2.9 Peak Radiated Spurious Emission in the Frequency Range 30 - 25000 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-5b (low), Figure 5c-5f (mid) and Table 5g-5j (high).

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

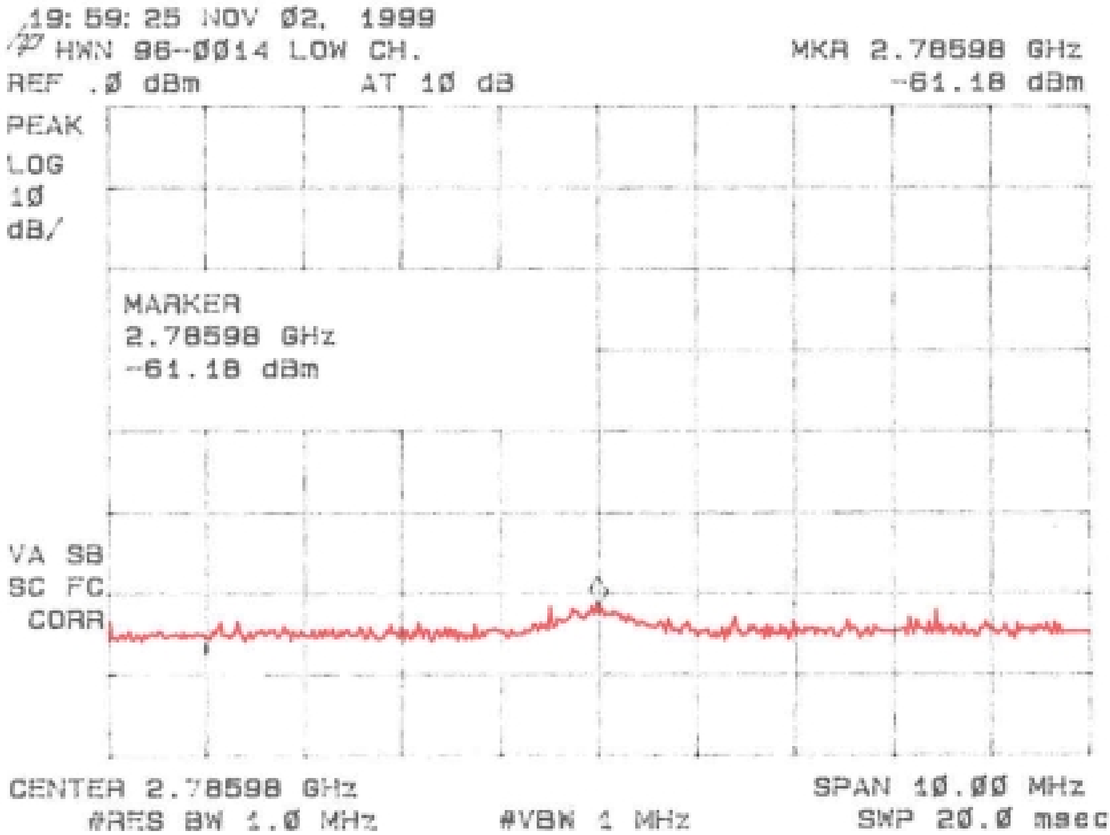


Figure 5b
Peak Radiated Spurious Emission 15.247(c) Low

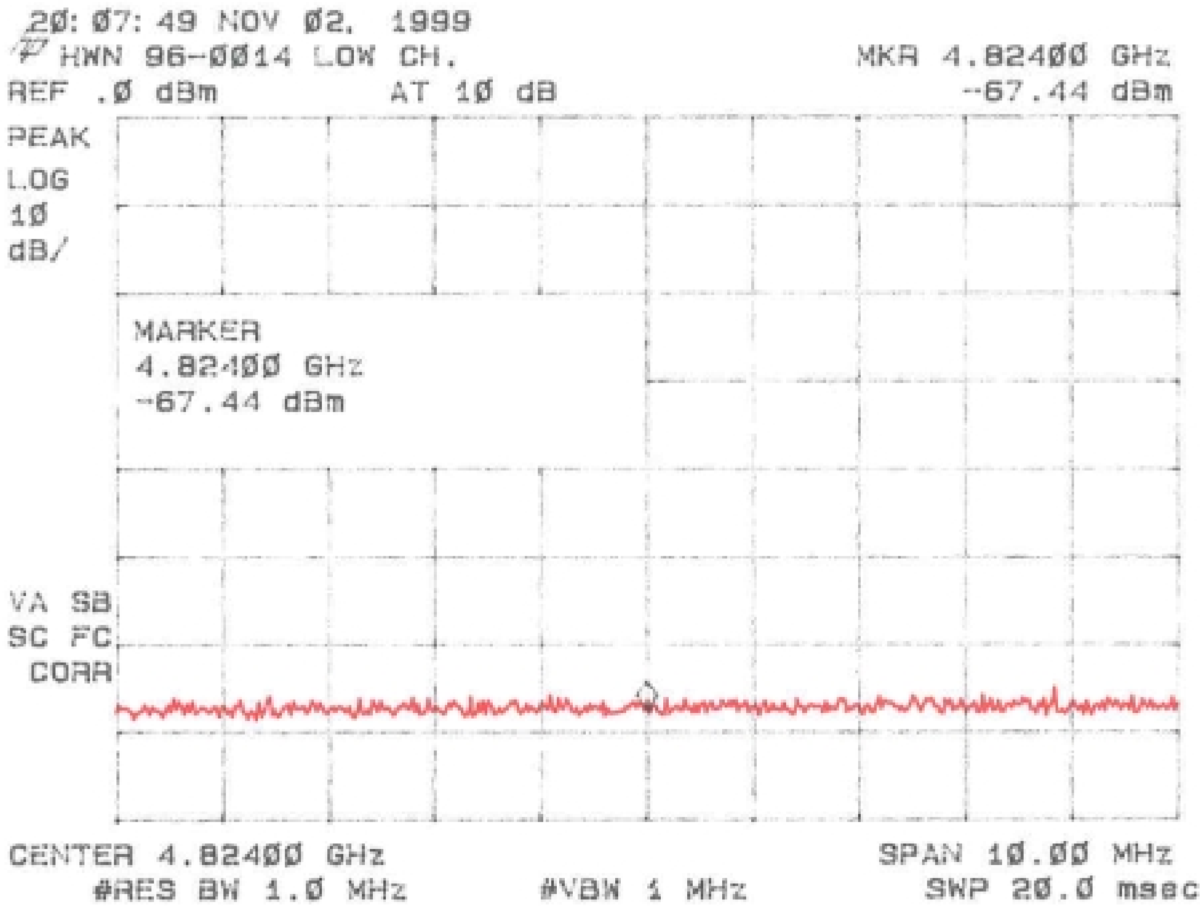


Figure 5c
Peak Radiated Spurious Emission 15.247(c) Mid

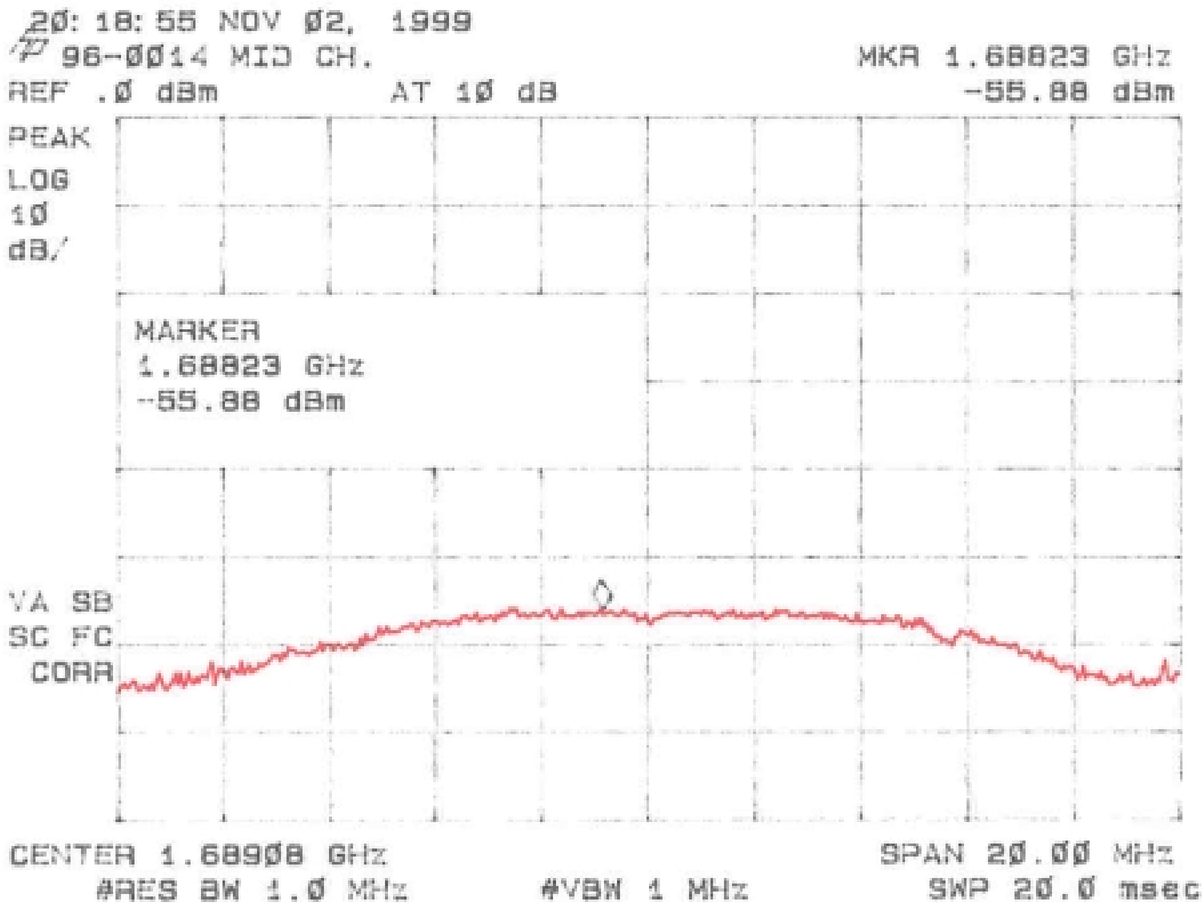


Figure 5d
Peak Radiated Spurious Emission 15.247(c) Mid

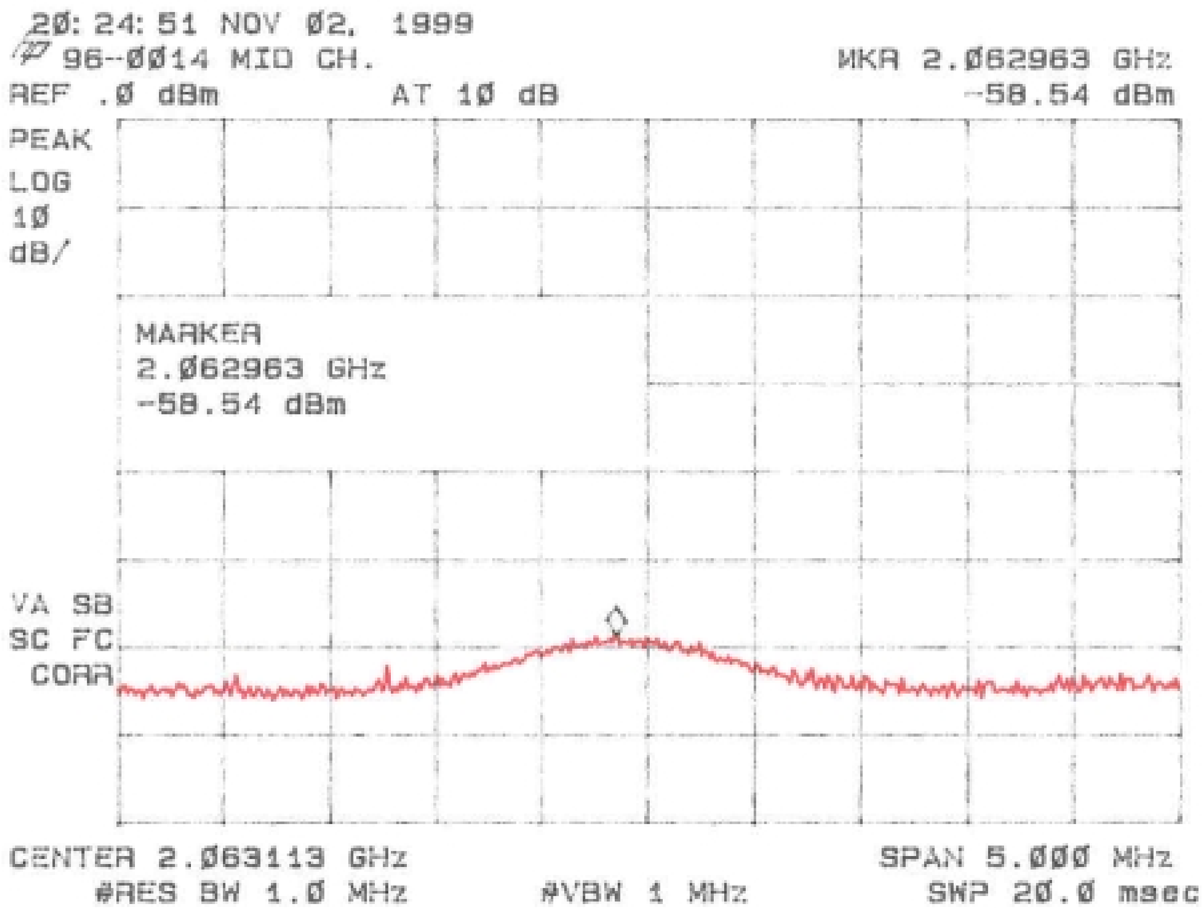


Figure 5e
Peak Radiated Spurious Emission 15.247(c) Mid

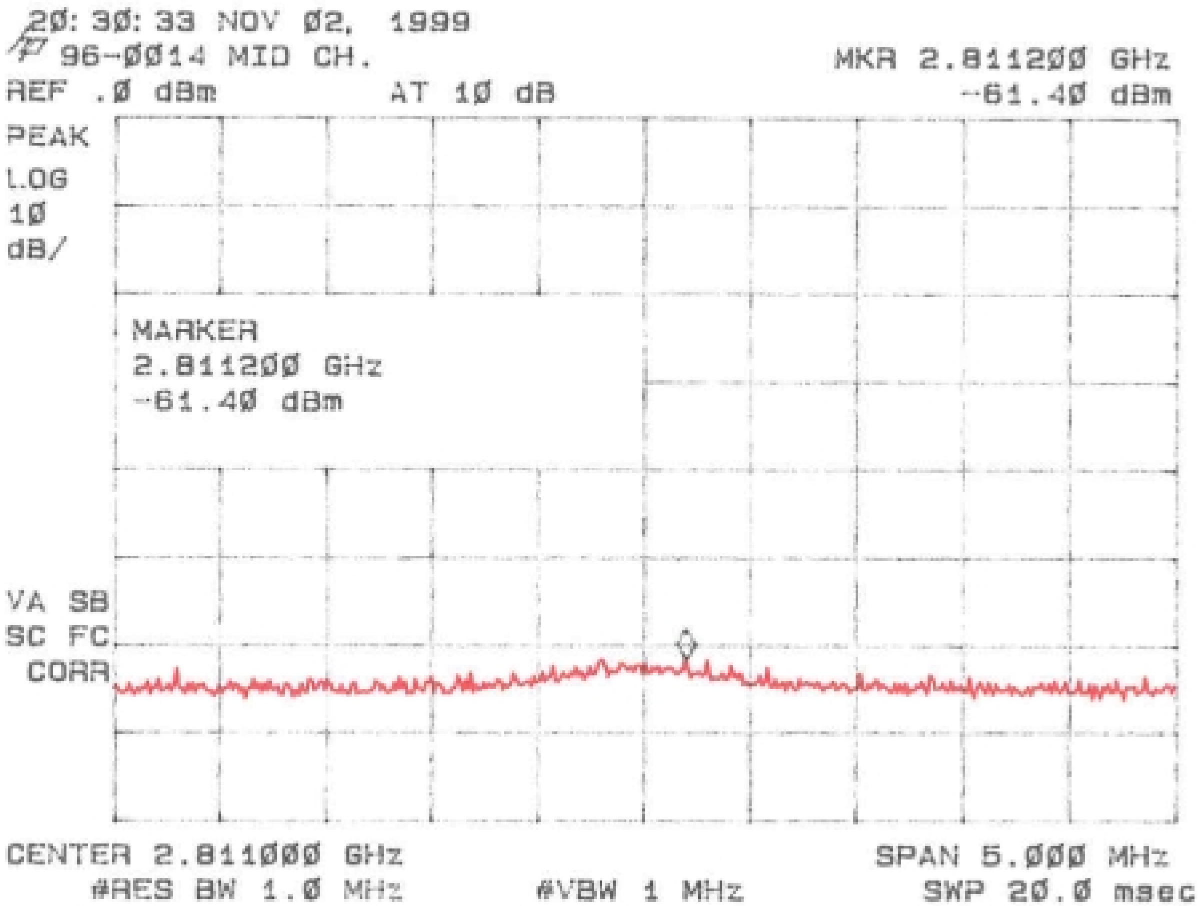


Figure 5f
Peak Radiated Spurious Emission 15.247(c) Mid

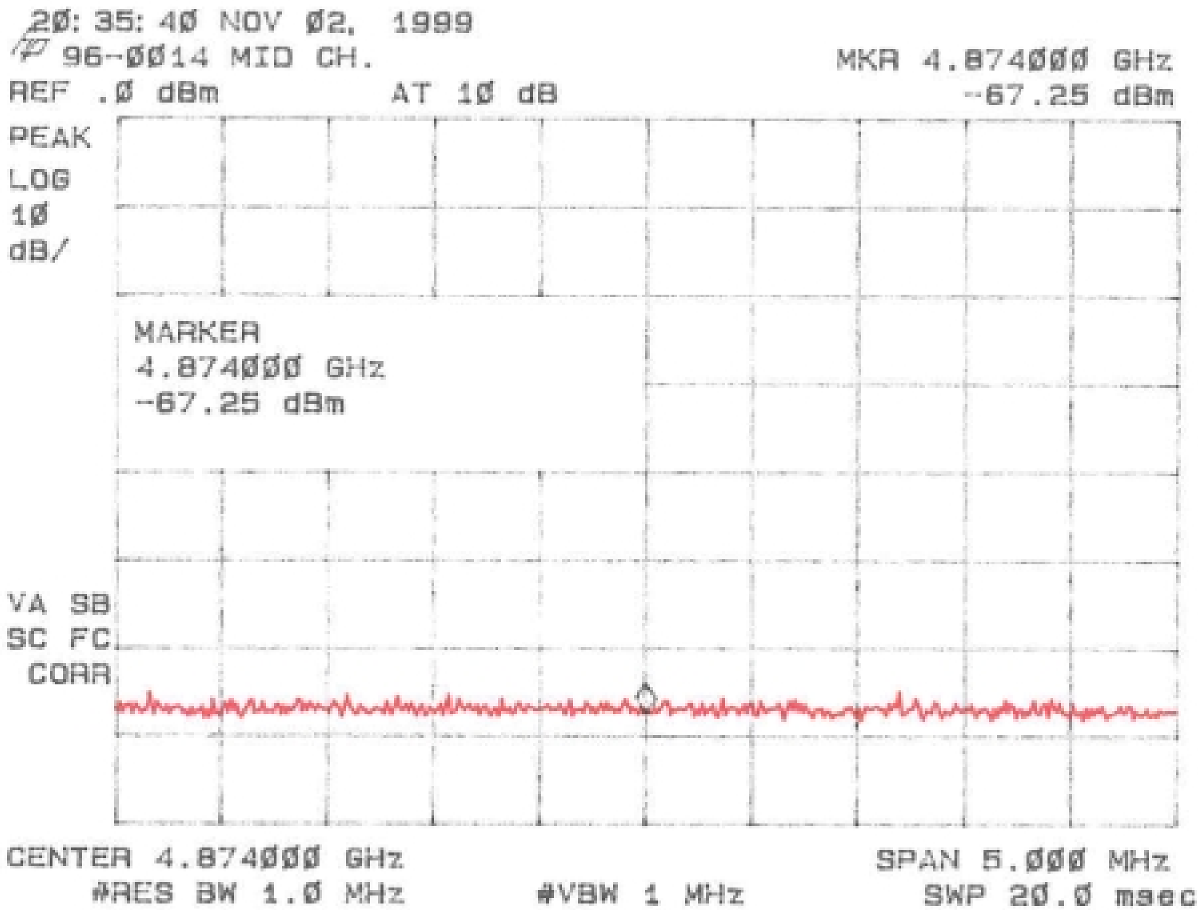


Figure 5g
Peak Radiated Spurious Emission 15.247(c) High

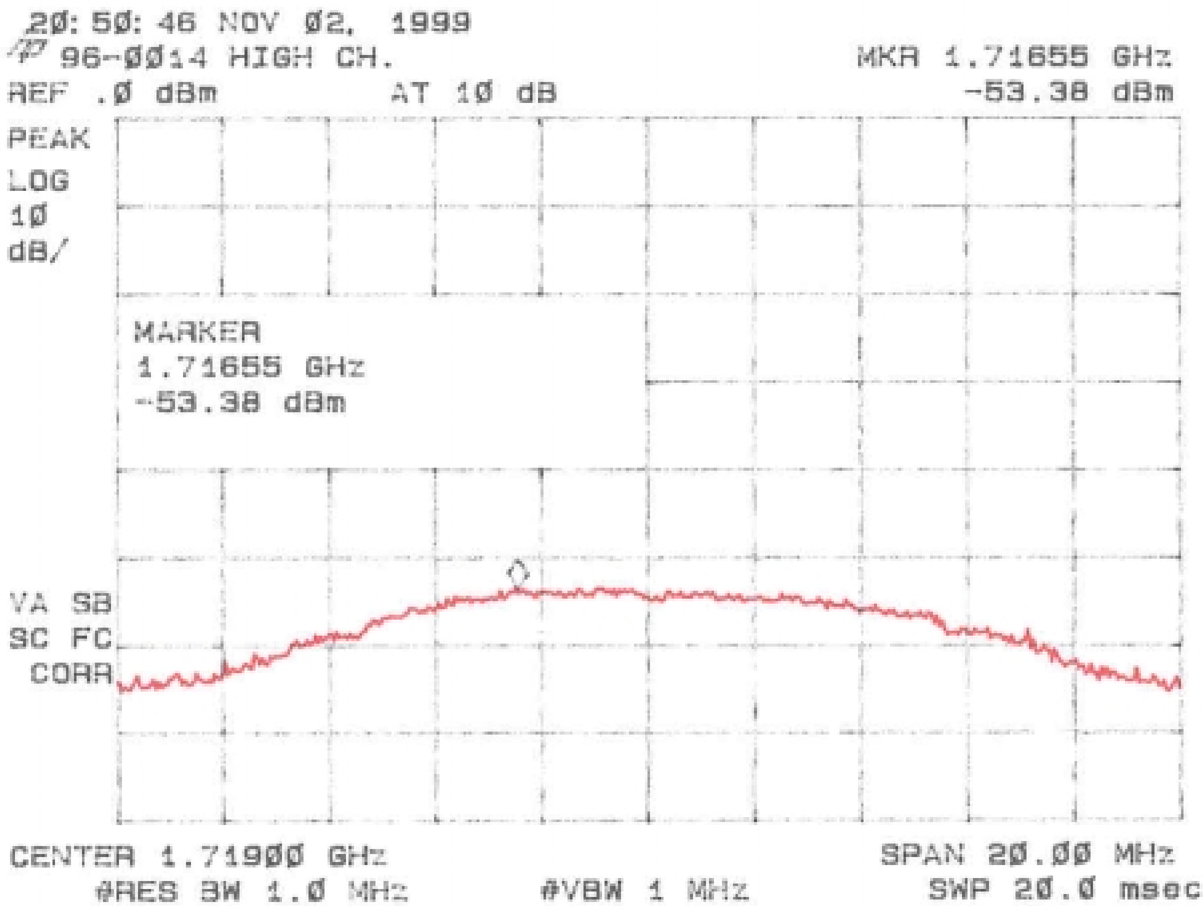


Figure 5h
Peak Radiated Spurious Emission 15.247(c) High

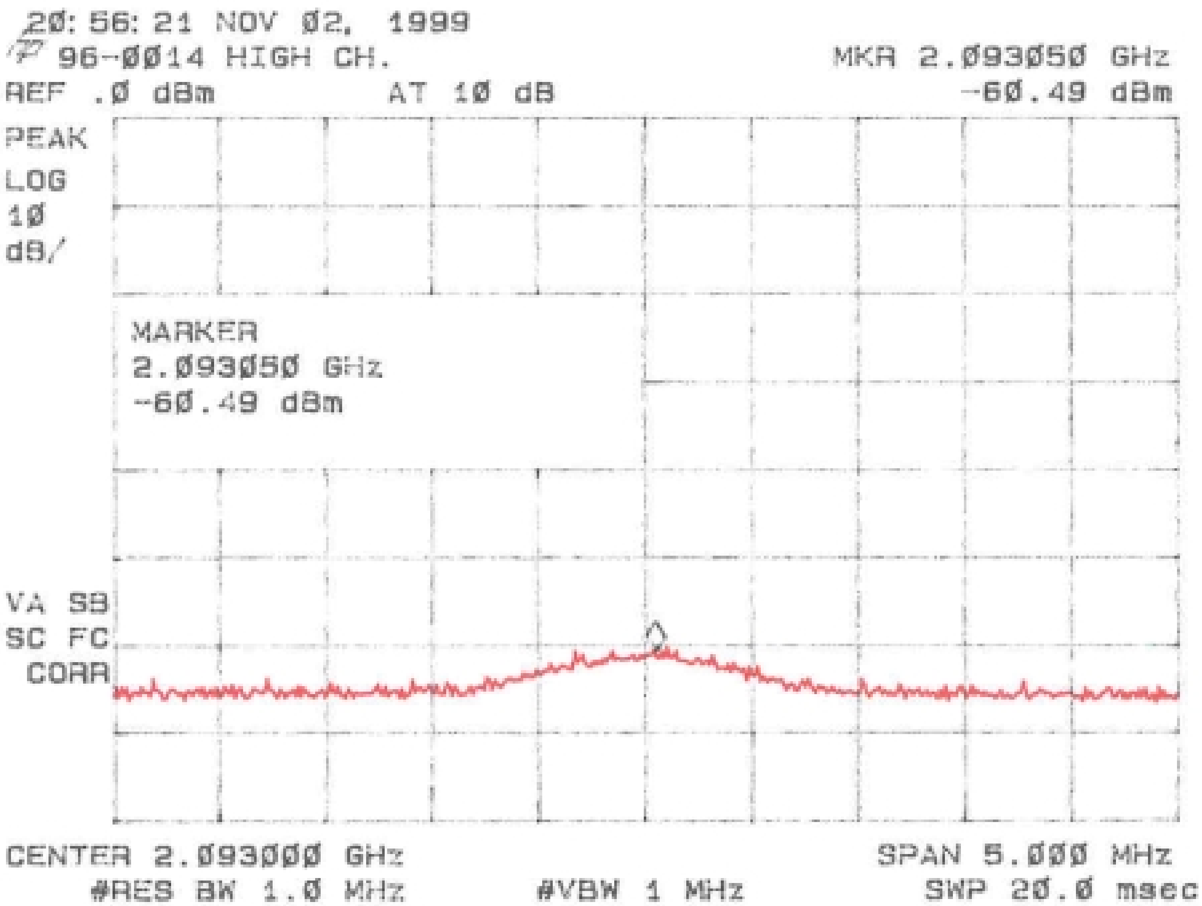


