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TEST REPORT

FCC Test for Clear Call
Certification

APPLICANT
GS Instech Co., Ltd.

REPORT NO.
HCT-RF-2011-FC030

DATE OF ISSUE
November 27, 2020

Tested by
Kyung Soo Kang

Technical Manager
Jong Seok Lee

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Additional Model
-

Applicant	**GS Instech Co., Ltd.** 70, Gilpa-ro 71beon-gil, Nam-gu, Inchen, Korea
Product Name	Consumer Cellular Booster
Model Name	Clear Call
FCC ID	U88-CCQ13
Date of Test	April 29, 2020 ~ November 25, 2020
Test Standard Used	CFR 47 Part 2, Part 20, Part 22, Part 24, Part 27

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	November 27, 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	GS Instech Co., Ltd.
Company Address	70, Gilpa-ro 71beon-gil, Nam-gu, Inchen, Korea

1.2. PRODUCT INFORMATION

EUT Type	Consumer Cellular Booster
Power Supply	AC 90 ~ 264V, Output : DC 12V
Frequency Range	Band Name / Uplink (MHz) / Downlink (MHz) Lower 700 MHz / 698 ~ 716 / 728 ~ 746 Upper 700 MHz / 776 ~ 787 / 746 ~ 757 Cellular / 824 ~ 849 / 869 ~ 894 AWS-1 / 1 710 ~ 1 755 / 2 110 ~ 2 155 Broadband PCS / 1 850 ~ 1 915 / 1 930 ~ 1 995
Tx Output Power	Band Name / Uplink (dBm) / Downlink (dBm) Lower 700 MHz / 24 / -1 Upper 700 MHz / 24 / -1 Cellular / 24 / 3 AWS-1 / 27 / -2 Broadband PCS / 25 / 0
Antenna	Donor (AC-D7027P11): LPDA Antenna Service (AC-XD7027-187): Wall Mount Antenna

1.3. TEST INFORMATION

FCC Rule Parts	CFR 47 Part 2, Part 20, Part 22, Part 24, Part 27
Measurement Standards	KDB 935210 D03 v04r04, 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, Part 20, Part 22, Part 24 and Part 27.

Description	Reference	Results
Authorized frequency band verification	§ 20.21(e)(3)	Compliant
Maximum power measurement	§ 20.21(e)(8)(i)(B), § 20.21(e)(8)(i)(D), § 20.21(e)(8)(ii)(B), § 2.1046, § 22.913, § 24.232, § 27.50(b),(c),(d)	Compliant
Maximum booster gain computation	§ 20.21(e)(8)(i)(B), § 20.21(e)(8)(i)(C)(2)	Compliant
Intermodulation product	§ 20.21(e)(8)(i)(F)	Compliant
Out-of-band emissions	§ 20.21(e)(8)(i)(E)	Compliant
Conducted spurious emissions	§ 2.1051, § 22.917, § 24.238, § 27.53(c),(f),(g),(h)	Compliant
Noise limits	§ 20.21(e)(8)(i)(A), § 20.21(e)(8)(i)(H)	Compliant
Uplink inactivity	§ 20.21(e)(8)(i)(I)	Compliant
Variable booster gain	§ 20.21(e)(8)(i)(C)(1), § 20.21(e)(8)(i)(H)	Compliant
Occupied bandwidth	§ 2.1049	Compliant
Oscillation detection	§ 20.21(e)(5), § 20.21(e)(8)(ii)(A)	Compliant
Radiated spurious emissions	§ 2.1053	Compliant

3.2. ADDITIONAL DESCRIPTIONS ABOUT TEST

The test was generally based on the method of KDB 935210 D03 v04r04 and only followed ANSI C63.26-2015 if there was no test method in KDB standard.

The frequency stability measurement has been omitted because EUT does not alter the input signal.
: It can be confirmed through occupied bandwidth test.

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

: Output Path (Direct)

Correction factor table			
Frequency (MHz)	Factor (dB)	Frequency (MHz)	Factor (dB)
600	1.028	1 800	1.894
700	1.120	1 900	1.940
800	1.179	2 000	2.017
900	1.241	2 100	2.015
1 600	1.754	2 200	1.954
1 700	1.666	2 300	1.965

: Coupled Path (Switch Coupled)

Correction factor table			
Frequency (MHz)	Factor (dB)	Frequency (MHz)	Factor (dB)
600	4.452	1 800	5.672
700	4.374	1 900	5.257
800	4.305	2 000	6.298
900	4.374	2 100	5.552
1 600	5.602	2 200	5.906
1 700	5.429	2 300	5.089

: Output Path (20 dB Attenuator)

Correction factor table			
Frequency (MHz)	Factor (dB)	Frequency (MHz)	Factor (dB)
2	20.393	4 000	24.420
10	20.523	4 500	24.499
50	20.772	5 000	24.838
100	20.815	5 500	25.418
200	21.078	6 000	25.814
300	21.416	6 500	25.903
400	21.819	7 000	26.697
500	21.538	7 500	27.253
600	21.859	8 000	27.459
700	22.075	8 500	27.066
800	22.144	9 000	27.725
900	22.239	9 500	27.039
1 000	22.288	10 000	26.549
1 100	22.377	11 000	27.916
1 200	22.687	12 000	27.545
1 300	22.693	13 000	27.989
1 400	22.867	14 000	28.254
1 500	22.872	15 000	28.526
1 600	23.105	16 000	27.908
1 700	23.069	17 000	29.351
1 800	23.325	18 000	29.914
1 900	23.392	19 000	31.066
2 000	23.539	20 000	30.722
2 100	23.579	21 000	31.902
2 200	23.561	22 000	32.047
2 300	23.569	23 000	31.909
2 400	23.563	24 000	34.021
2 500	23.508	25 000	30.670
3 000	24.192	26 000	32.943
3 500	24.570	26 500	33.434

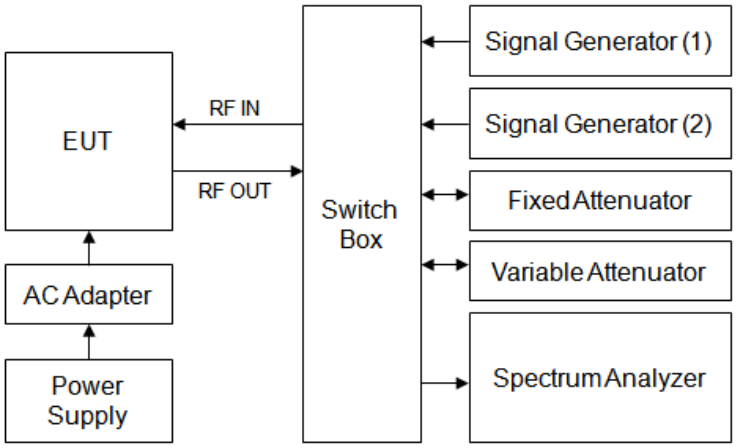
3.3. MEASUREMENTUNCERTAINTY

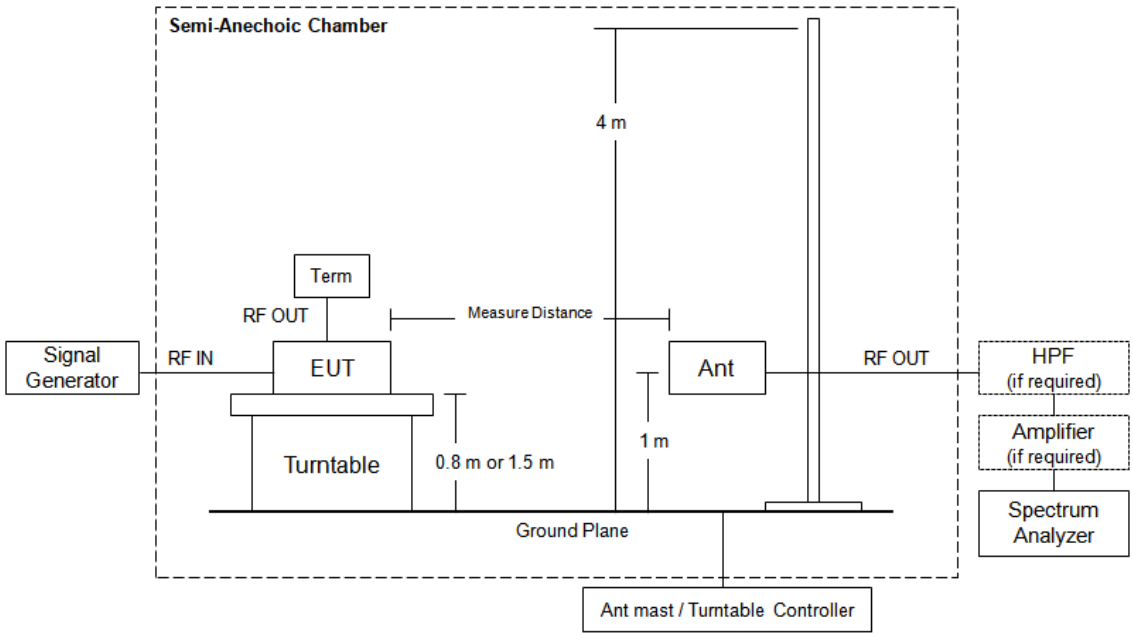
Description	Reference	Results
Authorized frequency band verification	-	±0.58 MHz
Maximum power measurement	-	±0.87 dB
Maximum booster gain computation		
Intermodulation product	-	±1.08 dB
Out-of-band emissions		
Conducted spurious emissions		
Noise limits	-	±0.87 dB
Uplink inactivity	-	±0.01 %
Variable booster gain	-	±0.87 dB
Occupied bandwidth	-	±0.58 MHz
Oscillation detection	-	±0.01 %
Radiated spurious emissions	f ≤ 1 GHz	±4.80 dB
	f > 1 GHz	±6.07 dB

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


※ EUT position is refer to placement of tabletop refer to section 5.5.2.3.1 of ANSI C63.26-2015

4. TEST EQUIPMENTS

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Agilent	N9020A / Spectrum Analyzer	08/18/2020	Annual	MY46471250
Agilent	N5182A / Signal Generator	08/26/2020	Annual	MY50140312
Agilent	N5182A / Signal Generator	12/23/2019	Annual	MY46240523
Changwoo	18N-20 dB / Attenuator	08/31/2020	Annual	4
KEITHLEY	S46 / Switch	N/A	N/A	1088024
HP	Switch Driver	N/A	N/A	3334A11210
HP	Variable Attenuator / 8496G	06/02/2020	Annual	2817A14133
HP	Variable Attenuator / 8494G	06/02/2020	Annual	2813A14121
KIKUSUI	PMR4000M / 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
Emco	2090 / Controller	N/A	N/A	060520
Ets	- / Turn Table	N/A	N/A	N/A
Rohde&Schwarz	- / Loop Antenna	05/18/2020	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	03/22/2019	Biennial	760
Schwarzbeck	BBHA 9120D / Horn Antenna	06/28/2019	Biennial	9120D-1300
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	02/11/2020	Biennial	BBHA9170124
Rohde&Schwarz	FSP / Spectrum Analyzer	09/14/2020	Annual	836650/016
Wainwright Instruments	WHKX10-900-1000-15000-40SS / High Pass Filter	07/13/2020	Annual	5
TNM system	FBSM-05B / HPF(3~18GHz) + LNA1(1~18GHz)	01/21/2020	Annual	F6
TNM system	FBSM-05B / LNA1(1~18GHz)	01/21/2020	Annual	25540
CERNEX	CBL18265035 / Power Amplifier	12/26/2019	Annual	22966
CERNEX	CBL26405040 / Power Amplifier	03/23/2020	Annual	25956

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 RESULTS

5.1. AUTHORIZED FREQUENCY BAND VERIFICATION

Test Requirement:

§ 20.21(e)(3) Frequency Bands.

Consumer Signal Boosters must be designed and manufactured such that they only operate on the frequencies used for the provision of subscriber-based services under parts 22 (Cellular), 24 (Broadband PCS), 27 (AWS-1, 700 MHz Lower A-E Blocks, and 700 MHz Upper C Block), and 90 (Specialized Mobile Radio) of this chapter. The Commission will not certificate any Consumer Signal Boosters for operation on part 90 of this chapter (Specialized Mobile Radio) frequencies until the Commission releases a public notice announcing the date Consumer Signal Boosters may be used in the band.

Test Procedures:

Measurements were in accordance with the test methods section 7.1 of KDB 935210 D03 v04r04.

a) Begin with the uplink output (donor) port connected to the spectrum analyzer.

b) Set the spectrum analyzer resolution bandwidth (RBW) for 100 kHz with the video bandwidth (VBW) ≥ 3 x the RBW, using a PEAK detector with the MAX HOLD function.

c) Set the center frequency of the spectrum analyzer to the center of the operational band under test with a span of 1 MHz.

d) Set the signal generator for CW mode and tune to the center frequency of the operational band under test.

e) Set the initial signal generator power to a level that is at least 6 dB below the AGC level specified by the manufacturer.

f) Slowly increase the signal generator power level until the output signal reaches the AGC operational level.

g) Reduce the signal generator power to a level that is 3 dB below the level noted above, then manually reset the EUT.

h) Reset the spectrum analyzer span to 2 x the width of the CMRS band under test. Adjust the tuned frequency of the signal generator to sweep 2 x the width of the CMRS band using the sweep function. The AGC must be deactivated throughout the entire sweep.

i) Using three markers, identify the CMRS band edges and the frequency with the highest power. Affirm that the values of all markers are visible on the display of the spectrum analyzer (e.g., marker table set to on).

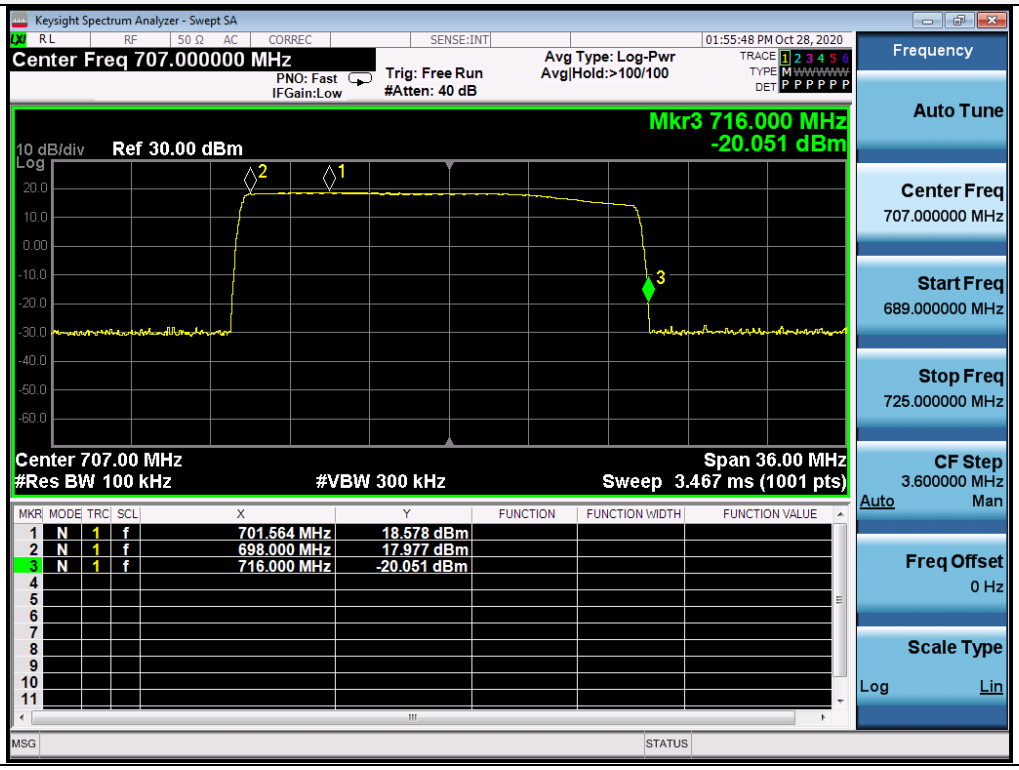
j) Capture the spectrum analyzer trace for inclusion in the test report.

k) Repeat c) to j) for all operational uplink and downlink bands.

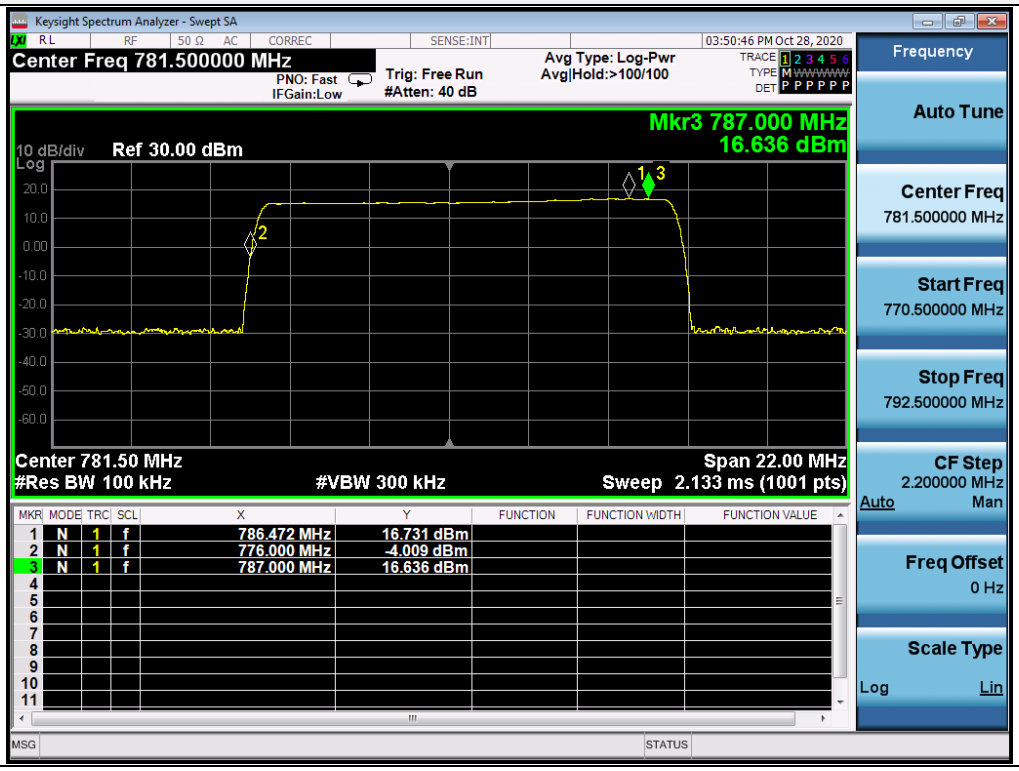
Test Results:

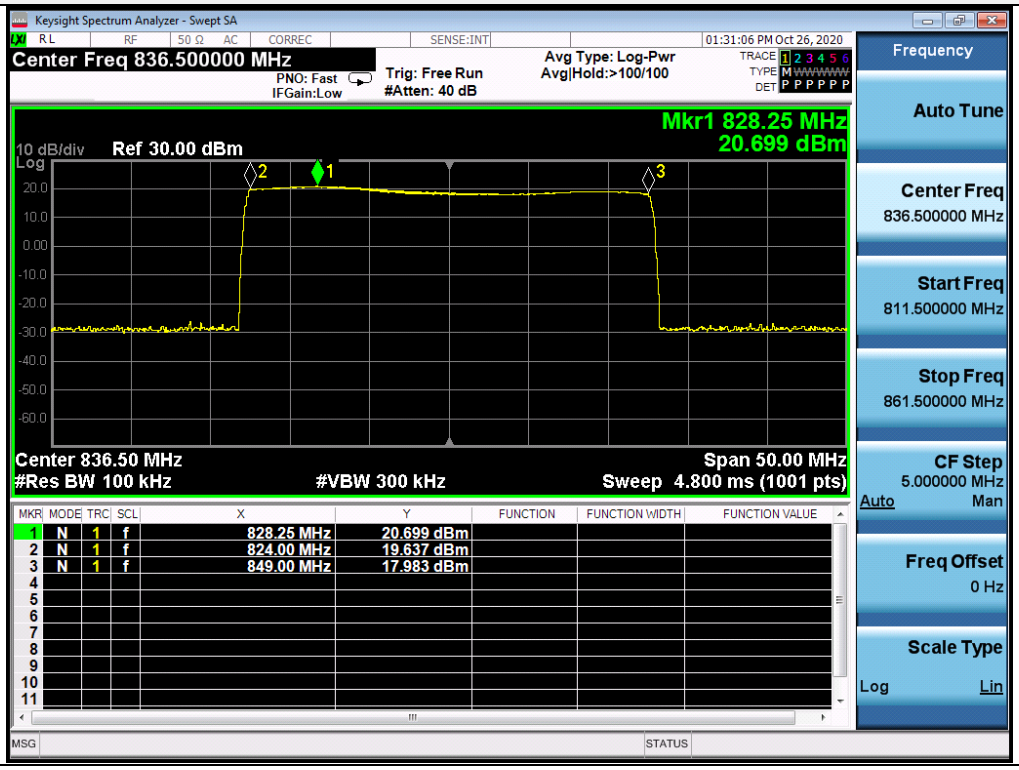
Plot data of Authorized Frequency Band

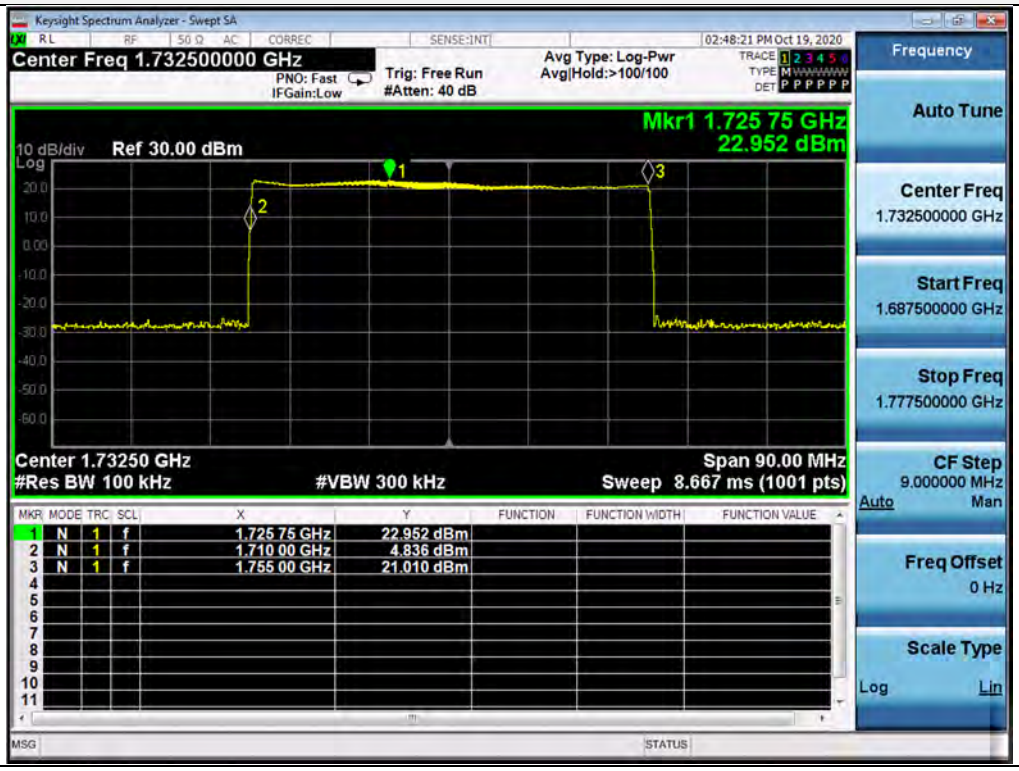
Lower 700 MHz / Uplink

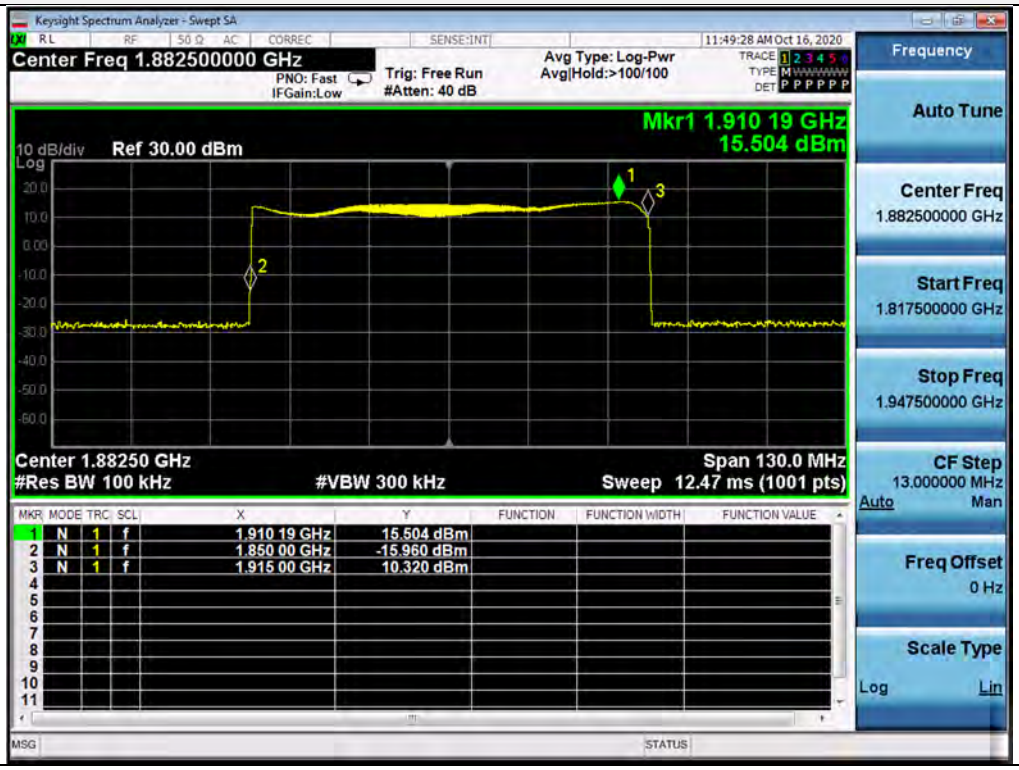


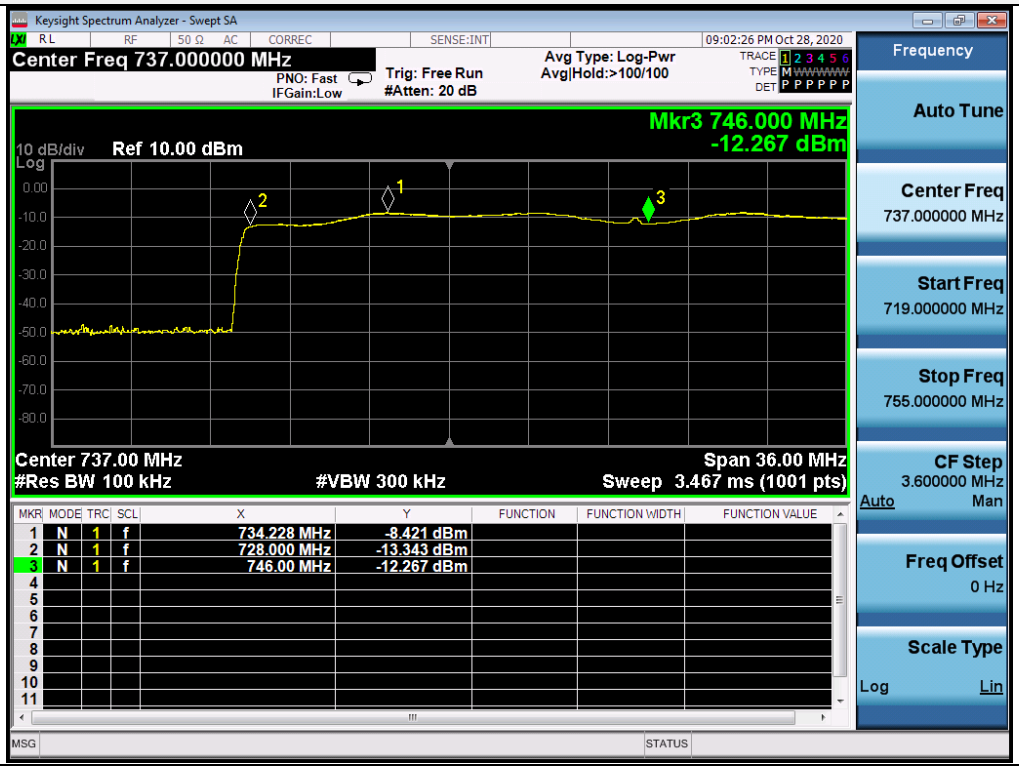
Upper 700 MHz / Uplink



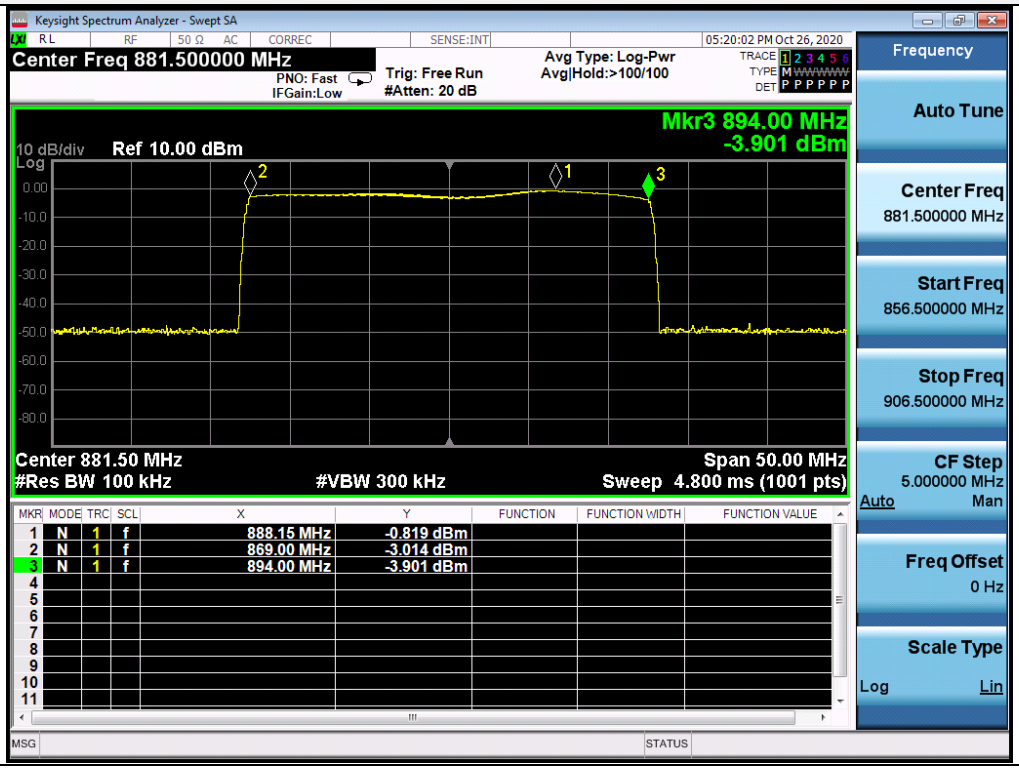
Cellular / Uplink


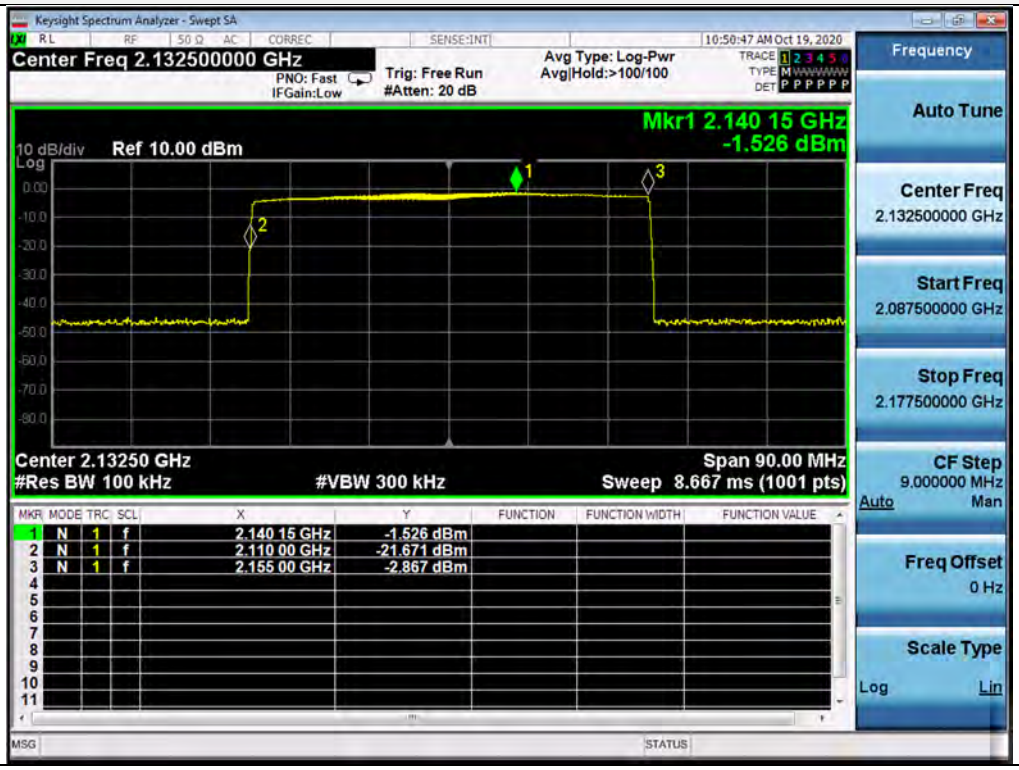
AWS-1 / Uplink


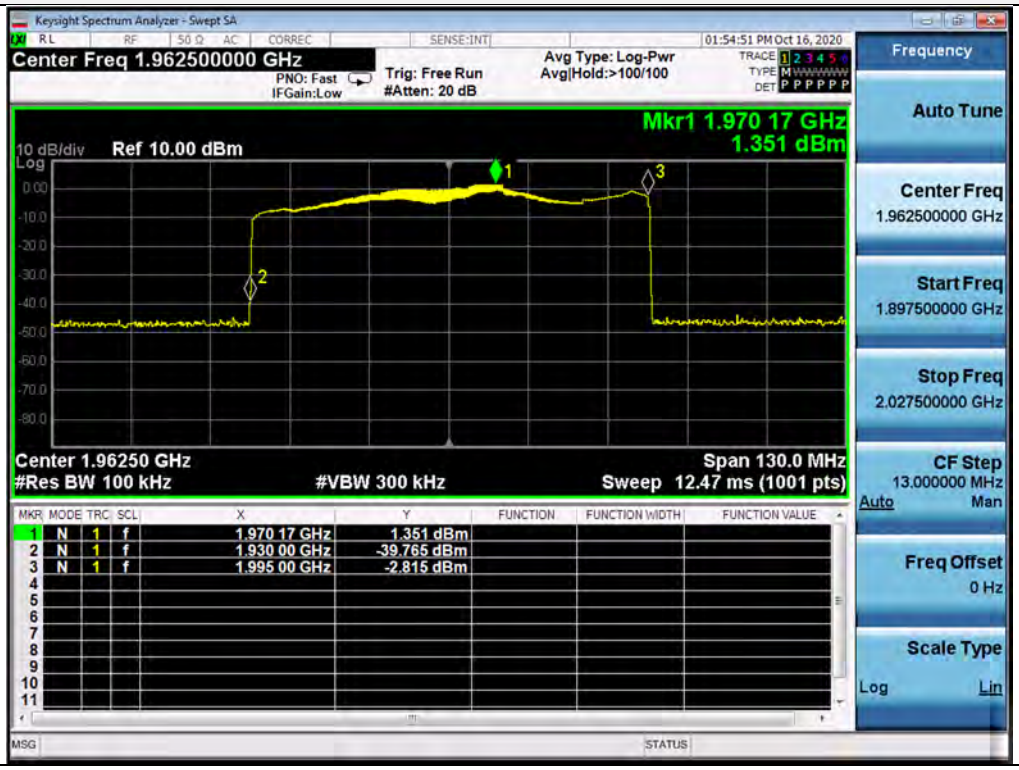
Broadband PCS / Uplink


Lower 700 MHz / Downlink


Upper 700 MHz / Downlink


Cellular / Downlink


AWS-1 / Downlink


Broadband PCS / Downlink


5.2. MAXIMUM POWER MEASUREMENT

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.

