

**HCT. CO., LTD.**

CERTIFICATION DIVISION

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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 : June 7, 2011****Test Report No.: HCTR1106FR06****Test Site: HCT CO., LTD.****FCC ID:****U88-SMR700****APPLICANT:****GS Instruments Co., Ltd.****EUT Type: Smart-700MHz SOHO LTE Repeater****Model: SMR700-Remote****Frequency Ranges: 746 MHz ~ 756 MHz****RF Output Power: 13.0 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.

Report prepared by  
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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

- FCC ID: U88-SMR700
- APPLICANT: GS Instruments Co., Ltd.
- EUT Type: Smart-700MHz SOHO LTE Repeater
- Model: SMR700-Remote
- Frequency Ranges: 746 MHz ~ 756 MHz
- RF Output Power: 13.0 dBm
- FCC Rules Part(s): CFR Title 47 Part 27
- Emission Designators: G7D (QPSK), W7D (16QAM/64QAM)
- Modulation: QPSK, 16QAM, 64QAM

## 2. TEST SPECIFICATIONS

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 °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	11/11/2011	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	04/16/2012	MY51110020
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	05/02/2012	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

### 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.

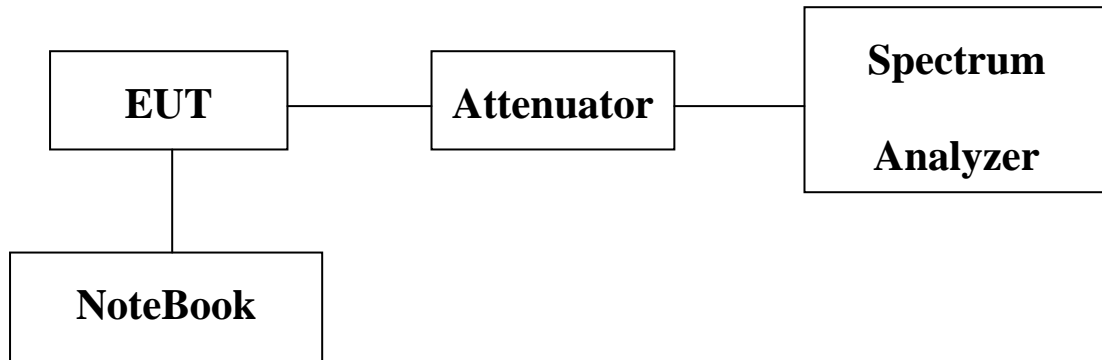
§ 2.1046 (b) For single sideband, independent sideband, and single channel, controlled carrier radiotelephone transmitters, the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and as applicable in § 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. (2) Fixed and base stations transmitting a signal in the 746–757 MHz, 758–763 MHz, 776–787 MHz, and 788–793 MHz bands with an emission bandwidth of 1 MHz or less must not exceed an ERP of 1000 watts and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts ERP in accordance with Table 1 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**

**Test Results:**

Input Signal	Modulation	Level (dBm)
WiMax	QPSK, 16QAM, 64QAM	-37.2

Carrier Channel	Frequency (MHz)	Measured Average Output Power dBm (mW)
Mid	751	12.99(19.9067)

## Plots of RF Output Power

### Mid CH





## 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.

Input Signal	Modulation	Level (dBm)
WiMax	QPSK, 16QAM, 64QAM	-37.2

**Output**

Carrier Channel	Frequency (MHz)	Bandwidth(MHz)
Mid	751	8.9229

**Input**

Carrier Channel	Frequency (MHz)	Bandwidth(MHz)
Mid	751	8.9406

## Plots of Occupied Bandwidth

### Mid CH Input



### Mid CH Output



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## 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;

