



# FCC Test Report

## FCC Part 15.247 for FHSS systems

**FOR:**

**ShotSpotter, Inc  
1060 Terra Bella Ave  
Mountain view, CA 94043**

**FCC ID: WLI-L3ALV900**

**TEST REPORT #: EMC\_SHOTS\_001\_08001\_15.247\_2009**

**DATE: 2009-2-5**



**FCC listed  
A2LA Accredited**

**IC recognized #  
3462B**

***CETECOM Inc.***

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Board of Directors: Dr. Harald Ansorge, Dr. Klaus Matkey, Hans Peter May

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## 1 Assessment

**The following is in compliance with the applicable criteria specified in FCC rules Part 15.247 of the Code of Federal Regulations.**

Company	Model #
ShotSpotter, Inc	L3-ALV900

This report is reviewed by:

Lothar Schmidt  
(Director Regulatory and  
Antenna Services)

2009-2-5

EMC & Radio

Date

Section

Name

Signature

The test results of this test report relate exclusively to the test item specified in Identification of the Equipment under Test. The CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM Inc USA.

This report is prepared by:

Peter Mu  
(EMC Project Engineer)

2009-2-5

EMC & Radio

Date

Section

Name

Signature

## **2 Administrative Data**

### **2.1 Identification of the Testing Laboratory Issuing the EMC Test Report**

Company Name:	<b>CETECOM Inc.</b>
Department:	<b>EMC</b>
Address:	<b>411 Dixon Landing Road Milpitas, CA 95035 U.S.A.</b>
Telephone:	<b>+1 (408) 586 6200</b>
Fax:	<b>+1 (408) 586 6299</b>
Responsible Test Lab Manager:	<b>Lothar Schmidt</b>
Responsible Project Leader:	<b>Peter Mu</b>
Date of test:	<b>2008-8-1 to 2008-11-10</b>

### **2.2 Identification of the Client**

<b>APPLICANT</b>	
<b>Applicant (Company Name)</b>	<b>ShotSpotter, Inc.</b>
<b>Street Address</b>	<b>1060 Terra Bella Ave</b>
<b>City/Zip Code</b>	<b>Mountain View, CA 94043</b>
<b>Country</b>	<b>USA</b>
<b>Contact Person</b>	<b>Gouglas McFarlin</b>
<b>Telephone</b>	<b>650-960-9200</b>
<b>Fax</b>	
<b>e-mail</b>	<b>dmcfarlin@shotspotter.com</b>

### **3 Equipment under Test (EUT)**

#### **3.1 Specification of the Equipment under Test**

Marketing Name:	<b>L3ALV900</b>
Model No:	<b>L3ALV900</b>
Antenna Type:	<b>External Panel MT-263006/N, 12.5dBi</b> <b>External Panel WRP900-100, 10.0dBi</b>
Type(s) of Modulation:	<b>GFSK DTS/FHSS hybrid</b>
Frequency Band(s) of Operation:	<b>904.0 - 926.0MHz</b>
Equipment Classification: (CLASS)	<input checked="" type="checkbox"/> FIXED <input type="checkbox"/> VEHICULAR <input type="checkbox"/> PORTABLE <input type="checkbox"/> MODULE
Equipment Classification: (POWER(AC MAINS))	<input type="checkbox"/> 110VAC ( <i>GROUND</i> ) <input checked="" type="checkbox"/> 110VAC ( <i>NO GROUND</i> ) <input type="checkbox"/> 12VDC

#### **3.2 Identification of the Equipment Under Test (EUT)**

<b>EUT #</b>	<b>TYPE</b>	<b>MODEL</b>	<b>SERIAL #</b>
1	<b>EUT</b>	<b>L3ALV900</b>	<b>L3B-00-B36-0556</b>

#### **3.3 Identification of Accessory equipment**

<b>AE #</b>	<b>TYPE</b>	<b>MODEL</b>
1	AC Adapter Power Supply	MDR-20-12

#### **4 Subject Of Investigation**

This report supports an application for FCC approval of a final device under the FCC ID: **WLI-L3ALV900**.

All testing was performed on the product referred to in Section 3 as EUT. This test report contains full radiated and conducted testing results as per FCC15.247. Frequency hopping timing characteristics were measured at Alvarion's laboratory in Carlsbad, CA. All other FCC tests were performed at Compliance Certification Services, 571F Monterey Road, Morgan Hill, CA 95037. Conducted values are verified by Cetecom.

The objective of the measurements done by Cetecom Inc. was to measure the performance of the EUT as specified by requirements listed in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations. The maximization of portable equipment is conducted in accordance with ANSI C63.4.

During the testing process the EUT was tested with manufacture' testing software in normal modulation with carrier placed on the first, middle, and the last transmitting channels in the band. Maximum output power is used for all testing. All data in this report shows the worst case between horizontal and vertical polarization for above 1GHz.

From the test data collected this device complies with applicable FCC rules in Part 15.247.

## 5 Measurements (Radiated)

### 5.1 MAXIMUM PEAK OUTPUT POWER

#### 5.1.1 Test Result:

EIRP with 10 dBi antenna:

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
Frequency (MHz)		904	915	926
T <sub>nom</sub> (23)°C	V <sub>nom</sub> VDC	31.24	30.60	31.73
Measurement uncertainty		±0.5dBm		

EIRP with 12.5 dBi antenna:

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
Frequency (MHz)		904	915	926
T <sub>nom</sub> (23)°C	V <sub>nom</sub> VDC	34.93	34.23	35.64
Measurement uncertainty		±0.5dBm		

Note: End users are cautioned to only use the supplied external panel antennae and RF cable assembly to ensure that the power output meets applicable FCC requirements. For detail see users manual.

Test conducted with EUT operating at 1.5dBm higher than normal operation as a built-in safety margin per applicant's request. Thus EIRP under normal operation can only be lower than what is measured and all emission should also comply with applicable FCC requirements.



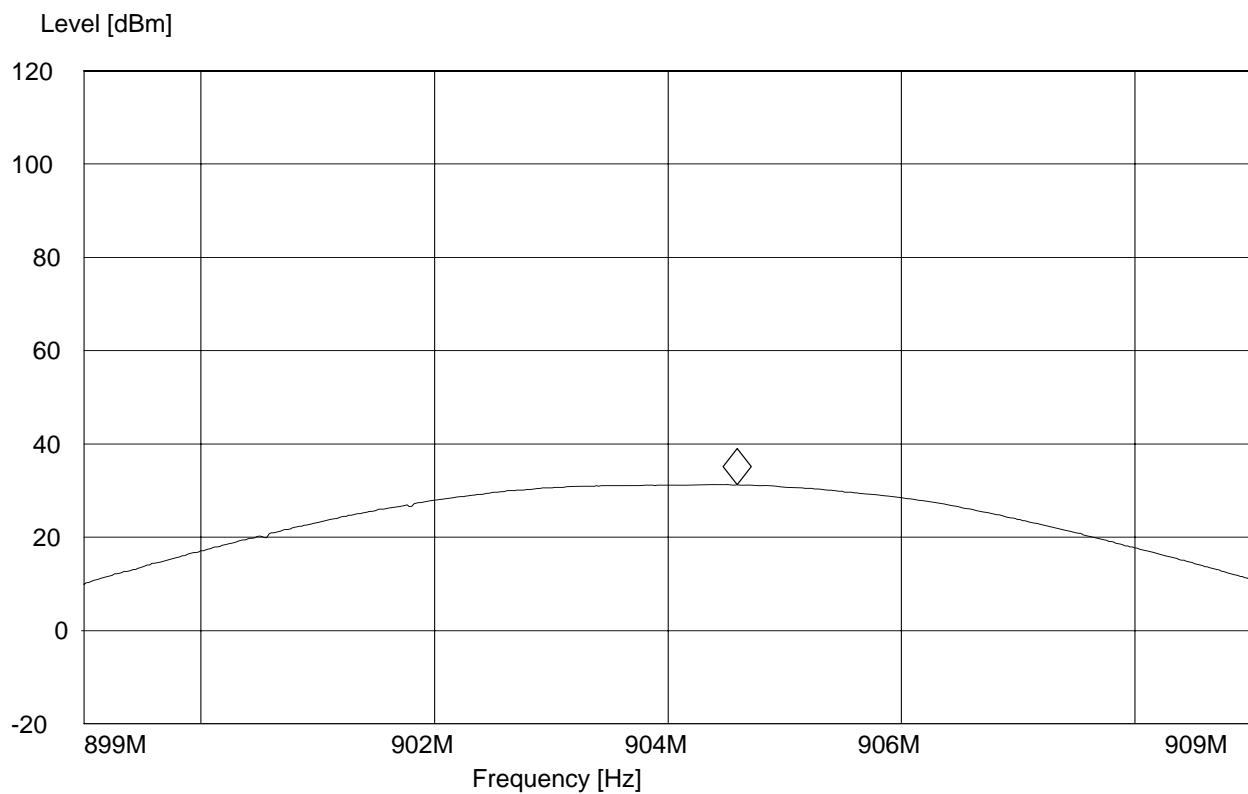
## EIRP LOW CHANNEL

EUT: 900MHz Acoustic Sensor  
 Customer:: Shotspotter  
 Test Mode: 904MHz  
 ANT Orientation: V  
 EUT Orientation: V  
 Test Engineer: Chris  
 Voltage: AC Adapter  
 Comments:

### ***SWEEP TABLE: "EIRP 904MHz V"***

Start	Stop	Detector	Meas.	IF	Transducer
Frequency	Frequency		Time	Bandw.	
899.0 MHz	909.0 MHz	MaxPeak	Coupled	3 MHz	DUMMY-DBM
		MaxPeak			

Marker: 904.591182 MHz 31.24 dBm





**EIRP MIDDLE CHANNEL**

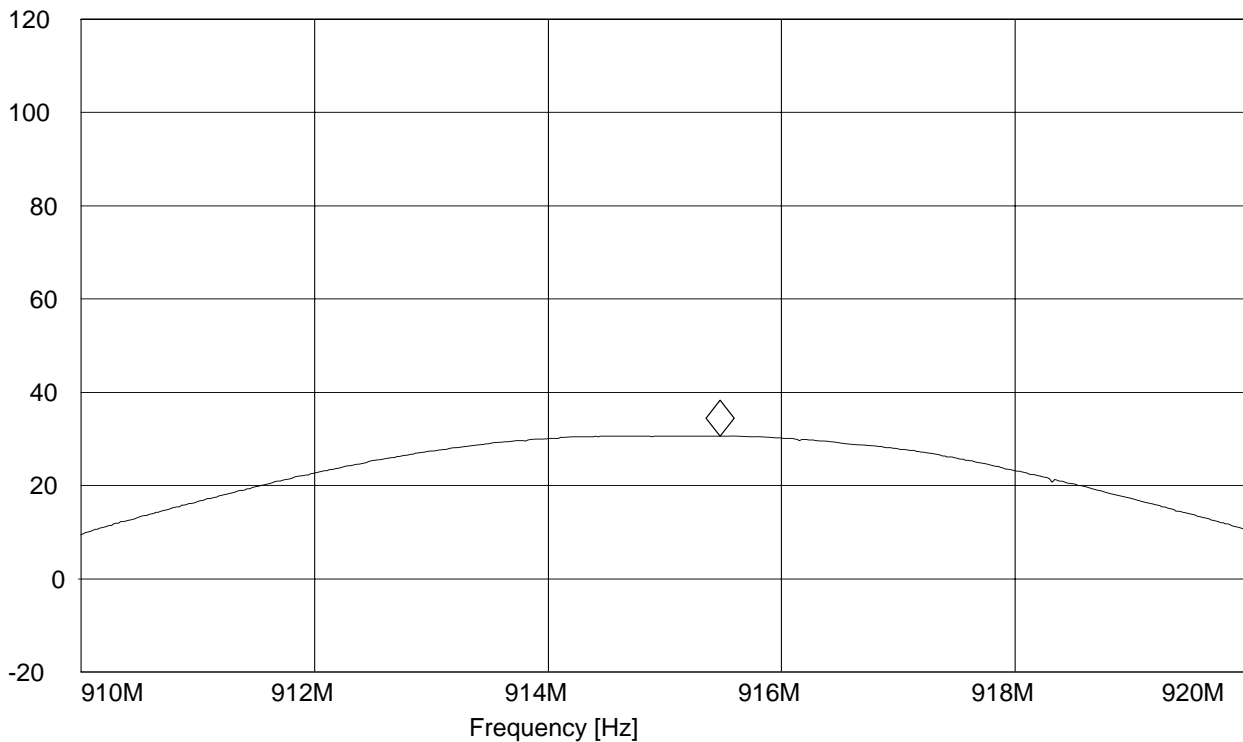
EUT: 900MHz Acoustic Sensor  
Customer:: Shotspotter  
Test Mode: 915MHz  
ANT Orientation: V  
EUT Orientation: V  
Test Engineer: Chris  
Voltage: AC Adapter  
Comments:

***SWEEP TABLE: "EIRP 915MHz V"***

Start	Stop	Detector	Meas.	IF	Transducer
Frequency	Frequency		Time	Bandw.	
910.0 MHz	920.0 MHz	MaxPeak	Coupled	3 MHz	DUMMY-DBM
		MaxPeak			

Marker: 915.470942 MHz 30.6 dBm

Level [dBm]





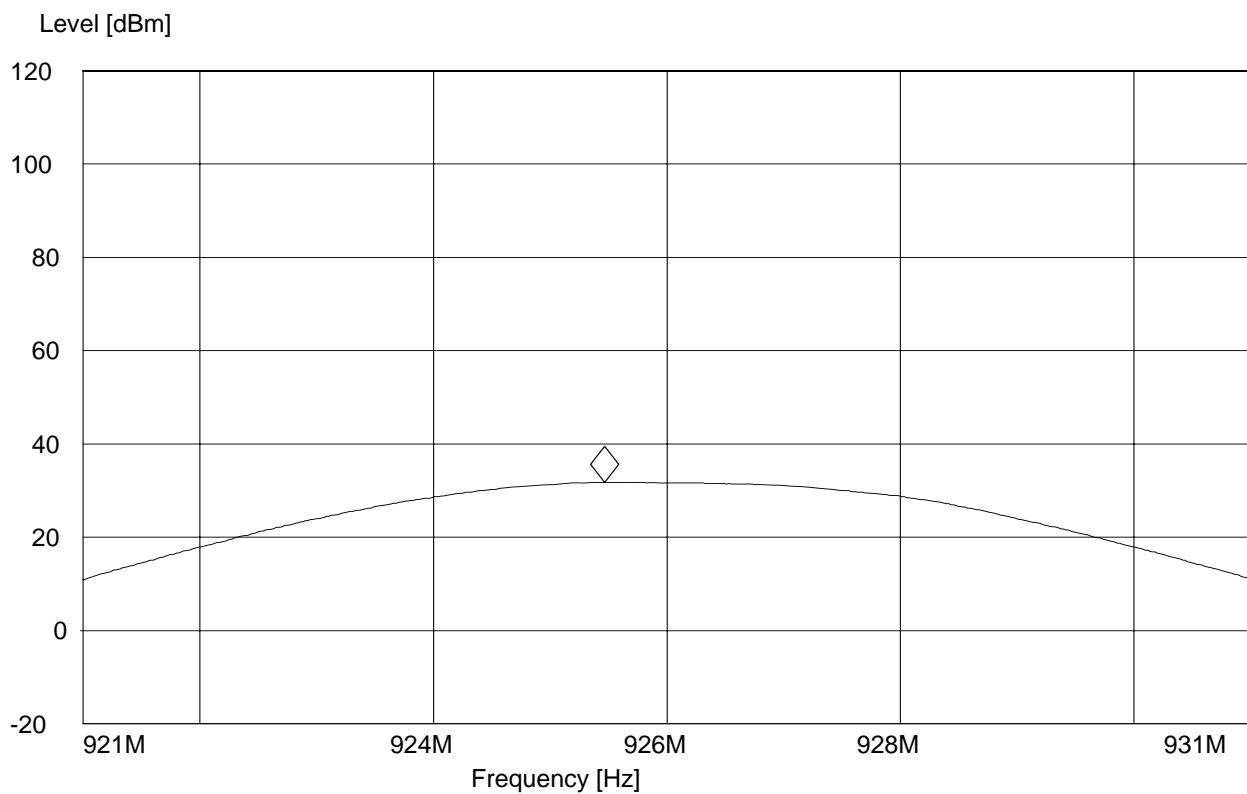
## EIRP HIGH CHANNEL

EUT: 900MHz Acoustic Sensor  
Customer:: Shotspotter  
Test Mode: 926MHz  
ANT Orientation: V  
EUT Orientation: V  
Test Engineer: Chris  
Voltage: AC Adapter  
Comments:

### ***SWEEP TABLE: "EIRP 926MHz V"***

Start	Stop	Detector	Meas.	IF	Transducer
Frequency	Frequency		Time	Bandw.	
921.0 MHz	931.0 MHz	MaxPeak	Coupled	3 MHz	DUMMY-DBM
		MaxPeak			

Marker: 925.468938 MHz 31.73 dBm

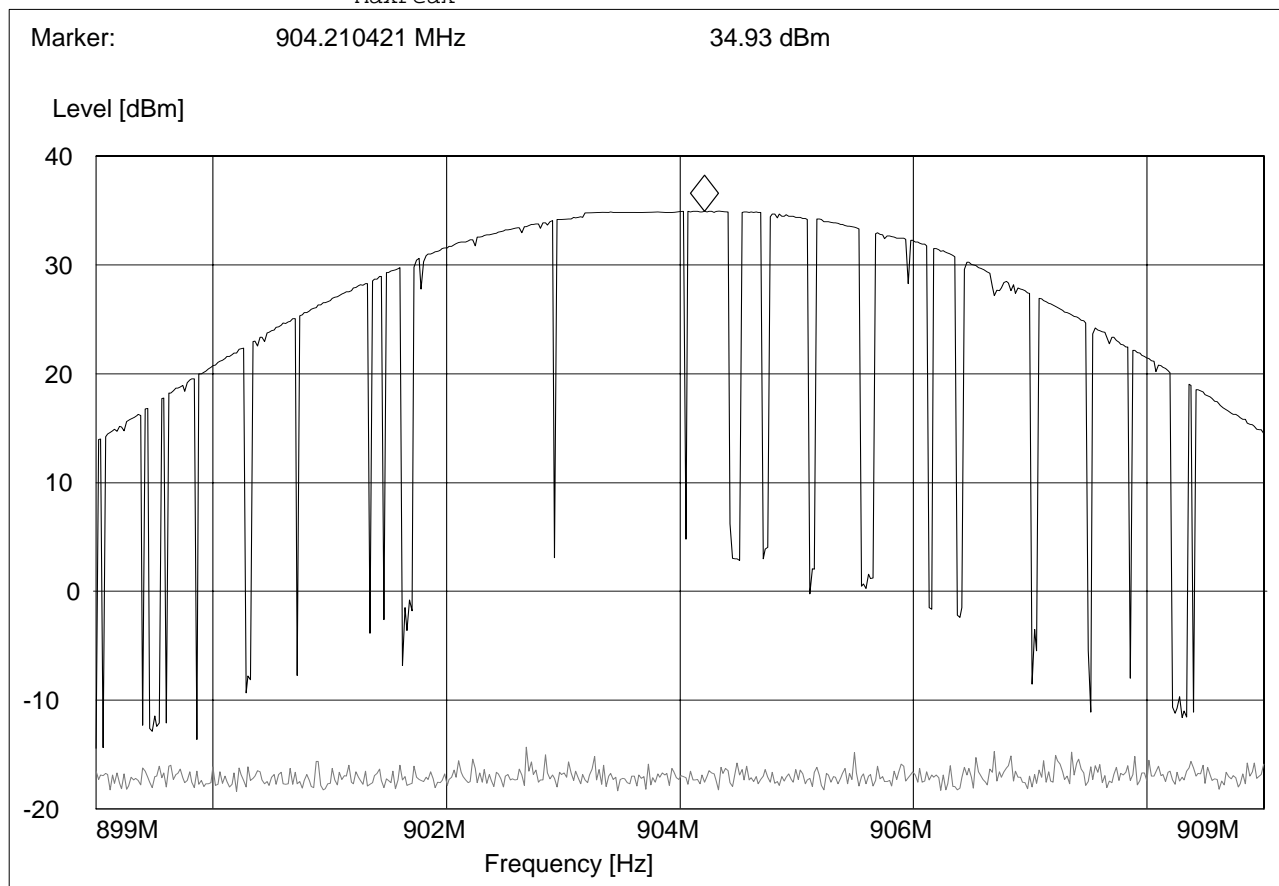


## EIRP LOW CHANNEL

EUT: sensor  
Customer:: shotspotter  
Test Mode: 904mhz  
ANT Orientation: v  
EUT Orientation: H  
Test Engineer: peter  
Voltage: AC  
Comments:

### ***SWEEP TABLE: "EIRP 904MHz V"***

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
899.0 MHz	909.0 MHz	MaxPeak MaxPeak	100.0 ms	3 MHz	DUMMY-DBM

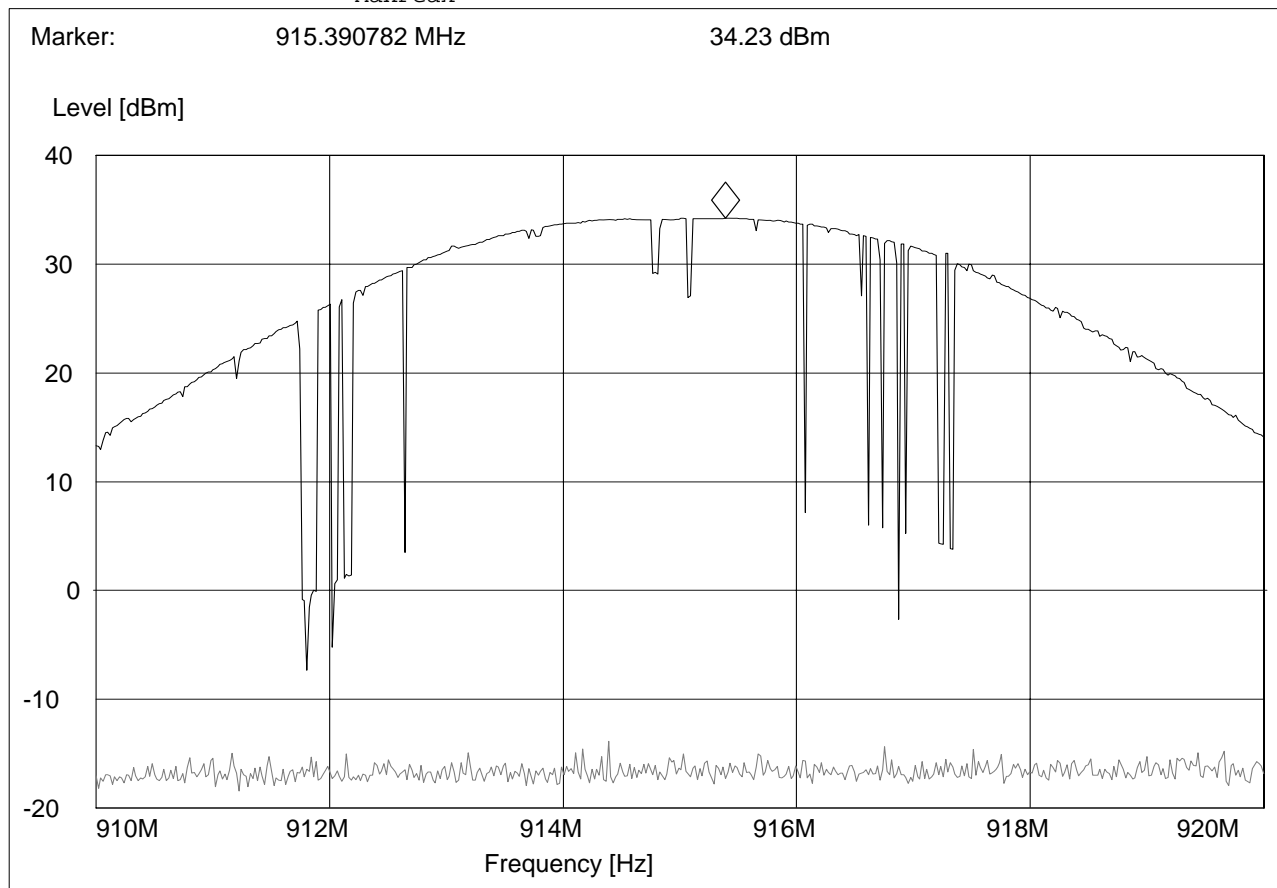


## EIRP MID CHANNEL

EUT: sensor  
Customer:: shotspotter  
Test Mode: 915mhz  
ANT Orientation: v  
EUT Orientation: H  
Test Engineer: peter  
Voltage: AC  
Comments:

### ***SWEEP TABLE: "EIRP 915MHz V"***

Start Frequency	Stop Frequency	Detector MaxPeak	Meas. Time	IF Bandw.	Transducer
910.0 MHz	920.0 MHz	MaxPeak	100.0 ms	3 MHz	DUMMY-DBM

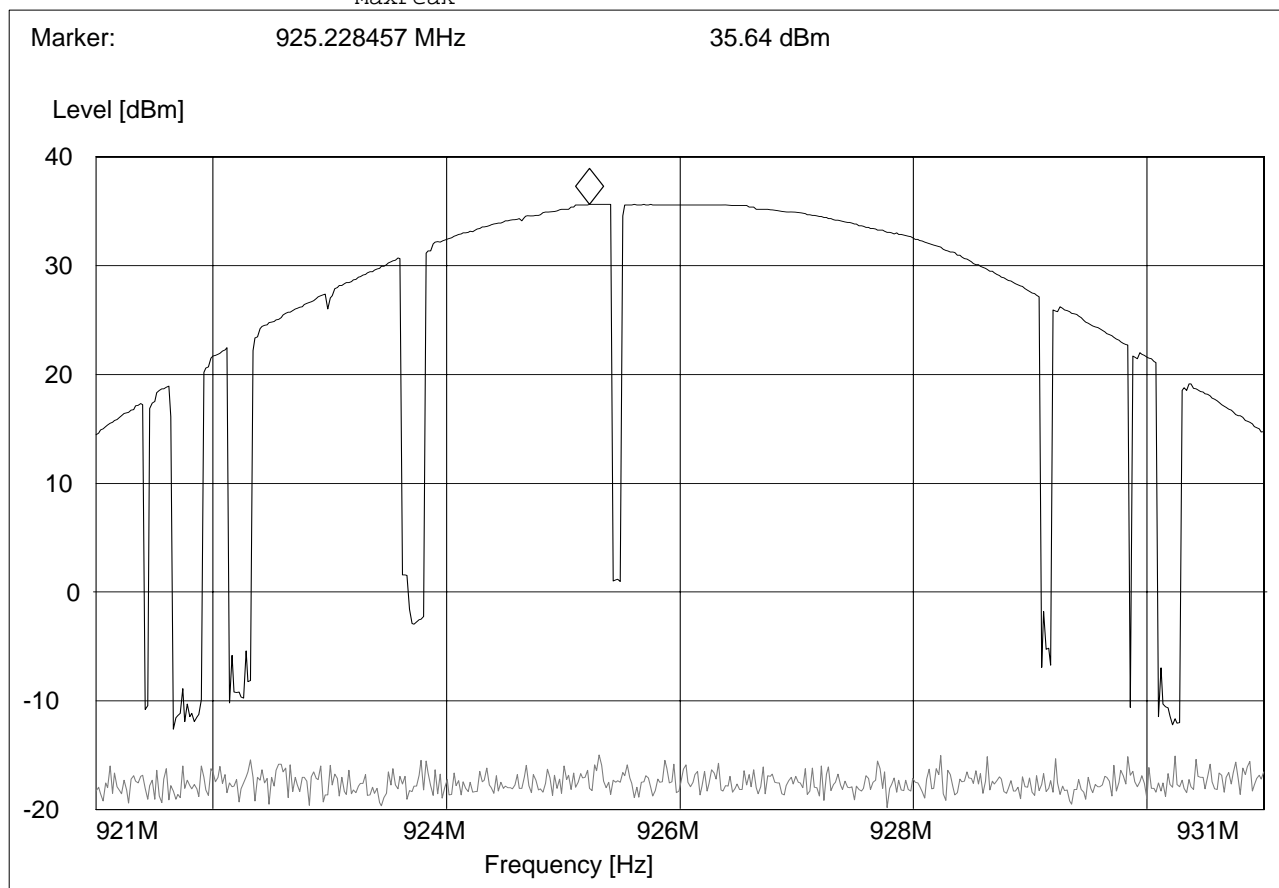


## EIRP HIGH CHANNEL

EUT: sensor  
Customer:: shotspotter  
Test Mode: 926mhz  
ANT Orientation: v  
EUT Orientation: H  
Test Engineer: peter  
Voltage: AC  
Comments:

### ***SWEEP TABLE: "EIRP 926MHz V"***

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
921.0 MHz	931.0 MHz	MaxPeak MaxPeak	Coupled	3 MHz	DUMMY-DBM



## 5.2 TRANSMITTER SPURIOUS EMISSIONS RADIATED § 15.247/15.205/15.209

### 5.2.1 LIMITS

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
<sup>1</sup> 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	( <sup>2</sup> )
13.36 - 13.41			

\*PEAK LIMIT= 74dBuV/m

\*AVG. LIMIT= 54dBuV/m

#### NOTE:

1. The radiated emissions were done with different settings, using the relevant pre-amplifiers for the relevant frequency ranges. This is the reason that the graphs show different noise levels. In the range between 3 and 25 GHz very short cable connections to the antenna was used to minimize the noise level.

2. All measurements are done in peak mode using an average limit, unless specified with the plots.

#### Results for the radiated measurements below 30MHz according § 15.33

Frequency	Measured values	Remarks
9KHz – 30MHz	No emissions found, caused by the EUT	This is valid for all the tested channels

## 5.2.2 RESULTS

### 30MHz – 1GHz

Antenna: vertical

**Note: This plot shows worse case emission for low, mid, and high channel.**

EUT: 900MHz Acoustic Sensor  
Customer:: Shotspotter  
Test Mode: 915MHz  
ANT Orientation: V  
EUT Orientation: V  
Test Engineer: Chris  
Voltage: AC Adapter  
Comments:

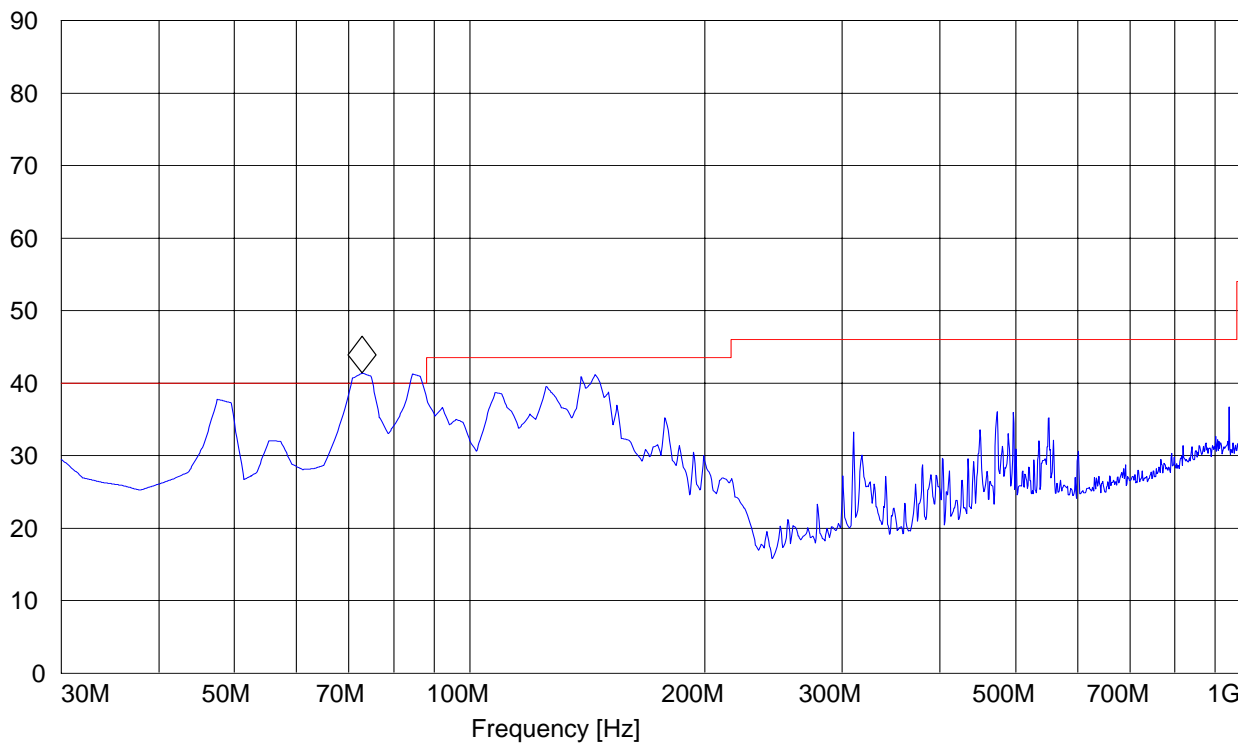
QuasiPeak @ 70.82MHz 36.62 dBuV/m  
QuasiPeak @ 72.77MHz 35.09 dBuV/m  
QuasiPeak @ 74.71MHz 36.87 dBuV/m  
QuasiPeak @ 84.43MHz 38.85 dBuV/m  
QuasiPeak @ 86.37MHz 34.77 dBuV/m

#### ***SWEEP TABLE: "FCC15.247\_30M-1G\_Ver"***

Start	Stop	Detector	Meas.	IF	Transducer
Frequency	Frequency		Time	Bandw.	
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186_Vert

Marker: 72.765531 MHz 41.39 dBuV/m

Level [dBuV/m]



**30MHz – 1GHz**

**Antenna: horizontal.**

**Note: This plot shows worse case emission for low, mid, and high channel.**

EUT: 900MHz Acoustic Sensor  
Customer:: Shotspotter  
Test Mode: 915MHz  
ANT Orientation: H  
EUT Orientation: V  
Test Engineer: Chris  
Voltage: AC Adapter  
Comments:

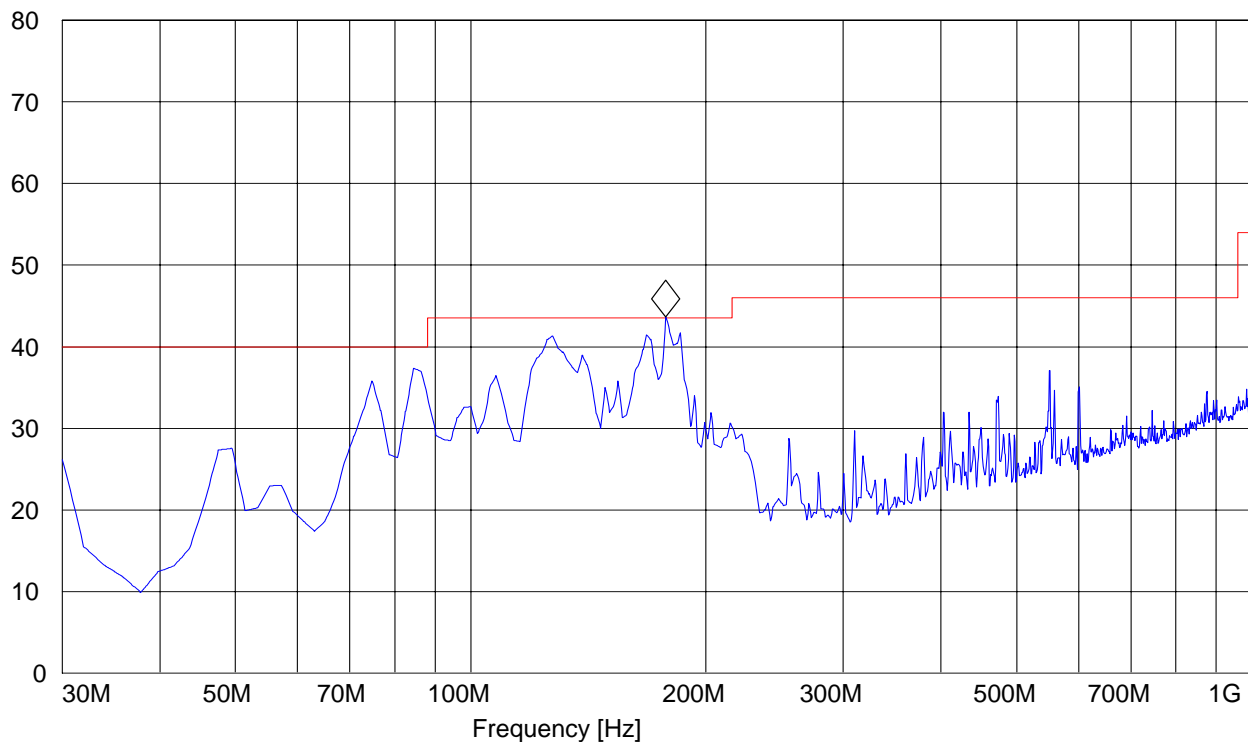
QuasiPeak @ 177.74 37.73 dBuV/m

***SWEEP TABLE: "FCC15.247\_30M-1G\_Hor"***

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186_Horz

Marker: 177.735471 MHz 43.63 dBuV/m

Level [dBuV/m]







### 1-3GHz

**Note: Peak Reading vs. Average limit**

**Note: This plot shows worse case emission for low, mid, and high channel.**

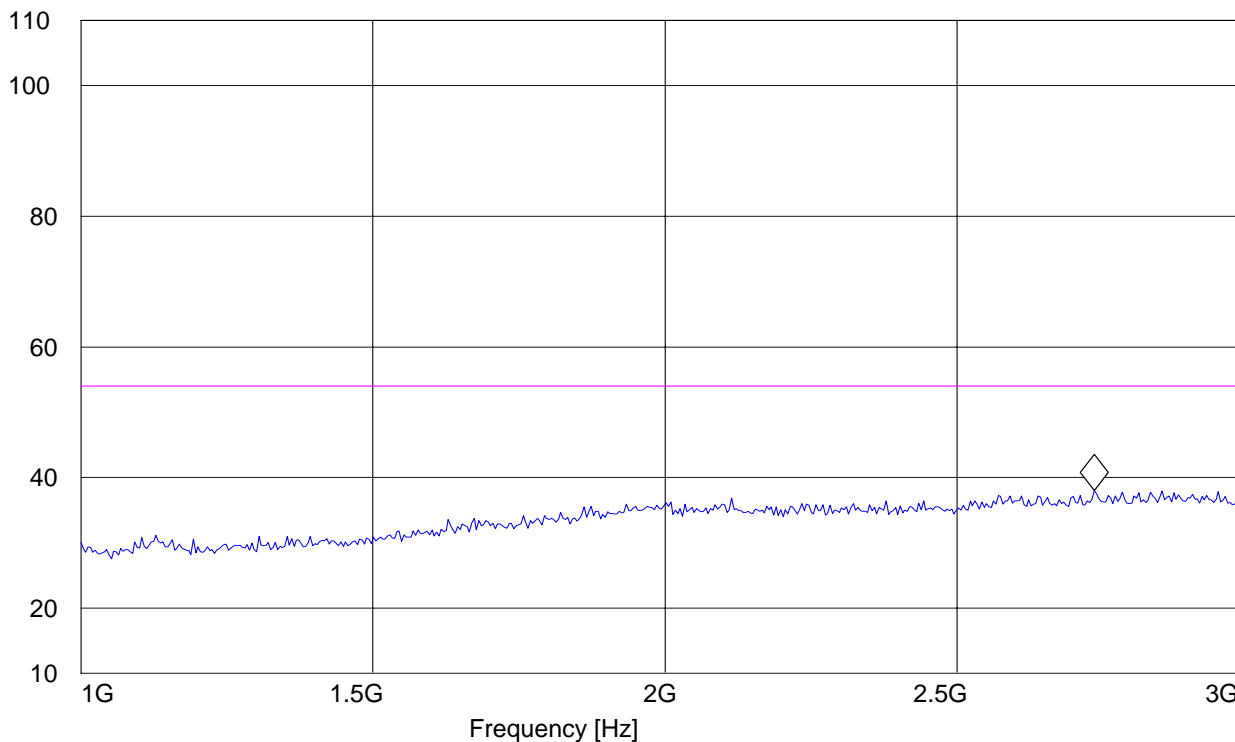
EUT: 900MHz Acoustic Sensor  
Customer:: Shotspotter  
Test Mode: 926MHz  
ANT Orientation: V  
EUT Orientation: V  
Test Engineer: Chris  
Voltage: AC Adapter  
Comments:

#### ***SWEEP TABLE: "FCC15.247\_1-3G"***

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
1.0 GHz	3.0 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_vert

Marker: 2.735470942 GHz 37.95 dB $\mu$ V/m

Level [dB $\mu$ V/m]



### 3-18GHz

**Note: Peak Reading vs. Average limit**

**Note: This plot shows worse case emission for low, mid, and high channel.**

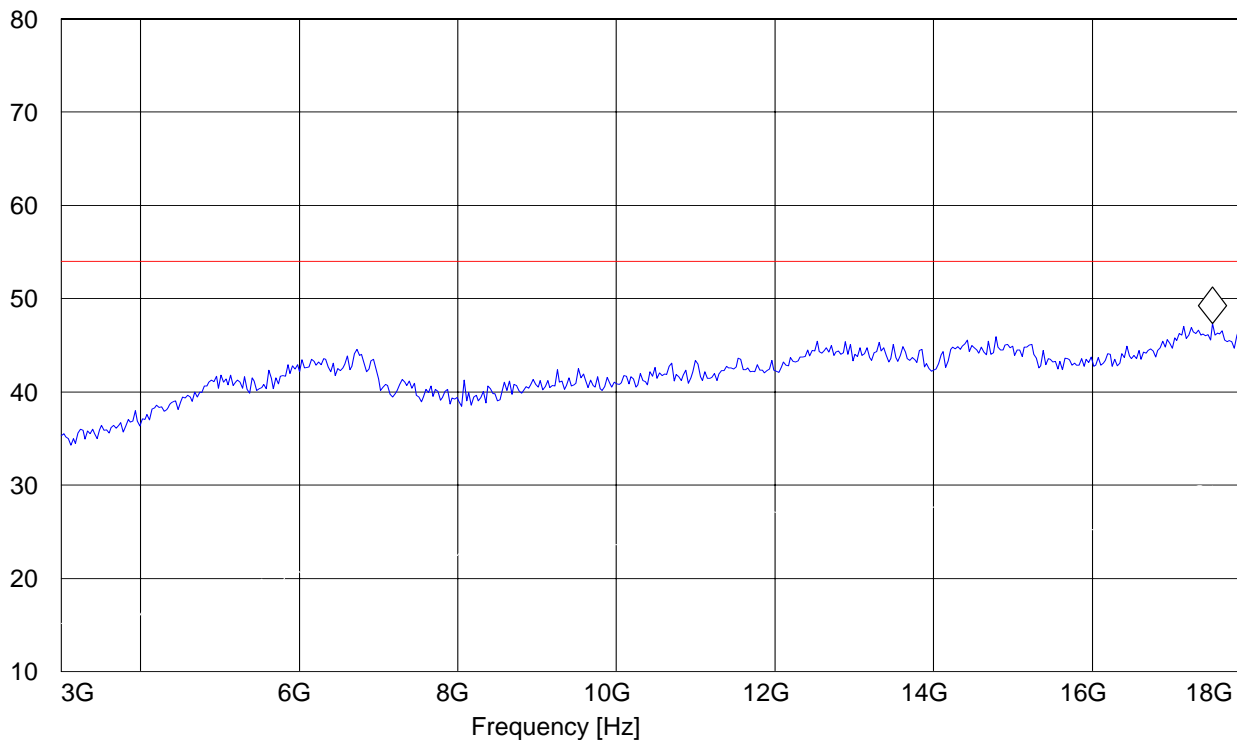
EUT: 900MHz Acoustic Sensor  
Customer:: Shotspotter  
Test Mode: 926MHz  
ANT Orientation: V  
EUT Orientation: V  
Test Engineer: Chris  
Voltage: AC Adapter  
Comments:

#### ***SWEEP TABLE: "FCC15.247\_3-18G"***

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
3.0 GHz	18.0 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_vert

Marker: 17.519038076 GHz 47.29 dBμV/m

Level [dBμV/m]



## **6 Measurements (Conducted)**

### **6.1 MAXIMUM PEAK OUTPUT POWER § 15.247 (CONDUCTED)**

#### **6.1.1 LIMIT SUB CLAUSE § 15.247 (b) (1)**

<b>Frequency range</b>	<b>RF power output</b>
<b>2400-2483.5 MHz</b>	<b>30dBm</b>

**\*limit is based upon antenna gain of less than or equal to 6dBi.**

#### **6.1.2 RESULTS:**

**Test conducted by Compliance Certification Services, 571F Monterey Road, Morgan Hill, CA 95037. Test report date 5/31/2003.**

<b>TEST CONDITIONS</b>	<b>MAXIMUM PEAK OUTPUT POWER (dBm)</b>		
<b>Frequency (MHz)</b>	<b>904</b>	<b>915</b>	<b>926</b>
<b>Antenna Port</b>	<b>24.24</b>	<b>24.56</b>	<b>23.9</b>
<b>Measurement uncertainty</b>	<b>±0.5dBm</b>		

## 6.2 6dB BANDWIDTH

### 6.2.1 LIMIT SUB CLAUSE § 15.247 (a) (2)

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### 6.2.2 RESULTS:

Test conducted by Compliance Certification Services, 571F Monterey Road, Morgan Hill, CA 95037. Test report date 5/31/2003.

TEST CONDITIONS		6dB Bandwidth (MHz)		
Frequency (MHz)		904	915	926
T <sub>nom</sub> (23)°C	V <sub>nom</sub> VDC	1.725	1.713	1.725
Measurement uncertainty		±0.5dBm		

## 6.3 POWER SPECTRAL DENSITY

Test conducted by Compliance Certification Services, 571F Monterey Road, Morgan Hill, CA 95037. Test report date 5/31/2003.

