

**EMISSIONS TEST REPORT FOR A LOW POWER TRANSMITTER**

**I. GENERAL INFORMATION**

Requirement: Federal Communications Commissions  
 Test Requirements: 15.205, 15.207, 15.209, 15.247  
 Applicant: RadarGolf Inc.  
 FCC ID: **SHY26SJR**

**II. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)**

The RadarGolf FCC ID: SHY26SJR (model number BPS-X2) is a hand held proprietary RFID system used to locate golf balls imbedded with RadarGolf RFID tags.

**Transmitter Specification**

TX Power	29.58 dBm max.
Antenna	5.5 dBi panel (RadarGolf design)
Frequency of operation	Single Frequency :914.22MHz
Modulation	BPSK and OOK 200 usec pulse/4.807 kHz rate
6 dB bandwidth	1.47 MHz
99% bandwidth	4.22 MHz
Power source	6-AA batteries

**III. TEST DATES AND TEST LOCATION**

Testing was performed 23-24 June 2005. All tests were performed at:

Compliance Certification Services  
 561F Monterey Road  
 Morgan Hill, CA 95037

T.N. Cokenias  
 EMC Consultant/Agent for RadarGolf Inc.

13 July 2005

**15.203 Antenna connector requirement**

The antenna is permanently attached to the product. For antenna conducted tests, a unit was modified by disconnecting the printed circuit antenna and replacing it with a 50 ohm coaxial cable connection terminated at one end with an SMA connector.

**15.204 Antenna description**

The EUT has two antennas, a 5.5 dBi TX only antenna and a 7 dBi RX only antenna:

Antenna description	Gain
Panel antenna (TX)	5.5 dBi
Patch antenna (RX)	7 dBi

**TEST PROCEDURES**

All tests were performed in accordance with the applicable procedures called out in the following documents, unless otherwise noted:

- 1) **ANSI C63.4 – 2003**, 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
- 2) **FCC Public Notice 97-114**, Guidance on Measurements for Direct Sequence Spread Spectrum Systems

## TEST RESULTS

### Radiated Emissions

Test Requirement: 15.205, 15.247

### Out of Band Measurements

Test Requirement: 15.247

### Measurement Equipment Used:

Agilent 4446A Spectrum Analyzer, 9 kHz-40 GHz

Sunol Sciences JB1 Biconolog antenna

EMCO 3115 Horn antenna, 1-18 GHz

Miteq NSP2600-SP pre-amplifier, 1 – 26.5 GHz

IFI High pass filter,  $f_p = 1500$  MHz

### Radiated Test Set-up, 1-26 GHz

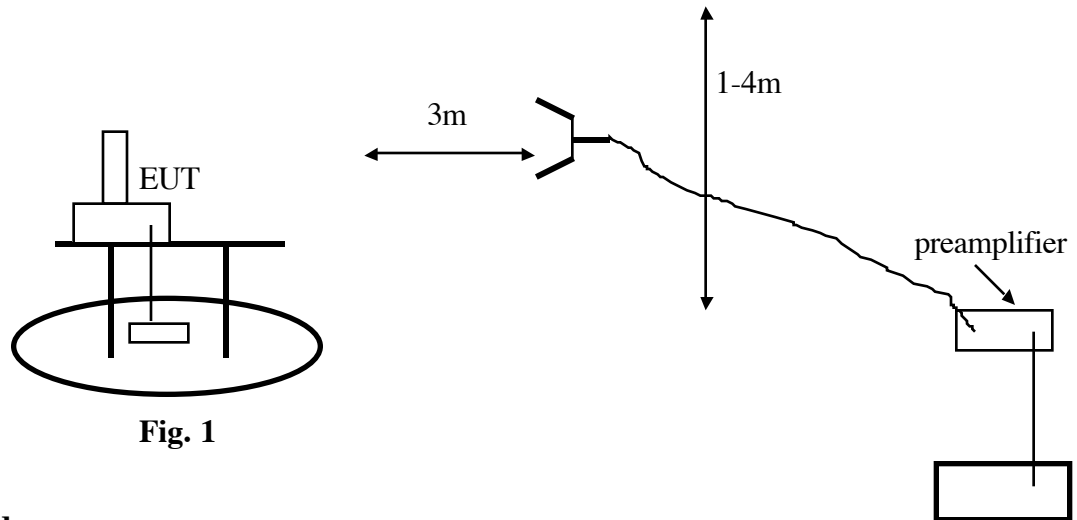


Fig. 1

### Test Procedures

0. Preliminary investigations were made for EUT in each orientation: XY, XZ, and YZ planes with respect to the search antenna. Worst-case emissions were for XY orientation, with the EUT antenna in normal operating positions.
1. The EUT was placed on a wooden table resting on a turntable on the test site. The search antenna was placed 3m from the EUT. The EUT antenna was mounted in the with the EUT TX antenna pointed directly to the search antenna.
2. The turntable was slowly rotated to locate the direction of maximum emission at each emission falling in the restricted bands of 15.205.
3. Emissions were investigated to the 10<sup>th</sup> harmonic of the fundamental.
4. Once maximum direction was determined, the search antenna was raised and lowered in both vertical and horizontal polarizations. The maximum readings so obtained are recorded in the data listed below.

4. Once maximum direction was determined, the search antenna was raised and lowered in both vertical and horizontal polarizations. The maximum readings so obtained are recorded in the data listed below.

**Test Results:** Worst case results are presented. Refer to data sheets below. Restricted band emissions meet 54 dBuV/m. Other undesired emissions from the transmitter meet the -20 dBc requirement in 15.247(c). FCC Radiated Emissions Limits

**Section 15.205** Restricted bands of operation.

(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
0.495 - 0.505 (1)	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 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	(2)
13.36 - 13.41	322 - 335.4		

1 Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

2 Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e), regardless of the field strength limits specified elsewhere in this Subpart, the provisions of this Section apply to emissions from any intentional radiator.

**Section 15.209** Radiated emission limits, general requirements.

- (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

\*\* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other Sections within this Part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

(e) The provisions in Sections 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this Part.

