

**CERTIFICATE OF COMPLIANCE (ERM EVALUATION)**

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

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

**Date of Issue : July 30, 2010**

**Test Report No.: HCTR1007FR27**

**Test Site: HCT CO., LTD.**

**FCC ID**

:

**U88-GRS-1923R-SPR**

**APPLICANT**

:

**GS Instruments Co., Ltd.**

**EUT Type:**

**RF Repeater**

**Model :**

**GRS-1923R-SPR**

**Frequency Ranges:**

**Downlink : 1930 – 1995 MHz**

**Uplink : 1850 – 1915 MHz**

**RF Output Power:**

**Downlink : 23.0 dBm**

**Uplink : 23.0 dBm**

**FCC Rules Part(s):**

**CFR 47, Part 24 Subpart E**

**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 24 Subpart E 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	GS Instruments Co., Ltd
Contact Point	1385-14, Juan-Dong, Nam-Ku, Incheon,,402-200 Korea

- EUT Type: RF Repeater
- FCC ID: U88-GRS-1923R-SPR
- Frequency Ranges: Downlink : 1930 - 1995 MHz  
Uplink : 1850 - 1915 MHz
- RF Output Power: Downlink : 23.0 dBm  
Uplink : 23.0 dBm
- FCC Rules Part(s): CFR Title 47 Part 24 Sub Part E
- Emission Designators: 1M26G7W

## 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 24 Subpart E**

Reference	Description	Results
§2.1046, §24.232	RF Power Output	Compliant
§2.1047	Modulation Characteristics	N/A
§2.1049	Occupied Bandwidth	Compliant
§2.1051, §24.238	Spurious Emissions at Antenna Terminals	Compliant
§2.1053, §24.238	Radiated Spurious Emissions	Compliant
§2.1055, §24.235	Frequency Stability	Compliant

### 3. STANDARDS ENVIRONMENTAL TEST CONDITIONS

Temperature :	+ 15 °C to + 35 °C
Relative humidity:	30 % to 60 %
Air pressure	860 mbar to 1060 mbar

## 4. TEST EQUIPMENT

Manufacturer	Model / Equipment	Cal Interval	Calibration Due	Serial No.
Agilent	E4438C /Signal Generator	Annual	12/15/2010	MY42082646
Agilent	E4416A /Power Meter	Annual	01/14/2011	GB41291412
WEINSCHL	67-30-33/ATTENUATOR	Annual	01/14/2011	BR0530
Korea Eng	KR-1005L/ Temperature and Humidity Chamber	Annual	12/28/2010	KRAC05063-3CH
Agilent	N9020AA /Signal Analyzer	Annual	03/03/2011	US46220219
Schwarzbeck	VULB 9168/BI-LOG Antenna	Biennial	01/06/2011	9168-200
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	AFS44-00102650-42-10P44-PS	Annual	04/05/2011	1532439
Schwarzbeck	BBHA 9120D/ Horn Antenna	Biennial	04/13/2011	147
Schwarzbeck	BBHA 9120D/ Horn Antenna	Biennial	09/23/2010	296
EMCO	6502/Loop Antenna	Biennial	01/13/2012	9009-2536
Agilent	E4438C /Signal Generator	Annual	12/15/2010	MY42082646

## 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.

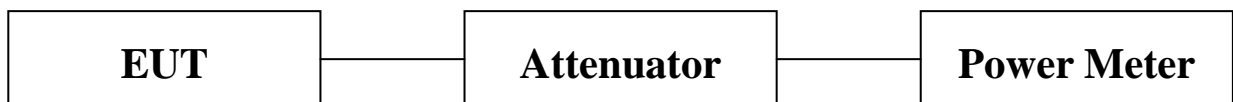
**§ 2.1046 (b)** For single sideband, independent sideband, and single channel, controlled carrier radiotelephone transmitters, the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and as applicable 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.

**§ 24.50 (h):** (2) Mobile and other user stations. Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

#### 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**

## 5.2 Test Results

### (Downlink)

DownLink		
Carrier Channel	Frequency (MHz)	Measured Average Output Power dBm (mW)
Low	1932.5	23.05(201.84)
Mid	1957.5	23.00(199.53)
High	1992.5	23.04(201.37)

## 5.3 Test Results

### (Uplink)

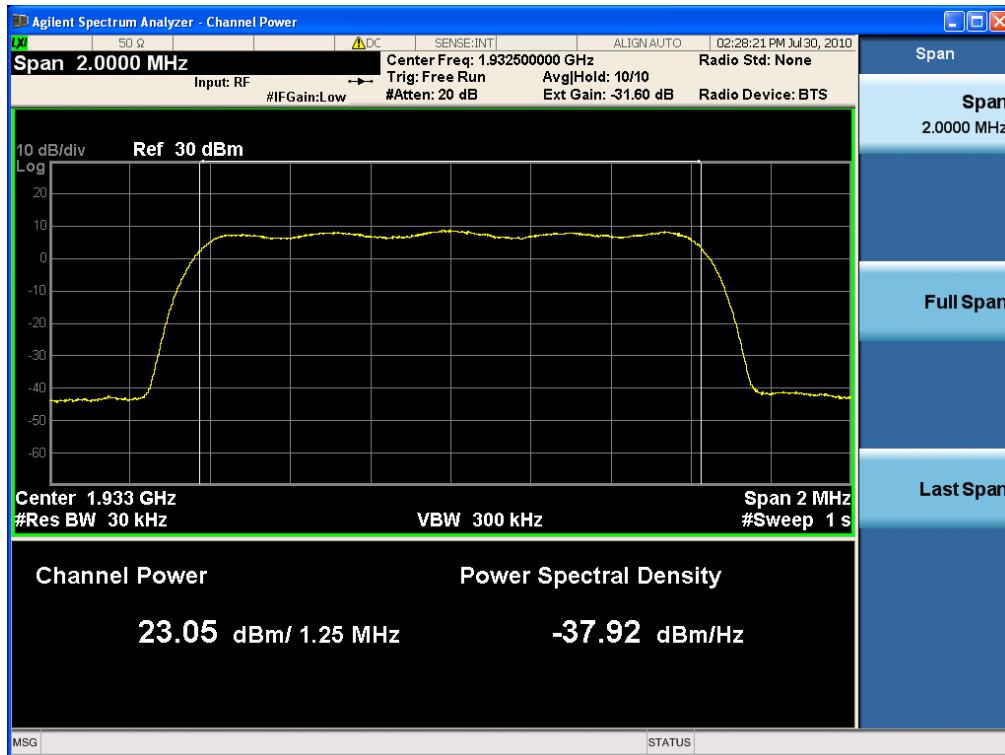
UpLink		
Carrier Channel	Frequency (MHz)	Measured Average Output Power dBm (mW)
Low	1852.5	22.75(188.36)
Mid	1872.5	23.08(203.24)
High	1912.5	23.04(201.37)

INPUT SIGNAL	DOWNLINK	UPLINK
Source	Real-time CDMA Forward	Real-time CDMA Reverse
Power Level	-56.0 dBm	-57.2 dBm
Amplitude offset	-31.6 dB	-31.6 dB

