FCC Part 15
(Subpart C – Intentional Radiators)

Test Report

Dated: 3/17/03

Prepared For:
Socket Communications
34700 Central Court
Newark, CA

Model:
Bluetooth Module

Prepared by:

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1 CUSTOMER INFORMATION

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Customer:	Socket Communications 34700 Central Court Newark, CA Tel: 510-744-2723 Fax: 510-744-2727
Contact Person:	Charles Ader
Receipt of EUT:	2/18/03
Test plan reference:	FCC Part 2, 15 (15.247)
Date of testing:	2/20/03-2/22/03
Date of Report:	3/1/03

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 Socket Bluetooth Module

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	"Socket BT Module"	Bluetooth Module	N/A	E0001
Accessories	Laptop Computer	Fujitsu Lifebook M/N: CP15331	R3105476	S0001
Software	CSR Bluesuite	Bluetest	N/A	N/A

3 SUMMARY OF TEST RESULTS

	Section in CFR 47	Results
15.247 (a)(2) (b)(1)	Peak output power (Radiated Emissions)	PASSED
15.247 (a)(1)	Carrier Frequency Separation	PASSED
15.247 (a)(1)(iii)	Number of Hopping Frequencies	PASSED
15.247 (a)(1)(iii)	Dwell Time	PASSED
15.247 (a)(1)(ii)	20 dB Bandwidth	PASSED
15.247, (a)(5)(c)	Band-edge compliance of RF Radiated emissions	PASSED
15.247, (a)(5)(c)	Restricted Band (Radiated Emissions)	PASSED
15.249,(a)	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 Part 15, Subpart C, 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

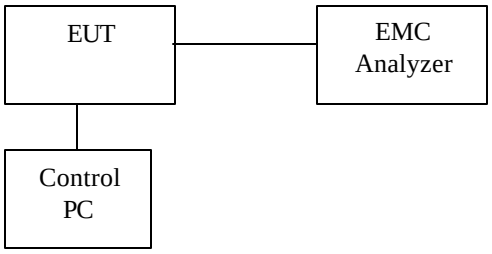
To fulfill all requirements for the testing, a total of two different test setup were used. One EUT was used, unmodified for radiated tests and for conductive measurements.

5.1 Setup A (conducted measurements, hopping enabled – Inquiry Mode)

5.1.1 Operational description

- This setup was used in conducted measurements with EUT performing the INQUIRY function. The EUT was connected to the Laptop Computer through the serial port (COM1), the antenna bypassed and the SMA Cable connected to the Spectrum Analyzer. This setup was used for the ***TIME OF OCCUPANCY*** measurements.

5.1.2 Block Diagram



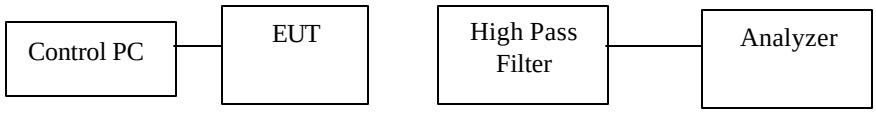
The solid lines are coaxial cables and the dashed lines are either EUT insertion to the test board or control cables between test setup devices. The measurement results were adjusted with the attenuation of the coaxial cable.

5.2 Setup B (Radiated measurements, hopping enabled)

5.2.1 Operational description

This setup was used in conducted measurements with hopping enabled. The EUT (master) was connected to the laptop PC via the serial bus (COM1). THIS SETUP USED FOR ***RADIATED SPURIOUS EMISSIONS***

5.2.2 Block diagram



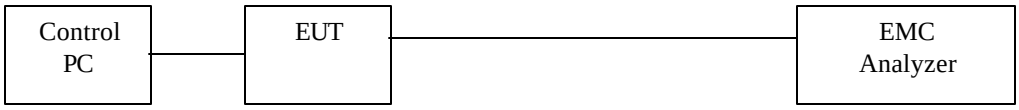
The solid lines are coaxial cables and the dashed lines are either EUT insertion to the test board or control cables between test setup devices.

5.3 Setup C (Conducted emissions, hopping enabled & hopping disabled)

5.3.1 Operational description

This setup was used in antenna conducted measurements with hopping enabled. The EUT was connected to the Laptop Computer through the serial port (COM1), the antenna bypassed and the SMA Cable connected to the Spectrum Analyzer. This setup was used for ***PEAK POWER OUTPUT, POWER DENSITY, CF SEPARATION, NUMBER OF HOPPPING FREQUENCIES, DWELL TIME, 20 dB BW, and RESTRICTED BAND*** measurements.

5.3.2 Block diagram



6 TEST RESULTS

6.1 Peak Output Power [CFR 47, 15.247(b)(1)]

EUT	Socket Bluetooth Raw Serial Module
Test setup	C (conducted – *Hopping Disabled*)
Temp, Humidity, Air Pressure	56º F, 29.96
Date of Measurement	2/19/03
Measured by	Bob Cole
Result	PASSED

6.1.1 EUT operation mode

EUT operation mode	Hopping Disabled
EUT channel	2, 41, 80
EUT TX power level	Nominal
Operation voltage	5 VDC

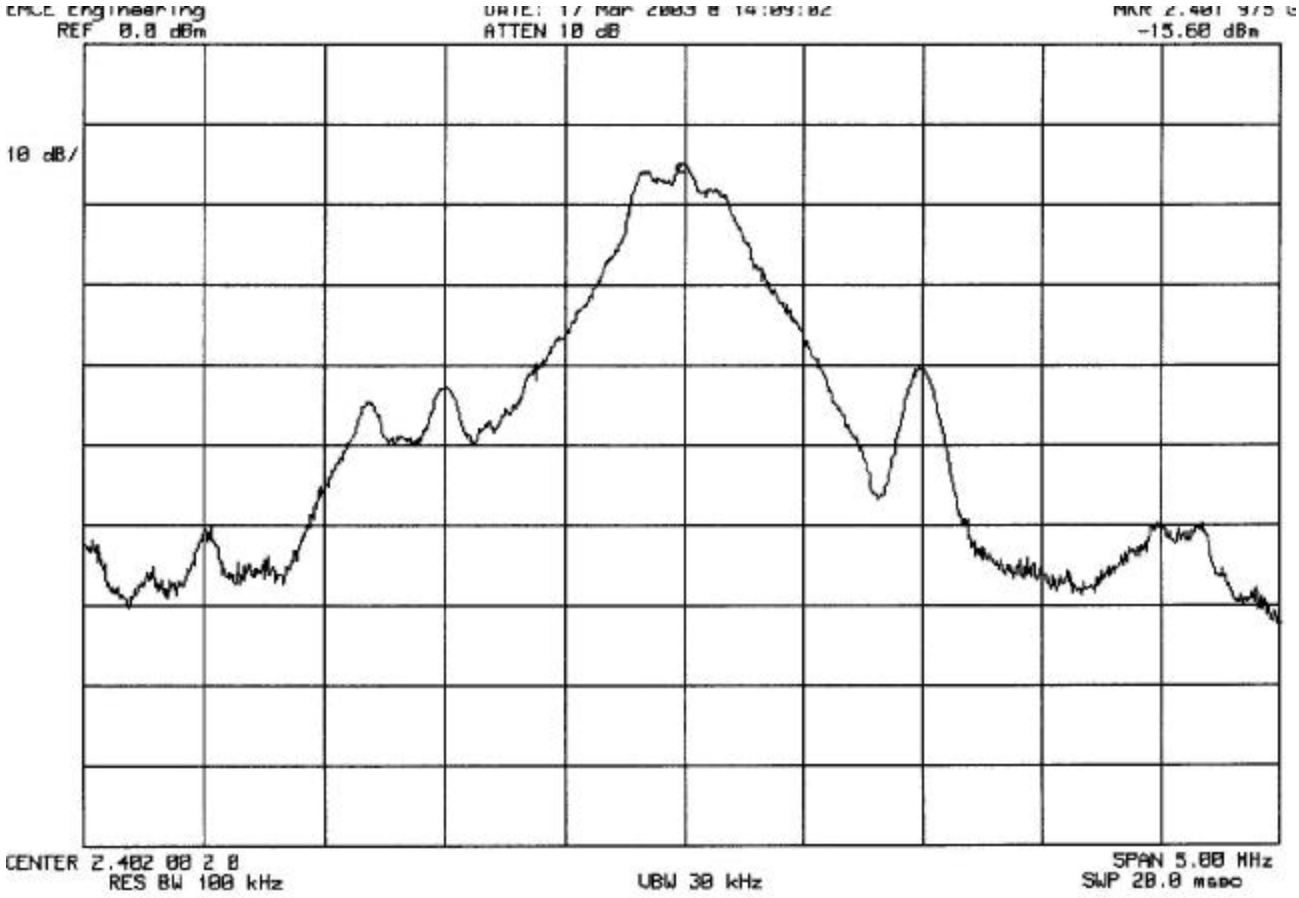
6.1.2 Limits and results

Peak output power

EUT Channel	Limit (W)	Test results (dBm)	Cable Loss	Peak Power (dBm)
2	</= 1.0	-15.60	2.0	-13.6
40	</= 1.0	-14.70	2.0	-12.7
80	</= 1.0	-13.40	2.0	-11.4