**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.

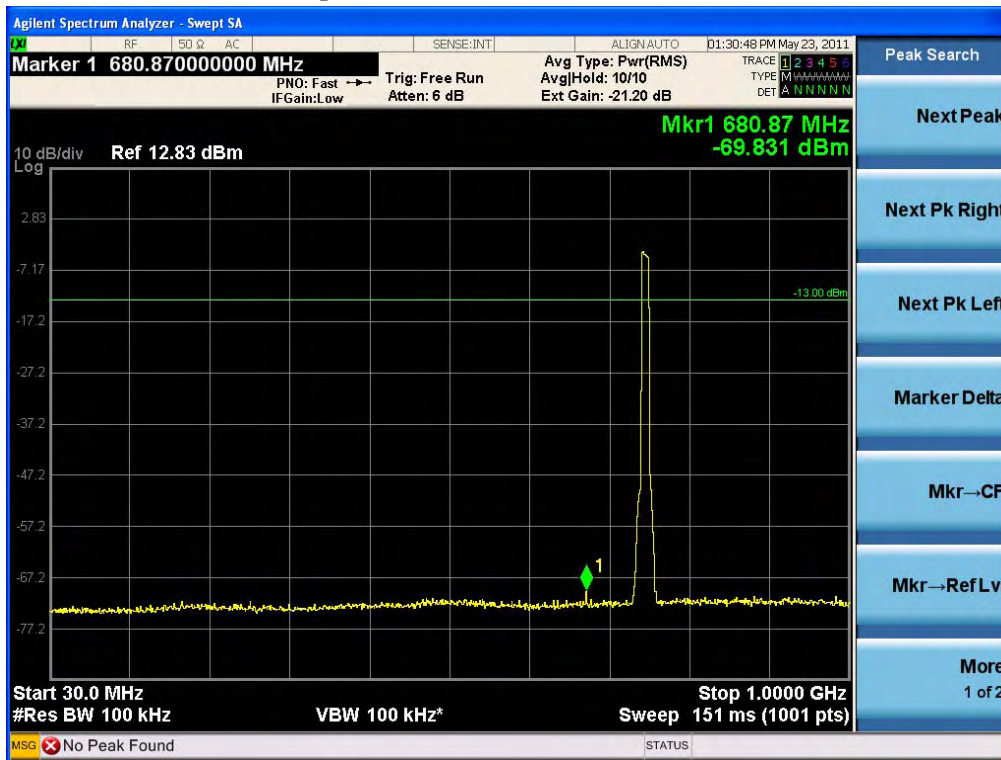
## Plots of BAND EDGE

### Mid CH



## Plots of Spurious Emission

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



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