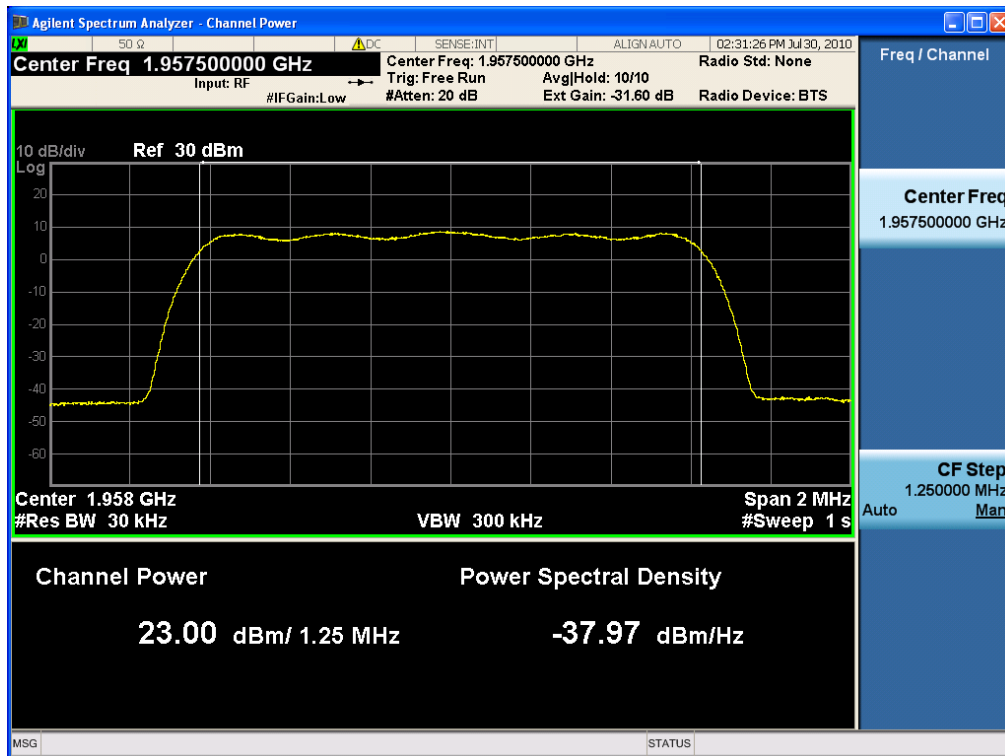


## Plots of RF Output Power

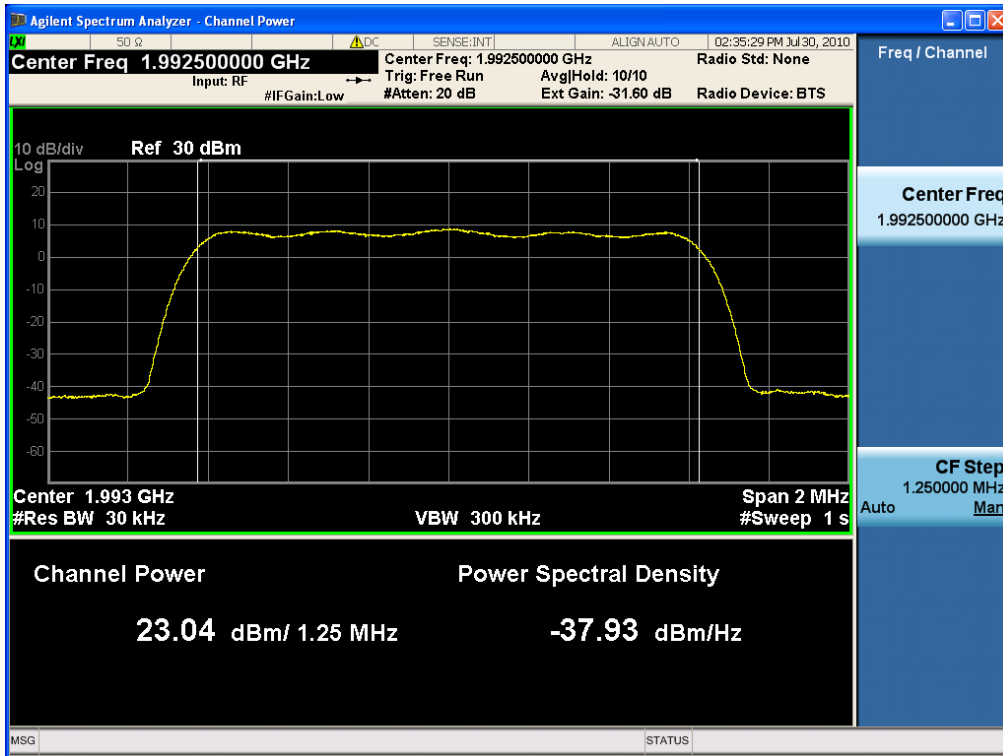
### Downlink Low CH



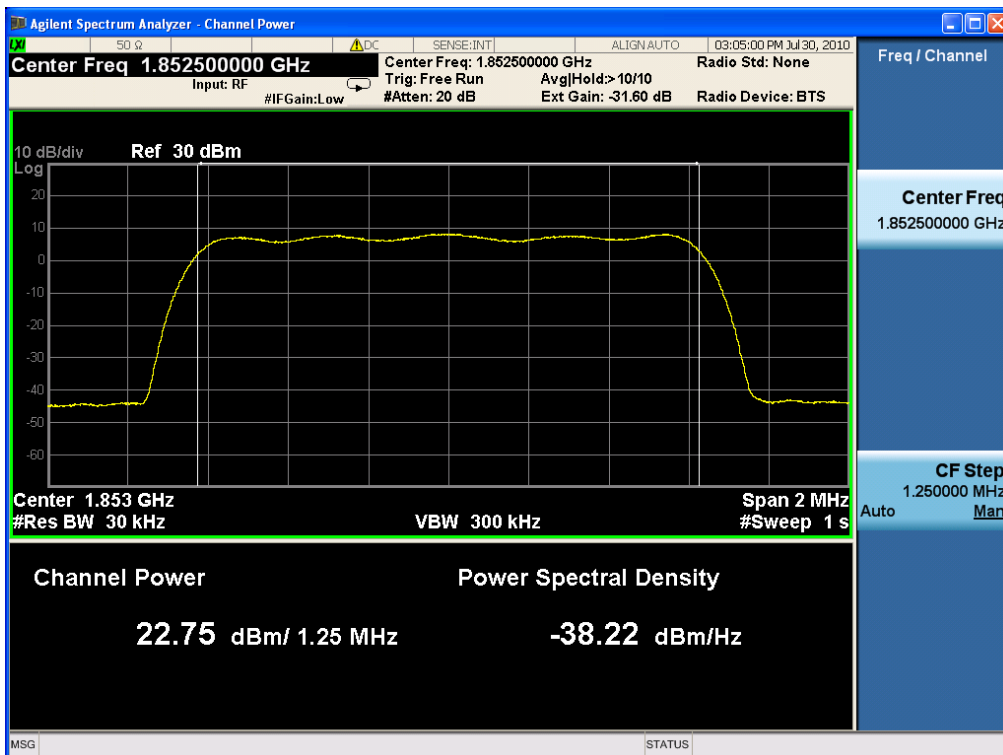
### Downlink Middle CH



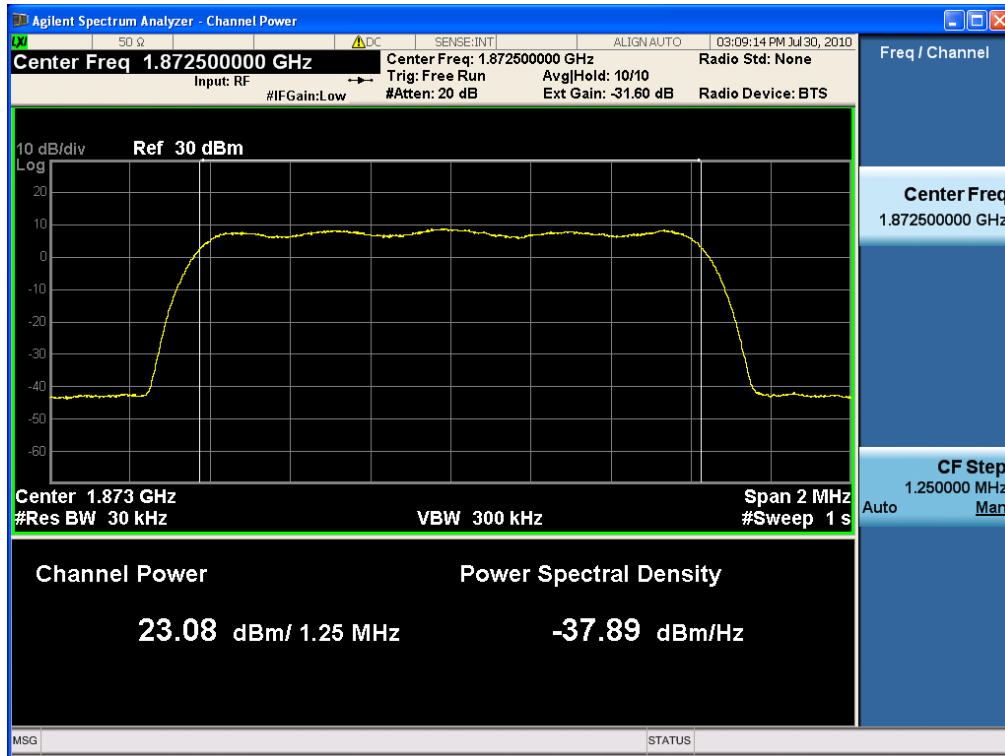
**Downlink High CH**



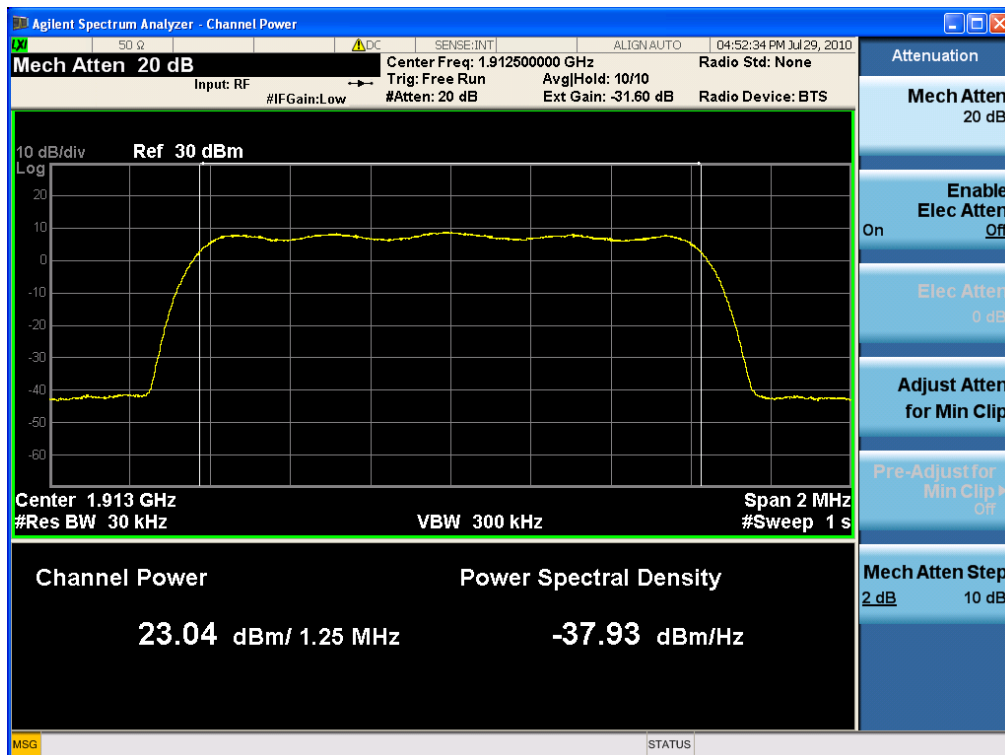
**Uplink Low CH**



### 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.

**NOTE:** The EUT is a band selective repeater. The test was performed using all selective bands and there was not much difference between them. The test result is reported using the widest bands.

**(Downlink)**

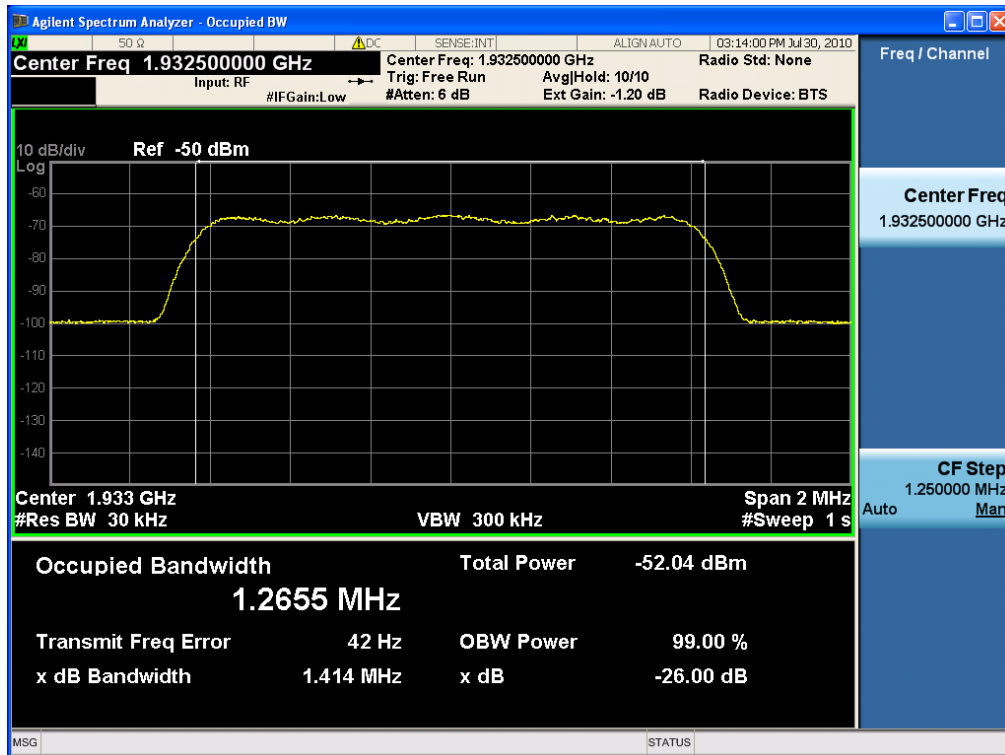
DownLink		
Carrier Channel	Frequency (MHz)	Bandwidth(MHz)
Low	1932.5	1.2637
Mid	1957.5	1.2626
High	1992.5	1.2634

**(Uplink)**

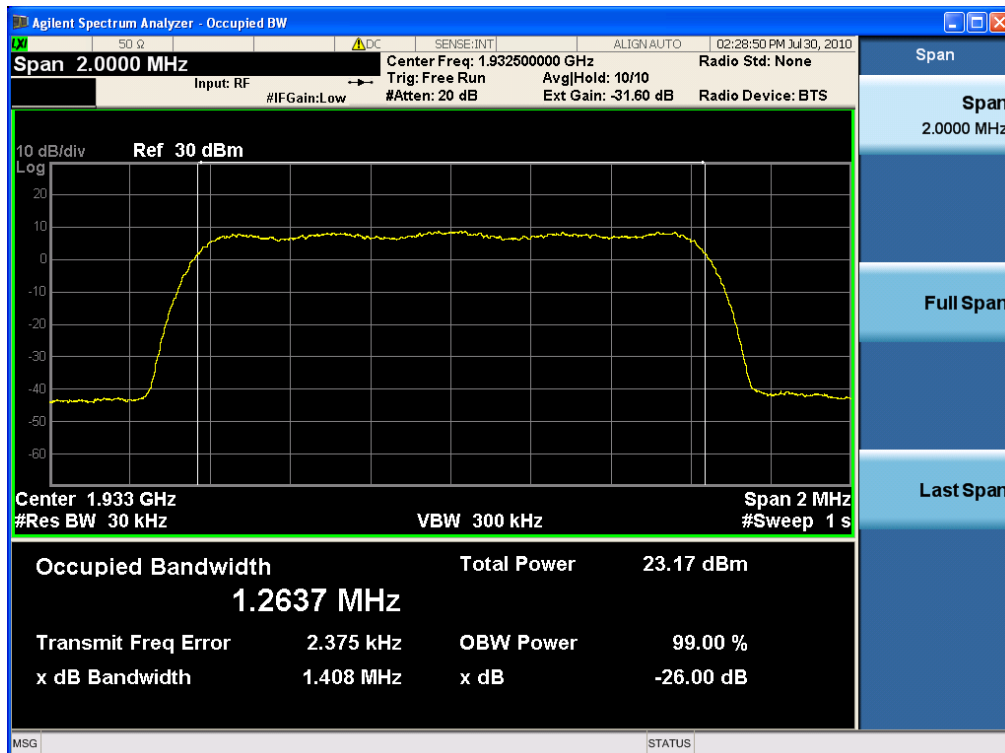
UpLink		
Carrier Channel	Frequency (MHz)	Bandwidth(MHz)
Low	1852.5	1.2635
Mid	1872.5	1.2631
High	1912.5	1.2623

## Plots of Occupied Bandwidth

### Downlink Low CH Input



### Downlink Low CH Output



HCT Co., Ltd.

