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-5e (low), Figure 5f-5i (mid) and Figure 5j-5m (high).

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

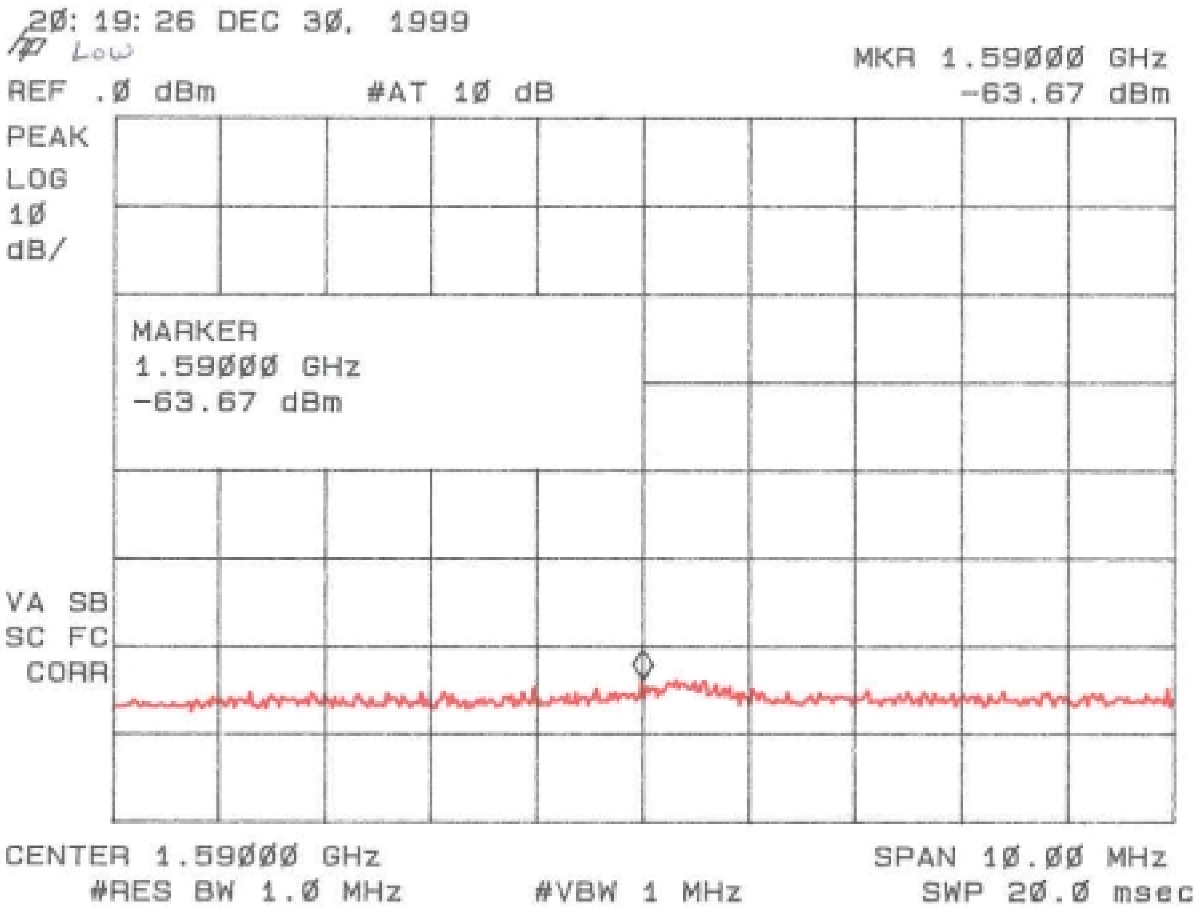


Figure 5b
Peak Radiated Spurious Emission 15.247(c) Low

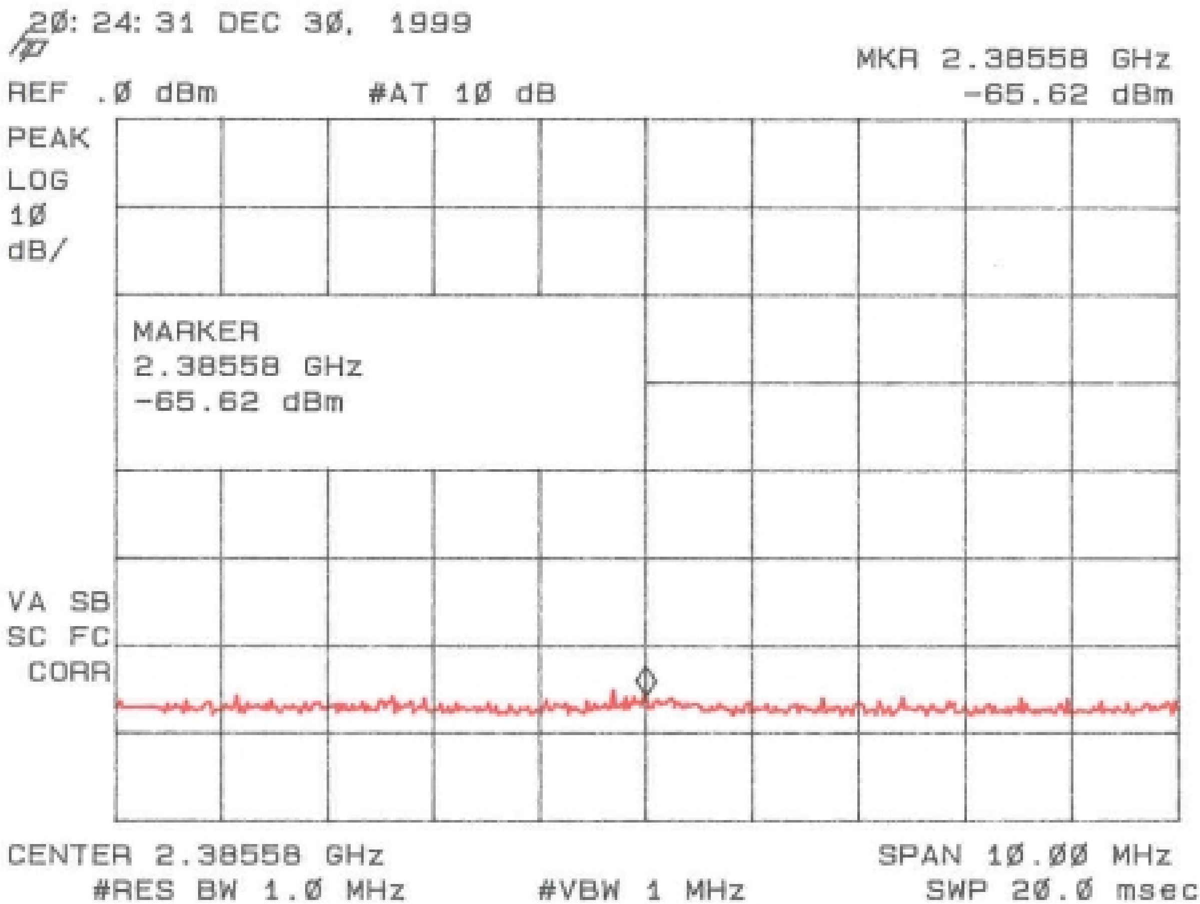


Figure 5c
Peak Radiated Spurious Emission 15.247(c) Low

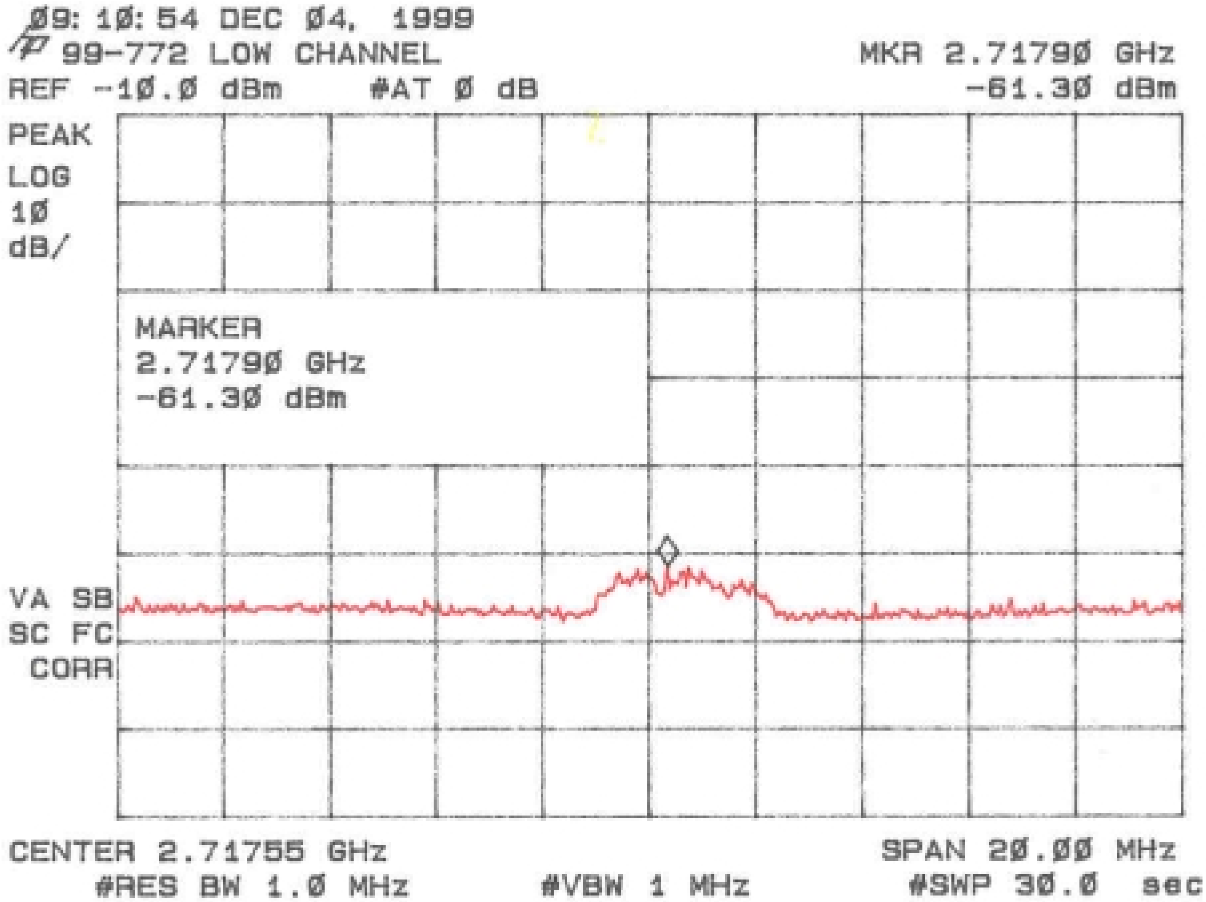


Figure 5d
Peak Radiated Spurious Emission 15.247(c) Low

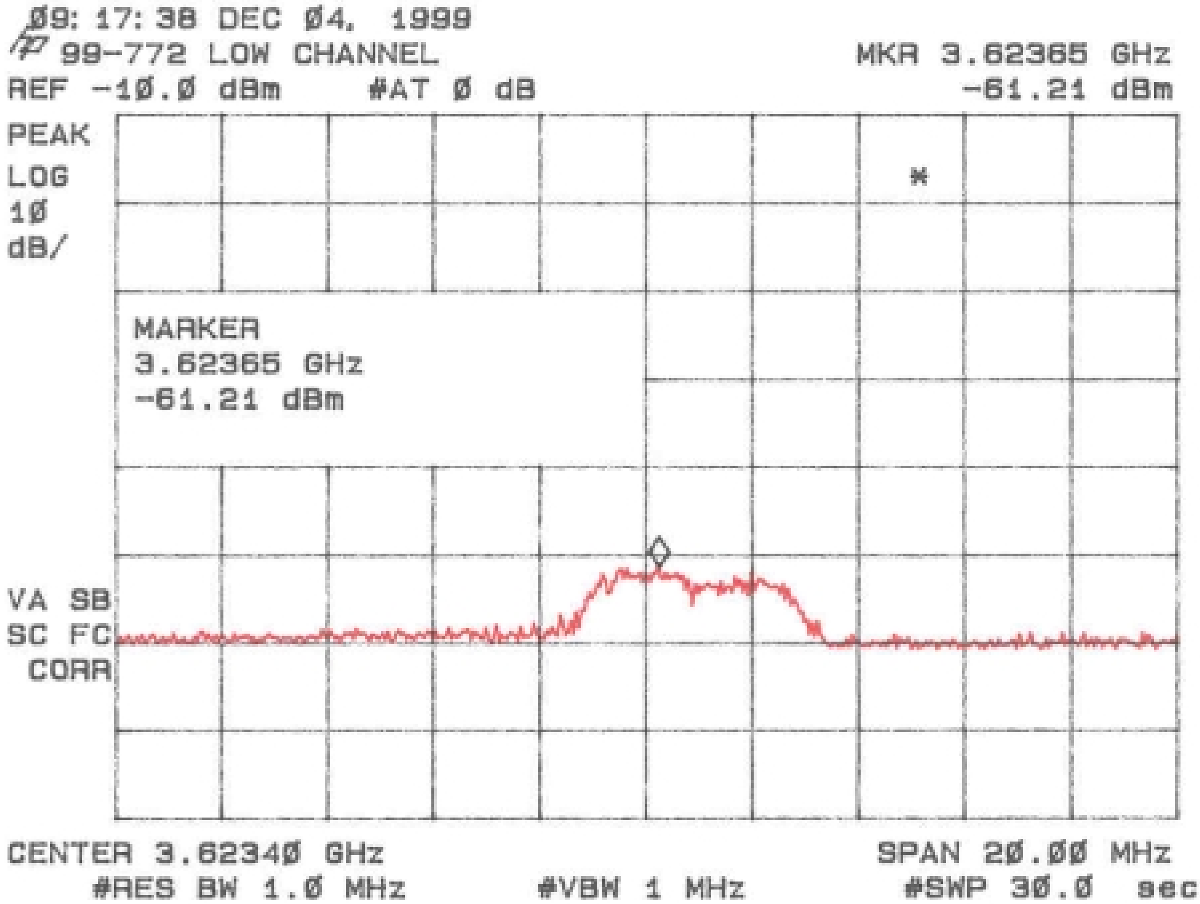


Figure 5e
Peak Radiated Spurious Emission 15.247(c) Low

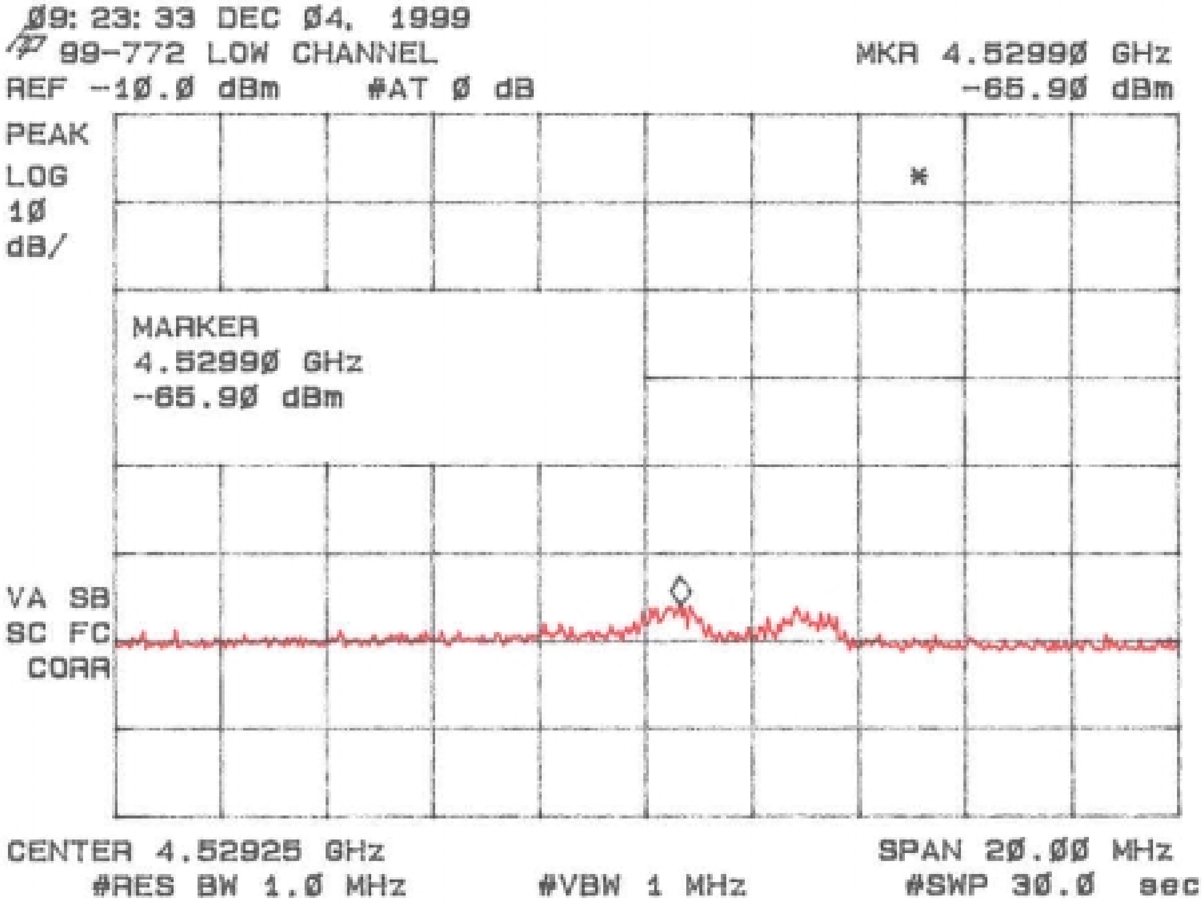


Figure 5f
Peak Radiated Spurious Emission 15.247(c) Mid

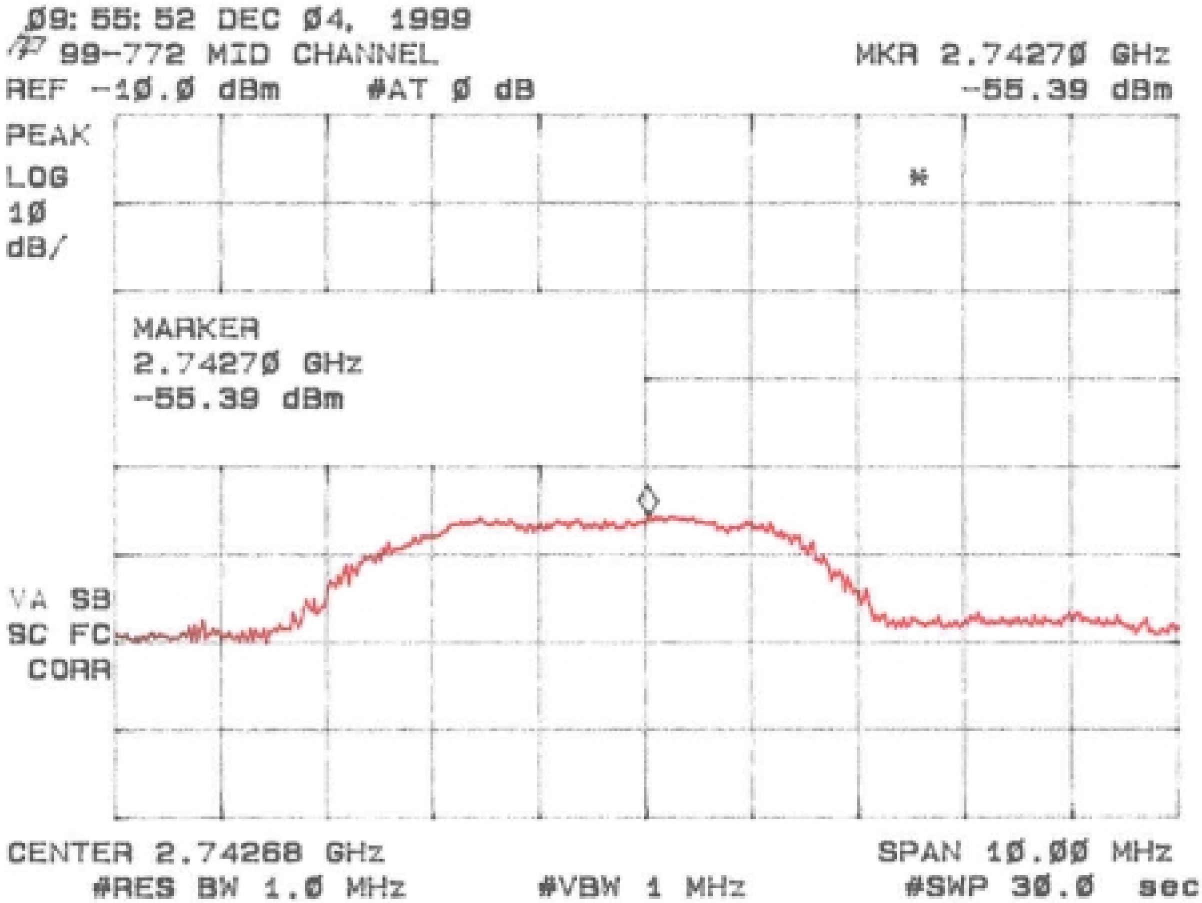


Figure 5g
Peak Radiated Spurious Emission 15.247(c) Mid

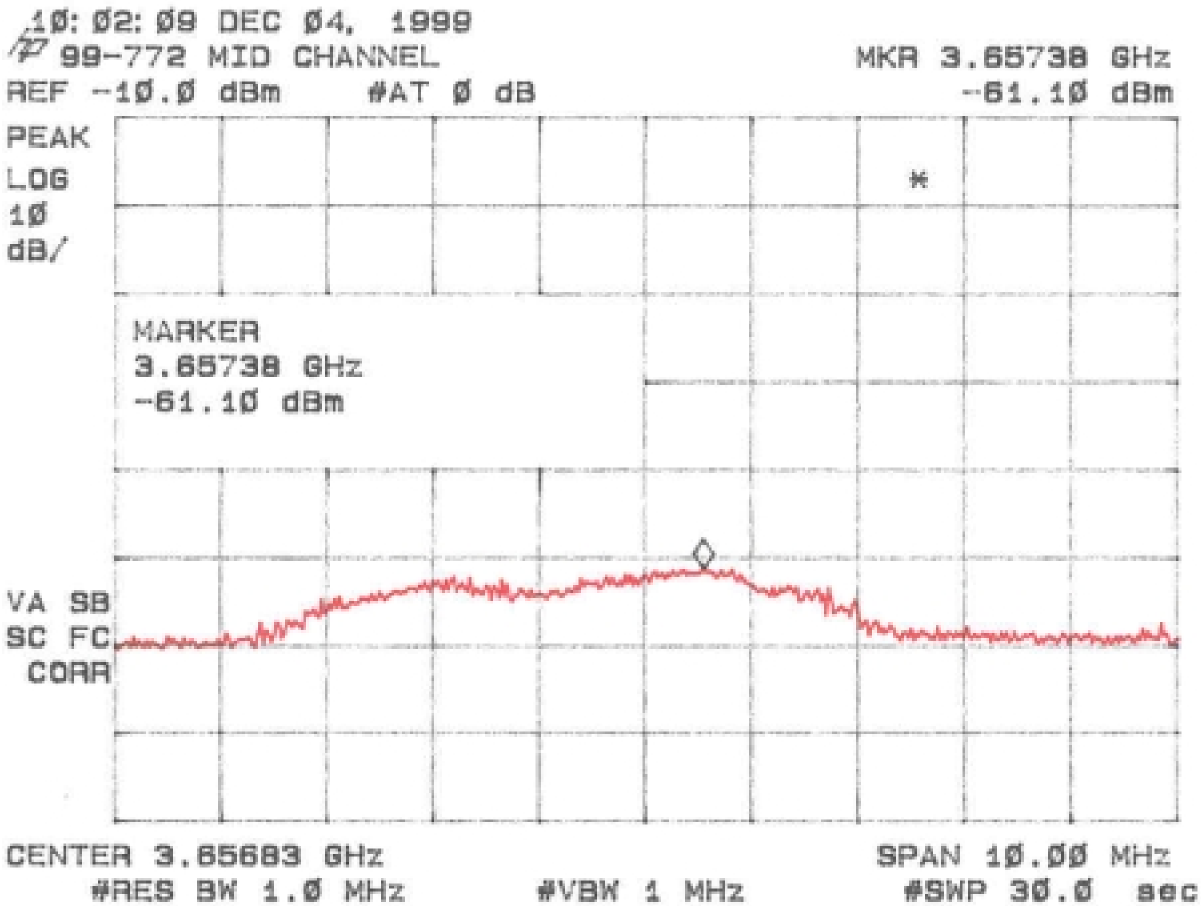


Figure 5h
Peak Radiated Spurious Emission 15.247(c) Mid

