HCT. CO., LTD.
CERTIFICATION DIVISION
105-1, JANGAM-RI, MAJANG-MYEON, ICHEON-SI, KYUNGGI-DO, KOREA
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CERTIFICATE OF COMPLIANCE (ERM EVALUATION)

Manufacture: **GS Instruments Co., Ltd.**

1385-14, Juan-Dong, Nam-Ku, Incheon,,402-200 Korea

Date of Issue : May 20, 2011

Test Report No.: HCTR1105FR10

Test Site: HCT CO., LTD.

FCC ID:	**U88-SC-2624AMP**
APPLICANT:	**GS Instruments Co., Ltd.**
EUT Type:	**In-Building RF Repeater**
Model:	**GMS-2624AMP/DFU-SPR**
Frequency Ranges:	**Uplink: 2502 MHz – 2690 MHz** **Downlink: 2502 MHz – 2690 MHz**
RF Output Power:	**Uplink: 24.0 dBm** **Downlink: 24.0 dBm**
FCC Rules Part(s):	**CFR 47, Part 27**

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

CONTENTS

1. CLIENT INFORMATION

The EUT has been tested by request of

Company	GS Instruments Co., Ltd
Contact Point	1385-14, Juan-Dong, Nam-Ku, Incheon,,402-200 Korea

- **FCC ID:** **U88-SC-2624AMP**
- **APPLICANT:** **GS Instruments Co., Ltd.**
- **EUT Type:** **In-Building RF Repeater**
- **Model:** **GMS-2624AMP/DFU-SPR**
- **Frequency Ranges:** **Uplink: 2502 MHz – 2690 MHz**
  Downlink: 2502 MHz – 2690 MHz
- **RF Output Power:** **Uplink: 24.0 dBm**
  Downlink: 24.0 dBm
- **FCC Rules Part(s):** **CFR Title 47 Part 27**
- **Emission Designators:** **G7D (QPSK), D7D (16QAM/64QAM)**
- **Modulation:** **QPSK, 16QAM, 64QAM**

2. TEST SPECIFICATIONS

2.1 Standards

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance With Part 27.

Reference	Description	Results
§2.1046; §27.50	RF Power Output	Compliant
§2.1049	Occupied Bandwidth	Compliant
§2.1051, §27.53	Band Edge Measurement	Compliant
§2.1053, §27.53	Spurious Emissions at Antenna Terminals	Compliant
§2.1055, §27.54	Frequency Stability	Compliant

3. STANDARDS ENVIRONMENTAL TEST CONDITIONS

Temperature :	**+ 15 ℃ to + 35 ℃**
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	11/11/2011	MY42082646
Agilent	E4416A /Power Meter	Annual	01/04/2012	GB41291412
Agilent	E9327A/ Power Sensor	Annual	07/23/2011	MY4442009
Korea Eng	KR-1005L/ Temperature and Humidity Chamber	Annual	12/28/2011	KRAC05063-3CH
Agilent	N9020A /Signal Analyzer	Annual	03/03/2012	US46220219
WEINSCHEL	67-30-33/ATTENUATOR	Annual	12/29/2011	BR0530
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	05/20/2011	990893
Schwarzbeck	BBHA 9120D/ Horn Antenna	Biennial	04/13/2012	147
Schwarzbeck	BBHA 9120D/ Horn Antenna	Biennial	09/23/2011	296
Schwarzbeck	VULB 9168/TRILOG Antenna	Biennial	02/09/2013	9168-200
Schwarzbeck	VULB 9160/TRILOG Antenna	Biennial	07/15/2012	9160-3150

5. RF OUTPUT POWER

5.1 Test Procedure

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.

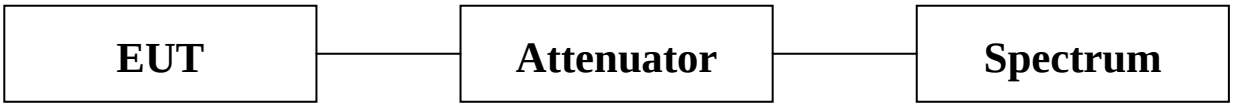
§ 2.1046 (b) For single sideband, independent sideband, and single channel, controlled carrier radiotelephone transmitters, the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and as applicable in § 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. (1) *Main, booster and base stations.* (i) The maximum EIRP of a main, booster or base station shall not exceed 33 dBW + 10log(X/Y) dBW, where X is the actual channel width in MHz and Y is either 6 MHz if prior to transition or the station is in the MBS following transition or 5.5 MHz if the station is in the LBS and UBS following transition, except as provided in paragraph (h)(1)(ii) of this section.

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

InPut Signal

	Modulation	Level (dBm)
WiMax	64QAM	-30.9

5.2 Test Results

(Downlink)

DownLink		
Carrier Channel	**Frequency (MHz)**	**Measured Average Output Power dBm (mW)**
Low	2508.5	23.93(247.1724)
Mid	2640.5	23.98(250.0345)
High	2683.5	23.96(248.8857)

(Uplink)

UpLink		
Carrier Channel	**Frequency (MHz)**	**Measured Average Output Power dBm (mW)**
Low	2508.5	24.03(252.9298)
Mid	2640.5	24.01(251.7677)
High	2683.5	24.05(254.0973)

Plots of RF Output Power

Downlink Low CH

Downlink Middle CH

Downlink High CH

Uplink Low CH

Uplink Middle CH

Uplink High CH

6. OCCUPIED BANDWIDTH

6.1 Test Procedure

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.

InPut Signal

	Modulation	Level (dBm)
WiMax	64QAM	-30.9

(Downlink) - Output

DownLink		
Carrier Channel	**Frequency (MHz)**	**Bandwidth(MHz)**
Low	2508.5	9.494
Mid	2640.5	9.452
High	2683.5	9.450

(Downlink) - Input

DownLink		
Carrier Channel	**Frequency (MHz)**	**Bandwidth(MHz)**
Low	2508.5	9.459
Mid	2640.5	9.460
High	2683.5	9.461

(Uplink) - Output

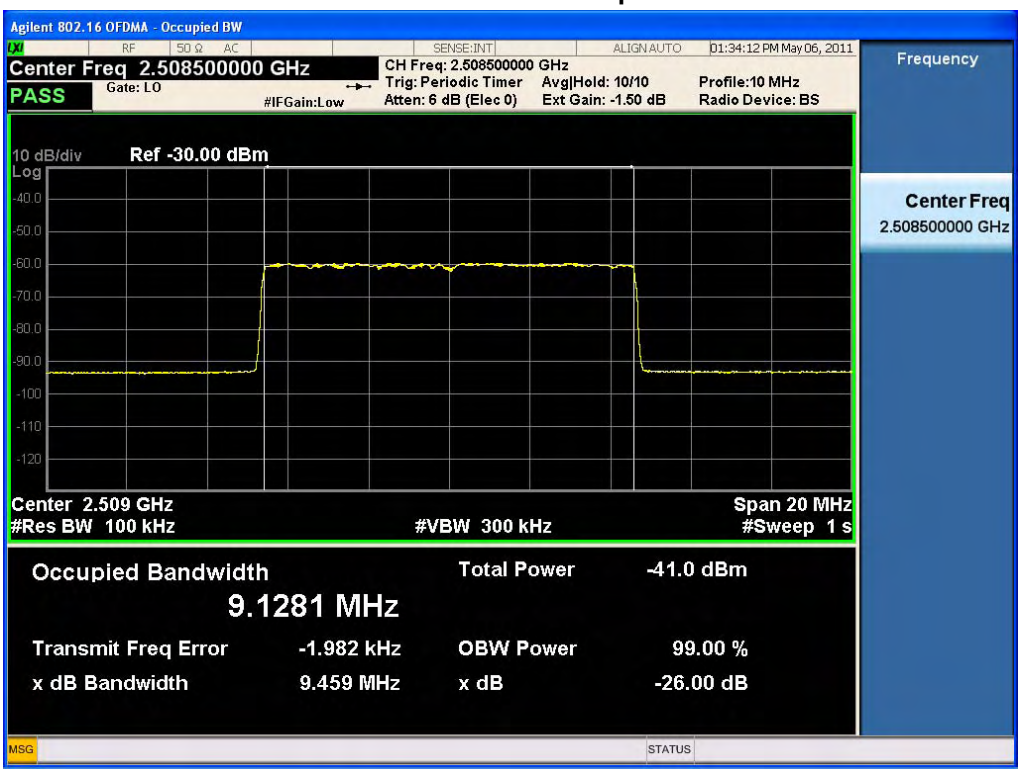
UpLink		
Carrier Channel	**Frequency (MHz)**	**Bandwidth(MHz)**
Low	2508.5	9.439
Mid	2640.5	9.451
High	2683.5	9.469

(Uplink) - Input

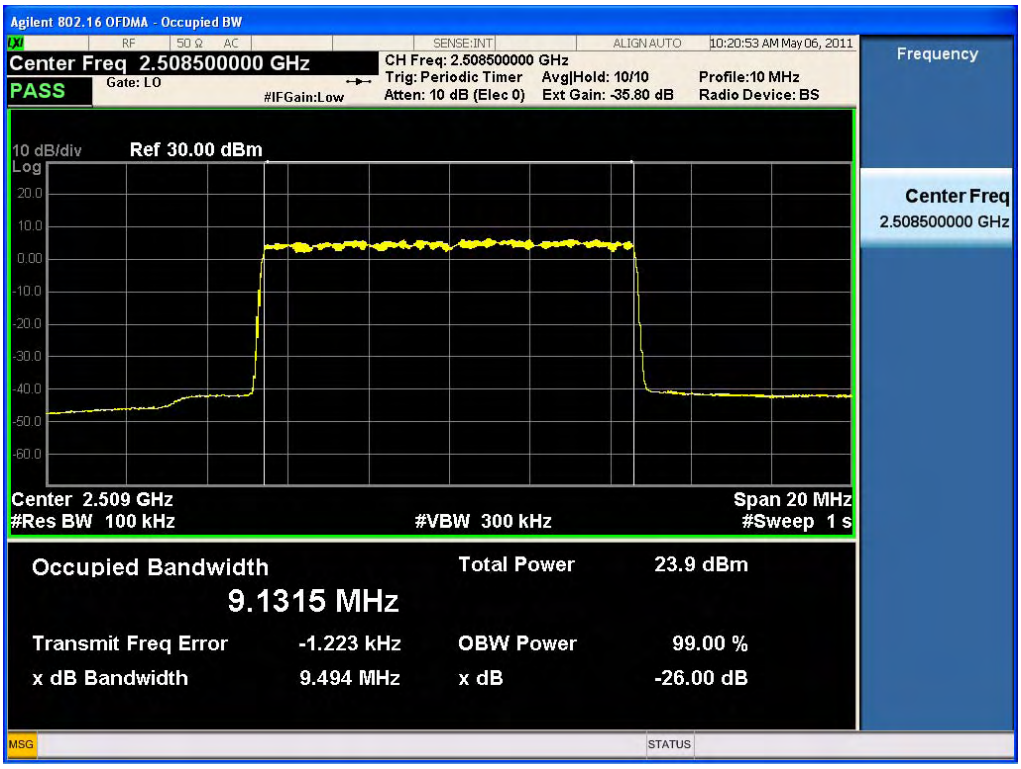
UpLink		
Carrier Channel	**Frequency (MHz)**	**Bandwidth(MHz)**
Low	2508.5	9.457
Mid	2640.5	9.459
High	2683.5	9.460

