

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.: HCTR1205FR01

IC Recognition No.: 5944A-3

FCC ID:

S2O-ADX-R-C30S

IC :

6416A-ADXRC30S

APPLICANT:

Advanced RF Technologies, Inc

EUT Type:

DAS(Distributed Antenna System)

Model:

ADX-R-C30S

Frequency Ranges:

DL : 869 MHz ~ 894 MHz

Conducted Output Power:

DL : 30.03 dBm

FCC Rules Part(s):

CFR 47, Part 22

IC Rule Part(s):

RSS-Gen (Issue 2, June 2007) , RSS-131 (Issue 2, July 2003)

Engineering Statement:

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

Chang Seok Choi

Report prepared by

:Chang Seok Choi

Test engineer of RF Team



Approved by

: Sang Jun Lee

Manager of RF Team

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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-C30S |
| ■ IC ID: | 6416A-ADXRC30S |
| ■ APPLICANT: | Advanced RF Technologies, Inc |
| ■ EUT Type: | DAS(Distributed Antenna System) |
| ■ Model: | ADX-R-C30S |
| ■Frequency Ranges: | DL : 869 MHz ~ 894 MHz |
| ■ Conducted Output Power: | DL : 30.0 dBm |
| ■ Antenna Gain(s): | 2 dBi |
| ■ FCC Rules Part(s): | CFR Title 47 Part 22 |
| ■ IC Rules Part(s): | RSS-Gen (Issue 2, June 2007) , RSS-131 (Issue 2, 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; §22.913	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, §22.917	RSS-131, Section 4.4 RSS-GEN, Section 4.9	Compliant
Radiated Spurious Emissions	§2.1053, §22.917	RSS-131, Section 4.4 RSS-GEN, Section 4.9	Compliant
Frequency Stability	§2.1055, §22.355	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.

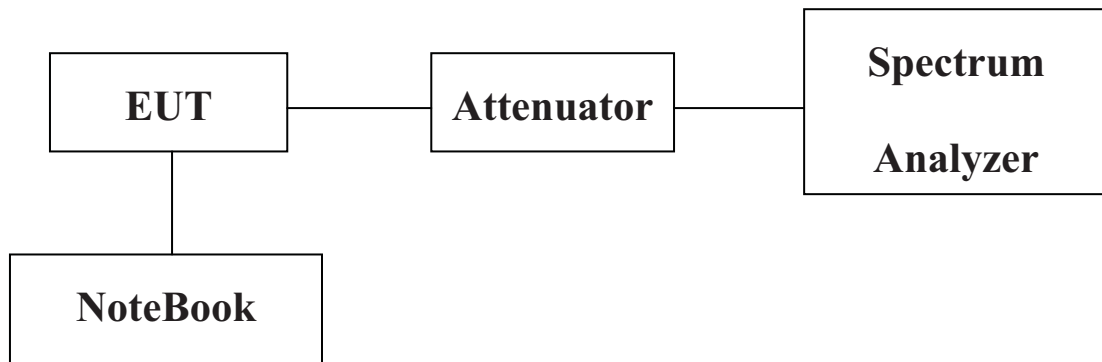
§ 2.1046 (c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output 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.

§ 22.913 Effective radiated power limits. The effective radiated power (ERP) of transmitters in the Cellular Radiotelephone Service must not exceed the limits in this section.

(a) Maximum ERP. In general, the effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 Watts. However, for those systems operating in areas more than 72 km (45 miles) from international borders that:

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
GSM	GMSK	0 dBm
LTE	16QAM	0 dBm

[Downlink]

	Channel	Frequency (MHz)	Output Power (dBm)
CDMA	Low	869.7	29.60
	Middle	881.52	30.03
	High	893.31	29.36
WCDMA	Low	871.4	29.70
	Middle	881.6	29.72
	High	891.6	29.94
GSM	Low	869.2	29.75
	Middle	881.6	29.89
	High	893.8	29.58
LTE	Low	871.5	29.51
	Middle	881.5	29.37
	High	891.5	29.83

Plots of RF Output Power

[CDMA Downlink Low]



[CDMA Downlink Middle]



[CDMA Downlink High]



[WCDMA Downlink Low]



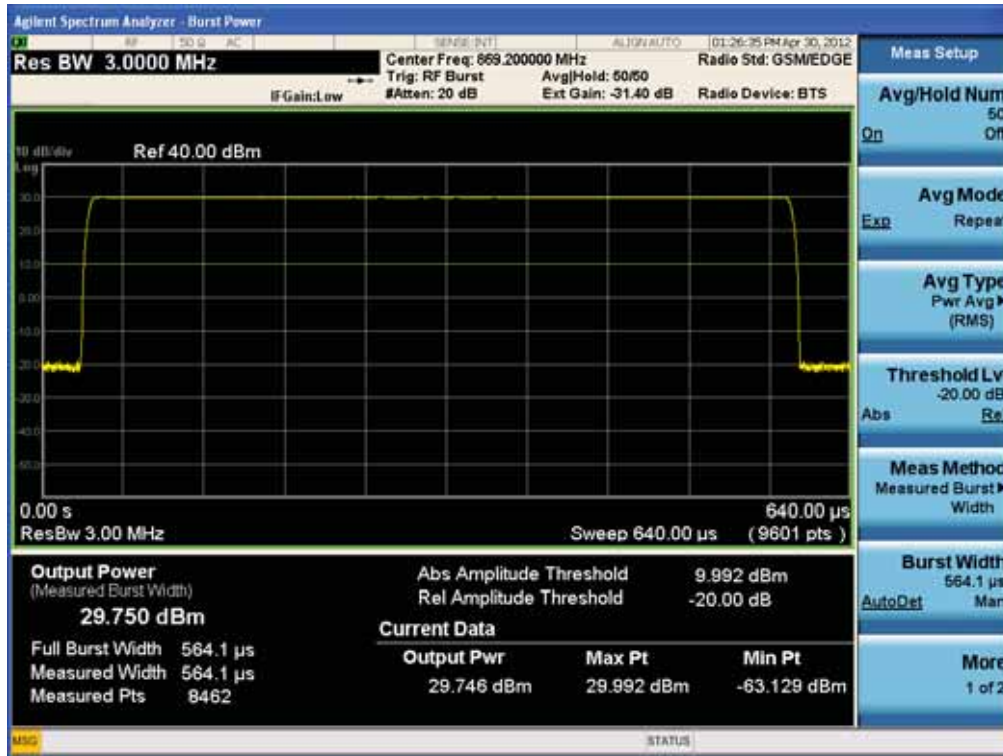
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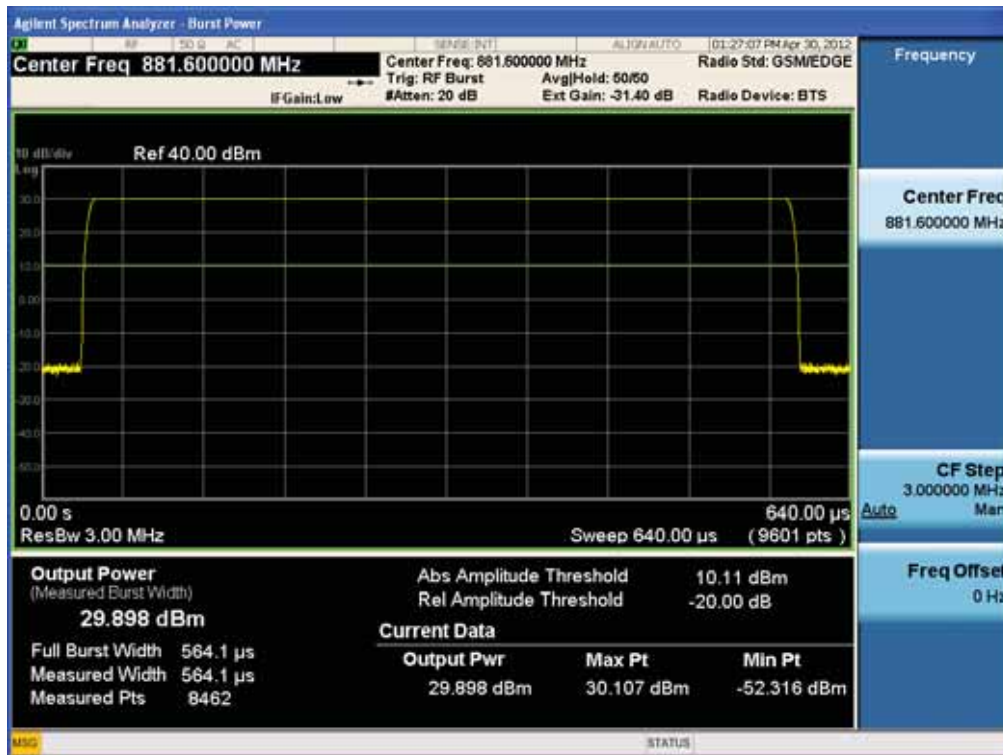
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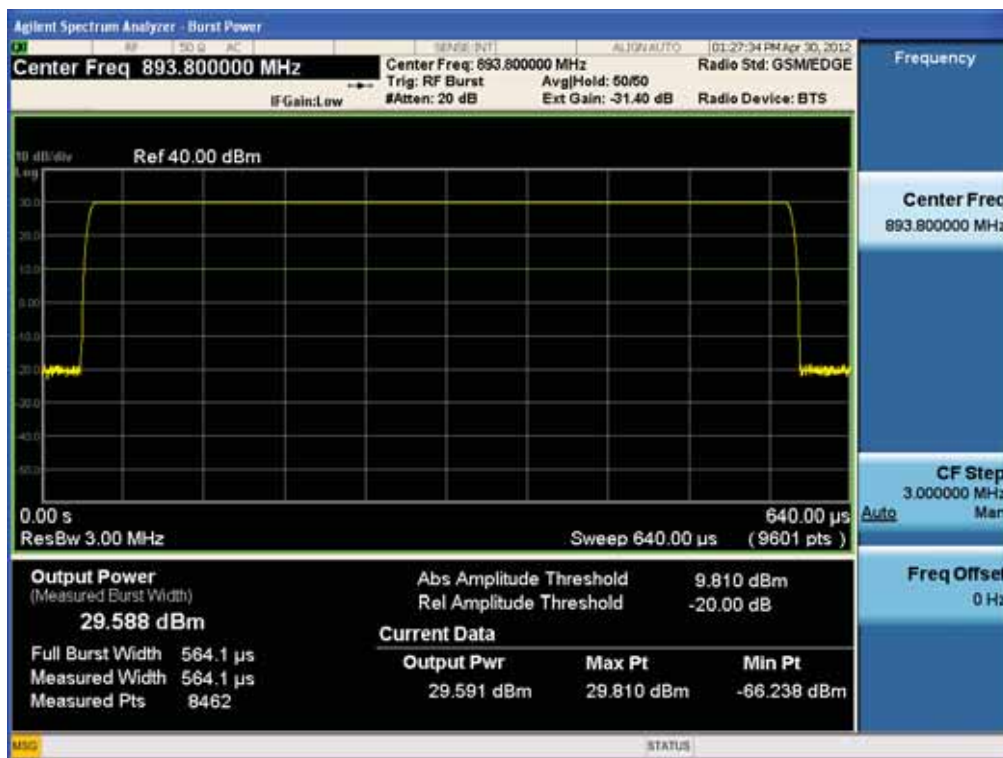
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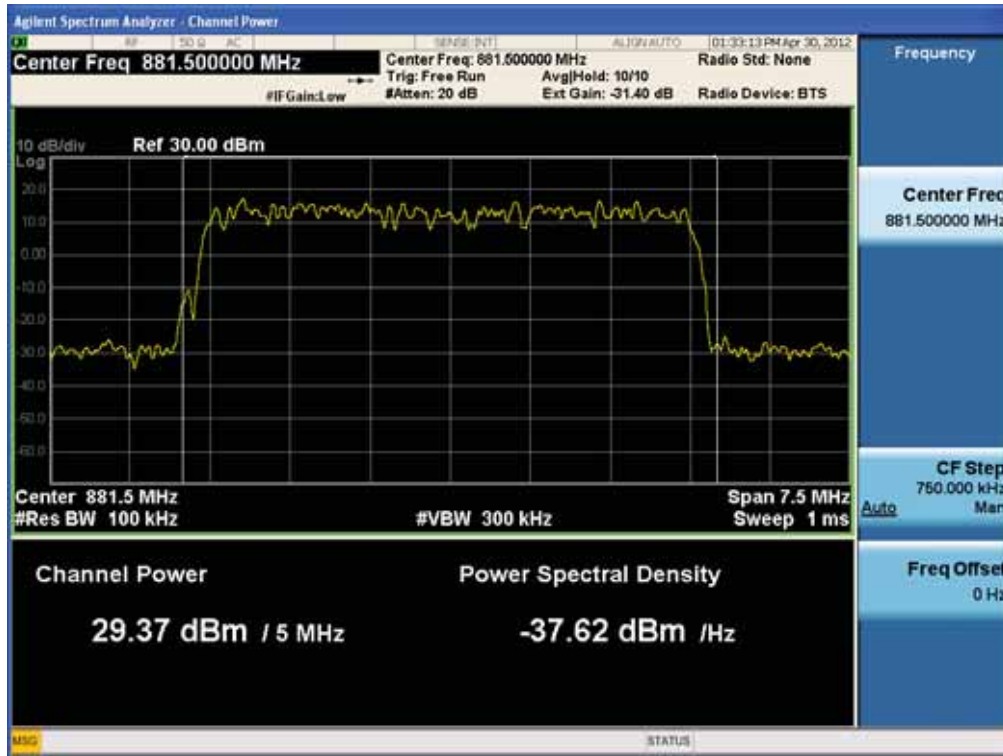
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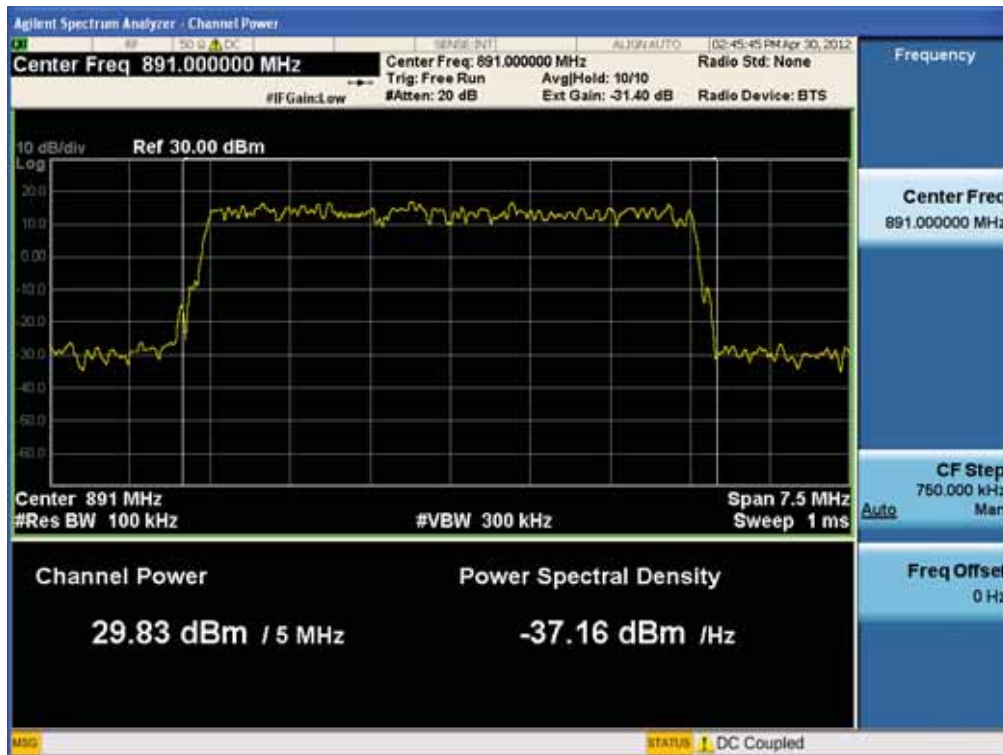
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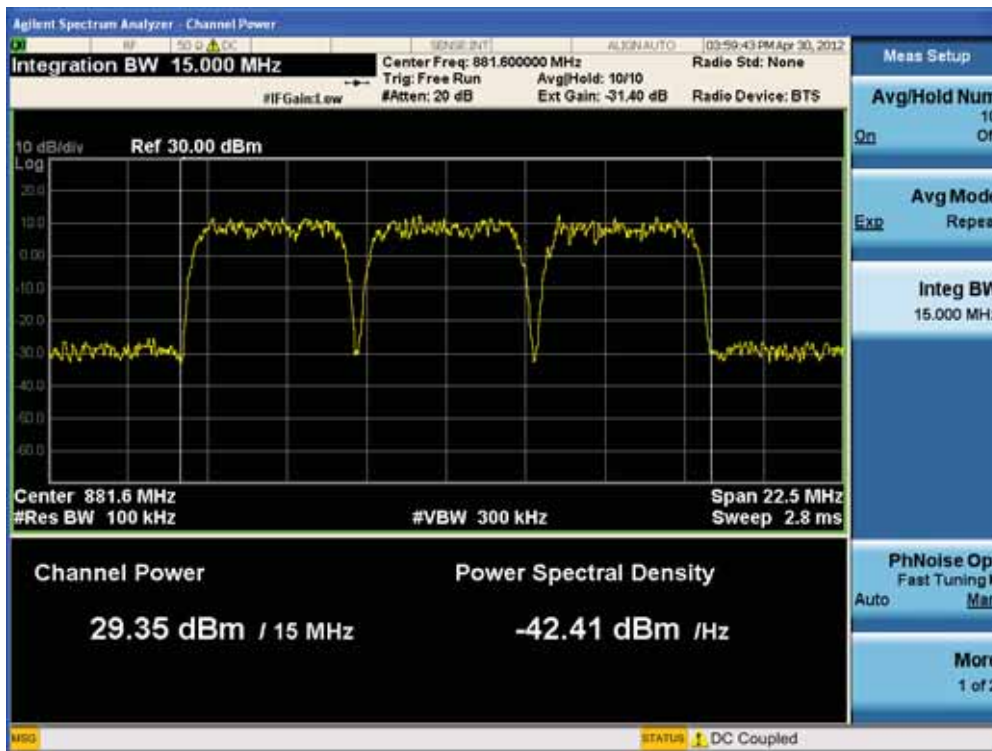
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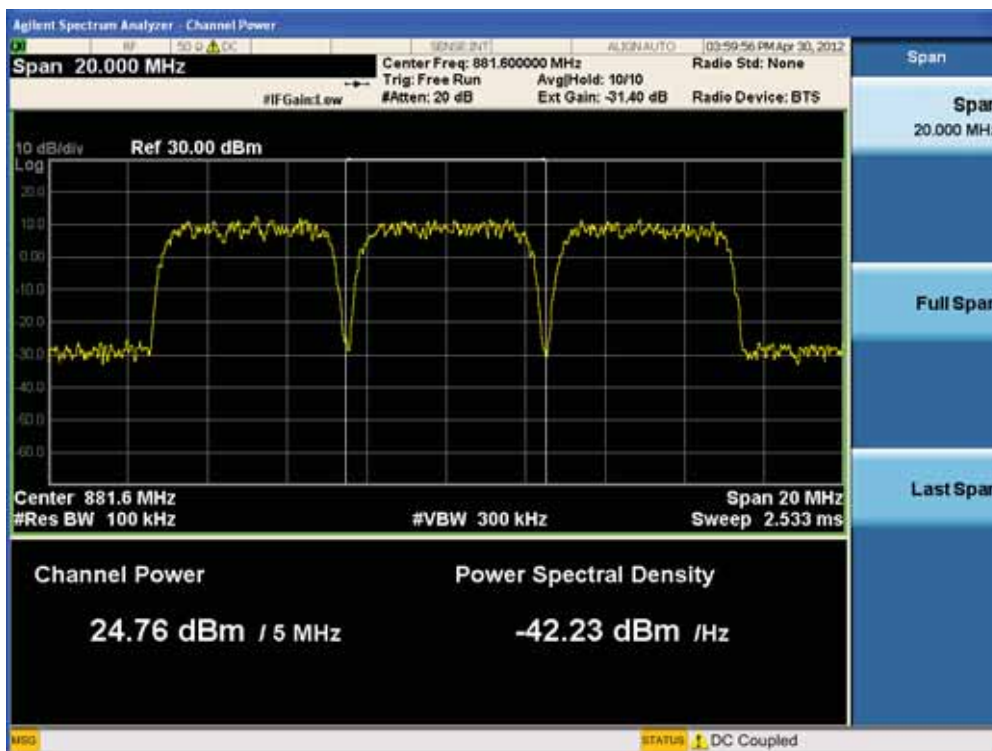
[LTE Downlink High]