Figure 5i
Peak Radiated Spurious Emission 15.247(c) High

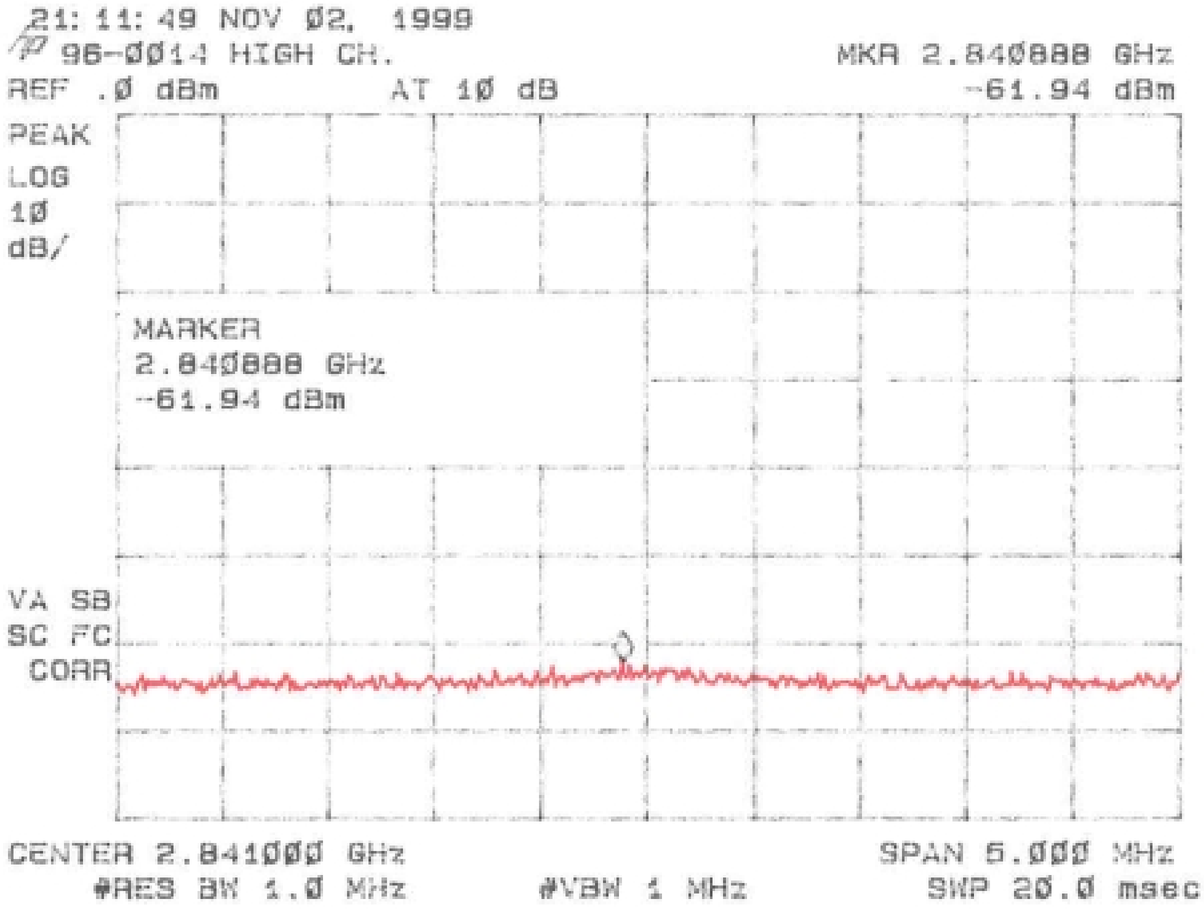


Figure 5j
Peak Radiated Spurious Emission 15.247(c) High

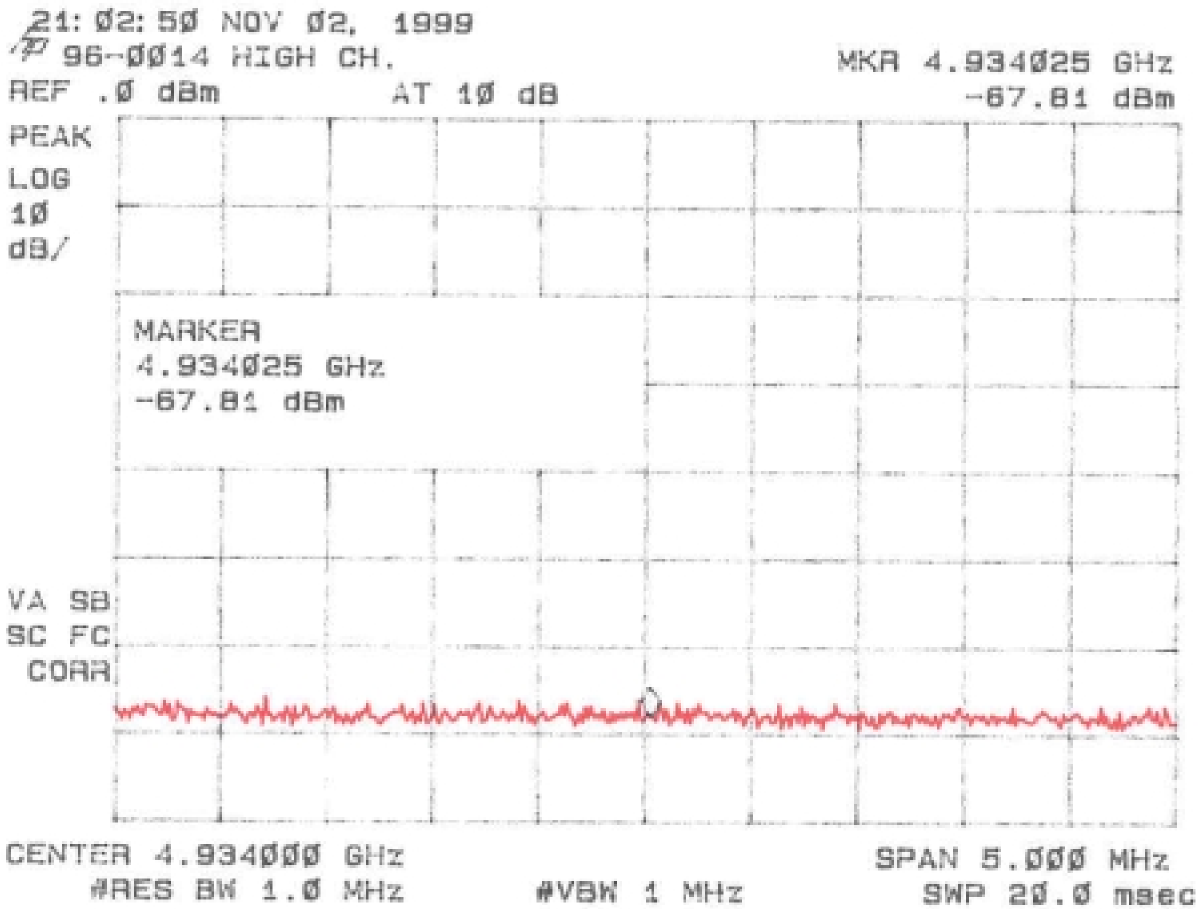


TABLE 4a
PEAK RADIATED SPURIOUS EMISSIONS (Low)

Test Date: November 2 & 3, 1999
UST Project: 99-867
Customer: Home Wireless Networks, Inc.
Model: 95-0016-XXX

Freq. (GHz)	Test Data (dBm) @3m	High Pass Filter Loss (dB)	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
2.786	-61.2	1.6	34.9	31.4	4.2	254.3	5000
4.824	-67.4**	1.0	34.2	34.7	7.9	283.5	5000

**** = Instrumentation ground floor**

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-61.2 + 1.6 - 34.9 + 31.4 + 4.2 + 107)/20) = 254.3
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: ____________________ **Name:** __Tim R. Johnson___

TABLE 4b
PEAK RADIATED SPURIOUS EMISSIONS (Mid)

Test Date: November 2 & 3, 1999
UST Project: 99-867
Customer: Home Wireless Networks, Inc.
