

TEST REPORT FROM:

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

Type of Report: Certification

TEST OF: 0920

FCC ID: PY20920

To FCC PART 15.247, Subpart C

Test Report Serial No: 73-7720

Applicant:

Graviton, Inc.
11025 North Torrey Pines Road
Suite 200
La Jolla, CA 92037

Date(s) of Test: March 1st & 4th, 2002

Issue Date: March 15, 2002

Equipment Receipt Date: March 1, 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: Graviton, Inc.
- Manufacturer: Graviton, Inc.
- Brand Name: Graviton
- Model Number: 0920
- FCC ID: PY20920

On this 15th day of March, 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 RESPONSIBLE PARTY:

1.1 Applicant:

Company Name: Graviton, Inc.
11025 North Torrey Pines Road
Suite 200
La Jolla, CA 92037

Contact Name: Don Hohnstein
Title: Director

1.2 Manufacturer:

Company Name: Graviton, Inc.
11025 North Torrey Pines Road
Suite 200
La Jolla, CA 92037

Contact Name: Don Hohnstein
Title: Director

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

Trade Name: Graviton
Model Name or Number: 0920
Serial Number: N/A
Country of Manufacture: U.S.A.

2.2 Description of EUT:

The 0920 consists of at least two transievers. One transiever is connected to each battery cell in a battery backup system and monitors the health of the backup system. The 0920 measure voltage, current and temperature and transmit the data every 15 minutes using a 2.4GHz direct sequence spread spectrum (DSSS) radio. The battery data is received by the second tranceiver, that provides a radio to serial (PC) interface.

This report covers the transmitter portion of the device only the receiver/computer peripheral is 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 Serial No.	FCC ID Number	Description	Name of Interface Ports / Interface Cables
BN: Graviton MN: 0920 (1)	PY20920	2.4 GHz Tranciever	See Sec 2.5.
BN: Micron MN: NBKV370	DOC	Laptop Computer	Serial / 2 foot serial cable

Note: (1) EUT.
(2) Interface port connected to EUT (See Section 2.4)
(3) Mouse cable permanently attached.
(4) Monitor's attached video cable includes
manufacturer-supplied ferrite.

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

2.5 Interface Ports on EUT:

Name of Port	No. of Ports Fitted to EUT.	Cable Descriptions/Length
Antenna	1	Soldered directly to PCB
Serial	1	Mini serial to RS232 / 2 foot

2.6 Channels of Operation:

The 0920 operates on the following channels:

Channel Number	Channel Frequency (MHz)	Channel Number	Channel Frequency (MHz)
1	2401.50	27	2440.50
2	2403.00	28	2442.00
3	2404.50	29	2443.50
4	2406.00	30	2445.00
5	2407.50	31	2446.50
6	2409.00	32	2448.00
7	2410.50	33	2449.50
8	2412.00	34	2451.00
9	2413.50	35	2452.50
10	2415.00	36	2454.00
11	2416.50	37	2455.50
12	2418.00	38	2457.00
13	2419.50	39	2458.50
14	2421.00	40	2460.00
15	2422.50	41	2461.50
16	2424.00	42	2463.00
17	2425.50	43	2464.50
18	2427.00	44	2466.00
19	2428.50	45	2467.50
20	2430.00	46	2469.00
21	2431.50	47	2470.50
22	2433.00	48	2472.00
23	2434.50	49	2473.50
24	2436.00	50	2475.00
25	2437.50	51	2476.50
26	2439.00	52	2478.00

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 transmitting 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 the 5725 - 5850 MHz bands shall use at least 75 hopping frequencies. The maximum allowed 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.

(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 operating in the 2400 - 2483.5 MHz or 5725 - 5850 MHz band and for all direct sequence systems: 1 watt.

(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 show 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, omnidirectional applications, and multiple co-located 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 the 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 Sec. 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 any 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 levels 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 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 passband 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. This 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 transmission over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopset to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

NOTE: Spread spectrum systems are sharing these bands on a non-interference basis with systems supporting critical Government requirements that have been allocated the usage of these bands, secondary only to ISM equipment operated under the provisions of part 18 of this chapter. Many of these Government systems are airborne radiolocation systems that emit a high EIRP, which can cause interference to other users. Also, investigations of the effect of spread spectrum interference to U.S. Government operations in the 902-928 MHz band may require a future decrease in the power limits allowed

for spread spectrum operation.

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 the 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 quasi-peak detector function: If the level of the emission measured using the quasi-peak 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 quasi-peak 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 of 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 operation 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 systems 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 μ V 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, 15.225 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 provision for, the

use of battery chargers which permit operation 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 1, 1999 (31040/SIT).

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 that is 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: 120 VAC /12 VDC
AC Mains Frequency: 60 Hz / N/A

4.2 Operating Modes:

Each mode of operation was exercised to produce worst case emissions. The worst case emissions were with the 0920 running in the following mode. The 0920 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 0920 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)(2)	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 (d)	Power Spectral Density	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.

The 0920 can operate on 52 channels from 2401.5 MHz to 2478.0 MHz; therefore, the 0920 was tested on three different channels (2401.5 MHz, 2439.0 MHz and 2478.0 MHz), the results for each channel are shown below.

6.2 Test Results**6.2.1 § 15.247 (a) (2)****Measurement Data Emission Bandwidth:**

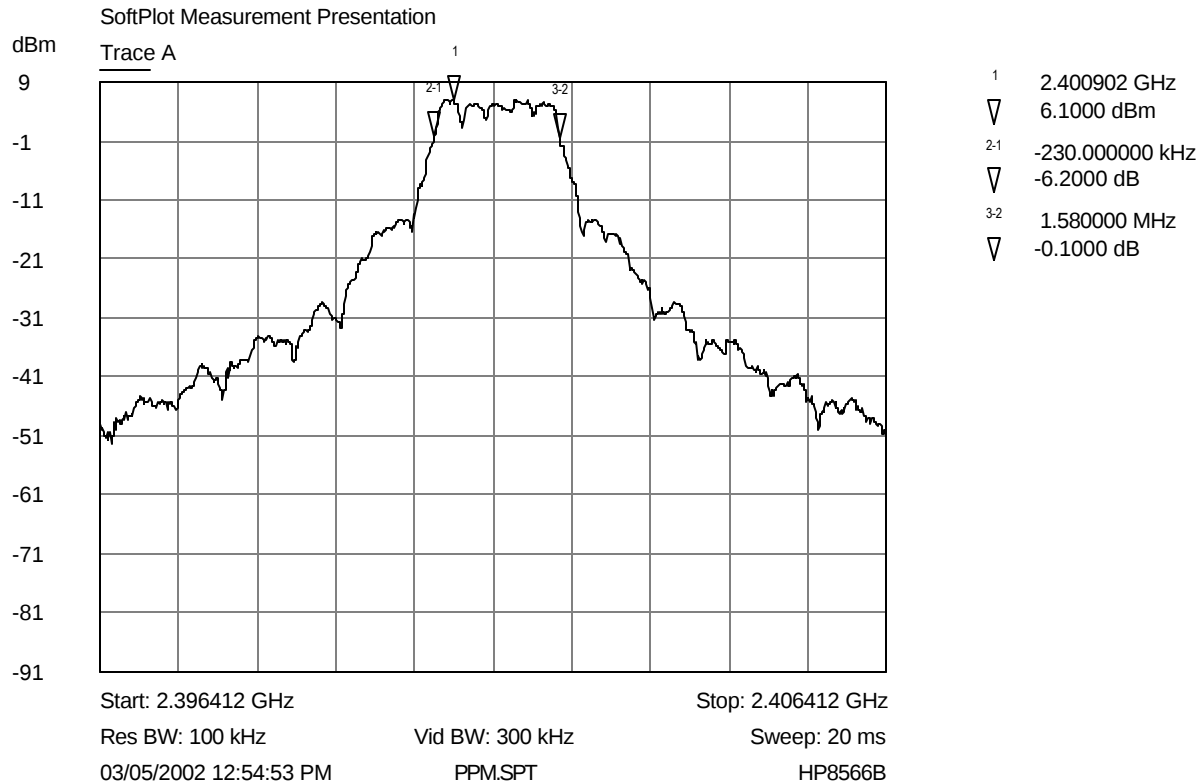
A diagram of the test configuration and the test equipment used is enclosed in Appendix 1.

Frequency (MHz)	Emission Bandwidth (MHz)
2401.5	1.58
2439.0	1.62
2478.0	1.70

RESULT

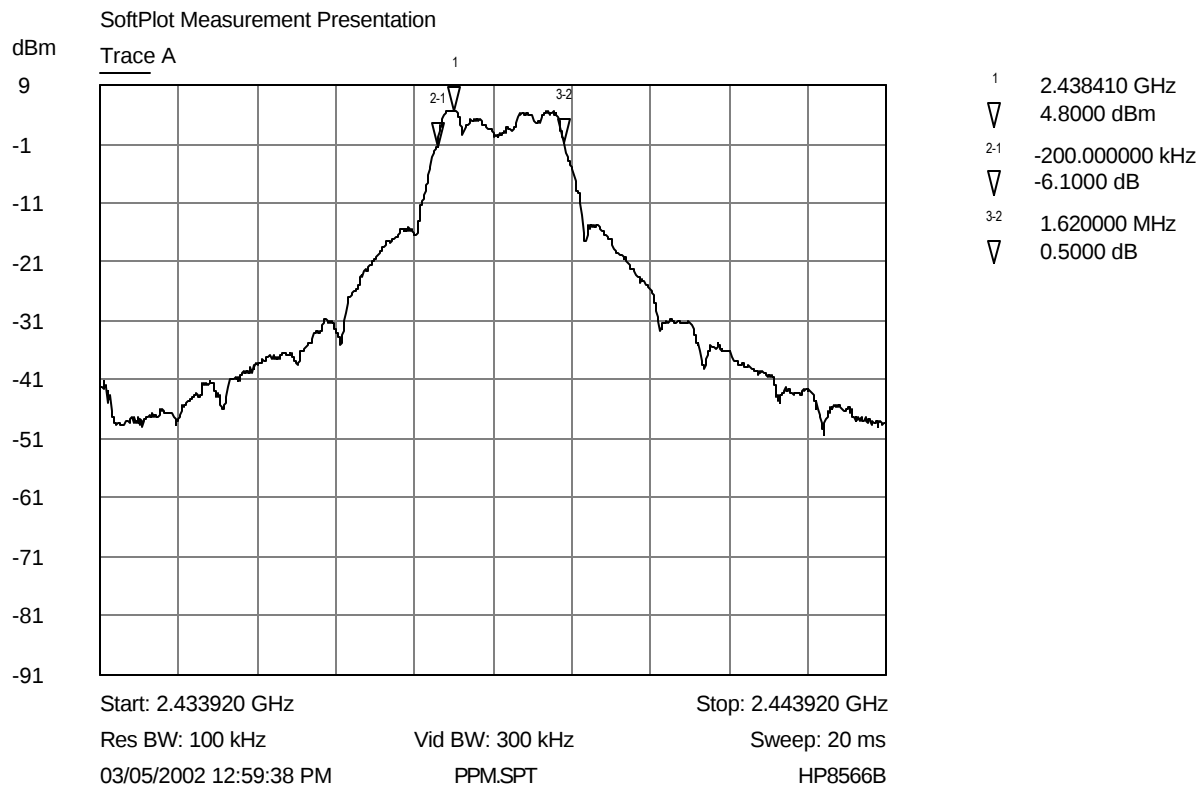
In the configuration tested, the 6 dB bandwidth was greater than 500 kHz; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).

