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 Tables 5a – 5f. These values were calculated using the following duty cycle corrections:

The maximum transmit time of the EUT, based upon software and firmware settings, is 40 ms. Measured time of occupancy from Section 2.13 is 30.75 ms therefore:

39.75 ms/100 ms = 39.75% duty cycle
$20^{log}(.3975)$= -8.01 dB correction factor

Table 5a. AVERAGE RADIATED SPURIOUS EMISSIONS Low Channel

Dual Band Antenna

Freq. (MHz)	Test Data (dBm) @ 3m	AF + CA - AMP (dB)	Results (uV/m) 3m	FCC Limits (uV/m)	MARGIN BELOW FCC Limits (dB)
910.52	-24.4	30.7	460543.3	-	-
1821.06	-30.6	-6.9	2996.7	46054.3	23.6
2731.51	-60.2	-2.4	165.3	500.0	9.6
3641.93	-57.9	1.0	321.5	500.0	3.8
4552.58	-64.0	4.8	245.0	500.0	6.2
5463.01	-52.7**	6.8	1136.1	46054.3	32.2
6373.48	-69.0**	8.1	201.5	46054.3	47.2
7283.96	-65.7**	9.9	364.2	500.0	2.8

Data corrected by 1 dB for loss of high pass filter except for fundamental frequency
** Data conversion from 1 meter to 3 meters = -9.54

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-30.6 + -6.9 + 107)/20) = 2996.7
CONVERSION FROM dBm TO dBuV = 107 dB

Tester Signature: David P. Blethen **Name: David Blethen**

Table 5b. AVERAGE RADIATED SPURIOUS EMISSIONS Mid Channel

Dual Band Antenna

Freq. (MHz)	Test Data (dBm) @ 3m	AF + CA - AMP (dB)	Results (uV/m) 3m	FCC Limits (uV/m)	MARGIN BELOW FCC Limits (dB)
918.97	-23.3	30.7	526458.8	-	-
1838.13	-30.1	-6.6	3276.9	52645.9	24.1
2756.88	-58.9	-2.4	193.7	500.0	8.2
3676.35	-60.9	1.2	232.6	500.0	6.6
4595.23	-63.0	4.9	280.2	500.0	5.0
5513.93	-55.1**	6.9	867.6	52645.9	36.0
6432.93	-68.8**	8.1	206.1	52645.9	48.5
7351.98	-73.2**	9.9	154.0	500.0	10.2

Data corrected by 1 dB for loss of high pass filter except for fundamental frequency
** Data conversion from 1 meter to 3 meters = -9.54

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-30.1 + -6.6 + 107)/20) = 3276.9
CONVERSION FROM dBm TO dBuV = 107 dB

Tester Signature:  **Name: David Blethen**

Table 5c. AVERAGE RADIATED SPURIOUS EMISSIONS High Channel

Dual Band Antenna

Freq. (MHz)	Test Data (dBm) @ 3m	AF + CA - AMP (dB)	Results (uV/m) 3m	FCC Limits (uV/m)	MARGIN BELOW FCC Limits (dB)
927.47	-23.9	30.7	492443.5	-	-
1855.1	-31.7	-6.3	2813.2	49244.4	24.9
2782.63	-53.9	-2.3	347.8	500.0	3.2
3710.2	-60.2	1.4	257.6	500.0	5.8
4637.88	-64.8	5.1	232.2	500.0	6.7
5565.0	-58.6**	7.0	588.7	49244.4	38.4
6492.45	-70.3**	8.1	173.3	49244.4	49.1
7419.93	-68.4**	10.0	268.3	500.0	5.4

Data corrected by 1 dB for loss of high pass filter except for fundamental frequency
** Data conversion from 1 meter to 3 meters = -9.54

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-31.7 + -6.3 + 107)/20) = 2813.2
CONVERSION FROM dBm TO dBuV = 107 dB

