

2.6 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 3a –3d and Figure 5a – Figure 5x.

Table 3a. PEAK RADIATED SPURIOUS EMISSIONS (Low)
Mobile Mark 2.5 dBi Vehicle Mount Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.803	-56.95	33.9	34.5	3.4	508.1	5000.0
7.205	-46.79	33.7	37.4	4.7	2689.1	5000.0

Table 3a. PEAK RADIATED SPURIOUS EMISSIONS (Middle)
Mobile Mark 2.5 dBi Vehicle Mount Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.871	-60.12	33.9	34.7	3.4	361.7	5000.0
7.307	-50.89	33.7	37.4	4.7	1685.2	5000.0

Table 3a. PEAK RADIATED SPURIOUS EMISSIONS (High)
Mobile Mark 2.5 dBi Vehicle Mount Antenna

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.939	-55.86	33.9	34.9	3.5	605.7	5000.0
7.410	-45.66	33.7	37.5	4.7	3091.7	5000.0

* - Data corrected by 1 dB for loss of high pass filter

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) = Antilog $((-56.95 - 33.9 + 34.9 + 3.5 + 107)/20)$ = 508.1

CONVERSION FROM dBm TO dBuV = 107 dB

Tester

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Table 3b. PEAK RADIATED SPURIOUS EMISSIONS (Low)
Mobile Mark 9 dBi Corner Reflector Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.803	-56.71	33.9	34.5	3.4	522.4	5000.0
7.205	-50.35	33.7	37.4	4.7	1784.8	5000.0

Table 3b. PEAK RADIATED SPURIOUS EMISSIONS (Middle)
Mobile Mark 9 dBi Corner Reflector Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.871	-59.69	33.9	34.7	3.4	380.1	5000.0
7.307	-51.52	33.7	37.4	4.7	1567.3	5000.0

Table 3b. PEAK RADIATED SPURIOUS EMISSIONS (High)
Mobile Mark 9 dBi Corner Reflector Antenna

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.939	-53.55	33.9	34.9	3.5	790.2	5000.0
7.410	-46.97	33.7	37.5	4.7	2658.9	5000.0

* - Data corrected by 1 dB for loss of high pass filter

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) = Antilog $((-56.71 - 33.9 + 34.5 + 3.4 + 107)/20)$ = 522.4

CONVERSION: BuV = 107 dB

Tester

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Table 3c. PEAK RADIATED SPURIOUS EMISSIONS (Low)
MaxRad 5 dBi Whip Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.803	-56.66	33.9	34.5	3.4	525.4	5000.0
7.205	-48.72	33.7	37.4	4.7	2153.3	5000.0

Table 3c. PEAK RADIATED SPURIOUS EMISSIONS (Middle)
MaxRad 5 dBi Whip Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.871	-59.31	33.9	34.7	3.4	397.1	5000.0
7.307	-53.16	33.7	37.4	4.7	1297.6	5000.0

Table 3c. PEAK RADIATED SPURIOUS EMISSIONS (High)
MaxRad 5 dBi Whip Antenna

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.939	-55.33	33.9	34.9	3.5	629.1	5000.0
7.410	-47.53	33.7	37.5	4.7	2492.9	5000.0

* - Data corrected by 1 dB for loss of high pass filter

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) = Antilog $((-56.66 - 33.9 + 34.5 + 3.4 + 107)/20)$ = 525.4

CONVERSION FROM dBm TO uV/m = 107 dB

Tester

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Table 3d. PEAK RADIATED SPURIOUS EMISSIONS (Low)
Andrews 24 dBi Parabolic Dish Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.803	-60.44	33.9	34.5	3.4	340.0	5000.0
7.205	-50.98	33.7	37.4	4.7	1660.0	5000.0

Table 3d. PEAK RADIATED SPURIOUS EMISSIONS (Middle)
Andrews 24 dBi Parabolic Dish Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.871	-63.16	33.9	34.7	3.4	254.9	5000.0
7.307	-51.75	33.7	37.4	4.7	1526.3	5000.0

Table 3d. PEAK RADIATED SPURIOUS EMISSIONS (High)
Andrews 24 dBi Parabolic Dish Antenna

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.939	-49.74	33.9	34.9	3.5	1225.3	5000.0
7.410	-45.23	33.7	37.5	4.7	3248.6	5000.0

* - Data corrected by 1 dB for loss of high pass filter

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) = Antilog $((-60.44 - 33.9 + 34.5 + 3.4 + 107)/20)$ = 340.0

CONVERSION FROM dBm TO dBuV = 107 dB

Tester

Signature:  Name: Sam Wismer

Figure 3a
Peak Radiated Spurious Emission 15.247(c) Low – Mobile Mark 2.5 dBi Vehicle Mount

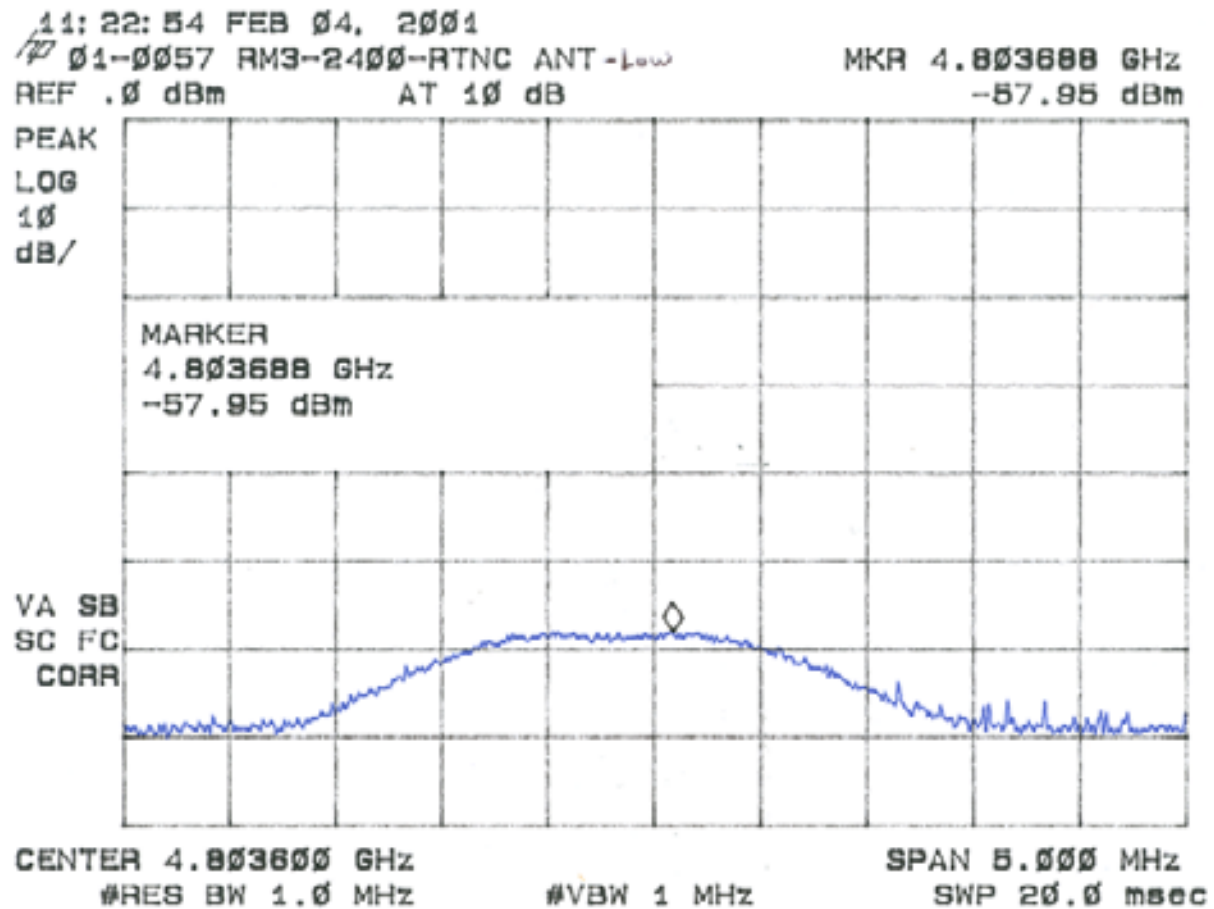


Figure 3b

Peak Radiated Spurious Emission 15.247(c) Low – Mobile Mark 2.5 dBi Vehicle Mount

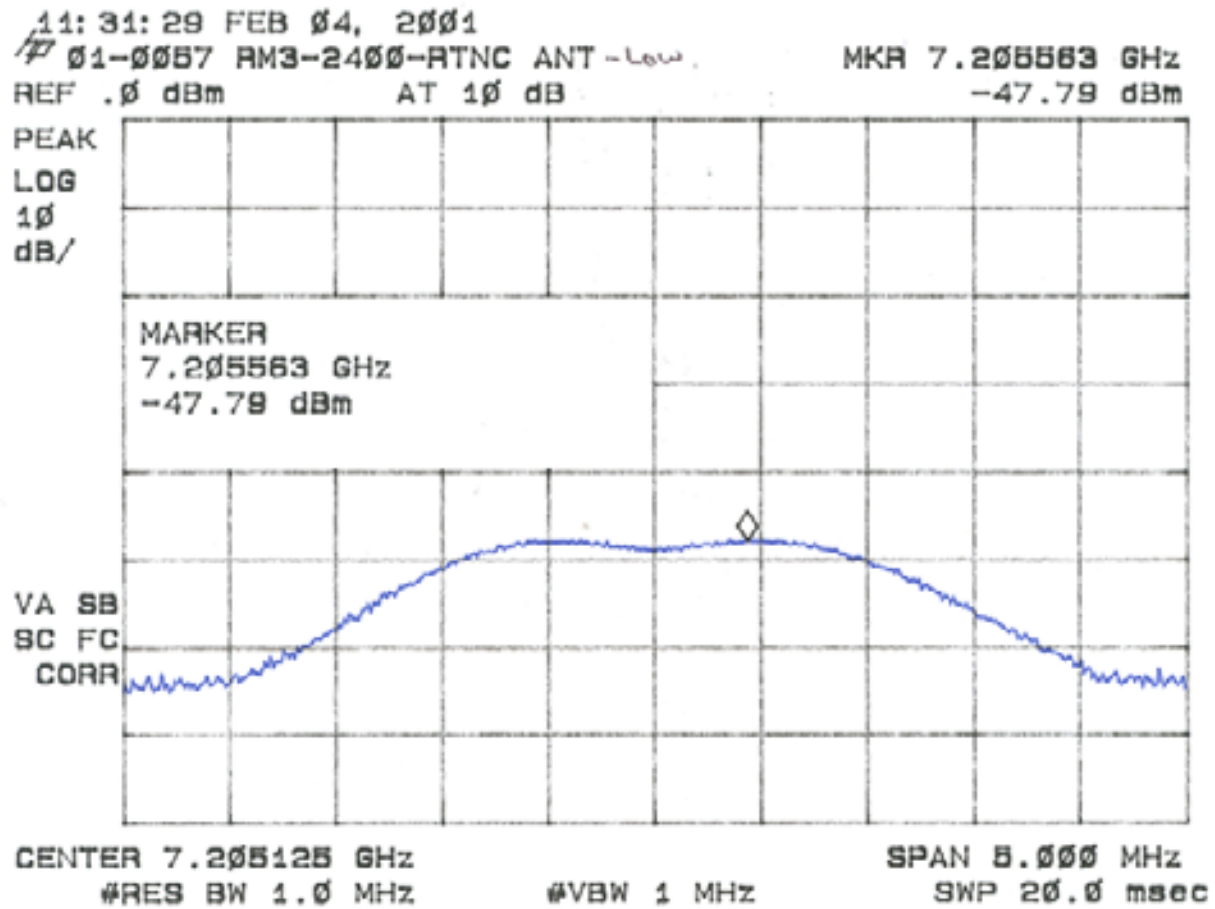


Figure 3c
Peak Radiated Spurious Emission 15.247(c) Mid – Mobile Mark 2.5 dBi Vehicle Mount