[Downlink 3 FA]



[Downlink 1 FA]



* RSS-131 6.2 Power Back-off : $29.35 - 24.76 = 4.59$ 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]

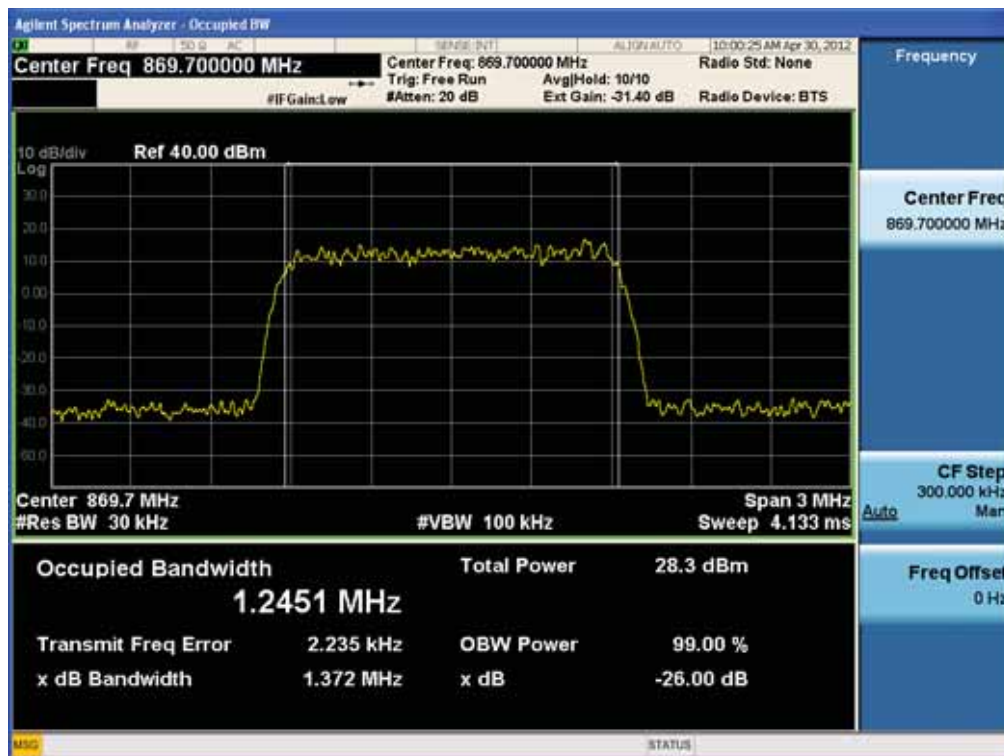
	Channel	Frequency (MHz)	99% Bandwidth (MHz)
CDMA	Low	869.7	1.2451
	Middle	881.52	1.2360
	High	893.31	1.2387
WCDMA	Low	871.4	4.1760
	Middle	881.6	4.1524
	High	891.6	4.1733
GSM	Low	869.2	0.24264
	Middle	881.6	0.24379
	High	893.8	0.24372
LTE	Low	871.5	4.5036
	Middle	881.5	4.4795
	High	891.5	4.4745

[Downlink Input]

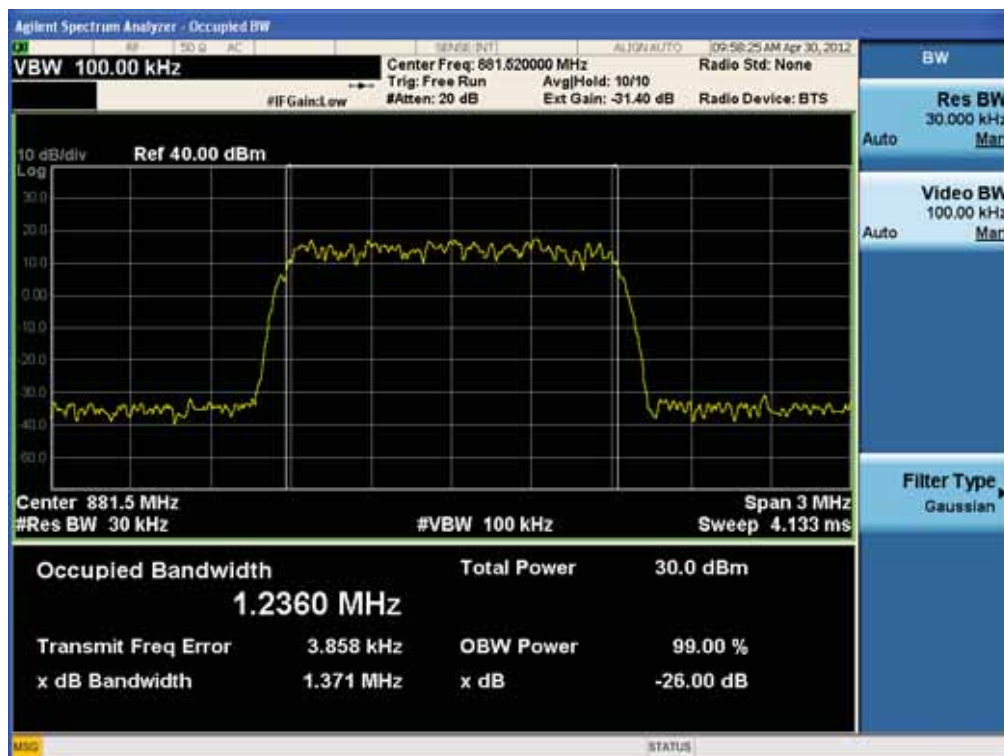
	Channel	Frequency (MHz)	99% Bandwidth (MHz)
CDMA	Low	869.7	1.2392
	Middle	881.52	1.2403
	High	893.31	1.2396
WCDMA	Low	871.4	4.1766
	Middle	881.6	4.1761
	High	891.6	4.1743
GSM	Low	869.2	0.24686
	Middle	881.6	0.24843
	High	893.8	0.24758
LTE	Low	871.5	4.5007
	Middle	881.5	4.5004
	High	891.5	4.5006

Plots of Occupied Bandwidth

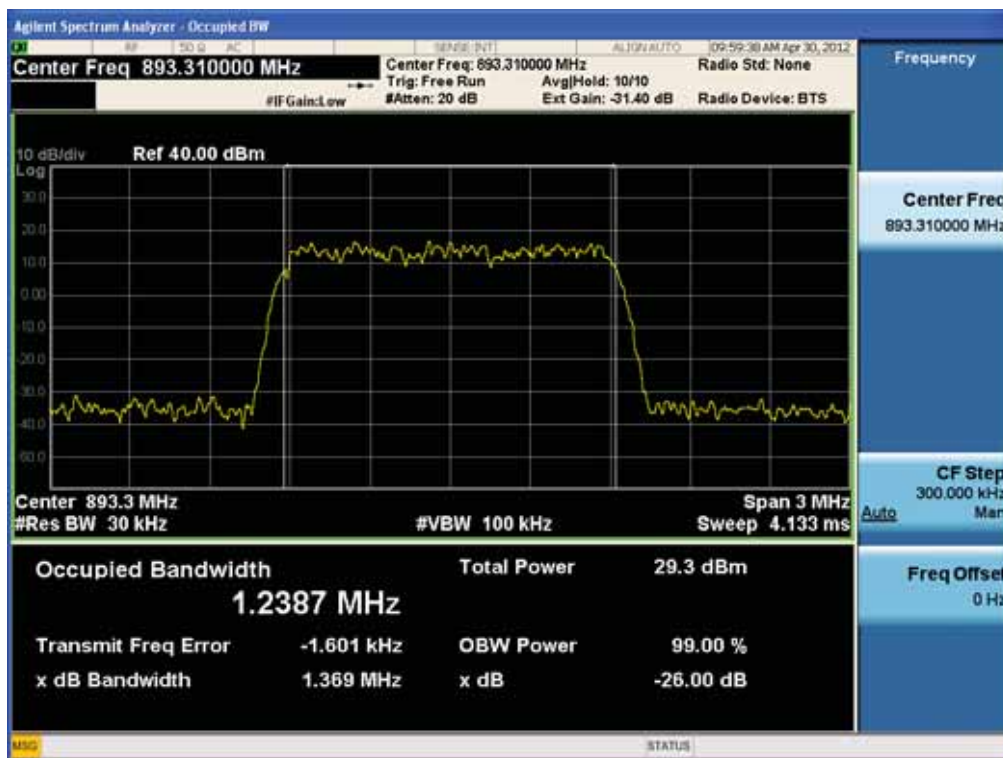
[Output CDMA Downlink Low]



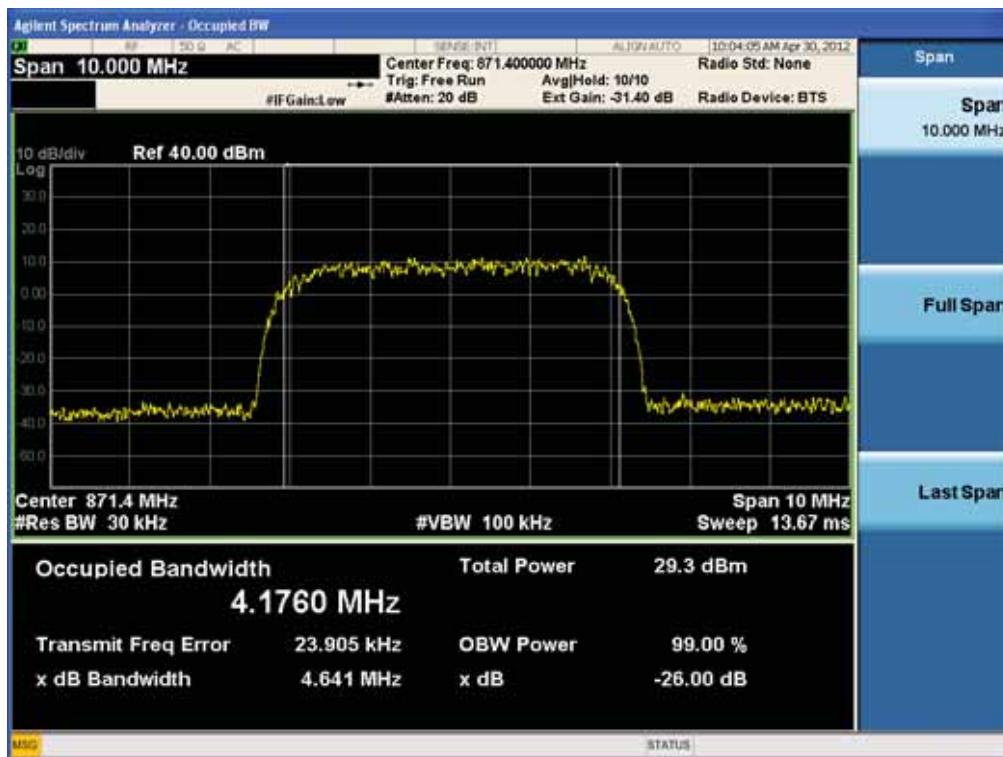
[Output CDMA Downlink Middle]



