# CERTIFICATE OF COMPLIANCE
## FCC PART 90 Certification

| Applicant Name: | Date of Testing |
|---|---|
| Advanced RF Technologies, Inc. | March 8 to March 31, 2011 |
| | **Test Site/Location** |
| **Address:** | BWS TECH Inc. #611-1 Maesan-Ri, Mohyeon-Myeon, Yongin-Si, Gyeonggi-Do 449-853, Korea |
| 3116 WEST VANOWEN STREERT BURBANK, CA 91505, USA | **Test Report No.:** BWS-11-RF-0001 |
| | **BWS FRN:** 00099636881 |

| | |
|---|---|
| **FCC ID:** | **S2O-PSR78** |
| **APPLICANT:** | **Advanced RF Technologies, Inc.** |

| | |
|---|---|
| **Model(s):** | PSR78 |
| **EUT Type:** | iDEN Band Repeater |
| **RF Output Power:** | SMR700 : Downlink: 0.964W , Uplink: 0.859W |
| | SMR800 : Downlink: 0.743W , Uplink: 0.635W |
| **Frequency Range:** | SMR700 : 763 ~ 775 MHz(Downlink) , 793 ~ 805 MHz(Uplink) |
| | SMR800 : 851 ~ 869 MHz(Downlink) , 806 ~ 824 MHz(Uplink) |
| **FCC Classification:** | TNB |
| **FCC Rule Part(s):** | CFR 47, Part 90 subpart I |

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.
**BWS TECH Inc.** Certifies that no party to this application has been denied FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998,21 U.S C.862

(Date) 03/31/2011

Tested by **KwanHeon, Lee**

(Date)03/31/2011

Reviewed by **TaeHyun, Nam**

**BWS TECH Inc.**
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# 1. General Information

**Applicant**

| | |
|---|---|
| **Company Name** | :Advanced RF Technologies, Inc. |
| **Company Address** | :3116 WEST VANOWEN STREERT BURBANK, CA 91505, USA |
| **Phone/Fax** | :Phone : 800-313-9345 Fax : 818-840-8138 |

**Manufacturer**

| | |
|---|---|
| **Company Name** | :ADRF KOREA Inc. |
| **Company Address** | :5-5, Mojeon-Ri, Backsa-Myun, Incheon-City, Kyunggi-Do, Korea. |
| **Phone/Fax** | :Phone : +82-31-637-4435 Fax : +82-31-638-7749 |

| | |
|---|---|
| ● **EUT Type** | :iDEN Band Repeater |
| ● **Model Name** | :PSR78 |
| ● **FCC ID** | :S2O-PSR78 |
| ● **S/N** | :Prototype |
| ● **Freq. Range** | SMR700 : 763 ~ 775 MHz(Downlink) , 793 ~ 805 MHz(Uplink) |
| ● | SMR800 : 851 ~ 869 MHz(Downlink) , 806 ~ 824 MHz(Uplink) |
| ● **FCC Rule Part(s)** | :CFR 47,Part 90 Subpart I |
| ● **Test Procedure** | :ANSI C63.4-2009, EIA/TIA-603-Edition C 2004 |
| ● **Dates of Tests** | :March 8 to March 31, 2011 |
| ● **Place of Tests** | :BWS TECH Inc.(FCC Registration Number : 553281)<br>#611-1 Maesan-Ri, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do 449-853, Korea<br>TEL: +82 31 333 5997 FAX: +82 31 333 0017 |
| ● **Test Report No.** | :BWS-11-RF-0001 |

# 2. Description of Test Facility

The measurement for radiated emission test were practiced at the open area test site of BWS TECH Inc. Measurement for conducted emission test were practiced at the semi EMC Anechoic Chamber test site of BWS TECH Inc. facility located at #611-1 Maesan-Ri, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do 449-853, Korea. The site is constructed in conformance with the requirements of the ANSI C63.4-2009 and CISPR Publication 16. The BWS TECH measurement facility has been filed to the Commission with the FCC for 3 and 10-meter site configurations. Detailed description of test facility was found to be in compliance with the requirements of Section 2.948 FCC Rules according to the ANSI C63.4-1992 and registered to the Federal Communications Commission (Registration Number : 553281 ).

# 3. Product Information

## 3.1 Equipment Description

The Equipment Under Test (EUT) is RF transmitter by the Advanced RF Technologies.
Model : PSR78. (FCC ID :S2O-PSR78).

## 3.2 General Specification

The system specifications are subject to change without notice. For detailed system specifications, refer to the product catalog.

| Parameters | | Specifications | Remark |
|---|---|---|---|
| Frequency | SMR700 UL | 793 ~ 805MHz (BW: 12MHz) | |
| | SMR700 DL | 763 ~ 775 MHz (BW: 12MHz) | |
| | SMR800 DL | 851 ~ 869 MHz (BW: 18MHz) | |
| | SMR800 UL | 806 ~ 824 MHz (BW: 18MHz) | |
| Port | | 2Donor, 2Server | |
| Composite Output Power | | +36 dBm | 700 + 800 MHz |
| Gain Ripple | DL / UL | ≤ ±1.5 dB p-p | 700 + 800 MHz |
| Gain (DL / UL) | Maximum | 90 dB | |
| | Range | 30 dB | |
| | Step | 0.5 dB | |
| | Tolerance | ≤1 dB | |
| Input | SMR700 UL | -60 ~ -30dBm | |
| | SMR700 DL | -60 ~ -30dBm | |
| | SMR800 DL | -60 ~ -30dBm | |
| | SMR800 UL | -60 ~ -30dBm | |
| Channel Type | | Public Safety Multiple Channel | |
| Modulation Type | | iDen | |
| Roll Offs | DL / UL | ≥65 dBc | @ 0.5 MHz outside pass band |
| Adjustable Band Edge | SMR700 DL/UL | Resolution: 250kHz (Filter Download function.) | 250 kHz steps Size. |
| | SMR800 DL/UL | | |
| OIP3 | DL / UL | ≥ 50 dB | @ Gain 90 dB/60 dB |
| IMD | DL / UL | ≥ 40 dBc @ +30dBm total. Max Output Power @ 2Tone/1MHz | At least FCC Rule (-13dBm) |
| VSWR | DL / UL | ≤ 1.5: 1 | |
| RF Spurious Emission | DL / UL | ≤ -13 dBm | |
| Noise Figure | UL | ≤ 5 dB @max gain | ( UL-Only) |
| Delay | DL / UL | ≤ 8 us@ Standard Product. | Special Request It will be increase. |
| Impedance | | 50 Ohms | |

# 4. Test Specifications & Standards Environmental Test Conditions

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 90 Subpart I in accordance with BWS TECH Inc.

| Reference | Description | Compliant |
|---|---|---|
| Part 15 Subpart B §15.109(a) | Conducted Emissions | Yes |
| Part 15 Subpart B §15.107(a) | Radiated Emissions | Yes |
| §2.1046, §90.219 | RF Power Output | Yes |
| §2.1049 | Occupied Bandwidth | Yes |
| §2.1053, §2.1057, §90.210 | Radiated Spurious Emissions | Yes |
| §2.2053, §2.1057, §90.210 | Spurious Emissions at Antenna Terminals and Inter-Modulation | Yes |
| §2.1055, §90.213 | Frequency Stability | Yes |
| | Out Band Rejection | Yes |

| | |
|---|---|
| **Temperature** | 15℃ ~ 35℃ |
| **Relative humidity** | 30% ~ 60% |
| **Air pressure** | 860 ~ 1060 mbar |

# 5. Test Summary

The results in this report apply only to sample tested

| Test Case | Applied standard | Results |
|---|---|---|
| Conducted Emissions | Part 15 Subpart B §15.109(a) | Pass |
| Radiated Emissions | Part 15 Subpart B §15.107(a) | Pass |
| RF Power Output | §2.1046, §90.205 | Pass |
| Occupied Bandwidth | §2.1049 | Pass |
| Radiated Spurious Emissions | §2.1053, §2.1057, §90.210 | Pass |
| Spurious Emissions at Antenna Terminals and Inter-Modulation | §2.1053, §2.1057, §90.210 | Pass |
| Frequency Stability | §2.1055, §90.213 | Pass |
| Out Band Rejection | | Pass |

# 6. Test Equipment

The listing below denotes the test equipments utilized for the test(s).

| EQUIPMENT | | MODEL | MANUFACTURE | SERIAL NUMBER | Calibration Due date |
|---|---|---|---|---|---|
| 1 | Spectrum analyzer | FSP13SE | Rohde & Schwarz | 100278 | 11/07/01 |
| 2 | Spectrum analyzer | N9020A | Agilent | US46220101 | 11/09/25 |
| 3 | Frequency Counter | R5372 | Advantest | 41855204 | 11/10/14 |
| 4 | Power Meter | E4418A | Agilent | GB38272621 | 11/10/14 |
| 5 | Power Sensor | E9301B | Agilent | US40010238 | 11/10/14 |
| 6 | Signal Generator | IFR3413 | AEROFLEX | 341006/006 | 12/03/28 |
| 7 | Signal Generator | E4432B | Agilent | US40053157 | 11/10/15 |
| 8 | ATTENUATOR | SA18N25WA | FAIRVIEW MICROWAVE INC. | | 11/12/10 |
| 9 | Temperature & Humidity chanber | EN-GLMP-3000 | ENEX | | 12/03/04 |
| 10 | POWER DIVIDER | 11636A | H.P | 06434 | 12/03/31 |
| 11 | EMI Receiver | ESVN30 | Rohde & Schwarz | 832854/010 | 12/01/24 |
| 12 | Bilog Antenna | VULB9160 | SCHWARZBECK | 9160-3122 | 12/02/10 |
| 13 | Horn Antenna | BBHA 9120 D | SCHWARZBECK | BBHA 9120 D 234 | 12/10/04 |
| 14 | Test Receiver | ESPI | Rohde & Schwarz | 100012 | 12/01/25 |
| 15 | Test Receiver | ESPI | Rohde & Schwarz | 10063 | 12/01/24 |
| 16 | LISN | L1-115 | Com-Power | 241017 | 12/03/09 |
| 17 | Shield Room (7m x 4m x 3m) | N/A | SJEMC | 0004 | N/A |
| 18 | Turn Table | OSC-30 | N/A | BWS-01 | N/A |
| 19 | Antenna Mast | JAC-3 | Dail EMC | N/A | N/A |

# 7. Conducted Emissions

**Test Requirement:** **§15.107 Conducted limits**

15.107 (a) “Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 7. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.”

15.107 (b) “For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 7. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

| Frequency Range (MHz) | 15.107(b),Class A Limits (dBμV) | | 15.107(a),Class B Limits (dBμV) | |
|---|---|---|---|---|
| | Quasi-Peak | Average | Quasi-Peak | Average |
| 0.15 – 0.5 | 79 | 66 | 66 – 56 | 56 – 46 |
| 0.5 – 5.0 | 73 | 60 | 56 | 46 |
| 5.0 – 30 | 73 | 60 | 60 | 50 |
| Note 1 – The lower limit shall apply at the transition frequencies. | | | | |

Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 section 15.107(a)(b)

**Test Procedures:** The EUT was placed on a 0.8m-high wooden table inside a semi-anechoic chamber. The method of testing, test conditions, and test procedures of ANSI C63.4 were used. The EUT was powered through a 50Ω/50μH LISN. An EMI receiver, connected to the measurement port of the LISN, scanned the frequency range from 150 kHz to 30 MHz in order to find the peak conducted emissions. All peak emissions within 6 dB of the limit were measured using a quasi-peak and/or average detector as appropriate.

**Test Results:** The EUT was found compliant with the Class A requirement(s) of this section. Measured emissions were below applicable limits.

**Test Engineer(s):** Kwanheon, LEE

**Test Date(s):** March 31, 2011

# Conducted Emissions Test Results – Model SMR700 & SMR800

| | | |
|---|---|---|
| EUT | : | PSR78-9030 |
| Test Standard | : | FCC Part 15 Subpart B Section 15.107 |
| Test Date | : | March 31, 2011 |
| Operating Condition | : | RF Signal INPUT & OUTPUT Mode |
| Environment Condition | : | Temperature : 23 ℃, Humidity Level : 40 %RH |
| Result | : | Passed by –15.22 dB |

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line.

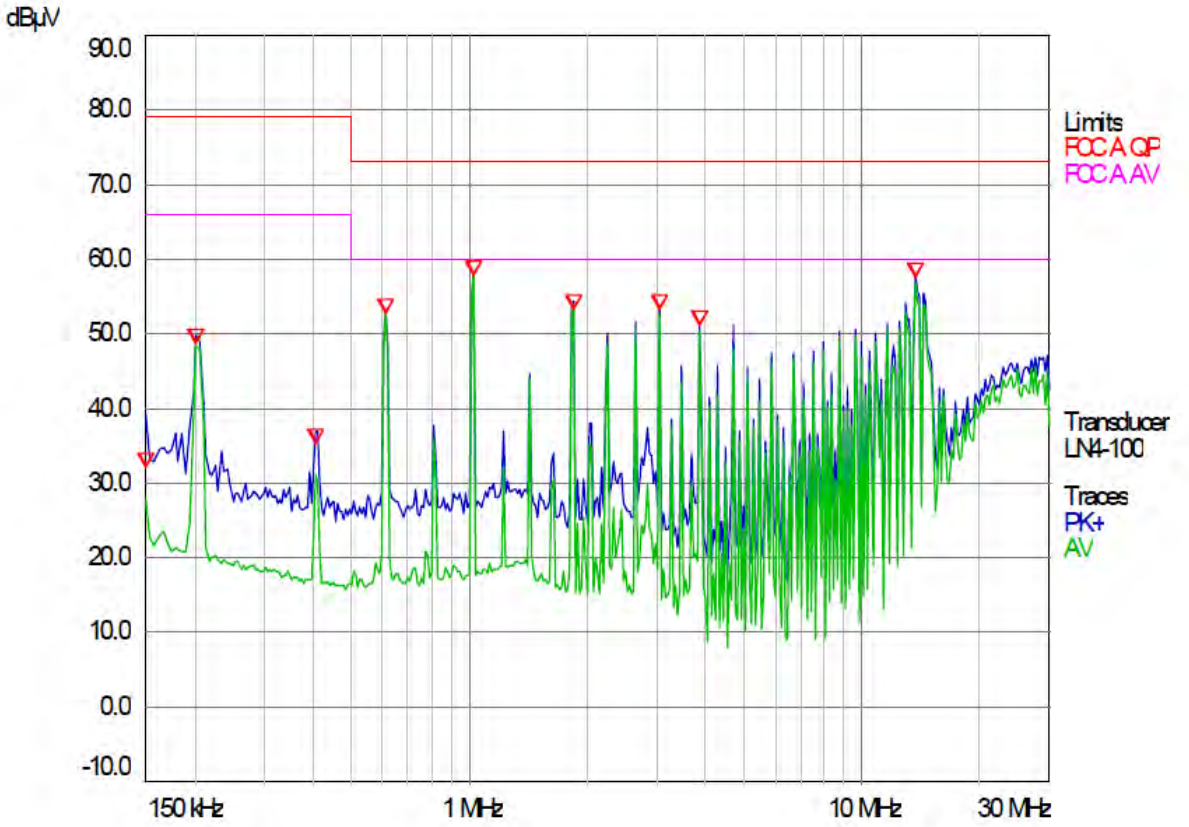
**Tabulated Conducted Emission Test Data**

Detector Mode ; CISPR Quasi Peak mode / Average mode (6dB Bandwidth : 9kHz).

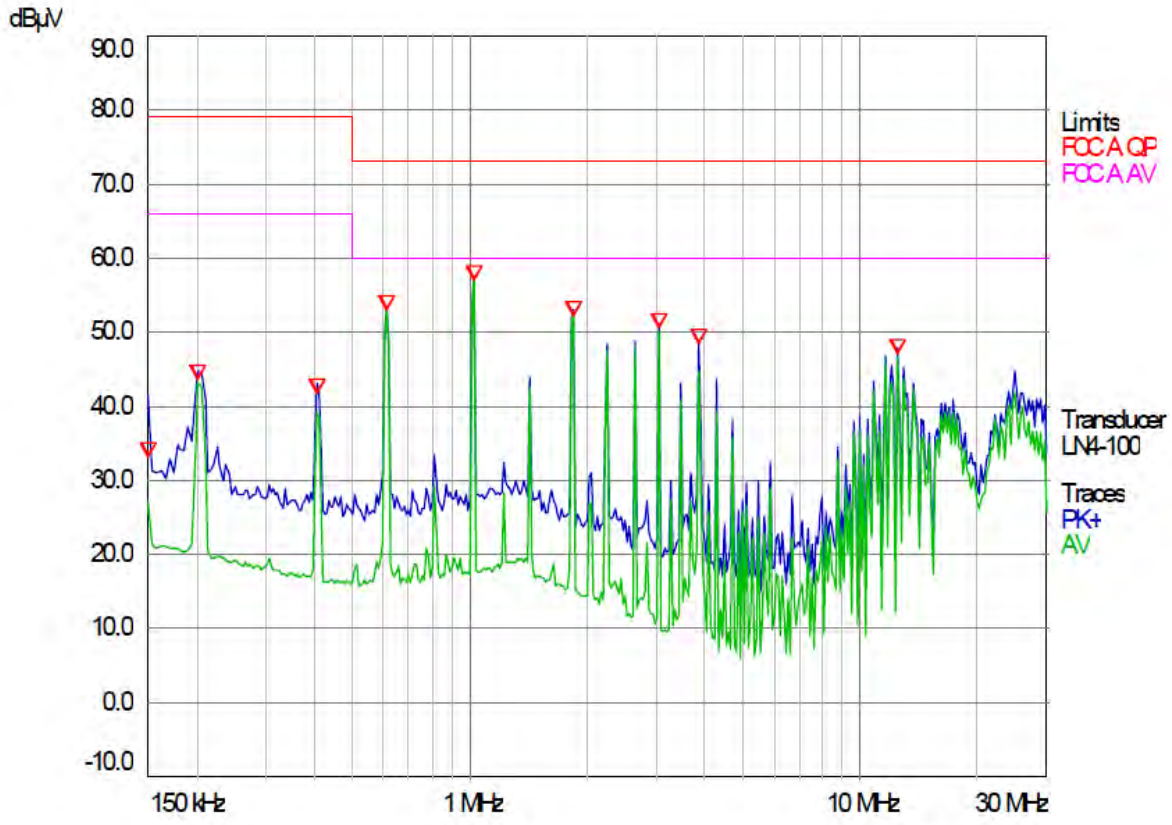
| Freq [MHz] | Correcton | | Phase [H/N] | Quasi-Peak Mode | | | | Average Mode | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | AMN | C.L | | Limit | Reading | Emission Level | Margin | Limit | Reading | Emission Level | Margin |
| | | | | [dBuV] | [dBuV] | [dBuV] | [dBuV] | [dBuV] | [dBuV] | [dBuV] | [dBuV] |
| 0.150 | 0.06 | 0.03 | H | 79.00 | 33.13 | 33.22 | -45.78 | 66.00 | | | |
| 0.202 | 0.07 | 0.10 | N | | 48.44 | 48.61 | -30.39 | | | | |
| 0.406 | 0.08 | 0.26 | N | | 41.33 | 41.67 | -37.33 | | | | |
| 0.612 | 0.07 | 0.30 | H | 73.00 | 52.51 | 52.88 | -20.12 | 60.00 | | | |
| 1.020 | 0.04 | 0.40 | N | | 57.34 | 57.78 | -15.22 | | | | |
| 1.836 | 0.03 | 0.52 | H | | 52.80 | 53.35 | -19.65 | | | | |
| 3.056 | 0.04 | 0.61 | H | | 52.54 | 53.19 | -19.81 | | | | |
| 3.872 | 0.03 | 0.74 | H | | 50.35 | 51.12 | -21.88 | | | | |
| 13.652 | 0.06 | 1.20 | H | | 56.28 | 57.54 | -15.46 | | | | |

**NOTES :**

1. H : Hot Line , N :Neutral Line
2. Emission Level = Reading + Correction Factor
3. Measurements were performed at the AC Power Inlet of the host PC with the EUT plugged in the frequency band of 150kHz ~30MHz
4. Margin = Limit - Emission Level
5. Measurement uncertainty estimated at ±3.736 dB.
   The measurement uncertainty is given with a confidence of 95.00 % with the coverage factor, k=2.




Plot of Conducted Emission Test Mode NEUTRAL




Plot of Conducted Emission Test Mode HOT

# 8. Radiated Emissions

**Test Requirement:** **§15.109 Radiated emission limits**

15.109 (a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 10.

15.109 (b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the Class A limits expressed in Table 10.

| Frequency (MHz) | Field Strength (dBμV/m) | |
|---|---|---|
| | 15.107(b),Class A Limits (dBμV) | 15.107(a),Class B Limits (dBμV) |
| 30 – 88 | 39.00 | 40.00 |
| 88 – 216 | 43.50 | 43.50 |
| 216 – 960 | 46.40 | 46.00 |
| Above 960 | 49.50 | 54.00 |

Radiated Emissions Limits calculated from FCC Part 15 , §15.109(a)(b)

**Test Procedures:** The EUT was placed on a 0.8m-high wooden table inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 3 m from the EUT on an adjustable mast. A pre-scan was first performed in order to find prominent radiated emissions. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

(Emissions measured at 3m were normalized using an inverse proportionality factor of 20dB per decade for comparison to the 10 m limit.)

**Test Results:** The EUT was found Compliant with the Class A requirement(s) of this section. Measured emissions were below applicable limits

**Test Engineer(s):** Kwanheon, LEE

**Test Date(s):** March 30, 2011

# Radiated Emissions Test Results – Model SMR700 & SMR800

| | | |
|---|---|---|
| EUT | : | PSR78-9030 |
| Test Standard | : | FCC Part 15 Subpart B Section 15.109 |
| Test Date | : | March 31, 2011 |
| Operating Condition | : | RF Signal INPUT & OUTPUT Mode |
| Environment Condition | : | Temperature : 15 ℃, Humidity Level : 48 %RH |
| Result | : | Passed |

## Radiated Emission Test Data(below 1 GHz)

| Frequency [MHz] | Reading [dBμV] | Polarization [*H/**V] | Ant.Factor [dB] | Cable Loss [dB] | Limit [dBμV/m] | Emission Level [dBμV/m] | Margin [dB] |
|---|---|---|---|---|---|---|---|
| 46.30 | 22.67 | V | 12.30 | 1.53 | 39.00 | 36.50 | -2.50 |
| 54.86 | 22.51 | V | 12.22 | 1.67 | 39.00 | 36.40 | -2.60 |
| 119.68 | 21.82 | V | 11.59 | 2.39 | 43.50 | 35.80 | -7.70 |
| 150.04 | 19.07 | V | 13.22 | 2.71 | 43.50 | 35.00 | -8.50 |

NOTES:

1. All modes of operation were investigated and the worst-case emissions are reported.
2. This test being a result which used RF amplifier.
3. AF = Antenna Factor CL = Cable Loss F/S = Field Strength
4. POL H = Horizontal POL V = Vertical

# 9. RF Power Output

**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.

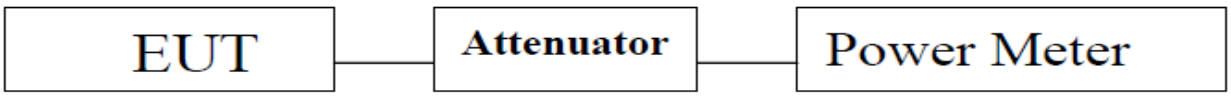
§ 90.219(b) Class A narrowband signal boosters must be equipped with automatic gain control circuitry which will limit the total effective radiated power(ERP) of the unit to a maximum of 5 watts under all conditions.

**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.

**Test Results:** The EUT complies with the requirements of this section. The EUT conducted power does not exceed limit at the carrier frequency.