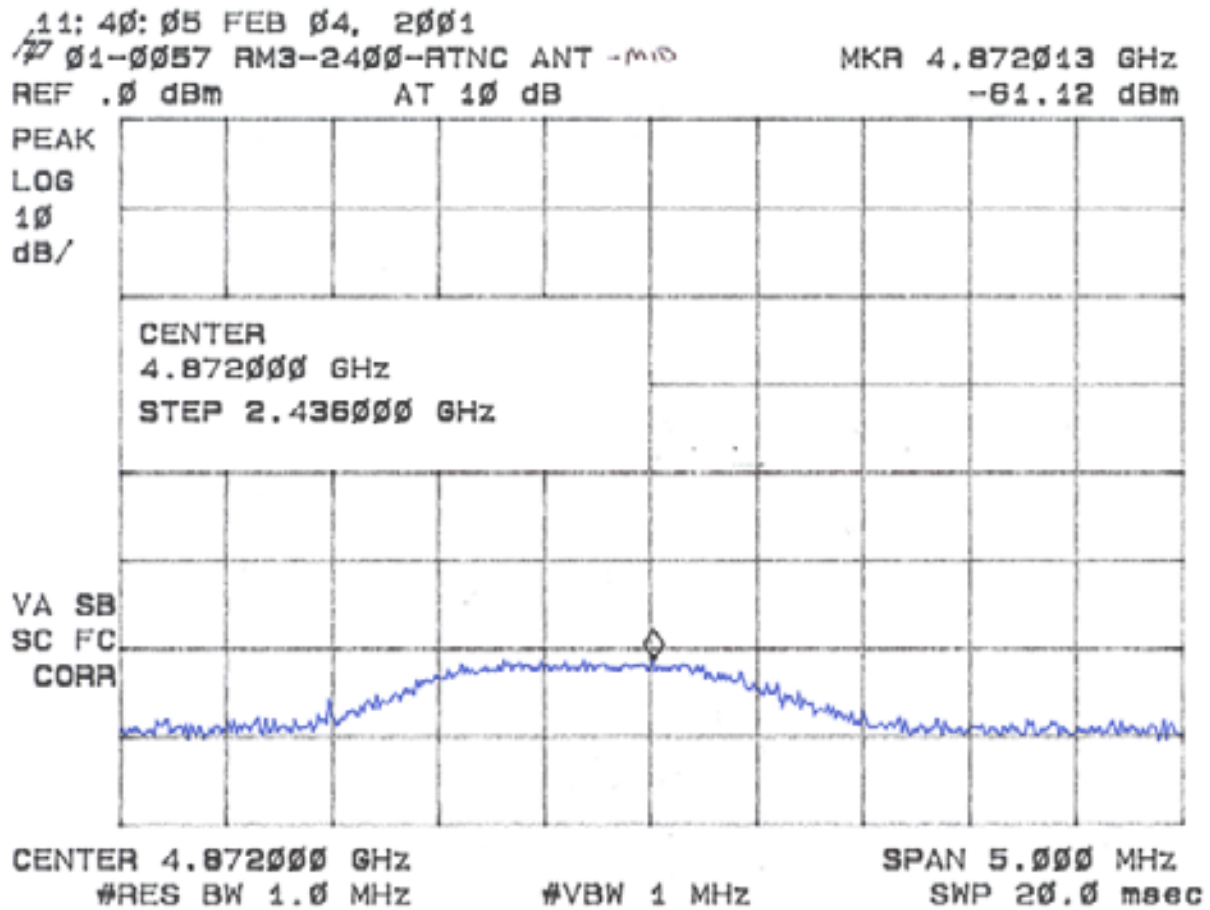


Figure 3d

Peak Radiated Spurious Emission 15.247(c) Mid – Mobile Mark 2.5 dBi Vehicle Mount

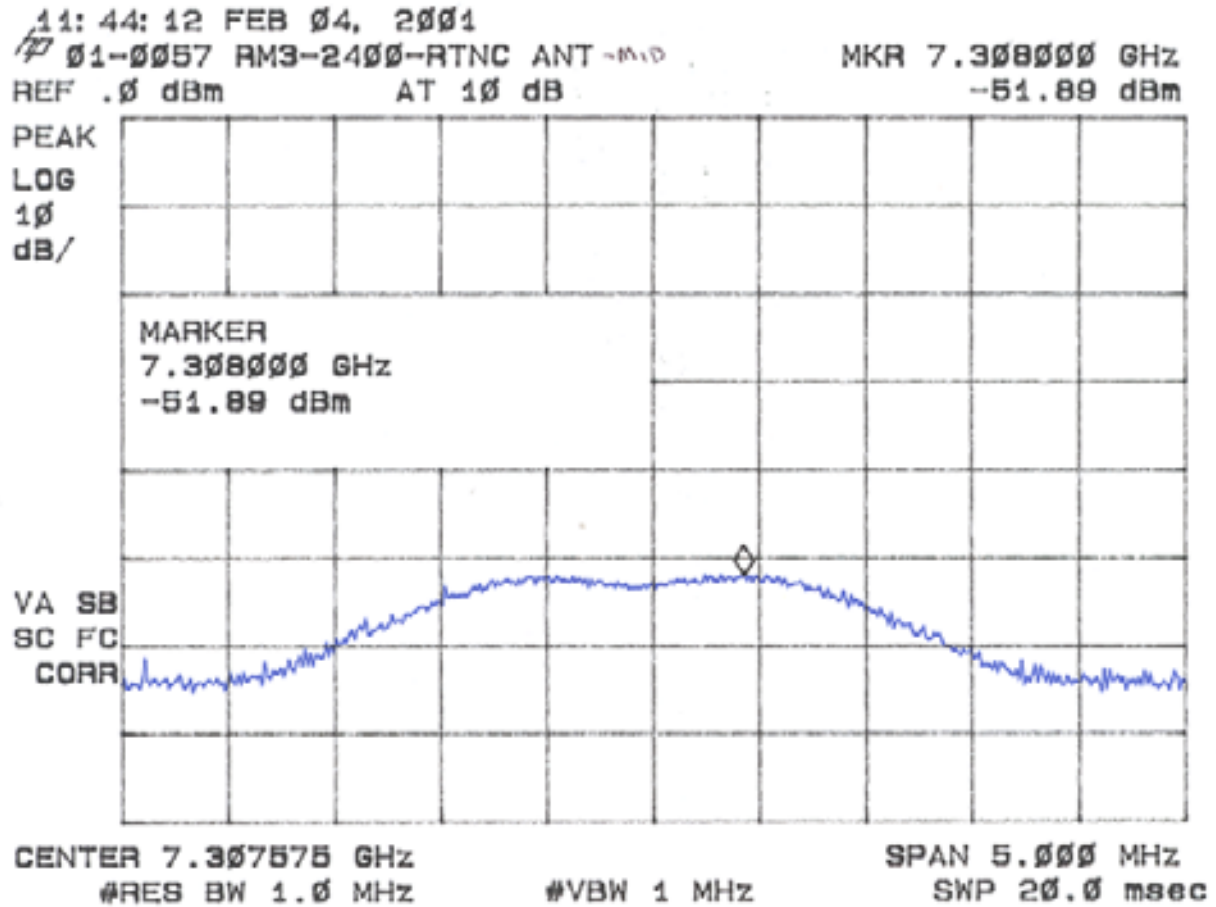


Figure 3e
Peak Radiated Spurious Emission 15.247(c) High– Mobile Mark 2.5 dBi Vehicle Mount

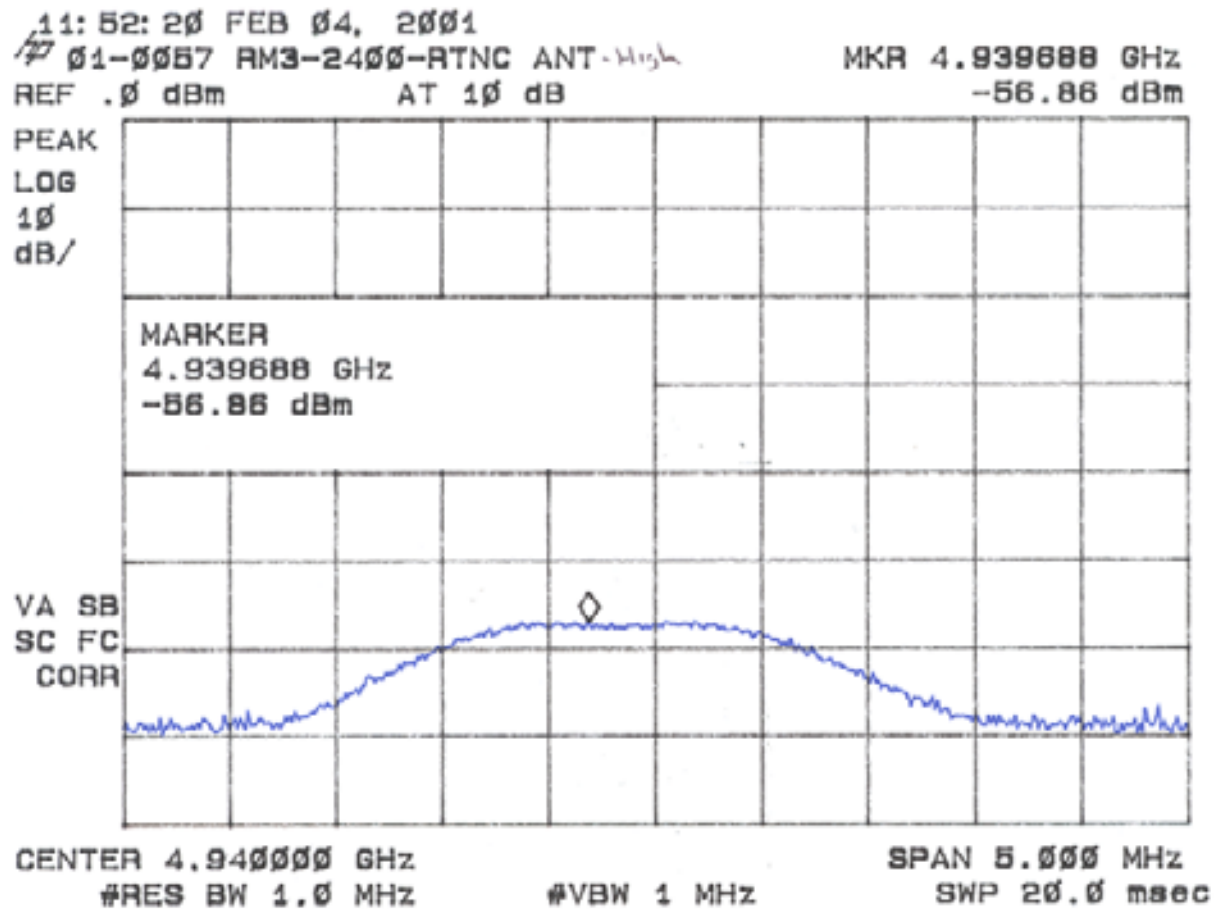


Figure 3f
Peak Radiated Spurious Emission 15.247(c) High– Mobile Mark 2.5 dBi Vehicle Mount

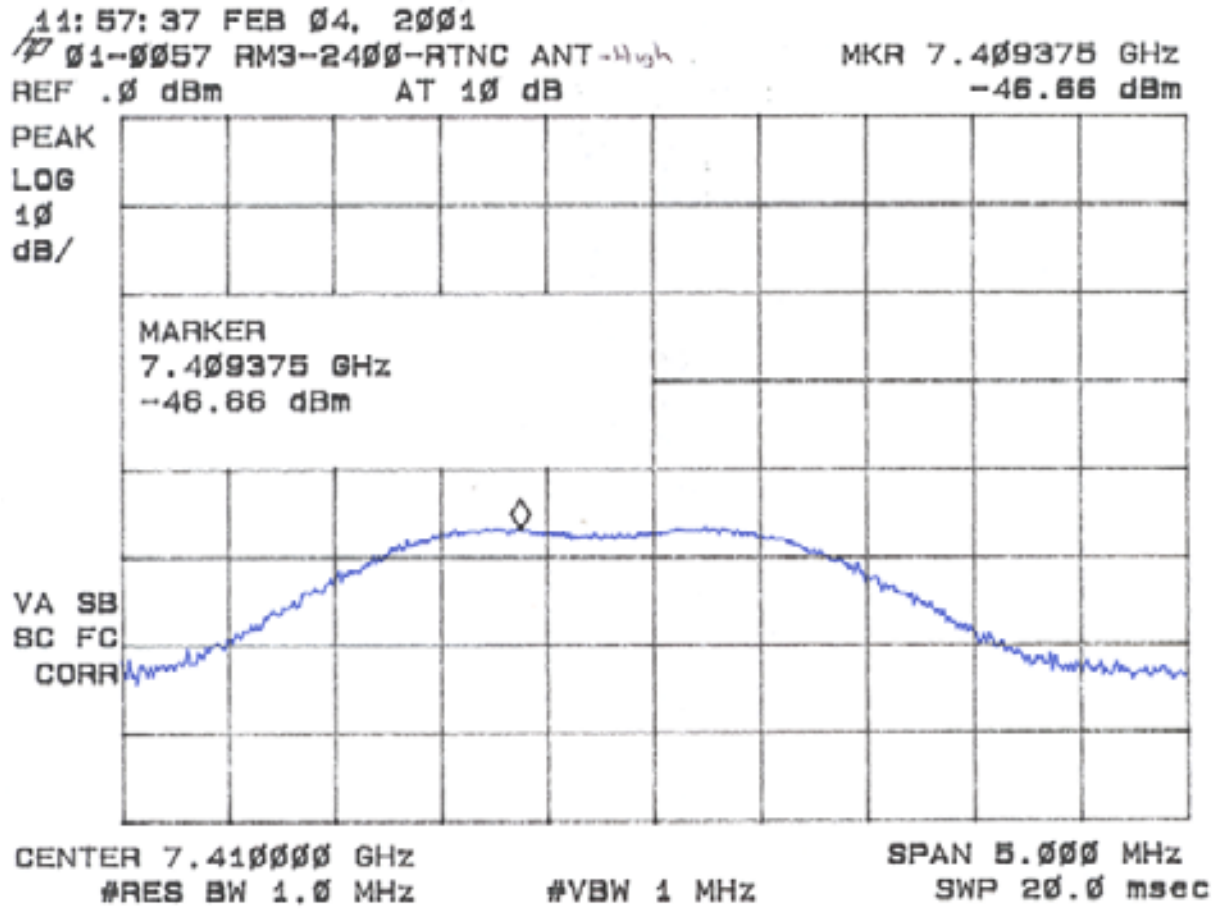


Figure 3g
Peak Radiated Spurious Emission 15.247(c) Low – Mobile Mark 9 dBi Corner Reflector

