



# L.S. Compliance, Inc.

W66 N220 Commerce Court  
Cedarburg, WI 53012  
262-375-4400 Fax: 262-375-4248

---

## COMPLIANCE TESTING OF:

RF2000BP

## PREPARED FOR:

R F Technologies, Inc.  
Attn.: Ms. Maryann Trittschuh  
542 South Prairie Street  
Bethalto, IL 62010

## TEST REPORT NUMBER:

305422

TEST DATE(S): September 20, 21 and November 4, 2005

*All results of this report relate only to the items that were tested. This report is not to be reproduced, except in full, without written approval of L. S. Compliance, Inc.*

## Table of Contents

<b>Section</b>	<b>Description</b>	<b>Page</b>
<b>Index</b>		2
1	L. S. Compliance in Review	3
2	Signature Page	4
3	Product and General Information	5
4	Product Description	5
5	Test Requirements	5
6	Summary of Test Report	6
7	Introduction	6
8	Purpose	6
9	Radiated Emissions Test	7-12
10	Power Output 47 CFR 2.1046, 90.217	13
11	Conducted Spurious Emissions: 47 CFR 90.217	14-16
12	Bandwidth Measurements 47 CFR 90.217	17-18
Appendix		
A	Test Equipment List	19
B	Uncertainty Statement	20

## 1. L. S. Compliance In Review

### **L.S. Compliance - Accreditations and Listing's**

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:

#### **A2LA – American Association for Laboratory Accreditation**

Accreditation based on ISO/IEC 17025 : 1999  
with Electrical (EMC) Scope of Accreditation  
A2LA Certificate Number: 1255.01

#### **Federal Communications Commission (FCC) – USA**

Listing of 3 Meter Semi-Anechoic Chamber based on Title 47 CFR – Part 2.948  
FCC Registration Number: 90756

#### **Industry Canada**

On file, 3 Meter Semi-Anechoic Chamber based on RSS-212 – Issue 1  
File Number: IC 3088-A

#### **U. S. Conformity Assessment Body (CAB) Validation**

Validated by the European Commission as a U. S. Competent Body operating under the U. S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union Electromagnetic Compatibility –Council Directive 2004/108/EC (formerly 89/336/EEC, Article 10.2).

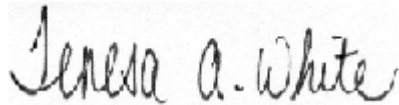
Date of Validation: January 16, 2001

Validated by the European Commission as a U.S. Notified Body operating under the U.S./EU, Mutual Recognition Agreement (MRA) operating under the European Union Telecommunication Equipment – Council Directive 99/5/EC, Annex V.

Date of Validation: November 20, 2002

Notified Body Identification Number: 1243

2. Signature Page



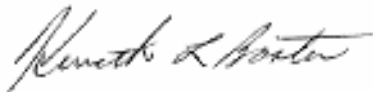
Prepared By:

November 1, 2005

---

Teresa A. White, Document Coordinator

Date



Tested and Approved By:

November 1, 2005

---

Kenneth L. Boston, EMC Lab Manager  
PE #31926 Licensed Professional Engineer  
Registered in the State of Wisconsin, United States

Date

### 3. Product and General Information

Manufacturer:	R F Technologies, Inc
Model No.:	RF2000BP
Serial No.:	Ref 1
Description:	50 mw beltback transceiver

### 4. Product Description

The RF2000BP is a wireless headset and beltback transceiver, which is used for fast food restaurant order taking. The current design is expected to replace an existing product from a third party OEM that is no longer manufactured or available. The present design is compatible with the previously installed and licensed base stations and use the same frequency plan. Transmit power is 50 mW, is capable of operating on one of 16 channels, and is a narrow band FM voice system.

### 5. Test Requirements

The above mentioned tests were performed in order to determine the compliance of the EUT system with limits contained in various provisions of Title 47 CFR, FCC Part 90.217.

All radiated emissions tests were performed to measure the emissions in the frequency bands described by the above sections, and to determine whether said emissions are below the limits established by the above sections. These tests were performed in accordance with the procedure described in the 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 (ANSI C63.4-2003). Another document used as reference for the EMI receiver specification was the International Special Committee on Radio Interference CISPR 16-1 (2003).

## 6. Summary of Test Report

### DECLARATION OF CONFORMITY

The RF2000BP was found to **MEET** the requirements as described within the specification of Title 47 CFR FCC, Part 90.217, for a low power business/industrial transmitter.

## 7. Introduction

During September and November of 2005, a series of Radiated and Conducted Emission tests were performed on one sample of the RF2000BP, here forth referred to as the "*Equipment Under Test*" or "*EUT*". The three models tested all use the same RF transmitter topology and are used to transmit digitized audio. These tests were performed using the procedures outlined in ANSI C63.4-2003 for intentional radiators. These tests were performed by Kenneth Boston, EMC Lab Manager of L.S. Compliance, Inc.

## 8. Purpose

All Radiated and Conducted Emission tests upon the EUT were performed to measure the emissions in the frequency bands described in title 47 CFR, FCC Part 90.217 (as this device falls under 120 mw output) to determine whether these emissions are below the limits expressed within the standards. These tests were performed in accordance with the procedure described in the 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 (ANSI C63.4-2003). Another document used as a reference for the EMI Receiver specification was the Comite International Special Des Perturbations Radioelectriques CISPR 16-1, 2003.

