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 REPORT

Certification

Applicant Name:
SOLiD, Inc.

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

Date of Issue:
September 22, 2016

Location:
HCT CO., LTD.,
74, Seoicheon-ro 578beon-gil, Majang-myeon,
Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

Report No.: HCT-R-1609-F023
HCT FRN: 0005866421
IC Recognition No.: 5944A-5

FCC ID:	**W6UHM23WCS**
APPLICANT:	**SOLiD, Inc**

FCC Model(s):	MRDU_2300_WCS
EUT Type:	ALLIANCE_5W
Frequency Ranges:	2350-2360 MHz (Downlink)
Conducted Output Power:	5 W (37 dBm)
Date of Test:	September 8, 2016 ~ September 21, 2016
FCC Rule Part(s):	CFR 47 Part 2, Part 27

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
Test Engineer of RF Team

Approved by
: Jong Seok Lee
Manager of RF Team

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1609-F023	September 22, 2016	- First Approval Report

Table of Contents

1. CLIENT INFORMATION

The EUT has been tested by request of

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

FCC ID:	W6UHM23WCS
EUT Type:	ALLIANCE_5W
FCC Model(s):	MRDU_2300_WCS
Frequency Ranges:	2350-2360 MHz (Downlink)
Conducted Output Power:	5 W (37 dBm)
Antenna Gain(s):	Manufacturer does not provide an antenna.
Measurement standard(s):	ANSI/TIA-603-C-2004, KDB 971168 D01 v02r02, KDB 935210 D02 v03r02, KDB 935210 D05 v01r01.
FCC Rule Part(s):	CFR 47 Part 2, Part 27
Place of Tests:	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA(IC Recognition No. : 5944A-5)

2. FACILITIES AND ACCREDITATIONS

2.1. FACILITIES

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

Description	Reference (FCC)	Results
Conducted RF Output Power	§2.1046, §27.50	Compliant
Occupied Bandwidth	§2.1049	Compliant
Passband Gain and Bandwidth & Out of Band Rejection	KDB 935210 D02 v03r02	Compliant
Spurious Emissions at Antenna Terminals	§2.1051, §27.53	Compliant
Radiated Spurious Emissions	§2.1053, §27.53	Compliant
Frequency Stability	§2.1055, §27.54	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.

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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
Passband Gain and Bandwidth & Out of Band Rejection	Gain 20 dB bandwidth	± 0.89 dB ± 0.58 MHz
Spurious Emissions at Antenna Terminals	-	± 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	E4438C /Signal Generator	09/02/2016	Annual	MY42082646
Agilent	N5182A /Signal Generator	03/29/2016	Annual	MY50141649
Agilent	N5182A /Signal Generator	05/13/2016	Annual	MY47070230
Agilent	N9030A / Signal Analyzer	11/24/2015	Annual	MY49431210
Weinschel	67-30-33 / Fixed Attenuator	10/29/2015	Annual	BR5347
Weinschel	1506A / Power Divider	02/15/2016	Annual	MD793
DEAYOUNG ENT	DFSS60 / AC Power Supply	04/06/2016	Annual	1003030-1
AMETEK	XFR 60-20 / DC Power Supply	02/27/2016	Annual	1045A01016
NANGYEUL CO., LTD.	NY-THR18750 / Temperature and Humidity Chamber	10/27/2015	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	02/23/2016	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	04/15/2015	Biennial	255
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	10/05/2015	Annual	836650/016
Rohde & Schwarz	FSV40-N / Spectrum Analyzer	09/23/2015	Annual	101068-SZ
Wainwright Instruments	WHK1.2/15G-10EF / Highpass Filter	04/11/2016	Annual	4
Wainwright Instruments	WHK3.0/18G-10EF / Highpass Filter	06/24/2016	Annual	8
CERNEX	CBLU1183540 / Power Amplifier	02/01/2016	Annual	24614
CERNEX	CBL06185030 / Power Amplifier	02/01/2016	Annual	24615
CERNEX	CBL18265035 / Power Amplifier	07/11/2016	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.

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.

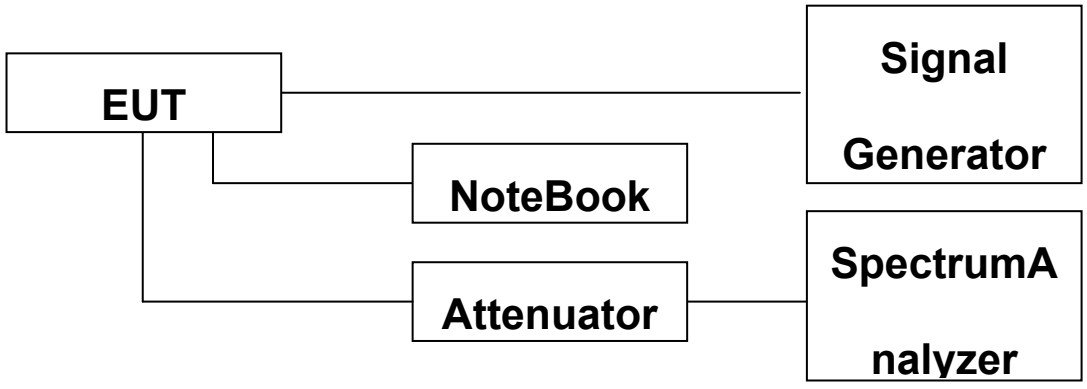
h) Repeat steps f) and g) with input signal amplitude set to 3 dB above the AGC threshold level.

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.

Power measurement Method:

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



Block Diagram 1. RF Power Output Test Setup

Test Results:

Input Signal	Input Level (dBm)	Maximum Amp Gain
2300_WCS	-16 dBm	53 dB

Single channel Enhancer

* Due to EUT's ALC function (Auto Level Control), even if input signal is increased, the same output power is transmit.

[Downlink]

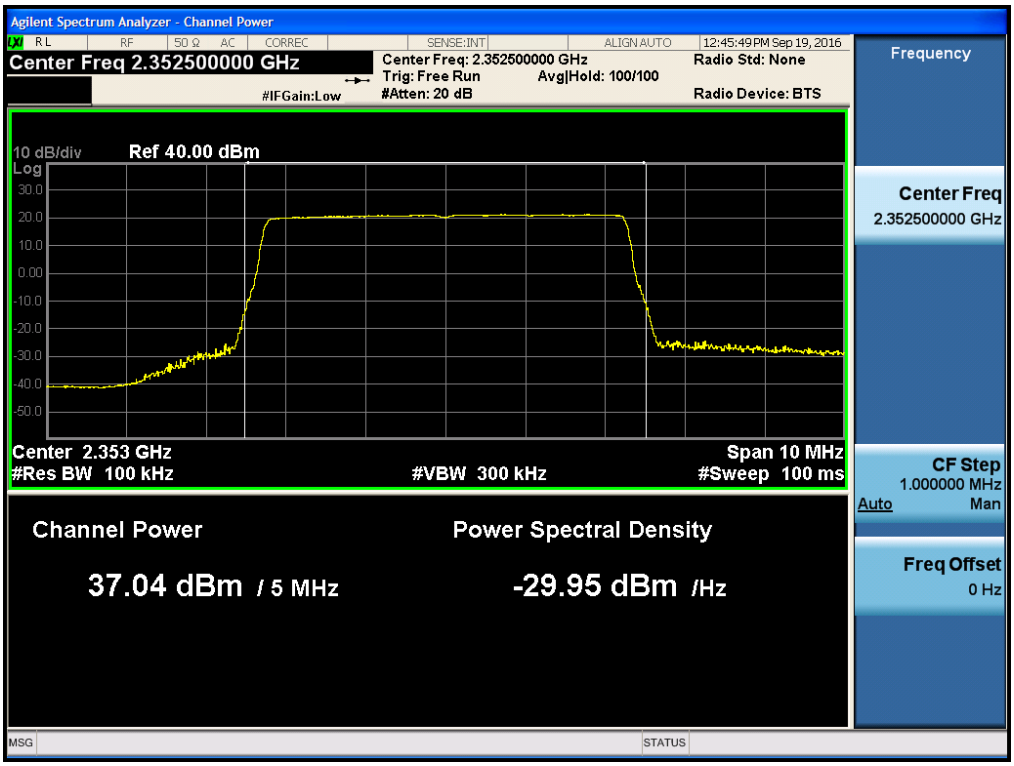
	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
2300_WCS Band_ LTE 5 MHz AGC threshold	Low	2352.50	37.04	5.059
	Middle	-	-	-
	High	2357.50	37.04	5.063
2300_WCS Band_ LTE 5 MHz +3dBm above the AGC threshold	Low	2352.50	37.06	5.076
	Middle	-	-	-
	High	2357.50	37.05	5.074
2300_WCS Band_ LTE 10 MHz AGC threshold	Low	-	-	-
	Middle	2355.00	37.09	5.117
	High	-	-	-
2300_WCS Band_ LTE 10 MHz +3dBm above the AGC threshold	Low	-	-	-
	Middle	2355.00	37.03	5.052
	High	-	-	-

[PAPR]

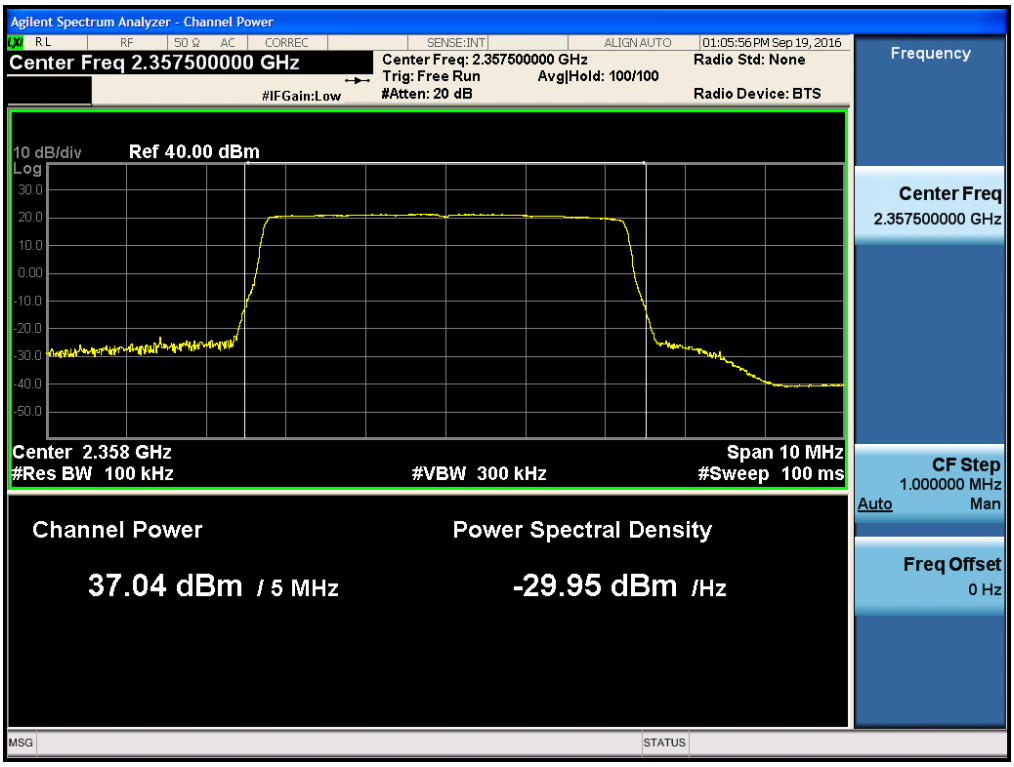
	Channel	Frequency (MHz)	PAPR (dB)
2300_WCS Band_ LTE 10 MHz The peak-to-average ratio (PAPR) AGC threshold	Low	-	-
	Middle	2355.00	8.37
	High	-	-
2300_WCS Band_ LTE 10 MHz The peak-to-average ratio (PAPR) +3dBm above the AGC threshold	Low	-	-
	Middle	2355.00	8.31
	High	-	-

Plots of RF Output Power for 2300_WCS Band LTE 5 MHz

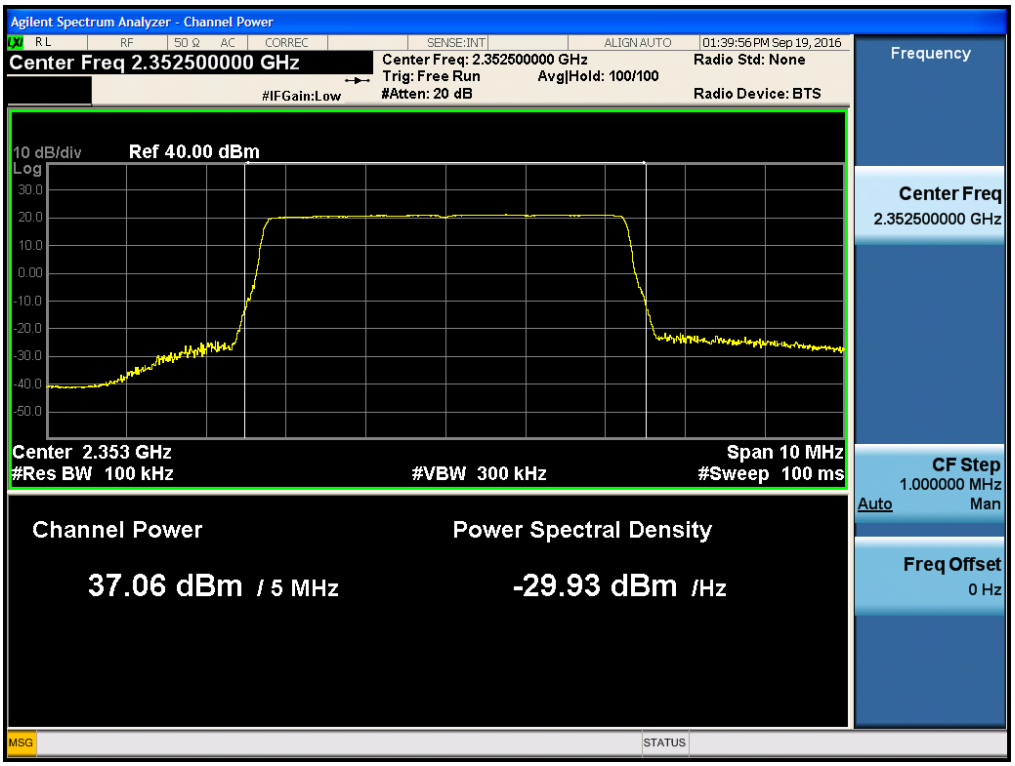
[AGC threshold Downlink Low]



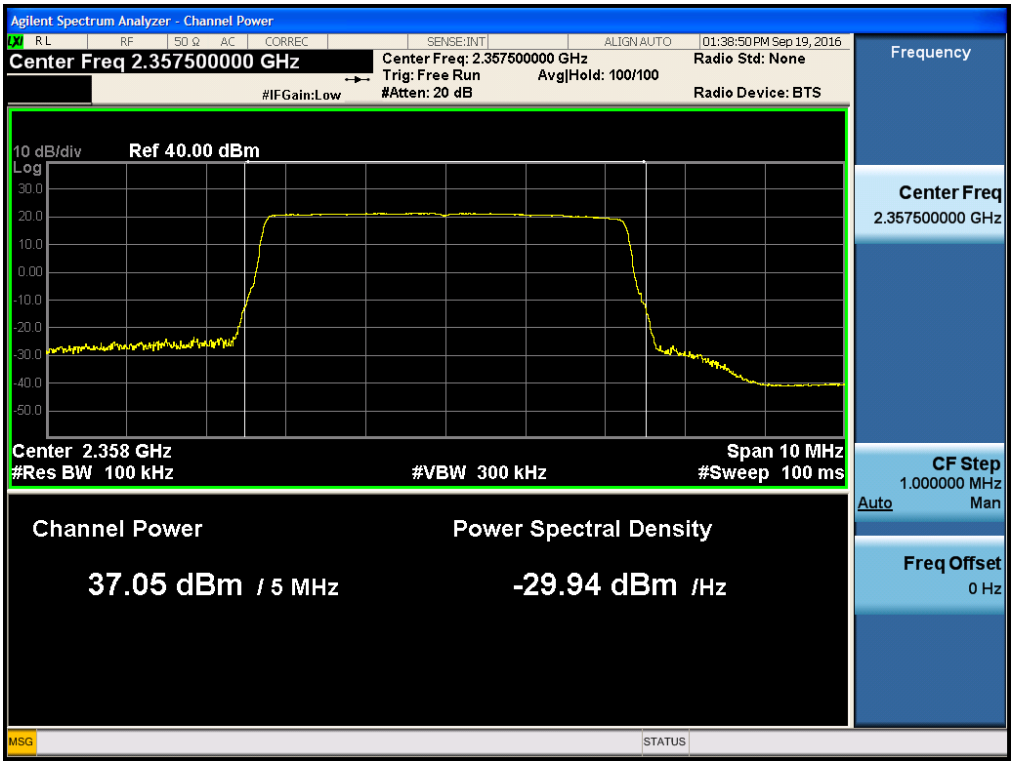
[AGC threshold Downlink High]



[+3dBm above AGC threshold Downlink Low]

