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FCC / ISED REPORT

Certification

Applicant Name:
ADVANCED RF TECHNOLOGIES, INC

Address:
3116 WEST VANOWEN STREET, BURBANK, CA 91505, USA

Date of Issue:
August 28, 2017
Location:
HCT CO., LTD.,
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
Report No.: HCT-R-1708-F015
ISED Registration No.: 5944A-5

FCC ID:	**N52-ADXV-R-37BT**
IC:	**6416A-ADXVR37BT**
APPLICANT:	**ADVANCED RF TECHNOLOGIES, INC**

FCC/ IC Model:	ADXV-R-37BT
EUT Type:	DAS (Distributed Antenna System)
Frequency Ranges:	2 496 ~ 2 690 MHz (for FCC, Downlink / Uplink)
	2 500 ~ 2 690 MHz (for ISED, Downlink / Uplink)
Conducted Output Power:	5 W (37 dBm, Downlink) / 2.5 mW (4 dBm, Uplink)
Date of Test:	June 23, 2017 ~ August 25, 2017
FCC Rule Part(s):	CFR 47 - Part 2, Part 27
IC Rules :	RSS-Gen (Issue 4, November 2014), RSS-131 (Issue 3, January 2017),

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from thisequipment 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 / IC Rules under normal use and maintenance.

Report prepared by : Kyung Soo Kang
Engineer of Telecommunication testing center

Approved by : Yong Hyun Lee
Manager of Telecommunication testing center

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Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1708-F015	August 28, 2017	- First Approval Report

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1. CLIENT INFORMATION

The EUT has been tested by request of

Applicant	ADVANCED RF TECHNOLOGIES, INC 3116 WEST VANOWEN STREET, BURBANK, CA 91505, USA
Manufacturer	ADRF Korea, inc 5-5, Mojeon-Ri, Backsa-Myun, Icheon-City, Kyunggi-Do, Korea

FCC ID:	N52-ADXV-R-37BT
IC:	6416A-ADXVR37BT
EUT Type:	DAS (Distributed Antenna System)
FCC/ IC Model(s):	ADXV-R-37BT
Power Supply:	AC 100 ~ 240 V DC -48 V
Frequency Ranges:	2 496 ~ 2 690 MHz (for FCC, Downlink / Uplink) 2 500 ~ 2 690 MHz (for ISED, Downlink / Uplink)
Conducted Output Power:	5 W (37 dBm, Downlink) / 2.5 mW (4 dBm, Uplink)
Antenna Gain(s):	Manufacturer does not provide an antenna.
Measurement standard(s):	ANSI/TIA-603-D-2010, KDB 971168 D01 v02r02, KDB 935210 D05 v01r01, RSS-GEN, RSS-131, RSS-199
FCC Rule Part(s):	CFR 47 – Part 2, Part 27
IC Rules Part(s):	RSS-Gen (Issue 4, November 2014), RSS-131 (Issue 3, January 2017)
Place of Tests:	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA (ISED Registration Number: 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, 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 July 07, 2015 (Registration Number: 90661).

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 27, RSS-Gen, RSS-131, RSS-199

Description	Reference (FCC)	Reference (ISED)	Results
Conducted RF Output Power	§2.1046; §27.50(h)	RSS-131, Section 4.1 RSS-199, Section 4.4 SRSP-517	Compliant
Occupied Bandwidth	§2.1049	RSS-Gen, Section 6.6	Compliant
Input-versus-output Spectrum	-	RSS-131 Section 5.2.2	Compliant
Out of Band Rejection & Mean Output Power and Zone Enhancer Gain	KDB 935210 D05 v01r01	RSS-131, Section 5.2.1 RSS-131 Section 5.2.3	Compliant
Spurious Emissions at Antenna Terminals	§2.1051, §27.53(m)	RSS-199, Section 4.5	Compliant
Radiated Spurious Emissions	§2.1051, §27.53(m)	RSS-Gen, Section 7.1.2	Compliant
Frequency Stability	§2.1055, §27.54	RSS-131, Section 5.2.4 RSS-199 Section 4.3	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.

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

3.3. MAXIMUM MEASUREMENTUNCERTAINTY

The value of the measurement uncertainty for the measurement of each parameter.
Coverage factor *k* = 2, Confidence levels of 95 %

Description	Condition	Uncertainty
Conducted RF Output Power	-	± 0.72 dB
Occupied Bandwidth	OBW ≤ 20 MHz	± 52 kHz
Input-versus-output Spectrum		
Out of Band Rejection & Mean Output Power and Zone Enhancer Gain	Gain 20 dB bandwidth	± 0.89 dB ± 0.58 MHz
Transmitter unwanted emissions	-	± 1.08 dB
Radiated Spurious Emissions	f ≤ 1 GHz f > 1 GHz	± 4.80 dB ± 6.07 dB
Frequency Stability	-	± 1.22 x 10^{-6}

4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

Temperature :	**+ 15 ℃ to + 35 ℃**
Relative humidity:	**30 % to 60 %**
Air pressure	**860 mbar to 1 060 mbar**

5. TEST EQUIPMENT

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Agilent	N5182A /Signal Generator	03/29/2017	Annual	MY50141649
Agilent	N5182A /Signal Generator	01/23/2017	Annual	MY47070406
Agilent	N9020A / Signal Analyzer	07/18/2017	Annual	MY49100060
Weinschel	WA67-30-33 / Fixed Attenuator	09/22/2016	Annual	WA67-30-33-1
Weinschel	2-10 / 10 dB Attenuator	02/22/2017	Annual	BR0554
Agilent	11636A / Power Divider	08/01/2017	Annual	09109
DEAYOUNG ENT	DFSS60 / AC Power Supply	04/05/2017	Annual	1003030-1
HP	6674A / DC Power Supply	07/26/2017	Annual	3501A00901
NANGYEUL CO., LTD.	NY-THR18750 / Temperature and Humidity Chamber	10/21/2016	Annual	NY-2009012201A
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	04/19/2017	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	04/06/2017	Biennial	760
Schwarzbeck	BBHA 9120D / Horn Antenna	12/11/2015	Biennial	9120D-1191
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	09/03/2015	Biennial	BBHA9170541
Rohde & Schwarz	FSP / Spectrum Analyzer	09/29/2016	Annual	836650/016
Rohde & Schwarz	FSV40-N / Spectrum Analyzer	09/23/2016	Annual	101068-SZ
Wainwright Instruments	WHKX10-2700-3000-18000-40SS / High Pass Filter	08/01/2017	Annual	4
CERNEX	CBLU1183540 / Power Amplifier	01/25/2017	Annual	24614
CERNEX	CBL06185030 / Power Amplifier	01/25/2017	Annual	24615
CERNEX	CBL18265035 / Power Amplifier	01/23/2017	Annual	22966

6. RF OUTPUT POWER

FCC Rules

Test Requirements:

§ 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 radio telephone 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.

(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.

(h) The following power limits shall apply in the BRS and EBS:

(1) *Main, booster and base stations.*

(i) The maximum EIRP of a main, booster or base station shall not exceed 33 dBW + 10log(X/Y) dBW, where X is the actual channel width in MHz and Y is either 6 MHz if prior to transition or the station is in the MBS following transition or 5.5 MHz if the station is in the LBS and UBS following transition, except as provided in paragraph (h)(1)(ii) of this section.

(ii) If a main or booster station sectorizes or otherwise uses one or more transmitting antennas with a non-omnidirectional horizontal plane radiation pattern, the maximum EIRP in dBW in a given direction shall be determined by the following formula: EIRP = 33 dBW + 10 log(X/Y) dBW + 10 log(360/beamwidth) dBW, where X is the actual channel width in MHz, Y is either (i) 6 MHz if prior to transition or the station is in the MBS following transition or (ii) 5.5 MHz if the station is in the LBS and UBS following transition, and beamwidth is the total horizontal plane beamwidth of the individual transmitting antenna for the station or any sector measured at the half-power points.

IC Rules

Test Requirements:

RSS-199

4. Transmitter and receiver standard specifications

4.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.)

The transmitter output power shall be measured in terms of average value.

For base station equipment, refer to SRSP-517 for the maximum permissible e.i.r.p.

SRSP-517

5. Technical Criteria

5.1 Radiated Power Limits and Antenna Height Limits

5.1.1 Fixed and Base Stations

Fixed and base stations (except fixed subscriber stations) are limited to a maximum ermissible equivalent isotropically radiated power (e.i.r.p.) of 1640 W/MHz (i.e. no more than 1640 W e.i.r.p. in any 1 MHz band segment) with an antenna height above average terrain (HAAT) up to 300 metres. For all installations with antenna HAAT in excess of 300 metres, a corresponding reduction in e.i.r.p. according to Table 2 shall be applied.

Table 2 — Reduction to Maximum Allowable E.I.R.P. for HAAT > 300 m	
HAAT (m)	**Reduction in maximum e.i.r.p. (dB)**
300 < HAAT ≤500	2
500 < HAAT ≤1,000	5
1,000 < HAAT ≤1,500	8
1,500 < HAAT ≤2,000	10

5.1.2 Subscriber Stations

Maximum e.i.r.p. limits are specified in RSS-199, Issue 2, *Broadband Radio Service (BRS) Equipment Operating in the Band 2500-2690 MHz*. Subscriber stations should employ automatic transmit power control such that stations operate on the minimum required power.

Test Procedures:

Measurements were in accordance with the test methods section 3.5.2 of KDB 935210 D05 v01r01.

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.

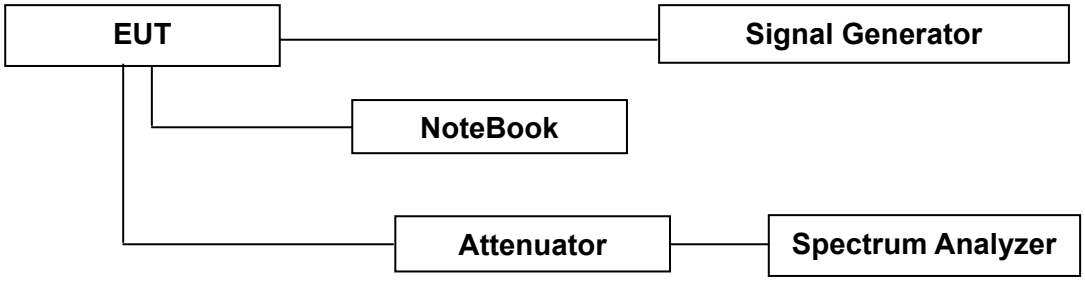
RSS-131

4. Measurement Methods

4.1 Output power

Unless indicated otherwise in the applicable standards of the equipment with which the zone enhancer is to be used, the output power and noise limit of the zone enhancer shall be measured in terms of root-mean-square (RMS) average value.

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 D01 v02r02.



Block Diagram 1. RF Power Output Test Setup

Test Results:

Input Signal	Input Level (dBm)	Maximum Amp Gain
BRS	DL: -21 dBm	DL : 58 dB
	UL: -45 dBm	UL : 49 dB

*** Note:**

1. The Maximum Amp Gain values in the above table are only RU gain value except HeadEnd.
2. These tests were measured only on the RU except for the HeadEnd.
3. Due to EUT's ALC function (Auto Level Control), even if input signal is increased, The same output power is transmit.

[Downlink]

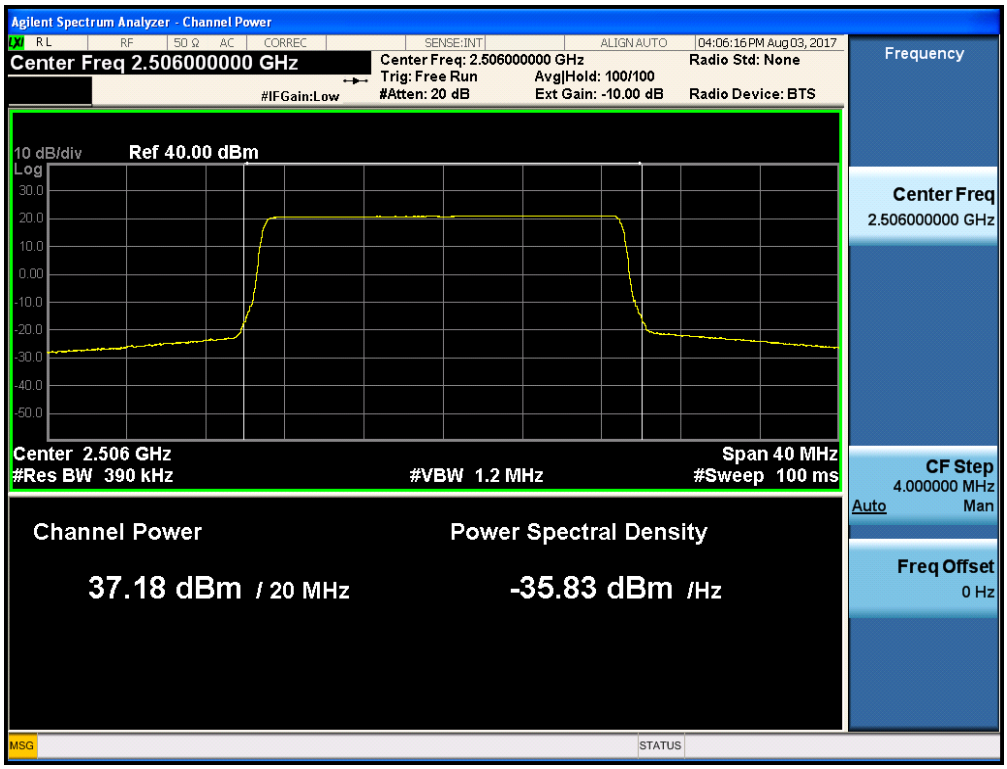
	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
BRS Band_ LTE 20 MHz AGC threshold	Low	2506.00	37.18	5.224
	Middle	2593.00	37.10	5.129
	High	2680.00	37.01	5.023
BRS Band_ LTE 20 MHz +3dBm above the AGC threshold	Low	2506.00	37.23	5.284
	Middle	2593.00	37.77	5.984
	High	2680.00	37.24	5.297

[Uplink]

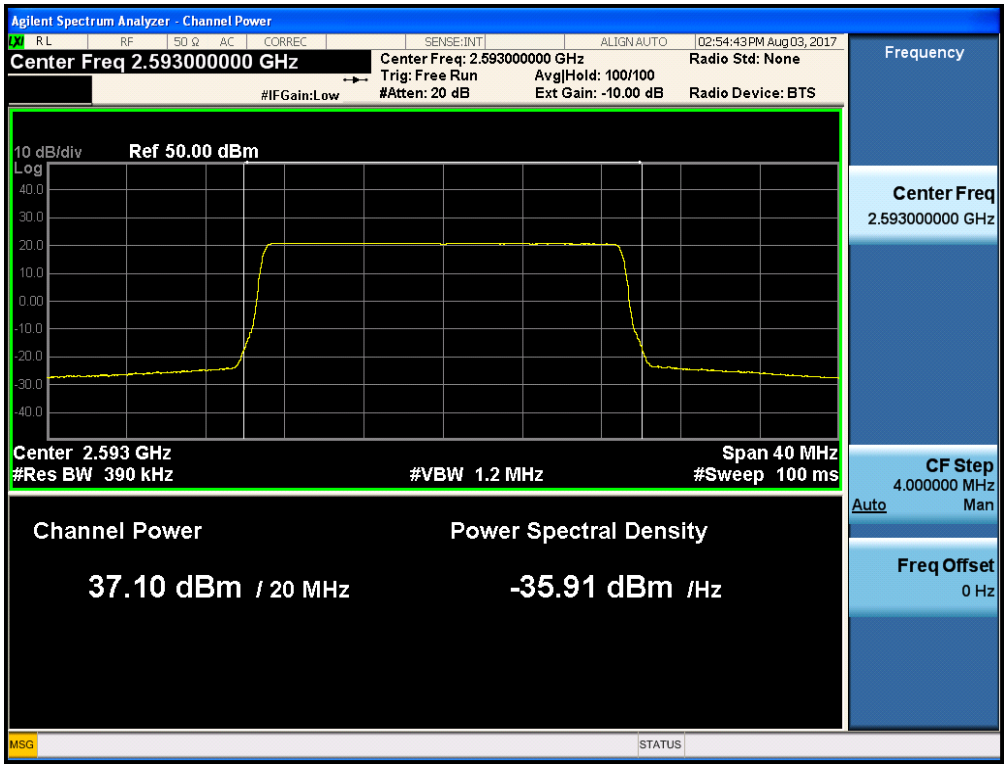
	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
BRS Band_ LTE 20 MHz AGC threshold	Low	2506.00	3.94	0.002
	Middle	2593.00	4.17	0.003
	High	2680.00	4.15	0.003
BRS Band_ LTE 20 MHz +3dBm above the AGC threshold	Low	2506.00	4.09	0.003
	Middle	2593.00	4.33	0.003
	High	2680.00	4.07	0.003

Plots of RF Output Power for BRS Band LTE 20MHz

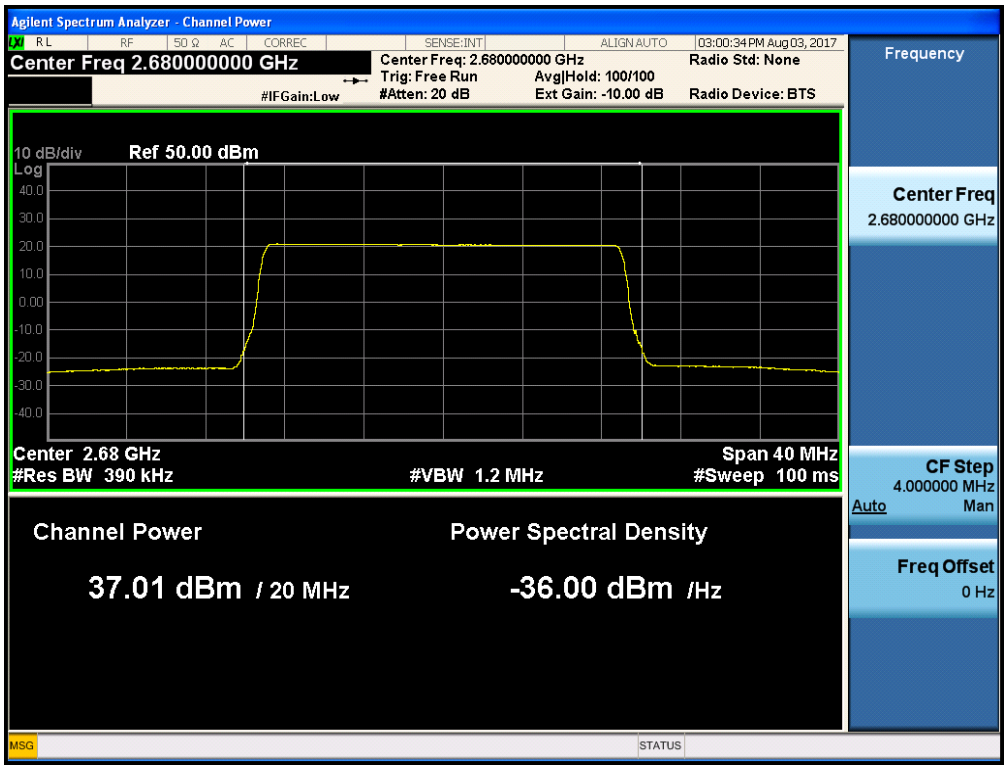
[AGC threshold Downlink Low]



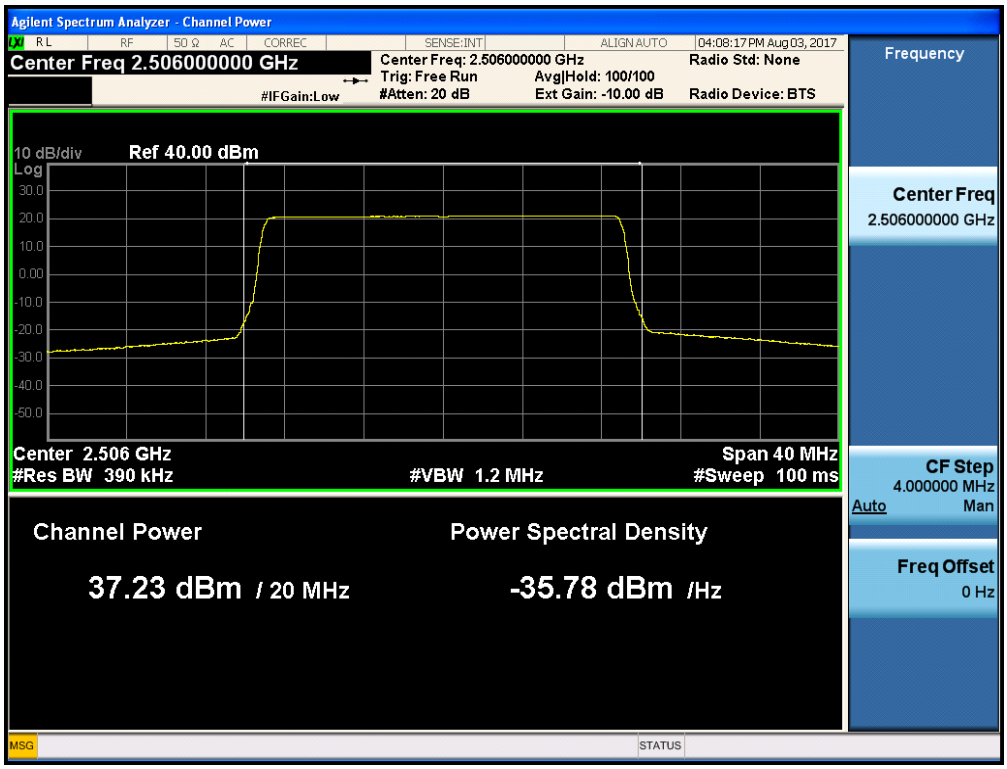
[AGC threshold Downlink Middle]



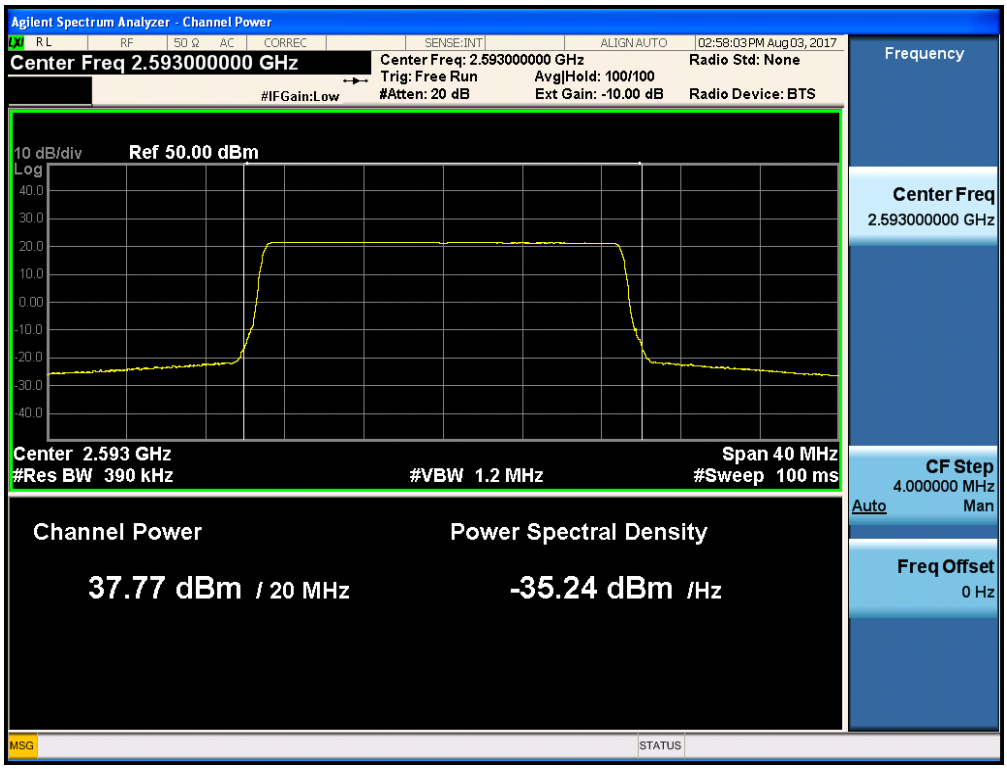
[AGC threshold Downlink High]



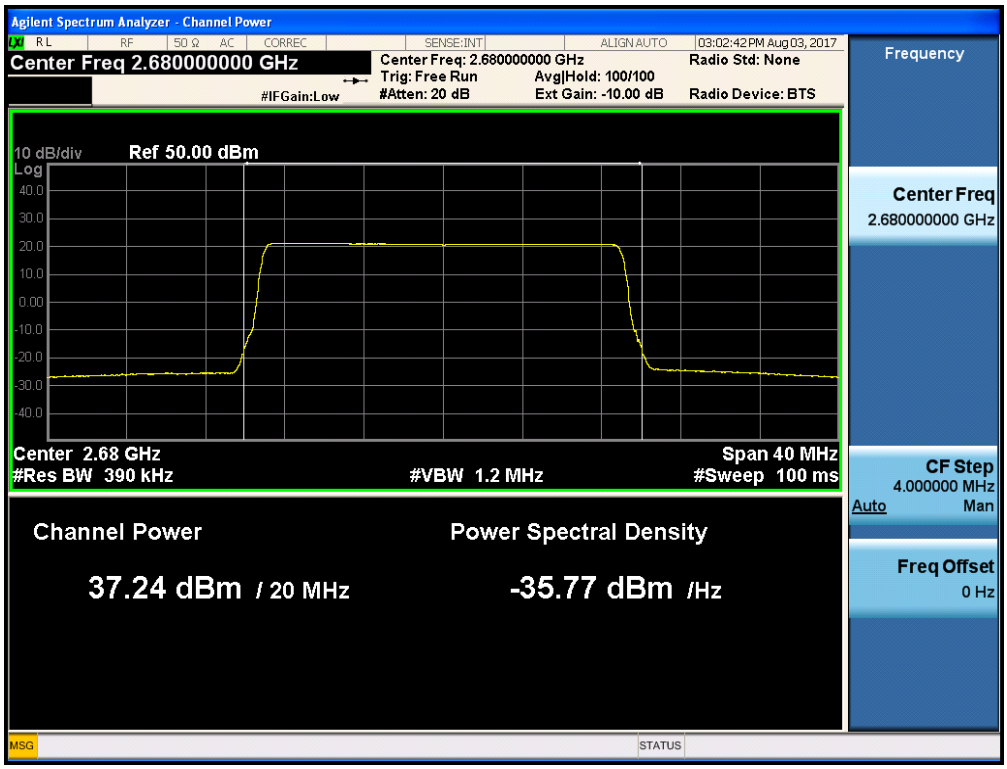
[+3dBm above AGC threshold Downlink Low]



