



L.S. Compliance, Inc.

W66 N220 Commerce Court
Cedarburg, WI 53012
262-375-4400 Fax: 262-375-4248

COMPLIANCE TESTING OF:

Bluetooth USB Dongle

PREPARED FOR:

Stonestreet One, Inc.
322 West Main Street
Louisville, KY 40202

TEST REPORT NUMBER:

302328

TEST DATES:

September 18th, 19th, 23rd and 24th, 2002

All results of this report relate only to the items that were tested. This report is not to be reproduced, except in full, without written approval of L. S. Compliance, Inc.

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1. L. S. Compliance In Review

L. S. Compliance, Inc. is located in Cedarburg, Wisconsin – United States.

We may be contacted by:

Mail: L. S. Compliance, Inc.
W66 N220 Commerce Court
Cedarburg, Wisconsin 53012

Phone: 262-375-4400
Fax: 262-375-4248
E-mail: eng@lsr.com

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025 : 2001
with Electrical (EMC) Scope of Accreditation
A2LA Certificate Number: **1255.01**

U. S. Conformity Assessment Body (CAB) Validation

Validated by the European Commission as a U. S. Conformity Assessment Body operating under the U. S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union EMC Directive 89/336/EEC, Article 10.2.
Date of Validation: **January 16, 2001**

Federal Communications Commission (FCC) – USA

Listing of 3 Meter Semi-Anechoic Chamber based on 47CFR 2.948
FCC Registration Number: **90756**

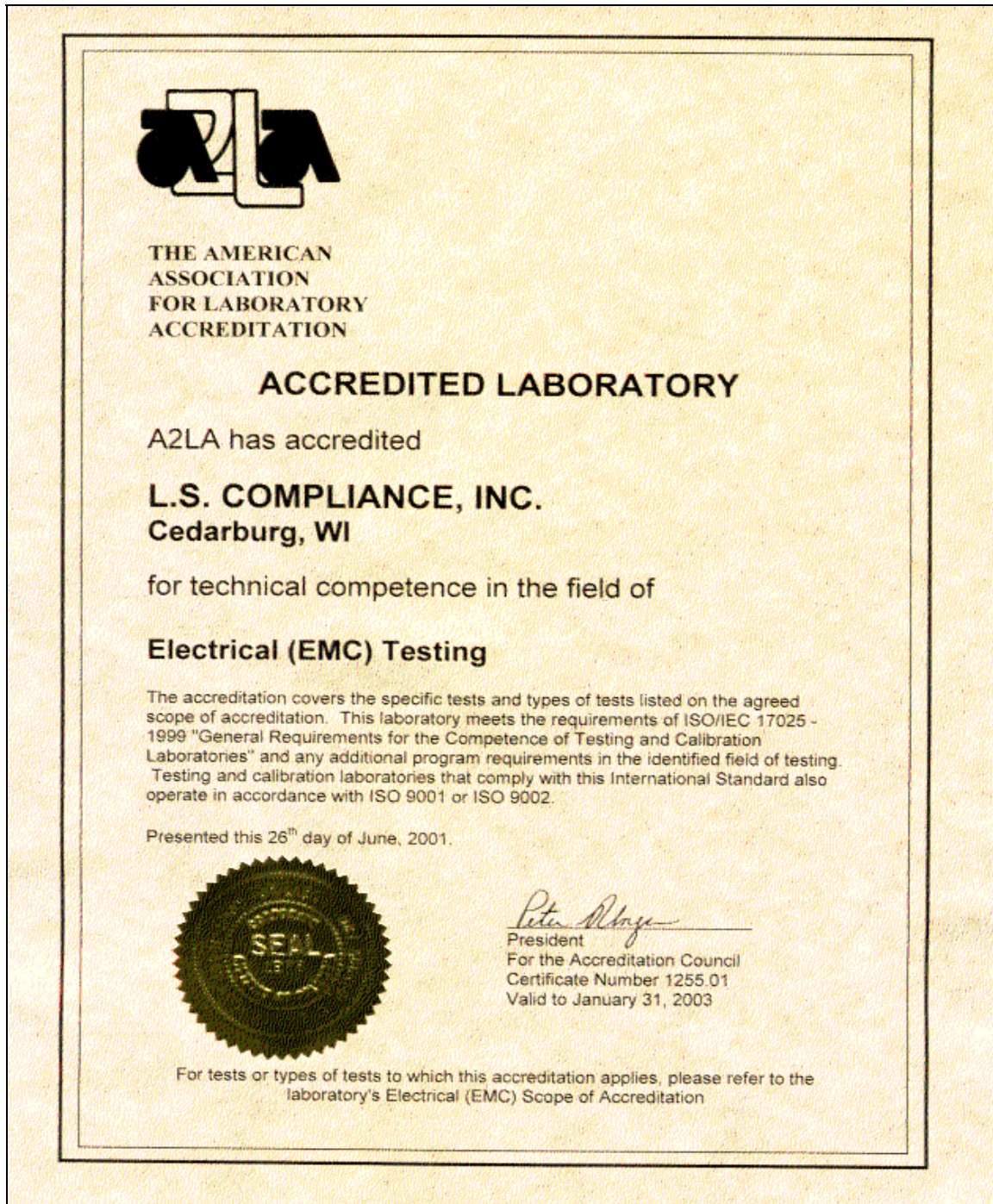
Listing of 3 and 10 meter OATS based on 47CFR 2.948
FCC Registration Number: **90757**

Industry Canada

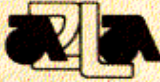


On-file, 3 Meter Semi-Anechoic Chamber based on 47CFR 2.948
File Number: **IC 3088**

On-file 3 and 10 Meter OATS based on RSS-210
File Number: **IC 3088-A**




2. A2LA Certificate of Accreditation



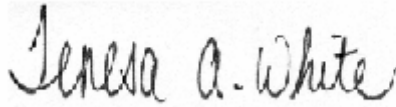
3. A2LA Scope of Accreditation

	
American Association for Laboratory Accreditation	
 <u>SCOPE OF ACCREDITATION TO ISO/IEC 17025-1999</u>	
<p>L.S. COMPLIANCE, INC. W66 N220 Commerce Court Cedarburg, WI 53012 James Blaha Phone: 262 375 4400</p>	
<p>ELECTRICAL (EMC)</p>	
Valid to: January 31, 2003	Certificate Number: 1255-01
<p>In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following tests:</p>	
<u>Test</u>	<u>Test Method(s)</u>
Conducted Emissions Continuous/Discontinuous	Code of Federal Regulations (CFR) 47, FCC Method Parts 15 and 18 using ANSI C63.4; EN: 55011, 55022, 55081-1, 55081-2; CISPR: 11, 22; CNS 13438
Radiated Emissions	Code of Federal Regulations (CFR) 47, FCC Method Parts 15 and 18 using ANSI C63.4; EN: 55011, 55022, 55081-1, 55081-2; CISPR: 11,22; CNS 13438
Conducted Immunity Fast Transients/Burst	IEC: 1000-4-4, 801-4; EN: 61000-4-4, 50082-1, 50082-2
Surge	IEC: 1000-4-5, 801-5; ENV 50142; EN: 61000-4-5, 50082-1, 50082-2
RF Fields	IEC: 1000-4-6, 801-6; ENV 50141; EN: 61000-4-6, 50082-1, 50082-2
Voltage Dips/Interruptions	IEC 1000-4-11; EN: 61000-4-11, 50082-1, 50082-2
Radiated Immunity RF Fields	IEC: 801-3, 1000-4-3; ENV 50140; EN: 61000-4-3, 50082-1, 50082-2
RF Fields (50 Hz)	IEC 1000-4-8; EN 61000-4-8
RF Fields (Pulse Mode)	EN: 50082-1, 50082-2; ENV 50204
Electrostatic Discharge (ESD)	IEC: 1000-4-2, 801-2; BSEN 60801-2; EN: 61000-4-2, 50082-1, 50082-2
<p>(A2LA Cert. No. 1255.01) 06/26/01</p>	
<p>5301 Buckeystown Pike, Suite 350 • Frederick, MD 21704-8373 • Phone: 301-644-3248 • Fax: 301-662 2974</p>	
<p> Page 1 of 1</p>	
	

