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

Antenna conducted spurious emissions in the frequency range 30 – 10000 MHz are normally 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 has an integrated non-removable antenna, this test has been deemed unnecessary.

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-5d (low), Figure 5e-5h (mid) and Figure 5i-5l (high).

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

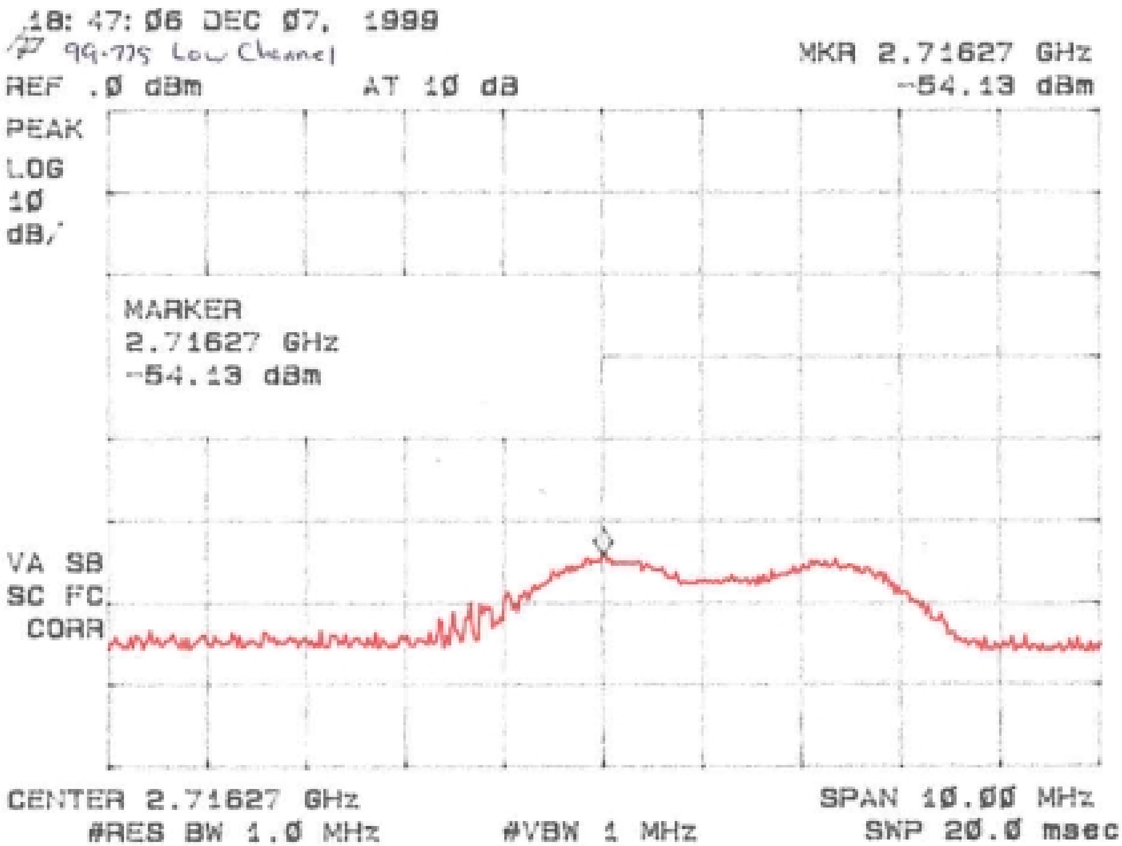


Figure 5b
Peak Radiated Spurious Emission 15.247(c) Low

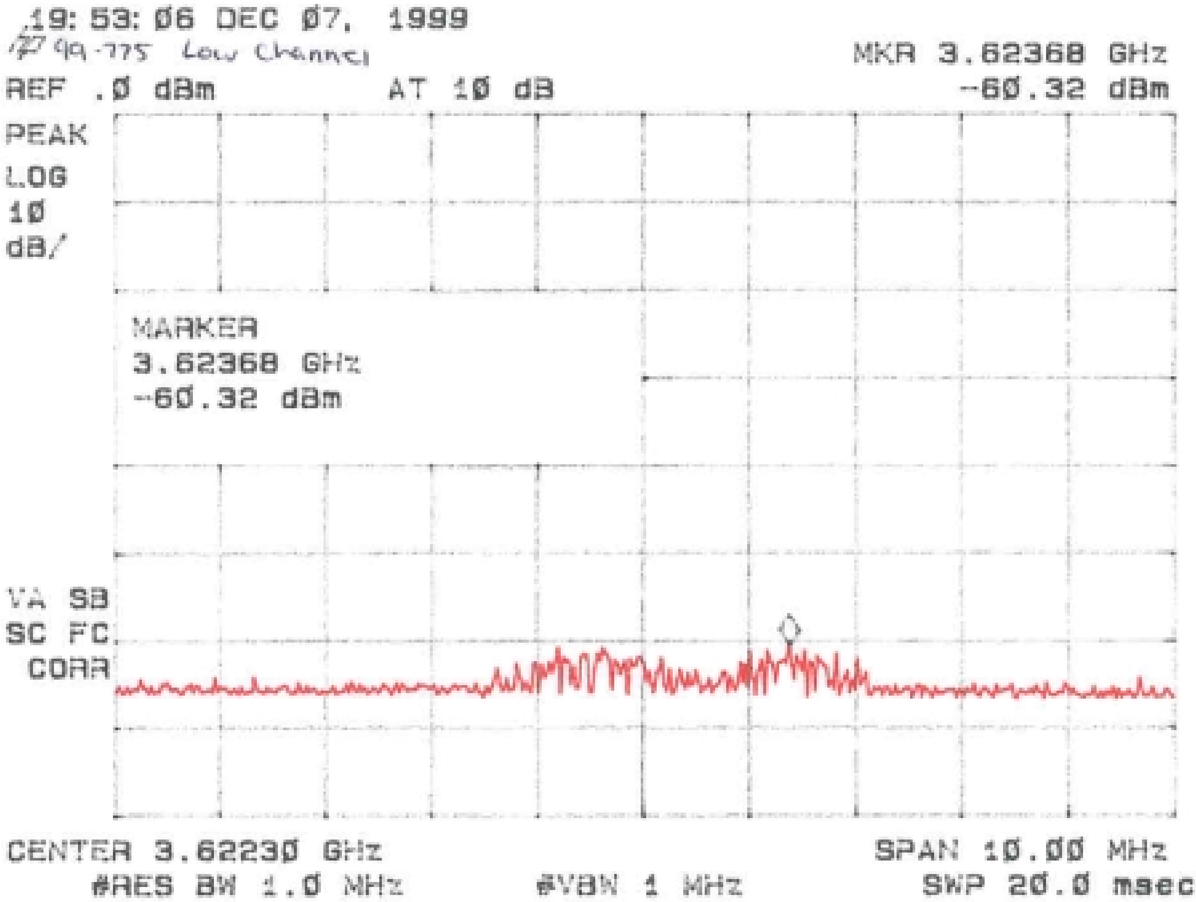


Figure 5c
Peak Radiated Spurious Emission 15.247(c) Low

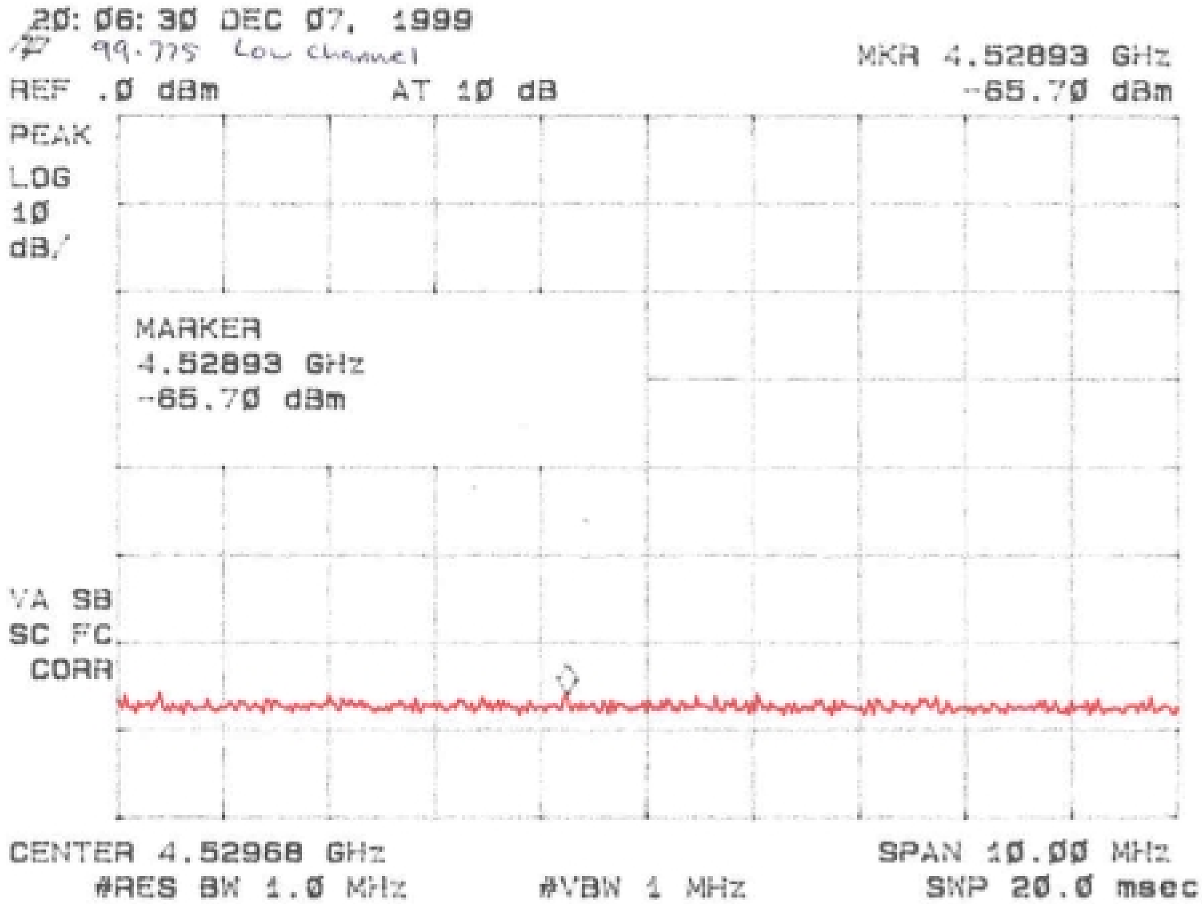


Figure 5d
Peak Radiated Spurious Emission 15.247(c) Low

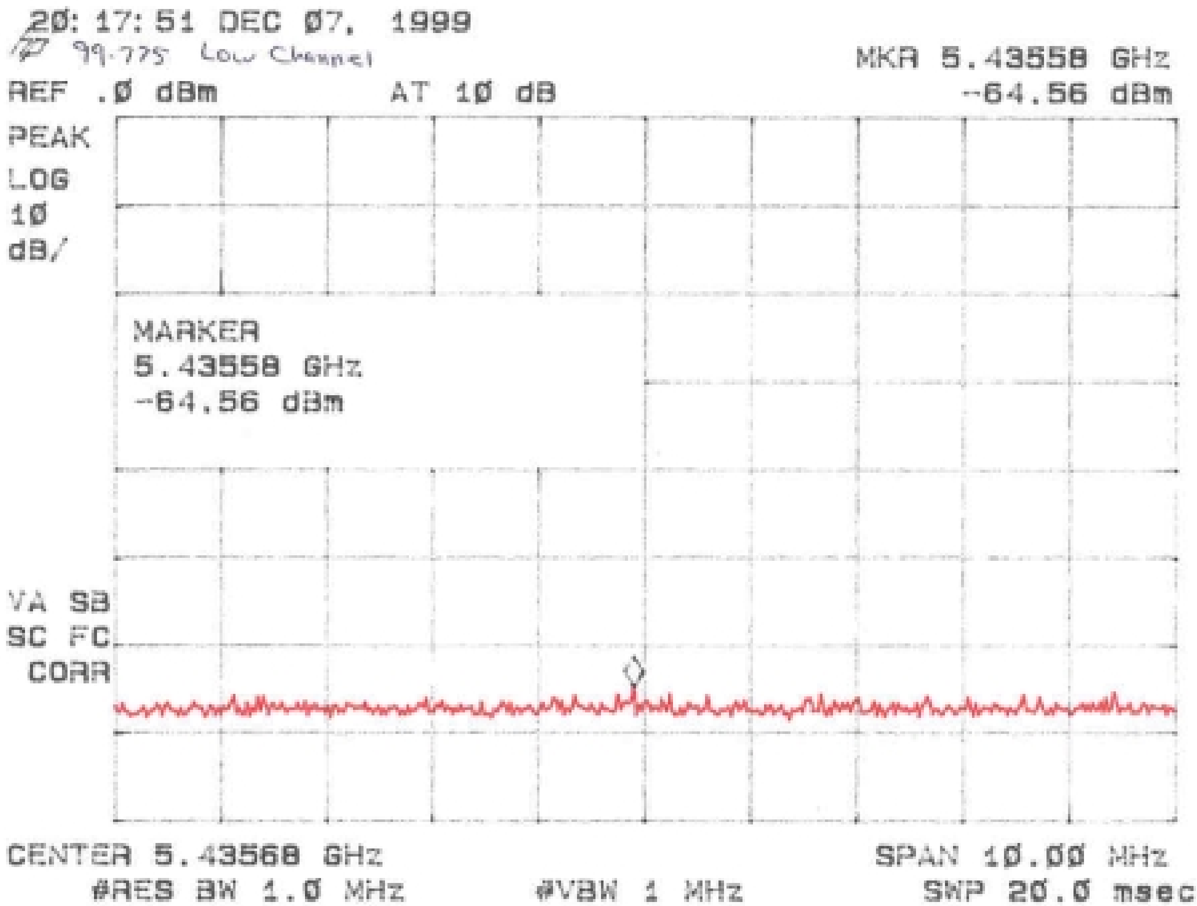