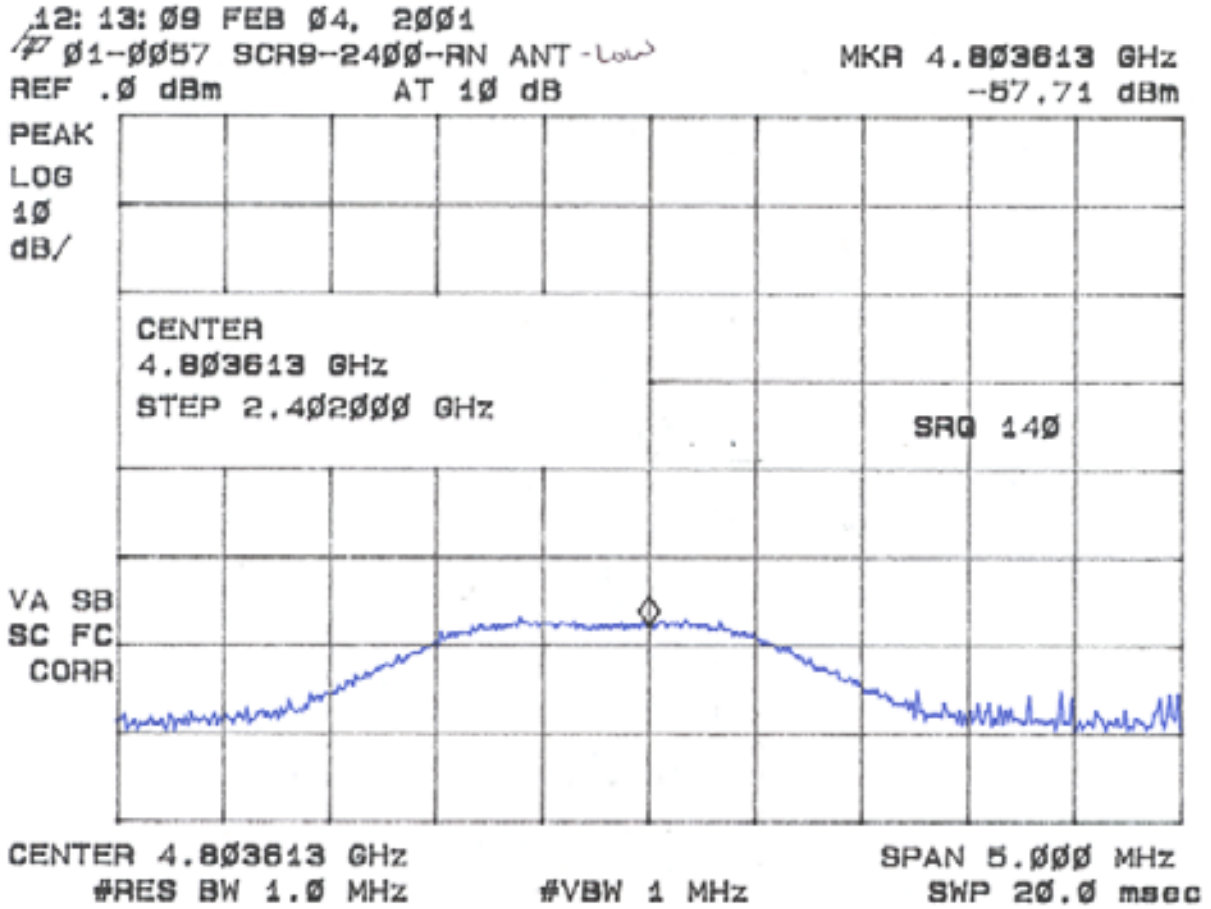


Figure 3h
Peak Radiated Spurious Emission 15.247(c) Low – Mobile Mark 9 dBi Corner Reflector

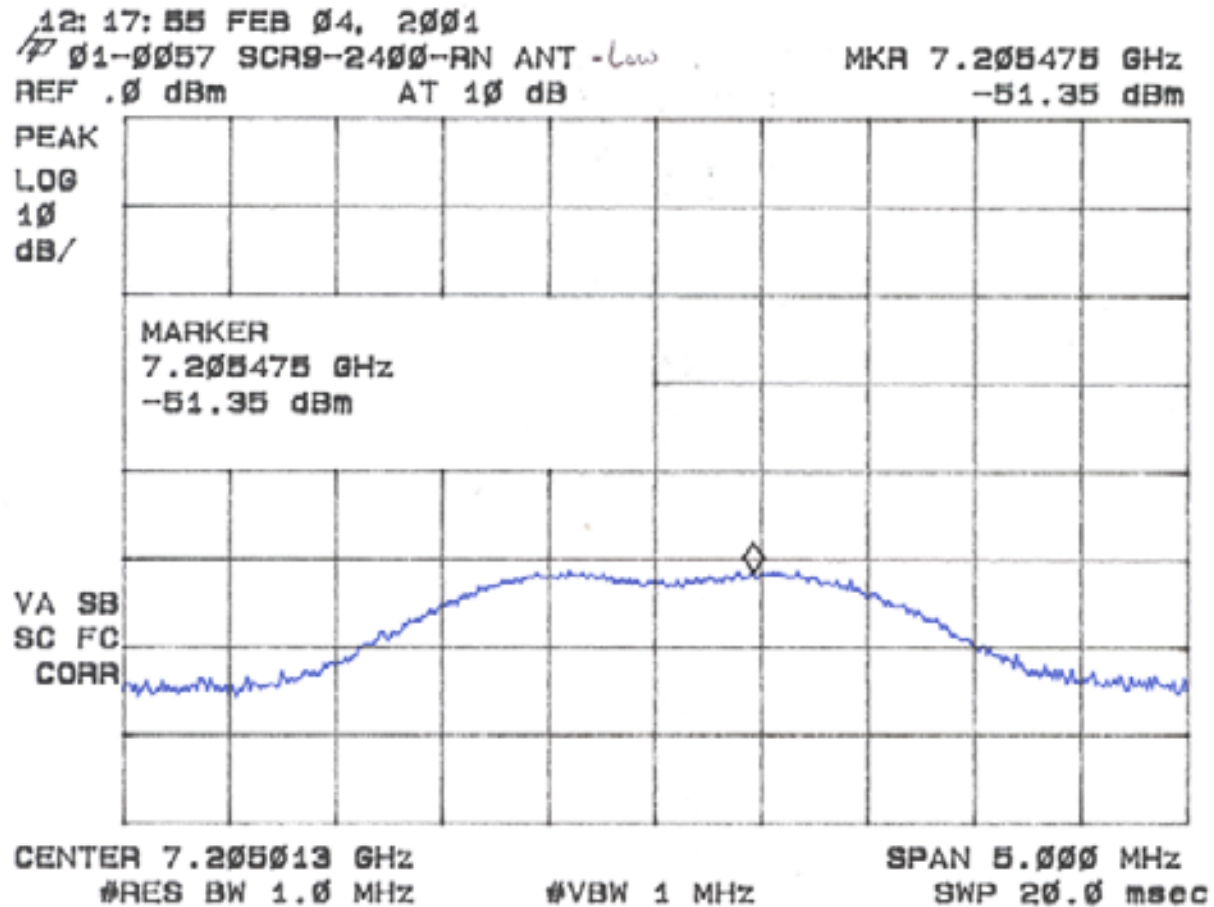


Figure 3i

Peak Radiated Spurious Emission 15.247(c) Mid – Mobile Mark 9 dBi Corner Reflector

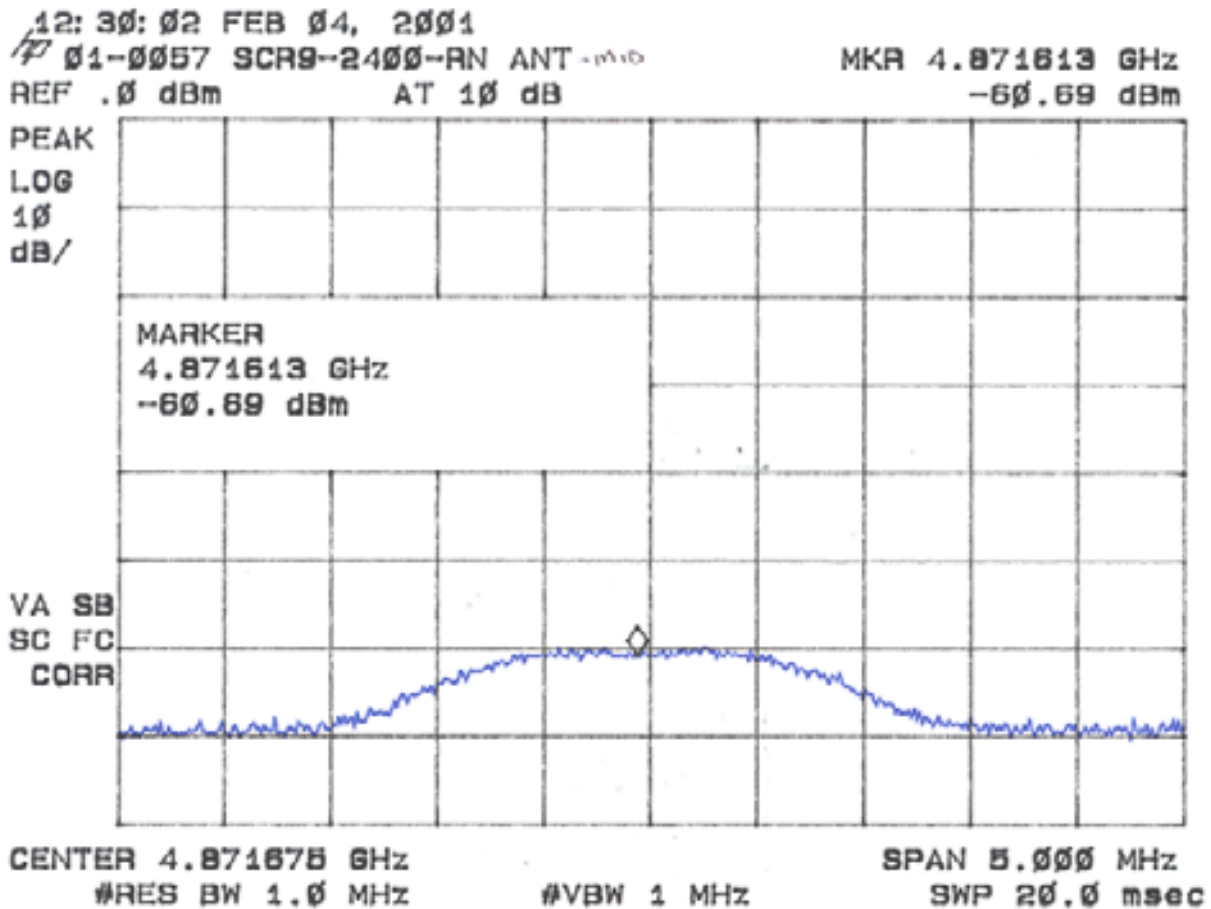


Figure 3j

Peak Radiated Spurious Emission 15.247(c) Mid – Mobile Mark 9 dBi Corner Reflector