4. Validation Letter – U.S. Competent Body for EMC Directive 89/336/EEC

 1901/2001 NIST CENTENNIAL	 DEPARTMENT OF COMMERCE UNITED STATES OF AMERICA	UNITED STATES DEPARTMENT OF COMMERCE National Institute of Standards and Technology Gaithersburg, Maryland 20899-
January 16, 2001		
Mr. James J. Blaha L.S. Compliance Inc. W66 N220 Commerce Court Cedarburg, WI 53012-2636		
Dear Mr. Blaha:		
I am pleased to inform you that the European Commission has validated your organization's nomination as a U.S. Conformity Assessment Body (CAB) for the following checked (✓) sectoral annex(es) of the U.S.-EU Mutual Recognition Agreement (MRA).		
<input checked="" type="checkbox"/> Electromagnetic Compatibility-Council Directive 89/336/EEC, Article 10(2)		
<input type="checkbox"/> Telecommunication Equipment-Council Directive 98/13/EC, Annex III		
<input type="checkbox"/> Telecommunication Equipment-Council Directive 98/13/EC, Annex III and IV Identification Number:		
<input type="checkbox"/> Telecommunication Equipment-Council Directive 98/13/EC, Annex V Identification Number:		
This validation is only for the location noted in the address block, unless otherwise indicated below.		
<input checked="" type="checkbox"/> Only the facility noted in the address block above has been approved.		
<input type="checkbox"/> Additional EMC facilities:		
<input type="checkbox"/> Additional R&TTE facilities:		
Please note that an organization's validations for various sectors of the MRA are listed on our web site at http://ts.nist.gov/mra . You may now participate in the conformity assessment activities for the operational period of the MRA as described in the relevant sectoral annex or annexes of the U.S.-EU MRA document.		
NIST will continue to work with you throughout the operational period. All CABs validated for the operational phase of the Agreement must sign and return the enclosed CAB declaration form, which states that each CAB is responsible for notifying NIST of any relevant changes such as accreditation status, liability insurance, and key staff involved with projects under the MRA. Please be sure that you fully understand the terms under which you are obligated to operate as a condition of designation as a CAB. As a designating authority, NIST is responsible for monitoring CAB performance to ensure continued competence under the terms of the MRA.		
		

5. Signature Page



Prepared By:

Teresa A. White, Document Coordinator

October 8, 2002

Date

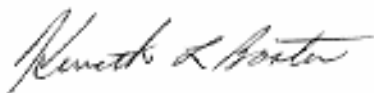


Tested By:

Abtin Spantman, EMC Engineer

October 8, 2002

Date

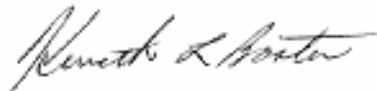


Tested By:

Kenneth. L. Boston, EMC Engineer

October 8, 2002

Date



Approved By:

Kenneth L. Boston, EMC Lab Manager
PE #31926 Licensed Professional Engineer
Registered in the State of Wisconsin, United States

October 8, 2002

Date

6. Product and General Information

Manufacturer:	Stonestreet One
Model No.:	BTD-001L
Serial No.:	0001
Description:	2.4 GHz FHSS Transceiver (Bluetooth)
Frequency Range:	2.402 – 2.481 GHz

7. Product Description

The Bluetooth USB Dongle is a small Bluetooth Transceiver that is encased in a blue plastic case, and is connected to the computer or laptop via a short USB cable. It serves as a “dongle” or small wireless data port. It is powered and controlled by the DC voltages and signals present on the USB cable. It is a Power Class 3 Bluetooth device, with a nominal 1 milliwatt power level, intended for use in Piconet applications. The data transfer rate is 1 Mbit/second.

8. Test Requirements

The above mentioned tests were performed in order to determine the compliance of the Bluetooth USB Dongle with limits contained in various provisions of Title 47 CFR, FCC Part 15, including:

15.207	15.247b	15.247e
15.205	15.247c	15.109
15.247a	15.247d	

All radiated emissions tests were performed to measure the emissions in the frequency bands described by the above sections, and to determine whether said emissions are below the limits established by the above sections. These tests were performed in accordance with the procedure described in the 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 (ANSI C63.4-1992). Another document used as reference for the EMI receiver specification was the International Special Committee on Radio Interference (CISPR) Number 16-1 (1999). Measurement technique guidelines found in Appendix C to FCC 97-114 were also consulted. Supporting information is also found in the Bluetooth Specification Version 1.1 (Feb. 2001).

9. Summary of Test Report

DECLARATION OF CONFORMITY

The Bluetooth USB Dongle was found to **MEET** the requirements as described within the specification of Title 47 CFR FCC, Part 15.247, Subpart C; and I.C. RSS-210, Section 6.2.2(0) for a Frequency Hopping Spread Spectrum Transmitter.

10. Introduction

On September 18th, 19th, 23rd and 24th, 2002 a series of Radiated Emission tests were performed on the Bluetooth USB Dongle. These tests were performed using the procedures outlined in ANSI C63.4-2001 for intentional radiators, and in accordance with the limits set forth in FCC Part 15.247 (Industry Canada RSS-210) for a low power transmitter. These tests were performed by Kenneth L. Boston, EMC Lab Manager and Abtin Spantman, EMC Engineer of L.S. Compliance, Inc.

11. Purpose

All Radiated and Conducted Emission tests upon the Bluetooth USB Dongle were performed to measure the emissions in the frequency bands described in title 47 CFR, FCC Part 15, including 15.35, 15.209, 15.247 and Industry Canada RSS-210 to determine whether these emissions are below the limits expressed within the standards. These tests were performed in accordance with the procedure described in the 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 (ANSI C63.4-2001). Another document used as a reference for the EMI Receiver specification was the Comite International Special Des Perturbations Radioelectriques (CISPR) Number 16-1, 1999.

12. Radiated Emissions Test

Test Setup

The test setup was assembled in accordance with Title 47, CRF FCC Part 15 and ANSI C63.4-2001. The EUT was placed on an 80cm high non-conductive pedestal centered on a flush mounted 2-meter diameter turntable inside the 3 Meter Semi-Anechoic, FCC listed Chamber located at L. S. Compliance, Inc., Cedarburg, Wisconsin. The EUT was operated in one of several test modes and powered via the USB cable to a Dell laptop computer. This laptop was running a test program that allowed both fixed channel and frequency hopping operations to be examined. For some operations, a pair of EUTs were operating in tandem (via 2 laptop P.C. controllers) and communicating back and forth with each other, using a test message. The applicable limits apply at a 3 meter distance, and are found on Page 12 of this report. Measurements above 5 GHz were also performed at a 0.3 meter separation distance, and the calculation can also be found on Page 12 of this report. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a list of the test equipment. The test sample was operated on one of three (3) standard channels: low (1), medium (39) and high (79) to comply with Part 15.35.

Test Procedure

Radiation measurements were performed on the EUT in the 3 Meter Semi-Anechoic, FCC listed Chamber, located at L. S. Compliance, Inc. in Cedarburg, Wisconsin. The frequency range from 30 MHz to 24,000 MHz was pre-scanned, and levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on the non-conductive pedestal in the 3 Meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the test object. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double Ridged Waveguide Horn Antenna was used from 1 GHz to 18 GHz. The maximum radiated emissions were found by raising and lowering the antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities. 18 GHz to 24 GHz was measured at a 0.3 meter separation, using a standard gain horn and pre-amplifier. Since the device was quite small, it was rotated through all 3 axes to find the worst case emissions.

Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at an N.I.S.T. traceable site. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and a HP 8546A EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the HP 8546A EMI Receiver database. As a result, the data taken from the HP 8546A EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The HP 8546A EMI Receiver was operated with a bandwidth of 120 kHz for measurements below 1 GHz. Both the Peak and Quasi-Peak Detector functions were utilized. From 5 GHz to 18 GHz, an HP E4407 Spectrum Analyzer and an EMCO Horn Antenna were used. From 18 GHz to 24 GHz, the HP E4407, along with a standard gain horn, and pre-amplifier were used.

Test Results

The EUT was found to MEET the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 for a FHSS transmitter (Canada RSS-210). The frequencies with significant signals were recorded and plotted as shown in the Data Charts and Graphs.

Notes:

CALCULATION OF RADIATED EMISSIONS LIMITS

The following table depicts the Class B limits for an unintentional radiator. These limits are obtained from Title 47 CFR, Part 15.209, for radiated emissions measurements. These limits were applied to any signals found in the 15.205 restricted bands.