Frequency (MHz)		Power Spectral Density (dBm)		
		904	915	926
T <sub>nom</sub> (23)°C	V <sub>nom</sub> VDC	7.57	7.23	7.80

### LIMITS: Clause 5.2.2

Under normal test conditions only	≤ -20dBW/MHz (10dBm/MHz)
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#### **6.4 TIME OF OCCUPANCY (DWELL TIME)**

##### **6.4.1 LIMIT SUB CLAUSE § 15.247 (a) (1) (i) (ii) (iii)**

<b>FREQUENCY RANGE</b>	<b>AVERAGE TIME OF OCCUPANCY PER 31.6 SECONDS (LIMIT)</b>
<b>2400-2483.5</b>	<b>0.4 SECONDS</b>

##### **6.4.2 RESULTS:**

**Test conducted by Compliance Certification Services, 571F Monterey Road, Morgan Hill, CA 95037. Test report date 5/31/2003. Below assessment and plots are extracted from the test report.**

Plot 1 is the plot of hopping from 904 - 926 (inclusive) step 2 MHz, total 12 channels.

Plot 2 shows the 4.8s sweep on 926MHz, 0 span. (12 hops \* 0.4 = 4.8s)

Plot 3 is the same as above but on 904 MHz.

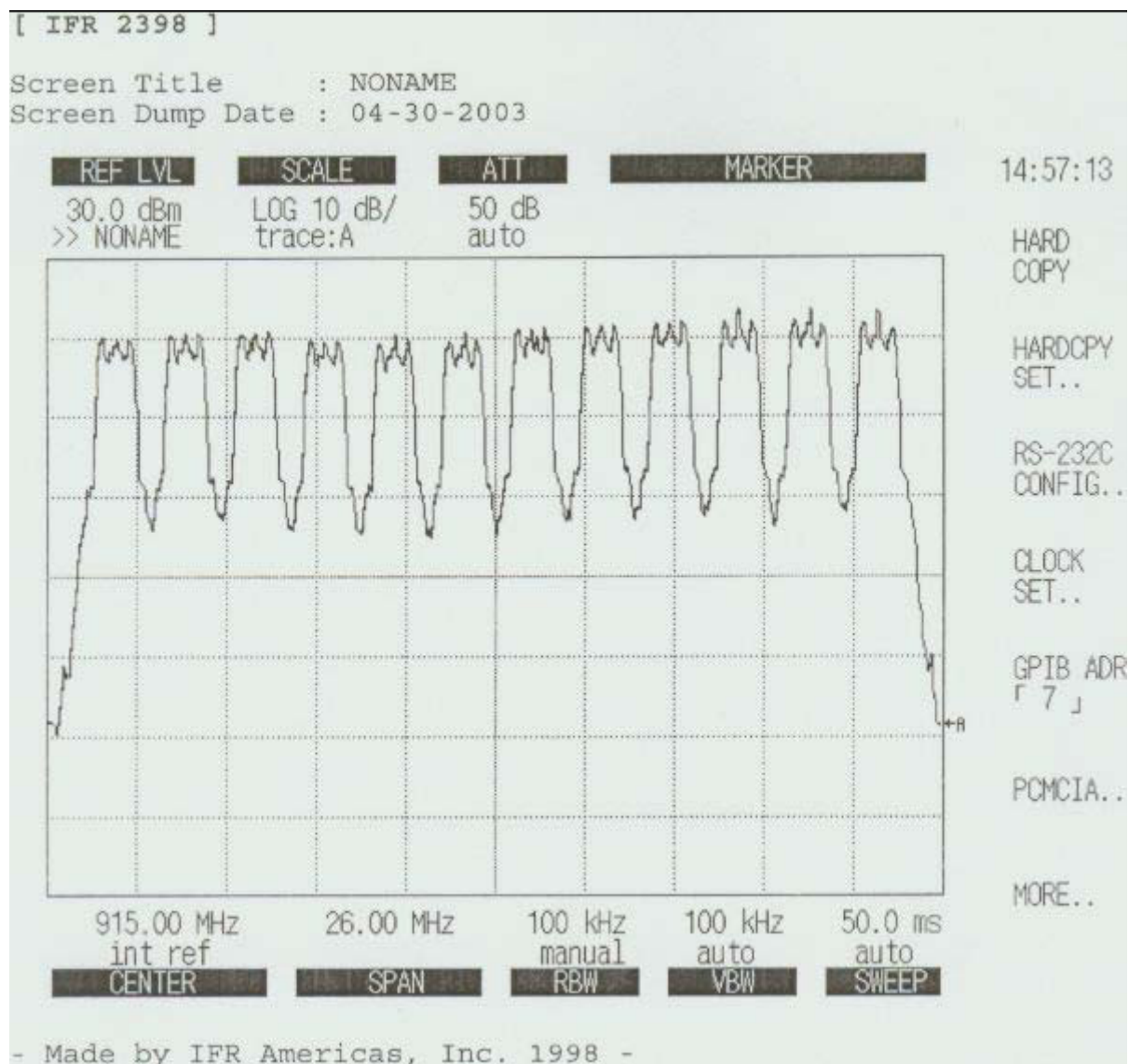
Plot 4 is the same as above but on 916 MHz. (2 - 4 shows the same number of hops and duration of hop per 4.8s period for 3 representative hop channels)

Plot 5 shows the duration of the transmission on the hop as 126mS each. As shown in 2- 4, the average time occupied is 126mS per hop 4.8s period.

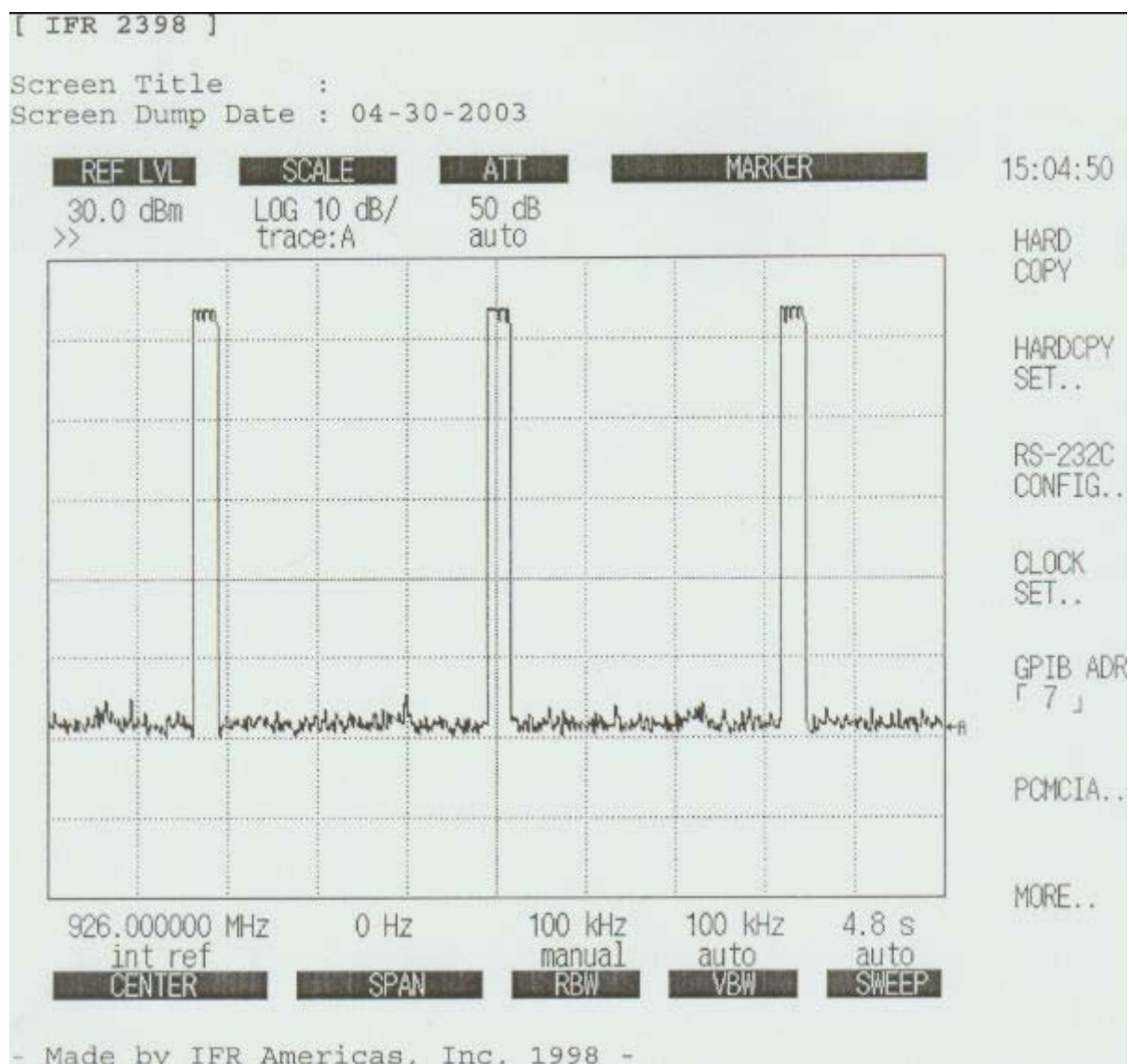
Plot 6 shows hopping on 6 channels, 904 - 914 MHz.

Plot 7 shows the same average time occupied for the 2.4s period (6 hops \* 0.4s = 2.4s)  
is the same as for 12 hop