[+3dBm above AGC threshold Downlink Middle]

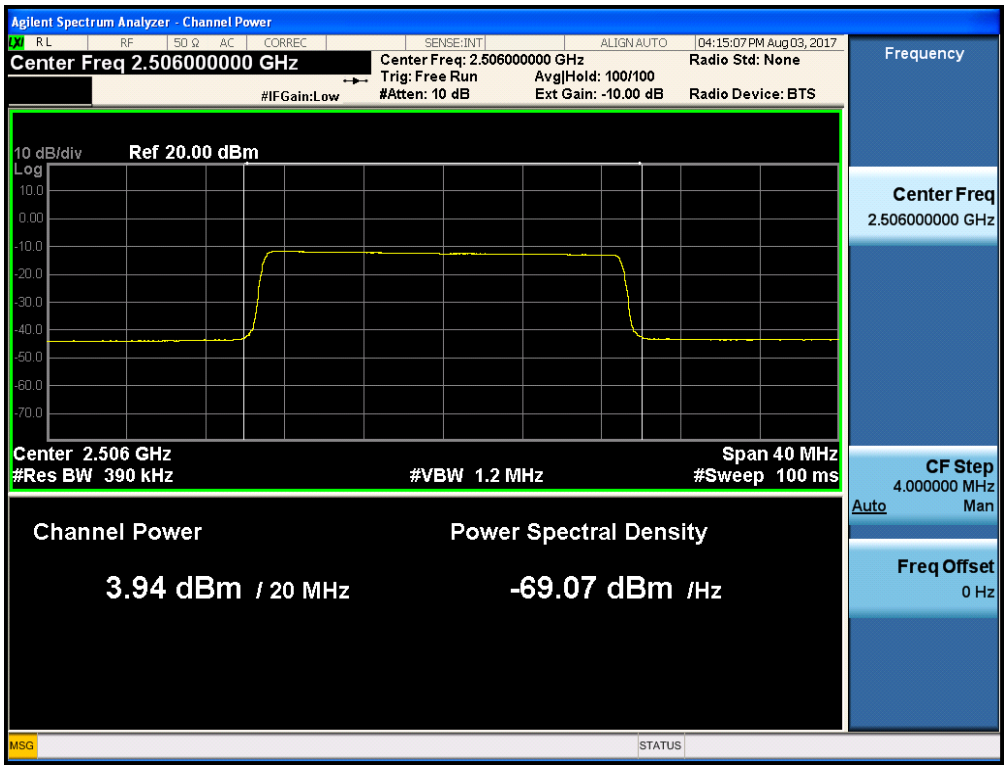


[+3dBm above AGC threshold Downlink High]

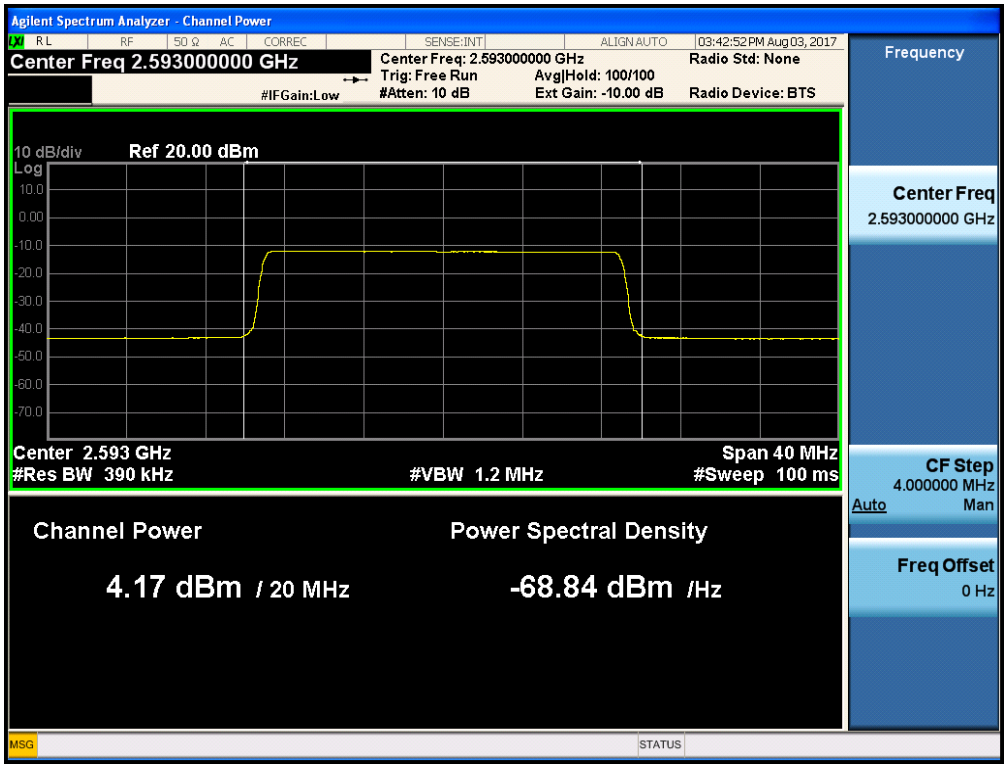


Plots of RF Output Power for BRS Band LTE 20MHz

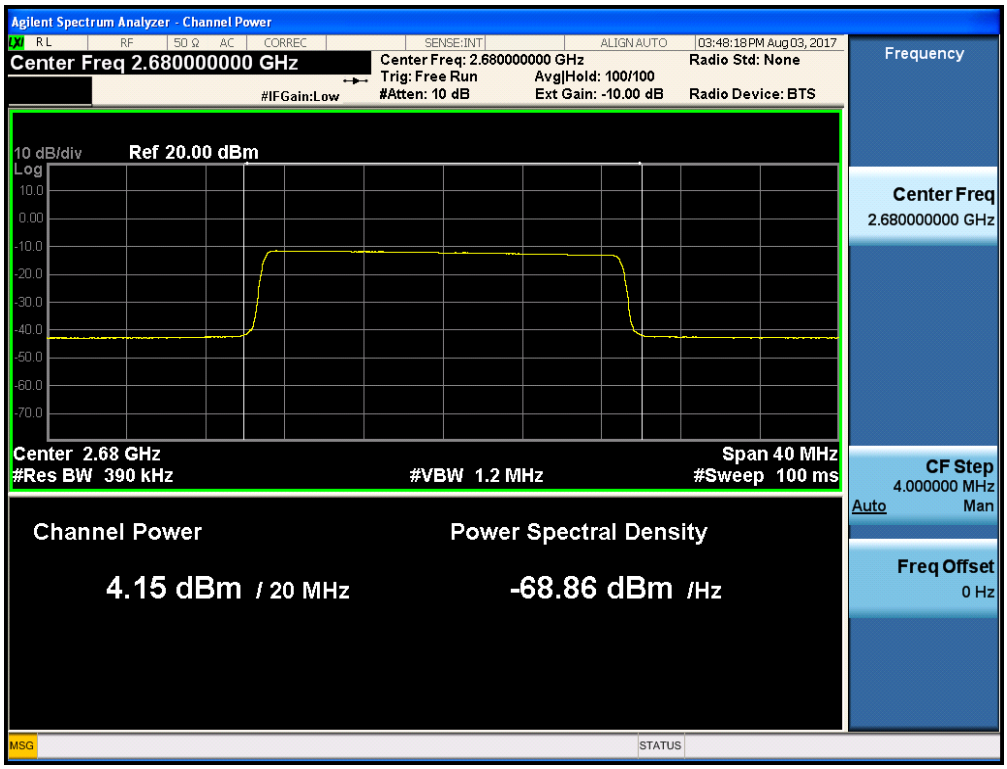
[AGC threshold Uplink Low]



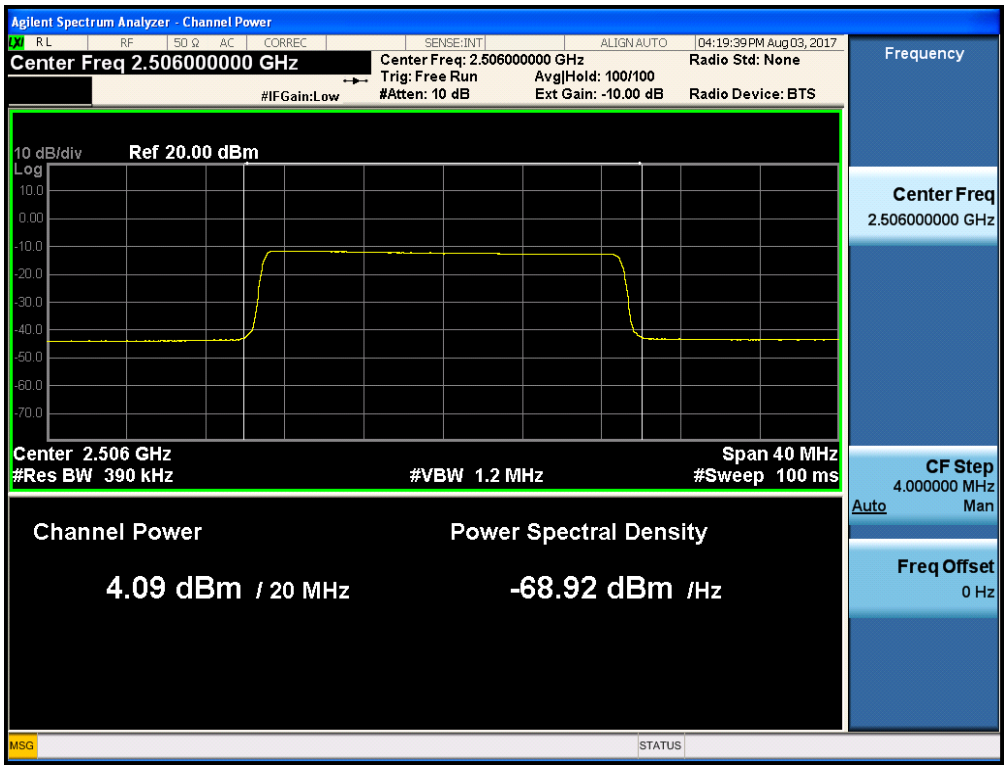
[AGC threshold Uplink Middle]



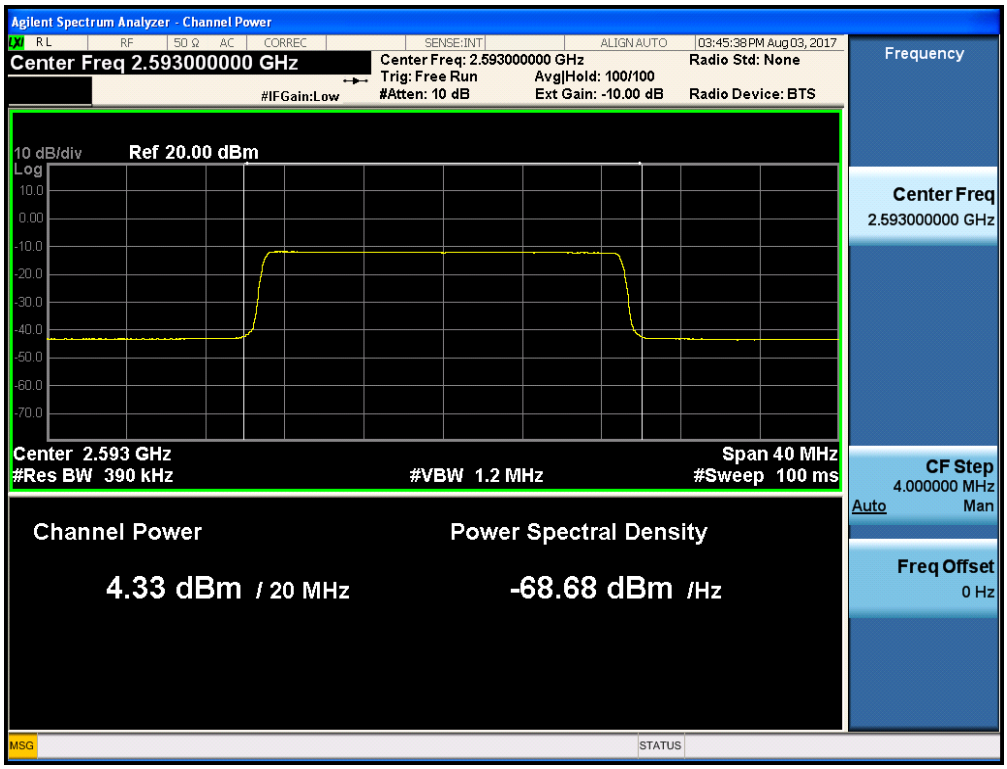
[AGC threshold Uplink High]



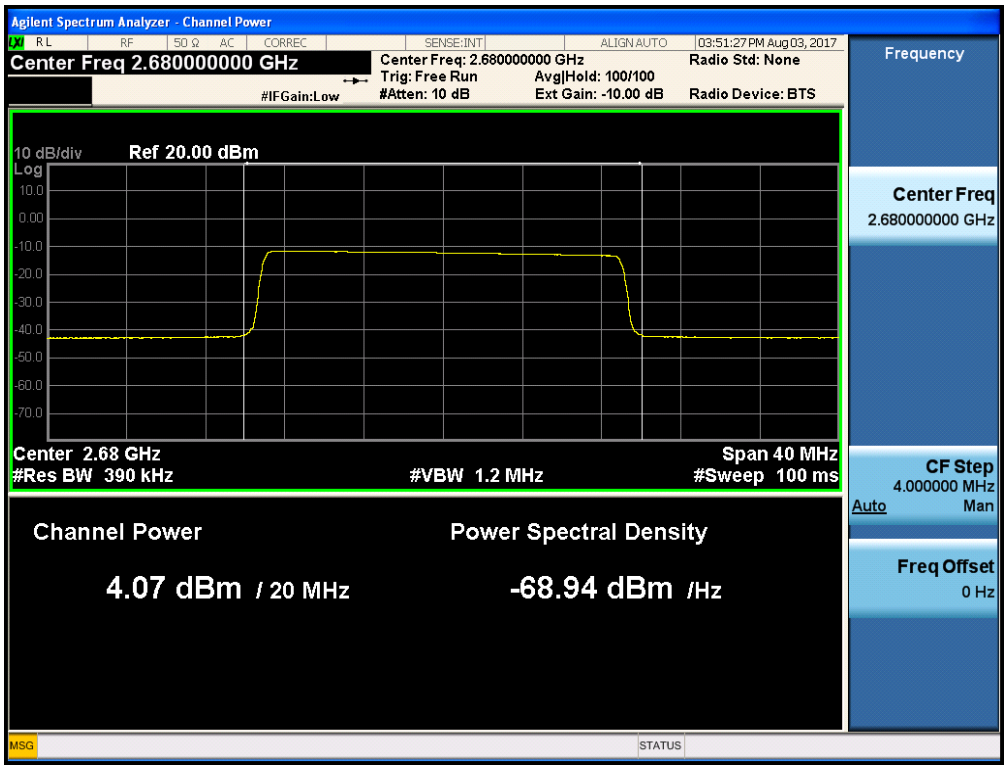
[+3dBm above AGC threshold Uplink Low]



[+3dBm above AGC threshold Uplink Middle]



[+3dBm above AGC threshold Uplink High]



7. OCCUPIED BANDWIDTH

FCC Rules

Test Requirements:

§ 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.

IC Rules

Test Requirements:

RSS-Gen

6 Technical Requirements

6.6 Occupied Bandwidth

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:

Measurements were in accordance with the test methods section 3.4 of KDB 935210 D05 v01r01 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 emission bandwidth (EBW) or alternatively, the OBW.

f) The nominal RBW shall be in the range of 1 % to 5 % of the anticipated OBW, and the VBW shall be ≥ 3 × RBW.

g) Set the reference level of the instrument as required to preclude the signal from exceeding the maximum spectrum analyzer input mixer level for linear operation. In general, the peak of the spectral envelope must be more than [10 log (OBW / RBW)] below the reference level.

Steps f) and g) may require iteration to enable adjustments within the specified tolerances.

h) The noise floor of the spectrum analyzer at the selected RBW shall be at least 36 dB below

the reference level.

i) Set spectrum analyzer detection function to positive peak.

j) Set the trace mode to max hold.

k) Determine the reference value: Allow the trace to stabilize. Set the spectrum analyzer marker to the highest amplitude level of the displayed trace (this is the reference value) and record the associated frequency as f_0.

l) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the −26 dB down amplitude. The 26 dB EBW (alternatively OBW) is the positive frequency difference between the two markers. If the spectral envelope crosses the −26 dB down amplitude at multiple points, the lowest or highest frequency shall be selected as the frequencies that are the furthest removed from the center frequency at which the spectral envelope crosses the −26 dB down amplitude point.

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

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

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

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

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

RSS-Gen

6 Technical Requirements

6.6 Occupied Bandwidth

- 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 3×RBW.

Note: 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:

[Downlink Output_BRS BAND]

	Channel	Frequency (MHz)	OBW (MHz)
BRS Band_ LTE 20 MHz AGC threshold	Low	2506.00	18.039
	Middle	2593.00	18.022
	High	2680.00	18.026
BRS Band_ LTE 20 MHz +3dBm above the AGC threshold	Low	2506.00	18.046
	Middle	2593.00	18.017
	High	2680.00	18.027

[Downlink Input_BRS BAND]

	Channel	Frequency (MHz)	OBW (MHz)
BRS Band_ LTE 20 MHz AGC threshold	Low	2506.00	18.092
	Middle	2593.00	18.107
	High	2680.00	18.143

[Uplink Output_BRS BAND]

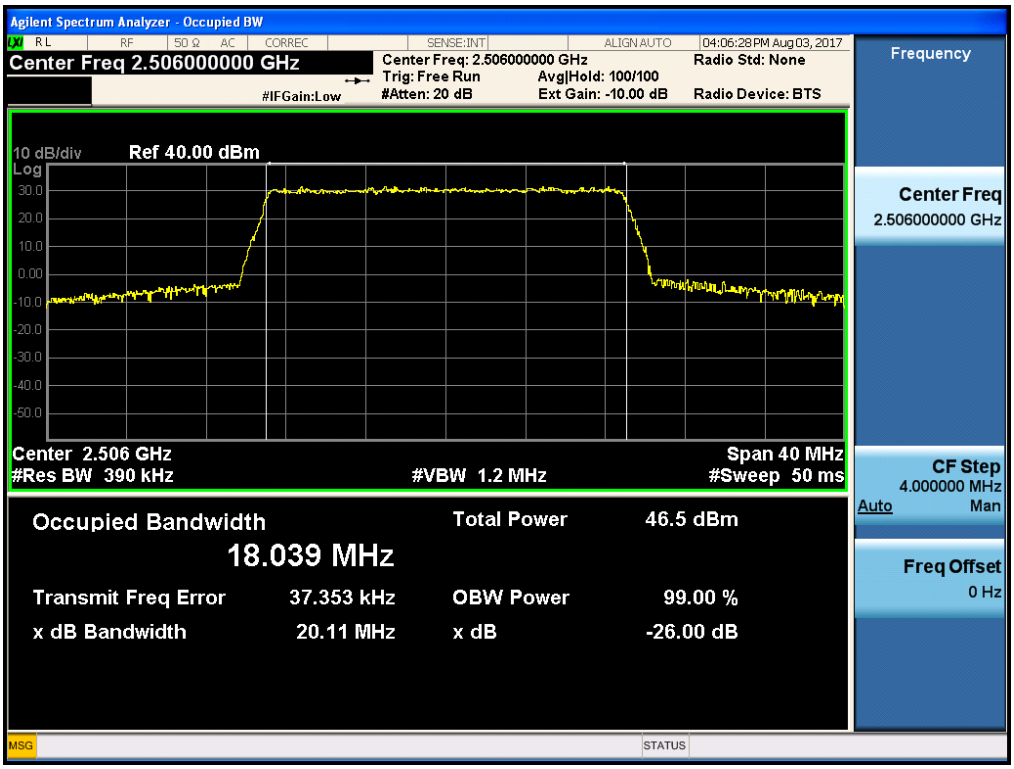
	Channel	Frequency (MHz)	OBW (MHz)
BRS Band_ LTE 20 MHz AGC threshold	Low	2506.00	18.057
	Middle	2593.00	18.033
	High	2680.00	18.034
BRS Band_ LTE 20 MHz +3dBm above the AGC threshold	Low	2506.00	18.066
	Middle	2593.00	18.067
	High	2680.00	18.058

[Uplink Input_BRS BAND]

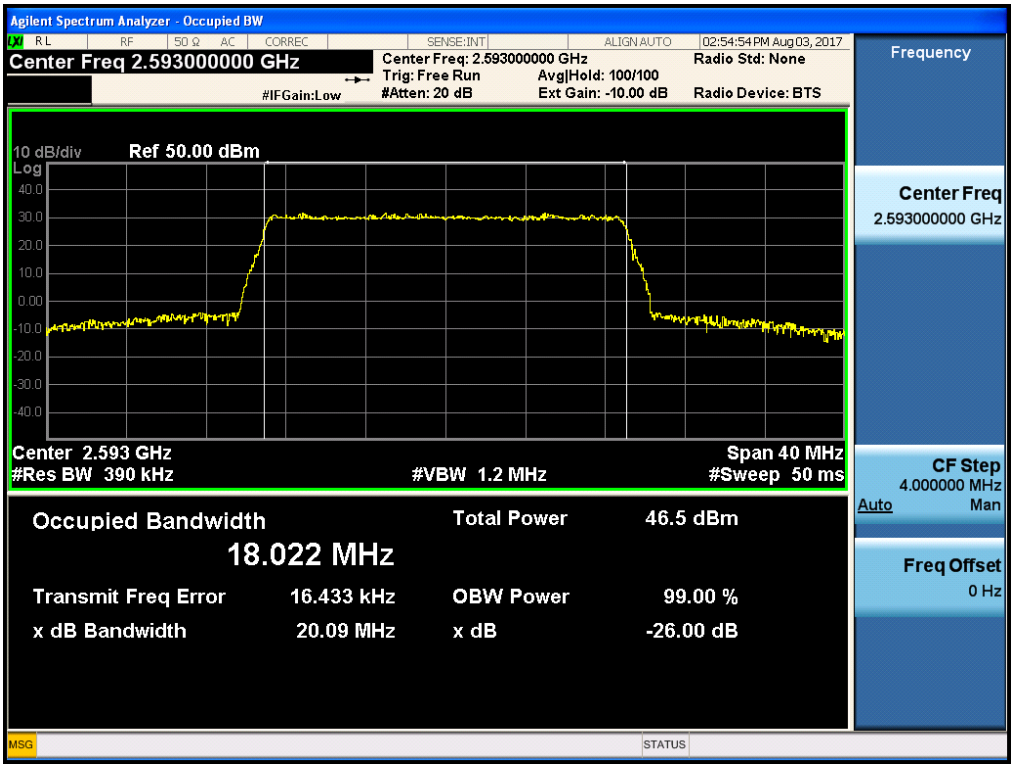
	Channel	Frequency (MHz)	OBW (MHz)
BRS Band_ LTE 20 MHz AGC threshold	Low	2506.00	18.092
	Middle	2593.00	18.107
	High	2680.00	18.143

Plots of Occupied Bandwidth_ BRS BAND LTE 20MHz

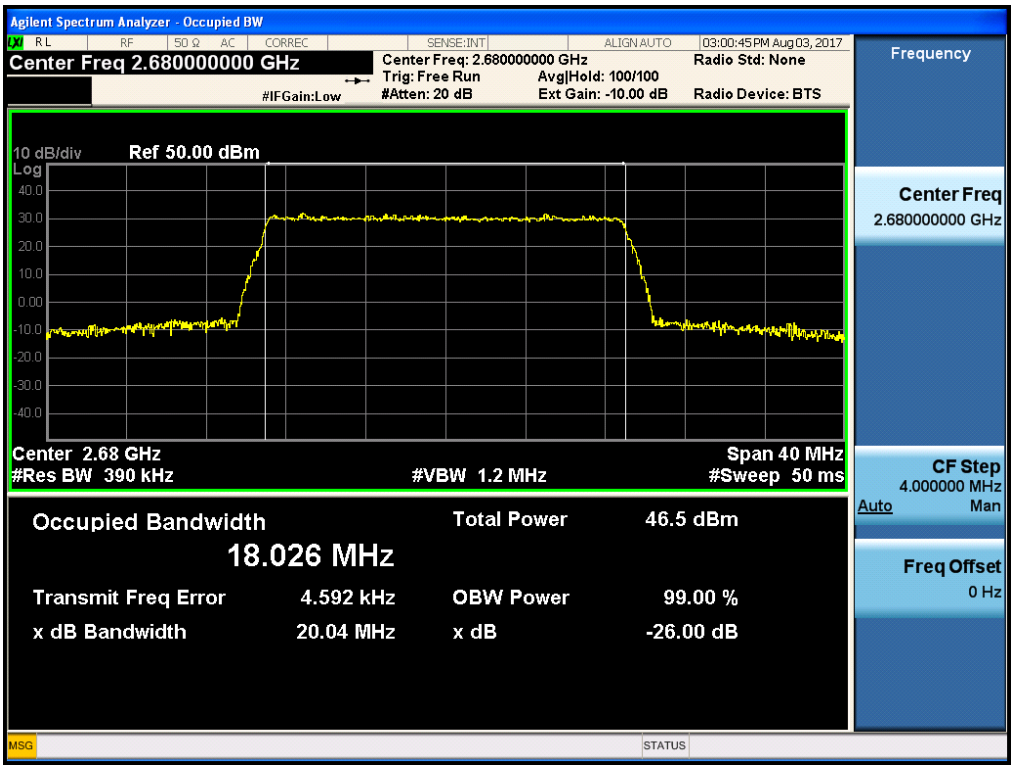
[AGC threshold Output Downlink Low]



