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

DATE: 2008-11-11

Certificate # 2135.01

Bluetooth Qualification Test Facility (BQTF)

LAB CODE 20020328-00

FCC listed
A2LA Accredited

IC recognized # 3462B

***CETECOM* Inc.**
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CETECOM Inc. is a Delaware Corporation with Corporation number: 2113686
Board of Directors: Dr. Harald Ansorge, Dr. Klaus Matkey, Hans Peter May

TABLE OF CONTENTS

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:

Date	Section	Name	Signature
2008-11-11	EMC & Radio	Lothar Schmidt (Director Regulatory and Antenna Services)	Lothar Schmidt I am approving this document

This report is prepared by:

Date	Section	Name	Signature
2008-11-11	EMC & Radio	Peter Mu (EMC Project Engineer)	Peter Mu

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

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

2.2 Identification of the Client

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

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

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

3.2 Identification of the Equipment Under Test (EUT)

EUT #	TYPE	MODEL	SERIAL #
1	**EUT**	**L3ALV900**	**L3B-00-B36-0556**

3.3 Identification of Accessory equipment

AE #	TYPE	MODEL
1	AC Adapter Power Supply	MDR-20-12

4 Subject Of Investigation

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.

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.

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_{nom}(23)°C	V_{nom}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_{nom}(23)°C	V_{nom}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.

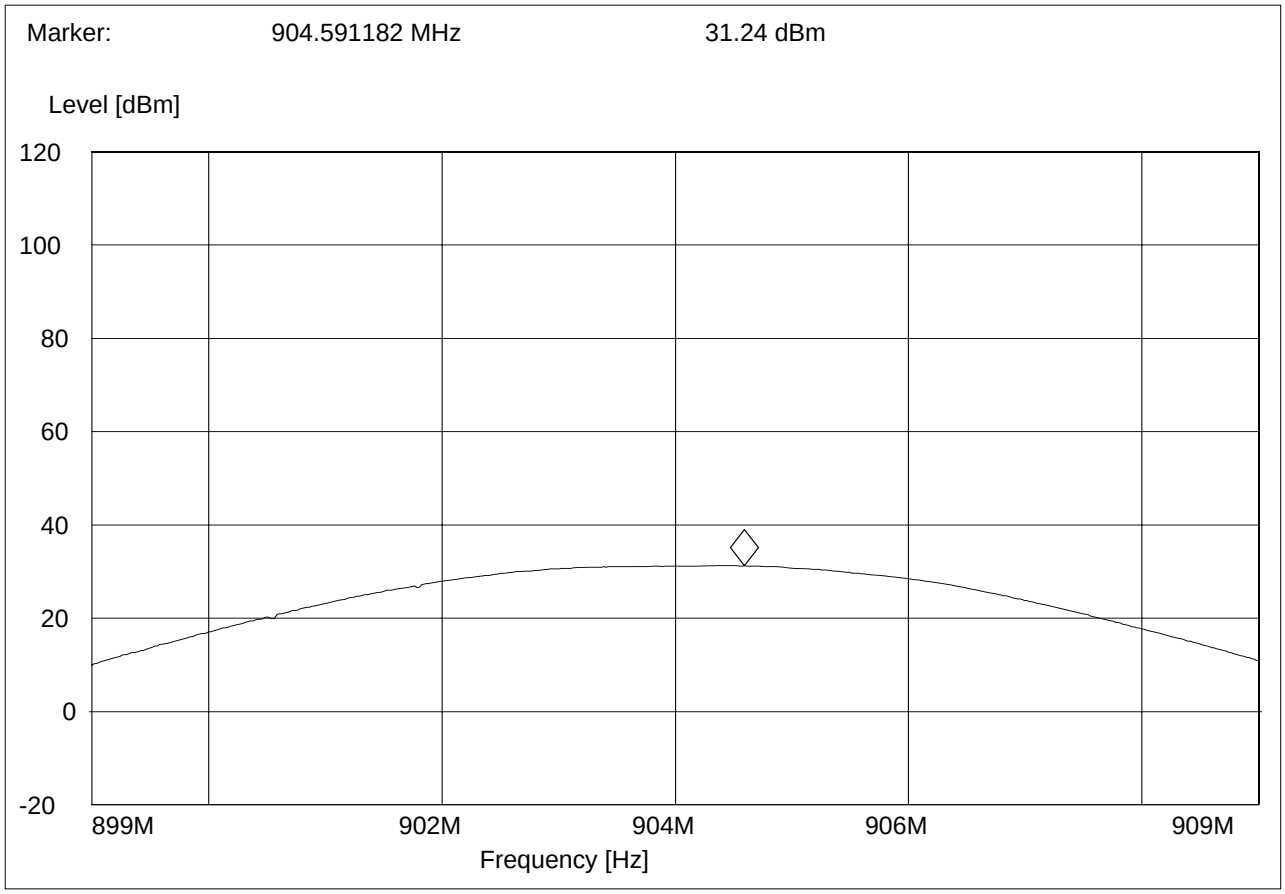
Test conducted with EUT operating at 1.5dBm higher than normal operation as a built-in safety margin per applicant's request. Thus EIRP under normal operation can only be lower than what is measured and all emission should also comply with applicable FCC requirements.

