

TEST REPORT FROM:

COMMUNICATION CERTIFICATION LABORATORY
1940 W. Alexander Street
Salt Lake City, Utah
84119-2039

Type of Report: Certification

TEST OF: SL-1022

FCC ID: 09C-SL-1022

To FCC PART 15.247, Subpart C

Test Report Serial No: 73-7757

Applicant:

3Com Corporation
3930 West Parkway Blvd.
West Valley City, UT 84119

Date of Test: May 29, 2002

Issue Date: June 14, 2002

Equipment Receipt Date: May 29, 2002

CERTIFICATION OF ENGINEERING REPORT

This report has been prepared by Communication Certification Laboratory to determine compliance of the device described below with the requirements of FCC PART 15.247, Subpart C. This report may be reproduced in full, partial reproduction may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested.

- Applicant: 3Com Corporation
- Manufacturer's: 3Com Corporation
- Brand Name: 3Com
- Model Number: SL-1022
- FCC ID: 09C-SL-1022

On this 14th day of June 2002, I, individually, and for Communication Certification Laboratory, certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge, and are made in good faith.

COMMUNICATION CERTIFICATION LABORATORY



Tested by: Kirk P. Thomas
Project Engineer

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SECTION 1. CLIENT INFORMATION AND MANUFACTURER:

1.1 Client Information:

Company Name: 3Com Corporation
3930 West Parkway Blvd.
West Valley City, UT 84119

Contact Name: Greg Hansen
Title: Regulatory Engineer

1.2 Manufacturer:

Company Name: 3Com Corporation
3930 West Parkway Blvd.
West Valley City, UT 84119

Contact Name: Greg Hansen
Title: Regulatory Engineer

SECTION 2. EQUIPMENT UNDER TEST (EUT)**2.1 Identification of EUT:**

Trade Name: 3Com Corporation
Model Name or Number: SL-1022
Serial Number: N/A
Options Fitted: None
Country of Manufacture: U.S.A.

2.2 Description of EUT:

The SL-1022 is a PC Card that enables PCMCIA-enabled Personal Computers (esp. laptops) with Bluetooth capabilities.

This provides the user with fast, secure, and reliable data and voice exchange capabilities with other Bluetooth enabled devices. The SL-1022 enables wireless communications with Palms, Palm-PC's, Mobile Phones, LAN Access Points, PSTN Access Points, Cordless Headsets, and other Bluetooth-enabled PC's.

This report covers the transmitter only. The receiver and class B computer peripheral are covered under a separate declaration of conformity report.

2.3 Modification Incorporated/Special Accessories on EUT:

There were no modifications or special accessories required to comply with the specification.

2.4 EUT and Support Equipment:

The FCC ID numbers for all the EUT and support equipment used during the test (including inserted cards) are listed below:

Brand Name Model Number	FCC ID Number	Description	Name of Interface Ports / Interface Cables
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Brand Name Model Number	FCC ID Number	Description	Name of Interface Ports / Interface Cables
BN: 3Com (1) MN: SL-1022	09C- 3CRWB60	Direct Sequence Spread Spectrum Device	See Section 2.5.
BN: Dell MN: Inspiron 4000 SN: TW-07914H-12800- 11B-0882	DoC	Laptop Computer	PCMCIA / N/A

Note: (1) EUT.
(2) Interface port connected to EUT (See Section 2.5)
(3) Mouse cable permanently attached.

The support equipment listed above was not modified in order to achieve compliance with this standard.

2.5 Interface Ports on EUT:

Name of Ports	No. of Ports Fitted to EUT.	Cable Descriptions/Length
PCMCIA	1	Direct connect to laptop through PCMCIA card slot.
Antenna	1	N/A

2.6 List of Channels:

Channel Number	Channel Frequency (MHz)	Channel Number	Channel Frequency (MHz)
1	2402.0	41	2442.0
2	2403.0	42	2443.0
3	2404.0	43	2444.0
4	2405.0	44	2445.0
5	2406.0	45	2446.0
6	2407.0	46	2447.0
7	2408.0	47	2448.0
8	2409.0	48	2449.0
9	2410.0	49	2450.0
10	2411.0	50	2451.0
11	2412.0	51	2452.0
12	2413.0	52	2453.0
13	2414.0	53	2454.0
14	2415.0	54	2455.0
15	2416.0	55	2456.0
16	2417.0	56	2457.0
17	2418.0	57	2458.0
18	2419.0	58	2459.0
19	2420.0	59	2460.0
20	2421.0	60	2461.0
21	2422.0	61	2462.0
22	2423.0	62	2463.0
23	2424.0	63	2464.0
24	2425.0	64	2465.0
25	2426.0	65	2466.0
26	2427.0	66	2467.0
27	2428.0	67	2468.0
28	2429.0	68	2469.0
29	2430.0	69	2470.0
30	2431.0	70	2471.0
31	2432.0	71	2472.0
32	2433.0	72	2473.0
33	2434.0	73	2474.0
34	2435.0	74	2475.0
35	2436.0	75	2476.0
36	2437.0	76	2477.0
37	2438.0	77	2478.0
38	2439.0	78	2479.0
39	2440.0	79	2480.0
40	2441.0		

SECTION 3. TEST SPECIFICATION, METHODS & PROCEDURES**3.1 Test Specification:**

Title: FCC PART 15.247, Subpart C (47 CFR 15).

Limits and methods of measurement of radio interference characteristics of radio frequency devices. Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.

Purpose of Test: The tests were performed to demonstrate Initial compliance.

3.2 Methods & Procedures:**3.2.1 § 15.247**

(a) Operation under the provisions of this section is limited to frequency hopping and direct sequence spread spectrum intentional radiators that comply with the following provisions:

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(ii) Frequency hopping systems operating in the 2400-2483.5 MHz and 5725- 5850 MHz bands shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

(iii) Frequency hopping systems in the 2400-2483.5 MHz band may utilize hopping channels whose 20 dB bandwidth is greater than 1 MHz provided the systems use at least 15 non-overlapping channels. The total span of hopping channels shall be at least 75 MHz. The average time of occupancy on any one channel shall not be greater than 0.4 seconds within the time period required to hop through all channels.

(2) For direct sequence systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

(b) The maximum peak output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems in the 2400-2483.5 MHz band employing at least 75 hopping channels, all frequency hopping systems in the 5725-5850 MHz band, and all direct sequence systems: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

(3) Except as shown in paragraphs (b)(3) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(i) Systems operating in the 2400- 2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(ii) Systems operating in the 5725- 5850 MHz band that are used exclusively for fixed, point-to-point operations may

employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

(iii) Fixed, point-to-point operation, as used in paragraphs (b)(3)(i) and (b)(3)(ii) of this section, excludes the use of point-to-multipoint systems, omni-directional applications, and multiple collocated intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

(4) Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this chapter.

(c) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

(d) For direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

(e) The processing gain of a direct sequence system shall be at least 10 dB. The processing gain represents the improvement to the received signal-to-noise ratio, after filtering to the information bandwidth, from the spreading/ despreading function. The processing gain may be determined using one of the following methods:

(1) As measured at the demodulated output of the receiver: the ratio in dB of the signal-to-noise ratio with the system spreading code turned off to the signal-to-noise ratio with the system spreading code turned on.

(2) As measured using the CW jamming margin method: a signal generator is stepped in 50 kHz increments across the pass band of the system, recording at each point the generator level required to produce the recommended Bit Error Rate (BER). This level is the jammer level. The output power of the intentional radiator is measured at the same point. The jammer to signal ratio (J/S) is then calculated, discarding the worst 20% of the J/S data points. The lowest remaining J/S ratio is used to calculate the processing gain, as follows: $G_p = (S/N)_o + M_j + L_{sys}$, where G_p = processing gain of the system, $(S/N)_o$ = signal to noise ratio required for the chosen BER, M_j = J/S ratio, and L_{sys} = system losses. Note that total losses in a system, including intentional radiator and receiver, should be assumed to be no more than 2 dB.

(f) Hybrid systems that employ a combination of both direct sequence and frequency hopping modulation techniques shall achieve a processing gain of at least 17 dB from the combined techniques. The frequency hopping operation of the hybrid system, with the direct sequence operation turned off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. The direct sequence operation of the hybrid system, with the frequency hopping operation turned off, shall comply with the power density requirements of paragraph (d) of this section.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

3.2.2 § 15.207 Conducted Limits

(a) For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 450 kHz to 30 MHz shall not exceed 250 microvolts. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

(b) The following option may be employed if the conducted emissions exceed the limits in paragraph (a) of this section when measured using instrumentation employing a quasipeak detector function: If the level of the emission measured using the quasipeak instrumentation is 6 dB, or more, higher than the level of the same emission measured with instrumentation having an average detector and a 9 kHz minimum bandwidth, that emission is considered broadband and the level obtained with the quasipeak detector may be reduced by 13 dB for comparison to the limits. When employing this option, the following conditions shall be observed:

(1) The measuring instrumentation with the average detector shall employ a linear IF amplifier.

(2) Care must be taken not to exceed the dynamic range of the measuring instrument when measuring an emission with a low duty cycle.

(3) The test report required for verification or for an application for a grant of equipment authorization shall contain all details supporting the use of this option.

(c) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

(1) For carrier current system containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 uV within the frequency band 535-1705 kHz.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in § 15.205, § 15.209, § 15.221, § 15.223, or § 15.227, as appropriate.

(d) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power

lines, shall be tested to demonstrate compliance with the conducted limits.

3.2.3 Test Procedure

The testing was performed according to the procedures in ANSI C63.4 (1992). Testing was performed at CCL's anechoic chamber located in Salt Lake City, Utah. This site has been fully described in a report submitted to the FCC, and was accepted in a letter dated March 11, 2002 (Registration Number 90502).

CCL participates in the National Voluntary Laboratory Accreditation Program (NVLAP) and has been accepted under NVLAP Lab Code: 100272-0, which is effective until September 30, 2002.

For radiated emissions testing performed at distances closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

SECTION 4. OPERATION OF EUT DURING TESTING.**4.1 Operating Environment:**

Power Supply: 3.3/5.0 VDC

4.2 Operating Modes:

Each mode of operation was exercised to produce worst-case emissions. The worst-case emissions were with the SL-1022 running in the following mode. The SL-1022 was placed in the transmit mode with the same type of modulation that would normally be used during normal operation.

4.3 Configuration & Peripherals:

The SL-1022 was placed on the table in the transmit mode with the same type of modulation that would normally be used during normal operation.

SECTION 5. SUMMARY OF TEST RESULTS:**5.1 FCC PART 15.247, Subpart C****5.1.1 Summary of Tests:**

Section	Test Performed	Frequency Range (MHz)	Result
15.247 (a)(1)	Hopping Channel Carrier Frequencies	2400 to 2483.5	Complied
15.247 (a)(1)(ii)	Average Time of Occupancy	2400 to 2483.5	Complied
15.247 (a)(1)(ii)	Emission Bandwidth	2400 to 2483.5	Complied
15.247 (b)(1)	Peak Output Power	2400 to 2483.5	Complied
15.247 (C)	Antenna Conducted Spurious Emissions	10 to 25,000	Complied
15.247 (C)	Radiated Spurious Emissions	10 to 25,000	Complied
15.247 (f)	Hybrid Systems	2400 to 2483.5	Complied
15.207	Line Conducted Emissions (Hot Lead to Ground)	0.45 to 30	Complied
15.207	Line Conducted Emissions (Neutral Lead to Ground)	0.45 to 30	Complied

5.2 Result

In the configuration tested, the EUT complied with the requirements of the specification.

SECTION 6. MEASUREMENTS, EXAMINATIONS AND DERIVED RESULTS:**6.1 General Comments:**

This section contains the test results only. Details of the test methods used, etc., can be found in Appendix 1 of this report.

6.2 Test Results**6.2.1 § 15.247 (a)(1) pseudorandomly ordered list of hopping frequencies and receiver input bandwidth**

The SL-1022 contains a transceiver module that determines the pseudorandom sequence of the hop set in the data mode.

The following are two examples of possible 79 channel hopping sequences with channels identified as 1 through 79. The channel numbering scheme starts with channel 2 at 2402 MHz with the 79th channel then appearing at 2480 MHz as channel 80.

