

CERTIFICATE OF COMPLIANCE (ERM EVALUATION)

Manufacture: Advanced RF Technologies, Inc

3116 West VANOWEN STREET, BURBANK, CA
91505 U.S.A

Date of Issue:

May 03, 2012

Location:

HCT CO., LTD., 105-1, Jangam-ri, Majang-Myeon,
Icheon-si, Gyeonggi-Do, Korea

Test Report No.: HCTR1205FR04

IC Recognition No.: 5944A-3

FCC ID:

S2O-ADX-R-A30S

IC :

6416A-ADXRA30S

APPLICANT:

Advanced RF Technologies, Inc

EUT Type:

DAS(Distributed Antenna System)

Model:

ADX-R-A30S

Frequency Ranges:

DL : 2110 MHz ~ 2155 MHz

Conducted Output Power:

DL : 30.0 dBm

FCC Rules Part(s):

CFR 47, Part 27

IC Rule Part(s):

RSS-Gen (December 2010) , RSS-131 (July 2003)

Engineering Statement:

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

Chang Seok Choi

Report prepared by
:Chang Seok Choi
Test engineer of RF Team

Sang Jun Lee

Approved by
: Sang Jun Lee
Manager of RF Team

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1. CLIENT INFORMATION

The EUT has been tested by request of

Company	Advanced RF Technologies, Inc 3116 WEST VANOWEN STREET, BURBANK, CA 91505 U.S.A
Contact Point	Attention: Ms. Julie Song Tel. : 800-313-9345

- FCC ID: S2O-ADX-R-A30S
- IC ID: 6416A-ADXRA30S
- APPLICANT: Advanced RF Technologies, Inc
- EUT Type: DAS(Distributed Antenna System)
- Model: ADX-R-A30S
- Frequency Ranges: DL : 2110 MHz ~ 2155 MHz
- Conducted Output Power: DL : 30.0 dBm
- Antenna Gain(s) : 3 dBi
- FCC Rules Part(s): CFR Title 47 Part 27
- IC Rules Part(s): RSS-Gen (December 2010) , RSS-131 (July 2003)
- Place of Tests: 105-1, Jangam-ri , Majang-Myeon, Icheon-si, Gyeonggi-Do, 467-811, KOREA. (IC Recognition No. : 5944A-3)

2. TEST SPECIFICATIONS

Description	Reference (FCC)	Reference (IC)	Results
RF Power Output	§2.1046; §27.50	RSS-131, Section 4.3 RSS-GEN, Section 4.8	Compliant
Occupied Bandwidth	§2.1049	RSS-131, Section 4.2 RSS-GEN, Section 4.6.1	Compliant
Spurious Emissions at Antenna Terminals	§2.1053, §27.53	RSS-131, Section 4.4 RSS-GEN, Section 4.9	Compliant
Radiated Spurious Emissions	§2.1053, §27.53	RSS-131, Section 4.4 RSS-GEN, Section 4.9	Compliant
Frequency Stability	§2.1055, §27.54	RSS-131, Section 4.5 RSS-GEN, Section 4.7	Compliant

3. STANDARDS ENVIRONMENTAL TEST CONDITIONS

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

4. TEST EQUIPMENT

Manufacturer	Model / Equipment	Cal Interval	Calibration Due	Serial No.
Agilent	E4438C /Signal Generator	Annual	11/08/2012	MY42082646
Agilent	N5182A /Signal Generator	Annual	08/23/2012	MY50141649
Agilent	E4416A /Power Meter	Annual	11/07/2012	GB41291412
Agilent	E9327A/ Power Sensor	Annual	05/02/2012	MY4442009
Korea Eng	KR-1005L/ Temperature and Humidity Chamber	Annual	11/07/2012	KRAC05063-3CH
Agilent	N9020A /Signal Analyzer	Annual	06/10/2012	MY51110020
Agilent	8498A /ATTENUATOR	Annual	11/07/2012	51162
HD	MA240/ Antenna Position Tower	N/A	N/A	556
EMCO	1050/ Turn Table	N/A	N/A	114
HD GmbH	HD 100/ Controller	N/A	N/A	13
HD GmbH	KMS 560/ SlideBar	N/A	N/A	12
MITEQ	AMF-6D-001180-35-20P/AMP	Annual	12/26/2012	990893
Schwarzbeck	BBHA 9120D/ Horn Antenna	Biennial	10/17/2013	937
Schwarzbeck	BBHA 9120D/ Horn Antenna	Biennial	02/20/2014	296
Schwarzbeck	VULB 9168/TRILOG Antenna	Biennial	02/09/2013	9168-200

5. RF OUTPUT POWER

Test Requirements:

§ 2.1046 Measurements required: RF power output:

§ 2.1046 (a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

§ 2.1046 (b) For single sideband, independent sideband, and single channel, controlled carrier radiotelephone transmitters, the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and as applicable in § 2.1046 (b) (1-5). In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.

§ 2.1046 (c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

§ 27.50 Power limits and duty cycle.

(d) The following power and antenna height requirements apply to stations transmitting in the 1710–1755 MHz and 2110–2155 MHz bands:

(1) The power of each fixed or base station transmitting in the 2110–2155 MHz band and located in any county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, is limited to:

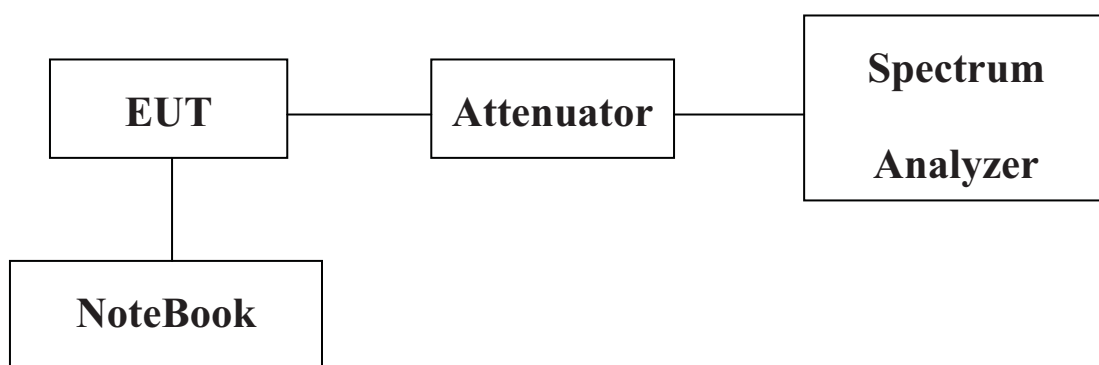
(A) an equivalent isotropically radiated power (EIRP) of 3280 watts when transmitting with an emission bandwidth of 1 MHz or less;

(B) an EIRP of 3280 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

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

Test Procedures:

As required by 47 CFR 2.1046, RF power output measurements were made at the RF output terminals using an attenuator and spectrum analyzer or power meter. This test was performed in all applicable modulations.



Block Diagram 1. RF Power Output Test Setup

Test Results:

Input Signal	Modulation	Level (dBm)
CDMA	QPSK	0 dBm
WCDMA	QPSK	0 dBm
LTE	16QAM	0 dBm

[Downlink]

	Channel	Frequency (MHz)	Output Power (dBm)
CDMA	Low	2111.25	29.53
	Middle	2132.5	29.73
	High	2153.75	29.32
WCDMA	Low	2112.4	29.84
	Middle	2136.9	29.43
	High	2152.6	29.43
LTE	Low	2115.0	29.71
	Middle	2135.0	29.56
	High	2150.0	29.90

Plots of RF Output Power

[CDMA Downlink Low]

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[CDMA Downlink Middle]



[CDMA Downlink High]



[WCDMA Downlink Low]



[WCDMA Downlink Middle]



[WCDMA Downlink High]



[LTE Downlink Low]



[LTE Downlink Middle]



[LTE Downlink High]



[Downlink 3 FA]

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[Downlink 1 FA]



* RSS-131 6.2 Power Back-off : $28.38 - 23.62 = 4.76$ dB

6. OCCUPIED BANDWIDTH

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: As required by 47 CFR 2.1049, *occupied bandwidth measurements* were made with a Spectrum Analyzer connected to the RF ports for both Uplink and Downlink. The modulation characteristics of signal generator's carrier was measured first at a maximum RF level prescribed by the OEM. The signal generator was then connected to either the Uplink or Downlink input at the appropriate RF level. The resulting modulated signal through the EUT was measured and compared against the original signal.

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

[Downlink Output]

	Channel	Frequency (MHz)	OBW (MHz)
CDMA	Low	2111.25	1.2402
	Middle	2132.5	1.2401
	High	2153.75	1.2422
WCDMA	Low	2112.4	4.1787
	Middle	2136.9	4.1895
	High	2152.6	4.1811
LTE	Low	2115.0	8.9386
	Middle	2135.0	8.9287
	High	2150.0	8.9433

[Downlink Input]

	Channel	Frequency (MHz)	OBW (MHz)
CDMA	Low	2111.25	1.2408
	Middle	2132.5	1.2407
	High	2153.75	1.2400
WCDMA	Low	2112.4	4.1833
	Middle	2136.9	4.1761
	High	2152.6	4.1828
LTE	Low	2115.0	8.9345
	Middle	2135.0	8.9416
	High	2150.0	8.9356

Plots of Occupied Bandwidth

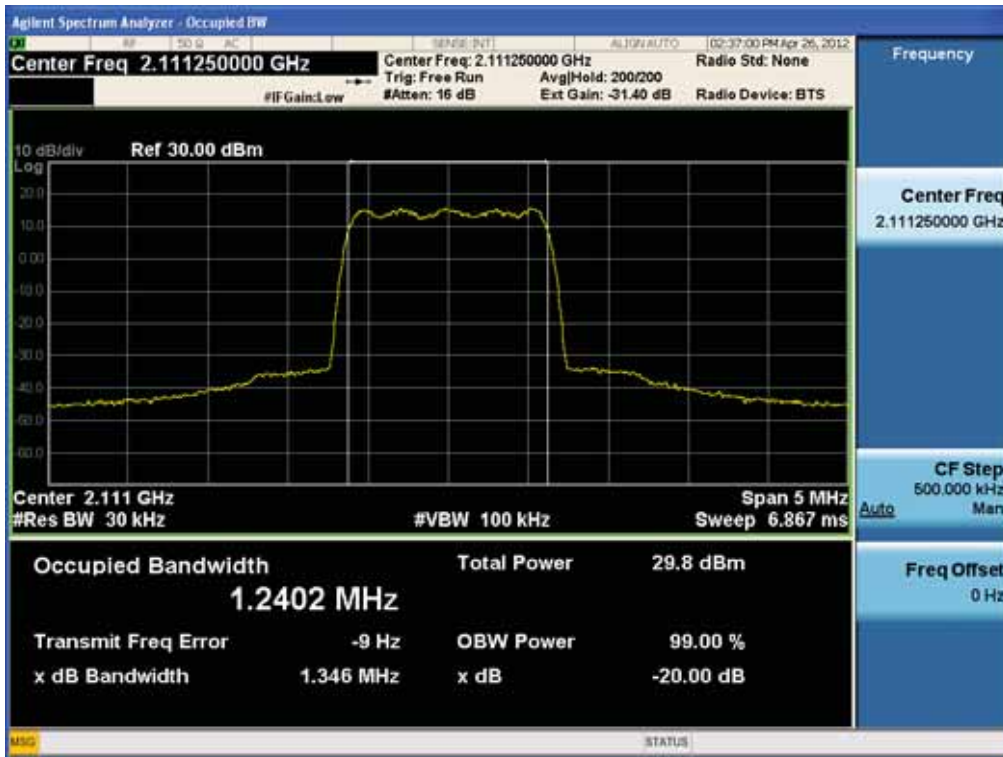
[Output CDMA Downlink Low]

