# FCC PART 90 TYPE APPROVAL
# EMI MEASUREMENT AND TEST REPORT

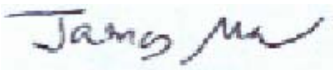
For

## UNION PACIFIC CORPORATION

1400 Douglas Street, Omaha,
NE 68179, USA

**FCC ID: TPBAM090945SF-1H**

| This Report Concerns: | Equipment Type: |
|---|---|
| ☒ Original Report | Booster Amplifier for Portable Transceiver |

| | |
|---|---|
| **Test Engineer:** | James Ma  |
| **Report No.:** | R0510032 |
| **Report Date:** | 2005-11-14 |
| **Reviewed By:** | Daniel Deng  |
| **Prepared By:** | Bay Area Compliance Laboratory Corporation<br>230 Commercial Street<br>Sunnyvale, CA 94085<br>Tel: (408) 732-9162<br>Fax: (408) 732 9164 |

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# GENERAL INFORMATION

## Product Description for Equipment Under Test (EUT)

The *Union Pacific Corporation's* product, FCC ID: *TPBAM090945SF-1H* or the "EUT" as referred to in this report is a Booster Amplifier for Portable Transceiver, which measures approximately 150.88mmL x 63.50mmW x 57.15mmH.

**The test data gathered are from production sample serial number 102, provided by the manufacturer.*

## Objective

This type approval report is prepared on behalf of *Union Pacific Corporation* in accordance with Part 2 and Part 90 of the Federal Communication Commissions rules.

The objective of the manufacturer is to determine compliance with FCC rules for output power, occupied bandwidth, spurious emission at antenna terminal, radiated spurious emission, two-tone test and RF exposure.

## Related Submittal(s)/Grant(s)

No Related Submittals

## Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-2003 and TIA/EIA 603A, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

All radiated and conducted emissions measurement was performed by Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

## Test Facility

The Open Area Test site used by BACL to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, Sunnyvale, California, USA.

Test site at BACL has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC file 31040/SIT 1300F2 and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The current scope of accreditations can be found at http://ts.nist.gov/ts/htdocs/210/214/scopes/2001670.htm

# SYSTEM TEST CONFIGURATION

## Justification

The EUT was configured for testing according to TIA/EIA-603.

The EUT was tested in the normal (native) operating mode to represent *worst*-case results during the final qualification test.

## Block Diagram

Please refer to Exhibit D.

## Equipment Modifications

No modifications were made to the EUT.

## Power Supply Information

| Manufacturer | Description | Model | Serial Number | FCC ID |
|---|---|---|---|---|
| Astron Power Source | 12 V dc, 20 A | MCP DC Power cord, and AC Power cord | N/A | N/A |

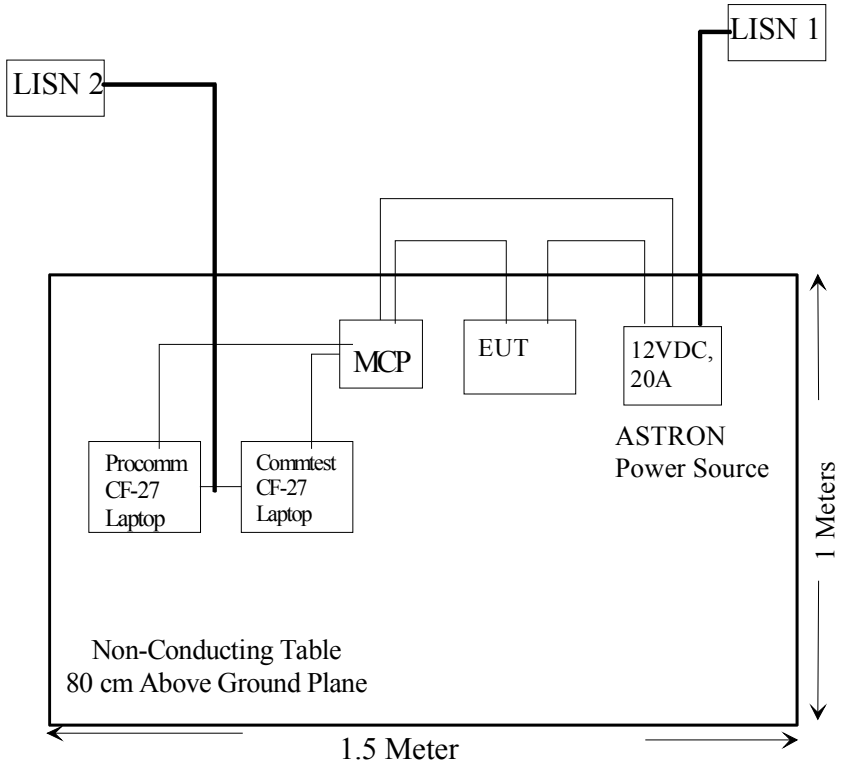
## Local Support Equipment

| Manufacturer | Description | Model | Serial Number | FCC ID |
|---|---|---|---|---|
| Panasonic | Procomm Laptop | CF-27 | N/A | N/A |
| Panasonic | Commtest Laptop | CF-27 | N/A | N/A |
| Astron Power Source | 12 V dc, 20 A | MCP DC Power cord, and AC Power cord | N/A | N/A |
| MCP | MCP Service Port Cable, DE9 to DA15 | N/A | N/A | N/A |

## Interface Ports and Cable in

| Cable Description | Length (M) | From | To |
|---|---|---|---|
| Shielded Cable | 0.2 | RF Output / Generator | RF Port / EUT |

**Test Setup Block Diagram**



# SUMMARY OF TEST RESULTS

| RULE | DESCRIPTION OF TEST | RESULT |
|---|---|---|
| § 2.1046<br>§ 90.205 | RF Output Power | Compliant |
| § 2.1049<br>§ 90.209<br>§ 90.210 | Occupied Bandwidth | Compliant |
| § 2.1051<br>§ 90.210 | Spurious Emissions at Antenna Terminals | Compliant |
| § 2.1053<br>§ 90.210 | Radiated Spurious Emission | Compliant |
| § 90.210 | Two-Tone Test | N/A |
| § 1.1310<br>§ 2.1091 | RF Exposure | Compliant |

# §2.1046, and §90.205 - RF OUTPUT POWER

## Provision Applicable

Per FCC §2.1046 and §90.205: maximum ERP is dependent upon the station's antenna HAAT and required service area. The maximum output power of the transmitter for mobile station is 100 watts (20dBW).

## Test Procedure

The RF output of the transceiver was connected to a power meter through appropriate attenuator.