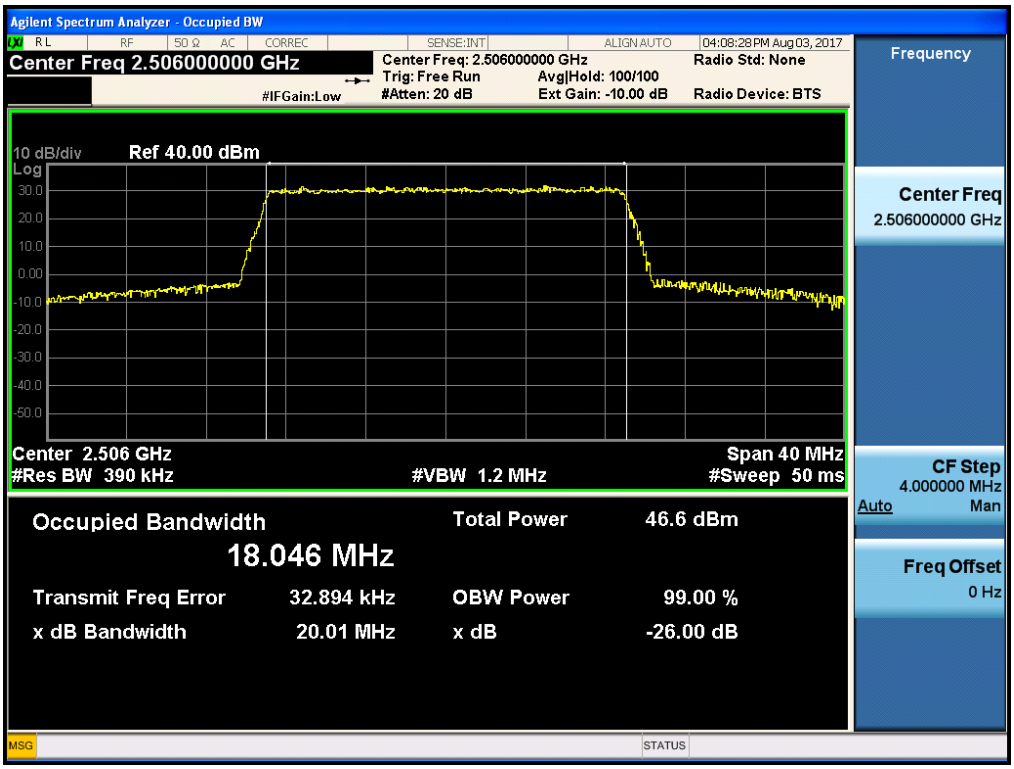
[AGC threshold Output Downlink Middle]



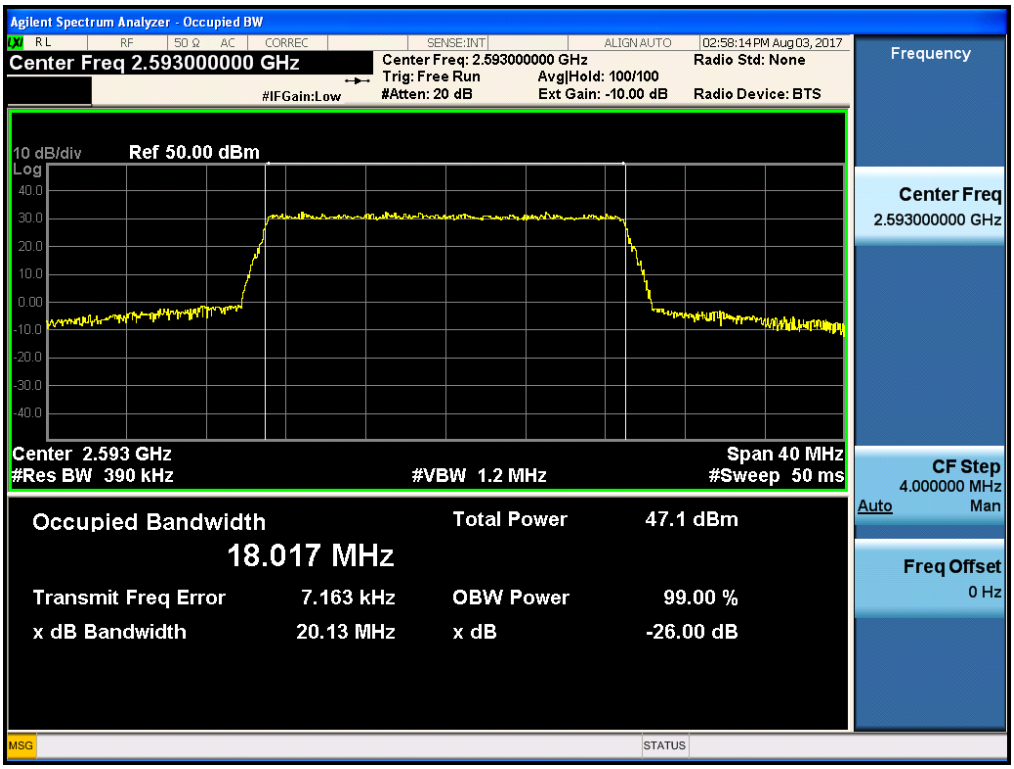
[AGC threshold Output Downlink High]



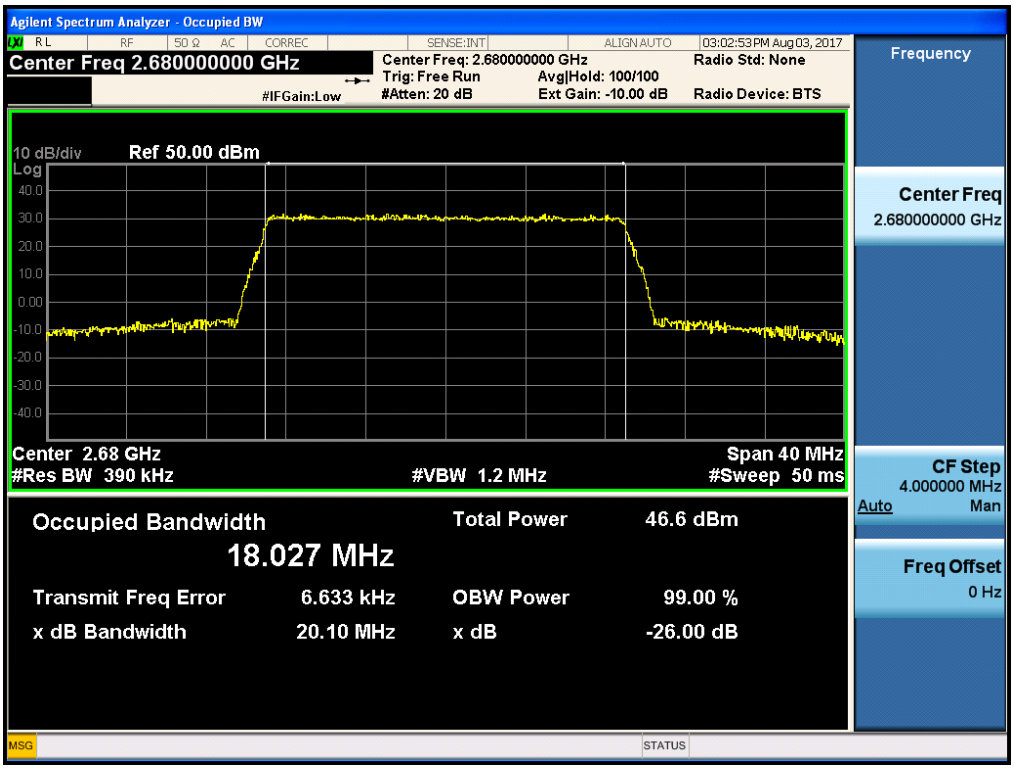
[+3dBmabove AGC threshold Output Downlink Low]



[+3dBm above AGC threshold Output Downlink Middle]

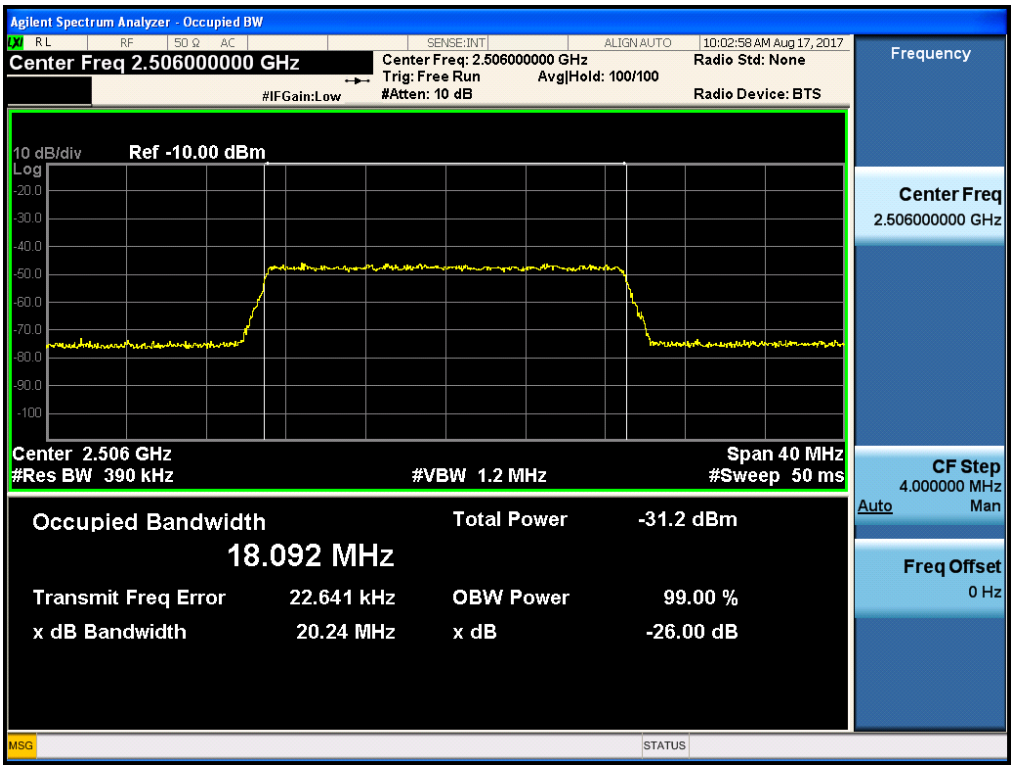


[+3dBm above AGC threshold Output Downlink High]

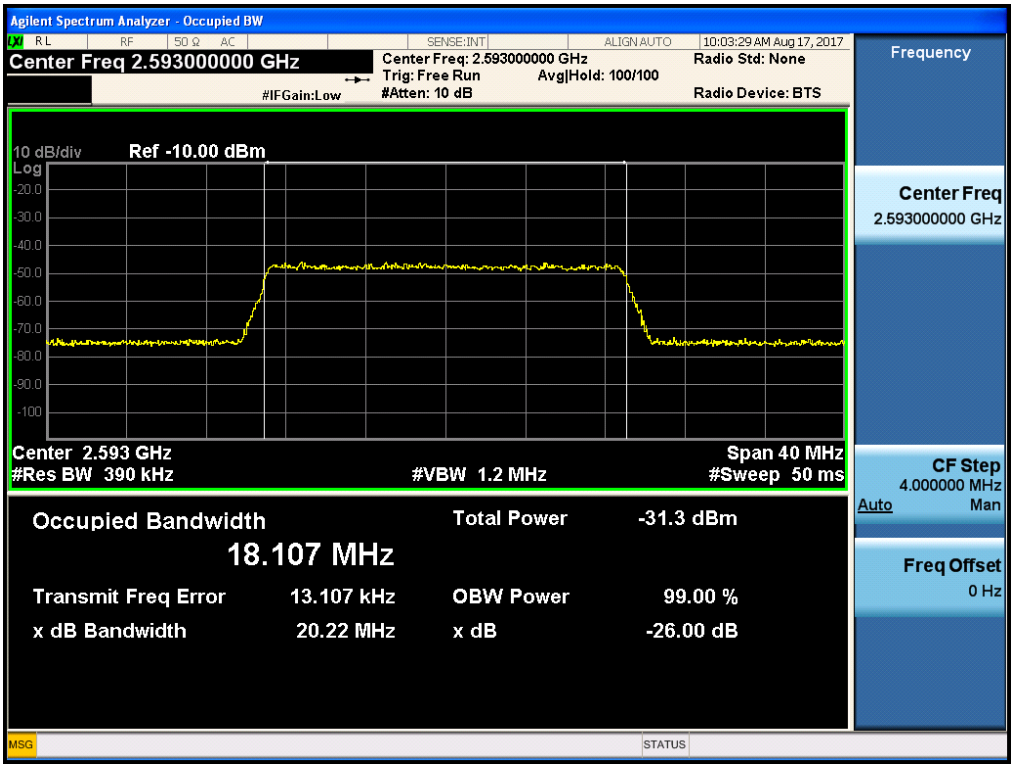


Plots of Occupied Bandwidth_BRS BAND LTE 20MHz

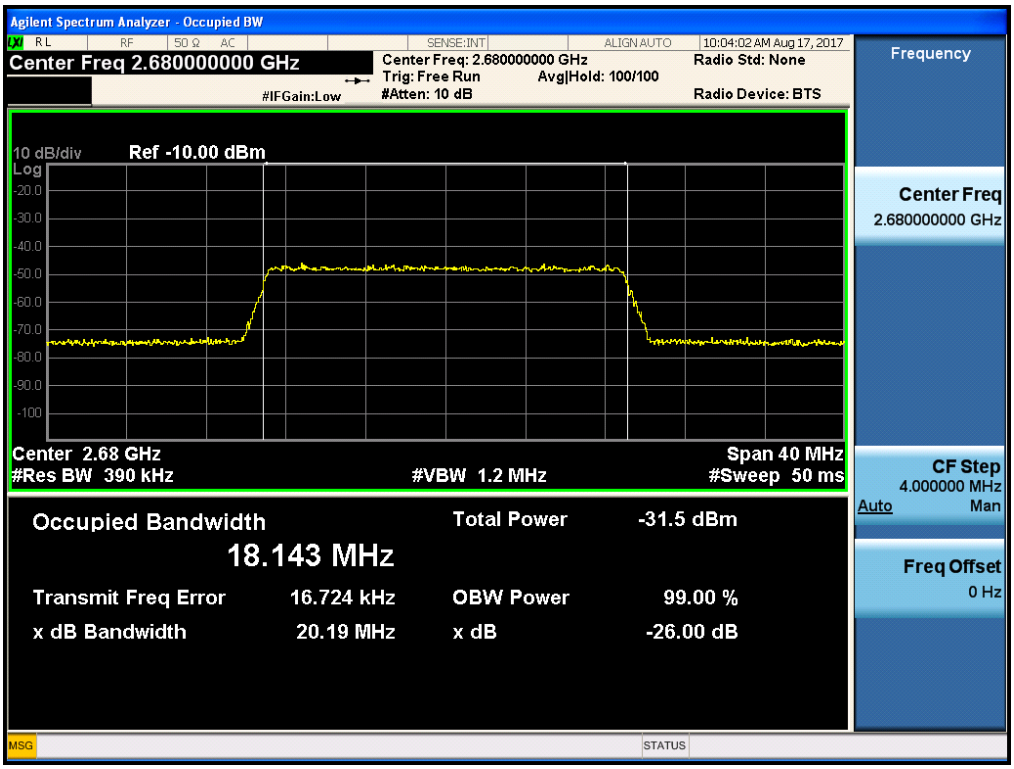
[AGC threshold Input Downlink Low]



[AGC threshold Input Downlink Middle]

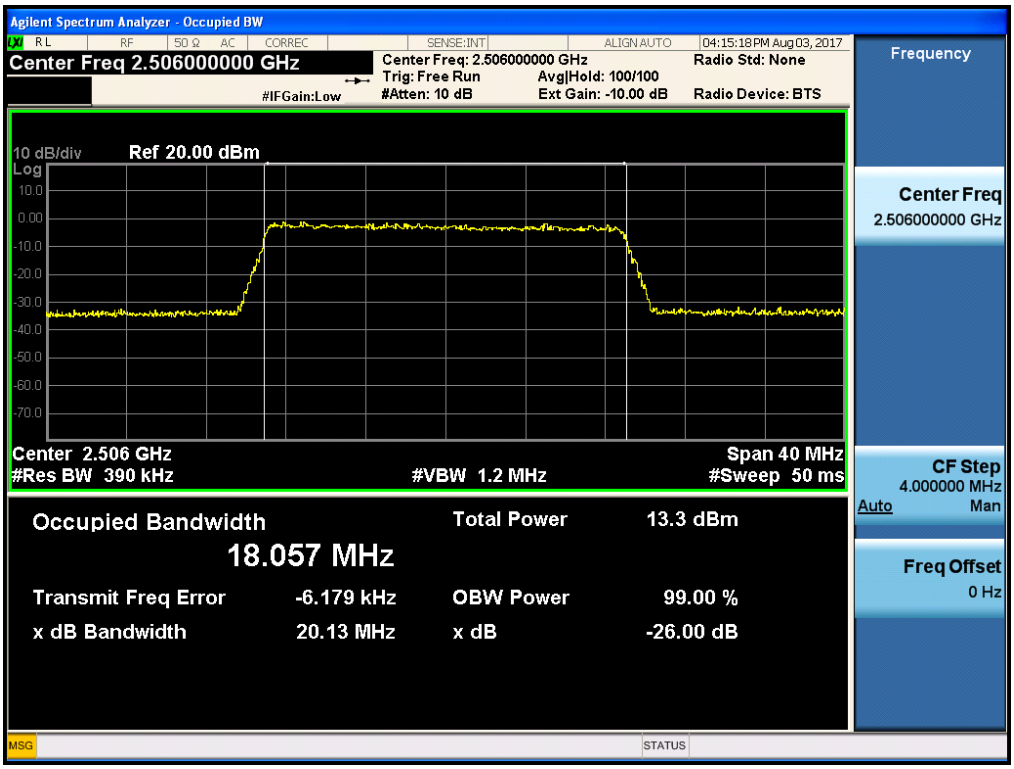


[AGC threshold Input Downlink High]

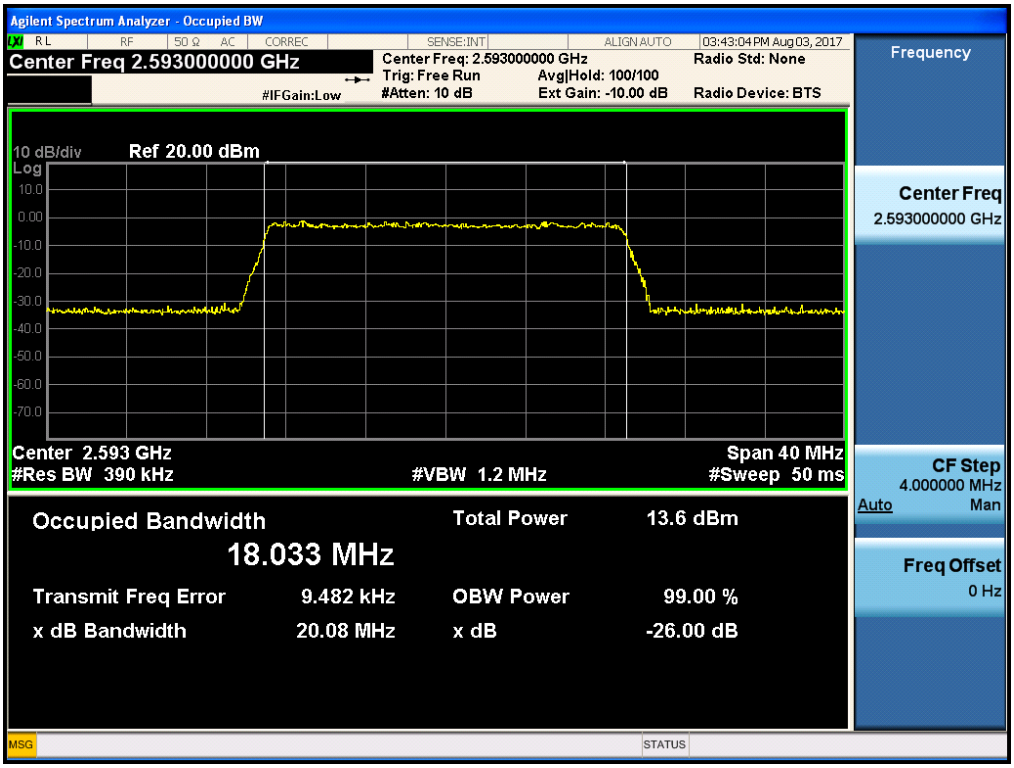


Plots of Occupied Bandwidth_ BRS BAND LTE 20MHz

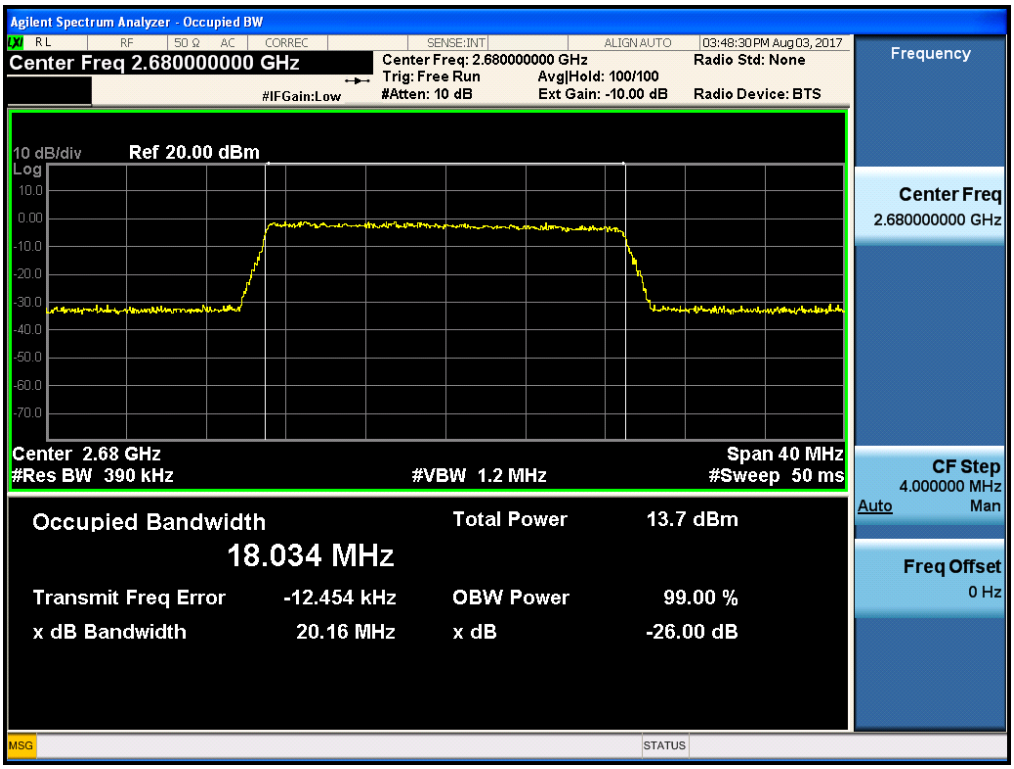
[AGC threshold Output Uplink Low]



