



## HCT. CO., LTD.

CERTIFICATION DIVISION

105-1, JANGAM-RI, MAJANG-MYEON, ICHEON-SI, GYEONGGI-DO, KOREA

TEL : +82 31 645 6300 FAX : +82 31 645 6401

### 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.:** HCTR1205FR03

**HCT FRN:** 0005866421

**IC Recognition No.:** 5944A-3

**FCC ID:**

**S2O-ADX-R-730S**

**IC :**

**6416A-ADXR730S**

**APPLICANT:**

**Advanced RF Technologies, Inc**

**EUT Type:**

**DAS(Distributed Antenna System)**

**Model:**

**ADX-R-730S**

**Frequency Ranges:**

**728 MHz ~ 740 MHz, 746 MHz ~ 757 MHz**

**Conducted Output Power:**

**30.0 dBm**

**FCC Rules Part(s):**

**CFR 47, Part 27**

**IC Rule Part(s):**

**RSS-Gen (Issue 3, December 2010) , 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.

Report prepared by : Chang-Seok Choi  
Engineer of RF Team

Report 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. : 323-254-8131

- FCC ID: S2O-ADX-R-730S
- IC: 6416A-ADXR730S
- APPLICANT: Advanced RF Technologies, Inc
- EUT Type: DAS(Distributed Antenna System)
- Model: ADX-R-730S
- Frequency Ranges: 728 MHz ~ 740 MHz, 746 MHz ~ 757 MHz
- Conducted Output Power: 30.0 dBm
- Antenna Gain(s) : 2 dBi
- FCC Rules Part(s): CFR Title 47 Part 27 Sub Part C
- 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; §27.50	RSS-131, Section 6.2 RSS-GEN, Section 4.8	Compliant
Occupied Bandwidth	§2.1049	RSS-131, Section 6.1 RSS-GEN, Section 4.6.1	Compliant
Spurious Emissions at Antenna Terminals	§2.1053, §27.53	RSS-131, Section 6.3 RSS-131, Section 6.4 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	RSS-131, Section 6.5 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.** (c) The following power and antenna height requirements apply to stations transmitting in the 698- 746 MHz band (9) Control and mobile stations are limited to 30 watts ERP

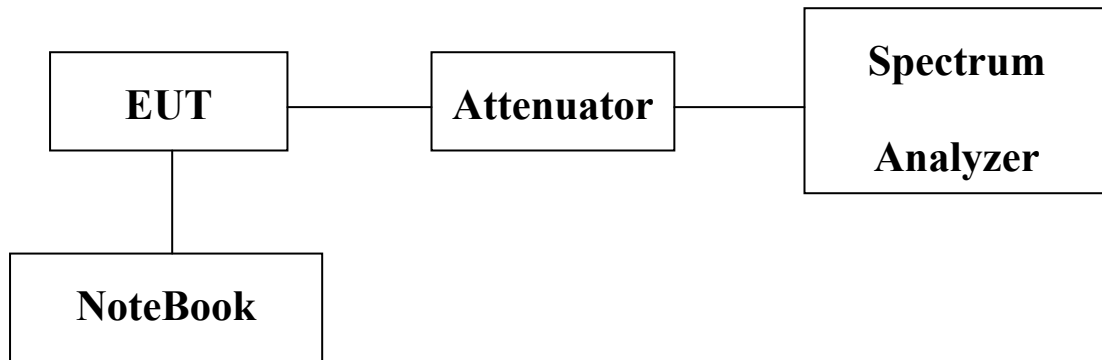
(b)(9) Control stations and mobile stations transmitting in the 746- 757 MHz, 758- 763 MHz, 776- 793 MHz, and 805- 806 MHz bands and fixed stations transmitting in the 787- 788 MHz and 805- 806 MHz bands are limited to 30 watts ERP.

#### **RSS-131 6.2 Output Power**

The manufacturer's output power rating Prated MUST NOT be greater than Pmean for all types of enhancers.

**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)
LTE	16QAM	0 dBm

**\* As the response mentioned- higher output in the pre-test is 16QAM. So the exam was 16QAM.**

**[Downlink]**

Band	Bandwidth	Frequency (MHz)	Measured Average Output Power (dBm)
A	5 MHz	731	29.92
B		737	29.55
A&B	10 MHz	734	29.83
C		751	29.32

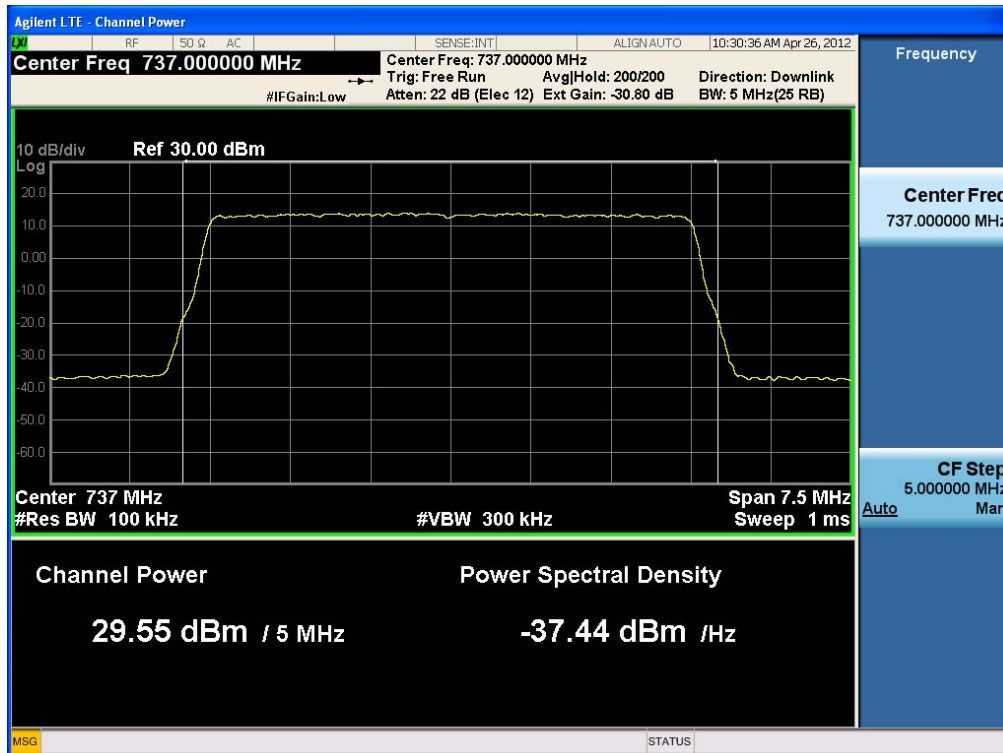


Plots of RF Output Power

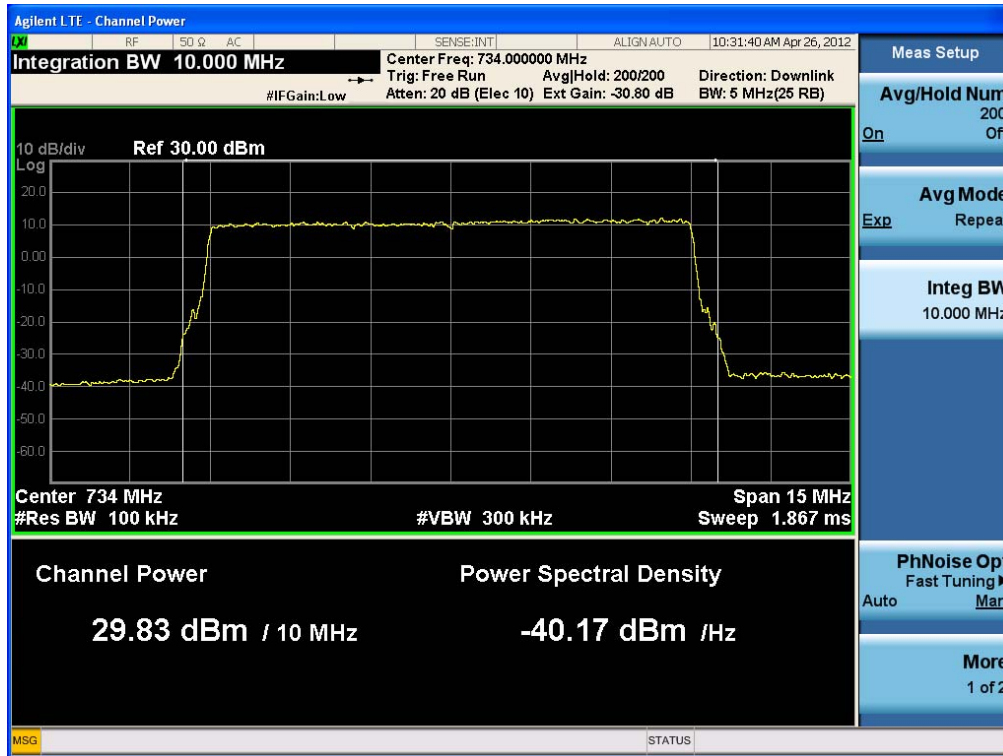
[LTE Downlink A\_5 MHz]



