HCT CO.,LTD
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea
TEL: +82-31-645-6300 FAX: +82-31-645-6401

FCC / IC REPORT

FCC/IC Certification

Applicant Name:
GS Instruments Co.,Ltd.

Address:
10, 9th Floor, SOLiD Space, Pangyoyeok-ro 220, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-400, South Korea

Date of Issue:
May 13, 2016
Test Site/Location:
HCT CO., LTD., 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea
Report No.: HCT-R-1604-F039-2
HCT FRN: 0005866421
IC Recognition No.: 5944A-5

FCC ID	**:U88-SMT-L33-R**
IC:	**: 8137A-SMTL33R**
APPLICANT	**: GS Instruments Co.,Ltd.**

FCC/IC Model Name:	SMT-L33-R
EUT Type:	LTE In-Building RF Repeater
Frequency Ranges:	DL: 728 MHz ~ 746 MHz, 746 MHz ~ 757 MHz (FCC) 728 MHz ~ 757 MHz (IC) UL: 698 MHz ~ 716 MHz, 776 MHz ~ 787 MHz (FCC/IC)
Conducted Output Power:	DL:2.00 W (33 dBm), UL: 2.00 W (33 dBm)
Date of Test :	March 16, 2016 ~ May 13, 2016
FCC Rules Part(s):	CFR 47, Part 27
IC Rules :	RSS-Gen (Issue 4, November 2014), RSS-131 (Issue 2, July 2003)

Engineering Statement:
The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 27 of the FCC Rules under normal use and maintenance.

Report prepared by : Kyung Soo Kang
Engineer of RF Team

Report approved by : Jong Seok Lee
Manager of RF Team

Report Revision

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1604-F039	April 08, 2016	- First Approval Report
HCT-R-1604-F039-1	May 09, 2016	- Revised the frequency range for each rules. - Add the revision number for KDB935210 D02 and D05 on page 4 - Revised the rule on page 9 and 10 - Revised the SRSP rule number on page 11 - Revised the sub rules in 27.53 on page 62
HCT-R-1604-F039-2	May 13, 2016	- Added test resultsfor the 27.53(c)(3), 27.53(f)

Table of Contents

1. CLIENT INFORMATION

The EUT has been tested by request of

Company	GS Instruments Co.,Ltd. 1385-14, Juan-Dong, Nam-Ku, Incheon, 402-200, Korea

■ FCC ID:	U88-SMT-L33-R
■ IC:	8137A-SMTL33R
■ APPLICANT:	GS Instruments Co.,Ltd.
■ EUT Type:	LTE In-Building RF Repeater
■ FCC/ IC Model:	SMT-L33-R
■ Frequency Ranges:	DL: 728 MHz ~ 746 MHz, 746 MHz ~ 757 MHz (FCC) 728 MHz ~ 757 MHz (IC) UL: 698 MHz ~ 716 MHz, 776 MHz ~ 787 MHz (FCC/IC)
■ Conducted Output Power:	DL:2 W (33 dBm), UL: 2 W (33 dBm)
■ Antenna Gain(s) :	Manufacturer does not provide an antenna.
■ FCC Rules Part(s):	CFR Title 47 Part 27
■ IC Rules Part(s):	RSS-Gen (Issue 4, November 2014), RSS-131 (Issue 2, July 2003)
■ Measurement standard(s):	ANSI/TIA-603-C-2004, KDB 971168 D01 v02r02 KDB 935210 D02 v03r02, KDB 935210 D05 v01r01, RSS-131 (Issue 2, July 2003)
■ Place of Tests:	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea. (IC Recognition No. : 5944A-5)

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, 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 July 07, 2015 (Registration Number: 90661) / June 22, 2015 (IC Registration Number: 5944A-5)

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 SUMMARY

3.1. STANDARDS

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 27, RSS-GEN, RSS-131.

Description	Reference (FCC)	Reference (IC)	Results
RF Output Power	§2.1046; §27.50	RSS-131, Section 4.3 RSS-131, Section 6.2 SRSP-517	Compliant
Occupied Bandwidth	§2.1049	RSS-GEN, Section 6.6	Compliant
Passband Gain and Bandwidth & Out of Band Rejection	KDB 935210 D02 v03	RSS-131, Section 4.2 RSS-131, Section 6.1	Compliant
Spurious Emissions at Antenna Terminals	§2.1051, §27.53	RSS-131, Section 4.4 RSS-131, Section 6.3 RSS-131, Section 6.4	Compliant
Radiated Spurious Emissions	§2.1053, §27.53	-	Compliant
Frequency Stability	§2.1055, §27.54	RSS-131, Section 4.5 RSS-131, Section 6.5	Compliant

3.2. MODE OF OPERATION DURING THE TEST

The EUT was operated in a manner representative of the typical usage of the equipment.

During all testing, system components were manipulated within the confines of typical usage to maximize each emission.

The device does not supply antenna(s) with the system, so the dummy loads were connected to the RF output ports for radiated spurious emission testing.

4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

Temperature :	**+ 15 ℃ to + 35 ℃**
Relative humidity:	**30 % to 60 %**
Air pressure	**860 mbar to 1060 mbar**

5. TEST EQUIPMENT

Manufacturer	Model / Equipment	Cal Interval	Calibration Date	Serial No.
Agilent	E4438C / Signal Generator	Annual	09/02/2015	MY42082646
Agilent	N5182A / Signal Generator	Annual	04/07/2015	MY50141649
Agilent	N5182A / Signal Generator	Annual	05/13/2015	MY47070230
Agilent	N9020A / Signal Analyzer	Annual	06/30/2015	MY51110085
Weinschel	67-30-33 / Fixed Attenuator	Annual	02/16/2016	CC7265
Weinschel	1506A / Power Divider	Annual	02/15/2016	MD793
DEAYOUNG ENT	DFSS60 / AC Power Supply	Annual	04/06/2016	1003030-1
Innco system	MA4000-EP / Antenna Position Tower	N/A	N/A	N/A
Innco system	CT0800 / Turn Table	N/A	N/A	N/A
Innco system	CO3000 / Controller(Antenna mast)	N/A	N/A	CO3000-4p
ETS	2090 / Controller(Turn table)	N/A	N/A	1646
Rohde&Schwarz	Loop Antenna	Biennial	02/23/2016	1513-175
Schwarzbeck	VULB 9160 / Trilog Antenna	Biennial	10/10/2014	3368
Schwarzbeck	BBHA 9120D / Horn Antenna	Biennial	08/26/2014	9120D-1300
Rohde & Schwarz	FSP / Spectrum Analyzer	Annual	10/05/2015	836650/016
Wainwright Instruments	WHK3.0/18G-10EF / Highpass Filter	Annual	06/29/2015	8
CERNEX	CBLU1183540 / Power Amplifier	Annual	02/01/2016	24614

6. RF OUTPUT POWER

FCC Rules

Test Requirements:

§ 2.1046 Measurements required: RF power output:

§ 2.1046 (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.

§ 2.1046 (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 as 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.

§ 2.1046 (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.

§ 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:

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

(5) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population

statistics from the Bureau of the Census, and transmitting a signal in the 746-757 MHz and 776-787 MHz bands with an emission bandwidth greater than 1 MHz must not exceed an ERP of 2000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts/MHz ERP in accordance with Table 4 of this section.

(c) The following power and antenna height requirements apply to stations transmitting in the 600 MHz band and the 698-746 MHz band: permitted if power levels are reduced below 1000 watts/MHz ERP in accordance with Table 3 of this section;

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

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

Test Procedures:

Measurements were in accordance with the test methods section 3.5.2 of KDB 935210 D05 v01.

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

b) Configure to generate the AWGN (broadband) test signal.

c) The frequency of the signal generator shall be set to the frequency of (f0) as determined from 3.3.

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 (see 3.2), but not more than 0.5 dB below.

f) Measure the output power of the EUT and record (Power measurement with a spectrum analyzer).

g) Remove the EUT from the measurement setup and using the same signal generator settings, repeat the power measurement on the input signal to the EUT and record as input power.

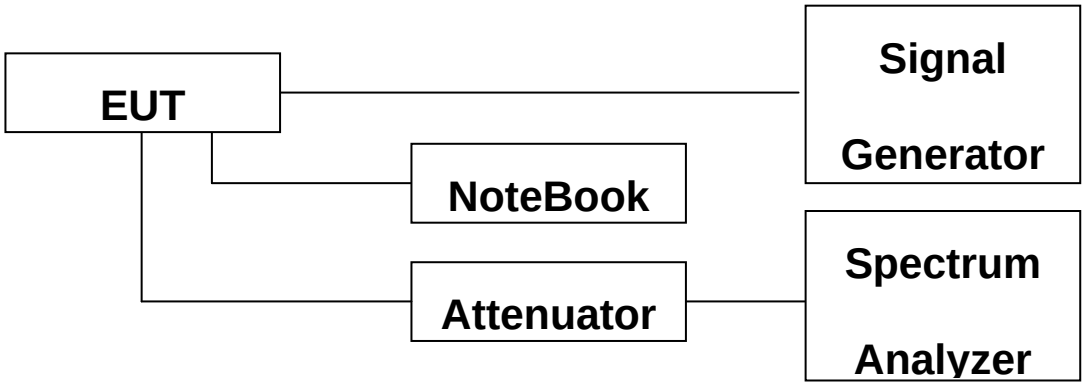
h) Repeat the procedure with the narrowband test signal.

i) Repeat the procedure for both test signals with input signal amplitude set to 3 dB above the AGC threshold level.

j) Repeat for all frequency bands authorized for use by the EUT.

Power measurement Method :

Guidance for performing input/output power measurements using a spectrum or signal analyzer is provided in 5.2 of KDB Publication 971168.



Block Diagram 1. RF Power Output Test Setup

IC Rules

Test Requirements:

SRSP-518

5. Technical Criteria

5.1 Radiated Power and Antenna Height Limits

5.1.1.2 For fixed and base stations transmitting in accordance with sections 4.1.1 to 4.1.3 within the frequency range 716-756 MHz with a channel bandwidth greater than 1 MHz, the maximum permissible e.i.r.p. is 1640 watts/MHz (i.e. no more than 1640 watts e.i.r.p. in any 1 MHz band segment) with a HAAT up to 305 metres. The same e.i.r.p. limit also applies to fixed and base stations operating at any frequency in the 700 MHz band in accordance with Section 4.1.4.

5.1.1.4 For all installations with an antenna HAAT in excess of 305 metres, a corresponding reduction in e.i.r.p. according to the following formula shall be applied:

EIRPreduction =20 log10(HAAT/305) dB

RSS-131 6.2

The manufacturer's output power rating Prated MUST NOT be greater than Pmean for all types of enhancers.

Additional Power Back-off Condition for Multiple Carrier Operations:

An example of a single carrier operation is a band translator that incorporates an (IF) filter of a passband equal to one channel bandwidth. Another example of a single carrier operation is the use of an enhancer, before the connection to the antenna, to boost a low power transmitter (single carrier) to a higher power.

An example of a multiple carrier operation is the use of an enhancer to amplify off-air signals that contain the wanted carrier and two (or more) adjacent band carriers. If the enhancer passband is wide enough to pass more than the wanted channel bandwidth, the enhancer output stage will be loaded by the multiple carriers.

Examination: with 3 carrier signals (of assumed equal level), the peak voltage will be 3 times the single carrier voltage. The corresponding Peak Envelope Power (PEP) will be 3^2 times greater than a single carrier or 9/4 = 2.25 times greater than 2 tones PEP. Therefore the permissible wanted signal operating point has to be backed off by 3.5 dB (i.e. **Ppermissible = Prated - 3.5 dB**).

Note 1: All enhancers will be classified in the Radio Equipment List (REL) for a single carrier operation.

Note 2: For a multiple carrier operation, the rating must be reduced by 3.5 dB or more.

Note 3: If there are more than 3 carriers present at the amplifier input point, greater power back-off may be required. This can be examined on a case-by-case basis.

Test Procedures: RSS-131 4.3

4.3.1 Multi-channel Enhancer

The following subscript "o" denotes a parameter at the enhancer output point.

Connect two signal generators to the input of the Device Under Test (DUT), via a proper impedance matching network (and preferably via a variable attenuator) so that the two input signals are equal sinusoids (and can be raised equally).

Connect a dummy load of suitable load rating to the enhancer output point. Connect also a spectrum analyser to this output point via a coupling network and attenuator, so that only a portion of the output signal is coupled to the spectrum analyser. The coupling attenuation shall be stated in the test report.

Set the two generator frequencies f1 and f2 such that they and their third-order intermodulation product frequencies, f3= 2f1-f2 and f4 = 2f2 - f1, are all within the passband of the DUT.

Raise the input level to the DUT while observing the output tone levels, Po1 and Po2, and the intermodulation product levels, Po3 and Po4.

For enhancers rated 500 watts or less: Raise the input level to the DUT until the greater level of the intermodulation products at the enhancer output terminals, Po3 or Po4, equals -43 dBW.
For enhancers rated over 500 watts: Raise the input level to the DUT until the greater level of the intermodulation products at the enhancer output terminals, Po3 or Po4, is 67 dB below the level of either output tone level, Po1 or Po2.
Record all signal levels and their frequencies. Calculate the mean output power (Pmean) under this testing condition using Pmean = Po1 + 3 dB.

4.3.2 Single Channel Enhancer

A suitably modulated signal, representative of the technology for which certification is sought, is applied to the input of the amplifier. The input power level is increased until the manufacturer's rated input power level is achieved or until a 2 dB increase in input level results in a 1 dB increase in output level (i.e. compression begins). Record the output power in the 99% emission bandwidth using any suitable means.

Test Results:

Input Signal	Input Level (dBm)	Maximum Amp Gain
700 MHz LTE	-57 dBm	90 dB

Single channel Enhancer

* Due to EUT's ALC function (Auto Level Control), even if input signal is increased,

The same output power is transmit.

[Downlink]

	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
LTE 5MHz AGC threshold	Low	730.50	33.09	2.037
	Middle	737.00	33.16	2.070
	High	743.50	33.18	2.080
LTE 5MHz +3dB above the AGC threshold	Low	730.50	32.79	1.901
	Middle	737.00	32.95	1.972
	High	743.50	32.96	1.977
LTE 10MHz AGC threshold	Low	-	-	-
	Middle	751.50	32.87	1.936
	High	-	-	-
LTE 10MHz +3dB above the AGC threshold	Low	-	-	-
	Middle	751.50	32.75	1.884
	High	-	-	-

[Uplink]

	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
LTE 5MHz AGC threshold	Low	700.50	33.57	2.275
	Middle	707.00	33.56	2.270
	High	713.50	33.60	2.291
LTE 5MHz +3dB above the AGC threshold	Low	700.50	33.78	2.388
	Middle	707.00	33.98	2.500
	High	713.50	33.58	2.280
LTE 10MHz AGC threshold	Low	-	-	-
	Middle	781.50	33.01	2.000
	High	-	-	-
LTE 10MHz +3dB above the AGC threshold	Low	-	-	-
	Middle	781.50	32.92	1.959
	High	-	-	-

Multi-channel Enhancer for IC

* Due to EUT's ALC function (Auto Level Control), even if input signal is increased,

The same output power is transmit.

[Downlink]

Channel	Frequency (MHz)	Output Power	
		Po1(dBm)	Pmean(dBm)
Low	728.60	30.113	33.113
Middle	747.70	30.050	33.050
High	756.80	30.131	33.131

[Uplink]

Channel	Frequency 698 ~ 716 (MHz)	Output Power	
		Po1(dBm)	Pmean(dBm)
Low	698.60	30.000	33.000
Middle	707.20	30.059	33.059
High	715.80	30.006	33.006

Channel	Frequency 776 ~ 787 (MHz)	Output Power	
		Po1(dBm)	Pmean(dBm)
Low	777.20	30.003	33.003
Middle	781.80	30.010	33.010
High	786.80	30.016	33.016

Additional Power Back-off Condition for Multiple Carrier Operations for IC

[Downlink]

Channel	1 Carrier (dBm)	3 Carrier (dBm)	Power Back-off (dB)
Middle	33.16	28.25	4.91

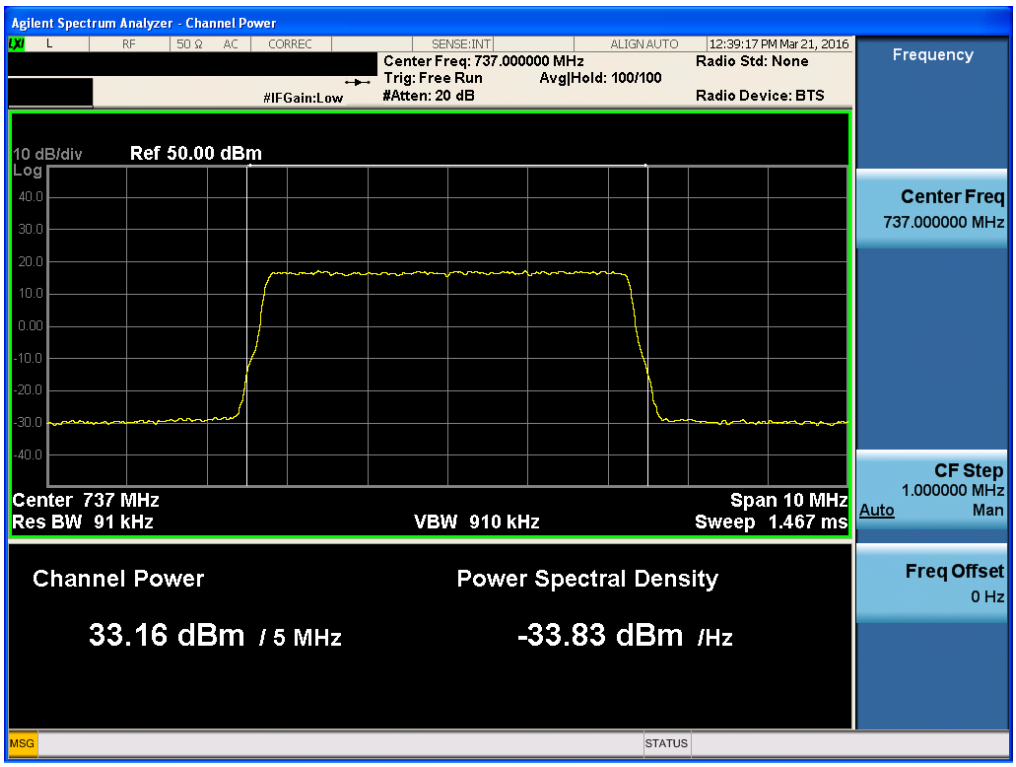
[Uplink]

Channel	1 Carrier (dBm)	3 Carrier (dBm)	Power Back-off (dB)
Middle	33.56	28.62	4.94

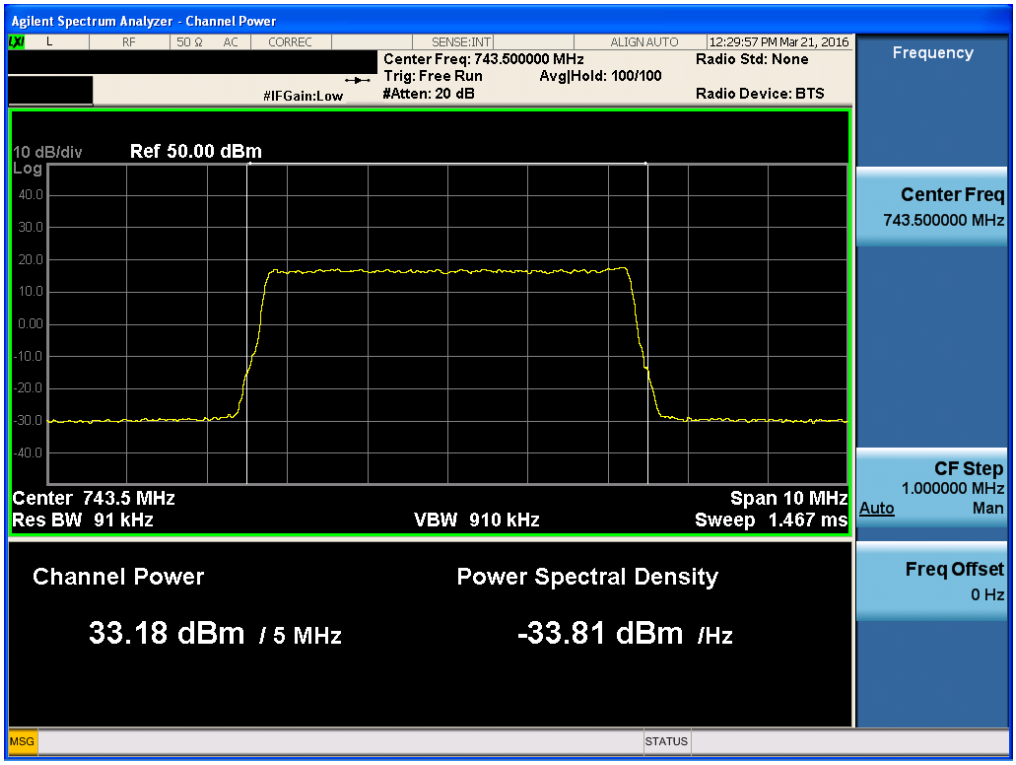
Plots of RF Output Power_LTE 5 MHz _Downlink

[AGC threshold Downlink Low]

[AGC threshold Downlink Middle]

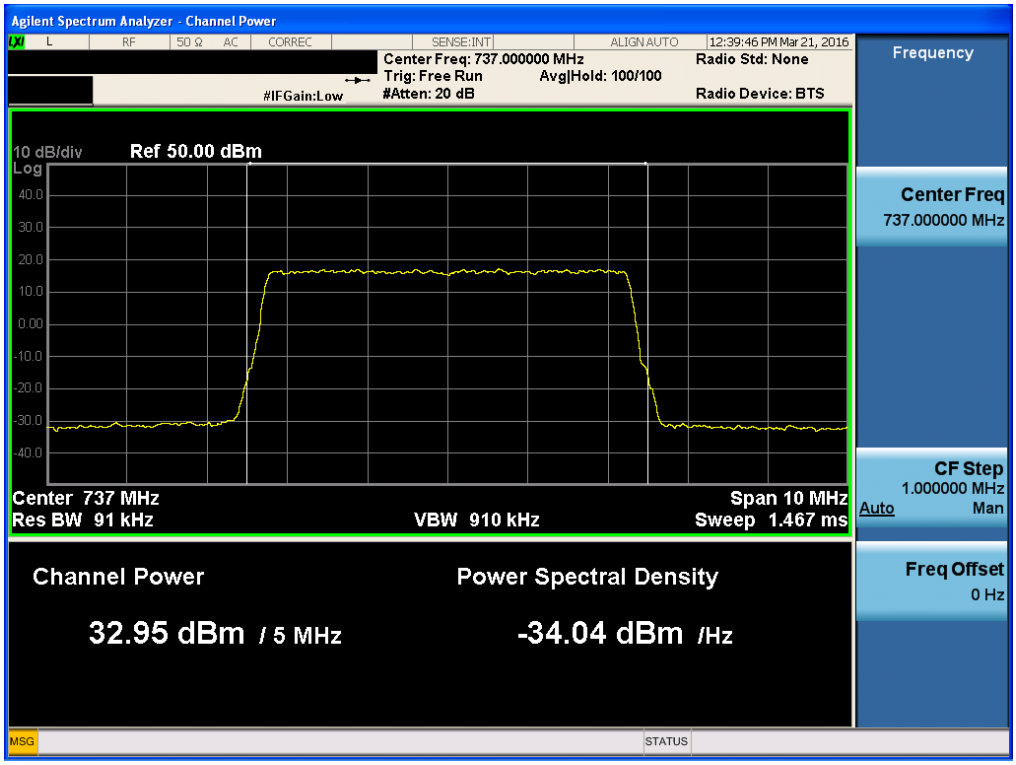


[AGC threshold Downlink High]

