

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: Sensus Metering Systems
FCC ID: **KCH510R2**

II. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

The Sensus Model 510R2 MXU (Meter Transceiver Unit) FCC ID: KCH510R2 IC: 2220A-510R2 is a Radio Frequency transceiver unit operating under CFR47 Part 15 of the FCC rules. The Model 510R2 incorporates a part 15.247 Direct Sequence Spread Spectrum Transmitter operating in the 902 to 928 MHz ISM band, and a Part 15 AM Receiver operating in the 952 or 956 MHz MAS bands. The MXU uses spread spectrum techniques for remote water meter reading. The 510R2 will be used for non water pit applications (i.e. side of the house installations). The product transmits meter readings to a vehicle mounted or hand-held mobile data collection devices. The product receives a wake-up signal from the licensed transmitter in the mobile collection system; the 510R2 spread spectrum transmitter sends short bursts of data. A lithium battery powers the EUT; the battery has an expected life of 20 years.

Transmitter Specification

TX Power	24.37 dBm max.
Frequency of operation	904.6-925.4 MHz
Data Rate	15.625 Kbps in <50ms burst
6 dB bandwidth	1.2 MHz
Power source	lithium battery

Software/firmware version: 2R105271

III. TEST DATES AND TEST LOCATION

Testing was performed 10-11 October 2006. All tests were performed at:

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

T.N. Cokenias
EMC Consultant/Agent for Sensus Metering Systems

14 November 2006

Report Revision History

Revision No.	Description	Revised by	Date
-	Original issue	T. Cokenias	11 Oct 2006
1.1	Correct typos p7	T. Cokenias	14 Nov 2006

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 meter transceiver uses a printed circuit folded dipole antenna:

Antenna description	Gain
printed ckt antenna	4.0 dBi (max)
	0.0 dBi (average)

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 EQUIPMENT

TEST EQUIPMENT LIST				
Name of Equipment	Manufacturer	Model No.	Serial No.	Due Date
RF Filter Section	Agilent / HP	85420E	3705A00256	2/4/07
EMI Receiver, 9 kHz ~ 2.9 GHz	Agilent / HP	8542E	3942A00286	2/4/07
Antenna, Horn 1 ~ 18 GHz	ETS	3117	35234	4/22/07
Preamplifier, 1 ~ 26 GHz	Agilent / HP	8449B	3008A00931	8/1/07
Antenna, Bilog 30 MHz ~ 2 Ghz	Sunol Sciences	JB1	A121003	8/13/07
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent / HP	E4446A	MY43360112	5/3/07
Active Loop Antenna	EMCO	6502	9202-2722	11/7/06

TEST RESULTS

Radiated Emissions

Test Requirement: 15.205, 15.247

Out of Band Measurements

Test Requirement: 15.247

Radiated Test Set-up, 1-26 GHz

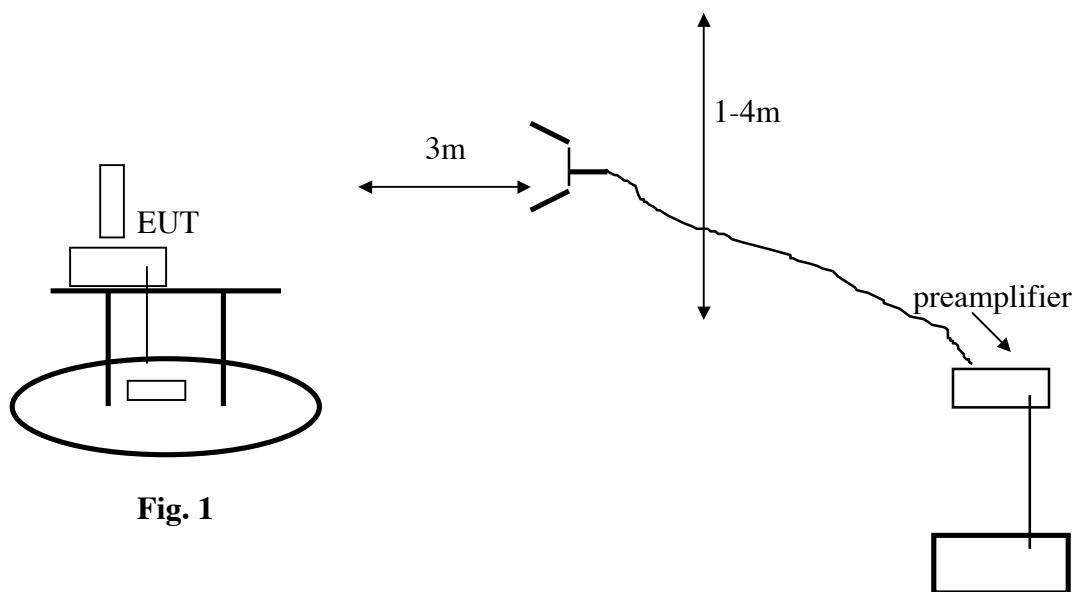


Fig. 1

Measurement Equipment Used:

Spectrum Analyzer, 9 kHz-26.5 GHz

Biconic horn antenna

Horn antenna, 1-18 GHz

Pre-amplifier, 1 – 26.5 GHz

High pass filter, $f_p = 1500$ MHz

Test Procedures

1. The EUT was placed on a wooden table resting on a turntable on the test site. A water meter was connected to the appropriate ports as a typical load.

The search antenna was placed 3m from the EUT. The EUT antenna was mounted vertically as per normal installation.

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. Radiated emissions were investigated for a LOW channel, a MID channel, and HIGH channel. Emissions were investigated to the 10th harmonic.

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). All emissions not reported were more than 20 dB below limits or were below noise floor of measuring system.

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.

Radiated Emissions Above 1 GHz (except for 3rd harmonic, due to 2.7 GHz ambient)
Open Area Site B

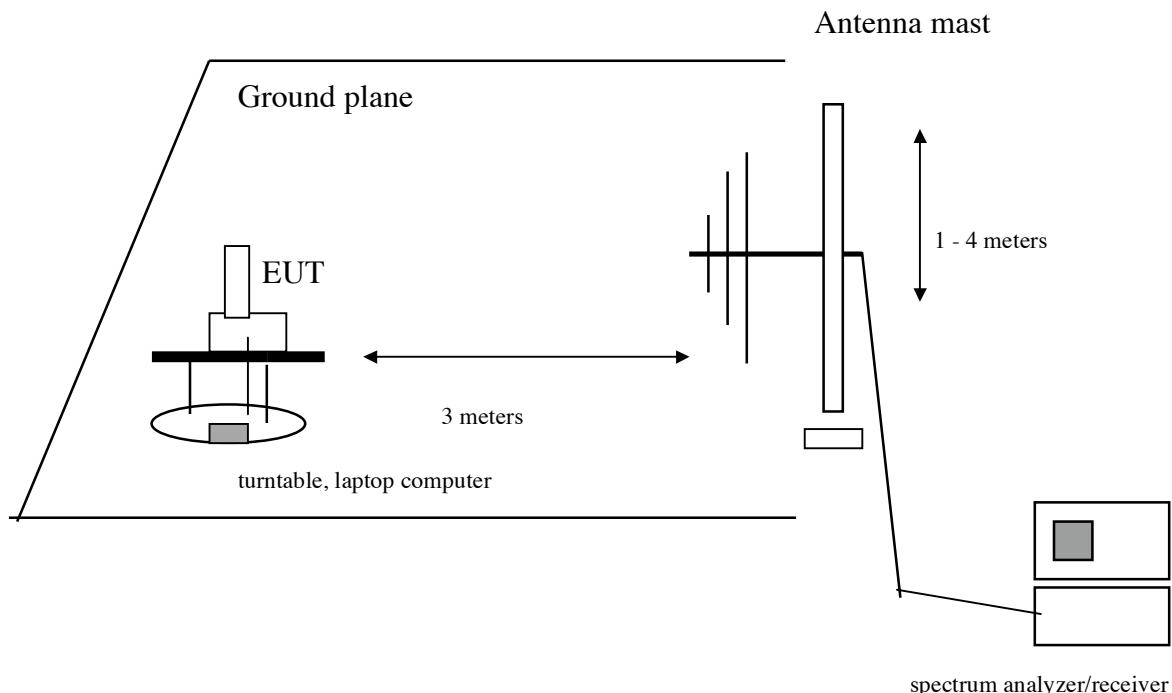
High Frequency Measurement Compliance Certification Services, Morgan Hill Open Field Site																																												
Company: Sensus Meter Systems Project #: 06U10xxx Date: 10/10/2006 Test Engineer: Mengistu Mekuria Configuration: EUT with Utility meter Transceiver Mode: Tx																																												
Spread spectrum wireless translator, Model-510R2, KCH510R2																																												
Test Equipment:																																												
<div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">Horn 1-18GHz</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">Pre-amplifier 1-26GHz</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">Pre-amplifier 26-40GHz</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">Horn > 18GHz</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">HPF</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">Reject Filter</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">Peak Measurements</div> </div>																																												
<div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">T136; M/N: 3117 @3m</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">T144 Miteq 3008A00931</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">Hi Frequency Cables</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">2 foot cable</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">3 foot cable</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">12 foot cable</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">Vien 197209005</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">Joseph 187207005</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">HPF_1.5GHz</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">Reject Filter</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">Peak Measurements</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">RBW=VBW=1MHz</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">Average Measurements</div> <div style="border: 1px solid #ccc; padding: 5px; margin-right: 10px;">RBW=1MHz, VBW=10Hz</div> </div>																																												
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)																													
Low Ch (904.6MHz) E@3m, 100 kHz BW: 110.13dBuV/m (H) 119.1 dBuV/m (V)																																												
3.618	3.0	49.4	44.2	32.9	3.1	-36.9	0.0	0.6	49.0	43.8	74	54	-25.0	-10.2	V																													
4.522	3.0	45.2	34.8	33.5	3.3	-36.5	0.0	0.6	46.1	35.7	74	54	-27.9	-18.3	V																													
1.809	3.0	74.9	30.3	2.5	-38.3	0.0	0.3	69.6	-5.2	99.1	99.1	99.1	-29.5	-104.3	-20 dBc V																													
4.522	3.0	45.2	35.3	33.5	3.3	-36.5	0.0	0.6	46.1	36.2	74	54	-27.9	-17.8	V																													
5.427	3.0	46.5	37.9	34.2	3.7	-36.3	0.0	0.5	48.6	40.0	74	54	-25.4	-14.0	V																													
6.332	3.0	49.6	34.8	3.9	-36.3	0.0	0.5	52.6	2.9	99.1	99.1	99.1	-46.5	-96.2	-20 dBc V																													
7.236	3.0	48.5	42.8	35.2	4.1	-36.2	0.0	0.6	52.2	46.5	74.0	54.0	-21.8	-7.5	V																													
1.809	3.0	70.8	30.3	2.5	-38.3	0.0	0.3	65.6	-5.2	90.1	90.1	90.1	-24.5	-95.3	-20 dBc H																													
2.713	3.0	52.8	46.7	32.1	2.8	-37.4	0.0	0.6	50.8	44.7	74	54	-23.2	-9.3	H																													
3.618	3.0	49.4	44.9	32.9	3.1	-36.9	0.0	0.6	49.0	44.5	74	54	-25.0	-9.5	H																													
4.523	3.0	46.3	36.3	33.5	3.3	-36.5	0.0	0.6	47.2	37.2	74	54	-26.8	-16.8	H																													
5.427	3.0	47.0	36.9	34.2	3.7	-36.3	0.0	0.5	49.1	39.1	74	54	-24.9	-14.9	H																													
7.236	3.0	50.1	46.0	35.2	4.1	-36.2	0.0	0.6	53.8	49.7	74.0	54.0	-20.2	-4.3	H																													
Mid Ch (915MHz) E@3m, 100 kHz BW: 111.24 dBuV/m (H) 119 dBuV/m (V)																																												
1.830	3.0	72.9	30.4	2.5	-38.3	0.0	0.3	67.8	-5.1	99.0	99.0	99.0	-31.2	-104.1	-20 dBc V																													
3.660	3.0	49.1	45.1	32.9	3.1	-36.9	0.0	0.6	48.8	44.7	74	54	-25.2	-9.3	V																													
4.574	3.0	44.6	36.2	33.6	3.3	-36.5	0.0	0.6	45.6	37.2	74	54	-28.4	-16.8	V																													
5.490	3.0	47.2	34.3	3.7	-36.4	0.0	0.5	49.4	2.2	99.0	99.0	99.0	-49.6	-96.8	-20 dBc V																													
6.405	3.0	49.4	34.8	3.9	-36.3	0.0	0.5	52.3	3.0	99.0	99.0	99.0	-46.7	-96.0	-20 dBc V																													
7.325	3.0	47.4	41.0	35.3	4.1	-36.2	0.0	0.6	51.1	44.8	74	54	-22.9	-9.2	V																													
8.234	3.0	46.9	35.9	35.5	4.3	-36.3	0.0	0.7	51.0	40.0	74	54	-23.0	-14.0	V																													
1.830	3.0	69.8	30.4	2.5	-38.3	0.0	0.3	64.7	-5.1	91.2	91.2	91.2	-26.5	-96.3	-20 dBc H																													
3.660	3.0	50.4	45.5	32.9	3.1	-36.9	0.0	0.6	50.0	45.2	74	54	-24.0	-8.8	H																													
4.575	3.0	46.4	37.3	33.6	3.3	-36.5	0.0	0.6	47.4	38.3	74	54	-26.6	-15.7	H																													
5.489	3.0	46.4	34.3	3.7	-36.4	0.0	0.5	48.6	2.1	91.2	91.2	91.2	-42.6	-89.1	-20 dBc H																													
6.405	3.0	50.9	34.8	3.9	-36.3	0.0	0.5	53.9	3.0	91.2	91.2	91.2	-37.3	-88.2	-20 dBc H																													
7.319	3.0	49.0	44.1	35.3	4.1	-36.2	0.0	0.6	52.7	47.9	74	54	-21.3	-6.1	H																													
8.235	3.0	45.1	35.1	35.5	4.3	-36.3	0.0	0.7	49.2	39.2	74	54	-24.8	-14.8	H																													
Hi Ch (925.4MHz) E@3m, 100 kHz BW: 110.1 dBuV/m (H) 117.5 dBuV/m (V)																																												
1.850	3.0	70.9	30.5	2.5	-38.3	0.0	0.3	65.9	-5.0	97.5	97.5	97.5	-31.6		-20 dBc V																													
2.776	3.0	57.1	53.3	32.1	2.8	-37.4	0.0	0.6	55.2	51.4	74	54	-18.8	-2.6	V																													
3.701	3.0	47.0	41.1	32.9	3.1	-36.8	0.0	0.6	46.8	40.9	74	54	-27.2	-13.1	V																													
4.627	3.0	45.3	36.0	33.6	3.4	-36.5	0.0	0.6	46.3	37.0	74	54	-27.7	-17.0	V																													
5.552	3.0	46.2	34.3	34.3	3.7	-36.4	0.0	0.5	48.4	2.2	97.5	97.5	-49.1	-95.3	-20 dBc V																													
6.477	3.0	56.1	34.9	34.9	3.9	-36.3	0.0	0.5	59.1	3.1	97.5	97.5	-38.4	-94.4	-20 dBc V																													
7.403	3.0	47.0	38.7	35.3	4.1	-36.2	0.0	0.6	50.8	42.5	74	54	-23.2	-11.5	V																													
8.328	3.0	45.6	34.9	35.5	4.3	-36.3	0.0	0.7	49.8	39.0	74	54	-24.2	-15.0	V																													
1.850	3.0	66.4	30.5	2.5	-38.3	0.0	0.3	61.5	-5.0	90.1	90.1	90.1	-28.6		-20 dBc H																													
2.776	3.0	52.9	47.2	32.1	2.8	-37.4	0.0	0.6	51.0	45.3	74	54	-23.0	-8.7	H																													
3.701	3.0	49.1	42.5	32.9	3.1	-36.8	0.0	0.6	48.9	42.3	74	54	-25.1	-11.7	H																													
4.627	3.0	45.2	37.4	33.6	3.4	-36.5	0.0	0.6	46.2	38.4	74	54	-27.8	-15.6	H																													
5.552	3.0	47.1	34.3	34.3	3.7	-36.4	0.0	0.5	49.3	2.2	90.1	90.1	-40.8	-87.9	-20 dBc H																													
6.477	3.0	51.0	34.9	34.9	3.9	-36.3	0.0	0.5	54.1	3.1	90.1	90.1	-36.0	-87.0	-20 dBc H																													
7.403	3.0	47.0	40.3	35.3	4.1	-36.2	0.0	0.6	50.8	44.1	74	54	-23.2	-9.9	H																													
8.328	3.0	45.2	35.2	35.5	4.3	-36.3	0.0	0.7	49.3	39.3	74	54	-24.7	-14.7	H																													
For the Freq. 1.8M we used 100K VBW and RBW																																												
Rev. 5.1.6																																												
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33.33%;">f</td><td style="width: 33.33%;">Measurement Frequency</td><td style="width: 33.33%;">Amp</td><td style="width: 33.33%;">Preamp Gain</td><td style="width: 33.33%;">Avg Lim</td><td style="width: 33.33%;">Average Field Strength Limit</td></tr> <tr> <td>Dist</td><td>Distance to Antenna</td><td>D Corr</td><td>Distance Correct to 3 meters</td><td>Pk Lim</td><td>Peak Field Strength Limit</td></tr> <tr> <td>Read</td><td>Analyzer Reading</td><td>Avg</td><td>Average Field Strength @ 3 m</td><td>Avg Mar</td><td>Margin vs. Average Limit</td></tr> <tr> <td>AF</td><td>Antenna Factor</td><td>Peak</td><td>Calculated Peak Field Strength</td><td>Pk Mar</td><td>Margin vs. Peak Limit</td></tr> <tr> <td>CL</td><td>Cable Loss</td><td>HPF</td><td>High Pass Filter</td><td></td><td></td></tr> </table>															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		
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 Above 1 GHz, 3rd harmonic
5m Anechoic Chamber