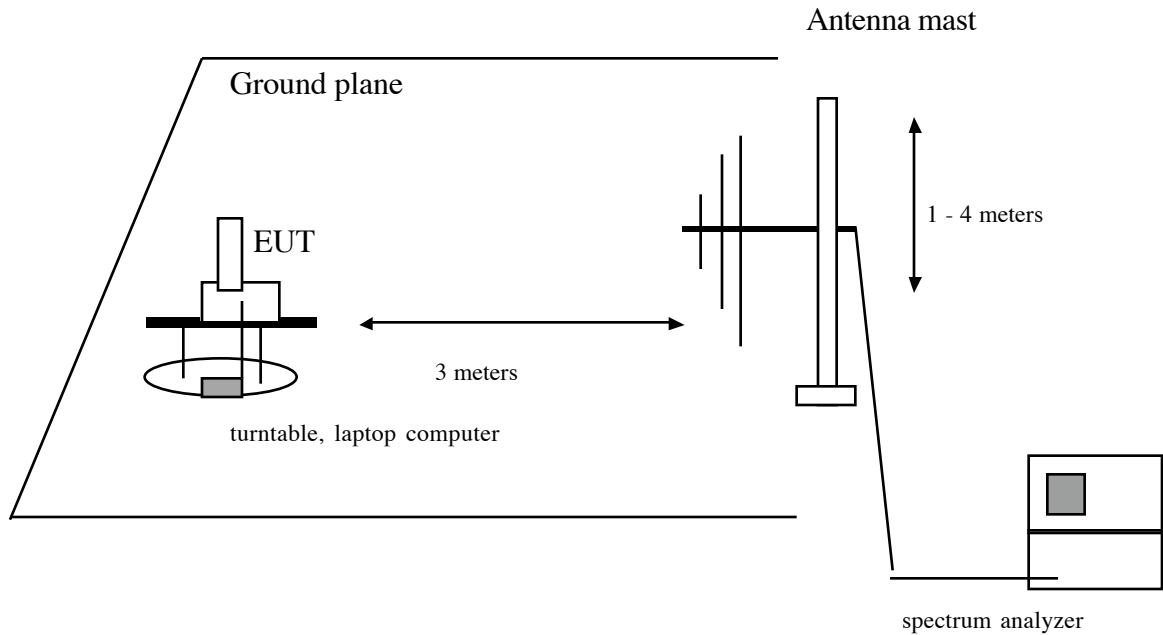
06/23/05 High Frequency Measurement Compliance Certification Services, Morgan Hill Open Field Site																	
Test Engr: William Zhuang Project #: 05U3499 Company: Tom Cokenias / Radar Golf EUT Descrip.: 902-928MHz Device EUT M/N: BPS-X2, FCC ID No.: SHY-BPS-X2 Test Target: 15.205 Mode Oper: Tx On, ball on the table Average Power Meter: Low = xx dBm, Mid = xx dBm, High = xx dBm																	
Test Equipment:																	
EMCO Horn 1-18GHz T73; S/N: 6717 @3m Hi Frequency Cables		Pre-amplifier 1-26GHz T34 HP 8449B		Pre-amplifier 26-40GHz		Horn > 18GHz											
2 foot cable 2_Thanh		3 foot cable		4 foot cable		12 foot cable 12_William		HPF HPF_1.5GHz		Reject Filter							
														Peak Measurements RBW=VBW=1MHz			
														Average Measurements RBW=1MHz ; VBW=10Hz			
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)		
<b>-20 dBc Limit:</b>																	
1.828	3.0	88.3		26.7	1.9	-36.5	0.0	0.3	80.6	-7.6	105.7	54	-25.1	-61.6	V, RB=VB=100KHz		
1.828	3.0	89.5		26.7	1.9	-36.5	0.0	0.3	81.8	-7.6	105.7	54	-23.9	-61.6	V, RB=VB=1MHz		
1.828	3.0	84.9		26.7	1.9	-36.5	0.0	0.3	77.3	-7.6	105.7	54	-28.4	-61.6	H, RB=VB=100KHz		
1.828	3.0	85.9		26.7	1.9	-36.5	0.0	0.3	78.2	-7.6	105.7	54	-27.5	-61.6	H, RB=VB=1MHz		
<b>Normal Limit:</b>																	
2.742	3.0	71.5	34.1	29.4	2.4	-35.0	0.0	0.6	68.8	31.4	74.0	54	-5.2	-22.6	H		
2.742	3.0	69.3	34.1	29.4	2.4	-35.0	0.0	0.6	66.6	31.4	74	54	-7.4	-22.6	V		
3.657	3.0	53.6	32.1	31.9	2.8	-34.1	0.0	0.6	54.8	33.3	74	54	-19.2	-20.7	V		
3.657	3.0	58.4	33.8	31.9	2.8	-34.1	0.0	0.6	59.5	35.0	74	54	-14.5	-19.0	H		
4.571	3.0	47.1	31.3	33.4	3.2	-33.6	0.0	0.6	50.7	34.9	74	54	-23.3	-19.1	H		
4.571	3.0	45.0	31.1	33.4	3.2	-33.6	0.0	0.6	48.6	34.7	74	54	-25.4	-19.3	V		
<b>Ball at 1.5M between EUT and Antenna</b>																	
2.742	3.0	71.6	34.0	29.4	2.4	-35.0	0.0	0.6	68.9	31.3	74	54	-5.1	-22.7	H		
2.742	3.0	72.0	34.0	29.4	2.4	-35.0	0.0	0.6	69.3	31.3	74	54	-4.7	-22.7	V		
															V		
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f	Measurement Frequency					Amp	Preamp Gain					Avg Lim	Average Field Strength Limit				
Dist	Distance to Antenna					D Corr	Distance Correct to 3 meters					Pk Lim	Peak Field Strength Limit				
Read	Analyzer Reading					Avg	Average Field Strength @ 3 m					Avg Mar	Margin vs. Average Limit				
AF	Antenna Factor					Peak	Calculated Peak Field Strength					Pk Mar	Margin vs. Peak Limit				
CL	Cable Loss					HPF	High Pass Filter										

**Radiated Emissions  
Test Requirement: 15.109**

**Measurement Equipment Used:**

HP 8542E Receiver, 9 kHz - 2.9 GHz  
Sunol Sciences JB1 Biconolog Antenna

**Radiated Test Set-up, 30 - 1000 MHz**

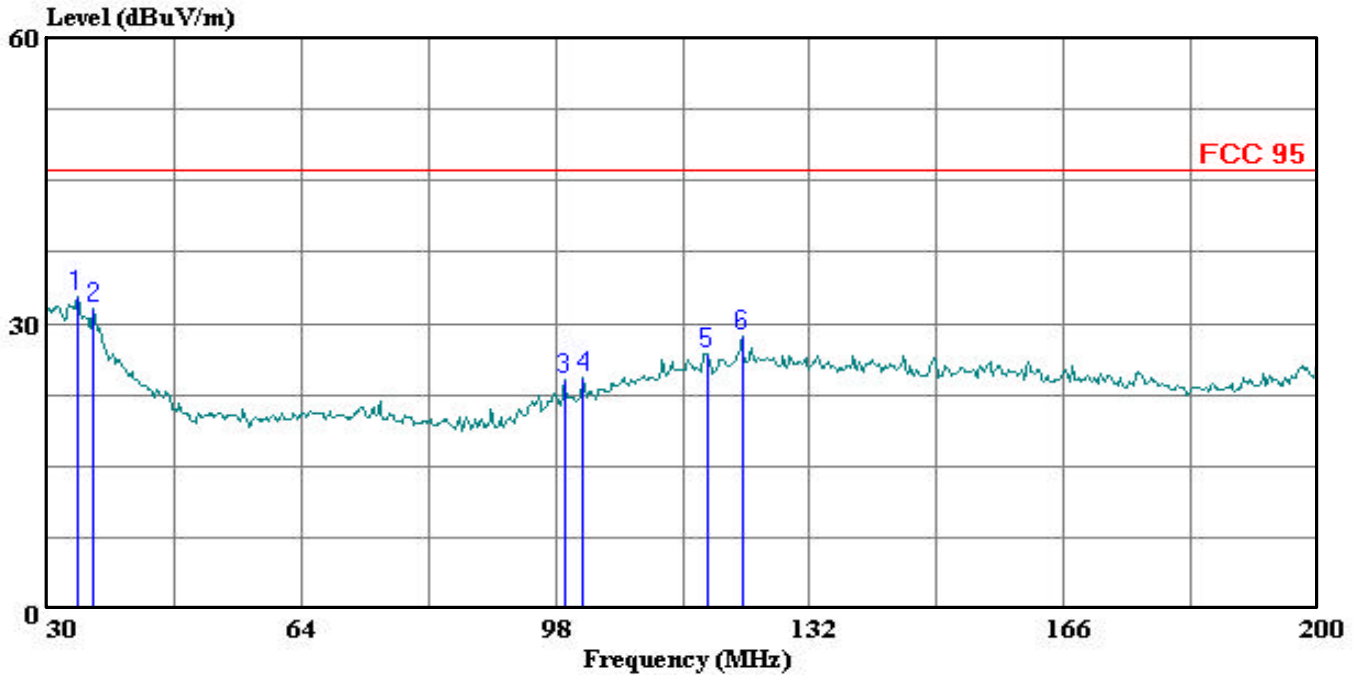


**Test Procedures**

1. The EUT was placed on a wooden table resting on a turntable on the open air test site. The search antenna was placed 3m from the EUT. The EUT antenna was mounted vertically as per normal installation. The EUT was set to transmit continuously on the MID channel.
2. The turntable was slowly rotated to locate the direction of maximum emission at each emission falling in the restricted bands of 15.205.
3. Once maximum direction was determined, the search antenna was raised and lowered in both vertical and horizontal polarizations. The maximum readings so obtained are recorded in the data listed below.