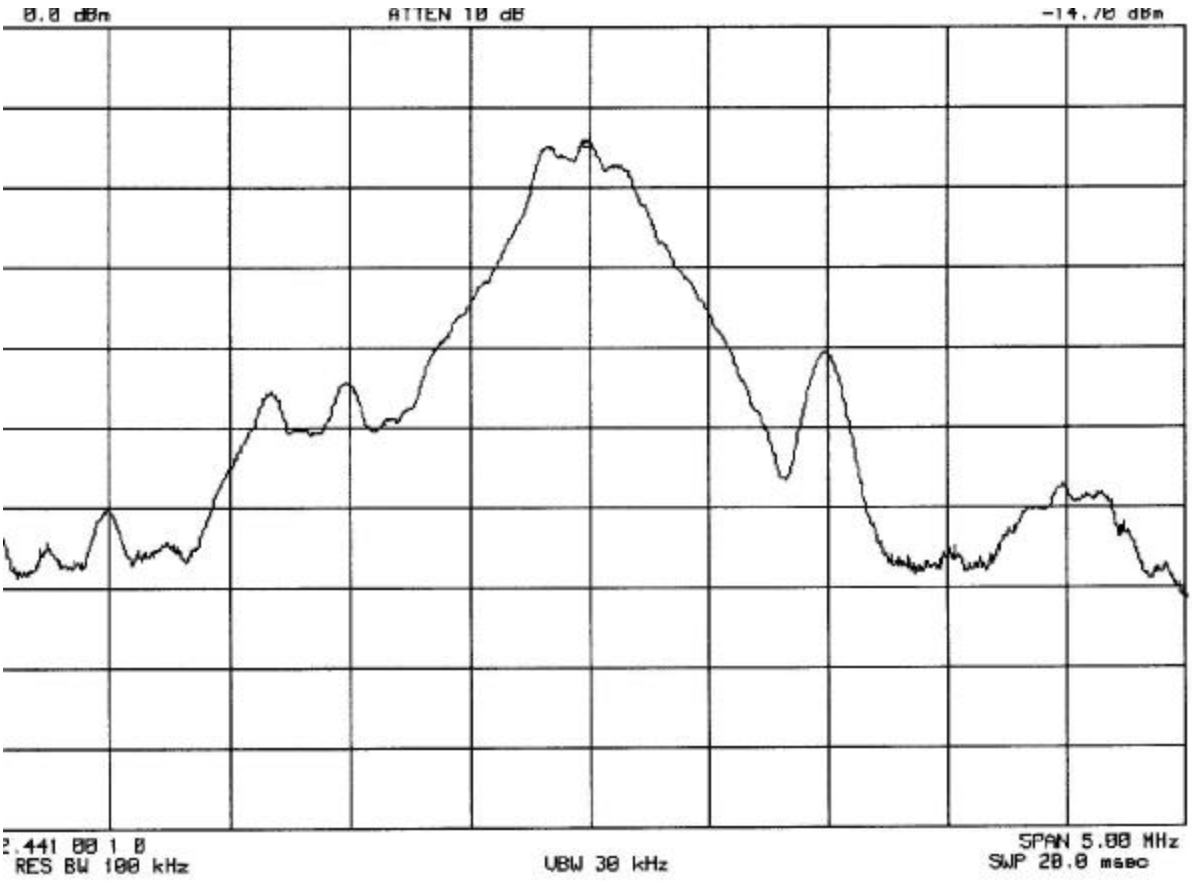
6.1.3 Screen shots

Plot 1: Peak output power 2402 MHz



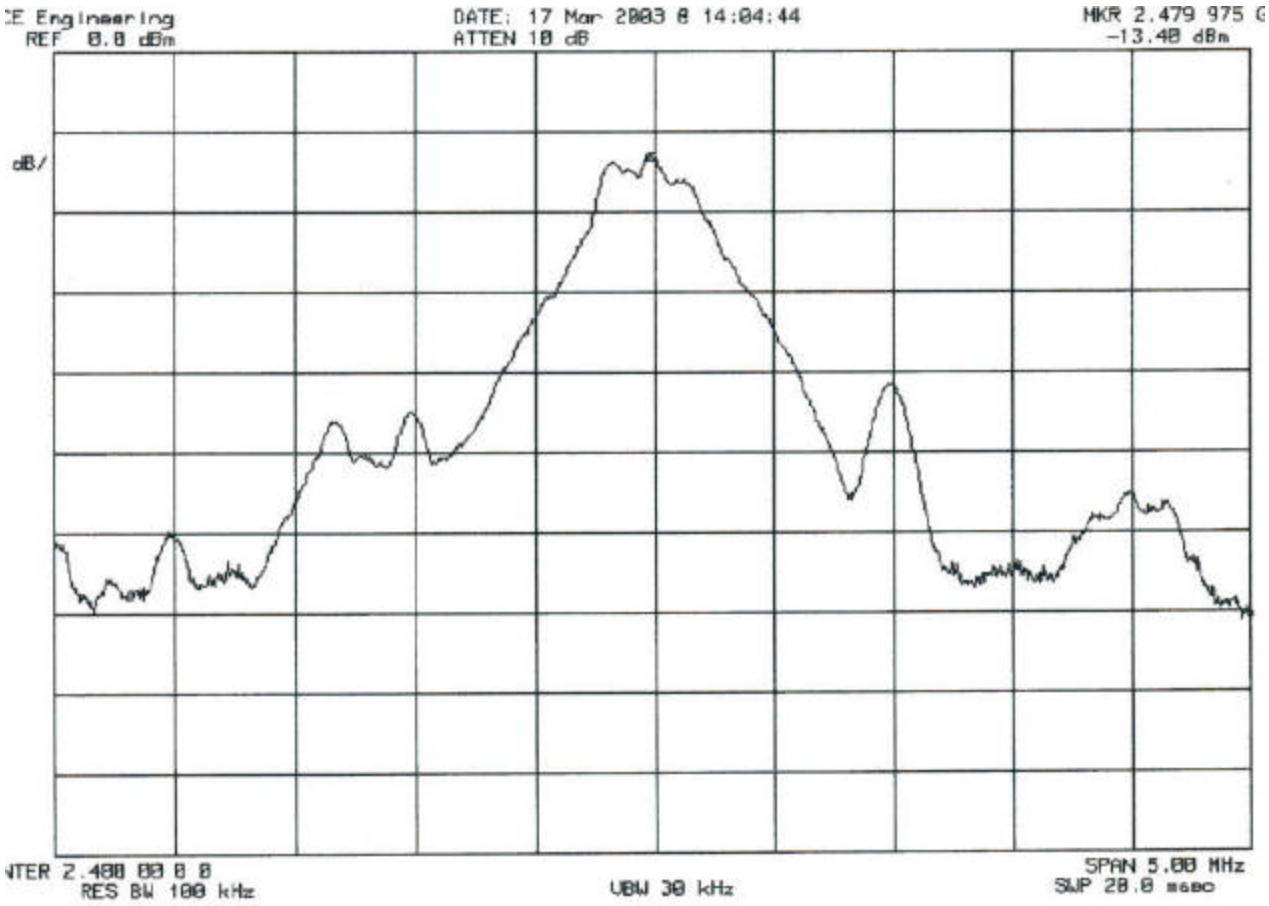
FIGURE

Plot 2: Peak output power 2441 MHz



FIGURE

Plot 3: Peak output power 2480 MHz



FIGURE

6.2 CF Separation [CFR 47, 15.247 (a)(1)]

EUT	Socket Bluetooth Raw Serial Module
Test setup	C (conducted – hopping enabled)
Temp, Humidity, Air Pressure	56º F, 29.96
Date of Measurement	2/19/03
Measured by	Bob Cole
Result	PASSED