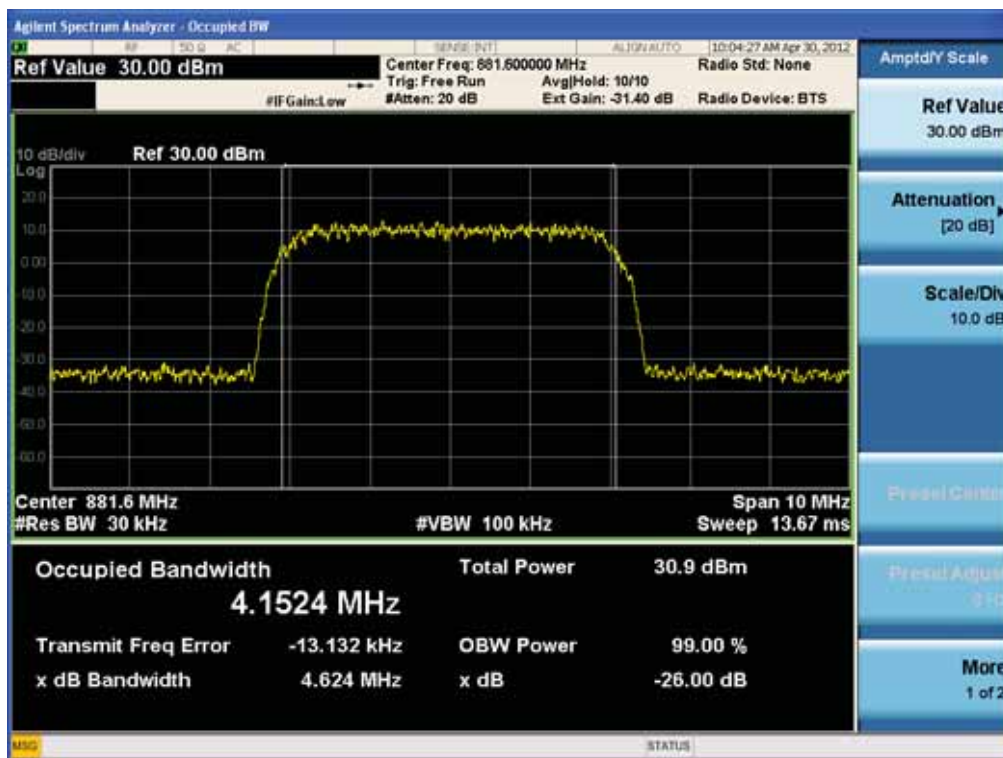
[Output CDMA Downlink High]



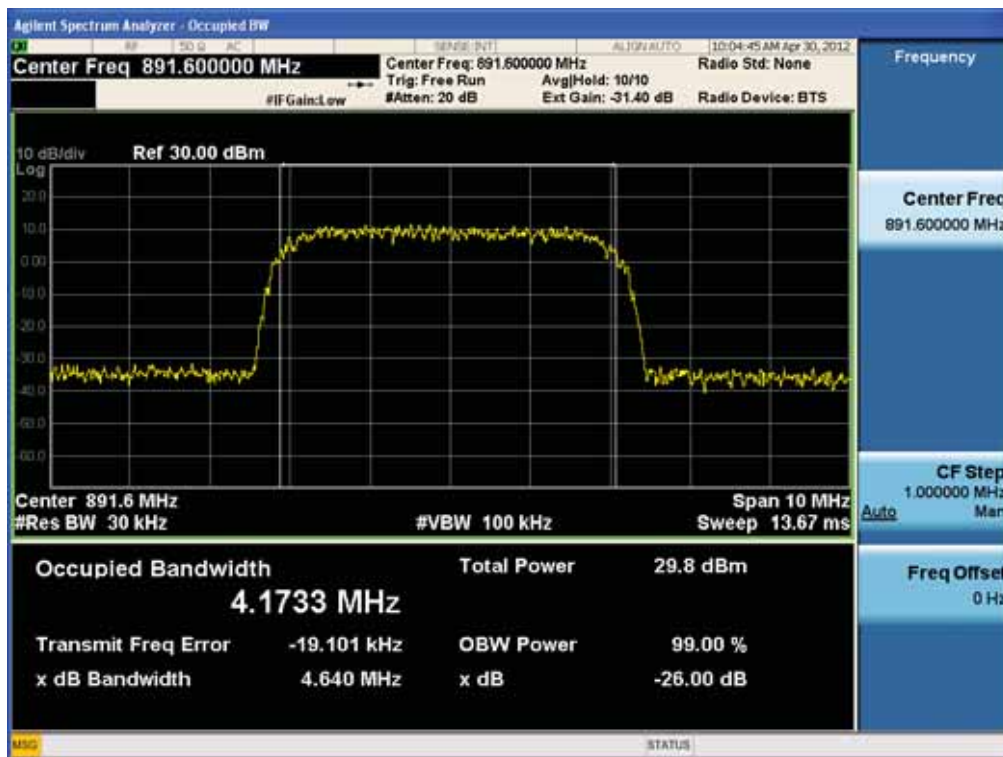
[Output WCDMA Downlink Low]



[Output WCDMA Downlink Middle]



[Output WCDMA Downlink High]



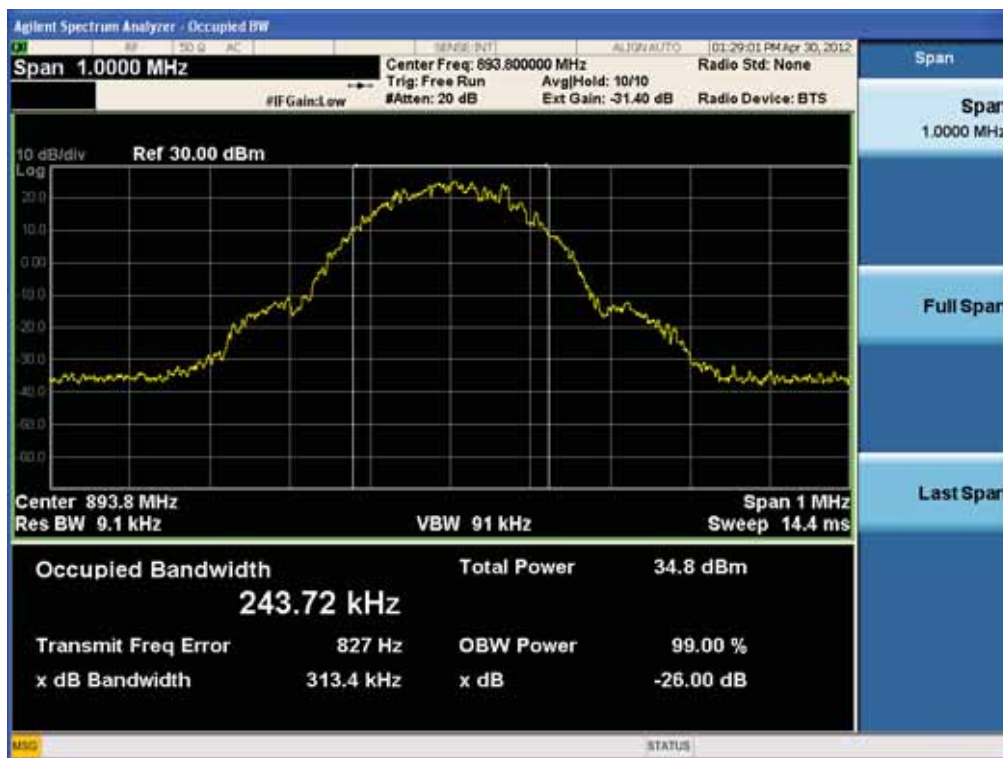
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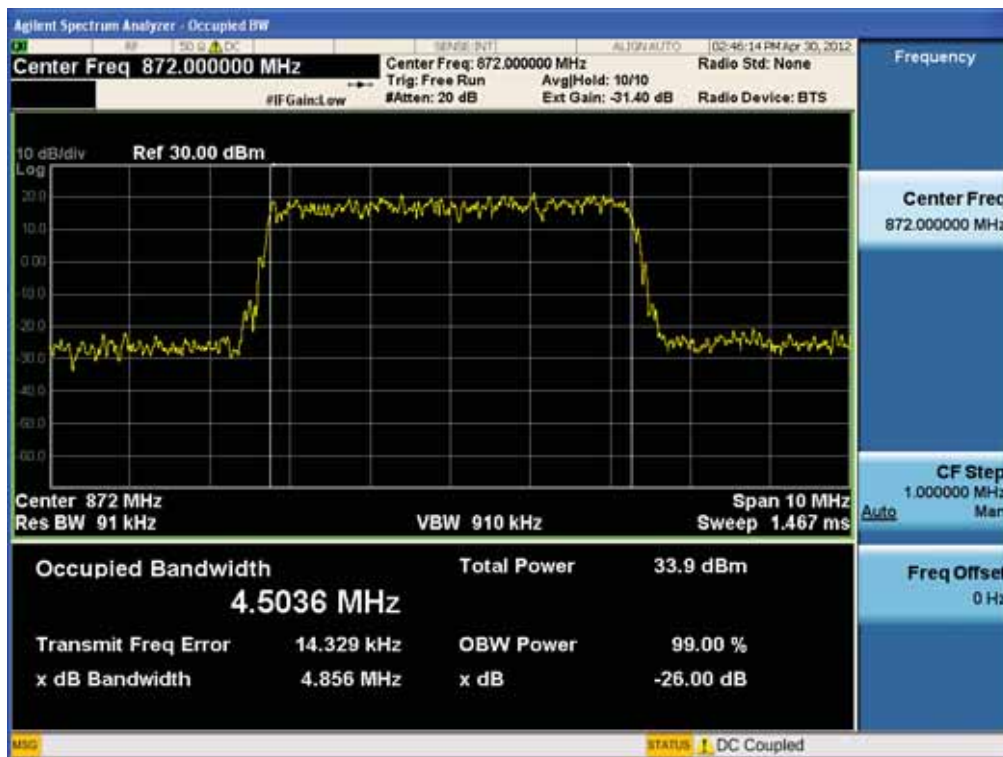
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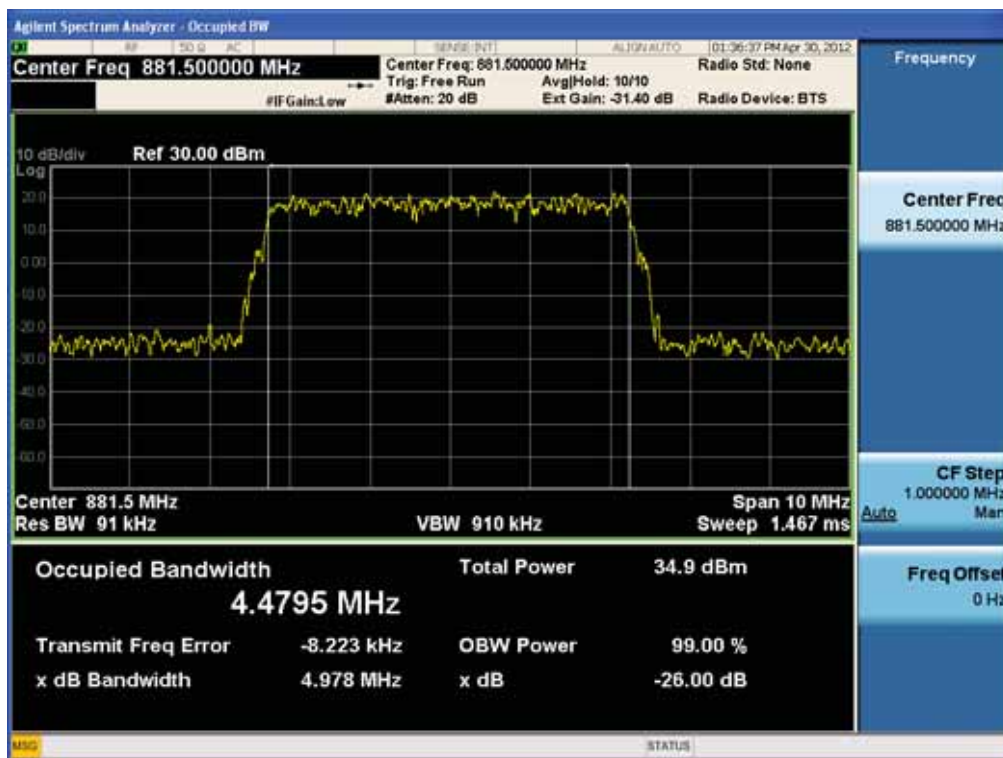
[Output GSM Downlink High]



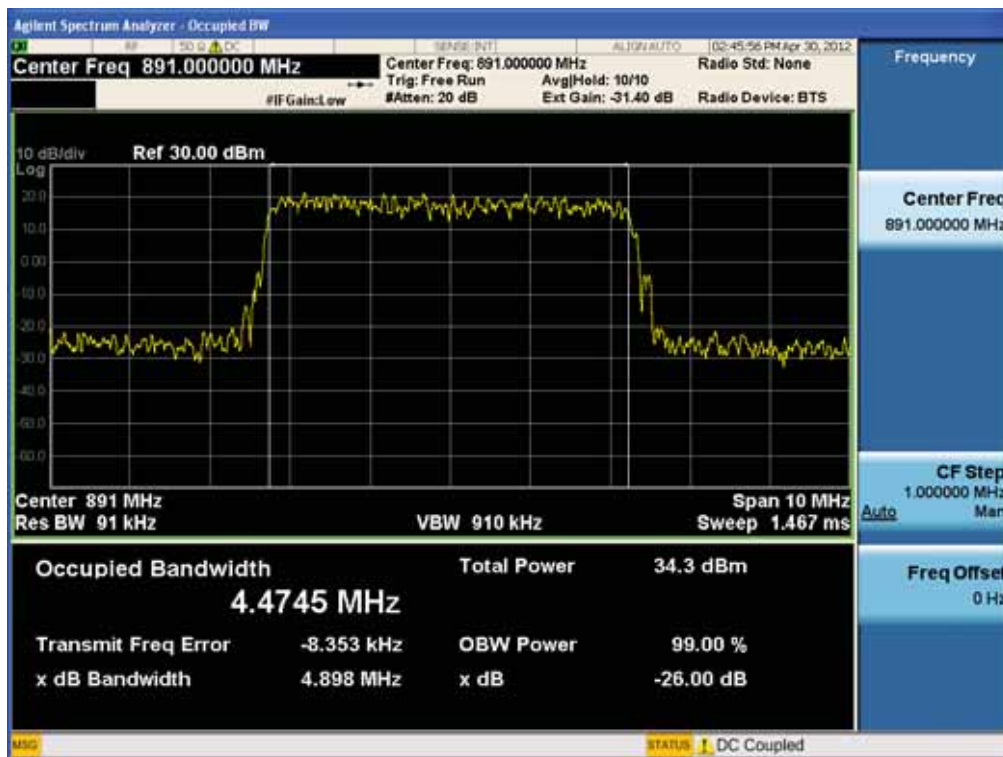
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[Output LTE Downlink Middle]