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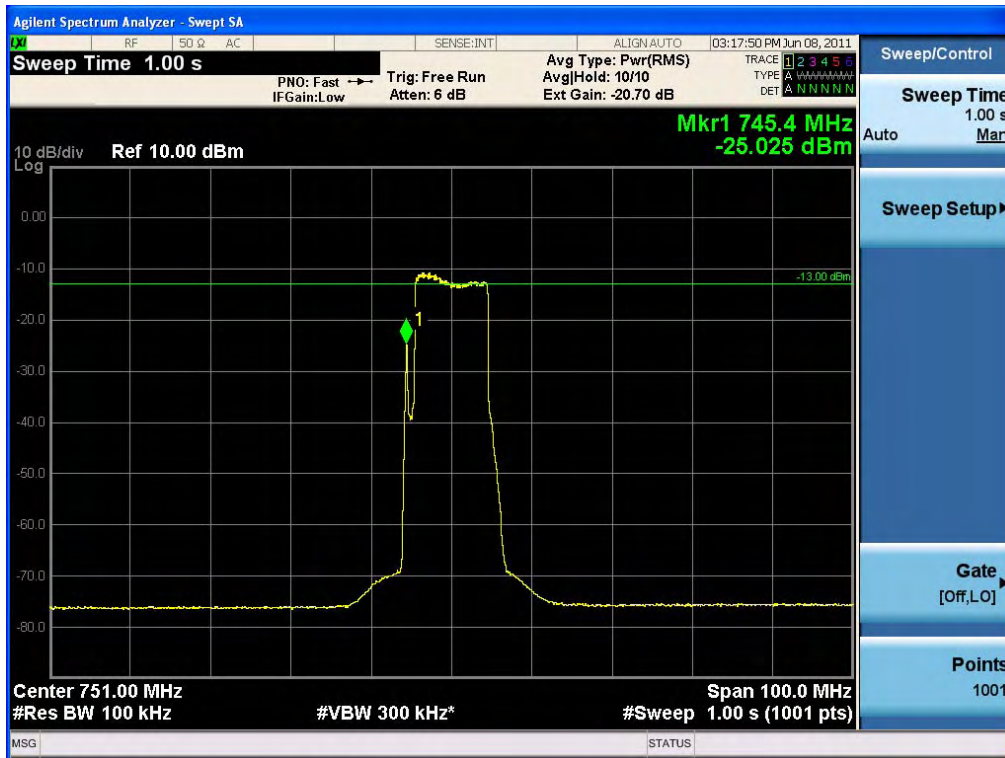
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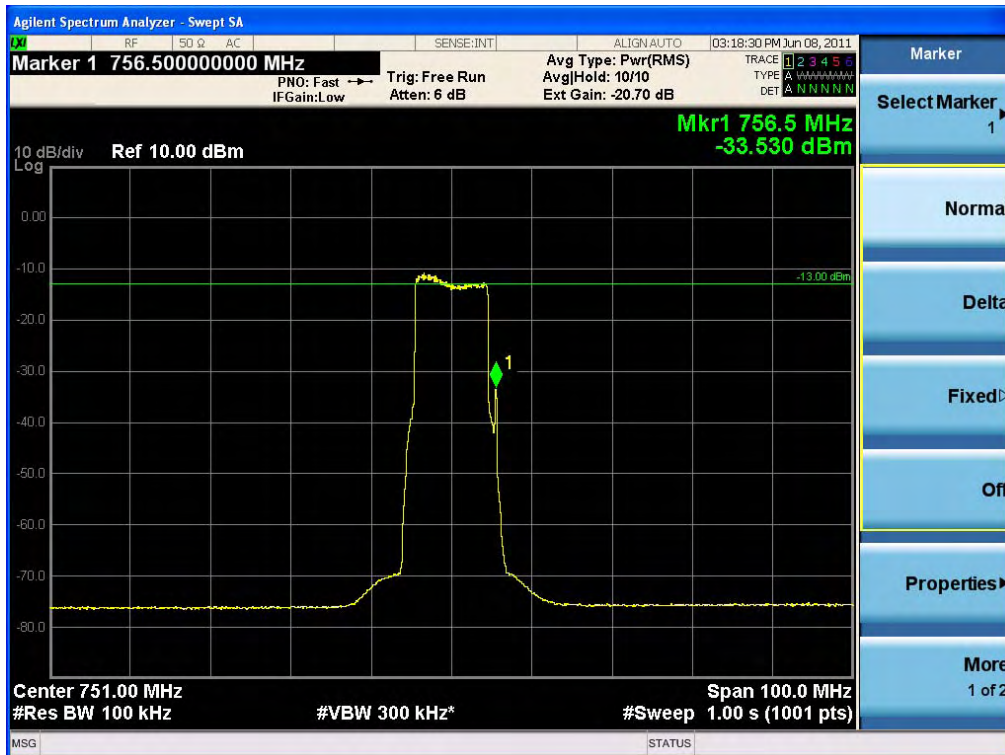
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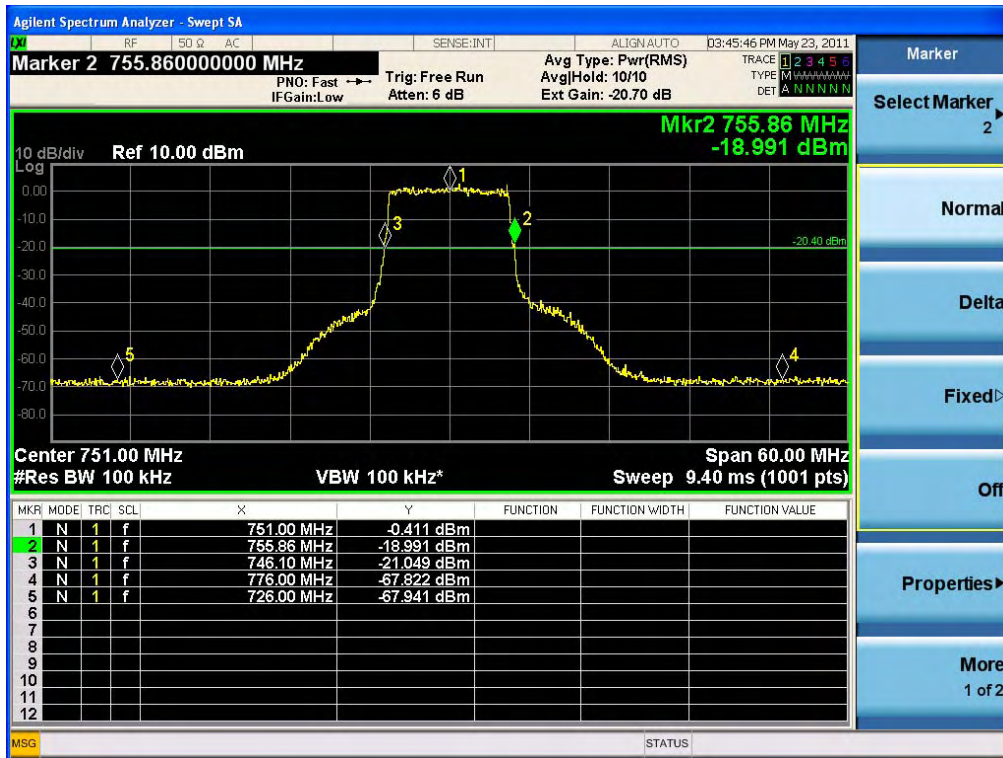
### Intermodulation Spurious Emissions Low CH