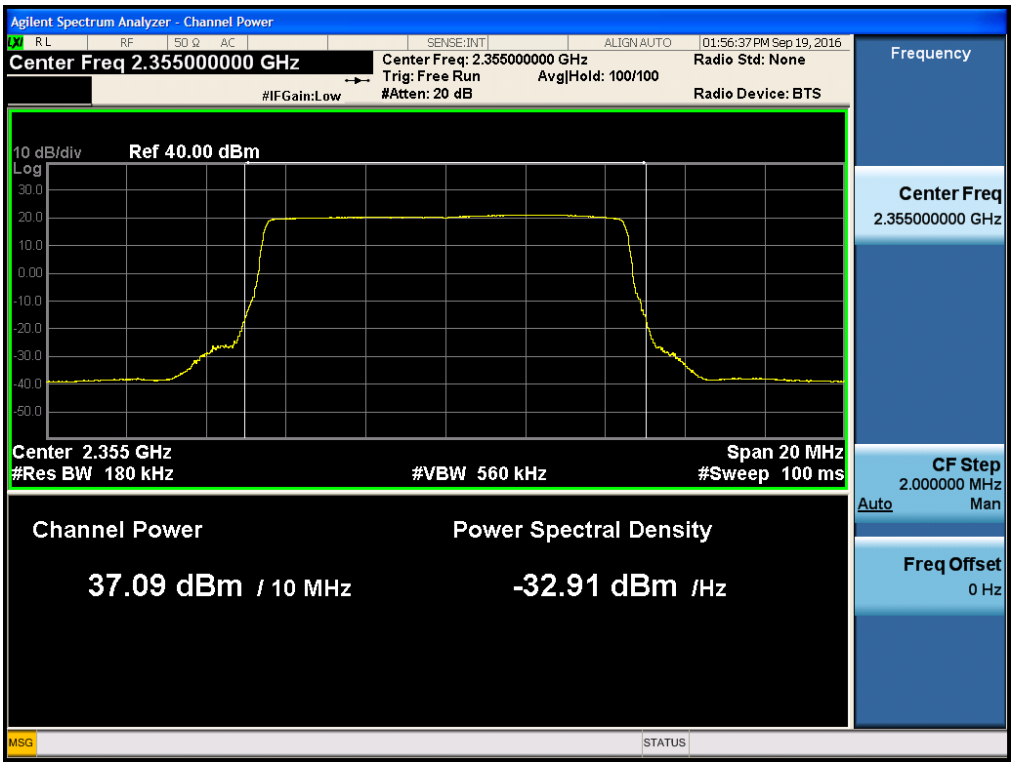


[+3dBm above AGC threshold Downlink High]

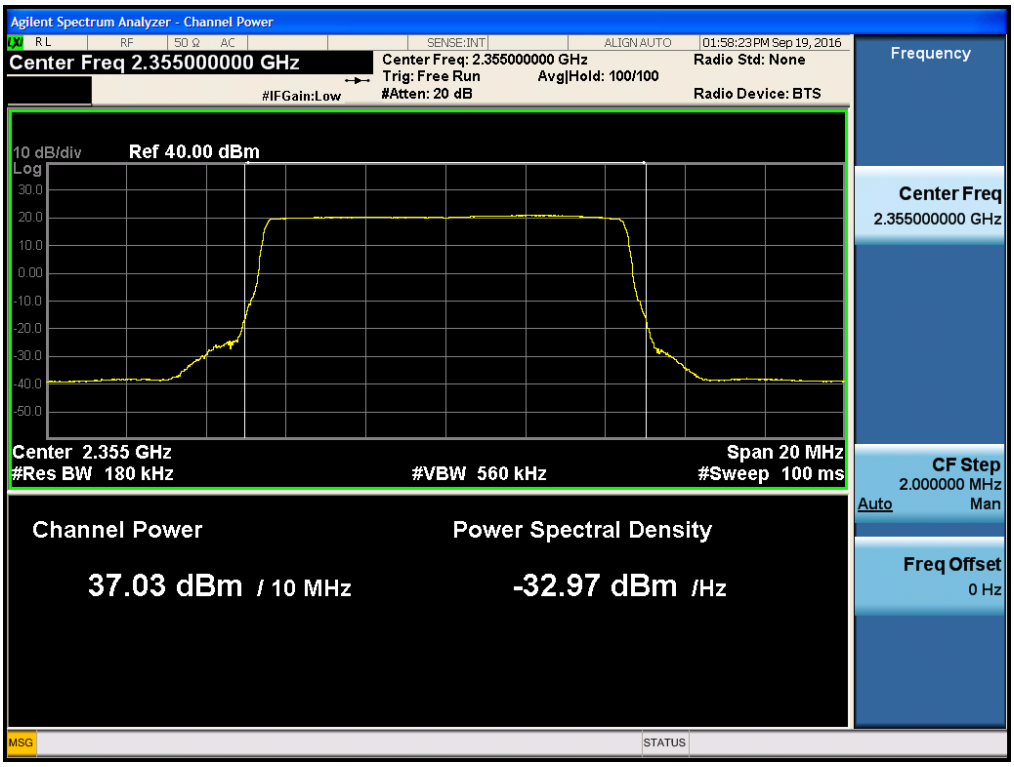


Plots of RF Output Power for 2300_WCS Band LTE 10 MHz

[AGC threshold Downlink Middle]

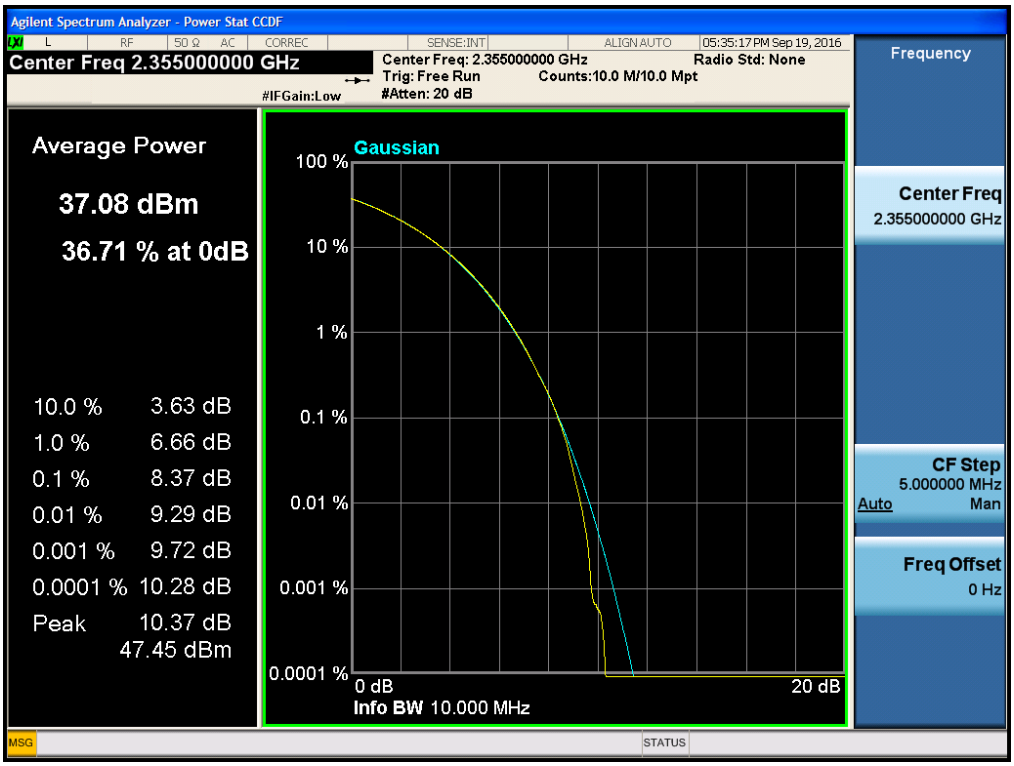


[+3dBm above AGC threshold Downlink Middle]

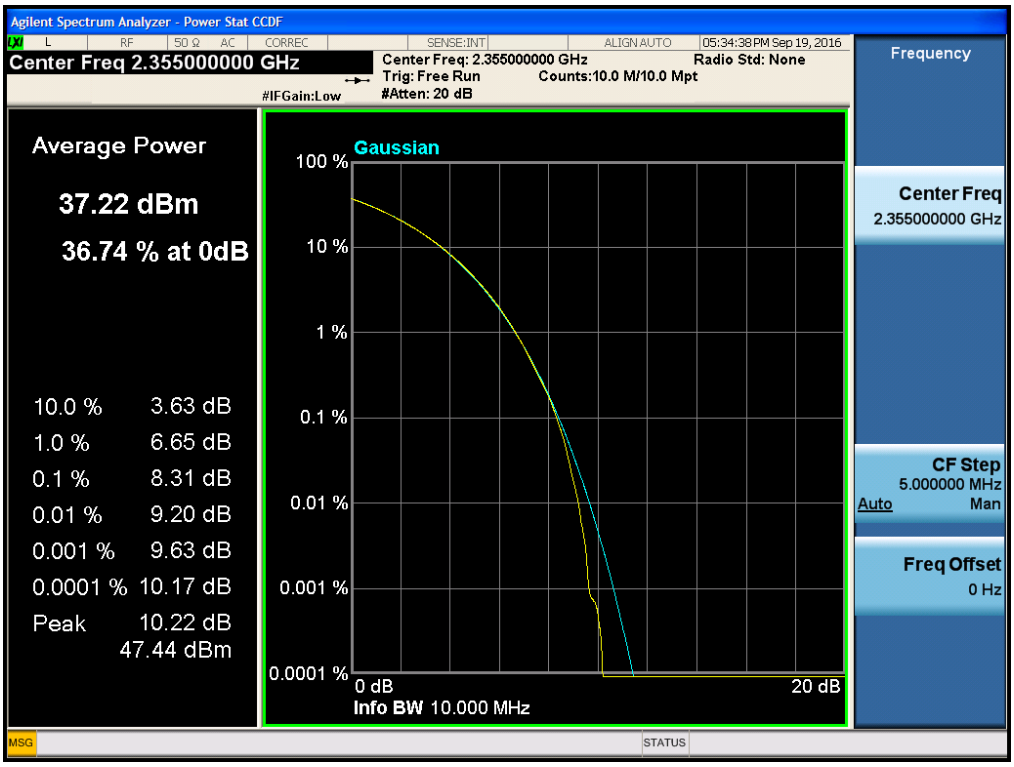


Plots of PAPR for 2300_WCS Band LTE 10 MHz

[AGC threshold Downlink Middle]



[+3dBm above AGC threshold Downlink Middle]



7. OCCUPIED BANDWIDTH

FCC Rules

Test Requirement(s):

§ 2.1049 Measurements required: Occupied bandwidth:

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

Test Procedures:

Measurements were in accordance with the test methods section 3.4 of KDB 935210 D05 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 OBW.

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

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

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

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

i) Set spectrum analyzer detection function to positive peak.

j) Set the trace mode to max hold.

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

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

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

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

Test Results:

The EUT complies with the requirements of this section.

Input Signal	Input Level (dBm)	Maximum Amp Gain
2300_WCS	-16 dBm	53 dB

[Downlink Output_2300_WCS BAND]

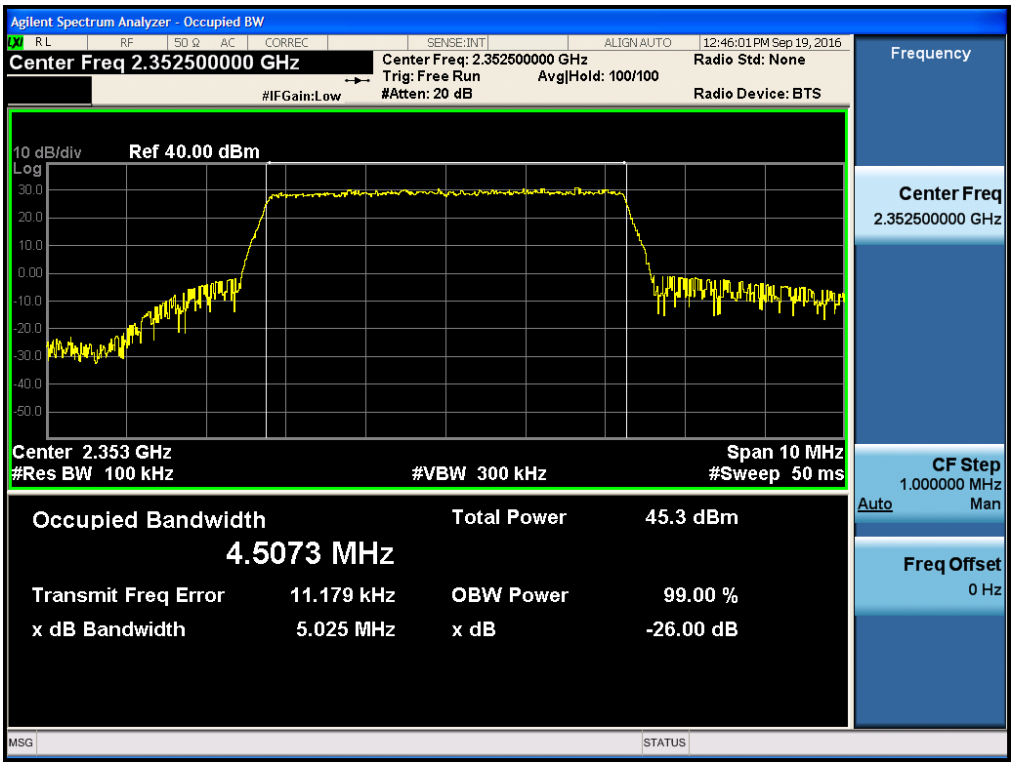
	Channel	**Frequency (MHz)**	**OBW (MHz)**
2300_WCS Band_ LTE 5 MHz AGC threshold	Low	2352.50	4.5073
	Middle	-	-
	High	2357.50	4.4951
2300_WCS Band_ LTE 5 MHz +3dBm above the AGC threshold	Low	2352.50	4.5082
	Middle	-	-
	High	2357.50	4.4937
2300_WCS Band_ LTE 10 MHz AGC threshold	Low	-	-
	Middle	2355.00	8.9557
	High	-	-
2300_WCS Band_ LTE 10 MHz +3dBm above the AGC threshold	Low	-	-
	Middle	2355.00	8.9548
	High	-	-

[Downlink Input_2300_WCS BAND]

	Channel	Frequency (MHz)	OBW (MHz)
2300_WCS Band_ LTE 5 MHz AGC threshold	Low	2352.50	4.5111
	Middle	-	-
	High	2357.50	4.5107
2300_WCS Band_ LTE 10 MHz AGC threshold	Low	-	-
	Middle	2355.00	8.9980
	High	-	-

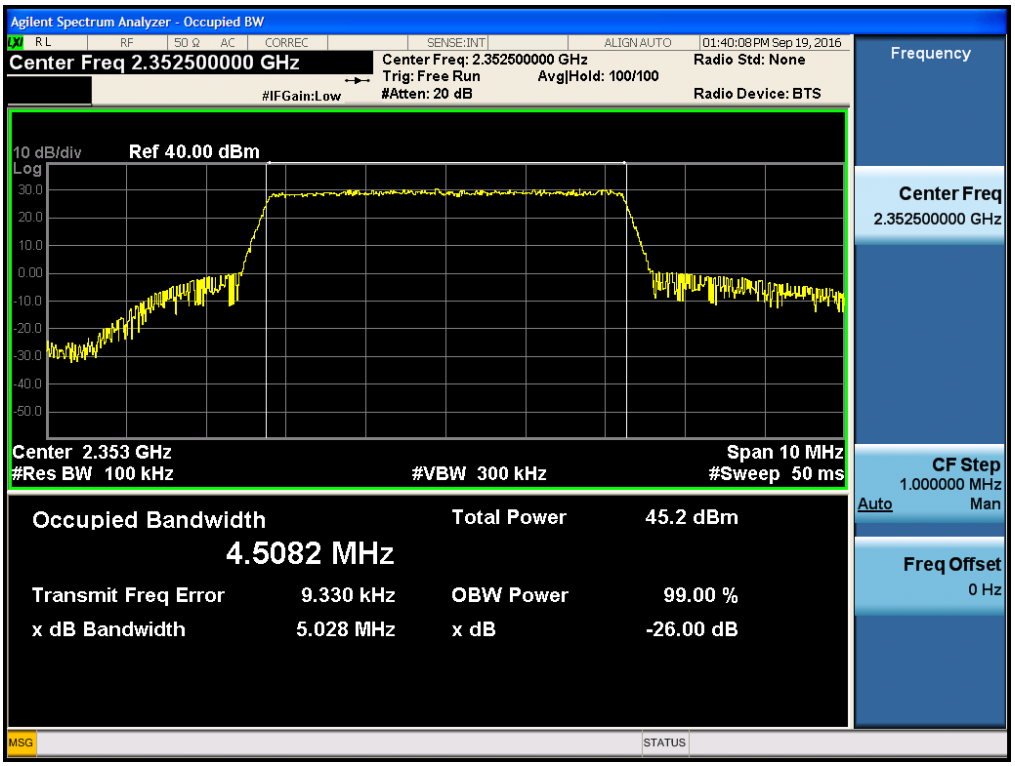
Plots of Occupied Bandwidth_2300_WCS BAND LTE 5 MHz_Output

[AGC threshold Output Downlink Low]