Model: 95-0016-XXX

Freq. (GHz)	Test Data (dBm) @3m	High Pass Filter Loss (dB)	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
1.688	-55.9	1.9	35.1	27.8	3.2	278.6	5000
2.063	-58.5	1.4	34.8	29.6	3.7	261.0	5000
2.811	-61.4	1.6	34.9	31.4	4.2	250.2	5000
4.874	-67.3**	1.0	34.1	34.8	8.1	295.8	5000

**** = Instrumentation ground floor**

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-55.9 + 1.9 - 35.1 + 27.8 + 3.2 + 107)/20) = 278.6
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: ____________________ Name: Tim R. Johnson

TABLE 4c
PEAK RADIATED SPURIOUS EMISSIONS (High)

Test Date: November 2 & 3, 1999
UST Project: 99-867
Customer: Home Wireless Networks, Inc.
Model: 95-0016-XXX

Freq. (GHz)	Test Data (dBm) @3m	High Pass Filter Loss (dB)	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
1.717	-53.4	1.7	35.1	28.0	3.2	372.4	5000
2.093	-60.5	1.4	34.8	29.7	3.7	210.0	5000
2.840	-61.9	1.6	34.9	31.4	4.3	238.1	5000
4.934	-67.8**	1.0	34.1	34.9	8.2	289.7	5000

**** = Instrumentation ground floor**

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-53.4 + 1.7 - 35.1 + 28.0 + 3.2 + 107)/20) = 372.4
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: ____________________ Name: __Tim R. Johnson___

2.10 Average Spurious Emission in the Frequency Range 30 - 25000 MHz (FCC Section 15.247(c))

The EUT is capable of transmitting in excess of 100 msec periods, therefore duty cycle corrections were considered not applicable. Additionally, the peak measurements met with the average limits. The results of average radiated spurious emissions falling within restricted bands are given in Table 5a (low), Table 5b, (mid), Table 5c (high) and Figure 6.

Figure 6
Average Radiated Spurious Emission 15.247(c)

Since the EUT can transmit for longer than 100 msec duration (100% duty cycle) and the peak measurements met with the average limits, further testing was deemed unnecessary.

