FCC Certification Test Report

FCC Certification Test Report for Motorola Corporation FCC ID: RUN-XSUWBWDK

May 28, 2004

Revision 1 issued July 23, 2004

Prepared for:

Motorola, Inc. – UWB Organization
8133 Leesburg Pike
Vienna, VA 22182
(703) 269-3000

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879
(301) 417-0220

FCC Certification Test Report
for the
Motorola Corporation
Ultra Wideband Transmitter
FCC ID: RUN-XSUWBWDK

WLL JOB# 7959

Prepared by: Gregory M. Snyder
Chief EMC Engineer

Reviewed by: Steven D. Koster
EMC Operations Manager

Abstract

This report has been prepared on behalf of Motorola Corporation to support the attached Application for Equipment Authorization. The test report and application are submitted for an Indoor Ultra Wideband Transceiver under Part 15 Subpart F of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for a Motorola Corporation Model: XSUWBWDK, Wireless Developer Kit (WDK).

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The Motorola Corporation XSUWBWDK, Wireless Developer Kit (WDK) complies with the requirements for an Indoor Ultra Wideband Transceiver device under Part 15 Subpart F of the FCC Rules and Regulations.

Revision History	Revision 1 issued July 23, 2004. Section 4.5 has been revisited to address comments received from the Federal Communications Commission Office of Engineering and Technology.

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1 Introduction

1.1 Compliance Statement

The Motorola Corporation XSUWBWDK, WDK UWB transceiver complies with the limits for an Indoor UWB transmitter device under Part 15 Subpart F of the FCC Rules and Regulations.

Table 1: Summary of Test Results

FCC Rule Part	Test Description	Pass/Fail/ Comments	Reference Section
15.517(a)	Indoor Operation Limitations		
15.517(b)	UWB Bandwidth	Pass	4.2
15.517(c) and 15.209	Radiated Emissions	Pass	4.3
15.517(d),	Radiated Emissions in GPS Bands	Pass	4.4
15.517(e)	Peak Emissions within a 50 MHz Bandwidth	Pass	4.5
15.517(f)	UWB Labeling requirements		
15.207	AC Powerline Conducted Emissions	Pass	4.6

1.2 Test Scope

Tests for radiated and conducted emissions were performed. All measurements were performed according to the following documents:

- ANSI C63.4-2001, American National Standard for Methods of Measurement of Radio-Noise Emissions form Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz..
- CFR 47, Part 15 Subpart F – Ultra Wideband Operation, Dec. 12, 2003
- FCC 02-48, Report and Order, Appendix F - Measurement Procedures

The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer: Motorola, Inc. – UWB Organization
8133 Leesburg Pike
Vienna, VA 22182

Purchase Order Number: 82992

Quotation Number: 61396

1.4 Test Dates

Testing was performed from February 20, 2004 to May 5, 2004.

1.5 Test and Support Personnel

Washington Laboratories, LTD	James Ritter
Customer	John McCorkle

1.6 Abbreviations

A	Ampere
Ac	alternating current
AM	Amplitude Modulation
Amps	Amperes
b/s	bits per second
BW	Bandwidth
CE	Conducted Emission
Cm	centimeter
CW	Continuous Wave
DB	decibel
Dc	direct current
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FM	Frequency Modulation
G	giga - prefix for 10^9 multiplier
Hz	Hertz
IF	Intermediate Frequency
K	kilo - prefix for 10^3 multiplier
M	Mega - prefix for 10^6 multiplier
M	Meter
μ	micro - prefix for 10^{-6} multiplier
NB	Narrowband
LISN	Line Impedance Stabilization Network
RE	Radiated Emissions
RF	Radio Frequency
Rms	root-mean-square
SN	Serial Number
S/A	Spectrum Analyzer
V	Volt

2 Equipment Under Test

2.1 EUT Identification & Description

The Motorola XSUWBWDK Wireless Developer Kit (WDK) is an 802.15.3 application development platform and an ultra wide band technology evaluation tool. Each wireless Developer Kit contains two second generation Motorola UWB communications transceivers, model XSUWBWDK, antennas, power supplies, and a Software Development Kit (SDK) that together allow development of consumer electronics applications. The SDK supports configuration and control of Evaluation Kit nodes via software APIs and IEEE 802.15.3 functionality. Additional transceivers can be used to create a multi station pico-net configuration.

Power to the WDK is 5Vdc provided via an AC to DC power adapter.

Table 2. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Motorola Corporation
FCC ID Number	RUN-XSUWBWDK
EUT Name:	Ultra Wide Band Transceiver
Model:	XSUWBWDK
FCC Rule Parts:	Part 15 Subpart F, §15.517
Frequency Range:	Fixed
Modulation:	Direct Sequence Spread Spectrum
Necessary Bandwidth:	N/A
Keying:	Automatic
Type of Information:	Data
Number of Channels:	1
Antenna Type	External, Printed Circuit Board, Unity Gain
Interface Cables:	RS-232 Maintenance Port, 1394 Firewire Interface
Power Source & Voltage:	120VAC

2.2 Test Configuration

The EUT was configured with a cable connected to the 1394 Firewire port and the RS-232 port was connected to a laptop for program loading. An antenna was connected to the antenna port 2, which is used for both transmitting and receiving. The additional antenna port, which is receive only, was terminated as this port will not be used. The unit was placed on the test table and raised to 1m with plastic standoffs.

2.3 Testing Algorithm

The unit was placed into continuous transmit mode Two transmit modulation modes were used during the test and data for both is contained in this report. The modulations are identified as Code 8 (Sparse Modulation) and Code 0 (Full Modulation). Tests on Codes 1 thru 7 showed they were identical to Code 0.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

FCC Report and Order, FCC 02-48, Appendix F

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The measurement uncertainty of the data contained herein is ±2.3 dB.

For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ± dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

Total Uncertainty = $(A^2 + B^2 + C^2)^{1/2}/(n-1)$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, total uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2}$ = ±2.3 dB.

3 Test Equipment

Table 3 shows a list of the test equipment used for measurements along with the calibration information.

Table 3: Test Equipment List

Manufacturer	Model/Type	Function	Identification	Cal. Due
HP	8568B	Spectrum Analyzer	2634A02888	7/07/04
HP	85650A	Quasi-Peak Adapter	3303A01786	7/08/04
HP	8564E	Spectrum Analyzer	3643A00657	5/22/04
HP	HP 8593A	Spectrum Analyzer	3009A00739	6/25/04
HP	8449B	Microwave Preamp	3008A00385	9/29/05
A.H. Systems, Inc	1840	Microwave Preamp	126	1/6/05
Rohde & Schwarz	ESIB 1088.7490.26	EMI Test Receiver	837491/0002	3/23/05
Solar	8012-50-R-24BNC	LISN	8379493	6/30/04
ARA	LPB-2520	BiconiLog Antenna	1044	6/20/04
ARA	DRG118/A	Microwave Horn Antenna	1236	4/17/05
Narda	V638	Horn Antenna	00210	7/22/04
Narda	V637	Horn Antenna	00209	7/22/04
HP	85685A	RF Preselector	3221A01395	7/07/04

4 Test Results

4.1 Operation Limitations, §15.517(a)

Operation under the provisions of §15.517 is limited to UWB transmitters employed solely for indoor operation. The following are the requirements for ensuring compliance with these operational limitations.

1. Indoor UWB devices, by the nature of their design, must be capable of operation only indoors. The necessity to operate with a fixed indoor infrastructure, e.g., a transmitter that must be connected to the AC power lines, may be considered sufficient to demonstrate this.
2. The emissions from equipment operated under this section shall not be intentionally directed outside of the building in which the equipment is located, such as through a window or a doorway, to perform an outside function, such as the detection of persons about to enter a building.
3. The use of outdoor mounted antennas, e.g., antennas mounted on the outside of a building or on a telephone pole, or any other outdoors infrastructure is prohibited.
4. Field disturbance sensors installed inside of metal or underground storage tanks are considered to operate indoors provided the emissions are directed towards the ground.
5. A communications system shall transmit only when the intentional radiator is sending information to an associated receiver.

4.2 Occupied Bandwidth, §15.517(b)

The UWB bandwidth of a UWB system operating under the provisions of Section 15.517 must be contained between 3100 MHz and 10,600 MHz. Part 15.503 states that the occupied bandwidth is measured at the 10 dB point.

4.2.1 Test Procedure

The bandwidth was measured using the R&S analyzer with the receiving antenna located 1m from the EUT. The turn-table was rotated through 360° and the antenna was raised between 1 and 4 meters to obtain the highest readings.

The resolution bandwidth of the receiver was set to 1 MHz and the frequency range was set from 3 GHz to 5.5 GHz. Note that the frequency range would have been set from 3 GHz to 10.6 GHz, however, the EUT does not occupy that large of a span and stopping at 5.5 GHz provides better resolution of the signal. All corrections for the antenna, pre-amp and cable were input to the receiver. Additionally, the adjustment for 1m to 3m was also placed into the receiver so that the plots produced are directly compared to the specification limit.

The unit was checked with both modulation codes as described in Section 2.3.

4.2.2 Test Results

The bandwidth of the EUT was found to comply with the requirements of 15.517(b). Bandwidth plots are located in Figure 4-1 and Figure 4-2. It should be noted that the in some tests, the signal levels being measured are so low that the noise floor of the background (instrument and atmospheric) is masking the true low level of the signal being measured. This error could be corrected by subtracting RMS the power (in watts) of the background noise from the RMS power (in watts) indicated when the signal was present, since RMS powers add. This was not done, however, because the EUT passed all tests even with this error that artificially raised the indicated signal level. The blue traces on the plots are of the background noise floor with all corrections (transducer factors for antenna, cable, and range) tuned on.

Code 0 Modulation:

Bandwidth = 1.8612 GHz, f_L = 3.1564 GHz, f_H = 5.0176 GHz, f_M = 4.087 GHz

Code 8 Modulation:

Bandwidth = 2.016 GHz, f_L = 3.1476 GHz, f_H = 5.1636 GHz, f_M = 4.1556 GHz

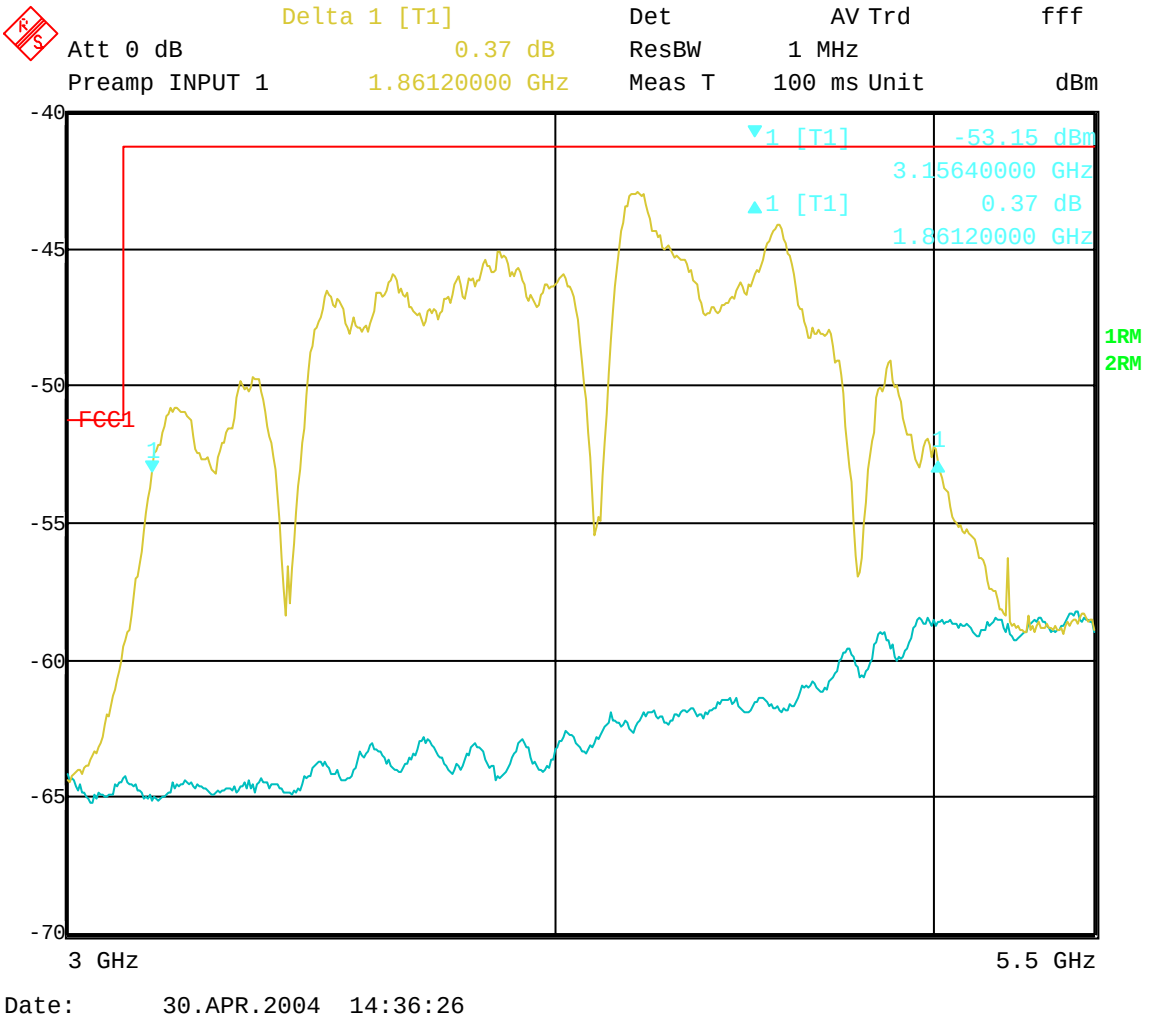

Figure 4-1. Occupied Bandwidth, Code 0 Modulation

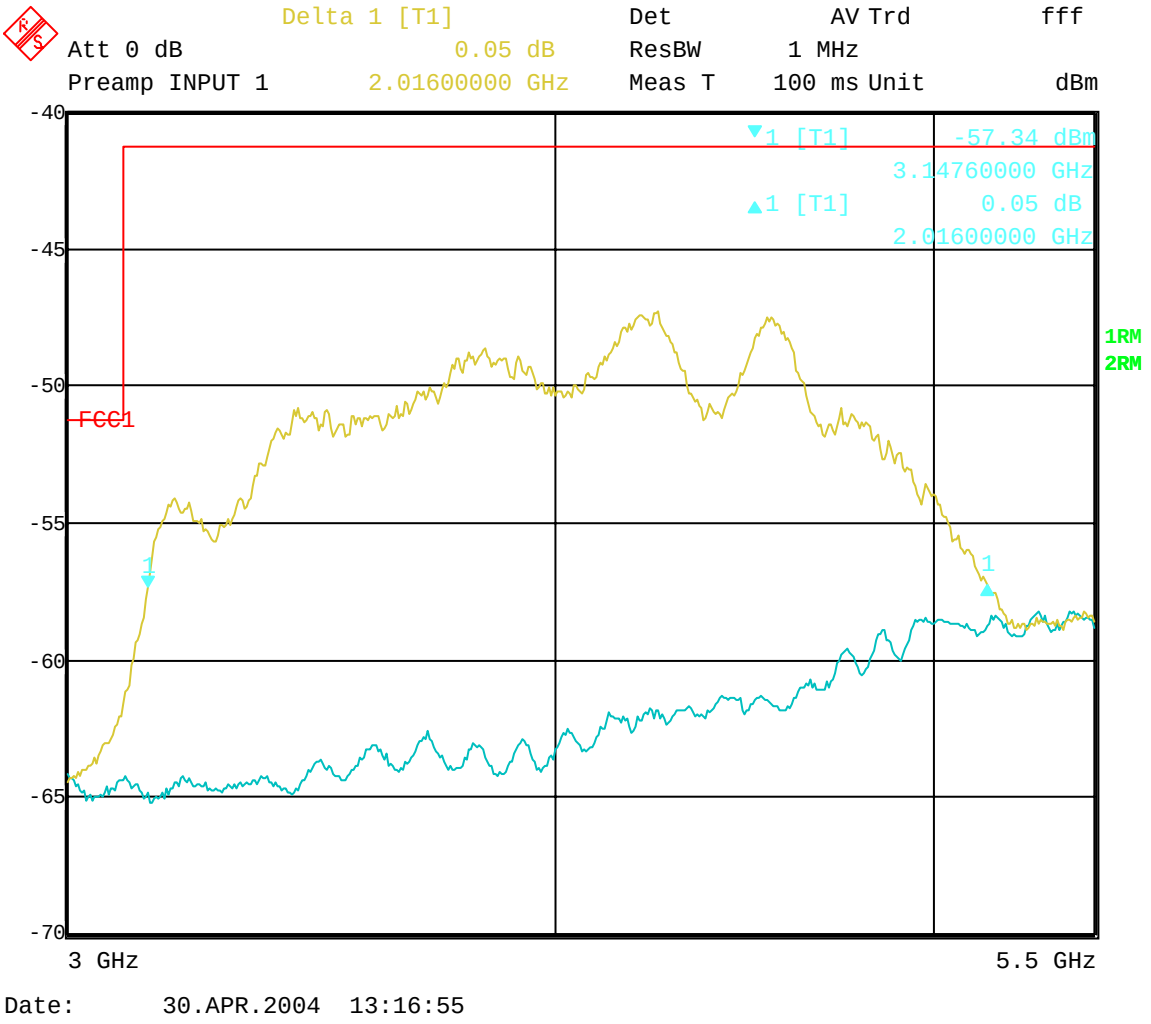

Figure 4-2. Occupied Bandwidth, Code 8 Modulation

4.3 Radiated Spurious Emissions, §15.247(c) and §15.209

Radiated emissions below 960 MHz must comply with the emission limits of §15.209. Emissions above 960 MHz must comply with the average limits given in the following table when measured with a 1 MHz resolution bandwidth.

Frequency in MHz	EIRP in dBm
960 - 1610	-75.3
1610 – 1990	-53.3
1990 - 3100	-51.3
3100 – 10600	-41.3
Above 10600	-51.3

4.3.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-1992. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

For emission measurements below 960MHz the following bandwidths were used.

Frequency Range	**Resolution Bandwidth**	**Video Bandwidth**
30 MHz-960 MHz	120 kHz	>120 kHz

Measurements below 960MHz were made with a spectrum analyzer equipped with a Quasi-peak detector. For measurements from 1 GHz to 10.6 GHz an EMI receiver with an RMS detector and 1 MHz resolution bandwidth setting was used. Peak measurements from 960M to 1GHz and 10.6 GHz to 40 GHz were made using a spectrum analyzer with a 1 MHz resolution bandwidth. Testing above 1 GHz was performed at 1m or 2m test distance. The adjustment for 1m or 2m to 3m was also placed into the receiver so that the plots produced are directly compared to the specification limit.

For all radiated emissions testing per §15.517(c), (d), and (e) all signal level corrections were entered into the receiver so that the plots obtained were final data that could be compared to the specification limit. The following is a sample of the factors and conversions entered in the receiver for calculations.

Sample Calculations:

Analyzer/Receiver Voltage (SA Level):	VdBμV
Antenna Factor (Ant Corr):	AFdB/m
Cable Loss Correction (Cable Corr):	CCdB
Amplifier Gain:	GdB (if applicable)
Distance Correction Factor:	DCdB (9.54dB for 1m to 3m, 3.52 for 2m to 3m)
Electric Field (Corrected Level):	EdBμV/m = VdBμV + AFdB/m + CCdB – GdB + DCdB

The E-Field strength was then mathematically converted to an EIRP level using the equation from §15.521(g): **P(dBm EIRP) = E(dBμV/m) – 95.2**

4.3.2 Test Results

The EUT complied with the requirements of Section 15.517(c). Data are supplied in the following tables and plots. The blue traces on the plots are of the background noise floor with all corrections (transducer factors for antenna, cable, and range) tuned on. No emissions were detected from 960 MHz to 1 GHz. Note that the 20 dB increase of the noise floor at 7 GHz is due to the internal preamp. The internal preamp is only usable to 7 GHz.