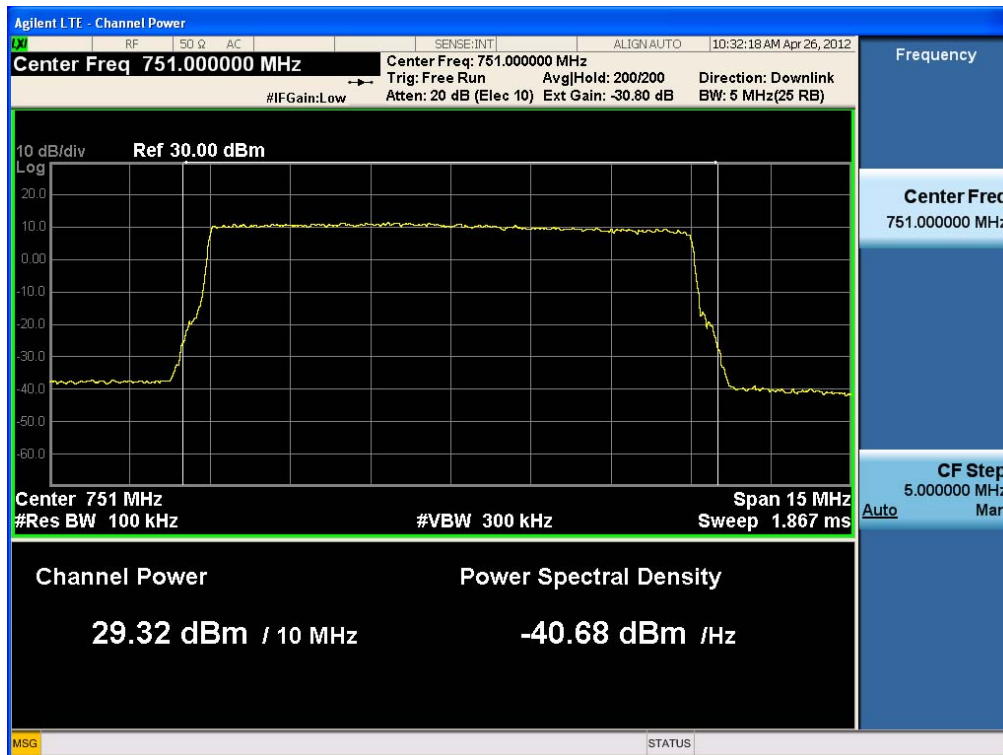
[LTE Downlink B\_5 MHz]



[LTE Downlink A&B\_10 MHz]

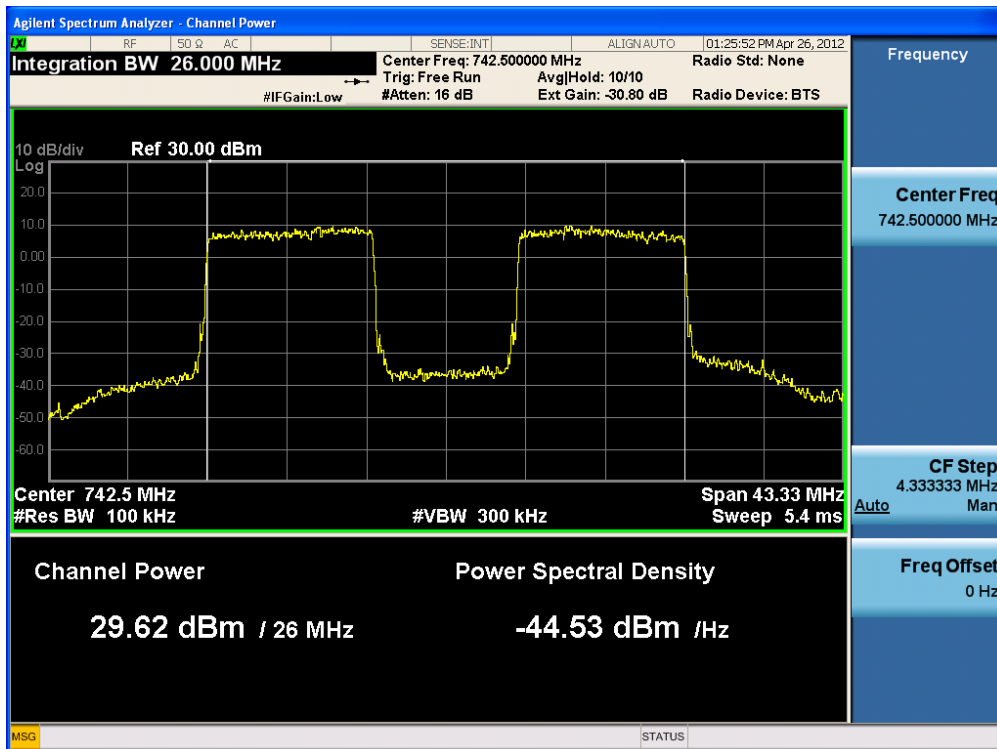


[LTE Downlink C\_10 MHz]

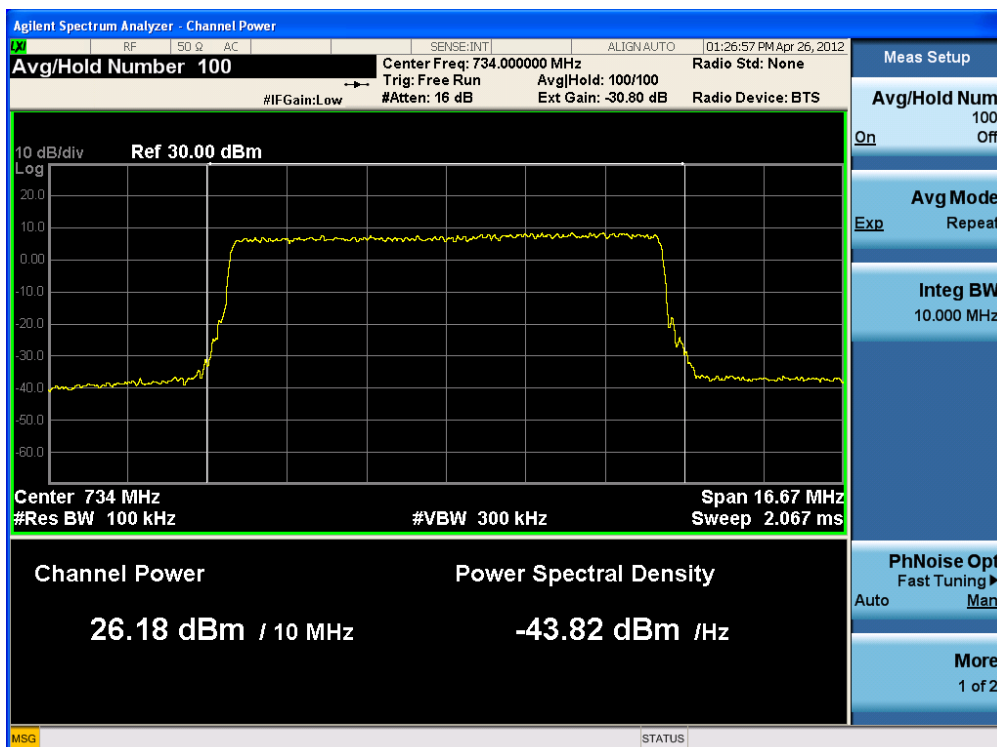


\* RSS-131 6.2 Power Back-off :  $29.62 - 26.18 = 3.44$  dB

[ Downlink 2 FA ]



[ Downlink 1 FA ]



## 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.

**RSS-131 6.1 Amplifier Gain and Bandwidth**

The passband gain shall not exceed the nominal gain by more than 1.0 dB. The 20 dB bandwidth shall not exceed the nominal bandwidth that is stated by the manufacturer. Outside of the 20 dB bandwidth, the gain shall not exceed the gain at the 20 dB point.

**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]**

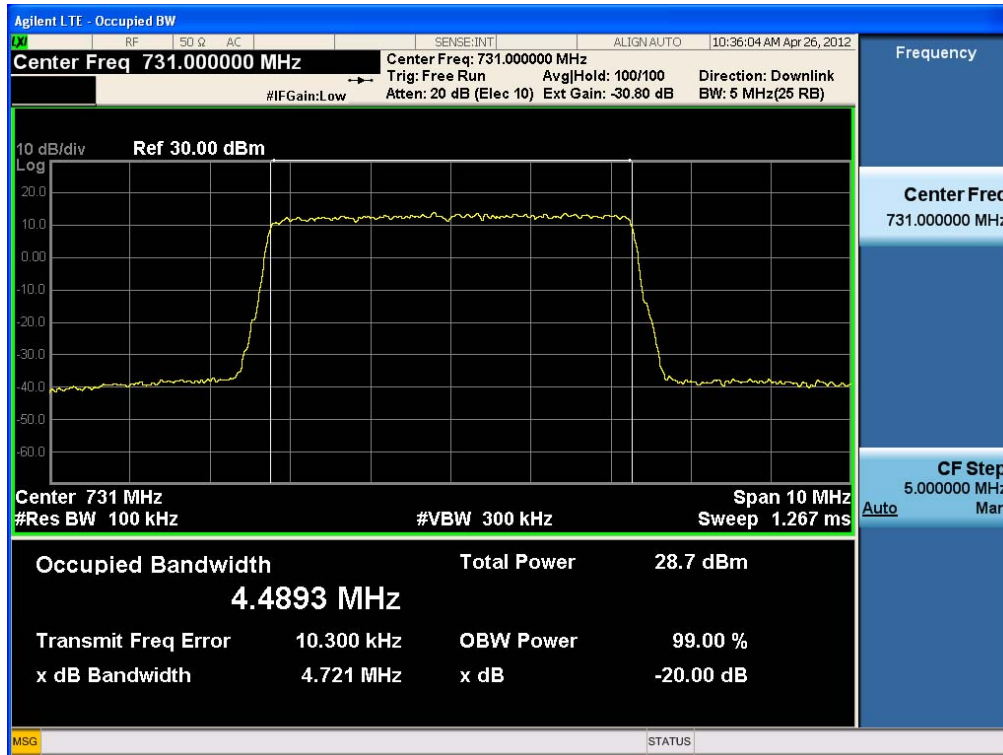
Band	Bandwidth	Frequency (MHz)	Occupied Bandwidth (MHz)
A	5 MHz	731	4.4893
B		737	4.4964
A&B	10 MHz	734	8.9243
C		751	8.9005