TABLE 5a
PEAK RADIATED SPURIOUS EMISSIONS (Low)

Test Date: November 2 & 3, 1999
UST Project: 99-867
Customer: Home Wireless Networks, Inc.
Model: 95-0016-XXX

Freq. (GHz)	Test Data (dBm) @3m	High Pass Filter Loss (dB)	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
2.786	-61.2	1.6	34.9	31.4	4.2	254.3	500
4.824	-67.4**	1.0	34.2	34.7	7.9	283.5	500

**** = Instrumentation ground floor**

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-61.2 + 1.6 - 34.9 + 31.4 + 4.2 + 107)/20) = 254.3
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: ____________________ Name: __Tim R. Johnson___

TABLE 5b
PEAK RADIATED SPURIOUS EMISSIONS (Mid)

Test Date: November 2 & 3, 1999
UST Project: 99-867
Customer: Home Wireless Networks, Inc.
Model: 95-0016-XXX

Freq. (GHz)	Test Data (dBm) @3m	High Pass Filter Loss (dB)	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
1.688	-55.9	1.9	35.1	27.8	3.2	278.6	500
2.063	-58.5	1.4	34.8	29.6	3.7	261.0	500
2.811	-61.4	1.6	34.9	31.4	4.2	250.2	500
4.874	-67.3**	1.0	34.1	34.8	8.1	295.8	500

**** = Instrumentation ground floor**

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-55.9 + 1.9 - 35.1 + 27.8 + 3.2 + 107)/20) = 278.6
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: ____________________ Name: Tim R. Johnson

TABLE 5c
PEAK RADIATED SPURIOUS EMISSIONS (High)

Test Date: November 2 & 3, 1999
UST Project: 99-867
Customer: Home Wireless Networks, Inc.
Model: 95-0016-XXX

Freq. (GHz)	Test Data (dBm) @3m	High Pass Filter Loss (dB)	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
1.717	-53.4	1.7	35.1	28.0	3.2	372.4	500
2.093	-60.5	1.4	34.8	29.7	3.7	210.0	500
2.840	-61.9	1.6	34.9	31.4	4.3	238.1	500
4.934	-67.8**	1.0	34.1	34.9	8.2	289.7	500

**** = Instrumentation ground floor**

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-53.4 + 1.7 - 35.1 + 28.0 + 3.2 + 107)/20) = 372.4
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: ____________________ Name: Tim R. Johnson

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)

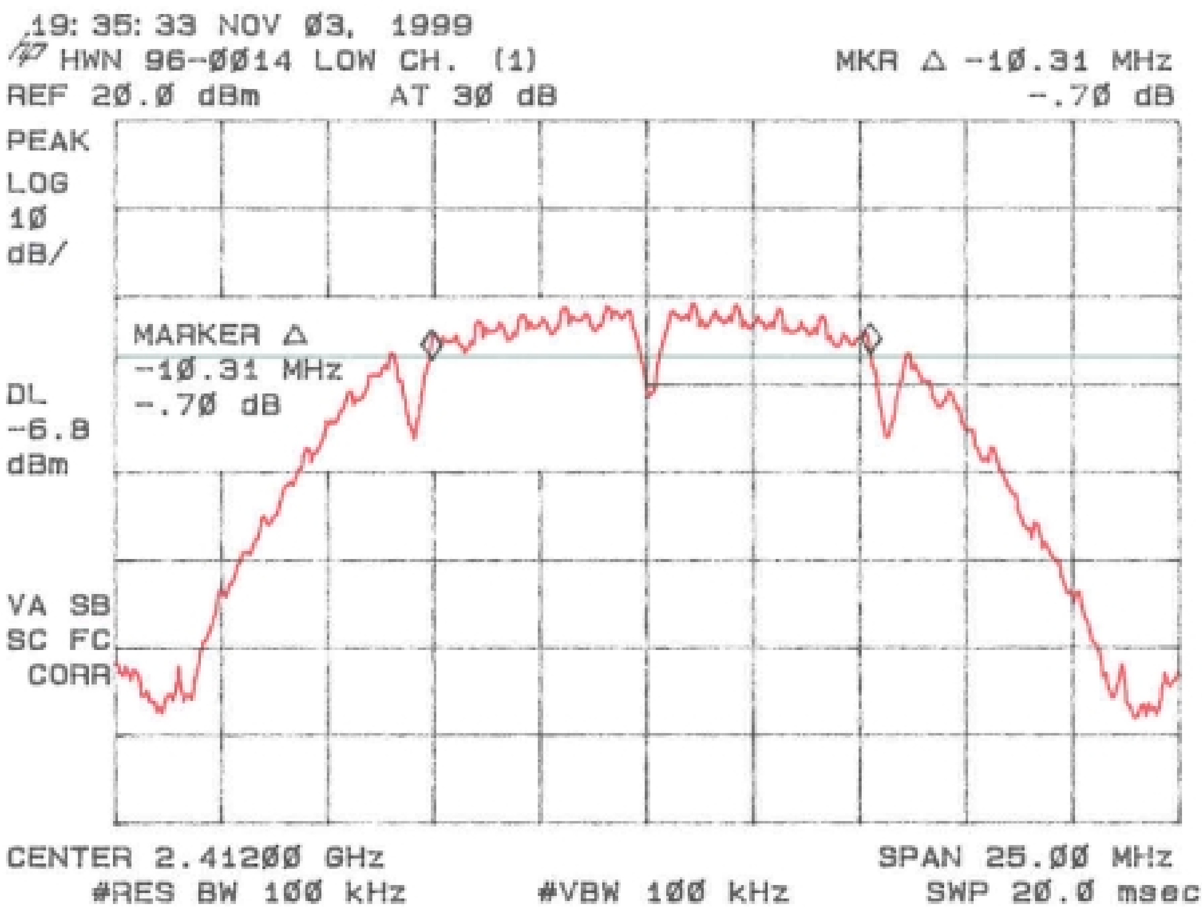


Figure 7b.
6 dB Bandwidth per FCC Section 15.247(a)(2) (Mid)

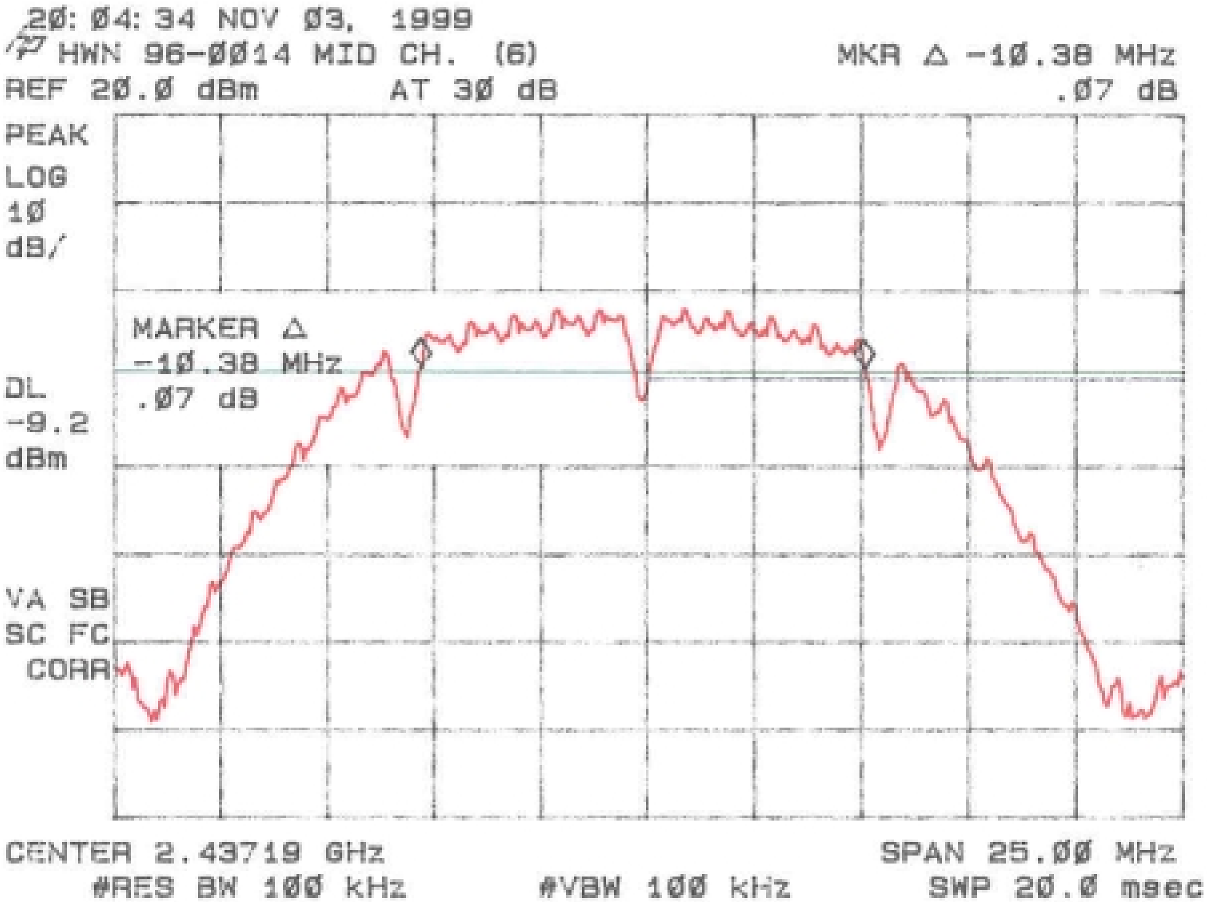
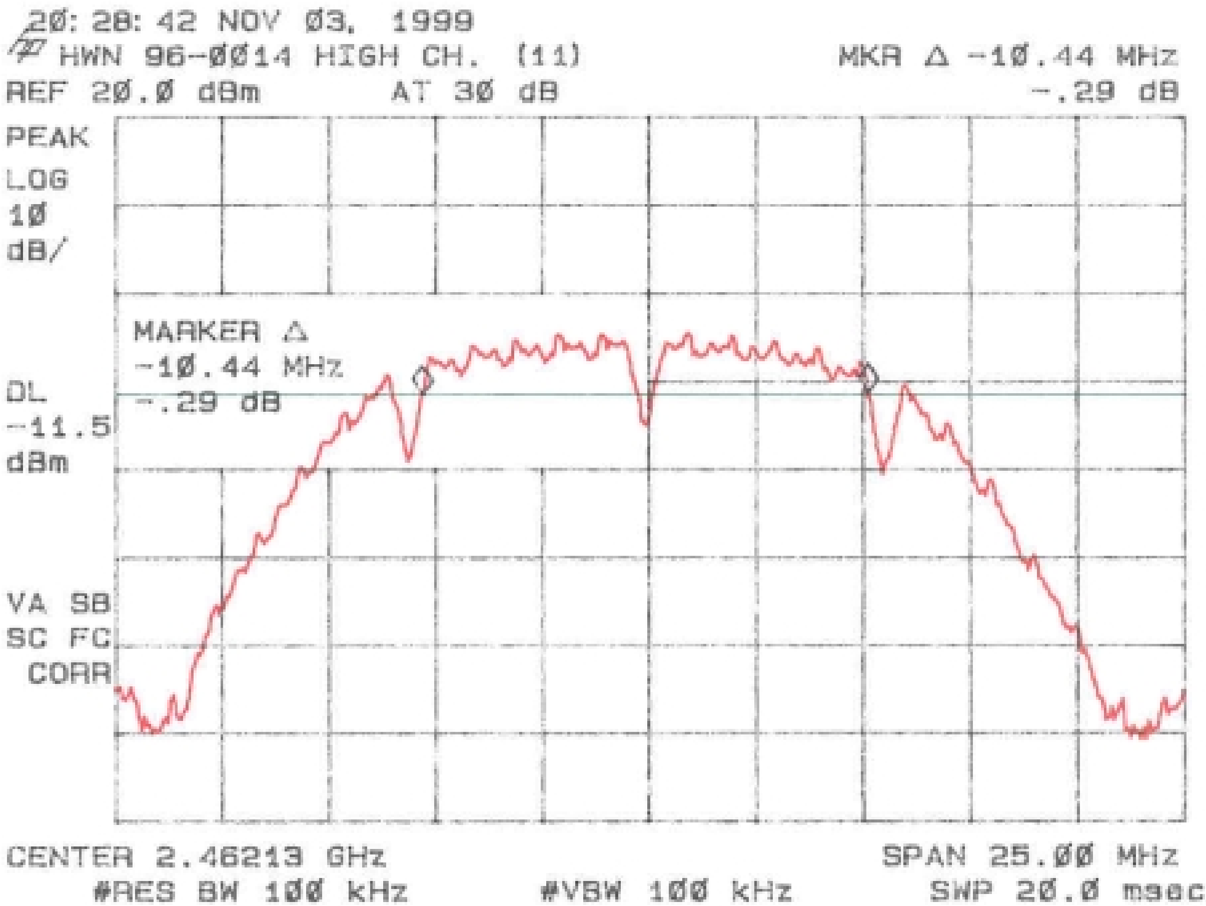