Figure 5e
Peak Radiated Spurious Emission 15.247(c) Mid

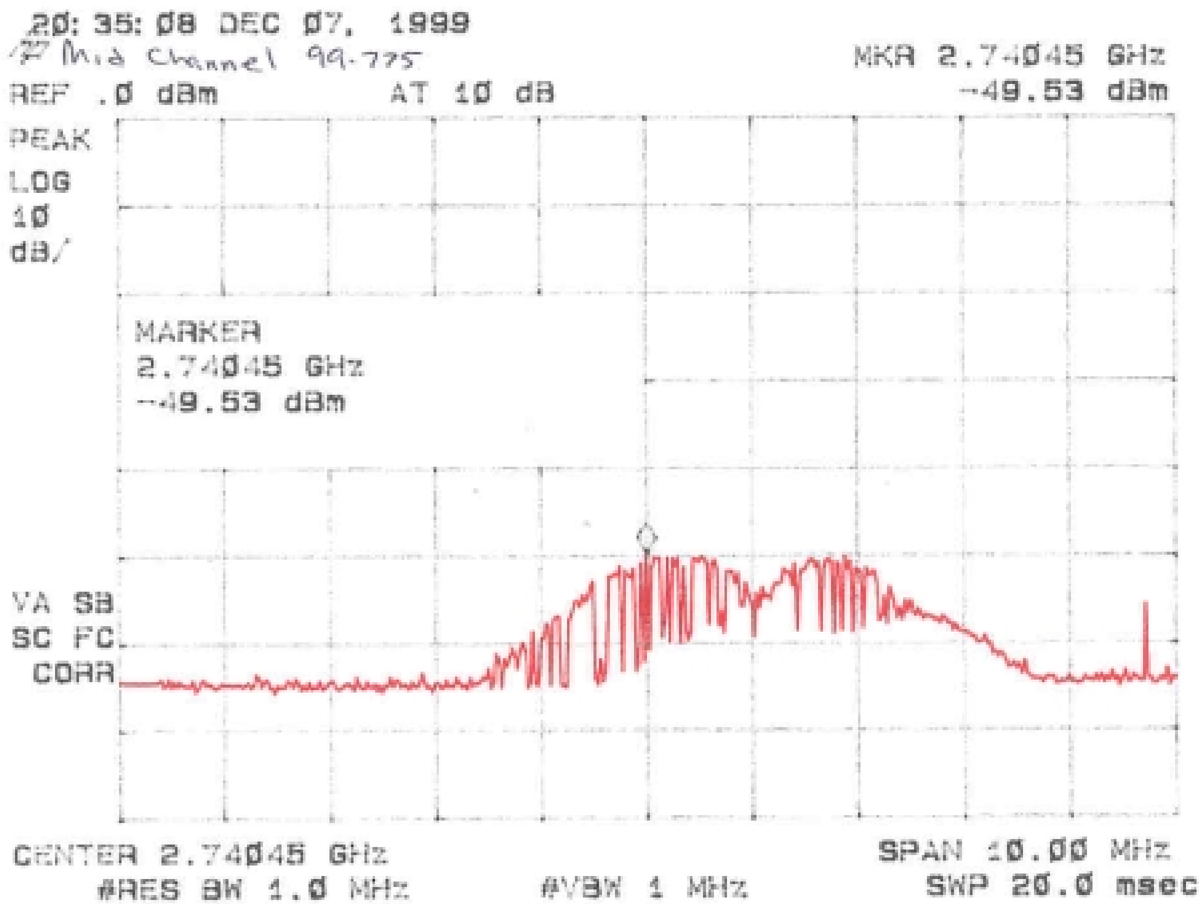


Figure 5f
Peak Radiated Spurious Emission 15.247(c) Mid

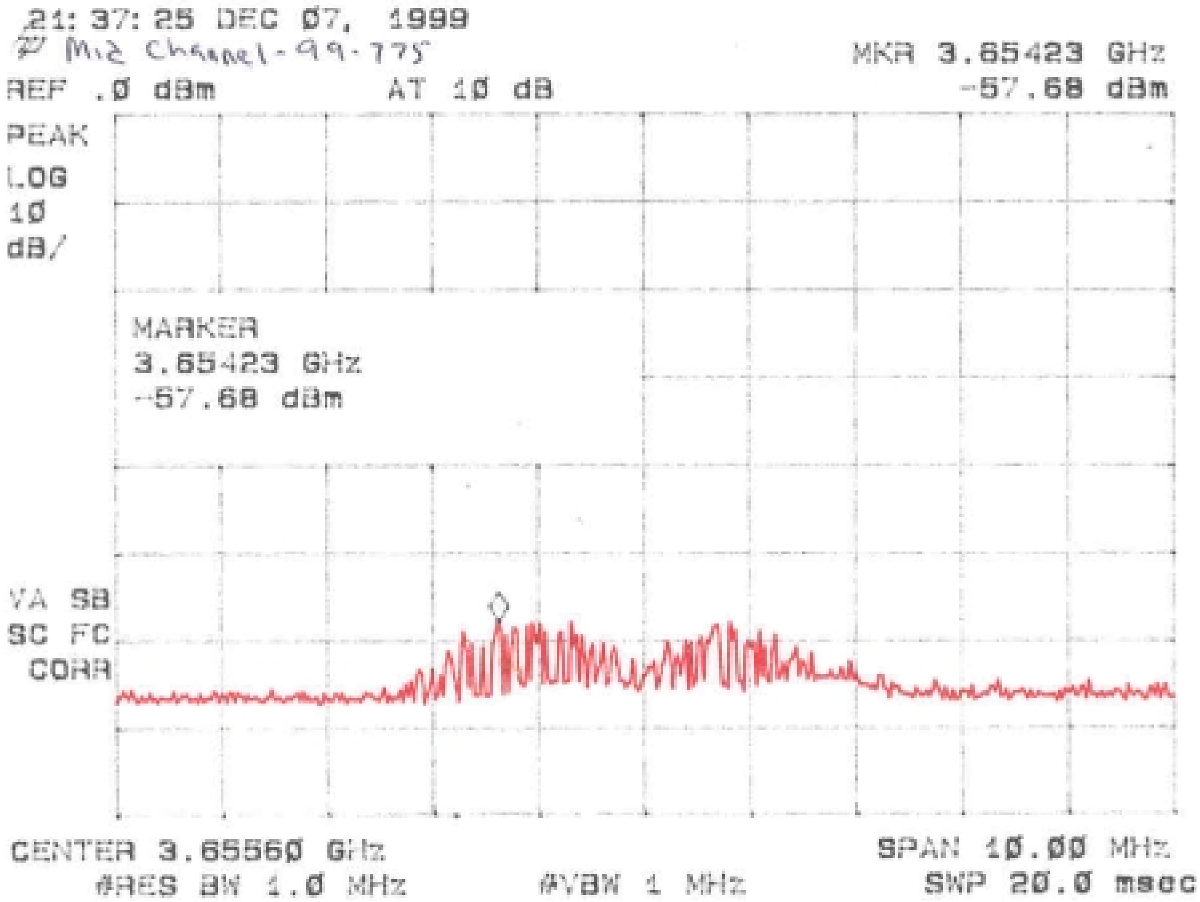


Figure 5g
Peak Radiated Spurious Emission 15.247(c) Mid

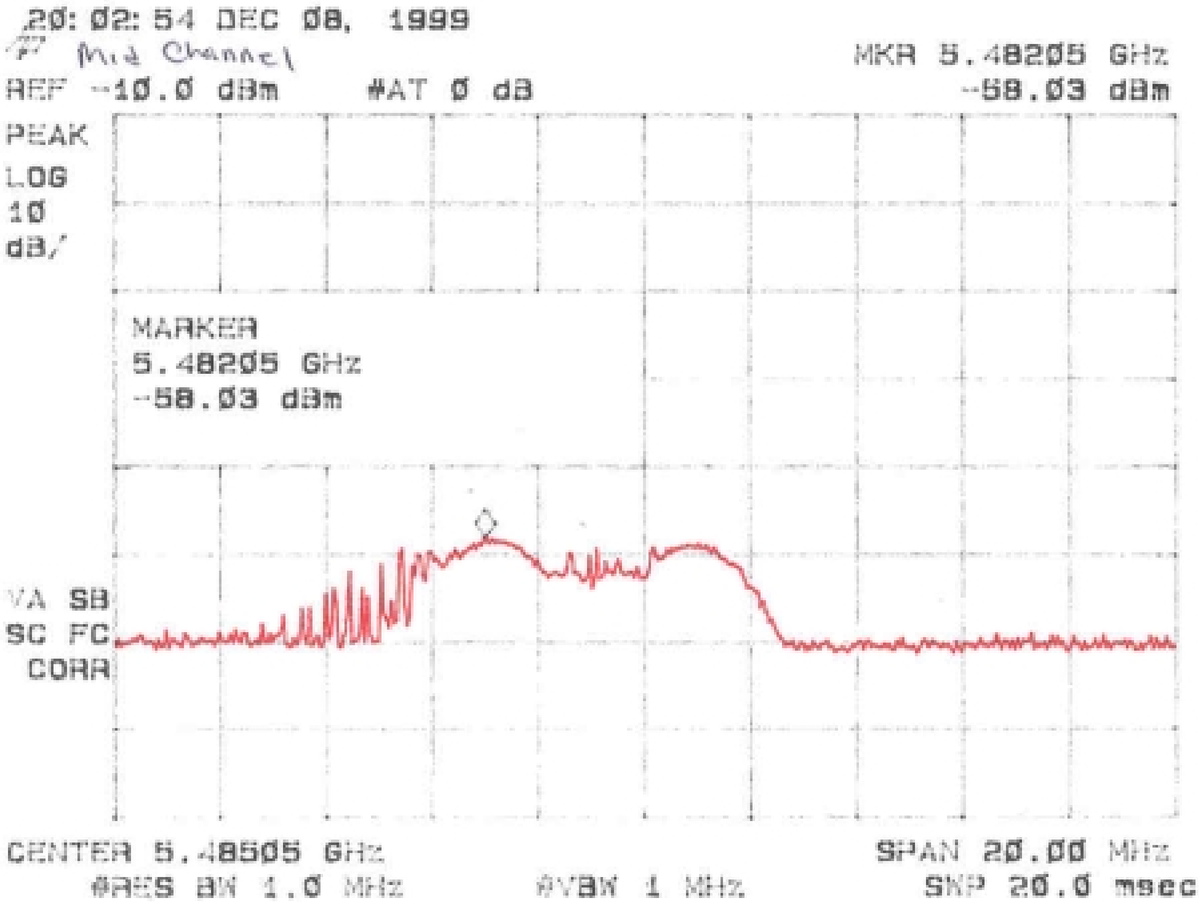


Figure 5h
Peak Radiated Spurious Emission 15.247(c) Mid