**Test Results:** EUT meets requirements. All transmitter emissions in the 30-1000 MHz band are at least 20 below the carrier:

Data#: 6 File#: EMIradar.EMI Date: 06-23-2005 Time: 10:17:44



(Audix ATC)

Trace: 5

Ref Trace:

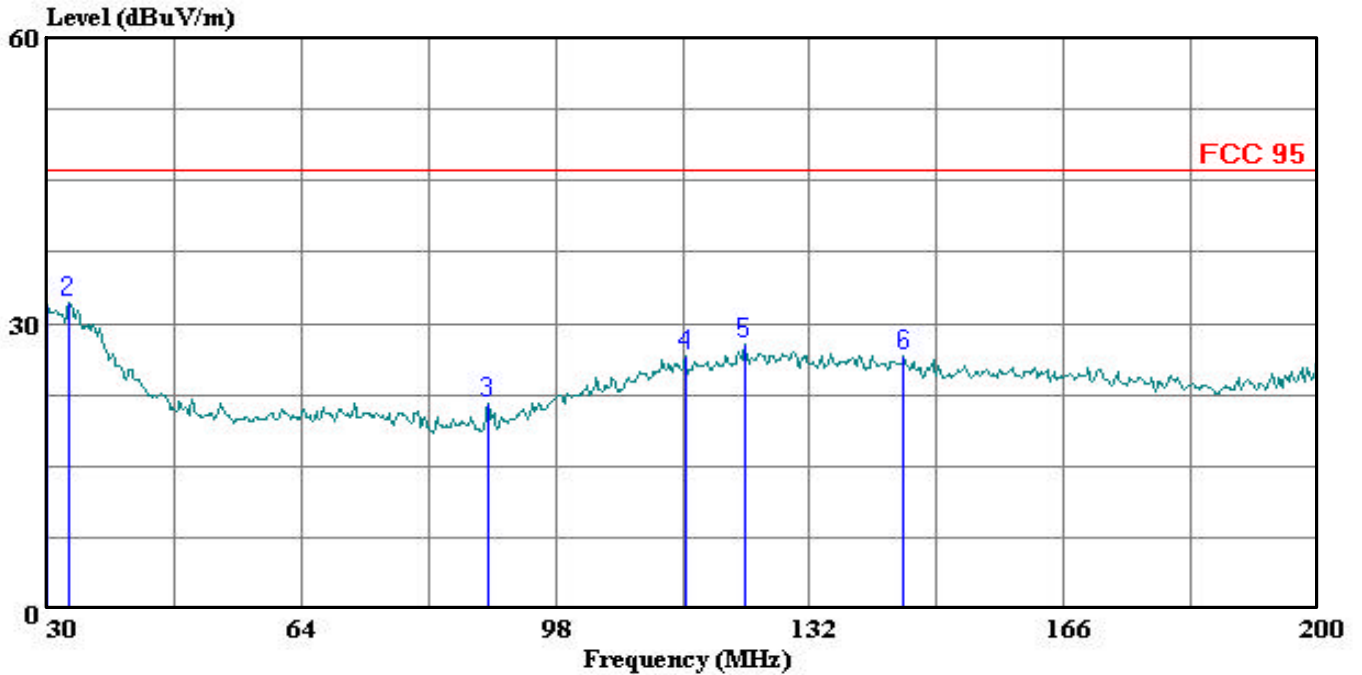
Condition: FCC 95 HORIZONTAL  
 Test Operator: : William Zhuang  
 Project #: : 05U3499  
 Company: : RADAR GOLF Hand Held  
 EUT: : 902-928 MHz Device  
 Model No. : BPS-X2  
 Configuration : EUT Stand Alone  
 Target of Test : 15.209  
 Mode of Operation: Continous transmitting

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	34.080	14.17	18.58	32.75	46.00	-13.25	Peak
2	36.290	14.38	17.27	31.65	46.00	-14.35	Peak
3	99.190	12.86	11.25	24.11	46.00	-21.89	Peak
4	101.740	12.46	11.81	24.27	46.00	-21.73	Peak
5	118.230	11.76	14.94	26.70	46.00	-19.30	Peak
6	122.990	13.35	15.21	28.56	46.00	-17.44	Peak



Data#: 8 File#: EMIradar.EMI Date: 06-23-2005 Time: 10:24:54



(Auxiliary ATC)

Trace: 7

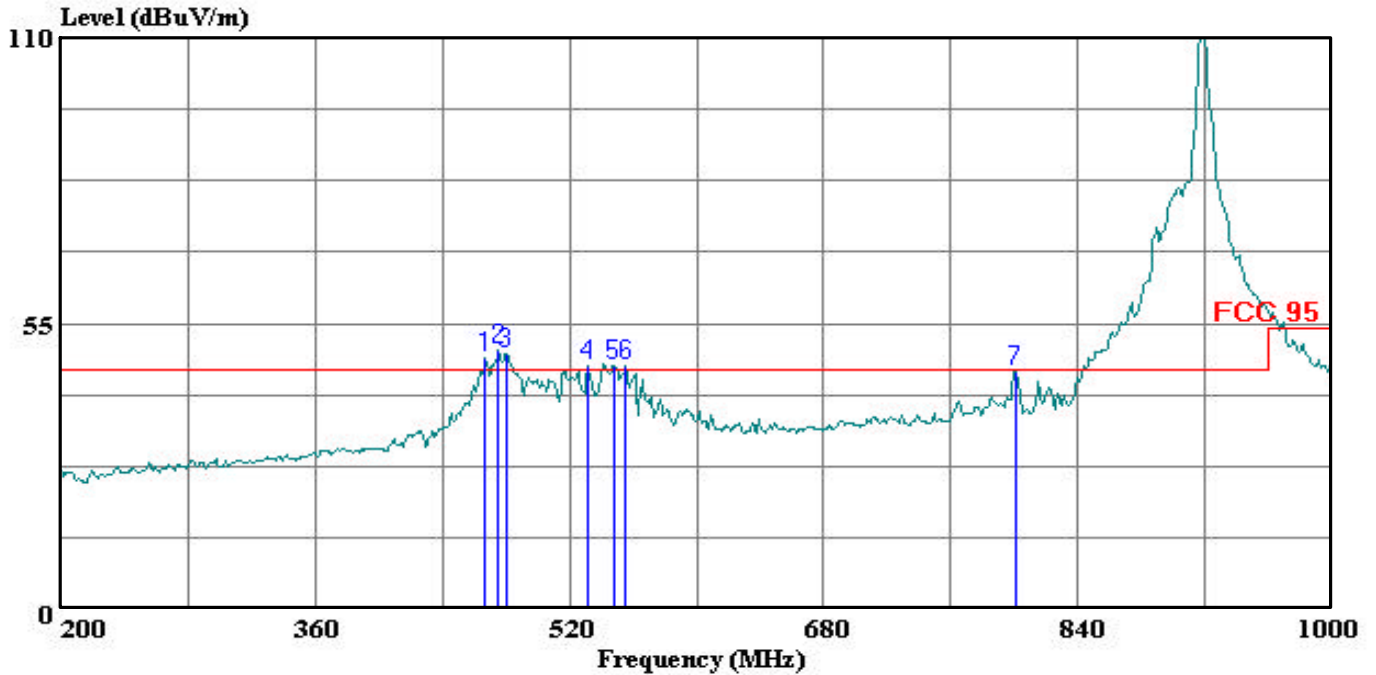
Ref Trace:

Condition: FCC 95 VERTICAL  
 Test Operator: : William Zhuang  
 Project #: : 05U3499  
 Company: : RADAR GOLF Hand Held  
 EUT: : 902-928 MHz Device  
 Model No. : BPS-X2  
 Configuration : EUT Stand Alone  
 Target of Test : 15.209  
 Mode of Operation: Continous transmitting

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	30.000	11.48	20.45	31.93	46.00	-14.07	Peak
2	32.890	13.06	19.21	32.26	46.00	-13.74	Peak
3	88.990	13.02	8.63	21.65	46.00	-24.35	Peak
4	115.340	11.92	14.62	26.54	46.00	-19.46	Peak
5	123.330	12.70	15.22	27.92	46.00	-18.09	Peak
6	144.580	12.05	14.47	26.52	46.00	-19.48	Peak

Data#: 12 File#: EMIRadar.EMI Date: 06-23-2005 Time: 10:42:50



(Auxix ATC)