Tester Signature:  **Name: David Blethen**

Table 5d. AVERAGE RADIATED SPURIOUS EMISSIONS Low Channel

Fractal Antenna

Freq. (MHz)	Test Data (dBm) @ 3m	AF + CA - AMP (dB)	Results (uV/m) 3m	FCC Limits (uV/m)	MARGIN BELOW FCC Limits (dB)
910.47	-33.0	30.7	171048.5	-	-
1820.98	-32.1	-6.9	2521.1	17104.9	16.6
2731.48	-61.5	-2.4	142.3	500.0	10.9
3641.98	-61.4	1.0	214.9	500.0	7.3
4552.5	-69.6	4.8	128.5	500.0	11.8
5462.93	-72.8**	6.8	112.3	17104.9	43.7
6372.43	-81.6**	8.1	47.2	17104.9	51.2
7284.05	-77.0**	9.9	99.2	500.0	14.1

Data corrected by 1 dB for loss of high pass filter except for fundamental frequency
** Data conversion from 1 meter to 3 meters = -9.54

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-32.1 + -6.9 + 107)/20) = 2521.1
CONVERSION FROM dBm TO dBuV = 107 dB

Tester Signature:  **Name: David Blethen**

Table 5e. AVERAGE RADIATED SPURIOUS EMISSIONS Mid Channel

Fractal Antenna

Freq. (MHz)	Test Data (dBm) @ 3m	AF + CA - AMP (dB)	Results (uV/m) 3m	FCC Limits (uV/m)	MARGIN BELOW FCC Limits (dB)
918.97	-33.0	30.7	170358.7	-	-
1837.93	-37.1	-6.6	1463.2	17035.9	21.3
2756.9	-64.7	-2.4	99.4	500.0	14.0
3675.93	-64.9	1.2	146.7	500.0	10.6
4595.05	-71.2	4.9	109.0	500.0	13.2
5514.05	-73.6**	6.9	103.1	17035.9	44.4
6430.75	-82.1**	8.1	44.6	17035.9	51.6
7351.95	-75.7**	9.9	115.5	500.0	12.7

Data corrected by 1 dB for loss of high pass filter except for fundamental frequency
** Data conversion from 1 meter to 3 meters = -9.54

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-37.1 + -6.6 + 107)/20) = 1463.2
CONVERSION FROM dBm TO dBuV = 107 dB

Tester Signature:  **Name: David Blethen**

Table 5f. AVERAGE RADIATED SPURIOUS EMISSIONS High Channel

Fractal Antenna

Freq. (MHz)	Test Data (dBm) @ 3m	AF + CA - AMP (dB)	Results (uV/m) 3m	FCC Limits (uV/m)	MARGIN BELOW FCC Limits (dB)
927.47	-32.4	30.7	185078.7	-	-
1854.95	-37.9	-6.3	1377.5	18507.9	22.6
2782.3	-66.2	-2.3	84.4	500.0	15.5
3709.93	-65.5	1.4	139.9	500.0	11.1
4637.2	-71.2	5.1	111.1	500.0	13.1
5565.0	-74.6**	7.0	93.3	18507.9	45.9
6493.0	-81.4**	8.1	48.3	18507.9	51.7
7420.08	-73.7**	10.0	145.8	500.0	10.7

Data corrected by 1 dB for loss of high pass filter except for fundamental frequency.
** Data conversion from 1 meter to 3 meters = -9.54

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-37.9 + -6.3 + 107)/20) = 1377.5
CONVERSION FROM dBm TO dBuV = 107 dB

Tester Signature:  **Name: David Blethen**

2.11 20 dB Bandwidth per FCC Section 15.247(a)(1)(ii)

The antenna port was connected to a spectrum analyzer that was set for a 50 Ω impedance with the RBW = approximately 1/100 of the operating bandwidth & VBW > RBW. The results of this test are given in Table 6 and Figure 6a through 6c.

