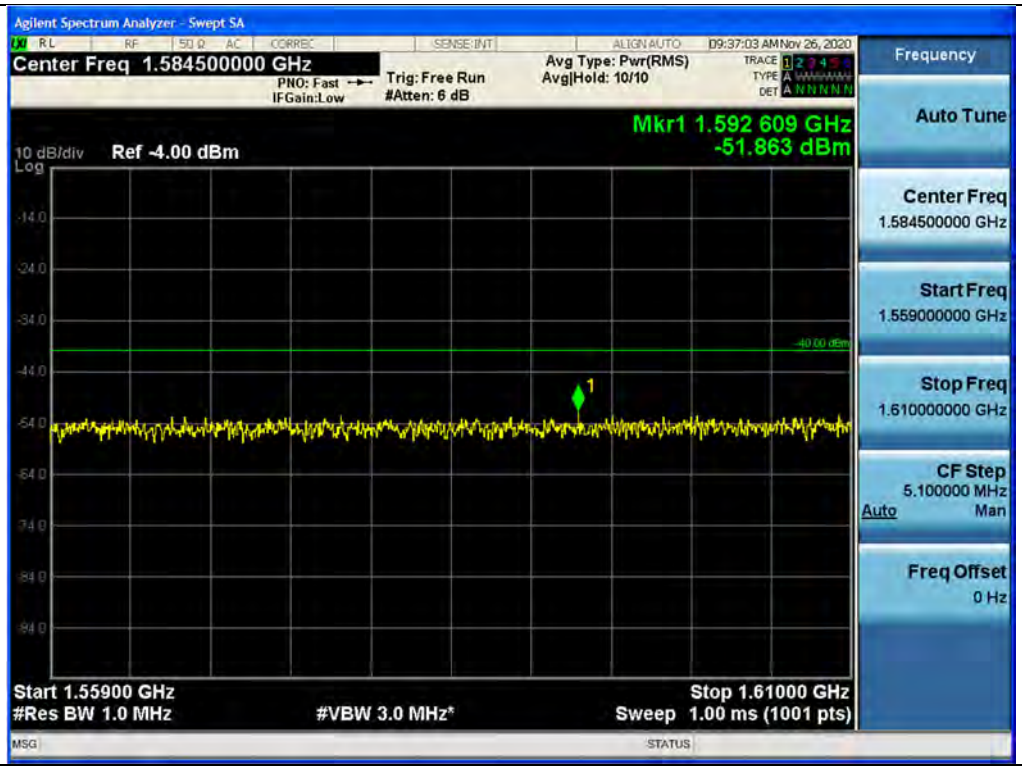
Spurious / FistNet / Downlink / LTE 10 MHz / Middle / 2 GHz ~ 4 GHz


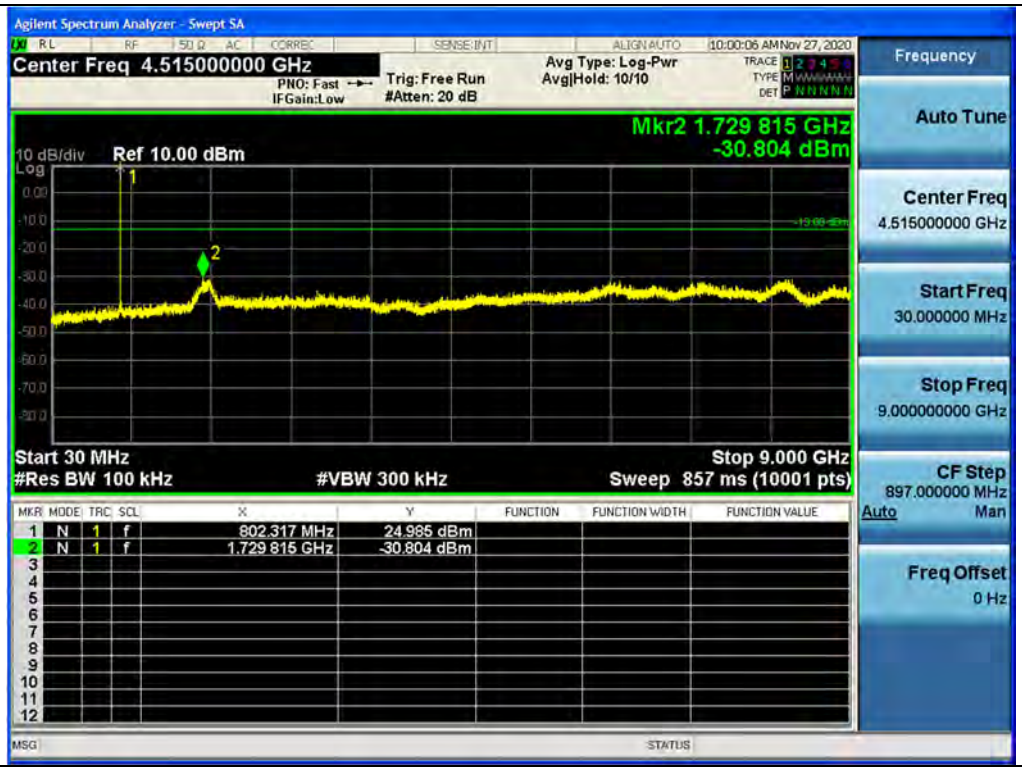
Spurious / FistNet / Downlink / LTE 10 MHz / Middle / 4 GHz ~ 6 GHz


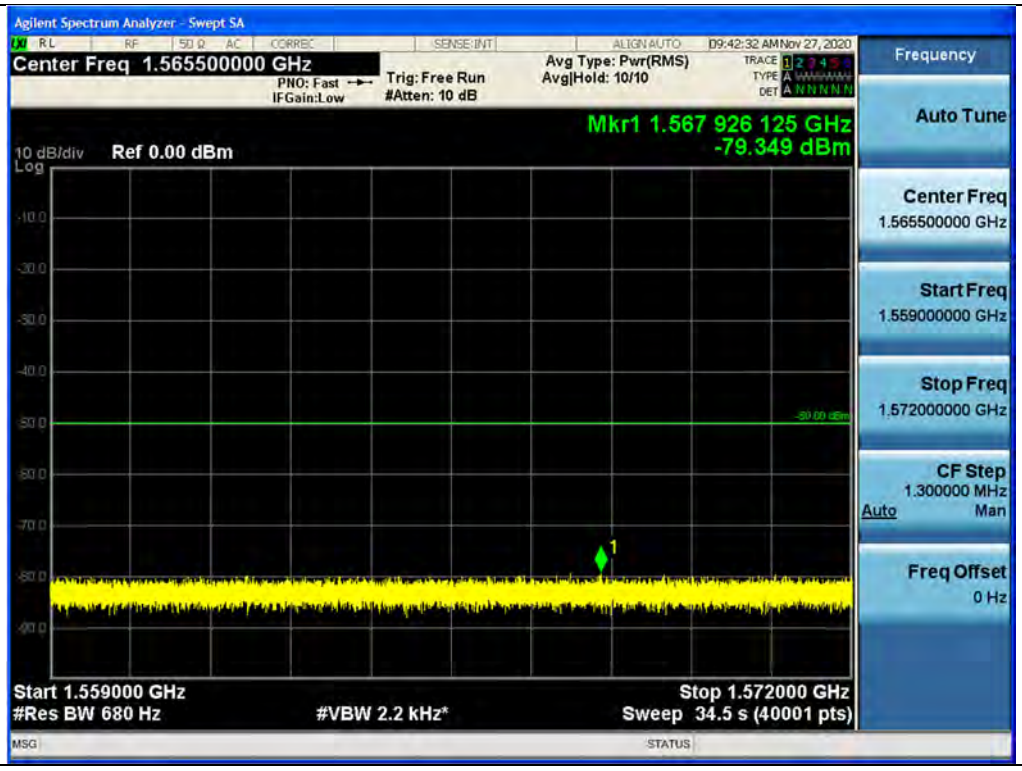
Spurious / FistNet / Downlink / LTE 10 MHz / Middle / 6 GHz ~ 8 GHz