Trace: 11

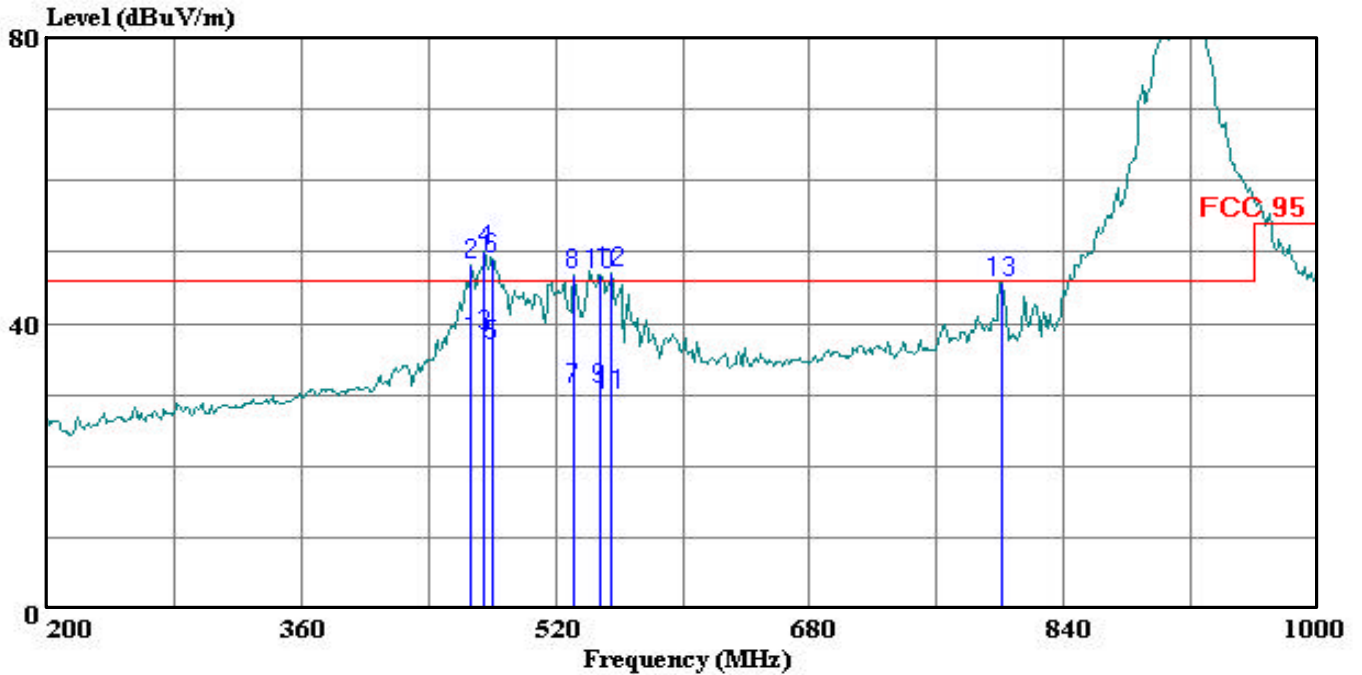
Ref Trace:

Condition: FCC 95 HORIZONTAL  
 Test Operator: : William Zhuang  
 Project #: : 05U3499  
 Company: : RADAR GOLF Hand Held  
 EUT: : 902-928 MHz Device  
 Model No. : BPS-X2  
 Configuration : EUT Stand Alone  
 Target of Test : 15.209  
 Mode of Operation: Continous transmitting

Page: 1

		Read		Limit	Over	
	Freq	Level	Factor	Line	Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB
1 *	467.200	28.66	19.56	48.22	46.00	2.22 Peak
2 *	475.200	30.26	19.75	50.01	46.00	4.01 Peak
3 *	480.000	29.22	19.82	49.04	46.00	3.04 Peak
4 *	531.200	26.02	20.68	46.70	46.00	0.70 Peak
5 *	548.000	25.91	20.86	46.77	46.00	0.77 Peak
6 *	555.200	26.07	20.94	47.01	46.00	1.01 Peak
7	800.800	21.16	24.58	45.74	46.00	-0.26 Peak

Data#: 14 File#: EMIRadar.EMI Date: 06-23-2005 Time: 11:03:04



(Auxiliary ATC)

Trace: 11

Ref Trace:

Condition: FCC 95 HORIZONTAL  
 Test Operator: : William Zhuang  
 Project #: : 05U3499  
 Company: : RADAR GOLF Hand Held  
 EUT: : 902-928 MHz Device  
 Model No. : BPS-X2  
 Configuration : EUT Stand Alone  
 Target of Test : 15.209  
 Mode of Operation: Continuous transmitting

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	467.200	17.84	19.54	37.38	46.00	-8.62	QP
2 *	467.200	28.66	19.56	48.22	46.00	2.22	Peak
3	475.200	18.37	19.75	38.12	46.00	-7.88	QP
4 *	475.200	30.26	19.75	50.01	46.00	4.01	Peak
5	480.000	17.00	19.82	36.82	46.00	-9.18	QP
6 *	480.000	29.22	19.82	49.04	46.00	3.04	Peak
7	531.200	10.00	20.68	30.68	46.00	-15.32	QP
8 *	531.200	26.02	20.68	46.70	46.00	0.70	Peak
9	548.000	10.00	20.86	30.86	46.00	-15.14	QP

Data#: 14

File#: EMIRadar.EMI

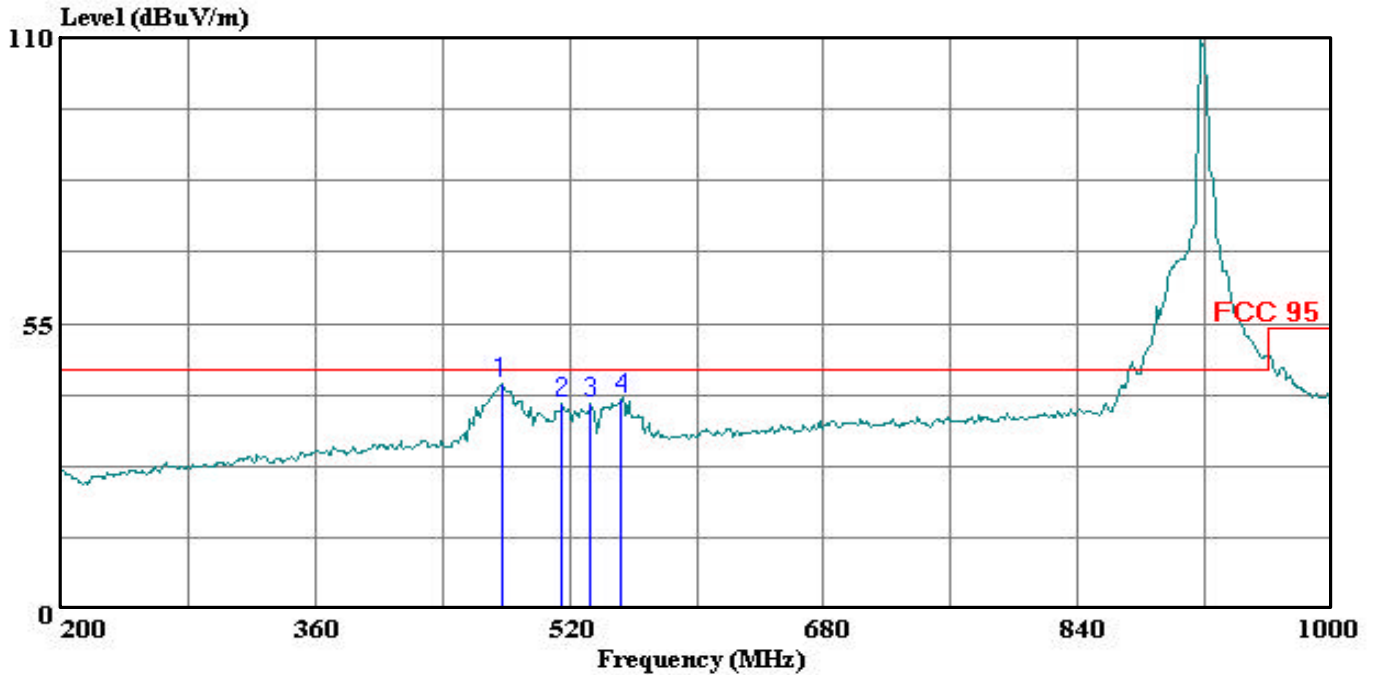
Date: 06-23-2005

Time: 11:03:04

Page: 2

		Read			Limit	Over	
	Freq	Level	Factor	Level	Line	Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
10	*	548.000	25.91	20.86	46.77	46.00	0.77 Peak
11		555.200	8.90	20.94	29.84	46.00	-16.16 QP
12	*	555.200	26.07	20.94	47.01	46.00	1.01 Peak
13		800.800	21.16	24.58	45.74	46.00	-0.26 Peak