San 136-1, Ami-ri, Bubal-eup, Icheon-si, Kyounki-do, 467-701, Korea

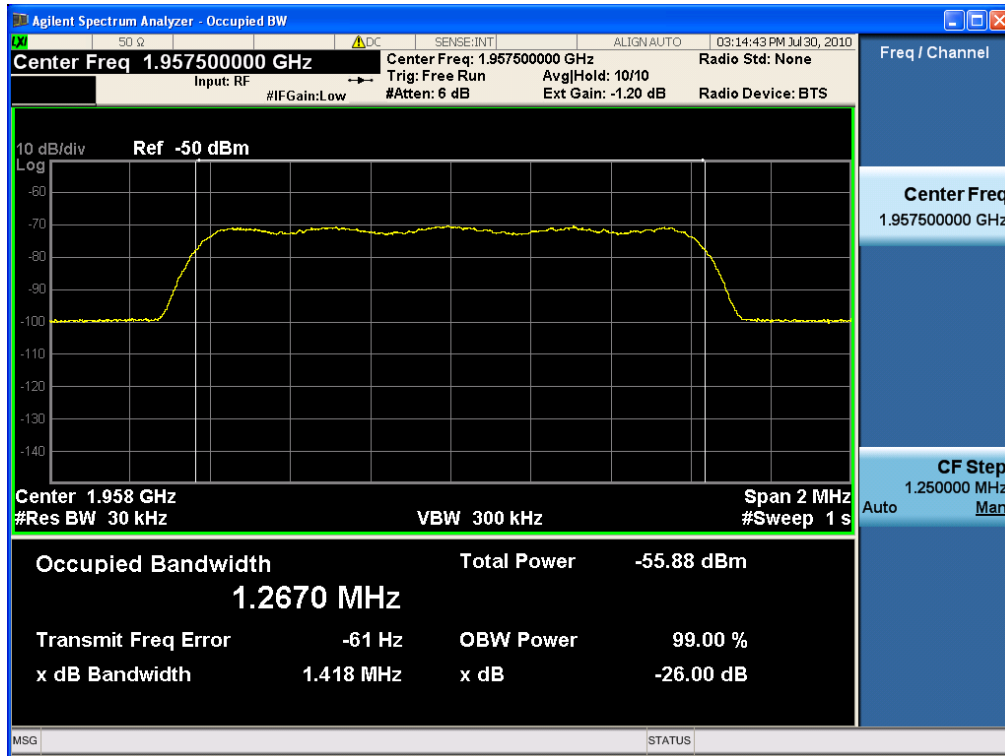
TEL : +82 31 639 8518

FAX : +82 31 639 8525

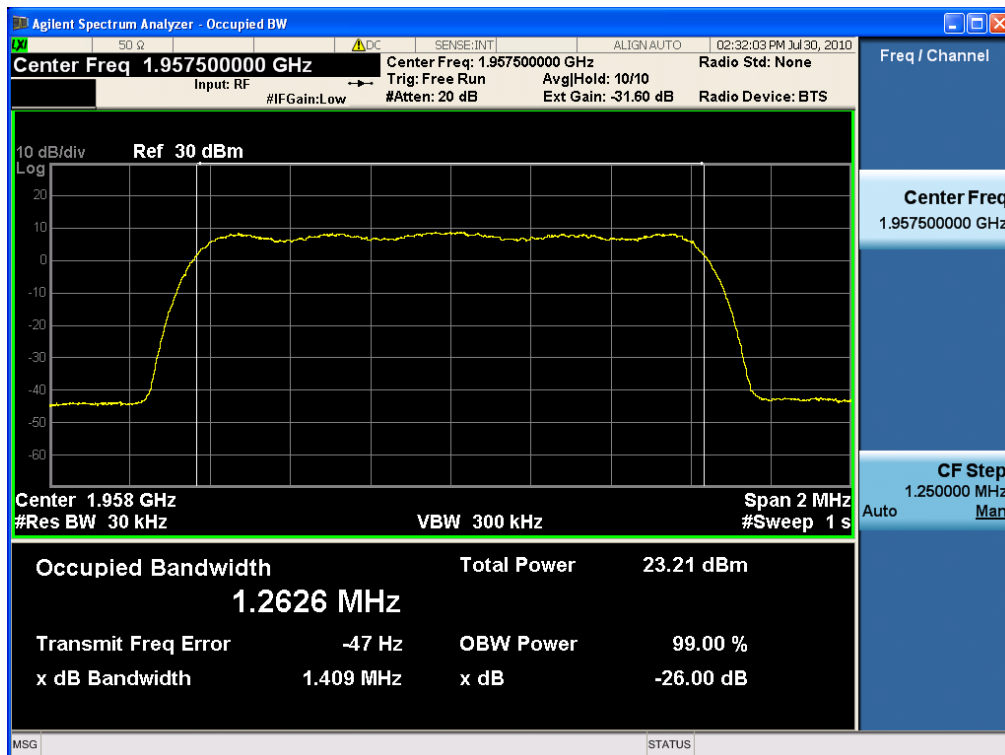
[www.hct.co.kr](http://www.hct.co.kr)

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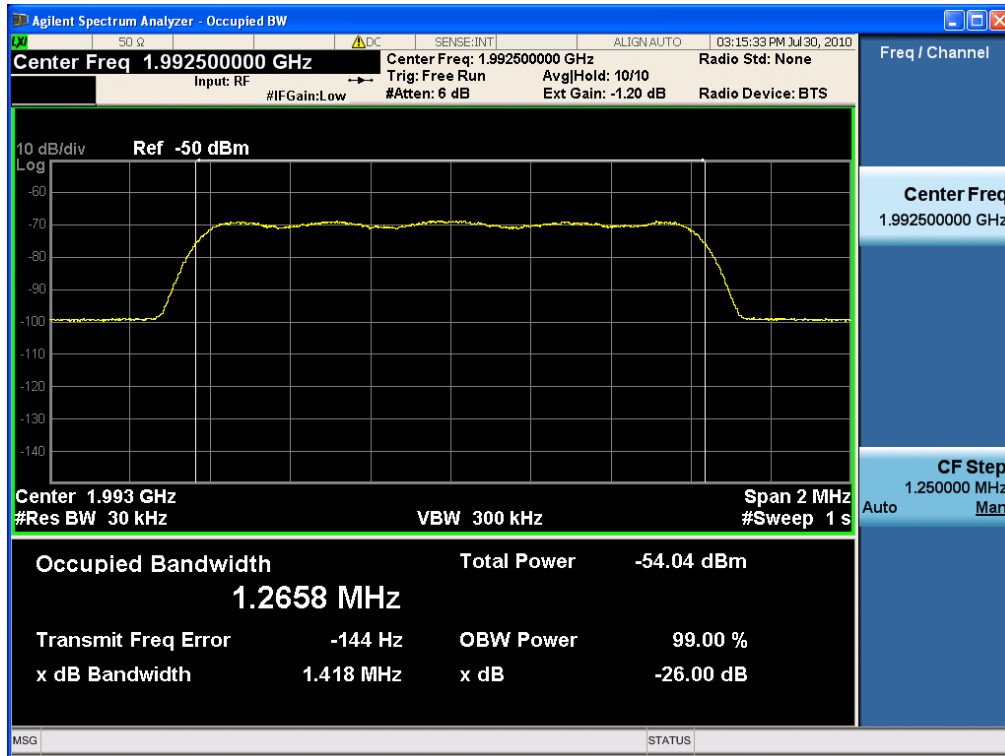
**Downlink Middle CH Input**



