

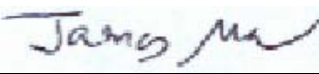
FCC PART 90 TYPE APPROVAL EMI MEASUREMENT AND TEST REPORT

For

UNION PACIFIC CORPORATION

1400 Douglas Street, Omaha,
NE 68179, USA

FCC ID: TPBAM090945SF-1H

This Report Concerns: ☒ Original Report	Equipment Type: Booster Amplifier for Portable Transceiver
Test Engineer: James Ma 	
Report No.: R0510032	
Report Date: 2005-11-14	
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Note: The test report is specially limited to the above company and this particular sample only. It may not be duplicated without prior written consent of Bay Area Compliance Laboratory Corporation. This report **must not** be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the US Government.

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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

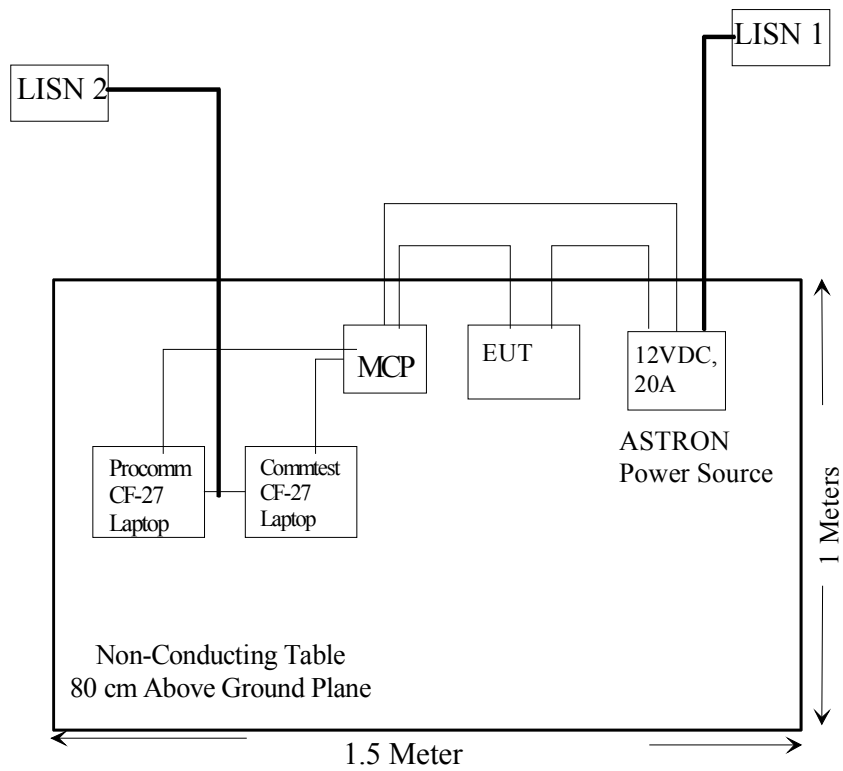
Manufacturer	Description	Model	Serial Number	FCC ID
Astron Power Source	12 V dc, 20 A	MCP DC Power cord, and AC Power cord	N/A	N/A

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 § 90.205	RF Output Power	Compliant
§ 2.1049 § 90.209 § 90.210	Occupied Bandwidth	Compliant
§ 2.1051 § 90.210	Spurious Emissions at Antenna Terminals	Compliant
§ 2.1053 § 90.210	Radiated Spurious Emission	Compliant
§ 90.210	Two-Tone Test	N/A
§ 1.1310 § 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

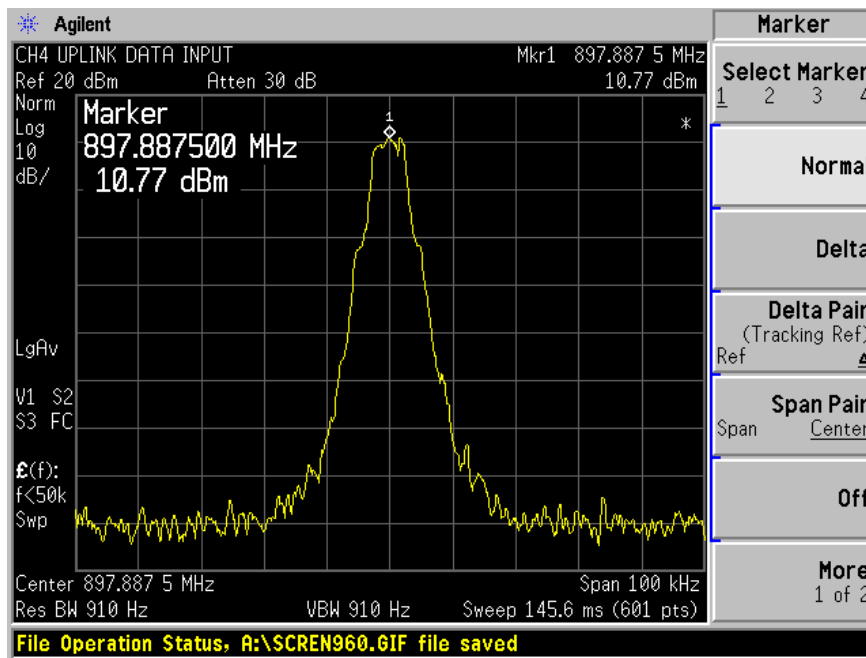
Temperature:	24° C
Relative Humidity:	59%
ATM Pressure:	1017 mbar

