

TEST REPORT FROM:

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

Type of Report: Certification

TEST OF: RFD

FCC ID: P4N-9294

To FCC PART 15.247, Subpart C

Test Report Serial No: 73-7713

Applicant:

Engineering Technology, Inc.
3275 Progress Drive
Orlando, FL 32826

Date of Test: February 4, 2002

Issue Date: February 12, 2002

Equipment Receipt Date: January 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: Engineering Technology, Inc.
- Manufacturer: World Wireless Communications, Inc.
- Brand Name: ETI
- Model Number: RFD
- FCC ID: P4N-9294

On this 12th day of February 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 Client Information:

Company Name: Engineering Technology, Inc.
3275 Progress Drive
Orlando, FL 32826

Contact Name: Dan Jackson
Title: Research Engineer

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

Trade Name: ETI
Model Name or Number: RFD
Serial Number: N/A
Options Fitted: None
Country of Manufacture: U.S.A.

2.2 Description of EUT:

The RFD is used to remotely initiate either electric detonators or shock tube devices. Each RFD set consists of one transmitter and multiple receivers. The RFD is intended for use by qualified law enforcement agencies, military units, and professional demolition personnel. This report covers the transmitter only the receiver is covered under a separate verification report.

The RFD uses the World Wireless Communications, Inc. 900 μ Hopper radio, which was certified under FCC # NQE-900UHOPPER. The 900 μ Hoppers reverse sex SMA connector has been removed and a short length (approximately 10") of RG-316 coaxial cable terminated in a reverse sex TNC bulkhead connector was added.

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: ETI MN: RFD	P4N-9294	Remote Firing Device	Reverse gender TNC connector

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: 4.5 VDC
AC Mains Frequency: N/A

4.2 Operating Modes:

Each mode of operation was exercised to produce worst-case emissions. The worst-case emissions were with the RFD running in the following mode. The RFD 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 RFD 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	902 to 928	Complied
15.247 (a) (1) (i)	Emission Bandwidth	902 to 928	Complied
15.247 (b) (2)	Peak Output Power	902 to 928	Complied
15.247 (C)	Antenna Conducted Spurious Emissions	9 to 10,000	Complied
15.247 (C)	Radiated Spurious Emissions	9 to 10,000	Complied
15.207	Line Conducted Emissions (Hot Lead to Ground)	0.45 to 30	Not Applicable
15.207	Line Conducted Emissions (Neutral Lead to Ground)	0.45 to 30	Not Applicable

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 B of this report.

6.2 Test Results**6.2.1 □ 15.247 (a) (1)****Demonstration of Compliance:**

The RFD uses the World Wireless Communications, Inc. 900 μ Hopper radio, which was certified under FCC # NQE-900UHOPPER. See the 900 μ Hopper theory of operation.

6.3.2 □ 15.247 (a) (1) (i)**Demonstration of Compliance:**

The RFD uses the World Wireless Communications, Inc. 900 μ Hopper radio, which was certified under FCC # NQE-900UHOPPER. See the 900 μ Hopper theory of operation.

Measurement Data Emission Bandwidth:

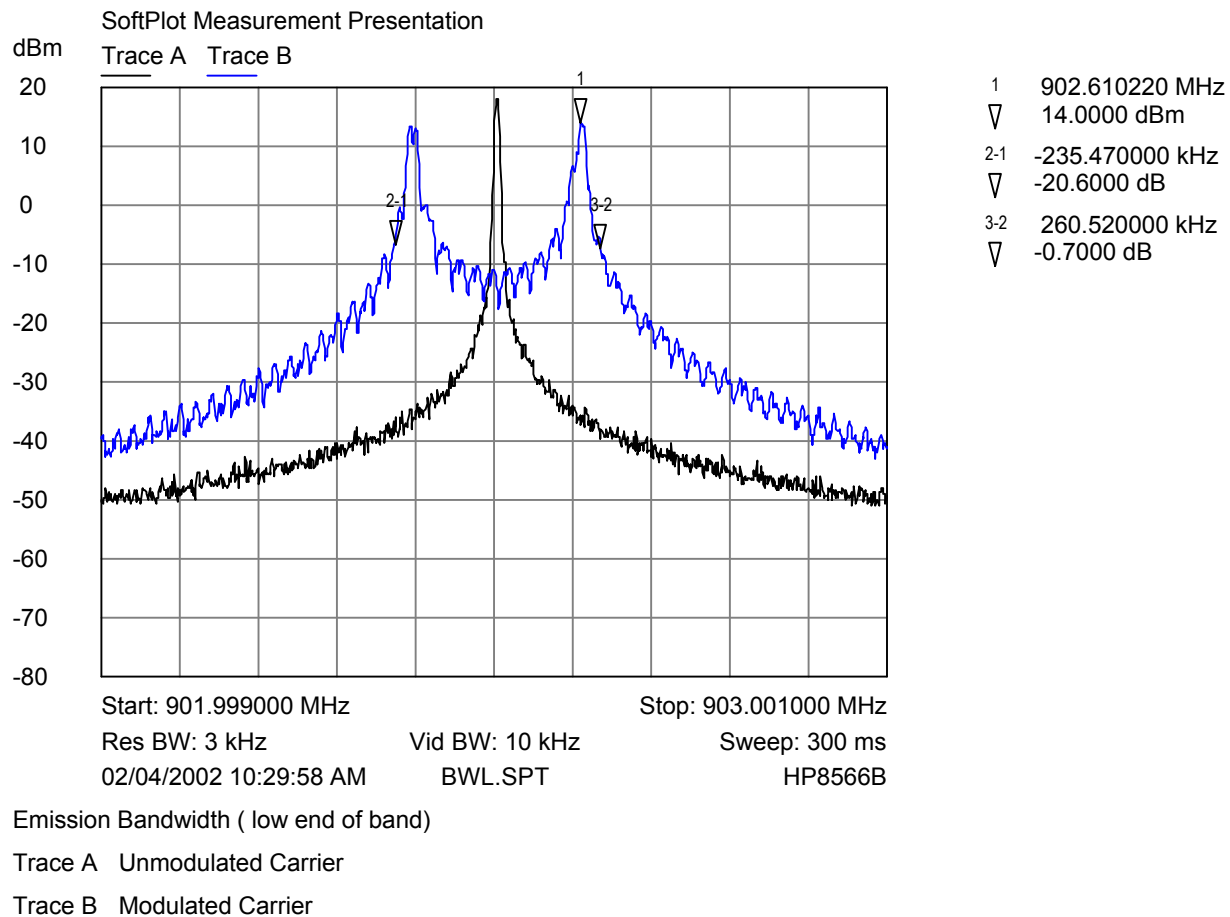
A diagram of the test configuration is enclosed in Appendix A and a list of reference codes for test equipment used is enclosed in Appendix B.

Test equipment used: 1, 3 and 4.