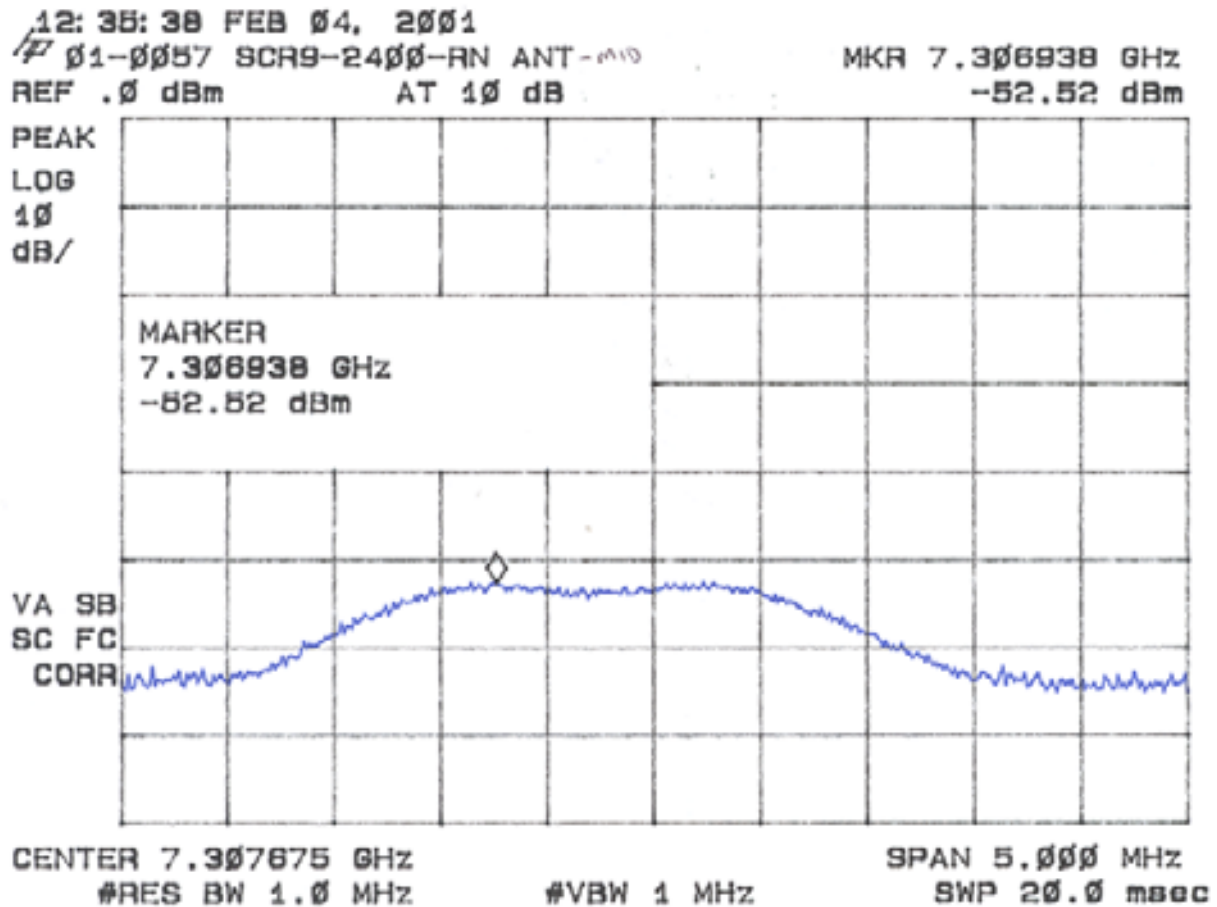


Figure 3k
Peak Radiated Spurious Emission 15.247(c) High– Mobile Mark 9 dBi Corner Reflector

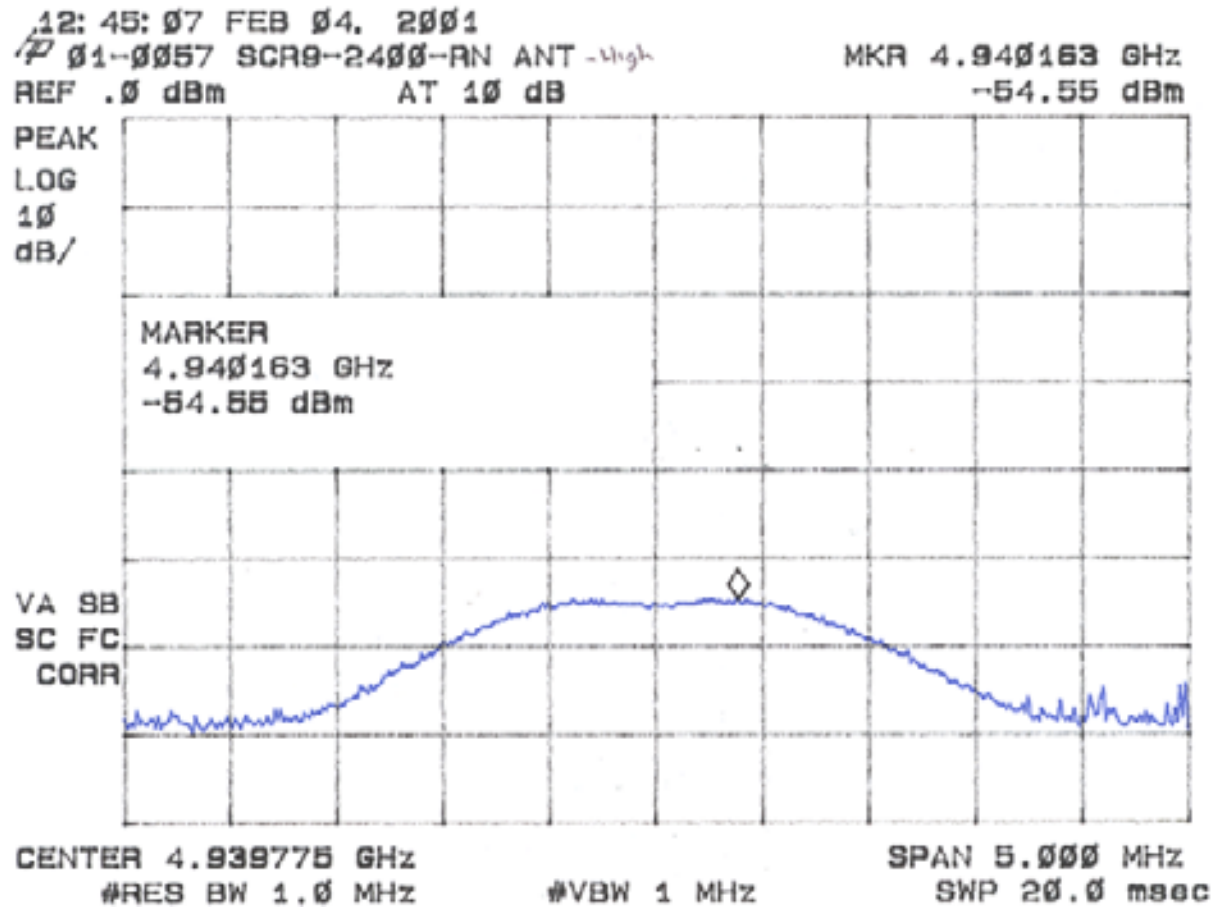


Figure 3l
Peak Radiated Spurious Emission 15.247(c) High– Mobile Mark 9 dBi Corner Reflector