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

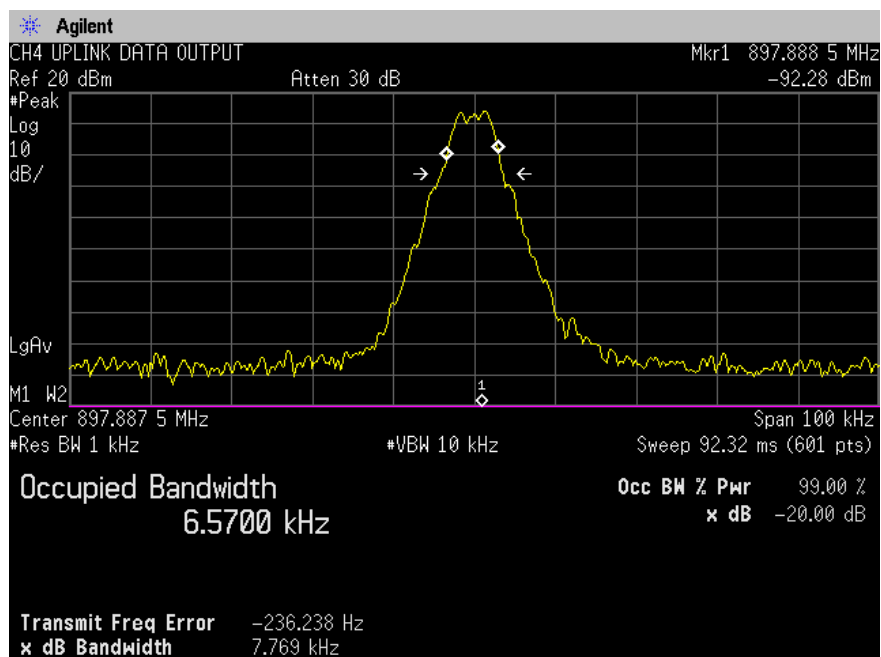
Test Results

Please refer to the hereinafter plots.

