2.9 Peak Radiated Spurious Emission in the Frequency Range 30 -25000 MHz (FCC Section 15.247(c))

The EUT was hop-stopped and when possible, placed into a continuous transmit mode of operation. 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 –4c and Figure 5a1 – Figure 5c7.

TABLE 4a PEAK RADIATED SPURIOUS EMISSIONS (Low Channel)

Peak Radiated Emissions							
Test By:	**Test:** FCC 15.247, Low Channel				**Client:** Wireless Detection		
DPB	**Project:** 05-0071				**Model:** FWS-002		
Frequency (MHz)	**Test Data (dBm)**	**Test Data (dBuV)**	**AF+CA-AMP (dB)**	**Results (uV/m)**	**Limits (uV/m)**	**Margin (dB)**	**PK = n / QP**
902.32	-24.6	82.4	30.6	446381.8			**PK**
1804.66	-30.7	76.3	-7.1	2873.2	44638.2	**23.8**	**PK**
2707.02	-37.8	69.2	-2.5	2159.1	5000.0	**7.3**	**PK**
3609.6	-61.0	46.0	0.9	220.5	5000.0	**27.1**	**PK**

Data corrected by 1 dB for loss of high pass filter except for fundamental frequency

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-30.7 + -7.1 + 107)/20) = 28732
CONVERSION FROM dBm TO dBuV = 107 dB

Test Date: March 21, 2005

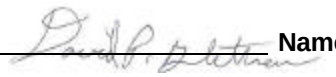
Tester Signature:  **Name: David Blethen**

