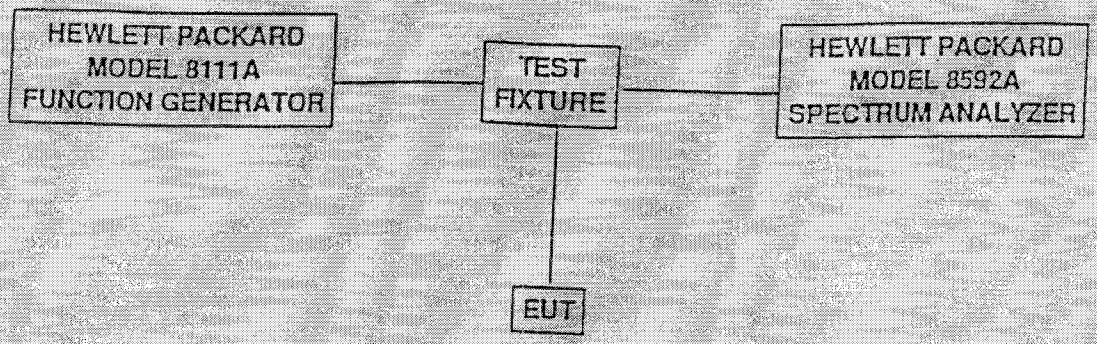
2.991 Conducted Spurious Emissions

Spurious emissions at the antenna terminals were measured using the test configuration illustrated below. The output of the transmitter was filtered through a Model FH-113 high pass filter which provided 20 dB of attenuation above 1 GHz. This filtering was necessary to increase the dynamic range of the spectrum analyzer. External attenuation was added as necessary to prevent overloading the spectrum analyzer. The carrier was modulated by the 10 millivolt signal described in the occupied bandwidth measurements which was found to produce worst case emissions.

The emission spectrum was examined up to the tenth harmonic of the carrier. Every emission not recorded was more than 20 dB below the limit. The results are given in Table 1. The emissions limitation specified in Paragraph 90.209 is expressed as 43 + 10 log (mean output power in Watts). For 4.0 milliwatts, this equals 19 dB below the unmodulated carrier. All of the data recorded in Table 1 meet this restriction.



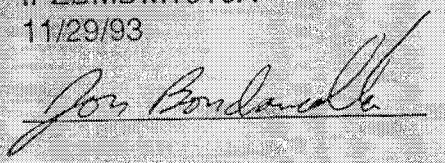
CONDUCTED SPURIOUS EMISSIONS TEST CONFIGURATION

TABLE 1. SPURIOUS EMISSIONS AT THE ANTENNA TERMINAL
POWER LEVEL 6.5 (dBm)

EMISSION FREQUENCY (MHz)	EMISSION LEVEL (dBc)	FCC LIMIT (dBc)
915.048	-50.3	-19.0
1372.572	-66.0	-19.0
1830.096	-48.1	-19.0
2287.620	-61.2	-19.0
2745.144	<-77.0	-19.0
3202.668	-66.1	-19.0
3660.192	<-77.0	-19.0
4117.716	<-77.0	-19.0
4575.240	<-77.0	-19.0

Emission levels preceded by a "<" indicate frequencies which were found to be below the spectrum analyzer's noise as indicated.

Client: Hewlett-Packard Company
FCC ID: IPZBMDM1310A
Test Date: 11/29/93

Test Engineer: 

CARL T. JONES
CORPORATION

2.993 Radiated Spurious Emissions

Field strength measurements of radiated spurious emissions were made on the three-meter range maintained by Carl T. Jones Corporation at the Springfield facility. Complete description and measurement data have been placed on file with the Commission. The equipment was scanned for radiated emissions in a shielded enclosure prior to open field testing. The transmitter output was terminated with the standard patient leads provided with the transmitter. Although these leads also act as the transmitter's antenna system, if the system demonstrates compliance in this configuration, the results can definitely be considered worst case. The normal configuration for this test is to terminate the transmitter's output with a non-radiating load operating at the transmitter's characteristic impedance. However, implementation of this configuration would require either significant modification to the transmitter's construction or the use of the manufacturer's test fixture. The test fixture uses a large ground plane which would distort the fields being measured. Since it was expected that the spurious radiated emissions would be extremely small, it was decided to test with the patient leads. This configuration most closely represents normal operation.

The transmitter was placed on a rotatable wooden test stand approximately one meter in height. The emission spectrum was examined up to 5.0 GHz using a Hewlett-Packard Model 8592A spectrum analyzer and Antenna Corporation of America 2203-LJ N log periodic antenna. Measurements below 1.0 GHz were made using Compliance Design "Roberts" tuned dipole antennas. A Hewlett-Packard Model 8447E broadband amplifier was used to provide approximately 27 dB gain when necessary. At each frequency, the device was rotated through 360 degrees, and the antenna was raised and lowered from one to four meters. Measurements were made using both vertically and horizontally polarized antennas. In each case, only the maximum radiation measured was recorded for this report. All emissions not reported were more than 20 dB below the specified limit.

