HCT CO.,LTD.
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
TEL: +82-31-645-6300 FAX: +82-31-645-6401

FCC /ISED REPORT

Certification

Applicant Name:
ADVANCED RF TECHNOLOGIES, INC

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

Date of Issue:
August 25, 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-F014
HCT FRN: 0005866421
ISED Registration No.: 5944A-5

FCC ID:	**N52-ADXV-R-37W**
IC:	**6416A-ADXVR37W**
APPLICANT:	**ADVANCED RF TECHNOLOGIES, INC**

FCC/ IC Model:	ADXV-R-37W
EUT Type:	DAS (Distributed Antenna System)
Frequency Ranges:	2 350 ~ 2 360 MHz (Downlink) / 2 305 ~ 2 315 MHz (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(s):	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 : Jong Seok Lee
Manager of Telecommunication testing center

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1708-F014	August 25, 2017	- First Approval Report

Table of Contents

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-37W
IC:	6416A-ADXVR37W
EUT Type:	DAS (Distributed Antenna System)
FCC/ IC Model(s):	ADXV-R-37W
Power Supply:	AC 100 ~ 240 V DC -48 V
Frequency Ranges:	2 350 ~ 2 360 MHz (Downlink) / 2 305 ~ 2 315 MHz (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-195
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-195

Description	Reference (FCC)	Reference (IC)	Results
Conducted RF Output Power	§2.1046, §27.50(a)	RSS-131, Section 4.1 RSS-195, Section 5.5	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(a)	RSS-195, Section 5.6	Compliant
Radiated Spurious Emissions	§2.1053, §27.53(a)	RSS-Gen, Section 7.1.2	Compliant
Frequency Stability	§2.1055, §27.54	RSS-131, Section 5.2.4 RSS-195, Section 5.4	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	Gain	± 0.89 dB
Mean Output Power and Zone Enhancer Gain	20 dB bandwidth	± 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.

(a) The following power limits and related requirements apply to stations transmitting in the 2305-2320 MHz band or the 2345-2360 MHz band.

(1) Base and fixed stations.

(i) For base and fixed stations transmitting in the 2305-2315 MHz band or the 2350-2360 MHz band:

(A) The average equivalent isotropically radiated power (EIRP) must not exceed 2,000 watts within any 5 megahertz of authorized bandwidth and must not exceed 400 watts within any 1 megahertz of authorized bandwidth.

(B) The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB. The PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that PAPR will not exceed 13 dB for more than 0.1 percent of the time or other Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

IC Rules

Test Requirements:

RSS-195

5. Transmitter and Receiver Standard Specifications

5.5 Transmitter Output Power and Equivalent Isotropically Radiated Power

The equivalent isotropically radiated power (e.i.r.p.) of base and fixed station equipment shall comply with the e.i.r.p. limit in SRSP-516.

The e.i.r.p. of fixed subscriber equipment shall not exceed 20 W/5 MHz.

The e.i.r.p. of mobile or portable equipment transmitting in the band 2305-2315 MHz or the band 2350-2360 MHz, employing 3GPP LTE (Third Generation Partnership Project Long Term Evolution) standards, shall not exceed 250 mW within any 5 MHz bandwidth. For other technologies, the e.i.r.p. shall not exceed 50 mW within any 1 MHz bandwidth.

5.5.1 Peak to Average Power Ratio (PAPR) for Base and Fixed Station Equipment in the Frequency Ranges 2305-2315 MHz and 2350-2360 MHz

The PAPR of the transmitter output power of base and fixed station equipment shall not exceed 13 dB for more than 0.1% of the time, using a signal that corresponds to the highest PAPR during periods of continuous transmission.

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 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 and record the output power of the EUT; use 3.5.3 or 3.5.4 for power measurement.

g) Remove the EUT from the measurement setup. Using the same signal generator settings, repeat the power measurement at the signal generator port, which was used as the input signal to the EUT, and record as the input power. EUT gain may be calculated as described in 3.5.5.

h) Repeat steps f) and g) with input signal amplitude set to 3 dB above the AGC threshold level.

i) Repeat steps e) to h) with the narrowband test signal.

j) Repeat steps e) to i) for all frequency bands authorized for use by the EUT.

RSS-131

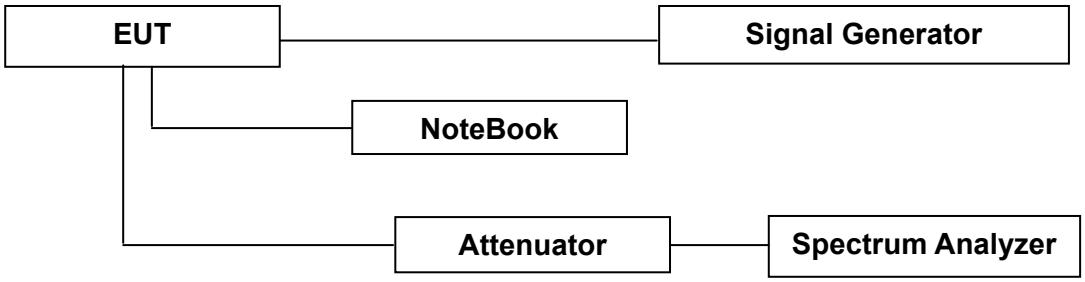
4. Measurement Methods

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 (dB)	
	DL	UL	DL	UL
WCS	-21 dBm	-45 dBm	58 dB	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)
WCS Band_ LTE 5 MHz AGC threshold	Low	2352.50	37.00	5.012
	Middle	2355.00	37.02	5.035
	High	2357.50	37.05	5.070
WCS Band_ LTE 5 MHz +3dBm above the AGC threshold	Low	2352.50	37.24	5.297
	Middle	2355.00	37.18	5.224
	High	2357.50	36.74	4.721

[Uplink]

	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
WCS Band_ LTE 5 MHz AGC threshold	Low	2307.50	4.19	0.003
	Middle	2310.00	4.20	0.003
	High	2312.50	4.16	0.003
WCS Band_ LTE 5 MHz +3dBm above the AGC threshold	Low	2307.50	4.04	0.003
	Middle	2310.00	4.17	0.003
	High	2312.50	4.26	0.003

Peak-to-Average Power Ratio

[Downlink]

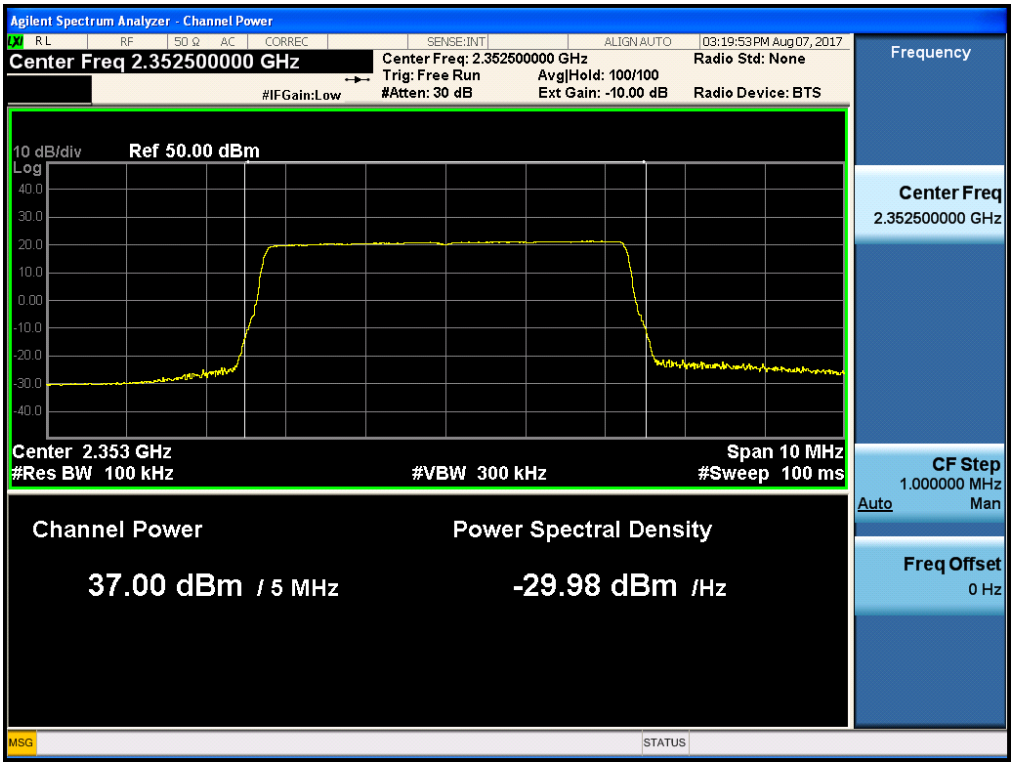
	Channel	Frequency (MHz)	PAPR (dB)
LTE 5 MHz	Low	2352.5	8.19
LTE 5 MHz	Middle	2355.0	8.17
LTE 5 MHz	High	2357.5	8.22

[Uplink]

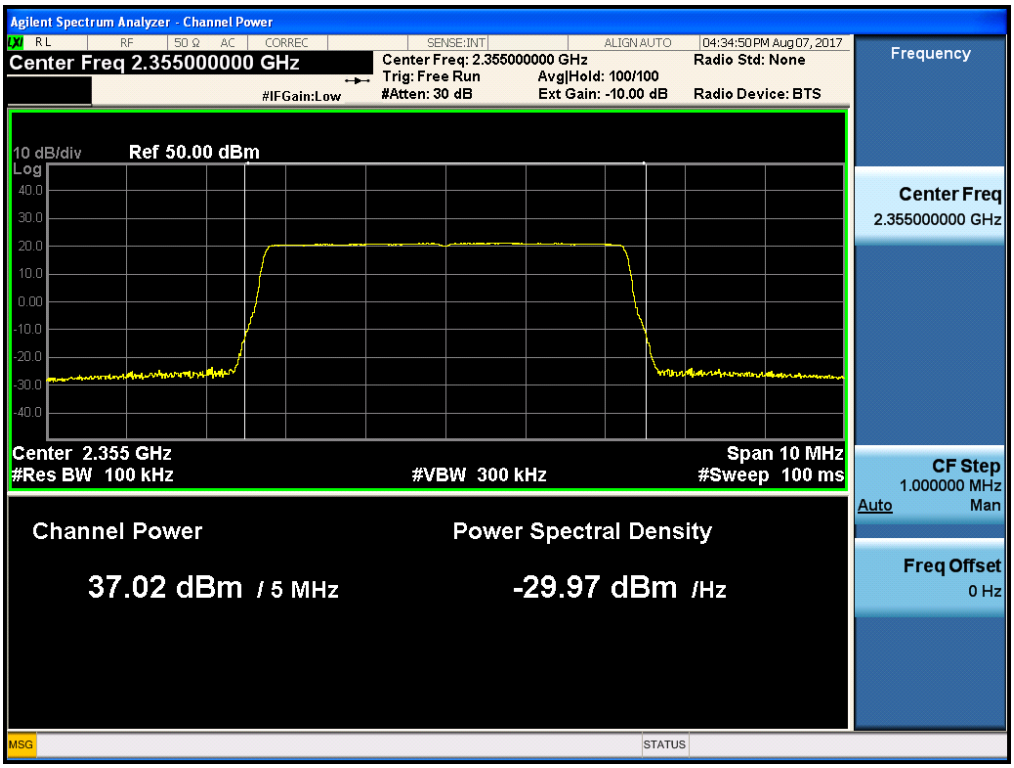
	Channel	Frequency (MHz)	PAPR (dB)
LTE 5 MHz	Low	2307.5	8.30
LTE 5 MHz	Middle	2310.0	8.31
LTE 5 MHz	High	2312.5	8.30

RF Output Power for WCS Band LTE 5 MHz

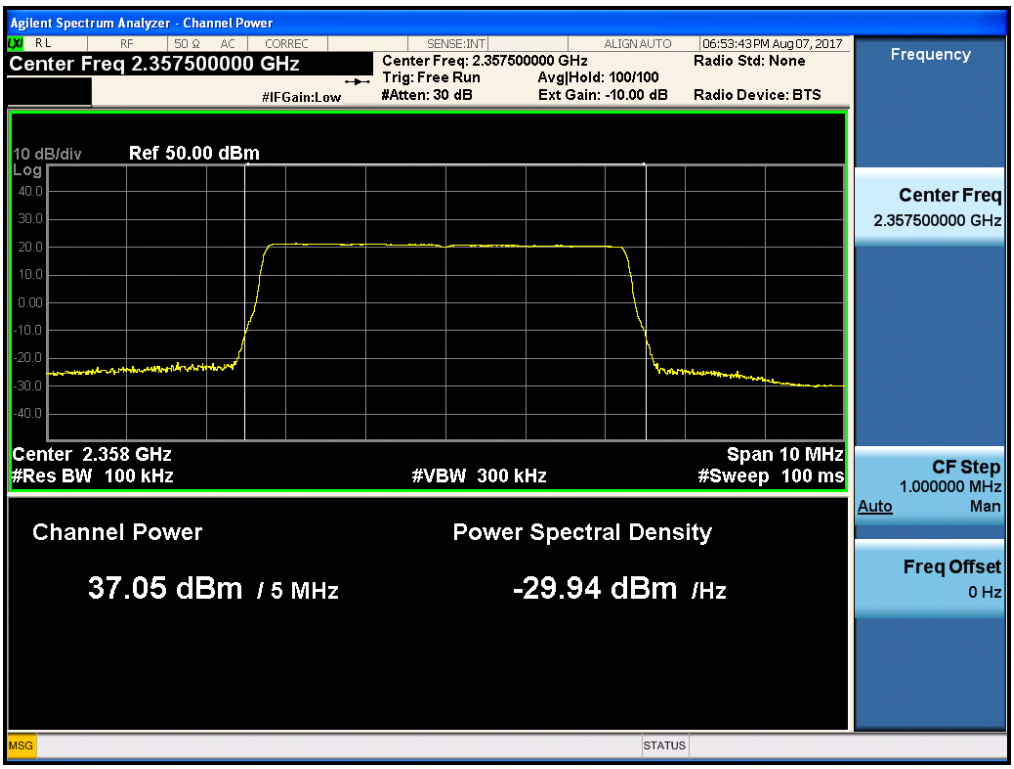
[AGC threshold Downlink Low]



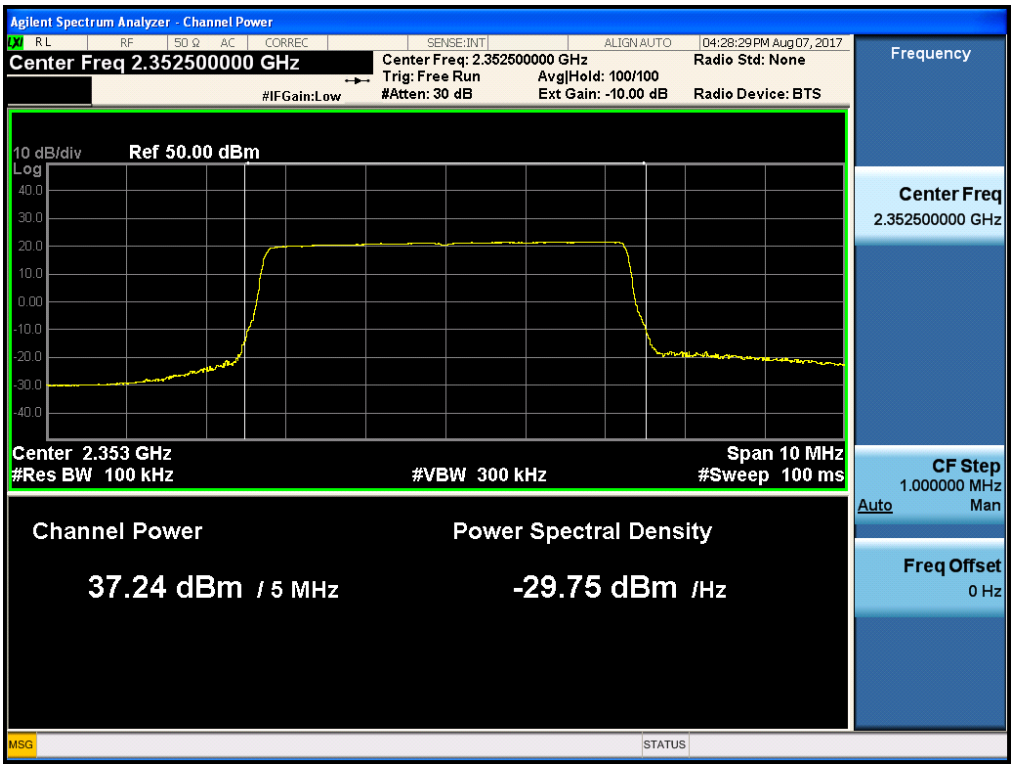
[AGC threshold Downlink Middle]



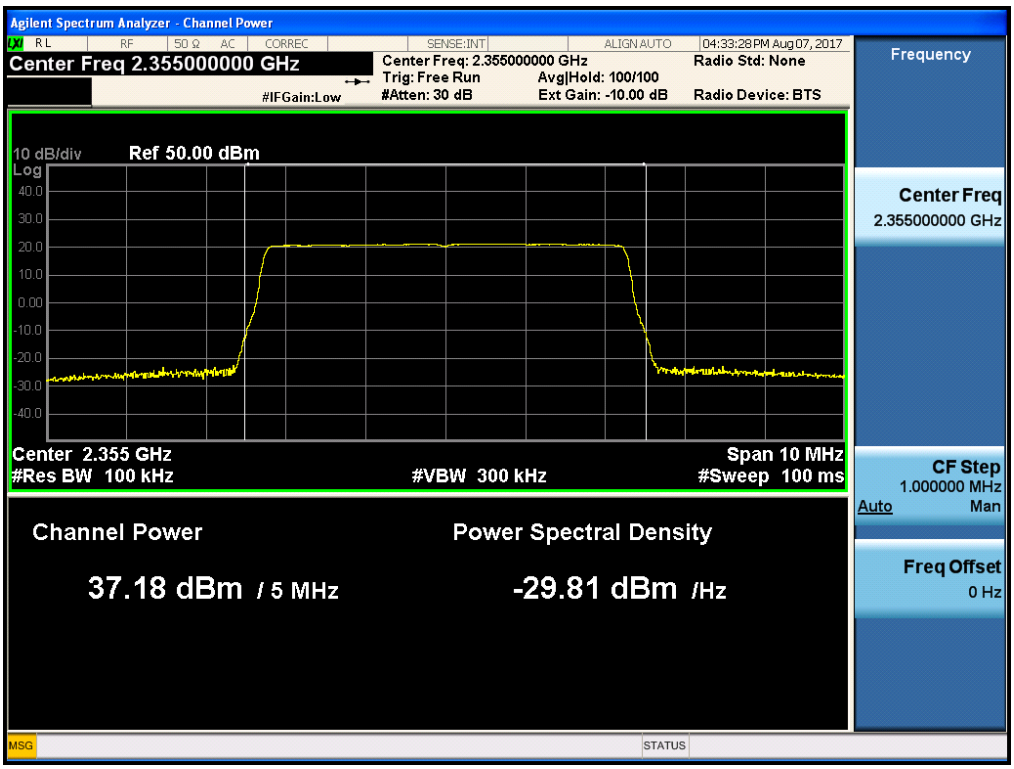
[AGC threshold Downlink High]



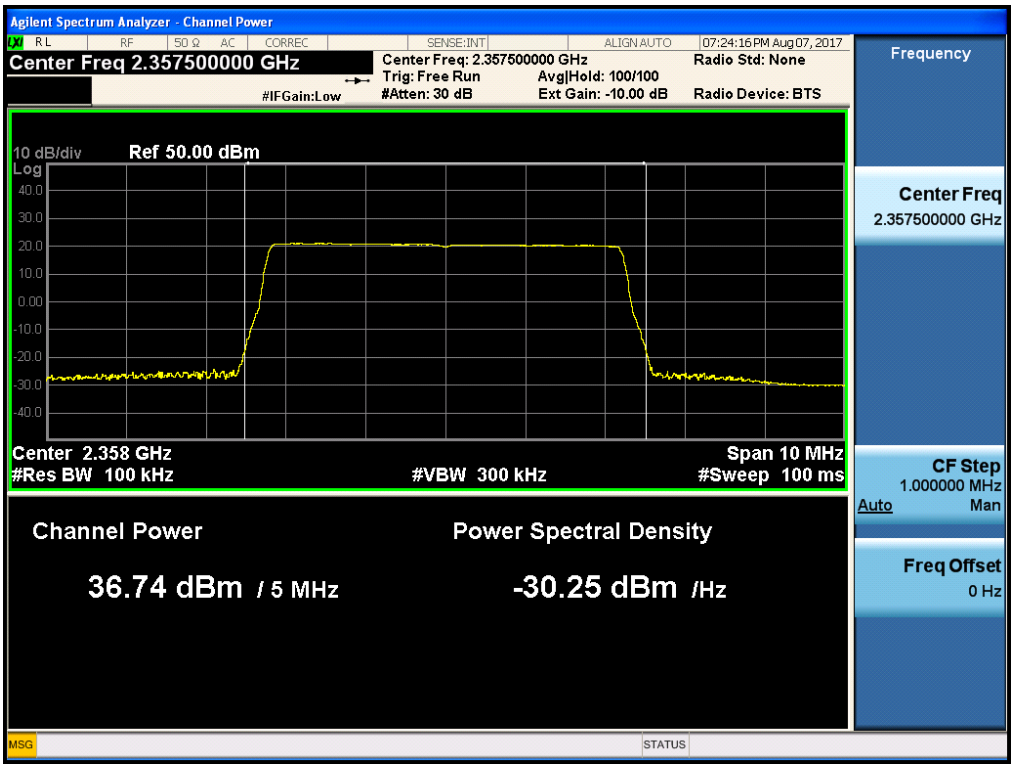
[+3dBm above AGC threshold Downlink Low]



[+3dBm above AGC threshold Downlink Middle]

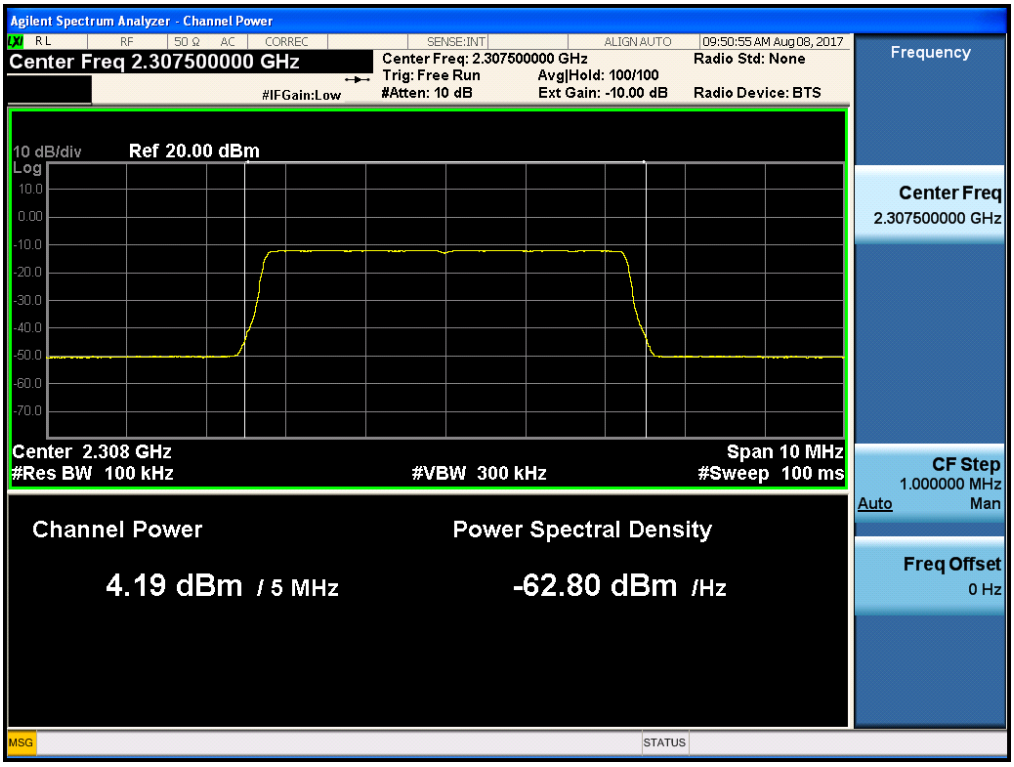


[+3dBm above AGC threshold Downlink High]



RF Output Power for WCS Band LTE 5 MHz

[AGC threshold Uplink Low]



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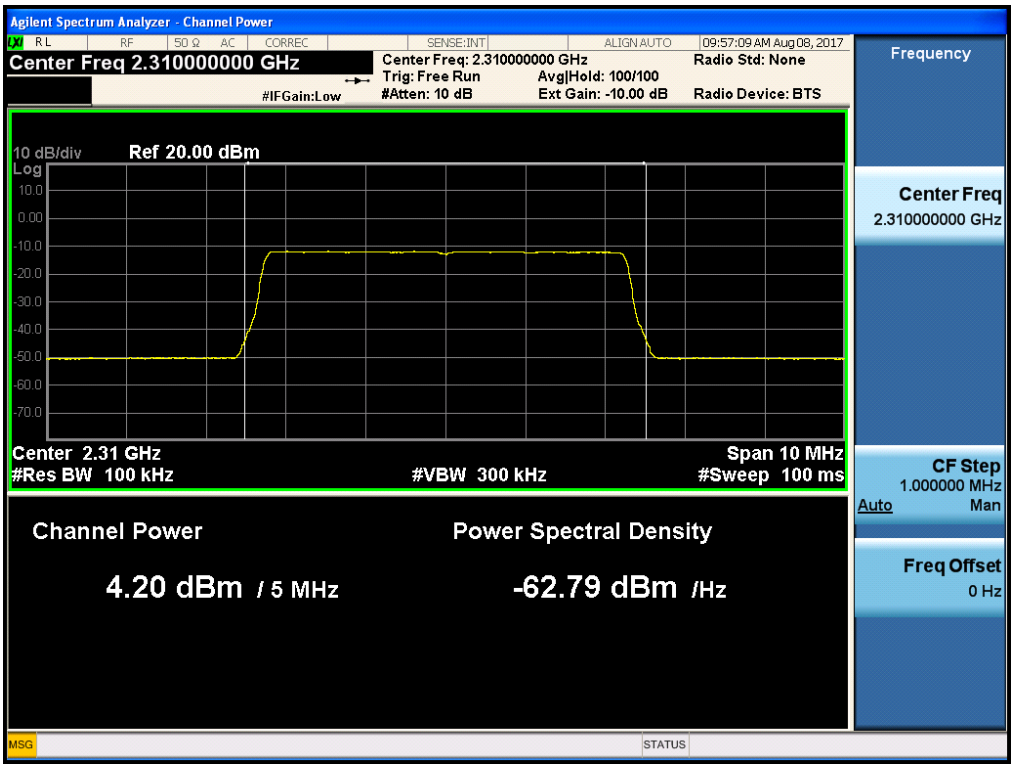

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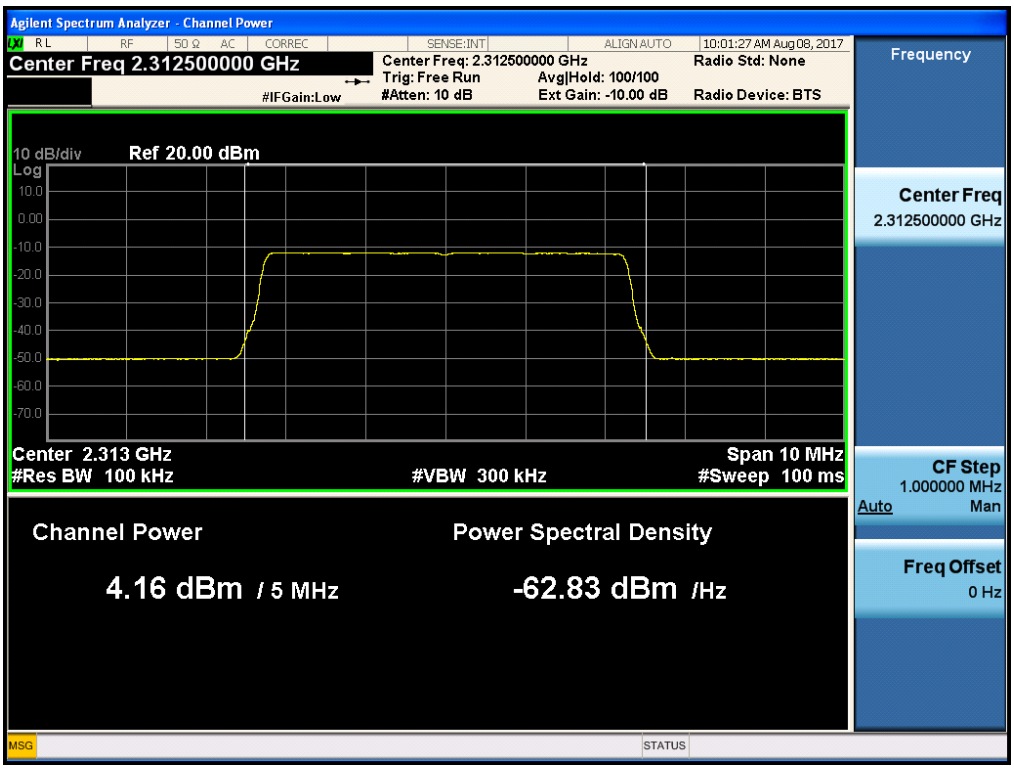
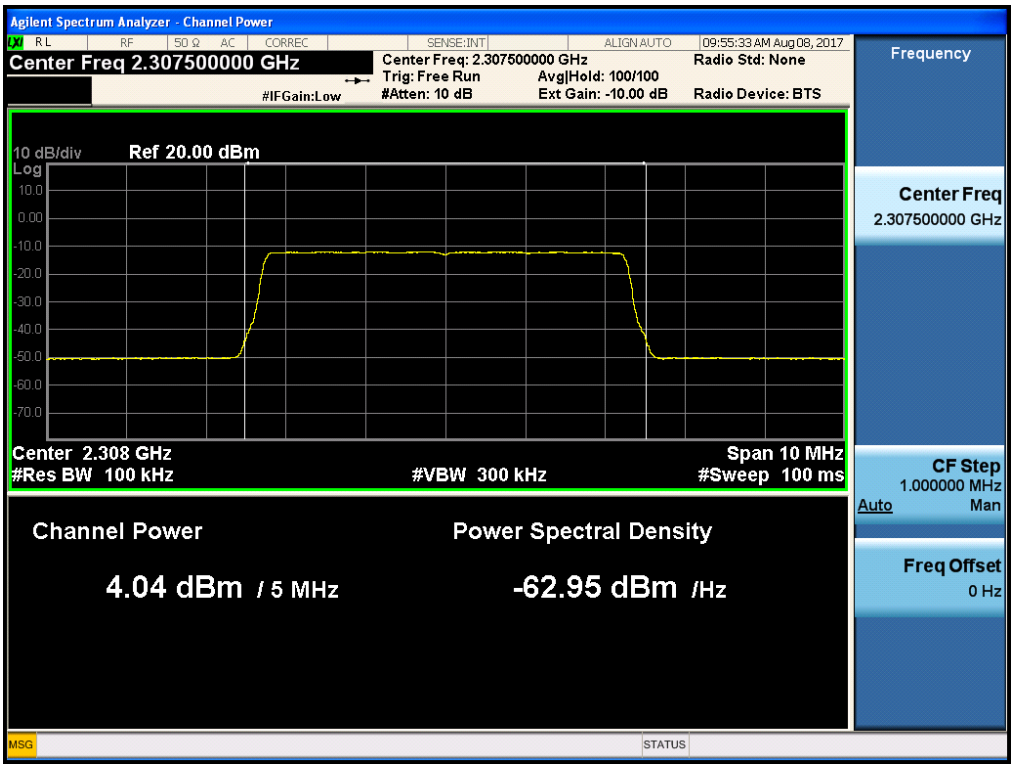
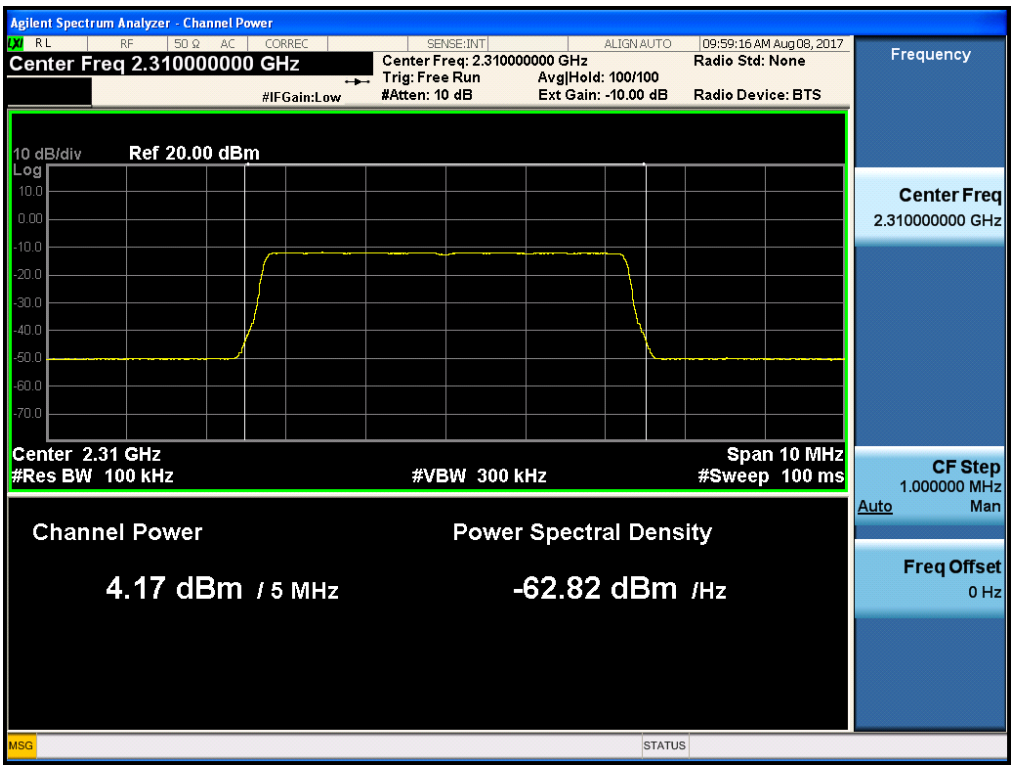