High Frequency Measurement Compliance Certification Services, Morgan Hill 5m Chamber															
Company: Sensus Metry Systems Project #: 06U10XXX Date: 10/11/2006 Test Engineer: Mengistu Mekuria Configuration: EUT with Utility meter Transceiver Mode: Tx															
Test Equipment:															
Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz												
T136; M/N: 3117 @3m Hi Frequency Cables	T144 Miteq 3008A00931														
2 foot cable	3 foot cable	12 foot cable	HPF		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	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
High Ch 925.4 MHz															
2.776	3.0	54.8	49.8	32.1	2.5	-37.4	0.0	0.6	52.6	47.6	74	54	-21.4	-6.4	V
2.776	3.0	52.4	47.5	32.1	2.5	-37.4	0.0	0.6	50.1	45.2	74	54	-23.9	-8.8	H
Mid Ch 915 MHz															
2.745	3.0	56.1	51.4	32.1	2.5	-37.4	0.0	0.6	53.8	49.1	74	54	-20.2	-4.9	V
2.745	3.0	53.3	46.5	32.1	2.5	-37.4	0.0	0.6	51.1	44.2	74	54	-22.9	-9.8	H
Low Ch 904.6 MHz															
2.713	3.0	53.4	47.9	32.1	2.5	-37.4	0.0	0.6	51.1	45.5	74	54	-22.9	-8.5	V
2.713	3.0	50.3	43.8	32.1	2.5	-37.4	0.0	0.6	47.9	41.4	74	54	-26.1	-12.6	H
Rev. 5.1.6															
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

Radiated Test Set-up, 30 - 1000 MHz



Measurement Equipment Used:

Receiver, 9 kHz - 2.9 GHz
Bilog Antenna, 30 - 2000 MHz

Radiated emissions generated by the digital portion of the EUT were measured.

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.

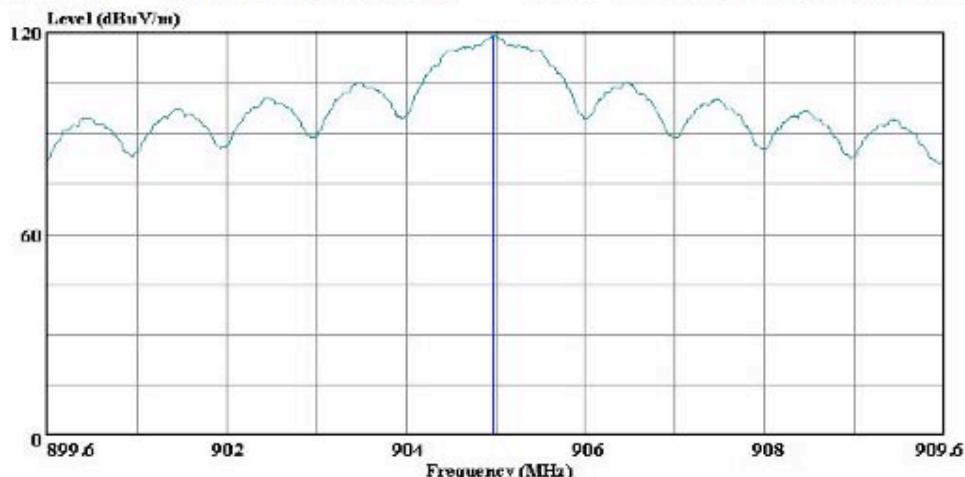
Test Results: EUT meets requirements. All unwanted transmitter emissions in the 30-1000 MHz band are at least 20 below the carrier:

904.6 MHz Fundamental Frequency Field Strength (100kHz BW), Vertical



561F Monterey Road
Morgan Hill, CA 95037
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 37 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 12:29:28



(Audix ATC)

Trace: 36

Ref Trace:

Condition: VERTICAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.:: TX Low Ch Fundamental
Target: : FCC Class B

Page: 1

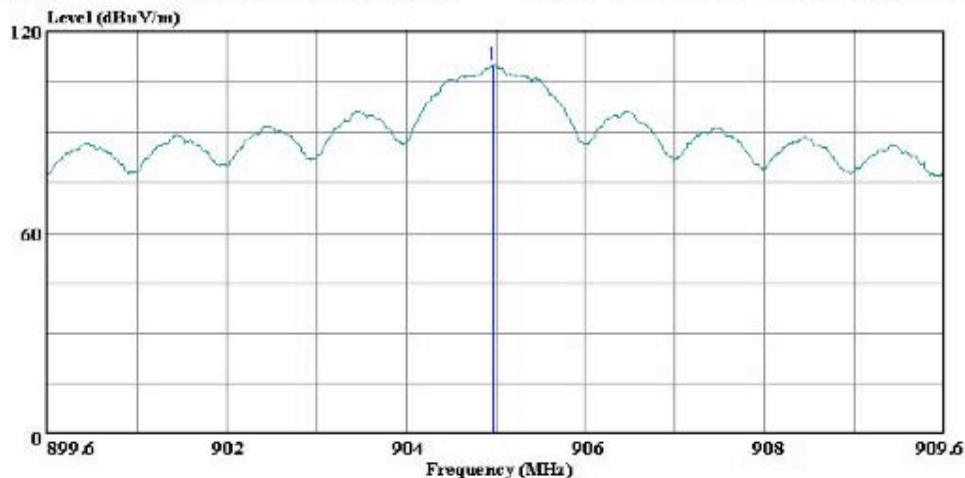
	Read		Limit	Over	
Freq	Level	Factor	Level	Line	Limit
MHz	dBuV		dB	dBuV/m	dBuV/m
1	904.580	93.19	25.99	119.18	----- Peak

904.6 MHz Fundamental Frequency Field Strength (100kHz BW), Horizontal



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Fax: (408) 463-0885

Data#: 39 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 12:33:47



(Audix ATC)

Trace: 38

Ref Trace:

Condition: HORIZONTAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.: TX Low Ch Fundamental
Target: : FCC Class B

Page: 1

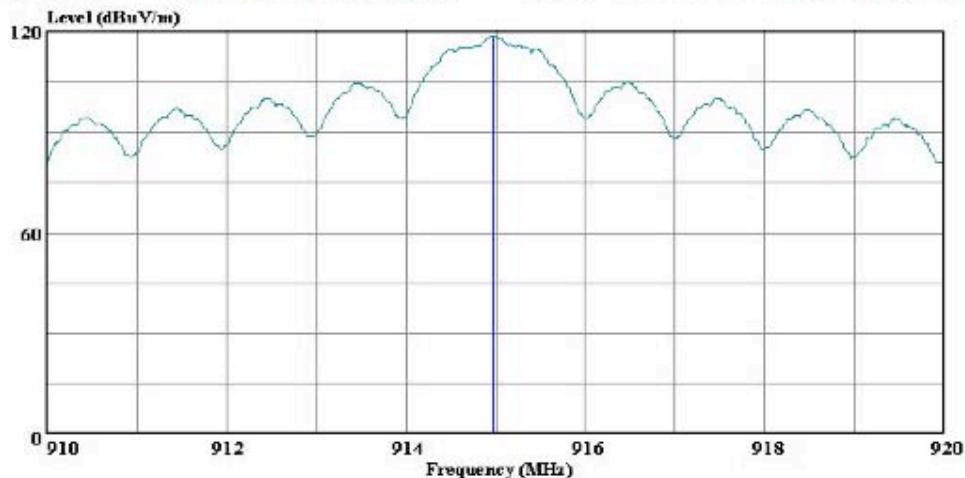
	Read		Limit	Over	
Freq	Level	Factor	Level	Line	Limit
MHz	dBuV		dB	dBuV/m	dBuV/m
1	904.570	84.14	25.99	110.13	----- Peak

915 MHz Fundamental Frequency Field Strength (100kHz BW), Vertical



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Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 35 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 12:19:54



(Audix ATC)

Trace: 34

Ref Trace:

Condition: VERTICAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.: TX Mid Ch Fundamental
Target: : FCC Class B

Page: 1

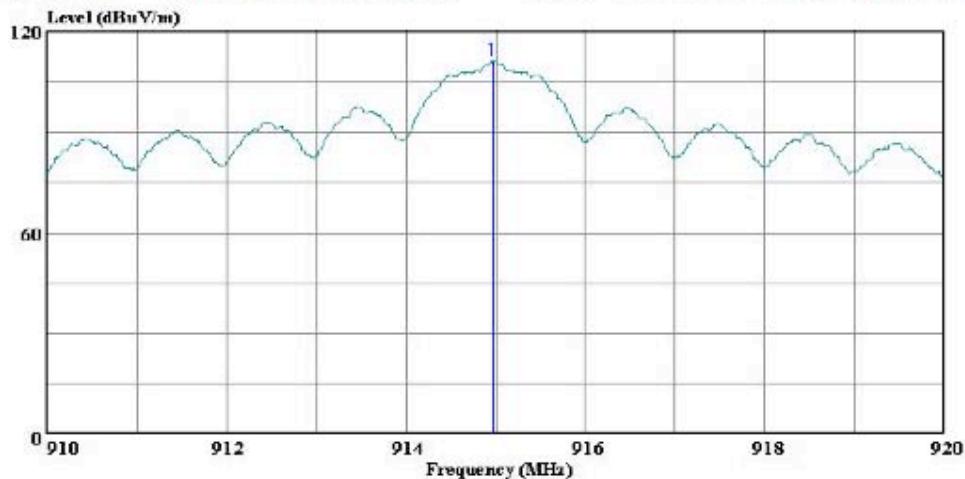
	Read		Limit	Over	
Freq	Level	Factor	Level	Line	Limit
MHz	dBuV		dB	dBuV/m	dBuV/m
1	914.970	92.94	26.03	118.97	----- Peak

915 MHz Fundamental Frequency Field Strength (100kHz BW), Horizontal



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Tel: (408) 463-0888
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Data#: 33 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 12:14:56



(Audix ATC)

Trace: 32

Ref Trace:

Condition: HORIZONTAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.:: TX Mid Ch Fundamental
Target: : FCC Class B

Page: 1

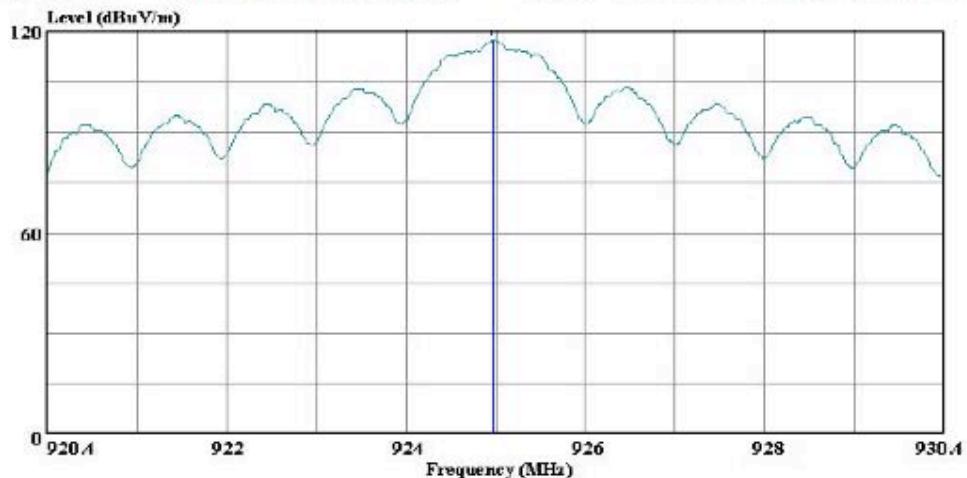
	Read		Limit	Over	
Freq	Level	Factor	Level	Line	Limit
MHz	dBuV		dB	dBuV/m	dBuV/m
1	914.970	85.21	26.03	111.24	----- Peak

925.4 MHz Fundamental Frequency Field Strength (100kHz BW), Vertical



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Data#: 29 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 11:55:16



(Audix ATC)

Trace: 28

Ref Trace:

Condition: VERTICAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.: TX Hi Ch Fundamental
Target: : FCC Class B

Page: 1

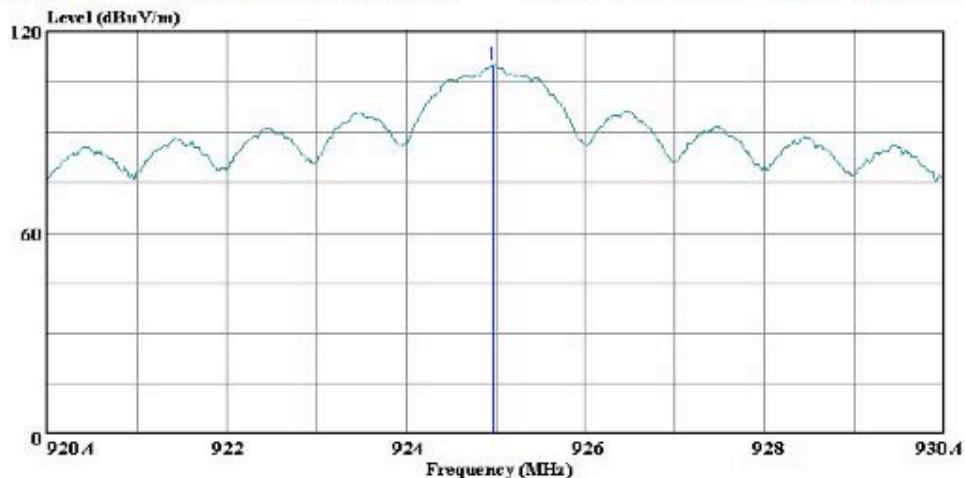
	Read		Limit	Over	
Freq	Level	Factor	Level	Line	Limit
MHz	dBuV		dB	dBuV/m	dBuV/m
1	925.370	91.29	26.22	117.51	----- Peak

925.4 MHz Fundamental Frequency Field Strength (100kHz BW), Horizontal



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Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 31 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 12:03:37



(Audix ATC)

Trace: 30

Ref Trace:

Condition: HORIZONTAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.: TX Hi Ch Fundamental
Target: : FCC Class B