Table 4: Radiated Emission Test Data, 30 MHz – 960 MHz (FCC §15.209)

CLIENT:	Motorola	DATE:	2/20/2004
TESTER:	James Ritter	JOB #:	7959
EUT Information:		**Test Requirements:**	
EUT:	UWB Device	TEST STANDARD:	FCC Part 15
CONFIG:	Transmit on, Ant on port 2	DISTANCE:	3m
CLASS:	B		
Test Equipment/Limit:			
ANTENNA:	A_00007	LIMIT:	LFCC_3m_Class_B
CABLE:	CSITE2_3m	AMPLIFIER (dB)	None

Freq.	Polarity	Azimuth	Ant. Hght	SA Level (QP)	Ant. Corr.	Cable Corr.	Corr. Level	Corr. Level	Limit	Margin
MHz	H/V	Degree	M	dBµV	dB/m	dB	dBµV/m	µV/m	µV/m	dB
196.64	H	180.0	1.3	20.4	9.9	2.2	32.5	42.0	150.0	-11.1
294.94	H	0.0	1.5	22.3	12.8	2.6	37.7	76.9	200.0	-8.3
299.99	H	165.0	1.3	17.8	13.3	2.6	33.7	48.5	200.0	-12.3
354.64	H	270.0	3.5	16.9	14.3	2.9	34.1	50.5	200.0	-12.0
393.28	H	270.0	1.2	20.2	15.1	2.9	38.2	81.7	200.0	-7.8
491.57	H	20.0	2.5	18.0	16.7	3.3	38.0	79.4	200.0	-8.0
589.88	H	180.0	1.5	17.4	18.1	3.6	39.1	90.0	200.0	-6.9
786.53	H	90.0	1.3	14.5	21.3	4.2	40.1	100.7	200.0	-6.0
196.64	V	270.0	2.0	15.4	9.9	2.2	27.5	23.6	150.0	-16.1
294.94	V	45.0	1.6	18.5	12.8	2.6	33.9	49.7	200.0	-12.1
299.98	V	180.0	2.0	13.5	13.3	2.6	29.4	29.6	200.0	-16.6
305.12	V	270.0	3.0	14.1	13.6	2.7	30.4	33.2	200.0	-15.6
354.64	V	180.0	2.0	14.1	14.3	2.9	31.3	36.6	200.0	-14.8
393.28	V	180.0	1.3	16.2	15.1	2.9	34.2	51.5	200.0	-11.8
449.47	V	90.0	1.3	16.1	15.7	3.2	35.0	56.2	200.0	-11.0
491.58	V	270.0	1.3	15.1	16.7	3.3	35.1	56.8	200.0	-10.9
569.98	V	345.0	1.1	16.9	18.2	3.5	38.6	85.5	200.0	-7.4
589.88	V	90.0	1.2	14.2	18.1	3.6	35.9	62.2	200.0	-10.1
786.53	V	270.0	1.1	11.5	21.3	4.2	37.1	71.3	200.0	-9.0

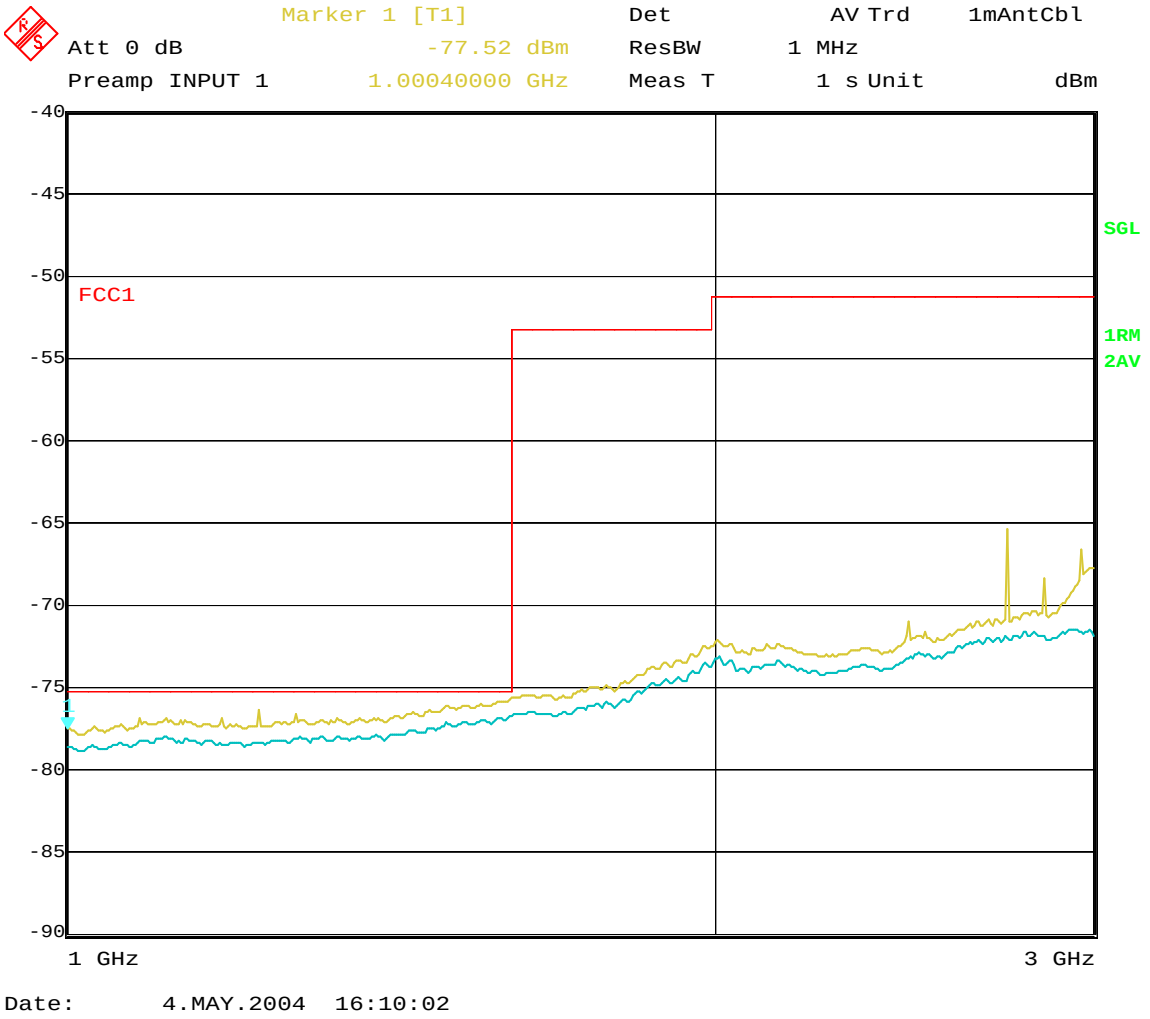

Figure 4-3. Radiated Spurious Emissions, Code 0 Modulation, 1G – 3GHz, Horizontal

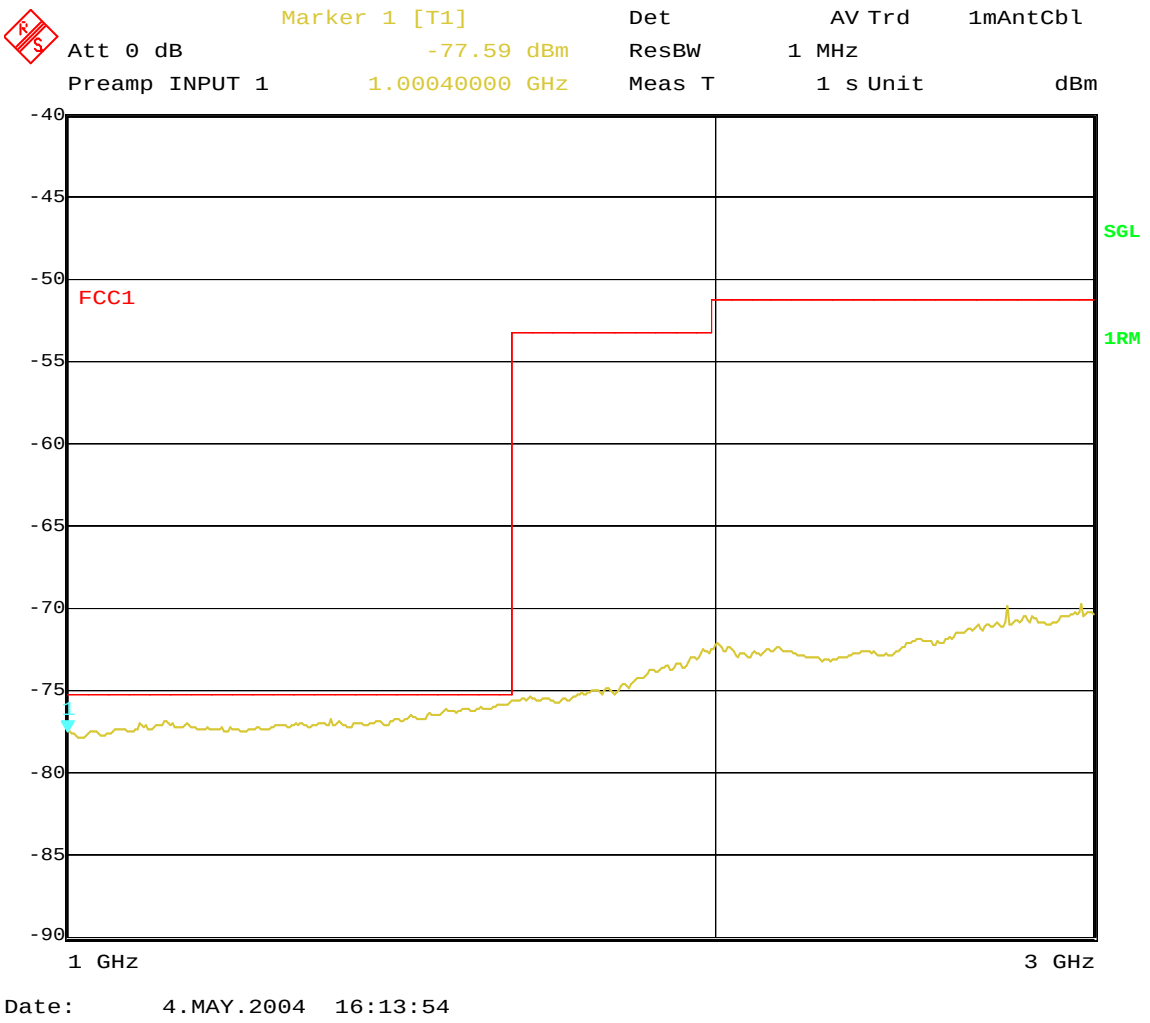

Figure 4-4. Radiated Spurious Emissions, Code 0 Modulation, 1G – 3GHz, Vertical

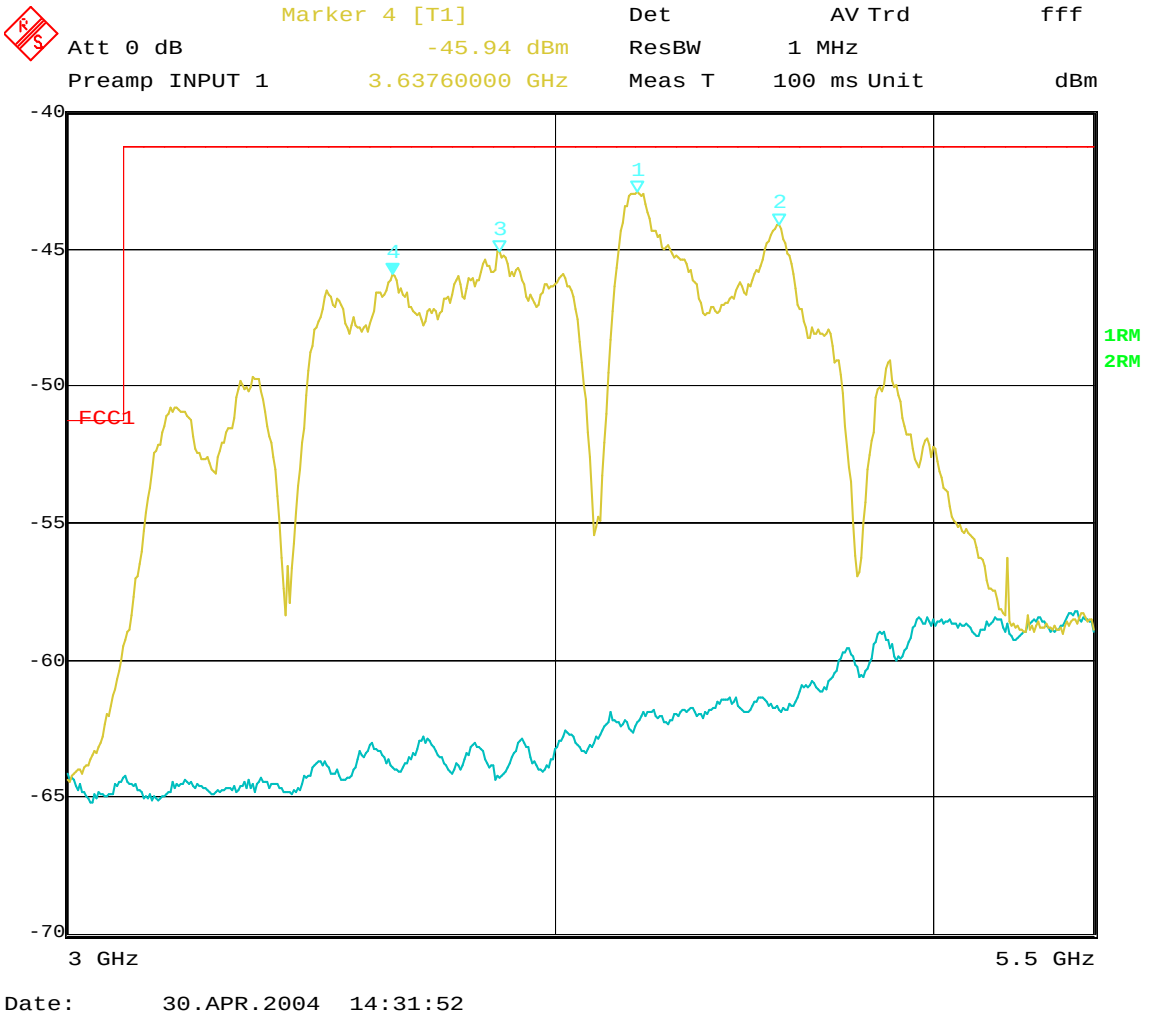

Figure 4-5. Radiated Spurious Emissions, Code 0 Modulation, 3GHz – 5.5GHz, Horizontal

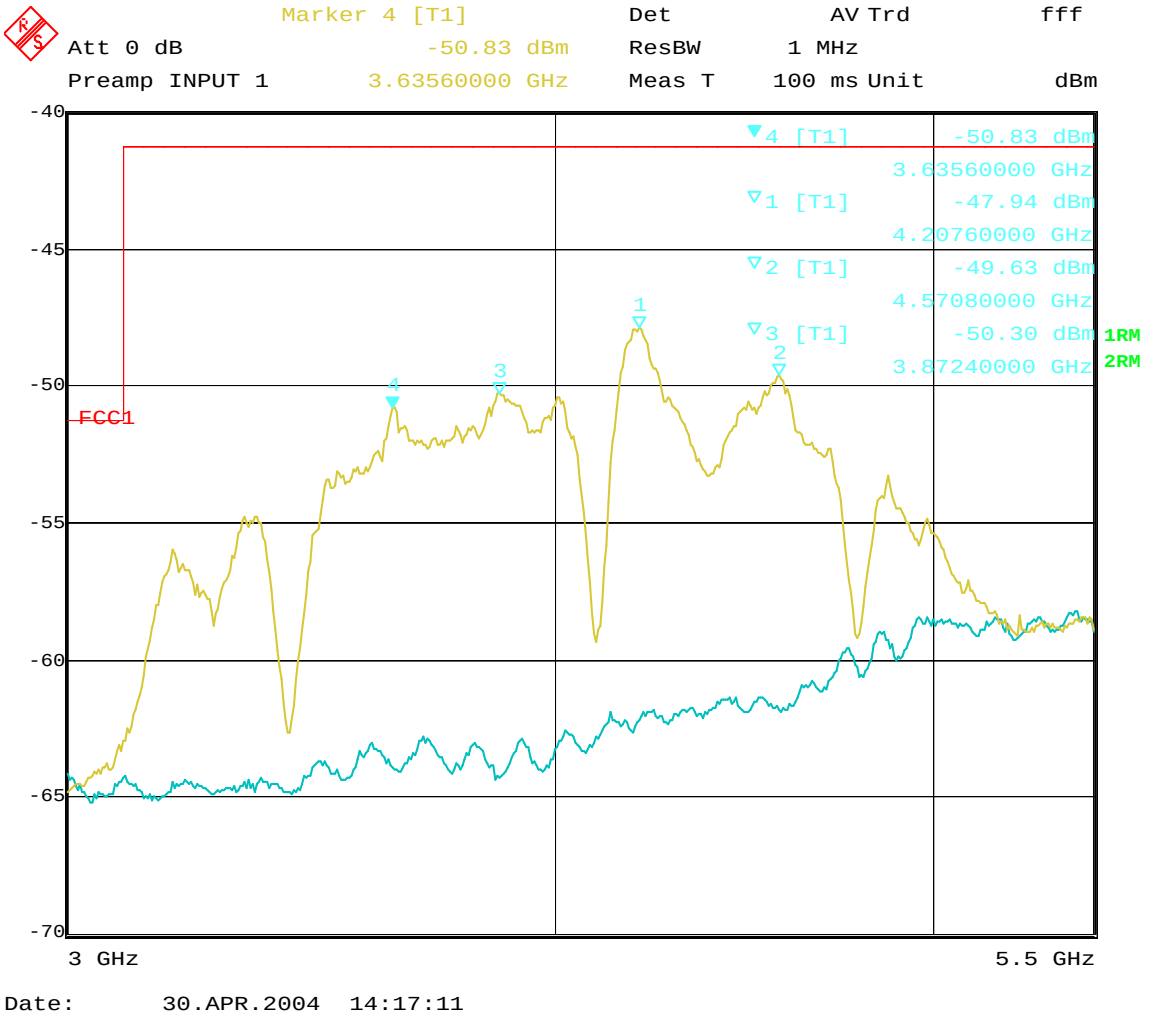

Figure 4-6. Radiated Spurious Emissions, Code 0 Modulation, 3GHz – 5.5GHz, Vertical