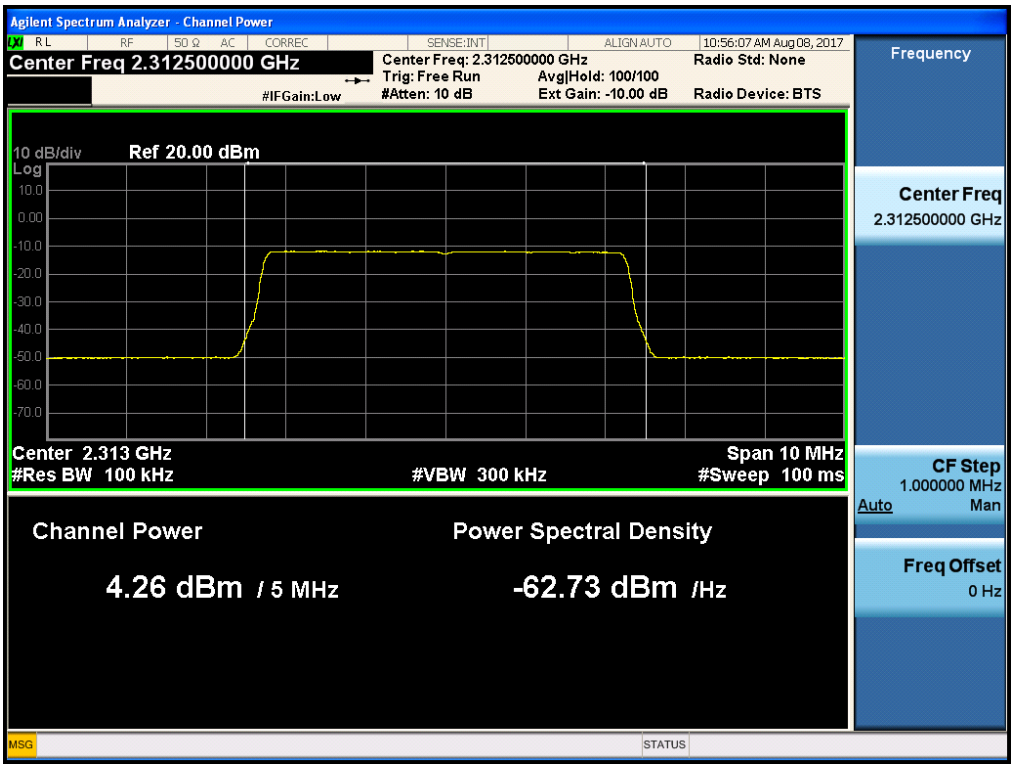
[+3dBm above AGC threshold Uplink Low]



[+3dBm above AGC threshold Uplink Middle]

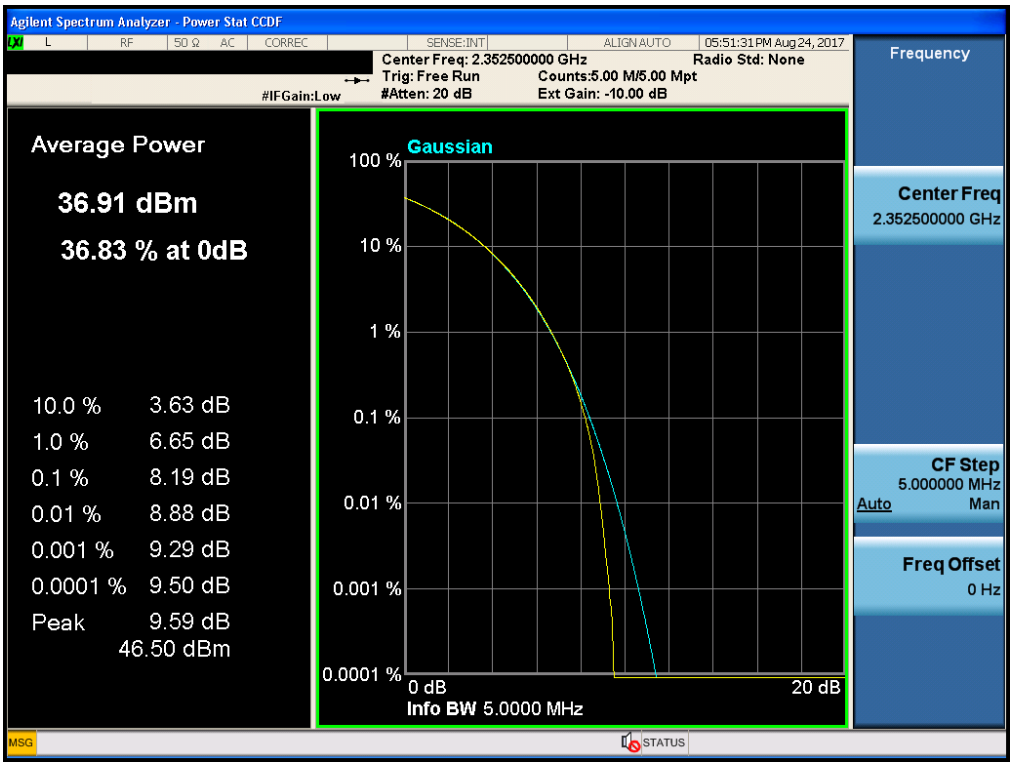


[+3dBm above AGC threshold Uplink High]



PAPR for WCS Band LTE 5 MHz

[Downlink Low]



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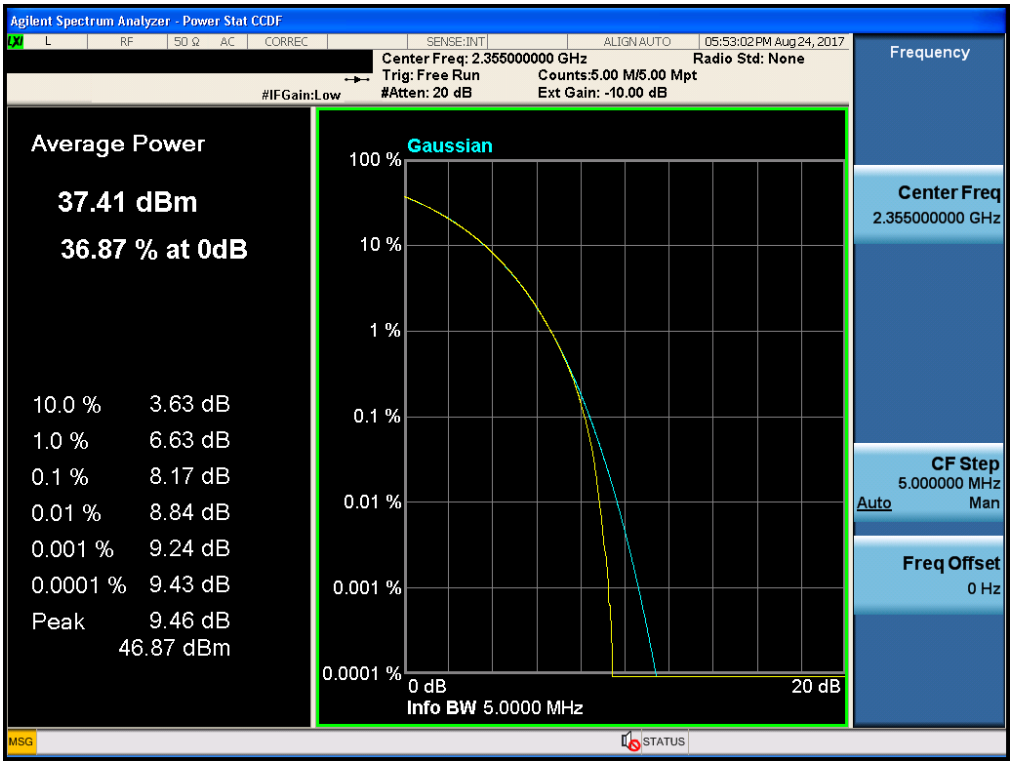

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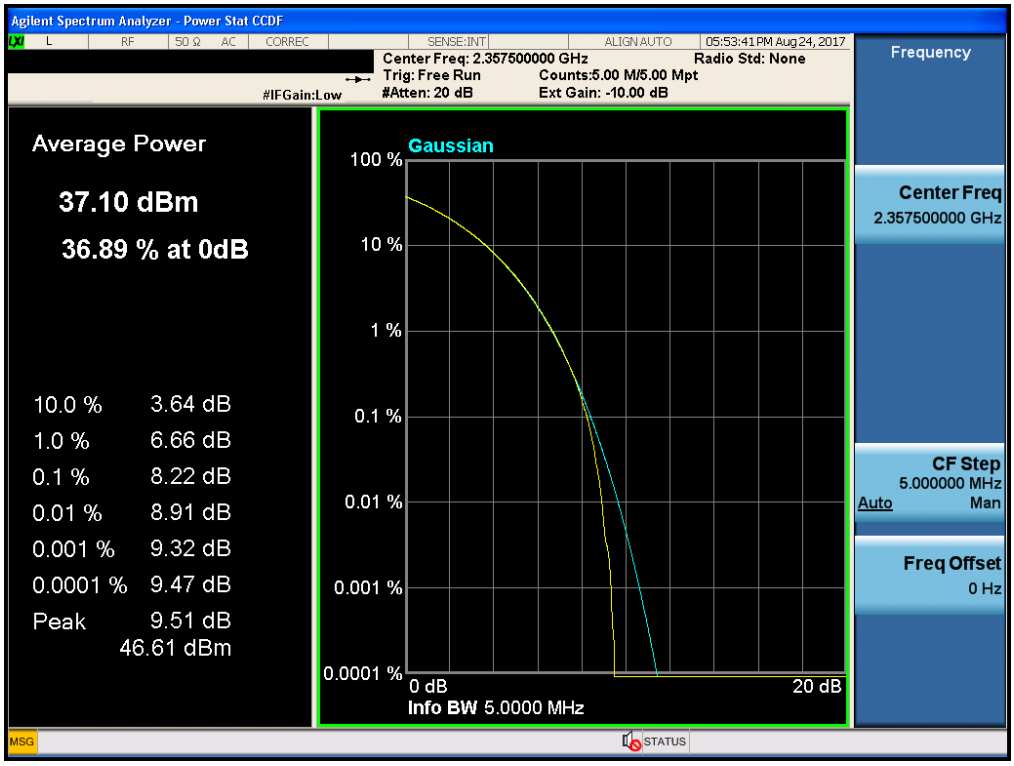

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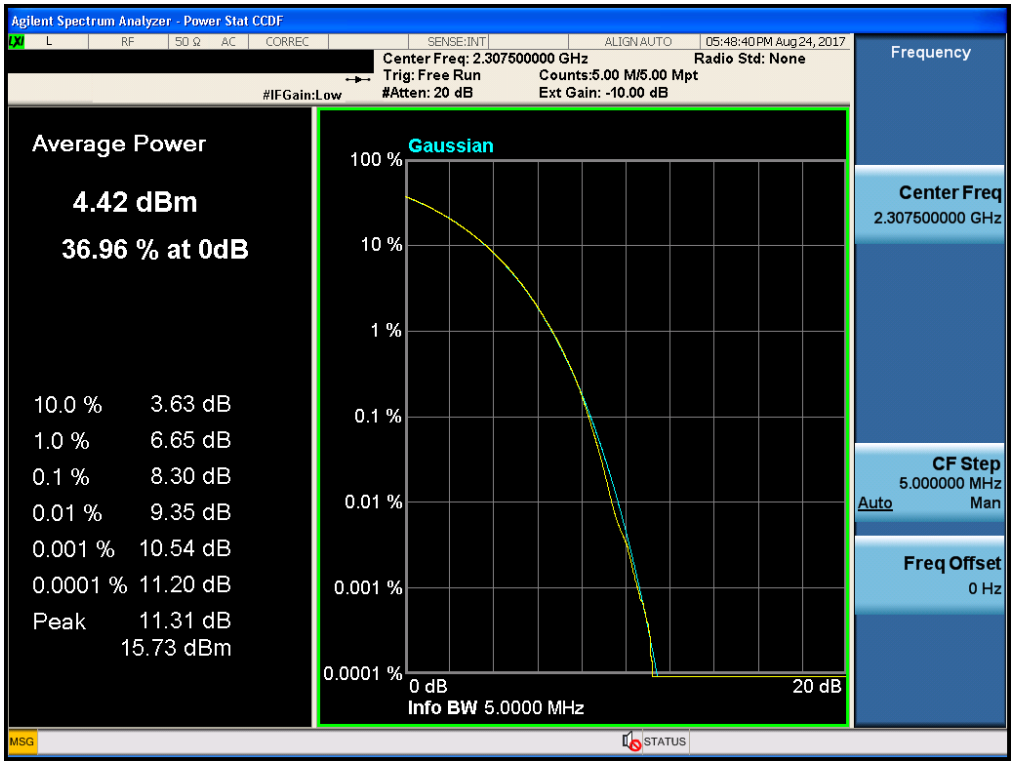

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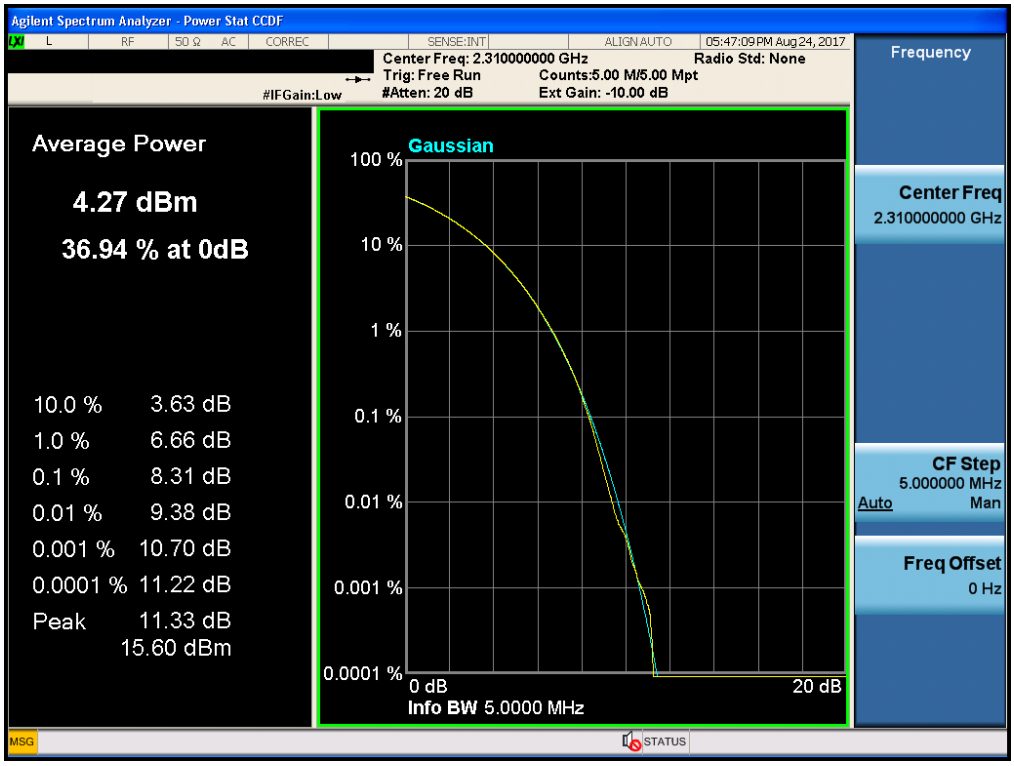

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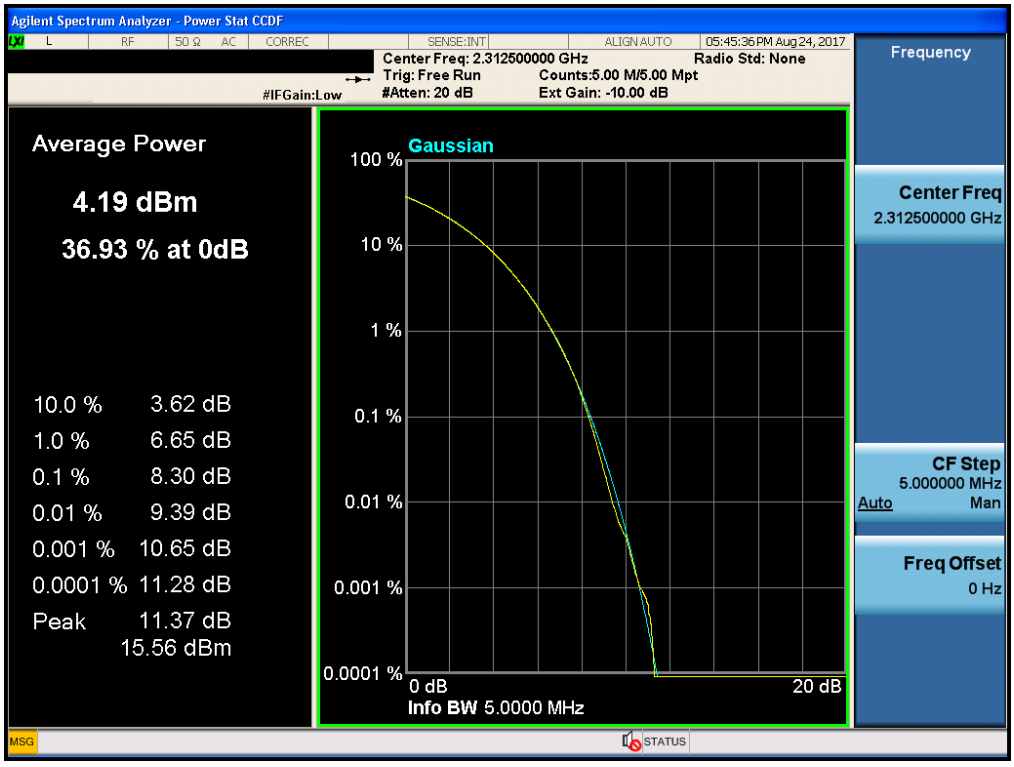


7. OCCUPIED BANDWIDTH

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 $\geq$ 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_2300_WCS BAND]

	Channel	Frequency (MHz)	OBW (MHz)
WCS Band_ LTE 5 MHz AGC threshold	Low	2352.50	4.5097
	Middle	2355.00	4.5113
	High	2357.50	4.5194
WCS Band_ LTE 5 MHz +3dBm above the AGC threshold	Low	2352.50	4.5140
	Middle	2355.00	4.5134
	High	2357.50	4.4259

[Downlink Input_2300_WCS BAND]

	Channel	Frequency (MHz)	OBW (MHz)
WCS Band_ LTE 5 MHz AGC threshold	Low	2352.50	4.5217
	Middle	2355.00	4.5231
	High	2357.50	4.5212

[Uplink Output_2300_WCS BAND]

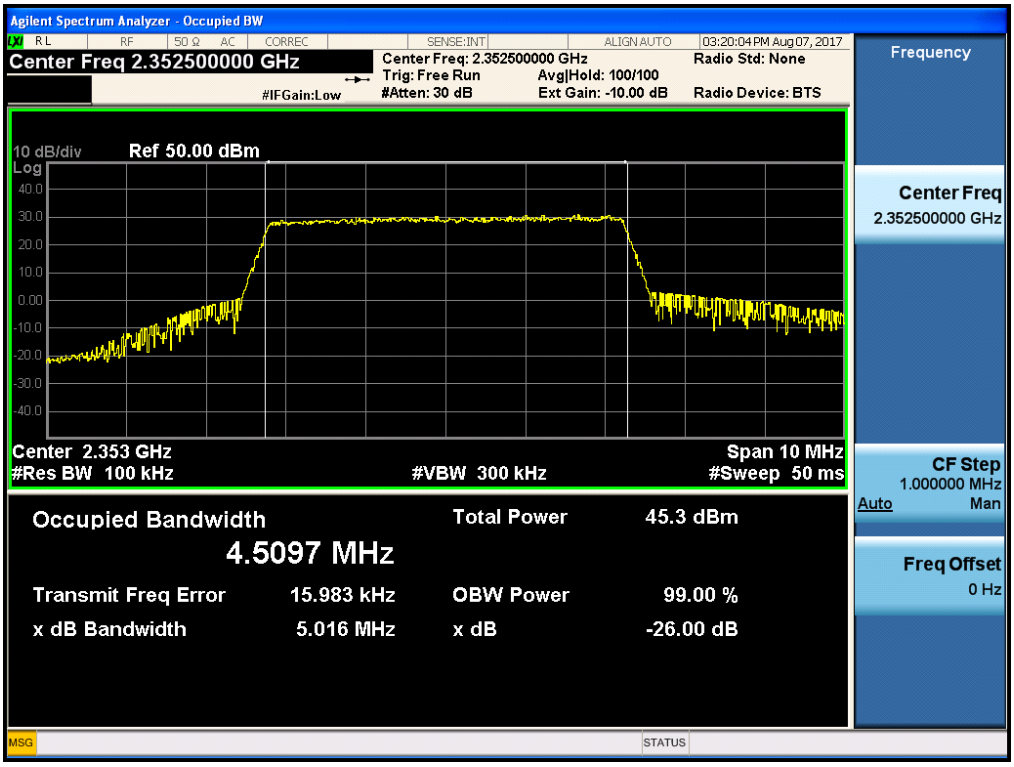
	Channel	Frequency (MHz)	OBW (MHz)
WCS Band_ LTE 5 MHz AGC threshold	Low	2307.50	4.5136
	Middle	2310.00	4.5184
	High	2312.50	4.5118
WCS Band_ LTE 5 MHz +3dBm above the AGC threshold	Low	2307.50	4.5142
	Middle	2310.00	4.5146
	High	2312.50	4.5100

[Uplink Input_2300_WCS BAND]

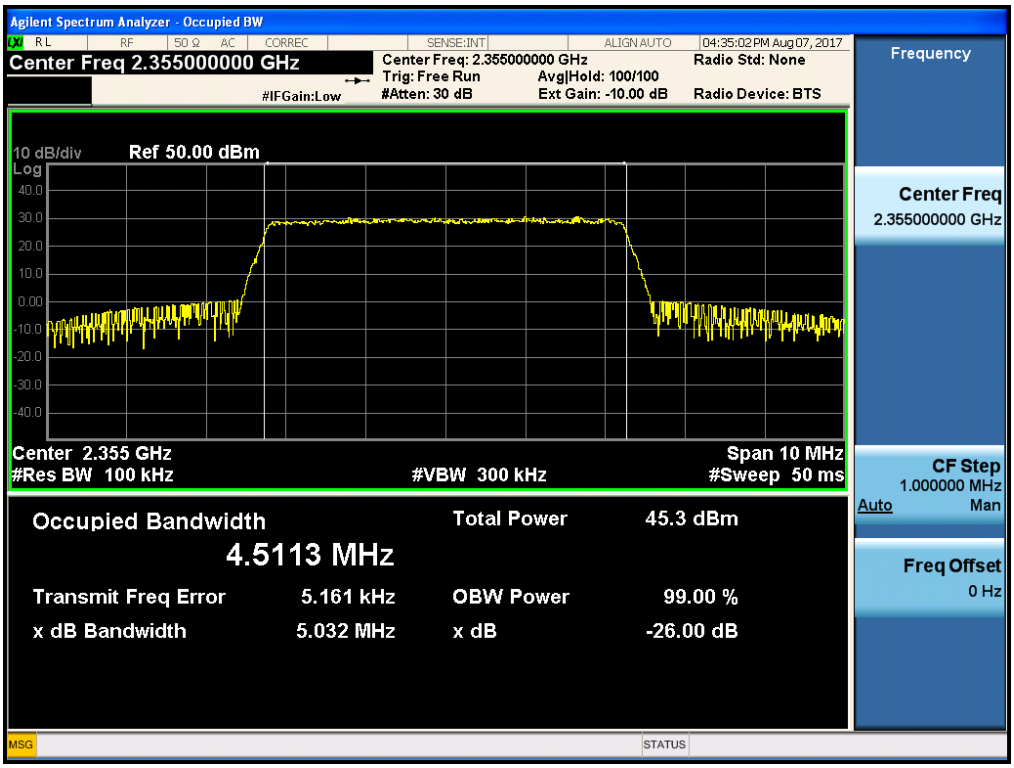
	Channel	Frequency (MHz)	OBW (MHz)
WCS Band_ LTE 5 MHz AGC threshold	Low	2307.50	4.5180
	Middle	2310.00	4.5221
	High	2312.50	4.5220

Occupied Bandwidth_WCS BAND LTE 5 MHz_Output

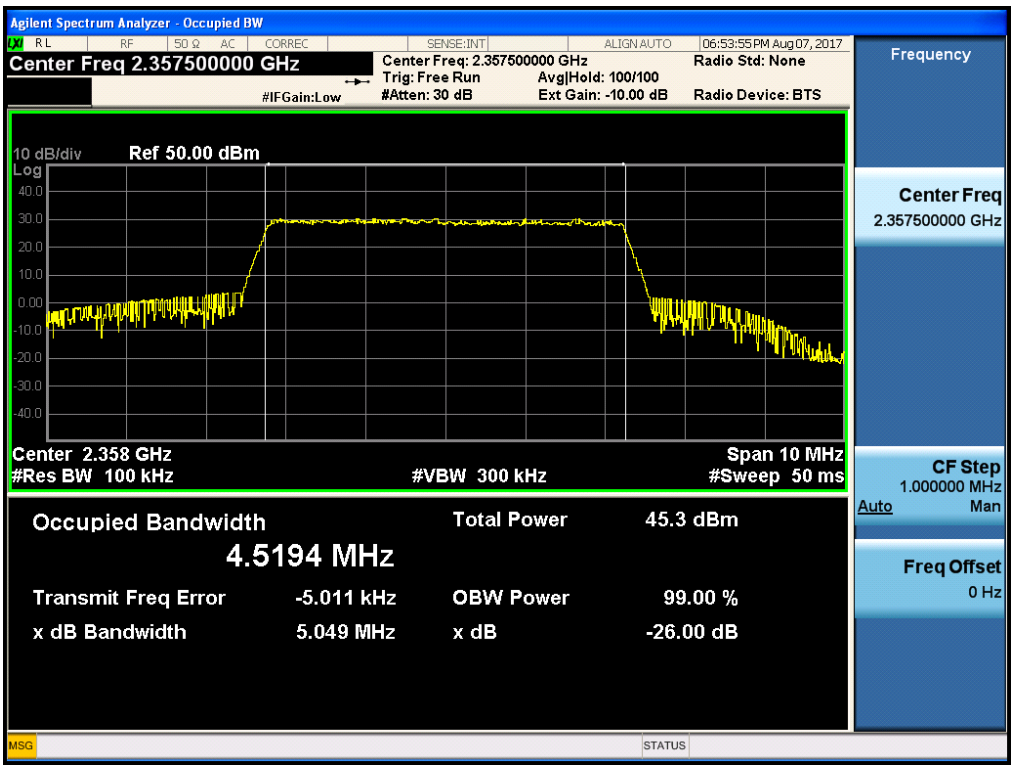
[AGC threshold Output Downlink Low]



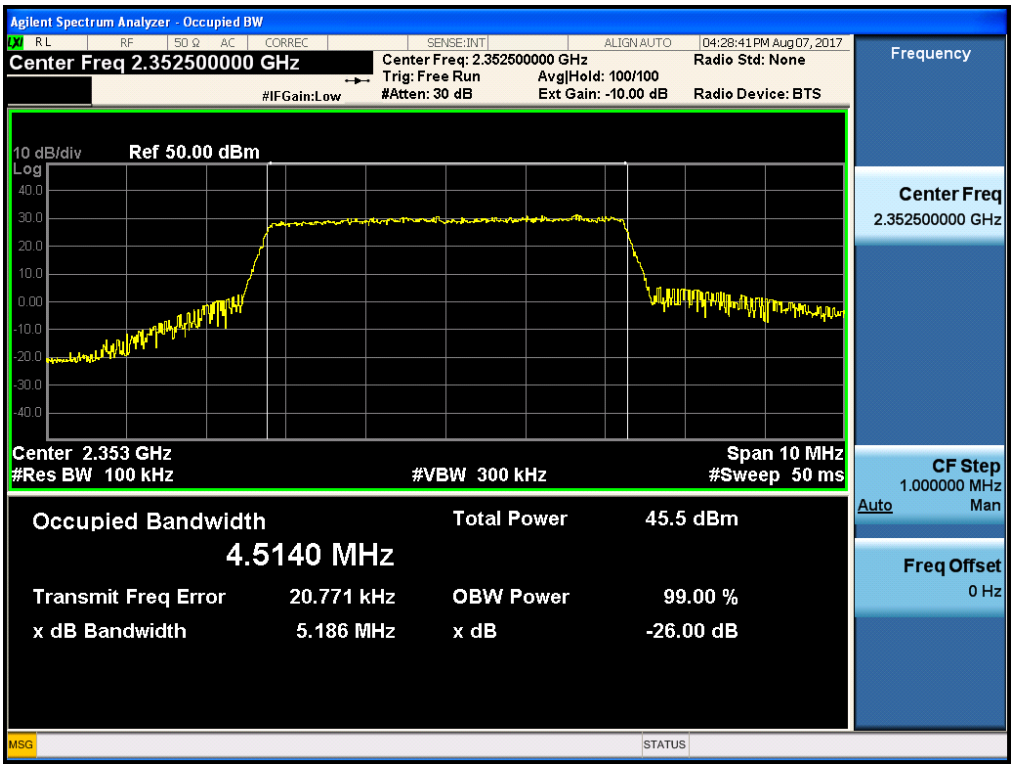
[AGC threshold Output Downlink Middle]



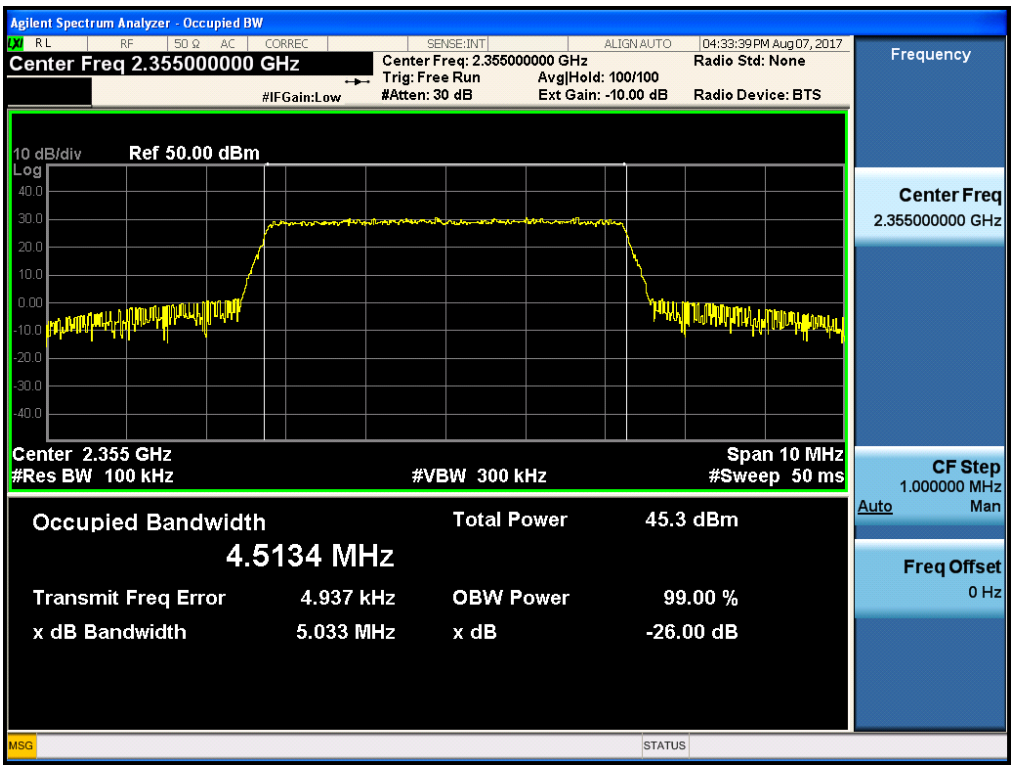
[AGC threshold Output Downlink High]



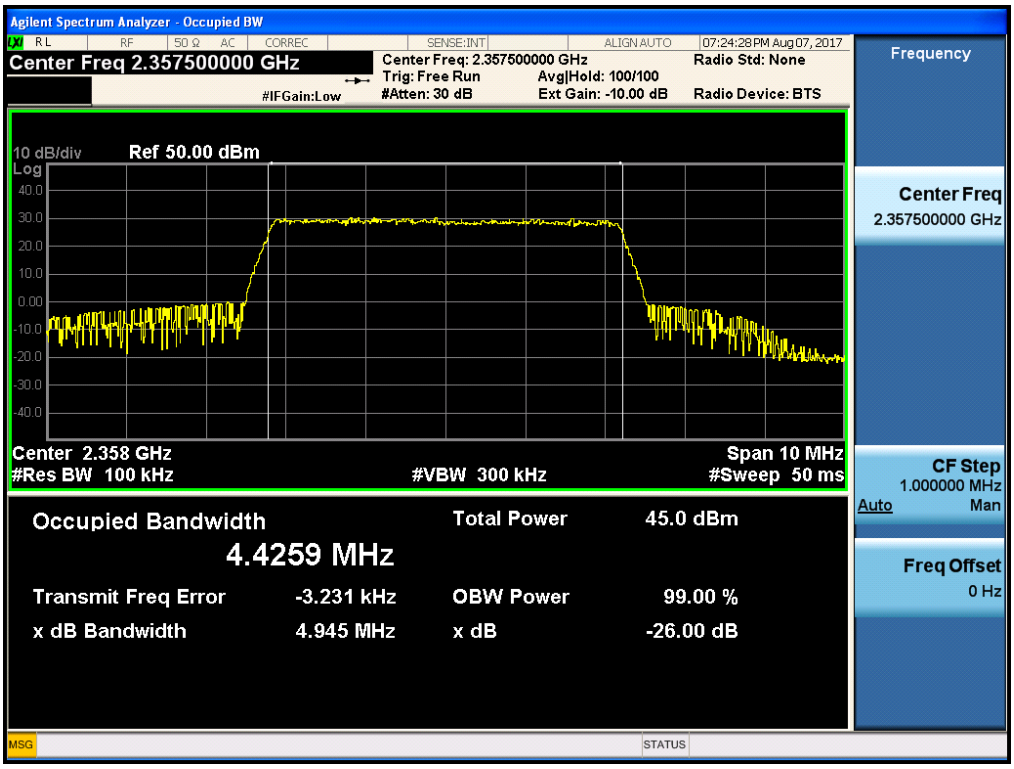
[+3dBmabove AGC threshold Output Downlink Low]