Sequence a:

2,17,68,55,4,77,56,27,70,80,22,33,57,34,29,79,44,50,3,71,66,36,
78,20,67,30,24,11,37,69,23,7,41,38,63,14,31,59,40,13,6,25,65,1
5,
61,73,58,47,19,28,54,76,74,48,52,75,5,42,64,72,62,51,60,18,45,
53,16,39,46,32,49,43,8,21,9,12,10,26,35

Sequence b:

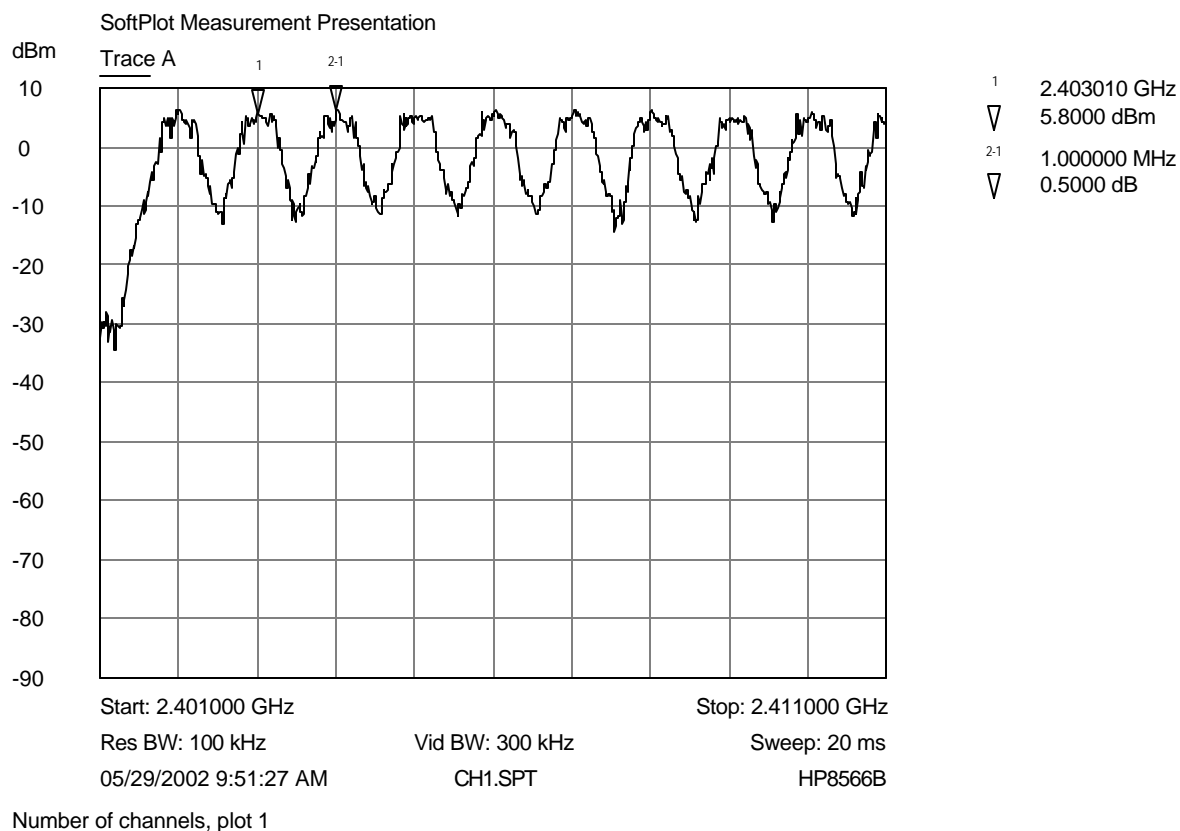
50,6,41,57,64,14,42,33,79,3,20,38,56,69,75,21,80,23,31,40,45,6
8,
32,28,4,15,34,59,71,61,70,5,72,13,48,70,39,54,78,7,77,62,30,2,
8,
55,10,63,12,16,37,11,43,66,25,51,58,74,17,47,9,29,65,19,53,18,
52,36,27,26,44,22,49,24,35,60,73,76,67

The pseudorandom sequence is generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage with the result fed back to the input of the first stage. This produces a pseudorandom sequence length of 511 bits.

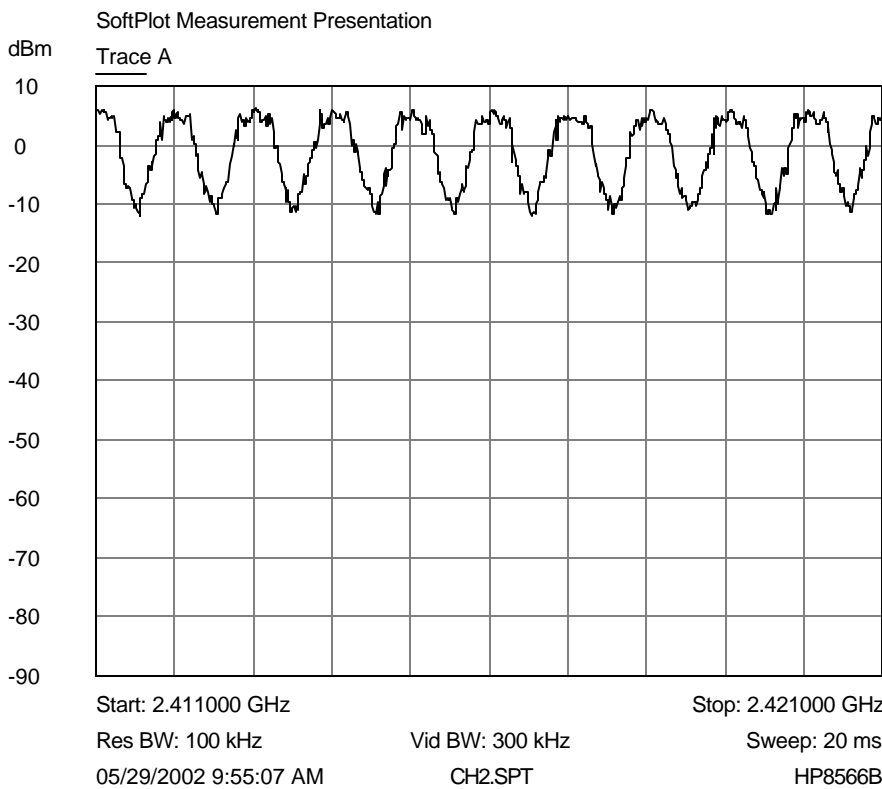
**6.2.2 § 15.247 (a)(1) Hopping Channel Carrier Frequencies
§ 15.247 (a)(1)(ii) Number of Hopping Channels**

The SL-1022 operates on the 79 channels that are shown in

Section 2.6; 1 MHz separates these channels. Shown below are the plots that show the number of hopping channels and the carrier frequency separation:

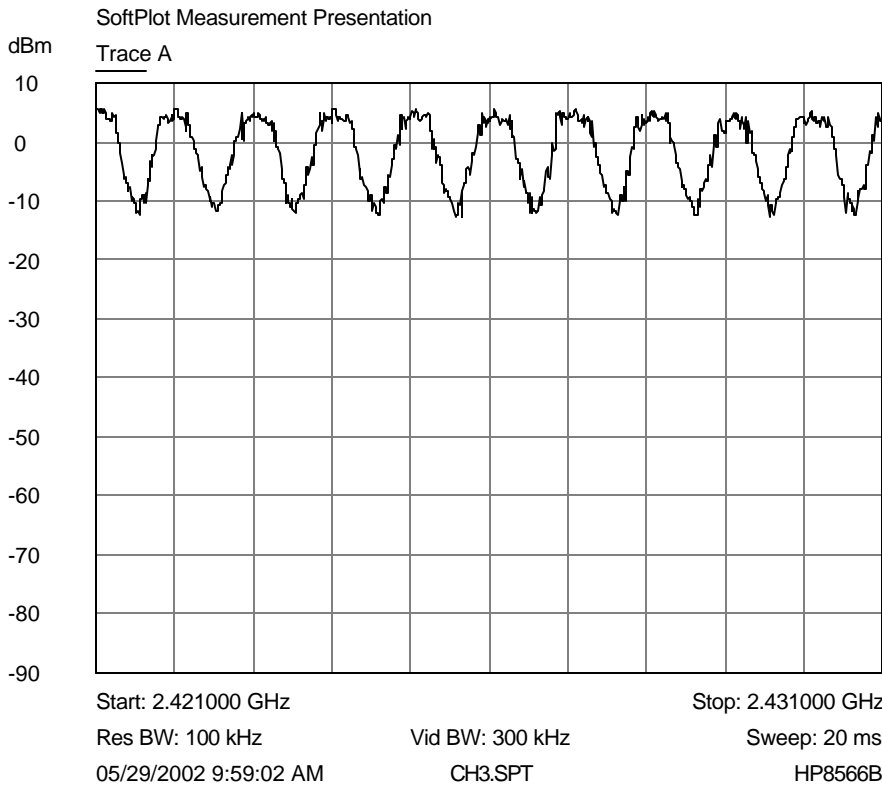


Number of Hopping Channels (Plot 1)



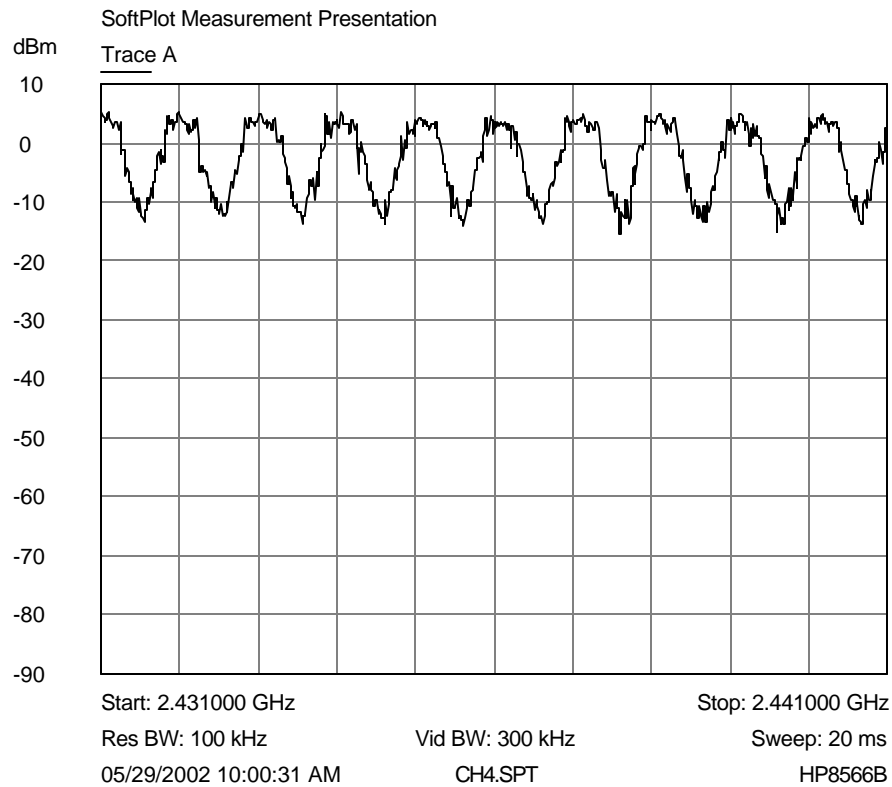
Number of channels, plot 2

Number of Hopping Channels (Plot 2)



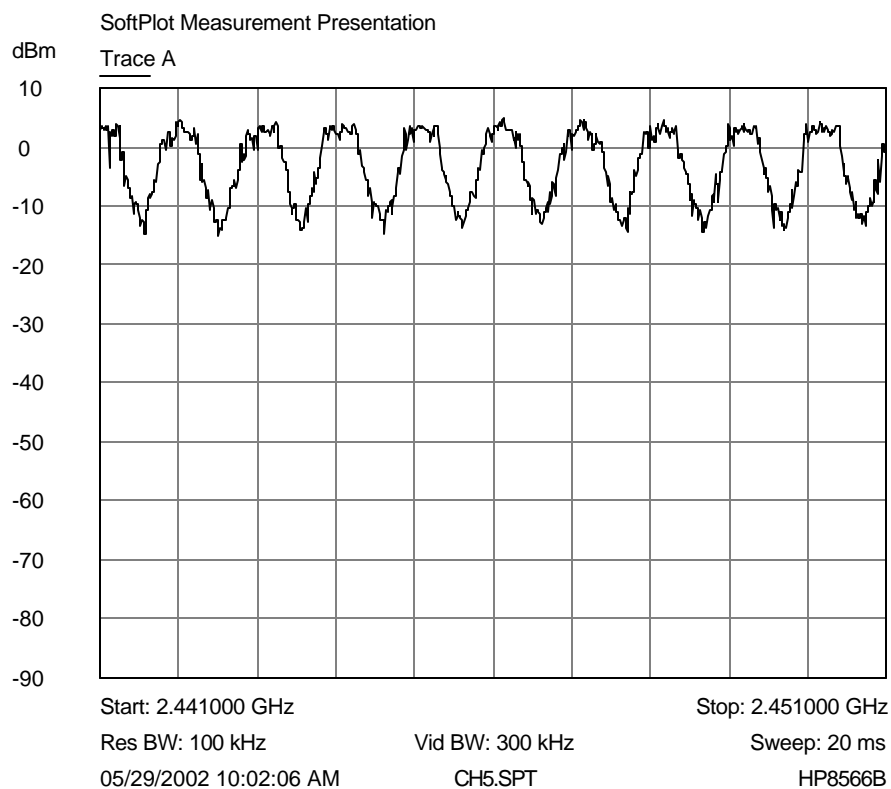
Number of channels, plot 3

Number of Hopping Channels (Plot 3)