**Test Engineer(s):** KwanHeon, Lee

**Test Date(s):** March 24, 2011




**Block Diagram 1. RF Power Output Test Setup**

# RF Power Output Test Results – Model SMR700 & SMR800

| SMR700(Downlink) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Carrier Channel | Frequency (MHz) | Input Signal Level (dBm) | Maximum Gain (dB) | Measured Average Output Power (dBm) | Antenna Gain (dB) | Measured Average Output Power (W) | ERP (mW) |
| Low | 763 | -60 | 90 | 26.50 | 11 | 0.447 | 3428 |
| Mid | 769 | -60 | 90 | 29.84 | 11 | 0.964 | 7396 |
| High | 775 | -60 | 90 | 28.12 | 11 | 0.649 | 4977 |
| SMR700(Uplink) | | | | | | | |
| Carrier Channel | Frequency (MHz) | Input Signal Level (dBm) | Maximum Gain (dB) | Measured Average Output Power (dBm) | Antenna Gain (dB) | Measured Average Output Power (W) | ERP (mW) |
| Low | 793 | -60 | 90 | 27.35 | 2 | 0.543 | 525 |
| Mid | 799 | -60 | 90 | 29.34 | 2 | 0.859 | 830 |
| High | 805 | -60 | 90 | 27.13 | 2 | 0.516 | 499 |

**RF Power Output Test Results**

| SMR800(Downlink) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Carrier Channel | Frequency (MHz) | Input Signal Level (dBm) | Maximum Gain (dB) | Measured Average Output Power (dBm) | Antenna Gain (dB) | Measured Average Output Power (W) | ERP (mW) |
| Low | 851 | -60 | 90 | 27.48 | 11 | 0.560 | 4295 |
| Mid | 860 | -60 | 90 | 28.42 | 11 | 0.695 | 5333 |
| High | 869 | -60 | 90 | 28.71 | 11 | 0.743 | 5702 |
| SMR800(Uplink) | | | | | | | |
| Carrier Channel | Frequency (MHz) | Input Signal Level (dBm) | Maximum Gain (dB) | Measured Average Output Power (dBm) | Antenna Gain (dB) | Measured Average Output Power (W) | ERP (mW) |
| Low | 806 | -60 | 90 | 27.39 | 2 | 0.548 | 530 |
| Mid | 815 | -60 | 90 | 28.03 | 2 | 0.635 | 614 |
| High | 824 | -60 | 90 | 26.74 | 2 | 0.472 | 456 |

**RF Power Output Test Results**

# 10. 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.

**Test Engineer(s):** KwanHeon, Lee

**Test Date(s):** March 30, 2011

## Occupied Bandwidth Test Results – Model SMR700 & SMR800

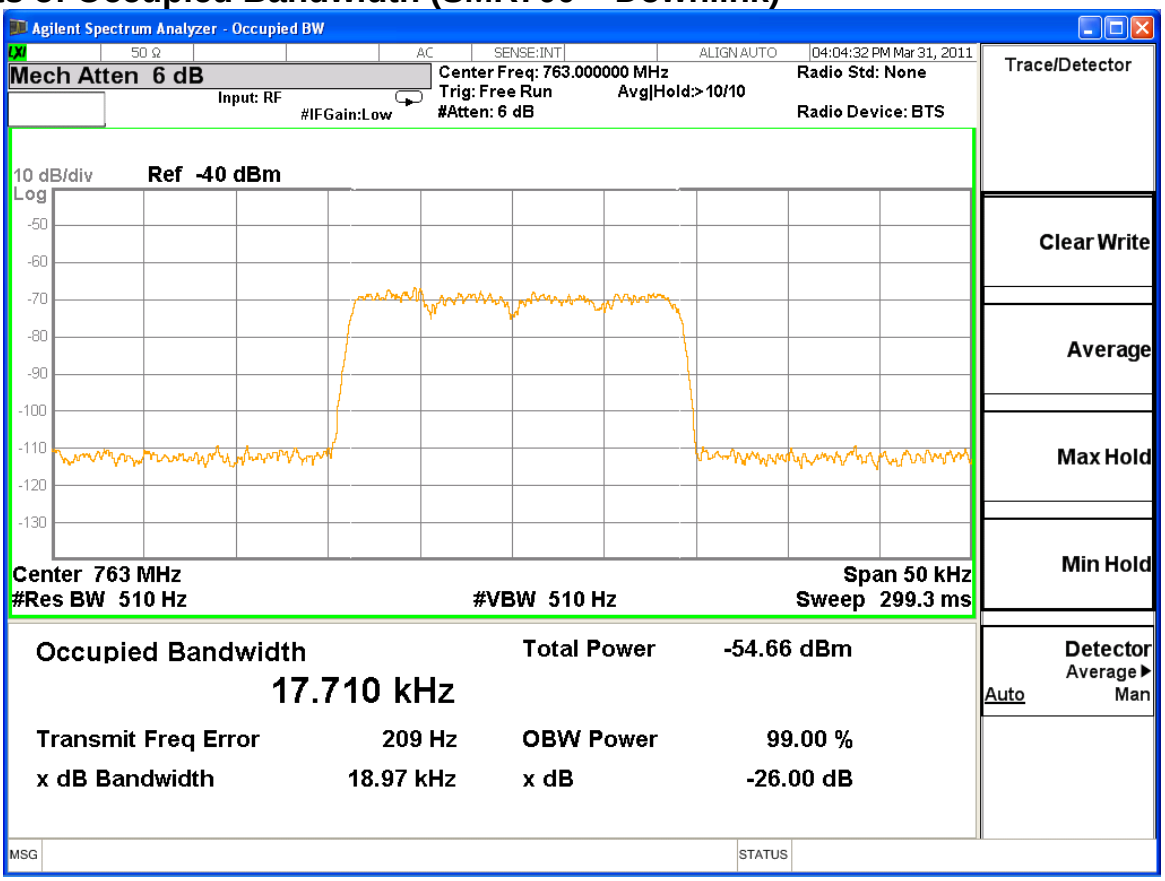
| SMR700(Downlink) | | |
|---|---|---|
| Carrier Channel | Frequency (MHz) | Occupied Bnadwidth (KHz) |
| Low | 763 | 17.712 |
| Mid | 769 | 17.653 |
| High | 775 | 17.614 |
| SMR700(Uplink) | | |
| Carrier Channel | Frequency (MHz) | Occupied Bnadwidth (KHz) |
| Low | 793 | 17.632 |
| Mid | 799 | 17.632 |
| High | 805 | 17.605 |

**Occupied Bandwidth Test Results**

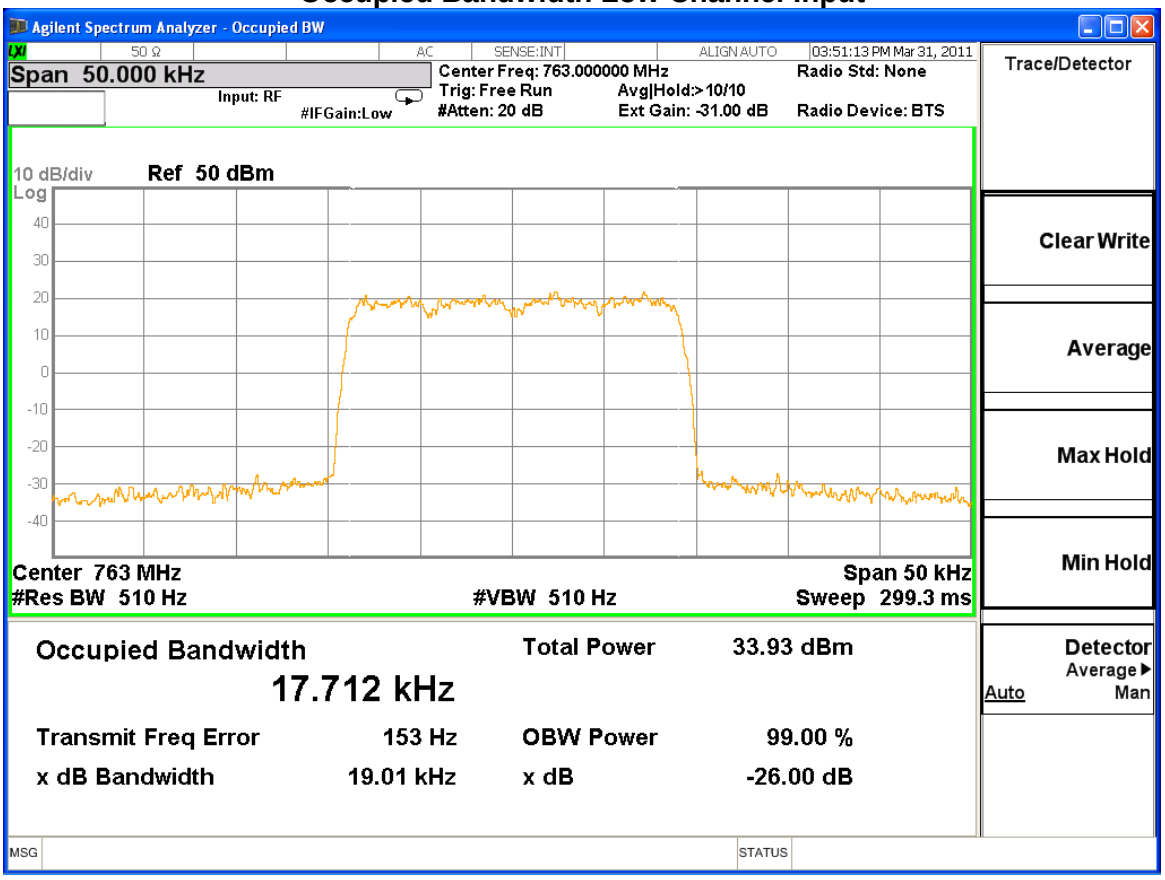
| SMR800(Downlink) | | |
|---|---|---|
| Carrier Channel | Frequency (MHz) | Occupied Bnadwidth (KHz) |
| Low | 851 | 17.694 |
| Mid | 860 | 17.756 |
| High | 869 | 17.659 |
| SMR800(Uplink) | | |
| Carrier Channel | Frequency (MHz) | Occupied Bnadwidth (KHz) |
| Low | 806 | 17.689 |
| Mid | 815 | 17.649 |
| High | 824 | 17.636 |

**Occupied Bandwidth Test Results**

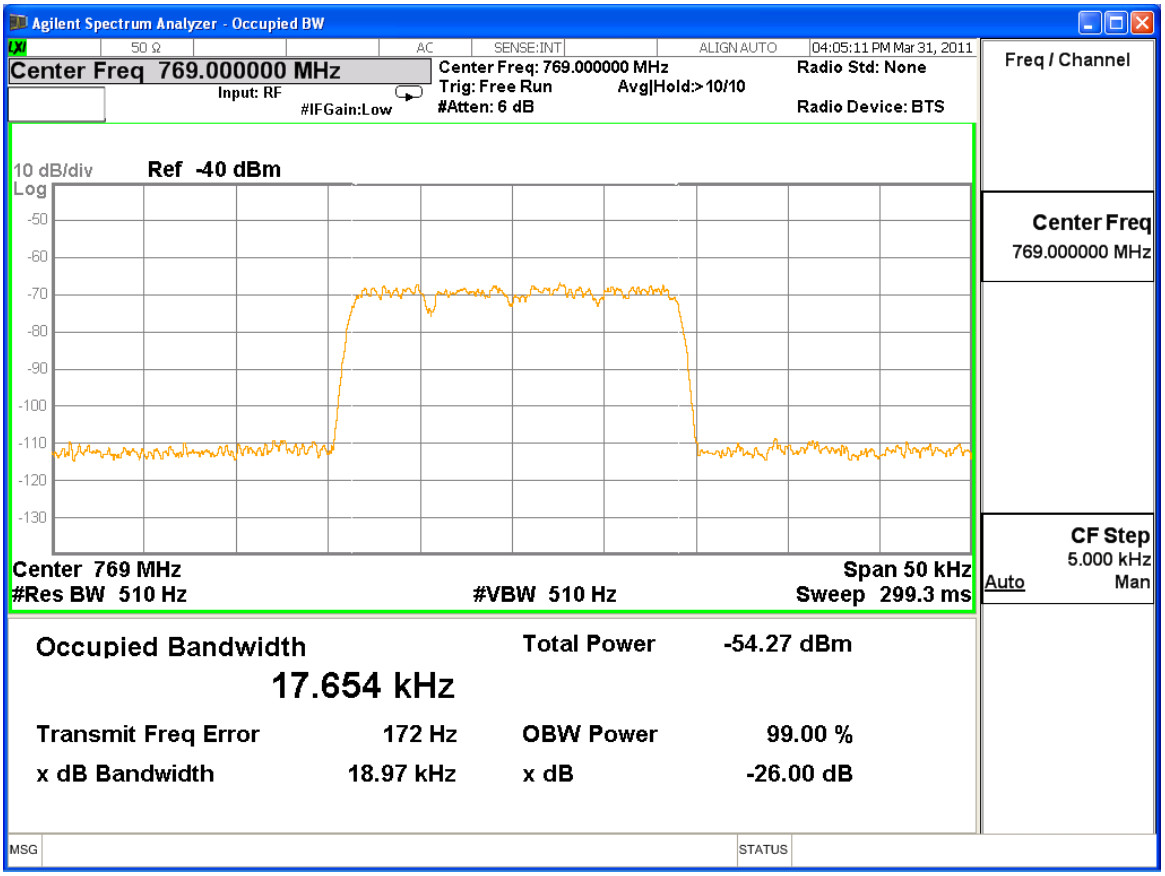
## Plots of Occupied Bandwidth (SMR700 – Downlink)