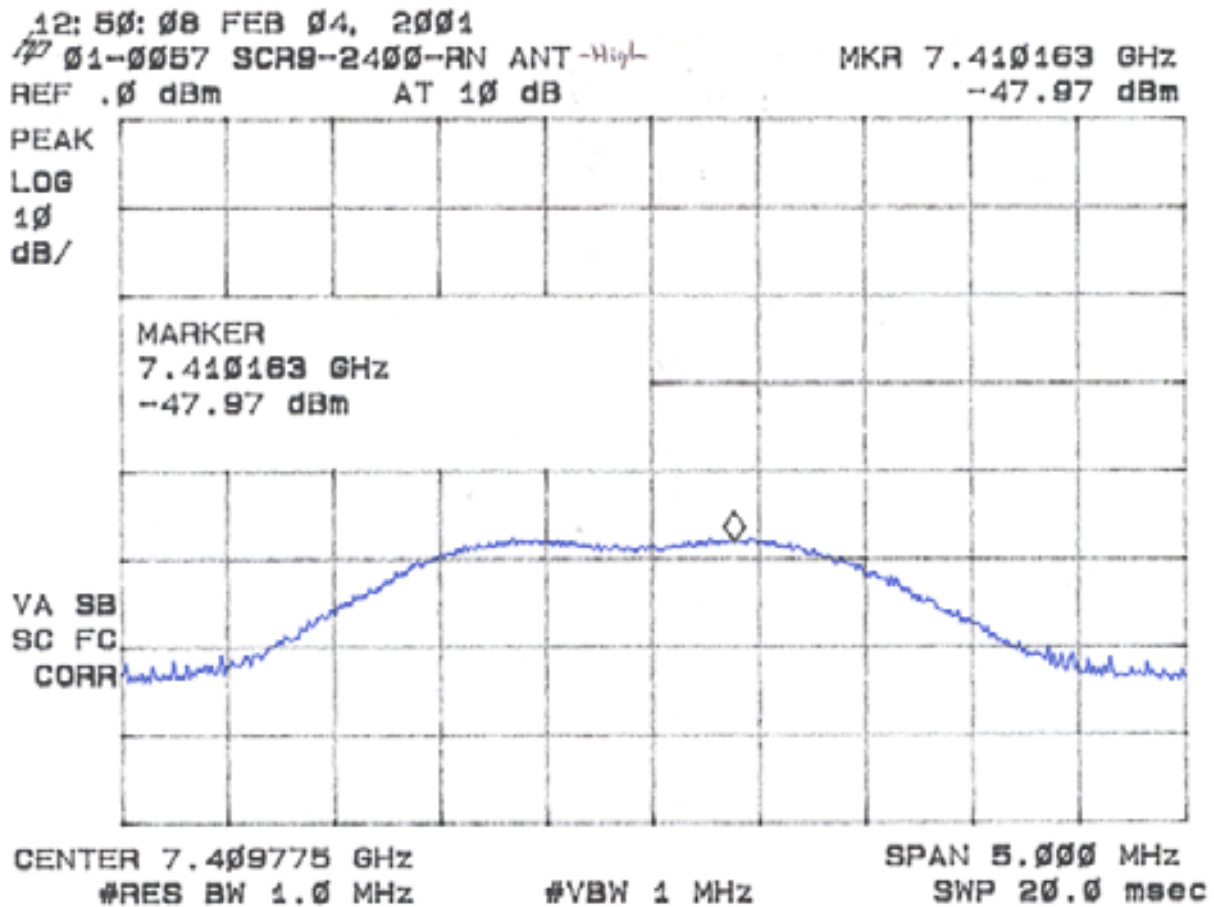


Figure 3m
Peak Radiated Spurious Emission 15.247(c) Low – MaxRad 5 dBi Whip

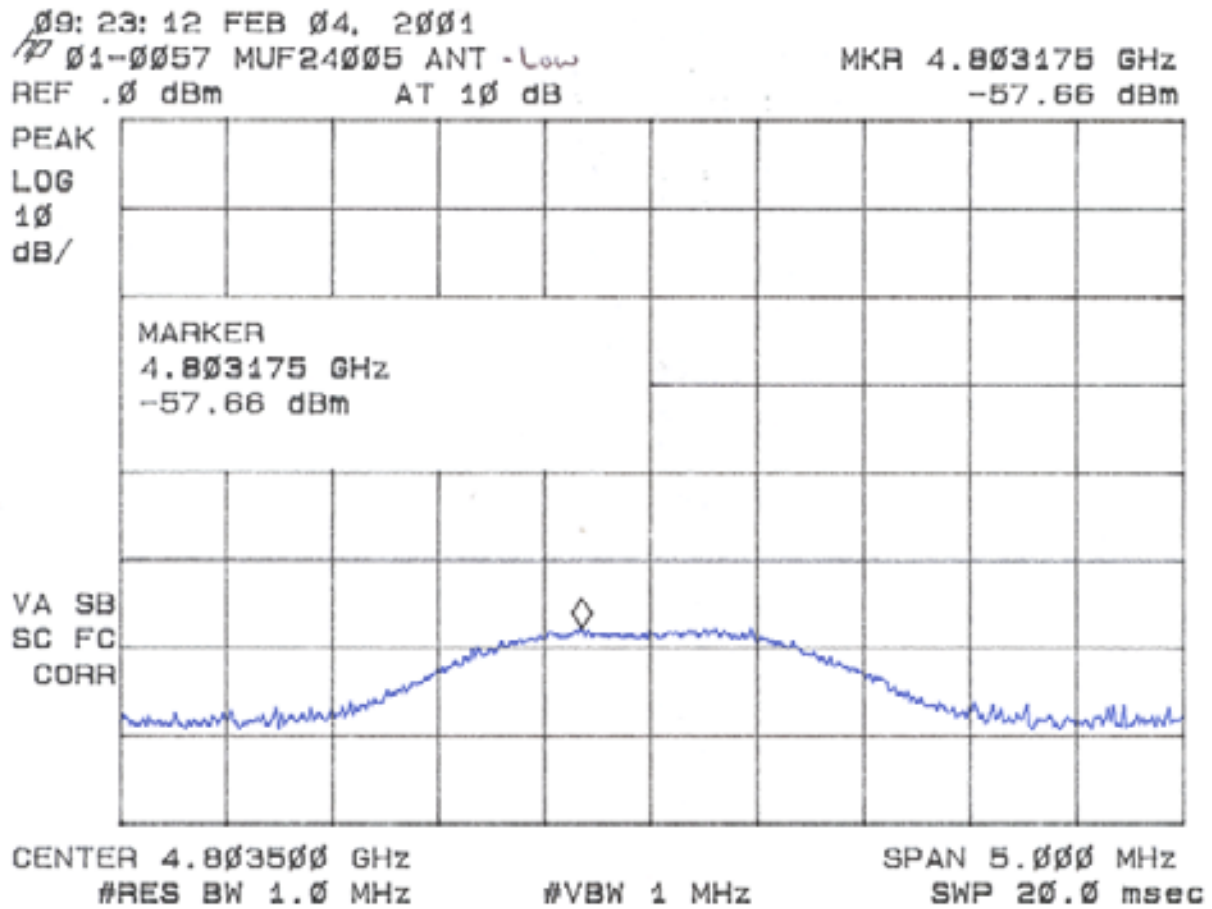


Figure 3n
Peak Radiated Spurious Emission 15.247(c) Low – MaxRad 5 dBi Whip \

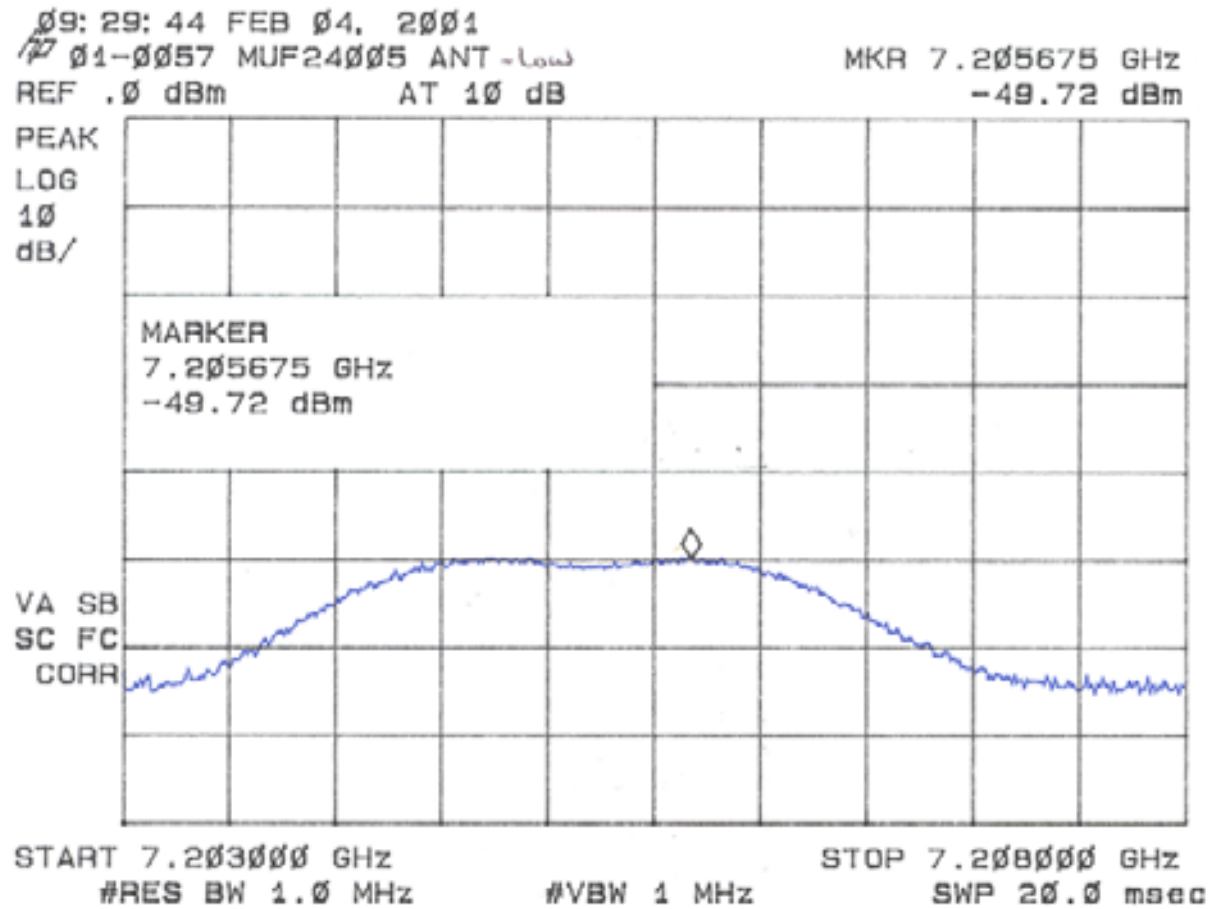


Figure 3o
Peak Radiated Spurious Emission 15.247(c) Mid – MaxRad 5 dBi Whip

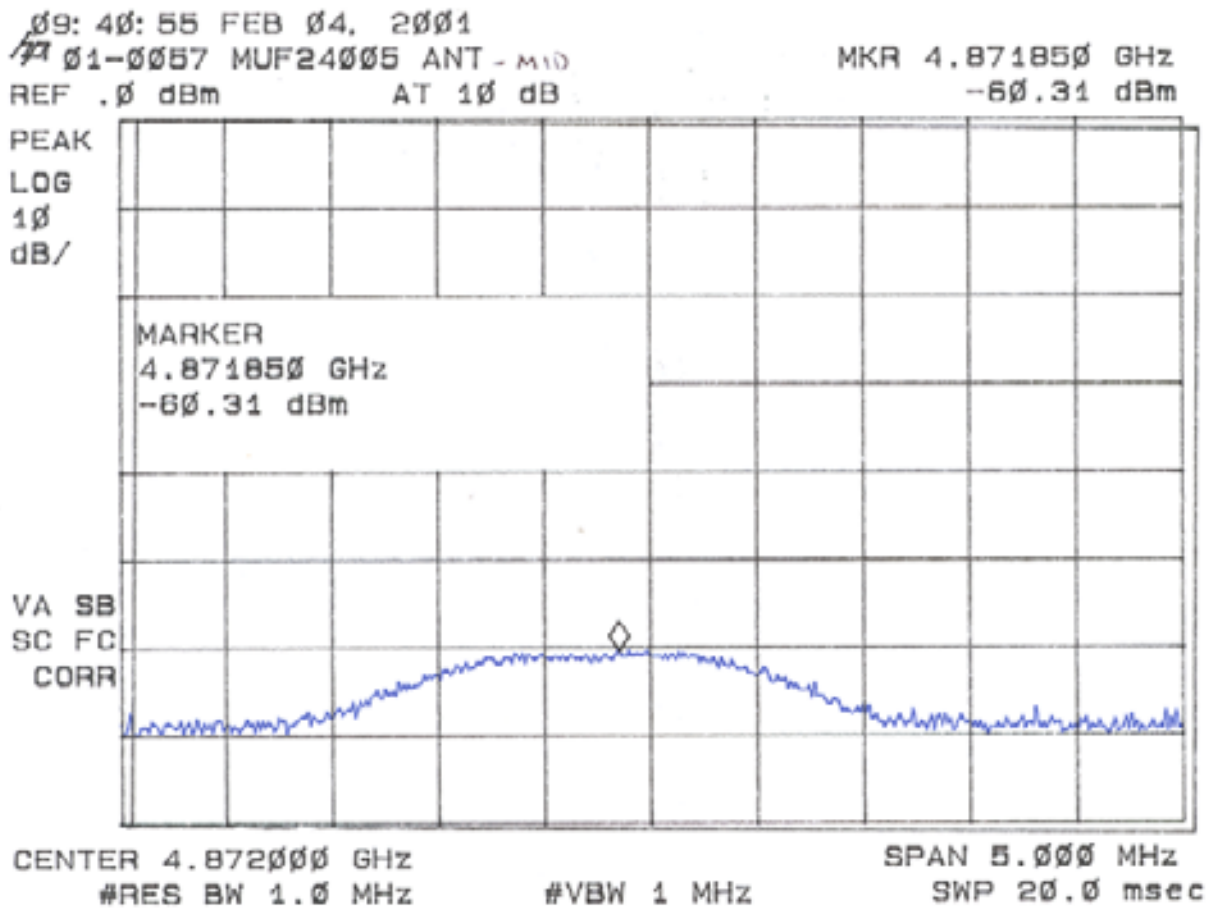


Figure 3p
Peak Radiated Spurious Emission 15.247(c) Mid – MaxRad 5 dBi Whip

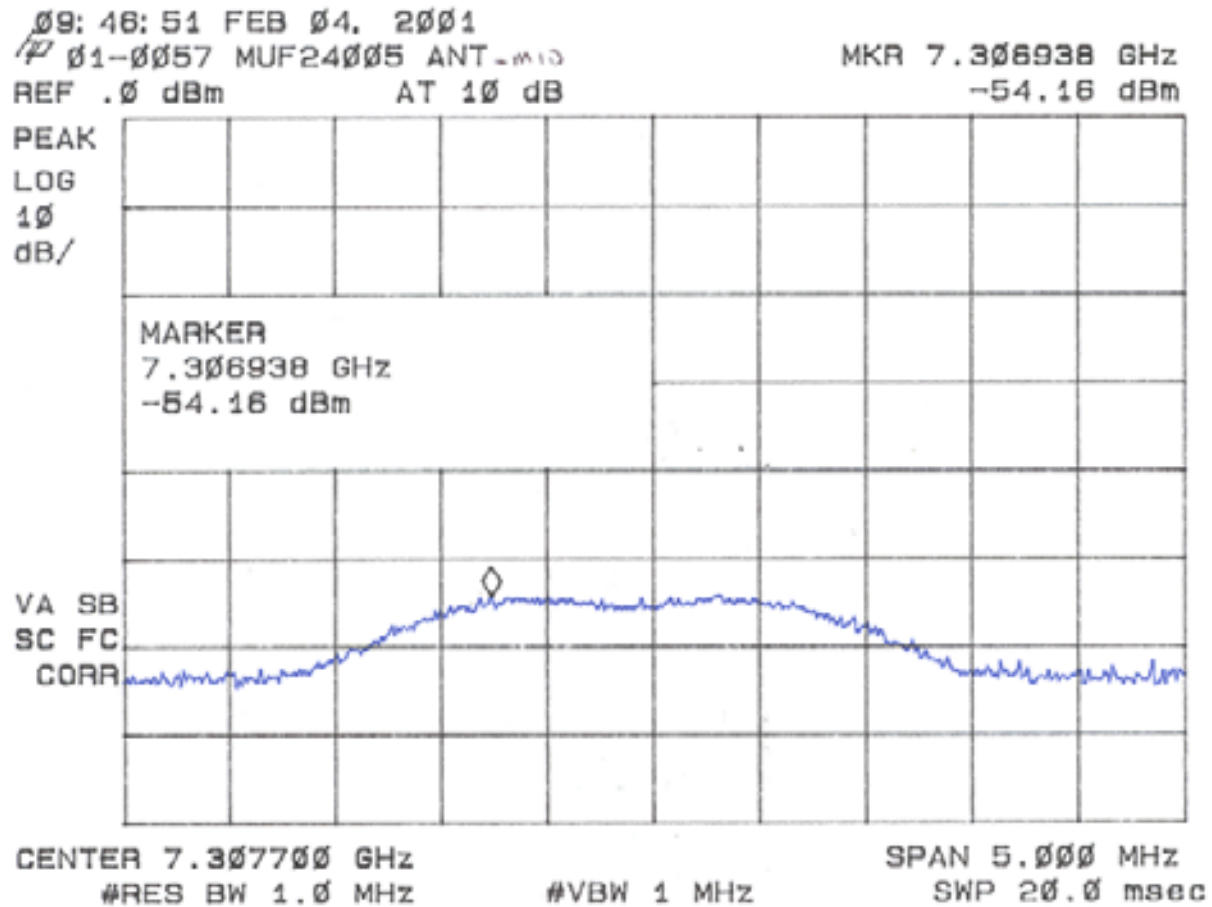


Figure 3q
