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 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), and Table 4c (high).

TABLE 4a PEAK RADIATED SPURIOUS EMISSIONS (Low Channel)

Unit 14424

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
4.85	-51.0	34.2	34.7	4.2	1077.7	5000
7.27	-57.0	34.5	37.1	6.8	931.4	5000
9.69	-63.0	34.6	38.3	8.2	622.6	5000

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

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-51.0 - 34.2 + 34.6 + 4.2 + 107)/20) = 1077.7
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Tim R. Johnson

TABLE 4b PEAK RADIATED SPURIOUS EMISSIONS (Mid Channel)

Unit 14399

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
4.86	-51.0	34.2	34.7	4.2	1078.9	5000
7.23	-63.0	34.5	37.0	6.7	460.6	5000
9.73	-64.0	34.6	38.4	8.2	564.2	5000

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

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-51.0 - 34.2 + 34.7 + 4.2 + 107)/20) = 1078.9
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Tim R. Johnson

TABLE 4c PEAK RADIATED SPURIOUS EMISSIONS (High Channel)

Unit 14396

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
2.81	-61.0	34.6	31.5	3.8	217.1	5000
4.90	-51.0	34.2	34.8	4.2	1083.9	5000
7.36	-62.0	34.5	37.3	6.8	539.8	5000
9.81	-61.0	34.6	38.7	8.3	823.8	5000

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

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-61.0 - 34.6 + 31.5 + 3.8 + 107)/20) = 217.1
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 results of average radiated spurious emissions falling within restricted bands are given in Table 5a (low), Table 5b, (mid), Table 5c (high). Figures 6a and 6b show characteristics of the worse case duty cycle of the transmitter.

Duty Cycle Correction During 100 msec:

(Data Transfer Mode)

The EUT as measured was considered to be 5 x 3 ms (during 100ms) = 18 %

Duty Cycle correction = 20 log (0.18) = -14.9 dB

Duty Cycle Correction During 100 msec:

(Communications Test Mode)

The EUT as measured was considered to be 8x(1.875ms + 0.750ms) = 21% (during 100ms)

Duty Cycle correction = 20 log (0.21) = -13.6 dB

Figure 6a
Duty Cycle Correction (Data Transfer Mode)

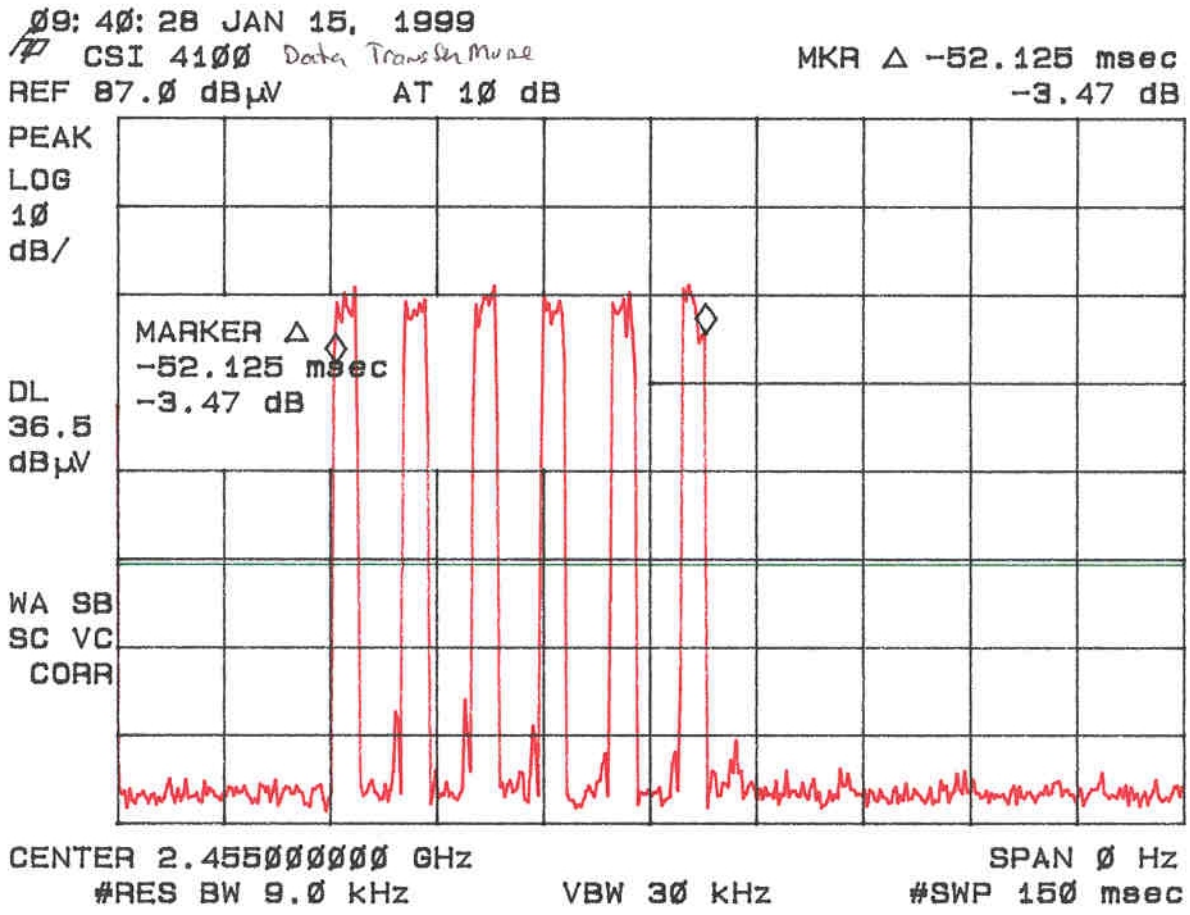

Figure 6b
Duty Cycle Correction (Data Transfer Mode)