Figure 5a-1
Peak Radiated Spurious Emission 15.247(c) Low Channel –
Fundamental

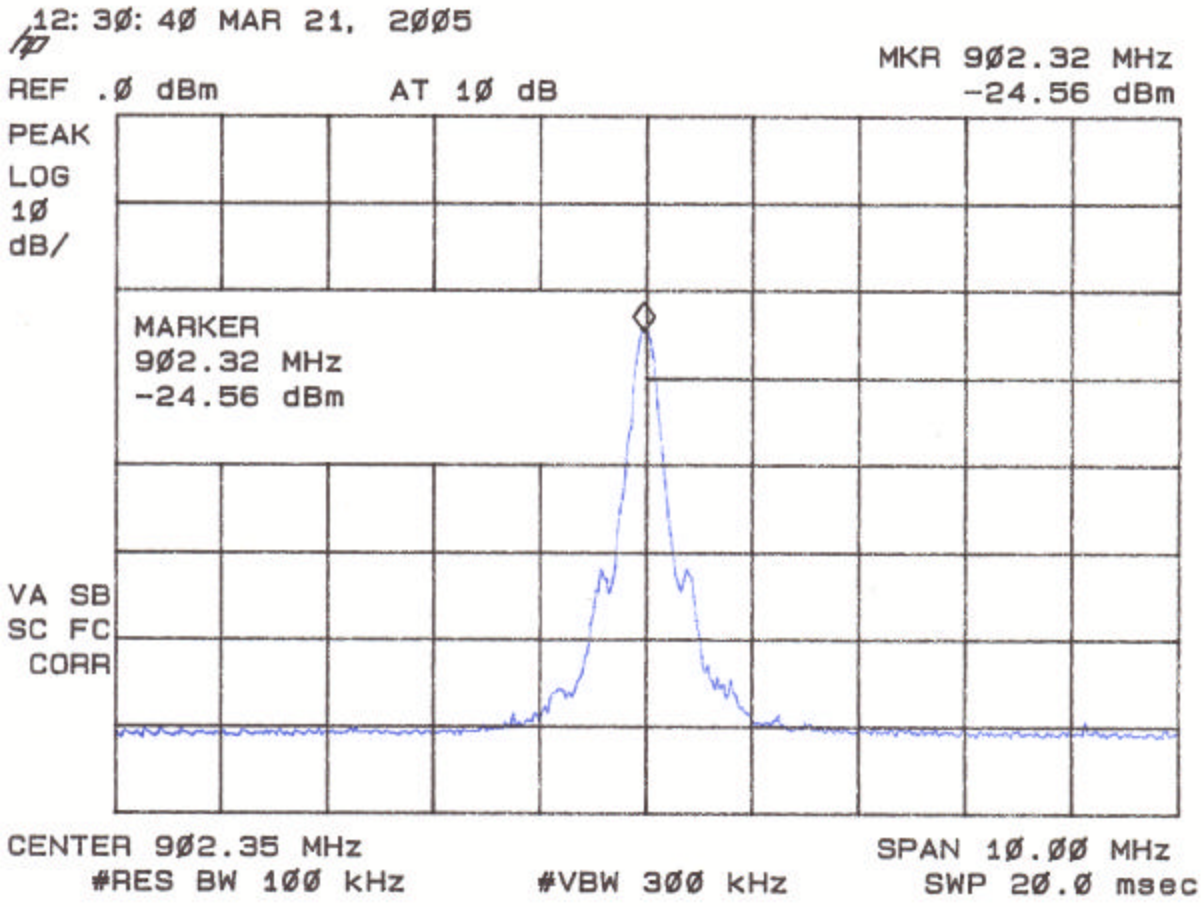


Figure 5a-2

Peak Radiated Spurious Emission 15.247(c) Low Channel – 2nd Harmonic

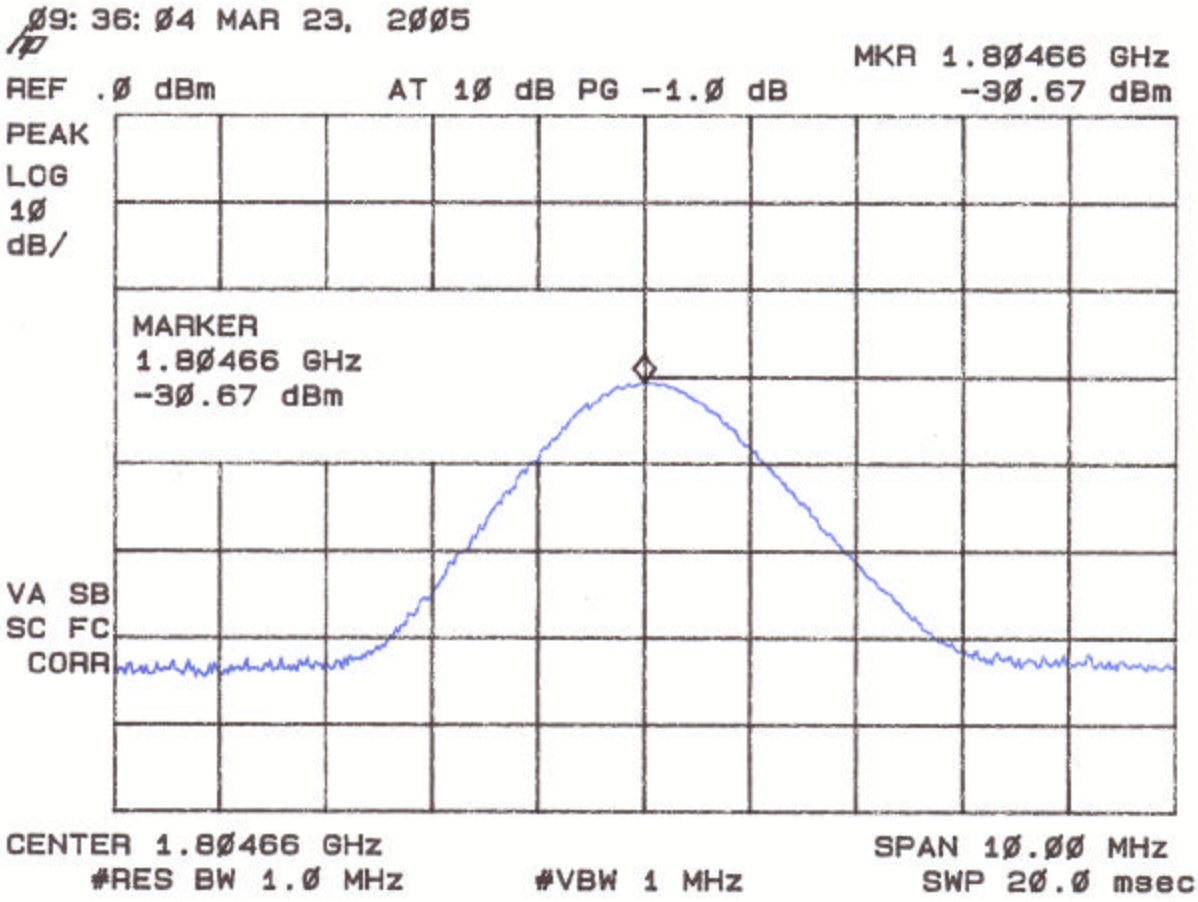


Figure 5a-3
Peak Radiated Spurious Emission 15.247(c) Low Channel – 3rd Harmonic

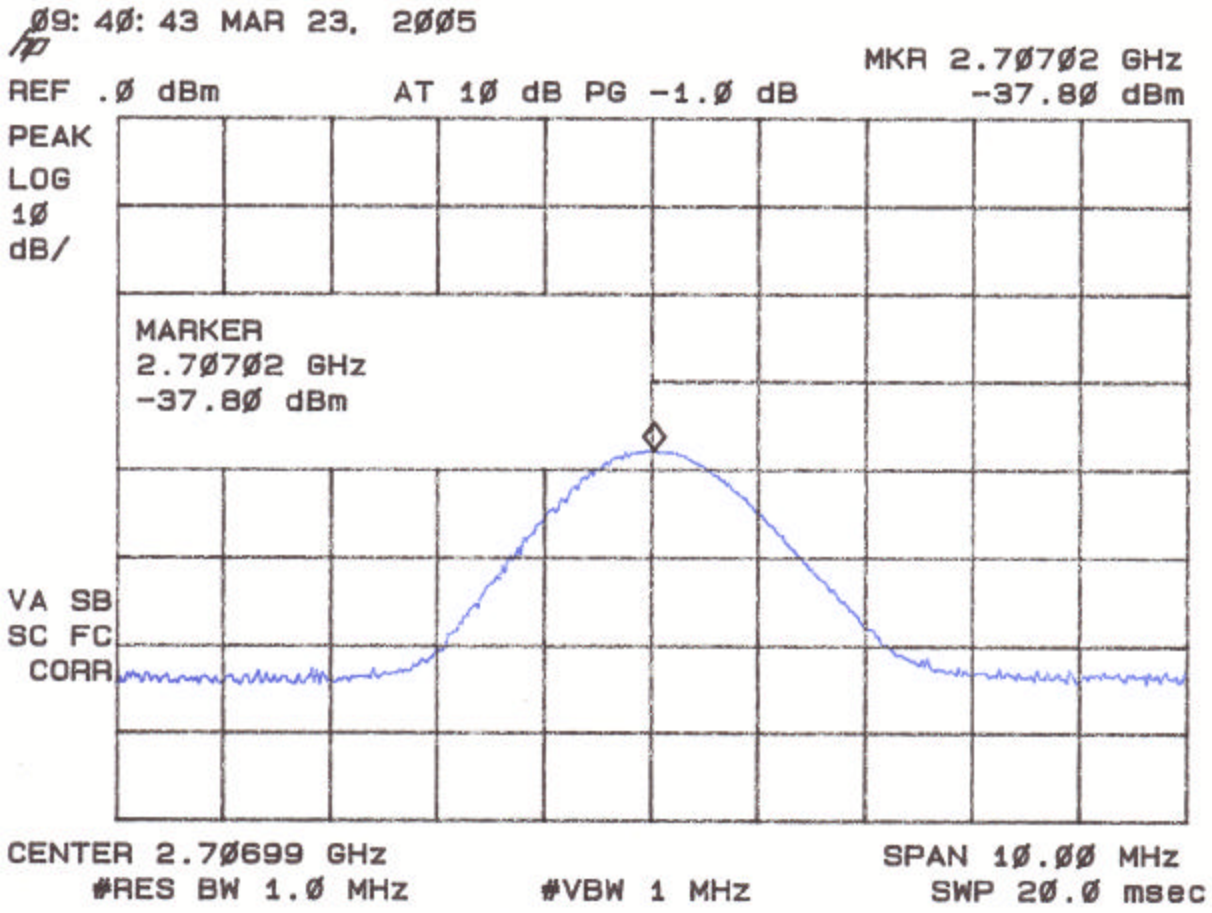


Figure 5a-4
Peak Radiated Spurious Emission 15.247(c) Low Channel – 4rh Harmonic

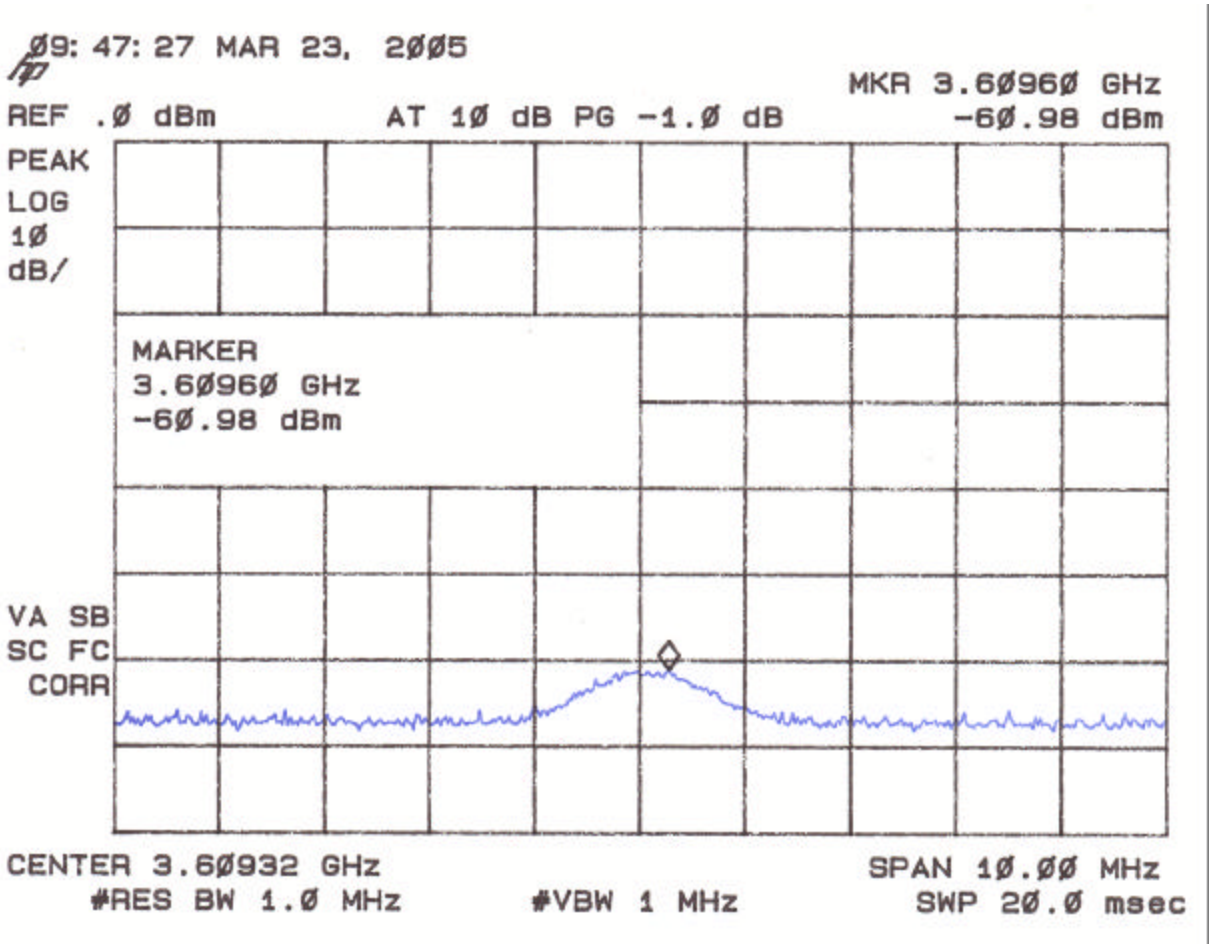


TABLE 4b PEAK RADIATED SPURIOUS EMISSIONS (Mid Channel)

Peak Radiated Emissions							
Test By:	**Test:** FCC 15.247, Mid Channel				**Client:** Wireless Detection		
DPB	**Project:** 05-0071				**Model:** FWS-002		
Frequency (MHz)	**Test Data (dBm)**	**Test Data (dBuV)**	**AF+CA-AMP (dB)**	**Results (uV/m)**	**Limits (uV/m)**	**Margin (dB)**	**PK = n / QP**
915.05	-24.3	82.7	30.8	472417.5			**PK**
1830.02	-25.7	81.3	-6.7	5356.7	47241.8	**18.9**	**PK**
2744.92	-36.4	70.6	-2.4	2572.3	5000.0	**5.8**	**PK**
3660	-64.1	42.9	1.1	159.3	5000.0	**29.9**	**PK**

Data corrected by 1 dB for loss of high pass filter except for fundamental frequency

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-25.7 + -6.7 + 107)/20) = 5356.7
CONVERSION FROM dBm TO dBuV = 107 dB