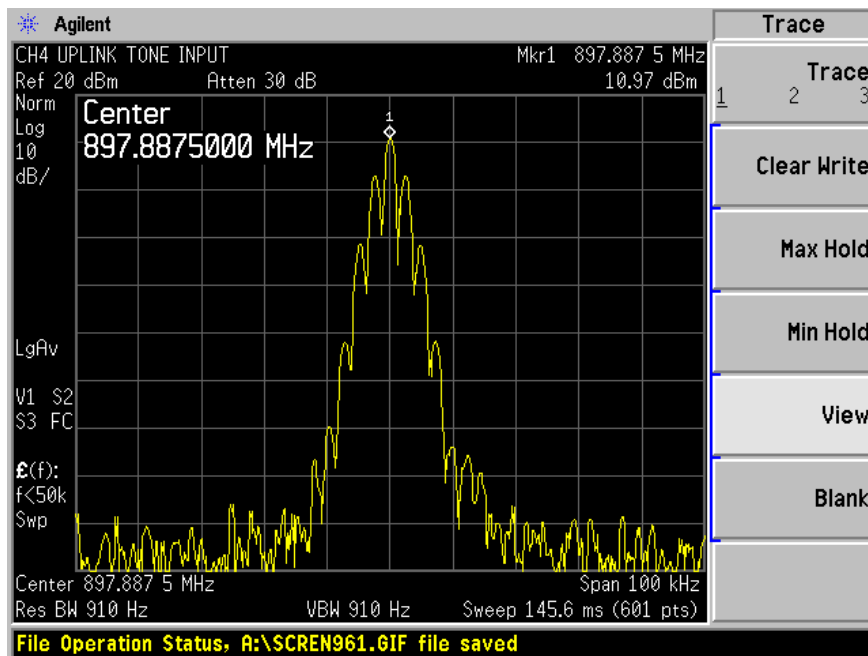
Uplink: data input



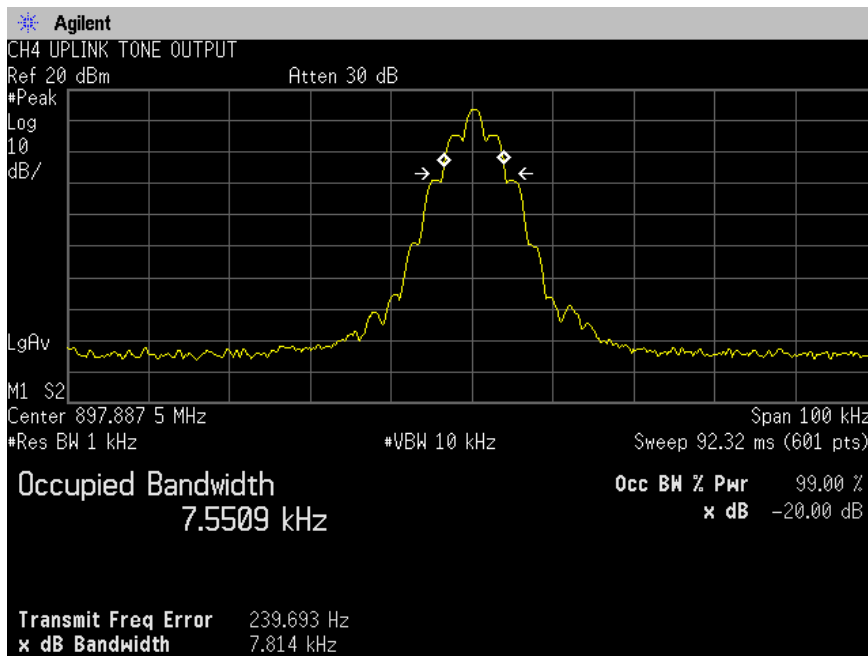
Uplink: data output



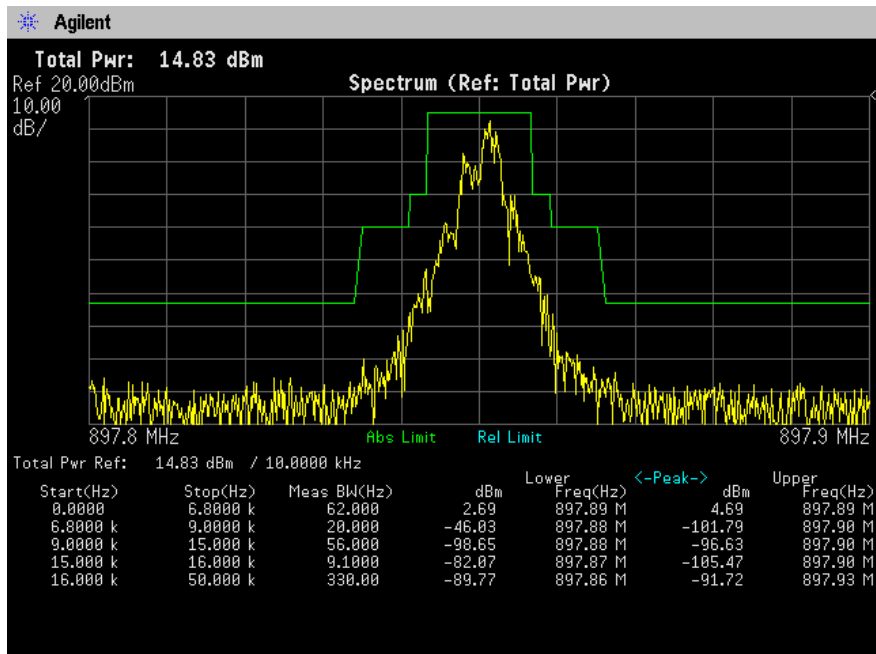
Uplink: Tone Input



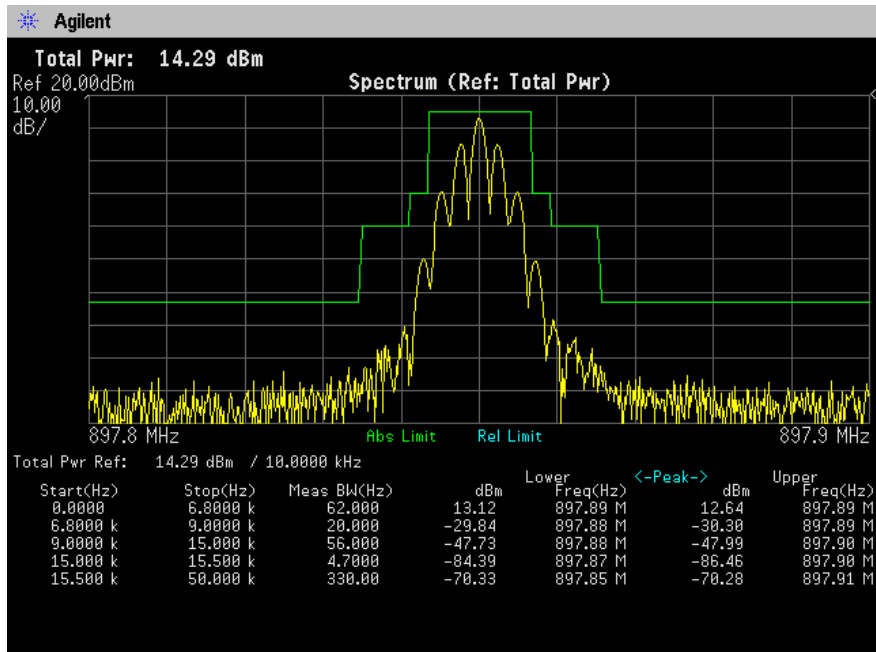