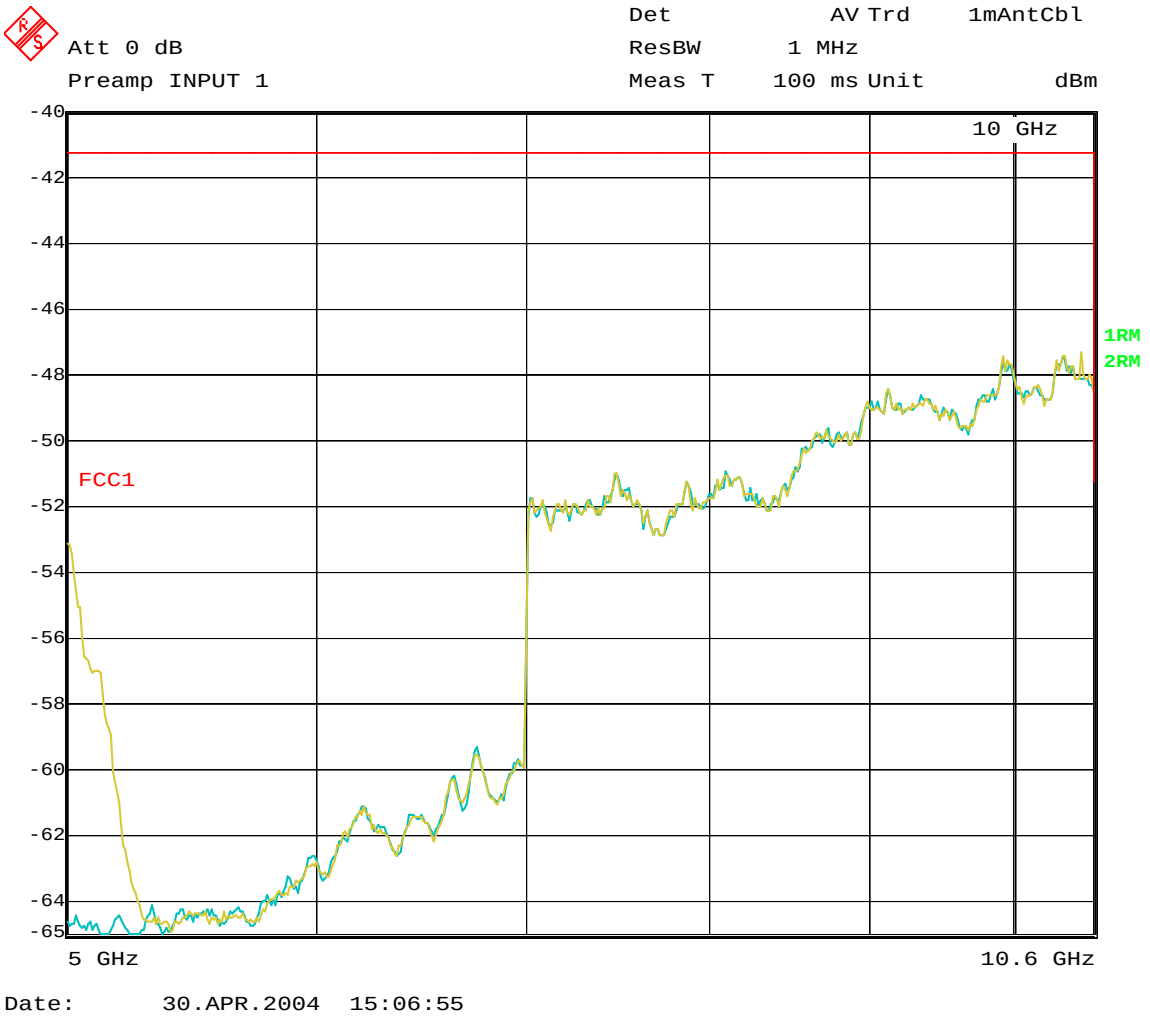

Figure 4-7. Radiated Spurious Emissions, Code 0 Modulation, 5G – 10.6 GHz, Horizontal

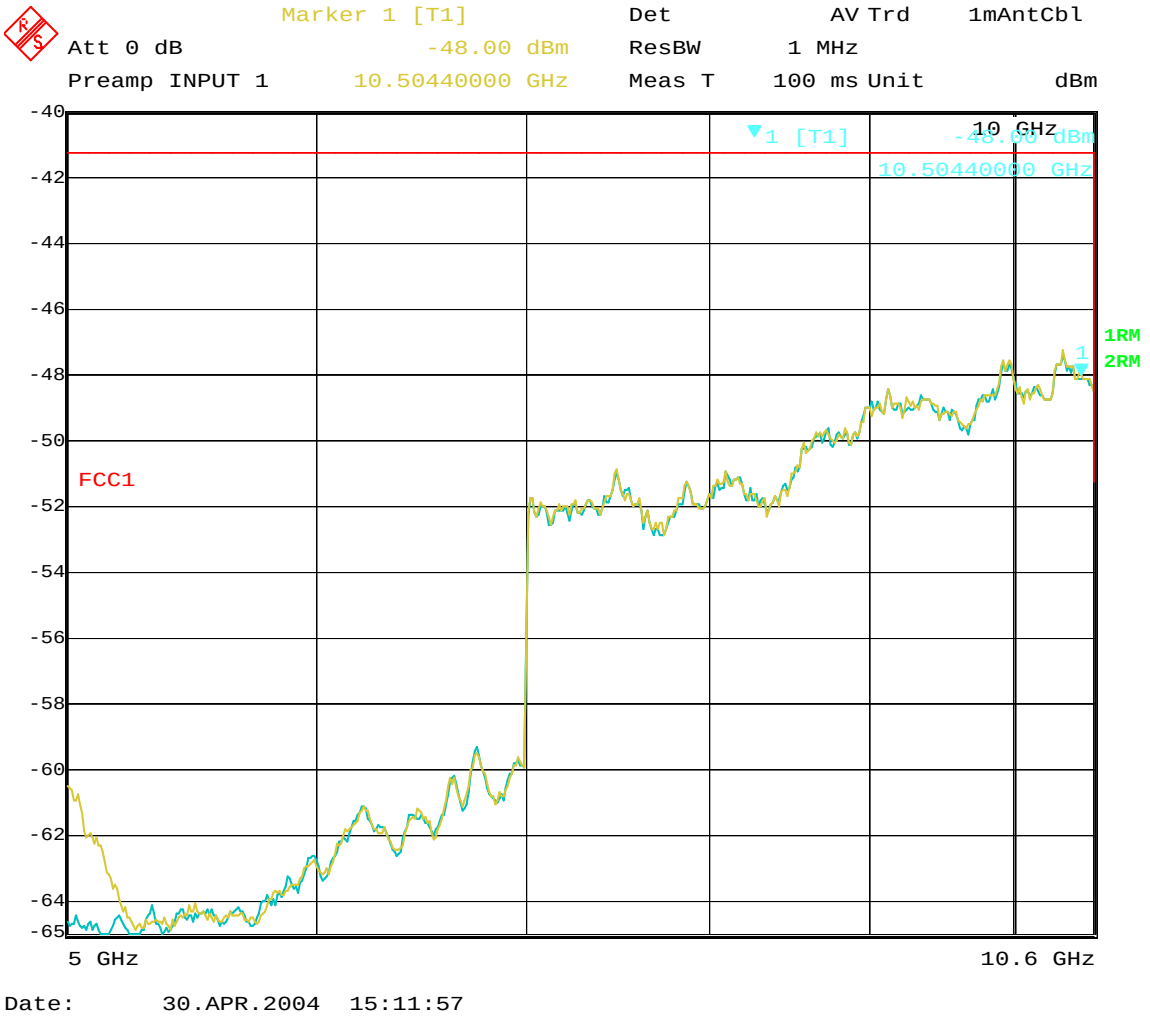

Figure 4-8. Radiated Spurious Emissions, Code 0 Modulation, 5G – 10.6GHz, Vertical

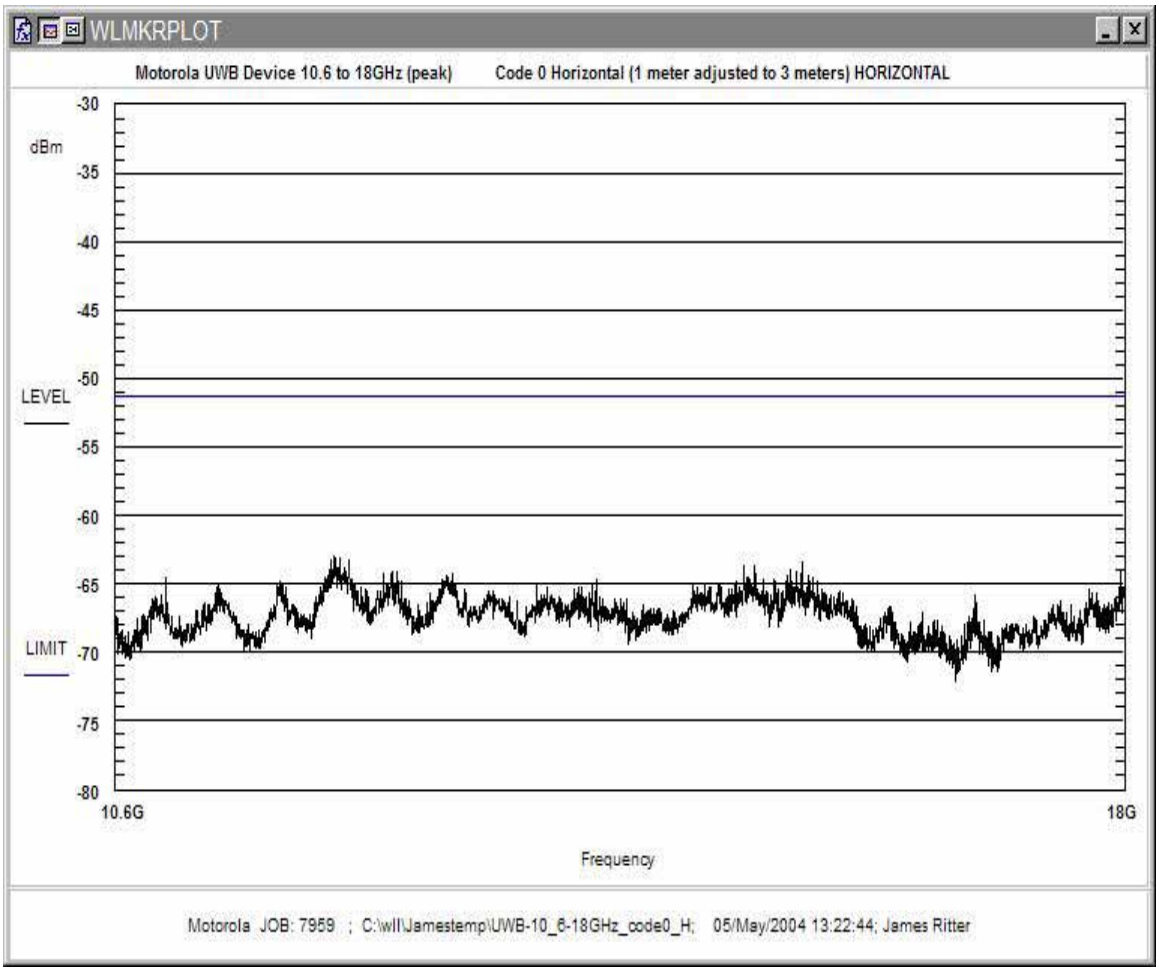

Figure 4-9. Radiated Spurious Emissions, Code 0 Modulation, 10.6G – 18 GHz, Horizontal

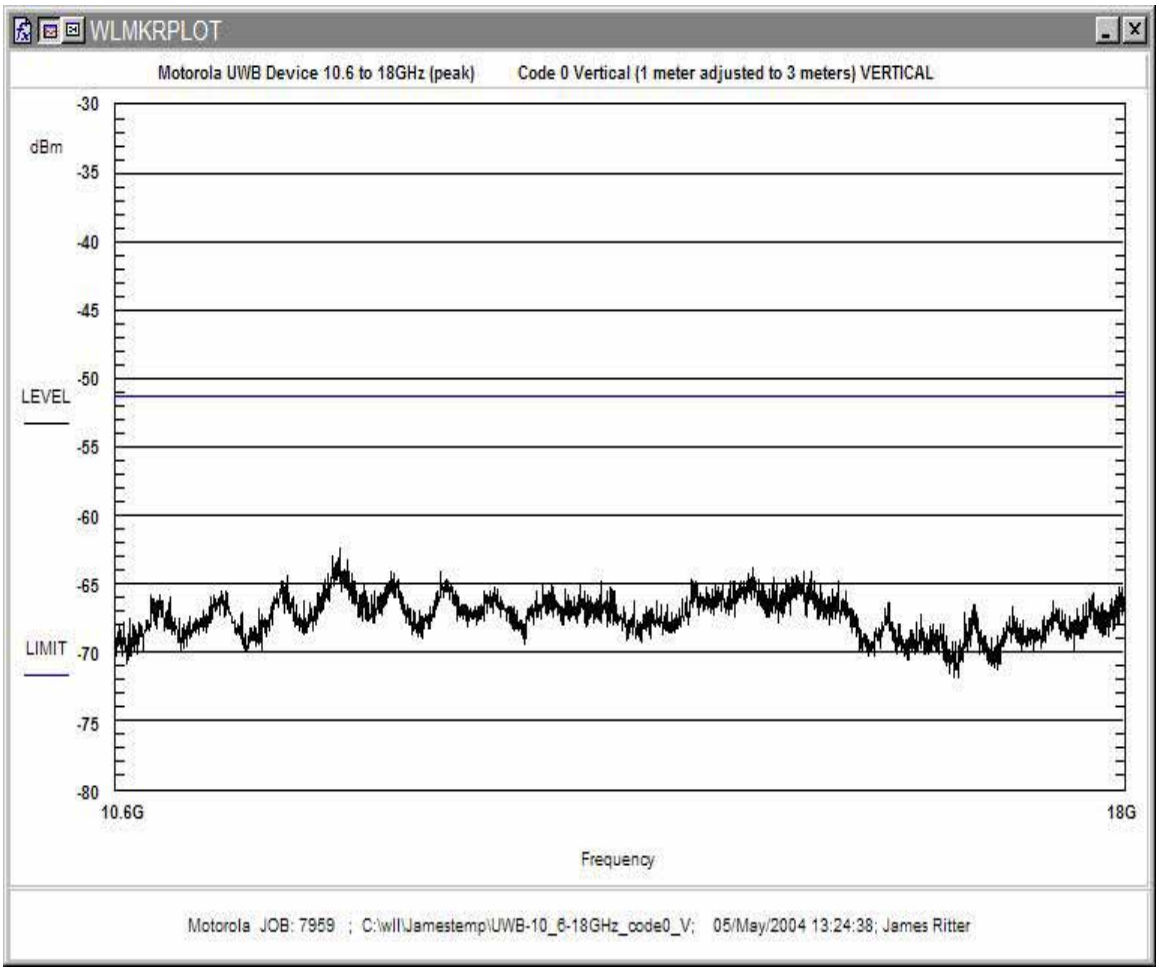

Figure 4-10. Radiated Spurious Emissions, Code 0 Modulation, 10.6G - 18GHz, Vertical

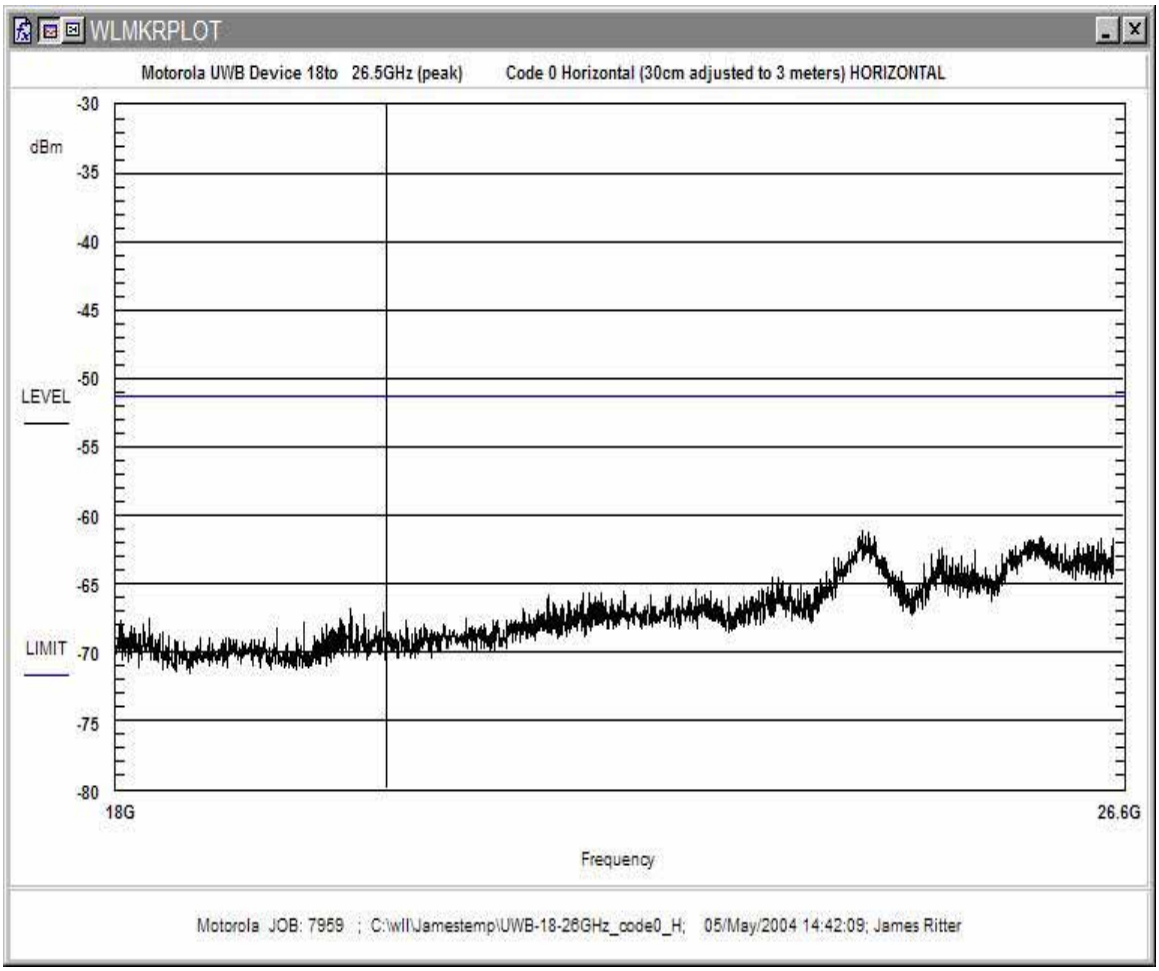

Figure 4-11. Radiated Spurious Emissions, Code 0 Modulation, 18G – 26.6GHz, Horizontal