Plots of Occupied Bandwidth

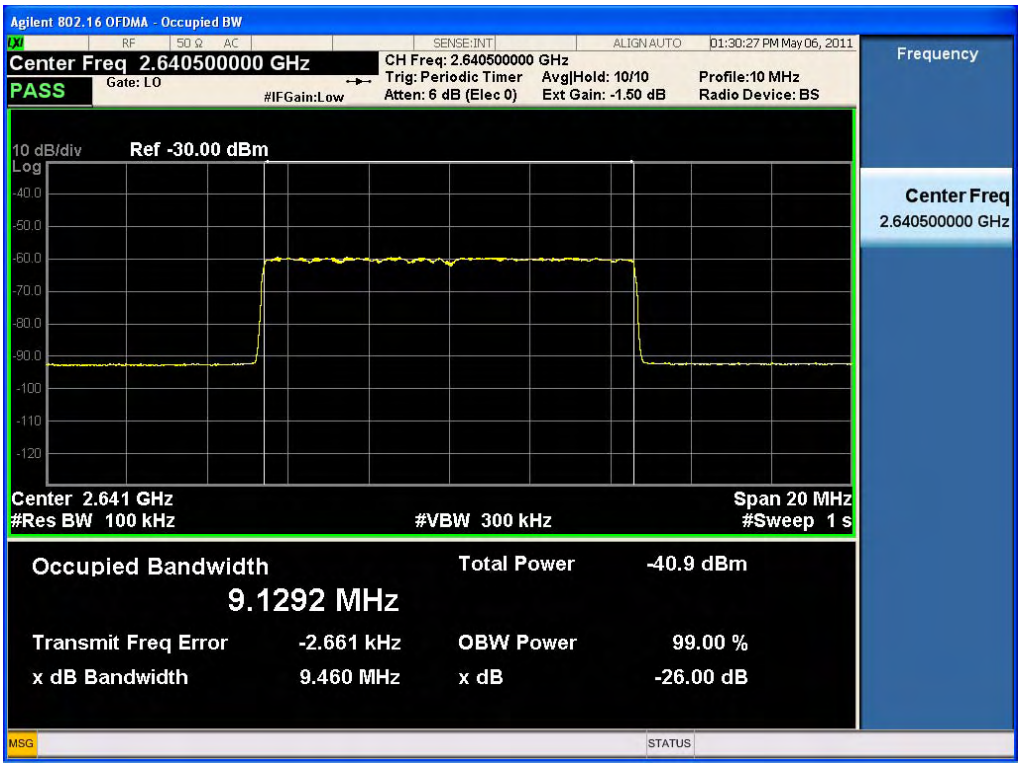
Downlink Low CH Input



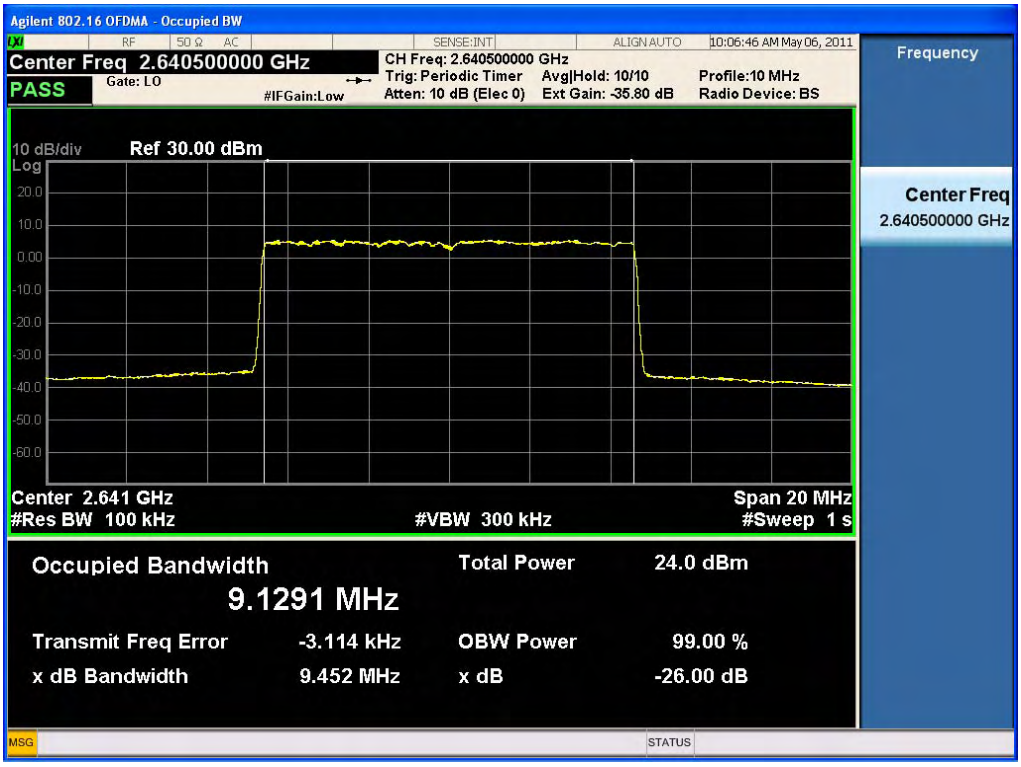
Downlink Low CH Ouput



Downlink Middle CH Input

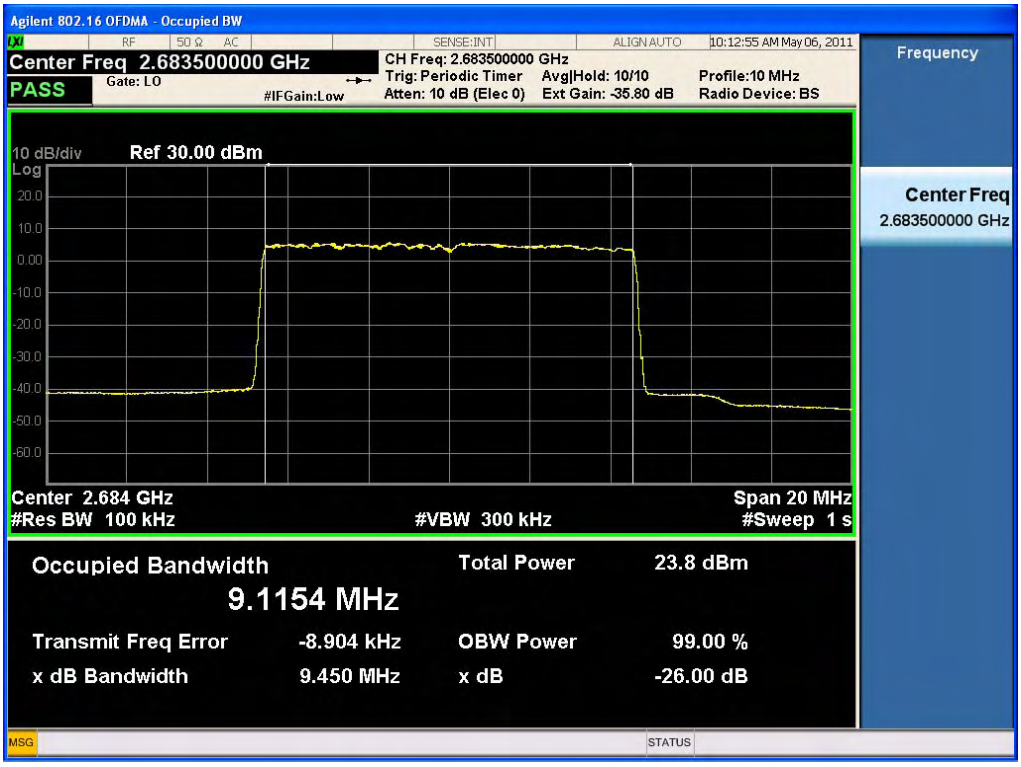


Downlink Middle CH Ouput

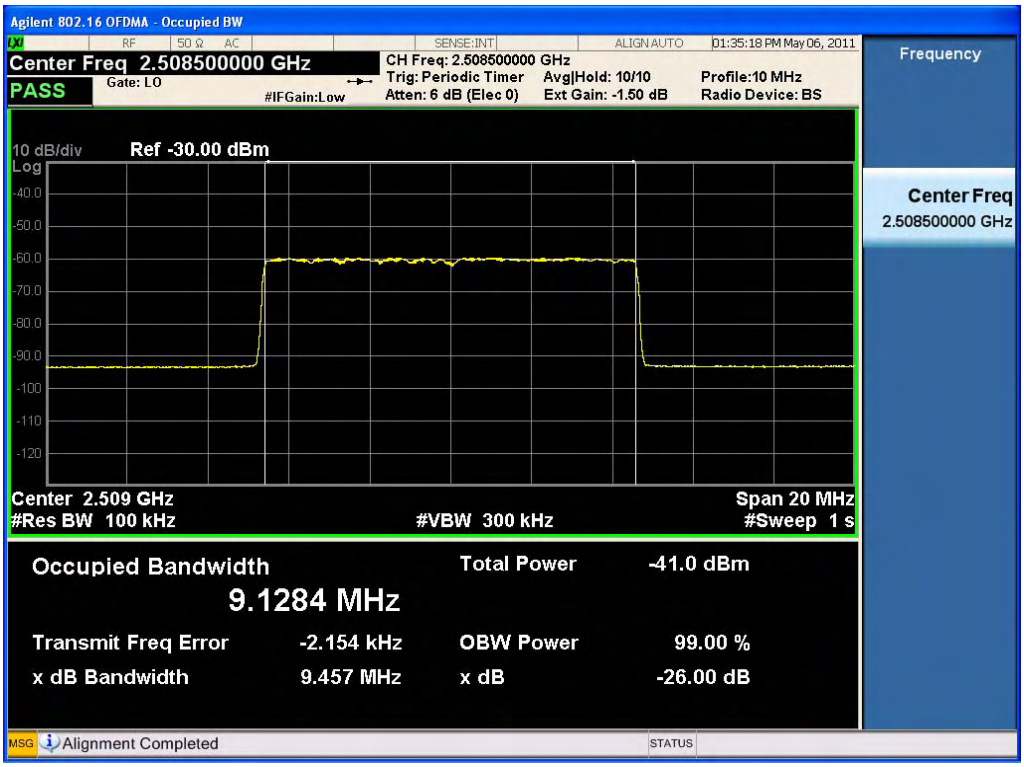


Downlink High CH Input

Downlink High CH Output

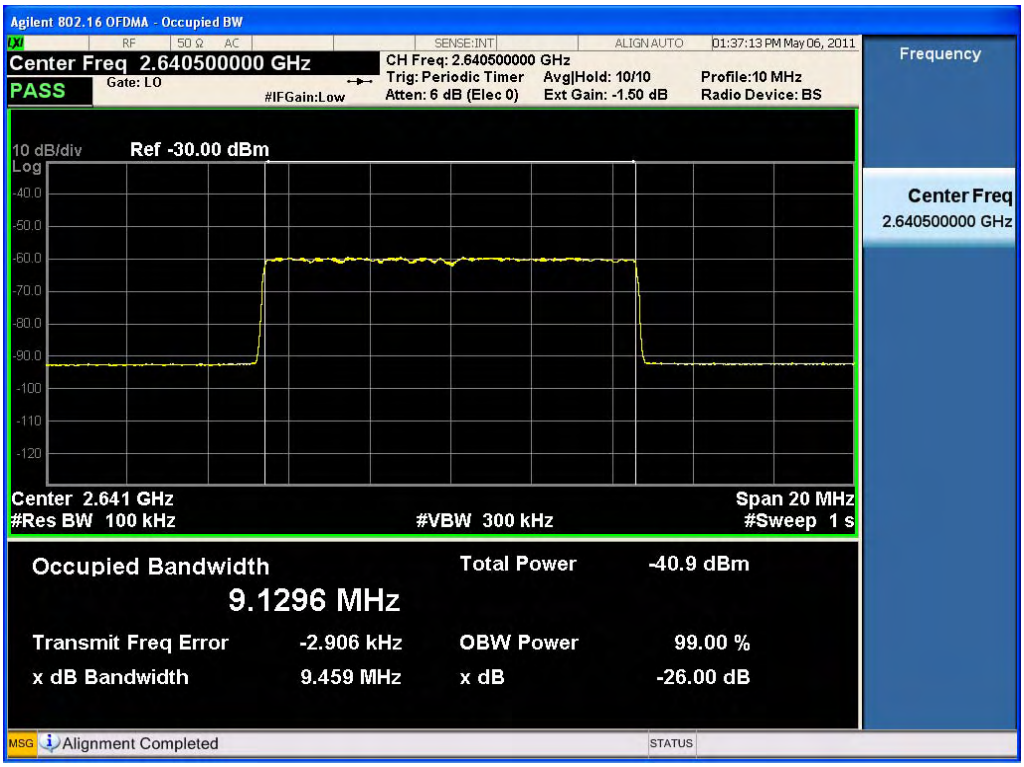


Uplink Low CH Input



Uplink Low CH Output

Uplink Middle CH Input



Uplink Middle CH Output

Uplink High CH Input

Uplink High CH Output

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