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

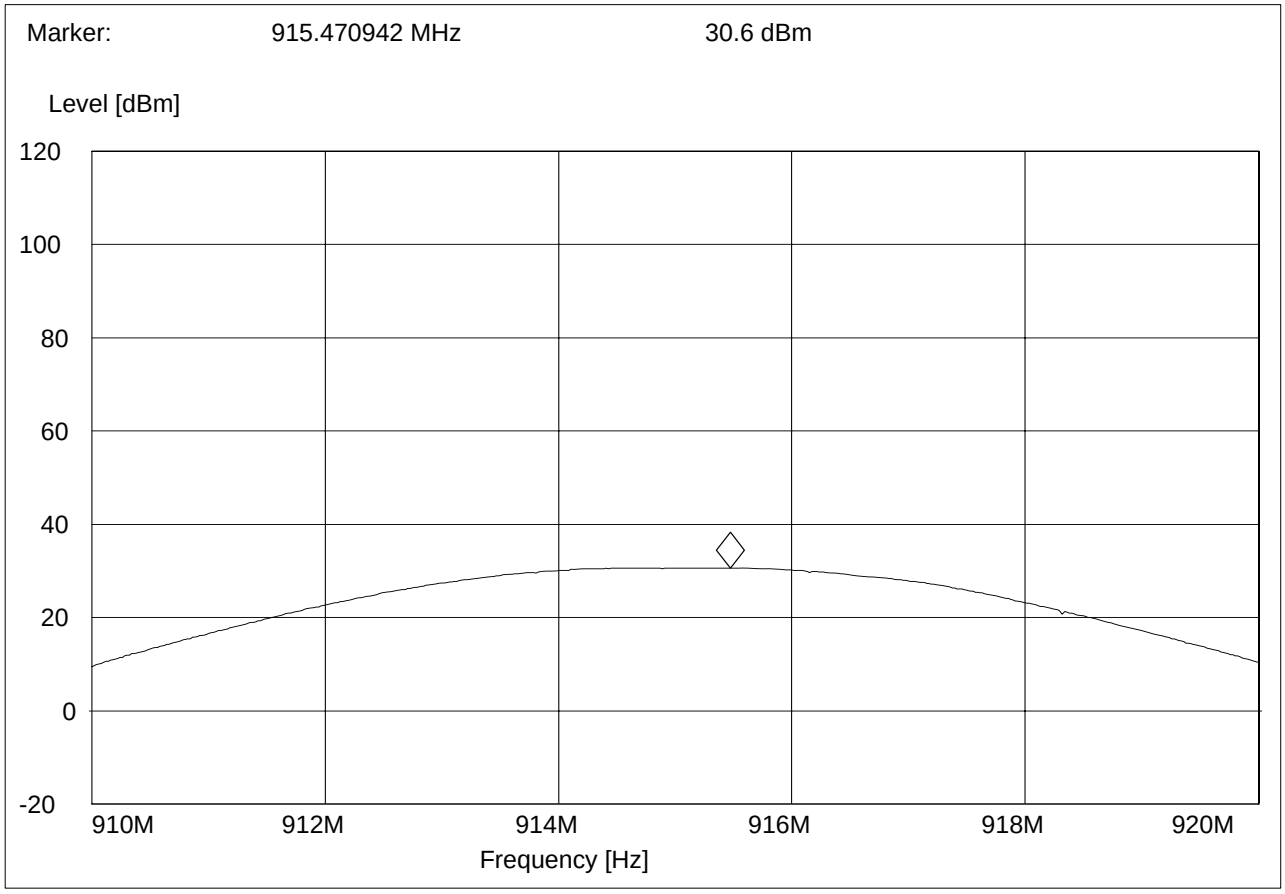


EIRP MIDDLE CHANNEL

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

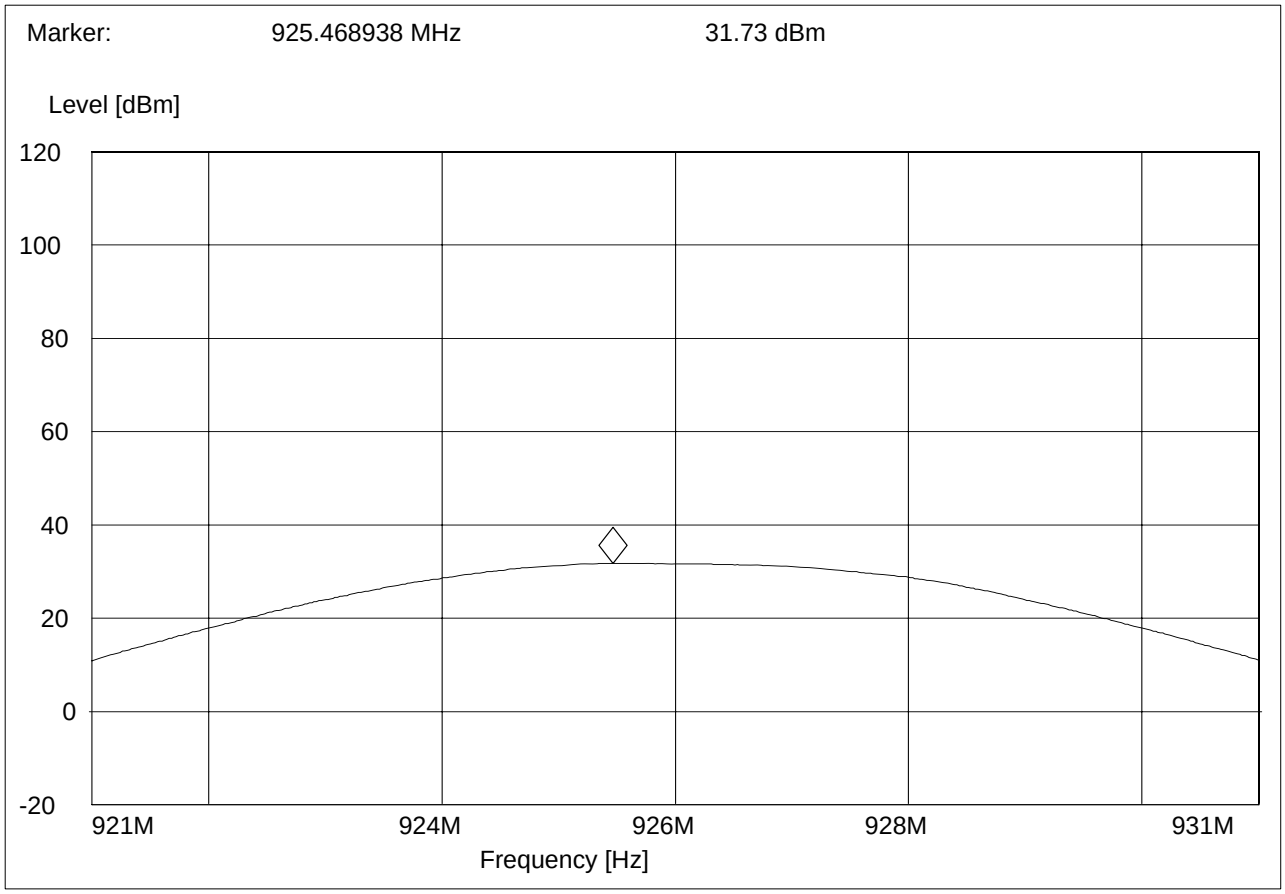


EIRP HIGH CHANNEL

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

