2.8 Antenna Conducted Spurious Emission in the Frequency Range 30 - 10000 MHz (FCC Section 15.247(c))

Spurious emissions in the frequency range 30 - 10000 usually are measured with a spectrum analyzer by connecting the spectrum analyzer directly via a short cable to the antenna output terminals or across the antenna leads on the PCB as specified by the manufacturer.

Since the EUT does not contain a removable antenna, this test was deemed unnecessary.

Figure 4a
Antenna Conducted Spurious Emissions 15.247(c) Low

EUT does not have an external antenna port, therefore antenna conducted emissions were deemed not applicable

2.9 Peak Radiated Spurious Emission in the Frequency Range 30 -10000 MHz (FCC Section 15.247(c))

A preliminary scan was performed on the EUT to determine frequencies that were caused by the transmitter portion of the product. Significant emissions that fell within restricted bands were then measured on an OAT's site. Radiated measurements below 1 GHz were tested with a RBW = 120 kHz. Radiated measurements above 1 GHz were measured using a RBW = VBW = 1 MHz. The results of peak radiated spurious emissions falling within restricted bands are given in Table 4a (low), Table 4b, (mid), Table 4c (high) and Figure 5a (low), Figure 5b (mid) and Table 5c (high).

Figure 5a
Peak Radiated Spurious Emission 15.247(c) Low

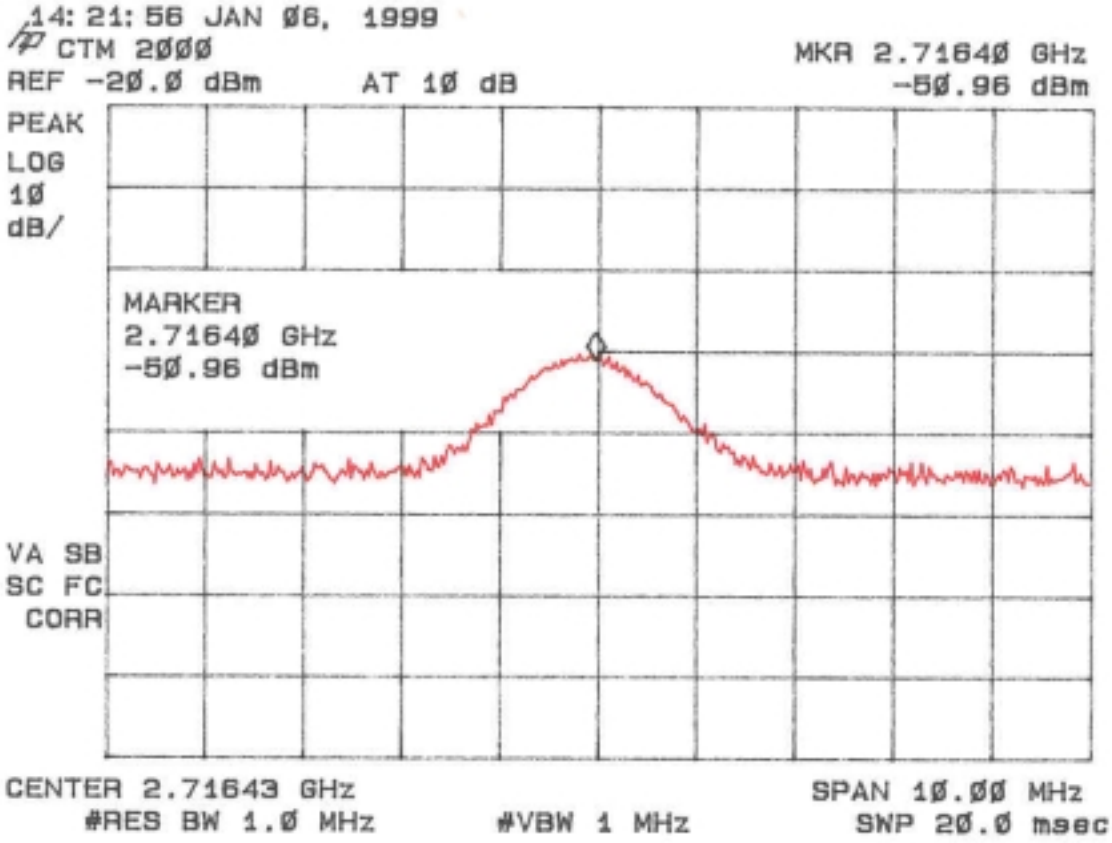

Figure 5b
Peak Radiated Spurious Emission 15.247(c) Low

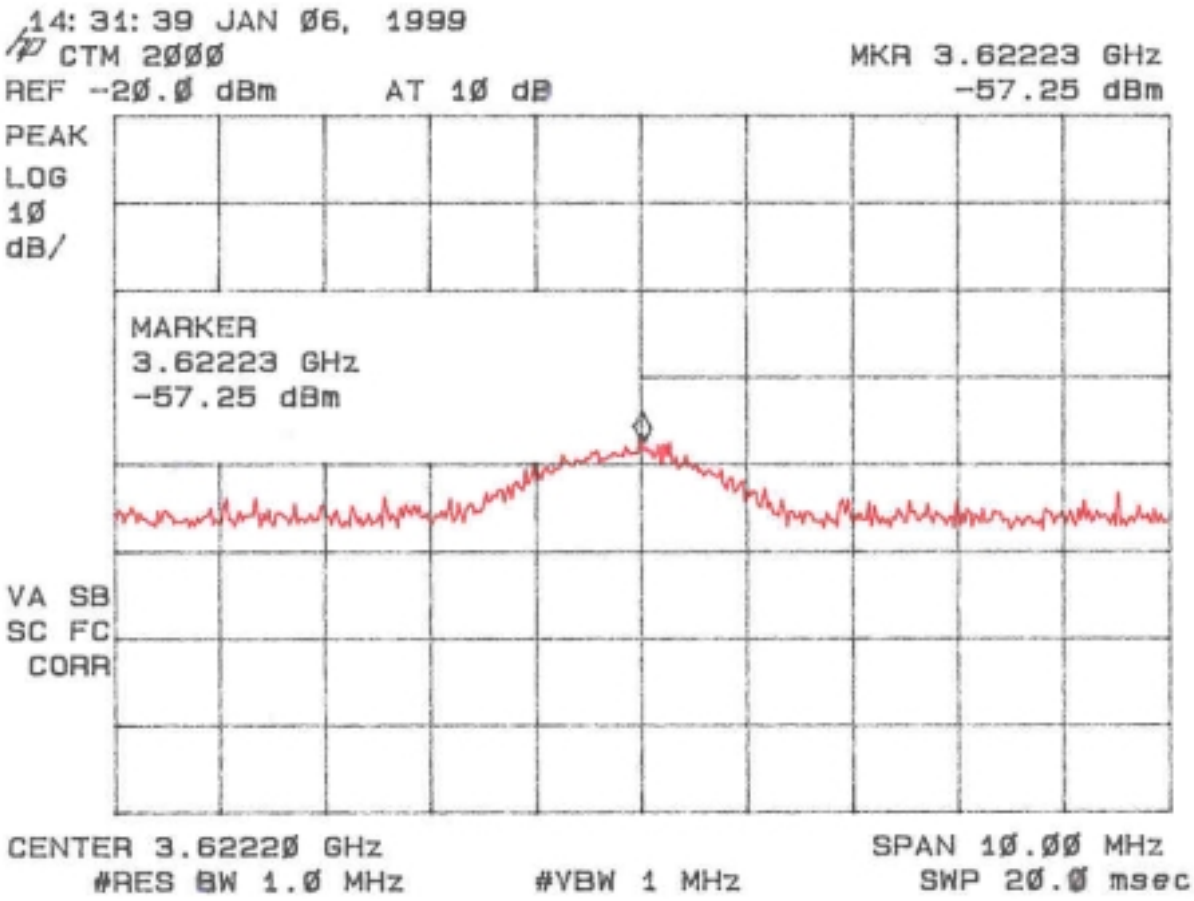

Figure 5c
Peak Radiated Spurious Emission 15.247(c) Low

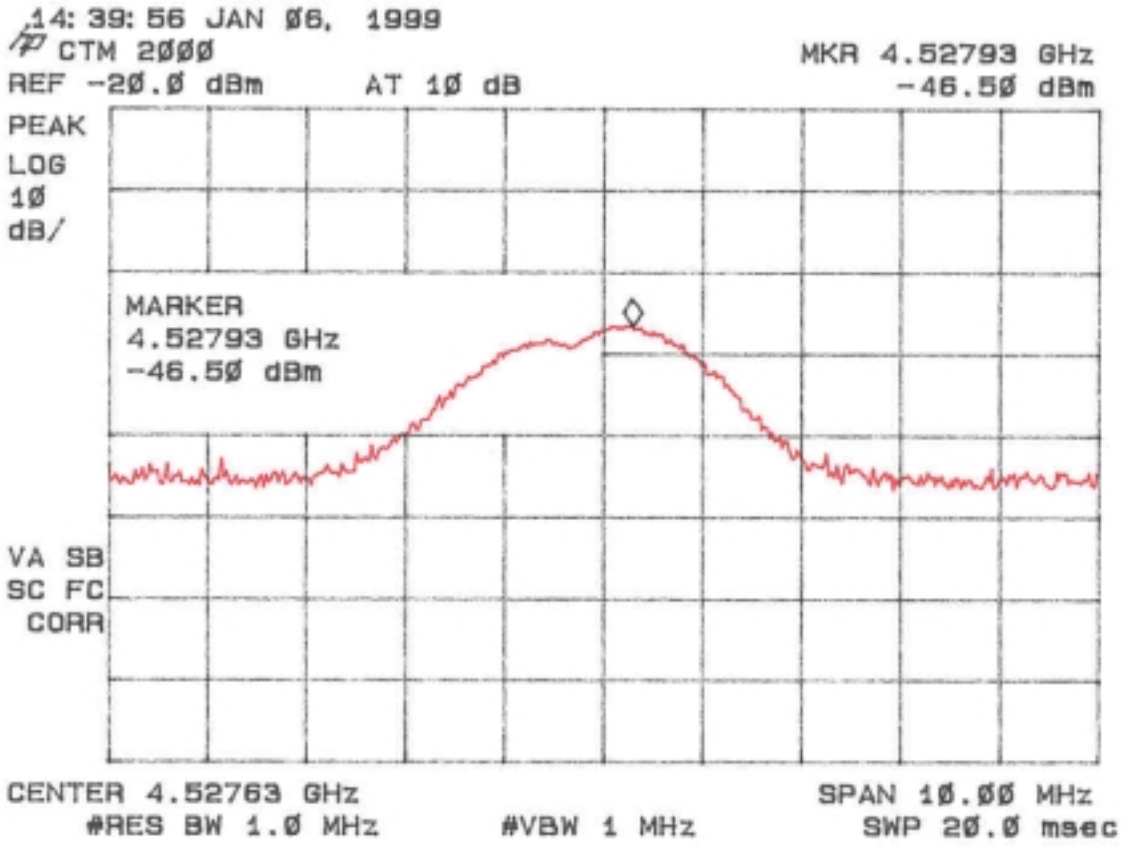

Figure 5d
Peak Radiated Spurious Emission 15.247(c) Low

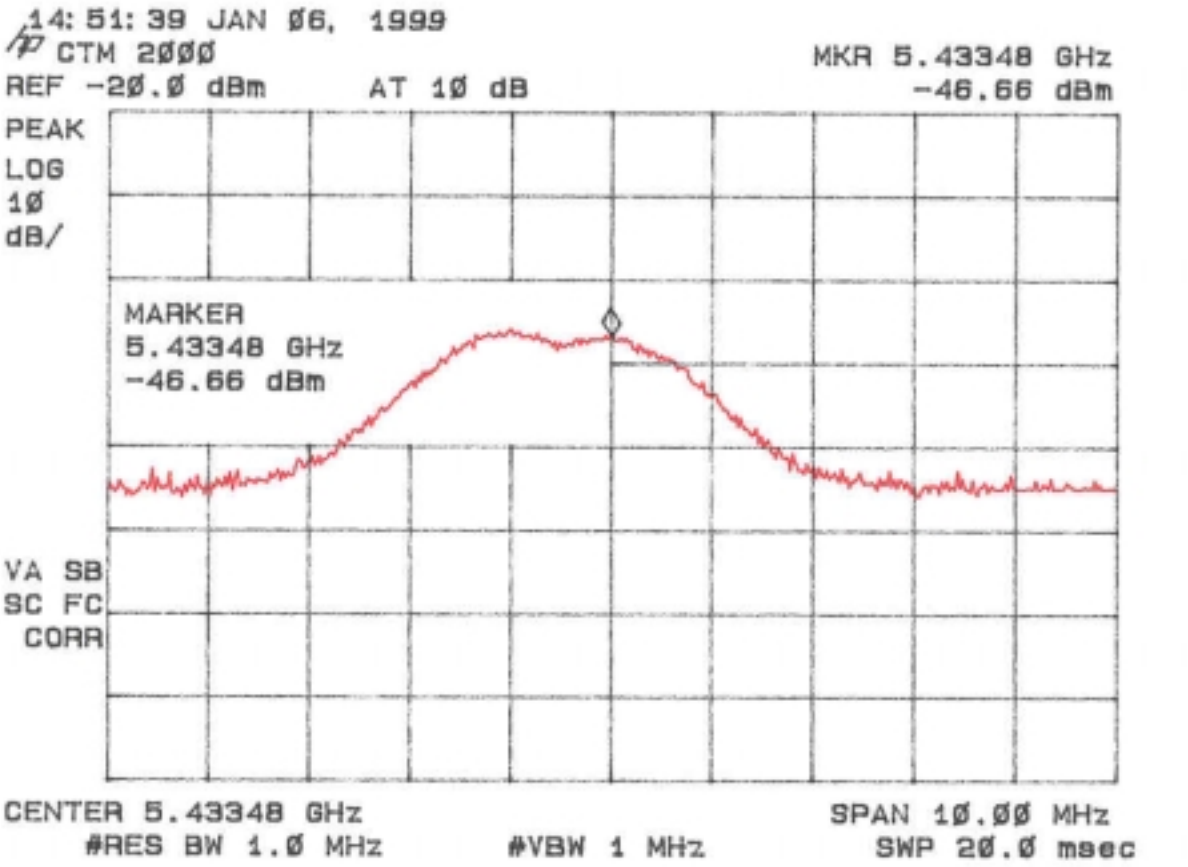