TABLE 6
20 dB Bandwidth

Frequency (MHz)	20 dB Bandwidth (MHz)	MAXIMUM FCC LIMIT (MHz)
910.4960	0.0108	1.0
918.9970	0.0105	1.0
927.4985	0.0108	1.0

Test Date: January 13, 2005

Tester Signature:  **Name: David Blethen**

Figure 6a.
20 dB Bandwidth per FCC Section 15.247(a)(1)(ii) (Low Channel)
Dual Band Antenna

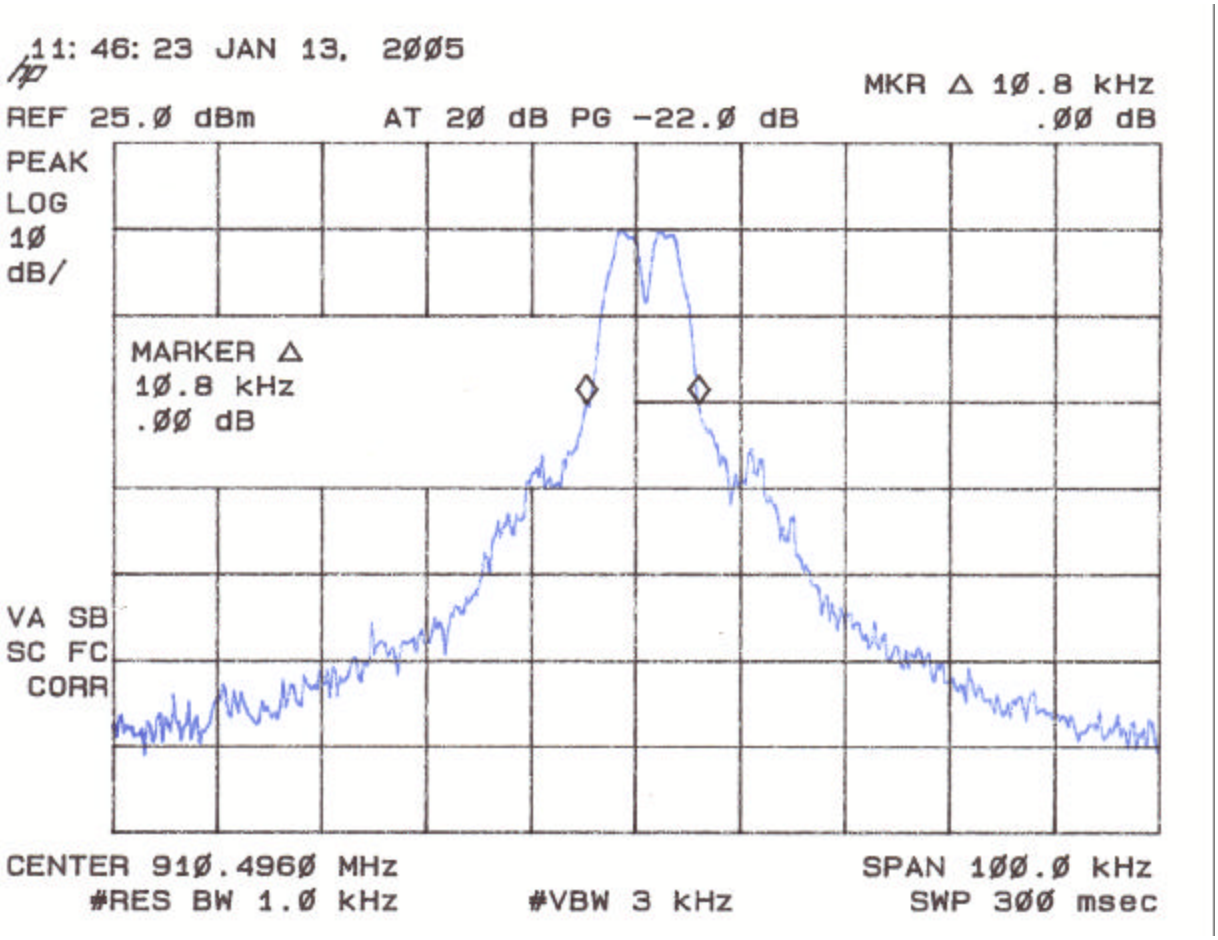


Figure 6b.
20 dB Bandwidth per FCC Section 15.247(a)(1)(ii) (Mid Channel)
Dual Band Antenna