Frequency (MHz)	$\mu\text{V/m}$	3 m Limit (dB $\mu\text{V/m}$)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
960-24,000	500	54.0

Sample conversion from field strength $\mu\text{V/m}$ to dB $\mu\text{V/m}$:

$$\begin{aligned}\text{dB}\mu\text{V/m} &= 20 \log_{10} (100) \\ &= 40 \text{ dB}\mu\text{V/m} \text{ (from 30-88 MHz)}\end{aligned}$$

For measurements made at 0.3 meter, a 20 dB correction has been invoked.

$$\begin{aligned}&960 \text{ MHz to } 10,000 \text{ MHz} \\ &500\mu\text{V/m or } 54.0 \text{ dB}/\mu\text{V/m at 3 meters} \\ &54.0 + 20 = 74.0 \text{ dB}/\mu\text{V/m at 0.3 meters}\end{aligned}$$

Summary of Results and Conclusions

Based on the procedures outlined in this report, and the test results, it can be determined that the EUT does **MEET** the emission requirements of Title 47 CFR, FCC Part 15, Subpart C (Industry Canada RSS-210) for an intentional radiator.

The enclosed test results pertain to the samples of the test item listed, and only for the tests performed per the data sheets. Any subsequent modification or changes to the test items could invalidate the data contained herein, and could therefore invalidate the findings of this report.

Measurement of Electromagnetic Radiated Emissions
Upon a 3 Meter I. C. Listed Site

Frequency Range Inspected: 30 MHz - 24,000 MHz

Manufacturer: Stonestreet One, Inc.

Date of Test: September 18th, 19th, 23rd and 24th, 2002

Model No.: BTD-001-L

Serial No.: 0001

Test Requirements: FCC Parts 15.247, 15.205 and 15.209

Distance: 3 Meters. 0.3 meters	Frequency Range Inspected: 30 to 24,000 MHz
Configuration: Continuous Data Transmit; test message; fixed hop channel	

Test Equipment Used:

EMI Receiver: HP 8546A	Biconical Antenna: EMCO 3110
Double-Ridged Wave Guide/Horn Antenna: EMCO 3115	Log Periodic Antenna: EMCO 43146A
Standard Gain Horn Antenna: EMCO 3160-09	PreAmp: Advanced Microwave WHA6224

Detector(s) Used:	√	Peak	√	Quasi-Peak	√	Average
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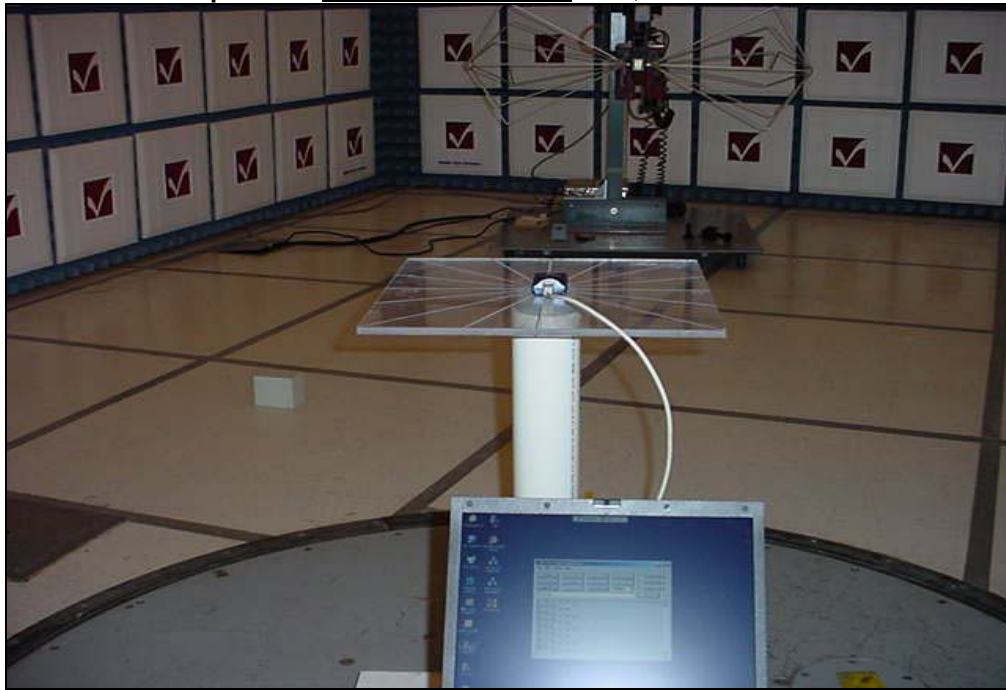
The following table depicts the level of significant emissions found:

Frequency (MHz)	Antenna Polarity	Channel	Height (meters)	Azimuth (0° - 360°)	EMI Meter Reading (dBμV/m)	15.209 Limit (dBμV/m)	Margin (dB)
1602	V	1	1.0	180	42.5	54.0	11.5
1664	V	1	1.0	180	40.7	54.0	13.3
1602	V	40	1.0	180	42.4	54.0	11.6
1664	V	40	1.0	180	40.2	54.0	13.8
1602	V	79	1.0	180	42.2	54.0	11.8
1664	V	79	1.0	180	40.0	54.0	14.0

Notes: Other signals seen were outside of the 15.205 bands and/or were greater than 20dB below the limits.

