FCC Part 15
(Subpart C – Intentional Radiators)
Section 15.247
Test Report

Prepared For:

Computer Access Technology Corporation
2403 Walsh Avenue
Santa Clara, CA 95051

Model:
Merlin

Prepared by:

Universal Compliance Laboratories
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San Jose, CA 95133
USA

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1 CUSTOMER INFORMATION

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Receipt of EUT:	7/12/01
Test plan reference:	FCC Part 2, 15 (15.247)
Date of testing:	7/16/01
Date of Report:	7/23/01

The tests listed in this report have been done to demonstrate compliance to the CFR 47 Section 15.247.

Contents approved:

Name: Bob Cole Title: President	Name Title

2 EUT AND ACCESSORY INFORMATION

2.1 EUT description

The EUT is a Bluetooth Protocol Analyzer

2.2 EUT and accessories

The table below lists all EUTs and accessories used in the tests. Later in this report, only numbers in the last column are used to refer to the devices in each test.

2.3 Software

The computers were equipped with test software provided by the customer. The software was used to control the EUT in the tests.

	Name	Type	S/N	Number
EUT	Protocol Analyzer	Merlin	01	02001
Accessories	Laptop Computer	Gateway Solo		02002
	Cable	SMA		02003
	Desktop PC	Own	N/A	02004
Software	Merlin FCC2	CATC	N/A	N/A

3 SUMMARY OF TEST RESULTS

	Section in CFR 47	Results
15.207	AC powerline conducted emissions	PASSED
15.247, a1	Carrier frequency separation	PASSED
15.247, a1ii	Number of hopping frequencies	PASSED
15.247, a1ii	Time of occupancy	PASSED
15.247, a	20dB	PASSED
15.247,b1	Peak output power	PASSED
15.247, c	Band-edge compliance of RF conducted emissions	PASSED
15.247, c	Spurious RF conducted emissions	PASSED
15.247,c	Spurious radiated emissions	PASSED

PASS The EUT passed that particular test.
FAIL The EUT failed that particular test.

4 STANDARDS AND MEASUREMENT METHODS

The tests were performed in guidance of CFR 47 section 15.247, FCC public notice DA 00-705 (March 30, 2000) and ANSI C63.4 (1992). Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method". For the test equipment, see device list in the end of this test.

4.1 Selection of operation mode for tests

Before tests, several operation modes, and modulation patterns were tried. The worst case was selected for each test and those results reported.

5 TEST SETUPS

To fulfill all requirements for the testing, total of two different test setup were used. One EUT was used, unmodified for radiated tests and for conductive measurements.

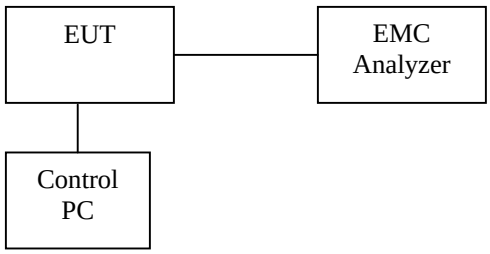
5.1 Setup A (conducted measurements, hopping disabled)

5.1.1 Operational description

This setup was used in conducted measurements with hopping disabled. The EUT connected to the Laptop Computer, the antenna removed and the SMA Cable connected to the Spectrum Analyzer. The setup was capable of doing following:

- set the EUT channel (2-80)
- set the EUT to Inquiry,TX, RX, and TX/RX mode

5.1.2 Block Diagram



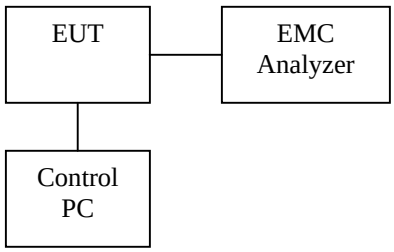
The solid lines are coaxial cables and the dashed lines are either EUT insertion to the test board or control cables between test setup devices. The measurement results were adjusted with the attenuation of the coaxial cable.

5.2 Setup B (conducted measurements, hopping enabled)

5.2.1 Operational description

This setup was used in conducted measurements with hopping enabled. The EUT (master) was inserted in a laptop PC equipped with a software, which can communicate with another device of same king (slave).

5.2.2 Block diagram



The solid lines are coaxial cables and the dashed lines are either EUT insertion to the test board or control cables between test setup devices.

The circulator forwards the master's TX signal to the spectrum analyzer. The reverse direction of the circulator leaks some of the EUT power through attenuator to the slave to allow communication. The slave's TX signal is forwarded through the attenuator and circulator to the master.

The reverse attenuation of the circulator and step attenuator (set to 40dB) is more than 60dB thus preventing the transmission of the slave from affecting the measurement results.

The attenuation of the coaxial cables, circulator and attenuator were used to adjust the measurement results.

5.3 Setup C (radiated measurements, hopping enabled)

5.3.1 Operational description

This setup was used in radiated measurements with hopping enabled. The EUT was connected to the Laptop PC via the USB interface.

5.3.2 Block diagram

The slave was placed far enough from the EUT not to disturb the measurements but still to allow communication with the master.

6 TEST RESULTS

6.1 AC powerline conducted emissions (§15.207)

EUT	02001
Accessories	02002, 02003
Test setup	A
Temp, Humidity	56º F, 29.86
Date of Measurement	7/16/01
Measured by	Bob Cole
Result	PASSED

6.1.1 Limit

Class B Limit

Frequency Band (Mhz)	Quasi-Peak (µV)
0.45 - 30	250

6.1.2 EUT operation mode

EUT operation mode	Inquiry
EUT channel	Hopping
EUT TX power level	Nominal
EUT operation voltage	115V / 60 Hz

6.1.3 EUT test setup

The EUT was set according to ANSI C63.4-1992, figure 9a

6.1.4 Picture 1. AC conducted emissions measurement setup

6.1.5 Emission measurement data

The measurement results were adjusted with the attenuation of the cable between the LISN and receiver.

Line/Detection Mode	Frequency (MHz)	Amplitude (uV)	Amplitude (dBuV)	Limiter Attenuation	Class A Limit	Margin
Hot/Quasi Peak	2.416	8.106	18.18	10.00	73.00	-44.82
Hot/Quasi Peak	4.040	10.112	20.10	10.00	83.00	-52.90
Hot/Quasi Peak	6.430	8.186	18.26	10.00	83.00	-54.74
Hot/Quasi Peak	8.040	13.563	22.65	10.00	83.00	-50.35
Hot/Quasi Peak	20.064	10.112	20.10	10.00	83.00	-52.90
Hot/Quasi Peak	24.080	36.034	31.13	10.00	83.00	-51.87

Line/Detection Mode	Frequency (MHz)	Amplitude (uV)	Amplitude (dBuV)	Limiter Attenuation	Class A Limit	Margin
Neutral/Quasi Peak	0.805	3.323	10.43	10.00	73.00	-52.57
Neutral/Quasi Peak	4.040	12.439	21.90	10.00	83.00	-51.10
Neutral/Quasi Peak	6.450	9.397	19.46	10.00	83.00	-53.54
Neutral/Quasi Peak	9.660	12.439	21.90	10.00	83.00	-51.10
Neutral/Quasi Peak	20.870	12.038	21.61	10.00	83.00	-51.39
Neutral/Quasi Peak	24.060	11.263	21.01	10.00	83.00	-51.99

6.2 Carrier frequency separation (§15.247a1)

EUT	02001
Test setup	A
Temp, Humidity, Air Pressure	56º F, 29.96
Date of Measurement	7/16/01
Measured by	Bob Cole
Result	PASSED

6.2.1 EUT operation mode

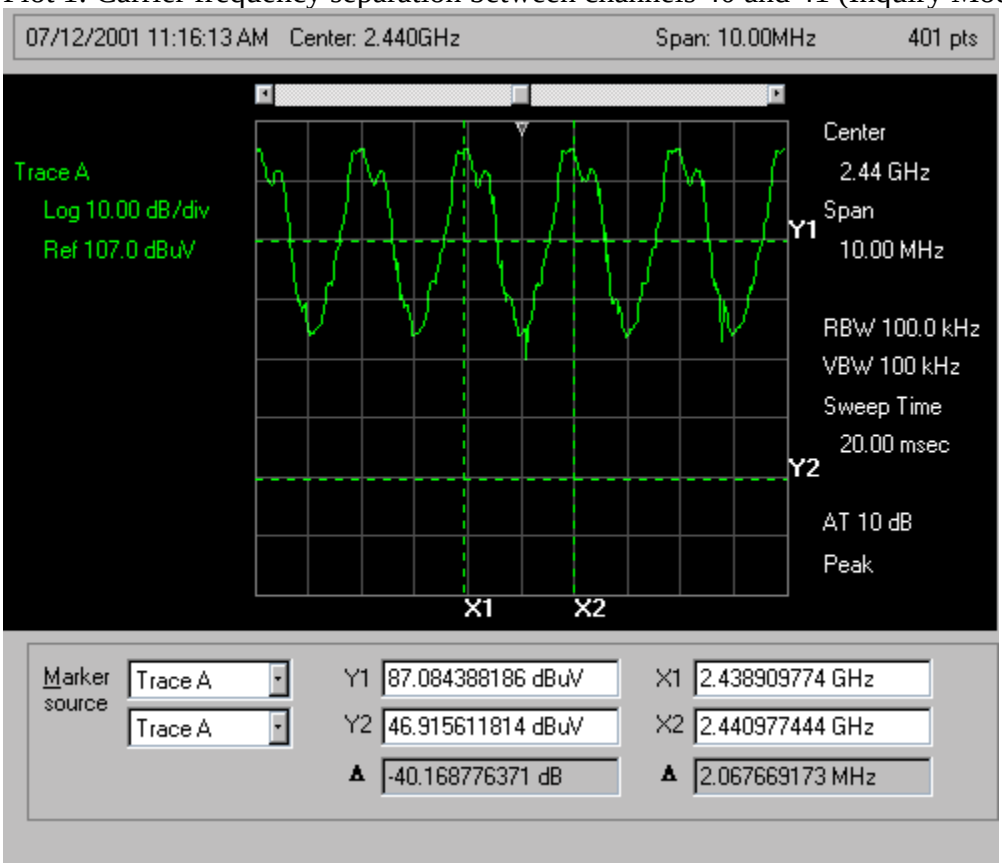
EUT operation mode	Inquiry
EUT channel	Hopping
EUT TX power level	Nominal