6.2.1 Limits and results

CF Separation

EUT Channel	Limit (MHz)	Test results (MHz)
41-42	</= 1.0	1.0

6.2.2 Screen Shot:

Plot 7: CF separation

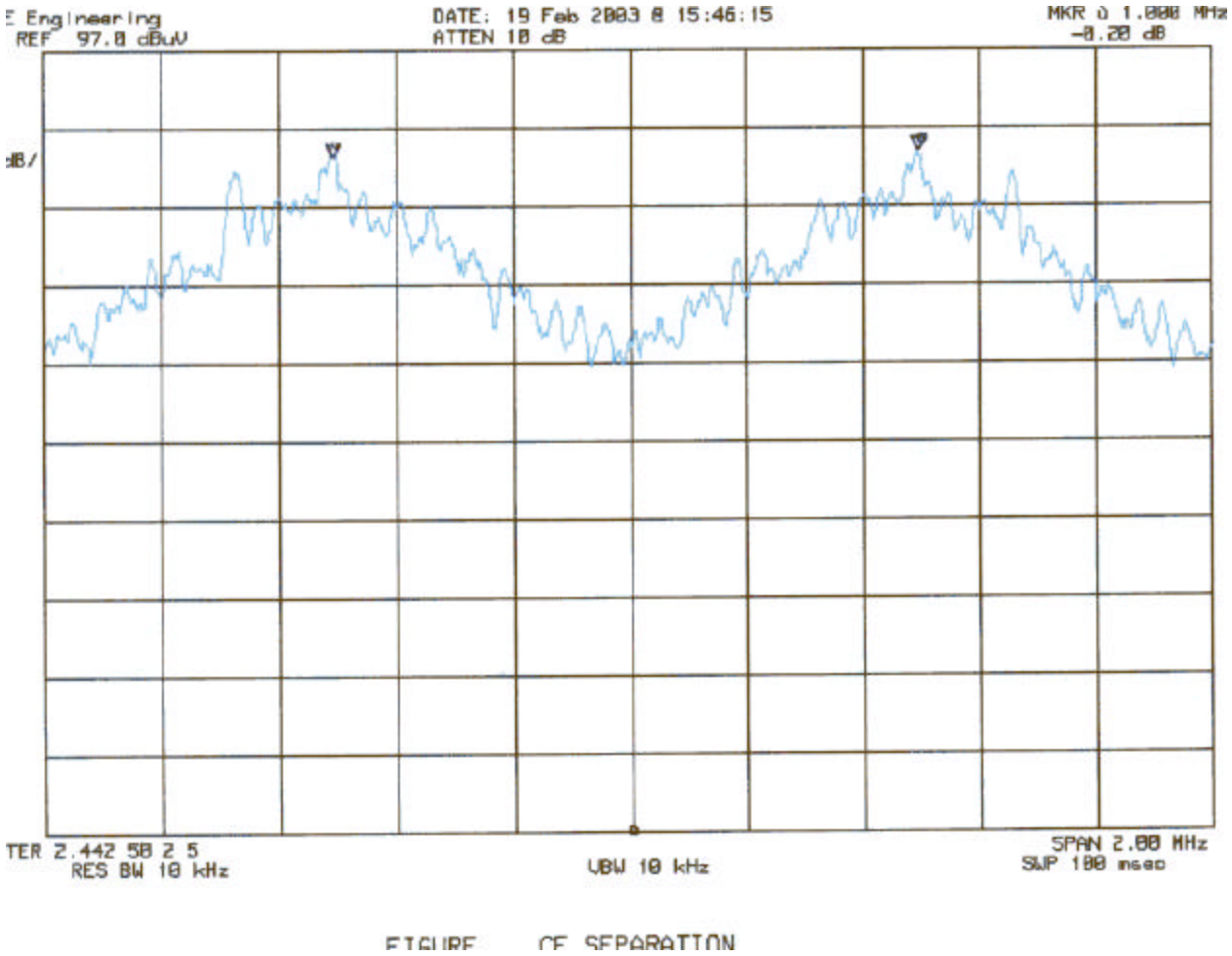


FIGURE CF SEPARATION

6.3 Number of Hopping Frequencies [CFR 47, 15.247 (a)(1)(iii)]

EUT	Socket Bluetooth Raw Serial Module
Test setup	C (conducted – hopping enabled)
Temp, Humidity, Air Pressure	56º F, 29.96
Date of Measurement	2/19/03
Measured by	Bob Cole
Result	PASSED

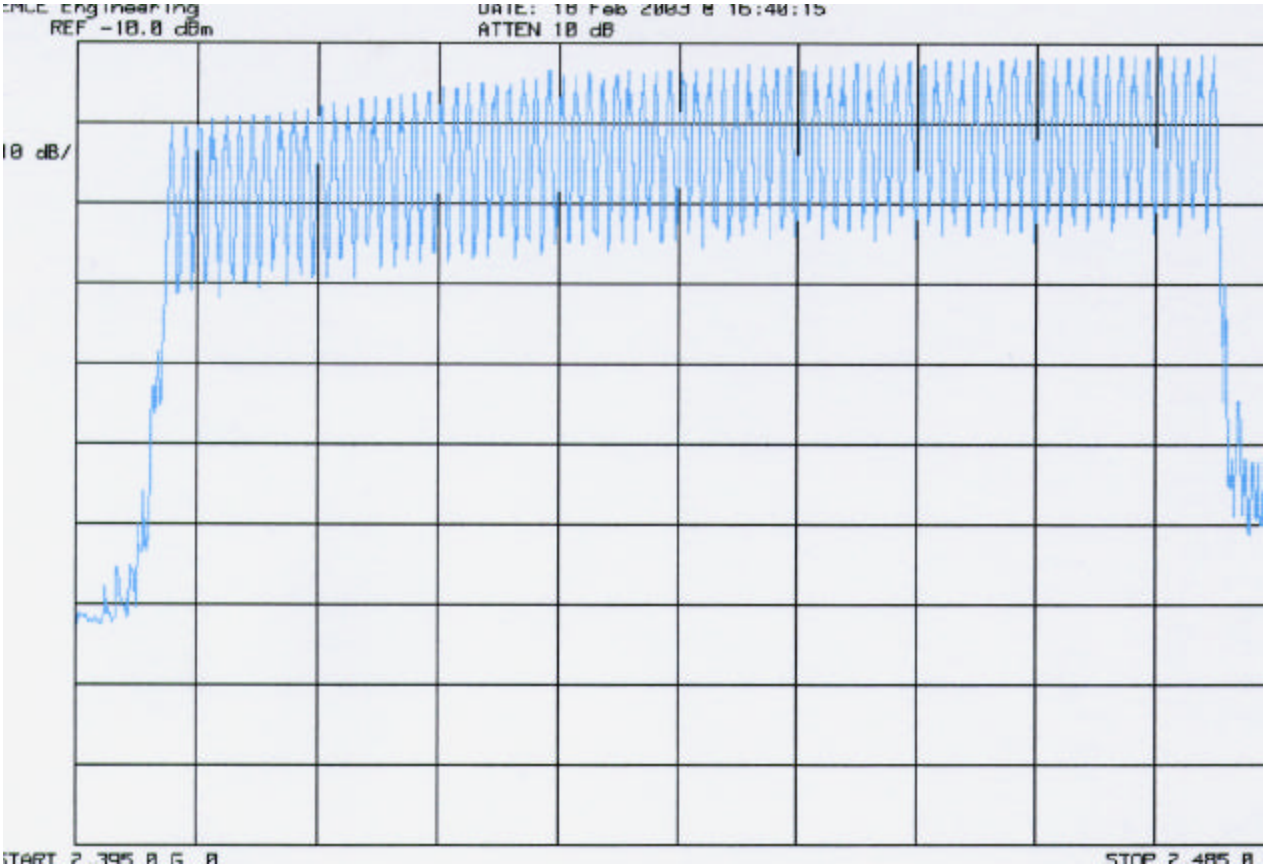
6.3.1 Limits and results

Number of Hopping Frequencies

EUT Channel	Limit (MHz)	Test results (MHz)
1-80	<= 75	79

6.3.2 Screen Shot:

Plot 8: Number of Hopping Frequencies (79)



6.4 Dwell Time

EUT	Socket Bluetooth Raw Serial Module
Test setup	B (conducted – hopping enabled)
Temp, Humidity, Air Pressure	56º F, 29.96
Date of Measurement	2/19/03
Measured by	Bob Cole
Result	PASSED

6.4.1 Limits and results

Dwell Time

EUT Channel	Limit	Test results
2	400 ms per 30 second of operation	PASSED Pulsewidth = 200 usec 100 pulses/sec when ON 15.2 sec ON per 30 second period Total ON time per 30 seconds = ***304 ms per 30 seconds***

6.4.2 Screen Shot:

Plot 9: Inquiry Mode (Full Cycle)
Pulse Width / Repetition Rate (Inquiry Mode) – 200 usec PW / 10 ms repetition rate

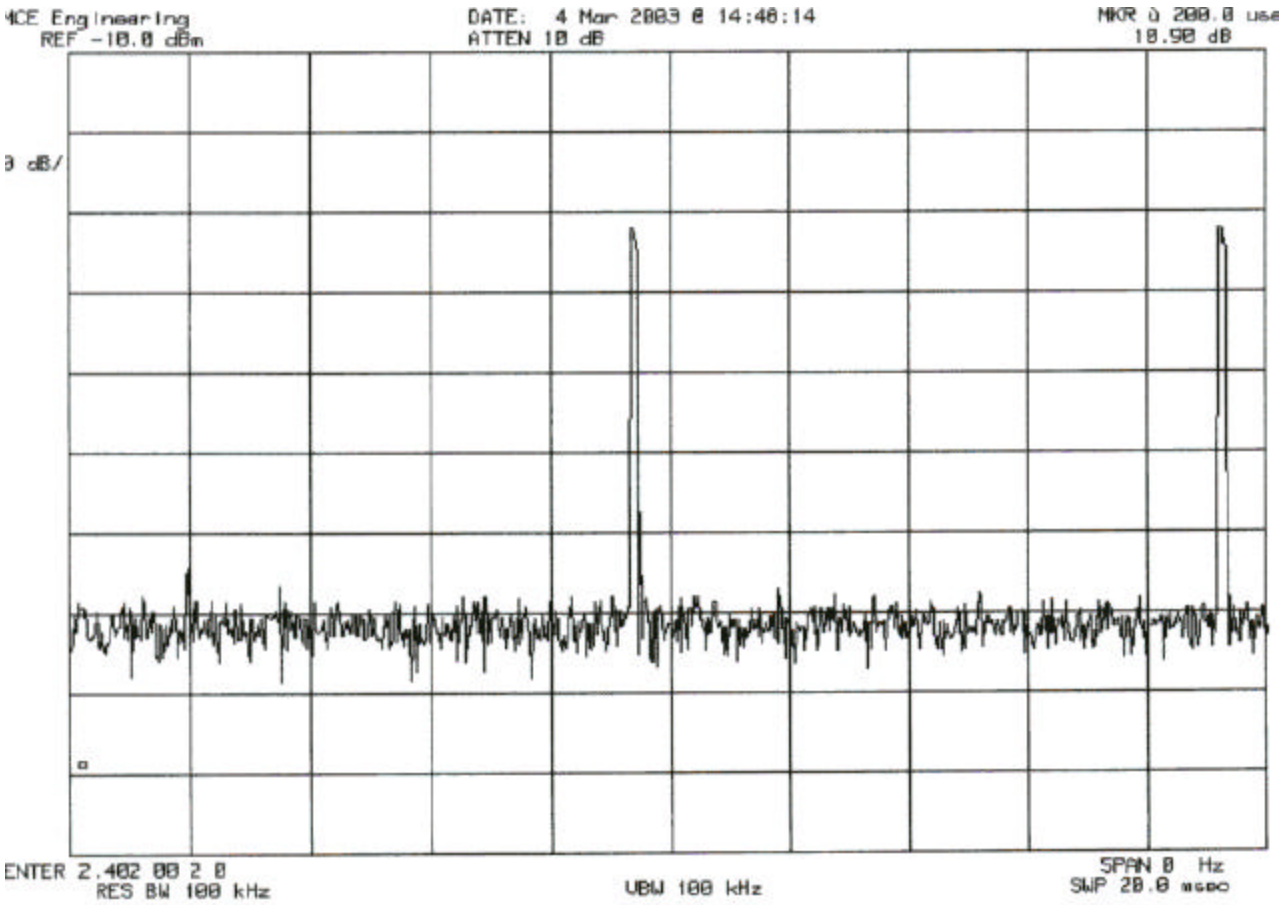


FIGURE INQUIRY PULSEWIDTH

Plot 10: Inquiry Mode (Full Cycle)