[+3dBm above AGC threshold Output Downlink Middle]

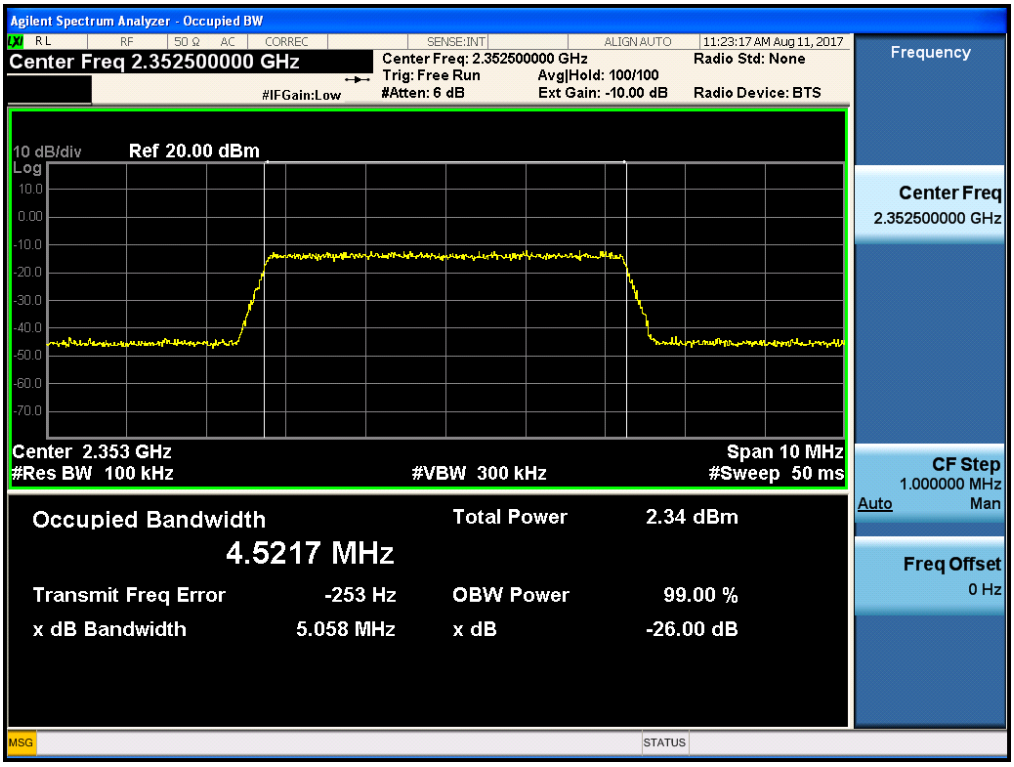


[+3dBm above AGC threshold Output Downlink High]

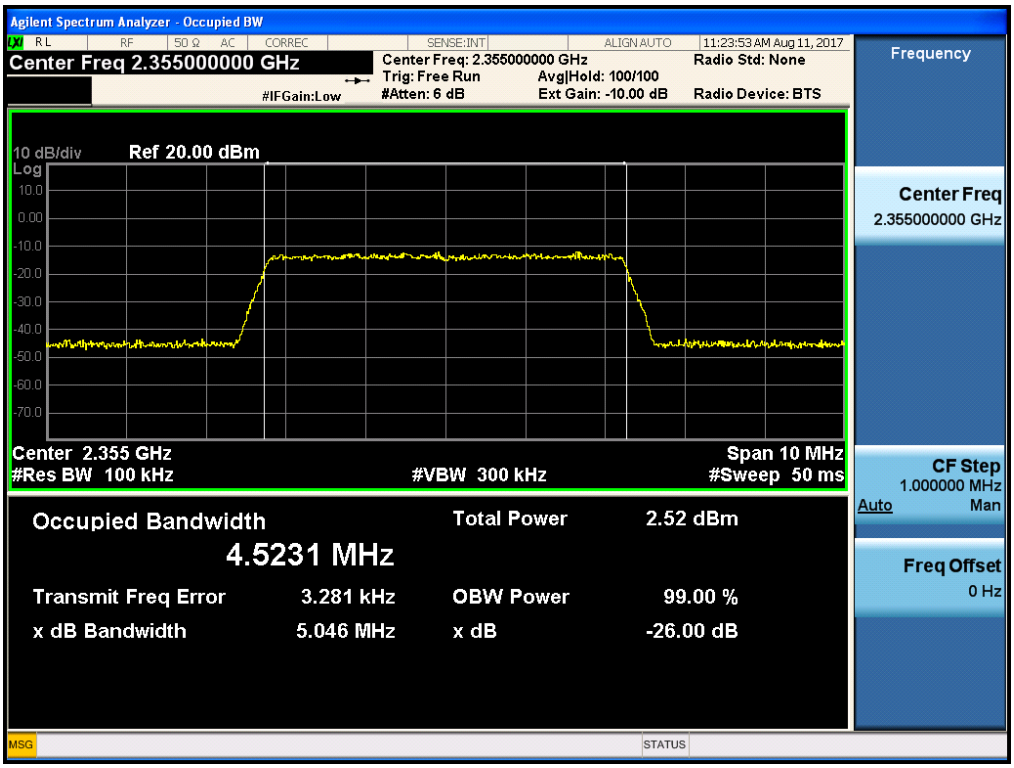


Occupied Bandwidth_WCS BAND LTE 5 MHz_ Input

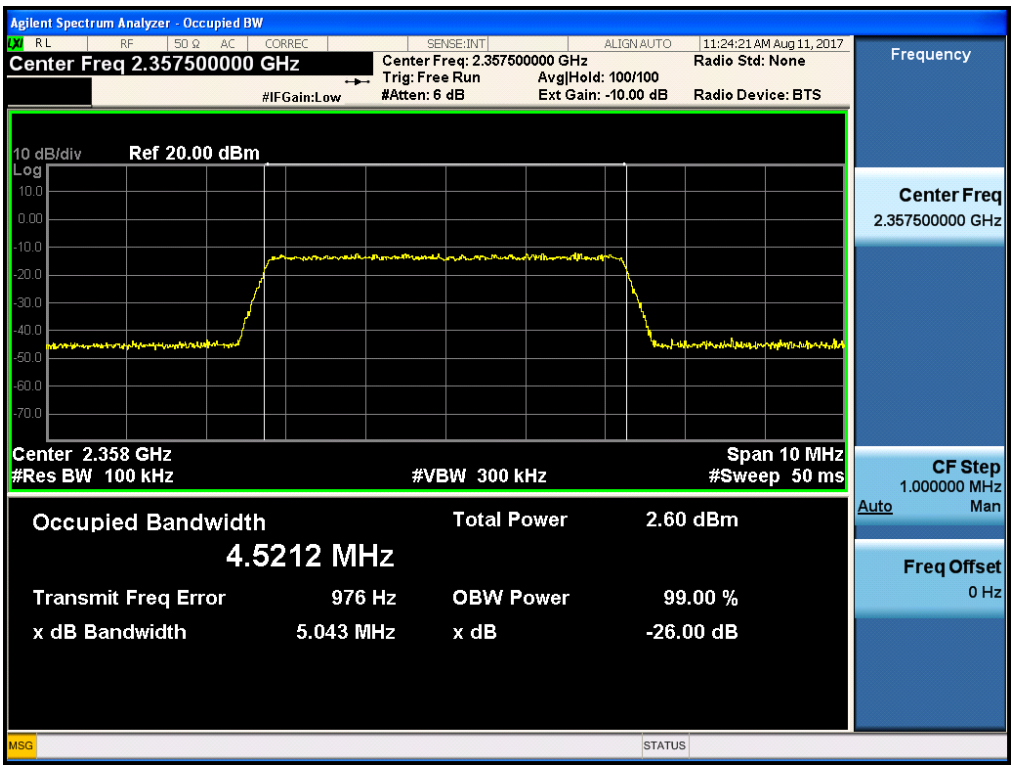
[AGC threshold Input Downlink Low]



[AGC threshold Input Downlink Middle]

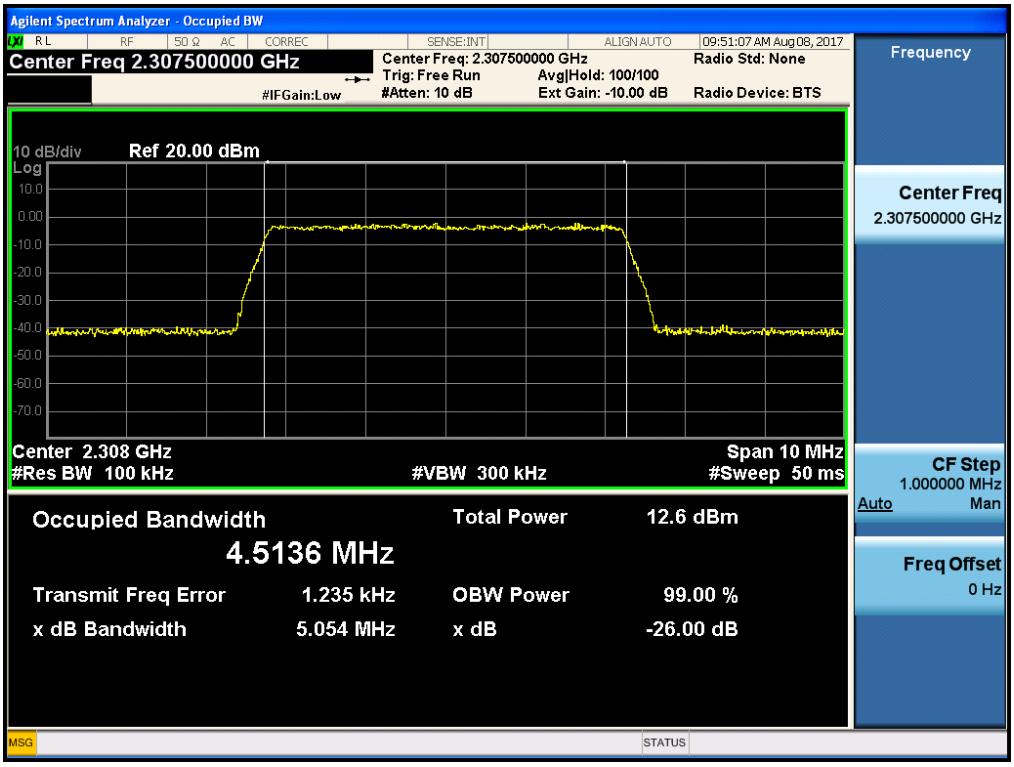


[AGC threshold Input Downlink High]

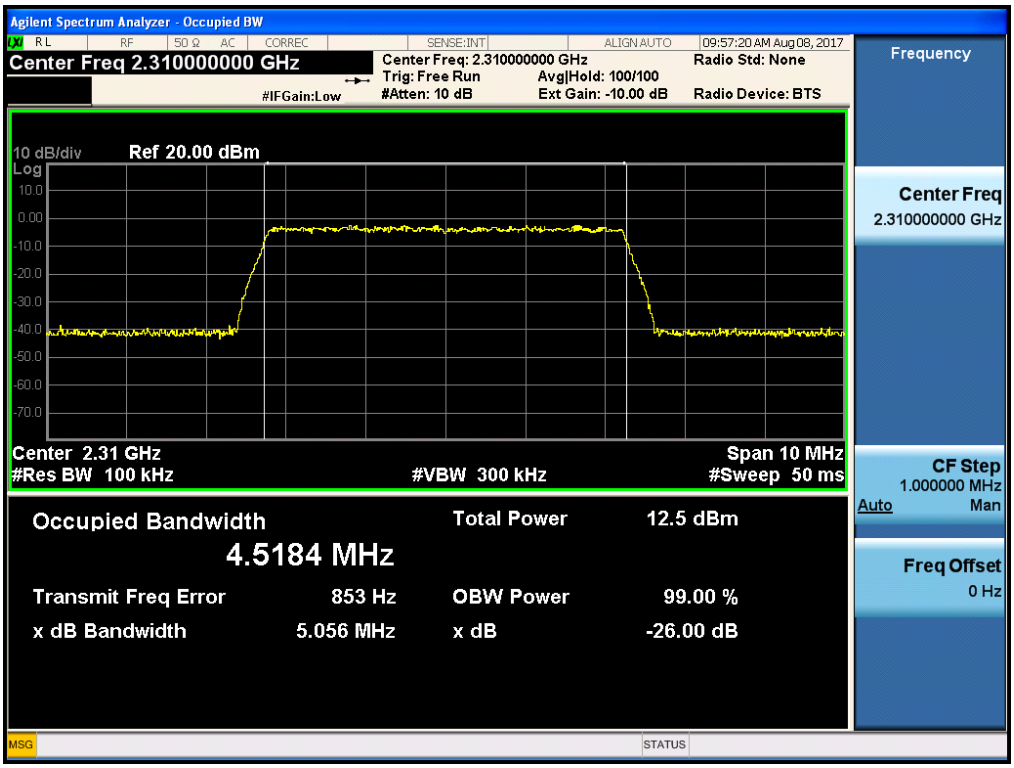


Occupied Bandwidth_WCS BAND LTE 5 MHz_Output

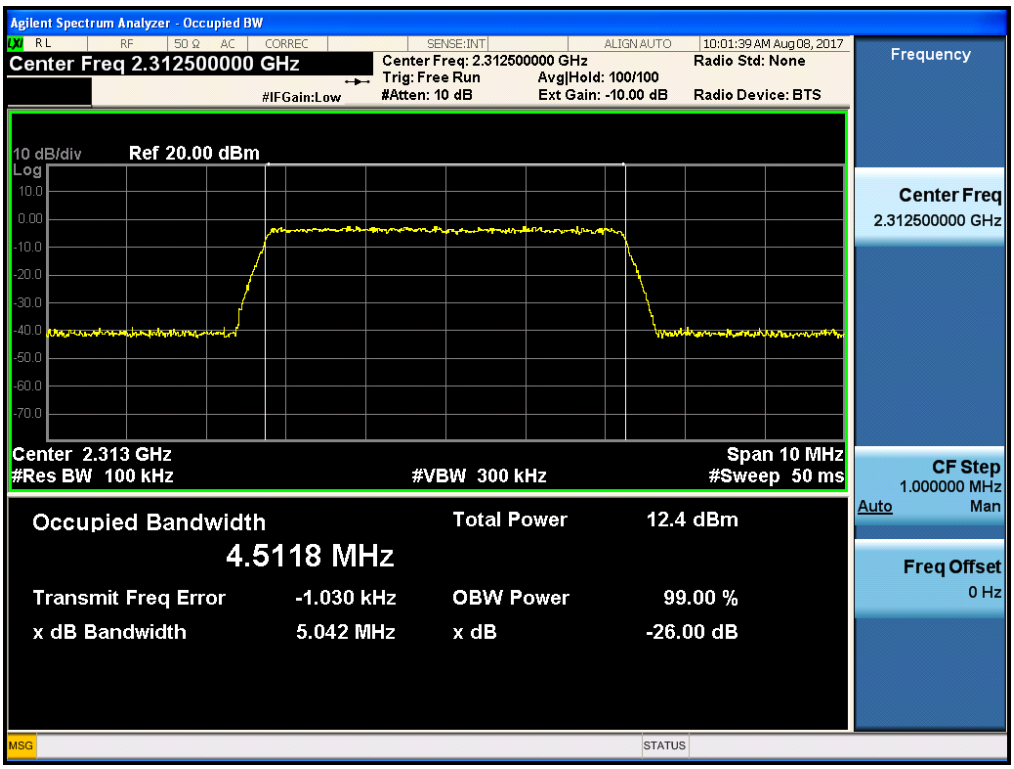
[AGC threshold Output Uplink Low]



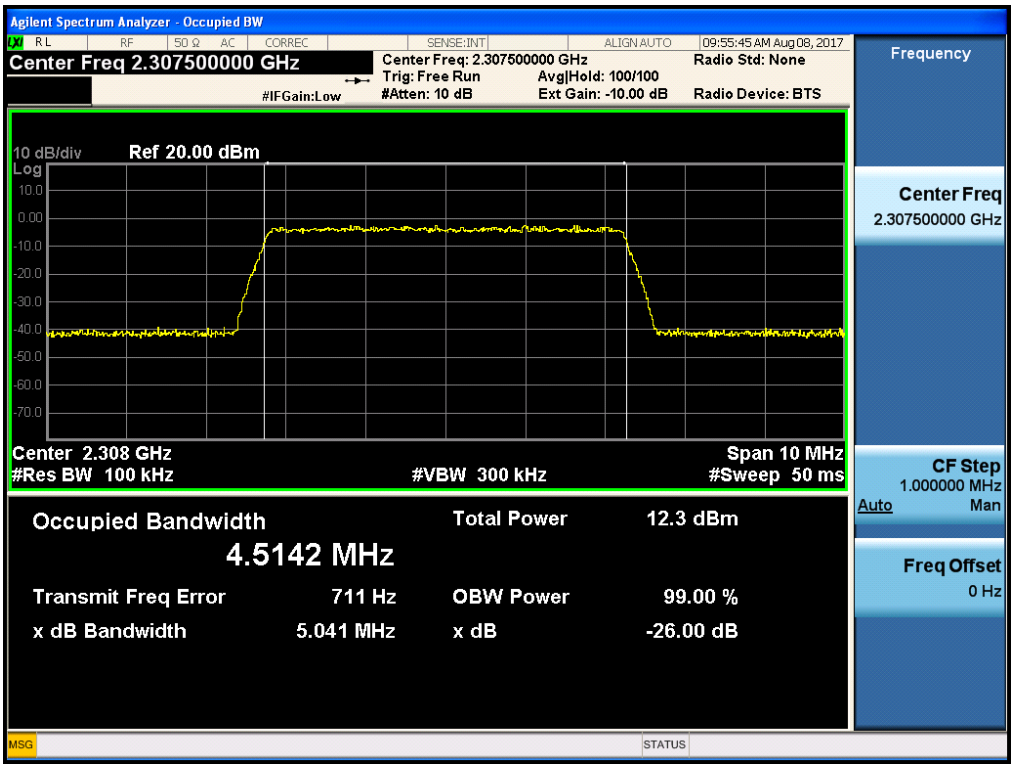
[AGC threshold Output Uplink Middle]



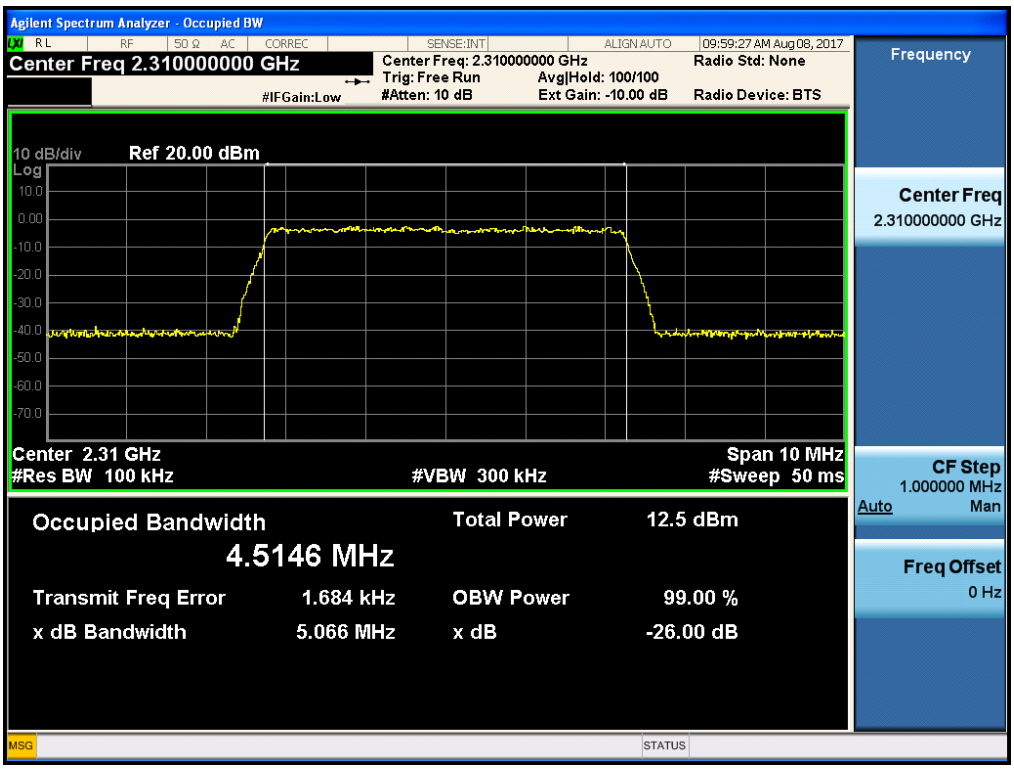
[AGC threshold Output Uplink High]



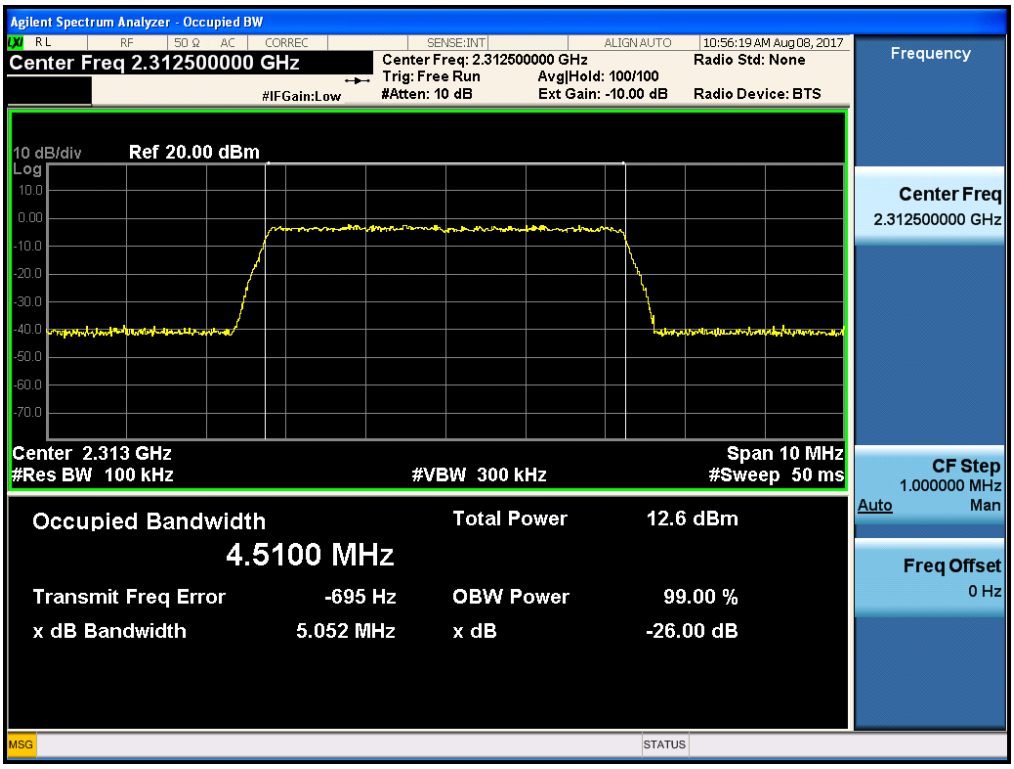
[+3dBmabove AGC threshold Output Uplink Low]



[+3dBm above AGC threshold Output Uplink Middle]

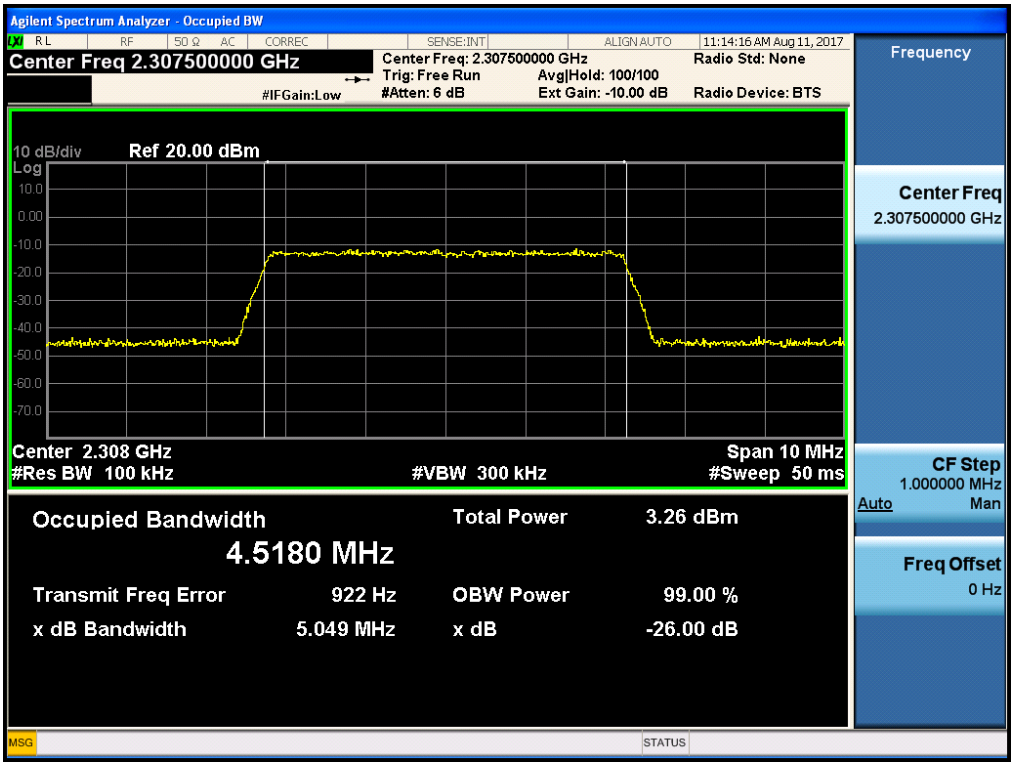


[+3dBm above AGC threshold Output Uplink High]

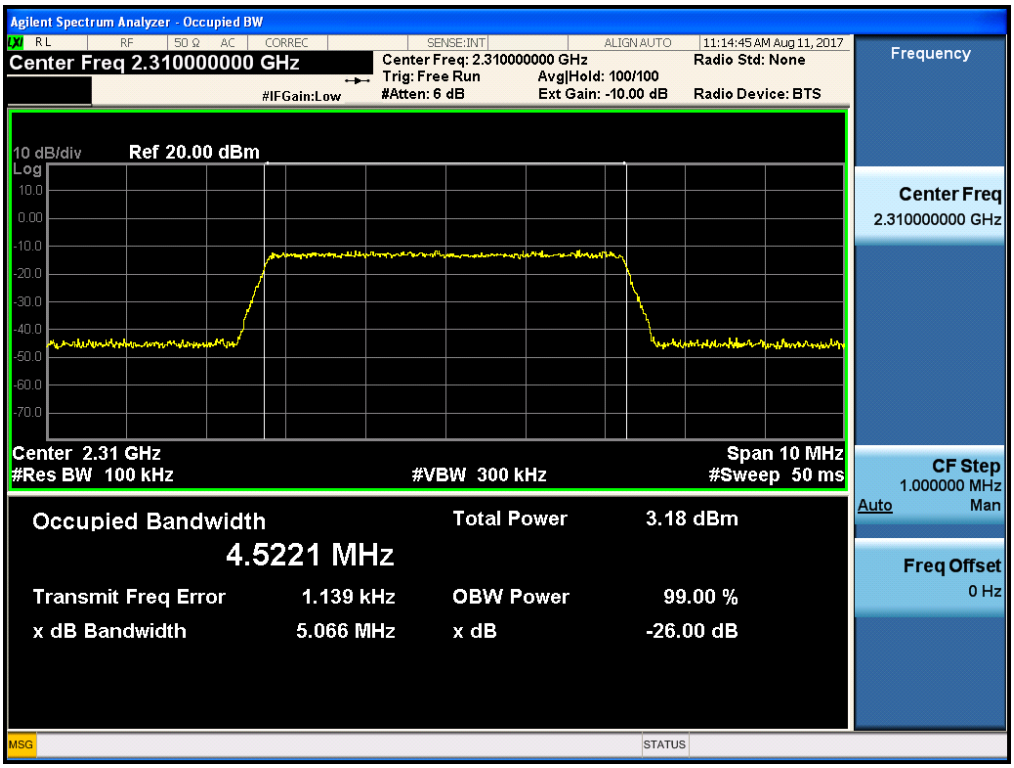


Occupied Bandwidth_WCS BAND LTE 5 MHz_Input

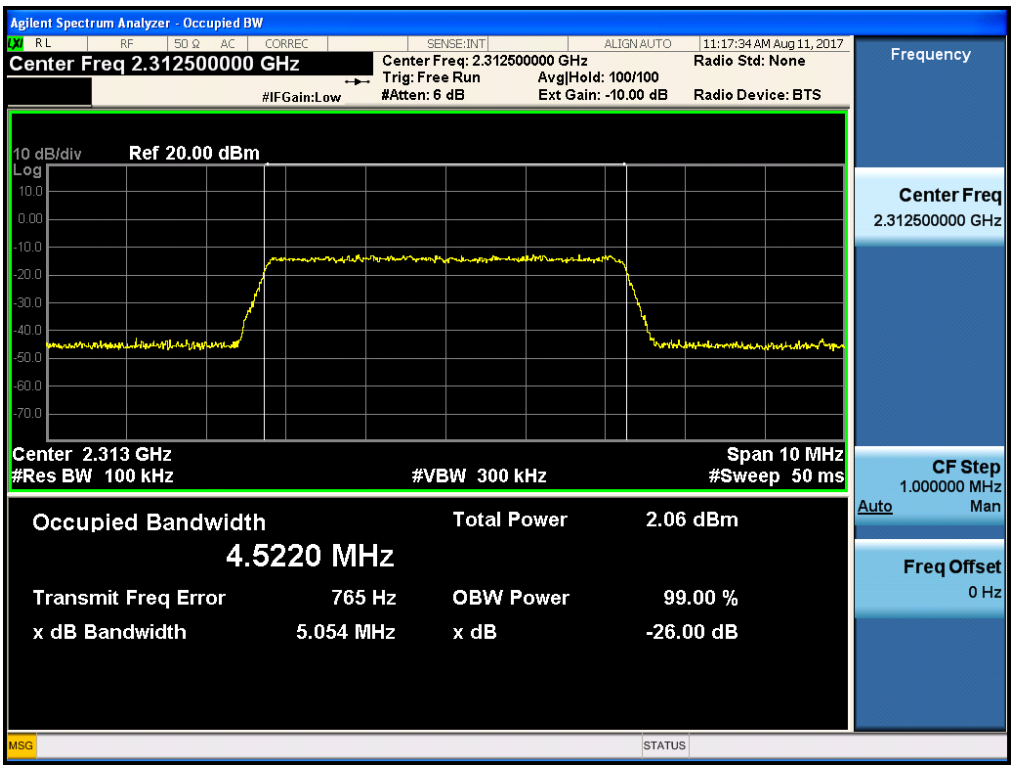
[AGC threshold Input Uplink Low]



[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)
WCS Band_ LTE 5 MHz AGC threshold	Low	2352.50	5.016
	Middle	2355.00	5.032
	High	2357.50	5.049
WCS Band_ LTE 5 MHz +3dBm above the AGC threshold	Low	2352.50	5.186
	Middle	2355.00	5.033
	High	2357.50	4.945

*** 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 (dB)	
	DL	UL	DL	UL
WCS	-21 dBm	-45 dBm	58 dB	49 dB

*** Note:**

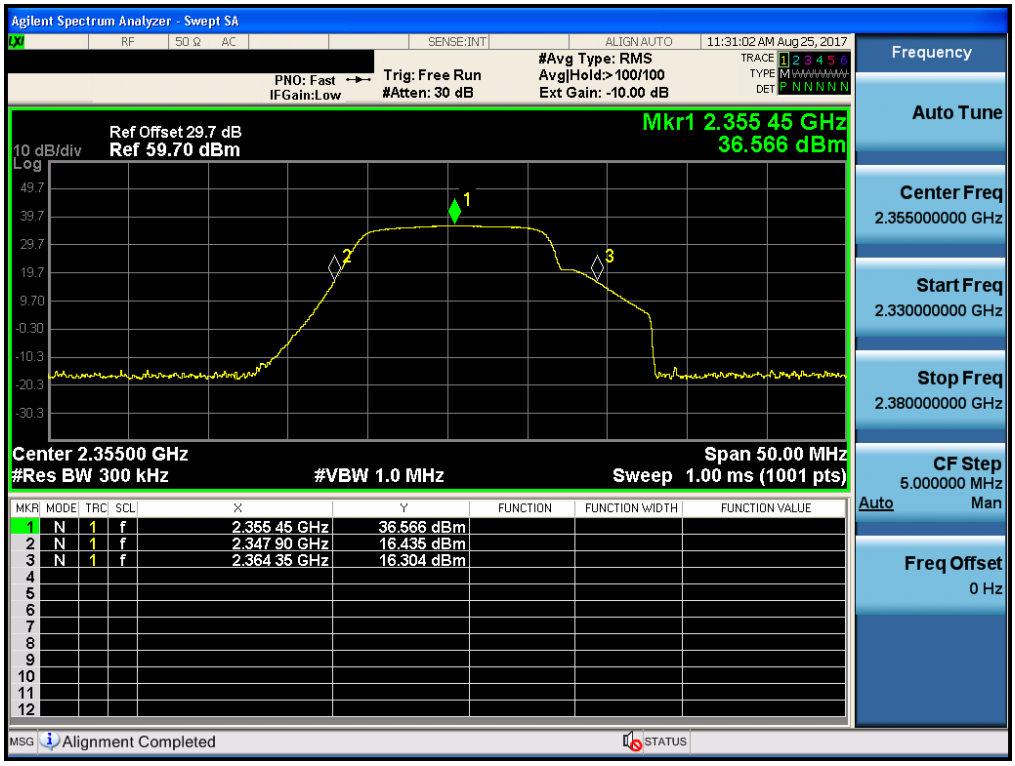
1. The Maximum Amp Gain values in the above table are only RU gain value except HeadEnd.
2. These tests were measured only on the RU except for the HeadEnd.