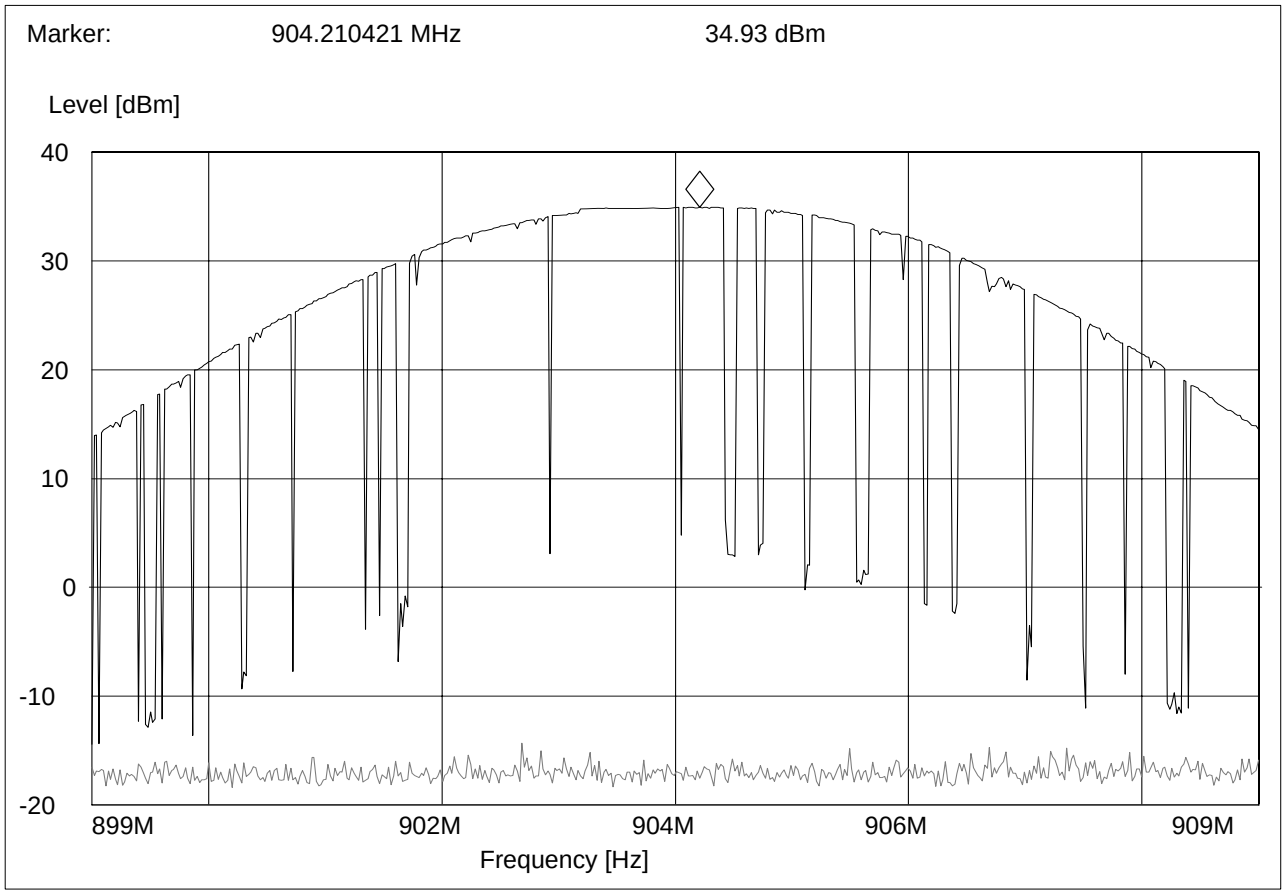


EIRP LOW CHANNEL

```
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

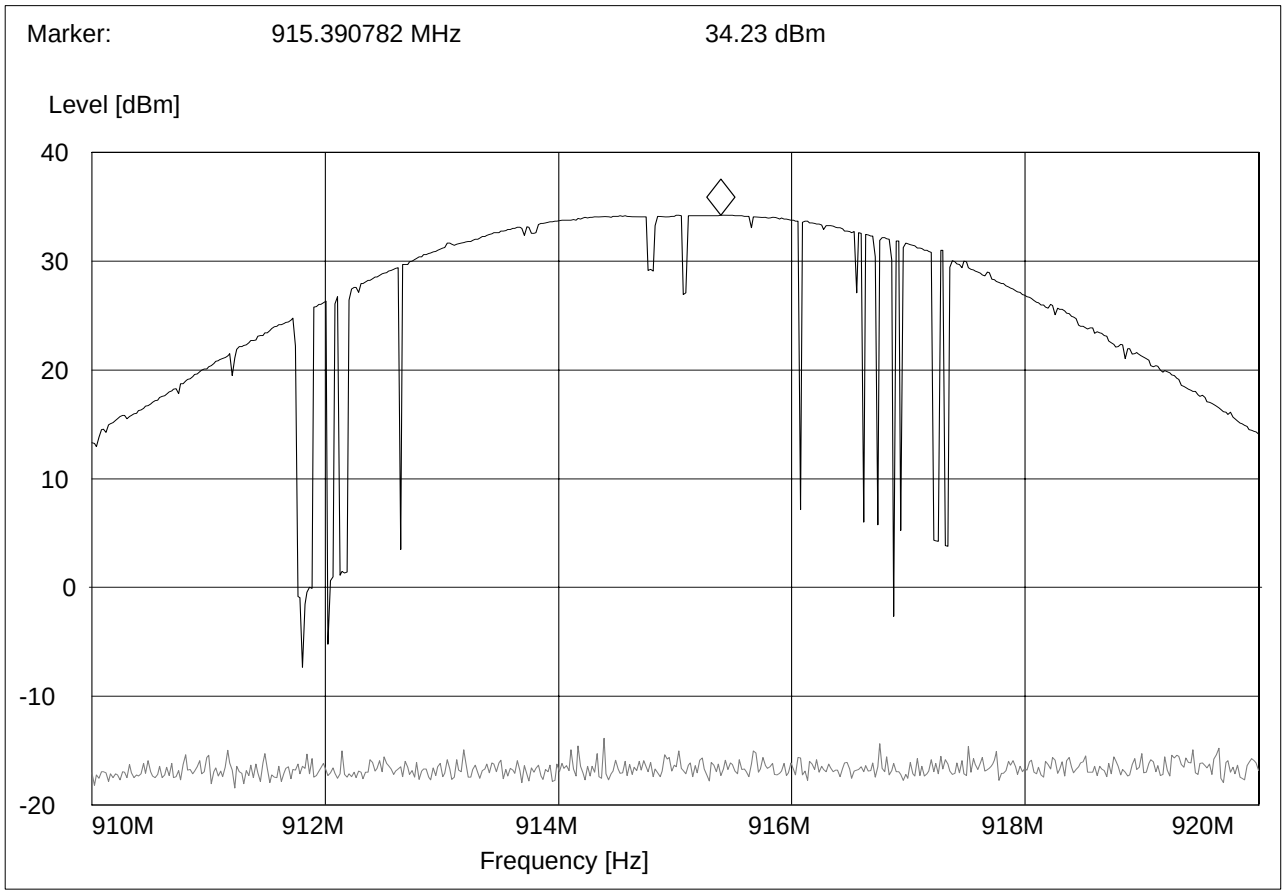


EIRP MID CHANNEL

```
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	Meas. Time	IF Bandw.	Transducer
910.0 MHz	920.0 MHz	MaxPeak MaxPeak	100.0 ms	3 MHz	DUMMY-DBM