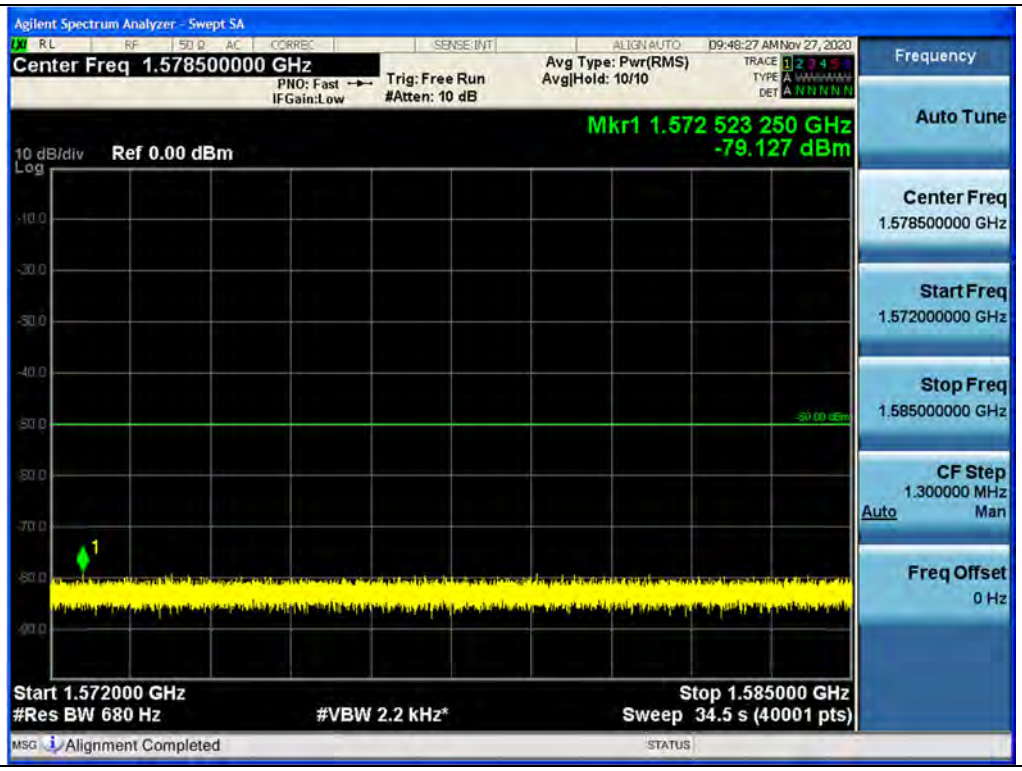
Spurious / FistNet / Downlink / LTE 10 MHz / Middle / 769 ~ 775 MHz