(2) For fixed and temporary fixed digital stations, the attenuation shall be not less than 43 + 10 log (P) dB, unless a documented interference complaint is received from an adjacent channel licensee.

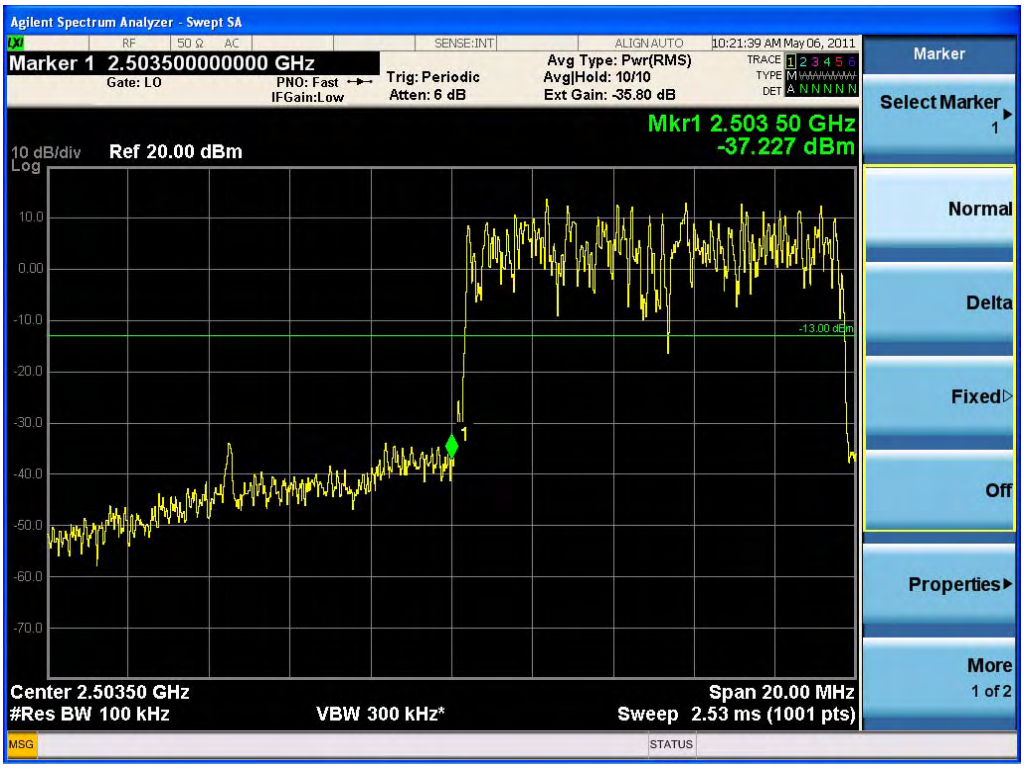
Test Procedures: A modulated carrier generated by the signal generator carrier was connected to either the Uplink

or Downlink RF port at a maximum level as determined by the OEM A 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.

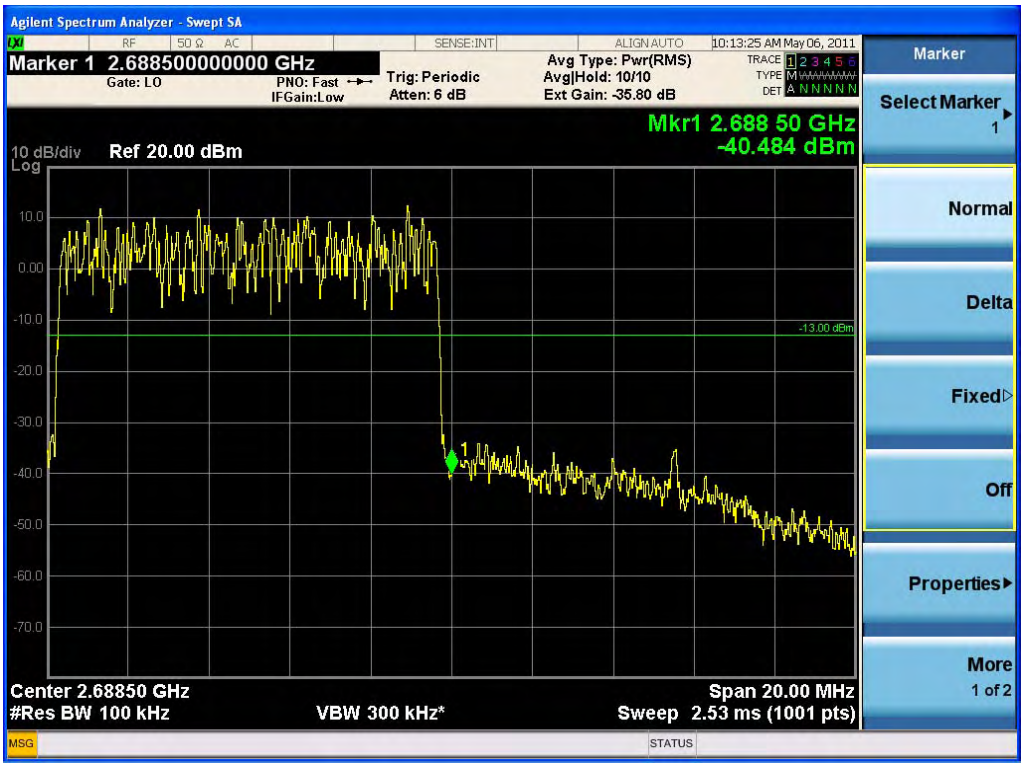
Test Results: The EUT complies with the requirements of this section. There were no detectable spurious emissions for this EUT.

Plots of BAND EDGE

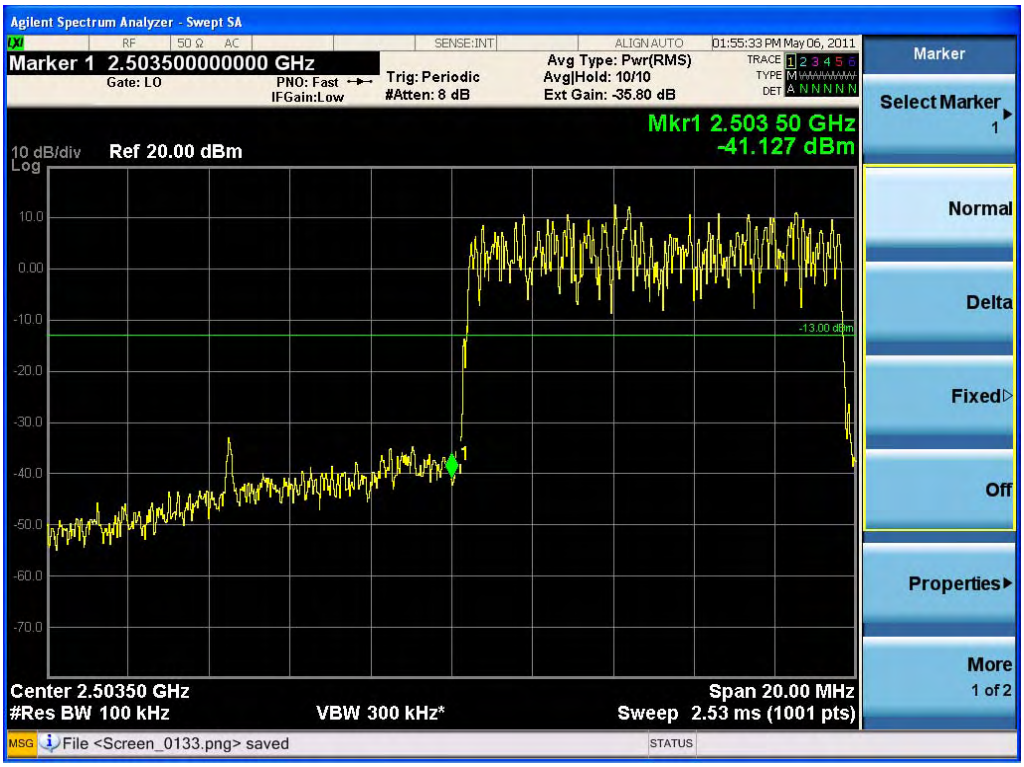
(Downlink Low CH)