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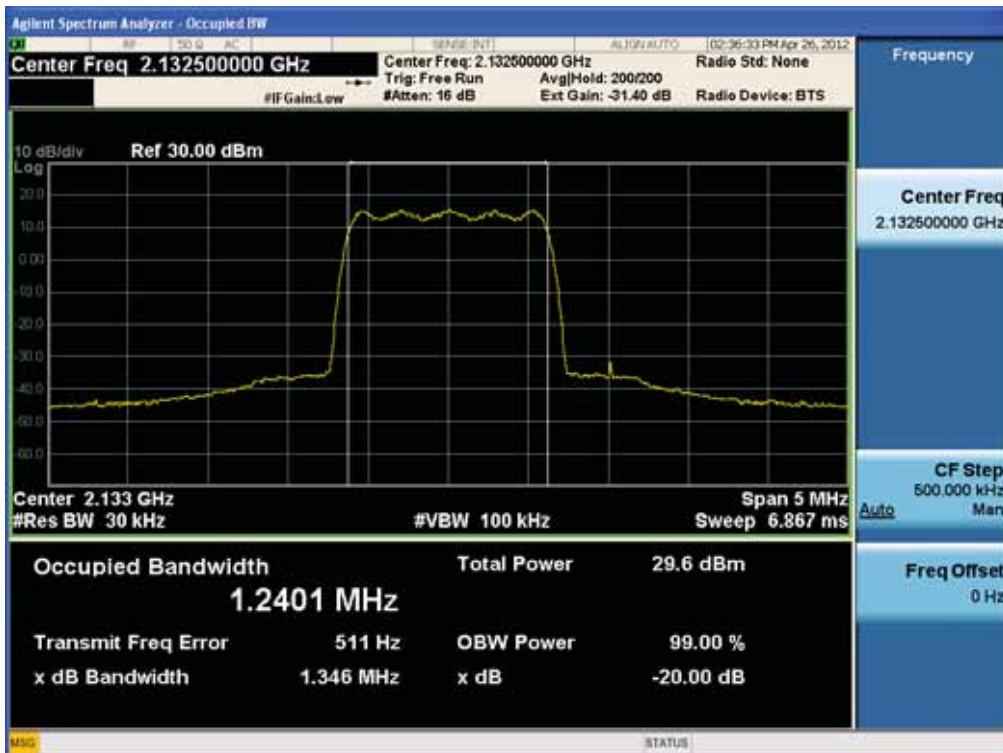
105-1, Jangam-ri, Majang-Myeon, Icheon-si, Gyeonggi-Do, Korea

TEL : +82 31 645 6300 FAX : +82 31 645 6401 www.hct.co.kr

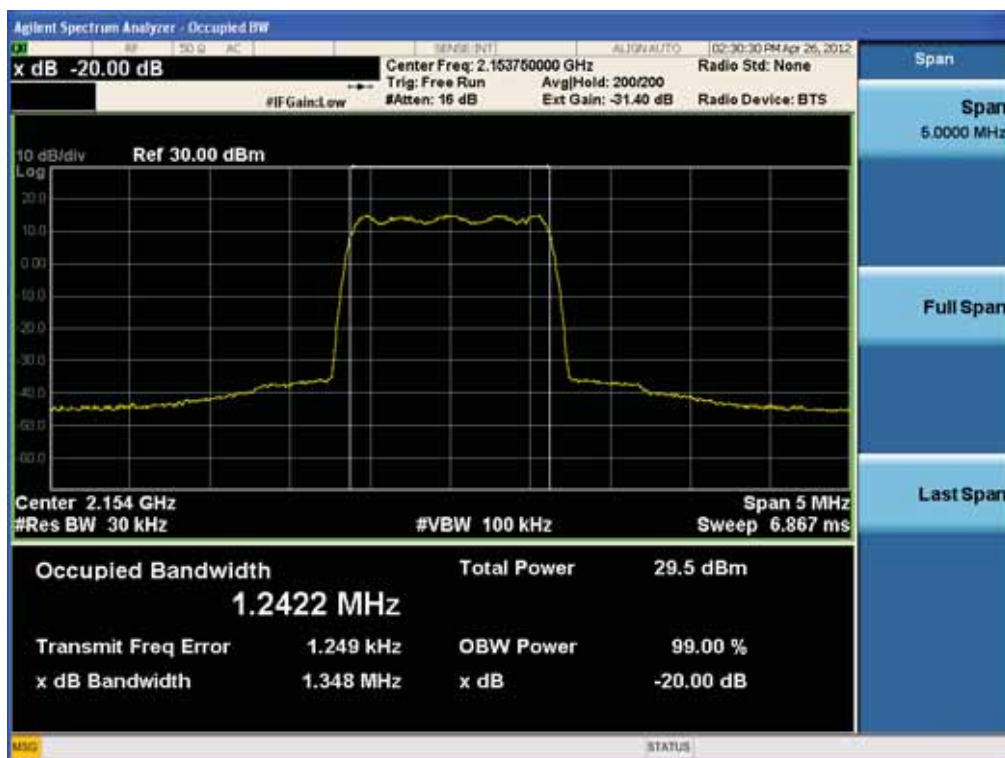
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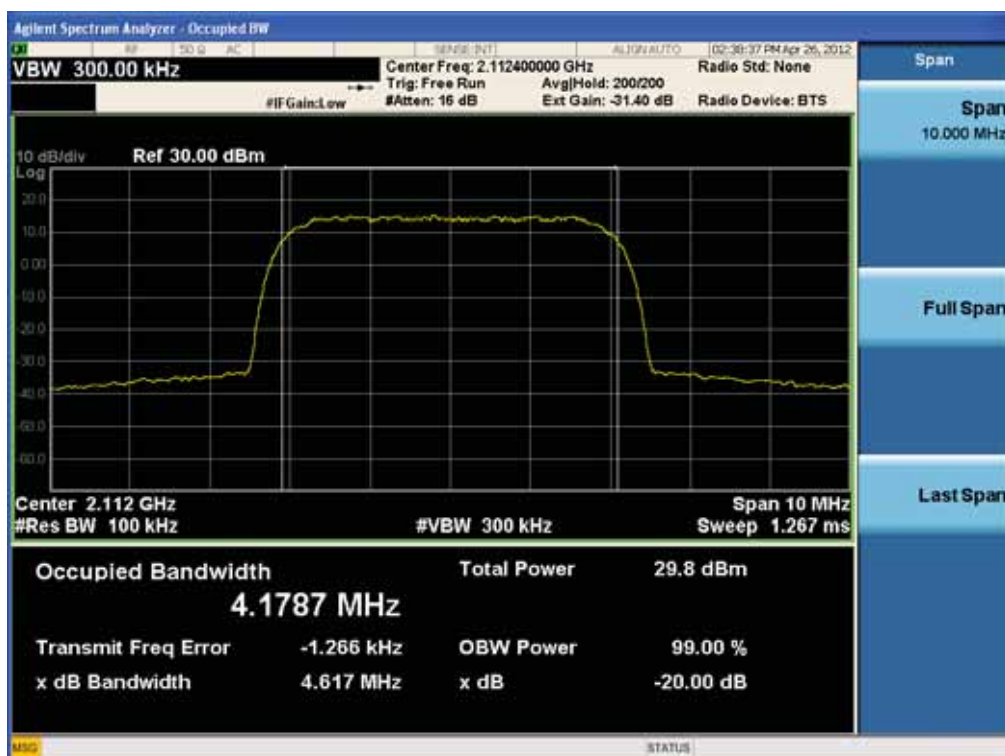
[Output CDMA Downlink Middle]