## Test Equipment

| Manufacturer | Description | Model | Serial Number | Cal. Date |
|---|---|---|---|---|
| Agilent | Power Meter | E4419B | MY4121511 | 2005-04-29 |

* **Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

## Environmental Conditions

| | |
|---|---|
| Temperature: | 23° C |
| Relative Humidity: | 48% |
| ATM Pressure: | 1023 mbar |

*The testing was performed by James Ma on 2005-10-27.*

## Test Results

| | Uplink | ( 2400 Hz Tone ) | ( 2400 Hz Tone ) | Mode = 1 |
|---|---|---|---|---|
| Channel | Frequency ( MHz ) | Input Power ( dBm ) From MCP | Output Power ( dBm ) | Rated Power ( dBm ) |
| 1.0 | 896.8875 | 33.2 ( 2.08 Watt ) | 44.8 ( 30.2 Watt ) | 45.44 ( 35 Watt ) |
| 4.0 | 897.8875 | 33.20 | 44.80 | 45.44 |
| 6.0 | 897.9875 | 33.20 | 44.70 | 45.44 |

| | Downlink | ( 2400 Hz Tone ) | ( 2400 Hz Tone ) | Mode = 2 |
|---|---|---|---|---|
| Channel | Frequency ( MHz ) | Input Power ( dBm ) From MCP | Output Power ( dBm ) | Rated Power ( dBm ) |
| 1.0 | 935.8875 | 31.0 ( 1.26 Watt ) | 44.2 ( 26.3 Watt ) | 45.44 ( 35 Watt ) |
| 4.0 | 936.8875 | 31.00 | 44.10 | 45.44 |
| 6.0 | 936.9875 | 31.00 | 44.10 | 45.44 |

| | Uplink | ( Data ) | ( Data ) | Mode = 1 |
|---|---|---|---|---|
| Channel | Frequency ( MHz ) | Input Power ( dBm ) From MCP | Output Power ( dBm ) | Rated Power ( dBm ) |
| 1.0 | 896.8875 | 33.3 ( 2.14 Watt ) | 44.8 ( 30.2 Watt ) | 45.44 ( 35 Watt ) |
| 4.0 | 897.8875 | 33.20 | 44.90 | 45.44 |
| 6.0 | 897.9875 | 33.20 | 44.80 | 45.44 |

| | Downlink | ( Data ) | ( Data ) | Mode = 2 |
|---|---|---|---|---|
| Channel | Frequency ( MHz ) | Input Power ( dBm ) From MCP | Output Power ( dBm ) | Rated Power ( dBm ) |
| 1.0 | 935.8875 | 31.2 ( 1.32 Watt ) | 44.3 ( 26.92 Watt ) | 45.44 ( 35 Watt ) |
| 4.0 | 936.8875 | 31.20 | 44.20 | 45.44 |
| 6.0 | 936.9875 | 31.20 | 44.20 | 45.44 |

# §2.1049, § 90.209, § 90.210 – OCCUPIED BANDWIDTH

## Applicable Standard

§2.1049, §90.209 and §90.210(g).

(g) Emission Mask G. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz, but no more than 10 kHz: At least 83 log (fd/5) dB;

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but no more than 250 percent of the authorized bandwidth: At least 116 log (fd/6.1) dB, or 50 + 10 log (P) dB, or 70 dB, whichever is the lesser attenuation;

(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

## Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set at 1 kHz and the spectrum was recorded in the frequency band ±50 KHz from the carrier frequency.

## Test Equipment

| Manufacturer | Description | Model No. | Serial No. | Calibration Date |
|---|---|---|---|---|
| Agilent | Analyzer, Spectrum | E4446A | US44300386 | 11/10/2004 |

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

## Environmental Conditions

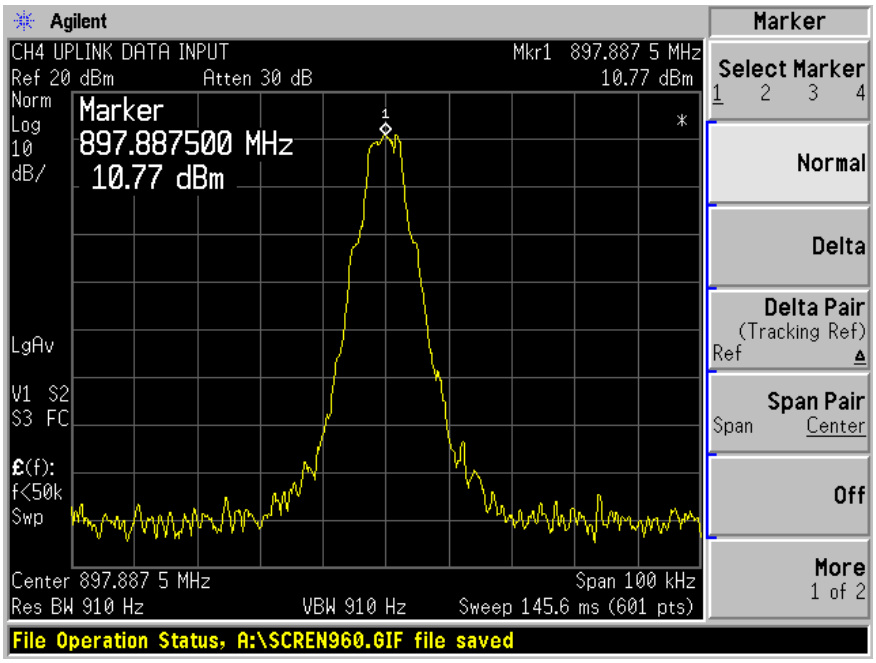
| | |
|---|---|
| Temperature: | 24° C |
| Relative Humidity: | 59% |
| ATM Pressure: | 1017 mbar |

*The testing was performed by James Ma on 2005-10-28.*

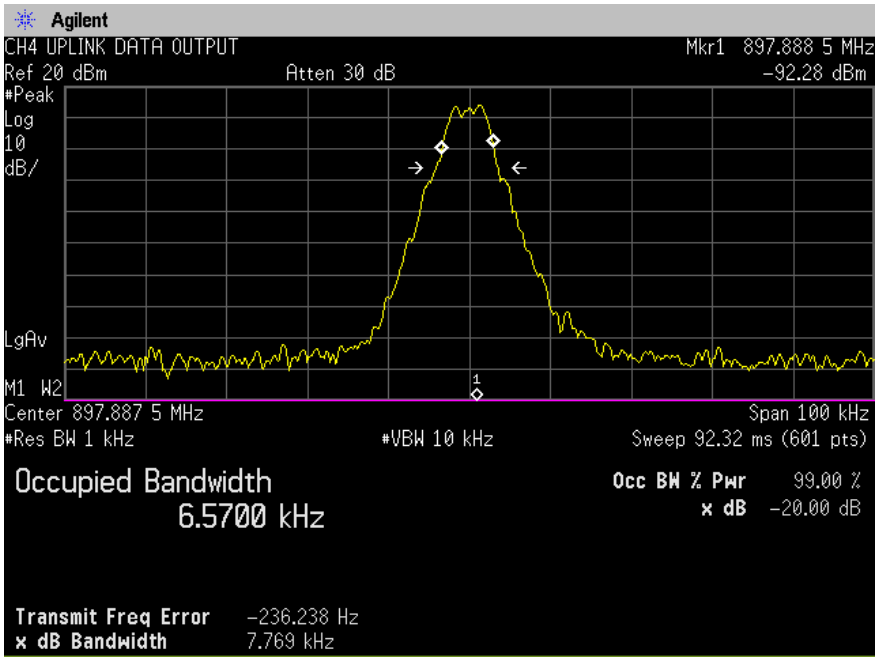
## Test Results

Please refer to the hereinafter plots.