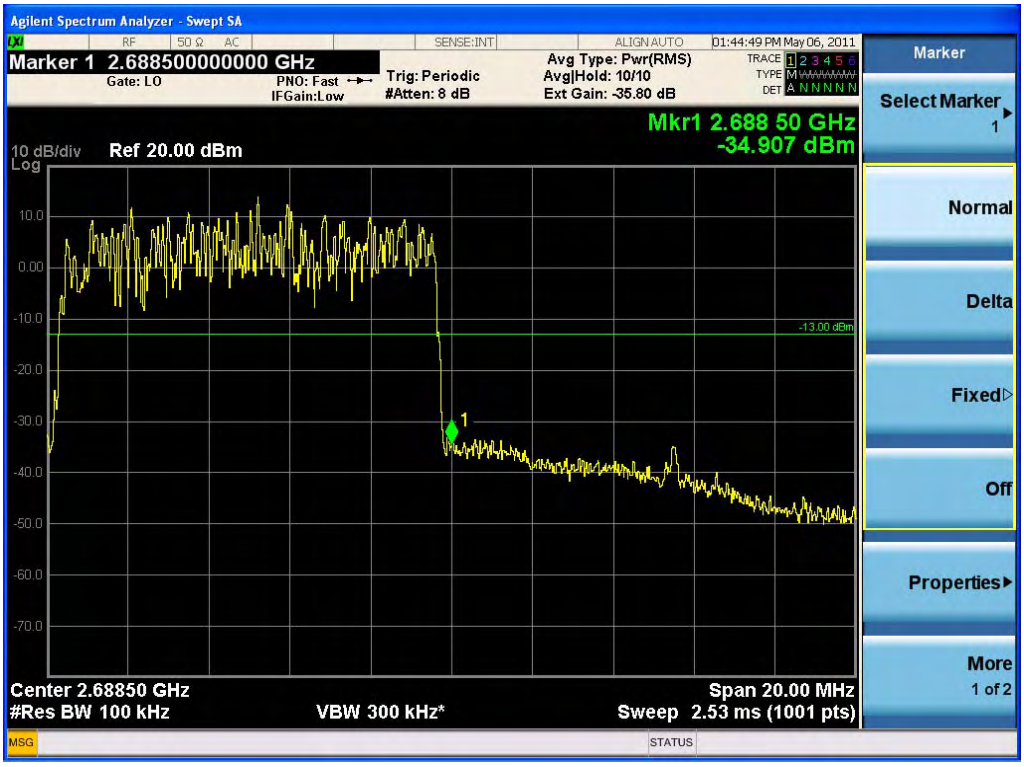
(Downlink High CH)



(Uplink Low CH)

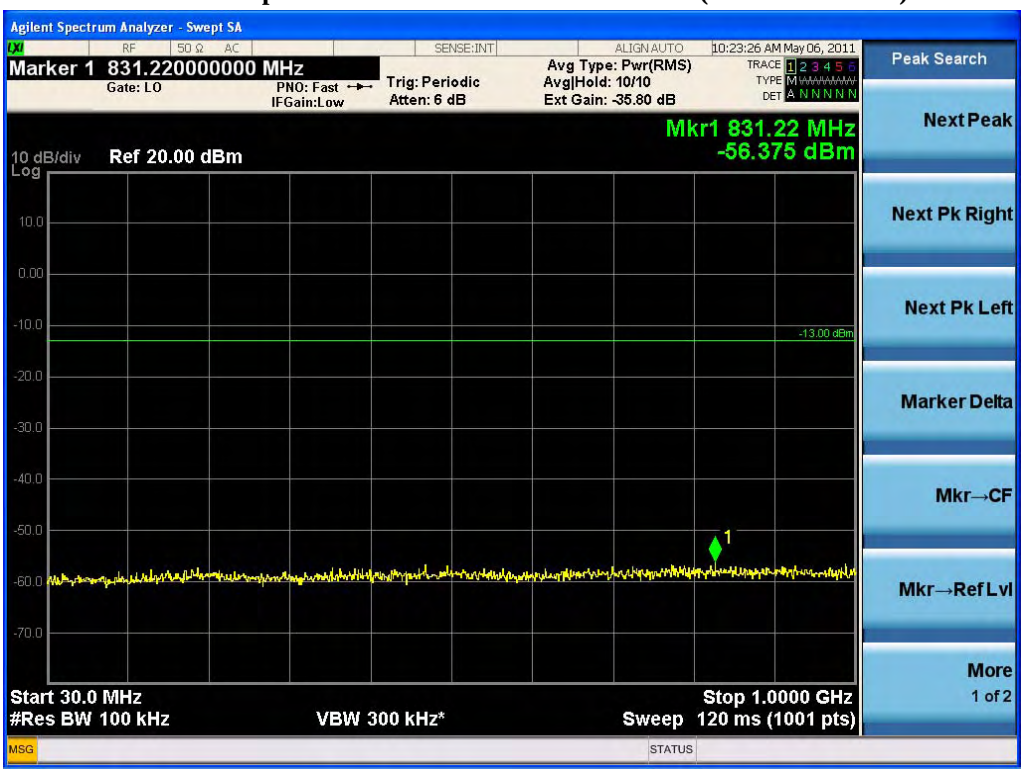


(Uplink High CH)

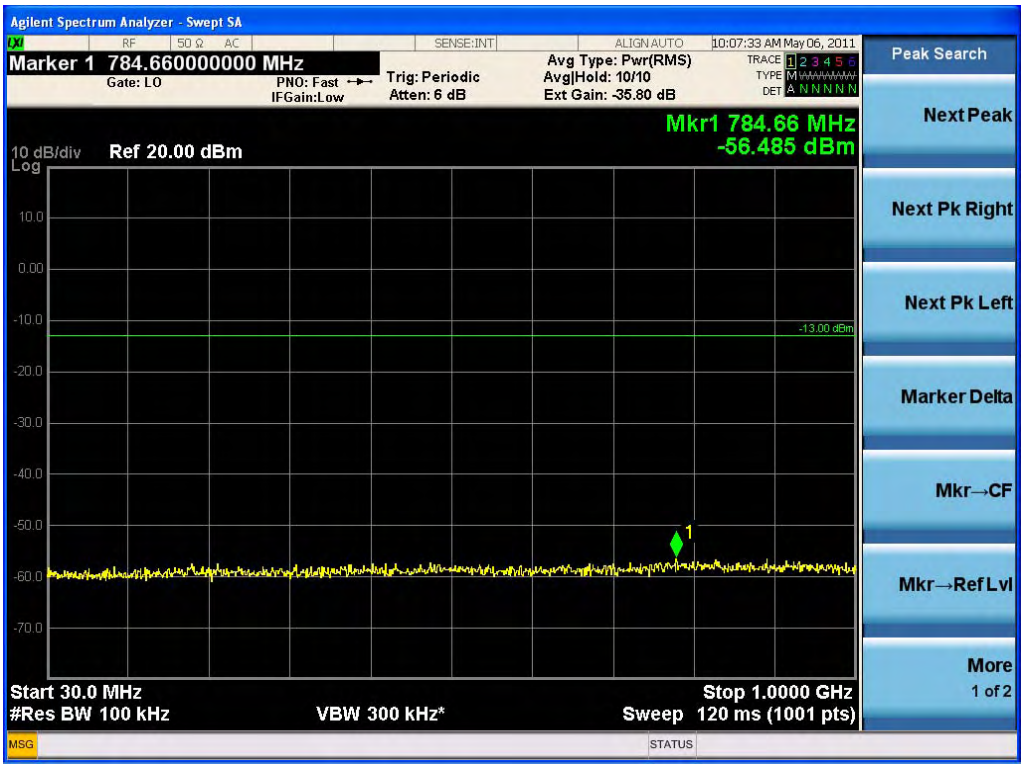


Plots of Spurious Emission

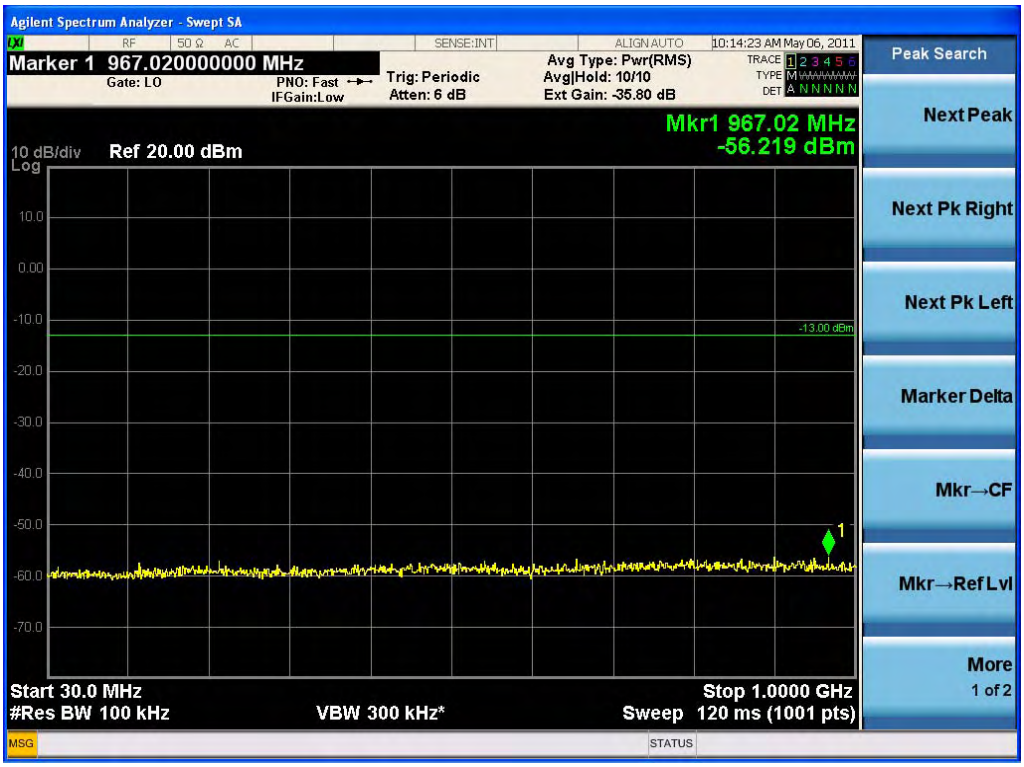
Conducted Spurious Emissions Downlink Low CH (30 MHz – 1 GHz)



