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 – 5g. Due to the functionality of the transmitter and the complexity of the test setup in order to measure worse case duty cycle, Digital Wireless provided an explanation of the worse case duty cycle of the transmitter (provided on the following pages).

Worst Case Transmit Duty Cycle for WIT2410

The duty cycle de-rating factor used in the calculation of average radiated limits (per 15.209) is described below. This factor was calculated by first determining the worst case scenario for system operation - worst case being defined as the scenario when the WIT2410 would be transmitting the longest period during a dwell.

This worst case operating scenario is as follows:

1) point-to-point operation
(only two units communicating with one another)

2) data flow is almost completely unidirectional
(that is, one radio is relaying a large amount of data to the other radio with only synchronization data being passed back the other direction)

3) The amount of data being fed to the sending radio is exactly portioned out to fit the maximum packet size allowable (280 bytes). The radio cannot send more than 280 bytes on a single channel – additional data must be sent on the next hop.

For this example, a remote unit is transferring a large data file to a base unit.

Maximum transmit time by Remote on a single channel:

= 280 bytes * 8 bits/byte * (1/460.8Kbps) = 4.86ms

The minimum hop duration for this scenario would be 6.94ms. Given that we have 75 channels in our hop set, it takes 521ms to go through the entire hop table and repeat a transmission on the same channel. Therefore, only 4.86milliseconds worth of data can be transmitted on a single channel in any 100ms time period.

The transmission duty cycle correction factor is then calculated as:

$$20 * \text{Log}_{10}(4.86\text{ms}/100\text{ms}) = \mathbf{-26.3\ dB}$$

Table 5A. AVERAGE RADIATED SPURIOUS EMISSIONS (Low End)
Ace Dipole Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
7.20450	-76.16	34.5	36.9	7.8	113.4	500

Table 5A. AVERAGE RADIATED SPURIOUS EMISSIONS (Middle)
Ace Dipole Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.87105	-87.75	34.3	34.7	8.1	24.3	500
7.30700	-77.65	34.6	37.2	7.9	98..0	500

Table 5A. AVERAGE RADIATED SPURIOUS EMISSIONS (High End)
Ace Dipole Antenna

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.93995	-85.05	34.3	34.8	8.2	34.3	500
7.41055	-80.43	34.6	37.4	7.9	73.1	500

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-76.16 – 34.5 + 36.9 + 7.8 + 107)/20) = 113.4
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Roger Bowen

Table 5B. AVERAGE RADIATED SPURIOUS EMISSIONS (Low End)
DWC 3dBi Patch Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
7.20465	-78.25	34.5	37.0	7.8	89.1	500

Table 5B. AVERAGE RADIATED SPURIOUS EMISSIONS (Middle)
DWC 3 dBi Patch Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.87105	-93.08	34.3	34.7	8.1	13.1	500
7.30710	-80.42	34.6	37.2	7.9	71.2	500

Table 5B. AVERAGE RADIATED SPURIOUS EMISSIONS (High End)
DWC 3 dBi Patch Antenna

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.93980	-87.61	34.3	34.8	8.2	25.5	500
7.41055	-81.61	34.6	37.4	7.9	62.7	500

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-78.25 – 34.5 + 37.0 + 7.8 + 107)/20) = 89.1
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Roger Bowen

Table 5C. AVERAGE SPURIOUS EMISSIONS (Low End)
Mobile Mark Patch Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.80356	-86.18	34.3	34.6	7.9	28.2	500
7.20459	-78.19	34.5	37.0	7.8	89.7	500

Table 5C. AVERAGE RADIATED SPURIOUS EMISSIONS (Middle)
Mobile Mark Patch Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.87210	-84.75	34.3	34.7	8.1	34.3	500
7.30720	-79.35	34.5	37.0	7.8	78.6	500

Table 5C. AVERAGE RADIATED SPURIOUS EMISSIONS (High End)
Mobile Mark Patch Antenna

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.93960	-86.03	34.3	34.8	8.2	30.6	500
7.40930	-77.65	34.6	37.4	7.9	100.6	500

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-86.18 - 34.3 + 34.6 + 7.9 + 107)/20) = 28.2
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Roger Bowen

