



FCC PARTS 90
MEASUREMENT AND TEST REPORT
For
COMTEK Communications Technology, Inc.

357 West 2700 South,
Salt Lake City, Utah 84115, USA

FCC ID: C6ZM169
Model: M-169

Report Type: Original Report	Product type: Wireless Microphone Transmitter
Test Engineer: <u>Xiao Ming Hu</u> 	
Report Number: <u>R0809052-90</u>	
Report Date: <u>2008-09-29</u>	
Reviewed By: <u>Boni Baniqued</u>  <u>Sr. RF Engineer</u>	
Prepared By: <u>Bay Area Compliance Laboratories Corp.</u> (66) <u>1274 Anvilwood Ave</u> <u>Sunnyvale, CA 94085, U.S.A.</u> <u>Tel: (408) 732-9162</u> <u>Fax: (408) 732 9164</u> <u>www.baclcorp.com</u>	

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* This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk "*" (Rev.2)

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DOCUMENT REVISION HISTORY

Revision #	Report Number	Description of Revision	Date of Revision
0	R0809052-90	Original	2008-09-29

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

The report has been prepared on behalf of COMTEK Communications Technology, Inc. and their product FCC ID: C6ZM169, model: M-169 or the EUT as referred to in the rest of this report. The EUT is a Wireless Microphone Transmitter that operates under FCC Parts 90.

EUT Technical Specifications	
Frequency Band	169.445 MHz – 171.905 MHz
Modulation Type	54K0F3E
RF Output Power	25 milliWatts
Number of Channels	8
Power Supply	9 VDC
Frequency Deviation	Peak ± 10 kHz
Antenna Type	Body induction microphone cord antenna, (< 0 dBi Gain)

1.2 Mechanical Description

The COMTEK Communications Technology Inc's product, model: M-169 or the "EUT" as referred to in this report is a Wireless Microphone Transmitter of plastic construction, which measures approximately 89.0 mm (L) x 57.0 mm (W) x 27.0 mm (H) and weighs 140 g.

** The test data gathered are from production sample, serial number: 260606 and 260607 provided by the manufacturer.*

1.3 EUT Photo



Additional Photo in Exhibit B

1.4 Objective

This Type approval report is prepared on behalf of *COMTEK Communications Technology, Inc.* in accordance with Part 90 of the Federal Communication Commissions rules.

1.5 Related Submittal(s)/Grant(s)

No related submittal(s).

1.6 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 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.

1.7 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>

2 SYSTEM TEST CONFIGURATION

2.1 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.

2.2 Equipment Modifications

No modifications were made to the EUT.

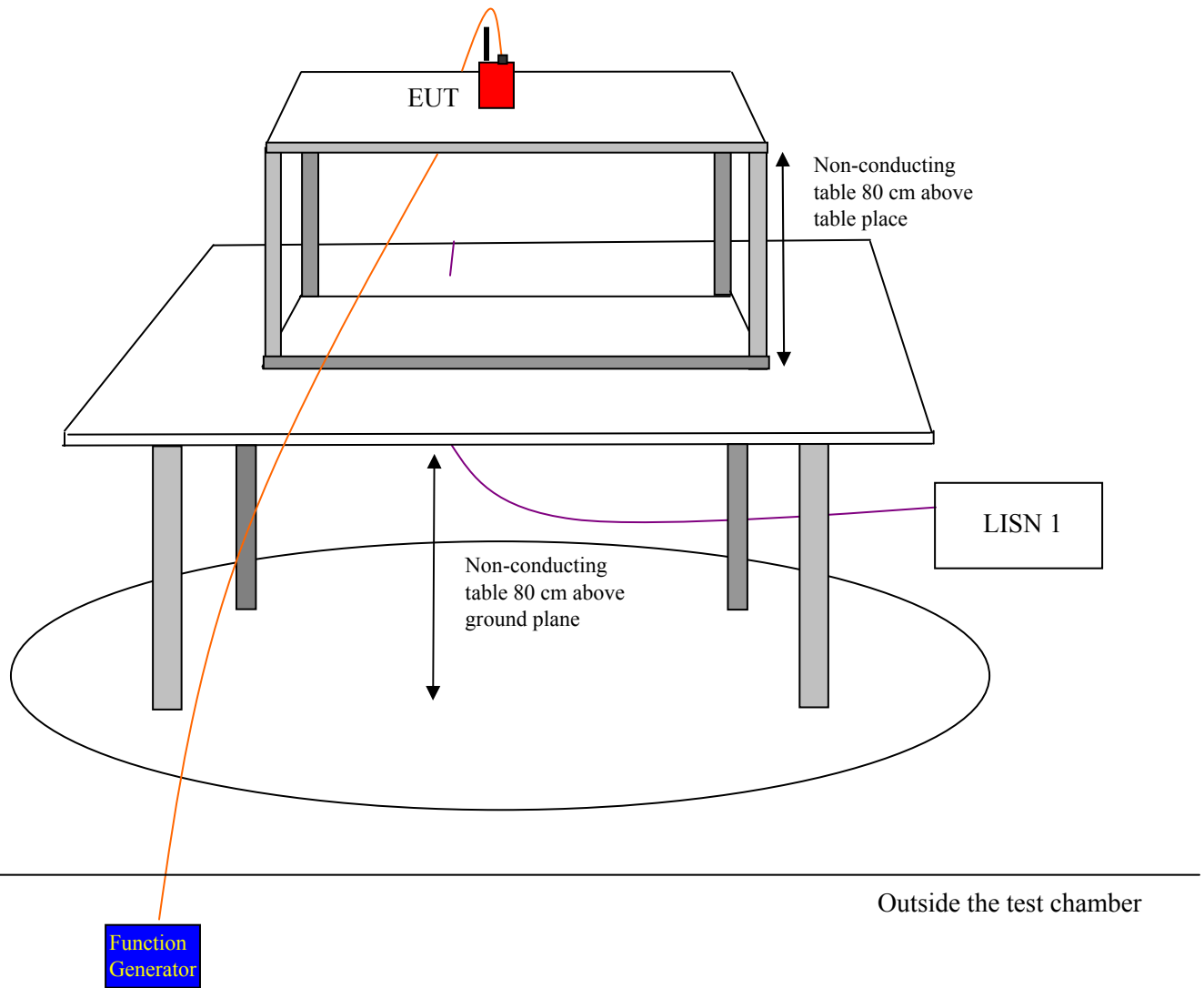
2.3 Local Support Equipment Power Supply and Line Filters