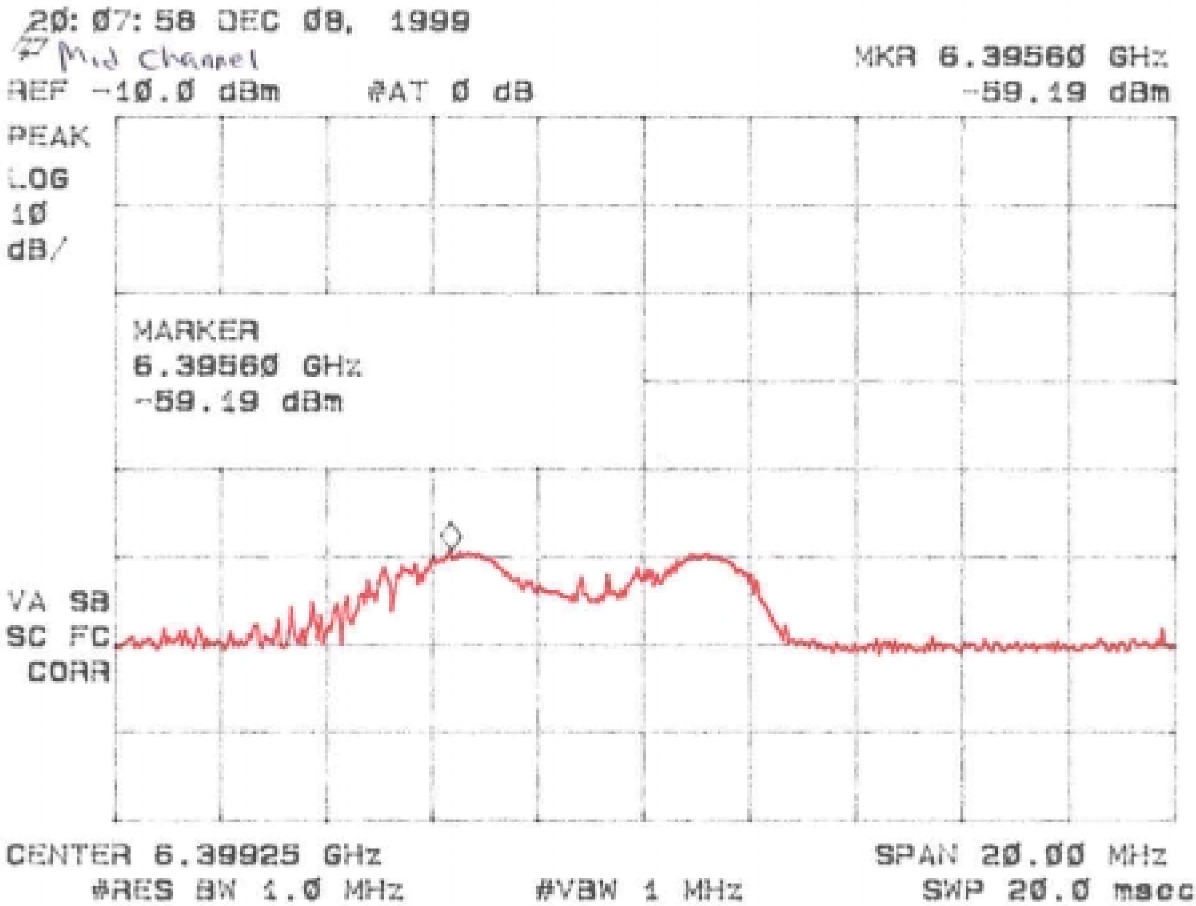


Figure 5i
Peak Radiated Spurious Emission 15.247(c) High

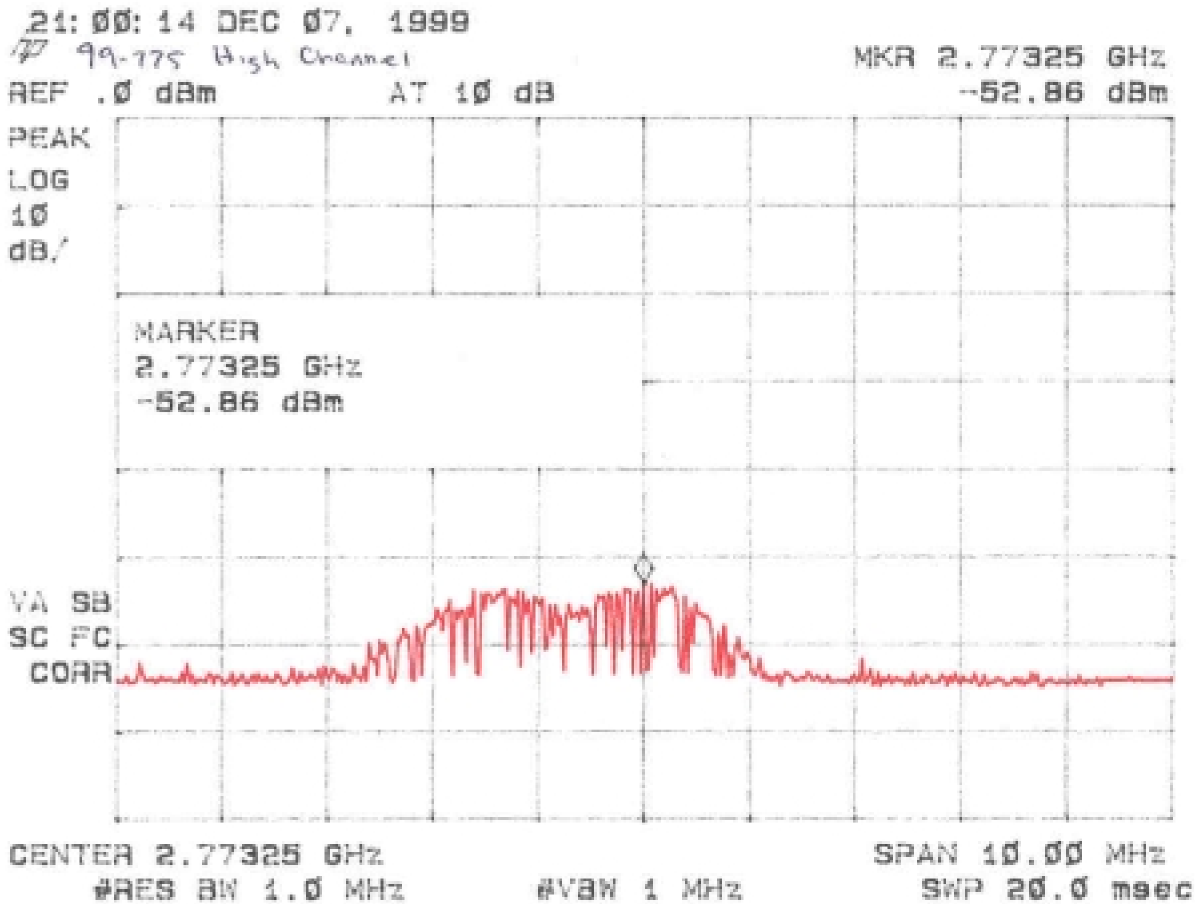


Figure 5j
Peak Radiated Spurious Emission 15.247(c) High

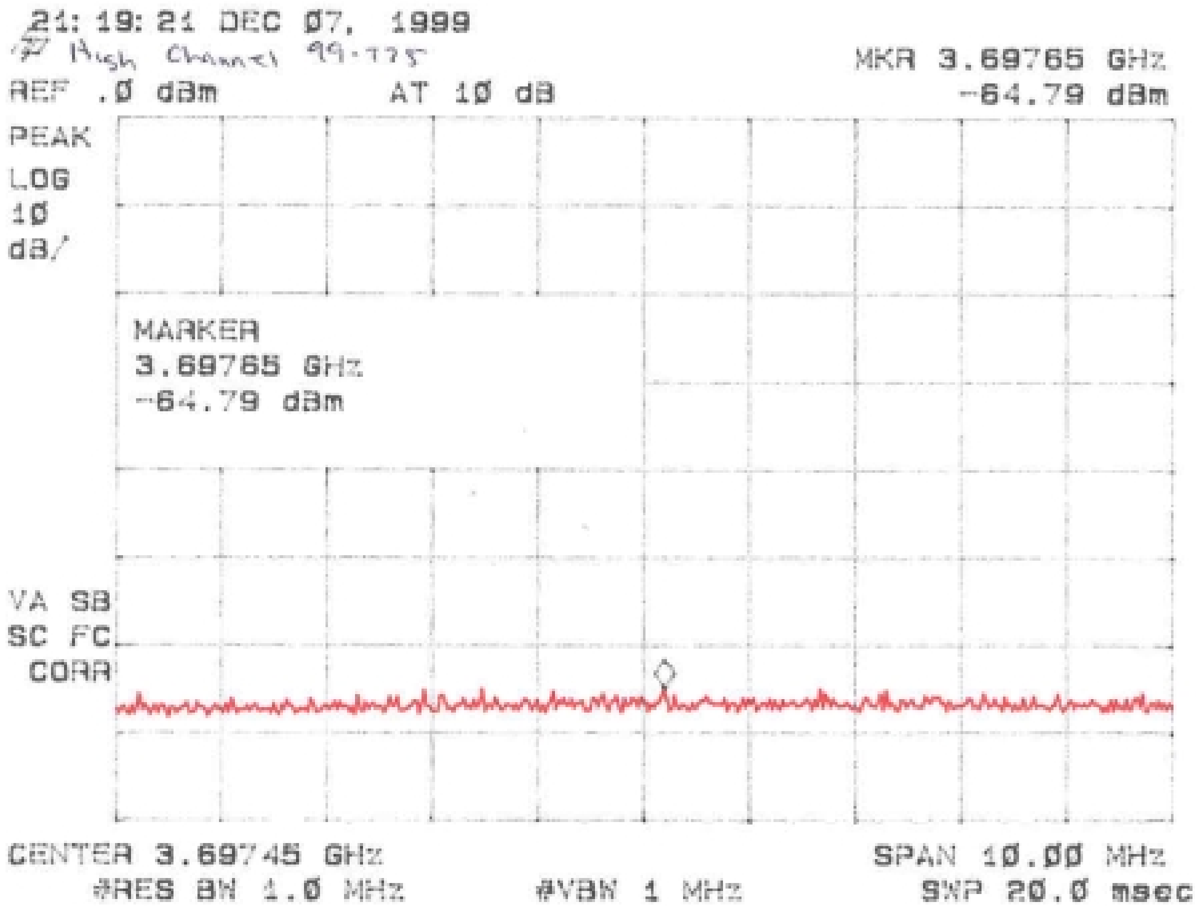


Figure 5k
Peak Radiated Spurious Emission 15.247(c) High

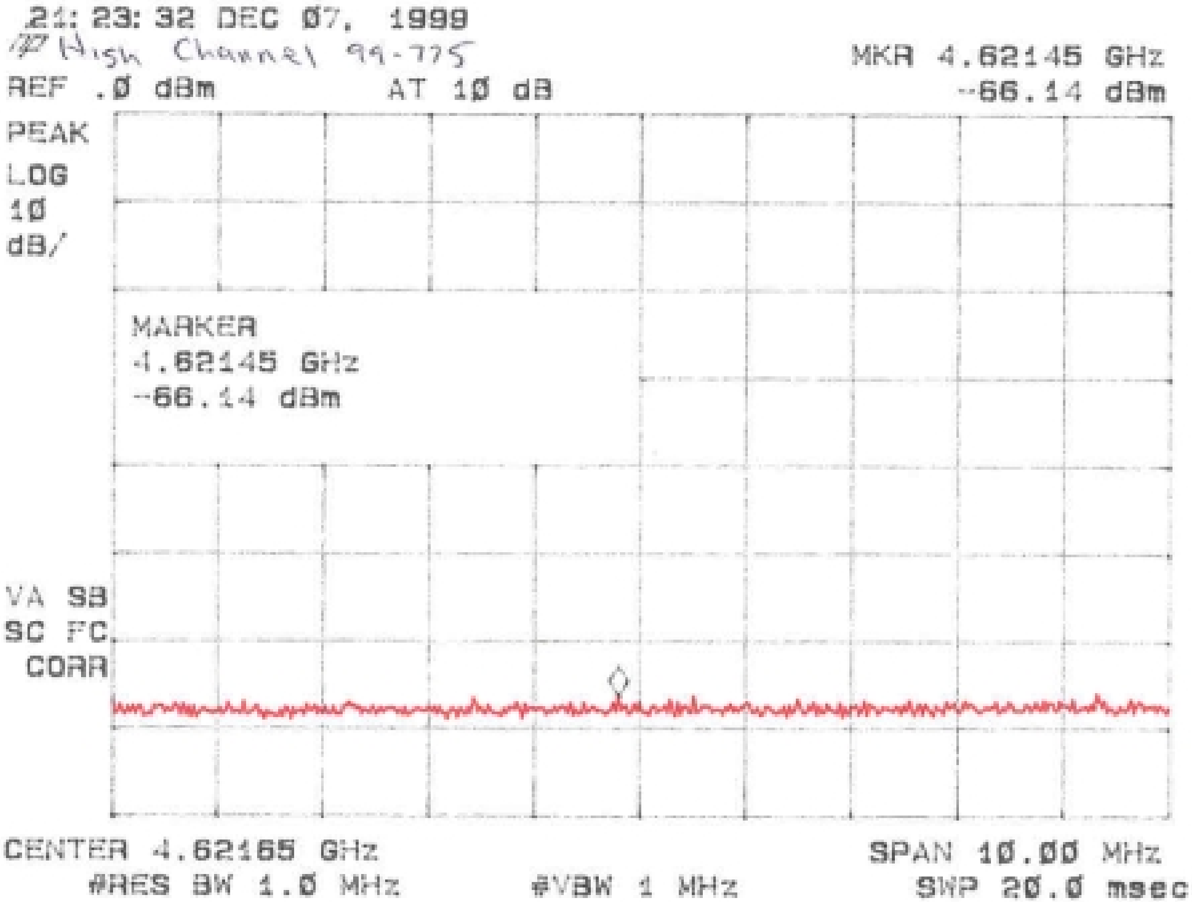
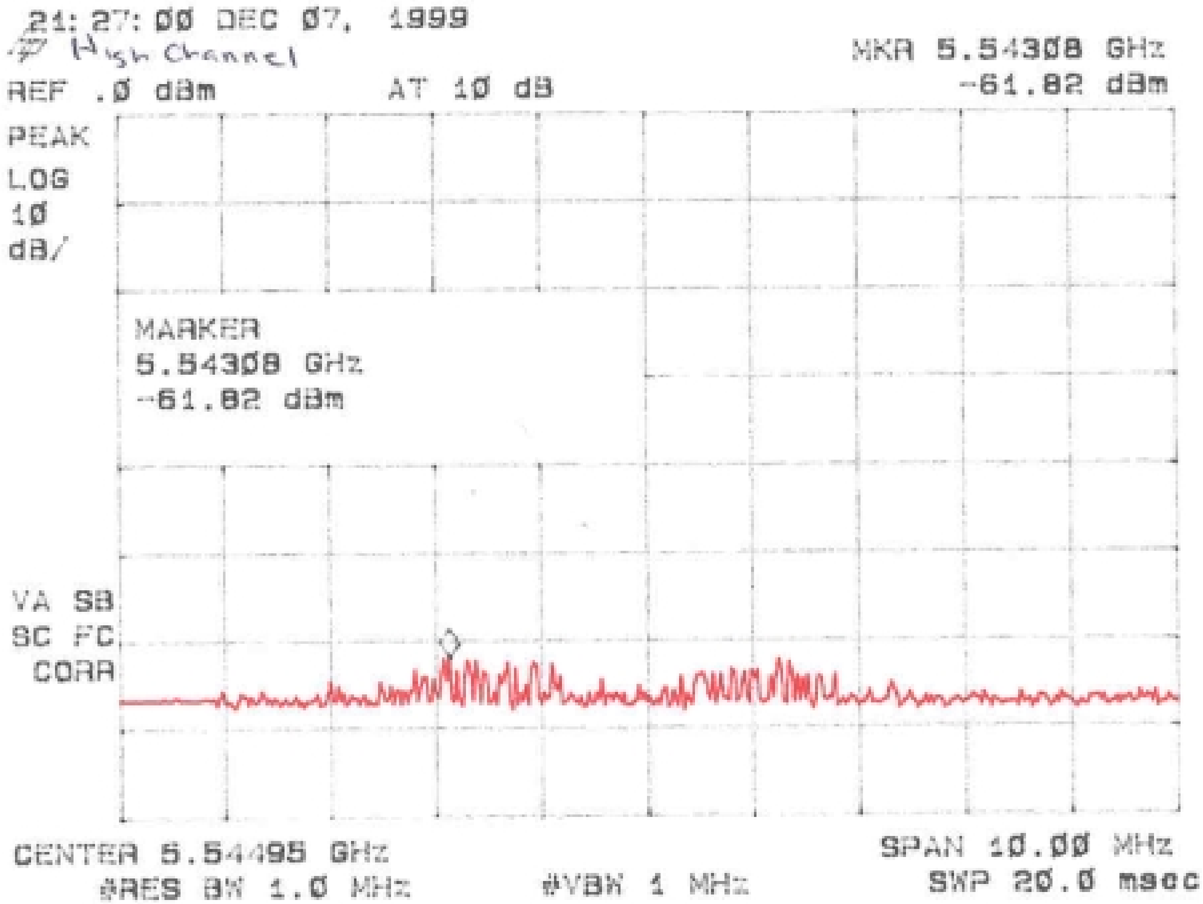