## **9. Radiated Emissions Test**

### **Test Setup**

The test setup was assembled in accordance with Title 47, CRF FCC Part 2 and ANSI C63.4-2003. The EUT was placed on an 80cm high non-conductive table, centered on a flush mounted 2-meter diameter turntable inside the 3 Meter Semi-Anechoic, FCC listed Chamber located at L. S. Compliance, Inc., Cedarburg, Wisconsin. The EUT was operated in continuous operation mode, using battery power as provided by the manufacturer. The applicable limits apply at a 3 meter distance. The calculations to determine the limits are detailed in the following pages. Please refer to Appendix A for a list of the test equipment. The EUT was operated on one of two (2) standard channels:

Channel 0 (low): 151.655 MHz;      Channel 1 (high): 154.540 MHz

### **Test Procedure**

Radiated Emission measurements were performed on the EUT in the 3 Meter Semi-Anechoic, FCC listed Chamber, located at L. S. Compliance, Inc. in Cedarburg, Wisconsin. The frequency range from 30 MHz to 1600 MHz was scanned, and levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on the non-conductive table (or pedestal) in the 3 Meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the test object. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double Ridged Waveguide Horn Antenna was used from 1 GHz to 1.6 GHz. The maximum radiated emissions were found by raising and lowering the antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities. The EUT was tested in three orthogonal positions; upright, flat and right side.

### **Test Equipment Utilized**

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at a N.I.S.T. traceable site. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and a HP 8546A EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the HP 8546A EMI Receiver database. As a result, the data taken from the HP 8546A EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The HP 8546A EMI Receiver was operated with a bandwidth of 120 kHz for measurements below 1 GHz, and a bandwidth of 1 MHz for measurements above 1 GHz. The Peak and Quasi-Peak Detector functions were all utilized.

### **Test Results**

The EUT was found to MEET the Radiated Emissions requirements of Title 47 CFR, FCC Part 90 for a Frequency Modulated mobile transmitter. The frequencies with significant signals were recorded and plotted as shown in the Data Charts and Graphs.

CALCULATION OF RADIATED EMISSIONS LIMITS (for 90.217 and 2.1053 compliance)

**FIELD STRENGTH OF PART 90 LIMIT: AT R = 3 METERS DISTANCE**

FROM THE STANDARD REFERENCE FORMULA FOR POWER TRANSMITTED VERSUS ELECTRIC FIELD:

$$P_t = (R^{**}) \times |E|^{**} / 30$$

Then to convert to dB:

$$P_t = 20\log |E| + 20\log(R) - 10\log(30)$$

Insert additional terms to convert watts to milli-watts (in dB) and volts to micro-volts (in dBuV):

$$P_t = 20\log |E_{\mu V}| - 20\log(1,000,000) + 10\log(1000) + 20\log(3) - 10\log(30)$$

$$P_t = 20\log |E_{\mu V}| - 120 + 30 + 9.54 - 14.77$$

$$P_t = 20\log |E_{\mu V}| - 95.23$$

$$\text{OR; } 20\log |E_{\mu V}| = P_t (\text{in dBm}) + 95.23$$

$$|E| (\text{in dBuV}) = -13 \text{ dBm} + 95.23 = \underline{82.23 \text{ dBuV/m}}, \text{ at 3 meters}$$

-13 dBm is a level that is 30 dBc below the +17 dBm (50 mw) conducted power output level for the devices tested.

*Note: Limits are conservatively rounded to the nearest whole number.*



**Measurement of Electromagnetic Radiated Emissions**  
**Within the 3 Meter FCC Listed Chamber**

Manufacturer: R F Technologies, Inc  
 Date of Test: Sept 20,21, Nov 4, 2005  
 Model Nos.: RF2000BP  
 Serial No.: Ref 1

Test Requirements: 90.217, 2.1053

Distance: 3 Meters,	Frequency Range Inspected: 30 to 1600 MHz
Configuration: Continuous Transmit,	

Test Equipment Used:

EMI Measurement Instrument: HP 8546A and Agilent E4407B	Biconical Antenna: EMCO 93110B
Double-Ridged Wave Guide/Horn Antenna: EMCO 3115	Log Periodic Antenna: EMCO 43146A

Detector(s) Used:	x	Peak	x	Quasi-Peak		Average
-------------------	---	------	---	------------	--	---------

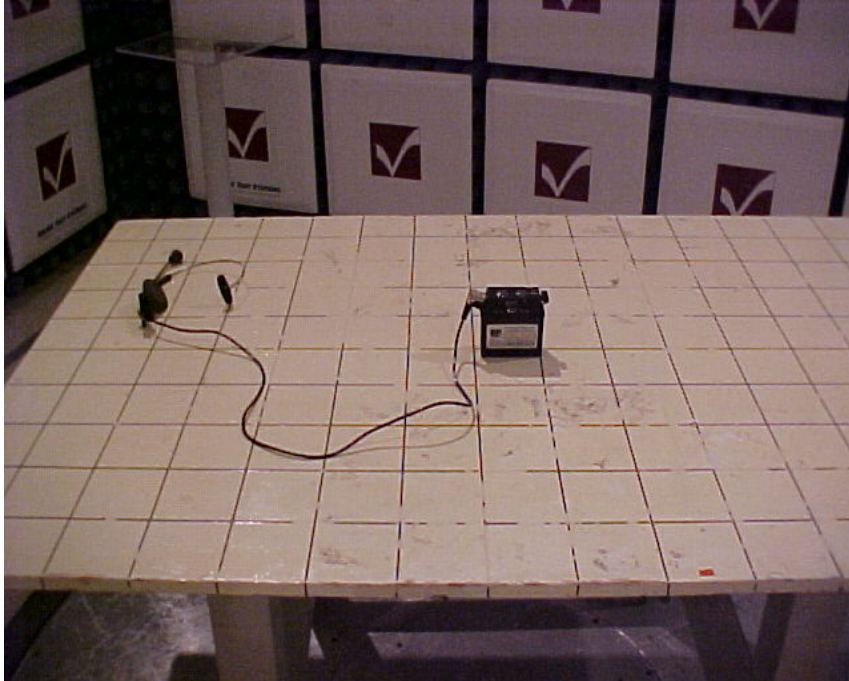
The following table depicts the level of significant radiated emissions found