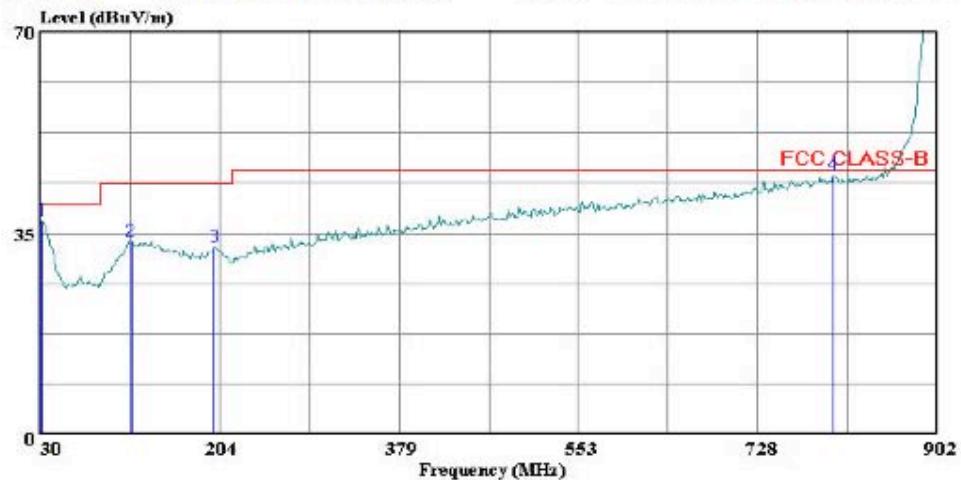
Page: 1

	Read		Limit	Over		
Freq	Level	Factor	Level	Line	Limit	Remark
MHz	dBuV		dB	dBuV/m	dBuV/m	dB
1	925.370	83.85	26.22	110.07	-----	Peak



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Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 47 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 15:13:52



(Audix ATC)
Trace: 46 Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.: TX Low Ch
Target: : FCC Class B

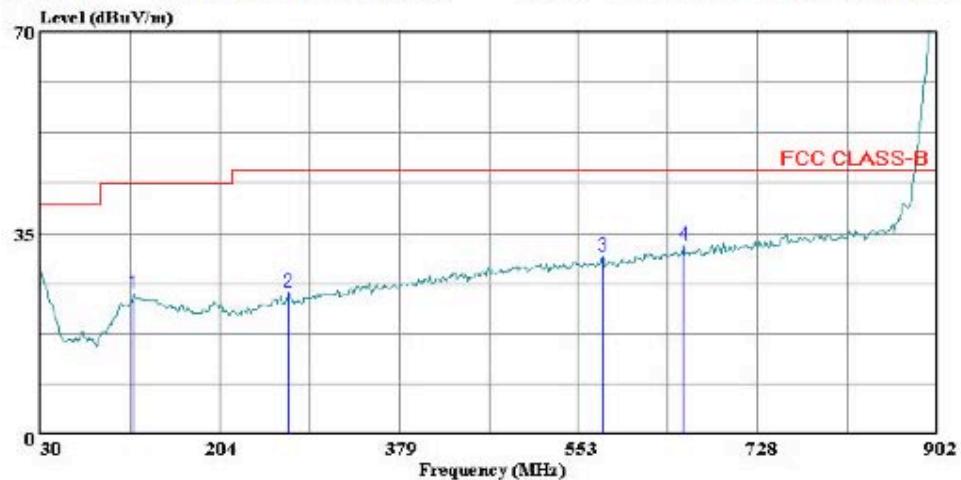
Page: 1

	Freq	Read Level	Factor	Limit Level	Limit Line	Over Limit	Remark
	MHz	dBuV		dBuV/m	dBuV/m	dB	
1	31.744	16.76	20.41	37.17	40.00	-2.83	Peak
2	118.072	18.70	14.84	33.54	43.50	-9.96	Peak
3	199.168	18.00	14.50	32.50	43.50	-11.00	Peak
4	800.848	20.42	24.58	45.00	46.00	-1.00	Peak



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Data#: 10 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 10:40:03



(Audit ATC)

Trace: 5

Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.:: TX Low Ch
Target: : FCC Class B

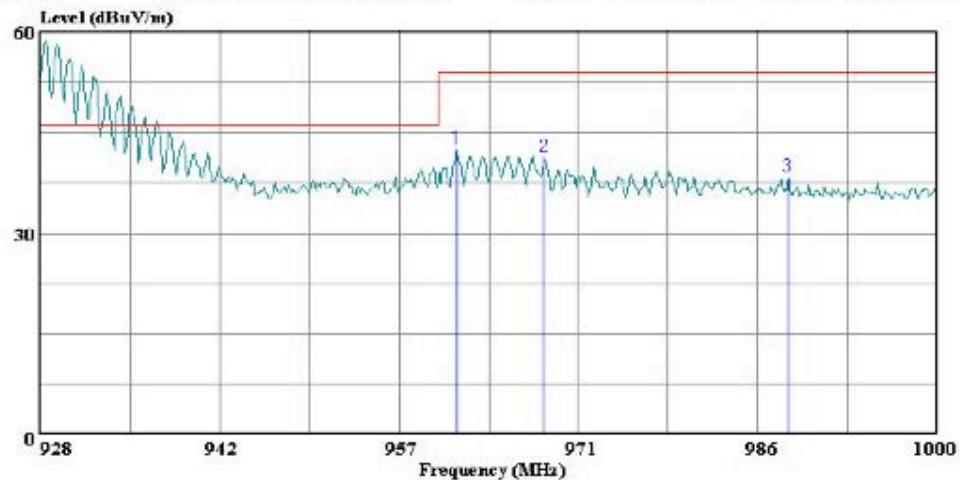
Page: 1

	Freq	Read Level	Factor	Limit Level	Line	Over Limit	Remark
	MHz	dBuV		dBuV/m	dBuV/m		
1	120.688	9.46	15.12	24.57	43.50	-18.93	Peak
2	271.544	10.07	14.65	24.72	46.00	-21.28	Peak
3	576.744	9.91	21.21	31.12	46.00	-14.88	Peak
4	655.224	10.42	22.43	32.85	46.00	-13.15	Peak



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Data#: 7 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 10:34:01



(Audix ATC)

Trace: 6

Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.:: TX Low Ch
Target: : FCC Class B

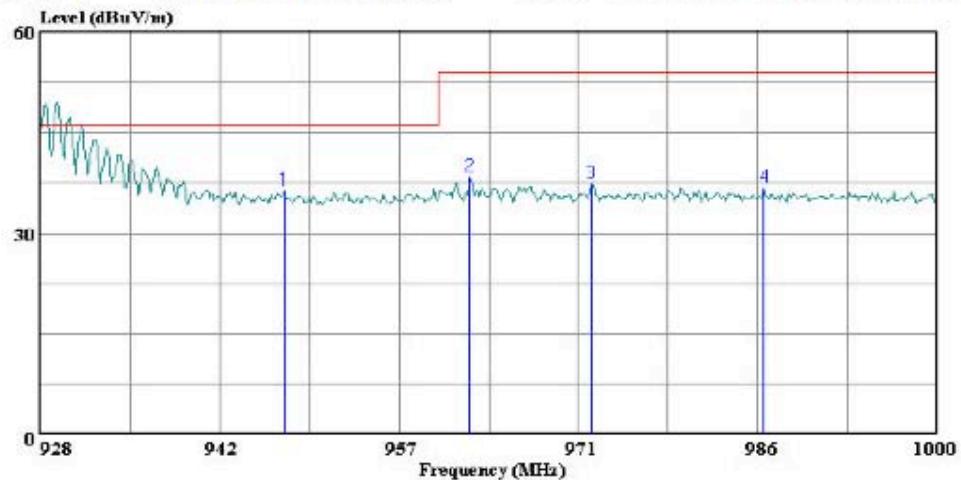
Page: 1

	Freq	Read Level	Factor	Limit Level	Line	Over Limit	Remark
	MHz	dBuV		dBuV/m	dBuV/m		
1	961.408	15.96	26.59	42.55	54.00	-11.45	Peak
2	968.464	14.57	26.65	41.23	54.00	-12.77	Peak
3	988.048	11.56	26.83	38.39	54.00	-15.61	Peak



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Data#: 9 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 10:38:35



(Audix ATC)

Trace: 8

Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.:: TX Low Ch
Target: : FCC Class B

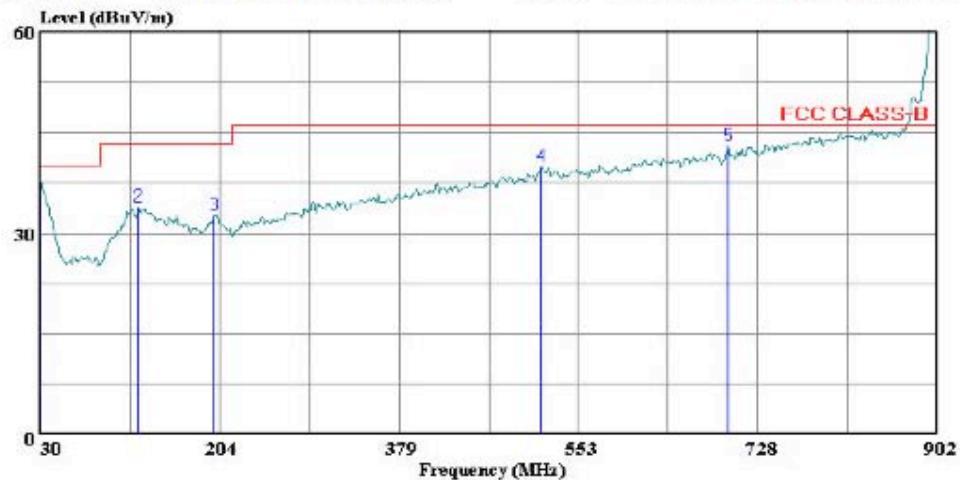
Page: 1

Freq	Read		Limit	Over	Remark
	MHz	dBuV			
		dB	dBuV/m	dBuV/m	dB
1	947.584	9.90	26.45	36.35	46.00 -9.65 Peak
2	962.488	11.78	26.61	38.39	54.00 -15.61 Peak
3	972.208	10.73	26.68	37.41	54.00 -16.59 Peak
4	986.104	10.02	26.79	36.81	54.00 -17.19 Peak



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Data#: 49 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 15:22:58



(Audix ATC)

Trace: 48

Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.:: TX Mid Ch
Target: : FCC Class B

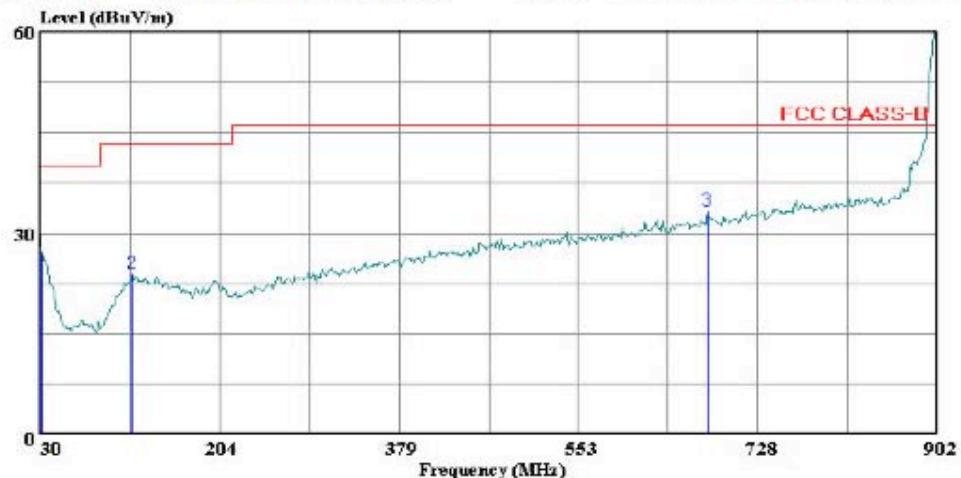
Page: 1

Freq	Read		Limit	Over	Remark
	MHz	dBuV			
			dBuV/m	dBuV/m	dB
1	30.000	17.04	20.45	37.49	40.00 -2.51 Peak
2	125.048	18.57	15.26	33.83	43.50 -9.67 Peak
3	199.168	18.13	14.50	32.63	43.50 -10.87 Peak
4	516.576	19.29	20.48	39.77	46.00 -6.23 Peak
5	698.824	19.92	23.07	42.99	46.00 -3.01 Peak



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Data#: 18 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 11:01:52



Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.: TX Mid Ch
Target: : FCC Class B

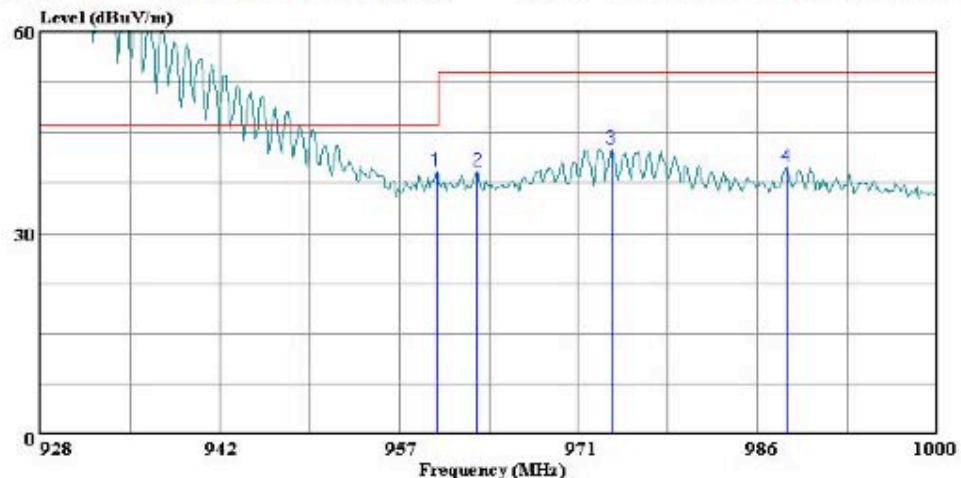
Page: 1

	Freq	Read Level	Factor	Limit Level	Line	Over Limit	Remark
	MHz	dBuV		dBuV/m	dBuV/m		
1	30.872	6.66	20.45	27.11	40.00	-12.89	Peak
2	118.944	8.79	15.01	23.80	43.50	-19.70	Peak
3	678.768	10.31	22.81	33.12	46.00	-12.88	Peak



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Data#: 14 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 10:52:37



(Audit ATC)

Trace: 13

Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.:: TX Mid Ch
Target: : FCC Class B

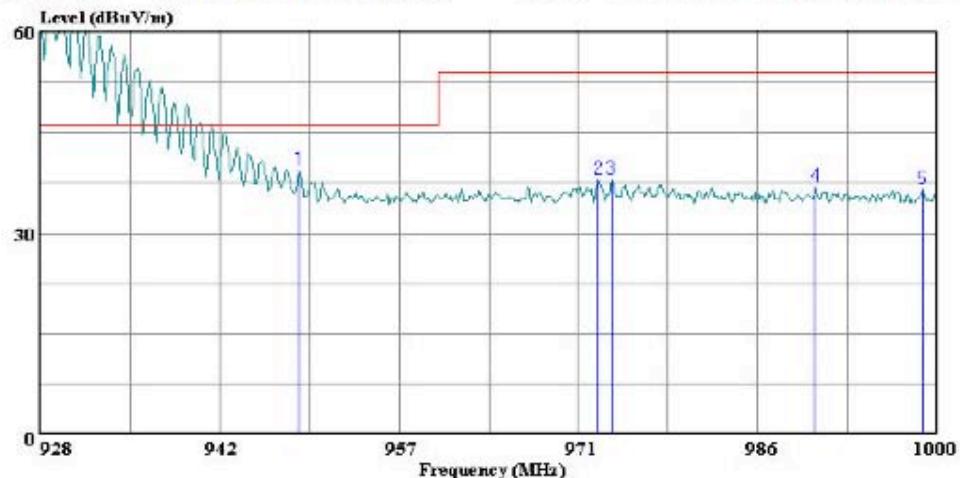
Page: 1

	Freq	Read Level	Factor	Limit Level	Line	Over Limit	Remark
	MHz	dBuV		dBuV/m	dBuV/m		
1	959.824	12.72	26.56	39.28	46.00	-6.72	Peak
2	963.064	12.57	26.61	39.18	54.00	-14.82	Peak
3	973.864	15.87	26.67	42.54	54.00	-11.46	Peak
4	987.904	13.05	26.83	39.88	54.00	-14.12	Peak



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Data#: 12 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 10:47:20



(Audit ATC)

Trace: 11

Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.:: TX Mid Ch
Target: : FCC Class B