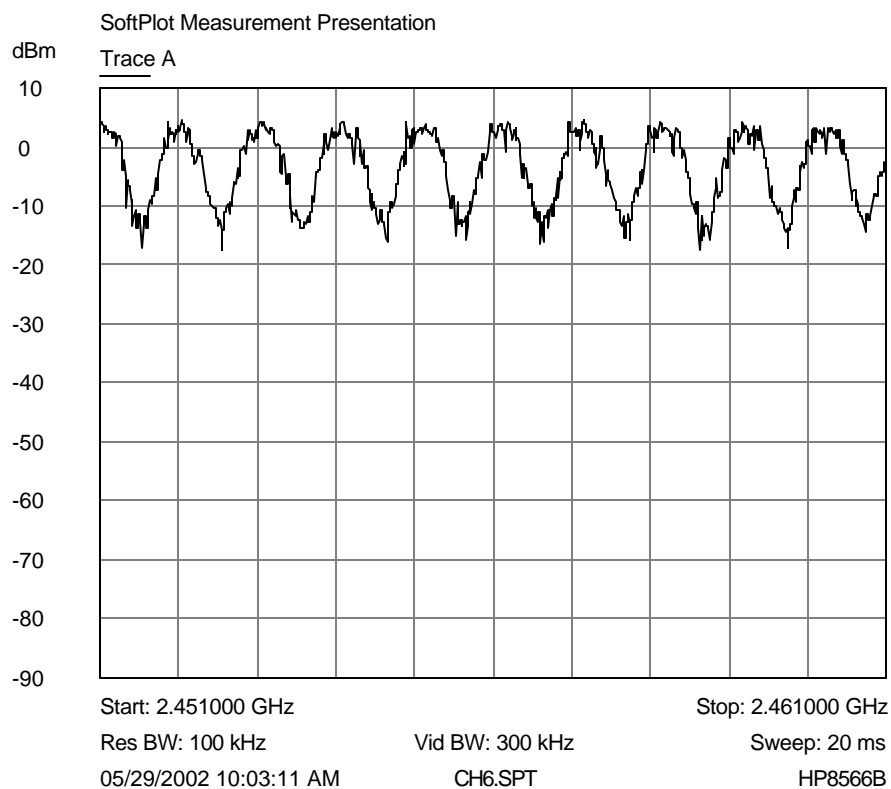
Number of channels, plot 4

Number of Hopping Channels (Plot 4)



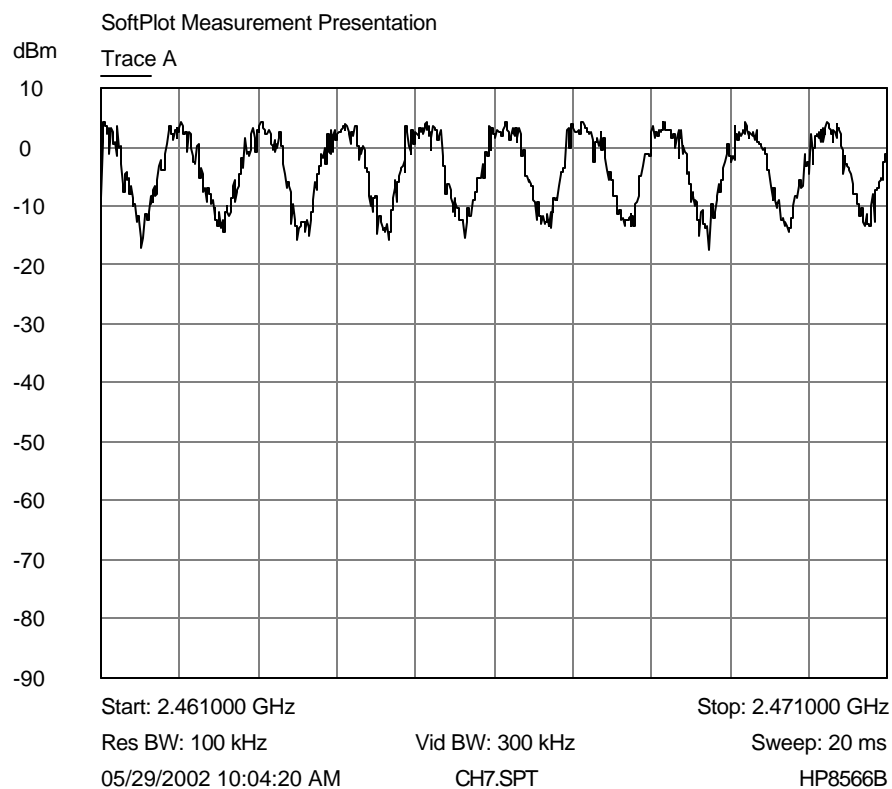
Number of channels, plot 5

Number of Hopping Channels (Plot 5)



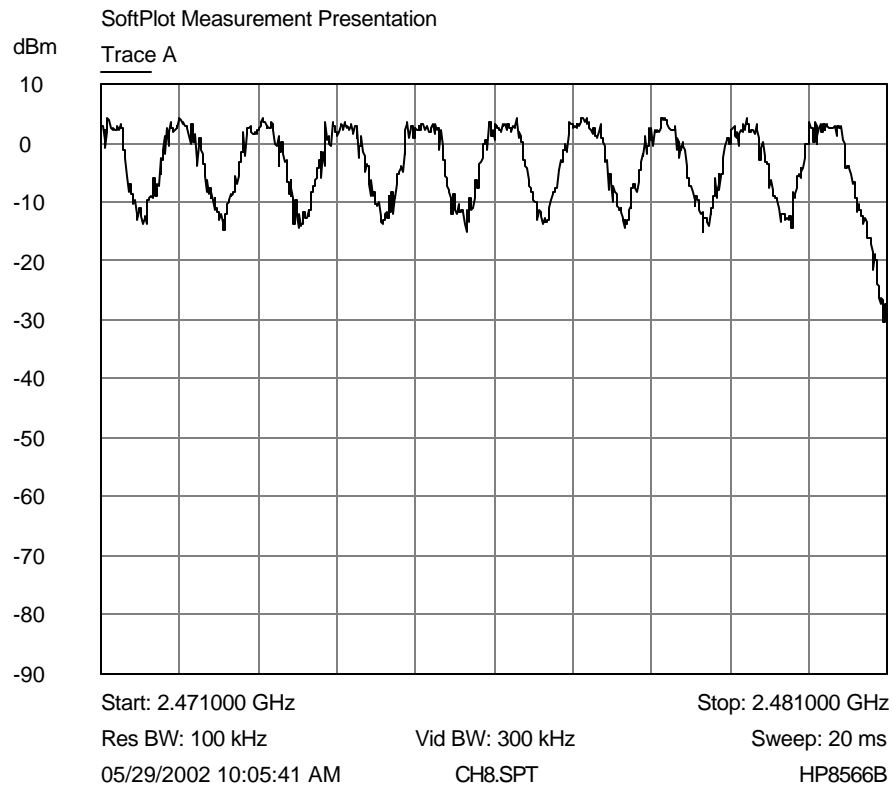
Number of channels, plot 6

Number of Hopping Channels (Plot 6)



Number of channels, plot 7

Number of Hopping Channels (Plot 7)



Number of channels, plot 8

Number of Hopping Channels (Plot 8)

6.2.3 § 15.247 (a)(1)(ii) Average Time of Occupancy

The SL-1022 hops 1600 times per second. Since the SL-1022 uses 79 hopping channels and each channel is used equally (see manufacturer's Exhibit 12), each channel will transmit 20.25 times per second (1600 hops/second divided by 79 channels); therefore, in any 30 second period the channel will transmit 607.5 times. This device only transmits when there is data to be sent and the amount of data to be sent depends on the file size. In the worst-case mode the maximum on time is 440 μ s before it hops to the next channel in its hop list. Therefore, the worst-case average time of occupancy in a 30 sec span is 267.3 msec (see calculation below).

Hop sequence duration: 49.375 msec (79 channels divided by 1600 hops/second; the time needed to complete a full hop sequence and return to a specific channel)

Number of hops per second: 20.25 (1600 hops/second divided by 79 channels)

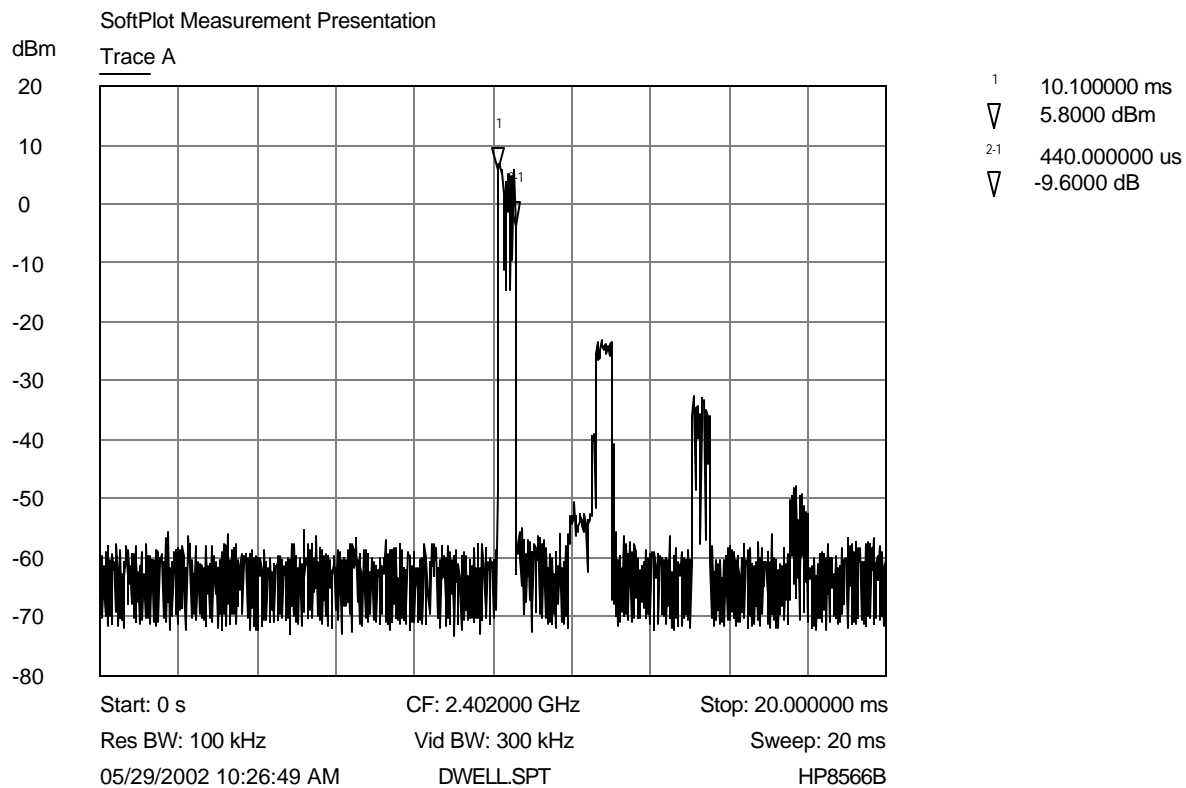
Single Channel hits in 30 sec: 607.5 hits (20.25 times 30)

Average time of single channel occupancy: 440 μ s (see plot below)

Average channel time of occupancy: (440 μ sec/hit) *(607.5 hits per 30 sec) = 267.3 msec

The maximum time of occupancy for a particular channel is 267.3 msec in any 30 second period, which is less than the 400 msec allowed by the rules; therefore, it meets the requirements of this section.

Average time of single channel occupancy



Dwell Time

6.2.4 § 15.247 (a)(1)(ii) Emission Bandwidth**Measurement Data:**

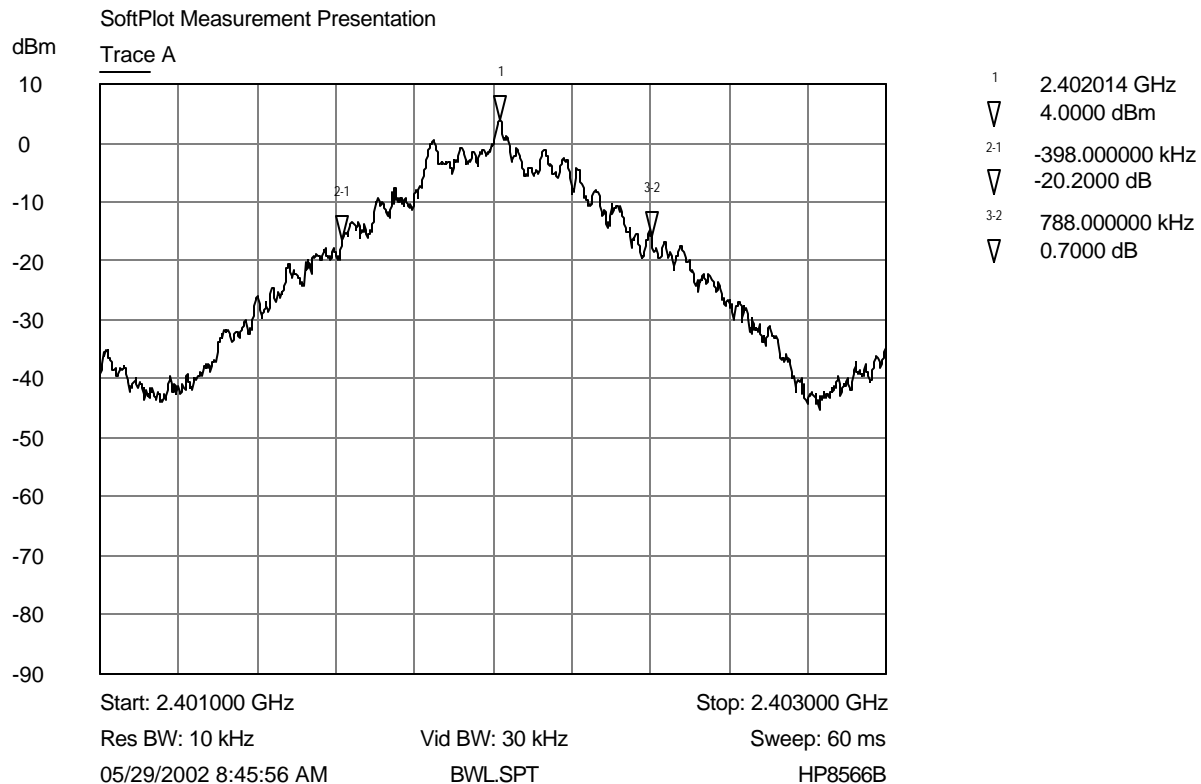
A diagram of the test configuration and the test equipment used is enclosed in Appendix 1.