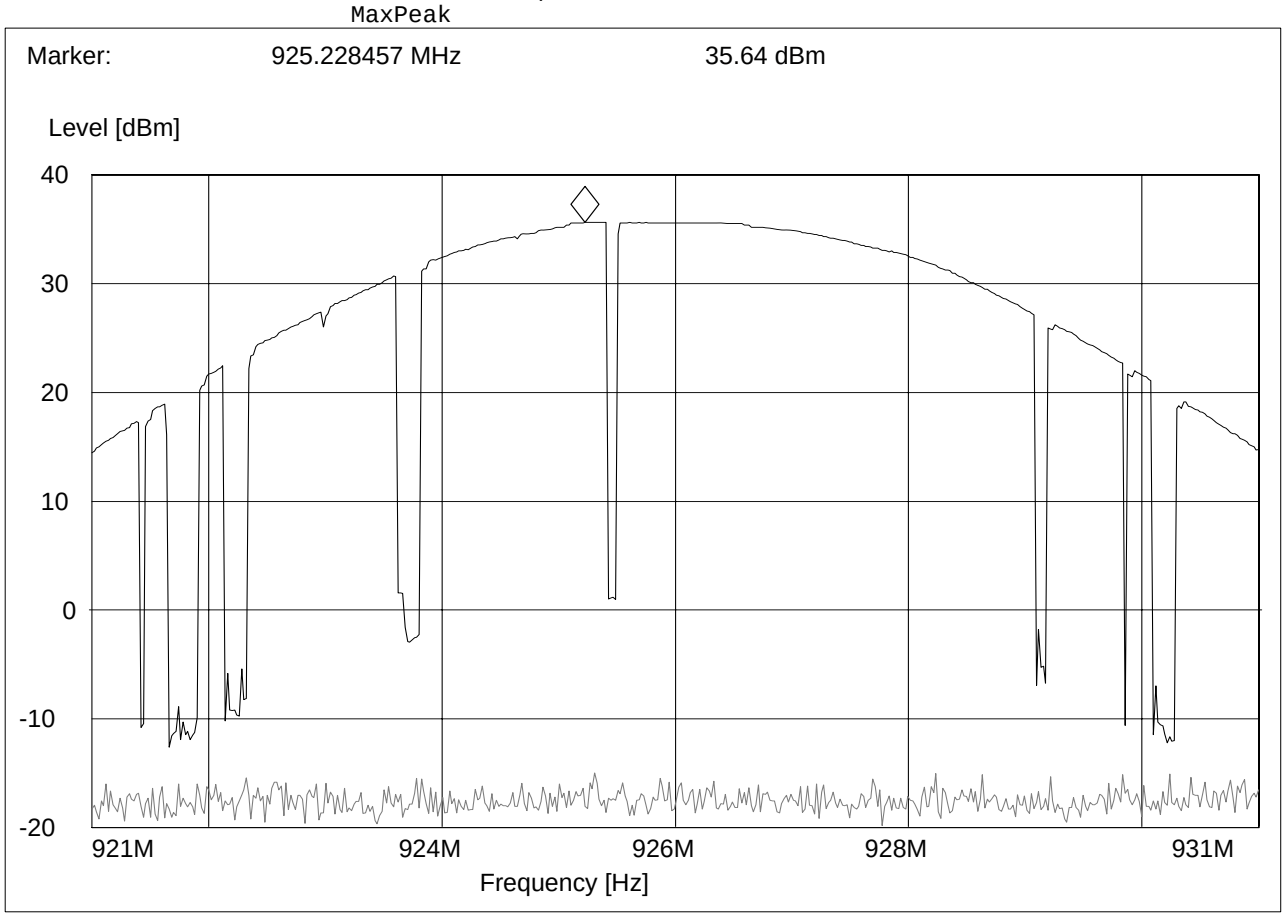


EIRP HIGH CHANNEL

```
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
[1]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	([2])
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

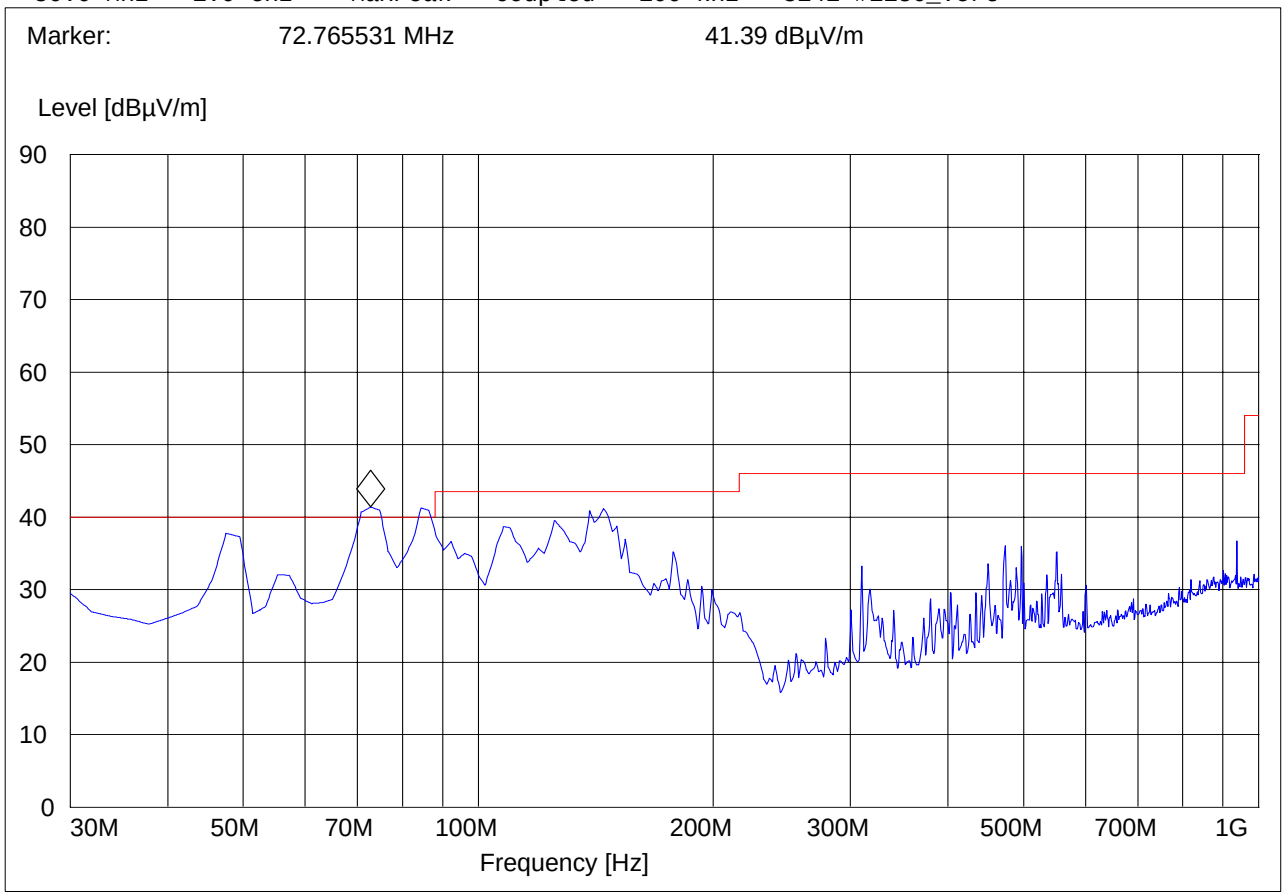
Note: This plot shows worse case emission for low, mid, and high channel.

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



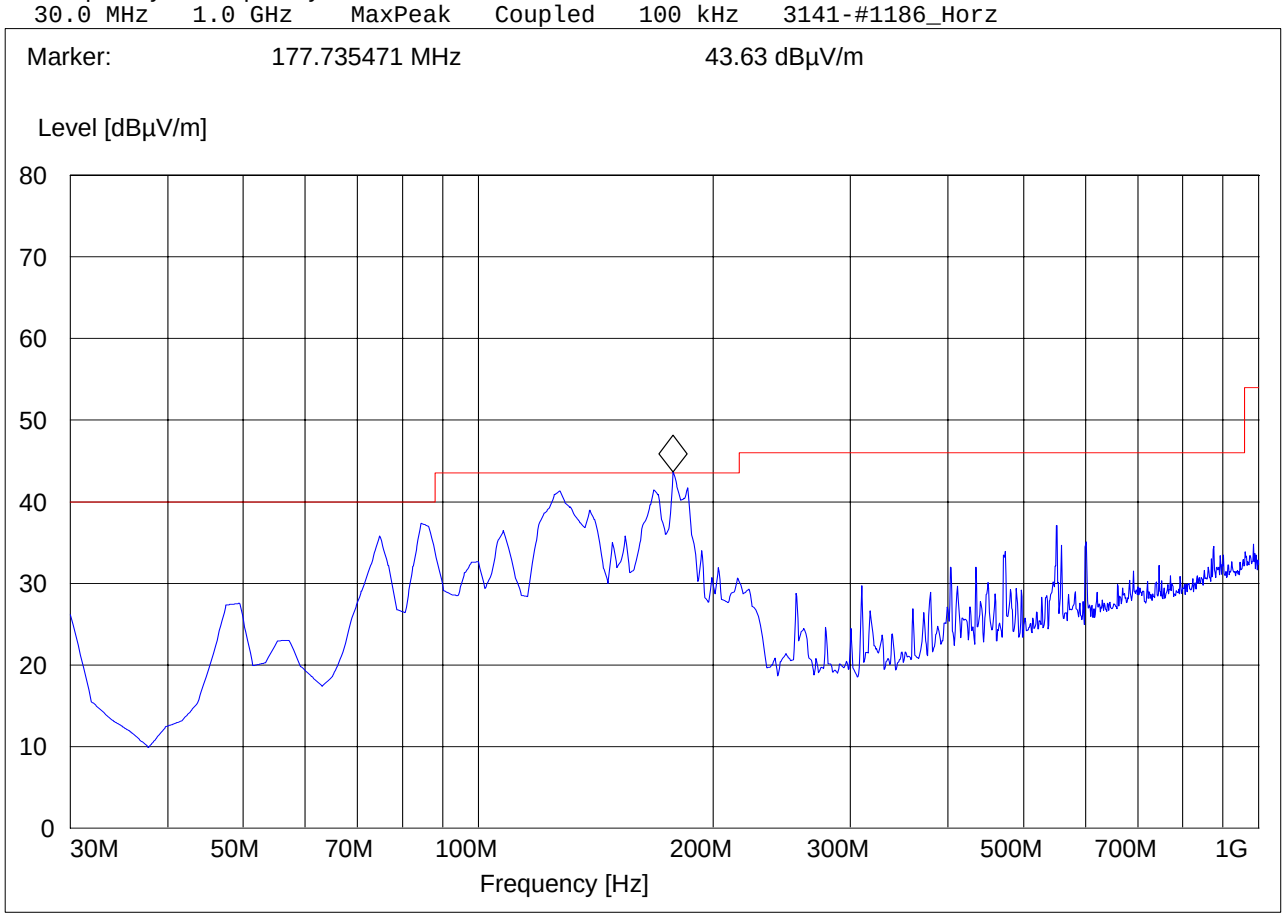
30MHz – 1GHz
Antenna: horizontal.
Note: This plot shows worse case emission for low, mid, and high channel.