**[Downlink Input]**

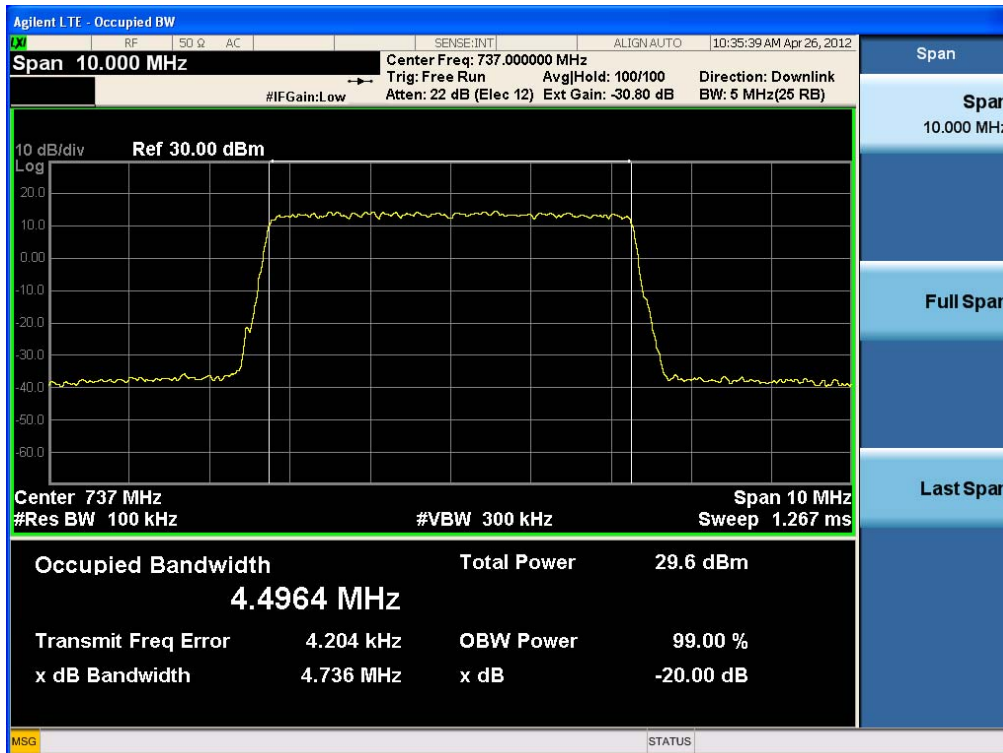
Band	Bandwidth	Frequency (MHz)	Occupied Bandwidth (MHz)
A	5 MHz	731	4.4982
B		737	4.5005
A&B	10 MHz	734	8.9421
C		751	8.9400

## Plots of Occupied Bandwidth

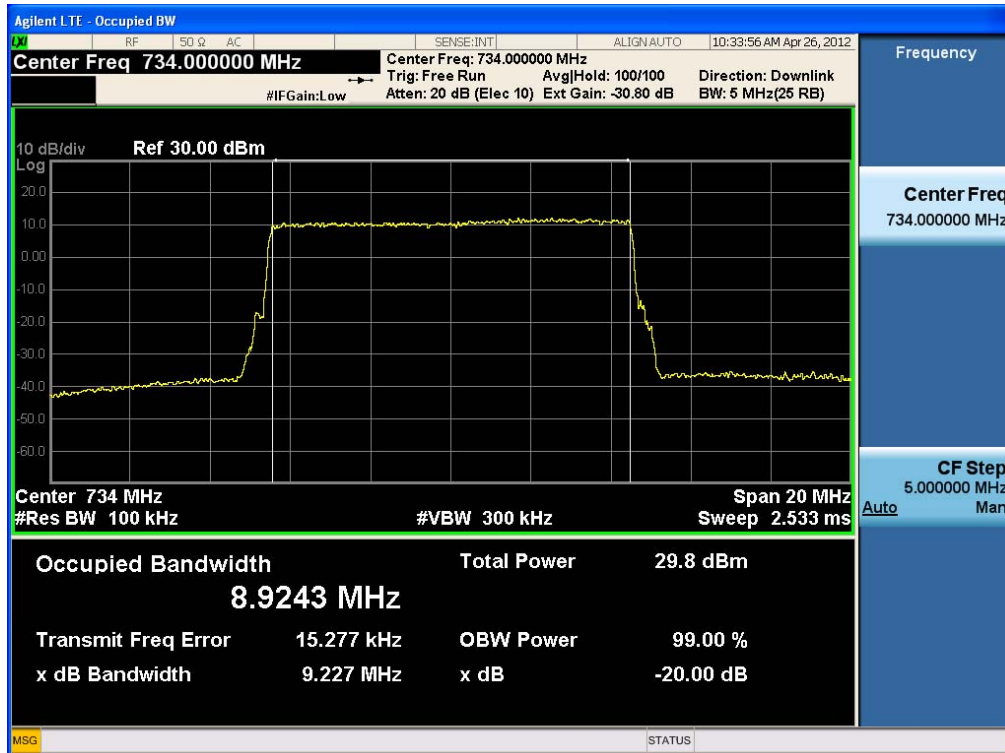
### [Output LTE Downlink A\_5 MHz]



### [Output LTE Downlink B\_5 MHz]



[Output LTE Downlink A&B\_10 MHz]

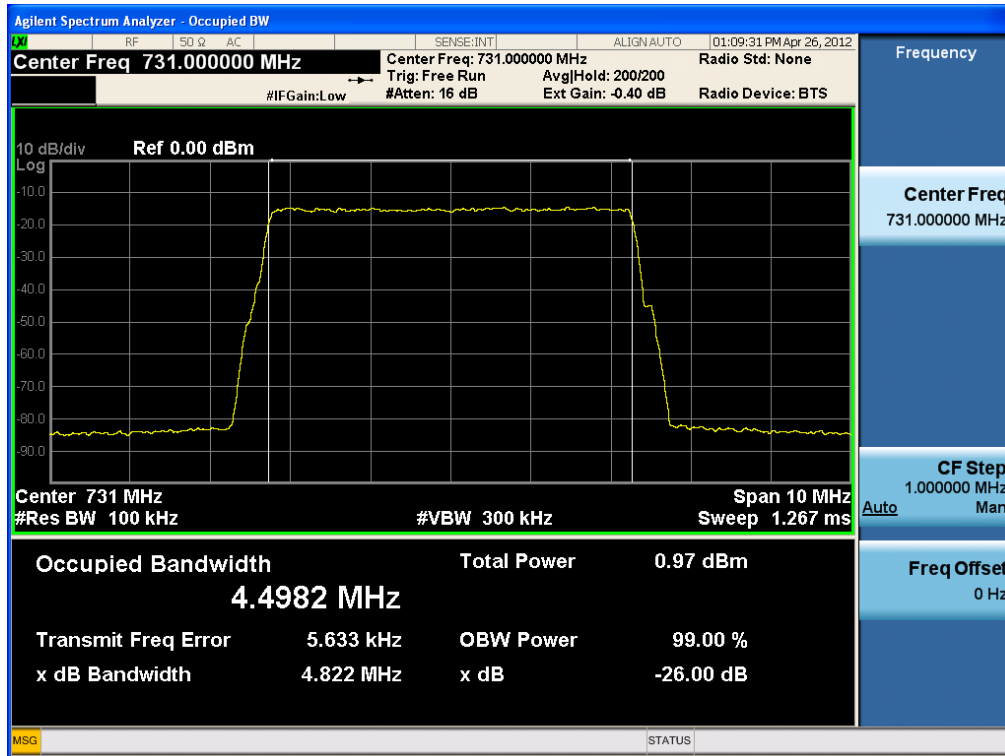


[Output LTE Downlink C\_10 MHz]