6.2.2 Limits and results

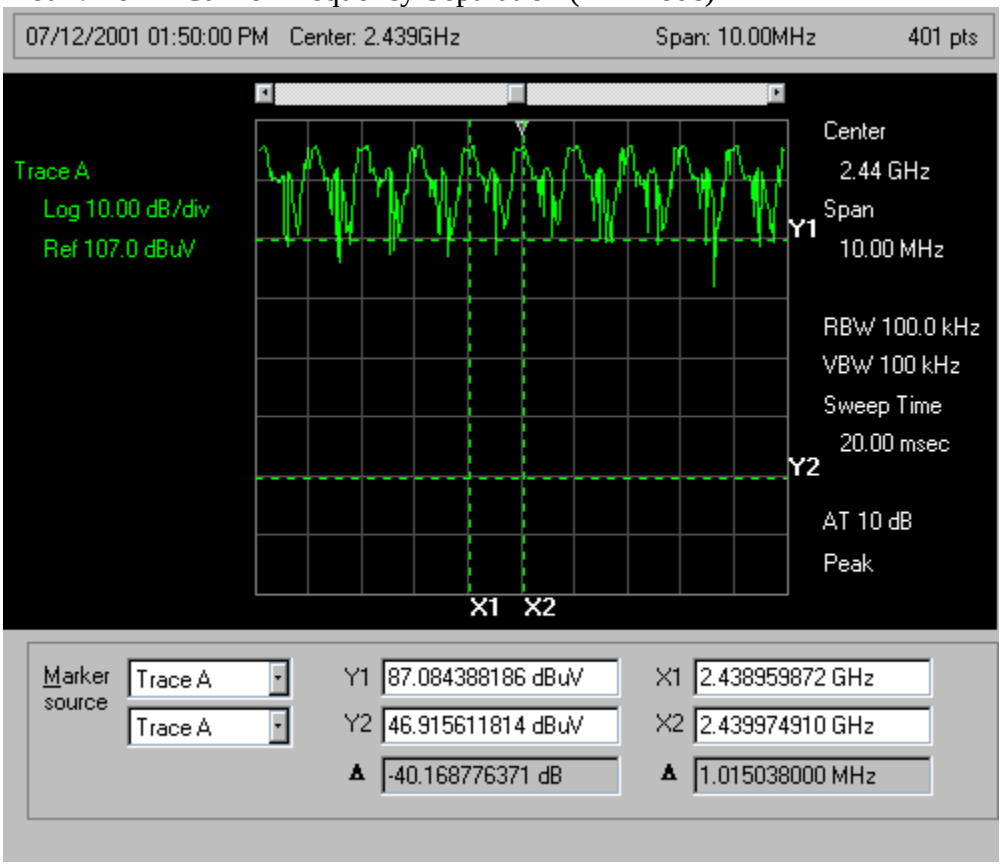
Limit (MHz)	Result (MHz)
>/= 1.0	

6.2.3 Screen shot

Plot 1: Carrier frequency separation between channels 40 and 41 (Inquiry Mode)



Plot 2:Merlin Carrier Frequency Separation (TX Mode)



6.3 Number of hopping frequencies (§15.247a2)

EUT	02001
Test setup	A
Temp, Humidity, Air Pressure	56º F, 29.96
Date of Measurement	7/16/01
Measured by	Bob Cole
Result	PASSED

6.3.1 EUT operation mode

EUT operation mode	Inquiry, TX
EUT channel	Hopping
EUT TX power level	Nominal

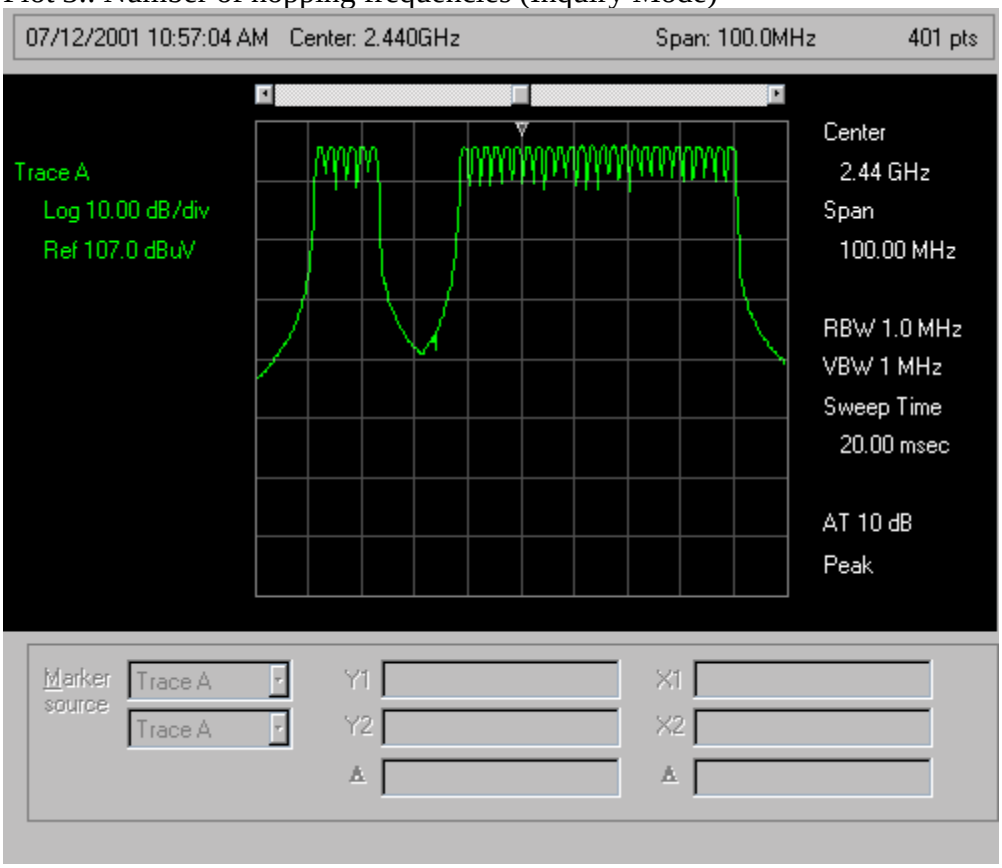
6.3.2 Limits and results

Number of hopping frequencies

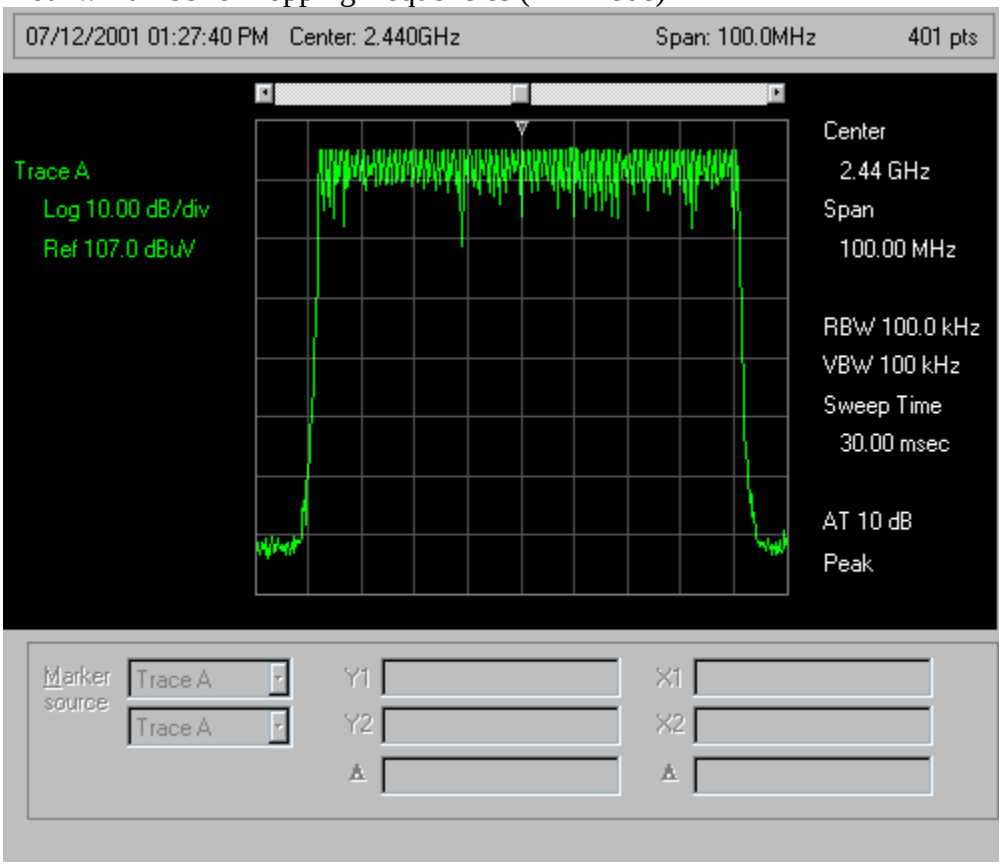
Number	Measured Value
>/= 75	78 (TX Mode)