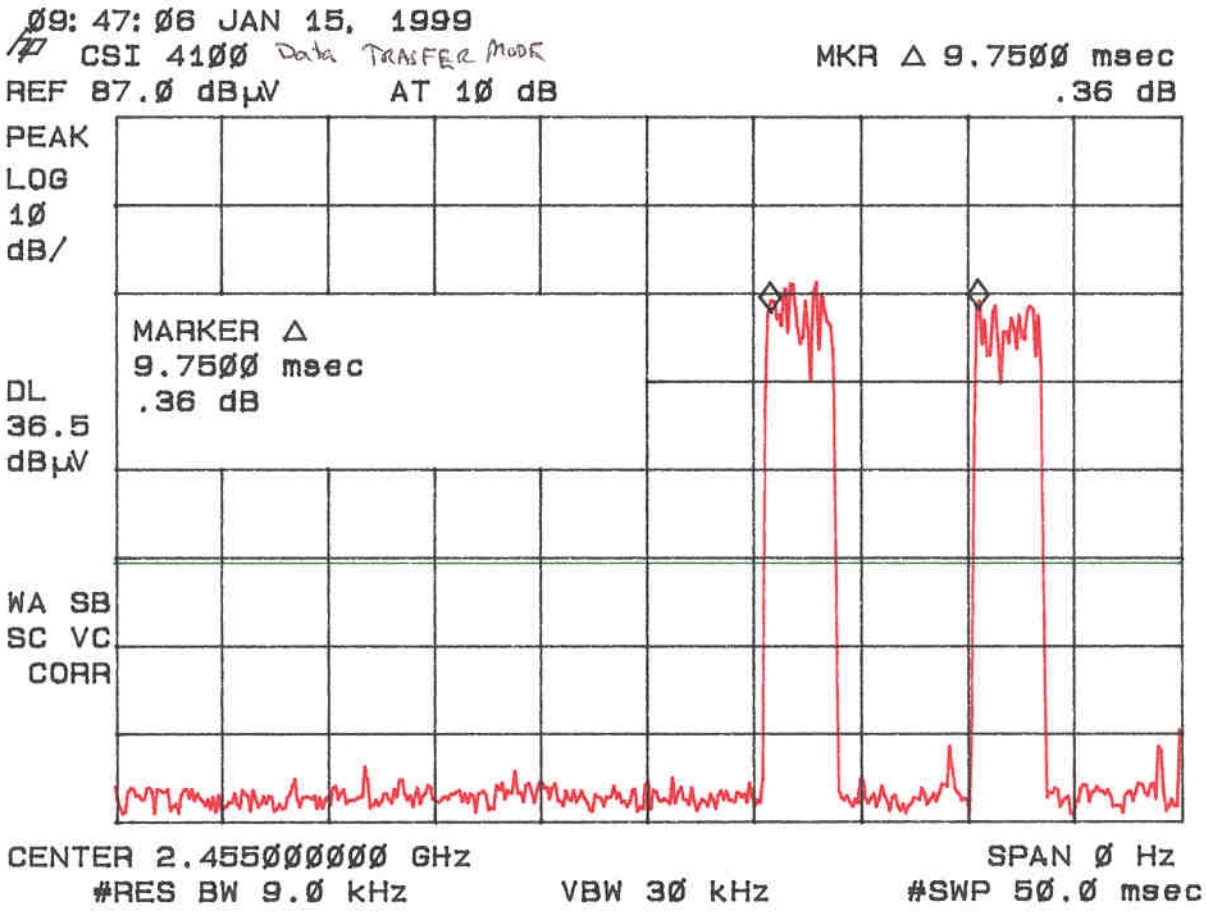

Figure 6c
Duty Cycle Correction (Data Transfer Mode)

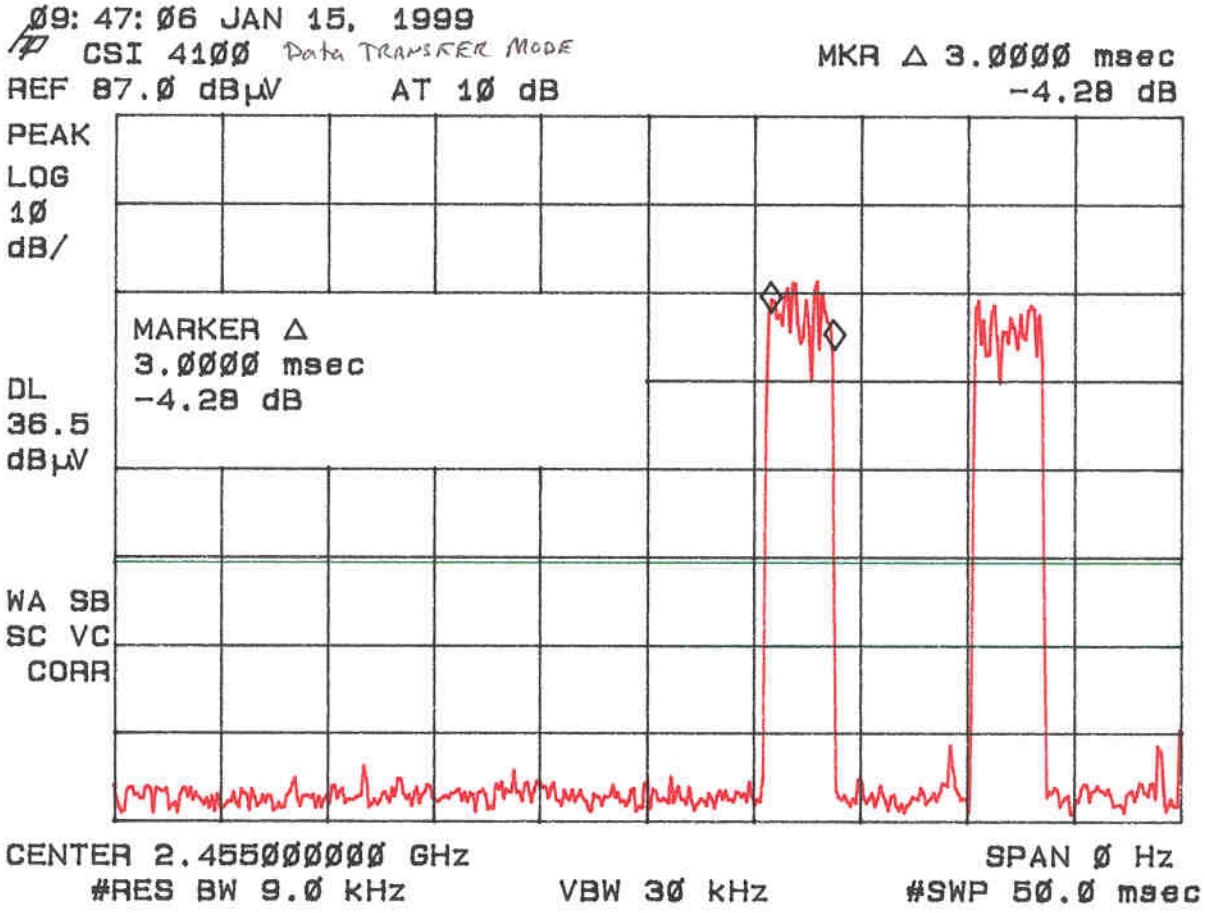

Figure 6d
Duty Cycle Correction (Communications Test Mode)