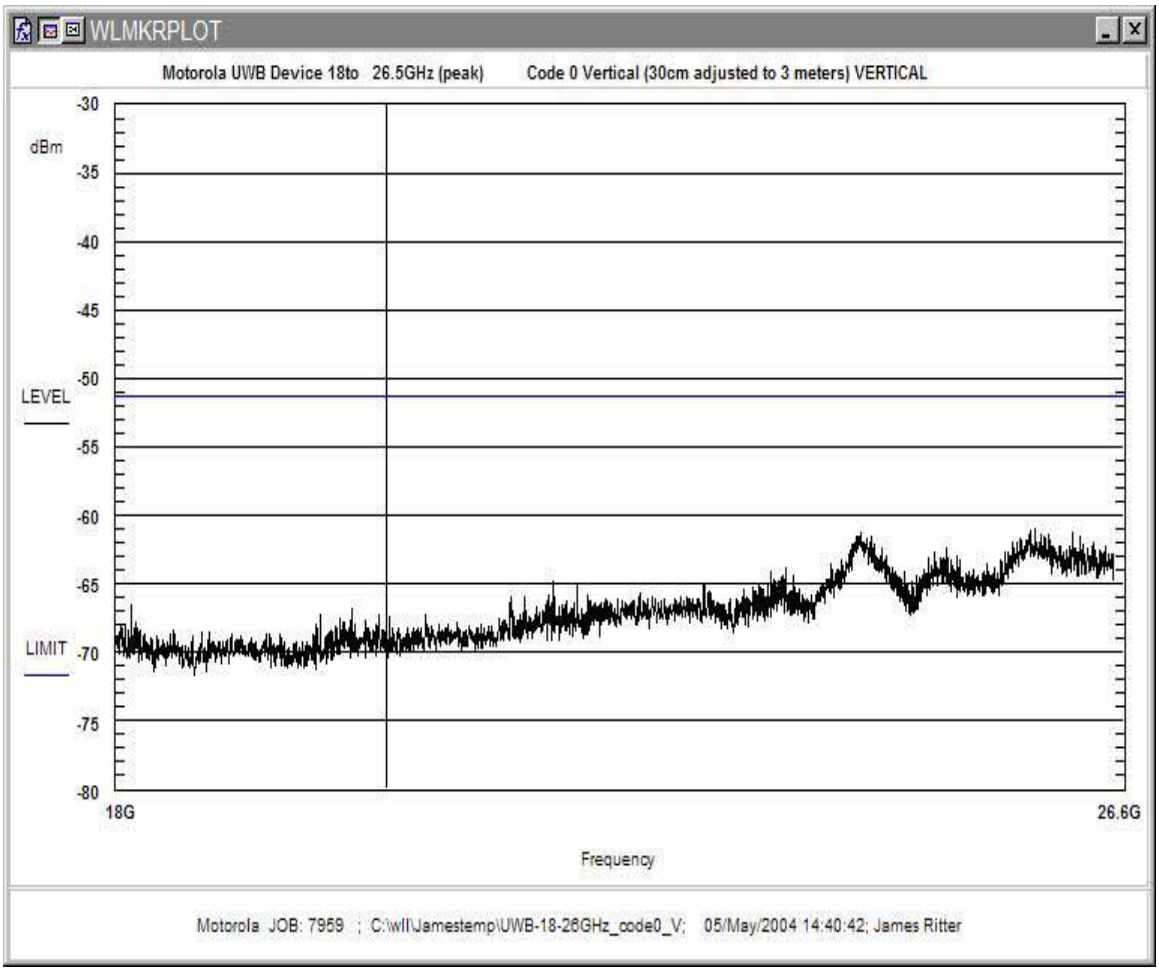

Figure 4-12. Radiated Spurious Emissions, Code 0 Modulation, 18G – 26.6GHz, Vertical

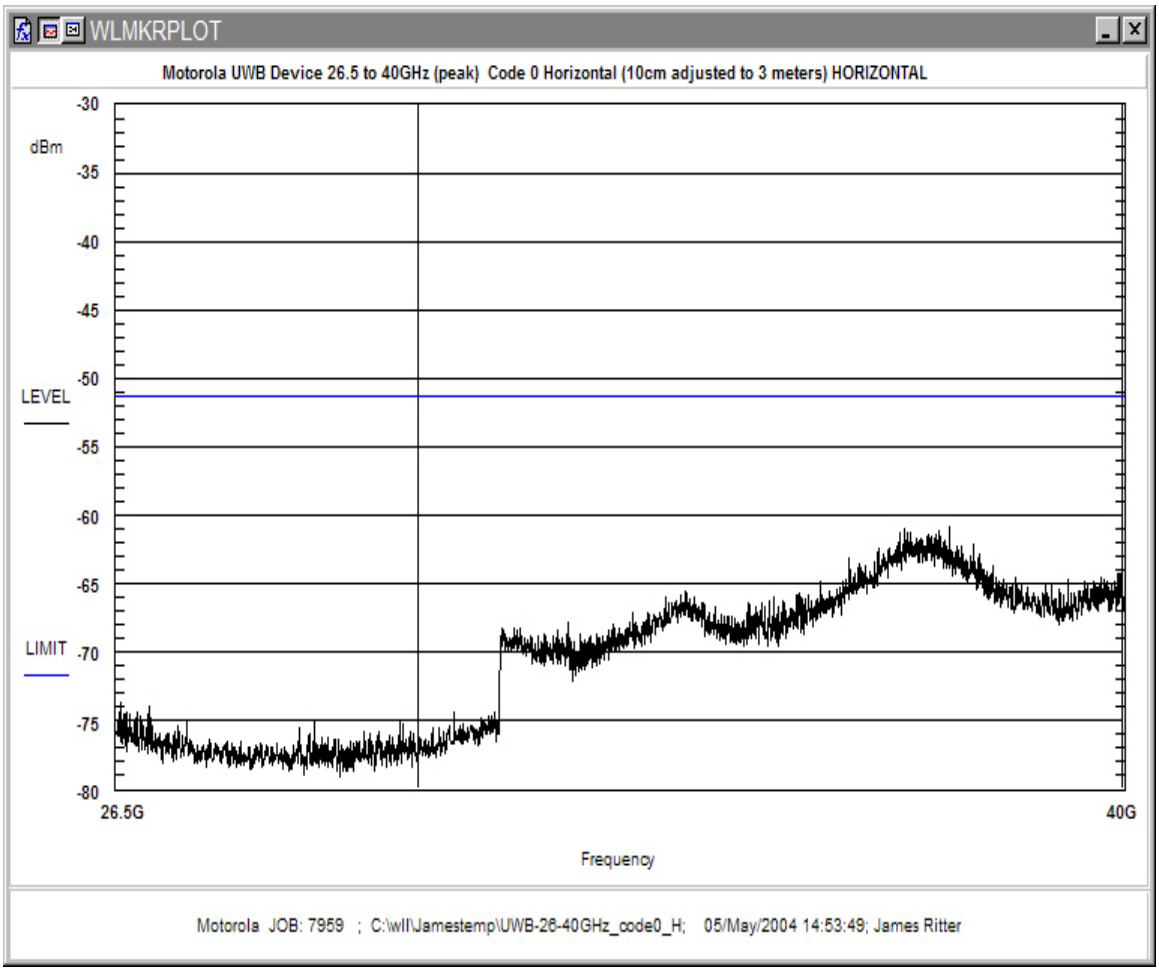

Figure 4-13. Radiated Spurious Emissions, Code 0 Modulation, 26.5G - 40GHz, Horizontal

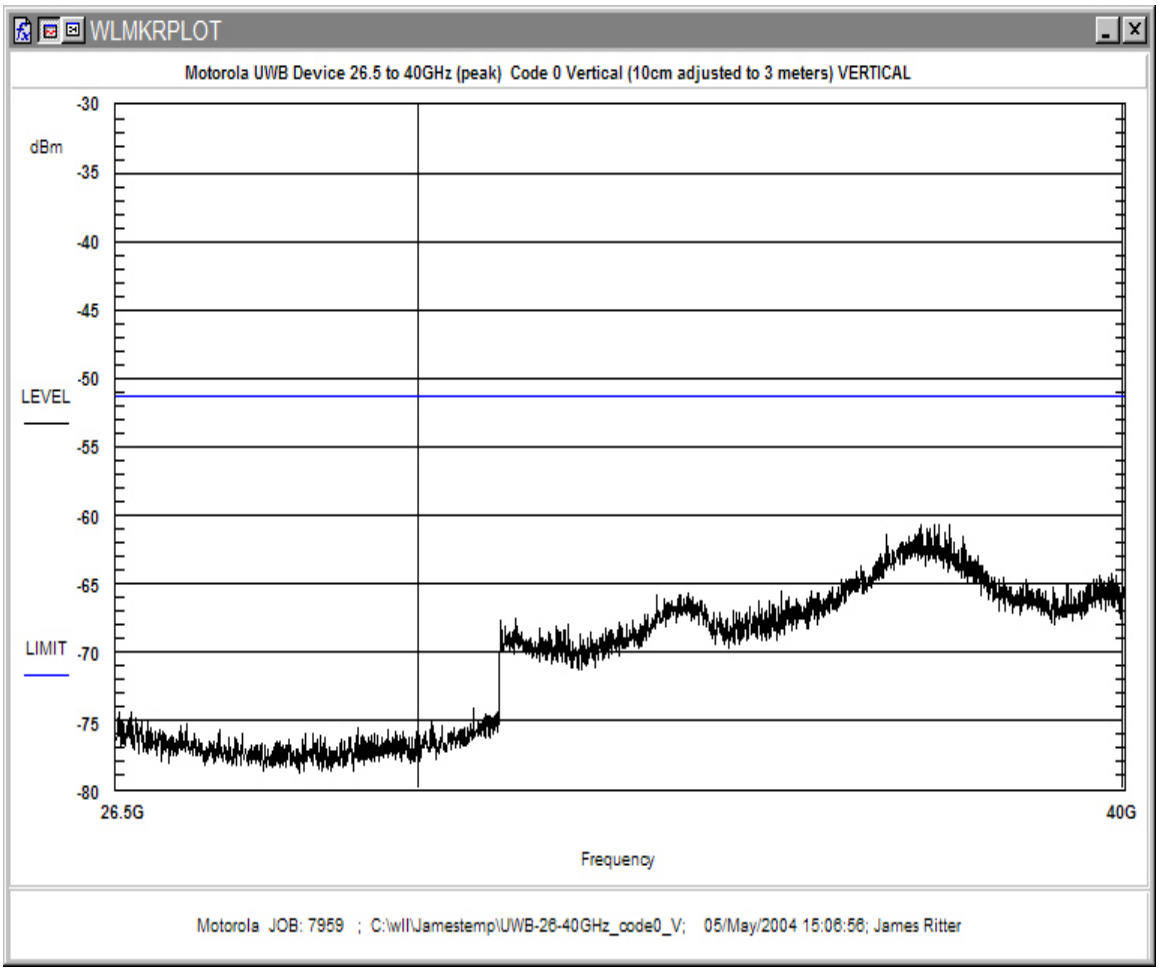

Figure 4-14. Radiated Spurious Emissions, Code 0 Modulation, 26.5G - 40GHz, Vertical

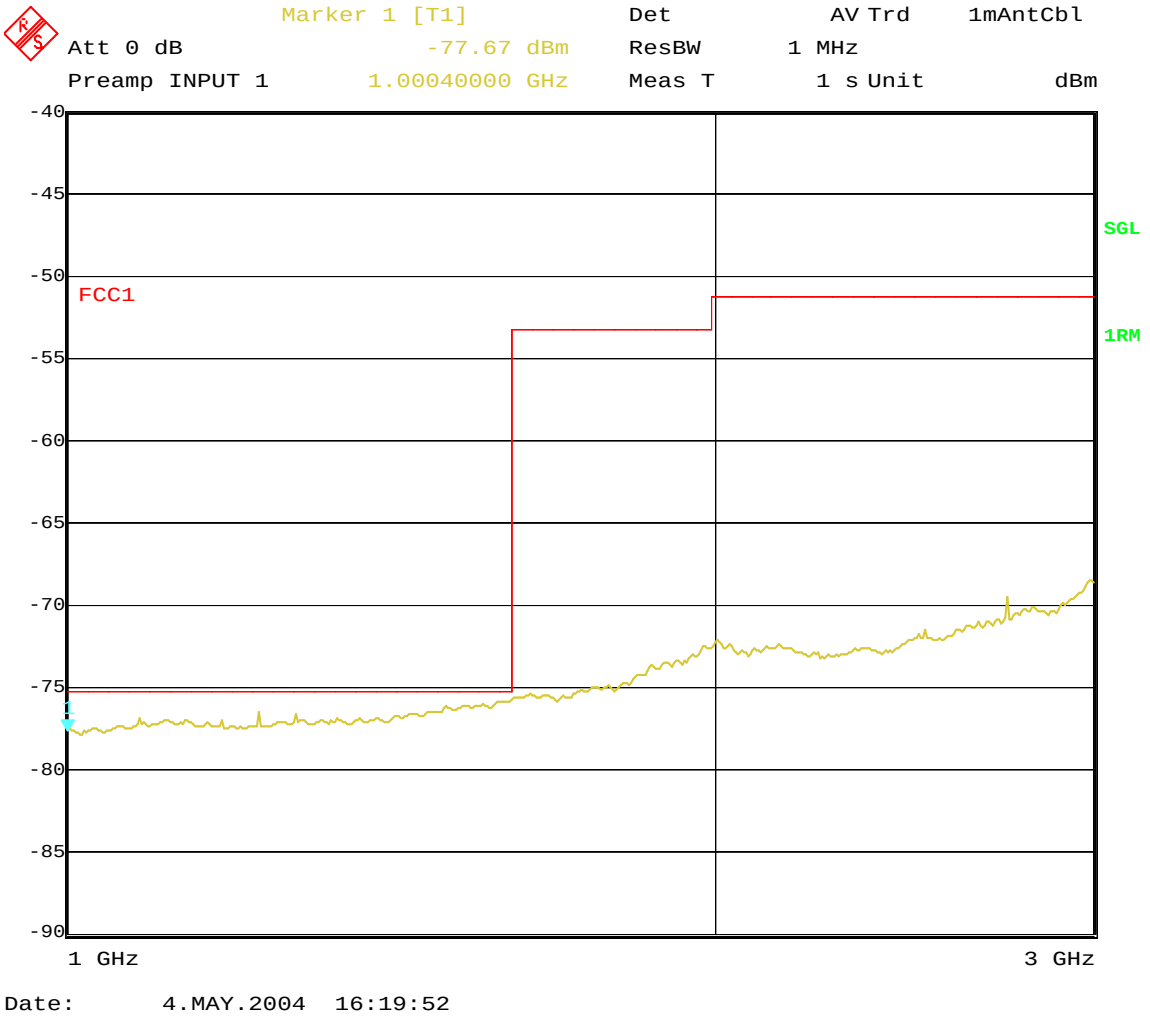

Figure 4-15. Radiated Spurious Emissions, Code 8 Modulation, 1G – 3GHz, Horizontal

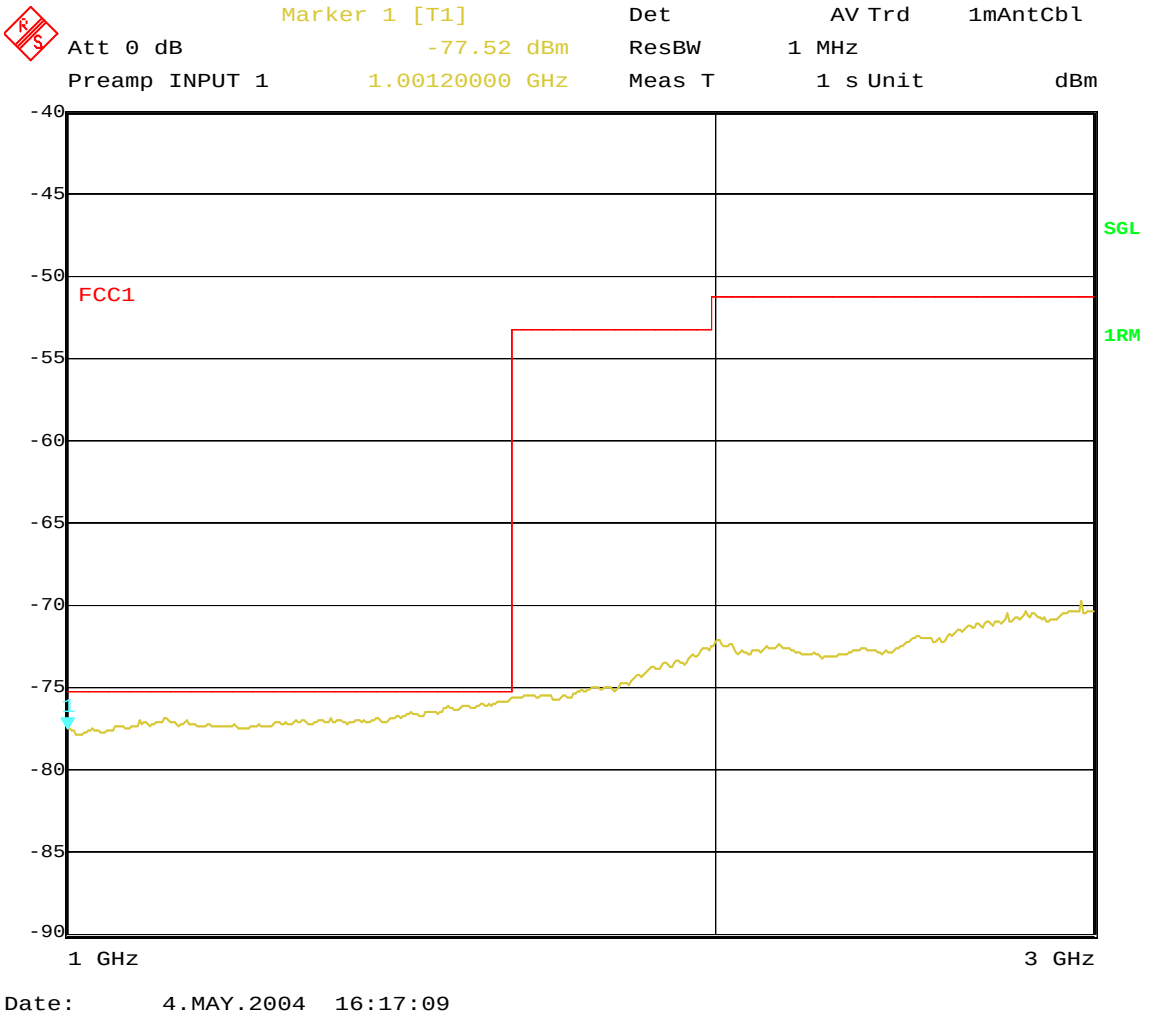

Figure 4-16. Radiated Spurious Emissions, Code 8 Modulation, 1G – 3GHz, Vertical

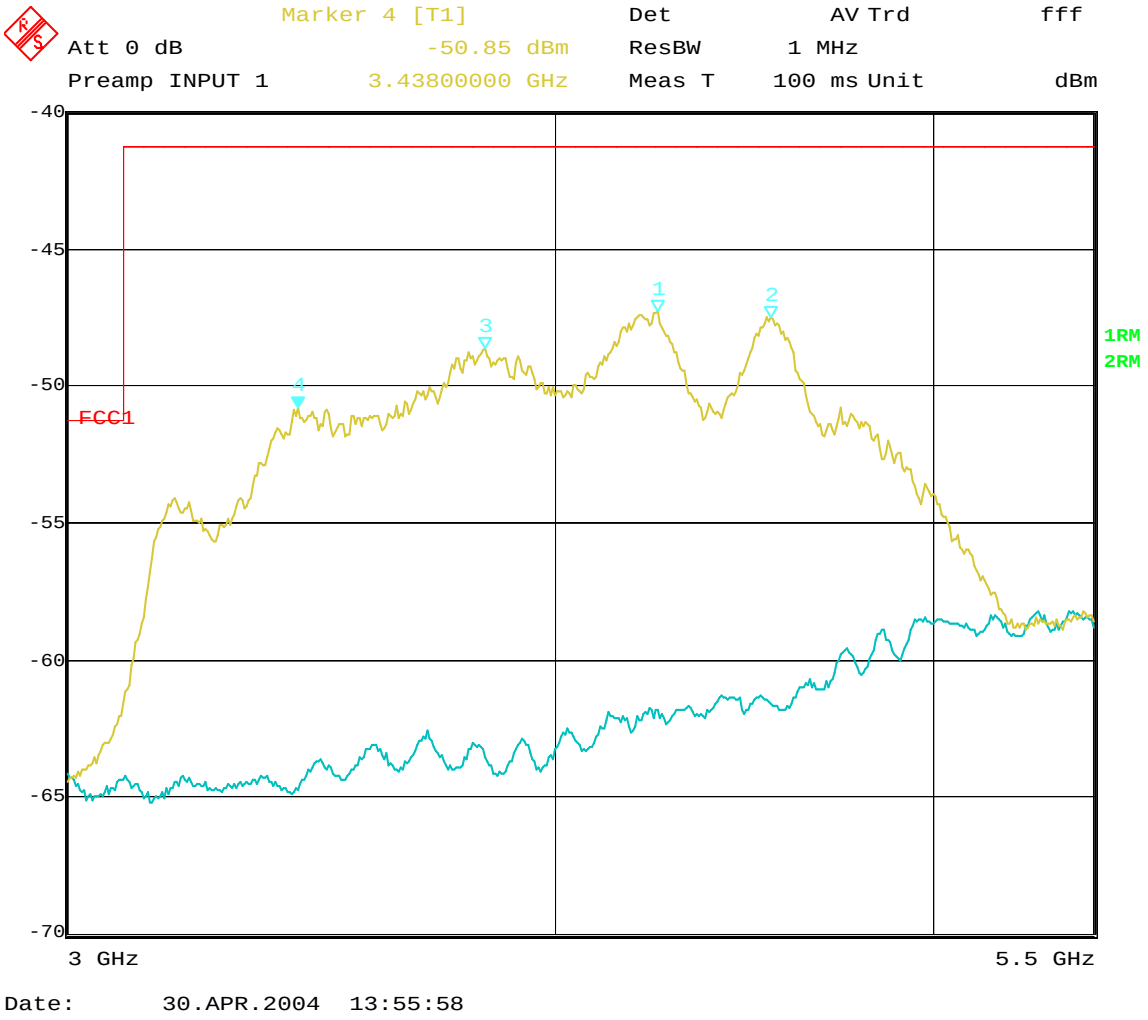

Figure 4-17. Radiated Spurious Emissions, Code 8 Modulation, 3GHz – 5.5GHz, Horizontal