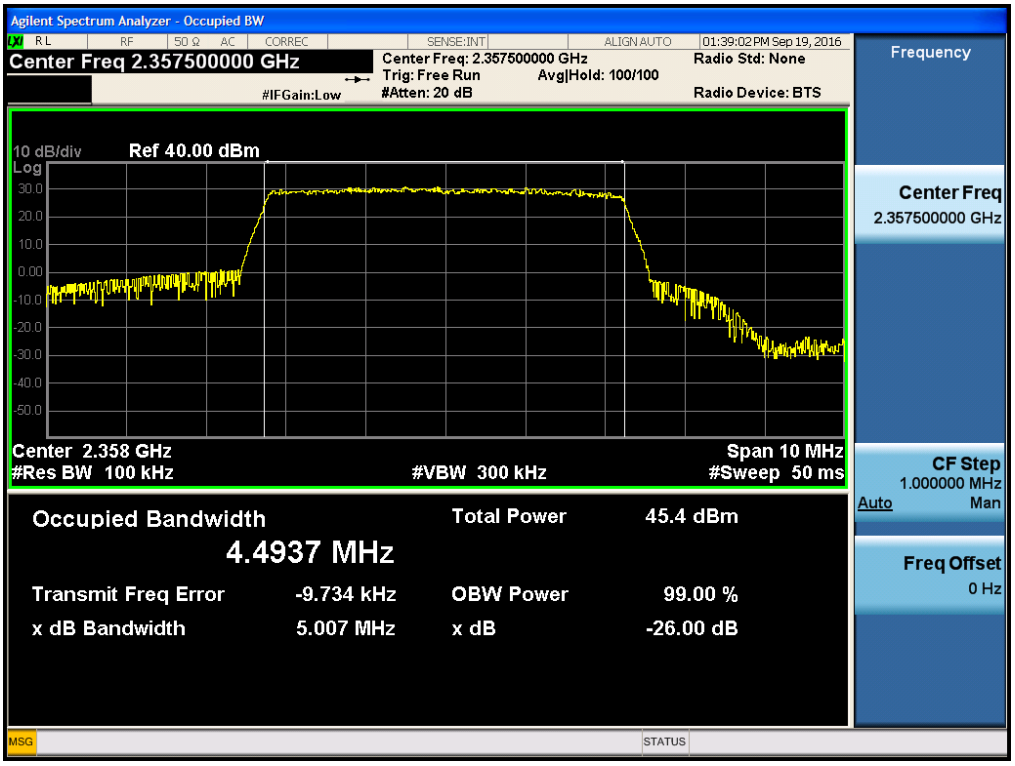


[AGC threshold Output Downlink High]

[+3dBmabove AGC threshold Output Downlink Low]

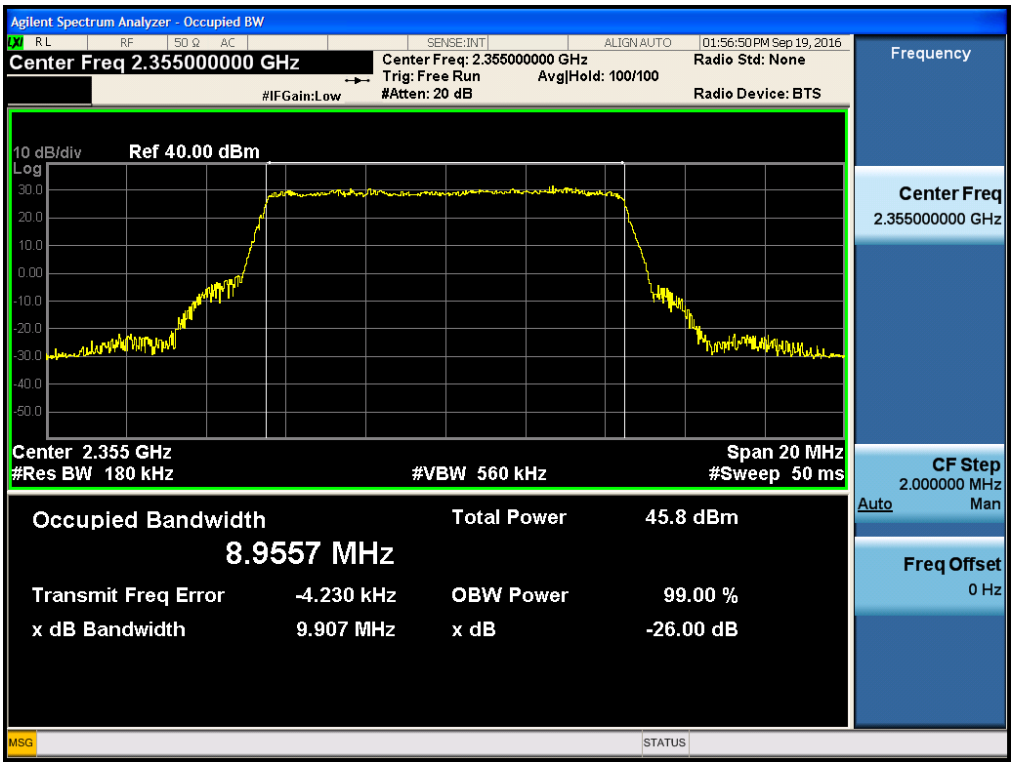


[+3dBm above AGC threshold Output Downlink High]

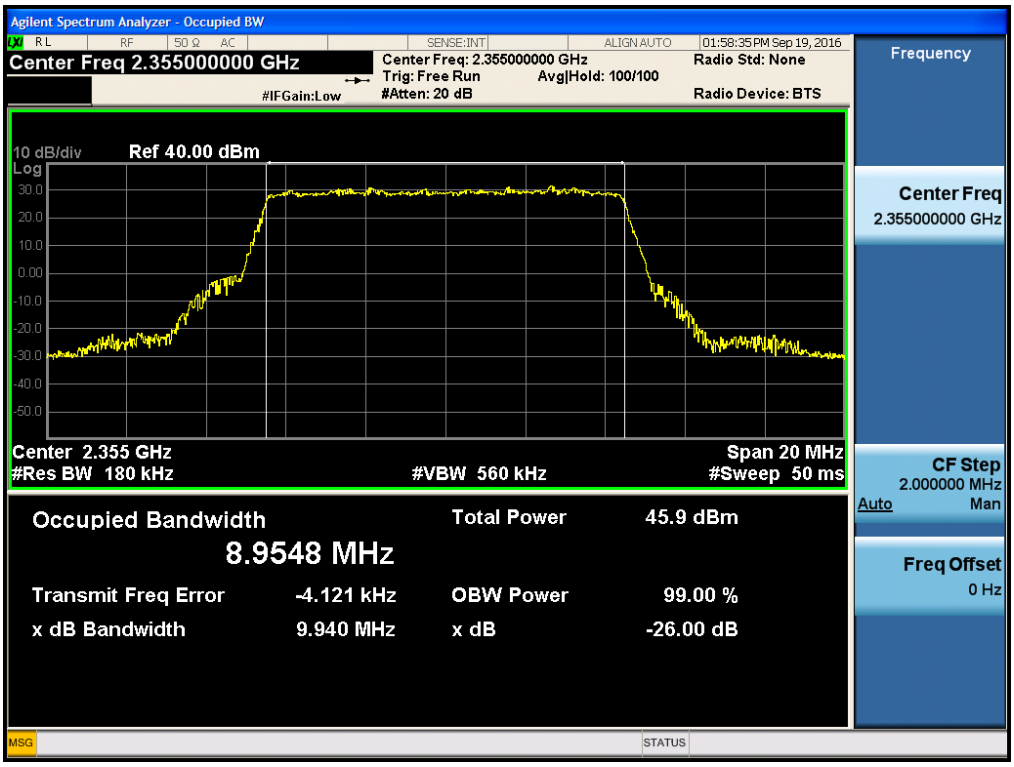


Plots of Occupied Bandwidth_ 2300_WCS BAND LTE 10 MHz_Output

[AGC threshold Output Downlink Middle]

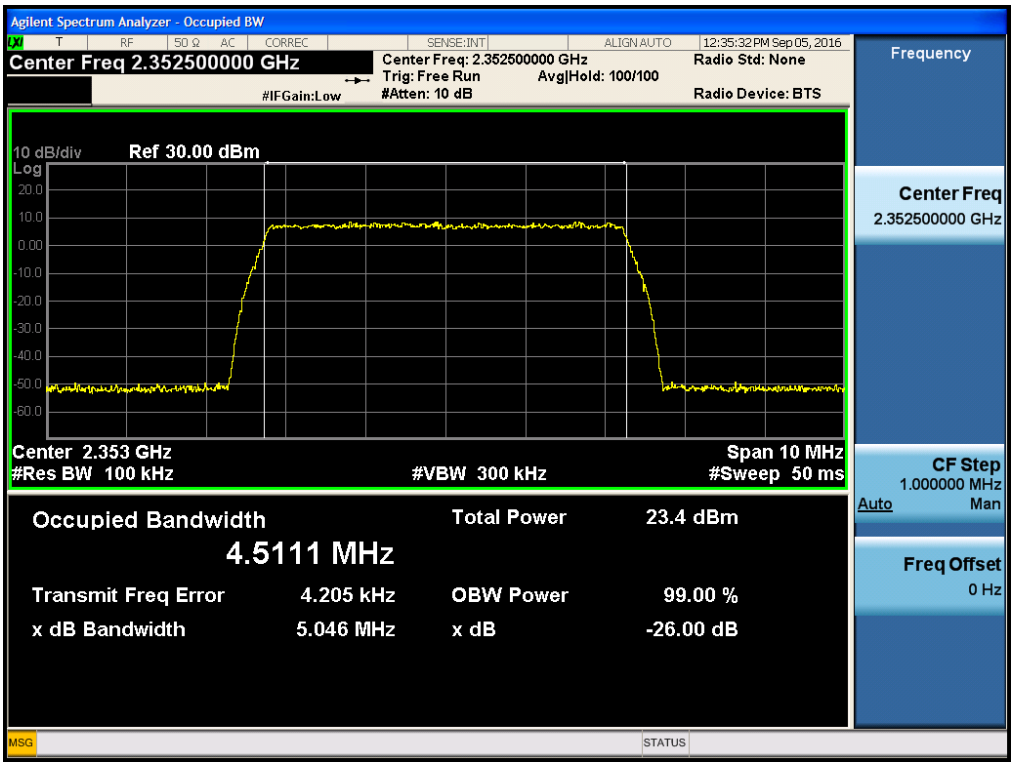


[+3dBm above AGC threshold Output Downlink Middle]

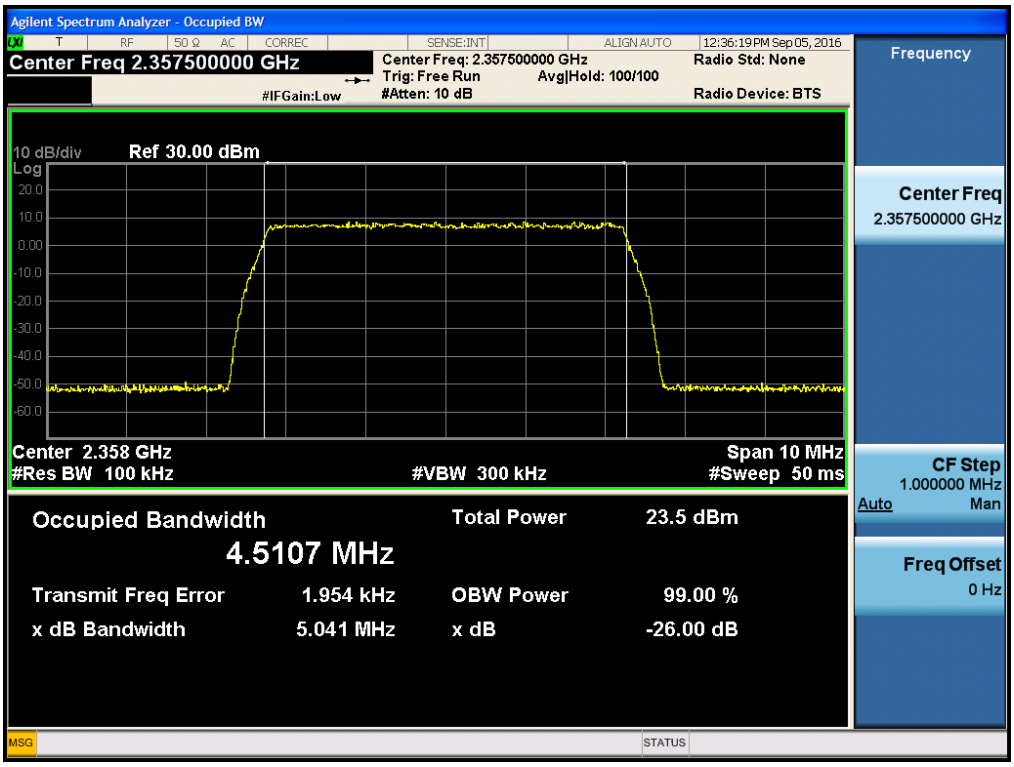


Plots of Occupied Bandwidth_2300_WCS BAND LTE 5 MHz_Input

[AGC threshold Input Downlink Low]

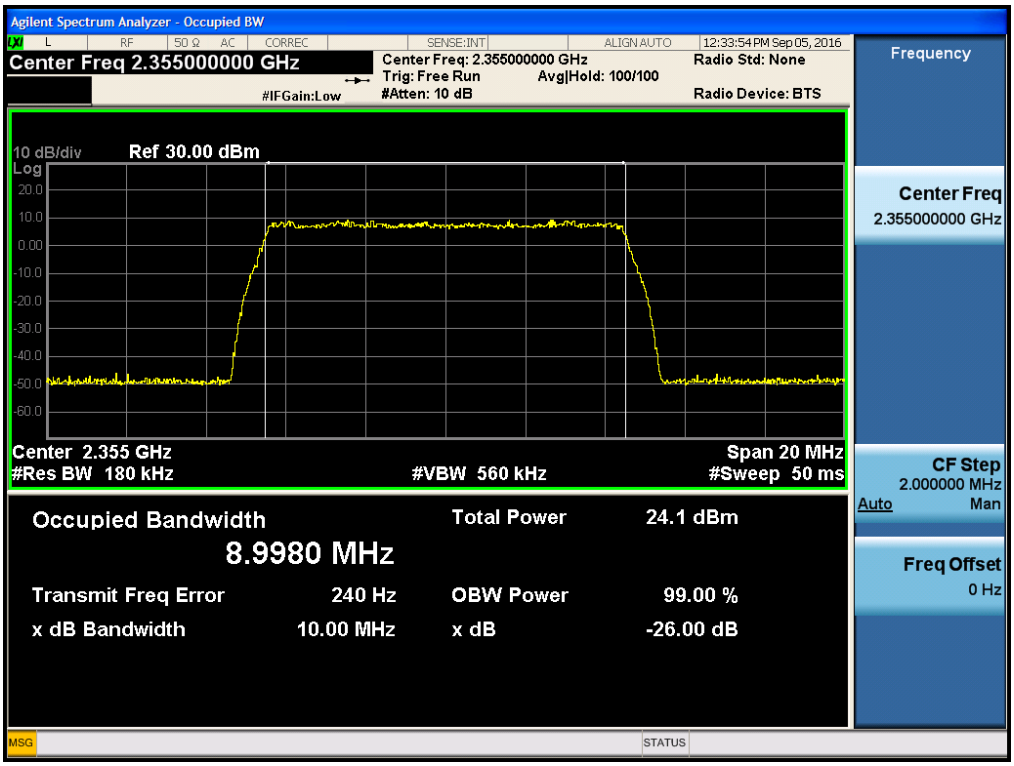


[AGC threshold Input Downlink High]



Plots of Occupied Bandwidth_ 2300_WCS BAND LTE 10 MHz_Input

[AGC threshold Input Downlink Middle]



8. PASSBAND GAIN AND BANDWIDTH & OUT OF BAND REJECTION

FCC Rules

Test Requirement(s):

KDB 935210 D02 v03r02

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

Test Procedures:

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

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

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

1) Frequency range = ± 250 % of the passband, for each applicable CMRS band (see also KDB Publication 935210 D02 [R7] and KDB Publication 634817 [R5] about selection of frequencies for testing and for grant listings).

2) Level = a sufficient level to affirm that the out-of-band rejection is > 20 dB above the noise floor and will not engage the AGC during the entire sweep.

3) Dwell time = approximately 10 ms.

4) Number of points = SPAN/(RBW/2).

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

d) Set the span of the spectrum analyzer to the same as the frequency range of the signal generator.

e) Set the resolution bandwidth (RBW) of the spectrum analyzer to be 1 % to 5 % of the EUT passband, and the video bandwidth (VBW) shall be set to ≥ 3 × RBW.

f) Set the detector to Peak Max-Hold and wait for the spectrum analyzer's spectral display to fill.

g) Place a marker to the peak of the frequency response and record this frequency as 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.

i) Capture the frequency response of the EUT.

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

Test Results:

The EUT complies with the requirements of this section.

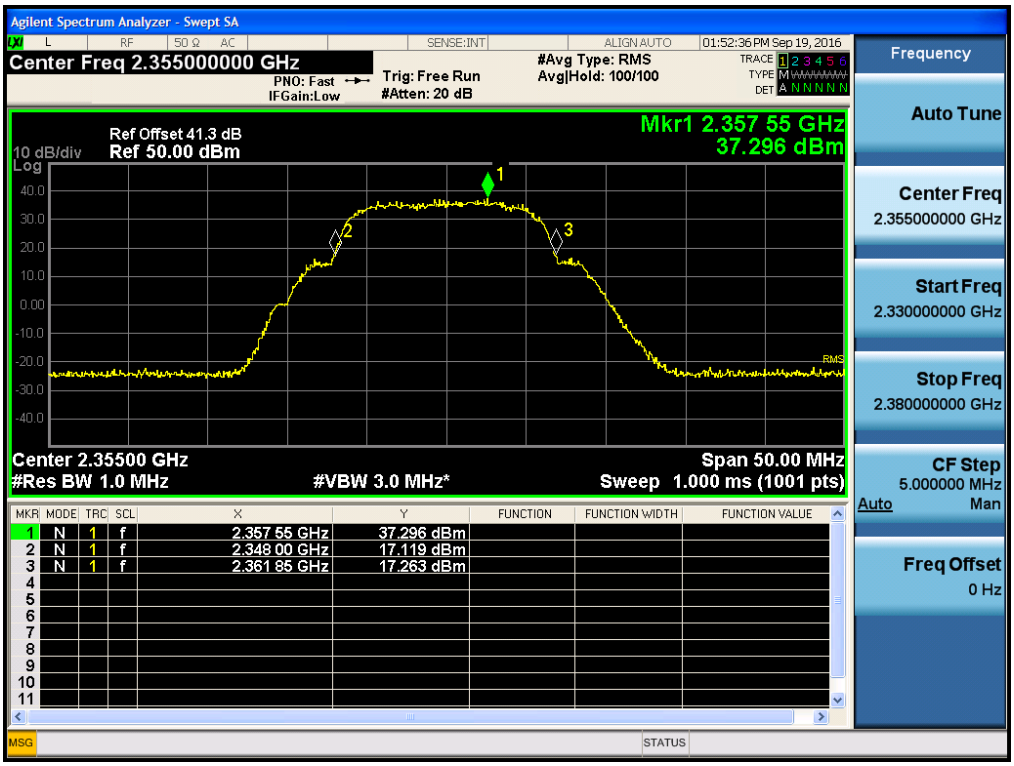
Input Signal	Input Level (dBm) Input Signal : Sinusoidal	Maximum Amp Gain
2300_WCS Band	-16 dBm	53 dB

[Downlink_2300_WCS BAND]

	20 dB point frequency (MHz)	**Output power (dBm)**	**Gain (dB)**
2300_WCS Band	2348.000 MHz ~ 2361.850 MHz	37.296	53.296

Plots of Passband Gain and Bandwidth & Out of Band Rejection

[2300_WCS BAND]



9. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL

FCC Rules

Test Requirement(s):

§ 2.1051 Measurements required: Spurious emissions at antenna terminals:

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

§ 27.53 Emission limits.