Frequency (MHz)	Antenna Polarity	Equipment Orientation configuration	Channel #	Antenna Height (meters)	Azimuth (0° - 360°)	EMI Meter Reading (dBμV/m)	90.217 Limit (dBμV/m)	Margin (dB)
153.2	H	Flat, w/ant	0	1.23	280	46.4	82.2	35.8
153.5	H	"	0	1.23	280	47.1	82.2	35.1
155.0	H	"	0	1.23	280	45.2	82.2	37.0
155.6	H	"	0	1.23	280	45.8	82.2	36.4
303.0	H	Upright, w/ant	0	1.0	237	44.8	82.2	37.4
463.6	H	"	1	1.0	123	42.4	82.2	39.8
1082.0	H	Upright, w/50Ω	1	1.0	49	47.7	82.2	34.5
1237.0	H	"	1	1.0	262	44.2	82.2	38.0
1364.7	H	"	0	1.0	20	46.2	82.2	36.0
1391.0	H	"	1	1.0	20	48.1	82.2	34.1
1546.0	H	"	1	1.0	174	46.3	82.2	35.9

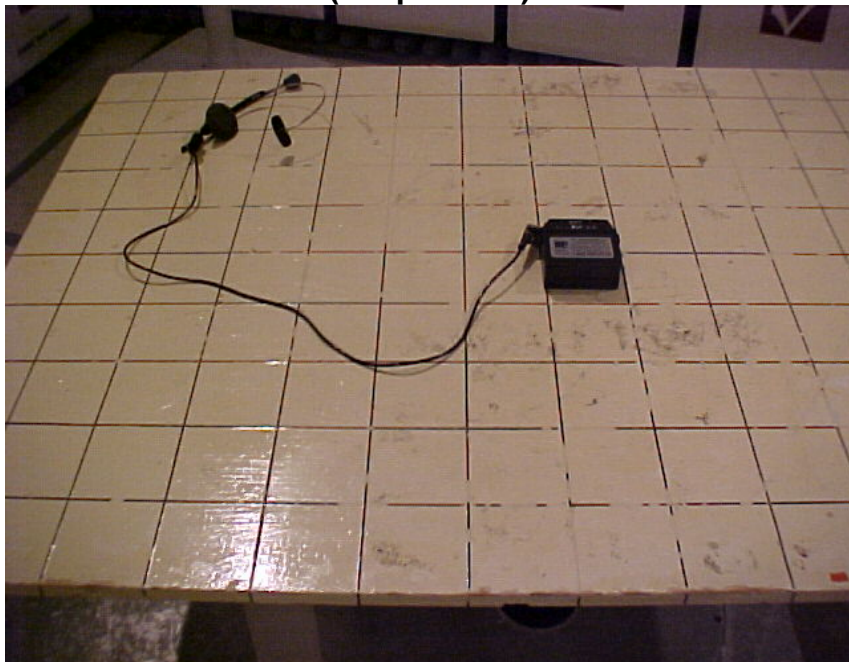
Notes: A Quasi-Peak Detector was used in measurements below 1 GHz, and a Peak Detector was used in measurements above 1 GHz. All other Radiated Spurious Emissions seen were found to be greater than 40 dB below the limits, or below the noise floor of the instrumentation.