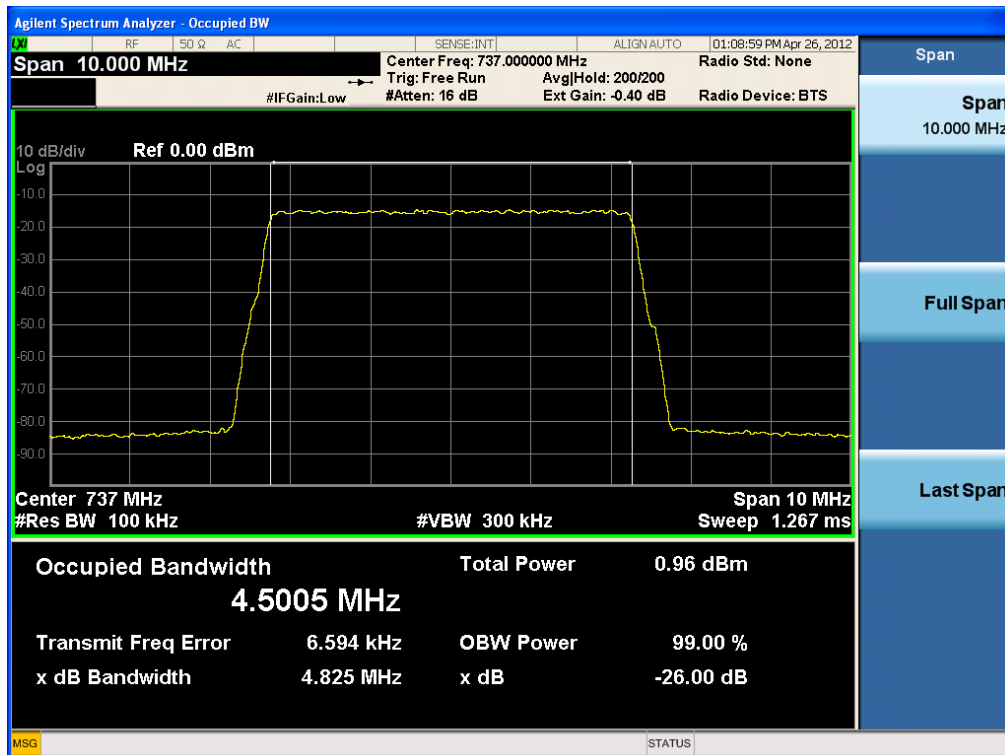




[Input LTE Downlink A\_5 MHz]

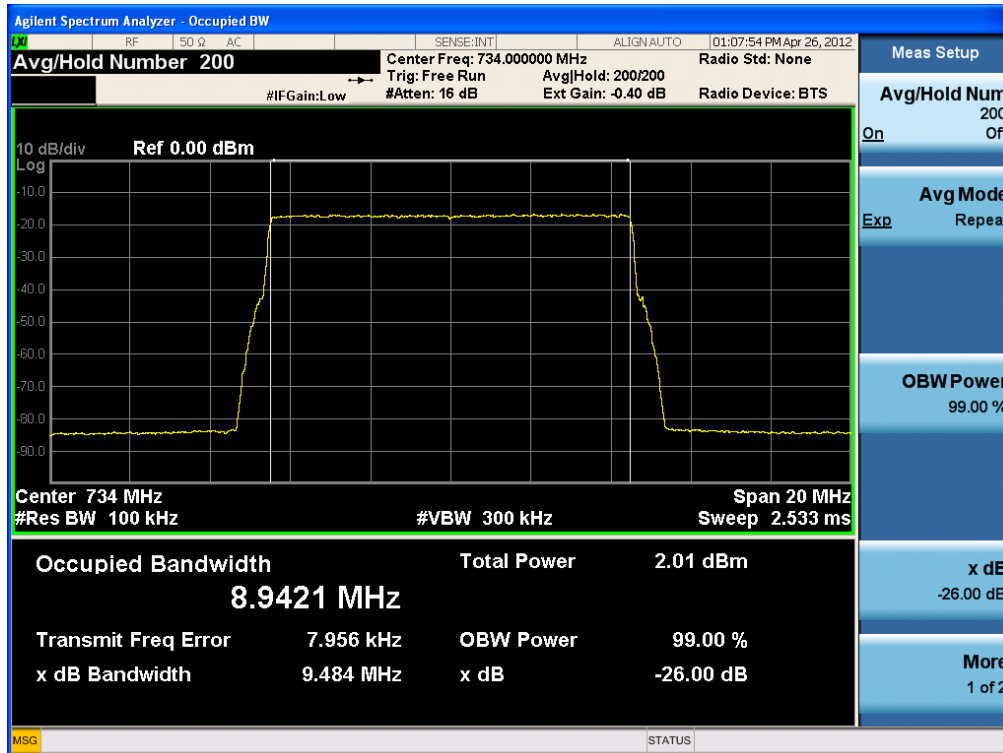


[Input LTE Downlink B\_5 MHz]

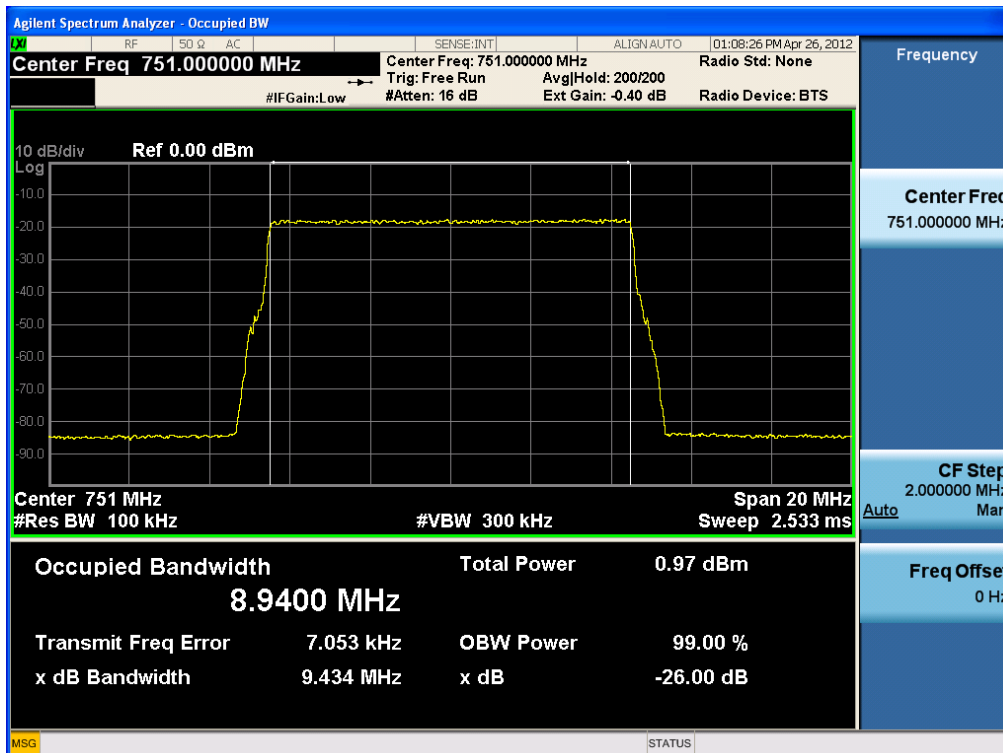




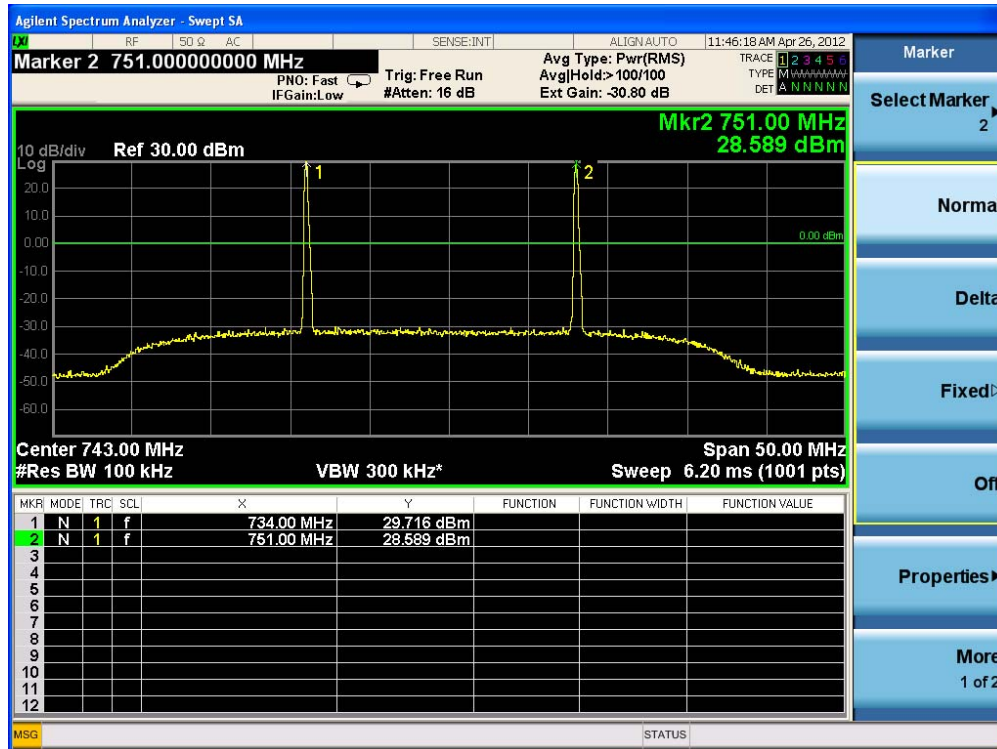
[Input LTE Downlink A&B\_10 MHz]