6.3.3 Screen shot

Plot 3:. Number of hopping frequencies (Inquiry Mode)



Plot 4:. Number of hopping frequencies (TX Mode)



6.4 Time of occupancy (§15.247a3)

EUT	02001
Test setup	A
Temp, Humidity, Air Pressure	56º F, 29.96
Date of Measurement	7/16/01
Measured by	Bob Cole
Result	PASSED

6.4.1 EUT operation mode

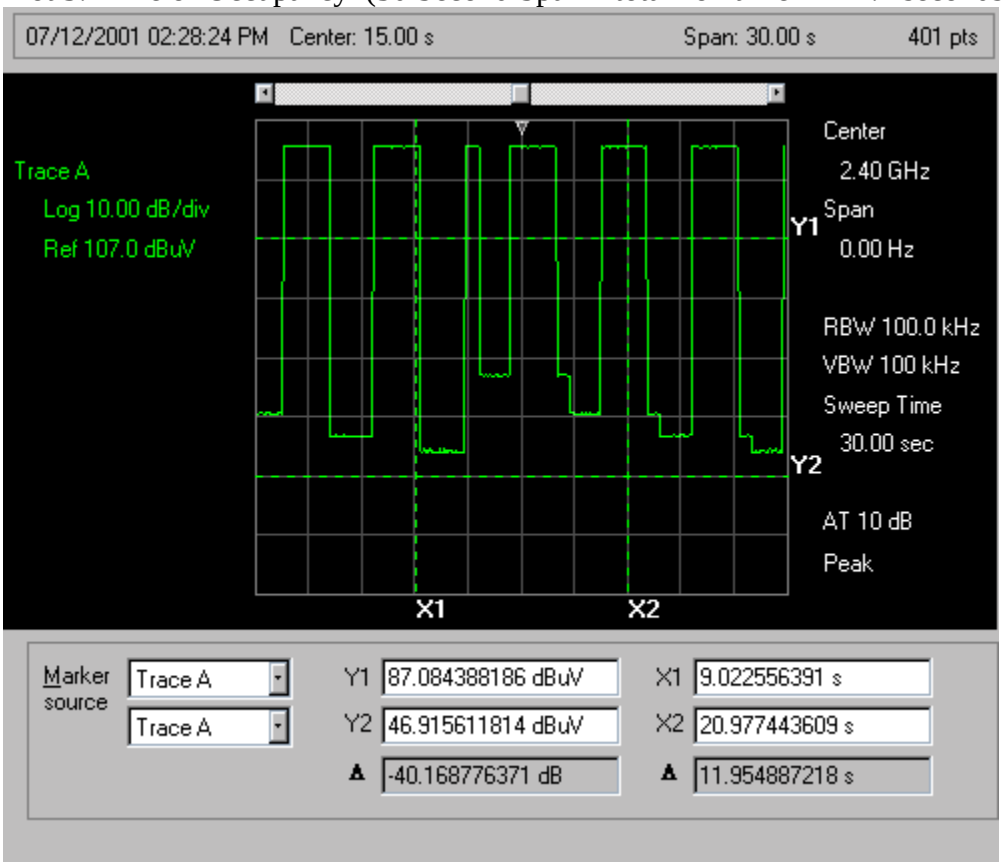
EUT operation mode	Inquiry
EUT channel	Hopping
EUT TX power level	Nominal

6.4.2 Limits and results

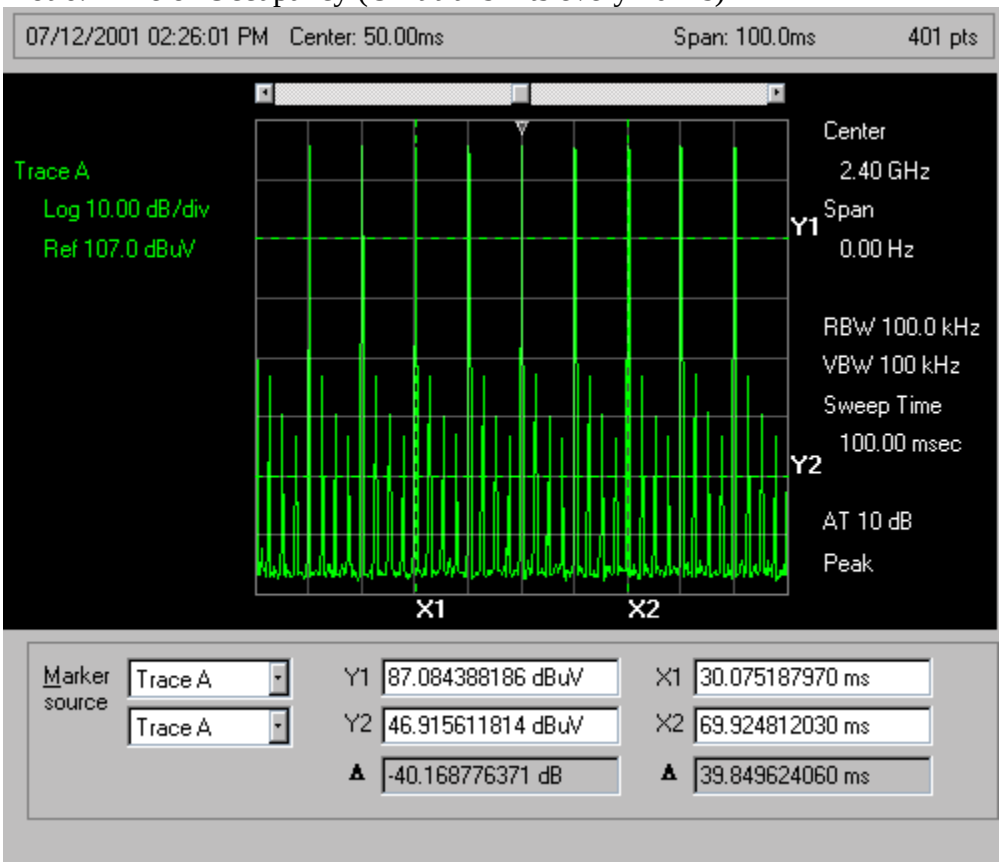
Limit(s)	Measured value (s)
</= 0.4	0.3692

6.4.3 Screen shot

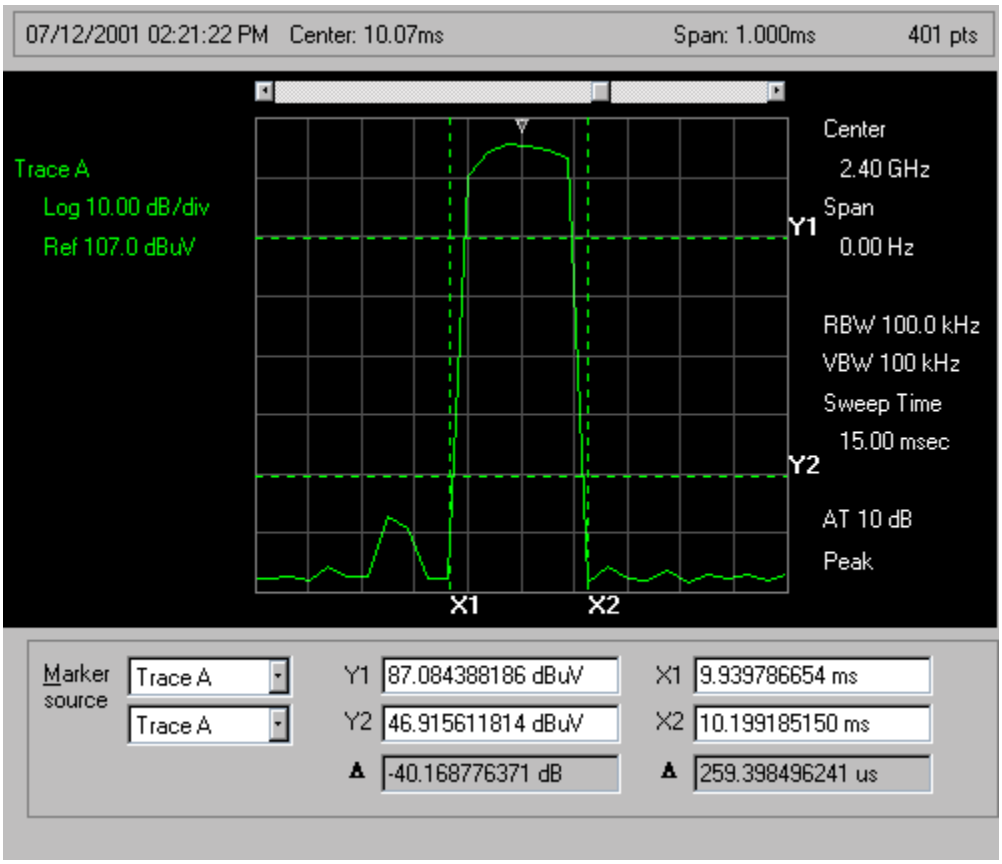
Plot 5: Time of Occupancy (30 Second Span – total "on time" = 14.2 seconds)