Table 5D. AVERAGE RADIATED SPURIOUS EMISSIONS (Low End)
6dB OMNI Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
7.20585	-79.44	34.5	37.0	7.8	77.7	500

Table 5D. AVERAGE RADIATED SPURIOUS EMISSIONS (Middle)
6dB OMNI Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.87200	-85.61	34.3	34.7	8.1	31.1	500
7.30735	-82.02	34.6	37.2	7.9	59.3	500

Table 5D. AVERAGE RADIATED SPURIOUS EMISSIONS (High End)
6dB OMNI Antenna

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.93970	-91.29	34.3	34.8	8.2	16.7	500
7.40950	-80.84	34.6	37.4	7.9	69.7	500

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-79.44 - 34.5 + 37.0 + 7.8 + 107)/20) = 77.7
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Roger Bowen

Table 5E. AVERAGE RADIATED SPURIOUS EMISSIONS (Low End)
12dB OMNI Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
7.20570	-81.09	34.5	37.0	7.8	64.3	500

Table 5E. AVERAGE RADIATED SPURIOUS EMISSIONS (Middle)
12dB OMNI Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.87145	-83.40	34.3	34.7	8.1	40.1	500
7.30840	-91.93	34.6	37.2	7.9	59.9	500

Table 5E. AVERAGE RADIATED SPURIOUS EMISSIONS (High End)
12dB OMNI Antenna

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.93980	-93.10	34.3	34.8	8.2	13.6	500
7.41025	-78.78	34.6	37.4	7.9	88.3	500

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-81.09 - 34.5 + 37.0 + 7.8 + 107)/20) = 64.3
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Roger Bowen

Table 5F. AVERAGE RADIATED SPURIOUS EMISSIONS (Low End)
14dBi Corner Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
7.20465	-76.88	34.5	37.0	7.8	104.4	500

Table 5F. AVERAGE RADIATED SPURIOUS EMISSIONS (Middle)
14dBi Corner Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.87250	-86.16	34.3	34.7	8.1	29.2	500
7.30815	-79.61	34.6	37.2	7.9	78.2	500

Table 5F. AVERAGE RADIATED SPURIOUS EMISSIONS (High End)
14dBi Corner Antenna

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.93960	-90.73	34.3	34.8	8.2	17.8	500
7.40940	-81.26	34.6	37.4	7.9	66.4	500

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-76.88 - 34.5 + 37.0 + 7.8 + 107)/20) = 104.4
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Roger Bowen

Table 5G. AVERAGE RADIATED SPURIOUS EMISSIONS (Low End)

14dB YAGI Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
7.20565	-81.59	34.5	37.0	7.8	60.7	500

Table 5G. AVERAGE RADIATED SPURIOUS EMISSIONS (Middle)
14dB YAGI Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.87201	-84.57	34.3	34.7	8.1	35.0	500
7.30694	-82.25	34.6	37.2	7.9	57.7	500

Table 5G. AVERAGE RADIATED SPURIOUS EMISSIONS (High End)
14dB YAGI Antenna

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.93960	-90.02	34.3	34.8	8.2	19.3	500
7.41010	-81.31	34.6	37.4	7.9	66.0	500

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-81.59 - 34.5 + 37.0 + 7.8 + 107)/20) = 60.7
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Roger Bowen

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

Test Date: **April 30, 1999**
UST Project: **99-317**
Customer: **Digital Wireless Corporation**
Model: **WIT2410**

Frequency (GHz)	20 dB Bandwidth (MHz)	MAXIMUM FCC LIMIT (MHz)
2.407	0.850	1.0
2.441	0.750	1.0
2.475	0.750	1.0