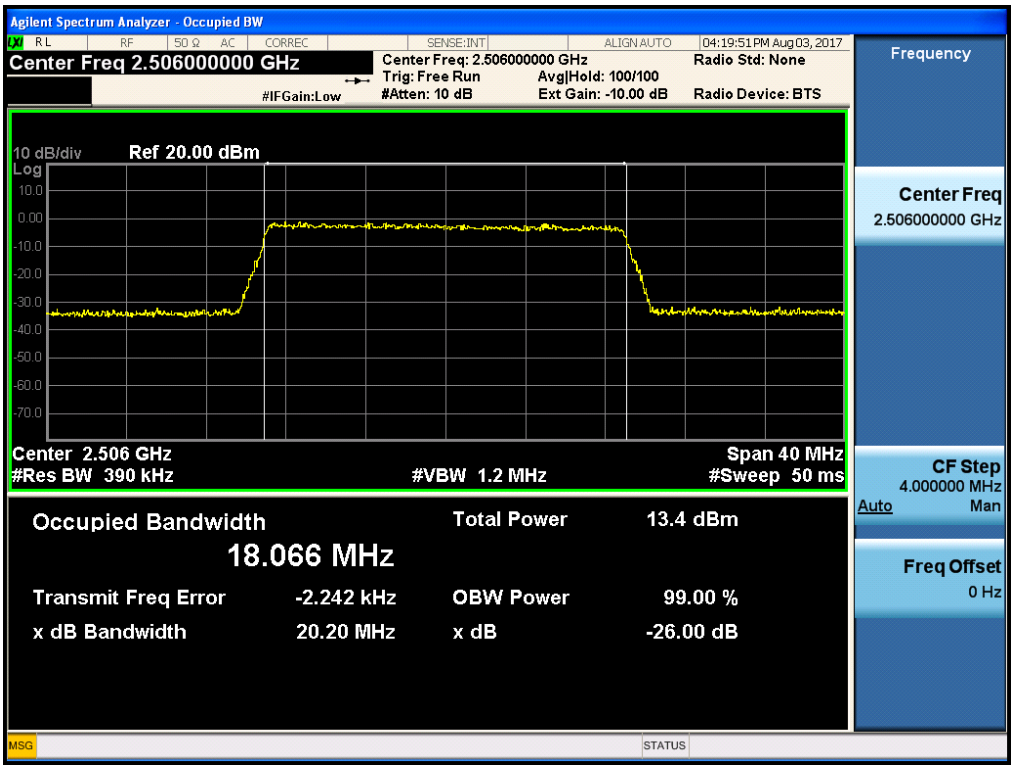
[AGC threshold Output Uplink Middle]



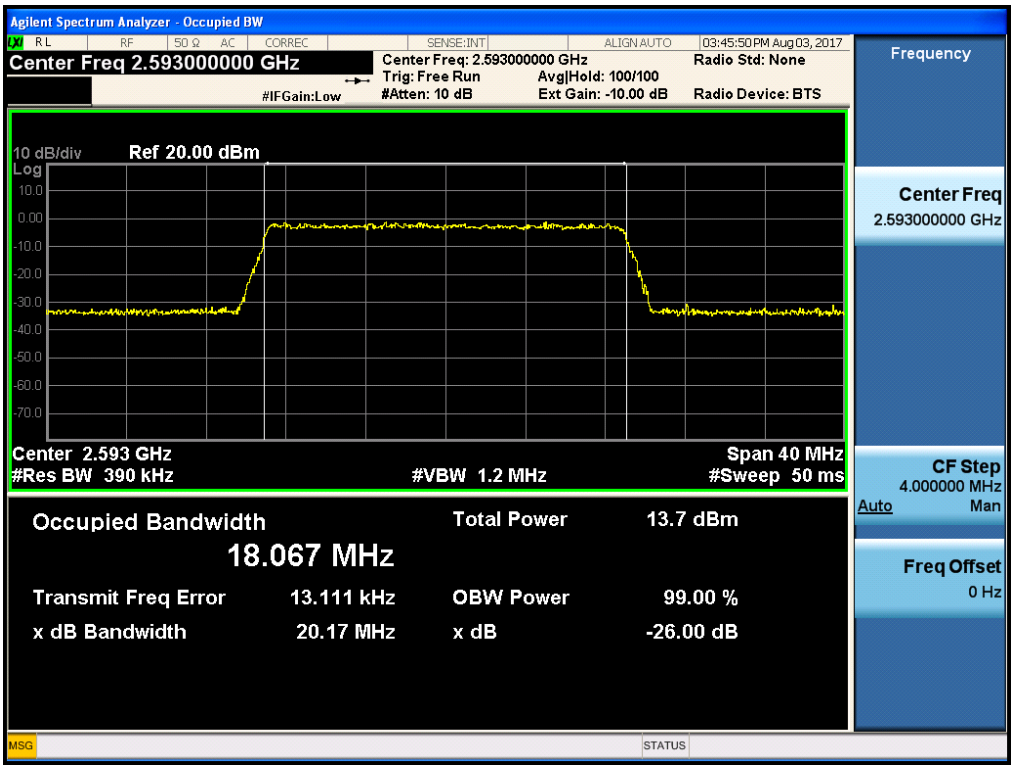
[AGC threshold Output Uplink High]



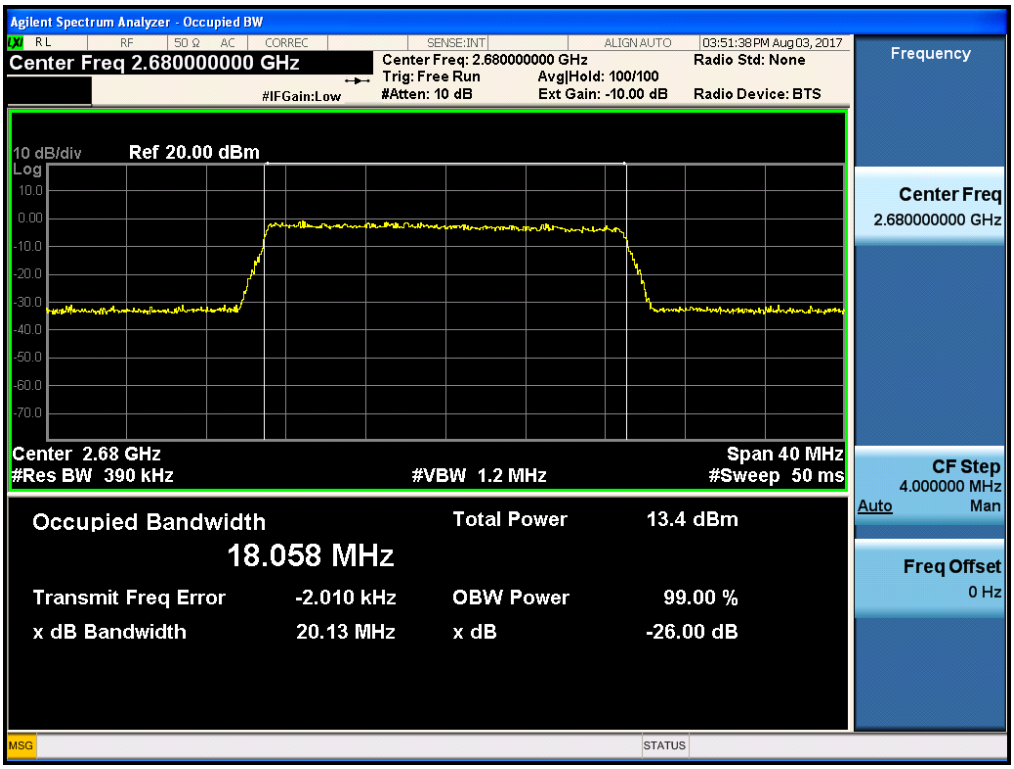
[+3dBmabove AGC threshold Output Uplink Low]



[+3dBm above AGC threshold Output Uplink Middle]

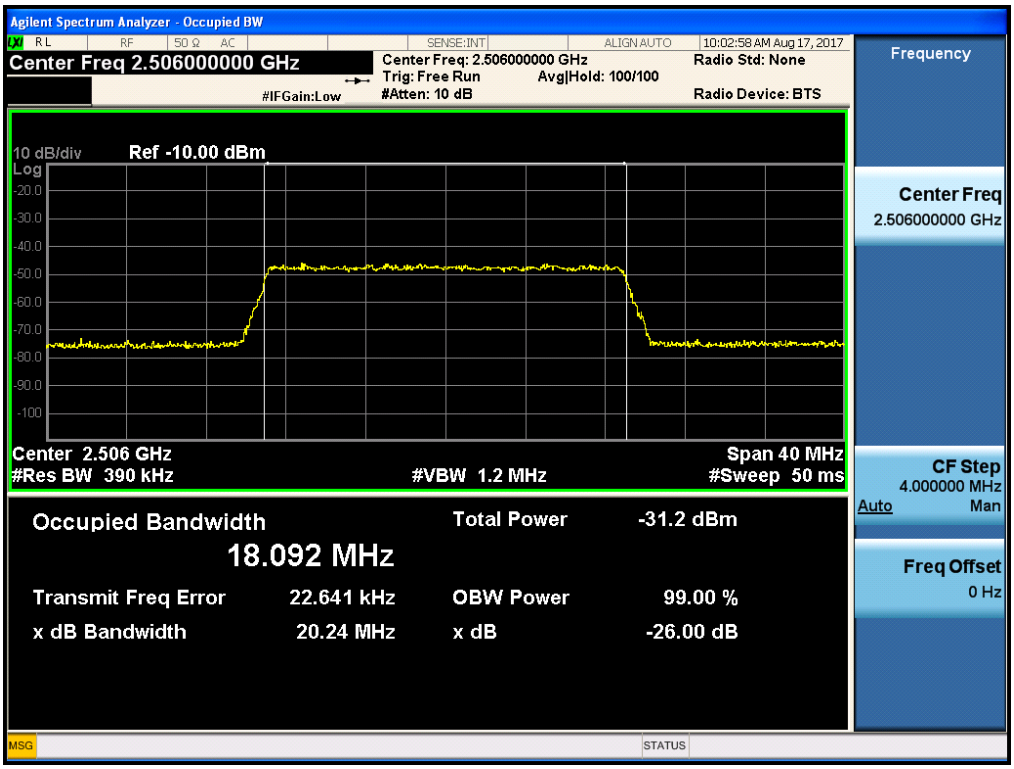


[+3dBm above AGC threshold Output Uplink High]

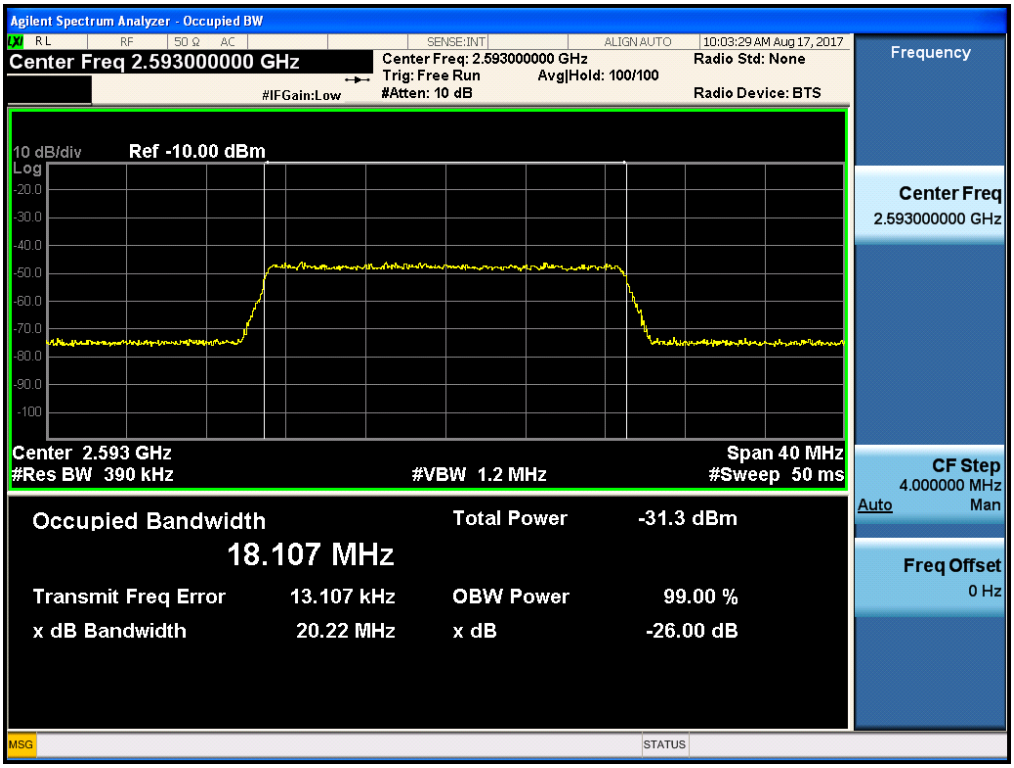


Plots of Occupied Bandwidth_BRS BAND LTE 20MHz

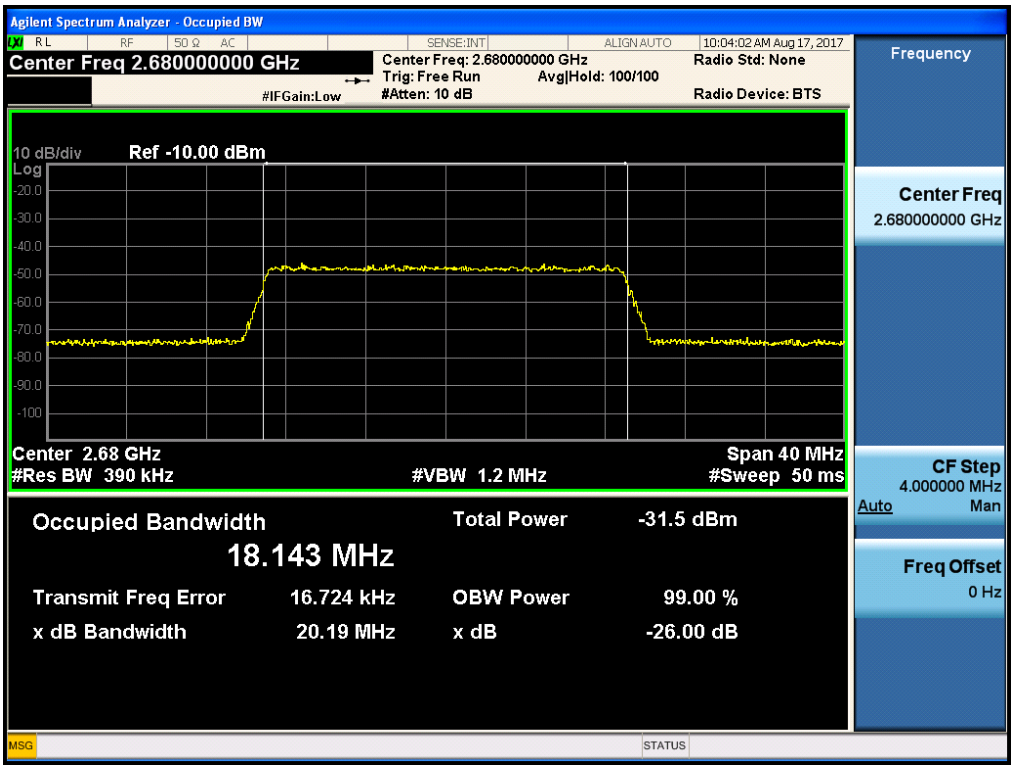
[AGC threshold Input Uplink Low]



[AGC threshold Input Uplink Middle]



[AGC threshold Input Uplink High]



8. INPUT VERSUS OUTPUT SPECTRUM

IC Rules

Test Requirements:

RSS-131

5. Equipment standard specifications for zone enhancers working with equipment certified in RSSs listed in section 1 except RSS-119

5.2 Industrial Zone Enhancers

5.2.2 Input-versus-output spectrum

The spectral growth of the 26 dB bandwidth of the output signal shall be less than 5% of the input signal spectrum.

Test Procedures:

RSS-GEN

6 Technical Requirements

6.6 Occupied Bandwidth

The emission bandwidth (X dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated X dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3 x the resolution bandwidth.

Note : We tested using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 26 dB.

Test Results:

[Downlink Output]

	Channel	Frequency (MHz)	26 dB BW (MHz)
LTE 20 MHz AGC threshold	Low	2120.00	20.11
	Middle	2145.00	20.09
	High	2170.00	20.04
LTE 20 MHz +3dBm above the AGC threshold	Low	2120.00	20.01
	Middle	2145.00	20.13
	High	2170.00	20.10

*** Plots of results are the same as Section 7.**

9. OUT OF BAND REJECTION & MEAN OUTPUT POWER AND ZONE ENHANCER GAIN

FCC Rules

Test Requirements:

KDB 935210 D05 v01r01

Out of Band Rejection – Testing for rejection of out of band signals. Alternatively, filter freq. response plots are acceptable.

IC Rules

Test Requirements:

RSS-131

5. Equipment standard specifications for zone enhancers working with equipment certified in RSSs listed in section 1 except RSS-119

5.2 Industrial Zone Enhancers

5.2.1 Out-of-band rejection

The gain-versus-frequency response and the 20 dB bandwidth of the zone enhancer shall be reported. The zone enhancer shall reject amplification of other signals outside the passband of the zone enhancer.

5.2.3 Mean output power and zone enhancer gain

The zone enhancer gain shall not exceed the nominal gain by more than 1.0 dB. Outside of the 20 dB bandwidth, the gain shall not exceed the gain at the 20 dB point.

Test Procedures:

Measurements were in accordance with the test methods section 3.3, 4.3 of KDB 935210 D05 v01r01.

3.3 EUT out-of-band rejection

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.

4.3 PLMRS device out-of-band rejection

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

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

b) Configure a swept CW signal with the following parameters:

c) Frequency range = ± 250 % of the manufacturer's pass band.

d) The CW amplitude will be 3 dB below the AGC threshold (see 4.2) and but not activate the AGC threshold throughout the test.

e) Dwell time = approx. 10 ms.

f) Frequency step = 50 kHz.

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

h) Set the resolution bandwidth of the spectrum analyzer between 1 % and 5 % of the manufacturer's pass band with the video bandwidth set to 3 × RBW.

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

j) After the trace is completely filled, place a marker at the peak amplitude, which is designated as f0, and with two additional markers (use the marker-delta method) at the 20 dB bandwidth (i.e., at the points where the gain has fallen by 20 dB).

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

Test Results:

Input Signal	Input Level (dBm)	Maximum Amp Gain
BRS	DL: -21 dBm	DL : 58 dB
	UL: -45 dBm	UL : 49 dB

*** Note:**

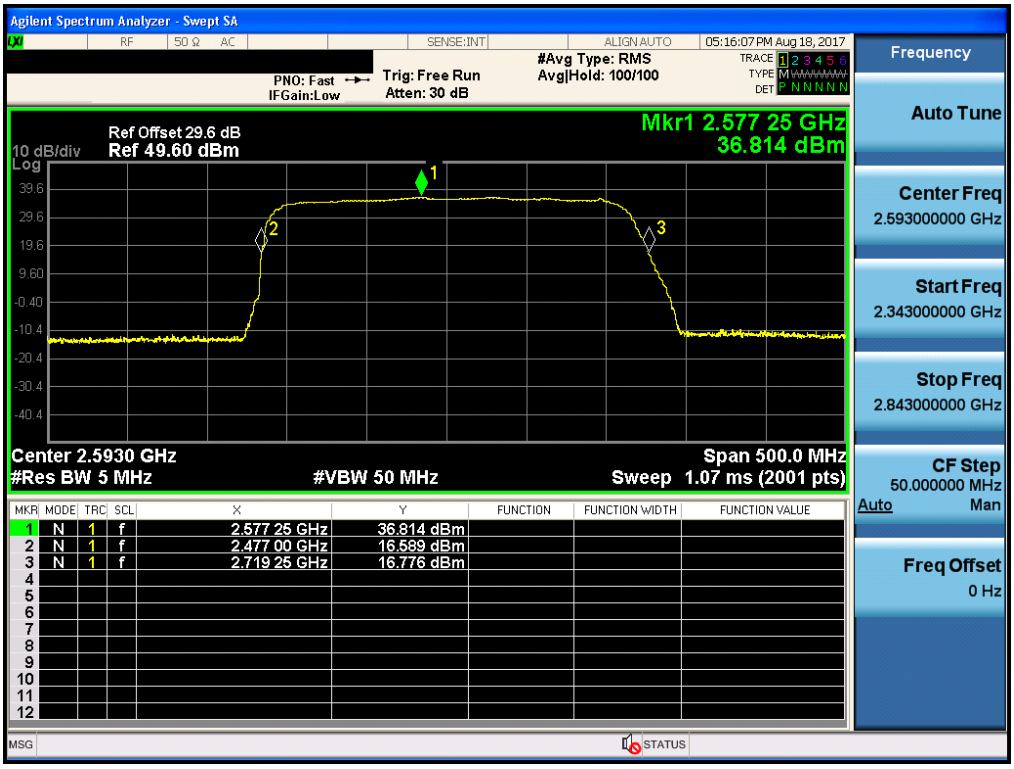
1. The Maximum Amp Gain values in the above table are only RU gain value except HeadEnd.
2. These tests were measured only on the RU except for the HeadEnd.

[Downlink_BRS BAND]

	20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
BRS	2477.000 MHz ~ 2719.250 MHz	36.814	57.814

Plots of Out of Band Rejection & Mean Output Power and Zone Enhancer Gain

[BRS BAND]

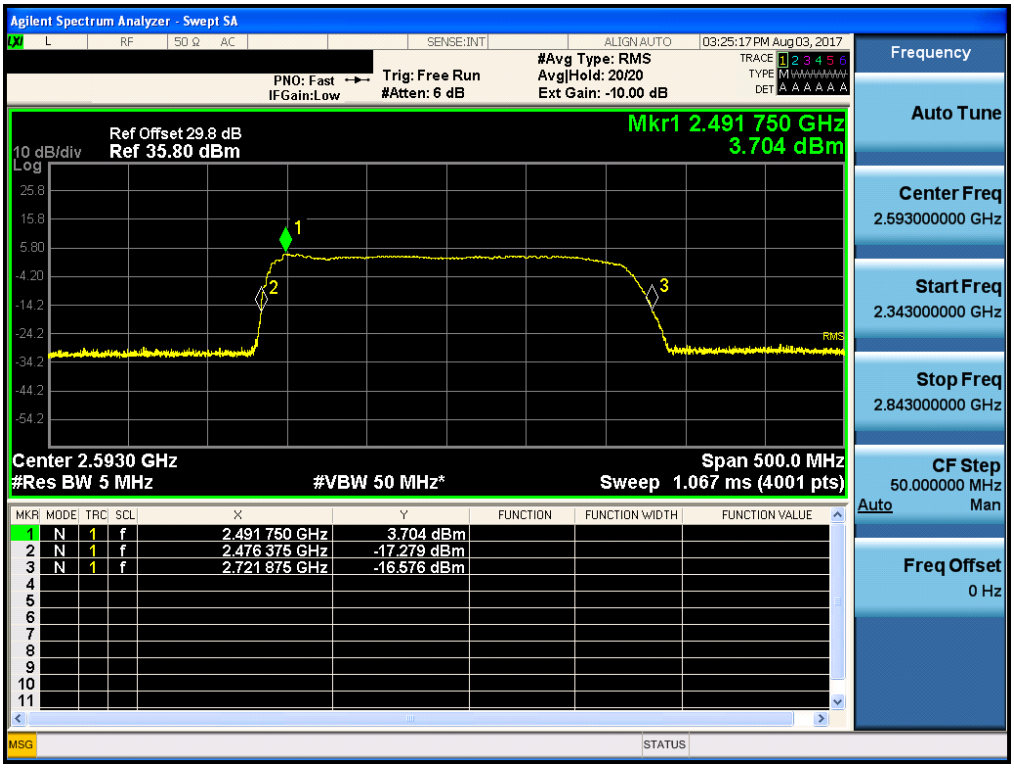


[Uplink_BRS BAND]

	20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
BRS	2476.375 MHz ~ 2721.875 MHz	3.704	48.704

Plots of Out of Band Rejection & Mean Output Power and Zone Enhancer Gain

[BRS BAND]



10. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL

FCC Rules

Test Requirements:

§ 2.1051 Measurements required: Spurious emissions at antenna terminals:

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 27.53 Emission limits

(m) For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts in accordance with the standards below. If a licensee has multiple contiguous channels, out-of-band emissions shall be measured from the upper and lower edges of the contiguous channels.

(2) For digital base stations, the attenuation shall be not less than 43 +10 log (P) dB, unless a documented interference complaint is received from an adjacent channel licensee with an overlapping Geographic Service Area. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS No. 1 on the same terms and conditions as adjacent channel BRS or EBS licensees. Provided that a documented interference complaint cannot be mutually resolved between the parties prior to the applicable deadline, then the following additional attenuation requirements shall apply:

(i) If a pre-existing base station suffers harmful interference from emissions caused by a new or modified base station located 1.5 km or more away, within 24 hours of the receipt of a documented interference complaint the licensee of the new or modified base station must attenuate its emissions by at least 67 +10 log (P) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block and shall immediately notify the complaining licensee upon implementation of the additional attenuation. No later than 60 days after the implementation of such additional attenuation, the licensee of the complaining base station must attenuate its base station emissions by at least 67 +10 log (P) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block of the new or modified base station.

(ii) If a pre-existing base station suffers harmful interference from emissions caused by a new or modified base station located less than 1.5 km away, within 24 hours of receipt of a documented interference complaint the licensee of the new or modified base station must

attenuate its emissions by at least 67 +10 log (P)−20 log (Dkm/1.5) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block of the complaining licensee, or if both base stations are co-located, limit its undesired signal level at the pre-existing base station receiver(s) to no more than −107 dBm measured in a 5.5 megahertz bandwidth and shall immediately notify the complaining licensee upon such reduction in the undesired signal level. No later than 60 days after such reduction in the undesired signal level, the complaining licensee must attenuate its base station emissions by at least 67 +10 log (P) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block of the new or modified base station.

(iii) If a new or modified base station suffers harmful interference from emissions caused by a pre-existing base station located 1.5 km or more away, within 60 days of receipt of a documented interference complaint the licensee of each base station must attenuate its base station emissions by at least 67 +10 log (P) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block of the other licensee.

(iv) If a new or modified base station suffers harmful interference from emissions caused by a pre-existing base station located less than 1.5 km away, within 60 days of receipt of a documented interference complaint: (a) The licensee of the new or modified base station must attenuate its OOBE by at least 67 +10 log (P)−20 log (Dkm/1.5) measured 3 megahertz above or below, from the channel edge of its frequency block of the other licensee, or if the base stations are co-located, limit its undesired signal level at the other base station receiver(s) to no more than −107 dBm measured in a 5.5-megahertz bandwidth; and (b) the licensee causing the interference must attenuate its emissions by at least 67 +10 log (P) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block of the new or modified base station.