Emission Bandwidth Plot (Low Channel)



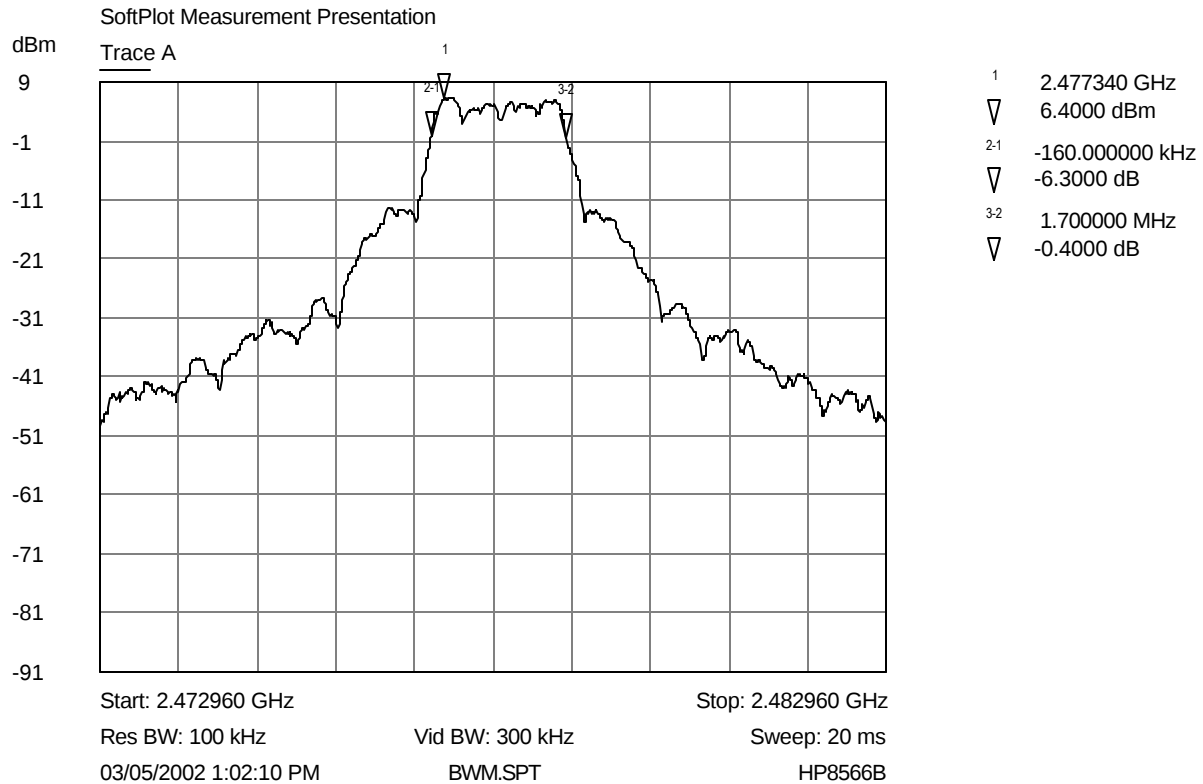
Emission Bandwidth Channel #2

Emission Bandwidth Plot (Center Channel)



Emission Bandwidth Channel #27

Emission Bandwidth Plot (Upper Channel)



Emission Bandwidth Channel #53

6.2.2 § 15.247 (b) Peak Output Power:**Measurement Data:**

The maximum peak RF Conducted output power measured for this device was 11.4 mW or 10.6 dBm. The maximum antenna gain is 0 dBi; therefore, the EIRP for this device is 11.4 mW or 10.6 dBm. Shown below is the measured peak output power. The maximum directional gain of the antenna is less than 6 dBi; therefore, reduction of the output power limit is not required.

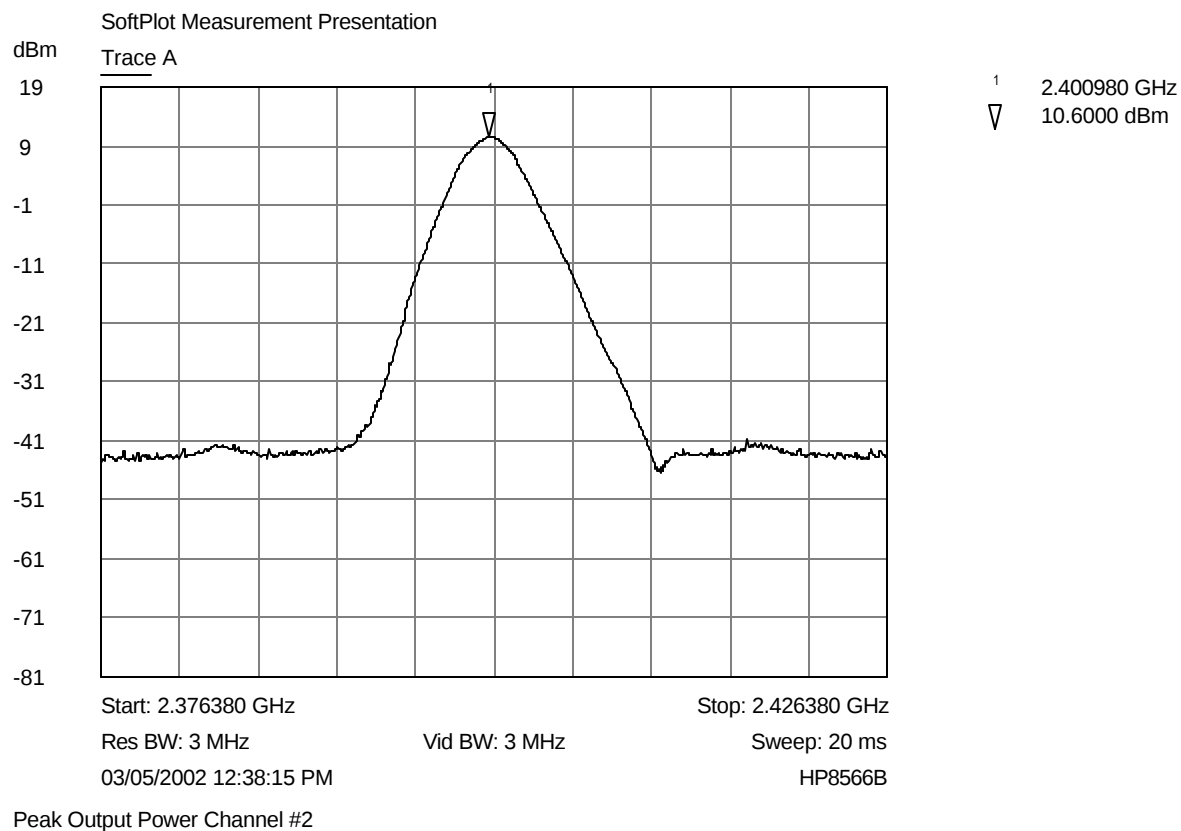
A diagram of the test configuration and the test equipment used is enclosed in Appendix 1.

Frequency (MHz)	Measured Output Power (dBm)	Measured Output Power (mW)
2401.5	10.6	11.4
2439.0	8.9	7.7
2478.0	9.9	9.7

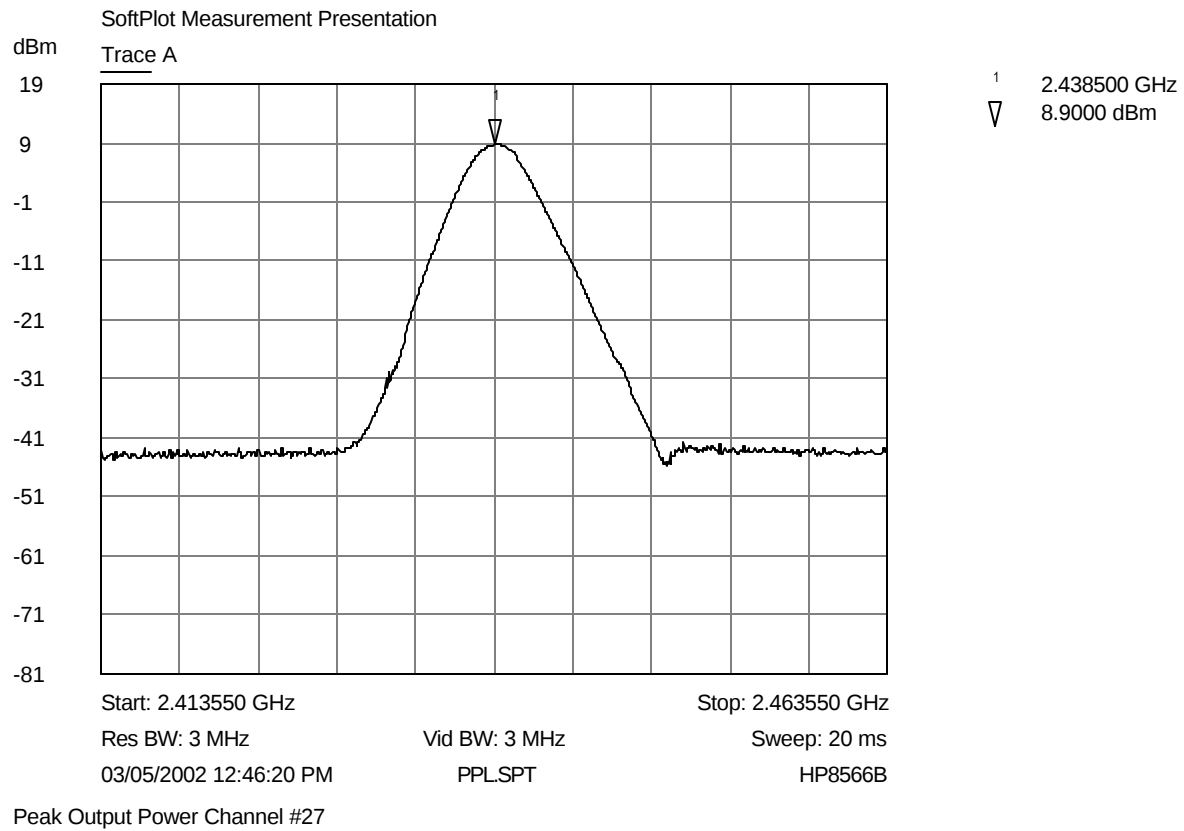
RESULT

In the configuration tested, the peak conducted power output was less than 1 W (30 dBm); therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).