Figure 5e
Peak Radiated Spurious Emission 15.247(c) Mid

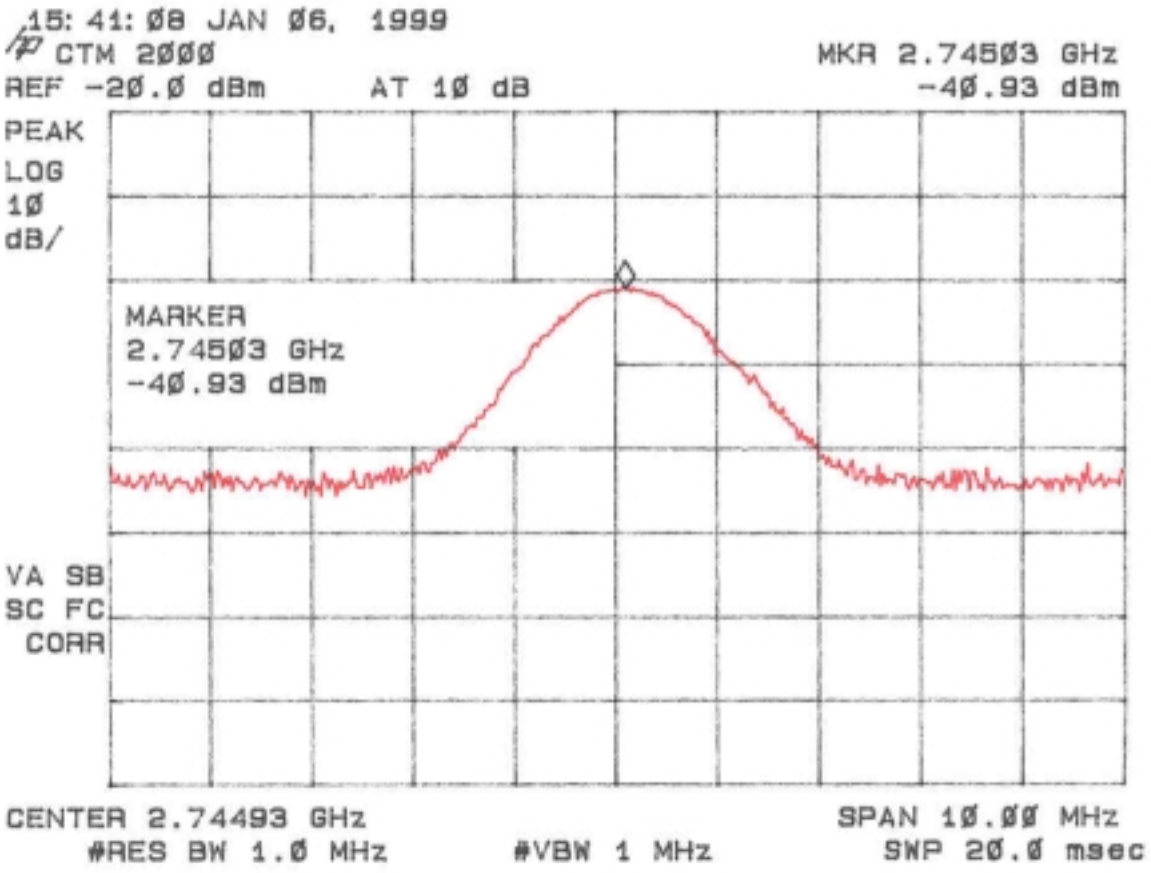

Figure 5f
Peak Radiated Spurious Emission 15.247(c) Mid

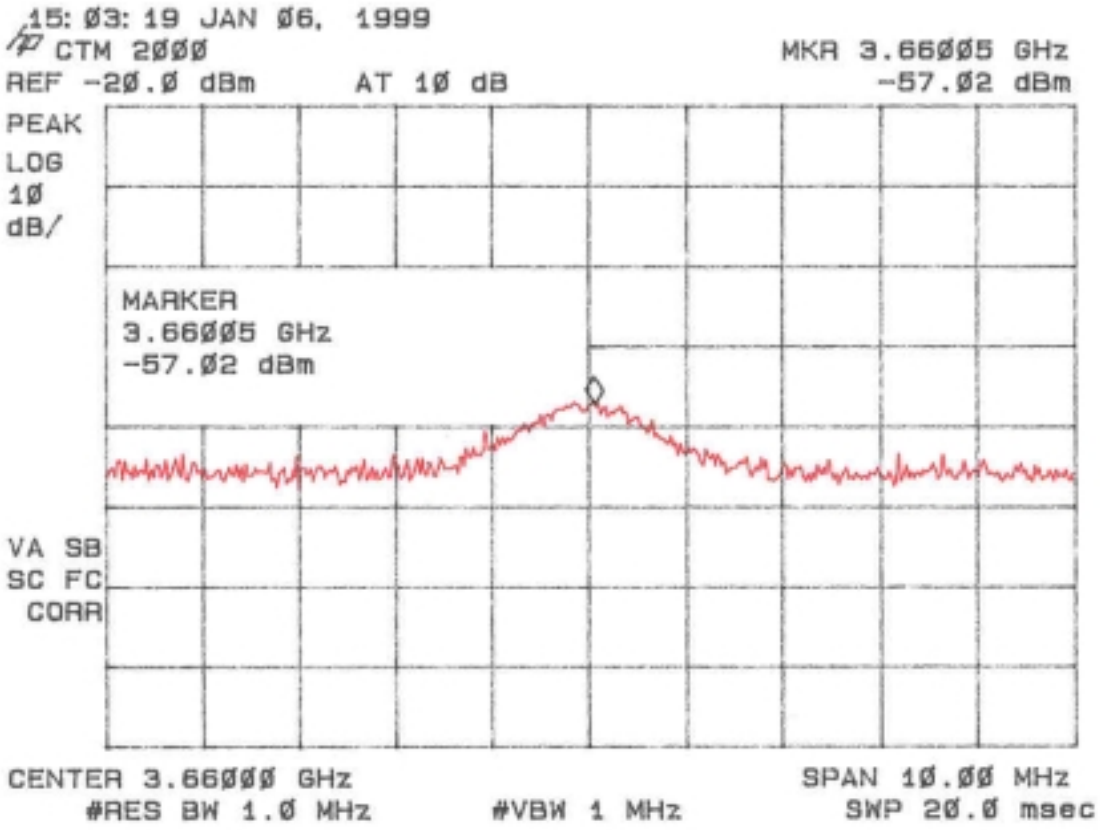

Figure 5g
Peak Radiated Spurious Emission 15.247(c) Mid

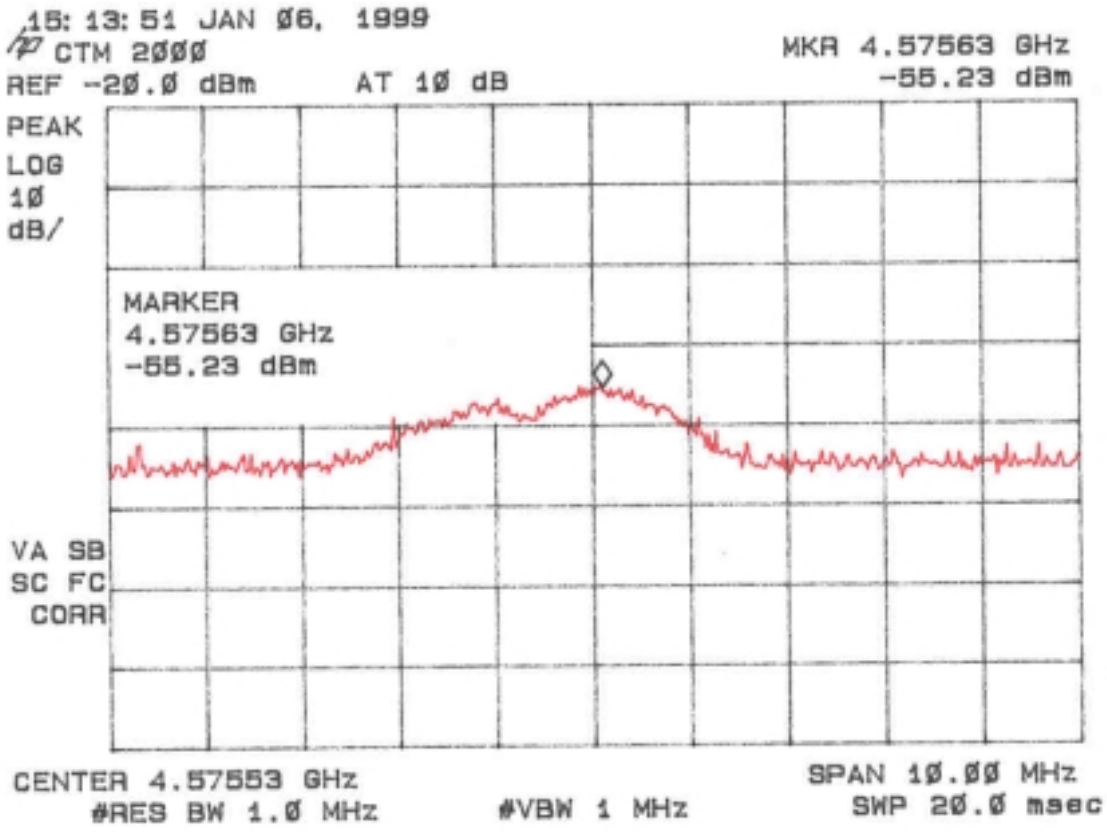

Figure 5h
Peak Radiated Spurious Emission 15.247(c) Mid

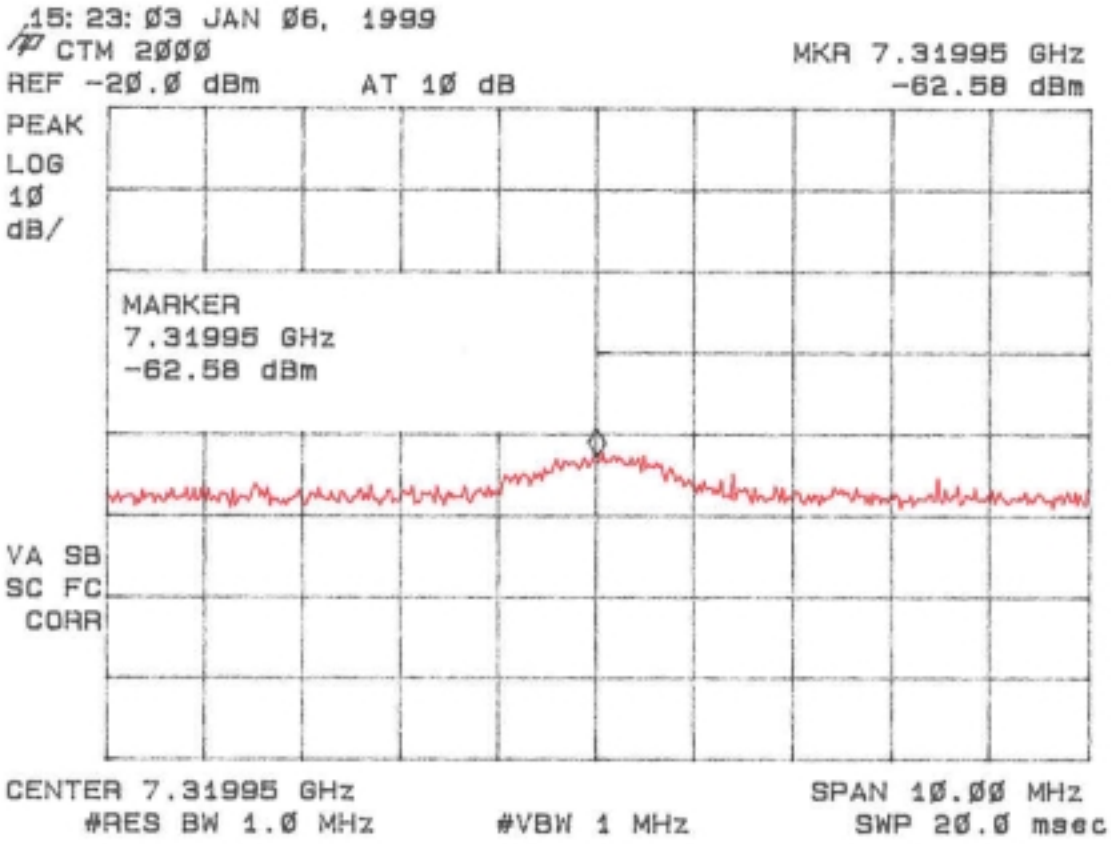

Figure 5i
Peak Radiated Spurious Emission 15.247(c) High

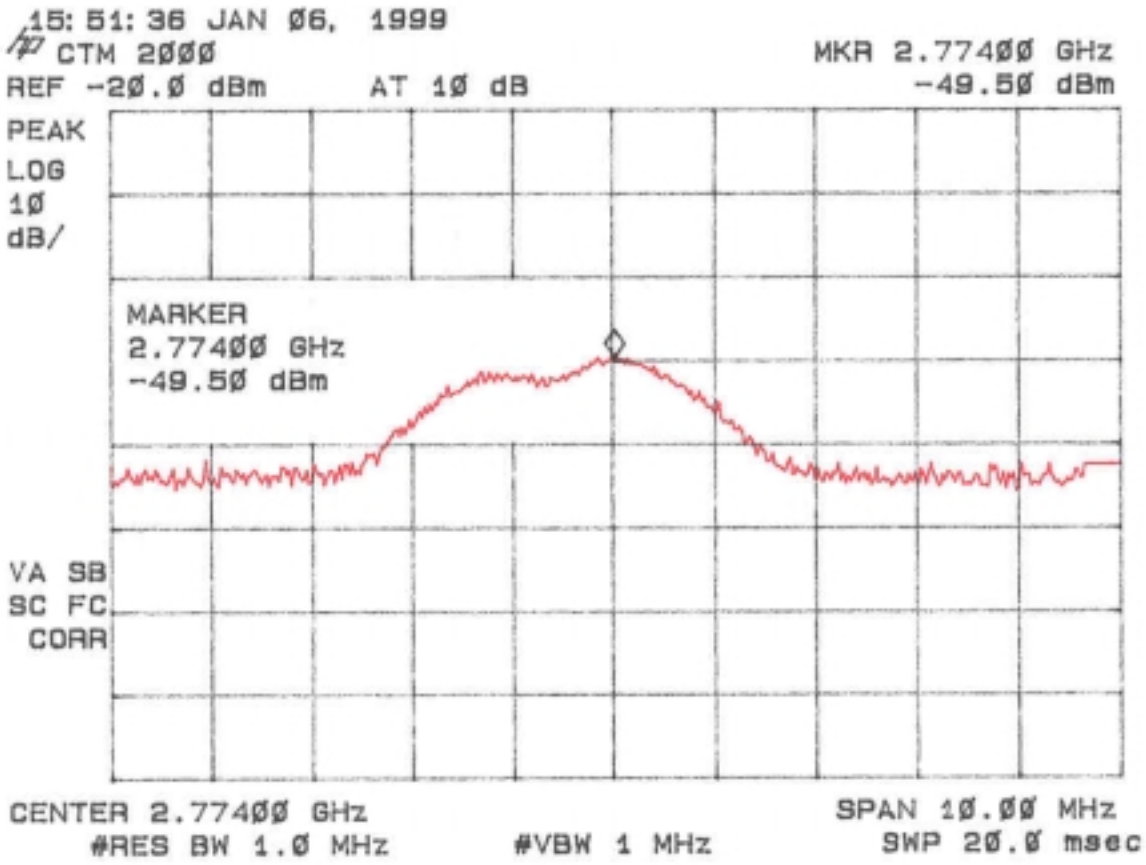

Figure 5j
Peak Radiated Spurious Emission 15.247(c) High