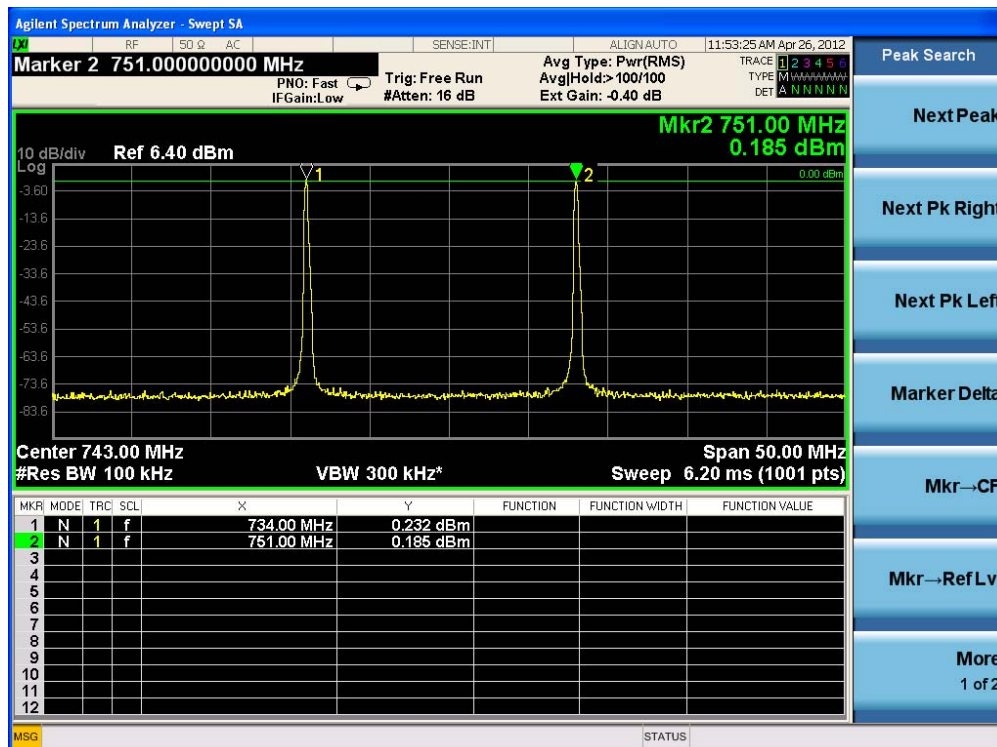
[Input LTE Downlink C\_10 MHz]



- RSS-131 6.1 Passband Gain :  $29.716 - 0.232 = 29.484$  dB < nominal gain 30 dB
- [Downlink Output Power]

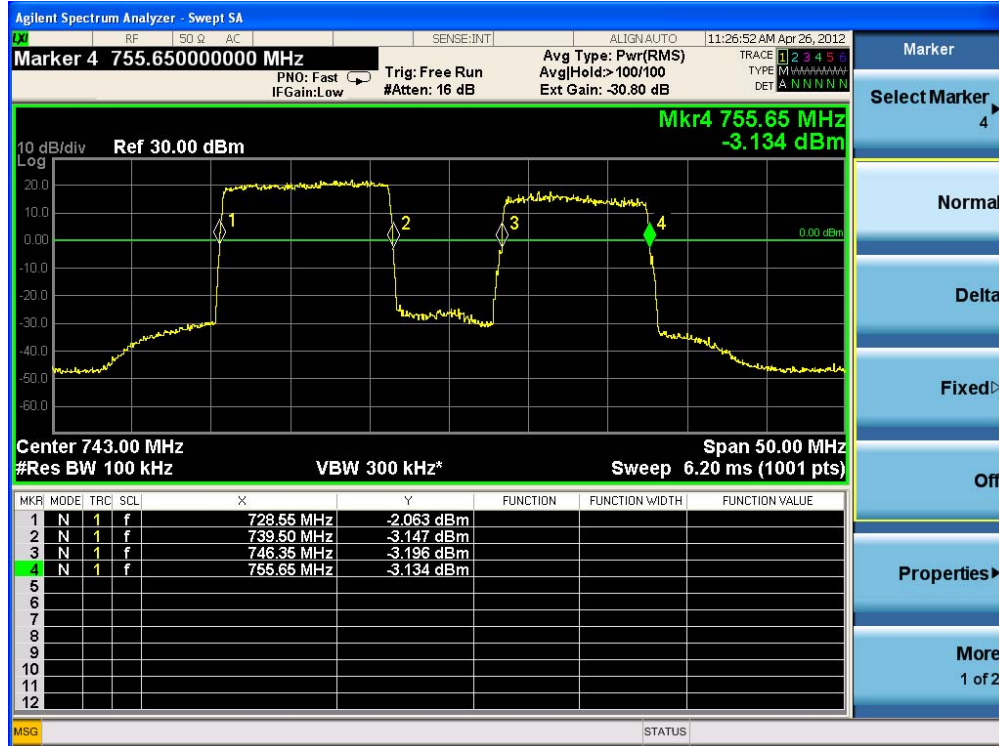


[Downlink Input Power]



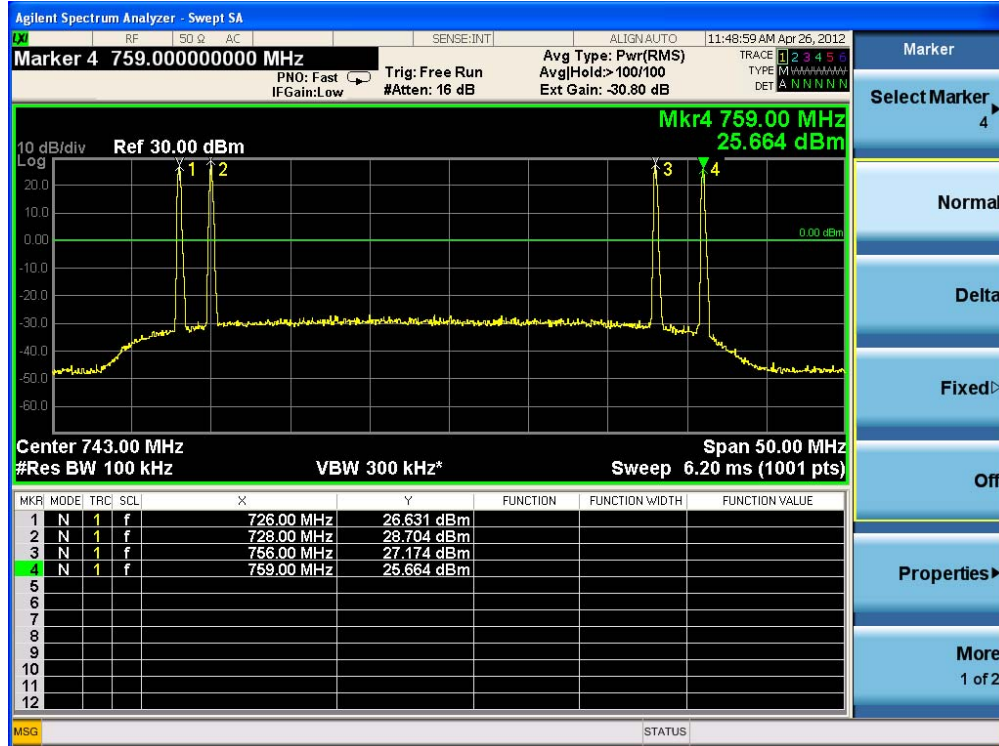
- RSS-131 6.1 20 dB Bandwidth :  $739.5 - 728.55 = 10.95$  MHz < Nominal Bandwidth 11 MHz

[Downlink Output Passband]



- RSS-131 6.1 Out of 20 dB Bandwidth Gain is less than 20 dB Bandwidth Gain by 1.51 dB

[Out of 20 dB Bandwidth Gain ]



## 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

(c) For operations in the 746–758 MHz band and the 776–788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746–758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB;

(2) On any frequency outside the 776–788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB;

(3) On all frequencies between 763–775 MHz and 793–805 MHz, by a factor not less than  $76 + 10 \log (P)$  dB in a 6.25 kHz band segment, for base and fixed stations;

### RSS-131 6.3 Non-Linearity

Transmitter signals amplified by a non-linear device (enhancer or translator) will alter the occupied bandwidth of the transmitted signals; therefore, the extent of non-linearity shall be tested.

#### 6.3.1 Multi-channel Enhancer

For a multi-channel enhancer, any intermodulation product level must be attenuated, relative to P, by at least:

$43 + 10 \log 10P$ , or 70 dB, whichever is less stringent,

where P is the total RF output power of the test tones in watts.

#### **RSS-131 6.4 Spurious Emissions**

Spurious emissions of zone enhancers and translators shall be suppressed as much as possible.

Spurious emissions shall be attenuated below the rated power of the enhancer by at least:

$43 + 10 \log_{10}(\text{Prated in watts})$ , or 70 dB, whichever is less stringent.

Note: If the minimum standard is not met, check to see if the input signal generators have a high harmonic content.