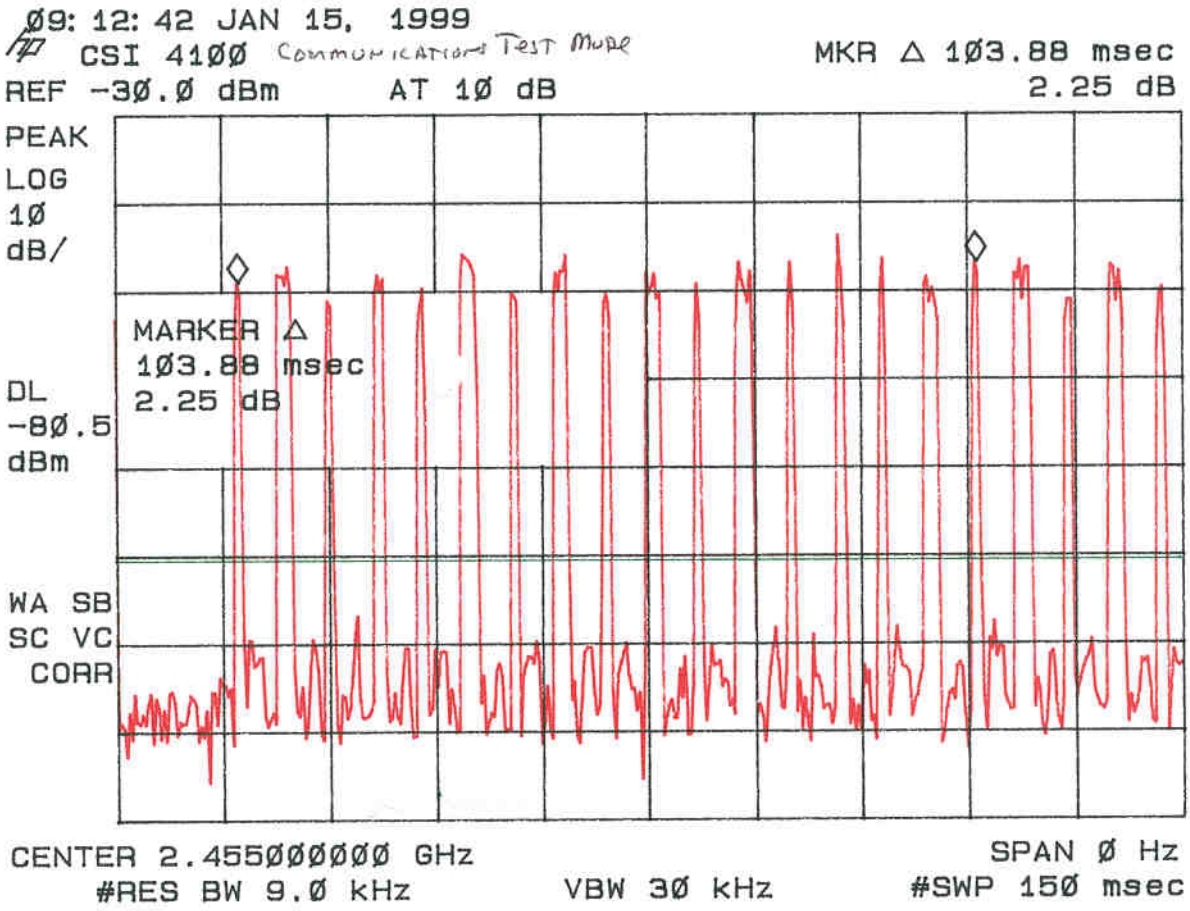

Figure 6e
Duty Cycle Correction (Communications Test Mode)

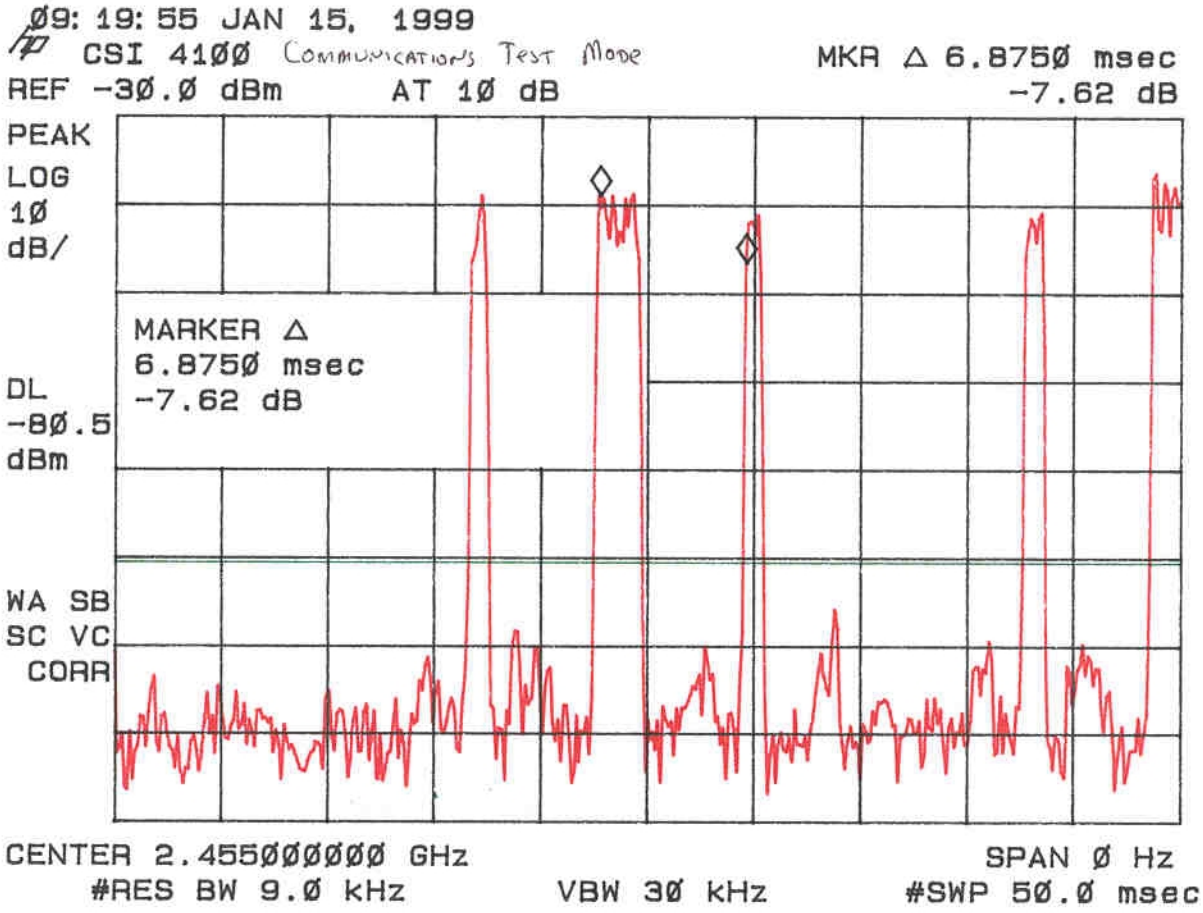

Figure 6f
Duty Cycle Correction (Communications Test Mode)