[Downlink_WCS BAND]

	20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
WCS Band	2347.900 MHz ~ 2364.350 MHz	36.566	57.566

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

[WCS BAND]

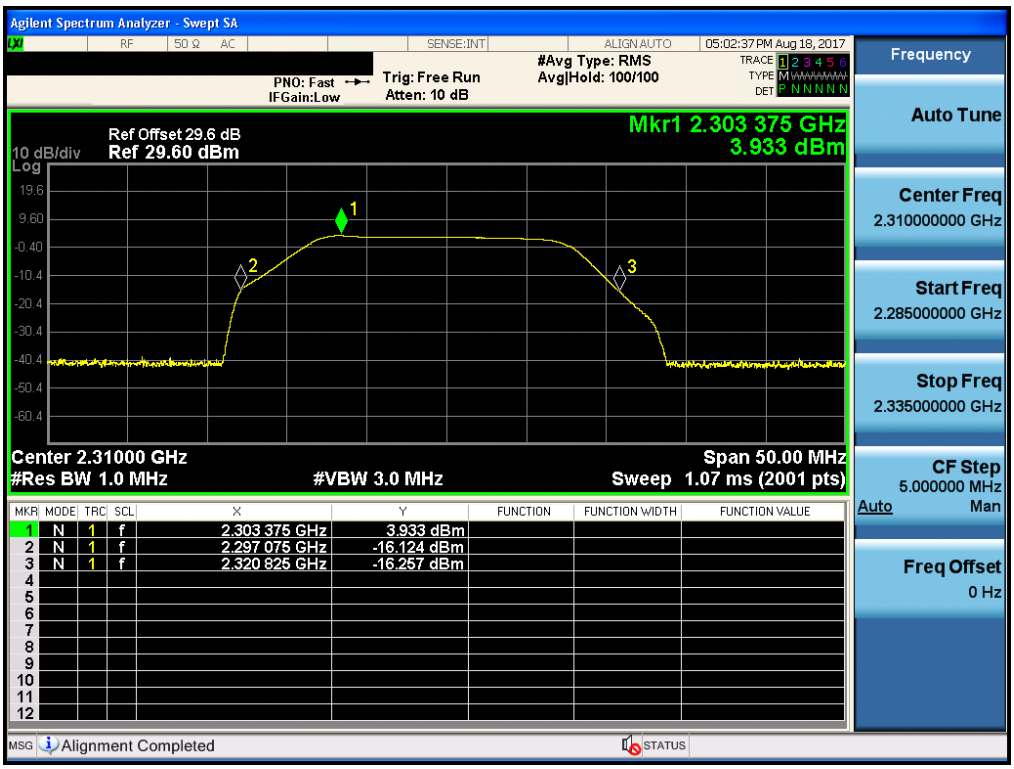


[Uplink_WCS BAND]

	20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
WCS Band	2297.075 MHz ~ 2320.825 MHz	3.933	48.933

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

[WCS BAND]



10. 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.

(a) For operations in the 2305-2320 MHz band and the 2345-2360 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power P (with averaging performed only during periods of transmission) within the licensed band(s) of operation, in watts, by the following amounts:

(1) For base and fixed stations' operations in the 2305-2320 MHz band and the 2345-2360 MHz band:

(i) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than 75 + 10 log (P) dB on all frequencies between 2320 and 2345 MHz;

(ii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2300 and 2305 MHz, 70 + 10 log (P) dB on all frequencies between 2287.5 and 2300 MHz, 72 + 10 log (P) dB on all frequencies between 2285 and 2287.5 MHz, and 75 + 10 log (P) dB below 2285 MHz;

(iii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2360 and 2362.5 MHz, 55 + 10 log (P) dB on all frequencies between 2362.5 and 2365 MHz, 70 + 10 log (P) dB on all frequencies between 2365 and 2367.5 MHz, 72 + 10 log (P) dB on all frequencies between 2367.5 and 2370 MHz, and 75 + 10 log (P) dB above 2370 MHz.

IC Rules

Test Requirements:

RSS-195

5. Transmitter and Receiver Standard Specifications

5.6 Transmitter Unwanted Emissions

The transmitter unwanted emissions shall be measured with a resolution bandwidth of 1 MHz. A

smaller resolution bandwidth is permitted provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz. However, in the 1 MHz bands immediately adjacent to the edges of the frequency range(s) in which the equipment is allowed to operate, a resolution bandwidth of as close as possible to, without being less than 1% of the occupied bandwidth, shall be employed provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz.

5.6.1 Base Station, Fixed Station and High-Power Fixed Subscriber Equipment

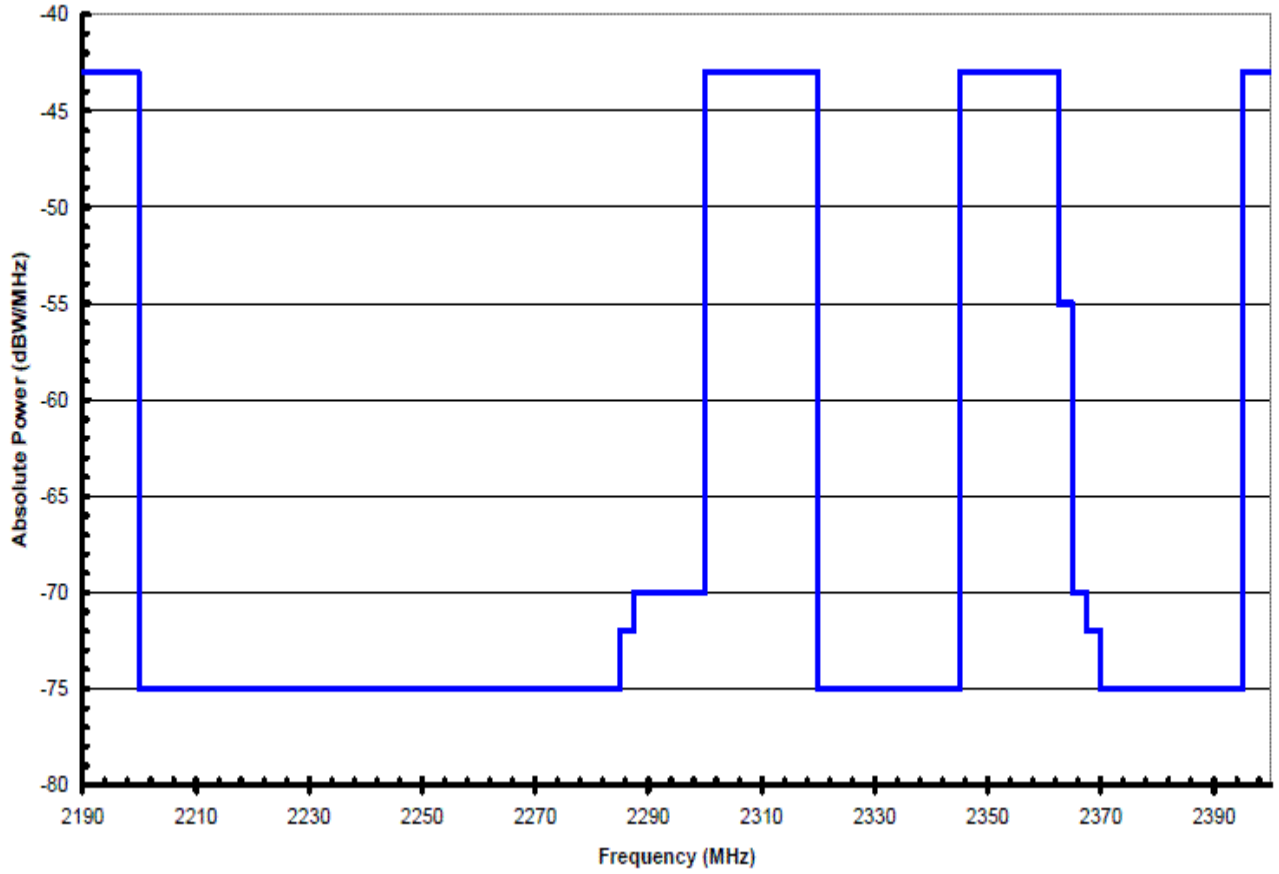
The power of any emission outside the frequency range(s) in which the equipment operates shall be attenuated below the transmitter power, P(dBW), by the amount indicated in Table 1 and graphically represented in Figure 1, where p is the transmitter output power measured in watts.

Table 1 — Unwanted Emissions for Base Station, Fixed Station and High-Power Fixed Subscriber Equipment

Frequency (MHz)	Attenuation (dB)
<2200	$43 + 10 \log_{10}(p)$
2200 - 2285	$75 + 10 \log_{10}(p)$
2285 - 2287.5	$72 + 10 \log_{10}(p)$
2287.5 - 2300	$70 + 10 \log_{10}(p)$
2300 - 2305	$43 + 10 \log_{10}(p)$
2305 - 2320	$43 + 10 \log_{10}(p)^{*}$
2320 - 2345	$75 + 10 \log_{10}(p)$
2345 - 2360	$43 + 10 \log_{10}(p)^{*}$
2360 - 2362.5	$43 + 10 \log_{10}(p)$
2362.5 - 2365	$55 + 10 \log_{10}(p)$
2365 - 2367.5	$70 + 10 \log_{10}(p)$
2367.5 - 2370	$72 + 10 \log_{10}(p)$
2370 - 2395	$75 + 10 \log_{10}(p)$
>2395	$43 + 10 \log_{10}(p)$

* Measured at the edges of the highest and lowest frequency range(s) in which the equipment is designed to operate. See Section 5.2 for the permitted frequency ranges for the various equipment types.

Figure 1 — Unwanted Emissions for Base Station, Fixed Station and High-Power Fixed Subscriber Equipment



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.

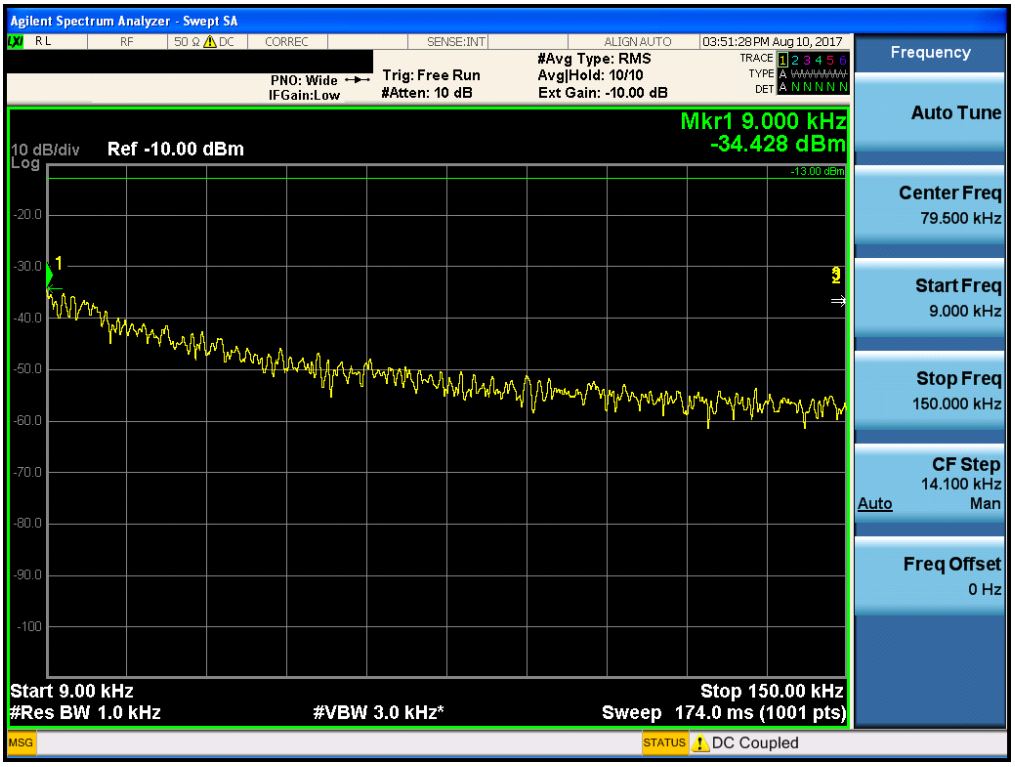
r) Repeat steps b) to q) for all authorized frequency bands/blocks used by the EUT.

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)

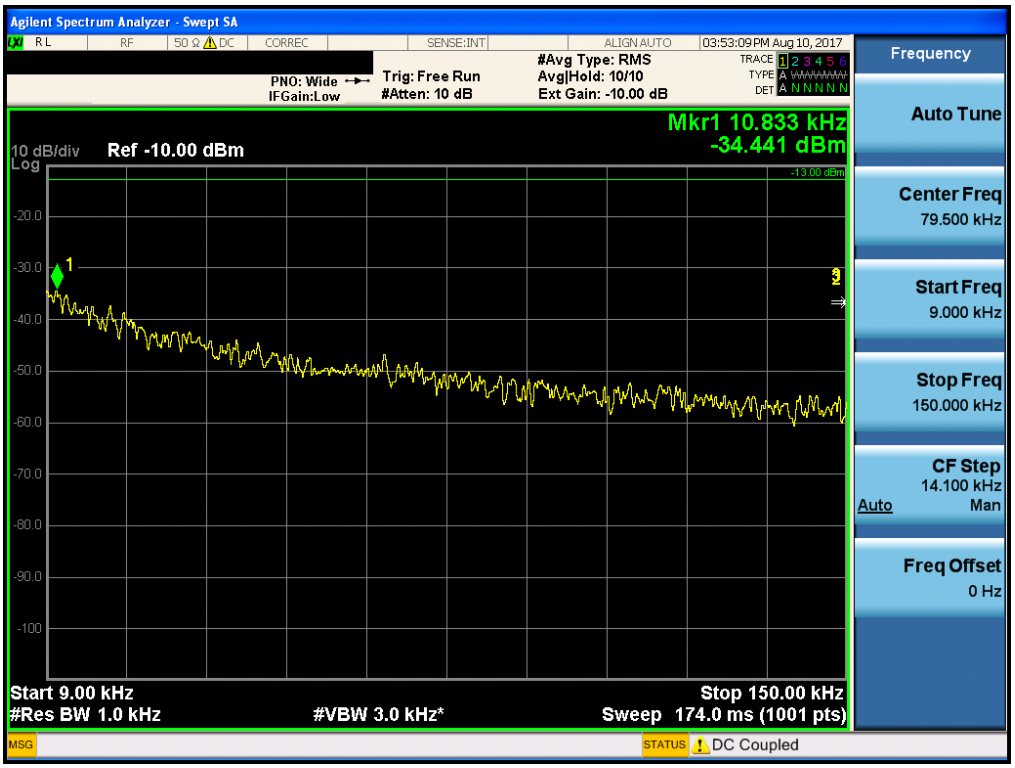
Plots of Spurious Emission for WCS BAND LTE 5 MHz

Conducted Spurious Emissions (9 kHz – 150 kHz)

[Downlink Low]



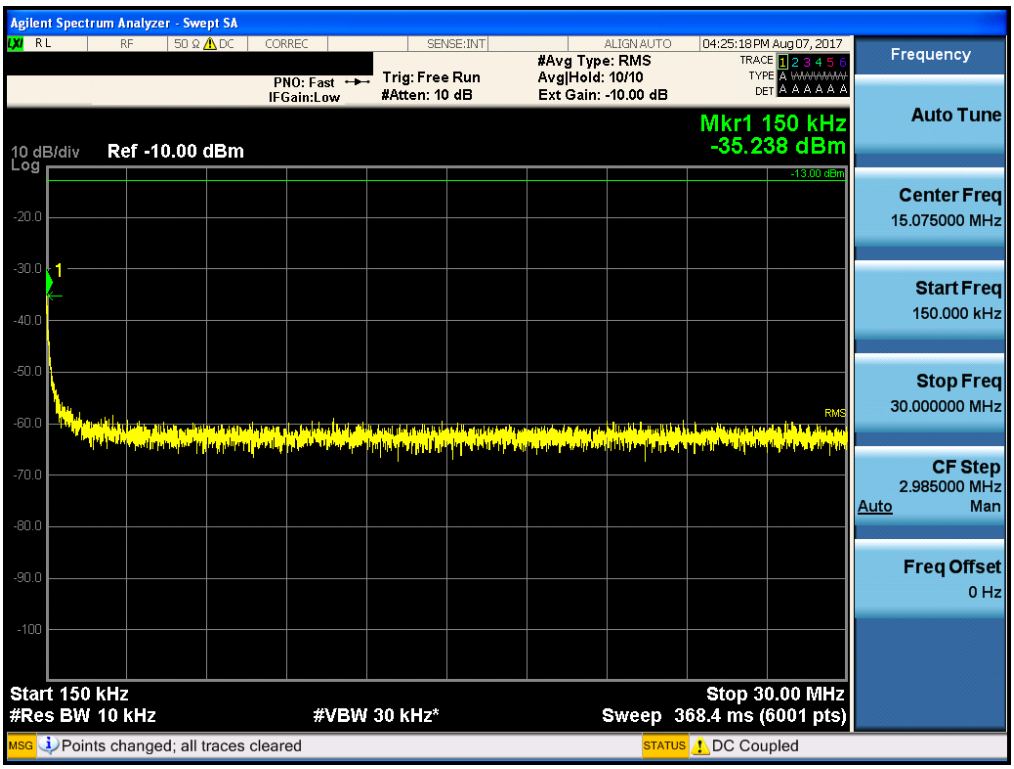
[Downlink Middle]



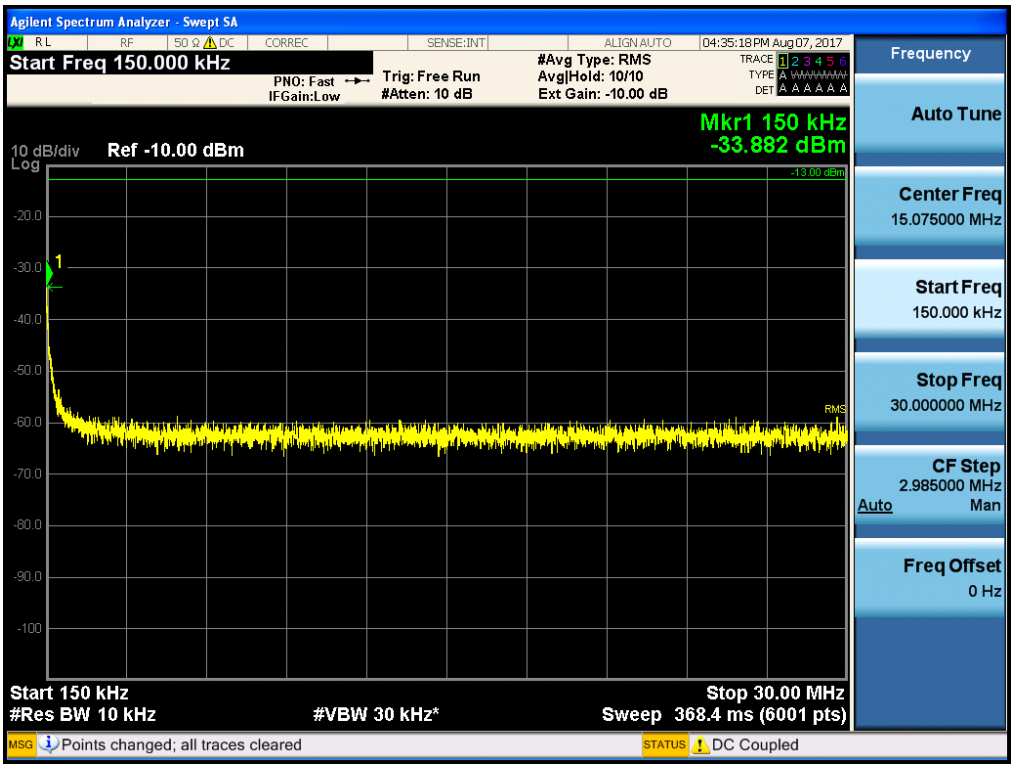
[Downlink High]

Conducted Spurious Emissions (150 kHz – 30 MHz)

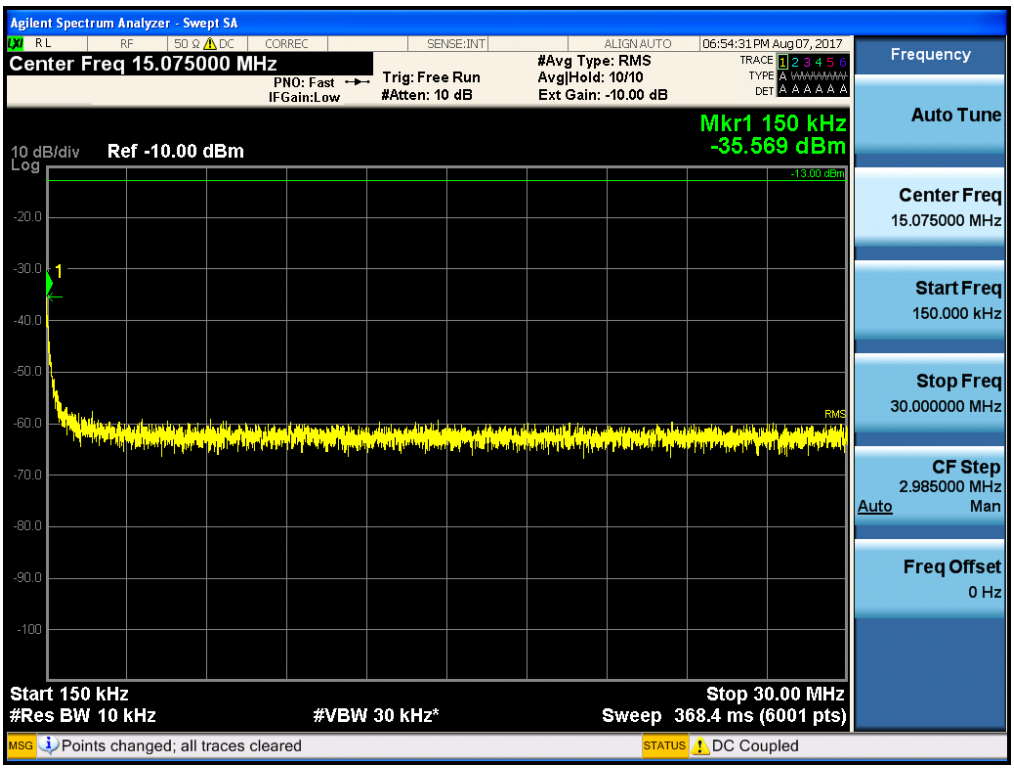
[Downlink Low]



[Downlink Middle]

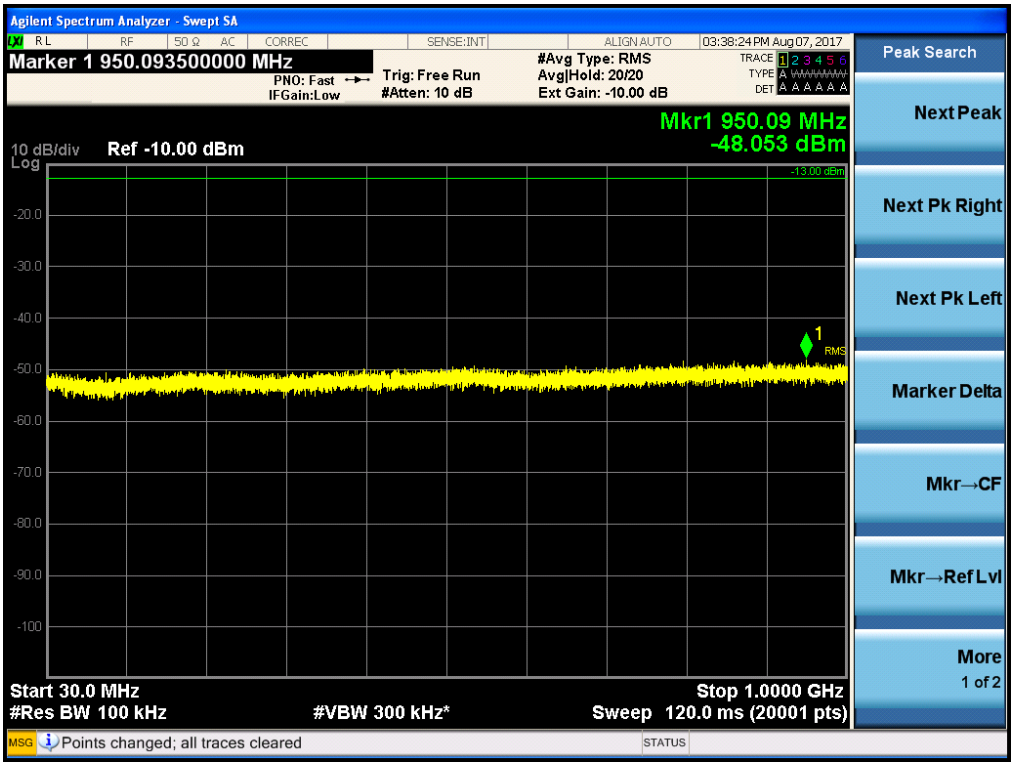


[Downlink High]

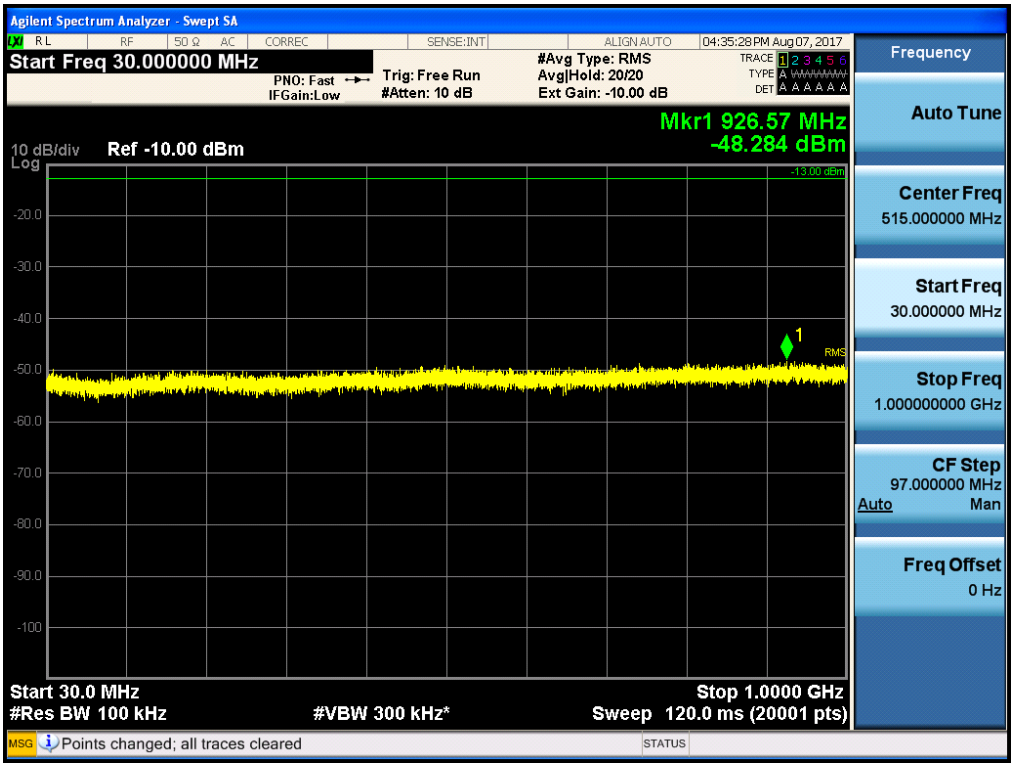


Conducted Spurious Emissions (30 MHz – 1 GHz)

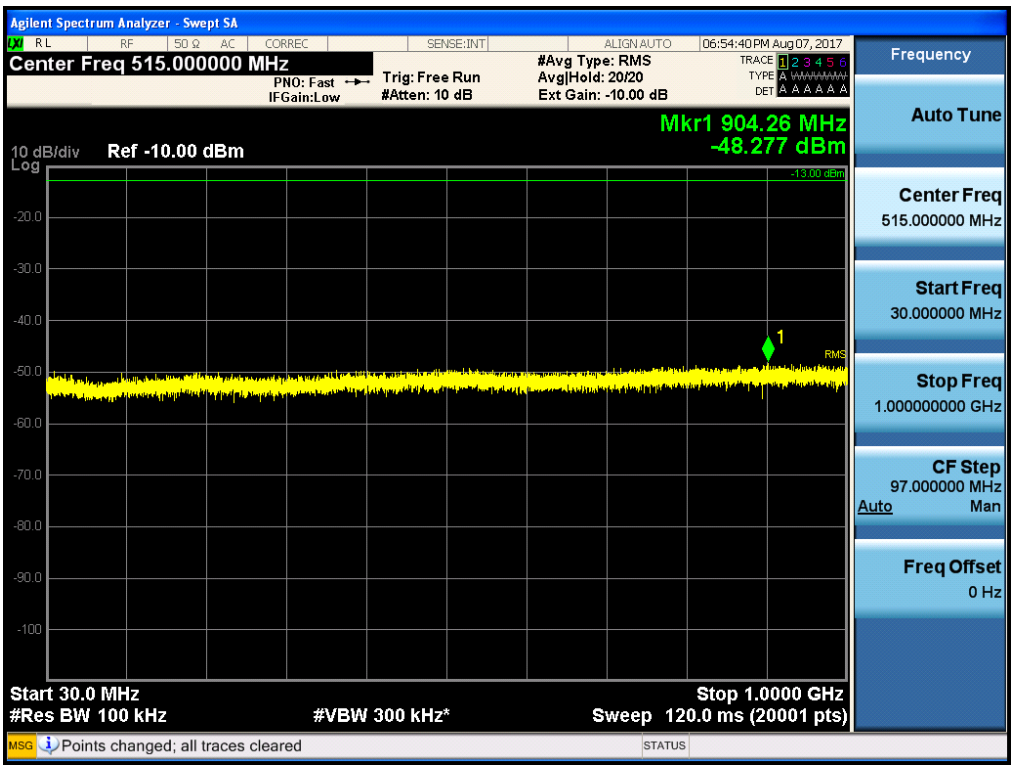
[Downlink Low]



[Downlink Middle]

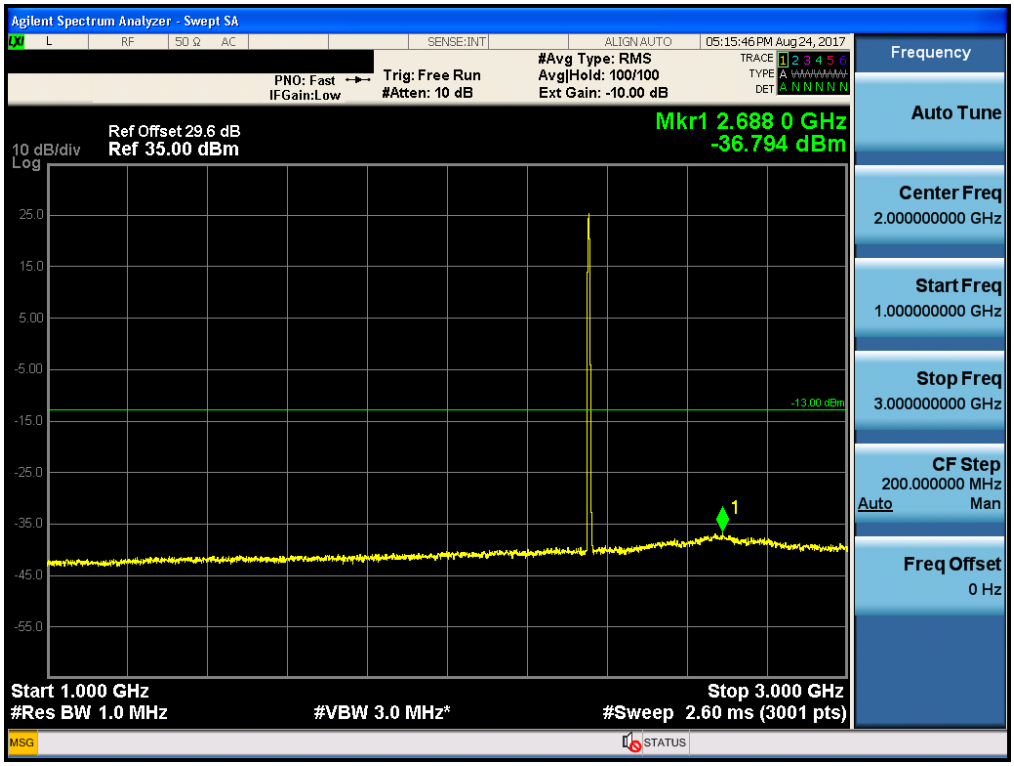


[Downlink High]

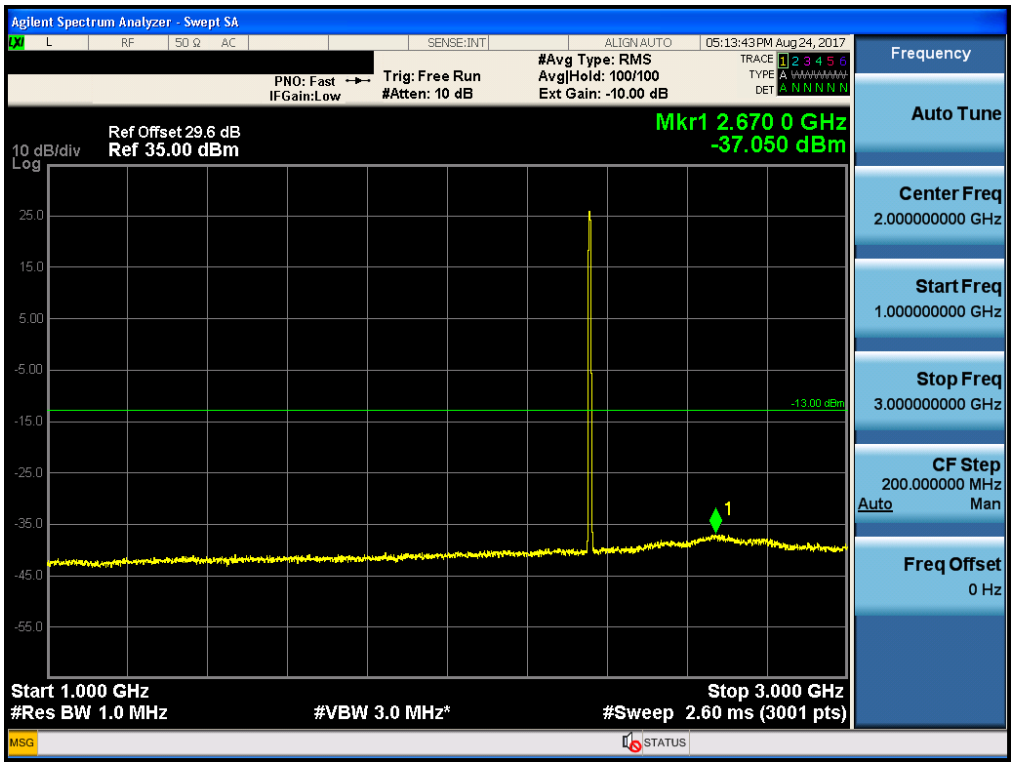


Conducted Spurious Emissions (1 GHz – 3 GHz)