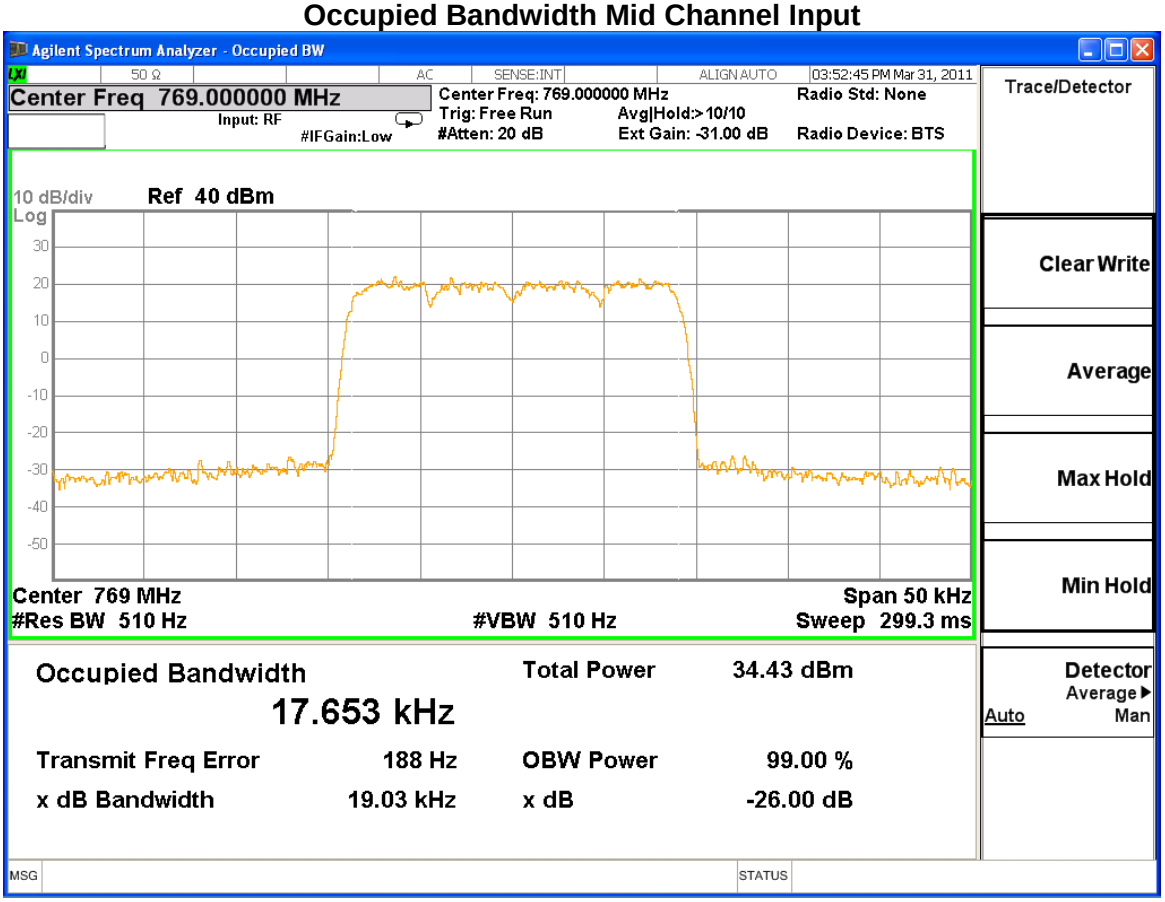

Occupied Bandwidth Low Channel Input



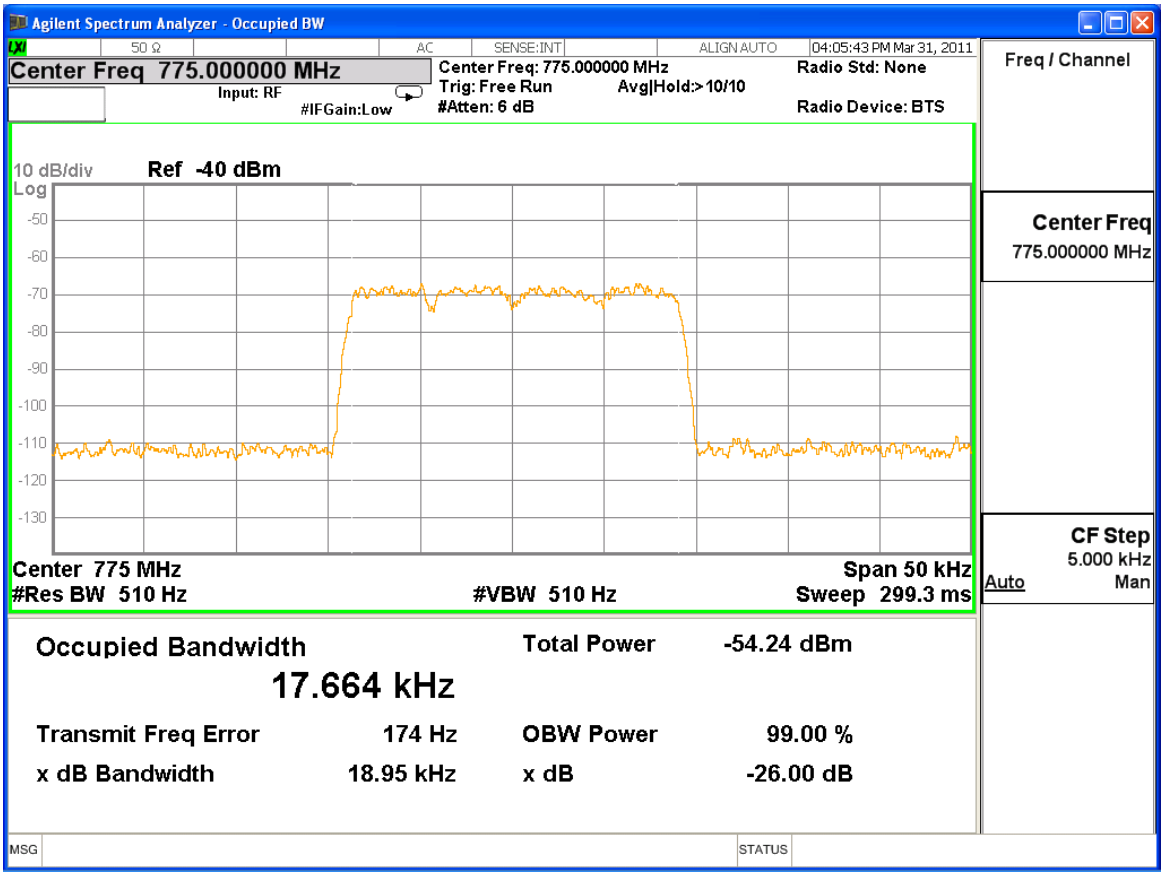

Occupied Bandwidth Low Channel Output



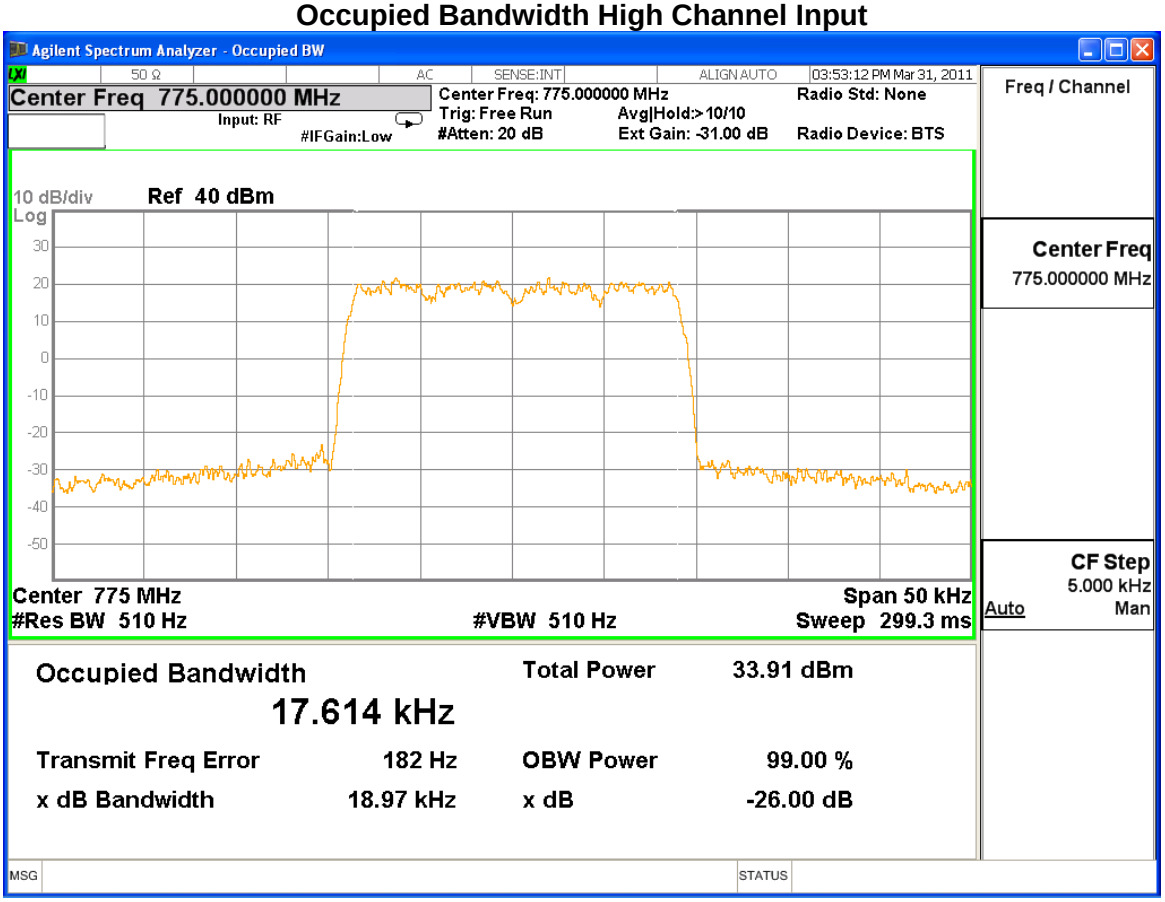

Occupied Bandwidth Mid Channel Input




Occupied Bandwidth Mid Channel Output

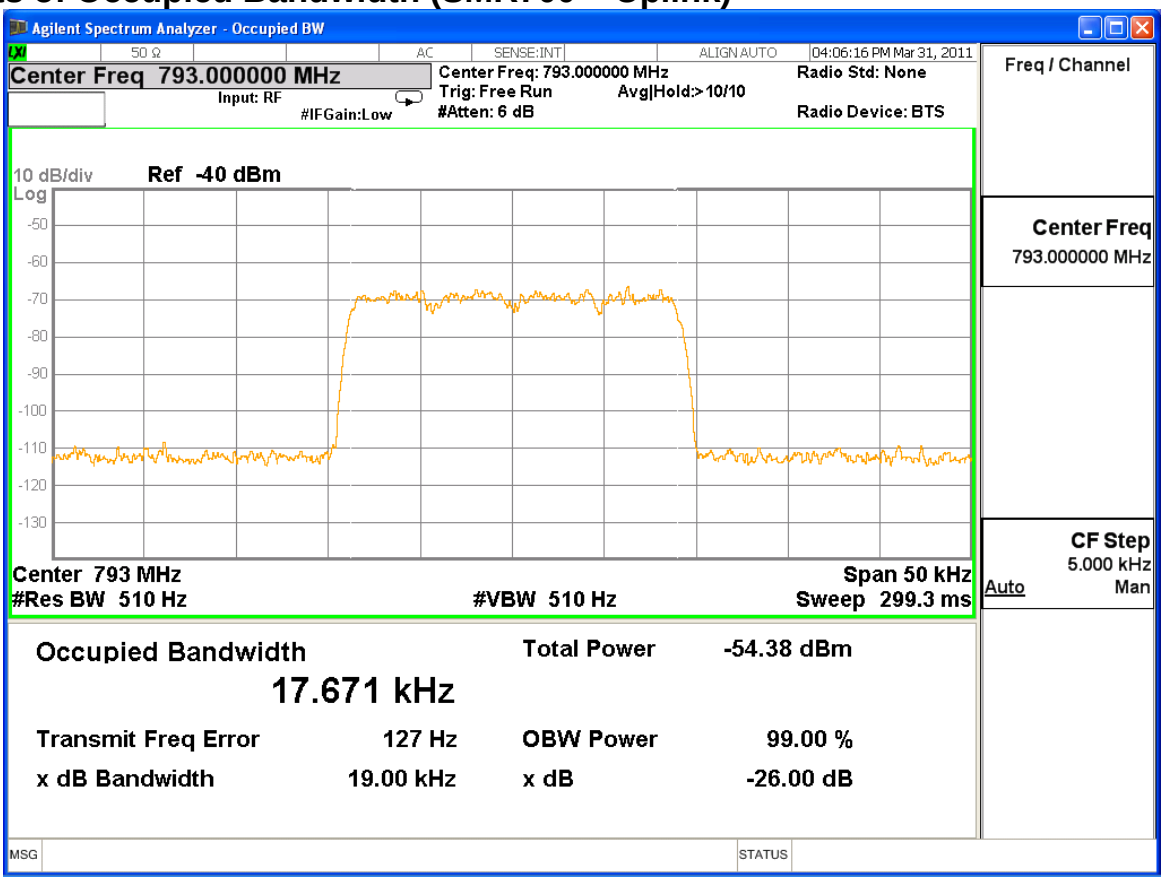



**Occupied Bandwidth High Channel Input**

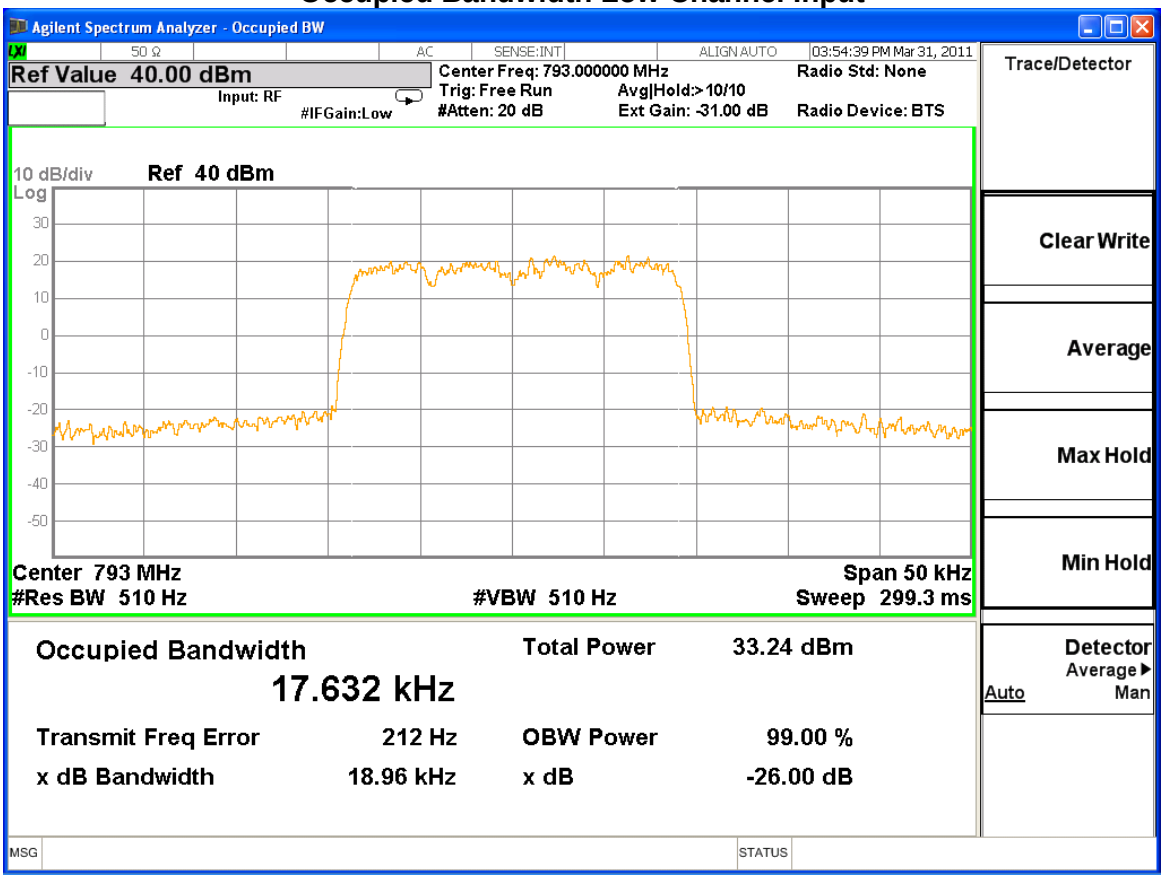



**Occupied Bandwidth High Channel Output**

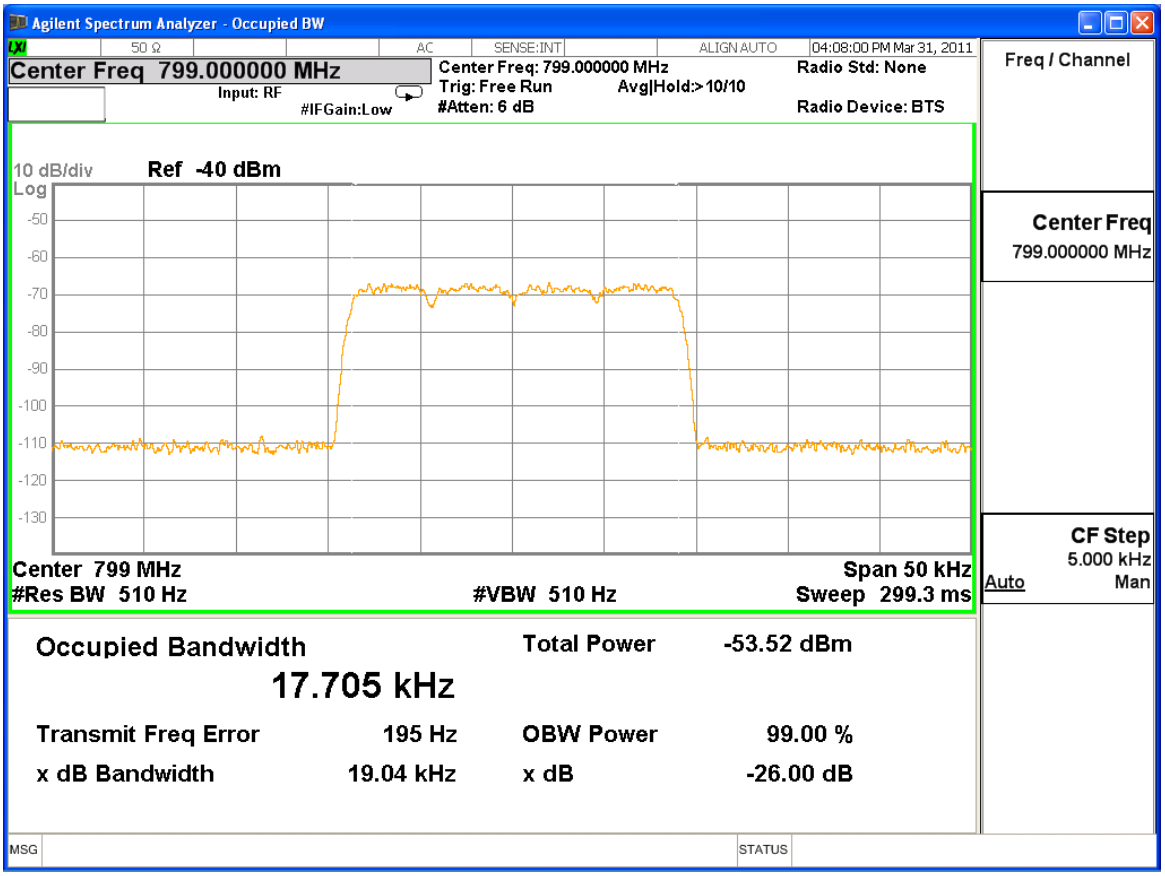
## Plots of Occupied Bandwidth (SMR700 – Uplink)