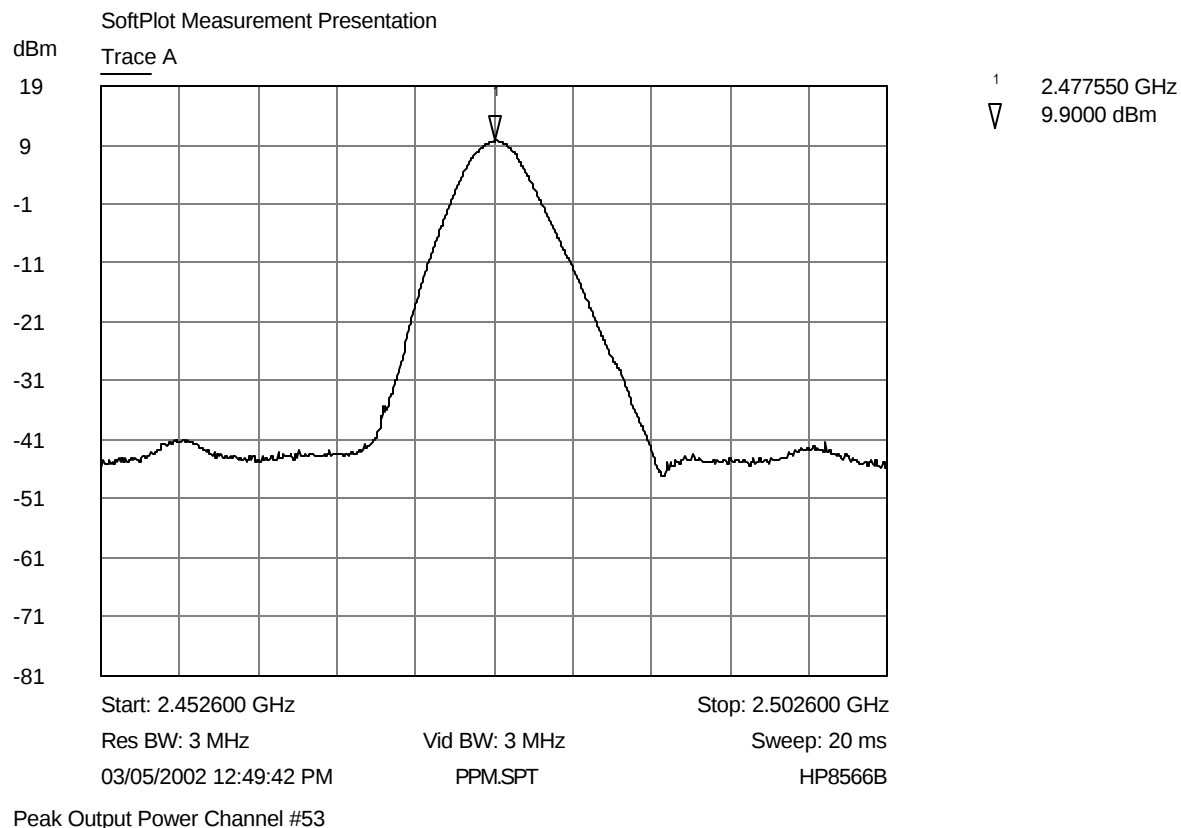
Peak Output Power (Low Channel)



Peak Output Power (Center Channel)



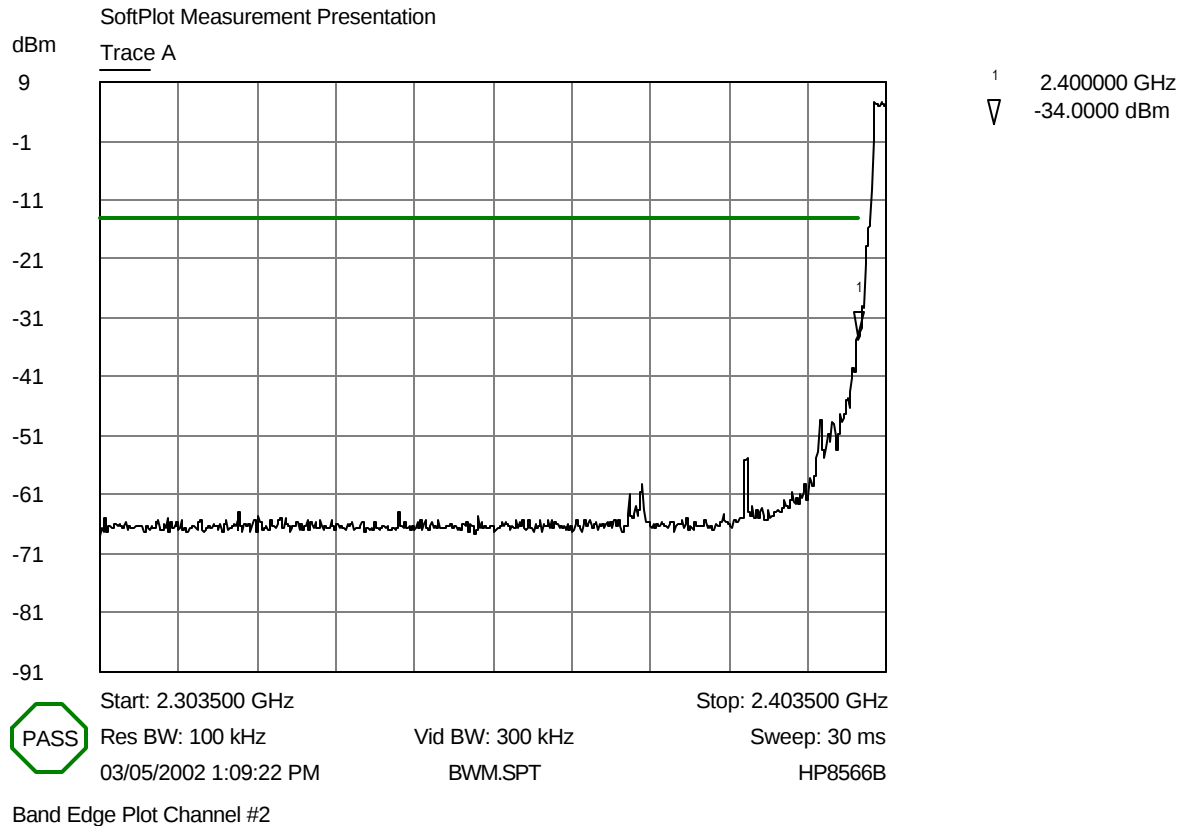
Peak Output Power (Upper Channel)

**6.2.3 § 15.247 (c) Spurious Emissions:****Measurement Data Antenna Conducted Emissions:**

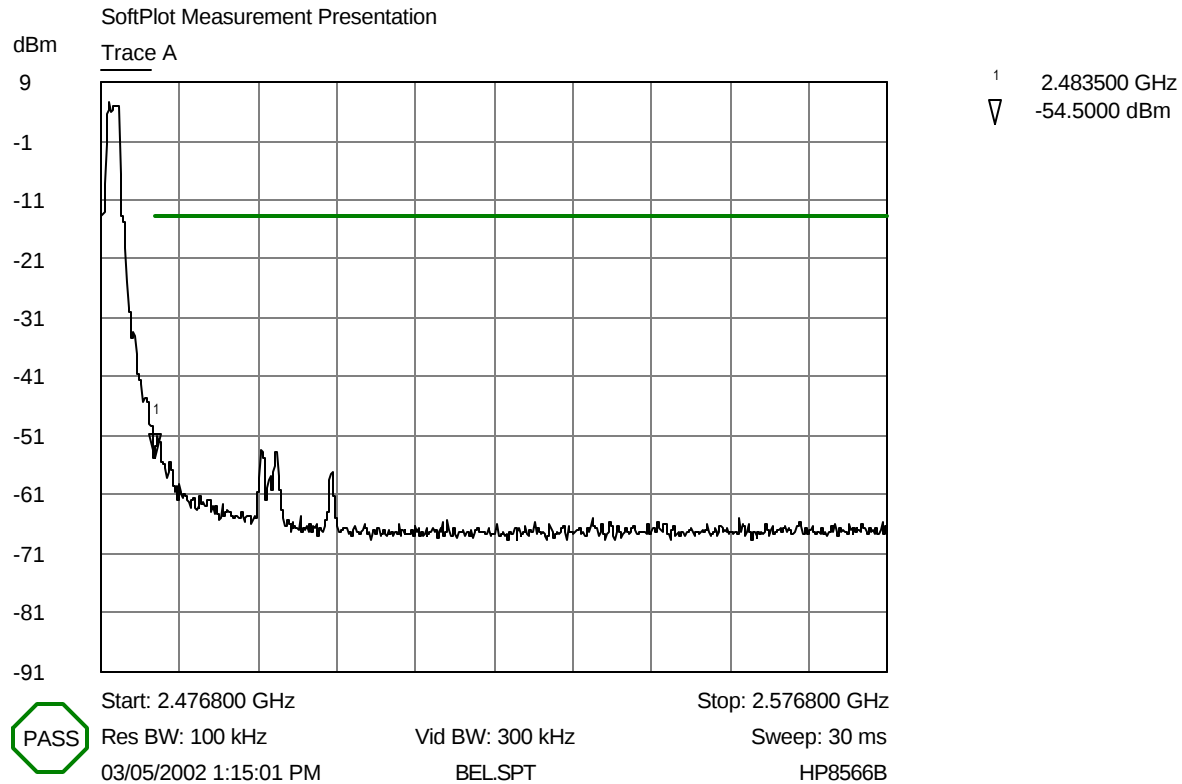
The frequency range from 10 MHz to the tenth harmonic of the highest fundamental frequency was investigated to measure any antenna-conducted emissions. Shown below are plots with the EUT tuned to the upper and lower channels. These demonstrate compliance with the provisions of this section.