(v) For all fixed digital user stations, the attenuation factor shall be not less than 43 +10 log (P) dB at the channel edge.

(4) For mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

IC Rules

Test Requirement(s):

RSS-199

4. Transmitter and receiver standard specifications

4.5 Transmitter unwanted emissions

In the 1 MHz band immediately outside and adjacent to the channel edge, the unwanted emission power shall be measured with a resolution bandwidth of at least 1% of the occupied bandwidth for base station and fixed subscriber equipment, and 2% for mobile subscriber equipment. Beyond the 1 MHz band, a resolution bandwidth of 1 MHz shall be used. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz, or 1% or 2% of the occupied bandwidth, as applicable.

Equipment shall comply with the following unwanted emission limits:

a. for base station and fixed subscriber equipment, the power of any unwanted emissions measured as above shall be attenuated (in dB) below the transmitter power, P (dBW), by at least 43 + 10 $\log_{10}$ p

Test Procedures:

Measurements were in accordance with the test methods section 3.6 and 4.7 of KDB 935210 D05 v01r01.

3.6.1 General

Refer to the applicable rule part(s) for specified limits on unwanted (out-of-band/out-of-block and spurious) emissions.

Spurious emissions shall be measured using a single test signal sequentially tuned to the low, middle, and high channels or frequencies within each authorized frequency band of operation.

Out-of-band/out-of-block emissions (including intermodulation products) shall be measured under each of the following two stimulus conditions:

a) two adjacent test signals sequentially tuned to the lower and upper frequency band/block edges;

b) a single test signal, sequentially tuned to the lowest and highest frequencies or channels within the frequency band/block under examination.

NOTE—Single-channel boosters that cannot accommodate two simultaneous signals within the passband may be excluded from the test stipulated in step a).

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

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

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

b) Set the signal generator to produce two AWGN signals as previously described (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 under test.

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 EBW or 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 spectrum analyzer start frequency to the upper block edge frequency, and the stop frequency to the upper block edge frequency plus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively.

k) Trace average at least 100 traces in power averaging (rms) mode.

l) Use the marker function to find the maximum power level.

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

n) Repeat steps k) to m) with the composite input power level set to 3 dB above the AGC threshold.

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

p) Reset the spectrum analyzer start frequency to the lower block edge frequency minus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively, and the stop frequency to the lower band or block edge frequency.

q) Repeat steps k) to n).

r) Repeat steps a) to q) with the signal generator configured for a single test signal tuned as close as possible to the block edges.

s) Repeat steps a) to r) with the narrowband test signal.

t) Repeat steps a) to s) for all authorized frequency bands or blocks used by the EUT.

3.6.3 Spurious emissions conducted measurements

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

b) Set the signal generator to produce the broadband test signal as previously described (i.e.,

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 spectrum analyzer start frequency to the lowest RF signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part.

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.2

j) Select the power averaging (rms) detector function.

k) Trace average at least 10 traces in power averaging (rms) mode.

l) Use the peak marker function to identify the highest amplitude level over each measured frequency range. Record the frequency and amplitude and capture a plot for inclusion in the test report.

m) Reset the spectrum analyzer start frequency to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the spectrum analyzer stop frequency to 10 times the highest frequency of the fundamental emission (see § 2.1057). The number of measurement points in each sweep must be ≥ (2 × span/RBW), which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.

n) Trace average at least 10 traces in power averaging (rms) mode.

o) Use the peak marker function to identify the highest amplitude level over each of the measured frequency ranges. Record the frequency and amplitude and capture a plot for inclusion in the test report; also provide tabular data, if required.

p) Repeat steps i) to o) with the input test signals firstly tuned to a middle band/block frequency/channel, and then tuned to a high band/block frequency/channel.

q) Repeat steps b) to p) with the narrowband test signal.

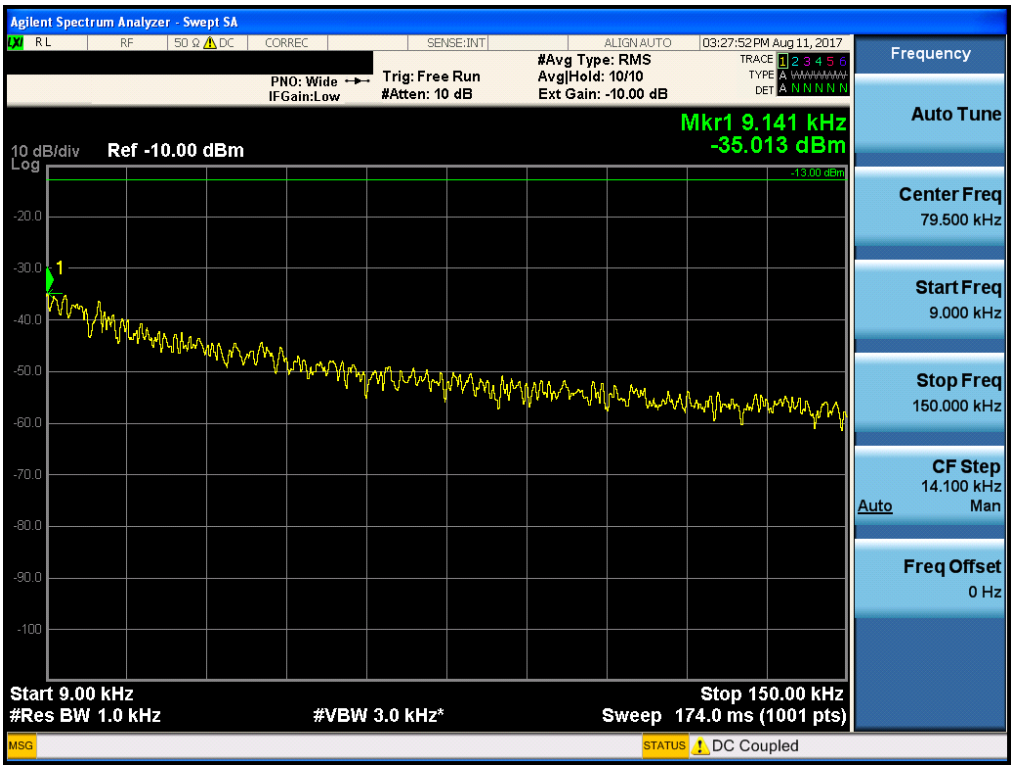
r) Repeat steps b) to q) for all authorized frequency bands/blocks used by the EUT.

Notes: In 9 KHz-150 KHz and 150 KHz-30 MHz bands, RBW was reduced to 1% and 10% of the reference bandwidth for measuring unwanted emission level(typically, 100KHz if the authorized frequency band is below 1GHz) and power was integrated.(1% = +20 dB, 10% = +10 dB)

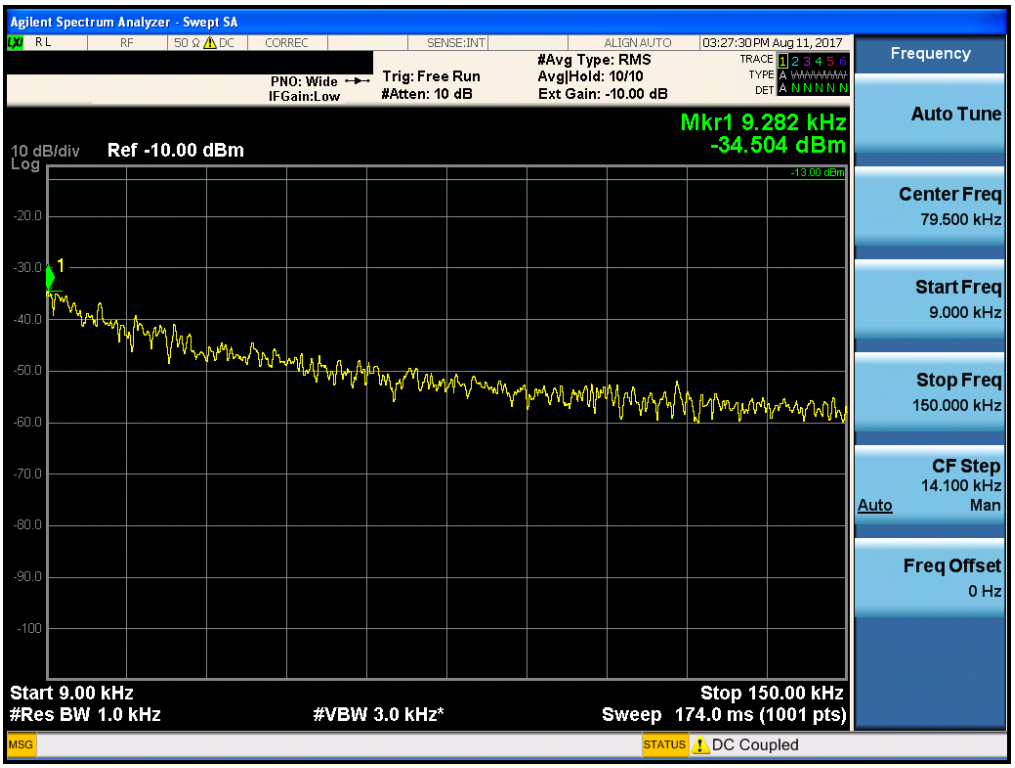
Plots of Spurious Emission for BRS BAND LTE 20 MHz

Conducted Spurious Emissions (9 kHz – 150 kHz)

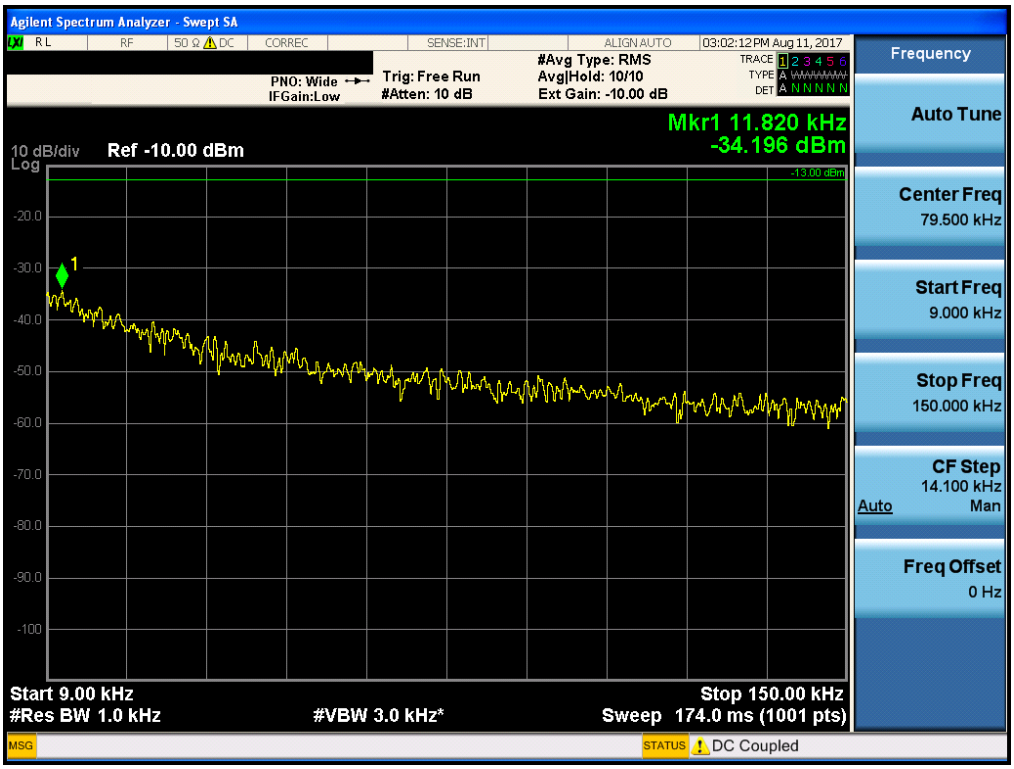
[Downlink Low]



[Downlink Middle]

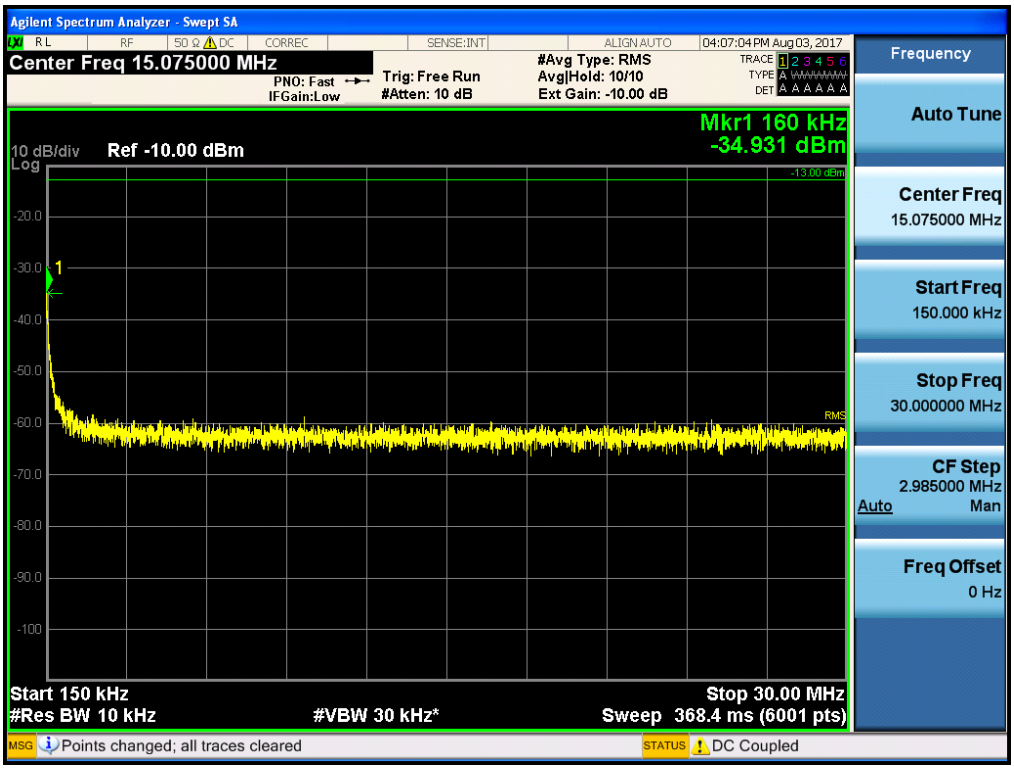


[Downlink High]

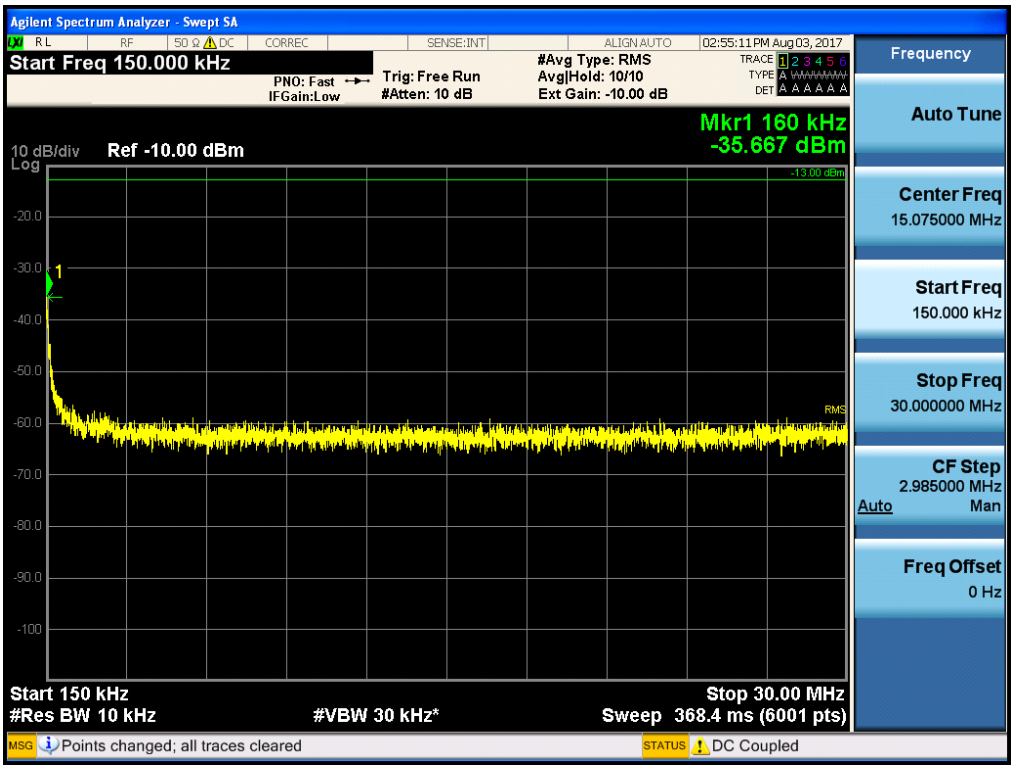


Conducted Spurious Emissions (150 kHz – 30 MHz)

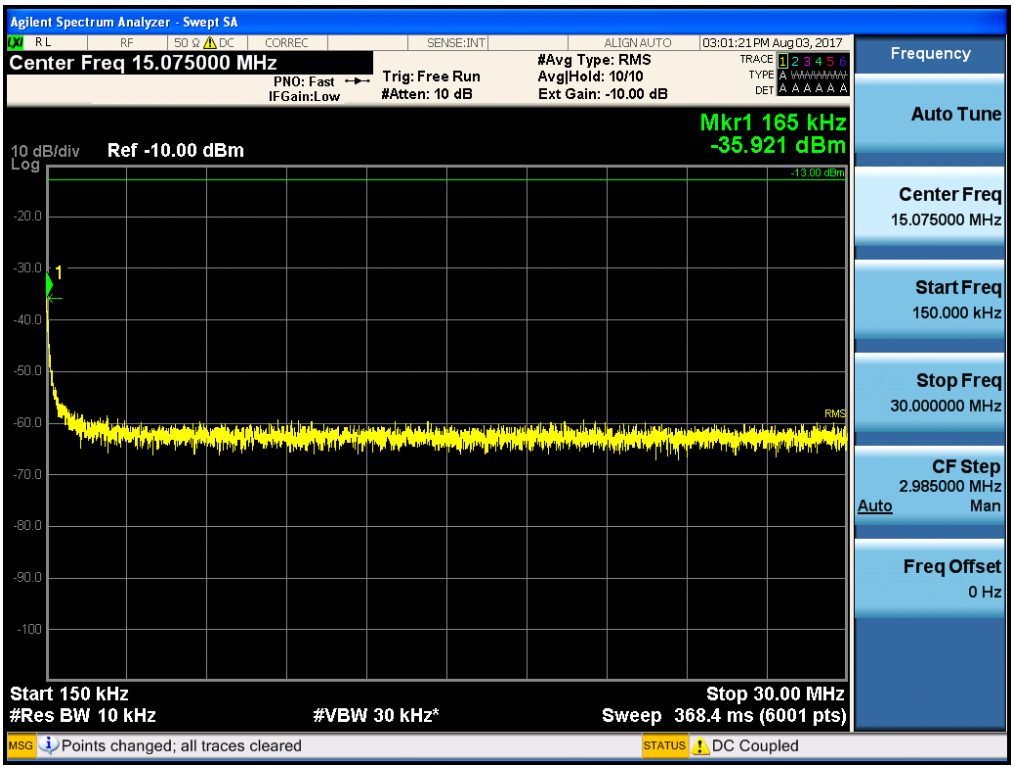
[Downlink Low]



[Downlink Middle]

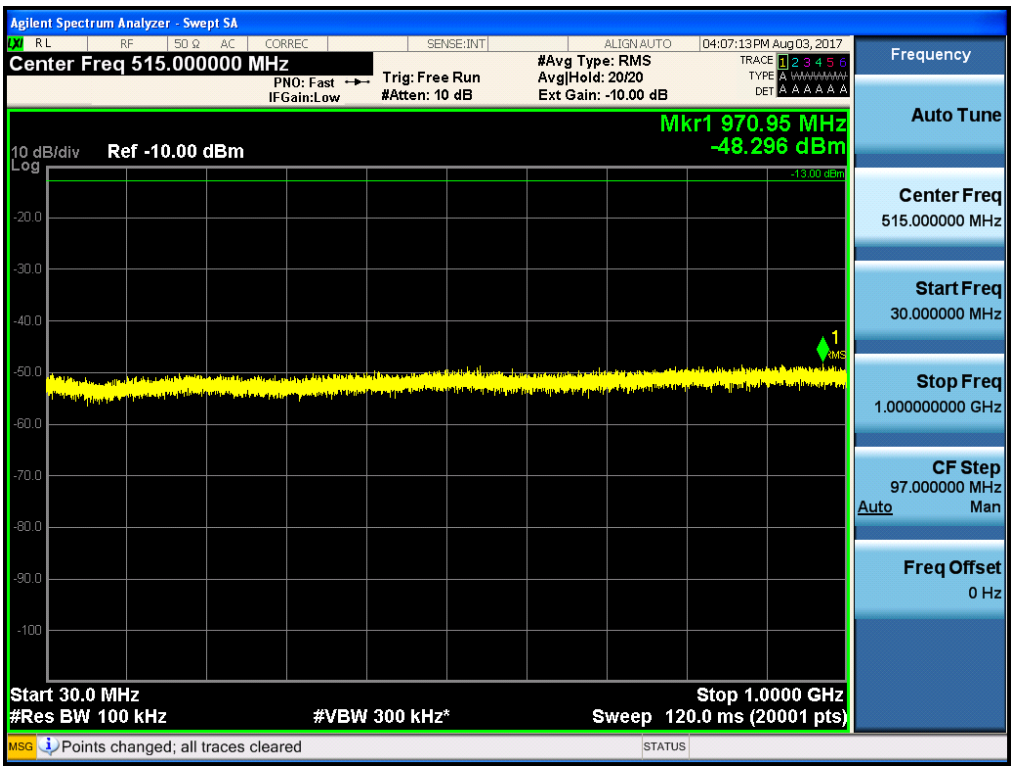


[Downlink High]

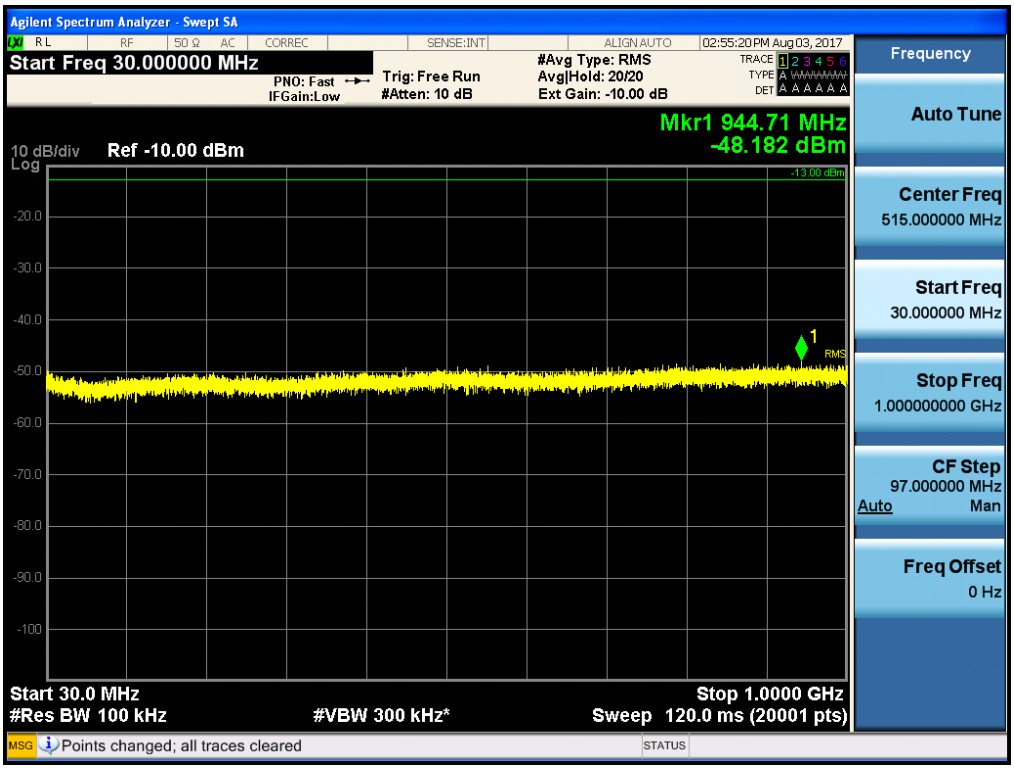


Conducted Spurious Emissions (30 MHz – 1 GHz)