Plot 6: Time of Occupancy (Unit transmits every 10 ms)



Plot 7:Time of Occupancy (Each Transmission = 260 µs)



- 14.2 seconds ‘on time’ per 30 seconds scan
- 100 pulses per second
- 260 µs per pulse

14.2 x 100 x .000260 = 0.3692 seconds Time of Occupancy

6.5 20dB bandwidth (§15.247a1)

EUT	02001
Test setup	A
Temp, Humidity, Air Pressure	65º F, 29.96
Date of Measurement	7/16/02
Measured by	Bob Cole
Result	PASSED

6.5.1 EUT operation mode

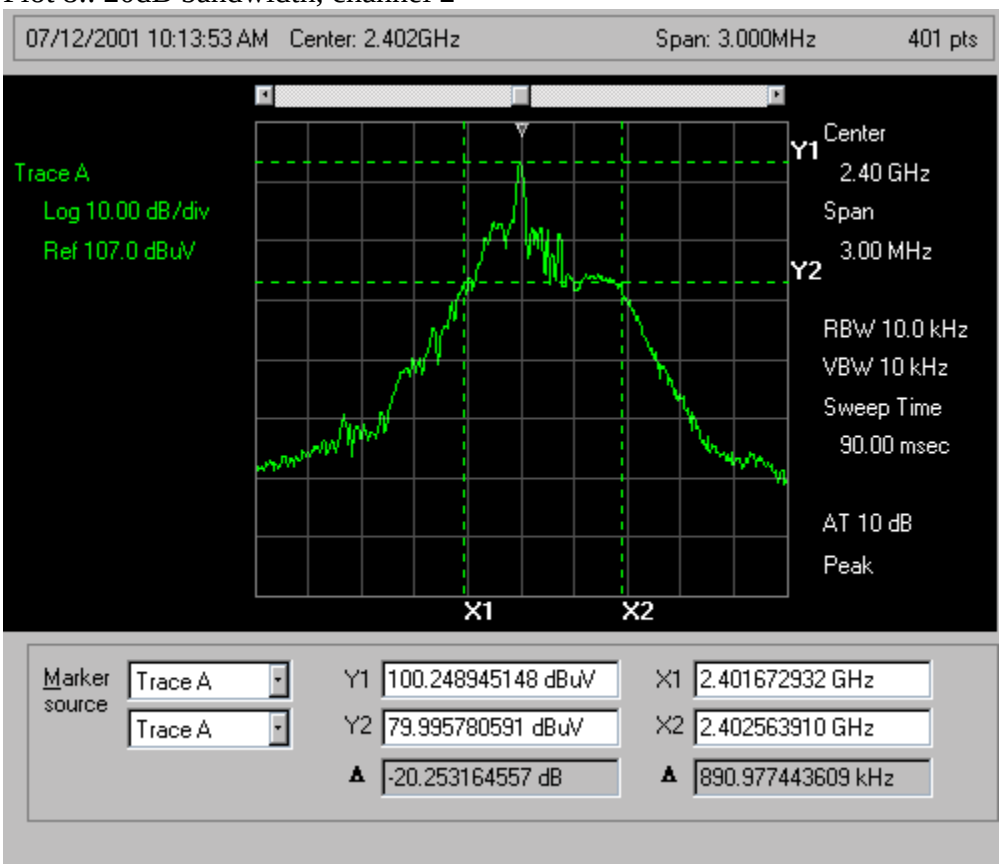
EUT operation mode	Inquiry (Hopping disabled)
EUT channel	2, 40, 80
EUT TX power level	Nominal

6.5.2 Limits and results

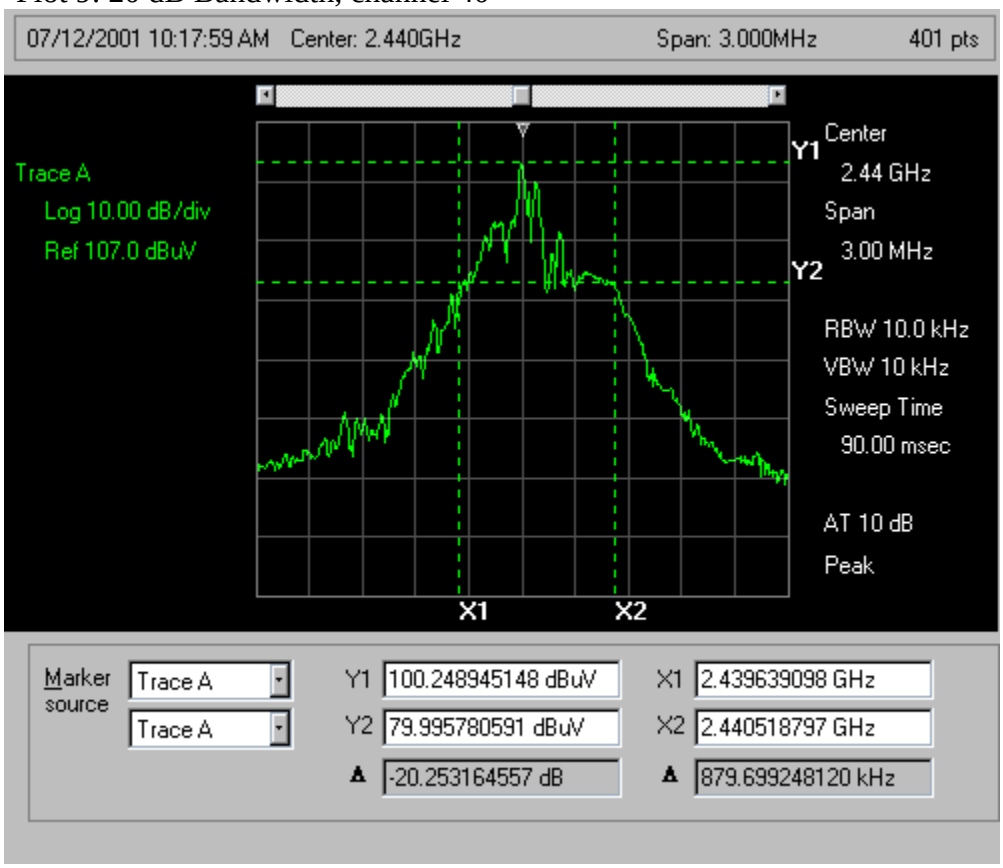
EUT Channel	Limit (MHz)	Measured value (MHz)
2	</= 1 MHz	.89097
40	</= 1 MHz	.87969
80	</= 1 MHz	.91739