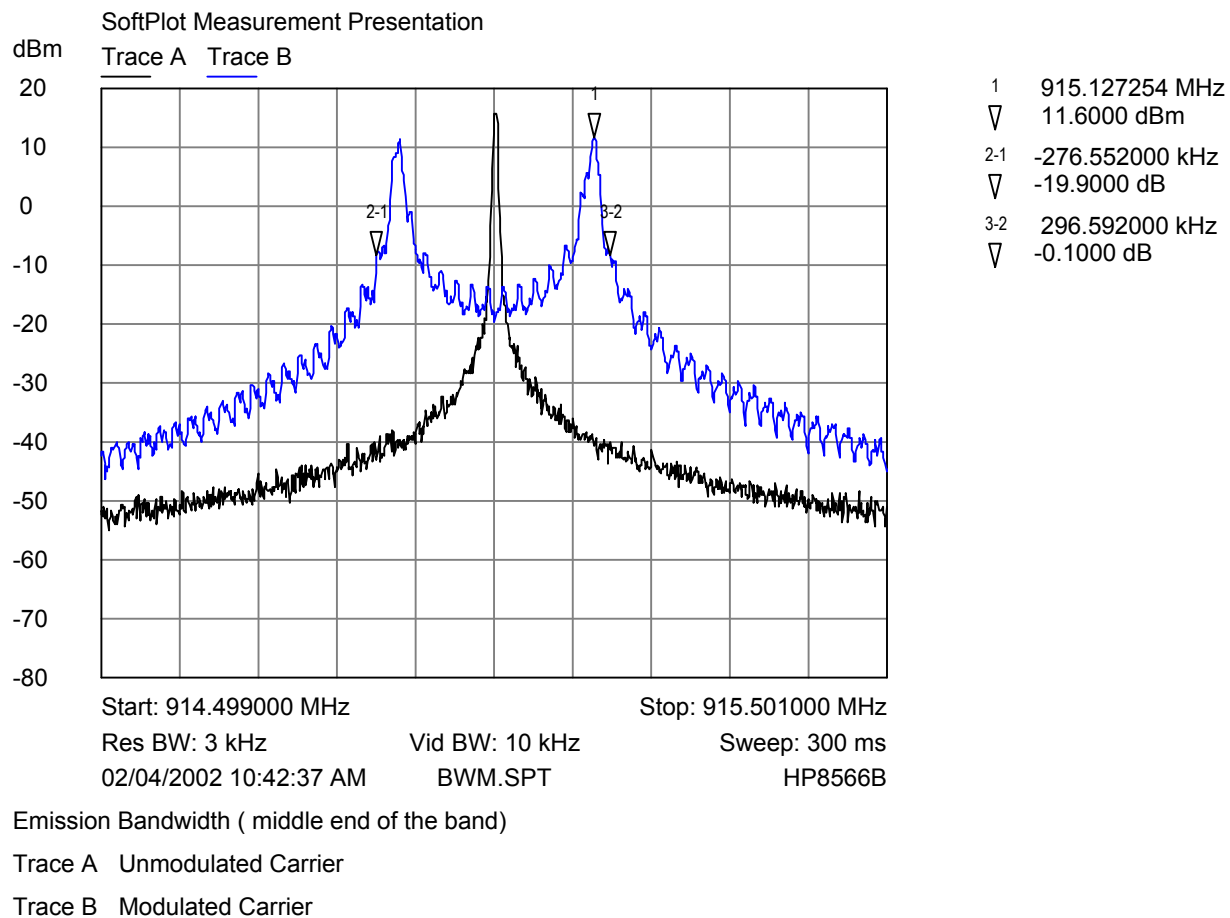
Frequency (MHz)	Measured Emission Bandwidth (kHz)
902.5	260.5
906.9	296.5
927.7	297.5

RESULT

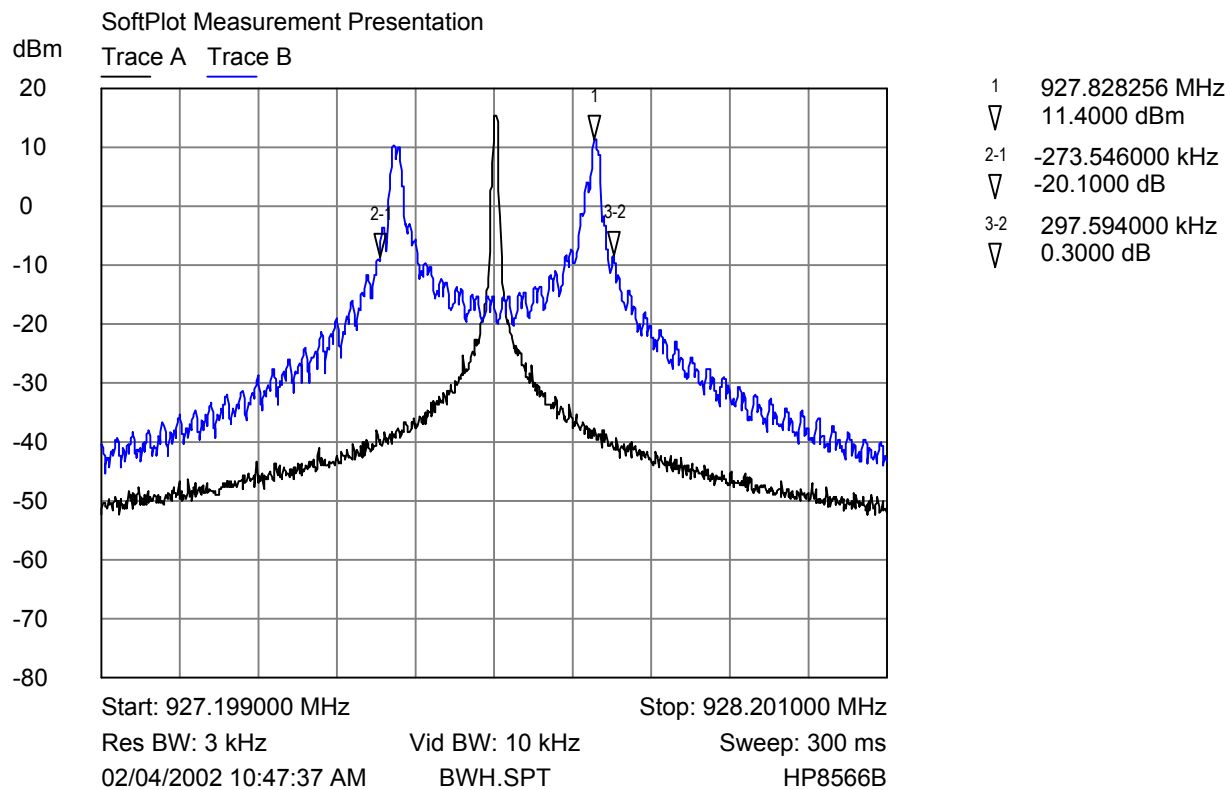
In the configuration tested, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).



Emission Bandwidth Plot (Low End of Band)



Emission Bandwidth Plot (Middle of Band)



Emission Bandwidth (upper end of the band)

Trace A Unmodulated Carrier

Trace B Modulated Carrier

Emission Bandwidth Plot (High End of Band)

6.2.3 □ 15.247 (b) Peak Output Power:**Measurement Data:**

The maximum peak output power measured for this device was 61.6 mW or 17.9 dBm. The maximum directional gain of the antenna is less than 6 dBi; therefore, the maximum output power is not required to be reduced from the value measured. See spectrum analyzer plots below.