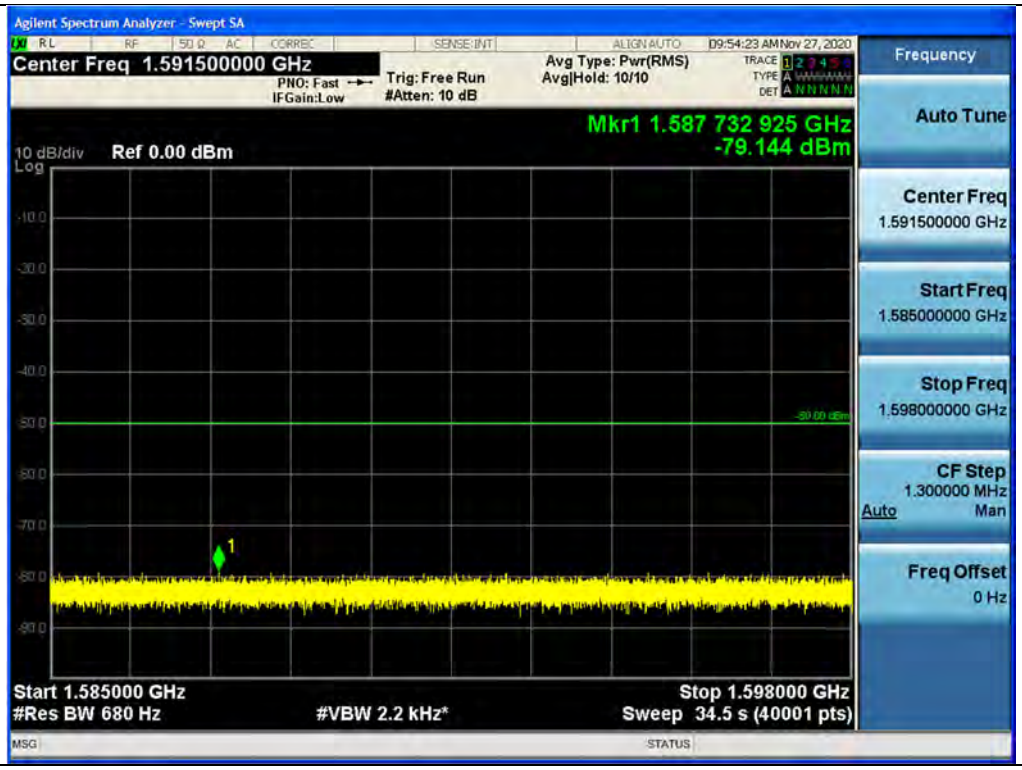

Spurious / FistNet / Downlink / LTE 10 MHz / Middle / 799 ~ 805 MHz


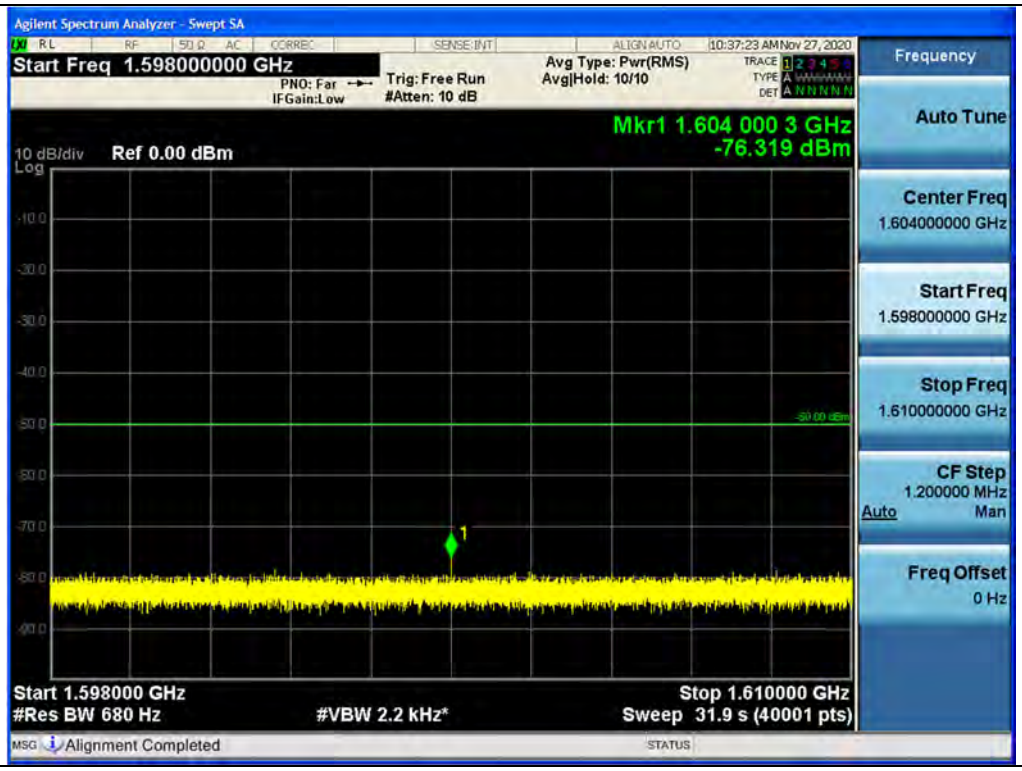
Spurious / FistNet / Downlink / LTE 10 MHz / Middle / 1559 ~ 1610 MHz (RBW 1 MHz)


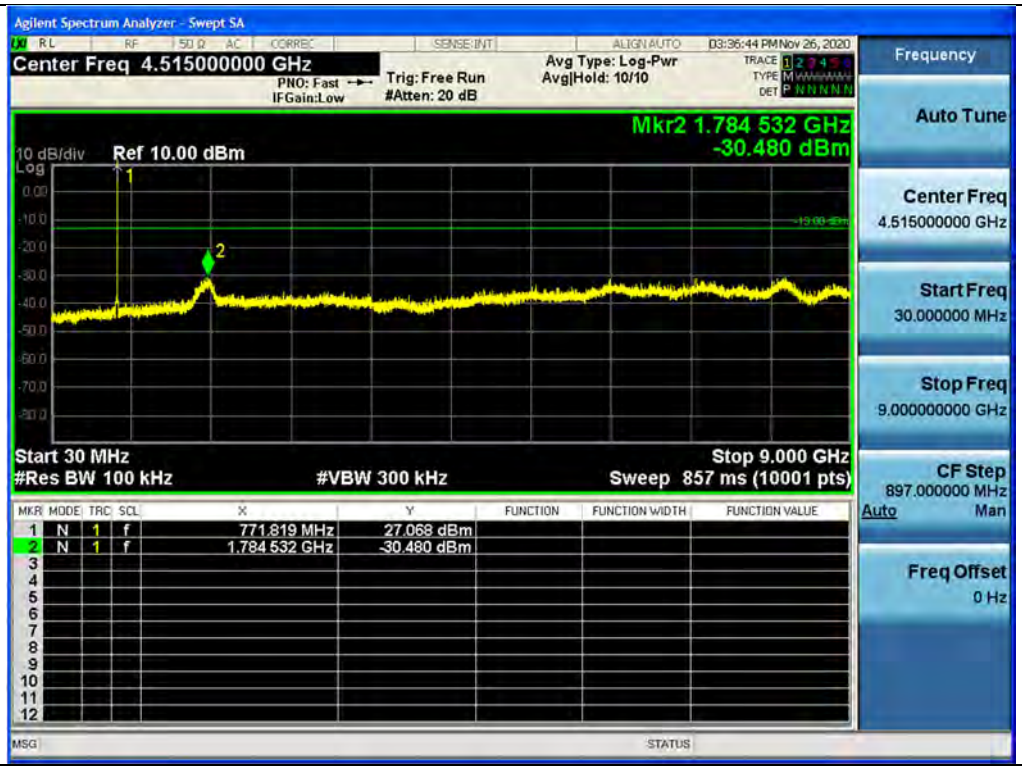
Spurious / PS Narrowband / Uplink


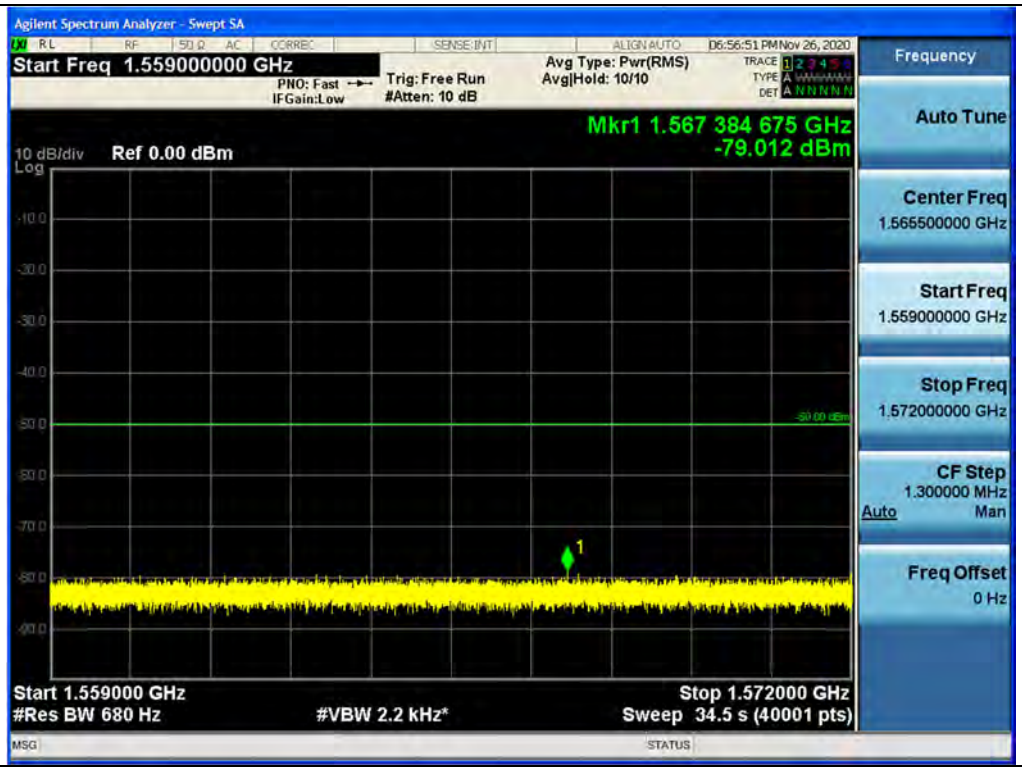
Spurious / PS Narrowband / 1559 ~ 1610 MHz (RBW 700 Hz) (1) / Uplink