Data#: 10 File#: EMIradar.EMI Date: 06-23-2005 Time: 10:34:20



(Audix ATC)

Trace: 9

Ref Trace:

Condition: FCC 95 VERTICAL  
 Test Operator: : William Zhuang  
 Project #: : 05U3499  
 Company: : RADAR GOLF Hand Held  
 EUT: : 902-928 MHz Device  
 Model No. : BPS-X2  
 Configuration : EUT Stand Alone  
 Target of Test : 15.209  
 Mode of Operation: Continous transmitting

Page: 1

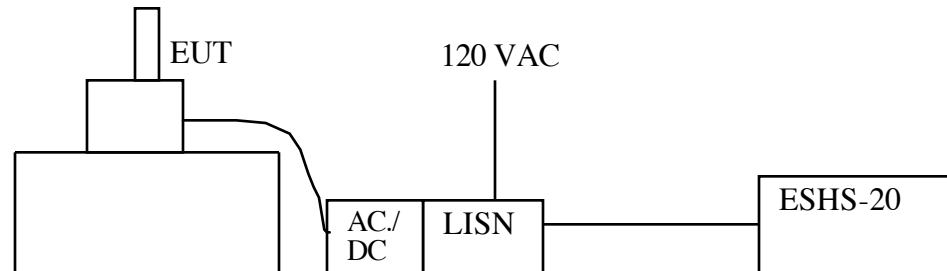
	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	477.600	23.58	19.78	43.36	46.00	-2.64	Peak
2	515.200	19.08	20.46	39.54	46.00	-6.46	Peak
3	533.600	18.73	20.70	39.42	46.00	-6.58	Peak
4	552.800	19.49	20.90	40.40	46.00	-5.60	Peak

**AC Line Conducted Emissions**  
**Test Requirement: 15.107, 15.207**

**Measurement Equipment Used:**

Rhode & Schwarz EMI Receiver ESHS-20  
Fischer Custom Communication LISN, FCC-LISN-50/250-25-2

**AC Conducted Set-up**



**Test Procedure**

1. The EUT was placed on a wooden table 40 cm from a vertical ground plane and approximately 80 cm above the horizontal ground plane on the floor. The EUT was set to transmit in normally.
2. Line conducted data was recorded for both NEUTRAL and HOT lines.

**Test Results**

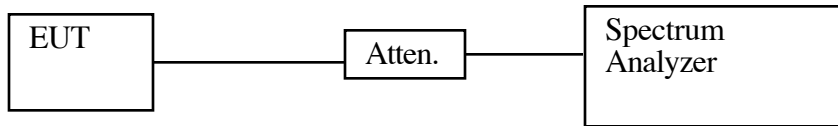
NOT APPLICABLE. EUT battery powered only.

**6dB Bandwidth for DTS**  
**Test Requirement: 15.247**

**Measurement Equipment Used:**

Agilent 4446A Spectrum Analyzer, 9 kHz-40 GHz  
20 dB attenuator

**Test Set-up**

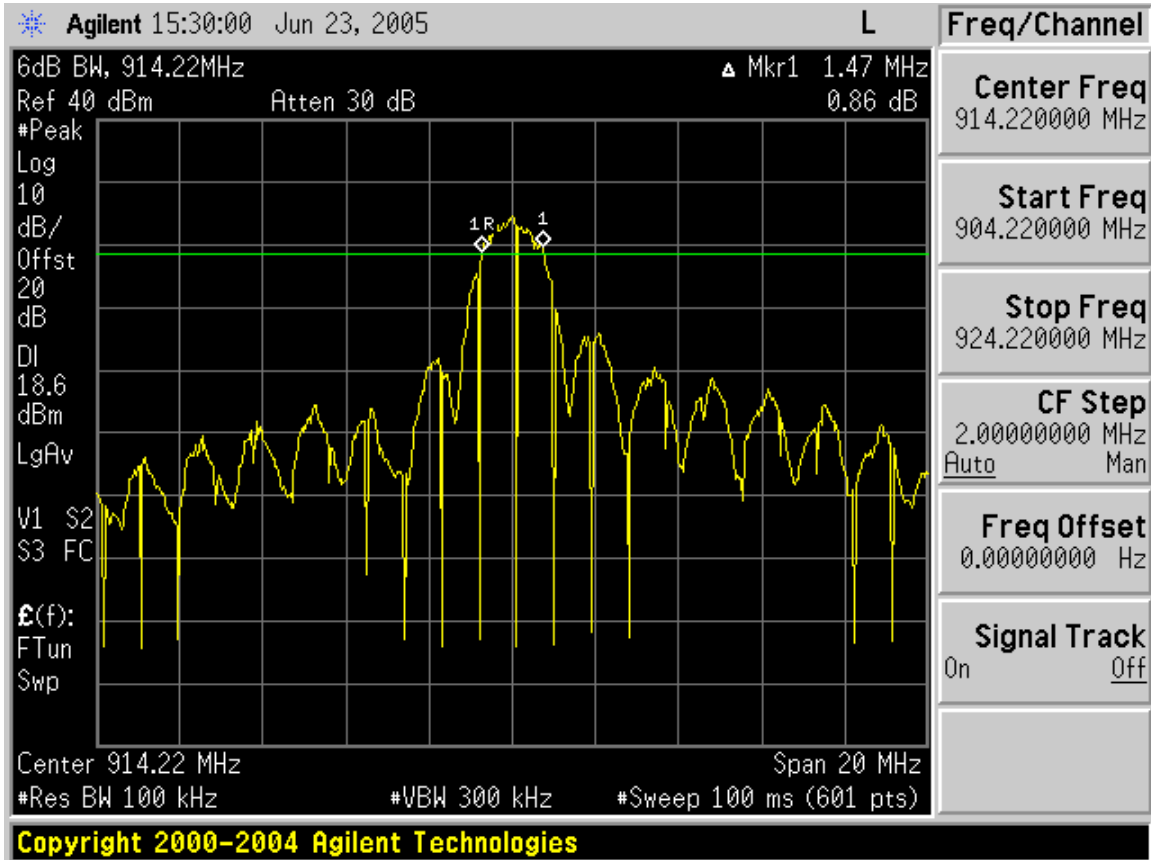


**Test Procedures**

A modified EUT with a coaxial cable attached to the radio antenna port was configured on a test bench. The cable's SMA connector was connected to the spectrum analyzer. transmission was continuous at 914.22 MHz . While the transmitter broadcast a steady stream of digital data, the analyzer MAX HOLD function was used to capture the envelope of the transmission occupied bandwidth.

**Test Results:** Measured approximately 1.47 MHz 6 dB BW. Refer to data sheets below.

15.247 6dB Bandwidth





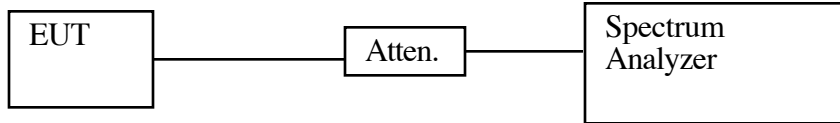
**99% Bandwidth**

**Test Requirement: RSS-210 (Canada Only, FCC Information Only)**

**Measurement Equipment Used:**

Agilent 4446A Spectrum Analyzer, 9 kHz-40 GHz  
20 dB attenuator

**Test Setup**



**Limit**

None: for reporting purposes only.