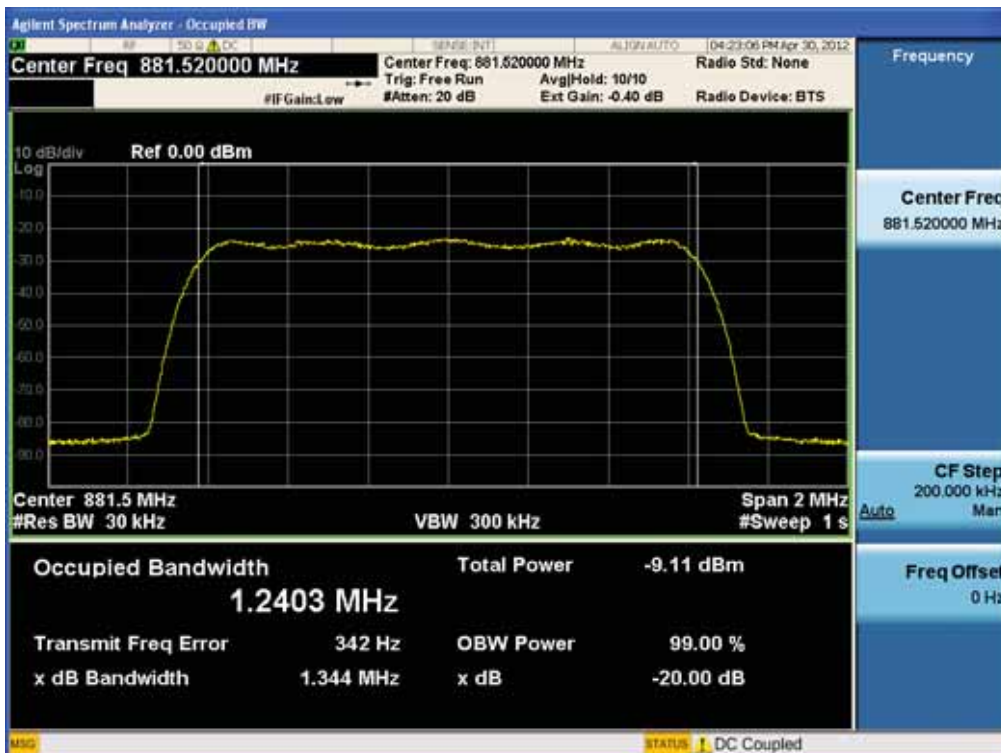
[Output LTE Downlink High]



[Input CDMA Downlink Low]