Figure 5l
Peak Radiated Spurious Emission 15.247(c) High



Test Date: December 7 & December 8, 1999
UST Project: 99-775
Customer: Axlon Electronics Corp.
Model: PLW-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
2.712	-53.1	34.9	31.3	4.2	526.4	5000
3.624	-60.3	34.6	33.9	5.2	362.8	5000
4.529	-64.7	34.2	34.0	7.1	287.1	5000
5.436	-63.6	34.0	35.8	7.9	450.0	5000

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

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-53.1 – 34.9 + 31.3 + 4.2 + 107)/20) = 526.4
CONVERSION FROM dBm TO dBuV = 107 dB

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

Test Date: December 7 & December 8, 1999
UST Project: 99-775
Customer: Axlon Electronics Corp.
Model: PLW-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
2.740	-48.5	34.9	31.3	4.2	901.8	5000
3.654	-56.7	34.6	34.0	5.2	557.2	5000
5.482	-57.0	34.0	35.9	7.8	961.4	5000
6.395	-58.1	33.9	36.4	7.4	876.1	5000

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

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-48.5 - 34.9 + 31.3 + 4.2 + 107)/20) = 901.8
CONVERSION FROM dBm TO dBuV = 107 dB

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

Test Date: December 7 & December 8, 1999
UST Project: 99-775
Customer: Axlon Electronics Corp.
Model: PLW-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
2.773	-51.9	34.9	31.3	4.2	617.4	5000
3.698	-63.8	34.6	34.1	5.3	252.9	5000
4.621	-65.1	34.2	34.2	7.4	290.0	5000
5.543	-60.8	34.0	36.0	7.8	626.0	5000

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

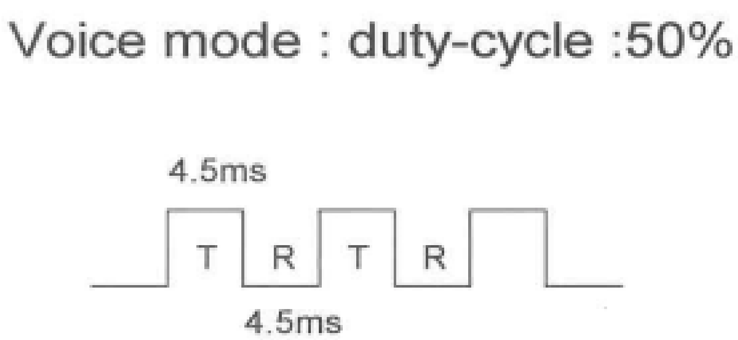
SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-51.9 - 34.9 + 31.3 + 4.2 + 107)/20) = 617.4
CONVERSION FROM dBm TO dBuV = 107 dB

Test Results
Reviewed By
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 7 & December 8, 1999
UST Project: 99-775
Customer: Axlon Electronics Corp.
Model: PLW-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
2.712	-59.1	34.9	31.3	4.2	264.2	500
3.624	-66.3	34.6	33.9	5.2	181.9	500
4.529	-70.7	34.2	34.0	7.1	143.8	500
5.436	-69.6	34.0	35.8	7.9	225.5	500

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

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) =
Antilog ((-59.1 – 34.9 + 31.3 + 4.2 + 107)/20) = 264.2
CONVERSION FROM dBm TO dBuV = 107 dB

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

Test Date: December 7 & December 8, 1999
Project: 99-775
Customer: Axlon Electronics Corp.
Model: PLW-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
2.740	-54.5	34.9	31.3	4.2	452.0	500
3.654	-62.7	34.6	34.0	5.2	279.9	500
5.482	-63.0	34.0	35.9	7.8	483.6	500
6.395	-64.1	33.9	36.4	7.4	440.6	500

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

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) =
Antilog ((-54.5 - 34.9 + 31.3 + 4.2 + 107)/20) = 452.0
CONVERSION FROM dBm TO dBuV = 107 dB

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

Test Date: December 7 & December 8, 1999
UST Project: 99-775
Customer: Axlon Electronics Corp.
Model: PLW-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
2.773	-57.9	34.9	31.3	4.2	308.2	500
3.698	-69.8	34.6	34.1	5.3	126.6	500
4.621	-71.1	34.2	34.2	7.4	145.4	500
5.543	-66.8	34.0	36.0	7.8	313.8	500

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

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) =
Antilog ((-57.9 – 34.9 + 31.3 + 4.2 + 107)/20) = 308.2
CONVERSION FROM dBm TO dBuV = 107 dB

Test Results
Reviewed By
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. Since the EUT contained a non-detachable antenna, an antenna was placed near the EUT in order to couple the emission to a spectrum analyzer.

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

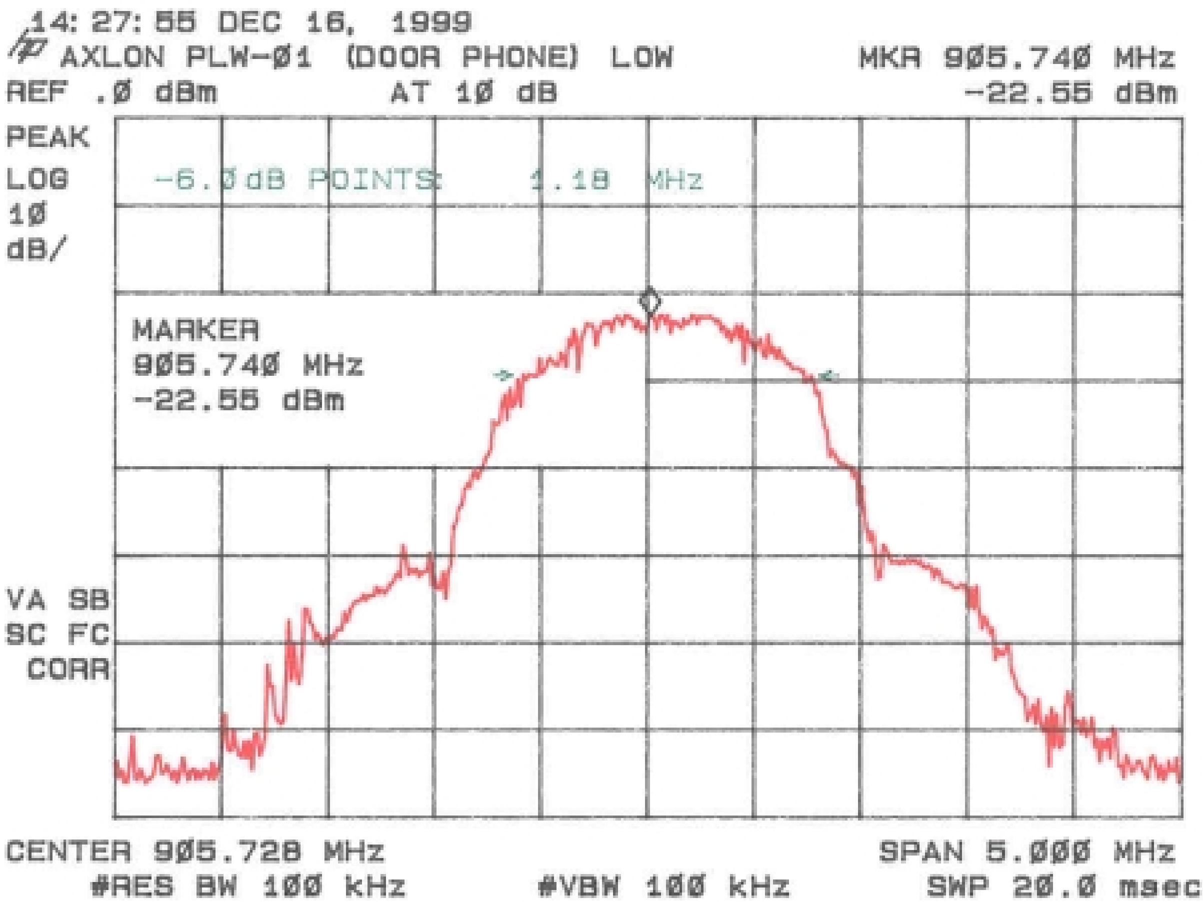


Figure 7b.
6 dB Bandwidth per FCC Section 15.247(a)(2) (Mid)