```
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

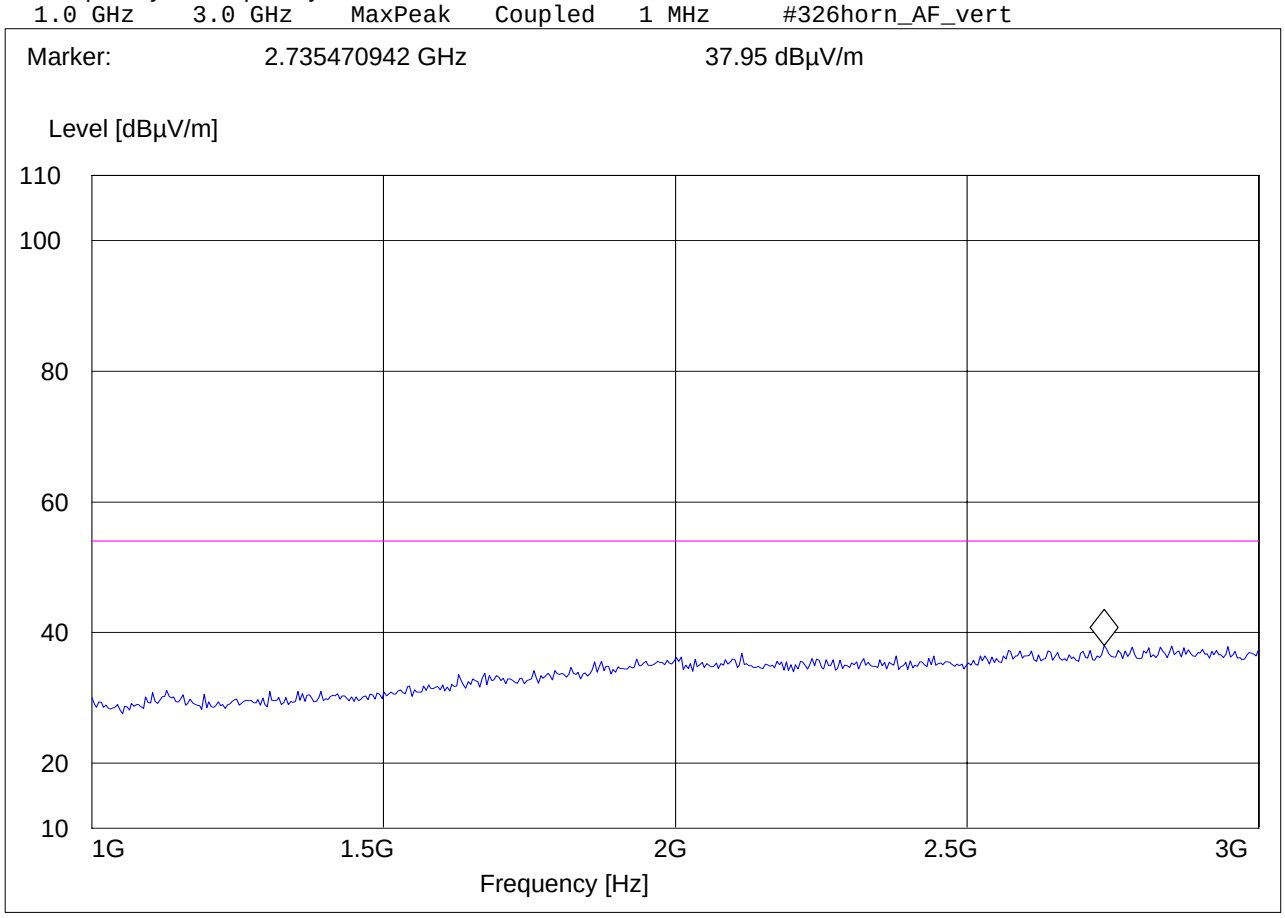


1-3GHz
Note: Peak Reading vs. Average limit
Note: This plot shows worse case emission for low, mid, and high channel.

```
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

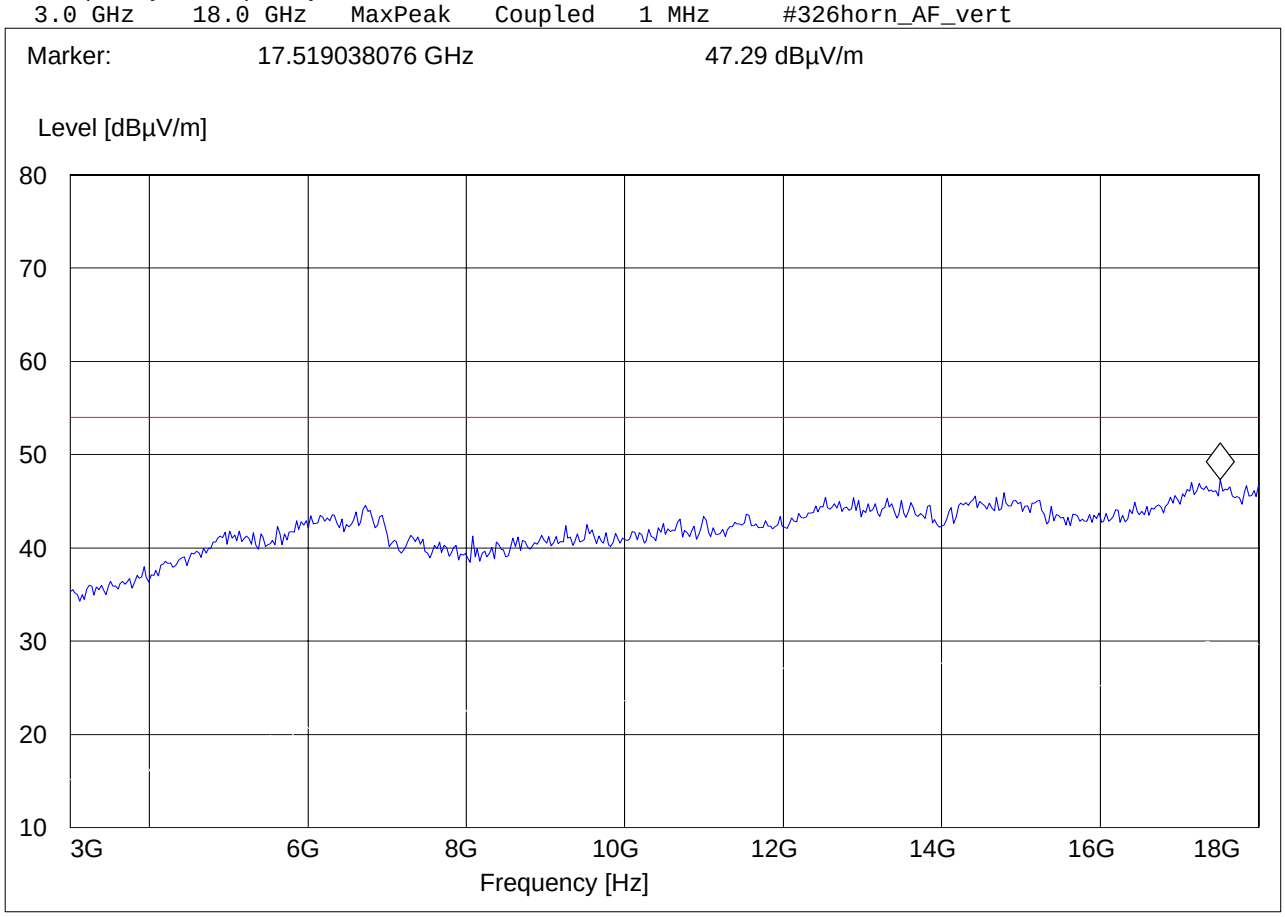


3-18GHz
Note: Peak Reading vs. Average limit
Note: This plot shows worse case emission for low, mid, and high channel.

```
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



6 Measurements (Conducted)

6.1 MAXIMUM PEAK OUTPUT POWER § 15.247 (CONDUCTED)

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

Frequency range	RF power output
2400-2483.5 MHz	30dBm

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

6.1.2 RESULTS:

Test not conducted

6.2 20dB BANDWIDTH

6.2.1 LIMIT SUB CLAUSE § 15.247 (a) (1) (i) (ii) (iii)

Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

6.2.2 RESULTS:

Test not conducted

6.3 CARRIER FREQUENCY SEPARATION

6.3.1 LIMIT SUB CLAUSE § 15.247 (a) (1) (i) (ii) (iii)

SEPARATION
> 25 KHz or > 2/3 * 20 dB BANDWIDTH = 839kHz

6.3.2 RESULTS:

Test not conducted.

6.4 NUMBER OF HOPPING CHANNELS

6.4.1 LIMIT SUB CLAUSE § 15.247 (a) (1) (iii)

NUMBER OF CHANNELS
> 15

6.4.2 RESULTS:

Test not conducted.

6.5 TIME OF OCCUPANCY (DWELL TIME)

6.5.1 LIMIT SUB CLAUSE § 15.247 (a) (1) (i) (ii) (iii)

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

6.5.2 RESULTS:

T_{nom}(23)°C	V_{nom}VDC

Test not conducted.

6.6 CONDUCTED SPURIOUS EMISSION

6.6.1 LIMIT SUB CLAUSE § 15.247 (d)

FREQUENCY RANGE	limit
30M-25GHz	-20dBc

6.6.2 RESULTS: Tnom(23)°C VnomVDC

Test not conducted.