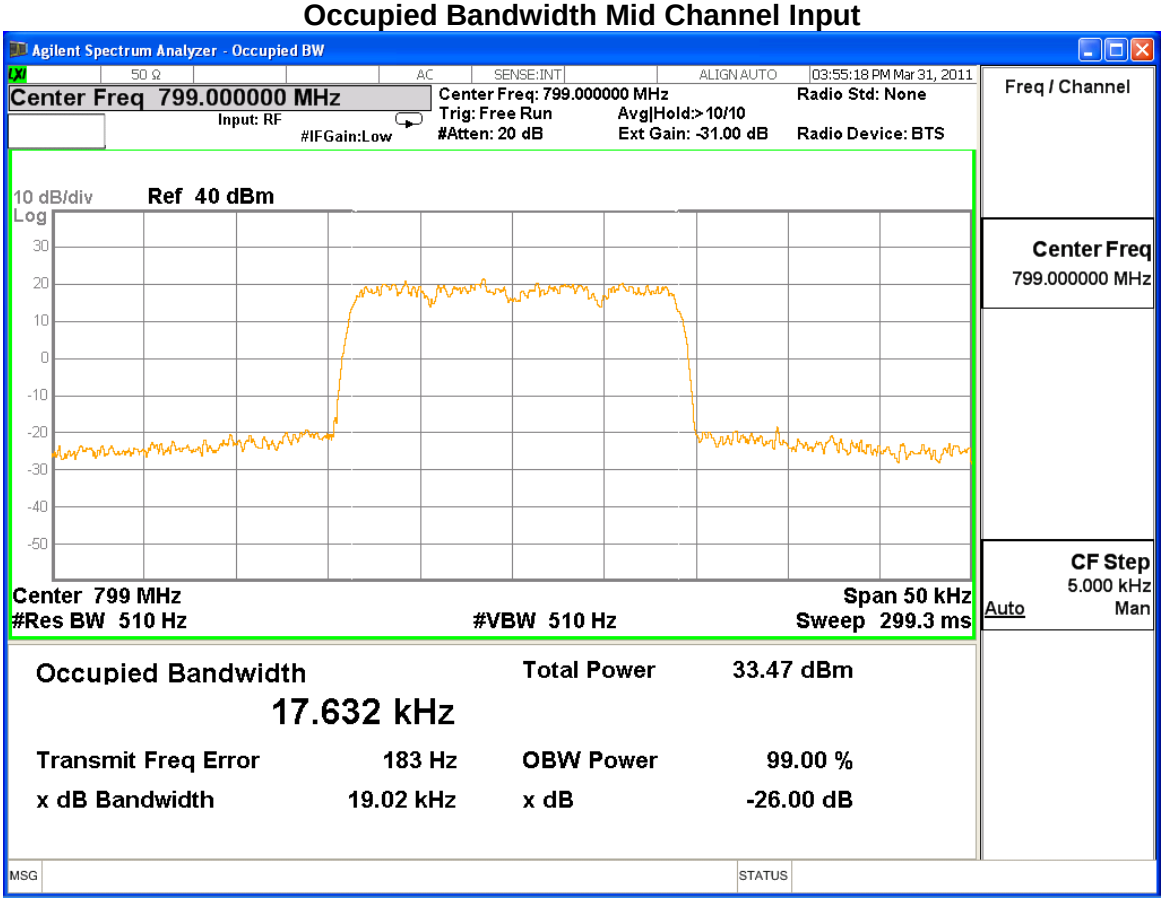

Occupied Bandwidth Low Channel Input



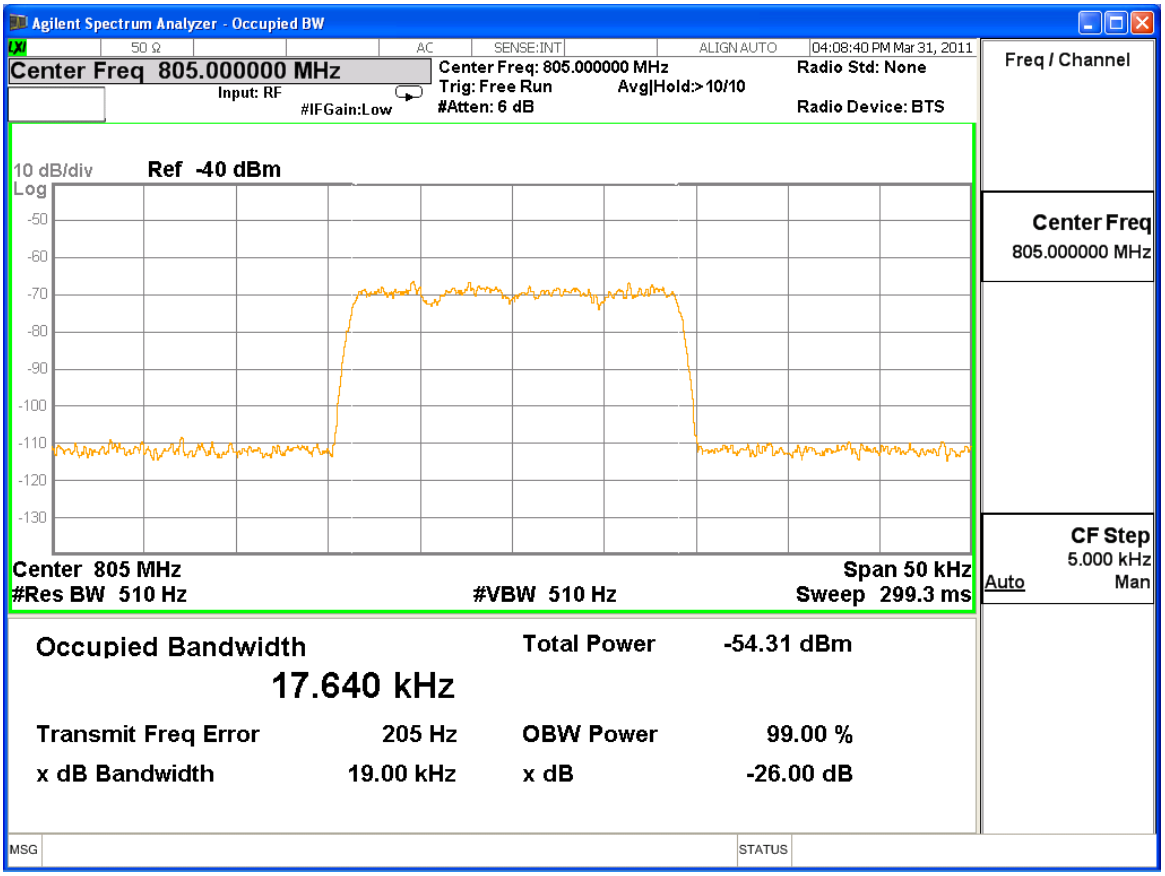

Occupied Bandwidth Low Channel Output



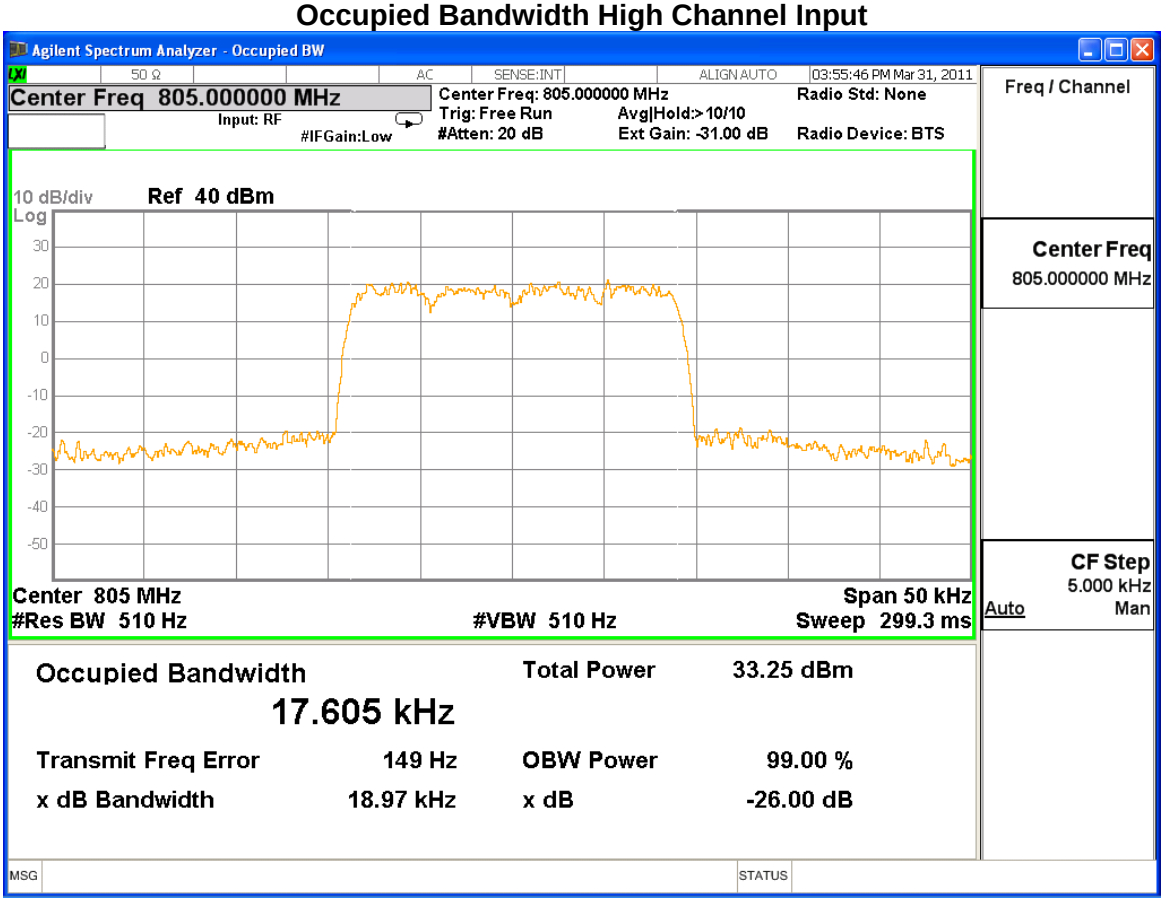

Occupied Bandwidth Mid Channel Input




Occupied Bandwidth Mid Channel Output

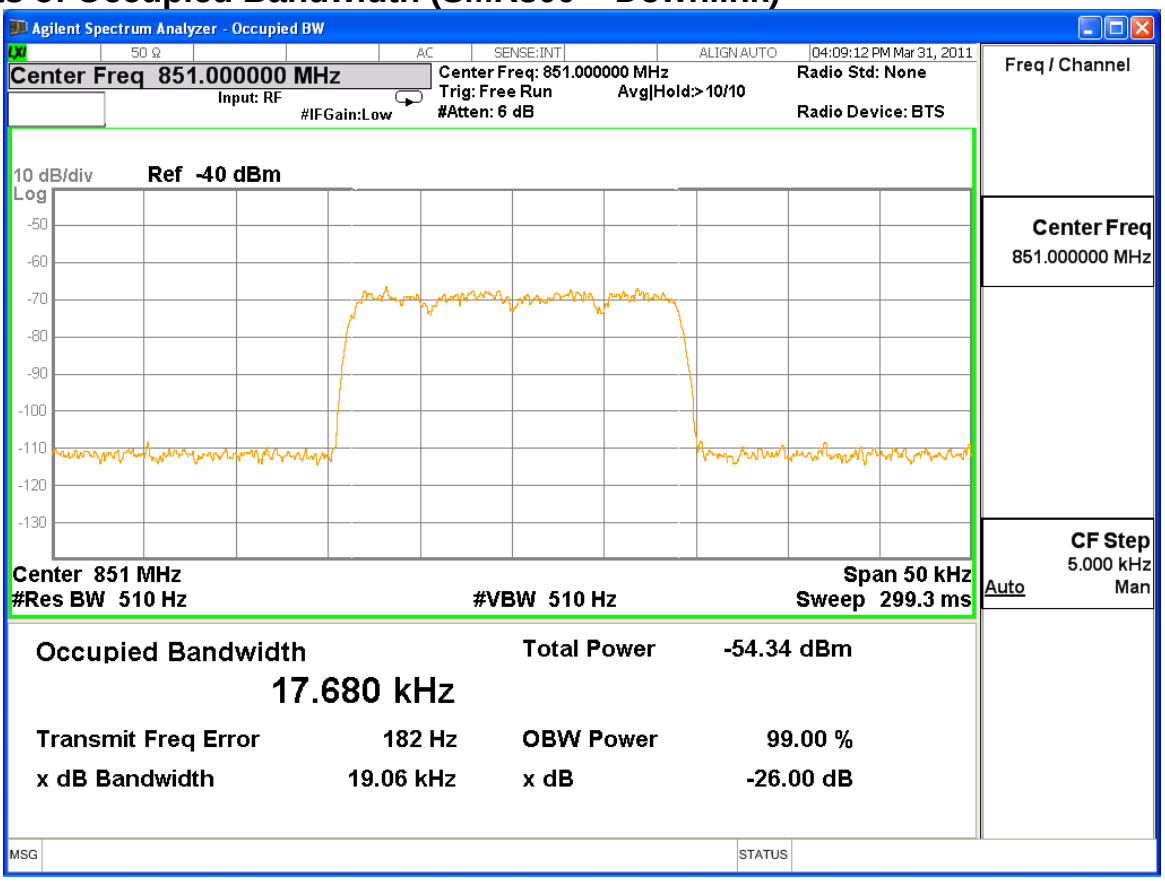



Occupied Bandwidth High Channel Input

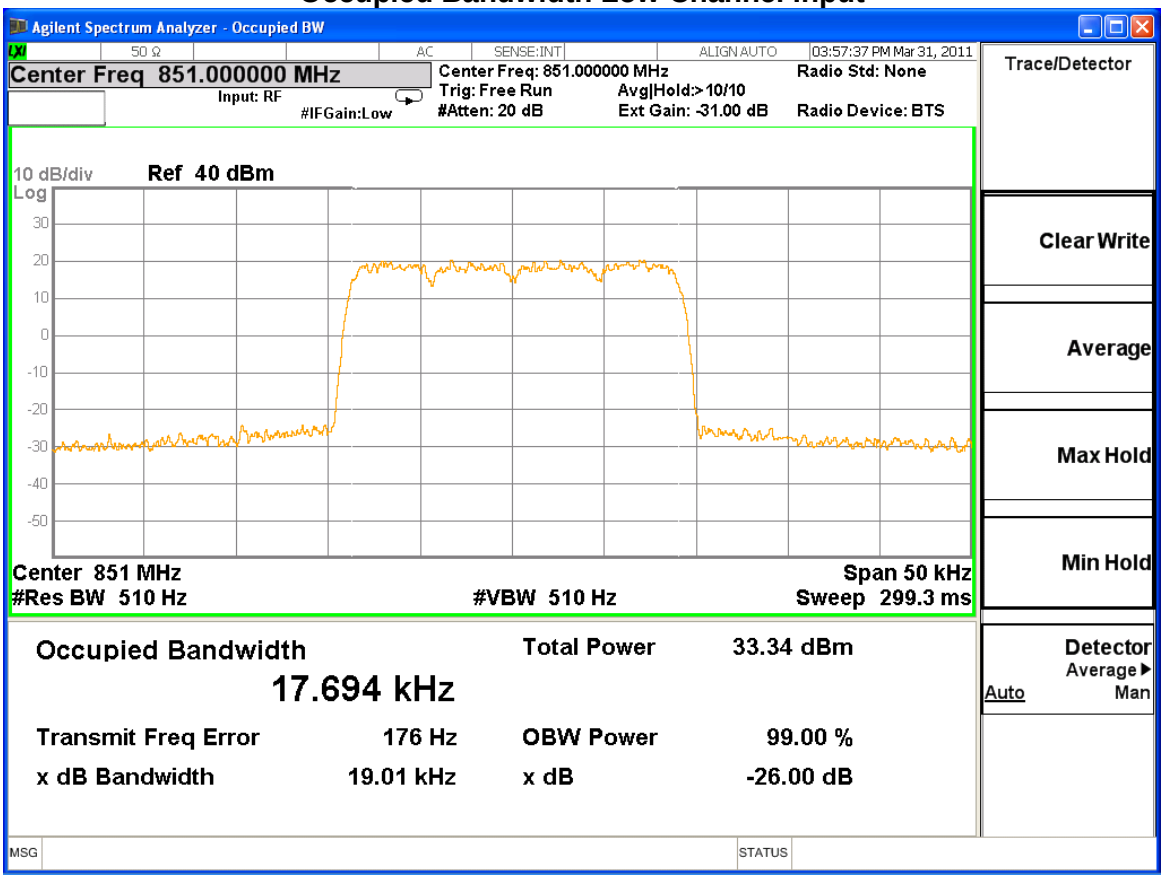



Occupied Bandwidth High Channel Output

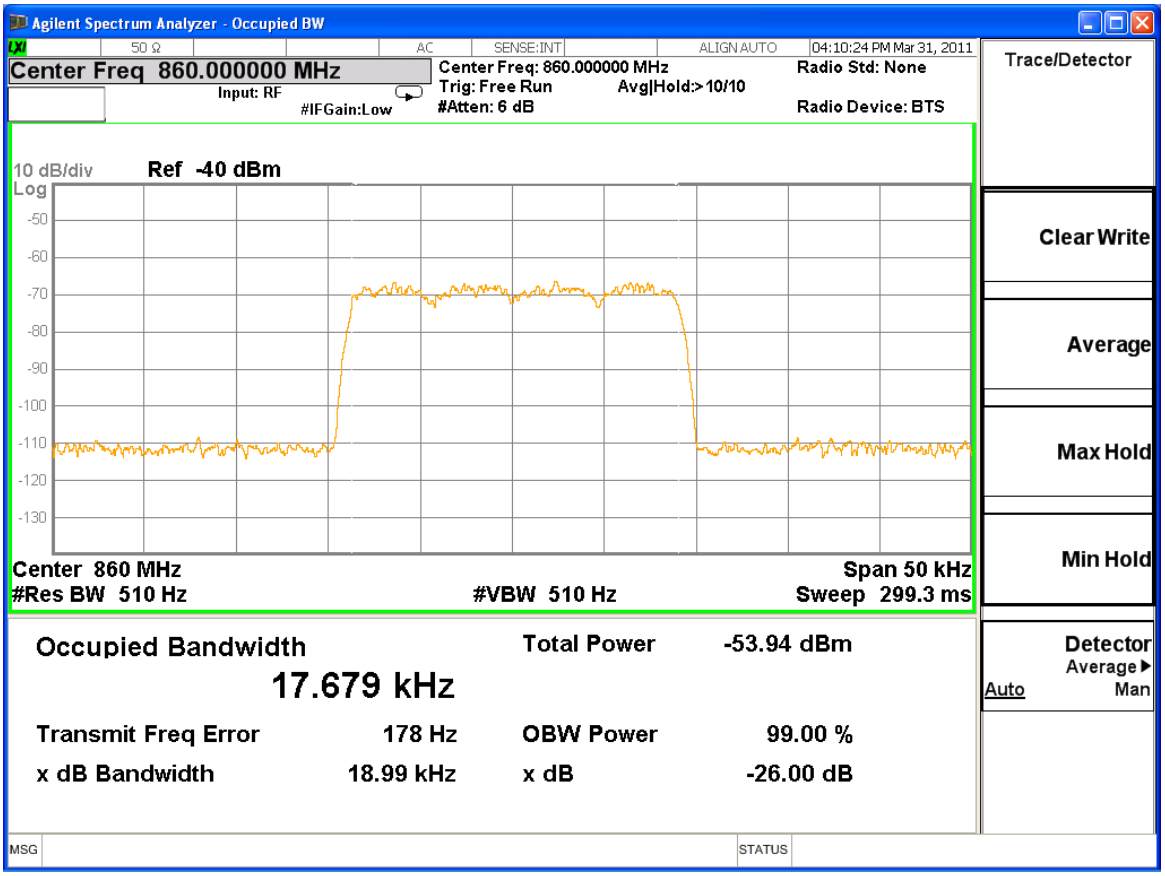
## Plots of Occupied Bandwidth (SMR800 – Downlink)



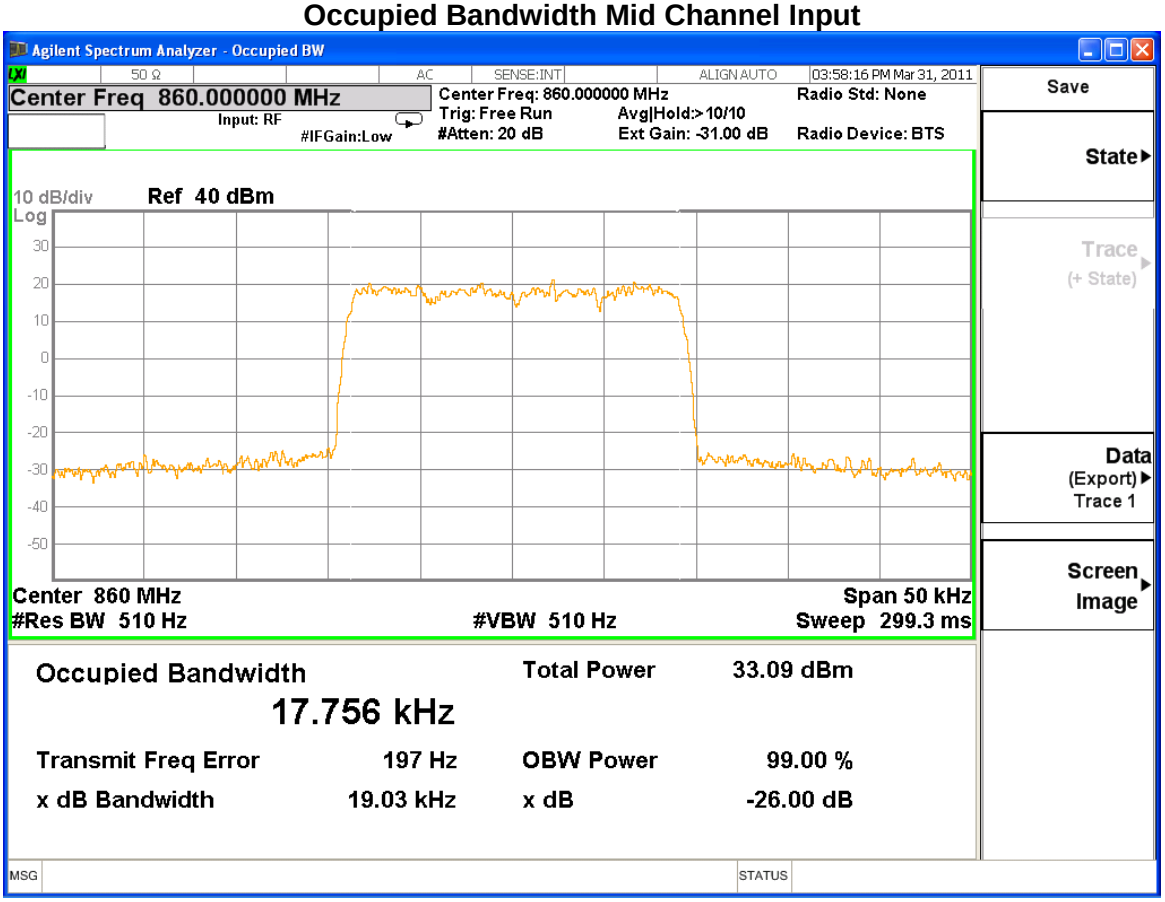

Occupied Bandwidth Low Channel Input



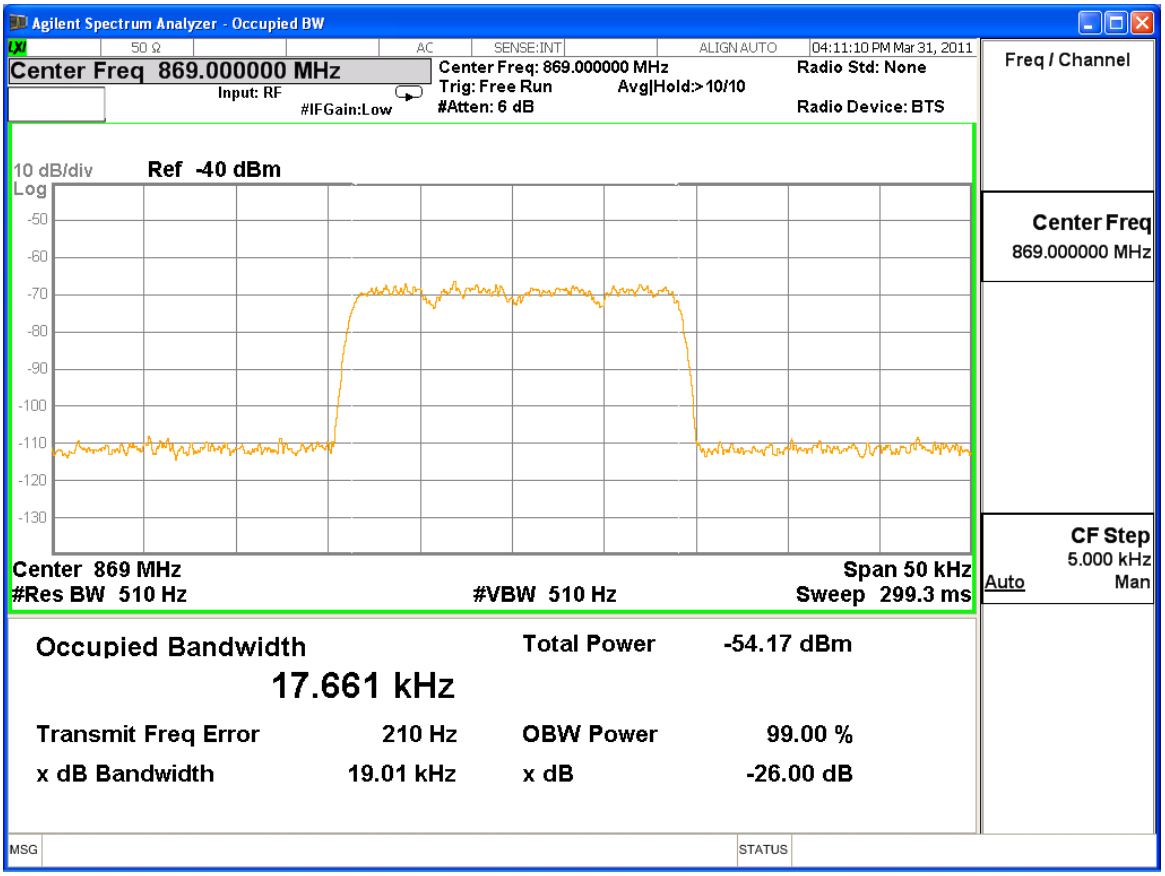

Occupied Bandwidth Low Channel Output



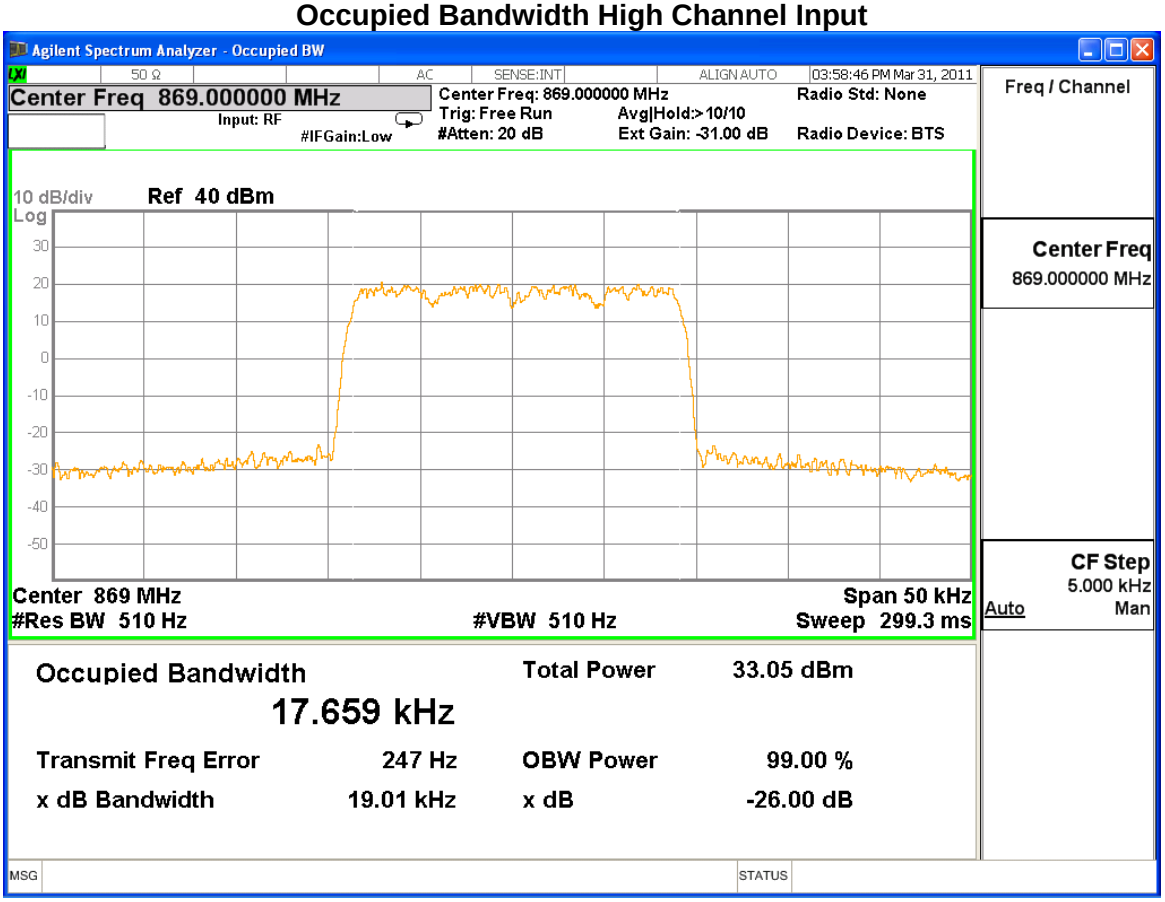

Occupied Bandwidth Mid Channel Input




Occupied Bandwidth Mid Channel Output

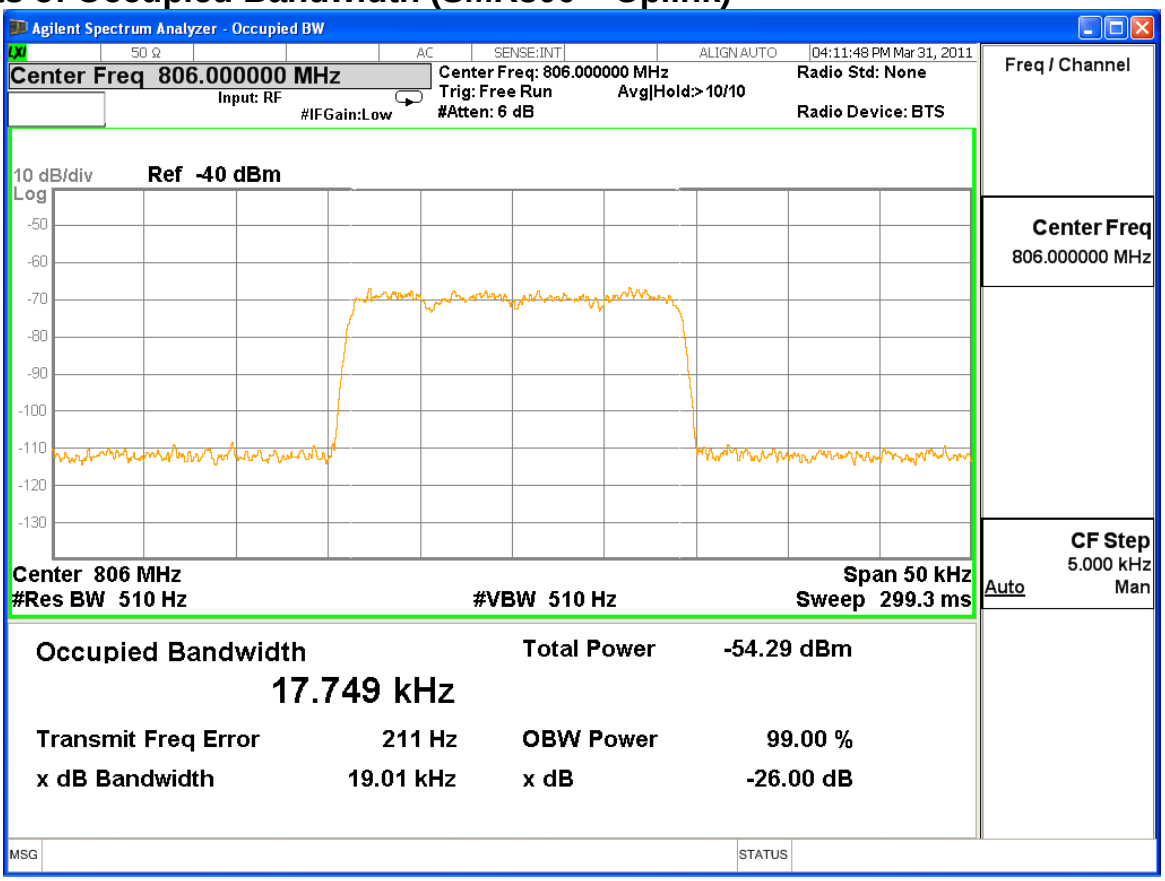



Occupied Bandwidth High Channel Input

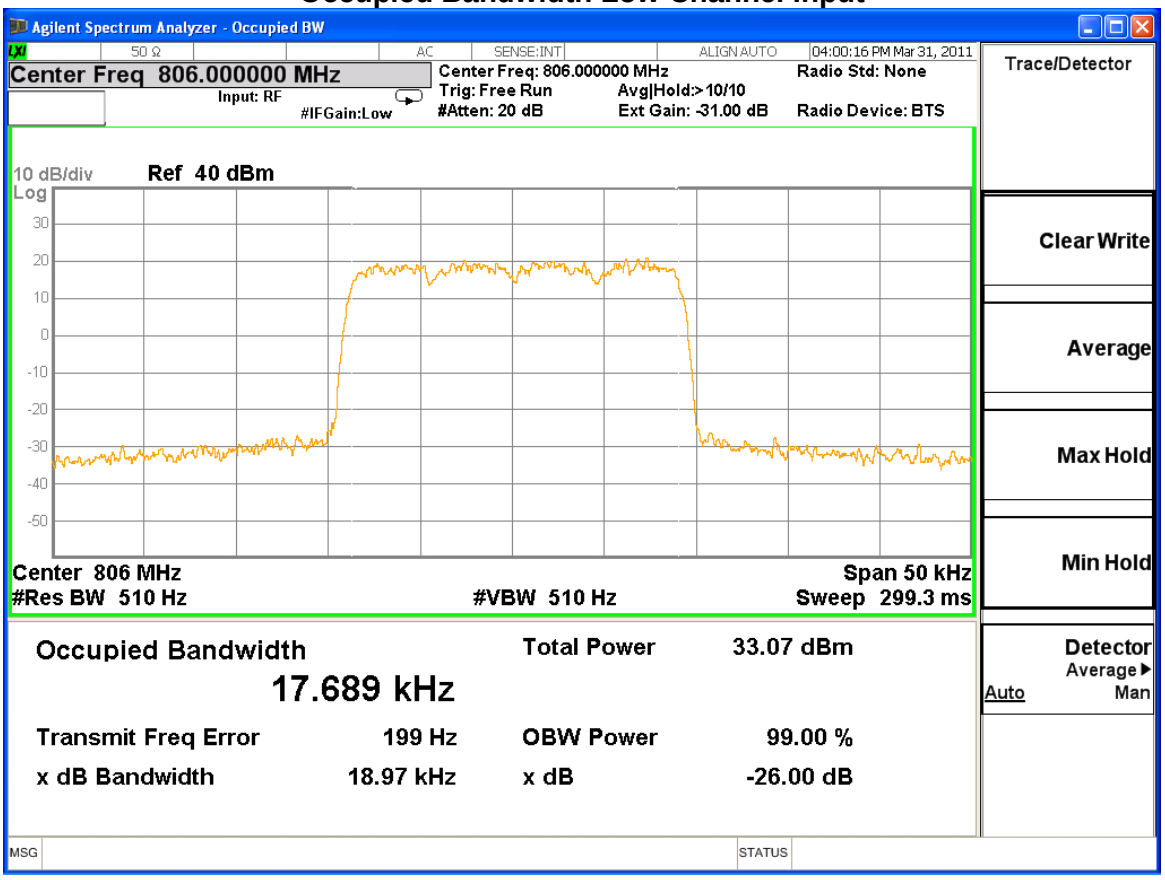



Occupied Bandwidth High Channel Output

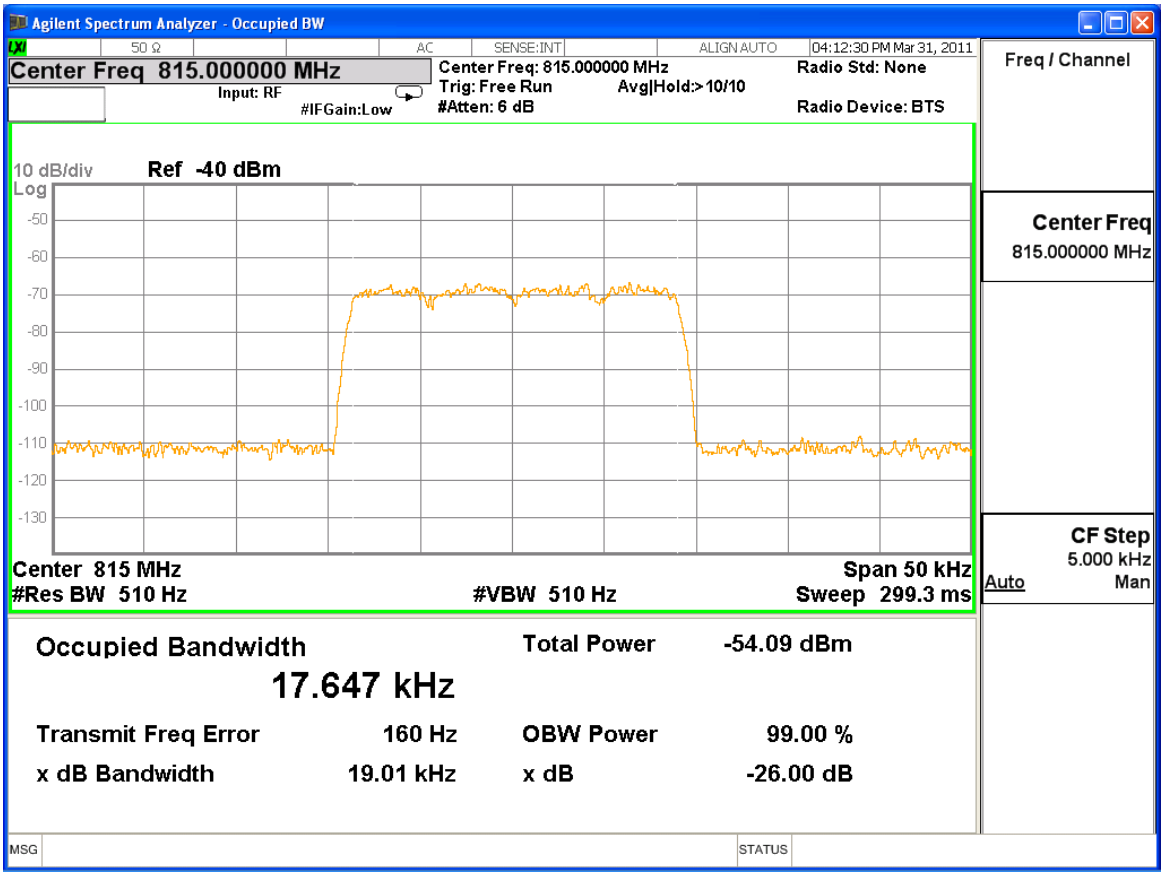
## Plots of Occupied Bandwidth (SMR800 – Uplink)