(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.

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

Spurious emissions shall be measured using a single test signal sequentially tuned to the low, middle and high channels or frequencies within each authorized frequency band of operation. Out-of-band/block emissions (including intermodulation products) shall be measured under each of the following two stimulus conditions:

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

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

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

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

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

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

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

c) Set the center frequencies such that the AWGN signals occupy adjacent channels, as defined by industry standards such as 3GPP or 3GPP2, at the upper edge of the frequency band or block of interest.

d) Set the composite power levels such that the input signal is just below the AGC threshold (see 3.2), but not more than 0.5 dB below. The composite power can be measured using the procedures provided in KDB Publication 971168, but it will be necessary to expand the power integration bandwidth so as to include both of the transmit channels. Alternatively, the composite power can be measured using an average power meter as described in KDB Publication 971168.

e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.

f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band (typically 1 % of the emission bandwidth, 100 kHz, or 1 MHz)

g) Set the VBW = 3 × RBW.

h) Set the detector to power averaging (rms) detector.

i) Set the Sweep time = auto-couple.

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

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

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

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

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

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

examination.

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

q) Repeat steps k) to n).

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

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

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

3.6.3. EUT spurious emissions conducted measurement

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

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

c) Set the center frequency of the test signal to the lowest available channel within the frequency band or block.

d) Set the EUT input power to a level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.

e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.

f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band of operation (e.g., reference bandwidth is typically 100 kHz or 1 MHz).

g) Set the VBW ≥ 3 × RBW.

h) Set the Sweep time = auto-couple.

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

NOTE—The number of measurement points in each sweep must be ≥ (2 × span/RBW) which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.

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

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

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

m) Reset the analyzer start frequency to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the analyzer stop frequency to 10 times the highest frequency of the fundamental emission (see §2.1057). Note that the number of

measurement points in each sweep must be ≥ (2 × span/RBW) which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.

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

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

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

q) Repeat entire procedure with the narrowband test signal.

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

Test Results:

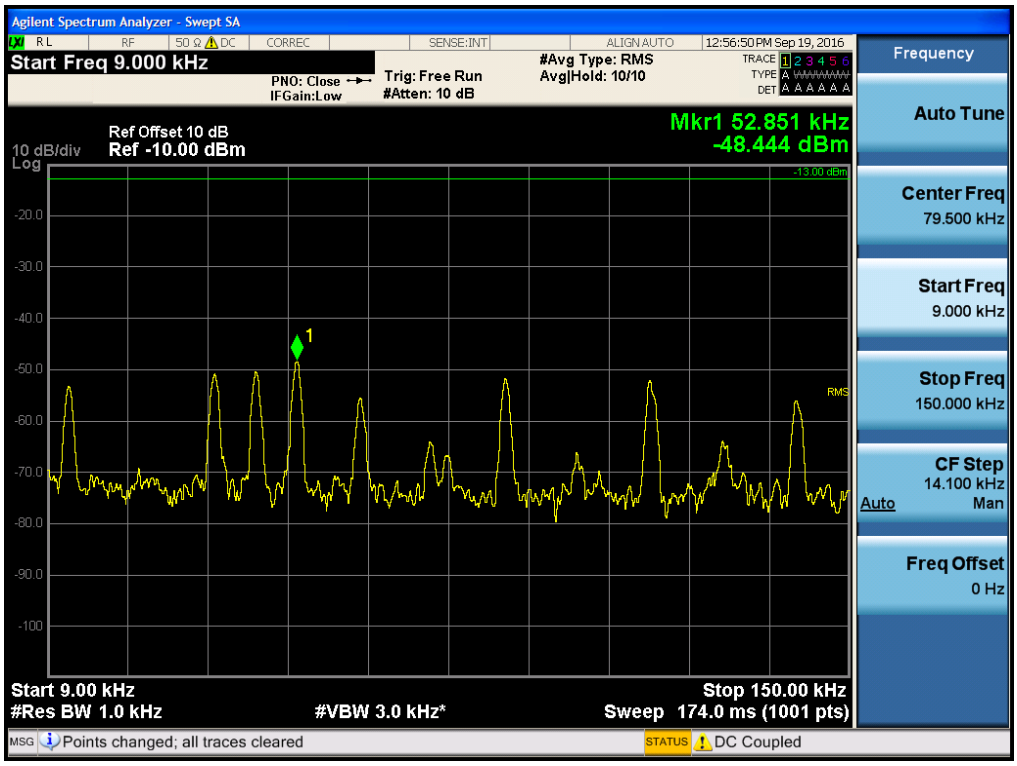
The EUT complies with the requirements of this section. There were no Detectable Spurious emissions for this EUT.

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)

Single channel Enhancer Plots of Spurious Emission for 2300_WCS BAND LTE 5 MHz

Conducted Spurious Emissions (9 kHz – 150 kHz)

[Downlink Low]



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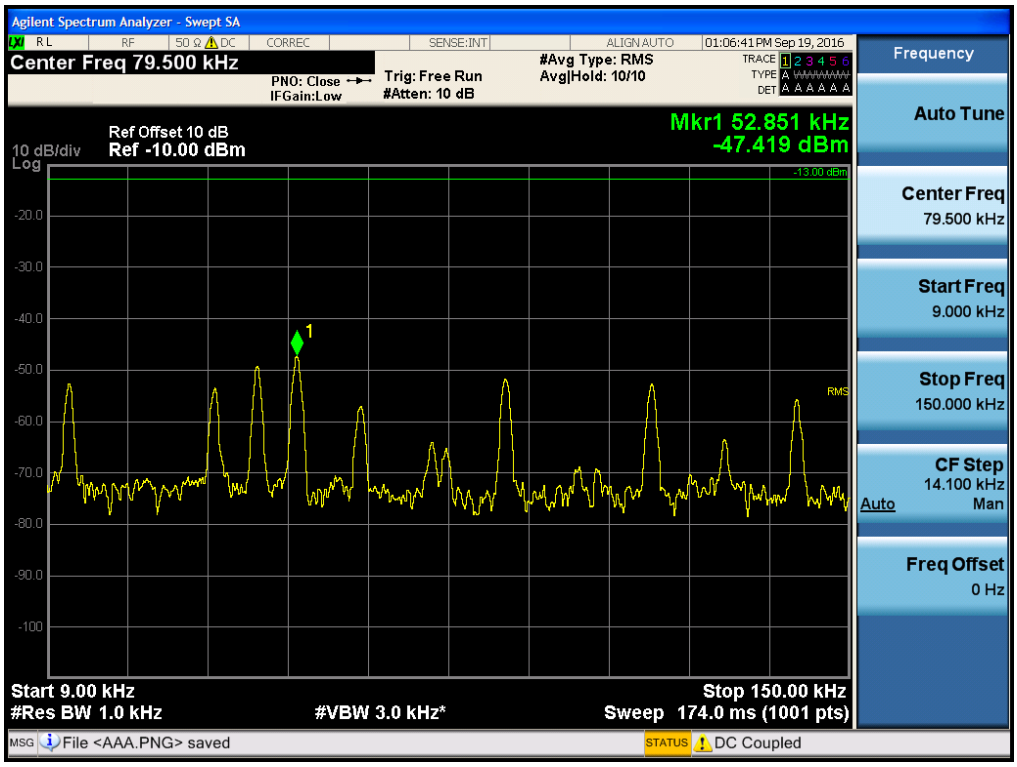
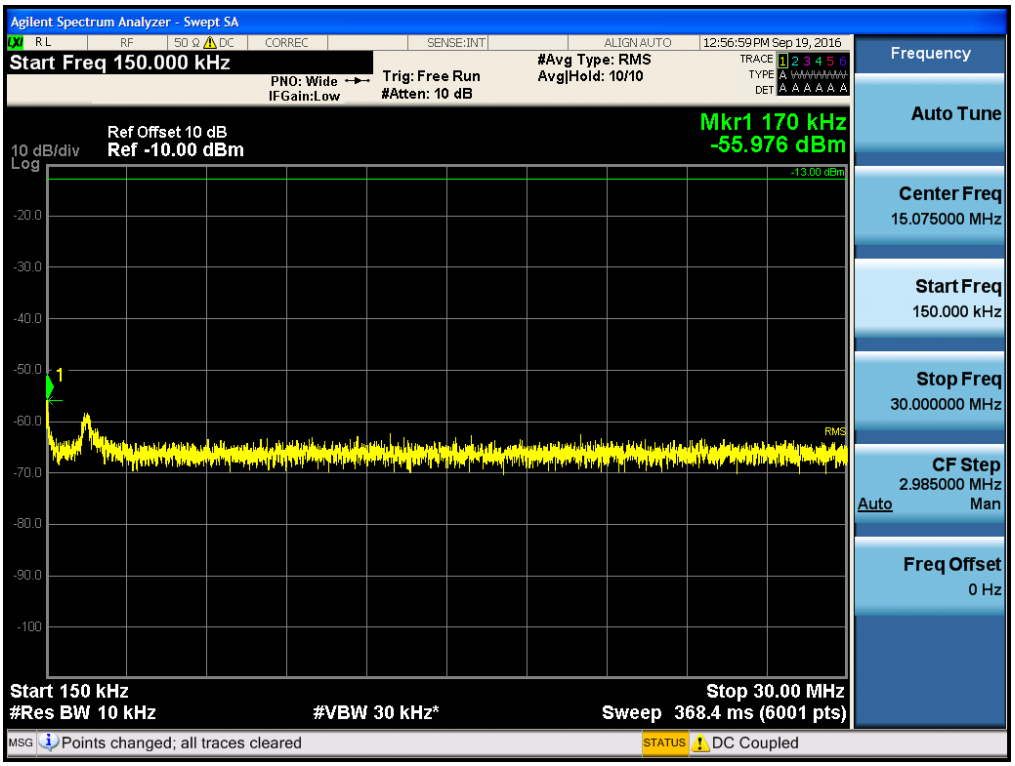


Conducted Spurious Emissions (150 kHz – 30 MHz)

[Downlink Low]



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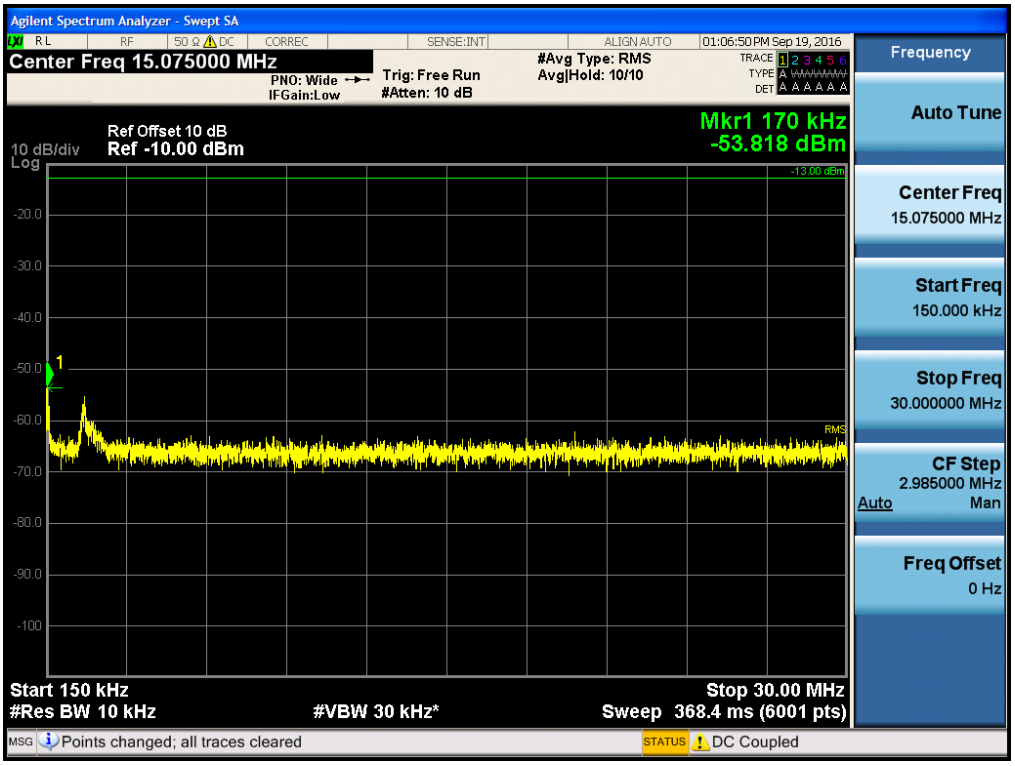

Conducted Spurious Emissions (30 MHz – 1 GHz)

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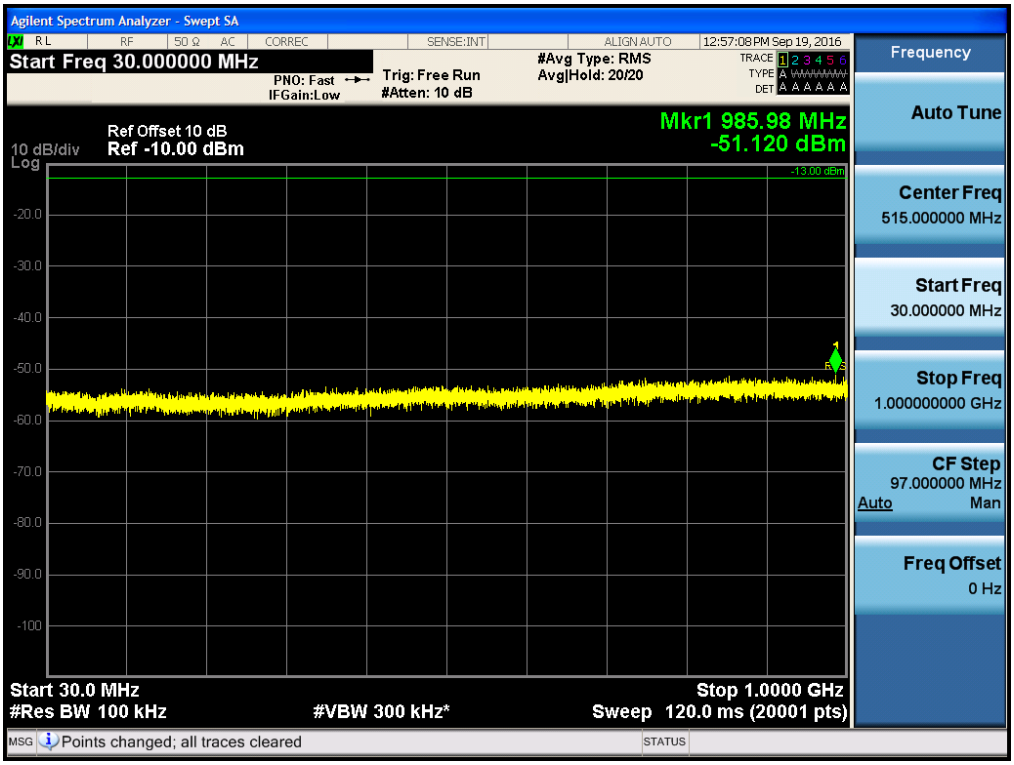