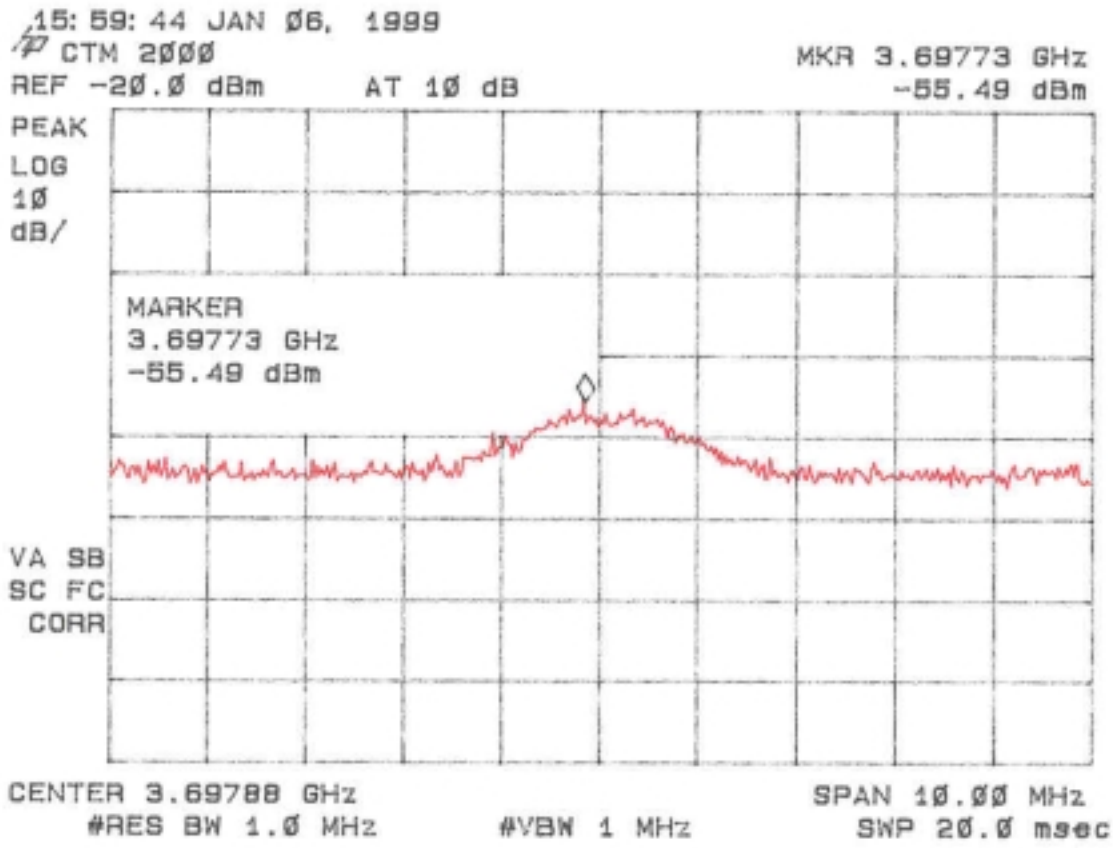

Figure 5k
Peak Radiated Spurious Emission 15.247(c) High

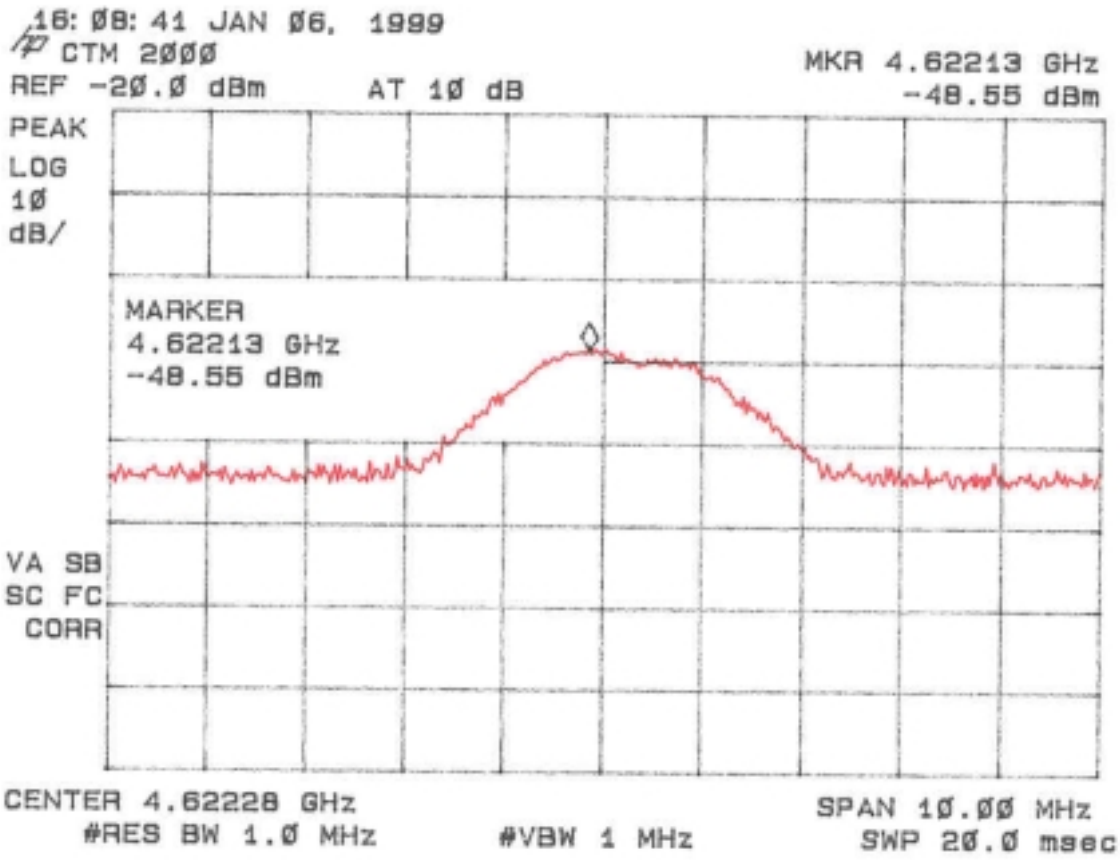

Figure 5l
Peak Radiated Spurious Emission 15.247(c) High

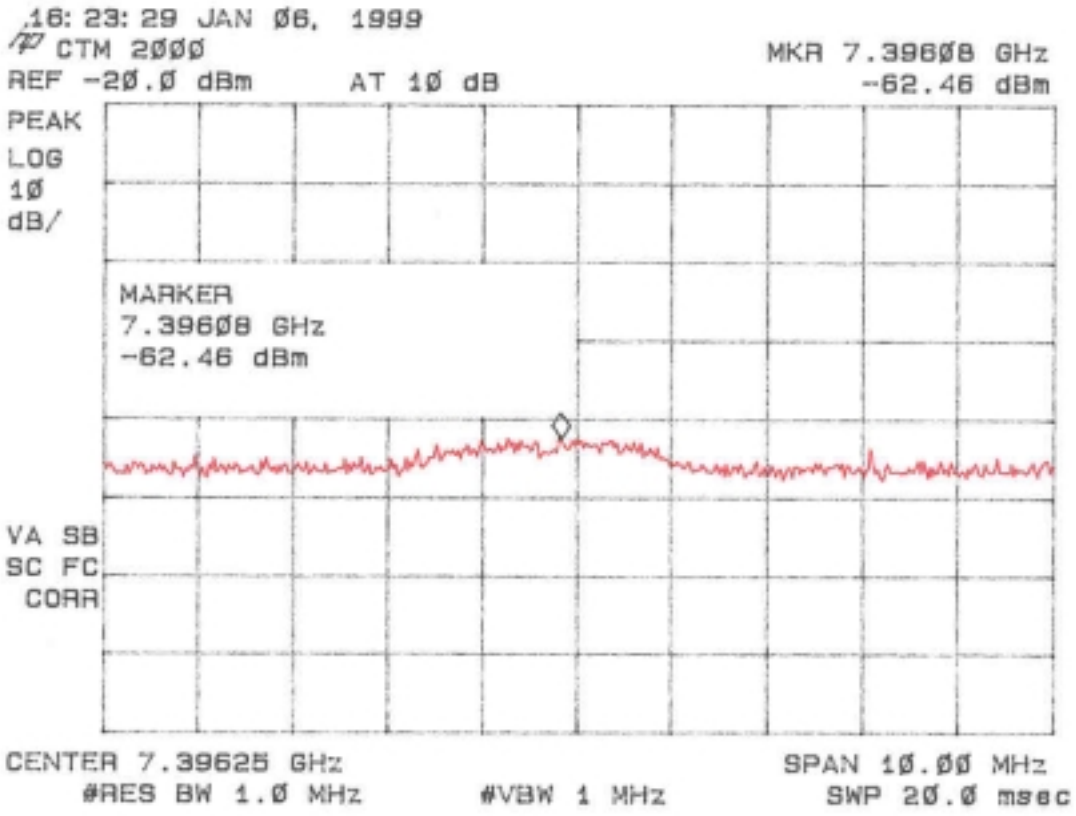

TABLE 4a PEAK RADIATED SPURIOUS EMISSIONS (Low)

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
2.716	-50.0	34.6	31.4	3.8	758.8	5000
3.622	-56.3	34.4	33.0	4.4	486.2	5000
4.528	-45.5	34.3	34.2	4.4	1956.1	5000
5.433	-45.7	34.2	36.0	4.9	2526.0	5000

TABLE 4b PEAK RADIATED SPURIOUS EMISSIONS (Mid)