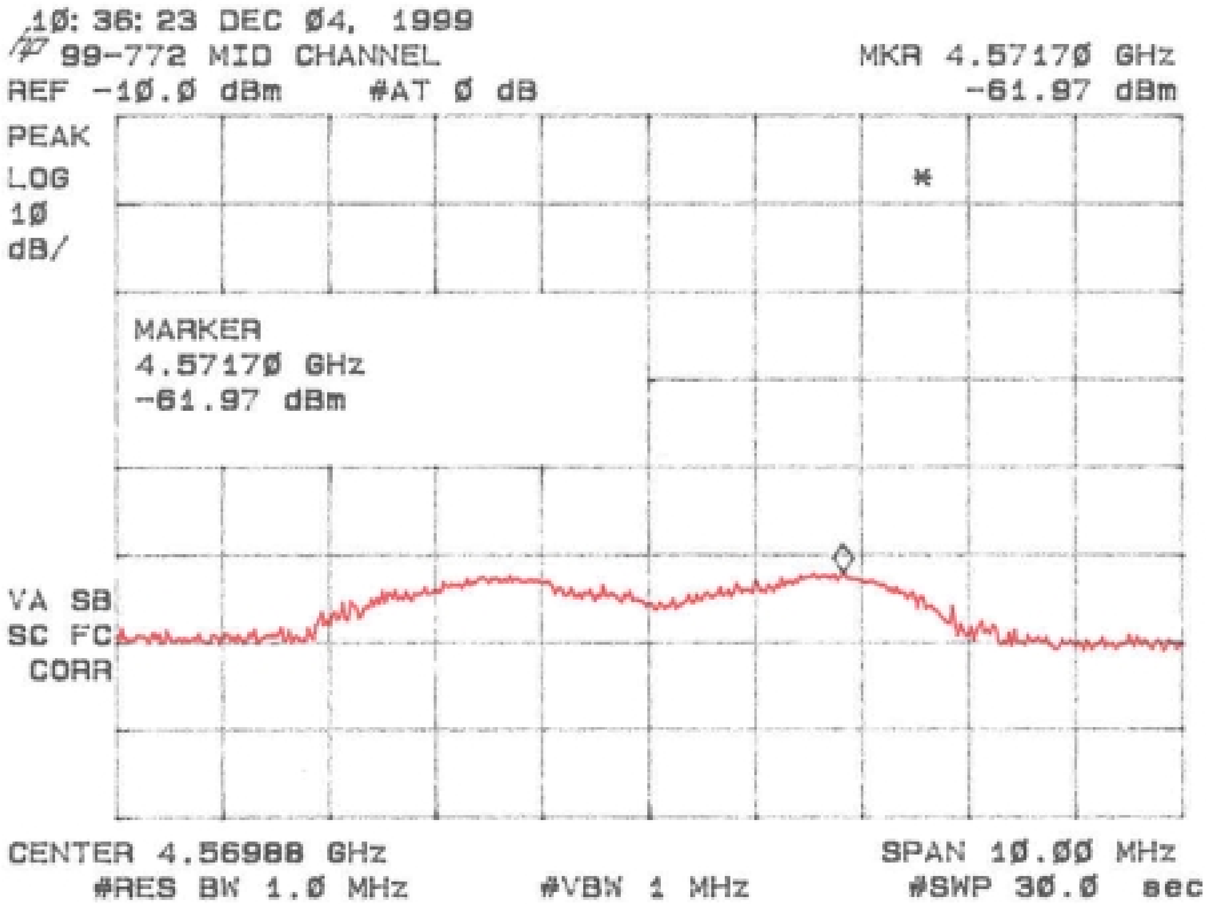


Figure 5i
Peak Radiated Spurious Emission 15.247(c) Mid

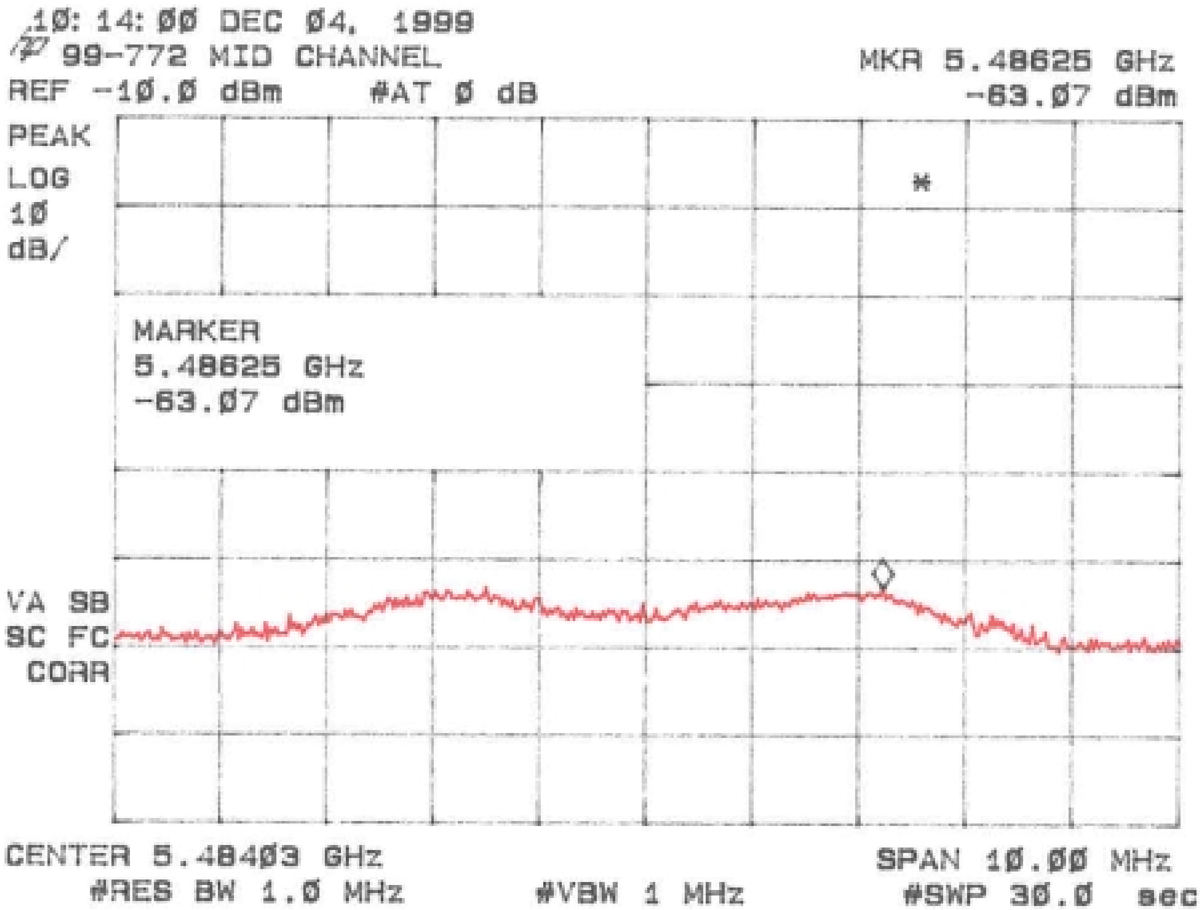


Figure 5j
Peak Radiated Spurious Emission 15.247(c) High

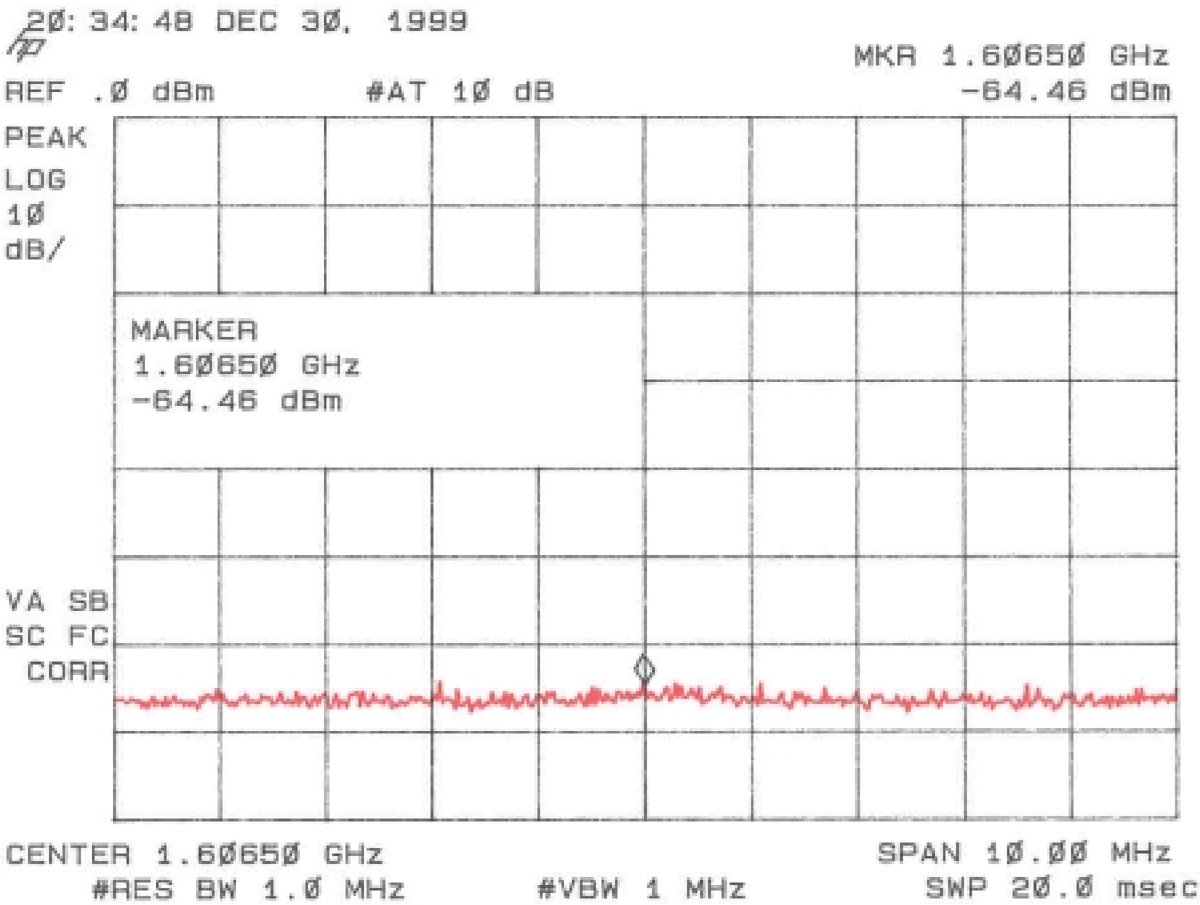


Figure 5k
Peak Radiated Spurious Emission 15.247(c) High

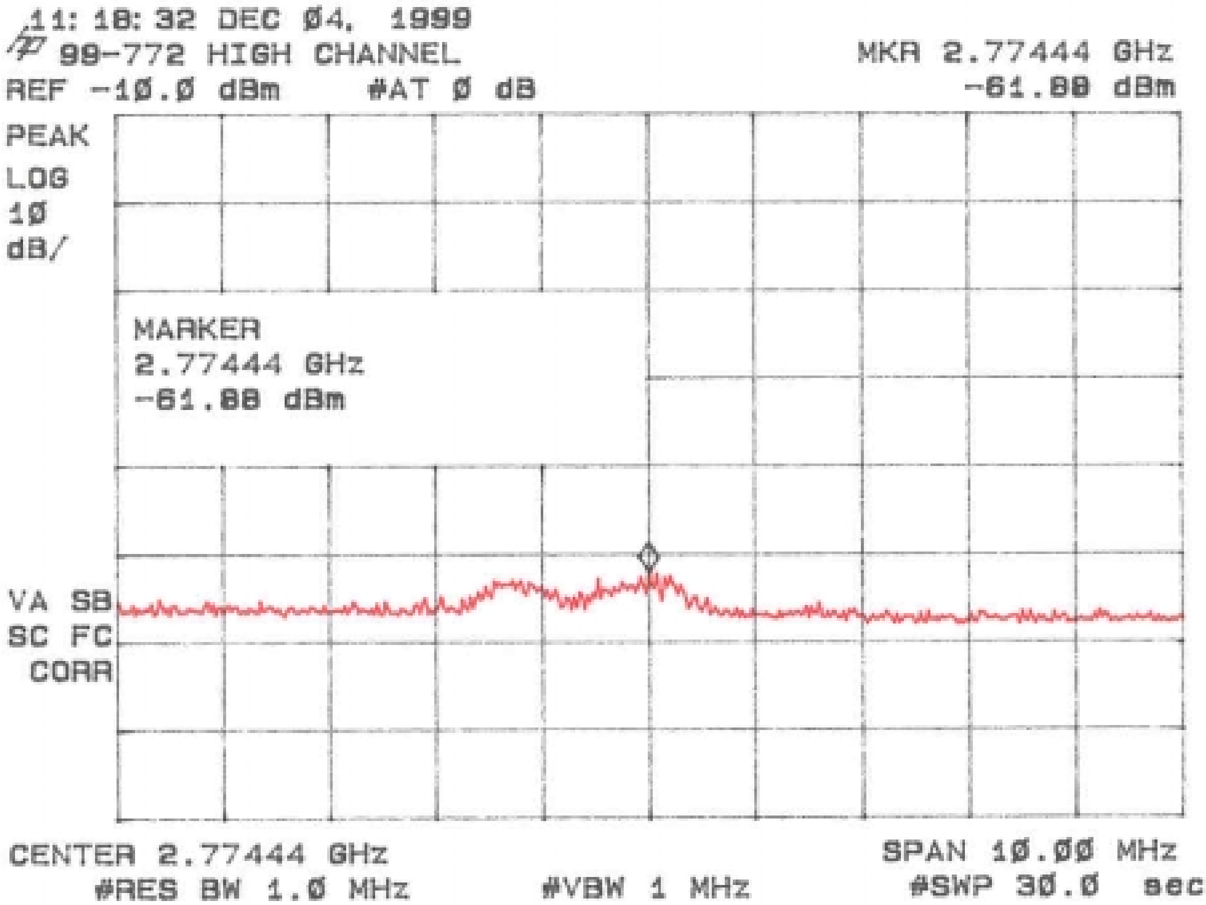


Figure 5l
Peak Radiated Spurious Emission 15.247(c) High

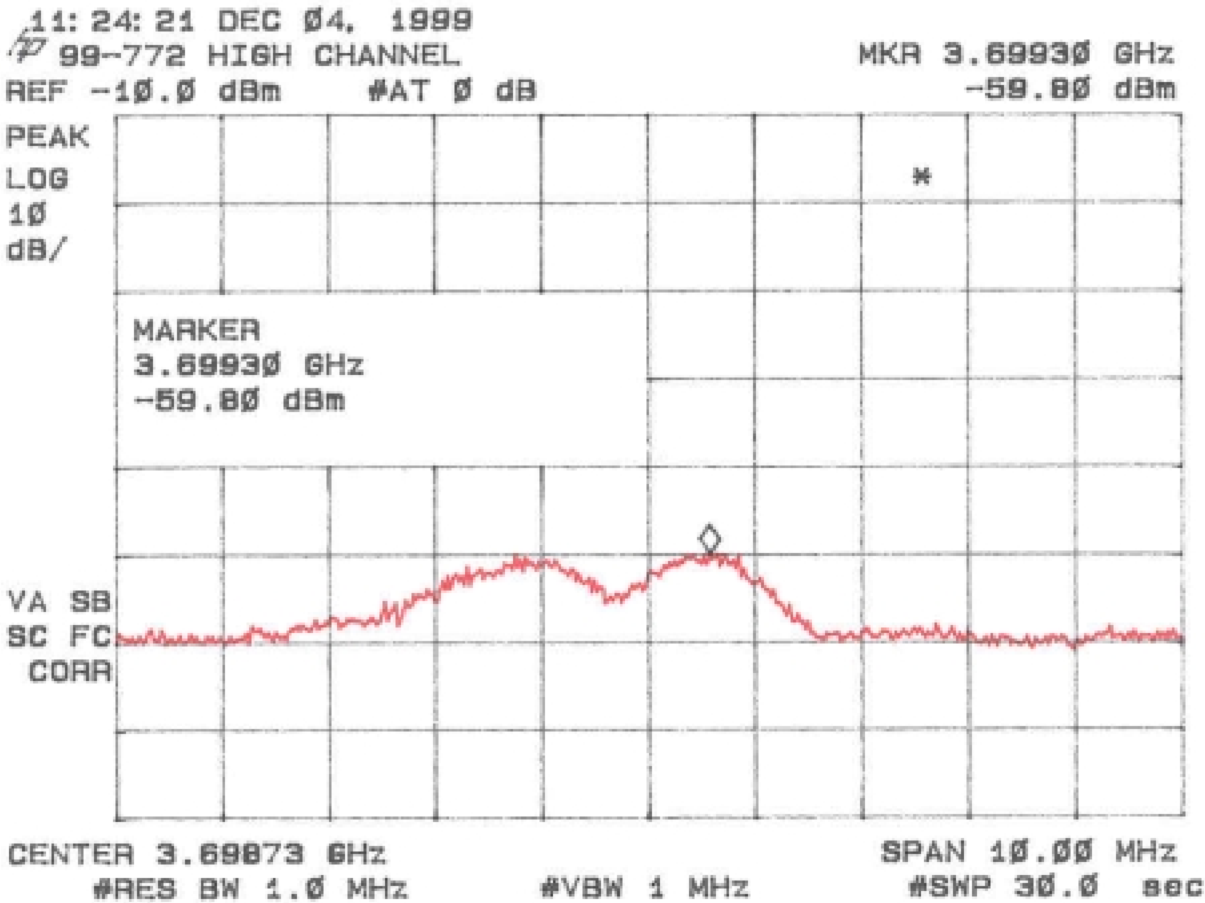
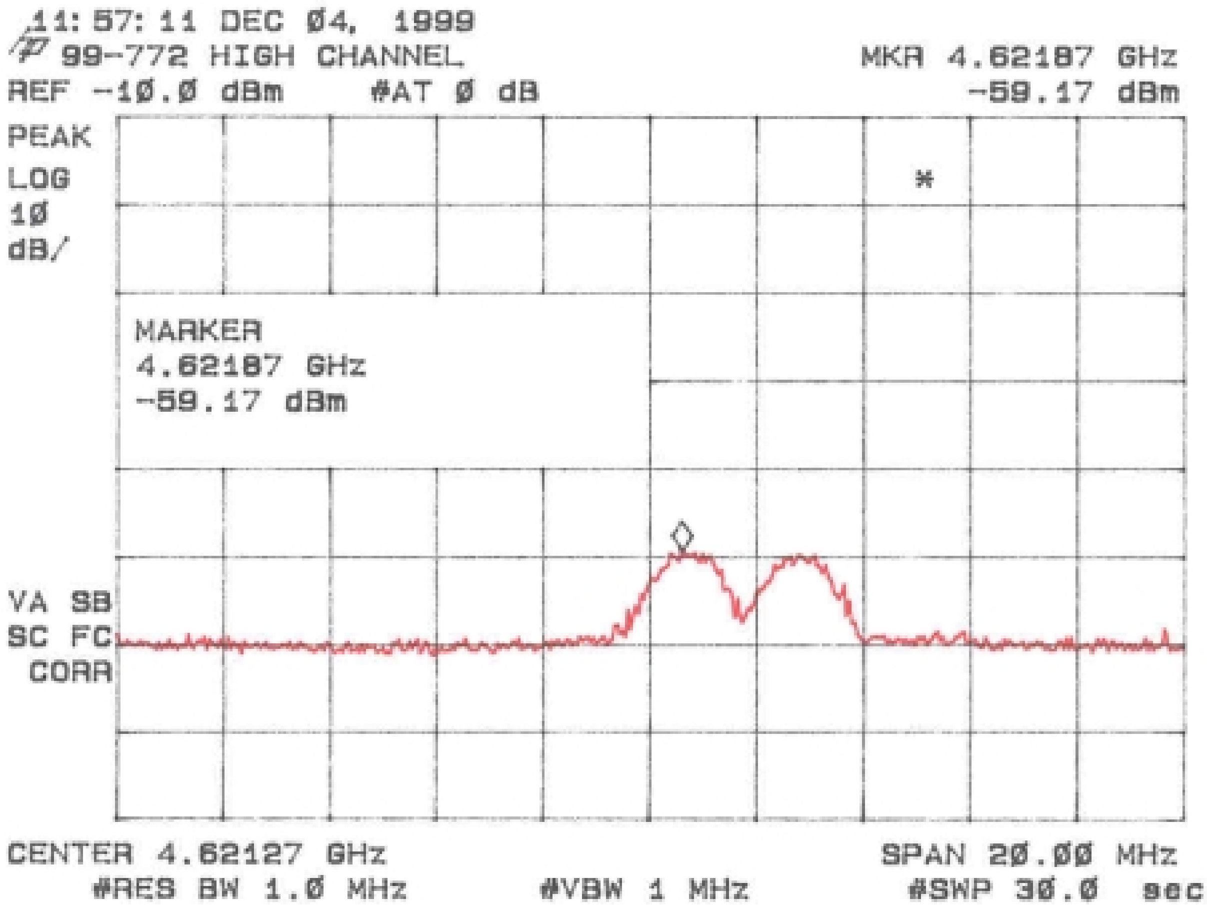


Figure 5m
Peak Radiated Spurious Emission 15.247(c) High



Test Date: December 4 & December 30, 1999
UST Project: 99-772
Customer: Axlon Electronics Corp.
Model: PLM-01

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
1.590	-61.1**	35.3	27.4	3.1	113.1	5000
2.390	-64.6	34.8	30.6	3.9	126.5	5000
2.700	-60.3	34.9	31.2	4.2	229.4	5000
3.624	-60.2	34.6	33.9	5.2	367.1	5000
