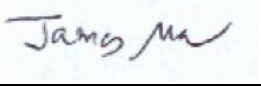
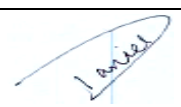


FCC PARTS 22, 74 AND 90  
MEASUREMENT AND TEST REPORT  
For  
**Headline Systems, INC**

Misung Bldg., Guro-Dong 612-6, Guro-Gu, Seoul, Korea, 152-865

**FCC ID: U5IHL-1521**  
**Model: HL-1521**

<b>Report Type:</b> <input checked="" type="checkbox"/> Original Report	<b>Product type:</b> UHF Data Radio Transciever
<b>Test Engineer:</b>	James Ma 
<b>Report Number:</b>	R0708102
<b>Report Date:</b>	2007-08-27
<b>Reviewed By:</b>	Daniel Deng: RF Engineering Lead 
<b>Prepared By:</b> (J8)	Bay Area Compliance Laboratories Corp. 1274 Anvilwood Ave Sunnyvale, CA 94085, U.S.A. Tel: (408) 732-9162 Fax: (408) 732 9164 www.baclcorp.com

**Note:** This test report is for the customer shown above and their specific product only. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. This report **must not** be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government

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## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

The report has been prepared on behalf of Headline Systems, INC and their product FCC ID: U5IHL-1521, model: HL-1521 or the EUT as referred to in the rest of this report. The EUT is a UHF Radio Transceiver that operates under FCC Parts 22, 74, and 90.

Specifications	
Frequency Band	430-470 MHz
Modulation Type	F3E
RF Output Power	1.0 -4.0 Watts
Channel Spacing	25 kHz / 12.5 kHz
Number of Channels	10
Power Supply	7.4 VDC
Frequency Deviation	Peak $\pm 5$ kHz (25 kHz Channel Spacing) Peak $\pm 2.5$ kHz (12.5 kHz Channel Spacing)
Antenna Type	External Omnidirectional Antenna with reverse polarity connection type, 0 dBi Gain

### Mechanical Description

The Headline Systems INC's product, model: HL-1521 or the "EUT" as referred to in this report is a UHF Radio Transceiver of plastic construction, which measures approximately 108.0 mm (L) x 50.8 mm (W) x 38.1 mm (H) and weighs 300 g.

*\* The test data gathered are from production sample, serial number: B1301 Revision: Rev 1 provided by the manufacturer.*

### EUT Photo



*Additional Photo in Exhibit C*

## Objective

This Type approval report is prepared on behalf of *Headline Systems, INC* in accordance with Part 22, Part 74 and Part 90 of the Federal Communication Commissions rules.

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

No related submittal(s).

## Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of federal Regulations Title 47 Part 2, Sub-part J as well as the following individual parts:

Part 22 – Public Mobile Services, Part 74 – Experimental Radio, Auxillary, Special Broadcast and other Program Distributional Services, Part 90 – Private Land Mobile Radio Service

Applicable Standards: TIA603-C and ANSI 63.4-2003, American National Standard for Method of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

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

## Test Facility

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test sites at BACL have 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, Industry Canada, and Voluntary Control Council for Interference has the reports on file and is listed under FCC registration number: 90464, IC registration number: 3062A, and VCCI Registration Number: C-2463 and R-2698. The test site has been approved by the FCC, IC, 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-C.

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

### Equipment Modifications

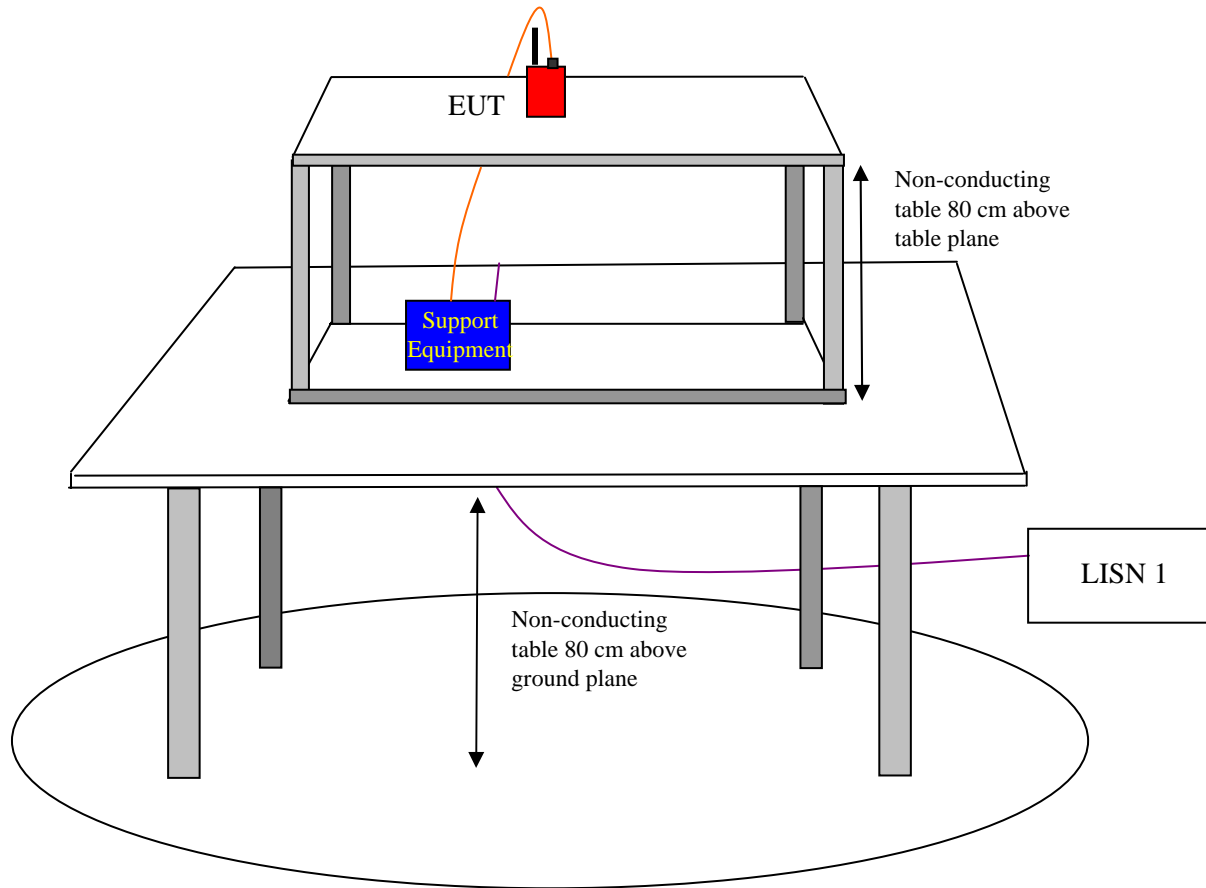
No modifications were made to the EUT.

### Local Support Equipment Power Supply and Line Filters

Manufacturer	Description	Model	Serial Number
Sceptre	I.T.E. power supply	AD2512B	0553WSC12

### Interface Ports and Cabling

Cable Description	Length (M)	From	To
PT5 Data test cable	1.0	PC Serial Port / Function Generator BNC output port	EUT Serial connector / BNC
PT5 Audio test cable	1.0	PC Serial Port / Function Generator BNC output port	EUT Serial connector / BNC

**Test Setup Block Diagram**

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**SUMMARY OF TEST RESULTS**

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<b>Fcc Rules</b>	<b>Description of Test</b>	<b>Result</b>
§1.1310, §2.1093	RF Exposure	Compliant, please refer to SAR report
§2.1046, §90.205	Conducted Output Power	Compliant
§2.1047 §90.207	Modulation Characteristic	Compliant
§2.1049, §22.359, §74.1236, §90.209/90.210	Occupied Bandwidth	Compliant
§2.1051, §90.210	Spurious Emissions AT Antenna Terminals	Compliant
§2.1055, §22.355, §74.1261, § 90.213	Frequency stability	Compliant
§2.1053, § 90.210	Field strength of spurious radiation, Emission Masks	Compliant
§ 90.214	Transient Frequency Behavior	Compliant



## §2.1046, and §90.205 - CONDUCTED OUTPUT POWER

### Applicable Standard

According to FCC §2.1046, and §90.205, maximum ERP is dependent upon the station's antenna HAAT and required service area.

### Test Procedure

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

Spectrum Analyzer Setting:

RBW	Video BW
100 kHz	300 kHz

### Environmental Conditions

Temperature:	26 °C
Relative Humidity:	32 %
ATM Pressure:	100.9 kPa

*\* The testing was performed by James Ma on 2007-08-21.*

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4446A	US44300386	2007-04-26

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

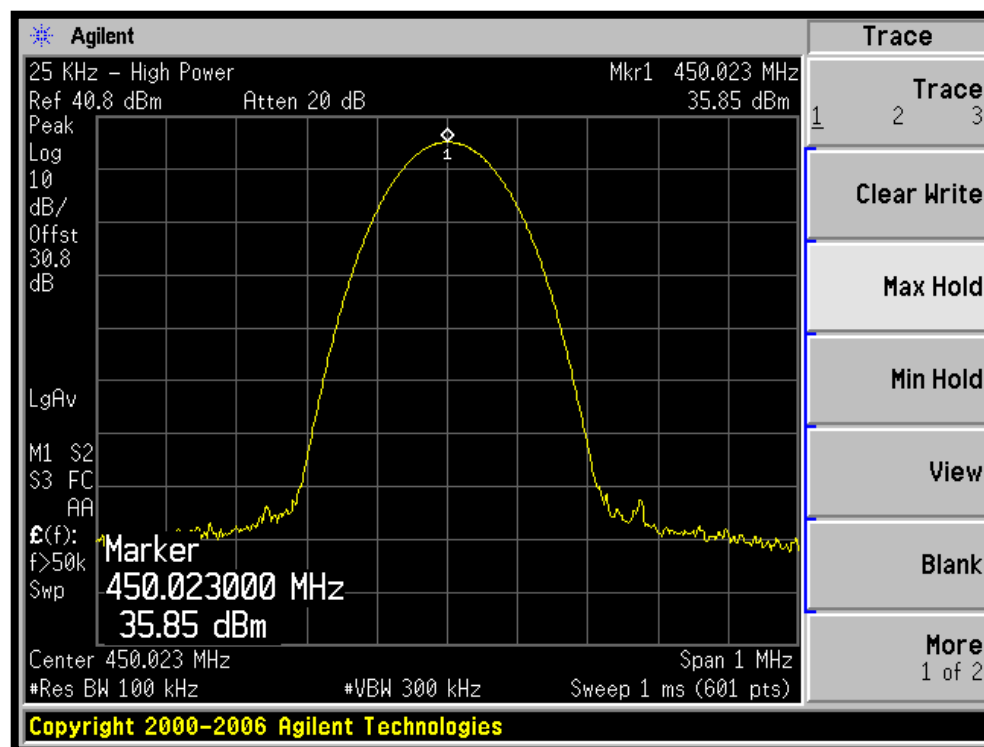
**Test Result***Test Mode: Transmitting***High Power**