6.5.3 Screen shot

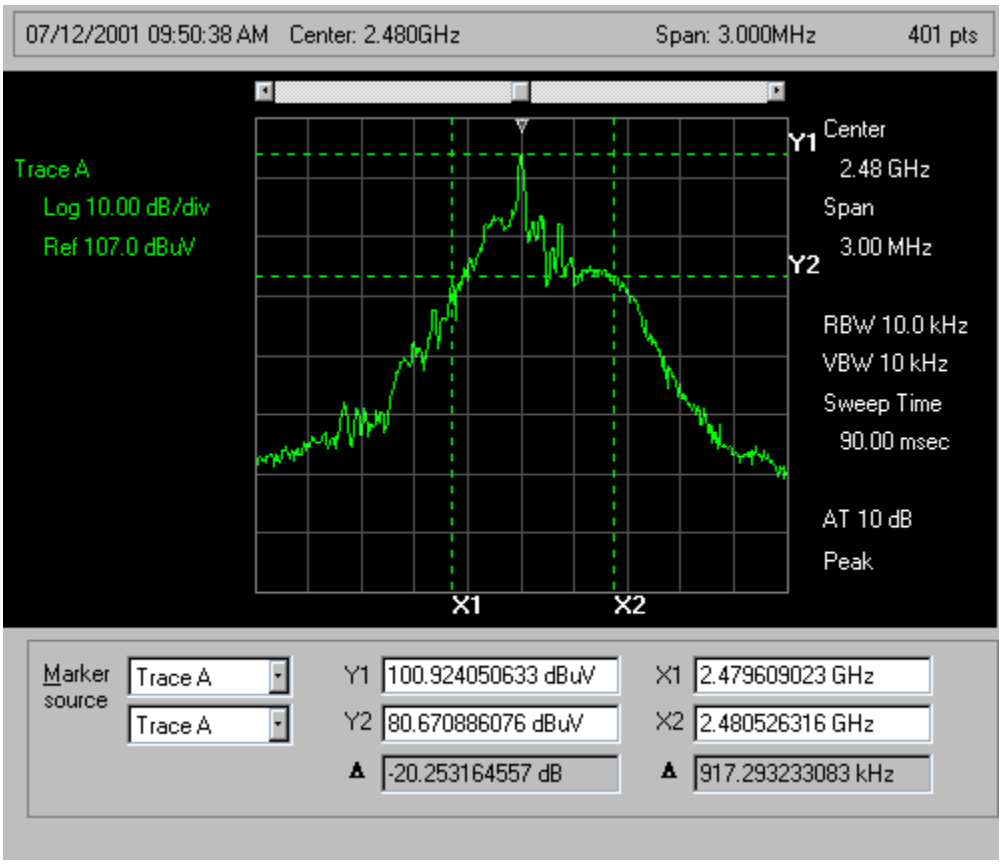
Plot 8:. 20dB bandwidth, channel 2



Plot 9: 20 dB Bandwidth, channel 40



Plot 10: 20 dB Bandwidth, channel 80



6.6 Peak output power (§15.247b1)

EUT	02001
Test setup	A
Temp, Humidity, Air Pressure	56º F, 29.96
Date of Measurement	7/16/01
Measured by	Bob Cole
Result	PASSED

6.6.1 EUT operation mode

EUT operation mode	Inquiry (Hopping Disabled)
EUT channel	2, 40, 80
EUT TX power level	Nominal
Operation voltage	115V, 60 Hz

6.6.2 Limits and results

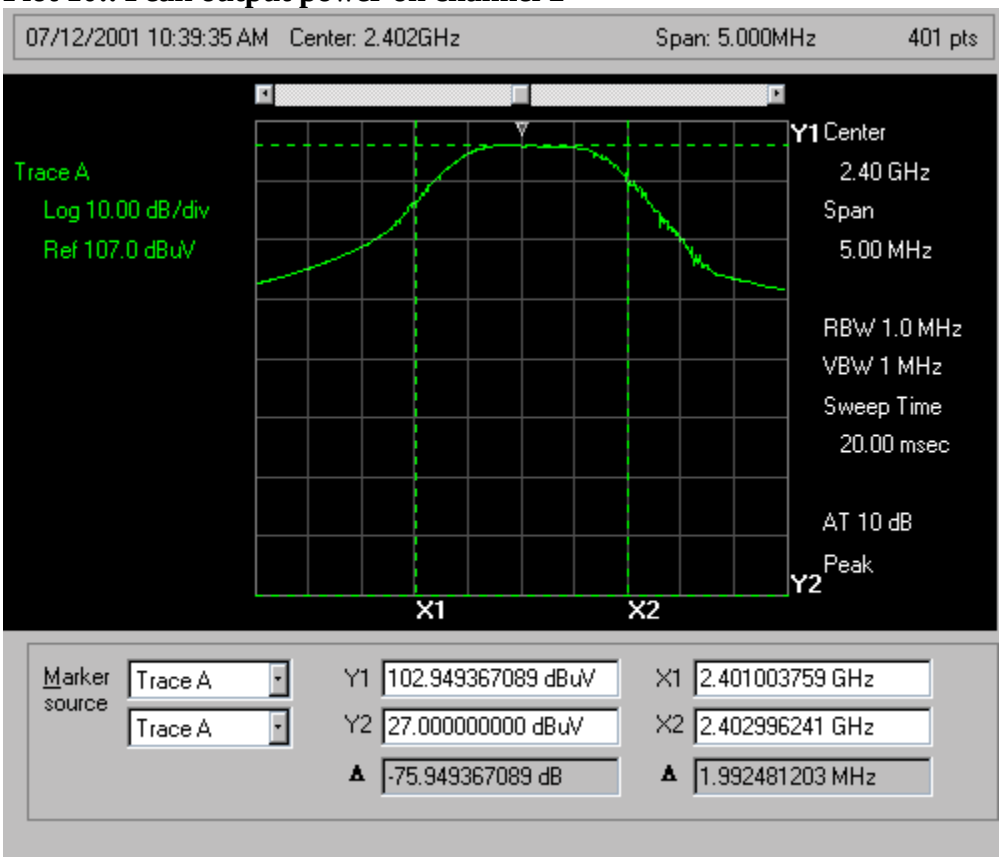
Peak output power

EUT Channel	Limit (W)	Test results (dBuV)
2	</= 1.0	102.74
40	</= 1.0	102.74
80	</= 1.0	102.74

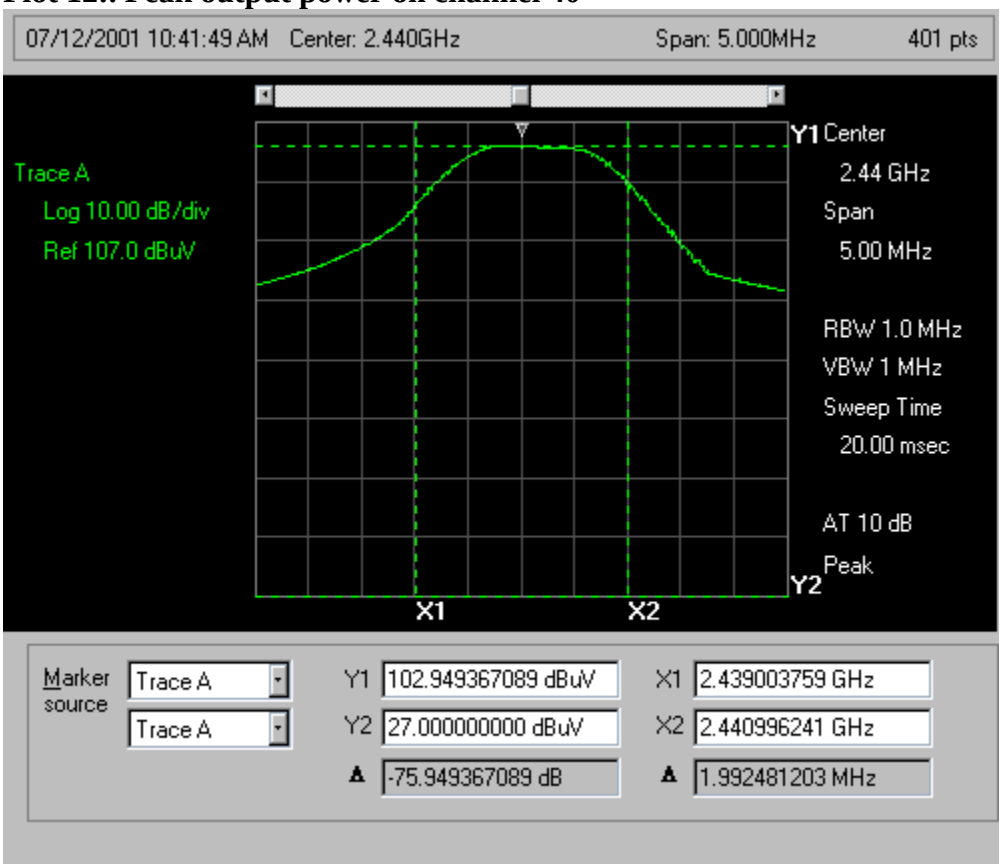
EUT Channe	Measured Value [dBuV	Cable attenuation [dB	Power output [dBuV	Power output [W
2	102.94	0.2	102.74	N/A