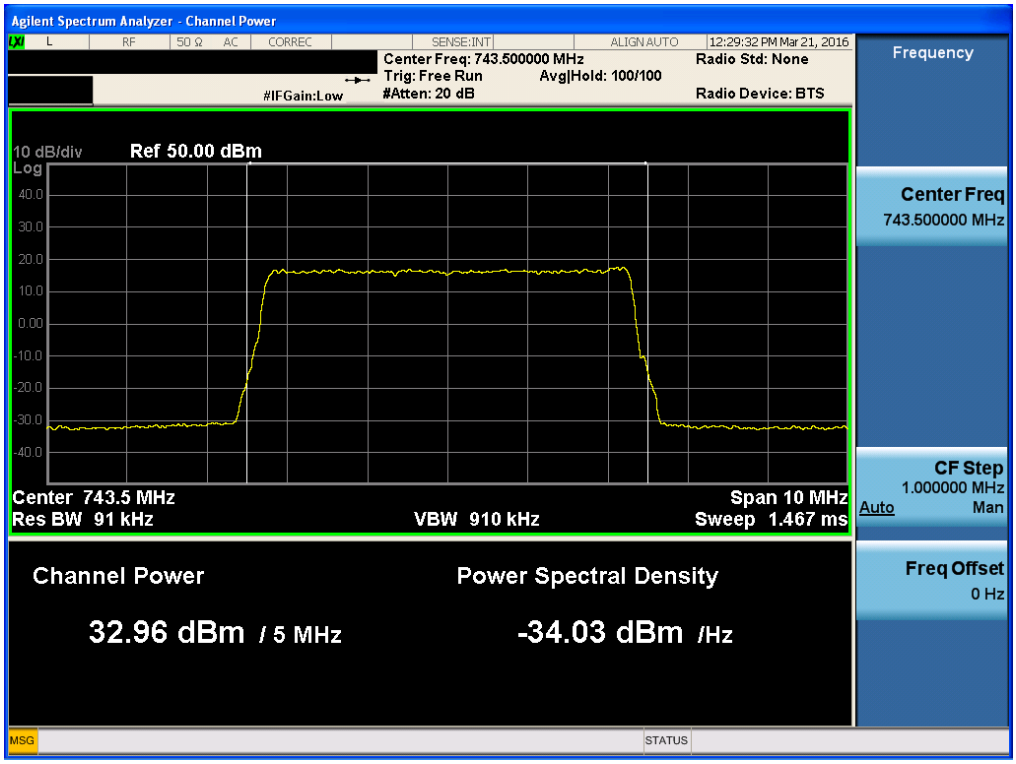


[+3 dB above the AGC threshold Downlink Low]

[+3 dB above the AGC threshold Downlink Middle]

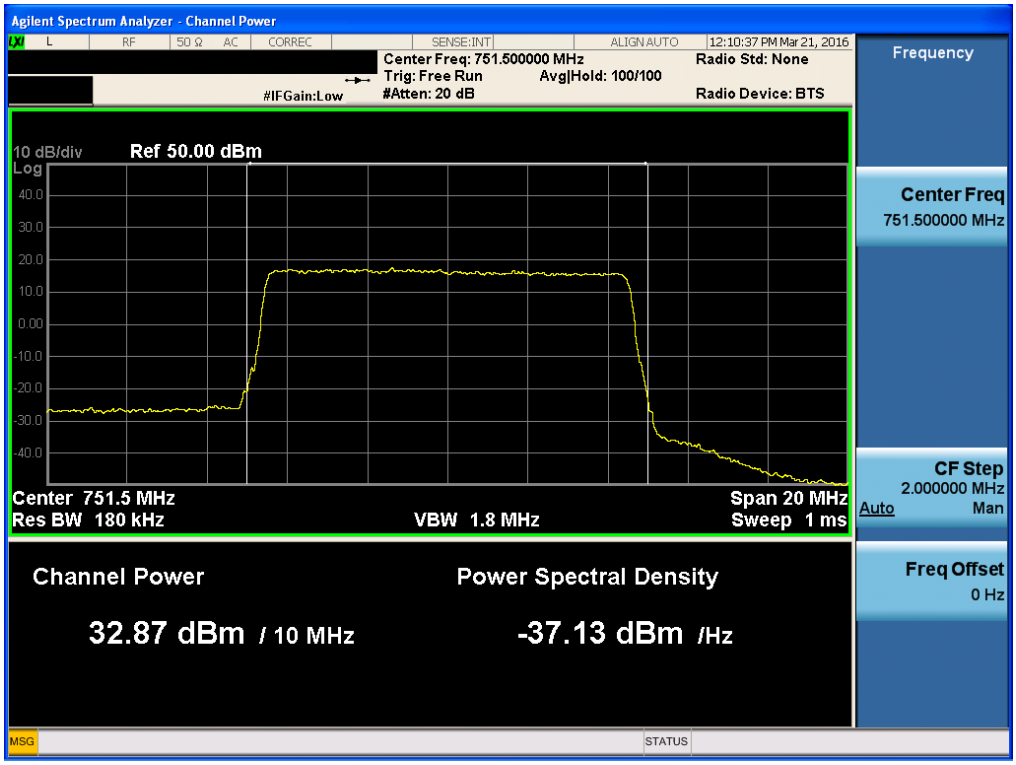


[+3 dB above the AGC threshold Downlink High]

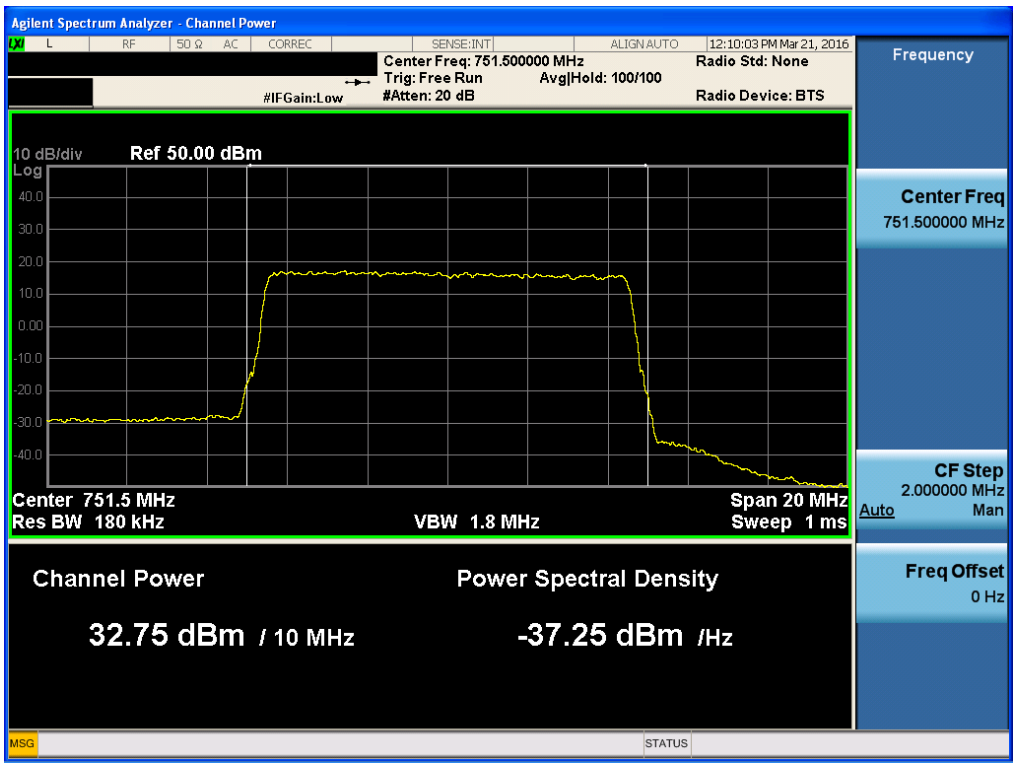


Plots of RF Output Power_LTE 10 MHz _Downlink

[AGC threshold Downlink Middle]



[+3 dB above the AGC threshold Downlink Middle]



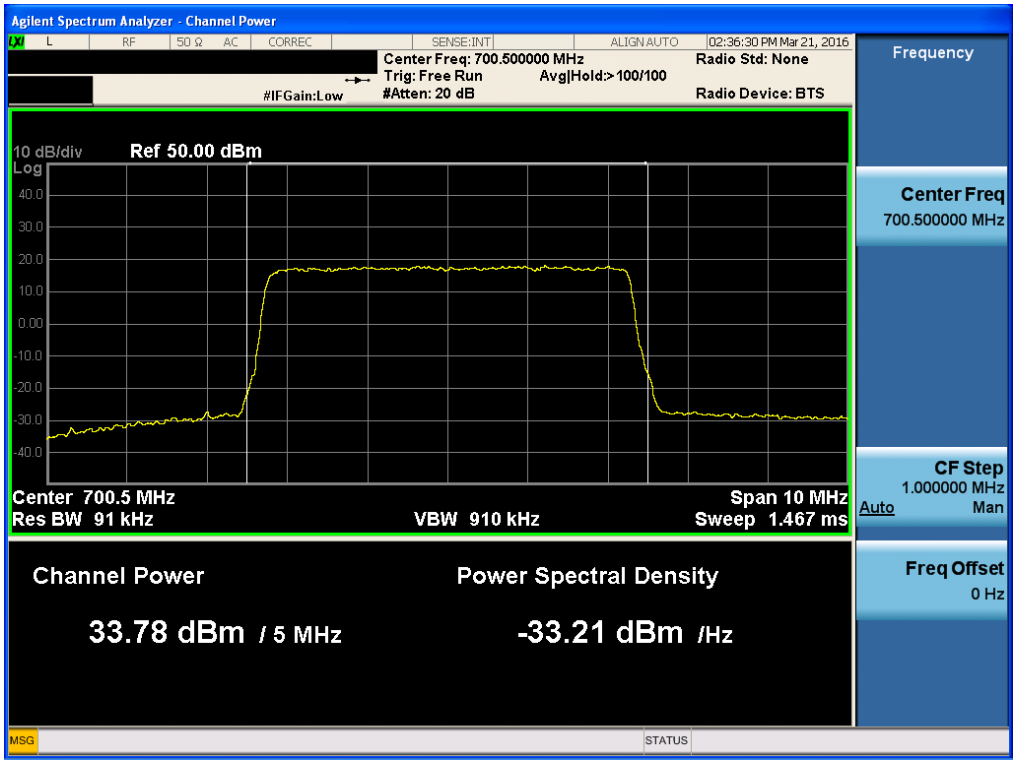
Plots of RF Output Power_LTE 10 MHz _Uplink

[AGC threshold Downlink Low]

[AGC threshold Downlink Middle]

[AGC threshold Downlink High]

[+3 dB above the AGC threshold Downlink Low]



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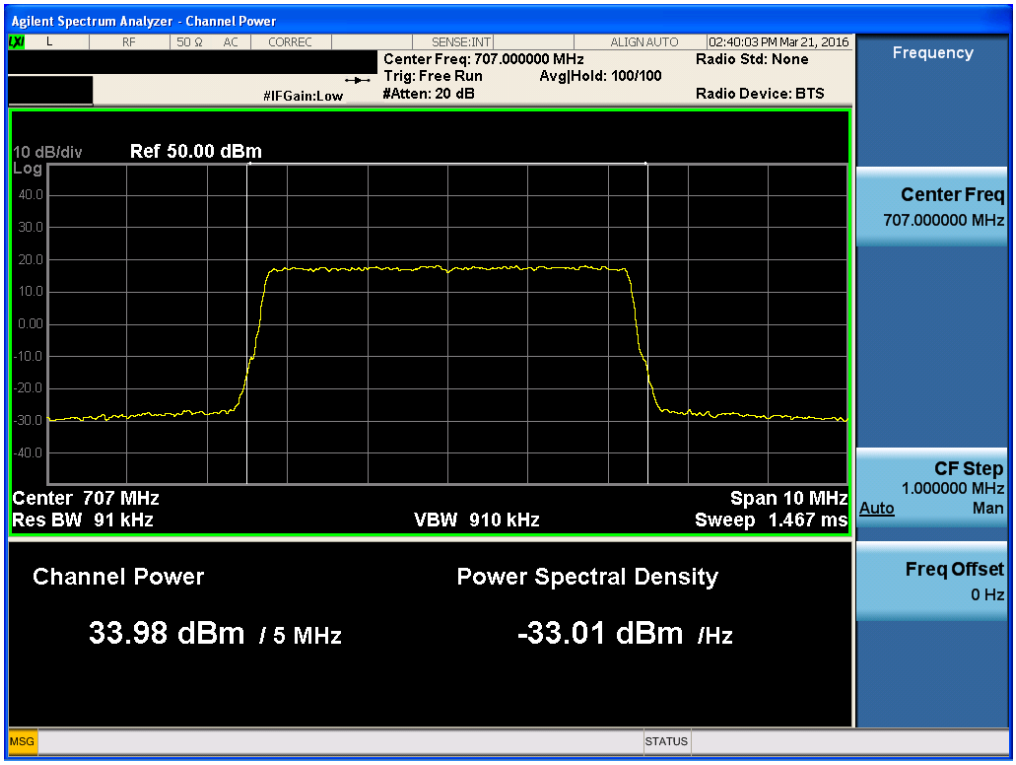
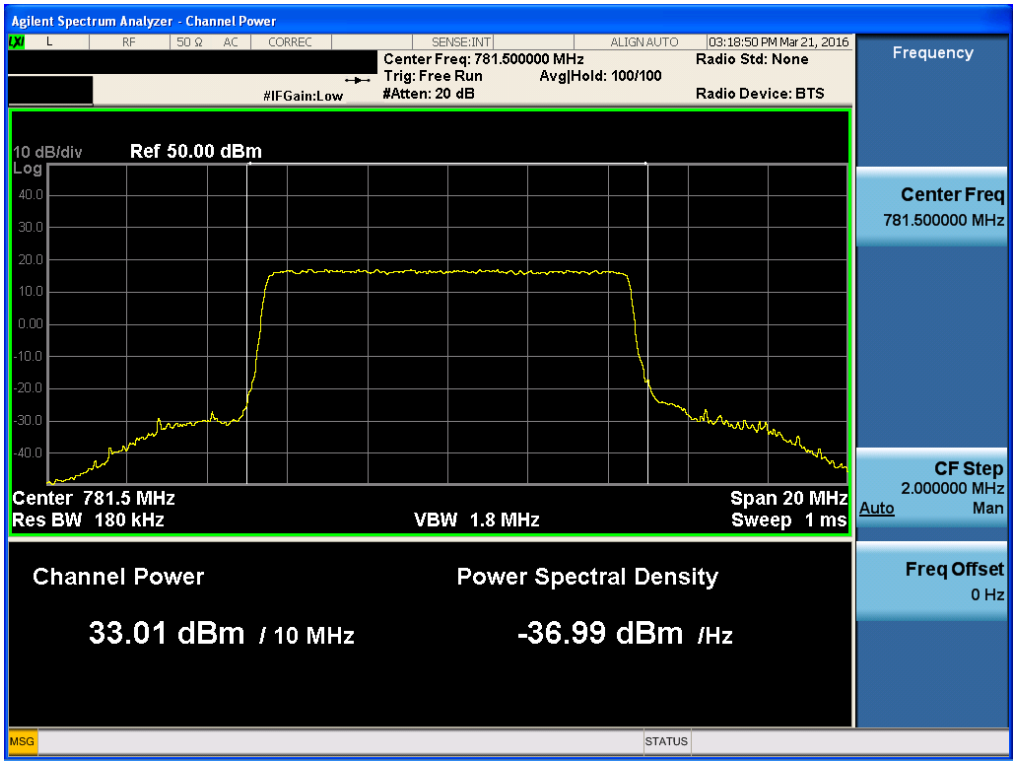


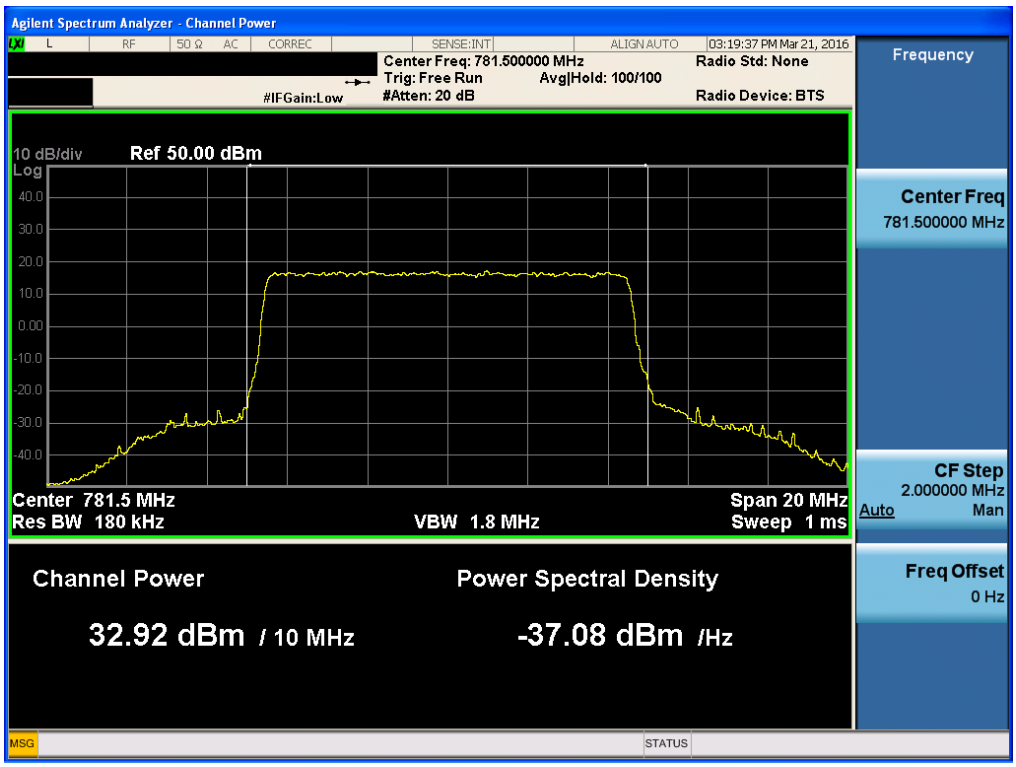
[+3 dB above the AGC threshold Downlink High]

Plots of RF Output Power_LTE 10 MHz _Uplink

[AGC threshold Downlink Middle]

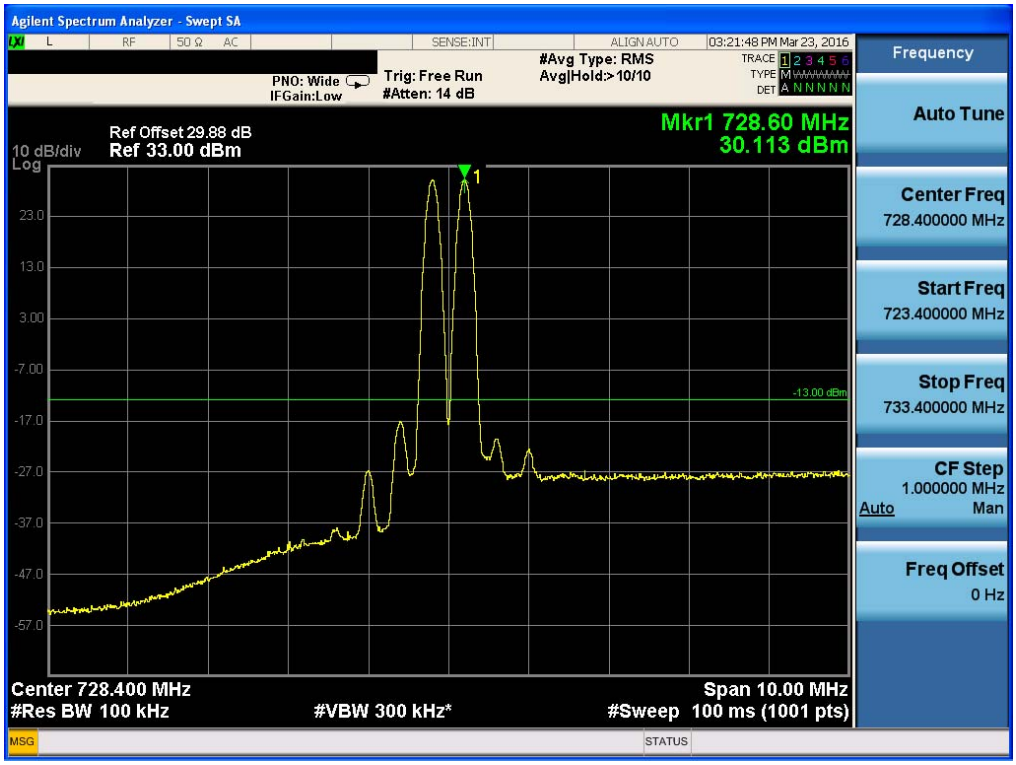


[+3 dB above the AGC threshold Downlink Middle]

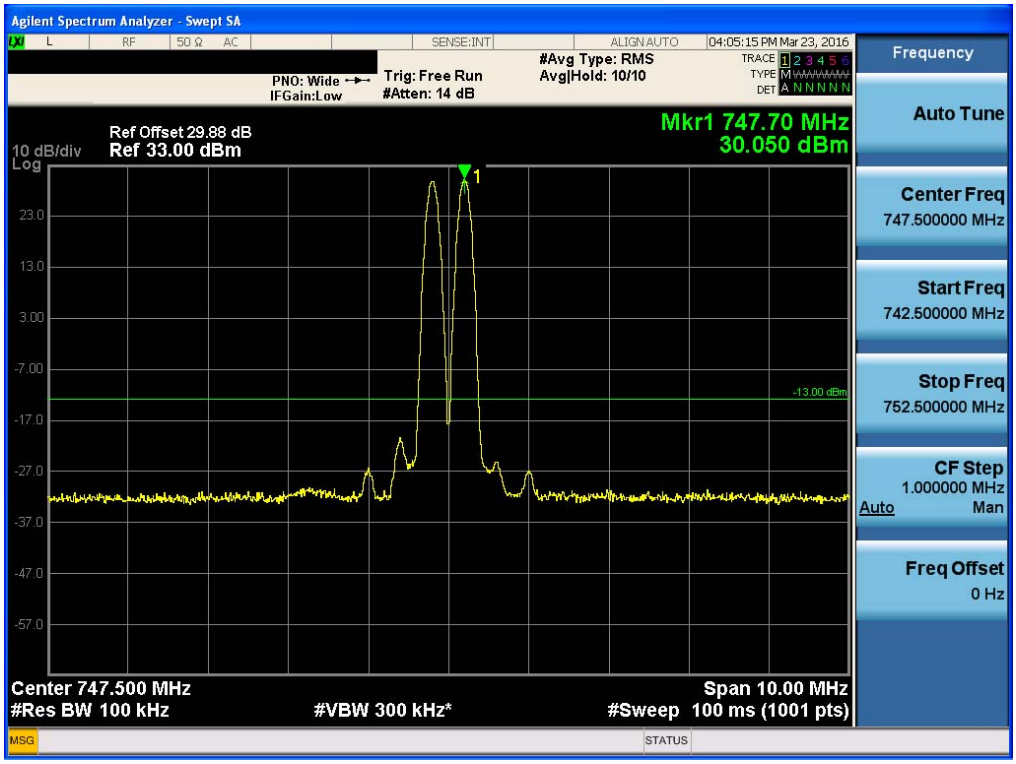


Multi-channel Enhancer for IC

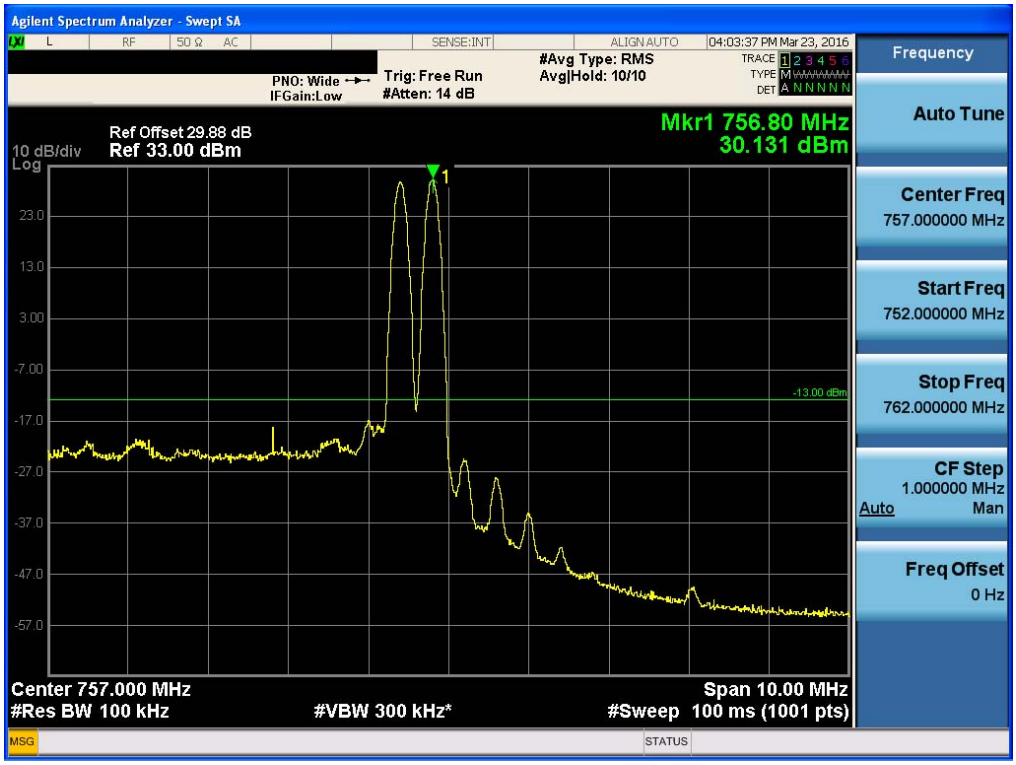
[Downlink Low]