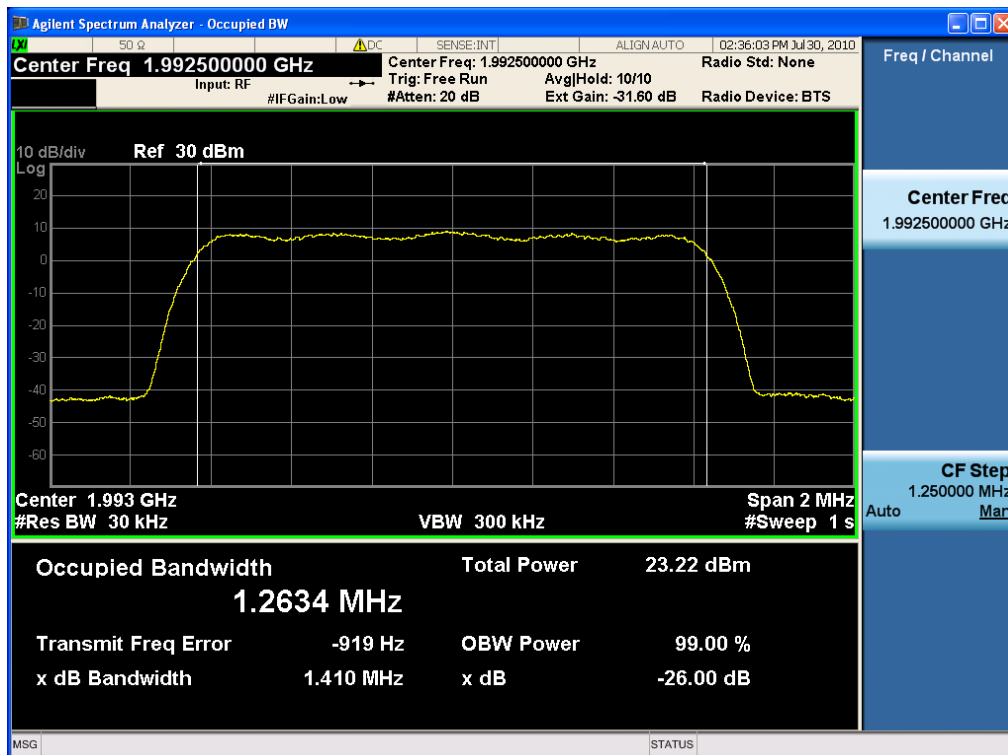
**Downlink Middle CH Ouput**



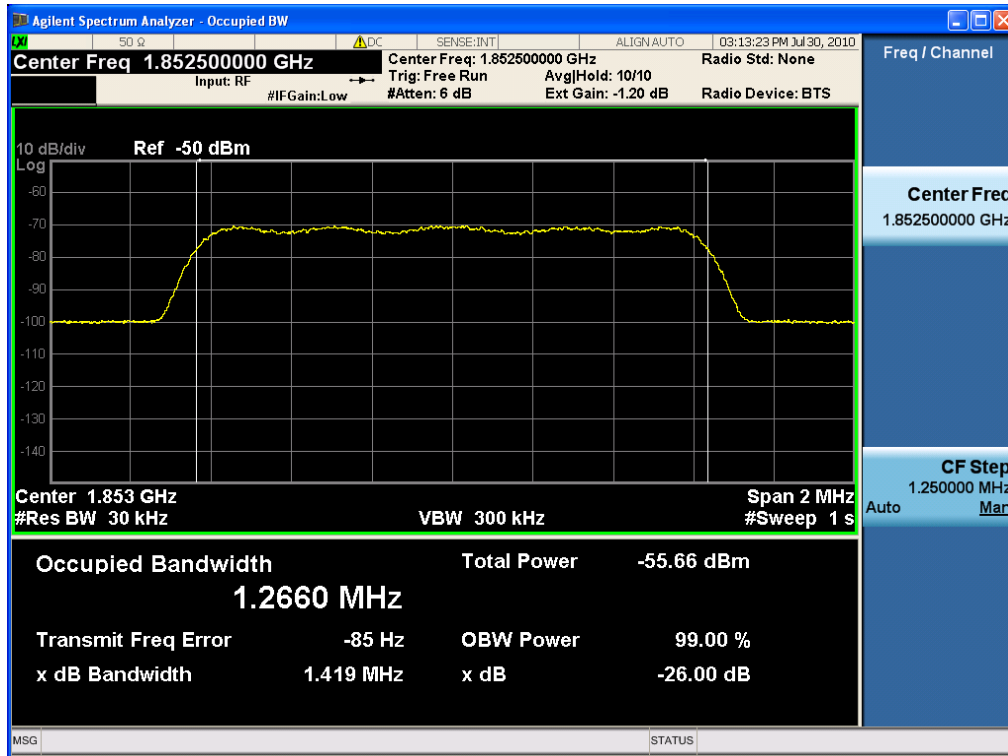
### Downlink High CH Input



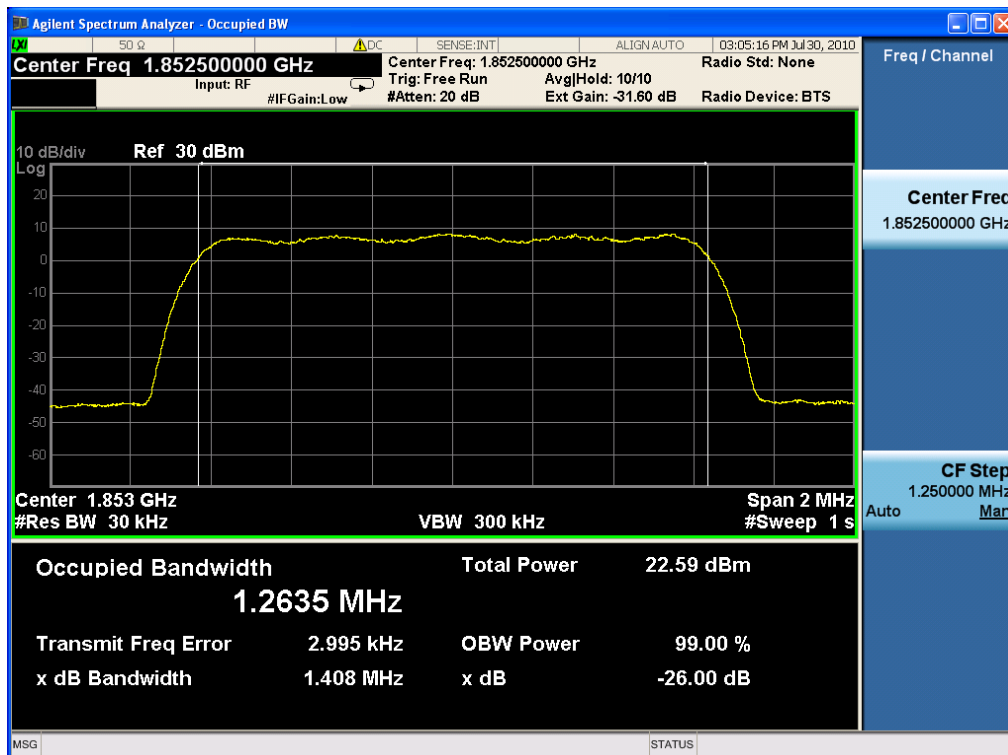
### Downlink High CH Output



**Uplink Low CH Input**

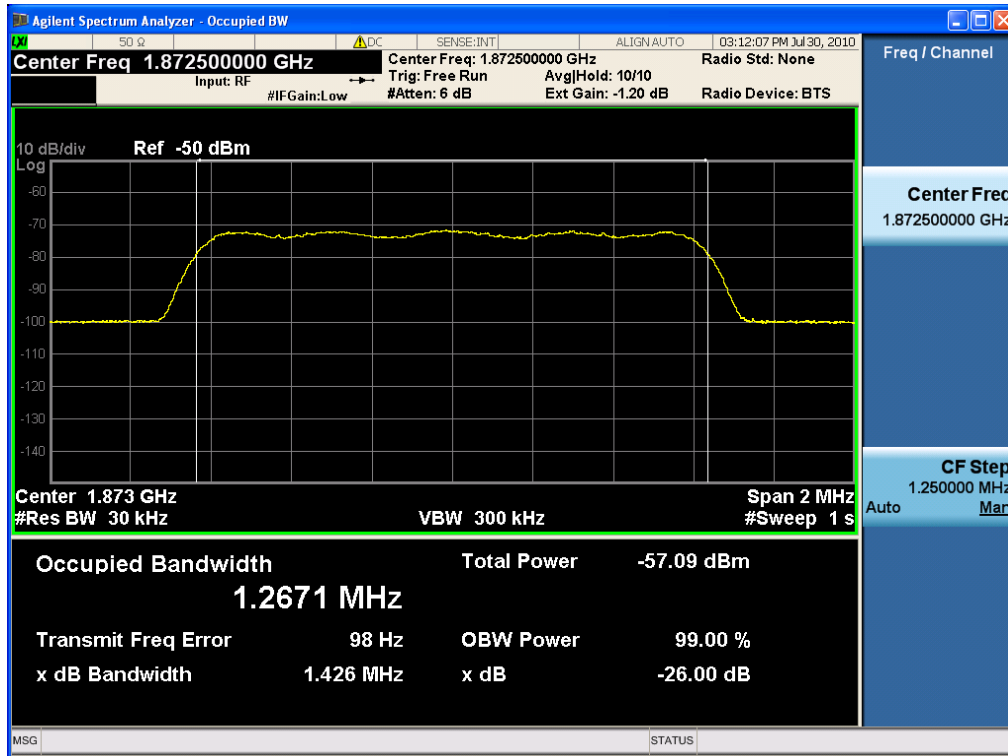


**Uplink Low CH Output**

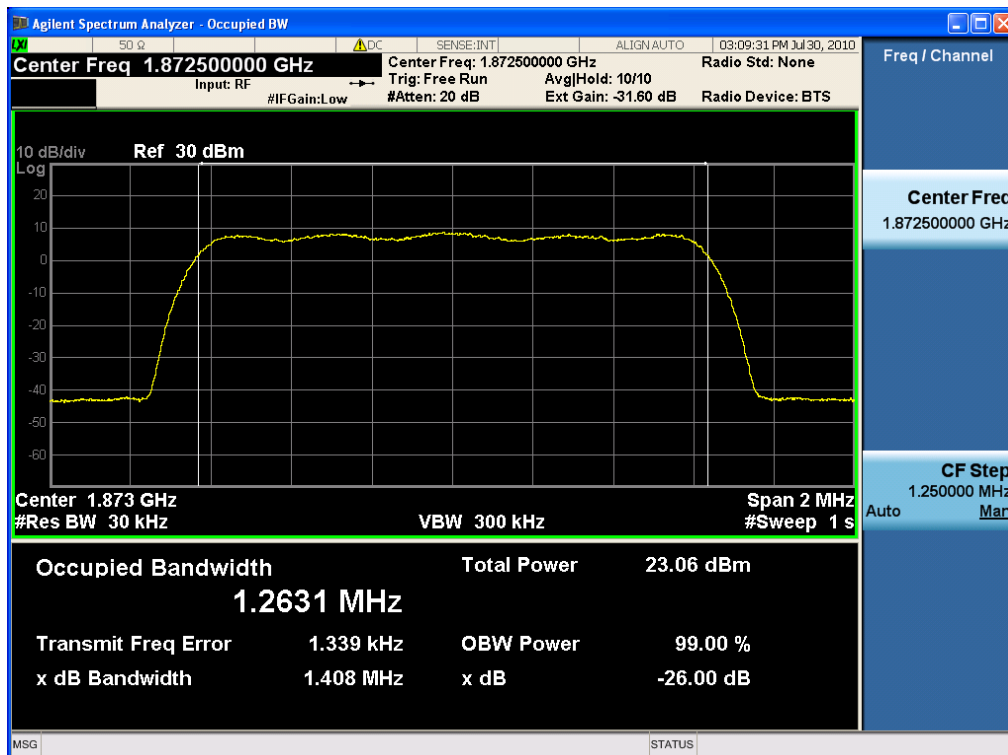




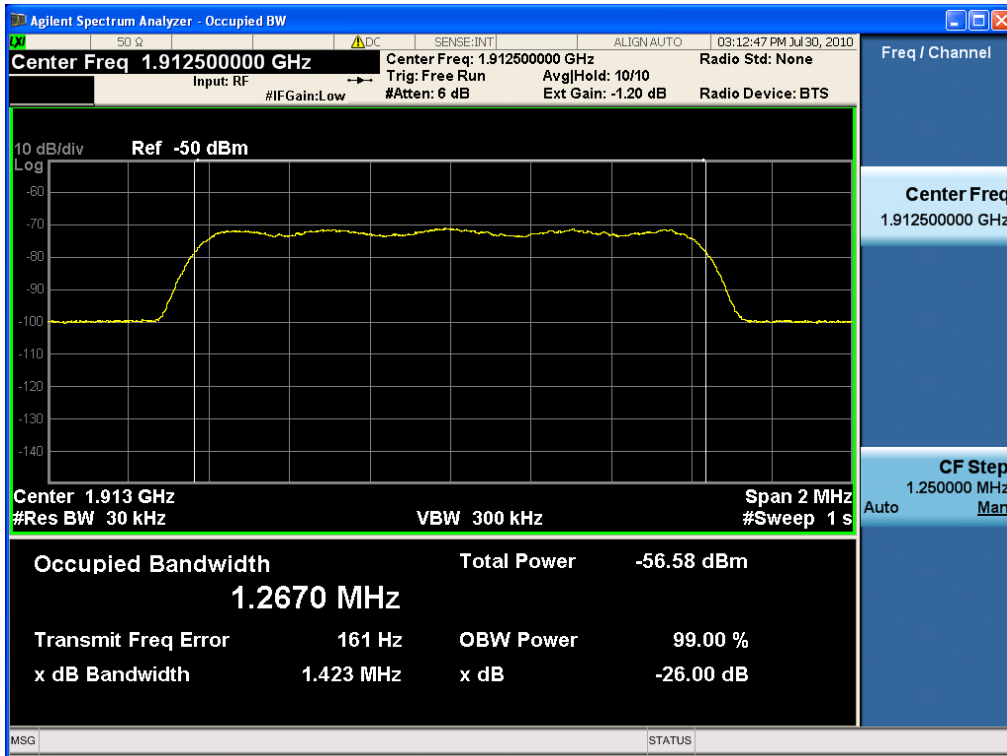
**Uplink Middle CH Input**



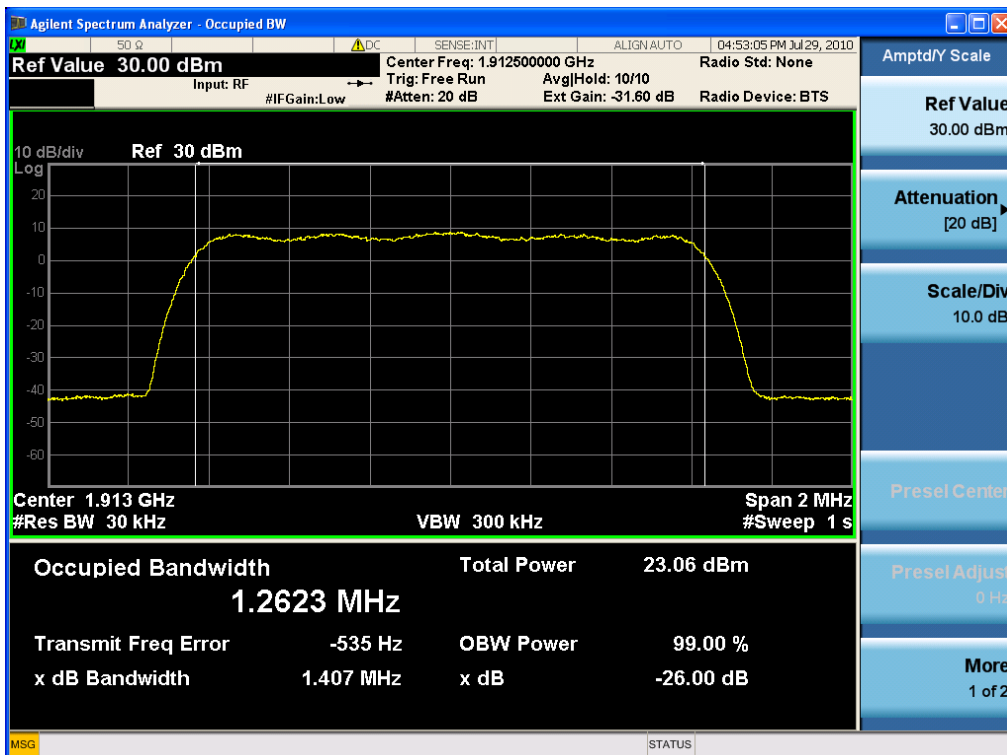
**Uplink Middle CH Output**



### 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.

**§24.238 Emission limitations for Broadband PCS equipment:** The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service. § 24.238 (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.

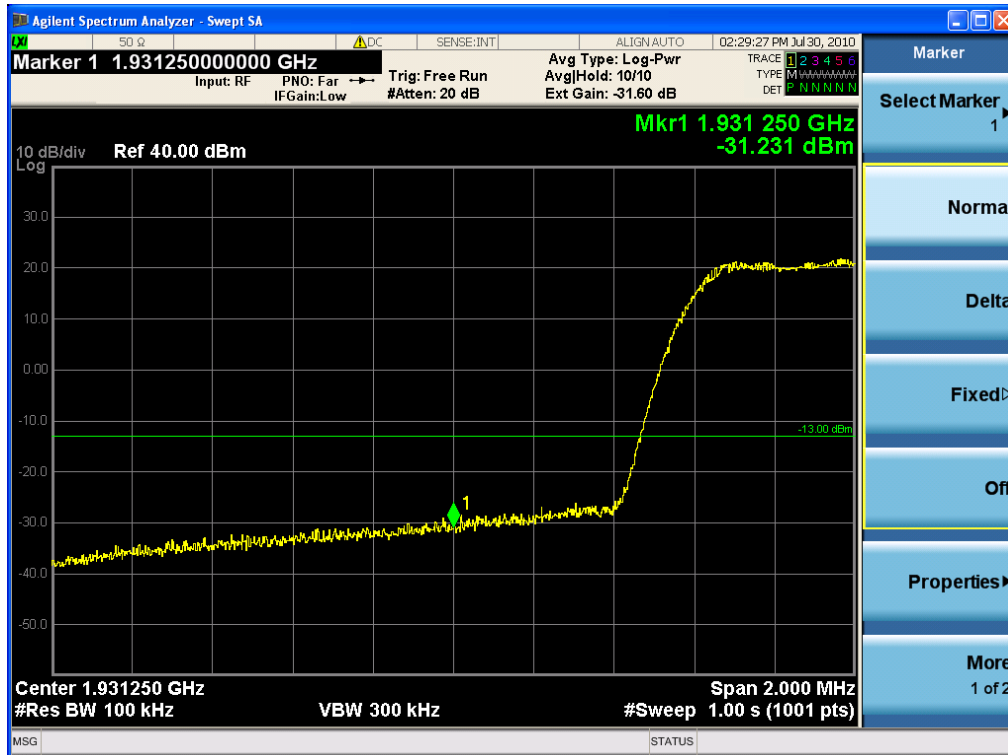
**Test Procedures:** A modulated carrier generated by the signal generator carrier was connected to either the Uplink

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.