**Photos Taken During Radiated Emission Testing**

**Setup for the Radiated Emissions Test  
(upright position)**

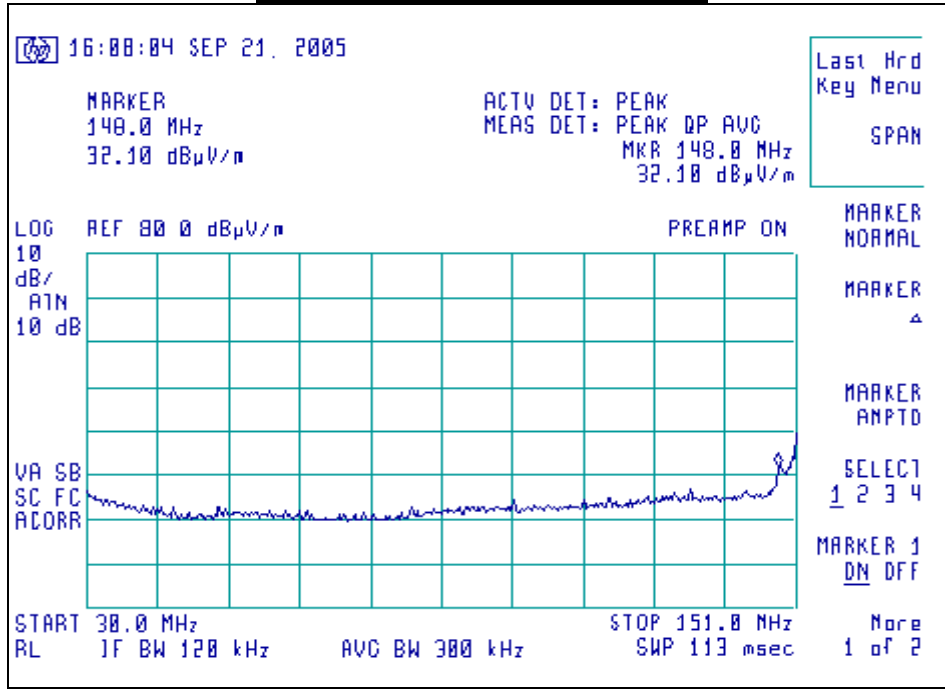


**(flat position)**

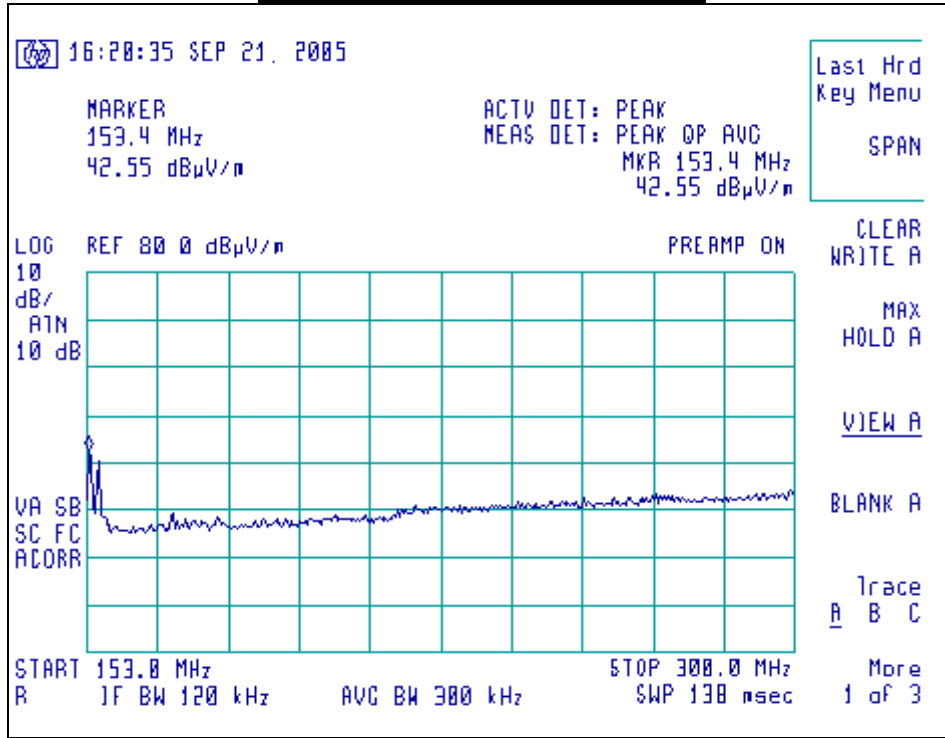


## Graphs made during Radiated Emission Testing

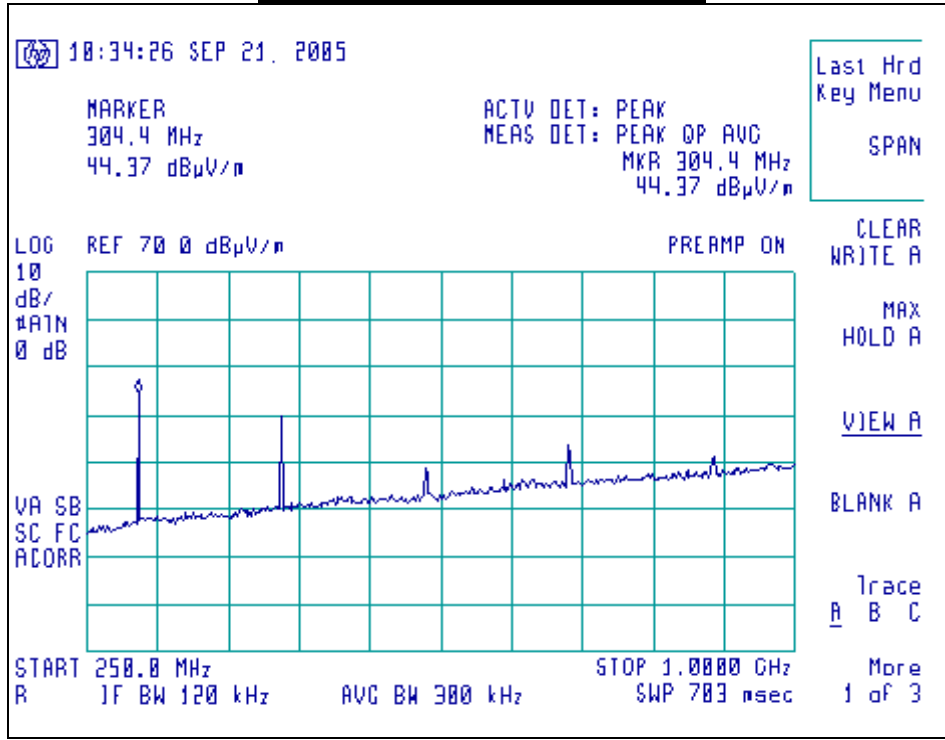
### Channel 0, Horizontal polarity



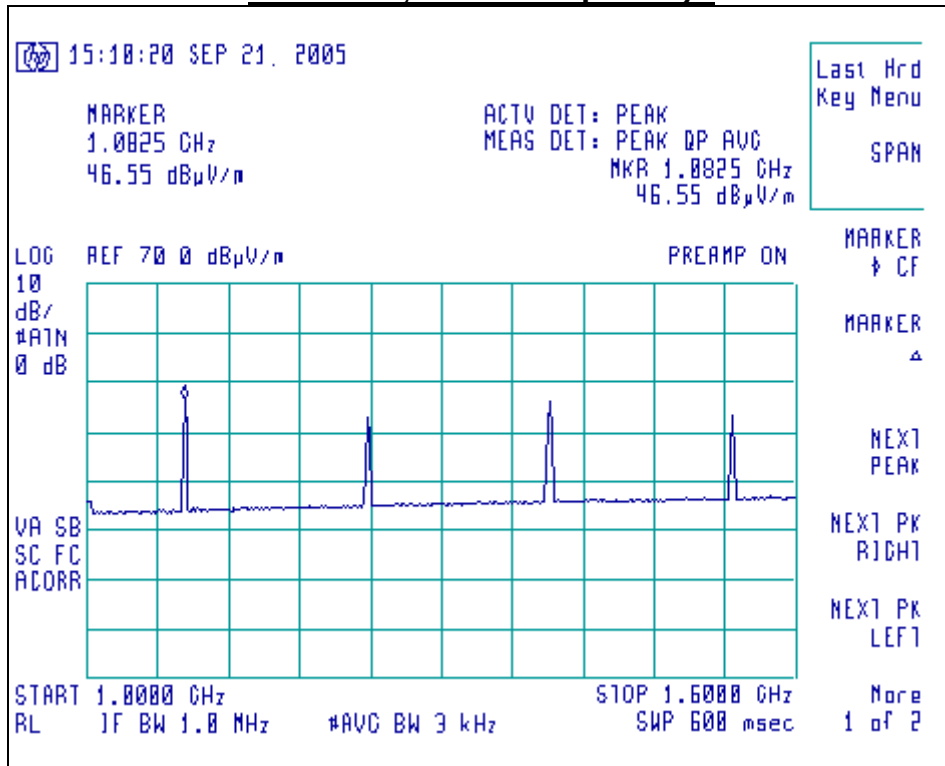
### Channel 0, horizontal polarity



### Channel 0, horizontal polarity



### Channel 1, horizontal polarity+



10. **Power Output,**            **47 CFR 2.1046, 90.217**

For the FCC Part 2.1046 measurement, the output of the RF2000BP sample was connected via a short jumper