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

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

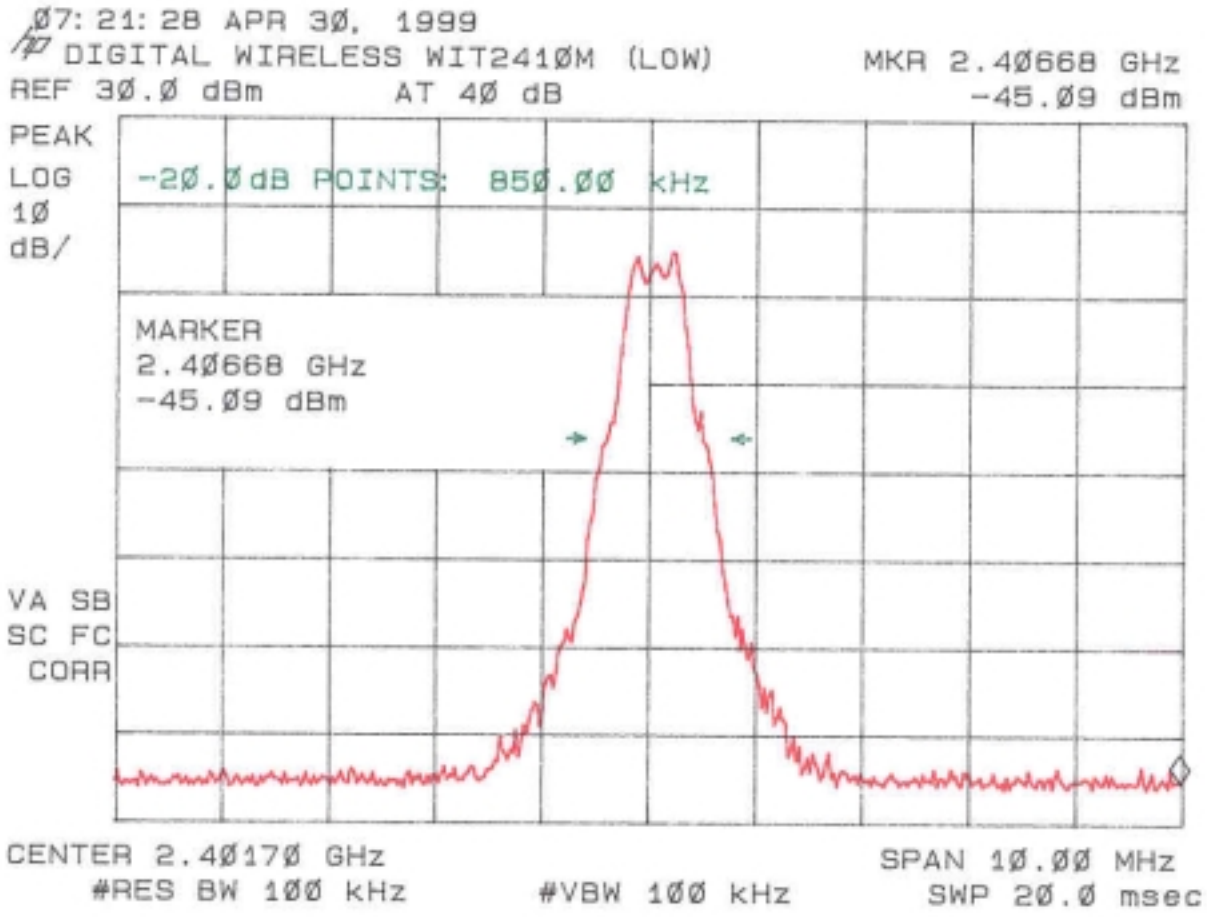


Figure 6b.
20 dB Bandwidth per FCC Section 15.247(a)(1)(ii) (Mid)