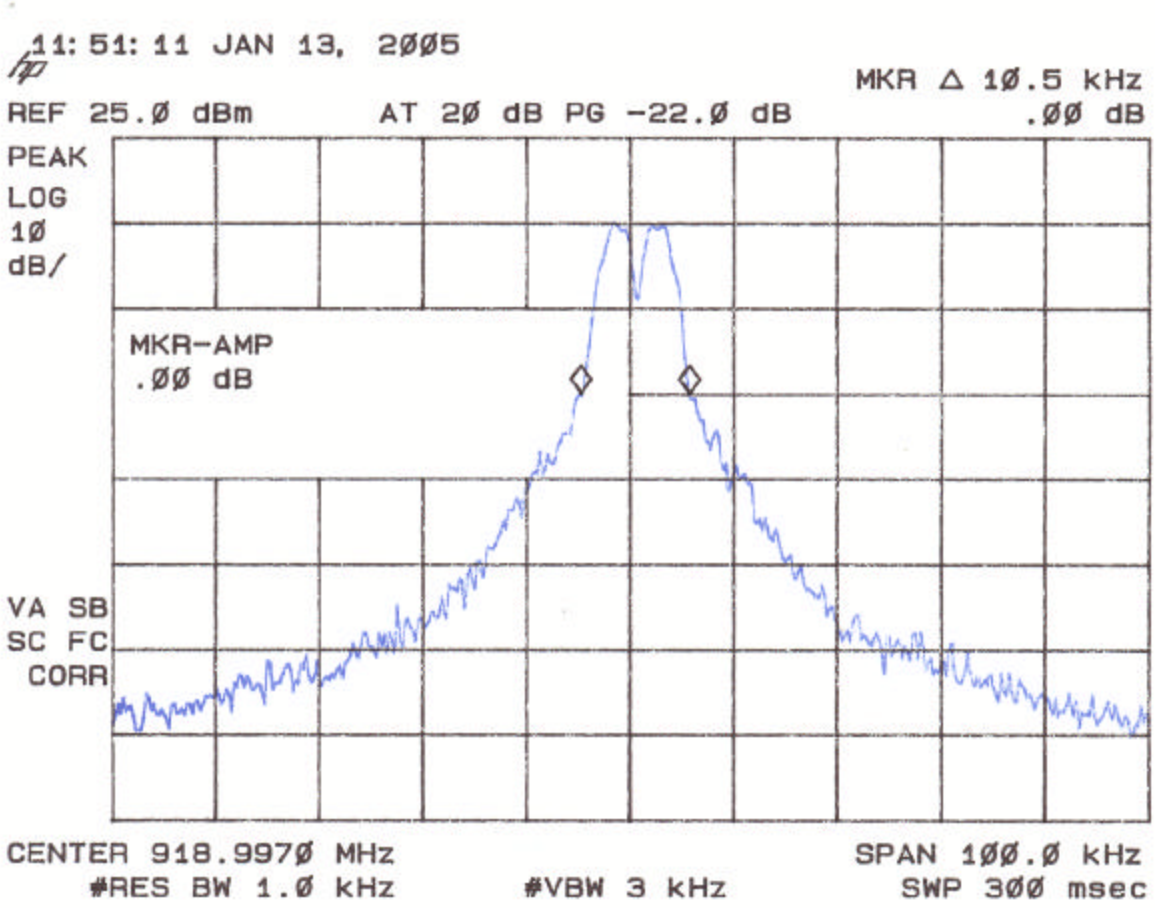