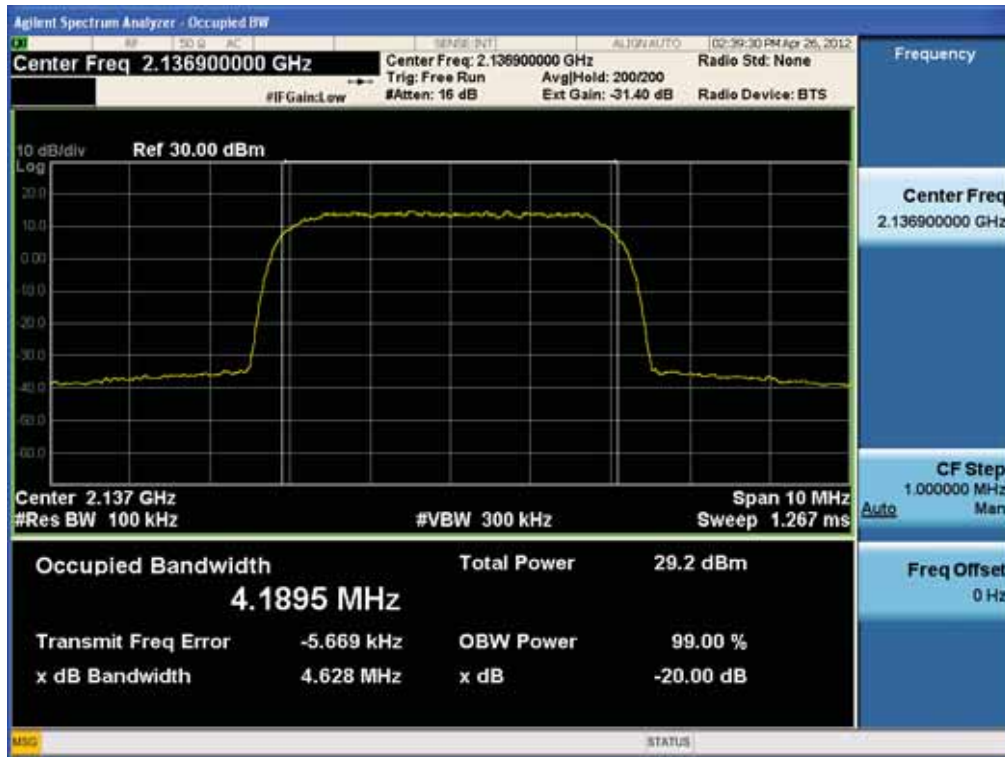
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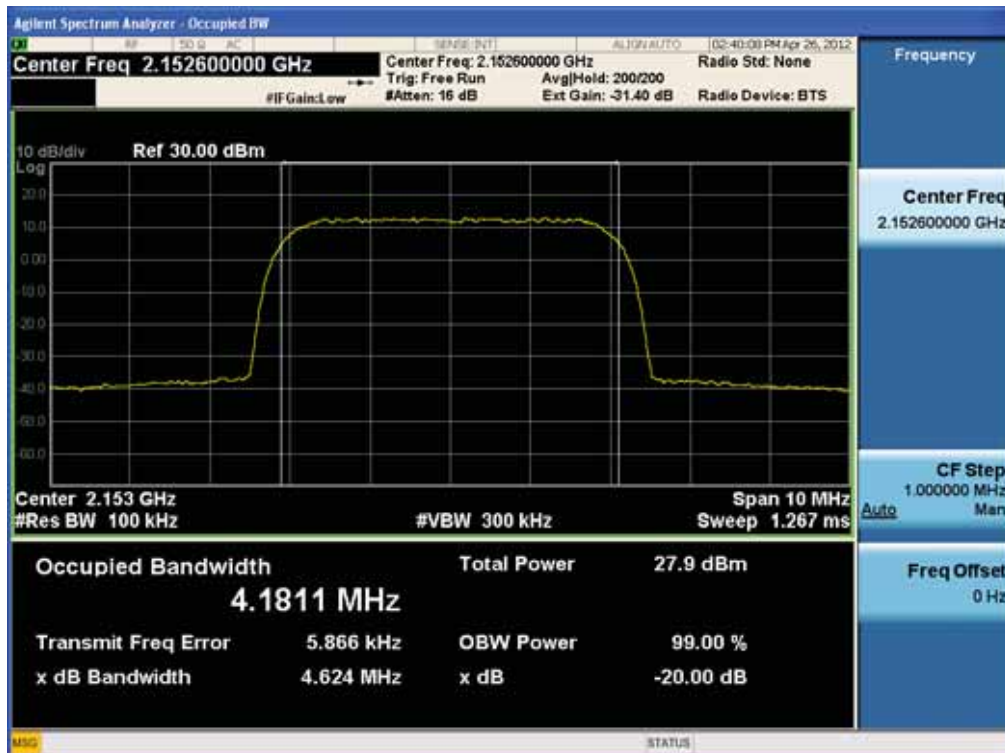
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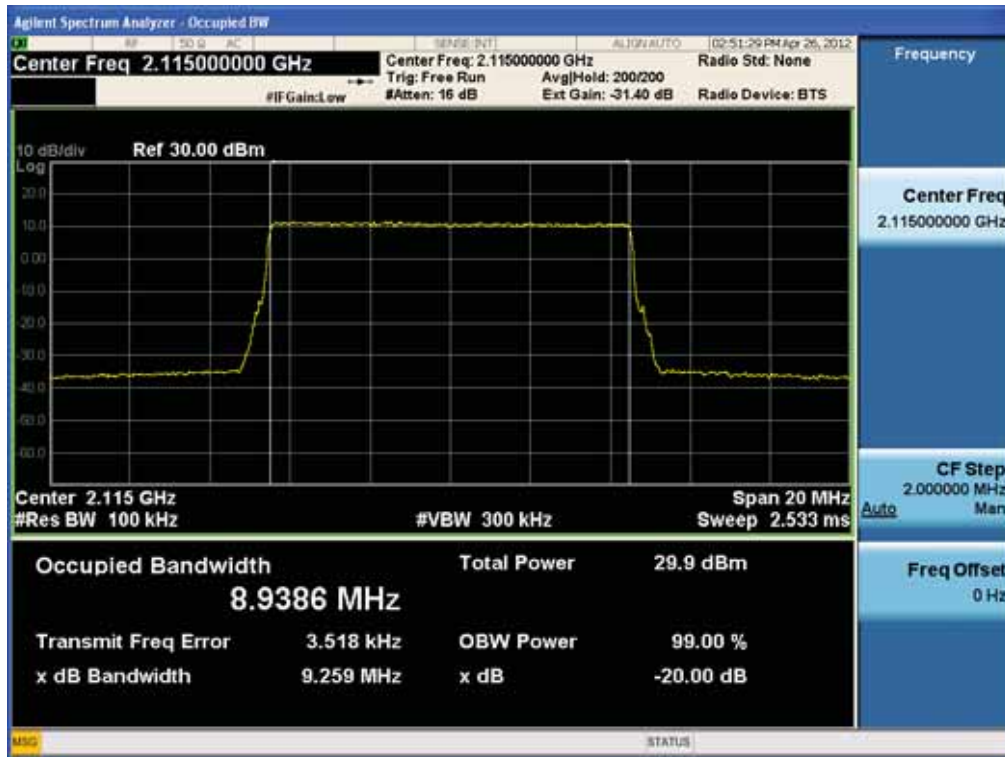
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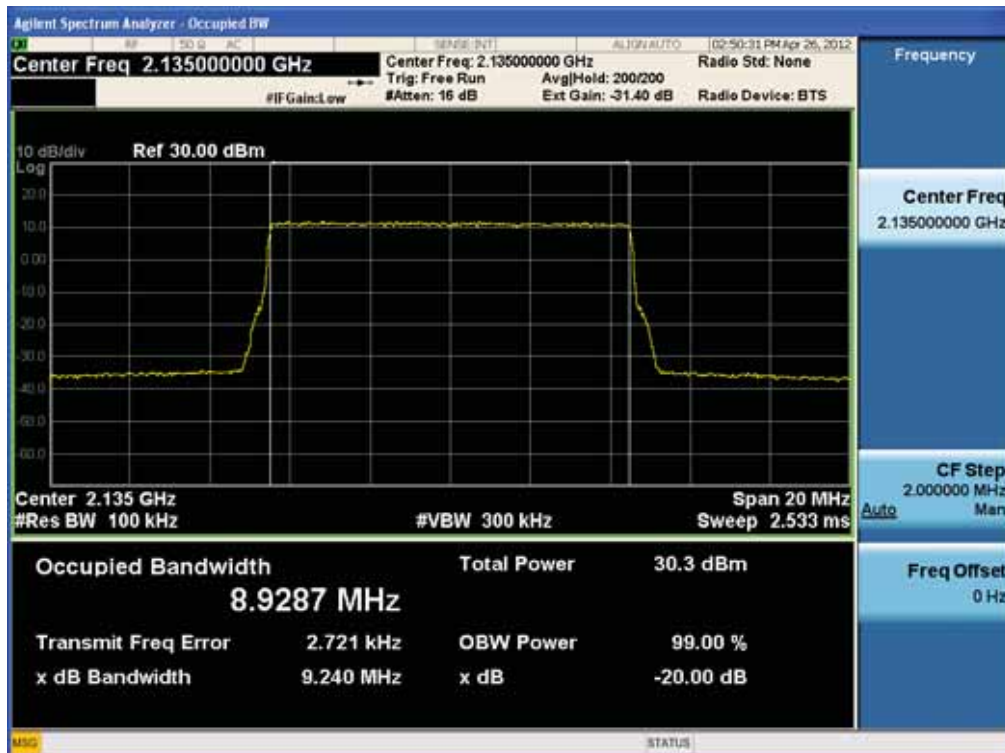
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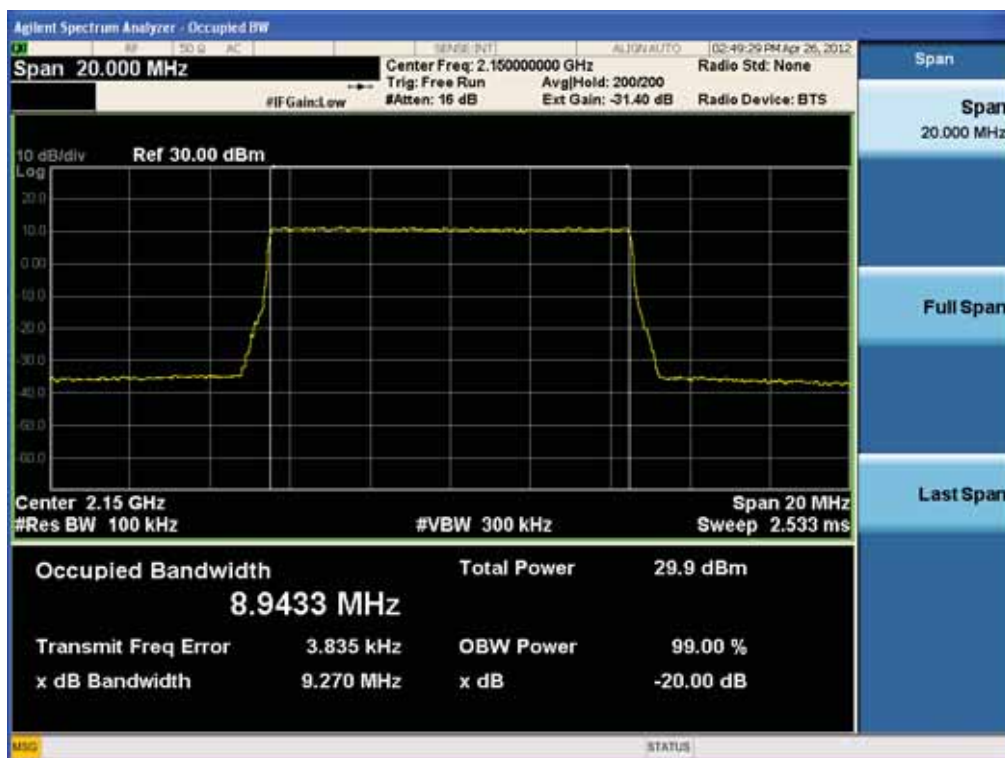
[Output LTE Downlink Low]