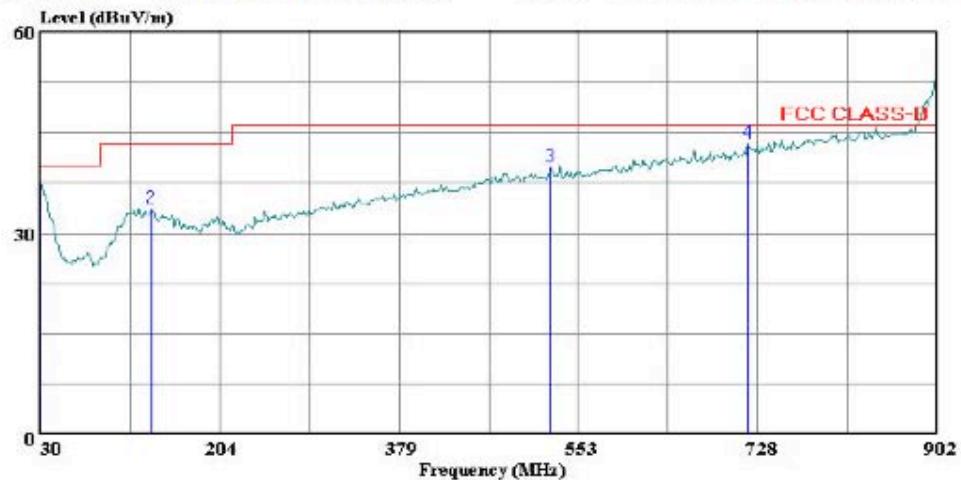
Page: 1

Freq	Read		Limit	Over	Remark
	MHz	dBuV			
			dB	dBuV/m	dBuV/m
1	948.808	12.93	26.46	39.39	46.00 -6.61 Peak
2	972.784	11.32	26.68	38.00	54.00 -16.00 Peak
3	973.864	11.34	26.67	38.01	54.00 -15.99 Peak
4	990.208	10.16	26.89	37.05	54.00 -16.95 Peak
5	998.848	9.60	26.88	36.48	54.00 -17.52 Peak



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Data#: 51 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 15:30:59



(Audix ATC)
Trace: 50 Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.:: TX Hi Ch
Target: : FCC Class B

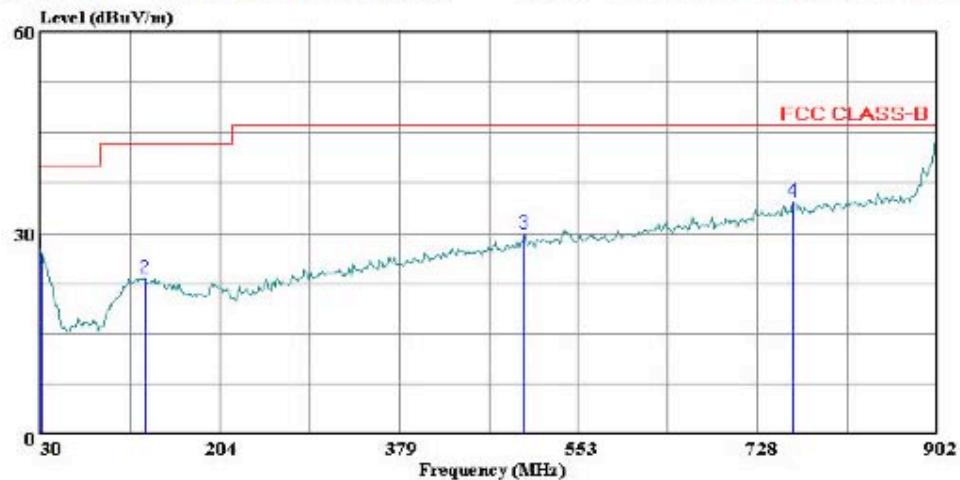
Page: 1

Freq	Read		Limit	Over	Remark
	MHz	dBuV			
			dBuV/m	dBuV/m	dB
1	30.000	16.88	20.45	37.33	40.00 -2.67 Peak
2	138.128	18.81	14.90	33.71	43.50 -9.79 Peak
3	526.168	19.17	20.62	39.79	46.00 -6.21 Peak
4	718.008	19.90	23.40	43.30	46.00 -2.70 Peak



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Tel: (408) 463-0888
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Data#: 23 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 11:21:15



(Audix ATC)
Trace: 22 Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.: TX Hi Ch
Target: : FCC Class B

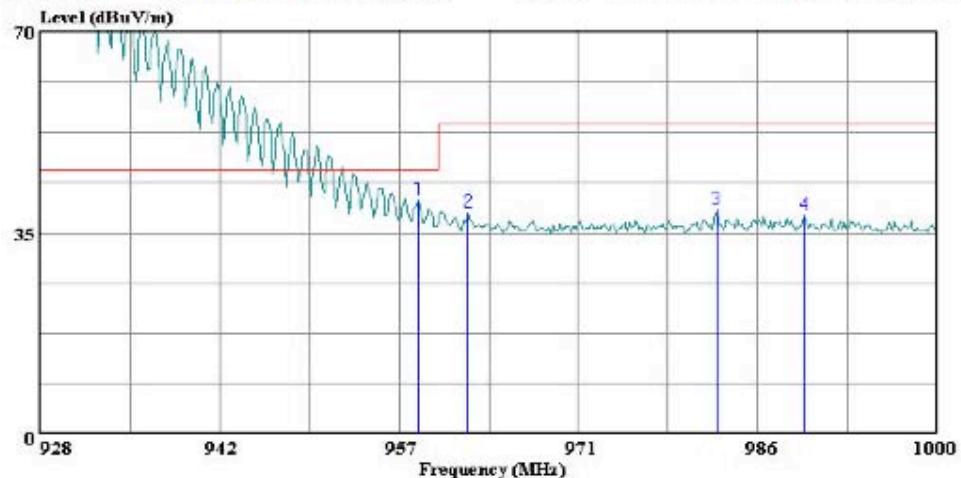
Page: 1

Freq	Read		Limit	Over	Remark
	MHz	dBuV			
			dBuV/m	dBuV/m	
1	30.872	6.60	20.45	27.05	40.00 -12.95 Peak
2	132.024	8.28	15.07	23.35	43.50 -20.15 Peak
3	500.008	9.69	20.22	29.91	46.00 -16.09 Peak
4	761.608	10.58	24.02	34.60	46.00 -11.40 Peak



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Data#: 25 File#: 30-900MHz H.EMI Date: 10-11-2006 Time: 11:31:38



(Audix ATC)

Trace: 24

Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Operator:: Mengistu Mekuria
Company: : Sensus
Project #: : 06U10606
Configuration:: EUT
Mode of Oper.: TX Hi Ch
Target: : FCC Class B

Page: 1

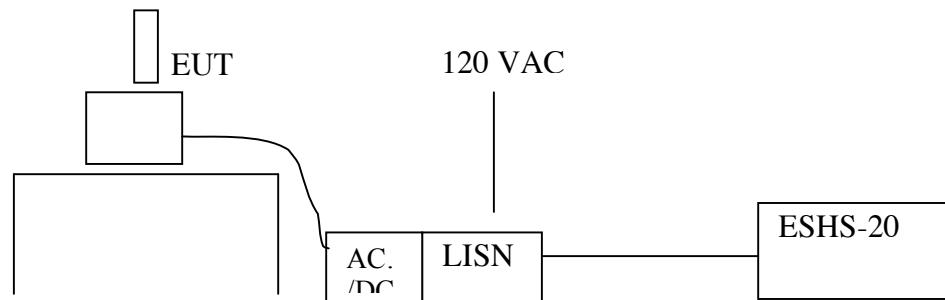
Freq	Read		Limit	Over	Remark
	Level	Factor			
MHz	dBuV	dB	dBuV/m	dBuV/m	dB
1	958.384	14.10	26.52	40.62	46.00 -5.38 Peak
2	962.344	11.85	26.60	38.45	54.00 -15.55 Peak
3	982.288	12.38	26.74	39.12	54.00 -14.88 Peak
4	989.344	11.23	26.87	38.10	54.00 -15.90 Peak

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

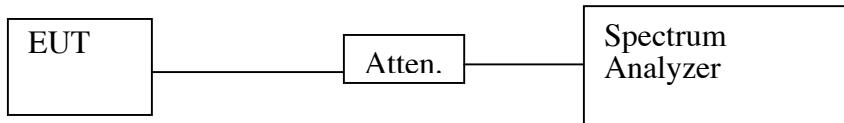
NOT APPLICABLE. EUT battery powered only.

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

Measurement Equipment Used:

Spectrum Analyzer, 9 kHz-26.5 GHz
20 dB attenuator

Test Set-up



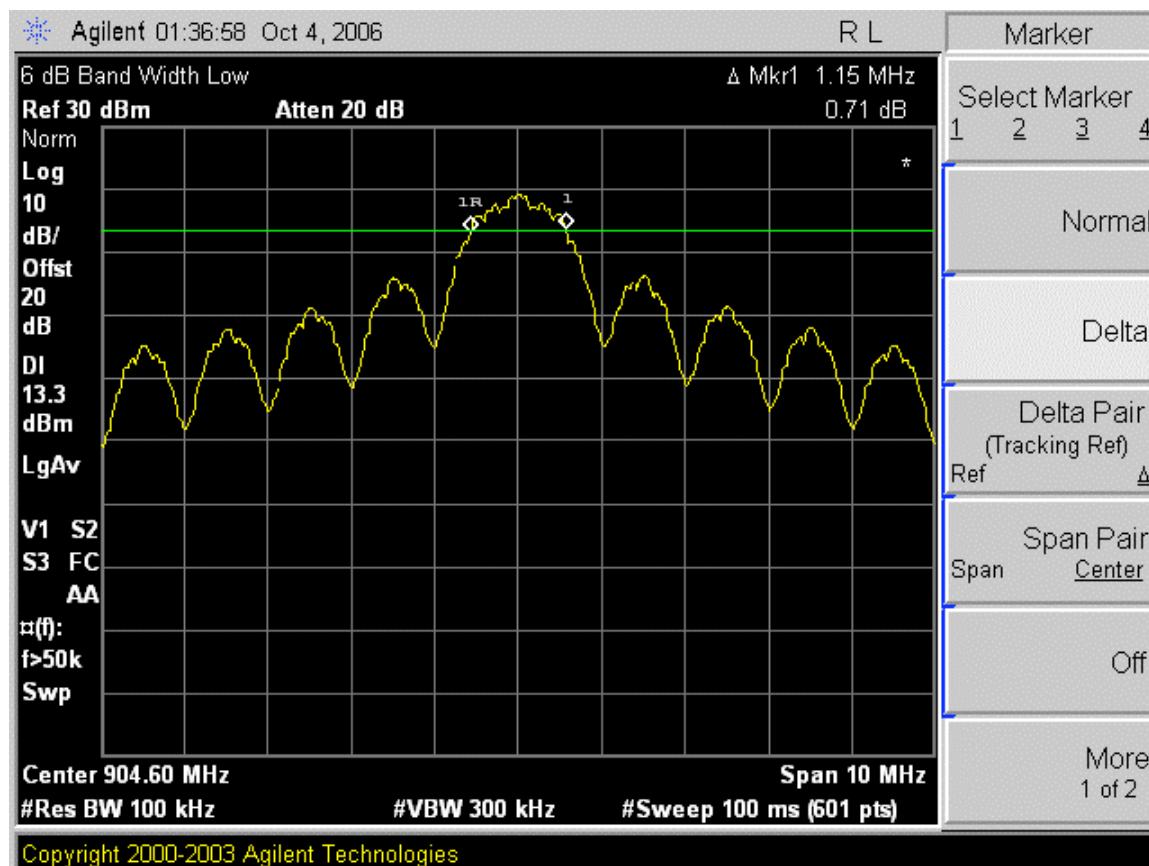
Test Procedures

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. The EUT transmission was continuous at 904.6 MHz (LOW channel). 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.

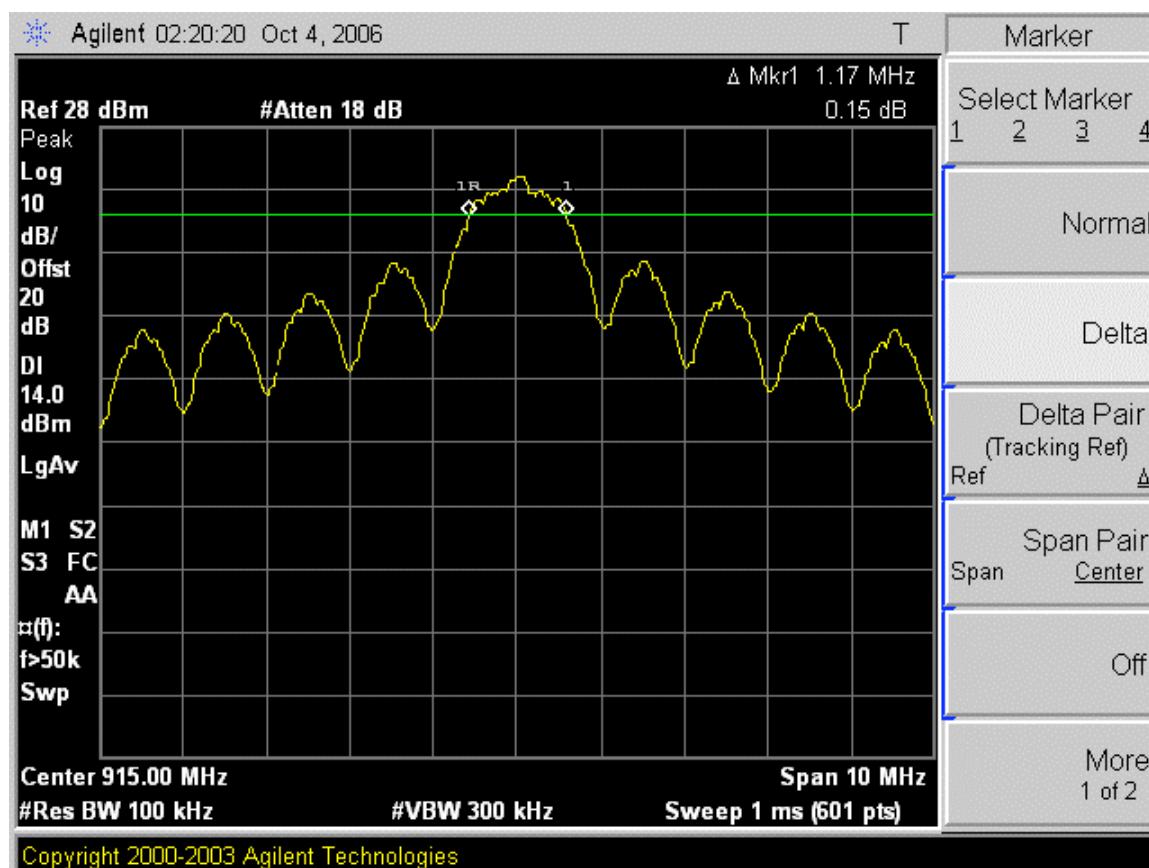
Test was repeated for MID and HIGH channels.

Test Results: 6dB BW measured approximately 1.15 MHz. Refer to data sheets below.