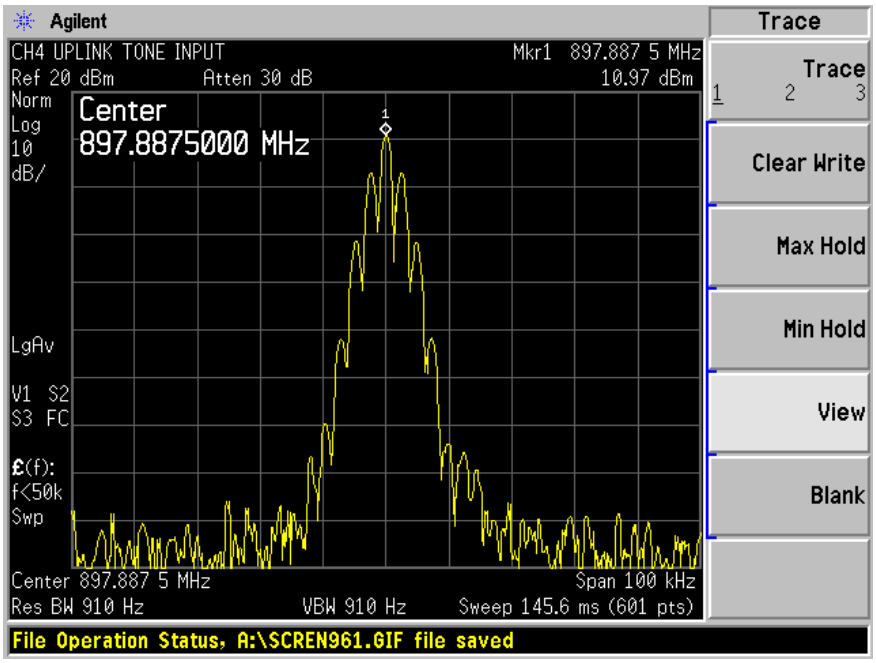
Uplink: data input



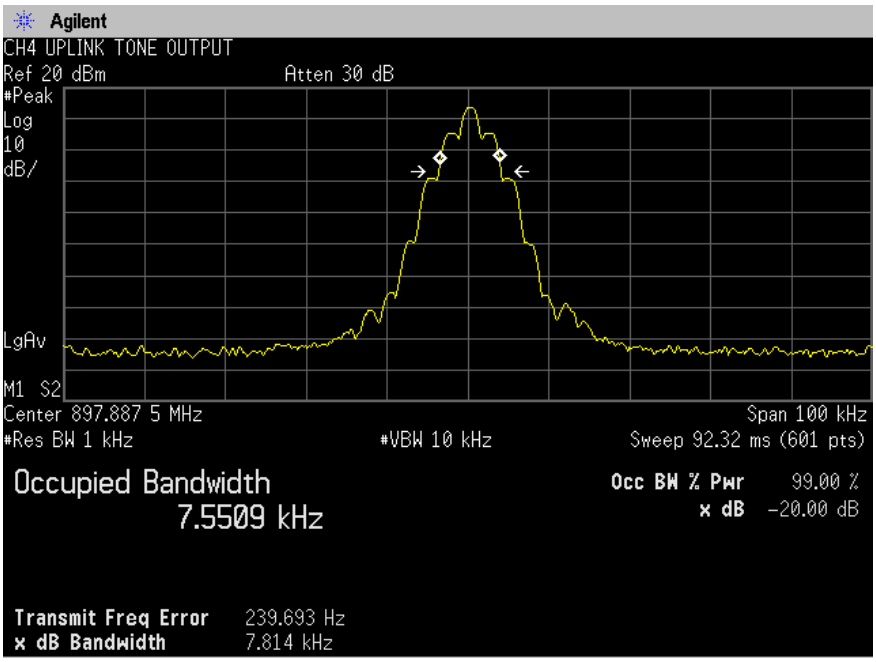

Uplink: data output



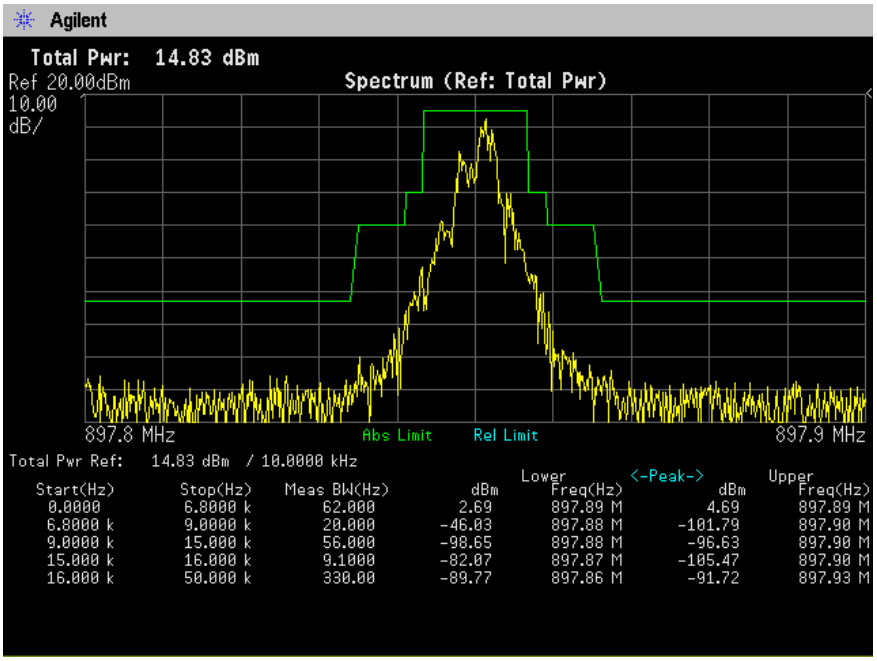
Uplink: Tone Input



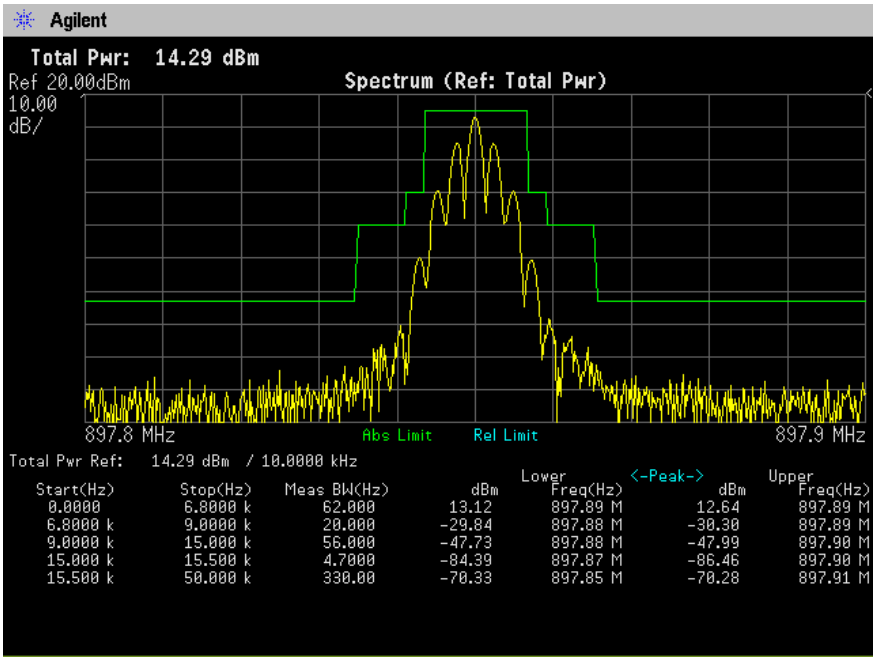

Uplink: Tone Output



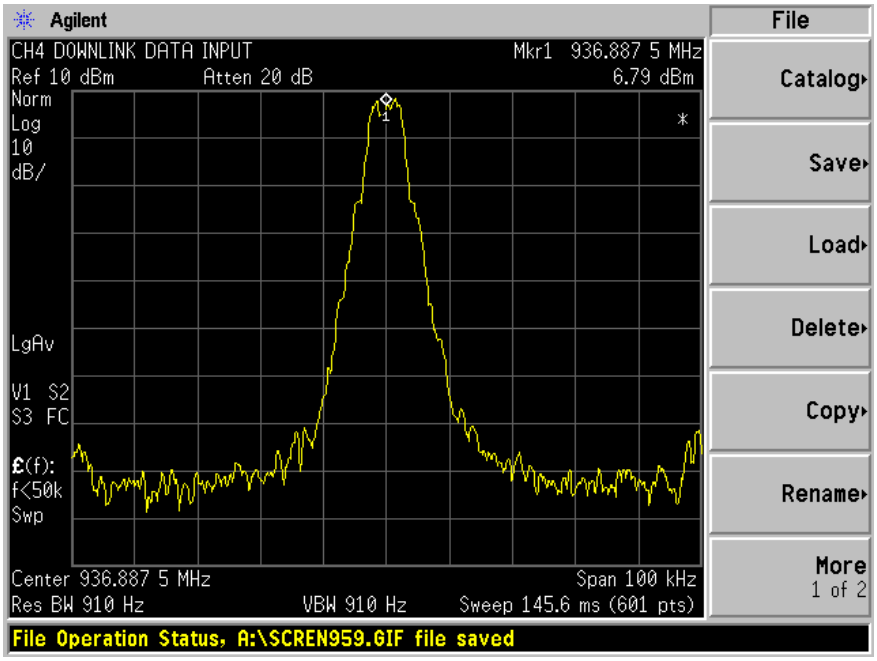
Spectrum Emission Mask Uplink Data Output