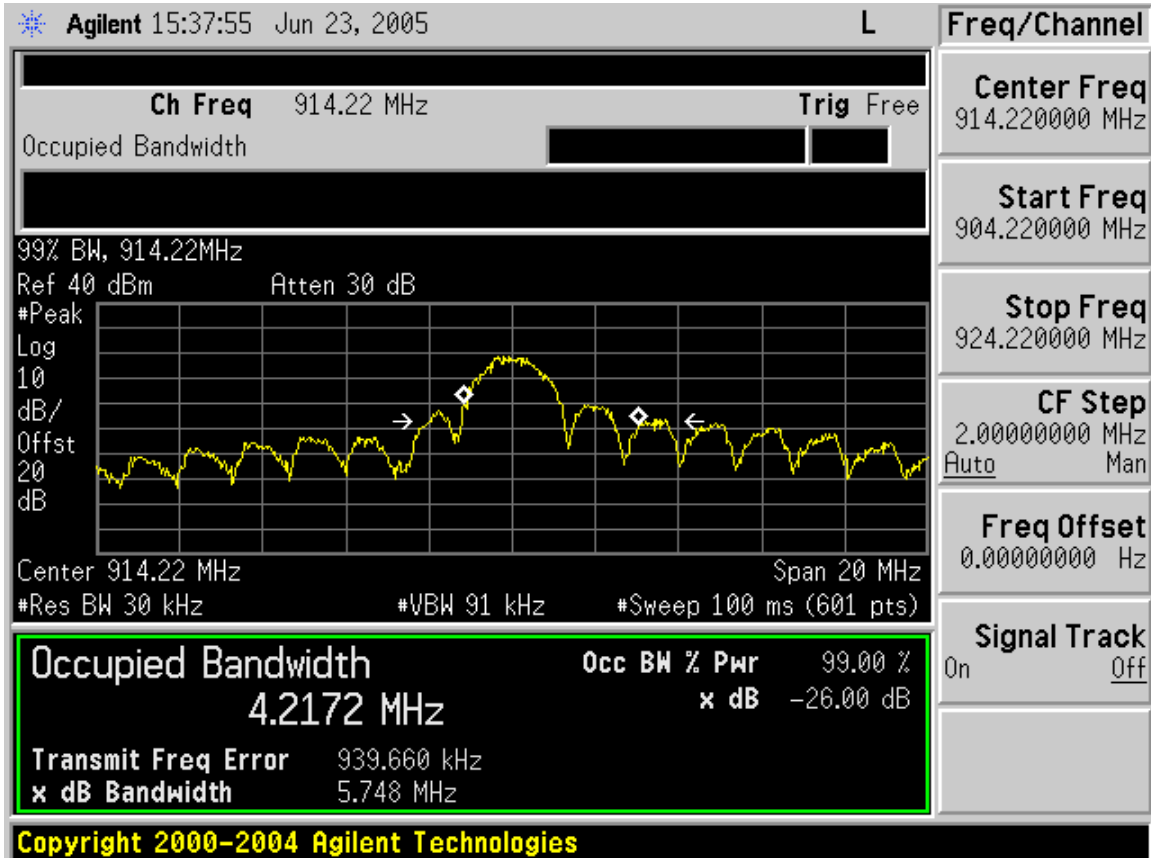
**Test Procedure**

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

**Test Results**

Refer to spectrum analyzer charts below. 99% bandwidth approximately 4.22 MHz.

**99% Bandwidth**

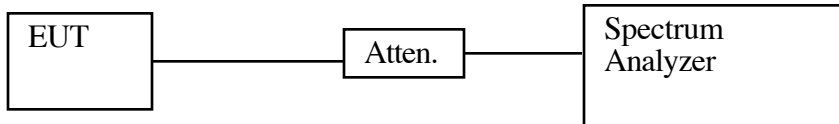


**RF Power Output**  
**Test Requirement: 15.247**

**Measurement Equipment Used:**

Agilent 4446A Spectrum Analyzer, 9 kHz-40 GHz  
20 dB attenuator

**Test Setup**



**Test Procedures**

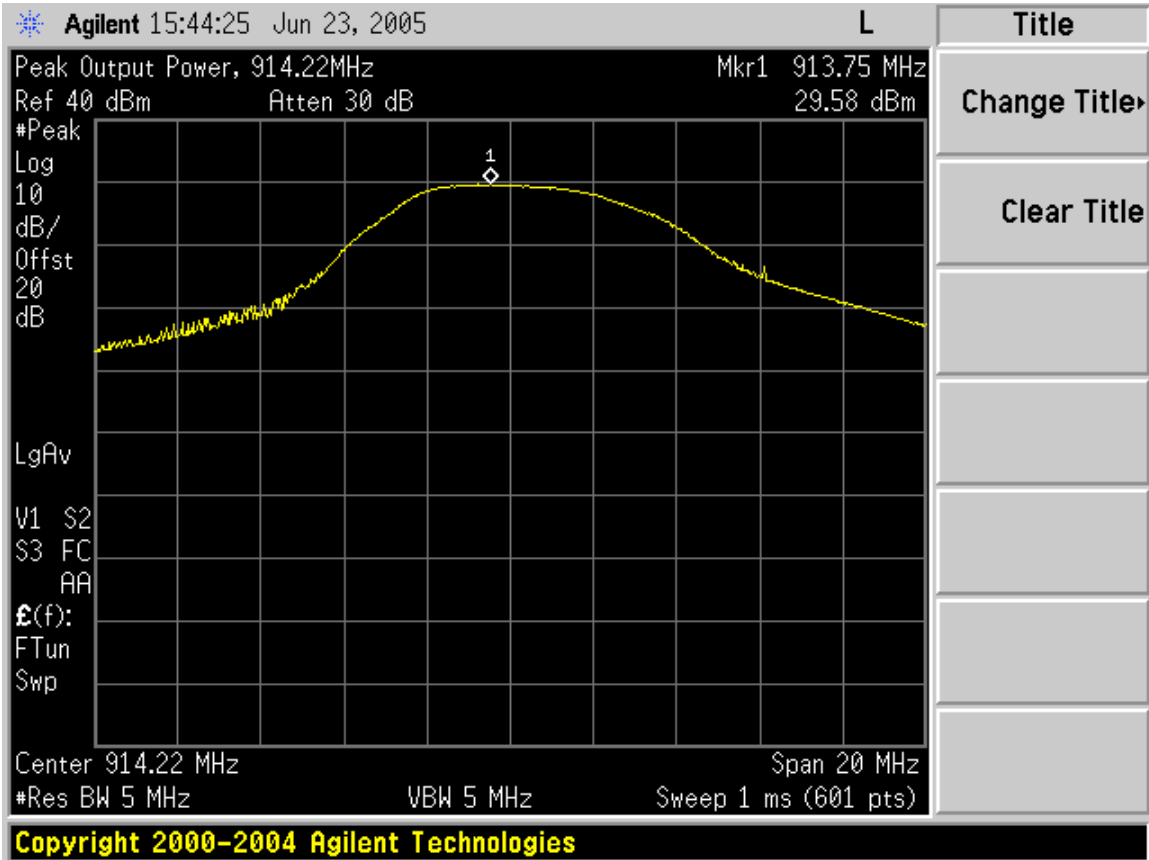
1. The EUT was configured on a test bench. The spectrum analyzer RBW and VBW were set to a value higher than the 4.22 MHz 99% bandwidth, 5MHz and 5MHz respectively.
2. The spectrum analyzer detector was set to PEAK and the highest value was recorded using the analyzer PEAK SEARCH function.

**Test Results**

Refer to spectrum analyzer graphs. Reference level offset corrects for external attenuation and cable loss.

<b>Frequency, MHz</b>	<b>Output Power, dBm</b>
914.22	29.58

### Peak Output Power



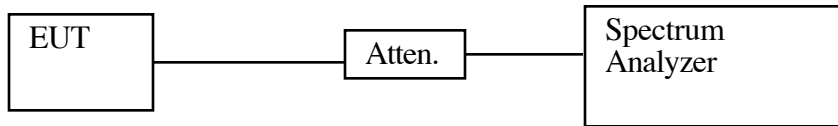
**Spurious Emissions, Conducted**  
**Test Requirement: 15.247(c)**

**Measurement Equipment Used:**

**Measurement Equipment Used:**

Agilent 4446A Spectrum Analyzer, 9 kHz-40 GHz  
20 dB attenuator

**Test Setup**



**Test Procedure**

1. The EUT was configured on a test bench. The cable was connected between the EUT antenna port and the spectrum analyzer input port.