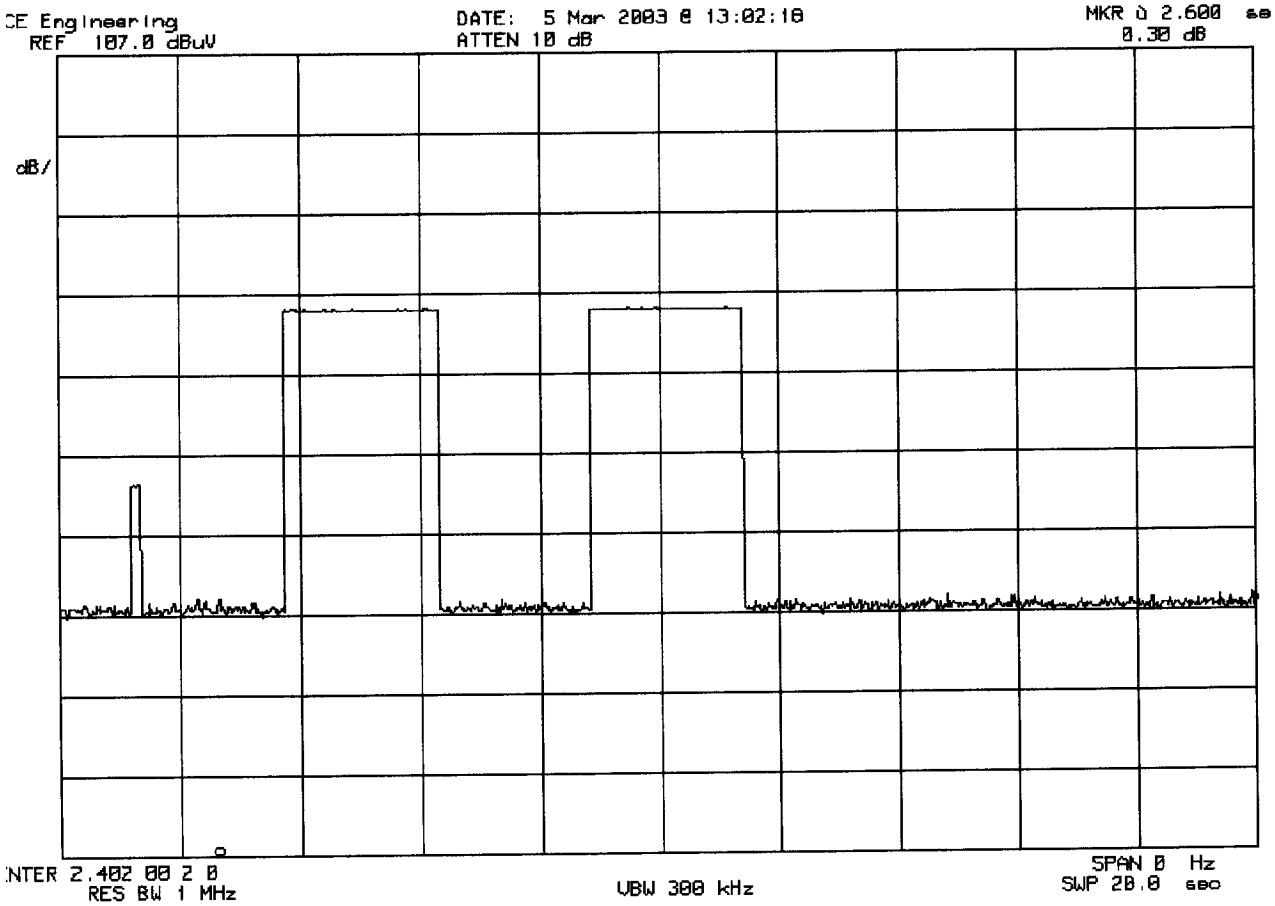


FIGURE INQUIRY TIME ON

6.5 20 dB Bandwidth [CFR 47, 15.247 (a)(1)(ii)]

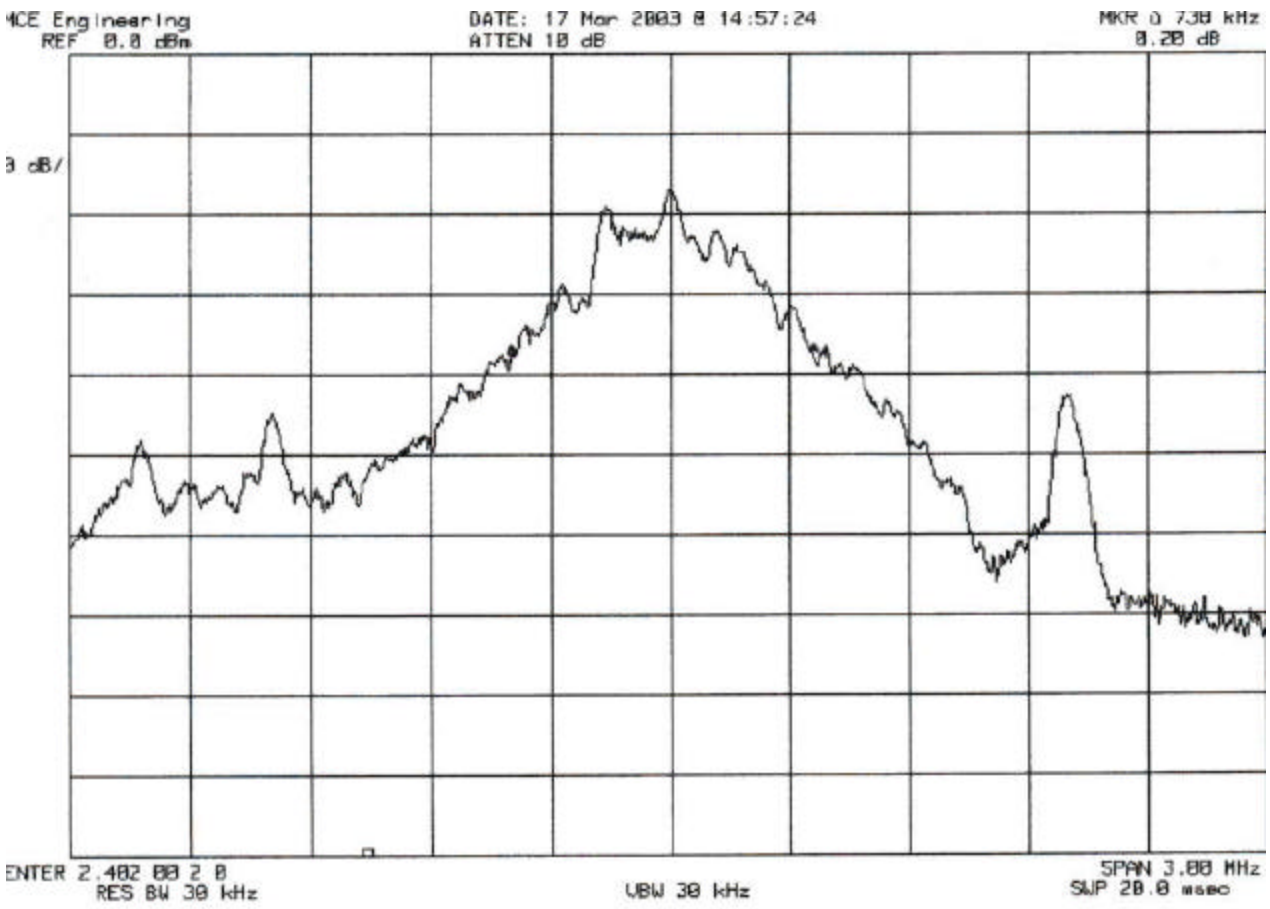
EUT	Socket Bluetooth Raw Serial Module
Test setup	C (conducted – *Hopping Disabled*)
Temp, Humidity, Air Pressure	62º F, 30.52
Date of Measurement	3/14/03
Measured by	Bob Cole
Result	PASSED

6.5.1 Limits and Results

EUT Channel	Limit (MHz)	Test results (MHz)
2	</= 1.0	.738
40	</= 1.0	.729
80	</= 1.0	.729