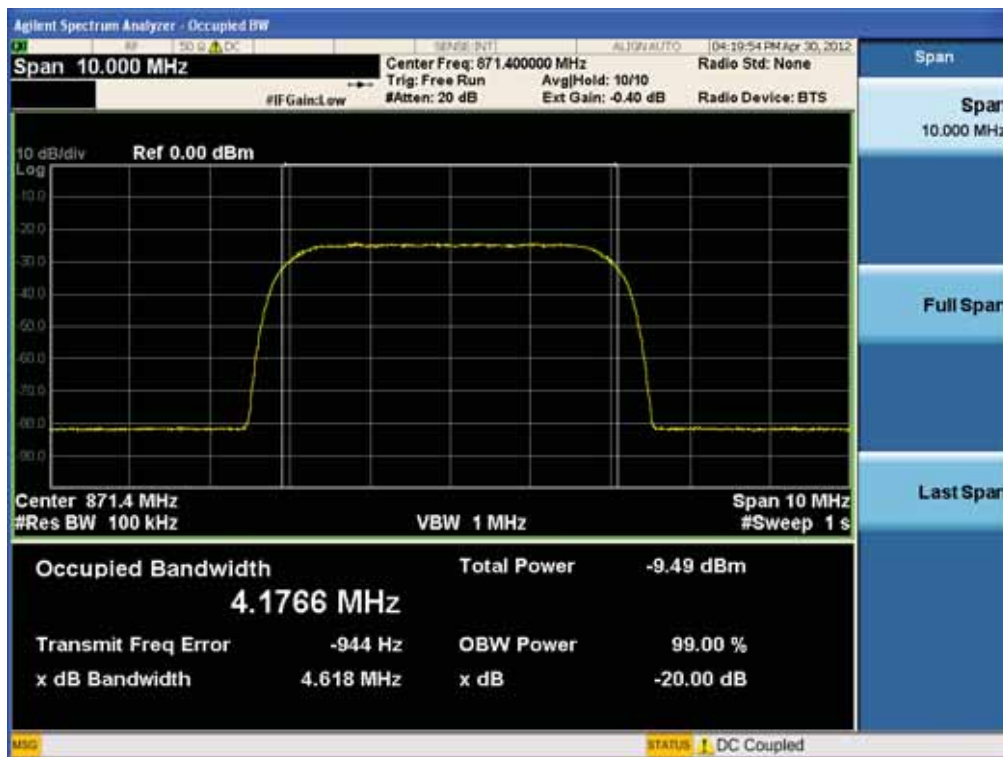
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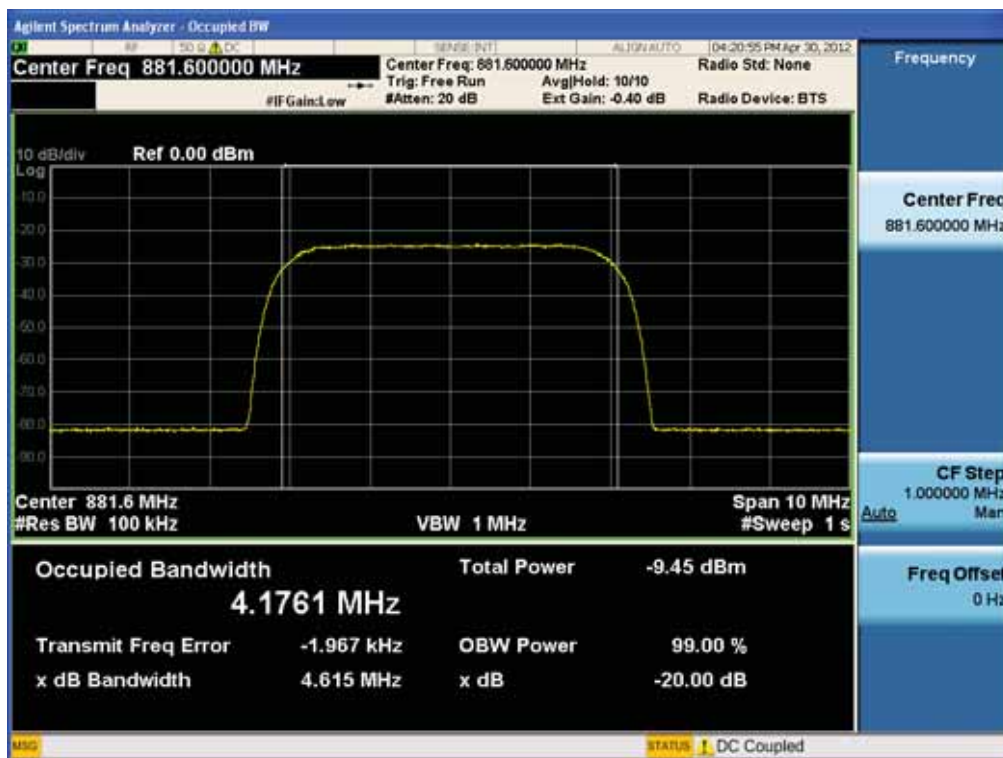
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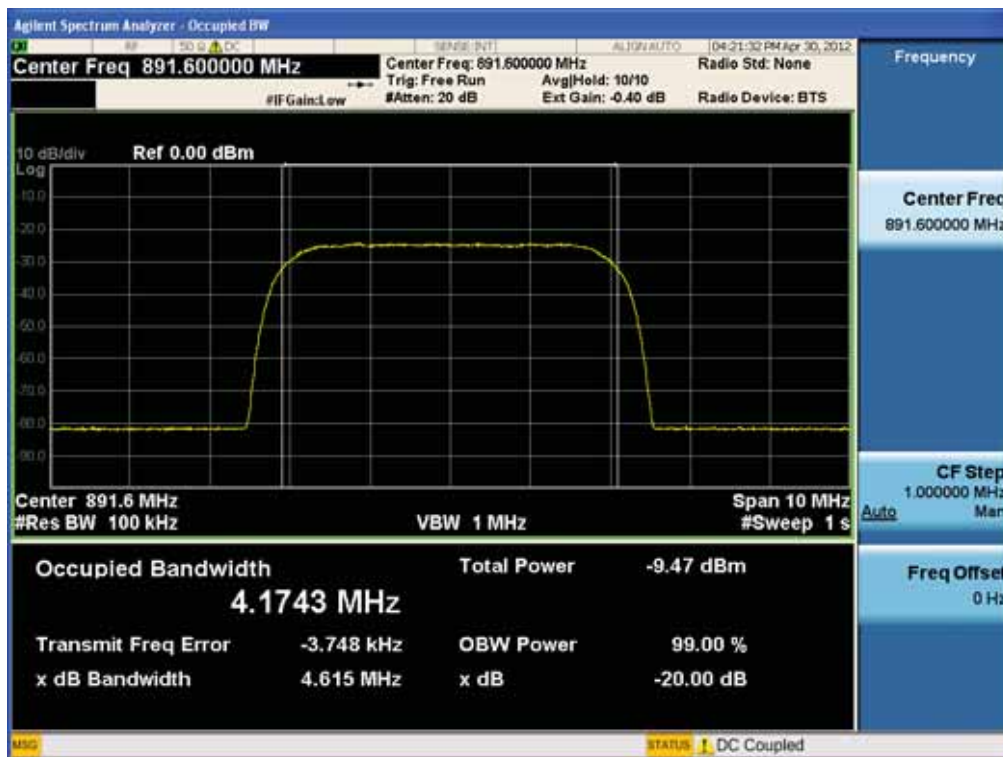
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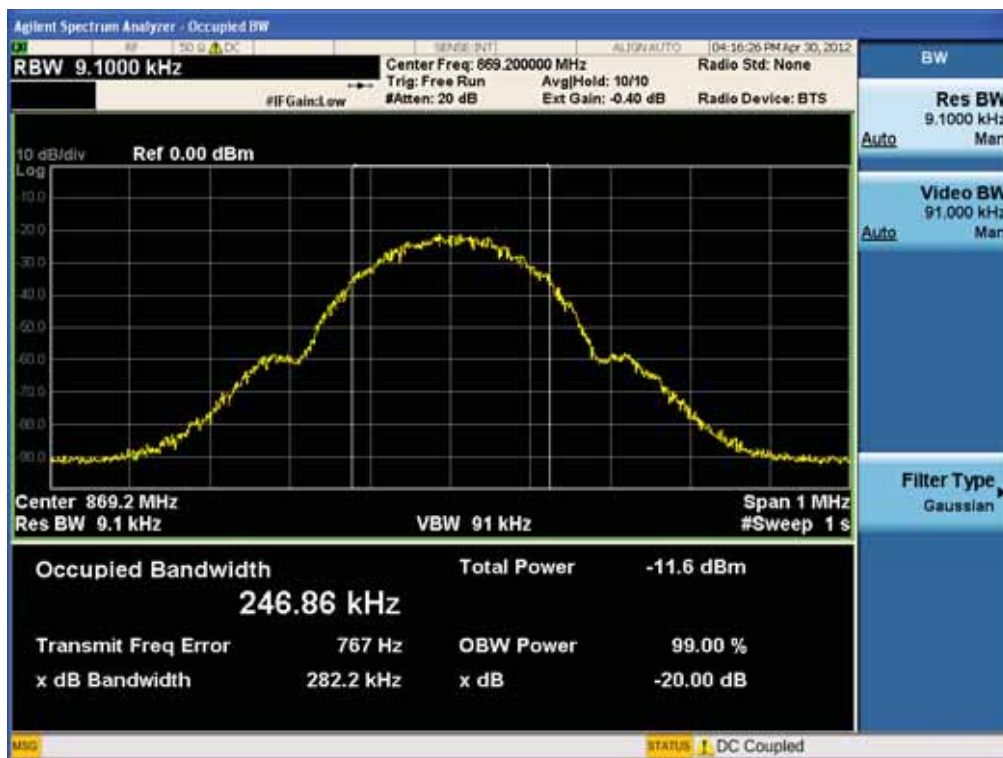
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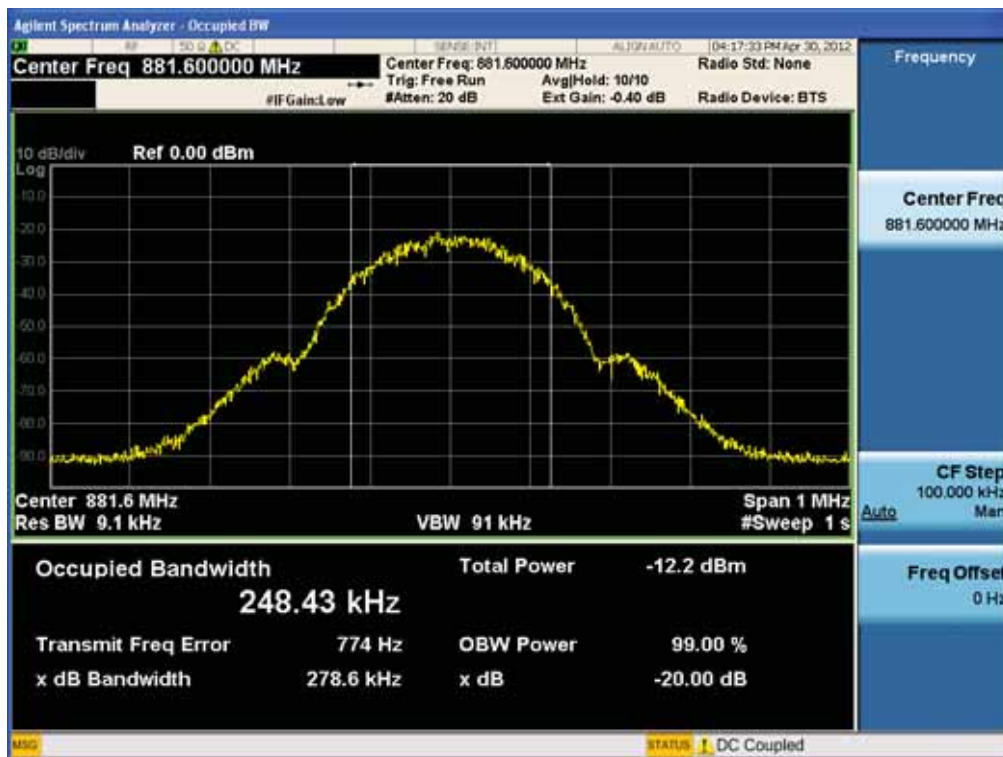
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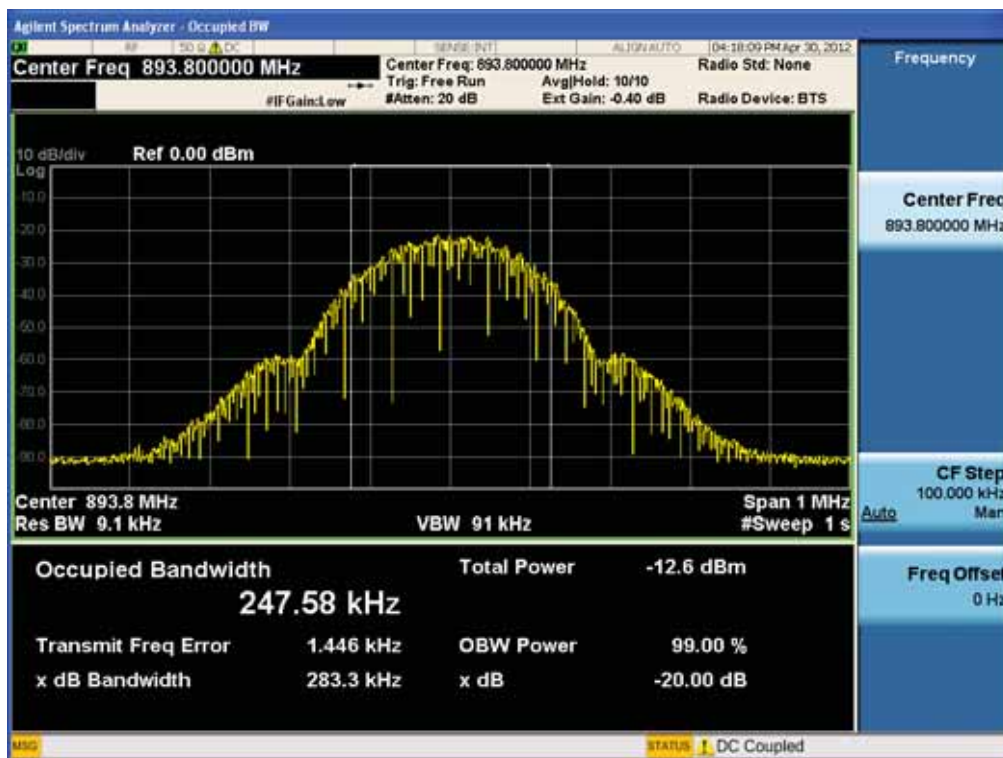
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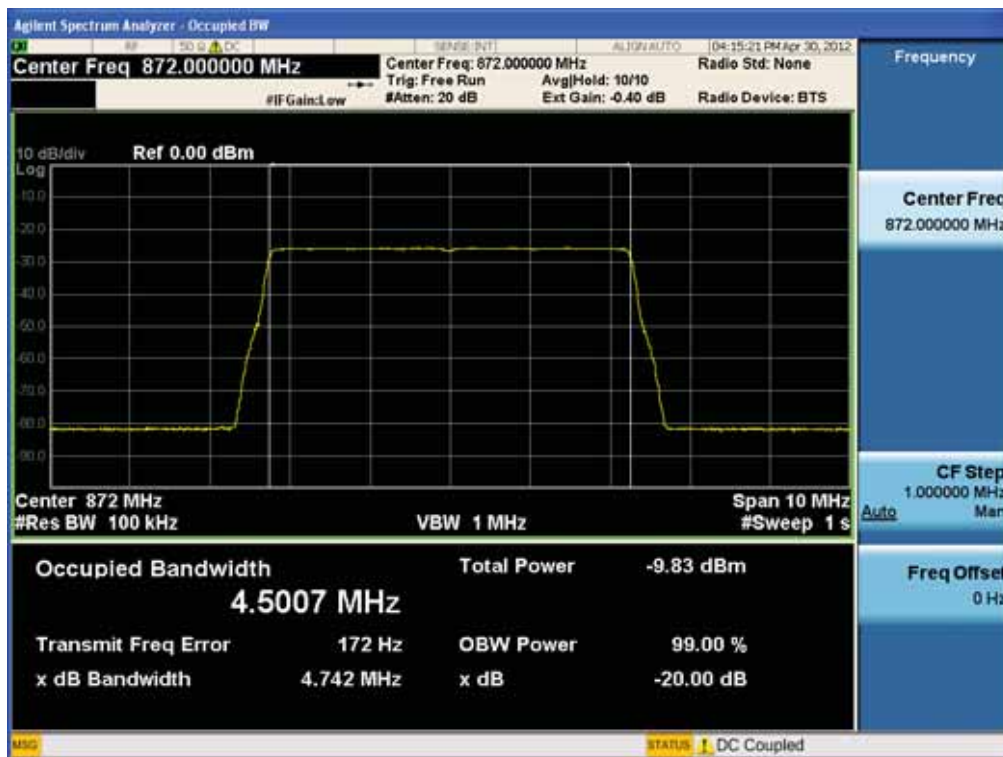
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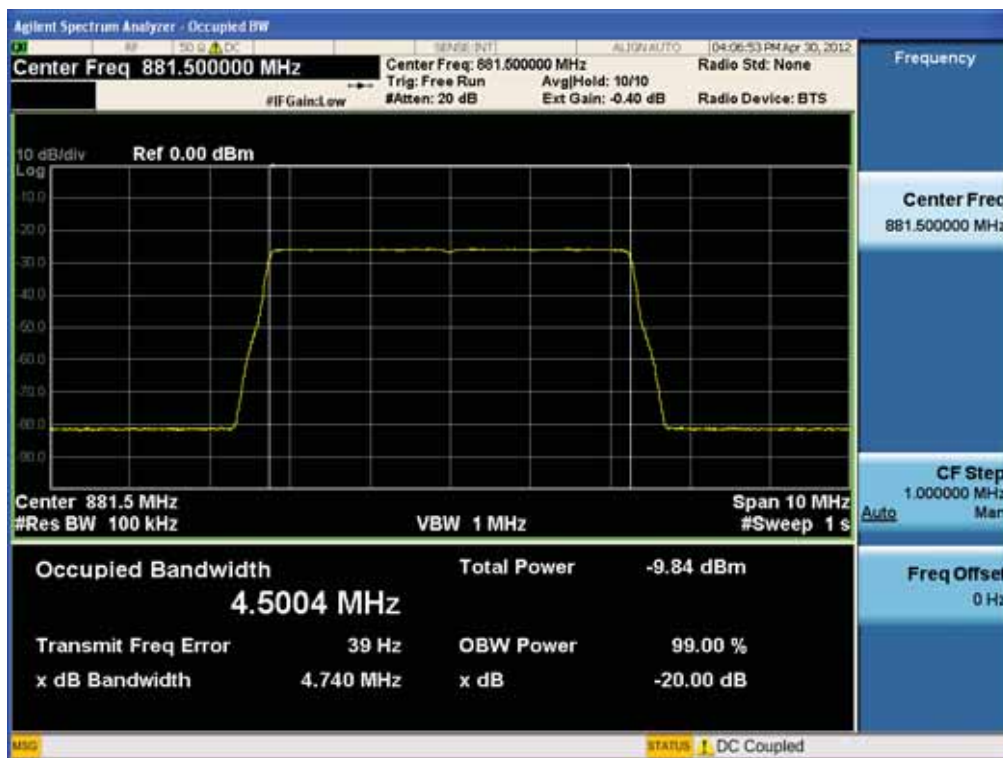
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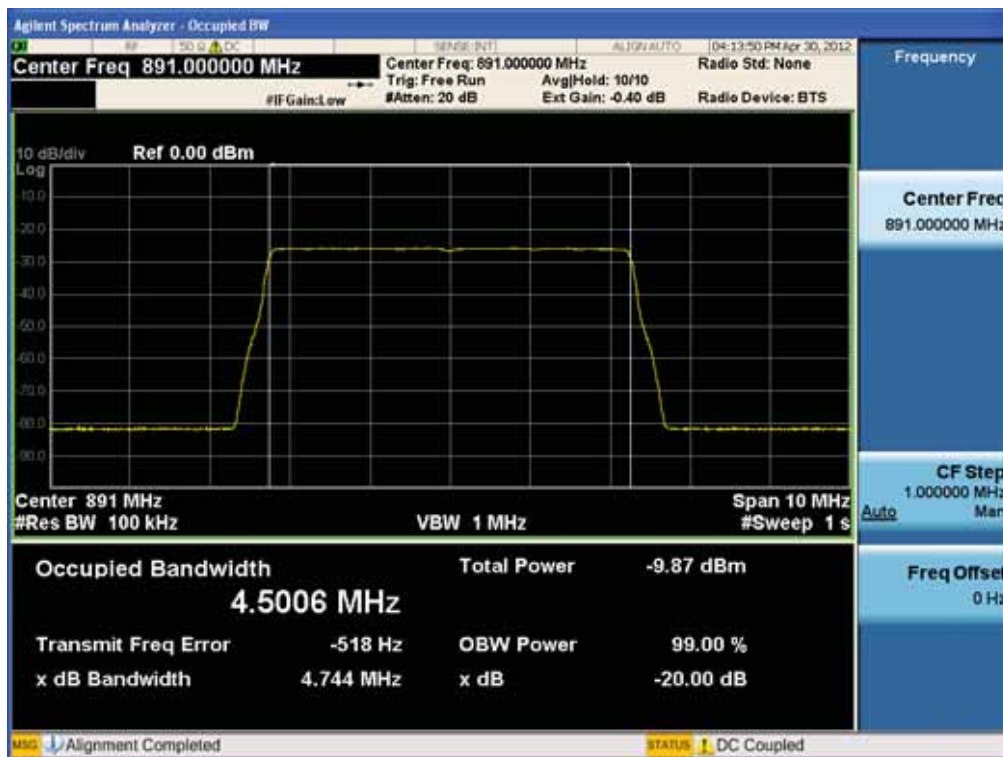
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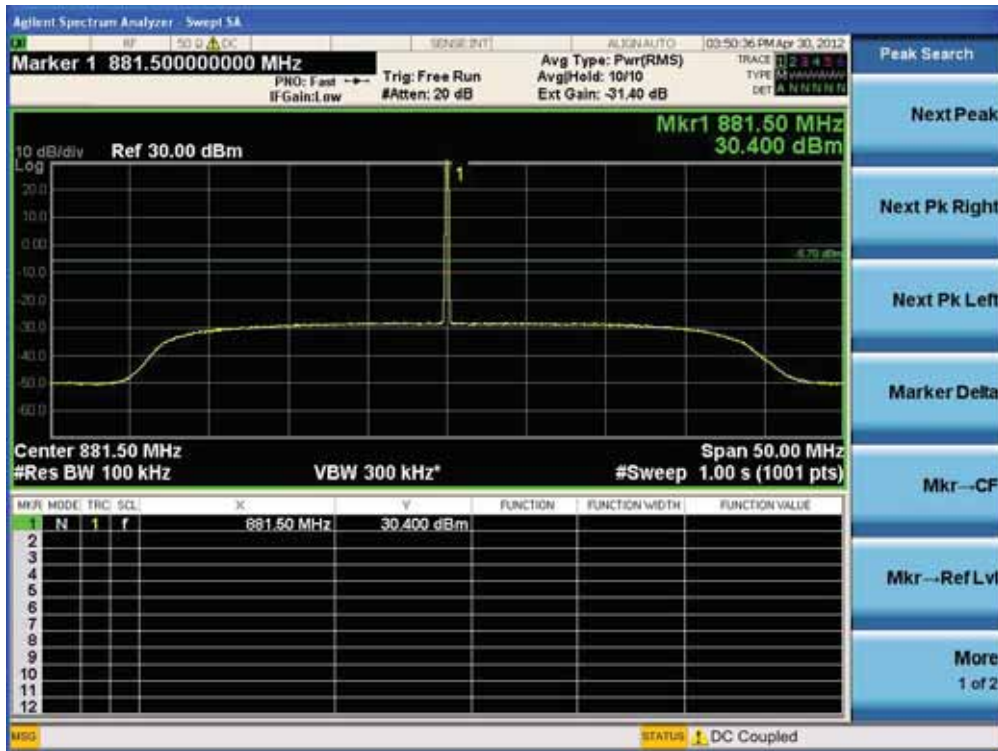
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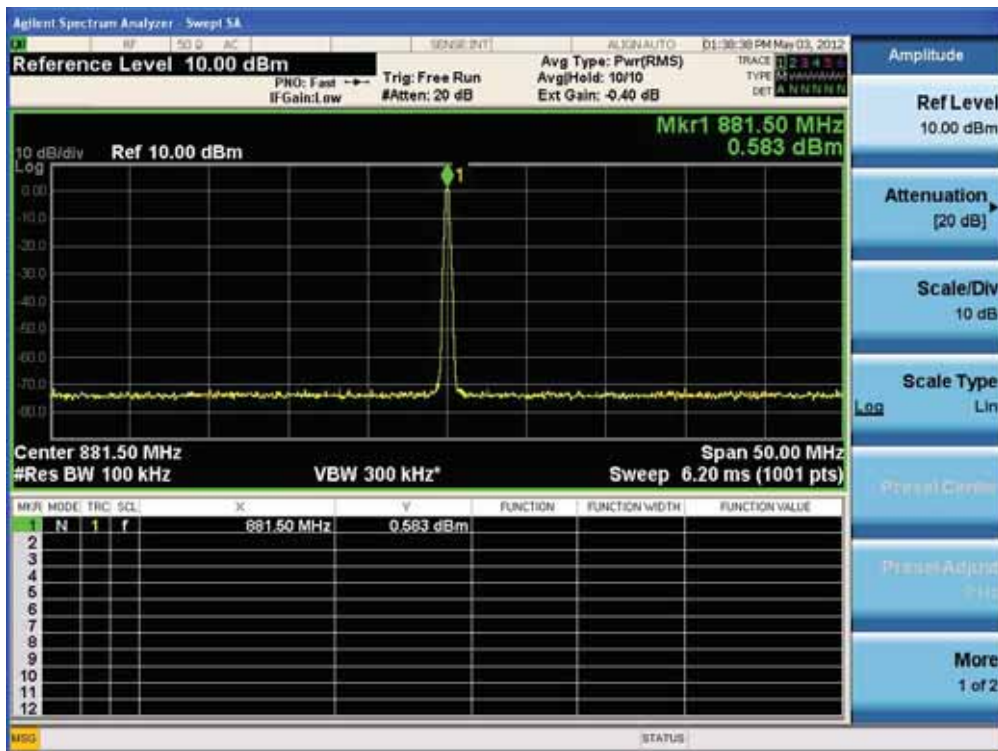
[Input LTE Downlink High]



[Downlink Output Power]



[Downlink Input Power]