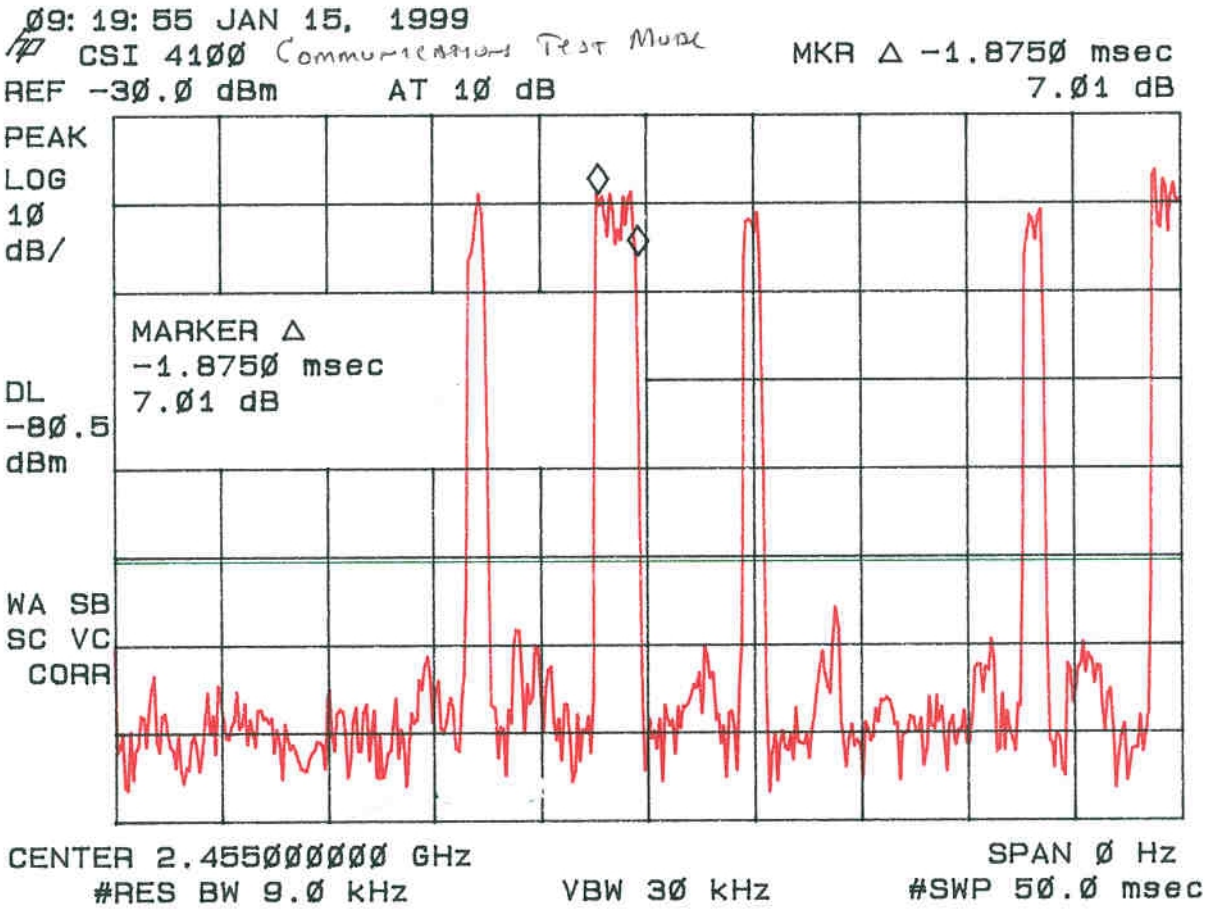

Figure 6g
Duty Cycle Correction (Communications Test Mode)

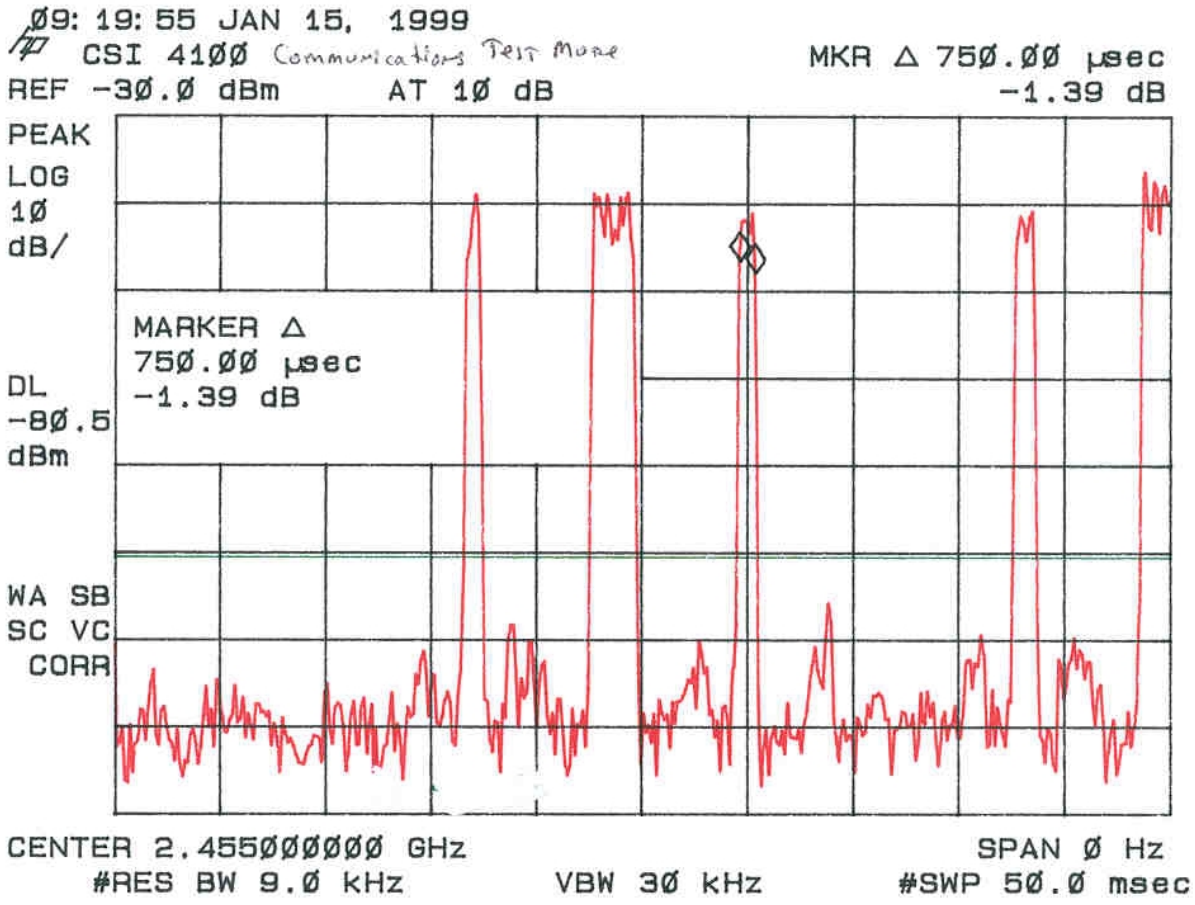

TABLE 5a AVERAGE RADIATED SPURIOUS EMISSIONS (Low Channel)
Unit 14424

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
4.85	-64.6	34.2	34.7	4.2	225.2	500
7.27	-70.6	34.5	37.1	6.8	194.6	500
9.69	-76.6	34.6	38.3	8.2	130.1	500