Uplink: Tone Output



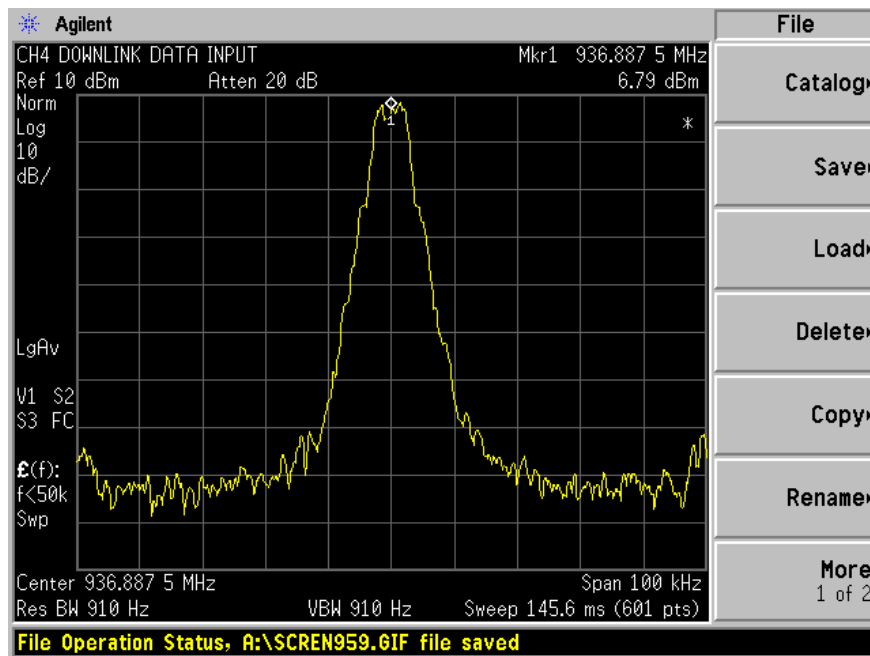
Spectrum Emission Mask Uplink Data Output



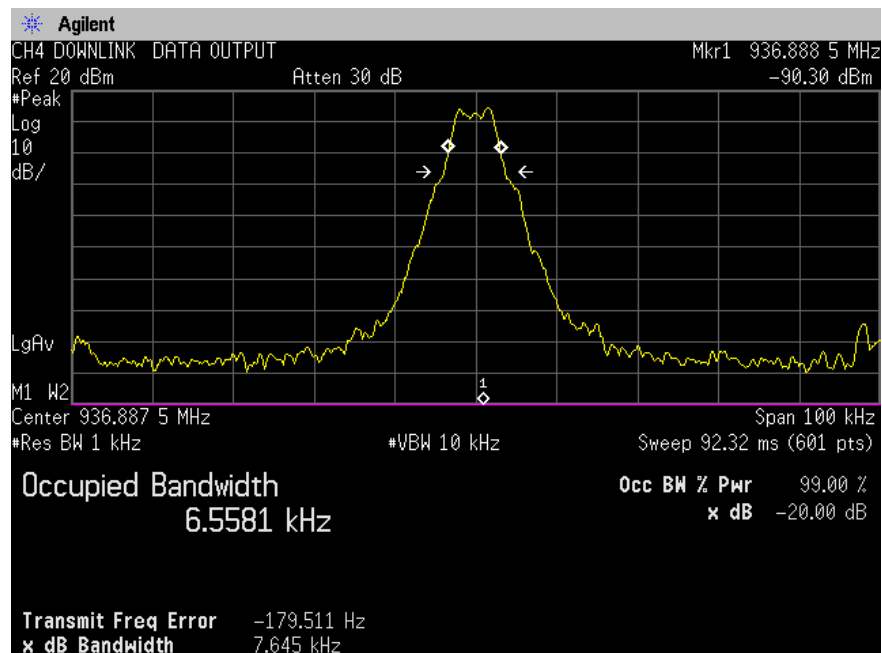
Spectrum Emission Mask Uplink Tone Output