4.530	-64.9	34.2	34.0	7.1	280.6	5000

*** = Data adjusted by + 1 dB for high pass filter**
**** = Data adjusted by + 2.6 dB for high pass filter**

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-61.1 – 35.3 + 27.4 + 3.1 + 107)/20) = 113.1
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: ____________________ Name: Tim R. Johnson

Test Date: December 4 & December 30, 1999
UST Project: 99-772
Customer: Axlon Electronics Corp.
Model: PLM-01

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
2.700	-54.4	34.9	31.2	4.2	452.4	5000
3.660	-60.1	34.6	34.0	5.3	378.8	5000
4.570	-61.0	34.2	34.1	7.2	450.7	5000
5.490	-62.1	34.0	35.9	7.8	536.7	5000

*** = Data adjusted by + 1 dB for high pass filter**
**** = Data adjusted by + 2.6 dB for high pass filter**

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-54.4 - 34.9 + 31.2 + 4.2 + 107)/20) = 452.4
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: ____________________ Name: Tim R. Johnson

Test Date: December 4 & December 30, 1999
UST Project: 99-772
Customer: Axlon Electronics Corp.
Model: PLM-01

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
1.607	-61.9**	35.2	27.4	3.1	104.6	5000
2.770	-60.9	34.9	31.3	4.2	218.0	5000
3.699	-58.8	34.6	34.1	5.3	449.5	5000
4.620	-58.2	34.2	34.2	7.4	641.8	5000

*** = Data adjusted by + 1 dB for high pass filter**
**** = Data adjusted by + 2.6 dB for high pass filter**

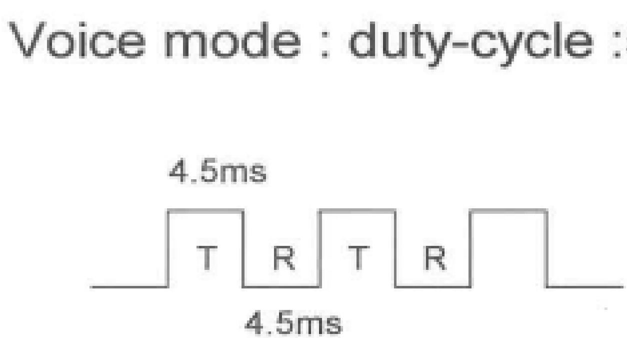
SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-61.9 - 35.2 + 27.4 + 3.1 + 107)/20) = 104.6
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: ____________________ Name: Tim R. Johnson

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) and Figure 6.