cable, through a 10 dB Attenuator to the input of the HP E4407B Spectrum Analyzer. The unit was configured to run in a normal continuous transmit mode. The HP receiver was set to a 30 kHz Bandwidth, and the transmit signal was then stored, with the peak signal level stored. This power level was collected for both channels and can be seen in the chart presented below. (Power output was also verified using a Gigatronics 8542C power meter, with values within 0.2 dB of the values listed below)

CHANNEL	CENTER FREQ (MHz)	MEASURED POWER (dBm)
0	151.655	17.4
1	154.540	17.5

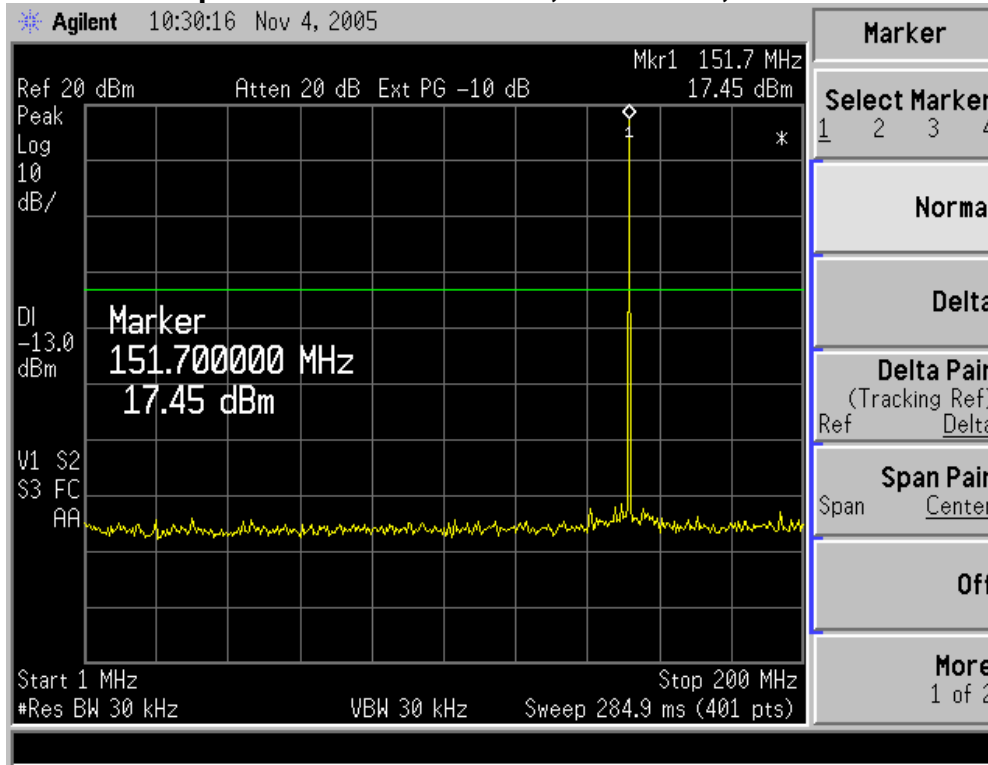
**View of Test Setup During all the Conducted RF measurements**