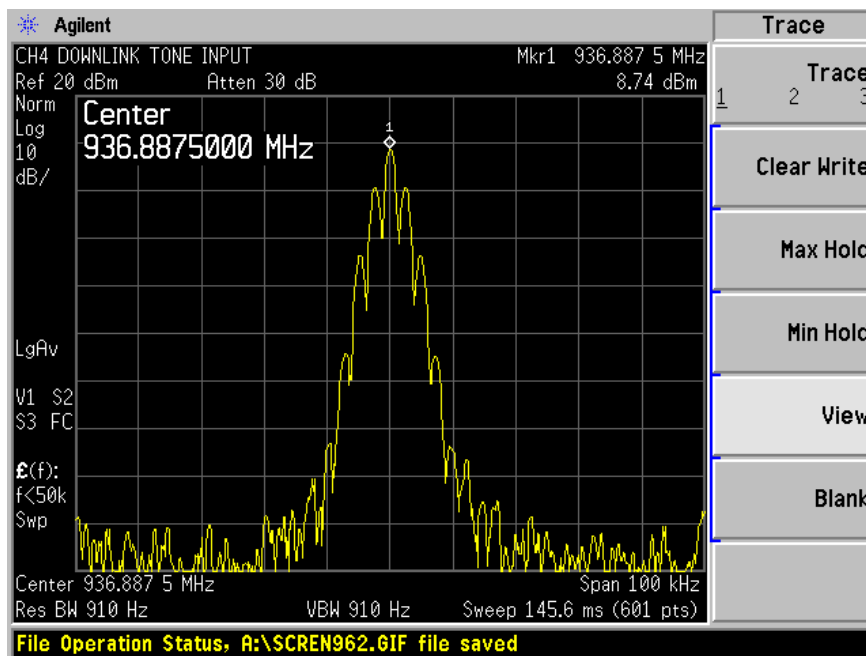
Downlink: data input



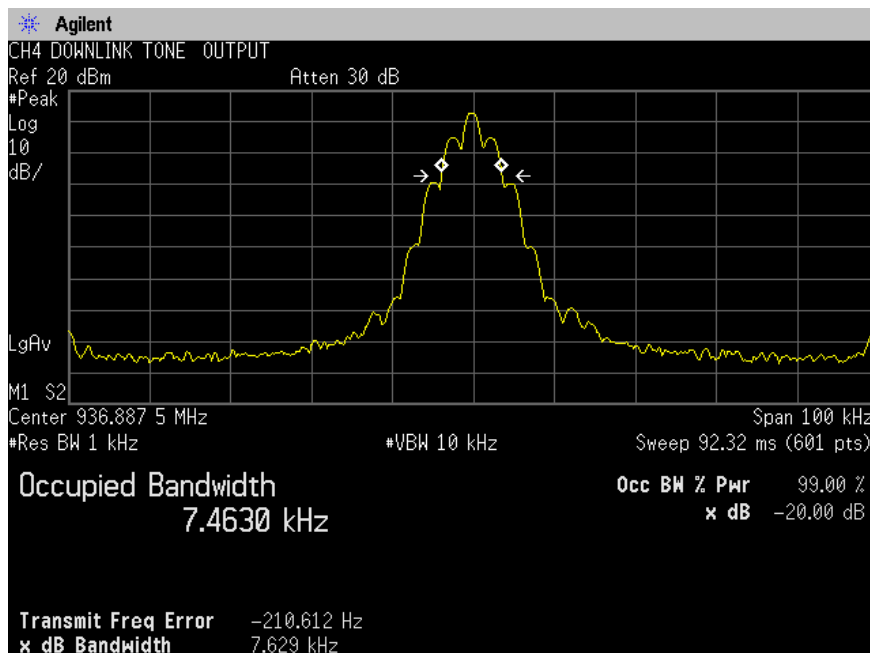
Downlink: data output



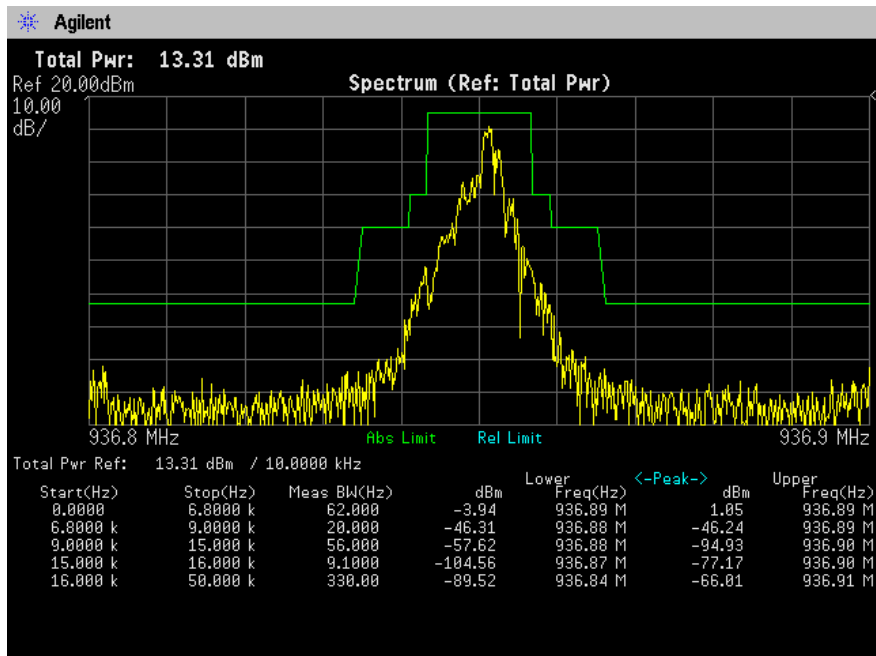
Downlink: Tone Input



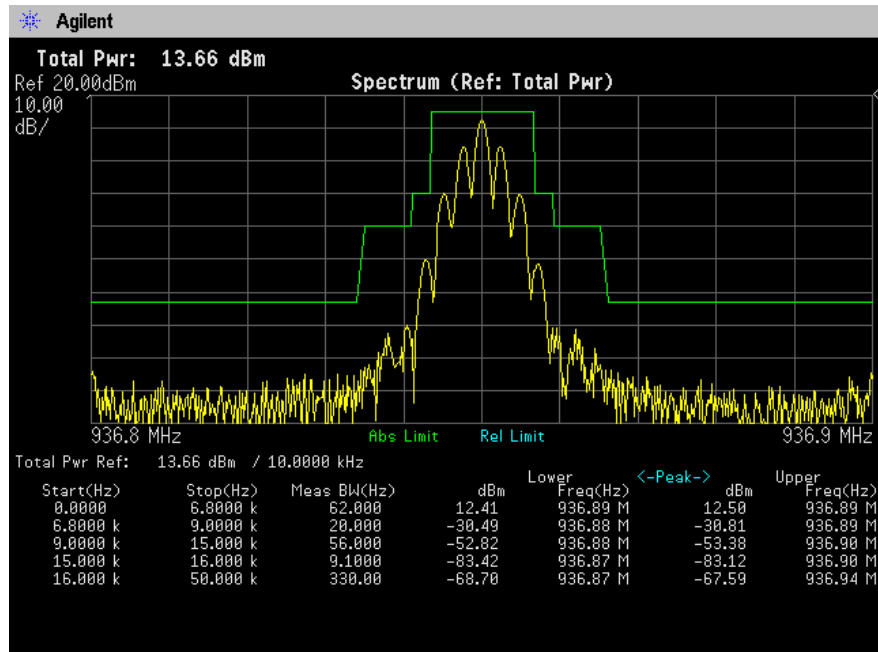
Downlink: Tone Output



Spectrum Emission Mask Downlink Data Output



Spectrum Emission Mask Downlink Tone Output