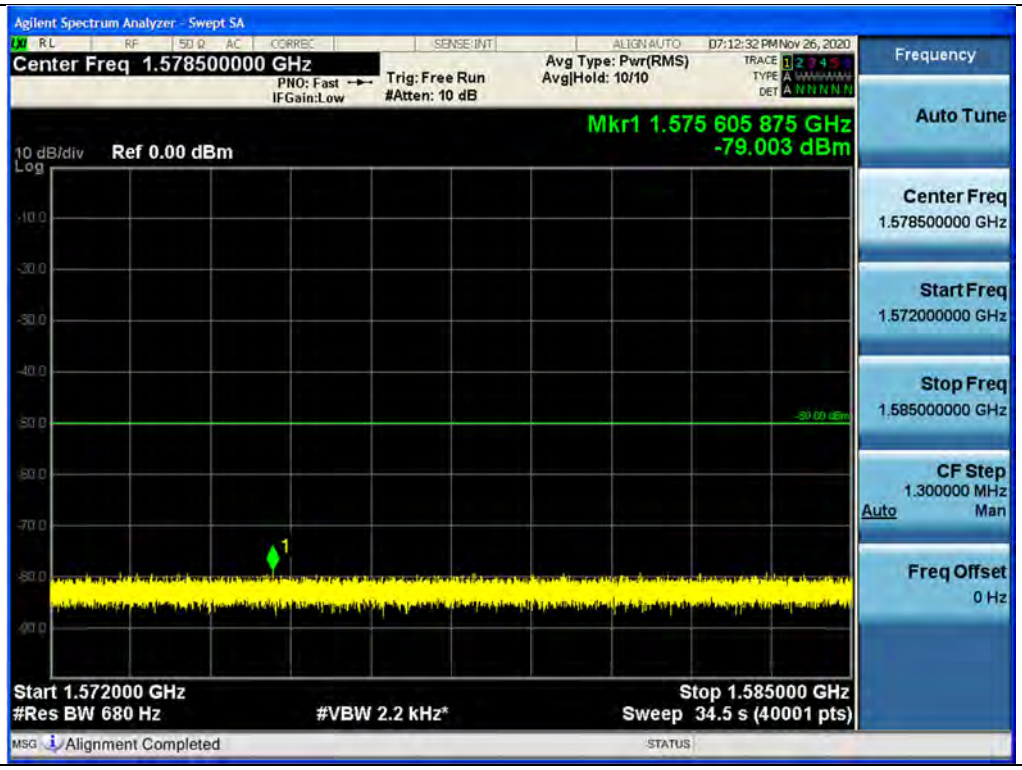
Spurious / PS Narrowband / 1559 ~ 1610 MHz (RBW 700 Hz) (2) /Uplink


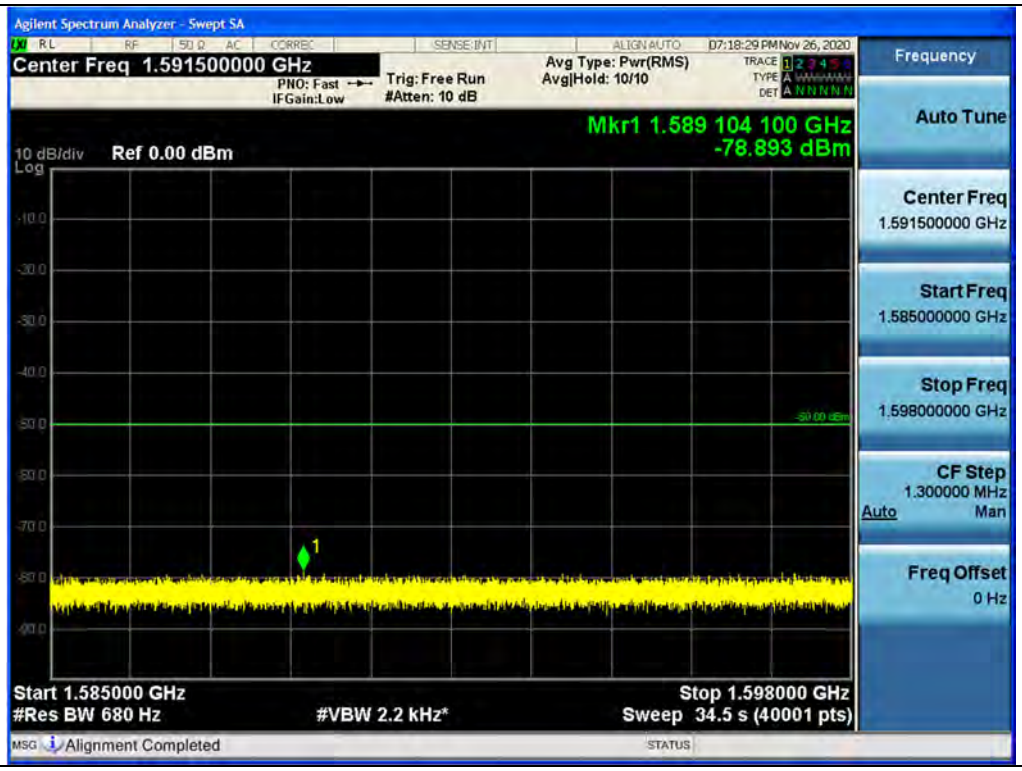
Spurious / PS Narrowband / 1559 ~ 1610 MHz (RBW 700 Hz) (3) /Uplink