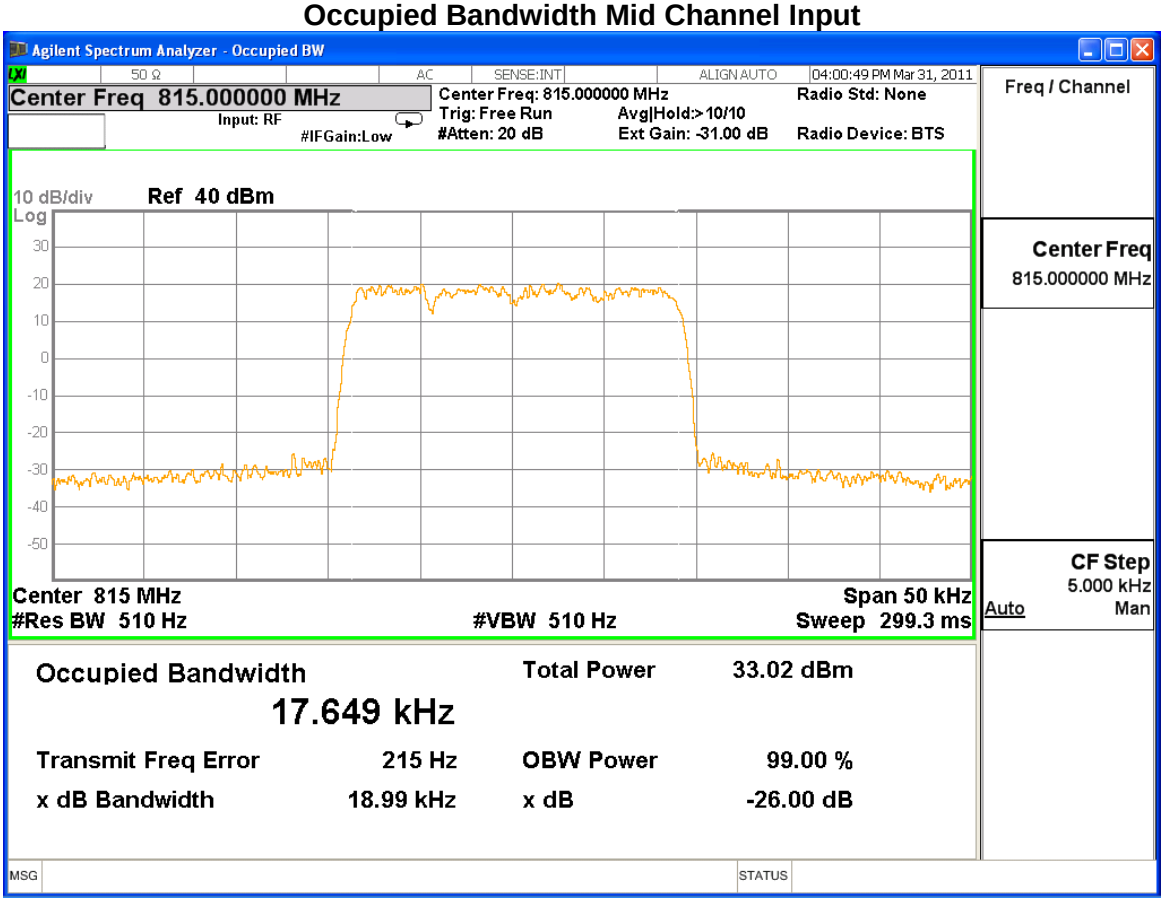

Occupied Bandwidth Low Channel Input



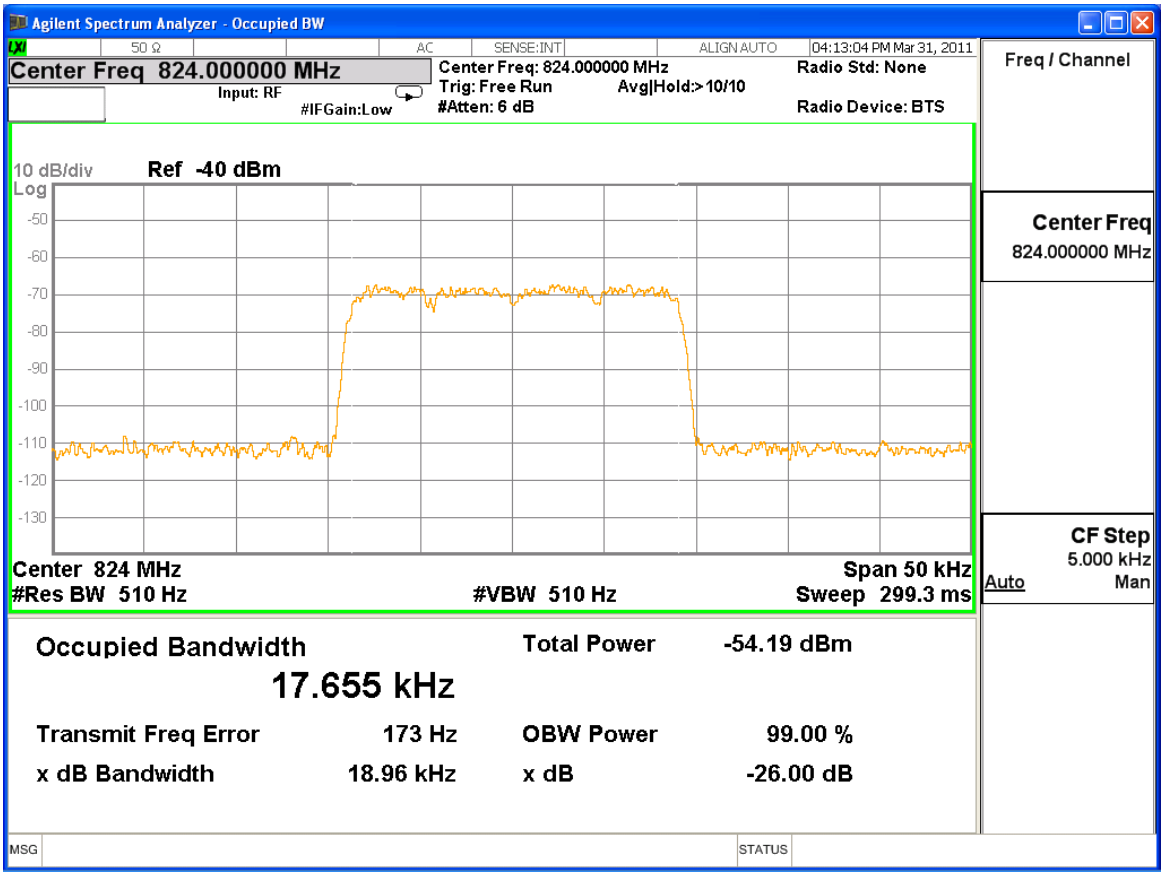

Occupied Bandwidth Low Channel Output



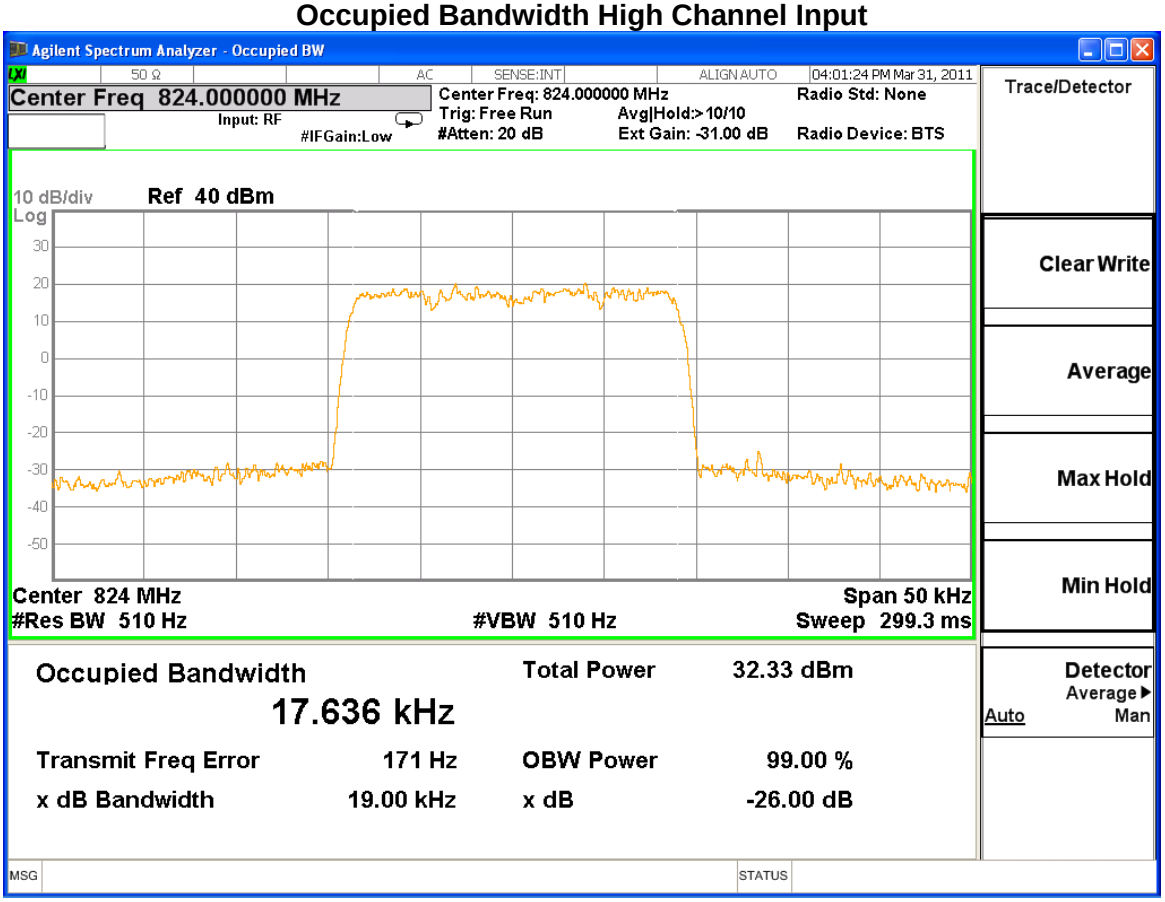

Occupied Bandwidth Mid Channel Input




Occupied Bandwidth Mid Channel Output




Occupied Bandwidth High Channel Input




Occupied Bandwidth High Channel Output

# 11. Radiated Spurious Emissions

**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 763 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.

**§ 90.210 Emission limits:** The rules in this section govern the spectral characteristics of emissions in the Radiotelephone Service. 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 or 80 dB whichever is the lesser attenuation.

**Test Procedures:**

As required by 47 CFR 2.1053, *field strength of radiated spurious measurements* were made in accordance with the procedures of EIA/TIA-603-Edition C 2004"Land Mobile FM or PM Communications Equipment Measurement and Performance Standards".

Radiated emission measurements were performed inside a 10 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 1-4m 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, which ever was the lesser, were investigated.

**Test Results:**

The EUT complies with the requirements of this section. All emissions were measured at the noise floor of the spectrum analyzer.

**Test Engineer:**

KwanHeon, Lee

**Test Date(s):**

March 12 & March 24, 2011

# 12. Spurious Emissions at Antenna Terminals

**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.

**§ 90.210 Emission limits:** The rules in this section govern the spectral characteristics of emissions in the Radiotelephone Service. 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 or 80 dB whichever is the lesser attenuation.

**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 30MHz to the 10th harmonic of the carrier.

The inter-modulation requirements were performed in a similar manner as described above. The spectrum analyzer was set to 100KHz RBW and 300KHz VBW. Two modulated carriers were injected into the EUT. One carrier was set at the band edge of either the Uplink or Downlink band and the other at carrier set at 1.5 MHz deviation from the first carrier. The in band spurious emissions were investigated.

**Test Results:** The EUT complies with the requirements of this section.

**Test Engineer(s):** KwanHeon, Lee

**Test Date(s):** March 30, 2011

## Conducted Spurious Emission Test Results – Model SMR700 & SMR800

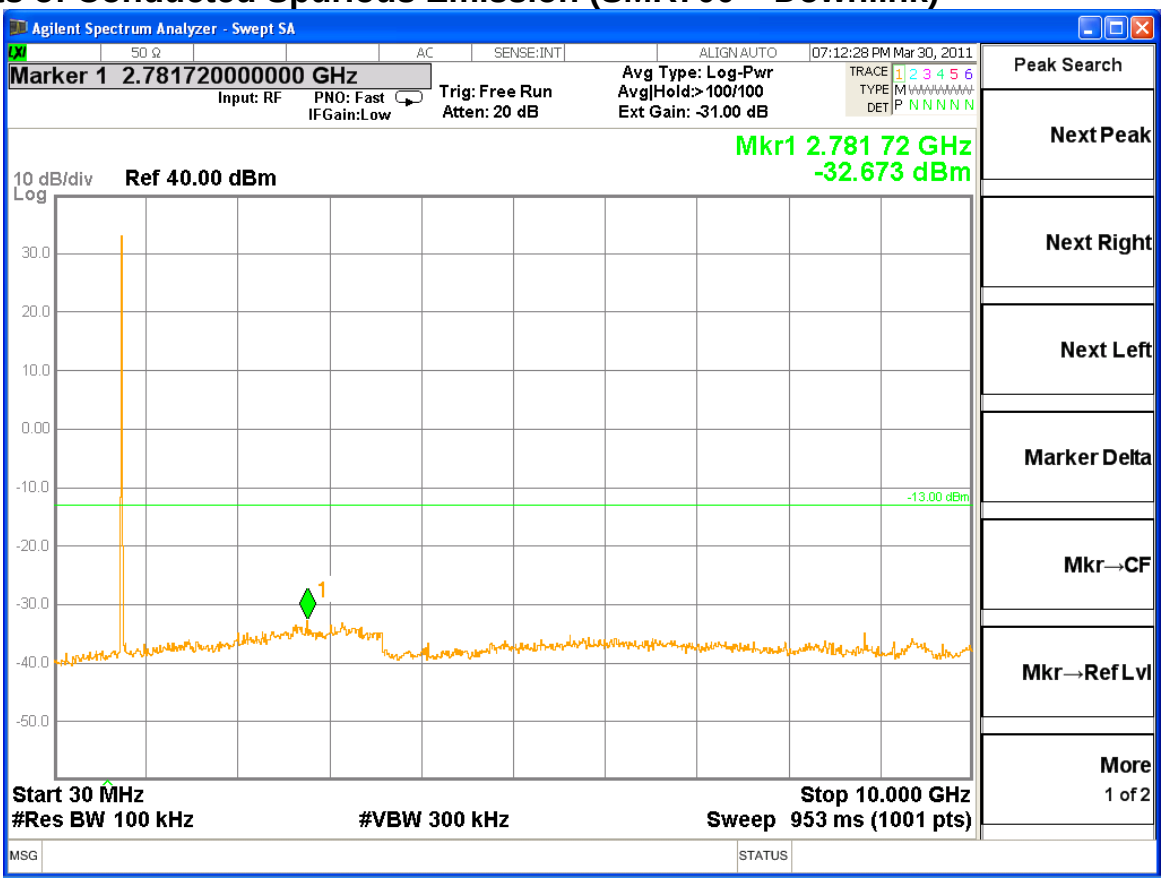
| SMR700(Downlink) | | | | |
|---|---|---|---|---|
| Carrier | | Result(dBm) | Limit(dBm) | Margin(dB) |
| Channel | Frequency(MHz) | | | |
| Low | 763 | -32.67 | -13 | 19.67 |
| Mid | 769 | -33.04 | -13 | 20.04 |
| High | 775 | -32.70 | -13 | 19.70 |
| SMR700(Uplink) | | | | |
| Carrier | | Result(dBm) | Limit(dBm) | Margin(dB) |
| Channel | Frequency(MHz) | | | |
| Low | 793 | -32.96 | -13 | 19.96 |
| Mid | 799 | -32.96 | -13 | 19.96 |
| High | 805 | -33.01 | -13 | 20.01 |

**Conducted Spurious Emission Test Results**

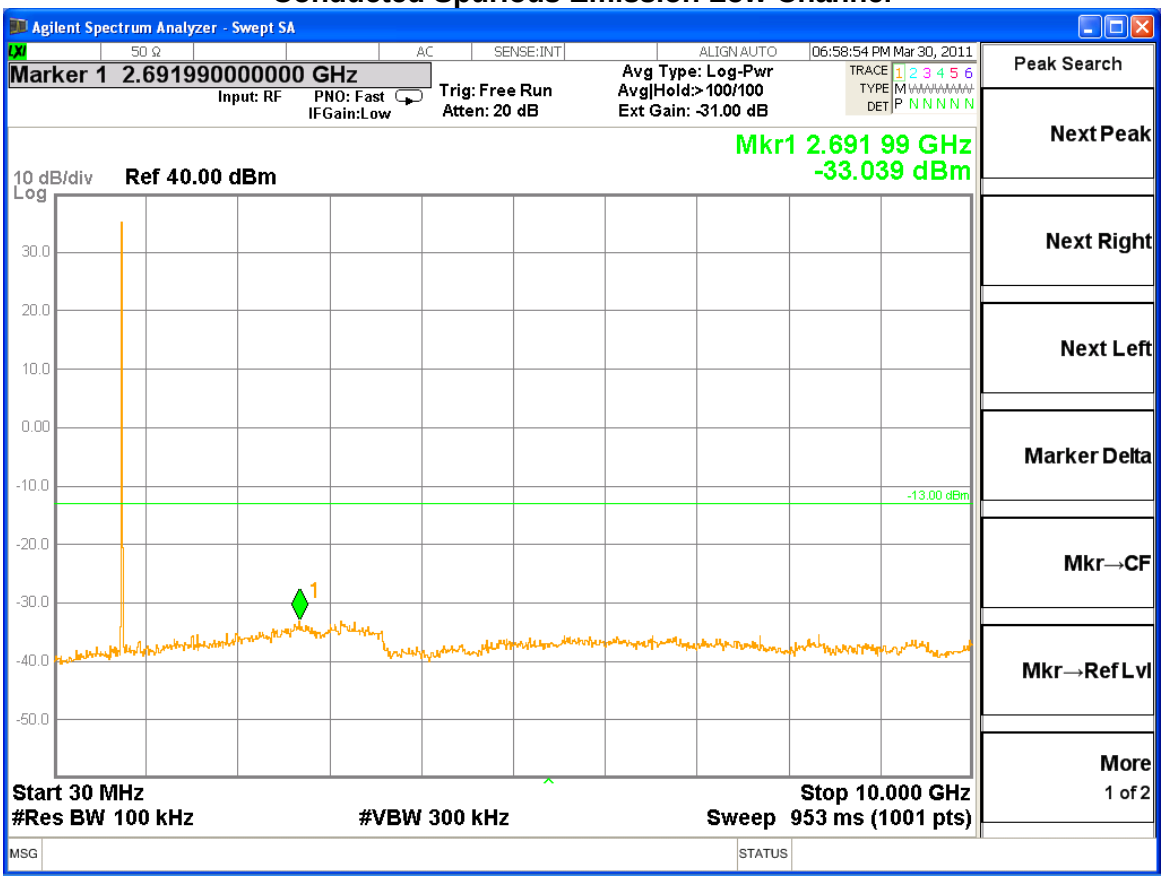
| SMR800(Downlink) | | | | |
|---|---|---|---|---|
| Carrier | | Result(dBm) | Limit(dBm) | Margin(dB) |
| Channel | Frequency(MHz) | | | |
| Low | 851 | -32.42 | -13 | 19.42 |
| Mid | 860 | -32.78 | -13 | 19.78 |
| High | 869 | -33.10 | -13 | 20.1 |
| SMR800(Uplink) | | | | |
| Carrier | | Result(dBm) | Limit(dBm) | Margin(dB) |
| Channel | Frequency(MHz) | | | |
| Low | 806 | -33.51 | -13 | 20.51 |
| Mid | 815 | -32.83 | -13 | 19.83 |
| High | 824 | -33.30 | -13 | 20.3 |

**Conducted Spurious Emission Test Results**

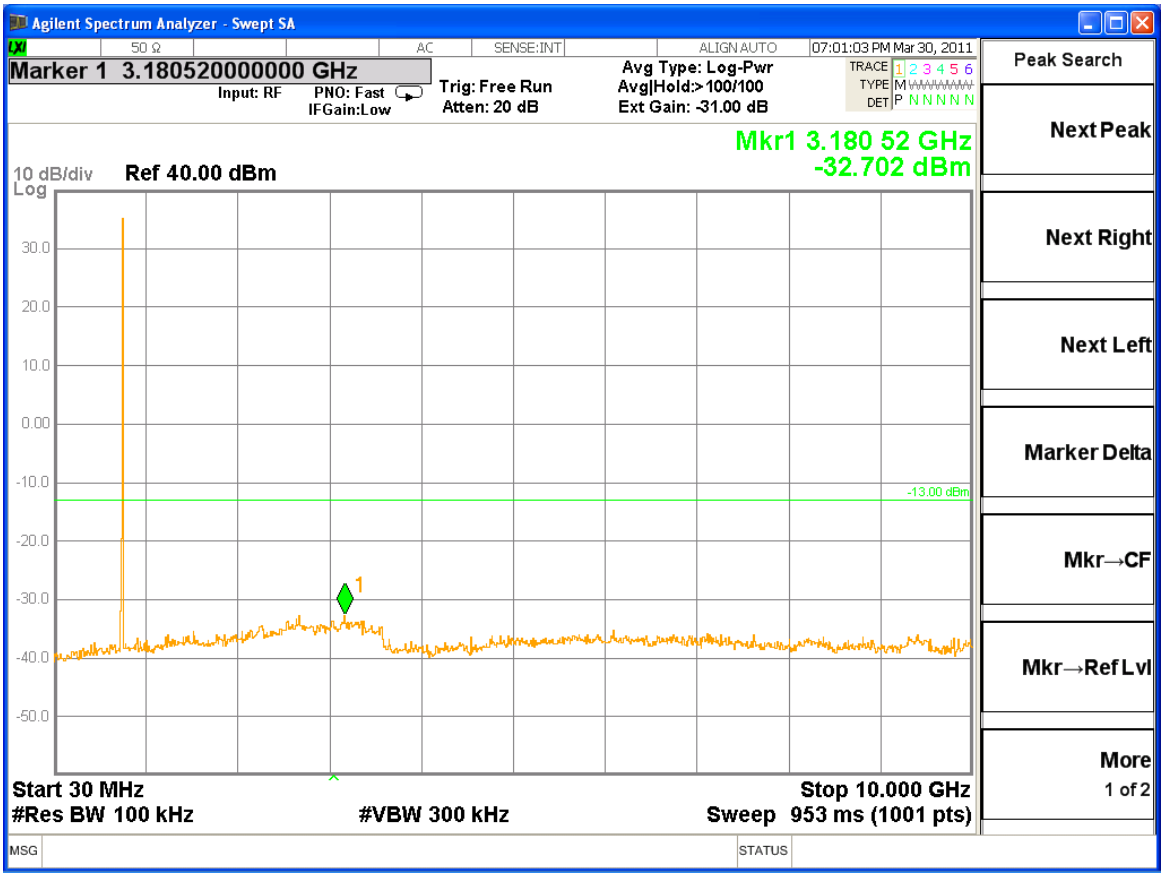
# Plots of Conducted Spurious Emission (SMR700 – Downlink)