§ 20.21(e)(8)(i)(B) Bidirectional Capability

Consumer Boosters must be able to provide equivalent uplink and downlink gain and conducted uplink power output that is at least 0.05 watts. One-way consumer boosters (i.e., uplink only, downlink only, uplink impaired, downlink impaired) are prohibited. Spectrum block filtering may be used provided the uplink filter attenuation is not less than the downlink filter attenuation, and where RSSI is measured after spectrum block filtering is applied referenced to the booster's input port for each band of operation.

§ 20.21(e)(8)(i)(D) Power Limits

A booster's uplink power must not exceed 1 watt composite conducted power and equivalent isotropic radiated power (EIRP) for each band of operation. Composite downlink power shall not exceed 0.05 watt (17 dBm) conducted and EIRP for each band of operation. Compliance with power limits will use instrumentation calibrated in terms of RMS equivalent voltage.

§ 20.21(e)(8)(ii)(B) Gain Control

Consumer boosters must have automatic limiting control to protect against excessive input signals that would cause output power and emissions in excess of that authorized by the Commission.

§ 22.913 Effective radiated power limits.

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

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

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

(i) 500 watts per emission; or

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

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

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

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

§ 24.232 Power and antenna height limits.

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

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

(3) Base station antenna heights may exceed 300 meters HAAT with a corresponding reduction in power; see Tables 3 and 4 of this section. (d) Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of § 24.51. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

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

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

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

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

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

§ 27.50 Power limits and duty cycle.

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

(3) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal in the 746-757 MHz and 776-787 MHz bands with an emission bandwidth 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.

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

(7) Licensees seeking to operate a fixed or base station located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal in the 746-757 MHz and 776-787 MHz bands at an ERP greater than 1000 watts must:

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

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

(11) For transmissions in the 757-758, 775-776, 787-788, and 805-806 MHz bands, 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.

(12) For transmissions in the 746-757 and 776-787 MHz bands, licensees may employ equipment operating in compliance with either the measurement techniques described in paragraph (b)(11) of this section or a Commission-approved average power technique. In both instances, equipment employed must be authorized in accordance with the provisions of § 27.51.

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

(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 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;

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

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

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

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

(11) Licensees may employ equipment operating in compliance with either the measurement techniques described in paragraph (b)(11) of this section or a Commission-approved average power technique. In both instances, equipment employed must be authorized in accordance with the provisions of § 27.51.

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

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

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

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

Table 2 to § 27.50—Permissible Power and Antenna Heights for Base and Fixed Stations in the 600 MHz, 698-757 MHz, 758-763 MHz, 776-787 MHz and 788-793 MHz Bands 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 4 to § 27.50—Permissible Power and Antenna Heights for Base and Fixed Stations in the 600 MHz, 698-757 MHz, 758-763 MHz, 776-787 MHz and 788-793 MHz Bands 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

Test Procedures:

Measurements were in accordance with the test methods section 7.2 of KDB 935210 D03 v04r04.

a) Begin with the uplink output (donor) port connected to the spectrum analyzer.

b) Configure the signal generator and spectrum analyzer for operation on the frequency determined in authorized frequency band verification test with the highest power level, but with the center frequency of the signal no closer than 2.5 MHz from the band edge. The spectrum analyzer span shall be set to at least 10 MHz.

c) Set the initial signal generator power to a level well below that which causes AGC activation.

d) Slowly increase the signal generator power level until the output signal reaches the AGC operational limit.

e) Reduce power sufficiently on the signal generator to ensure that the AGC is not controlling the power output.

f) Slowly increase the signal generator power to a level just below (and within 0.5 dB of) the AGC limit without triggering the AGC. Note the signal generator power level as P_{in}.

g) Measure the output power, P_{out}, with the spectrum analyzer as follows.

1) Set RBW = 100 kHz for AWGN signal type, or 300 kHz for CW or GSM signal type.

2) Set VBW ≥ 3 x RBW.

3) Select either the BURST POWER or CHANNEL POWER measurement mode, as required for each signal type. For AWGN, the channel power integration bandwidth shall be the 99% OBW of the 4.1 MHz signal.

4) Select the power averaging (rms) detector.

5) Affirm that the number of measurement points per sweep ≥ (2 x span)/RBW.

6) Set sweep time = auto couple, or as necessary (but no less than auto couple value).

7) Trace average at least 100 traces in power averaging (i.e., rms) mode.

8) Record the measured power level P_{out}, with one set of results for the GSM or CW input stimulus, and another set of results for the AWGN input stimulus.

h) Repeat step g) while increasing

the signal generator amplitude in 2 dB steps until the maximum input level indicated in maximum transmitter test input level is reached. If the booster has shut down at any point during the input power steps, it should be noted and step g) shall be repeated at an input level 1 dB less than that found to cause the shutdown. The test report shall include either a statement describing that the device complies at 10 dB above AGC or at the maximum transmitter power levels, or a table showing compliance at the additional input power(s) required.

i) Repeat the entire procedure for each operational uplink and downlink frequency band supported by the booster.

j) Provide tabulated results in the test report.

Note1. Test limits apply the worst value of all applicable rule part.

- § 20.21(e)(8)(i)(B): Conducted uplink power output that is at least 0.05 watt (16.99 dBm).
- § 20.21(e)(8)(i)(D): Uplink power must not exceed 1 watt (30 dBm) for EIRP and conducted output.
  Downlink power shall not exceed 0.05 watt (17 dBm) for EIRP and conducted output.

Note2. Coupling Gain is calculated according to following formula.

Coupled Gain = Antenna gain - Cable loss

Note3. Maximum Coupling Gain of each band is shown in the table below.

Port	Frequency (MHz)	Ant. Gain (dBi)	Cable length (ft)	Cable Loss (dB)	Coupled Gain (dB)
Donor	707	9	100	3.37	5.63
	781.5	9	100	3.63	5.37
	836.5	9	100	3.77	5.23
	1732.5	11	100	5.50	5.50
	1882.5	11	100	5.85	5.15
Server	737	5	75	2.63	2.37
	751.5	5	75	2.63	2.37
	881.5	5	75	2.93	2.07
	2132.5	5	75	4.50	0.50
	1962.5	5	75	4.62	0.38

* Donor Antenna gain is in accordance with specification.

* Server Antenna gain is quoted from measurements provide by vendor.

Note4. Following test signal is used according to KDB 935210 D02 v04r03.

Signal	Detail	Measuring function
Pulsed GSM	GSM signal with a pulse width of 570 μs and a duty cycle of 12.5%	burst power
4.1 MHz AWGN	AWGN signal with a 99% occupied bandwidth of 4.1 MHz	channel power

Note5. Following switch loss is corrected in signal generating.

Band	Uplink generating loss (dB)	Downlink generating loss (dB)
Lower 700 MHz	0.87	0.87
Upper 700 MHz	0.92	0.80
Cellular	0.85	0.88
AWS-1	1.33	1.58
Broadband PCS	1.35	1.35

Note6. In test using pulse GSM signal, shutdown is occurred when input level is increased to 3 dB from AGC threshold. Because of it pulsed GSM power measurement is performed only up to 2 dB.

Note7. PAPR of each rule part is tested about AWGN signal.

Note8. EIRP is calculated according to following formula.

EIRP = Conducted Output Power + Coupling Gain

Test Results:

Tabulated Result of Uplink Maximum Power (AGC Threshold input level)

Band	Frequency (MHz)	Input Signal	P_{in}(dBm)	Low Power Limit (dBm)	EIRP Limit (dBm)	Coupling Gain (dB)	P_{out} (dBm)	EIRP(dBm)
Lower 700 MHz	701.564	Pulse GSM	-33.50	16.99	30	5.63	19.33	24.96
		4.1 MHz AWGN	-35.80				17.24	22.87
Upper 700 MHz	784.500	Pulse GSM	-37.56			5.37	19.16	24.53
		4.1 MHz AWGN	-39.56				17.41	22.78
Cellular	828.250	Pulse GSM	-37.50			5.23	19.82	25.05
		4.1 MHz AWGN	-39.00				17.38	22.61
AWS-1	1 725.750	Pulse GSM	-43.20			5.50	24.22	29.72
		4.1 MHz AWGN	-44.80				21.80	27.30
Broadband PCS	1 910.190	Pulse GSM	-42.90			5.15	20.50	25.65
		4.1 MHz AWGN	-42.00				18.99	24.14

Tabulated Result of Uplink Maximum Power (AGC Threshold +10 / +2 dB input level)

Band	Frequency (MHz)	Input Signal	P_{in}(dBm)	Low Power Limit (dBm)	EIRP Limit (dBm)	Coupling Gain (dB)	P_{out} (dBm)	EIRP(dBm)
Lower 700 MHz	701.564	Pulse GSM	-23.50	16.99	30	5.63	19.89	25.52
		4.1 MHz AWGN	-25.80				17.28	22.91
Upper 700 MHz	784.500	Pulse GSM	-27.56			5.37	19.68	25.05
		4.1 MHz AWGN	-29.56				17.22	22.59
Cellular	828.250	Pulse GSM	-27.50			5.23	19.60	24.83
		4.1 MHz AWGN	-29.00				17.84	23.07
AWS-1	1 725.750	Pulse GSM	-33.20			5.50	24.33	29.83
		4.1 MHz AWGN	-34.80				19.84	25.34
Broadband PCS	1 910.190	Pulse GSM	-32.90			5.15	20.74	25.89
		4.1 MHz AWGN	-32.00				18.52	23.67

Tabulated Result of Downlink Maximum Power (AGC Threshold input level)

Band	Frequency (MHz)	Input Signal	P_{in}(dBm)	Power Limit (dBm)	Coupling Gain (dB)	P_{out} (dBm)	EIRP(dBm)
Lower 700 MHz	734.228	Pulse GSM	-59.50	17	2.37	-1.50	0.87
		4.1 MHz AWGN	-62.50			-4.84	-2.47
Upper 700 MHz	750.246	Pulse GSM	-61.00			-2.67	-0.30
		4.1 MHz AWGN	-64.00			-6.31	-3.94
Cellular	888.150	Pulse GSM	-58.00		2.07	2.73	4.80
		4.1 MHz AWGN	-61.00			0.19	2.26
AWS-1	2 140.150	Pulse GSM	-71.00		0.50	-1.97	-1.47
		4.1 MHz AWGN	-73.50			-4.33	-3.83
Broadband PCS	1 970.170	Pulse GSM	-63.70		0.38	1.73	2.11
		4.1 MHz AWGN	-63.00			-0.80	-0.42

Tabulated Result of Downlink Maximum Power (AGC Threshold +10 / +2 dB input level)

Band	Frequency (MHz)	Input Signal	P_{in}(dBm)	Power Limit (dBm)	Coupling Gain (dB)	P_{out} (dBm)	EIRP(dBm)
Lower 700 MHz	734.228	Pulse GSM	-49.50	17	2.37	-1.48	0.89
		4.1 MHz AWGN	-52.50			-6.06	-3.69
Upper 700 MHz	750.246	Pulse GSM	-51.00			-3.54	-1.17
		4.1 MHz AWGN	-54.00			-6.03	-3.66
Cellular	888.150	Pulse GSM	-48.00		2.07	2.16	4.23
		4.1 MHz AWGN	-51.00			-1.20	0.87
AWS-1	2 140.150	Pulse GSM	-61.00		0.50	-1.84	-1.34
		4.1 MHz AWGN	-63.50			-4.23	-3.73
Broadband PCS	1 970.170	Pulse GSM	-53.70		0.38	1.70	2.08
		4.1 MHz AWGN	-53.00			-0.87	-0.49

Tabulated result of Uplink PAPR

Band	Frequency (MHz)	Limit (dB)	PAPR (dB)
Lower 700 MHz	701.564	13	8.17
Upper 700 MHz	784.500		8.36
Cellular	828.250		8.41
AWS-1	1 725.750		8.76
Broadband PCS	1 910.190		8.73

Tabulated result of Downlink PAPR

Band	Frequency (MHz)	Limit (dB)	PAPR (dB)
Lower 700 MHz	734.228	13	8.45
Upper 700 MHz	750.246		8.41
Cellular	888.150		8.59
AWS-1	2 140.150		8.54
Broadband PCS	1 970.170		8.64

5.3. MAXIMUM BOOSTER GAIN COMPUTATION

Test Requirement:

§ 20.21(e)(8)(i)(B) Bidirectional Capability

Consumer Boosters must be able to provide equivalent uplink and downlink gain and conducted uplink power output that is at least 0.05 watts. One-way consumer boosters (i.e., uplink only, downlink only, uplink impaired, downlink impaired) are prohibited. Spectrum block filtering may be used provided the uplink filter attenuation is not less than the downlink filter attenuation, and where RSSI is measured after spectrum block filtering is applied referenced to the booster's input port for each band of operation.

§ 20.21(e)(8)(i)(C)(2) Booster Gain Limits

The uplink and downlink maximum gain of a Consumer Booster referenced to its input and output ports shall not exceed the following limits:

(i) Fixed Booster maximum gain shall not exceed 6.5 dB + 20 Log_{10} (Frequency)

(ii) Where, Frequency is the uplink mid-band frequency of the supported spectrum bands in MHz.

(iii) Mobile Booster maximum gain shall not exceed 50 dB when using an inside antenna (e.g., inside a vehicle), 23 dB when using direct contact coupling (e.g., cradle-type boosters), or 15 dB when directly connected (e.g., boosters with a physical connection to the phone).

Test Procedures:

Measurements were in accordance with the test methods section 7.3 of KDB 935210 D03 v04r04.

a) Calculate the maximum gain of the booster as follows to demonstrate compliance to the applicable gain limits as specified.

b) For both the uplink and downlink in each supported frequency band, use each of the Pout and Pin result pairs for all signal types used in maximum power measurement test in the following equation to obtain the maximum gain, G:

$$G\ (dB) = P_{out}\ (dBm) - P_{in}\ (dBm).$$

c) Record the maximum gain of the uplink and downlink paths for each supported frequency band, and verify that the each gain value complies with the applicable limit.

d) Provide tabulated results in the test report.

Note1. Test limits were applied as follows.

- § 20.21(e)(8)(i)(B): Consumer Boosters must be able to provide equivalent uplink and downlink gain.
  : 9 dB equivalent gain margin is applied by note 17 of section 7.3 in KDB 935210 D03.
- § 20.21(e)(8)(i)(C)(2): Mobile booster maximum gain shall not exceed 50 dB.

Test Results:

Tabulated Result of Uplink Booster Gain

Band	Frequency (MHz)	Input Signal	Pin(dBm)	Pout (dBm)	Limit (dB)	Gain (dB)
Lower 700 MHz	701.564	Pulse GSM	-33.50	19.33	63.49	52.83
		4.1 MHz AWGN	-35.80	17.24		53.04
Upper 700 MHz	784.500	Pulse GSM	-37.56	19.16	64.36	56.72
		4.1 MHz AWGN	-39.56	17.41		56.97
Cellular	828.250	Pulse GSM	-37.50	19.82	64.95	57.32
		4.1 MHz AWGN	-39.00	17.38		56.38
AWS-1	1 725.750	Pulse GSM	-43.20	24.22	71.27	67.42
		4.1 MHz AWGN	-44.80	21.80		66.60
Broadband PCS	1 910.190	Pulse GSM	-42.90	20.50	71.99	63.40
		4.1 MHz AWGN	-42.00	18.99		60.99

Tabulated Result of Downlink Booster Gain

Band	Frequency (MHz)	Input Signal	P_{in}(dBm)	P_{out} (dBm)	Limit (dB)	Gain (dB)
Lower 700 MHz	734.228	Pulse GSM	-59.50	-1.50	63.85	58.00
		4.1 MHz AWGN	-62.50	-4.84		57.66
Upper 700 MHz	750.246	Pulse GSM	-61.00	-2.67	64.02	58.33
		4.1 MHz AWGN	-64.00	-6.31		57.69
Cellular	888.150	Pulse GSM	-58.00	2.73	65.40	60.73
		4.1 MHz AWGN	-61.00	0.19		61.19
AWS-1	2 140.150	Pulse GSM	-71.00	-1.97	73.08	69.03
		4.1 MHz AWGN	-73.50	-4.33		69.17
Broadband PCS	1 970.170	Pulse GSM	-63.70	1.73	72.36	65.43
		4.1 MHz AWGN	-63.00	-0.80		62.20

Tabulated Result of Uplink and Downlink Gain Comparison

Band	Input Signal	UL Gain (dB)	DL Gain (dB)	Limit (dB)	Difference (dB)
Lower 700 MHz	Pulse GSM	52.83	58.00	9	5.17
	4.1 MHz AWGN	53.04	57.66		4.62
Upper 700 MHz	Pulse GSM	56.72	58.33		1.61
	4.1 MHz AWGN	56.97	57.69		0.72
Cellular	Pulse GSM	57.32	60.73		3.40
	4.1 MHz AWGN	56.38	61.19		4.81
AWS-1	Pulse GSM	67.42	69.03		1.60
	4.1 MHz AWGN	66.60	69.17		2.57
Broadband PCS	Pulse GSM	63.40	65.43		2.03
	4.1 MHz AWGN	60.99	62.20		1.20

5.4. INTERMODULATION-PRODUCT

Test Requirement:

§ 20.21(e)(8)(i)(F) Intermodulation Limits.

The transmitted intermodulation products of a consumer booster at its uplink and downlink ports shall not exceed the power level of -19 dBm for the supported bands of operation. Compliance with intermodulation limits will use boosters operating at maximum gain and maximum rated output power, with two continuous wave (CW) input signals spaced 600 kHz apart and centered in the pass band of the booster, and with a 3 kHz measurement bandwidth.

Test Procedures:

Measurements were in accordance with the test methods section 7.4 of KDB 935210 D03 v04r04.

a) Begin with the uplink output (donor) port connected to the spectrum analyzer.

b) Set the spectrum analyzer RBW = 3 kHz.

c) Set the VBW ≥ 3 x RBW.

d) Select the rms detector.

e) Set the spectrum analyzer center frequency to the center of the supported operational band under test.

f) Set the span to 5 MHz. Affirm that the number of measurement points per sweep ≥ (2 × span)/RBW.

g) Configure the two signal generators for CW operation with generator #1 tuned 300 kHz below the operational band center frequency and generator #2 tuned 300 kHz above the operational band center frequency. If the maximum output power is not at the operational-band (booster pass band) center frequency, configure the test signal pair around the frequency with maximum output power as determined per maximum power measurement test.

h) Set the signal generator amplitudes so that the power from each into the RF combiner is equivalent, then turn on the RF output.

i) Simultaneously increase each signal generators' amplitude equally until just before the EUT begins AGC, then affirm that all intermodulation-product emissions are below the specified limit of -19 dBm.

j) Use the trace averaging function of the spectrum analyzer, and wait for the trace to stabilize. Place a marker at the highest amplitude intermodulation-product emission.

k) Record the maximum intermodulation product amplitude level that is observed.

l) Capture the spectrum analyzer trace for inclusion in the test report.

m) Repeat e) to l) for all uplink and downlink operational bands.

n) Increase the signal generator amplitude in 2 dB steps to 10 dB above the AGC threshold determined in i), but not exceeding the maximum input level of maximum transmitter test input, to affirm that the EUT maintains compliance with the intermodulation limit.

Note1. Limits were applied -19 dBm by § 20.21(e)(8)(i)(F)

Note2. Test is performed using one signal generator of two tone generation function.

Test Results:

Tabulated Result of Uplink Intermodulation

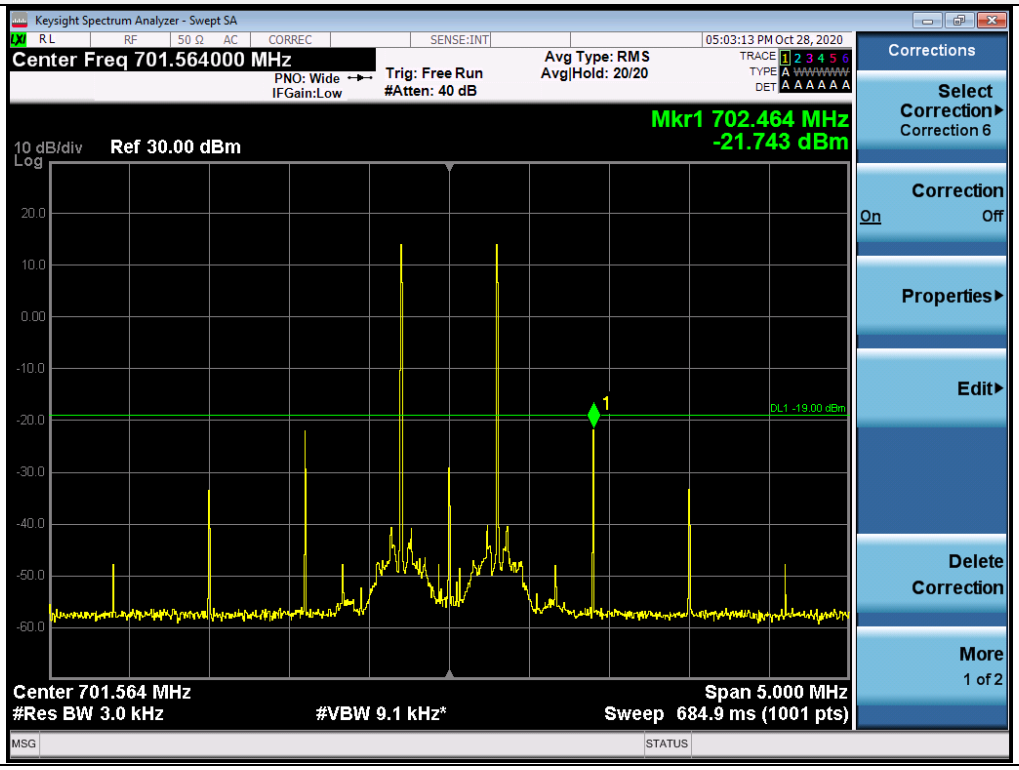
Band	Input level	Frequency (MHz)	Limit (dBm)	Intermodulation (dBm)
Lower 700 MHz	AGC threshold	702.464	-19	-21.743
	AGC threshold +10 dB	702.464		-19.023
Upper 700 MHz	AGC threshold	785.400		-25.197
	AGC threshold +10 dB	783.600		-24.148
Cellular	AGC threshold	829.150		-23.373
	AGC threshold +10 dB	827.350		-23.361
AWS-1	AGC threshold	1 725.750		-22.599
	AGC threshold +10 dB	1 725.750		-22.802
Broadband PCS	AGC threshold	1 909.290		-23.385
	AGC threshold +10 dB	1 909.290		-23.040

Tabulated Result of Downlink Intermodulation

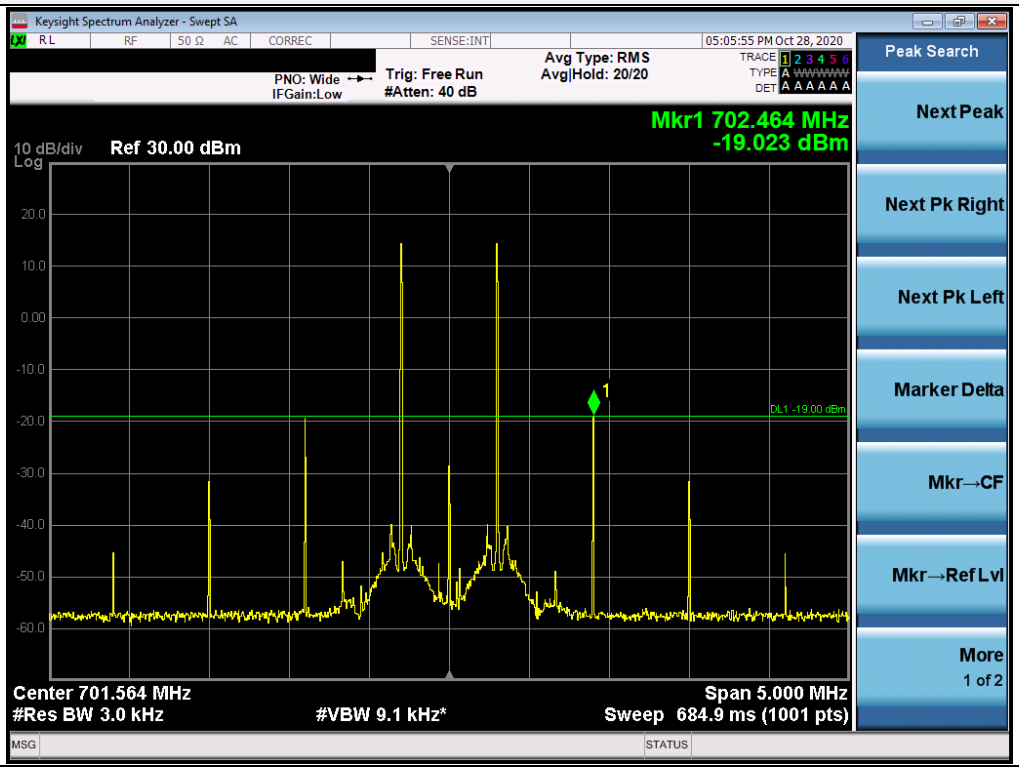
Band	Input level	Frequency (MHz)	Limit (dBm)	Intermodulation (dBm)
Lower 700 MHz	AGC threshold	734.228	-19	-57.763
	AGC threshold +10 dB	734.228		-58.552
Upper 700 MHz	AGC threshold	750.246		-56.488
	AGC threshold +10 dB	750.246		-57.626
Cellular	AGC threshold	888.150		-48.335
	AGC threshold +10 dB	888.150		-49.158
AWS-1	AGC threshold	2 140.150		-40.616
	AGC threshold +10 dB	2 140.150		-40.457
Broadband PCS	AGC threshold	1 970.170		-45.393
	AGC threshold +10 dB	1 970.170		-45.231

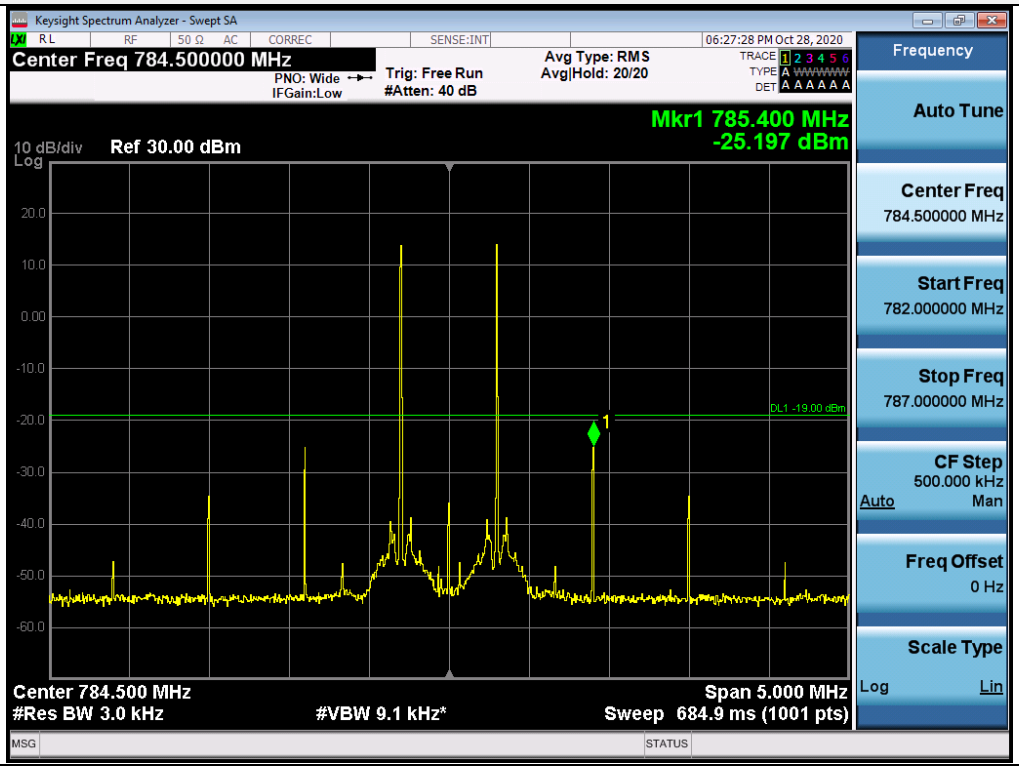
Plot data of Intermodulation

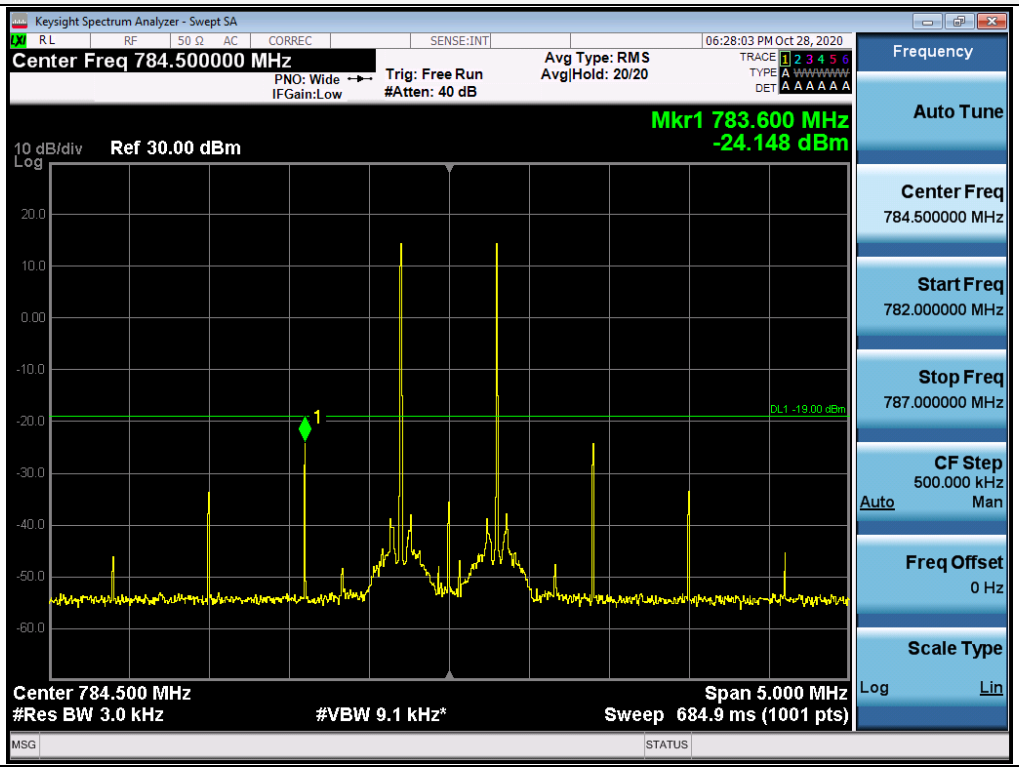
Intermodulation / Lower 700 MHz / Uplink / AGC threshold