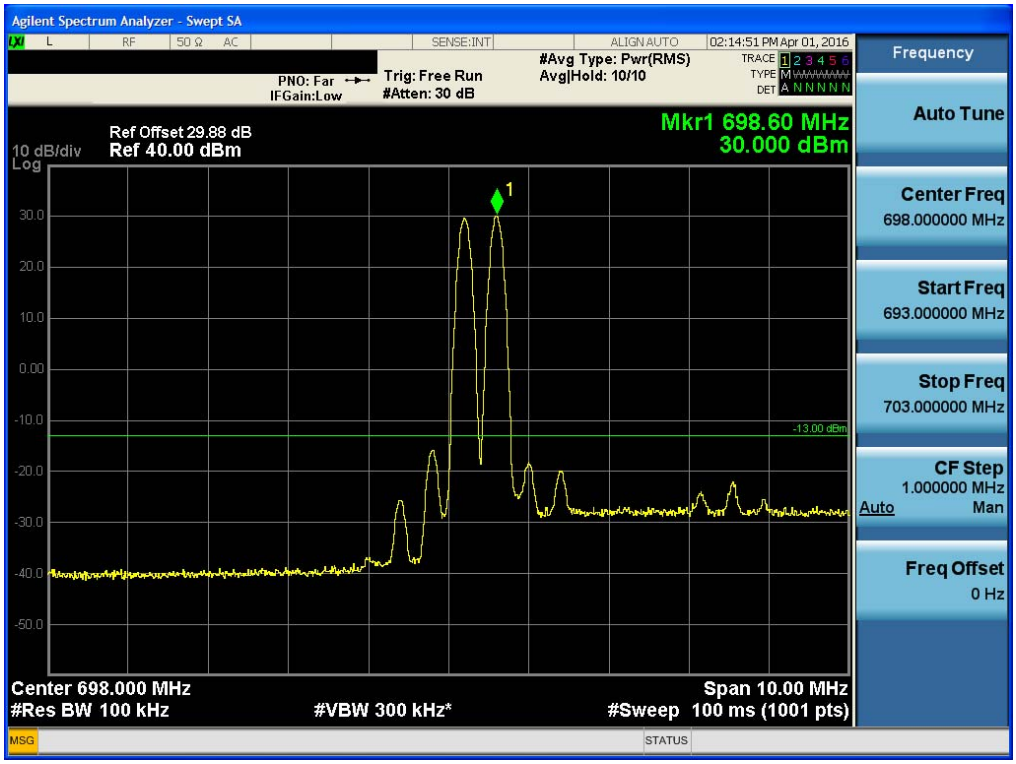
[Downlink Middle]



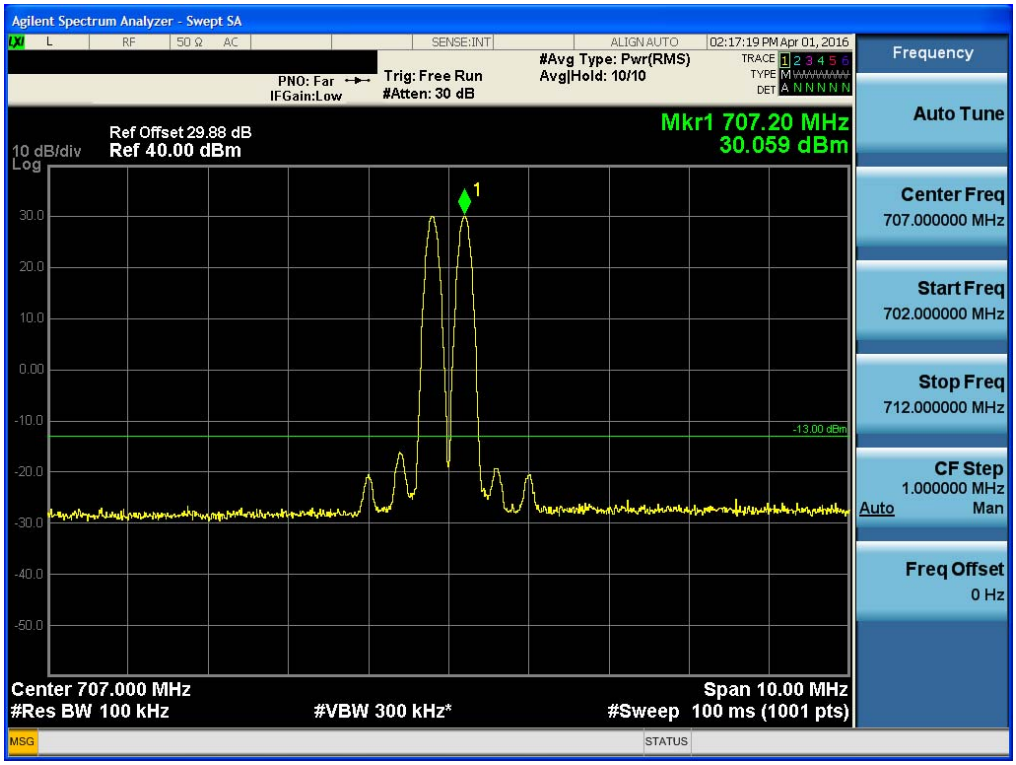
[Downlink High]



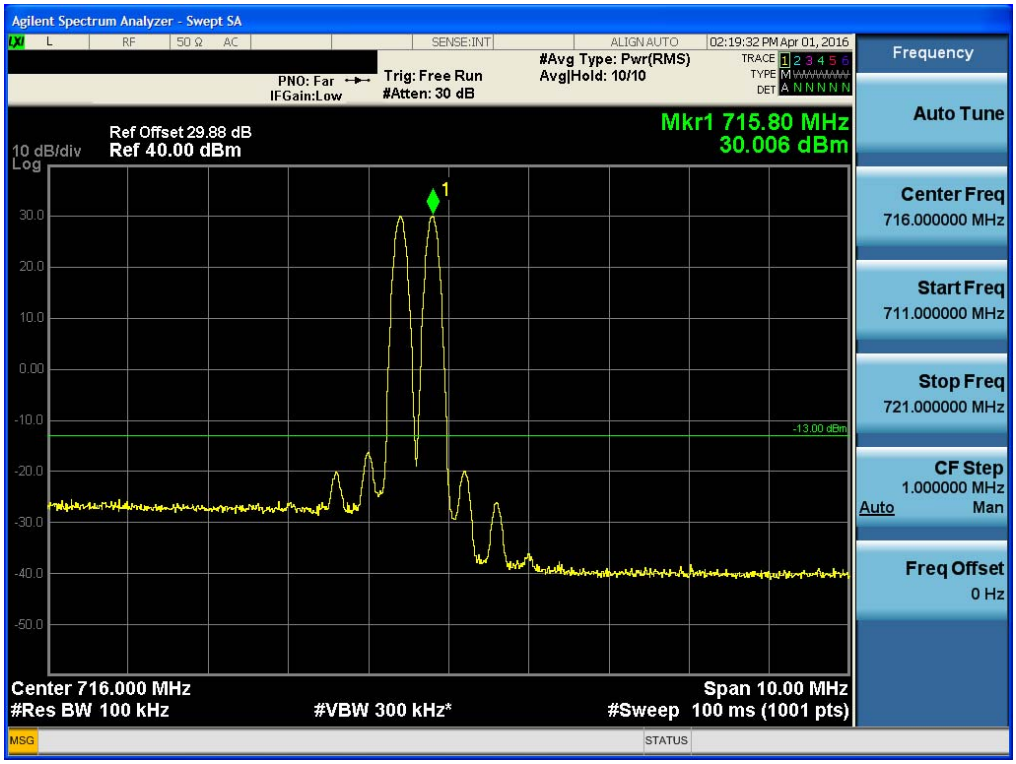
[Uplink LTE 5 MHz Low]



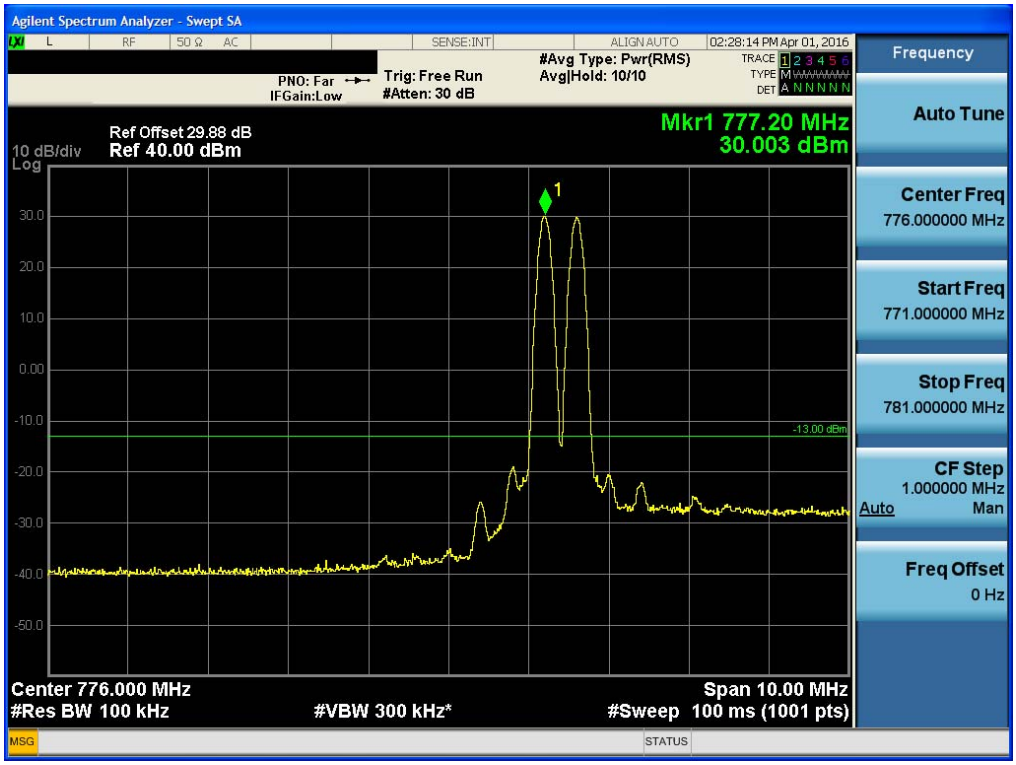
[Uplink LTE 5 MHz Middle]



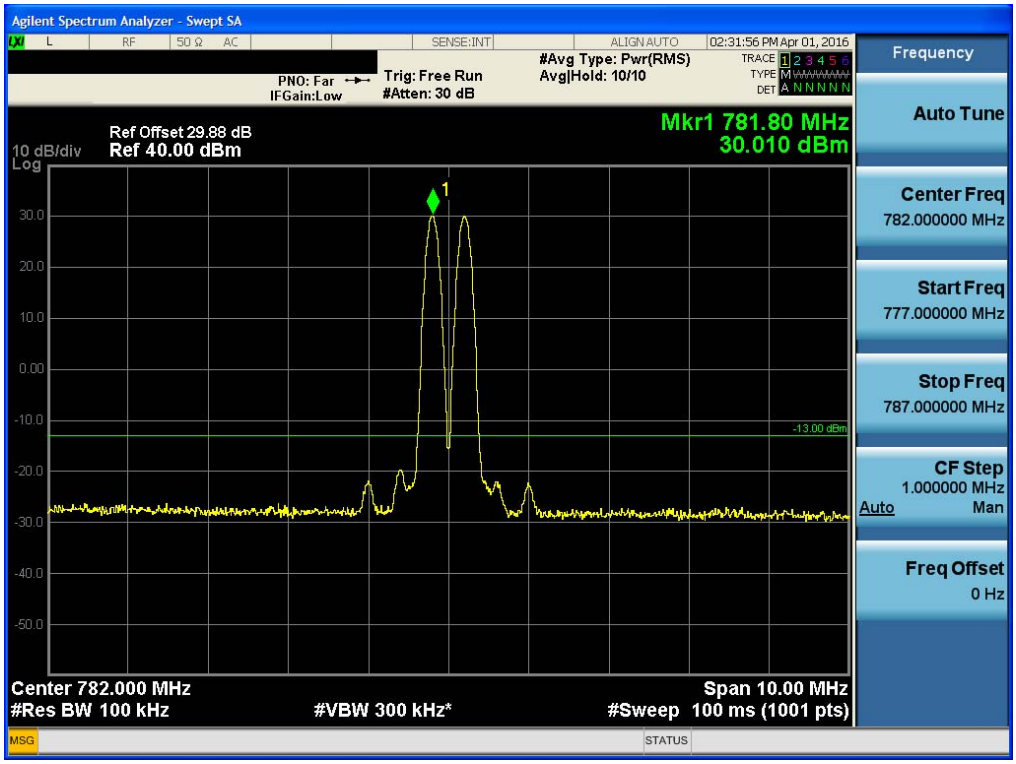
[Uplink LTE 5 MHz High]



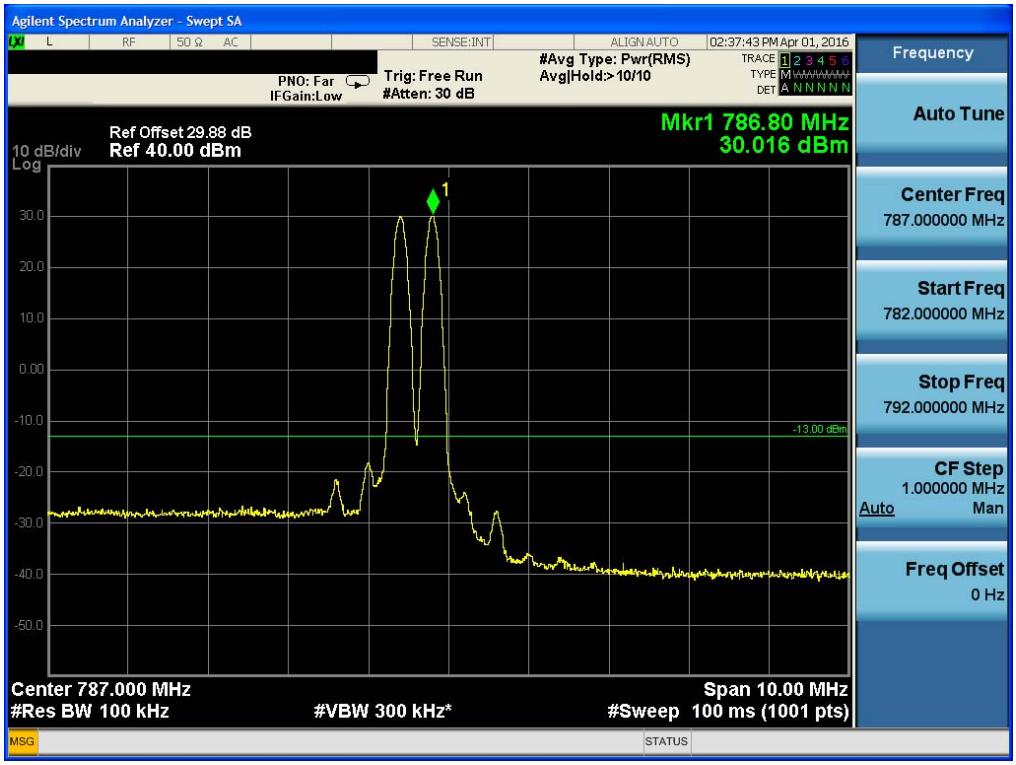
[Uplink LTE 10 MHz Low]



[Uplink LTE 10 MHz Middle]



[Uplink LTE 10 MHz High]



Power Back-off for IC

[Downlink 3 Carrier Middle]

[Uplink 3 Carrier Middle]

7. OCCUPIED BANDWIDTH

FCC Rules

Test Requirement(s): § 2.1049 Measurements required: Occupied bandwidth:

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to
0.5 percent of the total mean power radiated by a given emission shall be measured
under the specified conditions of § 2.1049 (a) through (i) as applicable.

Test Procedures:

Measurements were in accordance with the test methods section 3.4 of KDB 935210 D05 v01 and section 4.2 of KDB 971168 D01 v02r02.

Test is 99% OBW measured and used.

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

b) Configure the signal generator to transmit the AWGN signal.

c) Configure the signal amplitude to be just below the AGC threshold level (see 3.2), but not more than 0.5 dB below.

d) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.

e) Set the spectrum analyzer center frequency to the center frequency of the operational band under test. The span range of the spectrum analyzer shall be between 2 times to 5 times the OBW.

f) The nominal resolution bandwidth (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.

NOTE—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) Use the 99 % power bandwidth function of the spectrum analyzer (if available) and report the measured bandwidth.

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

m) Compare the spectral plot of the input signal (determined from step l) to the output signal (determined from step k) 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.

n) Repeat for all frequency bands authorized for use by the EUT.

IC Rules

Test Requirements: RSS-GEN 6.6

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99 % emission bandwidth, as calculated or measured.

Test Procedures: RSS-GEN 6.6

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

Video averaging is not permitted. A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.

Test Results: The EUT complies with the requirements of this section.

Input Signal	Input Level (dBm)	Maximum Amp Gain
700 MHz LTE	-57 dBm	90 dB

[Downlink Output]

	Channel	Frequency (MHz)	OBW (MHz)
5MHz AGC threshold	Low	730.50	4.4966
	Middle	737.00	4.5225
	High	743.50	4.5424
5MHz +3dBm above the AGC threshold	Low	730.50	4.5011
	Middle	737.00	4.5291
	High	743.50	4.5322
10MHz AGC threshold	Low	-	-
	Middle	751.50	9.0116
	High	-	-
10MHz +3dBm above the AGC threshold	Low	-	-
	Middle	751.50	9.0171
	High	-	-

[Downlink Input]

	Channel	Frequency (MHz)	OBW (MHz)
5MHz AGC threshold	Low	730.50	4.5442
	Middle	737.00	4.5479
	High	743.50	4.5390
5MHz +3dBm above the AGC threshold	Low	730.50	4.5258
	Middle	737.00	4.5338
	High	743.50	4.5379
10MHz AGC threshold	Low	-	-
	Middle	751.50	9.0994
	High	-	-
10MHz +3dBm above the AGC threshold	Low	-	-
	Middle	751.50	9.0707
	High	-	-

[Uplink Output]

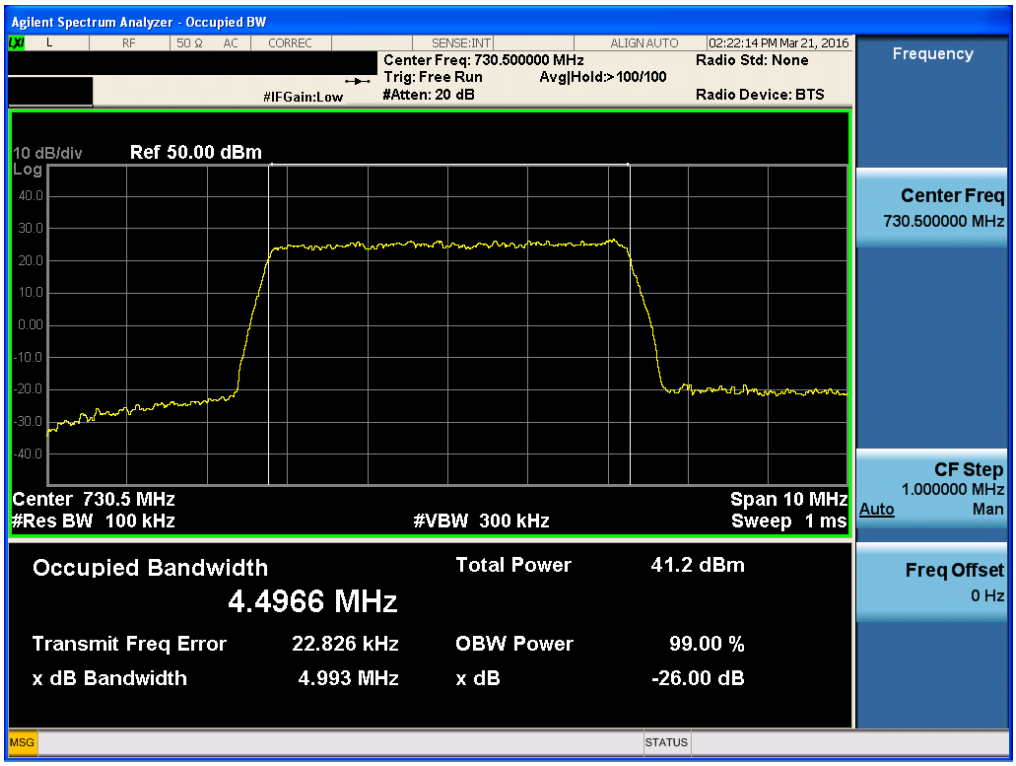
	Channel	Frequency (MHz)	OBW (MHz)
5MHz AGC threshold	Low	700.50	4.4835
	Middle	707.00	4.5201
	High	713.50	4.4876
5MHz +3dBm above the AGC threshold	Low	700.50	4.4855
	Middle	707.00	4.5187
	High	713.50	4.4801
10MHz AGC threshold	Low	-	-
	Middle	781.50	9.0288
	High	-	-
10MHz +3dBm above the AGC threshold	Low	-	-
	Middle	781.50	9.0295
	High	-	-

[Uplink Input]

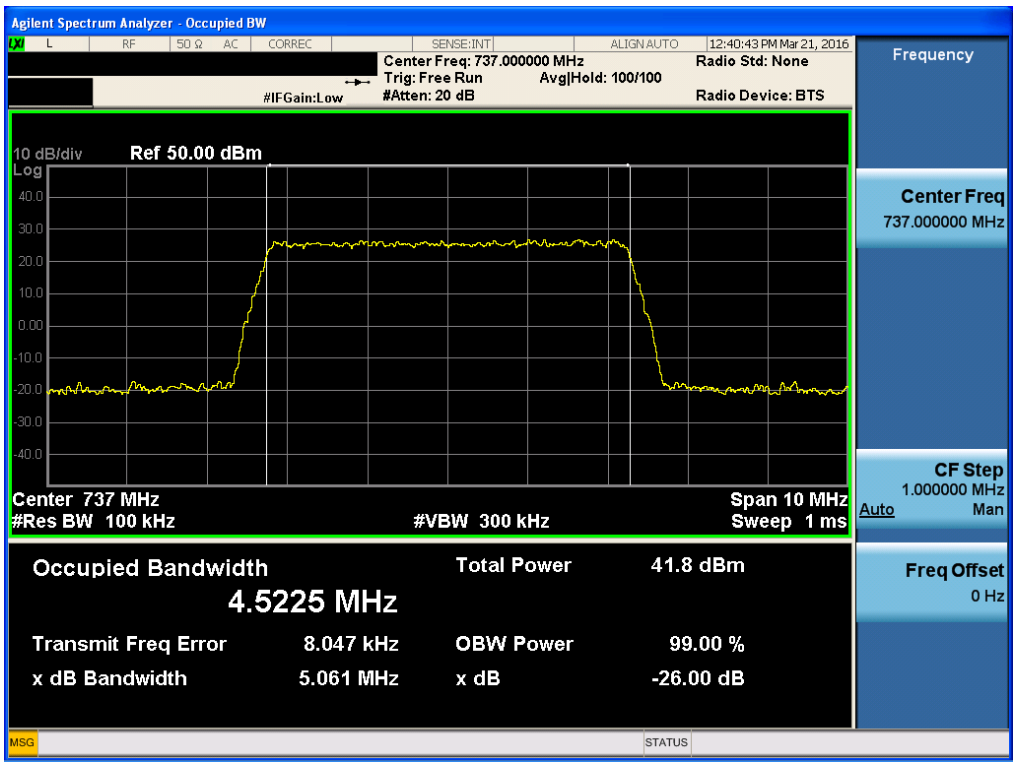
	Channel	Frequency (MHz)	OBW (MHz)
5MHz AGC threshold	Low	700.50	4.5293
	Middle	707.00	4.5400
	High	713.50	4.5340
5MHz +3dBm above the AGC threshold	Low	700.50	4.5274
	Middle	707.00	4.5300
	High	713.50	4.5326
10MHz AGC threshold	Low	-	-
	Middle	781.50	9.1212
	High	-	-
10MHz +3dBm above the AGC threshold	Low	-	-
	Middle	781.50	9.0801
	High	-	-