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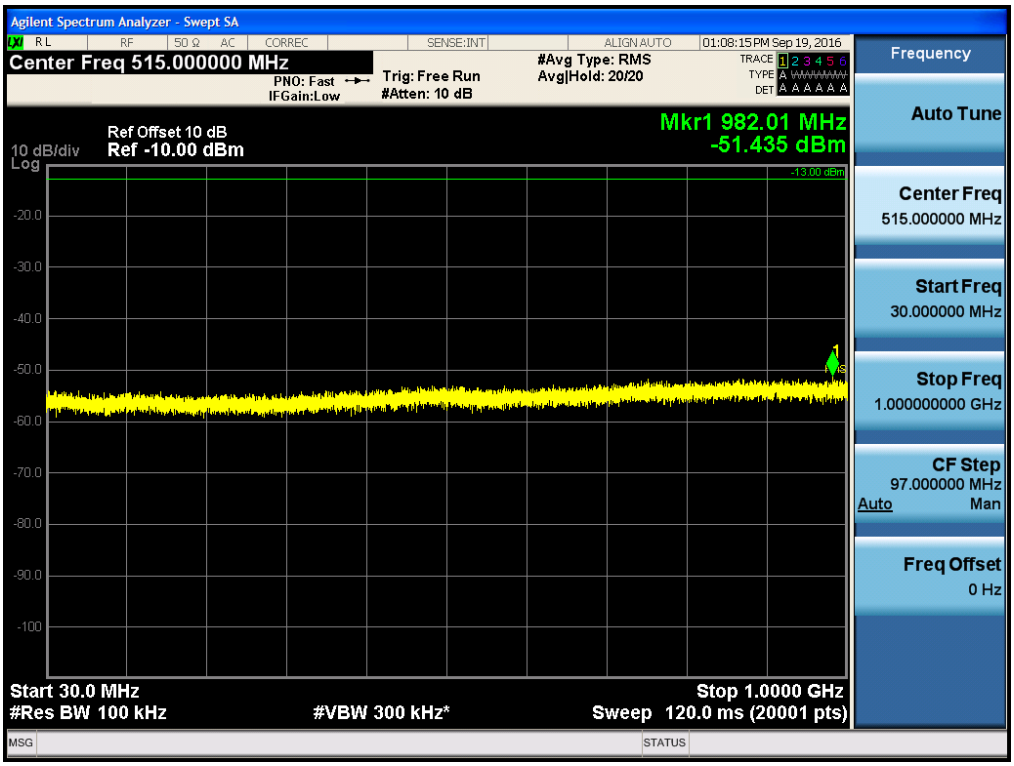
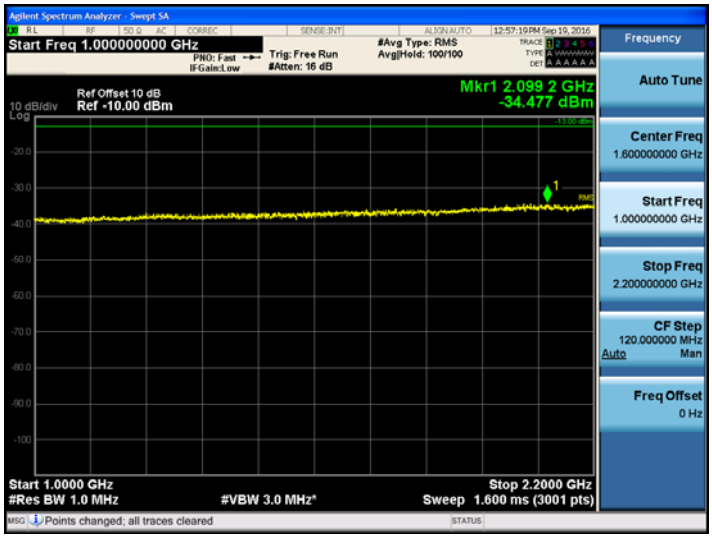
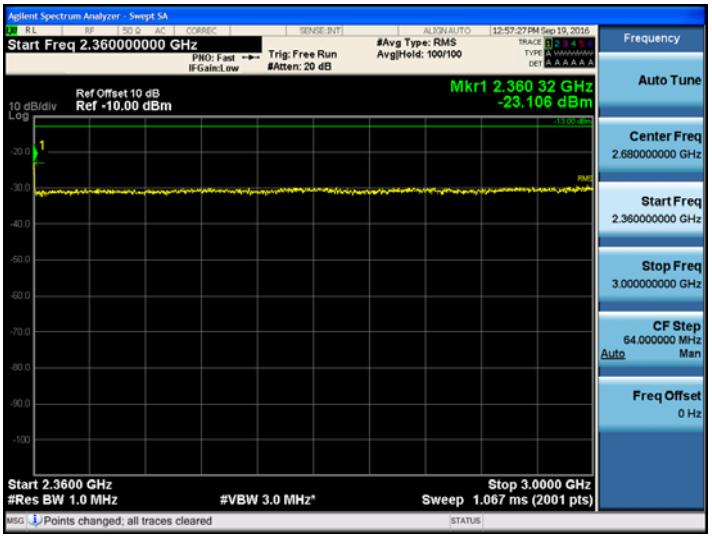
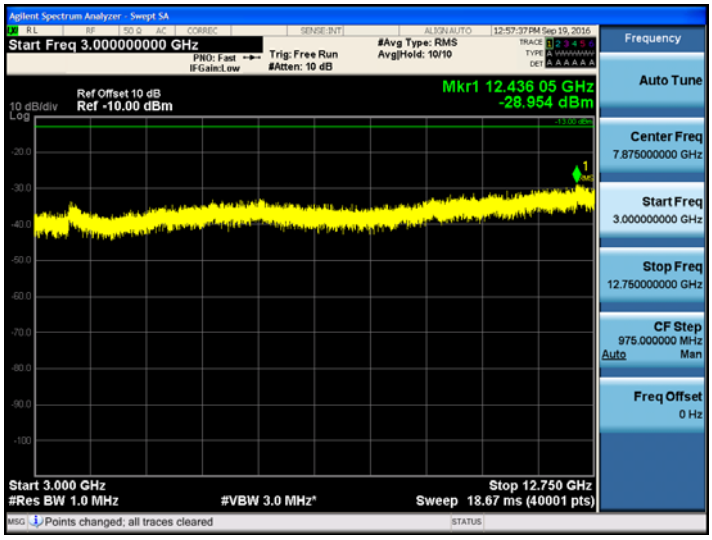
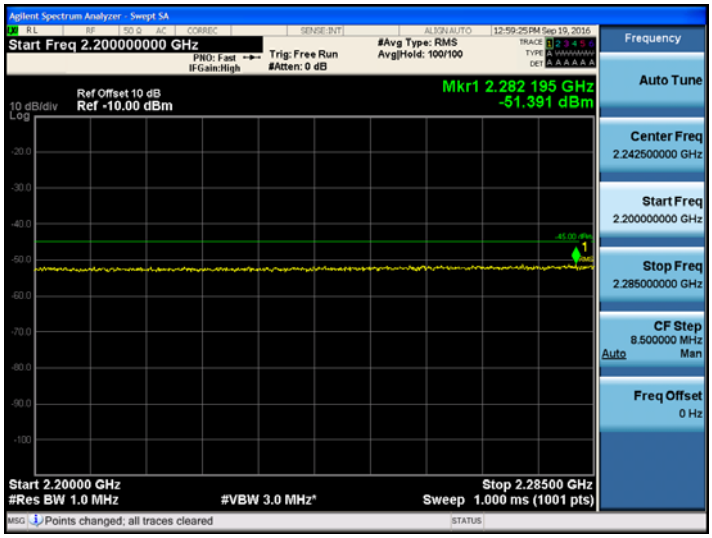
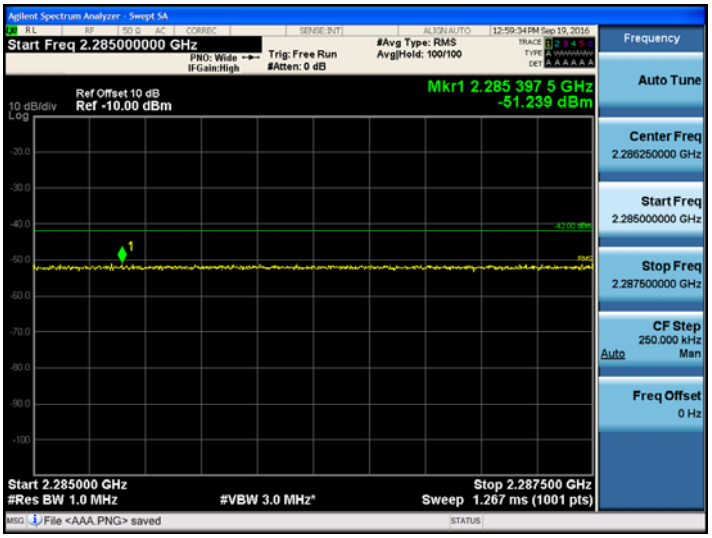
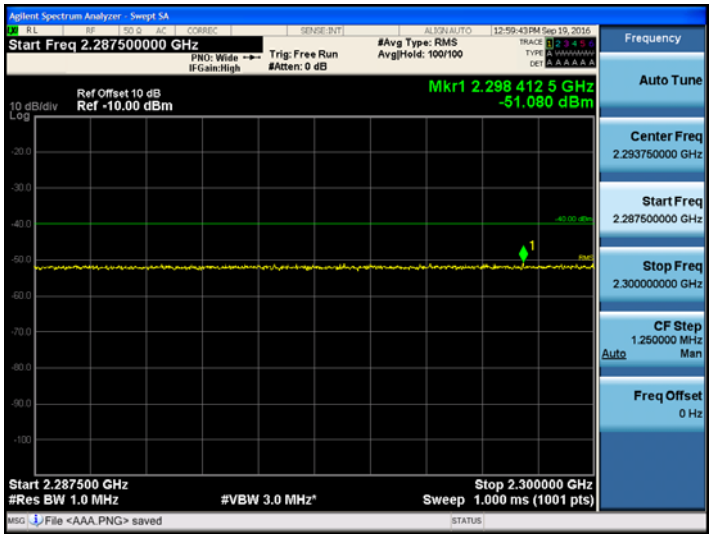
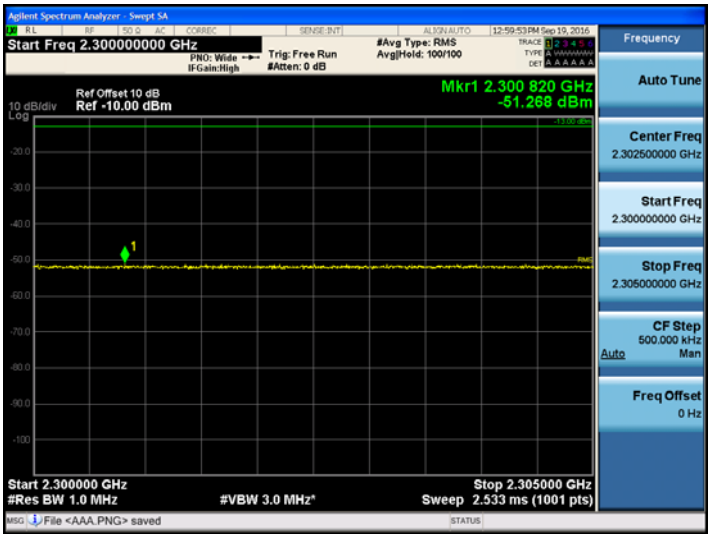
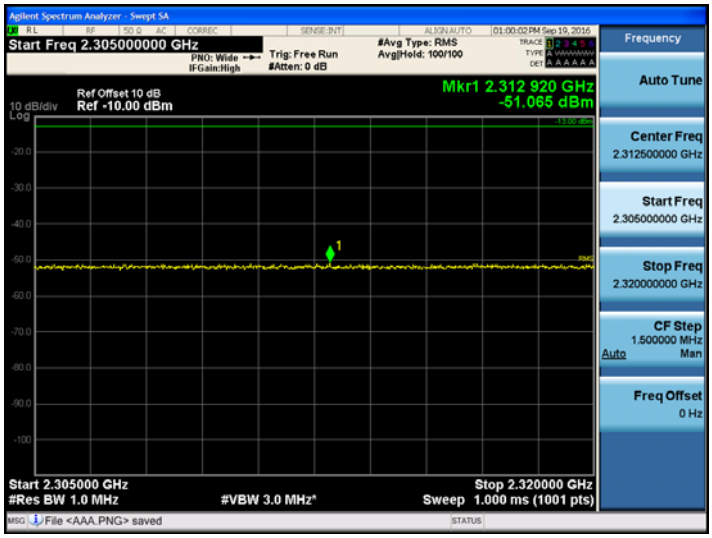
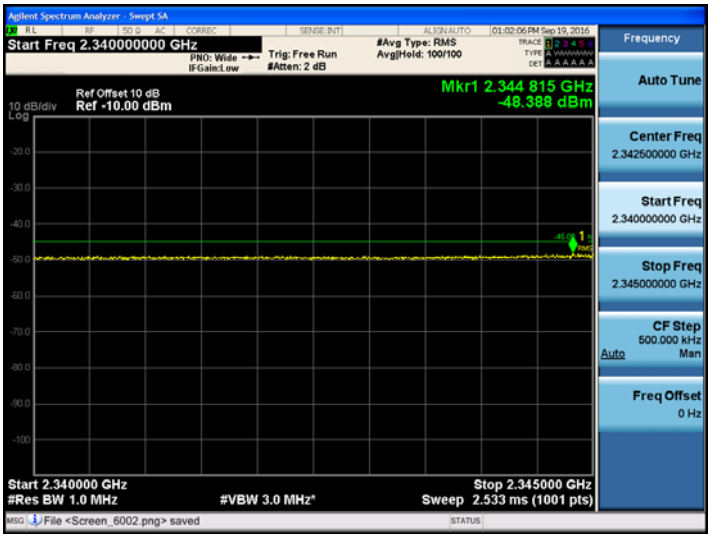
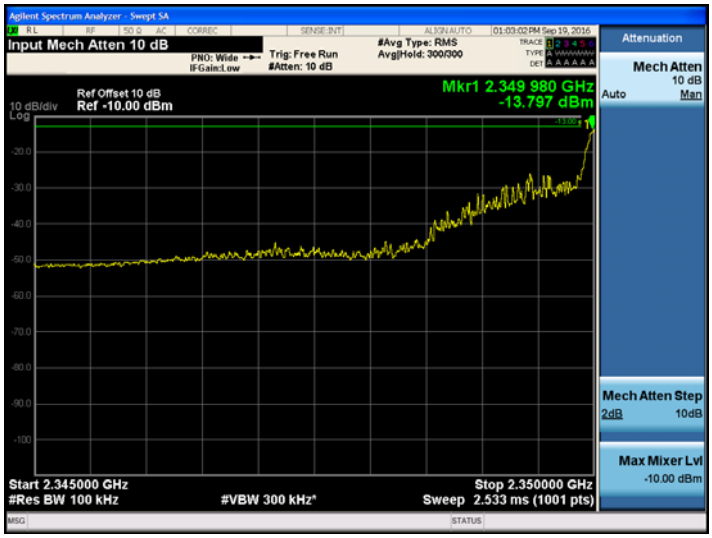


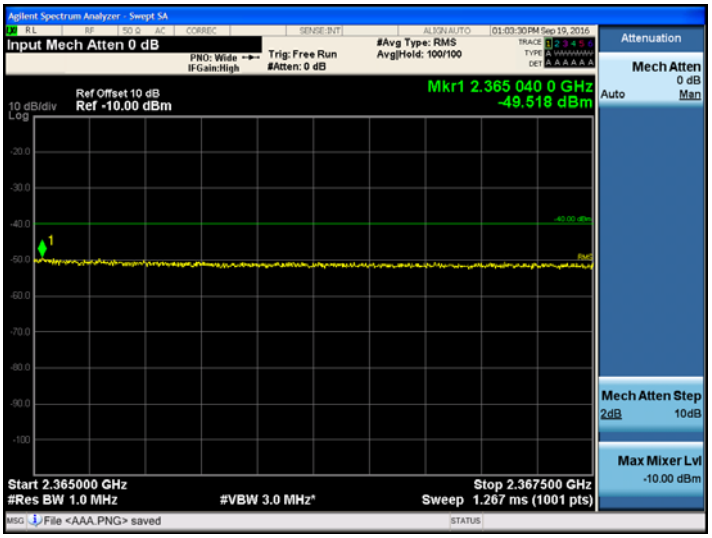
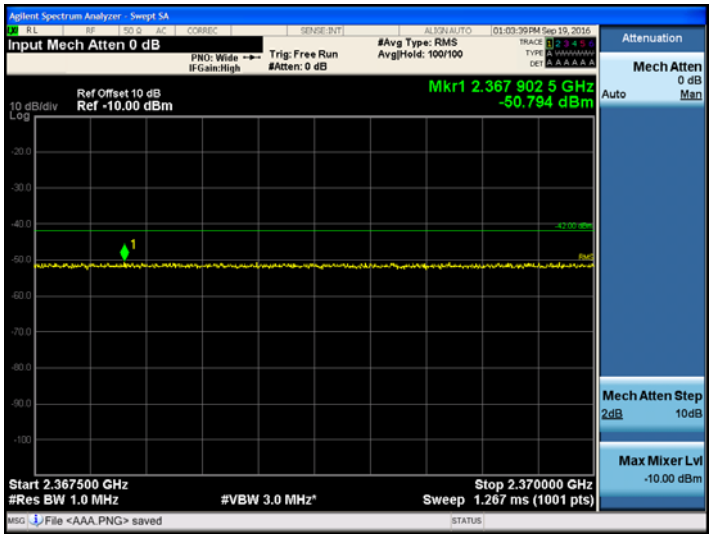
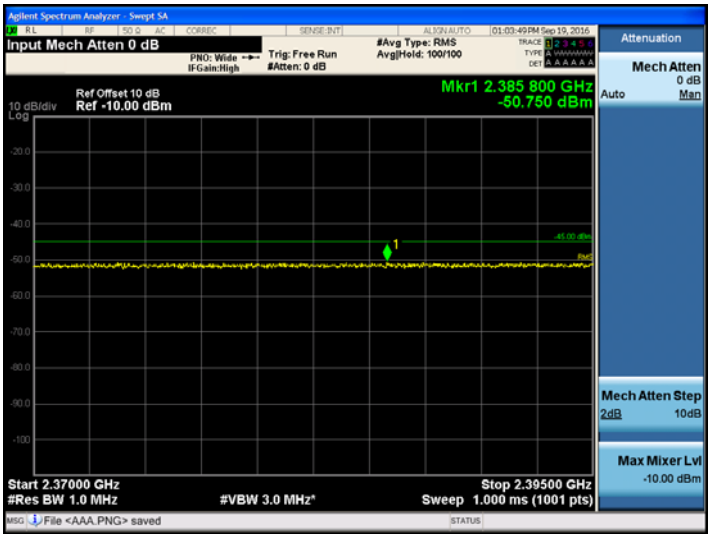
Conducted Spurious Emissions (1 GHz – 26.5 GHz)

[Downlink Low]