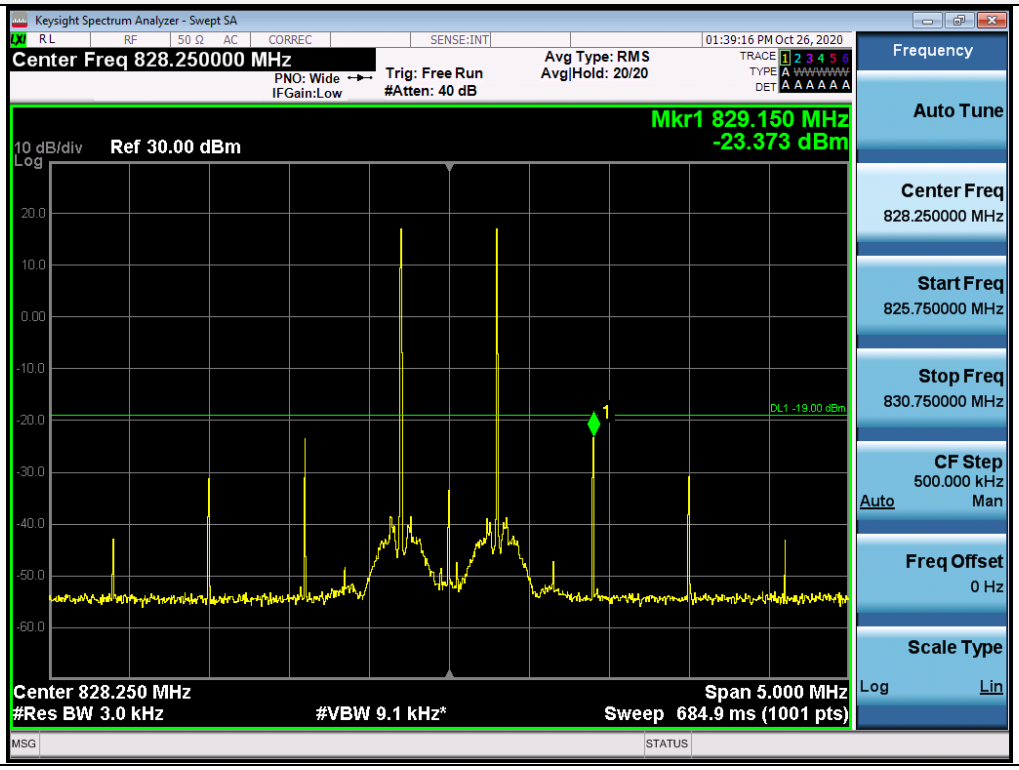


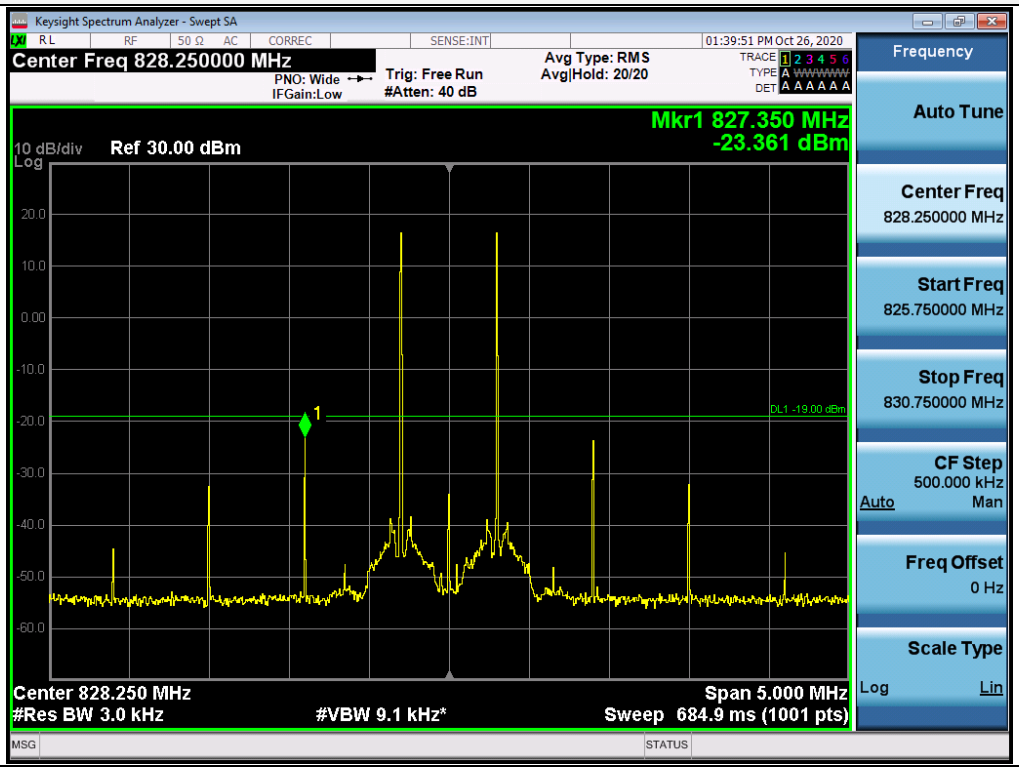
Intermodulation / Lower 700 MHz / Uplink / AGC threshold +10 dB

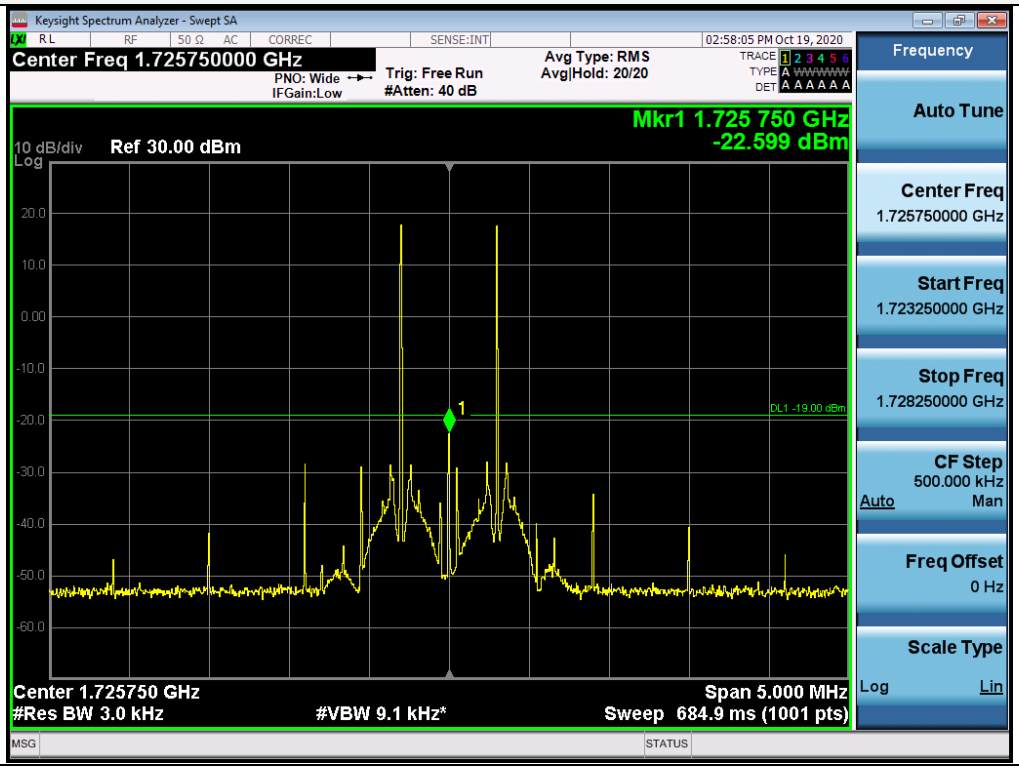


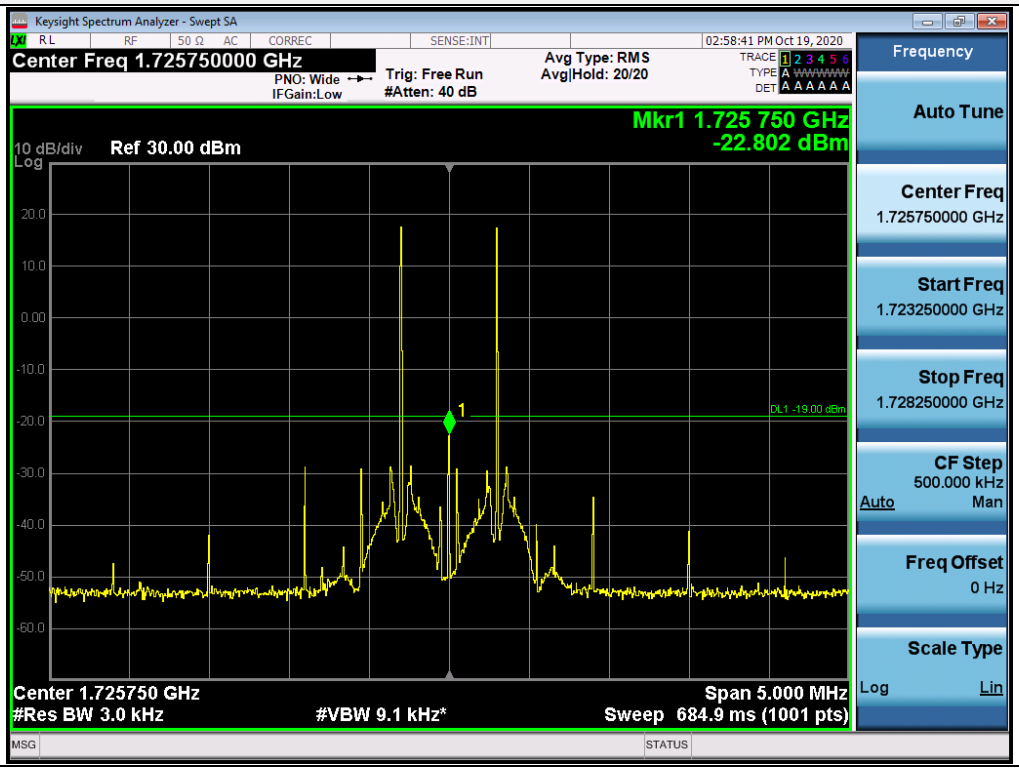
Intermodulation / Upper 700 MHz / Uplink / AGC threshold


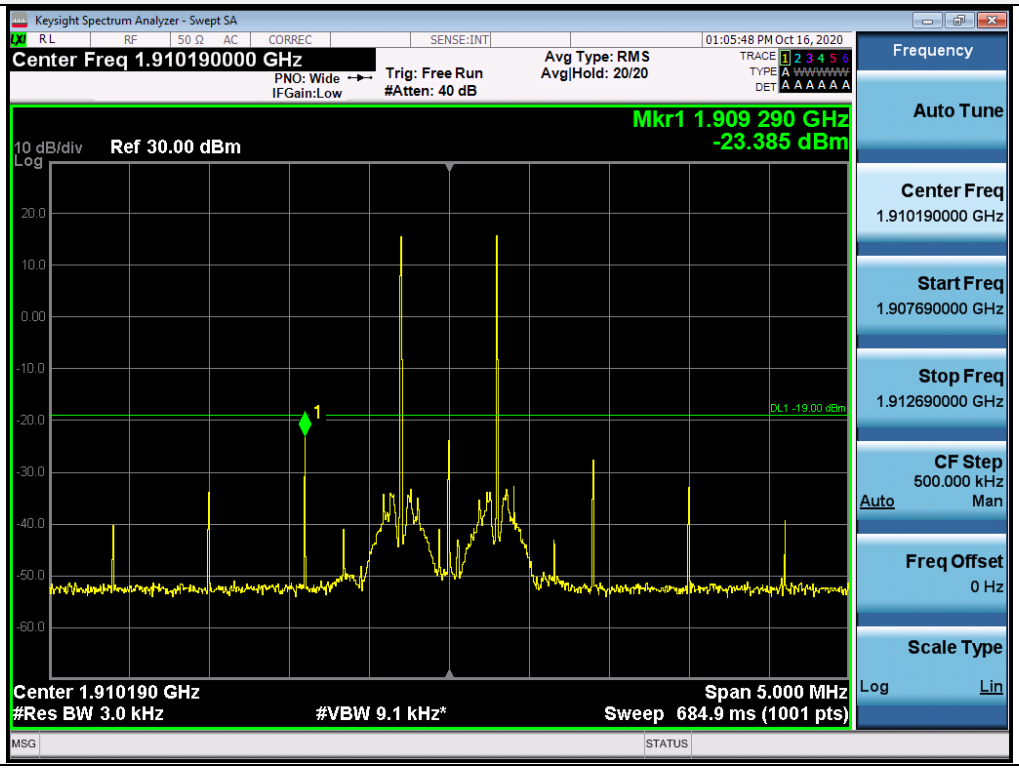
Intermodulation / Upper 700 MHz / Uplink / AGC threshold +10 dB


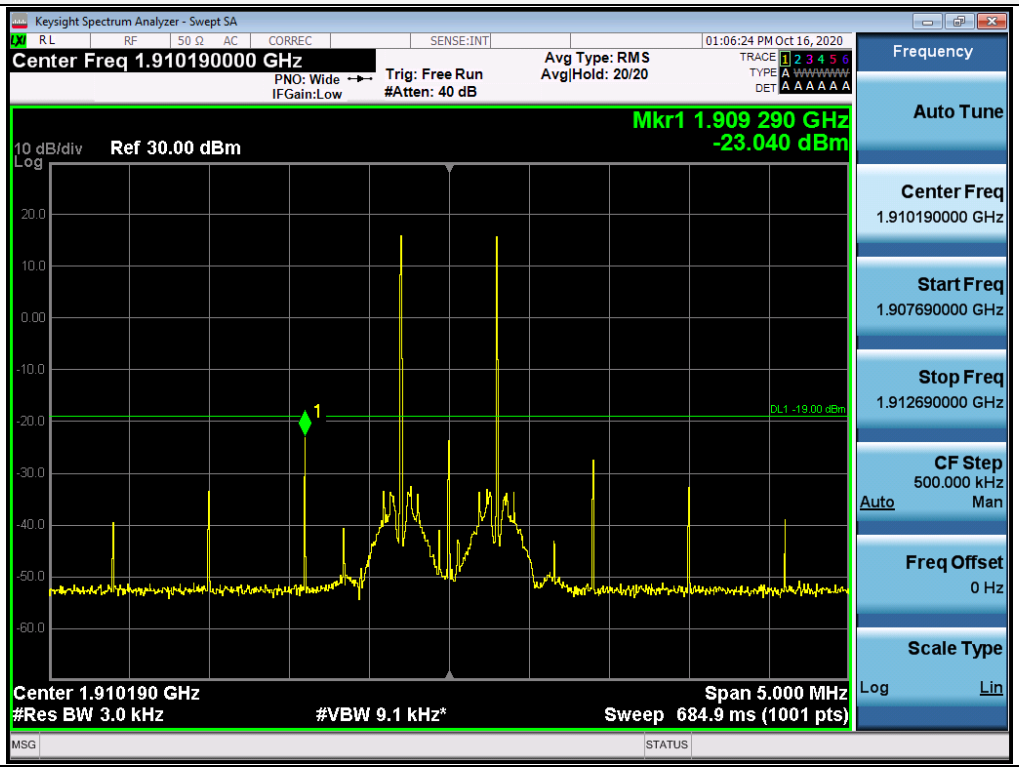
Intermodulation / Cellular / Uplink / AGC threshold


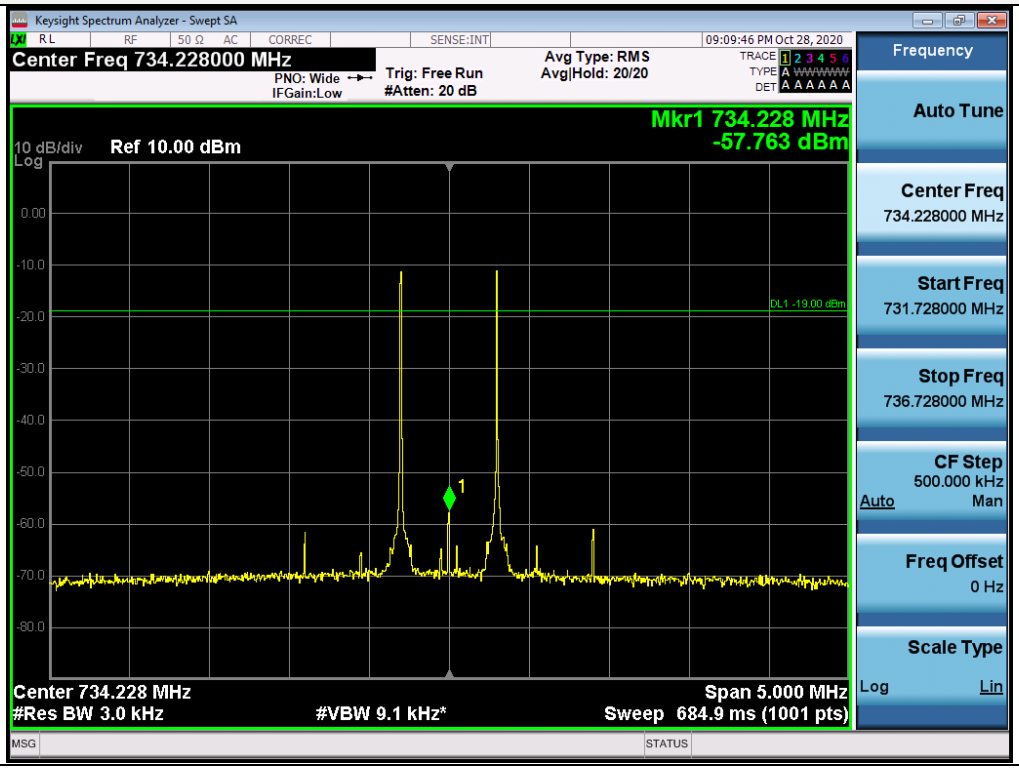
Intermodulation / Cellular / Uplink / AGC threshold +10 dB


Intermodulation / AWS-1 / Uplink / AGC threshold


Intermodulation / AWS-1 / Uplink / AGC threshold +10 dB


Intermodulation / Broadband PCS / Uplink / AGC threshold


Intermodulation / Broadband PCS / Uplink / AGC threshold +10 dB


Intermodulation / Lower 700 MHz / Downlink / AGC threshold


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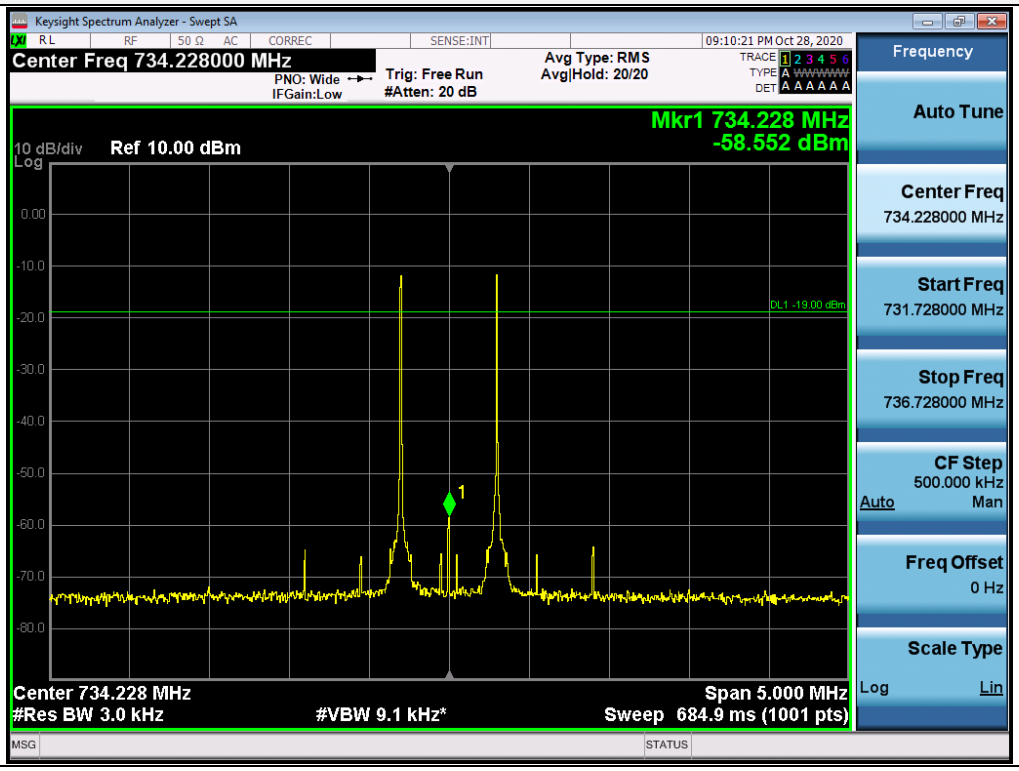
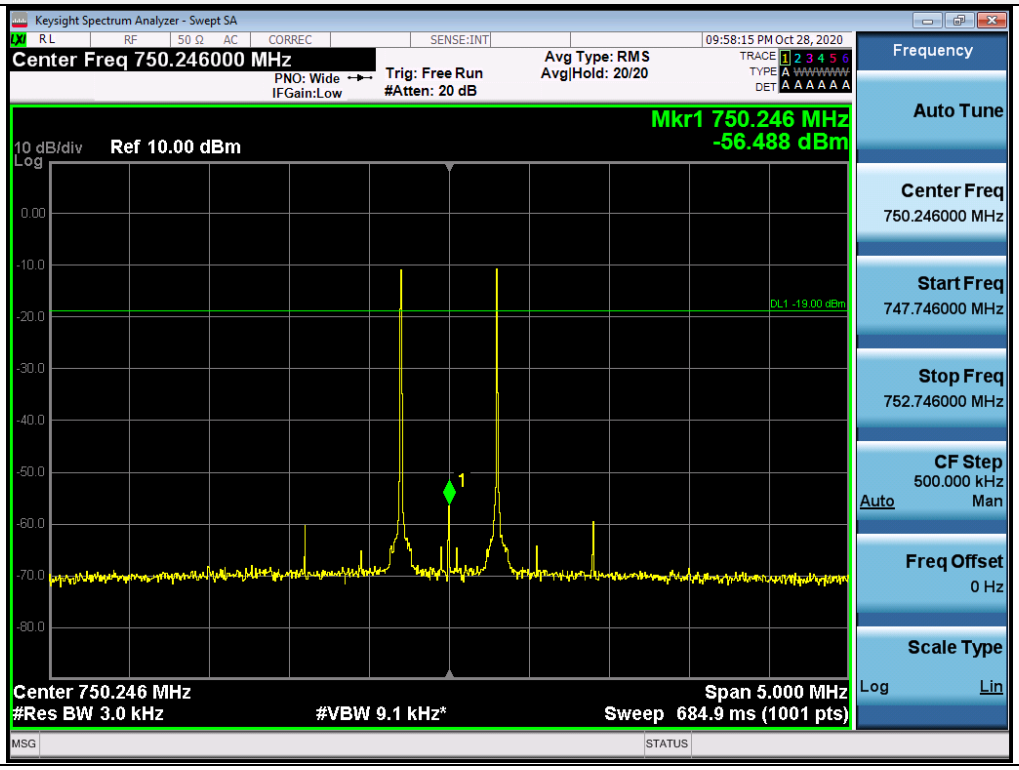


Intermodulation / Upper 700 MHz / Downlink / AGC threshold


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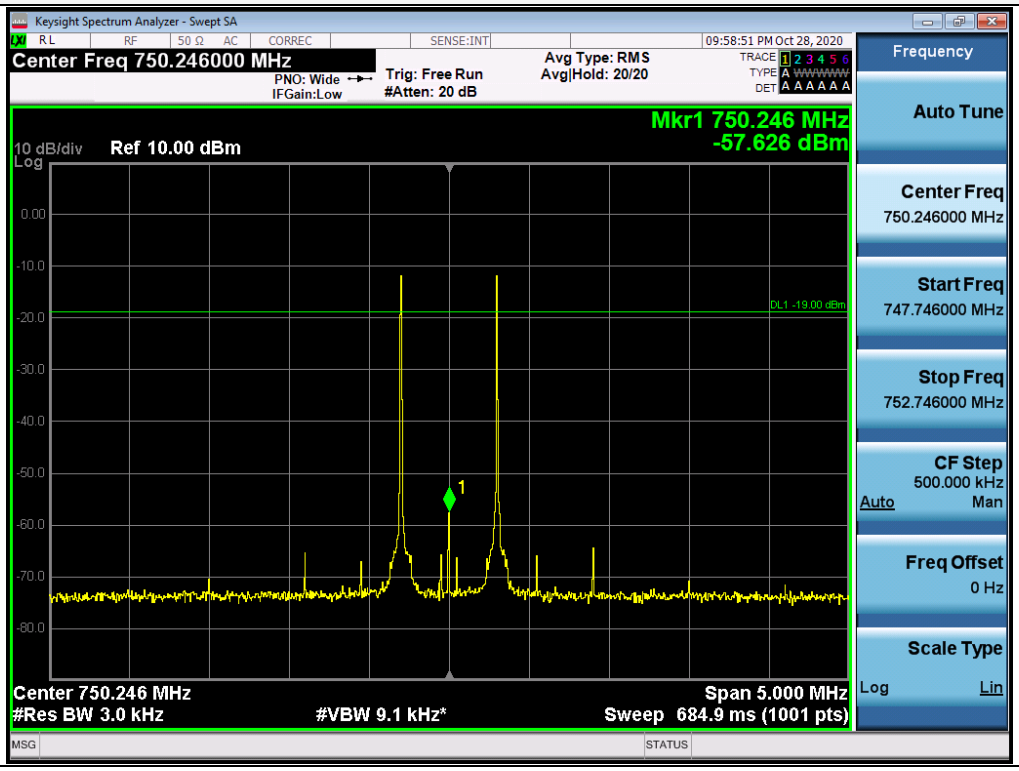
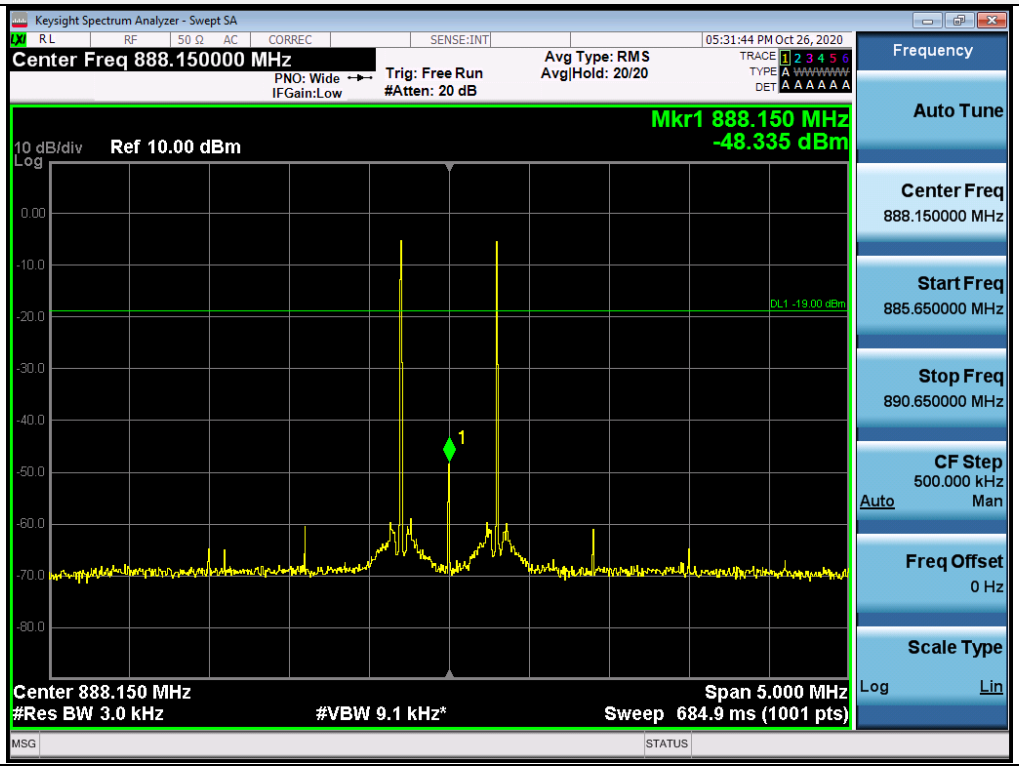
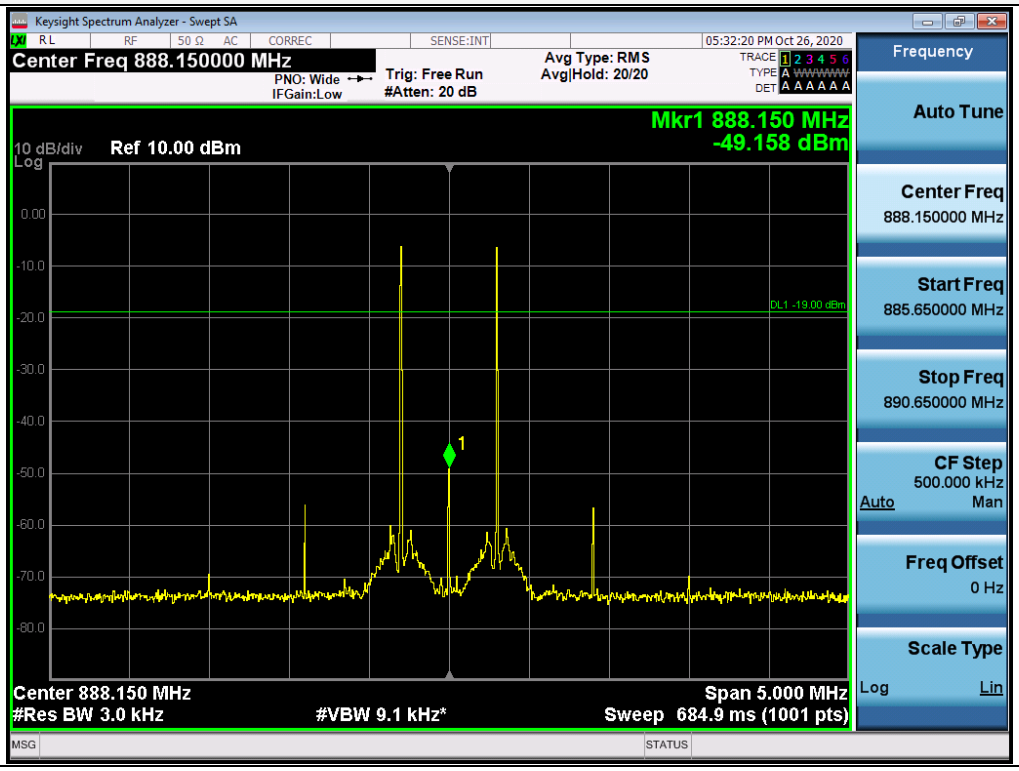
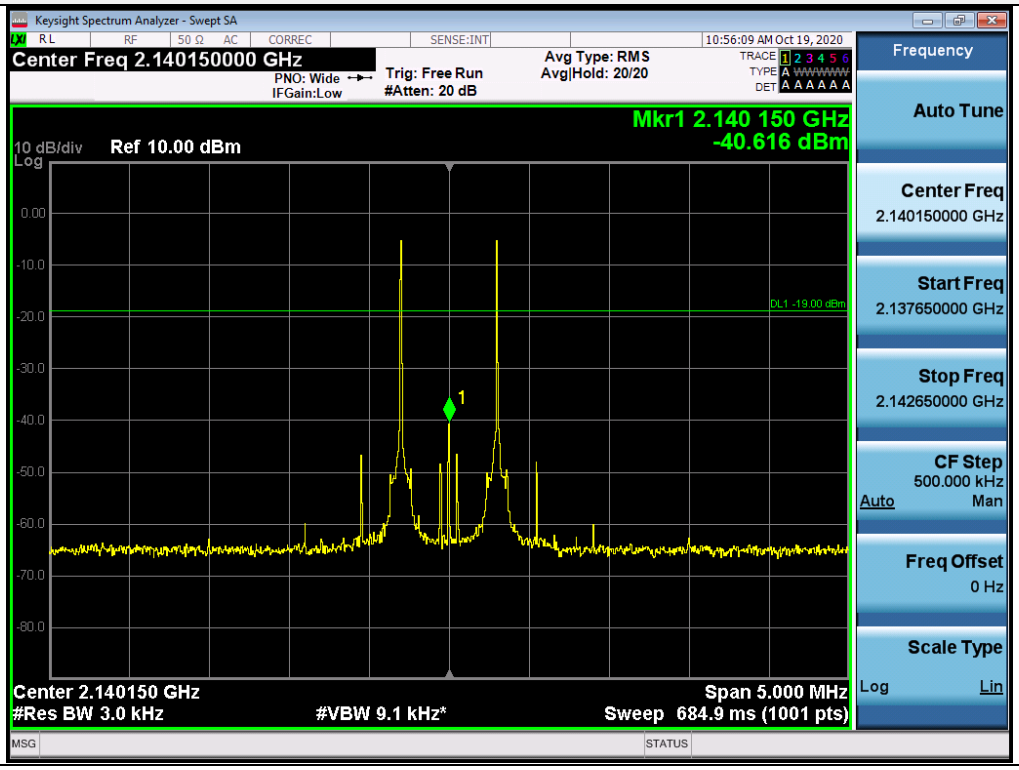
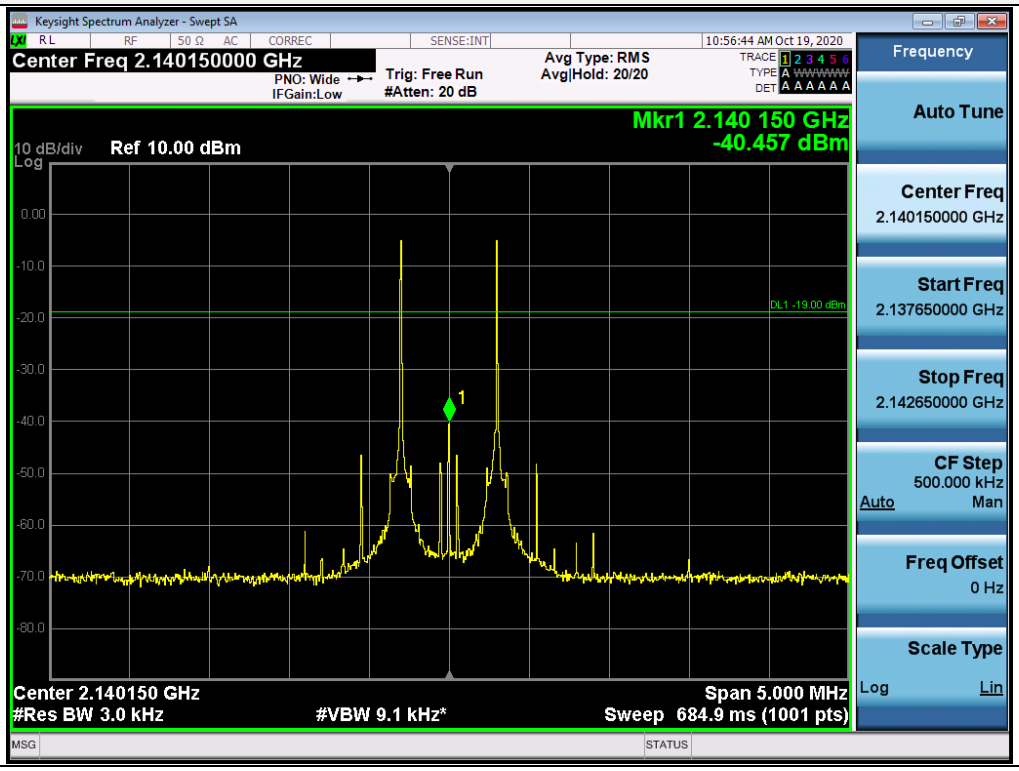
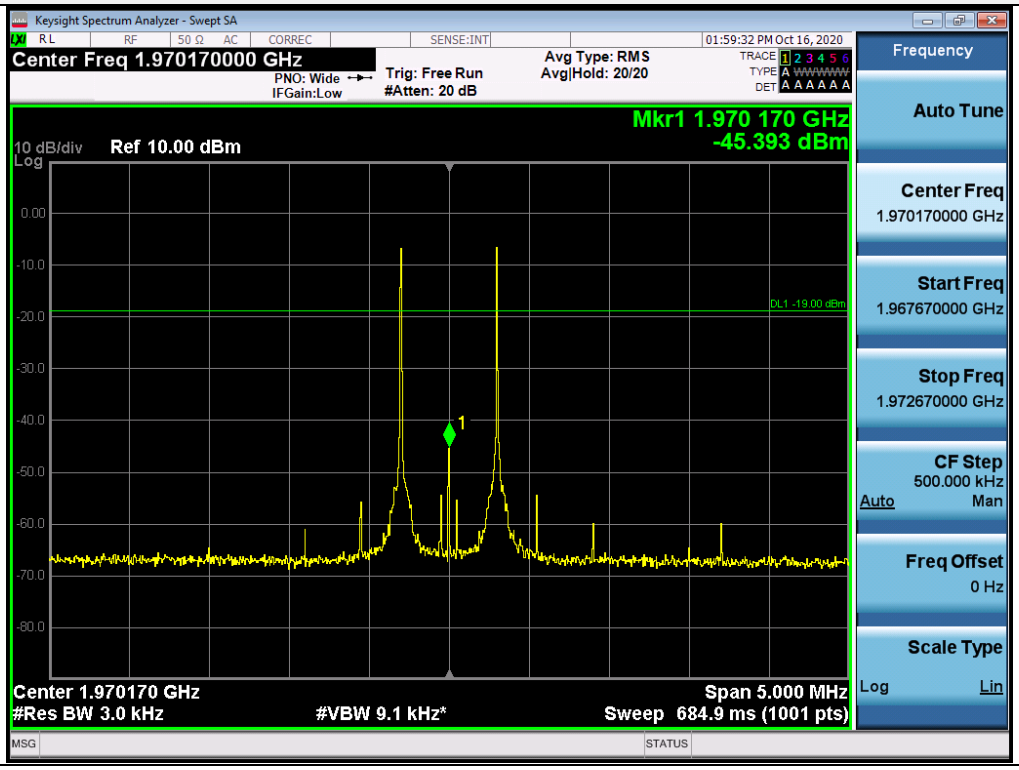