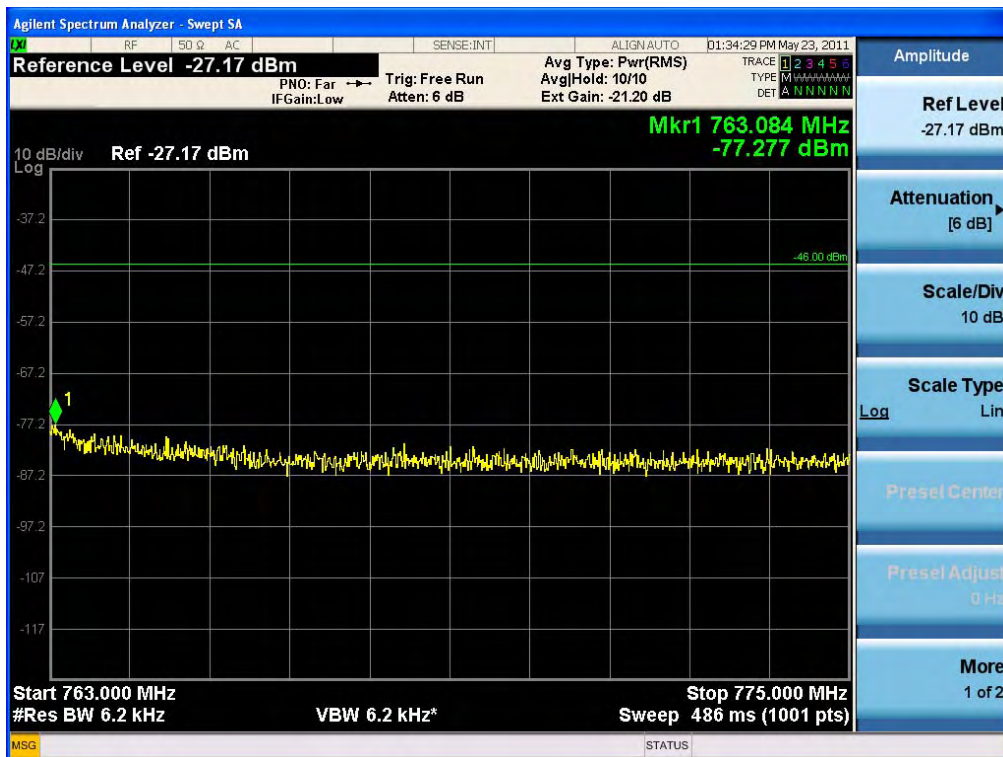
### Intermodulation Spurious Emissions High CH