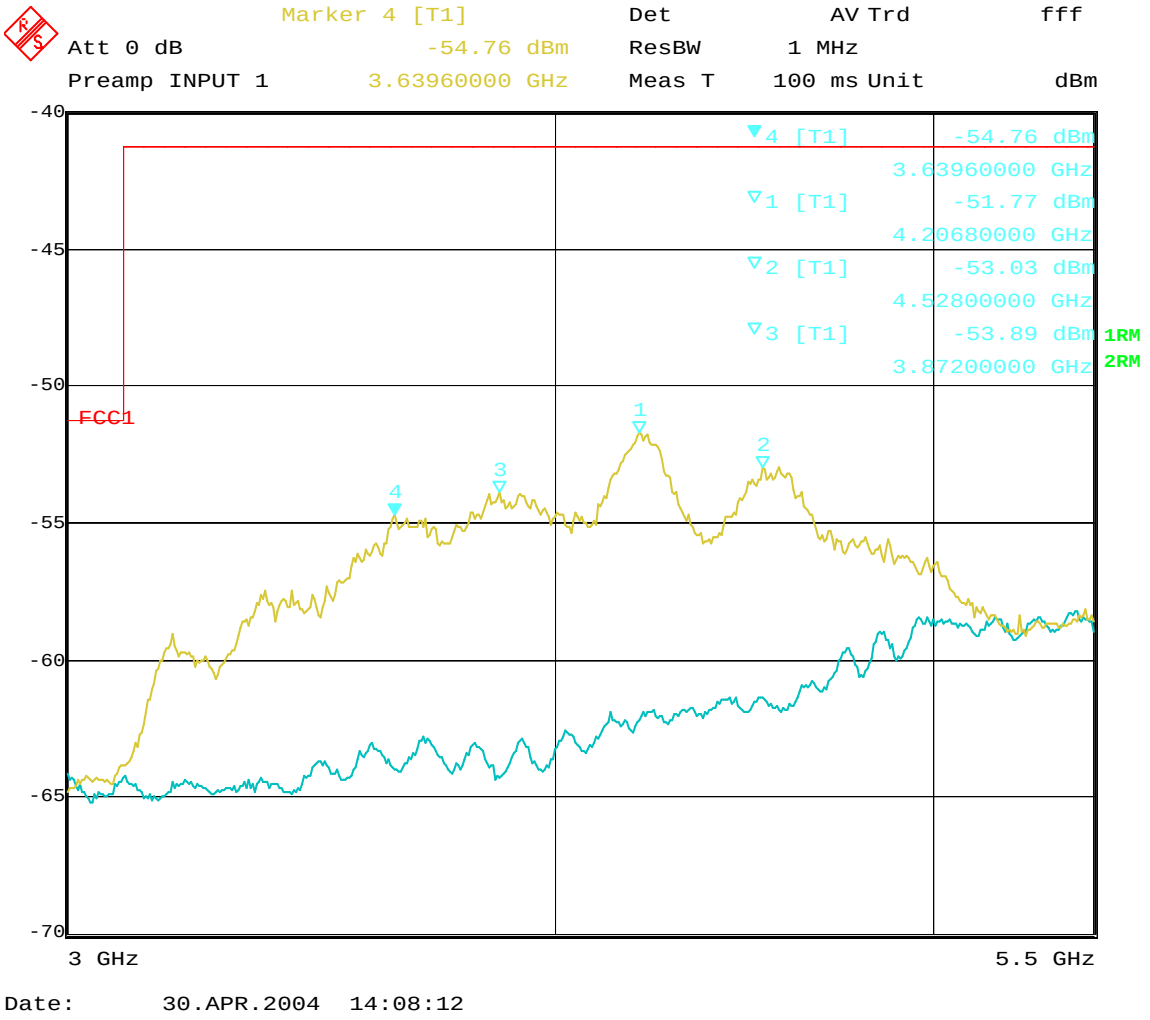

Figure 4-18. Radiated Spurious Emissions, Code 8 Modulation, 3GHz – 5.5GHz, Vertical

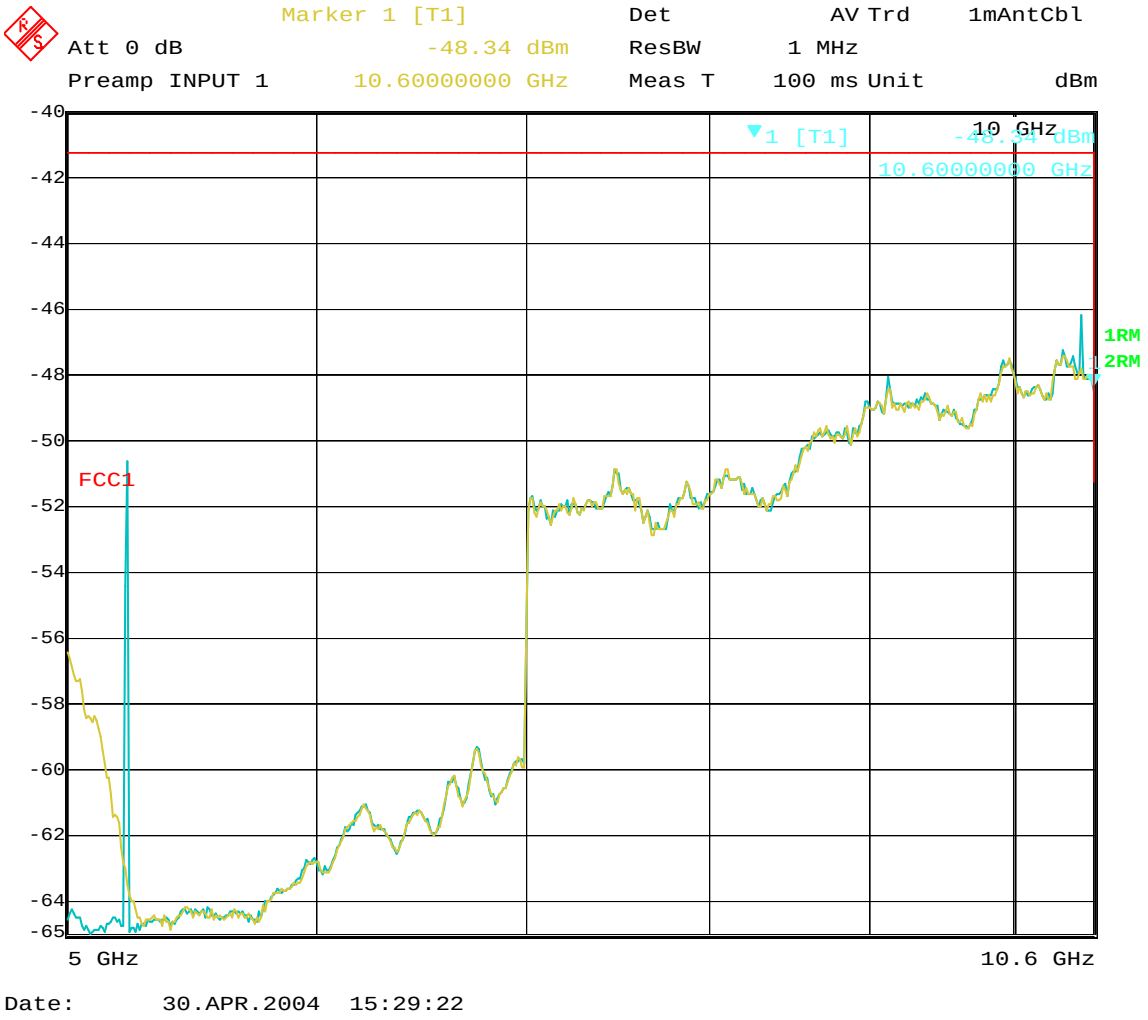

Figure 4-19. Radiated Spurious Emissions, Code 8 Modulation, 5G – 10.6 GHz, Horizontal

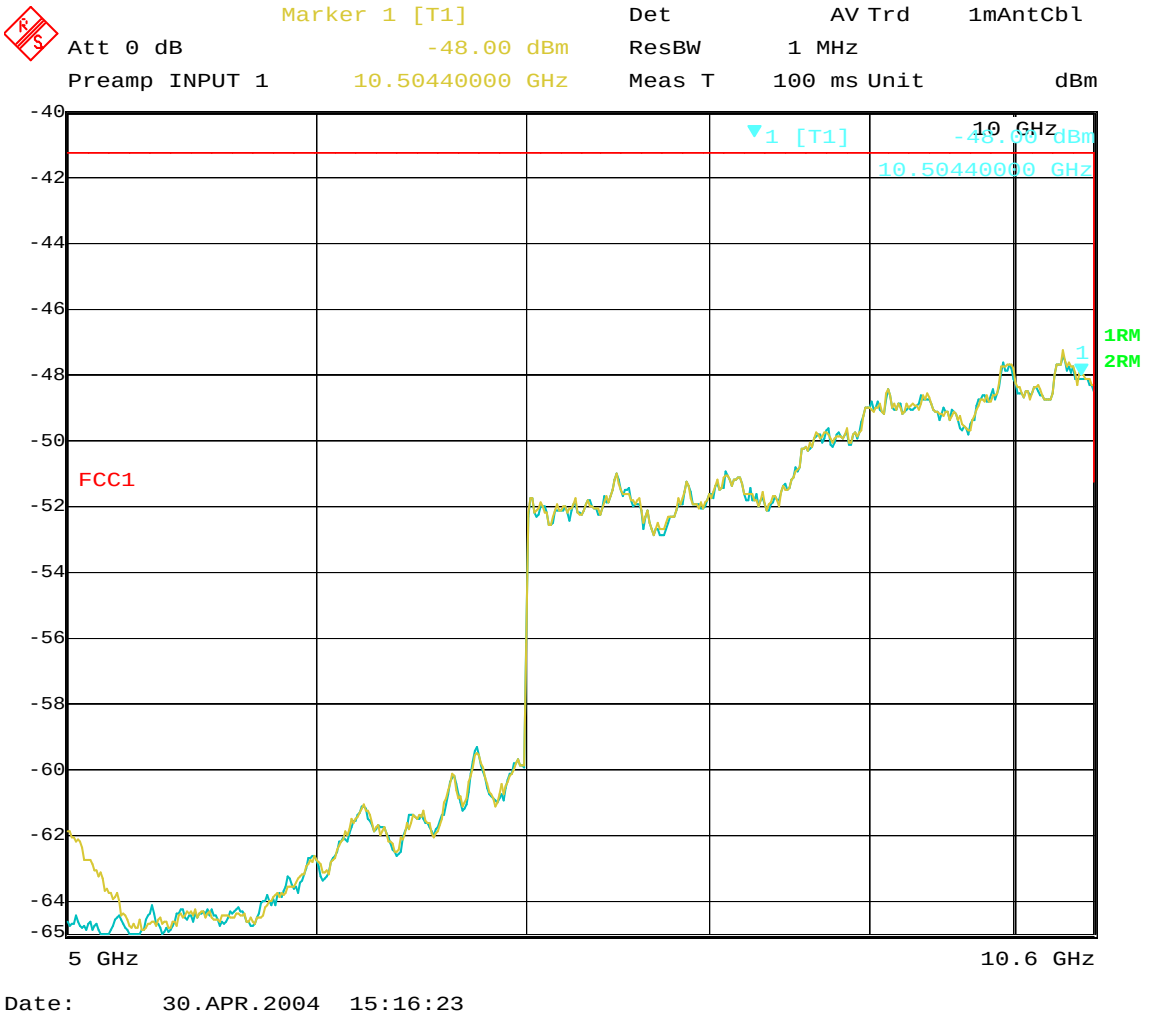

Figure 4-20. Radiated Spurious Emissions, Code 8 Modulation, 5G – 10.6GHz, Vertical

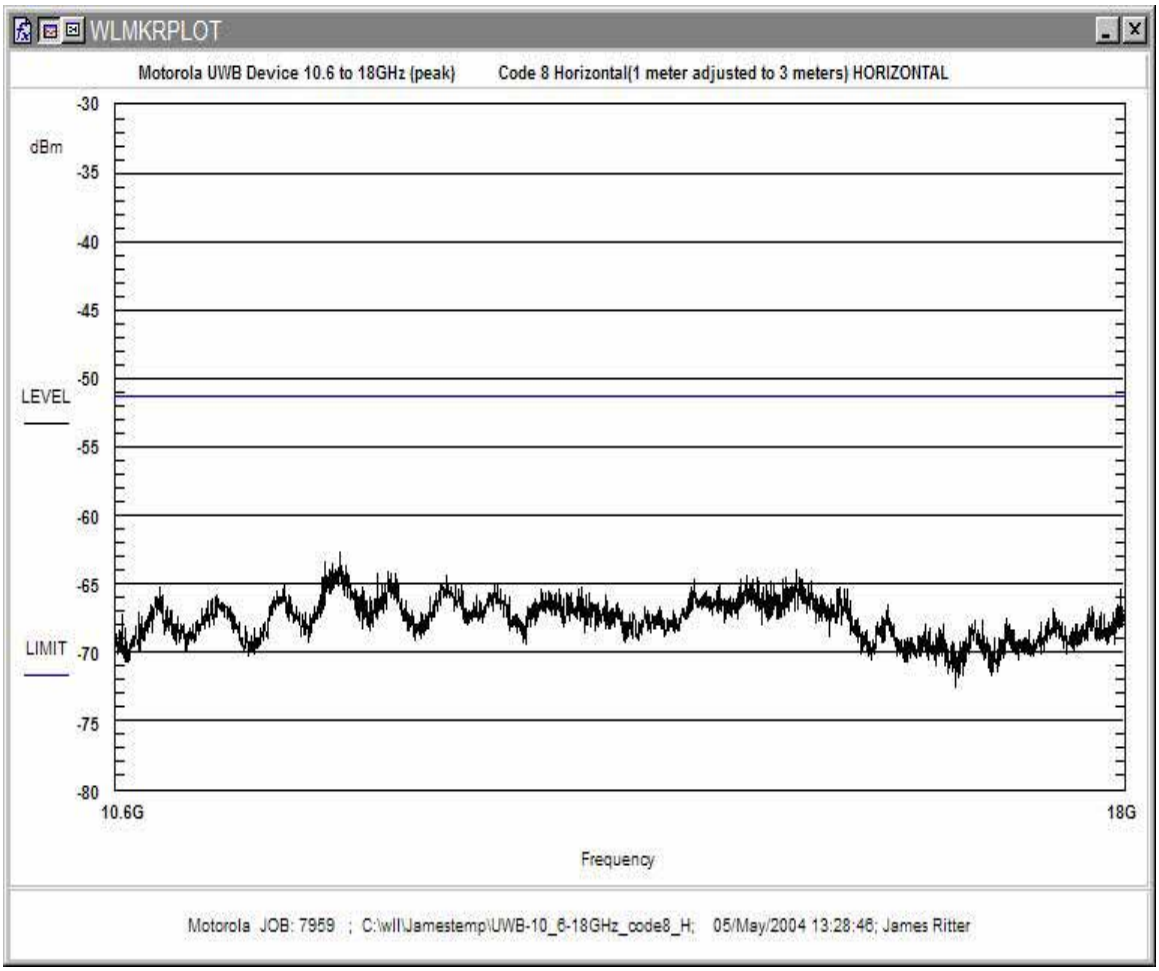

Figure 4-21. Radiated Spurious Emissions, Code 8 Modulation, 10.6G – 18 GHz, Horizontal

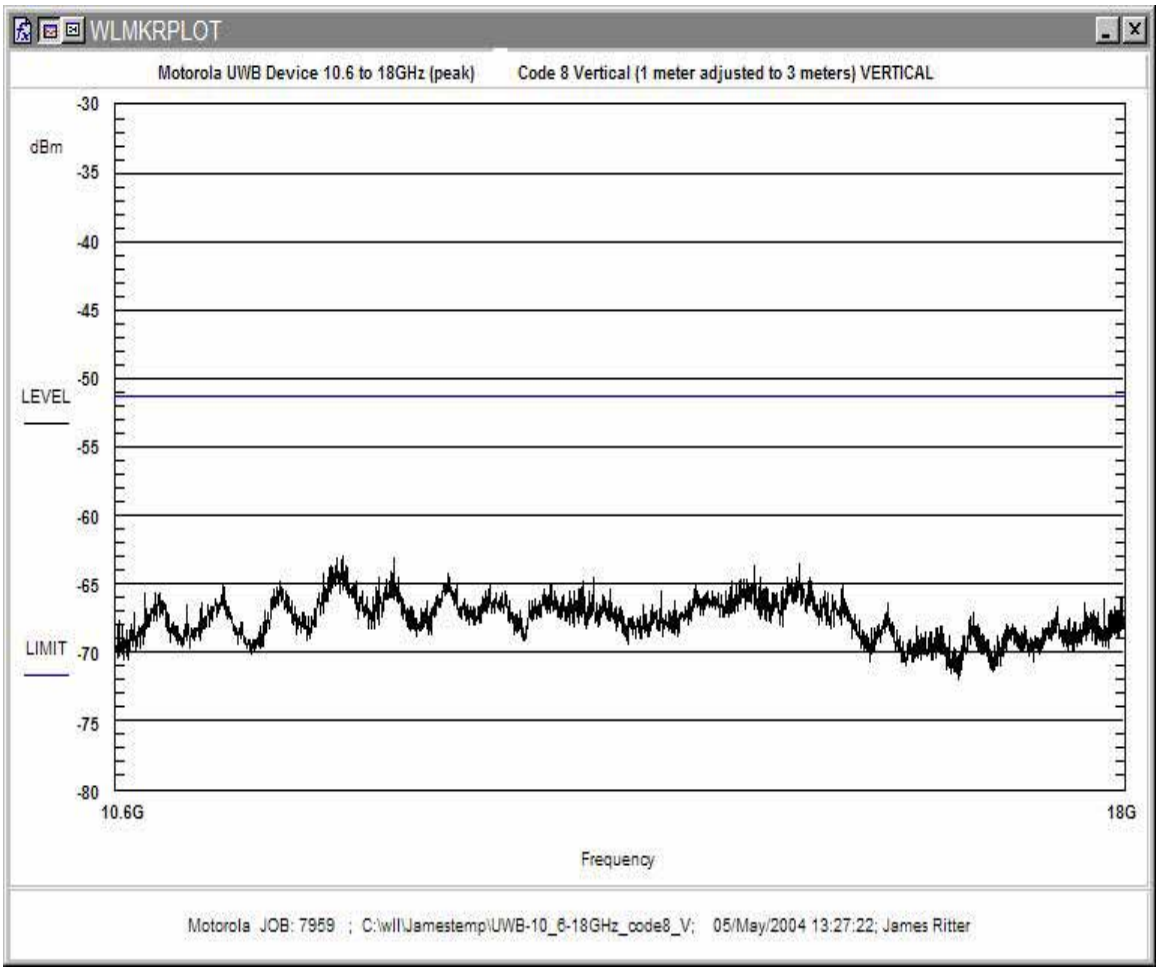

Figure 4-22. Radiated Spurious Emissions, Code 8 Modulation, 10.6G - 18GHz, Vertical