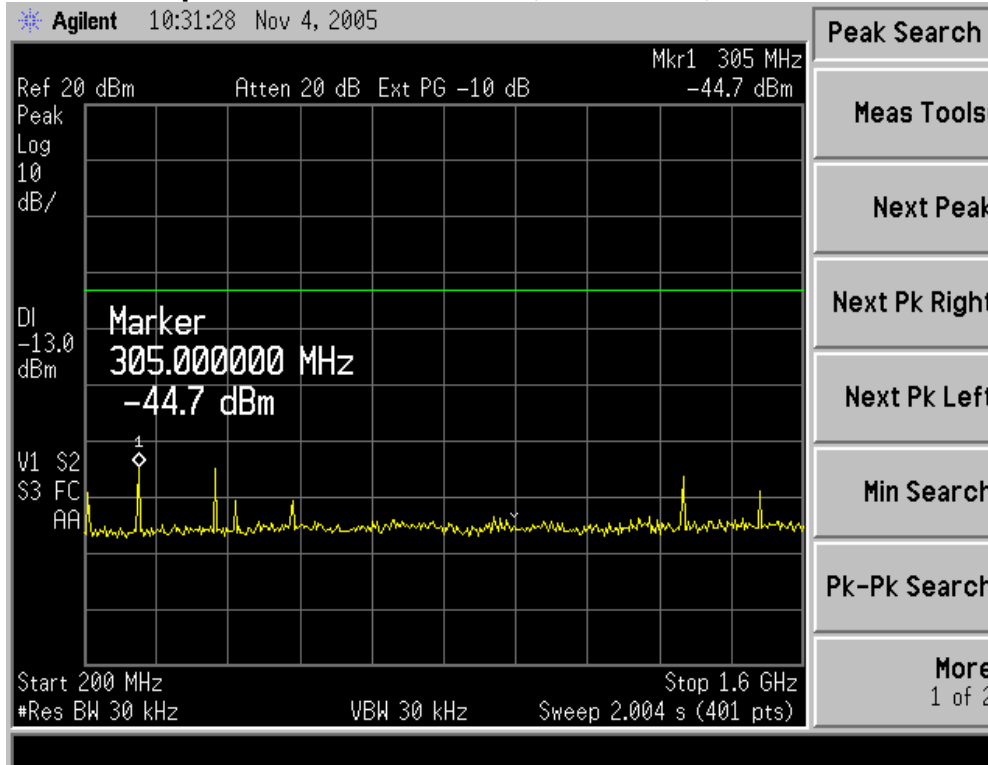
11. **Conducted Spurious Emissions: 47 CFR 90.217**

FCC Part 90.217 requires an antenna conducted measurement of conducted harmonic and spurious levels, as reference to the carrier frequency in a 30 kHz bandwidth. For this test, the transmitter was directly connected to the HP E4407B Spectrum Analyzer, through a very short Coaxial Cable and a 10 DB Attenuator. Plots were then taken, with any noticeable spurious or harmonic signals identified. No significant levels of any spurious products could be found within -30 dBc of the fundamental of the transmitter. The highest spurious signal seen was at 303.3 MHz which was measured at -44.7 dBm in a 30 kHz bandwidth, which is about 31.7 dB below the -13.0 dBm limit.

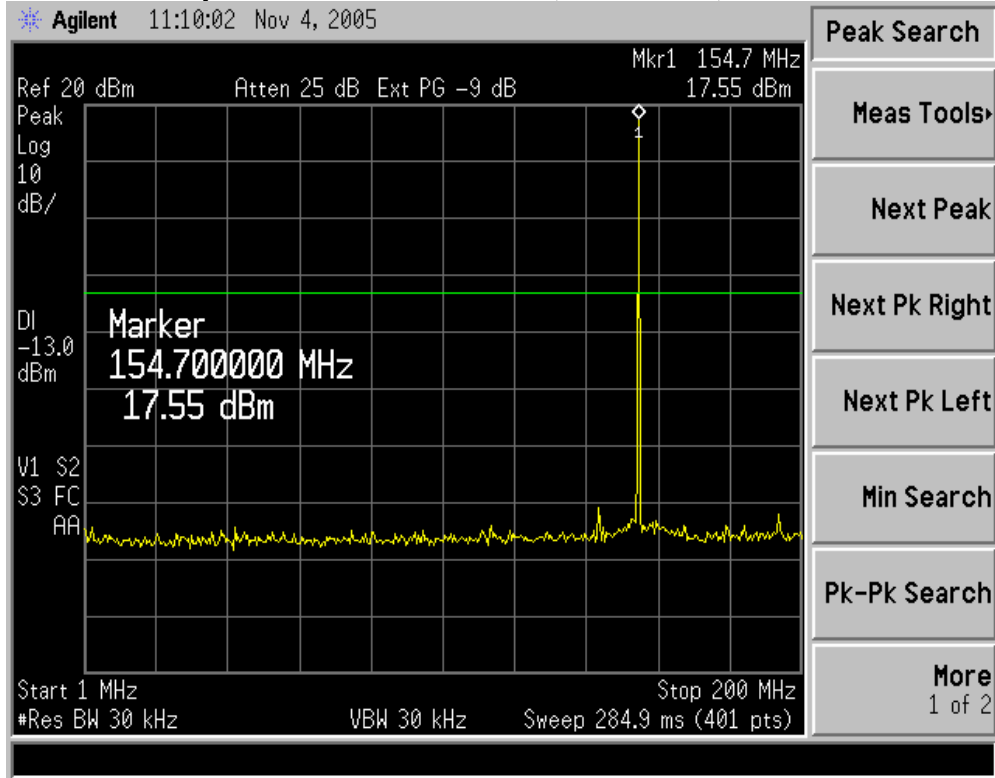
### Conducted Spurious measurements, Channel 0, 1 MHz to 200 MHz