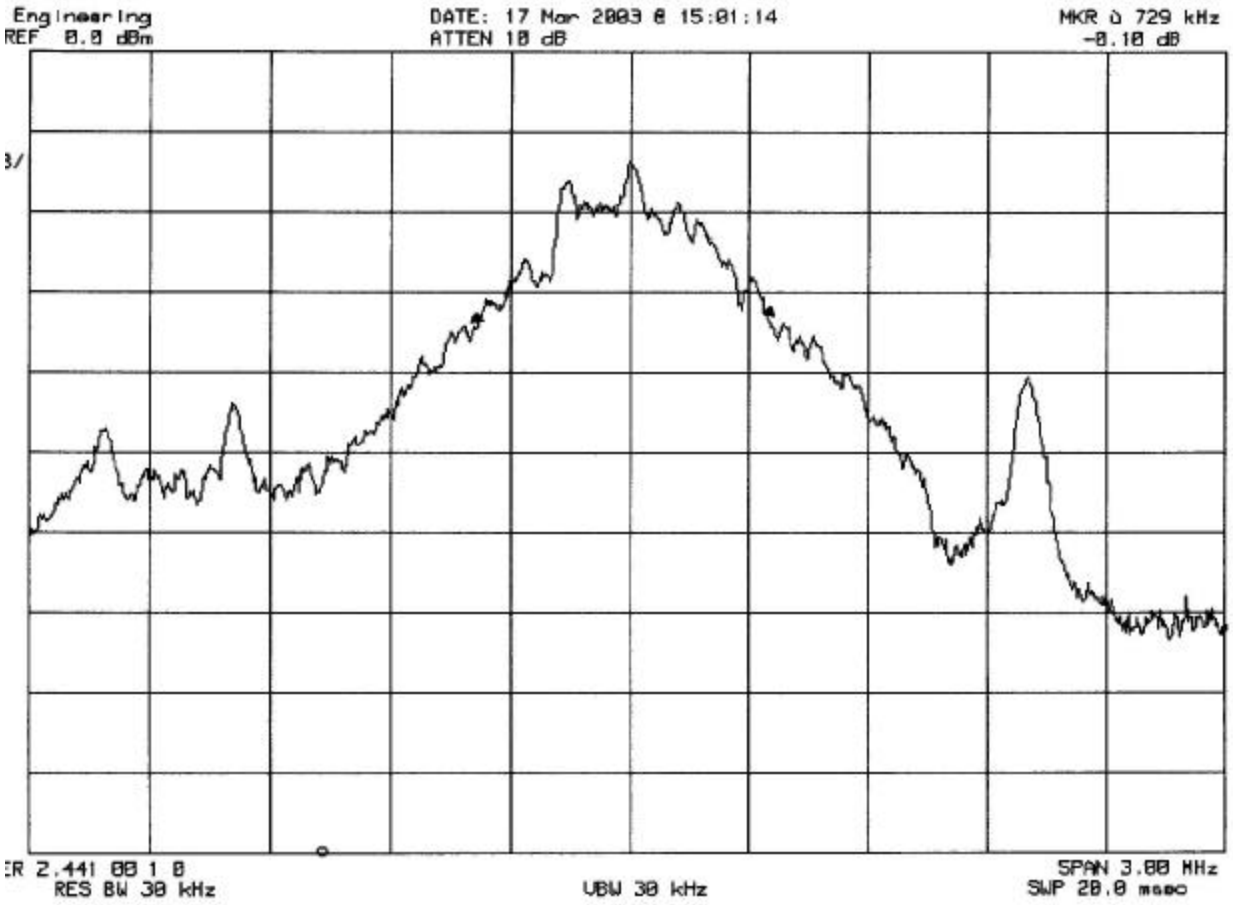
6.5.2 Screen Shots

Plot 11: 20 dB BW 2402 MHz

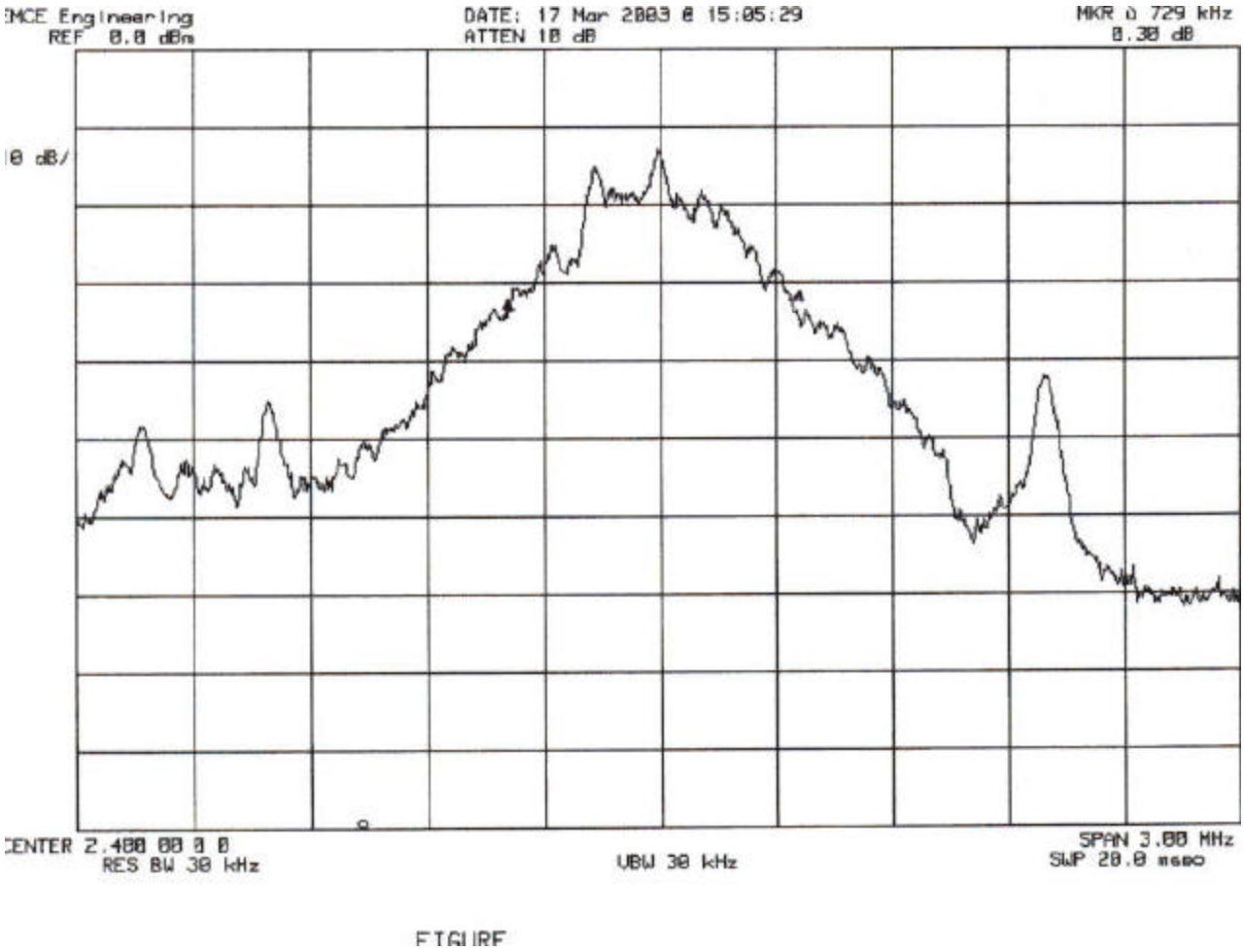


FIGURE

Plot 12: 20 dB BW 2441 MHz



Plot 13: 20 dB BW 2480 MHz



FIGURE

6.6 Band-edge compliance of RF Radiated emissions [CFR 47, 15.247, (a)(5)(c)]

EUT	Socket Bluetooth Raw Serial Module
Test setup	C (conducted – hopping enabled & with hopping disabled)
Temp, Humidity, Air Pressure	62º F, 30.47
Date of Measurement	3/14/03
Measured by	Bob Cole
Result	PASSED

6.6.1 EUT operation mode

EUT operation mode	Hopping Enabled & Disabled (Two sets of plots)
EUT channel	2, 80
EUT TX power level	Maximum