Manufacturer	Description	Model	Serial Number
BK PRECISION	DC power supply	1612A	0553WSC12
Agilent	Function Generator	33220A	MY43004878

2.4 Interface Ports and Cabling

Cable Description	Length (m)	From	To
MIC Cable	1.0	EUT	Function Generator
AUX Cable	1.0	EUT	50 Ohm Terminator

2.5 Test Setup Block Diagram



3 SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
§2.1093	RF Exposure	Compliant
§2.1046, §90.265 (b) (2)	RF Output Power	Compliant
§2.1047	Modulation Characteristics, Audio Frequency Response and Audio Filter Response	Compliant
§2.1049, §90.265 (b) (1)	Occupied Bandwidth and Emission Bandwidth	Compliant
§2.1051	Spurious Emissions AT Antenna Terminals	Compliant
§2.1055, § 90.265 (b) (3)	Frequency stability	Compliant
§2.1053	Field strength of spurious radiation	Compliant

4 §2.1093 - RF EXPOSURE

4.1 Applicable Standard

Routine SAR evaluation refers to that specifically required by § 2.1093, using measurements or computer simulation. When routine SAR evaluation is not required, portable transmitters with output power greater than the applicable low threshold require SAR evaluation to qualify for TCB approval.

Exposure category	Low threshold	High threshold
General Population	$(60/f_{\text{GHz}})$ mW, $d < 2.5$ cm $(120/f_{\text{GHz}})$ mW, $d \geq 2.5$ cm	$(900/f_{\text{GHz}})$ mW, $d < 20$ cm
Occupational	$(375/f_{\text{GHz}})$ mW, $d < 2.5$ cm $(900/f_{\text{GHz}})$ mW, $d \geq 2.5$ cm	$(2250/f_{\text{GHz}})$ mW, $d < 20$ cm

4.2 Result:

This is a portable device and the Maximum peak output power are 24.0436 mW, which is below the low threshold level of $352.9 \text{ mW} = (60/0.170 \text{ GHz}) \text{ mW}$. The SAR measurement is not applicable for this device.

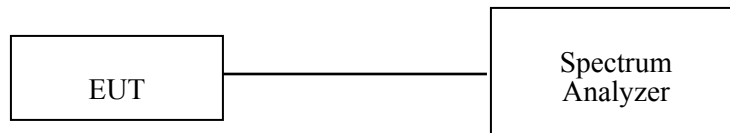
5 §2.1046 and §90.265 (b) (2) - Conducted Output Power

5.1 Applicable Standard

According to FCC §90.265 (b) (2), the output power shall not exceed 50 milliwatts.

5.2 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
1MHz	1MHz

5.3 Test Equipment List and Details

Manufacturer	Description	Model Number	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-04-28

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

5.4 Environmental Conditions

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

* The testing was performed by Xiao Ming Hu on 2008-09-09.