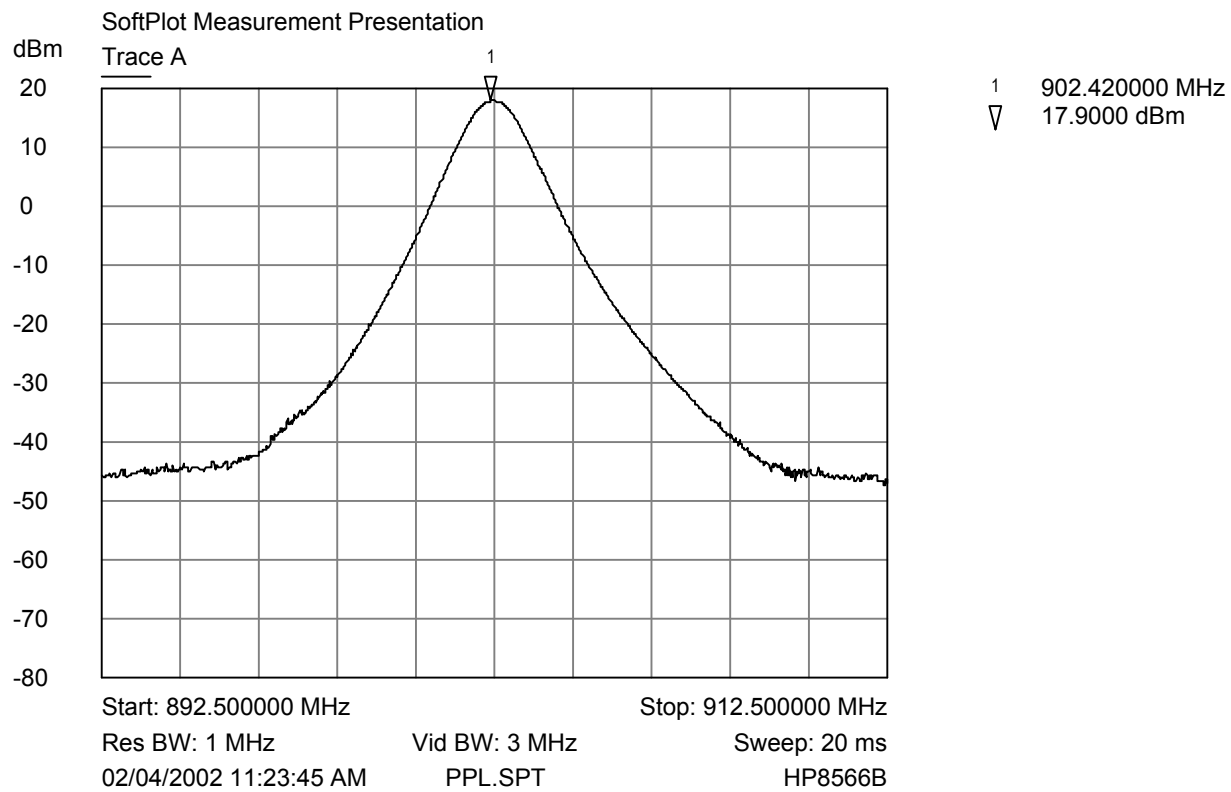
A diagram of the test configuration is enclosed in Appendix A and a list of reference codes for test equipment used is enclosed in Appendix B.

Test equipment used: 1, 3 and 4.

Peak Output Power		
Frequency (MHz)	Measured Output Power (dBm)	Measured Output Power (mW)
902.5	17.9	61.6
915.0	15.8	38.0
927.7	16.0	39.8

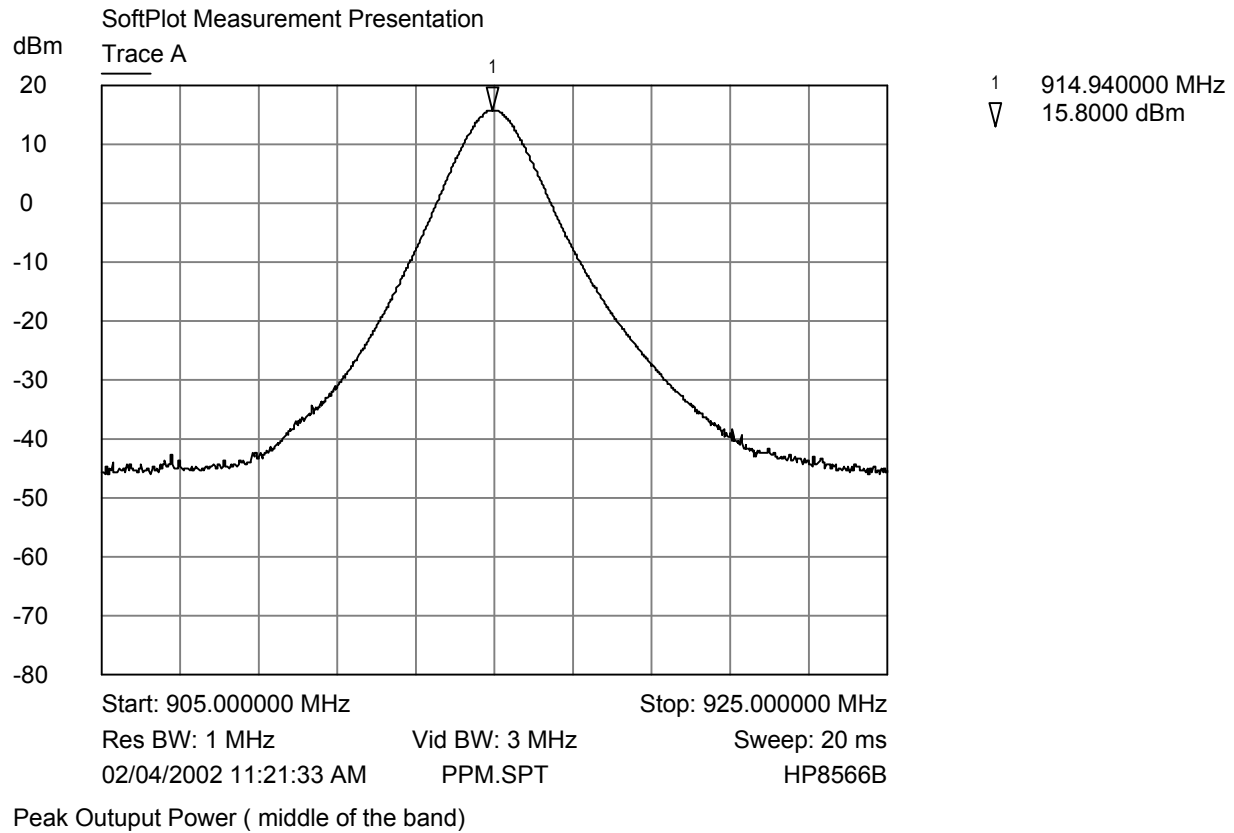
RESULT

In the configuration tested, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).