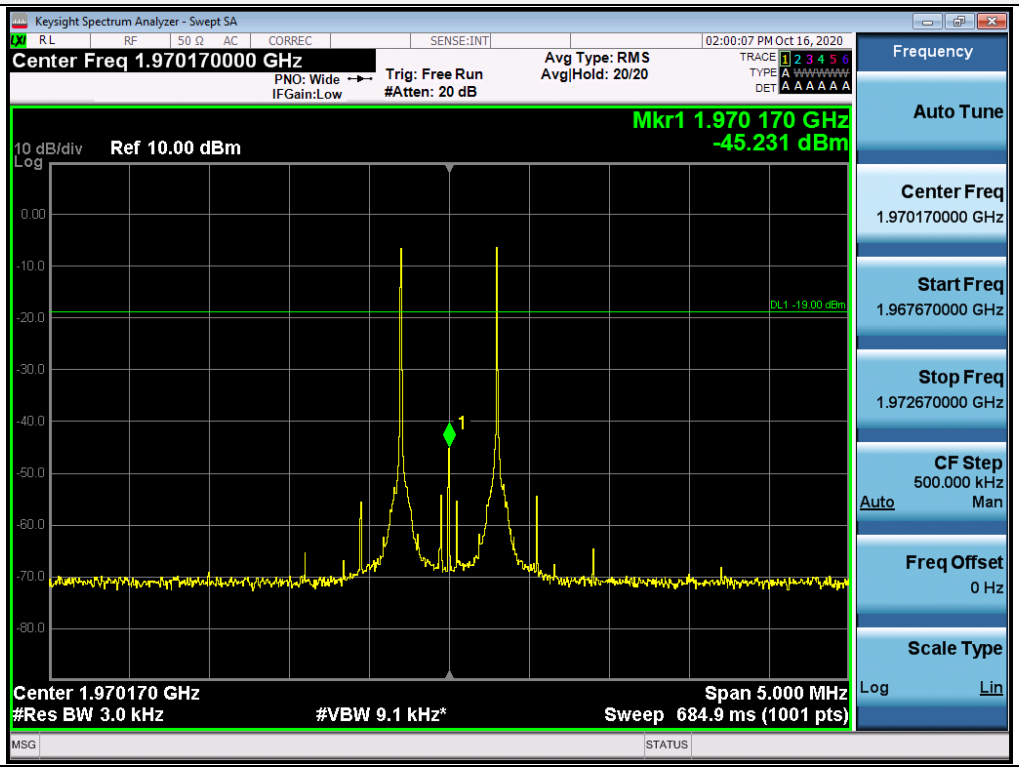
Intermodulation / Cellular / Downlink / AGC threshold


Intermodulation / Cellular / Downlink / AGC threshold +10 dB


Intermodulation / AWS-1 / Downlink / AGC threshold


Intermodulation / AWS-1 / Downlink / AGC threshold +10 dB


Intermodulation / Broadband PCS / Downlink / AGC threshold


Intermodulation / Broadband PCS / Downlink / AGC threshold +10 dB


5.5. OUT-OF-BAND EMISSIONS

Test Requirements:

§ 20.21(e)(8)(i)(E) Out of Band Emission Limits.

Booster out of band emissions (OOBE) shall be at least 6 dB below the FCC's mobile emission limits for the supported bands of operation. Compliance to OOBE limits will utilize high peak-to-average CMRS signal types.

Test Procedures:

Measurements were in accordance with the test methods section 7.5 of KDB 935210 D03 v04r04.

a) Begin with the uplink output (donor) port connected to the spectrum analyzer.

b) Configure the signal generator for the appropriate operation for all uplink and downlink bands:

1) GSM: 0.2 MHz from upper and lower band edges.
2) LTE (5 MHz): 2.5 MHz from upper and lower band edges.
3) CDMA: 1.25 MHz from upper and lower band edges, except for cellular band as follows
(only the upper and lower frequencies need to be tested):
824.88 MHz, 845.73 MHz, 836.52 MHz, 848.10 MHz,
869.88 MHz, 890.73 MHz, 881.52 MHz, 893.10 MHz.

c) Set the signal generator amplitude to the maximum power level prior to AGC similar to e) to f) of the power measurement procedures for the appropriate modulations.

d) Set RBW = measurement bandwidth specified in the applicable rule section for the supported frequency band.

e) Set VBW = 3 RBW.

f) Select the power averaging (rms) detector.

g) Sweep time = auto-couple.

h) Set the analyzer start frequency to the upper band/block edge frequency and the stop frequency to the upper band/block edge frequency plus: 300 kHz (when operational frequency is < 1 GHz), or 3 MHz (when operational frequency is ≥ 1 GHz).

i) Trace average at least 100 traces in power averaging (i.e., rms) mode.

j) Use peak marker function to find the maximum power level.

k) Capture the spectrum analyzer trace of the power level for inclusion in the test report.

l) Increase the signal generator amplitude in 2 dB steps until the maximum input level per maximum transmitter test input is reached. Affirm that the EUT maintains compliance with the OOBE limits. The test report shall include either a statement describing that the device complies at 10 dB above AGC or at the maximum transmitter test power levels, or a table showing compliance at the additional input power(s) required.

m) Reset the analyzer start frequency to the lower band/block edge frequency minus: 300 kHz (when operational frequency is < 1 GHz), or 3 MHz (when operational frequency is ≥ 1 GHz), and the stop frequency to the lower band/block edge frequency, then repeat i) to l).

n) Repeat b) through m) for each uplink and downlink operational band.

Note1. For all operation band of EUT, same mobile emission limit '43 + 10 Log (Power) dB' is applied. So, test limit of Out-of-Band Emissions is calculated as follows.

Out-of-Band Emissions Limit = 43 + 10 Log (Power) – 6 dB
= -13 dBm – 6 dB = -19 dBm

Note2. Measurement bandwidth specified in the applicable rule section for the supported frequency band.

Band	RBW Requirements
Lower 700 MHz	Reference 100 kHz or greater 30 kHz in the 100 kHz bands immediately block outside
Upper 700 MHz	Reference 100 kHz or greater 30 kHz in the 100 kHz bands immediately block outside
Cellular	Reference 100 kHz or greater (below 1 GHz) Reference 1 MHz or greater (above 1 GHz) 1 % of fundamental emission bandwidth in the 1 MHz bands immediately block outside
AWS-1	Reference 1 MHz or greater 1 % of fundamental emission bandwidth in the 1 MHz bands immediately block outside
Broadband PCS	Reference 1 MHz or greater 1 % of fundamental emission bandwidth in the 1 MHz bands immediately block outside

Test Results:

Tabulated Result of Uplink Out-of-Band Emissions

Band	Signal	Edge	Input Level	Frequency (MHz)	Limit (dBm)	Emission (dBm)
Lower 700 MHz	GSM	Upper	AGC	716.010 5	-19	-53.008
			AGC +10 dB	716.000 0		-53.231
		Lower	AGC	698.000 0		-25.025
			AGC +10 dB	697.994 9		-24.682
	LTE 5 MHz	Upper	AGC	716.152 1		-42.870
			AGC +10 dB	716.225 6		-42.763
		Lower	AGC	697.945 1		-31.507
			AGC +10 dB	697.997 0		-31.420
	CDMA	Upper	AGC	716.009 3		-42.821
			AGC +10 dB	716.053 7		-42.297
		Lower	AGC	697.982 6		-39.650
			AGC +10 dB	697.969 4		-39.020
Upper 700 MHz	GSM	Upper	AGC	787.000 0		-23.680
			AGC +10 dB	787.000 0		-23.723
		Lower	AGC	775.999 1		-44.195
			AGC +10 dB	776.000 0		-44.134
	LTE 5 MHz	Upper	AGC	787.006 0		-35.573
			AGC +10 dB	787.011 7		-34.980
		Lower	AGC	775.765 7		-40.996
			AGC +10 dB	775.897 7		-41.416
	CDMA	Upper	AGC	787.023 1		-41.065
			AGC +10 dB	787.018 9		-40.130
		Lower	AGC	775.937 0		-41.286
			AGC +10 dB	775.985 3		-40.777

Band	Signal	Edge	Input Level	Frequency (MHz)	Limit (dBm)	Emission (dBm)
Cellular	GSM	Upper	AGC	849.003 3	-19	-37.185
			AGC +10 dB	849.007 8		-37.033
		Lower	AGC	823.985 6		-36.307
			AGC +10 dB	823.986 5		-35.517
	LTE 5 MHz	Upper	AGC	849.008 7		-34.404
			AGC +10 dB	849.001 5		-33.458
		Lower	AGC	823.999 4		-33.662
			AGC +10 dB	824.000 0		-34.067
	CDMA	Upper	AGC	849.005 1		-46.709
			AGC +10 dB	849.126 6		-45.888
		Lower	AGC	823.931 3		-44.208
			AGC +10 dB	823.973 3		-43.930
AWS-1	GSM	Upper	AGC	1 755.003		-34.620
			AGC +10 dB	1 755.012		-35.400
		Lower	AGC	1 709.997		-46.561
			AGC +10 dB	1 709.997		-45.103
	LTE 5 MHz	Upper	AGC	1 755.000		-32.128
			AGC +10 dB	1 755.003		-33.109
		Lower	AGC	1 709.385		-37.920
			AGC +10 dB	1 707.414		-39.952
	CDMA	Upper	AGC	1 755.015		-44.192
			AGC +10 dB	1 755.024		-44.114
		Lower	AGC	1 709.958		-44.220
			AGC +10 dB	1 709.982		-43.577

Band	Signal	Edge	Input Level	Frequency (MHz)	Limit (dBm)	Emission (dBm)
Broadband PCS	GSM	Upper	AGC	1 915.009	-19	-37.187
			AGC +10 dB	1 915.006		-38.437
		Lower	AGC	1 849.991		-60.929
			AGC +10 dB	1 848.881		-63.991
	LTE 5 MHz	Upper	AGC	1 915.000		-36.022
			AGC +10 dB	1 915.006		-35.524
		Lower	AGC	1 849.343		-39.567
			AGC +10 dB	1 847.072		-39.424
	CDMA	Upper	AGC	1 915.114		-44.752
			AGC +10 dB	1 915.066		-44.385
		Lower	AGC	1 849.997		-45.544
			AGC +10 dB	1 849.082		-45.671

Tabulated Result of Downlink Out-of-Band Emissions

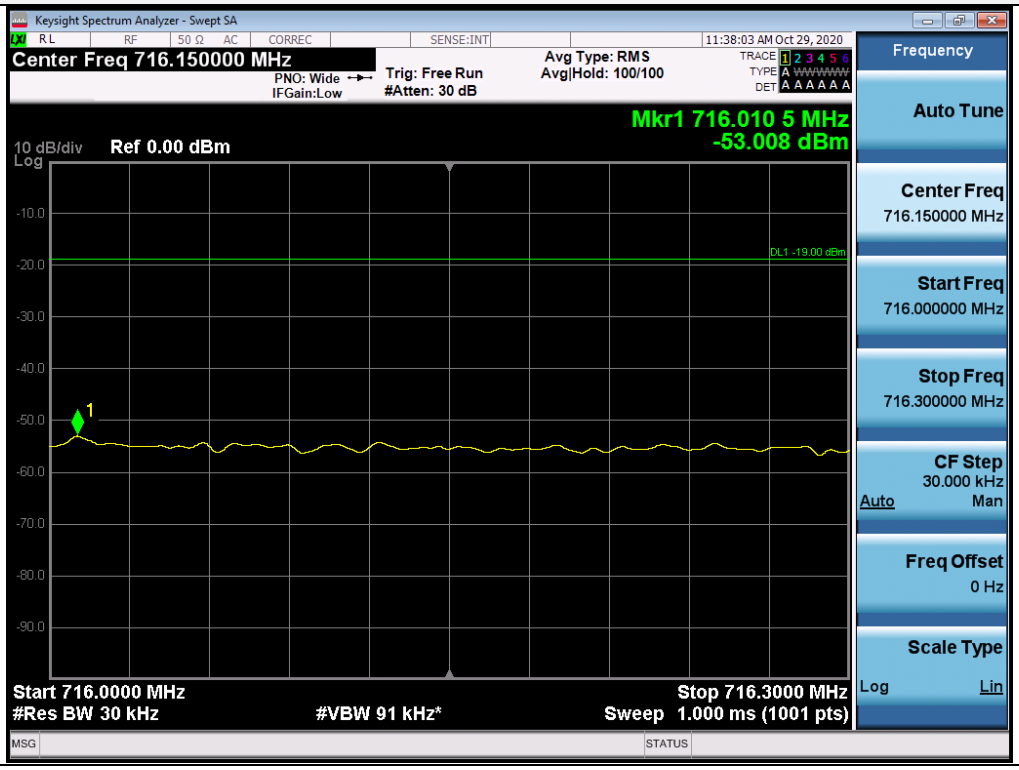
Band	Signal	Edge	Input Level	Frequency (MHz)	Limit (dBm)	Emission (dBm)
Lower 700 MHz	GSM	Upper	AGC	746.010 8	-19	-49.529
			AGC +10 dB	746.000 0		-49.273
		Lower	AGC	728.000 0		-48.443
			AGC +10 dB	727.991 3		-48.420
	LTE 5 MHz	Upper	AGC	746.0003		-59.246
			AGC +10 dB	746.005 4		-59.569
		Lower	AGC	728.000 0		-57.889
			AGC +10 dB	727.994 9		-60.876
	CDMA	Upper	AGC	746.151 8		-60.589
			AGC +10 dB	746.051 6		-63.040
		Lower	AGC	727.899 2		-60.163
			AGC +10 dB	727.790 6		-63.087
Upper 700 MHz	GSM	Upper	AGC	757.064 5		-54.110
			AGC +10 dB	757.061 2		-54.022
		Lower	AGC	745.984 1		-49.215
			AGC +10 dB	745.996 7		-50.779
	LTE 5 MHz	Upper	AGC	757.155 4		-63.768
			AGC +10 dB	757.099 0		-64.071
		Lower	AGC	745.991 9		-58.884
			AGC +10 dB	745.996 1		-60.938
	CDMA	Upper	AGC	757.289 8		-63.719
			AGC +10 dB	757.254 7		-63.951
		Lower	AGC	745.770 2		-60.499
			AGC +10 dB	745.984 4		-63.331

Band	Signal	Edge	Input Level	Frequency (MHz)	Limit (dBm)	Emission (dBm)
Cellular	GSM	Upper	AGC	894.011 4	-19	-55.133
			AGC +10 dB	894.005 4		-56.132
		Lower	AGC	868.997 0		-54.031
			AGC +10 dB	868.986 8		-55.111
	LTE 5 MHz	Upper	AGC	894.002 7		-51.486
			AGC +10 dB	894.006 6		-53.517
		Lower	AGC	868.994 0		-50.144
			AGC +10 dB	868.988 6		-52.872
	CDMA	Upper	AGC	894.042 3		-64.573
			AGC +10 dB	894.053 1		-65.600
		Lower	AGC	868.969 4		-62.039
			AGC +10 dB	868.960 1		-64.316
AWS-1	GSM	Upper	AGC	2 155.021		-52.966
			AGC +10 dB	2 155.012		-53.195
		Lower	AGC	2 109.976		-57.403
			AGC +10 dB	2 109.997		-56.447
	LTE 5 MHz	Upper	AGC	2 155.024		-49.945
			AGC +10 dB	2 155.000		-50.282
		Lower	AGC	2 109.913		-58.467
			AGC +10 dB	2 110.000		-58.594
	CDMA	Upper	AGC	2 155.048		-59.818
			AGC +10 dB	2 155.033		-63.719
		Lower	AGC	2 108.956		-64.475
			AGC +10 dB	2 109.841		-64.587

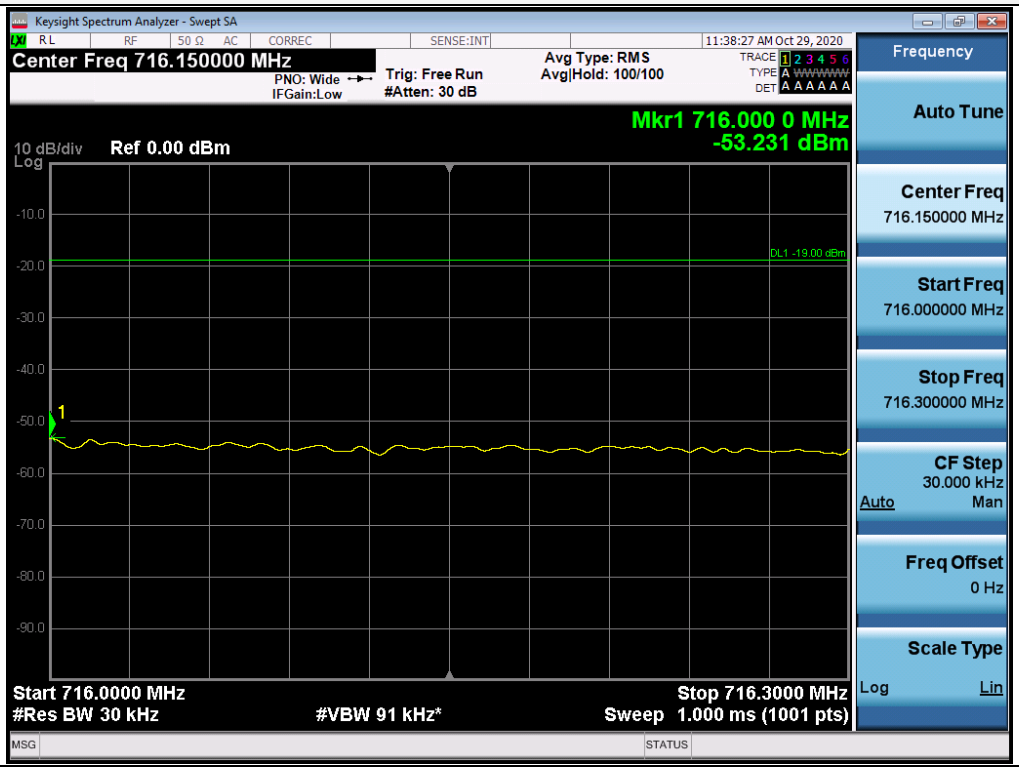
Band	Signal	Edge	Input Level	Frequency (MHz)	Limit (dBm)	Emission (dBm)
Broadband PCS	GSM	Upper	AGC	1 995.012	-19	-56.908
			AGC +10 dB	1 995.018		-57.072
		Lower	AGC	1 930.000		-63.234
			AGC +10 dB	1 929.973		-63.114
	LTE 5 MHz	Upper	AGC	1 995.000		-54.161
			AGC +10 dB	1 995.000		-53.433
		Lower	AGC	1 927.618		-58.937
			AGC +10 dB	1 929.829		-59.112
	CDMA	Upper	AGC	1 995.021		-61.613
			AGC +10 dB	1 997.991		-64.382
		Lower	AGC	1 929.028		-65.205
			AGC +10 dB	1 928.491		-64.808

Plot data of Out-of-Band Emissions

Out-of-Band Emissions / Lower 700 MHz / Uplink / GSM / Upper Edge / AGC threshold



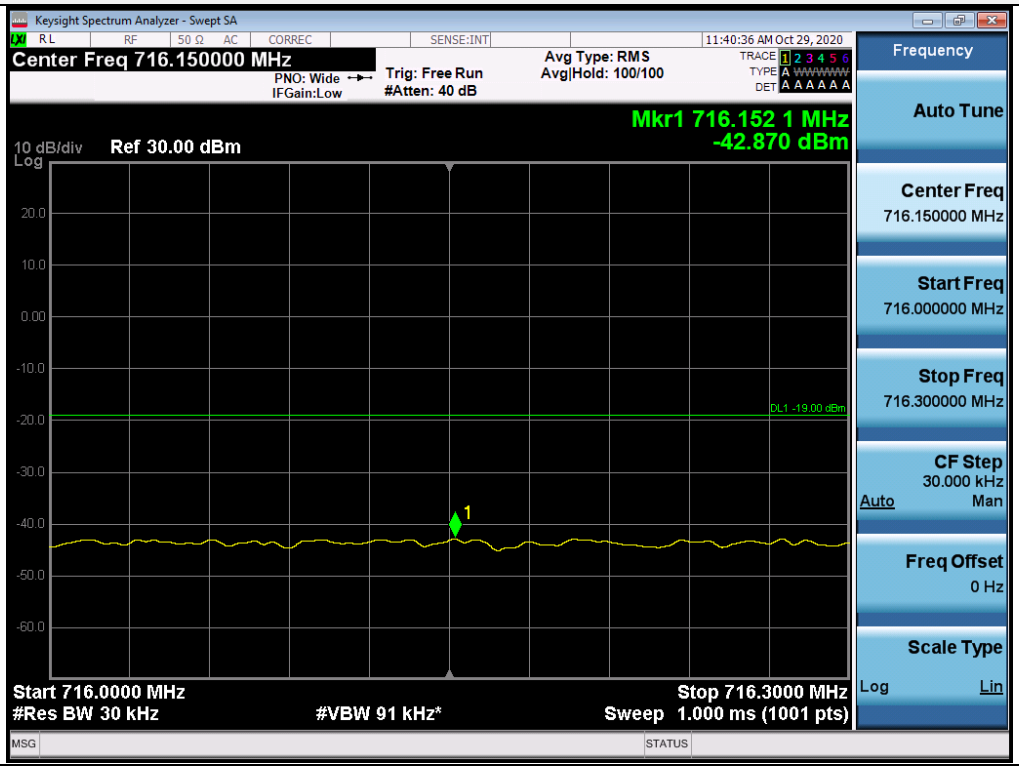
Out-of-Band Emissions / Lower 700 MHz / Uplink / GSM / Upper Edge / AGC threshold +10 dB



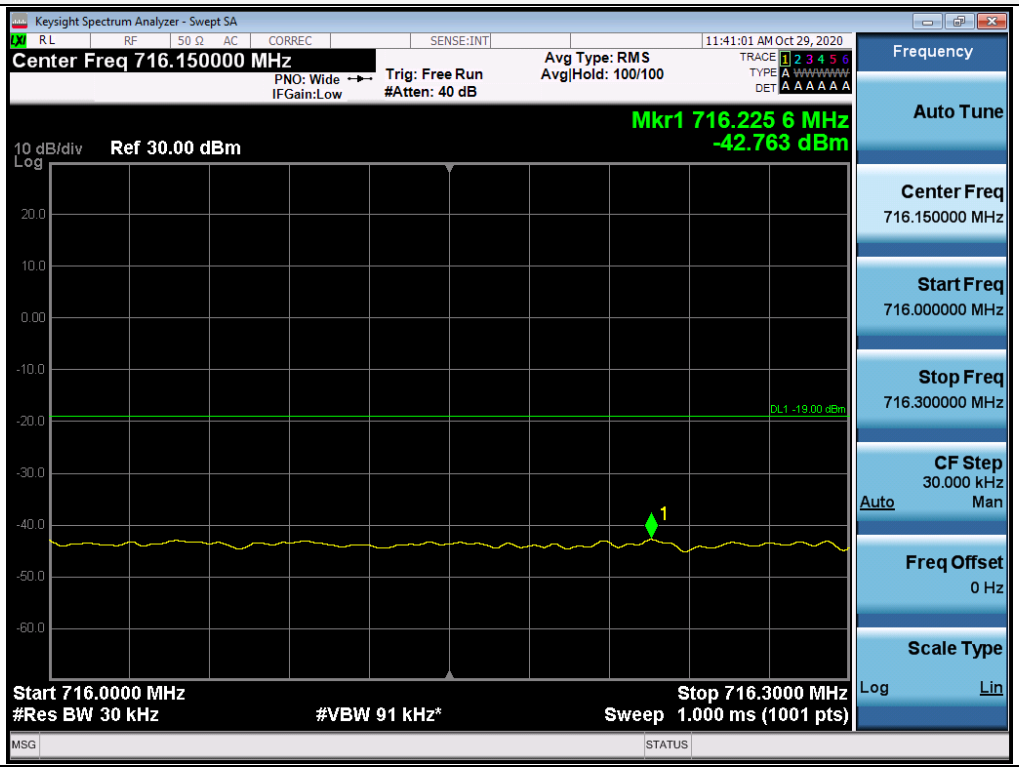
Out-of-Band Emissions / Lower 700 MHz / Uplink / GSM / Lower Edge / AGC threshold

Out-of-Band Emissions / Lower 700 MHz / Uplink / GSM / Lower Edge / AGC threshold +10 dB

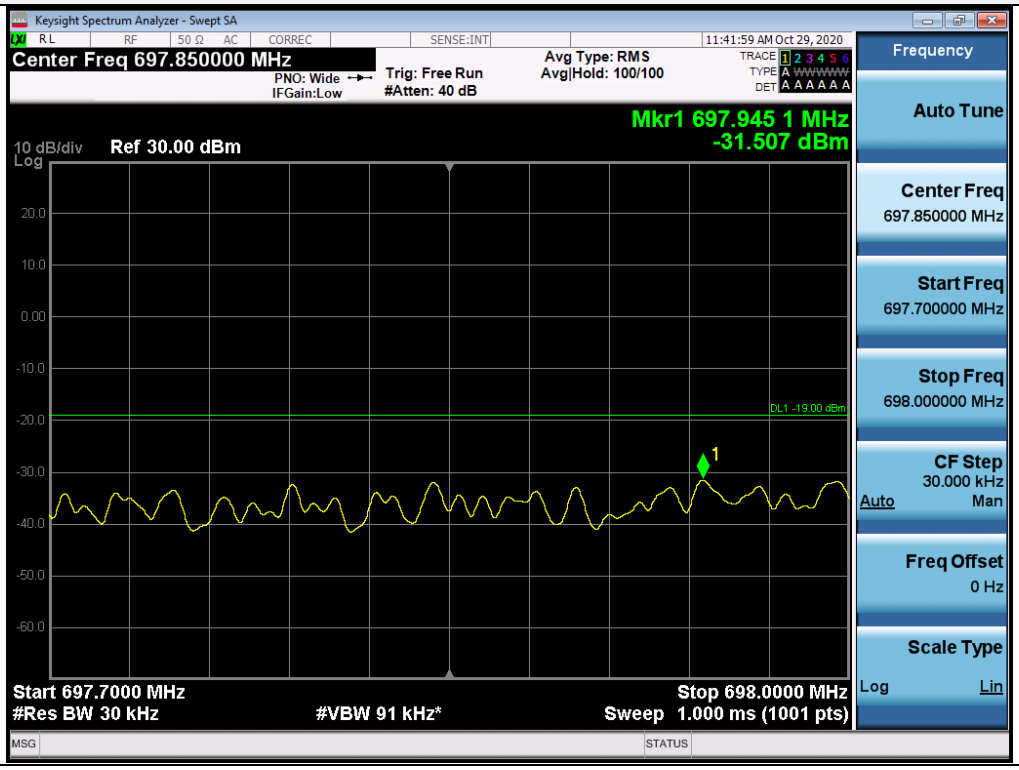
Out-of-Band Emissions / Lower 700 MHz / Uplink / LTE 5 MHz / Upper Edge / AGC threshold