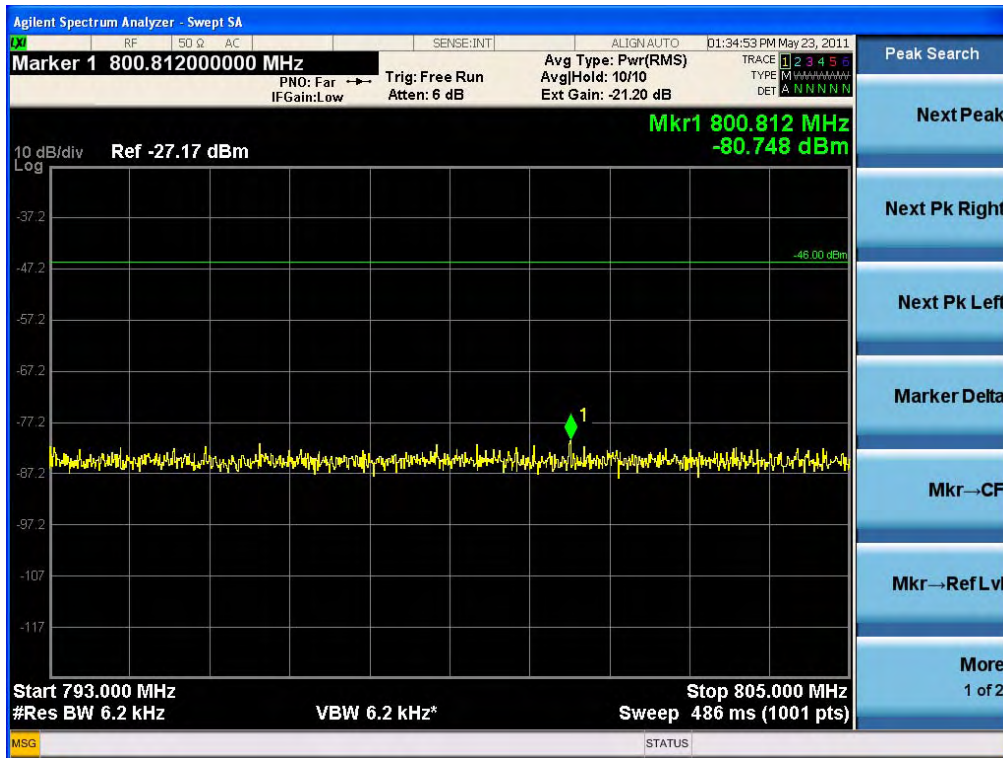
Out of Band Rejection Mid CH



27.53(c)(4) Mid CH (763~775: -46 dBm/6.25 kHz)



27.53(c)(4) Mid CH (793~805: -46 dBm/6.25 kHz)





## 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".

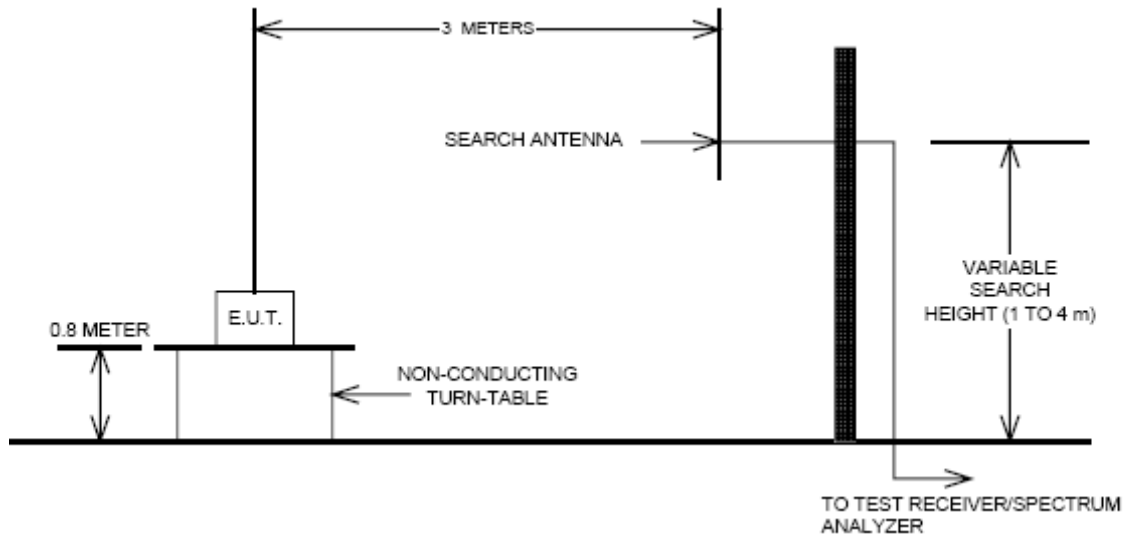
Radiated emission measurements were performed inside a 3 meter semi-anechoic chamber.