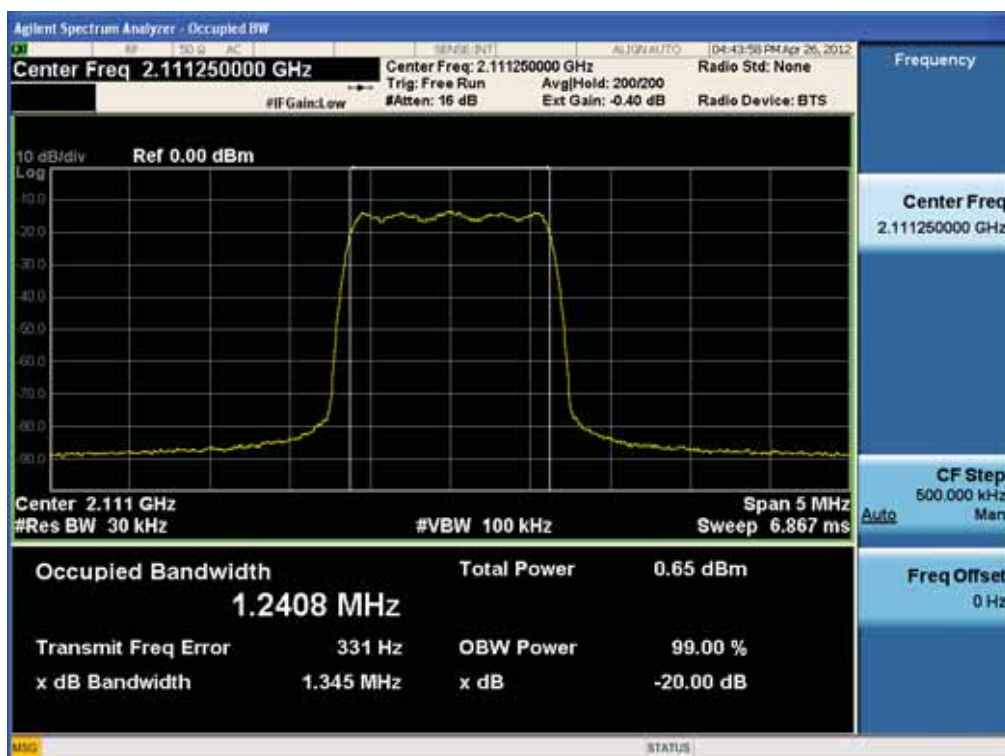
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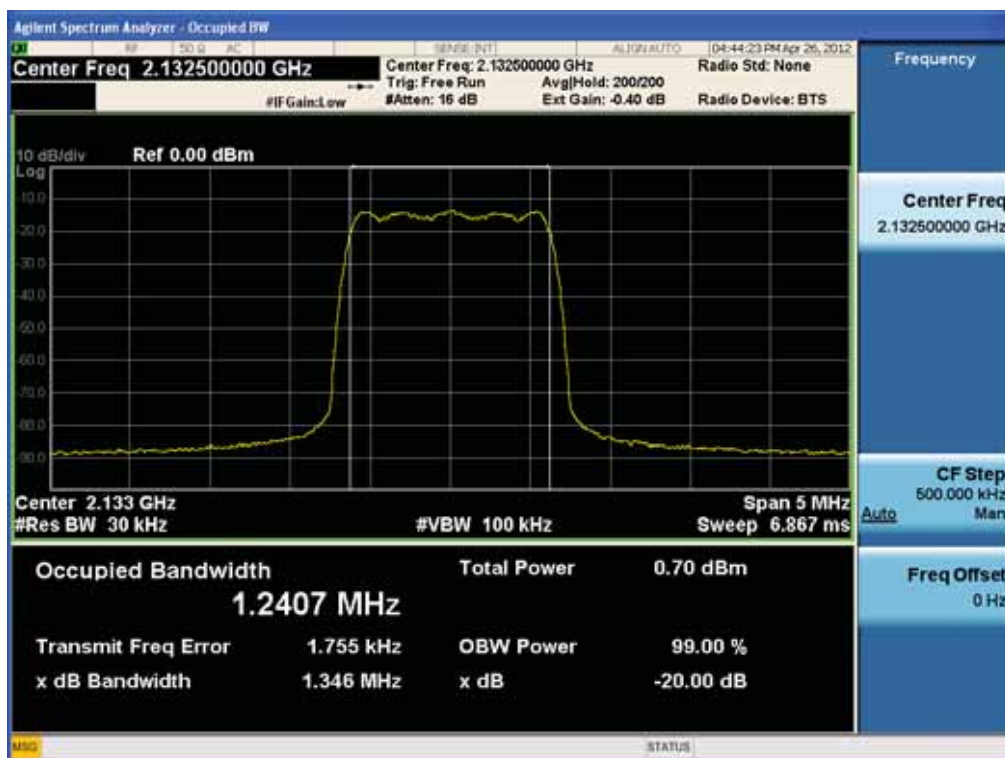
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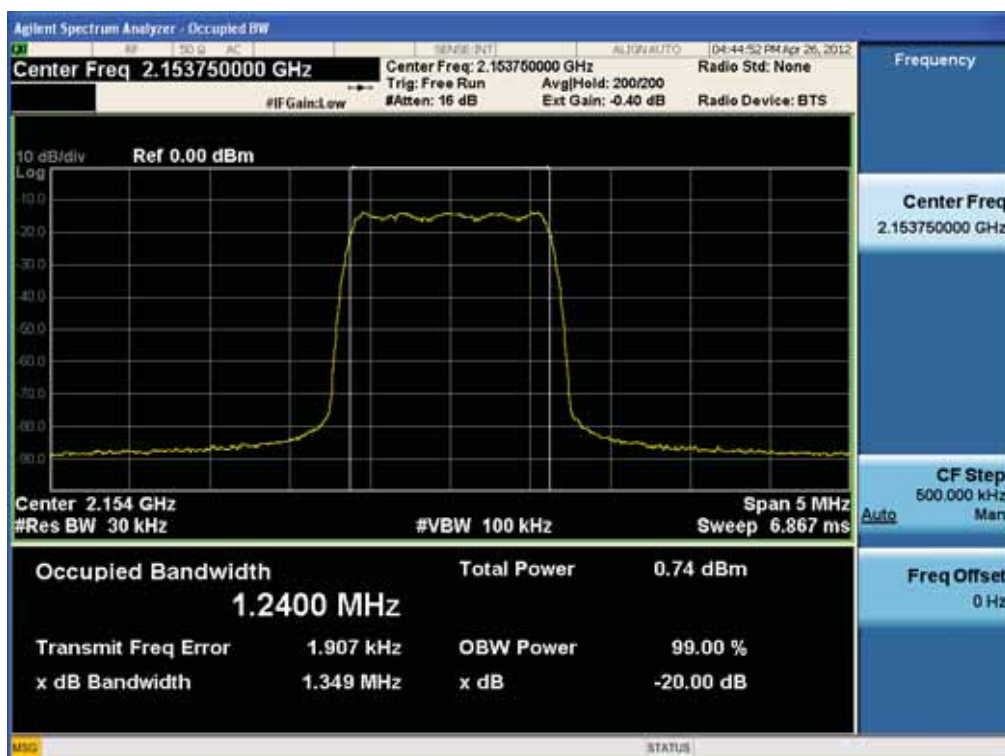
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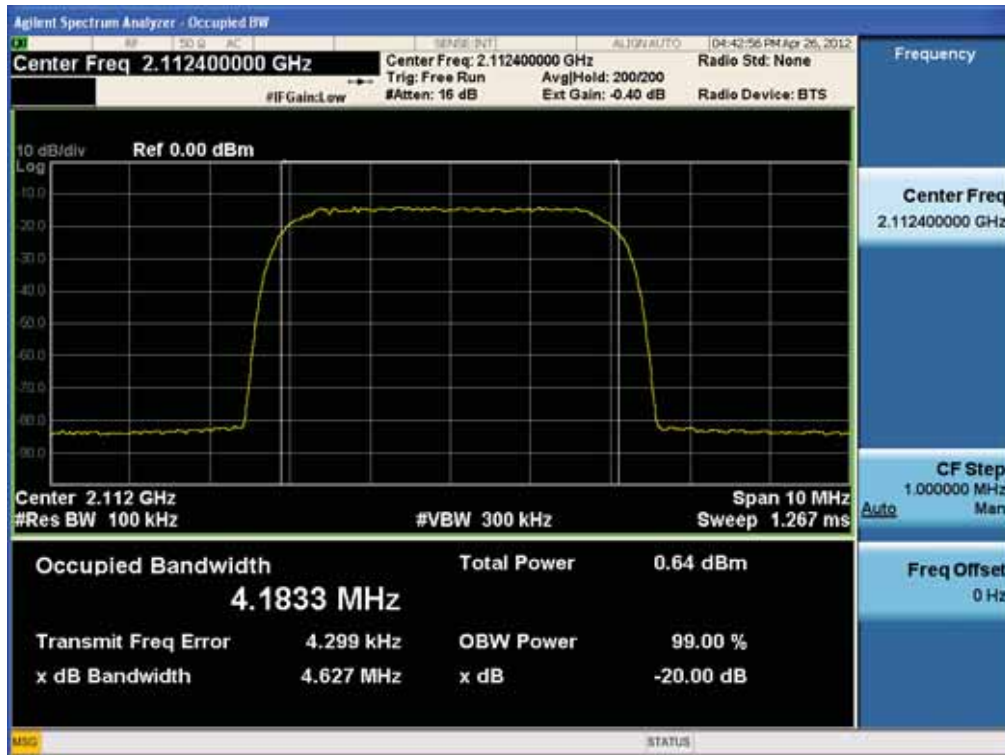
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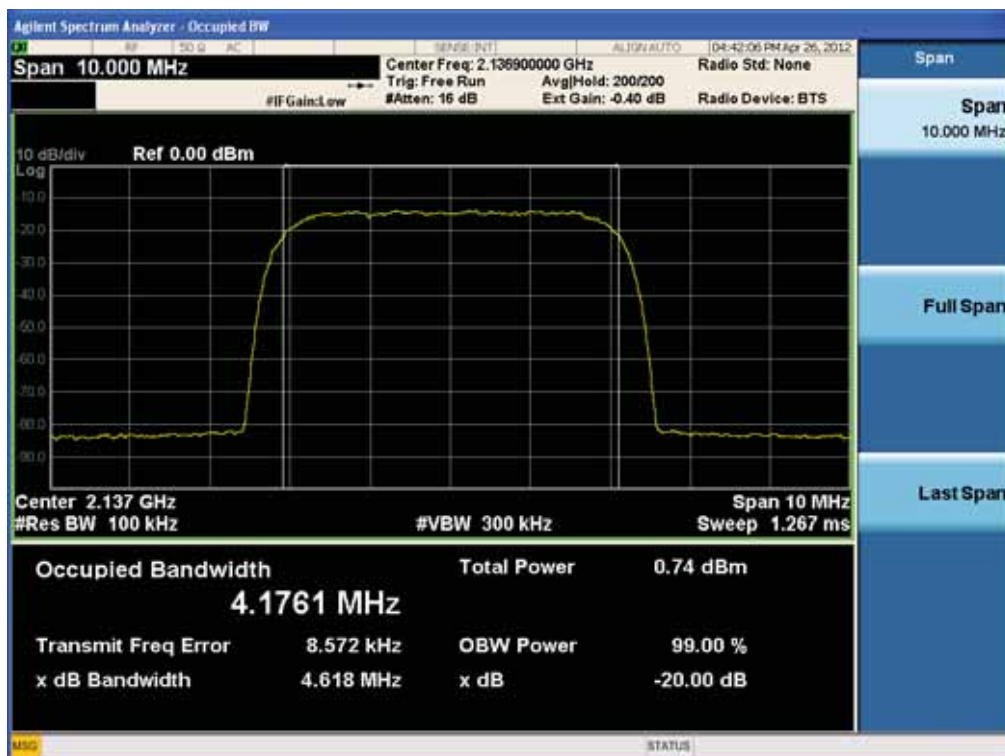
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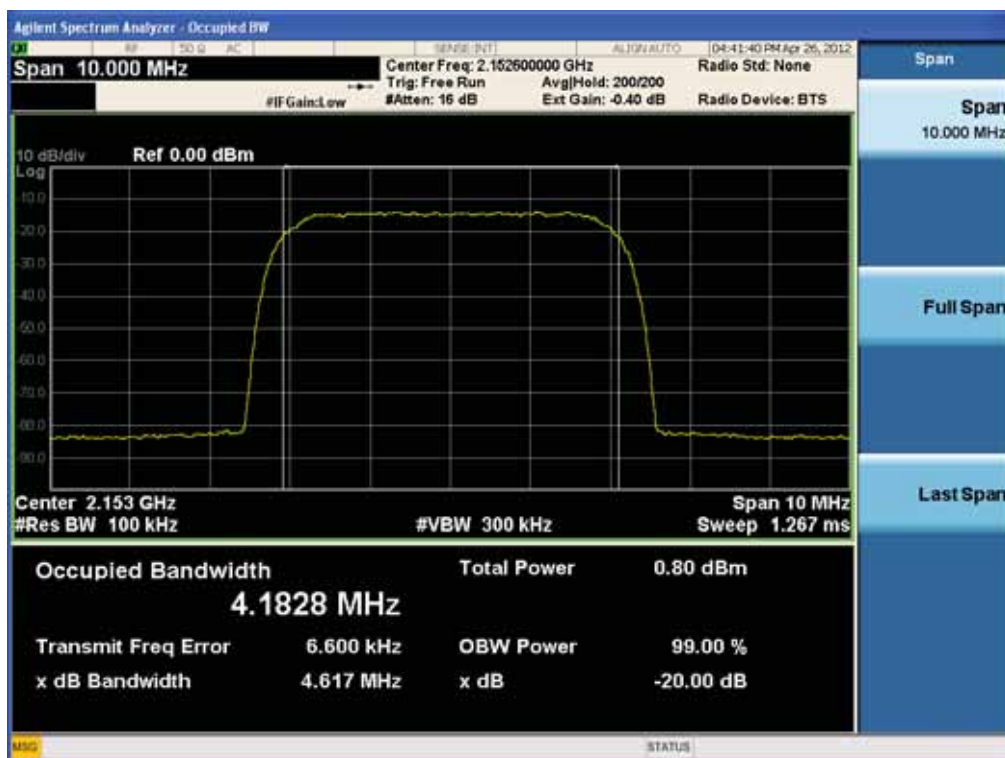
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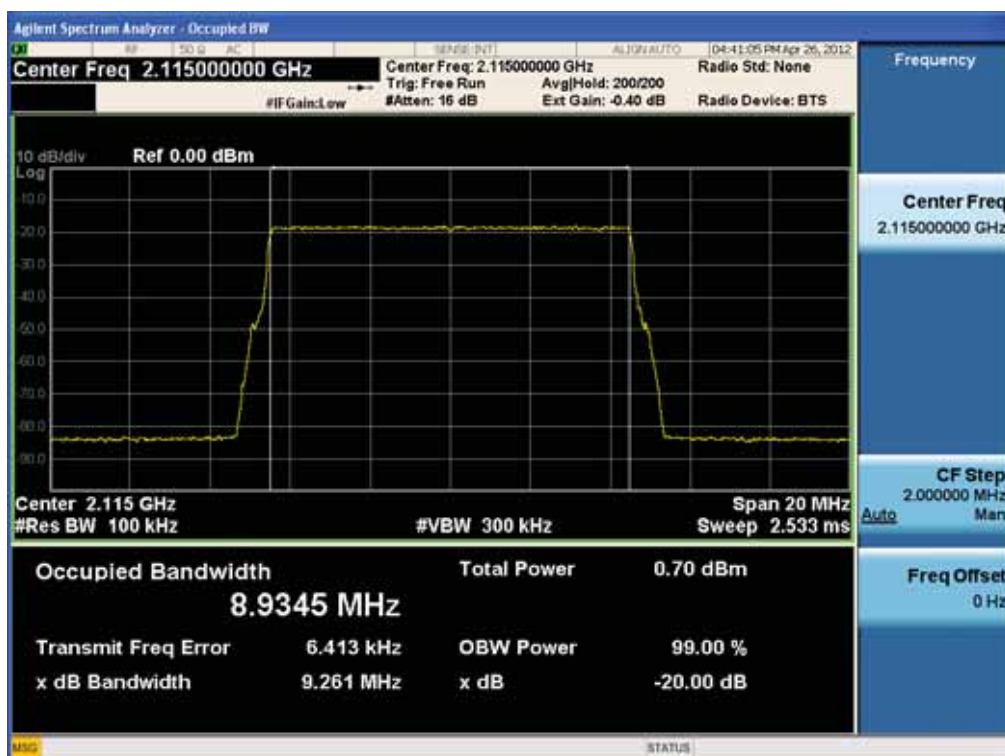
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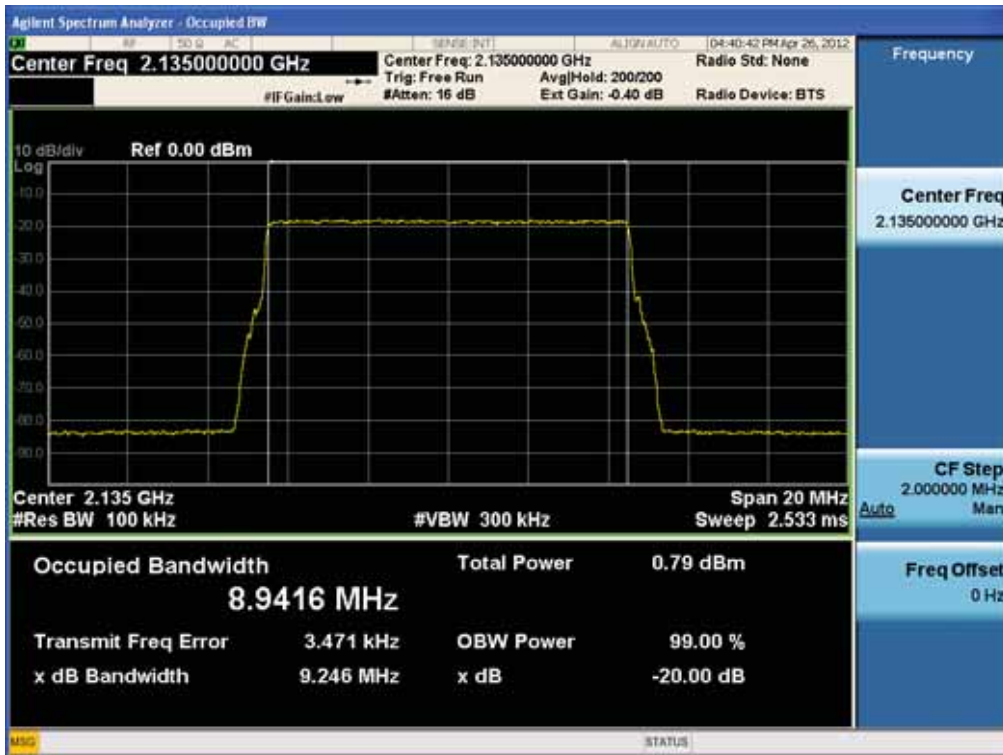
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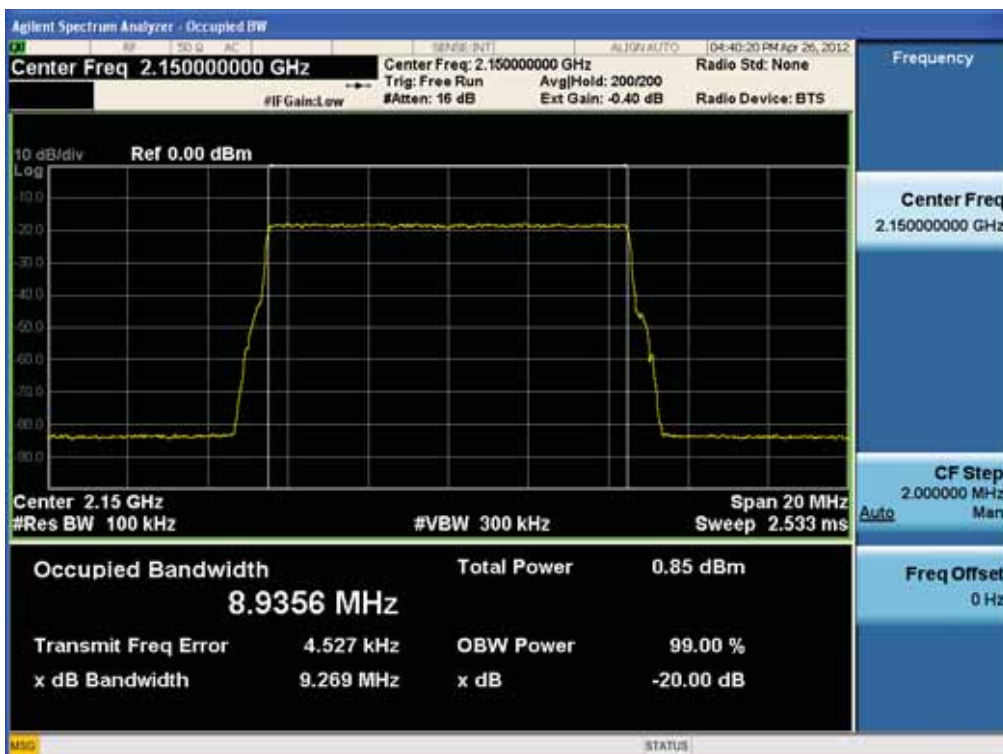
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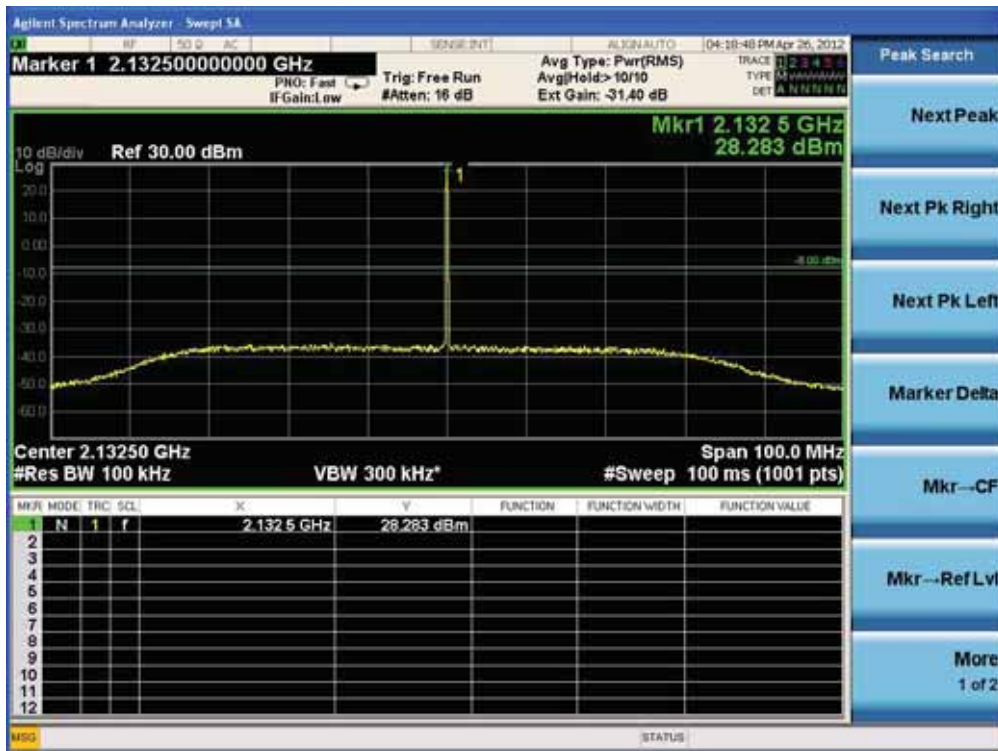
[Input LTE Downlink Middle]