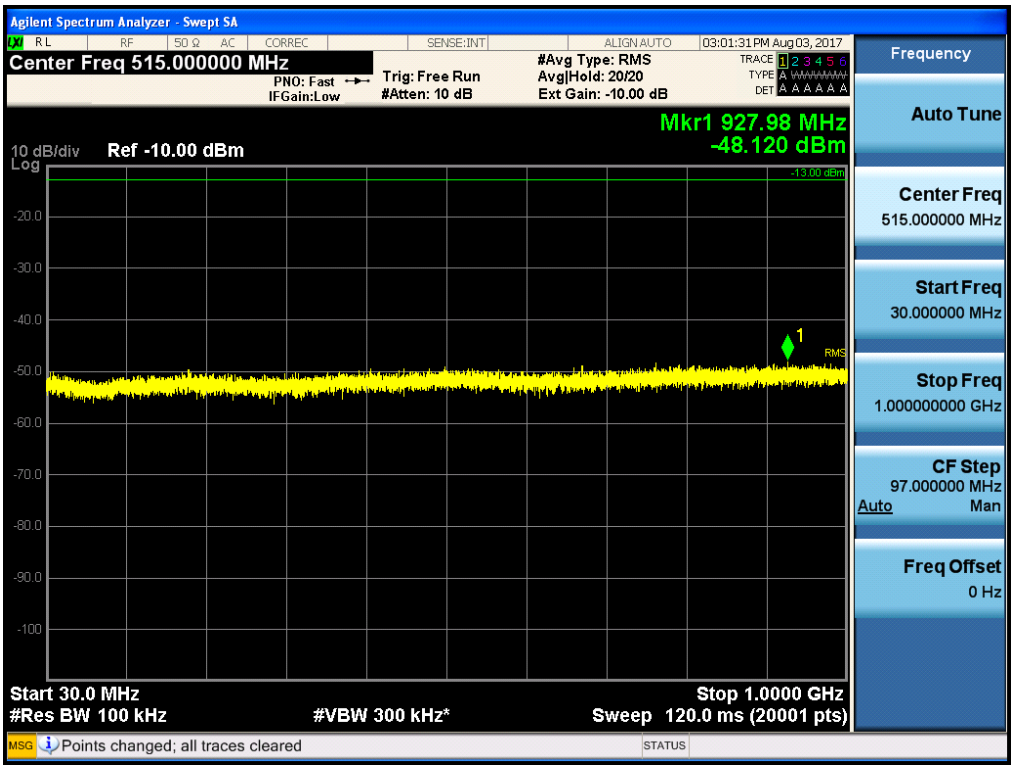
[Downlink Low]



[Downlink Middle]

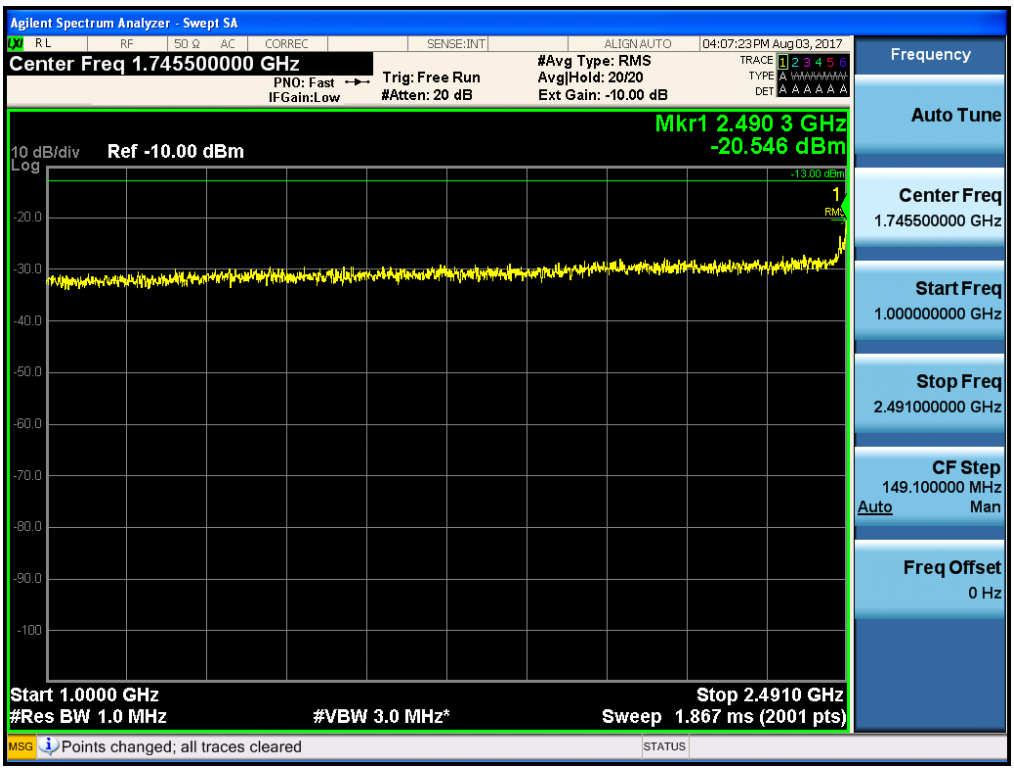


[Downlink High]

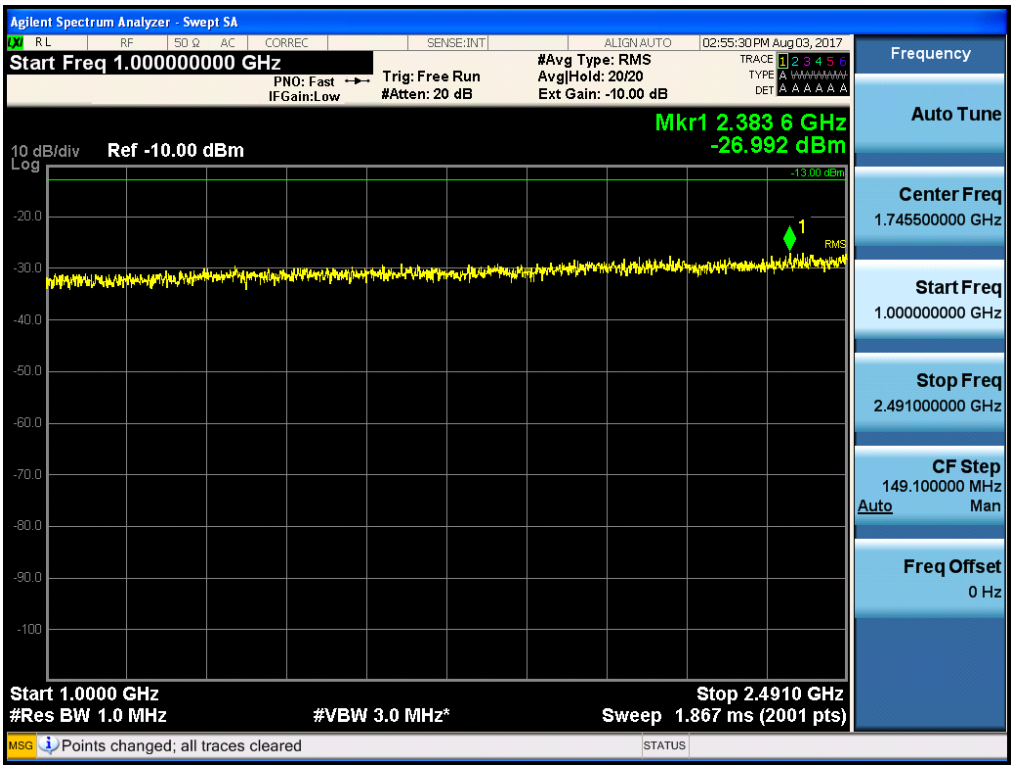


Conducted Spurious Emissions (1 GHz – 2.491 GHz)

[Downlink Low]



[Downlink Middle]



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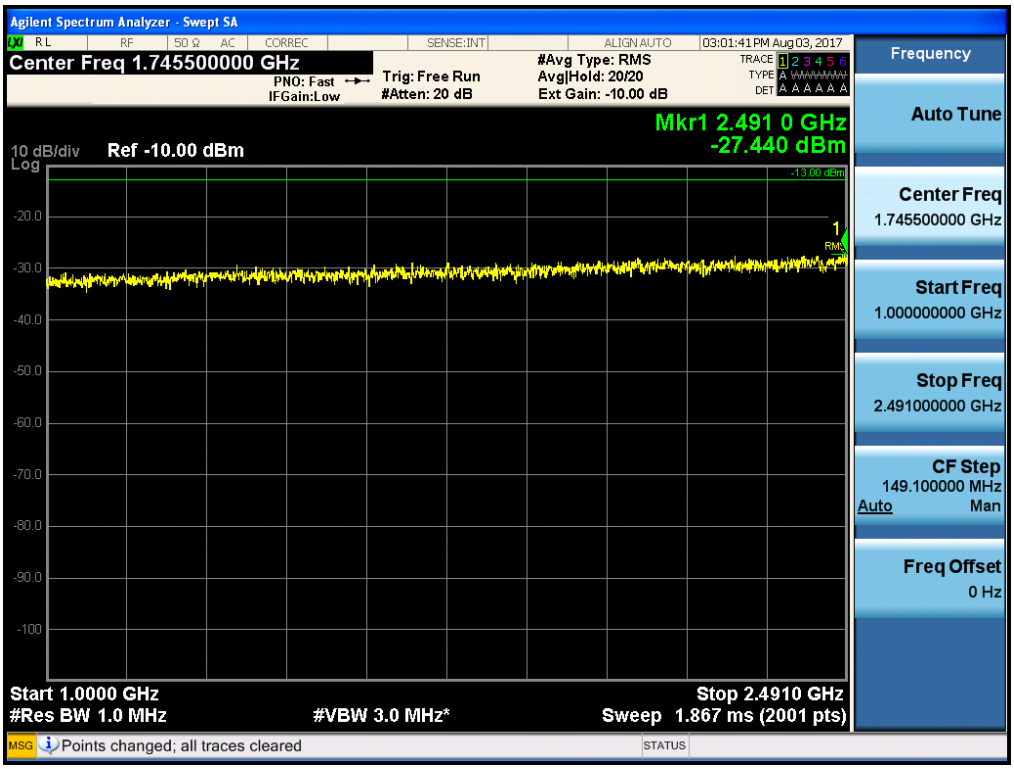
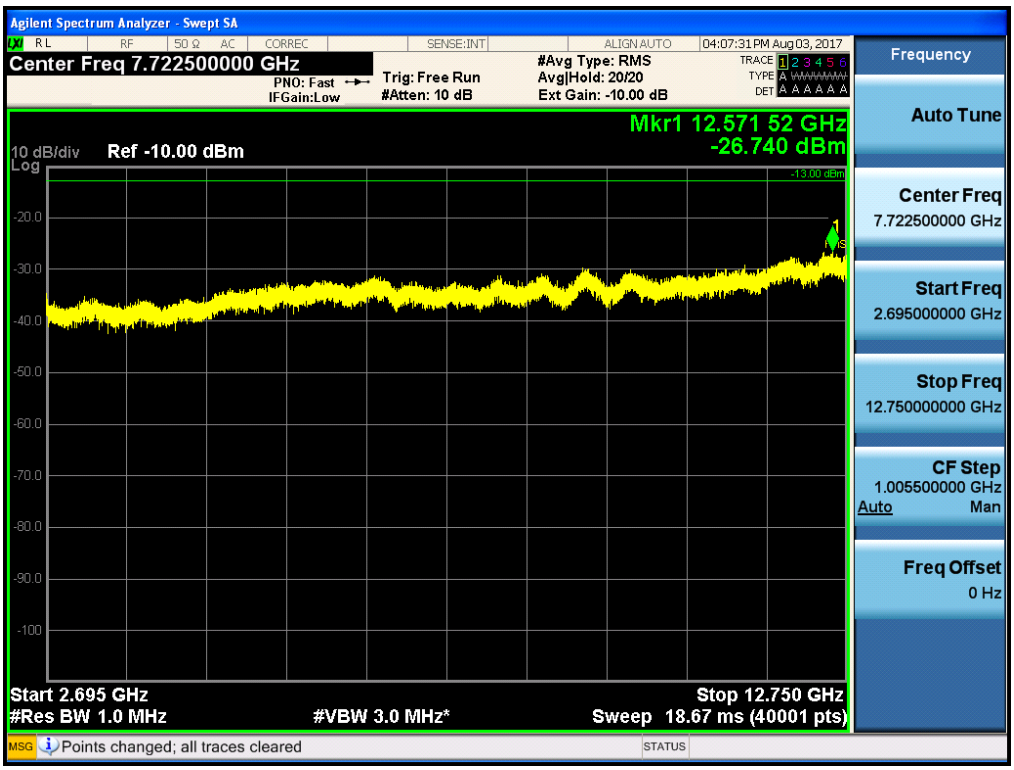
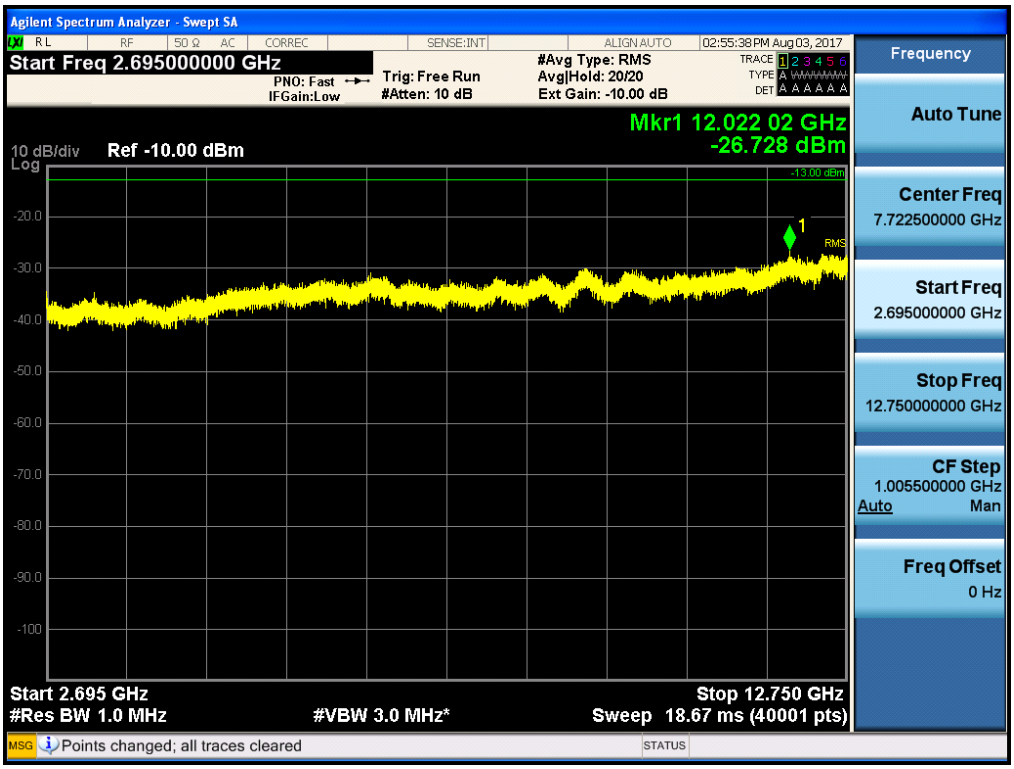


Conducted Spurious Emissions (2.695 GHz – 12.75 GHz)

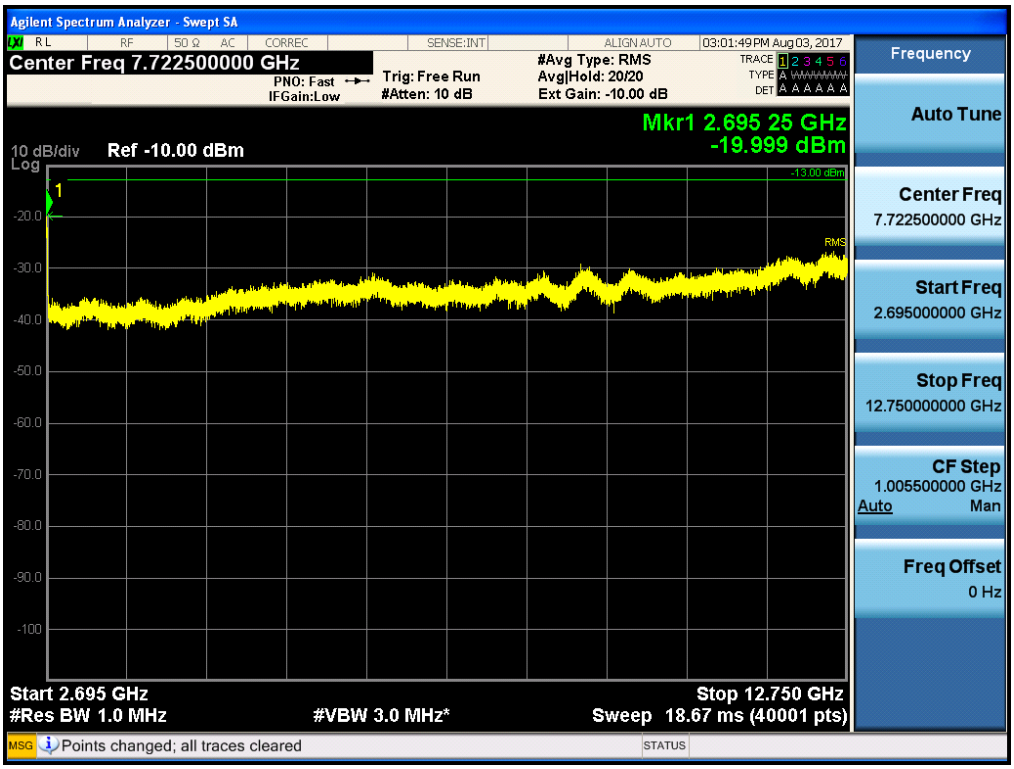
[Downlink Low]



[Downlink Middle]



[Downlink High]



Conducted Spurious Emissions (12.75 GHz – 26.5 GHz)

[Downlink Low]

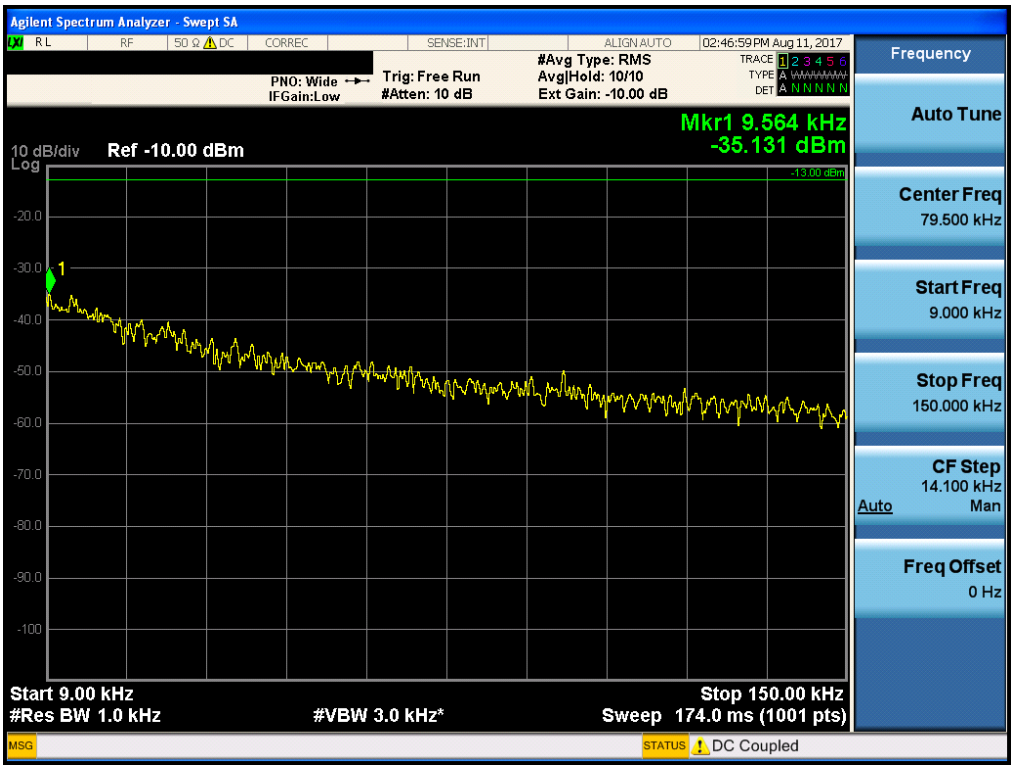
[Downlink Middle]

[Downlink High]

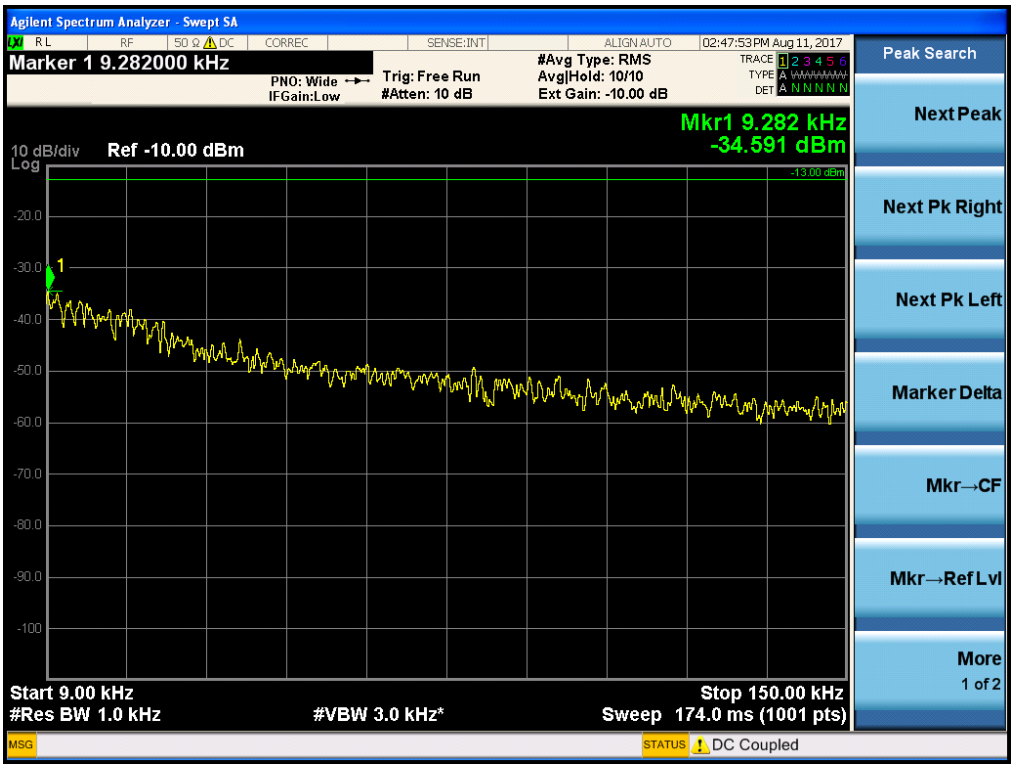
Plots of Spurious Emission for BRS BAND LTE 20 MHz

Conducted Spurious Emissions (9 kHz – 150 kHz)

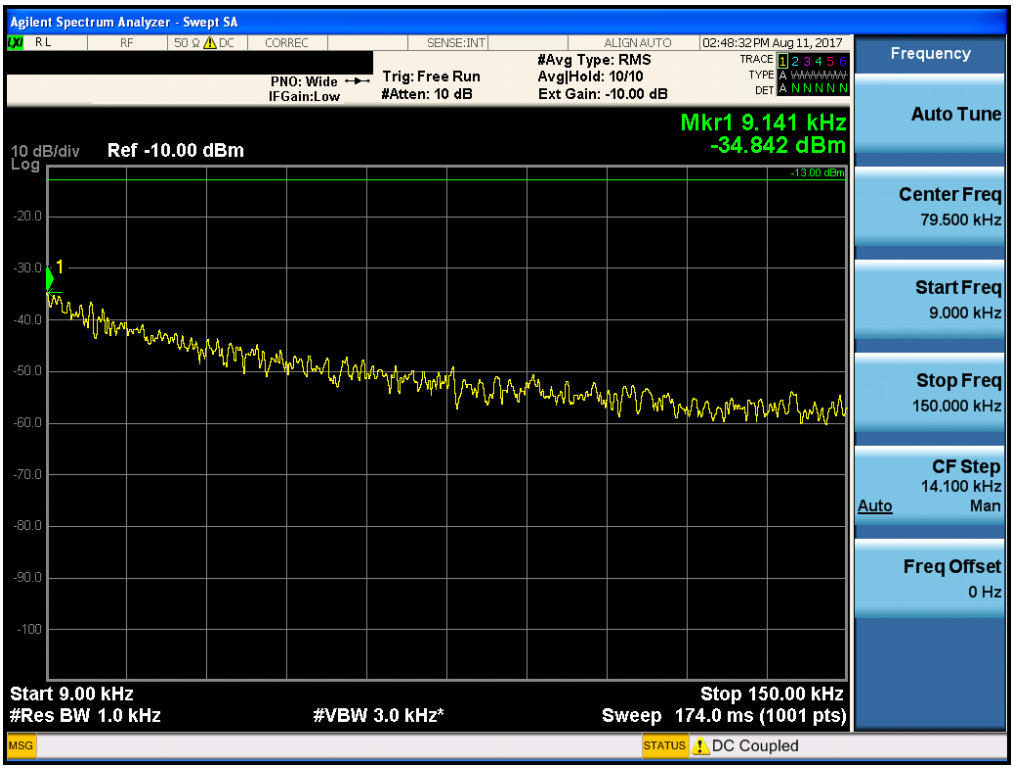
[Uplink Low]



[Uplink Middle]