5.5 Test Result

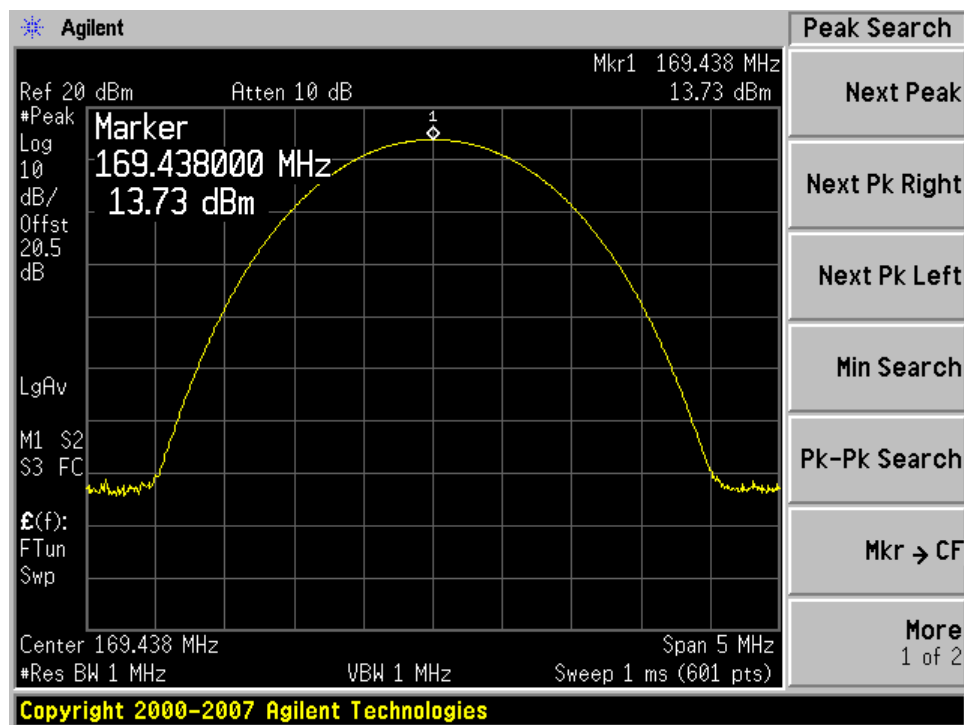
Test Mode: Transmitting

Frequency (MHz)	Output Power (dBm)	Output Power (mw)	FCC Limit (mw)
169.445	13.73	23.6048	50
170.305	13.80	23.9883	50
171.905	13.81	24.0436	50

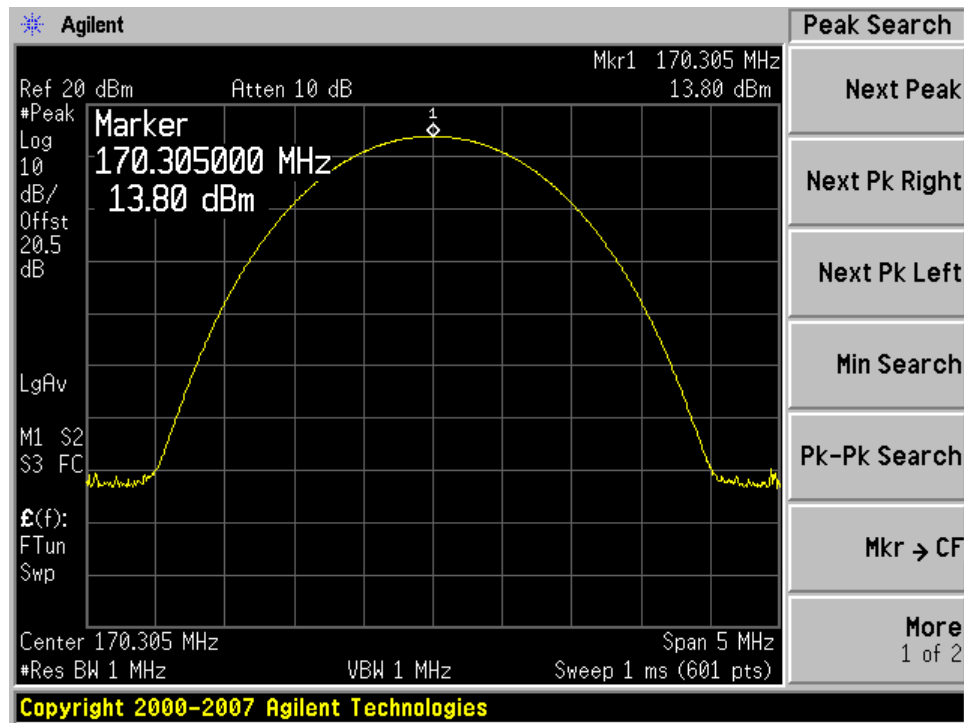
Note: Antenna Gain: 0 dBi.

Please refer to the following plots:

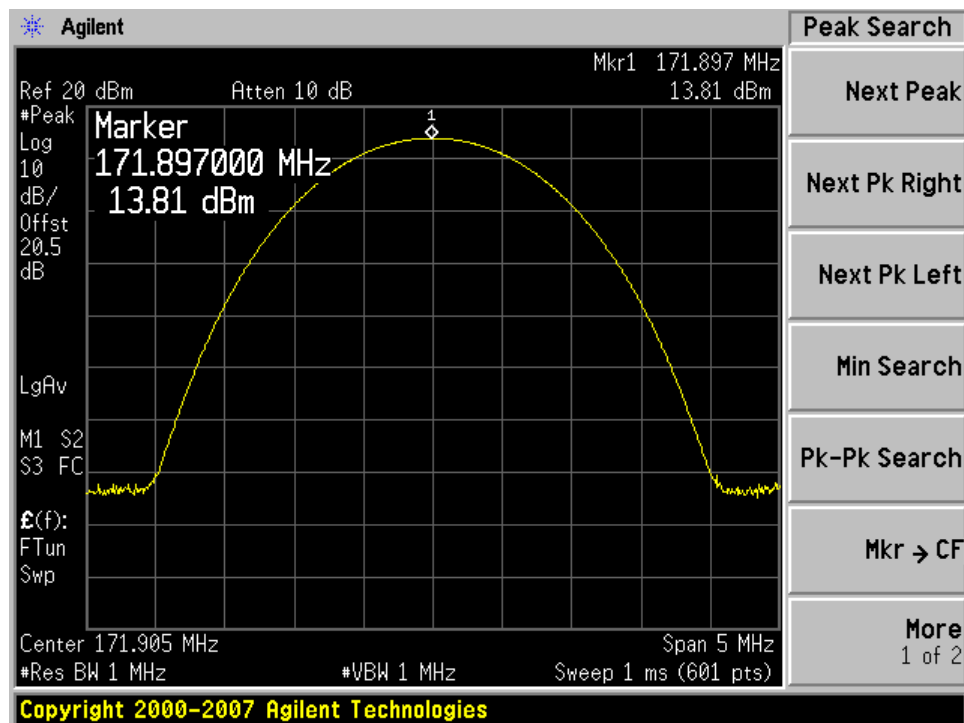
Low Channel



Middle Channel



High Channel



6 §2.1047 - MODULATION CHARACTERISTIC

6.1 Applicable Standard

§2.1047:

- (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.

6.2 Test Procedure

Test Method: TIA/EIA-603-C 2.2.3 and 2.2.6

6.3 Test Equipment List and Details

Manufacturer	Description	Model Number	Serial Number	Calibration Date
Agilent	Function Arbitrary Waveform Generator	33220A	MY43004878	2008-06-18
HP	RF Communication Test Set	8920A	3438A05338	2008-03-20

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

6.4 Environmental Conditions

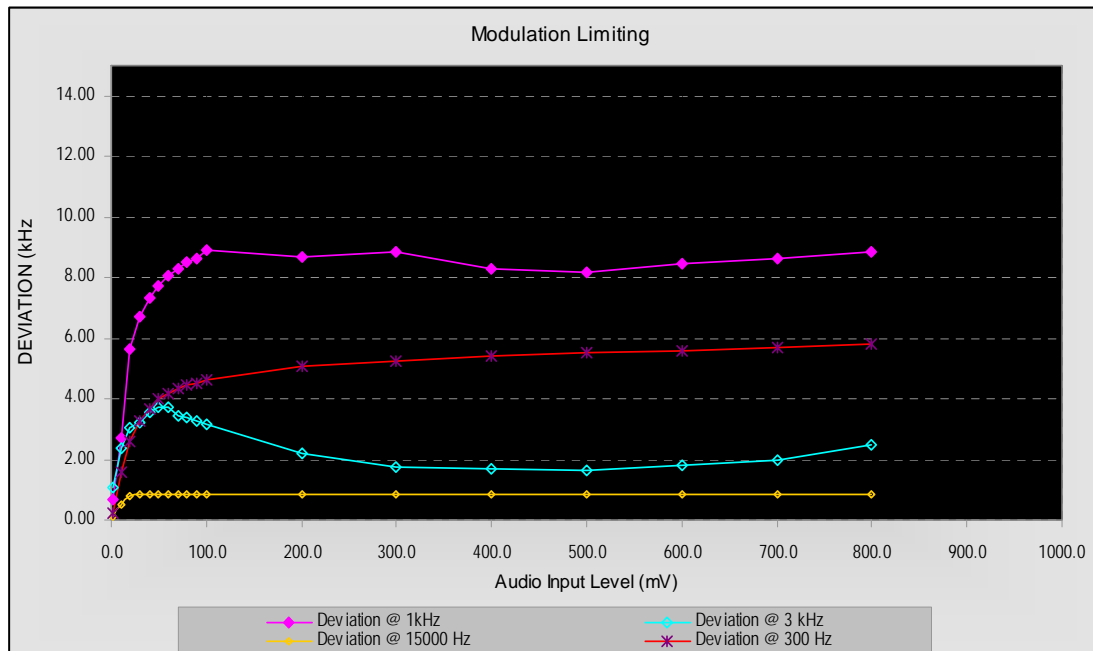
Temperature:	26 °C
Relative Humidity:	32 %
ATM Pressure:	100.9 kPa