6.6.3 Screen shots

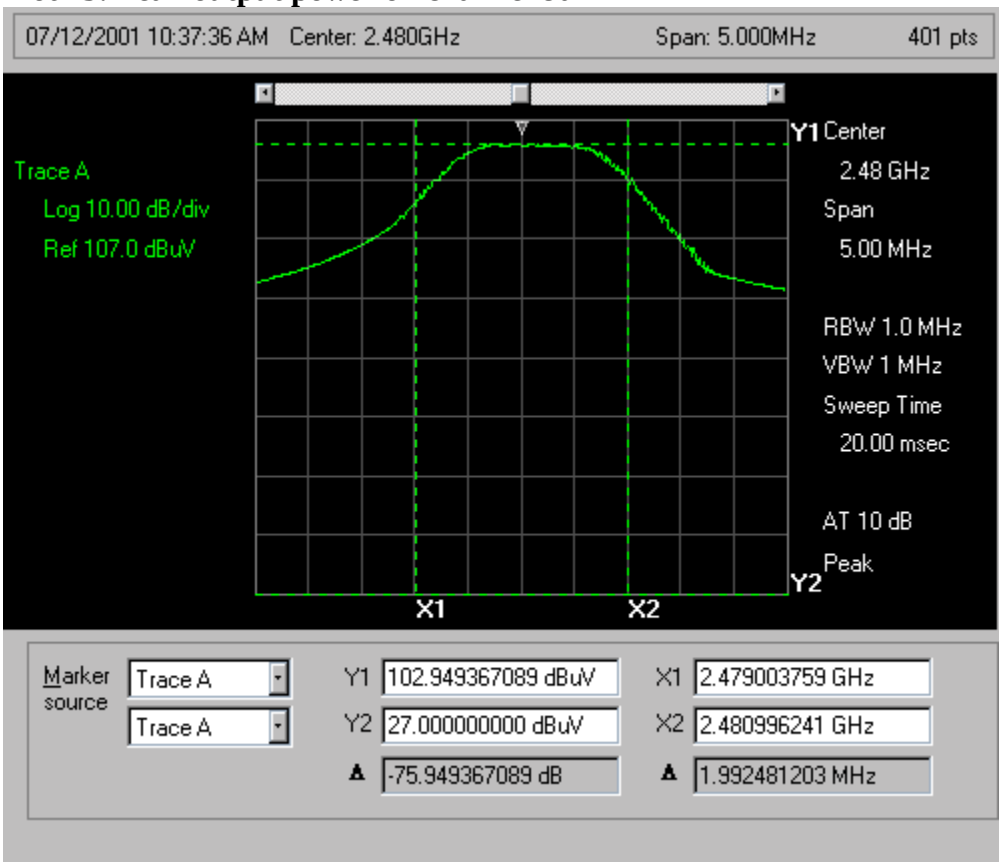
Plot 10:. Peak output power on channel 2



Plot 12:. Peak output power on channel 40



Plot 13: Peak output power on channel 80



6.7 Band-edge compliance of RF conducted emissions (§15.247c1)

6.7.1 Hopping enabled

EUT	02001
Test setup	A
Temp, Humidity, Air Pressure	56º F, 29.96
Date of Measurement	7/16/01
Measured by	Bob Cole
Result	PASSED

6.7.1.1 EUT operation mode

EUT operation mode	Inquiry
EUT channel	2, 80
EUT TX power level	Nominal

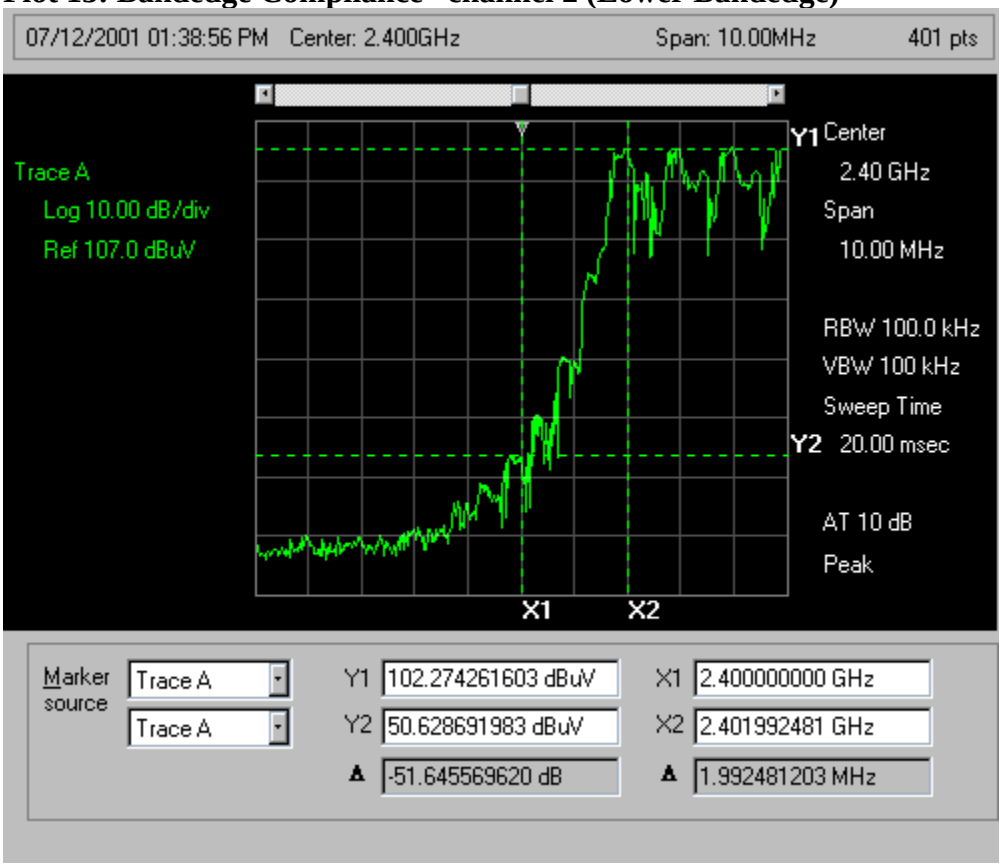
6.7.1.2 Limits and results

Band-edge compliance

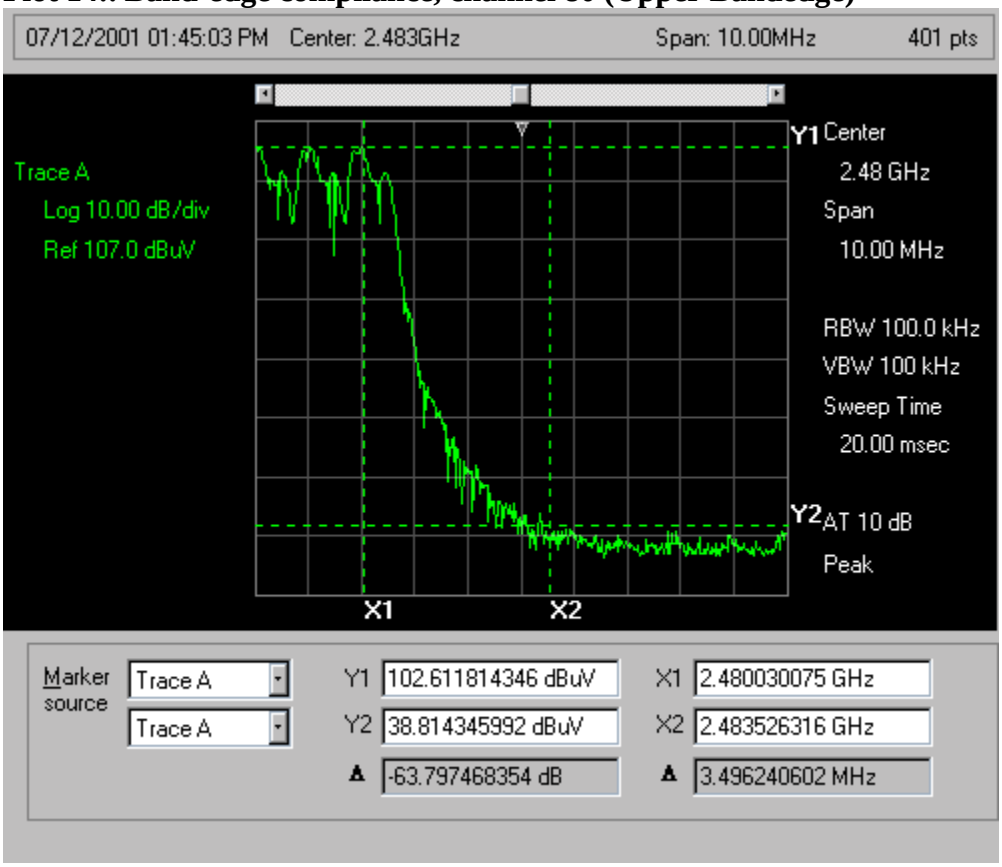
Channel	Limit (dBuV)	Results (dBuV)
2	54	50.62
80	54	38.81

6.7.1.3 Screen shots

Plot 13: Bandedge Compliance –channel 2 (Lower Bandedge)



Plot 14:. Band-edge compliance, channel 80 (Upper Bandedge)



6.7.2 Hopping disabled

EUT	02001
Test setup	A
Temp, Humidity, Air Pressure	56º F, 29.96
Date of Measurement	7/16/01
Measured by	Bob Cole
Result	PASSED

6.7.2.1 Test Method

The test is made according to ANSI C63.4 (1992)