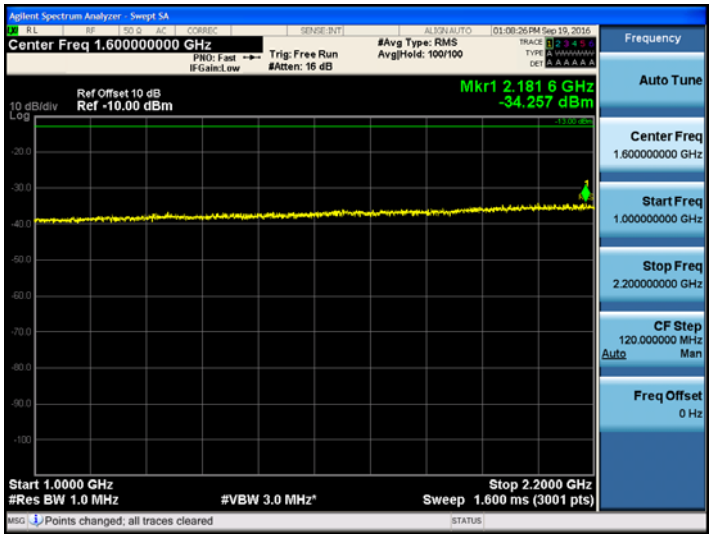
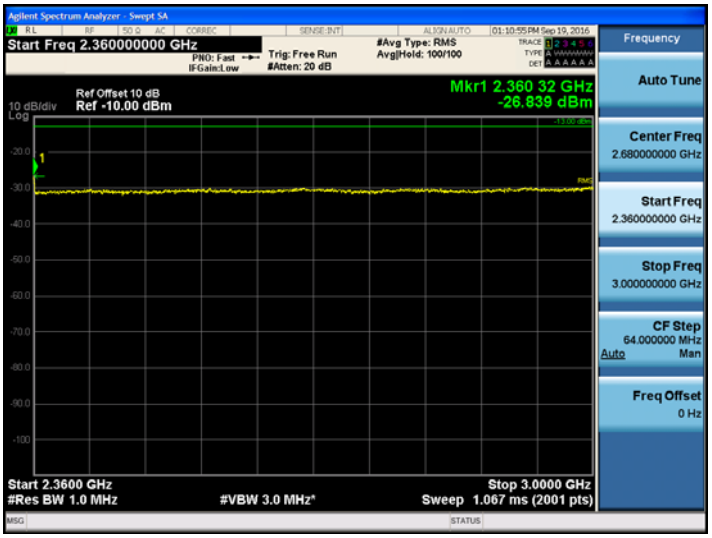
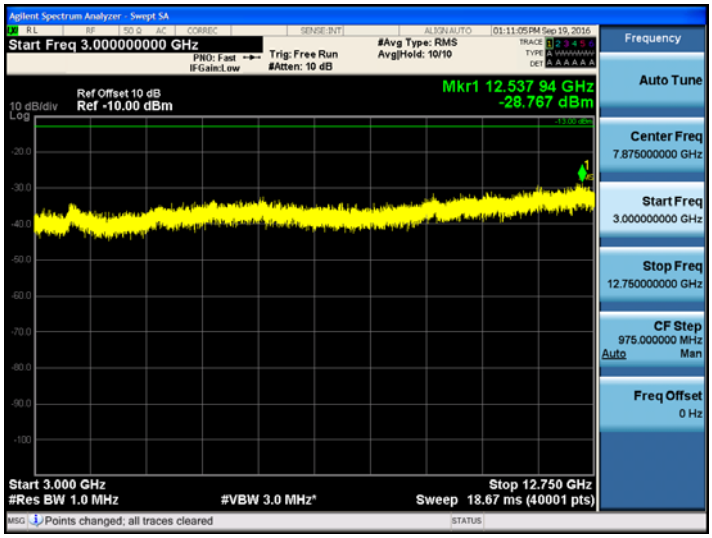
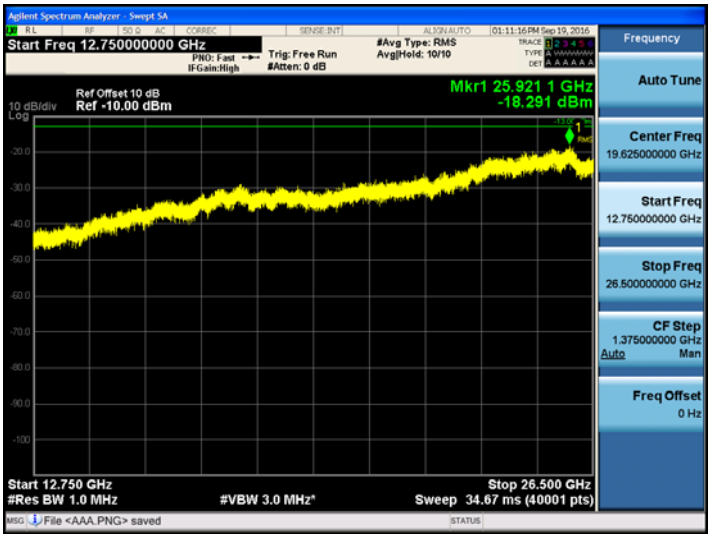
1000 ㎒ ~ 2200 ㎒	2360 ㎒ ~ 3000 ㎒
	
3000 ㎒ ~ 12750 ㎒	**12750 ㎒ ~ 26500 ㎒**
	

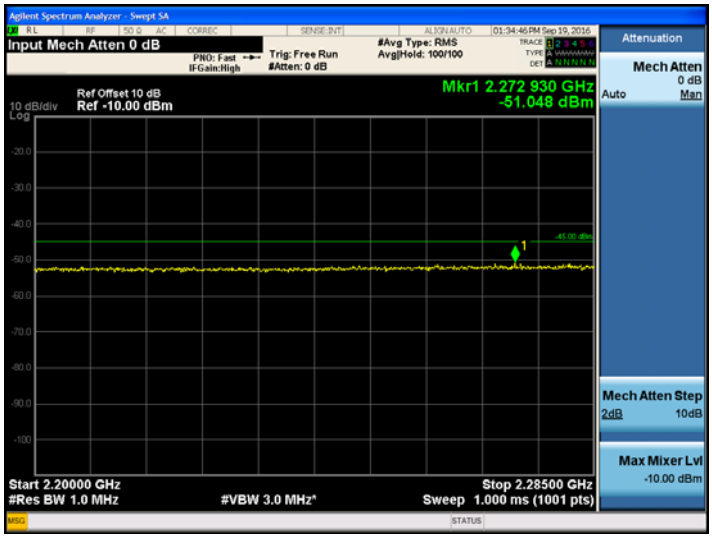
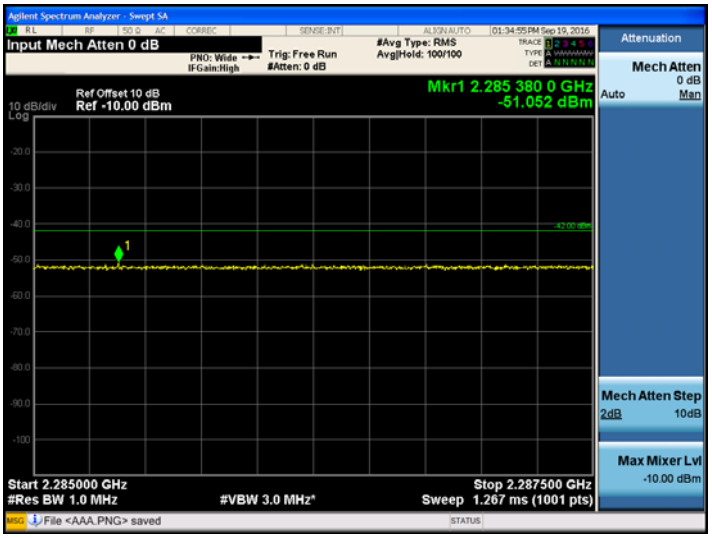
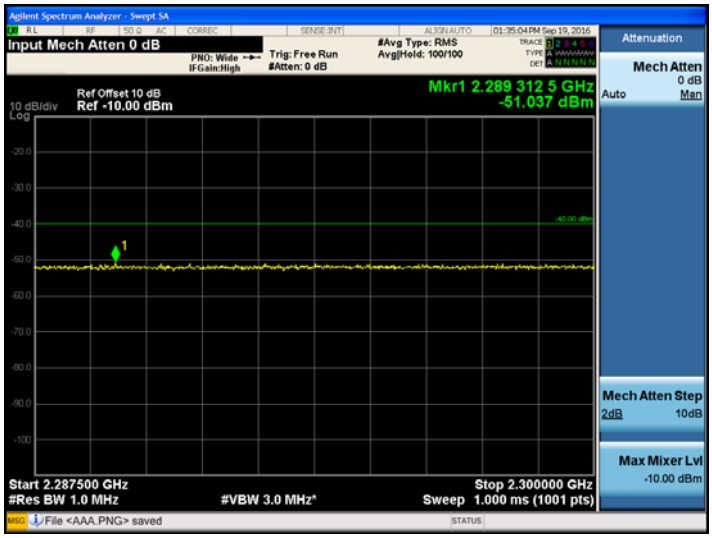
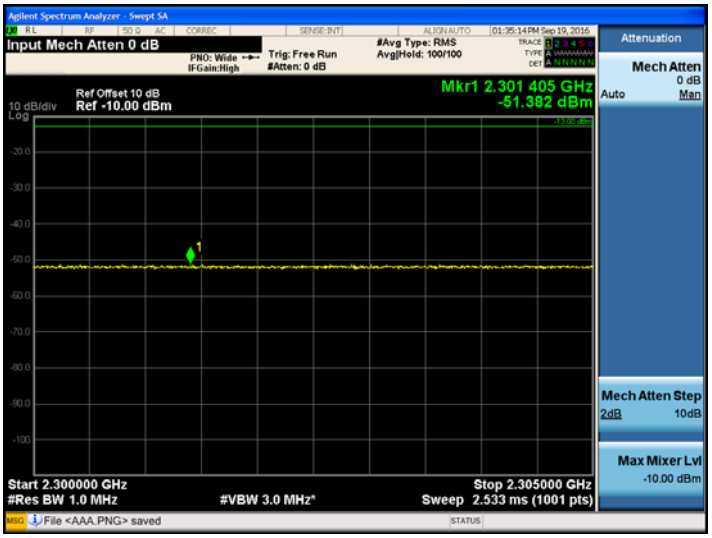
2200 ㎒ ~ 2285 ㎒	2285 ㎒ ~ 2287.5 ㎒
	
2287.5 ㎒ ~ 2300 ㎒	**2300 ㎒ ~ 2305 ㎒**
	

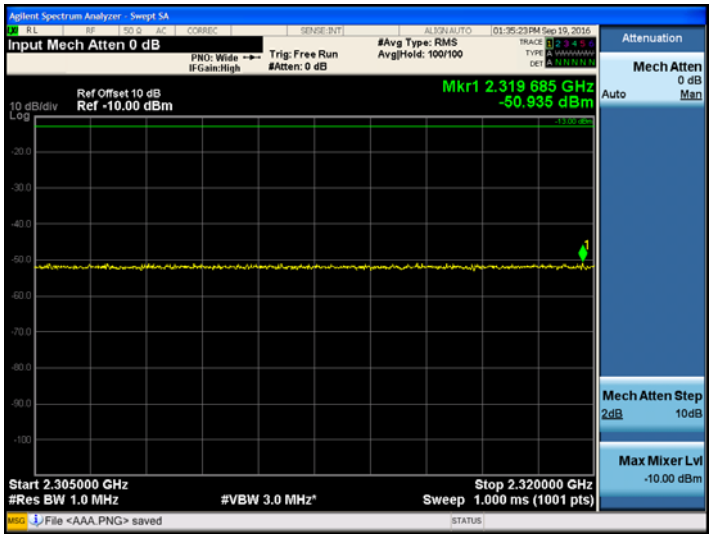
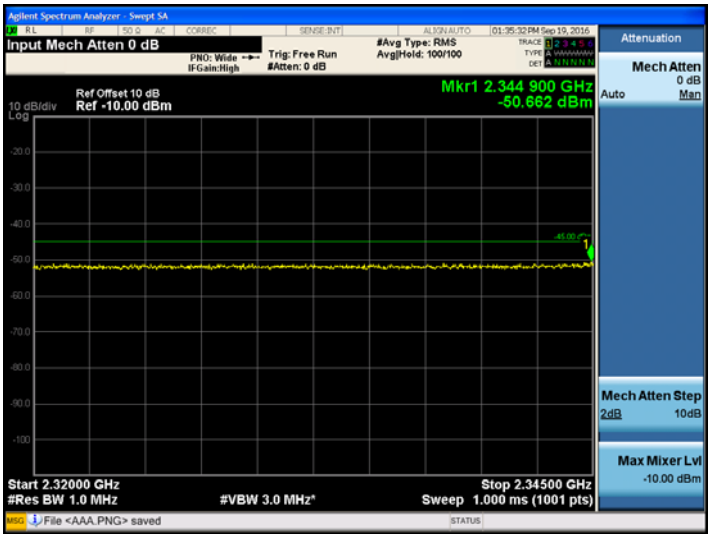
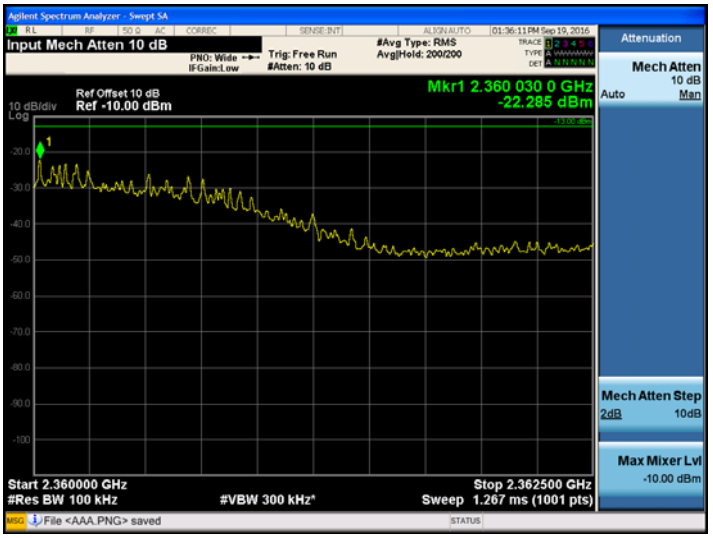
2305 ㎒ ~ 2320 ㎒	2320 ㎒ ~ 2345 ㎒
	
2345 ㎒ ~ 2350 ㎒	**2360 ㎒ ~ 2362.5 ㎒**
	

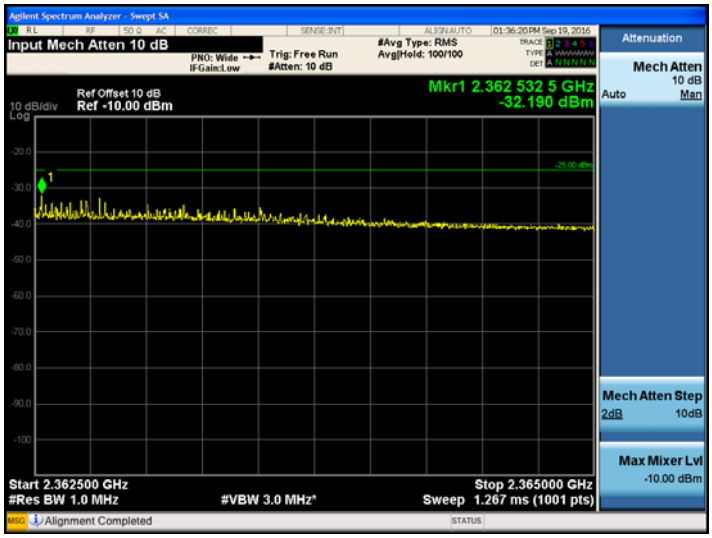
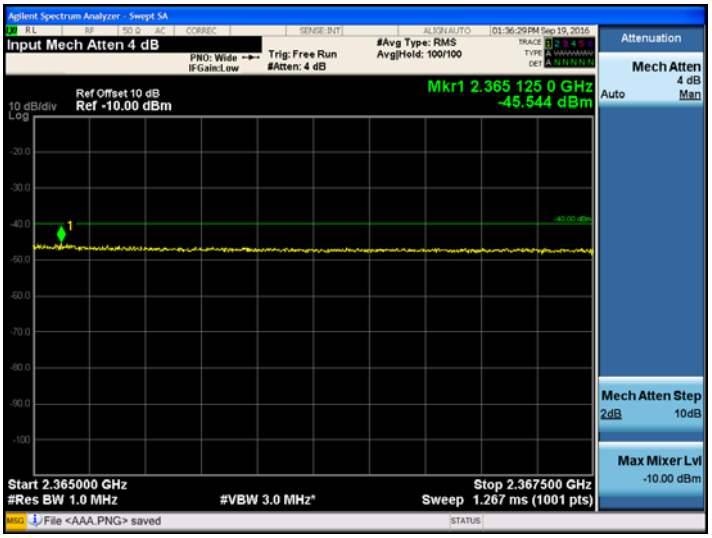
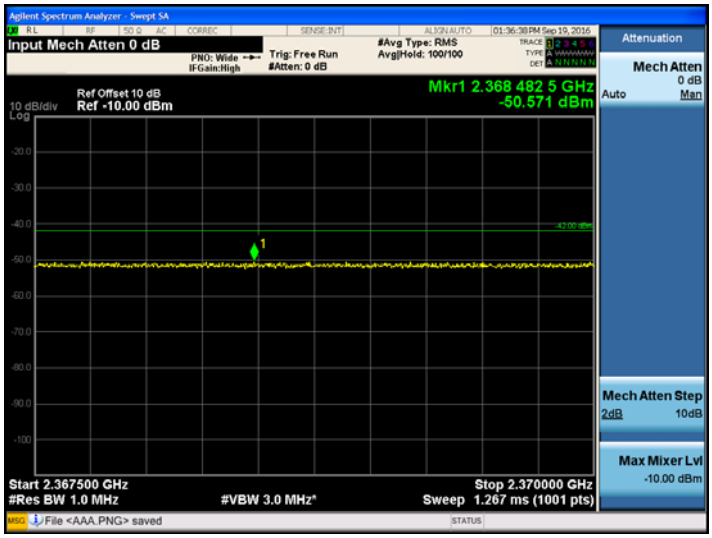
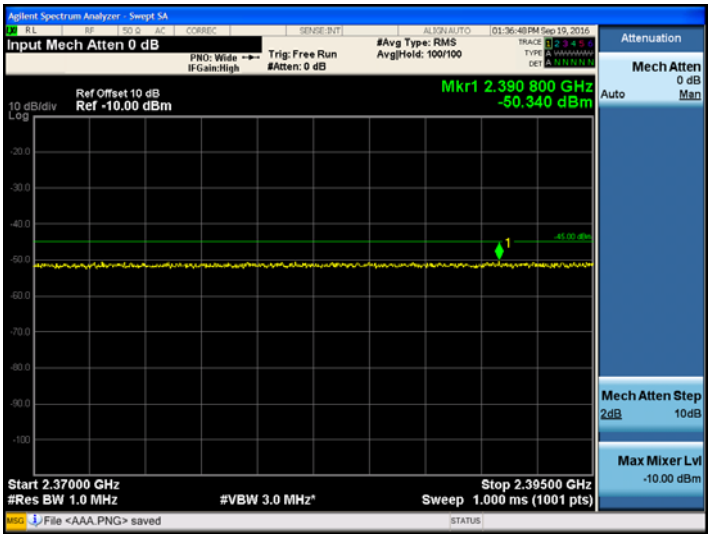
2362.5 ㎒ ~ 2365 ㎒	2365 ㎒ ~ 2367.5 ㎒
	