* *The testing was performed by Xiao Ming Hu on 2008-09-16.*

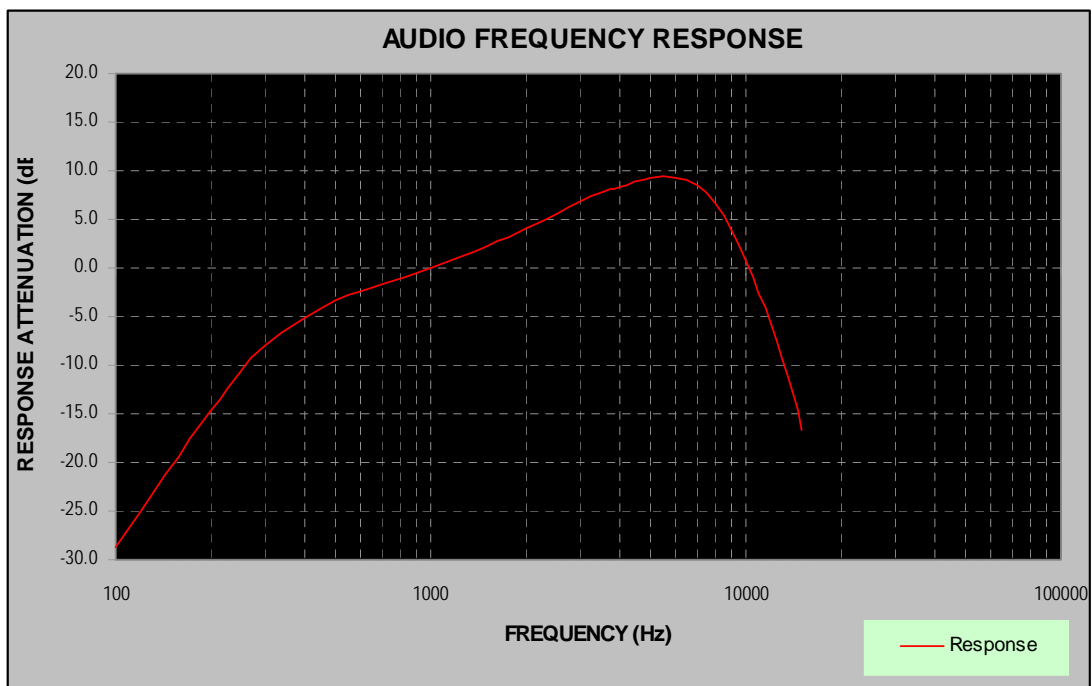
6.5 Test Result

Test Mode: Transmitting

Carrier Frequency: 170.305 MHz

Modulation Limiting Plot:

Note: The EUT has 10 kHz frequency deviation

Audio Frequency Response Plot:

7 §2.1049, § 90.210 (b) and § 90.265 (b) (1) – EMISSION BANDWIDTH & EMISSION MASK

7.1 Applicable Standard

§90.265

The Emission Bandwidth shall not exceed 54 kHz.

§2.1049 (c) (1)

Other than single sideband or independent sideband transmitters – when modulated by a 2500 Hz tone at input level 16 dB greater than that necessary to produce 50 percent modulation. The input level shall establish at the frequency of maximum response of the audio modulating circuit.

§90.210 (b)

(b) *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 $43 + 10 \log (P)$ dB.

7.2 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 least 1% of the emission bandwidth and the spectrum were recorded in the frequency band ± 100 KHz from the carrier frequency.

7.3 Test Equipment List and Details

Manufacturer	Description	Model Number	Serial Number	Calibration Date
Agilent	Function Arbitrary Waveform Generator	33220A	MY43004878	2008-06-18
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-04-28

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

7.4 Environmental Conditions

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

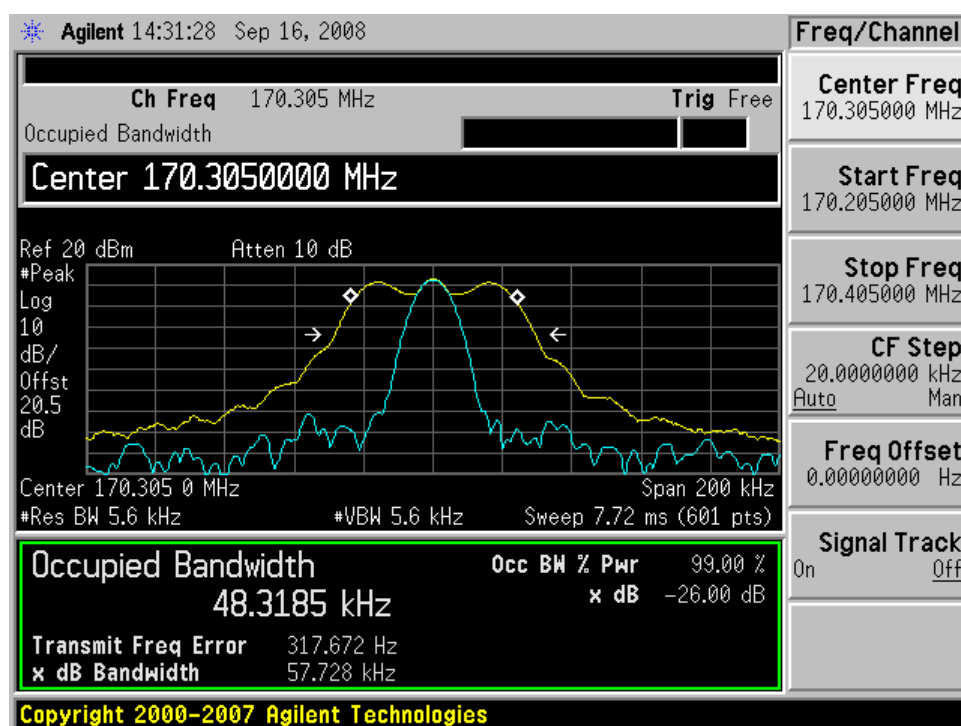
* The testing was performed by xiao Ming Hu on 2008-09-16.