Since the EUT was not capable of continuous mode of transmit, average measurements were not possible. Therefore only duty cycle corrections were applied to the peak measurements. Duty cycle corrections were based upon the following information as supplied by Axlon Electronics Corp.



Worse Case duty cycle per 100 msec = 4.5ms/9.0 ms = 50%

Duty Cycle Correction = 20 log (0.50) = -6.0 dB

Figure 6
Average Radiated Spurious Emission 15.247(c)

Since the EUT was not capable of continuous mode of transmit, average measurements were not possible. Therefore only duty cycle corrections were applied to the peak measurements.

Test Date: December 4 & December 30, 1999
UST Project: 99-772
Customer: Axlon Electronics Corp.
Model: PLM-01

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
1.590	-67.1**	35.3	27.4	3.1	56.7	500.0
2.390	-70.6	34.8	30.6	3.9	63.4	500.0
2.700	-66.3	34.9	31.2	4.2	114.9	500.0
3.624	-66.2	34.6	33.9	5.2	184.0	500.0
4.530	-70.9	34.2	34.0	7.1	140.6	500.0

*** = Data adjusted by + 1dB for high pass filter and 6.0 dB for duty cycle.**
**** = Data adjusted by + 2.6 dB for high pass filter and 6.0 dB for duty cycle.**

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) =
Antilog ((-67.1 – 35.3 + 27.4 + 3.1 + 107)/20) = 56.7
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: ____________________ Name: Tim R. Johnson

Test Date: December 4 & December 30, 1999
Project: 99-772
Customer: Axlon Electronics Corp.
Model: PLM-01

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
2.700	-60.4	34.9	31.2	4.2	226.7	500.0
3.660	-66.1	34.6	34.0	5.3	189.8	500.0
4.570	-67.0	34.2	34.1	7.2	225.9	500.0
5.490	-68.1	34.0	35.9	7.8	269.0	500.0

*** = Data adjusted by + 1dB for high pass filter and 6.0 dB for duty cycle.**
**** = Data adjusted by + 2.6 dB for high pass filter and 6.0 dB for duty cycle.**

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) =
Antilog ((-60.4 - 34.9 + 31.2 + 4.2 + 107)/20) = 226.7
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: ____________________ Name: Tim R. Johnson

Test Date: December 4 & December 30, 1999
UST Project: 99-772
Customer: Axlon Electronics Corp.
Model: PLM-01

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
1.607	-67.9**	35.2	27.4	3.1	52.4	500.0
2.770	-66.9	34.9	31.3	4.2	109.3	500.0
3.699	-64.8	34.6	34.1	5.3	225.3	500.0
4.620	-64.2	34.2	34.2	7.4	321.7	500.0

*** = Data adjusted by + 1dB for high pass filter and 6.0 dB for duty cycle.**
**** = Data adjusted by + 2.6 dB for high pass filter and 6.0 dB for duty cycle.**

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) =
Antilog ((-67.9 – 35.2 + 27.4 + 3.1 + 107)/20) = 52.4
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)

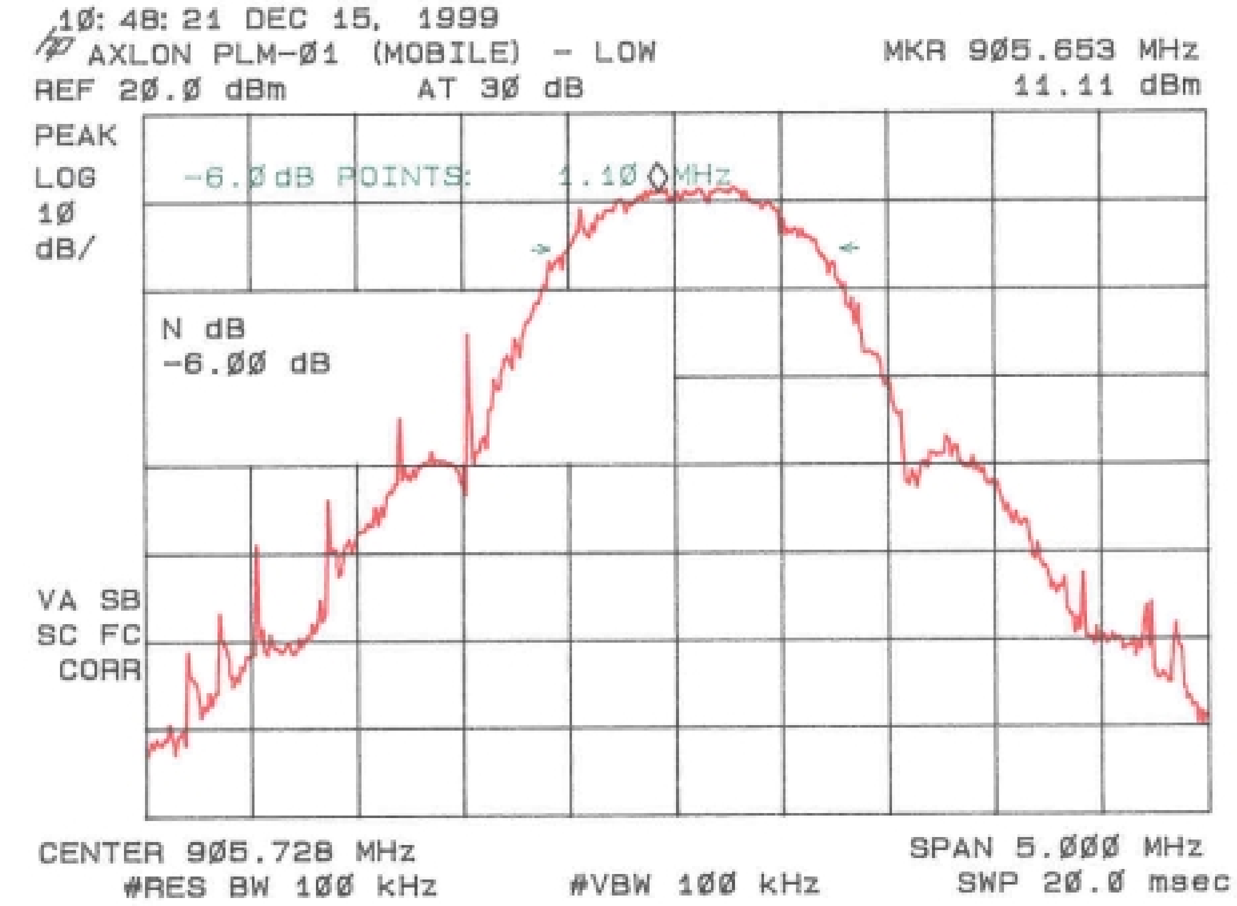


Figure 7b.
6 dB Bandwidth per FCC Section 15.247(a)(2) (Mid)

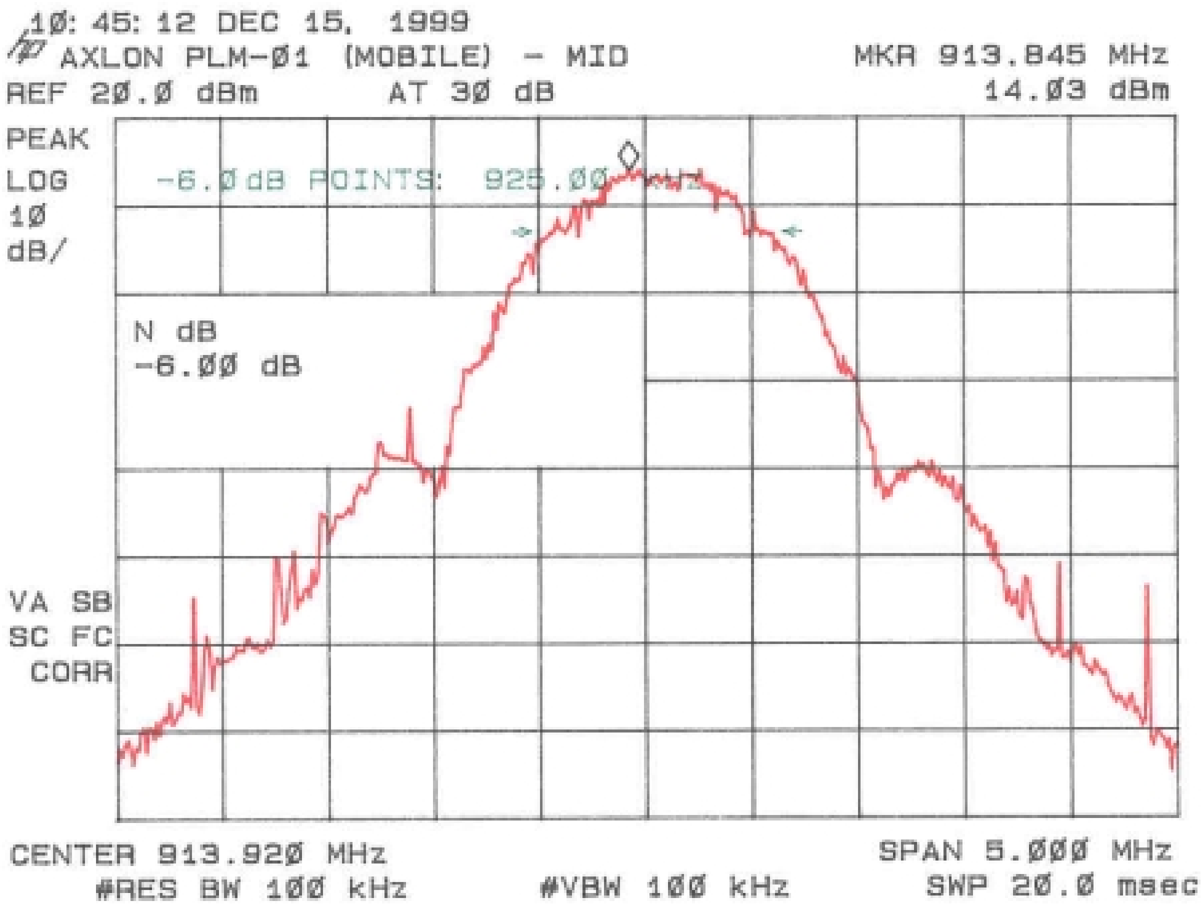
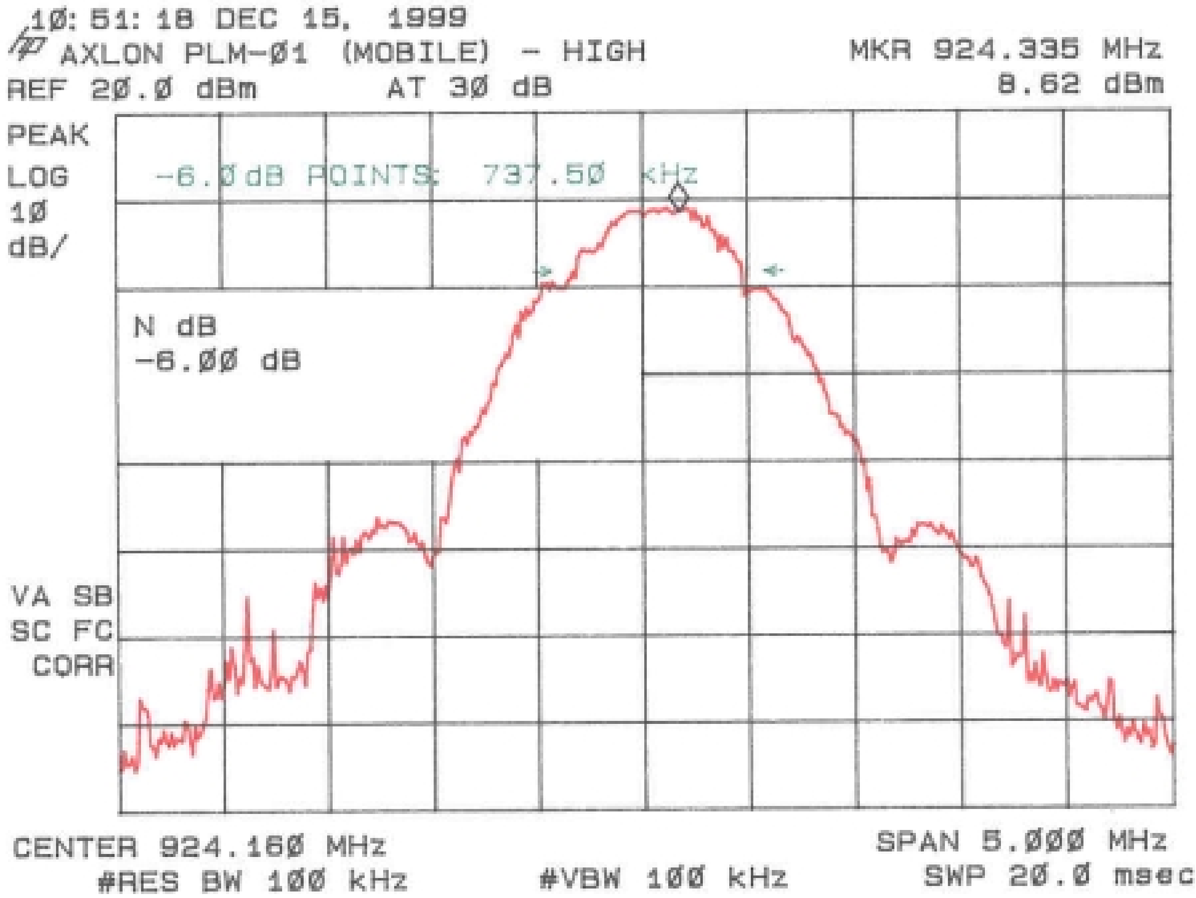