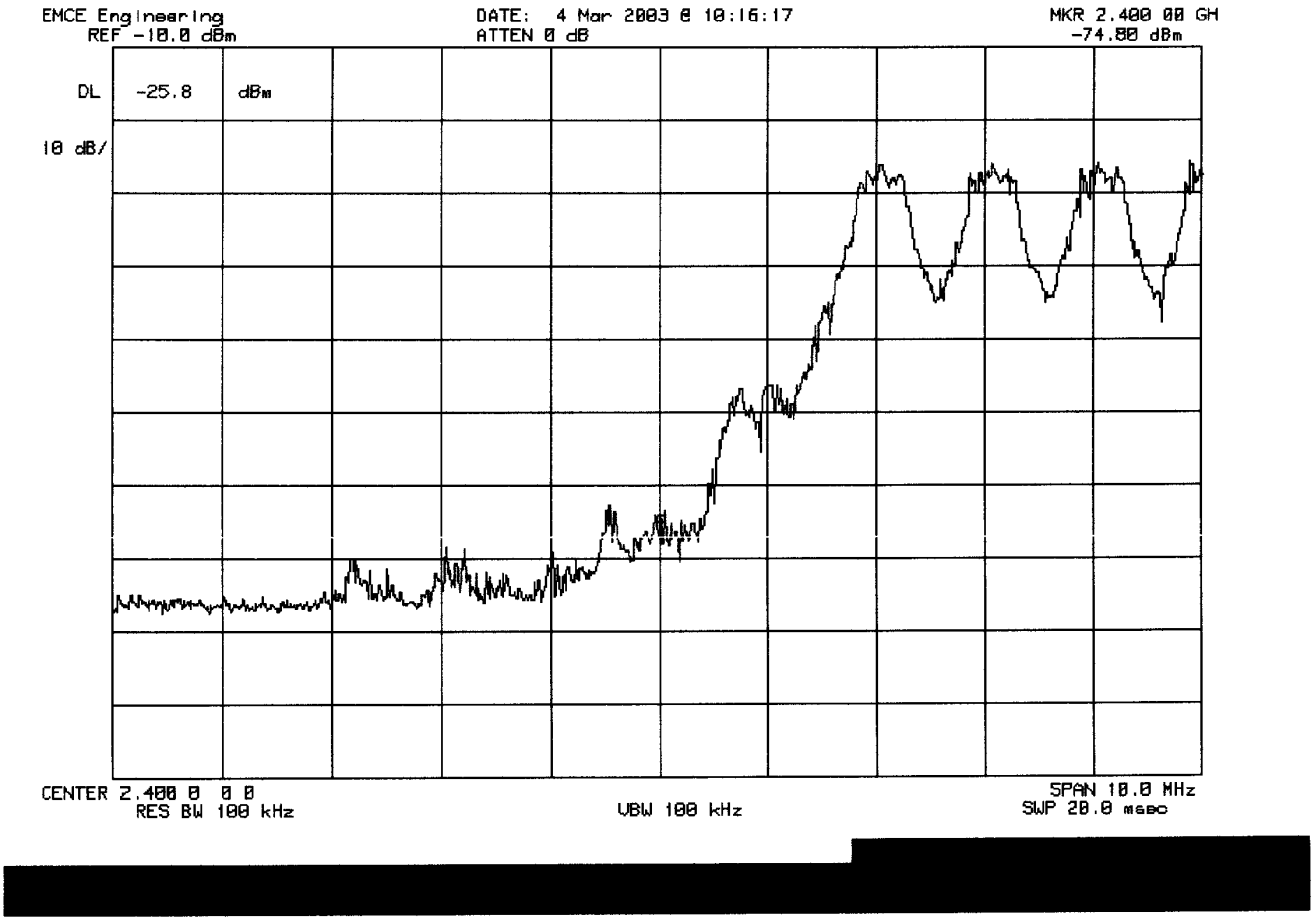
6.6.2 Limits and results

Band-edge compliance

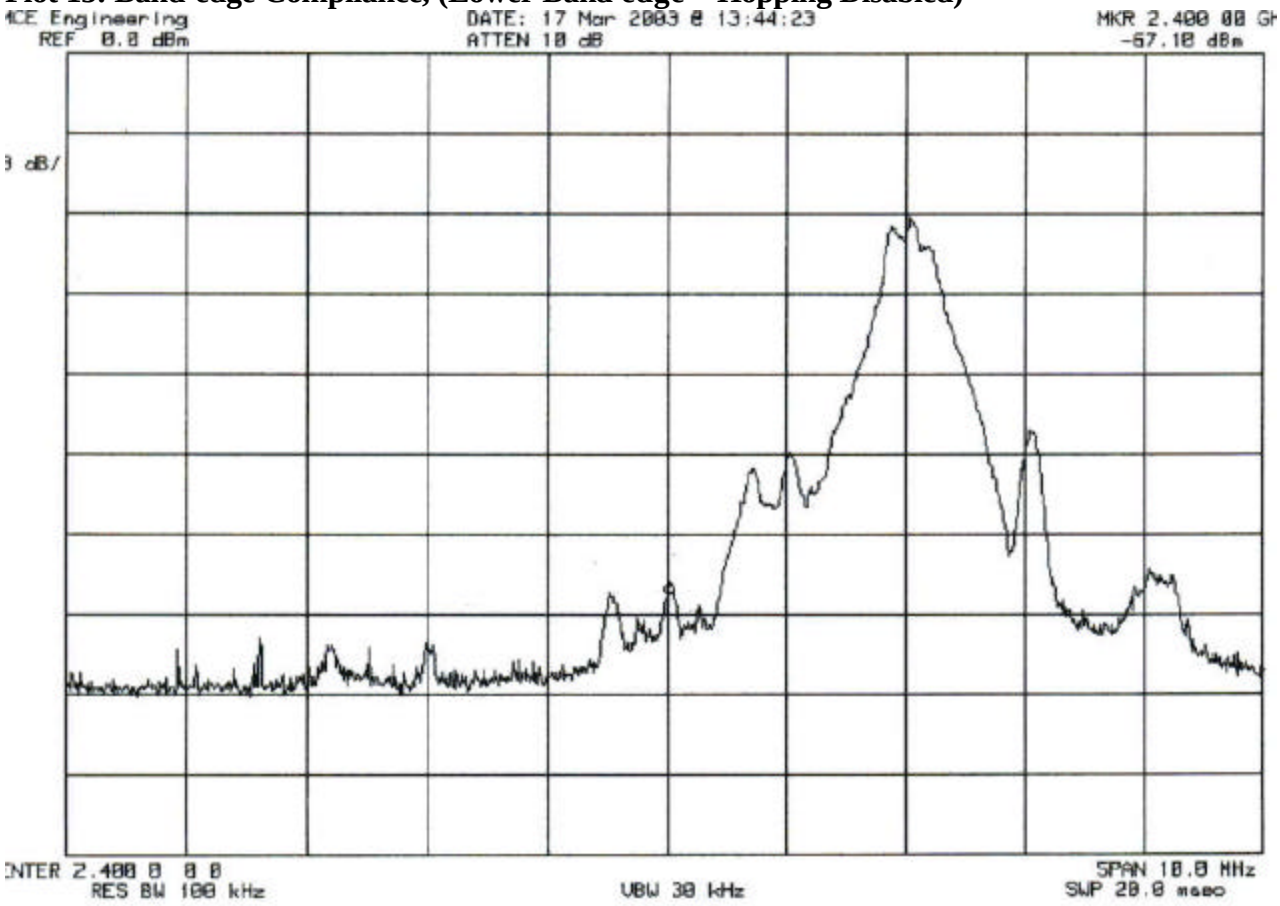
Channel	Limit (dBm)	Results (dBm)
2	-6.0	-67.10
80	-6.0	-69.80

6.6.3 Screen shots:

Plot 14: Band-edge Compliance, (Lower Band-edge – Hopping Enabled)

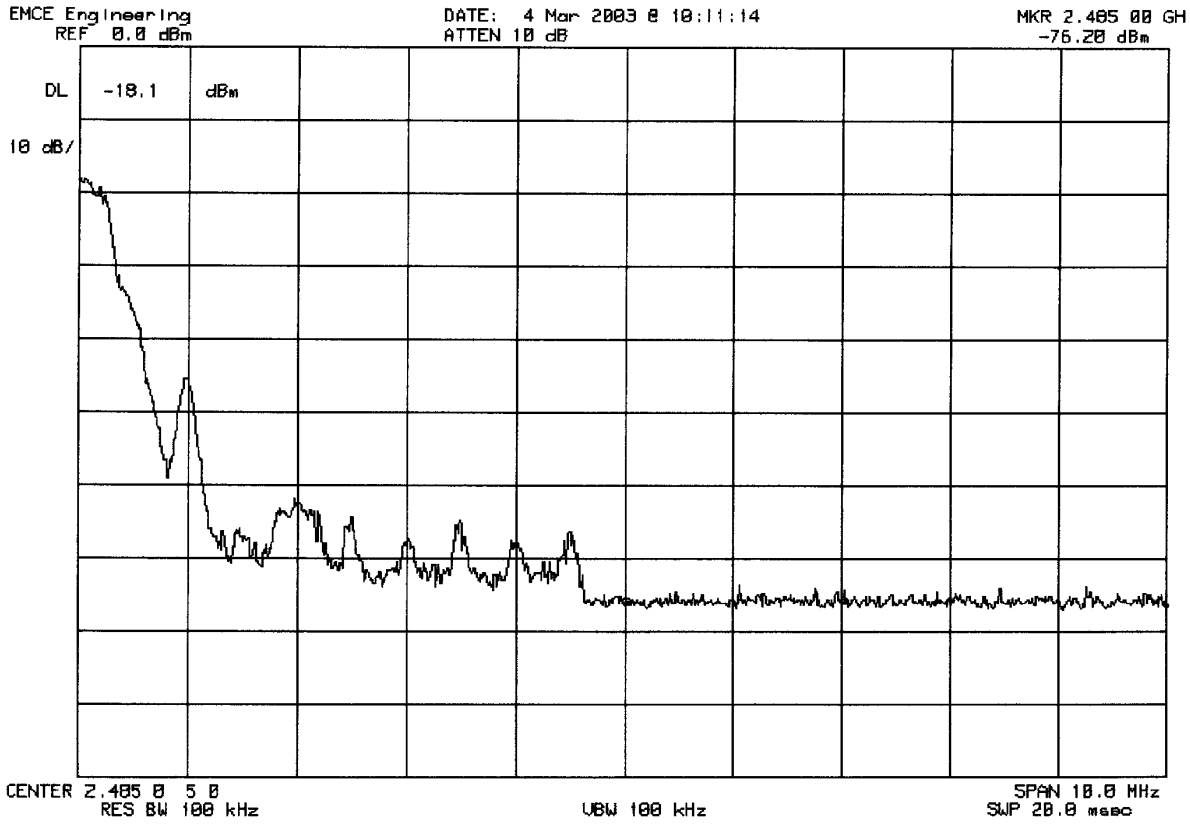


Plot 15: Band-edge Compliance, (Lower Band-edge – Hopping Disabled)