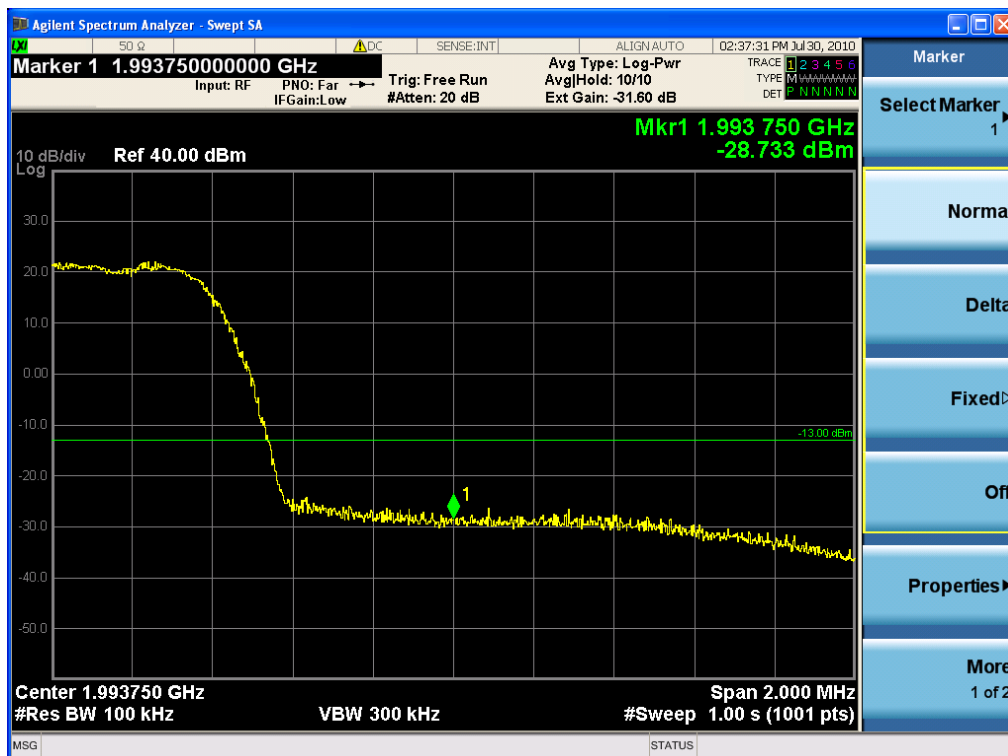
**Test Results:** The EUT complies with the requirements of this section. There were no detectable spurious emissions for this EUT.

## Plots of BAND EDGE

### (Downlink Low CH)



### (Downlink High CH)



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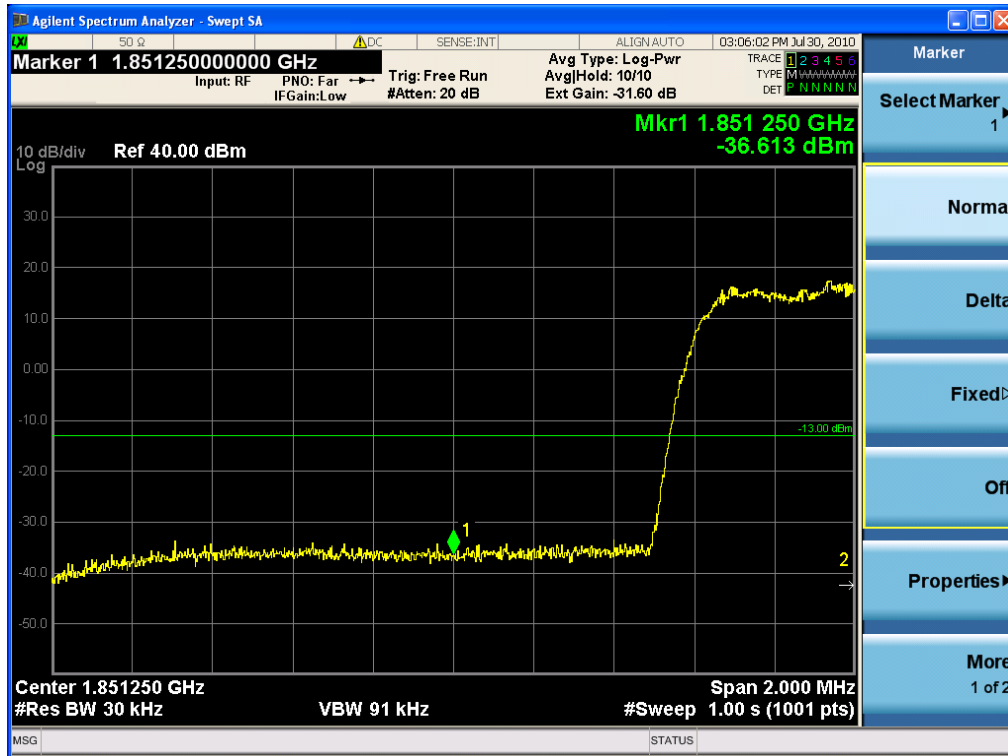
TEL : +82 31 639 8518

FAX : +82 31 639 8525

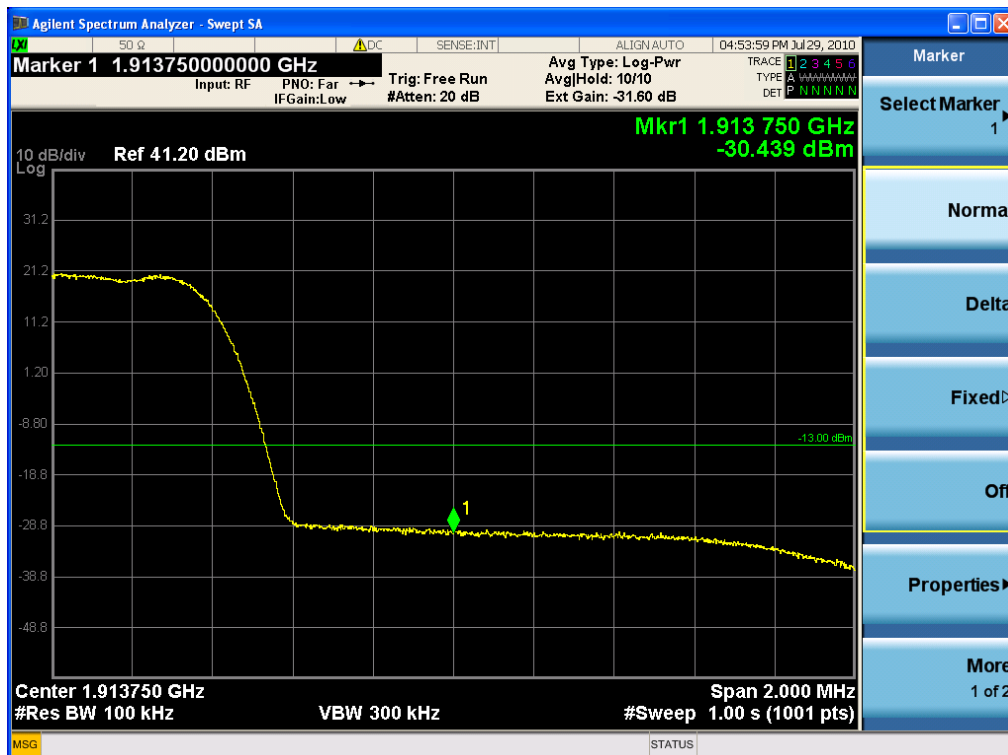
[www.hct.co.kr](http://www.hct.co.kr)

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(Uplink Low CH)

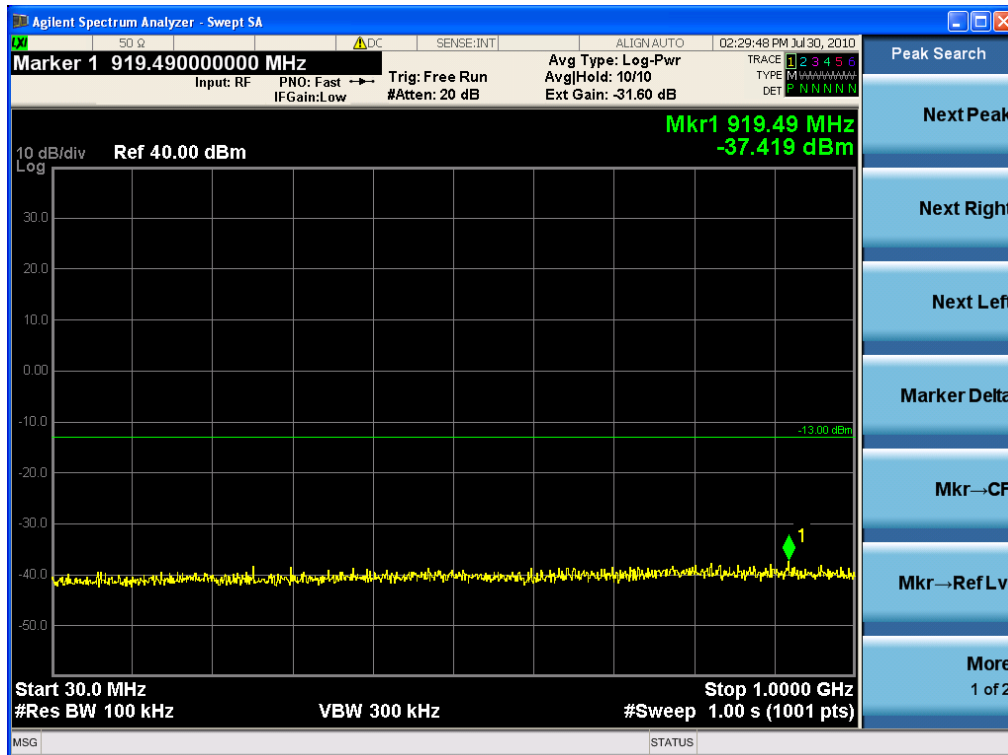


(Uplink High CH)