Photos Taken During Radiated Emission Testing

Setup for the Radiated Emissions Test; 3 Meter Distance

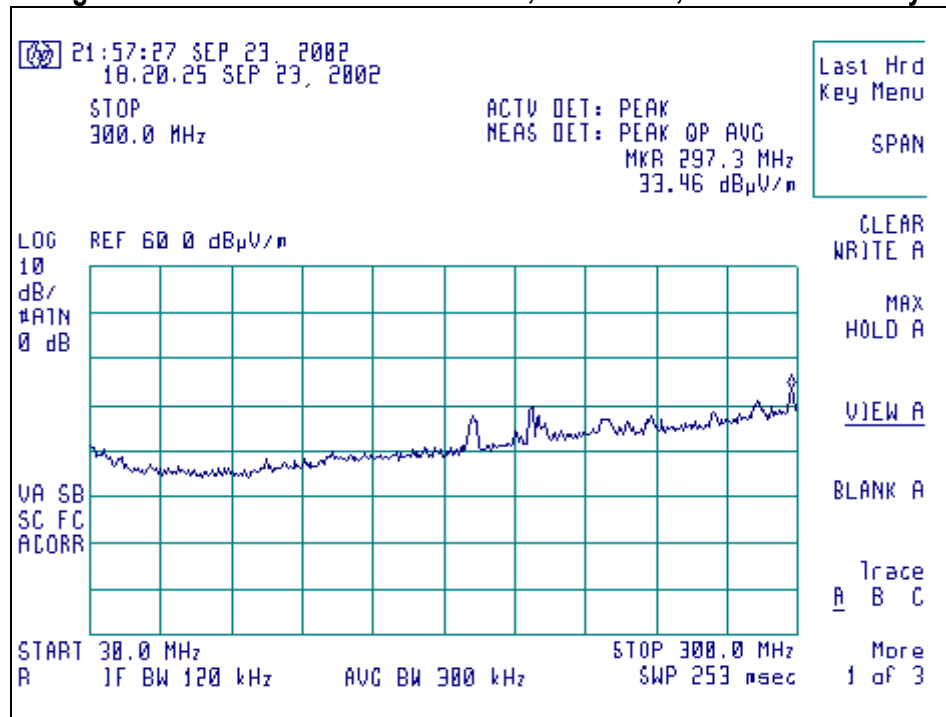


Setup for the Radiated Emissions Test; 0.3 Meter Distance

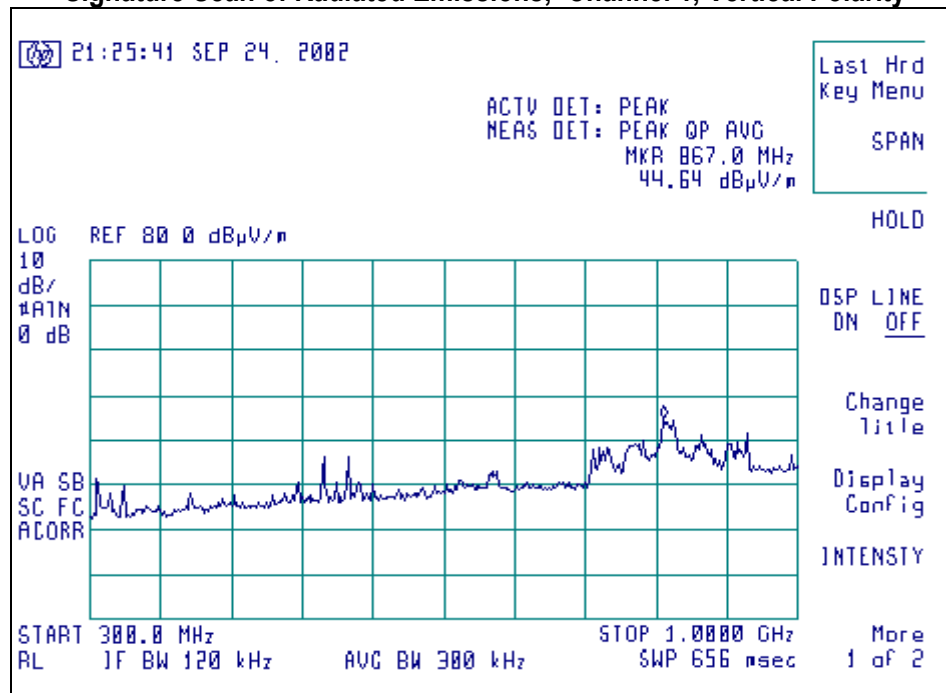


Graphs made during Radiated Emission Testing

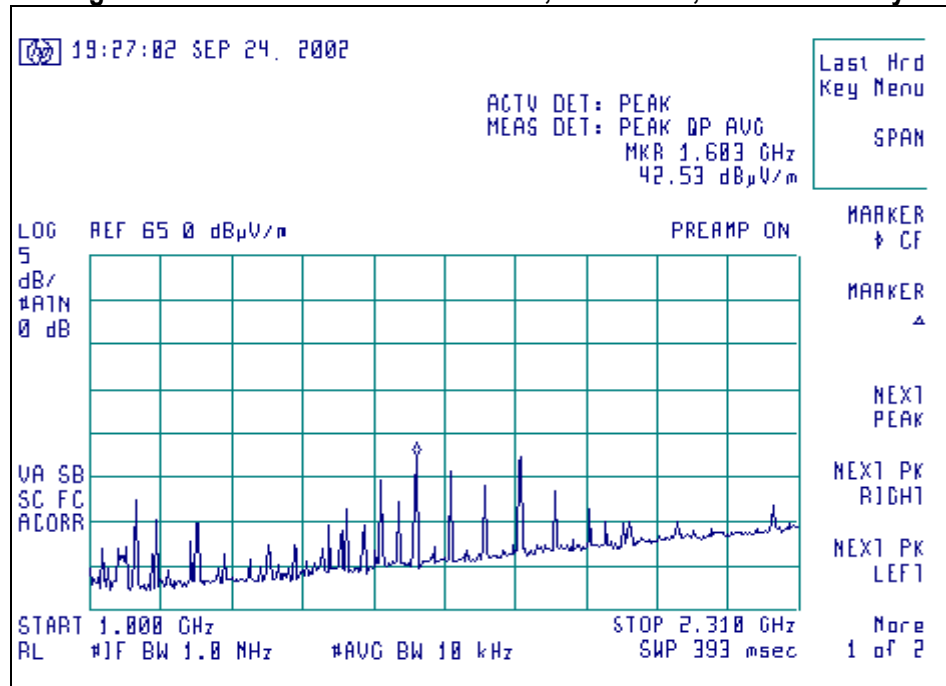
Signature Scan of Radiated Emissions; Channel 1, Horizontal Polarity



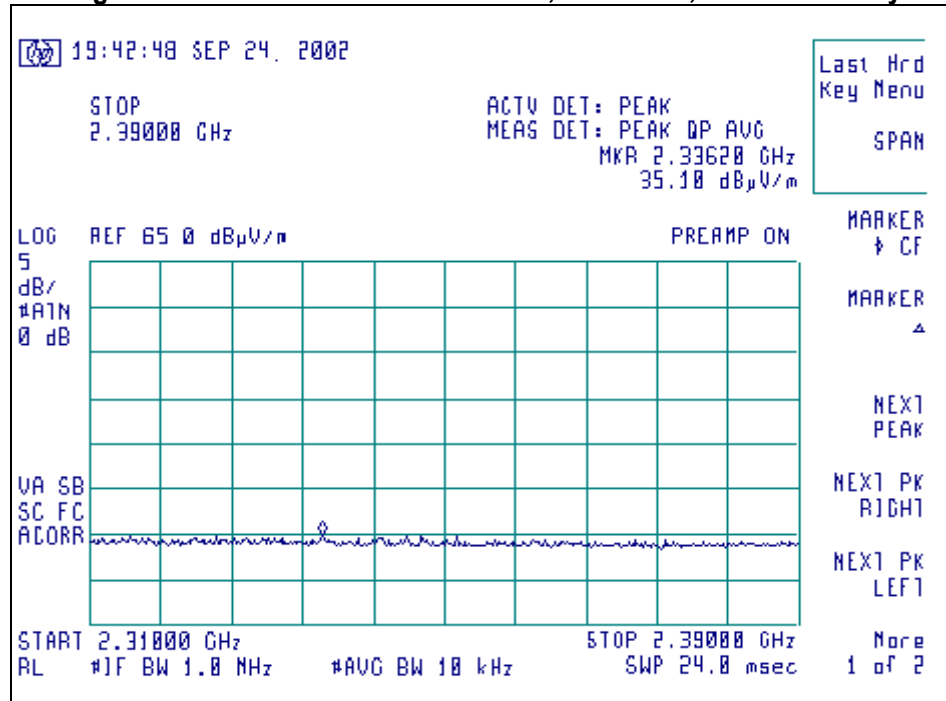
Signature Scan of Radiated Emissions; Channel 1, Vertical Polarity



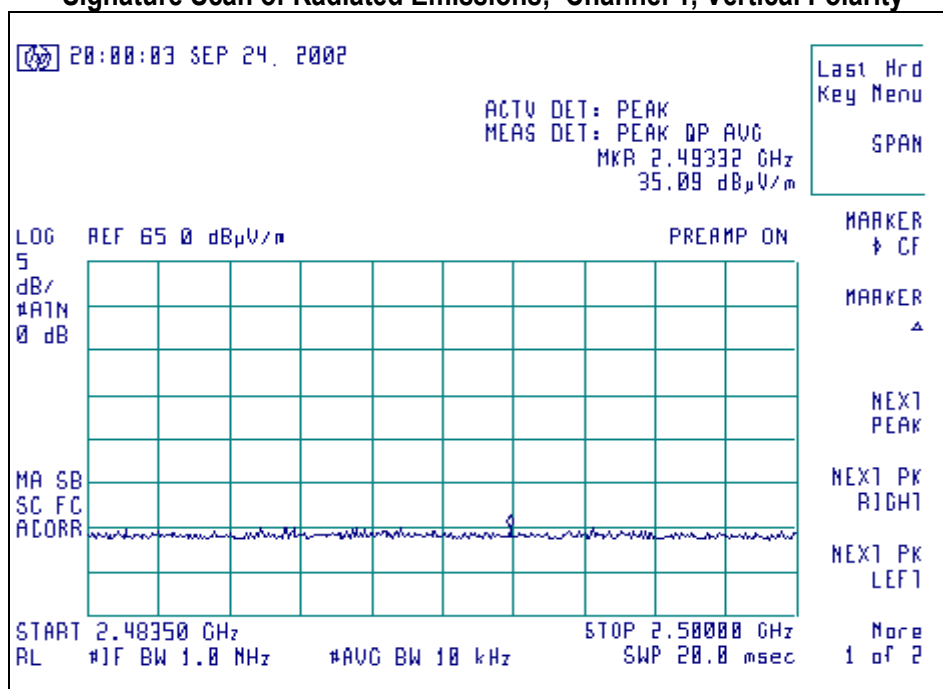
Signature Scan of Radiated Emissions; Channel 1, Vertical Polarity