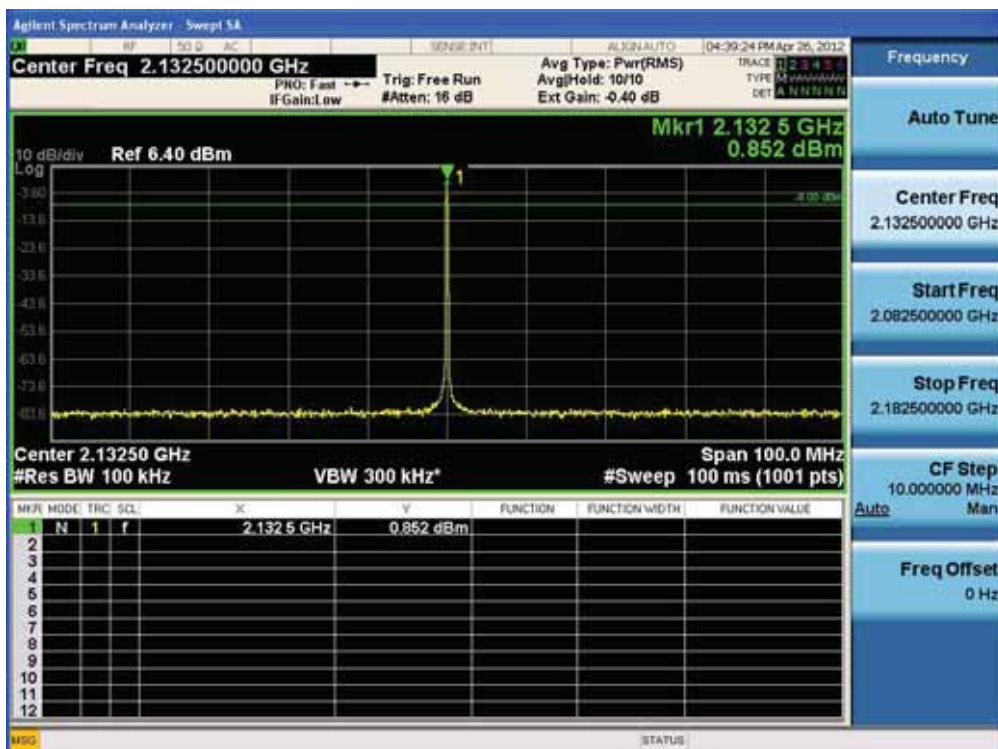
[Input LTE Downlink High]



[Downlink Output Power]

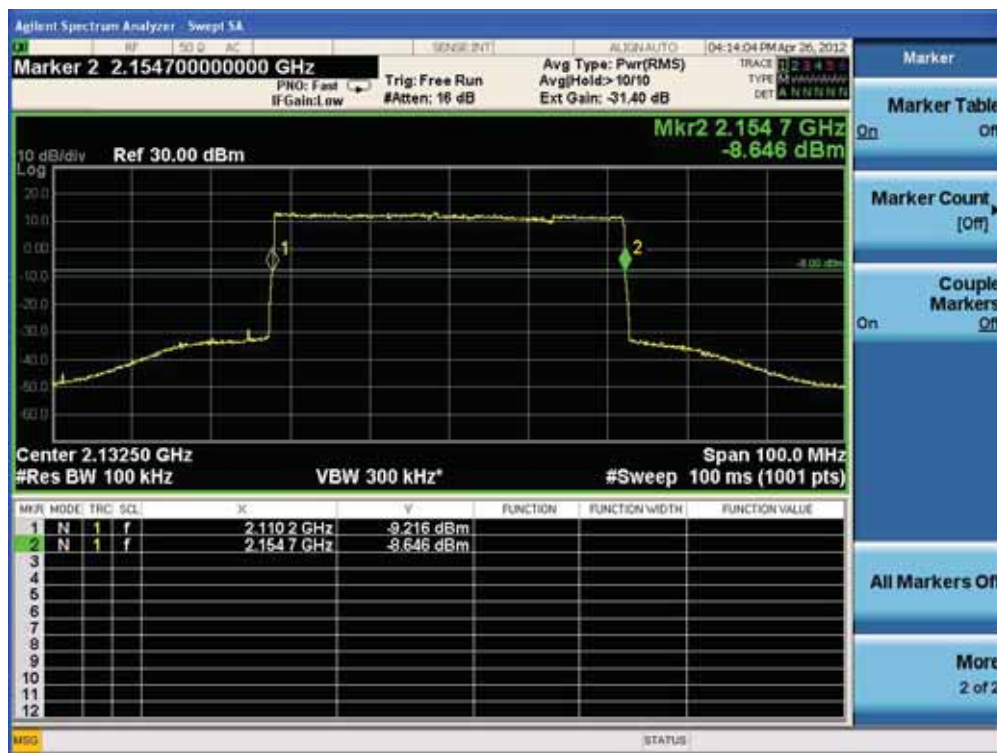


[Downlink Input Power]



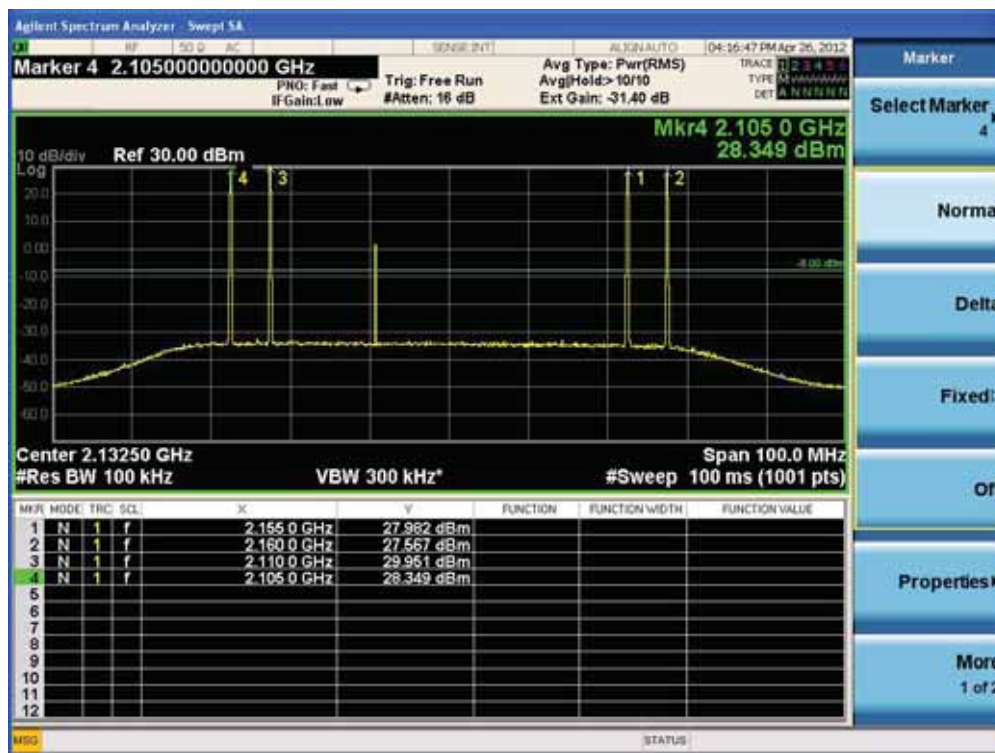
- RSS-131 6.1 Passband Gain : $28.283 - 0.852 = 27.431 \text{ dB} < \text{nominal gain } 30 \text{ dB}$

[Downlink Output Passband]



- RSS-131 4.2 20 dB Bandwidth : $2154.7 - 2110.2 = 44.5 \text{ MHz} < \text{Nominal Bandwidth } 45 \text{ MHz}$

[Out of 20 dB Bandwidth Gain]



- RSS-131 6.1 Out of 20 dB Bandwidth Gain is less than 20 dB Bandwidth Gain by 0.415 dB

7. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL

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

(h) For operations in the 1710- 1755 MHz and 2110- 2155 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least $43 + 10 \log_{10}(P)$ dB.