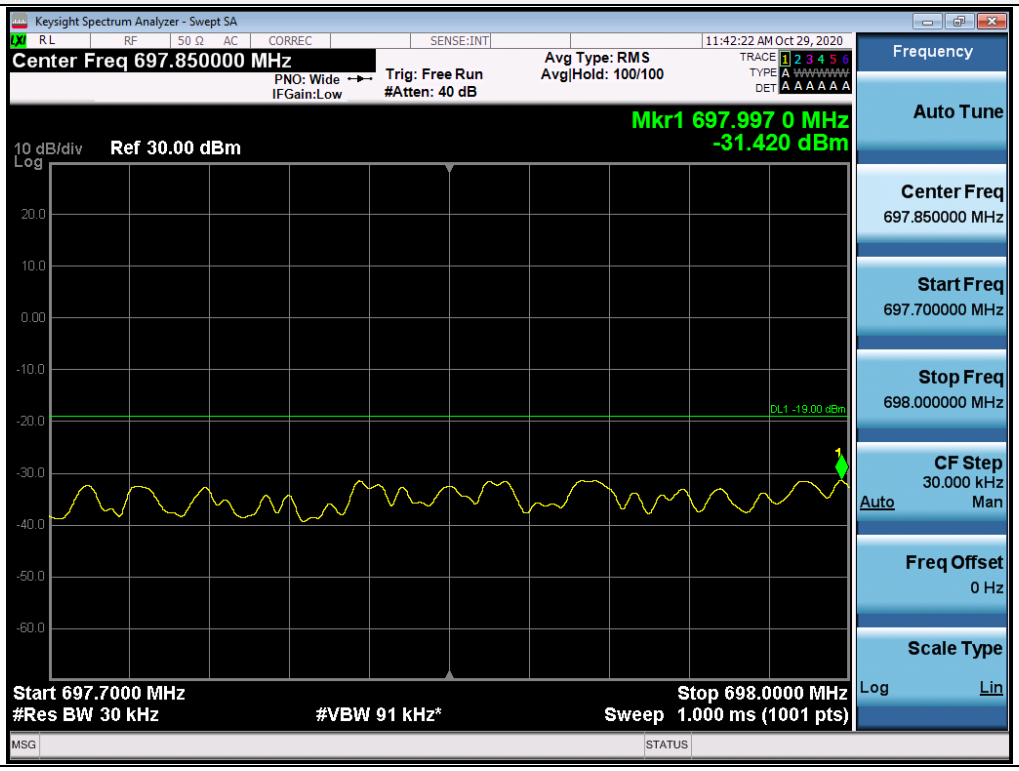
Out-of-Band Emissions / Lower 700 MHz / Uplink / LTE 5 MHz / Upper Edge / AGC threshold +10 dB



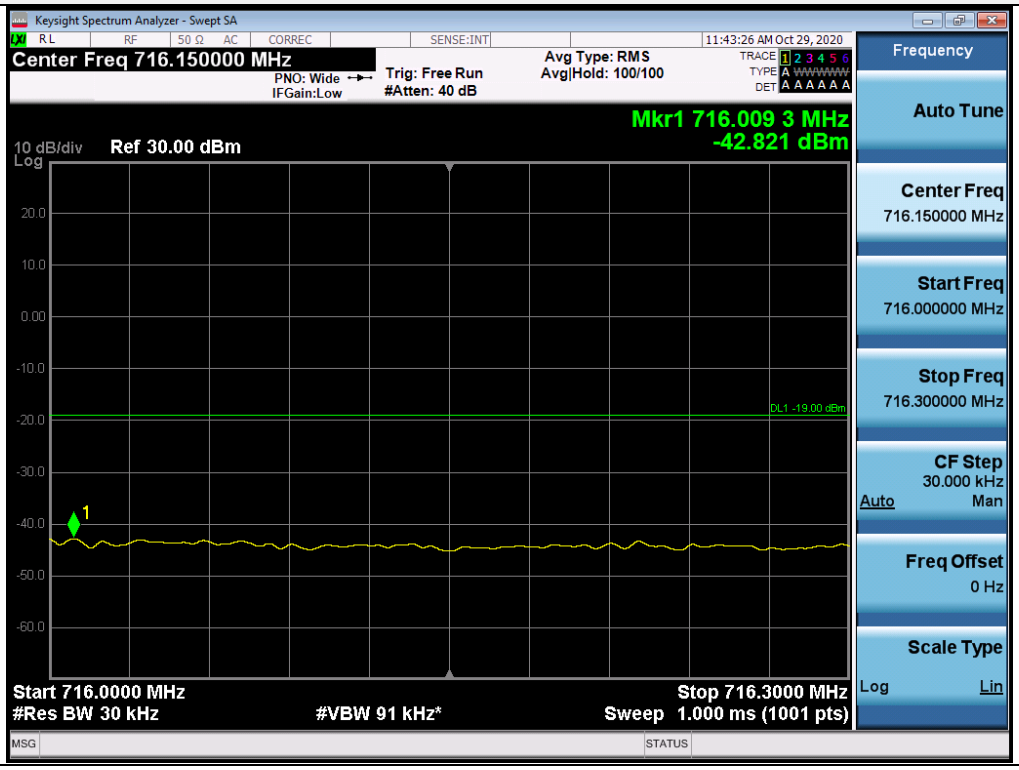
Out-of-Band Emissions / Lower 700 MHz / Uplink / LTE 5 MHz / Lower Edge / AGC threshold



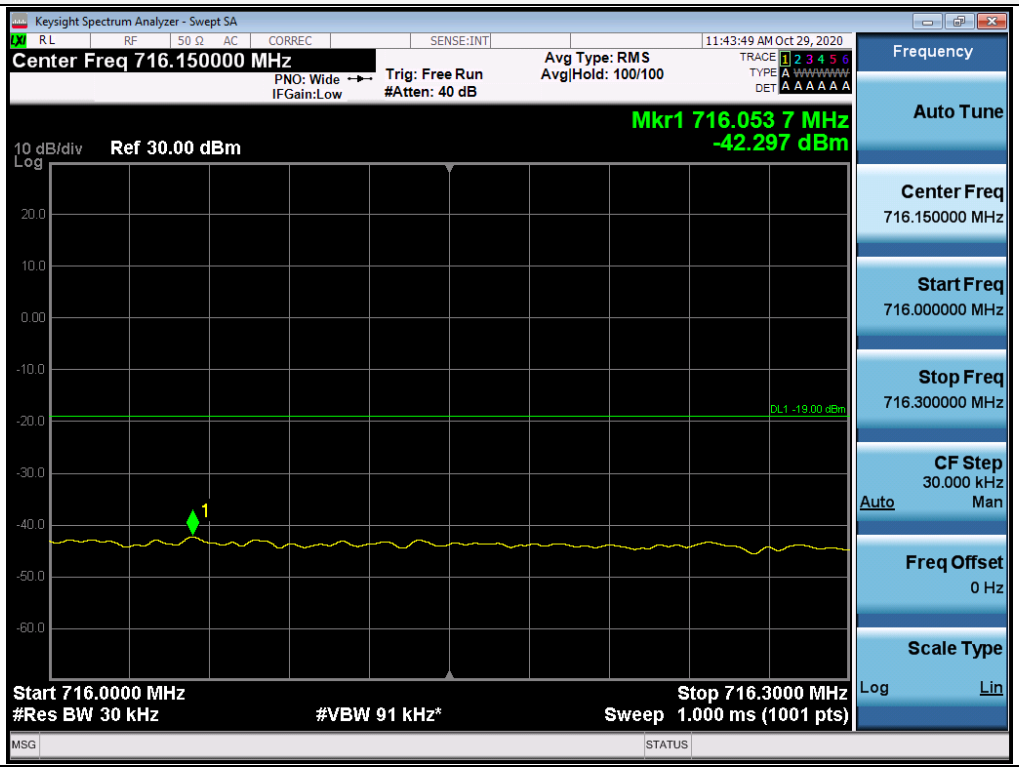
Out-of-Band Emissions / Lower 700 MHz / Uplink / LTE 5 MHz / Lower Edge / AGC threshold +10 dB



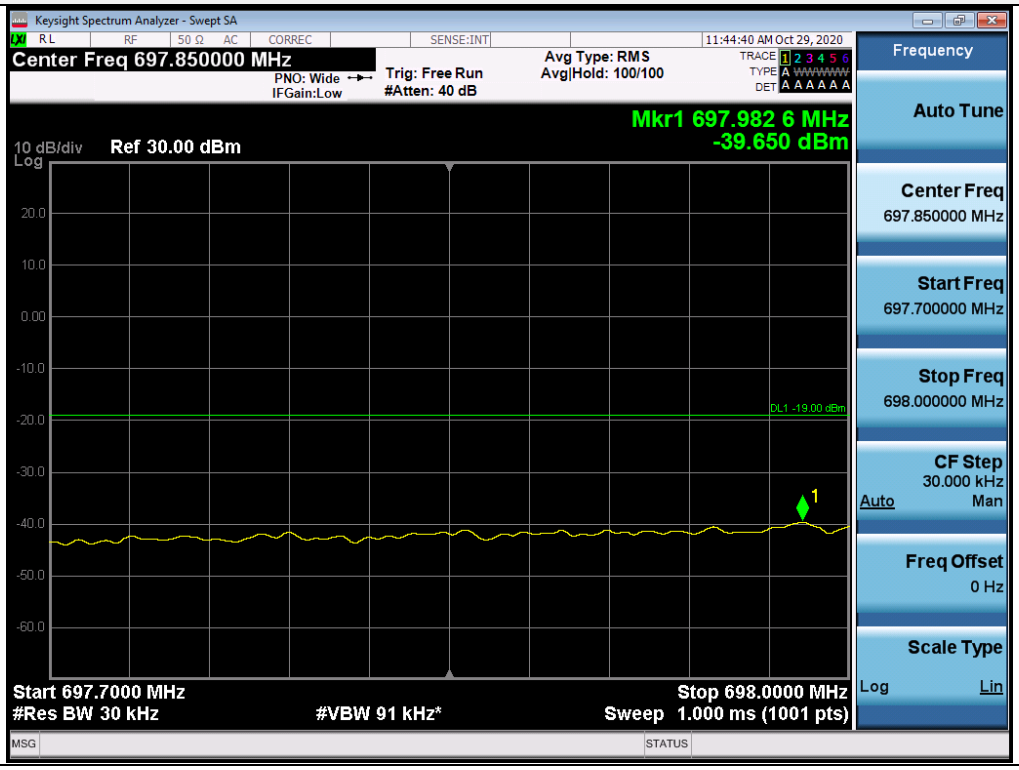
Out-of-Band Emissions / Lower 700 MHz / Uplink / CDMA / Upper Edge / AGC threshold



Out-of-Band Emissions / Lower 700 MHz / Uplink / CDMA / Upper Edge / AGC threshold +10 dB



Out-of-Band Emissions / Lower 700 MHz / Uplink / CDMA / Lower Edge / AGC threshold



Out-of-Band Emissions / Lower 700 MHz / Uplink / CDMA / Lower Edge / AGC threshold +10 dB

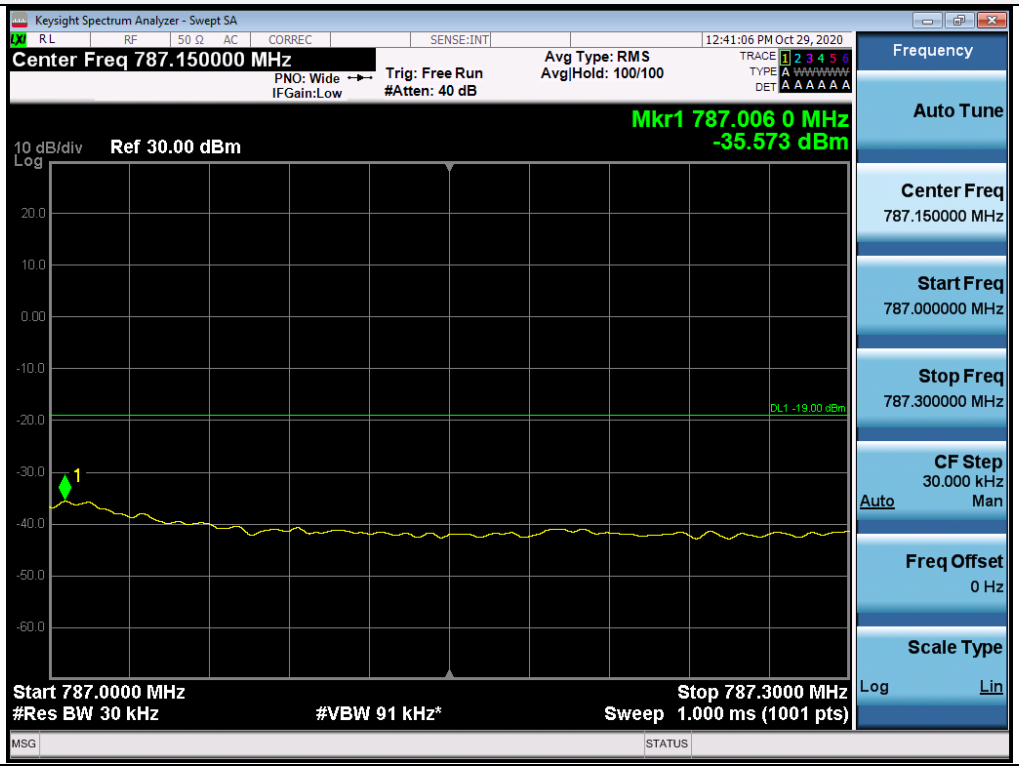
Out-of-Band Emissions / Upper 700 MHz / Uplink / GSM / Upper Edge / AGC threshold

Out-of-Band Emissions / Upper 700 MHz / Uplink / GSM / Upper Edge / AGC threshold +10 dB

Out-of-Band Emissions / Upper 700 MHz / Uplink / GSM / Lower Edge / AGC threshold

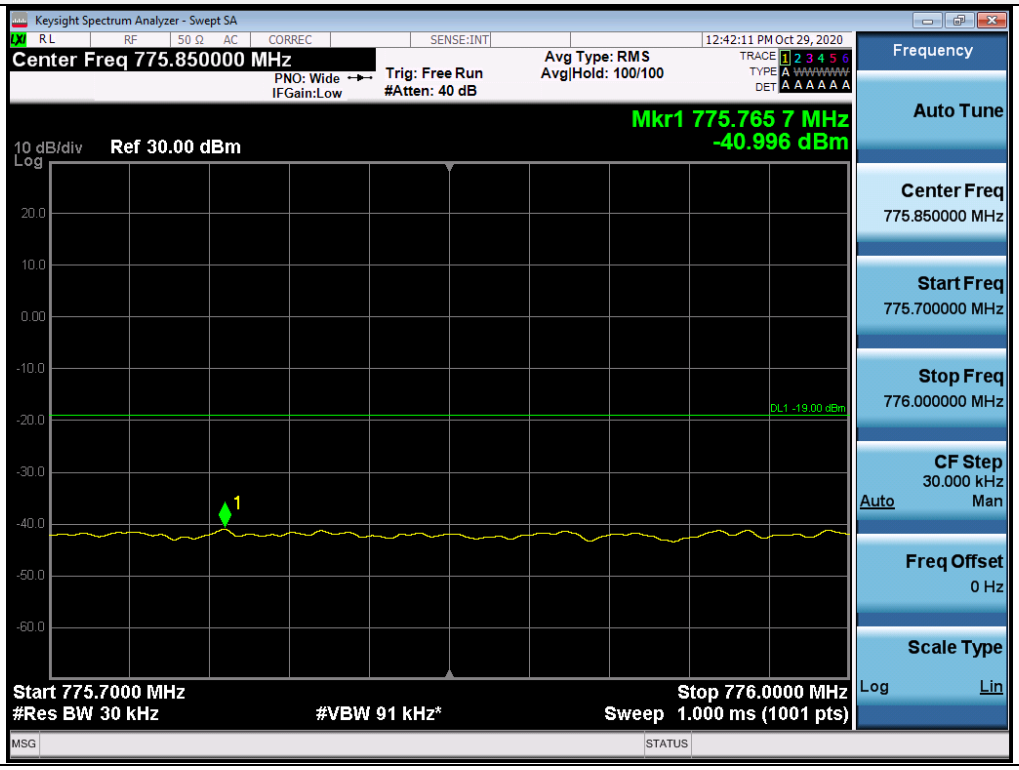
Out-of-Band Emissions / Upper 700 MHz / Uplink / GSM / Lower Edge / AGC threshold +10 dB

Out-of-Band Emissions / Upper 700 MHz / Uplink / LTE 5 MHz / Upper Edge / AGC threshold

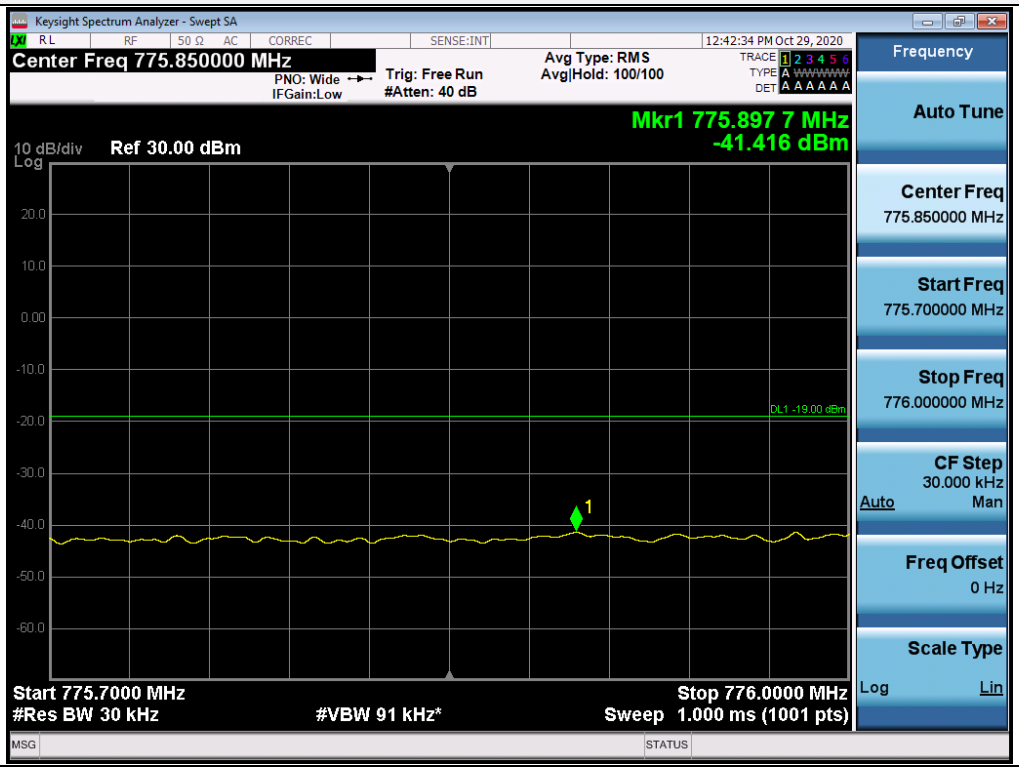


Out-of-Band Emissions / Upper 700 MHz / Uplink / LTE 5 MHz / Upper Edge / AGC threshold +10 dB

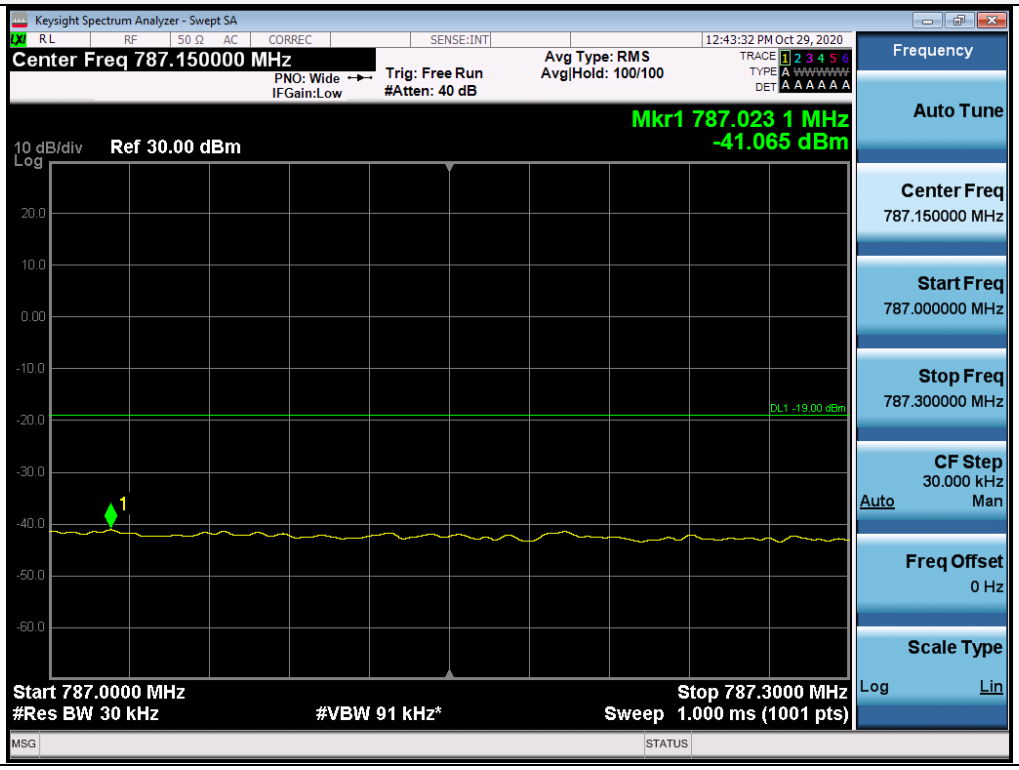
Out-of-Band Emissions / Upper 700 MHz / Uplink / LTE 5 MHz / Lower Edge / AGC threshold



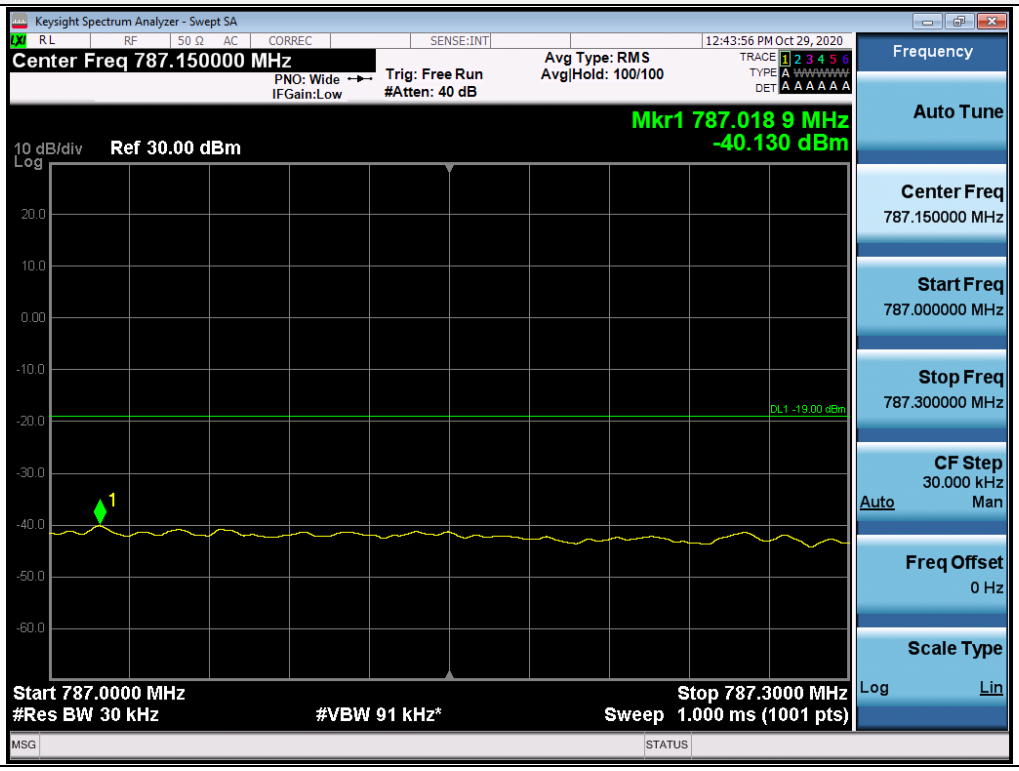
Out-of-Band Emissions / Upper 700 MHz / Uplink / LTE 5 MHz / Lower Edge / AGC threshold +10 dB



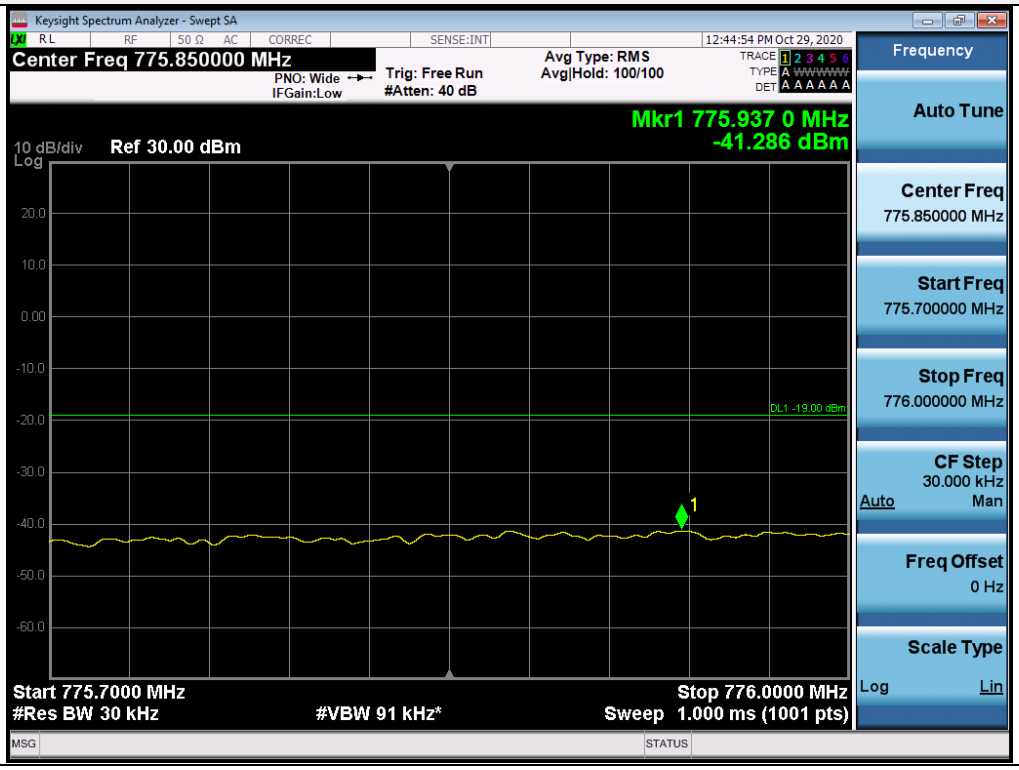
Out-of-Band Emissions / Upper 700 MHz / Uplink / CDMA / Upper Edge / AGC threshold



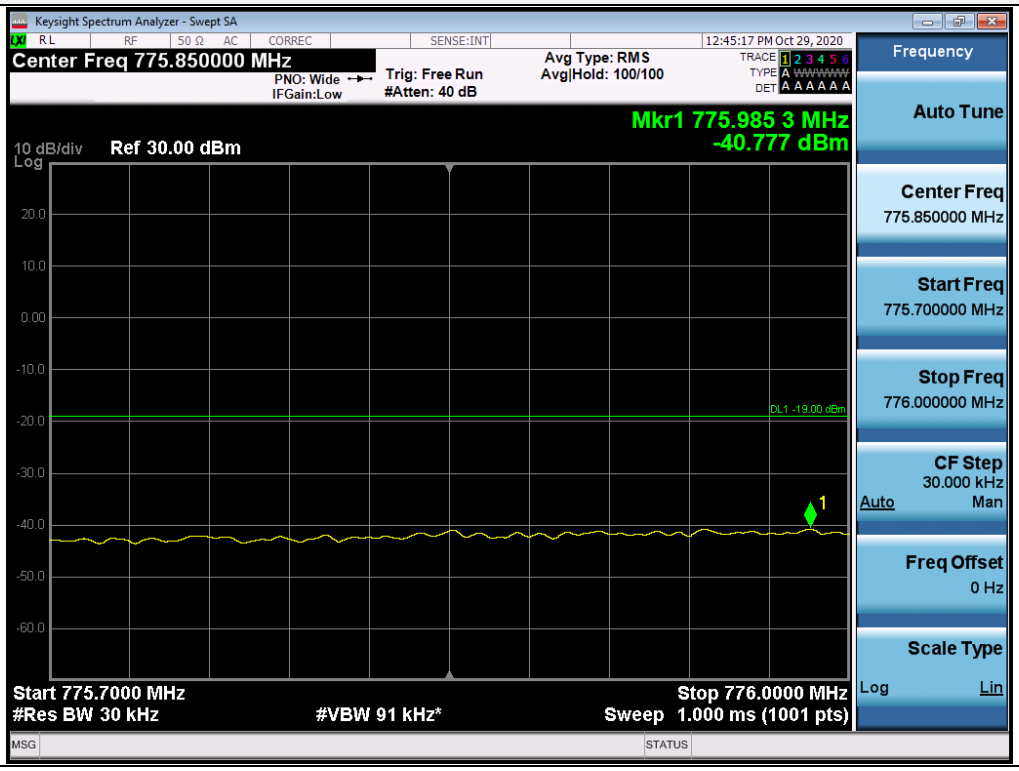
Out-of-Band Emissions / Upper 700 MHz / Uplink / CDMA / Upper Edge / AGC threshold +10 dB



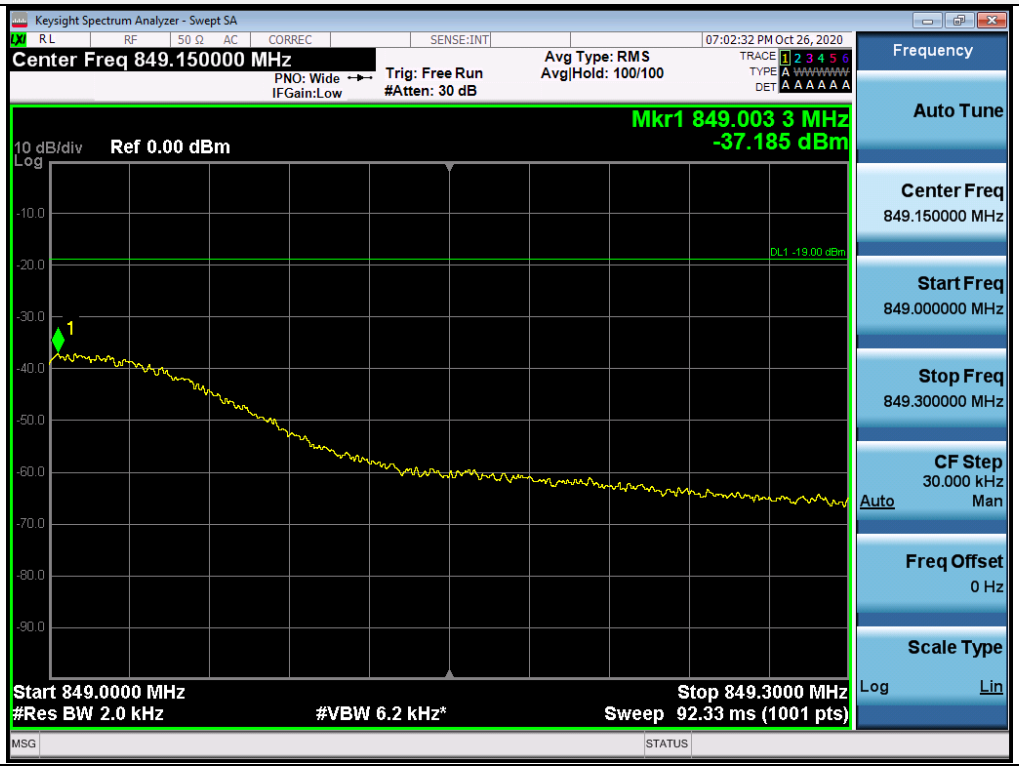
Out-of-Band Emissions / Upper 700 MHz / Uplink / CDMA / Lower Edge / AGC threshold