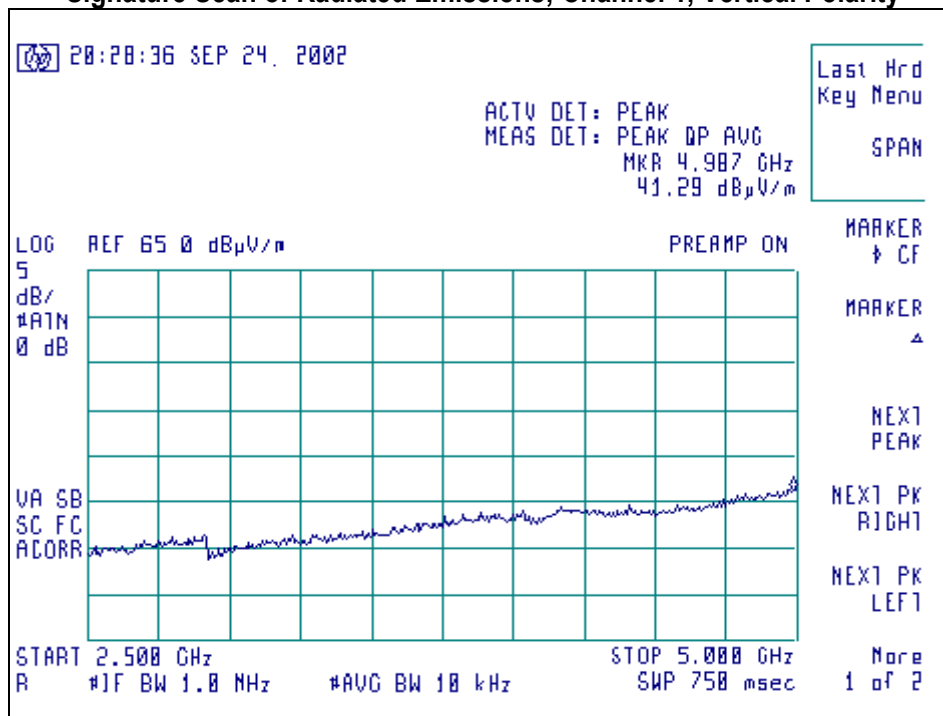
Signature Scan of Radiated Emissions; Channel 1, Vertical Polarity



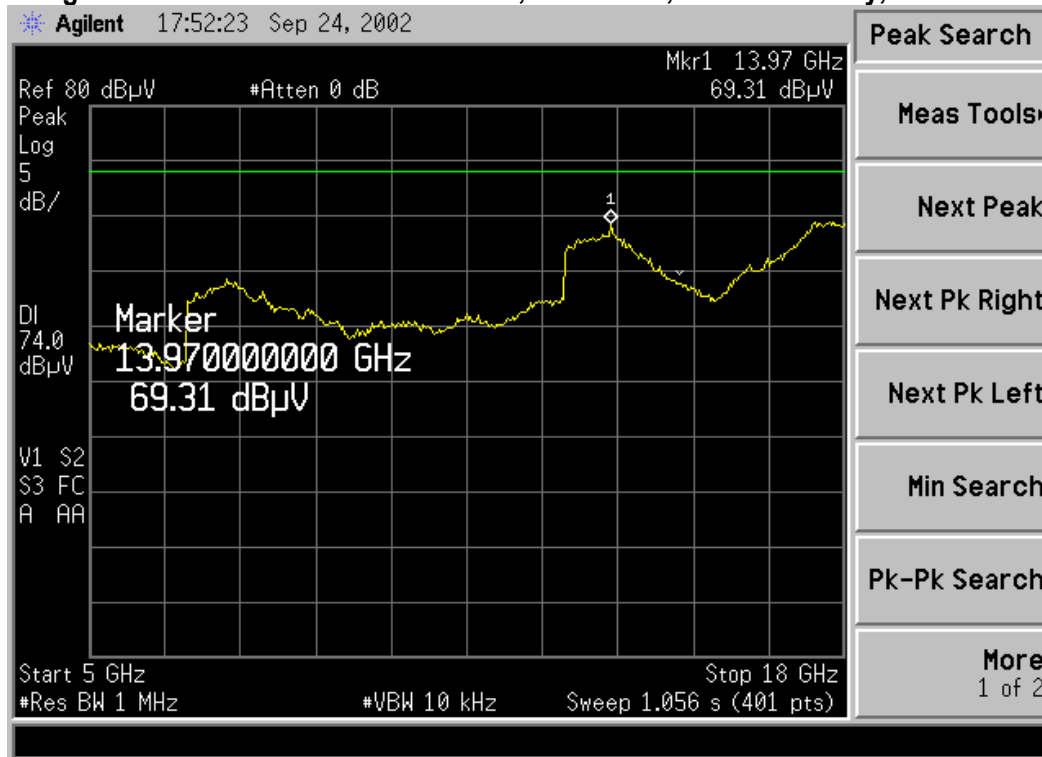
Signature Scan of Radiated Emissions; Channel 1, Vertical Polarity



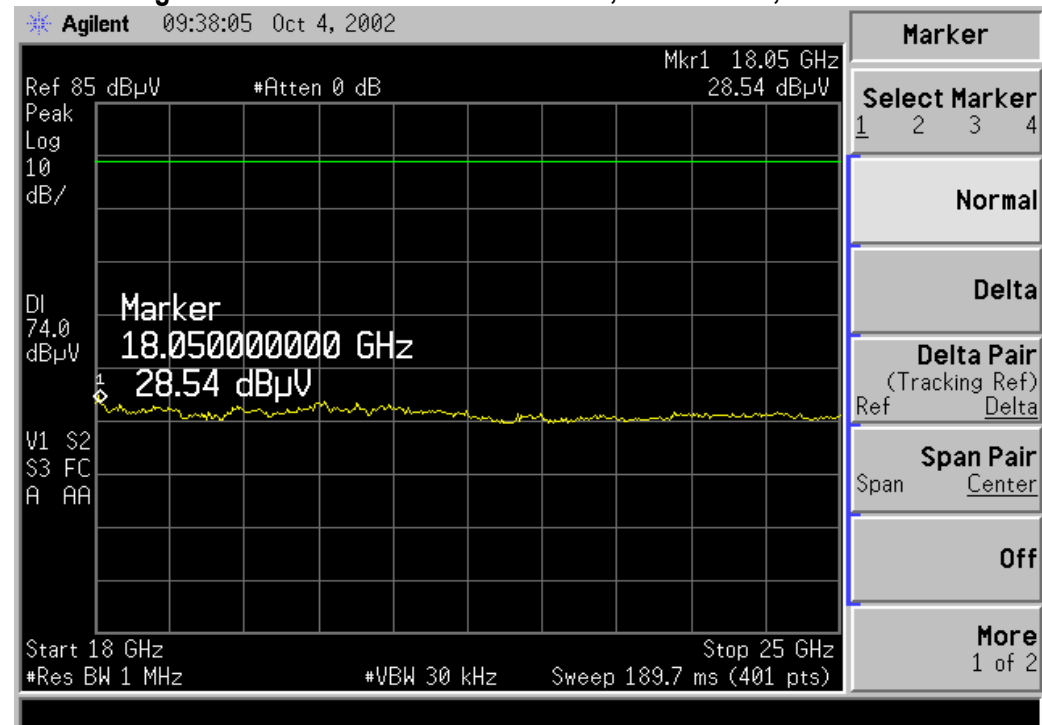
Signature Scan of Radiated Emissions; Channel 1, Vertical Polarity



Signature Scan of Radiated Emissions; Channel 1, Vertical Polarity, 0.3 Meters



Signature Scan of Radiated Emissions; Channel 39, 0.3 Meters



13. Conducted Emissions Test (AC Line)

Notes: No test of A.C. line Conducted Emissions was performed because the EUT is powered via the P.C. USB port.

14. Power Output Test Performed

For the 15.247b measurement, the output of the EUT was performed by a radiated measurement of the transmitter's EIRP, because the device uses an integral antenna, and has no provision for direct connection to the circuit RF output. The setup used was that of the previously described radiated setup, but performed at 1 meter. The maximum signal was found, and converted to equivalent power (at 1 meter), then compared to the limit of 1.0 watt.