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

Band Edge Plot (Low end of Band)



Band Edge Plot (Upper end of Band)



Band Edge Plot Channel #53

The emissions must be attenuated 20 dB below the highest power level measured; therefore, the criteria is $6.0 - 20.0 = -14.0$ dBm.

Transmitting at 2401.5 MHz			
Frequency Range MHz	Frequency MHz	Corrected Level dBm	Criteria dBm
10 - 200	113.4	-75.2	-14.0
200 - 1000	592.0	-47.2	-14.0
1000 - 2000	1796.0	-32.2	-14.0
2000 - 2399.9	2399.9	-39.4	-14.0
2483.6 - 4000	2490.0	-66.8	-14.0
4000 - 6000	4806.0	-57.5	-14.0
6000 - 8000	7204.0	-59.8	-14.0
8000 - 11,000	10988.0*	-71.2	-14.0
11,000 - 13,000	12914.0*	-67.9	-14.0
13,000 - 15,000	13870.0*	-67.2	-14.0
15,000 - 17,000	16262.0*	-65.3	-14.0
17,000 - 20,000	19934.0*	-62.6	-14.0
20,000 - 23,000	22550.0*	-61.1	-14.0
23,000 - 25,000	23740.0*	-59.0	-14.0
* Noise Floor			

The emissions must be attenuated 20 dB below the highest power level measured; therefore, the criteria is $4.6 - 20.0 = -15.4$ dBm.

Transmitting at 2439.0 MHz			
Frequency Range MHz	Frequency MHz	Corrected Level dBm	Criteria dBm
10 - 200	73.1	-65.8	-15.4
200 - 1000	629.6	-57.3	-15.4
1000 - 2000	1853.0	-57.3	-15.4
2000 - 2399.9	2399.1	-60.6	-15.4
2483.6 - 4000	2491.0	-60.4	-15.4
4000 - 6000	4880.0	-57.8	-15.4
6000 - 8000	7320.0	-54.7	-15.4
8000 - 11,000	8750.0*	-71.2	-15.4
11,000 - 13,000	12922.0*	-67.3	-15.4
13,000 - 15,000	14148.0*	-66.6	-15.4
15,000 - 17,000	15450.0*	-65.8	-15.4
17,000 - 20,000	19517.0*	-62.6	-15.4
20,000 - 23,000	20777.0*	-60.9	-15.4
23,000 - 25,000	23128.0*	-58.8	-15.4
* Noise Floor			

The emissions must be attenuated 20 dB below the highest power level measured; therefore, the criteria is $6.4 - 20.0 = -13.6$ dBm.

Transmitting at 2478.0 MHz			
Frequency Range MHz	Frequency MHz	Corrected Level dBm	Criteria dBm
10 - 200	190.9	-33.5	-13.6
200 - 1000	668.0	-45.5	-13.6
1000 - 2000	1912.0	-36.2	-13.6
2000 - 2399.9	2387.9	-69.4	-13.6
2483.6 - 4000	2484.0	-52.4	-13.6
4000 - 6000	4960.0	-57.0	-13.6
6000 - 8000	7440.0	-54.8	-13.6
8000 - 11,000	9620.0*	-70.6	-13.6
11,000 - 13,000	12992.0*	-67.7	-13.6
13,000 - 15,000	13008.0*	-66.9	-13.6
15,000 - 17,000	15268.0*	-66.3	-13.6
17,000 - 20,000	19598.0*	-63.0	-13.6
20,000 - 23,000	21677.0*	-61.6	-13.6
23,000 - 25,000	23576.0*	-58.9	-13.6
* 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.

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

Vertical Polarity

Transmitting at 2401.5 MHz						
Frequency MHz	Receiver Reading dBμV	Correction Factor dB	Average Factor dB	Corrected Reading dBμV/m	Limit dBμV/m	Margin dB
2483.5 P*	49.9	-3.6	0.0	46.3	74.0	-27.7
2483.5 A*	39.1	-3.6	0.0	35.5	54.0	-18.5
4803.0 P	56.2	1.4	0.0	57.6	74.0	-16.4
4803.0 A	51.1	1.4	0.0	52.5	54.0	-1.5
12007.5 P*	45.8	9.1	0.0	54.9	74.0	-19.1
12007.5 A*	33.0	9.1	0.0	42.1	54.0	-11.9
19212.0 P*	54.8	10.3	0.0	55.1	74.0	-18.9
19212.0 A*	42.2	10.3	0.0	52.5	54.0	-1.5
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						

Transmitting at 2439.0 MHz						
Frequency MHz	Receiver Reading dBμV	Correction Factor dB	Average Factor dB	Corrected Reading dBμV/m	Limit dBμV/m	Margin dB
2483.5 P*	47.4	-3.6	0.0	43.8	74.0	-30.2
2483.5 A*	35.1	-3.6	0.0	31.5	54.0	-22.5
4878.0 P	53.2	1.6	0.0	54.8	74.0	-19.2
4878.0 A	48.8	1.6	0.0	50.4	54.0	-3.6
7317.0 P	49.6	4.6	0.0	54.2	74.0	-19.8
7317.0 A	41.6	4.6	0.0	46.2	54.0	-7.8
12195.0 P*	46.0	9.1	0.0	55.1	74.0	-18.9
12195.0 A*	33.4	9.1	0.0	42.5	54.0	-11.5
19512.0 P*	54.8	10.3	0.0	55.1	74.0	-18.9

Transmitting at 2439.0 MHz						
Frequency MHz	Receiver Reading dBµV	Correction Factor dB	Average Factor dB	Corrected Reading dBµV/m	Limit dBµV/m	Margin dB
19512.0 A*	42.2	10.3	0.0	52.5	54.0	-1.5

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

Transmitting at 2478.0 MHz						
Frequency MHz	Receiver Reading dBµV	Correction Factor dB	Average Factor dB	Corrected Reading dBµV/m	Limit dBµV/m	Margin dB
2483.5 P	66.6	-3.6	0.0	63.0	74.0	-11.0
2483.5 A	51.8	-3.6	0.0	48.2	54.0	-5.8
4956.0 P	51.8	1.9	0.0	53.7	74.0	-20.3
4956.0 A	48.0	1.9	0.0	49.9	54.0	-4.1
7434.0 P	47.7	4.9	0.0	52.6	74.0	-21.4
7434.0 A	37.6	4.9	0.0	42.5	54.0	-11.5
12390.0 P*	46.0	9.1	0.0	55.1	74.0	-18.9
12390.0 A*	33.4	9.1	0.0	42.5	54.0	-11.5
19824.0 P*	54.8	10.3	0.0	55.1	74.0	-18.9
19824.0 A*	42.2	10.3	0.0	52.5	54.0	-1.5
22302.0 P*	54.1	11.2	0.0	65.3	74.0	-8.7
22302.0 A*	41.4	11.2	0.0	52.6	54.0	-1.4
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						

Horizontal Polarity

Transmitting at 2401.5 MHz						
Frequency MHz	Receiver Reading dBμV	Correction Factor dB	Average Factor dB	Corrected Reading dBμV/m	Limit dBμV/m	Margin dB
2483.5 P*	46.5	-3.6	0.0	42.9	74.0	-31.1
2483.5 A*	34.2	-3.6	0.0	30.6	54.0	-23.4
4803.0 P	51.8	1.4	0.0	53.2	74.0	-20.8
4803.0 A	47.8	1.4	0.0	49.2	54.0	-4.8
12007.5 P*	46.0	9.1	0.0	55.1	74.0	-18.9
12007.5 A*	33.4	9.1	0.0	42.5	54.0	-11.5
19212.0 P*	54.8	10.3	0.0	55.1	74.0	-18.9
19212.0 A*	42.2	10.3	0.0	52.5	54.0	-1.5
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						

Transmitting at 2439.0 MHz						
Frequency MHz	Receiver Reading dBμV	Correction Factor dB	Average Factor dB	Corrected Reading dBμV/m	Limit dBμV/m	Margin dB
2483.5 P*	48.3	-3.6	0.0	44.7	74.0	-29.3
2483.5 A*	35.8	-3.6	0.0	32.2	54.0	-21.8
4878.0 P	51.0	1.6	0.0	52.7	74.0	-21.3
4878.0 A	47.1	1.6	0.0	48.8	54.0	-5.2
7317.0 P	48.6	4.6	0.0	53.2	74.0	-20.8

Transmitting at 2439.0 MHz						
Frequency MHz	Receiver Reading dBμV	Correction Factor dB	Average Factor dB	Corrected Reading dBμV/m	Limit dBμV/m	Margin dB
7317.0 A	37.6	4.6	0.0	42.2	54.0	-11.8
12195.0 P*	46.0	9.1	0.0	55.1	74.0	-18.9
12195.0 A*	33.4	9.1	0.0	42.5	54.0	-11.5
19512.0 P*	54.8	10.3	0.0	55.1	74.0	-18.9
19512.0 A*	42.2	10.3	0.0	52.5	54.0	-1.5
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						

Transmitting at 2478.0 MHz						
Frequency MHz	Receiver Reading dBμV	Correction Factor dB	Average Factor dB	Corrected Reading dBμV/m	Limit dBμV/m	Margin dB
2483.5 P	56.1	-3.6	0.0	52.5	74.0	-21.5
2483.5 A	43.3	-3.6	0.0	39.7	54.0	-14.3
4956.0 P	50.8	1.9	0.0	52.7	74.0	-21.3
4956.0 A	46.3	1.9	0.0	48.2	54.0	-5.8
7434.0 P	47.0	4.9	0.0	51.9	74.0	-22.1
7434.0 A	35.1	4.9	0.0	40.0	54.0	-14.0
12390.0 P*	46.0	9.1	0.0	55.1	74.0	-18.9
12390.0 A*	33.4	9.1	0.0	42.5	54.0	-11.5
19824.0 P*	54.8	10.3	0.0	55.1	74.0	-18.9
19824.0 A*	42.2	10.3	0.0	52.5	54.0	-1.5
22302.0 P*	54.1	11.2	0.0	65.3	74.0	-8.7
22302.0 A*	41.4	11.2	0.0	52.6	54.0	-1.4
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.

6.2.4 § 15.247 (d) Power Spectral Density:

Measurement Data:

The maximum power spectral density measured for this device was -1.8 dBm. Shown below is the measured power spectral density.