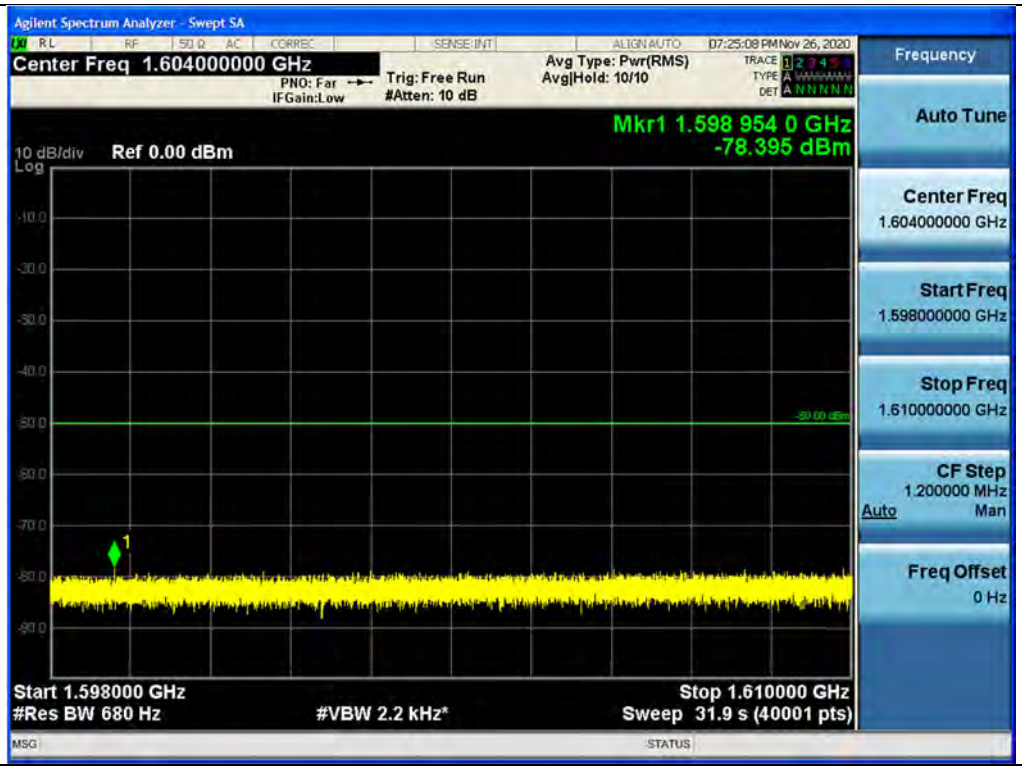
Spurious / PS Narrowband / 1559 ~ 1610 MHz (RBW 700 Hz) (4) / Uplink


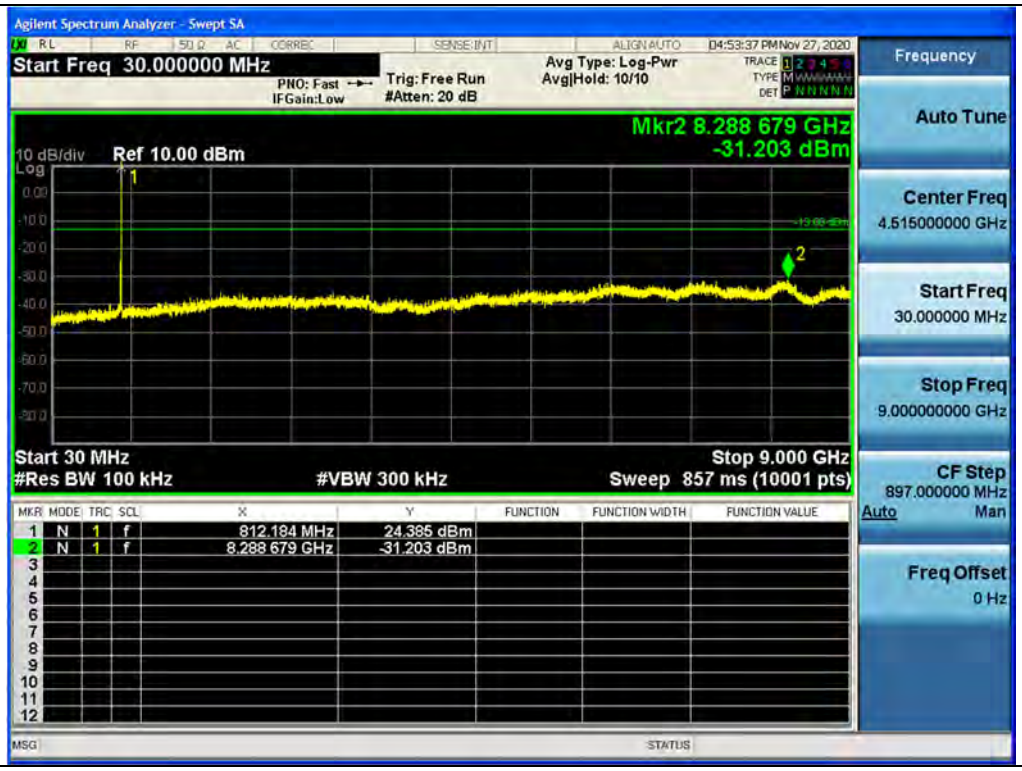
Spurious / PS Narrowband / Downlink


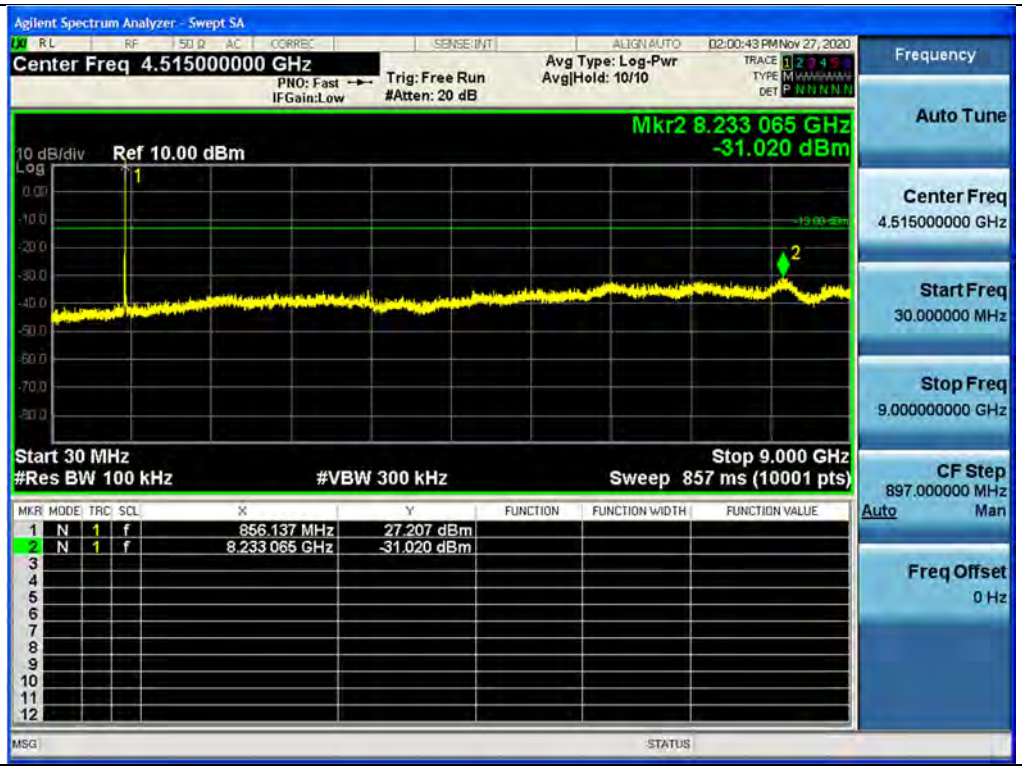
Spurious / PS Narrowband / 1559 ~ 1610 MHz (RBW 700 Hz) (1) / Downlink