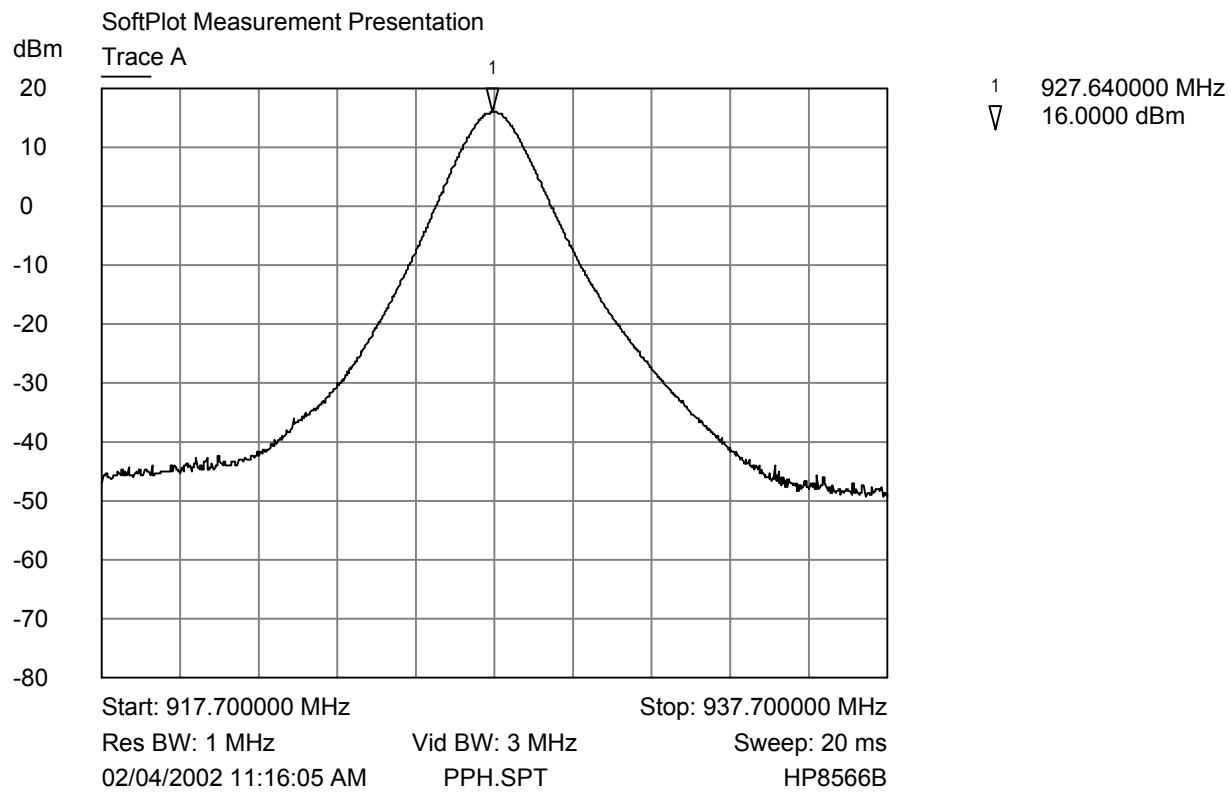


Peak Output Power (low end of the band)

RF Output Power (Low End of Band)



RF Output Power (Middle of Band)



Peak Output Power (upper end of the band)

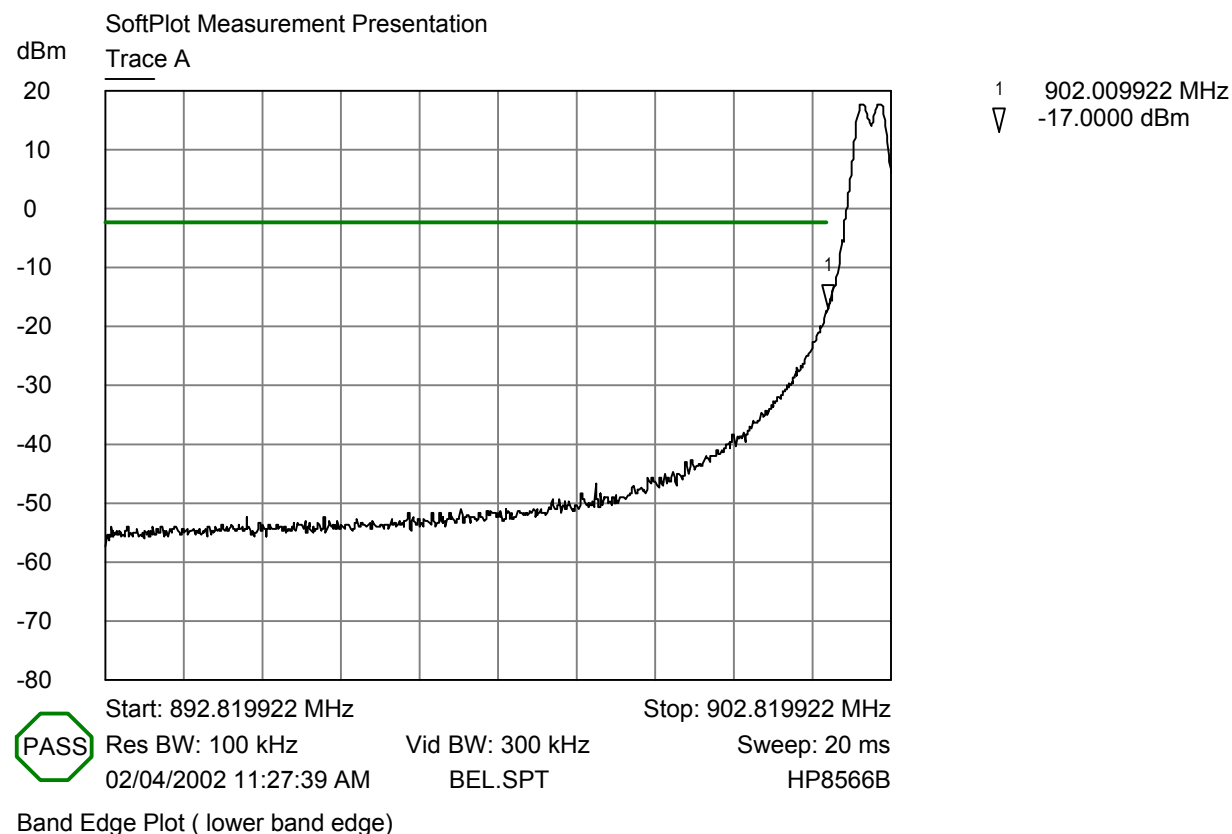
RF Output Power (High End of Band)

6.2.4 □ 15.247 (c) Spurious Emissions:**Measurement Data Antenna Conducted Emissions:**

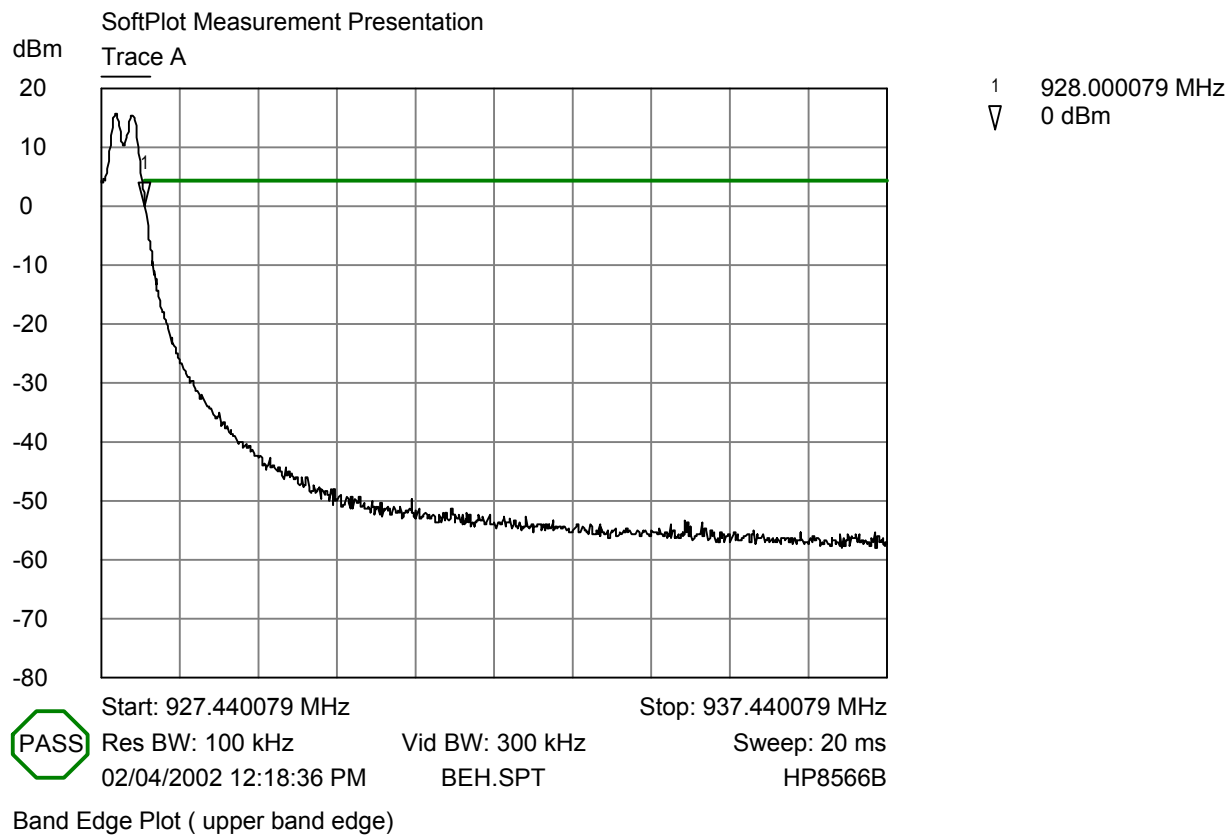
The frequency range from 9 MHz to the tenth harmonic of the highest fundamental frequency was investigated to measure any antenna-conducted emissions. Shown below are plots with the RFD tuned to the upper and lower band edges. These demonstrate compliance with the provisions of this section.