Tester Signature:  **Name: David Blethen**

Figure 5b-1
Peak Radiated Spurious Emission 15.247(c) Mid Channel – Fundamental

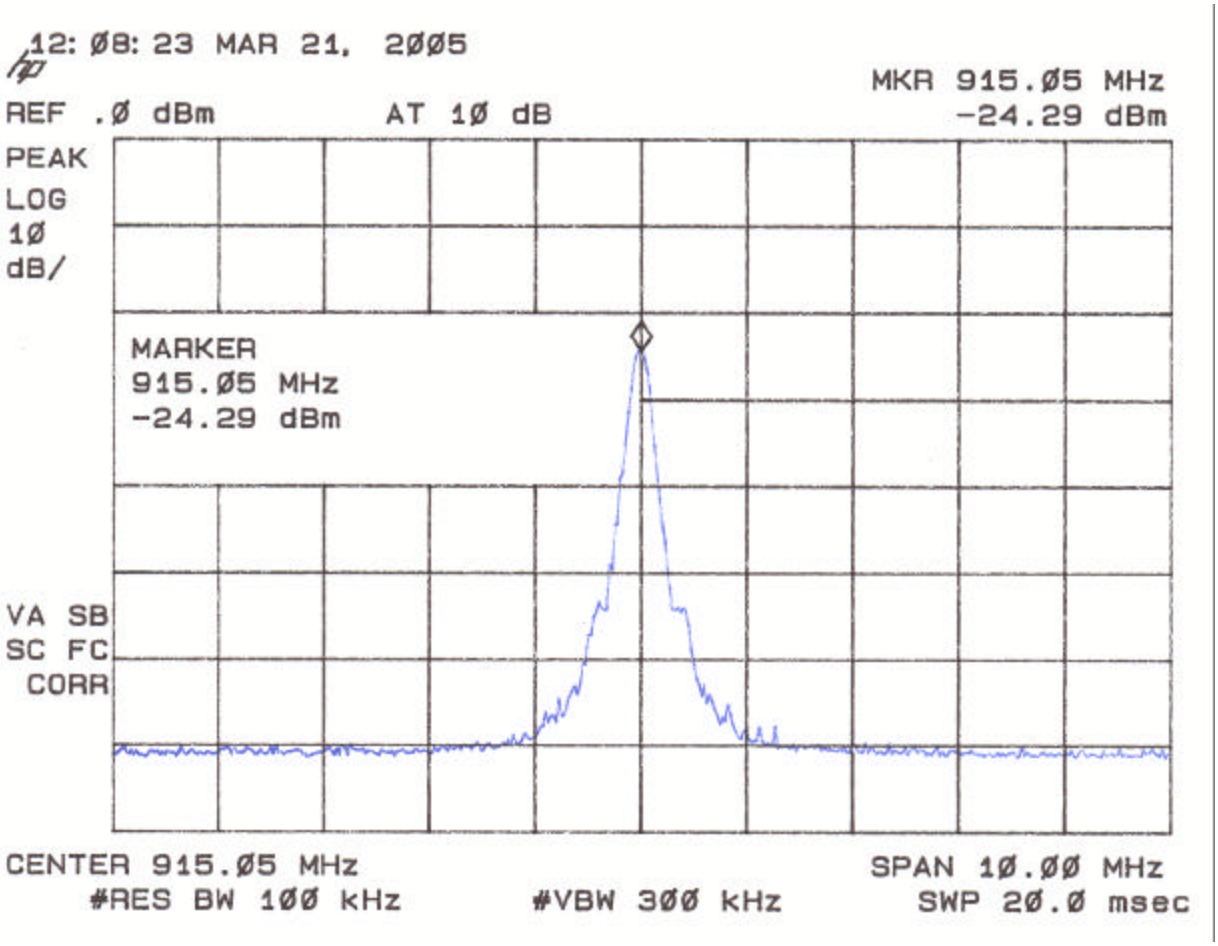


Figure 5b-2
Peak Radiated Spurious Emission 15.247(c) Mid Channel –
2nd Harmonic

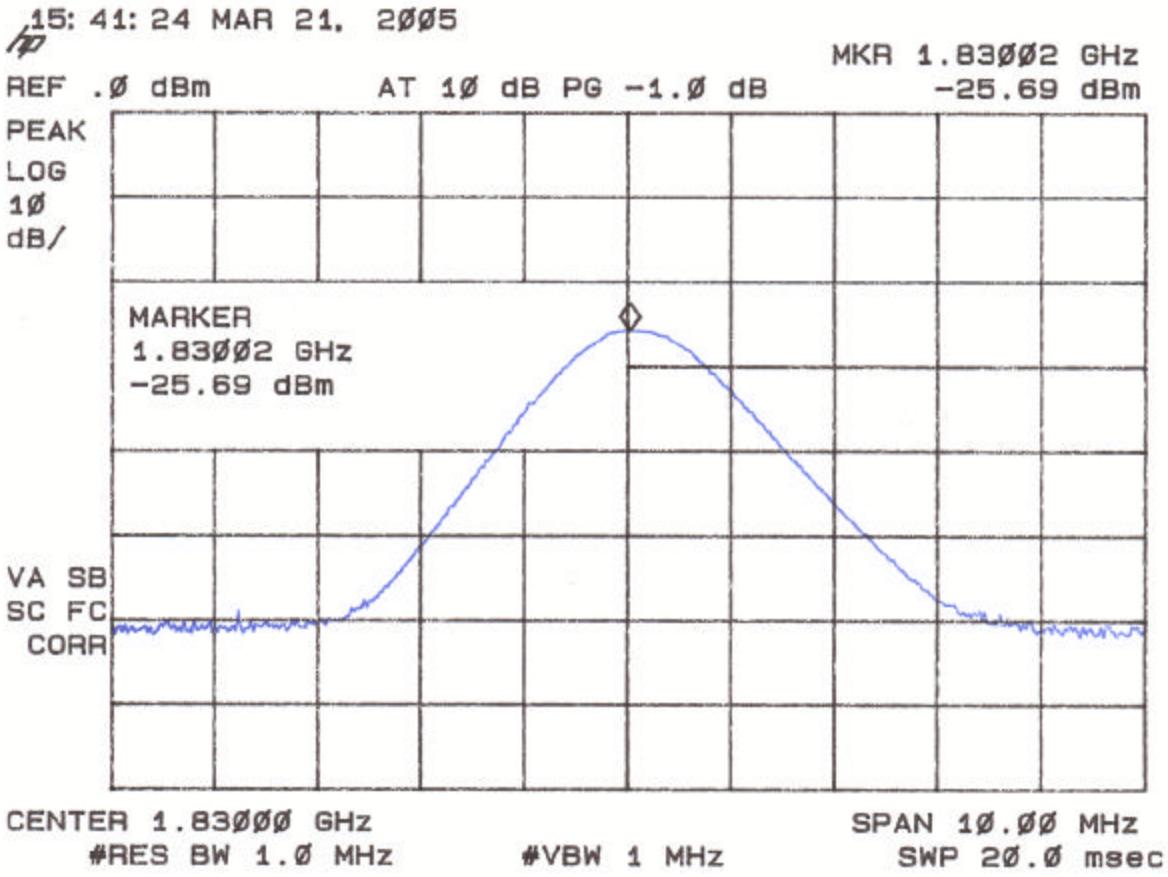


Figure 5b-3
Peak Radiated Spurious Emission 15.247(c) Mid Channel –
3rd Harmonic

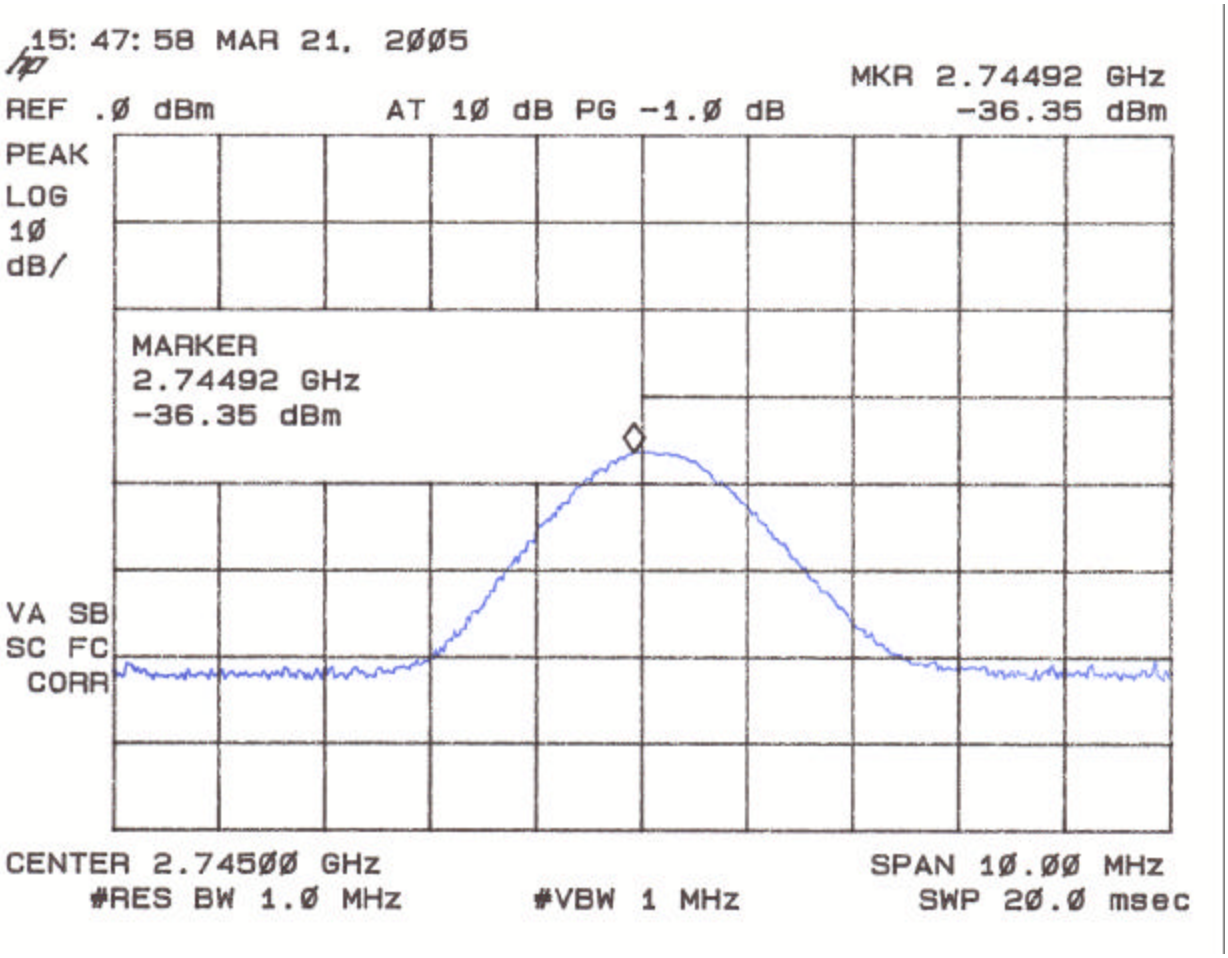


Figure 5b-4
Peak Radiated Spurious Emission 15.247(c) Mid Channel – 4rh Harmonic

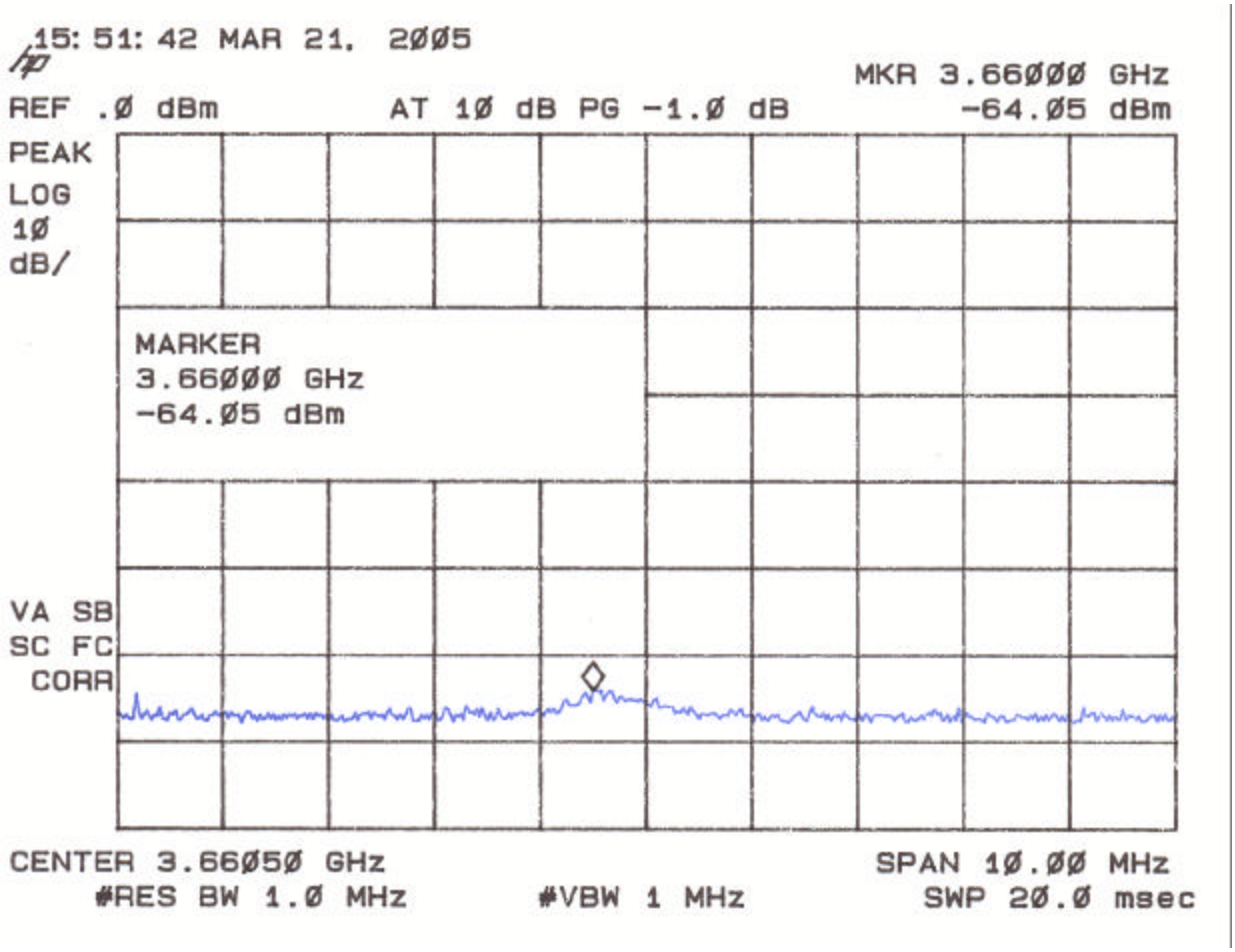


Table 4c. PEAK RADIATED SPURIOUS EMISSIONS (High Channel)

Peak Radiated Emissions							
Test By:	**Test:** FCC 15.247, High Channel				**Client:** Wireless Detection		
DPB	**Project:** 05-0071				**Model:** FWS-002		