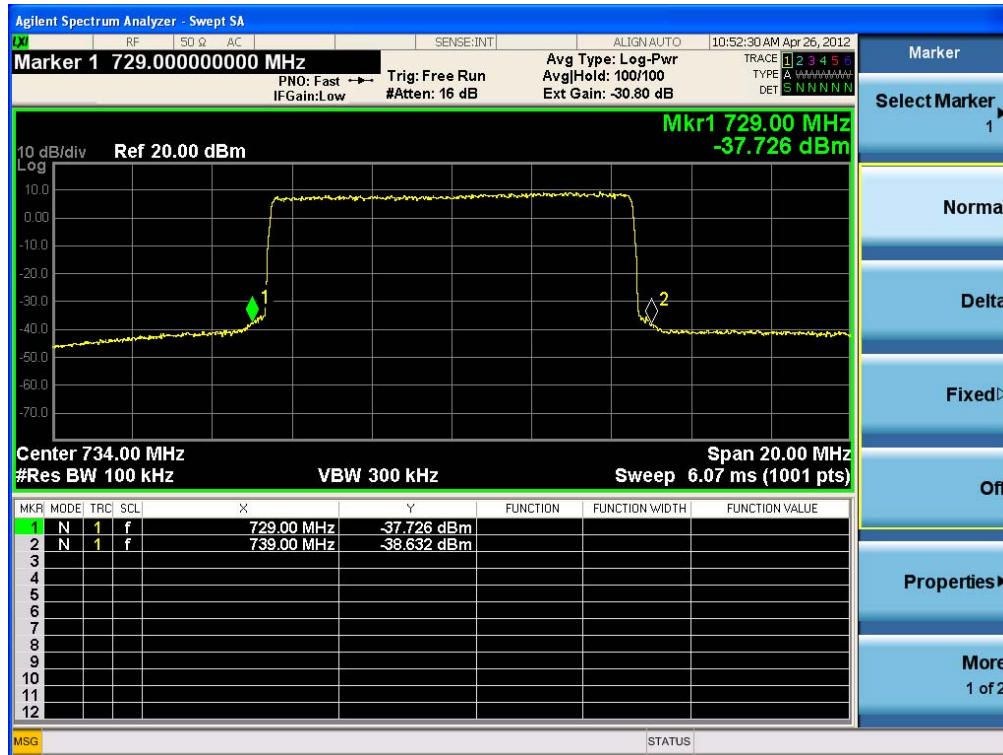
**Test Procedures:** A modulated carrier generated by the signal generator carrier was connected to either the Uplink or Downlink RF port at a maximum level as determined by the spectrum analyzer was connected to either the Uplink or Downlink port depending on the circuitry being measured.

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

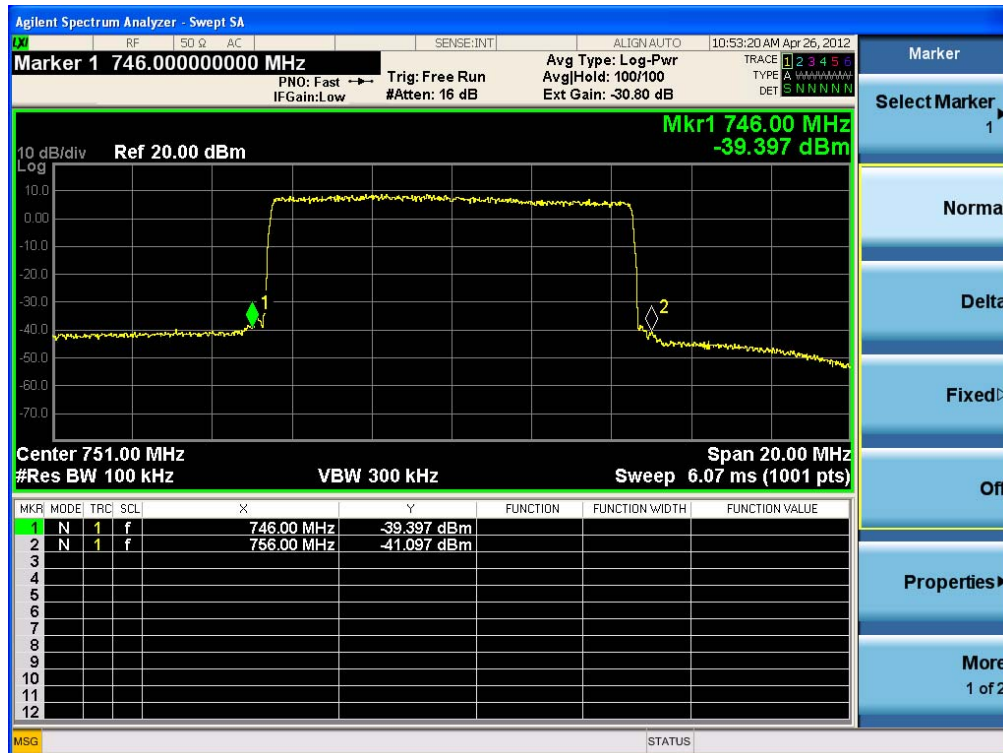
**Test Results:** The EUT complies with the requirements of this section. There were no detectable Spurious emissions for this EUT.