Plots of Occupied Bandwidth_LTE 5 MHz_Downlink

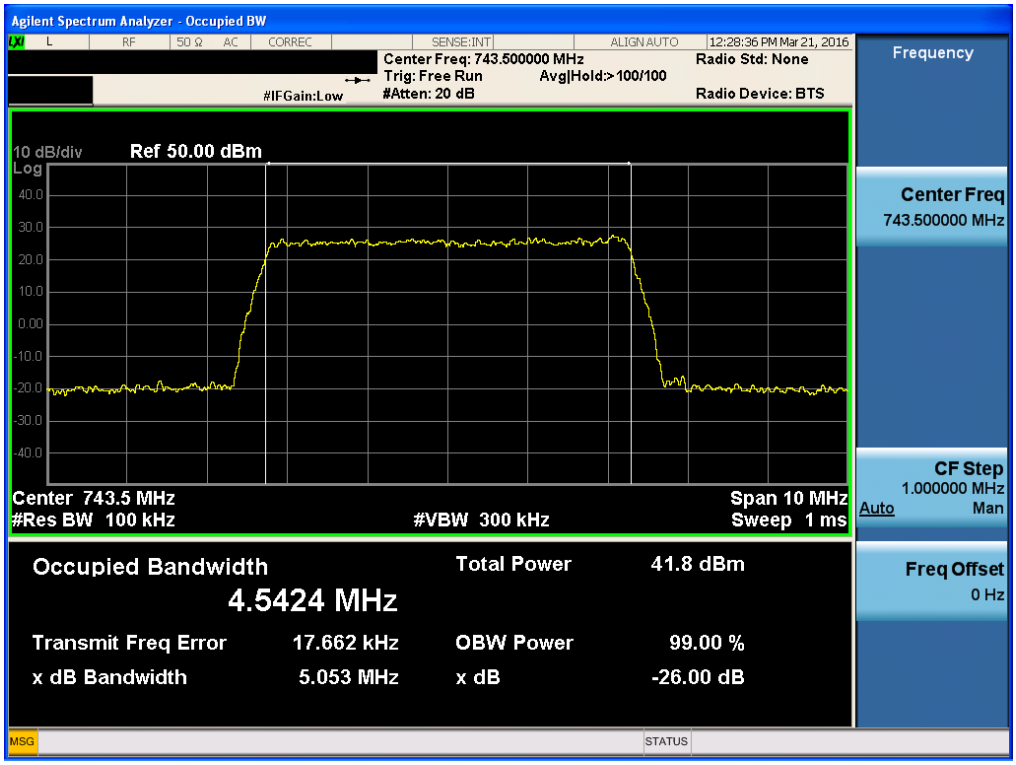
[Output Downlink Low_ AGC threshold]



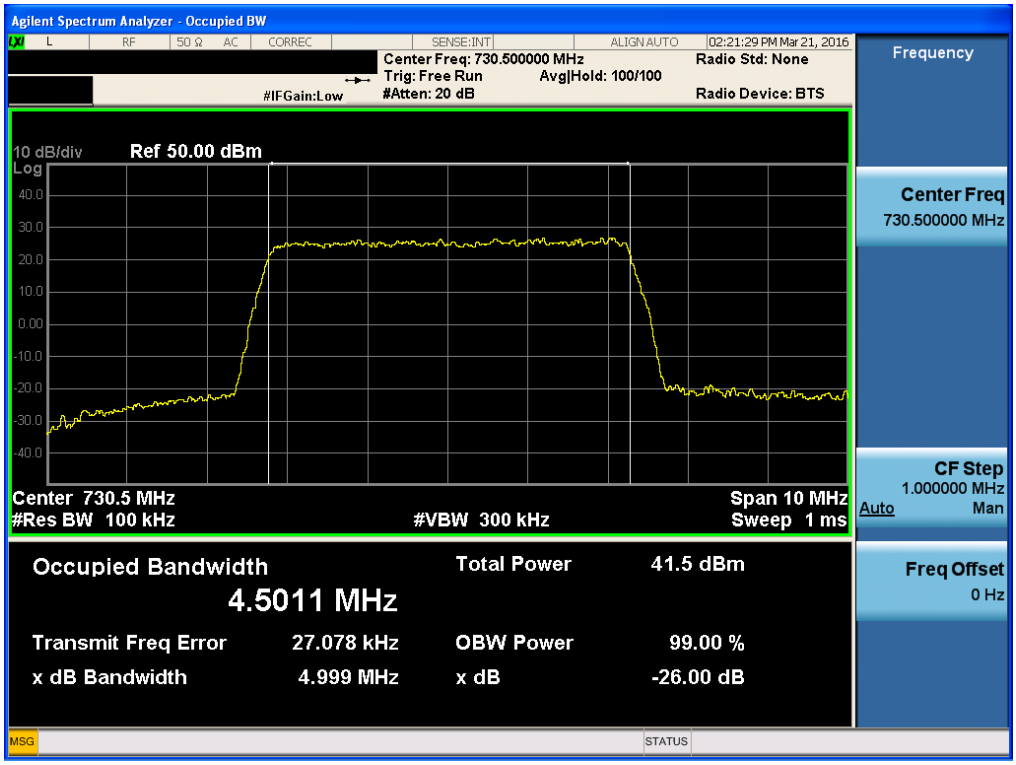
[Output Downlink Middle_ AGC threshold]



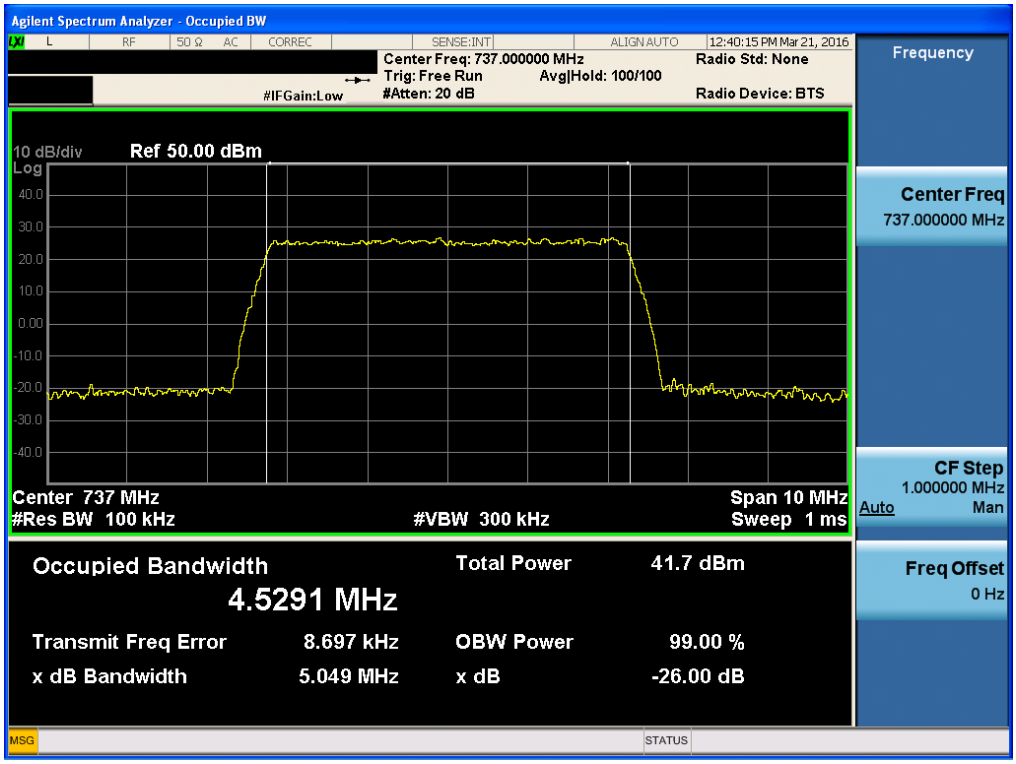
[Output Downlink High_ AGC threshold]



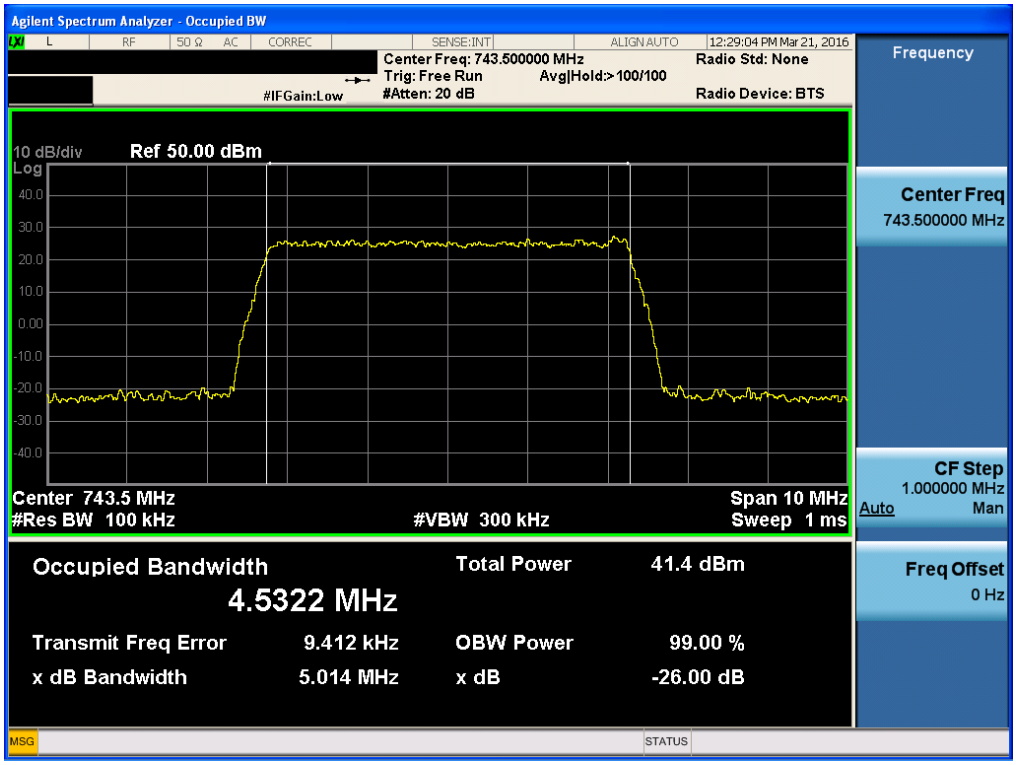
[Output Downlink Low_ +3 dB above the threshold]



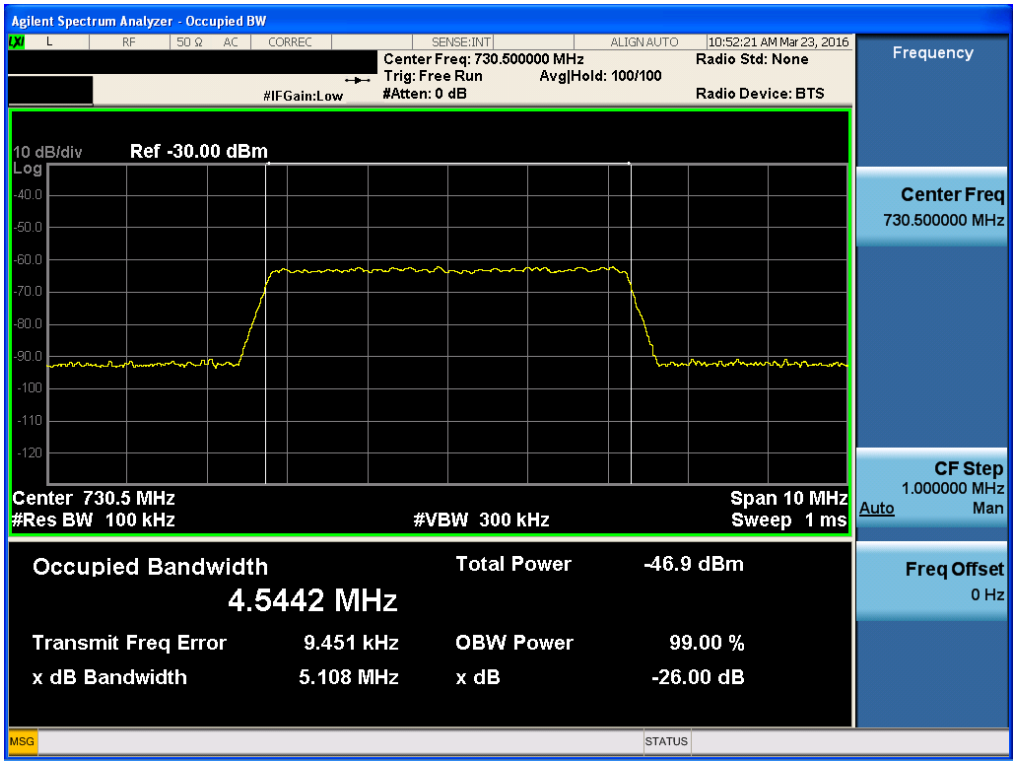
[Output Downlink Middle_ +3 dB above the threshold]



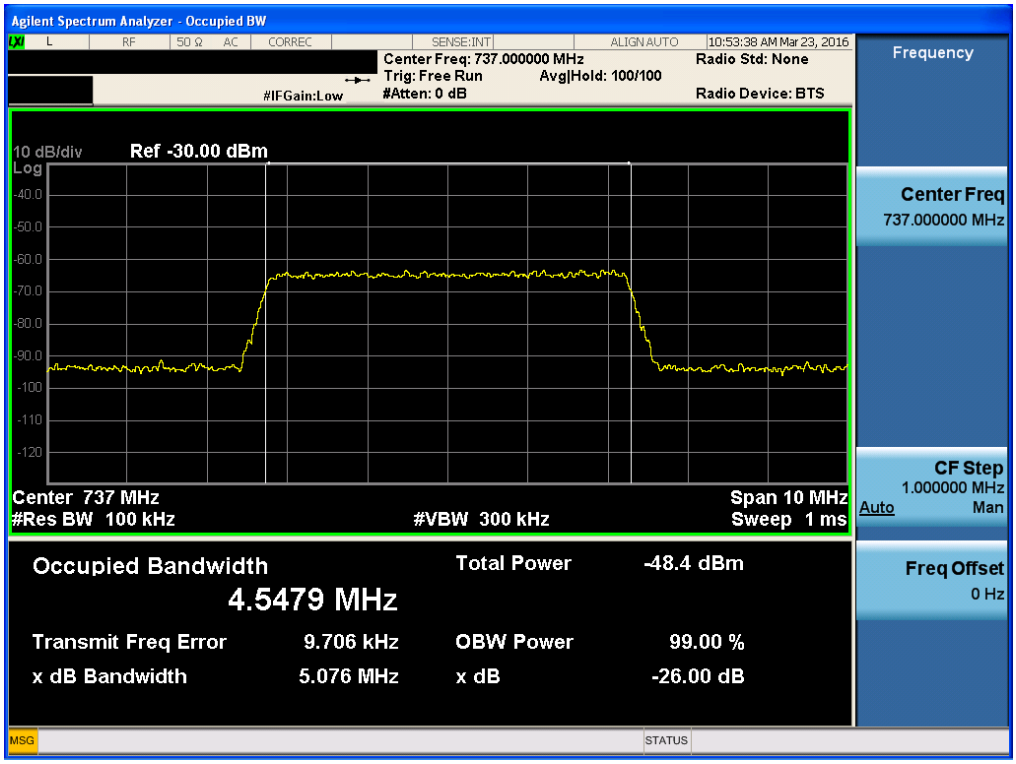
[Output Downlink High_ +3 dB above the threshold]



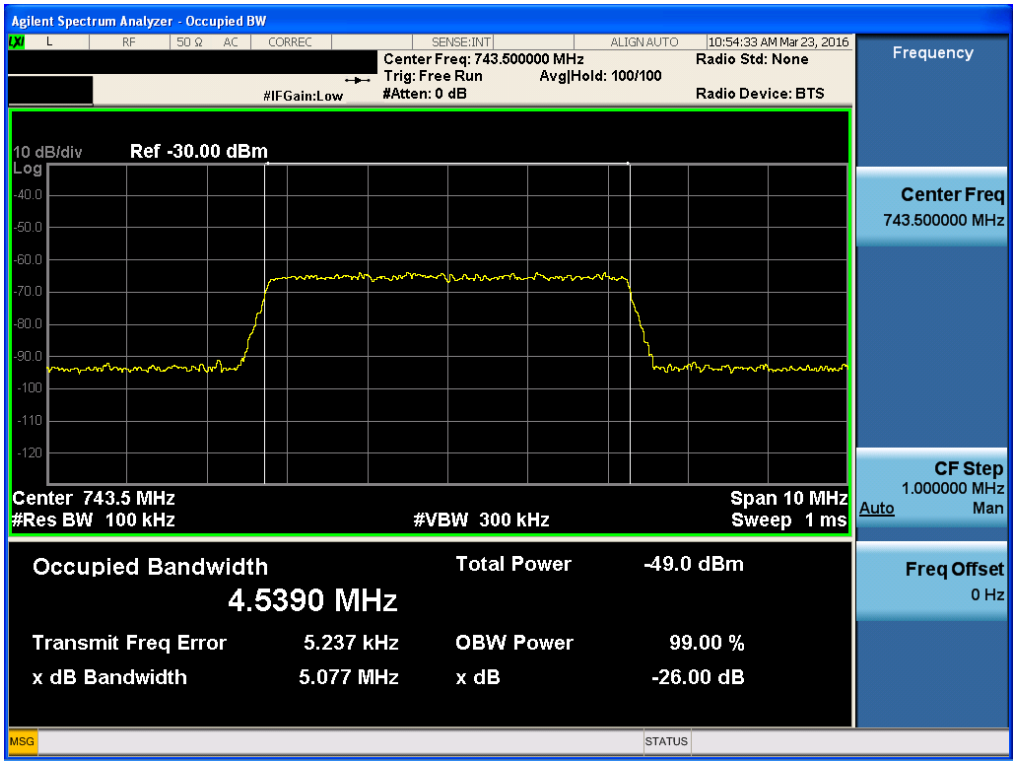
[Input Downlink Low_AGC threshold]



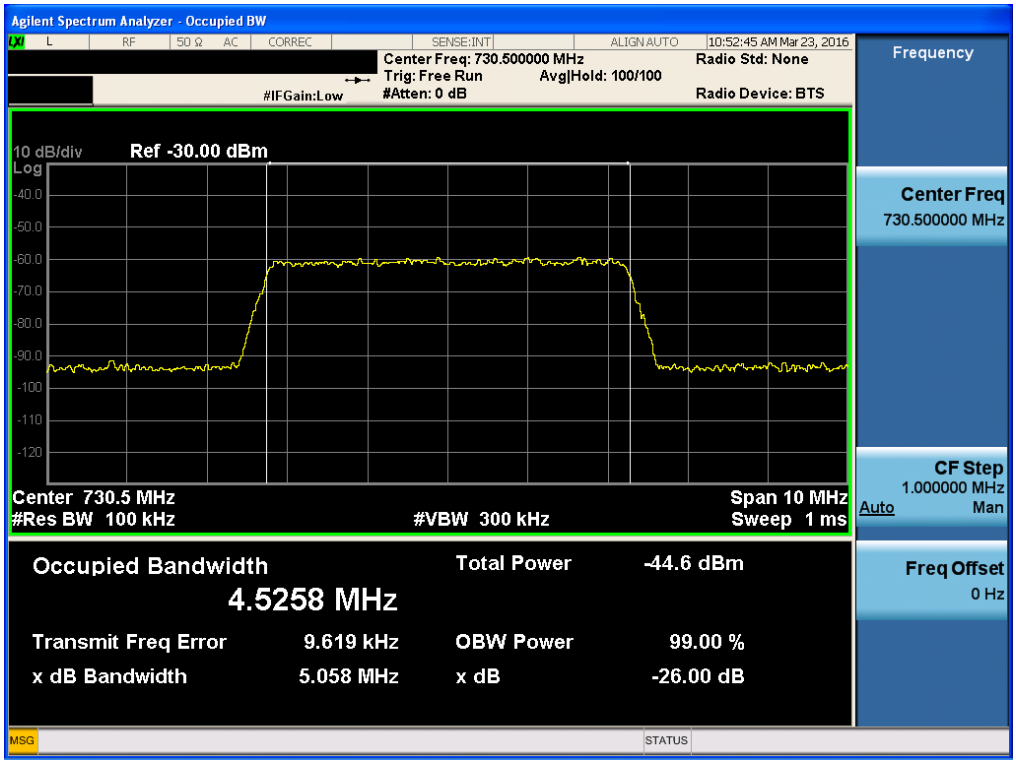
[Input Downlink Middle _AGC threshold]



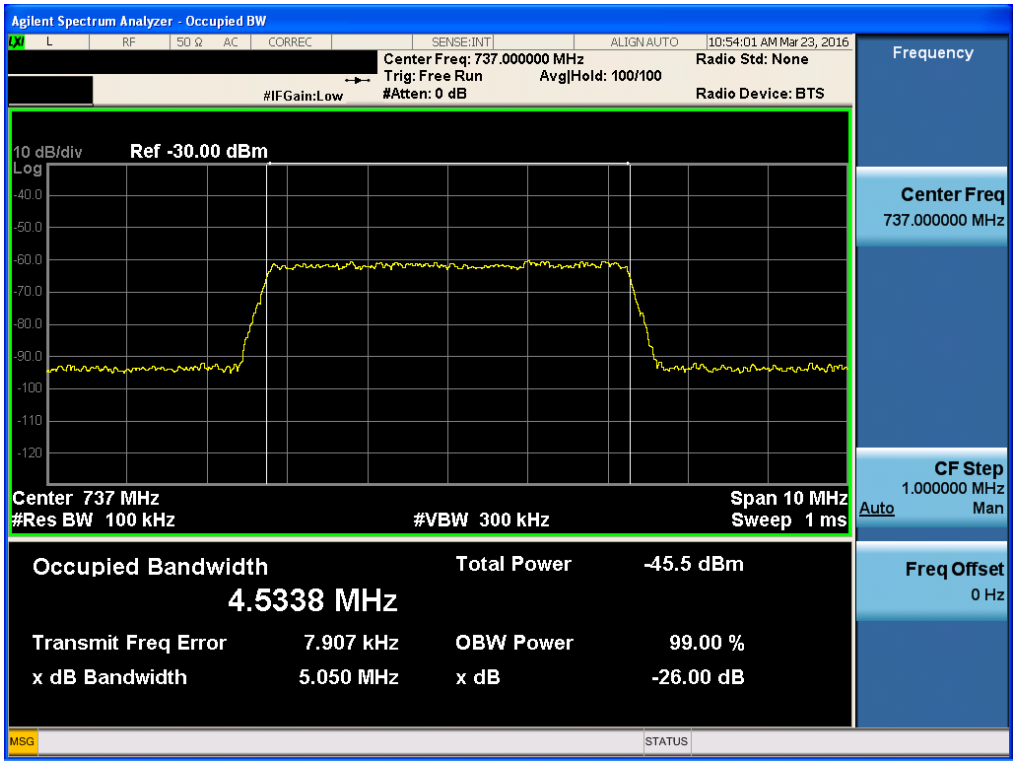
[Input Downlink High_AGC threshold]