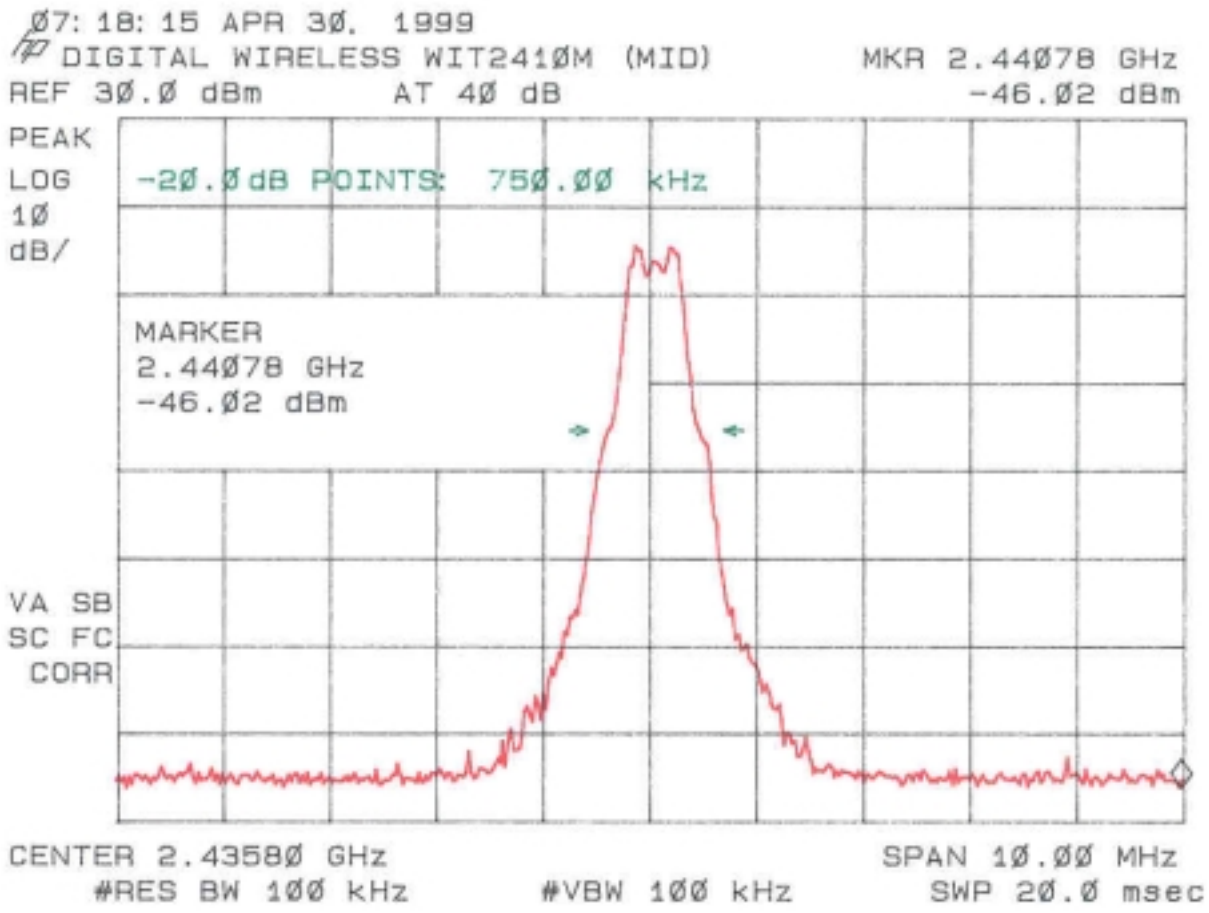