**Plots of BAND EDGE**

**[LTE Downlink A&B\_10 MHz]**



**[LTE Downlink C\_10 MHz]**

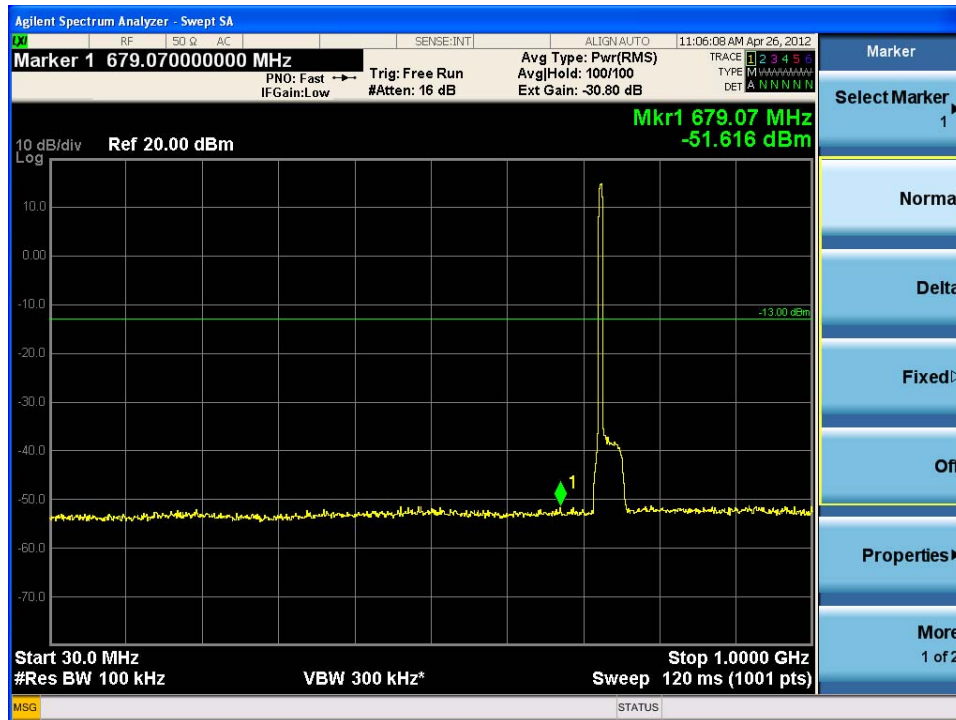




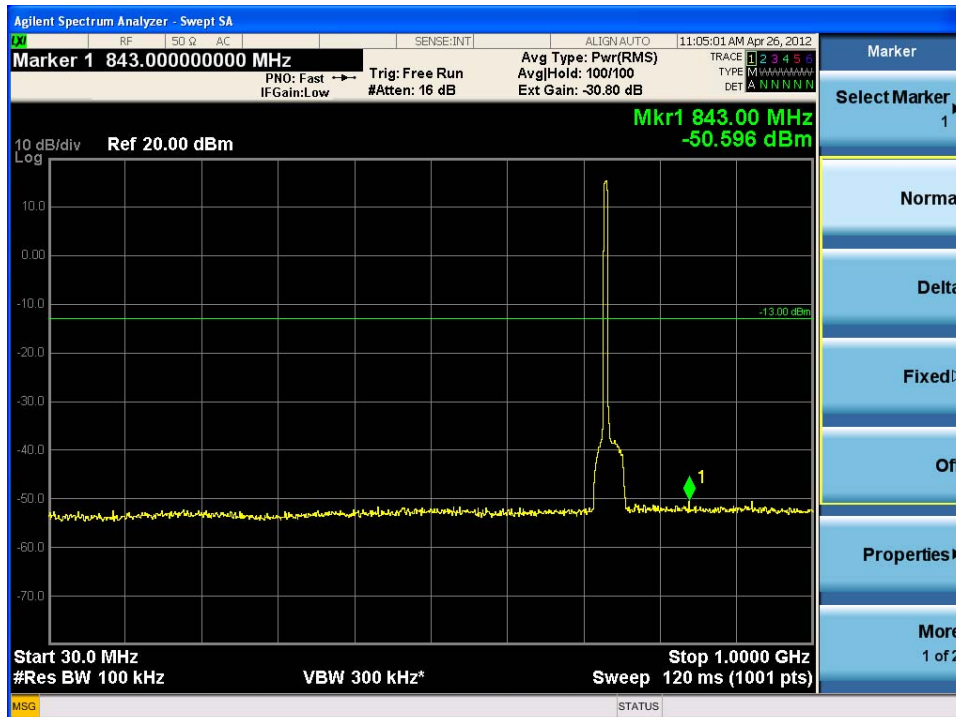
## Plots of Spurious Emission

### Conducted Spurious Emissions (30 MHz – 1 GHz)

#### [LTE Downlink A\_5 MHz]

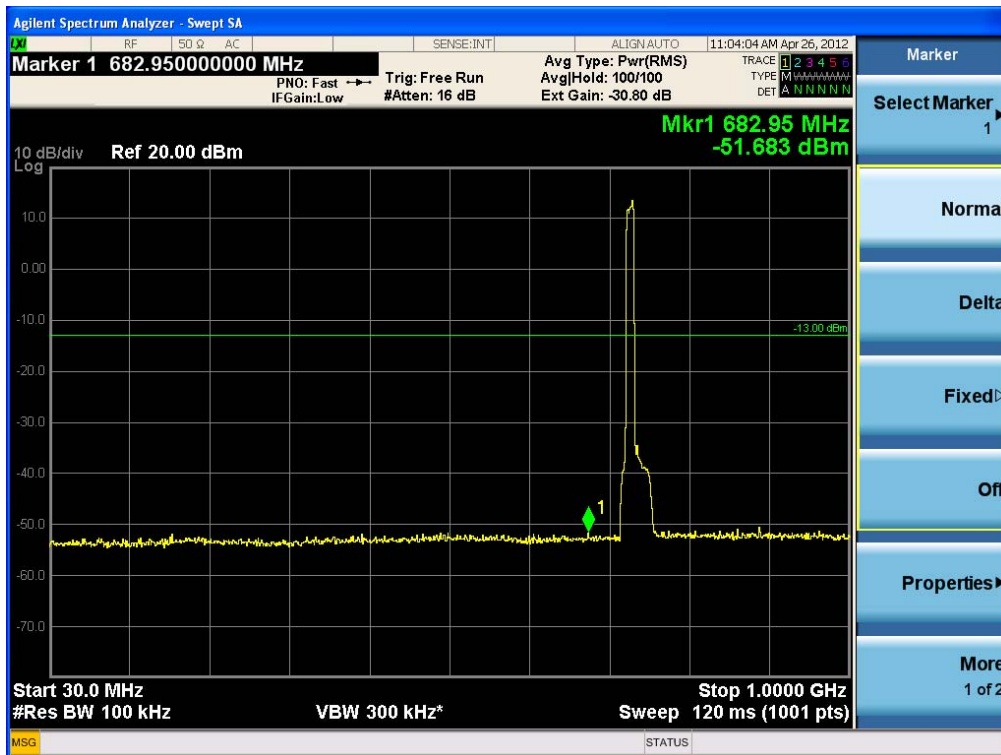


#### [LTE Downlink B\_5 MHz]

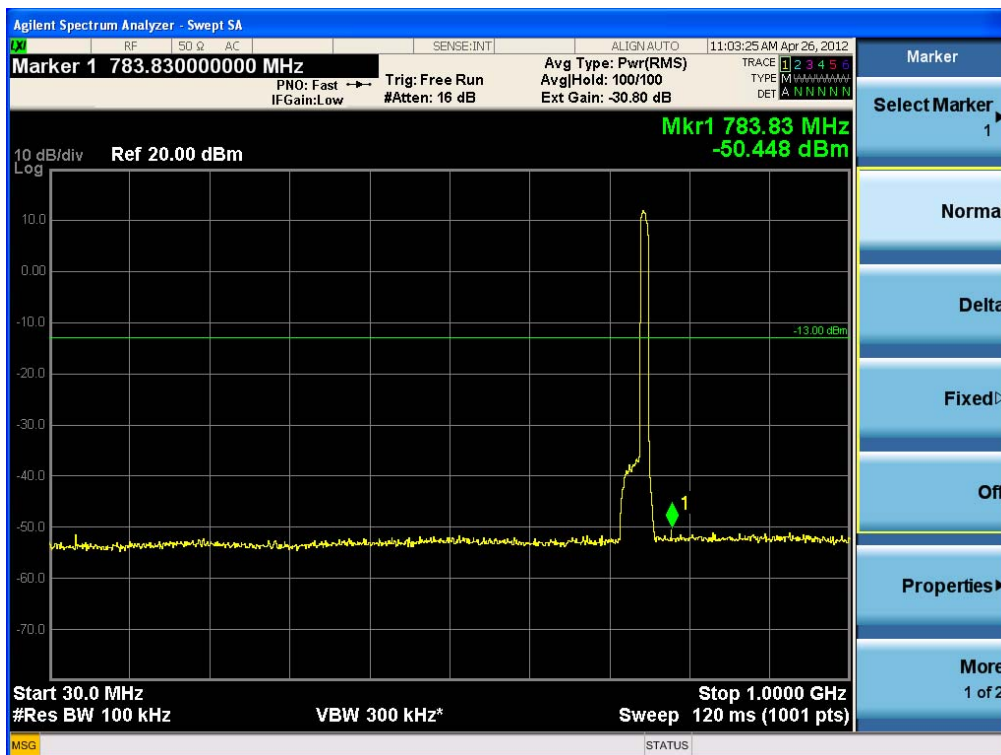




[LTE Downlink A&B\_10 MHz]



[LTE Downlink C\_10 MHz]



Conducted Spurious Emissions (1 GHz ~26.5 GHz)

[LTE Downlink A\_5 MHz]



[LTE Downlink B\_5 MHz]



**[LTE Downlink A&B\_10 MHz]**



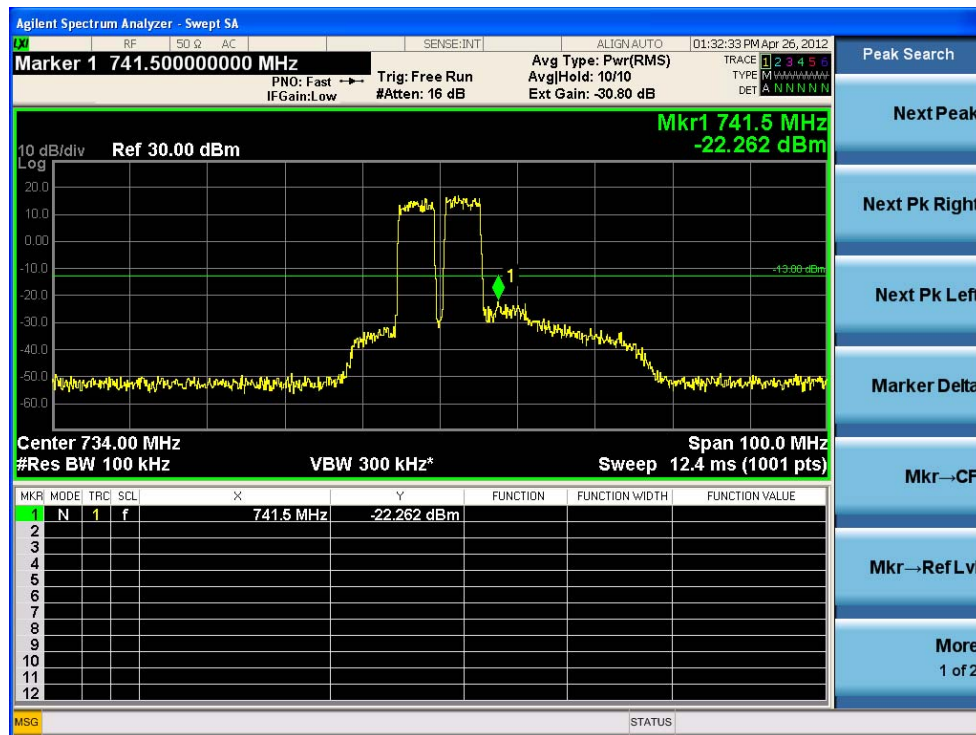
[LTE Downlink C\_10 MHz]