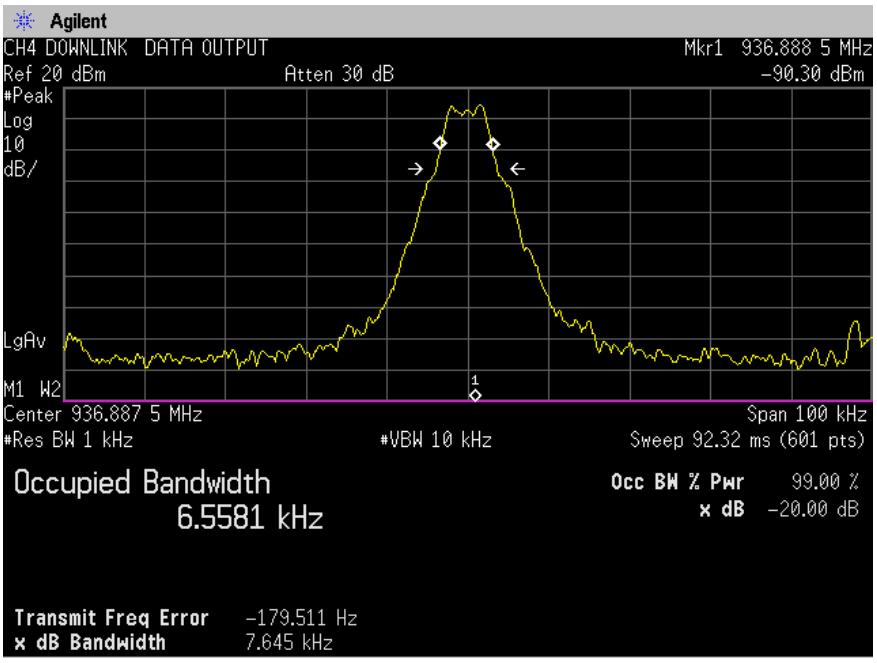

Spectrum Emission Mask Uplink Tone Output



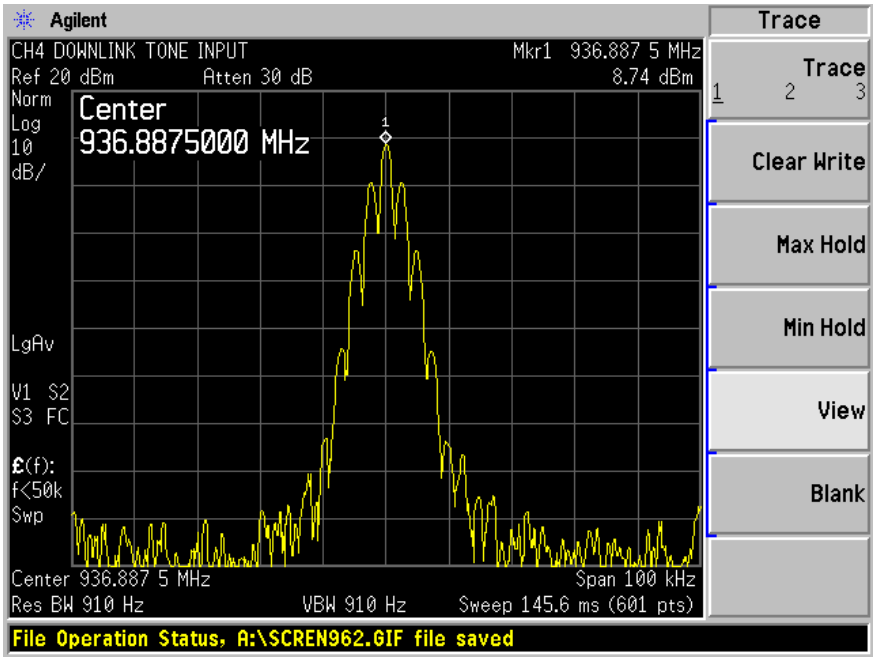
Downlink: data input



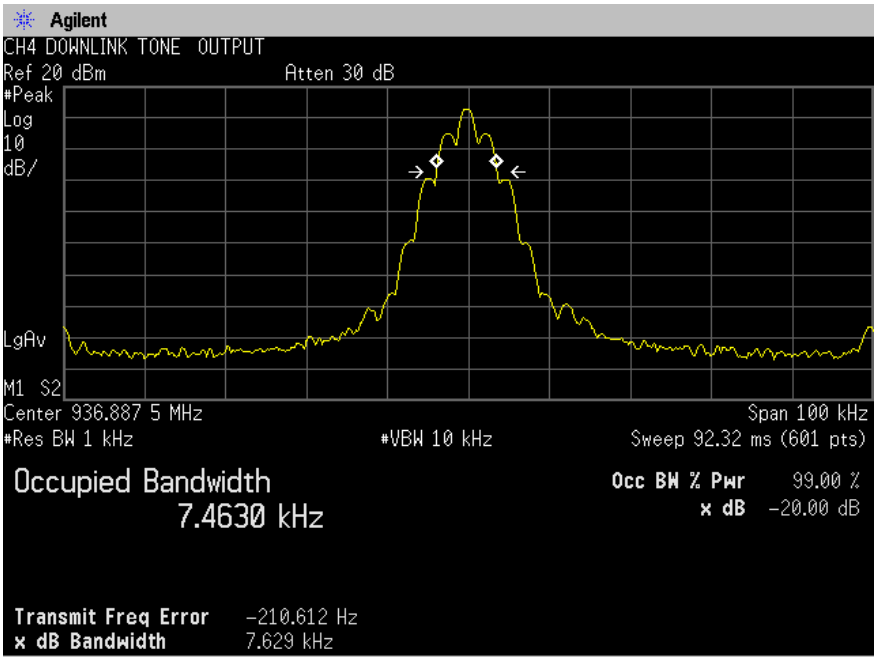

Downlink: data output



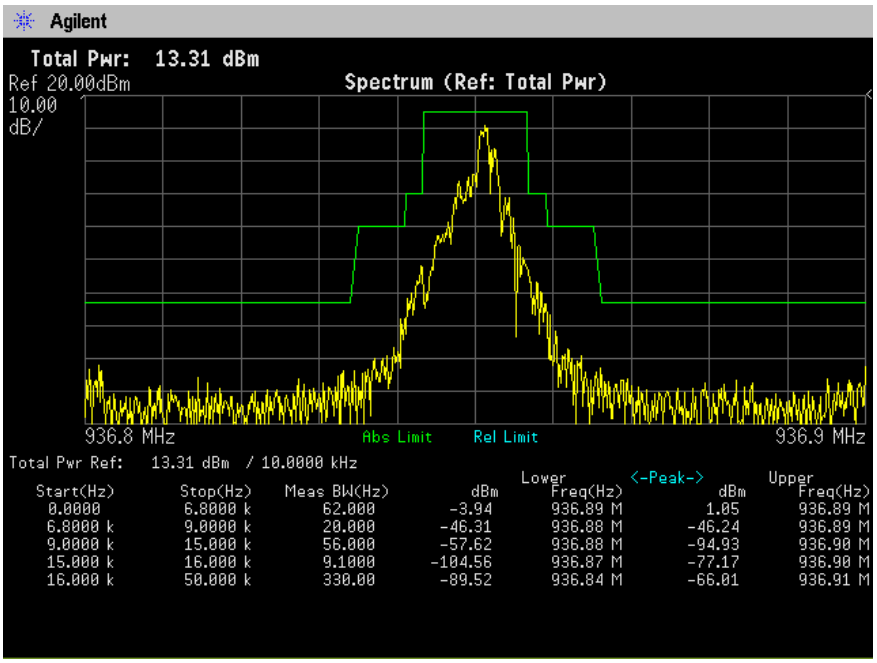
Downlink: Tone Input



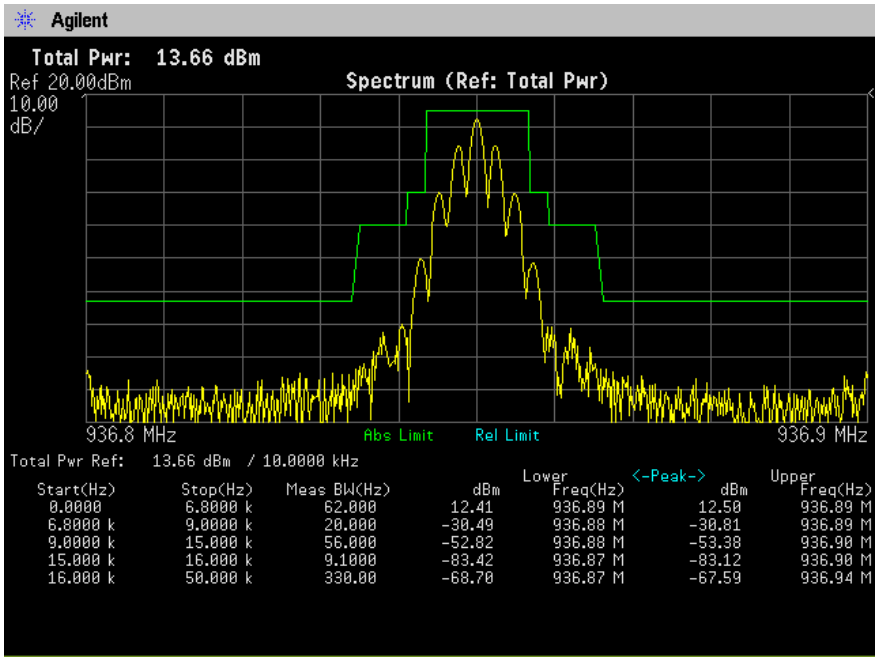

Downlink: Tone Output



Spectrum Emission Mask Downlink Data Output




Spectrum Emission Mask Downlink Tone Output



# §2.1051 and §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

## Applicable Standard

§2.1051and §90.210

On any frequency removed from the center of the assigned channel by more than 250 percent at least:

43+10logP dB

## Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10$^{th}$ harmonic.