Frequency Spacing (kHz)	Frequency (MHz)	Output Power (dBm)	Output Power (Watt)
UHF (25kHz )	450.025	35.85	3.846
UHF (12.5kHz )	450.025	35.86	3.855

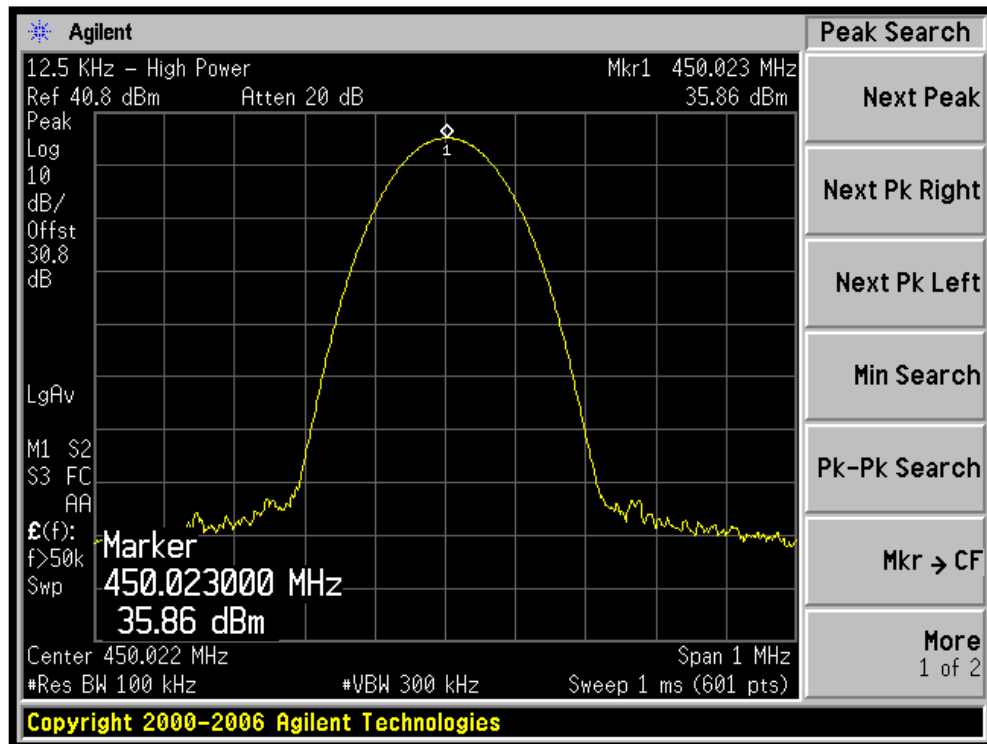
**Low Power**

Frequency Spacing (kHz)	Frequency (MHz)	Output Power (dBm)	Output Power (Watt)
UHF (25kHz )	450.025	29.14	0.820
UHF (12.5kHz )	450.025	29.13	0.818

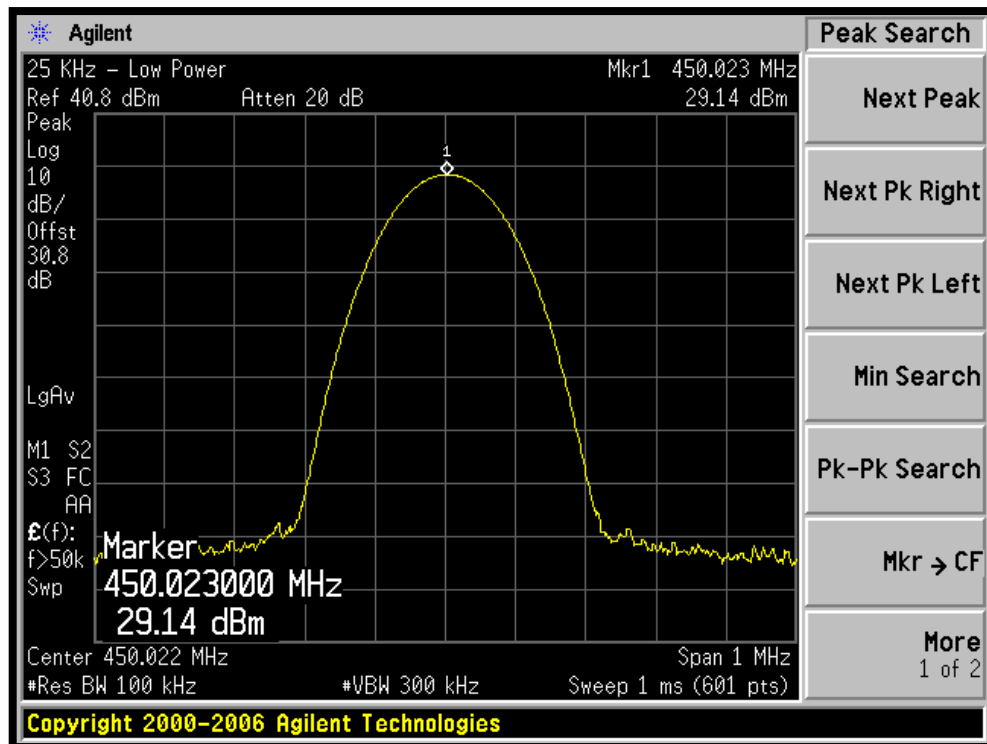
Plots of conducted output power:

**UHF (25 kHz) High Power**

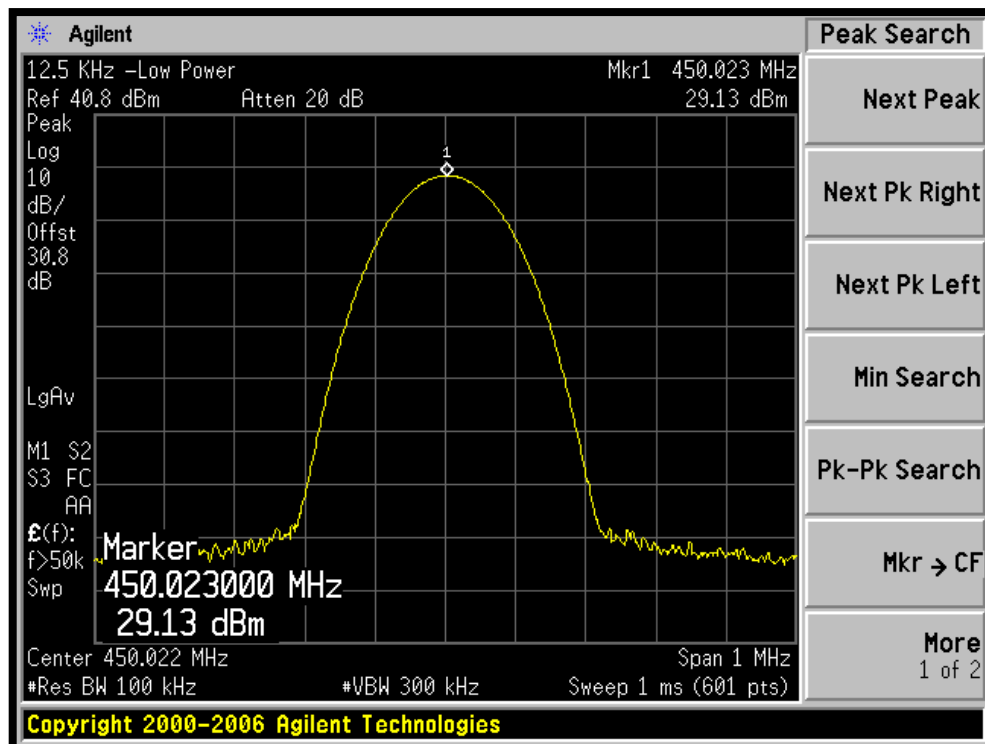
## UHF (12.5 kHz) High Power



## UHF (25 kHz) Low Power



## UHF (12.5 kHz) Low Power



## §2.1047, and §90.207 - MODULATION CHARACTERISTIC

### Applicable Standard

§2.1047 & §90.207:

- (a) Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz. for equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.
- (b) Equipment which employs modulation limiting, a curve showing the percentage of modulation versus the modulation input voltage shall be supplied.