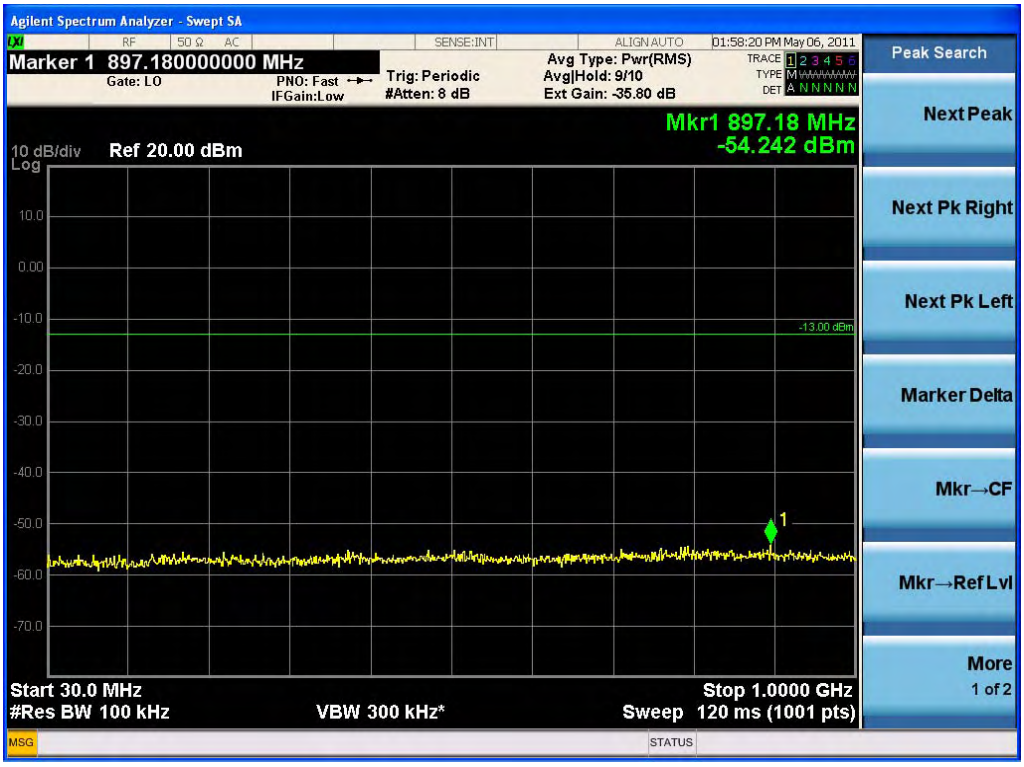
Conducted Spurious Emissions Downlink Mid CH (30 MHz – 1 GHz)



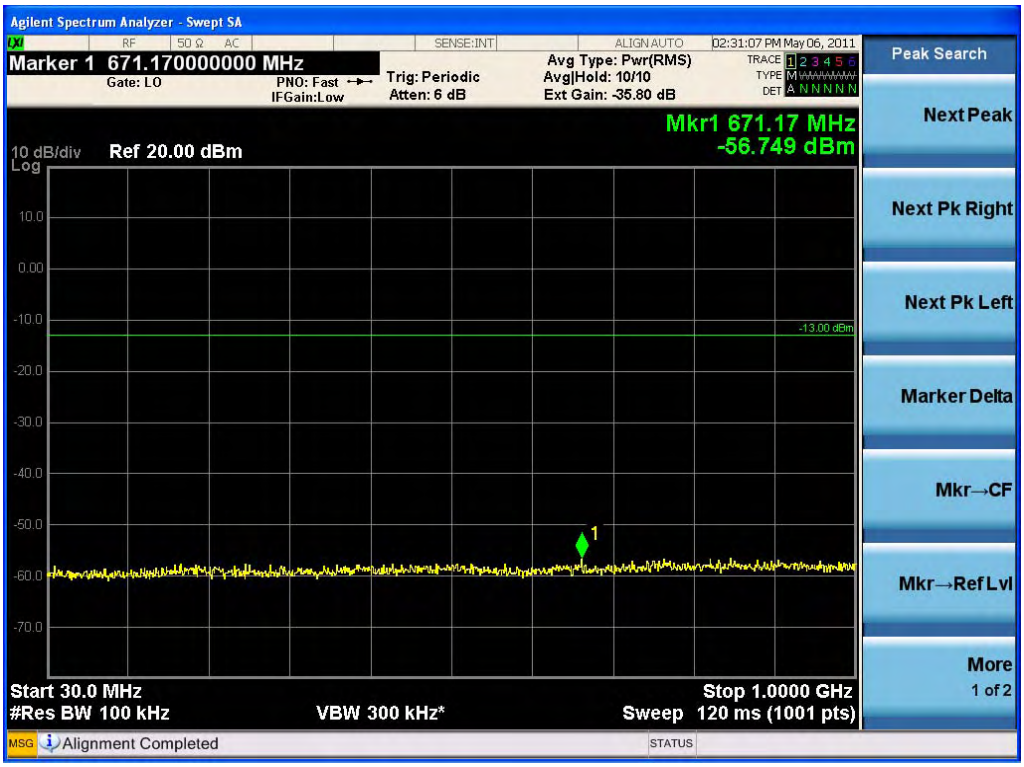
Conducted Spurious Emissions Downlink High CH (30 MHz – 1 GHz)



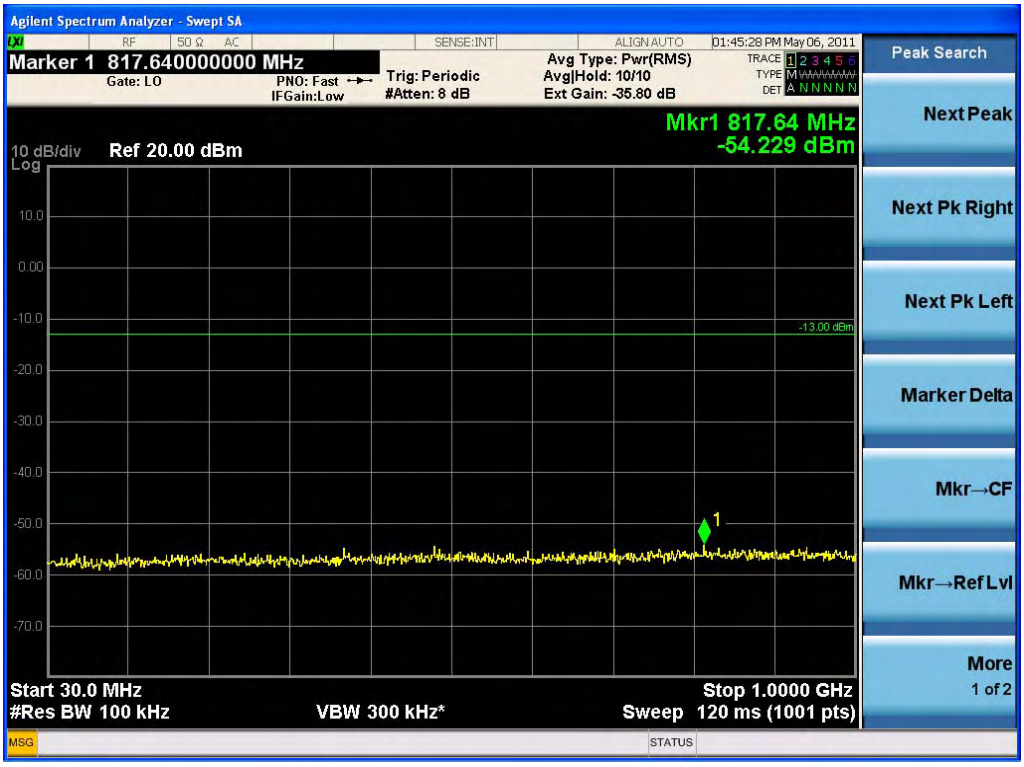
Conducted Spurious Emissions Uplink Low CH (30 MHz – 1 GHz)



Conducted Spurious Emissions Uplink Mid CH (30 MHz – 1 GHz)



Conducted Spurious Emissions Uplink High CH (30 MHz – 1 GHz)



Conducted Spurious Emissions Downlink Low CH (1 GHz – 26.5 GHz)

Conducted Spurious Emissions Downlink Mid CH (1 GHz – 26.5 GHz)

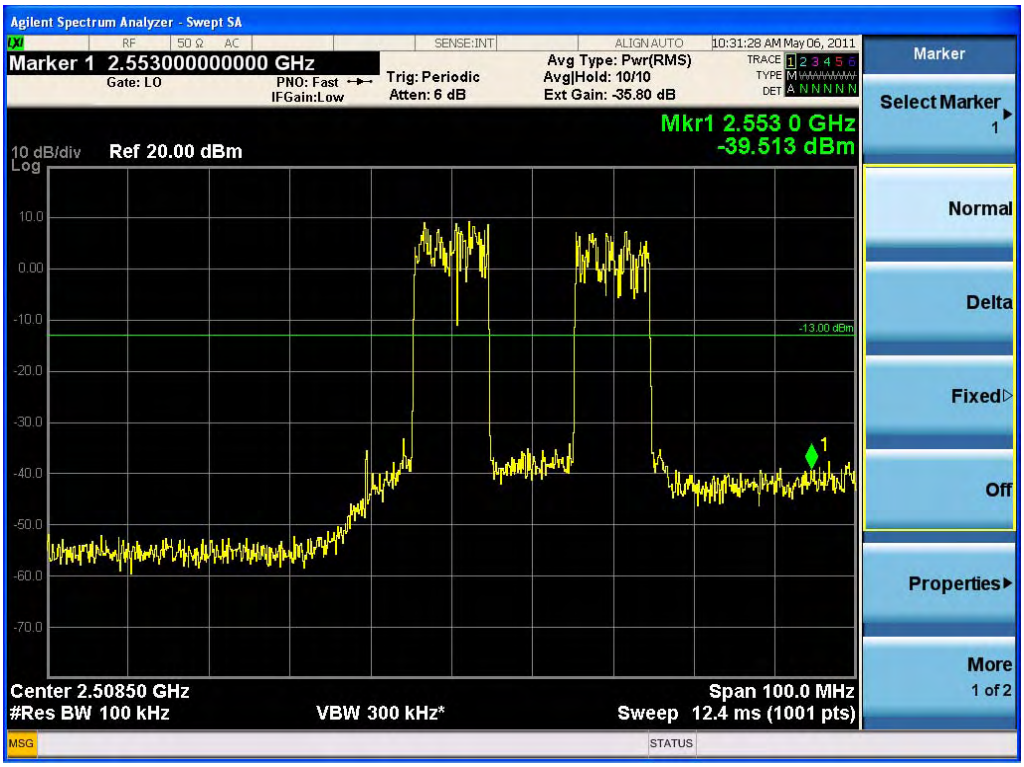
Conducted Spurious Emissions Downlink High CH (1 GHz – 26.5 GHz)