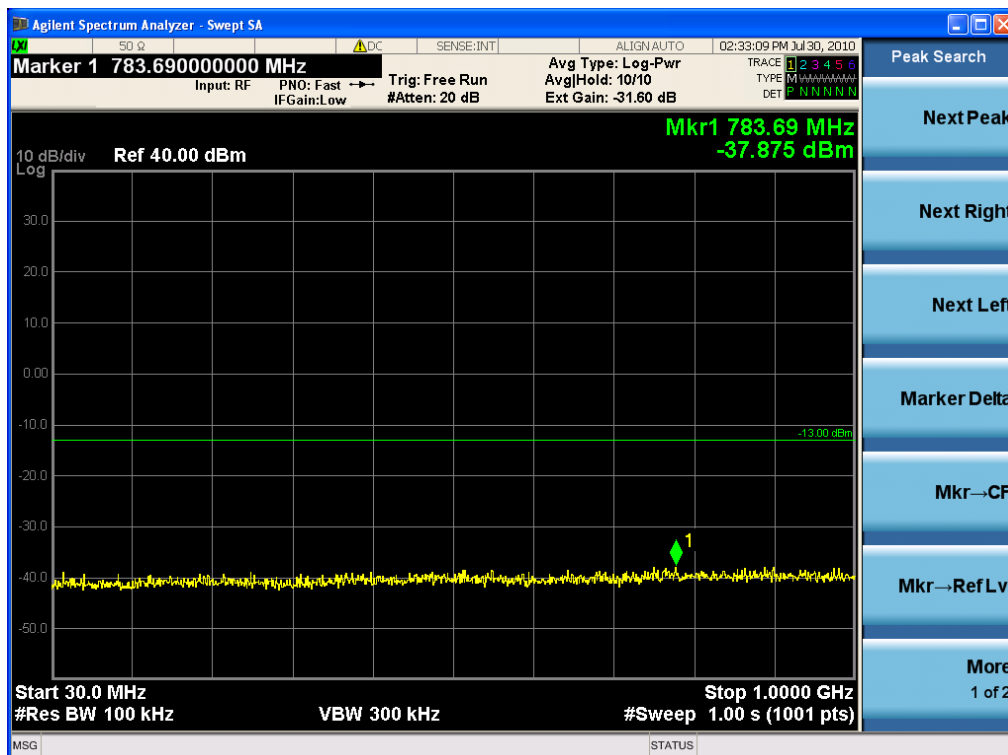


## Plots of Spurious Emission

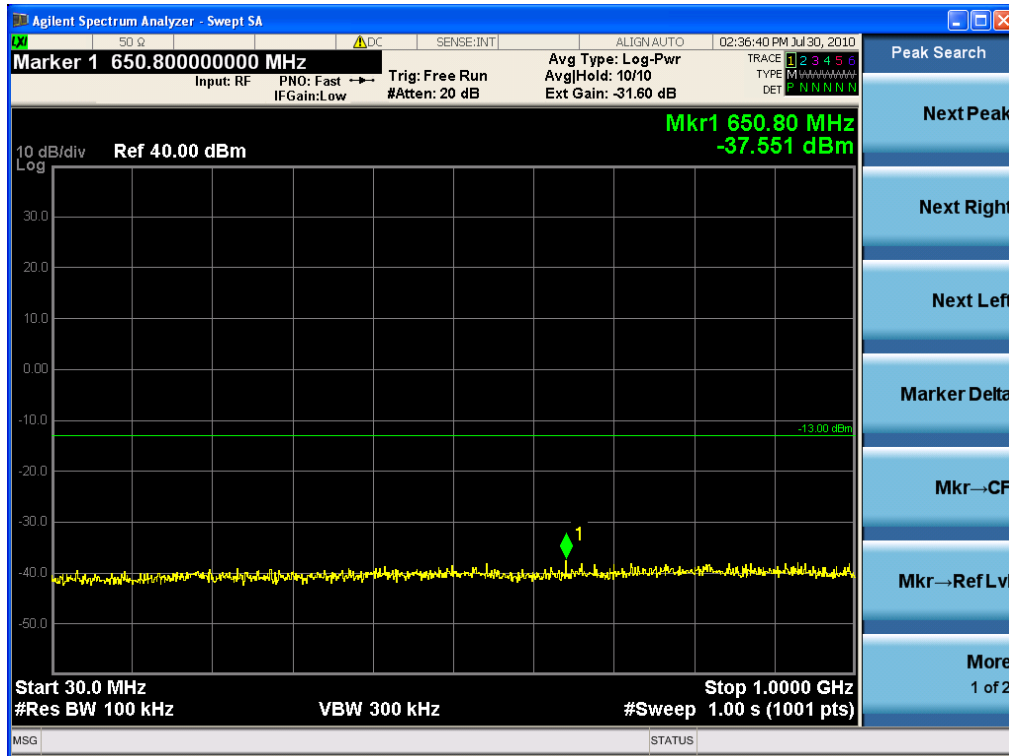
### Conducted Spurious Emissions Downlink Low CH (30 MHz – 1 GHz)



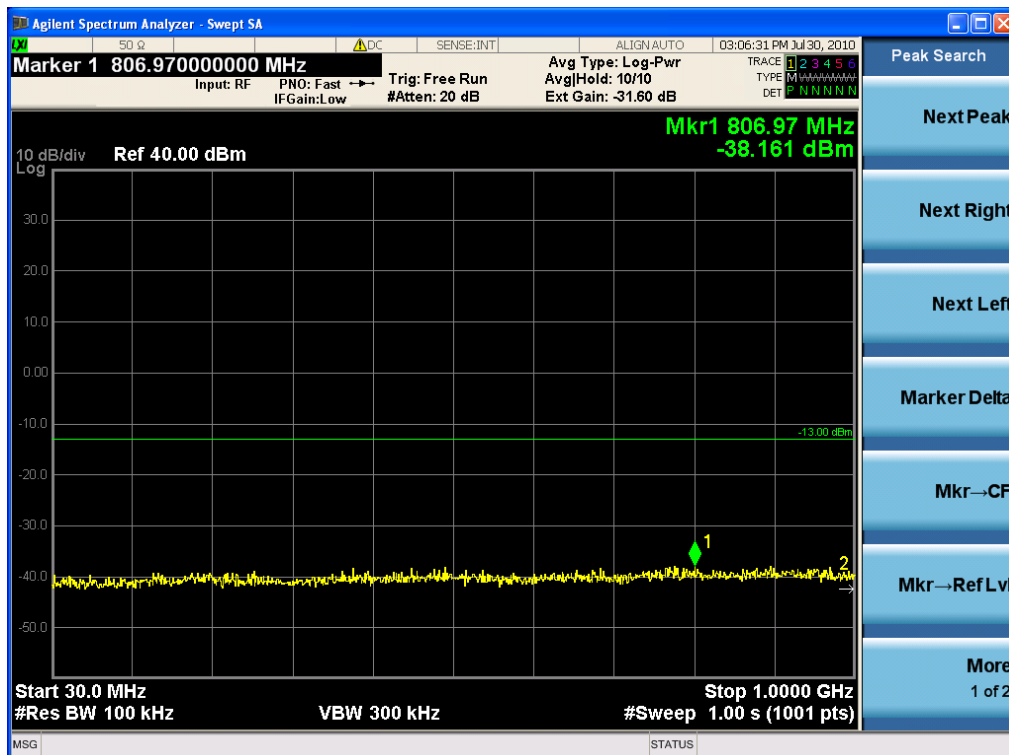
### Conducted Spurious Emissions Downlink Mid CH (30 MHz – 1 GHz)



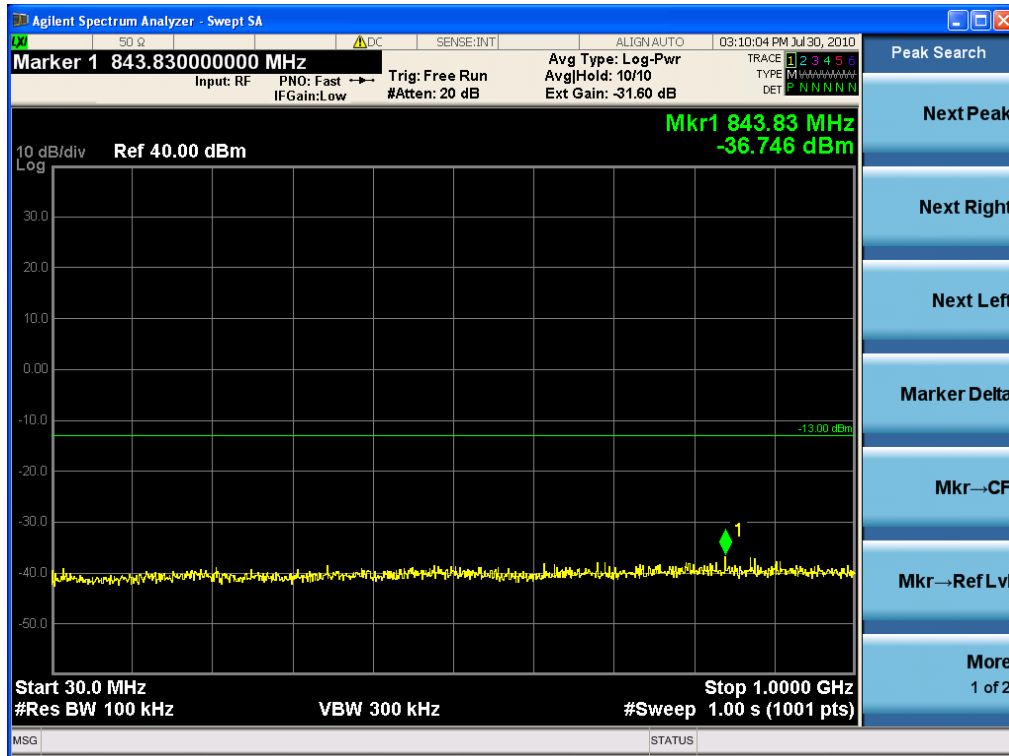
**Conducted Spurious Emissions Downlink High CH (30 MHz – 1 GHz)**



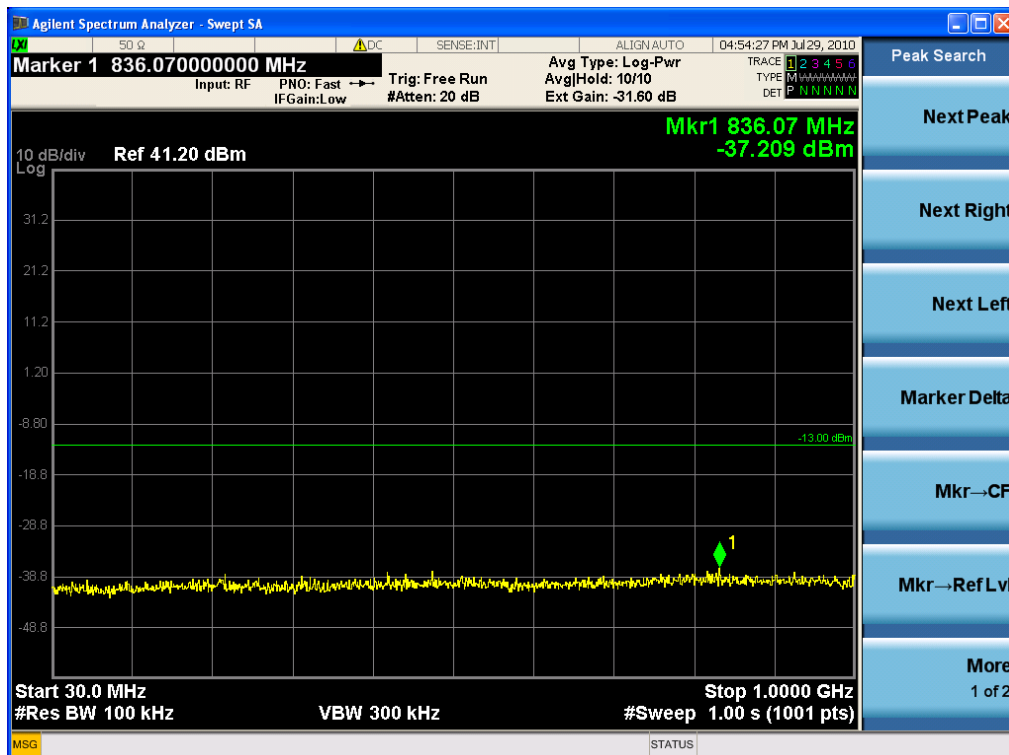
**Conducted Spurious Emissions Uplink Low CH (30 MHz – 1 GHz)**