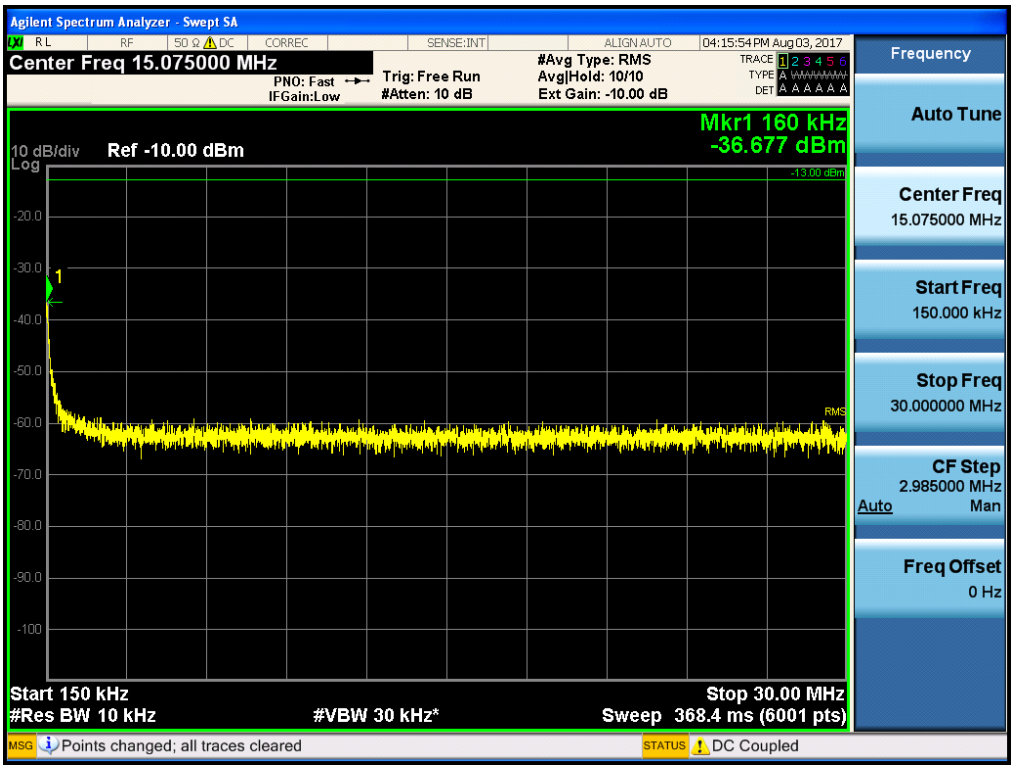


[Uplink High]

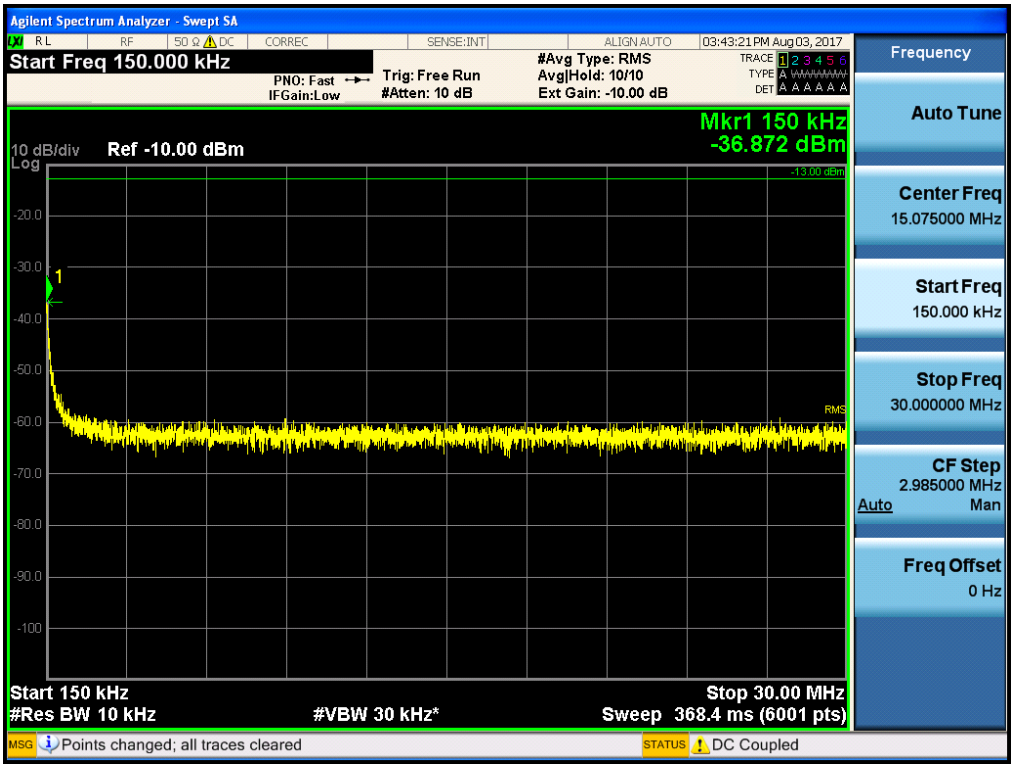

Agilent Spectrum Analyzer - Swept SA
R L
RF
50 Ω DC
CORREC
SENSE:INT
ALIGN AUTO
02:48:32 PM Aug 11, 2017
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 10 dB
#Avg Type: RMS
Avg|Hold: 10/10
Ext Gain: -10.00 dB
TRACE 1 2 3 4 5 6
TYPE A WWWWWWW
DET A N N N N N
Mkr1 9.141 kHz
-34.842 dBm
10 dB/div
Log
Ref -10.00 dBm
-13.00 dBm
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100
Start 9.00 kHz
#Res BW 1.0 kHz
#VBW 3.0 kHz*
Stop 150.00 kHz
Sweep 174.0 ms (1001 pts)
Frequency
Auto Tune
Center Freq
79.500 kHz
Start Freq
9.000 kHz
Stop Freq
150.000 kHz
CF Step
14.100 kHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS
DC Coupled

Conducted Spurious Emissions (150 kHz – 30 MHz)

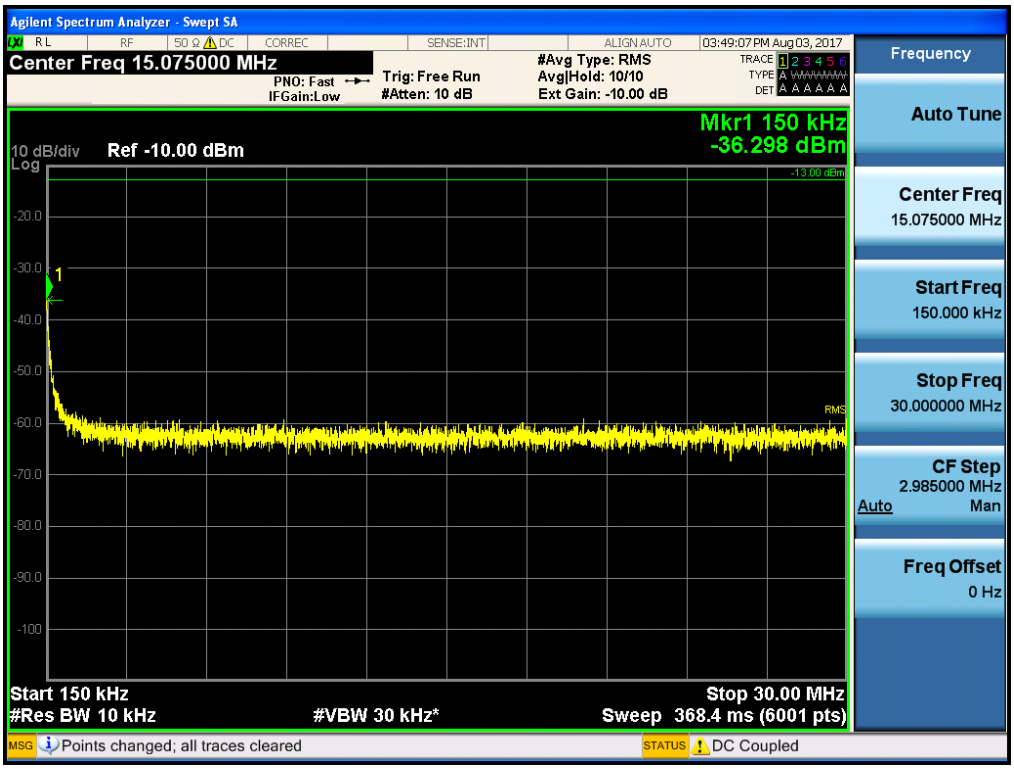
[Uplink Low]



[Uplink Middle]

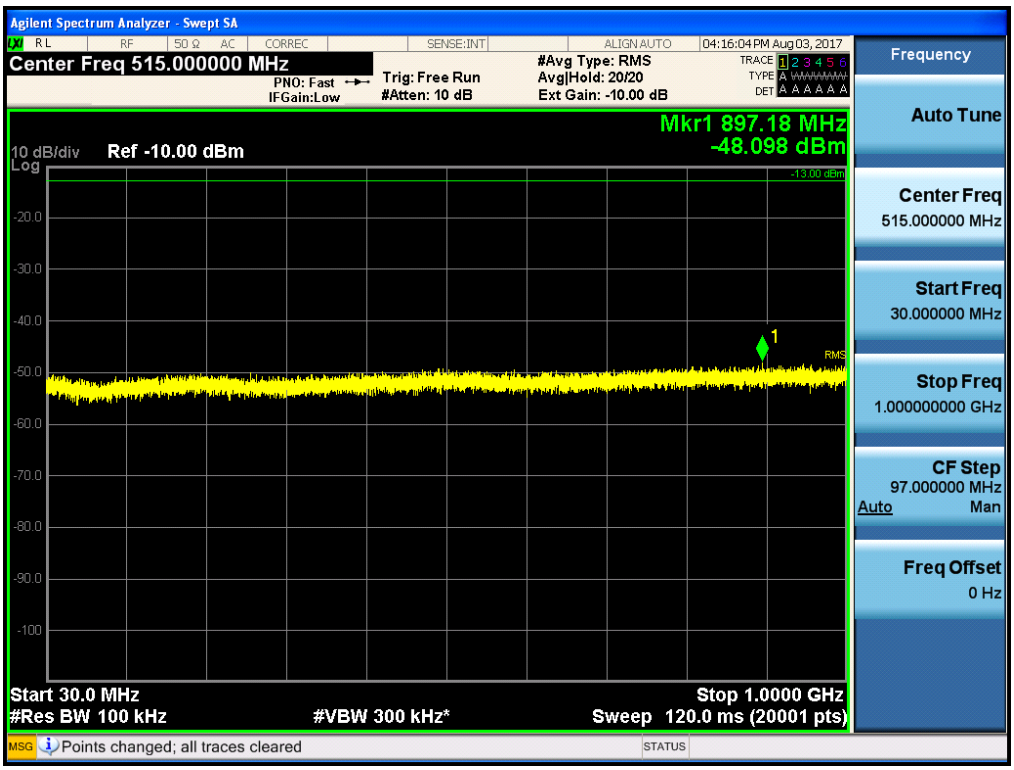


[Uplink High]


Agilent Spectrum Analyzer - Swept SA
Center Freq 15.075000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 10 dB
#Avg Type: RMS
Avg|Hold: 10/10
Ext Gain: -10.00 dB
03:49:07 PM Aug 03, 2017
Mkr1 150 kHz
-36.298 dBm
10 dB/div
Log
Ref -10.00 dBm
-13.00 dBm
Start 150 kHz
#Res BW 10 kHz
#VBW 30 kHz*
Stop 30.00 MHz
Sweep 368.4 ms (6001 pts)
Points changed; all traces cleared
DC Coupled
Frequency
Auto Tune
Center Freq
15.075000 MHz
Start Freq
150.000 kHz
Stop Freq
30.000000 MHz
CF Step
2.985000 MHz
Auto
Man
Freq Offset
0 Hz

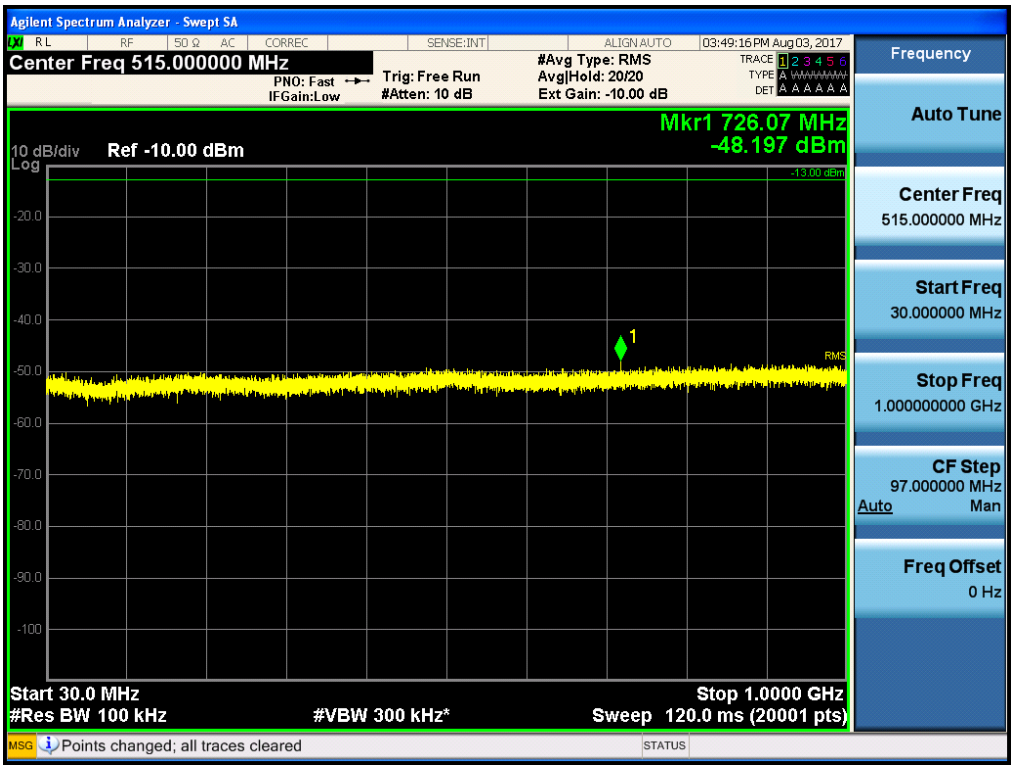
Conducted Spurious Emissions (30 MHz – 1 GHz)

[Uplink Low]



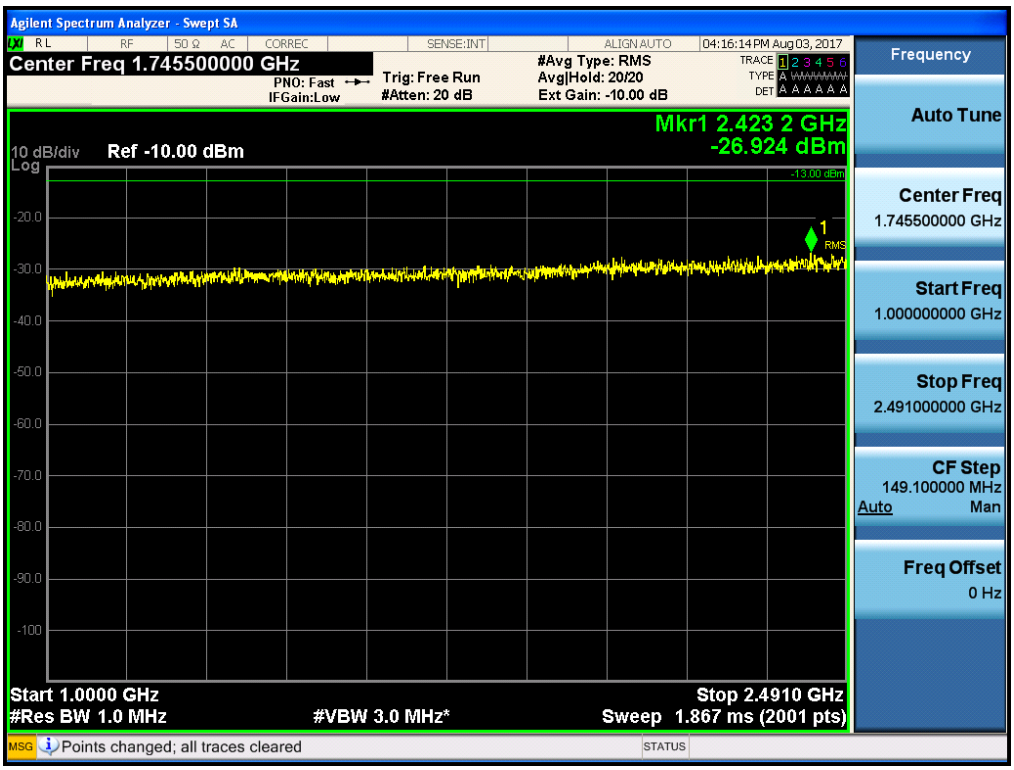
[Uplink Middle]

[Uplink High]

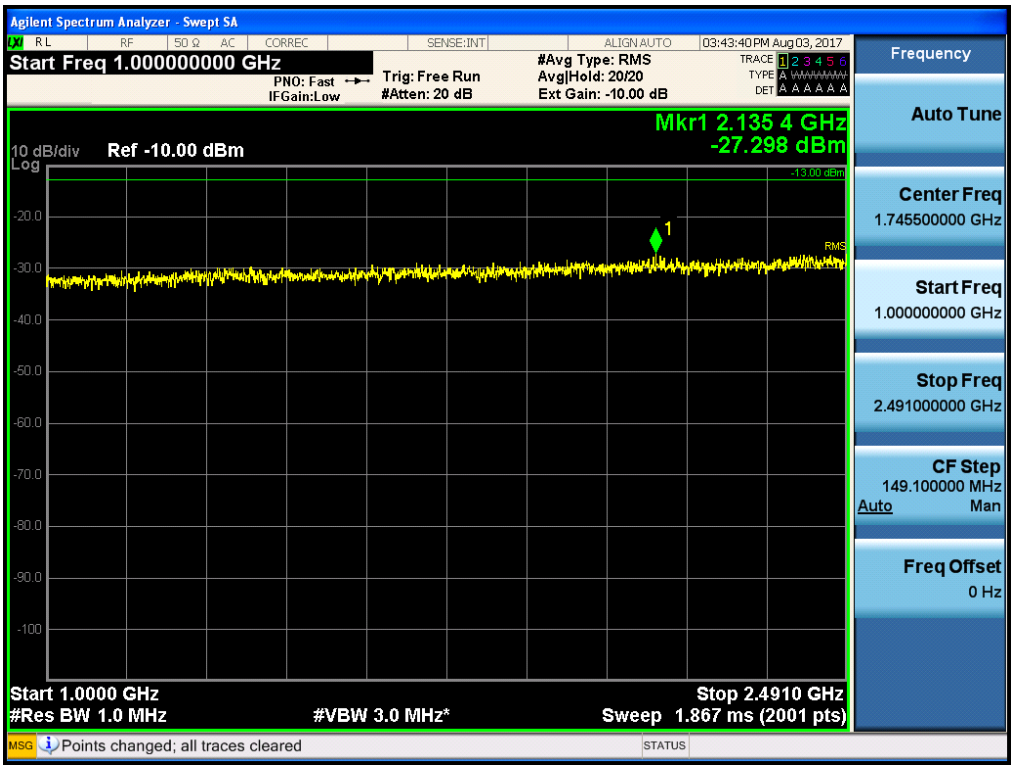

Agilent Spectrum Analyzer - Swept SA
Center Freq 515.000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 10 dB
#Avg Type: RMS
Avg|Hold: 20/20
Ext Gain: -10.00 dB
03:49:16 PM Aug 03, 2017
Mkr1 726.07 MHz
-48.197 dBm
10 dB/div
Log
Ref -10.00 dBm
-13.00 dBm
Start 30.0 MHz
#Res BW 100 kHz
#VBW 300 kHz*
Stop 1.0000 GHz
Sweep 120.0 ms (20001 pts)
Points changed; all traces cleared
Frequency
Auto Tune
Center Freq
515.000000 MHz
Start Freq
30.000000 MHz
Stop Freq
1.000000000 GHz
CF Step
97.000000 MHz
Auto
Man
Freq Offset
0 Hz

Conducted Spurious Emissions (1 GHz – 2.491 GHz)

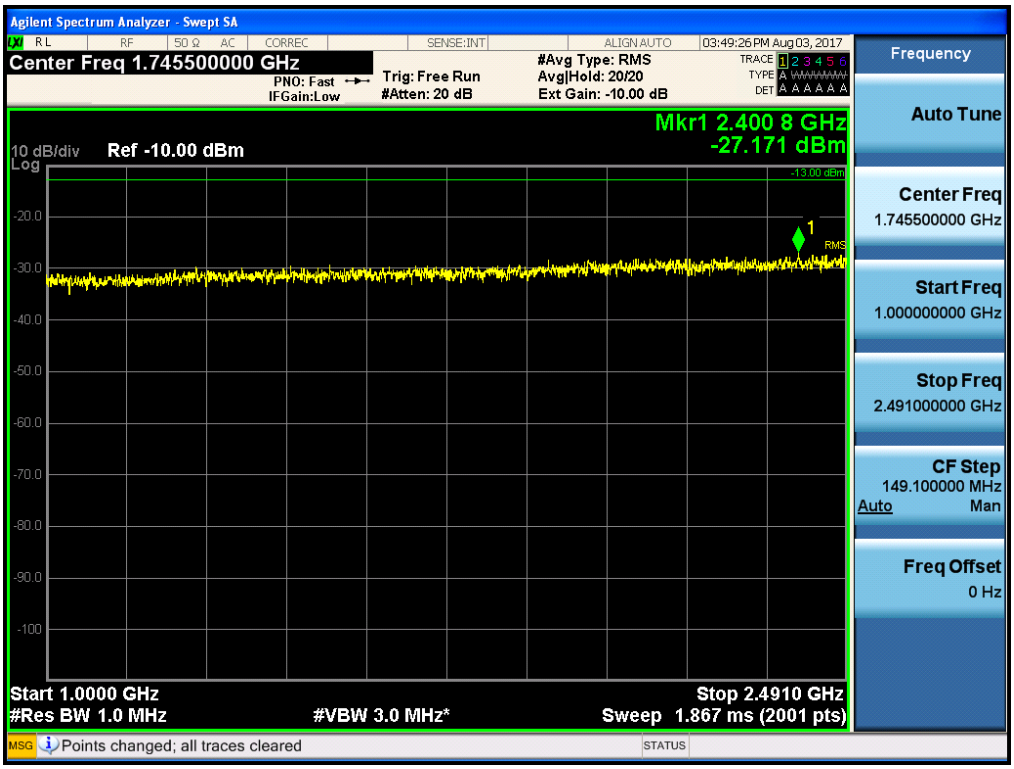
[Uplink Low]



[Uplink Middle]



[Uplink High]


Agilent Spectrum Analyzer - Swept SA
Center Freq 1.745500000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 20/20
Ext Gain: -10.00 dB
03:49:26 PM Aug 03, 2017
Mkr1 2.400 8 GHz
-27.171 dBm
10 dB/div
Ref -10.00 dBm
Log
-13.00 dBm
Start 1.0000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 2.4910 GHz
Sweep 1.867 ms (2001 pts)
Points changed; all traces cleared
Frequency
Auto Tune
Center Freq
1.745500000 GHz
Start Freq
1.000000000 GHz
Stop Freq
2.491000000 GHz
CF Step
149.100000 MHz
Auto
Man
Freq Offset
0 Hz

Conducted Spurious Emissions (2.695 GHz – 12.75 GHz)

[Uplink Low]

[Uplink Middle]

[Uplink High]

Agilent Spectrum Analyzer - Swept SA
Center Freq 7.722500000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 10 dB
#Avg Type: RMS
Avg|Hold: 20/20
Ext Gain: -10.00 dB
03:49:34 PM Aug 03, 2017
Mkr1 12.434 02 GHz
-26.697 dBm
10 dB/div
Log
Ref -10.00 dBm
-13.00 dBm
Start 2.695 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 12.750 GHz
Sweep 18.67 ms (40001 pts)
Points changed; all traces cleared
Frequency
Auto Tune
Center Freq
7.722500000 GHz
Start Freq
2.695000000 GHz
Stop Freq
12.750000000 GHz
CF Step
1.005500000 GHz
Auto
Man
Freq Offset
0 Hz

Conducted Spurious Emissions (12.75 GHz – 26.5 GHz)

[Uplink Low]

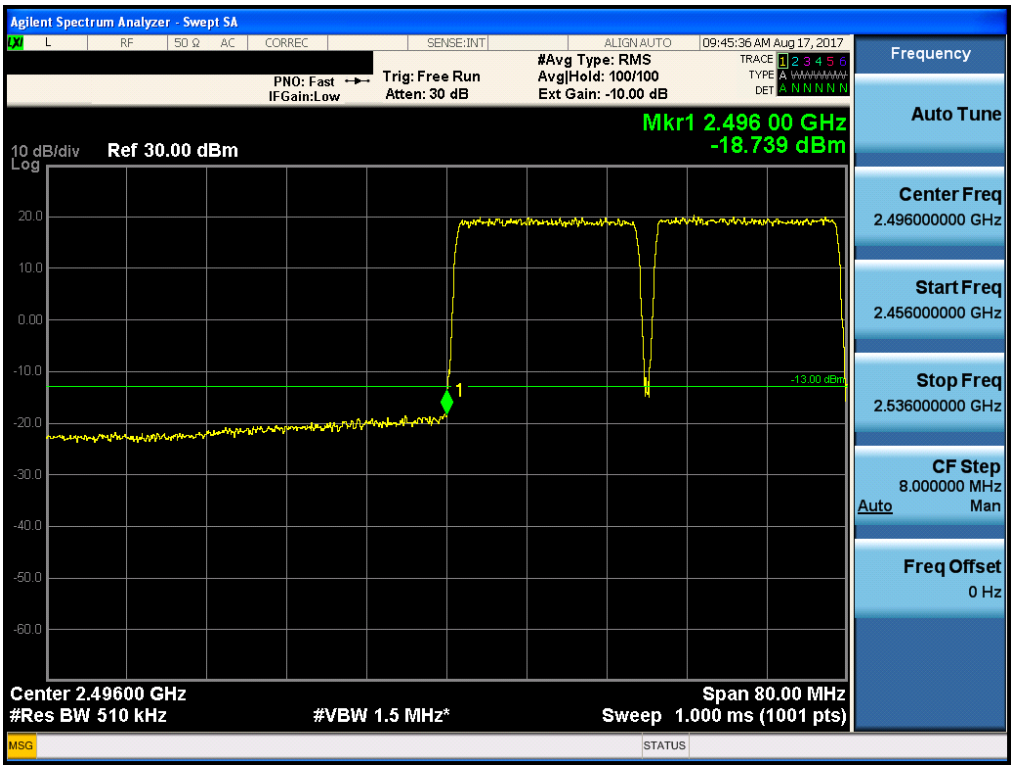
[Uplink Middle]