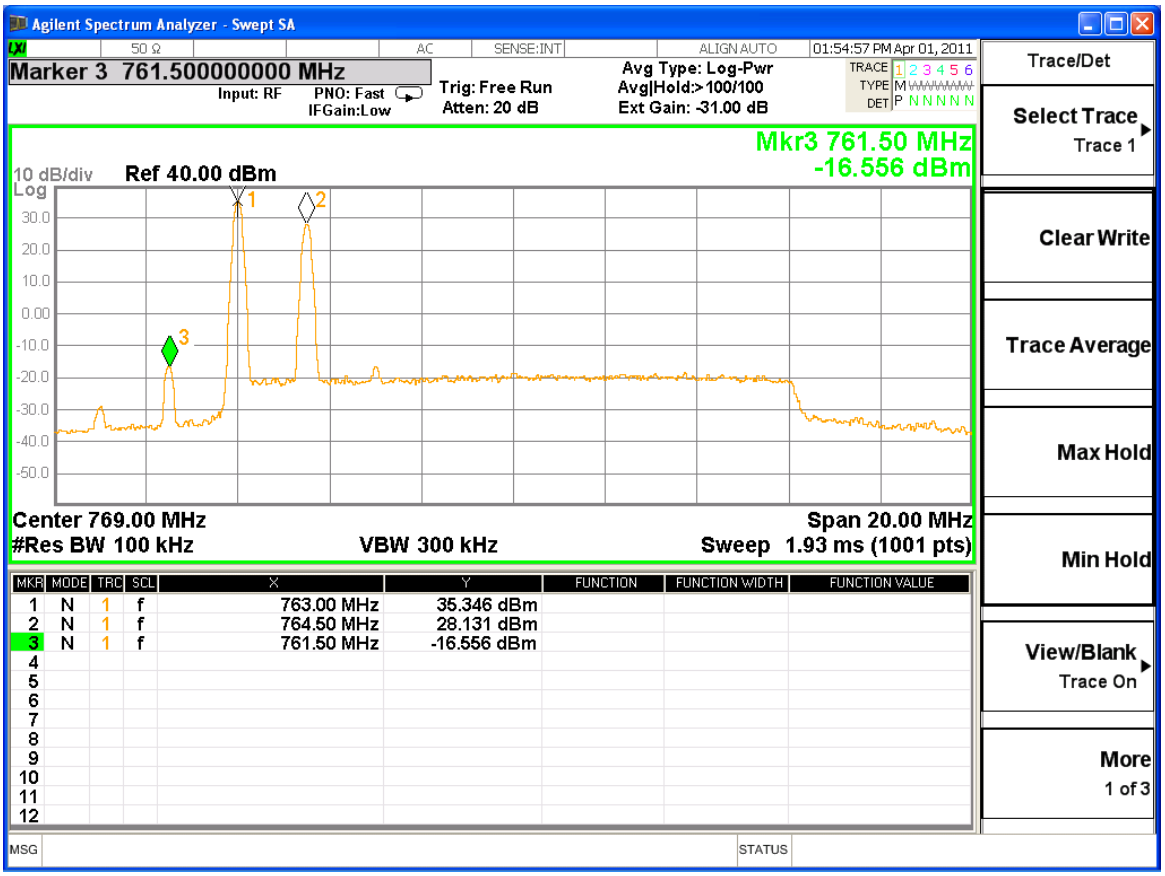

Conducted Spurious Emission Low Channel



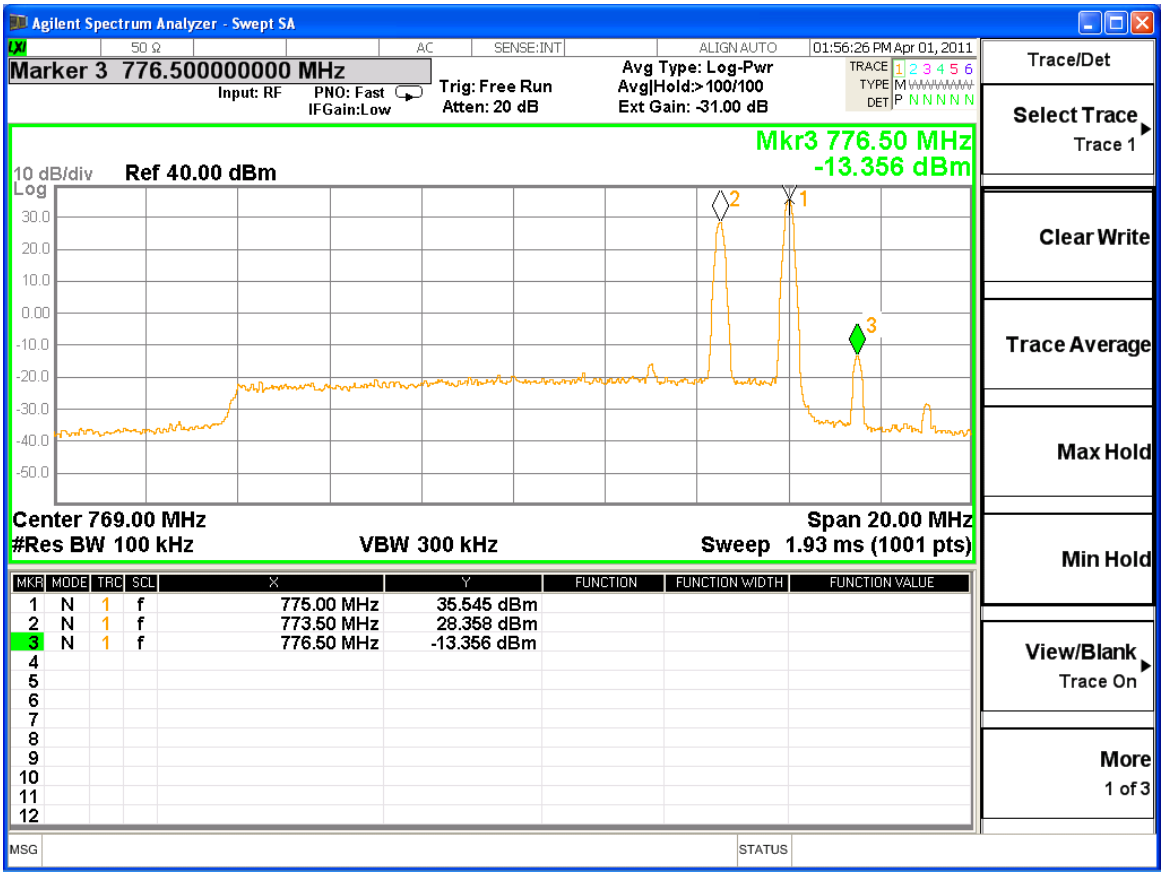

Conducted Spurious Emission Mid Channel




**Conducted Spurious Emission High Channel**

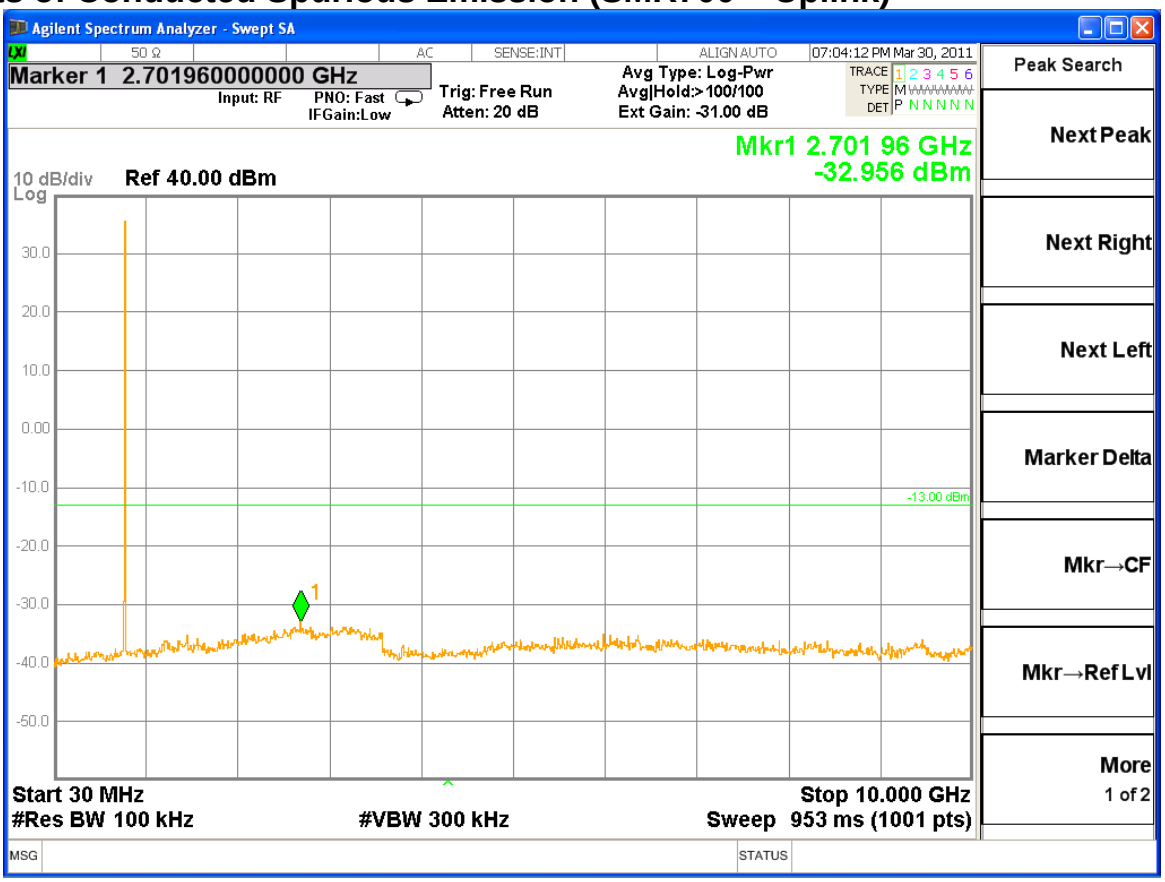



**Two Tone Low End Intermodulation**

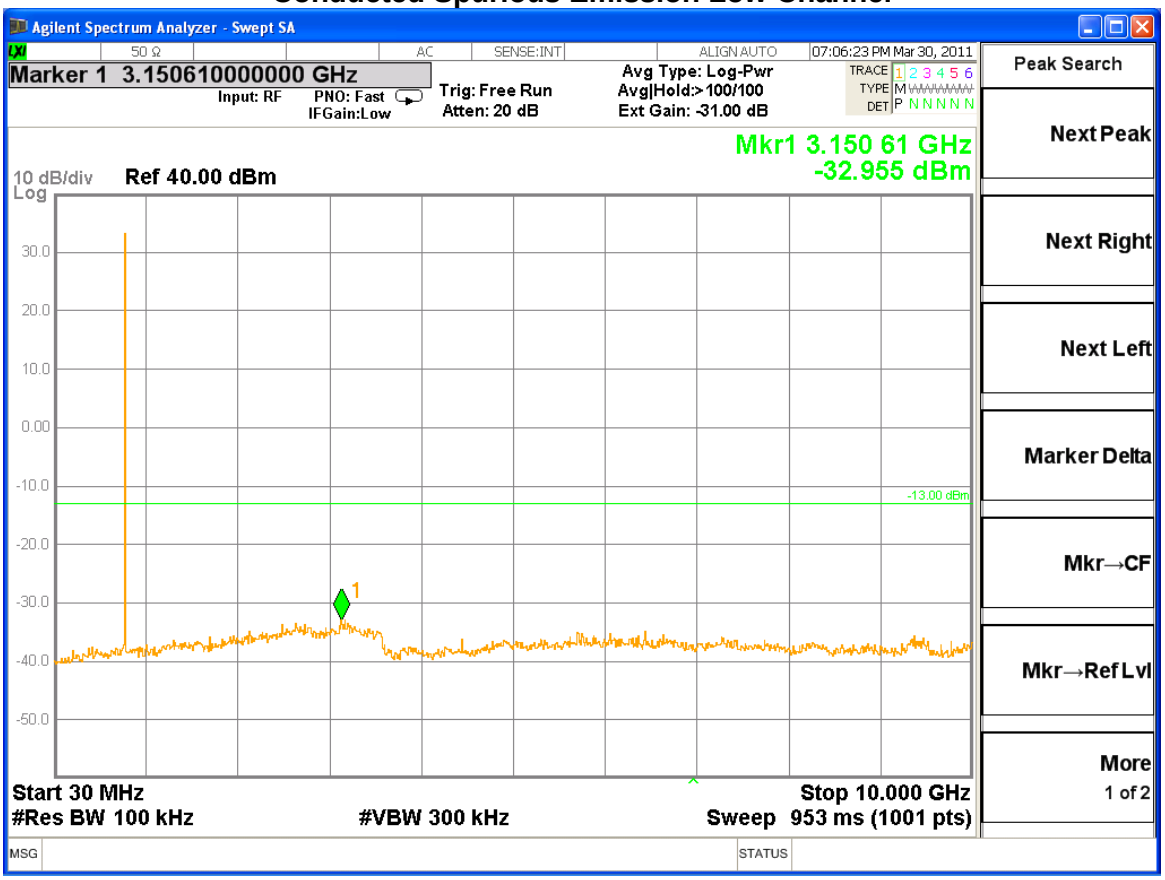



**Two Tone High End Intermodulation**

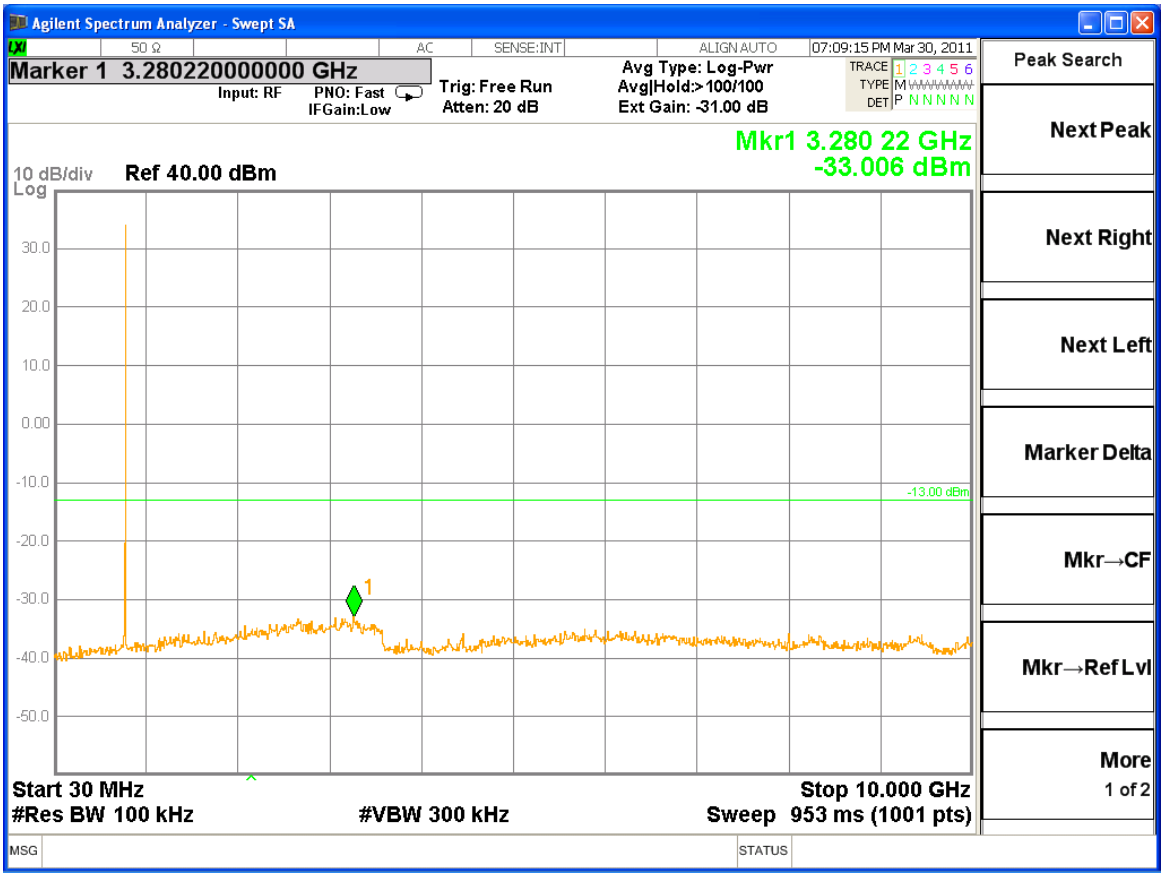
# Plots of Conducted Spurious Emission (SMR700 – Uplink)