Conducted Spurious Emissions Uplink Low CH (1 GHz – 26.5 GHz)

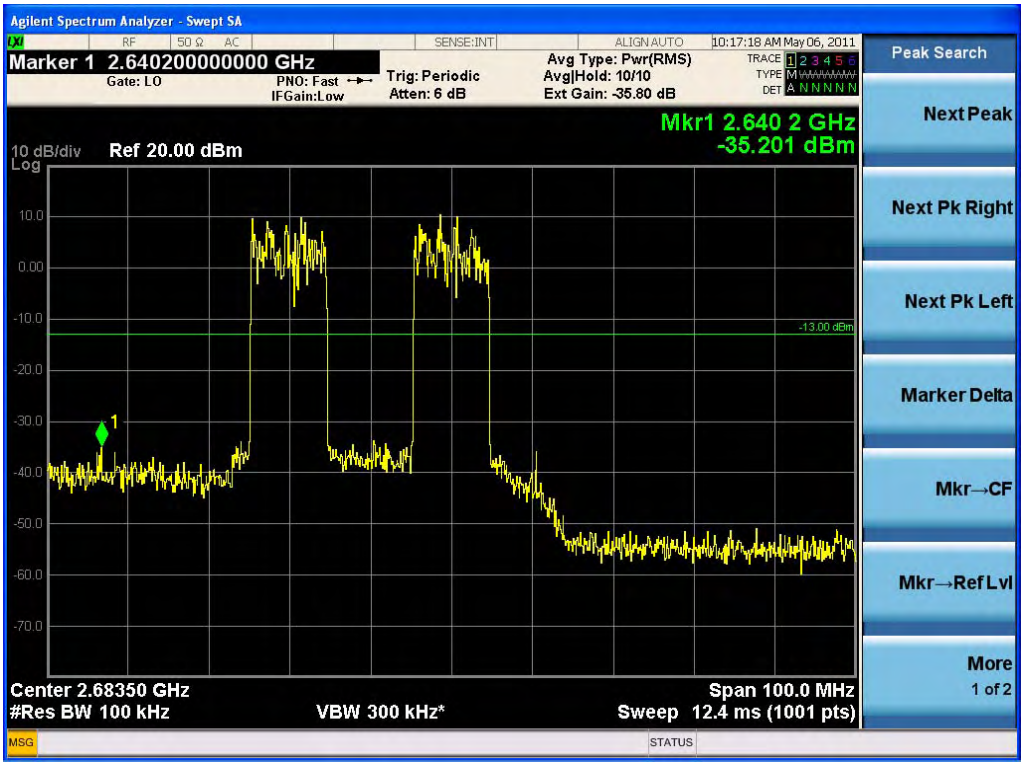
Conducted Spurious Emissions Uplink Mid CH (1 GHz – 26.5 GHz)

Conducted Spurious Emissions Uplink High CH (1 GHz – 26.5 GHz)

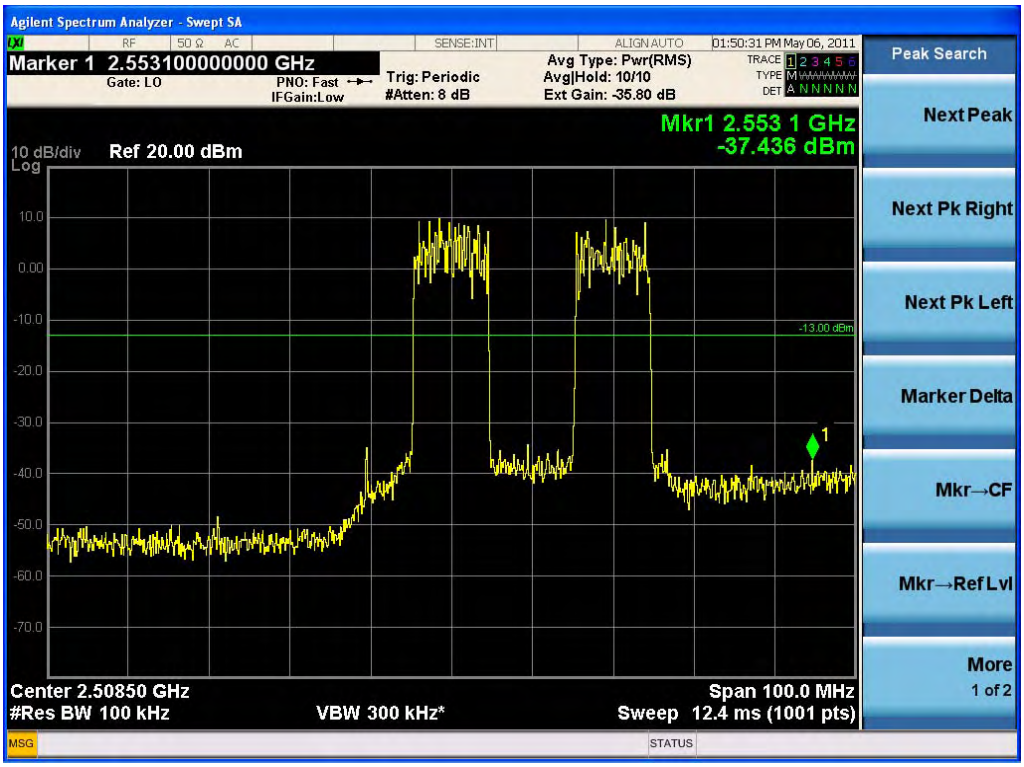
Intermodulation Spurious Emissions Downlink Low CH



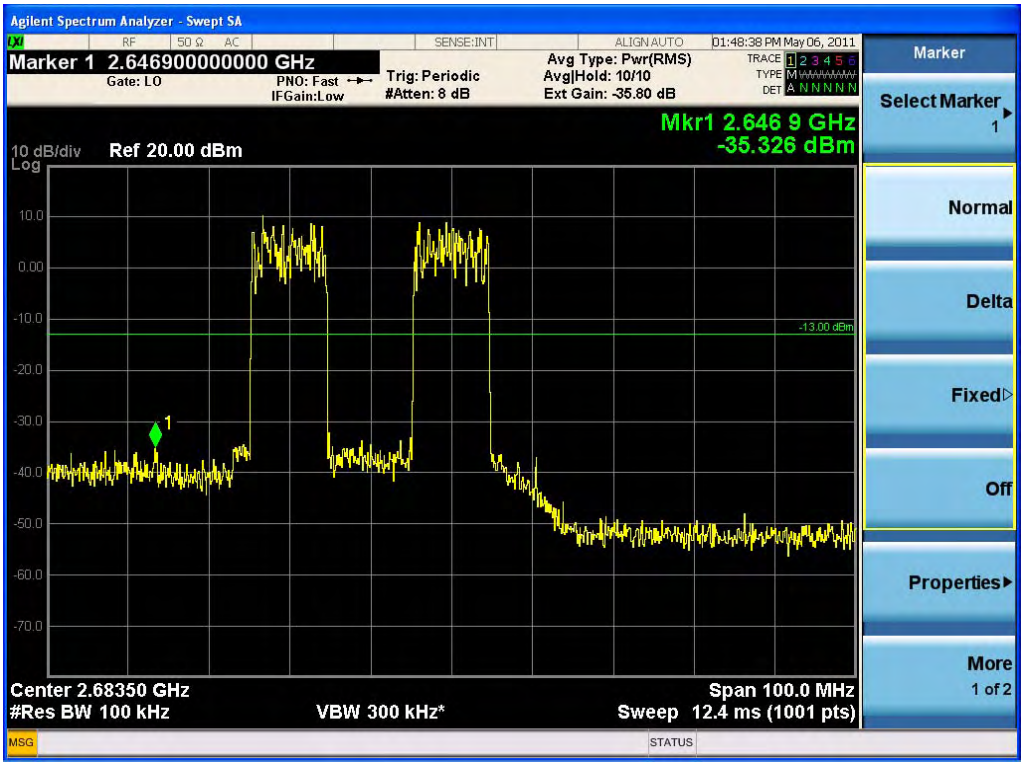
Intermodulation Spurious Emissions Downlink High CH



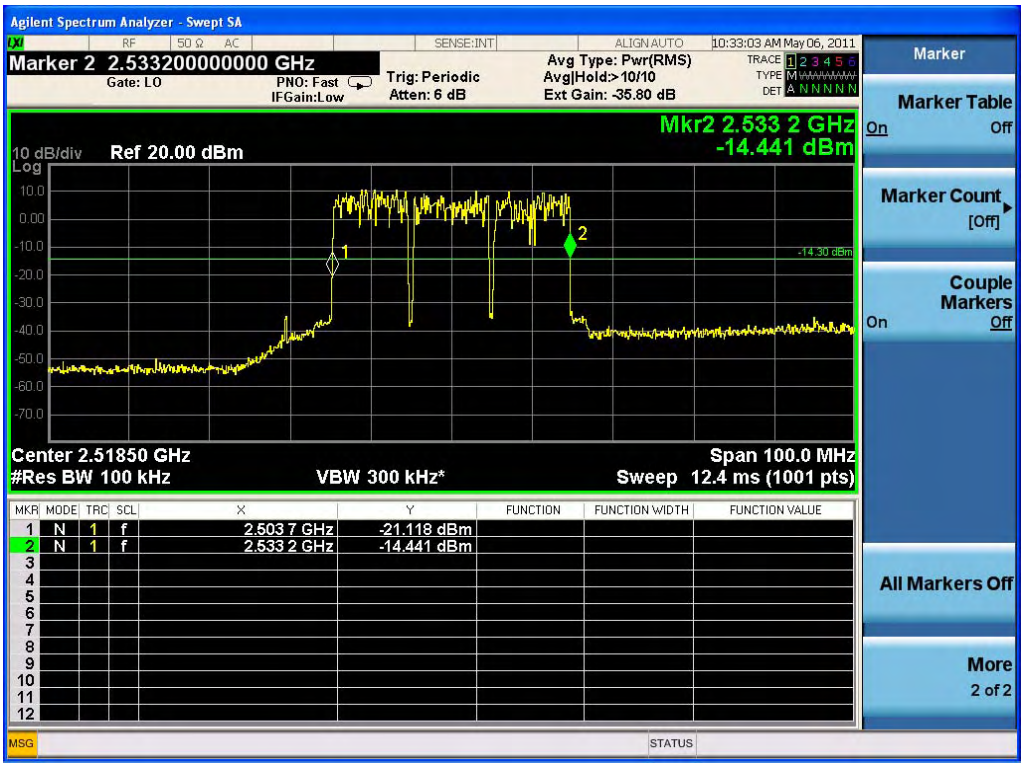
Intermodulation Spurious Emissions Uplink Low CH