Frequency	**Test Data**	**Test Data**	**AF+CA-AMP**	**Results**	**Limits**	**Margin**	**PK = n**
(MHz)	**(dBm)**	**(dBuV)**	**(dB)**	**(uV/m)**	**(uV/m)**	**(dB)**	**/ QP**
927.31	-25.4	81.6	30.8	414626.7			**PK**
1854.66	-34.7	72.3	-6.3	1990.0	41462.7	**26.4**	**PK**
2781.97	-43.1	63.9	-2.3	1205.7	5000.0	**12.4**	**PK**
3709.4	-64.8	42.2	1.4	151.6	5000.0	**30.4**	**PK**

Data corrected by 1 dB for loss of high pass filter except for fundamental frequency

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-34.7 + -6.3 + 107)/20) = 1990.0
CONVERSION FROM dBm TO dBuV = 107 dB

Tester Signature: _____ **Name: David Blethen**

Figure 5c-1
Peak Radiated Spurious Emission 15.247(c) High Channel – Fundamental

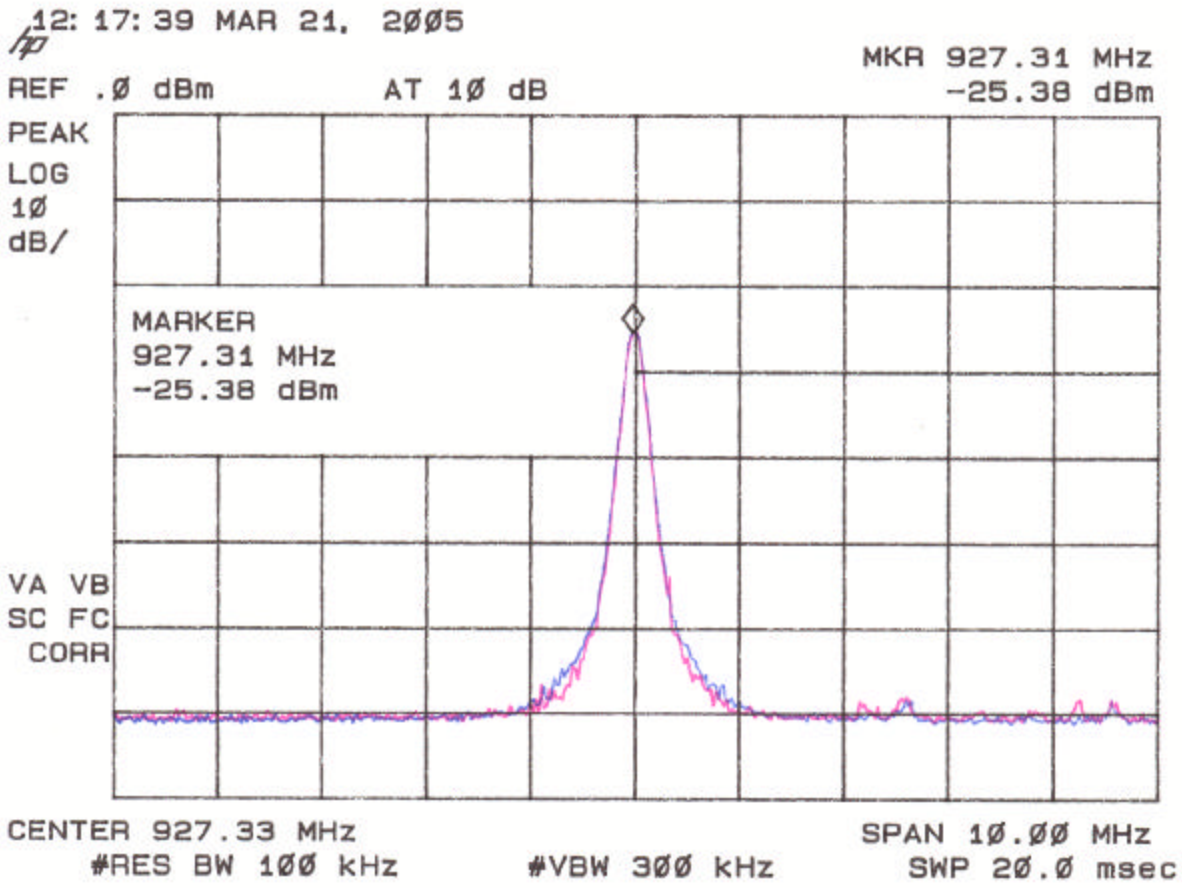


Figure 5c-2
Peak Radiated Spurious Emission 15.247(c) High Channel – 2nd Harmonic