The reference level for spurious radiations was taken at an ideal dipole exited by the rated output power according to the following relationship:[1]

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[1]Reference Data for Radio Engineers, Page 676. International Telephone and Telegraph Corporation, Fourth Edition.

$$E = \frac{[49.2 \times Pt]^{1/2}}{R}$$

Where E = Electric Field Intensity in Volts/Meter
P_t = Transmitter Power in Watts
R = Distance in Meters

At a maximum power of 4.0 milliwatts,

$$E = \frac{[49.2 \times 0.004]^{1/2}}{3} = 0.148 \text{ V/m} = 103.4 \text{ dBuV/m}$$

Paragraph 90.209 requires that the spurious radiated emissions be attenuated at least 43 + 10 log (mean output power in Watts) below the unmodulated carrier. In this case, the equipment's rated power of 4.0 milliwatts requires a minimum attenuation of 43 + 10 log 0.004 = 19 dB below the reference level of 103.4 dBuV/m calculated above. The data, as reported in Table 2, clearly meet this restriction.

TABLE 2. FIELD STRENGTH OF RADIATED EMISSIONS

EMISSION FREQUENCY (MHz)	ANTENNA POLARITY (H,V)	EMISSION LEVEL (dBm)	ANTENNA FACTOR (dB)	EMISSION LEVEL (dBuV/m)	EMISSION LEVEL (dBc)	FCC LIMIT (3 METERS) (dBc)
571.900	H	-93.4	31.6	45.2	-58.2	-19.0
686.280	H	-94.9	33.5	45.6	-57.8	-19.0
915.048	H	-93.9	38.4	51.5	-51.9	-19.0
1372.572	H&V	<-86.0	30.0	<51.0	<-52.4	-19.0
1830.096	H&V	<-86.0	33.5	<54.5	<-48.9	-19.0
2287.620	H&V	<-86.0	36.5	<57.5	<-45.9	-19.0
2745.144	H&V	<-86.0	39.0	<60.0	<-43.4	-19.0
3202.669	H&V	<-86.0	41.0	<62.0	<-41.4	-19.0

Client: Hewlett-Packard Company
FCC ID: IPZBMDM1310A
Test Date: 11/29/93

Test Engineer: Jon Bondurant

2.995 Frequency Stability Versus Temperature and Supply Voltage

The transmitter was placed in a Thermotron Model S-4 Temperature Chamber. The 4.5 Volt supply voltage was provided by an external DC power supply to allow precise control of the voltage for the tests. At each temperature setting, the transmitter was turned on from a cold start. Output frequency was measured directly with a Marconi 2305 modulation analyzer. The temperature was set at 10° intervals between -30° C and +50° C. At each setting, the device was allowed to stabilize for thirty minutes before the measurement was made. The data are reported in Table 3 below.

Paragraph 90.213 of the Commission's Rules specifies a tolerance of ±0.005% of the carrier frequency for mobile stations. For a transmitter operating at 457.5243 MHz, this tolerance translates into an allowed frequency error of ±2288 Hz. The data contained in Table 3 did not meet this restriction, since the device was not designed to operate in extreme environmental conditions. Because of the nature of the device, it will always be operated in a controlled environment such as a hospital. However, the provisions of Paragraph 90.217 provide an alternative for transmitters which operate at 120 milliwatts or less. Since this transmitter has a maximum power output of 4 milliwatts, it clearly qualifies for this provision. The data do support a frequency tolerance rating of ±3500 Hz.

This rating was used to determine compliance with the provisions of Paragraph 90.217 in conjunction with the occupied bandwidth measurements described earlier.

Using the same configuration discussed above, the supply voltage of 4.5 Volts DC was varied ±15% while the temperature was maintained at 20° C. The carrier frequency was measured directly from the output of the transmitter with a Marconi 2305 modulation analyzer, and the results were recorded in Table 4. The transmitter continuously maintained the rated frequency tolerance.

TABLE 3. FREQUENCY STABILITY VS. TEMPERATURE

TEMPERATURE (°C)	FREQUENCY (MHz)	ERROR (Hz)	FCC LIMIT (Paragraph 90.213) (Hz)
-30	457.52100	-3300	±2288
-20	457.52218	-2120	±2288
-10	457.52366	-640	±2288
0	457.52390	-400	±2288
10	457.52445	+150	±2288
20	457.52445	+150	±2288
30	457.52416	-140	±2288
40	457.52386	-440	±2288
50	457.52378	-520	±2288

TABLE 4. FREQUENCY STABILITY VS. SUPPLY VOLTAGE

SUPPLY (V DC)	VOLTAGE (%)	FREQUENCY (MHz)	ERROR (Hz)	FCC LIMIT (Hz)
3.60	80	457.52413	-170	±2288
3.83	85	457.52413	-170	±2288
4.05	90	457.52414	-160	±2288
4.28	95	457.52414	-160	±2288
4.50	100	457.52414	-160	±2288
4.73	105	457.52414	-160	±2288
4.95	110	457.52414	-160	±2288
5.18	115	457.52415	-150	±2288

Client: Hewlett-Packard Company
FCC ID: IPZBMDM1310A
Test Date: 11/29/93

Test Date: Jon Bordewick

CARL T. JONES