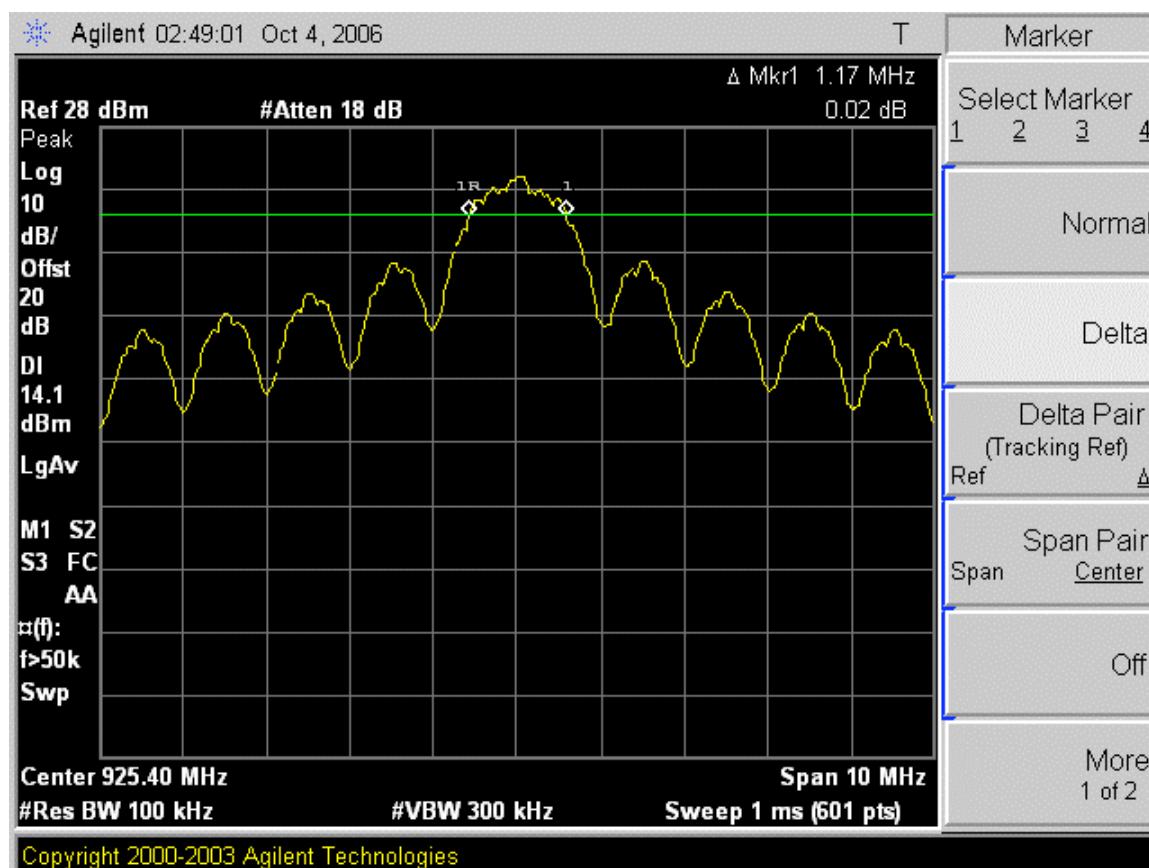
15.247 6dB Channel Bandwidth LOW channel



15.247 6 dB Channel Bandwidth MID channel



15.247 6 dB Channel Bandwidth HIGH channel



99% Bandwidth

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

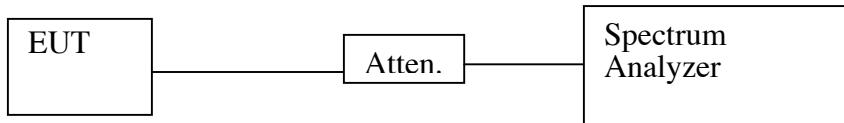
Measurement Equipment Used:

Spectrum Analyzer, 9 kHz-26.5 GHz
20 dB attenuator

Limit

None: for reporting purposes only.

Test Set-up



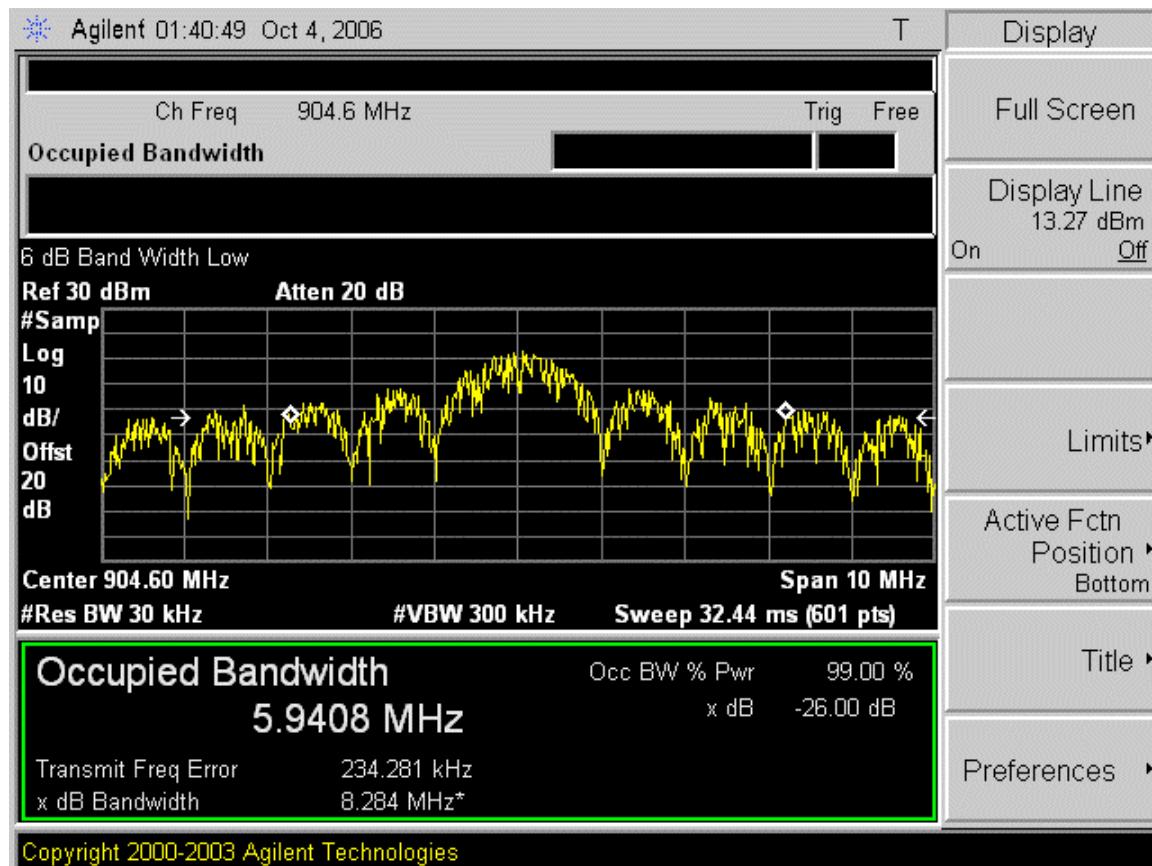
Test Procedure

The transmitter output is connected to the spectrum analyzer. The occupied bandwidth measuring function of the spectrum analyzer was activated and set to display the 99% occupied bandwidth.

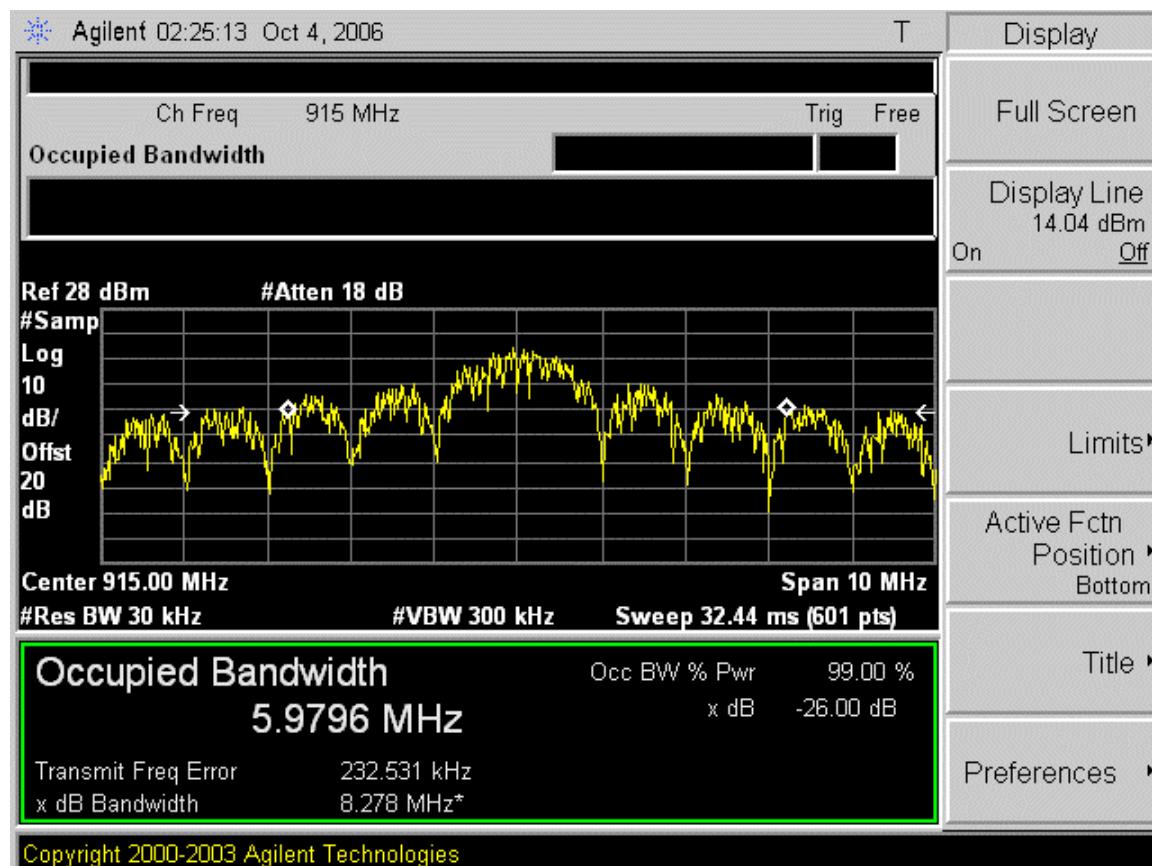
Test Results

Refer to spectrum analyzer charts below.

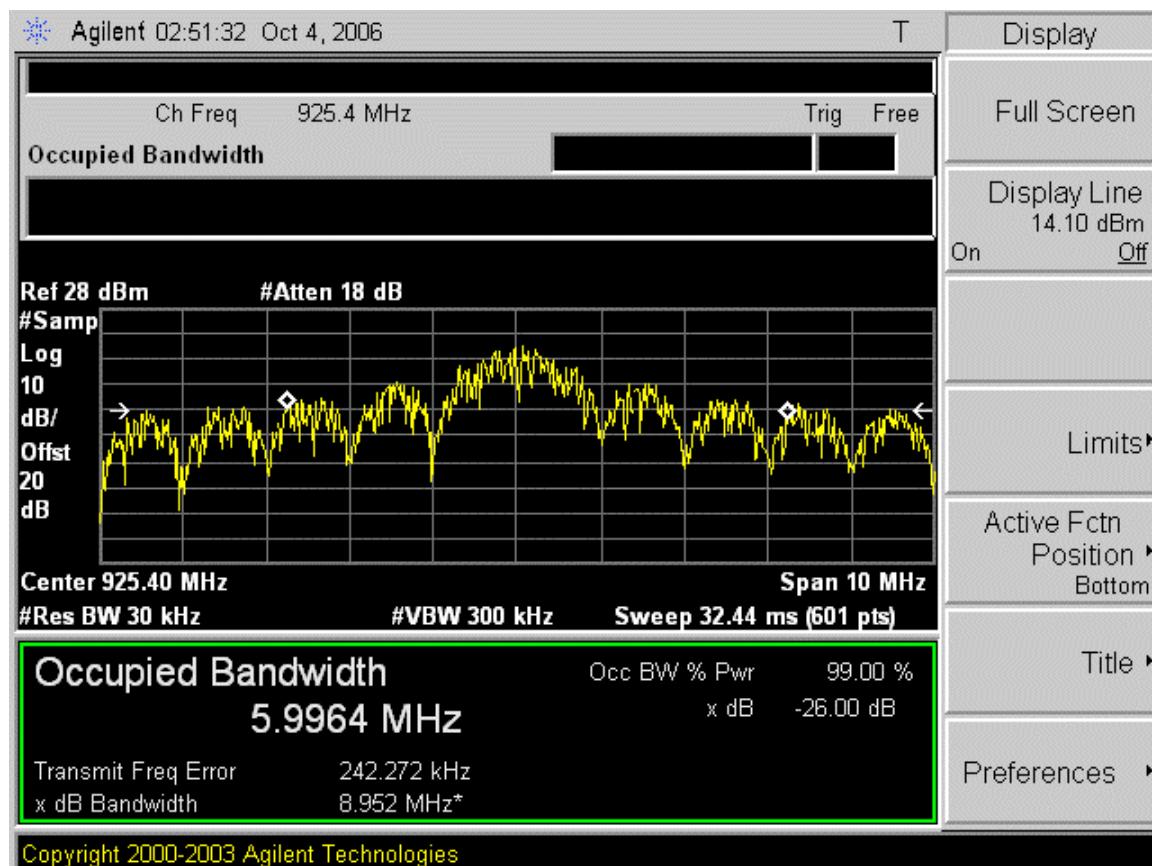
99% Bandwidth LOW Channel



99% Bandwidth MID Channel



99% Bandwidth HIGH Channel

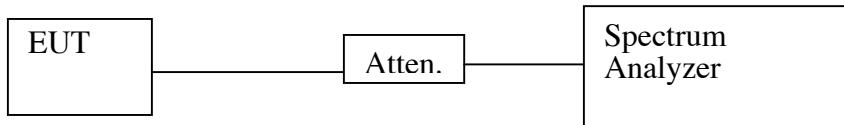


RF Power Output
Test Requirement: 15.247

Measurement Equipment Used:

Spectrum Analyzer, 9 kHz-26.5 GHz
20 dB attenuator

Test Set-up



Test Procedures

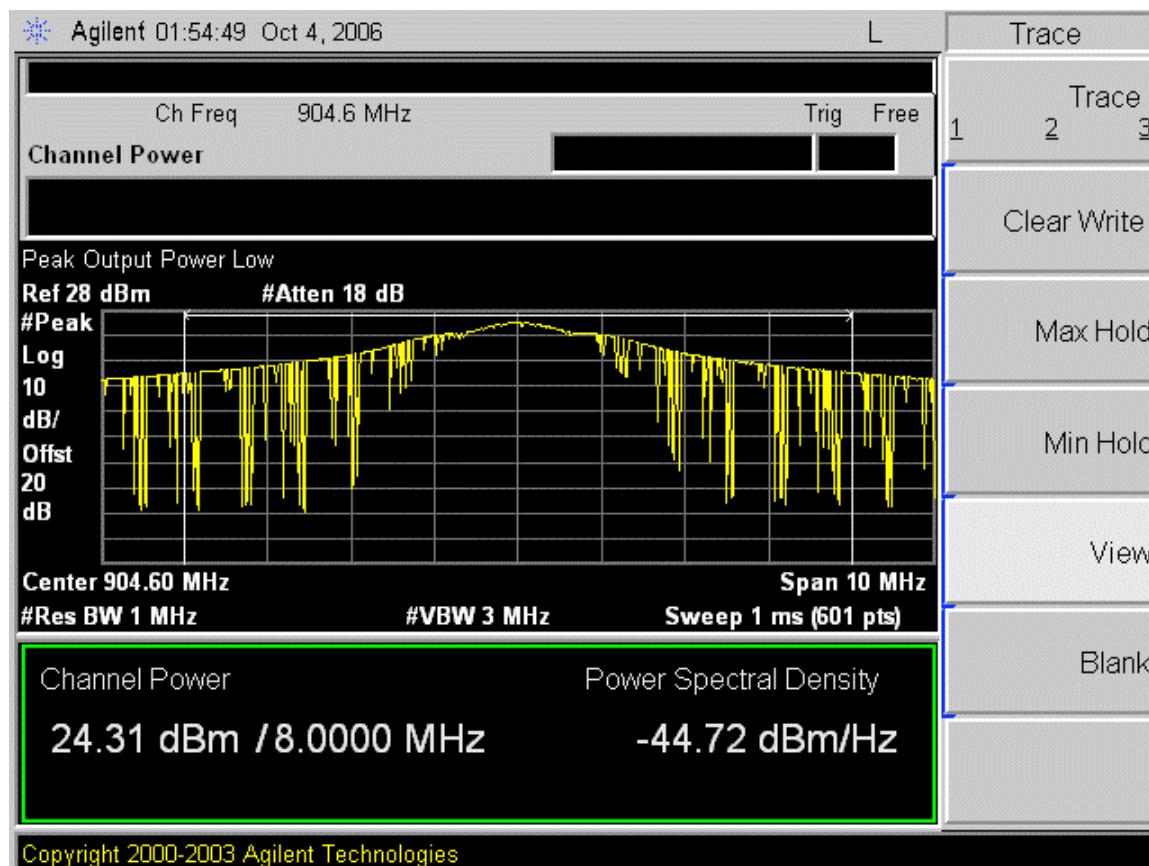
1. The EUT was configured on a test bench. The spectrum analyzer channel power measurement function was activated and set to measure peak power.
2. The process was repeated for LOW, MID channel and HIGH channel.