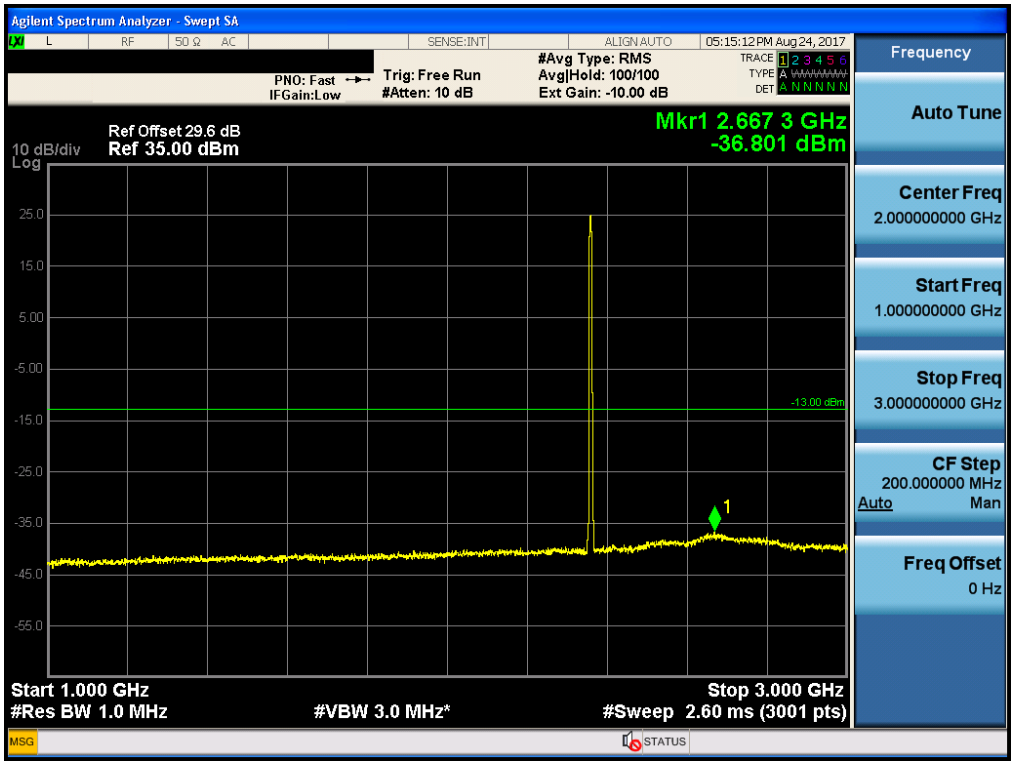
[Downlink Low]



[Downlink Middle]



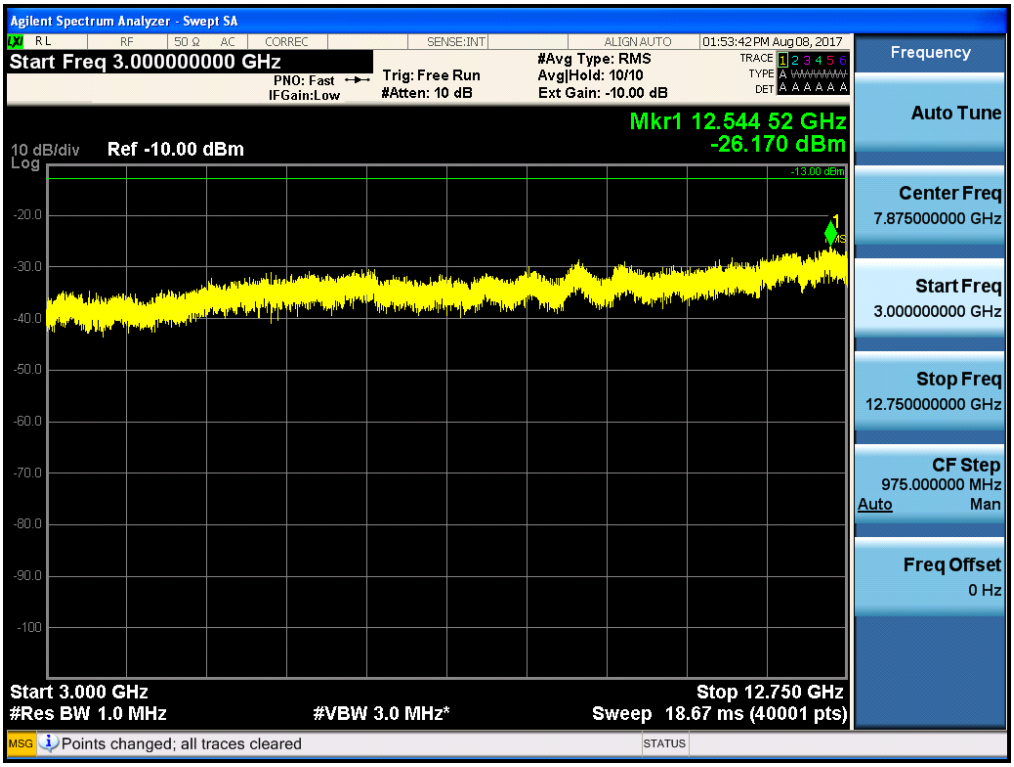
[Downlink High]



Conducted Spurious Emissions (3 GHz – 12.75 GHz)

[Downlink Low]

[Downlink Middle]



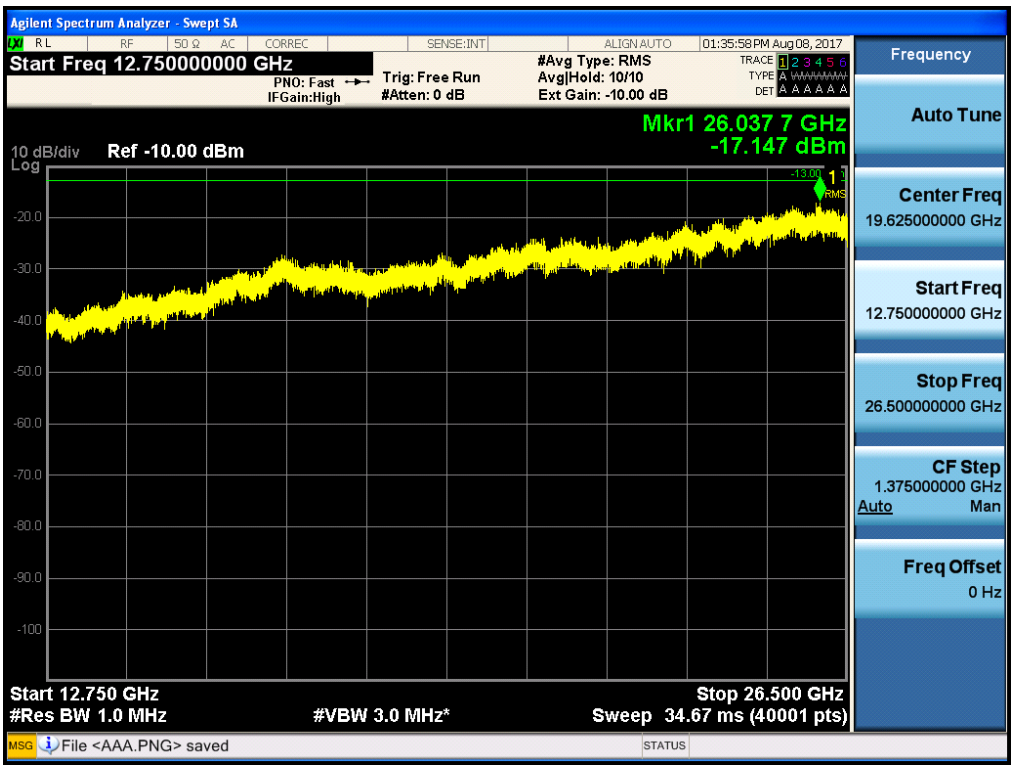
[Downlink High]

Conducted Spurious Emissions (12.75 GHz – 26.5 GHz)

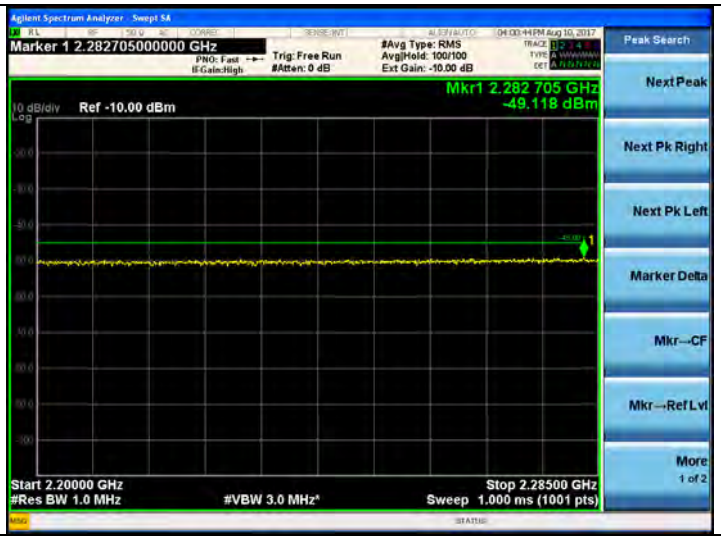
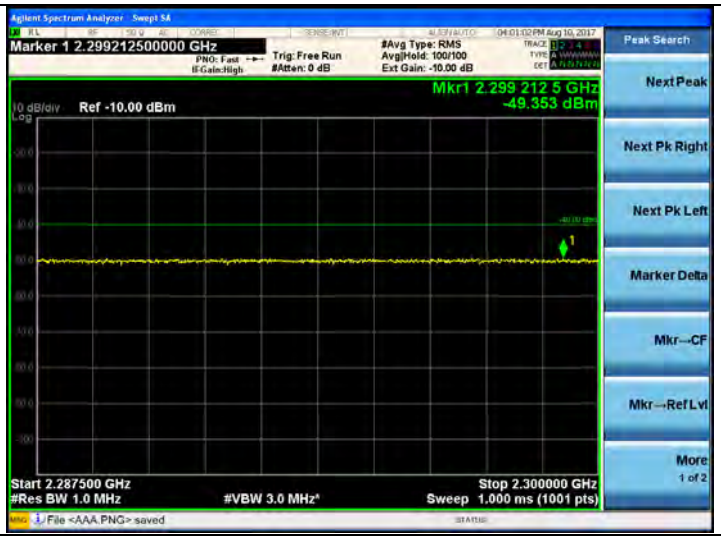
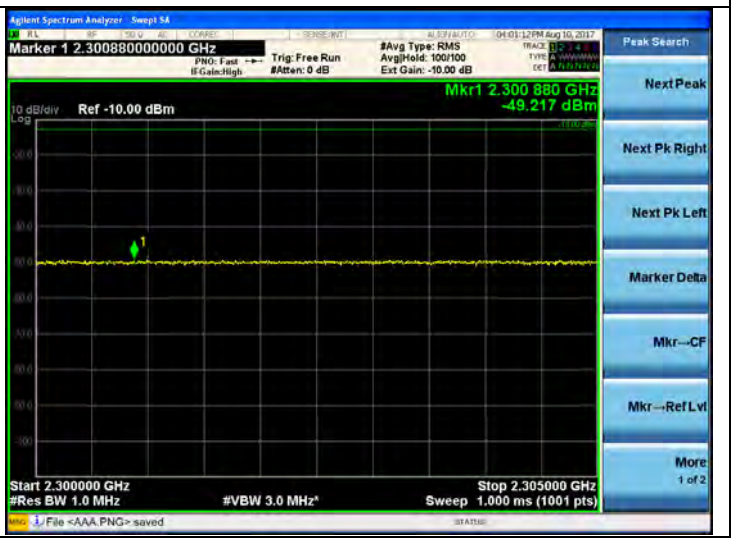
[Downlink Low]

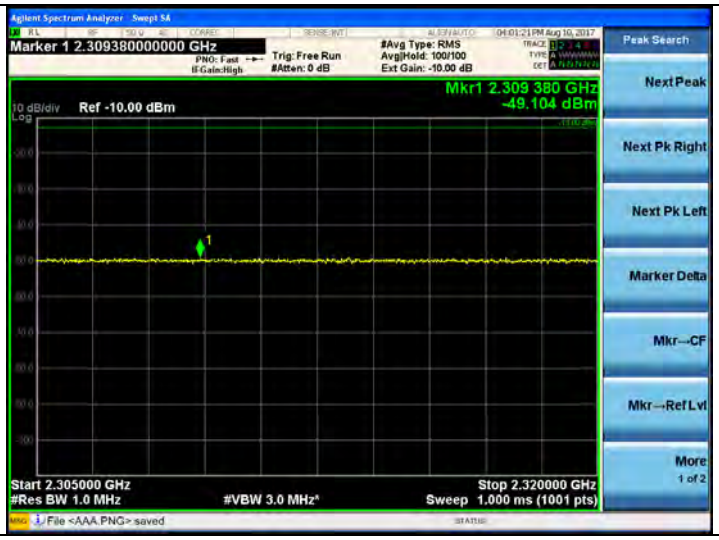
[Downlink Middle]

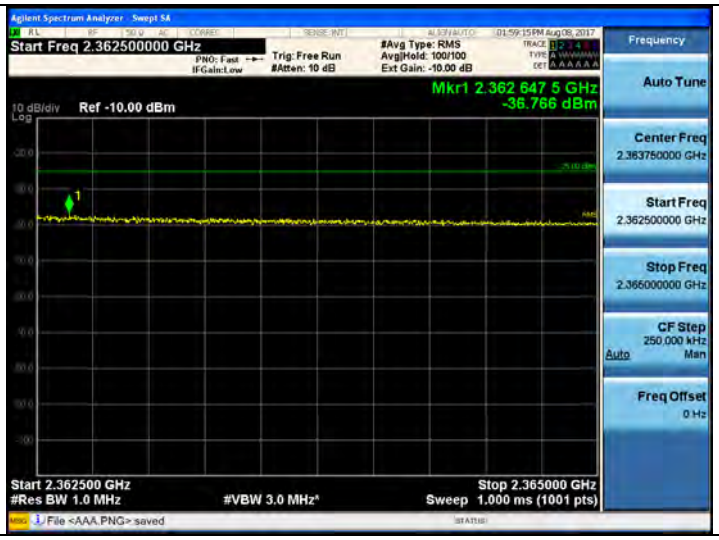
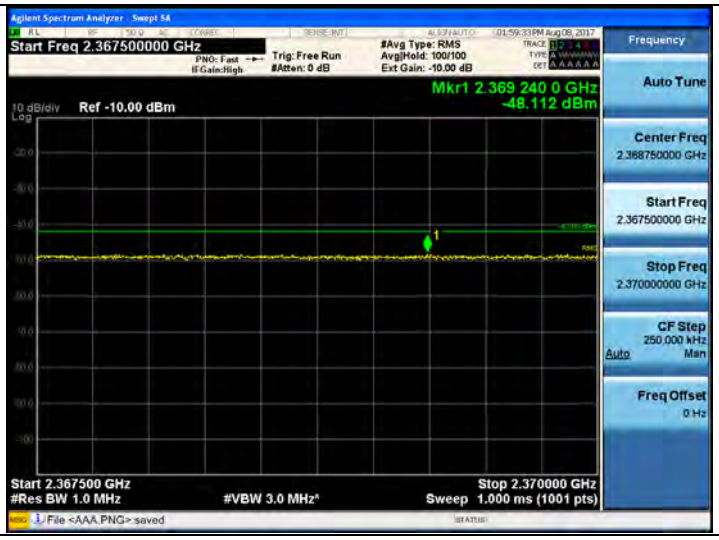
[Downlink High]



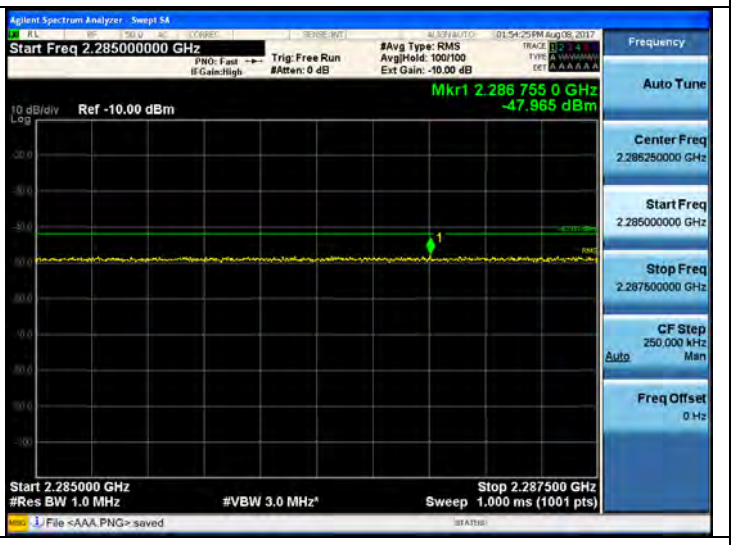
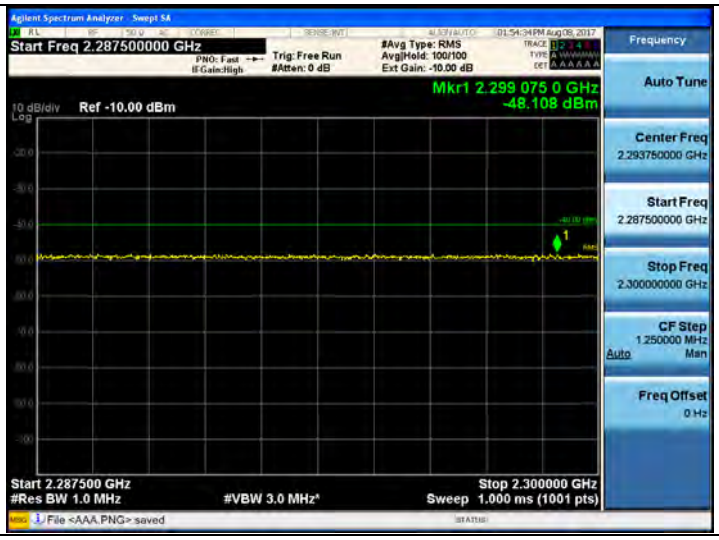
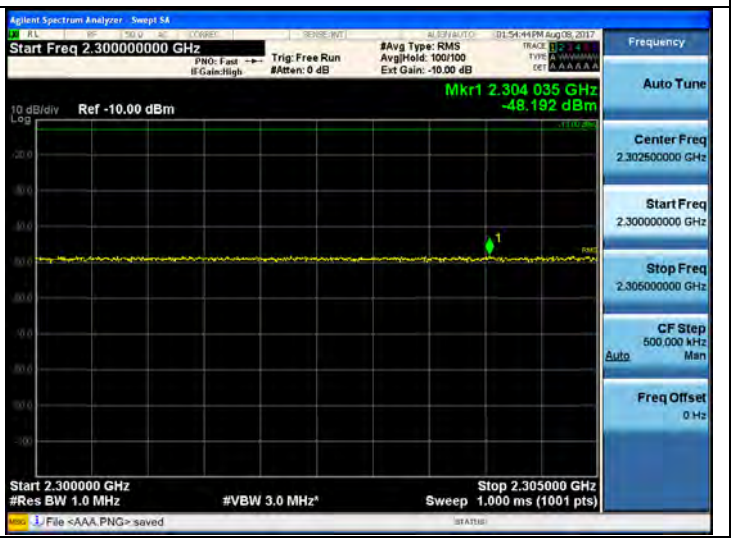
[Downlink Low]

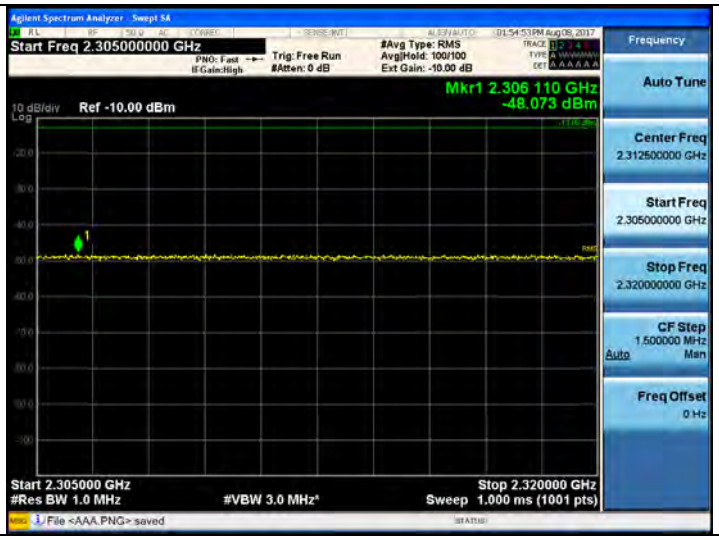
2200 ㎒ ~ 2285 ㎒	2285 ㎒ ~ 2287.5 ㎒
	
2287.5 ㎒ ~ 2300 ㎒	**2300 ㎒ ~ 2305 ㎒**
	

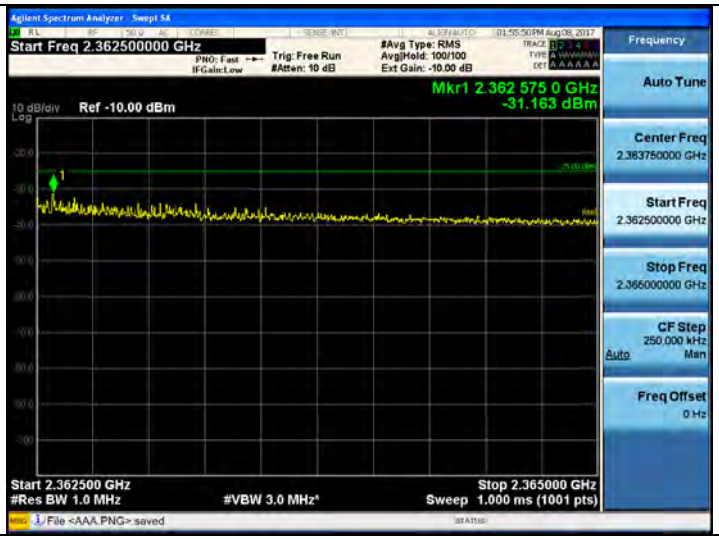
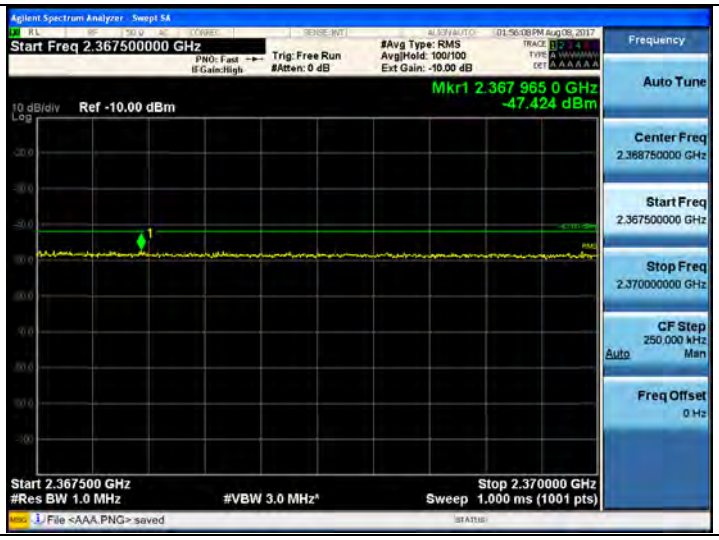
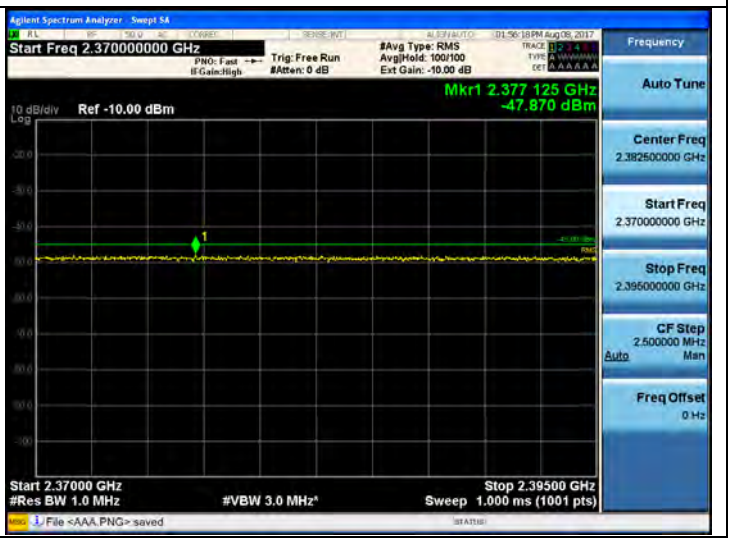
2305 ㎒ ~ 2320 ㎒	2320 ㎒ ~ 2345 ㎒
	
2345 ㎒ ~ 2350 ㎒	**2360 ㎒ ~ 2362.5 ㎒**
	
*** RBW(100KHz) was reduced to 10% of the reference bandwidth for measuring unwanted emission level and power was integrated.(10% = +10 dB)**	

2362.5 ㎒ ~ 2365 ㎒	2365 ㎒ ~ 2367.5 ㎒
	
2367.5 ㎒ ~ 2370 ㎒	**2370 ㎒ ~ 2395 ㎒**
	

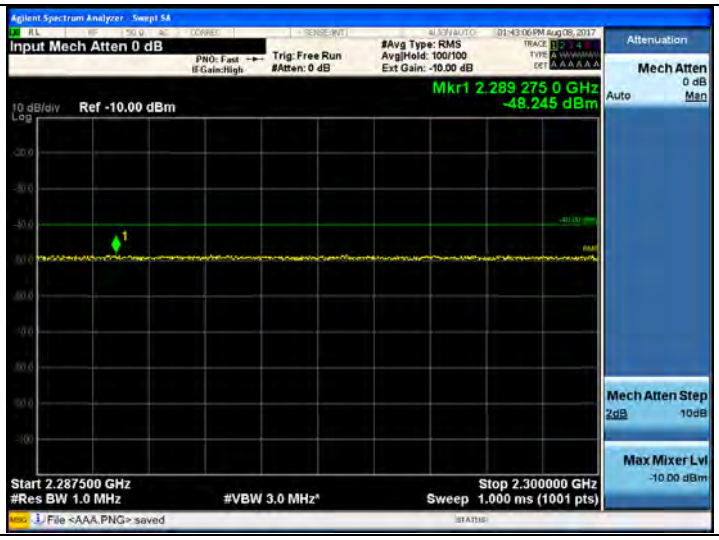
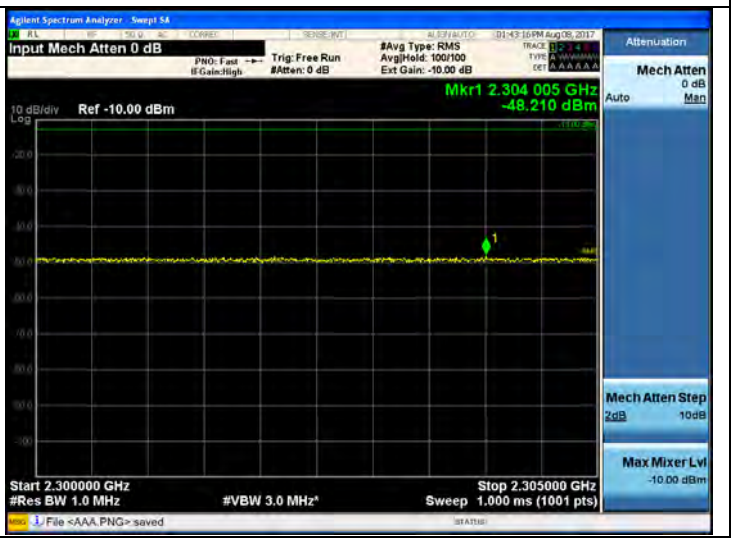
[Downlink Middle]

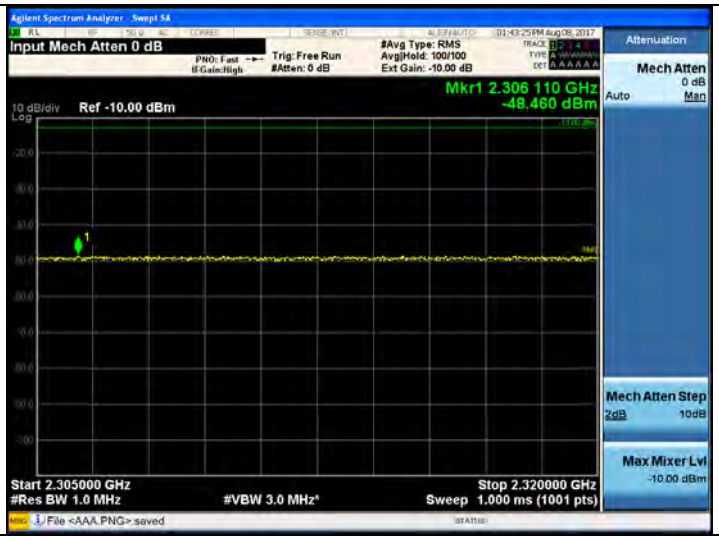
2200 ㎒ ~ 2285 ㎒	2285 ㎒ ~ 2287.5 ㎒
	
2287.5 ㎒ ~ 2300 ㎒	**2300 ㎒ ~ 2305 ㎒**
	

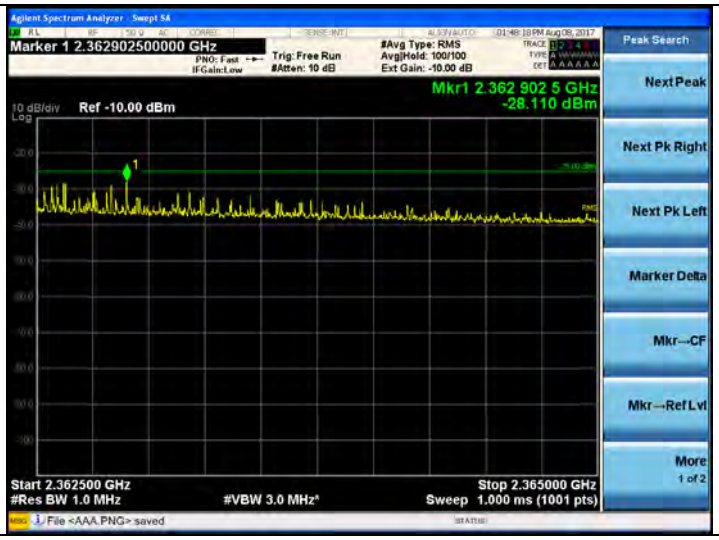
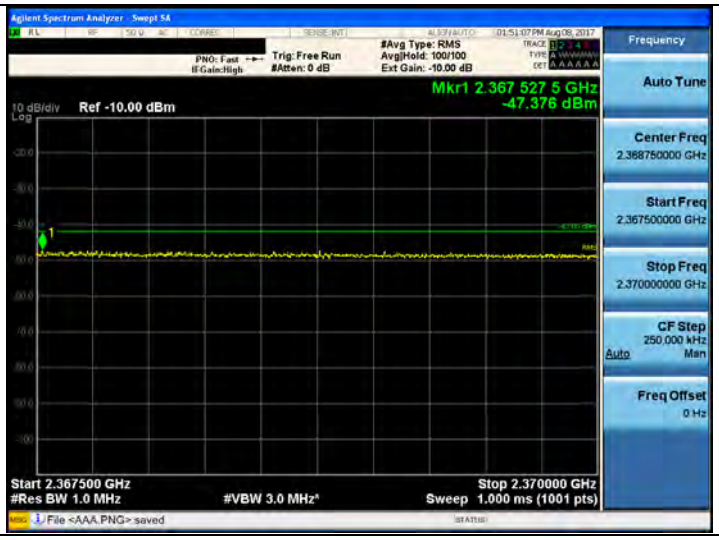
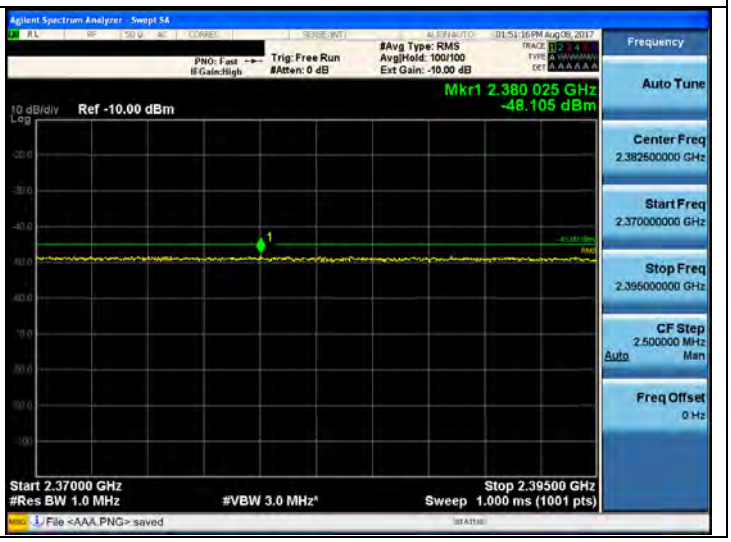
2305 ㎒ ~ 2320 ㎒	2320 ㎒ ~ 2345 ㎒
	
2345 ㎒ ~ 2350 ㎒	**2360 ㎒ ~ 2362.5 ㎒**
	

2362.5 ㎒ ~ 2365 ㎒	2365 ㎒ ~ 2367.5 ㎒
	
2367.5 ㎒ ~ 2370 ㎒	**2370 ㎒ ~ 2395 ㎒**
	

[Downlink High]