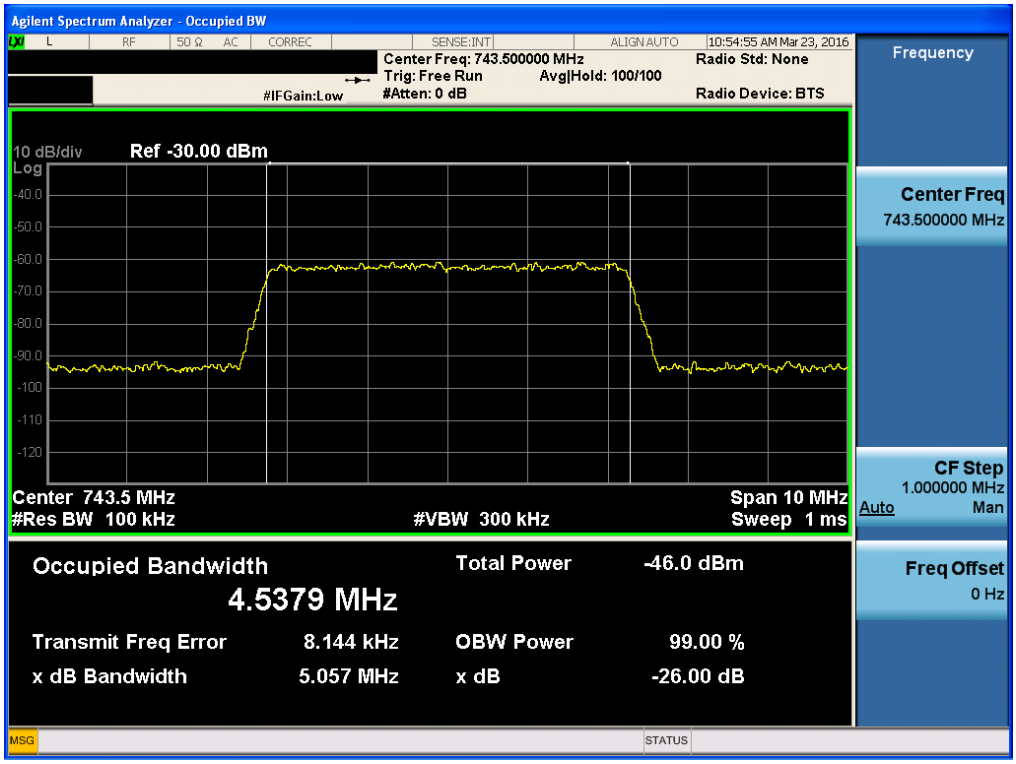
[Input Downlink Low_+3 dB above the threshold]



[Input Downlink Middle _+3 dB above the threshold]

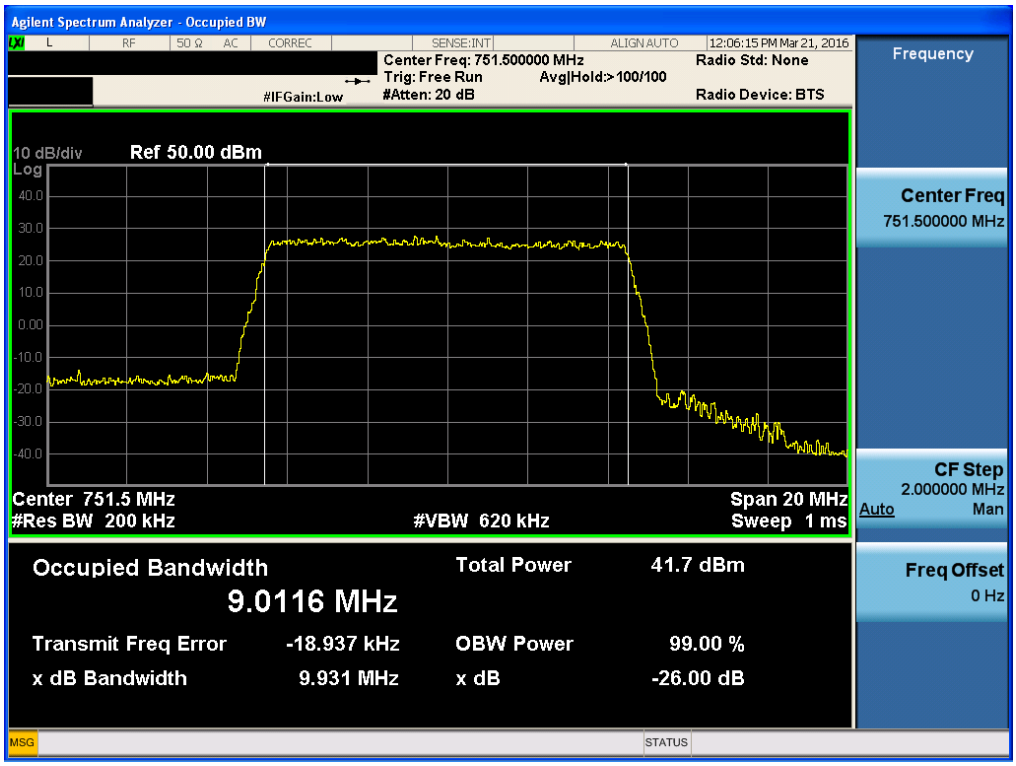


[Input Downlink High_+3 dB above the threshold]

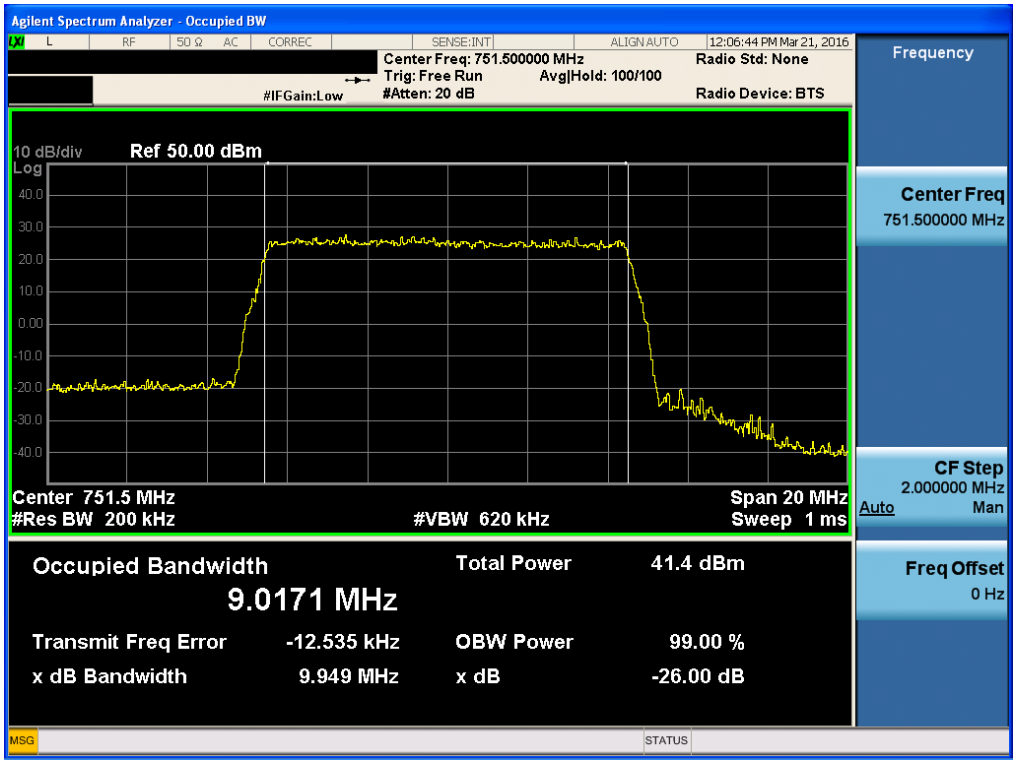


Plots of Occupied Bandwidth_LTE 10 MHz_Downlink

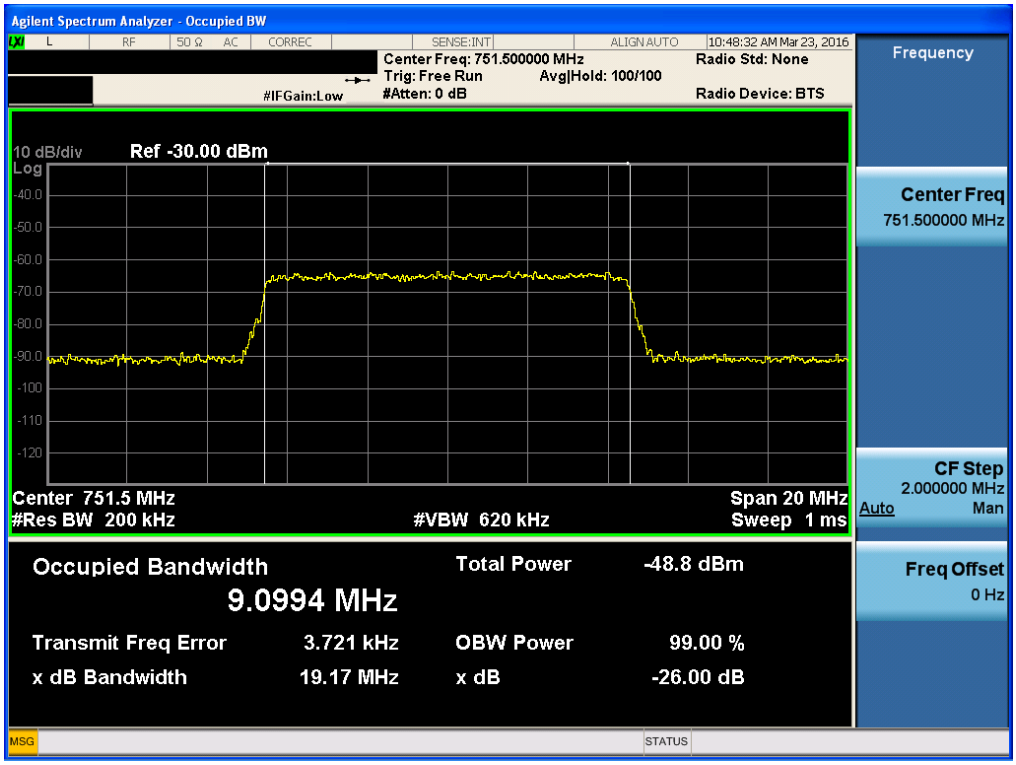
[Output Downlink Middle_ AGC threshold]



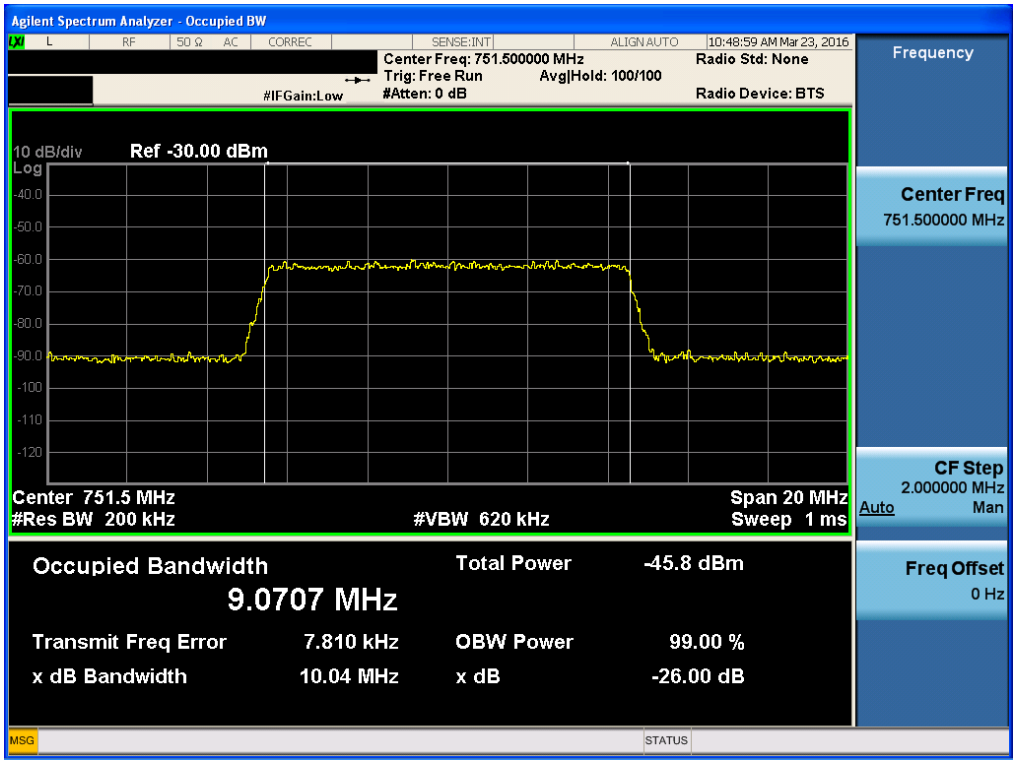
[Output Downlink Middle_ +3 dB above the threshold]



[Input Downlink Middle _AGC threshold]

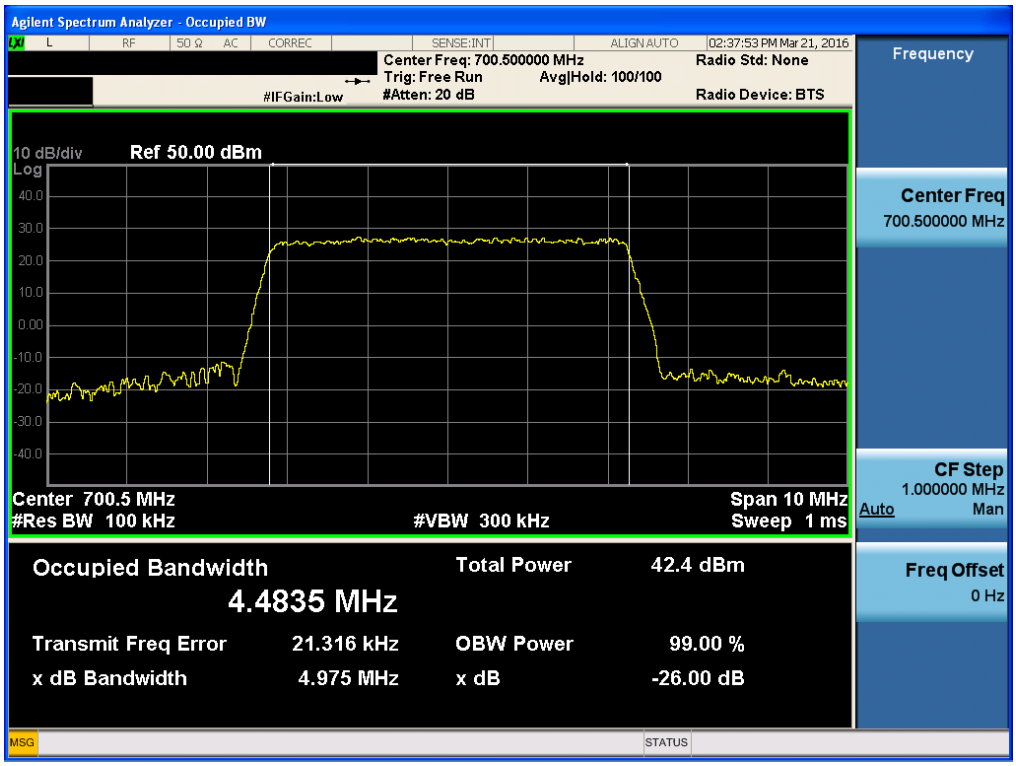


[Input Downlink Middle _+3 dB above the threshold]

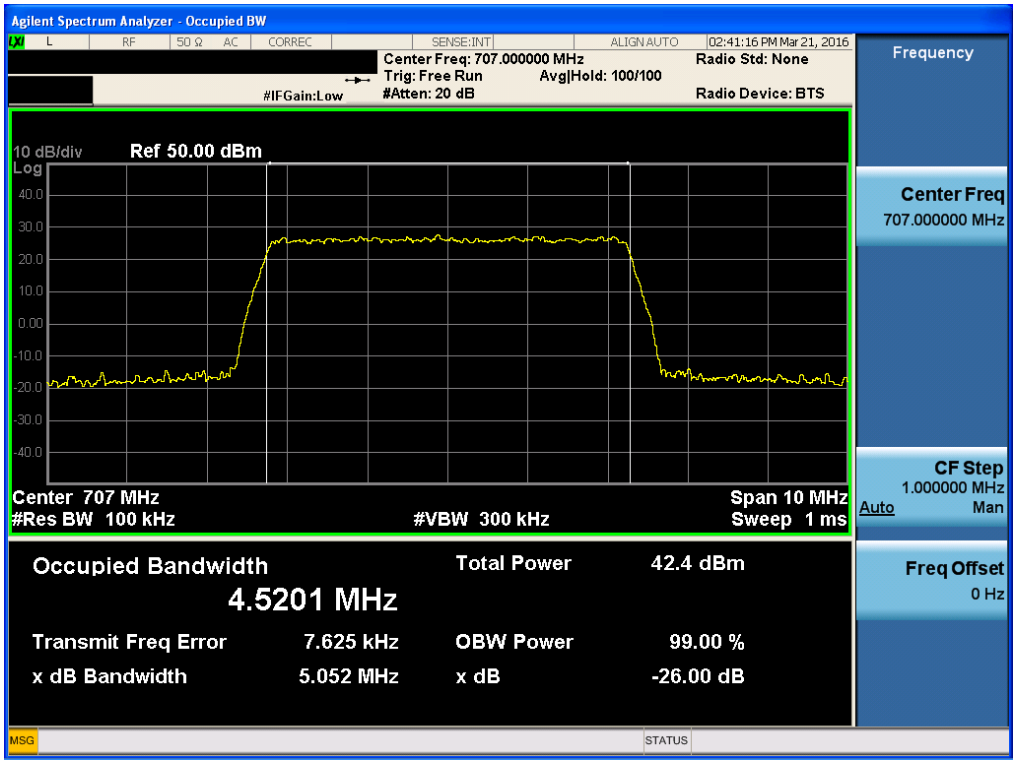


Plots of Occupied Bandwidth_LTE 5 MHz_Uplink

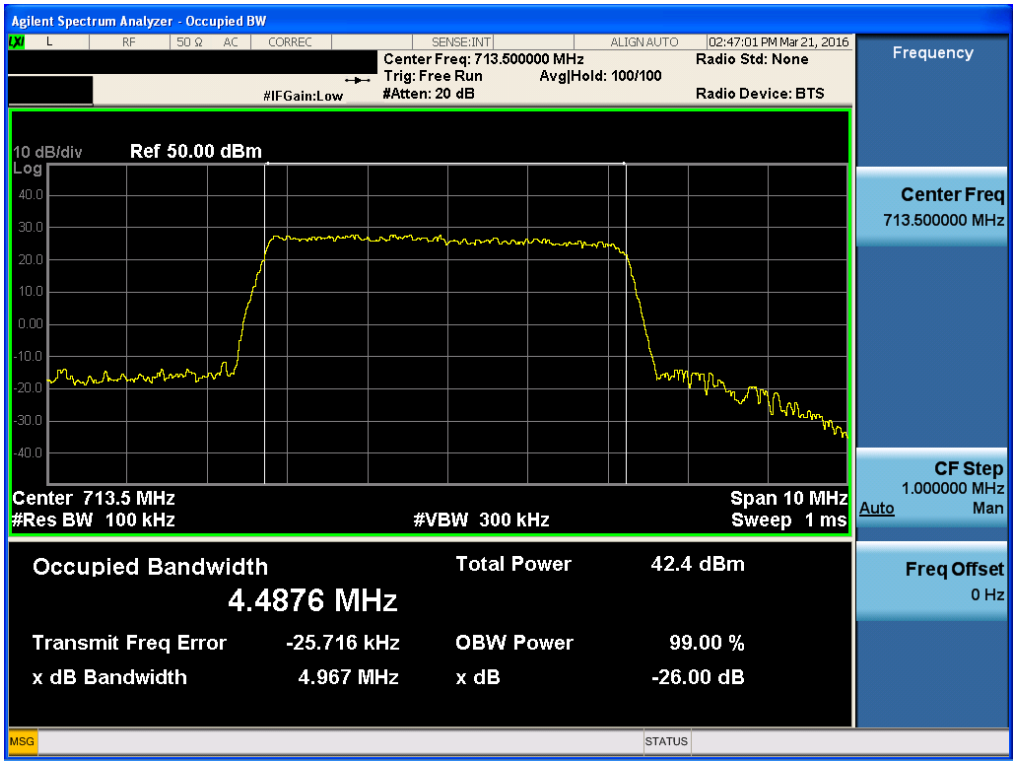
[Output Uplink Low_ AGC threshold]



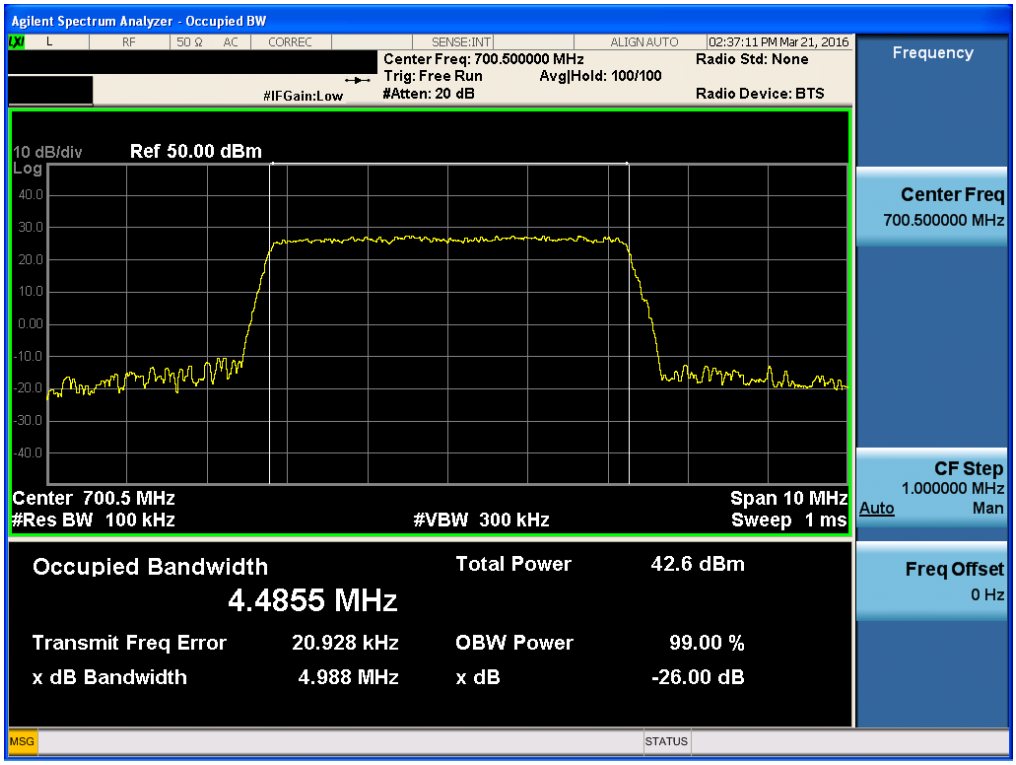
[Output Uplink Middle_ AGC threshold]



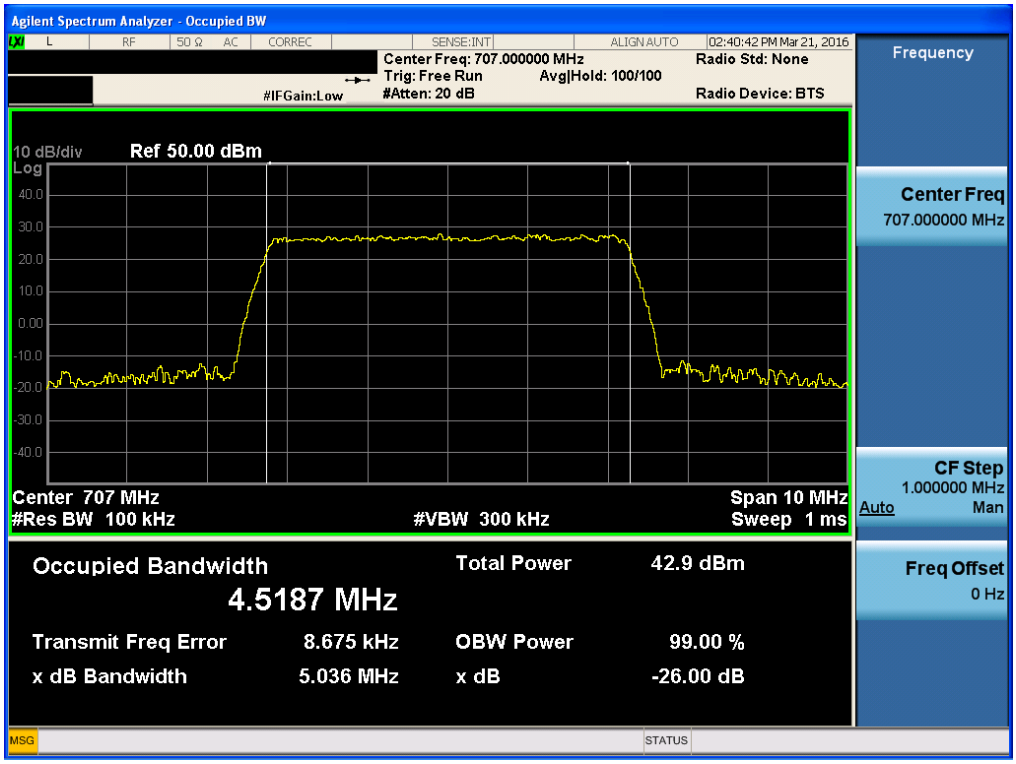
[Output Uplink High_ AGC threshold]