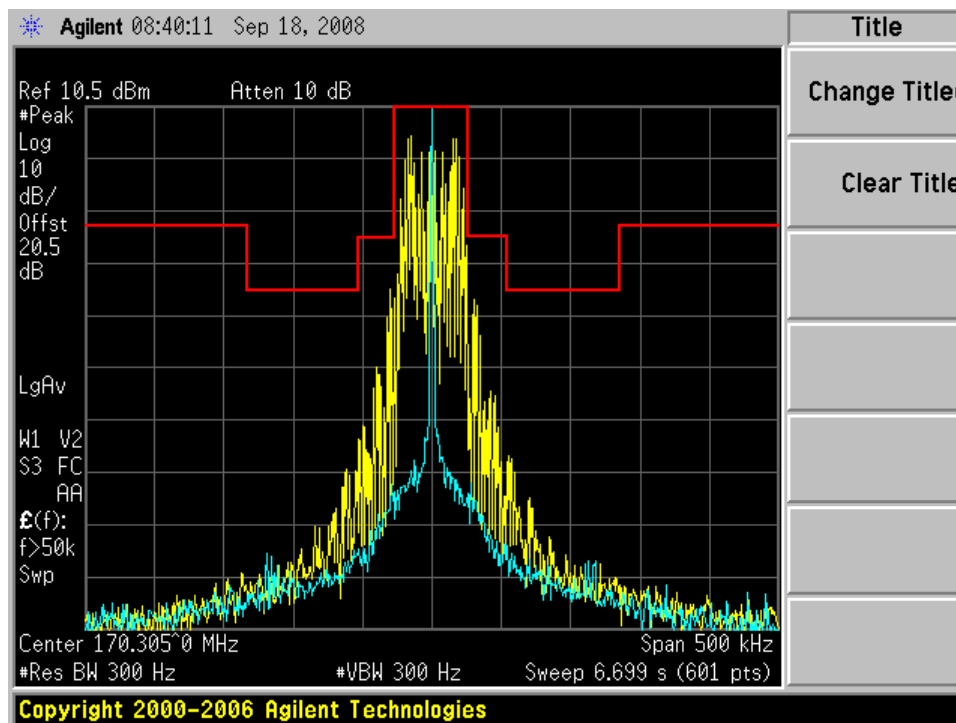
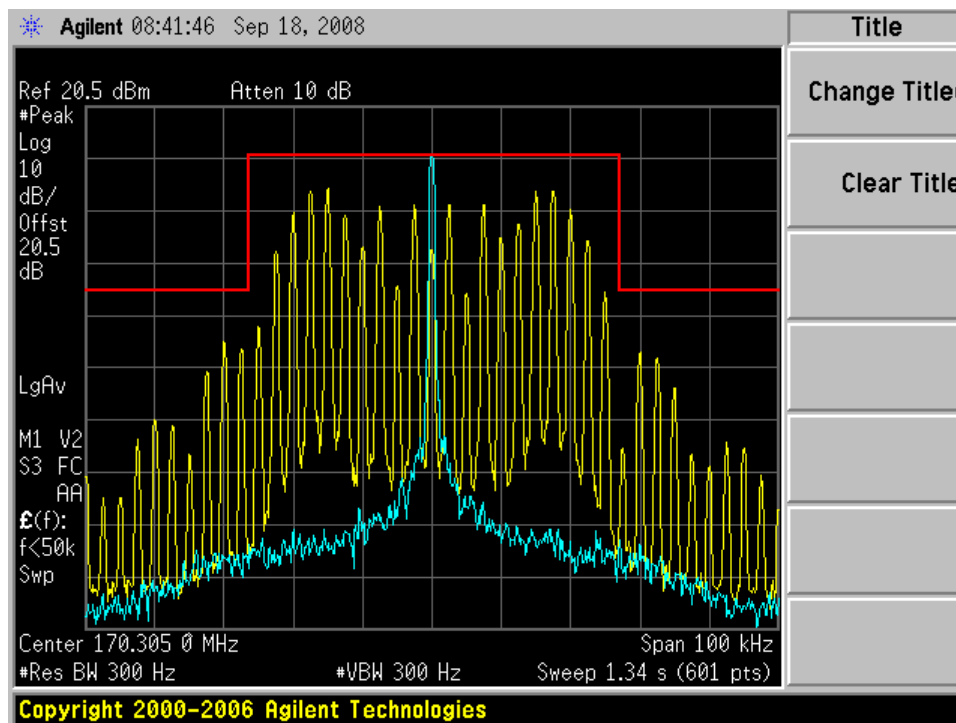
7.5 Test Result

Please refer to the hereinafter plots.

Test Condition	Frequency (MHz)	Occupied Bandwidth (kHz)	Limit (kHz)
With 2500 Hz Audio Output	170.305	48.3185	54.0

Occupied Bandwidth, Middle Channel



Emission Mask, Middle Channel

8 §2.1051 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

8.1 Applicable Standard

§2.1051

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

$$43+10\log(P)$$

8.2 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.