A diagram of the test configuration is enclosed in Appendix A and a list of reference codes for test equipment used is enclosed in Appendix B.

Test equipment used: 1, 3 and 4.



Spurious Emissions (Transmitting at Low End of Band)



Spurious Emissions (Transmitting at High End of Band)

The emissions must be attenuated 20 dB below the highest power level measured; therefore, the criteria is $17.7 - 20.0 = -2.3$ dBm.

Transmitting at 902.5 MHz			
Frequency Range MHz	Frequency MHz	Corrected Level dBm	Criteria dBm
9 - 200	90.4 *	-55.2	-2.3
200 - 901.9	901.9	-42.8	-2.3
928.1 - 1000	929.2 *	-55.2	-2.3
1000 - 2000	1809.0	-42.3	-2.3
2000 - 3000	2708.0	-47.3	-2.3
3000 - 4000	3311.0 *	-54.9	-2.3
4000 - 5000	4514.0 *	-54.0	-2.3
5000 - 6000	5834.0 *	-51.7	-2.3
6000 - 7000	6526.0 *	-50.8	-2.3
7000 - 8000	7006.0 *	-51.8	-2.3
8000 - 9000	8964.0 *	-50.7	-2.3
9000 - 10000	9624.0 *	-50.2	-2.3
* Noise Floor			

The emissions must be attenuated 20 dB below the highest power level measured; therefore, the criteria is $15.7 - 20.0 = -4.3$ dBm.

Transmitting at 915.0 MHz			
Frequency Range MHz	Frequency MHz	Corrected Level dBm	Criteria dBm
9 - 200	79.3 *	-55.7	-4.3
200 - 901.9	899.1	-54.7	-4.3
928.1 - 1000	929.39 *	-55.4	-4.3
1000 - 2000	1834.0	-47.3	-4.3
2000 - 3000	2746.0	-49.1	-4.3
3000 - 4000	3283.0 *	-55.5	-4.3
4000 - 5000	4170.0 *	-55.1	-4.3
5000 - 6000	5828.0 *	-51.5	-4.3
6000 - 7000	6704.0 *	-50.3	-4.3
7000 - 8000	7016.0 *	-50.7	-4.3
8000 - 9000	8020.0 *	-51.0	-4.3
9000 - 10000	9275.0 *	-50.2	-4.3
* Noise Floor			

The emissions must be attenuated 20 dB below the highest power level measured; therefore, the criteria is $15.6 - 20.0 = -4.4$ dBm.

Transmitting at 927.7 MHz			
Frequency Range MHz	Frequency MHz	Corrected Level dBm	Criteria dBm
9 - 200	196.2 *	-55.3	-4.4
200 - 901.9	900.5	-54.5	-4.4
928.1 - 1000	928.1	-7.8	-4.4
1000 - 2000	1860.0	-48.7	-4.4
2000 - 3000	2784.0	-48.9	-4.4
3000 - 4000	3318.0 *	-55.5	-4.4
4000 - 5000	4641.0 *	-54.7	-4.4
5000 - 6000	5999.0 *	-51.5	-4.4
6000 - 7000	6748.0 *	-50.6	-4.4
7000 - 8000	7005.0 *	-51.2	-4.4
8000 - 9000	8420.0 *	-51.2	-4.4
9000 - 10000	9014.0 *	-50.9	-4.4
* Noise Floor			

Measurement Data Radiated Emissions Restricted Bands □ 15.205:

The frequency range from 9 MHz to 10 GHz was investigated to measure any radiated emissions in the restricted bands.

A diagram of the test configuration is enclosed in Appendix A and a list of reference codes for test equipment used is enclosed in Appendix B.

Test equipment used: 1, 3, 4, 6, 7, 8, 9 and 12.

AVERAGE FACTOR

The RFD transmits continuously therefore; there is not an average factor for this device.