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



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

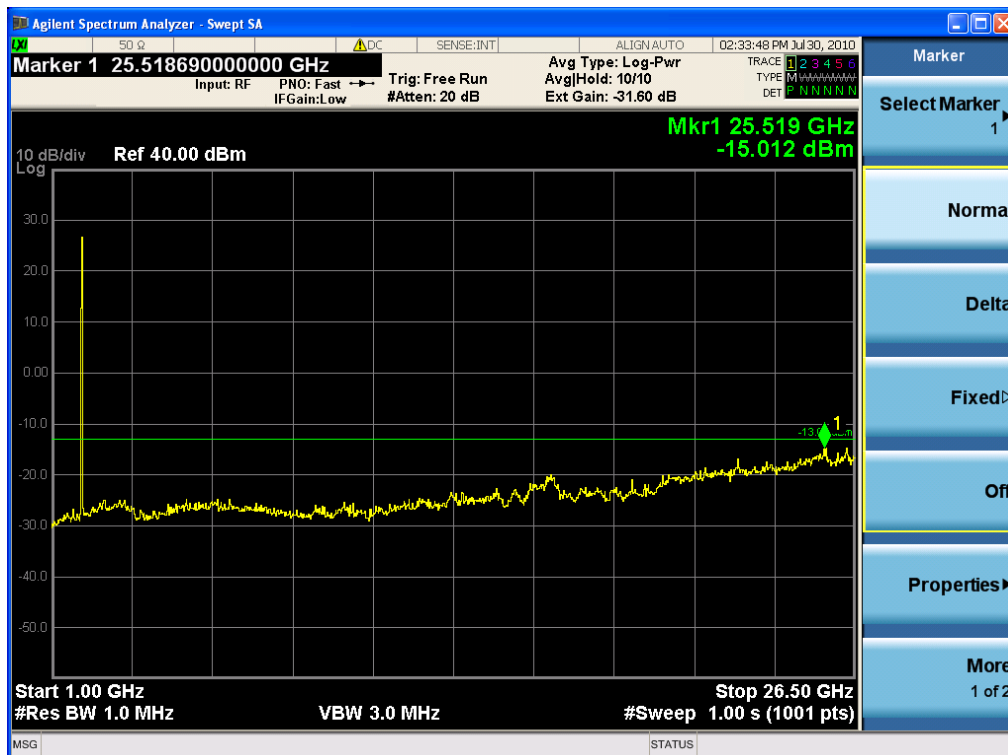




**Conducted Spurious Emissions Downlink Low CH (1 GHz – 26.5 GHz)**



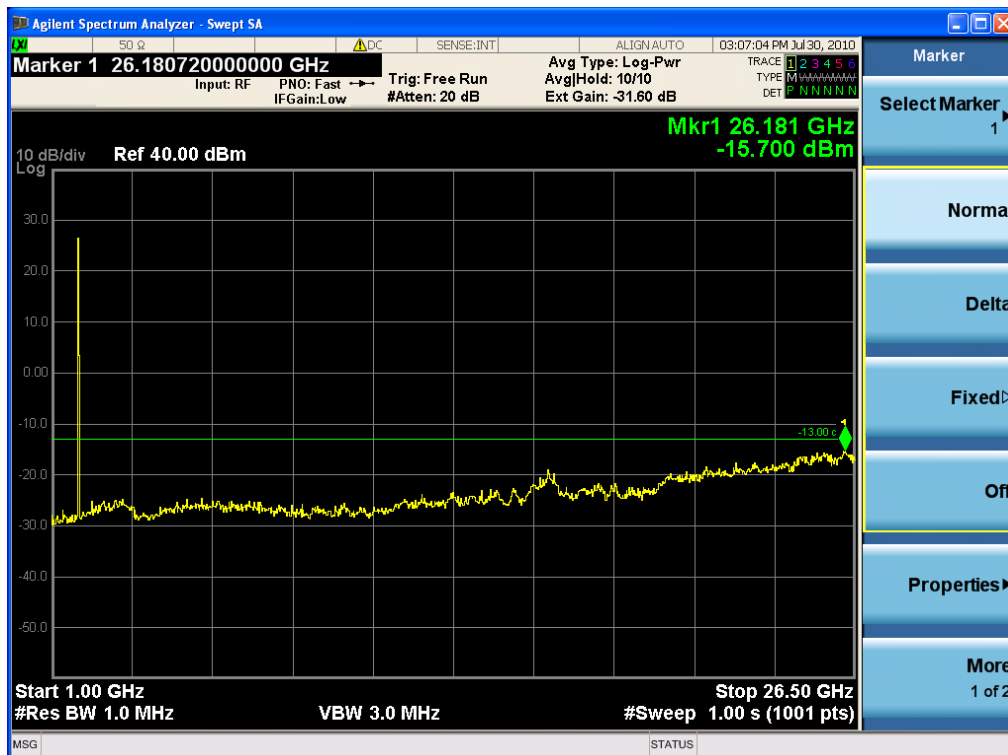
**Conducted Spurious Emissions Downlink Mid CH (1 GHz – 26.5 GHz)**



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



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



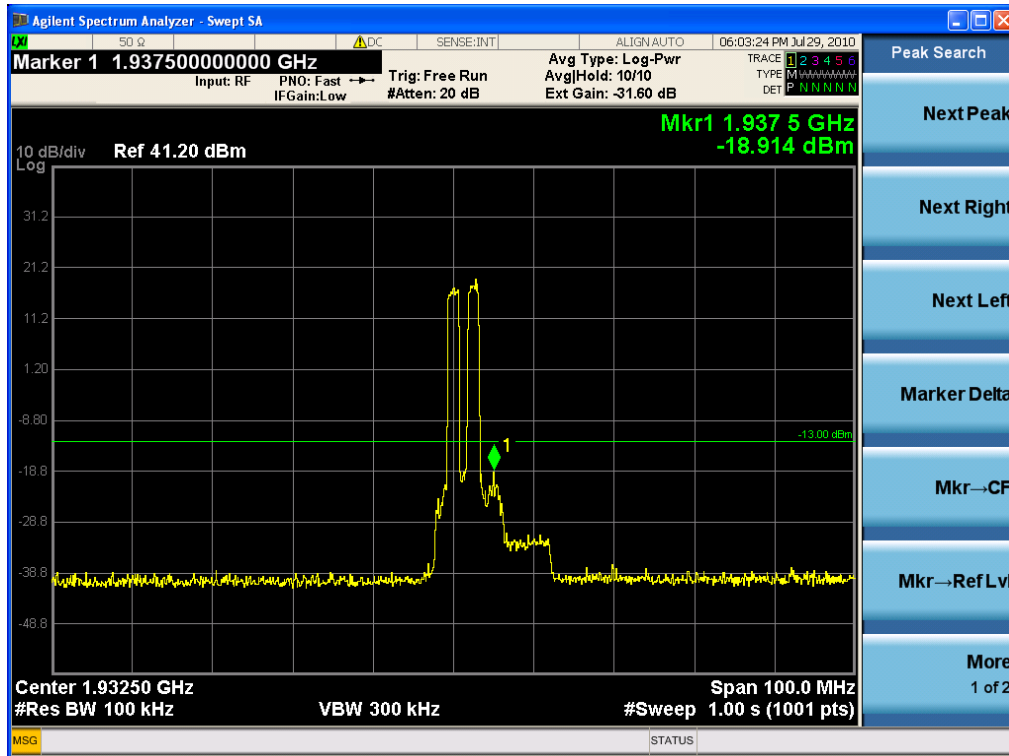
Conducted Spurious Emissions Uplink Mid CH (1 GHz – 26.5 GHz)



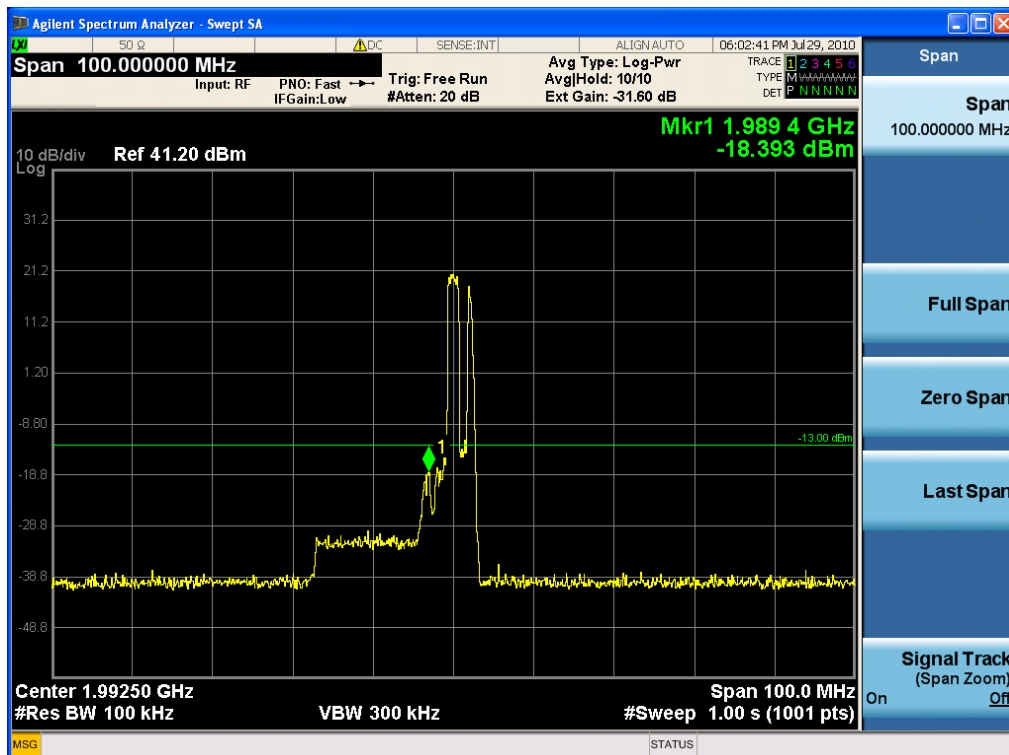
Conducted Spurious Emissions Uplink High CH (1 GHz – 26.5 GHz)



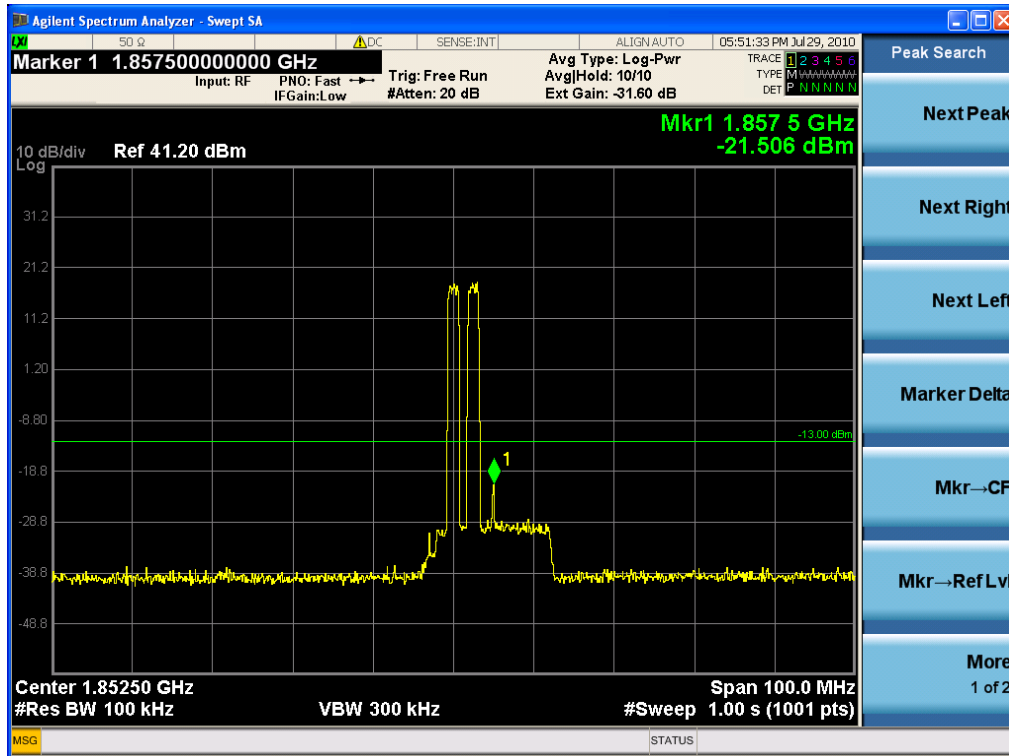
**Intermodulation Spurious Emissions Downlink Low CH**



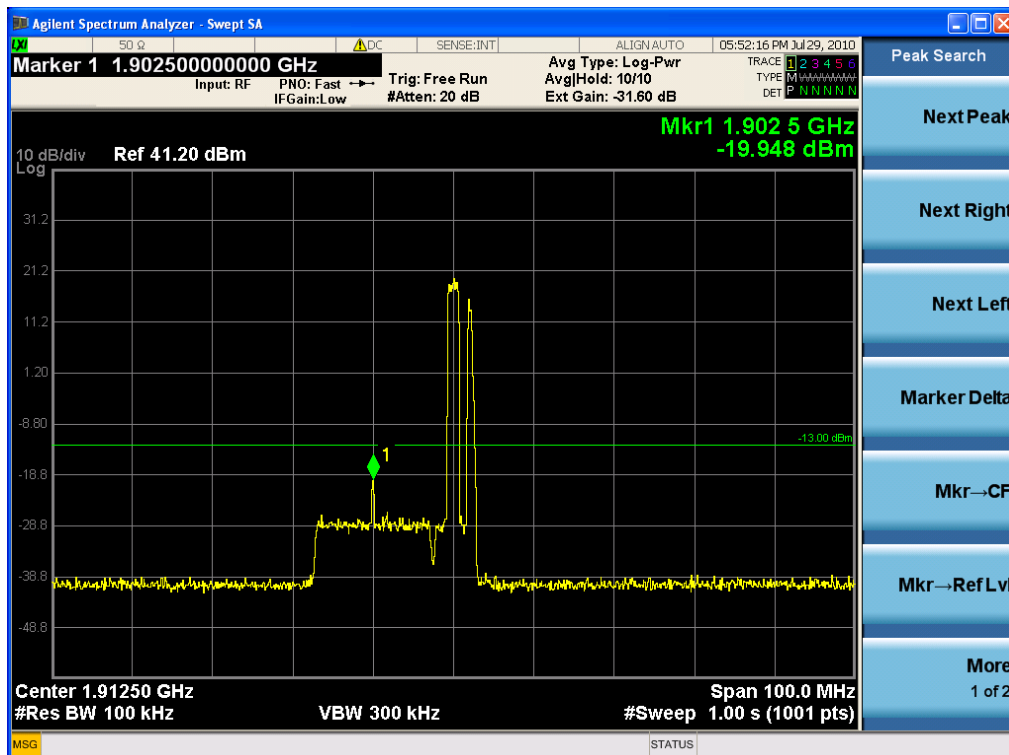
**Intermodulation Spurious Emissions Downlink High CH**