## Test Equipment

| Manufacturer | Description | Model No. | Serial No. | Calibration Date |
|---|---|---|---|---|
| Agilent | Analyzer, Spectrum | E4446A | US44300386 | 11/10/2004 |

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

## Environmental Conditions

| | |
|---|---|
| Temperature: | 23° C |
| Relative Humidity: | 48% |
| ATM Pressure: | 1023 mbar |

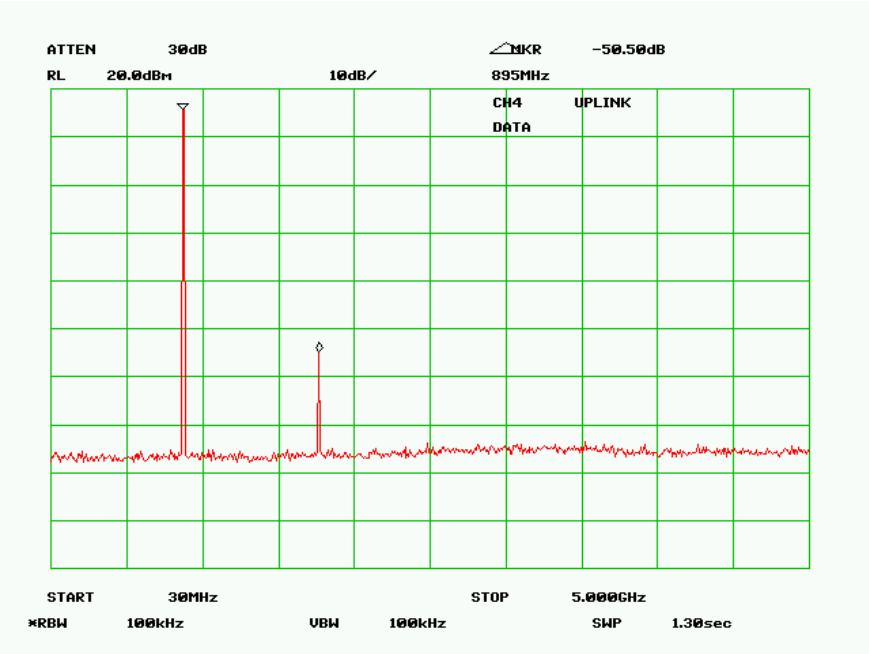
*The testing was performed by James Ma on 2005-10-31.*

## Test Results

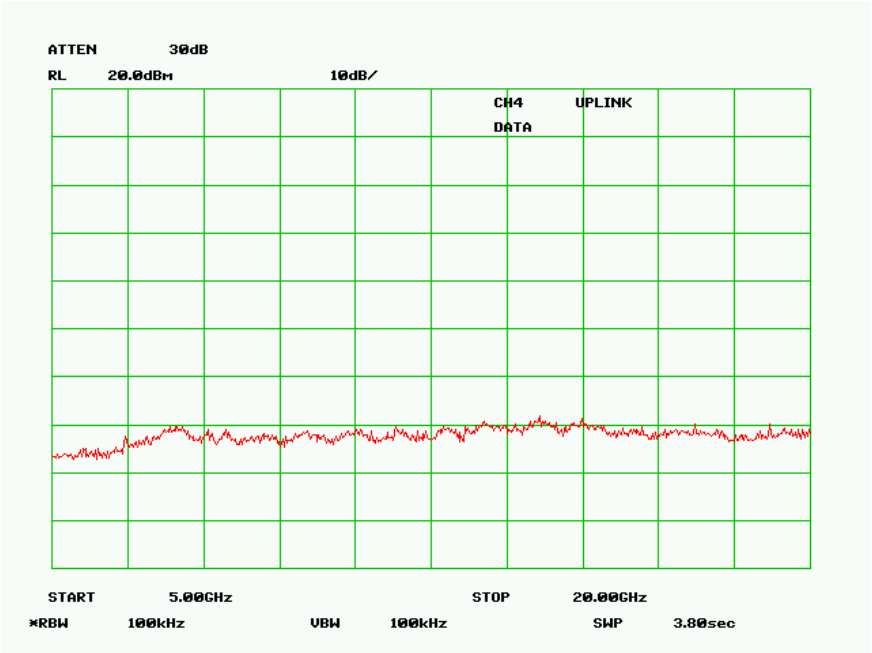
Please refer to the hereinafter plots.

Uplink:

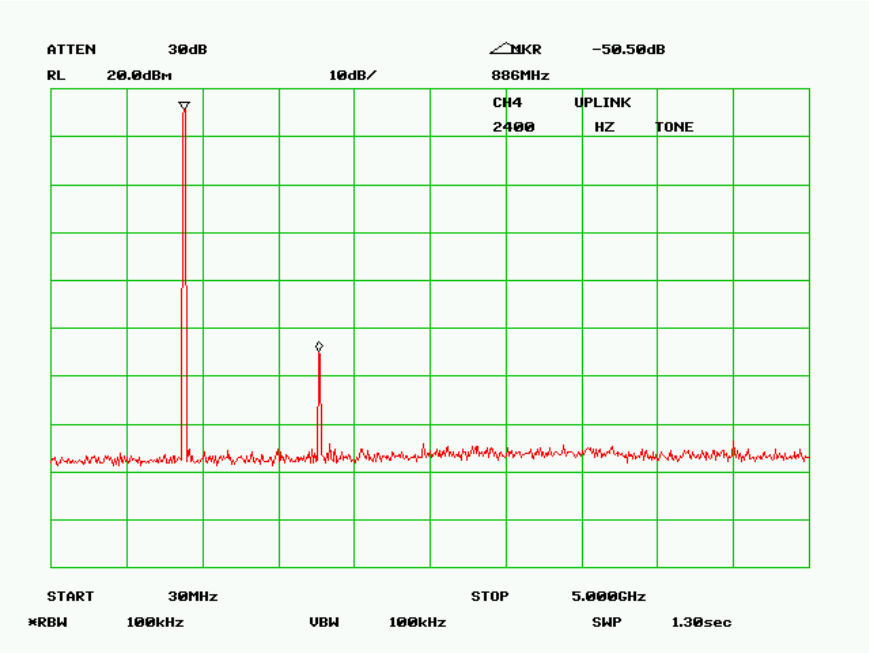
30Mhz to 5 GHz (Data)