Peak Radiated Spurious Emission 15.247(c) High – MaxRad 5 dBi Whip

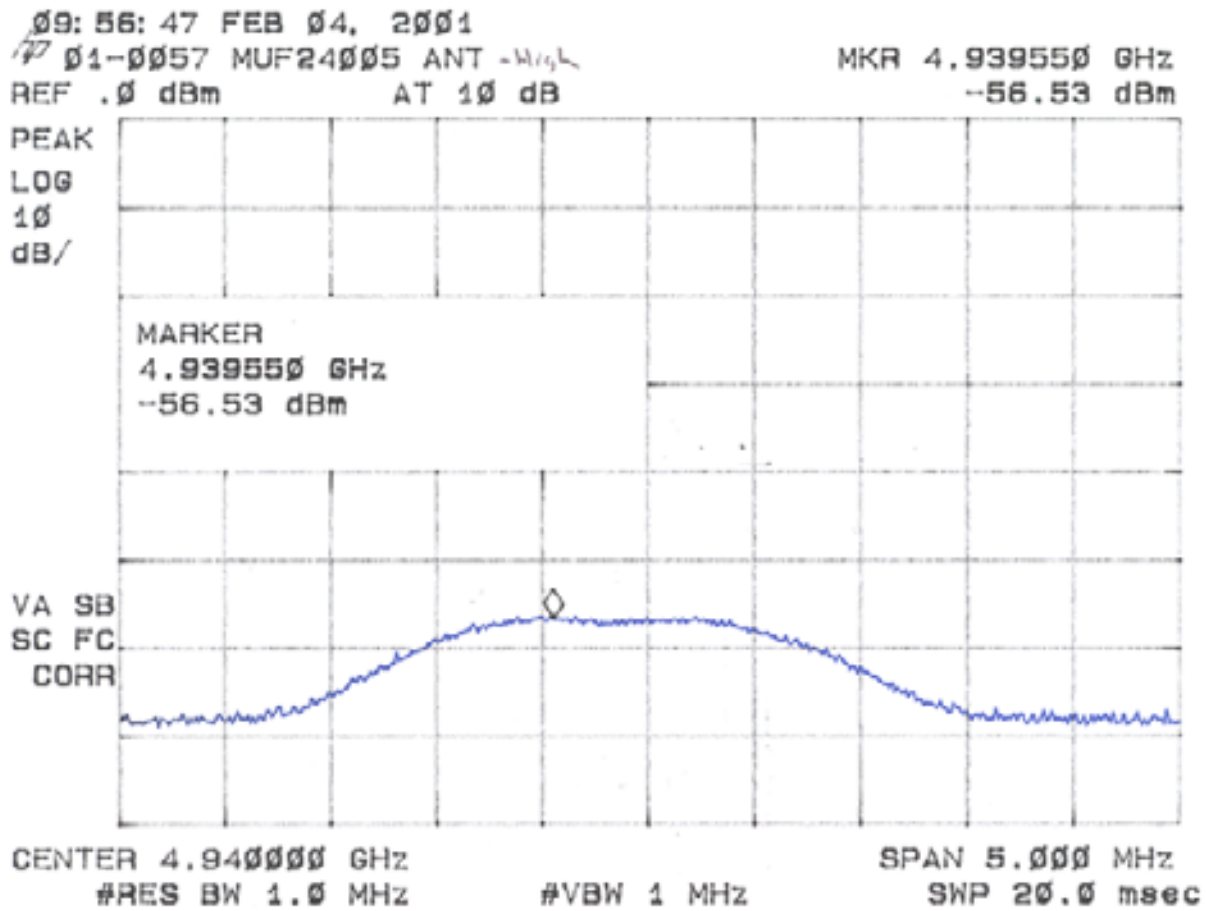


Figure 3r
Peak Radiated Spurious Emission 15.247(c) High – MaxRad 5 dBi Whip

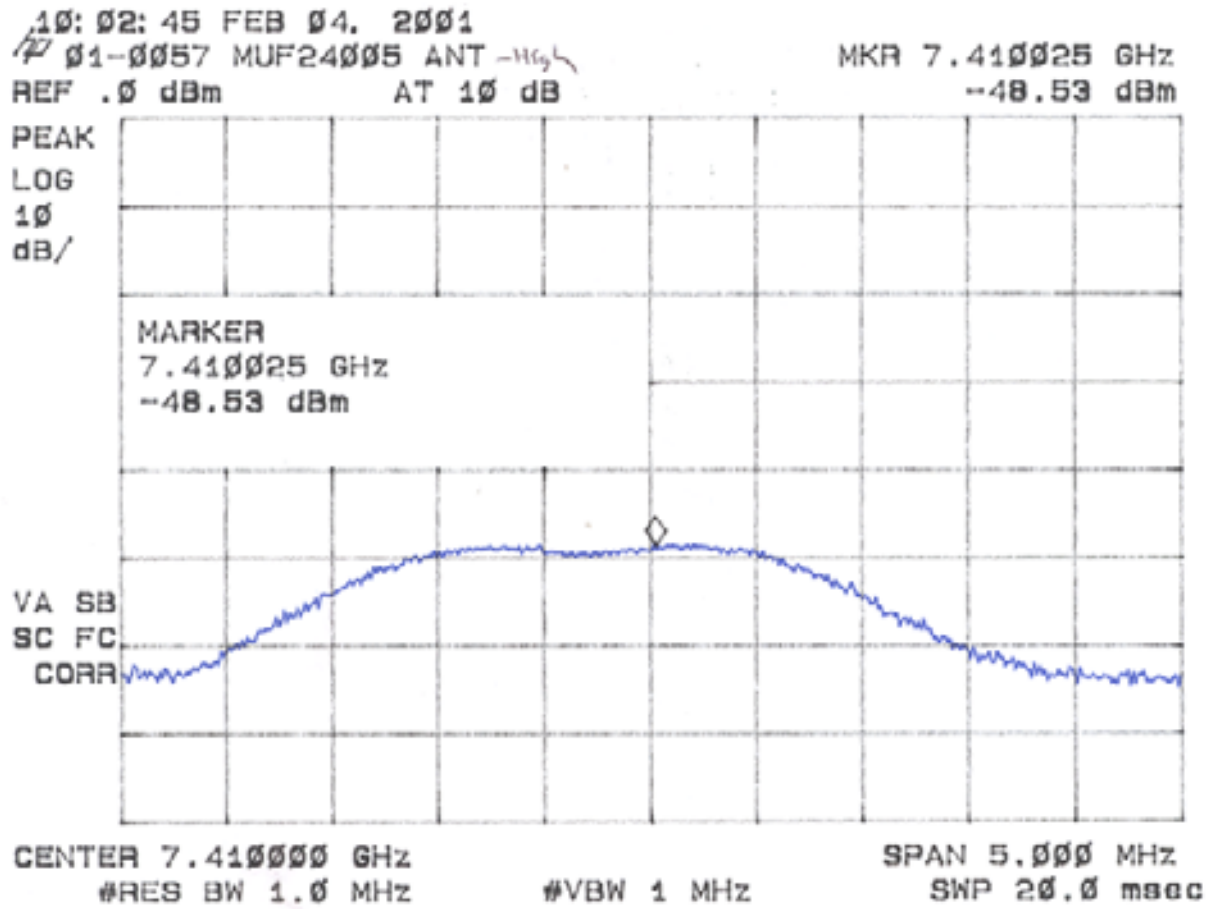


Figure 3s
Peak Radiated Spurious Emission 15.247(c) Low – Andrews 24 dBi Parabolic Dish

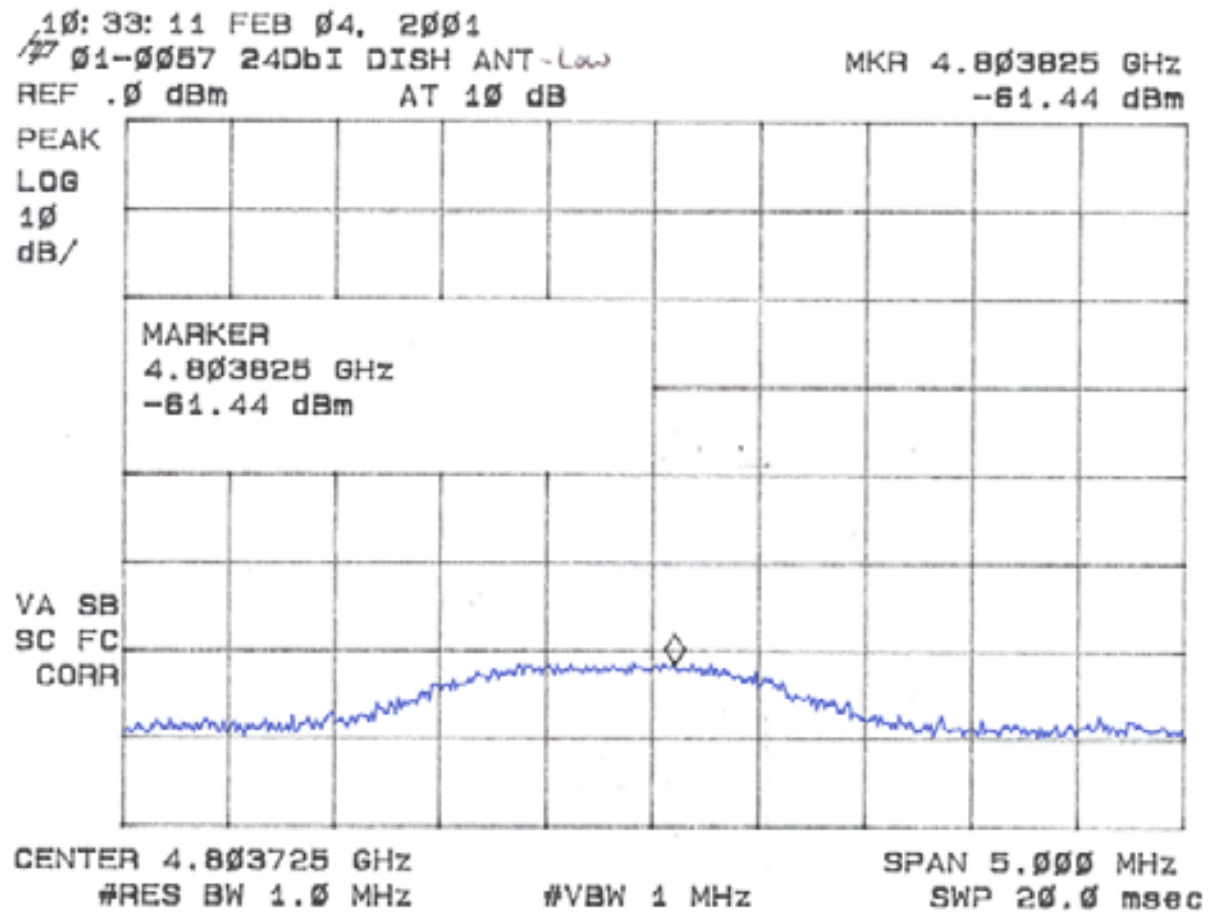


Figure 3t
Peak Radiated Spurious Emission 15.247(c) Low – Andrews 24 dBi Parabolic Dish

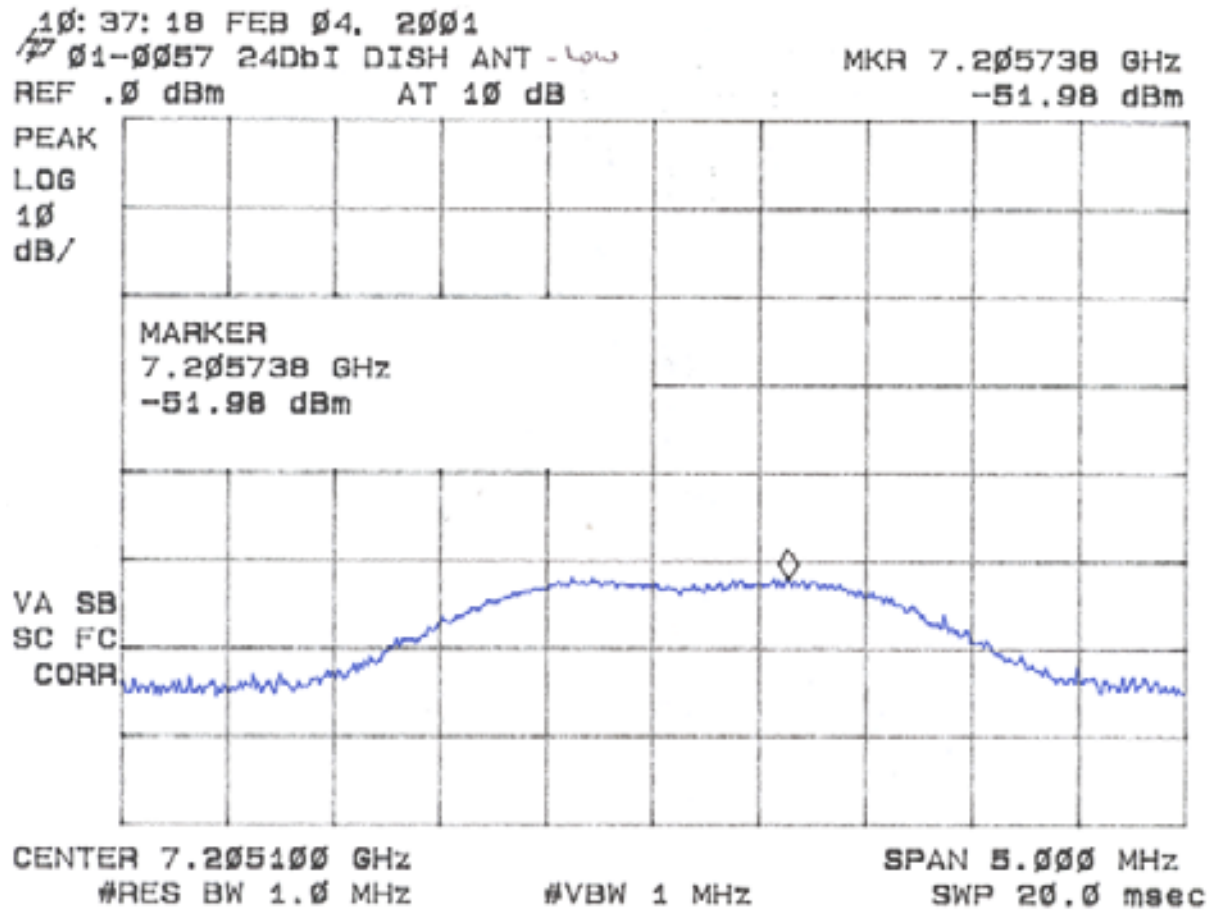


Figure 3u
Peak Radiated Spurious Emission 15.247(c) Mid – Andrews 24 dBi Parabolic Dish