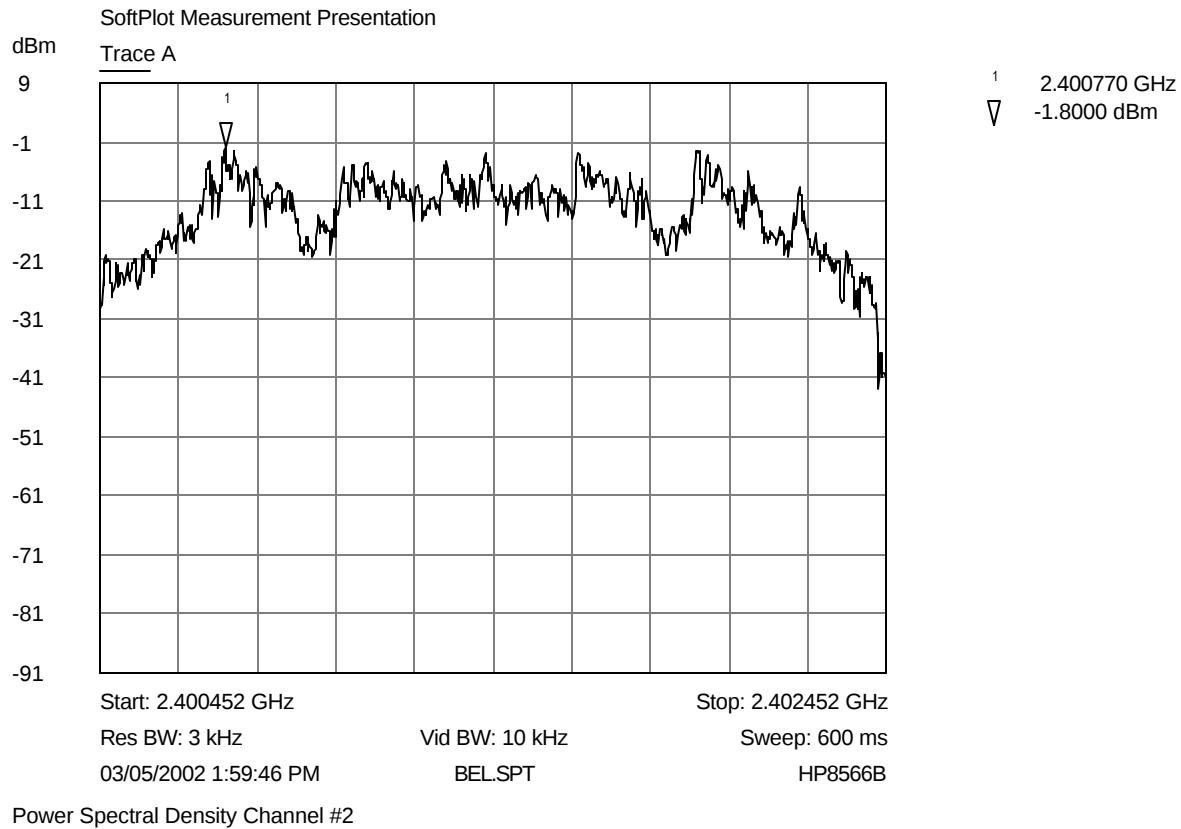
A diagram of the test configuration and the test equipment used is enclosed in Appendix 1.

Frequency (MHz)	Measured Power Spectral Density (dBm)
2401.5	-1.8
2437.0	-4.4
2462.0	-2.8

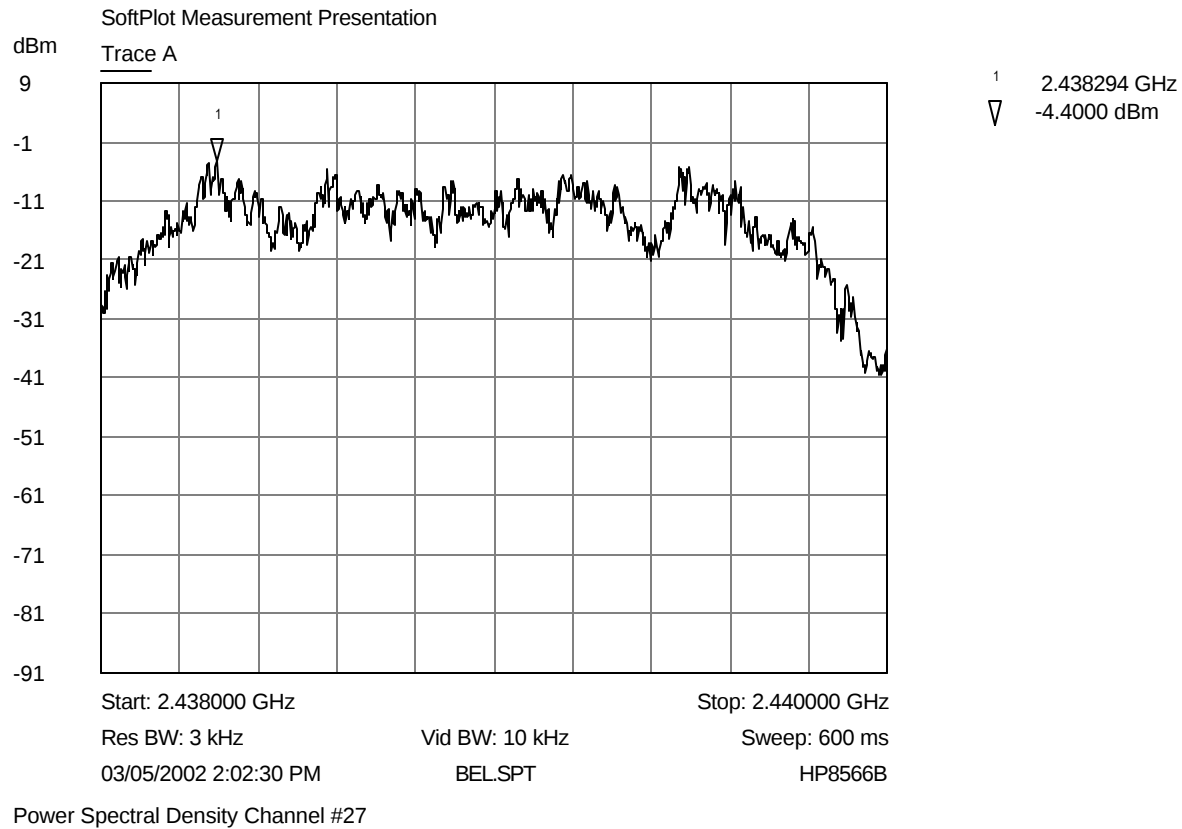
RESULT

In the configuration tested, the peak power spectral density was less than 8 dBm; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).

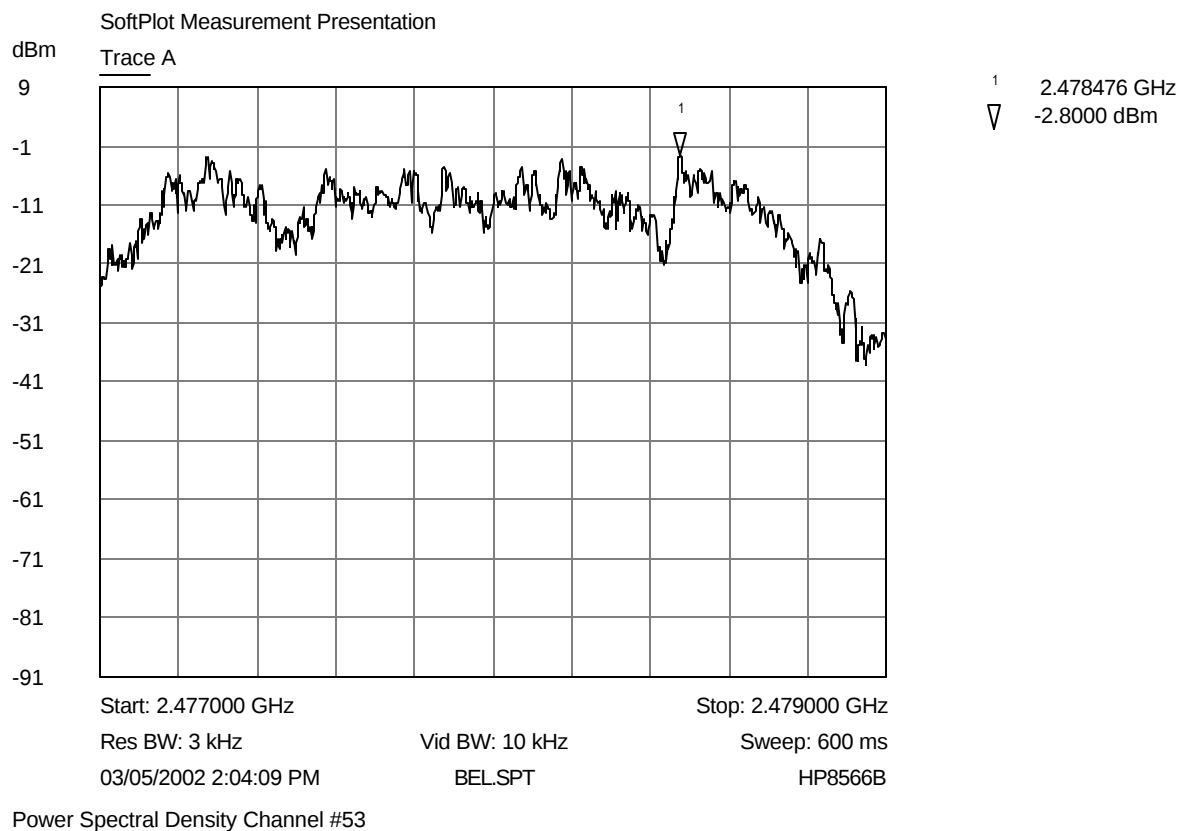
Power Spectral Density Plot (Low Channel)



Power Spectral Density Plot (Middle Channel)



Power Spectral Density Plot (High Channel)



6.2.5 § 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.

Line Conducted Data - (Hot Lead)

Frequency MHz	Detector	Measured Level dB μ V	Class B Limit dB μ V
0.60	Peak	42.3	48.0
0.62	Peak	42.9	48.0
0.71	Peak	44.2	48.0
0.73	Peak	41.8	48.0
0.83	Peak	37.7	48.0
0.94	Peak	34.2	48.0
22.17	Peak	24.8	48.0
24.06	Peak	47.7	48.0

Line Conducted Data - (Neutral Lead)

Frequency MHz	Detector	Measured Level dB μ V	Limit dB μ V
0.51	Peak	35.0	48.0
0.60	Peak	42.8	48.0
0.64	Peak	43.9	48.0
0.80	Peak	40.0	48.0
0.97	Peak	35.1	48.0
1.16	Peak	31.2	48.0
22.17	Peak	24.6	48.0
24.06	Peak	47.5	48.0

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.