Frequency (MHz)	Emission Bandwidth (kHz)
2402.0	788.0
2441.0	716.0
2480.0	760.0

RESULT

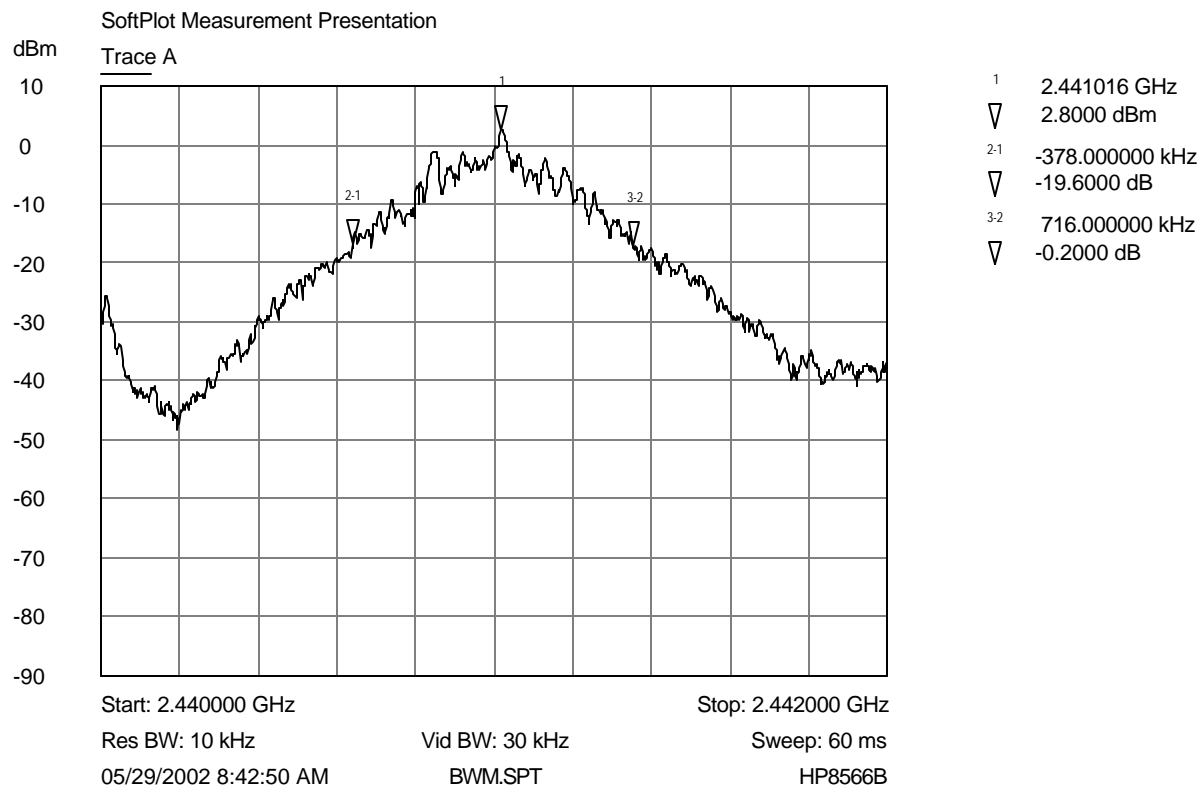
In the configuration tested, the 20 dB bandwidth was less than 1 MHz; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).

Emission Bandwidth Plot - (Low Channel)



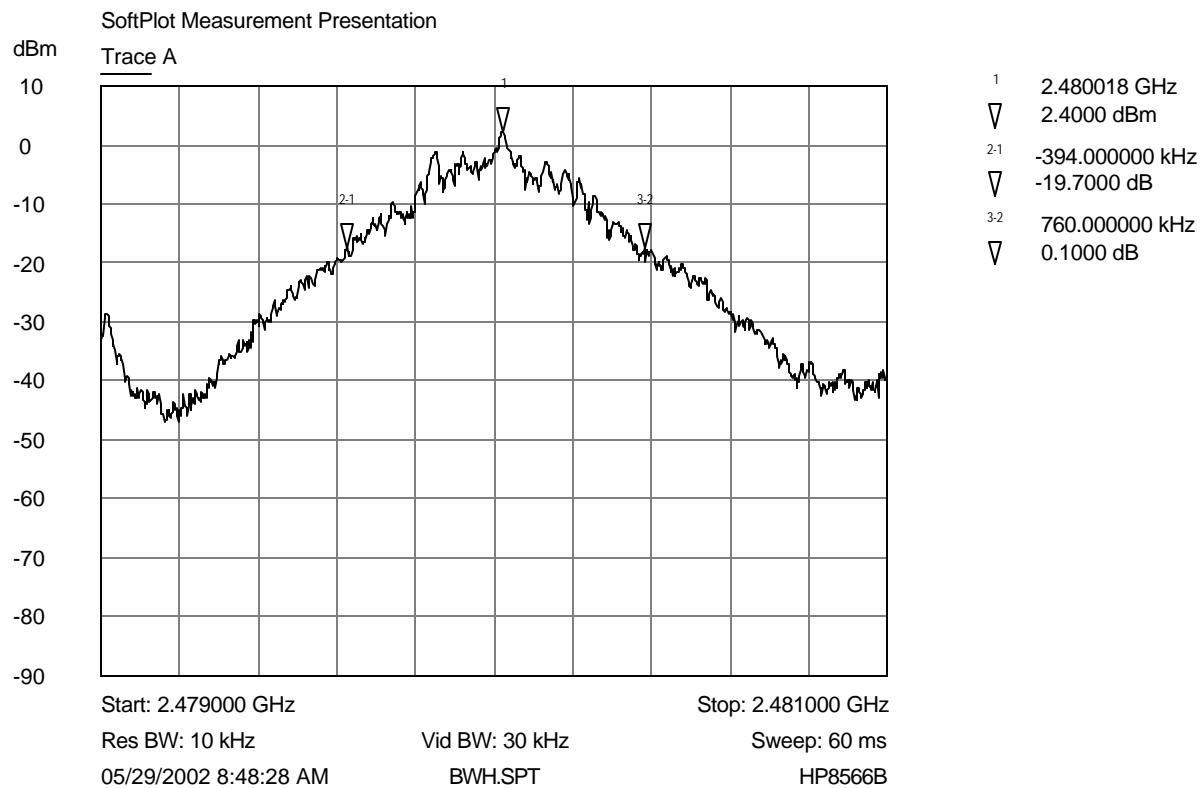
Bandwidth Plot, 2402 MHz, Power setting 63

Emission Bandwidth Plot - (Middle Channel)



Bandwidth Plot, 2441 MHz, Power setting 63

Emission Bandwidth Plot - (High Channel)



Bandwidth Plot, 2480 MHz, Power setting 63

6.2.5 § 15.247 (b)(1) Peak Output Power:**Measurement Data:**

The maximum peak RF Conducted output power measured for this device was 5.12 mW or 7.1 dBm. The maximum directional gain of the antenna is -1.5 dBi; therefore, the maximum output power is not required to be reduced from the value measured.

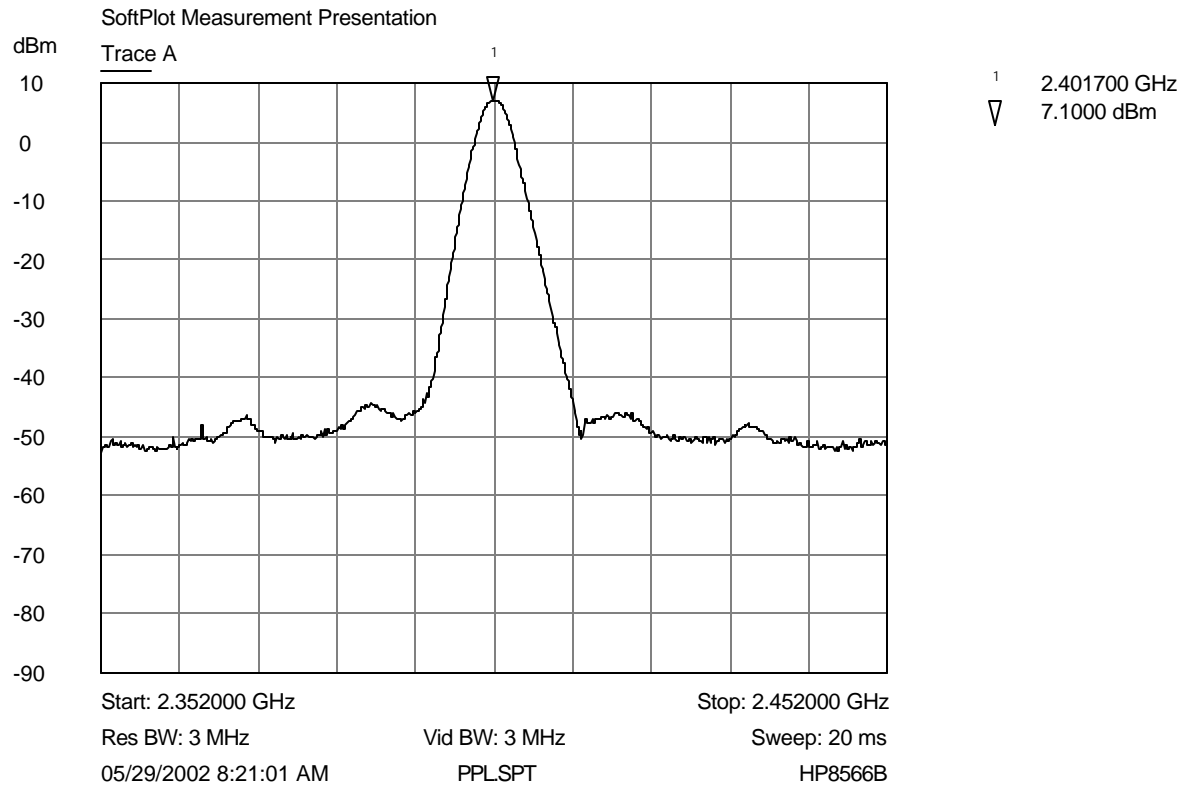
A diagram of the test configuration and the test equipment used is enclosed in Appendix 1.