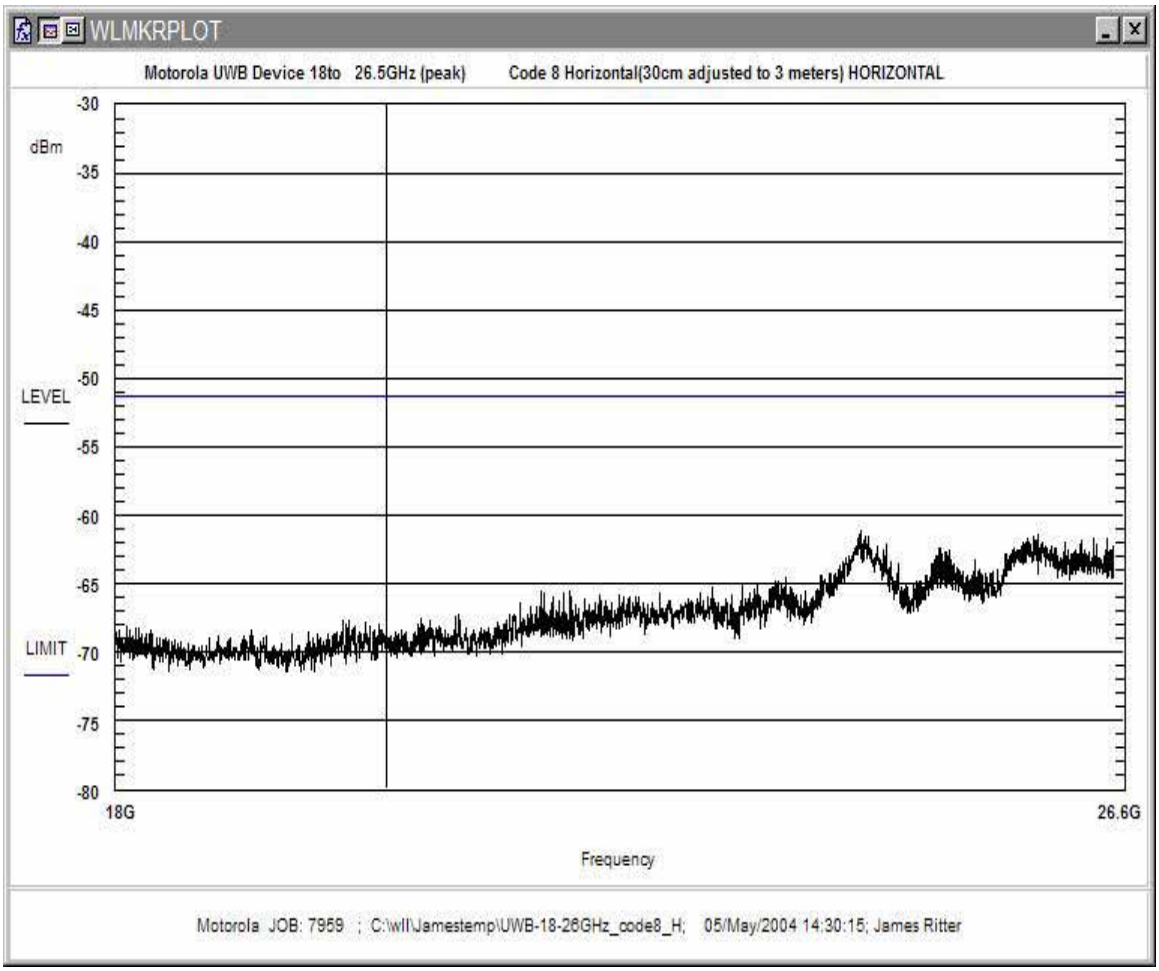

Figure 4-23. Radiated Spurious Emissions, Code 8 Modulation, 18G – 26.6GHz, Horizontal

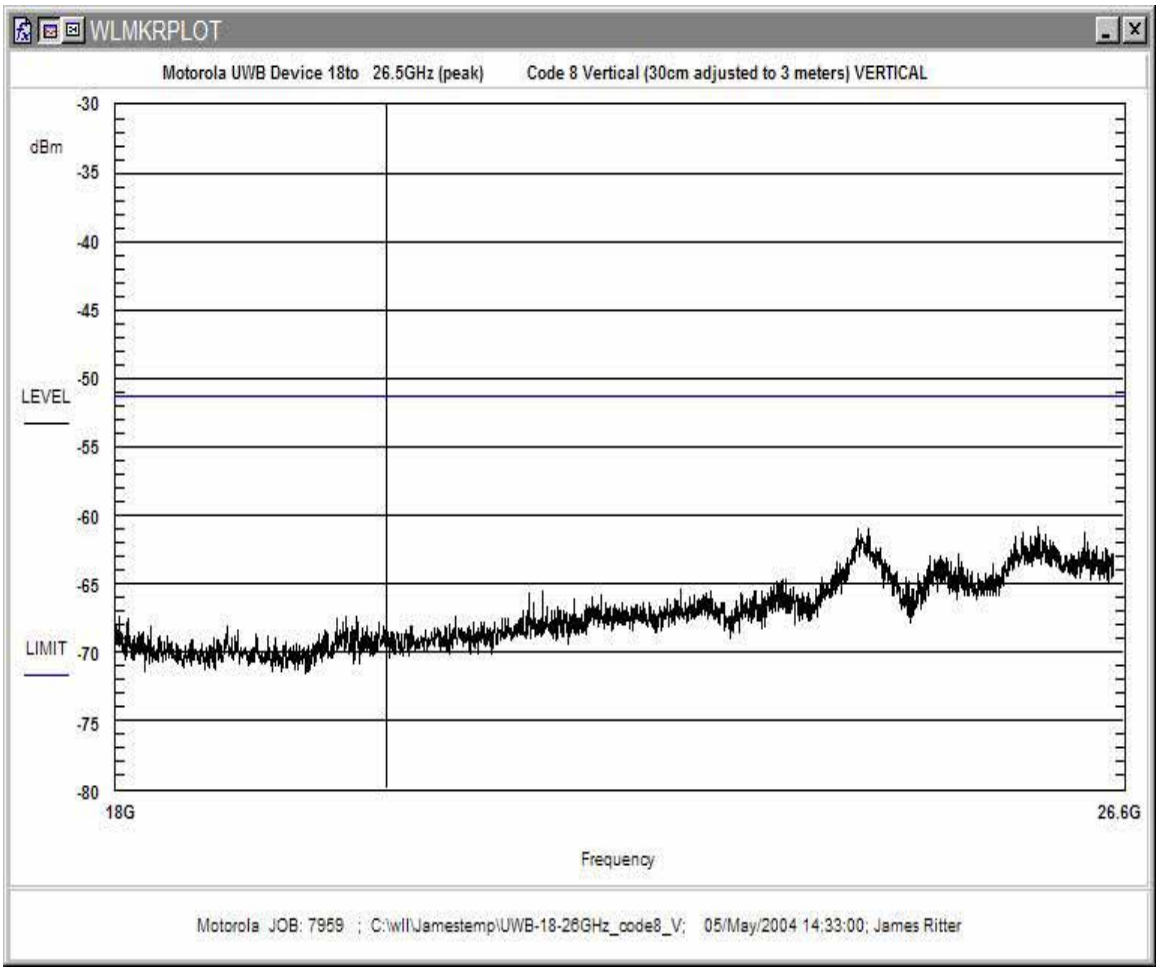

Figure 4-24. Radiated Spurious Emissions, Code 8 Modulation, 18G – 26.6GHz, Vertical

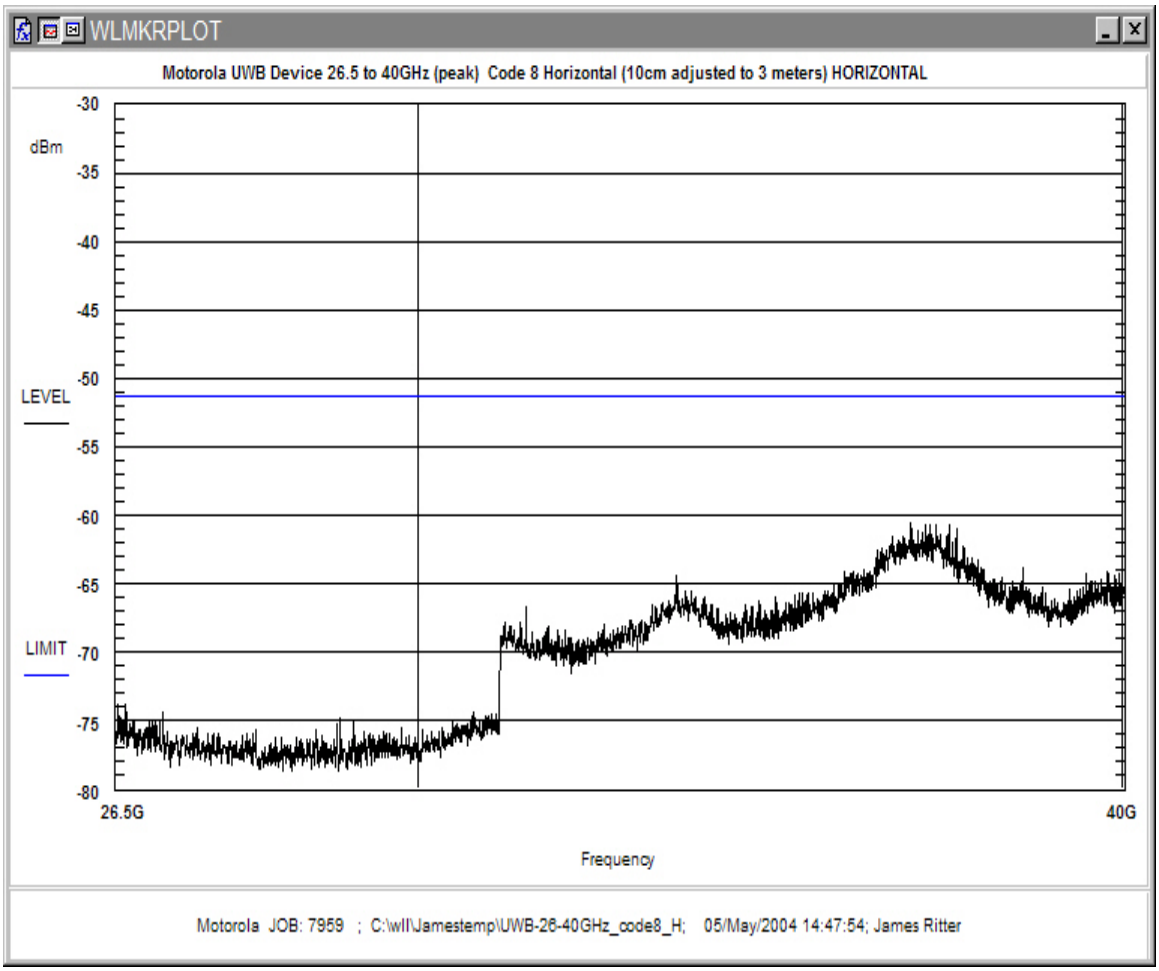

Figure 4-25. Radiated Spurious Emissions, Code 8 Modulation, 26.5G - 40GHz, Horizontal

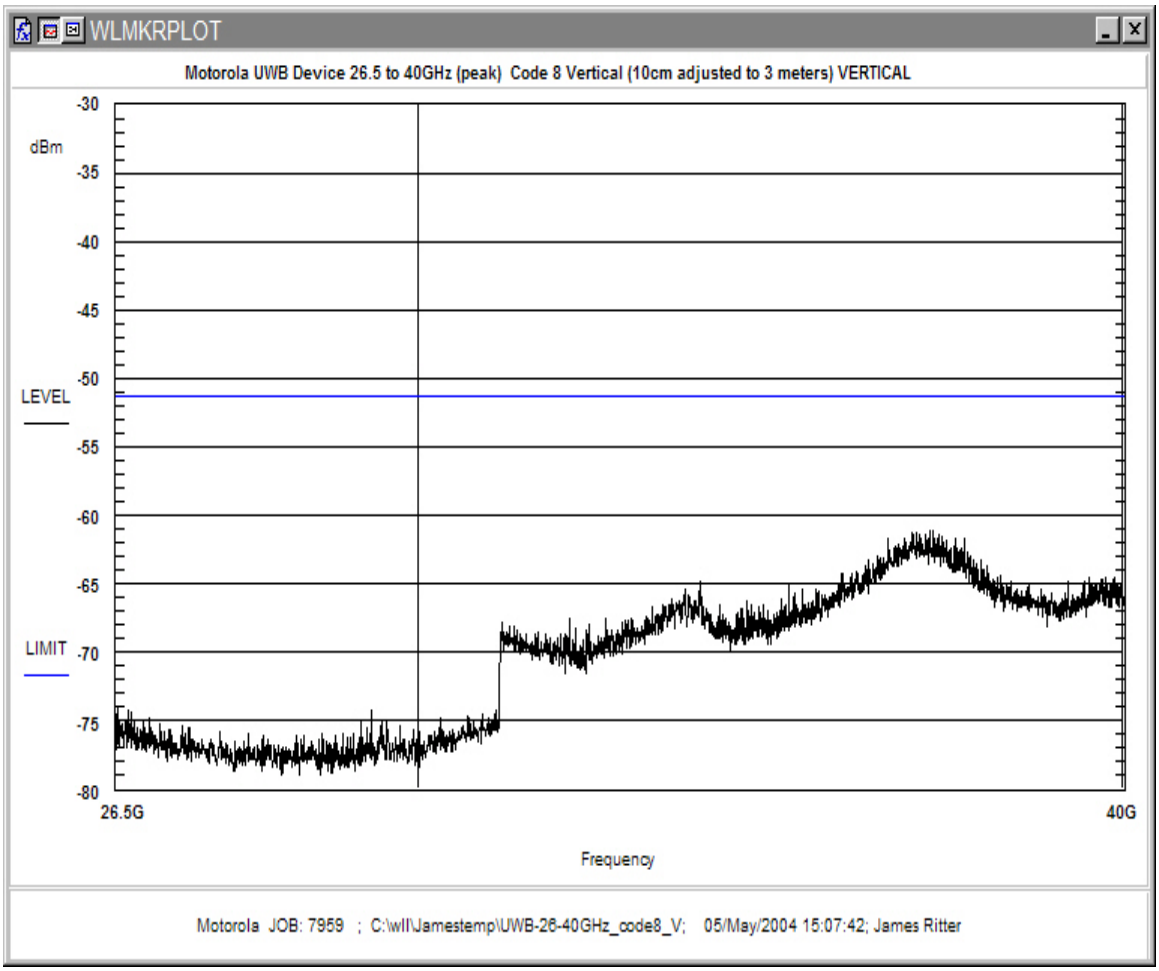

Figure 4-26. Radiated Spurious Emissions, Code 8 Modulation, 26.5G - 40GHz, Vertical

4.4 Radiated Emissions in GPS Bands, §15.517(d)

The radiated emissions of a UWB system operating under the provisions of Section 15.517 shall not exceed the following average limits when measured with a resolution bandwidth of no less than 1 kHz:

Frequency (MHz)	EIRP (dBm)
1164 – 1240	-85.3
1559 - 1610	-85.3

4.4.1 Test Procedure

The radiated emissions were measured using the R&S analyzer with the receiving antenna located 1m from the EUT.

The resolution bandwidth of the receiver was set to 1 kHz and the frequency range was set to each of the bands listed in the table above. All corrections for the antenna, pre-amp and cable were input to the receiver. Additionally, the adjustment for 1m to 3m was also placed into the receiver so that the plots produced are directly compared to the specification limit.

The unit was checked with both modulation codes as described in Section 2.3.

4.4.2 Test Results

The Motorola UWB device complies with the requirements of §15.517(d). Plots of the detected emissions are included in the following figures.

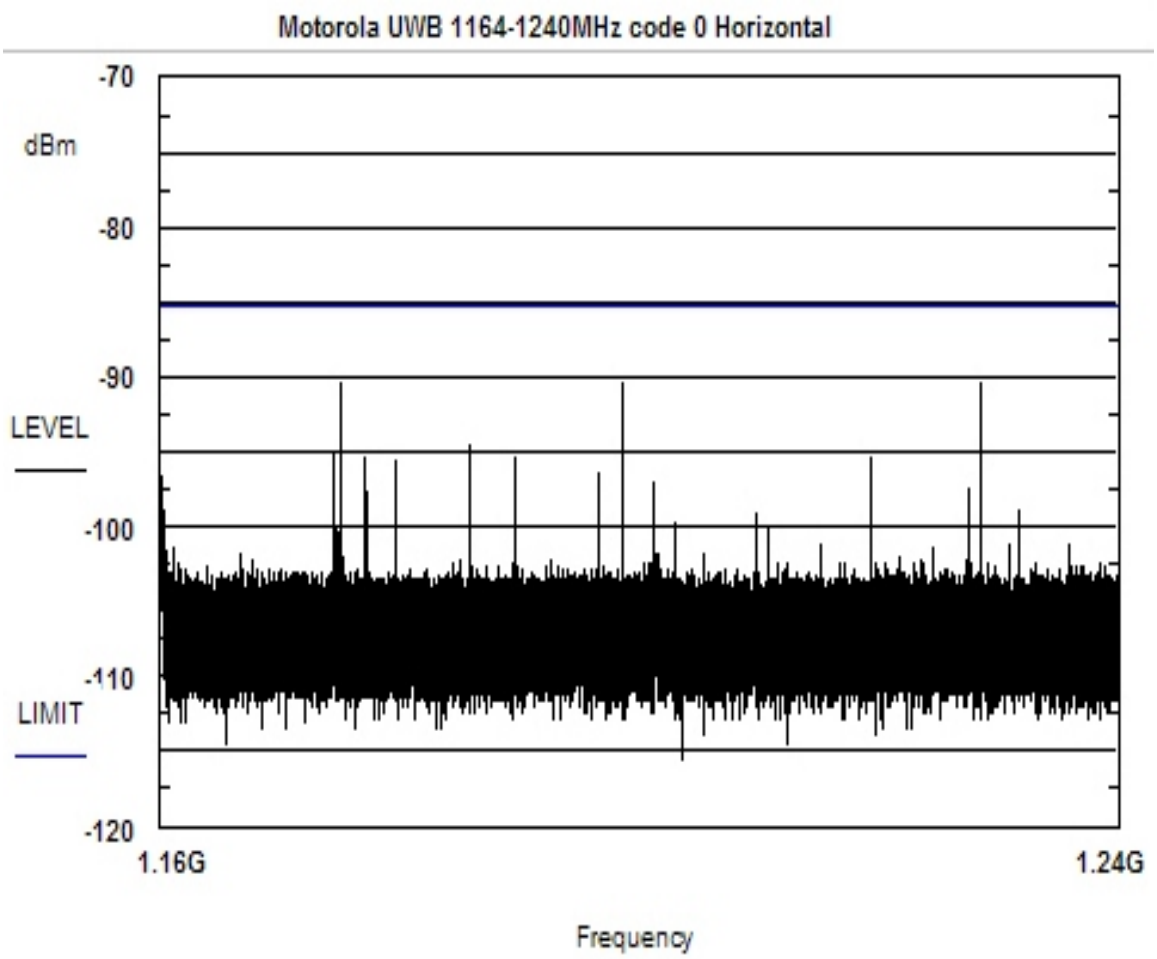

Figure 4-27. Radiated Spurious Emissions in GPS Bands, Code 0, Horizontal, 1164M – 1240MHz