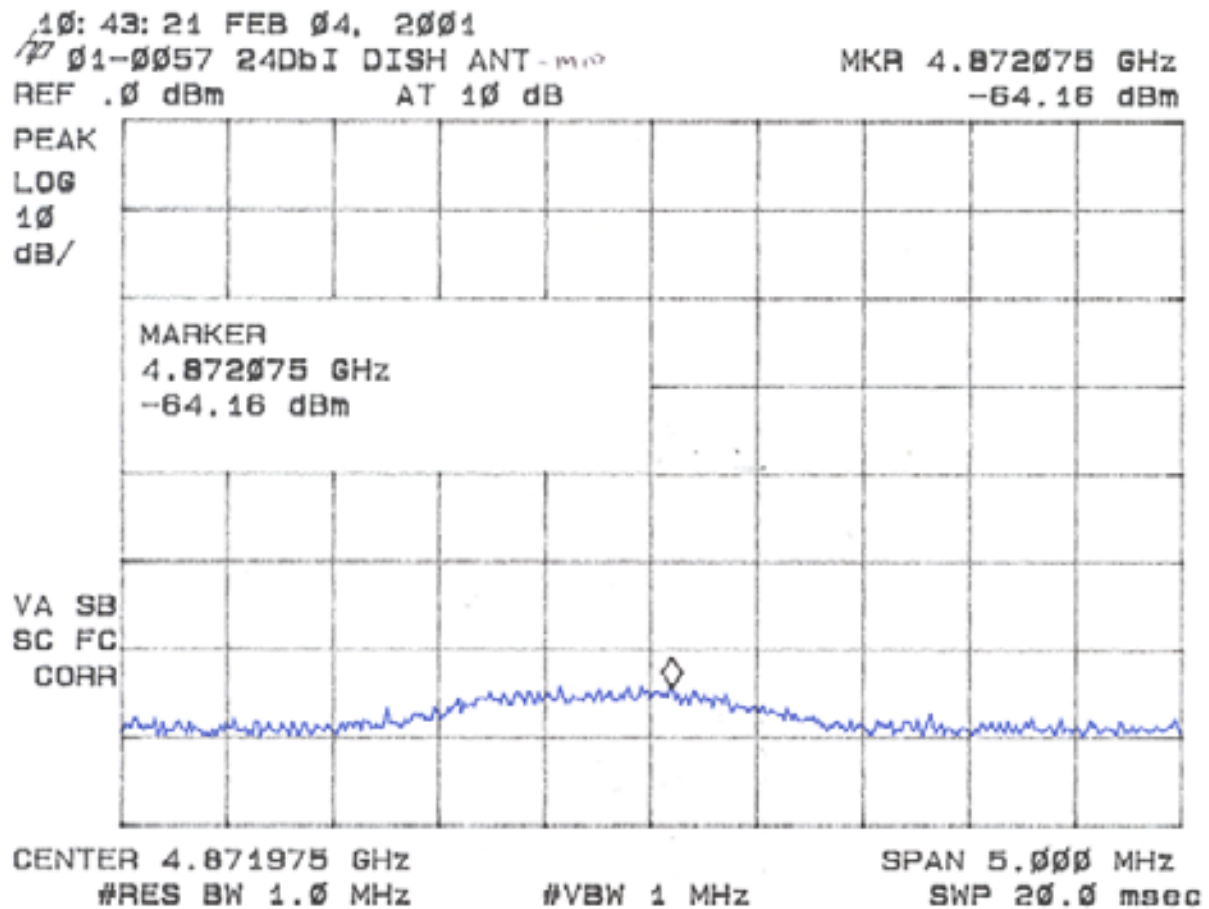


Figure 3v
Peak Radiated Spurious Emission 15.247(c) Mid – Andrews 24 dBi Parabolic Dish

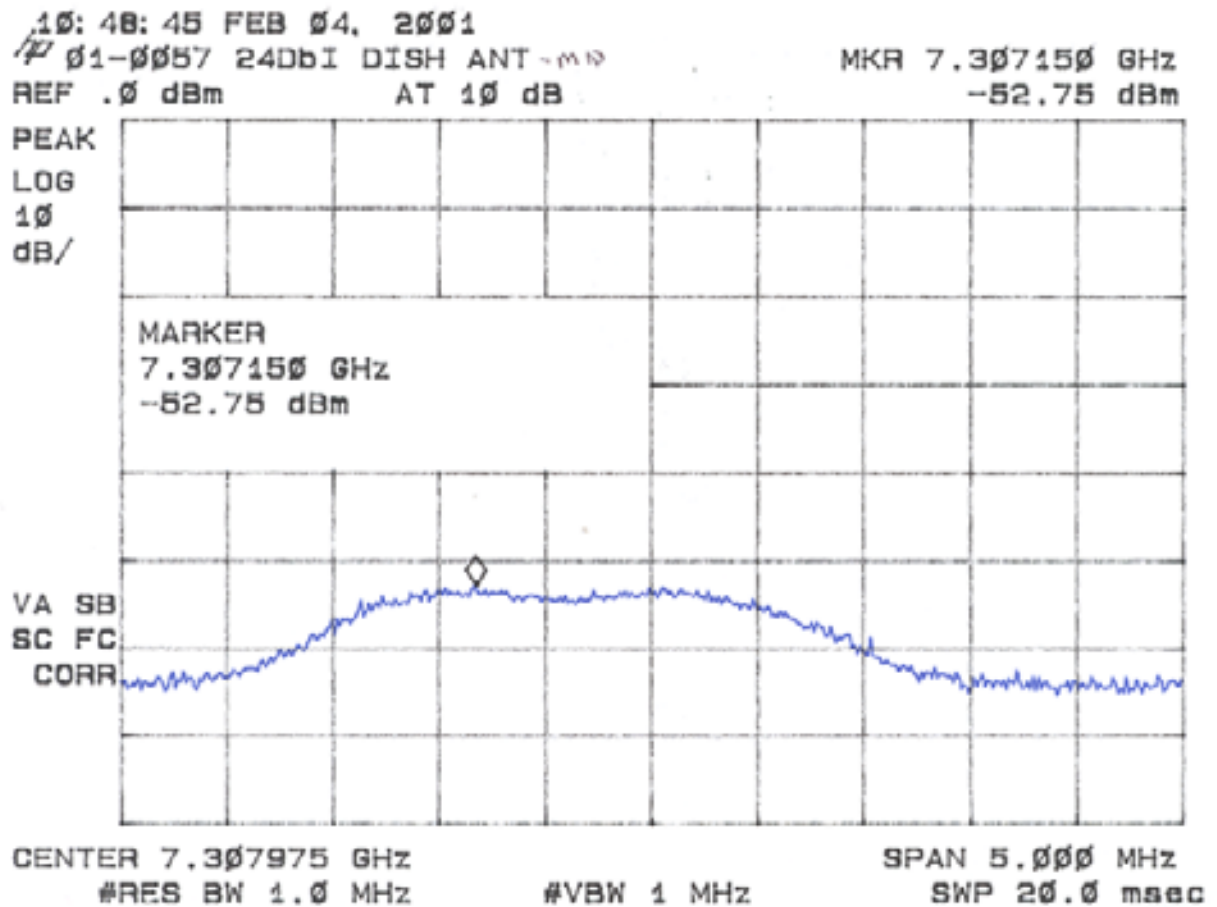


Figure 3w
Peak Radiated Spurious Emission 15.247(c) High - Andrews 24 dBi Parabolic Dish

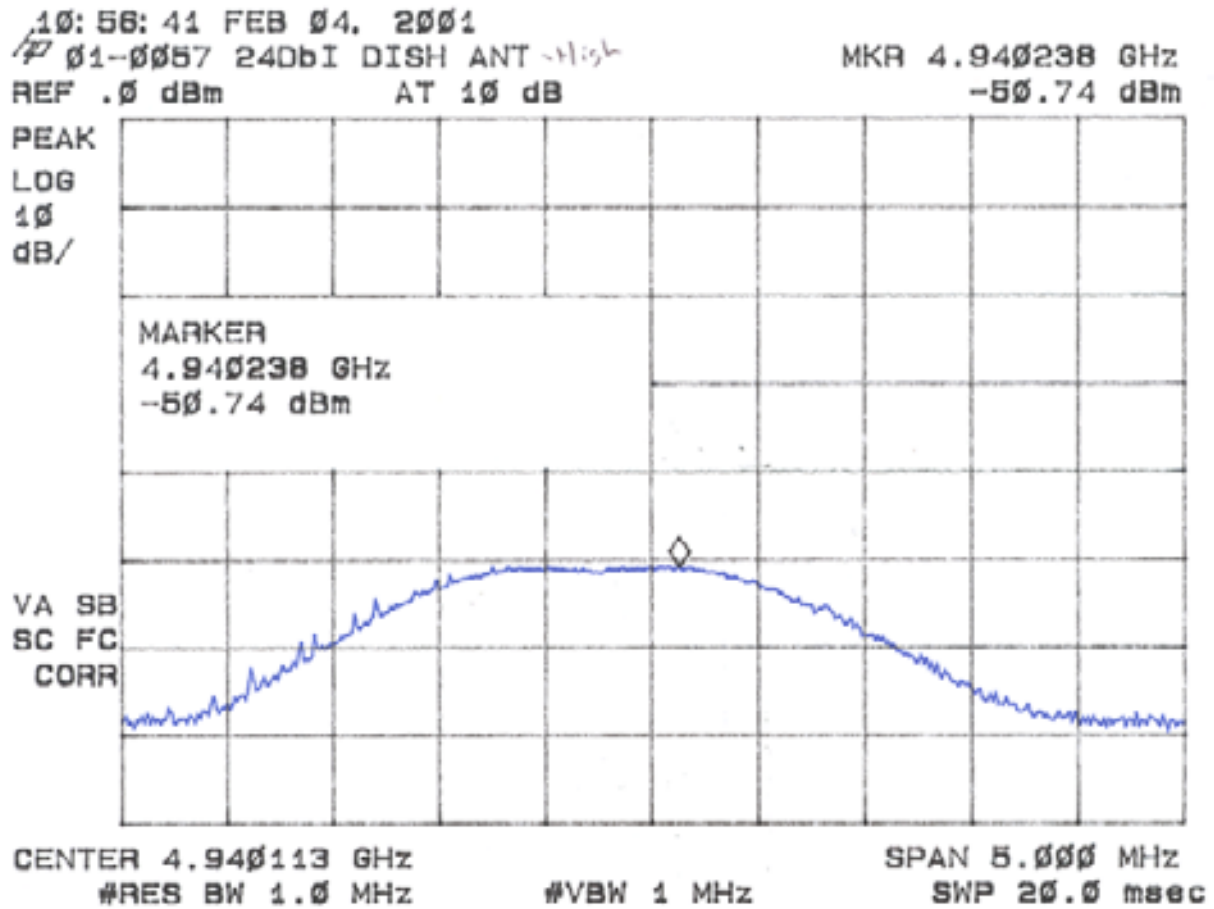
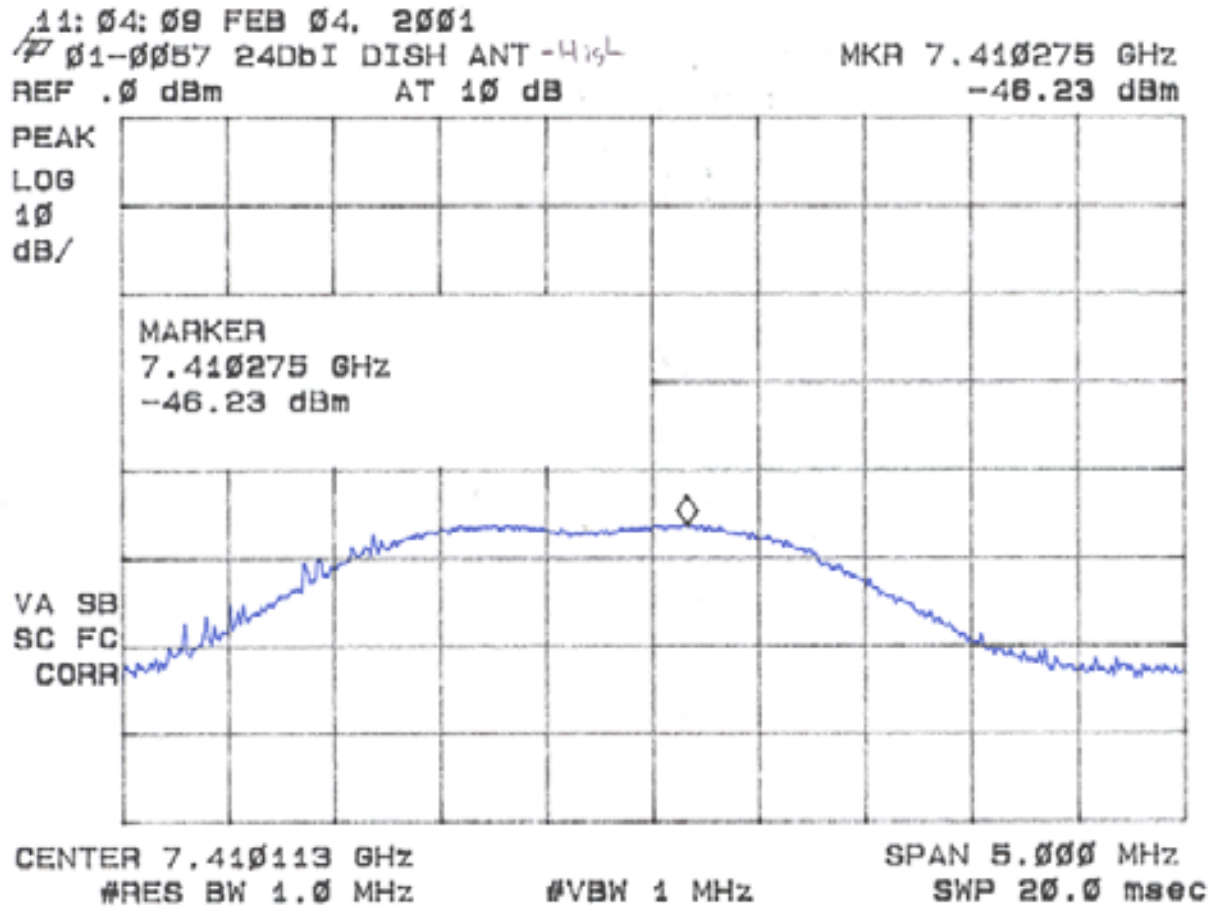