Frequency (MHz)	Measured Output Power (dBm)	Measured Output Power (mW)
2402.0	7.1	5.12
2441.0	5.8	3.80
2480.0	5.3	3.38

RESULT

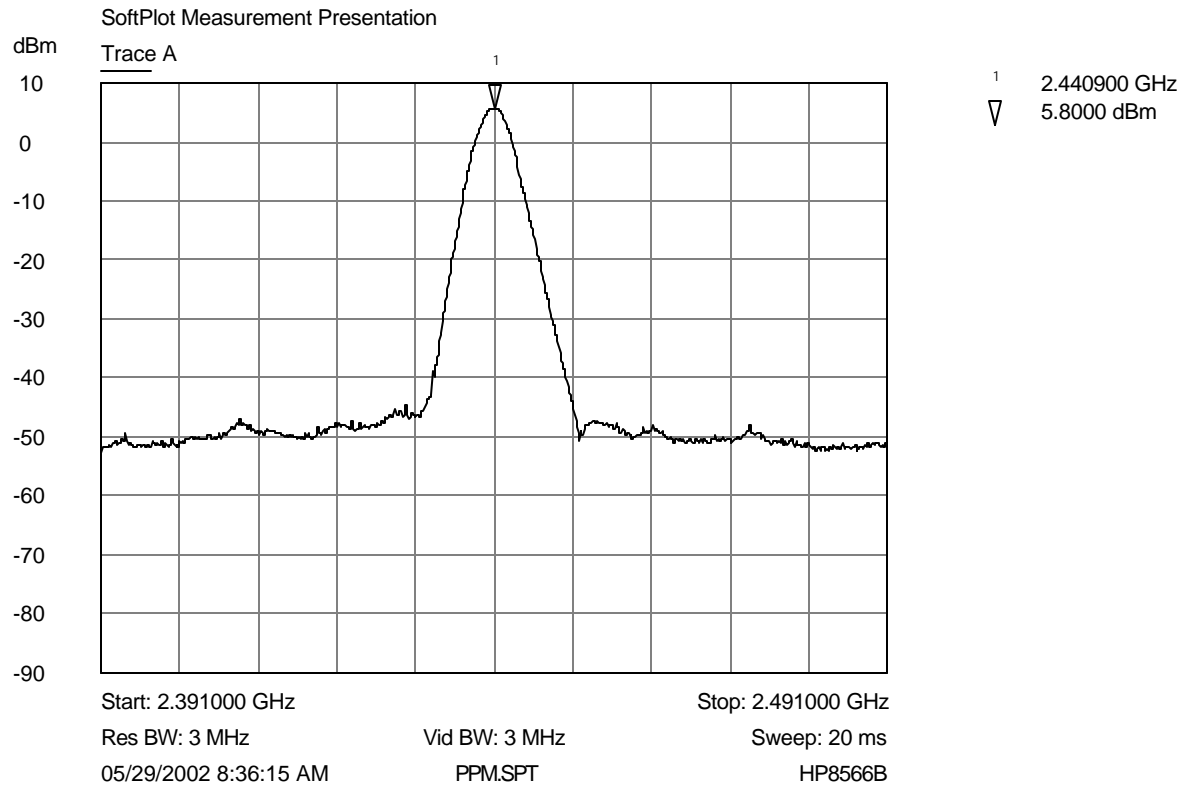
In the configuration tested, the RF peak output power was less than 1 Watt; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).

Peak Output Power Plot - (Low Channel)



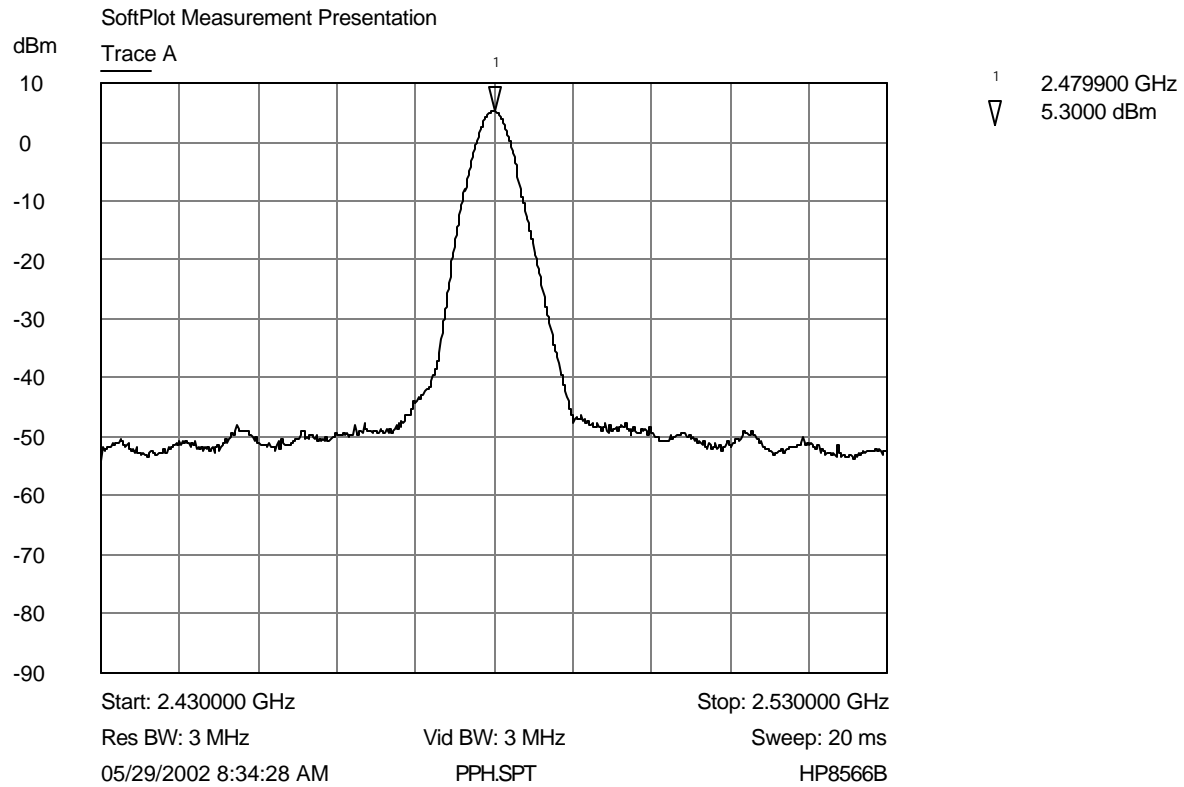
Peak Output Power, 2402 MHz, Power setting 63

Peak Output Power Plot - (Middle Channel)



Peak Output Power, 2441 MHz, Power setting 63

Peak Output Power Plot - (High Channel)



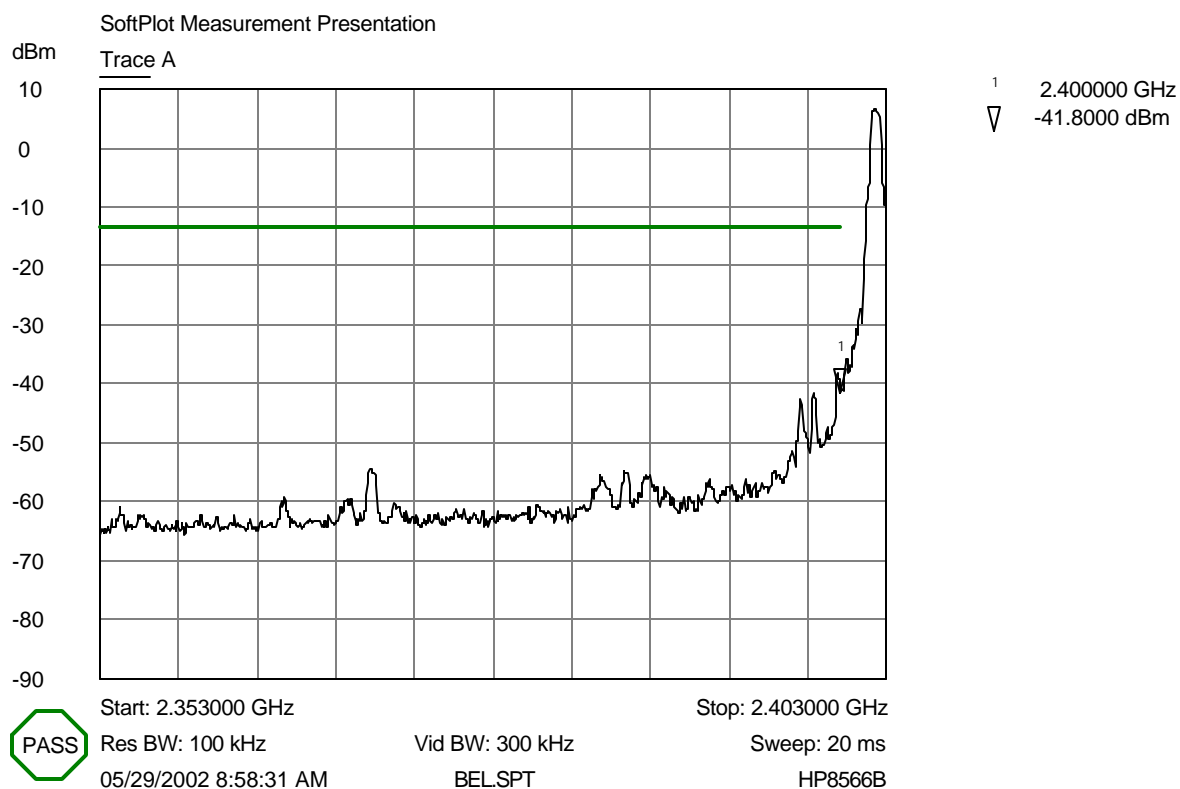
Peak Output Power, 2480 MHz, Power setting 63

6.2.6 § 15.247 (c) Spurious Emissions:**Measurement Data Antenna Conducted Emissions:**

The frequency range from 10 MHz to the tenth harmonic of the highest fundamental frequency was investigated to measure any antenna-conducted emissions. Shown below are plots with the SL-1022 tuned to the upper and lower channels. These demonstrate compliance with the provisions of this section.

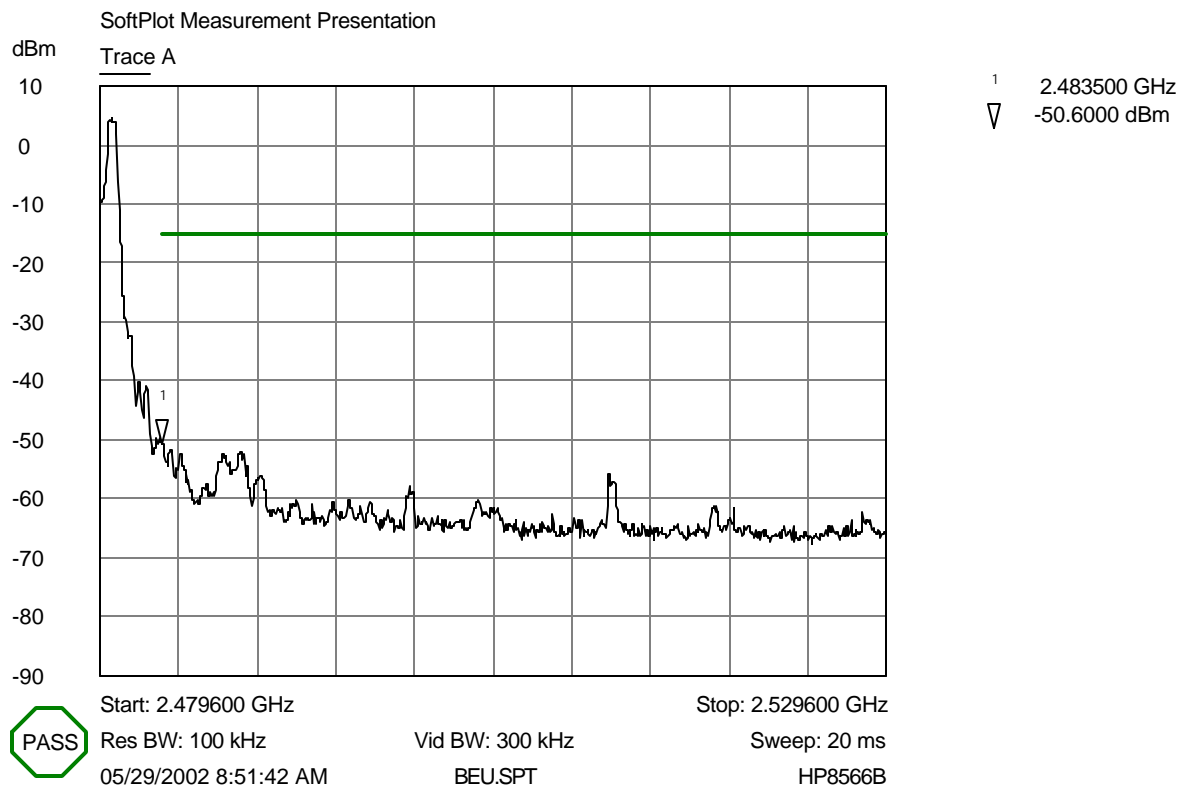
A diagram of the test configuration and the test equipment used is provided in Appendix 1.

Spurious emissions plot (Transmitting at 2402.0 MHz)



Bandedge Plot, 2402 MHz, Power setting 63

Spurious emissions plot (Transmitting at 2480.0 MHz)



Bandedge Plot, 2480 MHz, Power setting 63

The emissions must be attenuated 20 dB below the highest power level measured within the authorized band as measured with a 100 kHz RBW; the highest level measured with a 100 kHz RBW was 6.6 dBm therefore, the criteria is $6.6 - 20.0 = -13.4$ dBm.

Transmitting at 2402.0 MHz			
Frequency Range MHz	Frequency MHz	Corrected Level dBm	Criteria dBm
10 - 30	16.52 *	-64.8	-13.4
30 - 200	59.9 *	-64.7	-13.4
200 - 500	334.7 *	-64.7	-13.4
500 - 1000	591.0	-61.0	-13.4
1000 - 2000	1796.0	-61.0	-13.4
2000 - 2399.9	2399.1	-45.0	-13.4
2483.6 - 4000	2529.0	-58.6	-13.4
4000 - 6000	4806.0	-51.8	-13.4
6000 - 8000	6780.0 *	-60.1	-13.4
8000 - 10,000	9716.0 *	-59.0	-13.4
10,000 - 13,000	12790.0 *	-56.2	-13.4
13,000 - 15,000	13940.0 *	-54.3	-13.4
15,000 - 18,000	15387.0 *	-54.2	-13.4
18,000 - 21,000	20268.0 *	-50.9	-13.4
21,000 - 23,000	22428.0 *	-49.3	-13.4
23,000 - 25,000	23516.0 *	-48.0	-13.4
* Noise Floor			

The emissions must be attenuated 20 dB below the highest power level measured within the authorized band as measured with a 100 kHz RBW; the highest level measured with a 100 kHz RBW was 5.2 dBm therefore, the criteria is $5.2 - 20.0 = -14.8$ dBm.