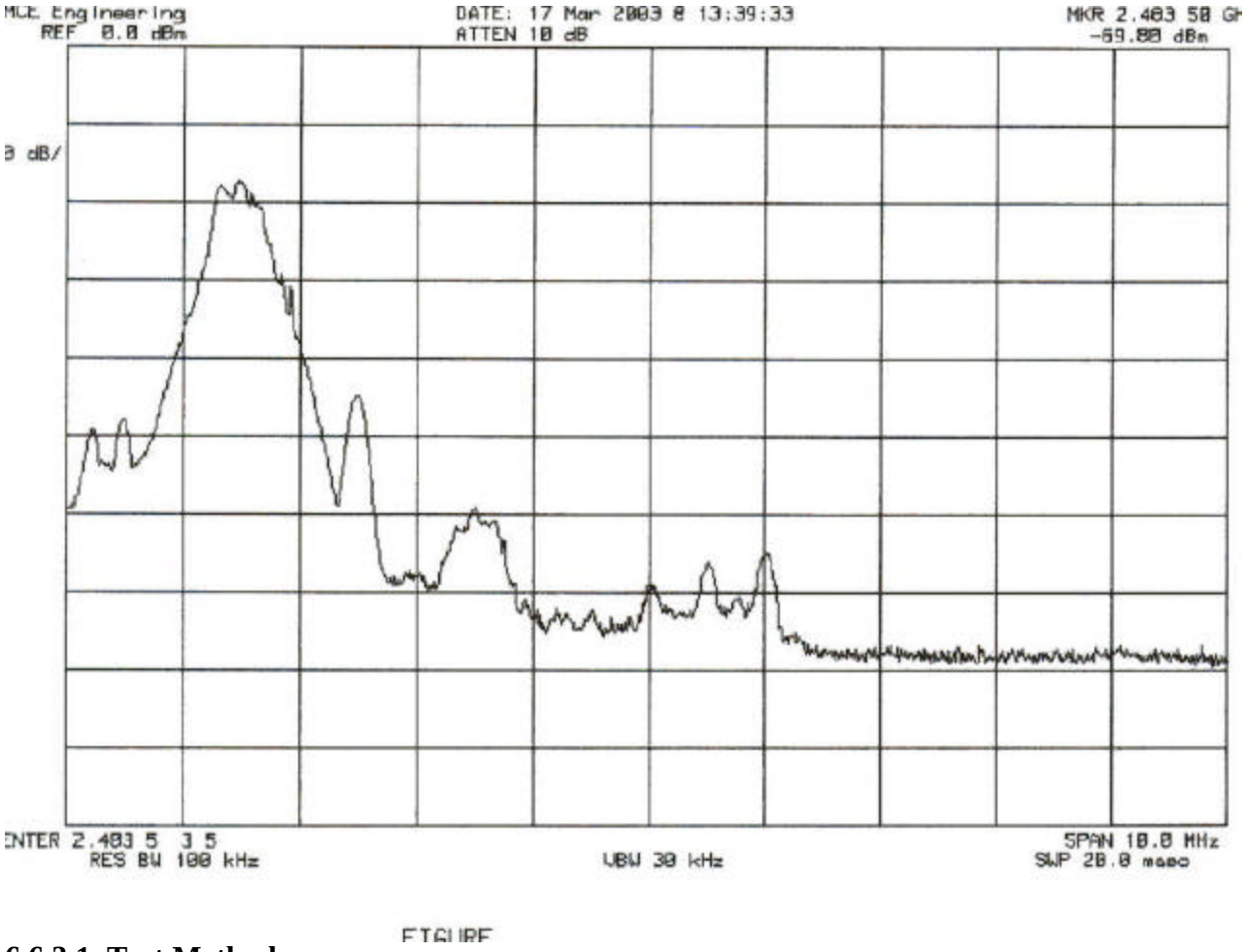
FIGURE

Plot 16: Band-edge compliance, (Upper Band-edge – Hopping Enabled)



[redacted]

Plot 17: Band-edge compliance, (Upper Band-edge – Hopping Disabled)



FIGURE

6.6.3.1 Test Method

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

6.7 Restricted Band Measurements

EUT	Socket Bluetooth Raw Serial Module
Test setup	C (conducted – hopping enabled)
Temp, Humidity, Air Pressure	56º F, 29.96
Date of Measurement	2/19/03
Measured by	Bob Cole
Result	PASSED

6.7.1 EUT Operation Mode

EUT operation mode	Hopping Enabled
EUT channel	N/A
EUT TX power level	Maximum

6.7.2 Limits and results

Restricted Bands

Frequency (MHz)	Limit (dBm)	Results (dBuV)
2310-2390	-53.0	-74.40
2483.5-2500	-53.0	-71.10

6.7.3 Screen Shots:

Plot 18: 2310-2390 MHz Restricted Band

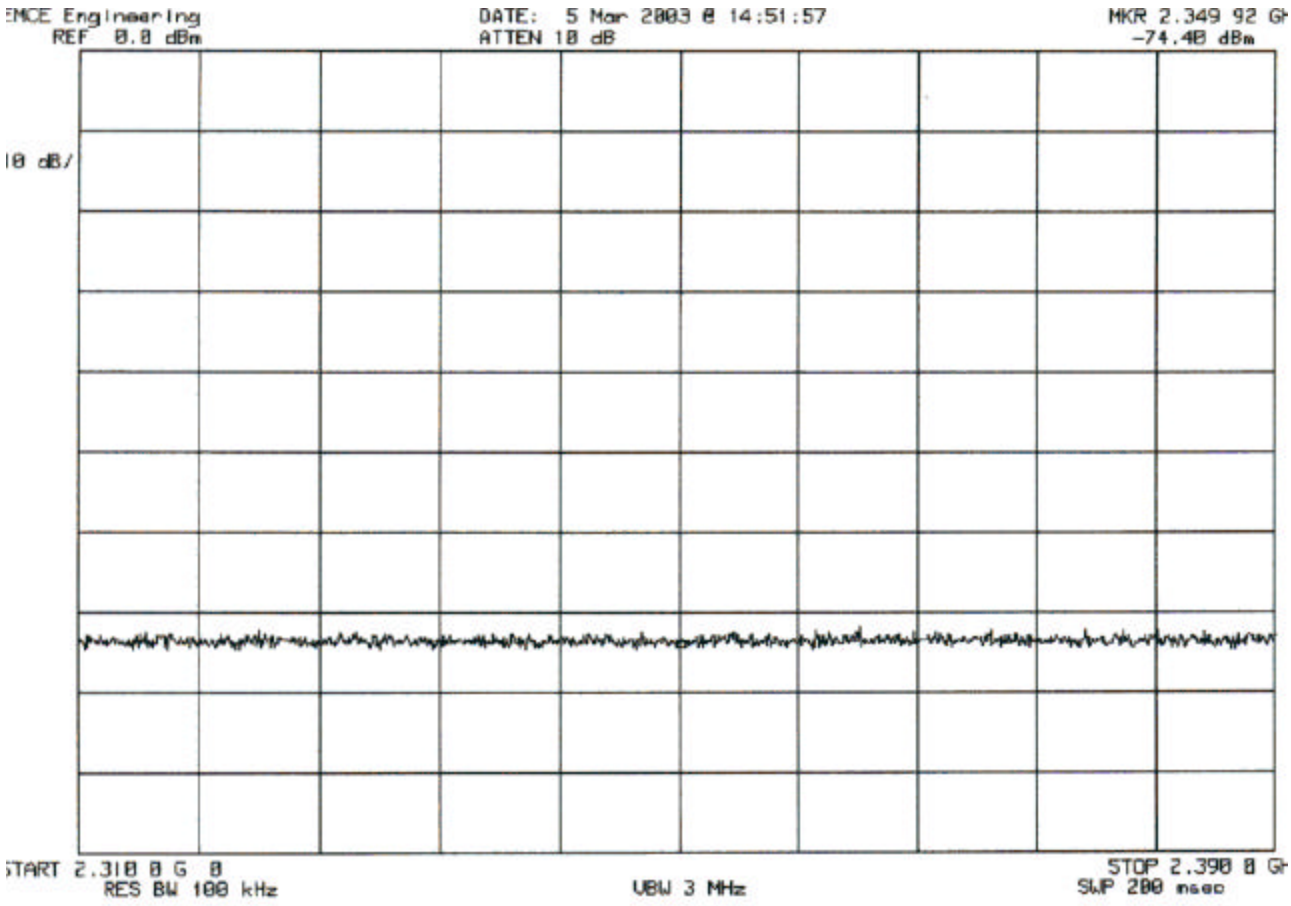


FIGURE 2310-2390 MHz

.