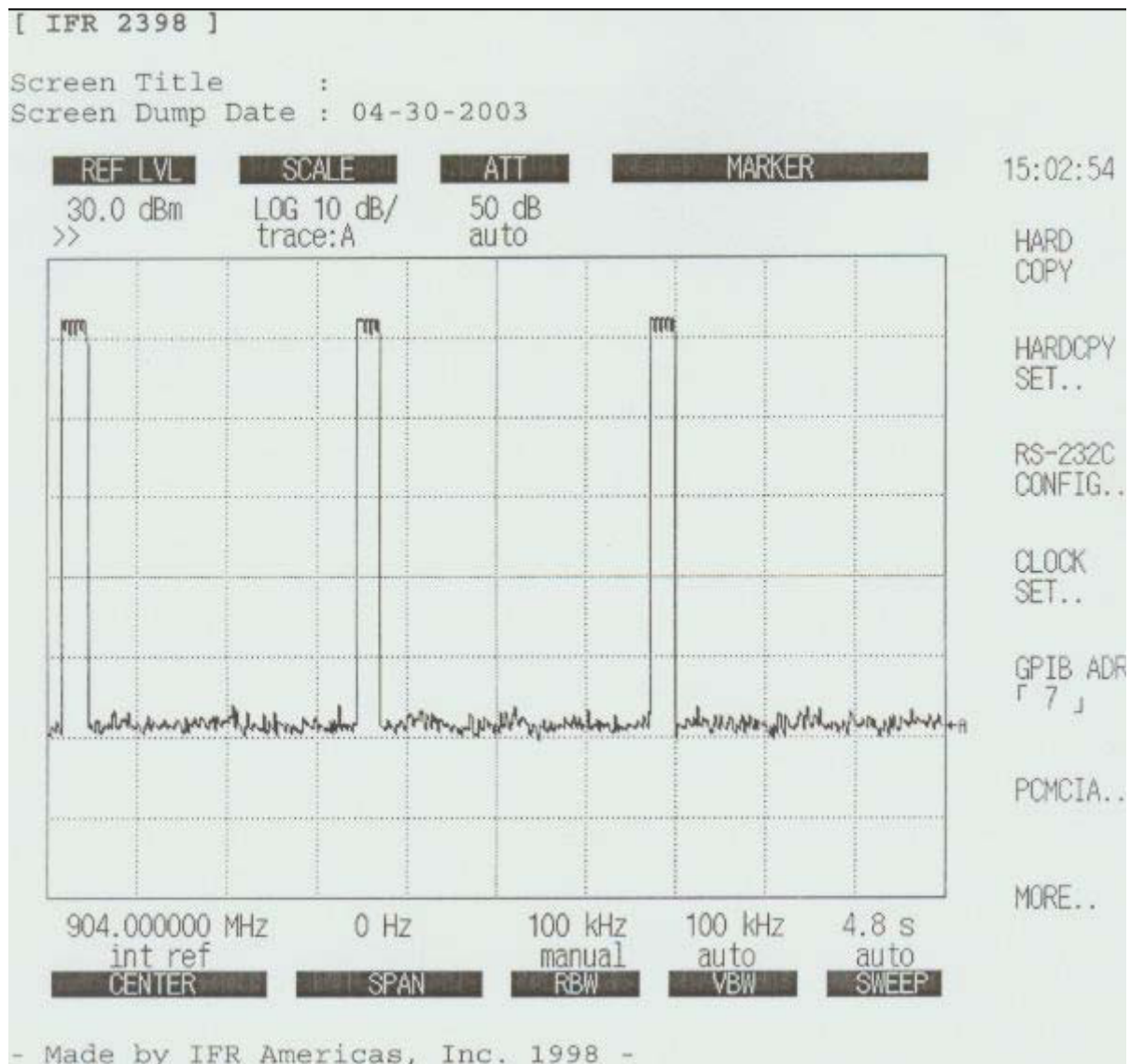
**Plot 1**



**Plot 2**

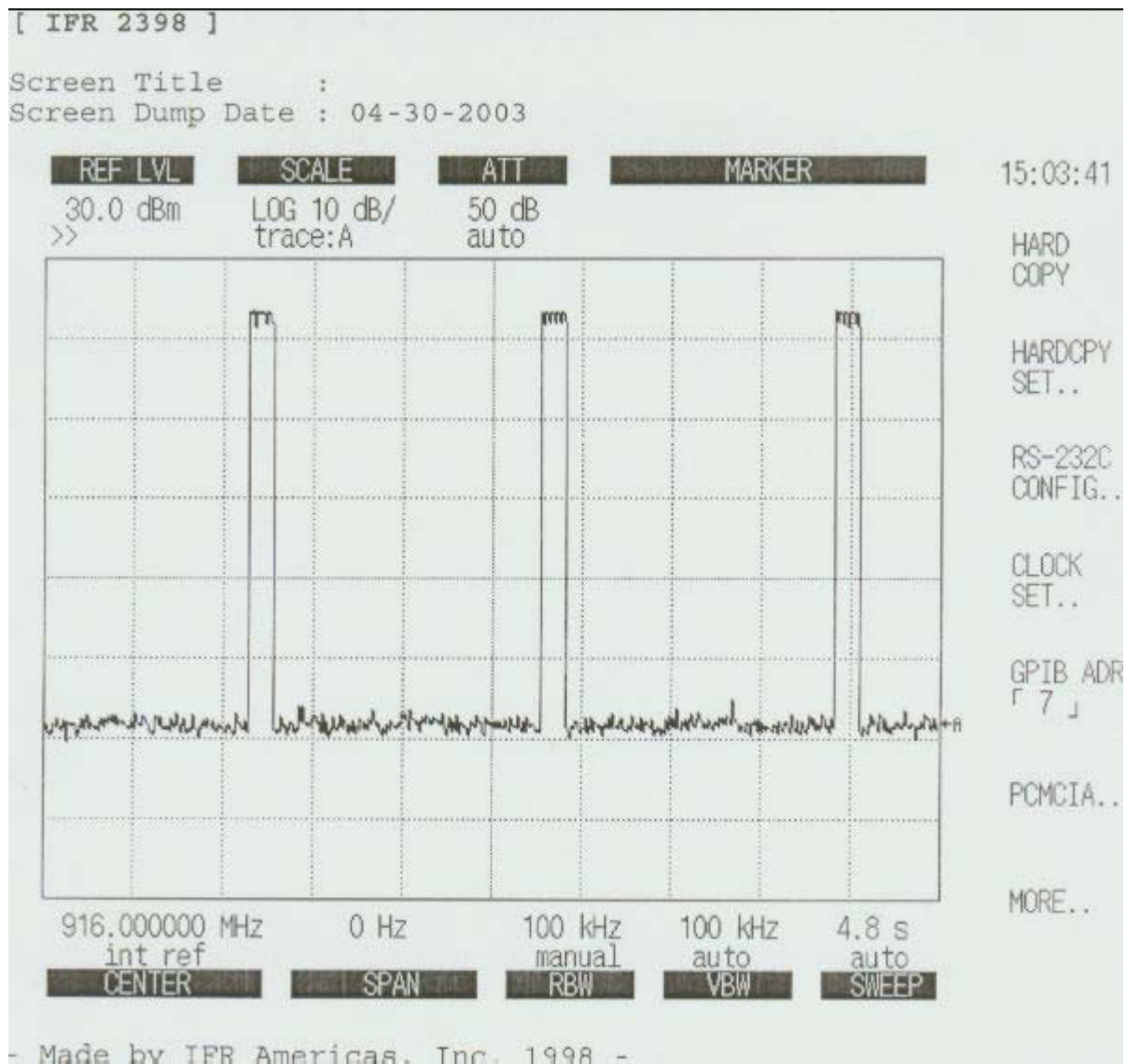


**Plot 3**

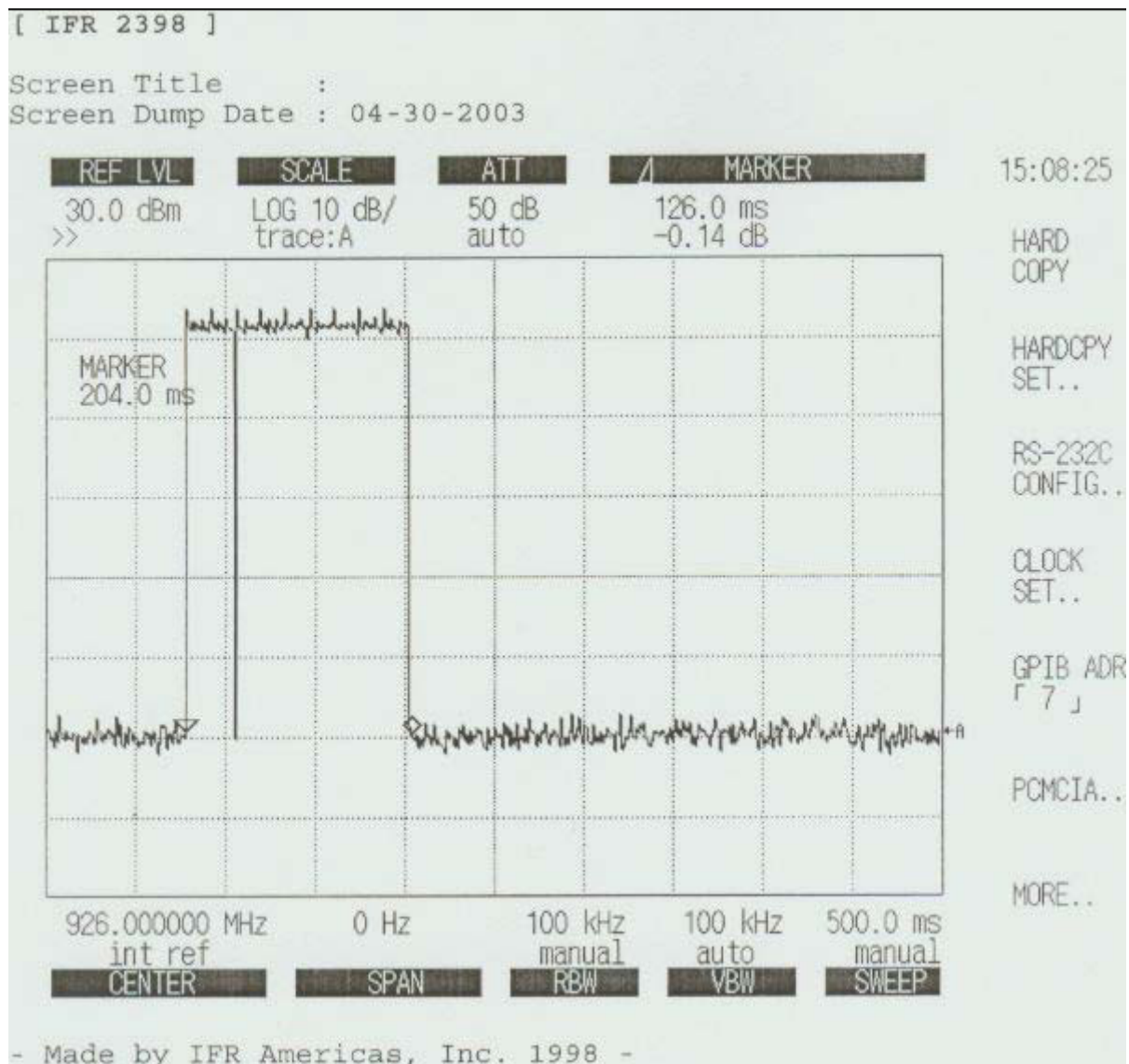




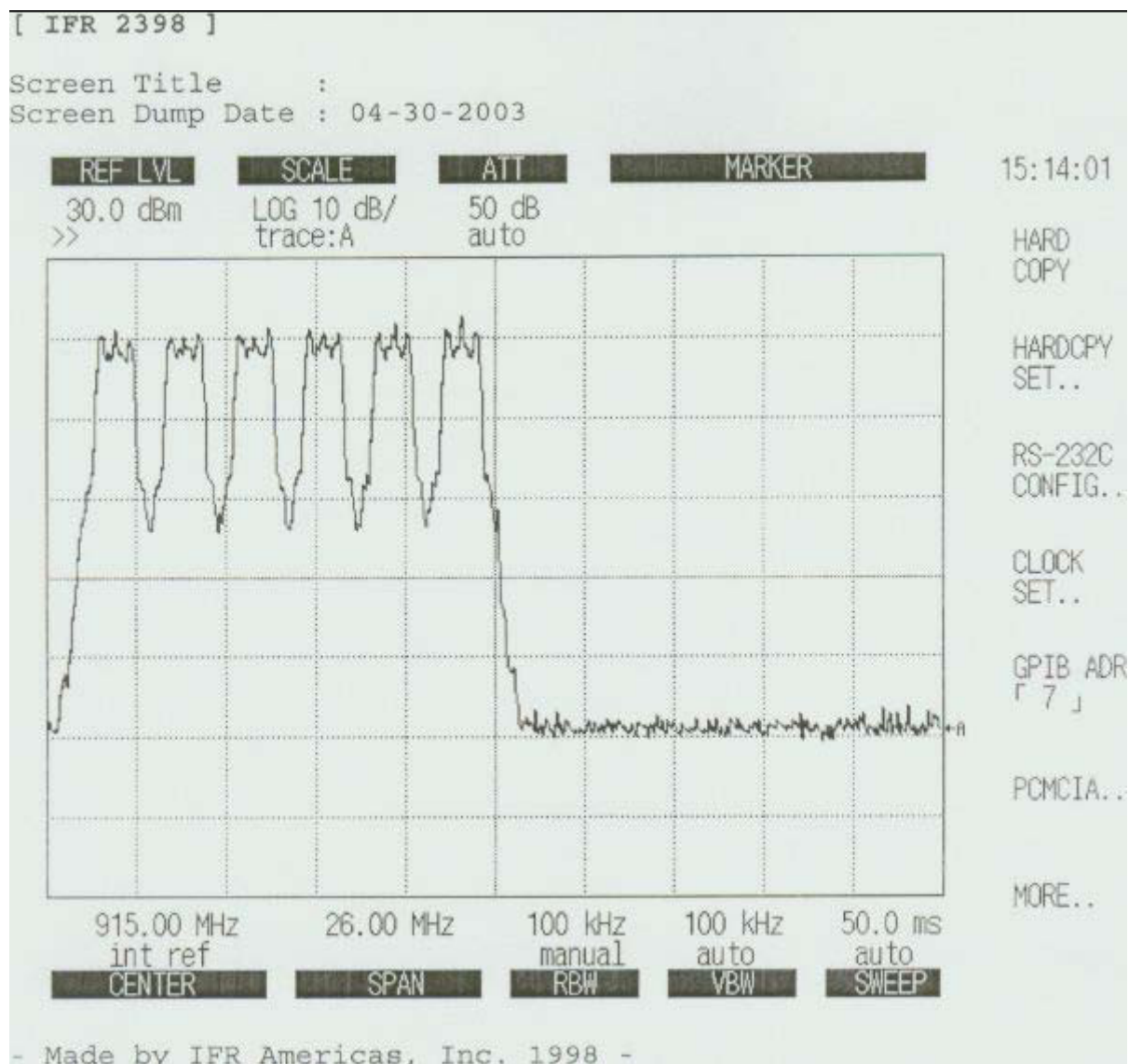
**Plot 4**



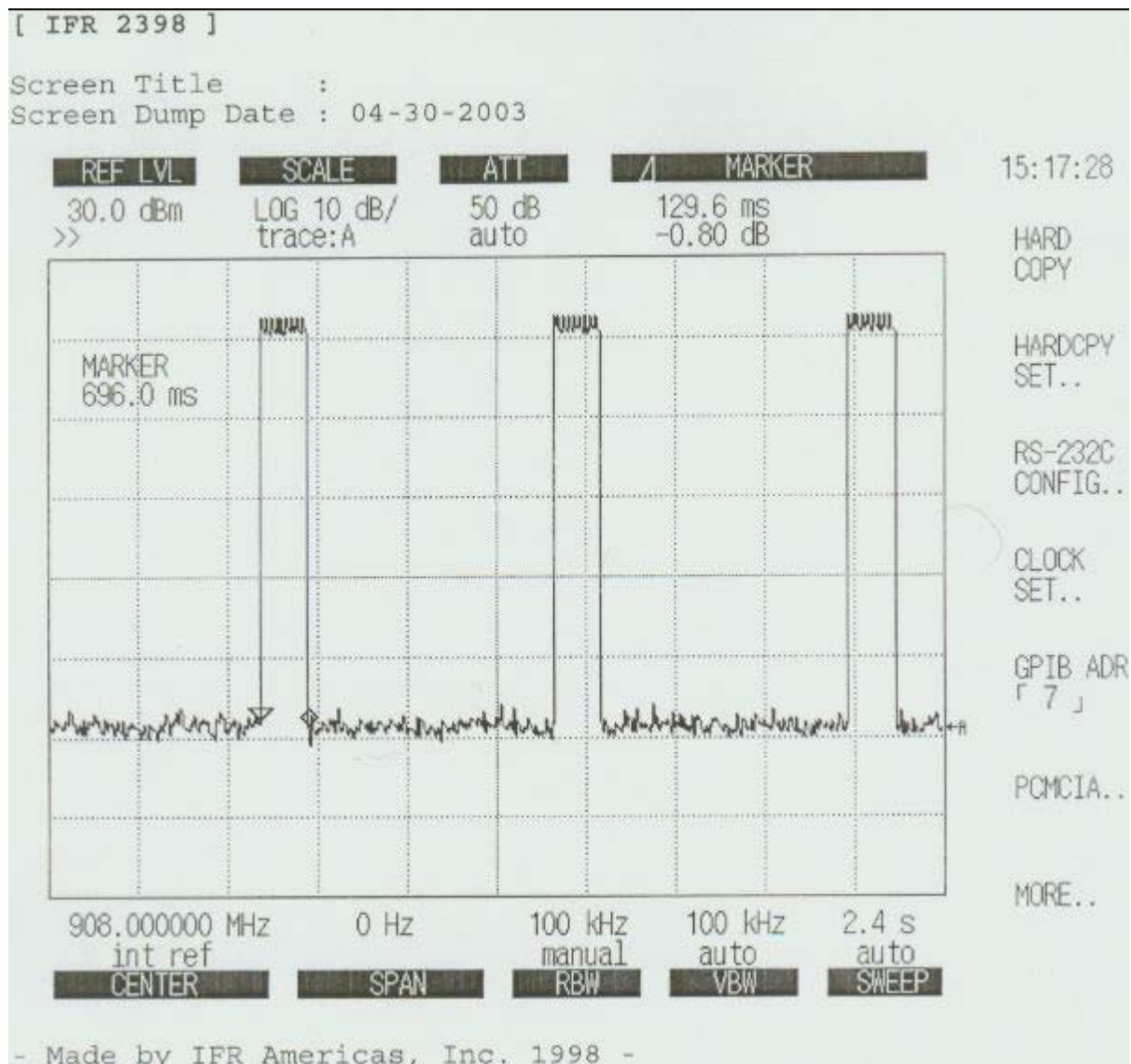
**Plot 5**



**Plot 6**



**Plot 7**



## **6.5 CONDUCTED SPURIOUS EMISSION**

### **6.5.1 LIMIT SUB CLAUSE § 15.247 (d)**

<b>FREQUENCY RANGE</b>	<b>limit</b>
<b>30M-25GHz</b>	<b>-20dBc</b>

**6.5.2 RESULTS:** Out of band emission is well below -20dBc limit.