Test Procedures: A modulated carrier generated by the signal generator carrier was connected to either the Uplink or Downlink RF port at a maximum level as determined by the spectrum analyzer was connected to either the Uplink or Downlink port depending on the circuitry being measured.

The spectrum was investigated from 30 MHz to the 26.5 GHz of the carrier.

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

Plots of Spurious Emission

Conducted Spurious Emissions (30 MHz – 1 GHz)

[CDMA Downlink Low]



[CDMA Downlink Middle]



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[CDMA Downlink High]



[WCDMA Downlink Low]



[WCDMA Downlink Middle]



[WCDMA Downlink High]



[LTE Downlink Low]



[LTE Downlink Middle]



[LTE Downlink High]



Conducted Spurious Emissions (1 GHz ~26.5 GHz)

[CDMA Downlink Low]



[CDMA Downlink Middle]



[CDMA Downlink High]



[WCDMA Downlink Low]



[WCDMA Downlink Middle]



[WCDMA Downlink High]



[LTE Downlink Low]



[LTE Downlink Middle]

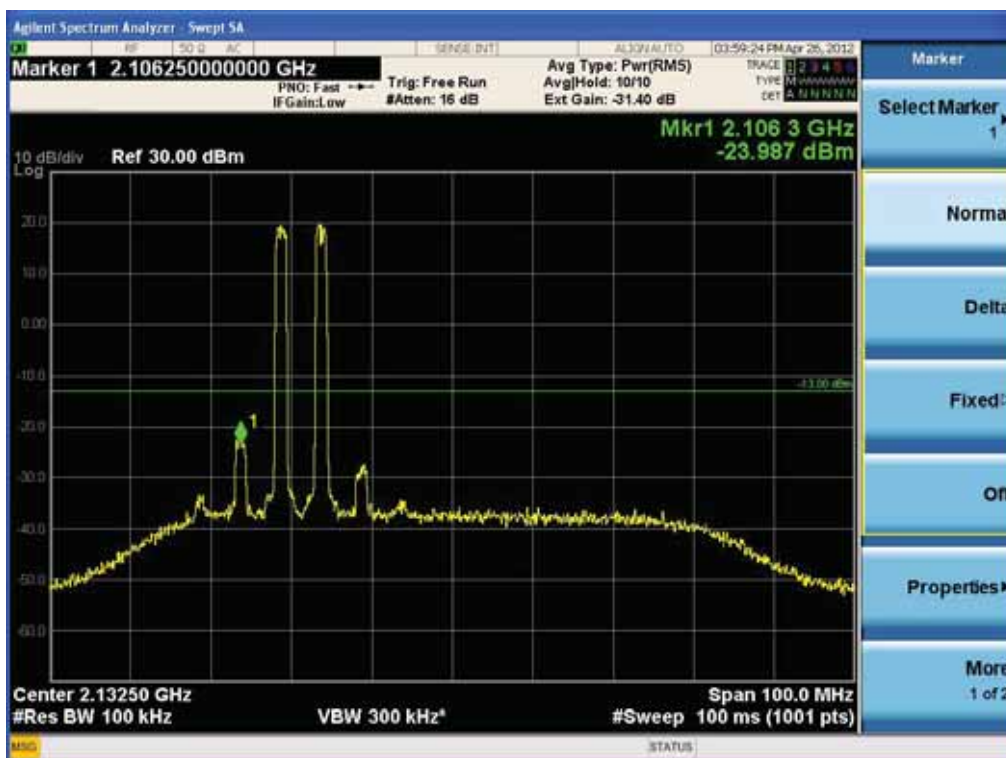


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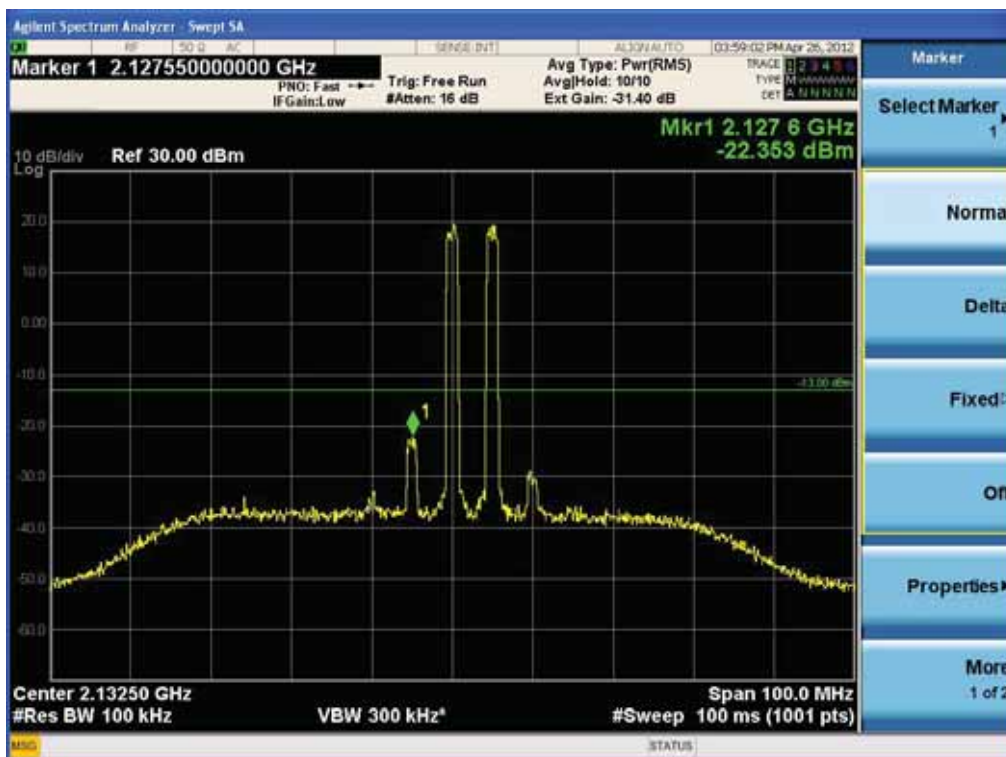


Intermodulation Spurious Emissions

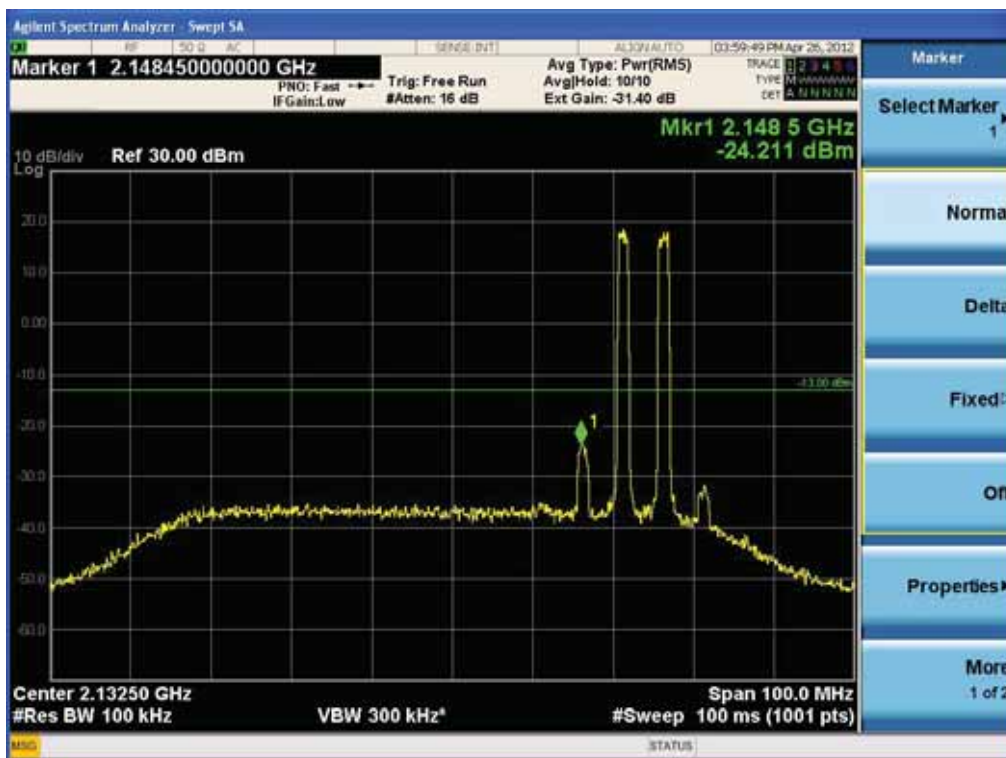
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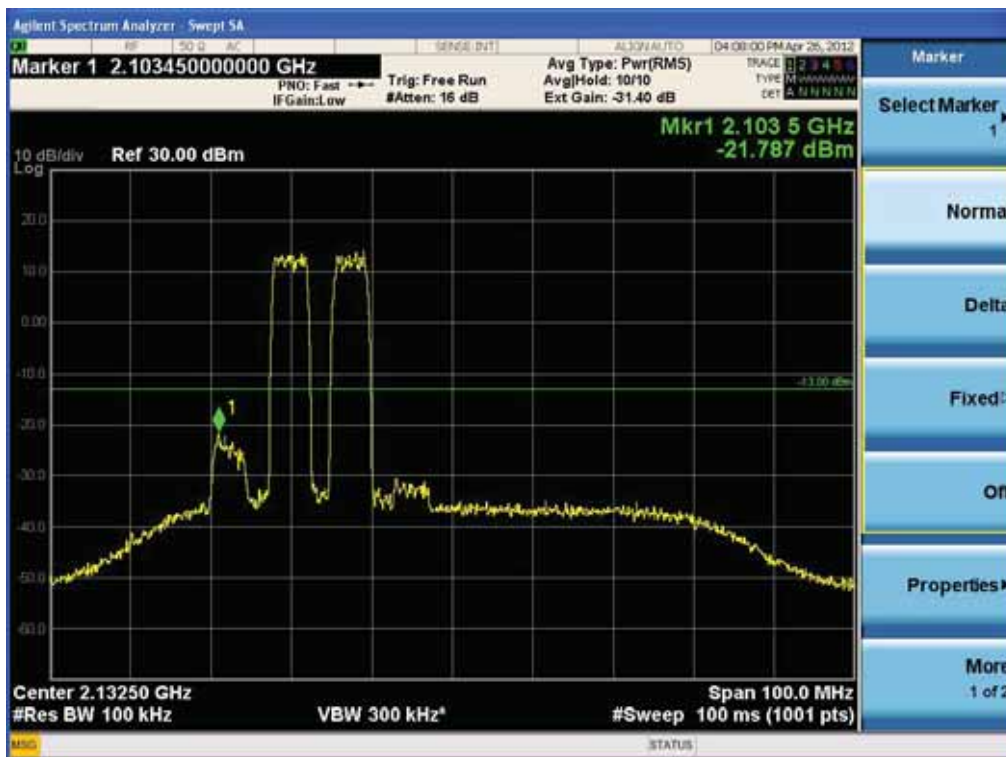
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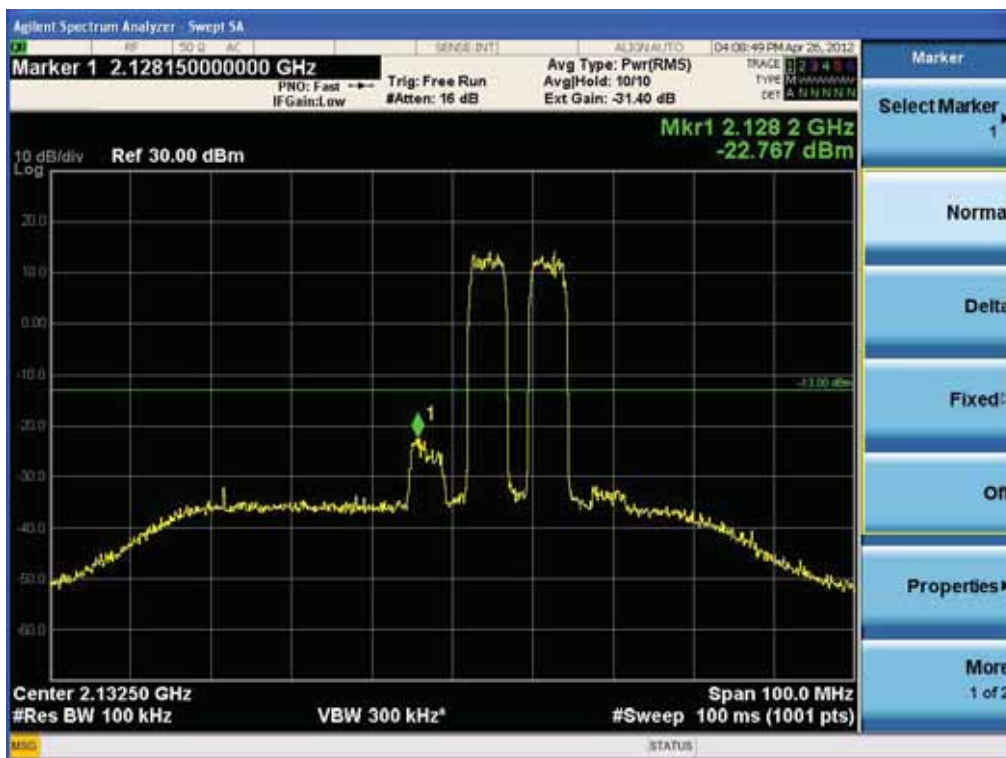
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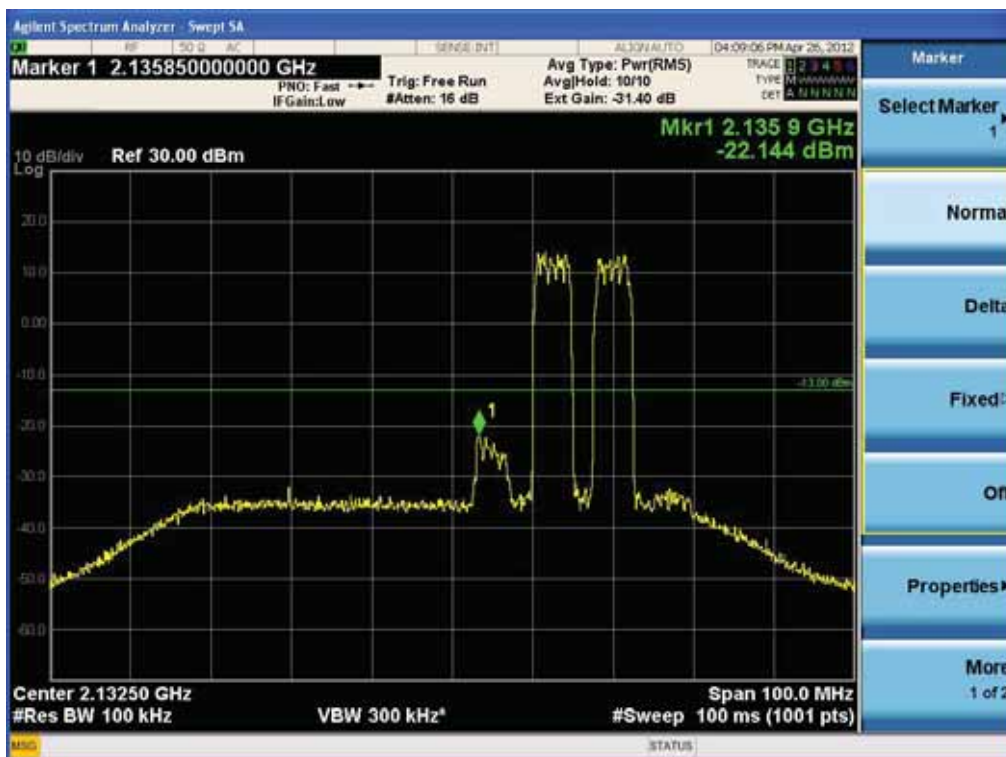
[WCDMA Downlink Low]