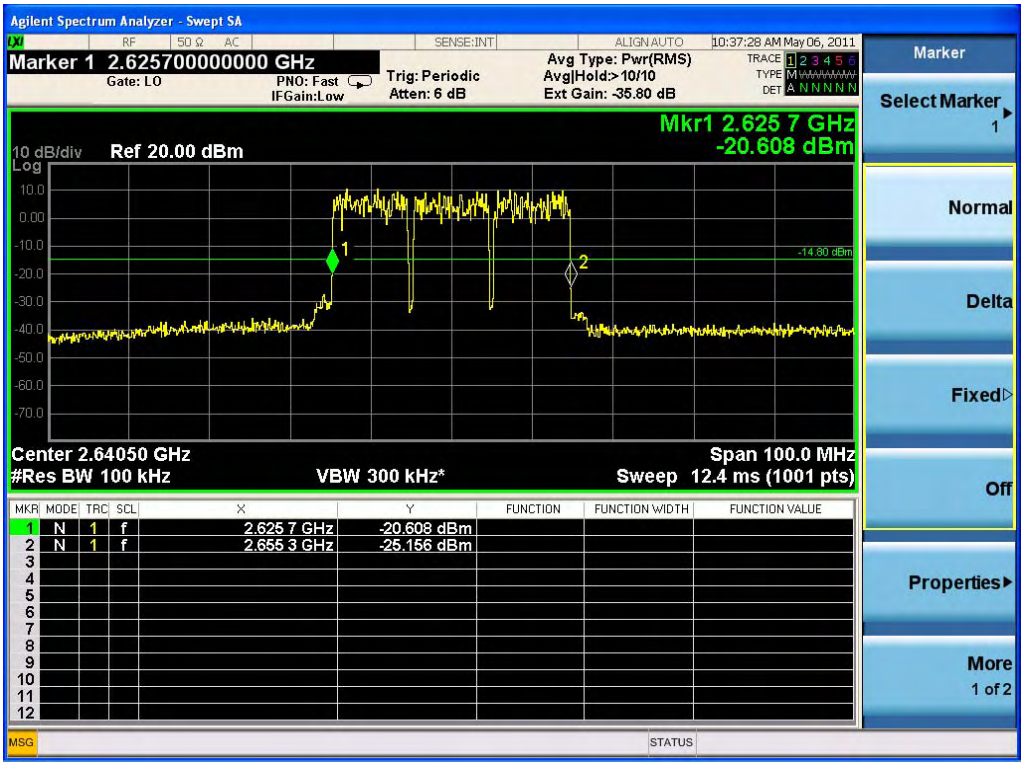
Intermodulation Spurious Emissions Uplink High CH



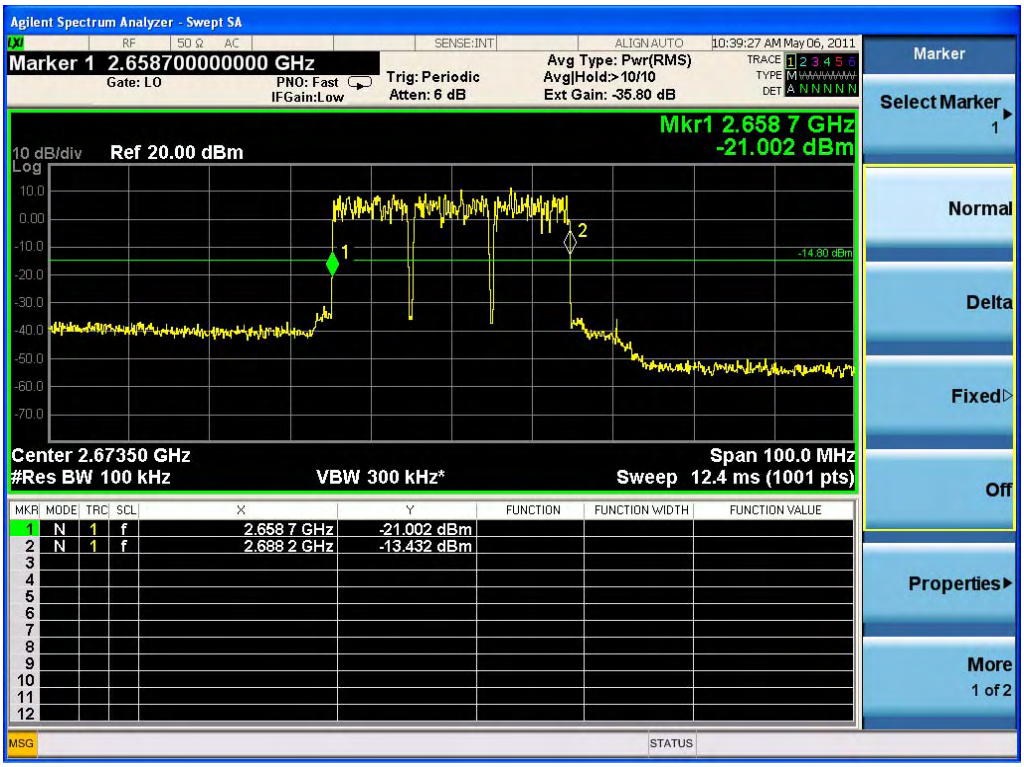
Out of Band Rejection Downlink Low CH



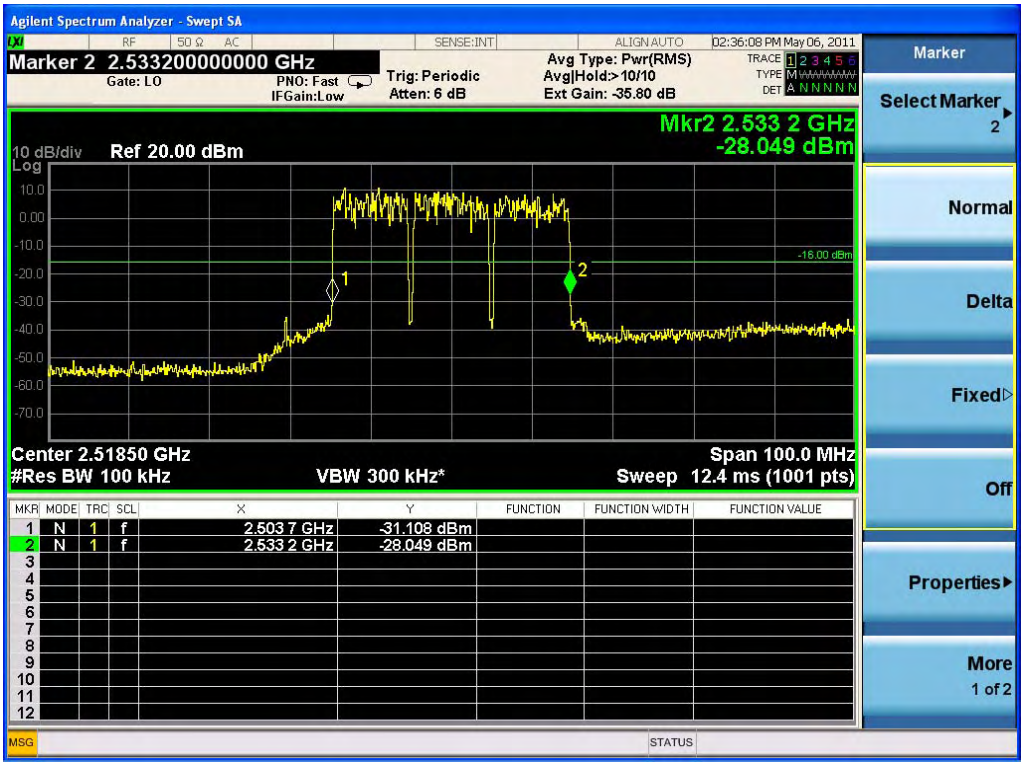
Out of Band Rejection Downlink Middle CH