Figure 7c.
6 dB Bandwidth per FCC Section 15.247(a)(2) (High)



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 8a through Figure 8c. 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. The measurement was made using a spectrum analyzer utilizing noise marker mode. A 34.8 dBm adjustment has been added to the measurement to correct from 1 Hz to 3 kHz measurement.

TABLE 7
POWER SPECTRAL DENSITY

Test Date: November 2 & 3, 1999
UST Project: 99-867
Customer: Home Wireless Networks, Inc.
Model: 95-0016-XXX

Frequency (GHz)	Test Data (dBm) Normalized to 1 Hz	Results (dBm)	FCC Limit (dBm)
2.413	-56.6	-21.8	8.0
2.438	-58.0	-23.2	8.0
2.461	-58.3	-23.5	8.0

Note: 34.8 dBm has been added to correct from 1 Hz to 3 kHz

Tester
Signature: ____________________ **Name:** __Tim R. Johnson________

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

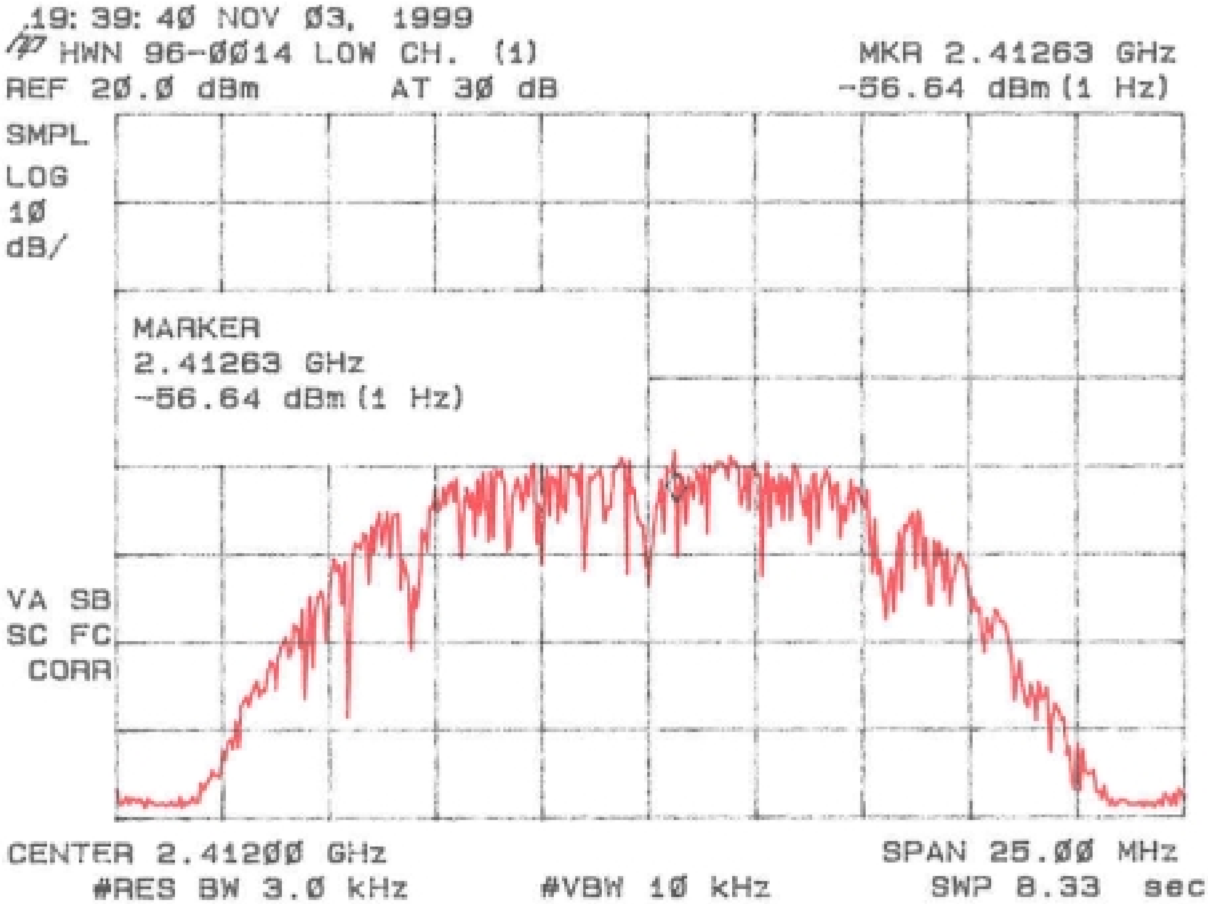


Figure 8b
Power Spectral Density 15.247(b) and 15.247(d) Mid

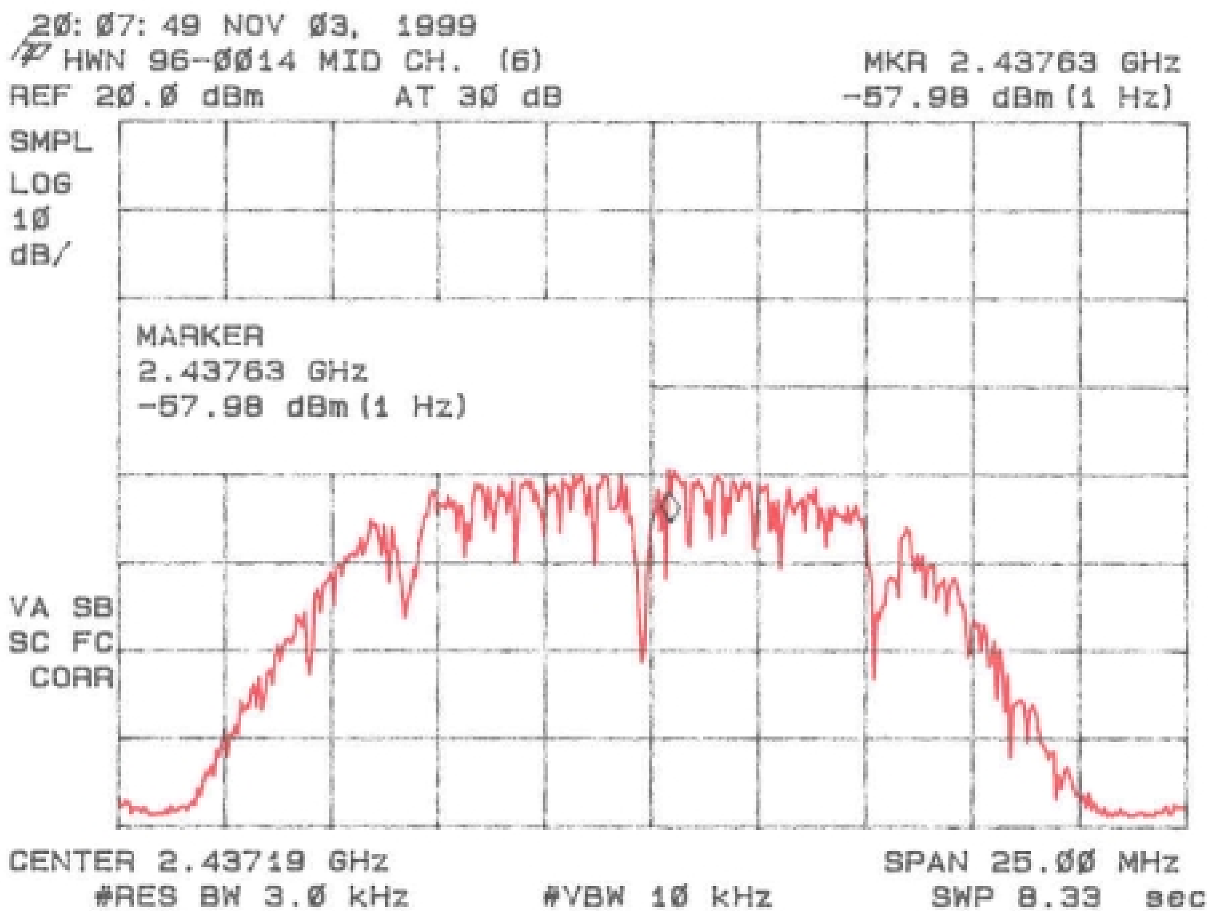
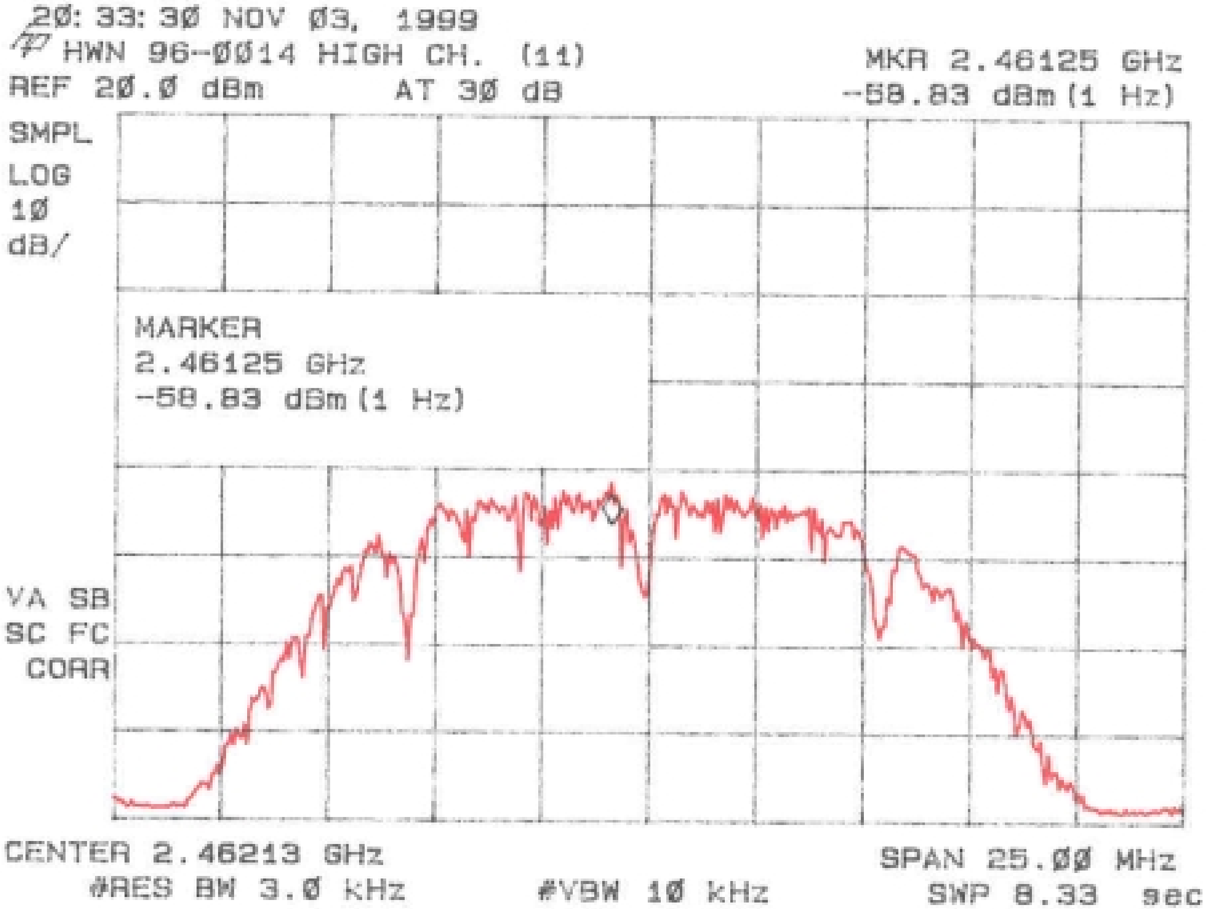


Figure 8c
Power Spectral Density 15.247(b) and 15.247(d) High



2.13 Processing Gain

Data regarding processing gain has been provided on the following page from Home Wireless Networks, Inc.

Processing Gain

The Wireless Ethernet Access Point FCC ID: NSK0016A utilizes the Prism I chipset produced by Intersil Corporation and is based on the Intersil reference design. This chipset is the basis for several Certified products. In particular, the HFA3824A Direct