## **6.6 AC POWER LINE CONDUCTED EMISSIONS § 15.107/207**

### **6.6.1 LIMITS**

**Technical specification: 15.107 / 15.207 (Revised as of August 20, 2002)**

#### **Limit**

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-Peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50
* Decreases with logarithm of the frequency		

**ANALYZER SETTINGS: RBW = 10KHz**

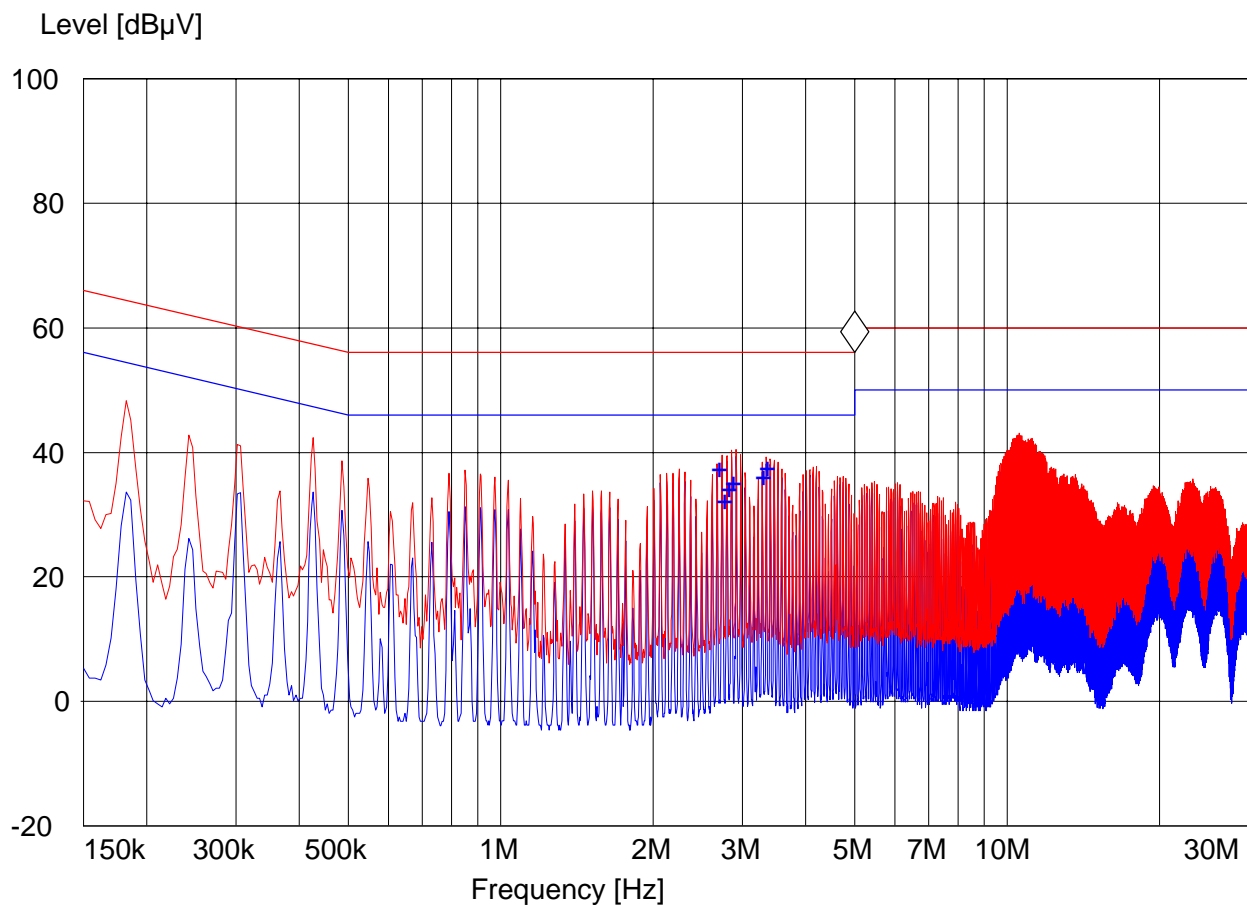
**VBW = 10KHz**

## 6.6.2 Test Results:

### Results TX Line

EUT: 900MHz Acoustic Sensor  
Manufacturer: Shotspotter  
Test Mode: 904 MHz  
ANT Orientation:: LISN  
EUT Orientation:: H  
Test Engineer:: Marc  
Power Supply: : 120V  
Comments: : Line