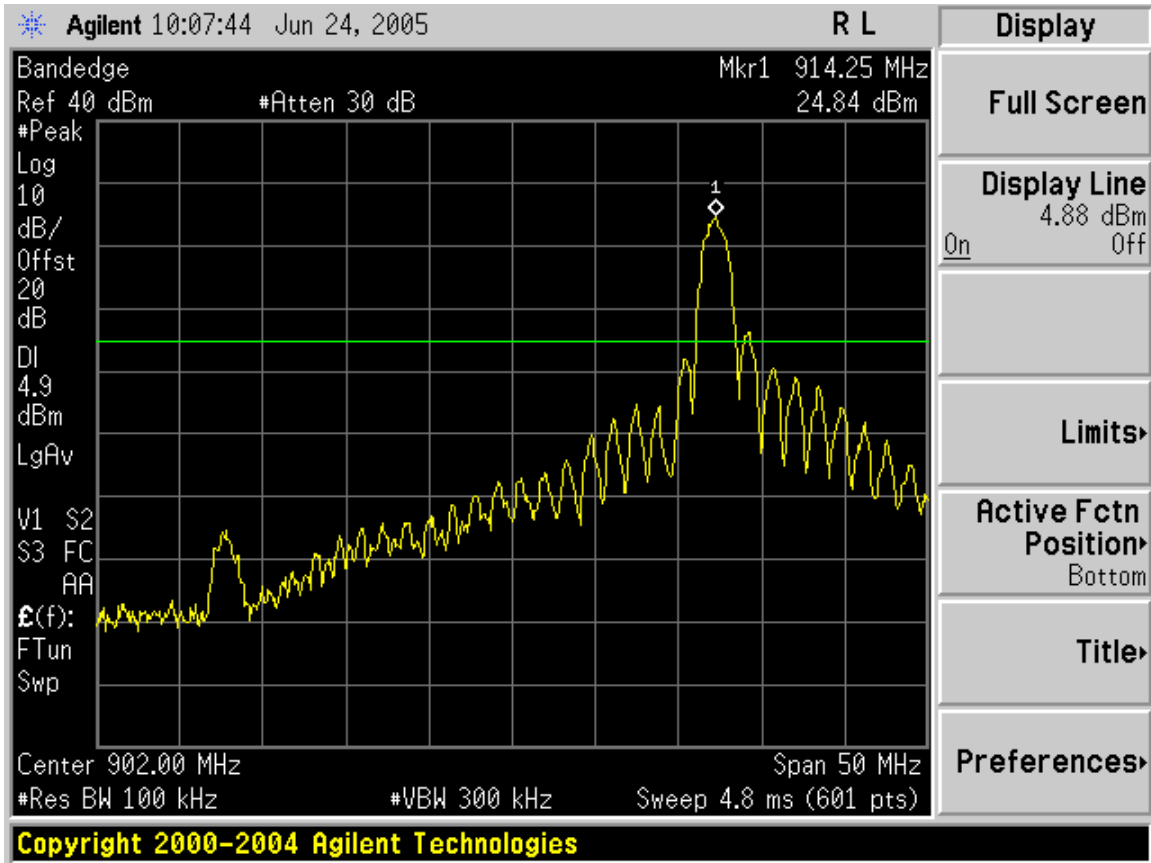
Spectrum analyzer RES BW was set to 100 kHz. While the transmitter broadcast a steady stream of digital data, the analyzer MAX HOLD function was used to capture the envelope of the transmission.

Readings were taken out to 10fo.

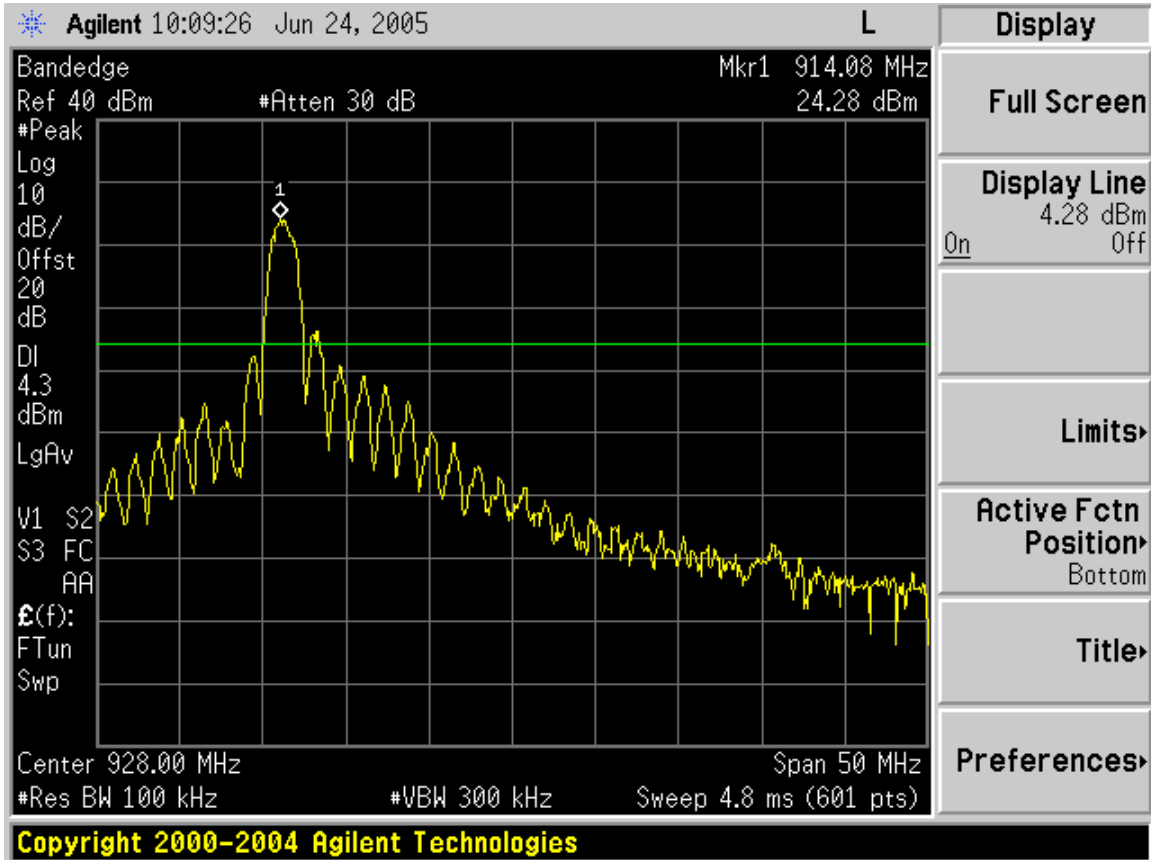
**Test Results**

Refer to spectrum analyzer plots. Data shows out of band emissions are suppressed well below the -20 dBc minimum required by the Rules.