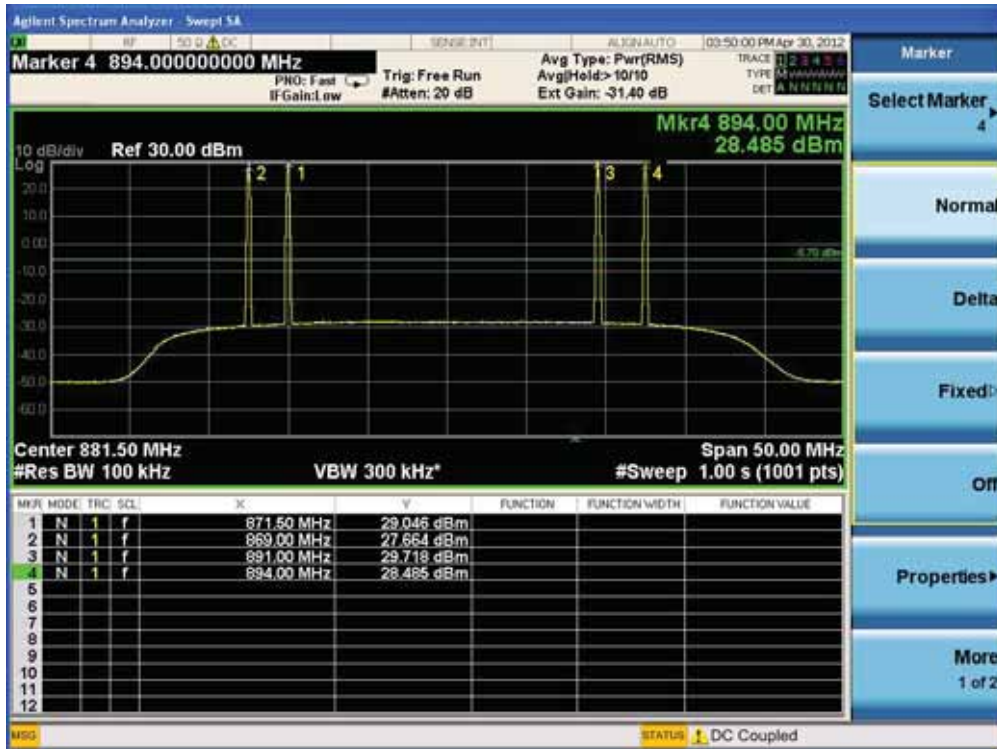
- RSS-131 6.1 Passband Gain : $30.4 - 0.583 = 29.817 \text{ dB} < \text{nominal gain } 30 \text{ dB}$

[Downlink Output Passband]



- RSS-131 4.2 20 dB Bandwidth : $893.85 - 869.15 = 24.7 \text{ MHz} < \text{Nominal Bandwidth } 25 \text{ MHz}$

[Out of 20 dB Bandwidth Gain]



- RSS-131 6.1 Out of 20 dB Bandwidth Gain is less than 20 dB Bandwidth Gain by 1.233 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.

§ 22.917 Emission limitations for cellular equipment.

The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone Service.

- (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.
- (b) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.
- (c) Alternative out of band emission limit. Licensees in this service may establish an alternative out of band emission limit to be used at specified band edge(s) in specified geographical areas, in lieu of that set forth in this section, pursuant to a private contractual arrangement of all affected licensees and applicants. In this event, each party to such contract shall maintain a copy of the contract in their station files and disclose it to prospective assignees or transferees and, upon request, to the FCC.
- (d) Interference caused by out of band emissions. If any emission from a transmitter operating in this service results in interference to users of another radio service, the FCC

may require a greater attenuation of that emission than specified in this section.

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.

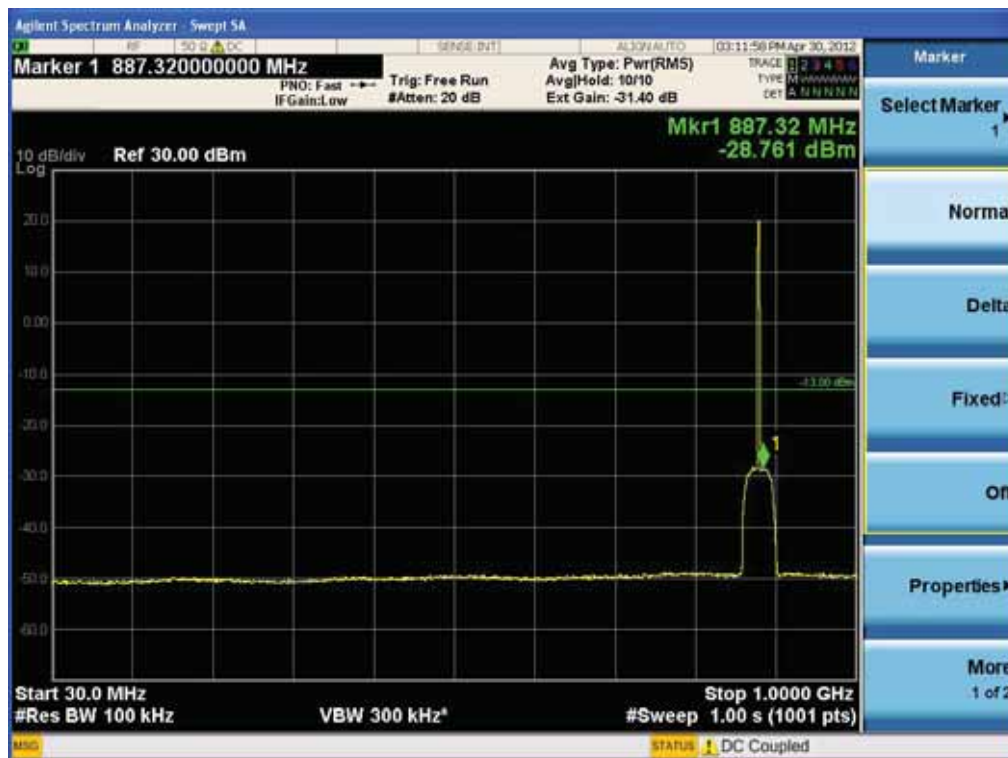
Plots of Spurious Emission

Conducted Spurious Emissions (30 MHz – 1 GHz)

[CDMA Downlink Low]



[CDMA Downlink Middle]



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- 36 /65-

[CDMA Downlink High]



[WCDMA Downlink Low]



[WCDMA Downlink Middle]



[WCDMA Downlink High]



[GSM Downlink Low]



[GSM Downlink Middle]



[GSM Downlink High]



[LTE Downlink Low]



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- 40 /65-

[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]



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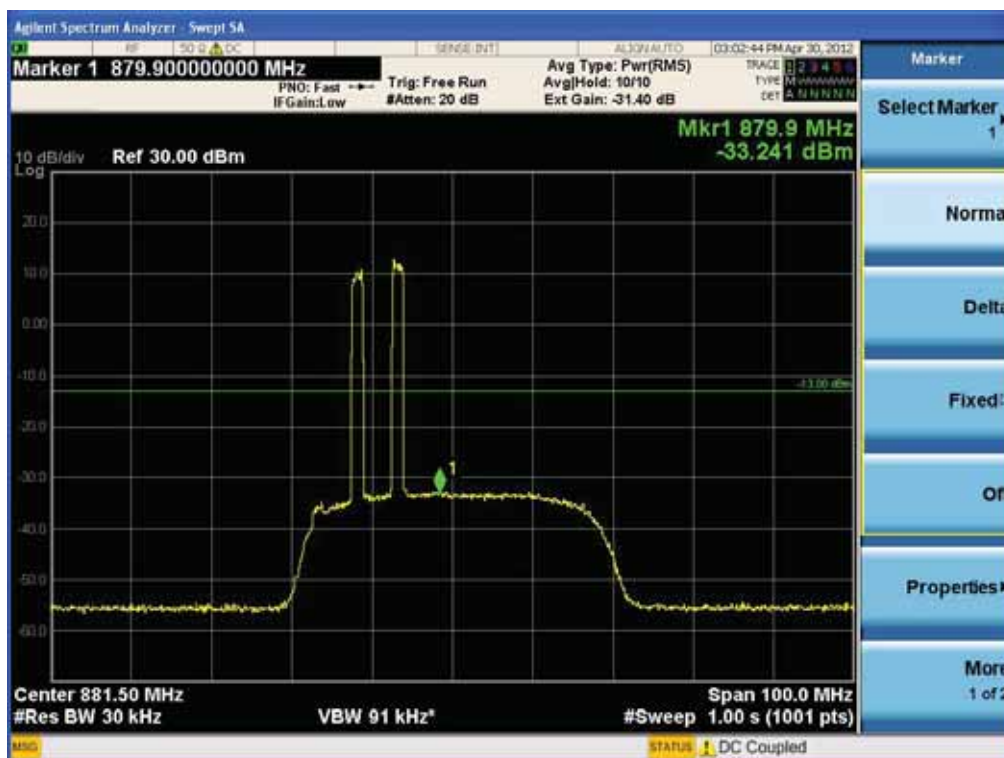


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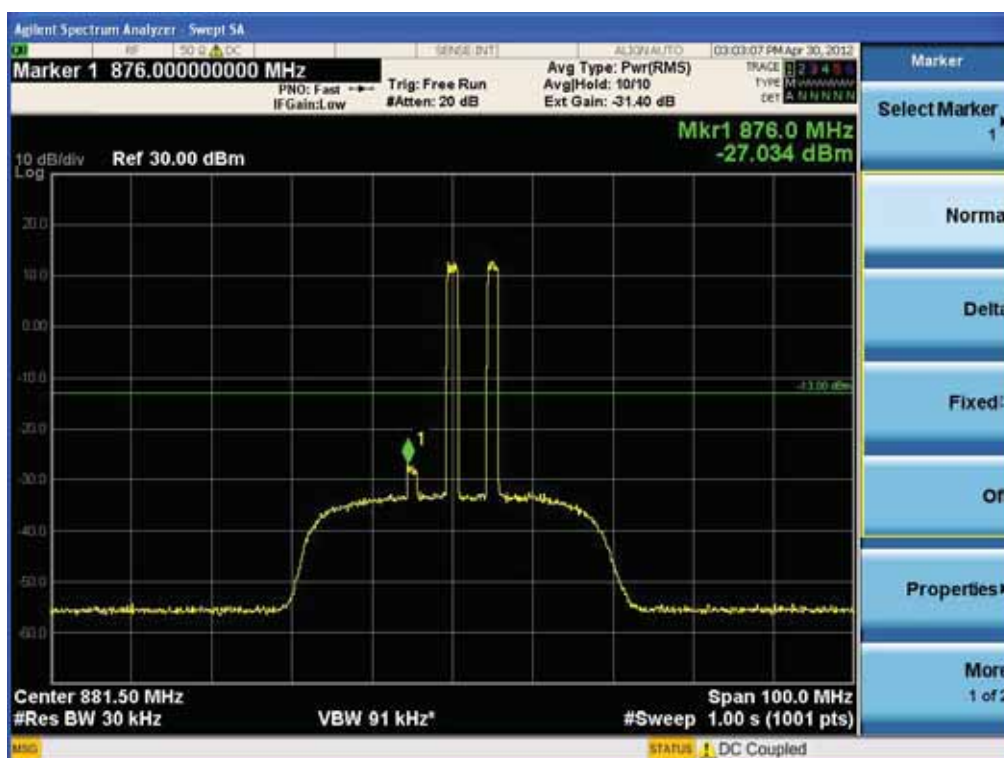


Intermodulation Spurious Emissions

[CDMA Downlink Low]



[CDMA Downlink Middle]



HCT Co., Ltd.

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

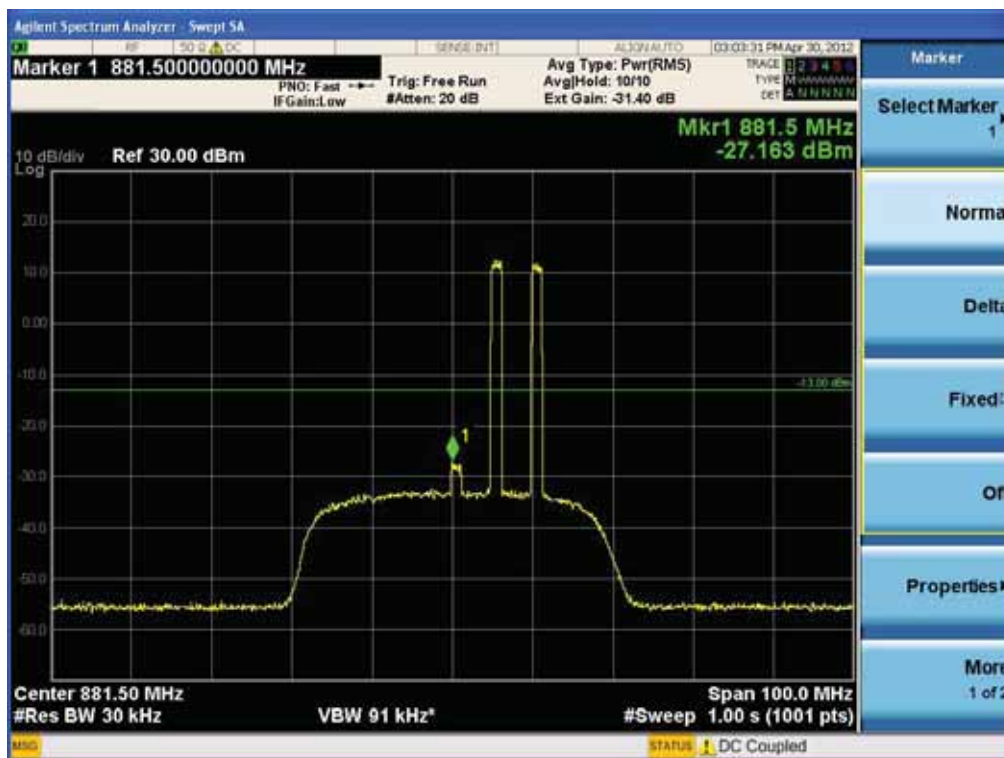
TEL : +82 31 645 6300

FAX : +82 31 645 6401

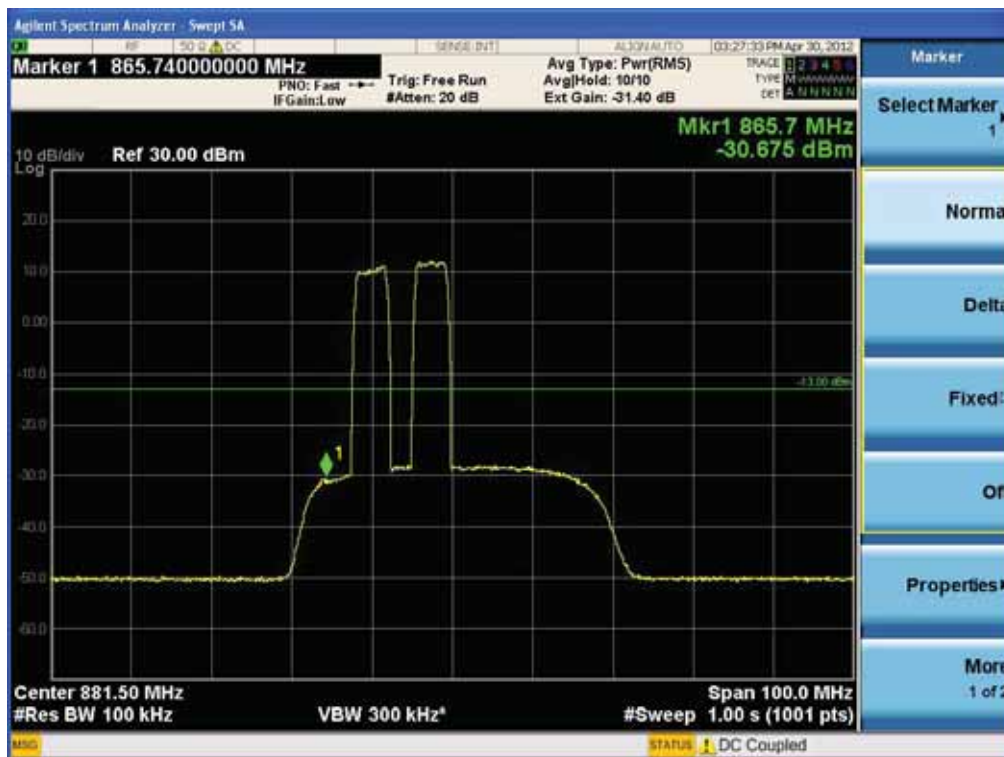
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- 48 /65-