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

## Radiated Spurious Emissions Test Setup



Frequency	Freq.(MHz)	Substitute Level[dBm]	Ant. Gain (dBd)	C.L	Pol.	ERP (dBm)	Margin (dB)
751	1502.00	-52.07	6.24	4.70	V	-50.53	-37.53
	2253.00	-51.13	8.05	5.80	V	-48.88	-35.88

### Pat 27.53(f)

Frequency	Freq.(MHz)	Substitute Level[dBm]	Ant. Gain (dBd)	C.L	Pol.	ERP (dBm)	Margin (dB)
751	1502.00	-52.30	6.65	4.80	V	-50.45	-37.45
	1610.00	-51.70	6.98	4.89	V	-49.61	-36.61

## 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.

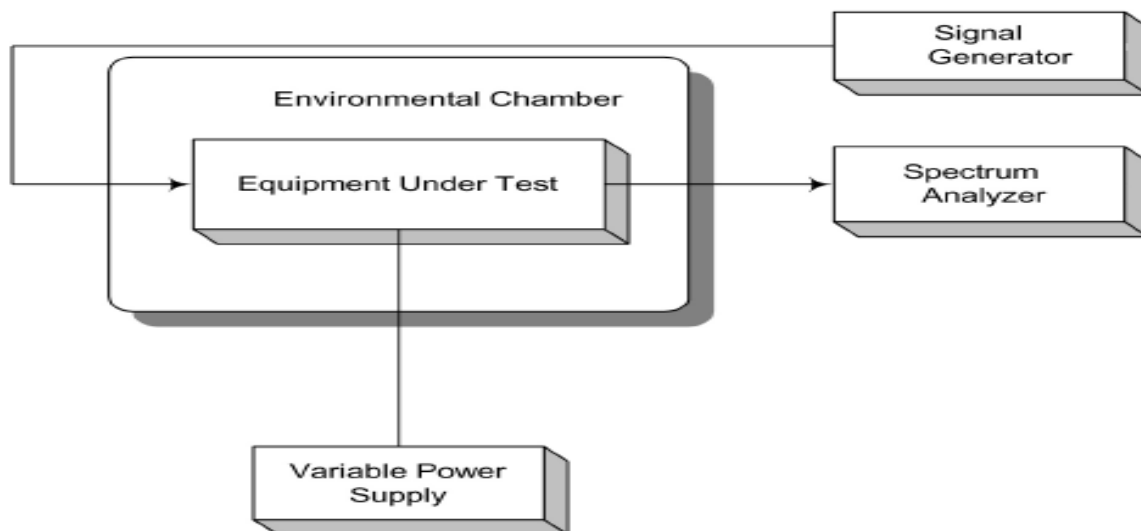
A CW signal was injected into the EUT at the appropriate RF level. The frequency counter option on the Spectrum Analyzer was used to measure frequency deviations.

The frequency drift was investigated for every 10 °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 Setup:**



**Test Results:**

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

## Frequency Stability and Voltage Test Results

**Reference: 12 Vdc at 20°C      Freq. = 751 MHz**

Voltage (%)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100%	+20(Ref)	751 000 003	3	0	0.0000
	-30	750 999 998	-2	-5	-0.0067
	-20	750 999 999	-1	-4	-0.0053
	-10	751 000 002	2	-1	-0.0013
	0	750 999 999	-1	-4	-0.0053
	+10	750 999 997	-3	-6	-0.0080
	+30	751 000 002	2	-1	-0.0013
	+40	750 999 997	-3	-6	-0.0080
	+50	750 999 998	-2	-5	-0.0067
115%	+20	750 999 999	-1	-4	-0.0053
85%	+20	750 999 998	-2	-5	-0.0067

## 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

Max Peak output Power at antenna input terminal	12.99	dBm
Max Peak output Power at antenna input terminal	19.907	mW
Prediction distance	20.000	cm
Prediction frequency	751.000	MHz
Antenna Gain(typical)	0.000	dBi
Antenna Gain(numeric)	1.000	—
Power density at prediction frequency( S)	0.00396	mW/cm <sup>2</sup>
MPE limit for uncontrolled exposure at prediction frequency	0.501	mW/cm <sup>2</sup>

3. RESULTS

The power density level at 20 cm is 0.00396 mW/cm<sup>2</sup>, which is below the uncontrolled exposure limit of 0.501 mW/cm<sup>2</sup> at 751 MHz for Repeater

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.