Transmitting at 2441.0 MHz			
Frequency Range MHz	Frequency MHz	Corrected Level dBm	Criteria dBm
10 - 30	18.2 *	-65.4	-14.8
30 - 200	165.0 *	-65.0	-14.8
200 - 500	359.6 *	-63.9	-14.8
500 - 1000	630.0 *	-63.7	-14.8
1000 - 2000	1581.0 *	-64.3	-14.8
2000 - 2399.9	2379.1	-55.9	-14.8
2483.6 - 4000	2505.0	-59.3	-14.8
4000 - 6000	4884.0	-49.3	-14.8
6000 - 8000	6684.0 *	-59.7	-14.8
8000 - 10,000	8730.0 *	-59.7	-14.8
10,000 - 13,000	12916.0 *	-56.8	-14.8
13,000 - 15,000	14168.0 *	-55.2	-14.8
15,000 - 18,000	17508.0 *	-54.2	-14.8
18,000 - 21,000	19959.0 *	-51.0	-14.8
21,000 - 23,000	22666.0 *	-49.3	-14.8
23,000 - 25,000	23474.0 *	-48.3	-14.8
* Noise Floor			

The emissions must be attenuated 20 dB below the highest power level measured within the authorized band as measured with a 100 kHz RBW; the highest level measured with a 100 kHz RBW was 4.6 dBm therefore, the criteria is $4.6 - 20.0 = -15.4$ dBm.

Transmitting at 2480.0 MHz			
Frequency Range MHz	Frequency MHz	Corrected Level dBm	Criteria dBm
10 - 30	17.2 *	-64.9	-15.4
30 - 200	171.4 *	-65.1	-15.4
200 - 500	220.4 *	-64.4	-15.4
500 - 1000	669.5	-62.7	-15.4
1000 - 2000	1465.0 *	-64.6	-15.4
2000 - 2399.9	2386.3	-58.6	-15.4
2483.6 - 4000	2484.0	-53.0	-15.4
4000 - 6000	4962.0	-57.8	-15.4
6000 - 8000	6804.0 *	-59.8	-15.4
8000 - 10,000	9306.0 *	-59.7	-15.4
10,000 - 13,000	12970.0 *	-56.1	-15.4
13,000 - 15,000	13782.0 *	-55.7	-15.4
15,000 - 18,000	15816.0 *	-55.3	-15.4
18,000 - 21,000	20088.0 *	-51.4	-15.4
21,000 - 23,000	22156.0 *	-49.4	-15.4
23,000 - 25,000	23312.0 *	-48.3	-15.4
* Noise Floor			

Measurement Data Radiated Emissions Restricted Bands § 15.205:

The frequency range from 10 MHz to 25 GHz was investigated to measure any radiated emissions in the restricted bands. Shown below are any emissions that fell into the restricted bands of § 15.205.

A diagram of the test configuration and the test equipment used is enclosed in Appendix 1. RBW = 1 MHz, VBW = 3 MHz

AVERAGE FACTOR

The SL-1022 transmits continuously therefore; there is not an average factor for this device.

Vertical Polarity

Transmitting at 2402.0 MHz						
Frequency MHz	Receiver Reading dBµV	Correction Factor dB	Average Factor dB	Corrected Reading dBµV/m	Limit dBµV/m	Margin dB
2483.5 P	51.6	-3.6	0.0	48.0	74.0	-26.0
2483.5 A	39.1	-3.6	0.0	35.5	54.0	-18.5
4804.0 P	48.8	1.4	0.0	50.2	74.0	-23.8
4804.0 A	37.4	1.4	0.0	38.8	54.0	-15.2
12,010.0 P *	45.1	7.5	0.0	52.6	74.0	-21.4
12,010.0 A *	33.6	7.5	0.0	41.1	54.0	-12.9
19,216.0 P *	50.9	9.6	0.0	60.5	74.0	-13.5
19,216.0 A *	35.6	9.6	0.0	45.2	54.0	-8.8
P = Peak Detection						
A = Average Detection						
* No emissions were detected with the antenna 1 meter from the EUT, the indicated readings are the noise floor measurements from the spectrum analyzer						

Transmitting at 2441.0 MHz						
Frequency MHz	Receiver Reading dBµV	Correction Factor dB	Average Factor dB	Corrected Reading dBµV/m	Limit dBµV/m	Margin dB
2483.5 P	53.9	-3.6	0.0	50.3	74.0	-23.7
2483.5 A	38.6	-3.6	0.0	35.0	54.0	-19.0
4882.0 P	50.5	1.6	0.0	52.1	74.0	-21.9
4882.0 A	39.0	1.6	0.0	40.6	54.0	-13.4
7323.0 P *	48.7	4.6	0.0	53.3	74.0	-20.7
7323.0 A *	36.7	4.6	0.0	41.3	54.0	-12.7
12,205.0 P *	46.1	7.0	0.0	53.1	74.0	-20.9
12,205.0 A *	33.7	7.0	0.0	40.7	54.0	-13.3
19,528.0 P *	51.5	9.6	0.0	61.1	74.0	-12.9
19,528.0 A *	36.1	9.6	0.0	45.7	54.0	-8.3

P = Peak Detection

A = Average Detection

* No emissions were detected with the antenna 1 meter from the EUT, the indicated readings are the noise floor measurements from the spectrum analyzer

Transmitting at 2480.0 MHz						
Frequency MHz	Receiver Reading dBµV	Correction Factor dB	Average Factor dB	Corrected Reading dBµV/m	Limit dBµV/m	Margin dB
2483.5 P	71.5	-3.6	0.0	67.9	74.0	-6.1
2483.5 A	52.0	-3.6	0.0	48.4	54.0	-5.6
4960.0 P	49.9	1.9	0.0	51.8	74.0	-22.2
4960.0 A	36.7	1.9	0.0	38.6	54.0	-15.4
7440.0 P *	48.9	5.0	0.0	53.9	74.0	-20.1
7440.0 A *	36.2	5.0	0.0	41.2	54.0	-12.8
12,400.0 P *	47.2	7.0	0.0	54.2	74.0	-19.8
12,400.0 A *	33.9	7.0	0.0	40.9	54.0	-13.1
19,840.0 P *	50.9	9.6	0.0	60.5	74.0	-13.5
19,840.0 A *	37.0	9.6	0.0	46.6	54.0	-7.4
22,320.0 P *	51.0	10.2	0.0	61.2	74.0	-12.8
22,320.0 A *	36.3	10.2	0.0	46.5	54.0	-7.5

P = Peak Detection

A = Average Detection

* No emissions were detected with the antenna 1 meter from the EUT, the indicated readings are the noise floor measurements from the spectrum analyzer

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Horizontal Polarity

Transmitting at 2402.0 MHz						
Frequency MHz	Receiver Reading dBµV	Correction Factor dB	Average Factor dB	Corrected Reading dBµV/m	Limit dBµV/m	Margin dB
2483.5 P	54.3	-3.6	0.0	50.7	74.0	-23.3
2483.5 A	38.4	-3.6	0.0	34.8	54.0	-19.2
4804.0 P	47.7	1.4	0.0	49.1	74.0	-24.9
4804.0 A	35.7	1.4	0.0	37.1	54.0	-16.9
12,010.0 P *	45.1	7.5	0.0	52.6	74.0	-21.4
12,010.0 A *	33.6	7.5	0.0	41.1	54.0	-12.9
19,216.0 P *	50.9	9.6	0.0	60.5	74.0	-13.5
19,216.0 A *	35.6	9.6	0.0	45.2	54.0	-8.8
P = Peak Detection A = Average Detection * No emissions were detected with the antenna 1 meter from the EUT, the indicated readings are the noise floor measurements from the spectrum analyzer						

Transmitting at 2441.0 MHz						
Frequency MHz	Receiver Reading dBµV	Correction Factor dB	Average Factor dB	Corrected Reading dBµV/m	Limit dBµV/m	Margin dB
2483.5 P	54.4	-3.6	0.0	50.8	74.0	-23.2
2483.5 A	38.6	-3.6	0.0	35.0	54.0	-19.0
4882.0 P	47.1	1.6	0.0	48.7	74.0	-25.3
4882.0 A	36.0	1.6	0.0	37.6	54.0	-16.4
7323.0 P *	49.1	4.6	0.0	53.7	74.0	-20.3
7323.0 A *	36.6	4.6	0.0	41.2	54.0	-12.8
12,205.0 P *	46.1	7.0	0.0	53.1	74.0	-20.9
12,205.0 A *	33.7	7.0	0.0	40.7	54.0	-13.3
19,528.0 P *	51.5	9.6	0.0	61.1	74.0	-12.9
19,528.0 A *	36.1	9.6	0.0	45.7	54.0	-8.3
P = Peak Detection A = Average Detection * No emissions were detected with the antenna 1 meter from the EUT, the indicated readings are the noise floor measurements from the spectrum analyzer						

Transmitting at 2480.0 MHz						
Frequency MHz	Receiver Reading dBμV	Correction Factor dB	Average Factor dB	Corrected Reading dBμV/m	Limit dBμV/m	Margin dB
2483.5 P	68.5	-3.6	0.0	64.9	74.0	-9.1
2483.5 A	52.6	-3.6	0.0	49.0	54.0	-5.0
4960.0 P	47.7	1.9	0.0	49.6	74.0	-24.4
4960.0 A	36.7	1.9	0.0	38.6	54.0	-15.4
7440.0 P *	48.5	5.0	0.0	53.5	74.0	-20.5
7440.0 A *	36.1	5.0	0.0	41.1	54.0	-12.9
12,400.0 P *	47.2	7.0	0.0	54.2	74.0	-19.8
12,400.0 A *	33.9	7.0	0.0	40.9	54.0	-13.1
19,840.0 P *	50.9	9.6	0.0	60.5	74.0	-13.5
19,840.0 A *	37.0	9.6	0.0	46.6	54.0	-7.4
22,320.0 P *	51.0	10.2	0.0	61.2	74.0	-12.8
22,320.0 A *	36.3	10.2	0.0	46.5	54.0	-7.5
P = Peak Detection A = Average Detection * No emissions were detected with the antenna 1 meter from the EUT, the indicated readings are the noise floor measurements from the spectrum analyzer						

Sample Field Strength Calculation:

The field strength is calculated by adding the Correction Factor (Antenna Factor + Cable Factor), to the measured level from the receiver. The basic equation with a sample calculation is shown below:

FS = RA + CF - AF Where

FS = Field Strength

RA = Receiver Amplitude (Receiver Reading - Amplifier Gain)

CF = Correction Factor (Antenna Factor + Cable Factor)

AF = Average Factor

RESULT

In the configuration tested, the EUT complied with the requirements of the specification.