### Test Procedure

Test Method: TIA/EIA-603-C 2.2.3

### Environmental Conditions

Temperature:	26 °C
Relative Humidity:	32 %
ATM Pressure:	100.9 kPa

*\* The testing was performed by James Ma on 2007-08-21.*

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Function Arbitrary Waveform Generator	33220A	MY43004878	2007-06-04
HP	Modulation Analyzer	8901A	2026A00847	2007-04-27

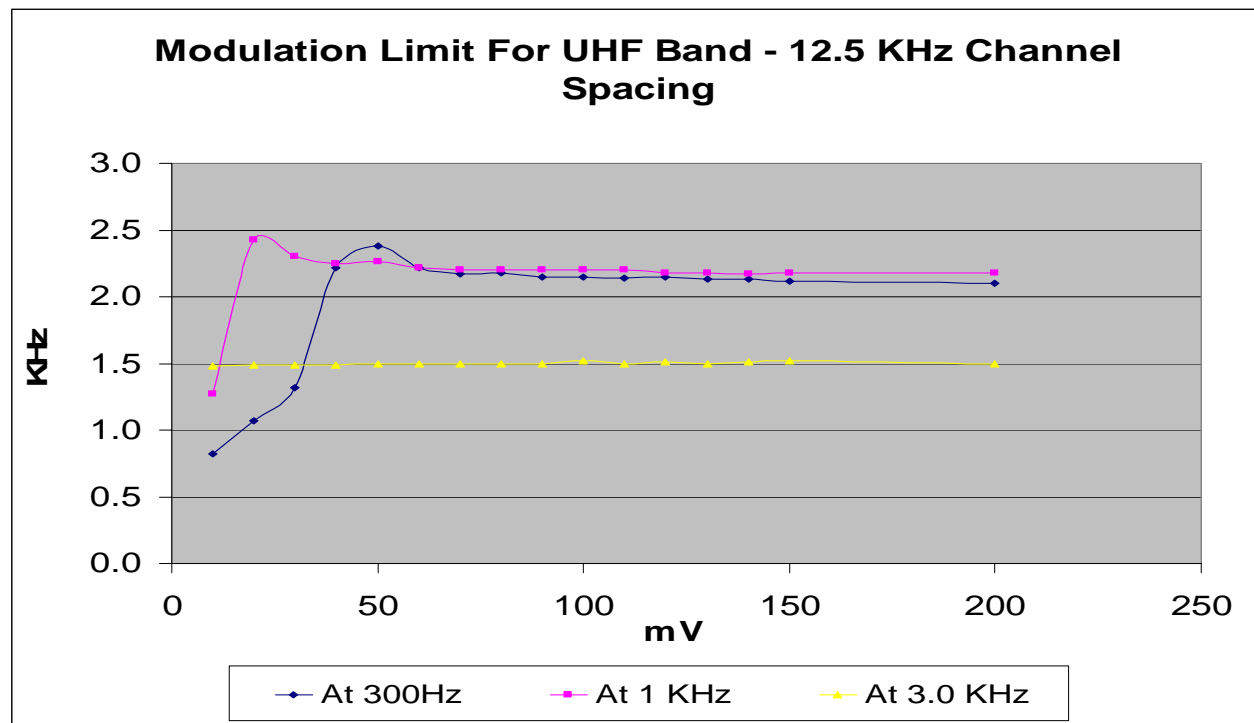
**\* Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

### Test Result

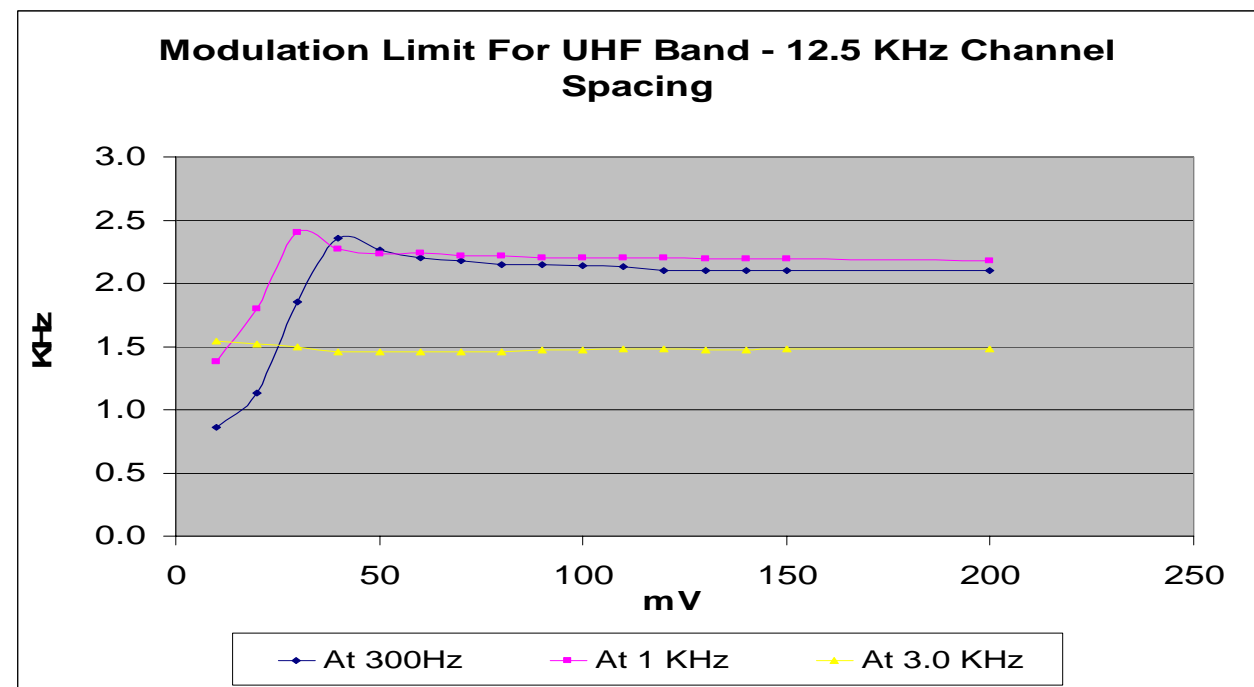
*Test Mode: Transmitting*

Modulation Limit for *HL – 1521 - UHF*

High Power

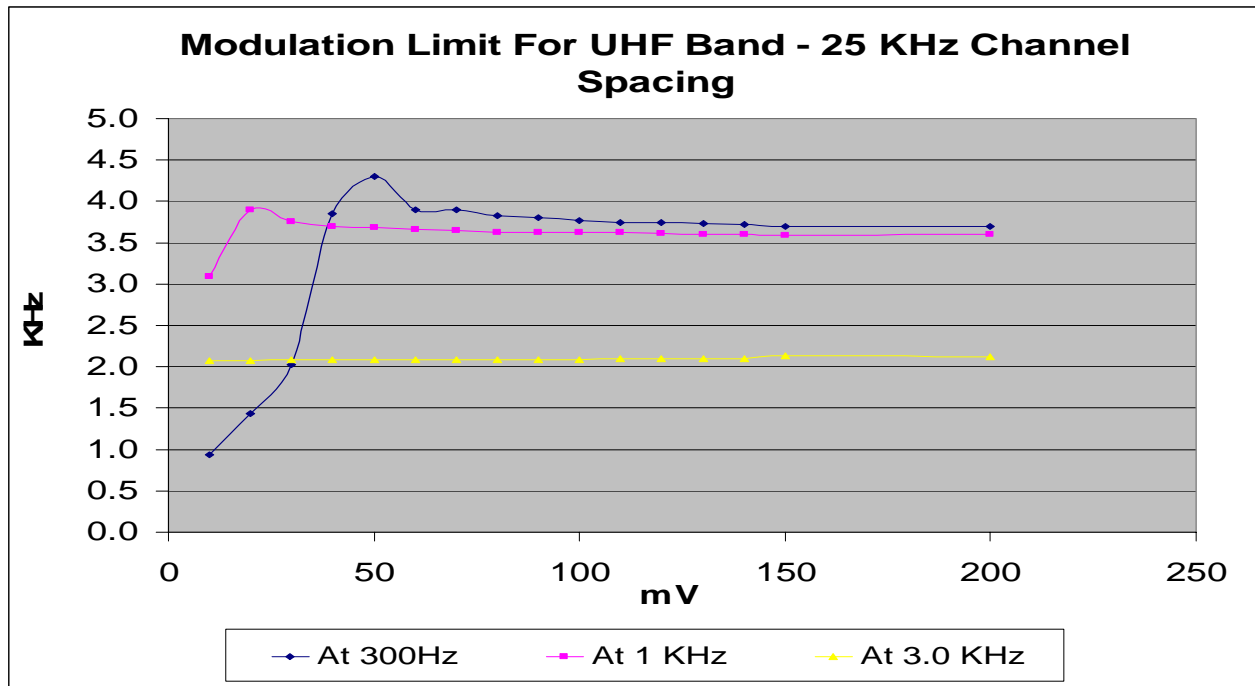


Low Power

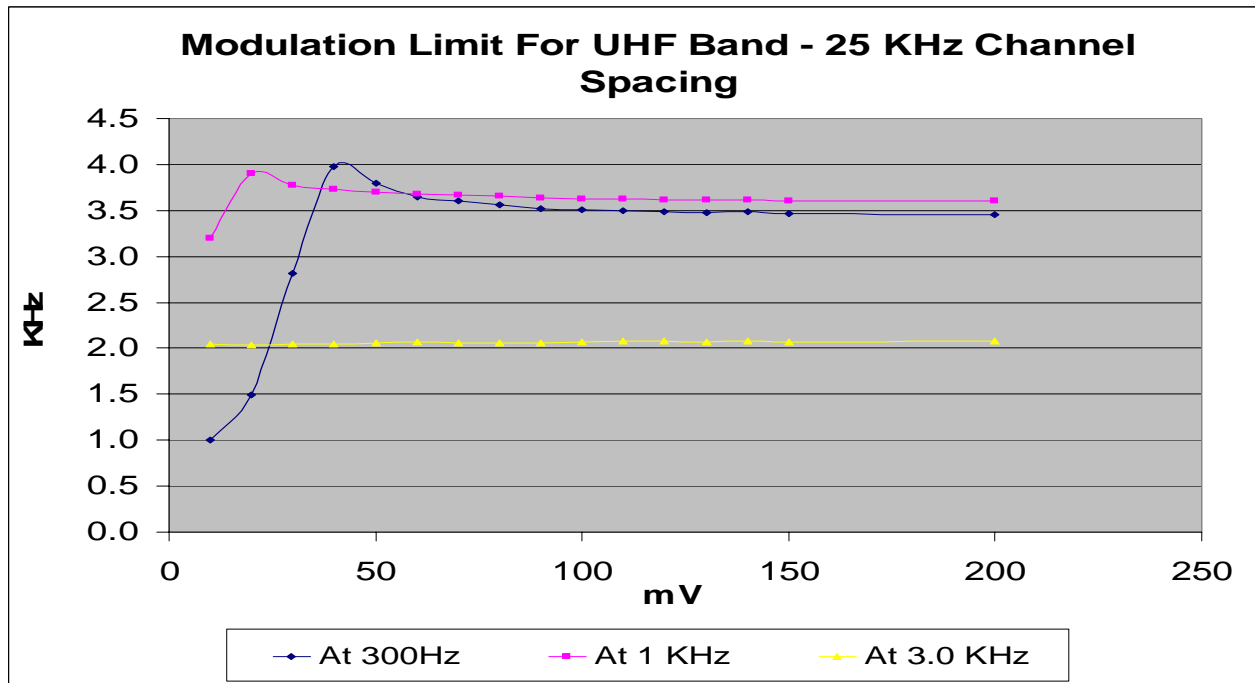


Modulation Limit for *HL – 1521 - UHF*

High Power



Low Power



---

**§2.1049, §22.359, §74.1236, and § 90.209/210– OCCUPIED BANDWIDTH & EMISSION LIMITATION**

---

**Applicable Standard**

## §90.209

Operations using equipment using a 25 kHz bandwidth will be authorized a 20 kHz bandwidth. Operations using equipment designed to operate with a 12.5 kHz channel bandwidth will be authorized an 11.25 kHz bandwidth.