Figure 7c.
6 dB Bandwidth per FCC Section 15.247(a)(2) (High)



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 6
POWER SPECTRAL DENSITY

Test Date: December 16, 1999
UST Project: 99-772
Customer: Axlon Electronics Corp.
Model: PLM-01

Frequency (GHz)	Test Data (dBm) Normalized to 1 Hz	Results (dBm)	FCC Limit (dBm)
905.772	-39.5	-4.7	8.0
913.719	-40.4	-5.6	8.0
924.326	-42.7	-7.9	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

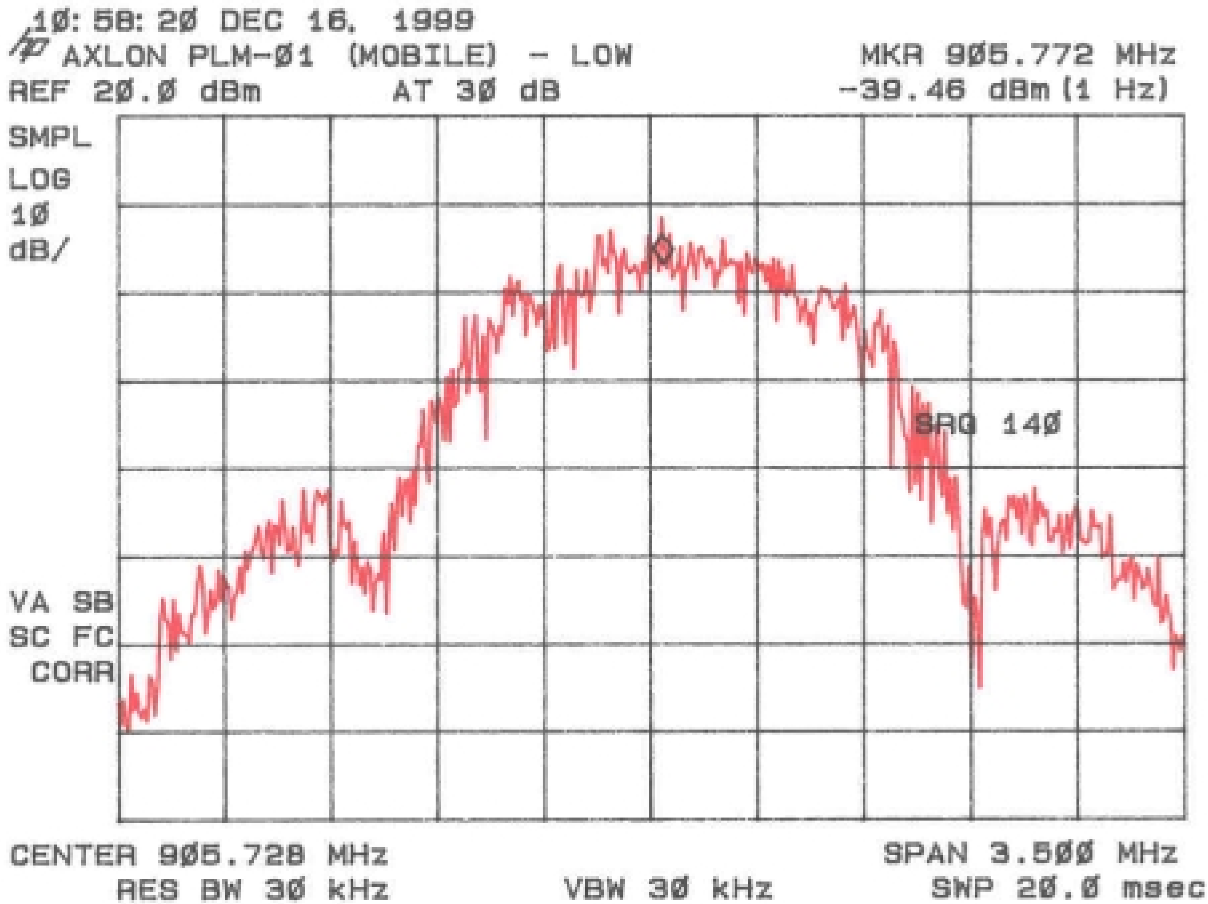


Figure 8b
Power Spectral Density 15.247(b) and 15.247(d) Mid

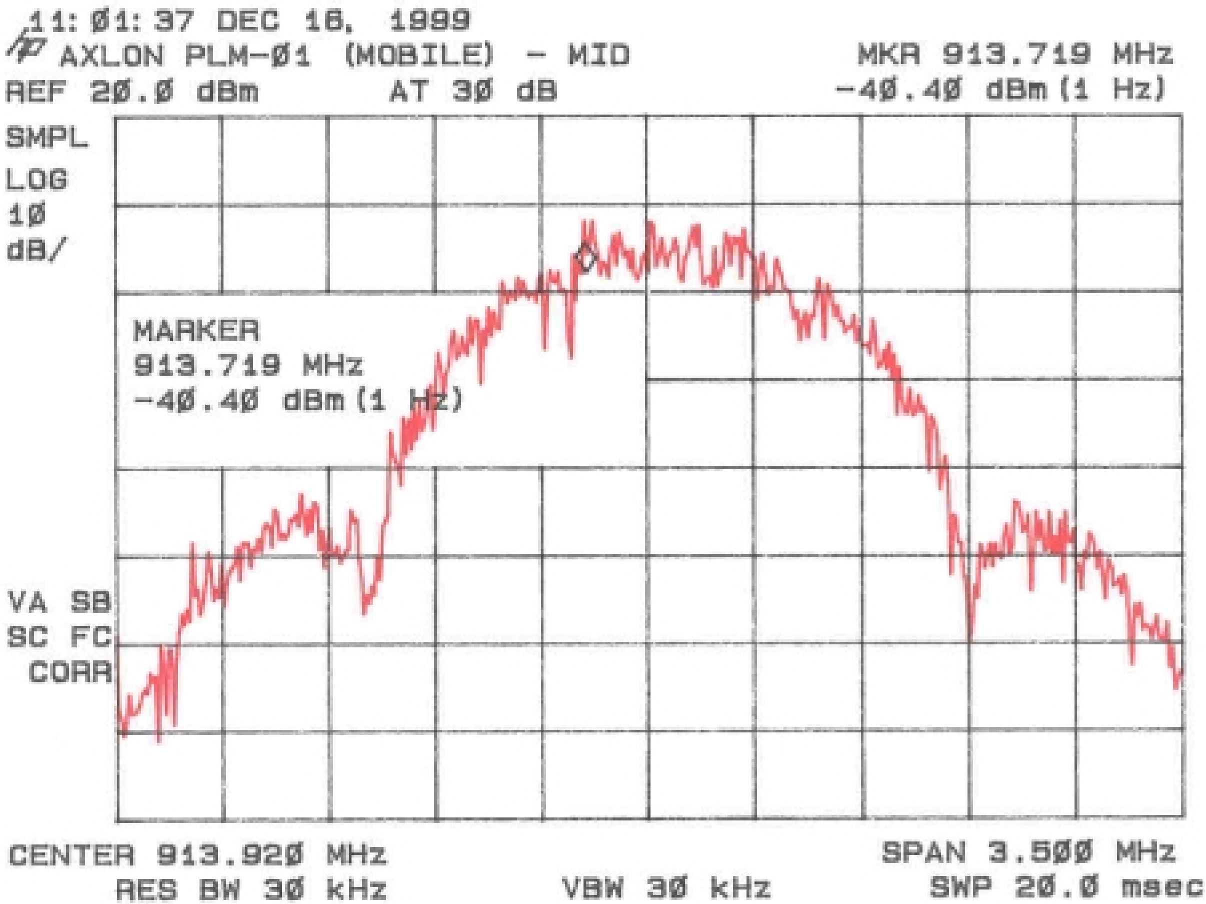
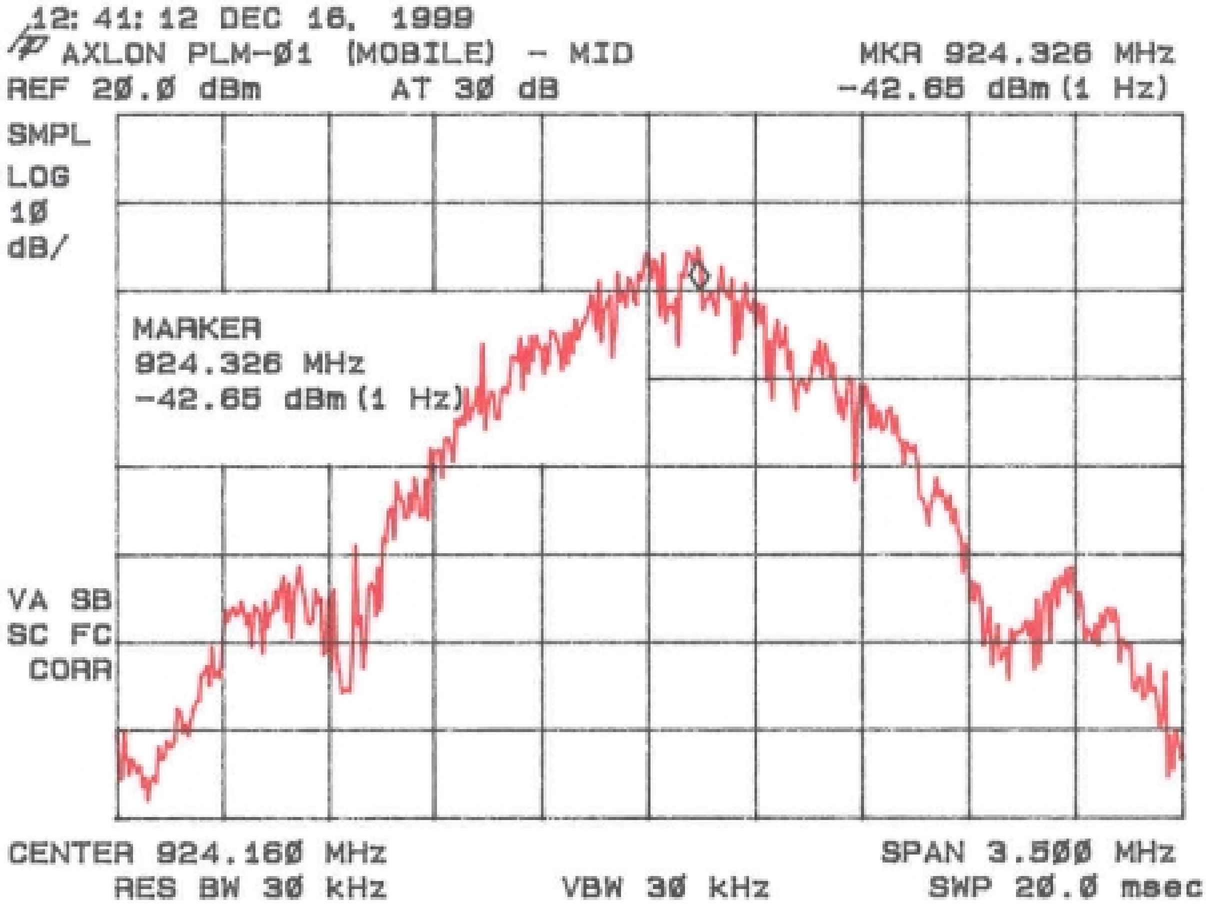


Figure 8c
Power Spectral Density 15.247(b) and 15.247(d) High



2.13 Processing Gain

Data regarding processing gain has been provided on the following page from Axlon Electronics Corp.