2367.5 ㎒ ~ 2370 ㎒	**2370 ㎒ ~ 2395 ㎒**
	

[Downlink High]

1000 ㎒ ~ 2200 ㎒	2360 ㎒ ~ 3000 ㎒
	
3000 ㎒ ~ 12750 ㎒	**12750 ㎒ ~ 26500 ㎒**
	

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

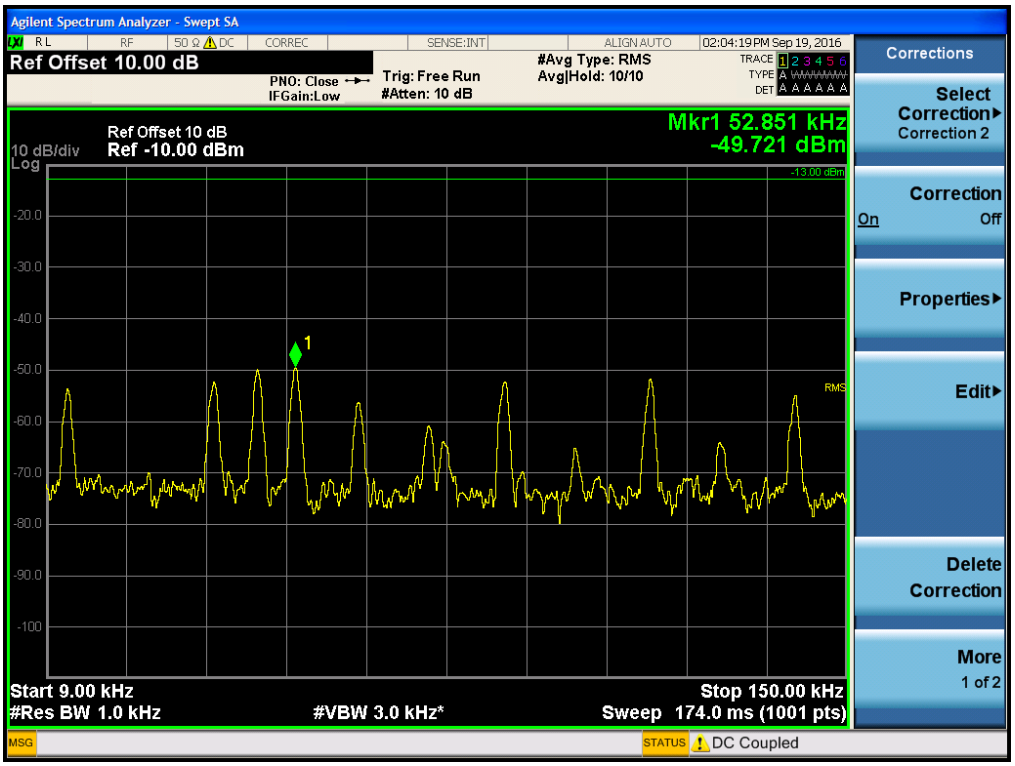
2305 ㎒ ~ 2320 ㎒	2320 ㎒ ~ 2345 ㎒
	
2345 ㎒ ~ 2350 ㎒	**2360 ㎒ ~ 2362.5 ㎒**
	

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

Single channel Enhancer Plots of Spurious Emission for 2300_WCS BAND LTE 10 MHz

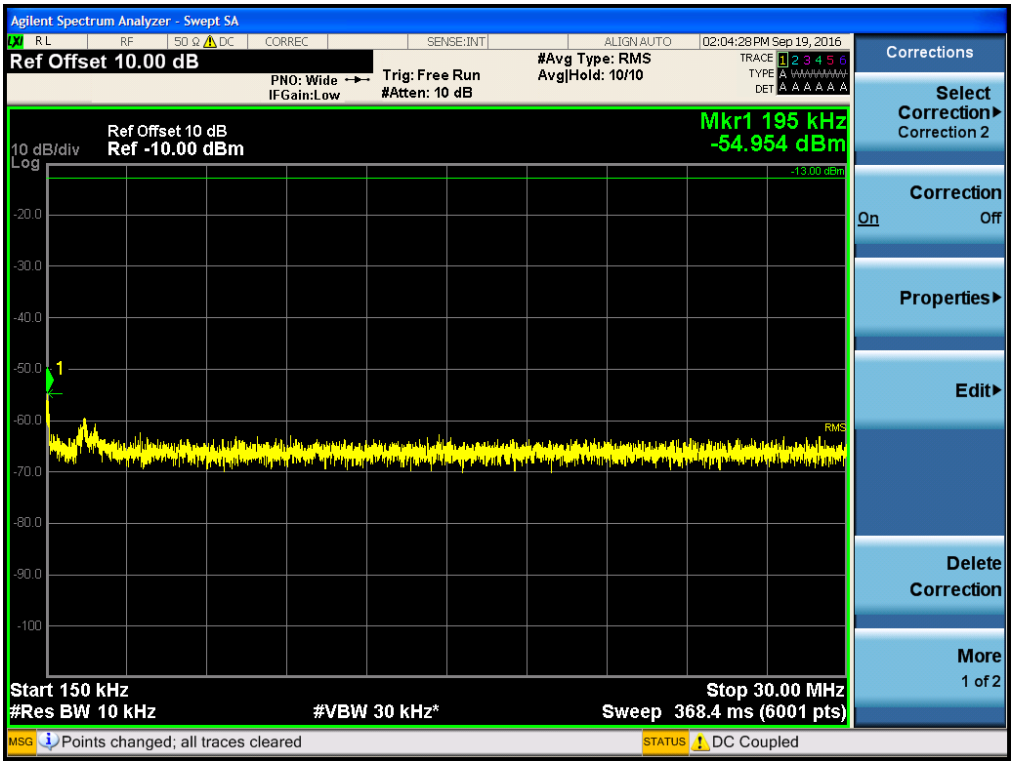
Conducted Spurious Emissions (9 kHz – 150 kHz)

[Downlink Middle]



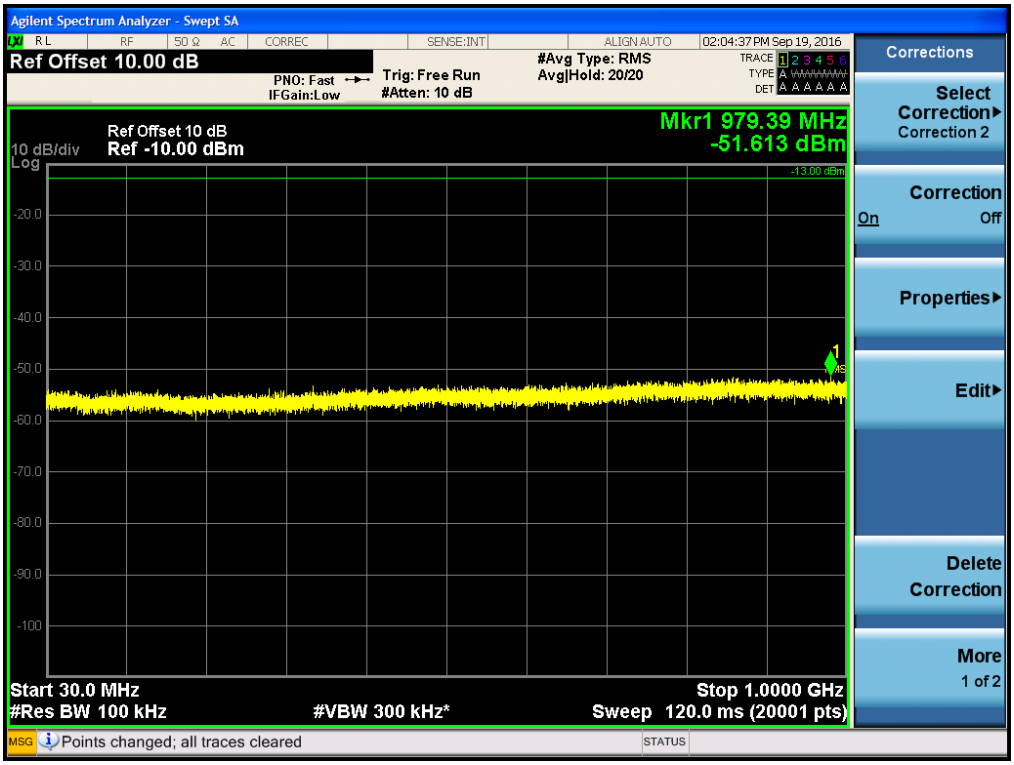
Conducted Spurious Emissions (150 kHz – 30 MHz)

[Downlink Middle]



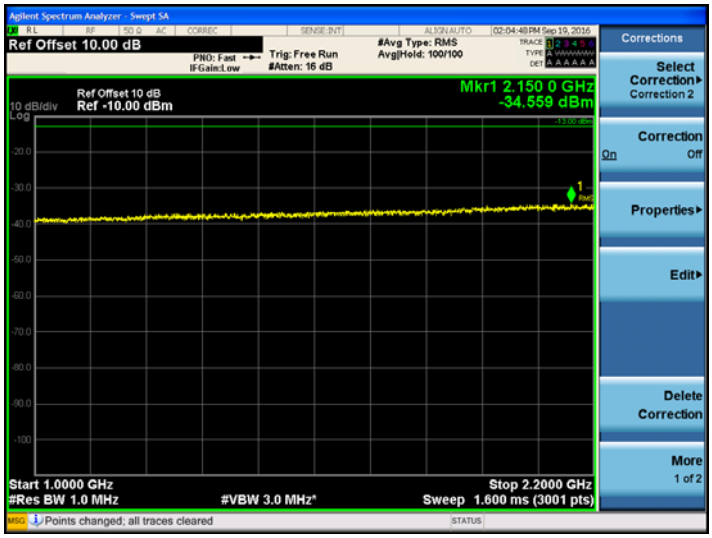
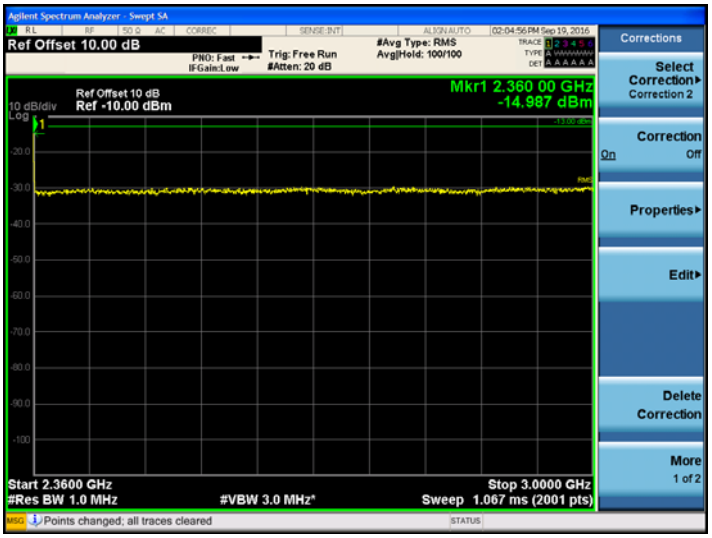
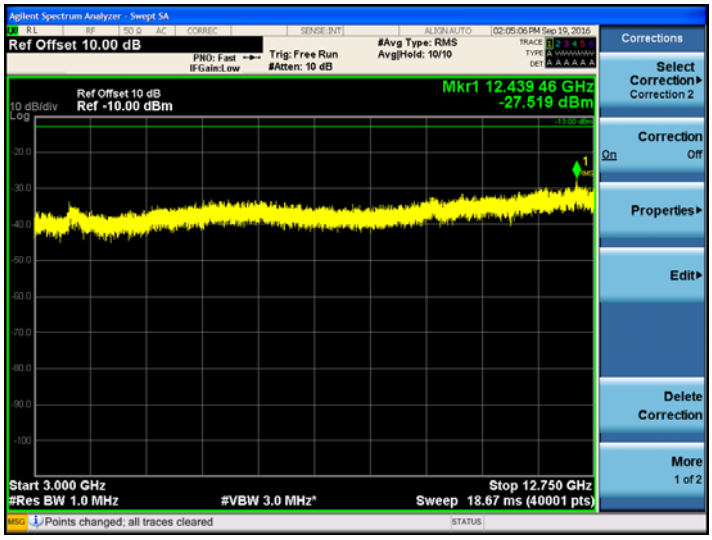
Conducted Spurious Emissions (30 MHz – 1 GHz)

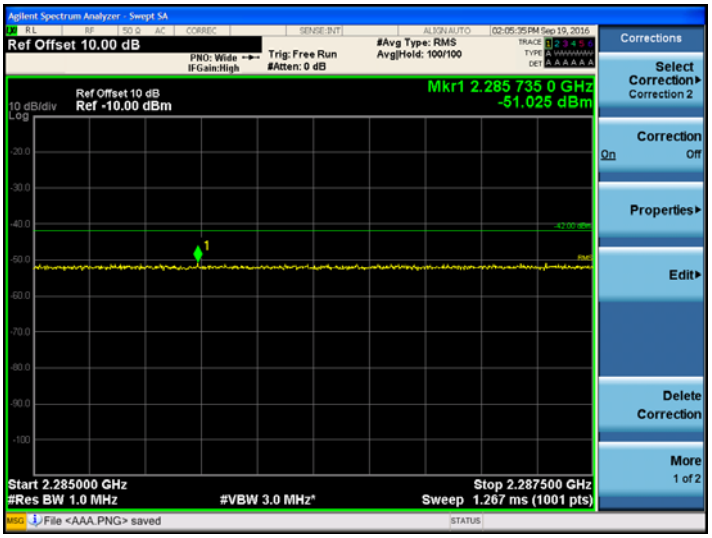
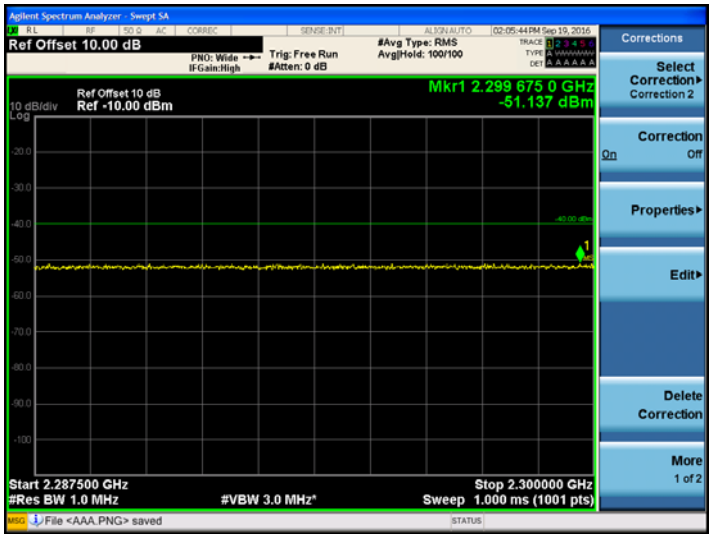
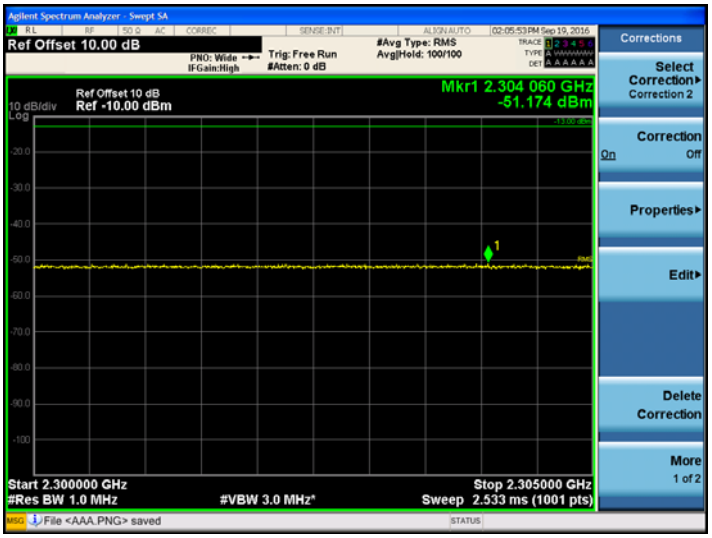
[Downlink Middle]