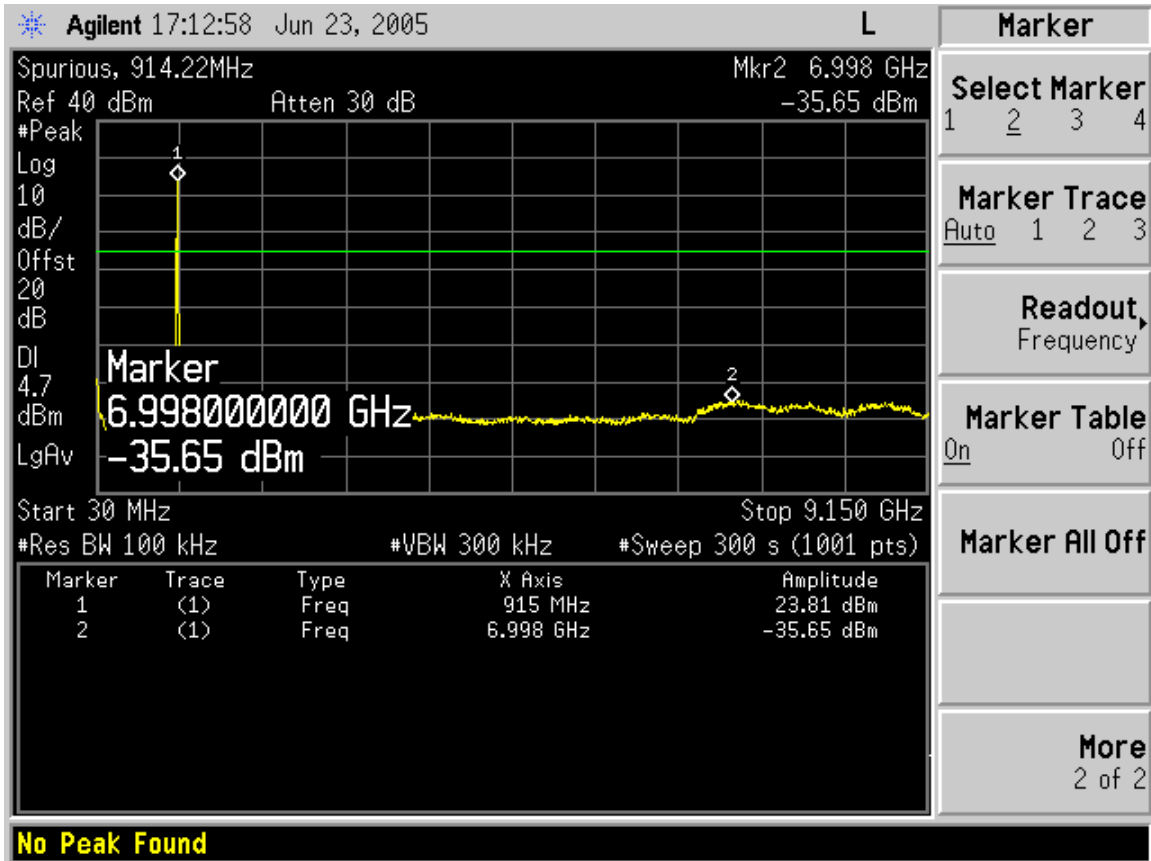
Lower band edge



Upper band edge



**Spurious Emissions**





**Power Spectral Density**

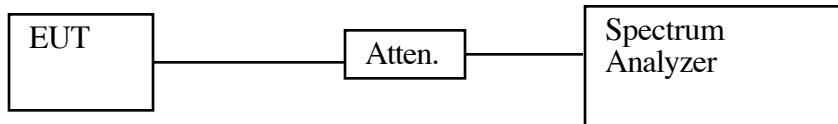
**Test Requirement: 15.247(d)**

**Measurement Equipment Used:**

**Measurement Equipment Used:**

Agilent 4446A Spectrum Analyzer, 9 kHz-40 GHz  
20 dB attenuator

**Test Setup**



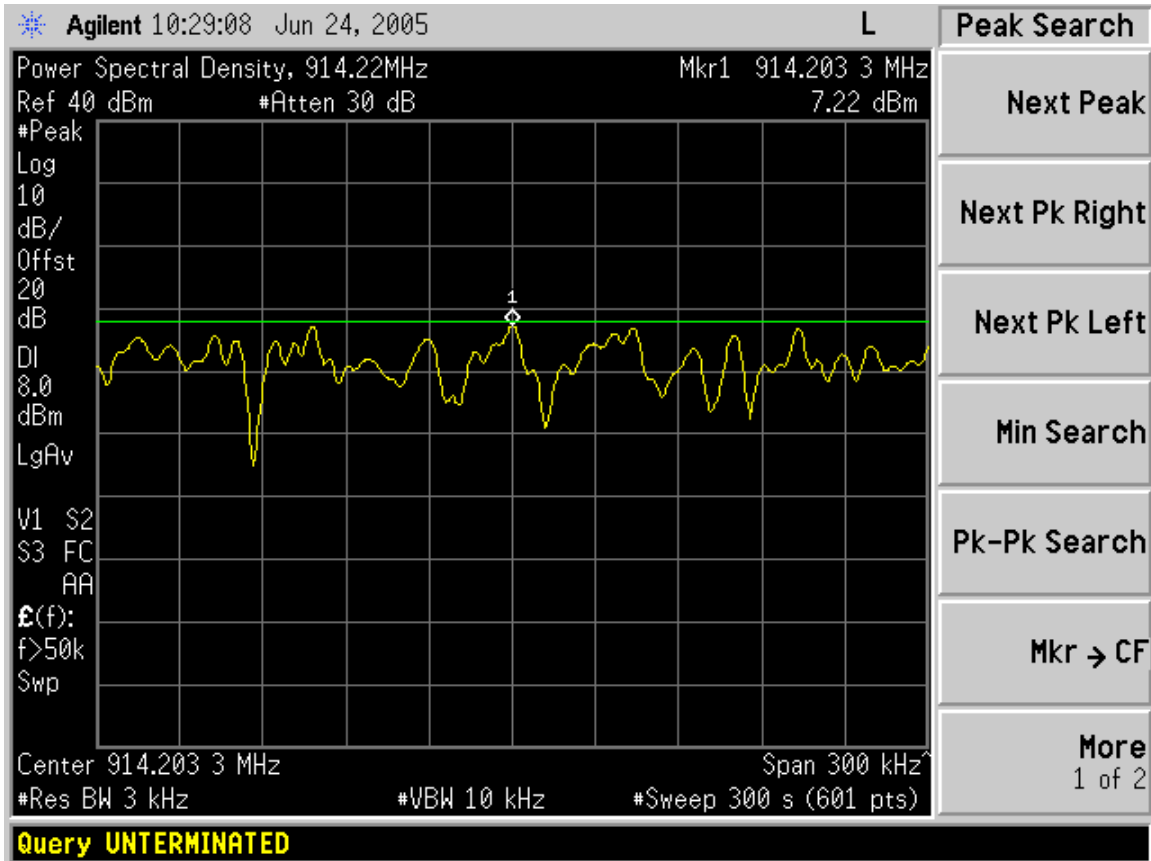
**Test Procedure**

1. Using PEAK search and CF analyzer functions, set LOW channel peak emission to center of analyzer screen.
2. Gradually reduce SPAN to 300 kHz, while adjusting tuning frequency so that peak remains at center of screen.
3. Set RES BW = 3 kHz, VID BW = 10 kHz, SWEEP = 100 sec.
4. Record highest reading and compare to 8 dBm limit.

**Test Results**

Maximum PSD was 7.22 dBm. Refer to attached spectrum analyzer chart.

### Power Spectral Density



## RF Exposure (MPE) Calculations

### 914.22 MHz DTS Radio

**Applicant:** RadarGolf Inc.

**FCC ID:** SHY26SJR

### RF Hazard Distance Calculation

mW/cm<sup>2</sup> from Table1: 0.6

Max RF Power TX Antenna P, dBm	G, dBi	MPE Safe Distance, cm	MPE, inches	Comment
29.58	5.5	20.5	8.1	peak Source Based
15.7	5.5	4.1	1.6	average

### Basis of Calculations:

$$E^2/3770 = S, \text{ mW/cm}^2$$

$$E, \text{ V/m} = (P_{\text{watts}} * G_{\text{gain}} * 30)^{.5} / d, \text{ meters}$$

$$d = ((P_{\text{watts}} * G * 30) / 3770 * S)^{.5} \quad P_{\text{watts}} * G_{\text{gain}} = 10^{(P_{\text{dBm}} - 30 + G_{\text{dBi}}) / 10}$$

Source based average:

EUT normal operation: each pulse 200usec, 208 pulses/sec

$$= 20.8 \text{ pulses/100msec}$$

$$\text{Duty cycle} = (20.8 * 0.2\text{msec}) / 100\text{msec} = 4.16\% = -13.8 \text{ dB}$$