Vertical Polarity

Transmitting at 902.5 MHz					
Frequency MHz	Detector	Receiver Reading dB μ V	Correction Factor dB	Corrected Reading dB μ V/m	Limit dB μ V/m
2707.5	Peak	53.8	-3.2	50.6	74.0
2707.5	Average	43.5	-3.2	40.3	54.0
3610.0	Peak	53.2	-0.8	52.4	74.0
3610.0	Average	48.8	-0.8	48.0	54.0
4512.5	Peak	46.0	0.4	46.4	74.0
4512.5	Average	44.5	0.4	44.9	54.0
5415.0	Peak	56.3*	2.7	59.0	74.0
5415.0	Average	42.8*	2.7	45.5	54.0
8122.5	Peak	47.3*	4.6	51.9	74.0
8122.5	Average	35.7*	4.6	40.3	54.0
9025.0	Peak	47.7*	5.7	53.4	74.0
9025.0	Average	35.5*	5.7	41.2	54.0
* 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 915.0 MHz					
Frequency MHz	Detector	Receiver Reading dB μ V	Correction Factor dB	Corrected Reading dB μ V/m	Limit dB μ V/m
2745.0	Peak	53.1	-3.1	50.0	74.0
2745.0	Average	45.8	-3.1	42.7	54.0
3660.0	Peak	48.4	-0.6	47.8	74.0
3660.0	Average	38.9	-0.6	38.3	54.0
4575.0	Peak	48.4	0.6	49.0	74.0
4575.0	Average	39.7	0.6	40.3	54.0
7320.0	Peak	48.3*	4.6	52.9	74.0
7320.0	Average	35.0*	4.6	39.6	54.0
8235.0	Peak	47.3*	4.6	51.9	74.0
8235.0	Average	35.7*	4.6	40.3	54.0
9150.0	Peak	47.7*	5.7	53.4	74.0
9150.0	Average	35.5*	5.7	41.2	54.0
* 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 927.7 MHz					
Frequency MHz	Detector	Receiver Reading dB μ V	Correction Factor dB	Corrected Reading dB μ V/m	Limit dB μ V/m
2783.1	Peak	54.5	-3.0	51.5	74.0
2783.1	Average	48.4	-3.0	45.4	54.0
3710.8	Peak	48.9	-0.3	48.6	74.0
3710.8	Average	34.0	-0.3	33.7	54.0
4638.5	Peak	50.0	0.8	50.8	74.0
4638.5	Average	41.5	0.8	42.3	54.0
7421.6	Peak	47.3*	4.9	52.2	74.0
7421.6	Average	34.7*	4.9	39.6	54.0
8349.3	Peak	47.3*	4.6	51.9	74.0
8349.3	Average	35.7*	4.6	40.3	54.0
* 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 902.5 MHz					
Frequency MHz	Detector	Receiver Reading dB μ V	Correction Factor dB	Corrected Reading dB μ V/m	Limit dB μ V/m
2707.5	Peak	53.0	-3.2	49.8	74.0
2707.5	Average	41.1	-3.2	37.9	54.0
3610.0	Peak	48.5	-0.8	47.7	74.0
3610.0	Average	39.0	-0.8	38.2	54.0
4512.5	Peak	49.3	0.4	49.7	74.0
4512.5	Average	41.8	0.4	42.2	54.0
5415.0	Peak	48.5	2.7	51.2	74.0
5415.0	Average	39.5	2.7	42.2	54.0
8122.5	Peak	47.9*	4.6	52.5	74.0
8122.5	Average	35.4*	4.6	40.0	54.0
9025.0	Peak	47.7*	5.7	53.4	74.0
9025.0	Average	35.5*	5.7	41.2	54.0
* 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 915.0 MHz					
Frequency MHz	Detector	Receiver Reading dB μ V	Correction Factor dB	Corrected Reading dB μ V/m	Limit dB μ V/m
2745.0	Peak	50.4	-3.1	47.3	74.0
2745.0	Average	41.4	-3.1	38.3	54.0
3660.0	Peak	46.0	-0.6	45.4	74.0
3660.0	Average	34.1	-0.6	33.5	54.0
4575.0	Peak	47.7	0.6	48.3	74.0
4575.0	Average	38.6	0.6	39.2	54.0
7320.0	Peak	47.4	4.6	52.0	74.0
7320.0	Average	35.0	4.6	39.6	54.0
8235.0	Peak	47.9*	4.6	52.5	74.0
8235.0	Average	35.4*	4.6	40.0	54.0
9150.0	Peak	47.7*	5.7	53.4	74.0
9150.0	Average	35.5*	5.7	41.2	54.0
* 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 927.7 MHz					
Frequency MHz	Detector	Receiver Reading dB μ V	Correction Factor dB	Corrected Reading dB μ V/m	Limit dB μ V/m
2783.1	Peak	52.1	-3.0	49.1	74.0
2783.1	Average	44.3	-3.0	41.3	54.0
3710.8	Peak	46.2	-0.3	45.9	74.0
3710.8	Average	35.7	-0.3	35.4	54.0
4638.5	Peak	48.1	0.8	48.9	74.0
4638.5	Average	38.5	0.8	39.3	54.0
7421.6	Peak	47.1*	4.9	52.0	74.0
7421.6	Average	34.7*	4.9	39.6	54.0
8349.3	Peak	47.3*	4.6	51.9	74.0
8349.3	Average	35.7*	4.6	40.3	54.0
* 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.

6.2.5 □ 15.207 Conducted Limits

The RFD is powered by three, 1.5 volt, AA batteries; therefore, this test is not applicable.

APPENDIX A TEST EQUIPMENT USED:

Reference No.	Type	Manufacturer	Model
1	Anechoic Chamber	EMC Test Systems	N/A
2	Wanship Open Area Test Site	CCL	N/A
3	Spectrum Analyzer	Hewlett Packard	8568B or 8566B
4	Quasi-Peak Detector	Hewlett Packard	8565A
5	Biconical Antenna	EMCO	3108 or 3104P
6	Log-Periodic Antenna	EMCO	3146
7	Biconilog Antenna	EMCO	3142
8	Double Ridged Guide Antenna	EMCO	3115
9	Pre-Amplifier	Hewlett Packard	8447D
10	Power Amplifier	Hewlett Packard	8447E
11	Power Amplifier	Hewlett Packard	8449A
12	Power Amplifier	Hewlett Packard	8449B
13	LISN Anechoic Chamber	EMCO	3825/2
14	LISN Wanship	EMCO	3725

An independent calibration laboratory following outlined calibration procedures calibrates all the equipment listed above every 12 months.

APPENDIX B TEST PROCEDURES:**Line Conducted Emissions:**

The line-conducted emission from the digital apparatus 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 line conducted emissions measurements are performed in a screen room using a (50 Ω /50 μ H) Line Impedance Stabilization Network (LISN).

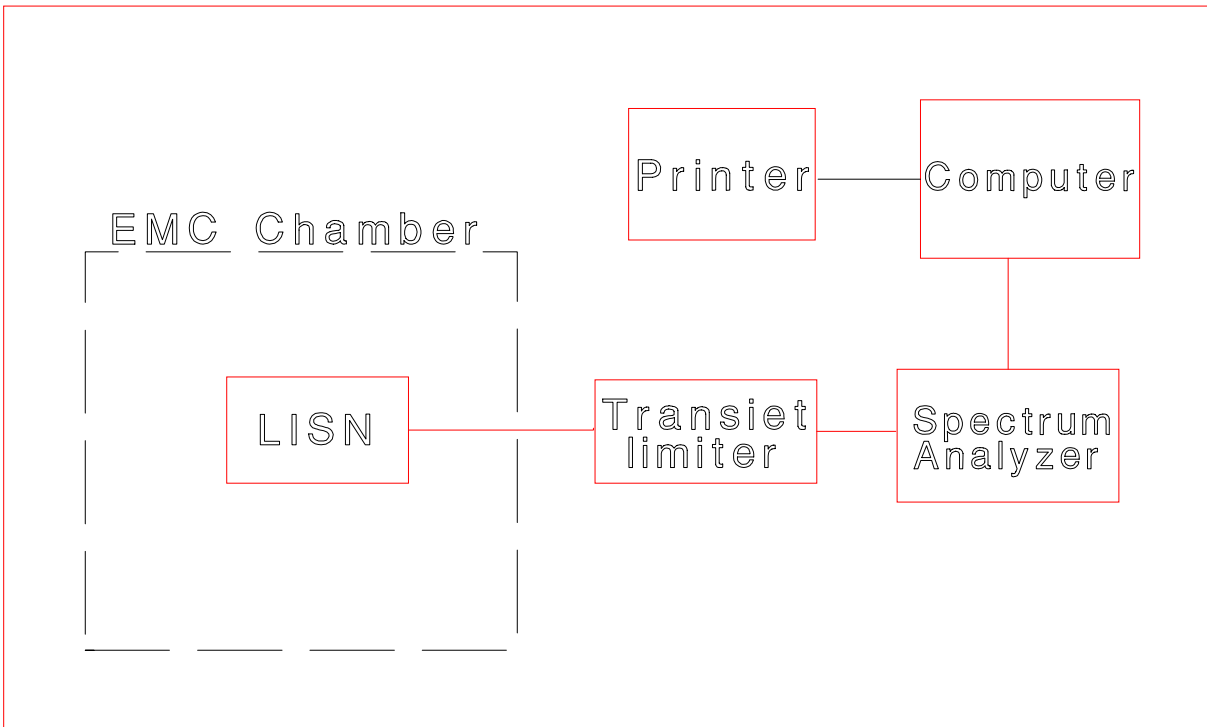
Where mains flexible power cords are longer than 1 m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4 m in length.

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

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

Desktop digital apparatus are placed on a non-conducting table at least 80 cm 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.

Line Conducted Emissions Test



Radiated Spurious Emissions:

The radiated emission from the transmitter was measured using a spectrum analyzer with a quasi-peak adapter for peak and quasi-peak readings. A preamplifier with a fixed gain of 30 dB was used to increase the sensitivity of the measuring instrumentation.