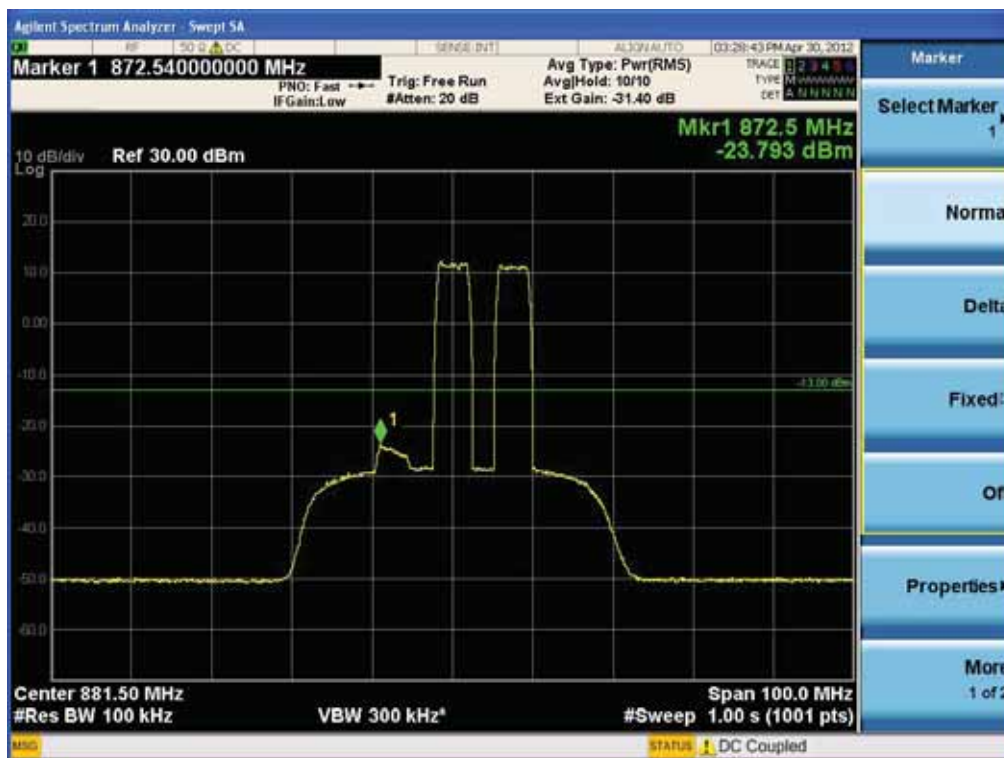
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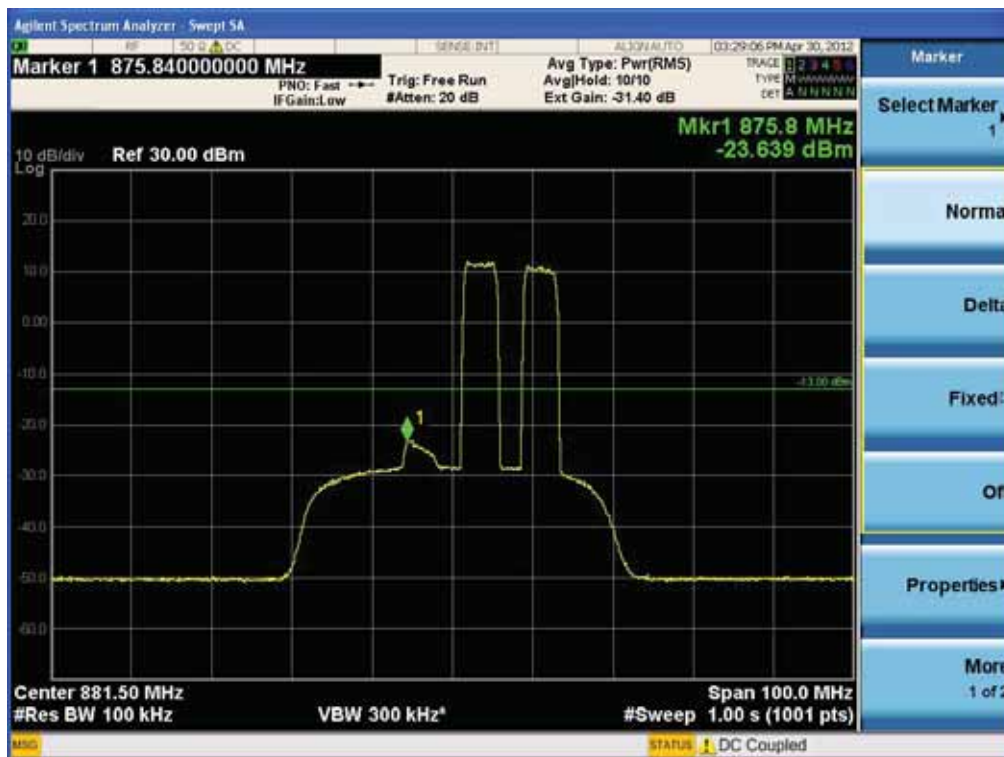
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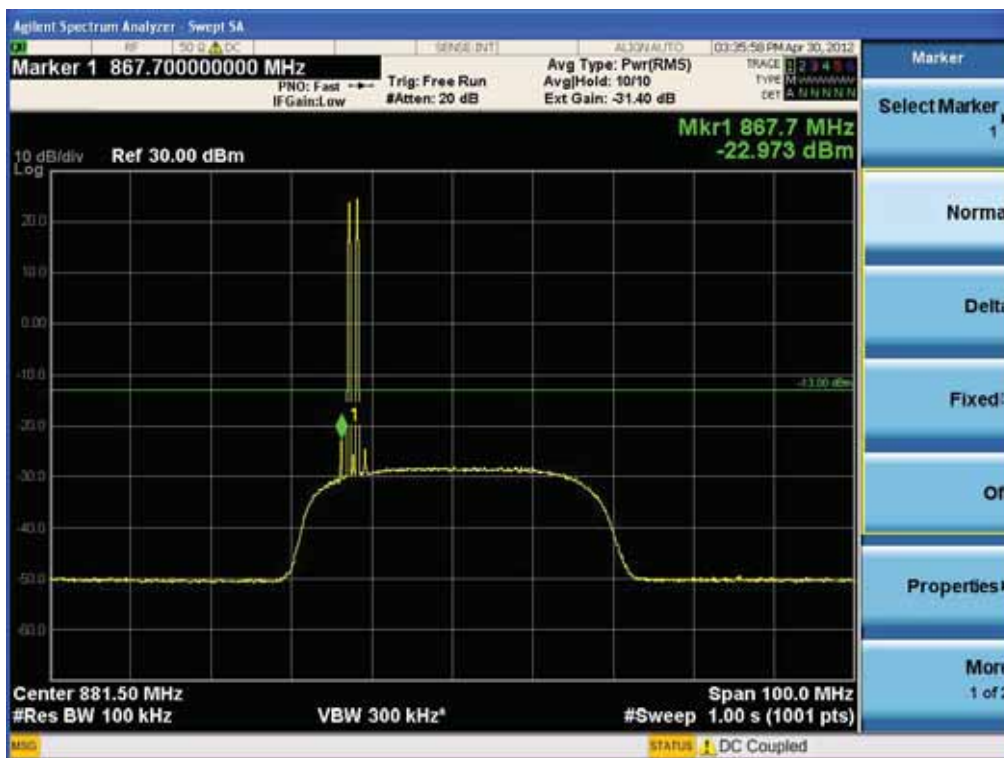
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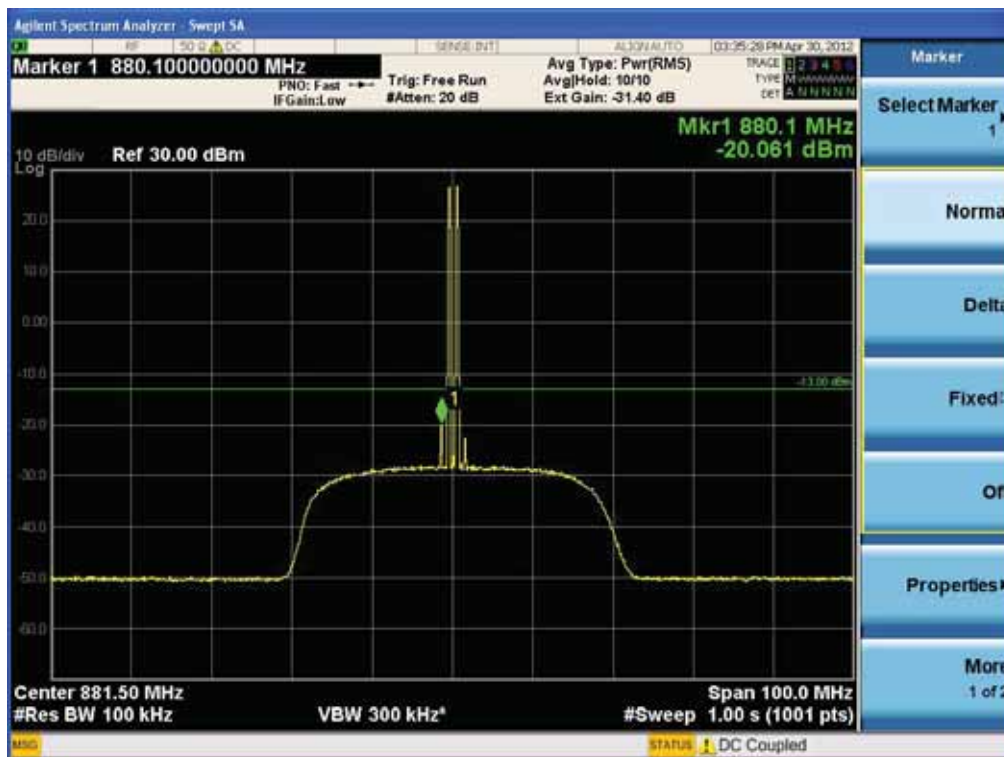
[WCDMA Downlink High]

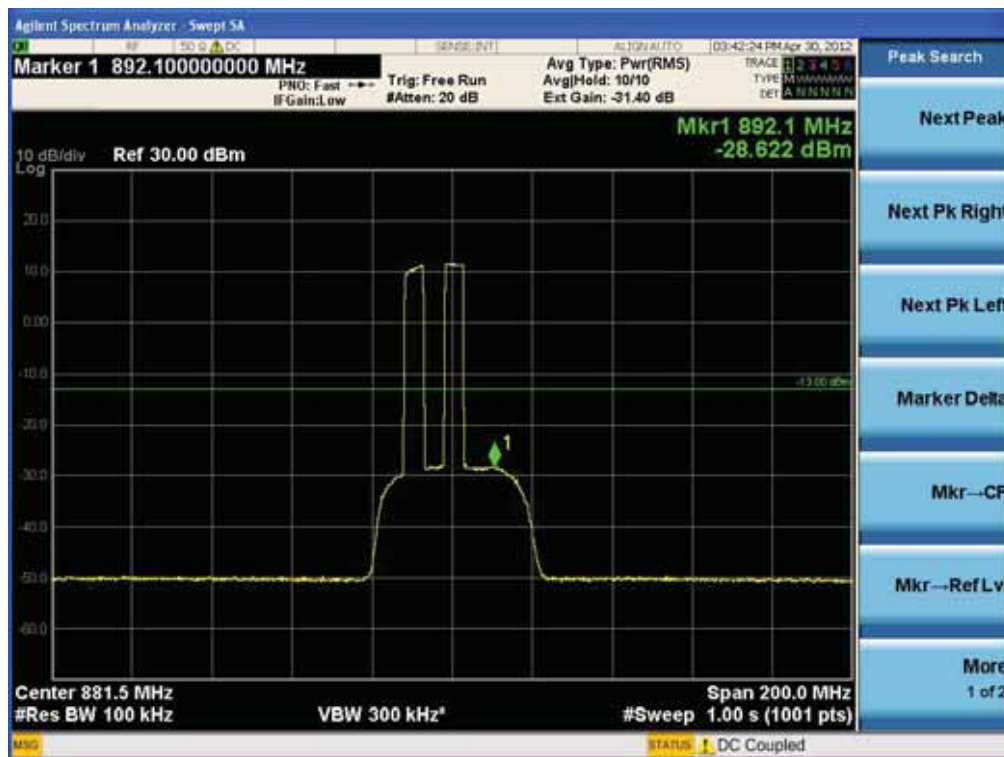


[GSM Downlink Low]

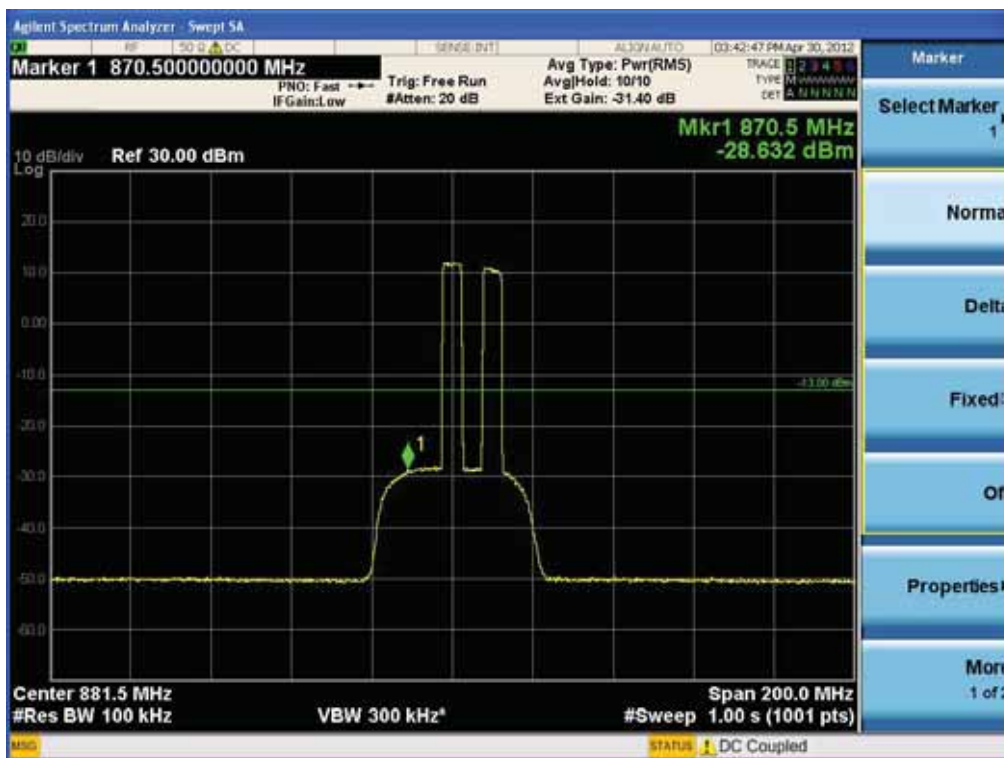


[GSM Downlink Middle]