2200 ㎒ ~ 2285 ㎒	2285 ㎒ ~ 2287.5 ㎒
	
2287.5 ㎒ ~ 2300 ㎒	**2300 ㎒ ~ 2305 ㎒**
	

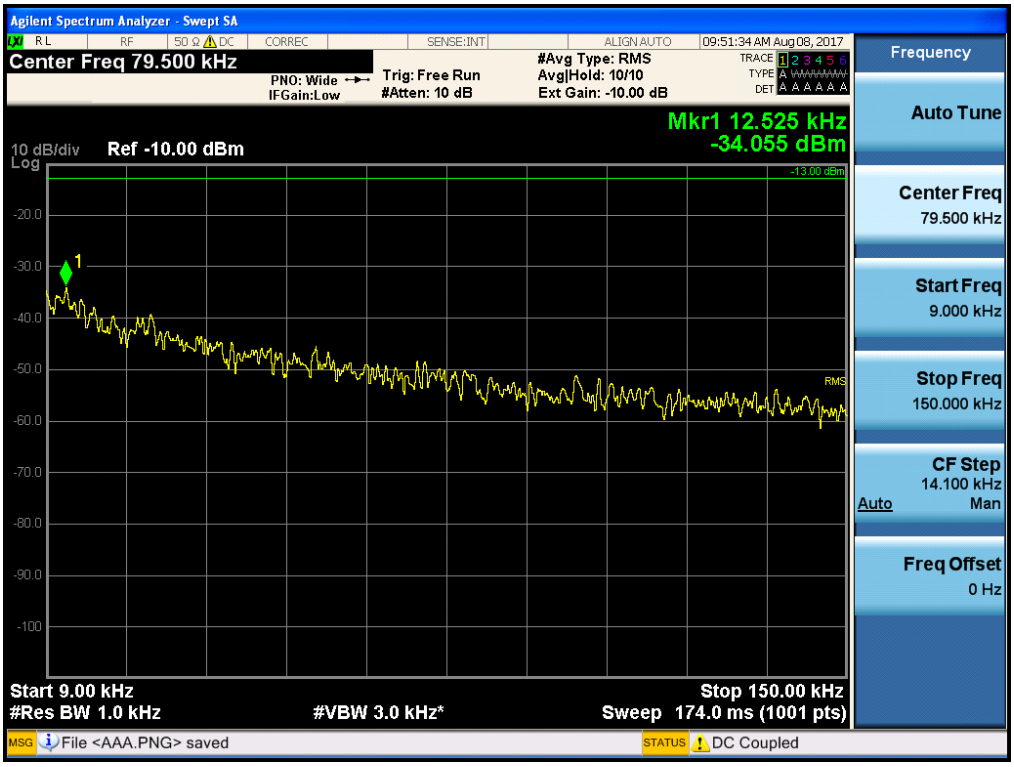
2305 ㎒ ~ 2320 ㎒	2320 ㎒ ~ 2345 ㎒
	
2345 ㎒ ~ 2350 ㎒	**2360 ㎒ ~ 2362.5 ㎒**
	
	*** RBW(100KHz) was reduced to 10% of the reference bandwidth for measuring unwanted emission level and power was integrated.(10% = +10 dB)**

2362.5 ㎒ ~ 2365 ㎒	2365 ㎒ ~ 2367.5 ㎒
	
2367.5 ㎒ ~ 2370 ㎒	**2370 ㎒ ~ 2395 ㎒**
	

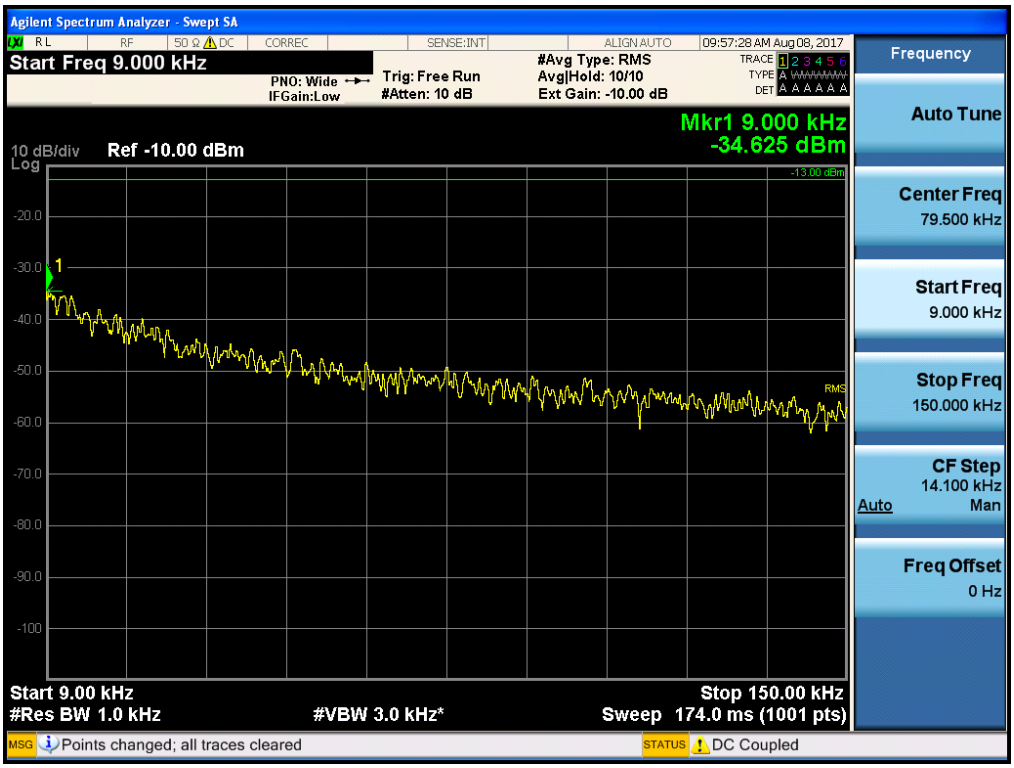
Plots of Spurious Emission for WCS BAND LTE 5 MHz

Conducted Spurious Emissions (9 kHz – 150 kHz)

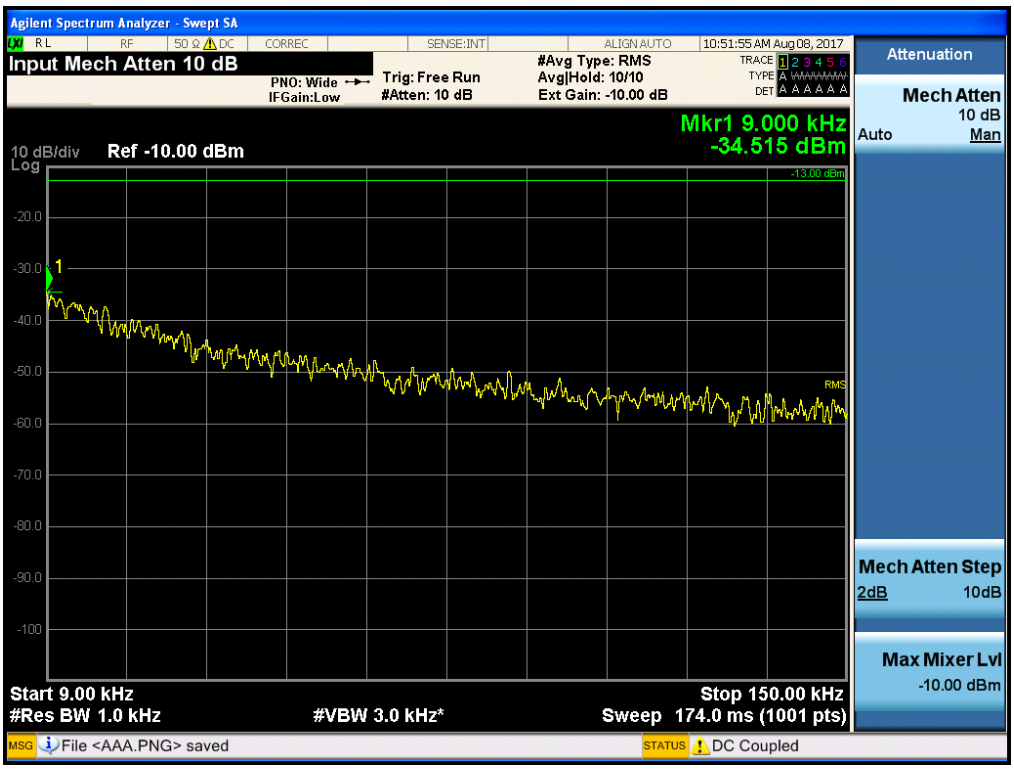
[Uplink Low]



[Uplink Middle]

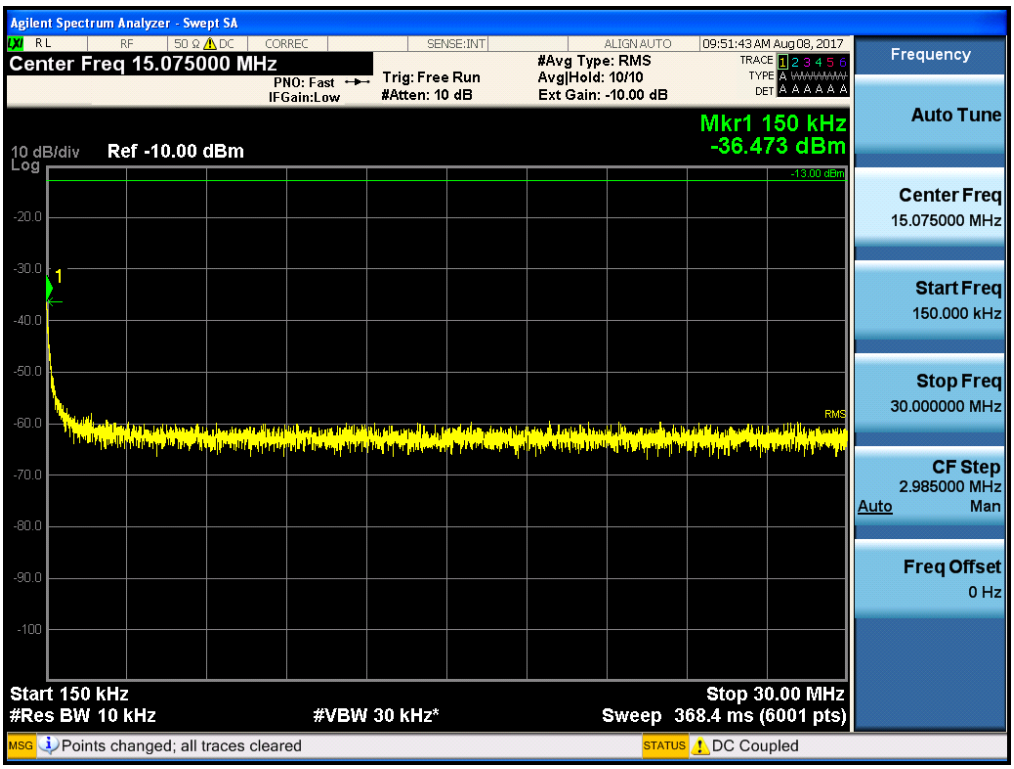


[Uplink High]

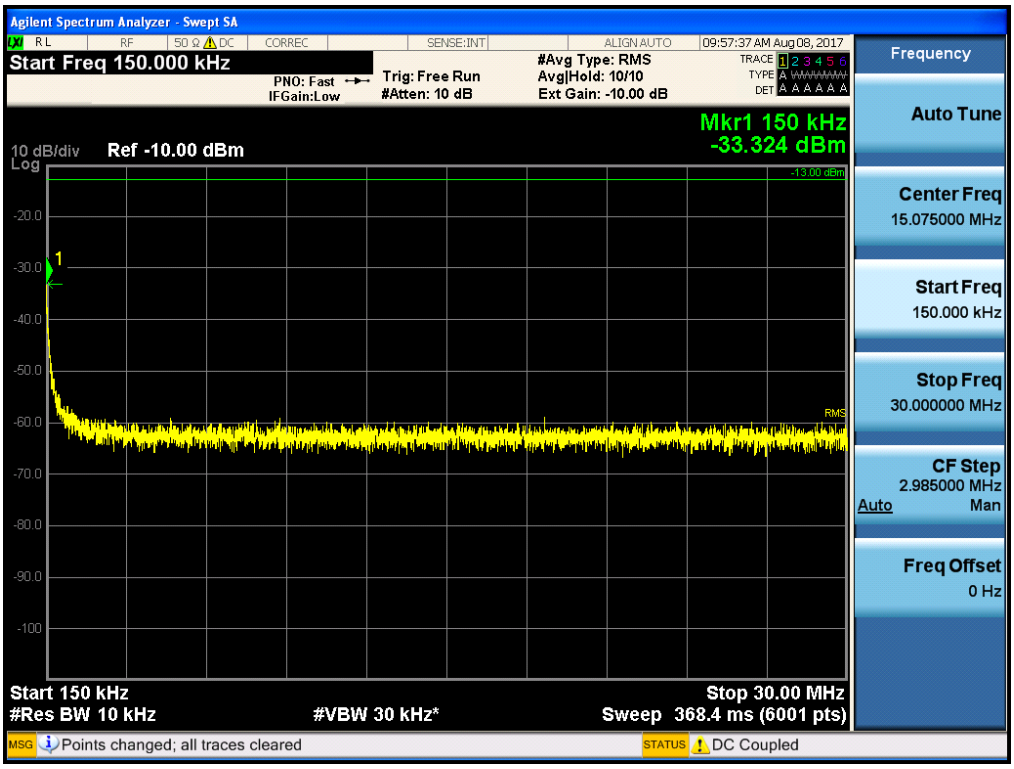

Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω DC
CORREC
SENSE:INT
ALIGN AUTO
10:51:55 AM Aug 08, 2017
Input Mech Atten 10 dB
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 10 dB
#Avg Type: RMS
Avg|Hold: 10/10
Ext Gain: -10.00 dB
TRACE 1 2 3 4 5 6
TYPE A WWWWW
DET A A A A A A
Mkr1 9.000 kHz
-34.515 dBm
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
1
RMS
Start 9.00 kHz
#Res BW 1.0 kHz
#VBW 3.0 kHz*
Stop 150.00 kHz
Sweep 174.0 ms (1001 pts)
Attenuation
Mech Atten
10 dB
Auto
Man
Mech Atten Step
2dB
10dB
Max Mixer Lvl
-10.00 dBm
MSG
File <AAA.PNG> saved
STATUS
DC Coupled

Conducted Spurious Emissions (150 kHz – 30 MHz)

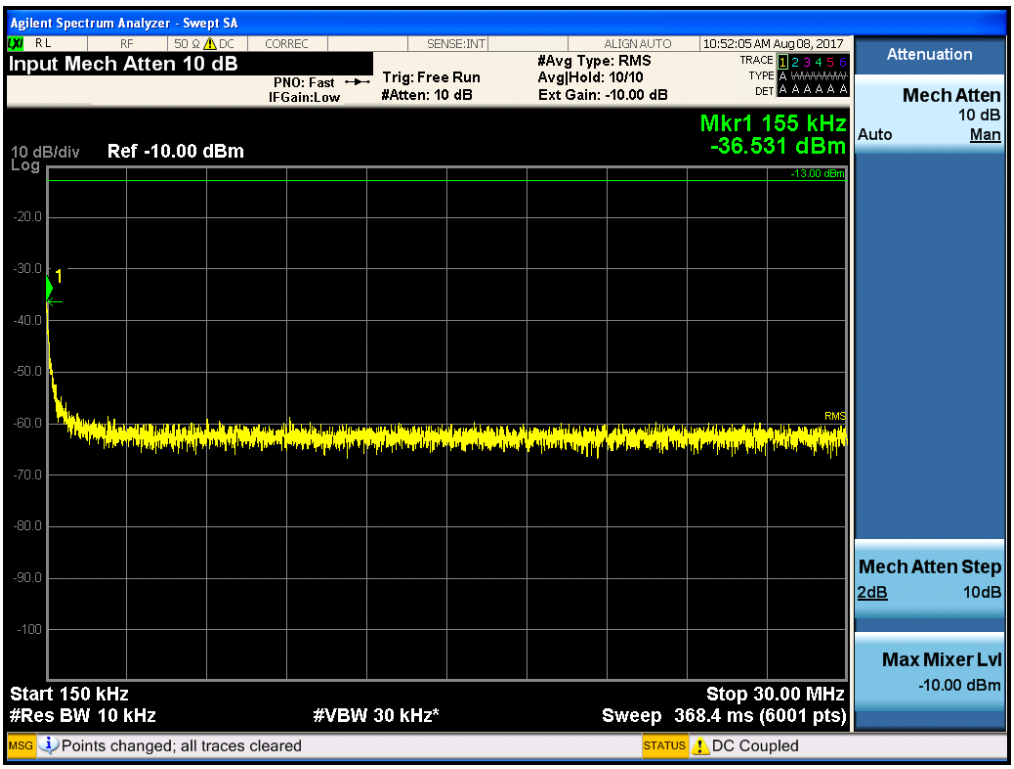
[Uplink Low]



[Uplink Middle]

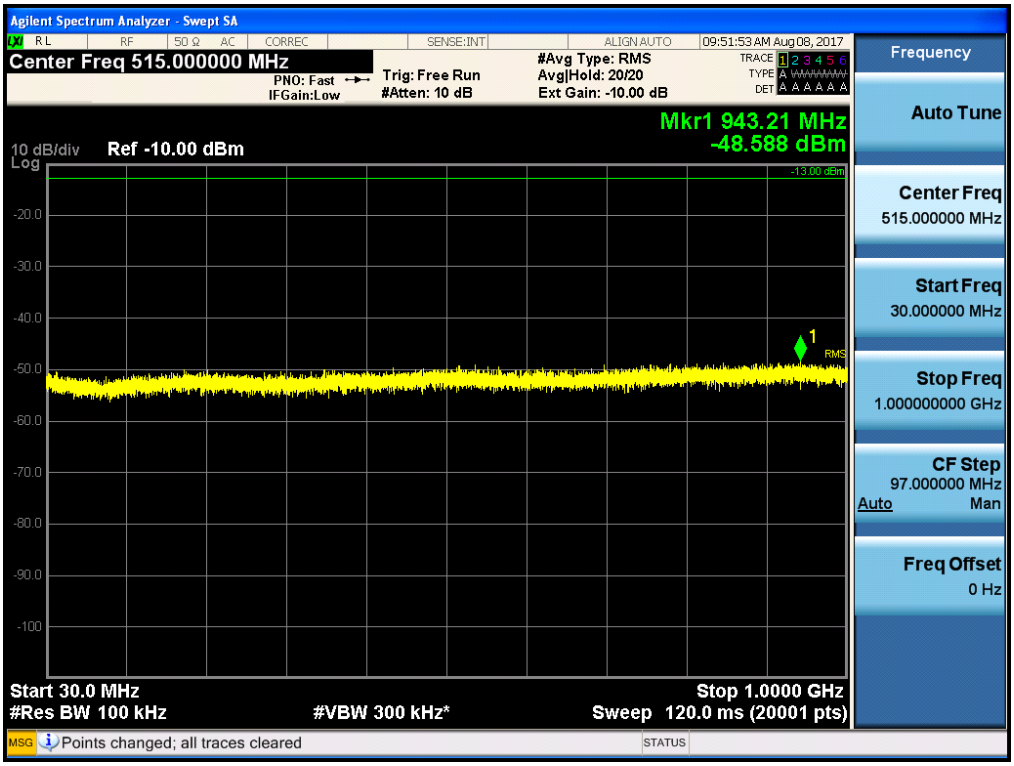


[Uplink High]

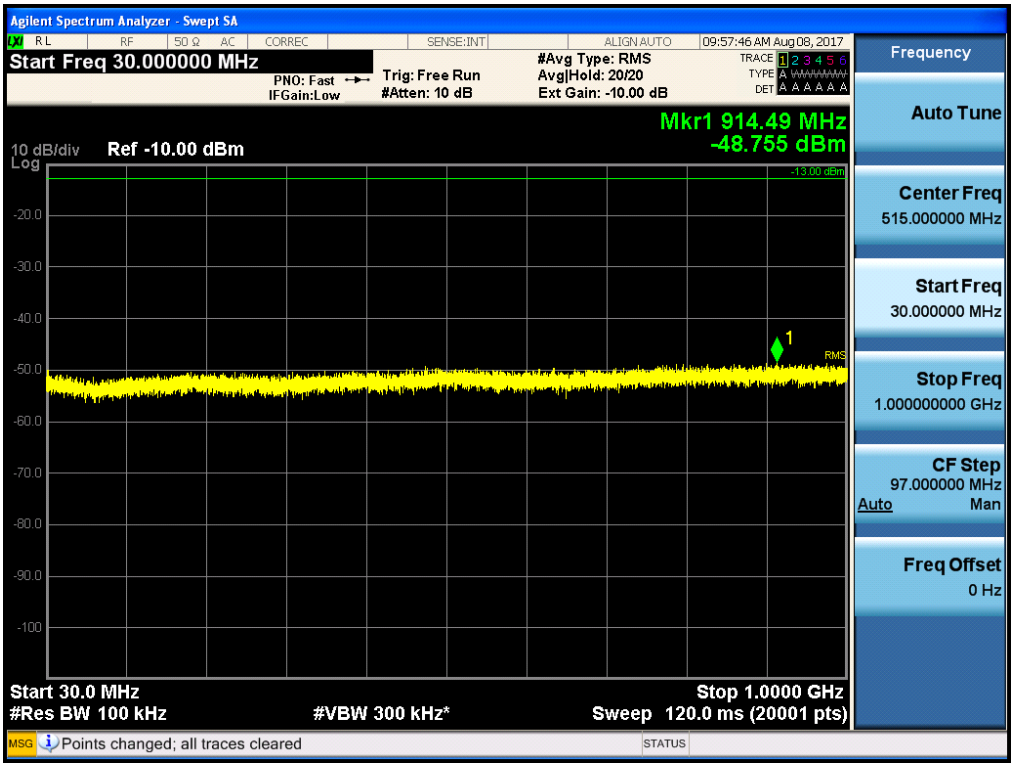

Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω DC
CORREC
SENSE:INT
ALIGN AUTO
10:52:05 AM Aug 08, 2017
Input Mech Atten 10 dB
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 10 dB
#Avg Type: RMS
Avg|Hold: 10/10
Ext Gain: -10.00 dB
TRACE 1 2 3 4 5 6
TYPE A WWWWW
DET A A A A A A
Mkr1 155 kHz
-36.531 dBm
10 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
1
RMS
Start 150 kHz
#Res BW 10 kHz
#VBW 30 kHz*
Stop 30.00 MHz
Sweep 368.4 ms (6001 pts)
Attenuation
Mech Atten
10 dB
Auto
Man
Mech Atten Step
2dB
10dB
Max Mixer Lvl
-10.00 dBm
MSG
Points changed; all traces cleared
STATUS
DC Coupled

Conducted Spurious Emissions (30 MHz – 1 GHz)

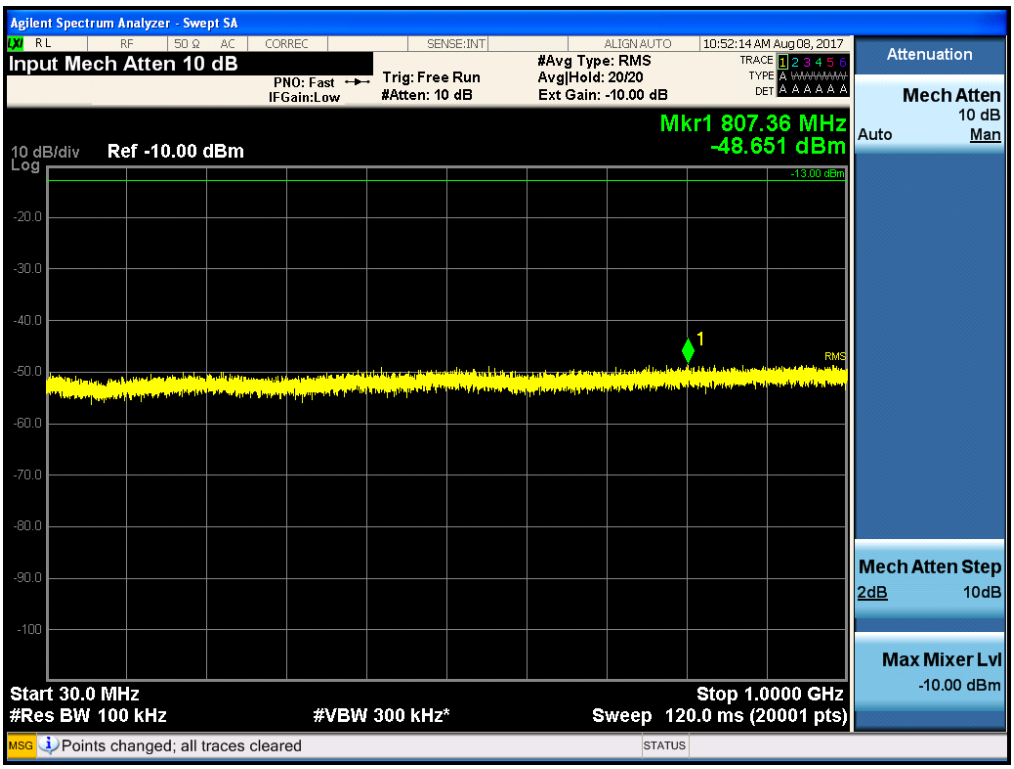
[Uplink Low]



[Uplink Middle]

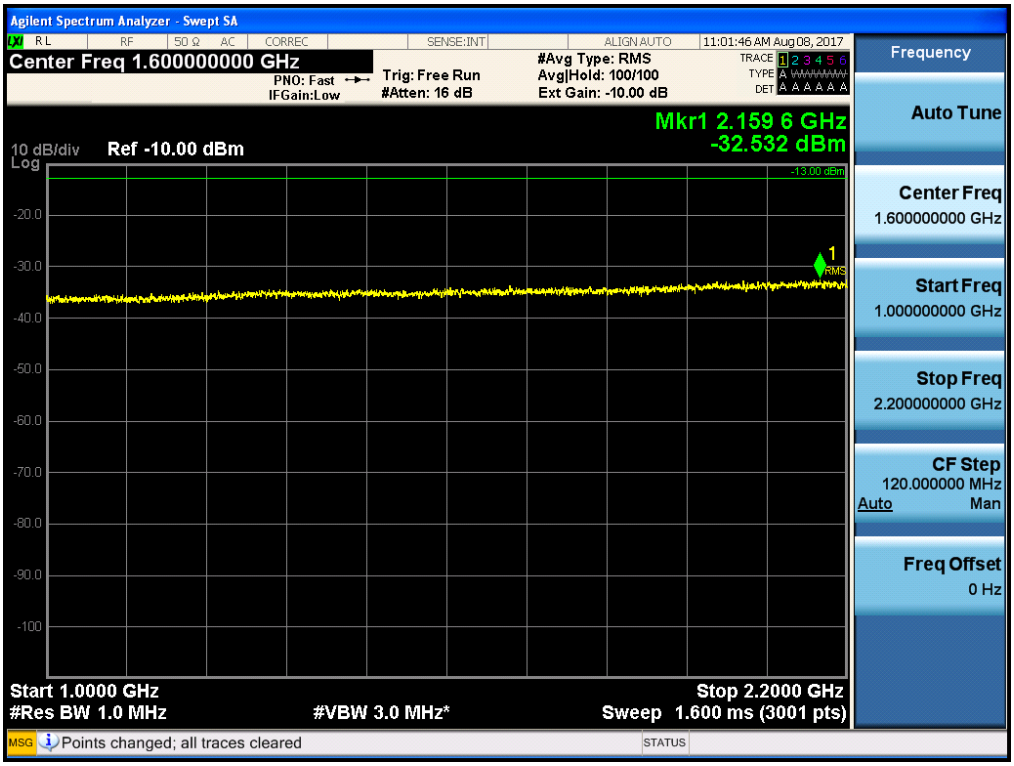


[Uplink High]

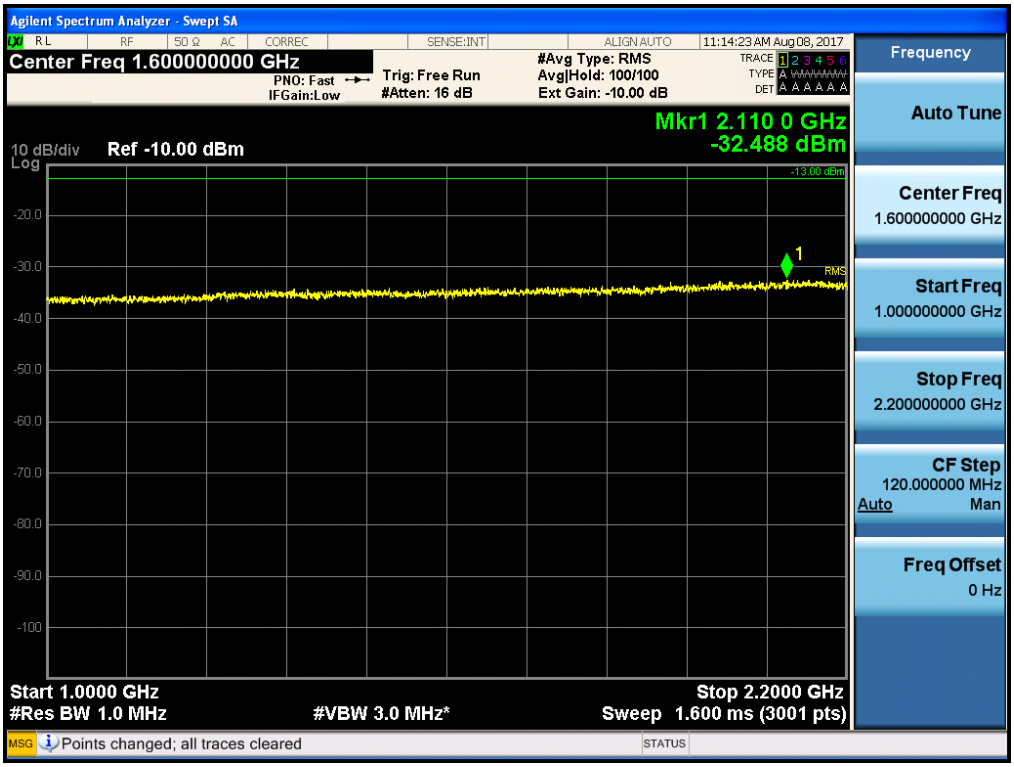

Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
CORREC
SENSE:INT
ALIGN AUTO
10:52:14 AM Aug 08, 2017
Input Mech Atten 10 dB
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 10 dB
#Avg Type: RMS
Avg|Hold: 20/20
Ext Gain: -10.00 dB
TRACE 1 2 3 4 5 6
TYPE A WWWWW
DET A A A A A A
Mkr1 807.36 MHz
-48.651 dBm
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
1
RMS
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
MSG
STATUS
Attenuation
Mech Atten
10 dB
Auto
Man
Mech Atten Step
2dB
10dB
Max Mixer Lvl
-10.00 dBm

Conducted Spurious Emissions (1 GHz – 2.2 GHz)

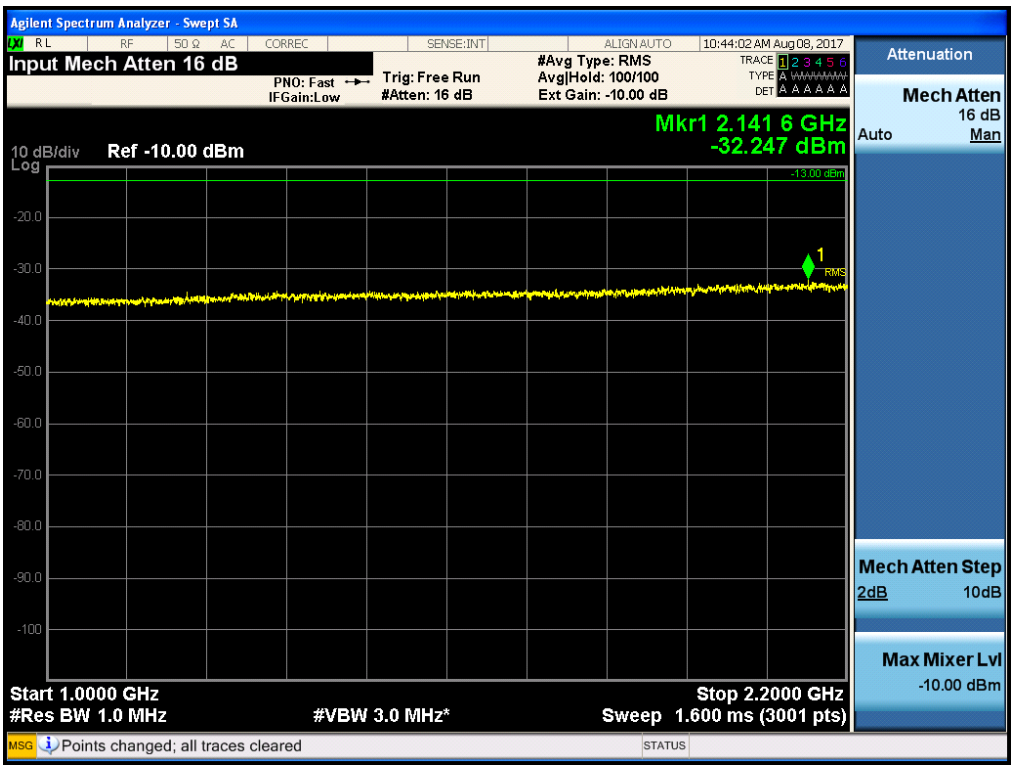
[Uplink Low]



[Uplink Middle]