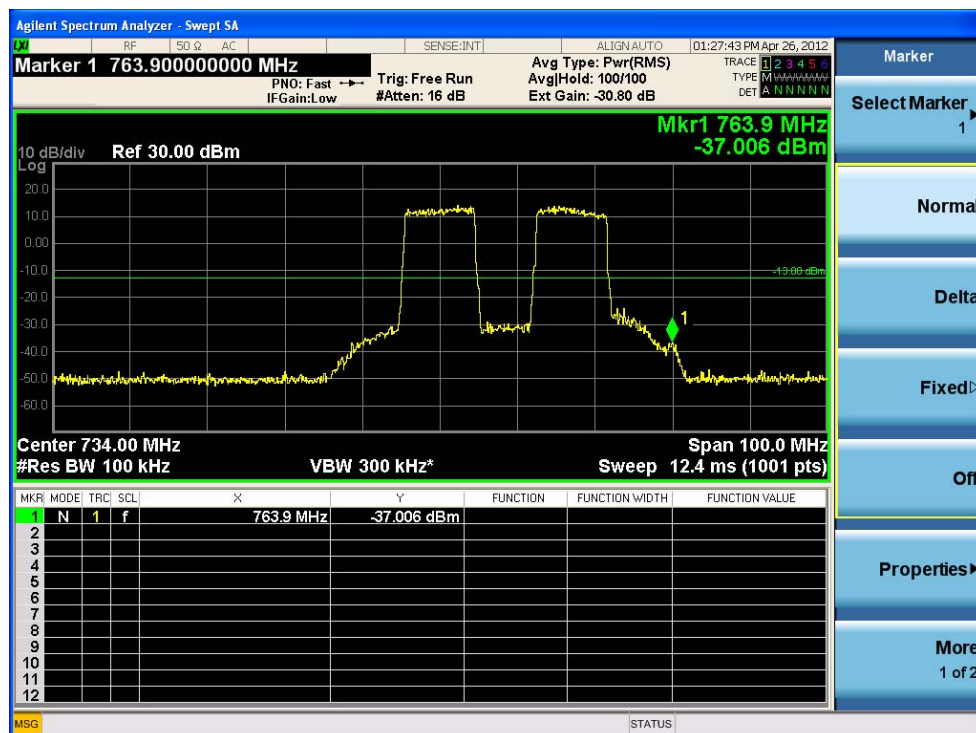


Intermodulation Spurious Emissions

[LTE Downlink B\_5 MHz]



[LTE Downlink C\_10 MHz]





## 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.

**§ 27.53 Emission limit** (c) For operations in the 746–758 MHz band and the 776–788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746–758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB;

(2) On any frequency outside the 776–788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB;

(f) For operations in the 746–763 MHz, 775–793 MHz, and 805–806 MHz bands, emissions in the band 1559–1610 MHz shall be limited to –70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and –80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

**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".

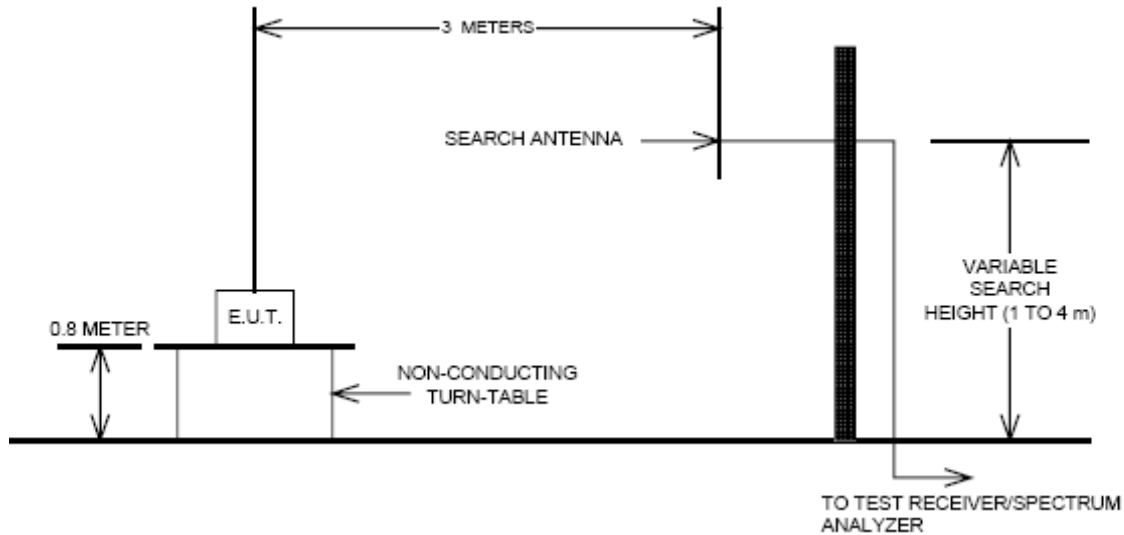
Radiated emission measurements were performed inside a 3 meter semi-anechoic chamber.

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.

**Test Results:**

## Radiated Spurious Emissions Test Setup



### [Downlink]

Frequency (MHz)	Freq.(MHz)	Substitute Level[dBm]	Ant. Gain (dBd)	C.L	Pol.	ERP (dBm)	Margin (dB)
734	1468	-52.5	6.02	4.73	V	-51.21	-38.21
	2202	-51.6	8.04	5.63	V	-49.19	-36.19
751	1502	-51.8	6.28	4.73	V	-50.25	-37.25
	2253	-52.3	8.05	6.07	V	-50.32	-37.32



## 9. FREQUENCY STABILITY OVER TEMPERATURE AND VOLTAGE VARIATIONS

**Test Requirement(s): §2.1055** (a) The frequency stability shall be measured with variation of ambient temperature as follows:

- (1) From  $-30^{\circ}$  to  $+50^{\circ}$  centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

### **RSS-131 6.5 Frequency Stability of Band Translators**

A band translator is essentially a repeater station and should introduce as little frequency error as possible. The frequency stability should therefore meet the objectives of the overall land mobile or cellular service for which it serves. Better frequency stability than the minimum standard cited below will therefore be required in some cases.

The frequency stability shall be within  $\pm 1.5$  parts per million (0.00015%).

### **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.

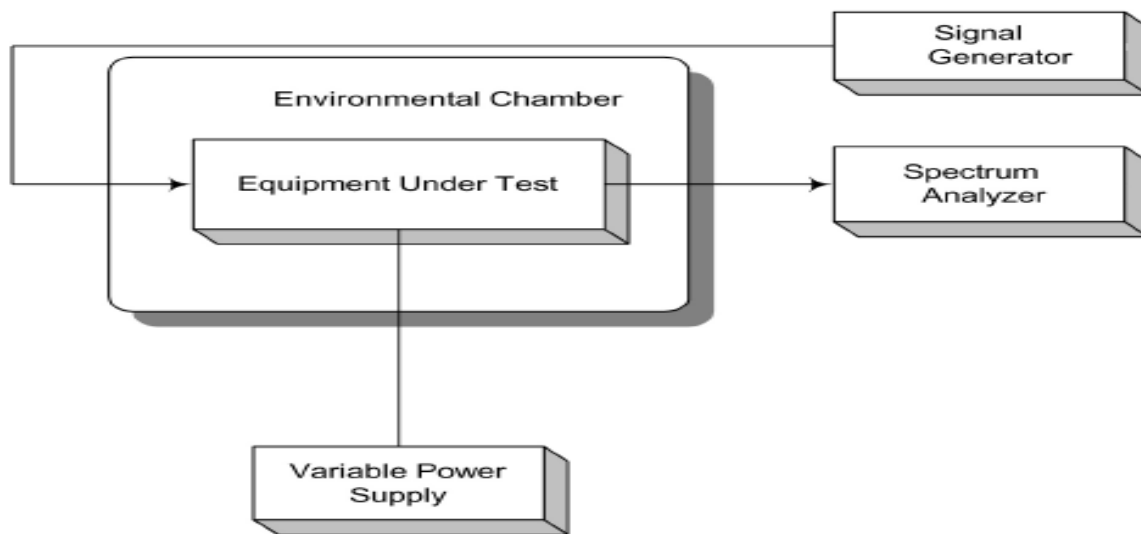
A CW signal was injected into the EUT at the appropriate RF level. The frequency counter option on the Spectrum Analyzer was used to measure frequency deviations.

The frequency drift was investigated for every  $10^{\circ}\text{C}$  increment until the unit is stabilized then recorded the reading in tabular format with the temperature range of  $-30$  to  $50^{\circ}\text{C}$ .

Voltage supplied to EUT is 110 Vac reference temperature was done at  $20^{\circ}\text{C}$ .

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. = 751 MHz**

Voltage (%)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100%	+20(Ref)	750 999 996	-4.3	0.0	0.0000
	-30	750 999 996	-3.6	0.7	0.0009
	-20	750 999 996	-3.7	0.6	0.0008
	-10	750 999 996	-3.6	0.7	0.0009
	0	750 999 997	-3.5	0.8	0.0011
	+10	750 999 996	-3.8	0.5	0.0007
	+30	750 999 997	-3.4	0.9	0.0012
	+40	750 999 996	-3.7	0.6	0.0008
	+50	750 999 996	-3.6	0.7	0.0009
115%	+20	750 999 996	-3.8	0.5	0.0007
85%	+20	750 999 996	-3.8	0.5	0.0007

## 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 <sup>2</sup> )	Averaging time (minutes)
0.3 - 1.34.....	614	1.63	*(100)	30
1.34 - 30.....	824/f	2.19/f	*(180/ f <sup>2</sup> )	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	29.920	dBm
Max Peak output Power at antenna input terminal	981.748	W
Prediction distance	20.000	cm
Prediction frequency	731.0000	MHz
Antenna Gain(typical)	2.000	dBi
Antenna Gain(numeric)	1.585	—
Power density at prediction frequency( S)	0.310	mW/cm <sup>2</sup>
MPE limit for uncontrolled exposure at prediction frequency	0.487	mW/cm <sup>2</sup>

## 3. RESULTS

The power density level at 20 cm is 0.31 mW/cm<sup>2</sup>, which is below the uncontrolled exposure limit of 0.487 mW/cm<sup>2</sup> 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.