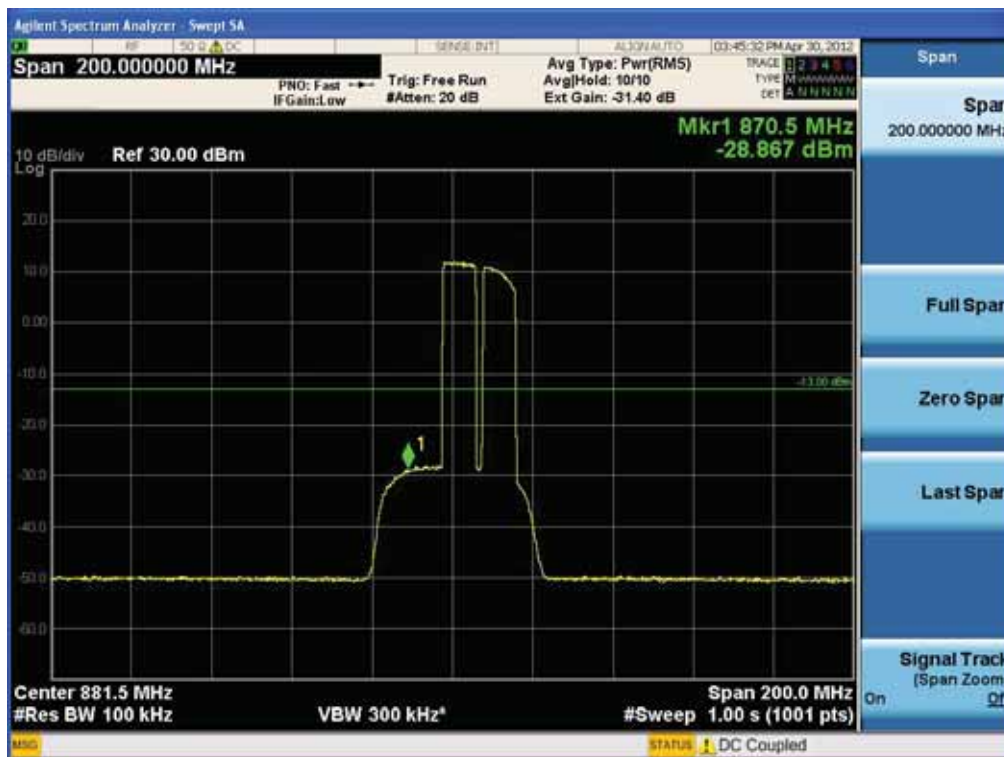




[LTE Downlink Middle]

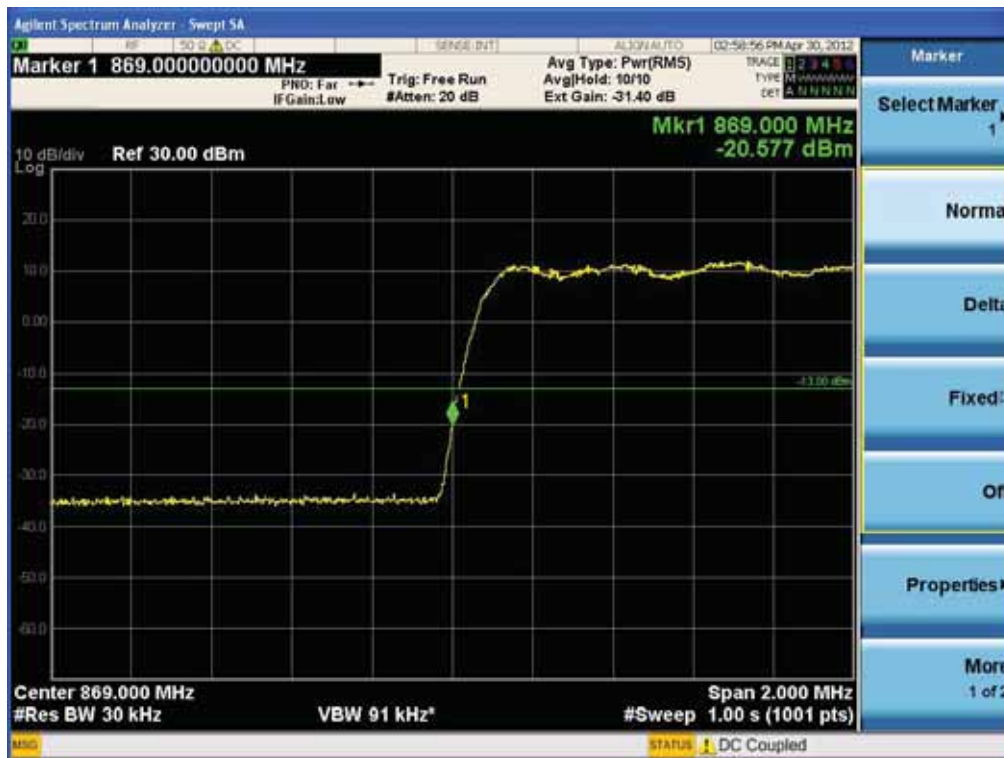


[LTE Downlink High]



Band Edge

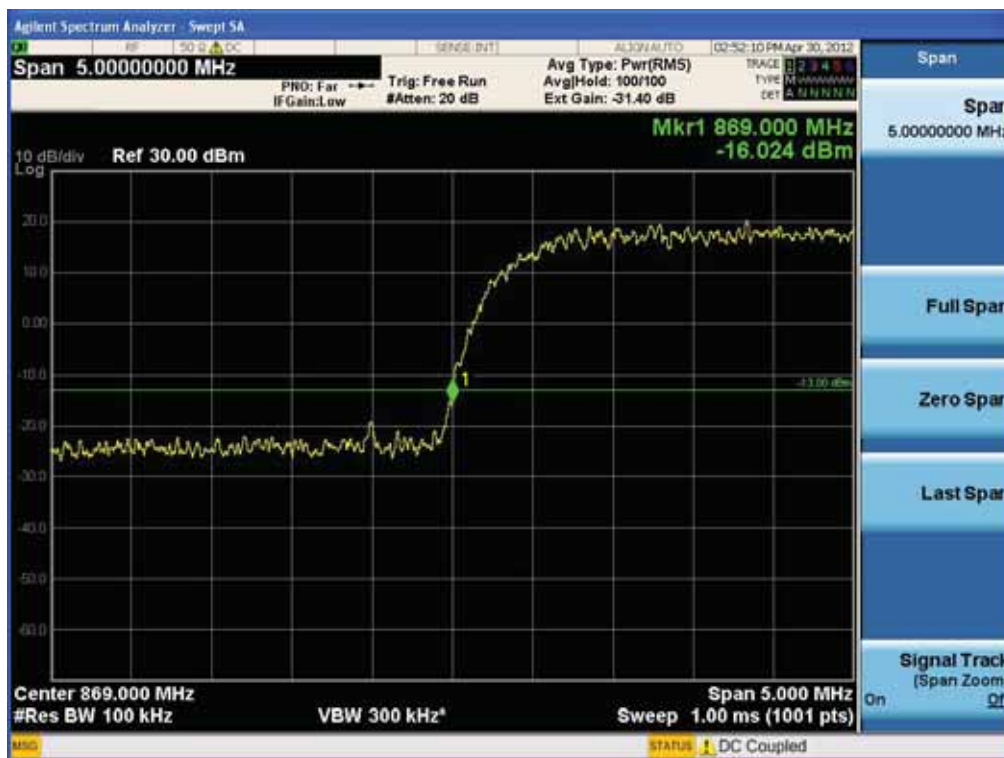
[CDMA Downlink Low]



[CDMA Downlink High]



[WCDMA Downlink Low]



[WCDMA Downlink High]



[GSM Downlink Low]



[GSM 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:

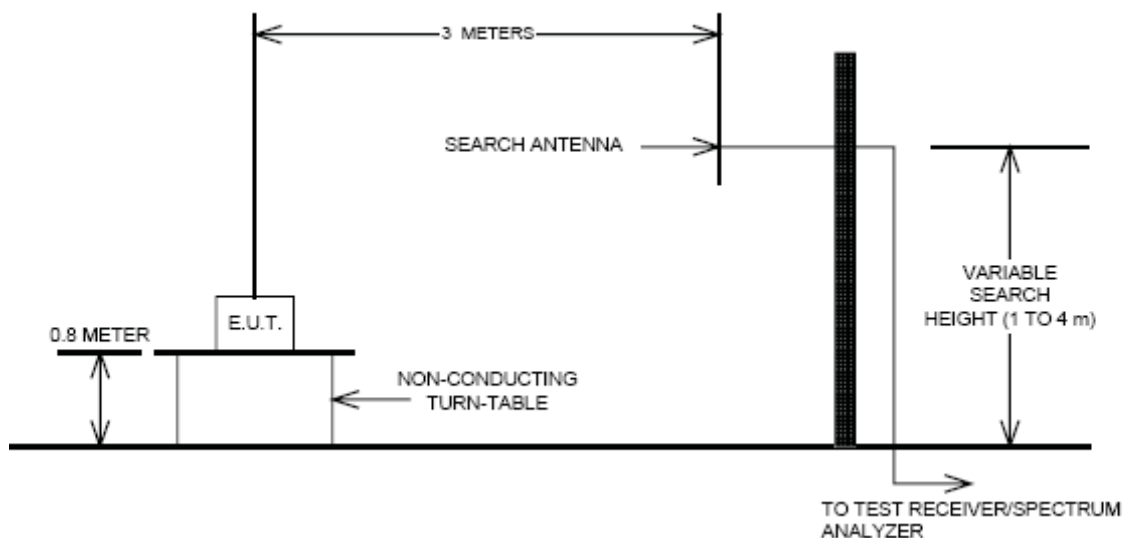
- (1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.
- (2) All equipment operating on frequencies higher than 25 MHz.
- (3) All equipment where the antenna is an integral part of, and attached directly to The transmitter.
- (4) Other types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

[Downlink]

Mode	Frequency	Freq.(MHz)	Substitute Level [dBm]	Ant. Gain (dBd)	C.L	Pol.	ERP (dBm)	Margin (dB)
CDMA	881.52	1763.04	-52.5	7.28	5.18	V	-50.40	-37.40
		2644.56	-52.9	8.16	6.64	V	-51.38	-38.38
WCDMA	881.6	1763.2	-51.8	7.28	5.18	V	-49.70	-36.70
		2644.8	-52.6	8.16	6.64	V	-51.08	-38.08
GSM	881.6	1763.2	-55.4	7.19	5.18	V	-53.39	-40.39
		2644.8	-56.2	8.16	6.64	V	-54.68	-41.68
LTE	881.5	1763	-50.9	7.28	5.18	V	-48.80	-35.80
		2644.5	-52	8.16	6.64	V	-50.48	-37.48

9. FREQUENCY STABILITY OVER TEMPERATURE AND VOLTAGE VARIATIONS

Test Requirement(s): §2.1055(a)(1) , §22.355

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.

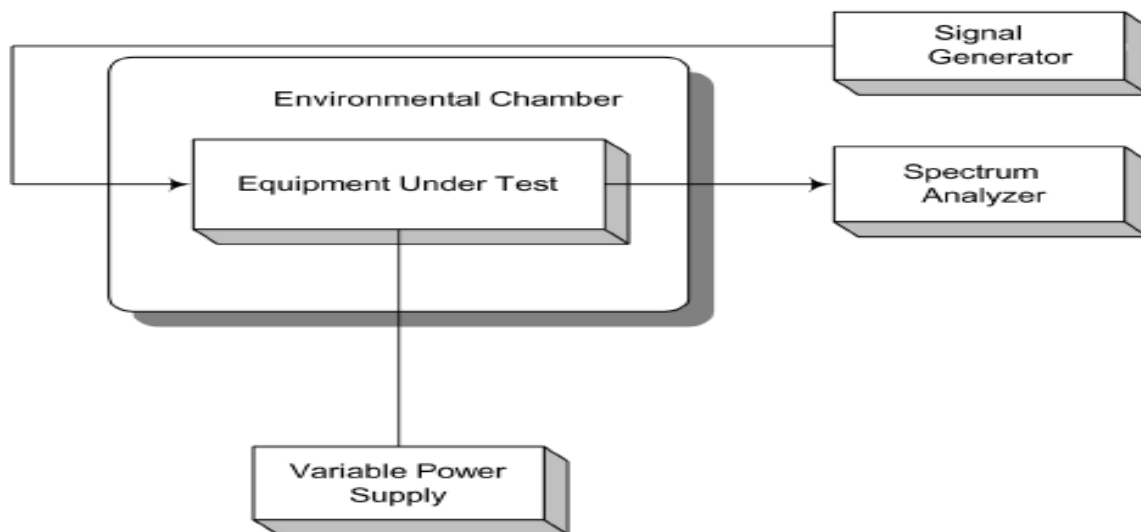
The voltage was varied by ± 15 % of nominal

§ 22.355 Frequency tolerance. Except as otherwise provided in this part, the carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table C- 1 of this section.

Table C- 1– Frequency Tolerance for Transmitters in the Public Mobile Services

Frequency range (MHz)	Base, fixed (ppm)	Mobile ≤ 3 watts (ppm)	Mobile ≤ 3 watts (ppm)
25 to 50	20.0	20.0	50.0
50 to 450	5.0	5.0	50.0
450 to 512	2.5	5.0	5.0
821 to 896	1.5	2.5	2.5
928 to 929	5.0	n/a	n/a
929 to 960	1.5	n/a	n/a
2110 to 2220	10.0	n/a	n/a

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.** = 881.6 MHz

Voltage (%)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100%	+20(Ref)	881 600 000	-0.5	0.0	0.0000
	-30	881 600 000	-0.4	0.1	0.0001
	-20	881 600 000	-0.4	0.1	0.0001
	-10	881 600 000	-0.3	0.2	0.0002
	0	881 600 000	-0.2	0.3	0.0003
	+10	881 600 000	-0.4	0.1	0.0001
	+30	881 600 000	-0.3	0.2	0.0002
	+40	881 600 000	-0.2	0.3	0.0003
	+50	881 600 000	-0.3	0.2	0.0002
115%	+20	881 600 000	-0.1	0.4	0.0005
85%	+20	881 600 000	-0.2	0.3	0.0003

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	30.030	dBm
Max Peak output Power at antenna input terminal	1006.932	W
Prediction distance	20.000	cm
Prediction frequency	881.5200	MHz
Antenna Gain(typical)	2.000	dBi
Antenna Gain(numeric)	1.585	—
Power density at prediction frequency(S)	0.317	mW/cm ²
MPE limit for uncontrolled exposure at prediction frequency	0.588	mW/cm ²

3. RESULTS

The power density level at 20 cm is 0.317 mW/cm², which is below the uncontrolled exposure limit of 0.588 mW/cm² at Down Link

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.