§2.1051 and §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Applicable Standard

§2.1051 and §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 10th 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

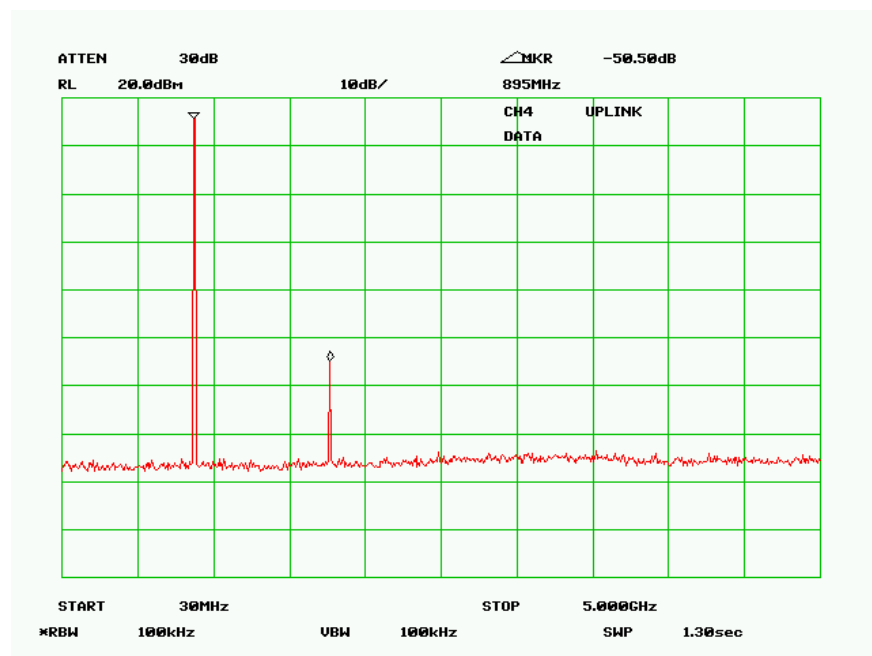
The testing was performed by James Ma on 2005-10-31.

Test Results

Please refer to the hereinafter plots.

Uplink:

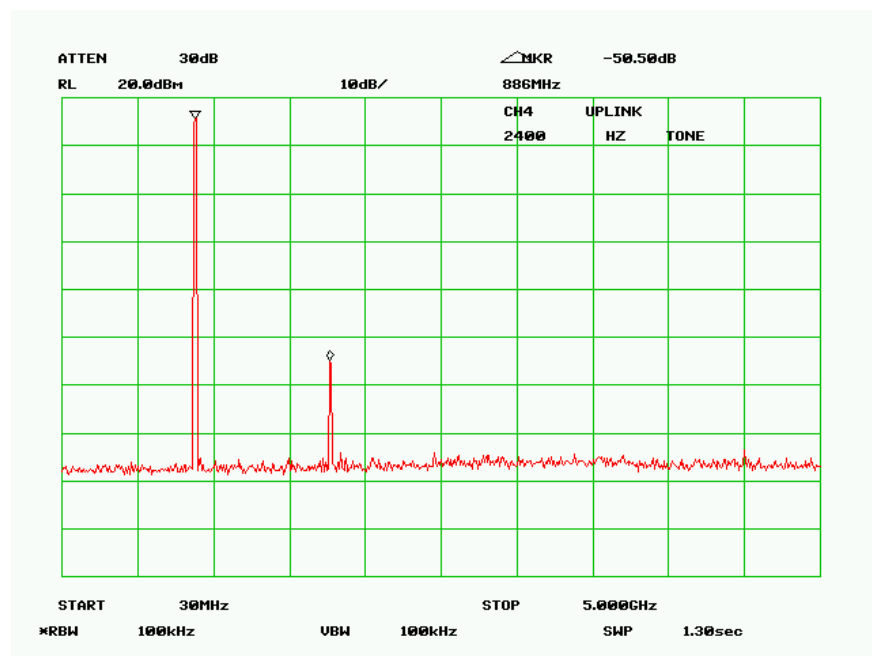
30Mhz to 5 GHz (Data)