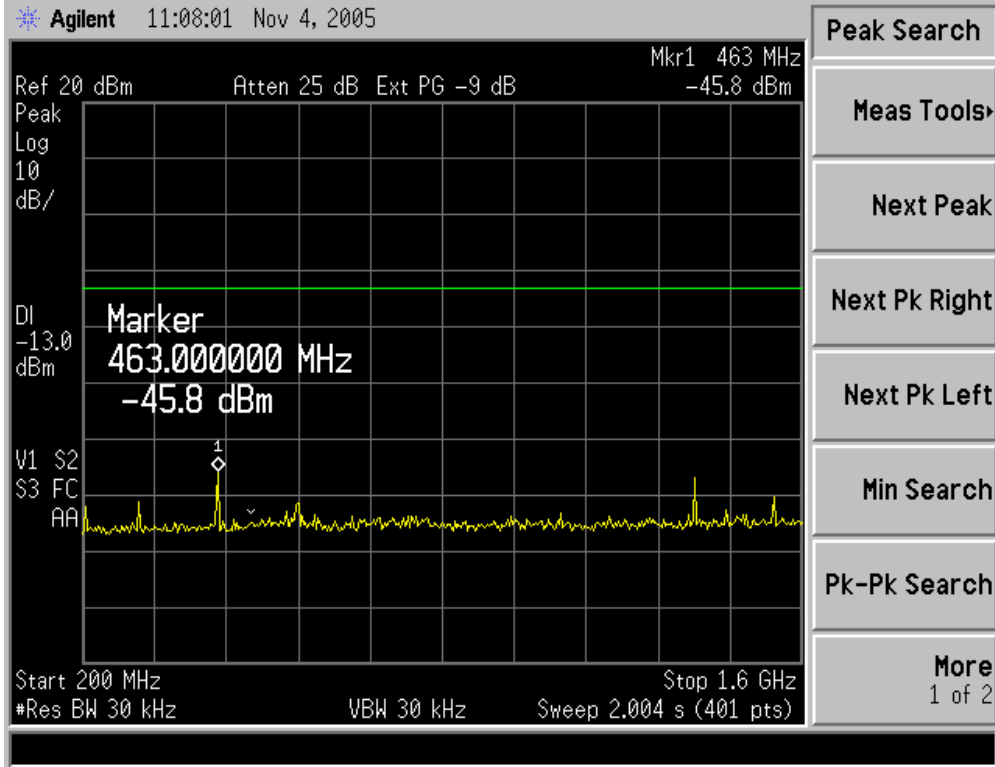
### Conducted Spurious measurements, Channel 0, 200 MHz to 1.6 GHz



### Conducted Spurious measurements, Channel1, 1 MHz to 200 MHz



### Conducted Spurious measurements, Channel1, 200 MHz to 1.6 GHz





**12. Bandwidth Measurements 47 CFR 90.217**

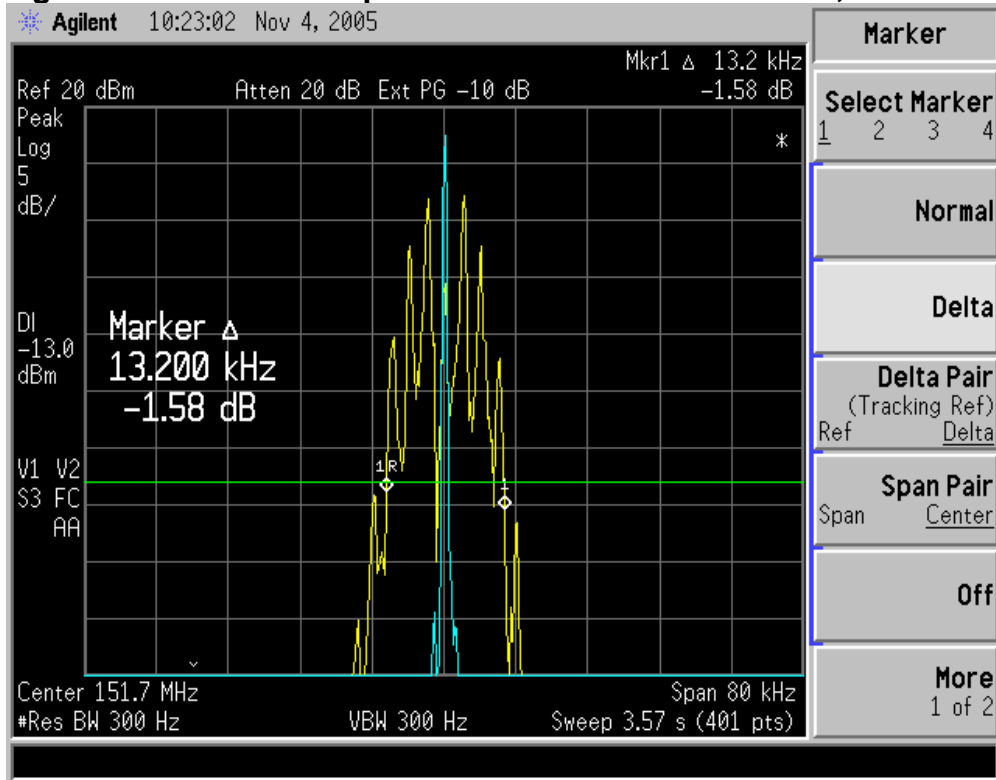
Direct measurement of the transmitted signal, via a cabled connection to the HP E4407B Analyzer, was then used to determine the signal bandwidth. For each of the representative channels, refer to the graphs found on the following pages.