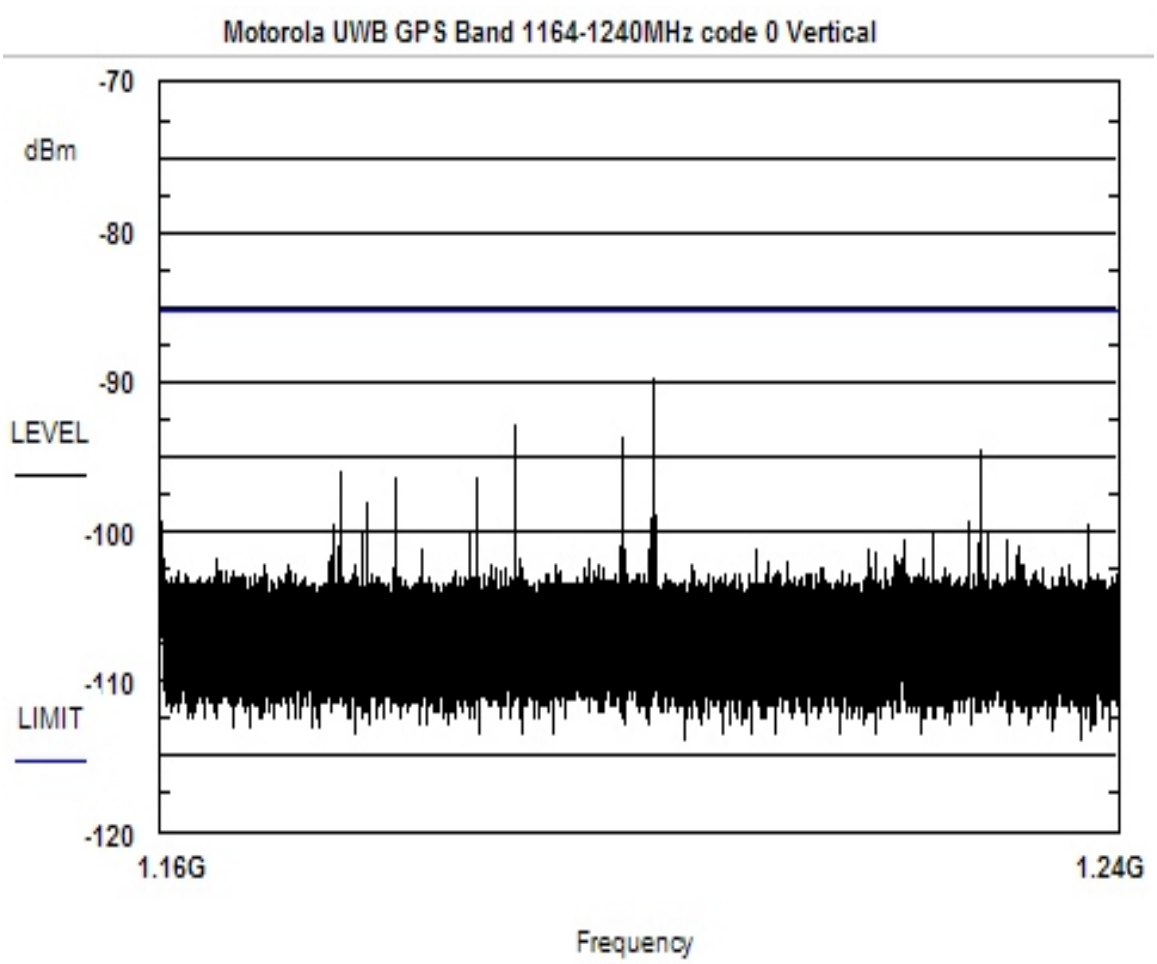

Figure 4-28. Radiated Spurious Emissions in GPS Bands, Code 0, Vertical, 1164M – 1240MHz

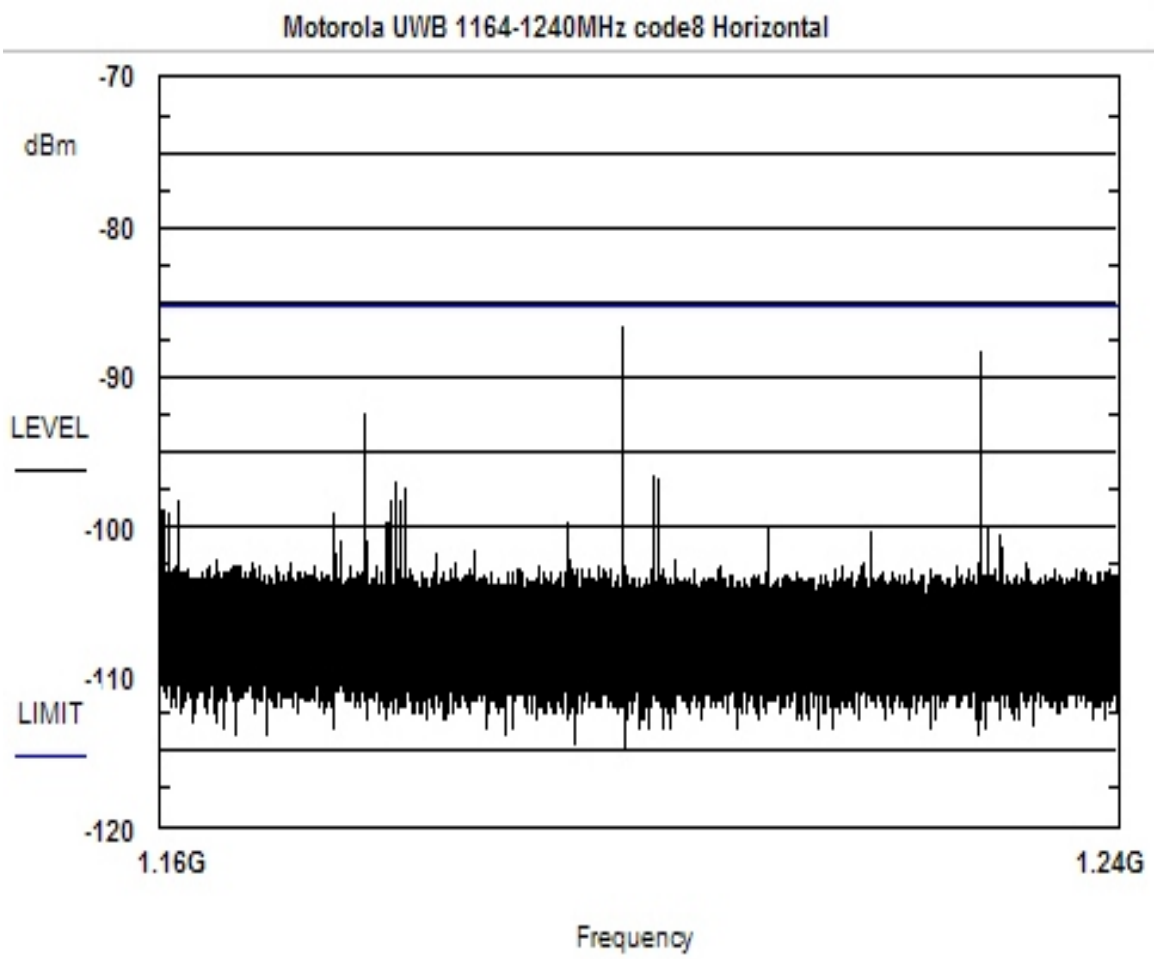

Figure 4-29. Radiated Spurious Emissions in GPS Bands, Code 8, Horizontal, 1164M – 1240MHz

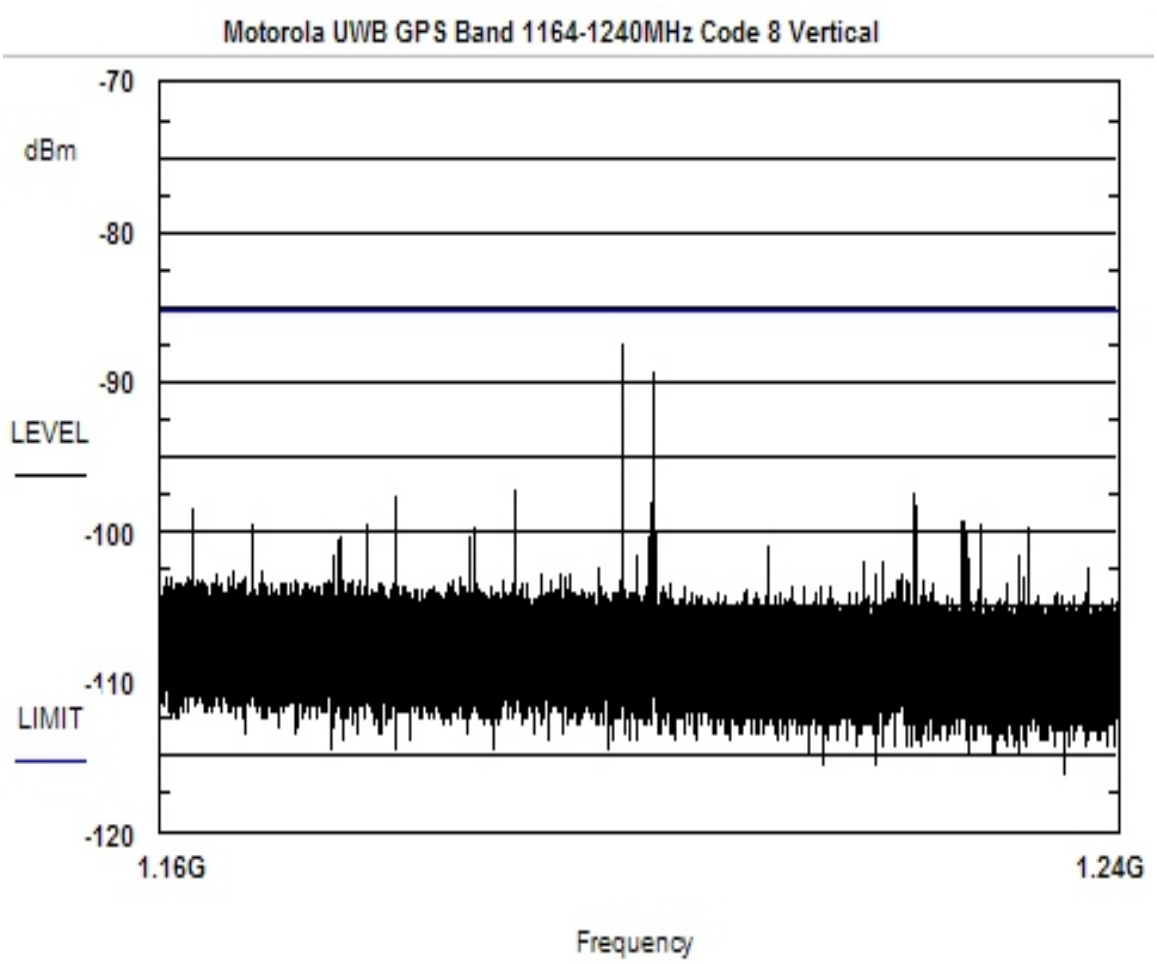

Figure 4-30. Radiated Spurious Emissions in GPS Bands, Code 8, Vertical, 1164M – 1240MHz

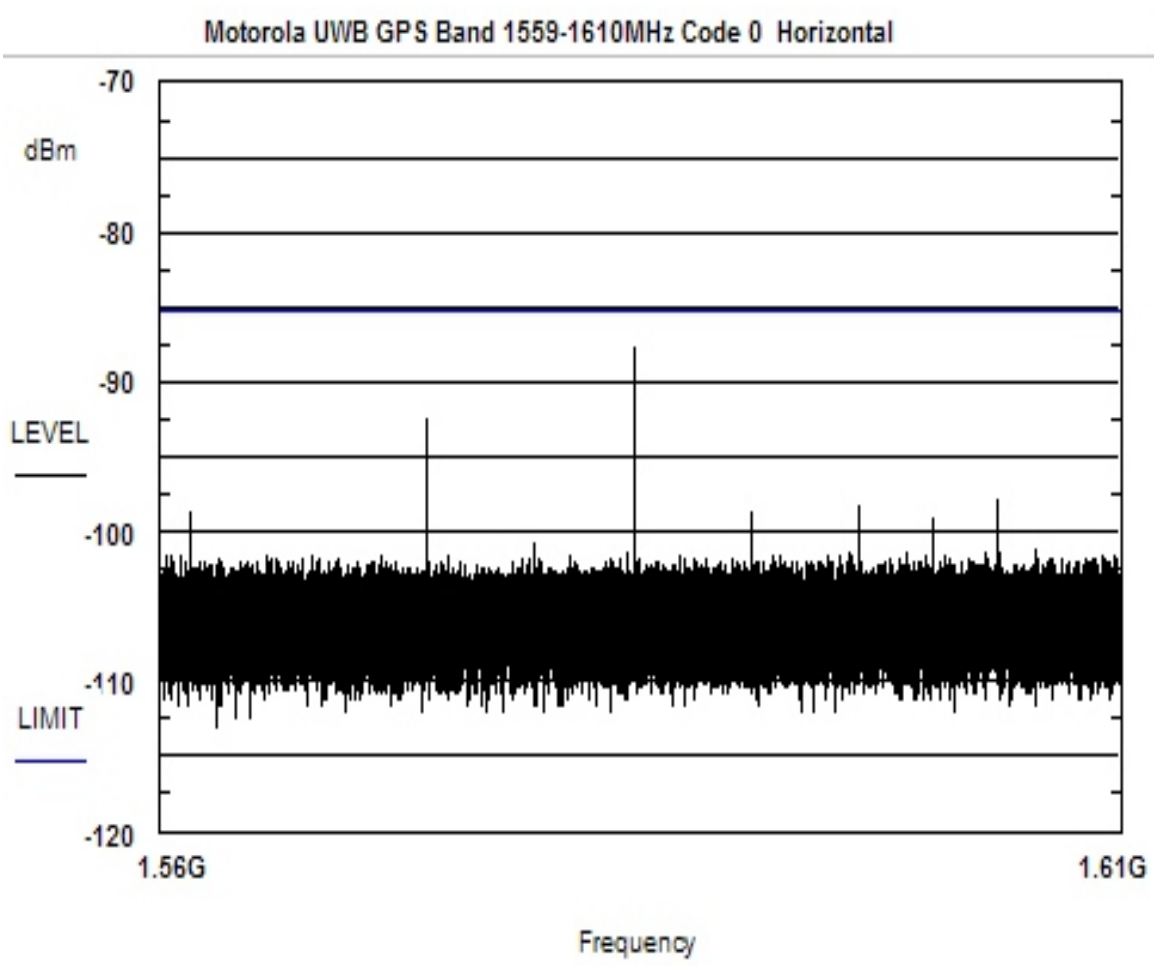

Figure 4-31. Radiated Spurious Emissions in GPS Bands, Code 0, Horizontal, 1559M – 1610MHz

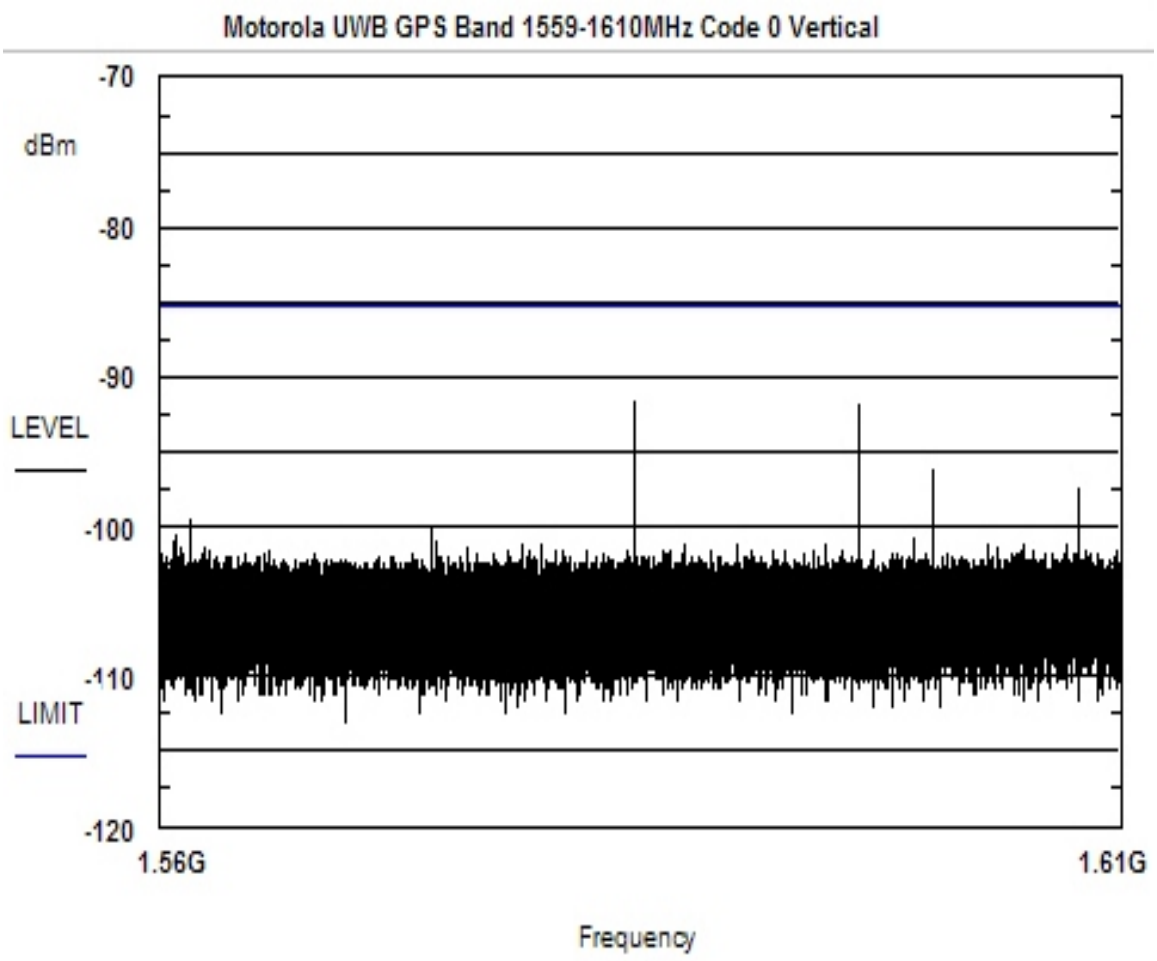

Figure 4-32. Radiated Spurious Emissions in GPS Bands, Code 0, Vertical, 1559M – 1610MHz