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

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) =
Antilog ((-64.6 - 34.2 + 34.7 + 4.2 + 107)/20) = 225.2
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
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TABLE 5b AVERAGE RADIATED SPURIOUS EMISSIONS (Mid Channel)
Unit 14399

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
4.86	-64.6	34.2	34.7	4.2	225.4	500
7.23	-76.6	34.5	37.0	6.7	96.2	500
9.73	-77.6	34.6	38.4	8.2	117.9	500

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

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) =
Antilog ((-64.6 - 34.2 + 34.7 + 4.2 + 107)/20) = 225.4
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Tim R. Johnson

TABLE 5c AVERAGE RADIATED SPURIOUS EMISSIONS (High Channel)
Unit 14396

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
2.81	-74.6	34.6	31.5	3.8	45.4	500
4.90	-64.6	34.2	34.8	4.2	226.5	500
7.36	-75.6	34.5	37.3	6.8	112.8	500
9.81	-74.6	34.6	38.7	8.3	173.8	500

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

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) =
Antilog ((-74.6 - 34.6 + 31.5 + 3.8 + 107)/20) = 45.4
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
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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)

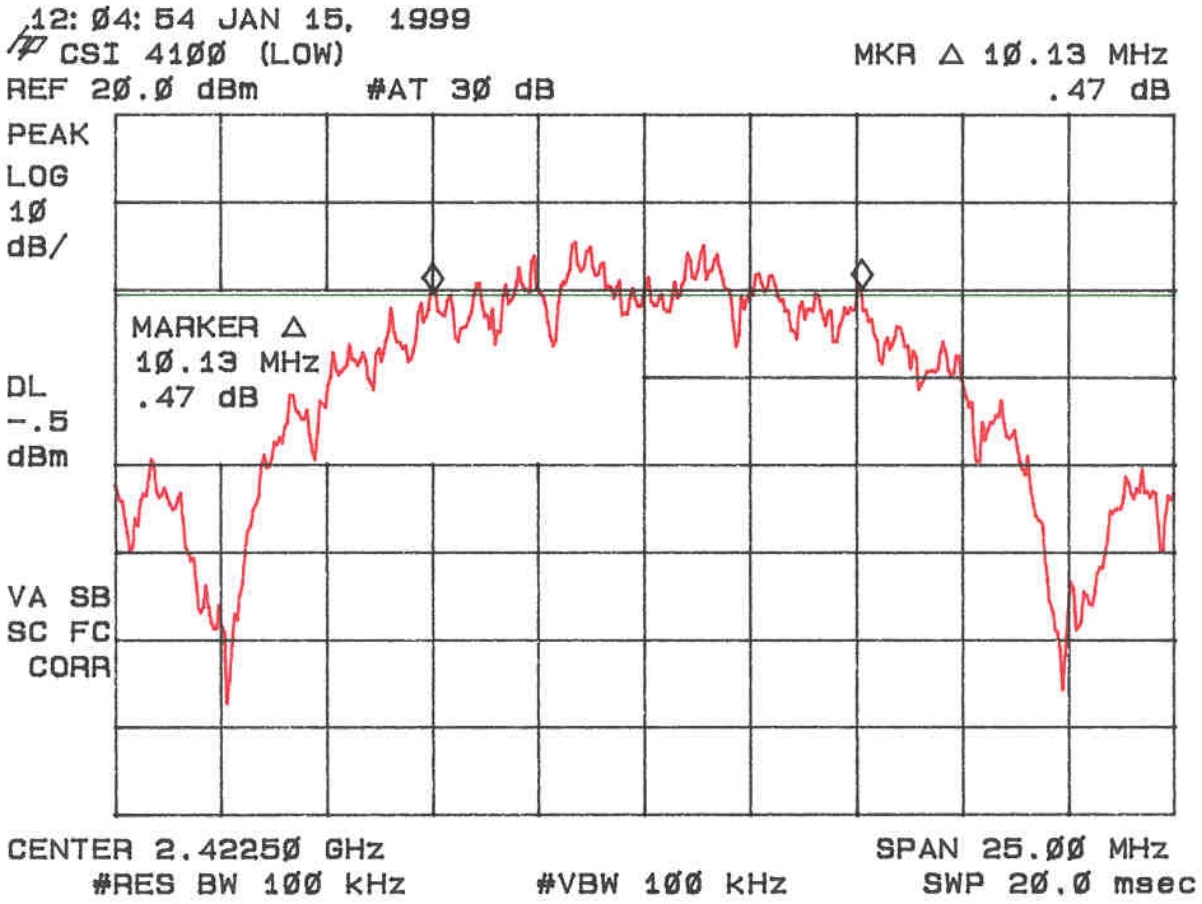


Figure 7b.
6 dB Bandwidth per FCC Section 15.247(a)(2) (Mid)