CHANNEL	CENTER FREQ (MHz)	LIMIT (dBm)	RADIATED FIELD STRENGTH at 1 Meter (dB μ V/m)	EQUIVALENT CONDUCTED POWER (dBm))	MARGIN (dB)
1	2402	30 dBm	109.7	4.9	25.1
40	2441	30 dBm	109.0	4.2	25.8
29	2481	30 dBm	108.6	3.8	26.2

Radiated Field Strength – 104.8 dB = Equivalent Power



15. Conducted RF Test Setup and Measurements

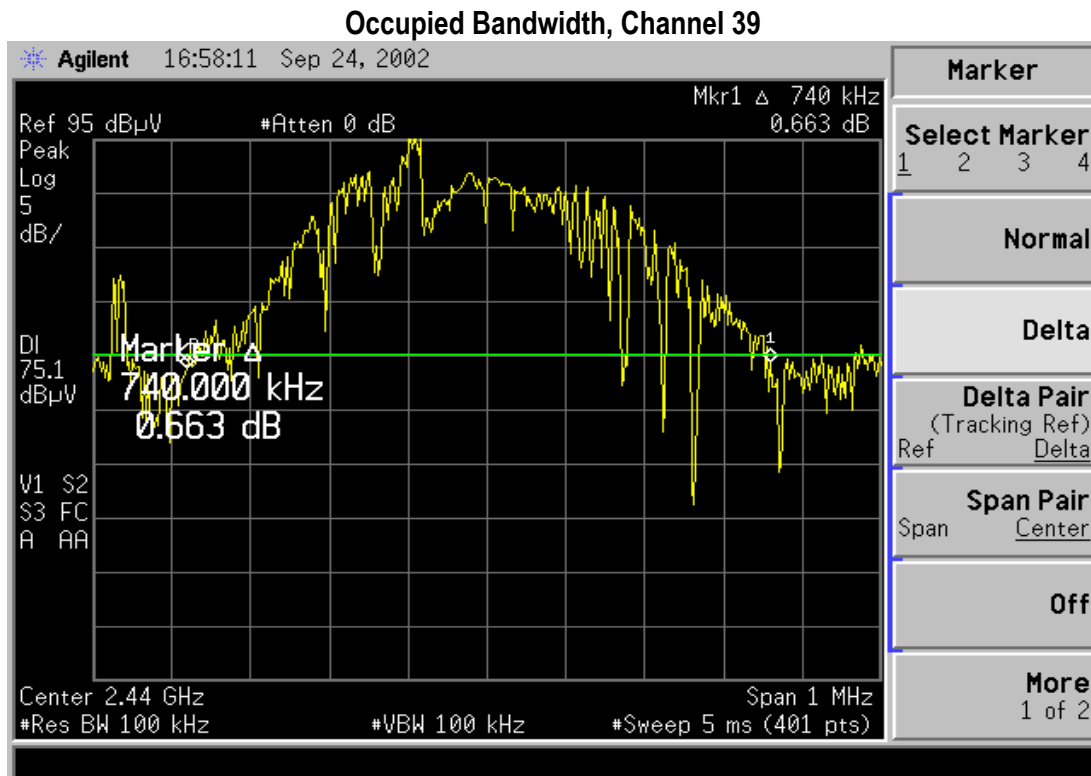
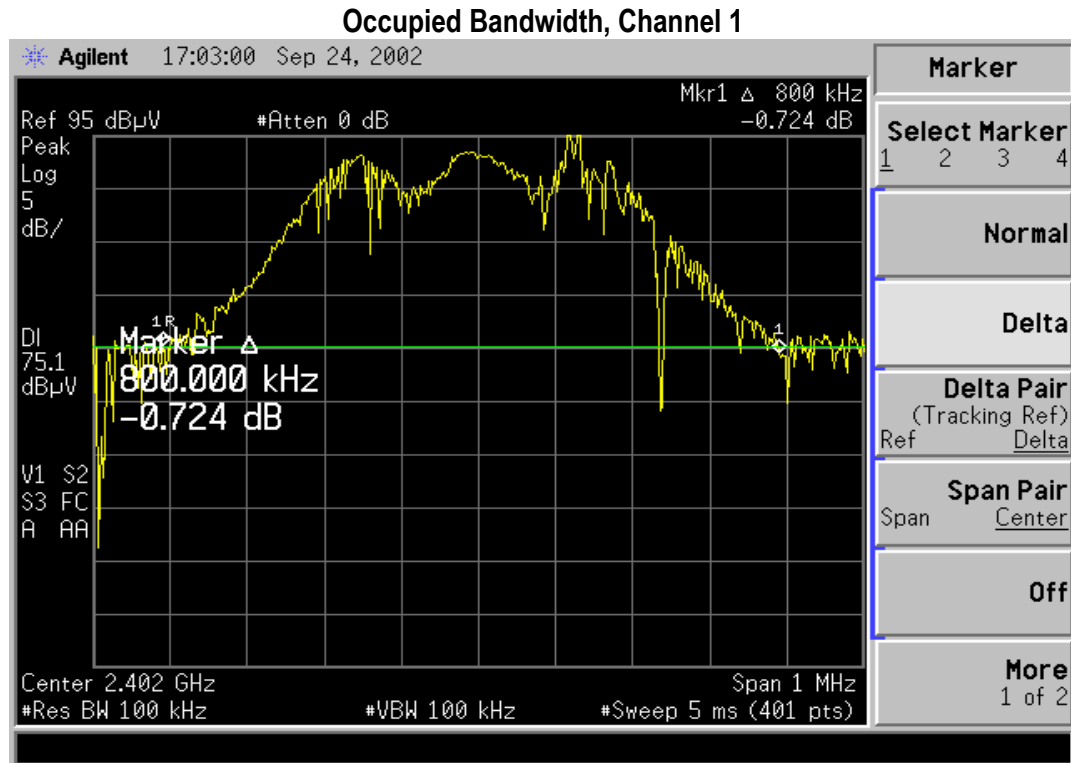
FCC Part 15.247 (c) requires an antenna conducted measurement of conducted harmonic and spurious levels, as reference to the carrier frequency in a 100 kHz bandwidth. This device has no provision for a direct connection, so spurious signal levels were inspected via the radiated technique used to inspect the 15.205 bands. Data presented, including graphs, can be found in Section 13 of this report. No significant levels at any spurious products could be found within -20 dBc of the fundamental of the transmitter.

16. Occupied Bandwidth Measurements

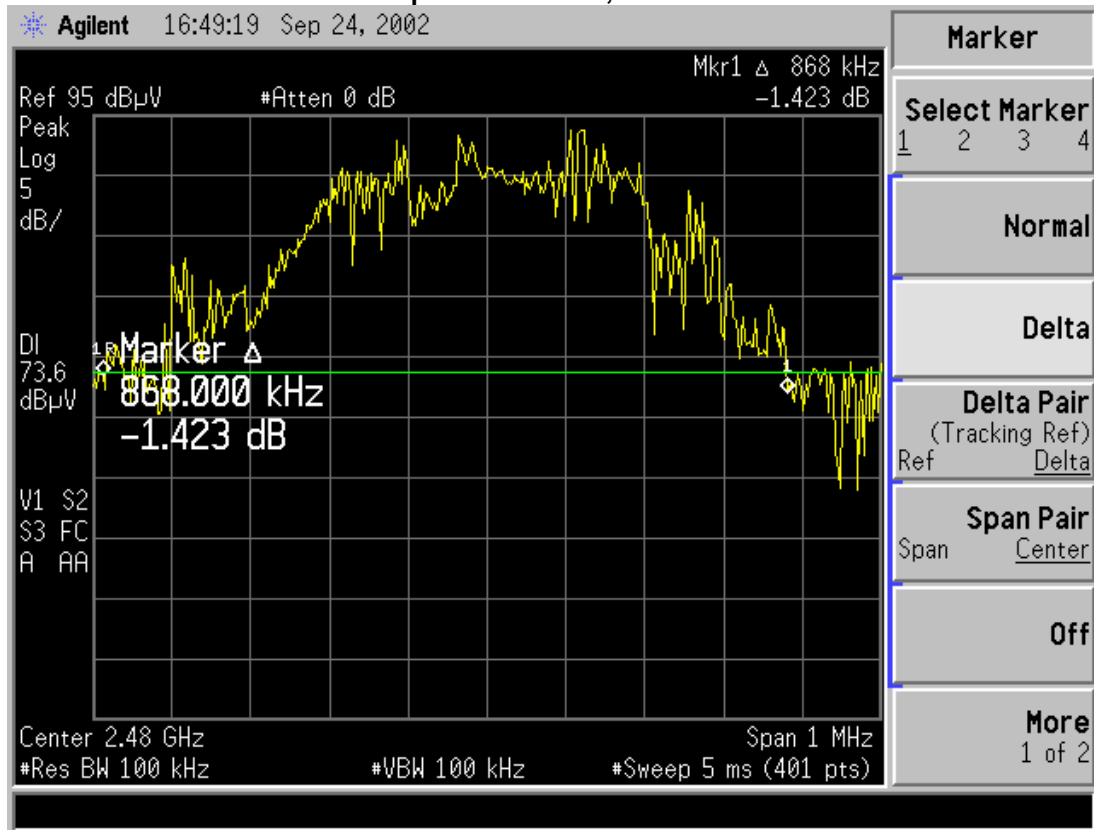
The 6 dB bandwidth requirement found in 15.247.a.2 is a minimum of 500 kHz. The output of the EUT was measured by a radiated measurement, because the device uses an integral antenna, and has no provision for direct connection to the circuit RF output.. For each of the representative channels, refer to the graphs found in the following pages. From this data, the bandwidth of Channel 39, which is the closest data to the specification limit, is 0.74 MHz, which is above the minimum of 500 kHz.