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
2.745	-39.9	34.6	31.4	3.8	2438.7	5000
3.660	-56.0	34.4	33.2	4.5	513.1	5000
4.576	-54.2	34.3	34.3	4.4	722.4	5000
7.320	-61.6	34.5	37.2	6.8	557.7	5000

*** = Data adjusted by + 1 dB for high pass filter**
**** = Instrumentation ground floor**

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-50.0 - 34.6 + 31.4 + 3.8 + 107)/20) = 758.8
CONVERSION FROM dBm TO dBuV = 107 dB

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TABLE 4c PEAK RADIATED SPURIOUS EMISSIONS (High)

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
2.774	-48.5	34.6	31.5	3.8	910.3	5000
3.698	-54.5	34.4	33.3	4.5	621.7	5000
4.622	-47.6	34.3	34.4	4.3	1552.7	5000
7.396	-61.5	34.5	37.4	6.8	578.7	5000

*** = Data adjusted by + 1 dB for high pass filter**
**** = Instrumentation ground floor**

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-48.5 - 34.6 + 31.5 + 3.8 + 107)/20) = 910.3
CONVERSION FROM dBm TO dBuV = 107 dB

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2.10 Average Spurious Emission in the Frequency Range 30 - 10000 MHz (FCC Section 15.247(c))

The results of average radiated spurious emissions falling within restricted bands are given in Table 5a (low), Table 5b, (mid), Table 5c (high). Figures 6a & Figure 6b show the characteristics of the worse case duty cycle of the transmitter.

Duty Cycle Correction During 100 msec:

The EUT as measured was considered to be 0.016ms/100 ms = 16.0%

Duty Cycle correction = 20 log (0.016) = -15.9 dB

Figure 6a
Average Radiated Spurious Emission 15.247(c) Low

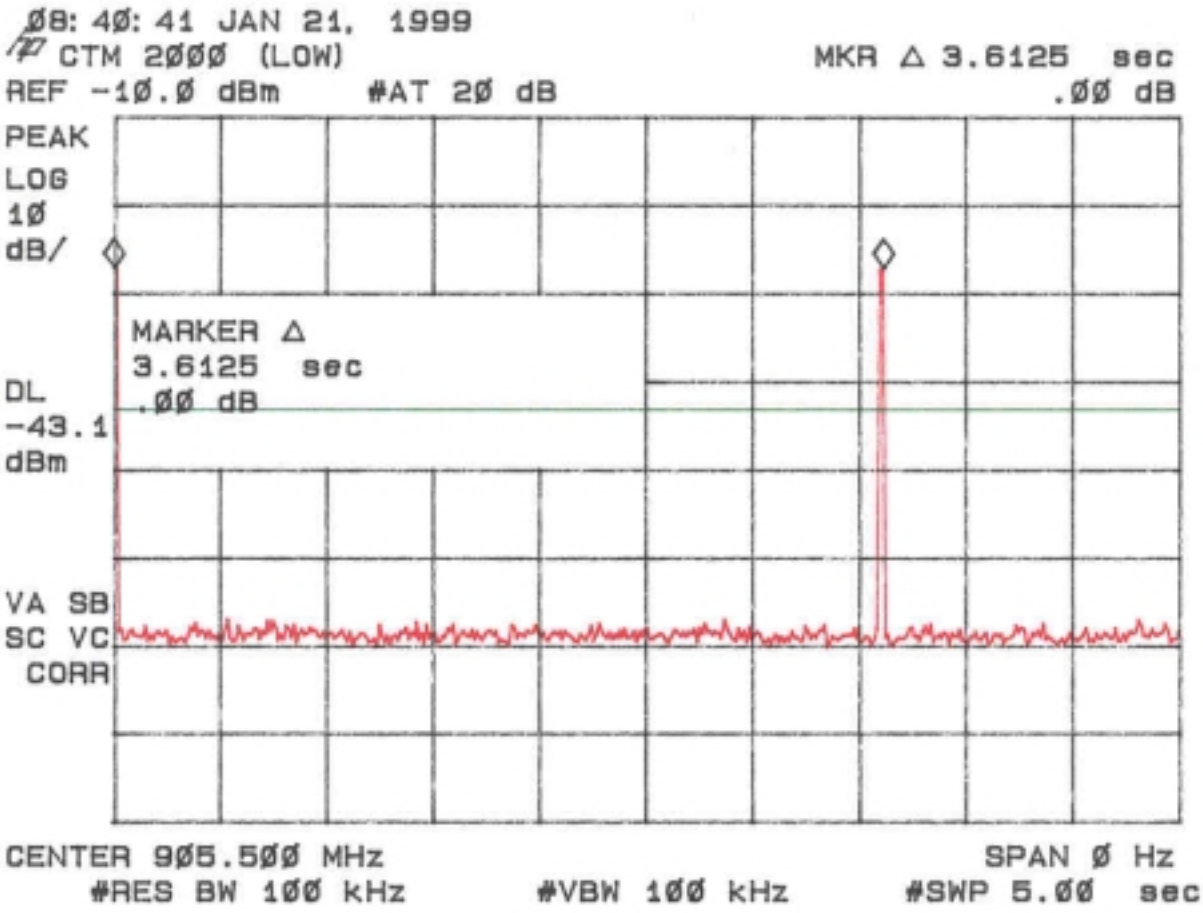

Figure 6b
Average Radiated Spurious Emission 15.247(c) Low

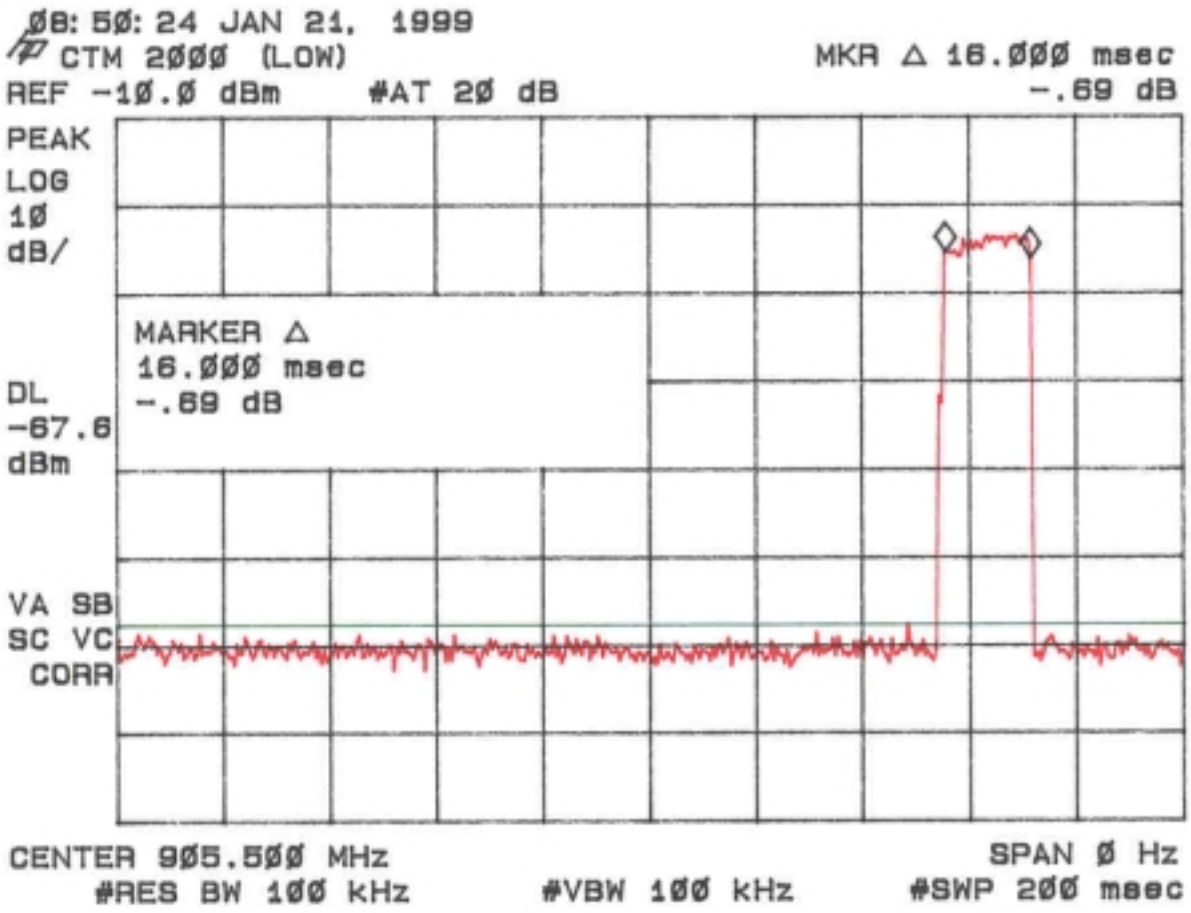

TABLE 5a AVERAGE RADIATED SPURIOUS EMISSIONS (Low)