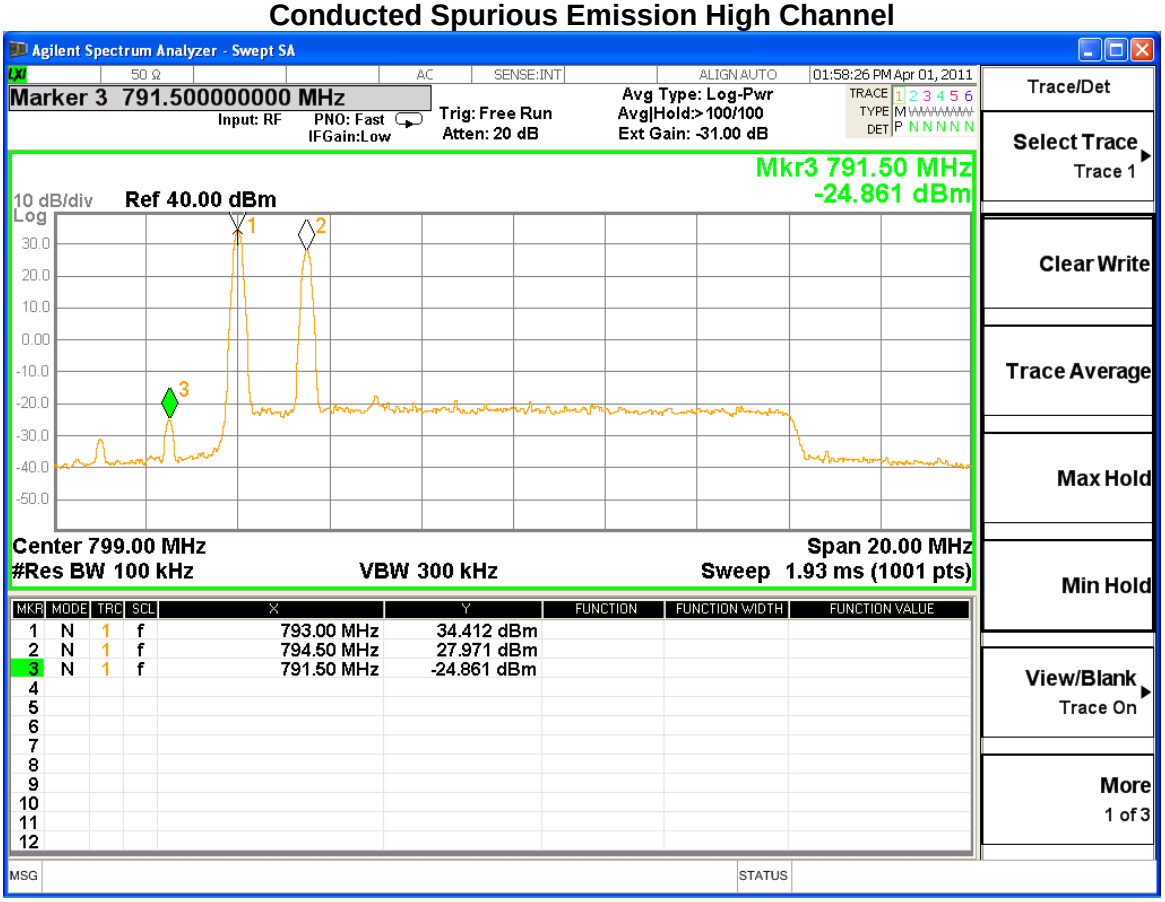

**Conducted Spurious Emission Low Channel**



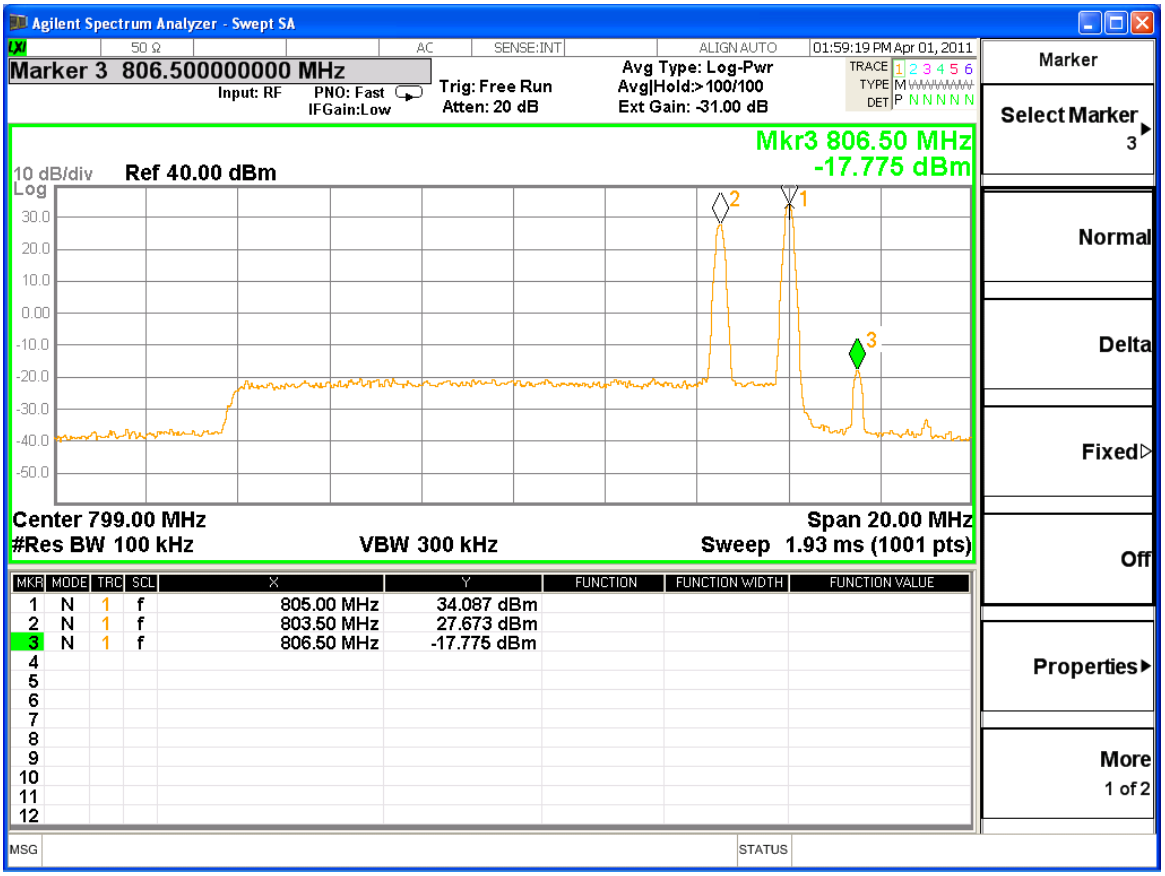

**Conducted Spurious Emission Mid Channel**




**Conducted Spurious Emission High Channel**

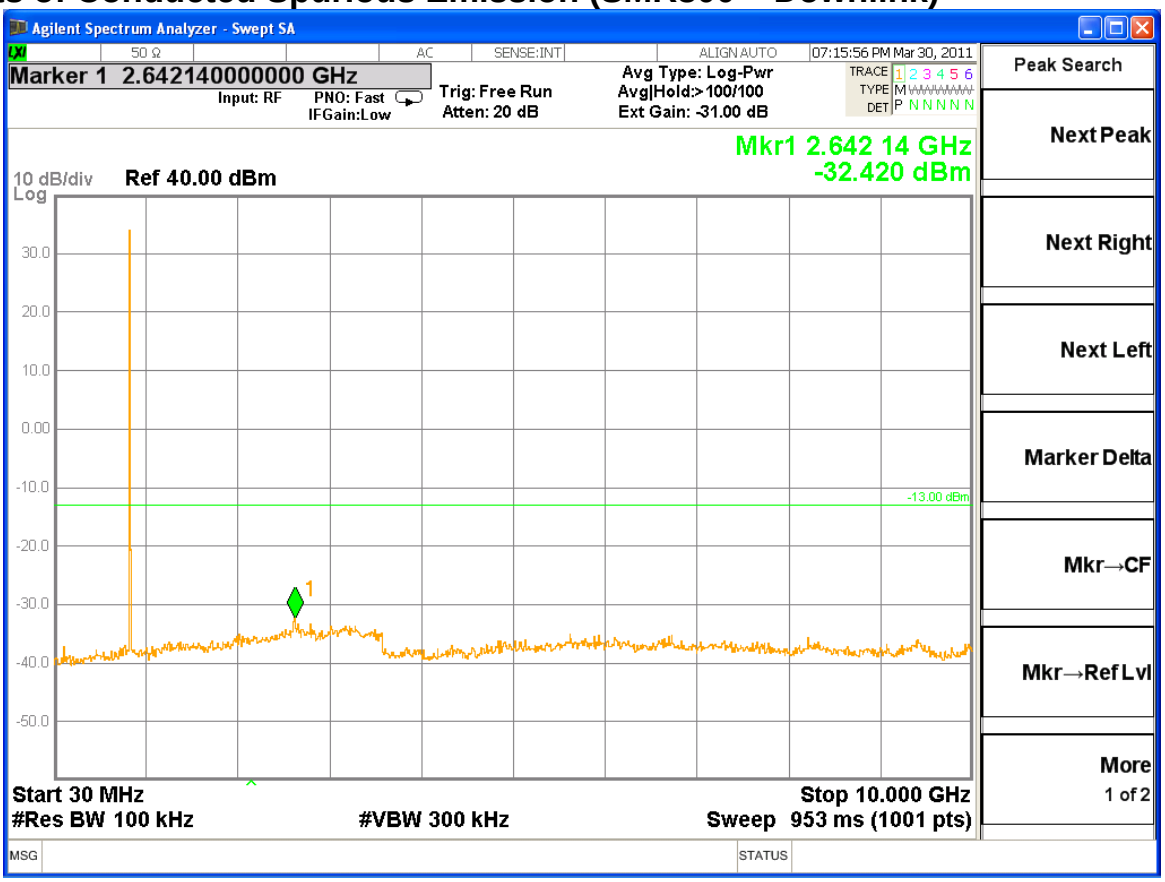



**Two Tone Low End Intermodulation**

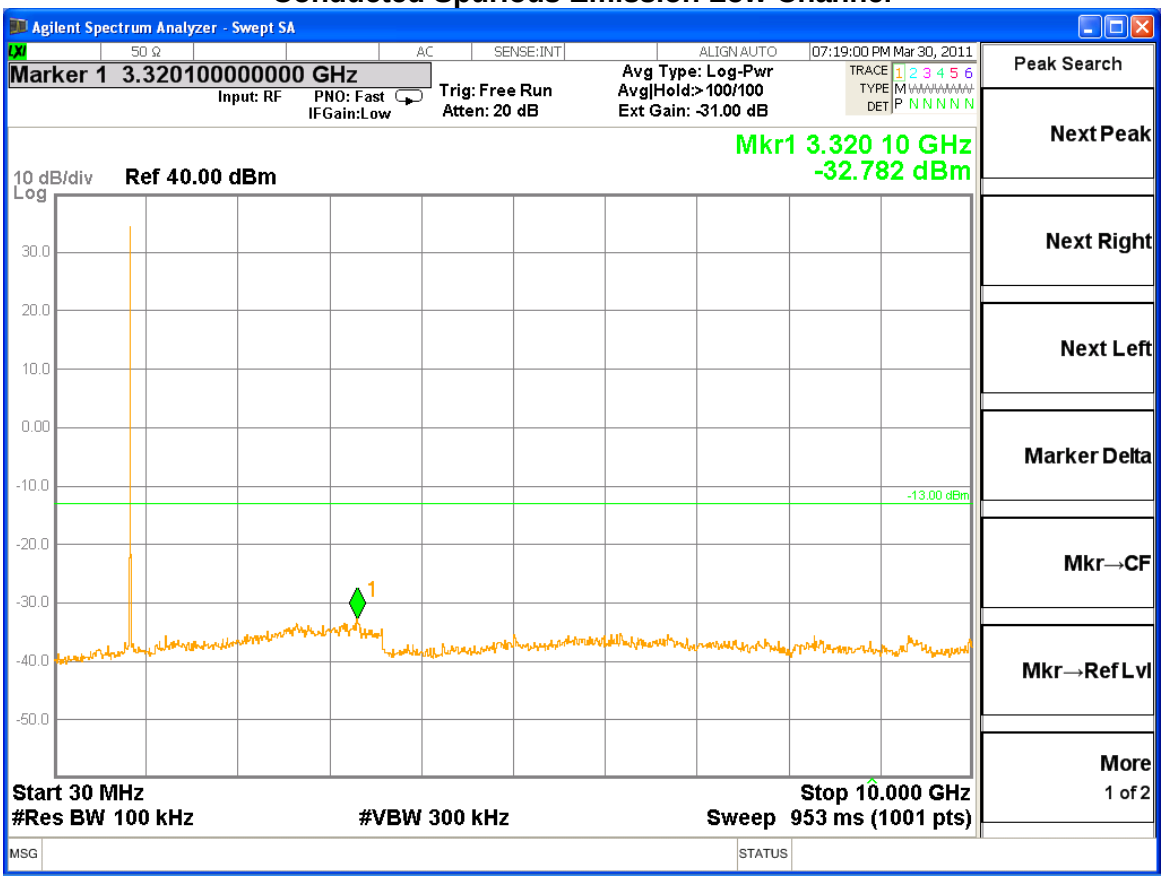



**Two Tone High End Intermodulation**

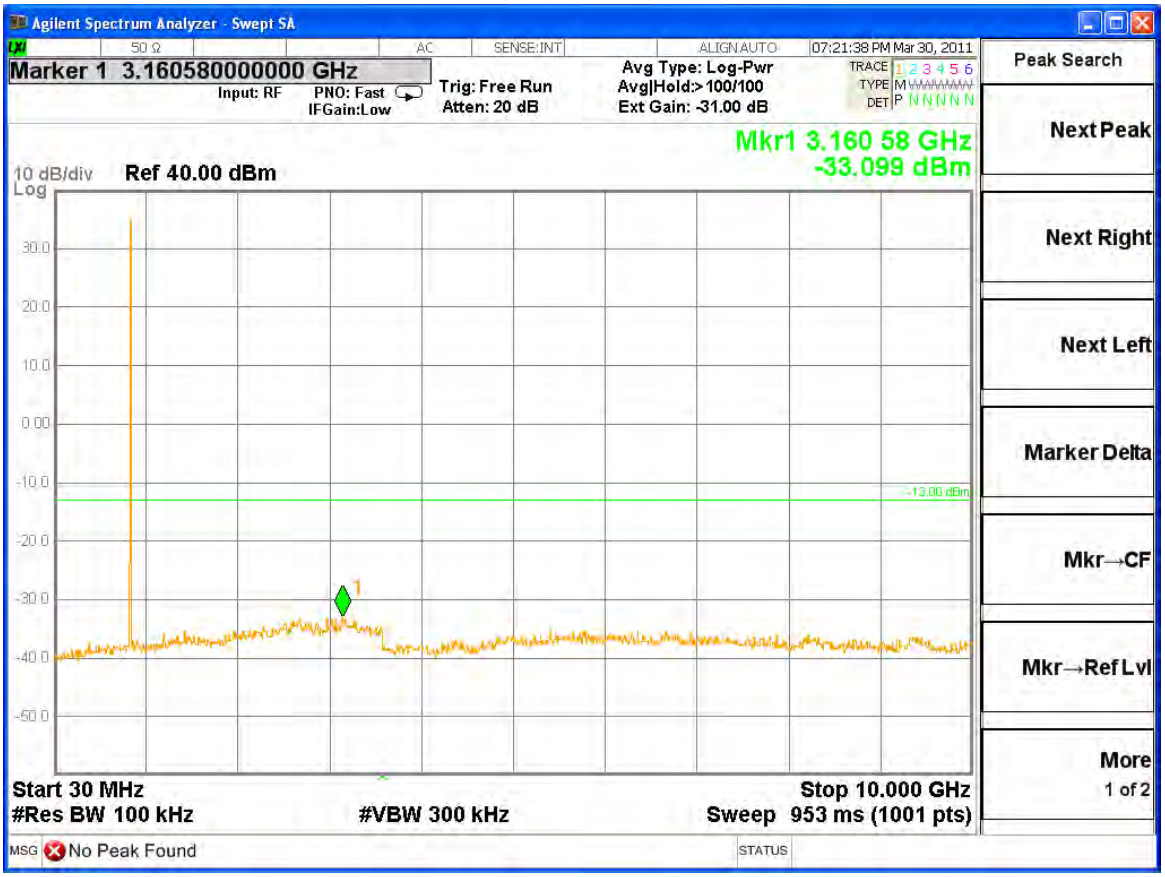
# Plots of Conducted Spurious Emission (SMR800 – Downlink)



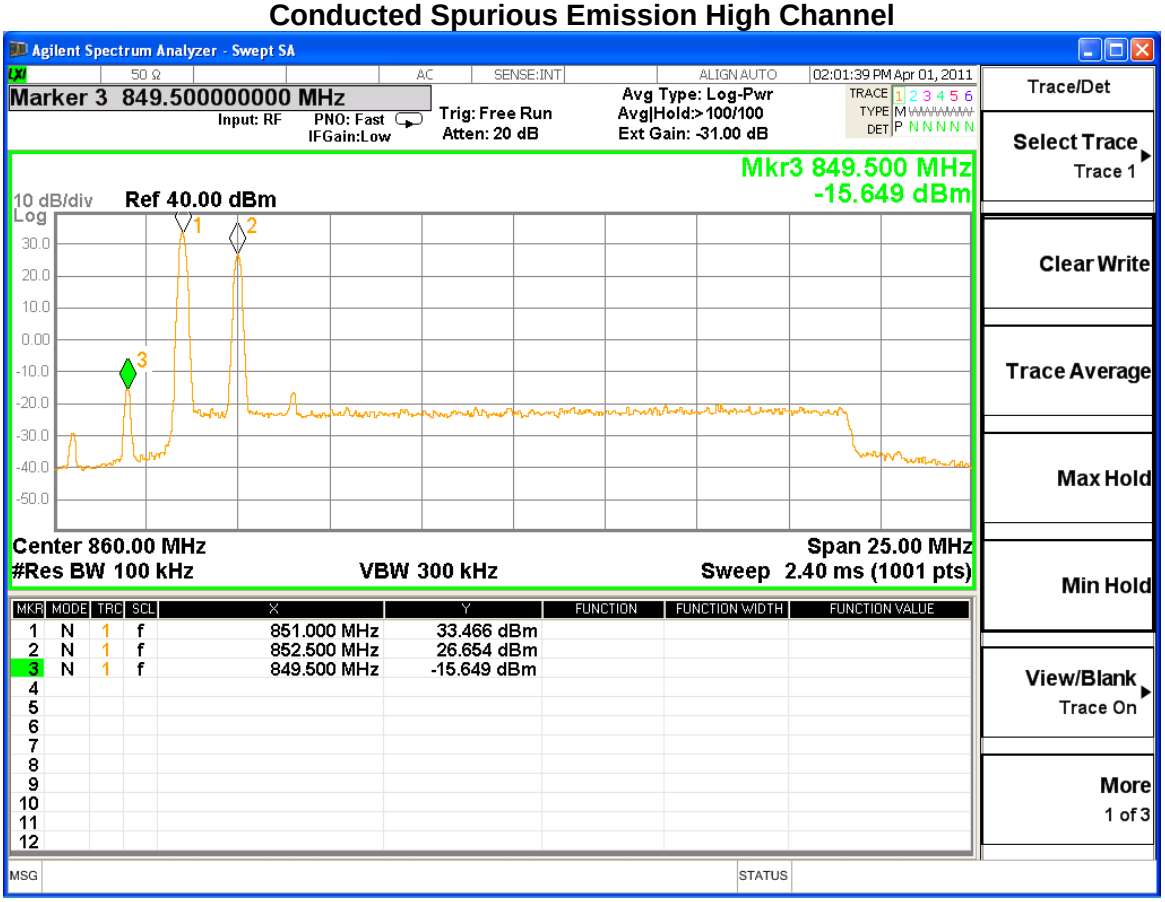

Conducted Spurious Emission Low Channel



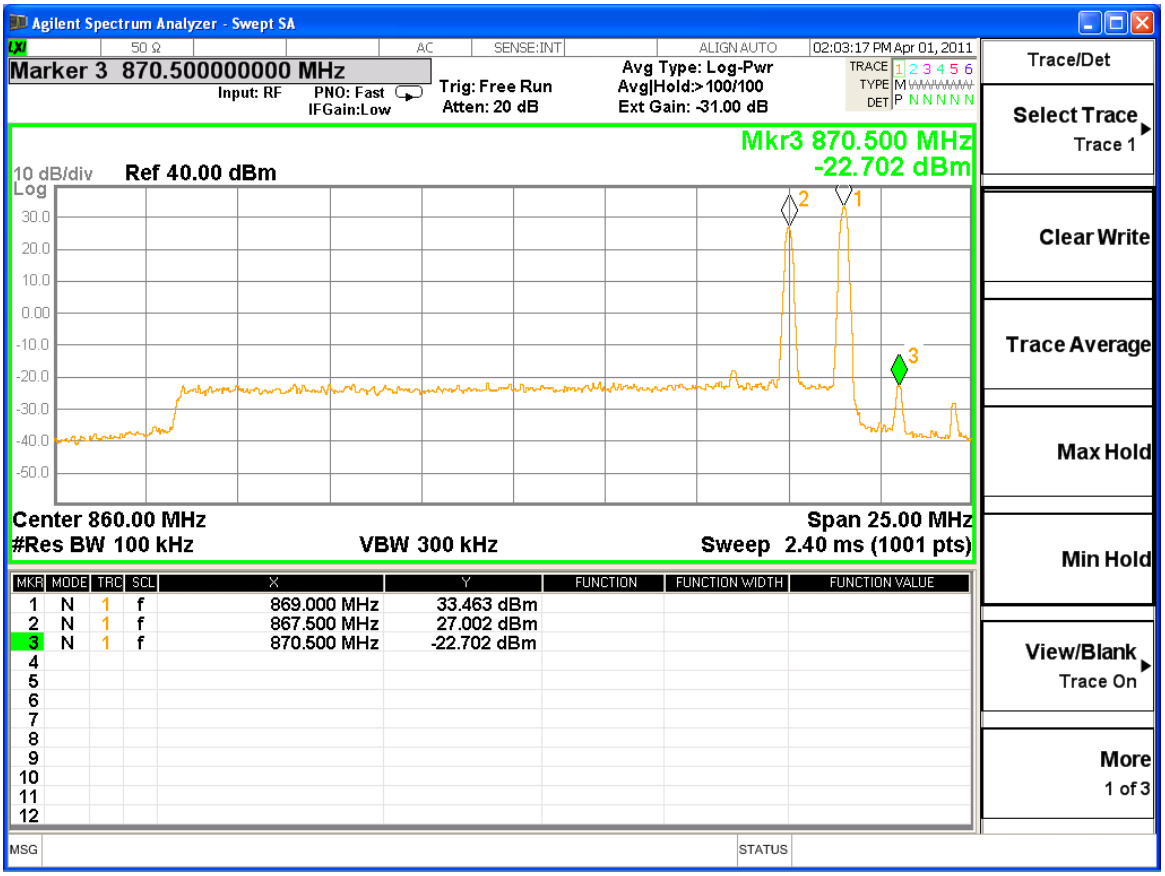

Conducted Spurious Emission Mid Channel




**Conducted Spurious Emission High Channel**

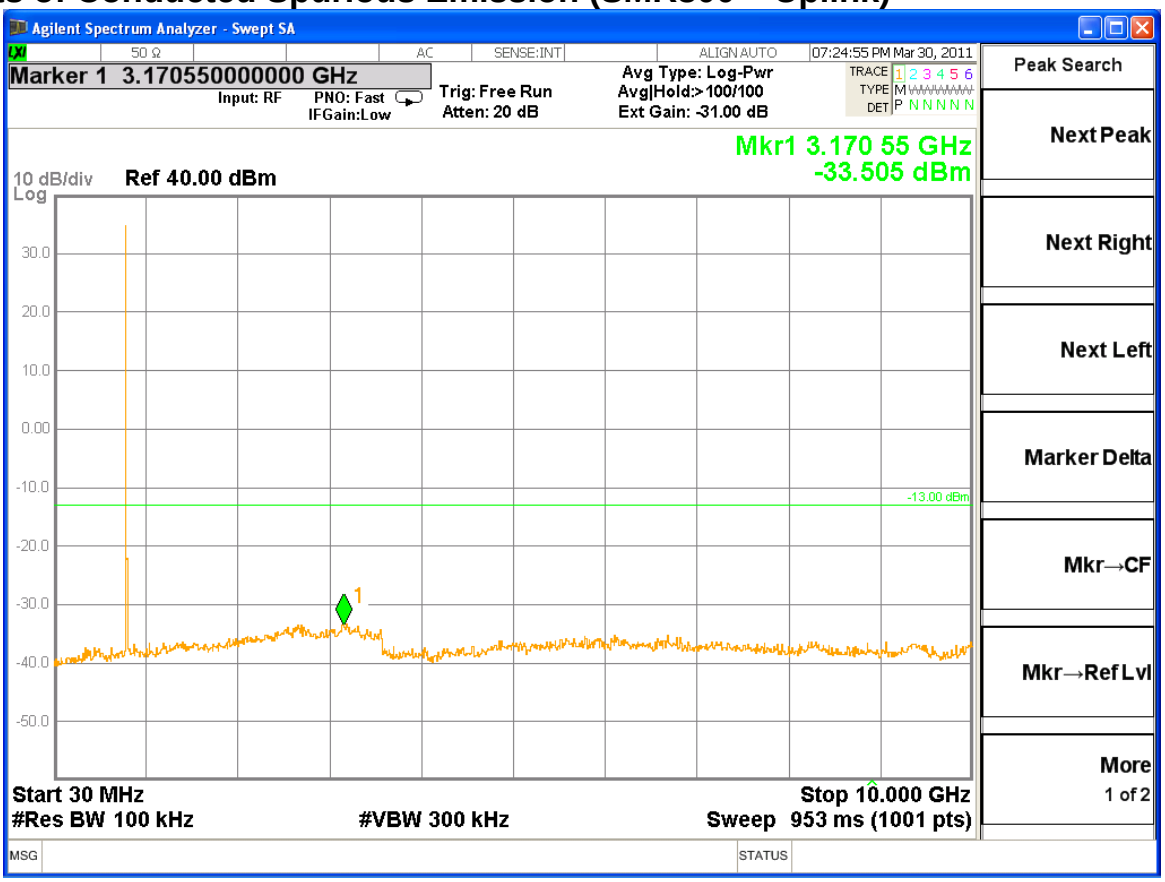



**Two Tone Low End Intermodulation**

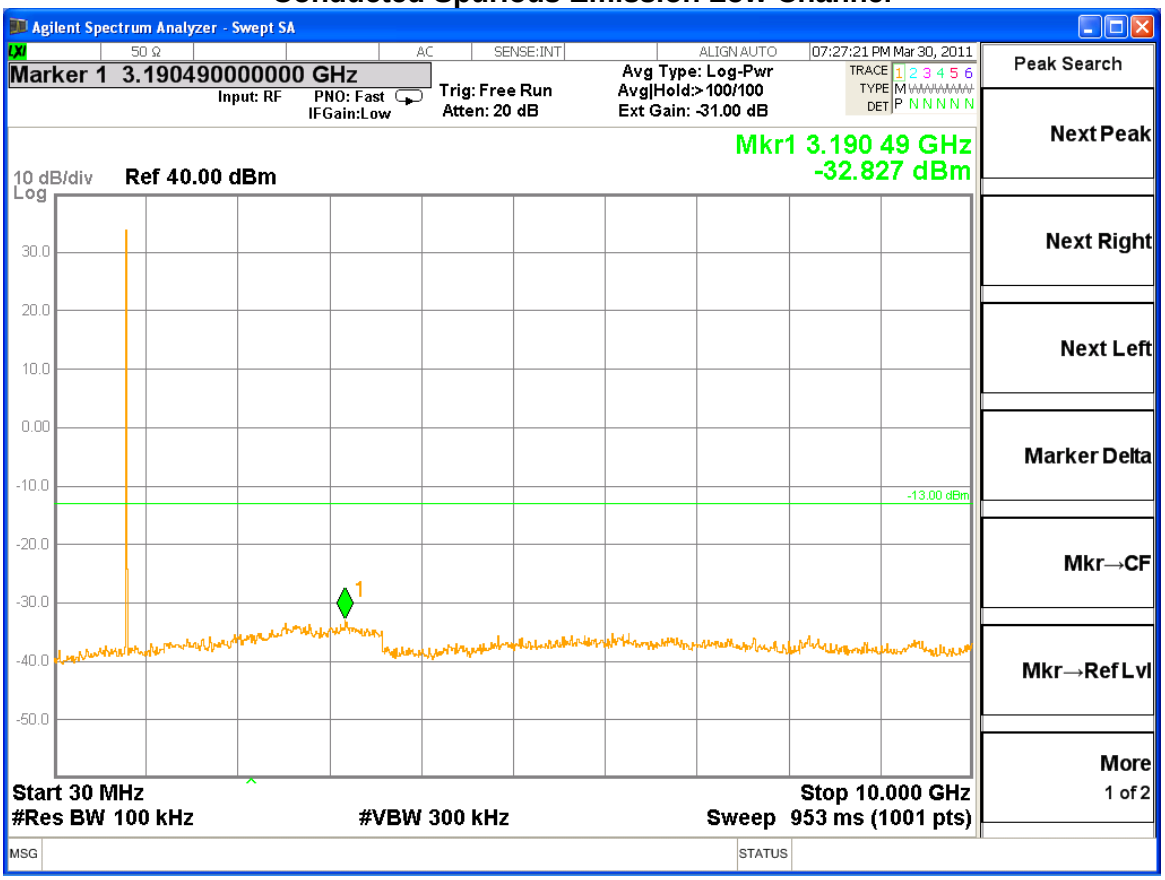



**Two Tone High End Intermodulation**

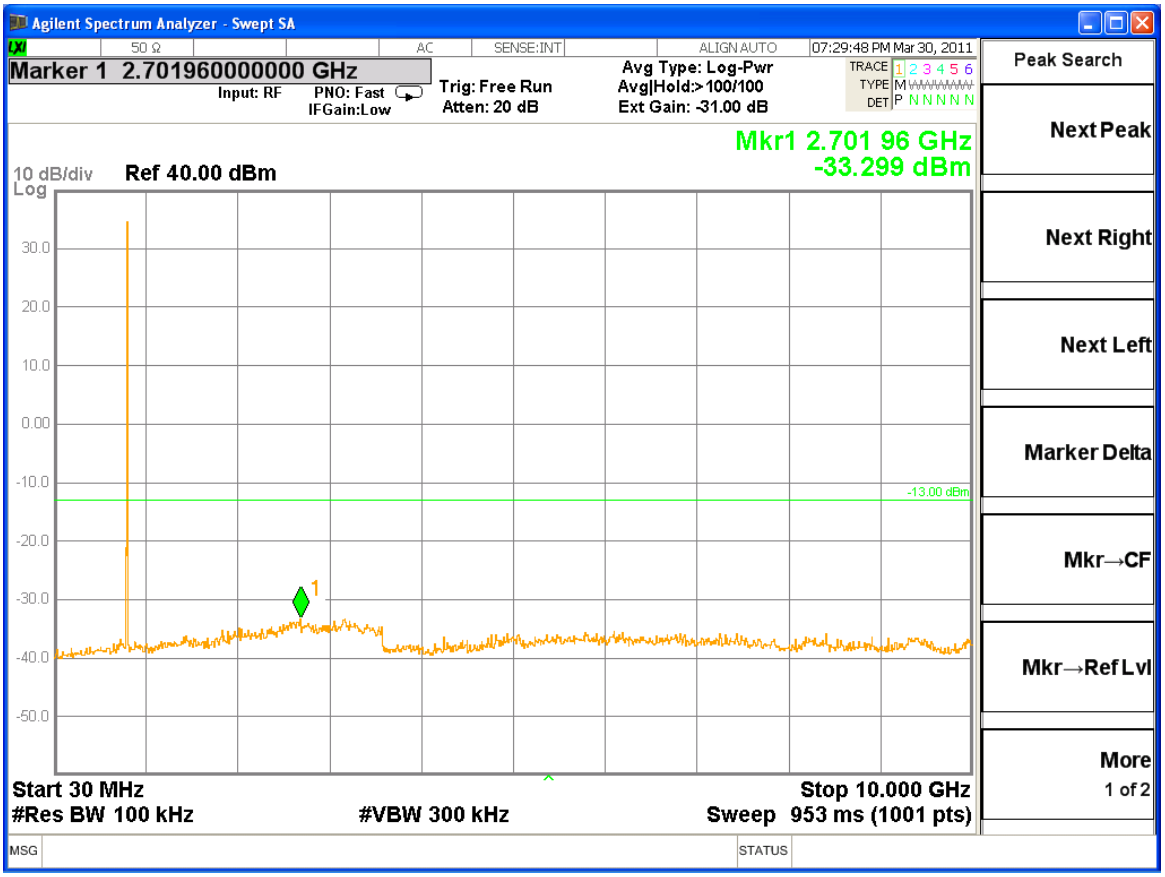
# Plots of Conducted Spurious Emission (SMR800 – Uplink)