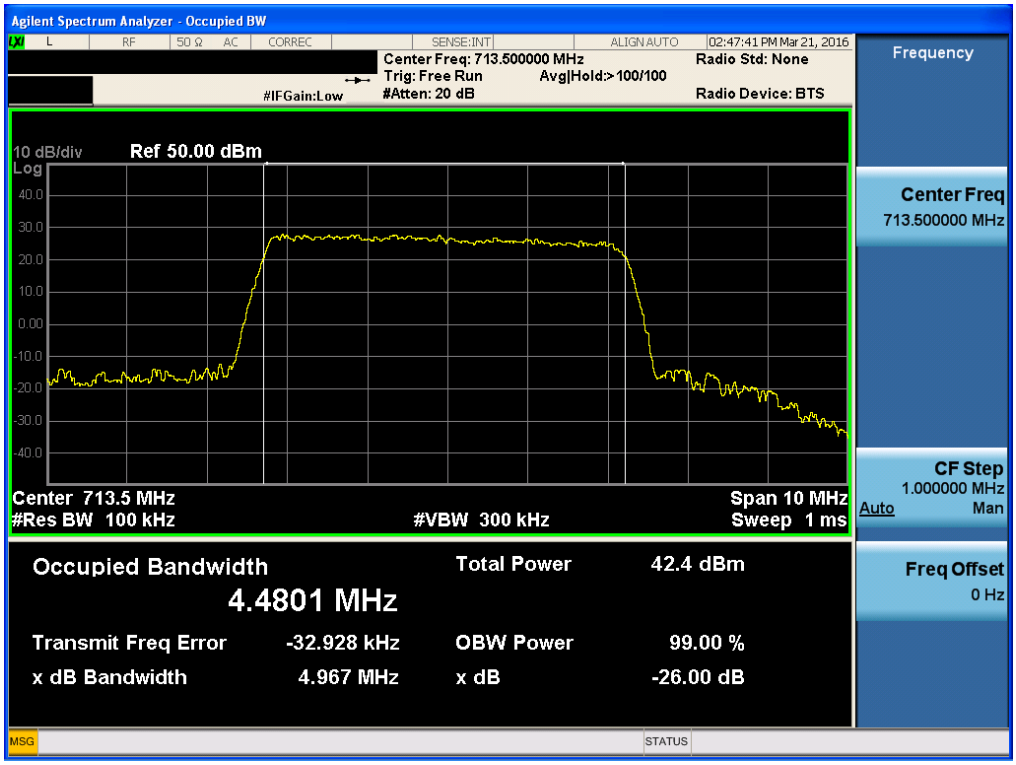
[Output Uplink Low_ +3 dB above the threshold]



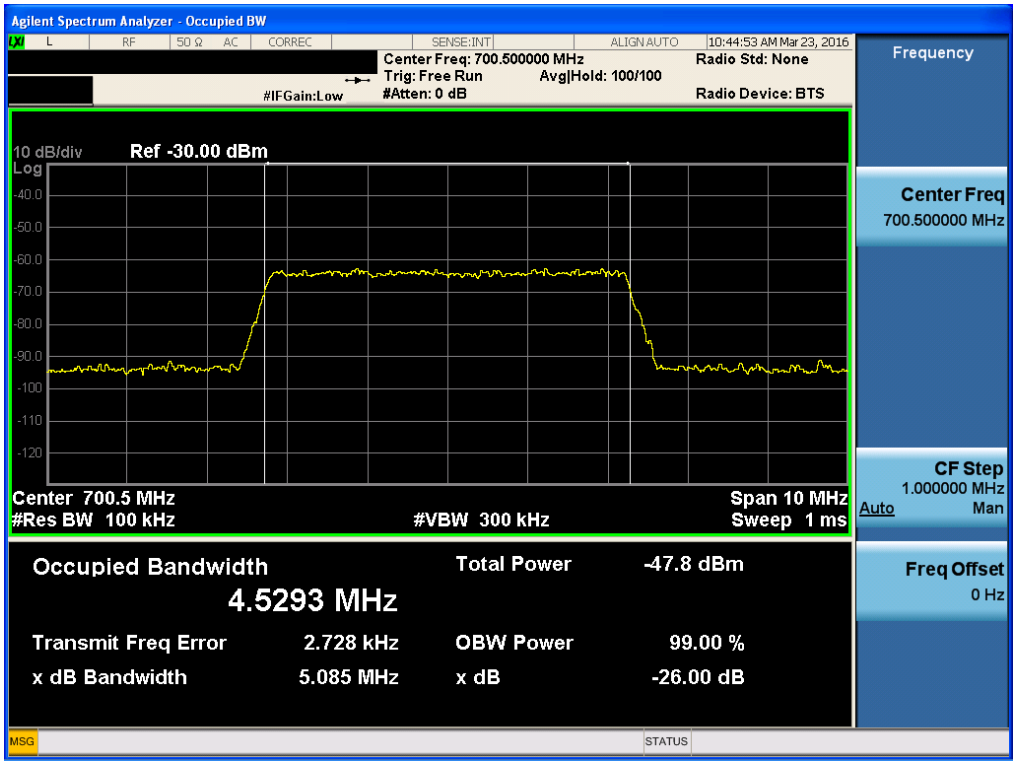
[Output Uplink Middle_ +3 dB above the threshold]



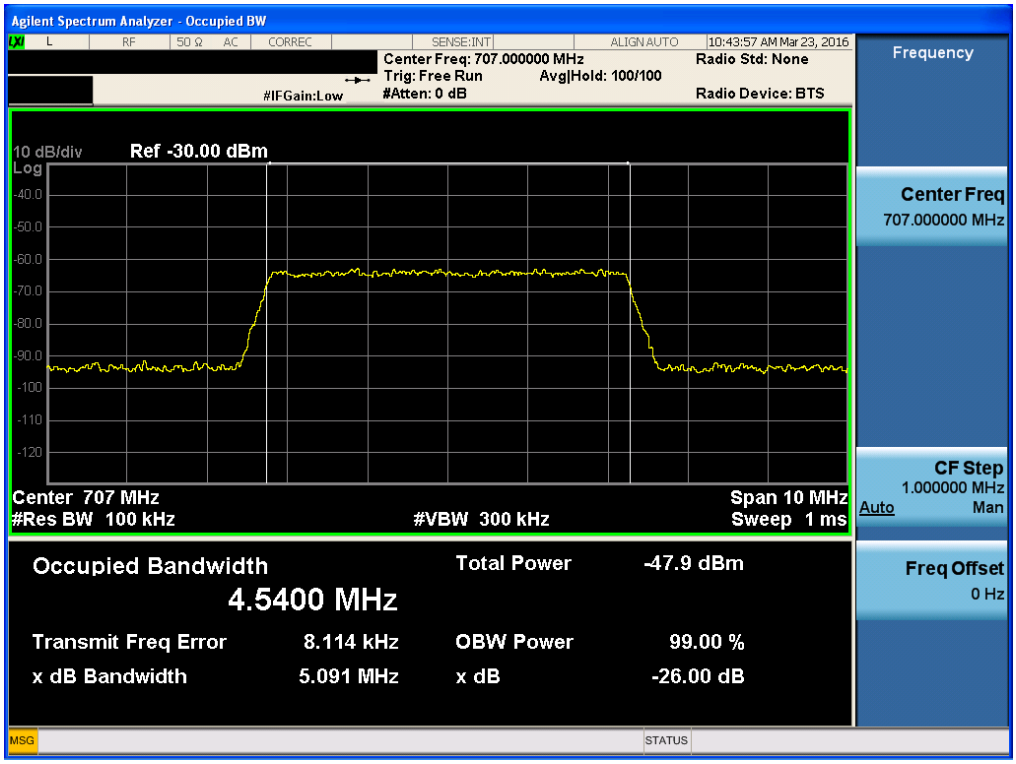
[Output Uplink High_ +3 dB above the threshold]



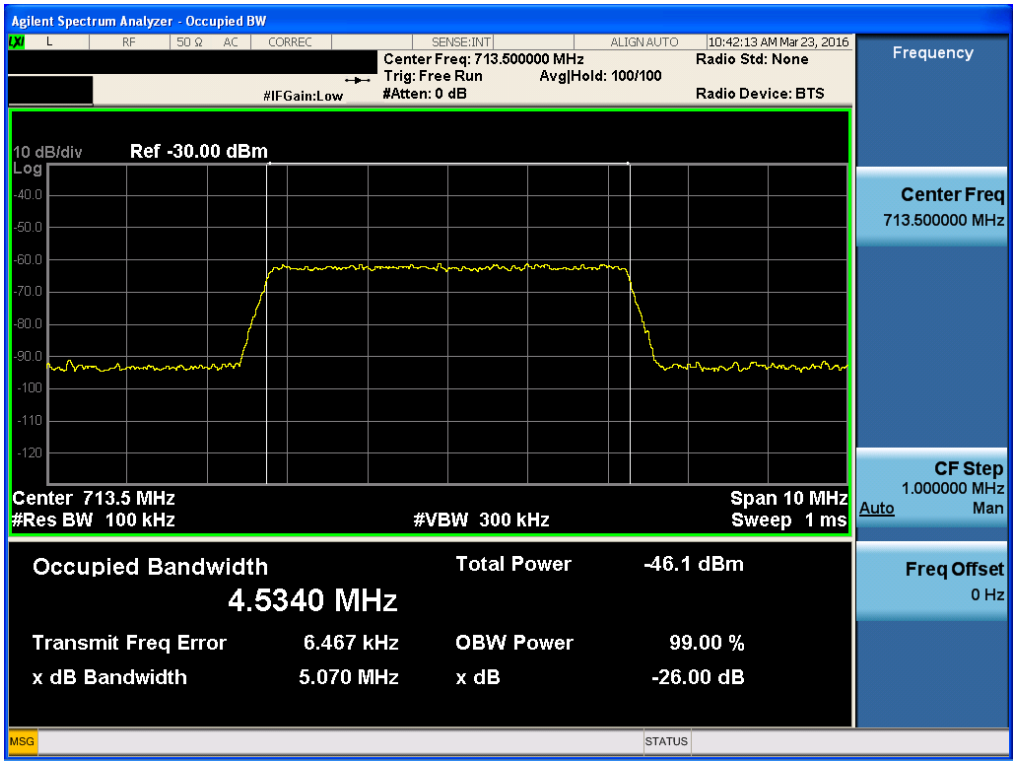
[Input Uplink Low_AGC threshold]



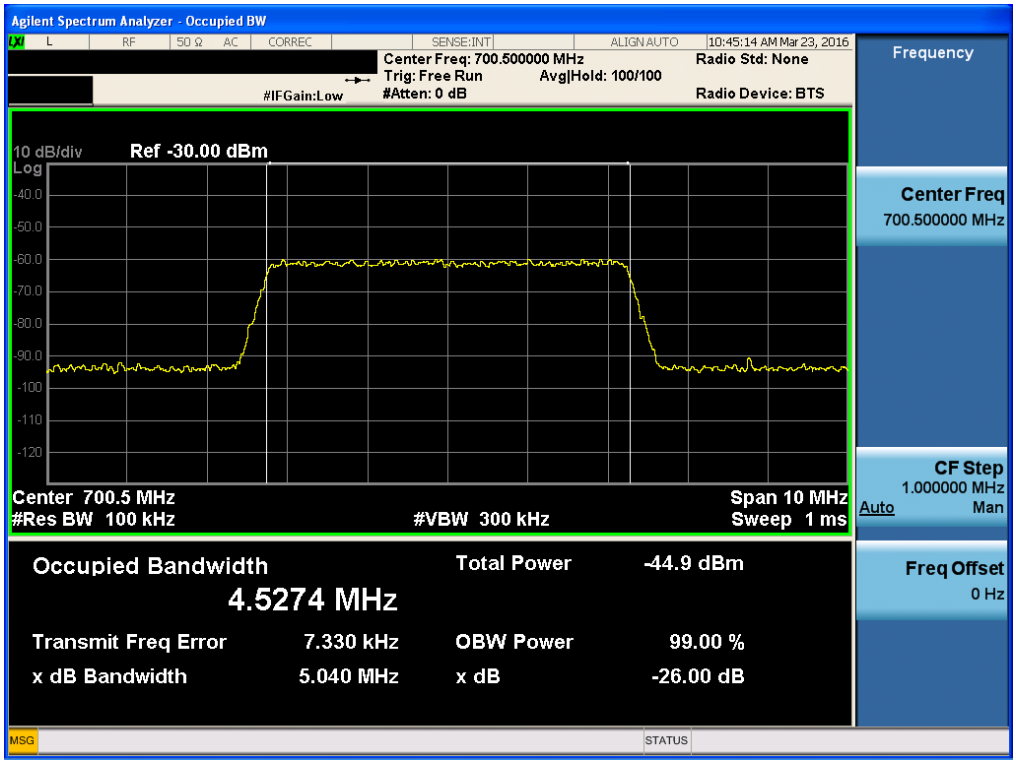
[Input Uplink Middle _AGC threshold]



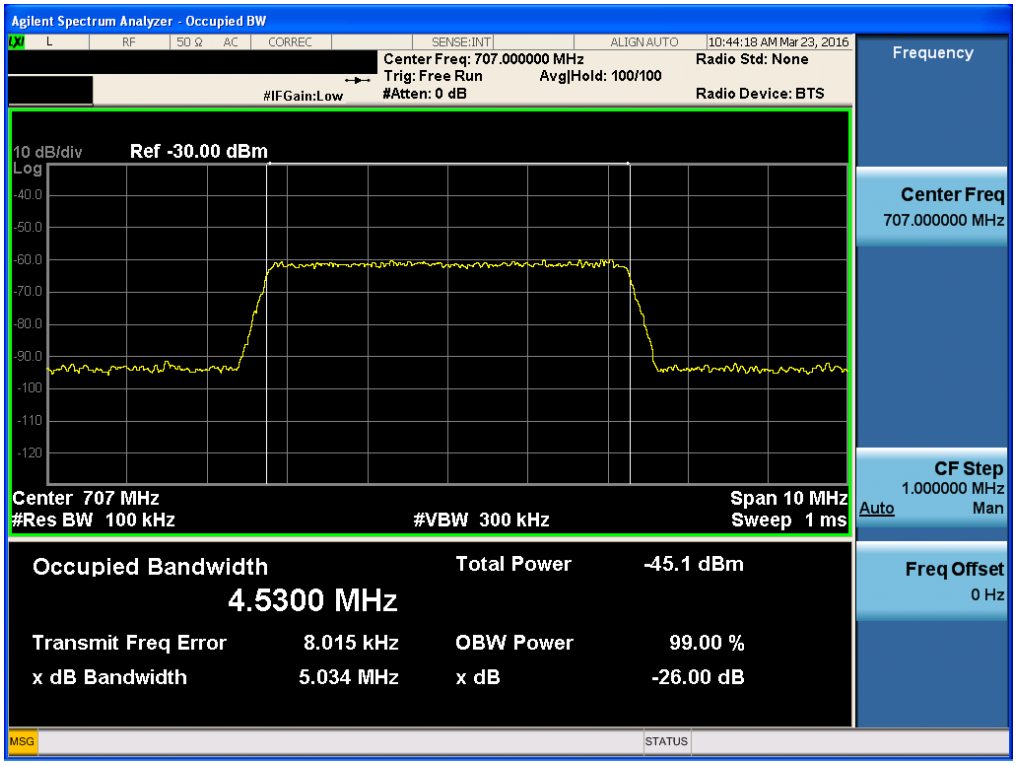
[Input Uplink High_AGC threshold]



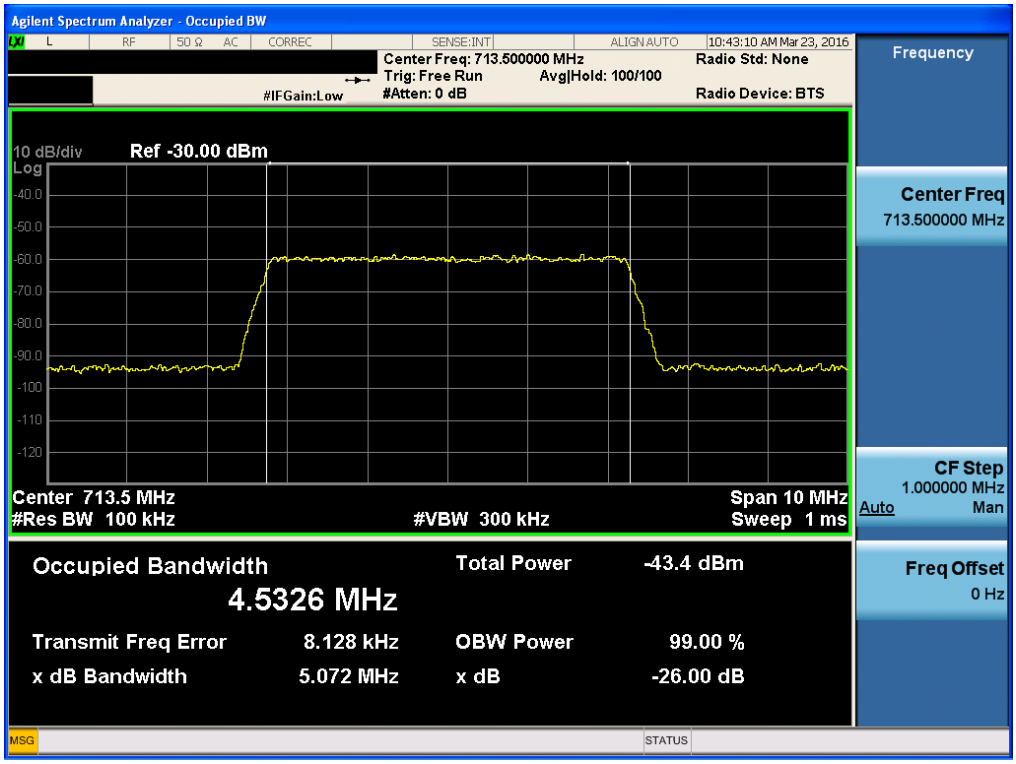
[Input Uplink Low_+3 dB above the threshold]



[Input Uplink Middle _+3 dB above the threshold]



[Input Uplink High_+3 dB above the threshold]

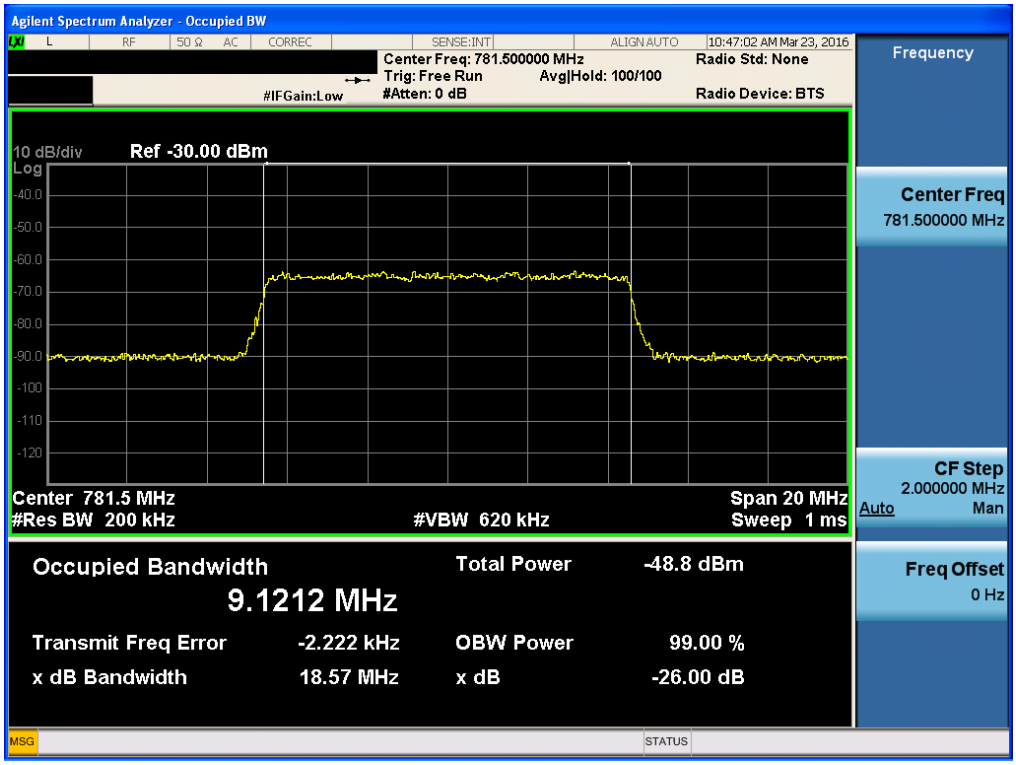


Plots of Occupied Bandwidth_LTE 10 MHz_ Uplink

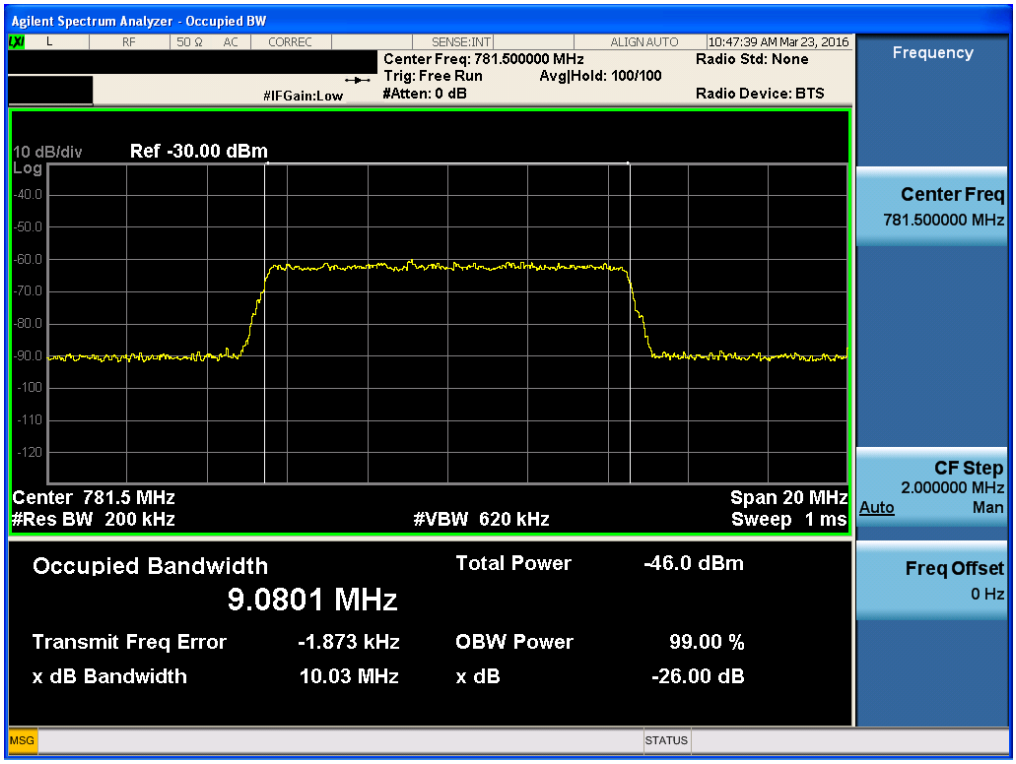
[Output Uplink Middle_ AGC threshold]

[Output Uplink Middle_ +3 dB above the threshold]

[Input Uplink Middle _AGC threshold]



[Input Uplink Middle _+3 dB above the threshold]



8. PASSBAND GAIN AND BANDWIDTH & OUT OF BAND REJECTION

FCC Rules

Test Requirement(s): KDB 935210 D02 v03

Out of Band Rejection – Test for rejection of out of band signals. Filter freq. response plots are acceptable.