Sequence Spread Spectrum Baseband Processor contains the DSP defining the spreading, de-spreading, modulation, and demodulation functions. The jamming margin data was reproduced from test data for the Intersil reference design, FCC ID: MRF13316C2.

METHOD OF MEASUREMENT: Jamming Margin Method

The processing gain is measured using the CW jamming margin method. Figure 1 shows the test configuration. The test consists of stepping a signal generator in 50 kHz increments across the passband of the system. At each point, the generator level required to produce the recommended Bit Error Rate (BER) is recorded. This level is the jammer level. The output power of the transmitting unit is then measured. The Jammer-to-Signal (J/S) ratio is then calculated. The worst 20% of the J/S data points are discarded. The lowest remaining J/S ratio is used when calculating the Process Gain.

The signal-to-noise ratio for ideal differentially coherent detection of differentially encoded PSK can be derived from the Bit Error Probability (Pb) versus Signal-to-Noise ratio curves.[1] For measurement of the (S/N), we use the Pb of 1.0 x 105 minimum. This value and the measured J/S ratio are used in the following equation to calculate the Processing Gain (Gp) of the system.[2]

Gp = (S/N)o+Mj+Lsys2

Where:

(S/N)o: Theoretical signal-to-noise ratio required to maintain the normal operation at the stated BER.

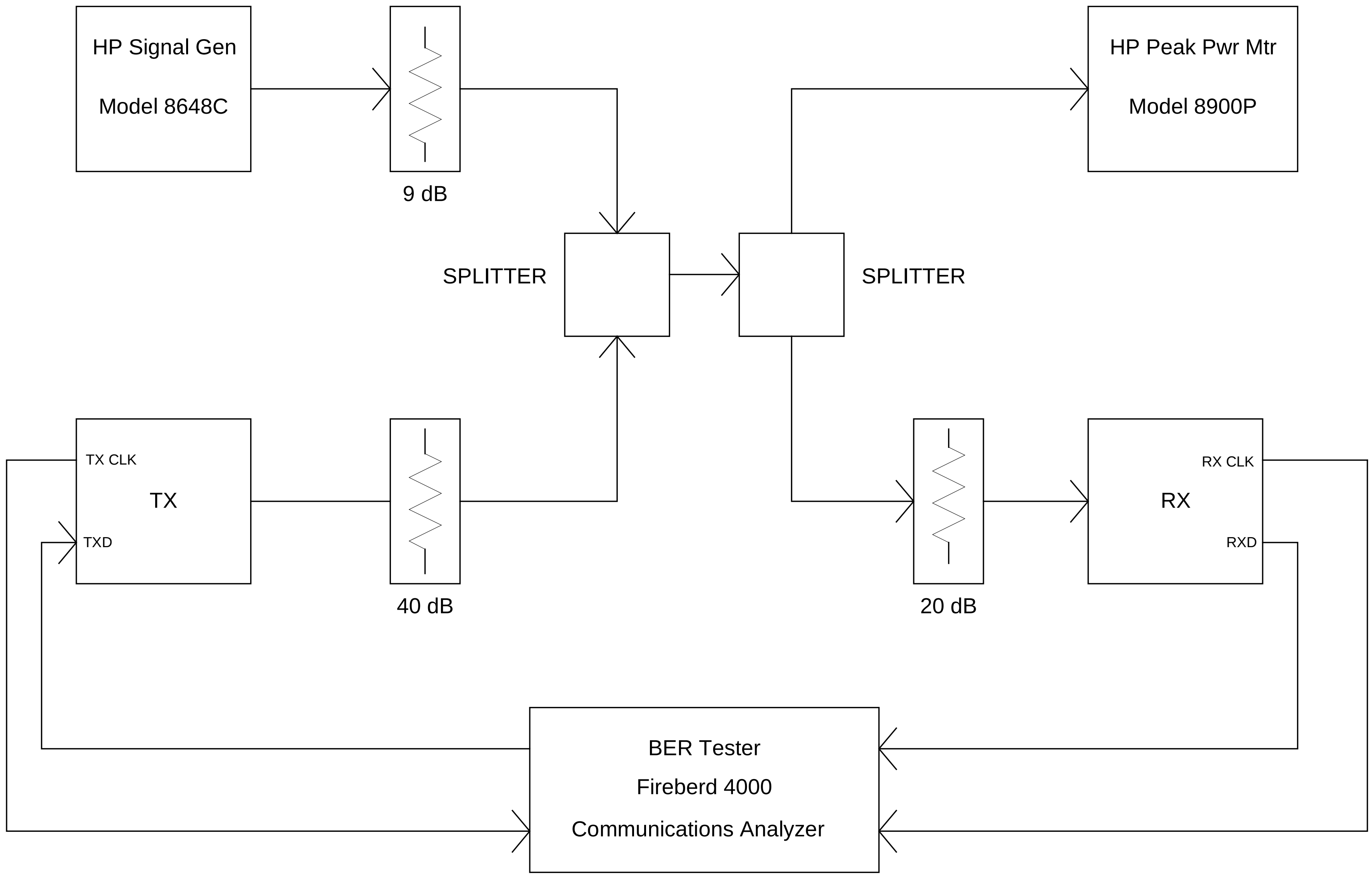
Mj: Maximum Jammer-to-Signal Ratio that recorded at the selected BER.