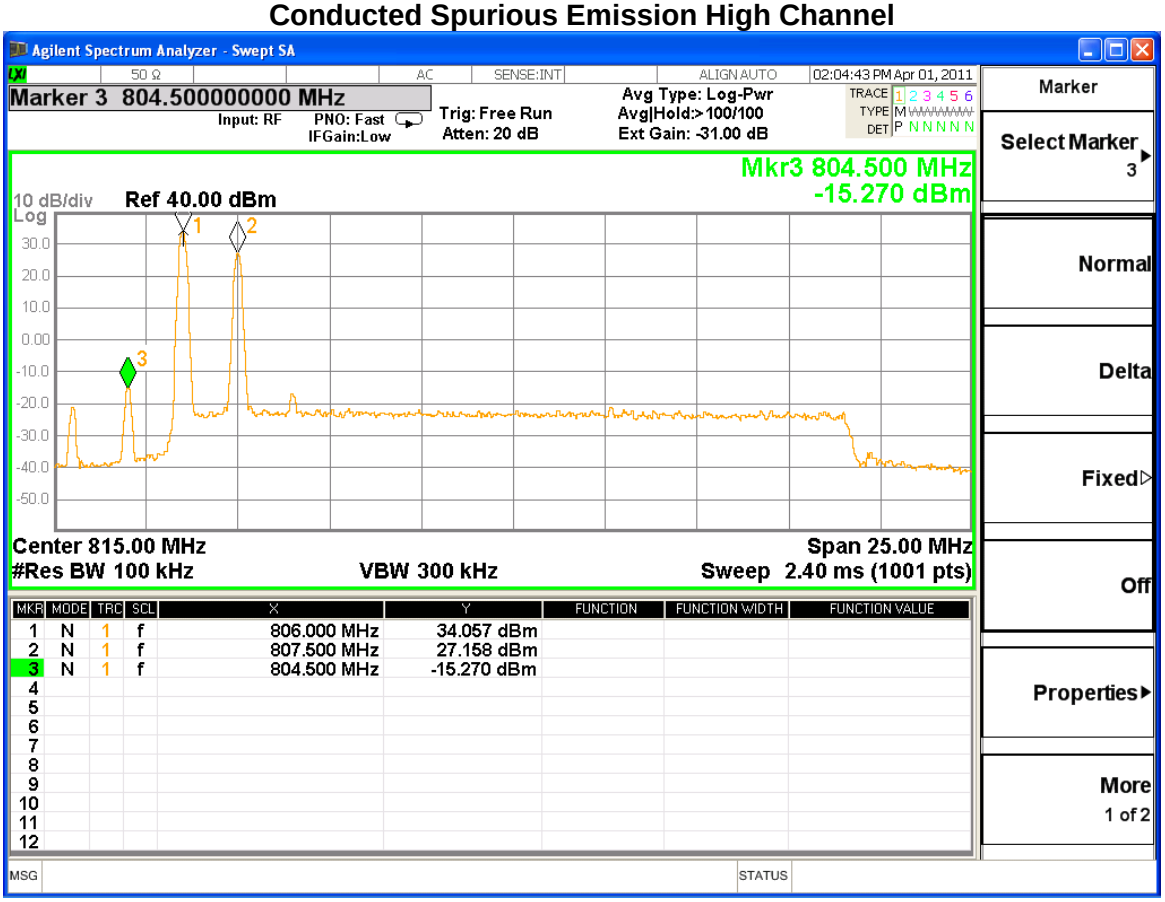

**Conducted Spurious Emission Low Channel**



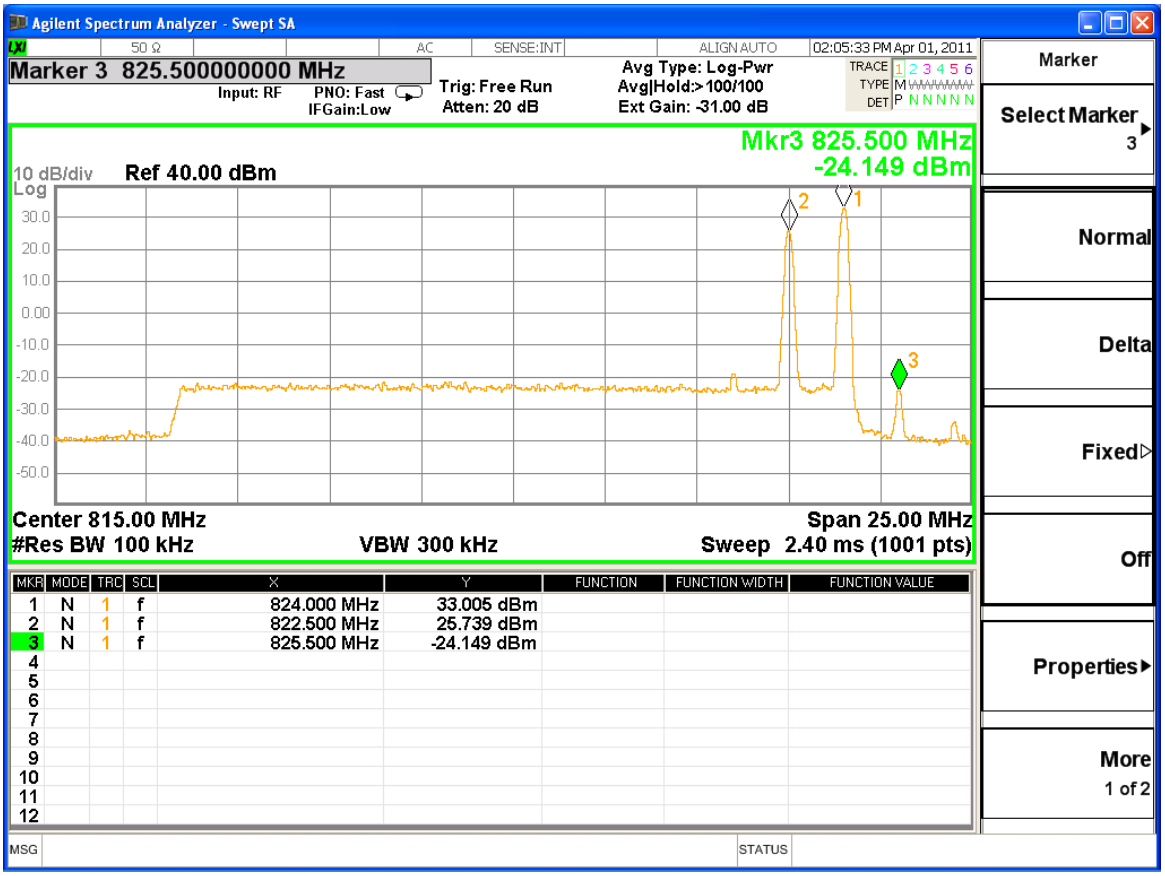

**Conducted Spurious Emission Mid Channel**




**Conducted Spurious Emission High Channel**




**Two Tone Low End Intermodulation**




**Two Tone High End Intermodulation**

# 13. 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 Directional Coupler through a Spectrum Analyzer and Power Meter.

The EUT was placed in the Environmental Chamber and support equipments are outside the chamber on a table. 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 10C increment until the unit is stabilized then recorded the reading in tabular format with the temperature range of -30 to 50C.

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

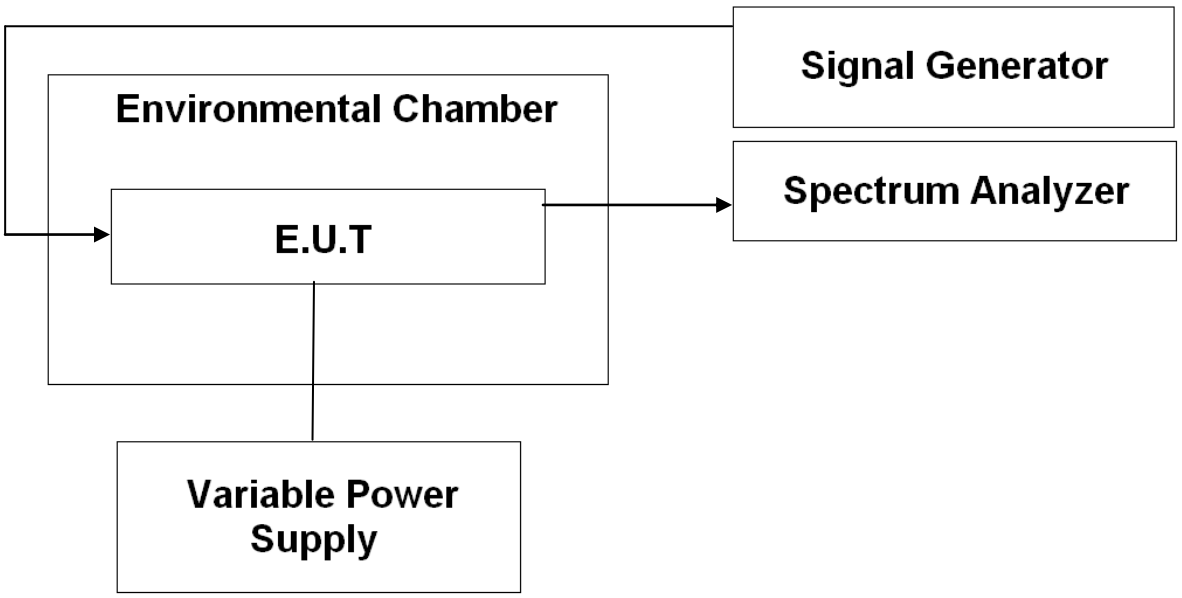
**Test Results:** The EUT was found in compliance for Frequency Stability and Voltage Test

**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 Engineer(s):** KwanHeon, Lee

**Test Date(s):** March 30, 2011

**Test Setup**



Reference : 120Vac at 20℃ Freq. = 769 MHz

| Temerature (Celsius) | Measured Freq(MHz) | Drift ppm |
|---|---|---|
| 50 | 769 | 0 |
| 40 | 769 | 0 |
| 30 | 769 | 0 |
| 20 | Reference | |
| 10 | 769 | 0 |
| 0 | 769 | 0 |
| -10 | 769 | 0 |
| -20 | 769 | 0 |
| -30 | 769 | 0 |

Reference : 120Vac at 20℃ Freq. = 769 MHz

| Voltage(dc) +/-15%Ref | Measured Freq(MHz) | Drift (Hz) |
|---|---|---|
| 102 | 769 | 0 |
| 138 | 769 | 0 |

Downlink Mid CH, SMR 700

Reference : 120Vac at 20℃ Freq. = 799 MHz

| Temerature (Celsius) | Measured Freq(MHz) | Drift ppm |
|---|---|---|
| 50 | 799 | 0 |
| 40 | 799 | 0 |
| 30 | 799 | 0 |
| 20 | Reference | |
| 10 | 799 | 0 |
| 0 | 799 | 0 |
| -10 | 799 | 0 |
| -20 | 799 | 0 |
| -30 | 799 | 0 |

Reference : 120Vac at 20℃ Freq. = 799 MHz

| Voltage(dc) +/-15%Ref | Measured Freq(MHz) | Drift (Hz) |
|---|---|---|
| 102 | 799 | 0 |
| 138 | 799 | 0 |

Uplink Mid CH, SMR 700

Reference : 120Vac at 20℃ Freq. = 860 MHz

| Temerature (Celsius) | Measured Freq(MHz) | Drift ppm |
|---|---|---|
| 50 | 860 | 0 |
| 40 | 860 | 0 |
| 30 | 860 | 0 |
| 20 | Reference | |
| 10 | 860 | 0 |
| 0 | 860 | 0 |
| -10 | 860 | 0 |
| -20 | 860 | 0 |
| -30 | 860 | 0 |

Reference : 120Vac at 20℃ Freq. = 860 MHz

| Voltage(dc) +/-15%Ref | Measured Freq(MHz) | Drift (Hz) |
|---|---|---|
| 102 | 860 | 0 |
| 138 | 860 | 0 |

Downlink Mid CH, SMR 800

Reference : 120Vac at 20℃ Freq. = 815 MHz

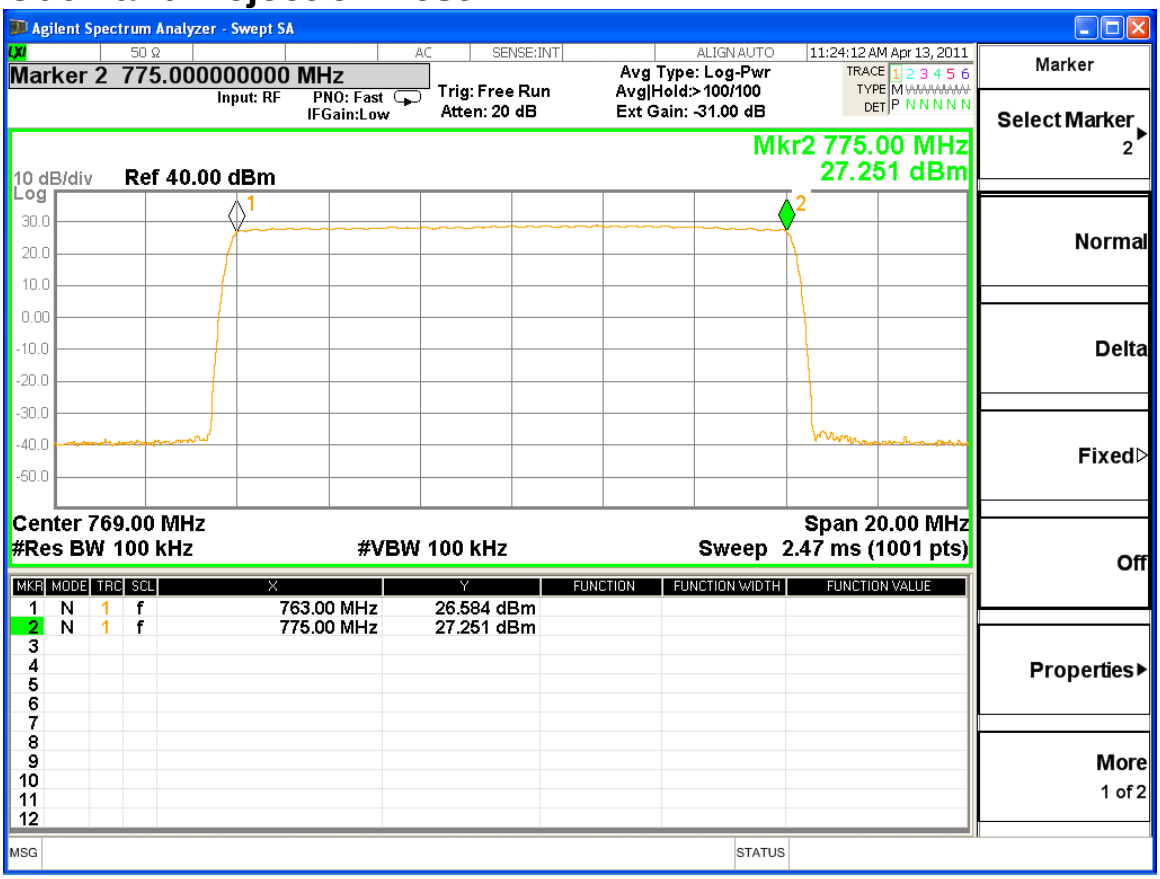
| Temerature (Celsius) | Measured Freq(MHz) | Drift ppm |
|---|---|---|
| 50 | 815 | 0 |
| 40 | 815 | 0 |
| 30 | 815 | 0 |
| 20 | Reference | |
| 10 | 815 | 0 |
| 0 | 815 | 0 |
| -10 | 815 | 0 |
| -20 | 815 | 0 |
| -30 | 815 | 0 |

Reference : 120Vac at 20℃ Freq. = 815 MHz

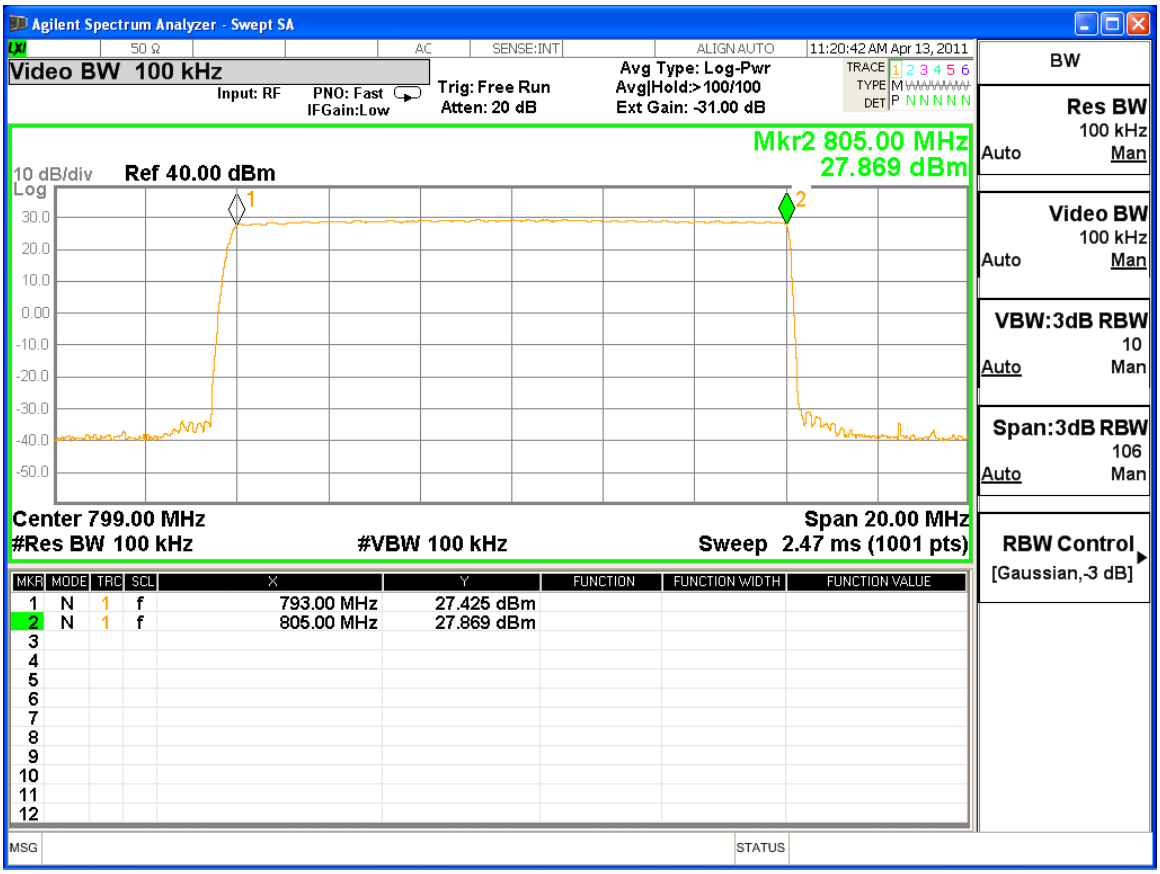
| Voltage(dc) +/-15%Ref | Measured Freq(MHz) | Drift (Hz) |
|---|---|---|
| 102 | 815 | 0 |
| 138 | 815 | 0 |

Uplink Mid CH, SMR 800

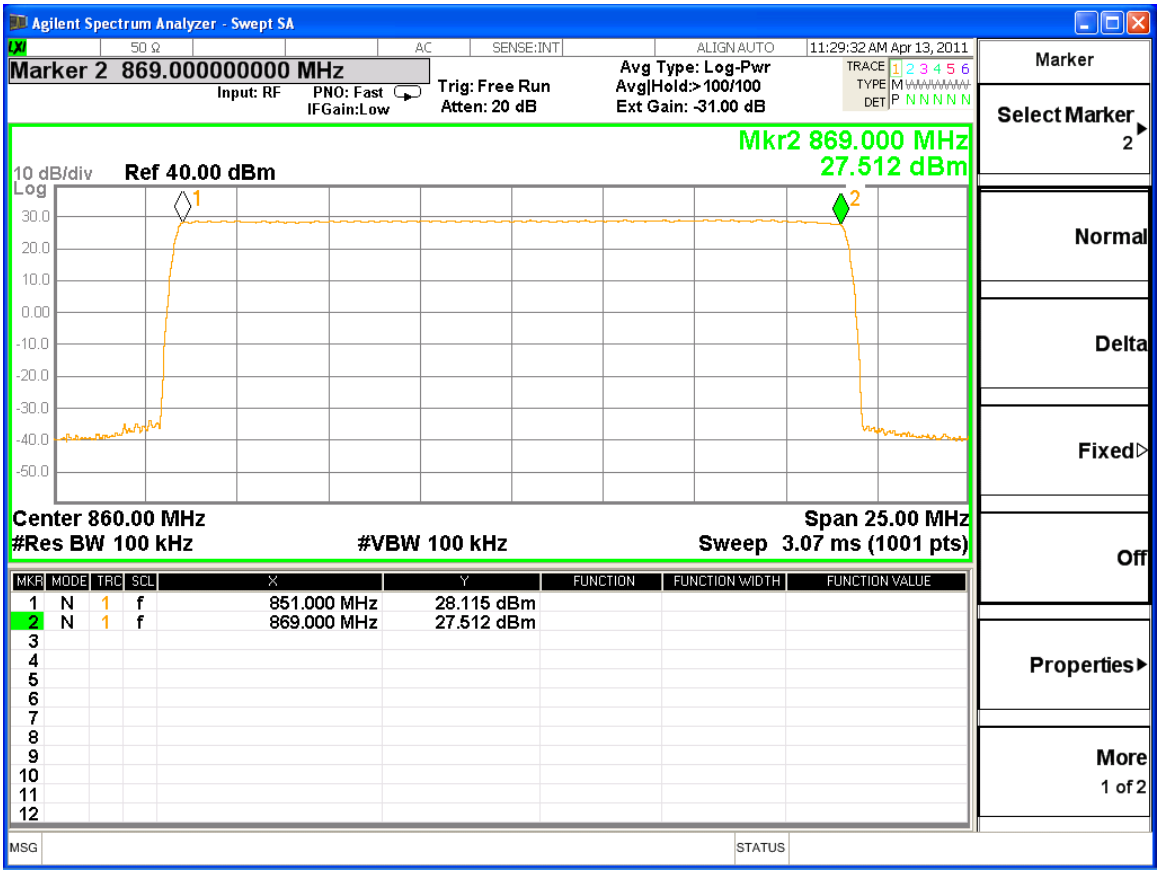
# 13. Out Band Rejection Test



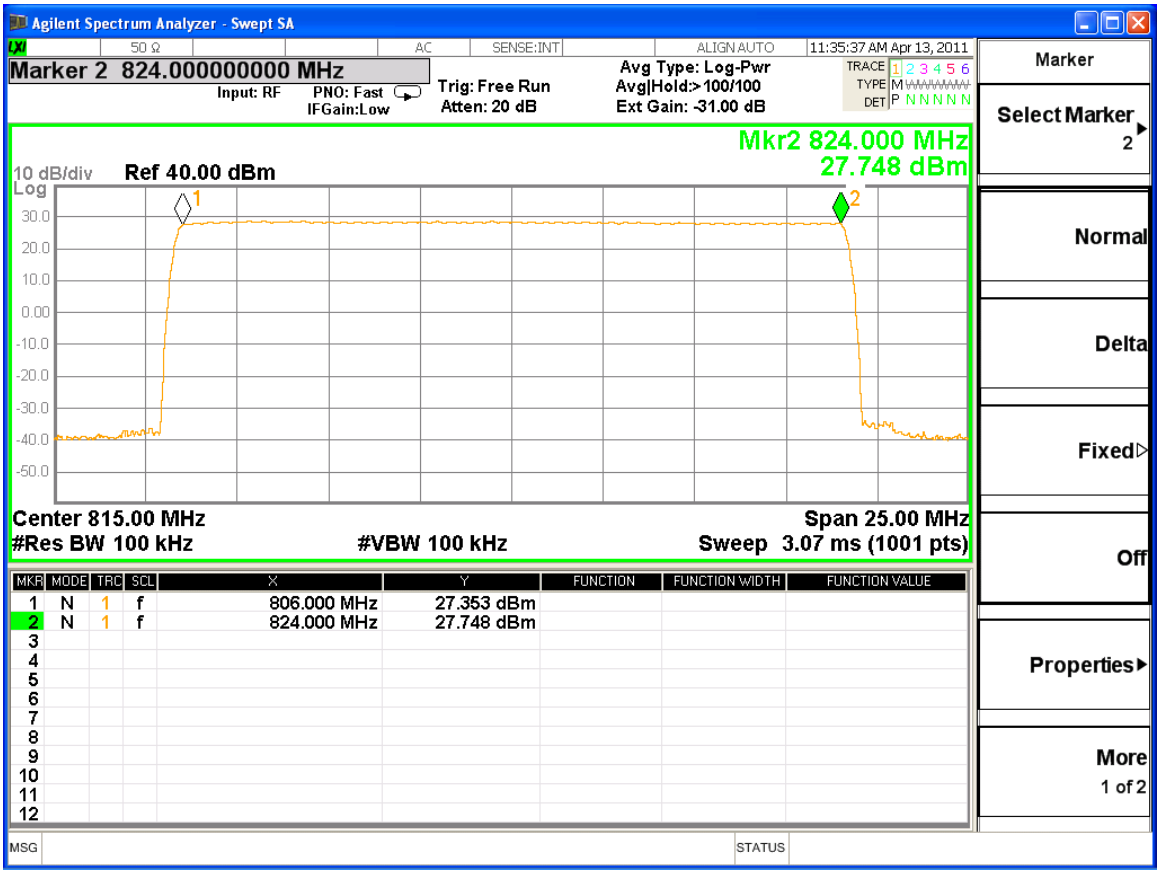

700 Downlink




700 Uplink




**800 Downlink**




**800 Uplink**