6.7 AC POWER LINE CONDUCTED EMISSIONS § 15.107/207

6.7.1 LIMITS

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

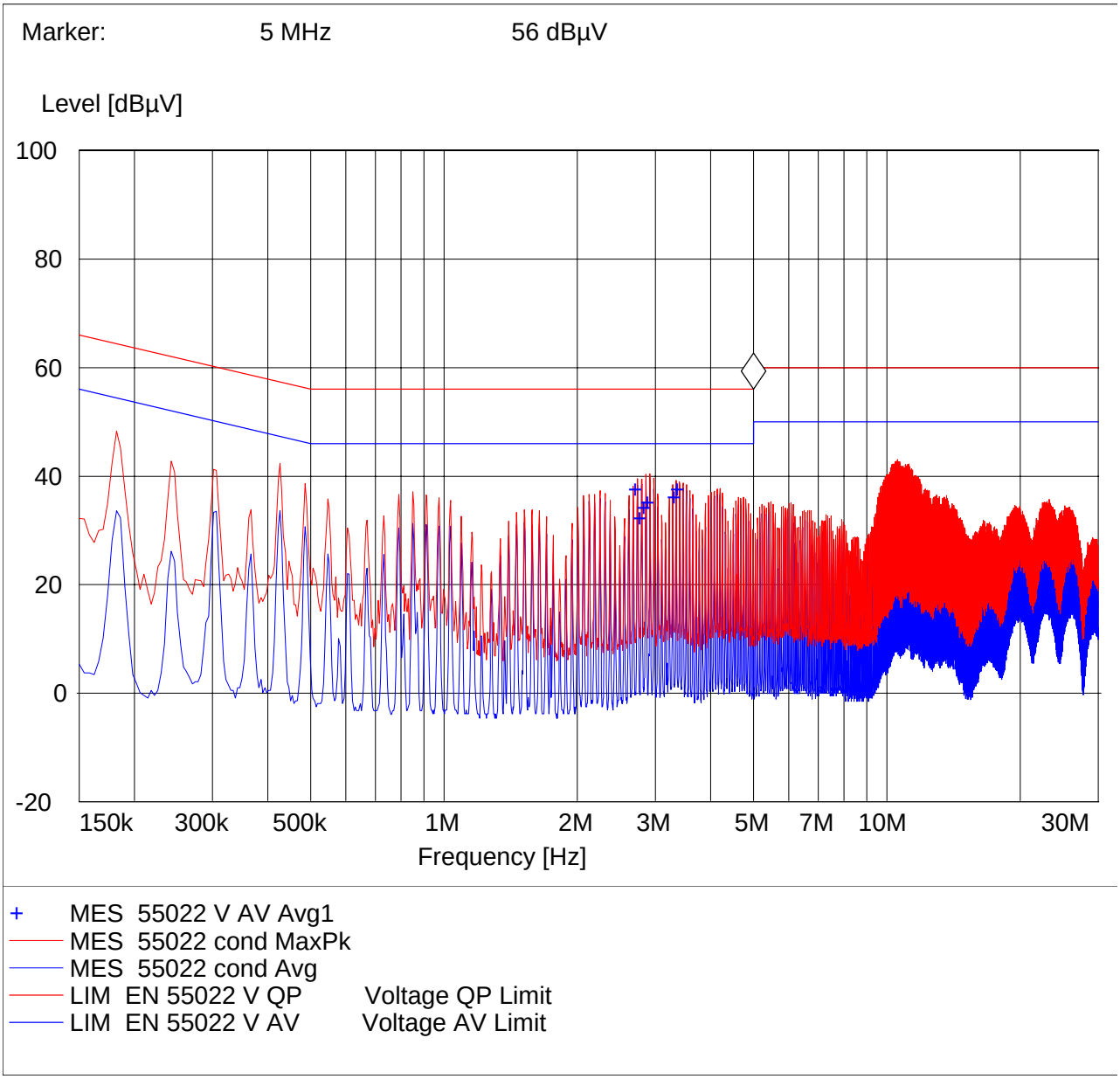
Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50
* Decreases with logarithm of the frequency		