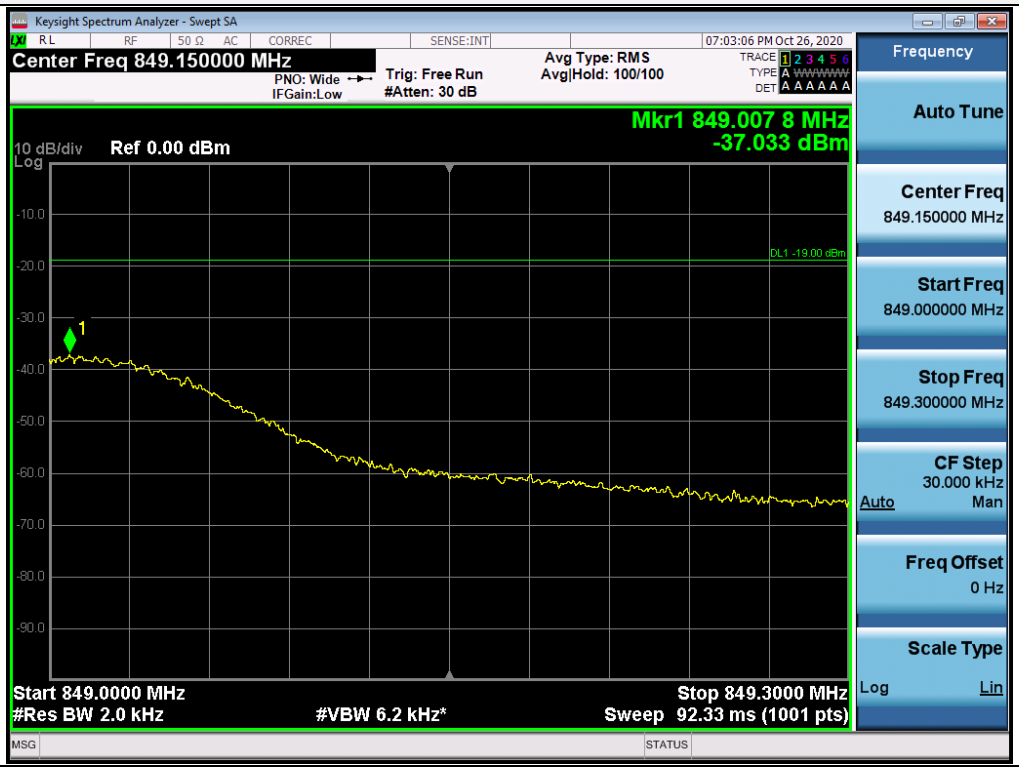
Out-of-Band Emissions / Upper 700 MHz / Uplink / CDMA / Lower Edge / AGC threshold +10 dB



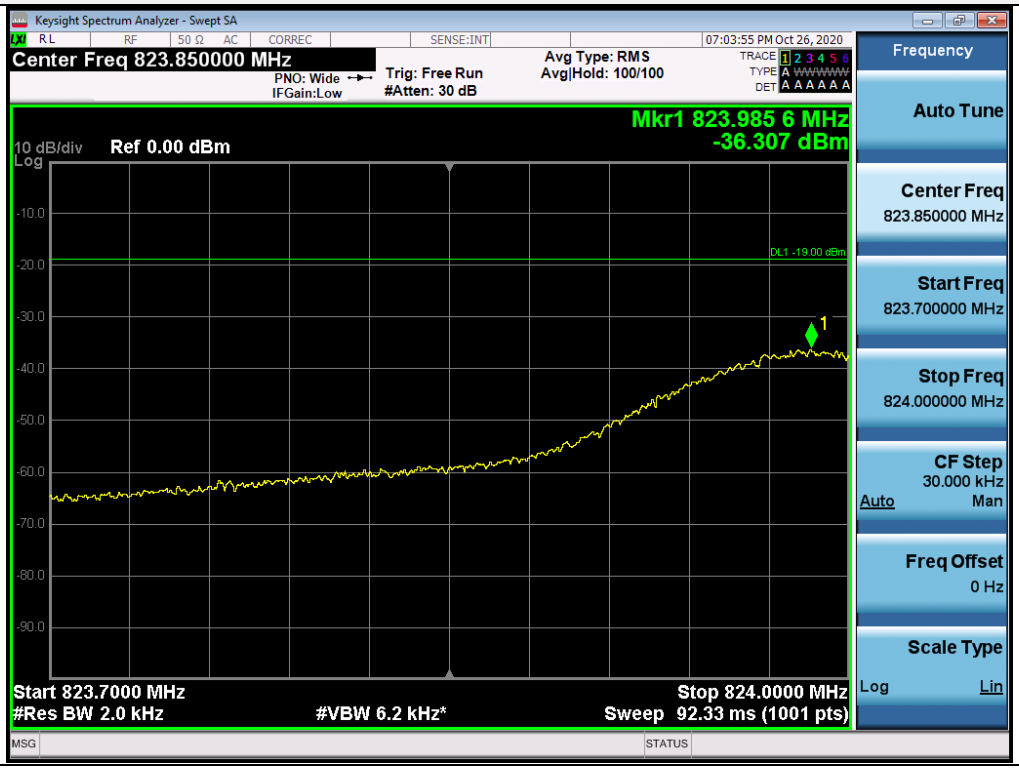
Out-of-Band Emissions / Cellular / Uplink / GSM / Upper Edge / AGC threshold



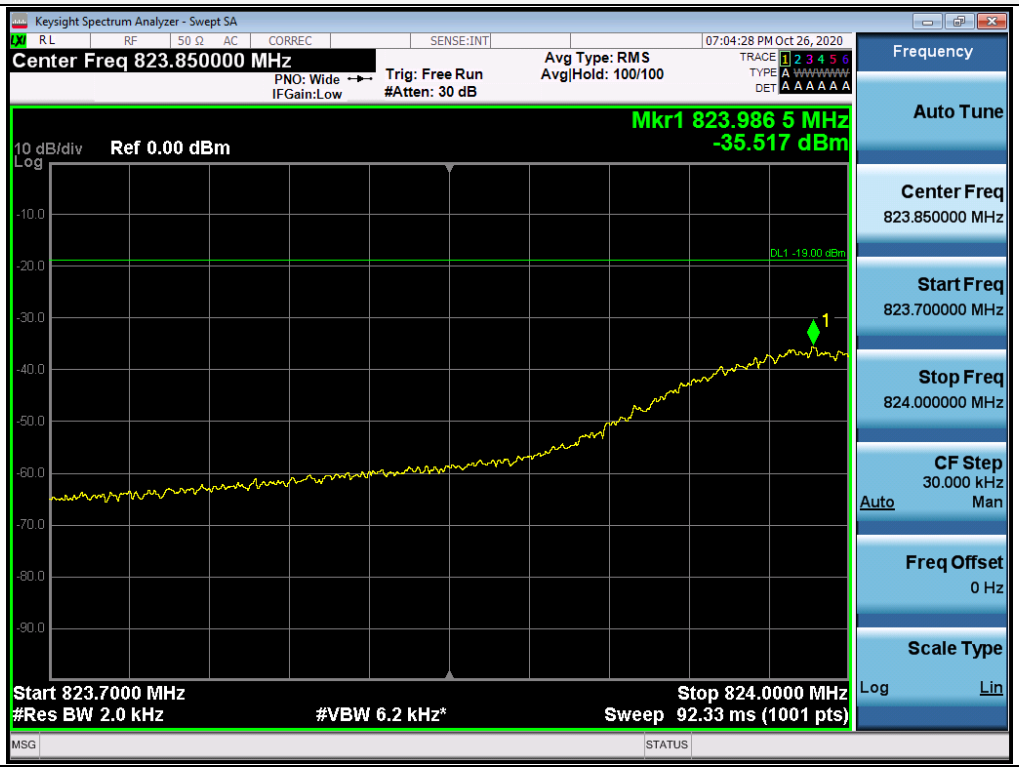
Out-of-Band Emissions / Cellular / Uplink / GSM / Upper Edge / AGC threshold +10 dB



Out-of-Band Emissions / Cellular / Uplink / GSM / Lower Edge / AGC threshold



Out-of-Band Emissions / Cellular / Uplink / GSM / Lower Edge / AGC threshold +10 dB



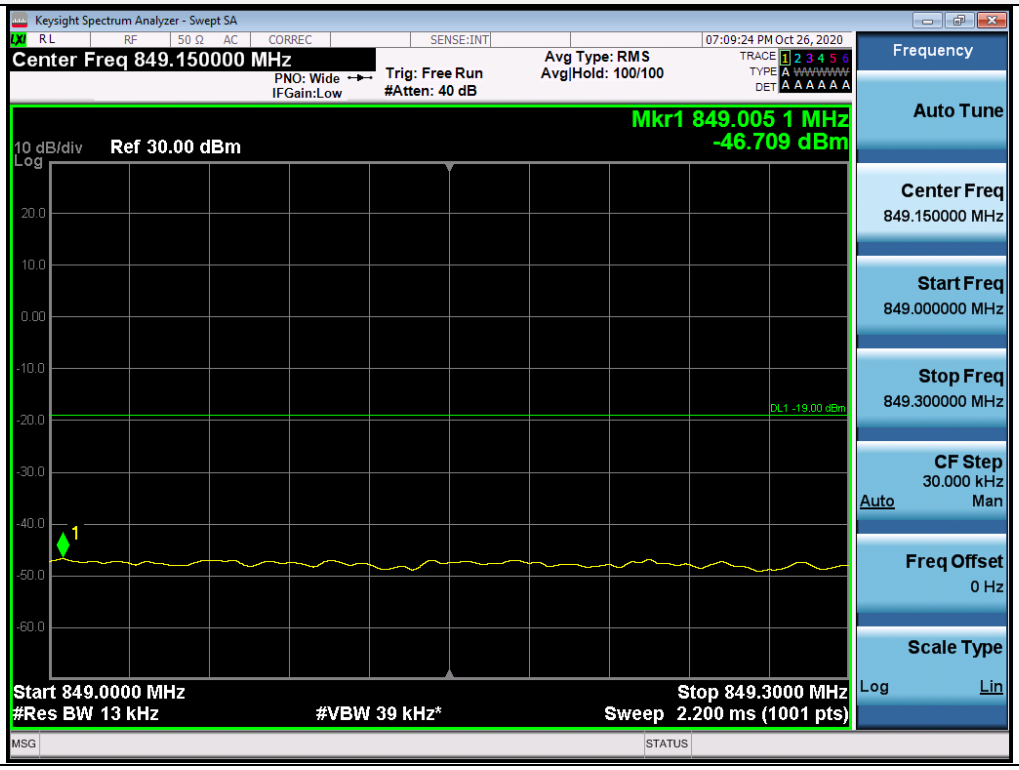
Out-of-Band Emissions / Cellular / Uplink / LTE 5 MHz / Upper Edge / AGC threshold

Out-of-Band Emissions / Cellular / Uplink / LTE 5 MHz / Upper Edge / AGC threshold +10 dB

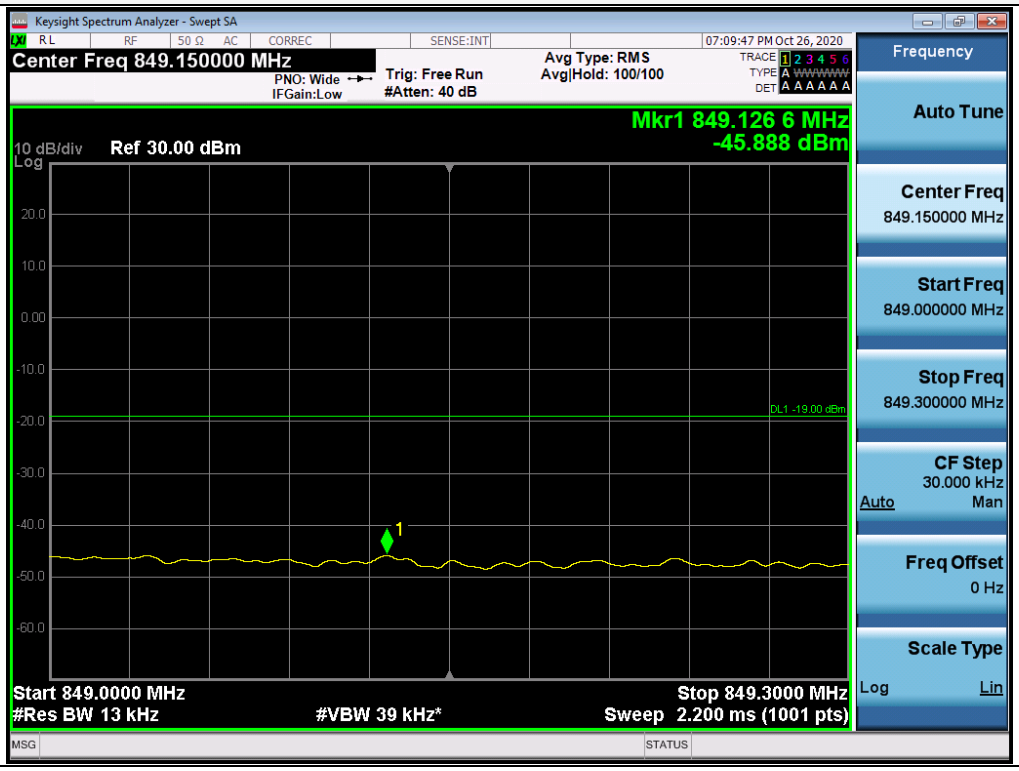
Out-of-Band Emissions / Cellular / Uplink / LTE 5 MHz / Lower Edge / AGC threshold

Out-of-Band Emissions / Cellular / Uplink / LTE 5 MHz / Lower Edge / AGC threshold +10 dB

Out-of-Band Emissions / Cellular / Uplink / CDMA / Upper Edge / AGC threshold

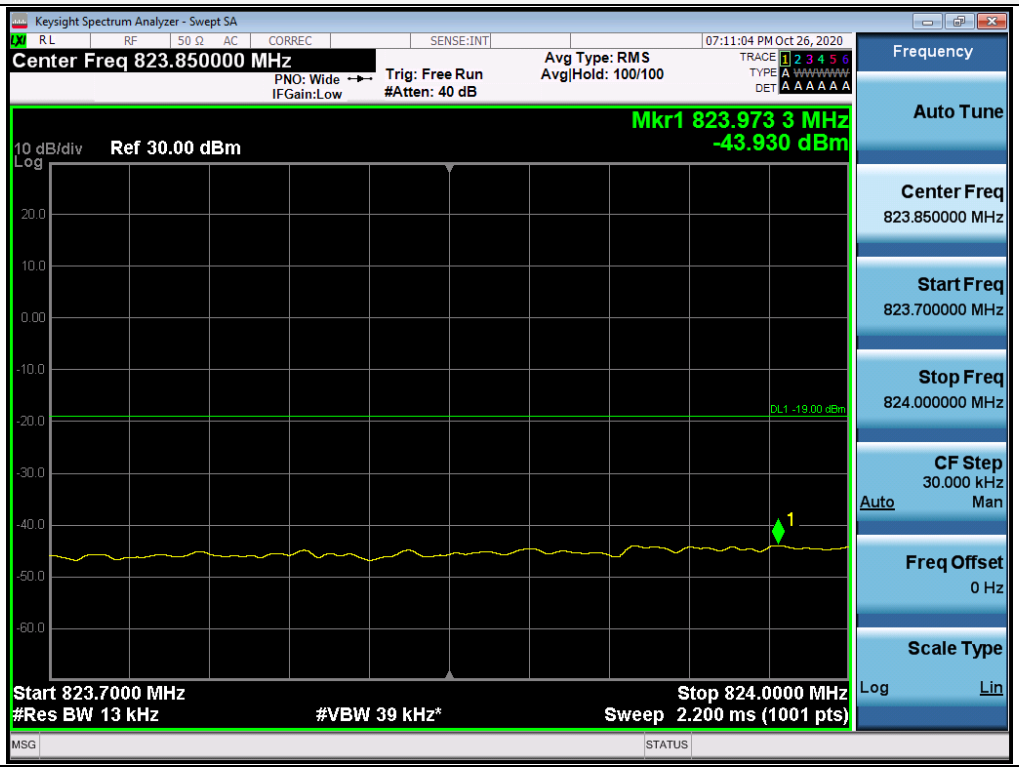


Out-of-Band Emissions / Cellular / Uplink / CDMA / Upper Edge / AGC threshold +10 dB

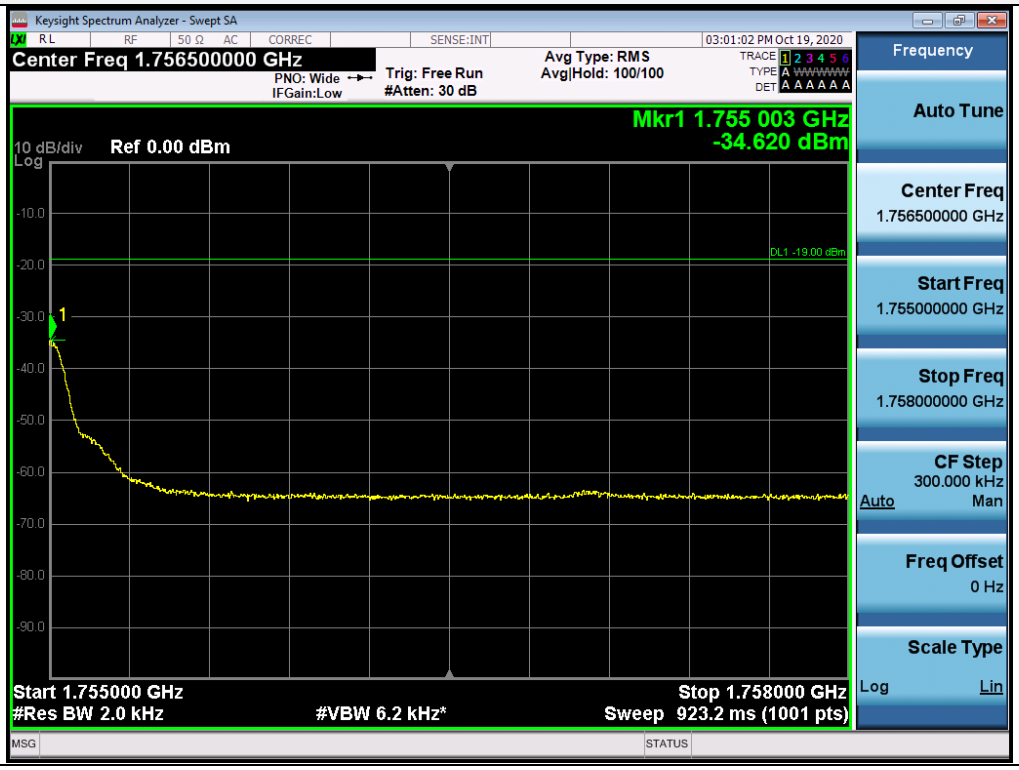


Out-of-Band Emissions / Cellular / Uplink / CDMA / Lower Edge / AGC threshold

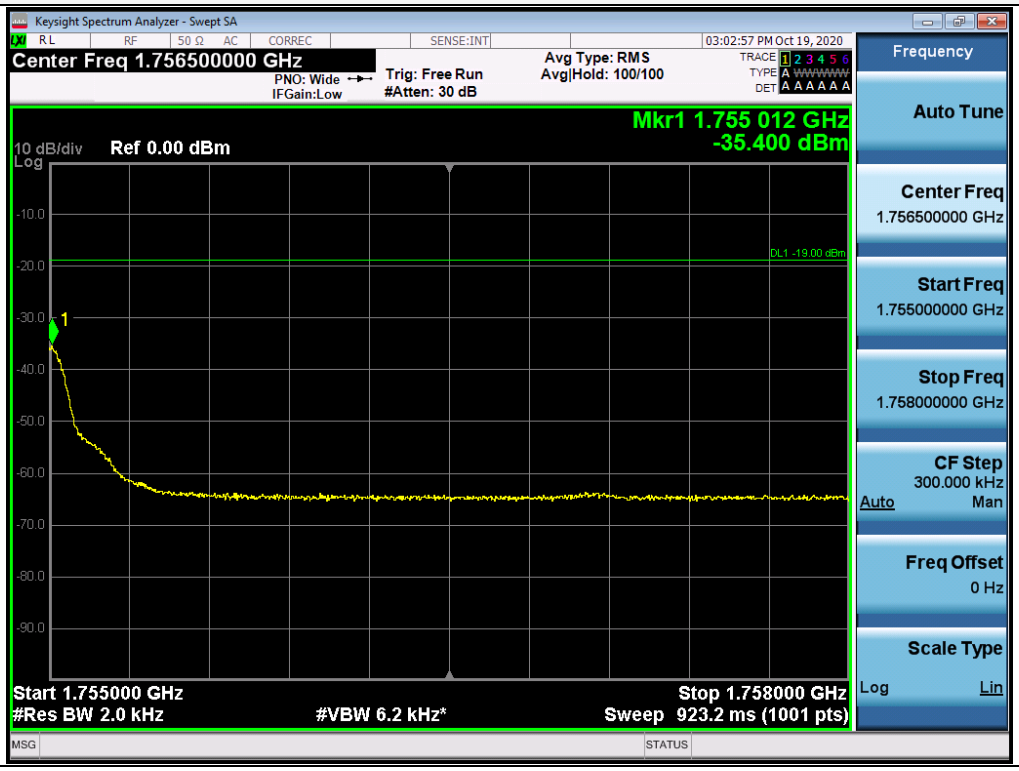
Out-of-Band Emissions / Cellular / Uplink / CDMA / Lower Edge / AGC threshold +10 dB



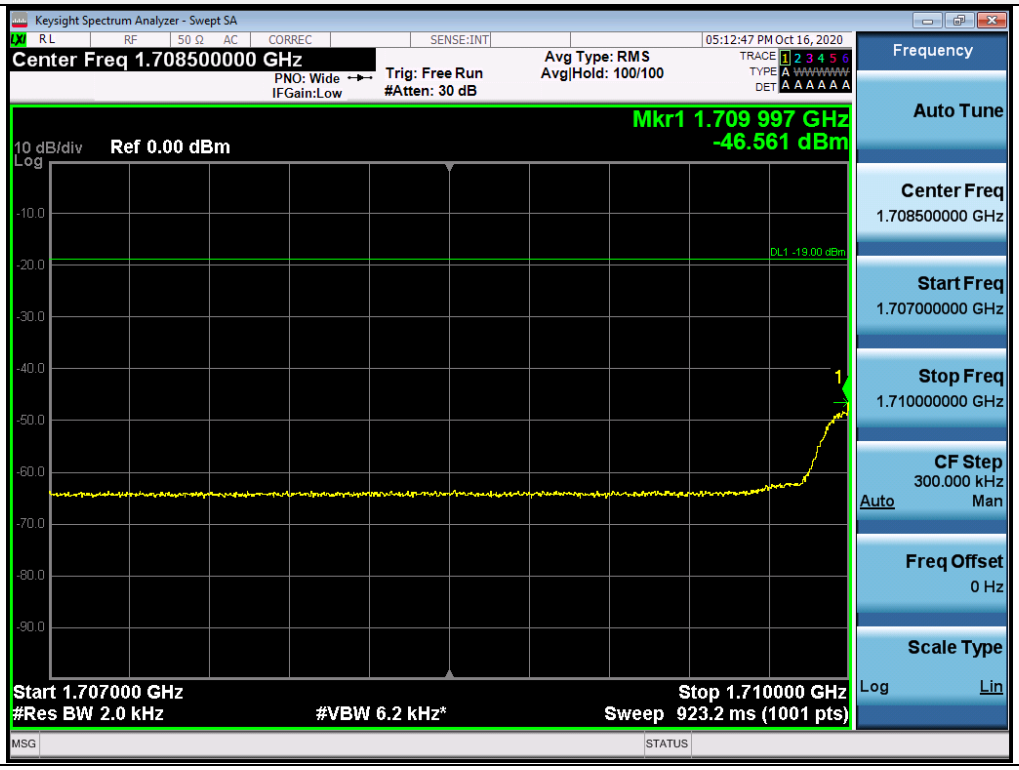
Out-of-Band Emissions / AWS-1 / Uplink / GSM / Upper Edge / AGC threshold



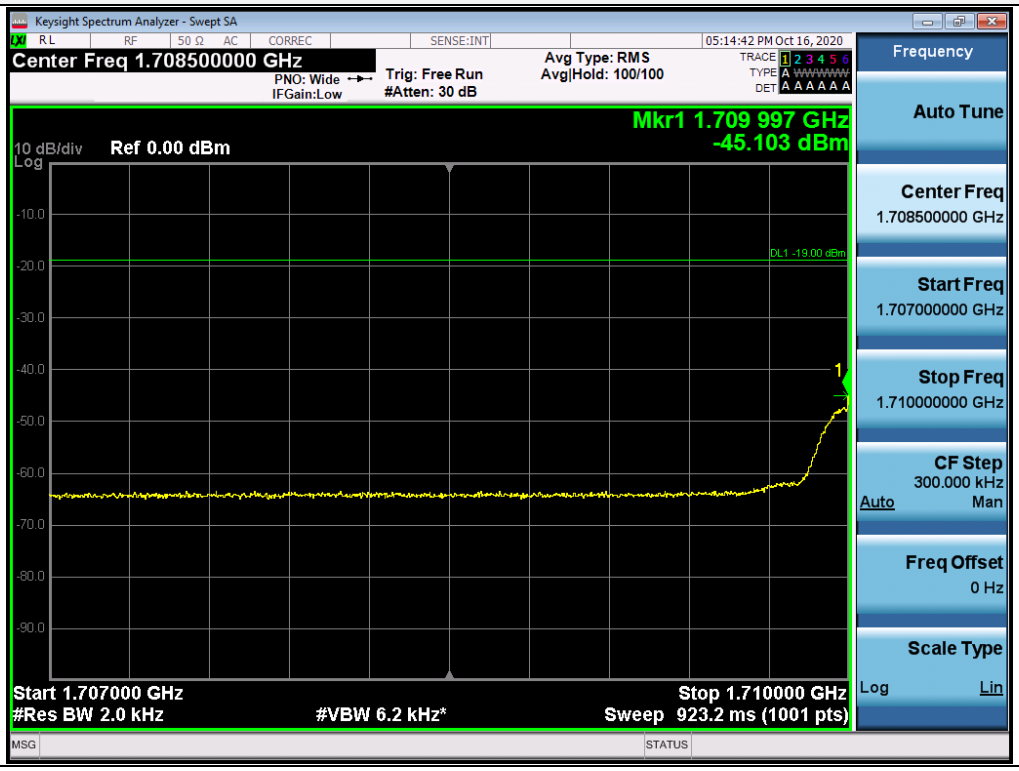
Out-of-Band Emissions / AWS-1 / Uplink / GSM / Upper Edge / AGC threshold +10 dB



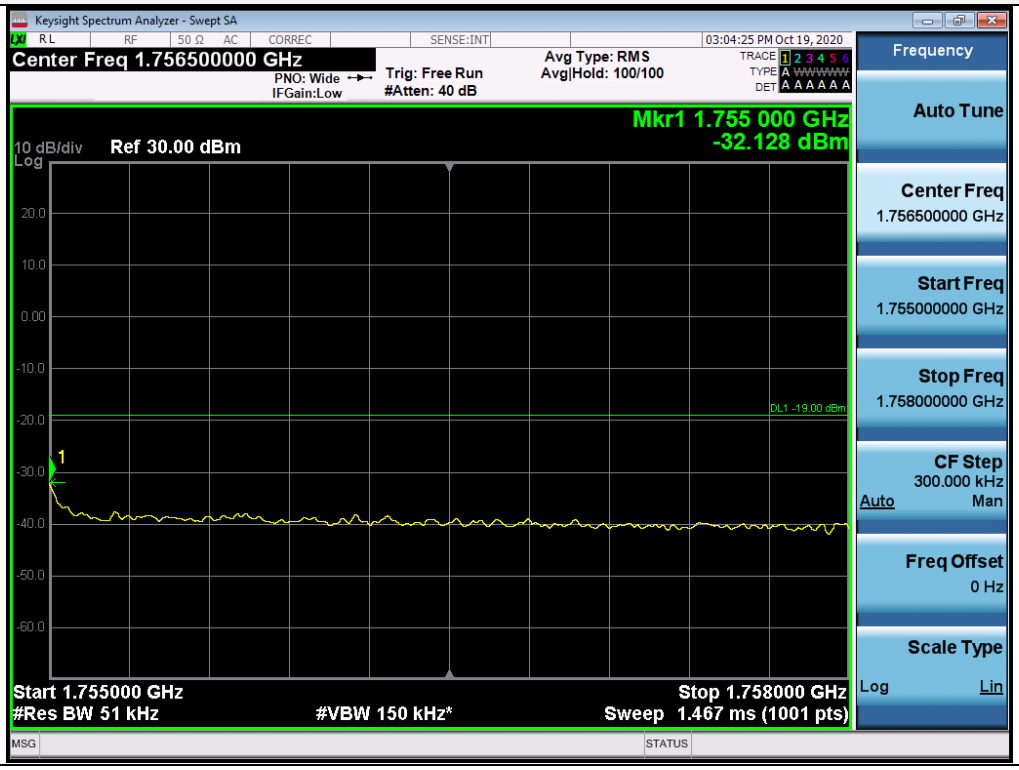
Out-of-Band Emissions / AWS-1 / Uplink / GSM / Lower Edge / AGC threshold



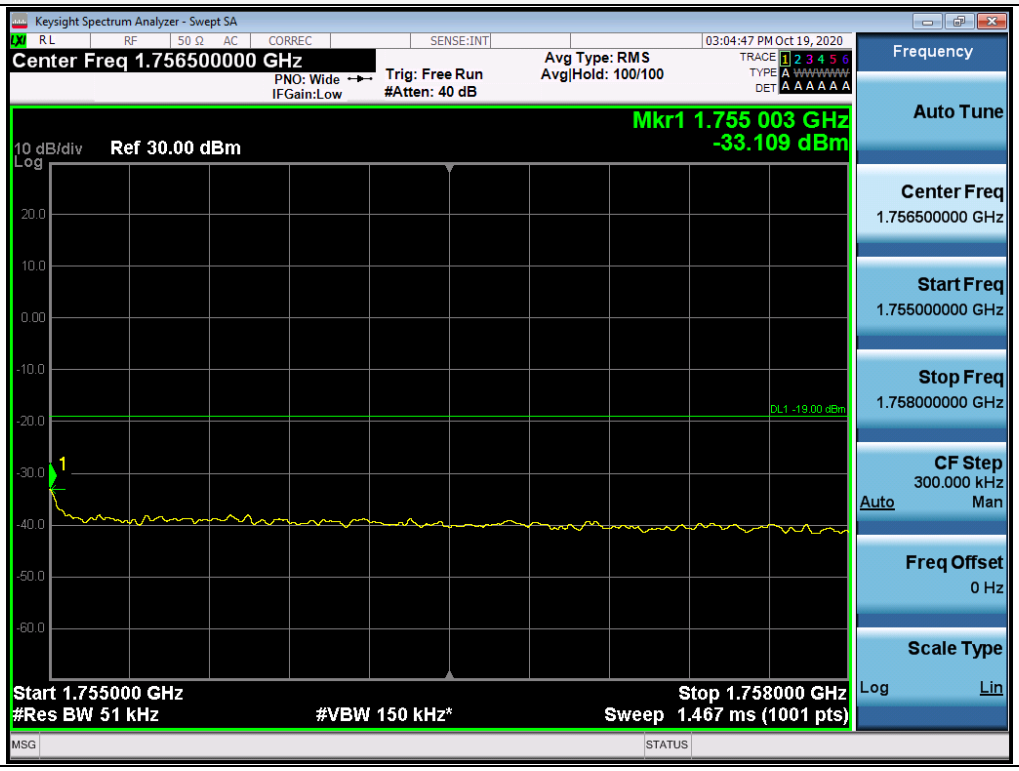
Out-of-Band Emissions / AWS-1 / Uplink / GSM / Lower Edge / AGC threshold +10 dB