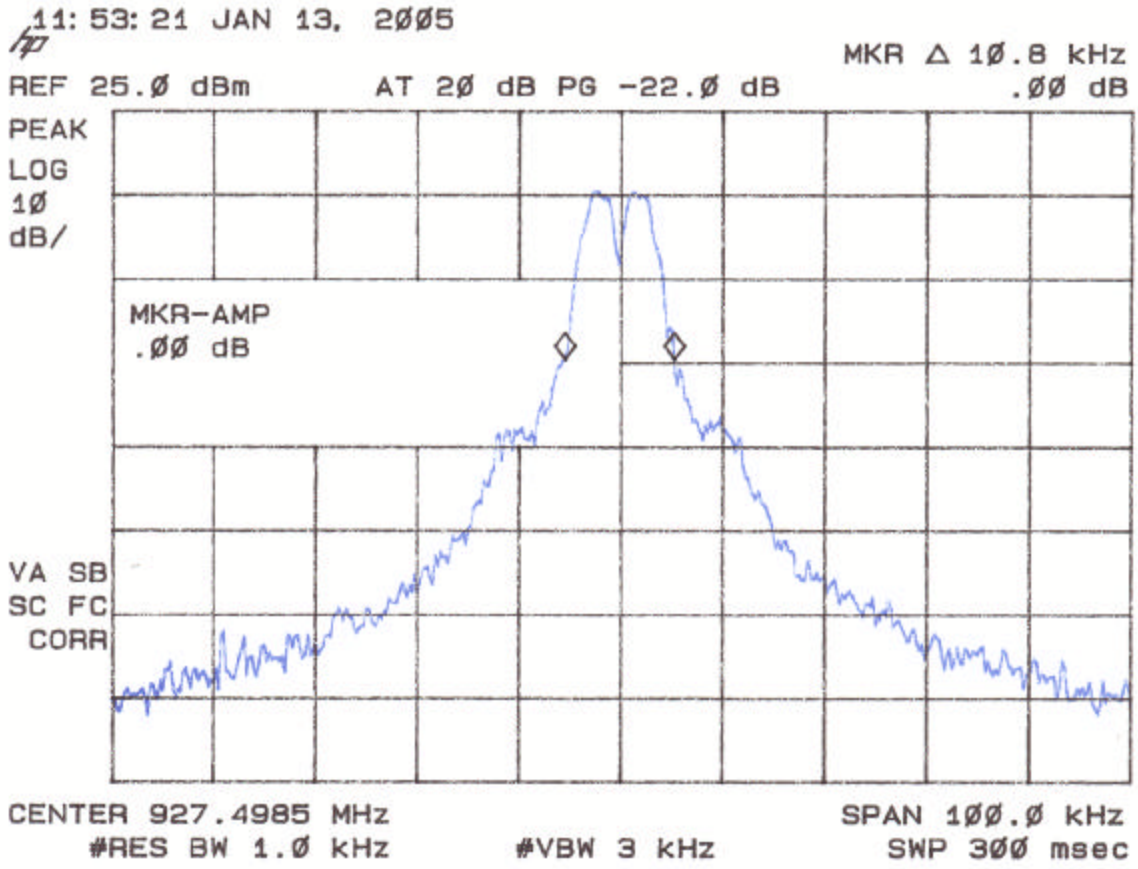