Test Results

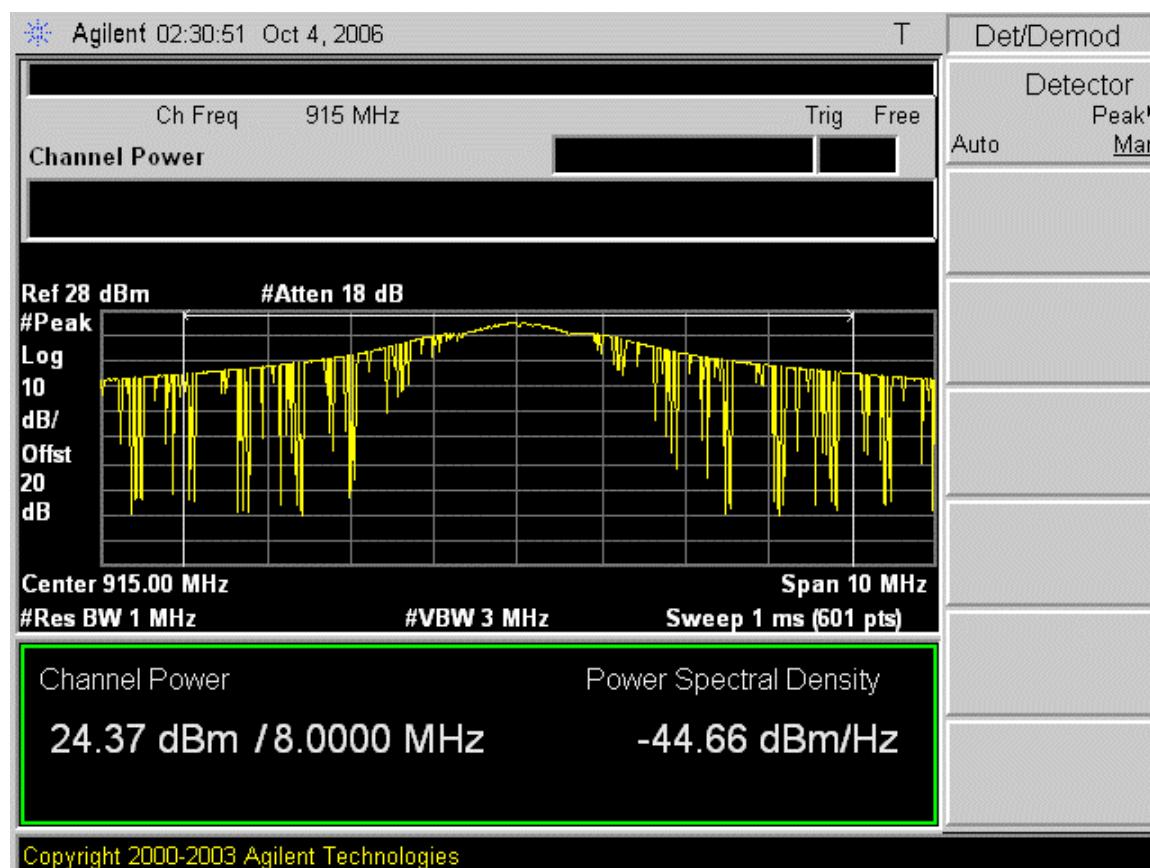
Power level readings converted to dBm are shown below. Refer also to spectrum analyzer graphs. Reference level offset corrects for external attenuation and cable loss.

Channel	Frequency, MHz	Output Power, dBm
LOW	904.6	24.31
MID	915	24.37
HIGH	925.4	24.37

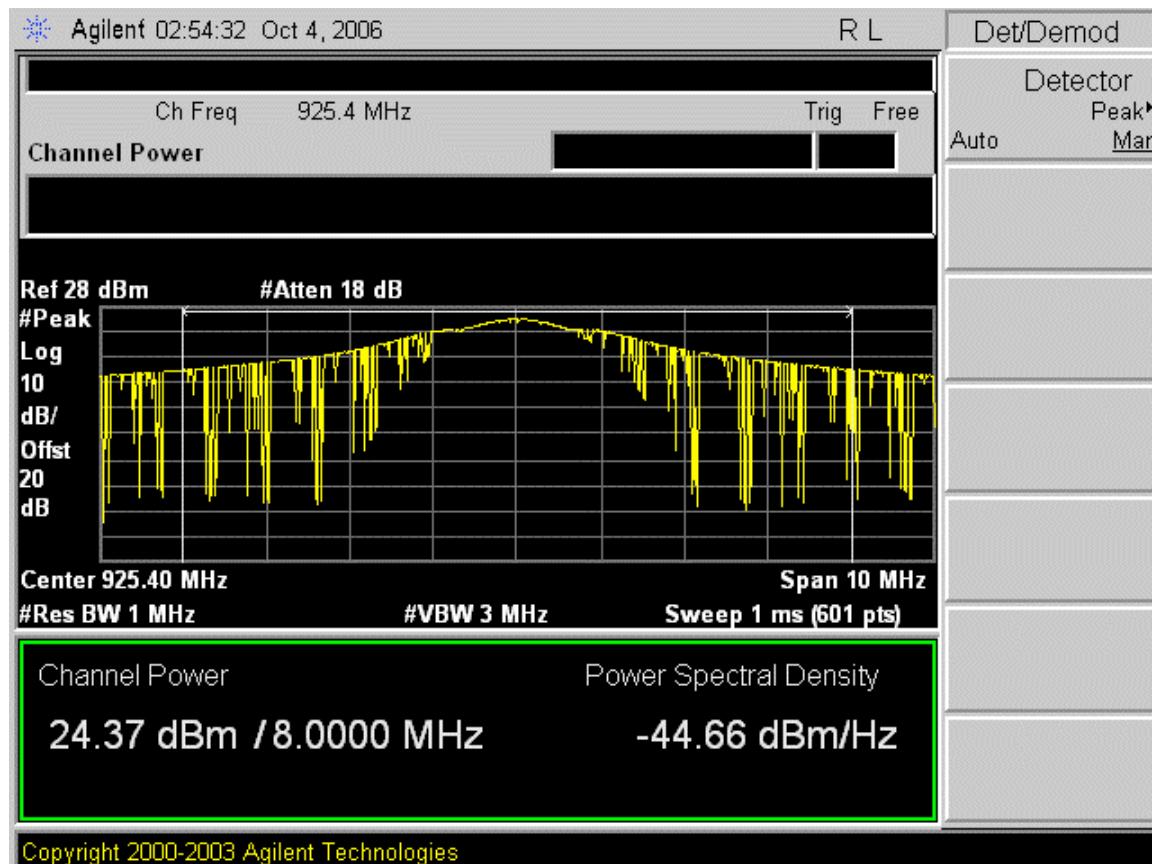
Low Channel Peak Output Power



Mid Channel Peak Output Power



High Channel Peak Output Power

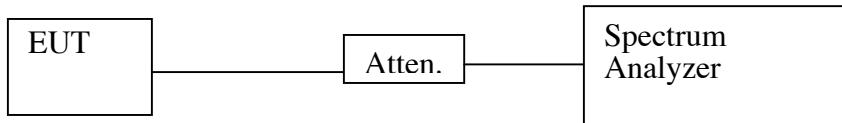


**Spurious Emissions, Conducted
Test Requirement: 15.247(c)**

Measurement Equipment Used:

Spectrum Analyzer, 9 kHz-26.5 GHz
20 dB attenuator

Test Set-up



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.

2. The process in (1) was repeated for MID channel and HIGH channel.

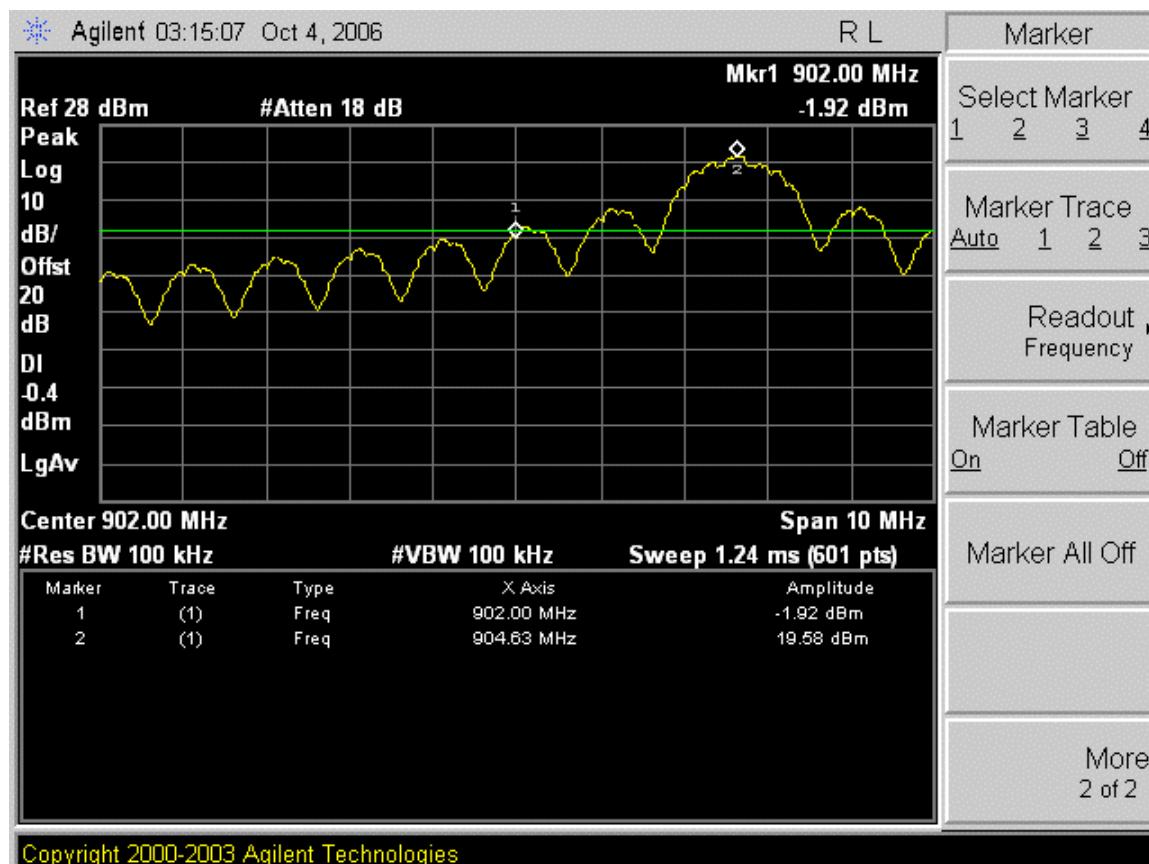
Test Results

PASS. Refer to attached data sheets. Data shows out of band emissions are suppressed well below the -20 dBc minimum required by the Rules.

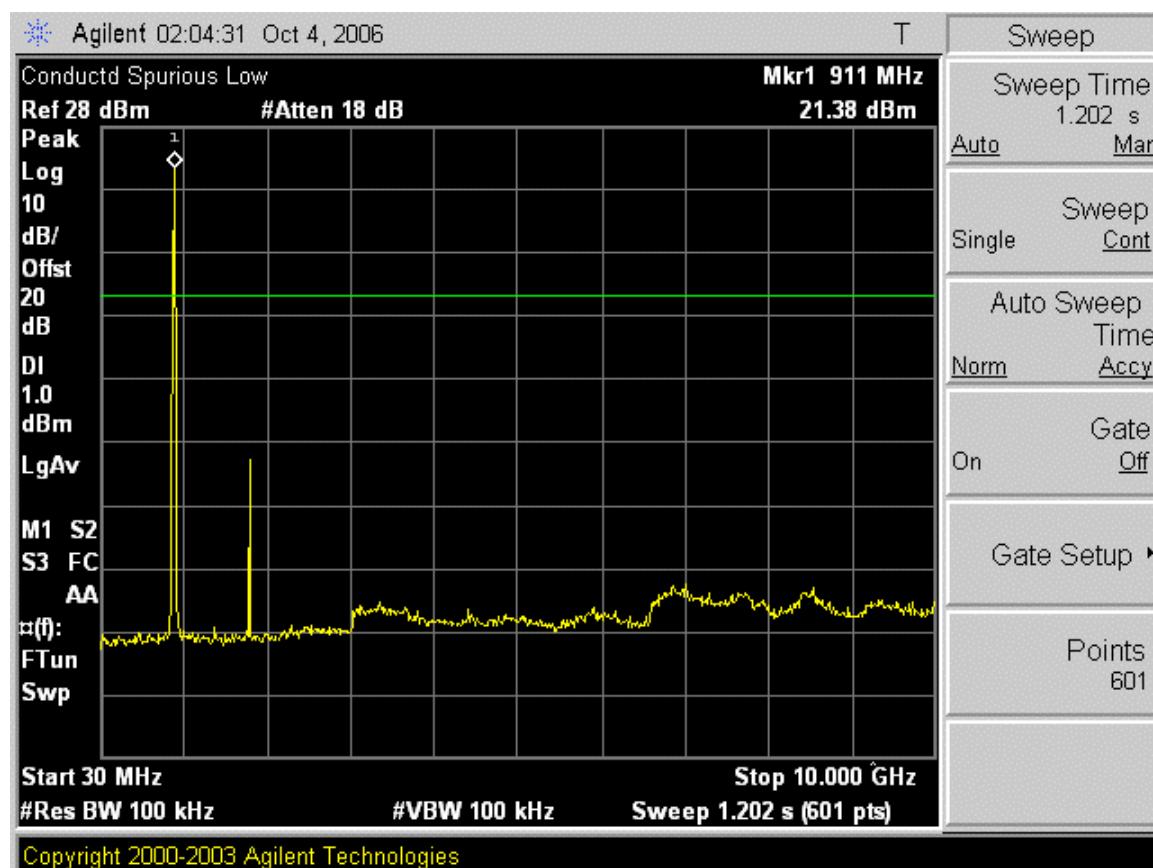
Channel Frequency, MHz

LOW	904.6
MID	915
HIGH	925.4

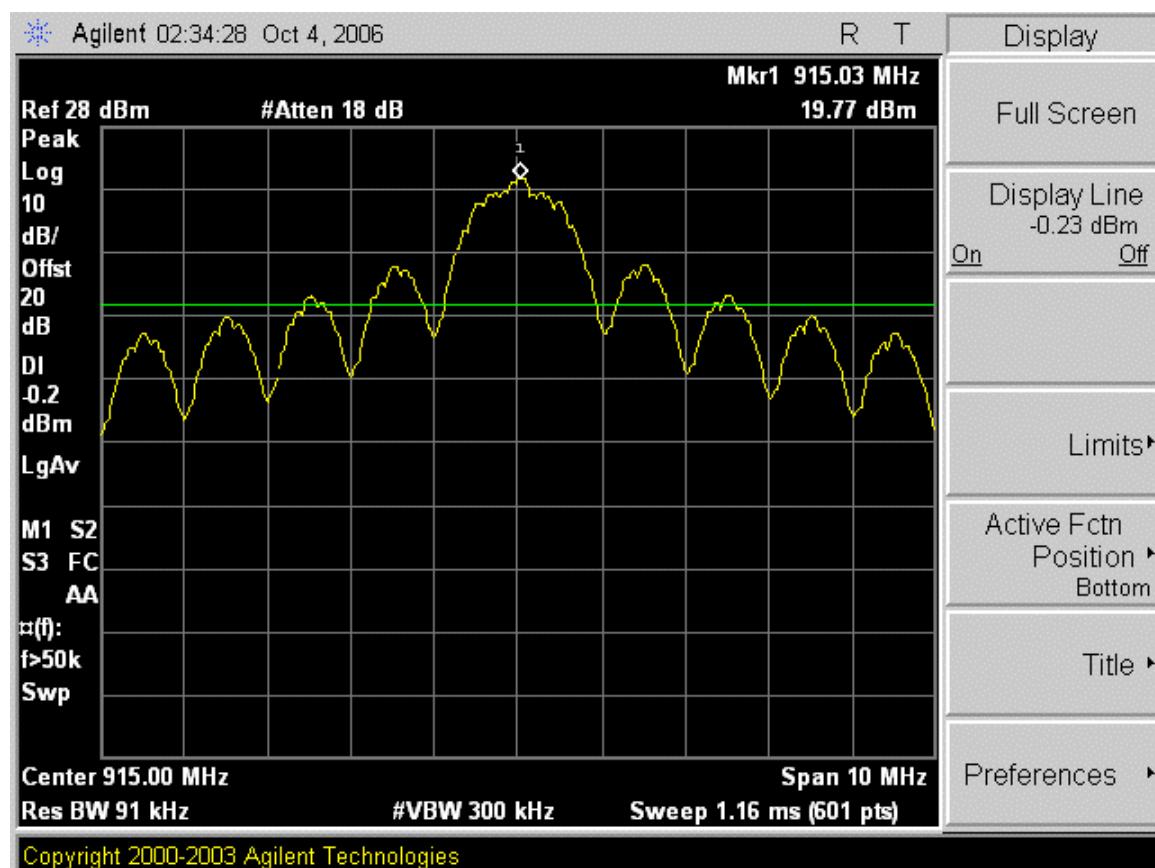
Out of Band Low Channel (1 of 2)