Axlon PalmPal Lite Processing Gain Measurement and Calculation

The processing gain of this spread spectrum system was measured using the CW jamming method. Figure 1 illustrates the measurement setup. The output power of the spread spectrum transmitter is fixed and the output power of jammer is adjustable. The frequency of jammer was stopped through the pass band of nominal channel in 50KHz step. In each frequency step of the jammer, the output power of jammer is adjusted to cause the Bit Error Rate (BER) to be $1.0*10^{-3}$. The power levels are recorded to calculate the J/S as shown in Table 1.

The processing gain Gp was calculated using the formula :

$$Gp=(S/N)o+Mj+Lsys$$

Where (S/N)o is the signal to noise ratio, Mj is the Jammer to signal ratio (J/S), and Lsys is the system loss.

For the BER=$1.0*10^{-3}$, the Eb/No of the GMSK discriminator (BT=0.5) is about 13.5dB (See Ref.1). Due to using the hard-decision receiver, the Eb/No will be 16.5dB and then signal to noise ratio (S/N)o should be 14.74 dB. According to Table 1, the minimun J/S ratio is -6.5dB. And assume the system loss is 2dB. Therefore, the processing gain is calculated below :

$$Gp=(S/N)o+Mj+Lsys=14.74+(-6.5)+2.0=10.24$$

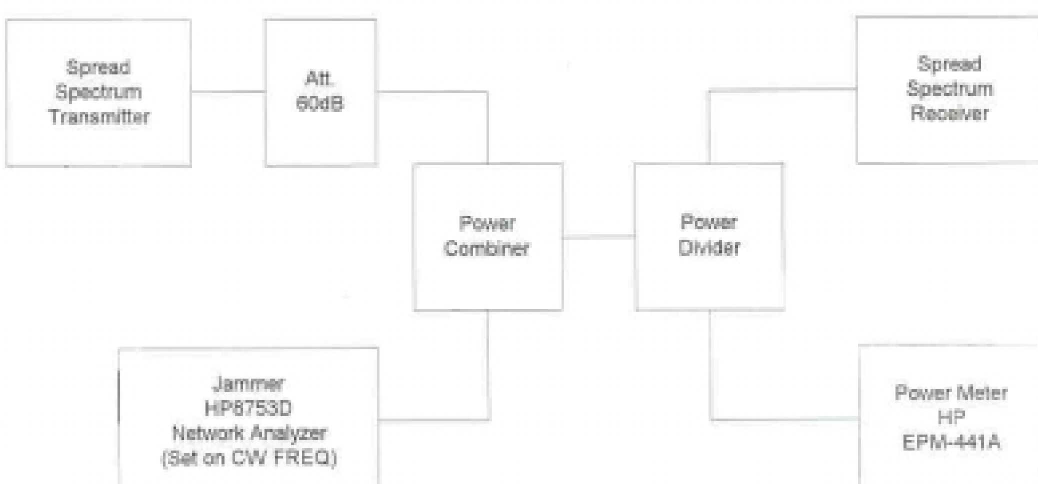


Figure 1.Processing Gain Measurement Setup

PPLFCC3.doc

	Frequency(MHz)	Jammer(dBm)	Signal(dBm)	J/S(dB)
1	915.268	-57.1	-52.6	-4.5
2	915.318	-57.6	-52.6	-5
3	915.368	-58.6	-52.6	-6
4	915.418	-59.1	-52.6	-6.5
5	915.468	-58.6	-52.6	-6
6	915.518	-59.1	-52.6	-6.5
7	915.568	-59.7	-52.6	-7.1
8	915.618	-58.6	-52.6	-6
9	915.668	-58.6	-52.6	-6
10	915.718	-57.6	-52.6	-5
11	915.768	-54.6	-52.6	-2
12	915.818	-54.6	-52.6	-2
13	915.868	-54.6	-52.6	-2
14	915.918	-55.1	-52.6	-2.5
15	915.968	-55.1	-52.6	-2.5
16	916.018	-55.6	-52.6	-3
17	916.068	-55.1	-52.6	-2.5
18	916.118	-54.9	-52.6	-2.3
19	916.168	-54.6	-52.6	-2
20	916.218	-54.1	-52.6	-1.5
21	916.268	-54.1	-52.6	-1.5
22	916.318	-54.1	-52.6	-1.5
23	916.368	-54.1	-52.6	-1.5
24	916.418	-54.6	-52.6	-2
25	916.468	-54.6	-52.6	-2
26	916.518	-54.8	-52.6	-2.2
27	916.568	-54.8	-52.6	-2.2
28	916.618	-54.6	-52.6	-2
29	916.668	-54.3	-52.6	-1.7
30	916.718	-54.1	-52.6	-1.5

Table 1. J/S Ratio Measurement Result for BER=$1.0*10^{-3}$

Optimization and Comparisons of Differential and Discriminator DECT Receivers

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ABSTRACT

Two noncoherent DECT receivers, namely the differential demodulator and the discriminator demodulator, in an AWGN (additive white Gaussian noise) channel are compared. We assume that the receiver band-pass filter (BPF) is a Gaussian BPF. The bandwidth of the BPF is optimized for each receiver. We found that the differential demodulator requires a wider bandwidth. However, its performance is slightly better than that of the discriminator demodulator. The assumptions being made in this initial study are ideal frequency tracking and clock recovery. Moreover, adjacent channel interference (ACI) is not considered. A more thorough comparison taking into account ACI, frequency-offset compensation, and clock synchronization is under investigation in our wireless communications laboratory.

1. Introduction

Cost and power-efficiency are among the most important issues concerned when designing a portable hand set, such as a DECT [1] phone, for wireless communications. Coherent demodulation is thus excluded for a DECT hand set. Although it can achieve better performance, coherent demodulation requires carrier phase synchronization which increases the complexity, cost, size, and power consumption of the receiver. Two demodulators which do not need carrier phase synchronization are considered in this paper. One is the differential demodulator [2] which compares the phases between two adjacent symbols to make decision. The other is the discriminator demodulator [3] which discriminates the instantaneous frequency of the RF signal and make decision based on the demodulated baseband signals. The differential demodulator has the advantage that the signal can be sampled at IF and the detector can be implemented in an all-digital form thereafter. However, the complexity of the digital receiver for a high-speed application, such as the DECT system, could become undesirable considering the size, weight, cost, and power consumption of the receiver. On the other hand, a discriminator demodulator could provide a light, small, low-cost, and low power-consumption solution. However, a discriminator demodulator is more sensitive to the frequency offset. A thorough comparison of these two receiver architectures is required before we can decide which demodulator to adopt.

In this initial study, AWGN is considered as the only interference. Besides, multi-path Rayleigh fading is not considered. Ideal frequency and bit clock synchronization are also assumed. However, since noncoherent demodulation is assumed, no carrier phase synchronization is necessary.

In Sect. 2, we study the optimum receiver bandwidth for a differential demodulator assuming that the receiver band-pass filter (BPF) is a Gaussian BPF. The performance of the differential demodulator is then studied assuming this optimum bandwidth. In Sect. 3, the optimum bandwidth and BER performance for the discriminator demodulator is studied. In Sect. 4, we discuss the numerical results obtained in Sect. 2 and 3. Conclusions are drawn in Sect. 5.

2. *Differential Demodulator*

more detail on this structure.

A simplified block diagram of a DECT receiver employing the 1-bit differential detector [2] is depicted in Fig. 1. The phase differential between two adjacent symbols is $\pi/2$ or $-\pi/2$ for an MSK signal. *For GMSK signals, intersymbol interference (ISI) will cause the phase differential to wander from the nominal* $\pm \pi/2$ values. However, in general, *this phase differential can be used to decide the transmitted symbols.*

For the simplicity of the receiver designs, we assume that the noise and other interferences are band-limited by the BPF at IF. The post-demodulation low-pass filter (LPF) is only used to remove the high-frequency component generated by the mixing of signals. Moreover, in this initial study, we assume an ideal (i.e. infinite-pole) Gaussian filter as the BPF. *The optimum receiver bandwidth for* $BER=10^{-3}$ is found to be $B_rT_b= 1.0$ *(see Fig. 2) where* T_b *is the bit duration. The bandwidth* B_r *is* defined to be the 3-dB bandwidth of the receiver Gaussian BPF.

Using this optimum filter, the BER performance of the 1-bit differential GMSK is simulated. The results are depicted in Fig. 3. We note that for BER= 10^{-3}, E_b/N_o=13 dB is required.

3. Discriminator Demodulator

– more detail on this structure

A simplified block diagram of the GMSK receiver employing a frequency discriminator is depicted in Fig. 4. The instantaneous frequency deviation of the modulated RF carrier corresponds to the baseband Gaussian-filtered signal at the transmitter. Without the BPF, and assuming that noise and interferences are absent, the demodulated signal will be identical to the baseband signal at the transmitter side. Although the BPF will affect the demodulated signal in a complex manner, the demodulated signal can be used to make decision directly. We will consider only symbol-by-symbol decision in this paper.

As in the differential detector, we assume that the LPF is used only to remove the high-frequency component. The optimum bandwidth for this discriminator demodulator is found to be B_rT_b=0.7. (See Fig. 2). The BER performance is depicted in Fig. 3 for B_rT_b=0.7. The E_b/N_o required to achieve BER=10^{-3} is 13.5 dB.

4. Discussions

From the results presented in last two sections, we note that for optimum performances, the differential detector requires wider bandwidth. This can be explained as follows. A narrower filter will cause more ISI yet reject more 'high-frequency' noise. In the discriminator demodulator, the decision is based on one symbol only. However, in the differential demodulator, ISI is approximately doubled in the decision process because the decision is based on comparing the phases of two symbols. On the other hand, the baseband noise in the discriminator demodulator is proportional to the cubic of the receiver bandwidth; limiting the high-frequency noise is thus highly desirable in the discriminator demodulator. We also note that the discriminator demodulator is more sensitive to the receiver bandwidth. Increasing the bandwidth will increase the baseband noise power dramatically. Decreasing the receiver bandwidth will lead to the distortion of the signal, hence increment of ISI. The differential detector, on the other hand, is less sensitive to the receiver bandwidth. Once the bandwidth is wide enough to pass the signal without introducing too much ISI, the performance degrades slowly as the bandwidth increases. Preliminary studies assuming a Butterworth or Chebyshev BPF also reveal similar results.

Although it appears that the differential demodulator has better performance, the narrower bandwidth requirement for the discriminator may suggest that the discriminator is more robust against the adjacent channel interference (ACI).

Frequency offset compensation and clock synchronization have not been considered in this paper. A thorough comparison is needed to take these two factors into account.

5. Conclusions

The receiver bandwidth assuming a Gaussian band-pass filter is optimized for both differential and discriminator demodulators of a DECT system. It is found that the discriminator requires a narrower receiver BPF. However, the E_b/N_o requirement for the 1-bit differential detector is about 0.5 dB lower than that for the discriminator demodulator if ACI is not considered. For a fair comparison, ACI must be taken into account. Frequency offset has not been considered in this paper. A simple yet effective frequency-offset compensation method can be found in [4]. This method can be incorporated into the DECT receiver to improve the performance. A DECT receiver which includes frequency-offset compensation and clock synchronization is currently under development in our Computer and Communication Research Laboratories.