Figure 6c.
20 dB Bandwidth per FCC Section 15.247(a)(1)(ii) (High Channel)
Dual Band Antenna



2.12 Number of Hopping Channels FCC Section 15.247(a)(1)(ii)

The transmitter was placed into a typical frequency hopping mode of operation. The 902-928 MHz band was centered on the screen and the RBW and VBW chosen such that the individual channels could be discerned. The trace capture time was a minimum of 5 minutes.

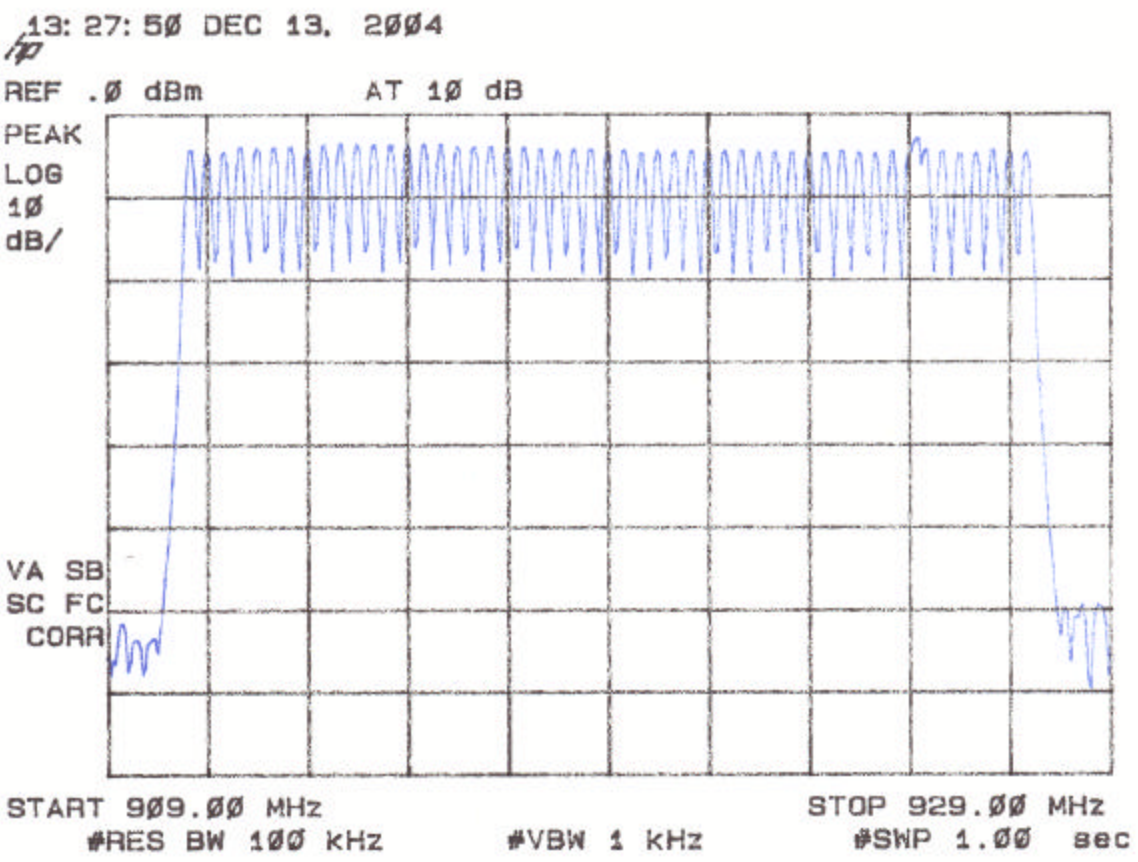
The results of this test are given in Table 7 and Figure 7.

TABLE 7

NUMBER OF HOPPING CHANNELS

Number of Hopping Frequencies Measured	FCC Limit (Minimum Number of Channels)
50	50