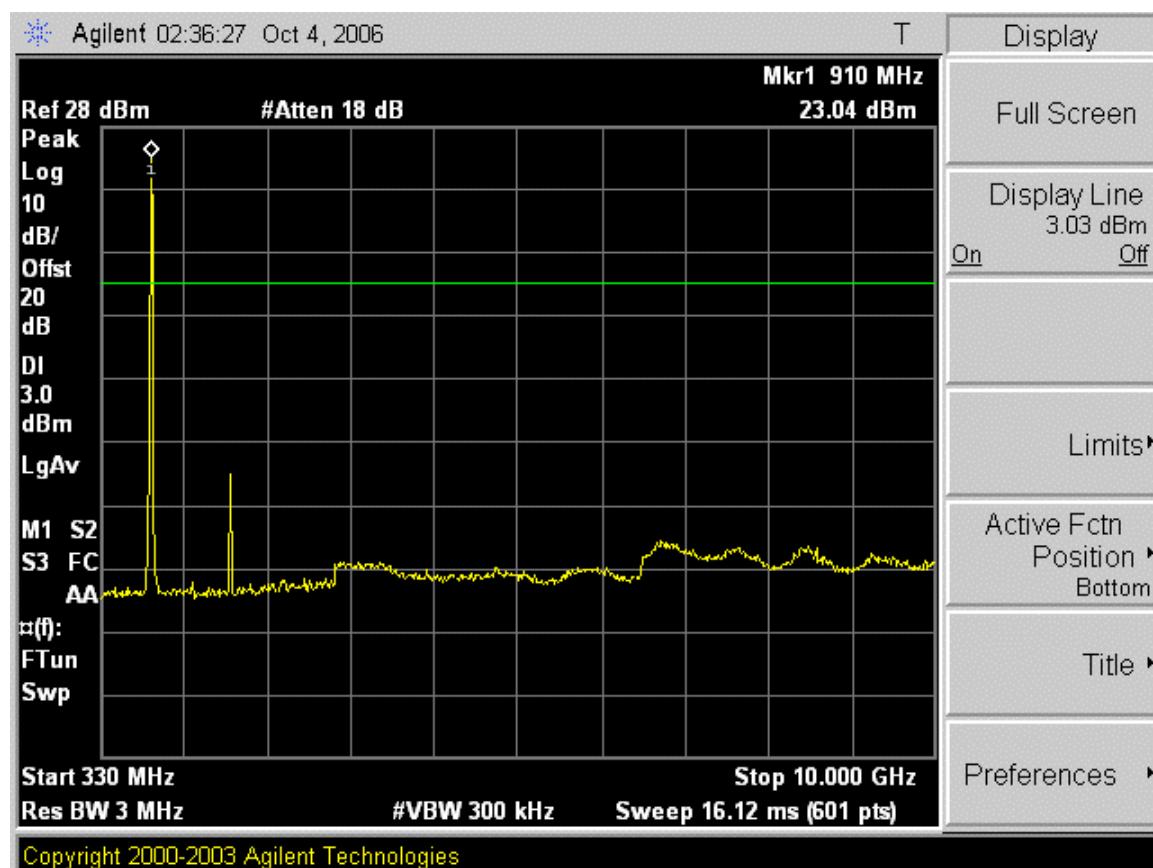
Out of Band Low Channel (2 of 2)



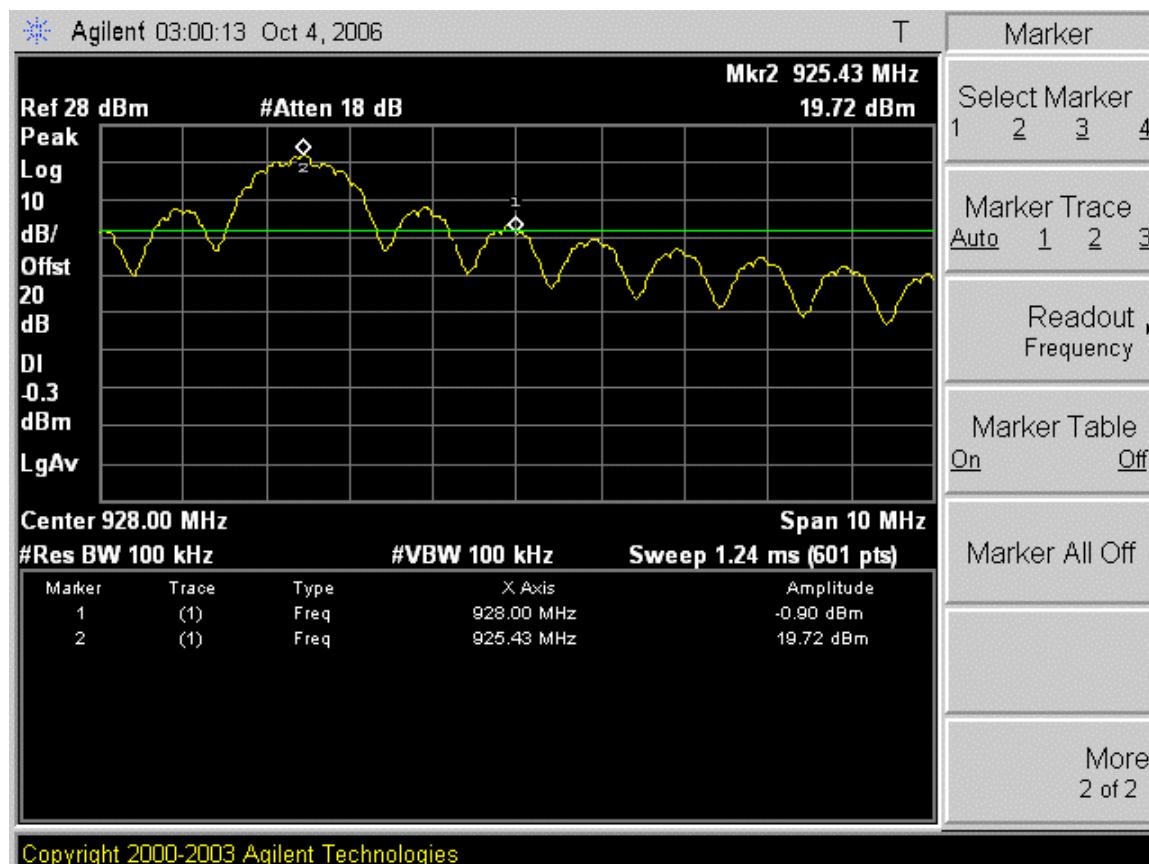
Out of Band Mid Channel (1 of 2)



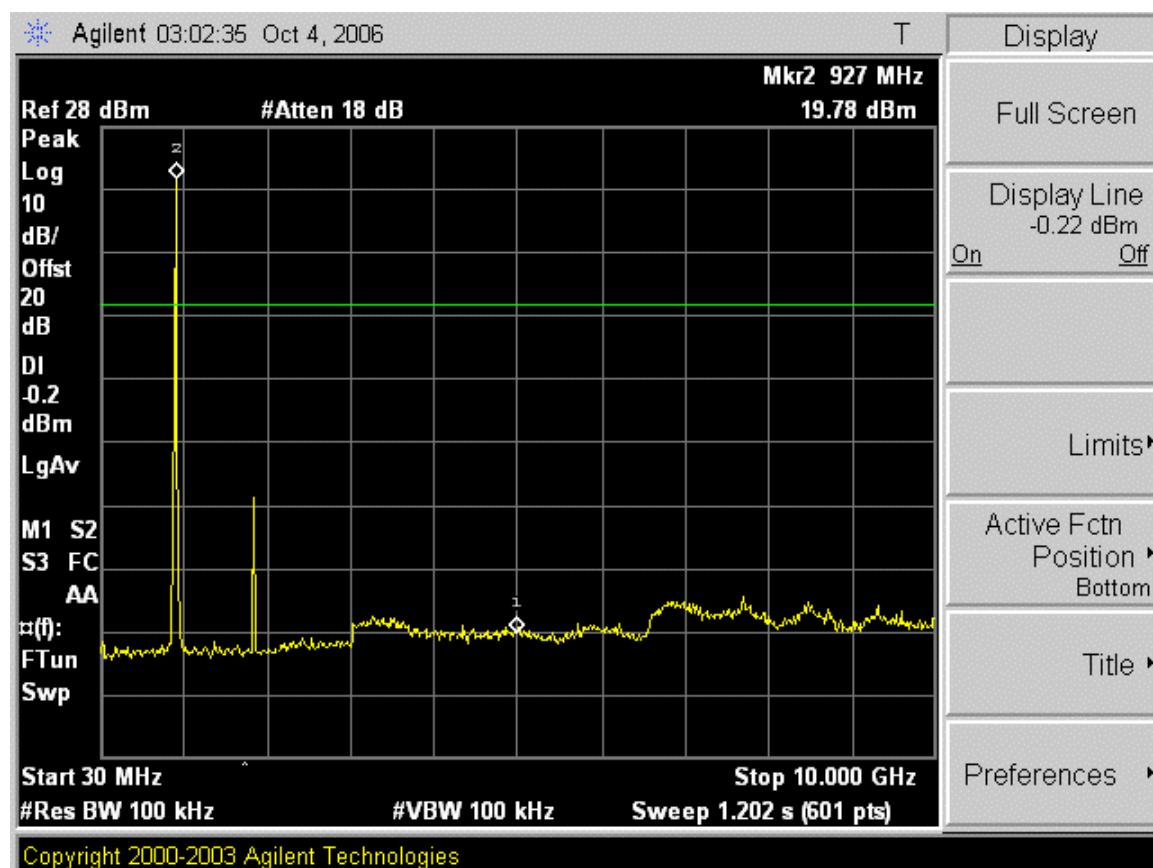
Out of Band Mid Channel (2 of 2)



Out of Band High Channel (1 of 2)



Out of Band High Channel (2 of 2)

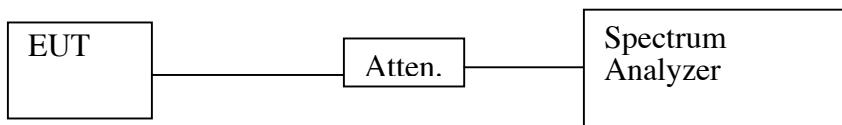


Power Spectral Density
Test Requirement: 15.247(d)

Measurement Equipment Used:

Spectrum Analyzer, 9 kHz-26.5 GHz
20 dB attenuator

Test Set-up



Test Procedure

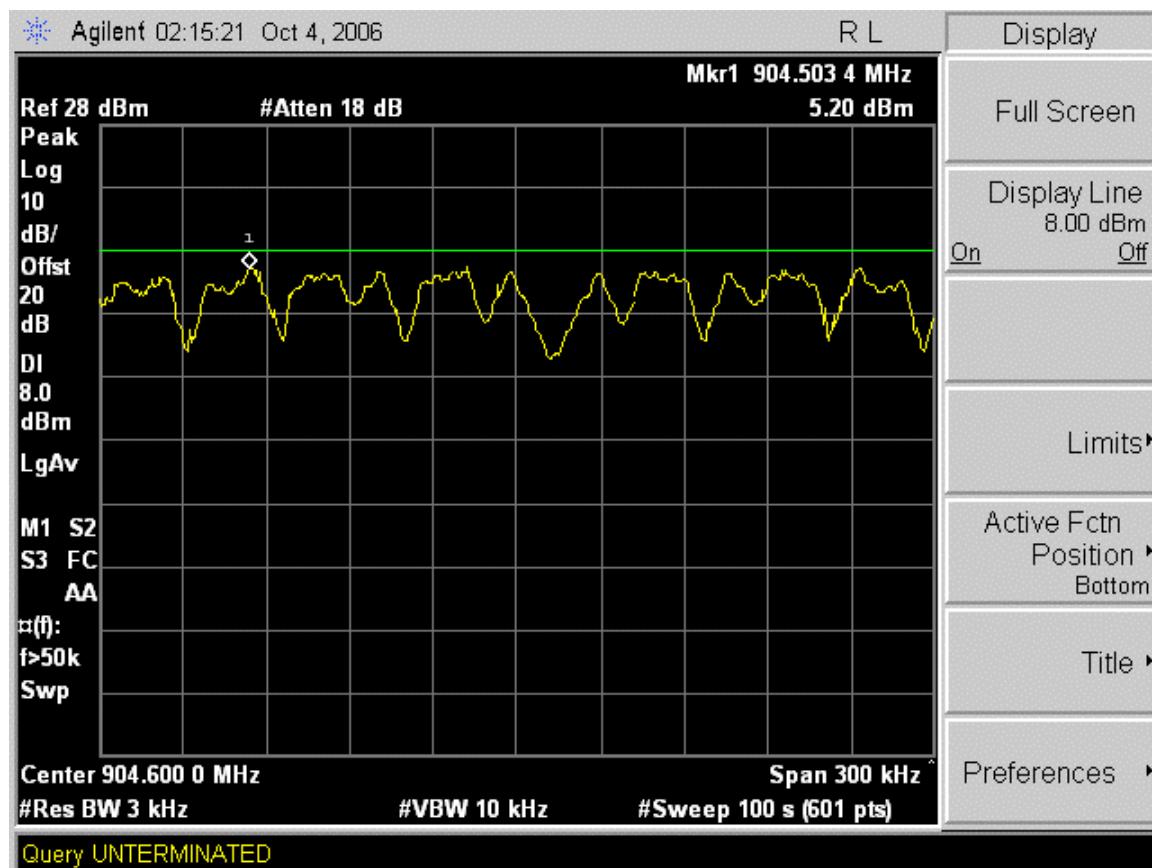
1. Using PEAK search and CF analyzer functions, set LOW channel peak emission to center of analyzer screen.
2. Gradually reduce SPAN to 300 kHz, while adjusting tuning frequency so that peak remains at center of screen.
3. Set RES BW =3 kHz, VID BW = 10 kHz, SWEEP = 100 sec.
4. Record highest reading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

The test was repeated for LOW, MID and HIGH channel.

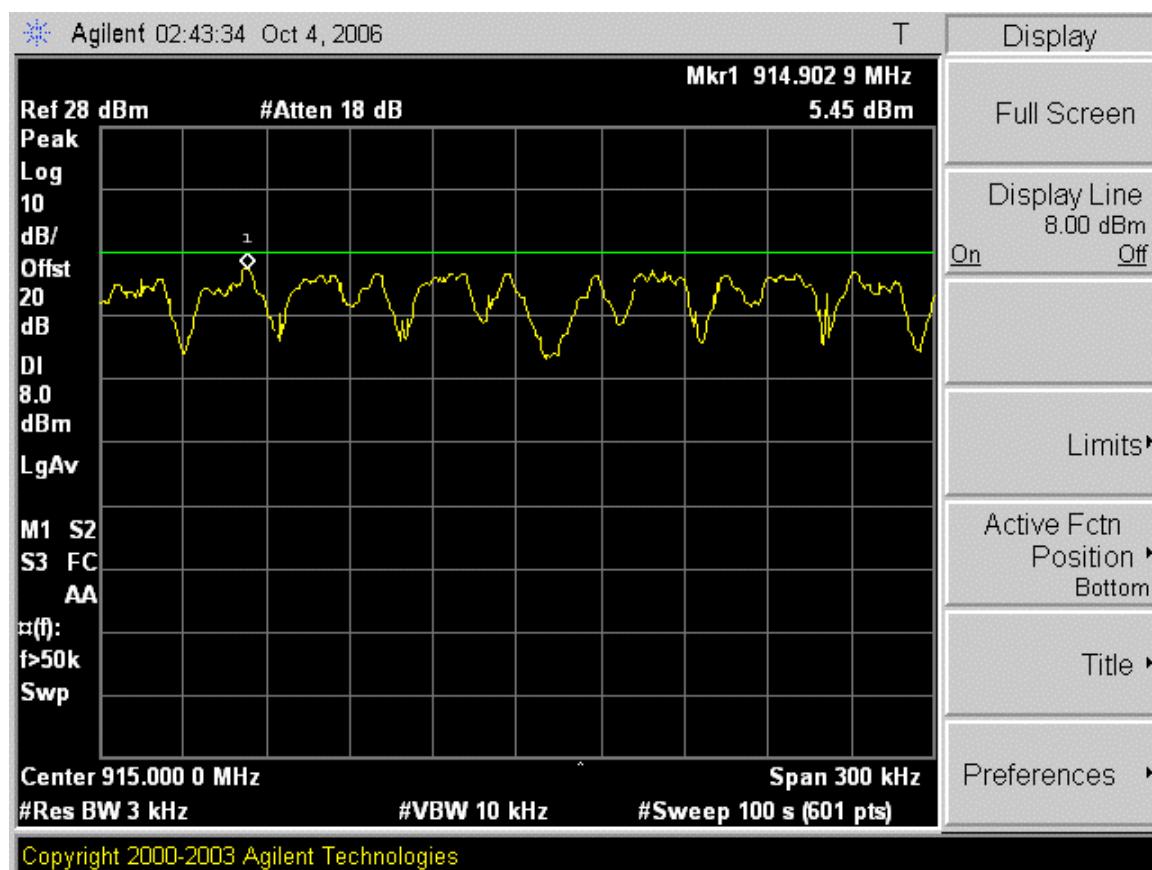
Test Results

PASS. Refer to attached spectrum analyzer charts.