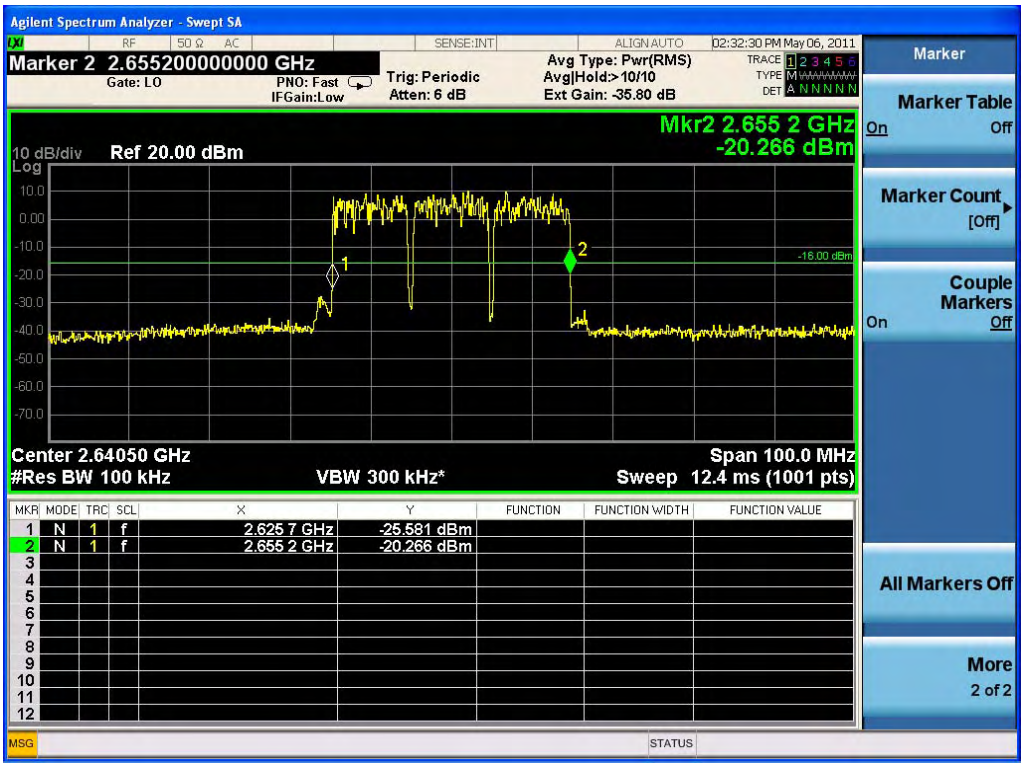
Out of Band Rejection Downlink High CH



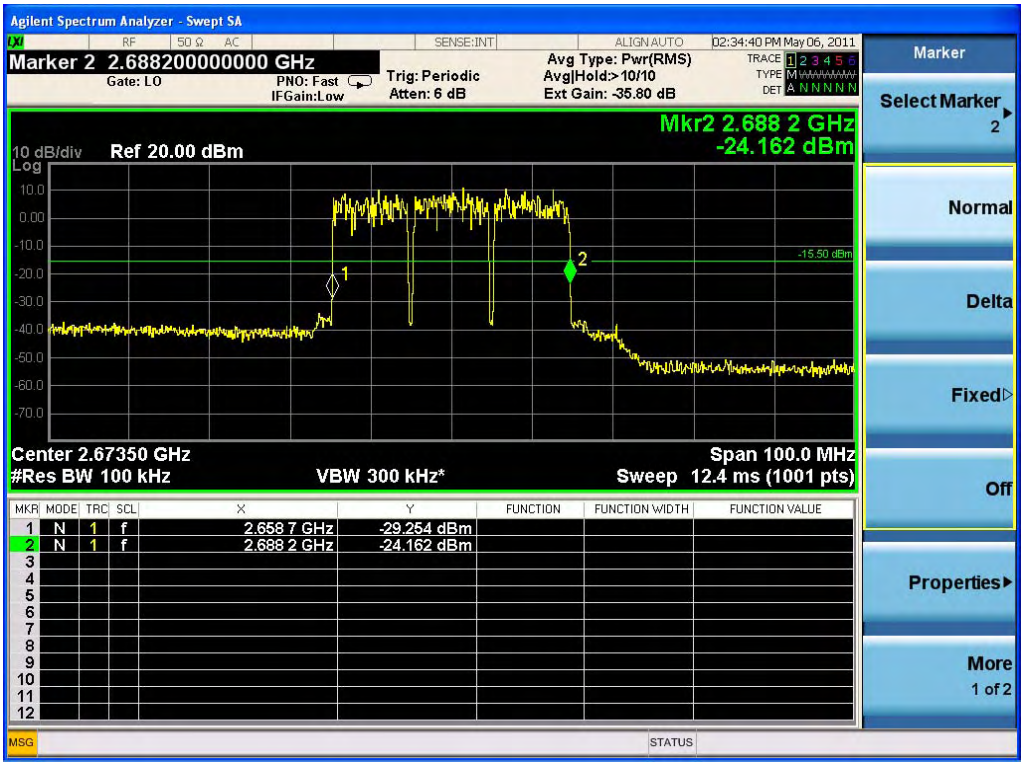
Out of Band Rejection Uplink Low CH



Out of Band Rejection Uplink Middle CH



Out of Band Rejection Uplink High CH



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

For fixed and temporary fixed digital stations, the attenuation shall be not less than 43 + 10 log (P) dB, unless a documented interference complaint is received from an adjacent channel licensee.

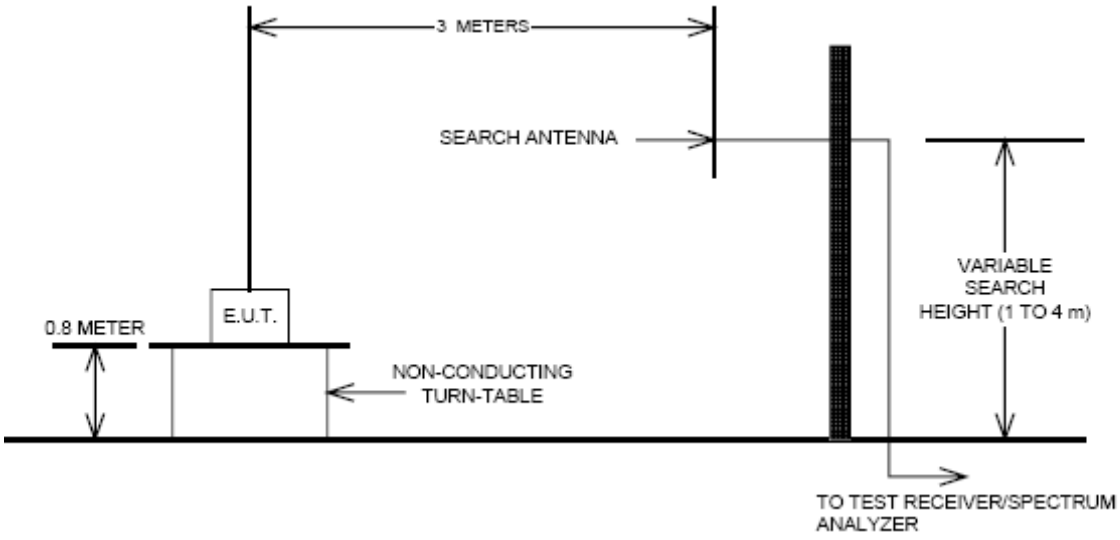
Test Procedures: As required by 47 CFR 2.1053, *field strength of radiated spurious measurements* were made in accordance with the procedures of TIA/EIA-603-A-2001 "Land Mobile FM or PM Communications Equipment Measurement and Performance Standards".

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: There were no emissions detected above the noise floor which was at least 20 dB below the limit.

Radiated Spurious Emissions Test Setup



Mode	Frequency	Freq.(MHz)	Substitute Level [dBm]	Ant. Gain (dBd)	C.L	Pol.	ERP (dBm)	Margin (dB)
DOWN-LINK	2640.5	5281.0	-59.90	12.55	4.33	V	-51.68	-38.68
		7921.5	-57.70	11.44	5.77	V	-52.03	-39.03
UPLINK	2640.5	5281.0	-59.60	12.55	4.33	V	-51.38	-38.38
		7921.5	-58.20	11.44	5.77	V	-52.53	-39.53

9. FREQUENCY STABILITY OVER TEMPERATURE AND VOLTAGE VARIATIONS

Test Requirement(s):

§2.1055(a)(1)

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.

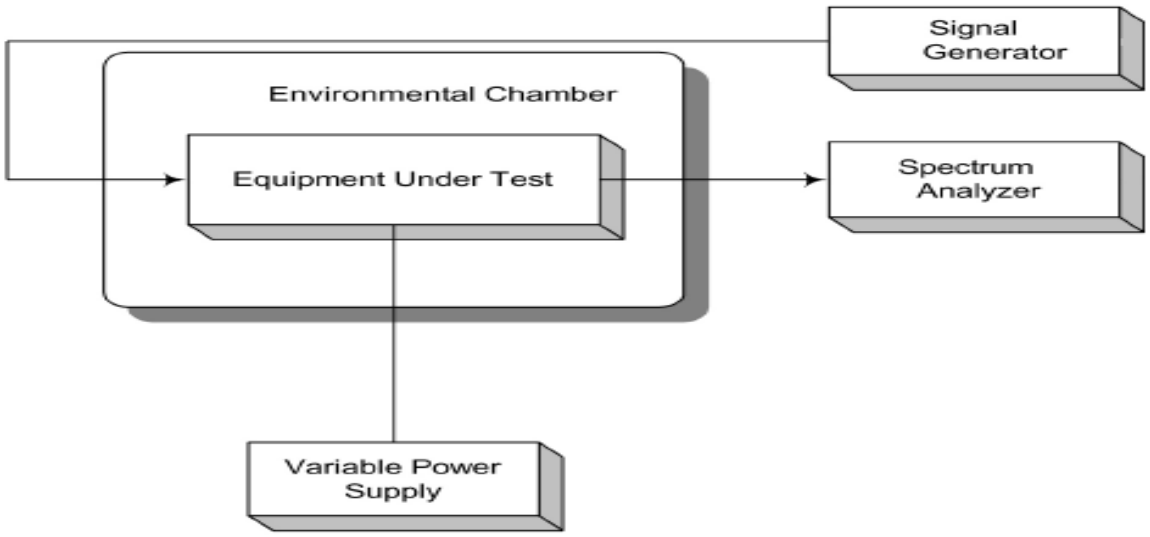
The frequency drift was investigated for every 10 ℃ increment until the unit is stabilized then recorded the reading in tabular format with the temperature range of -30 to 50 ℃.

Voltage supplied to EUT is 120 Vac reference temperature was done at 20℃. The voltage was varied by ± 15 % of nominal

Test Results:

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

Test Setup:



Frequency Stability and Voltage Test Results

Reference: 120 Vac at 20°C **Freq.** = 2640.5 MHz

Voltage (%)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100%	+20(Ref)	2640 500 000	0	0	0.0000
	-30	2640 499 998	-2	-2	-0.0008
	-20	2640 500 001	1	1	0.0004
	-10	2640 500 003	3	3	0.0011
	0	2640 500 002	2	2	0.0008
	+10	2640 499 999	-1	-1	-0.0004
	+30	2640 499 998	-2	-2	-0.0008
	+40	2640 500 001	1	1	0.0004
	+50	2640 499 998	-2	-2	-0.0008
115%	+20	2640 499 998	-2	-2	-0.0008
85%	+20	2640 499 999	-1	-1	-0.0004

Uplink Mid CH

Reference: 120 Vac at 20°C **Freq.** = 2640.5 MHz

Voltage (%)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100%	+20(Ref)	2640 499 998	-2	0	0.0000
	-30	2640 499 999	-1	1	0.0004
	-20	2640 500 002	2	4	0.0015
	-10	2640 499 998	-2	0	0.0000
	0	2640 499 999	-1	1	0.0004
	+10	2640 500 002	2	4	0.0015
	+30	2640 499 999	-1	1	0.0004
	+40	2640 499 998	-2	0	0.0000
	+50	2640 499 998	-2	0	0.0000
115%	+20	2640 499 999	-1	1	0.0004
85%	+20	2640 499 999	-1	1	0.0004

Downlink Mid CH

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. WiMax Downlink

Max Peak output Power at antenna input terminal	23.97000	dBm
Max Peak output Power at antenna input terminal	249.45947	mW
Prediction distance	20.00000	cm
Prediction frequency	2508.50000	MHz
Antenna Gain(typical)	12.00000	dBi
Antenna Gain(numeric)	15.84893	-
Power density at prediction frequency (S)	0.78656	mW/cm^2
MPE limit for uncontrolled exposure at prediction frequency	1.00000	mW/cm^2

2-2. WiMax Uplink

Max Peak output Power at antenna input terminal	24.03000	dBm
Max Peak output Power at antenna input terminal	252.92980	mW
Prediction distance	20.00000	cm
Prediction frequency	2508.50000	MHz
Antenna Gain(typical)	12.00000	dBi
Antenna Gain(numeric)	15.84893	-
Power density at prediction frequency (S)	0.79750	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 0.79750 mW/cm^2, which is below the uncontrolled exposure limit of 1.0 mW/cm^2 at 2640.5 MHz for BRS 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.