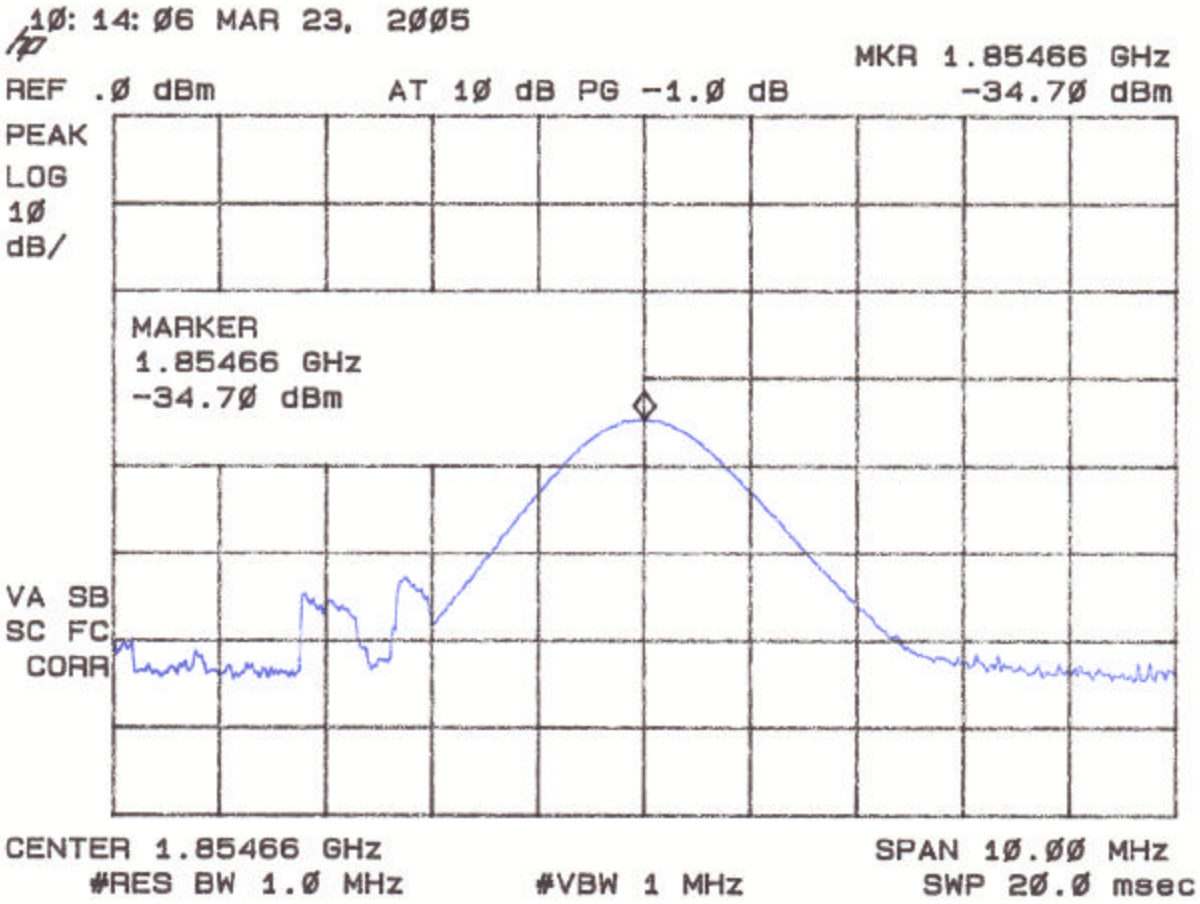


Figure 5c-3
Peak Radiated Spurious Emission 15.247(c) High Channel – 3rd Harmonic

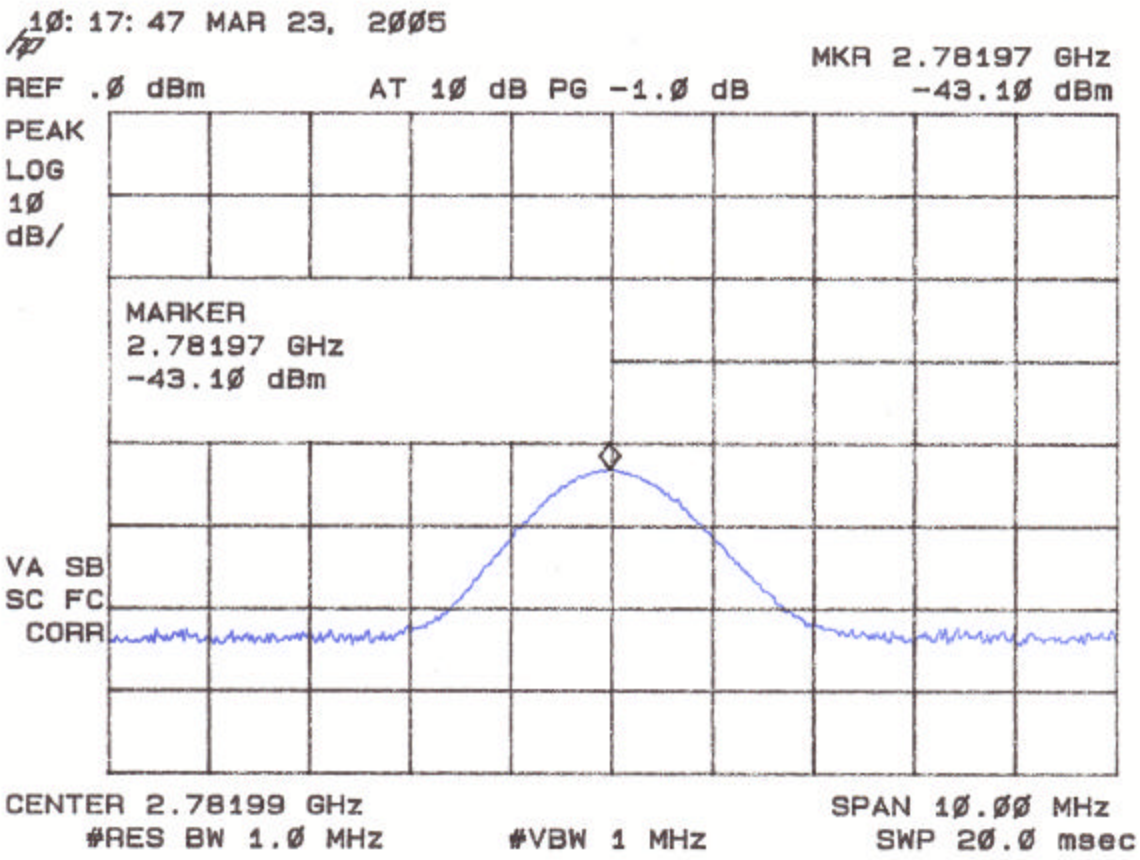
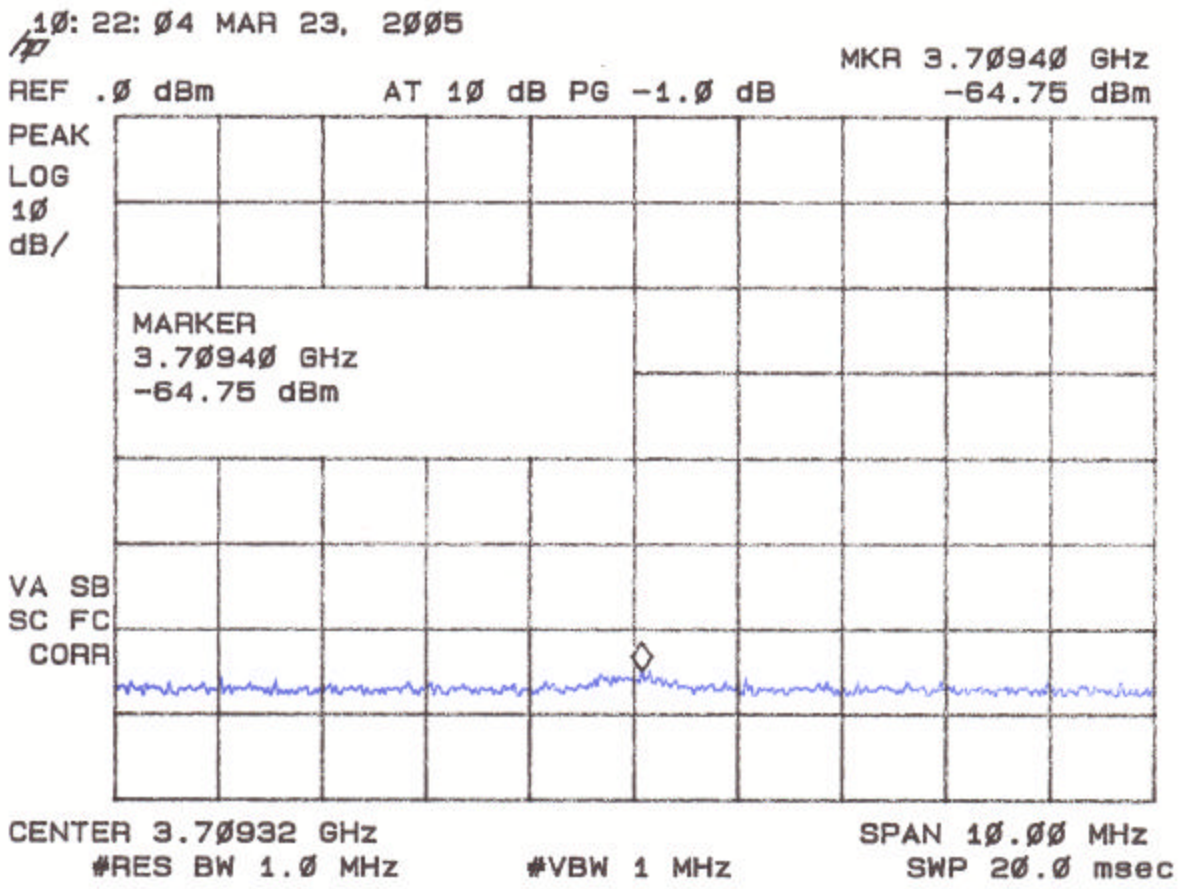