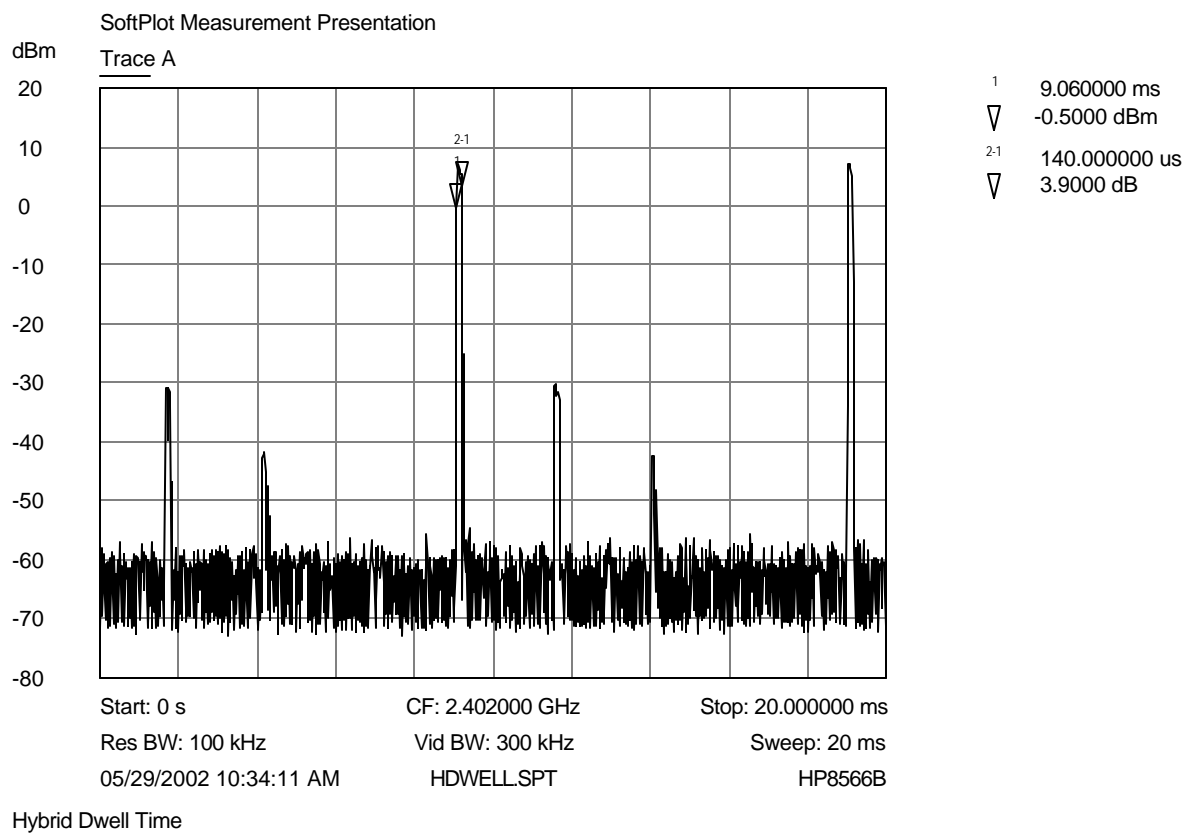
6.2.7 § 15.247 (f) Hybrid System:

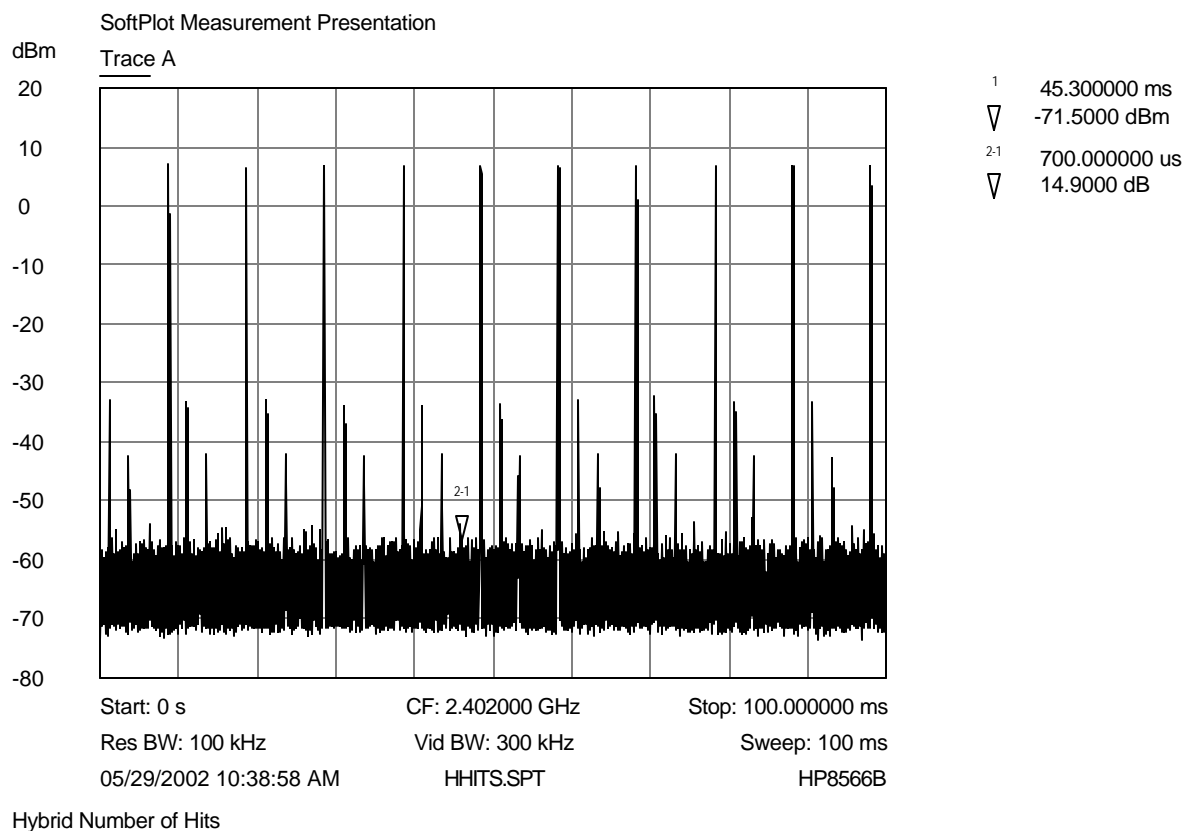
The SL-1022 has two modes of operation, Frequency Hopping mode (connection link) and Hybrid mode (page and inquiry acquisition). The page and inquiry acquisition functions operate under the provisions of this section. While in the Hybrid mode, the SL-1022 uses a hopping sequence consisting of 32 frequencies and the combined processing gain from the direct sequence and hopping operations is greater than 17 dB.

The frequency hopping operation of the SL-1022 with the direct sequence operation turned off does not exceed an average time of occupancy on any frequency greater than 0.4 seconds in a time span of 12.8 seconds (32 hopping frequencies x 0.4).

The direct sequence operation of the SL-1022 with the frequency hopping operation turned off does not exceed the peak power spectral density of 8 dBm in any 3 kHz band.

The SL-1022 uses an off-the-shelf chipset for the transceiver. Test results for the processing gain in the hybrid mode applicable to this device were uploaded as a separate exhibit. Refer to manufacturer's Exhibit 12 to review this data.





6.2.7 § 15.247 (g) and § 15.247 (h):

The SL-1022 is designed to comply with these sections; see technical description in manufacturer's Exhibit 12.

6.2.8 § 15.207 Line Conducted Emissions:

The frequency range from 450 kHz to 30 MHz was investigated to measure any AC line conducted emissions.

A diagram of the test configuration and the test equipment used is enclosed in Appendix 1. RBW = 10 kHz, VBW = 30 kHz

Line Conducted Data - (Hot Lead)

Frequency (MHz)	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)
0.57	Peak (Note 1)	42.4	48.0	-5.6
0.74	Peak (Note 1)	36.8	48.0	-11.2
5.40	Peak (Note 1)	36.9	48.0	-11.1
24.92	Peak (Note 1)	40.5	48.0	-7.5
26.43	Peak (Note 1)	41.2	48.0	-6.8
29.07	Peak (Note 1)	41.1	48.0	-6.9
<p>Note 1: The reference detector used for the measurements was peak or quasi-peak and the data was compared to the quasi-peak limit.</p> <p>Note 2: The reference detector used for the measurements were quasi-peak and average. The level of the emission measured using the quasi-peak detector was 6 dB, or more, higher than the level of the same emission measured with average detection; therefore, the quasi-peak level was reduced by 13 dB for comparison to the limits, as per FCC § 15.107 (d).</p>				

Line Conducted Data - (Neutral Lead)

Frequency (MHz)	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)
0.57	Peak (Note 1)	42.2	48.0	-5.8
5.56	Peak (Note 1)	36.9	48.0	-11.1
24.83	Peak (Note 1)	40.0	48.0	-8.0
25.64	Peak (Note 1)	41.2	48.0	-6.8
27.90	Peak (Note 1)	41.0	48.0	-7.0
<p>Note 1: The reference detector used for the measurements was peak or quasi-peak and the data was compared to the quasi-peak limit.</p> <p>Note 2: The reference detector used for the measurements were quasi-peak and average. The level of the emission measured using the quasi-peak detector was 6 dB, or more, higher than the level of the same emission measured with average detection; therefore, the quasi-peak level was reduced by 13 dB for comparison to the limits, as per FCC § 15.107 (d).</p>				

APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT**FCC Sections 15.247 (a)(1)(ii) Emission Bandwidth**

The EUT was directly connected to the spectrum analyzer via the antenna output port as shown in the block diagram below.

The measurements were performed on three channels, as per 47 CFR 15.31(m), one near the bottom of the spectrum, one near the middle of the spectrum and one near the top of the spectrum.

The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

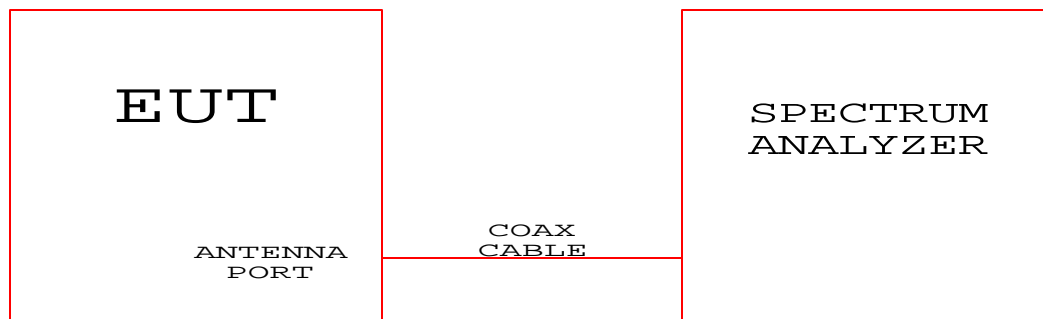
RBW = 10 kHz

VBW = 30 kHz

Type of Equipment	Manufacturer	Model Number	Serial Number
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	8565A	3107A01582
Low Loss Cable (1 dB)	N/A	N/A	N/A

All the equipment listed above is calibrated every 12 months by an independent calibration laboratory or by CCL personal following outlined calibration procedures.

Test Configuration Block Diagram

**FCC Sections 15.247 (b)(1) Peak Output Power**

The EUT was directly connected to the spectrum analyzer via the antenna output port as shown in the block diagram below.

The measurements were performed on three channels, as per 47 CFR 15.31(m), one near the bottom of the spectrum, one near the middle of the spectrum and one near the top of the spectrum.

The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

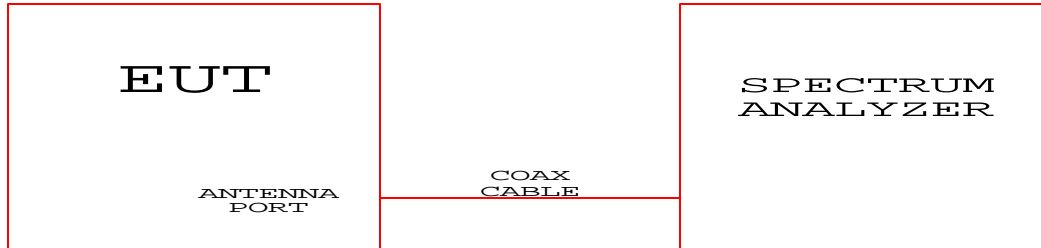
RBW = 3 MHz

VBW = 3 MHz

Type of Equipment	Manufacturer	Model Number	Serial Number
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	8565A	3107A01582
Low Loss Cable (1 dB)	N/A	N/A	N/A

All the equipment listed above is calibrated every 12 months by an independent calibration laboratory or by CCL personal following outlined calibration procedures.

Test Configuration Block Diagram



FCC Sections 15.247 (c) Spurious Emissions**Conducted Spurious Emissions**

The EUT was directly connected to the spectrum analyzer via the antenna output port as shown in the block diagram below.

The measurements were performed on three channels, as per 47 CFR 15.31(m), one near the bottom of the spectrum, one near the middle of the spectrum and one near the top of the spectrum.

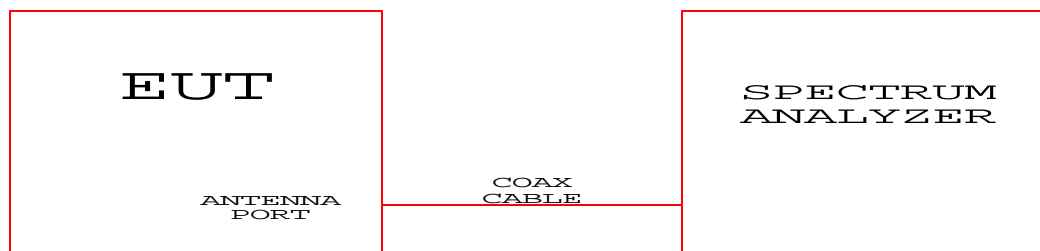
The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

RBW = 100 kHz

VBW = 300 kHz

Type of Equipment	Manufacturer	Model Number	Serial Number
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	8565A	3107A01582
Low Loss Cable (1 dB)	N/A	N/A	N/A

All the equipment listed above is calibrated every 12 months by an independent calibration laboratory or by CCL personal following outlined calibration procedures.

Test Configuration Block Diagram

Radiated Spurious Emissions in Restricted Bands:

The radiated emissions from the intentional radiator were measured using a spectrum analyzer with a quasi-peak adapter for peak and quasi-peak readings. An amplifier and preamplifier were used to increase the sensitivity of the measuring instrumentation. The quasi-peak adapter uses a bandwidth of 120 kHz, with the spectrum analyzer's resolution bandwidth set at 1 MHz, for readings in the 30 to 1000 MHz frequency ranges. For peak emissions above 1000 MHz the spectrum analyzer's resolution bandwidth was set to 1 MHz and the video bandwidth was set to 3 MHz. For average emissions above 1000 MHz the spectrum analyzer's resolution bandwidth was set to 1 MHz and the video bandwidth was set to 10 Hz.