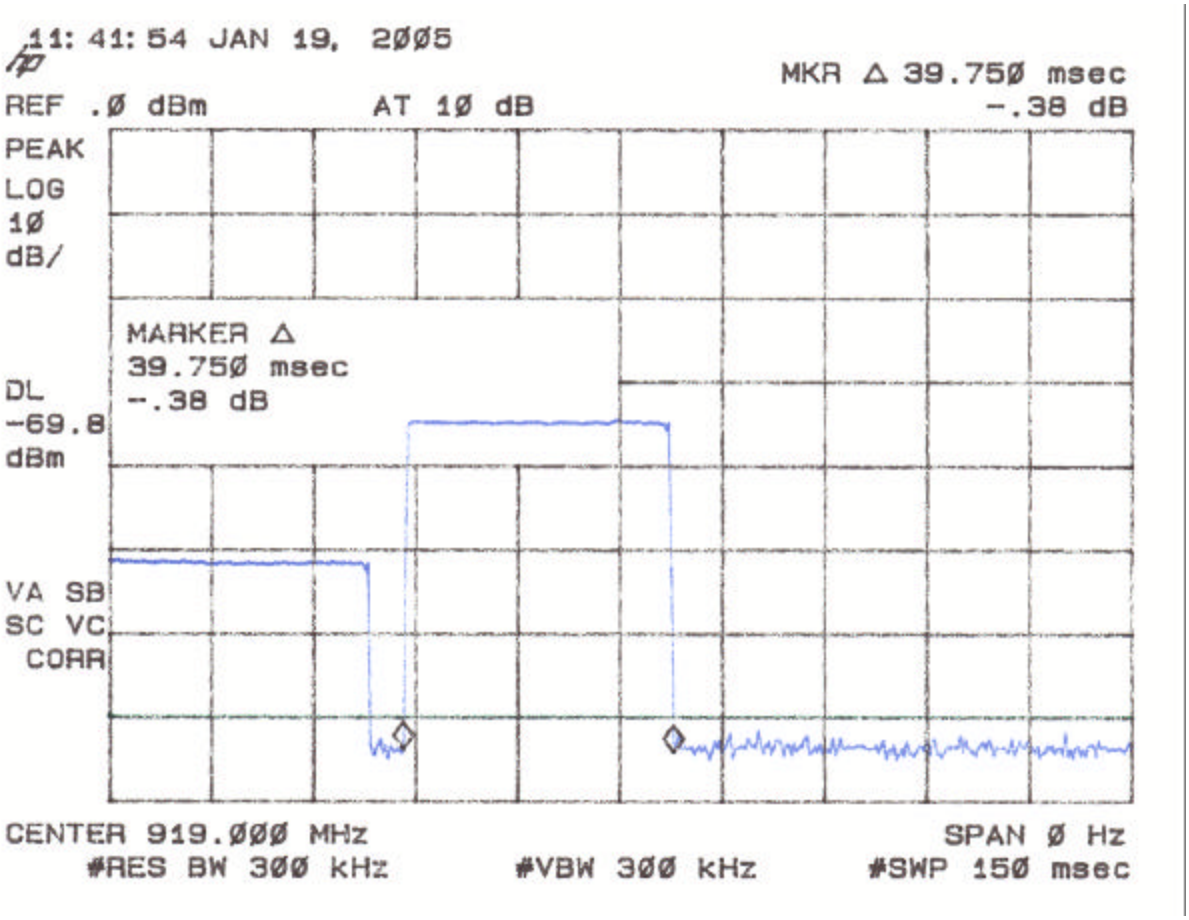
Figure 7
Number of Hopping Channels FCC Section 15.247(a)(1)(ii)



2.13 Average Time of Occupancy per Channel FCC Section 15.247(a)(1)(ii)

The maximum transmit time of the EUT, based upon software and firmware settings, is 40 ms average time of occupancy.

Figure 8
Average Time of Occupancy per Channel FCC Section 15.247(a)(1)(ii)



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 Tables 8a-8b and Figures 9a-9c.

TABLE 8a. CONDUCTED EMISSIONS DATA

CLASS B

Worse Case Mode of Operaton (TX – Low channel)

(Peak-Quasi Peak Measurements vs Average Limits) PHASE DATA

FREQUENCY (MHz)	TEST DATA (dBuV) PHASE	AF + CA - AMP	RESULTS (dBuV) PHASE	EN55022 CLASS B LIMITS (dBuV)	MARGIN BELOW LIMIT (dB) PHASE
0.16	41.8	0.2	42.0	55.9	13.9
0.17	42.9	0.2	43.1	55.4	12.3
20.813	22.7	0.9	23.6	50.0	26.4
21.925	28.0	0.9	28.9	50.0	21.1
22.088	18.5	0.9	19.4	50.0	30.6
23.923	30.7	0.9	31.6	50.0	18.4

SAMPLE CALCULATIONS: 41.8 + 0.2 = 42.0 dBuV

Test Date: December 13, 2004

Tested by
Signature: _____ **Name: David Blethen**

TABLE 8b. CONDUCTED EMISSIONS DATA

CLASS B

Worse Case Mode of Operaton (TX – Low channel)