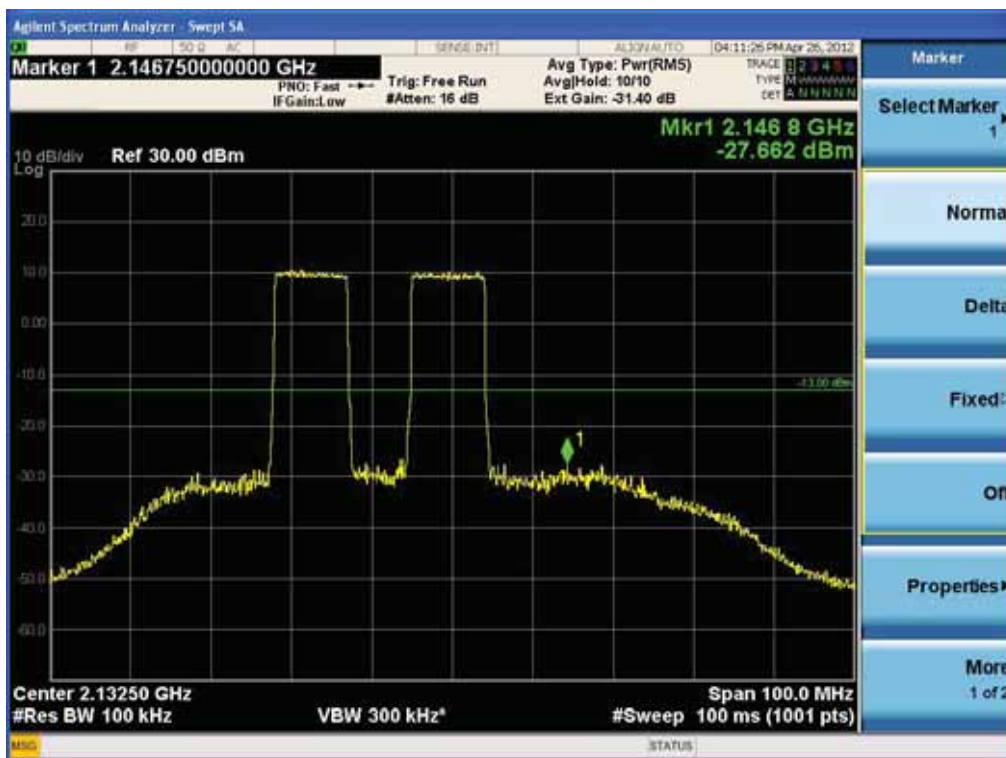
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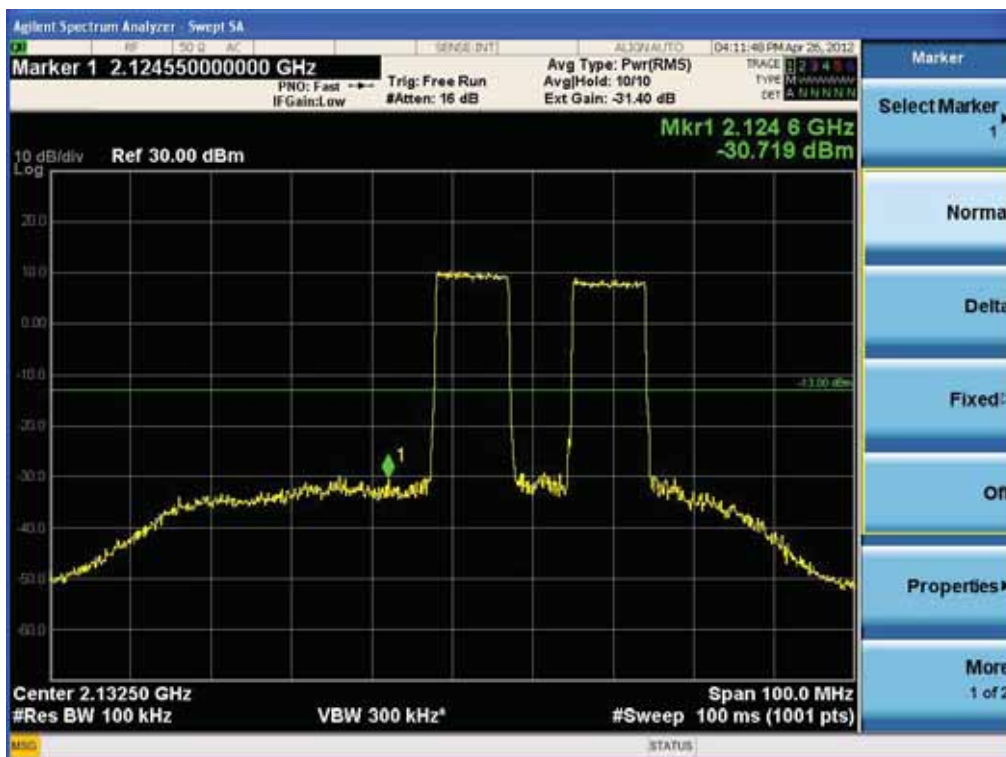
[WCDMA Downlink High]



[LTE Downlink Low]

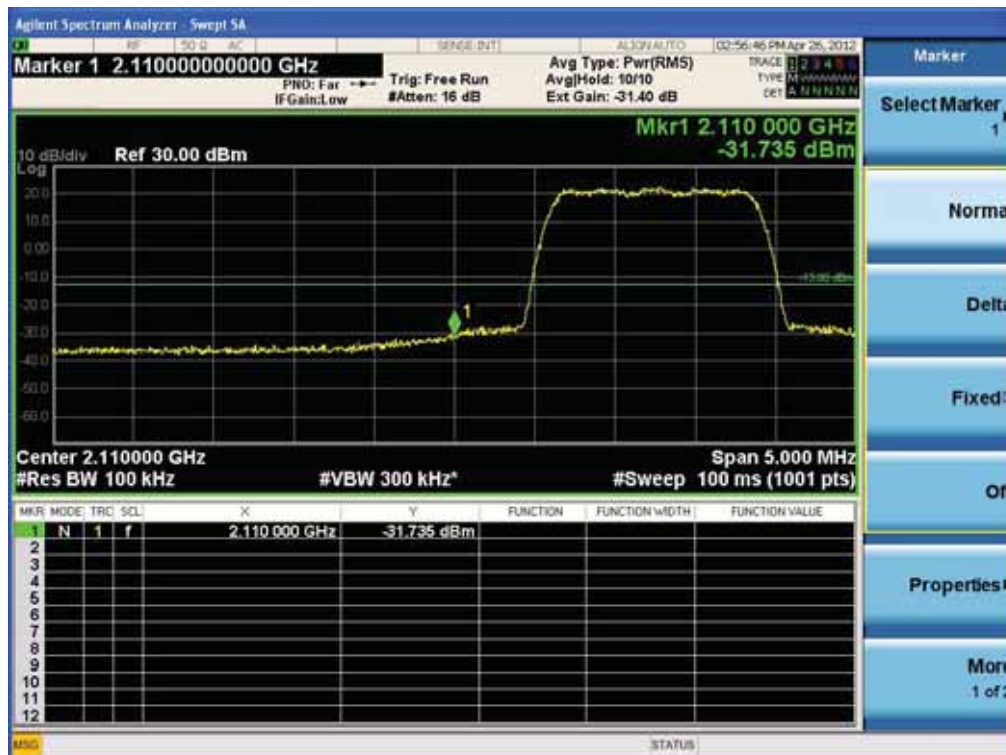


[LTE Downlink High]