5 GHz to 20 GHz (Data)



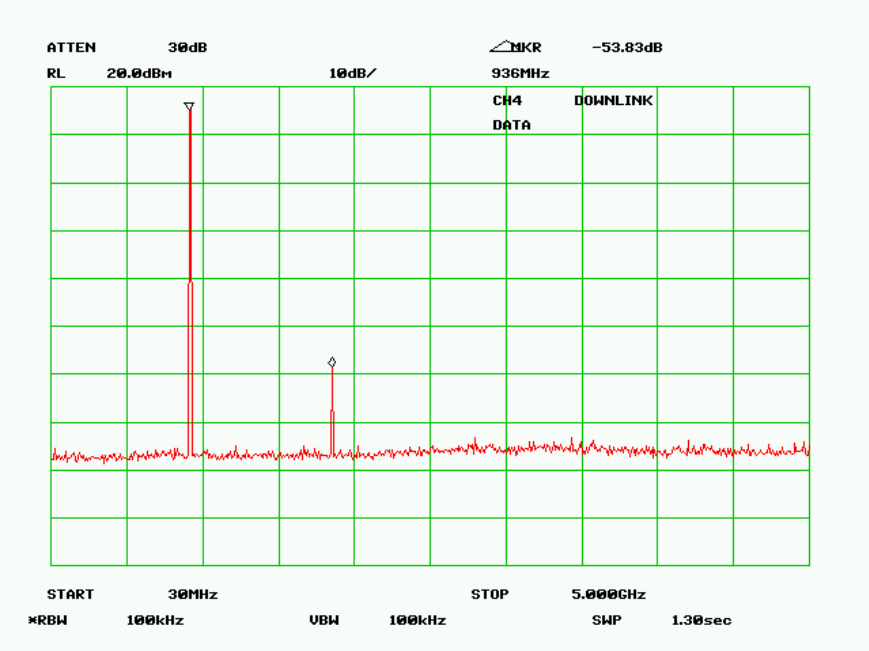
30Mhz to 5 GHz (Tone)



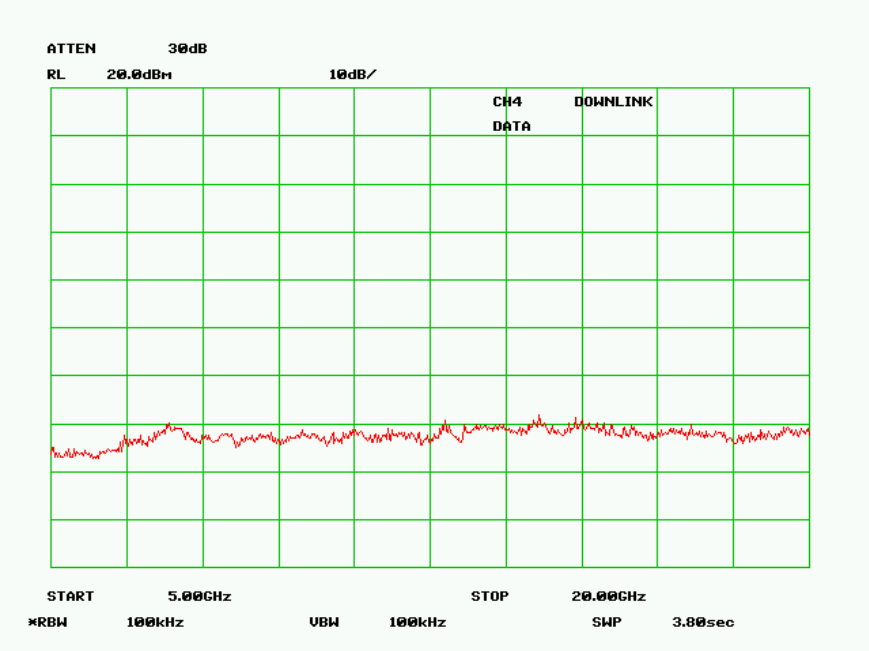

5 GHz to 20 GHz (Tone)

Downlink:

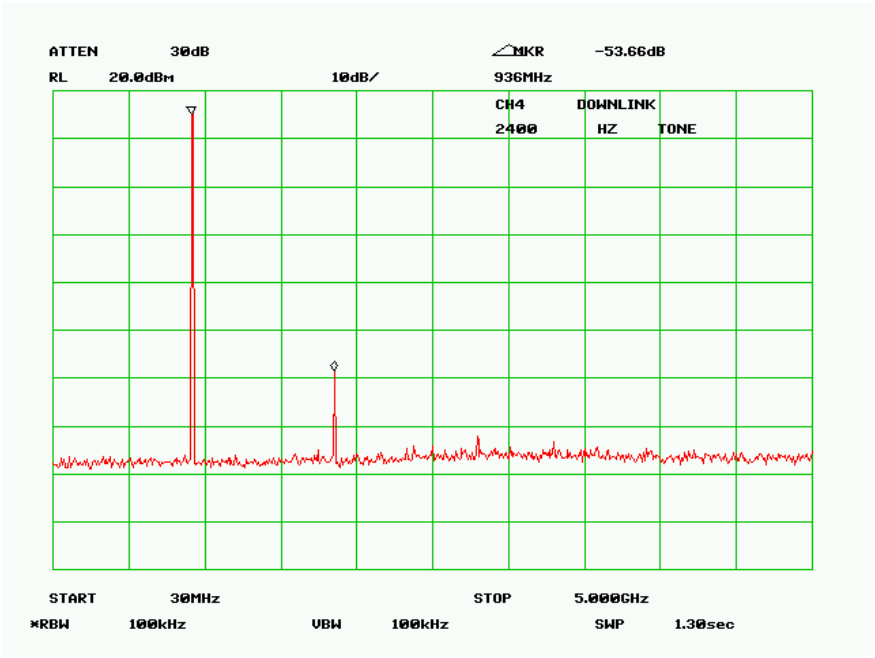
30Mhz to 5 GHz (Data)