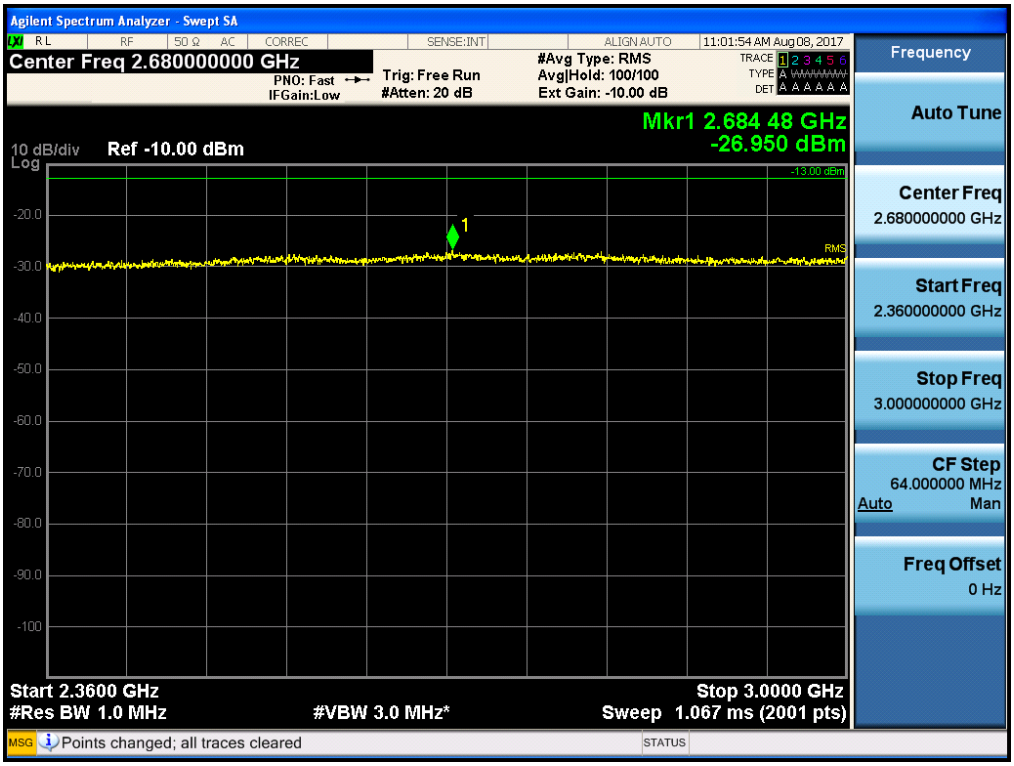


[Uplink High]

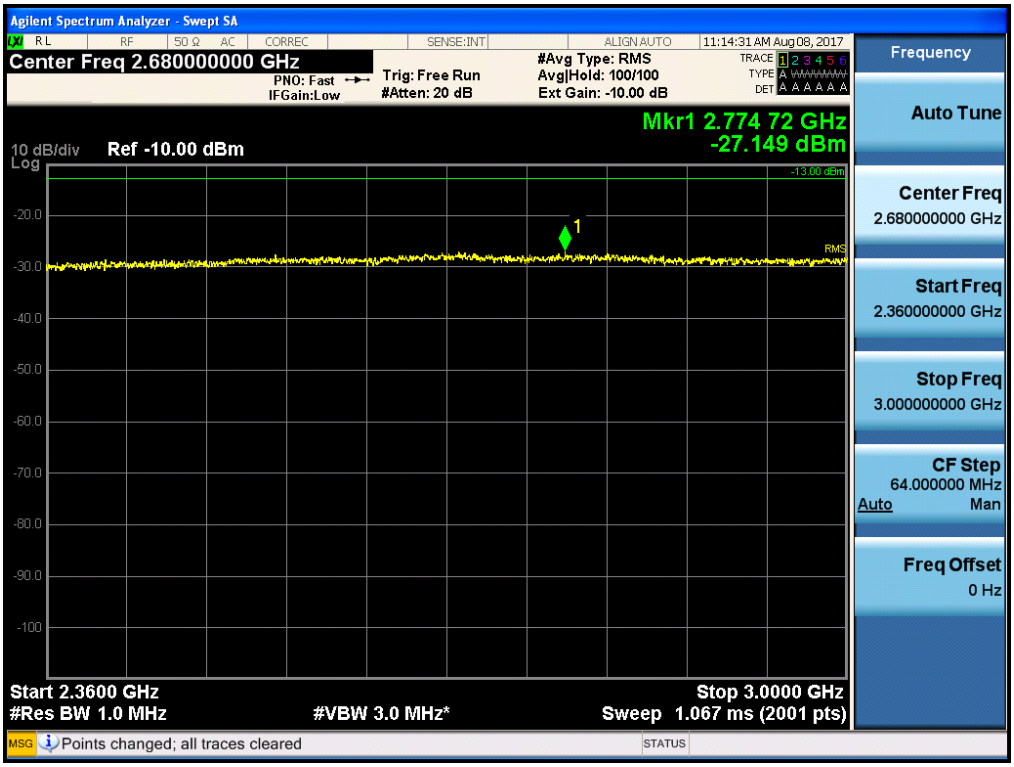

Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
CORREC
SENSE:INT
ALIGN AUTO
10:44:02 AM Aug 08, 2017
Input Mech Atten 16 dB
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 16 dB
#Avg Type: RMS
Avg|Hold: 100/100
Ext Gain: -10.00 dB
TRACE 1 2 3 4 5 6
TYPE A WWWWW
DET A A A A A A
Mkr1 2.141 6 GHz
-32.247 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
1
RMS
Start 1.0000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 2.2000 GHz
Sweep 1.600 ms (3001 pts)
Points changed; all traces cleared
MSG
STATUS
Attenuation
Mech Atten
16 dB
Auto
Man
Mech Atten Step
2dB
10dB
Max Mixer Lvl
-10.00 dBm

Conducted Spurious Emissions (2.36 GHz – 3 GHz)

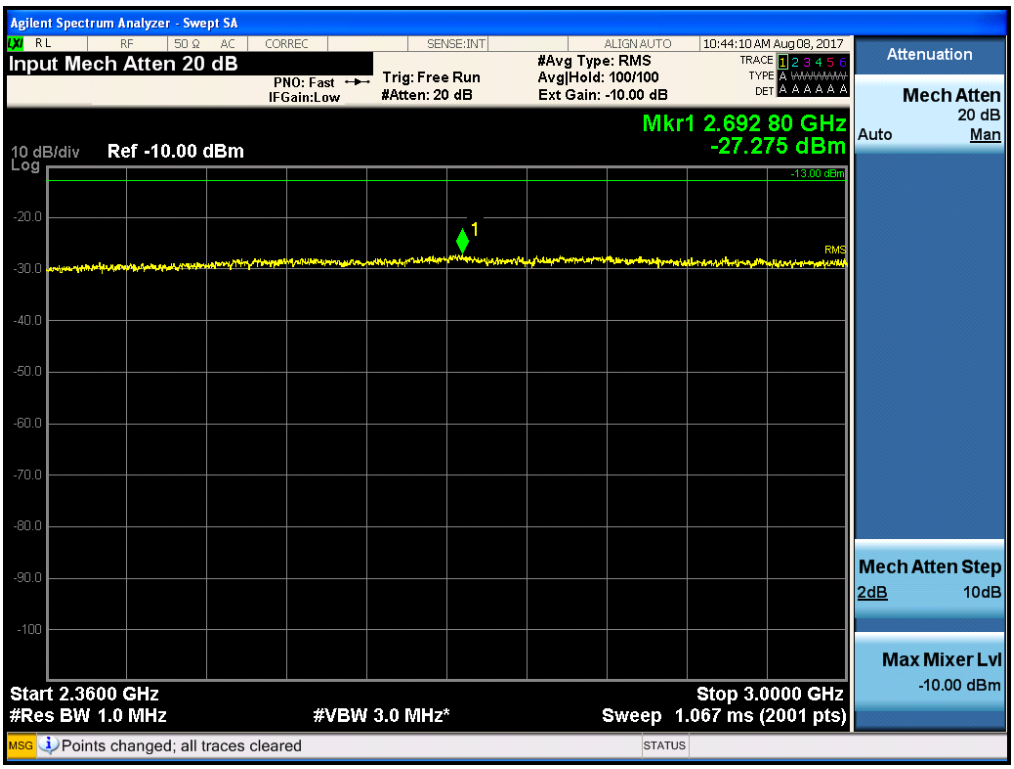
[Uplink Low]



[Uplink Middle]

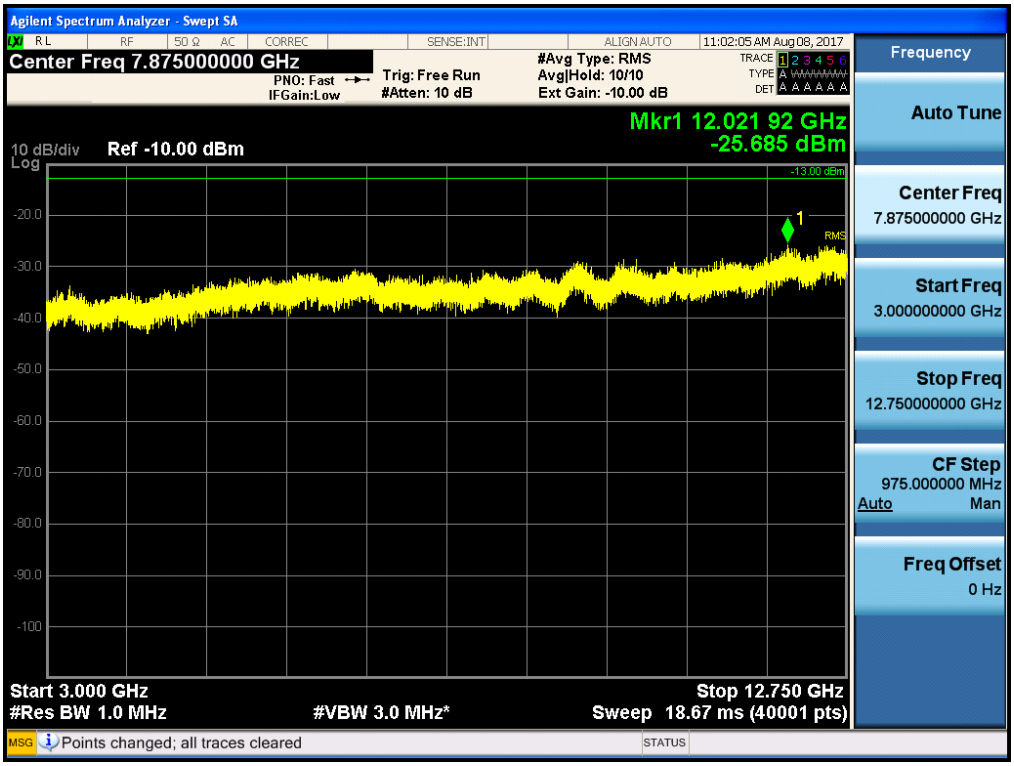


[Uplink High]

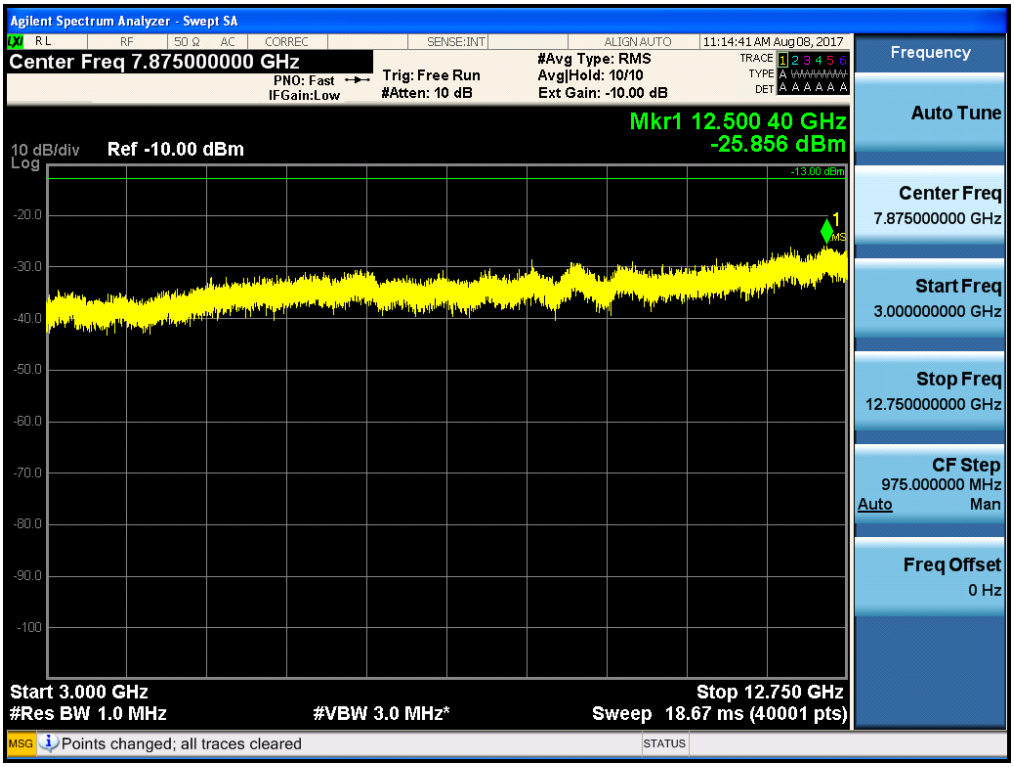

Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
CORREC
SENSE:INT
ALIGN AUTO
10:44:10 AM Aug 08, 2017
Input Mech Atten 20 dB
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 100/100
Ext Gain: -10.00 dB
TRACE 1 2 3 4 5 6
TYPE A WWWWW
DET A A A A A A
Mkr1 2.692 80 GHz
-27.275 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
1
RMS
Start 2.3600 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 3.0000 GHz
Sweep 1.067 ms (2001 pts)
MSG
Points changed; all traces cleared
STATUS
Attenuation
Mech Atten
20 dB
Auto
Man
Mech Atten Step
2dB
10dB
Max Mixer Lvl
-10.00 dBm

Conducted Spurious Emissions (3 GHz – 12.75 GHz)

[Uplink Low]



[Uplink Middle]



[Uplink High]


Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
CORREC
SENSE:INT
ALIGN AUTO
10:44:21 AM Aug 08, 2017
Input Mech Atten 10 dB
PNO: Fast
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 WWWWW
DET A A A A A A
Mkr1 12.496 26 GHz
-24.744 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 3.000 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
MSG
STATUS
Attenuation
Mech Atten
10 dB
Auto
Man
Mech Atten Step
2dB
10dB
Max Mixer Lvl
-10.00 dBm

Conducted Spurious Emissions (12.75 GHz – 26.5 GHz)

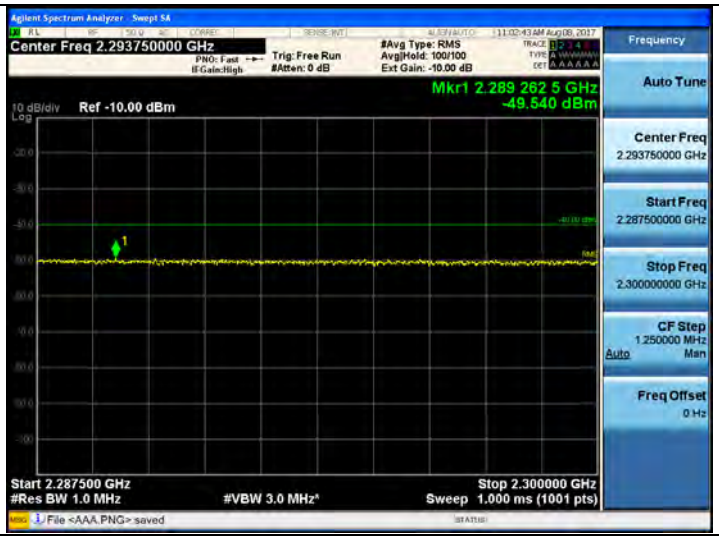
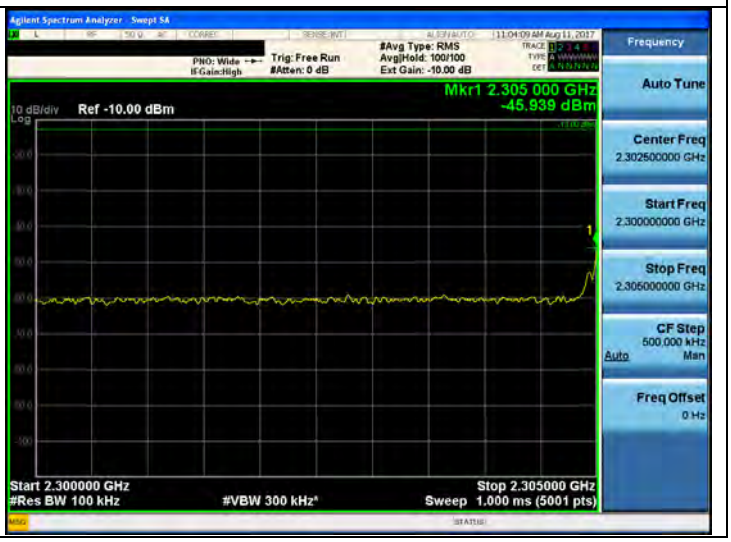
[Uplink Low]

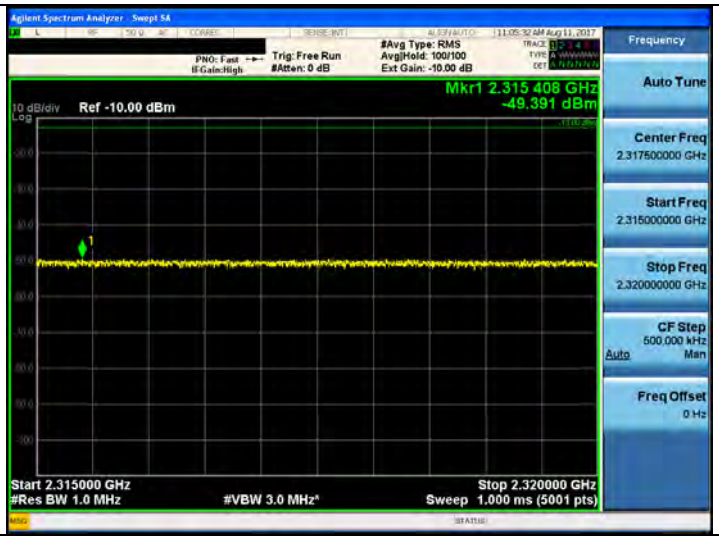
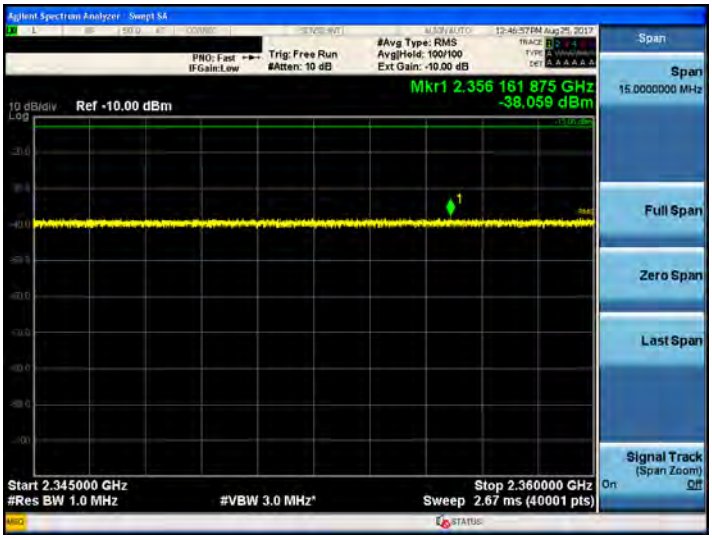
[Uplink Middle]

[Uplink High]

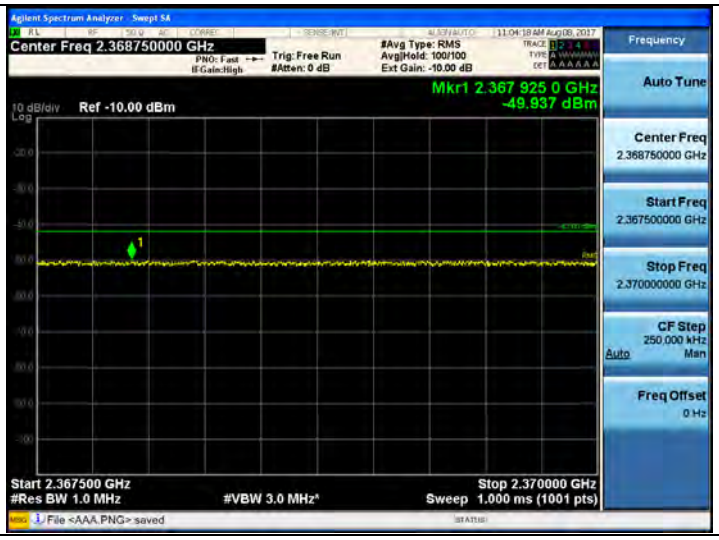

Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
CORREC
SENSE:INT
ALIGN AUTO
10:44:31 AM Aug 08, 2017
Input Mech Atten 0 dB
PNO: Fast
IFGain:High
Trig: Free Run
#Atten: 0 dB
#Avg Type: RMS
Avg|Hold: 10/10
Ext Gain: -10.00 dB
TRACE 1 2 3 4 5 6
TYPE A WWWWW
DET A A A A A A
Mkr1 25.481 8 GHz
-17.672 dBm
10 dB/div
Log
Ref -10.00 dBm
00 dBm
RMS
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100
Start 12.750 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 26.500 GHz
Sweep 34.67 ms (40001 pts)
MSG
File <AAA.PNG> saved
STATUS
Attenuation
Mech Atten
0 dB
Auto
Man
Mech Atten Step
2dB
10dB
Max Mixer Lvl
-10.00 dBm

[Uplink Low]

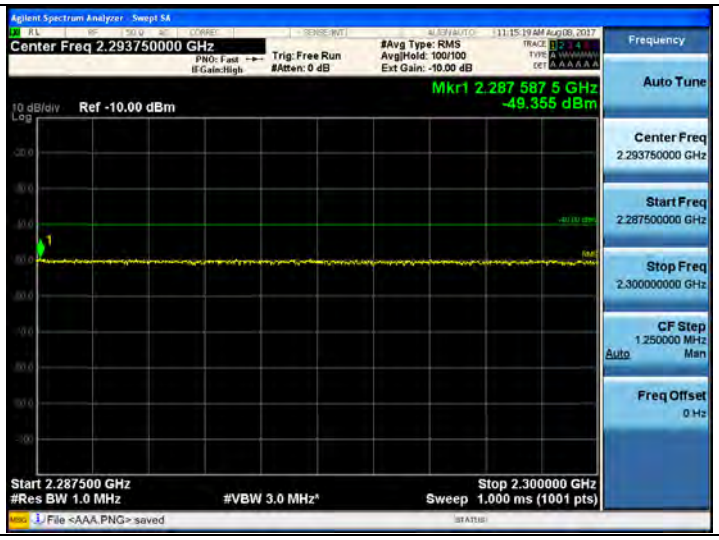
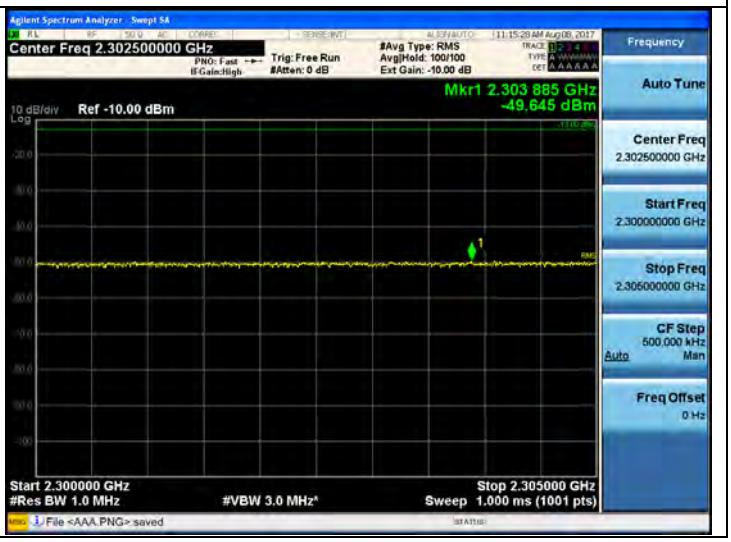
2200 ㎒ ~ 2285 ㎒	2285 ㎒ ~ 2287.5 ㎒
	
2287.5 ㎒ ~ 2300 ㎒	**2300 ㎒ ~ 2305 ㎒**
	

2315 ㎒ ~ 2320 ㎒	2320 ㎒ ~ 2345 ㎒
	
2345 ㎒ ~ 2360 ㎒	**2360 ㎒ ~ 2362.5 ㎒**
	

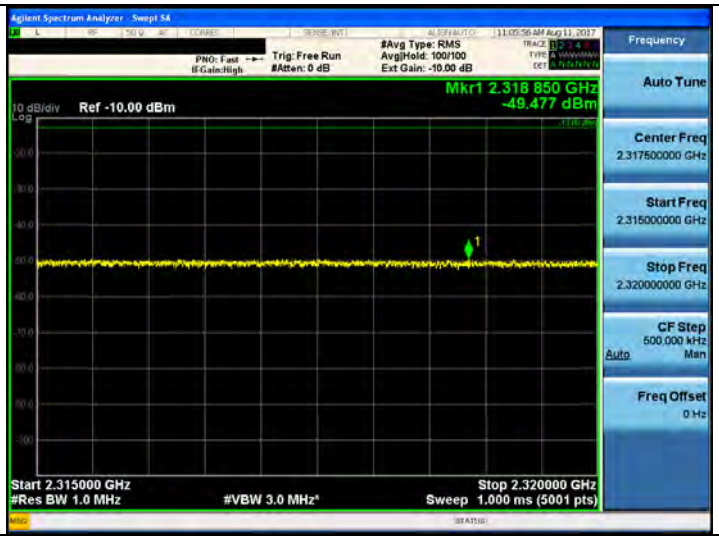
*** RBW(100KHz) was reduced to 10% of the reference bandwidth for measuring unwanted emission level and power was integrated.(10% = +10 dB)**

2362.5 ㎒ ~ 2365 ㎒	2365 ㎒ ~ 2367.5 ㎒
	
2367.5 ㎒ ~ 2370 ㎒	**2370 ㎒ ~ 2395 ㎒**
	

[Uplink Middle]

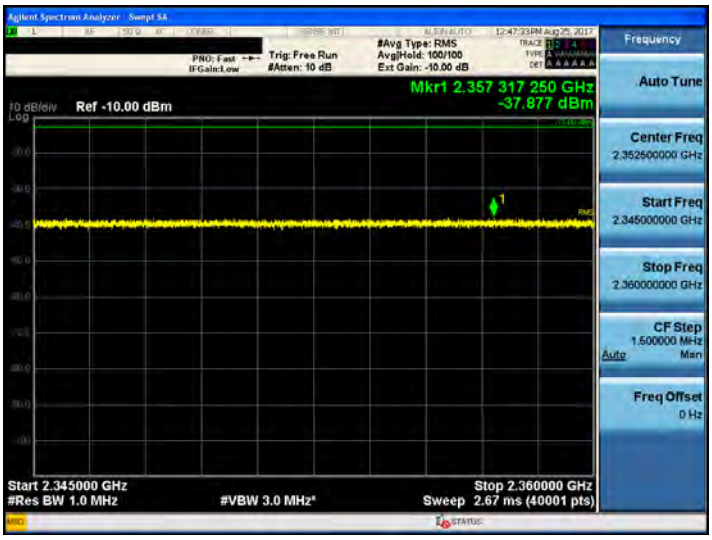
2200 ㎒ ~ 2285 ㎒	2285 ㎒ ~ 2287.5 ㎒
	
2287.5 ㎒ ~ 2300 ㎒	**2300 ㎒ ~ 2305 ㎒**
	

2315 ㎒ ~ 2320 ㎒



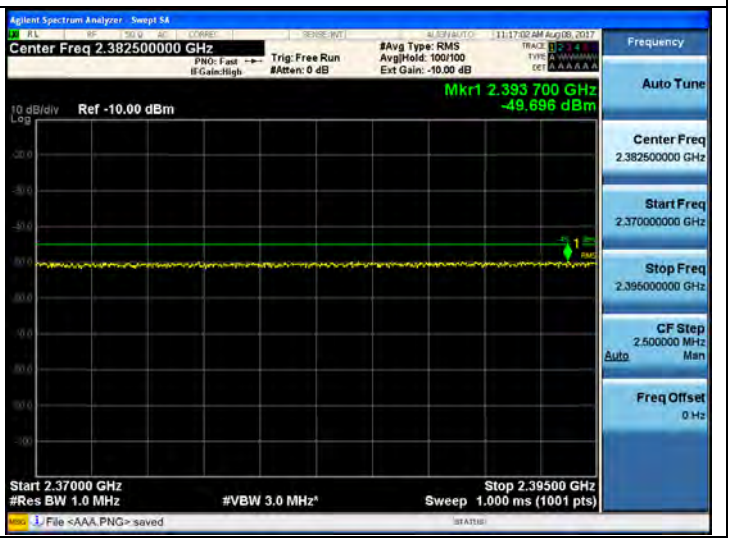
2320 ㎒ ~ 2345 ㎒

2345 ㎒ ~ 2360 ㎒

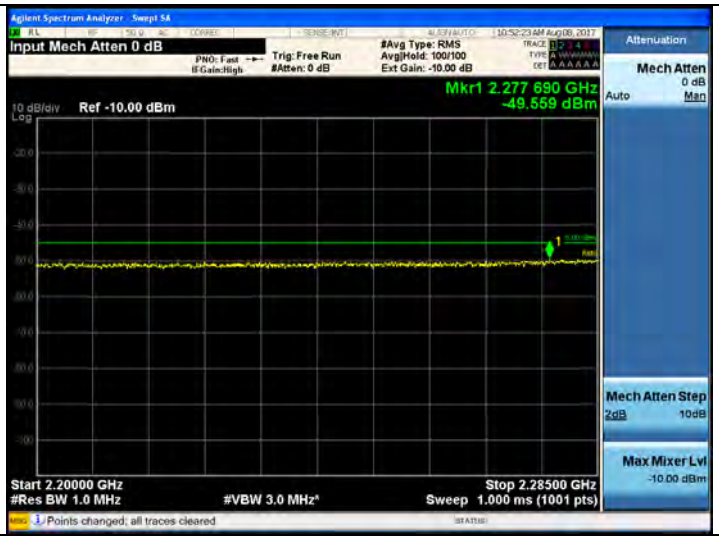
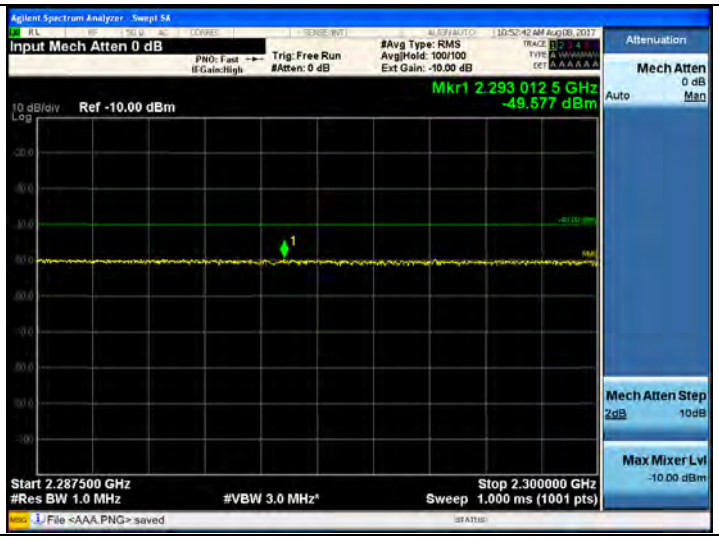
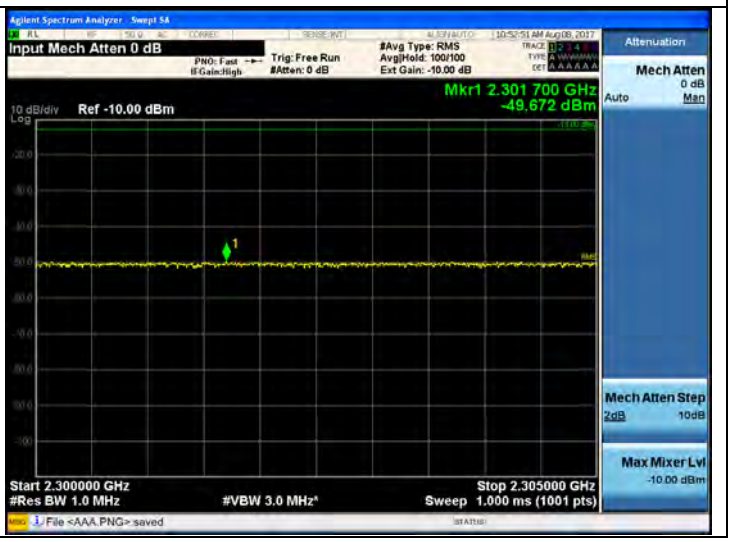


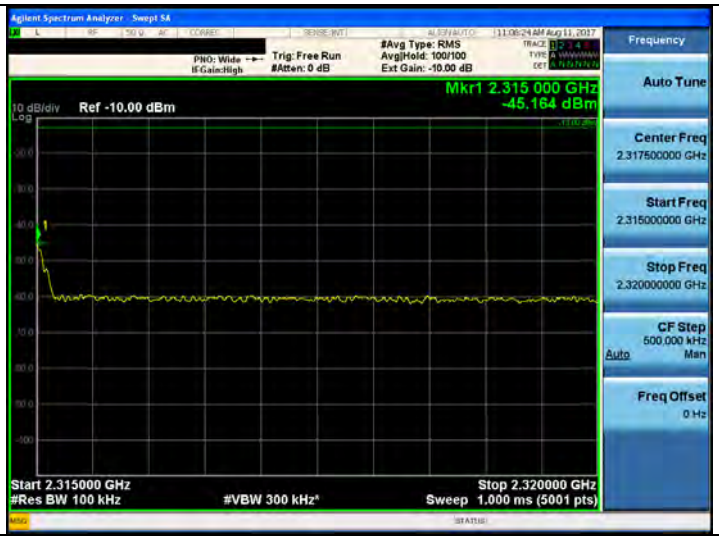
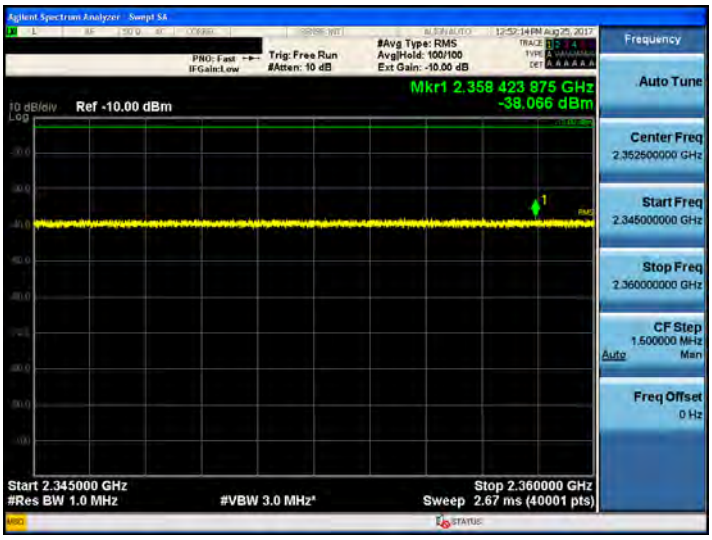
2360 ㎒ ~ 2362.5 ㎒