Figure 3x
Peak Radiated Spurious Emission 15.247(c) High - Andrews 24 dBi Parabolic Dish



2.7 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 4a – 4d. Due to the functionality of the transmitter and the complexity of the test setup in order to measure worse case duty cycle, Cirronet Corporation 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:

$$= 280 \text{ bytes} * 8 \text{ bits/byte} * (1/460.8\text{Kbps}) = 4.86\text{ms}$$

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:

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

Table 4a. AVERAGE RADIATED SPURIOUS EMISSIONS (Low)
Mobile Mark 2.5 dBi Vehicle Mount Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.803	-83.25	33.9	34.5	3.4	24.6	500.0
7.205	-73.09	33.7	37.4	4.7	130.2	500.0

Table 4a. AVERAGE RADIATED SPURIOUS EMISSIONS (Middle)
Mobile Mark 2.5 dBi Vehicle Mount Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.871	-86.42	33.9	34.7	3.4	17.5	500.0
7.307	-77.19	33.7	37.4	4.7	81.6	500.0

Table 4a. AVERAGE RADIATED SPURIOUS EMISSIONS (High)
Mobile Mark 2.5 dBi Vehicle Mount Antenna

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.939	-82.16	33.9	34.9	3.5	29.3	500.0
7.410	-71.96	33.7	37.5	4.7	149.7	500.0

* - Data corrected by 1 dB for loss of high pass filter and $20 \log_{10}(4.86\text{ms}/100\text{ms}) = -26.3 \text{ dB}$

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) = Antilog $((-83.25 - 33.9 + 34.5 + 3.4 + 107)/20) = 24.6$

CONVERSION FROM dBm TO dBuV = 107 dB

Tester

Signature: _____

Name: Sam Wismer

Table 4b. AVERAGE RADIATED SPURIOUS EMISSIONS (Low)
Mobile Mark 9 dBi Corner Reflector Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.803	-83.01	33.9	34.5	3.4	25.3	500.0
7.205	-76.65	33.7	37.4	4.7	86.4	500.0

Table 4b. AVERAGE RADIATED SPURIOUS EMISSIONS (Middle)
Mobile Mark 9 dBi Corner Reflector Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.871	-85.99	33.9	34.7	3.4	18.4	500.0
7.307	-77.82	33.7	37.4	4.7	75.9	500.0

Table 4b. AVERAGE RADIATED SPURIOUS EMISSIONS (High)
Mobile Mark 9 dBi Corner Reflector Antenna

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.939	-79.78	33.9	34.9	3.5	38.3	500.0
7.410	-73.27	33.7	37.5	4.7	128.7	500.0

* - Data corrected by 1 dB for loss of high pass filter and $20 \log_{10}(4.86\text{ms}/100\text{ms}) = -26.3 \text{ dB}$

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) = $\text{Antilog}((-83.01 - 33.9 + 34.5 + 3.4 + 107)/20) = 25.3$

CONVERSION FROM dBm TO dBuV = 107 dB

Tester

Signature: _____

Name: Sam Wismer

Table 4c. AVERAGE SPURIOUS EMISSIONS (Low)
MaxRad 5 dBi Whip Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.803	-82.96	33.9	34.5	3.4	25.4	500.0
7.205	-75.02	33.7	37.4	4.7	104.3	500.0

Table 4c. AVERAGE RADIATED SPURIOUS EMISSIONS (Middle)
MaxRad 5 dBi Whip Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.871	-85.61	33.9	34.7	3.4	19.2	500.0
7.307	-79.46	33.7	37.4	4.7	62.8	500.0

Table 4c. AVERAGE RADIATED SPURIOUS EMISSIONS (High)
MaxRad 5 dBi Whip Antenna

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.939	-81.83	33.9	34.9	3.5	30.5	500.0
7.410	-73.83	33.7	37.5	4.7	120.7	500.0

* - Data corrected by 1 dB for loss of high pass filter and $20 \log_{10}(4.86\text{ms}/100\text{ms}) = -26.3 \text{ dB}$

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) = Antilog $((-82.96 - 33.9 + 34.5 + 3.5 + 107)/20) = 25.4$

CONVERSION: BuV = 107 dB

Tester

Signature: _____

Name: Sam Wismer

Table 4d. AVERAGE RADIATED SPURIOUS EMISSIONS (Low)
Andrews 24 dBi Parabolic Dish Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.803	-86.74	33.9	34.5	3.4	16.5	500.0
7.205	-77.28	33.7	37.4	4.7	80.4	500.0

Table 4d. AVERAGE RADIATED SPURIOUS EMISSIONS (Middle)
Andrews 24 dBi Parabolic Dish Antenna

Freq. (GHz)	Test Data* (dBm) @ 3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.871	-89.46	33.9	34.7	3.4	12.3	500.0
7.307	-78.05	33.7	37.4	4.7	73.9	500.0

Table 4d. AVERAGE RADIATED SPURIOUS EMISSIONS (High)
Andrews 24 dBi Parabolic Dish Antenna

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) 3m	FCC Limits (uV/m)
4.939	-76.04	33.9	34.9	3.5	59.3	500.0
7.410	-71.53	33.7	37.5	4.7	157.3	500.0

* - Data corrected by 1 dB for loss of high pass filter and $20 \log_{10}(4.86\text{ms}/100\text{ms}) = -26.3 \text{ dB}$

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) = Antilog $((-86.74 - 33.9 + 34.5 + 3.4 + 107)/20) = 16.5$

CONVERSION FROM dBm TO dBuV = 107 dB

Tester

Signature: _____

Name: Sam Wismer

SECTION 3

PHOTOGRAPHS

PHOTOS OF THE TESTED EUT

The following photos are attached:

- Photo 1. Antenna, Mobile Mark 2.5 dBi Vehicle Mount (M/N RM3-2400-RTNC)
- Photo 2. Antenna, Mobile Mark 9 dBi Corner Reflector (M/N SCR9-2400-RN)
- Photo 3. Antenna, MaxRad 5 dBi Whip (M/N MUF24005-RTNC)
- Photo 4. Antenna, Andrews 18 dBi Parabolic Dish (M/N 18T-2400 A)
- Photo 5. Antenna, Andrews 24 dBi Parabolic Dish (M/N 26T-2400 A)

Photo 1. Antenna, Mobile Mark 2.5 dBi Vehicle Mount (M/N RM3-2400-RTNC)



Photo 2. Antenna, Mobile Mark 9 dBi Corner Reflector (M/N SCR9-2400-RN)



Photo 3. Antenna, MaxRad 5 dBi Whip (M/N MUF24005-RTNC)



Photo 4. Antenna, Andrews 18 dBi Parabolic Dish (M/N 18T-2400 A)

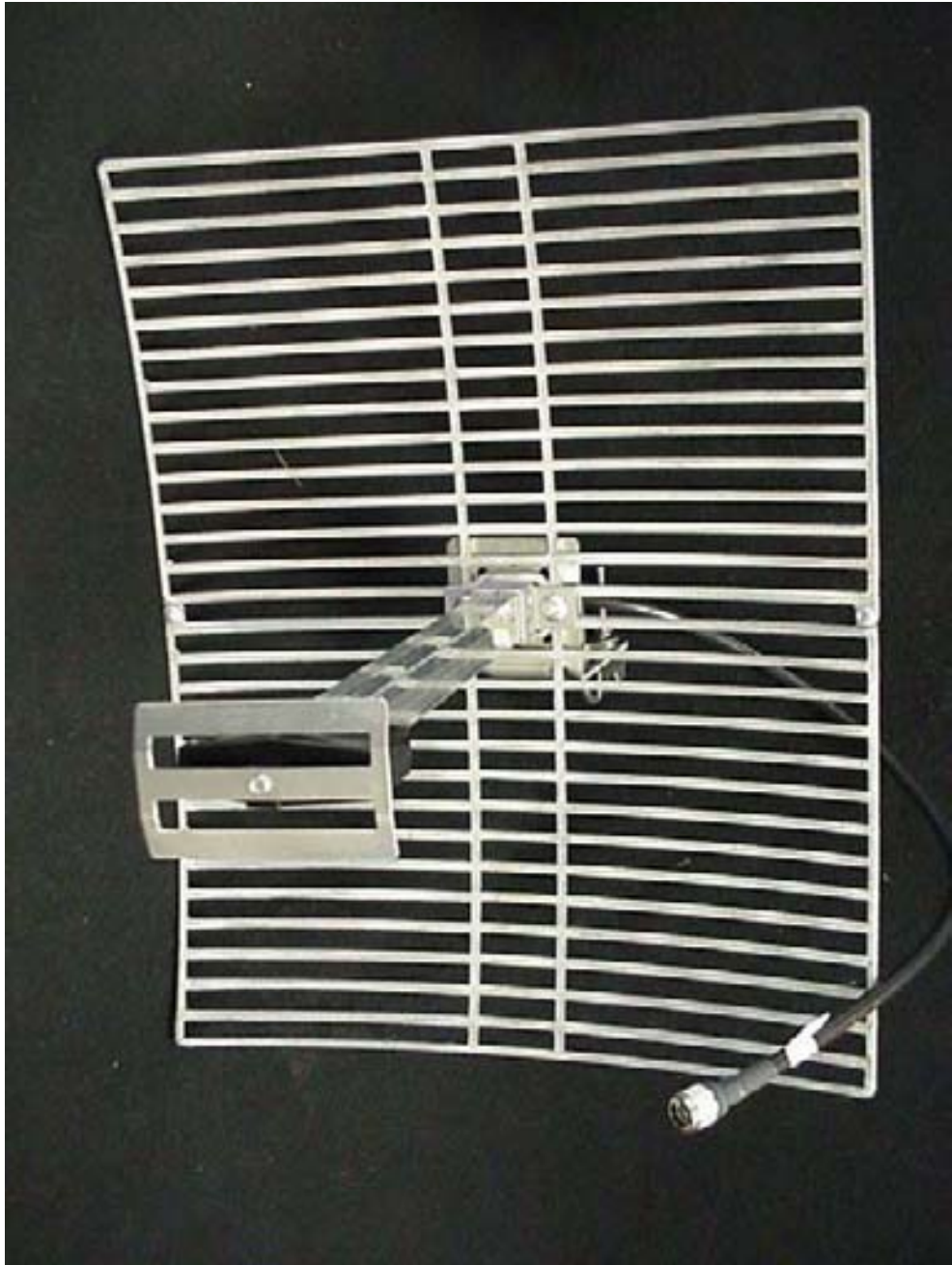


Photo 5. Antenna, Andrews 24 dBi Parabolic Dish (M/N 26T-2400 A)