Figure 5c-4
Peak Radiated Spurious Emission 15.247(c) High Channel – 4rh Harmonic



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 – 5c. These values were calculated using the following duty cycle corrections:

The maximum transmit time of the EUT, based upon software and firmware settings, is 2.84 ms. Measured time of occupancy from Section 2.13 is 3.125 ms therefore:

3.125 ms/100 ms = 3.125% duty cycle
20^{log}(.0313)= -30.1 dB correction factor

Table 5a. AVERAGE RADIATED SPURIOUS EMISSIONS Low Channel

Average Radiated Emissions 3.125% Duty Cycle, -30.1 dB correction							
Test By:	**Test:** FCC 15.247, Low Channel				**Client:** Wireless Detection		
DPB	**Project:** 05-0071				**Model:** FWS-002		
Frequency	**Test Data**	**Test Data**	**AF+CA-AMP**	**Results**	**Limits**	**Margin**	**PK = n**
(MHz)	**(dBm)**	**(dBuV)**	**(dB)**	**(uV/m)**	**(uV/m)**	**(dB)**	**/ QP**
902.32	-54.7	52.3	30.6	13890.1			**AVG**
1804.66	-60.8	46.2	-7.1	89.8	1389.0	**23.8**	**AVG**
2707.02	-67.9	39.1	-2.5	67.5	500.0	**17.4**	**AVG**
3609.6	-91.1	15.9	0.9	6.9	500.0	**37.2**	**AVG**

Data corrected by 1 dB for loss of high pass filter except for fundamental frequency

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-60.8 + -7.1 + 107)/20) = 89.8
CONVERSION FROM dBm TO dBuV = 107 dB

Tester Signature:  **Name: David Blethen**

Table 5b. AVERAGE RADIATED SPURIOUS EMISSIONS Mid Channel

Average Radiated Emissions 3.125% duty cycle, - 30.1 dB correction							
Test By:	**Test:** FCC 15.247, Mid Channel				**Client:** Wireless Detection		
DPB	**Project:** 05-0071				**Model:** FWS-002		
Frequency (MHz)	**Test Data (dBm)**	**Test Data (dBuV)**	**AF+CA-AMP (dB)**	**Results (uV/m)**	**Limits (uV/m)**	**Margin (dB)**	**PK = n / QP**
915.05	-54.4	52.6	30.8	14768.1			**AVG**
1830.02	-55.8	51.2	-6.7	167.5	1476.8	**18.9**	**AVG**
2744.92	-66.5	40.5	-2.4	80.4	500.0	**15.9**	**AVG**
3660	-94.2	12.8	1.1	5.0	500.0	**40.0**	**AVG**

Data corrected by 1 dB for loss of high pass filter except for fundamental frequency

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-55.8 + -6.7 + 107)/20) = 167.5
CONVERSION FROM dBm TO dBuV = 107 dB

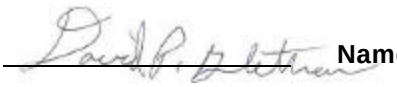
Tester Signature:  **Name: David Blethen**

Table 5c. AVERAGE RADIATED SPURIOUS EMISSIONS High Channel

Average Radiated Emissions 3.125% -30.1 dB correction							
Test By:	**Test:** FCC 15.247, High Channel				**Client:** Wireless Detection		
DPB	**Project:** 05-0071				**Model:** FWS-002		
Frequency (MHz)	**Test Data (dBm)**	**Test Data (dBuV)**	**AF+CA-AMP (dB)**	**Results (uV/m)**	**Limits (uV/m)**	**Margin (dB)**	**PK = n / QP**
927.31	-55.5	51.5	30.8	12961.6			**AVG**
1854.66	-64.8	42.2	-6.3	62.2	1296.2	**26.4**	**AVG**
2781.97	-73.2	33.8	-2.3	37.7	500.0	**22.5**	**AVG**
3709.4	-94.9	12.1	1.4	4.7	500.0	**40.5**	**AVG**

Data corrected by 1 dB for loss of high pass filter except for fundamental frequency

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-64.8 + -6.3 + 107)/20) = 62.2
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 manufacturers claimed RBW & 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)
902.349	0.130	1.0
915.040	0.125	1.0
927.334	0.125	1.0

Test Date: **March 21, 2005**

Tester Signature:  **Name: David Blethen**

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

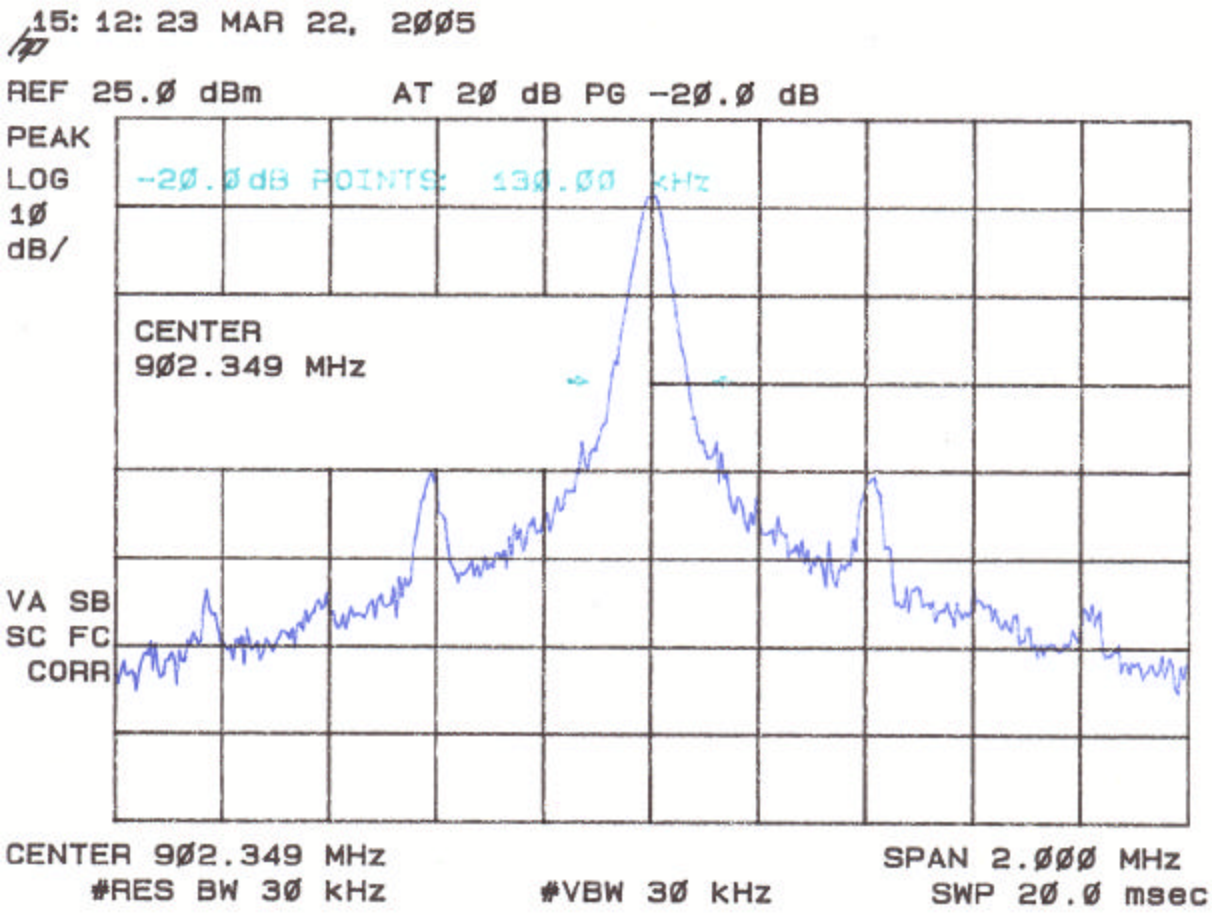


Figure 6b.
20 dB Bandwidth per FCC Section 15.247(a)(1)(ii) (Mid Channel)