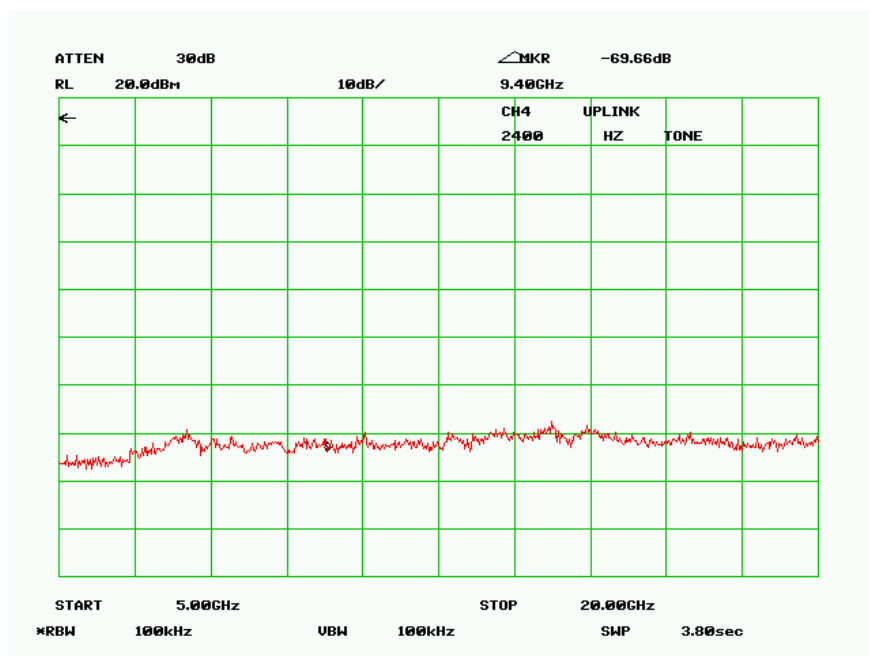
5 GHz to 20 GHz (Data)



30Mhz to 5 GHz (Tone)