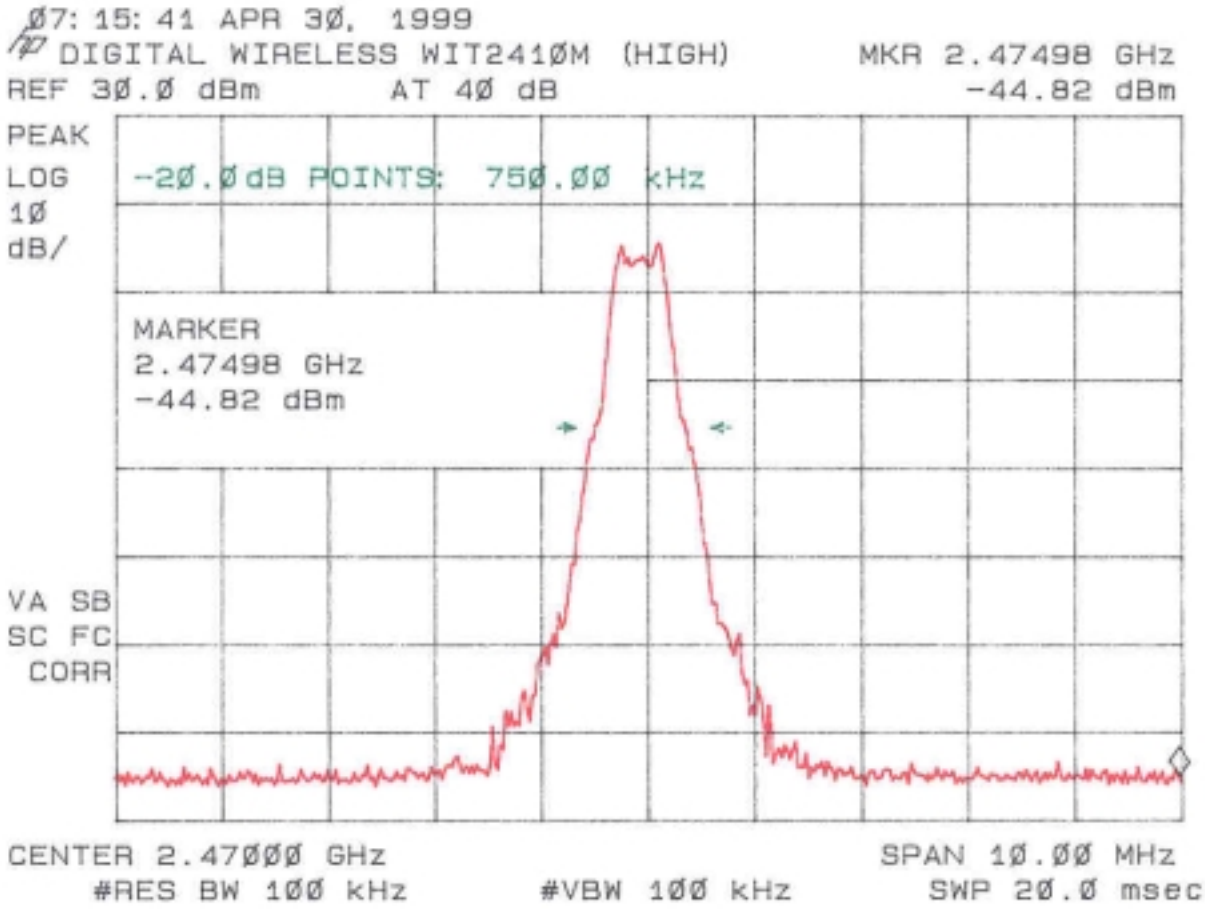