Test Procedures:

Measurements were in accordance with the test methods section 3.3 of KDB 935210 D05 v01.

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 from the center of the passband.

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 = approx. 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 of the spectrum analyzer to be 1 % to 5 % of the passband and the video bandwidth 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 f0.

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. Capture the frequency response of the EUT.

IC Rules

Test Requirements: RSS-131 6.1

The passband gain shall not exceed the nominal gain by more than 1.0 dB. The 20 dB bandwidth shall not exceed the nominal bandwidth that is stated by the manufacturer. Outside of the 20 dB bandwidth, the gain shall not exceed the gain at the 20 dB point.

Test Procedures: RSS-131 4.2

Adjust the internal gain control of the equipment under test to the nominal gain for which equipment certification is sought.

With the aid of a signal generator and spectrum analyzer, measure the 20 dB bandwidth of the amplifier (i.e. at the point where the gain has fallen by 20 dB). Measure the gain-versus-frequency response of the amplifier from the midband frequency f0 of the passband up to at least f0 + 250% of the 20 dB bandwidth.

Signal generator sweep from the frequency more lower than the low frequency -250% to the frequency more higher than high frequency +250%.

Test Results: The EUT complies with the requirements of this section.

Input Level (dBm) Input Signal : Sinusoidal	Maximum Amp Gain
-57 dBm	90 dB

[Downlink]

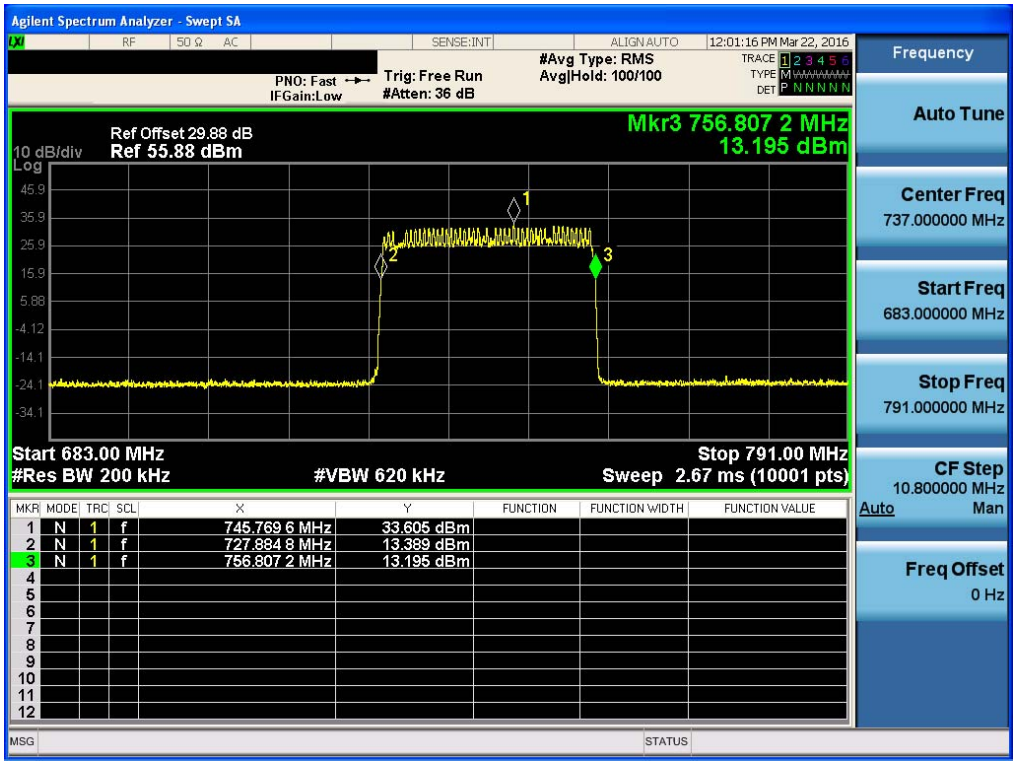
	20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
LTE 5MHz	727.885 MHz ~ 756.807 MHz	33.61	90.61
LTE 10MHz	727.793 MHz ~ 756.740 MHz	33.28	90.28

[Uplink]

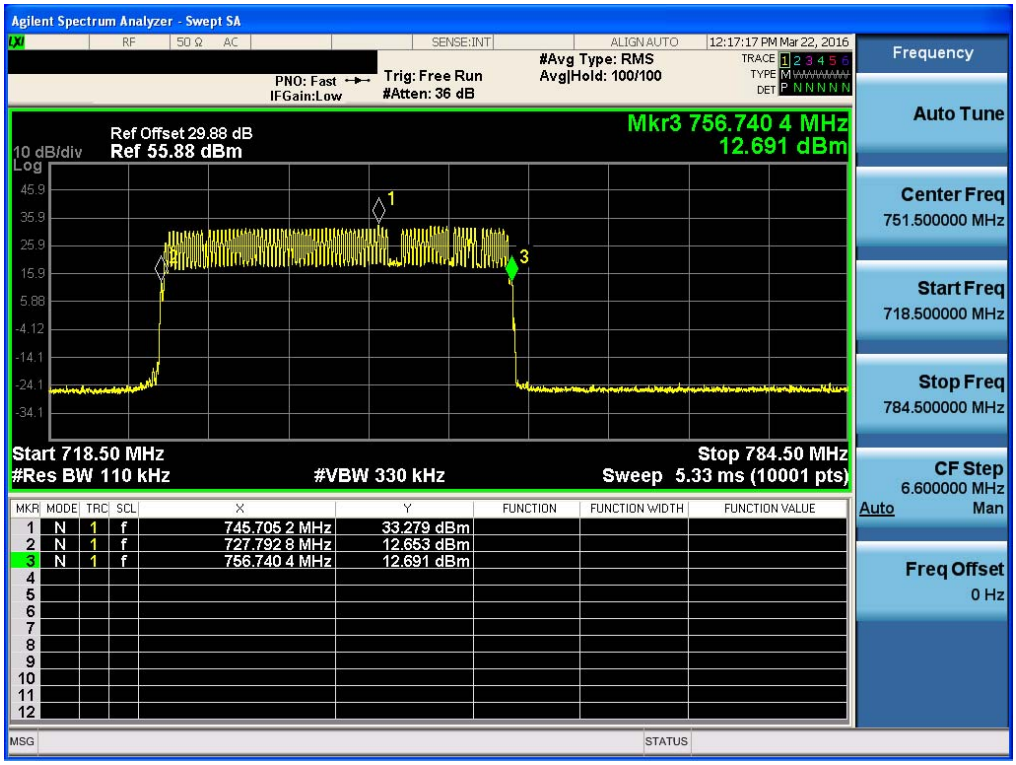
	20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
LTE 5MHz	697.863 MHz ~ 716.137 MHz	33.49	90.49
LTE 10MHz	776.430 MHz ~ 787.735 MHz	33.25	90.25

Plots of Passband Gain and Bandwidth & Out of Band Rejection

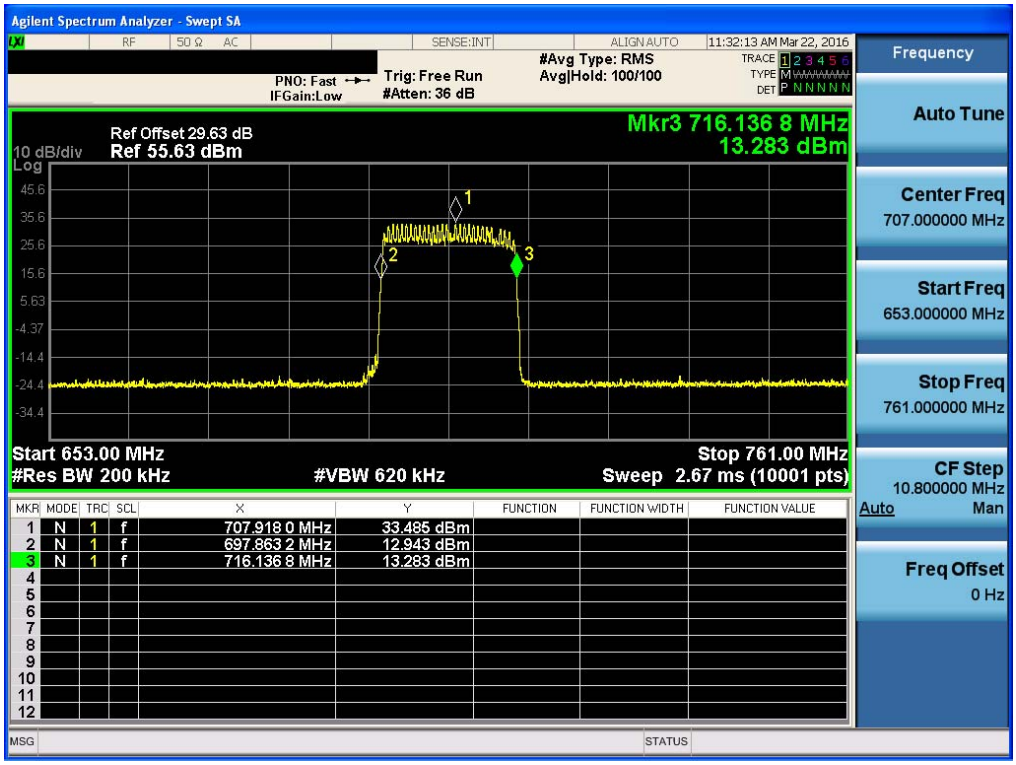
[Downlink LTE 5 MHz]



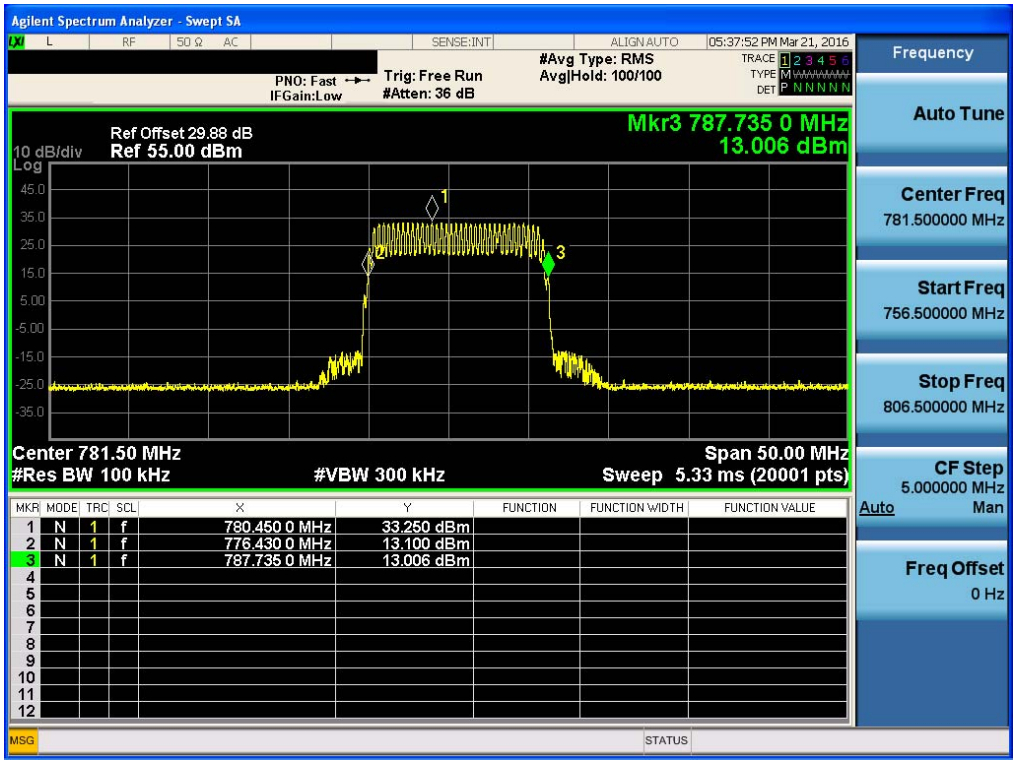
[Downlink LTE 10 MHz]



[Uplink LTE 5 MHz]



[Uplink LTE 10 MHz]



9. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL

FCC Rules

Test Requirement(s): § 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.

§ 27.53 Emission limits

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

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

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

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

(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;

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

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

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

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

Test Procedures:

Measurements were in accordance with the test methods section 3.5.2 of KDB 935210 D05 v01.

1. General

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/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, can be excluded from the test stipulated in step a).

2. EUT out-of-band/block emissions conducted measurement

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

NOTE—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 the two-tone test.

b) Set the signal generator to produce two AWGN signals as previously described (e.g., 4.1 MHz OBW).

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 of interest.

d) Set the composite power levels such that the input signal is just below the AGC threshold (see 3.2), 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. Alternatively, the composite power can be measured using an average power meter as described in KDB Publication 971168.

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 (typically 1 % of the emission bandwidth, 100 kHz, or 1 MHz)

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 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 (i.e., 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 the procedure with the composite input power level set to 3 dB above the AGC threshold.

o) Reset the input signals frequencies to the lower edge of the frequency block or band under examination.

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. EUT spurious emissions conducted measurement

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 (e.g., 4.1 MHz OBW AWGN).
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 (see 3.2), 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 (e.g., reference bandwidth is typically 100 kHz or 1 MHz).
g) Set the VBW ≥ 3 × RBW.
h) Set the Sweep time = auto-couple.
i) Set the analyzer start frequency to the lowest radio frequency signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part.
NOTE—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 (i.e., 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 analyzer start frequency to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the analyzer stop frequency to 10 times the highest frequency of the fundamental emission (see §2.1057). Note that 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 (i.e., 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 and provide tabular data, if required.

p) Repeat the procedure with the input test signals tuned to a middle band/block frequency/channel and then a high band/block frequency/channel.

q) Repeat entire procedure with the narrowband test signal.

r) Repeat for all authorized frequency bands/blocks used by the EUT.

IC Rules

Test Requirement(s): RSS-131 6.4

Spurious emissions of zone enhancers and translators shall be suppressed as much as possible.

Spurious emissions shall be attenuated below the rated power of the enhancer by at least:

43 + 10 Log10(Prated in watts), or 70 dB, whichever is less stringent.

Note: If the minimum standard is not met, check to see if the input signal generators have a high harmonic content.

Test Procedures: RSS-131 4.4

4.4.1 Multi-channel Enhancer

The spurious emissions of the equipment under test shall be measured using the two-tone method in section 4.3.1, with the two tones Po1 and Po2 set to the required levels. Using a spectrum analyser with a resolution bandwidth set at 100 kHz, search for spurious emissions from 30 MHz to at least 5 times the highest RF passband frequency. The search may omit the band that contains the test tones and intermodulation products.

4.4.2 Single channel Enhancer

The enhancer shall be operated as described in section 4.3.2 during the search for spurious emissions.

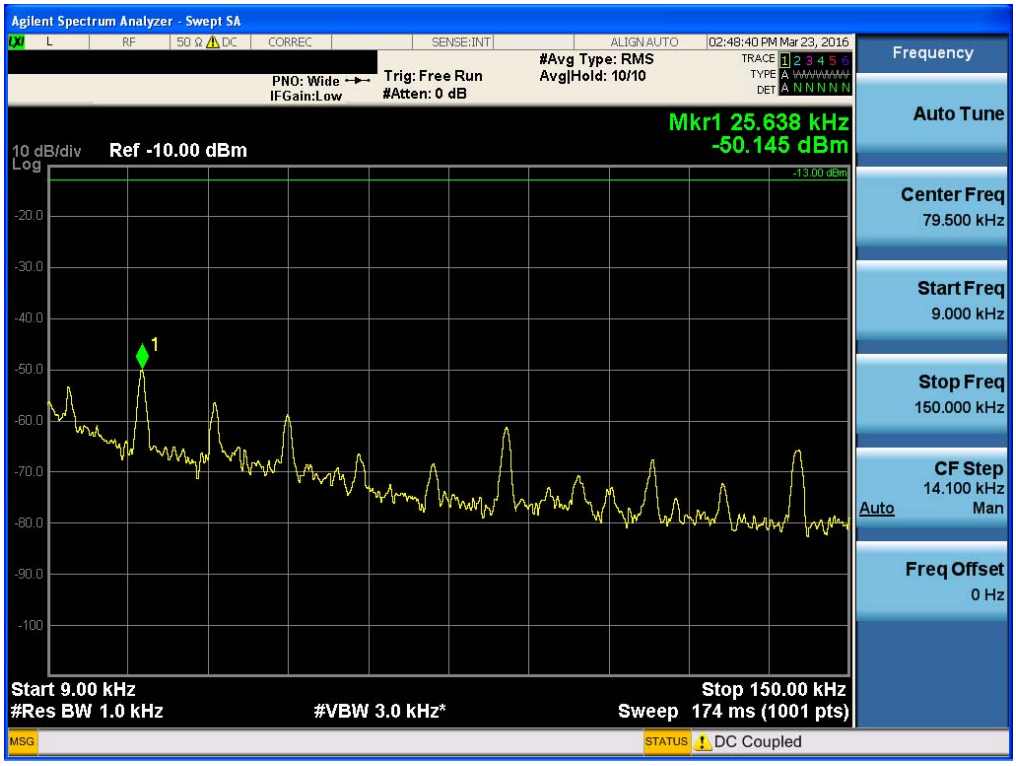
Using a spectrum analyser with a resolution bandwidth set at 100 kHz, search for spurious emissions from 30 MHz to at least 5 times the highest RF passband frequency. The search may omit the band that contains the input signal.

Test Results: The EUT complies with the requirements of this section. There were no Detectable Spurious emissions for this EUT.

Single channel Enhancer Plots of Spurious Emission [Downlink LTE 5 MHz]

Conducted Spurious Emissions (9 kHz – 150 kHz)

[Downlink Low]



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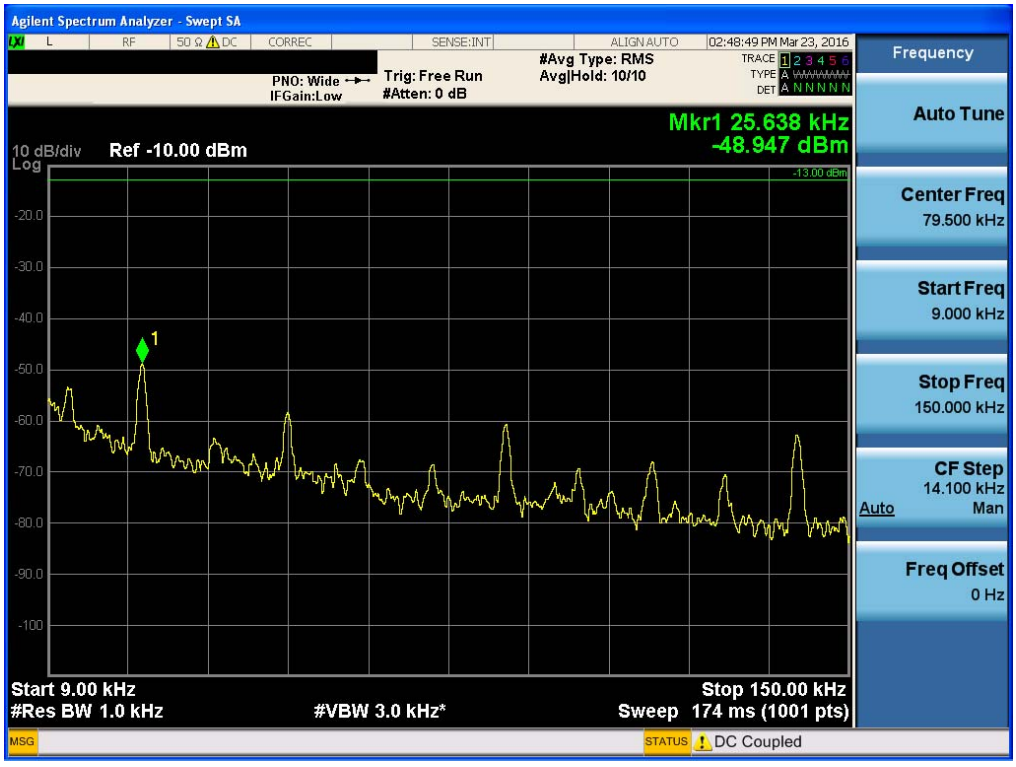

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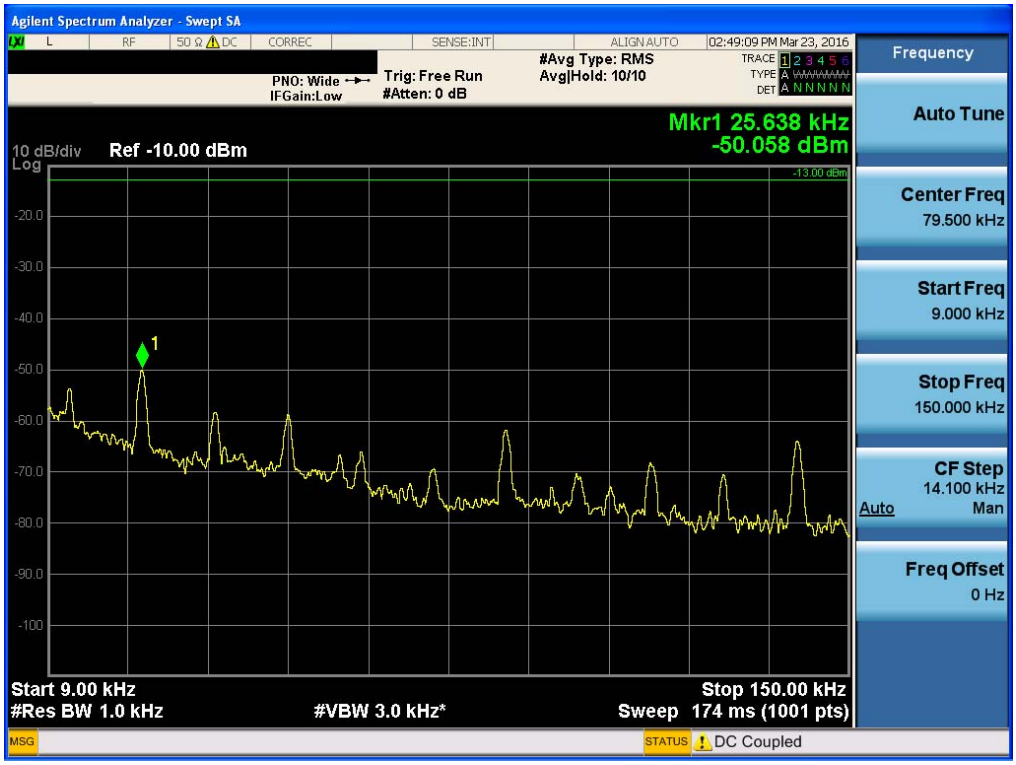
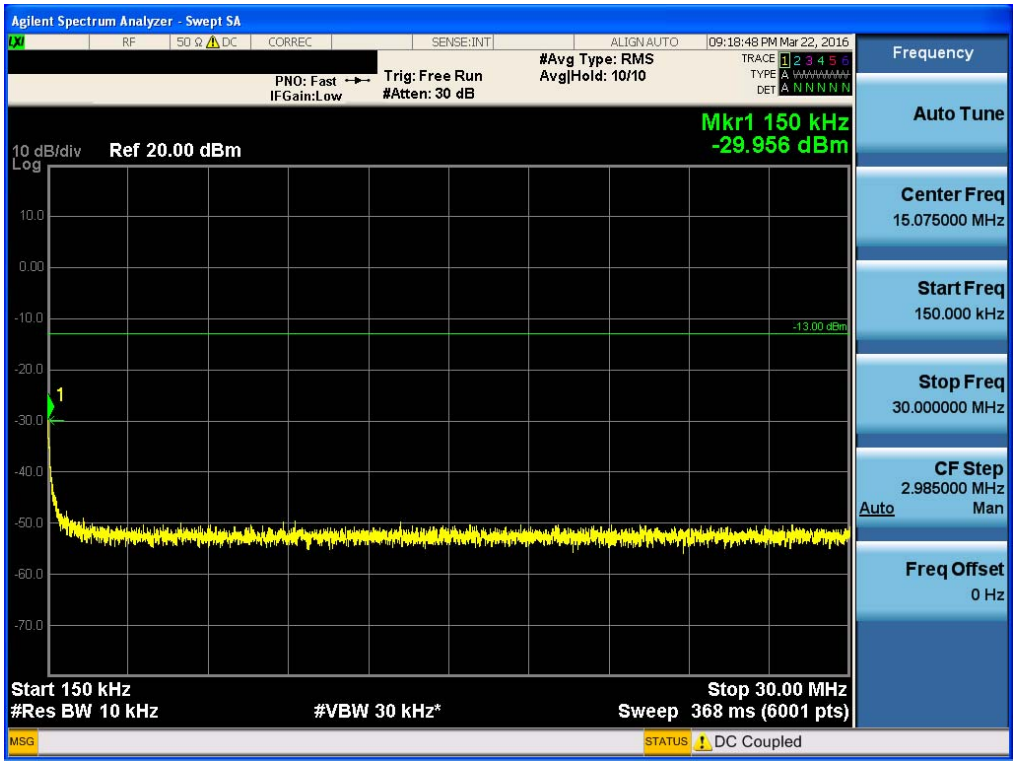