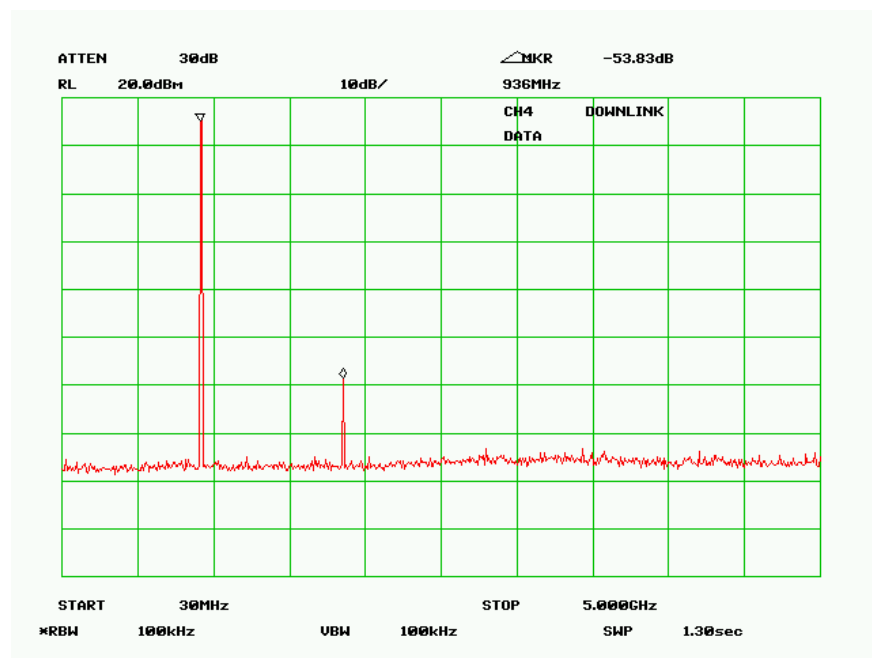


5 GHz to 20 GHz (Tone)

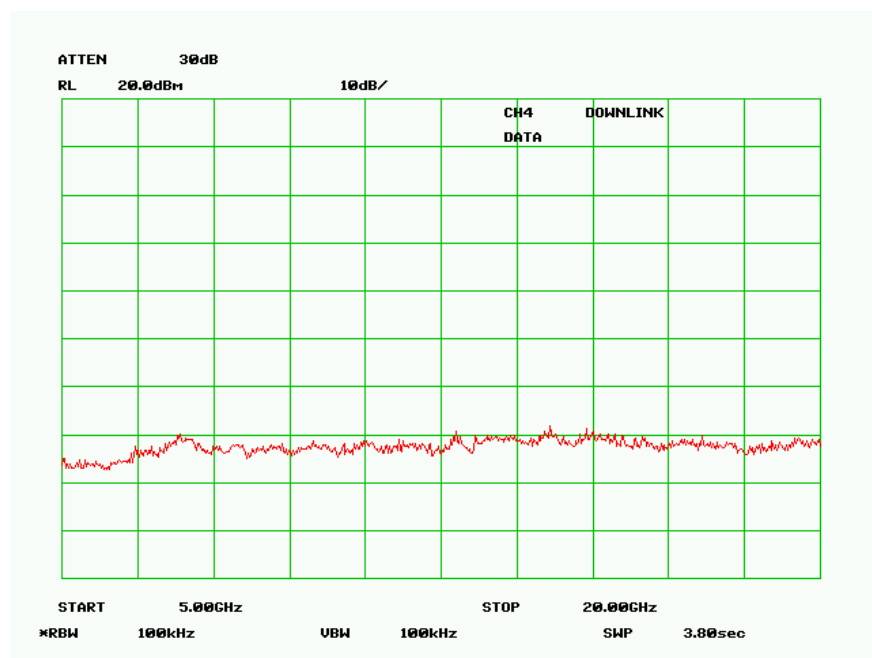


Downlink:

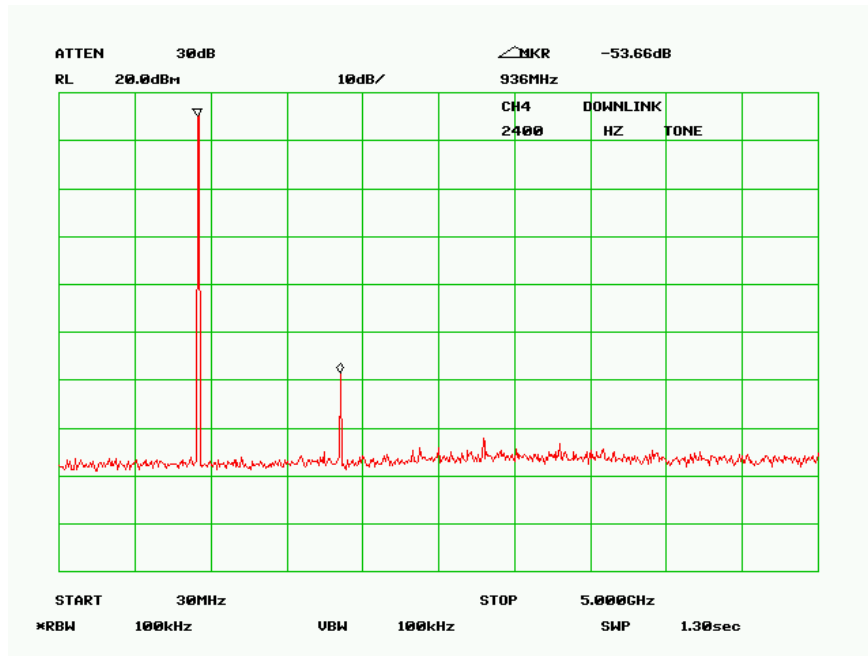
30Mhz to 5 GHz (Data)



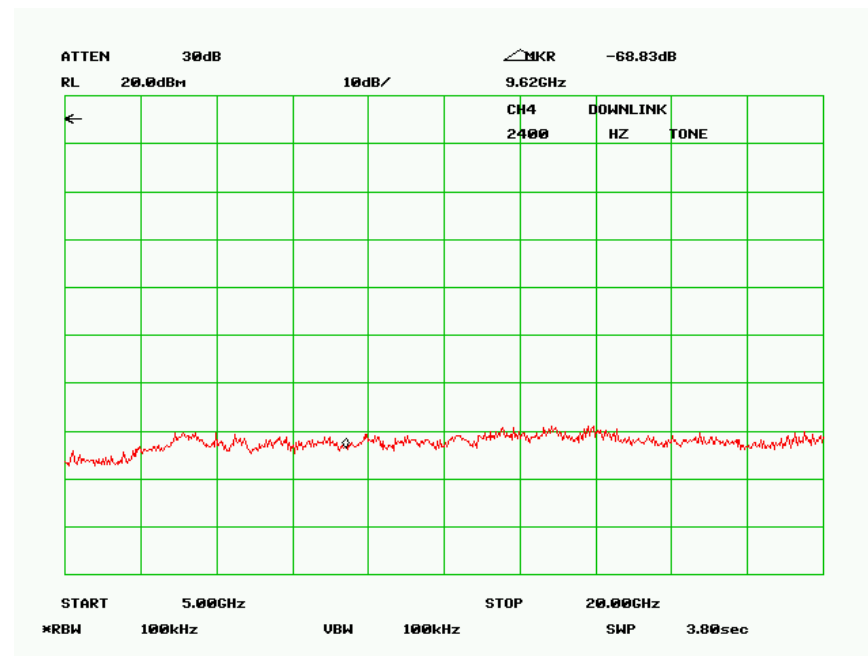
5 GHz to 20 GHz (Data)



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 ± 4.0 dB.

EUT					Generator					Standard	
Indicated	Table	Test Antenna			Substitution		Antenna	Cable	Absolute	FCC	FCC
Frequency	Ampl.	Angle	Height	Polar	Frequency	Level	Gain	Loss	Level	Limit	Margin
MHz	dBuV/m	Degree	Meter	H/V	MHz	dBm	Corrected	dB	dBm	dBm	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.