Figure 6c.
20 dB Bandwidth per FCC Section 15.247(a)(1)(ii) (High)



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 2400 – 2483.5 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.

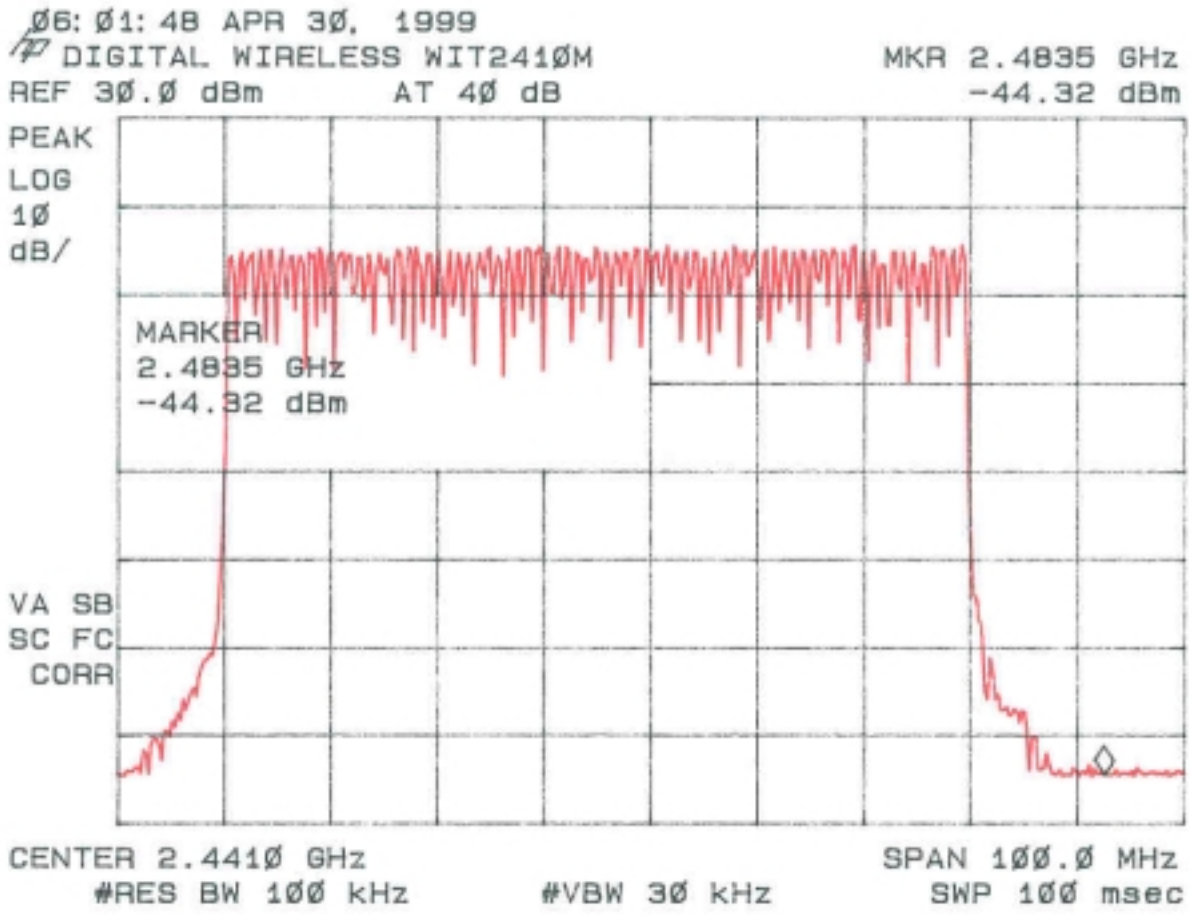
TABLE 7
NUMBER OF HOPPING CHANNELS

Test Date: **April 30, 1999**
UST Project: **99-317**
Customer: **Digital Wireless Corporation**
Model: **WIT2410**

Number of Hopping Frequencies Measured	FCC Limit (Minimum Number of Channels)
75	75

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

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)

Please refer to the theory of operation portion of the report for this.

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: April 26, 1999
UST Project: 99-317
Customer: Digital Wireless
Model: WIT 2410M

Worse Case Mode of Operaton (TX – Low channel)

FREQUENCY (MHz)	TEST DATA (dBm)		RESULTS (uV)		FCC LIMITS (uV)
	PHASE	NEUTRAL	PHASE	NEUTRAL	
0.455	-63.0*	-62.0*	158.5	177.8	250
1.42	-74.0*	-78.0*	44.7	28.2	250
7.45	-84.0*	-83.0*	14.1	15.8	250
11.4	-78.0*	-81.0*	28.2	20.0	250
15.9	-79.0*	-72.0*	25.1	56.2	250
17.6	-81.0*	-81.0*	20.0	20.0	250
22.7	-81.0*	-80.0*	20.0	22.4	250
26.5	-68.0*	-68.0*	89.1	89.1	250

* = QUASI PEAK

SAMPLE CALCULATION:

RESULTS uV = Antilog ((-63.0 + 107)/20) = 158.5
CONVERSION FROM dBm TO dBuV = 107 dB

Test Results Reviewed By
Signature: _____ **Name:** **Tim Johnson**

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

Radiated emissions were evaluated from 30 to 5000 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 9. RADIATED EMISSIONS DATA
(Digital Device & Receiver)

CLASS B

Test Date: April 26, 1999
UST Project: 99-317
Customer: Digital Wireless Corporation
Product: WIT2410

Frequency (MHz)	Receiver Reading (dBm) @3m	Correction Factor (dB)	Corrected Reading (uV/m)	FCC Limit (uV/m) @3m
No Emissions seen within 10 dB of the FCC limit				

*= Quasi Peak

SAMPLE CALCULATIONS:

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

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.