Conducted Spurious Emissions (150 kHz – 30 MHz)

[Downlink Low]



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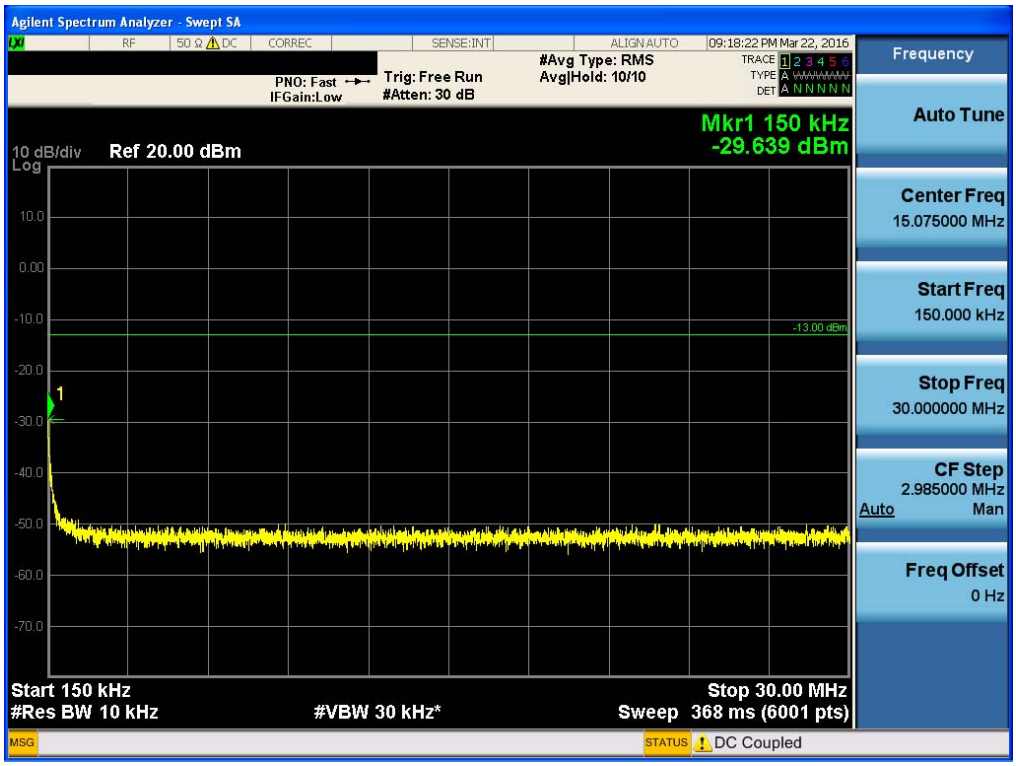

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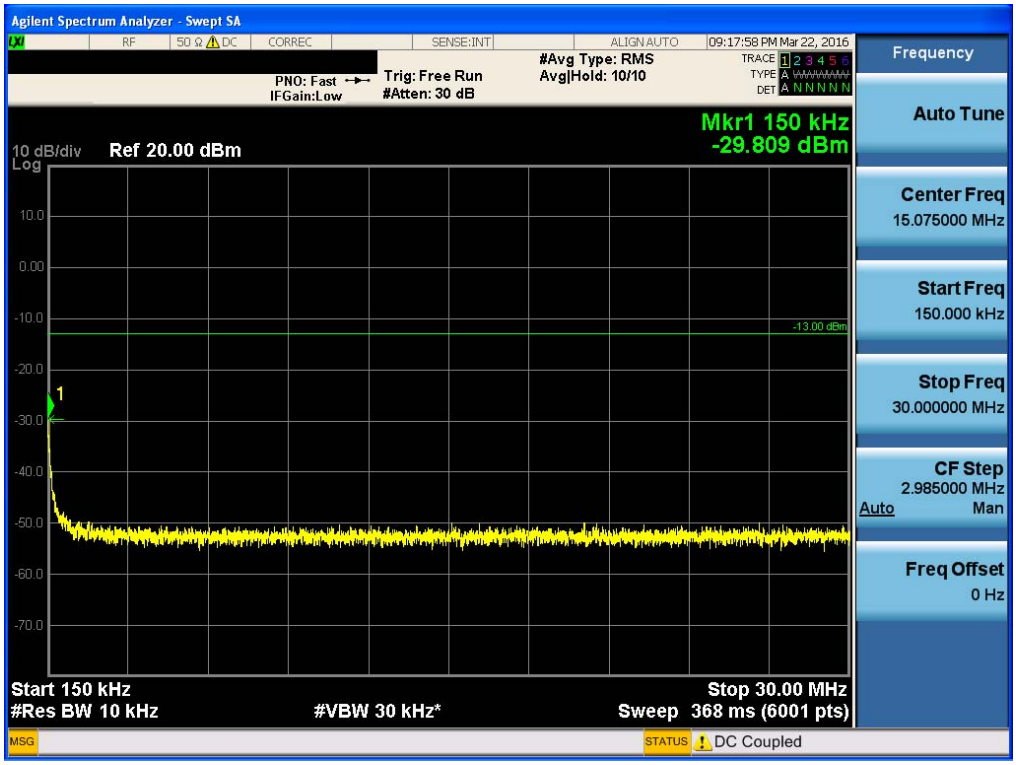
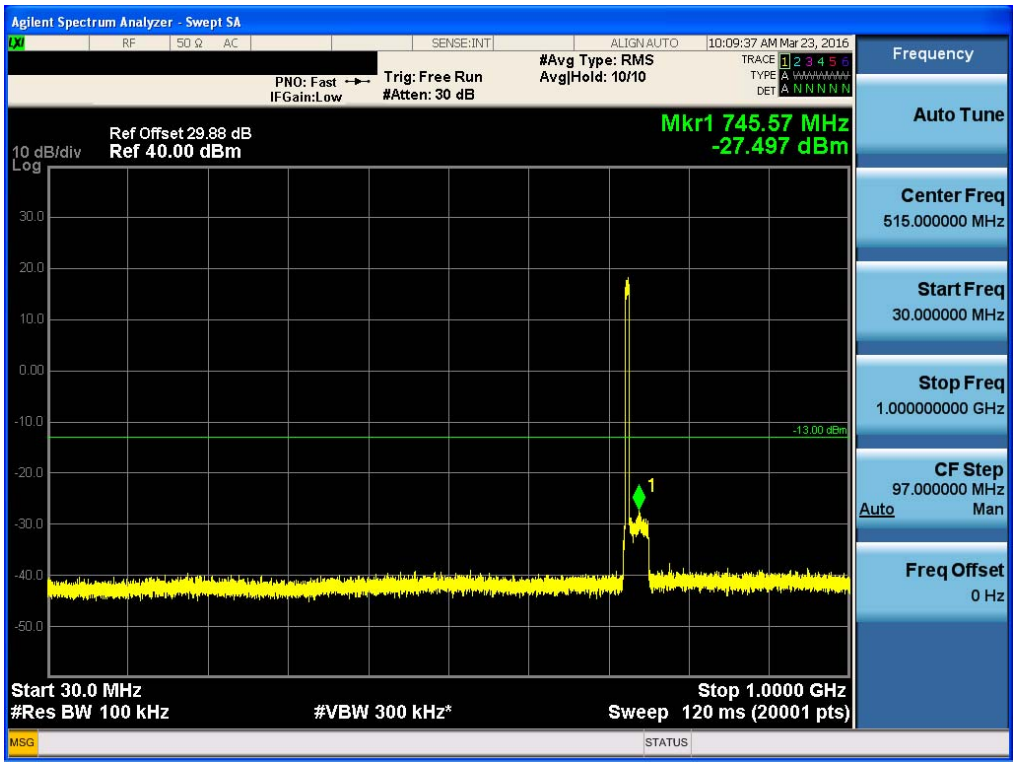


Conducted Spurious Emissions (30 MHz – 1 GHz)

[Downlink Low]



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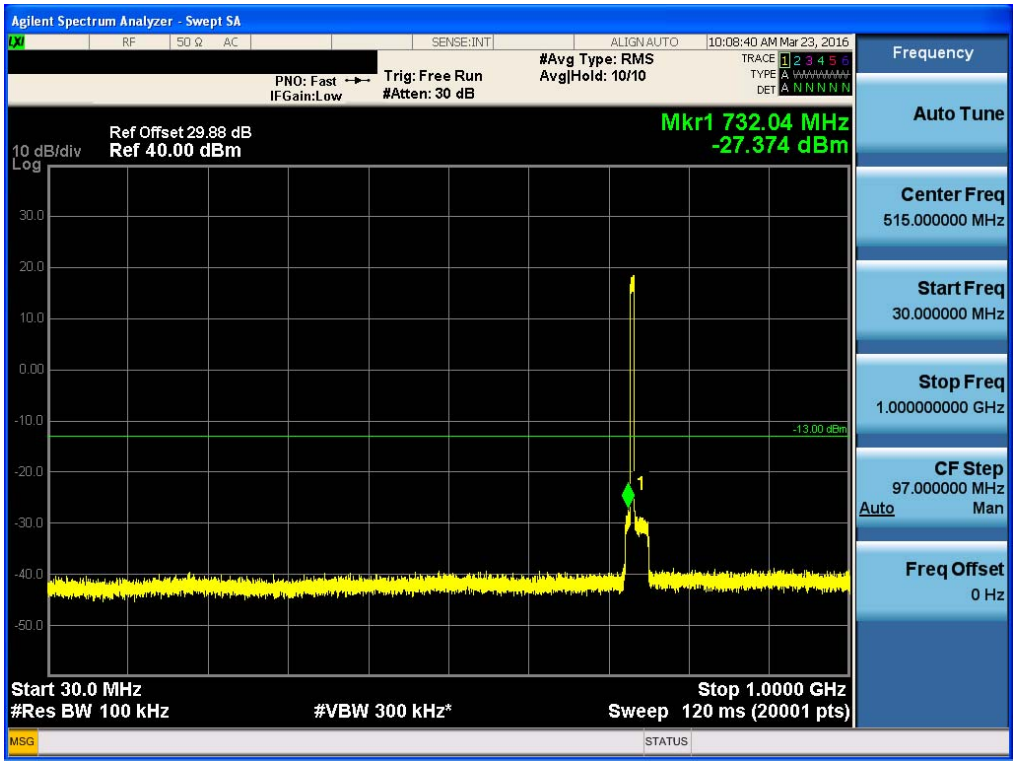

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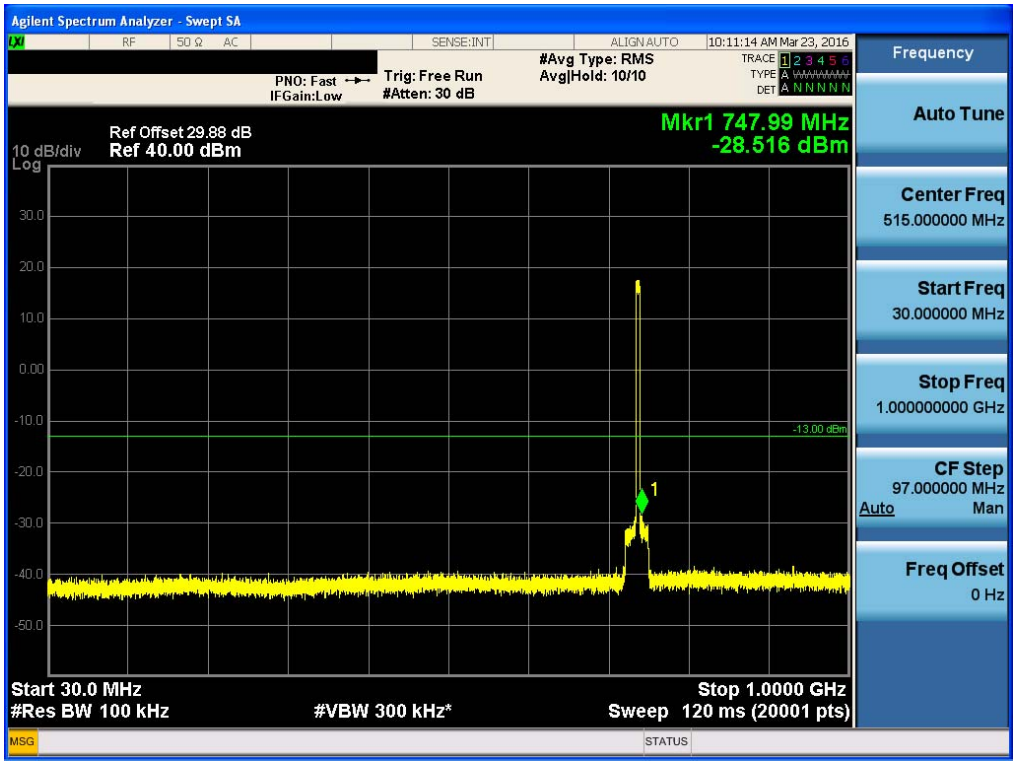
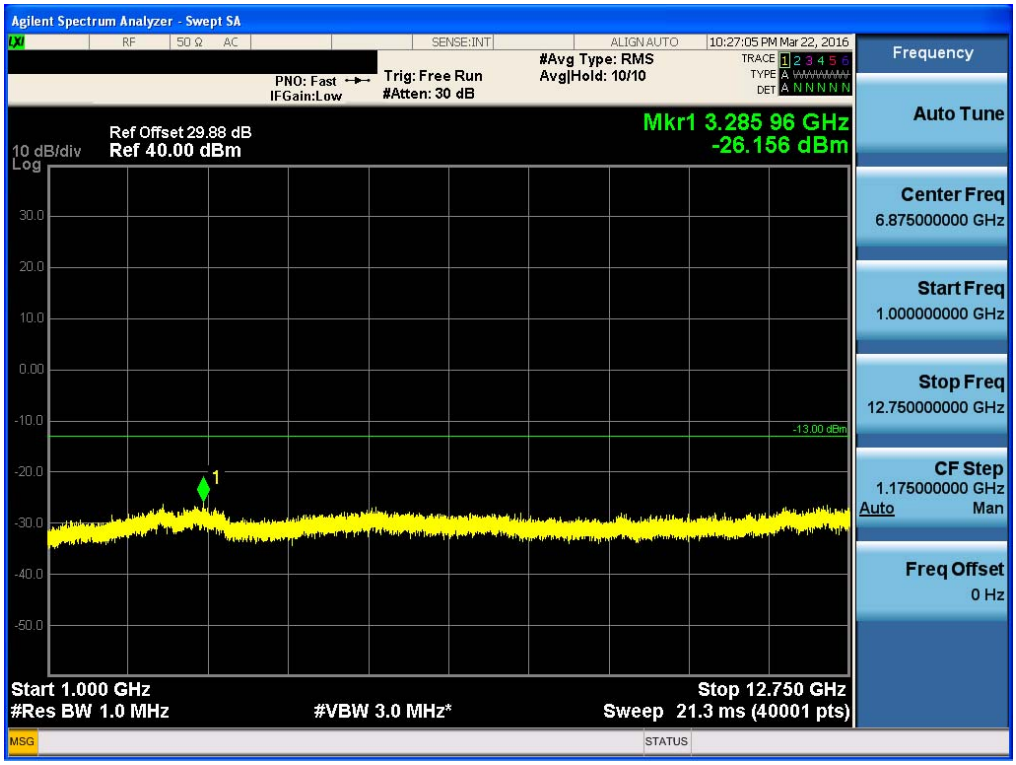


Conducted Spurious Emissions (1 GHz –12.75 GHz)

[Downlink Low]



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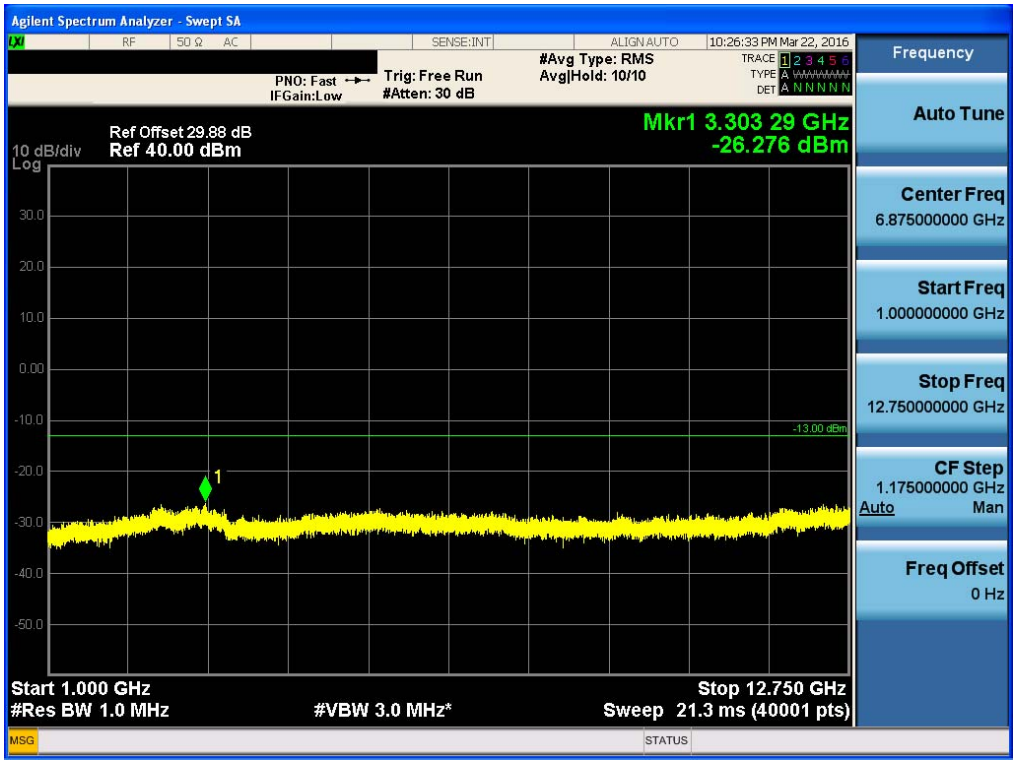

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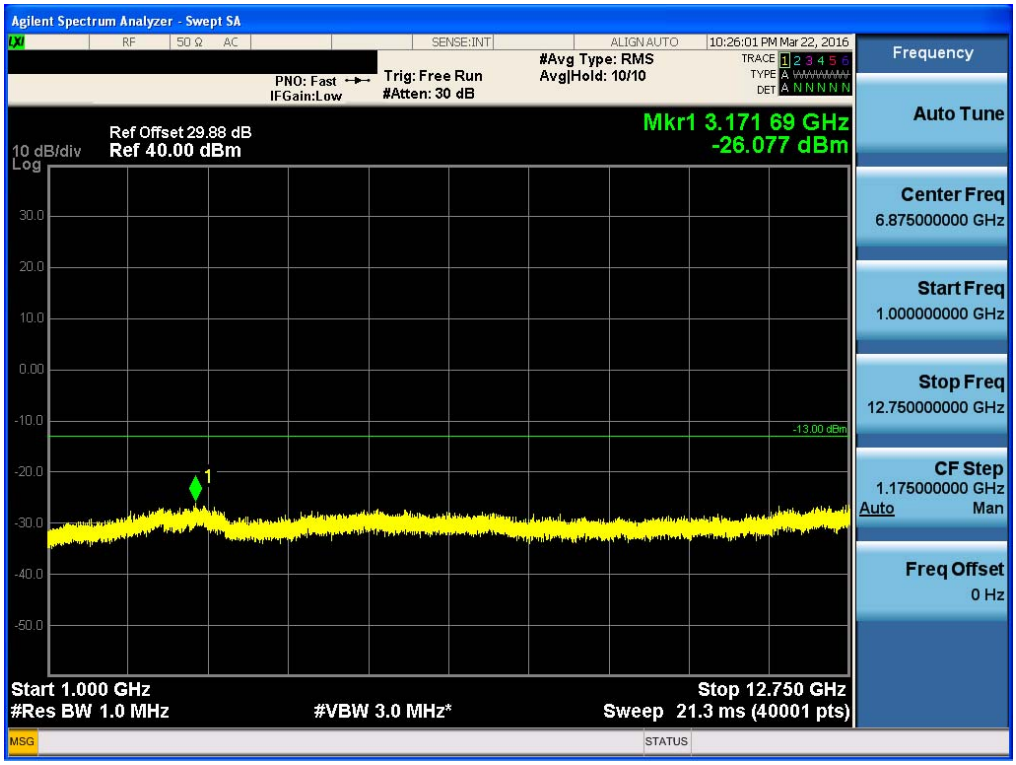
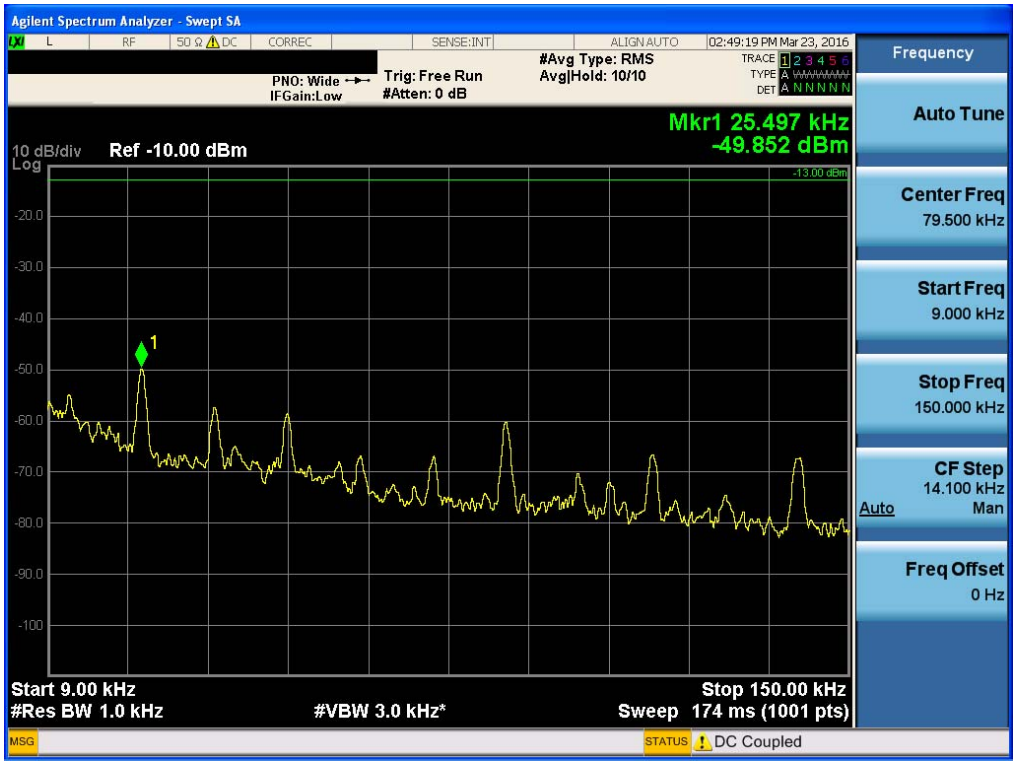


Single channel Enhancer Plots of Spurious Emission [Downlink LTE 10 MHz]

Conducted Spurious Emissions (9 kHz – 150 kHz)

[Downlink Middle]



Conducted Spurious Emissions (150 kHz – 30 MHz)

[Downlink Middle]