Plot 19: 2483.5-2500 MHz Restricted Band

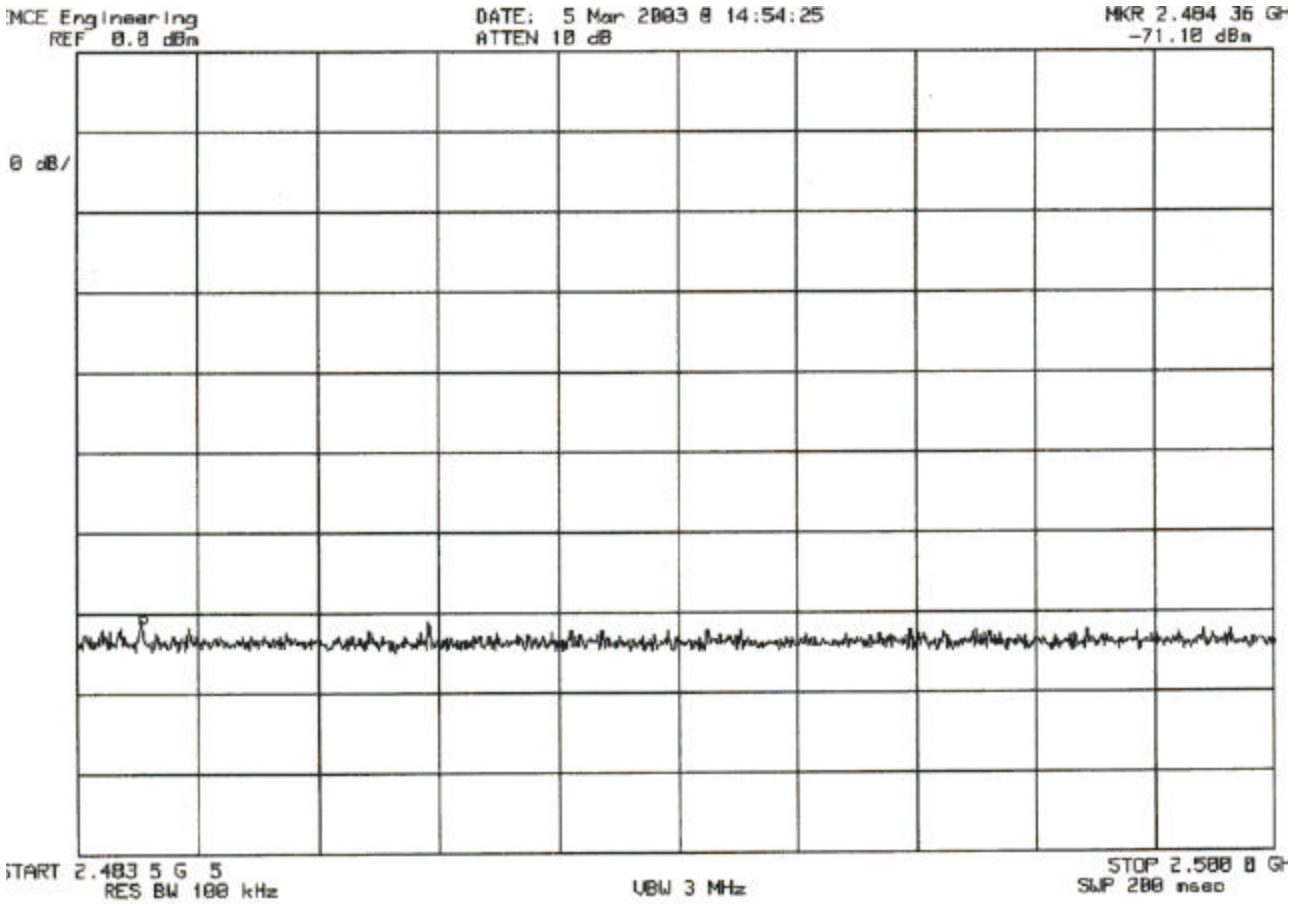


FIGURE 2483.5-2500 MHz

6.8 Spurious RF Radiated Emissions [CFR 47, 15.247c1)

EUT	Socket Bluetooth Raw Serial Module
Test setup	C (Radiated – hopping enabled)
Temp, Humidity, Air Pressure	56º F, 29.96
Date of Measurement	2/19/03
Measured by	Bob Cole
Result	PASSED
EUT	Socket Bluetooth Raw Serial Module

6.8.1 AC Line Conducted Emissions Measurement Procedure 450 kHz – 30 MHz

Line conducted Emissions Test Procedure:

1. **SET UP EUT ON TURNTABLE PER ANSI 63.4 FIGURE 11:** Be careful to maintain proper spacing between peripheral devices. Bundle excessive lengths of I/O cable to achieve 1 meter cable length, make sure I/O cables are at least 40 cm from ground plane. Power up the system and initialize any software necessary to exercise the EUT.

2. **SET UP SPECTRUM ANALYZER:** Per instrument settings in Appendix A of this document.

3. **BEGIN MEASUREMENT SEQUENCE:**

   a) **<Start Freq> <450> <kHz>, <Stop Freq> <5> <MHz>;** Start Sweep #1 as defined in Appendix A by starting a single sweep **<Single>** from 450 kHz to 5 MHz.

   b) **<Start Freq> <5> <MHz>, <Stop Freq> <15> <MHz>;** Start Sweep #2 as defined in Appendix A by starting a single sweep **<Single>** from 5 MHz to 15 MHz.

   c) **<Start Freq> <15> <MHz>, <Stop Freq> <30> <MHz>;** Start Sweep #3 as defined in Appendix A by starting a single sweep **<Single>** from 15 MHz to 30 MHz.

   d) For any emissions within 10 dB of the limit; reduce Frequency Span to 1 MHz **<Frequency Span> <1> <MHz>**, set sweep time to 200 **seconds <Sweep Time> <200> <Sec>**, a perform a single sweep **<Single>** to attain a final measurement. Record this measurement on the measurement spreadsheet.

4. CABLE MANIPULATION TO MAXIMIZE EMISSIONS: The effect of cable position on the line conducted emissions must be fully investigated. Experiment with various positions of the I/O cables and power cords to determine if there is any interaction between cables. Repeat step 3 to re-measure emissions after each cable manipulation.

6.8.2 Radiated emissions Measuremetn Procedure, 30 MHz – 18GHz

Radiated Emissions Test Procedure:

1. **Setup EUT on turntable per ANSI 63.4 Figure 11:** Be careful to maintain proper spacing between peripheral devices. Bundle excessive lengths of I/O cable to achieve 1 meter cable length, make sure I/O cables are at least 40 cm from ground plane. Power up the system and initialize any software necessary to exercise the EUT.

2. Place the biconical antenna in vertical polarization on antenna mast.

3. **INITIAL SCAN:** Record signals from 30 - 300 MHz, vary the size of the frequency span (and corresponding Center Frequency Step Size) displayed on the analyzer depending on the number of signals present. Decrease the span to 5 MHz or 1 MHz to clearly identify signals in crowded areas of the spectrum.

4. **IDENTIFICATION OF AMBIENT SIGNALS:** In order to identify ambient signals, turn off power to the turntable and recheck the spectrum from 30 - 300 MHz. Any signals still present are ambient signals. Remove these datapoints from the measurement spreadsheet.

5. **MAXIMIZATION OF SIGNAL STRENGTH:** With the ambient signals eliminated from consideration, it is time to maximize the emissions from the EUT to record the final measurements. Apply power to the EUT.

a) **Identify worst case angle:** Center the spectrum analyzer display on the first recorded frequency. Set the frequency span to 1 MHz. With Trace A in **MAX HOLD**, rotate the turntable 360 degrees. Observe the display during turntable rotation. Trace A will record the maximum field strength, while Trace B (still in **Clear/Write** mode) will vary during the rotation. Return the turntable to the location where Trace B is at the same amplitude as Trace A. This is the worst case angle for this frequency.

b) **Identify worst case antenna height:** Now vary the antenna height from 1 to 4 meters, again with Trace A on MAX HOLD and Trace B on Clear/Write. Return the antenna to the height where Trace B is the same amplitude as Trace A. This is the worst case height for this frequency.

c) **Cable Manipulation:** It is essential to vary I/O cable and power cord positions to identify the maximum emission level from the EUT. With the turntable and mast still at the worst case positions, leave Trace A in MAX HOLD and vary the cable locations as much as they could reasonably be expected to vary in normal use of the EUT. For example, it is not necessary to lift any I/O cable or power cord to a position above the turntable height. Be careful to explore any possibilities for cable interactions which might increase emissions.

d) **Quasi-Peak Measurements:** Certain signals will exhibit a lower amplitude when measured in quasi-peak mode. When the amplitude is lower is quasi-peak mode than in peak detection mode the quasi-peak measurement shall be recorded as the final measurement (note: quasi-peak detection is valid from 9 kHz to 1 GHz, above 1GHz average mode is required). Quasi-peak measurement procedure is as follows:

1) Center the signal being measured on the analyzer display.
2) Narrow the span to 100 Hz and re-center the signal.
3) Narrow the span to 10 Hz and re-center the signal.
4) Set the Frequency Span to 0 Hz.
5) Adjust the Reference Level until the trace is near the top of the display.
6) Put the analyzer in Linear Mode **<LIN>**
7) Re-adjust the Reference Level until the signal is near the top of the display.
8) Set the analyzer to single sweep mode **<Single>**
9) Set the sweep time to 5 seconds **<Sweep Time> <5> <Sec>**
10) Turn Trace B off **<Off>**
11) Set Trace A to max hold **<Max Hold>**
12) Turn the quasi-peak adapter on **<On>**
13) Hit **<Single>** to start measurement
14) Use marker **<Normal>** to find highest reading
15) Convert measurement to dB uV/m using the equation 20 Log (amplitude in microvolts)
16) Record measurement if lower than peak measurement.

6. **COMPLETE THE SCAN:**

a) Repeat steps 3 - 5 with the biconical antenna in the horizontal position. Perform the initial scan (step 3) with the antenna height at 2 meters.

b) Repeat steps 3 - 5 utilizing the log-periodic antenna in the vertical polarization to explore the frequency range from 300 MHz to 1 GHz.

c) Repeat steps 3 - 5 utilizing the log-periodic antenna in the horizontal polarization to explore the frequency range from 300 MHz to 1 GHz. Perform the initial scan with the log-periodic antenna positioned at 1 meter antenna height.

a) Phase g was repeated with vertical antenna polarization.
b) 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

6.8.3 EUT operation mode

EUT operation mode	Hopping Enabled
EUT channel	Hopping
EUT TX power level	Maximum
EUT operation voltage	5 VDC

6.8.4 Radiated emissions measurement setup

6.8.5 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

Conducted Measurements:

Equipment	Type	Manufacturer	Device Number
EMI Analyzer	84125B	Hewlett-Packard	15921-12
Coaxial cable	SMA Male – Reverse SMA Male (Length = 1 ft.)	Own	C1

Spurious RF radiated emissions:

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.

CFR47, 15.207 (AC powerline conducted emissions)

Equipment	Type	Manufacturer	Device number
EMI Analyzer System	84125B	Hewlett-Packard	15921-12
LISN	EMCO		ACL-001
Coaxial cable	SMA – BNC (5 Meters)	Own	C2