8.3 Test Equipment List and Details

Manufacturer	Description	Model Number	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-04-28

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

8.4 Environmental Conditions

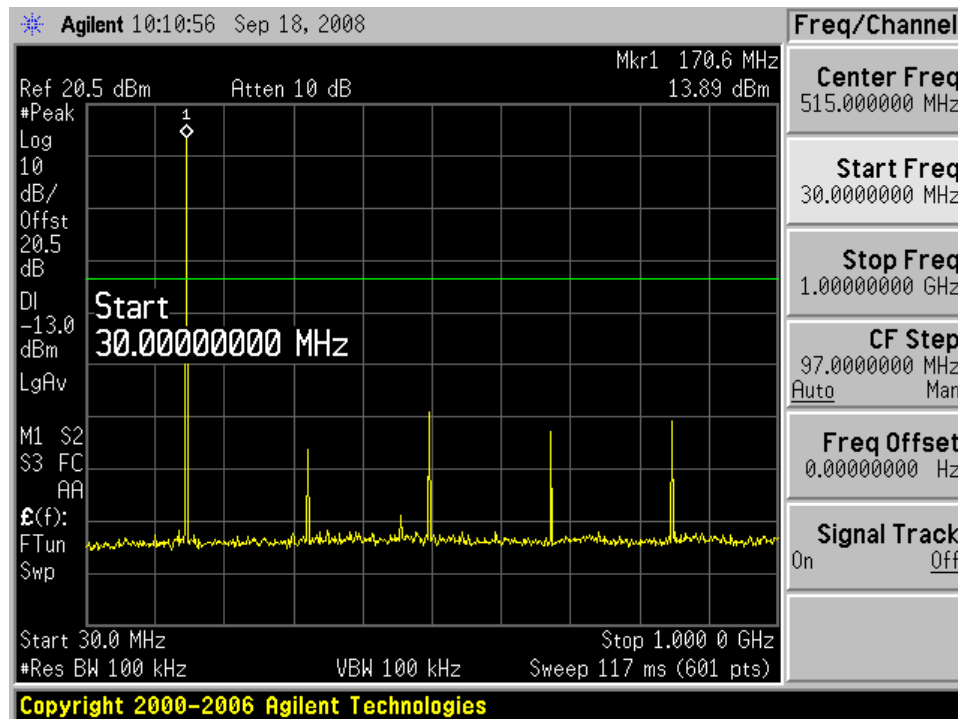
Temperature:	26 °C
Relative Humidity:	32 %
ATM Pressure:	100.9 kPa

* *The testing was performed by Xiao Ming Hu on 2008-09-16.*

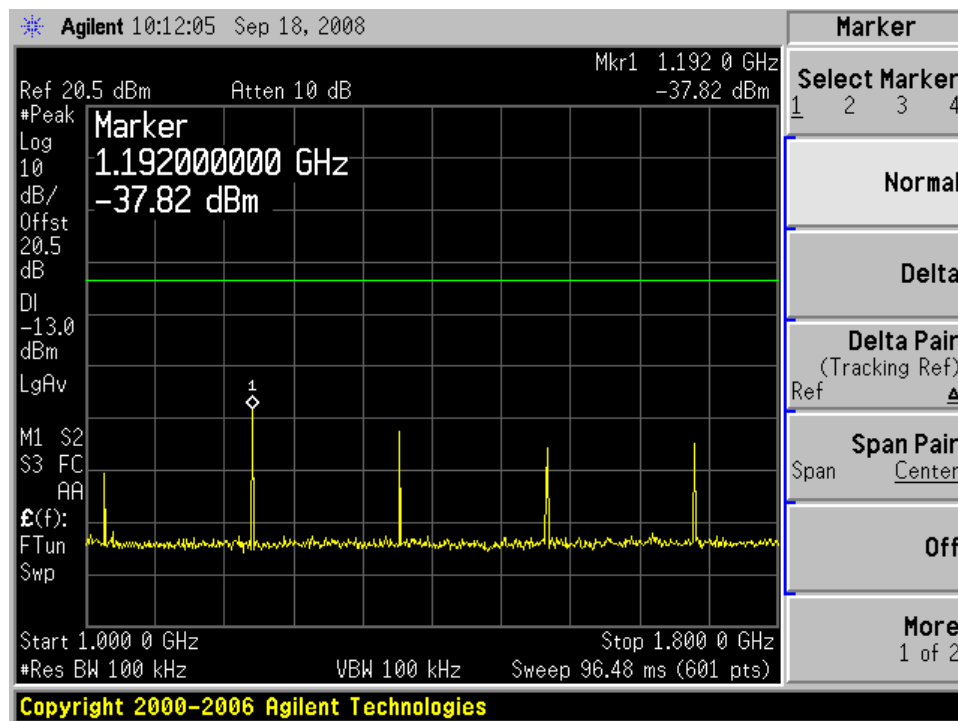
8.5 Test Results

Test Mode: Transmitting. Middle Channel.

30 MHz – 1 GHz (Middle Channel)



1 GHz – 10th Harmonics (Middle Channel)



9 §2.1055 and §90.265 (b) (3) - FREQUENCY STABILITY

9.1 Applicable Standard

§2.1055 (d)

§90.265 (b) (3)

The frequency stability of wireless microphones shall limit the total emission to within ± 32.5 KHz of the assigned frequency.

9.2 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 85% and 115% 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.

9.3 Test Equipment List and Details

Manufacturer	Description	Model Number	Serial Number	Calibration Date
HP	Microwave Frequency Counter	5242A	2232A06383	2008-01-26
BK Precision	Regulated DC Power Supply	1621A	D185052265	N/A
Tenney Engineering Inc.	Temperature Oven	Versa Tenn	12222193	N/A

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

9.4 Environmental Conditions

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

* The testing was performed by Xiao Ming Hu on 2008-09-17.