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
2.716	-65.9	34.6	31.4	3.8	121.7	500
3.622	-72.2	34.4	33.0	4.4	78.0	500
4.528	-61.4	34.3	34.2	4.4	313.6	500
5.433	-61.6	34.2	36.0	4.9	405.0	500

TABLE 5b AVERAGE RADIATED SPURIOUS EMISSIONS (Mid)

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
2.745	-55.8	34.6	31.4	3.8	391.0	500
3.660	-71.9	34.4	33.2	4.5	82.3	500
4.576	-70.1	34.3	34.3	4.4	115.8	500
7.320	-77.5	34.5	37.2	6.8	89.4	500

*** = Data adjusted by + 1dB for high pass filter & 15.9 dB for duty cycle.**
**** = Instrumentation ground floor.**

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) =
Antilog ((-65.9 - 34.6 + 31.4 + 3.8 + 107)/20) = 121.7
CONVERSION FROM dBm TO dBuV = 107 dB

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TABLE 5c AVERAGE RADIATED SPURIOUS EMISSIONS (High)

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
2.774	-64.4	34.6	31.5	3.8	145.9	500
3.698	-70.4	34.4	33.3	4.5	99.7	500
4.622	-63.5	34.3	34.4	4.3	248.9	500
7.396	-77.4	34.5	37.4	6.8	92.8	500

*** = Data adjusted by + 1dB for high pass filter & 15.9 dB for duty cycle.**
**** = Instrumentation ground floor.**

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) =
Antilog ((-64.4 - 34.6 + 31.5 + 3.8 + 107)/20) = 145.9
CONVERSION FROM dBm TO dBuV = 107 dB

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2.11 Minimum 6 dB Bandwidth per FCC Section 15.247(a)(2)

The minimum requirement is given in Figure 7a through 7c. If the EUT incorporates different spreading codes or data rates these were each investigated and the one which produced the smallest 6 dB bandwidth was selected for test.

Figure 7a.
6 dB Bandwidth per FCC Section 15.247(a)(2) (low)

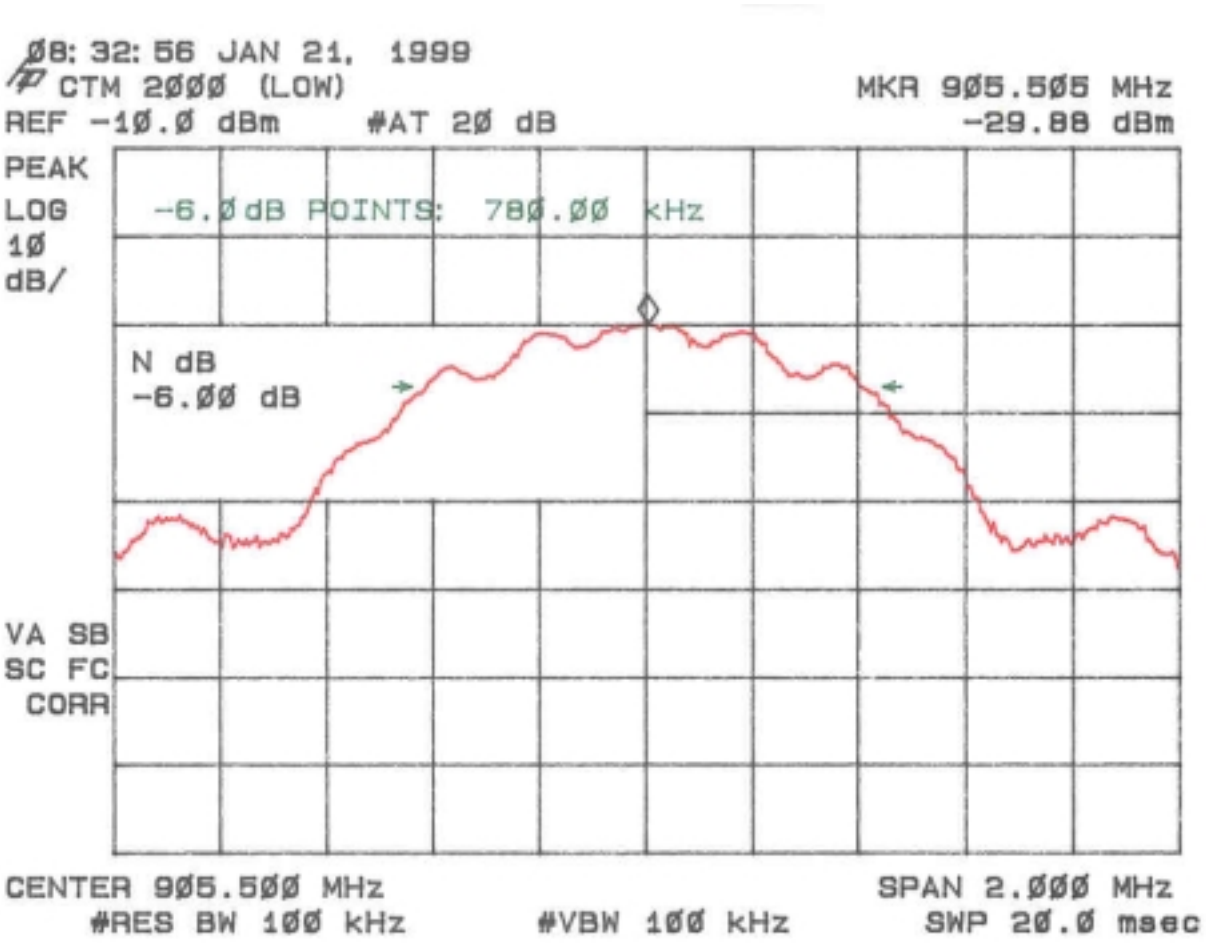


Figure 7b.
6 dB Bandwidth per FCC Section 15.247(a)(2) (Mid)