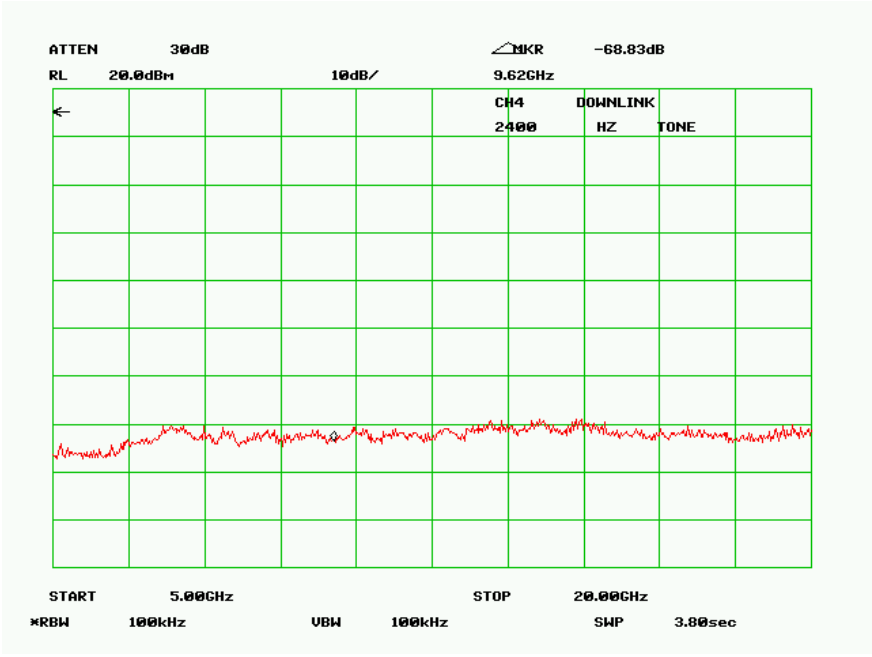

5 GHz to 20 GHz (Data)



30Mhz to 5 GHz (Tone)




5 GHz to 20 GHz (Tone)



# §2.1053 and §90.210 - RADIATED SPURIOUS EMISSION

## Applicable Standard

§2.1053 and §90.210(g)

## Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = 10 lg (TXpwr in Watts/0.001) – the absolute level

## Test Equipment

| Manufacturer | Description | Model | Serial Number | Cal. Date |
|---|---|---|---|---|
| Agilent | Analyzer, Spectrum | 8564E | 3943A01781 | 2004-12-14 |
| ETS | Antenna, Log-Periodic | 3148 | 4-1155 | 2004-12-14 |
| ETS | Antenna, Biconical | 3110B | 9603-2315 | 2005-05-02 |
| HP | Amplifier, Pre | 8447D | 2944A10198 | 2005-08-17 |
| HP | Amplifier, Pre, Microwave | 8449B | 3147A00400 | 2005-08-10 |
| Rohde & Schwarz | Generator, Signal | SMIQ03 | 849192/0085 | 2005-05-02 |
| A. H. Systems | Antenna, Horn, DRG | SAS-200/571 | 261 | 2005-04-20 |
| HP | Generator, Signal | 83650B | 3614A00276 | 2005-05-10 |
| A.R.A. | Antenna, Horn | DRG-118/A | 1132 | 2005-08-17 |
| Sunol Sciences | Antenna | JB1 | A013105-3 | 2005-02-11 |
| A.R.A. | Antenna, Horn | DRG-118/A | 1132 | 2005-08-17 |
| Rohde & Schwarz | Receiver, EMI Test | ESCI 1166.5950K03 | 100044 | 2004-10-04 |

* **Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

## Environmental Conditions

| | |
|---|---|
| Temperature: | 22° C |
| Relative Humidity: | 38% |
| ATM Pressure: | 1021 mbar |

*The testing was performed by James Ma on 2005-10-31.*

## Test Result

Andrew Vertical Antenna:

-1.6dB at 2693.663MHz, for Uplink Channel *
-2.2dB at 1873.775MHz, for Downlink Channel *

AS Antenna:

-0.8dB at 1795.775MHz, for Uplink Channel *
-2.2dB at 1873.775MHz, for Downlink Channel *

*: Test data are within the measurement uncertainty ±4.0dB.

| EUT | | | | | Generator | | | | | Standard | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Indicated | | Table | Test Antenna | | Substitution | | Antenna | Cable | Absolute | FCC | FCC |
| Frequency MHz | Ampl. dBuV/m | Angle Degree | Height Meter | Polar H/V | Frequency MHz | Level dBm | Gain Corrected | Loss dB | Level dBm | Limit dBm | Margin dB |
| Up Link Spurious Emission Primary scan 1 GHZ -20 GHZ (TX), Mid Channel 4, 897.8875MHz | | | | | | | | | | | |
| 2693.663 | 45.0 | 0 | 1.7 | v | 2693.663 | -22.5 | 9.9 | 2.0 | -14.6 | -13 | -1.6 |
| 2693.663 | 44.6 | 0 | 1.7 | h | 2693.663 | -23 | 9.9 | 2.0 | -15.1 | -13 | -2.1 |
| 1795.775 | 47.8 | 0 | 1.7 | v | 1795.775 | -26 | 8.8 | 1.6 | -18.8 | -13 | -5.8 |
| 1795.775 | 40.7 | 0 | 1.7 | h | 1795.775 | -32 | 8.8 | 1.6 | -24.8 | -13 | -11.8 |
| Down Link Spurious Emission Primary scan 1 GHZ -20 GHZ (TX), Mid Channel 4, 936.8875MHz | | | | | | | | | | | |
| 1873.775 | 47.0 | 0 | 1.7 | v | 1873.775 | -22.5 | 8.8 | 1.54 | -15.2 | -13 | -2.2 |
| 1873.775 | 41.0 | 0 | 1.7 | h | 1873.775 | -29.5 | 8.8 | 1.54 | -22.2 | -13 | -9.2 |

Note :
1) EUT connected to Andrew Vertical Antenna
2) Other spurious emission are under noise level.

| EUT | | | | | Generator | | | | | Standard | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Indicated | | Table | Test Antenna | | Substitution | | Antenna | Cable | Absolute | FCC | FCC |
| Frequency MHz | Ampl. dBuV/m | Angle Degree | Height Meter | Polar H/V | Frequency MHz | Level dBm | Gain Corrected | Loss dB | Level dBm | Limit dBm | Margin dB |
| Up Link Spurious Emission Primary scan 1 GHZ -20 GHZ (TX), Mid Channel 4, 897.8875MHz | | | | | | | | | | | |
| 1795.775 | 52.0 | 0 | 1.7 | v | 1795.775 | -21 | 8.8 | 1.57 | -13.8 | -13 | -0.8 |
| 1795.775 | 52.0 | 45 | 1.7 | h | 1795.775 | -21 | 8.8 | 1.57 | -13.8 | -13 | -0.8 |
| Down Link Spurious Emission Primary scan 1 GHZ -20 GHZ (TX), Mid Channel 4, 936.8875Mhz | | | | | | | | | | | |
| 1873.775 | 47.0 | 0 | 1.7 | v | 1873.775 | -22.5 | 8.8 | 1.54 | -15.2 | -13 | -2.2 |
| 1873.775 | 46.5 | 45 | 1.7 | h | 1873.775 | -23 | 8.8 | 1.54 | -15.7 | -13 | -2.7 |

Note :

1) EUT connected to AS Antenna
2) Other spurious emission are under noise level.