For a device operating under the exclusion clause of 90.217, due to low power, the bandwidth mask reduces to:

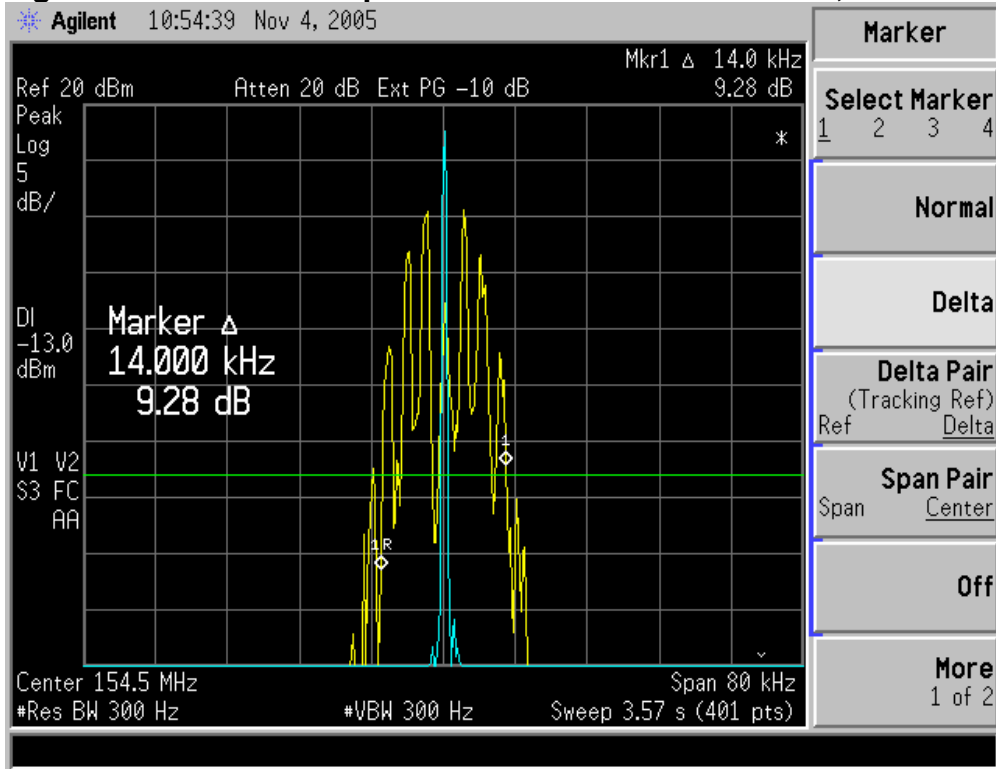
<i>90.217 (d)</i>	<i>Absolute Frequency Offset Range: <math> f_m </math></i>	<i>Attenuation relative to Carrier power (P).</i>
<i>(1)</i>	<i>0 to +/- 40.0 kHz</i>	<i>0 dB</i>
<i>(2)</i>	<i>+/- 40.0 kHz or more</i>	<i>-30 dBc</i>

From the following plots displayed, the device is seen to be compliant with the bandwidth requirement of 90.217 for a low power transmitter, while fully modulated with a 2 kHz tone.

### Signature Scan of Occupied Bandwidth measurements, Channel 0



### Signature Scan of Occupied Bandwidth measurements, Channel 1



## APPENDIX A

### Test Equipment List

Asset #	Manufacturer	Model #	Serial #	Description	Date	Due
AA960008	EMCO	3816/2NM	9701-1057	Line Impedance Stabilization Network	9/27/05	9/27/06
AA960031	HP	119474A	3107A01708	Transient Limiter	Note 1	Note 1
AA960077	EMCO	93110B	9702-2918	Biconical Antenna	9/27/05	9/27/06
AA960078	EMCO	93146	9701-4855	Log-Periodic Antenna	9/27/05	9/27/06
AA960081	EMCO	3115	6907	Double Ridge Horn Antenna	12/06/04	12/06/05
CC00221C	Agilent	E4407B	US39160256	Spectrum Analyzer	12/07/04	12/07/05
EE960004	EMCO	2090	9607-1164	Device Controller	N/A	N/A
EE960013	HP	8546A	3617A00320	Receiver RF Section	9/29/05	9/29/06
EE960014	HP	85460A	3448A00296	Receiver Pre-Selector	9/29/05	9/29/06
N/A	LSC	Cable	0011	3 Meter 1/2" Armored Cable	Note 1	Note 1
N/A	LSC	Cable	0050	10 Meter RG 214 Cable	Note 1	Note 1
N/A	Pasternack	Attenuator	N/A	10 dB Attenuator	Note 1	Note 1

*Note 1\* - Equipment calibrated within a traceable system.*

## Appendix B - Uncertainty Statement

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level, using a coverage factor of  $k=2$ .

**Table of Expanded Uncertainty Values, (K=2) for Specified Measurements**

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.8 dB
Radiated Emissions	10-Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10-Meter OATS, Log Periodic Antenna	3.92 dB
Conducted Emissions	Shielded Room/EMCO LISN	1.60 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	1.128 Volts/Meter
Conducted Immunity	3 Volts level	1.0 V