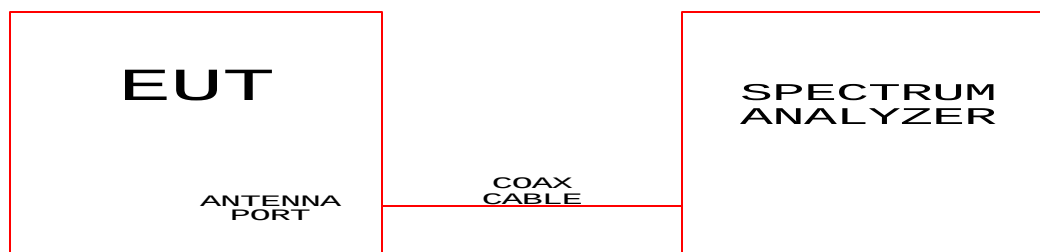
The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

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:

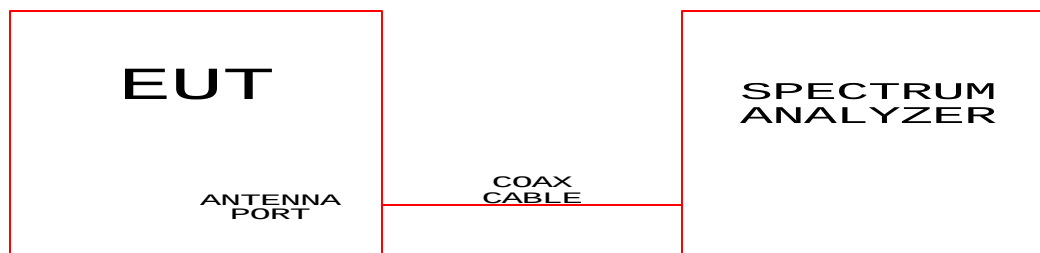
RBW = 3 MHz

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.

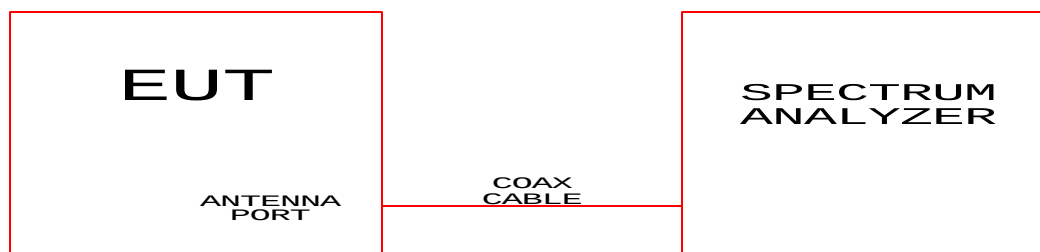
The spectrum analyzer's resolution bandwidth and video bandwidth were set as follows:

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 emission from the intentional radiator was measured using a spectrum analyzer with a quasi-peak adapter for peak and quasi-peak readings. A preamplifier with a fixed gain of 26 dB and a power amplifier with a fixed gain of 22 dB 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.

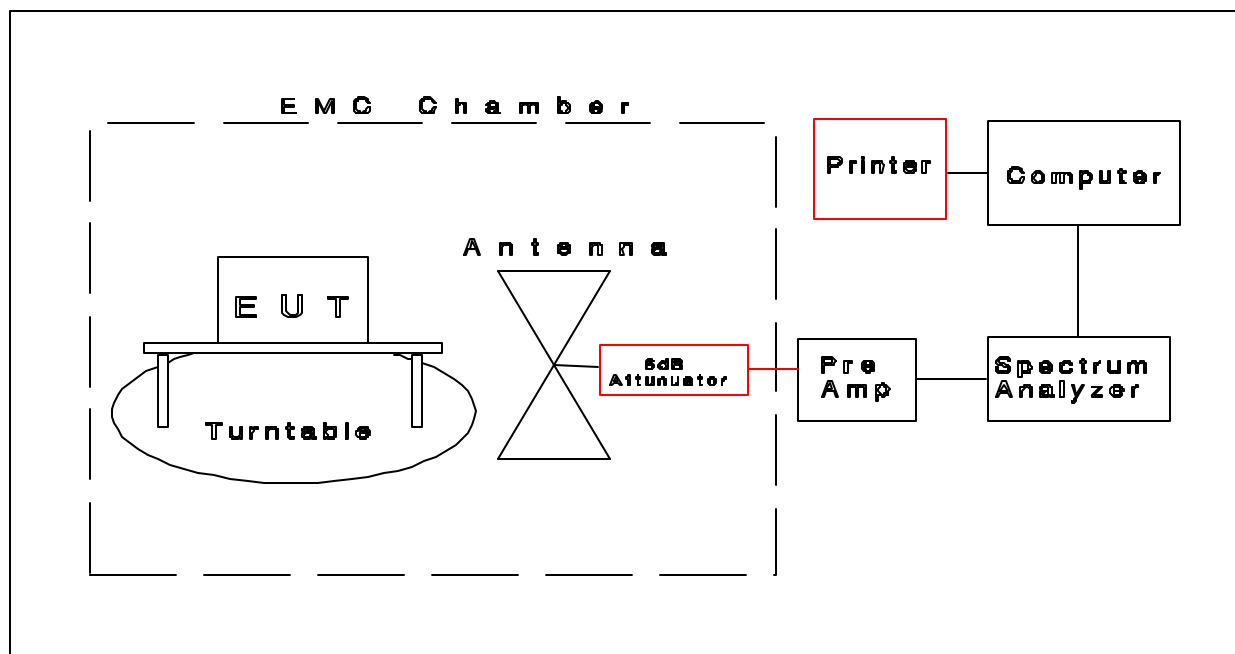
The configuration of the intentional radiator was varied to find the maximum radiated emission. The EUT was connected to the peripherals listed in Section 2.4 via the interconnecting cables listed in Section 2.5. These interconnecting cable were manipulated manually by a technician to obtain worst case 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

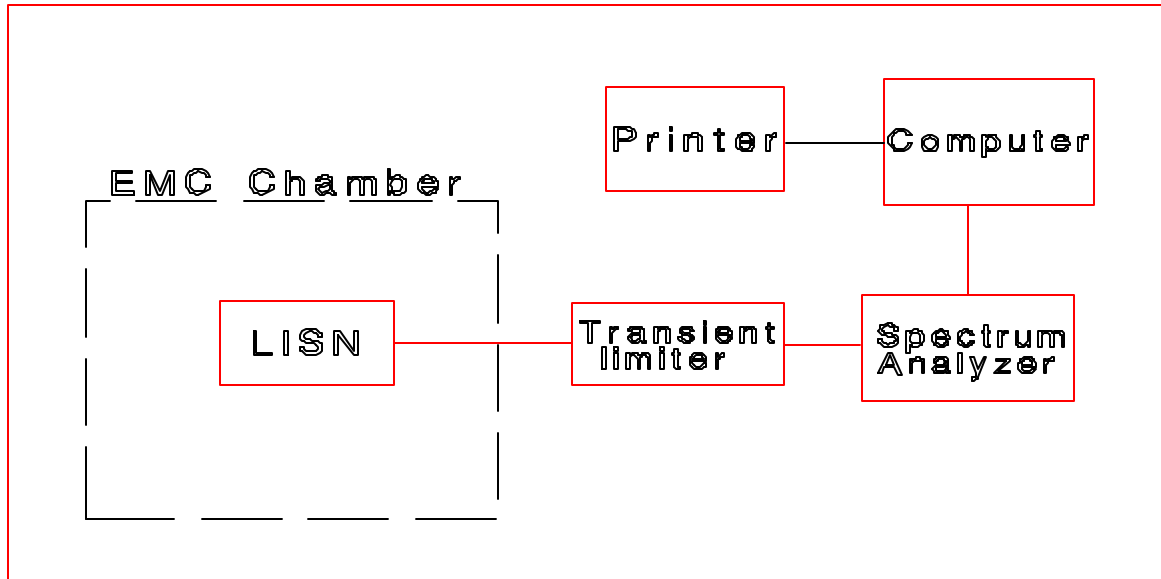
- equipment
- d) shall be connected to that host unit and the power cords of that host unit connected to the LISN and tested.
 - e) Where a special connection is specified, the necessary hardware to effect the connection is supplied by the manufacturer for the testing purpose.
 - f) When testing equipment 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

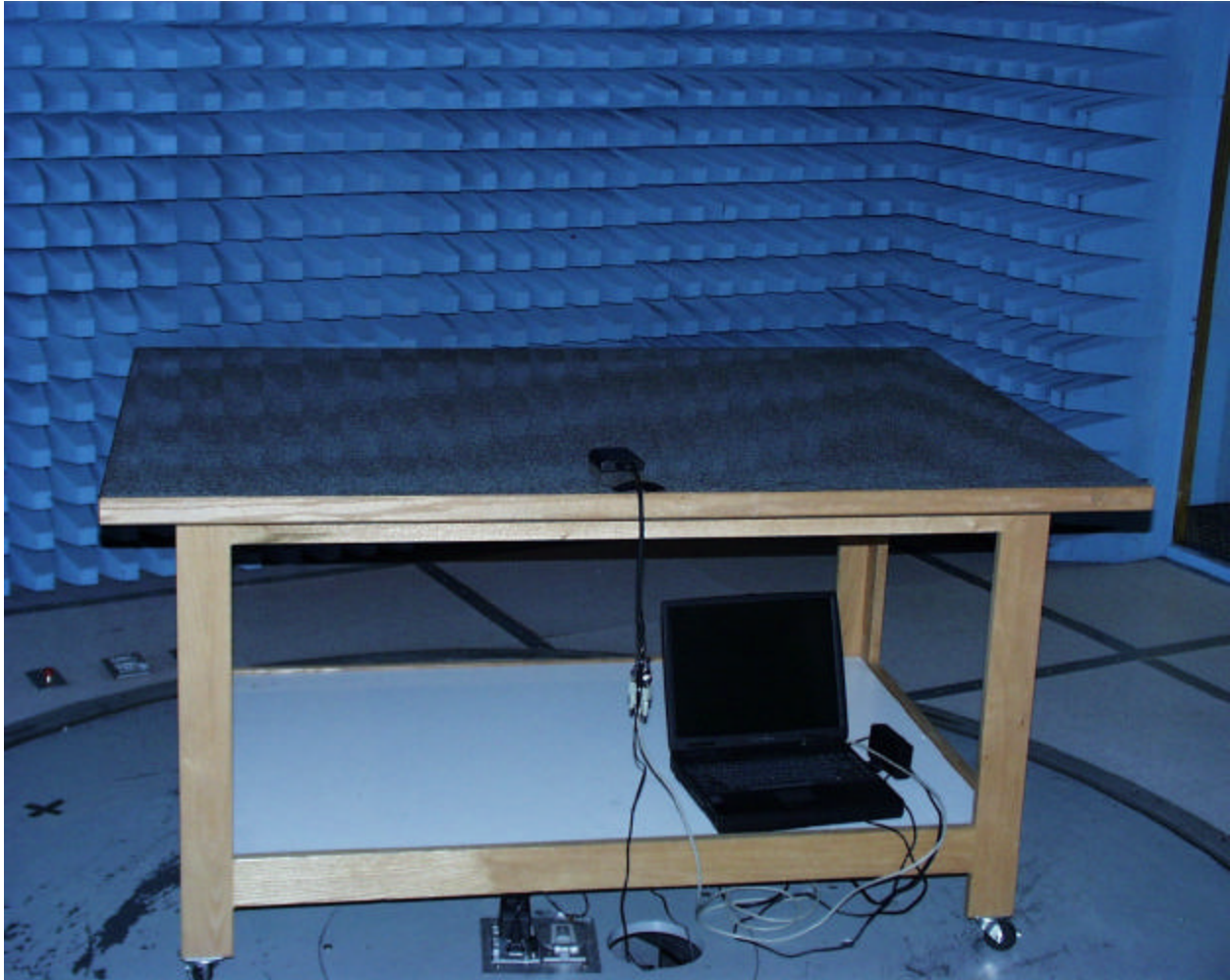
An independent calibration laboratory or CCL personal calibrates all the equipment listed above every 12 months following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability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