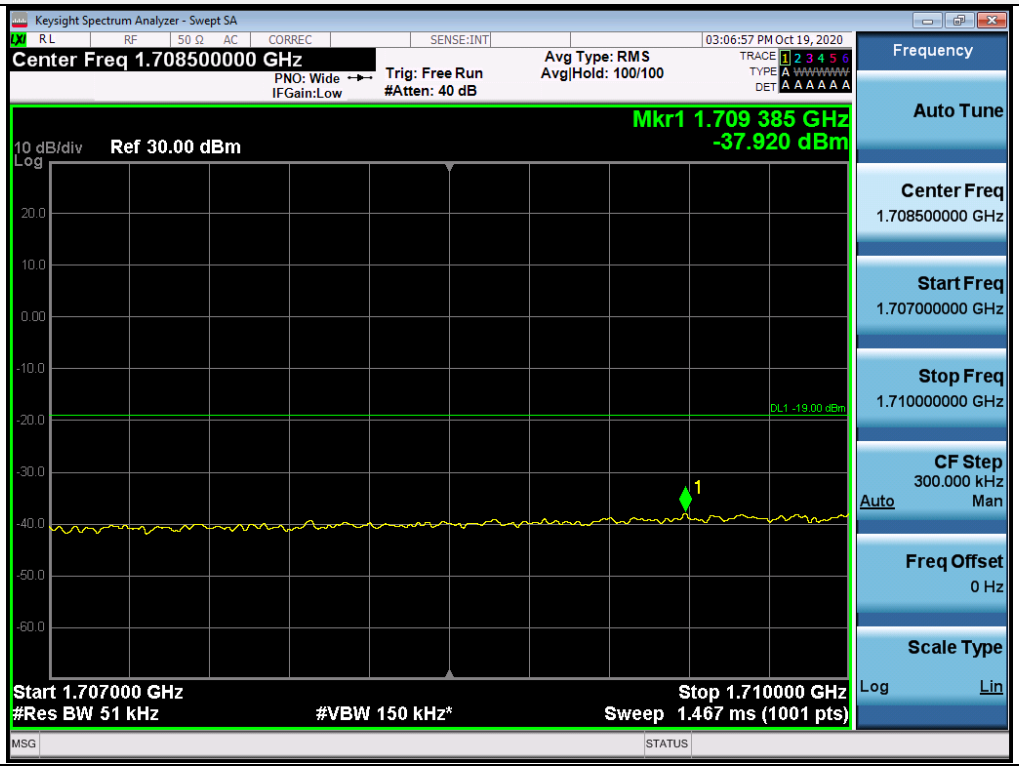
Out-of-Band Emissions / AWS-1 / Uplink / LTE 5 MHz / Upper Edge / AGC threshold



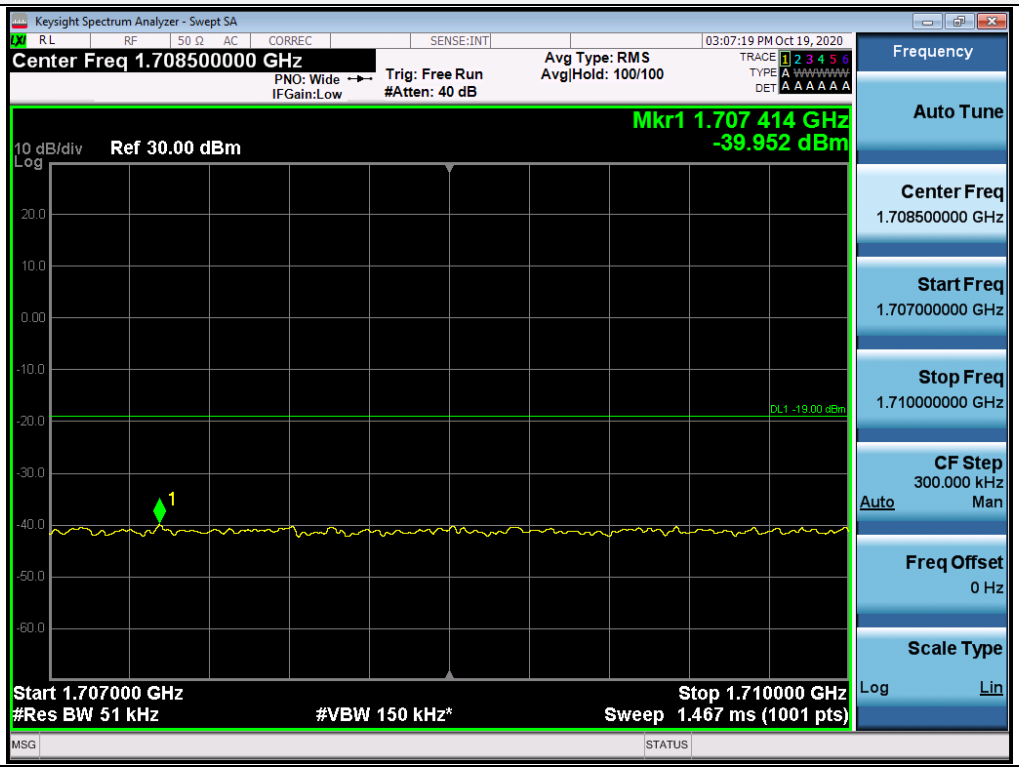
Out-of-Band Emissions / AWS-1 / Uplink / LTE 5 MHz / Upper Edge / AGC threshold +10 dB



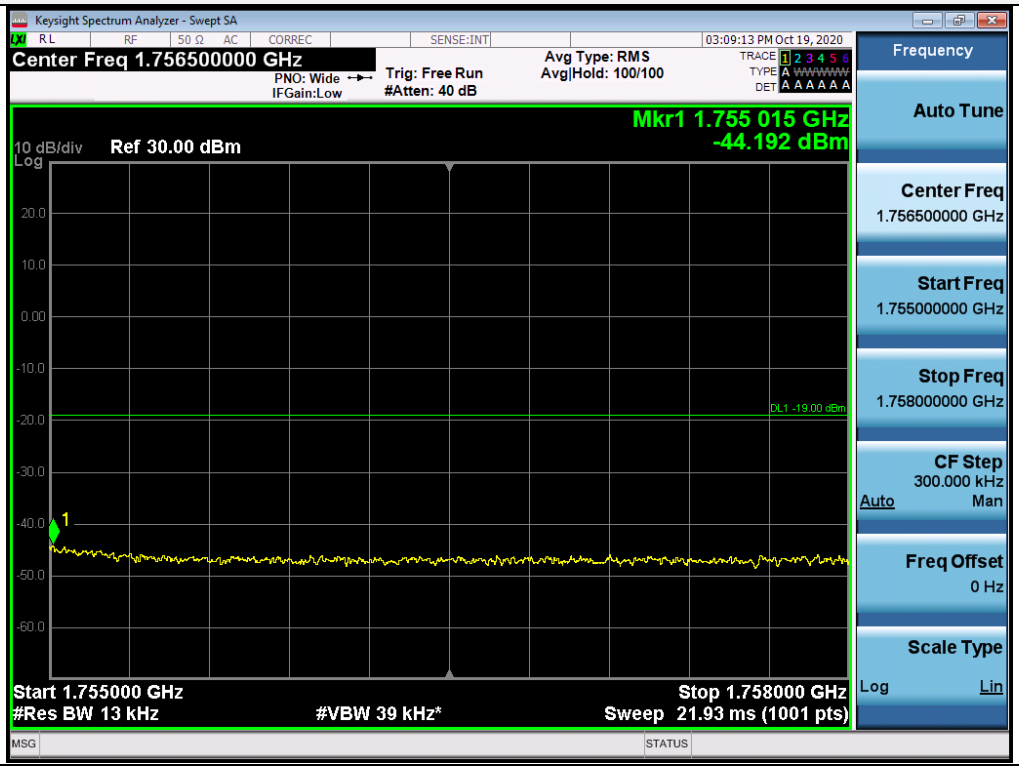
Out-of-Band Emissions / AWS-1 / Uplink / LTE 5 MHz / Lower Edge / AGC threshold



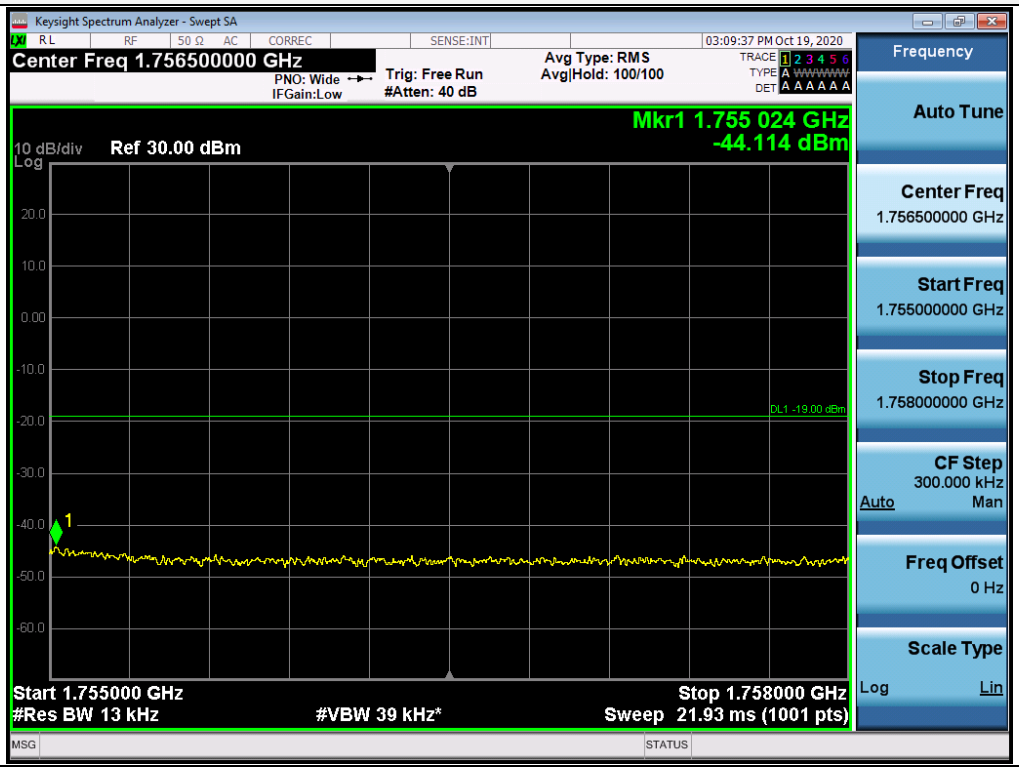
Out-of-Band Emissions / AWS-1 / Uplink / LTE 5 MHz / Lower Edge / AGC threshold +10 dB



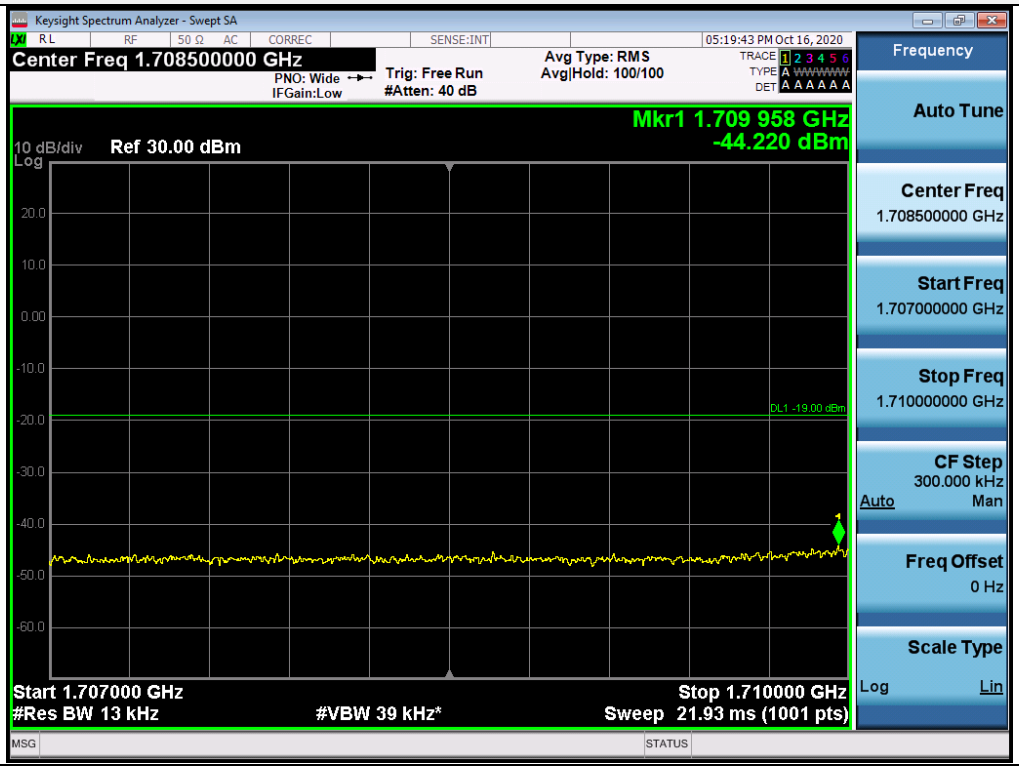
Out-of-Band Emissions / AWS-1 / Uplink / CDMA / Upper Edge / AGC threshold



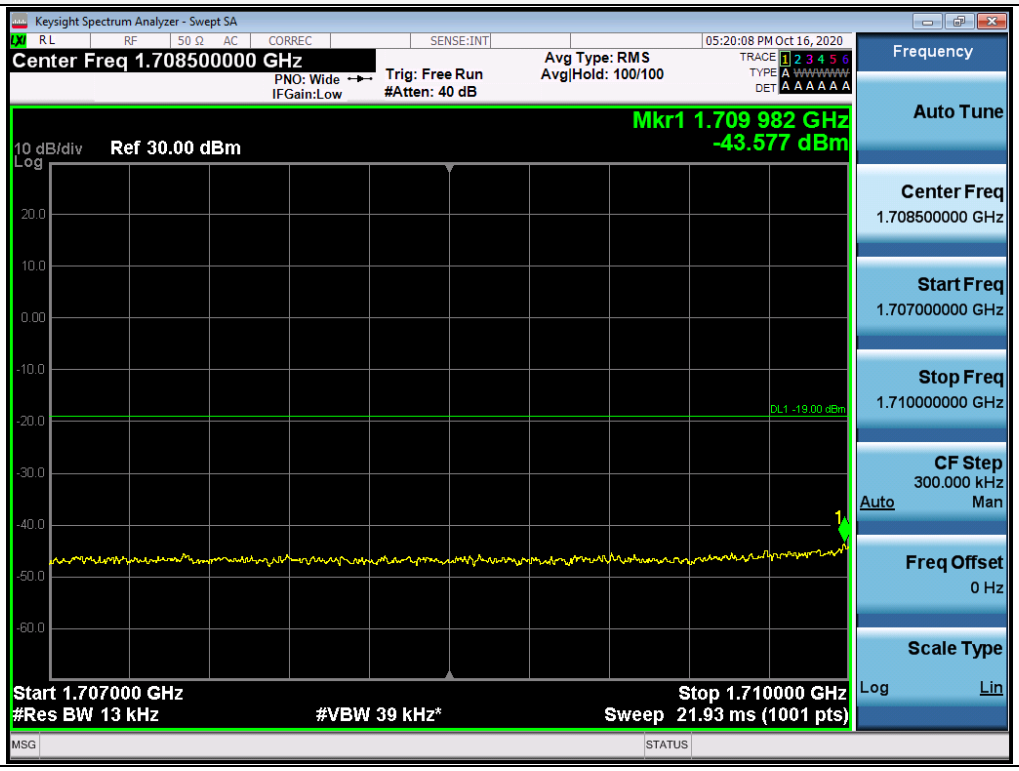
Out-of-Band Emissions / AWS-1 / Uplink / CDMA / Upper Edge / AGC threshold +10 dB



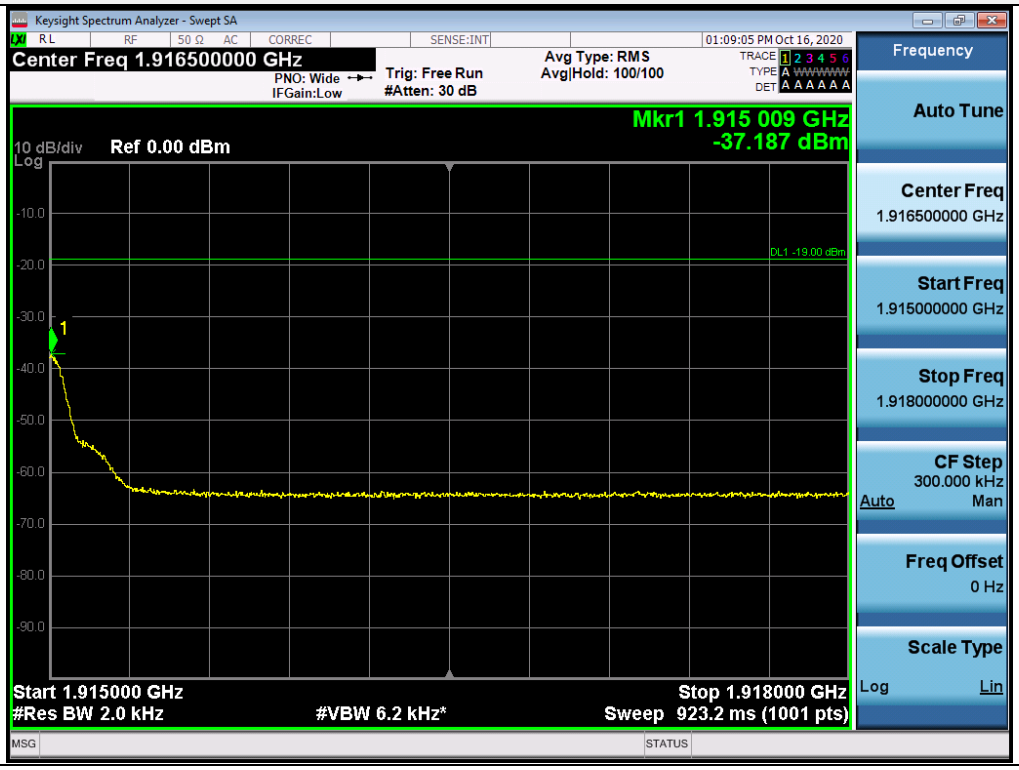
Out-of-Band Emissions / AWS-1 / Uplink / CDMA / Lower Edge / AGC threshold



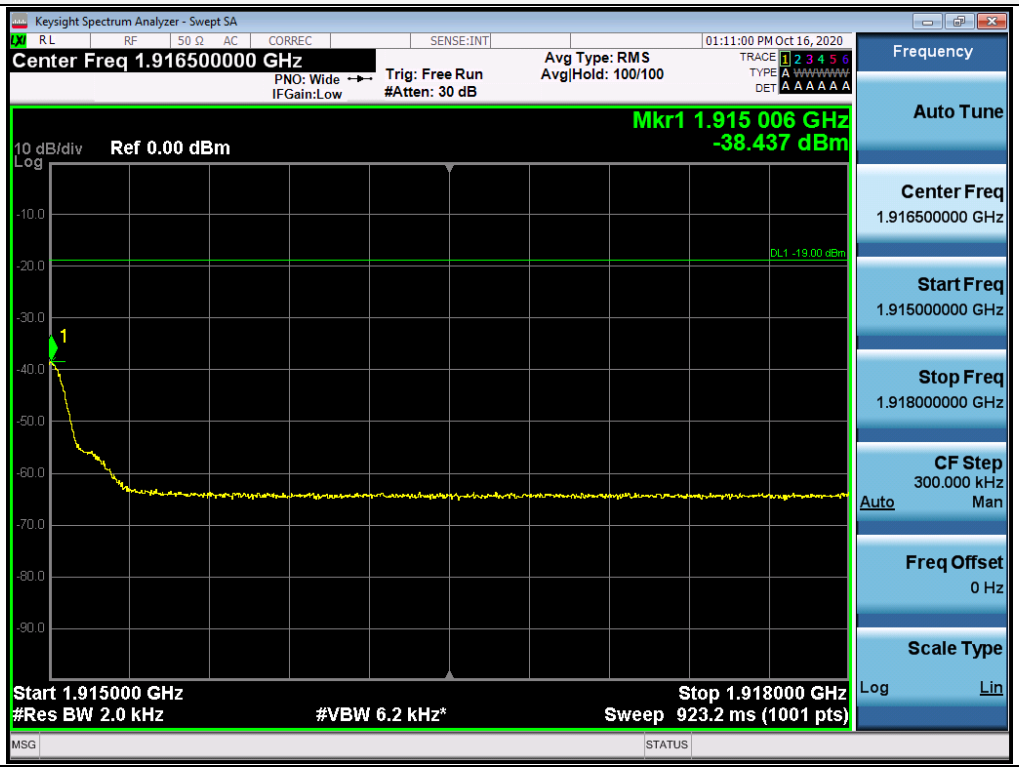
Out-of-Band Emissions / AWS-1 / Uplink / CDMA / Lower Edge / AGC threshold +10 dB



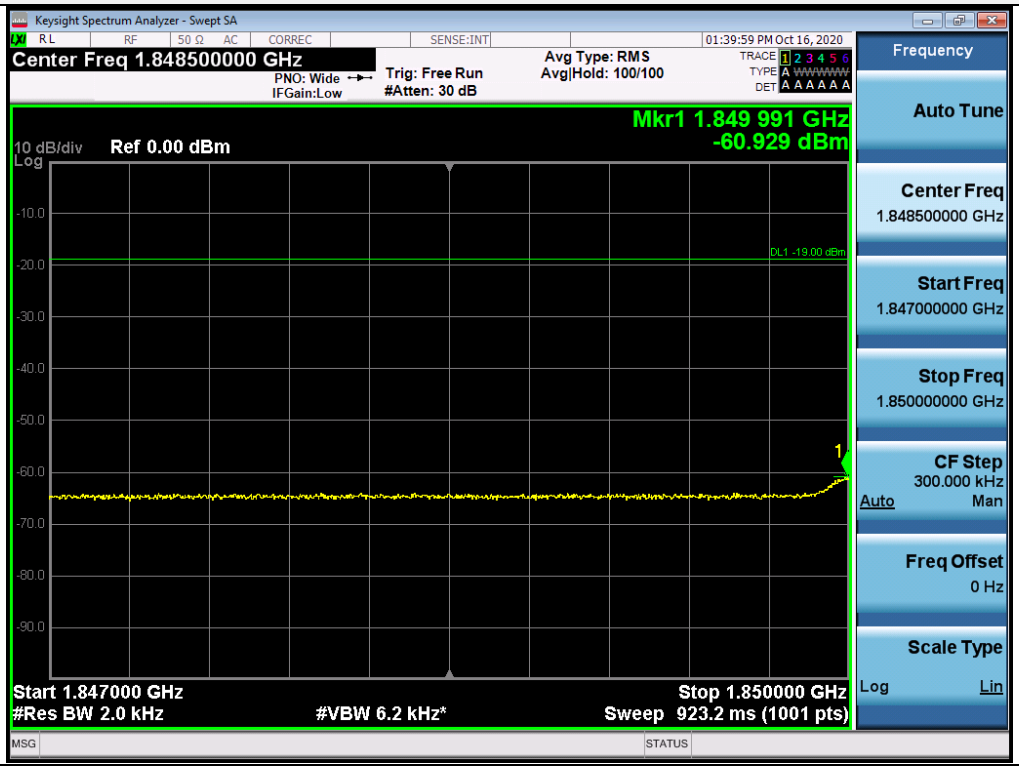
Out-of-Band Emissions / Broadband PCS / Uplink / GSM / Upper Edge / AGC threshold



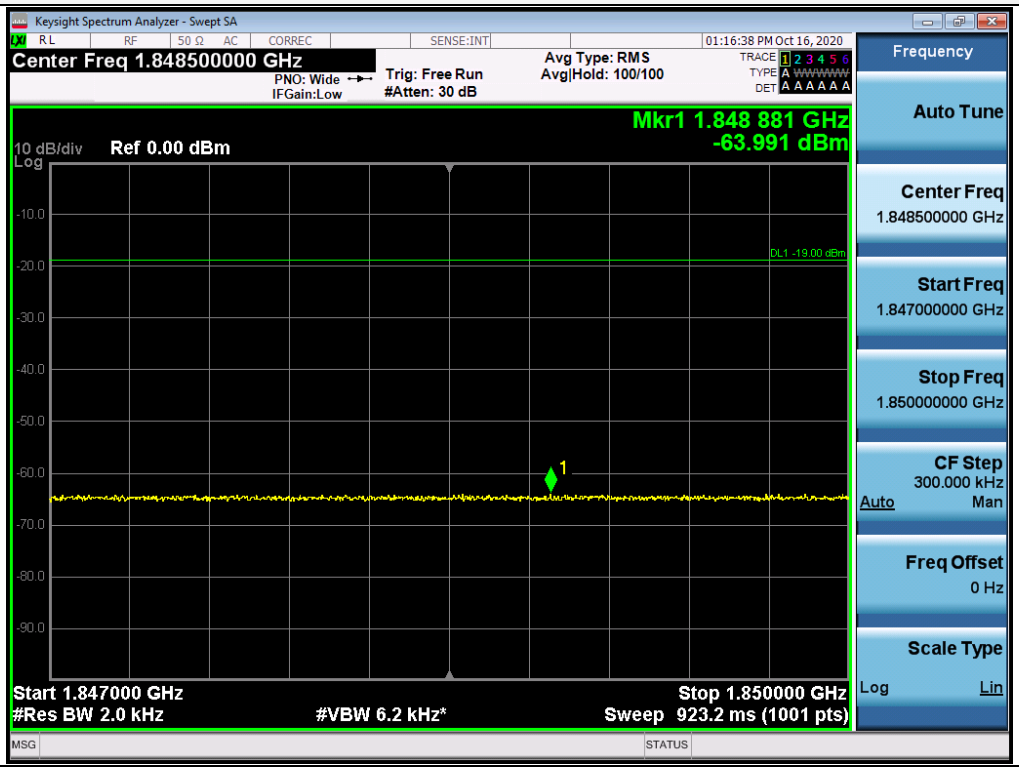
Out-of-Band Emissions / Broadband PCS / Uplink / GSM / Upper Edge / AGC threshold +10 dB



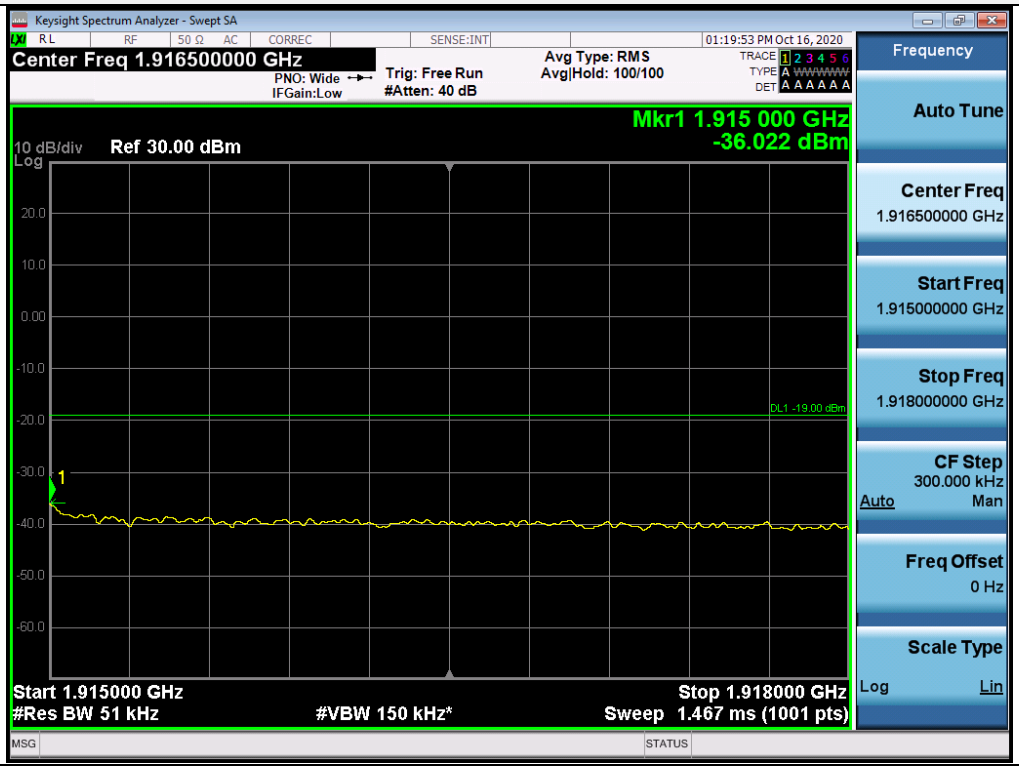
Out-of-Band Emissions / Broadband PCS / Uplink / GSM / Lower Edge / AGC threshold



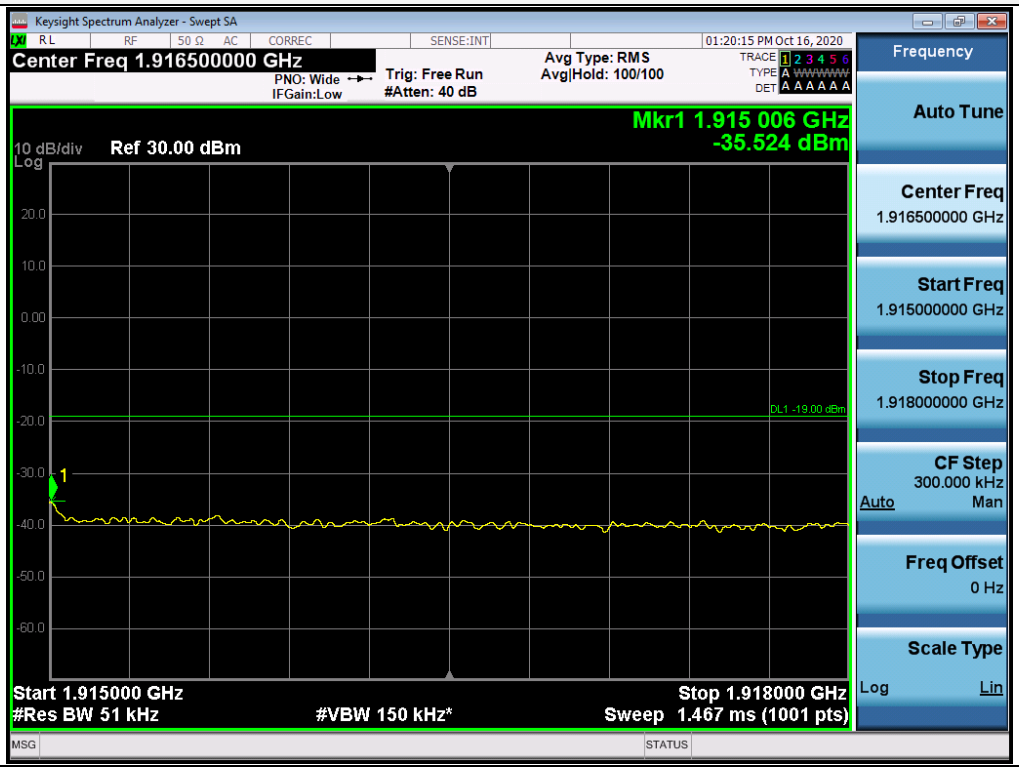
Out-of-Band Emissions / Broadband PCS / Uplink / GSM / Lower Edge / AGC threshold +10 dB



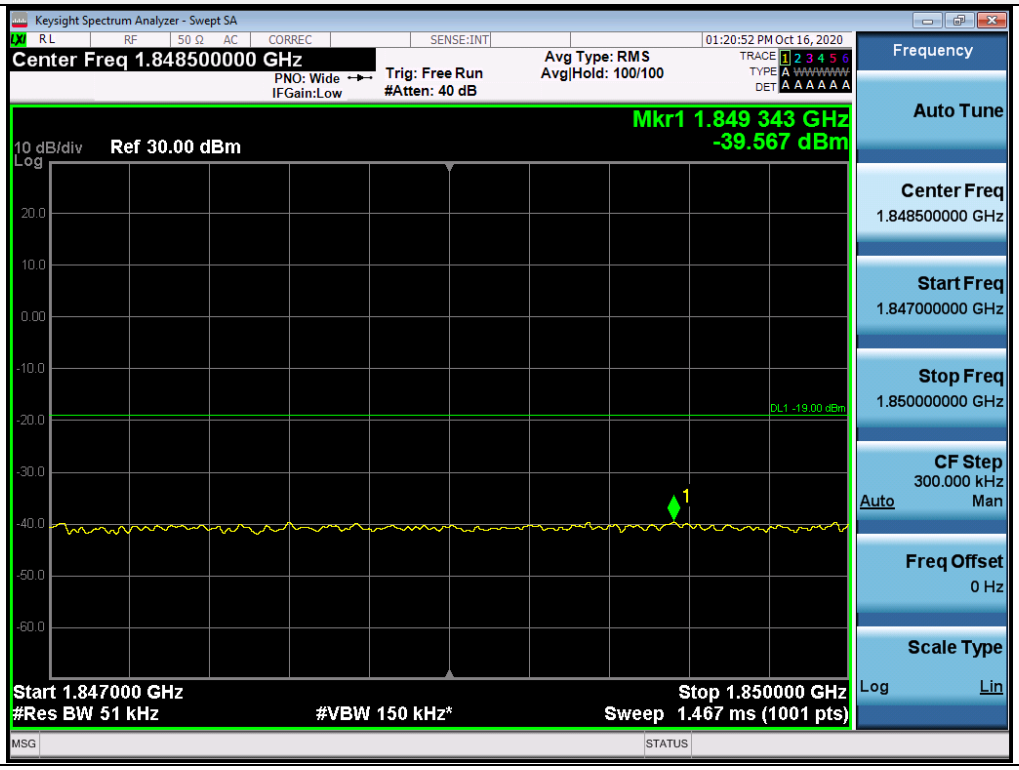
Out-of-Band Emissions / Broadband PCS / Uplink / LTE 5 MHz / Upper Edge / AGC threshold