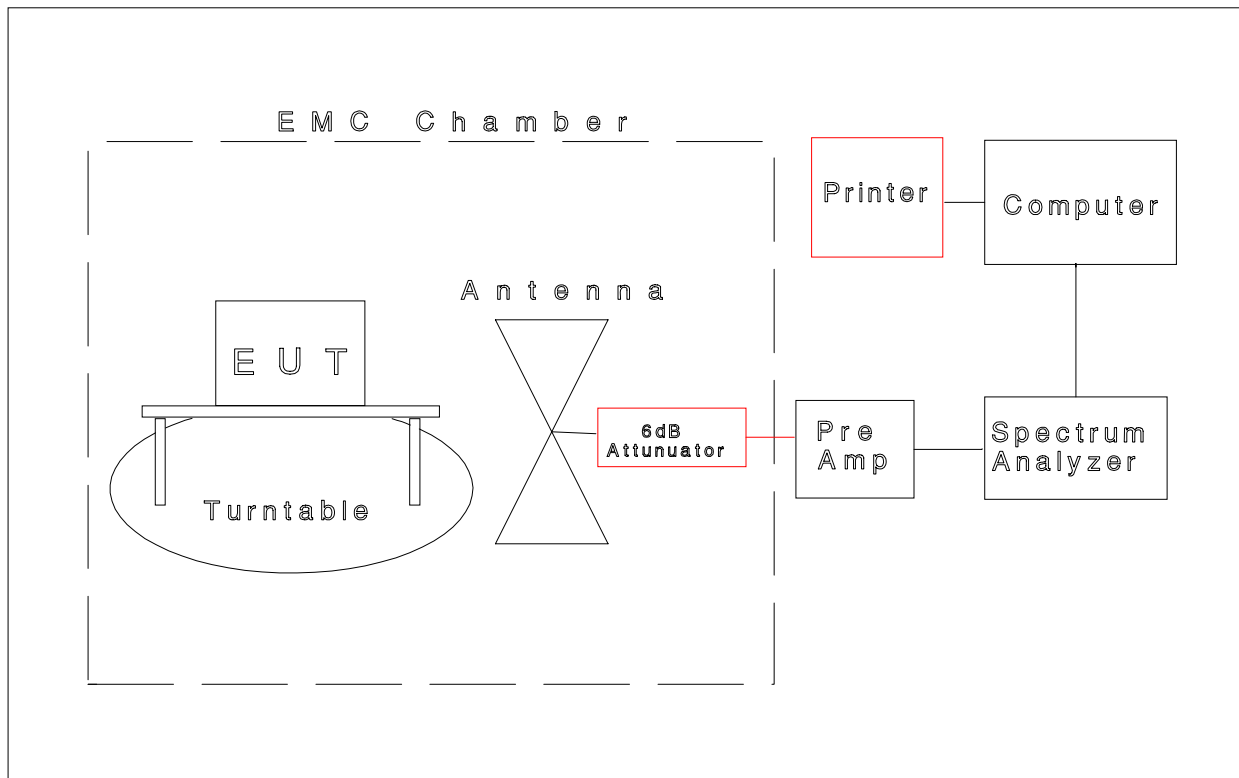
A Biconilog antenna was used to measure the frequency range of 30 to 1000 MHz and a Double Ridge Guide Horn antenna was used to measure the frequency range 1 GHz to 10 GHz, at a distance of 3 meters from the EUT. The readings obtained by these antennas are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors.

The configuration of the transmitter 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 digital apparatus 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.

Transmitters are 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 digital apparatus. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

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



FCC Sections 15.247 Peak Transmit Power, Emission Bandwidth and Spurious Emissions (antenna conducted)

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:

Peak Transmit Power

RBW = 100 kHz

VBW = 300 kHz

Emission Bandwidth

RBW = 3 kHz

VBW = 10 kHz

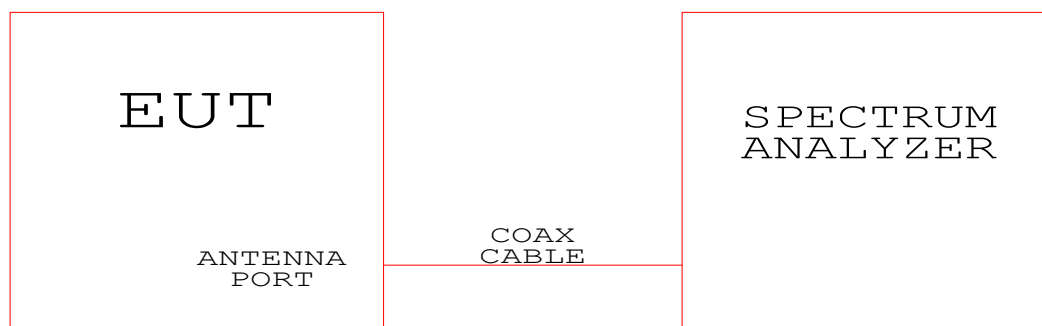
Spurious Emissions (Antenna Conducted)

RBW = 100 kHz - 30 MHz to 1000 MHz

VBW = 300 kHz

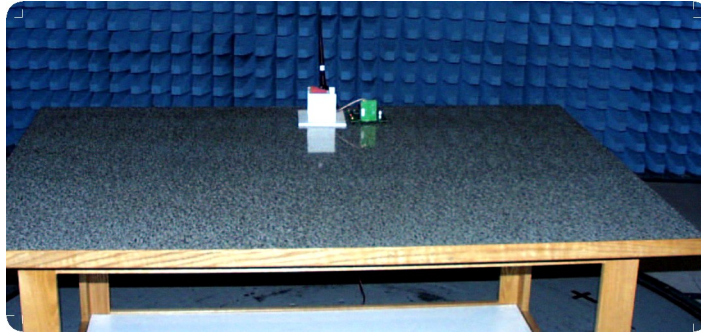
RBW = 1 MHz - 1 GHz to 10 GHz

VBW = 3 MHz

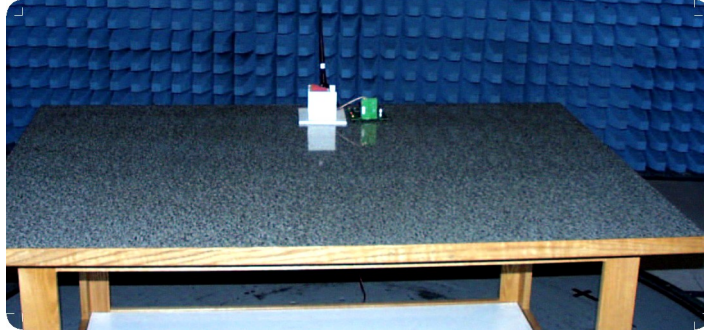
Test Configuration Block Diagram

APPENDIX C PHOTOGRAPHS:

Front View of the Radiated Test Setup



Back View of the Radiated Test Setup



Front view of the RFD with antenna attached



Front view of the RFD



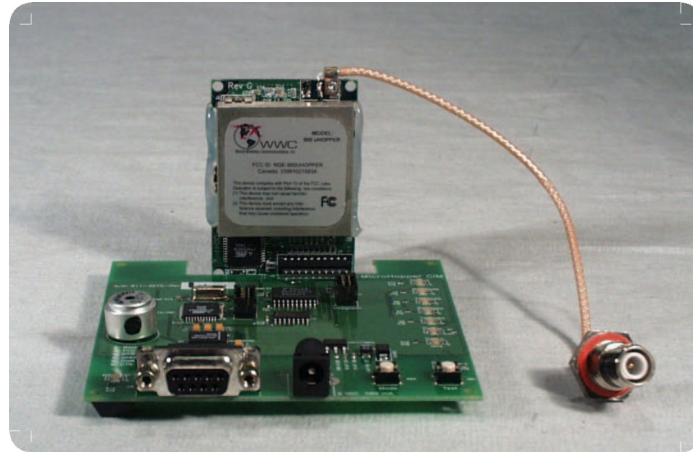
Back view of the RFD



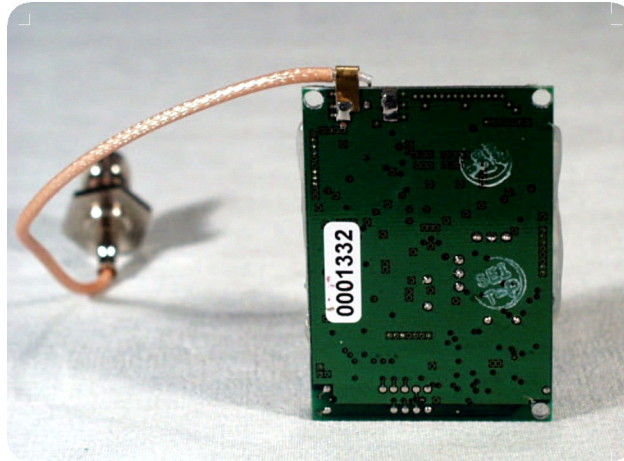
RFD antenna



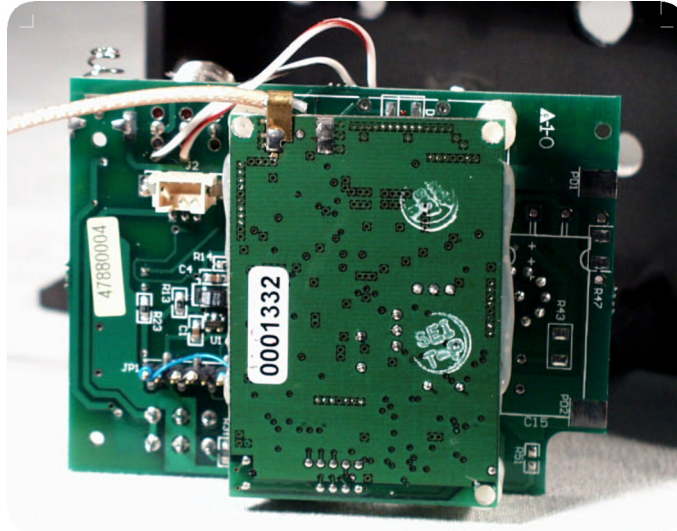
Front view of the RF daughter board



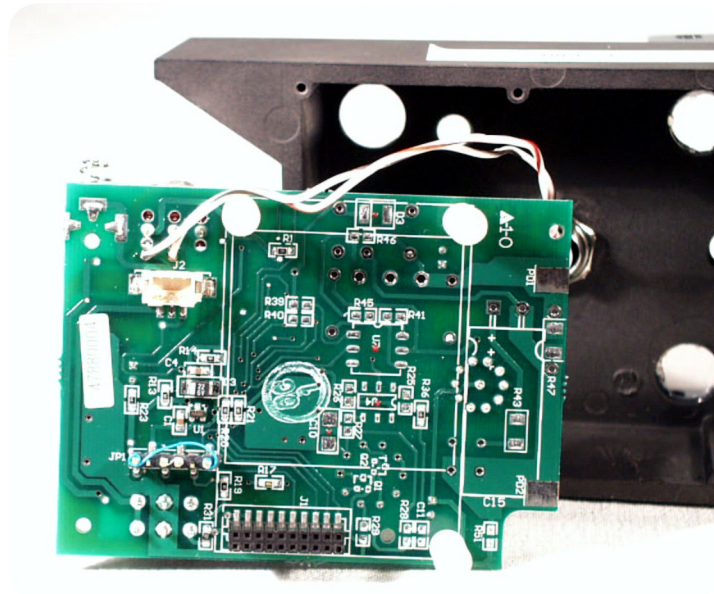
Back view of the RF daughter board



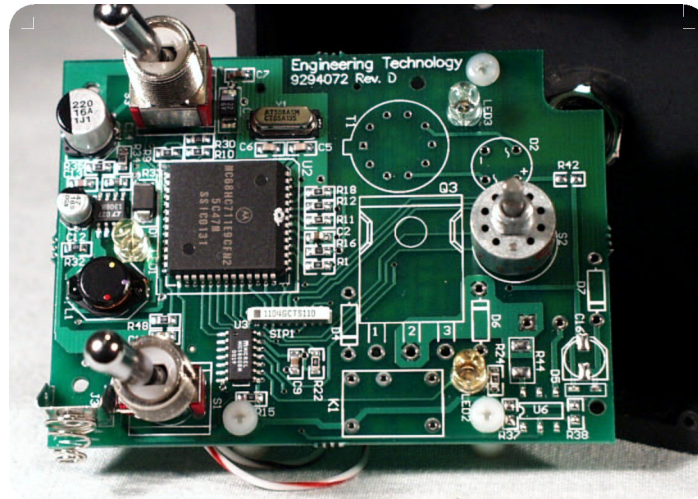
Bottom view of the RFD PCB with RF daughter board attached



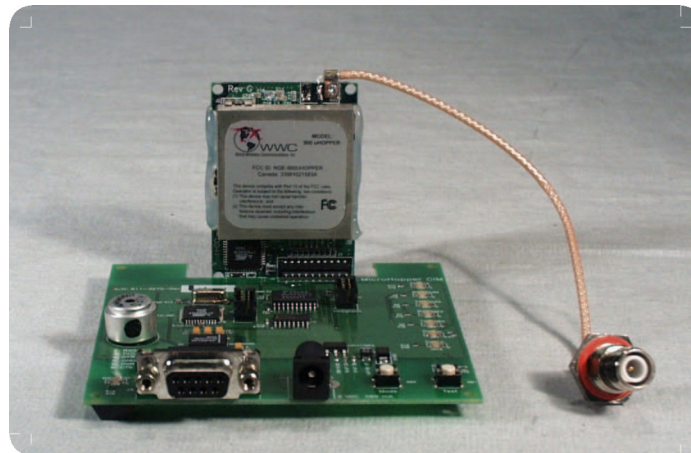
Bottom view of the RFD PCB



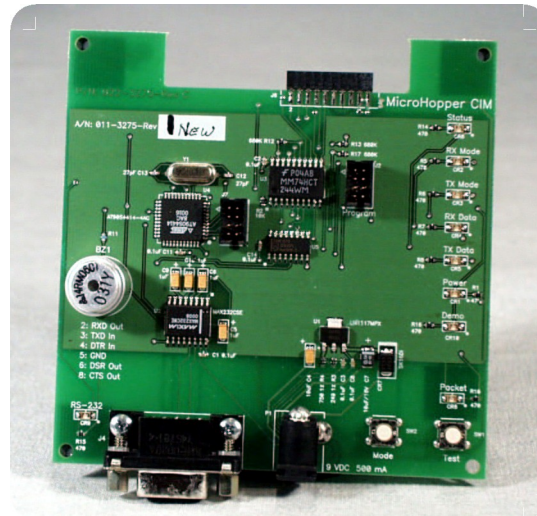
Top view of the RFD PCB



Top view of the RF test board with RF daughter board attached



Top view of the RF test board



Bottom view of the RF test board