## §2.1049, §90.210

Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- 1) For any frequency removed from the center of the authorized bandwidth  $f_0$  to 5.625kHz removed from  $f_0$ , 0dB.
- 2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 5.626kHz but no more than 12.5kHz, at least  $7.27 (f_d - 2.88\text{kHz})$  dB.
- 3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 12.5kHz at least:

$50 + 10\log P = 50 + 10\log (P)$  or 70 dB, whichever is the lesser attenuation.

Emission Mask B. For transmitters that are 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 assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
- 2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
- 3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least  $43 + \log (P)$  dB.

The resolution bandwidth was 100Hz or greater for measuring up to 250kHz from the edge of the authorized frequency segment, and 30kHz or greater for measuring more than 250kHz from the authorized frequency segment.



## 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 100 Hz and the spectrum was recorded in the frequency band  $\pm 50$  KHz from the carrier frequency.

## Environmental Conditions

Temperature:	26 °C
Relative Humidity:	32 %
ATM Pressure:	100.9 kPa

*\* The testing was performed by James Ma on 2007-08-21.*

## Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4446A	US44300386	2007-04-26

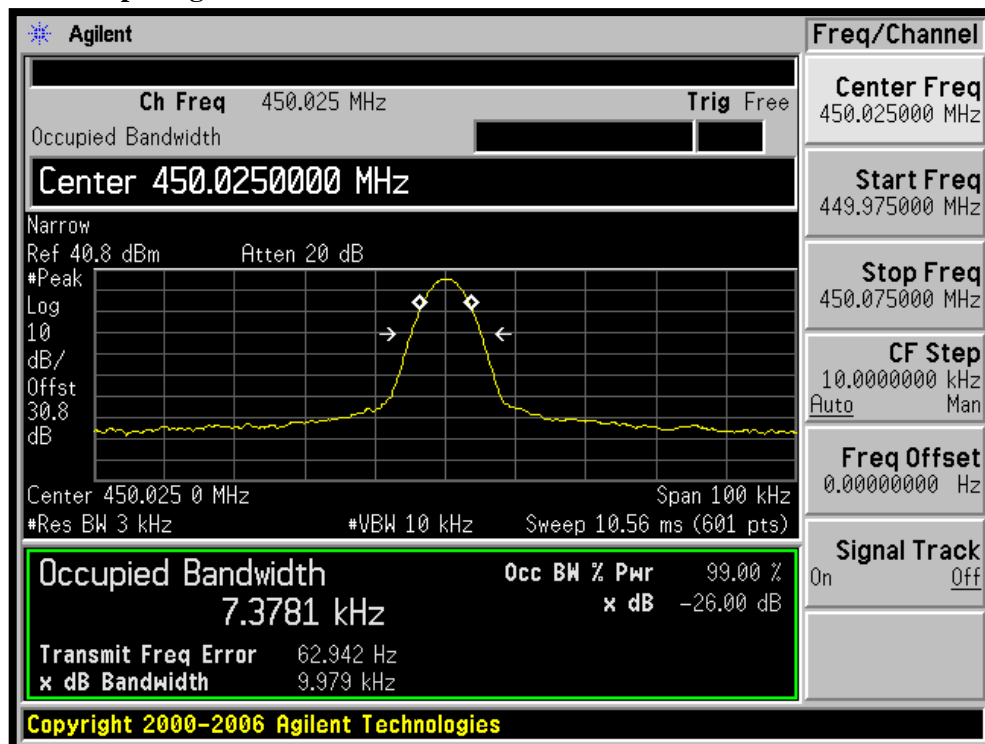
**\* Statement of Traceability:** BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

## Test Result

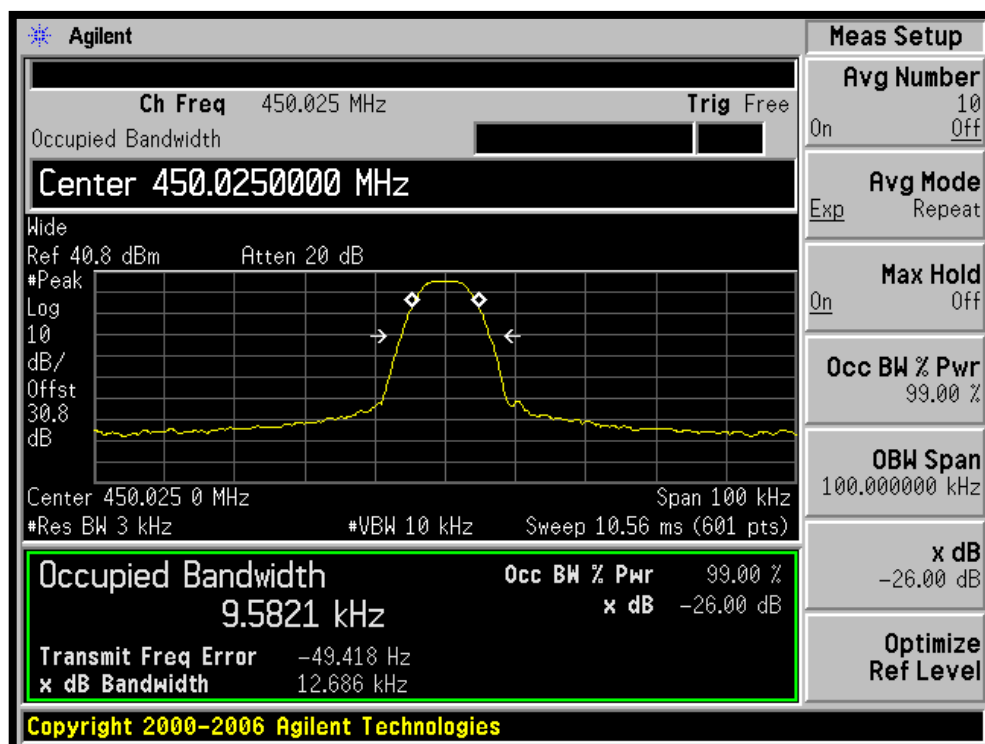
Please refer to the hereinafter plots.