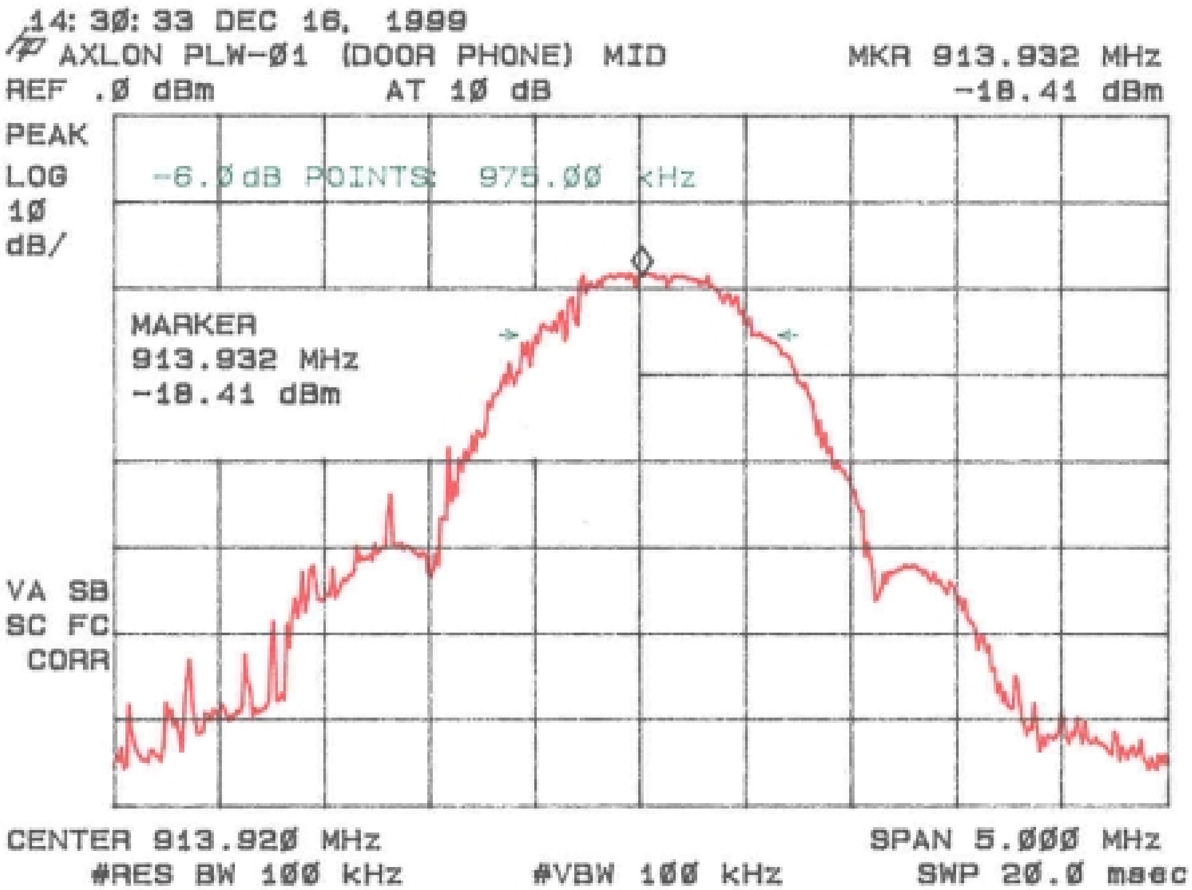
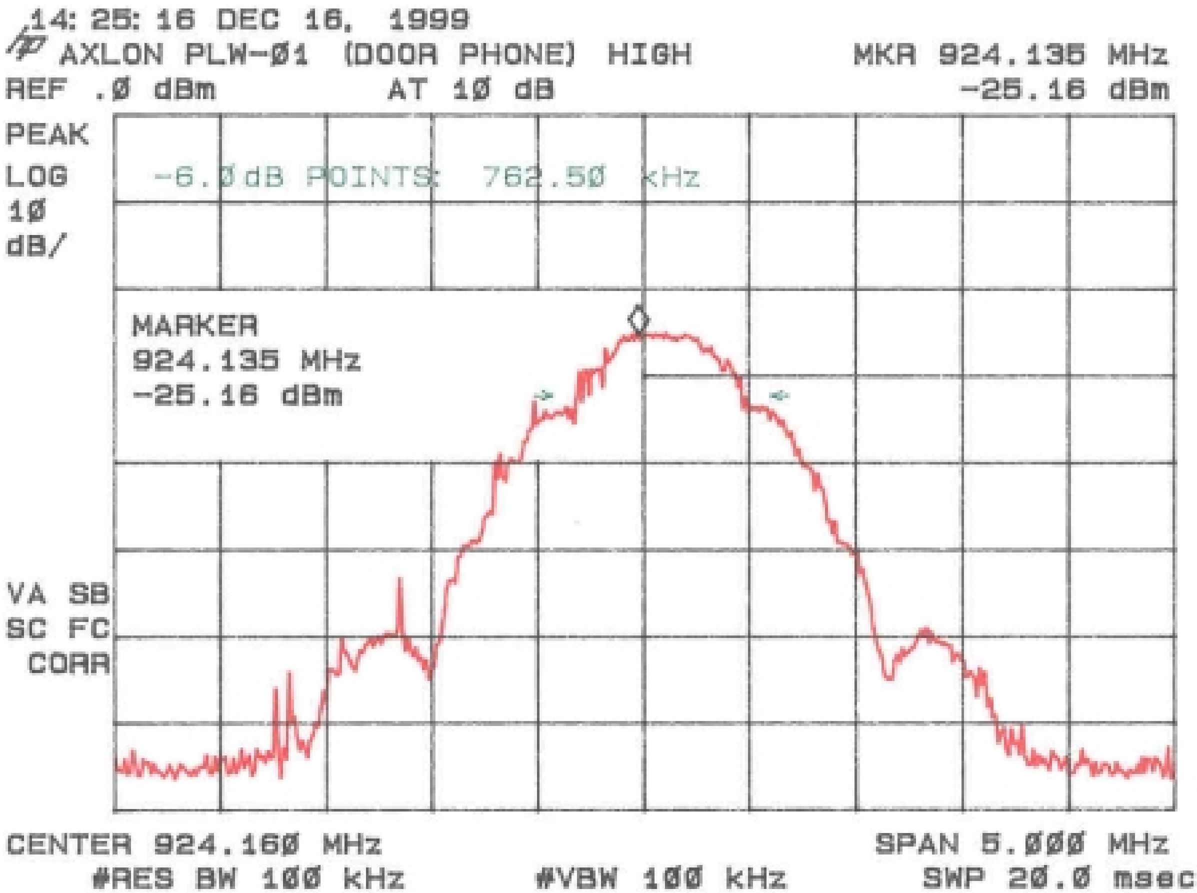


Figure 7c.
6 dB Bandwidth per FCC Section 15.247(a)(2) (High)



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 6 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.

Since the EUT incorporated an integrated antenna, this measurement was made on a OAT's by tuning a spectrum analyzer to the highest point of the maximized fundamental emission and zooming in on this portion of the emission utilizing the following spectrum analyzer settings: RBW = 3 kHz, VBW > RBW, span = 300 kHz, sweep = 100 seconds. The maximized point obtained by this method was then used to calculate the power spectral density as shown in Table 6.

TABLE 6
POWER SPECTRAL DENSITY

Test Date: January 2, 2000
UST Project: 99-775
Customer: Axlon Electronics Corp.
Model: PLW-01

Frequency (MHz)	Receiver Reading (dBm) @3m	Correction Factor (dB)	Corrected Reading (V/m) @3m	Measured Power (Watt)	FCC Limit (Watt)
905.728	-51.6	30.7	0.020107	0.0001	0.0063
913.920	-51.6	30.8	0.020513	0.0001	0.0063
924.160	-56.3	31.0	0.012094	<0.0001	0.0063

NOTE: Limit = Antilog(+8dBm/10) * 10^{-3} = 0.0063 Watts

Transmitters peak power calculated using:

$$P\,(W) = \frac{(E*d)^2}{30*G}$$

where d = 3 meters, E = corrected measured field strength in V/m, and G = numeric gain of transmitting antenna (1.0 for 0 dBi).