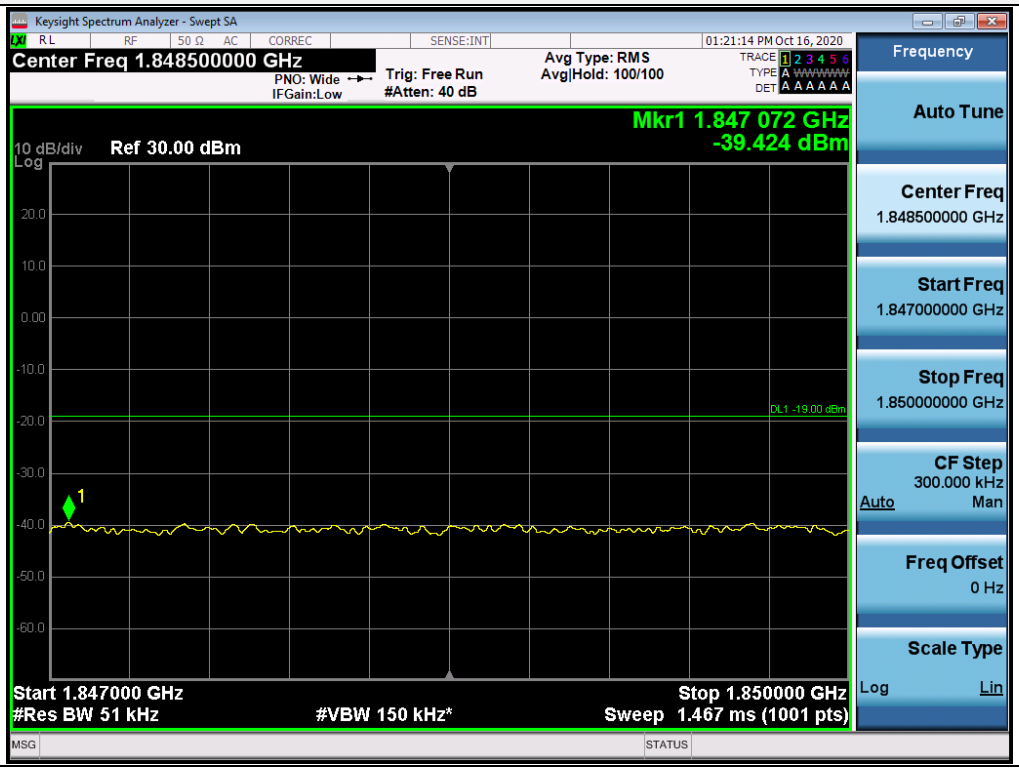
Out-of-Band Emissions / Broadband PCS / Uplink / LTE 5 MHz / Upper Edge / AGC threshold +10 dB



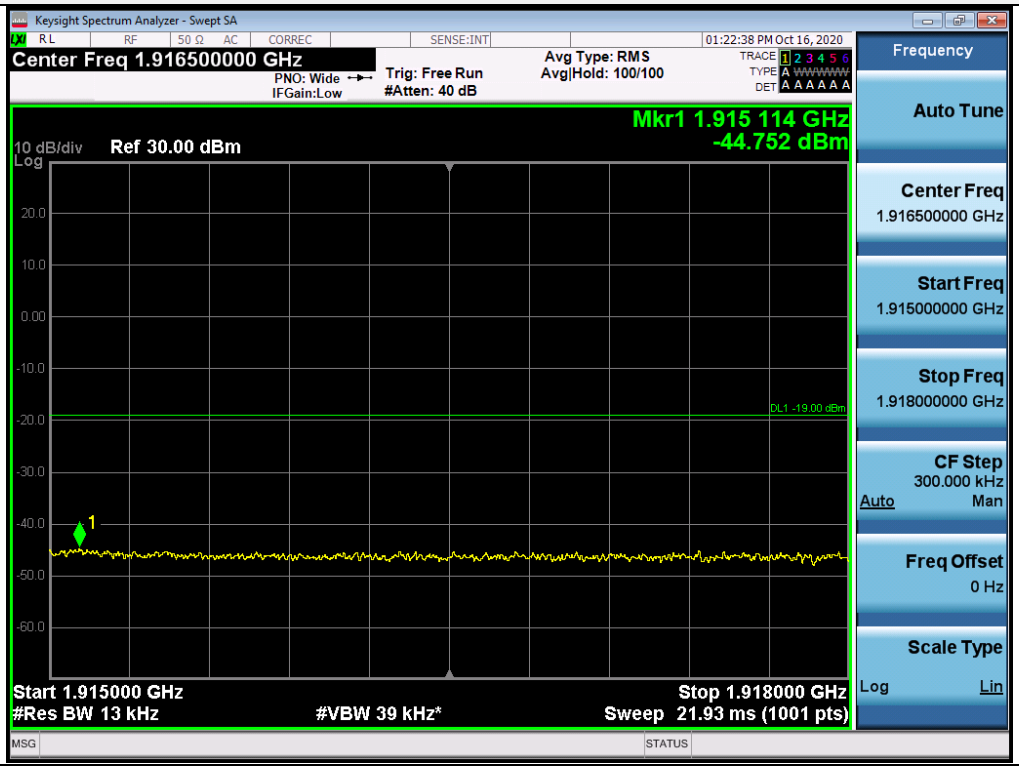
Out-of-Band Emissions / Broadband PCS / Uplink / LTE 5 MHz / Lower Edge / AGC threshold



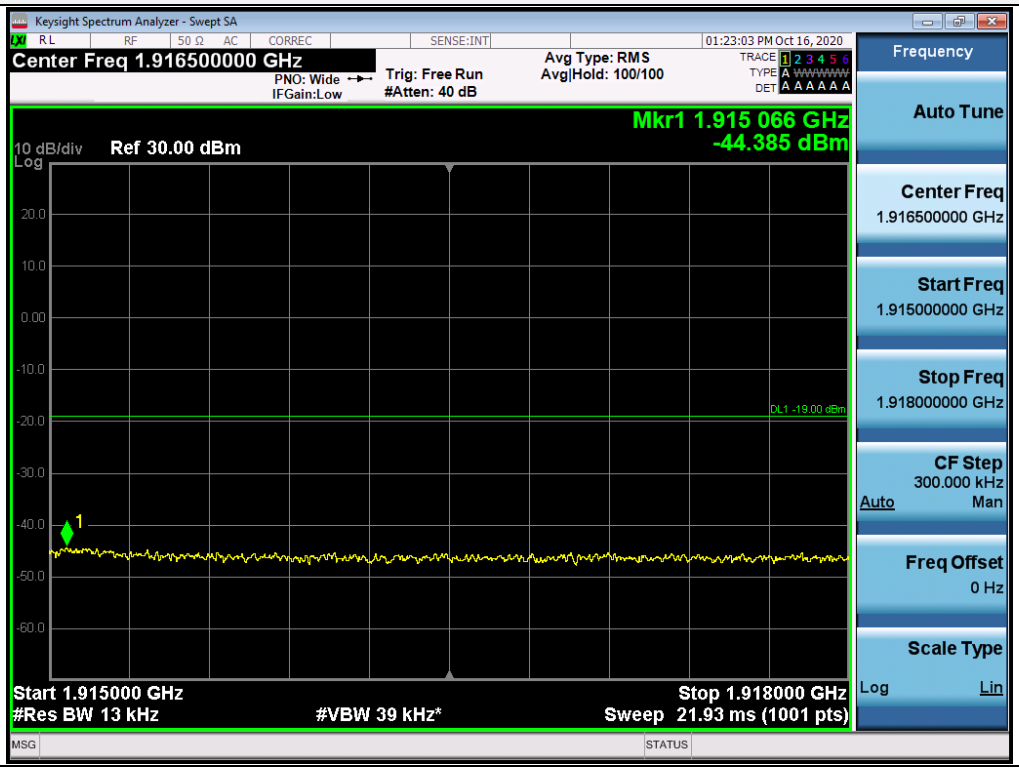
Out-of-Band Emissions / Broadband PCS / Uplink / LTE 5 MHz / Lower Edge / AGC threshold +10 dB



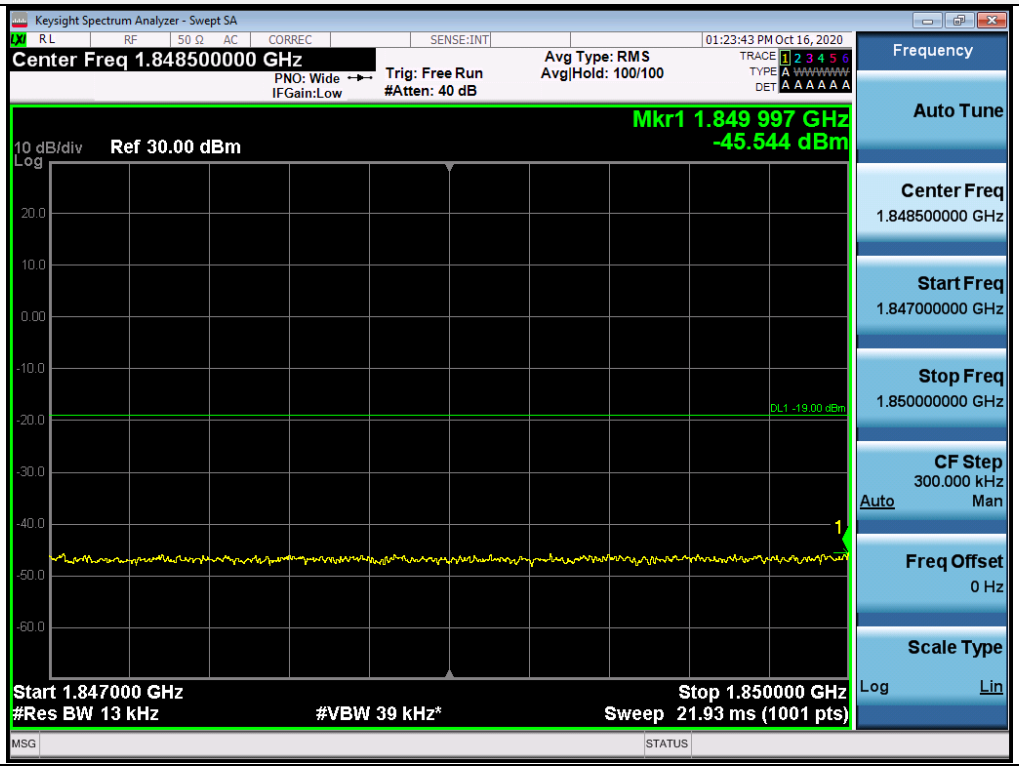
Out-of-Band Emissions / Broadband PCS / Uplink / CDMA / Upper Edge / AGC threshold



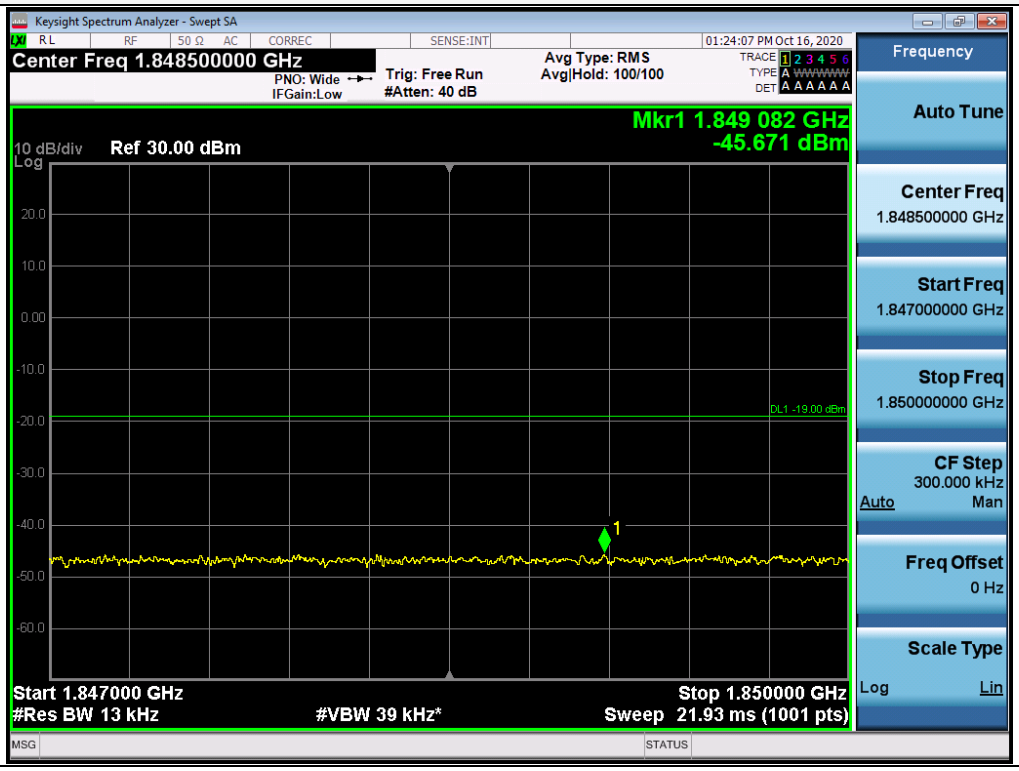
Out-of-Band Emissions / Broadband PCS / Uplink / CDMA / Upper Edge / AGC threshold +10 dB



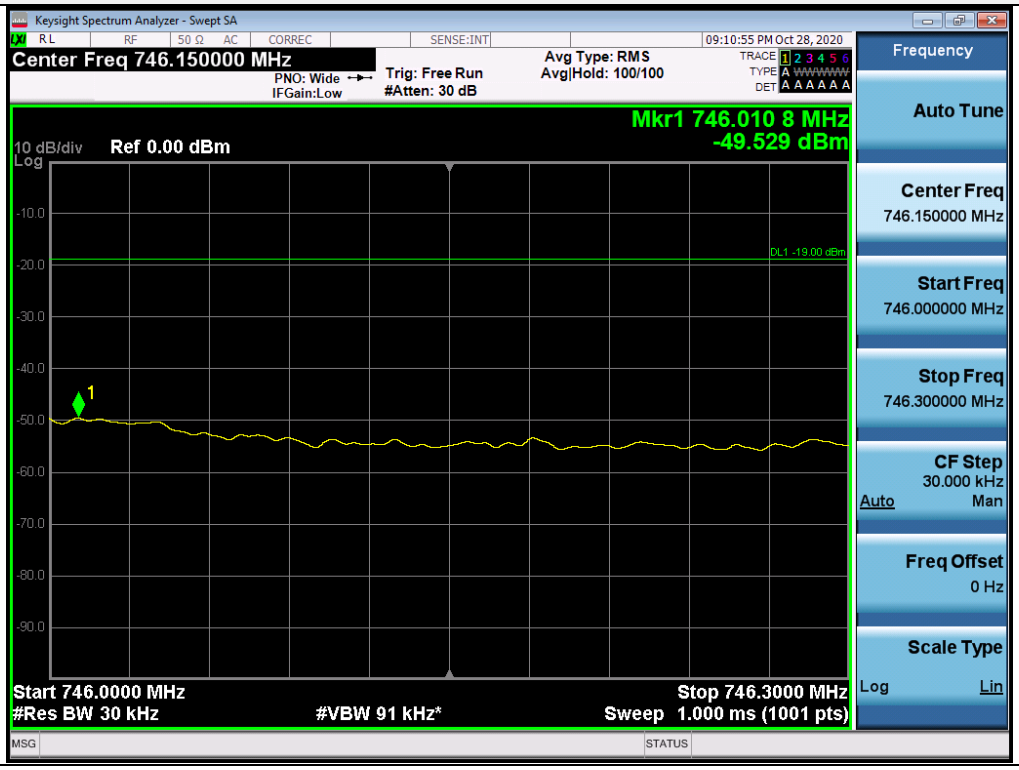
Out-of-Band Emissions / Broadband PCS / Uplink / CDMA / Lower Edge / AGC threshold



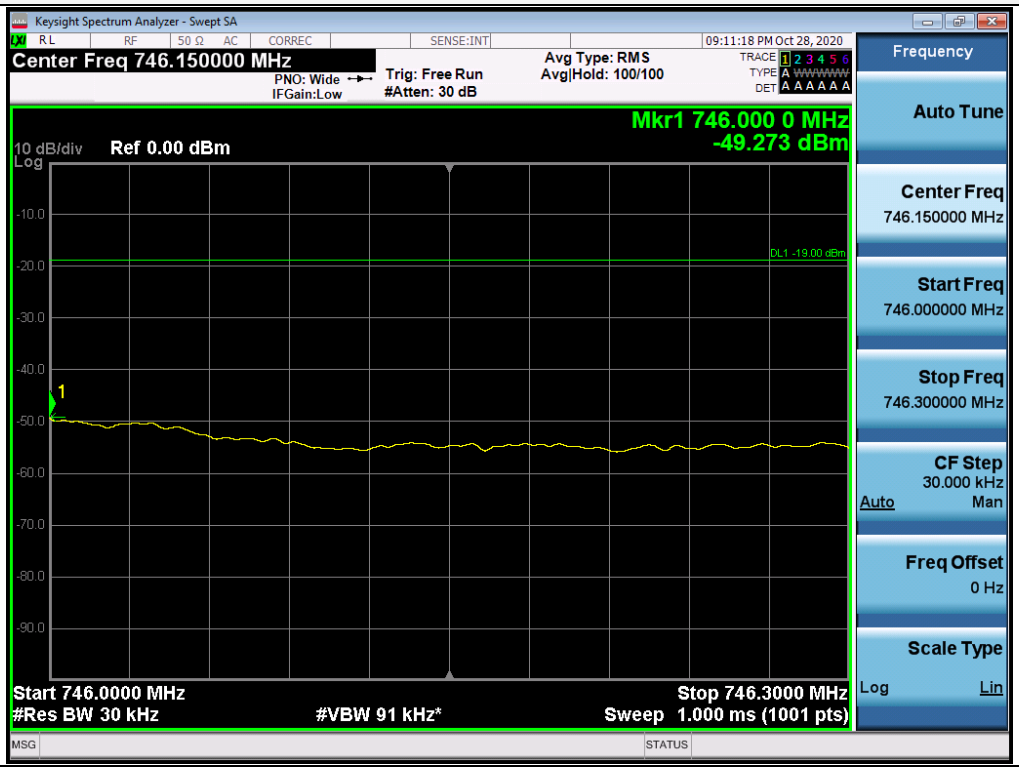
Out-of-Band Emissions / Broadband PCS / Uplink / CDMA / Lower Edge / AGC threshold +10 dB



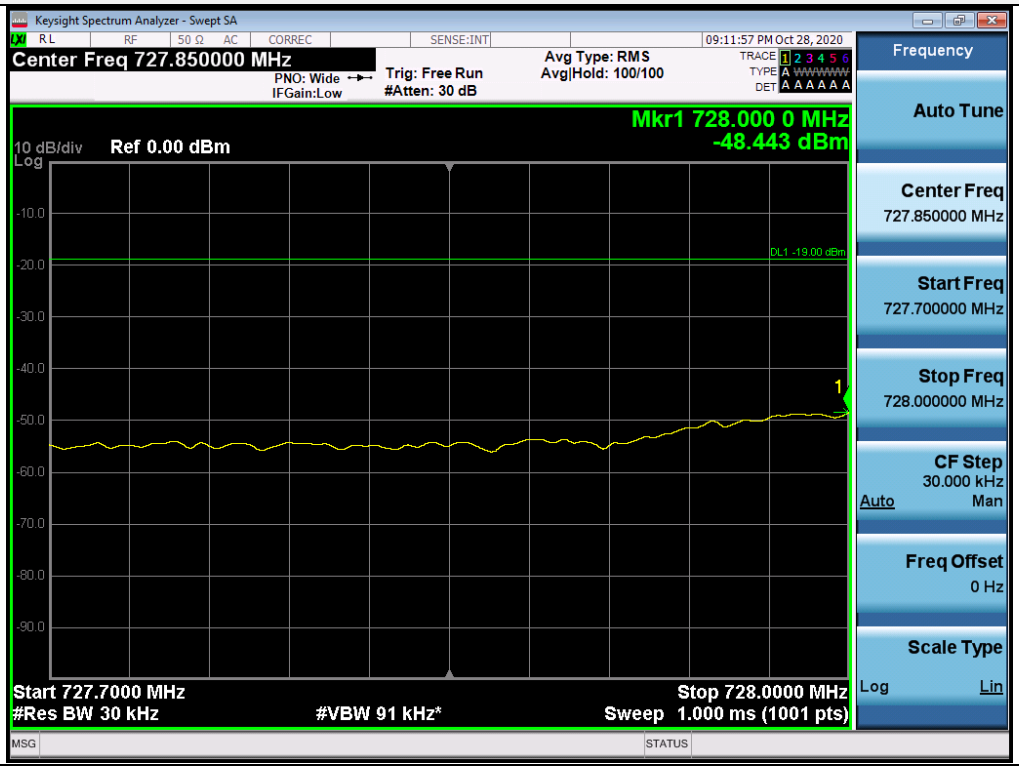
Out-of-Band Emissions / Lower 700 MHz / Downlink / GSM / Upper Edge / AGC threshold



Out-of-Band Emissions / Lower 700 MHz / Downlink / GSM / Upper Edge / AGC threshold +10 dB

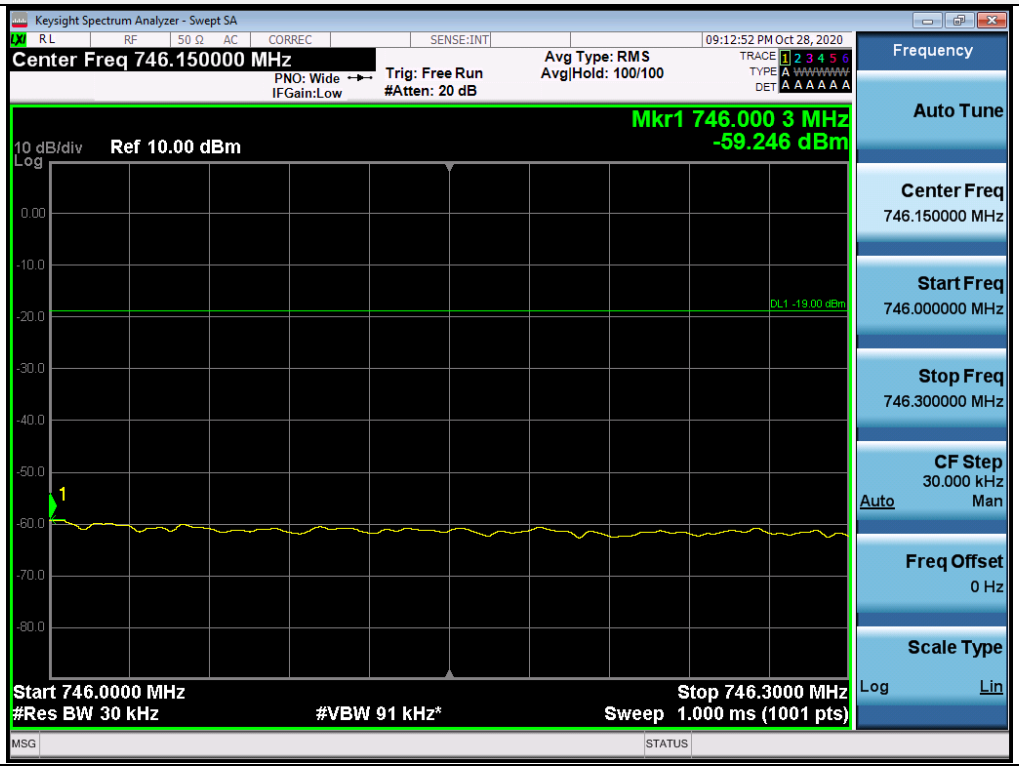


Out-of-Band Emissions / Lower 700 MHz / Downlink / GSM / Lower Edge / AGC threshold



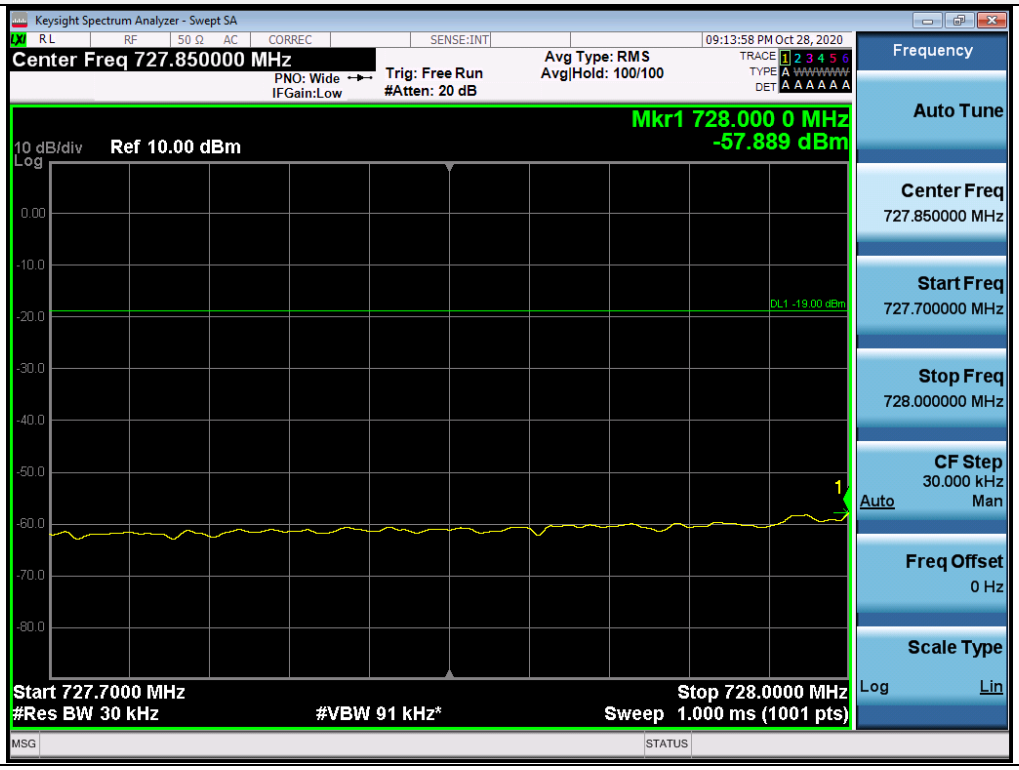
Out-of-Band Emissions / Lower 700 MHz / Downlink / GSM / Lower Edge / AGC threshold +10 dB

Out-of-Band Emissions / Lower 700 MHz / Downlink / LTE 5 MHz / Upper Edge / AGC threshold



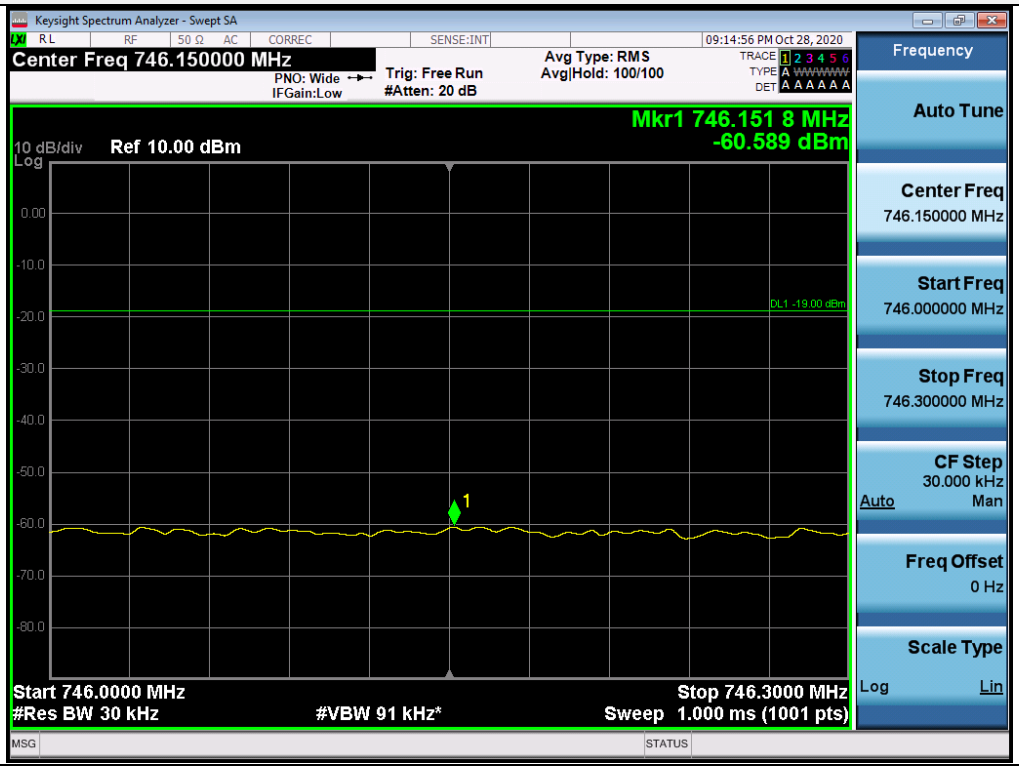
Out-of-Band Emissions / Lower 700 MHz / Downlink / LTE 5 MHz / Upper Edge / AGC threshold +10 dB

Out-of-Band Emissions / Lower 700 MHz / Downlink / LTE 5 MHz / Lower Edge / AGC threshold



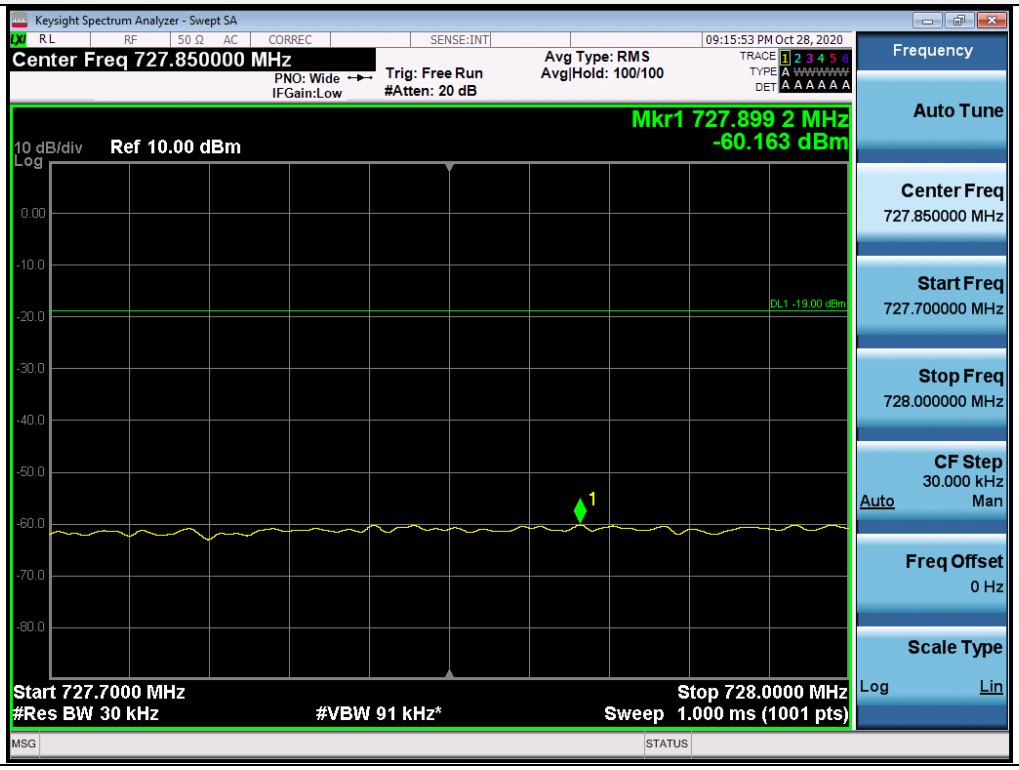
Out-of-Band Emissions / Lower 700 MHz / Downlink / LTE 5 MHz / Lower Edge / AGC threshold +10 dB

Out-of-Band Emissions / Lower 700 MHz / Downlink / CDMA / Upper Edge / AGC threshold



Out-of-Band Emissions / Lower 700 MHz / Downlink / CDMA / Upper Edge / AGC threshold +10 dB

Out-of-Band Emissions / Lower 700 MHz / Downlink / CDMA / Lower Edge / AGC threshold



Out-of-Band Emissions / Lower 700 MHz / Downlink / CDMA / Lower Edge / AGC threshold +10 dB