(Peak-Quasi Peak Measurements vs Average Limits) NEUTRAL DATA

FREQUENCY (MHz)	TEST DATA NEUTRAL	AF + CA - AMP	RESULTS (dBuV) NEUTRAL	EN55022 CLASS B LIMITS (dBuV)	MARGIN BELOW LIMIT (dB) NEUTRAL
0.16	42.4	0.2	42.6	55.9	13.3
19.363	28.0	0.9	28.9	50.0	21.1
21.925	29.3	0.9	30.2	50.0	19.8
23.108	23.1	1.0	24.1	50.0	25.9
23.923	33.1	0.9	34.0	50.0	16.0
25.9	22.3	0.9	23.2	50.0	26.8

SAMPLE CALCULATIONS: 42.4 + 0.2 = 42.6 dBuV

Test Date: December 13, 2004

Tested by
Signature: _____ **Name: David Blethen**

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

Radiated emissions were evaluated from 30 to 14500 MHz while the EUT was placed into a Receive mode of operation. Measurements were made with the analyzer's bandwidth set to 120 kHz measurements made less than 1 GHz and 1 MHz for measurements made greater than or equal to 1 GHz. The results for less than 1 GHz are shown in Table 9.

TABLE 9a. RADIATED EMISSIONS DATA
(Digital Device & Receiver)

CLASS B

Measurements 30 MHz – 1 GHz

Frequency (MHz)	Receiver Reading (dBm) @3m	Correction Factor (dB)	Corrected Reading (uV/m)	FCC Limit (uV/m) @3m	Margin Below FCC Limit (dB) @3m
311.00	-94.0	19.7	43.3	200.0	13.3
348.0	-95.0	19.1	35.7	200.0	15.0

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m
Antilog ((-94.0 + 19.7 + 107)/20) = 43.3
CONVERSION FROM dBm TO dBuV = 107 dB
Margin in dB = 20/ log (43.3 / 200.0) = 13.3 dB

Test Date: December 17, 2004

Tested by
Signature:  **Name: David Blethen**

TABLE 9b. RADIATED EMISSIONS DATA
(Digital Device & Receiver)

CLASS B

Measurements 1 GHz – 5 GHz (PEAK)

Frequency (MHz)	Receiver Reading (dBm) @3m	Correction Factor (dB)	Corrected Reading (uV/m)	FCC Limit (uV/m) @3m	Margin Below FCC Limit (dB) @3m
1838.20	-66.9	-6.6	47.4	5000.0	40.5

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m
Antilog ((-66.9 + -6.6 + 107)/20) = 47.4
CONVERSION FROM dBm TO dBuV = 107 dB
Margin in dB = 20/ log (47.4 / 5000.0) = 40.5

Test Date: December 17, 2004

Tested by
Signature: David B. Blethen **Name: David Blethen**

TABLE 9b. RADIATED EMISSIONS DATA
(Digital Device & Receiver)

CLASS B

Measurements 1 GHz – 5 GHz (AVERAGE)

Frequency (MHz)	Receiver Reading (dBm) @3m	Correction Factor (dB)	Corrected Reading (uV/m)	FCC Limit (uV/m) @3m	Margin Below FCC Limit (dB) @3m
1838.2	-70.6	-6.6	30.9	500.0	24.2

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m
Antilog ((-70.6 + -6.6 + 107)/20) = 30.9
CONVERSION FROM dBm TO dBuV = 107 dB
Margin in dB = 20/ log (30.9 / 500.0) = 24.2 dB

Test Date: December 17, 2004

Tested by
Signature:  **Name: David Blethen**

2.16 Power Line Conducted Emissions for Digital Device and Receiver 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 an idle condition or a continuous mode of receive. Similar results were seen as compared to the EUT in a transmit mode of operation. **Therefore, please refer to the results as shown in Table 8.**

2.17 Channel Separation

The transmitter was placed into a typical frequency hopping mode of operation. Using an RBW and UBW of 30 kHz, the delta between 2 peaks was measured and the distance between them was noted. Characteristics of the time of occupancy are shown in Figure 9 and Table 10.

TABLE 10

CHANNEL SEPARATION

Channel Separation	FCC Limit
335 kHz	25 kHz, 20 dB Bandwidth

Figure 9
Channel Separation FCC Section 15.247(a)(1)(ii)