CHANNEL	CENTER FREQ (MHz)	MEASURED 6 dB BW (kHz)
1	2,402	800.0
39	2,440	740.0
79	2,480	868.0

Plots of Occupied Bandwidth



Occupied Bandwidth, Channel 79



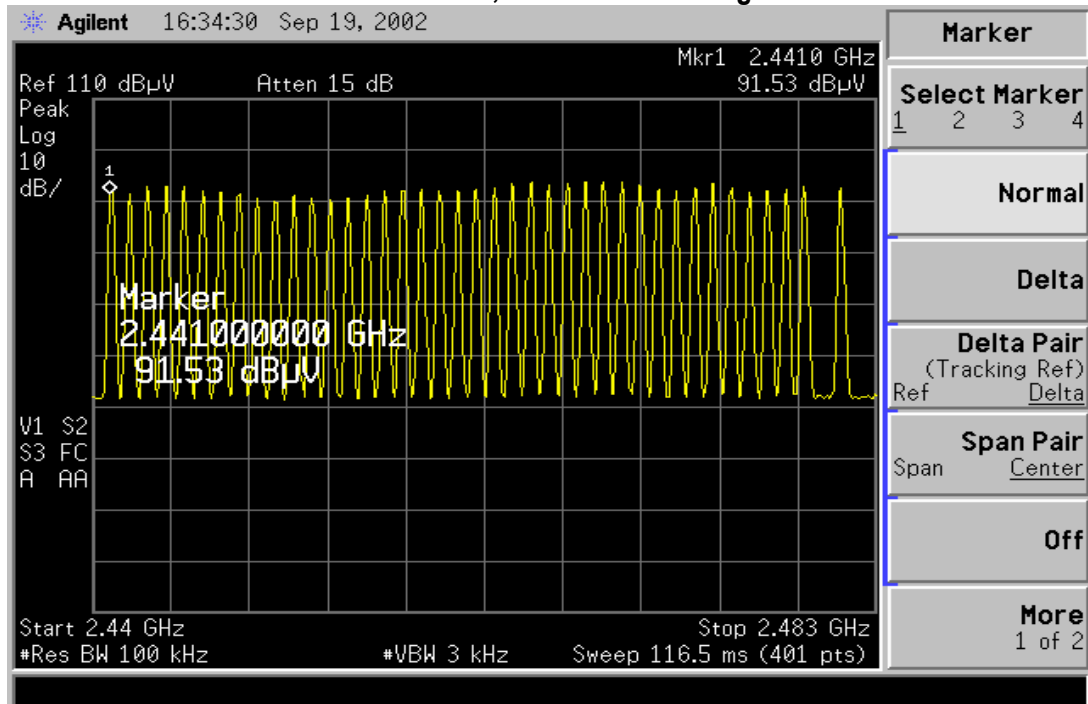
17. Channel Number, Channel Spacing, Channel Occupancy

During the testing of power and bandwidth, a set of Spectrum Analyzer plots were performed to demonstrate channel number, spacing and time of occupancy. The graphs presented in the following pages show the number of channels at 79, with a 1 MHz spacing (Channel 78 to Channel 79; 2 MHz).

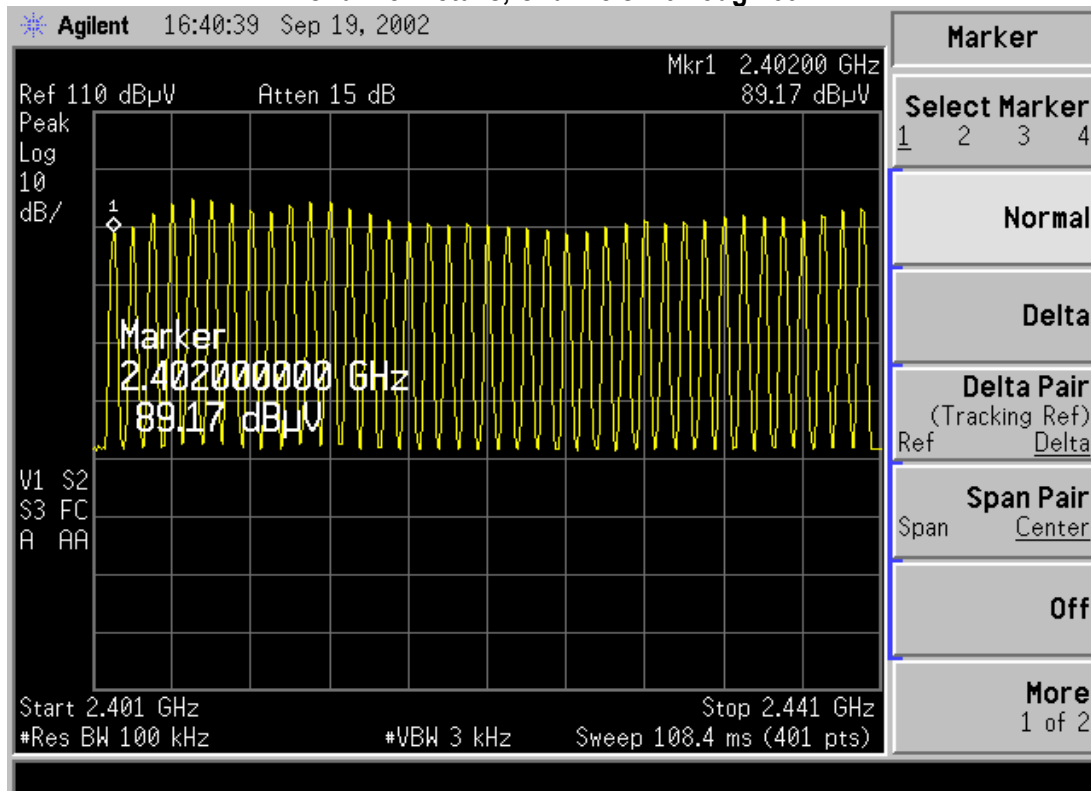
The occupancy time of a pseudo-random frequency hopping transmitter is a little more difficult to demonstrate. Two plots are presented, that show dwell time at one channel (0.2 milliseconds) and the worst case occurrence of the signal in an 80 millisecond window (2 occurrences). This ratio gives a dwell time of 0.4 milliseconds transmit within an 80 millisecond window (0.5%).