ANALYZER SETTINGS: RBW = 10KHz VBW = 10KHz

6.7.2 Test Results:

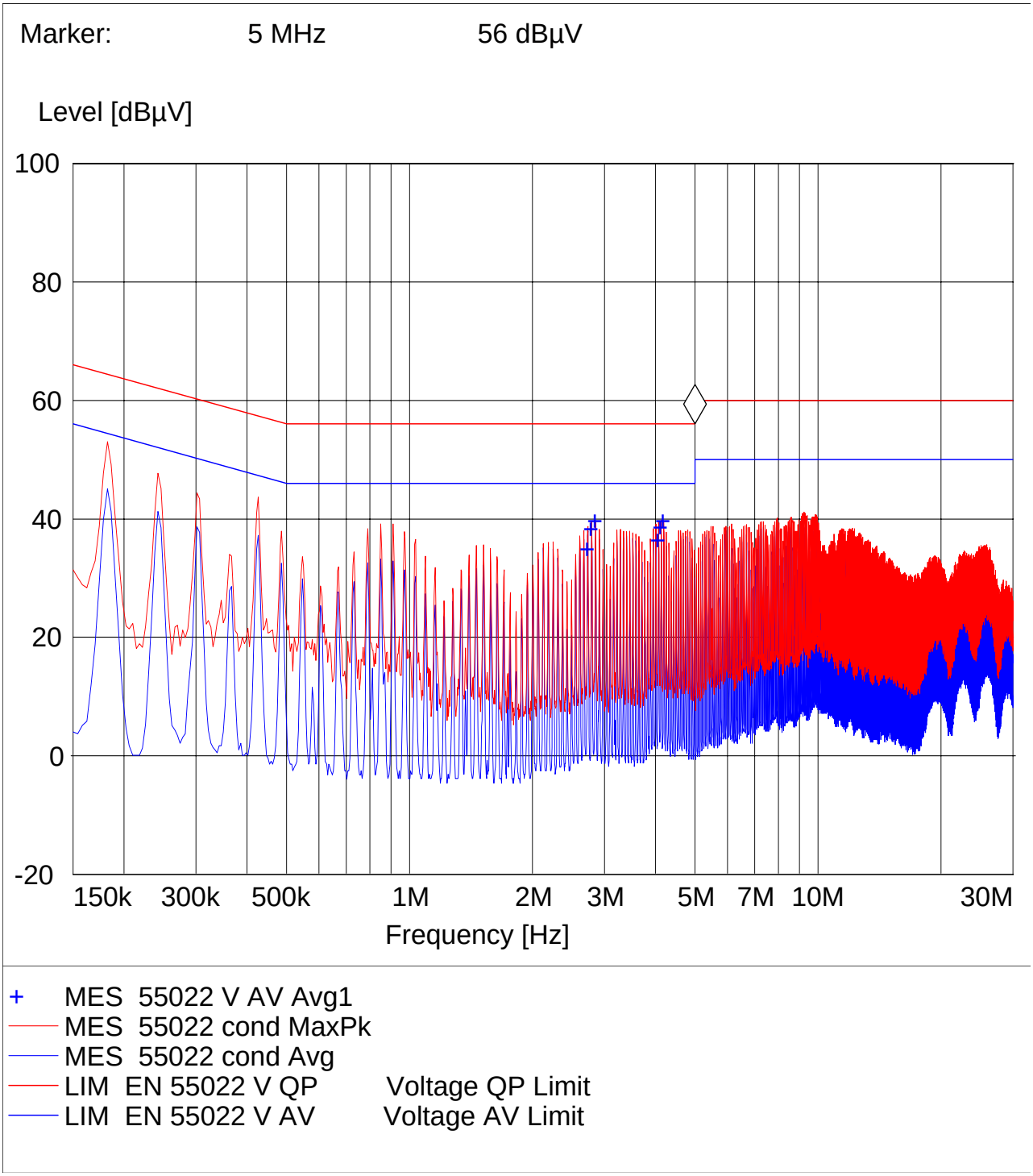
Results TX Line

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



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

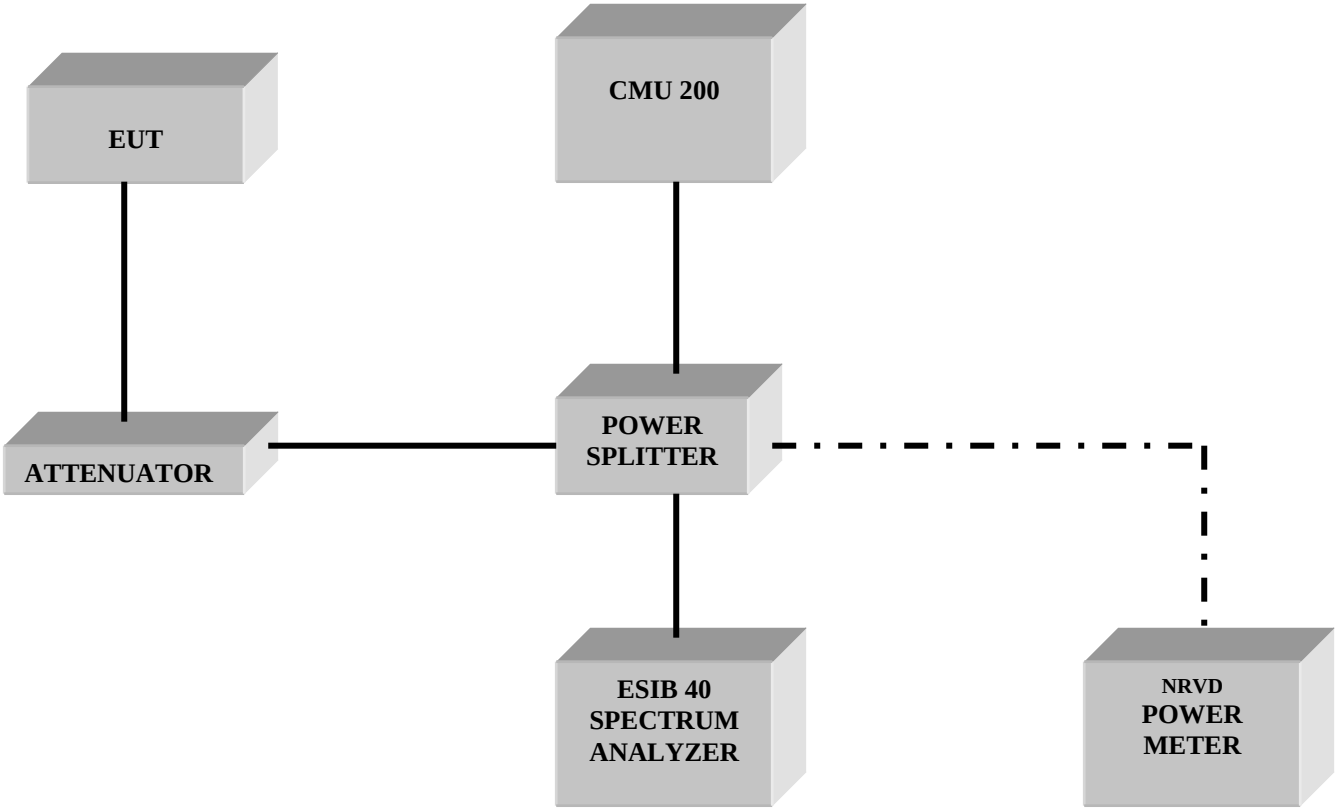


7 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

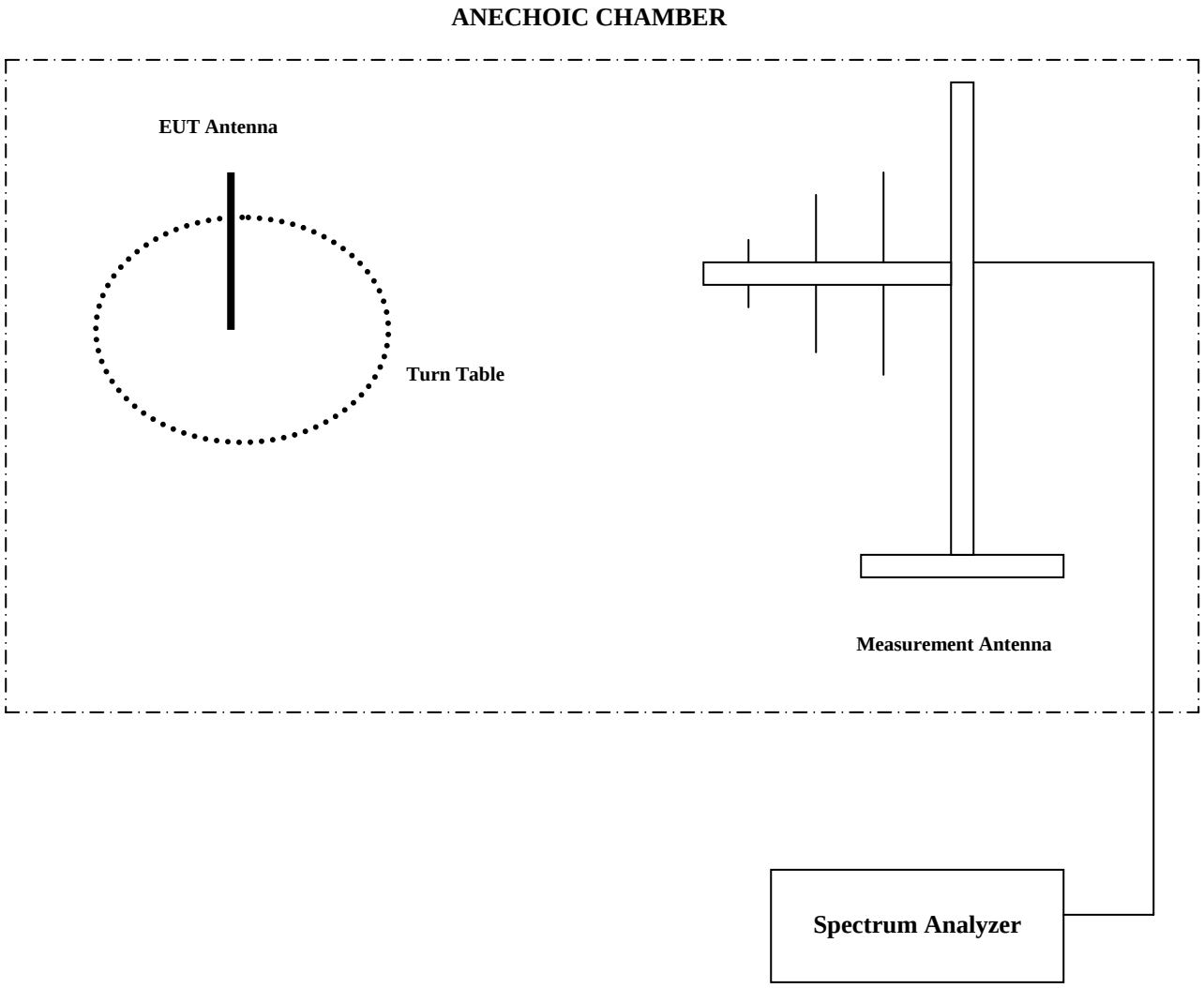
No	Instrument/Ancillary	Type	Manufacturer	Serial No.	Cal Due	Interval
01	Spectrum Analyzer	ESIB 40	Rohde & Schwarz	100107	May 2009	1 year
02	Spectrum Analyzer	FSEM 30	Rohde & Schwarz	100017	May 2009	1 year
03	Signal Generator	SMY02	Rohde & Schwarz	836878/011	May 2009	1 year
04	Power-Meter	NRVD	Rohde & 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



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9 REPORT HISTORY

2008-11-11: First issue.