## Occupied Bandwidth

### 12.5 kHz Channel Spacing

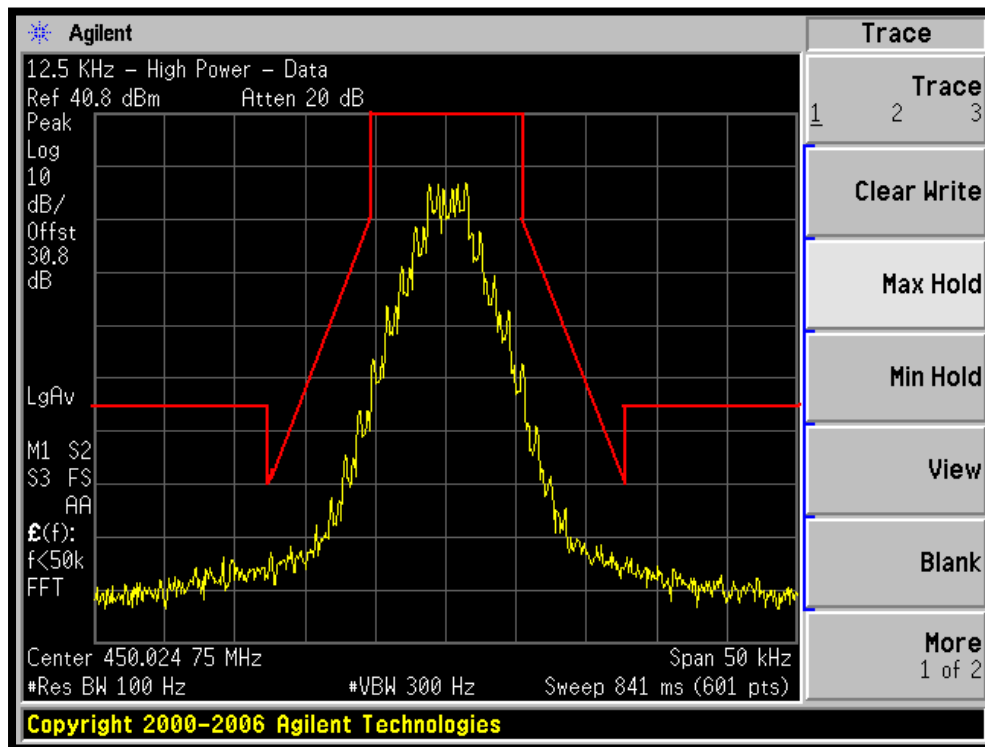


### 25 kHz Channel Spacing

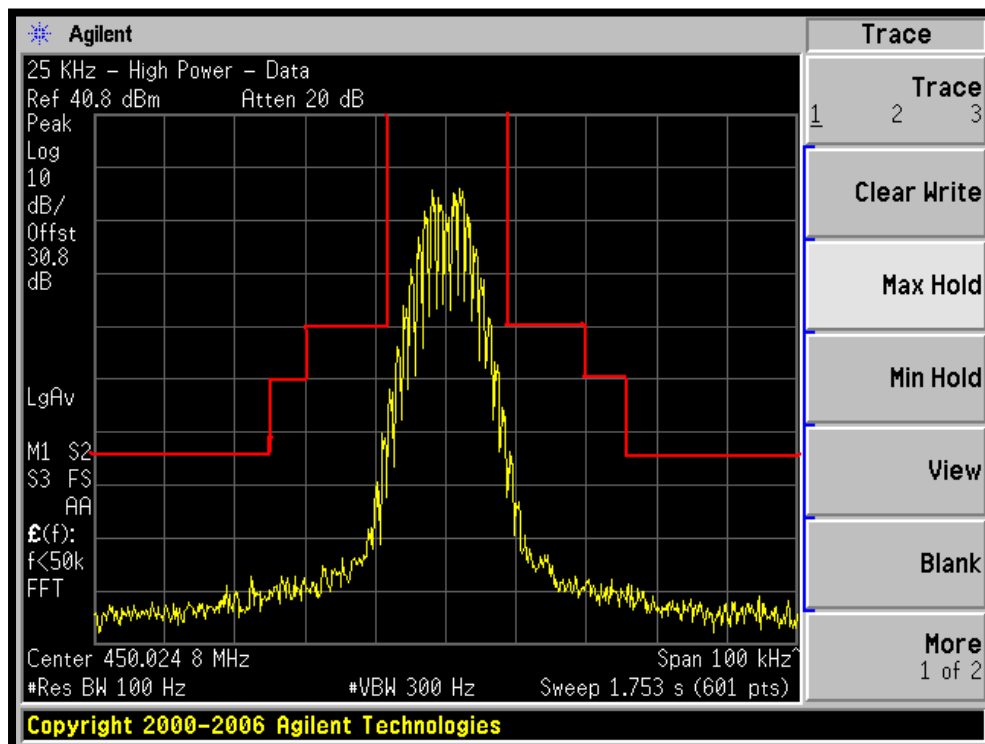


**Emission Mask****High Power**

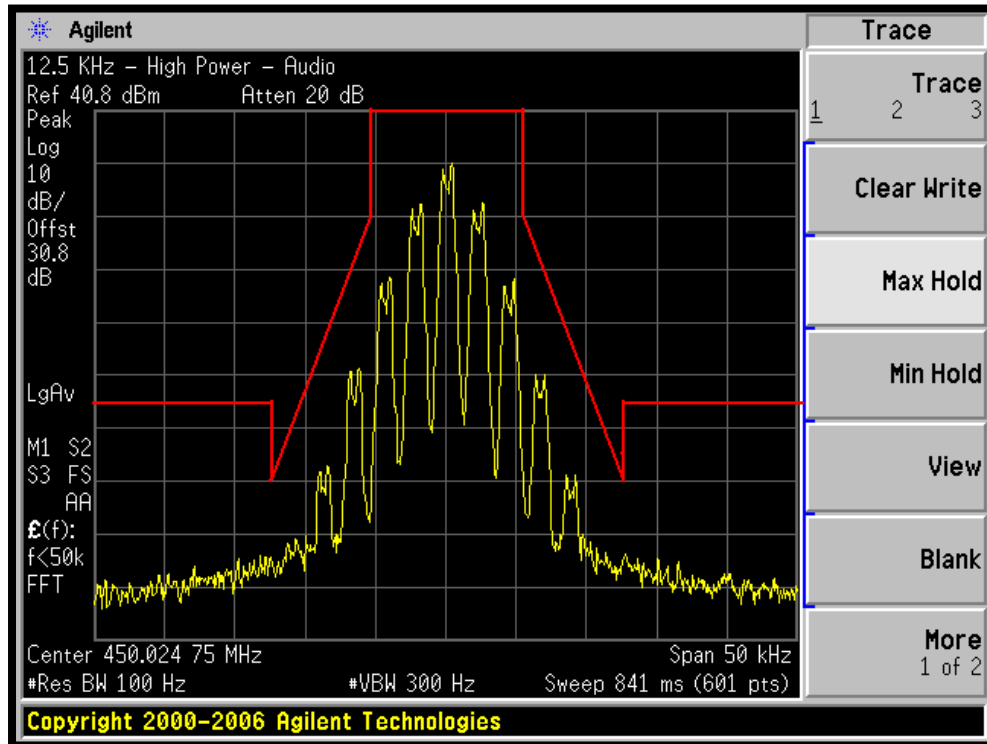
Data 12.5 kHz Channel Spacing High Power