Spurious / PS Narrowband / 1559 ~ 1610 MHz (RBW 700 Hz) (2) / Downlink


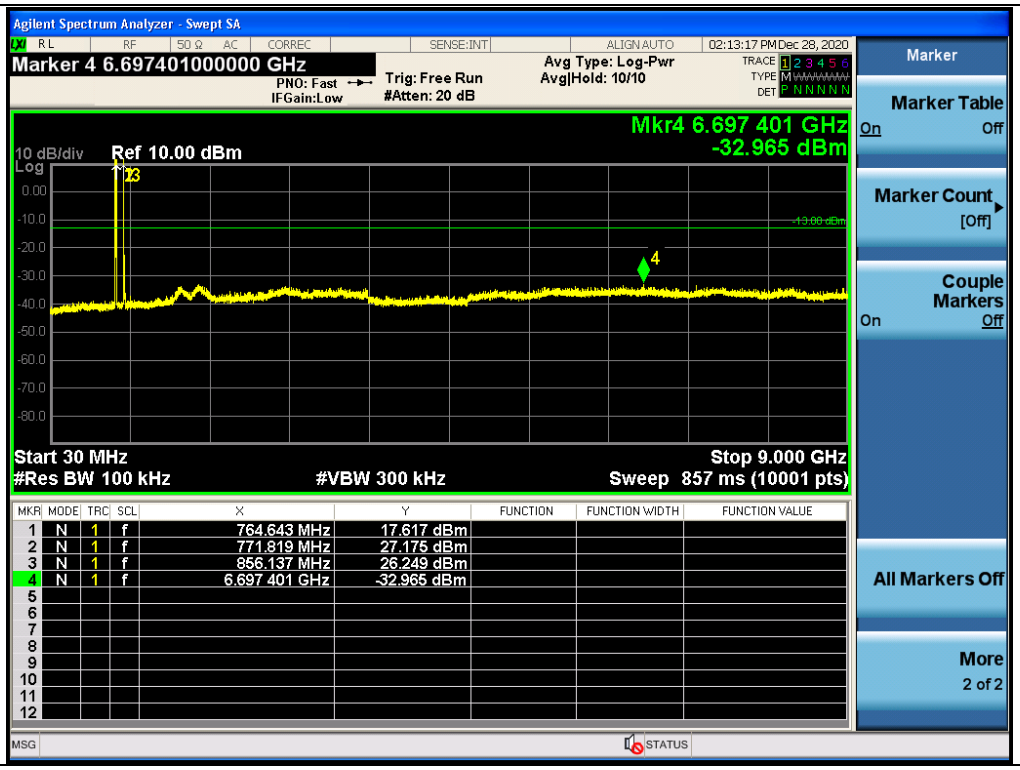
Spurious / PS Narrowband / 1559 ~ 1610 MHz (RBW 700 Hz) (3) / Downlink


Spurious / PS Narrowband / 1559 ~ 1610 MHz (RBW 700 Hz) (4) / Downlink


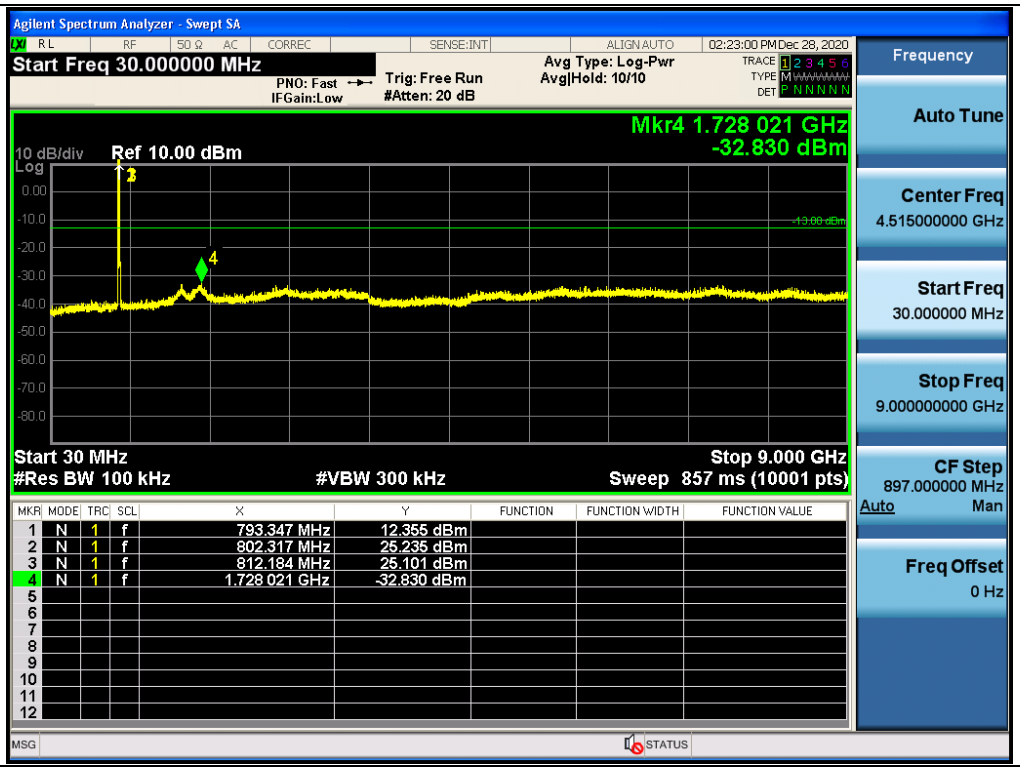
Spurious / SMR / Uplink


Spurious / SMR / Downlink


Simultaneous band emission conditions / DL



Simultaneous band emission conditions / UL



5.8. RADIATED SPURIOUS EMISSIONS

Test Requirements:

§ 2.1053 Measurements required: Field strength of spurious radiation.