6.7.2.2 EUT operation mode

EUT operation mode	Inquiry
EUT channel	2, 80
EUT TX power level	Nominal

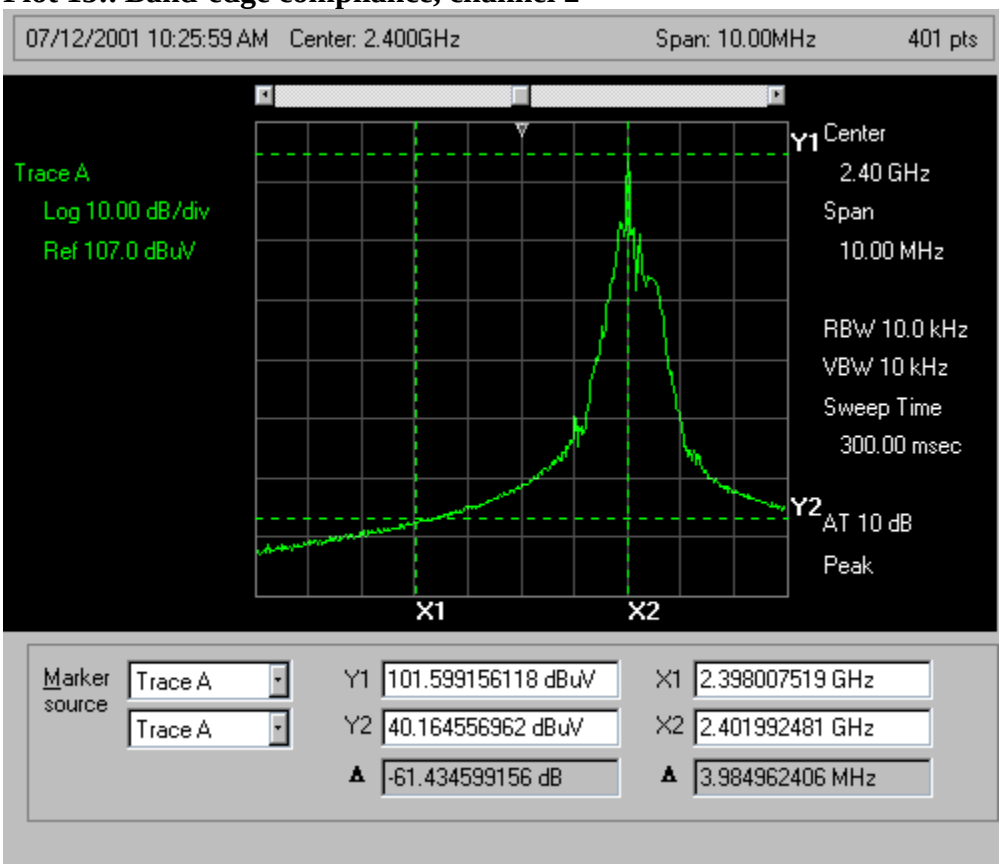
6.7.2.3 Limits and results

Band-edge compliance

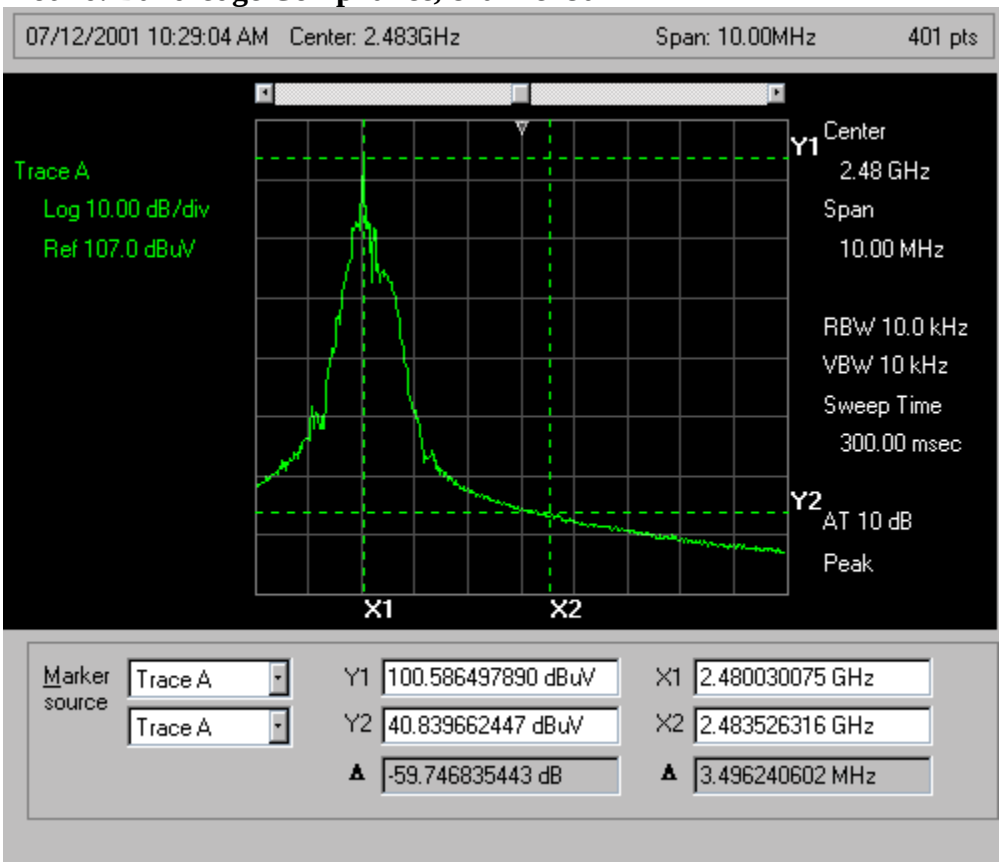
Channel	Limit (dBc)	Results (dBc)
2	54	40.16
80	54	40.84

6.7.2.4 Screen shots

Plot 15:. Band-edge compliance, channel 2



Plot 16: Band-edge Compliance, channel 80



6.8 Spurious RF Conducted emissions (§15.247c2)

EUT	02001
Test setup	A
Temp, Humidity, Air Pressure	56º F, 29.96
Date of Measurement	7/16/01
Measured by	Bob Cole
Result	PASSED

6.8.1 EUT operation mode

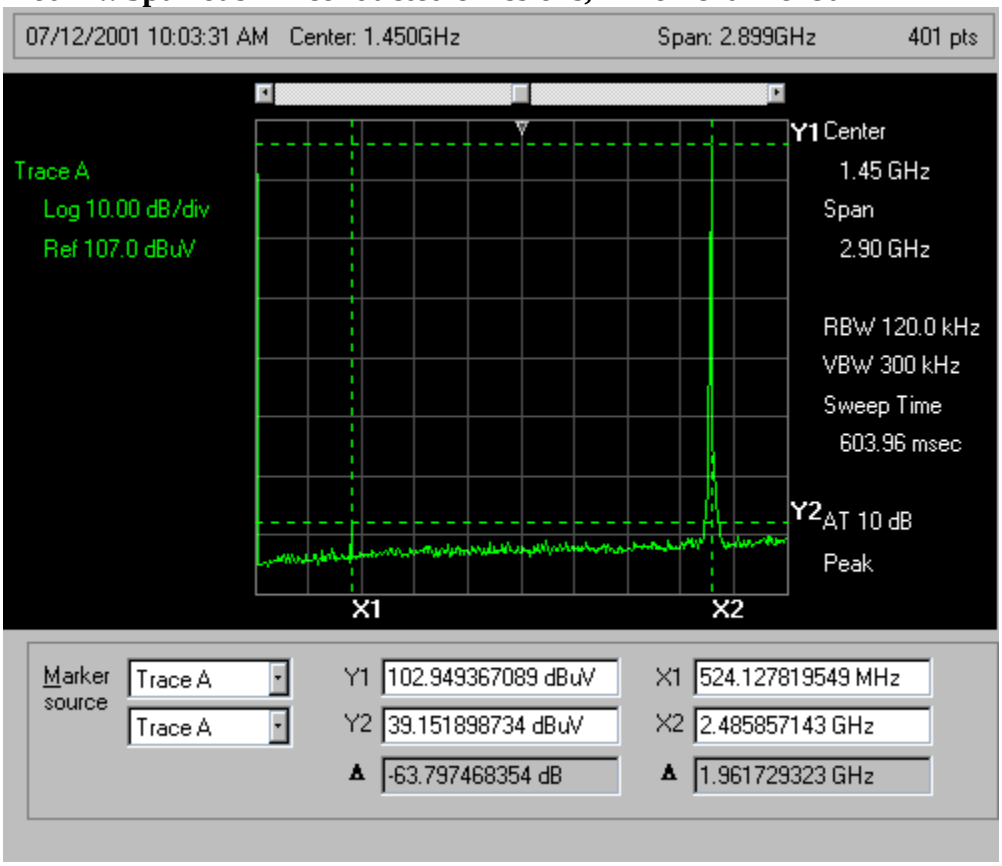
EUT operation mode	Inquiry
EUT channel	Hopping
EUT TX power level	Nominal

6.8.2 Limits and results

EUT Channel	Limit (dBuV)	Results (dBuV)
2	54	<54
40	54	<54
80	54	<54

6.8.3 Screen shots

Plot 17:. Spurious RF conducted emissions, TX on channel 80



6.9 Spurious RF Conducted emissions (§15.247c1)

EUT	02001
Accessories	02002,02003
Test setup	A
Temp, Humidity, Air Pressure	56º F, 29.96
Date of Measurement	7/16/01
Measured by	Bob Cole
Result	PASSED

6.9.1 Test Method and level, 30 MHz – 1GHz

The test was made according to ANSI C63.4 (1992) with following exceptions and additions:

1) The measurement was made in a semi-anechoic chamber at a measurement distance of 3m. The chamber had ferrite and absorber lining in all the walls and ceiling, the floor was metal covered.
2) The measurement was divided in two parts' prescan and final measurement.