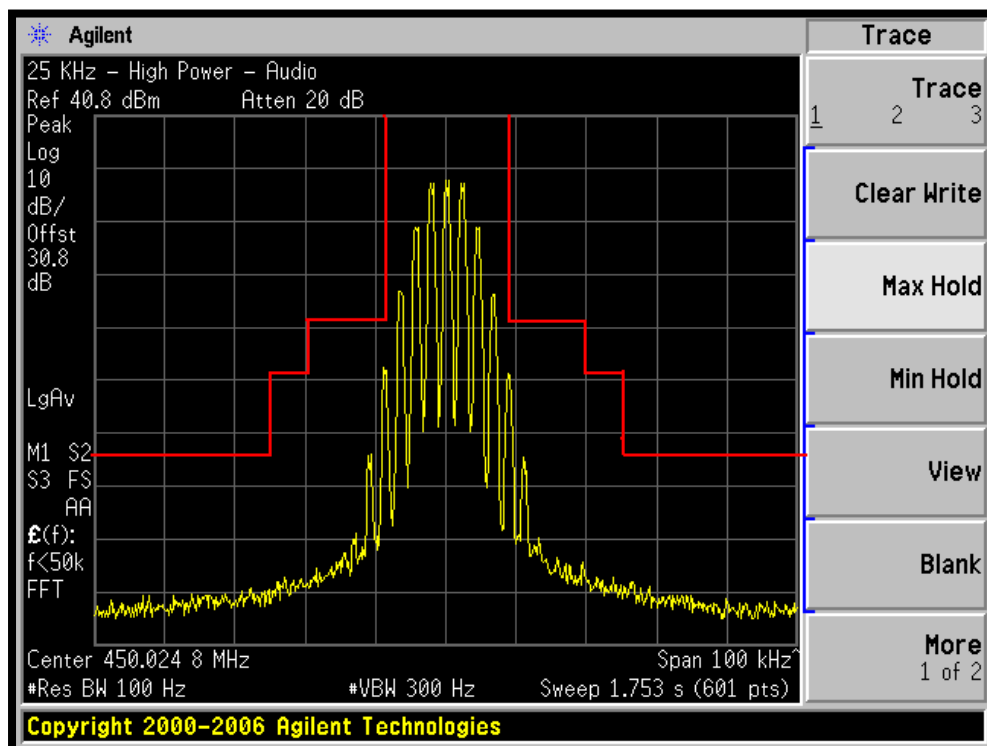
Data 25 kHz Channel Spacing High Power



## Audio 12.5 kHz Channel spacing High Power

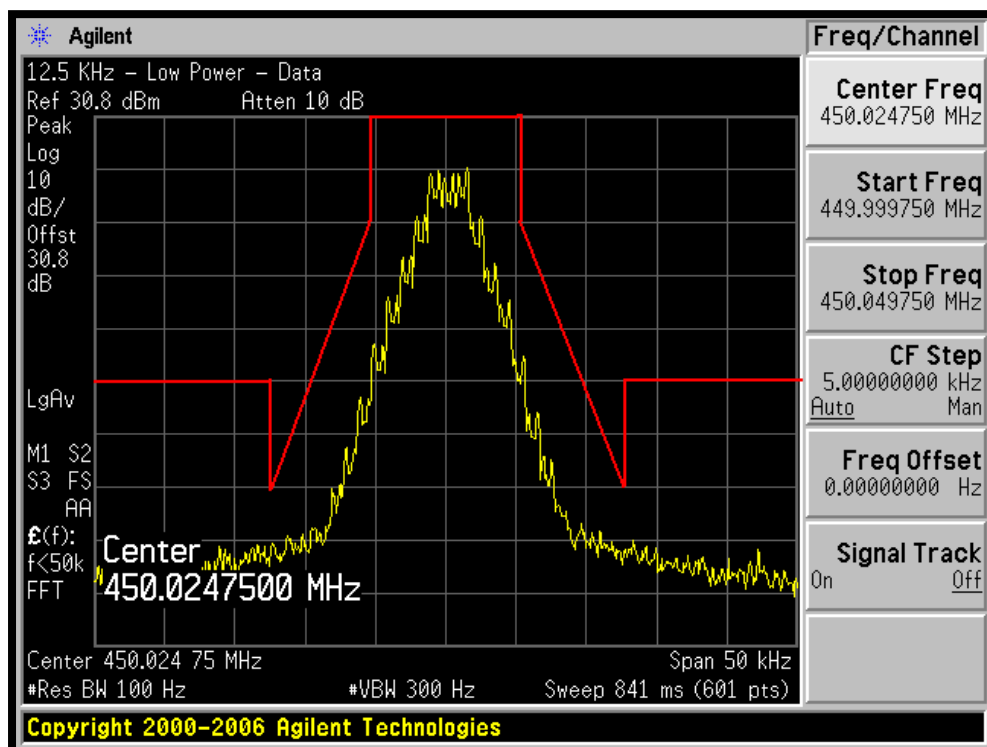


## Audio 25 kHz Channel spacing High Power

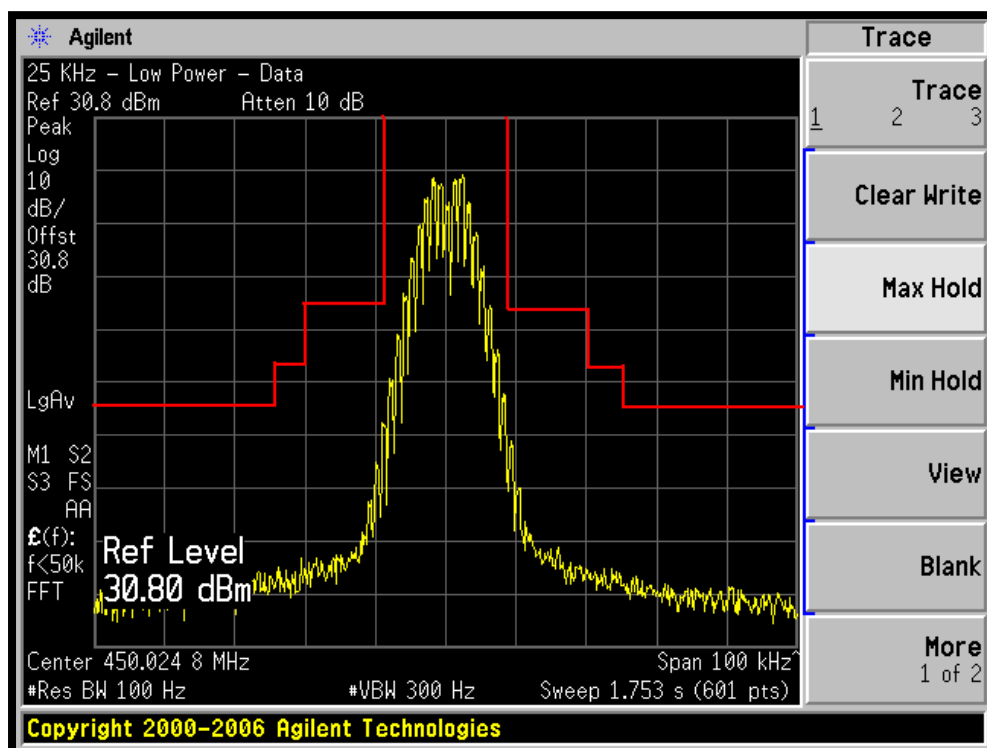


**Low Power**

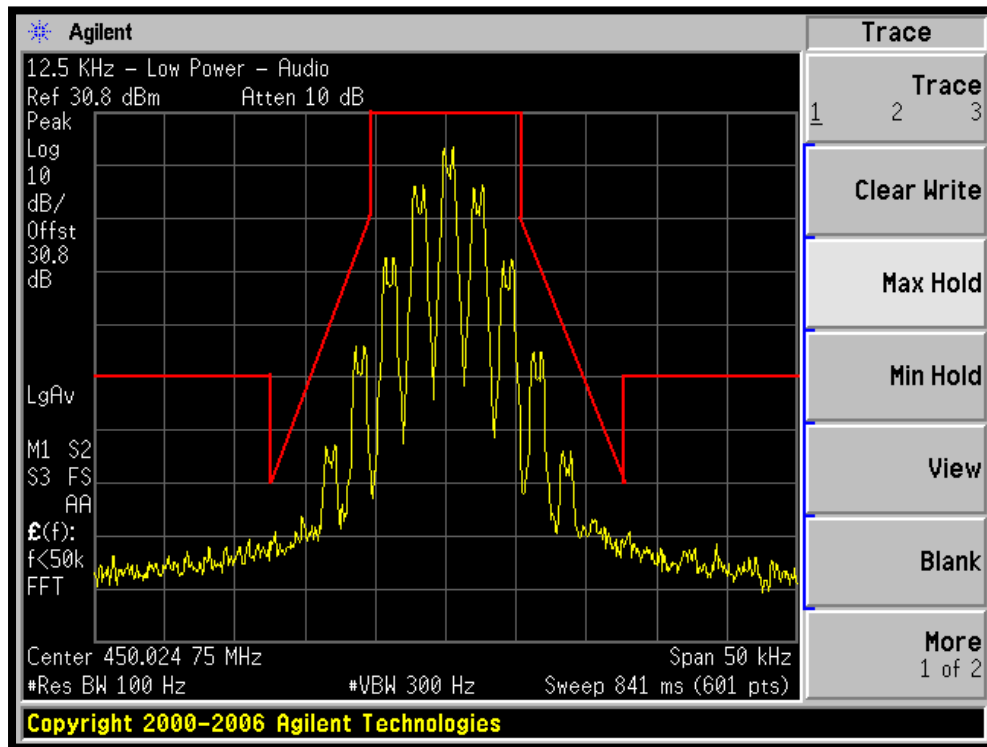
Data 12.5 kHz Channel spacing Low Power



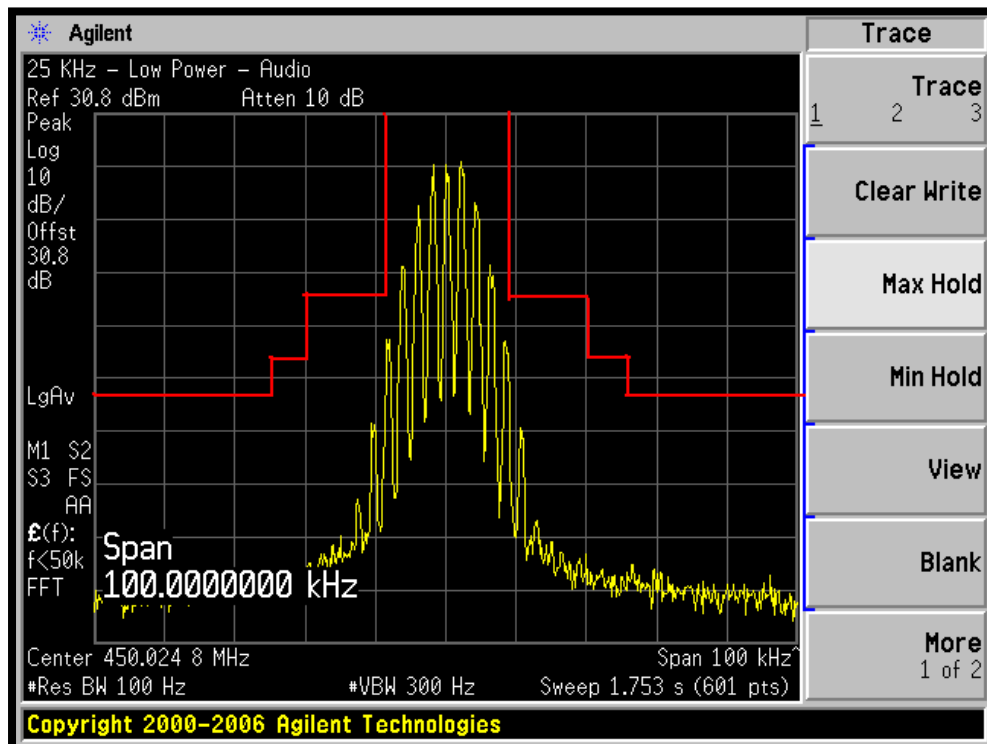
Data 25 kHz Channel spacing Low Power



## Audio 12.5 kHz Channel spacing Low Power



## Audio 25 kHz Channel spacing Low Power



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

### **Applicable Standard**

§90.210 (12.5 kHz bandwidth only)

On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 12.5kHz at least:

50+10logP or 70 dB

§2.1051and §90.210 (25 kHz bandwidth and 20 kHz bandwidth)

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

43+10log (P)