Acknowledgement

The fruitful discussions with Mr. Yung-Liang Huang, Mr. Sammy Shyue, and Mr. Jenn-Shyang Chiou of the Wireless Communication Department, CCL, ITRI are highly appreciated.

References

[1] European Telecommunication Standard Institute, *Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface*, Final Draft, Valbonne, France, May 1992.

[2] M. K. Simon and C. C. Wang,"Differential detection of Gaussian MSK in a mobile radio environment", *IEEE Transactions on Vehicular Technology*, Vol. VT-33, No. 4, pp. 307-320, November. 1984.

[3] L. B. Lopes, "Coherent and limiter-discriminator detection of GMSK in interference limited conditions," *Electronics Letters,* Vol. 27, No. 25, pp. 2313-2315, December 1991.

[4] K. Kage, Y. Sasaki, M. Ichihara, and T. Sato, "The feasibility study of the Nyquist baseband filtered 4-level FM for digital mobile communications," *Proceedings of IEEE Vehicular Technology Conference,* May 1985, pp. 200-204.

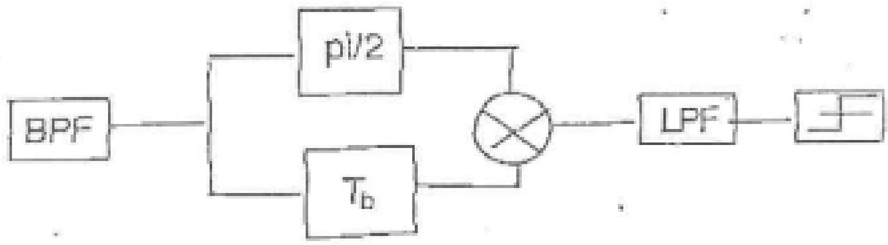

Fig. 1 Simplified block diagram of a 1-bit differential detector. The BPF *is assumed to be Gaussian.* The LPF is used only to remove the high-frequency term.

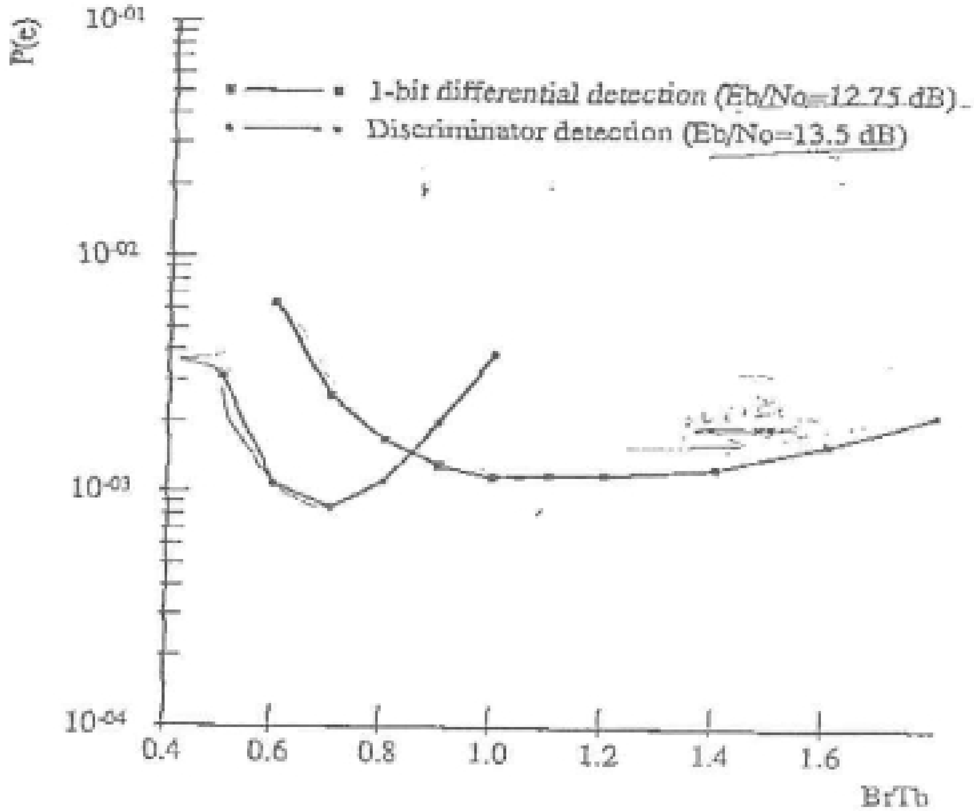

Fig. 2 BER of GMSK as functions of receiver bandwidth.

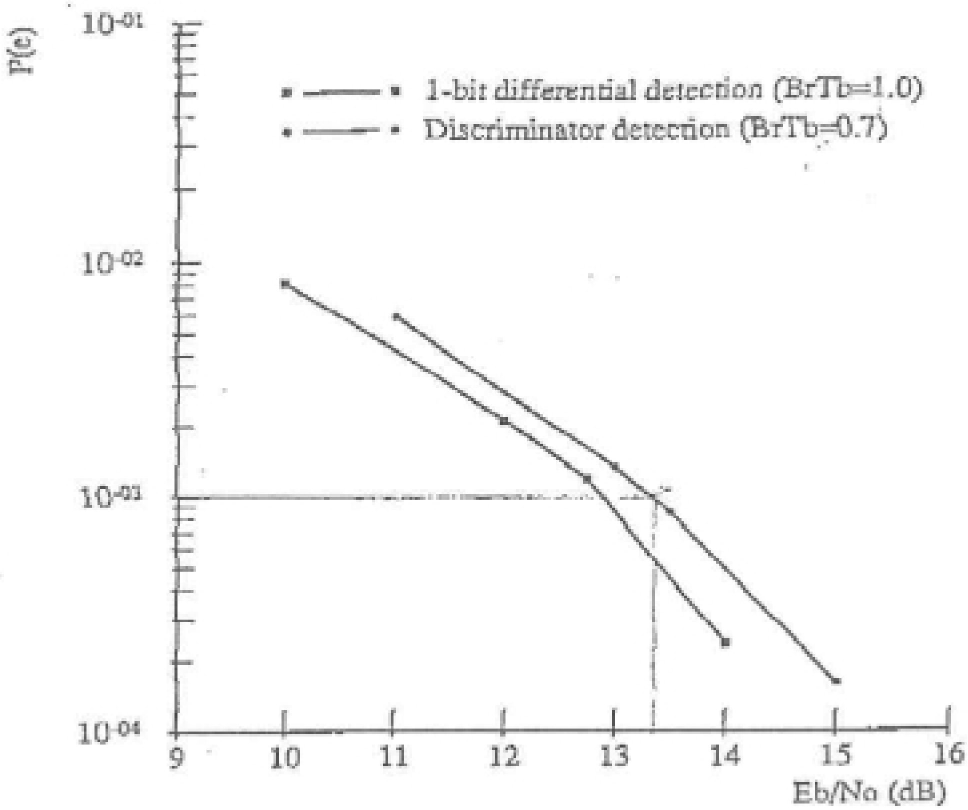

Fig. 3 BER of GMSK as functions of Eb/No

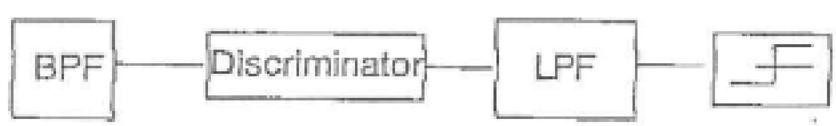

Fig. 4 Simplified block diagram of a discriminator demodulator. The BPF is assumed to be Gaussian. The LPF is used only to remove the high-frequency component.

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 7. CONDUCTED EMISSIONS DATA - TRANSMITTER CLASS B

Test Date: December 4 - December 30, 1999
UST Project: 99-772
Customer: Axlon Electronics Corp.
Product: PLM-01

Frequency (MHz)	Test Data (dBm) Phase Neutral	RESULTS (uV) Phase Neutral	FCC Limits (uV)
Conducted Emissions were considered not applicable since the EUT is portable and only battery powered.			

Tester Signature: ___________________ **Name:** Tim R. Johnson

2.15 Radiated Emissions (47 CFR 15.109a)

Radiated emissions were evaluated from 30 to 5000 MHz. Measurements were made with the analyzer's bandwidth set to 120 kHz measurements made less than 1 GHz and 1 MHz are shown in Table 8a. Measurements made over 1 GHz results are shown in Table 8b.

TABLE 8a. RADIATED EMISSIONS DATA

CLASS B

Test Date: December 13, 1999
UST Project: 99-772
Customer: Axlon Electronics Corp.
Product: PLM-01

Measurements 30-1000 MHz

Frequency (MHz)	Receiver Reading (dBm) @3m	Correction Factor (dB)	Corrected Reading (uV/m) @3m	FCC Limit (uV/m) @3m
251.0	-93.0	16.2	32.2	200.0
257.0	-93.0	16.5	33.4	200.0
268.0	-94.0	17.0	31.8	200.0
279.0	-93.0	17.6	37.8	200.0
295.0	-92.0	18.2	45.7	200.0

*= Quasi Peak

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-93.0 + 16.2 + 107)/20) = 32.2
CONVERSION FROM dBm TO dBuV = 107 dB

Test Results
Reviewed By
Signature: ___________________ **Name: __Tim R. Johnson______**

TABLE 8b RADIATED EMISSIONS

CLASS B

Test Date: December 28, 1999
UST Project: 99-772
Customer: Axlon Electronics Corp.
Model: PLM-01

Measurements >1GHz

FREQ. (GHz)	TEST DATA (dBm) @ 3m	AMP GAIN (dB)	ANT. FACTOR (dB)	CABLE LOSS (dB)	RESULTS (uV/m) @ 3m	FCC LIMITS (uV/m) @ 3m
1.011	-62.8	35.9	25.2	2.3	62.1	500
1.049	-62.8	35.8	25.4	2.4	63.7	500
1.130	-62.8	35.8	25.6	2.5	67.3	500
1.590	59.8	35.3	27.4	3.1	131.3	500

SAMPLE CALCULATIONS:
Results uV/m @3m = Antilog ((-62.8 - 35.9 + 25.2 + 2.3 + 107)/20 = 62.1
Conversion from dB to dBuV = 107 dB

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

2.16 Power Line Conducted Emissions for Digital Device FCC Section 15.107

The conducted voltage measurements have been carried out in accordance with FCC Section 15.107, 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 9. CONDUCTED EMISSIONS DATA – DIGITAL DEVICE CLASS B

Test Date: December 4 - December 30, 1999
UST Project: 99-772
Customer: Axlon Electronics Corp.
Product: PLM-01

Frequency (MHz)	Test Data (dBm) Phase Neutral	RESULTS (uV) Phase Neutral	FCC Limits (uV)
Conducted Emissions were considered not applicable since the EUT is portable and only battery powered.			

Tester
Signature: ___________________ **Name:** Tim R. Johnson

2.17 Cordless Telephones Security Codes Requirements (47 CFR 15.214(d))

Cordless Telephones shall incorporate circuitry which makes use of a digital security code to provide protection against unintentional access to the public switched network.

Information regarding the design of the security functions of this EUT were provided by Axlon Electronics Corp. as shown on the following page.

Axlon Electronics Corp
21st century digital home at your fingertips

Ref no: *PPLFCC5*

The Statement of the Digital Security Code.

PalmPal-lite system is consisting of four different types of device and they are base system, mobile unit, wireless door phone, and digital wireless module. Each device is built-in with one microprocessor named Neuron Chip 3150 that each Neuron Chip has its own ID. The base system is the communication center among all the devices. Before using this PalmPal-lite system, each device such as mobile unit, wireless door phone, and digital wireless I/O module all need to register its Neuron Chip ID with the base system. Once mobile unit, wireless door phone, and digital wireless I/O get registered, and they will be able to communicate with one another including the base system. Therefore, without the registration process, the device is not able to communicate with the base system.

For example, if the house A has three registered mobile units, these three mobile units will be able to work only with the base system in house A, and won't be able to work outside with other house owners' PalmPal-lite base system.

This system design is to prevent the mobile units of different owners to be interfered by one another.

The information should be able to provide protection against unintentional access to the public switch telephone network by the base system and unintentional ringing by the mobile unit.

The maximum number of Neuron Chip ID can be up to 2^{32}

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