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of § 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.

(2) All equipment operating on frequencies higher than 25 MHz.

(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

(4) Other types of equipment as required, when deemed necessary by the Commission.

Test Procedures:

Because KDB 935210 D05 procedure does not provide this requirement, measurements were in accordance with the test methods section 5.5 of ANSI C63.26-2015

a) Place the EUT in the center of the turntable. The EUT shall be configured to transmit into the standard non-radiating load (for measuring radiated spurious emissions), connected with cables of minimal length unless specified otherwise. If the EUT uses an adjustable antenna, the antenna shall be positioned to the length that produces the worst case emission at the fundamental operating frequency.

b) Each emission under consideration shall be evaluated:

1) Raise and lower the measurement antenna in accordance 5.5.2, as necessary to enable detection of the maximum emission amplitude relative to measurement antenna height.

2) Rotate the EUT through 360° to determine the maximum emission level relative to the axial position.

3) Return the turntable to the azimuth where the highest emission amplitude level was observed.

4) Vary the measurement antenna height again through 1 m to 4 m again to find the height associated with the maximum emission amplitude.

5) Record the measured emission amplitude level and frequency using the appropriate RBW.

c) Repeat step b) for each emission frequency with the measurement antenna oriented in both the horizontal and vertical polarizations to determine the orientation that gives the maximum emissions amplitude.

Test Result:

FirstNet_LTE10M_Uplink

Frequency (MHz)	Measured Level (dBuV)	Ant. Factor (dB/m)	C.L (dB)	A. G. (+ 1G H.P.F.) (dB)	Pol.	Measured Power (dBm)	Result (dBm/m)
1,200.36	75.90	25.10	4.25	42.87	V	-19.30	-32.82
1,600.04	61.34	25.10	4.98	42.17	V	-33.86	-45.95
2,000.07	58.32	26.00	5.65	41.49	V	-36.88	-46.72
2,400.11	58.45	27.40	6.27	40.48	V	-36.75	-43.56

* C.L.: Cable Loss / A.G.: Amp. Gain / H.P.F.: High Pass Filter

FirstNet_LTE10M_Downlink

Frequency (MHz)	Measured Level (dBuV)	Ant. Factor (dB/m)	C.L (dB)	A. G. (+ 1G H.P.F.) (dB)	Pol.	Measured Power (dBm)	Result (dBm/m)
1,200.36	75.90	25.10	4.25	42.87	V	-19.30	-32.82
1,600.04	61.40	25.10	4.98	42.17	V	-33.80	-45.89
2,000.07	58.23	26.00	5.65	41.49	V	-36.97	-46.81
2,400.11	59.21	27.40	6.27	40.48	V	-35.99	-42.80

* C.L.: Cable Loss / A.G.: Amp. Gain / H.P.F.: High Pass Filter

PS Narrowband_Uplink

Frequency (MHz)	Measured Level (dBuV)	Ant. Factor (dB/m)	C.L (dB)	A. G. (+ 1G H.P.F.) (dB)	Pol.	Measured Power (dBm)	Result (dBm/m)
1,200.36	76.13	25.10	4.25	42.87	V	-19.07	-32.59
1,600.04	61.86	25.10	4.98	42.17	V	-33.34	-45.43
2,000.07	58.21	26.00	5.65	41.49	V	-36.99	-46.83
2,400.11	58.89	27.40	6.27	40.48	V	-36.31	-43.12

* C.L.: Cable Loss / A.G.: Amp. Gain / H.P.F.: High Pass Filter

PS Narrowband_Downlink

Frequency (MHz)	Measured Level (dBuV)	Ant. Factor (dB/m)	C.L (dB)	A. G. (+ 1G H.P.F.) (dB)	Pol.	Measured Power (dBm)	Result (dBm/m)
1,200.36	76.19	25.10	4.25	42.87	V	-19.01	-32.53
1,600.04	62.65	25.10	4.98	42.17	V	-32.55	-44.64
2,000.07	58.83	26.00	5.65	41.49	V	-36.37	-46.21
2,400.11	59.22	27.40	6.27	40.48	V	-35.98	-42.79

* C.L.: Cable Loss / A.G.: Amp. Gain / H.P.F.: High Pass Filter

SMR_Uplink

Frequency (MHz)	Measured Level (dBuV)	Ant. Factor (dB/m)	C.L (dB)	A. G. (+ 1G H.P.F.) (dB)	Pol.	Measured Power (dBm)	Result (dBm/m)
1,200.36	75.92	25.10	4.25	42.87	V	-19.28	-32.80
1,600.04	63.03	25.10	4.98	42.17	V	-32.17	-44.26
2,000.07	58.37	26.00	5.65	41.49	V	-36.83	-46.67
2,400.11	58.59	27.40	6.27	40.48	V	-36.61	-43.42

* C.L.: Cable Loss / A.G.: Amp. Gain / H.P.F.: High Pass Filter

SMR_Downlink

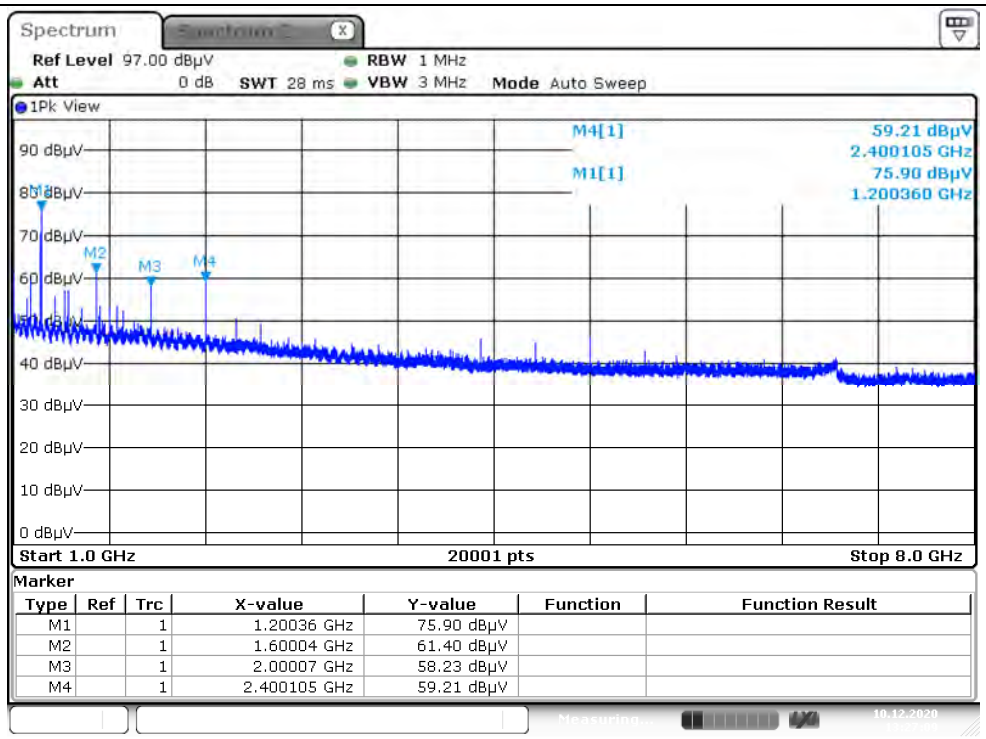
Frequency (MHz)	Measured Level (dBuV)	Ant. Factor (dB/m)	C.L (dB)	A. G. (+ 1G H.P.F.) (dB)	Pol.	Measured Power (dBm)	Result (dBm/m)
1,200.36	76.21	25.10	4.25	42.87	V	-18.99	-32.51
1,600.04	62.64	25.10	4.98	42.17	V	-32.56	-44.65
2,000.07	58.12	26.00	5.65	41.49	V	-37.08	-46.92
2,400.11	57.69	27.40	6.27	40.48	V	-37.51	-44.32