Channel Details

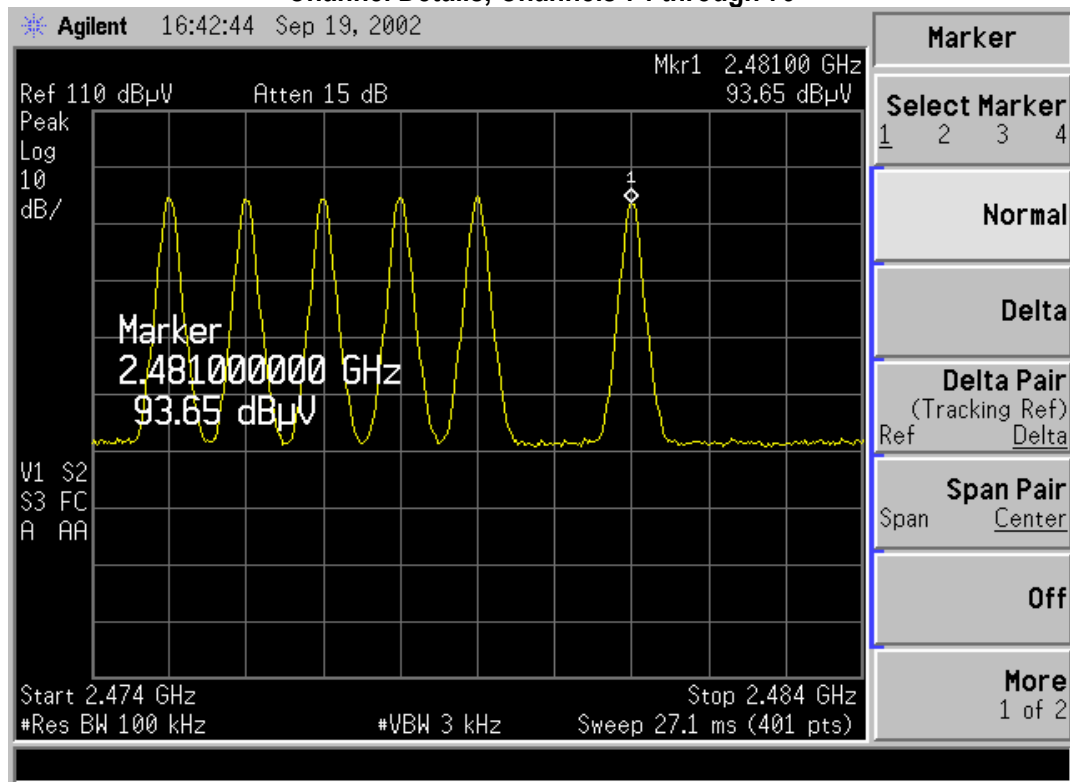
Channel Details, Channels 40 through 79



Channel Details, Channels 1 through 39

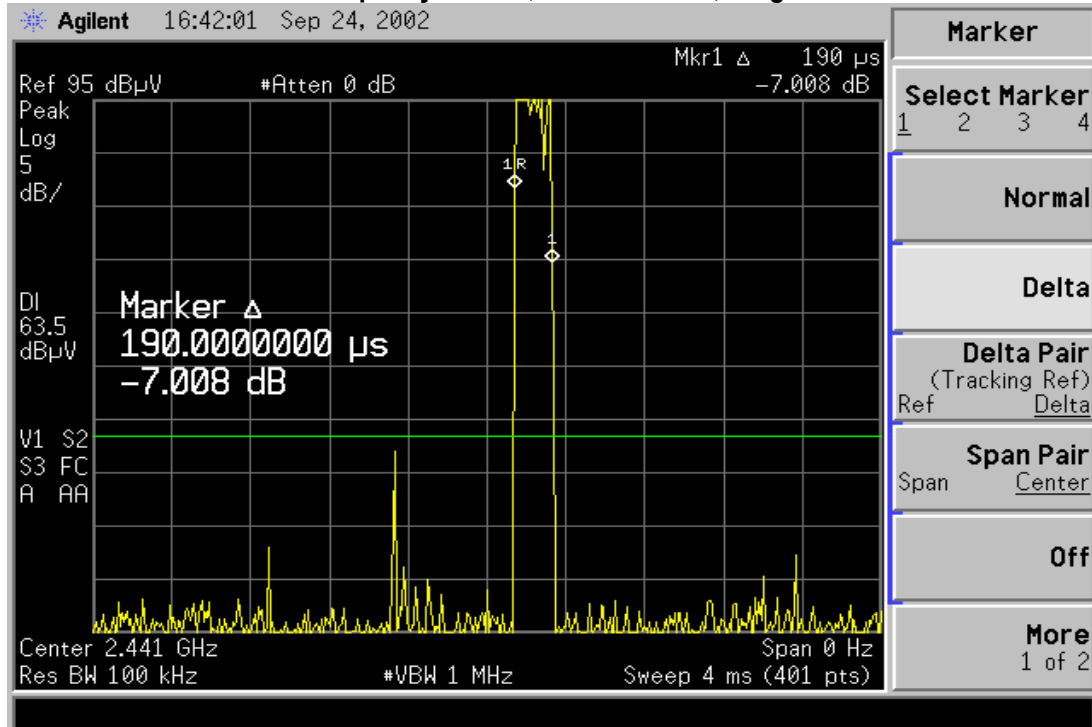


Channel Details, Channels 74 through 79

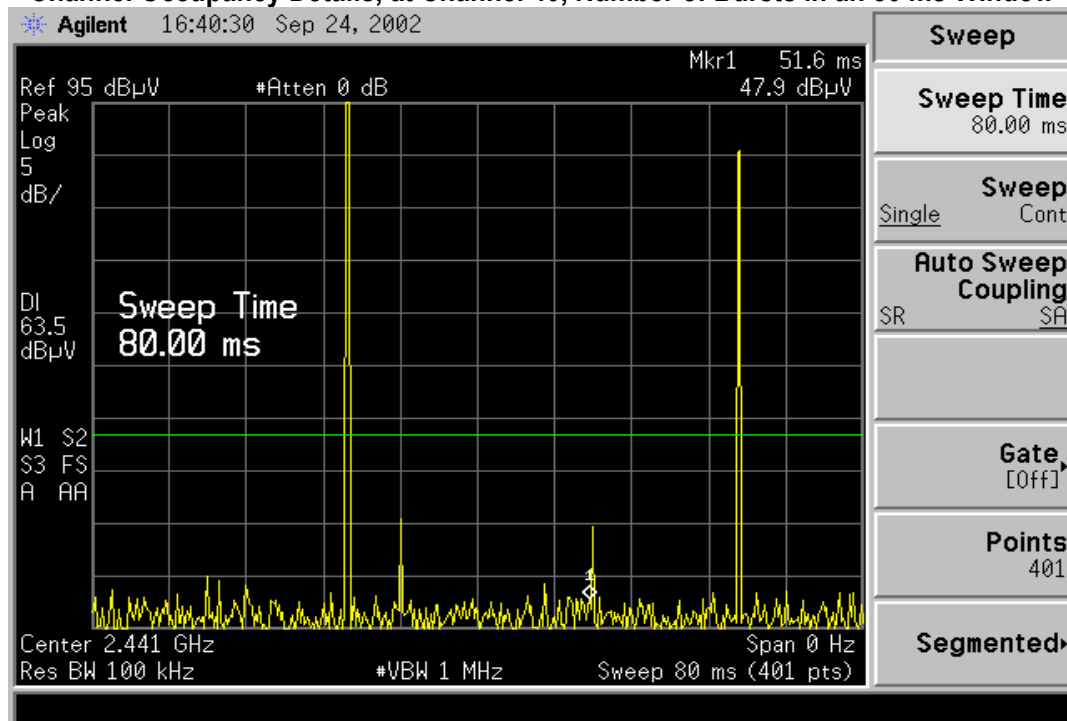


Channel Occupancy Details

Channel Occupancy Details, at Channel 40, Single TX Burst



Channel Occupancy Details, at Channel 40, Number of Bursts in an 80 ms Window



Appendix A

Test Equipment List

Asset #	Manufacturer	Model #	Serial #	Description	Calibration Information	
					Date	Due Date
AA960005	EMCO	3110B	9601-2280	Biconical Antenna	09-24-01	09-24-02
AA960007	EMCO	3115	99111-4198	Double Ridge Horn Antenna	08-21-01	08-21-02
AA960078	EMCO	93146	9701-4855	Log-Periodic Antenna	09-19-02	09-19-03
CC000221	HP	E4407b	Us39160256	26.5 GHz Spectrum Analyzer	Note 1	Note 1
EE960004	EMCO	2090	9607-1164	Device Controller	N/A	N/A
EE960013	HP	8546A	3617A00320	Receiver RF Section	09-20-02	09-20-03
EE960014	HP	85460A	3448A00296	Receiver Pre-Selector	09-20-02	09-20-03
EE960060	EMCO	3160-09	9809-1120	Standard Horn	N/A	N/A
EE960146	Advanced Microwave	WLA622-4	0123001	18-26 GHz Pre-Amp	Note 1	Note 1
N/A	LSC	Cable	0011	3 meter 1/2" Armored Cable	N/A	N/A
N/A	LSC	Cable	0038	1 meter RG 214 Cable	N/A	N/A
N/A	LSC	Cable	0050	10 meter RG 214 Cable	N/A	N/A
N/A	LSC	Attenuator		10 db Attenuator	N/A	N/A

Note 1* - Equipment calibrated within a traceable system.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 Meter Chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3 Meter Chamber, Log Periodic Antenna	4.80 dB
Radiated Emissions	10 Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10 Meter OATS, Log Periodic Antenna	3.92 dB
Conducted Emissions	Shielded Room/EMCO LISN	1.60 dB
Radiated Immunity	3 Meter Chamber, 3 Volts/Meter	1.128 Volts/Meter
Conducted Immunity	3 Volt level	1.0 V