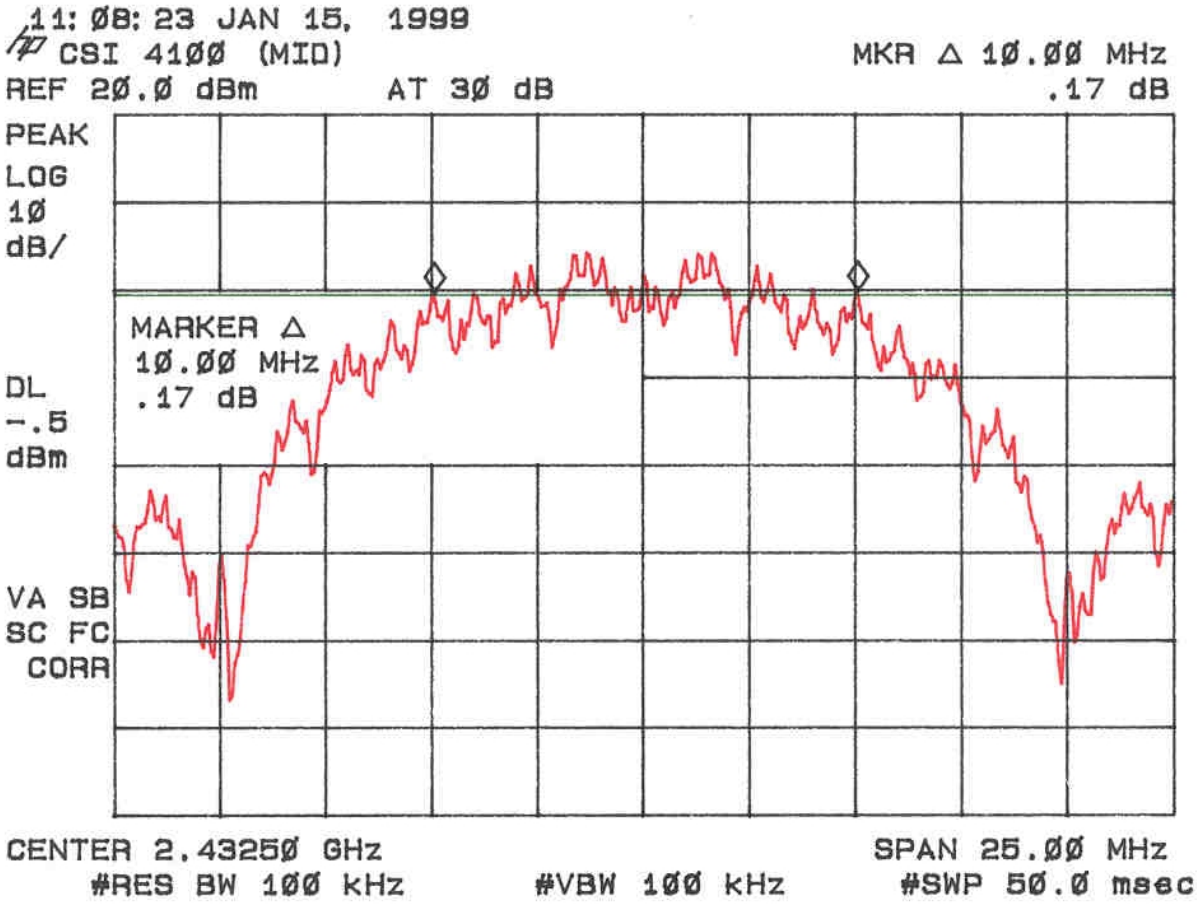
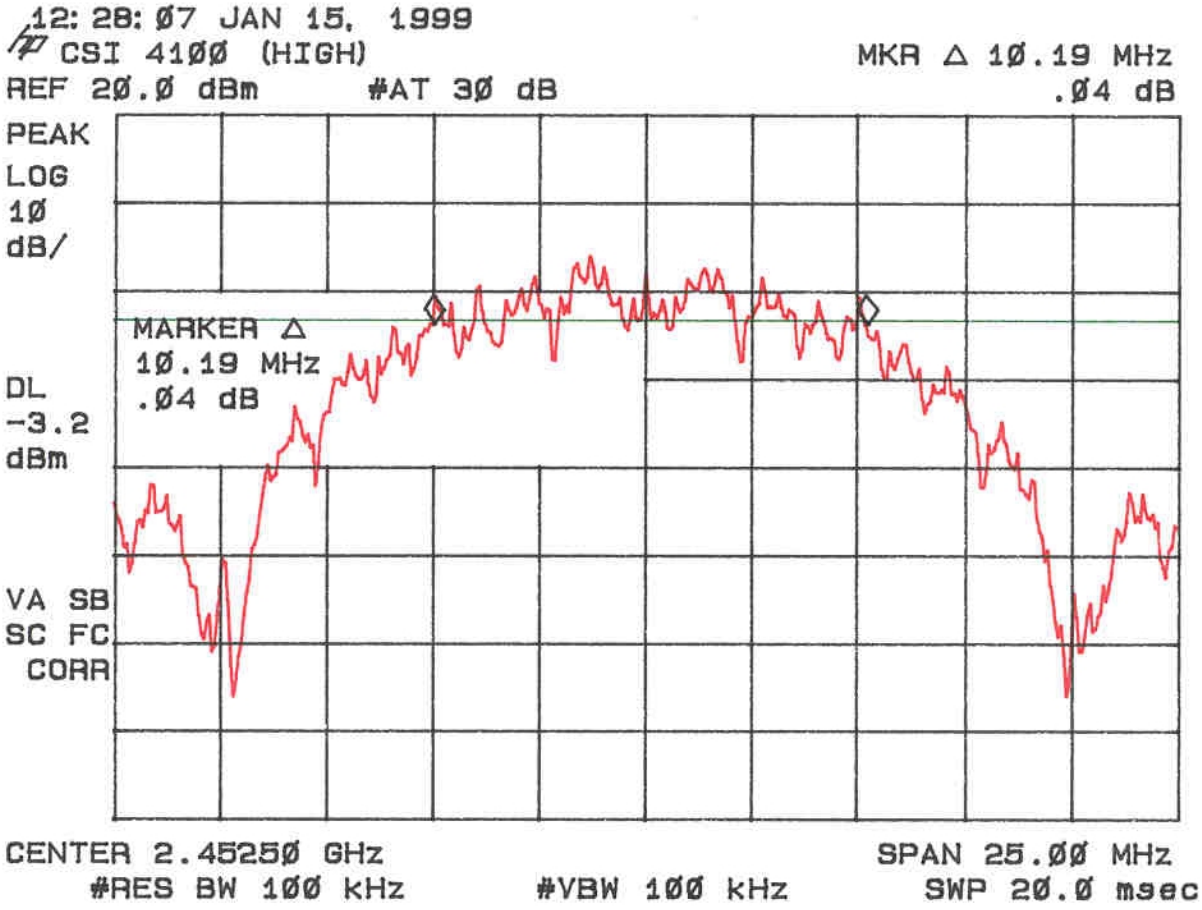


Figure 7c.
6 dB Bandwidth per FCC Section 15.247(a)(2) (High)



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 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: **January 15, 1998**
UST Project: **98-672**
Customer: **Computational Systems, Incorporated**
Model: **RF Smart Sensor, 4100, 001 Eng. Proto**

Test Data (dBm) Normalized to 1 Hz	Results (dBm)	FCC Limit (dBm)
-50.54	-15.74	8.0
-53.66	-18.86	8.0
-51.06	-16.26	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