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

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

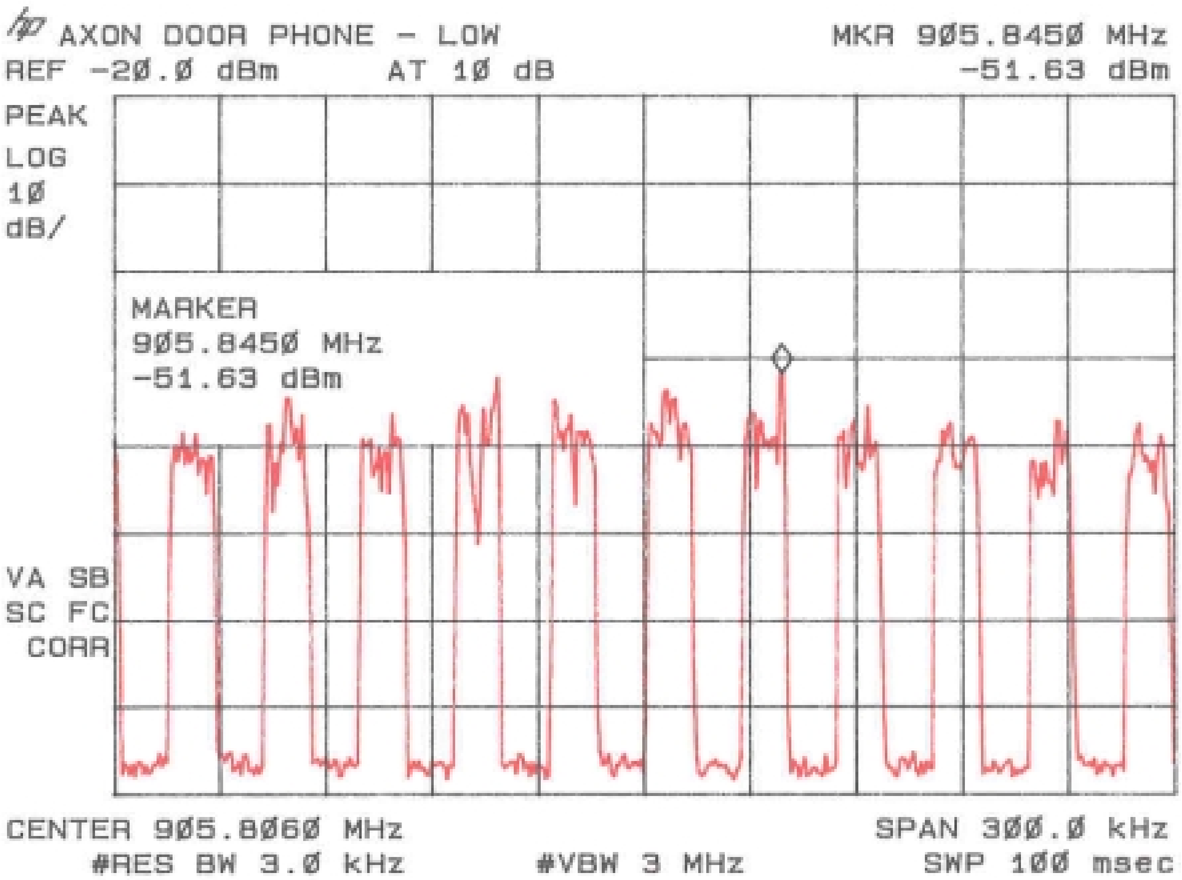


Figure 8b
Power Spectral Density 15.247(b) and 15.247(d) Mid

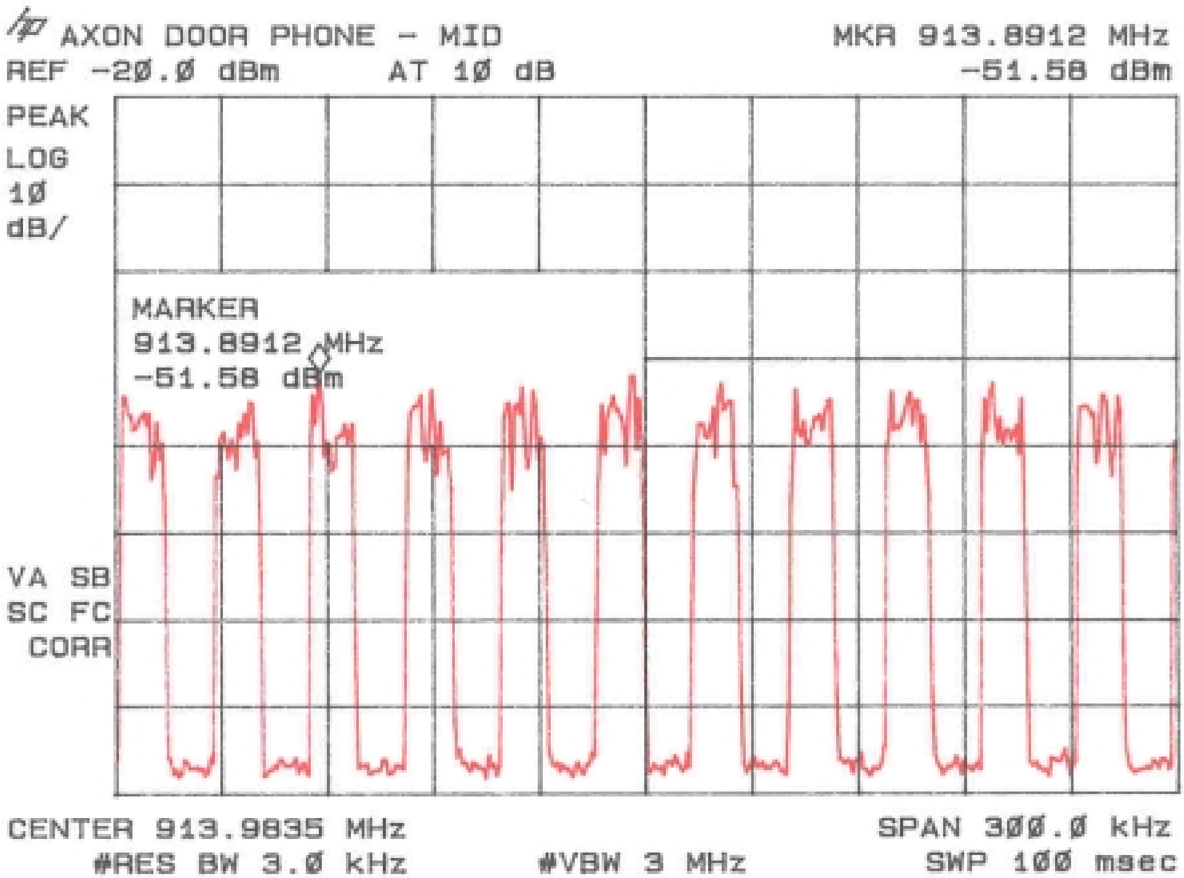
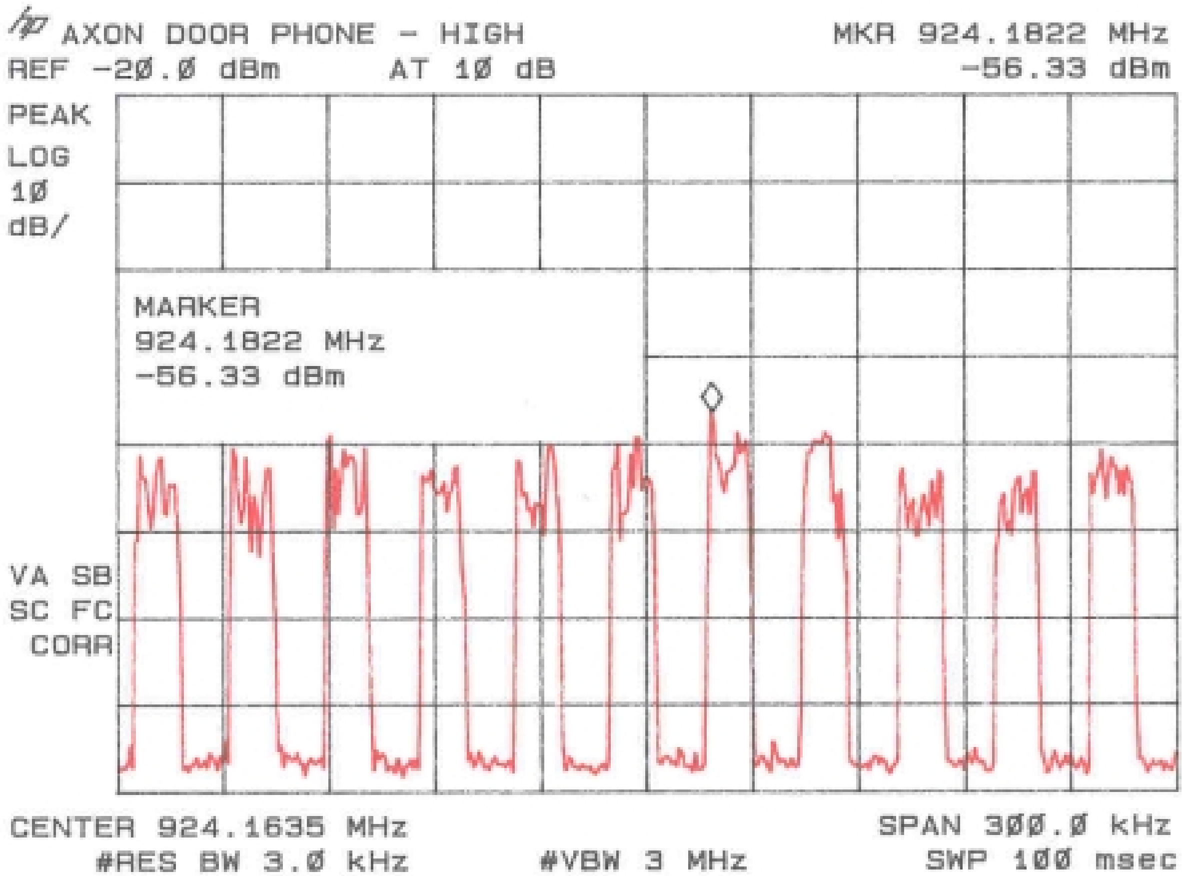


Figure 8c
Power Spectral Density 15.247(b) and 15.247(d) High



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 :

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

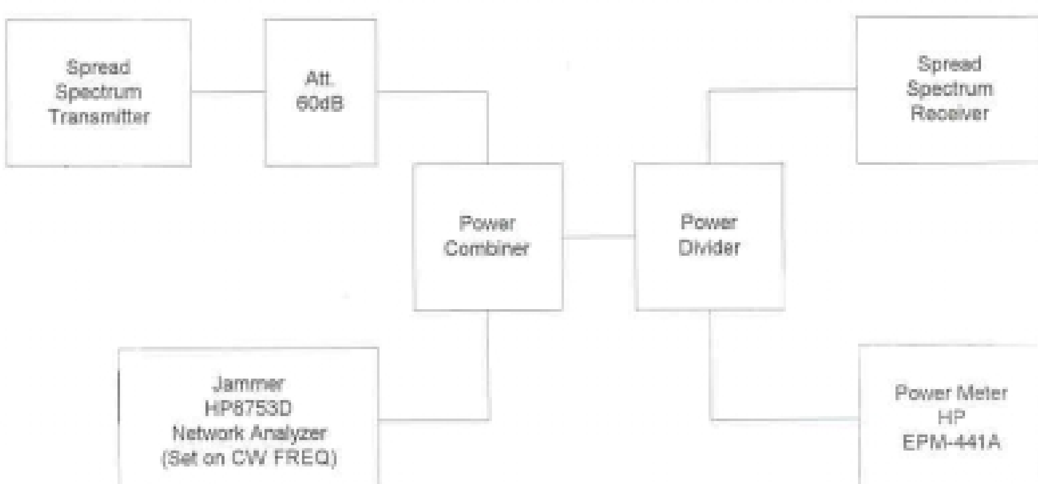


Figure 1.Processing Gain Measurement Setup

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

Chia-Liang Liu

Computer and Communication Research Laboratories
Industrial Technology Research Institute
M300, Bldg. 14, 195 Sec. 4, Chung Hsing Rd.
Chutung, Hsinchu, Taiwan 31015, ROC
Tel: +886 35 91 7542
Fax: +886 35 82 0204
E-mail: cll@m3sun6.ccl.itri.org.tw

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 det'l 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.