6.9.1.1 Prescan

a) The EUT was set on the turntable and measuring antenna in horizontal polarization at 1m.
b) The turntable was set at 0 degrees.
c) The receiver was set to record the maximum level using peak detector.
d) The antenna was raised from 1m to 4m in 1 meter steps.
e) For each antenna height the table was rotated full turn in 45 degree steps.
f) Antenna polarization was changed to vertical and phases b-e repeated.
g) All suspect frequencies were recorded in a file.
h) At every suspect frequency the turntable was rotated around, antenna scanned and the polarization changed to find the maximum levels.
i) If there were any emissions closer than 10dB to the limit line, the final measurement was done.

6.9.1.2 Final measurement

a) The final measurement was run at suspect frequencies only using quasi-peak detector.
b) The turntable was rotated full turn to find out the worst azimuth.
c) On those azimuths obtained in b, the antenna was scanned from 1m to 4m to find out the worst evaluation.
d) Phase b and c were repeated with another antenna polarization.
e) Obtained quasi-peak values were reported.

6.9.2 Test method and level, 1GHz – 18GHz

The test was made according to ANSI c63.4 (1992) with the following exceptions and additions:

3) The measurement was divided in two parts; prescan and final measurement.

6.9.2.1 Prescan

j) The EUT was set on the turntable and measuring antenna in horizontal polarization at 1m.
k) The turntable was set at 0 degrees.
l) The receiver was set to record the maximum level using peak detector.
m) The table was rotated full turn.
n) Antenna polarization was changed to vertical and phases k-m repeated.
o) All suspect frequencies were recorded in a file

6.9.2.2 Final Measurement

f) The final measurement was run at suspect frequencies only antenna in horizontal polarization
p) The receiver was set to record the maximum level using peak detector.
g) At every suspect frequency (or frequency band), the turntable was rotated full turn to find out the worst azimuth.
h) Phase g was repeated with vertical antenna polarization.
i) Obtained values were recorded.

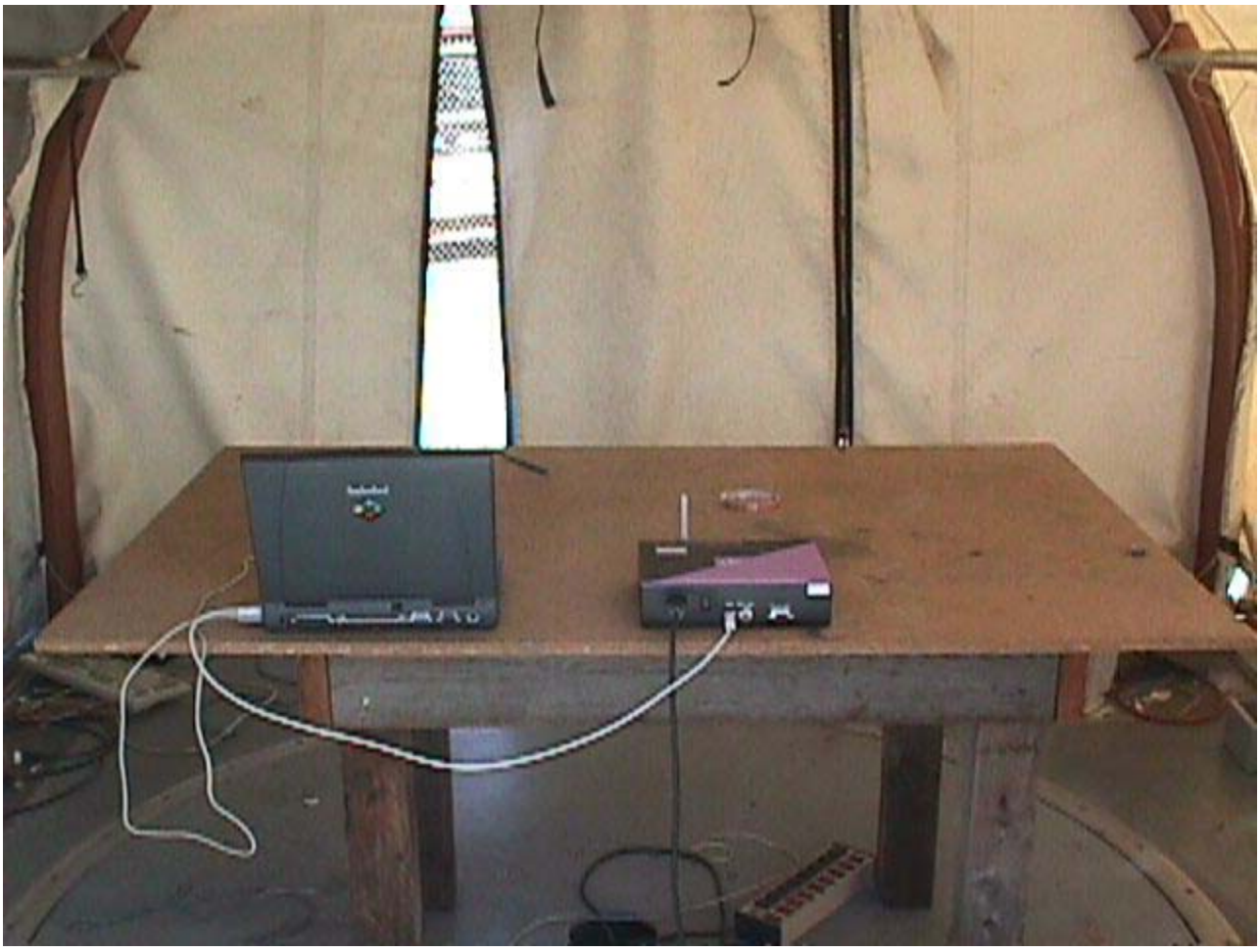
Class B limit (3m measuring distance)

Frequency Band (MHz)	Limit (dBµV/m)	Detector
30-88	40	Q-Peak
88-230	43.5	Q-Peak
230-960	47	Q-Peak
960-1000	54	Q-Peak
1000-25000	54	Peak

6.9.3 EUT operation mode

EUT operation mode	TX
EUT channel	Hopping
EUT TX power level	Nominal
EUT operation voltage	115V

6.9.4 Radiated emissions measurement setup



6.9.5 Emission measurement data, 30 MHz – 1GHz

The measurement results were obtained as described below.

$$E[uV/m]- U_{RX} + A_{CABLE} + AF – G_{PREAMP}$$

Where

U_{RX}	receiver reading
A_{CABLE}	Attenuation of the cable
AF	Antenna Factor
G_{PREAMP}	Gain of the preamplifier

Freq [Max] [Mhz]	[QP] EMI [dBµV/m]	Limit [dBµV/m]	QP Marg [dB]	Ttbl Agl [deg]	Twr Ht [meters]	Pol.
36.00	37.32	40	2.68	0	1.15	Vertical
48.00	36.97	40	3.03	15	1.10	Vertical
210.00	39.75	43.5	3.75	92	1.20	Vertical
240.00	44.86	47	2.14	0	1.00	Vertical
360.00	40.80	47	6.20	279	1.12	Horizontal
416.00	40.69	47	6.31	0	1.00	Vertical

Table 1. Highest emissions, 30-1000 MHz

7 TEST EQUIPMENT

15.247, a (20dB bandwidth), 15.247, a1 (Carrier frequency separation), 15.247, a1ii (Number of hopping frequencies), 15.247, a1ii (Time of occupancy), 15.247, b1 (Peak output power), 15.247, c (Band-edge compliance of RF conducted emissions), 15.247, c (Spurious RF conducted emissions)

Equipment	Type	Manufacturer	Device Number
EMI Analyzer	84125B	Hewlett-Packard	15921-12
Coaxial cable	SMA Male – Reverse SMA Male (Length = 1 ft.)	Own	12C

Equipment	Type	Manufacturer	Device Number
EMI Analyzer System	84125B	Hewlett-Packard	15921-12
Pre-Amp	83051A	Hewlett-Packard	15921-12
Pre-Amp	83017A	Hewlett-Packard	15921-12
High Pass Filter	9701	CMT	15921-12
Horn Antenna	3115	EMCO	15921-12
Cable		Hewlett Packard	15921-12

Note: The HP 84125B EMC Analyzer System is calibrated as a system, including the analyzer, pre-amps, filters, and cable.

15.247, c (Spurious radiated emissions)

Equipment	Type	Manufacturer	Device number
EMI Receiver			
RF Filter Section			
Biconilog antenna			
Preamplifier			
Computer, equipped with: -Standard emissions software -GPIB interface card	Control	CATC	

15.207 (AC powerline conducted emissions)

Equipment	Type	Manufacturer	Device number
EMI Analyzer			
LISN			
LISN			
Coaxial cable			