9.5 Test Result

Test Mode: Transmitting, Middle Channel 170.305 MHz

Frequency vs. Temperature

Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (kHz)	Limit (kHz)	Results
Voltage (Vdc)	Temperature (°C)					
9.0	-30	170.305	170.3057810	0.7810000	±32.5	Pass
9.0	-20	170.305	170.3064440	1.4440000	±32.5	Pass
9.0	-10	170.305	170.3060219	1.0219000	±32.5	Pass
9.0	0	170.305	170.3061110	1.1110000	±32.5	Pass
9.0	10	170.305	170.3056400	0.6400000	±32.5	Pass
9.0	20	170.305	170.3050610	0.0610000	±32.5	Pass
9.0	30	170.305	170.3041490	-0.8510000	±32.5	Pass
9.0	40	170.305	170.3038880	-1.1120000	±32.5	Pass
9.0	50	170.305	170.3038460	-1.1540000	±32.5	Pass

Frequency vs. Voltage

Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (kHz)	Limit (kHz)	Results
Voltage (Vdc)	Temperature (°C)					
10.35	20	170.305	170.3048060	-0.1940000	±32.5	Pass
7.65	20	170.305	170.3048000	-0.2000000	±32.5	Pass

10 §2.1053 - FIELD STRENGTH OF SPURIOUS RADIATION

10.1 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.

10.2 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

10.3 Test Equipment

Manufacturer	Description	Model Number	Serial Number	Calibration Date
HP	Amplifier, Pre	8447D	2944A10198	2007-12-18
Agilent	Analyzer, Spectrum	E4440A	US45303156	2008-05-31
HP	Amplifier (1 ~ 26.5 GHz)	8449B	3008A1978	2008-06-27
Sunol Science	30Mhz ~ 2 GHz Antenna	JB3	A020106-2 / S009976	2008-05-14
Antenna Research Associates, Inc.	Horn Antenna	DRG-118/A	1132	2008-07-28
Com-Power	Antenna, Dipole	AD-100	2219	2007-09-26
HP	Signal Generator	8648C	3426A00417	2008-05-28
A.H. Systems	Horn Antenna	SAS-200/571	261	2008-07-01

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

10.4 Environmental Conditions

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

* The testing was performed by Xiao Ming Hu on 2008-09-16.

10.5 Test Result

-9.07 dB at 681.220 MHz in the Horizontal polarization

-9.07 dB at 1362.440 MHz in the Vertical polarization

Test Mode: Transmission, Middle Channel

Indicated		Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Frequency (MHz)	Amplitude (dBuV)		Height (m)	Polar (H/V)	Frequency (MHz)	Level (dBm)	Antenna Correction (dBi)	Cable Loss (dB)	Absolute Level (dBm)		
681.220	74.30	360	1.220	H	681.220	-21.60	0.0	0.47	-22.07	-13.0	-9.07
1362.440	79.72	361	1.180	V	1362.440	-29.04	7.7	0.73	-22.07	-13.0	-9.07
1362.440	78.54	140	1.420	H	1362.440	-29.53	7.7	0.73	-22.56	-13.0	-9.56
681.220	68.49	89	1.000	V	681.220	-26.20	0.0	0.47	-26.67	-13.0	-13.67
1703.050	70.00	143	1.580	H	1703.050	-36.58	9.3	0.90	-28.18	-13.0	-15.18
1532.745	70.27	146	1.000	H	1532.745	-37.63	8.8	0.85	-29.68	-13.0	-16.68
1021.830	74.56	160	1.590	H	1021.830	-36.37	6.3	0.67	-30.74	-13.0	-17.74
1192.135	70.56	102	1.000	H	1192.135	-37.85	6.9	0.76	-31.71	-13.0	-18.71
1021.830	73.07	38	1.000	V	1021.830	-38.05	6.3	0.67	-32.42	-13.0	-19.42
1703.050	66.08	187	1.000	V	1703.050	-41.72	9.3	0.90	-33.32	-13.0	-20.32
1192.135	70.31	12	1.720	V	1192.135	-39.76	6.9	0.76	-33.62	-13.0	-20.62
1532.745	66.01	118	1.800	V	1532.745	-43.07	8.8	0.85	-35.12	-13.0	-22.12
340.610	63.51	29	1.000	V	340.610	-35.00	0.0	0.40	-35.40	-13.0	-22.40
851.525	56.77	110	1.000	H	851.525	-36.90	0.0	0.52	-37.42	-13.0	-24.42
851.525	52.57	226	1.550	V	851.525	-37.30	0.0	0.52	-37.82	-13.0	-24.82
510.915	58.30	98	1.000	V	510.915	-37.90	0.0	0.41	-38.31	-13.0	-25.31
510.915	61.32	174	1.000	H	510.915	-37.90	0.0	0.41	-38.31	-13.0	-25.31
340.610	59.19	238	1.530	H	340.610	-43.11	0.0	0.40	-43.51	-13.0	-30.51

Note: all emission readings besides fundamental frequencies are measured with RF filter and Pre-Amplifier