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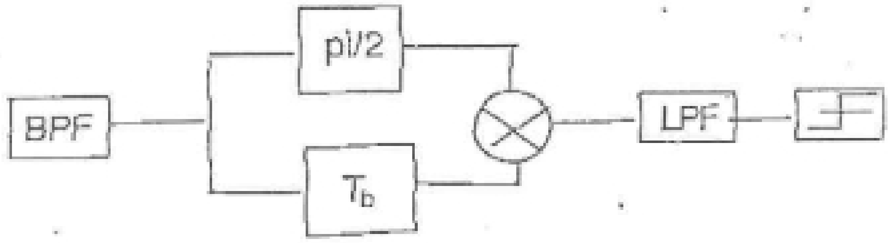

Fig. 1 Simplified block diagram of a 1-bit differential detector. The BPF *is assumed to be Gaussian*. The LPF is used only to remove the high-frequency term.

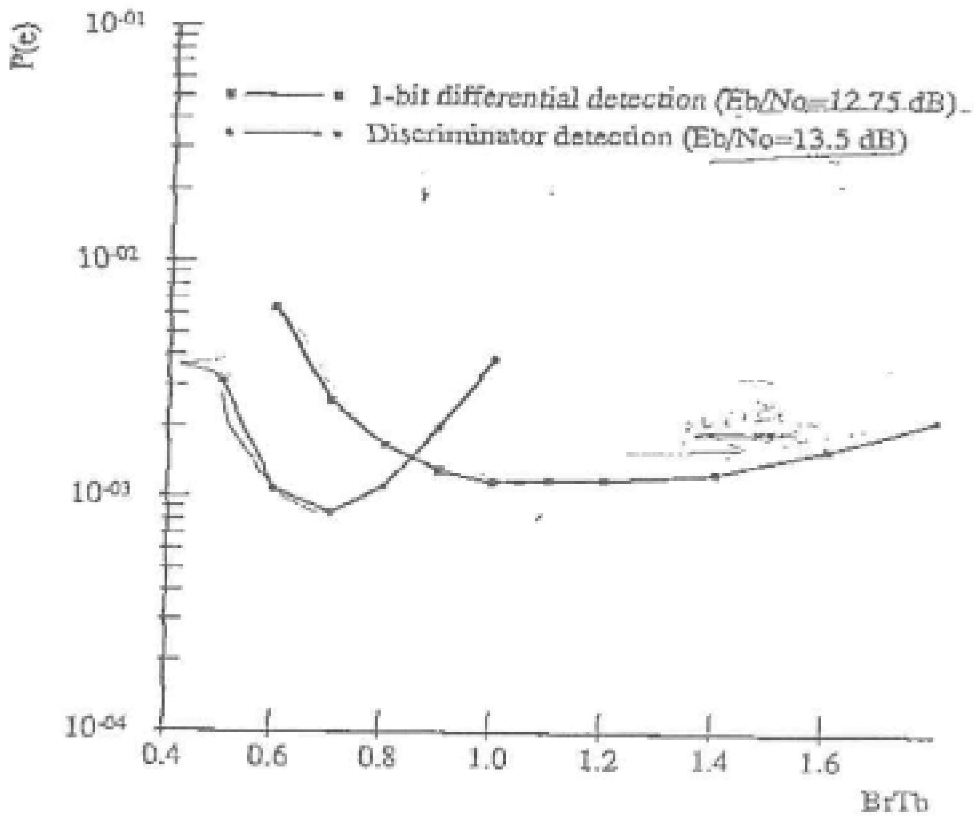

Fig. 2 BER of GMSK as functions of receiver bandwidth.

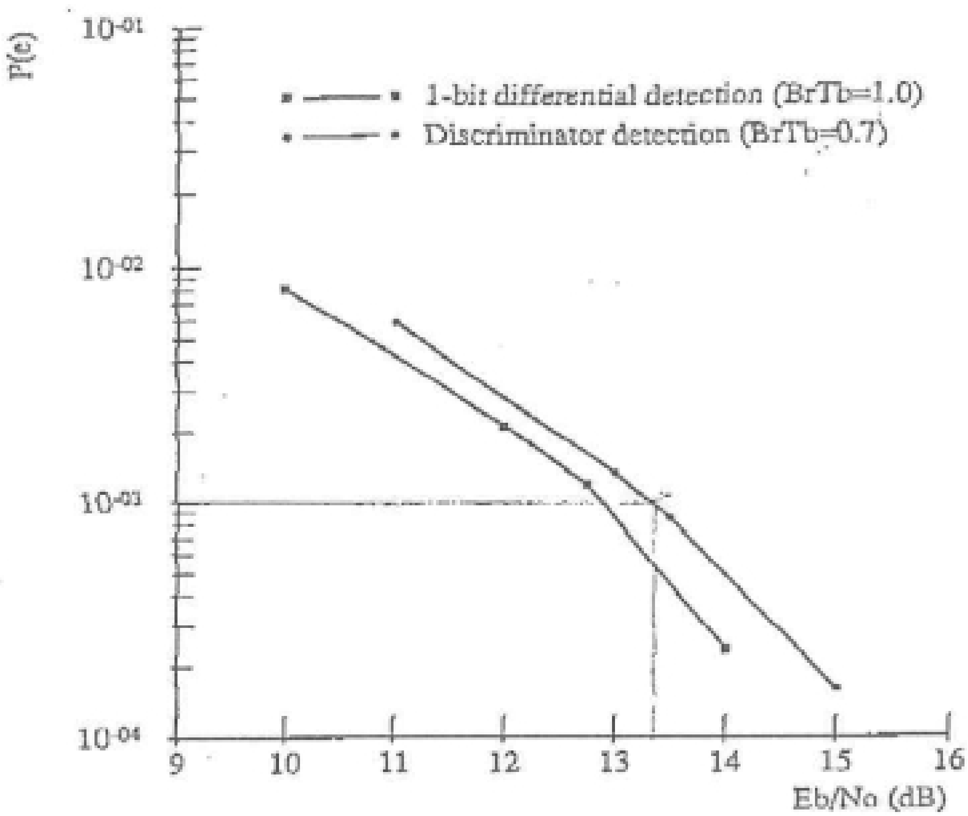

Fig. 3 BER of GMSK as functions of Eb/No

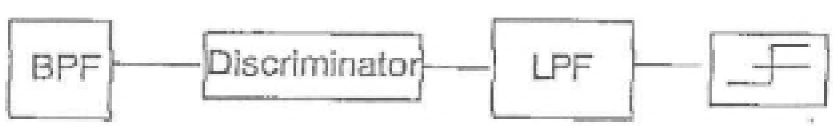

Fig. 4 Simplified block diagram of a discriminator demodulator. The BPF is assumed to be Gaussian. The LPF is used only to remove the high-frequency component.

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 16, 1999
UST Project: 99-775
Customer: Axlon Electronics Corp.
Product: PLW-01

Frequency (MHz)	Test Data (dBm)		RESULTS (uV)		FCC Limits (uV)
	Phase	Neutral	Phase	Neutral	
0.47	-68.0	-72.0	89.1	56.2	250
15.1	-73.0	-73.0	50.1	50.1	250
15.4	-74.0	-75.0	44.7	39.8	250
16.4	-71.0	-72.0	63.1	56.2	250
27.1	-70.0	-61.5	70.8	188.4	250
27.3	-72.0	-72.0	56.2	56.2	250

SAMPLE CALCULATIONS:

RESULTS uV = ANTILOG ((-68.0 + 107)/20) = 89.1
CONVERSION FROM dBm TO dBuV = 107 dB

Test Results
Reviewed By
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: January 2, 2000
UST Project: 99-775
Customer: Axlon Electronics Corp.
Product: PLW-01

Measurements 30-1000 MHz

Frequency (MHz)	Receiver Reading (dBm) @3m	Correction Factor (dB)	Corrected Reading (uV/m) @3m	FCC Limit (uV/m) @3m
122.8	-83.0	13.9	78.1	150.0
128.3	-82.0*	14.3	92.8	150.0
131.0	-85.0	14.6	67.3	150.0
133.1	-84.0	14.7	76.8	150.0
166.6	-84.0*	15.4	82.9	150.0
169.3	-85.0*	15.4	74.1	150.0

*= Quasi Peak

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-33.0 + 13.9 + 107)/20) = 78.1
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: 99-775
Customer: Axlon Electronics Corp.
Model: PLW-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
1.164	-57.8	35.7	25.8	2.5	122.3	500
1.175	-58.4	35.7	25.8	2.5	115.0	500
1.197	-57.7	35.7	25.9	2.6	126.5	500

SAMPLE CALCULATIONS:
Results uV/m @3m = Antilog ((-57.8 - 35.7 + 25.8 + 2.5 + 107)/20 = 122.3
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 9.

TABLE 9. CONDUCTED EMISSIONS DATA – DIGITAL DEVICE CLASS B

Test Date: December 16, 1999
UST Project: 99-775
Customer: Axlon Electronics Corp.
Product: PLW-01

Frequency (MHz)	Test Data (dBm)		RESULTS (uV)		FCC Limits (uV)
	Phase	Neutral	Phase	Neutral	
0.47	-68.0	-72.0	89.1	56.2	250
15.1	-73.0	-73.0	50.1	50.1	250
15.4	-74.0	-75.0	44.7	39.8	250
16.4	-71.0	-72.0	63.1	56.2	250
27.1	-70.0	-61.5	70.8	188.4	250
27.3	-72.0	-72.0	56.2	56.2	250

SAMPLE CALCULATIONS:

RESULTS uV = ANTILOG ((-68.0 + 107)/20) = 89.1
CONVERSION FROM dBm TO dBuV = 107 dB

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