* C.L.: Cable Loss / A.G.: Amp. Gain / H.P.F.: High Pass Filter

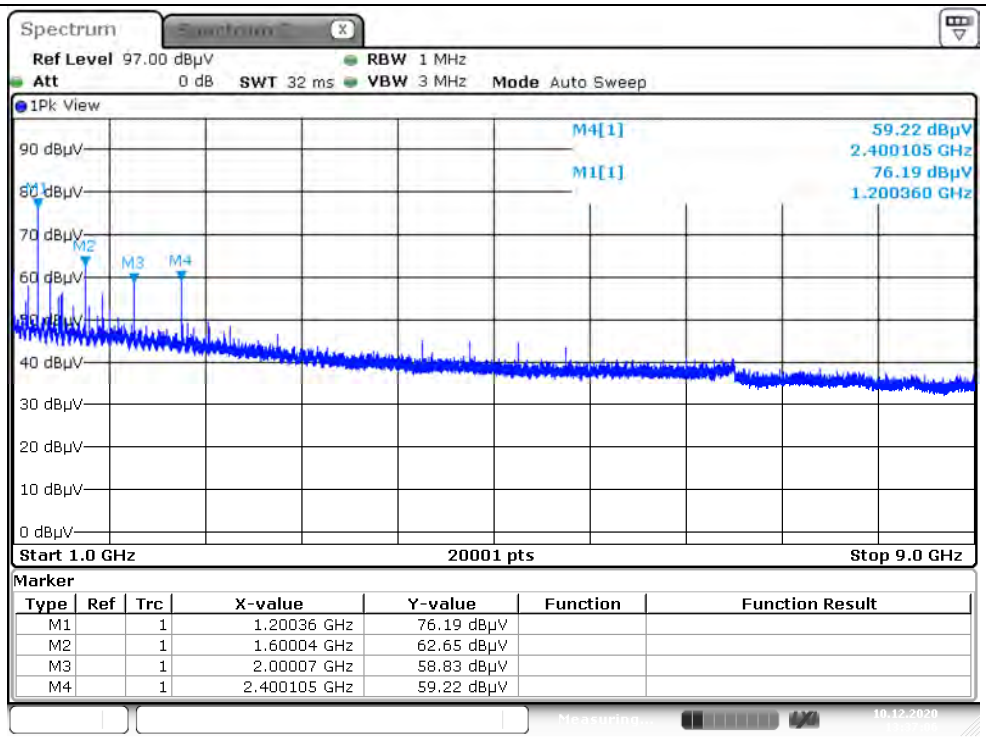
Note1. We have done horizontal and vertical polarization in detecting antenna.
Note2. The amplitude of the spurious domain emission attenuated by more than 20 dB over the permissible value was not recorded according to ANSI C63.26, clause 5.1.1., c).
Note3. Test data were only the worst case.

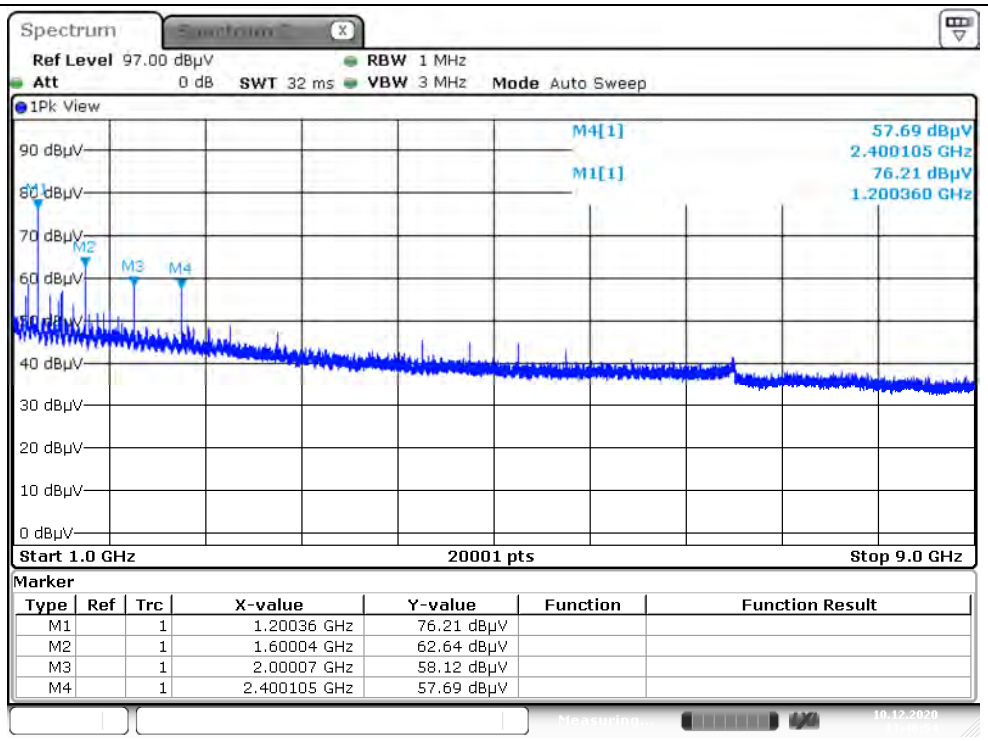
Plot data of radiated spurious emissions

Downlink / FirstNet



Downlink / PS Narrowband



Uplink / SMR


Note : Only the worst case plots for Radiated Spurious Emissions.

6. Annex A_EUT AND TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	HCT-RF-2012-FC042-P