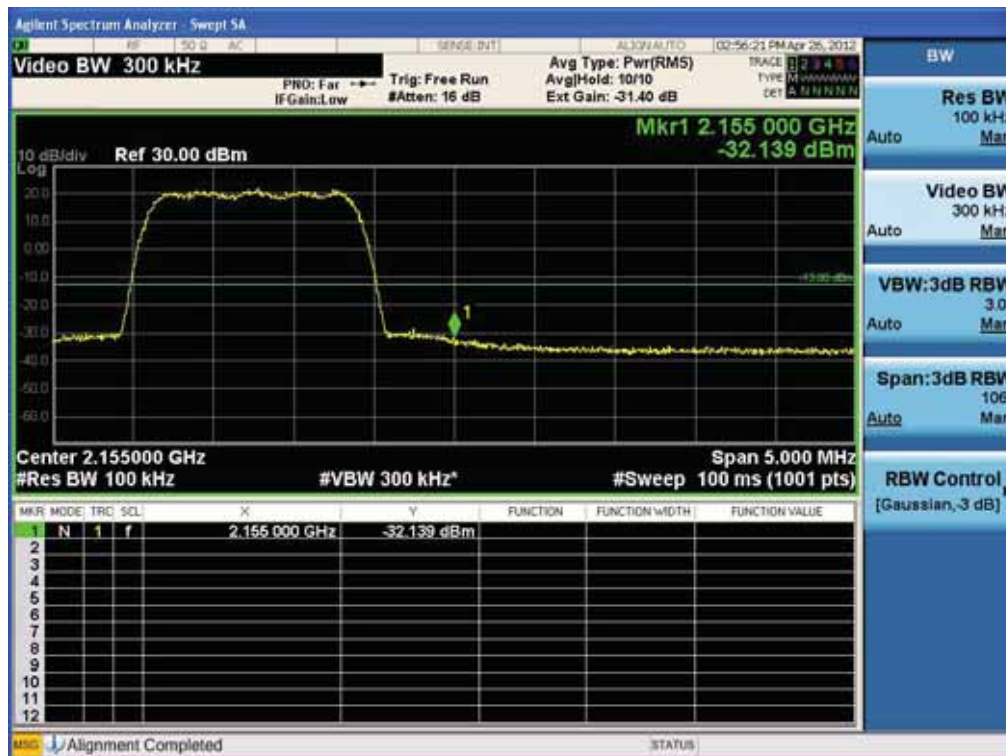


Band Edge

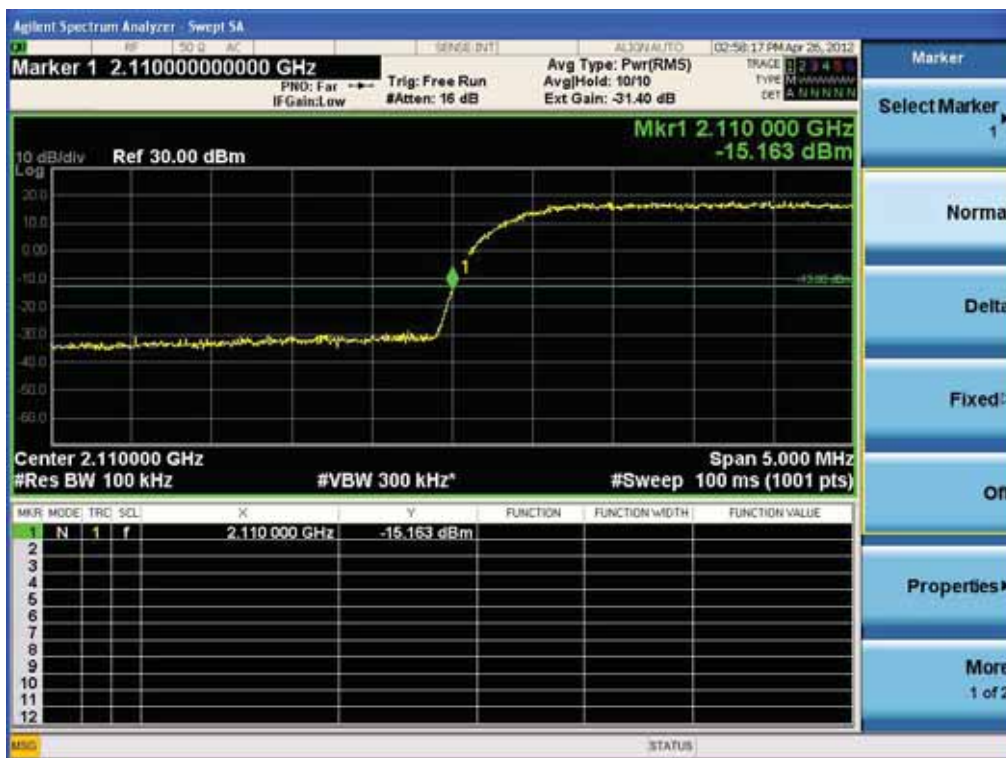
[CDMA Downlink Low]



[CDMA Downlink High]



[WCDMA Downlink Low]



[WCDMA Downlink High]



[LTE Downlink Low]



[LTE Downlink High]



8. FIELD STRENGTH OF SPURIOUS RADIATION

Test Requirement(s): § 2.1053 Measurements required: Field strength of spurious radiation.

§ 2.1053 (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 half-wave dipole antennas.

§ 2.1053 (b): The measurements specified in paragraph (a) of this section shall be made for the following equipment:

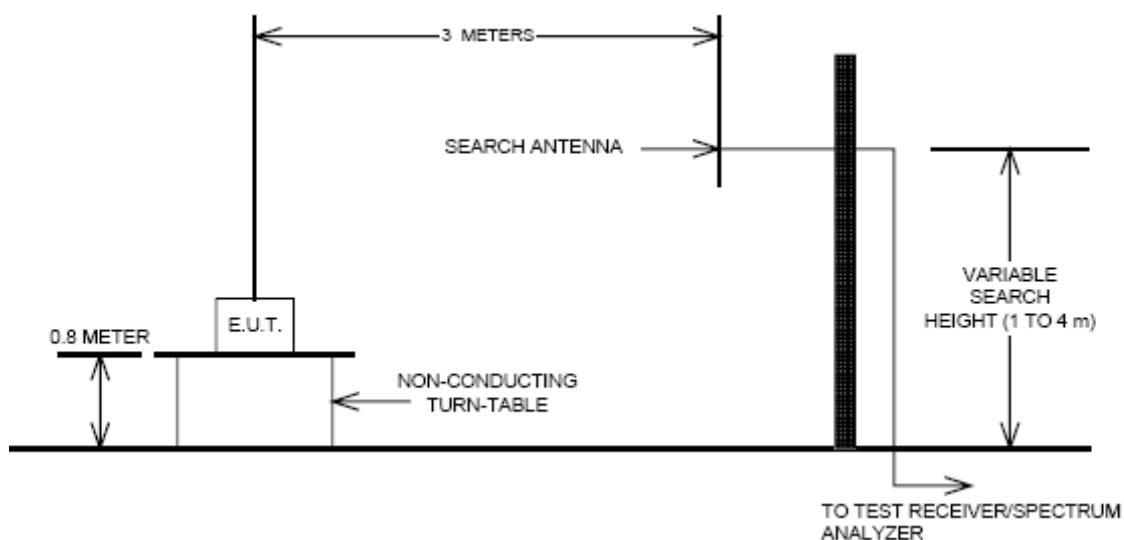
- (1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.
- (2) All equipment operating on frequencies higher than 25 MHz.
- (3) All equipment where the antenna is an integral part of, and attached directly to The transmitter.
- (4) Other types 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 TIA/EIA-603-A-2001 "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 360

and 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



Test Result:

Mode	Frequency	Freq.(MHz)	<u>Substitute</u> <u>Level</u> [dBm]	Ant. Gain (dBd)	C.L	Pol.	ERP (dBm)	Margin (dB)
CDMA	2132.5	4265	-51.2	10.3	8.36	V	-49.26	-36.26
		6397.5	-49.8	9.9	10.97	V	-50.87	-37.87
WCDMA	2136.9	4273.8	-50.4	10.3	8.45	V	-48.55	-35.55
		6410.7	-48.4	9.92	11.01	V	-49.49	-36.49
LTE	2135	4270	-49.2	10.3	8.42	V	-47.32	-34.32
		6405	-48	9.91	11	V	-49.09	-36.09

9. FREQUENCY STABILITY OVER TEMPERATURE AND VOLTAGE VARIATIONS

Test Requirement(s): §2.1055(a)(1), § 27.54

Test Procedures:

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

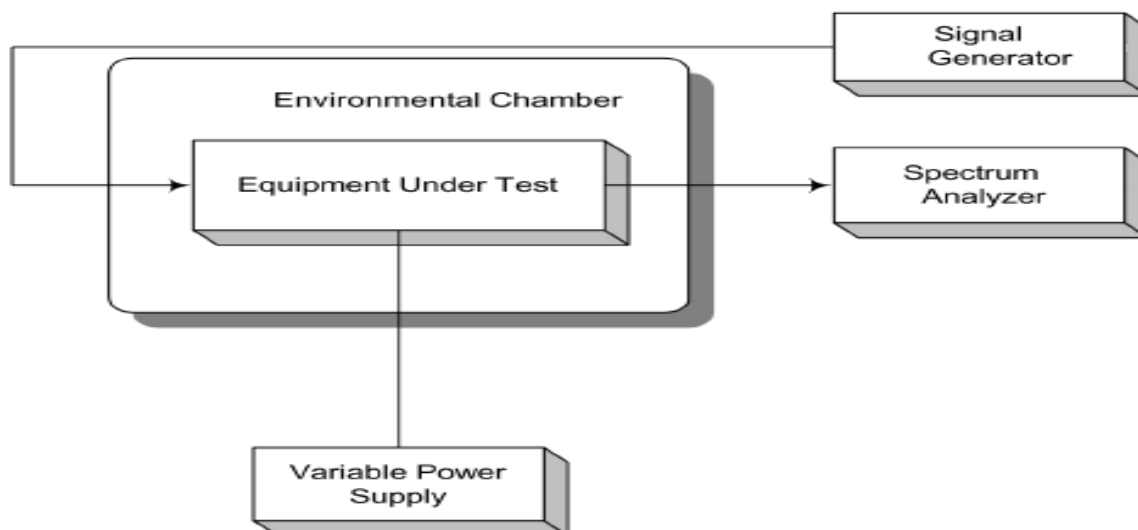
The EUT was placed in the Environmental Chamber.

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 $\pm 15\%$ 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

Reference: 110 Vac at 20°C **Freq.** = 2135.0 MHz

Voltage (%)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100%	+20(Ref)	2134 999 996	-3.6	0.0	0.0000
	-30	2134 999 996	-3.9	-0.3	-0.0001
	-20	2134 999 996	-4.3	-0.7	-0.0003
	-10	2134 999 996	-4.5	-0.9	-0.0004
	0	2134 999 996	-3.7	-0.1	0.0000
	+10	2134 999 996	-4.1	-0.5	-0.0002
	+30	2134 999 996	-3.6	0.0	0.0000
	+40	2134 999 996	-3.7	-0.1	0.0000
	+50	2134 999 996	-4.0	-0.4	-0.0002
115%	+20	2134 999 996	-3.8	-0.2	-0.0001
85%	+20	2134 999 997	-3.1	0.5	0.0002

10. RF EXPOSURE STATEMENT

1. LIMITS

According to §1.1310 and §2.1091 RF exposure is calculated.

(B) Limits for General Population/Uncontrolled Exposures

Frequency range (MHz)	Electric field Strength (V/m)	Magnetic field Strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
0.3 - 1.34.....	614	1.63	*(100)	30
1.34 - 30.....	824/f	2.19/f	*(180/ f ²)	30
30 - 300.....	27.5	0.073	0.2	30
300 - 1500.....			f/1500	30
1500 - 100.000.....			1.0	30

F = frequency in MHz

* = Plane-wave equivalent power density

2. MAXIMUM PERMISSIBLE EXPOSURE Prediction

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

S = Power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

2-1 Limit

Max Peak output Power at antenna input terminal	29.90000	dBm
Max Peak output Power at antenna input terminal	0.97724	W
Prediction distance	20.00000	cm
Prediction frequency	2150.00000	MHz
Antenna Gain(typical)	3.00000	dBi
Antenna Gain(numeric)	1.99526	—
Power density at prediction frequency (S)	0.38791	mW/cm ²
MPE limit for uncontrolled exposure at prediction frequency	1.00000	mW/cm ²

3. RESULTS

The power density level at 20 cm is 0.38791 mW/cm², which is below the uncontrolled exposure limit of 1.0 mW/cm² at AWS Band

Warning: In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, it must also have a minimum distance of 20 cm from the body during normal operation.