Line Conducted Emissions Test

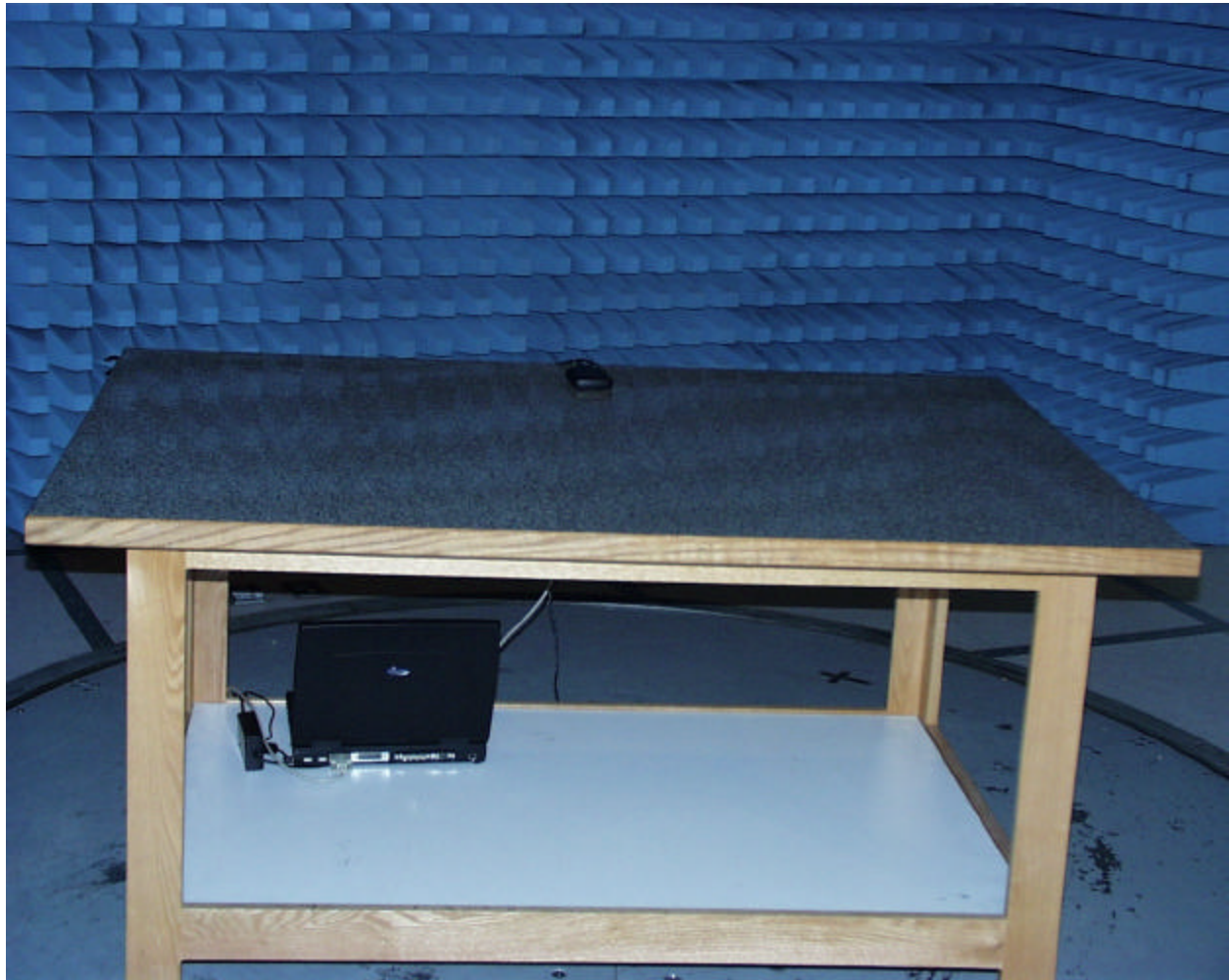


APPENDIX 2 Photographs

Front view worst case radiated emissions



Back view worst case radiated emissions



Front View of the 0920



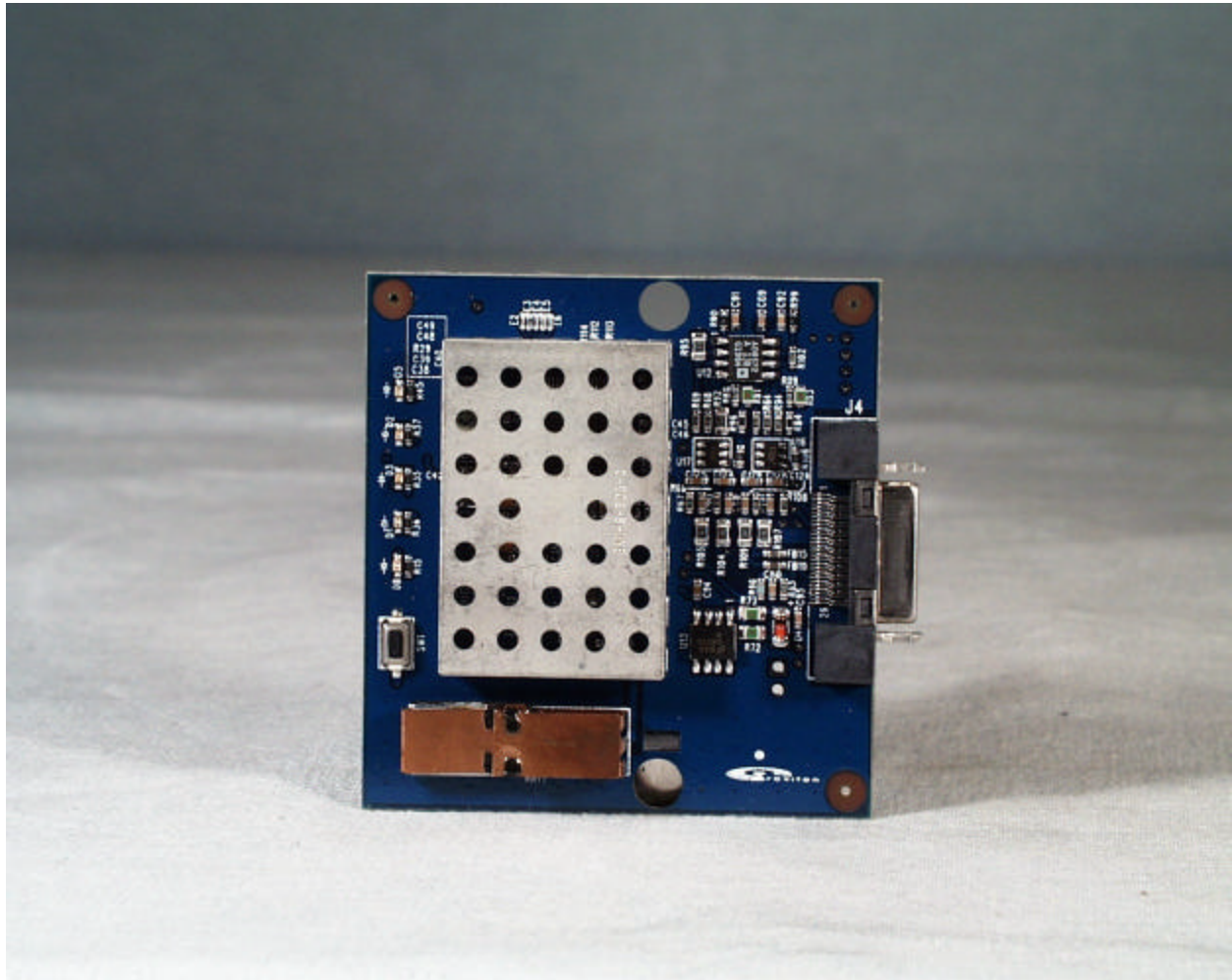
Back View of the 0920