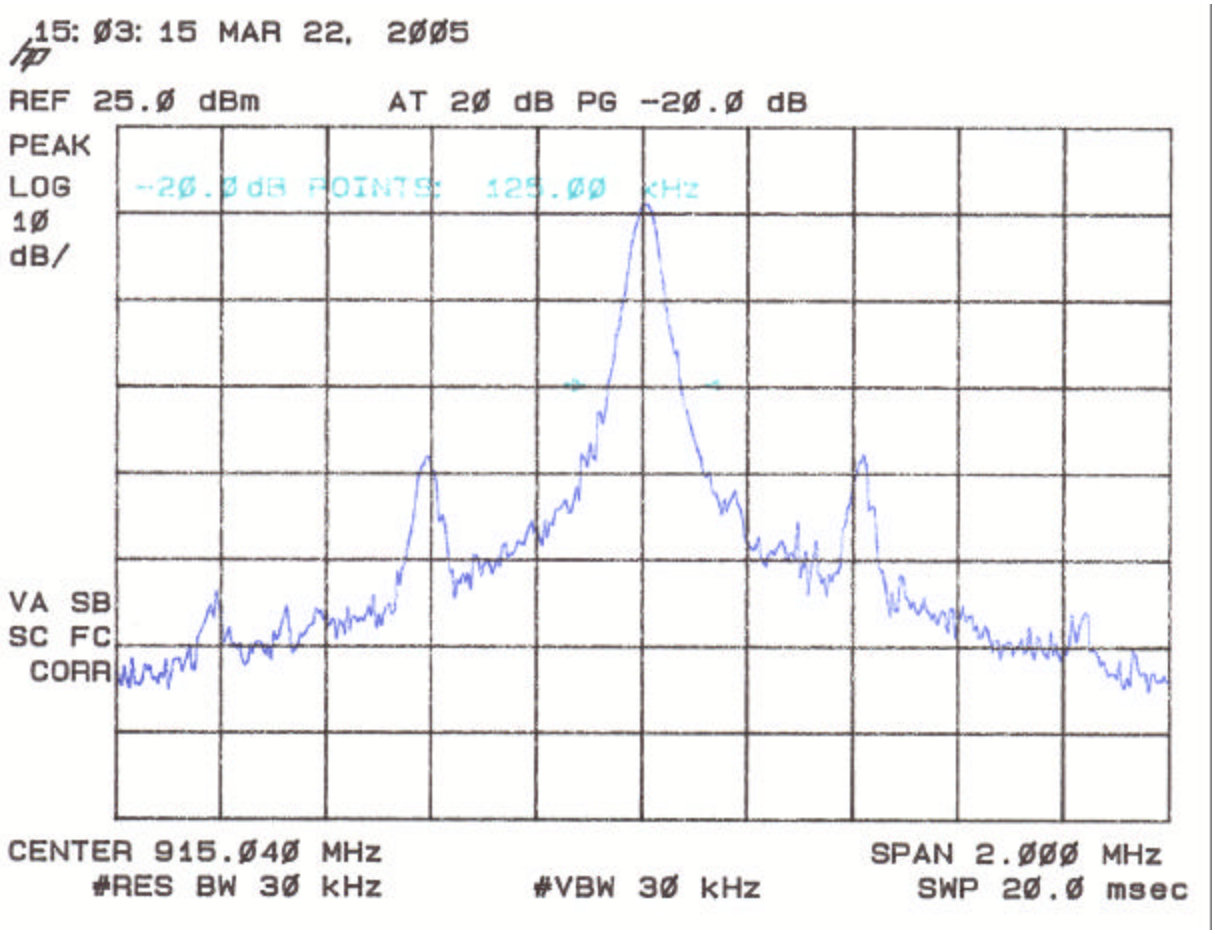
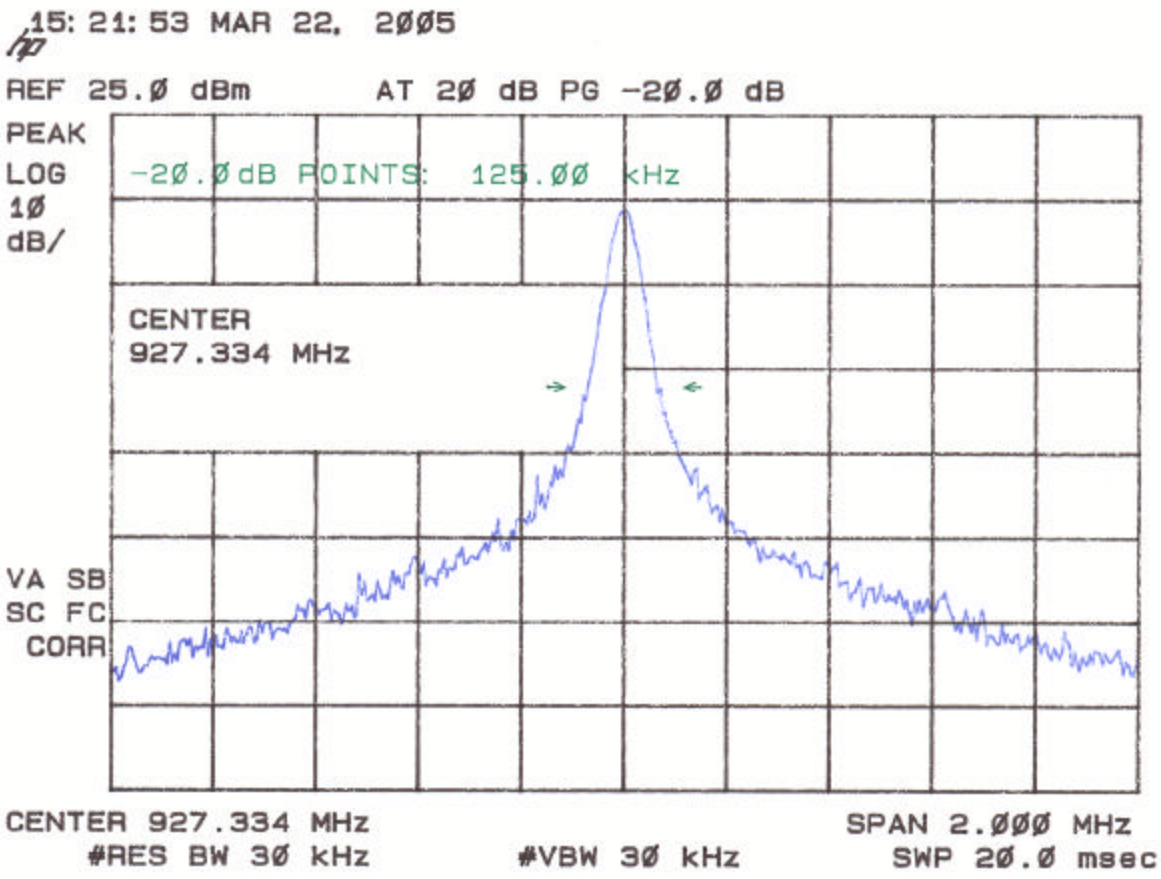


Figure 6c.
20 dB Bandwidth per FCC Section 15.247(a)(1)(ii) (High Channel)



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.

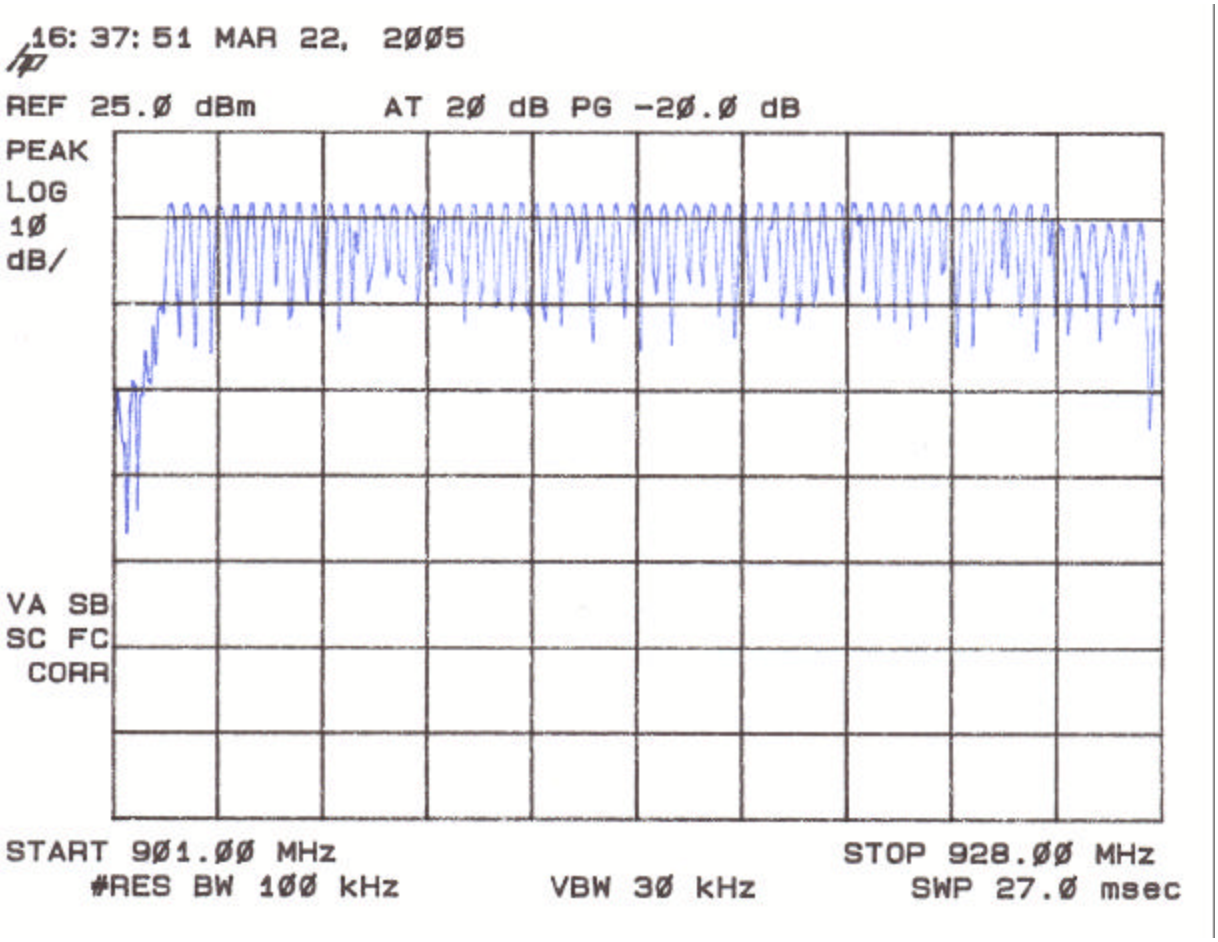
The results of this test are given in Table 7 and Figure 7.