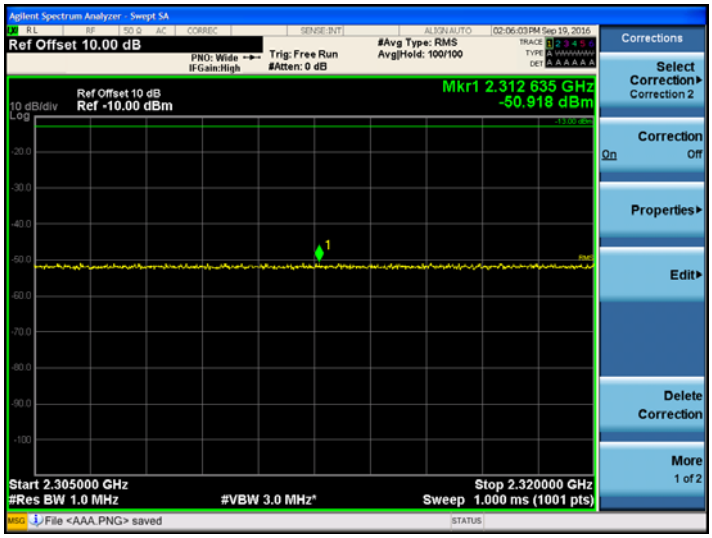
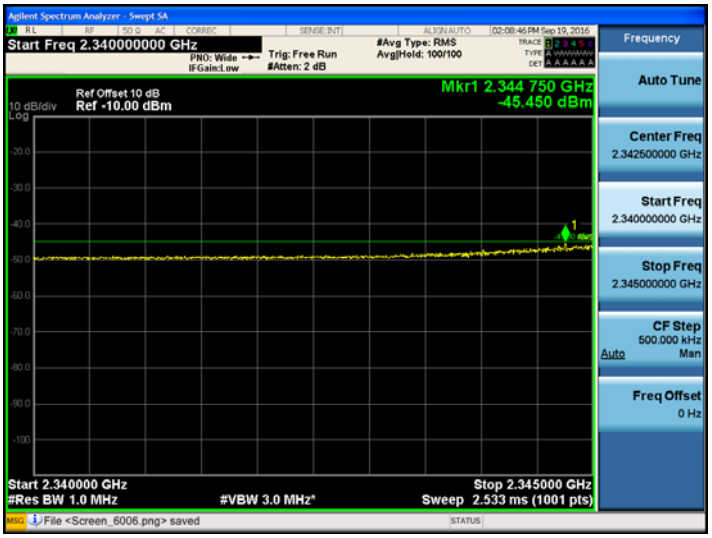


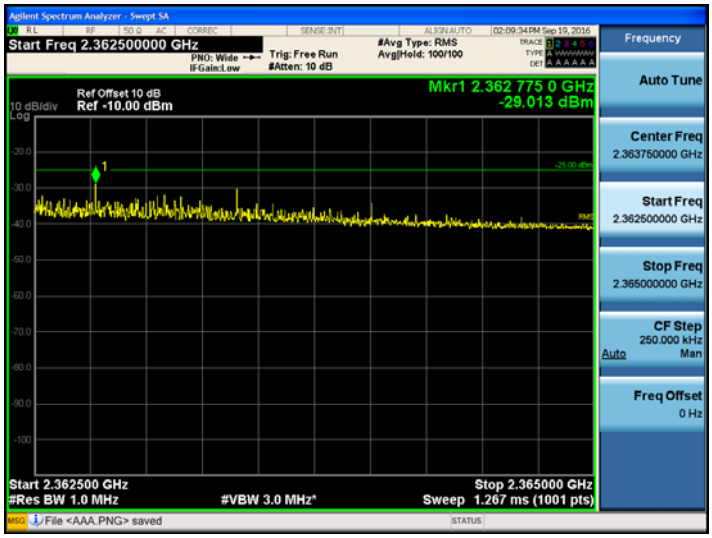
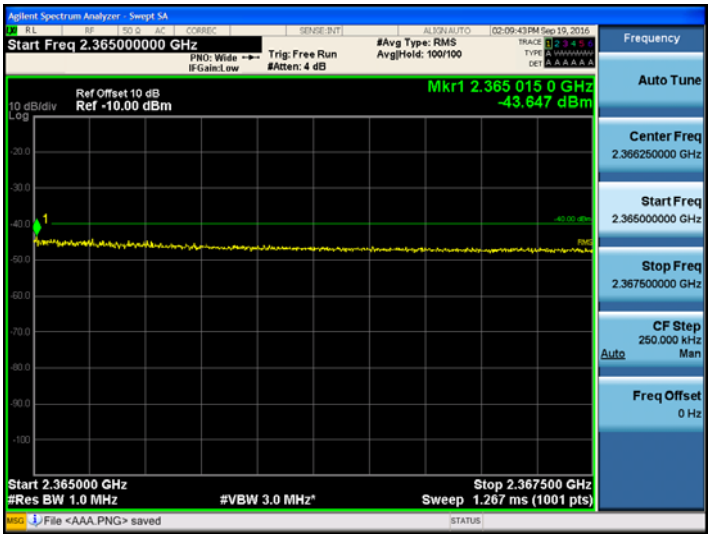
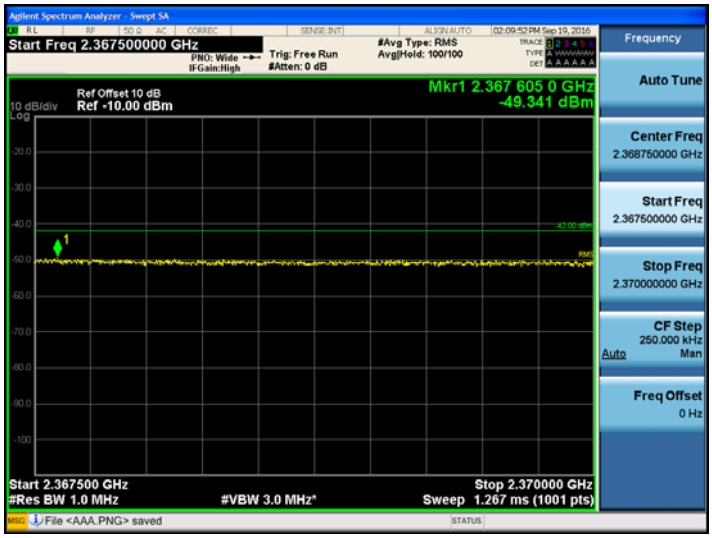
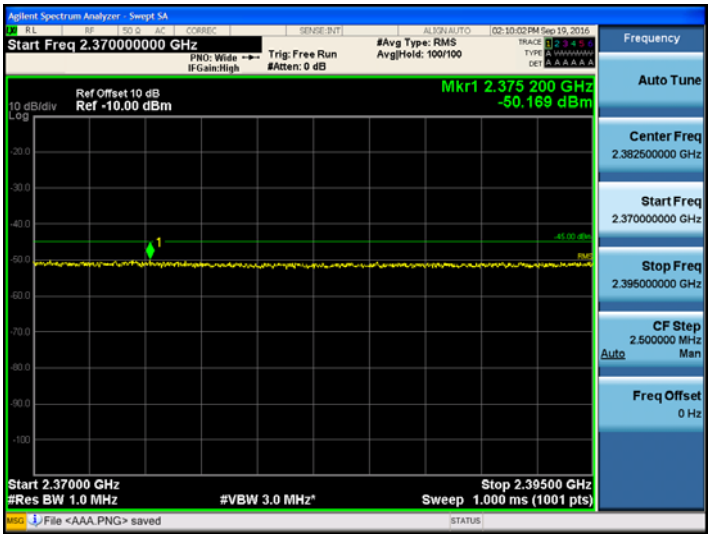
Conducted Spurious Emissions (1 GHz – 26.5 GHz)

[Downlink Middle]

1000 ㎒ ~ 2200 ㎒	2360 ㎒ ~ 3000 ㎒
	
3000 ㎒ ~ 12750 ㎒	**12750 ㎒ ~ 26500 ㎒**
	

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 ㎒**
	

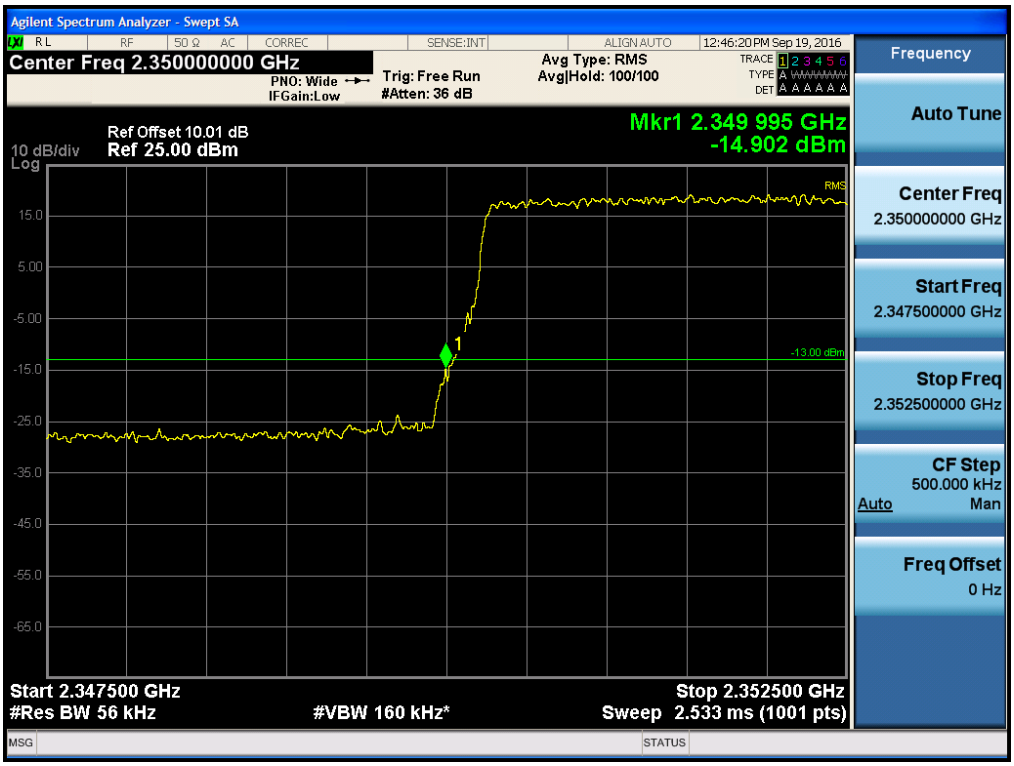
Intermodulation Spurious Emissions for FCC_2300_WCS BAND LTE 5 MHz

[Downlink Low]

[Downlink High]

Single channel Enhancer Band Edge_2300_WCS BAND LTE 5 MHz

[Downlink Low]



[Downlink High]

Single channel Enhancer Band Edge_2300_WCS BAND LTE 10 MHz

[Downlink Low]

[Downlink High]

10. RADIATED SPURIOUS EMISSIONS

Test Requirement(s):

§ 2.1053 Measurements required: Field strength of spurious radiation.

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

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

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

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

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

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

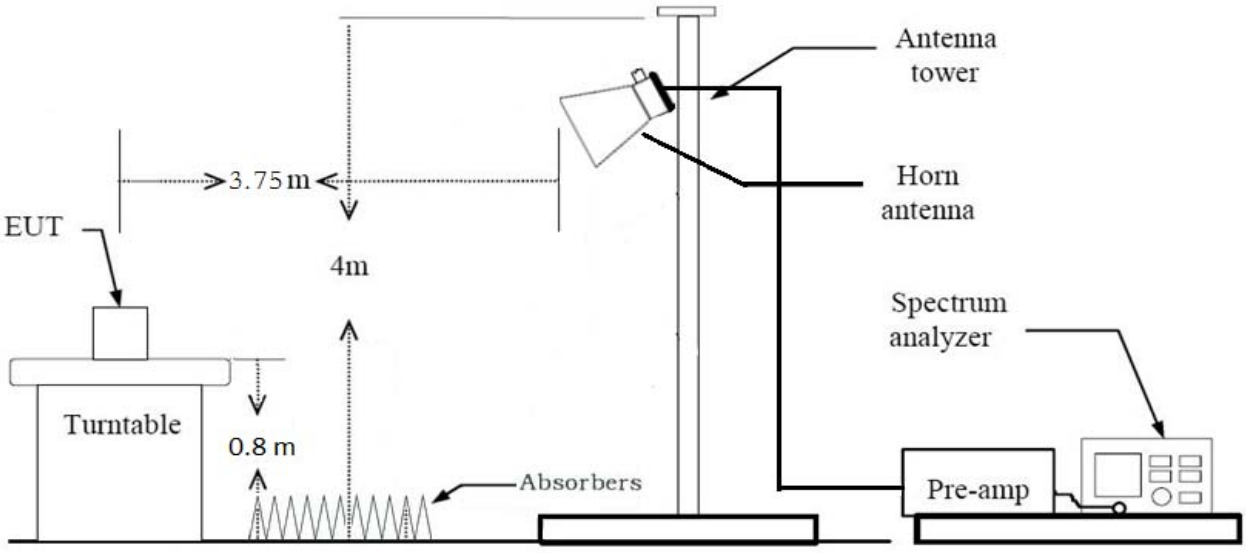
Test Procedures:

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)

Test Result:

2300_WCS Band

[LTE 5 MHz]

120 Vac

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]	dBuV/m @3m
Low	5,226.00	56.22	-38.98	31.260	4.49	43.81	-0.07	1.96	H	-45.150	50.050
	7,057.50	66.76	-28.44	35.516	5.53	44.80	-0.05	1.96	H	-30.284	64.916
Mid.	5,226.00	55.50	-39.70	31.260	4.49	43.81	-0.07	1.96	H	-45.870	49.330
	7,065.00	63.60	-31.60	35.519	5.55	44.85	-0.07	1.96	H	-33.486	61.714
High	5,226.00	56.21	-38.99	31.260	4.49	43.81	-0.07	1.96	H	-45.160	50.040
	7,072.50	63.55	-31.65	35.522	5.56	44.90	-0.08	1.96	H	-33.588	61.612

-48 Vdc

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]	dBuV/m @3m
Low	7,057.50	65.44	-29.76	35.516	5.53	44.80	-0.05	1.96	H	-31.604	63.596
Mid.	7,065.00	63.41	-31.79	35.519	5.55	44.85	-0.07	1.96	H	-33.676	61.524
High	7,072.50	63.30	-31.90	35.522	5.56	44.90	-0.08	1.96	H	-33.838	61.362

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

[LTE 10 MHz]

120 Vac

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]	dBuV/m @3m
Mid.	7,065.00	63.60	-31.60	35.519	5.55	44.85	-0.07	1.96	H	-33.486	61.714

-48 Vdc

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]	dBuV/m @3m
Mid.	7,065.00	63.03	-32.17	35.519	5.55	44.85	-0.07	1.96	H	-34.056	61.144

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

11. FREQUENCY STABILITY OVER TEMPERATURE AND VOLTAGE VARIATIONS

FCC Rules

Test Requirement(s):

§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.

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.

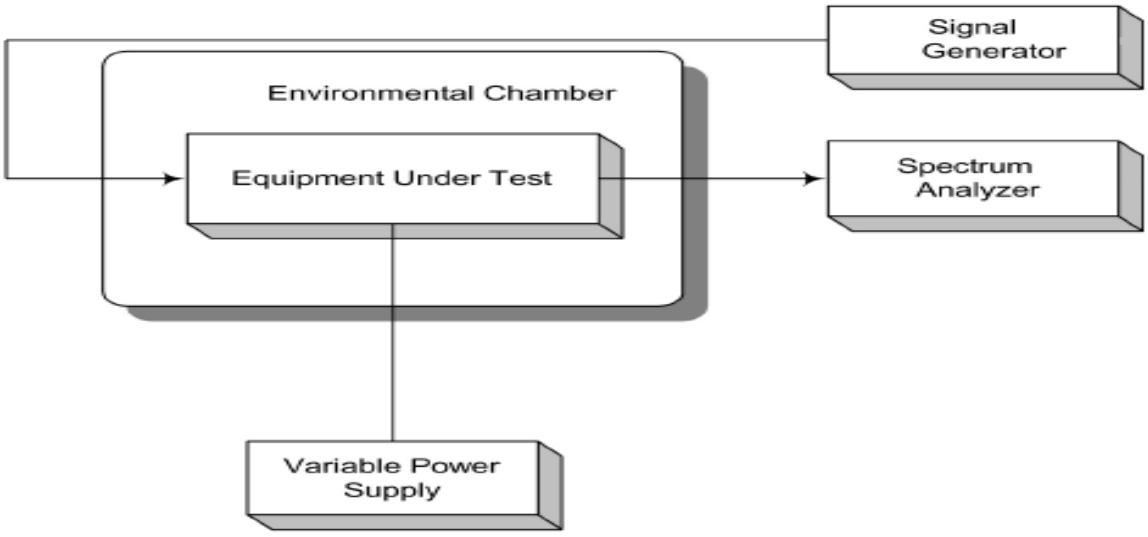
A CW signal was injected into the EUT at the appropriate RF level. The frequency counter option on the Spectrum Analyzer was used to measure frequency deviations.

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

Test Setup:



Test Results:

The E.U.T was found in compliance for Frequency Stability and Voltage Test

Frequency Stability and Voltage Test Results

[2300_WCS BAND]

Reference: 120 Vac at 20°C **Freq.** = 2550.0 MHz

Voltage (%)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	ppm
100%	+20(Ref)	2550 000 000	0.019	0.00000
	-30	2550 000 000	-0.123	-0.00005
	-20	2550 000 000	-0.052	-0.00003
	-10	2550 000 000	-0.001	-0.00001
	0	2550 000 000	0.006	-0.00001
	+10	2550 000 000	0.011	0.00000
	+30	2550 000 000	0.047	0.00001
	+40	2550 000 000	0.092	0.00003
	+50	2550 000 000	0.104	0.00003
115%	+20	2550 000 000	0.011	0.00000
85%	+20	2550 000 000	0.022	0.00000