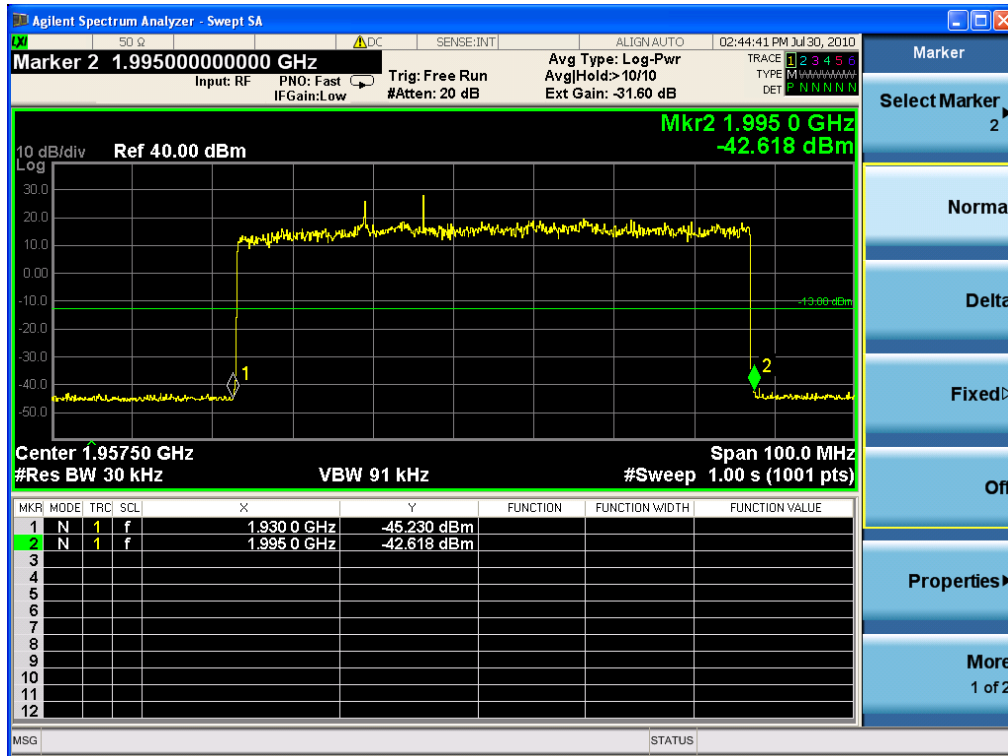
**Intermodulation Spurious Emissions Uplink Low CH**



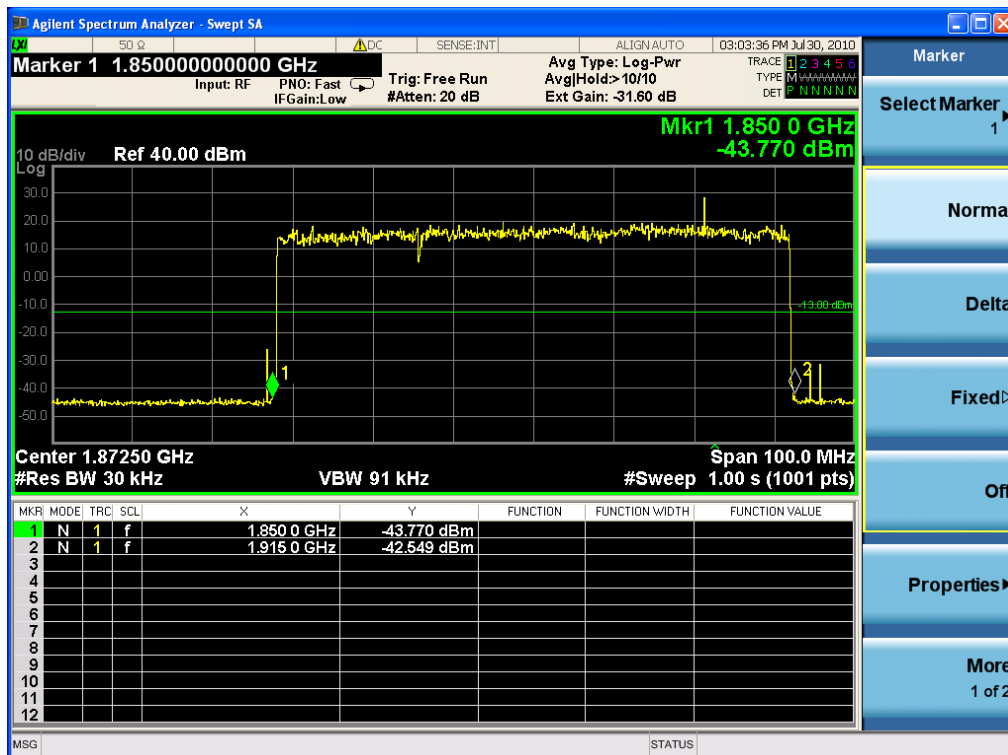
**Intermodulation Spurious Emissions Uplink High CH**



**Out of Band Rejection Downlink Middle CH**



**Out of Band Rejection Uplink Middle 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.

**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".

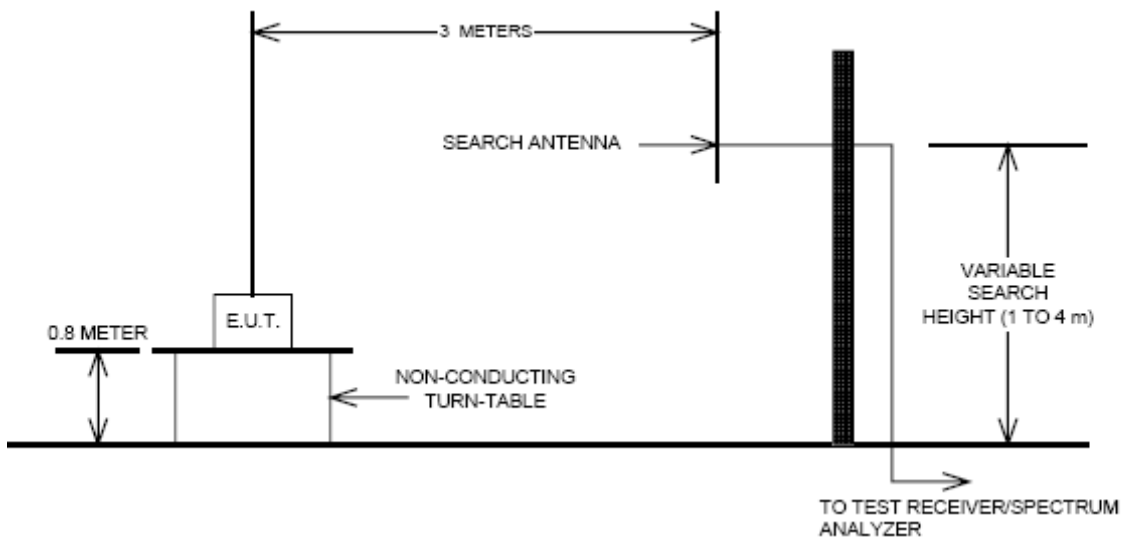
Radiated emission measurements were performed inside a 3 meter semi-anechoic chamber.

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





## 9. FREQUENCY STABILITY OVER TEMPERATURE AND VOLTAGE VARIATIONS

### Test Requirement(s):

§2.1055(a)(1) §90.213

### 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.

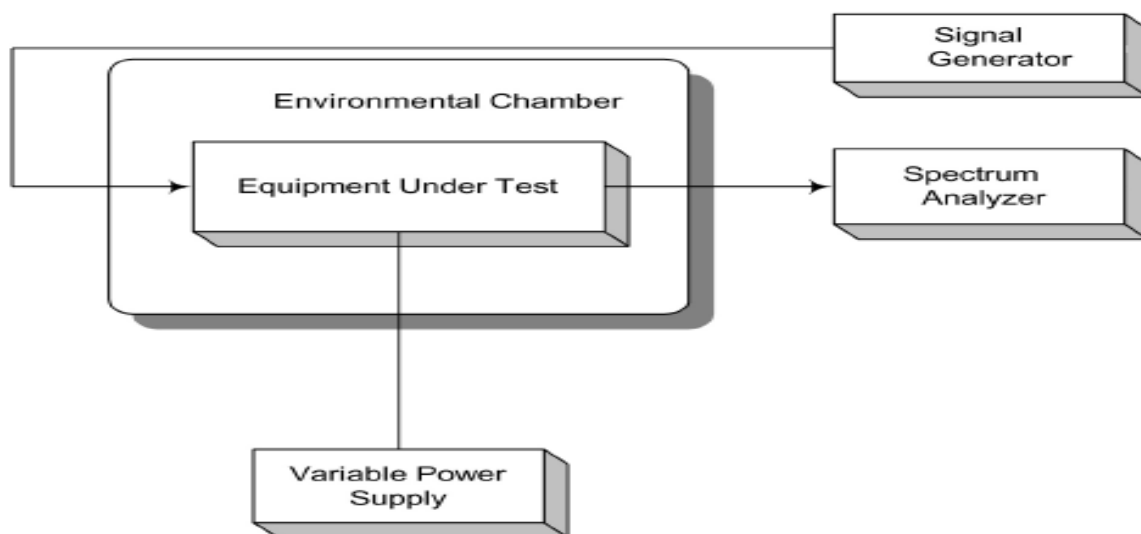
Voltage supplied to EUT is 120 Vac reference temperature was done at 20°C. The voltage was varied by  $\pm 15\%$  of nominal

### Test Results:

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

**NOTE:** The EUT is a band selective repeater. The test was performed using all selective bands and there was not much difference between them. The test result is reported using the widest bands.

### Test Setup:



## Frequency Stability and Voltage Test Results

Reference: 120 Vac at 20°C Freq. = 1957.50009 MHz

Temperature (Celsius)	Measured Freq (MHz)	Drift ppm
50	1957.50004	0.000002
40	1957.50003	0.000002
30	1957.50007	0.000004
20	Reference	
10	1957.50005	0.000003
0	1957.50007	0.000004
-10	1957.50014	0.000007
-20	1957.50012	0.000006
-30	1957.50014	0.000007

Reference: 120 Vac at 20°C Freq. = 1957.50005 MHz

Voltage(dc) +/-15% Ref	Measured Freq (MHz)	Drift (Hz)
102	1957.50004	0.00002
138	1957.50007	0.00004

### Uplink Mid CH

Reference: 120 Vac at 20°C Freq. = 1957.50003 MHz

Temperature (Celsius)	Measured Freq (MHz)	Drift Ppm
50	1872.50008	0.000004
40	1872.50007	0.000004
30	1872.50004	0.000002
20	Reference	
10	1872.50003	0.000002
0	1872.50004	0.000002
-10	1872.50006	0.000003
-20	1872.50005	0.000003
-30	1872.50011	0.000006

Reference: 120 Vac at 20°C Freq. = 2640.49995 MHz

Voltage(dc) +/-15% Ref	Measured Freq (MHz)	Drift (Hz)
102	1872.50012	0.000006
138	1872.50014	0.000007

### Downlink Mid CH

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## 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

Max Peak output Power at antenna input terminal	23.08000	dBm
Max Peak output Power at antenna input terminal	203.23570	mW
Prediction distance	20.00000	cm
Prediction frequency	1872.50000	MHz
Antenna Gain(typical)	12.00000	dBi
Antenna Gain(numeric)	15.84893	—
Power density at prediction frequency (S)	0.64081	mW/cm <sup>2</sup>
MPE limit for uncontrolled exposure at prediction frequency	1.00000	mW/cm <sup>2</sup>

### 3. RESULTS

The power density level at 20 cm is 0.64081 mW/cm<sup>2</sup>, which is below the uncontrolled exposure limit of 1.0 mW/cm<sup>2</sup> at 1872.5 MHz for PCS 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.