### **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<sup>th</sup> harmonic.

### **Environmental Conditions**

Temperature:	25 °C
Relative Humidity:	32 %
ATM Pressure:	100.9 kPa

*\* The testing was performed by James Ma on 2007-08-21.*

### **Test Equipment List and Details**

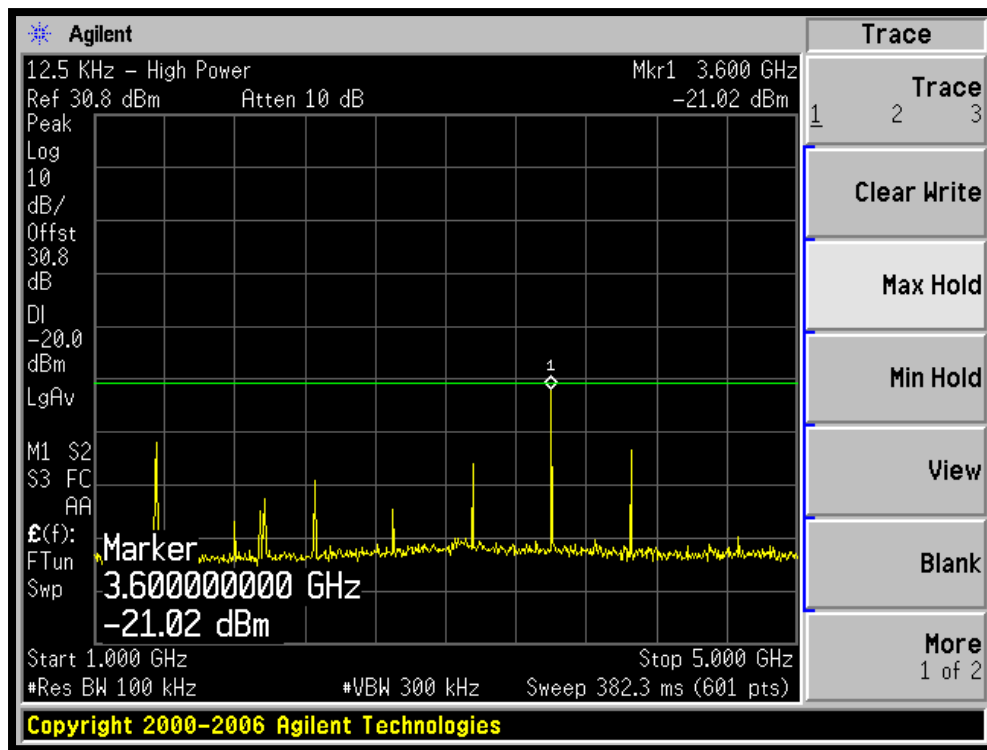
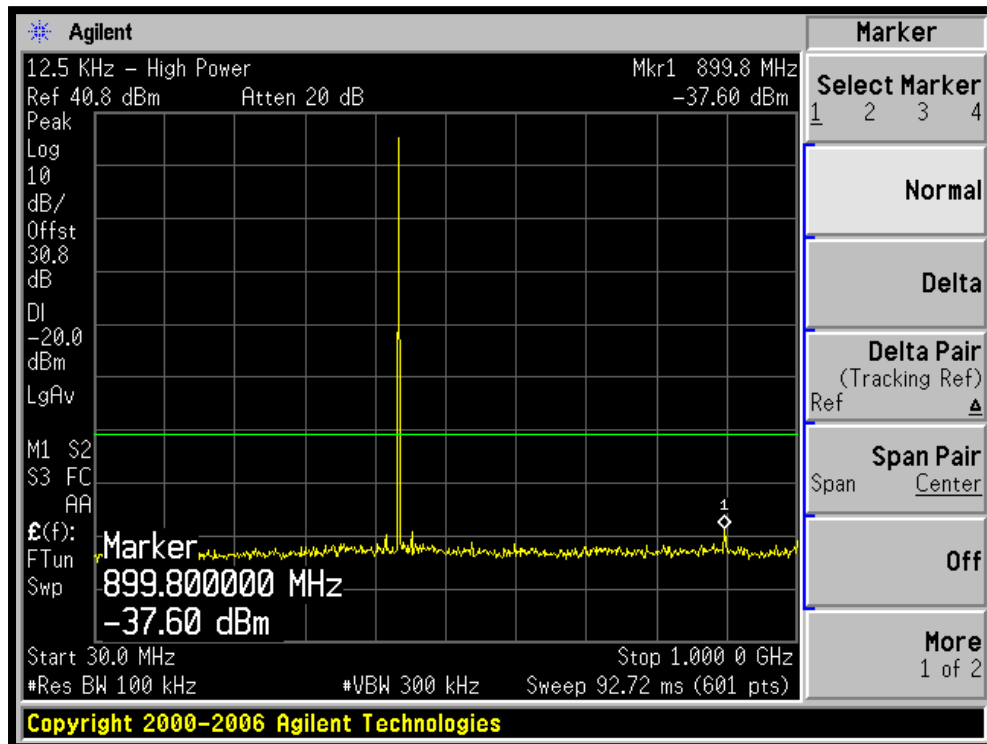
Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4446A	US44300386	2007-04-26

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

### **Test Results**

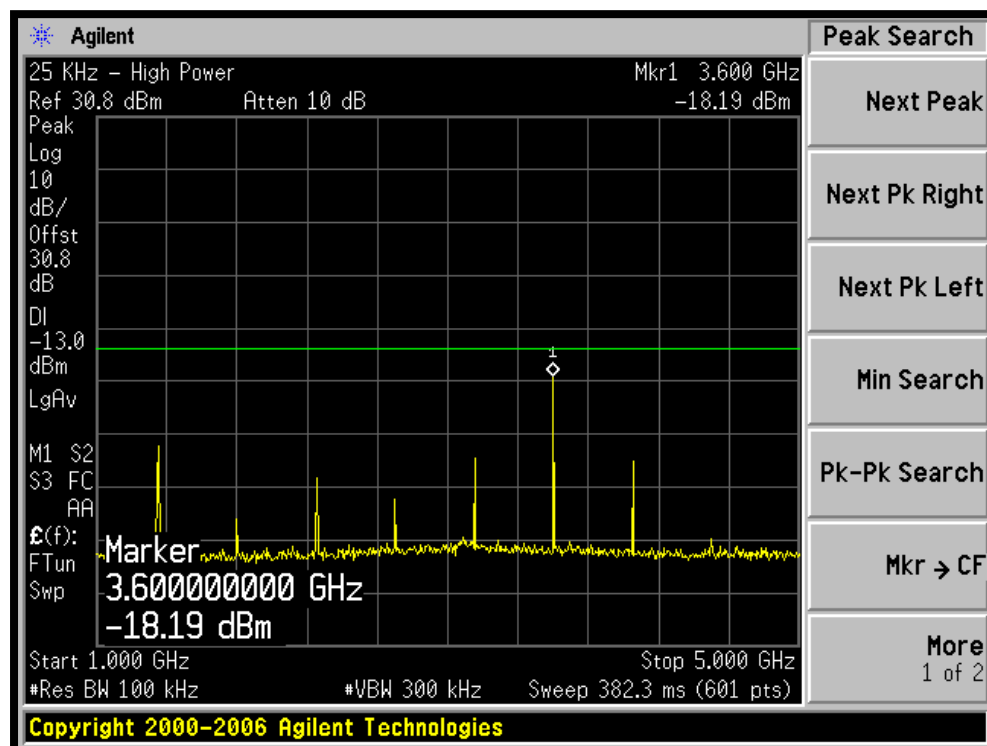
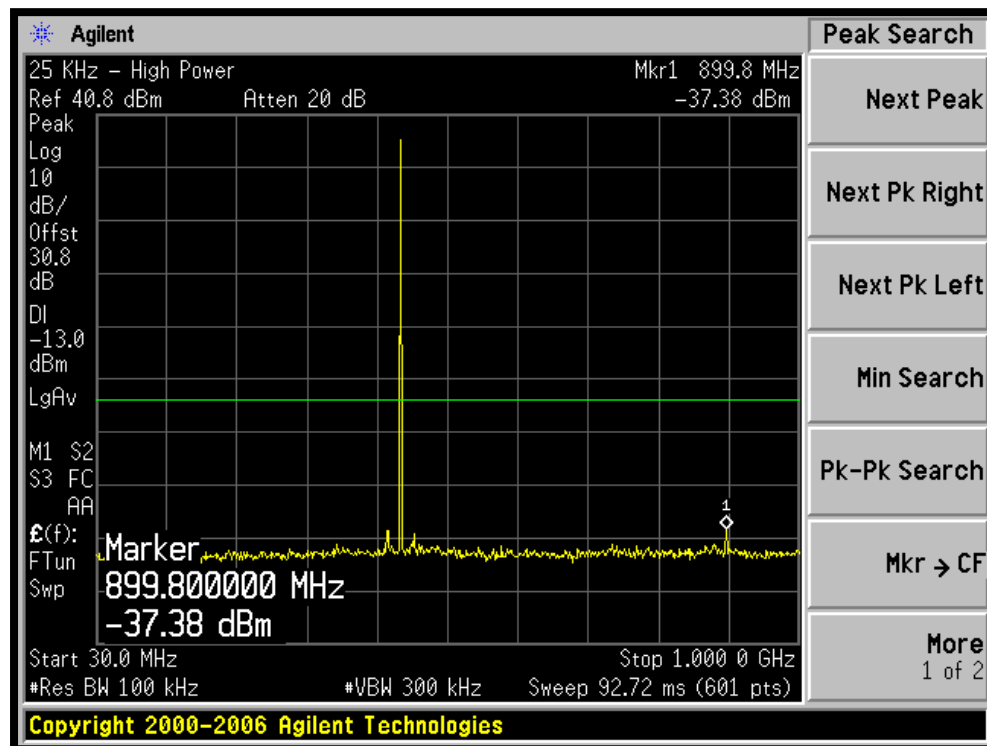
*Test Mode: Transmitting Using Conducted measuring method*

For UHF 12.5 kHz Channel Bandwidth:





For UHF 25 kHz Channel Bandwidth:



**§2.1055 (d), §22.355, §74.1261 (b) and §90.213- FREQUENCY STABILITY****Applicable Standard**

§2.1055 (d)

§90.213

For output power &gt; 2 watts, the limit is 5.0 ppm.

**Test Procedure**

Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power supply and the RF output was connected to the Spectrum Analyzer via feed-through attenuators. The EUT was placed inside the temperature chamber. The DC leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the Spectrum Analyzer.

Frequency Stability vs. Voltage: An external variable DC power supply Source. The voltage was set to 110% of the nominal value and was then decreased until the transmitter light no longer illuminated; i.e., the end point. The output frequency was recorded for each voltage.

**Environmental Conditions**

Temperature:	26 °C
Relative Humidity:	32 %
ATM Pressure:	100.9 kPa

*\* The testing was performed by James Ma on 2007-08-21.*

**Test Equipment List and Details**

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4446A	US44300386	2007-04-26
ESPN	Oven, Temperature	ESL-4CA	018010	N/A

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

**Test Result**

*Test Mode: Transmitting*

*For UHF Band***Frequency vs. Temperature**

Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)	Limit (PPM)
Voltage (VDC)	Temperature (°C )				
7.4	55	450.025000	450.02535	0.7733	5.00
7.4	40	450.025000	450.02524	0.5355	5.00
7.4	30	450.025000	450.02468	-0.7111	5.00
7.4	10	450.025000	450.02463	-0.8200	5.00
7.4	0	450.025000	450.02452	-1.0733	5.00
7.4	-10	450.025000	450.02437	-1.4110	5.00
7.4	-20	450.025000	450.02425	-1.6621	5.00

**Frequency vs. Voltage**

Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)	Limit (PPM)
Voltage (VDC)	Temperature (°C)				
8.14	20	450.025000	450.02472	-0.6222	5.00
6.66	20	450.025000	450.02461	-0.8666	5.00

## **§2.1053 and §90.210 (b), (d) - FIELD STRENGTH OF SPURIOUS RADIATION, EMISSION MASKS**

### **Applicable Standard**

§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. and §90.210(b),(d): Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

### **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 =  $10 \lg (\text{TXpwr in Watts}/0.001)$  – the absolute level

### **Environmental Conditions**

Temperature:	25 °C
Relative Humidity:	32 %
ATM Pressure:	100.9 kPa

*\* The testing was performed by James Ma on 2007-08-22.*

**Test Equipment**

Manufacturer	Description	Model	Serial Number	Calibration Date
HP	Generator, Signal	83650B	3614A00276	2007-05-08
A.R.A	Antenna, Horn	DGR-118/A	1132	2007-06-18
A.H. System	Antenna, Horn	SAS-200/571	261	2007-06-07
Agilent	Amplifier, Pre	8449B	3008A01978	2007-06-27
Agilent	Spectrum Analyzer	E4446A	US44300386	2007-04-26