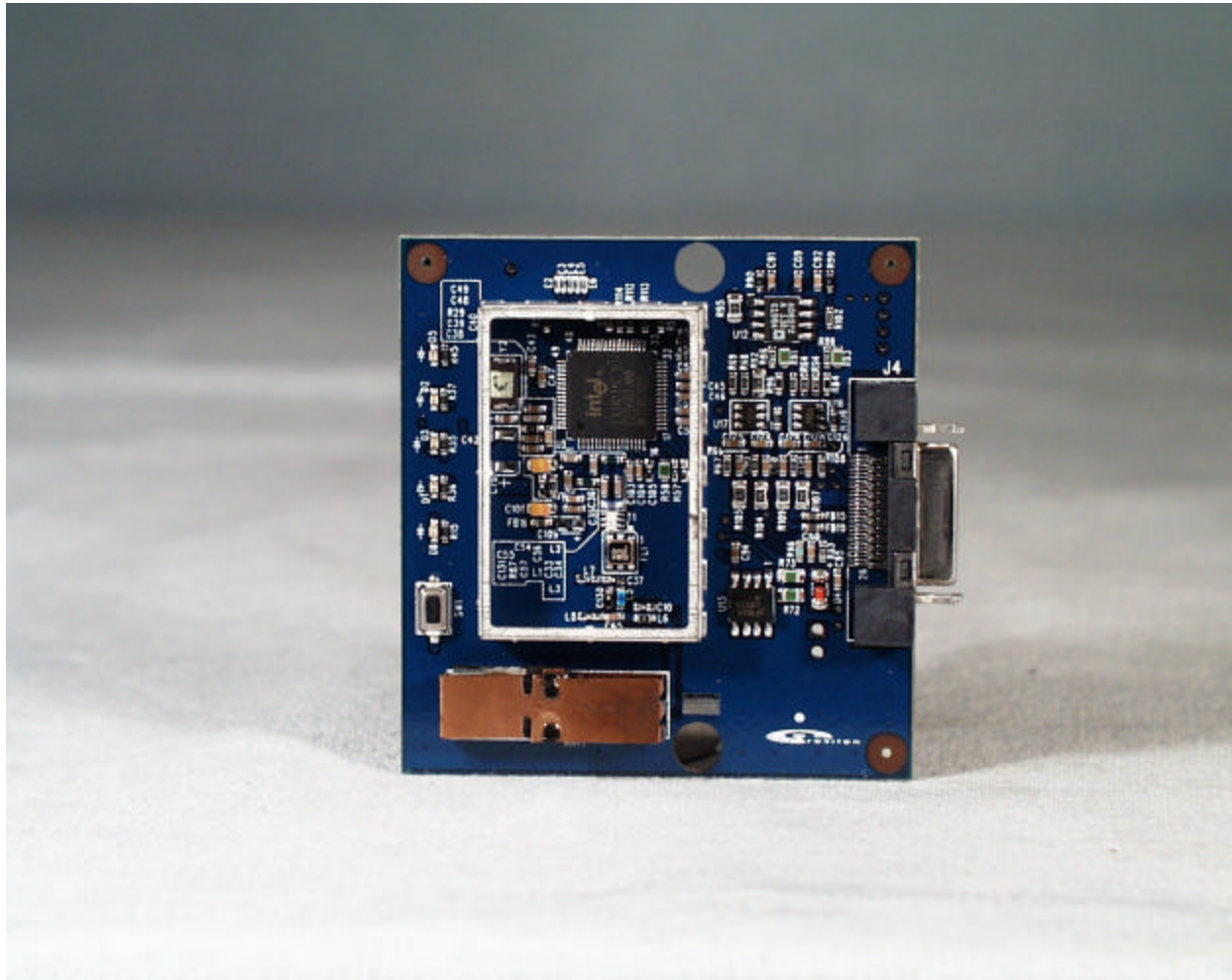
Side View of the 0920



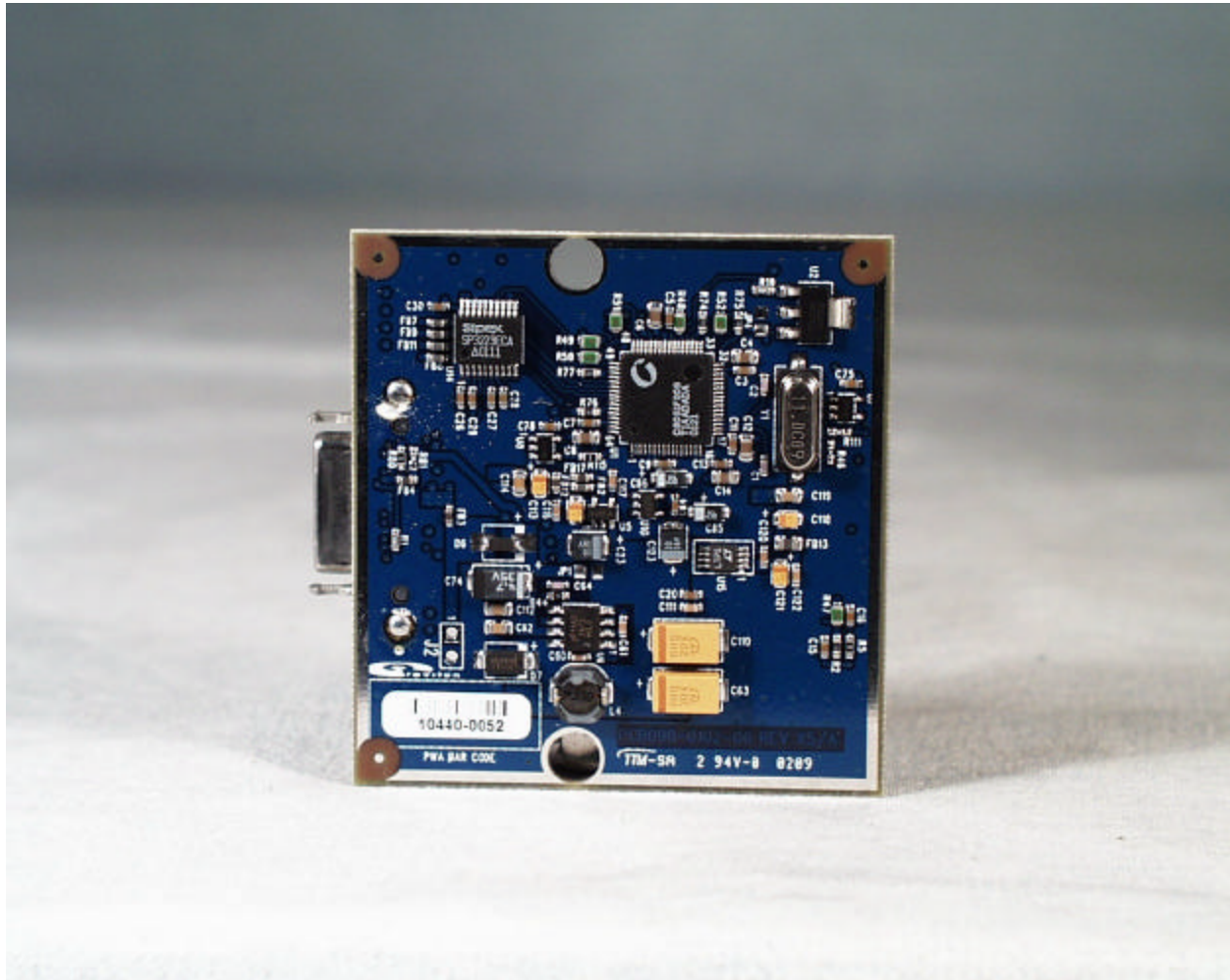
Front View of the 0920 PCB



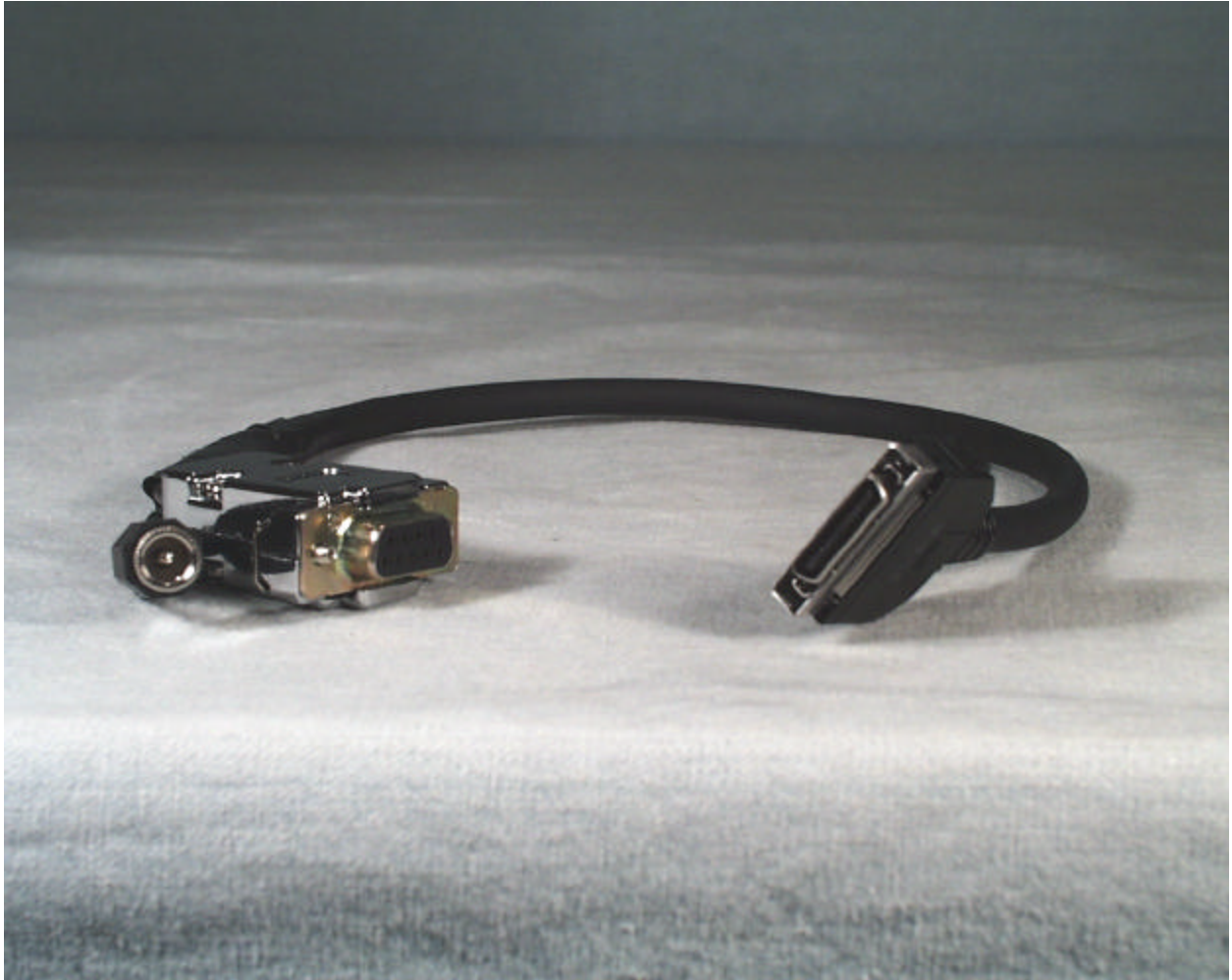
Front View of the 0920 PCB With Shield Removed



Back View of the 0920 PCB



Interface Cable



Power Supply