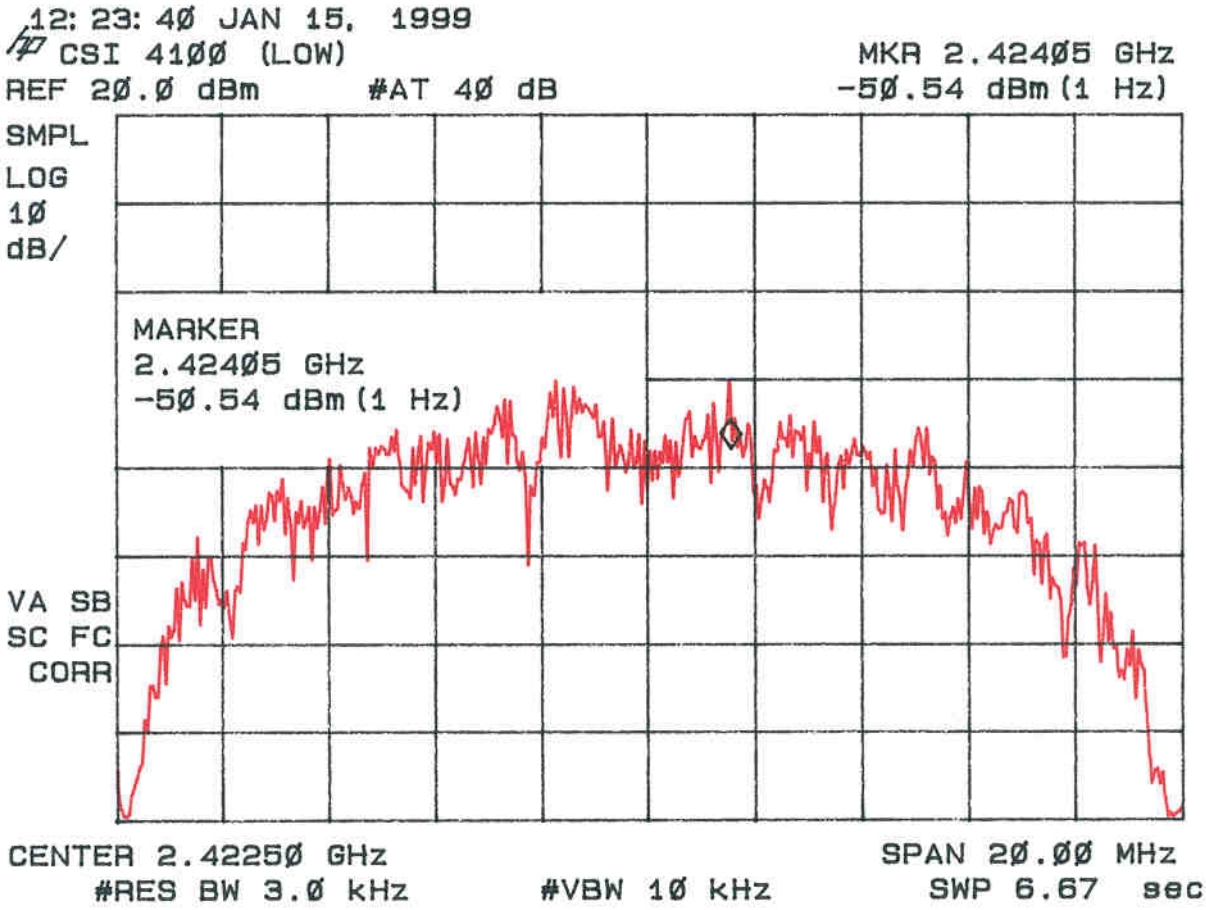


Figure 8b
Power Spectral Density 15.247(b) and 15.247(d) Mid

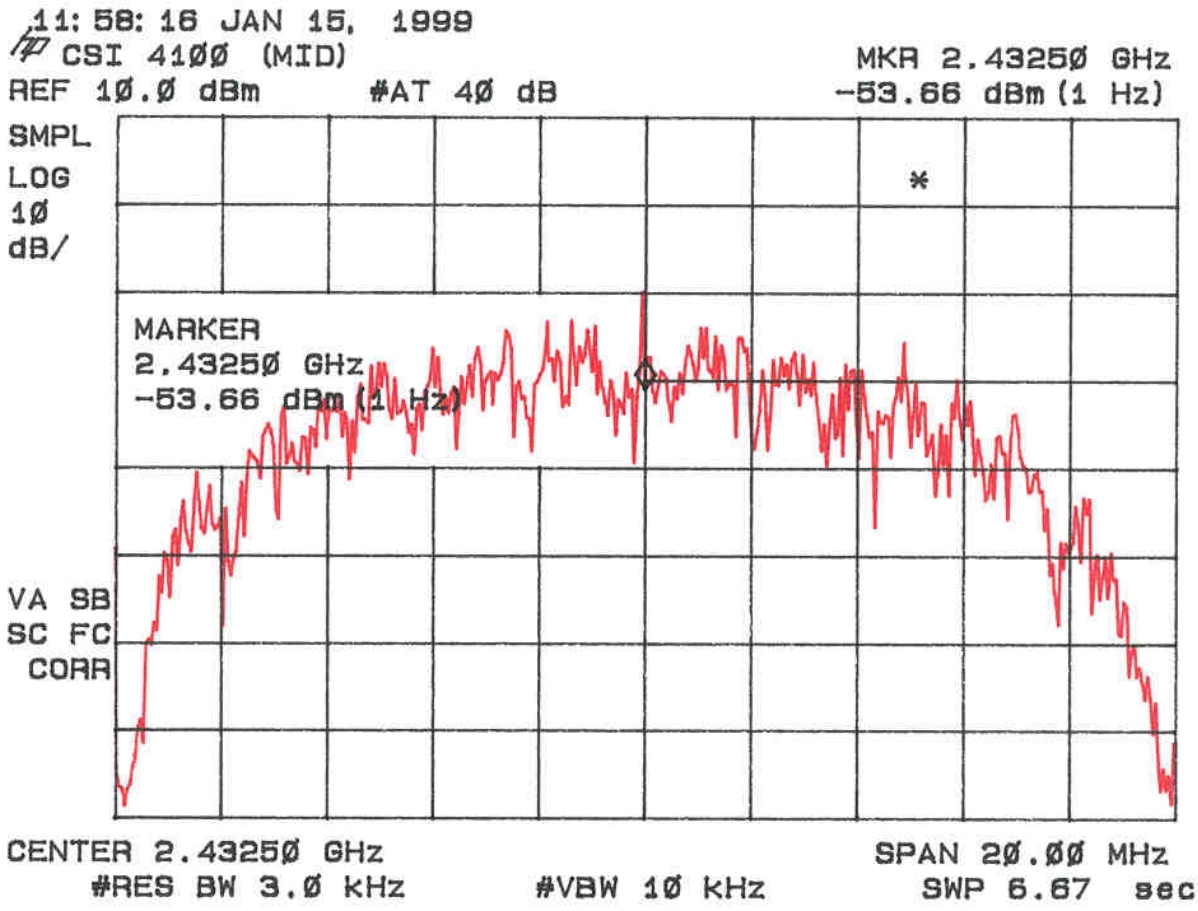
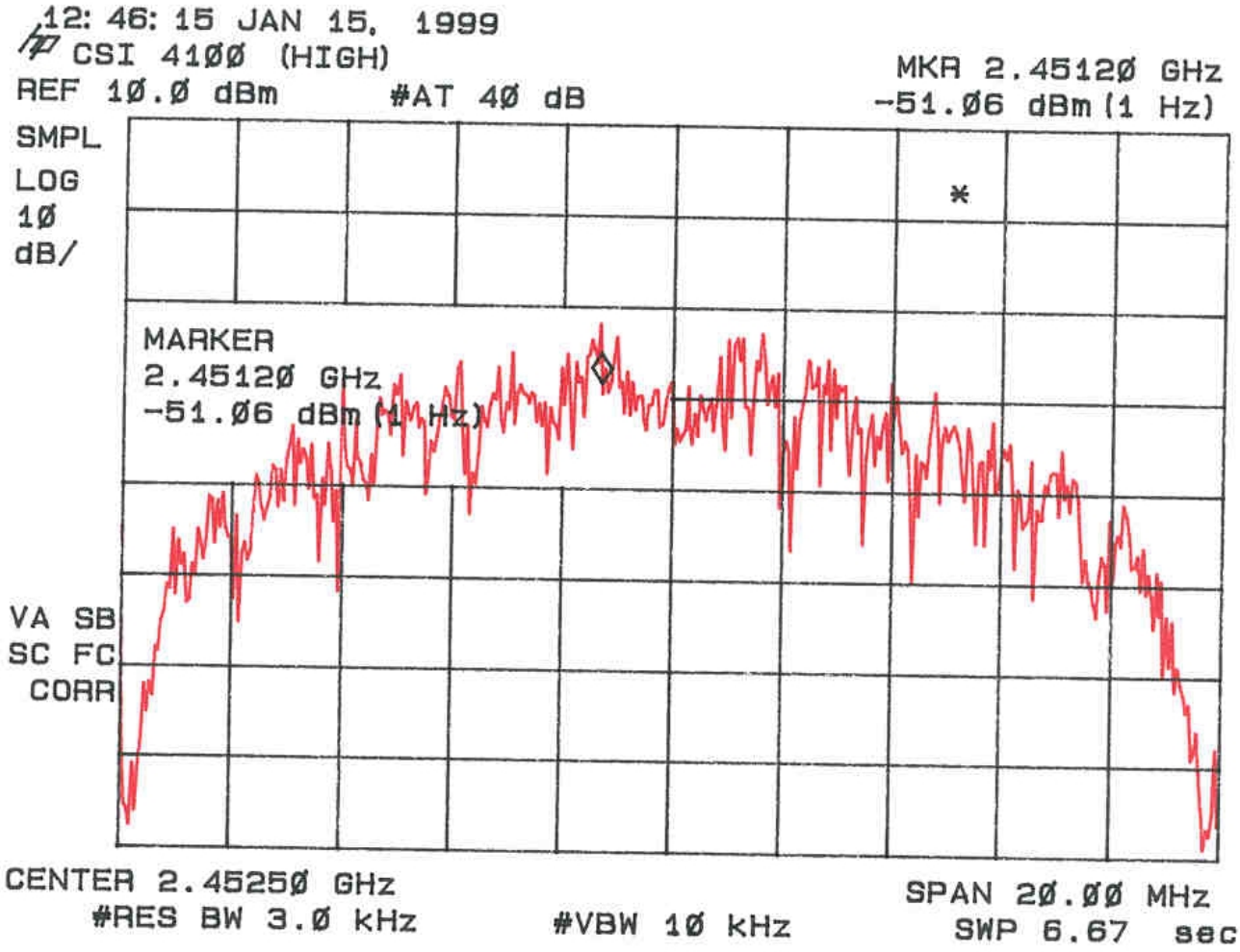