Lsys: System losses such as non-ideal synchronization, tracking circuitry, non-optimal baseband receiver filtering, etc. For the purpose of this processing gain calculation we assume a Lsys at its minimum value of 2dB.

---

1 B. Sklar., *Digital Communications* .(Englewood Cliffs, New Jersey: PTR Prentice Hall, 1988), pp. 160

2 Dixon, R., *Spread Spectrum Systems*. (New York: Wiley, 1984), Chapter 1.



FCC ID: NSK0016A

Figure 1. Jamming Margin Test Setup

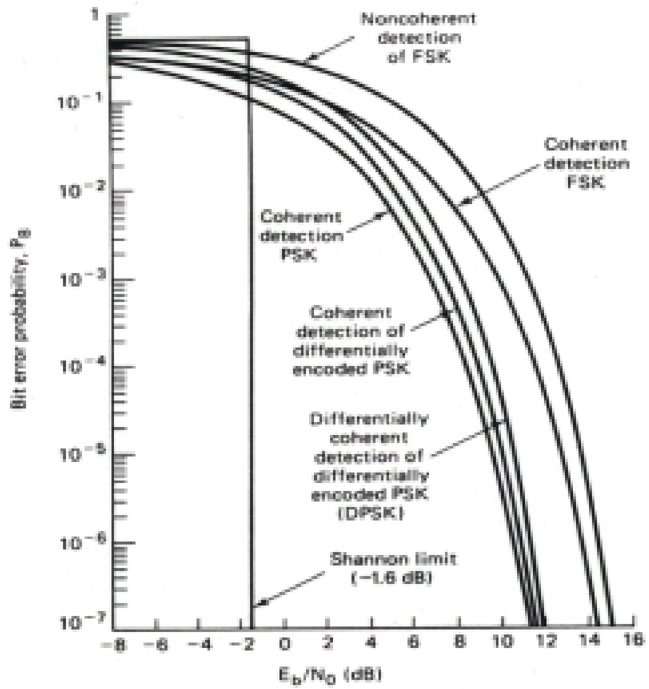


Figure 3.22 Bit error probability for several types of binary systems.

B. Sklar., *Digital Communications* .(Englewood Cliffs, New Jersey: PTR Prentice Hall, 1988), pp. 160

MEASUREMENT DATA:

Test Method Employed: Jamming Margin

SIG.GEN. FREQ. (MHz)	BER	(S/N)o (dB)	Lsys (dB)	Sig. Gen. Total Peak Power @ Rx (dBm)	Transmitter Total Peak Power @ Rx (dBm)	Jammer to Signal Ratio Mj (dB)	Processing Gain (dB)
Fc – 1.00	0.000020	9.6	2.0	-24.5	-27.9	3.4	15.0
Fc – 0.90	0.000013	9.9	2.0	-24.4	-27.9	3.5	15.3
Fc – 0.70	0.000010	9.9	2.0	-25.9	-27.9	2.0	13.9
Fc – 0.50	0.000015	9.8	2.0	-26.7	-27.9	1.2	13.0
Fc – 0.45	0.000018	9.7	2.0	-26.0	-27.9	1.9	13.6
Fc – 0.40	0.000015	9.8	2.0	-26.2	-27.9	1.7	13.5
Fc – 0.35	0.000012	9.9	2.0	-26.6	-27.9	1.3	13.2
Fc – 0.30	0.000015	9.8	2.0	-26.9	-27.9	1.0	12.8
Fc – 0.25	0.000018	9.7	2.0	-27.6	-27.9	0.3	12.0
Fc – 0.20	0.000011	9.9	2.0	-27.7	-27.9	0.2	12.1
Fc – 0.15	0.000016	9.8	2.0	-28.0	-27.9	-0.1	11.7
Fc – 0.10	0.000020	9.6	2.0	-28.4	-27.9	-0.5	11.1
Fc – 0.05	0.000010	9.9	2.0	-28.2	-27.9	-1.3	10.6
Fc	0.000020	9.6	2.0	-27.8	-27.9	0.1	11.7
Fc + 0.05	0.000010	9.9	2.0	-27.9	-27.9	0.0	11.9
Fc + 0.10	0.000020	9.6	2.0	-27.8	-27.9	0.1	11.7
Fc + 0.15	0.000017	9.7	2.0	-27.9	-27.9	0.0	11.7
Fc + 0.20	0.000015	9.8	2.0	-26.9	-27.9	1.0	12.8
Fc + 0.25	0.000010	9.9	2.0	-26.2	-27.9	1.7	13.6
Fc + 0.30	0.000010	9.9	2.0	-25.8	-27.9	2.1	14.0
Fc + 0.35	0.000012	9.9	2.0	-25.0	-27.9	2.9	14.8
Fc + 0.40	0.000013	9.8	2.0	-24.7	-27.9	3.2	15.0
Fc + 0.45	0.000014	9.8	2.0	-25.3	-27.9	2.6	14.4
Fc + 0.50	0.000020	9.6	2.0	-25.5	-27.9	2.4	14.0
Fc + 0.70	0.000015	9.8	2.0	-25.2	-27.9	2.7	14.5
Fc + 0.90	0.000016	9.7	2.0	-24.5	-27.9	3.4	15.1
Fc = 1.00	0.000013	9.8	2.0	-24.9	-27.9	3.0	14.8

MINIMUM PROCESSING GAIN: 10.6 dB

- (S/N)o: Refer to attached curves. BER versus (S/N)o for Differentially Coherent Detection of Differentially Encoded PSK
- Processing gain Gp = (S/N)o + Lsys + Mj = (S/N)o + 2 + Mj

2.14 Power Line Conducted Emissions for Transmitter FCC Section 15.207

The conducted voltage measurements have been carried out in accordance with FCC Section 15.207, with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmit. The results are given in Table 8.

TABLE 8a. CONDUCTED EMISSIONS DATA
CLASS B

Test Date: November 2 & 3, 1999
UST Project: 99-867
Customer: Home Wireless Networks, Inc.
Product: 95-0016-XXX

Configuration with NCU (AC Adapter attached to NCU)

Frequency (MHz)	Test Data (dBm) Phase	Neutral	RESULTS (uV) Phase	Neutral	FCC Limits (uV)
0.54	-60.0	-63.3	223.9	153.1	250
1.5	-64.2	-66.2	138.0	109.6	250
2.3	-66.8	-67.3	102.3	96.6	250
7.0	-77.9	-79.4	28.5	24.0	250
19.8	-75.8	-76.6	36.3	33.1	250
22.1	-75.4	-79.6	38.0	23.4	250
30.0	-83.6	-80.4	14.8	21.4	250

SAMPLE CALCULATIONS:

RESULTS uV = ANTILOG ((-60.0 + 107)/20) = 223.9
CONVERSION FROM dBm TO dBuV = 107 dB

Test Results
Reviewed By
Signature: ____________________ **Name: Tim R. Johnson**

TABLE 8b. CONDUCTED EMISSIONS DATA
CLASS B

Test Date: November 2 & 3, 1999
UST Project: 99-867
Customer: Home Wireless Networks, Inc.
Product: 95-0016-XXX

Configuration as self contained unit (AC Adapter attached to EUT)

Frequency (MHz)	Test Data (dBm) Phase	Test Data (dBm) Neutral	RESULTS (uV) Phase	RESULTS (uV) Neutral	FCC Limits (uV)
0.45	-60.4	-62.9	213.8	160.3	250
.86	-66.8	-70.8	102.3	64.6	250
1.4	-75.0	-78.3	39.8	27.2	250
6.1	-78.1	-86.1	27.9	11.1	250
15.4	-78.5	-82.2	26.6	17.4	250
19.8	-93.4	-87.2	4.8	9.8	250

SAMPLE CALCULATIONS:

RESULTS uV = ANTILOG ((-60.4 + 107)/20) = 213.8
CONVERSION FROM dBm TO dBuV = 107 dB

Test Results
Reviewed By
Signature: ____________________ **Name: Tim R. Johnson**