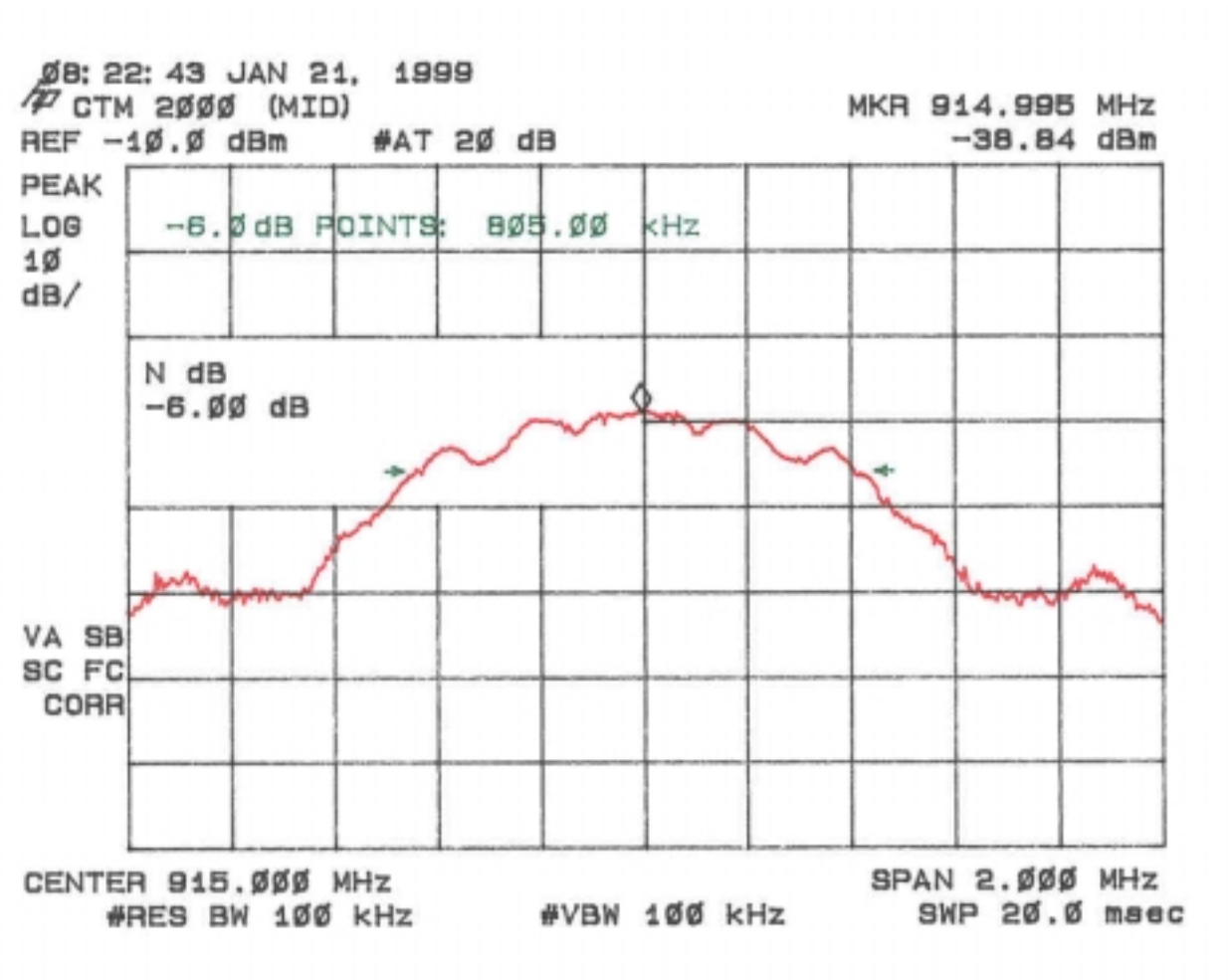
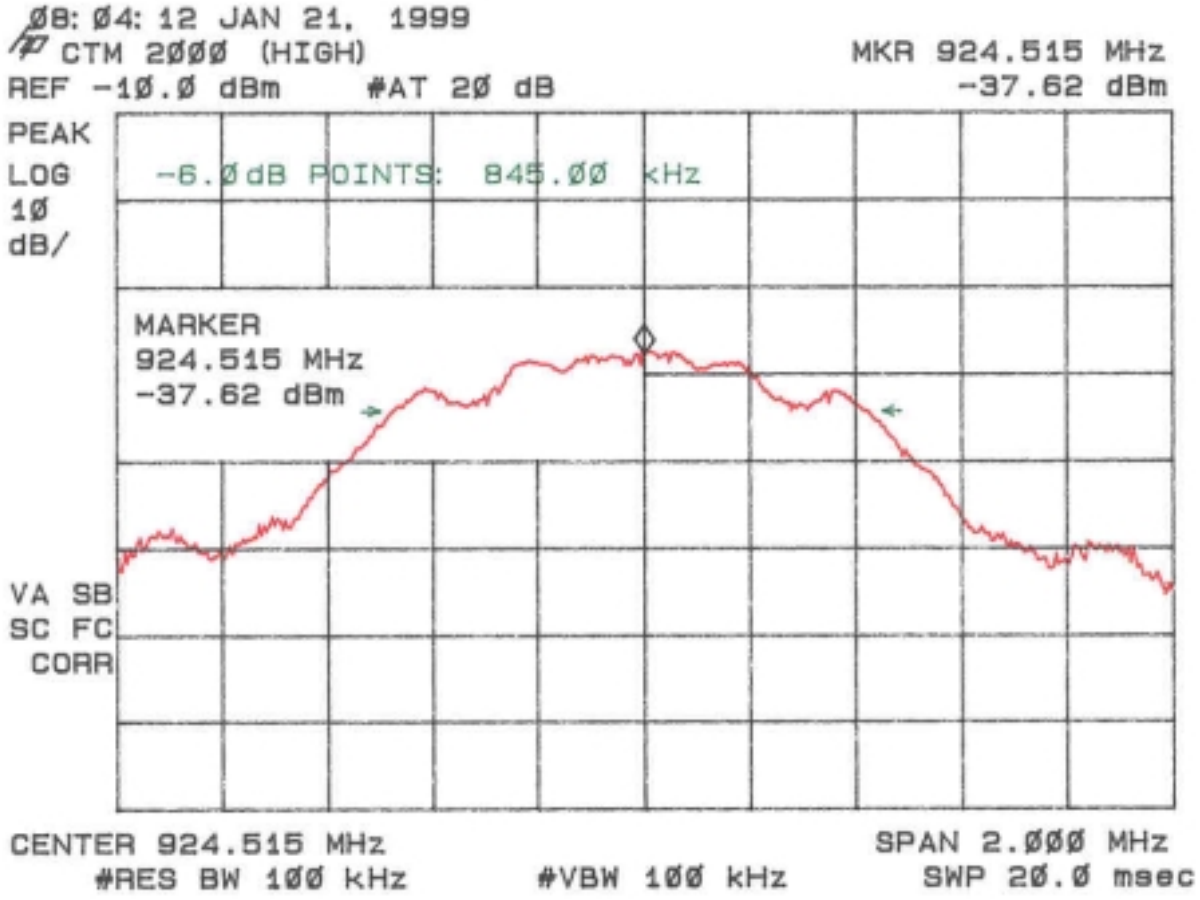


Figure 7c.
6 dB Bandwidth per FCC Section 15.247(a)(2) (High)



2.12 Power Spectral Density FCC Section 15.247(b) and 15.247(d)

The transmitter power Spectral density averaged over any 1 second interval is given in Table 7 and Figure 8. If the EUT incorporates different spreading codes or data rates these were each investigated and the one which produced the smallest 6 dB bandwidth was selected for test. Since the EUT was not capable of being directly attached to a spectrum analyzer, the following method was employeed.

The EUT was maximized at one of its fundamental emissions. A spectrum analyzer was tuned to the highest point of the emission and adjusted to RBW = 3 kHz, VBW > RBW, span 300 kHz, sweep = 100 sec. From the peak level obtained, the field strength was obtained and then compared to the limit based on the following formula:

$$\text{Power Received (E)} = (30*P*G)^{½} / d$$

Where

E= the measured maximum field strength in V/m
G = the numeric gain of the transmitting antenna over an isotropic radiator
D = the distance in meters from which the field strength was measured
P = the power in watts

$$P = (E*d)^2/30 * G$$

TABLE 7
POWER SPECTRAL DENSITY

Test Date: **February 15, 1999**
UST Project: **CTM 2000, WRM-9201**
Customer: **MGP Instruments, Inc.**
Model: **Transmitter, CTM 2000, WRM-9201**

Frequency of Fundamental (MHz)	Measurement @3m* (dBm)	Antenna Factor + Cable Loss (dB)	Calculated Power of Transmitter (dBm)	FCC Limit (dBm)
905.5	-50.83	30.7	-8.2	8.0

SAMPLE CALCULATIONS:

SAMPLE CALCULATION:
RESULTS (V/m @ 3m) = Antilog ((-50.8 + 30.7 + 107)/20)) * 10^{-6} = 0.02213 V/m
RESULTS $W_{transmitted}$ = $(0.02213* 3)^2$ /(30*1.0) = 0.15 mW
RESUTLS dBm = 10 log ($W_{transmitted}$ in mW) = -8.2 dBm
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Tim R. Johnson

Figure 8a
Power Spectral Density 15.247(b) and 15.247(d) Low