Marker: 5 MHz 56 dBμV

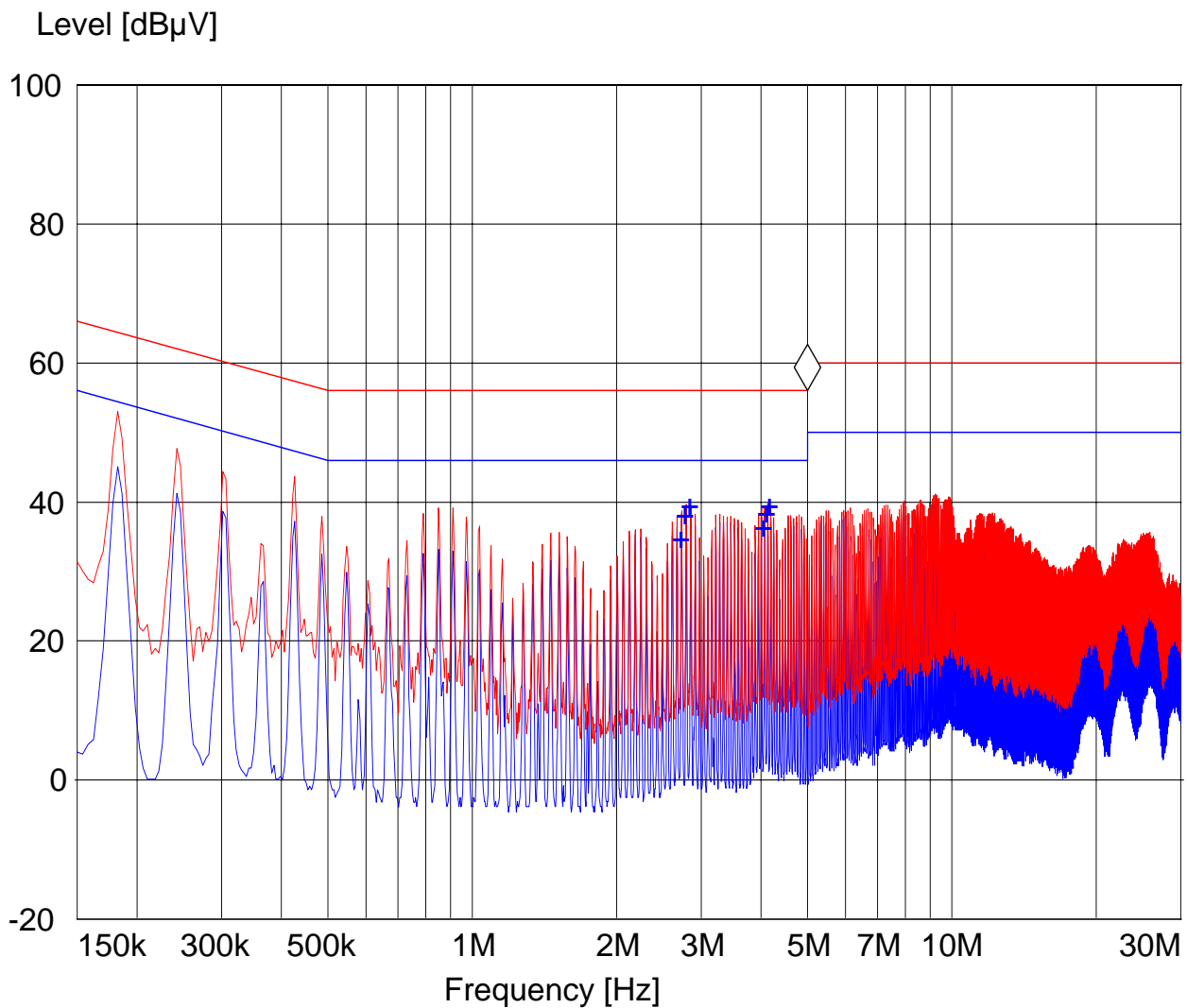


+ MES 55022 V AV Avg1  
— MES 55022 cond MaxPk  
— MES 55022 cond Avg  
— LIM EN 55022 V QP Voltage QP Limit  
— LIM EN 55022 V AV Voltage AV Limit

### Results TX Neutral

EUT: 900MHz Acoustic Sensor  
Manufacturer: Shotspotter  
Test Mode: 904 MHz  
ANT Orientation:: LISN  
EUT Orientation:: H  
Test Engineer:: Marc  
Power Supply: : 120V  
Comments: : Neutral

Marker: 5 MHz 56 dB $\mu$ V



+ MES 55022 V AV Avg1  
— MES 55022 cond MaxPk  
— MES 55022 cond Avg  
— LIM EN 55022 V QP Voltage QP Limit  
— LIM EN 55022 V AV Voltage AV Limit



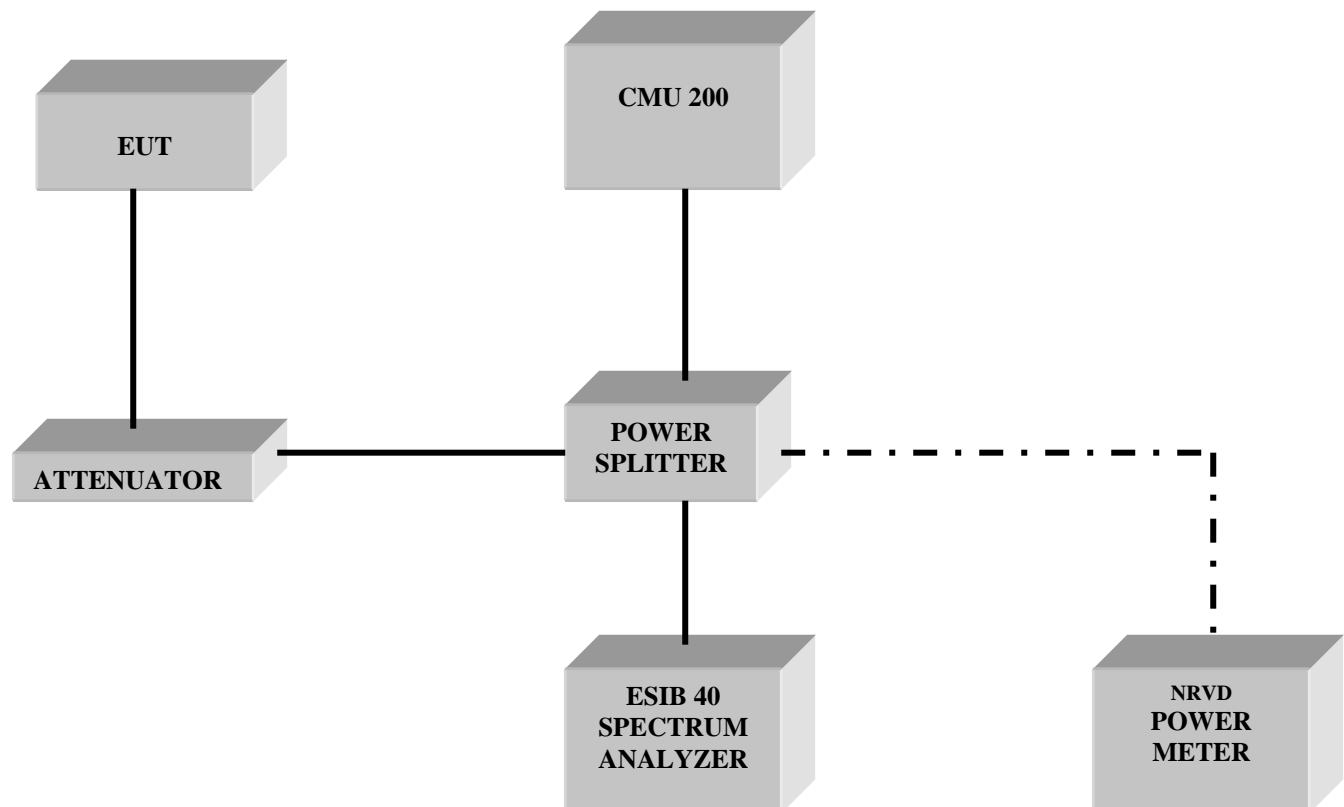
**7 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS**

No	Instrument/Ancillary	Type	Manufacturer	Serial No.	Cal Due	Interval
01	Spectrum Analyzer	ESIB 40	Rohde & Schwarz	100107	May 2009	1 year
02	Spectrum Analyzer	FSEM 30	Rohde & Schwarz	100017	May 2009	1 year
03	Signal Generator	SMY02	Rohde & Schwarz	836878/011	May 2009	1 year
04	Power-Meter	NRVD	Rohde & Schwarz	0857.8008.02	May 2009	1 year
05	Biconilog Antenna	3141	EMCO	0005-1186	June 2009	1 year
06	Horn Antenna (1-18GHz)	SAS-200/571	AH Systems	325	June 2009	1 year
07	Horn Antenna (18-26.5GHz)	3160-09	EMCO	1240	June 2009	1 year
08	Power Splitter	11667B	Hewlett Packard	645348	n/a	n/a
09	Climatic Chamber	VT4004	Voltsch	G1115	May 2009	1 year
10	High Pass Filter	5HC2700	Trilithic Inc.	9926013	n/a	n/a
11	High Pass Filter	4HC1600	Trilithic Inc.	9922307	n/a	n/a
12	Pre-Amplifier	JS4-00102600	Miteq	00616	May 2009	1 year
13	Power Sensor	URV5-Z2	Rohde & Schwarz	DE30807	May 2009	1 year
14	Digital Radio Comm. Tester	CMD-55	Rohde & Schwarz	847958/008	May 2009	1 year
15	Universal Radio Comm. Tester	CMU 200	Rohde & Schwarz	832221/06	May 2009	1 year
16	LISN	ESH3-Z5	Rohde & Schwarz	836679/003	May 2009	1 year
17	Loop Antenna	6512	EMCO	00049838	July 2010	2 years



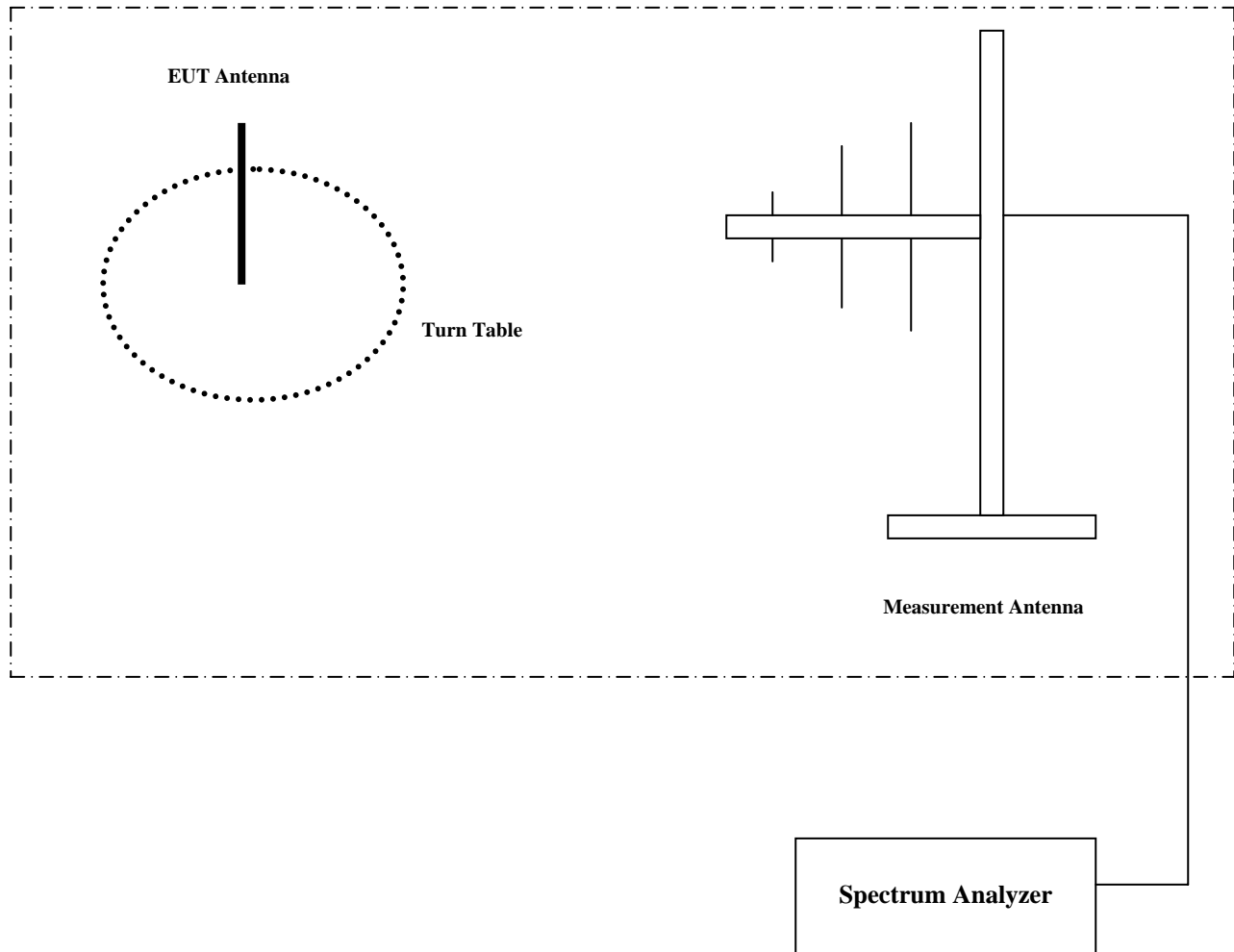
## 8 BLOCK DIAGRAMS

### Conducted Testing



## Radiated Testing

### ANECHOIC CHAMBER



## **9 REPORT HISTORY**

2008-11-11: First issue.

2009-2-5: Revision 1. Added conducted measurement data.