TABLE 7

NUMBER OF HOPPING CHANNELS

Number of Hopping Frequencies Measured	FCC Limit (Minimum Number of Channels)
62	50

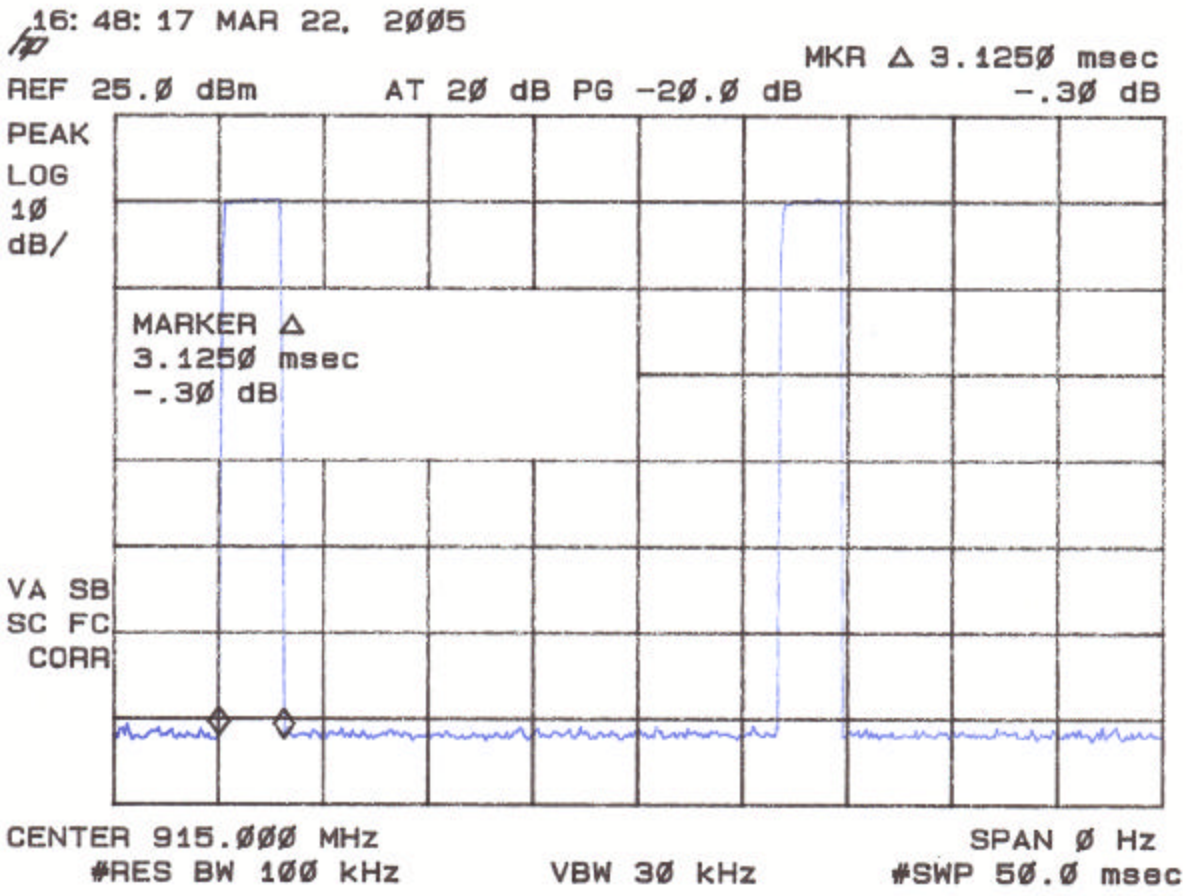
Figure 7
Number of Hopping Channels FCC Section 15.247(a)(1)(ii)



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 3.125 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 and the spectrum analyzer connected a LISN. The results are given in Tables 8a-8f.

TABLE 8a. CONDUCTED EMISSIONS DATA

CLASS B

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

Line Conducted Emissions							
Test By:	**Test:** Part 15 Phase vs. AVG limits				**Client:** Wireless Detection		
DPB	**Project:** 05-0071				**Model:** Smoke Detector Unit FWS-002		
Frequency (MHz)	**Test Data (dBm)**	**Test Data (dBuV)**	**AF+CA-AMP (dB)**	**Results (dBuV)**	**Limits (dBuV)**	**Margin (dB)**	**PK = n / QP**
0.18	-71.0	36.0	0.2	36.2	55.1	**18.9**	**PK**
0.198	-70.8	36.2	0.3	36.5	54.6	**18.1**	**PK**
0.228	-72.8	34.2	0.2	34.4	53.8	**19.4**	**PK**
9.832	-85.9	21.1	0.8	21.9	50.0	**28.1**	**PK**
19.663	-86.7	20.3	0.9	21.2	50.0	**28.8**	**PK**
29.493	-80.9	26.1	1.1	27.2	50.0	**22.8**	**PK**

SAMPLE CALCULATIONS: 36.0 + 0.2 = 36.2 dBuV

Test Date: March 21, 2005

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

TABLE 8b. CONDUCTED EMISSIONS DATA

CLASS B

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

Line Conducted Emissions							
Test By:	**Test:** Part 15 Neutral vs. AVG limits				**Client:** Wireless Detection		
DPB	**Project:** 05-0071				**Model:** Smoke Detector Unit FWS-002		
Frequency	**Test Data**	**Test Data**	**AF+CA-AMP**	**Results**	**Limits**	**Margin**	**PK = n**
(MHz)	**(dBm)**	**(dBuV)**	**(dB)**	**(dBuV)**	**(dBuV)**	**(dB)**	**/ QP**
0.18	-70.9	36.1	0.2	36.3	55.1	**18.8**	**PK**
0.198	-72.7	34.3	0.3	34.6	54.6	**20.0**	**PK**
0.228	-74.9	32.1	0.2	32.3	53.8	**21.5**	**PK**
9.832	-85.3	21.7	0.8	22.5	50.0	**27.5**	**PK**
19.663	-84.2	22.8	0.9	23.7	50.0	**26.3**	**PK**
29.493	-80.4	26.6	1.1	27.7	50.0	**22.3**	**PK**

SAMPLE CALCULATIONS: 36.1 + 0.2 = 36.3 dBuV

Test Date: March 21, 2005

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 Receive Mode)

CLASS B

Measurements 30 MHz – 1 GHz

Radiated Emissions							
Test By:	**Test:** Part 15 Digital device / Receive Mode				**Client:** Wireless Detection		
DPB	**Project:** 05-0071				**Model:** FWS-002		
Frequency	**Test Data**	**Test Data**	**AF+CA-AMP**	**Results**	**Limits**	**Margin**	**PK = n**
(MHz)	**(dBm)**	**(dBuV)**	**(dB)**	**(uV/m)**	**(uV/m)**	**(dB)**	**/ QP**
39.33	-88.2	18.8	12.0	34.9	100.0	**9.2**	**PK**
49.15	-85.0	22.0	11.4	46.7	100.0	**6.6**	**QP,PK=-85**
206.4	-90.0	17.0	15.2	40.7	200.0	**13.8**	**PK**
226.1	-88.4	18.6	15.0	47.9	200.0	**12.4**	**PK**
239.1	-91.6	15.4	15.6	35.6	200.0	**15.0**	**PK**
721.08	-92.0	15.0	28.2	145.3	200.0	**2.8**	**PK**
776.58	-94.0	13.0	28.6	119.6	200.0	**4.5**	**PK**

Test Date: **March 21, 2005**

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

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

CLASS B

Measurements 1 GHz – 5 GHz (PEAK)

Radiated Emissions								
Test By:	**Test:** Part 15 Digital device / Receive Mode					**Client:** Wireless Detection		
DPB	**Project:** 05-0071					**Model:** FWS-002		
Frequency	**Test Data**	**Test Data**	**AF+CA-AMP**	**Results**	**Limits**	**Distance /**	**Margin**	**PK = n**
(MHz)	**(dBm)**	**(dBuV)**	**(dB)**	**(uV/m)**	**(uV/m)**	**Polarity**	**(dB)**	**/ QP**
NO EMISSIONS DETECTED WITHIN 20 dB OF THE FCC LIMIT								

Test Date: **March 21, 2005**

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

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

CLASS B

Measurements 1 GHz – 5 GHz (AVERAGE)

Radiated Emissions								
Test By:	**Test:** Part 15 Digital device / Receive Mode					**Client:** Wireless Detection		
DPB	**Project:** 05-0071					**Model:** FWS-002		
Frequency	**Test Data**	**Test Data**	**AF+CA-AMP**	**Results**	**Limits**	**Distance /**	**Margin**	**PK = n**
(MHz)	**(dBm)**	**(dBuV)**	**(dB)**	**(uV/m)**	**(uV/m)**	**Polarity**	**(dB)**	**/ QP**
NO EMISSIONS DETECTED WITHIN 20 dB OF THE FCC LIMIT								

Test Date: **March 21, 2005**

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 8a and 8b.**

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 SEPARTAION

Channel Separation	FCC Limit (Minimum)
410 kHz	25 kHz, 20 dB Bandwidth

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