[Uplink High]

Agilent Spectrum Analyzer - Swept SA
Center Freq 19.625000000 GHz
PNO: Fast
IFGain:High
Trig: Free Run
#Atten: 0 dB
#Avg Type: RMS
Avg|Hold: 20/20
Ext Gain: -10.00 dB
03:49:45 PM Aug 03, 2017
Mkr1 25.555 0 GHz
-18.643 dBm
10 dB/div
Ref -10.00 dBm
Log
Start 12.750 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 26.500 GHz
Sweep 34.67 ms (40001 pts)
File <AAA.PNG> saved
Frequency
Auto Tune
Center Freq
19.625000000 GHz
Start Freq
12.750000000 GHz
Stop Freq
26.500000000 GHz
CF Step
1.375000000 GHz
Auto
Man
Freq Offset
0 Hz

Intermodulation Spurious Emissions for FCC_BRS BAND LTE 20 MHz

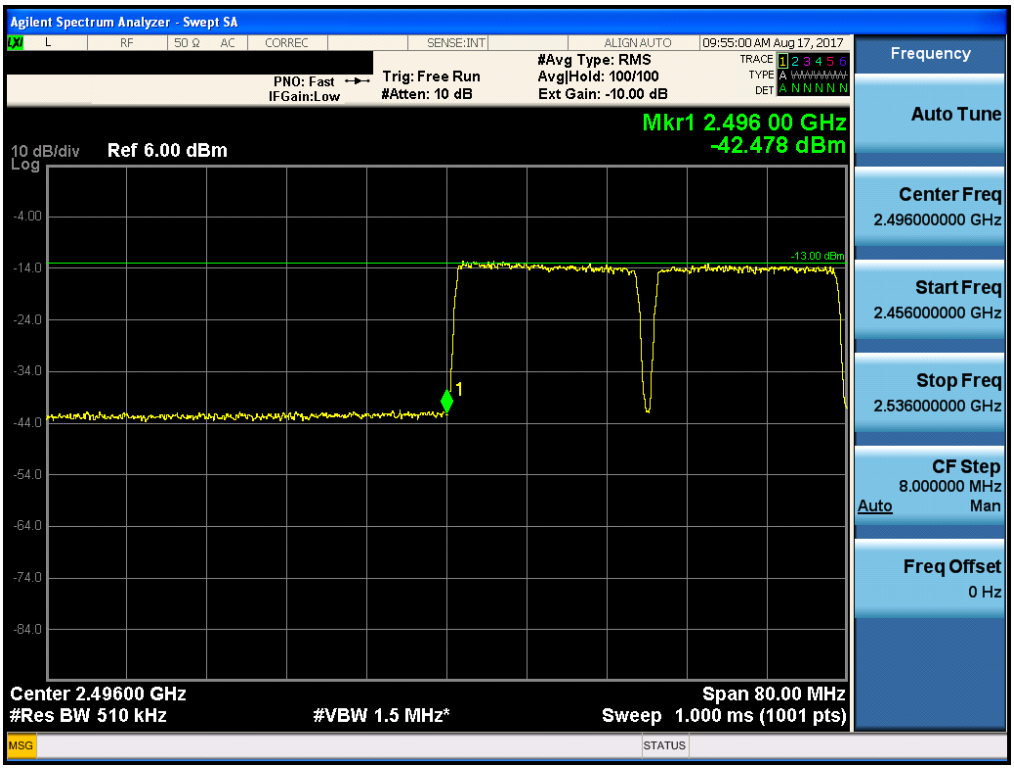
[Downlink Low]



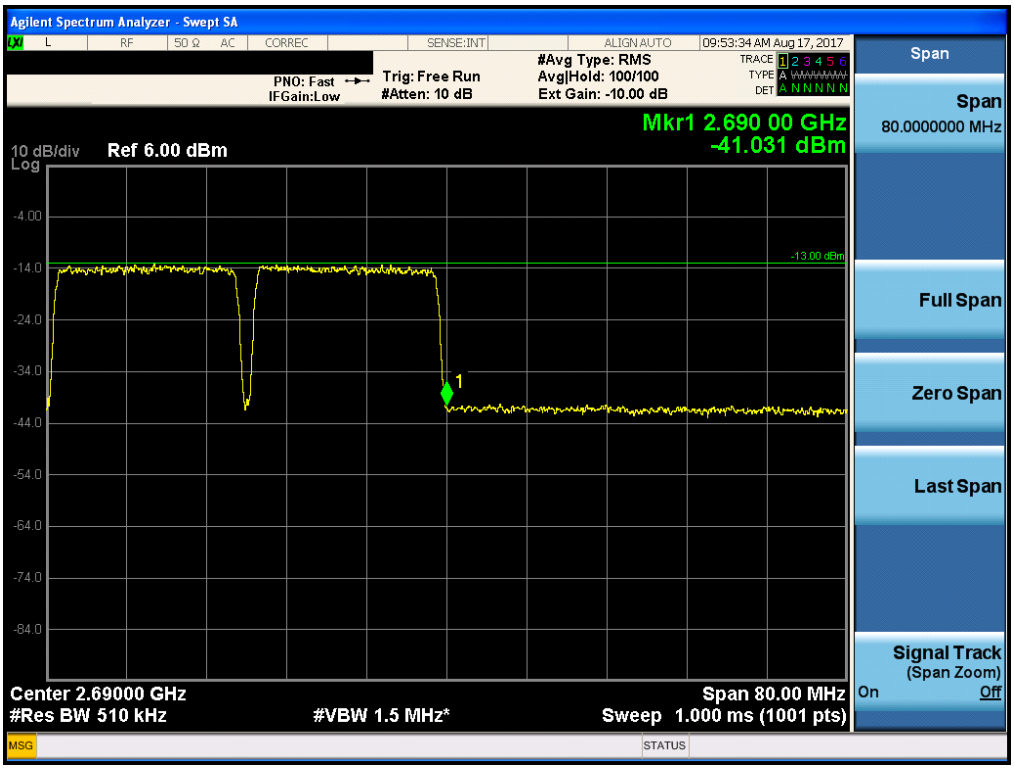
[Downlink High]

Intermodulation Spurious Emissions for FCC_BRS BAND LTE 20 MHz

[Uplink Low]

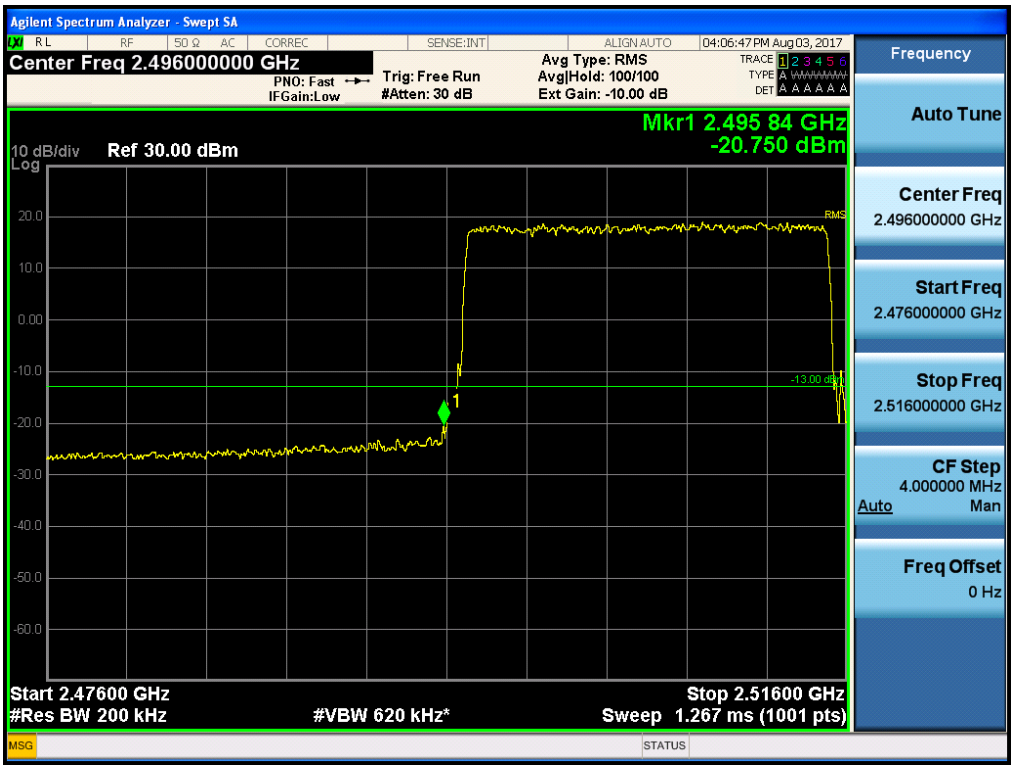


[Uplink High]



Single channel Enhancer Band Edge_BRS BAND LTE 20 MHz

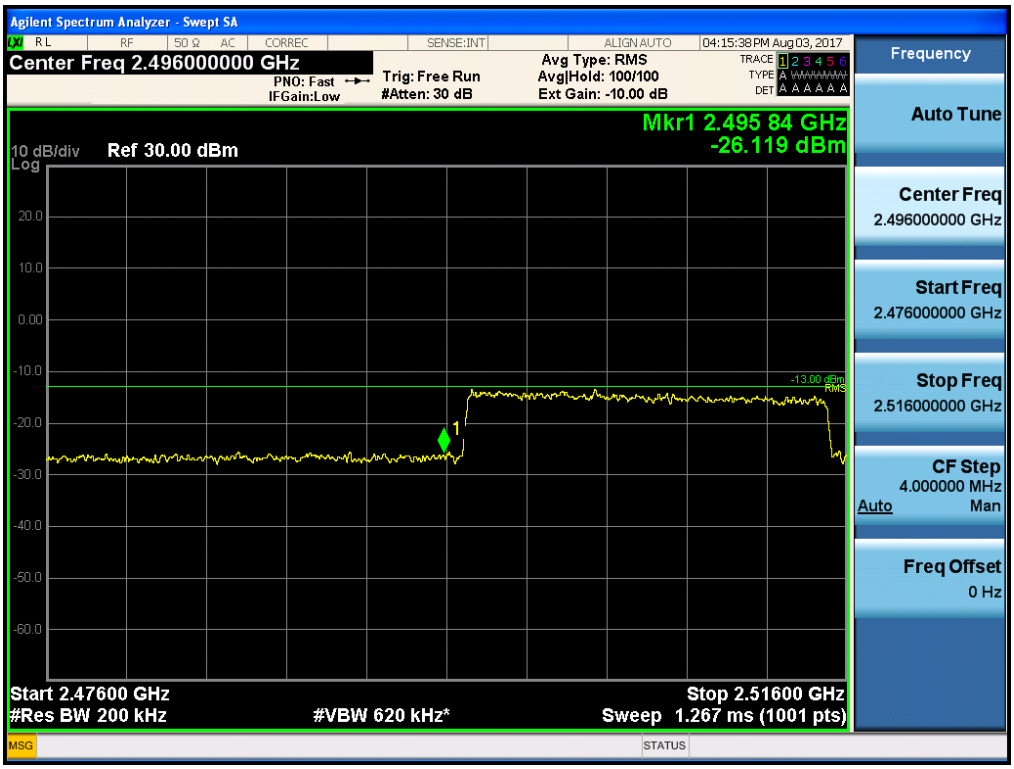
[Downlink Low]



[Downlink High]

Single channel Enhancer Band Edge_BRS BAND LTE 20 MHz

[Uplink Low]



[Uplink High]

11. RADIATED SPURIOUS EMISSIONS

FCC Rules

Test Requirements:

§ 2.1053 Measurements required: Field strength of spurious radiation.

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

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

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

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

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

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

IC Rules

Test Requirements:

RSS-Gen

7. Receiver Limits

7.1 Receiver Emission Limits

7.1.2 Receiver Radiated Limits

Radiated emission measurements shall be performed with the receiver antenna connected to the receiver antenna terminals. The search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or

carrier frequency), or 30 MHz, whichever is higher, to at least 5x the highest tunable or local oscillator frequency, whichever is higher, without exceeding 40 GHz.

Spurious emissions from receivers shall not exceed the radiated limits shown in Table 2 below:

Table 2 – Receiver Radiated Limits	
Frequency (MHz)	**Field Strength (µv/m at 3 metres)***
30-88	100
88-216	150
216-960	200
Above 960	500

Footnote *

Measurements for compliance with limits in the above table may be performed at distances other than 3 metres, in accordance with Section 6.5.

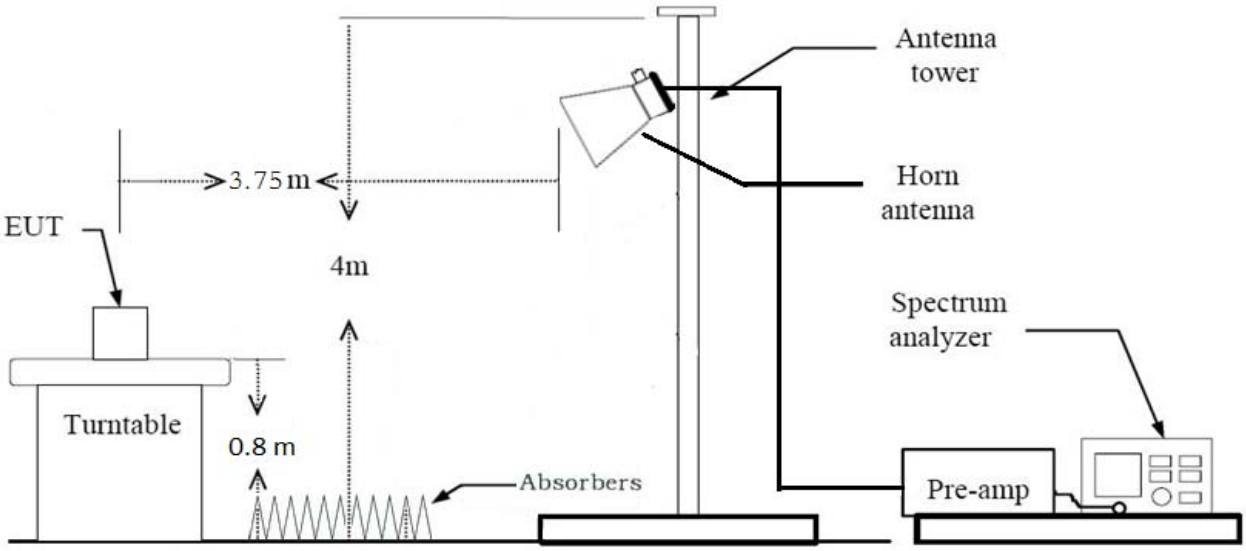
Test Procedures:

As required by 47 CFR 2.1053, *field strength of radiated spurious measurements* were made in accordance with the procedures of ANSI/TIA-603-C-2004 "Land Mobile FM or PM Communications Equipment Measurement and Performance Standards".

Radiated emission measurements were performed inside a 3 meter semi-anechoic chamber.

The EUT was set at a distance of 3m from the receiving antenna. The EUT's RF ports were terminated to 50ohm load. The EUT was set to transmit at the low, mid and high channels of the transmitter frequency range at its maximum power level. The EUT was rotated about 360and the receiving antenna scanned from 1-3m in order to capture the maximum emission. A calibrated antenna source was positioned in place of the EUT and the previously recorded signal was duplicated. The maximum EIRP of the emission was calculated by adding the forward power to the calibrated source plus its appropriate gain value. These steps were carried. out with the receiving antenna in both vertical and horizontal polarization. Harmonic emissions up to the 10th or 40GHz, whichever was the lesser, were investigated.

Radiated Spurious Emissions Test Setup



Note :

1. According to SVSWR requirement in ANSI 63.4-2014, We performed the radiated test at 3.75 m distance from center of turn table. So, we applied the distance factor(reference distance : 3 m).
2. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)

Receiver Spurious Emissions Test Result:

ISED Rule(s):	**RSS-Gen**
Test Requirements:	**Blow the table**
Operating conditions:	**Under normal test conditions**
Method of testing:	**Radiated**
S/A. Settings:	**F < 1 GHz: RBW: 120 kHz, VBW: 300 kHz (Quasi Peak)** **F > 1 GHz: RBW: 1 MHz, VBW: 1 MHz (Peak)**
Mode of operation:	**Receive**

Frequency (MHz)	Field Strength (microvolts/m at 3 meters)
30 – 88	100
88 - 216	150
216 – 960	200
Above 960	500

Operation Mode: Receive:

30 MHz ~ 1 GHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBμV	dB /m	dB	(H/V)	dBμV/m	dBμV/m	dB
No critical peaks found							

Above 1 GHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBμV	dB /m	dB	(H/V)	dBμV/m	dBμV/m	dB
No critical peaks found							

Radiated Spurious Emissions Test Result:

Test results are only attached worst cases.

[Downlink]

Ch.	Freq.(MHz)	Measured Level [dBuV/m]	Measured Power [dBm]	Ant. Factor [dB/m]	C.L [dB]	Amp. Gain [dB]	H.P.F. [dB]	D.F.(3.75m) [dB]	Pol.	Result [dBm]
Low 2506	5012	68.82	-26.38	31.745	7.038	43.906	0.564	1.96	H	-28.979
		63.13	-32.07	31.745	7.038	43.906	0.564	1.96	V	-34.669
High 2680	5360	72.61	-22.59	31.456	7.330	44.170	0.020	1.96	H	-25.994
		68.16	-27.04	31.456	7.330	44.170	0.020	1.96	V	-30.444

* C.L.: Cable Loss / A.G.: Ant. Gain / H.P.F.: High Pass Filter / D.F.: Distance Factor (3.75 m)

[Uplink]

Ch.	Freq.(MHz)	Measured Level [dBuV/m]	Measured Power [dBm]	Ant. Factor [dB/m]	C.L [dB]	A.G. [dB]	H.P.F.. [dB]	D.F. [dB]	Pol.	Result [dBm]
No Critical Peaks Found										

* C.L.: Cable Loss / A.G.: Ant. Gain / H.P.F.: High Pass Filter / D.F.: Distance Factor (3.75 m)

Notes:

1. Test datas were only the worst case.
2. We have done horizontal and vertical polarizaion in detecting antenna.

12. FREQUENCY STABILITY OVER TEMPERATURE AND VOLTAGE VARIATIONS

FCC Rules

Test Requirements:

§ 2.1055 Measurements required: Frequency stability.

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From −30° to + 50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

§ 27.54 Frequency stability.

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

IC Rules

Test Requirements:

RSS-131

5. Equipment standard specifications for zone enhancers working with equipment certified in RSSs listed in section 1 except RSS-119

5.2 Industrial Zone Enhancers

5.2.4 Frequency stability

Industrial Zone Enhancers shall comply with the frequency stability given in the RSS that applies to the equipment with which the zone enhancer is to be used. In cases where the frequency stability limit is not given in the applicable RSS, the equipment shall comply with a frequency stability of ± 1.5 ppm.

For zone enhancers with no input signal processing capability, the frequency stability measurement in this section is not required.

RSS-199

4. Transmitter and receiver standard specifications

4.3 Transmitter Frequency Stability

The transmitter frequency stability limit shall be determined as follows:

a. the frequency offset shall be measured according to the procedure described in RSS-Gen and recorded
b. using a resolution bandwidth equal to that permitted within the 1 MHz band immediately outside the channel edge, as found in section 4.5, reference points will be selected at the unwanted emission limits, which comply with the attenuation specified in section 4.5 for the type of device under test, on the emission mask of the lowest and highest channels.

The frequency at these points shall be recorded as f_L and f_H respectively

The applicant shall ensure compliance with frequency stability requirements by showing that f_L minus the frequency offset and f_H plus the frequency offset is within the frequency range in which the equipment is designed to operate.

Test Procedures:

As required by 47 CFR 2.1055, *Frequency Stability measurements* were made at the RF output terminals using a Spectrum Analyzer.

The EUT was placed in the Environmental Chamber.

A CW signal was injected into the EUT at the appropriate RF level. The frequency counter option on the Spectrum Analyzer was used to measure frequency deviations.

The frequency drift was investigated for every 10 °C increment until the unit is stabilized then recorded the reading in tabular format with the temperature range of -30 to 50 °C.

Voltage supplied to EUT is 110 Vac reference temperature was done at 20°C.

The voltage was varied by ± 15 % of nominal.

RSS-Gen

6. Technical Requirements

6.11 Transmitter Frequency Stability

In circumstances when the transmitter frequency stability is not stated in the applicable RSS or reference measurement method, the following applies:

- Frequency stability is a measure of frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at an appropriate reference temperature and the rated supply voltage. Unless specified otherwise in an RSS applicable to the device, the reference temperature for radio transmitters is +20°C (+68°F);
- A hand-held device that is only capable of operating using internal batteries shall be tested at the battery's nominal voltage, and again at the battery's operating end-point voltage, which must be specified by the equipment manufacturer. For this test, either a battery or an external power supply can be used; and
- The operating carrier frequency shall be set up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency-determiningcircuit element shall be made subsequent to this initial set-up.

With the transmitter installed in an environmental test chamber, the unmodulated carrier frequency shall be measured under the conditions specified below. A sufficient stabilization period at each temperature shall be used prior to each frequency measurement. The following temperatures and supply voltage ranges apply, unless specified otherwise in the applicable RSS:

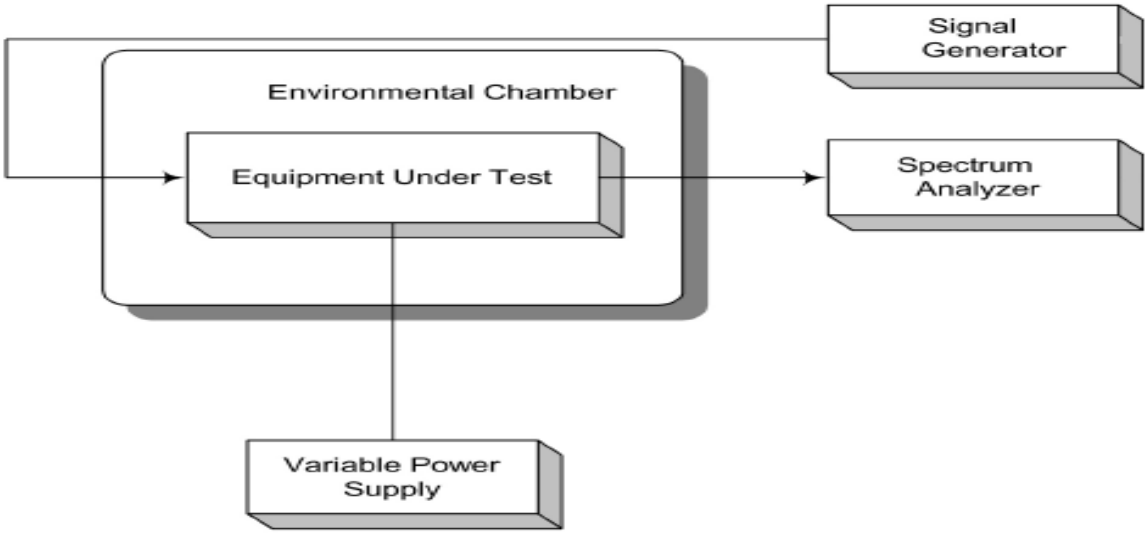
(a) at the temperatures of −30°C (−22°F), +20°C (+68°F) and +50°C (+122°F), and at the manufacturer's rated supply voltage; and

(b) at the temperature of +20°C (+68°F) and at ±15% of the manufacturer's rated supply voltage.

If the frequency stability limits are only met within a temperature range that is smaller than the −30°C to +50°C range specified in (a), the frequency stability requirement will be deemed to be met if the transmitter is automatically prevented from operating outside this smaller temperature range and if the published operating characteristics for the equipment are revised to reflect this restricted temperature range.

In addition, if an unmodulated carrier is not available, the measurement method shall be described in the test report.

Test Setup:



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

Test Results:

Frequency Stability and Voltage Test Results

[Downlink / Uplink]

Reference: 120 Vac at 20°C **Freq.** = 2593.0 MHz

Voltage (%)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100%	+20(Ref)	2593 000 000	0.258	0.000	0.00000
	-30	2593 000 000	0.016	-0.242	-0.00031
	-20	2593 000 000	0.367	0.110	0.00014
	-10	2593 000 000	-0.029	-0.287	-0.00037
	0	2593 000 000	0.229	-0.029	-0.00004
	+10	2593 000 000	0.176	-0.082	-0.00011
	+30	2593 000 000	-0.056	-0.314	-0.00041
	+40	2593 000 000	0.038	-0.219	-0.00028
	+50	2593 000 000	-0.123	-0.381	-0.00049
High	+20	2593 000 001	0.547	0.290	0.00038
Low	+20	2593 000 001	0.517	0.260	0.00034