*** RBW(100KHz) was reduced to 10% of the reference bandwidth for measuring unwanted emission level and power was integrated.(10% = +10 dB)**

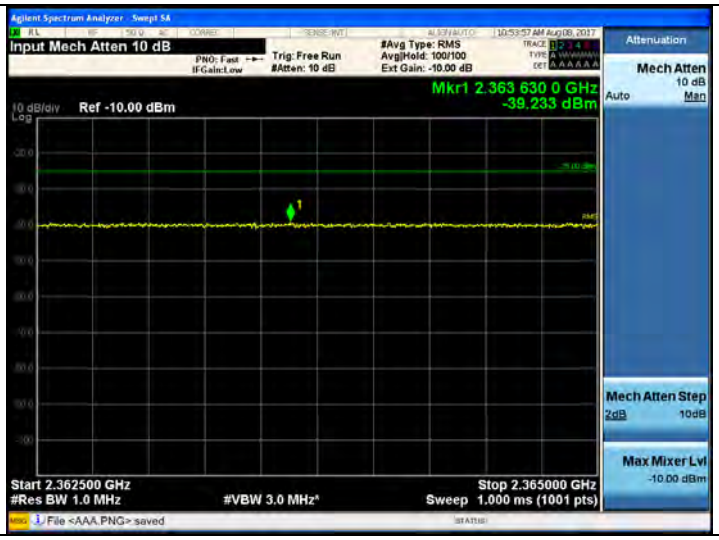
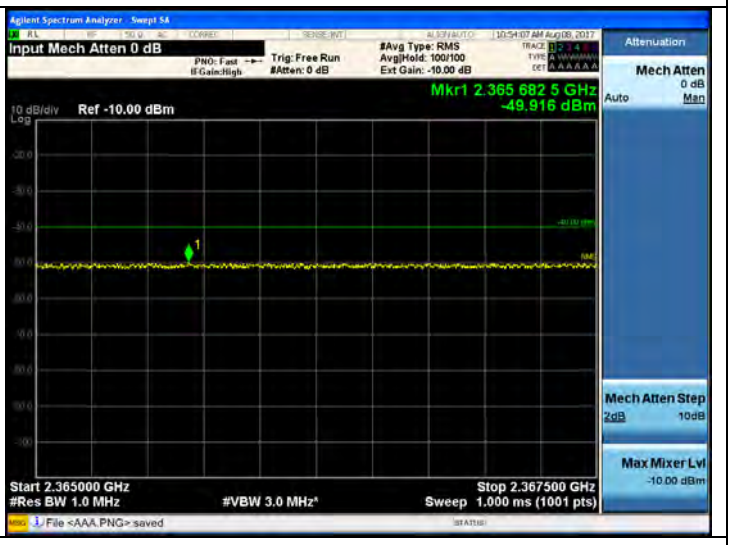
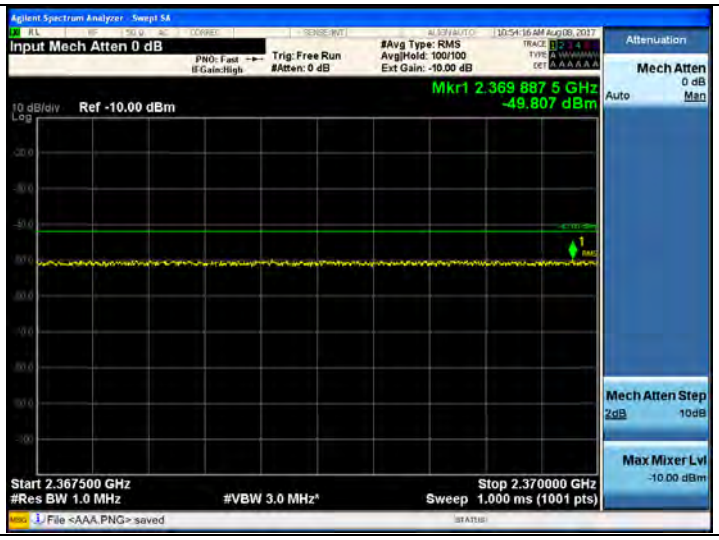
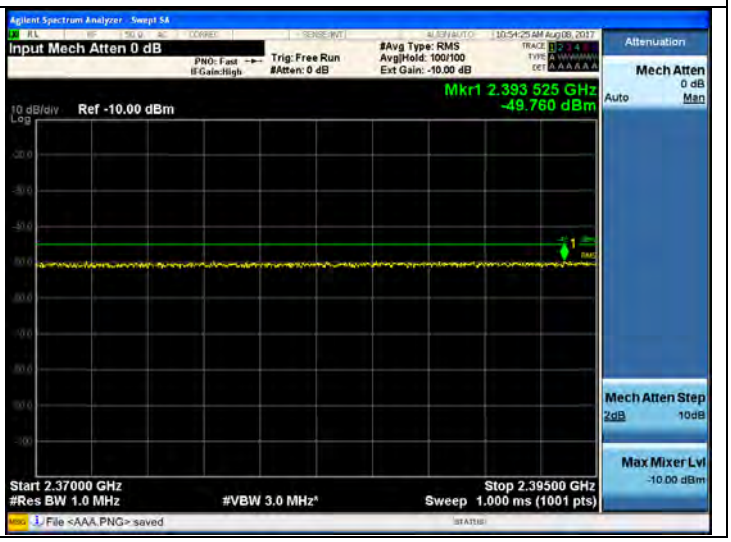
2362.5 ㎒ ~ 2365 ㎒	2365 ㎒ ~ 2367.5 ㎒
	
2367.5 ㎒ ~ 2370 ㎒	**2370 ㎒ ~ 2395 ㎒**
	

[Uplink High]

2200 ㎒ ~ 2285 ㎒	2285 ㎒ ~ 2287.5 ㎒
	
2287.5 ㎒ ~ 2300 ㎒	**2300 ㎒ ~ 2305 ㎒**
	

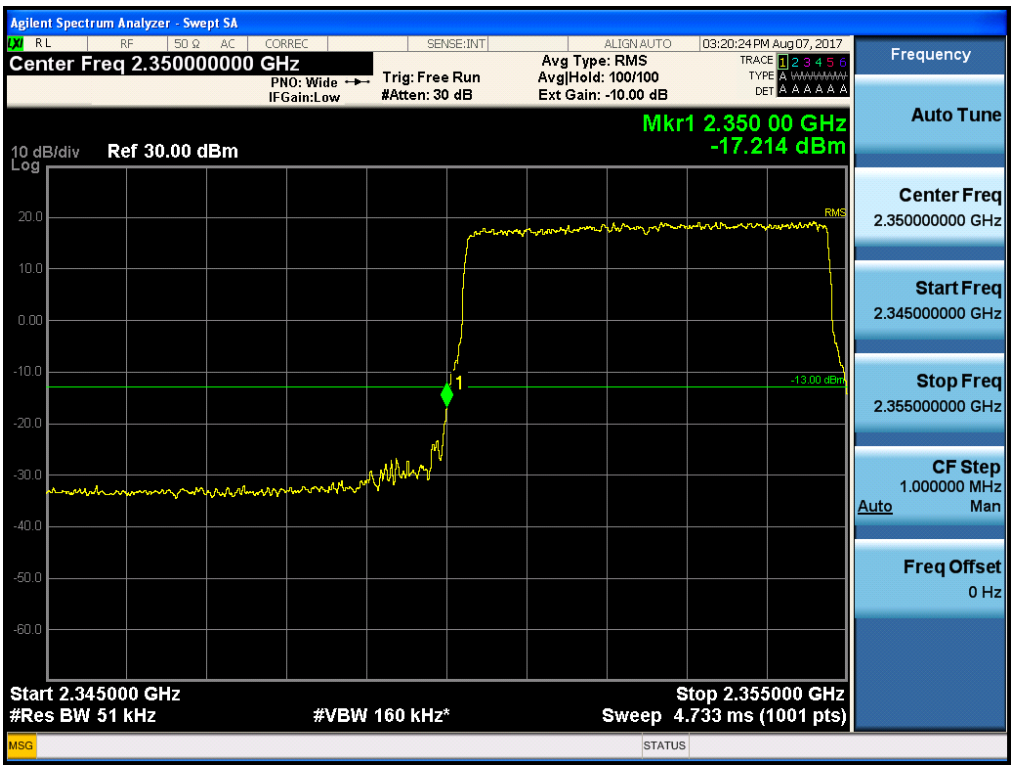
2315 ㎒ ~ 2320 ㎒	2320 ㎒ ~ 2345 ㎒
	
2345 ㎒ ~ 2350 ㎒	**2360 ㎒ ~ 2362.5 ㎒**
	

*** RBW(100KHz) was reduced to 10% of the reference bandwidth for measuring unwanted emission level and power was integrated.(10% = +10 dB)**

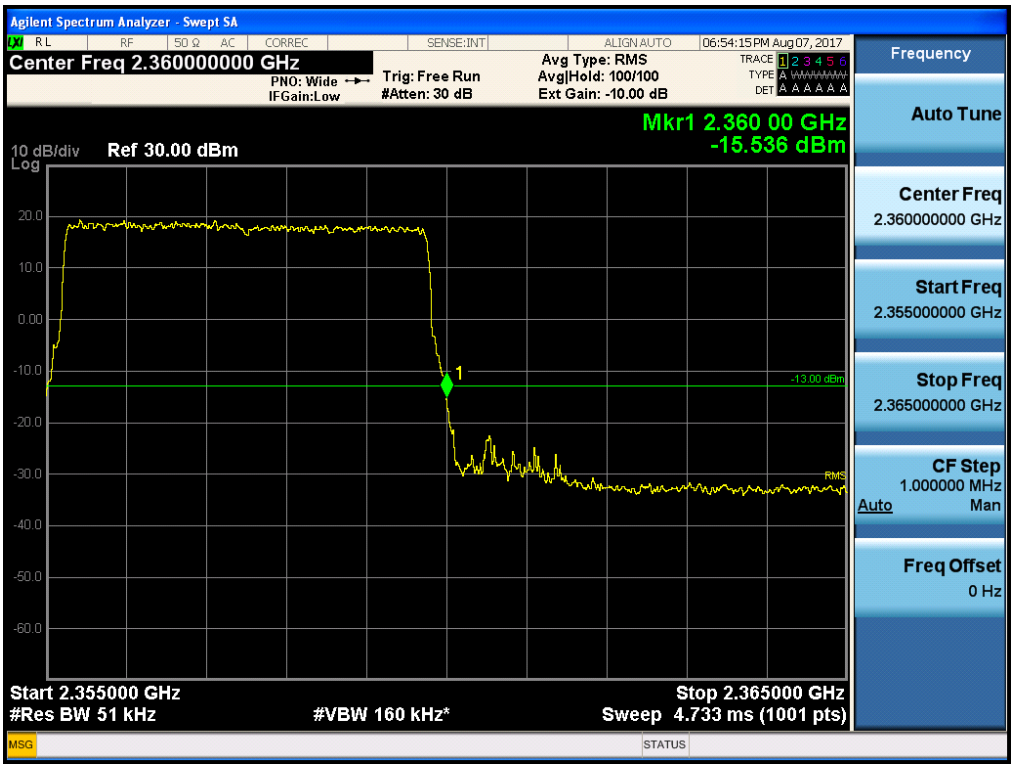
2362.5 ㎒ ~ 2365 ㎒	2365 ㎒ ~ 2367.5 ㎒
	
2367.5 ㎒ ~ 2370 ㎒	**2370 ㎒ ~ 2395 ㎒**
	

Single channel Enhancer Band Edge_WCS BAND LTE 5 MHz

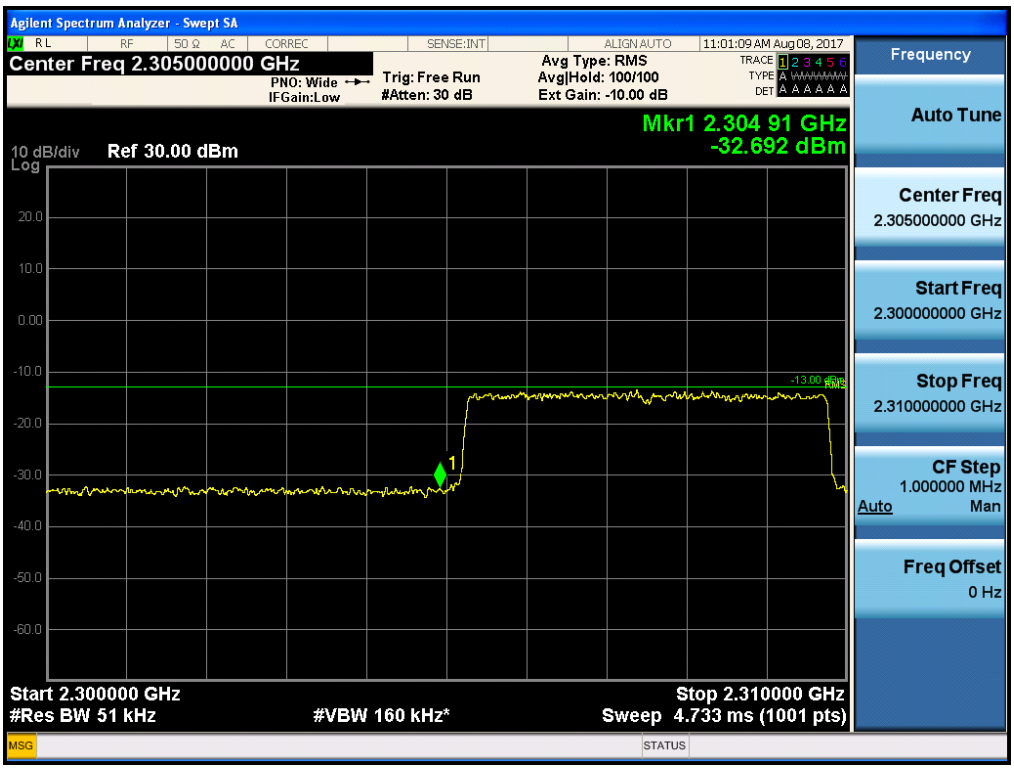
[Downlink Low]



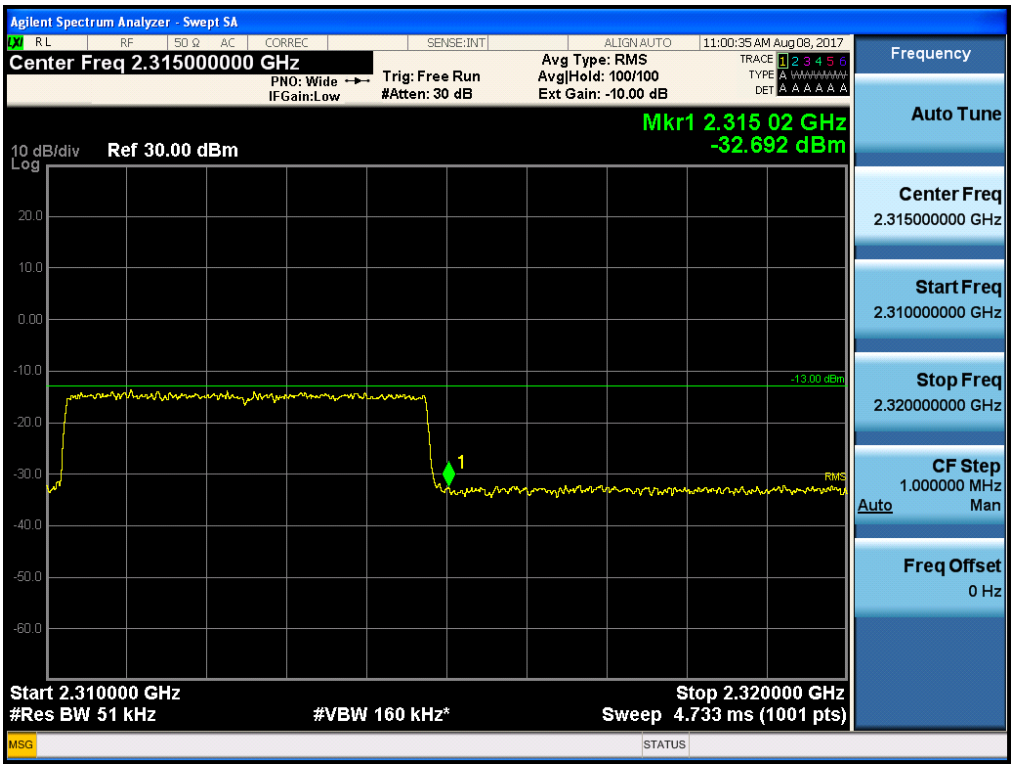
[Downlink High]



[Uplink Low]

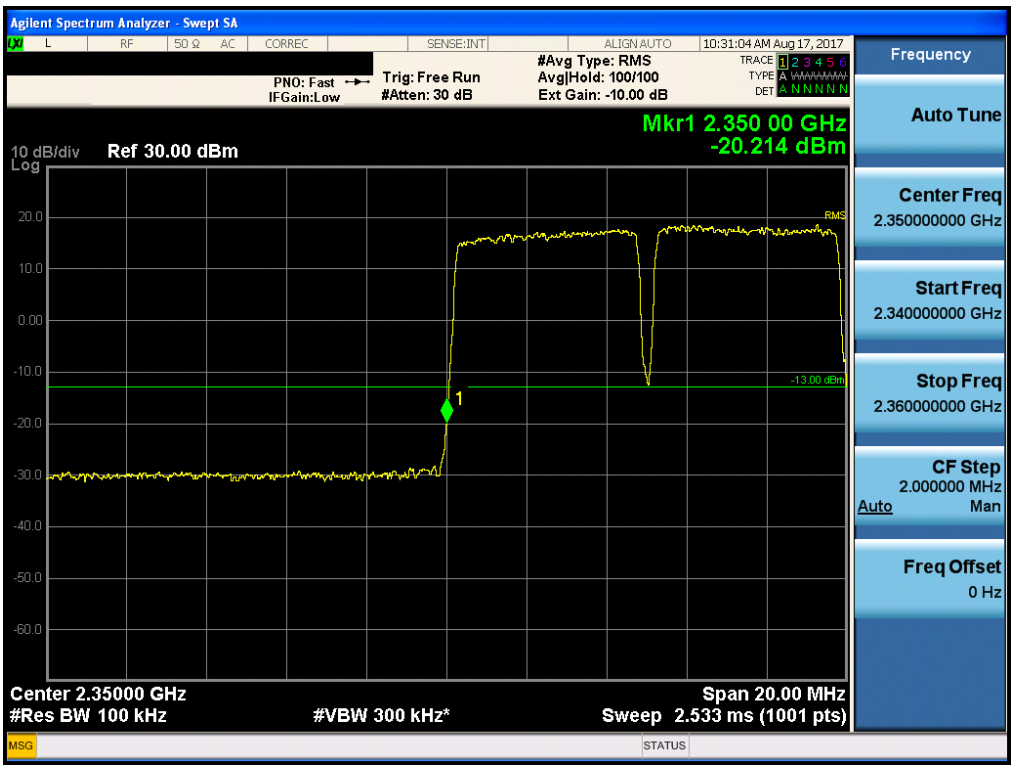


[Uplink High]

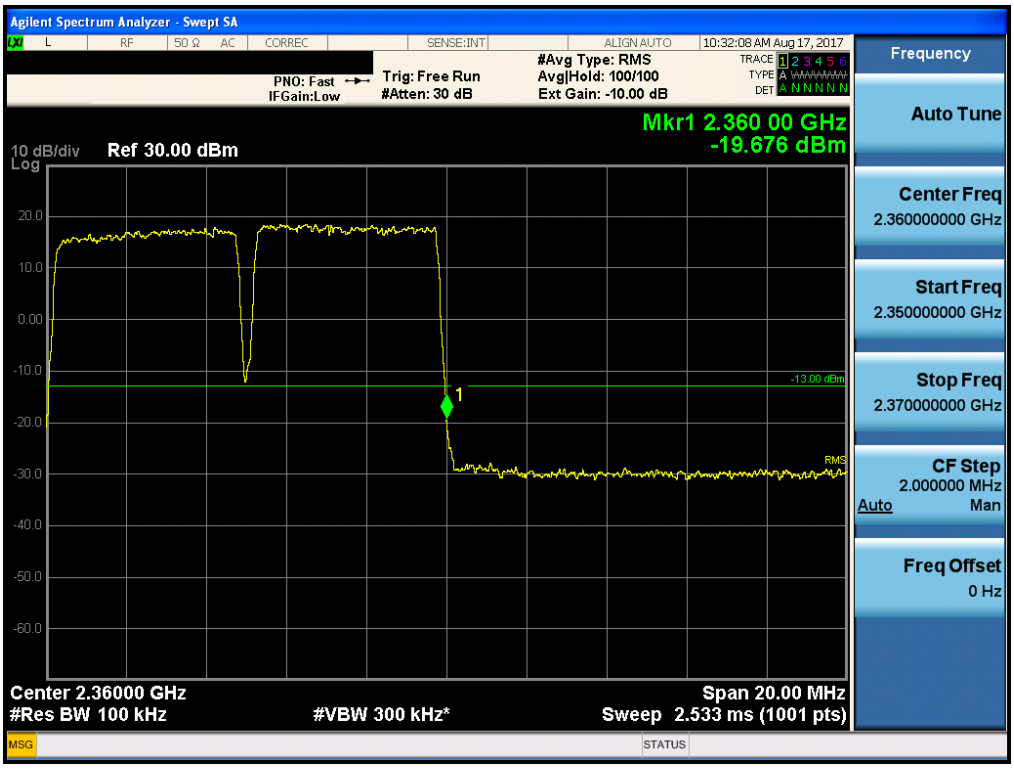


Intermodulation Spurious Emissions for WCS BAND LTE 5 MHz

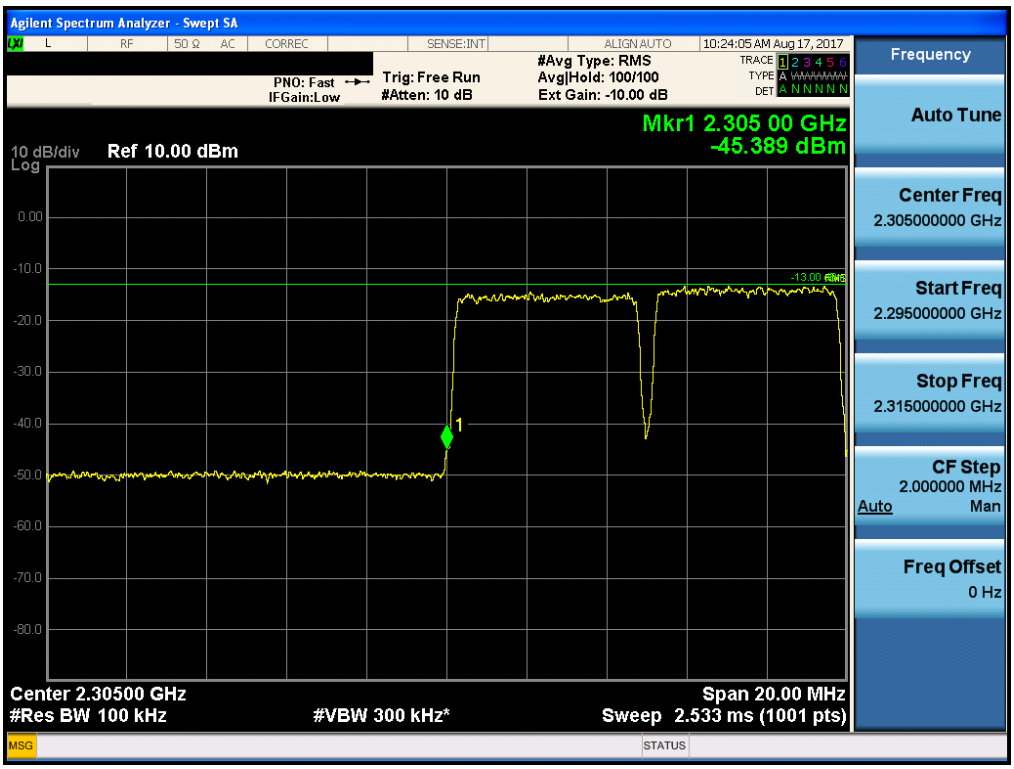
[Downlink Low]



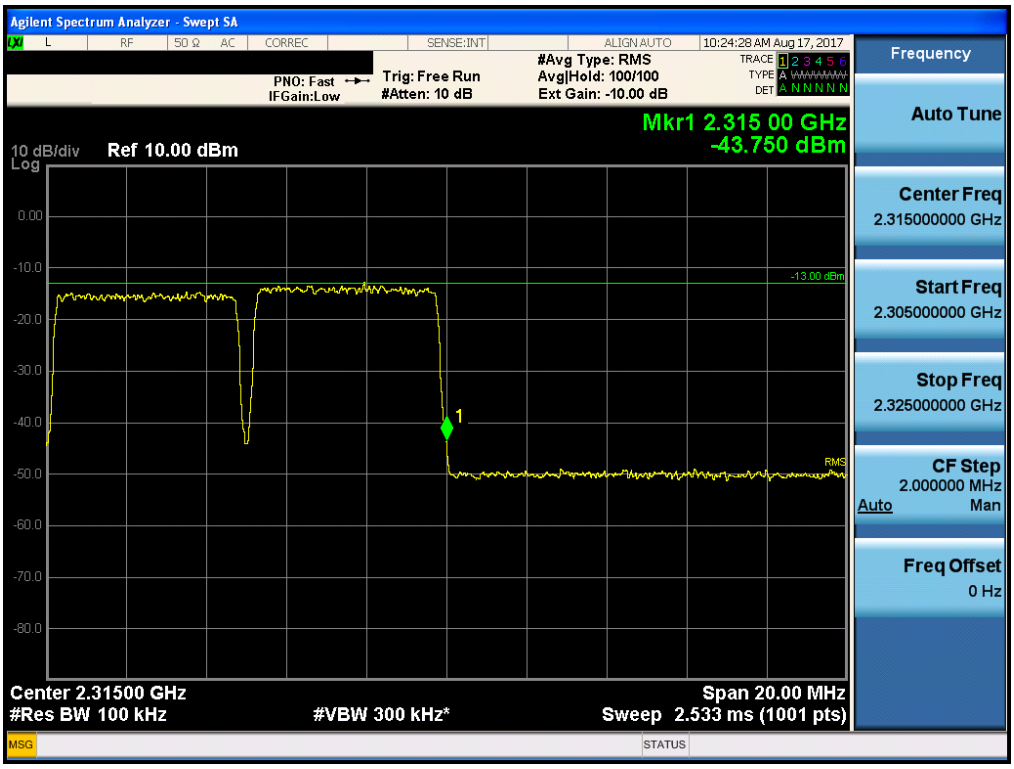
[Downlink High]



[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.

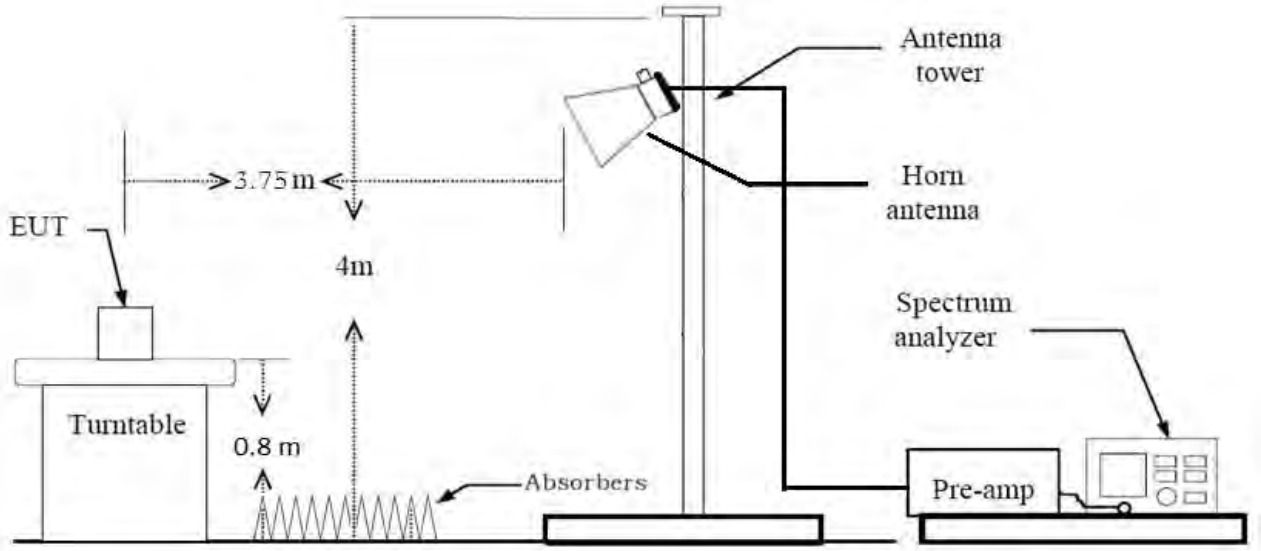
Test Procedures:

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	dBμN	dB /m	dB	(H/V)	dBμN/m	dBμN/m	dB
No critical peaks found							

Above 1 GHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBμN	dB /m	dB	(H/V)	dBμN/m	dBμN/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]	A.G. [dB]	H.P.F.. [dB]	D.F. [dB]	Pol.	Result [dBm]
Low	4,705.00	59.26	-35.94	31.090	6.840	44.66	-0.23	1.96	H	-40.940
2352.5	4,705.00	56.29	-38.91	31.090	6.840	44.66	-0.23	1.96	V	-43.910
Mid	4,710.00	55.87	-39.33	31.100	6.930	44.66	-0.24	1.96	H	-44.240
2355	-	-	-	-	-	-	-	-	-	-
High	4,715.00	62.00	-33.20	31.110	6.850	44.57	-0.28	1.96	H	-38.130
2357.5	4,715.00	57.98	-37.22	31.110	6.850	44.57	-0.28	1.96	V	-42.150

* 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-195

5. Transmitter and Receiver Standard Specifications

5.4 Frequency Stability

The applicant shall ensure frequency stability by showing that the occupied bandwidth is maintained within the range of the operating frequency blocks when testing under the temperature and supply voltage variations specified for the frequency stability measurement in RSS-Gen.

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-determining circuit 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:

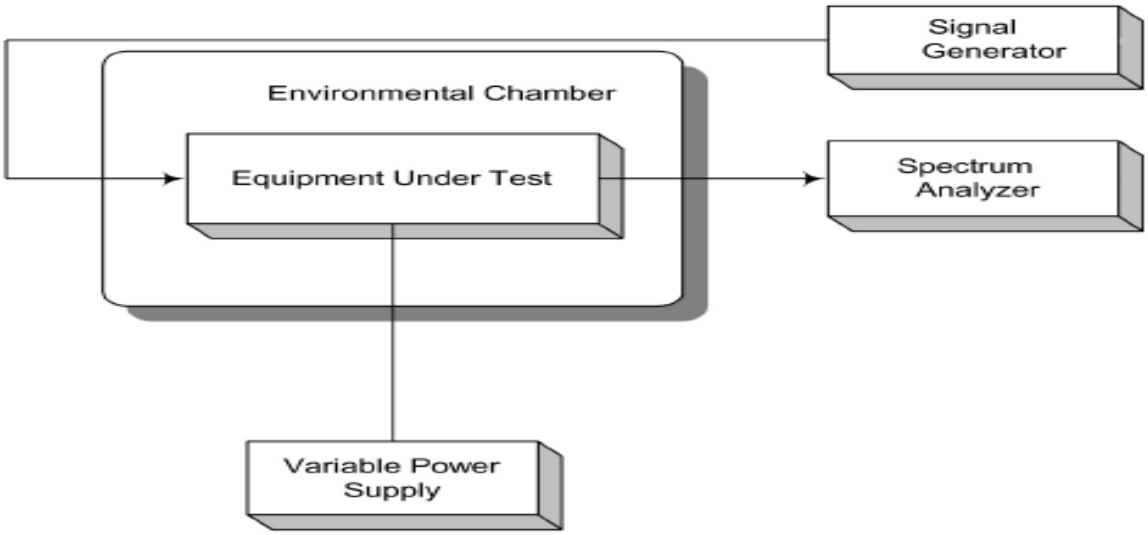
(a) at the temperatures of −30°C (−22°F), +20°C (+68°F) and +50°C (+122°F), and at the manufacturer's rated supply voltage; and

(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:

[Downlink]

Reference: 120 Vac at 20°C **Freq.** = 2355.0 MHz

Voltage (%)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100%	+20(Ref)	2355 000 000	0.410	0.000	0.00000
	-30	2355 000 001	0.881	0.472	0.00020
	-20	2355 000 000	-0.040	-0.450	-0.00019
	-10	2355 000 001	0.829	0.420	0.00018
	0	2355 000 000	0.269	-0.141	-0.00006
	+10	2355 000 000	-0.136	-0.546	-0.00023
	+30	2355 000 000	0.367	-0.043	-0.00002
	+40	2355 000 000	0.359	-0.051	-0.00002
	+50	2355 000 001	0.980	0.570	0.00024
High	+20	2355 000 000	-0.278	-0.688	-0.00029
Low	+20	2355 000 000	0.275	-0.135	-0.00006

[Uplink]

Reference: 120 Vac at 20°C **Freq.** = 2310.0 MHz

Voltage (%)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100%	+20(Ref)	2310 000 000	0.371	0.000	0.00000
	-30	2310 000 000	0.372	0.001	0.00000
	-20	2310 000 000	-0.133	-0.504	-0.00021
	-10	2310 000 000	0.459	0.088	0.00004
	0	2310 000 000	0.172	-0.199	-0.00008
	+10	2309 999 999	-0.639	-1.010	-0.00043
	+30	2310 000 001	0.553	0.182	0.00008
	+40	2310 000 000	0.046	-0.325	-0.00014
	+50	2310 000 000	0.205	-0.166	-0.00007
High	+20	2310 000 000	-0.312	-0.683	-0.00029
Low	+20	2310 000 000	0.072	-0.299	-0.00013