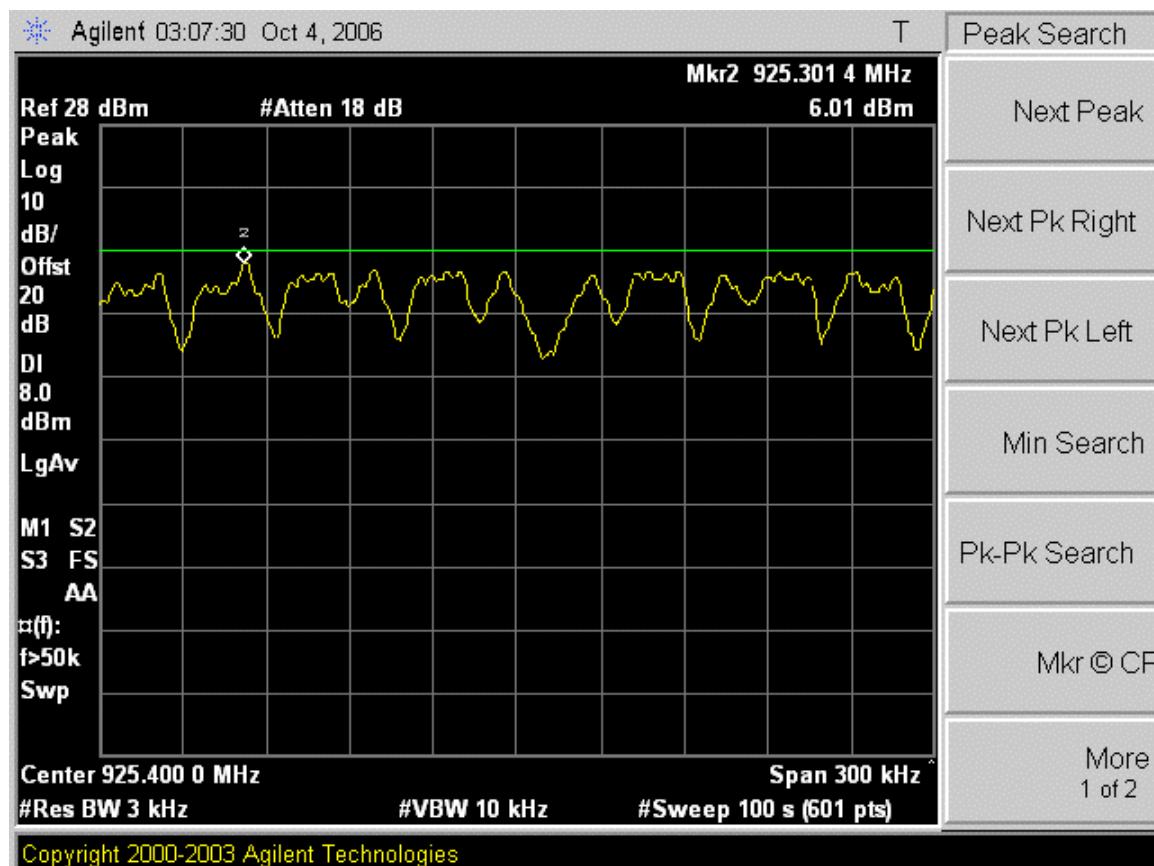
Power Spectral Density, LOW Channel



Power Spectral Density, MID Channel



Power Spectral Density, HIGH Channel



RF Exposure (MPE) Calculations

Sensus Metering Systems			
FCC ID: KCH510R2			
902-928 MHz DSSS Transmitter			
RF Hazard Distance Calculation			
mW/cm ² from Table1: 0.60		Calculate mW/cm ² here. Enter frequency in MHz:	
Max RF Power TX Antenna P, dBm	TX Antenna G, dBi	MPE distance S, mW/cm ² at 20 cm	Comment
24.37	4.00	9.5	0.14
Basis of Calculations: E/23770 = S, mW/cm ² E, V/m = (P(watts)*G(gain)*30)/5/d, meters d = ((P(watts)*G*30)/3770*S))/0.5 S@20cm = 20 log (MPE dist/20cm) NOTE: For mobile or fixed location transmitters, minimum separation distance is for FCC compliance is 20 cm, even if calculations indicate MPE distance is less			
Enter P(mW)	Equivalent dBm	Enter dBm	Equivalent Watts
895.4	29.52	29.52	895.4

TouchCoupler and Universal Programmer Interface Emissions

The TouchCoupler and Universal Programming Port are inductively coupled interfaces. The TouchCoupler interface communicates with a water meter register that is “attached” to the radio using a TRPL, which is basically an inductive coil in a plastic shell. The TRPL is held in close proximity to one of two TouchCoupler Coils connected to the radio board. The two coils and associated circuitry allow the radio to talk to two separate registers, communicating at 25 kHz and 50 kHz.

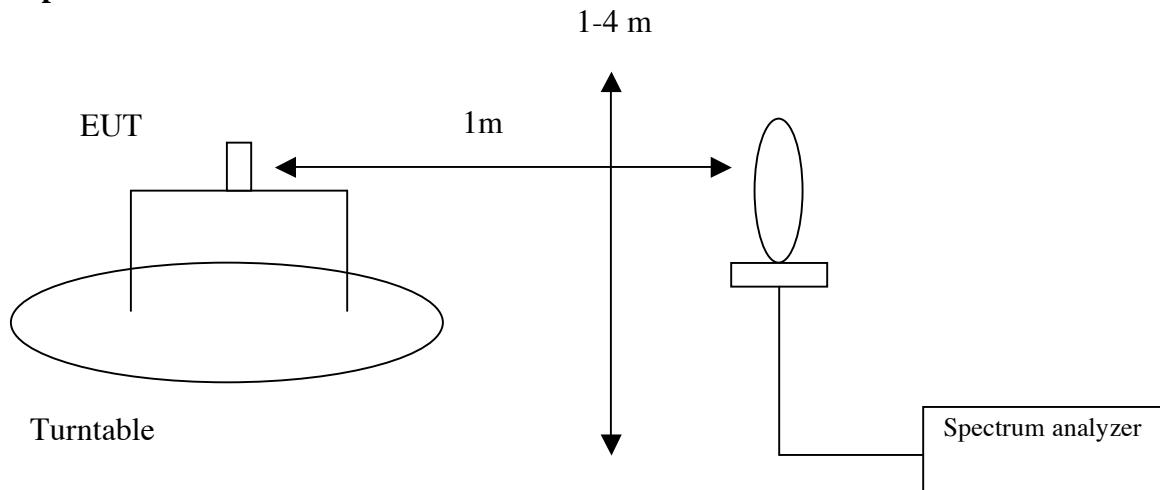
The Universal Programming Port communicates with various handheld devices through an inductive coil which is printed onto the 510R2 pcb. The handheld reader also has an inductive coil. The Handheld is positioned in very close proximity to the universal programming coil. The universal programming port also communicates at 25 and 50 KHz.

TEST RESULTS

Radiated Emissions

Test Requirement: 15.201, 15.209

Test Set-up



Test Procedures

1. The EUT was set on a turntable in the anechoic 5m chamber. The loop antenna was located 1 m away
2. The TRPL circuitry was activated, frequency range 25 kHz to 30 MHz was scanned and all emissions from the EUT were recorded.

Test Results

Tests were performed for both the Touchcoupler and Universal Programming Port Interfaces:

All emissions were at least 53 dB below 15.209 limits. Distance extrapolation correction factor per section 15.31(f) 2 is

$$40\log(1m/300m) = -99 \text{ dB}$$

Universal Programmer Interface Data

Frequency kHz	Reading dBuV	Antenna Factor, dB	Dist. Corr, dB	E, dBuV/m	Limt dBuV/m	Margin, dB
25 NF	48.5	12.1	-99	-38.4	39.6	-78
50 NF	47.7	12.3	-99	-39	33.6	-72.6
75 NF	49.6	12.3	-99	-37.1	30.1	-67.2
100 NF	47.65	12.3	-99	-39.05	27.6	-66.65

Touchcoupler Interface Data

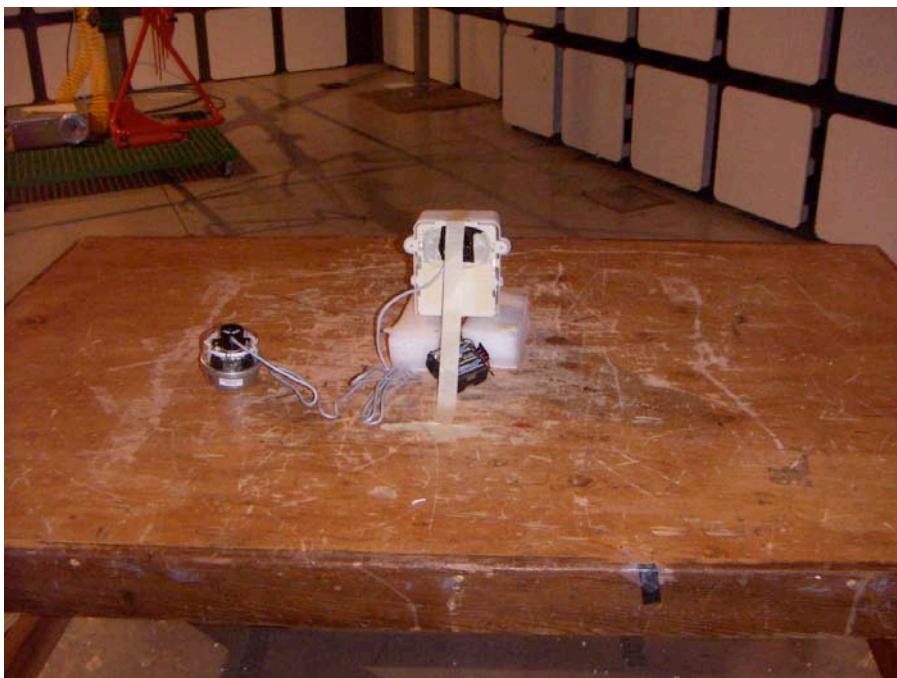
Frequency kHz	Reading dBuV	Antenna Factor, dB	Dist. Corr, dB	E, dBuV/m	Limt dBuV/m	Margin, dB
25	73.36	12.1	-99	-13.54	39.6	-53.14
50 NF	47.74	12.3	-99	-38.96	33.6	-72.56
75	55.48	12.3	-99	-31.22	30.1	-61.32
100 NF	47.1	12.3	-99	-39.6	27.6	-67.2

Test Set-up Photographs

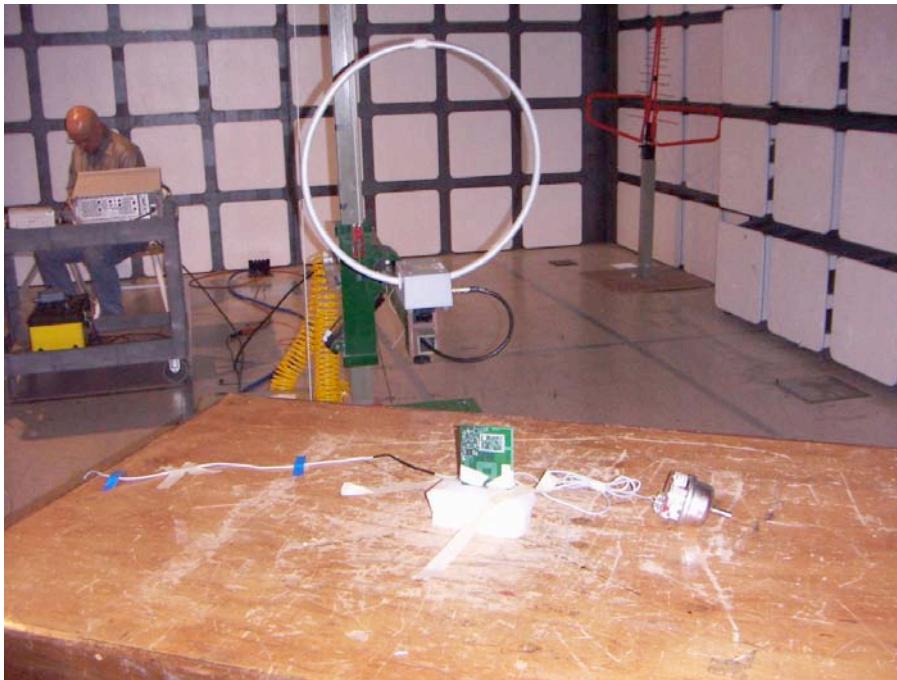
Radiated Above 1 GHz on Open Area Test Site



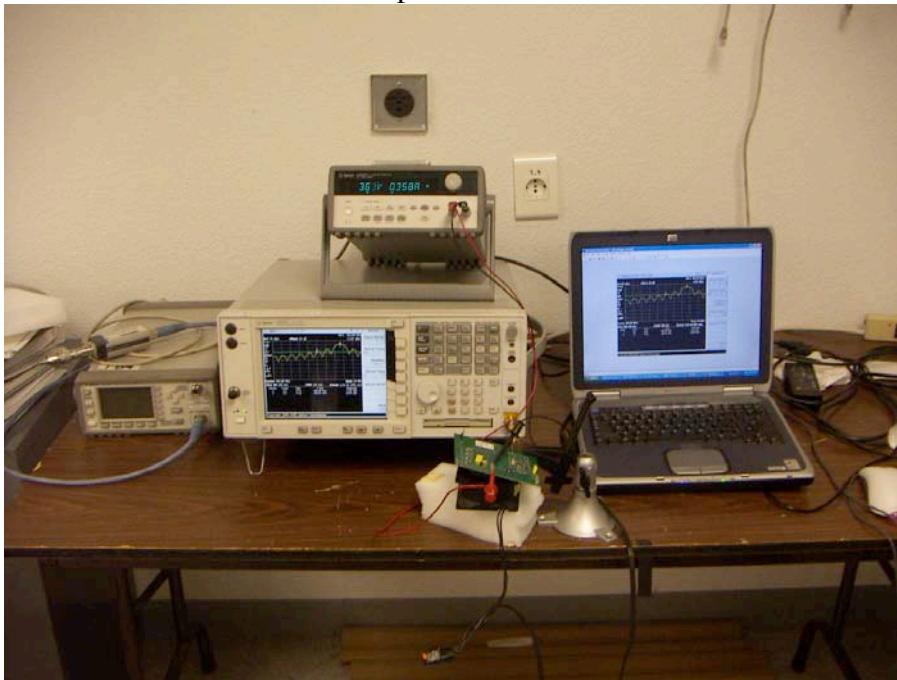
Radiated Above 1 GHz in 5m Anechoic Chamber



Radiated Test Setup below 30MHz for Touchcoupler and Universal Programmer Interfaces.



Antenna Port Conducted Set-up



END OF REPORT