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

**Test Result**

**-1.7 dB at 3600 MHz** for UHF in the **Vertical** polarization

Test Mode: Transmission Using substitution measuring method

Indicated		Azimuth degrees	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (m)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Correction (dBi)	Cable Loss (dB)	Absolute Level (dBm)		
3600.0	80.5	20	2.5	V	3600.0	-23.0	10.3	2.0	-14.7	-13	-1.7
3600.0	79.4	20	1.7	H	3600.0	-24.7	10.3	2.0	-16.4	-13	-3.4
1350.1	80.2	120	1.5	H	1350.1	-29.8	6.3	0.9	-24.4	-13	-11.4
1350.1	78.1	0	1.8	V	1350.1	-32.2	6.3	0.9	-26.8	-13	-13.8
900.1	86.2	200	2.4	V	900.1	-27.8	0	0.8	-28.6	-13	-15.6
900.1	85.1	70	1.6	H	900.1	-28.0	0	0.8	-28.8	-13	-15.8
2250.1	69.9	55	1.6	H	2250.1	-37.0	8.3	1.5	-30.2	-13	-17.2
2250.1	67.6	0	1.5	V	2250.1	-39.1	8.3	1.5	-32.3	-13	-19.3

## §90.214 - TRANSIENT FREQUENCY BEHAVIOR

### Applicable Standard

§90.214: Transmitters designed to operate in the 150–174 MHz and 421–512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time intervals <sup>1,2</sup>	Maximum frequency difference <sup>3</sup>	All equipment
		421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels		
t <sub>1</sub> <sup>4</sup>	±25.0 kHz	5.0 ms
t <sub>2</sub>	±12.5 kHz	20.0 ms
t <sub>3</sub> <sup>4</sup>	±25.0 kHz	5.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels		
t <sub>1</sub> <sup>4</sup>	±12.5 kHz	5.0 ms
t <sub>2</sub>	±6.25 kHz	20.0 ms
t <sub>3</sub> <sup>4</sup>	±12.5 kHz	5.0 ms

### Test Procedure

TIA/EIA-603-C 2.2.19

### Environmental Conditions

Temperature:	25 °C
Relative Humidity:	32 %
ATM Pressure:	100.9 kPa

\* The testing was performed by James Ma on 2007-08-22.

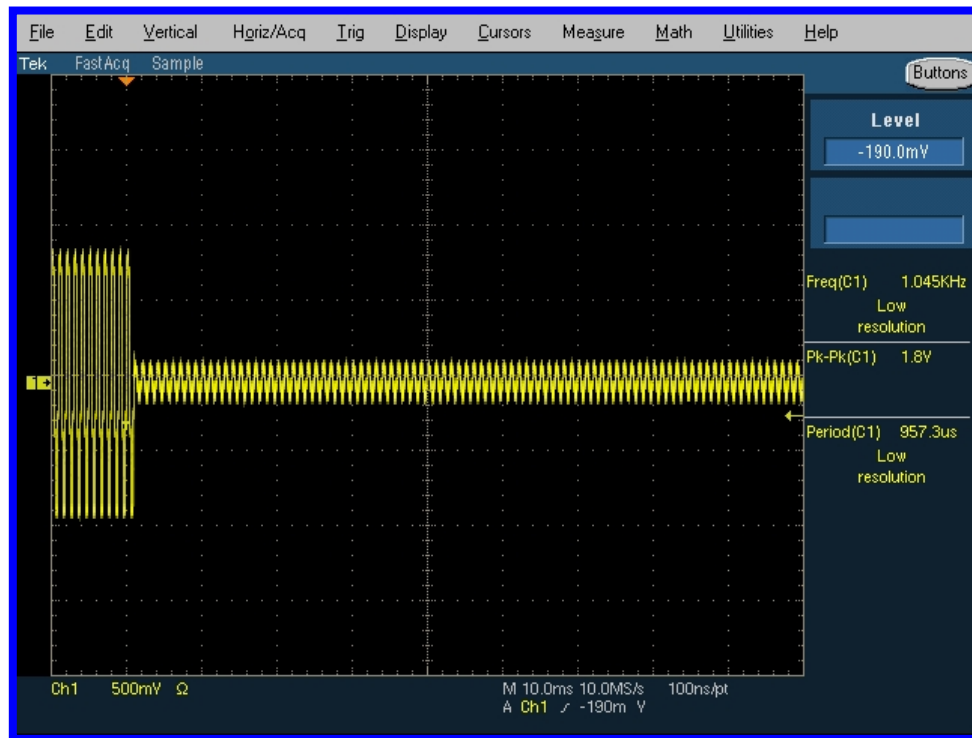
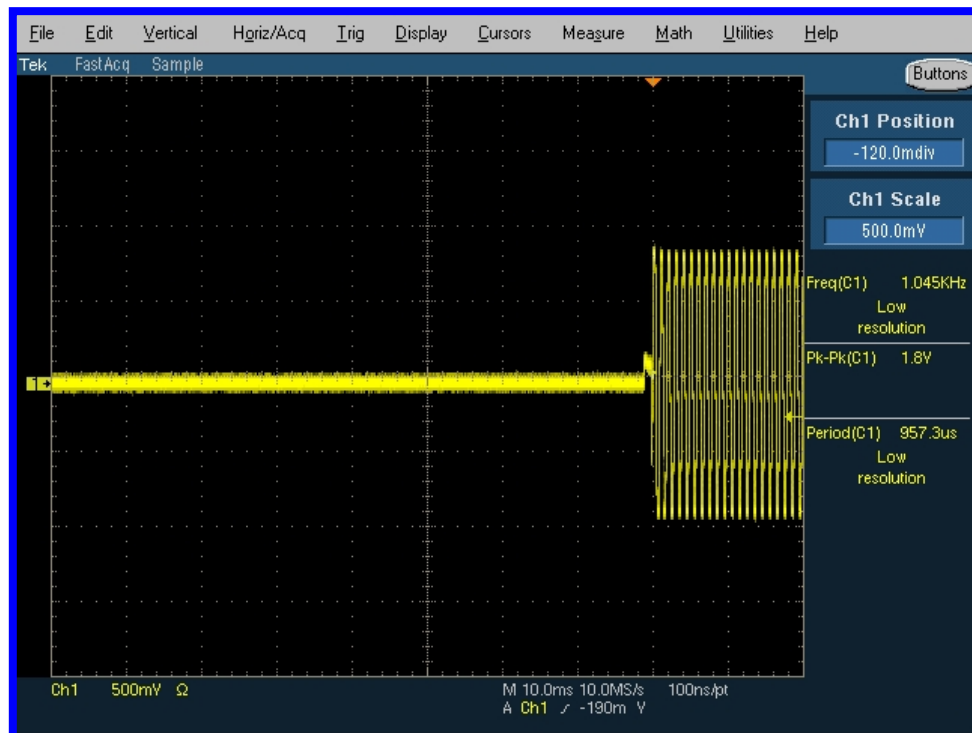
### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
HP	Modulation Analyzer	8901A	2026A00847	2007-04-27
Tektronix	Digital Phosphor Oscilloscope	TDS7104	B020557	2007-02-13
Agilent	Spectrum Analyzer	E4446A	US44300386	2007-04-26
HP	Signal Generator	8648C	3426A01345	2006-10-10

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

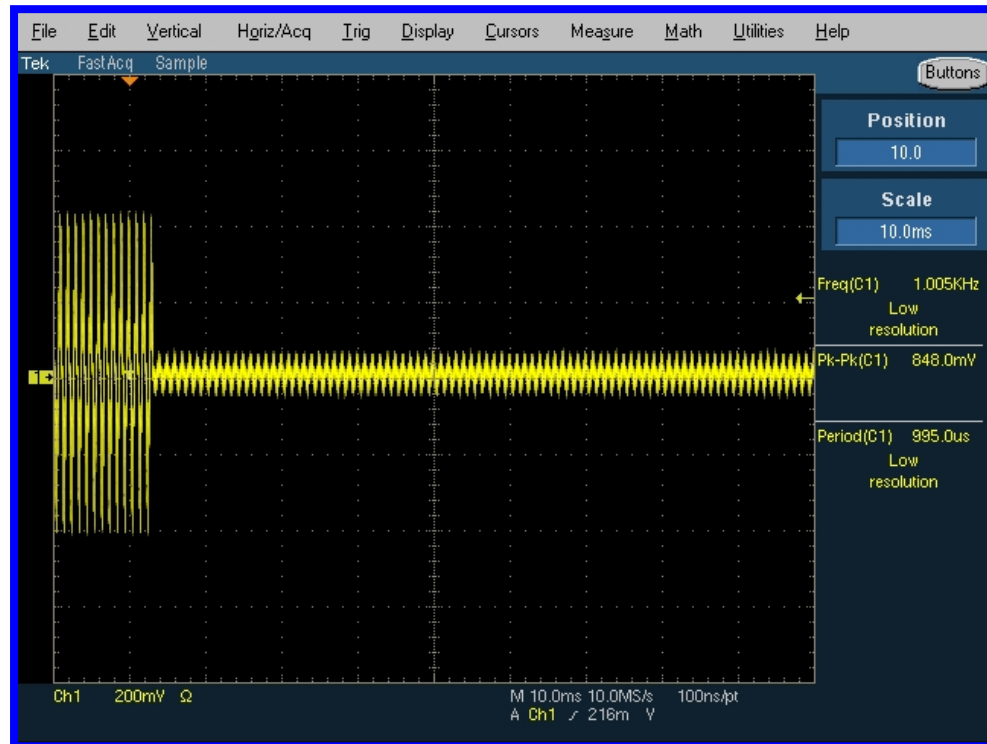
**Test Mode: Transmitting**

For UHF 12.5 kHz Channel Spacing

**Powering Up****Powering Down**

For UHF 25 kHz Channel Spacing

### Powering Up



### Powering Down