Figure 8c
Power Spectral Density 15.247(b) and 15.247(d) High



2.13 Processing Gain

Data regarding processing gain has been provided on the following pages from Computational Systems, Incorporated.

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 8. CONDUCTED EMISSIONS DATA
CLASS B

Test Date: January 15, 1998
UST Project: 98-672
Customer: Computational Systems, Incorporated
Product: RF Smart Sensor, 4100, 001 Eng. Proto

Frequency (MHz)	Test Data (dBm) Phase	Neutral	RESULTS (uV) Phase	Neutral	FCC Limits (uV) @3m
The EUT is Battery Powered, Therefore Conducted Emissions Were Deemed Not Applicable					

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

2.15 Radiated Emissions for Digital Device & Receiver (47 CFR 15.109a)

Radiated emissions were evaluated from 30 to 12500 MHz. While the EUT was placed into a receive mode of operation. Measurements were made with the analyzer's bandwidth set to 120 kHz for measurements made less than 1 GHz and 1 MHz for measurements made greater than or equal to 1 GHz.

TABLE 9a.

CLASS A
RADIATED EMISSIONS DATA

Test Date: January 15, 1998
UST Project: 98-672
Customer: Computational Systems, Incorporated
Product: RF Smart Sensor, 4100, 001 Eng. Proto

Frequency (MHz)	Receiver Reading (dBm) @10m	Correction Factor (dB)	Corrected Reading (uV/m)	FCC Limit (uV/m) @10m
240.0	-78.0	29.0	50.5	210.0

*= Quasi Peak

SAMPLE CALCULATIONS:

RESULTS uV/m @ 10m = Antilog ((-78.0 + 29.0 + 107)/20) = 50.5
CONVERSION FROM dBm TO dBuV = 107 dB

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

TABLE 9b

CLASS A
RADIATED EMISSIONS

Test Date: January 15, 1998
UST Project: 98-672
Customer: Computational Systems, Incorporated
Model: RF Smart Sensor, 4100, 001 Eng. Proto

Measurements >1GHz

FREQ. (GHz)	TEST DATA (dBm) @ 3m	AMP GAIN (dB)	ANT. FACTOR (dB)	CABLE LOSS (dB)	RESULTS (uV/m) @ 10m	FCC LIMITS (uV/m) @ 10m
1.68	-61.0	35.3	27.8	2.9	35.4	300.0
3.12	-62.0	34.5	31.8	4.1	62.4	300.0
4.41	-57.0	34.3	34.2	4.5	156.9	300.0

SAMPLE CALCULATIONS:
Results uV/m @10m = Antilog ((-61.0 - 35.3 + 27.8 + 2.9 - 10.46 + 107)(20) = 35.4
Conversion from dB to dBuV = 107 dB
Correction for 3m to 10m = 20log (3/10) = -10.46

Tested By
Signature: _____ **Name:** Tim R. Johnson

SECTION 3

LABELING INFORMATION

This information has been provided in a separate file

SECTION 4

BLOCK DIAGRAM / SCHEMATIC

This information has been provided in a separate file

SECTION 5

PHOTOGRAPHS

PHOTOS OF THE TESTED EUT

The following photos are attached:

Photo 1. 3D External View – Side 1
Photo 2. 3D External View – Side 2
Photo 3. Top View
Photo 4. Bottom View
Photo 5. Case Opened showing Battery and Antenna
Photo 6. Case Opened with Antenna and Antenna Housing Removed
Photo 7. Case Opened with Battery Housing Removed
Photo 8. Case Removed Showing Internal Circuit Board – Side 1
Photo 9. Case Removed Showing Internal Circuit Board – Side 2
Photo 10. Complete Circuit Board – Side 1
Photo 11. Complete Circuit Board – Side 2
Photo 12. RF Portion – Top
Photo 13. RF Portion – Bottom
Photo 14. IF Portion – Top
Photo 15. IF Portion – Bottom
Photo 16. Phase Lock Loop and Frequency Synthesizer Portion - Top
Photo 17. Phase Lock Loop and Frequency Synthesizer Portion - Bottom
Photo 18. Spread Spectrum Base Band Processor Portion - Top
Photo 19. Spread Spectrum Base Band Processor Portion - Bottom
Photo 20. Power Supply and TCXO Portion - Top
Photo 21. Power Supply and TCXO Portion - Bottom
Photo 22. Microprocessor Portion - Top
Photo 23. Microprocessor Portion - Bottom
Photo 24. Signal Processing Portion - Top
Photo 25. Signal Processing Portion - Bottom

This information has been provided in a separate files

SECTION 6

USER'S MANUAL

This information has been provided in a separate fi