A biconilog antenna was used to measure the frequency range of 30 to 1000 MHz and a Double Ridge Guide Horn antenna was used to measure the frequency range of 1 GHz to 18 GHz, and a Pyramidal Horn antenna was used to measure the frequency range of 18 GHz to 25 GHz, at a distance of 3 meters from the EUT. The readings obtained by these antennas are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors.

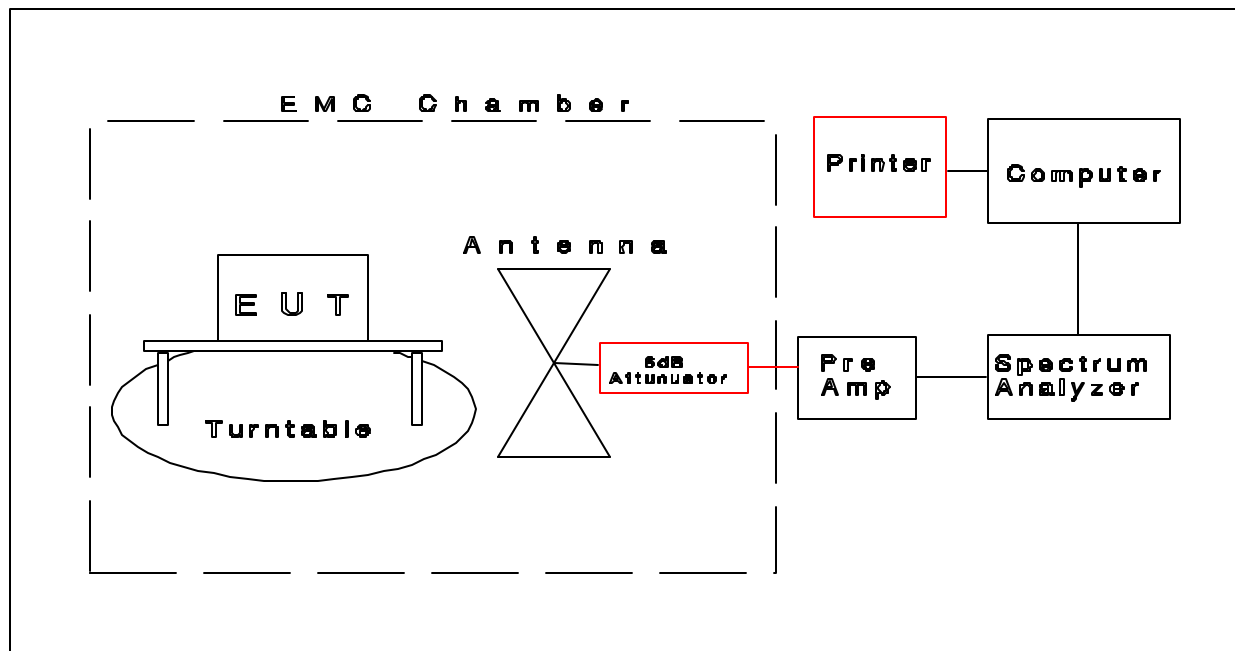
The configuration of the intentional radiator was varied to find the maximum radiated emission. The EUT was connected to the peripherals listed in Section 2.4 via the interconnecting cables listed in Section 2.5. These interconnecting cables were manipulated manually by a technician to obtain worst case radiated emissions. The intentional radiator was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Where there were multiple interface ports all of the same type, cables are either placed on all of the ports or cables added to these ports until the emissions do not increase by more than 2 dB.

Desktop intentional radiator is measured on a non-conducting table one meter above the ground plane. The table is placed on a turntable which is level with the ground plane. The turntable has slip rings, which supply AC power to the intentional radiator. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

Type of Equipment	Manufacturer	Model Number	Serial Number
Anechoic Chamber	CCL	N/A	N/A
Test Software	CCL	Radiated Emissions	Revision 1.3
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	8565A	3107A01582
Biconilog Antenna	EMCO	3141	1045
Double Ridged Guide Antenna	EMCO	3115	9409-4355
Pyramidal Horn Antenna	EMCO	3160-09	0003-1197
Harmonic Mixer	Hewlett Packard	11970K	3003A05756
Radiated Emissions Cable Anechoic Chamber	CCL	Cable B	N/A
Amplifier	Hewlett Packard	11975A	2738A02030
Pre-Amplifier	Hewlett Packard	8447D	1937A03151
Pre-Amplifier	Hewlett Packard	8449B	3008A00777
6 dB Attenuator	Hewlett Packard	8491A	32835

All the equipment listed above is calibrated every 12 months by an independent calibration laboratory or by CCL personal following outlined calibration procedures.

R a d i a t e d E m i s s i o n s T e s t



FCC Sections 15.207 AC Line Conducted Emissions:

The conducted disturbance at mains ports from the ITE was measured using a spectrum analyzer with a quasi-peak adapter for peak, quasi-peak and average readings. The quasi-peak adapter uses a bandwidth of 9 kHz, with the spectrum analyzer's resolution bandwidth set at 100 kHz, for readings in the 450 kHz to 30 MHz frequency ranges.

The conducted disturbance at mains ports measurements are performed in a screen room using a (50 Ω /50 μ H) Line Impedance Stabilization Network (LISN).

Where mains flexible power cords are longer than 1 m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4 m in length.

Where the EUT is a collection of ITE with each ITE having its own power cord, the point of connection for the LISN is determined from the following rules:

- Each power cord, which is terminated in a mains supply plug, shall be tested separately.
- Power cords, which are not specified by the manufacturer to be connected via a host unit, shall be tested separately.
- Power cords which are specified by the manufacturer to be

connected via a host unit or other power supplying equipment shall be connected to that host unit and the power cords of that host unit connected to the LISN and tested.

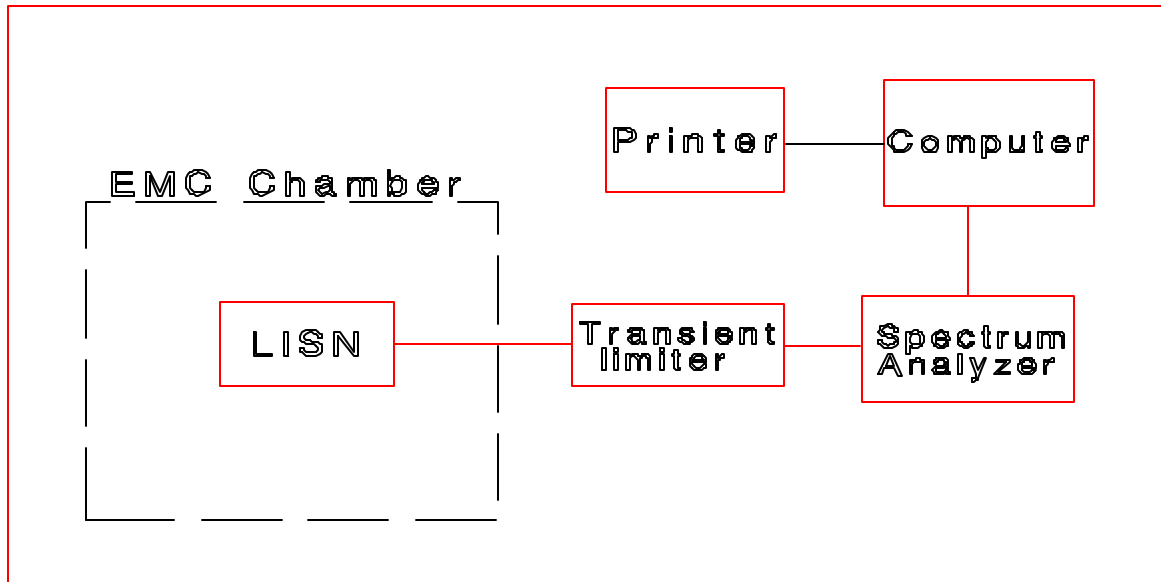
- d) Where a special connection is specified, the necessary hardware to effect the connection is supplied by the manufacturer for the testing purpose.
- e) When testing equipment with multiple mains cords, those cords not under test are connected to an artificial mains network (AMN) different than the AMN used for the mains cord under test.

Desktop ITE are placed on a non-conducting table at least 0.8 meters from the metallic floor. The equipment is placed a minimum of 40 cm from all walls. Floor standing equipment is placed directly on the earth grounded floor.

Type of Equipment	Manufacturer	Model Number	Serial Number
Anechoic Chamber Test Site #2	CCL	N/A	N/A
Test Software	CCL	Conducted Emissions	Revision 1.2
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	8565A	3107A01582
LISN	EMCO	3825/2	9307-1893
Conductance Cable Anechoic Chamber	CCL	Cable A	N/A
Transient Limiter	Hewlett Packard	11947A	3107A00895

An independent calibration laboratory or CCL personal calibrates all the equipment listed above every 12 months following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

Line Conducted Emissions Test



APPENDIX 2 Photographs

Front View of Radiated Test Setup



Back View Of Radiated Test Setup



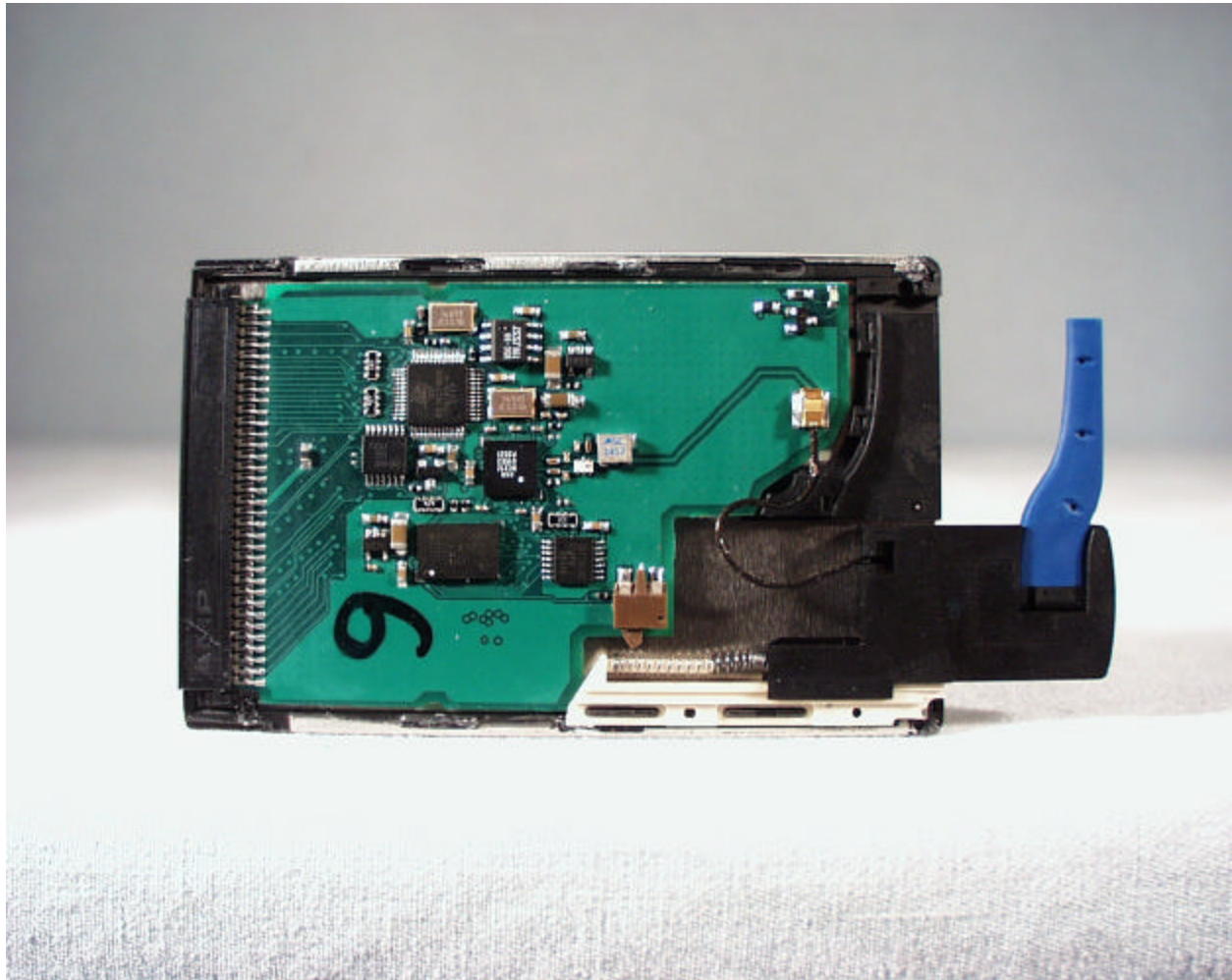
Top View of the SL-1022



Back View of the SL-1022



Component Side of the SL-1022 PCB



Back Side of the SL-1022 PCB