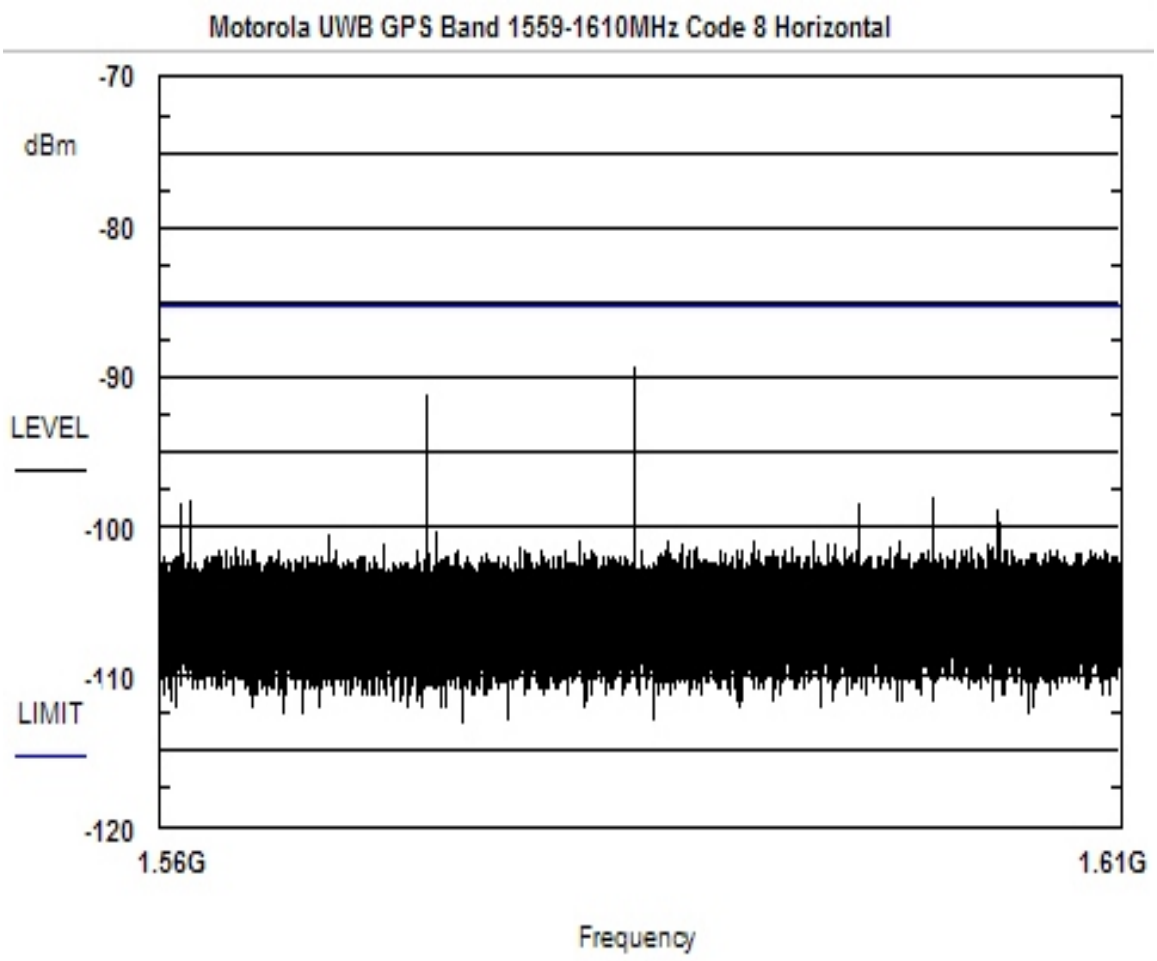

Figure 4-33. Radiated Spurious Emissions in GPS Bands, Code 8, Horizontal, 1559M – 1610MHz

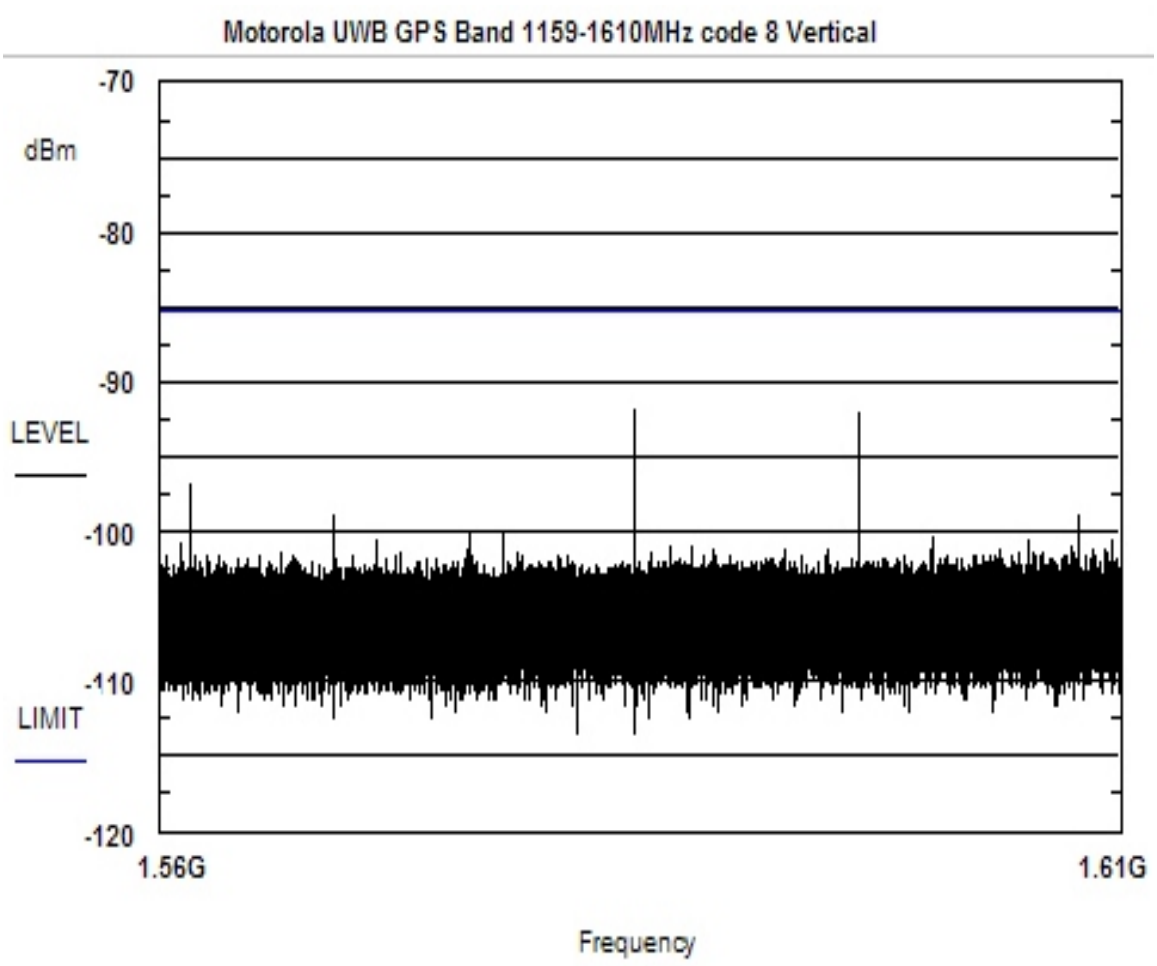

Figure 4-34. Radiated Spurious Emissions in GPS Bands, Code 8, Vertical, 1559M – 1610MHz

4.5 Peak Emissions within a 50 MHz Bandwidth, §15.517(e)

The limit on the peak EIRP emissions, centered on the frequency at which the highest radiated emissions occurs, fM, is 20 log (RBW/50) dBm, where RBW is the resolution bandwidth in megahertz used to take the measurement, and where the RBW used must be between 1 MHz and 50 MHz.

4.5.1 Test Procedure

The resolution bandwidth used to make the peak measurement was 1 MHz, resulting in a limit of –34 dBm peak EIRP. The procedure of 15.521(g) was used in performing the measurement of peak emissions Measurements were made at a test distance of 2m at the frequency of the highest radiated emission level. The Rhode & Schwarz ESI-26 analyzer was set to use its max peak detector and to stop at each measurement point for 1 second, effectively capturing the peak emission that occurred at any point during the 1 second interval. The traces shown, sweep across a 50 MHz range around fM to insure that the

device was compliant. As in the previously described tests, the ESI-26 had all calibration constants entered into its transducer tables. The transducer factors straddling the test frequency range of 3.6146 to 3.6646 are shown below:

Frequency (GHz)	Antenna Gain (dB)	Cable Loss (dB)	Range Factor (dB)
3.6	11	.828	49.6
3.78	11.7	.83	50.2

With this set of factors entered into the ESI-26 analyzer, all plots and markers read directly in EIRP. The instrument does the following calculation, where P_r is the power measured by the analyzer (dBm), G_r is the antenna gain (dB) of the receiving antenna connected to the analyzer, L is the cable loss (dB) used to connect between the receiving antenna to the analyzer, r is the measurement range in meters, λ is the wavelength in meters, and the resulting measured *EIRP* is in dBm.

$$EIRP = P_r - G_r + 20\log(4\pi r) - 20\log(\lambda) + L$$

The Range Factor in the transducer table is simply the two middle terms that account for the range and frequency.

The unit was checked with both modulation codes (Code 0 and Code 8) as described in Section 2.3.

4.5.2 Test Results

The UWB device complies with the requirements of §15.517(e). Plots of the peak emissions are included in the following figures.

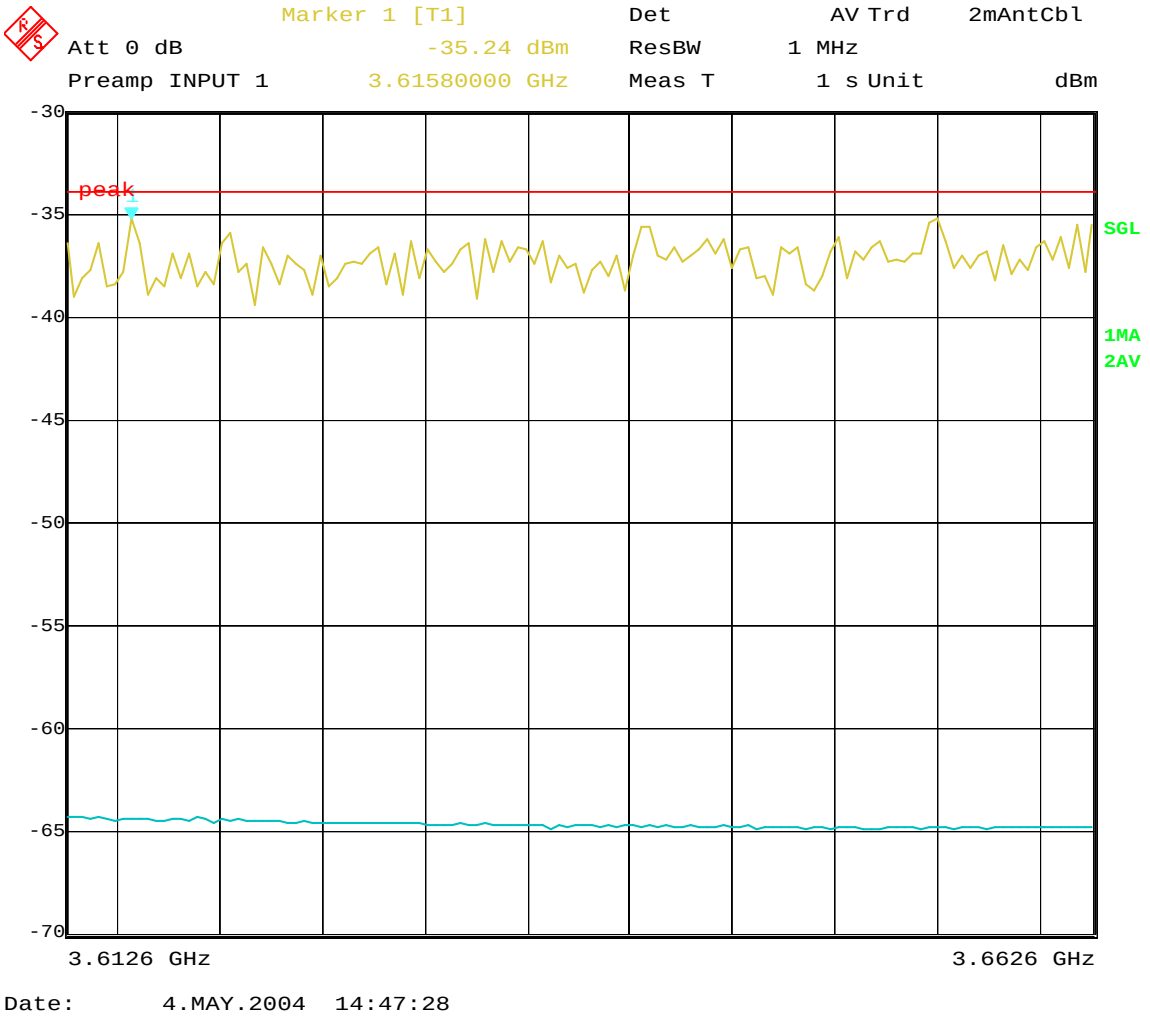

Figure 4-35. Peak Emissions, Code 0, Horizontal

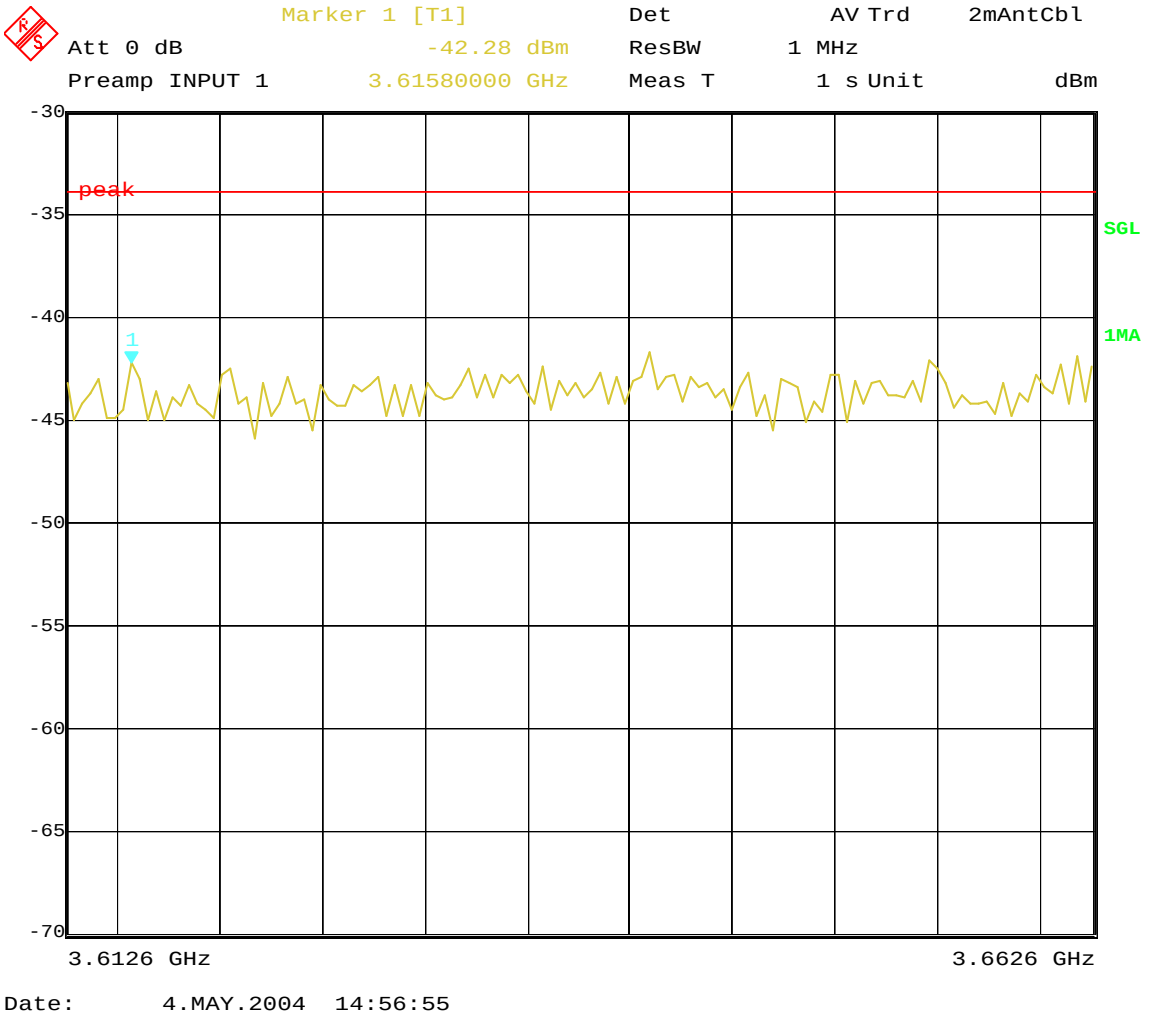

Figure 4-36. Peak Emissions, Code 0, Vertical

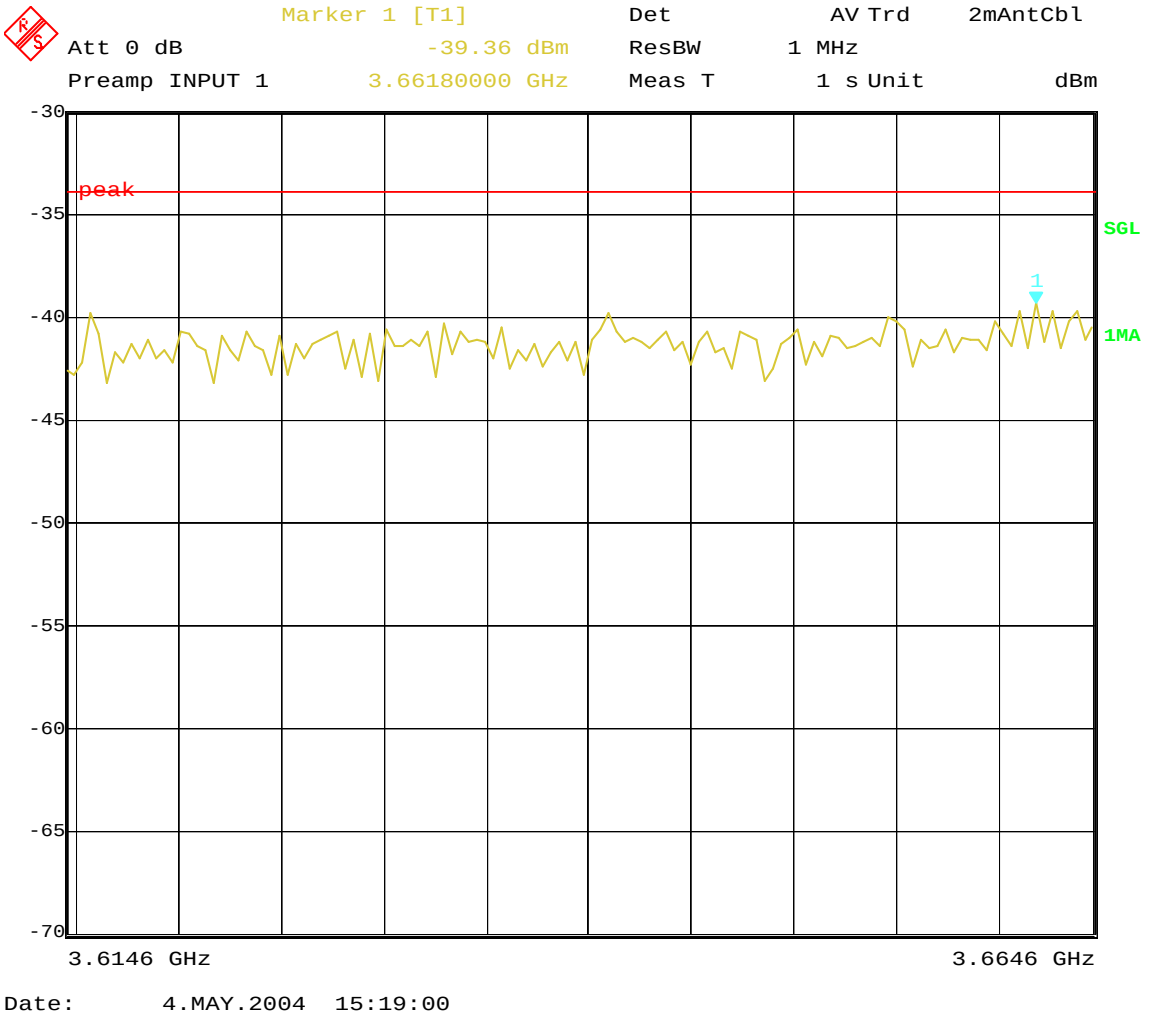

Figure 4-37. Peak Emissions, Code 8, Horizontal

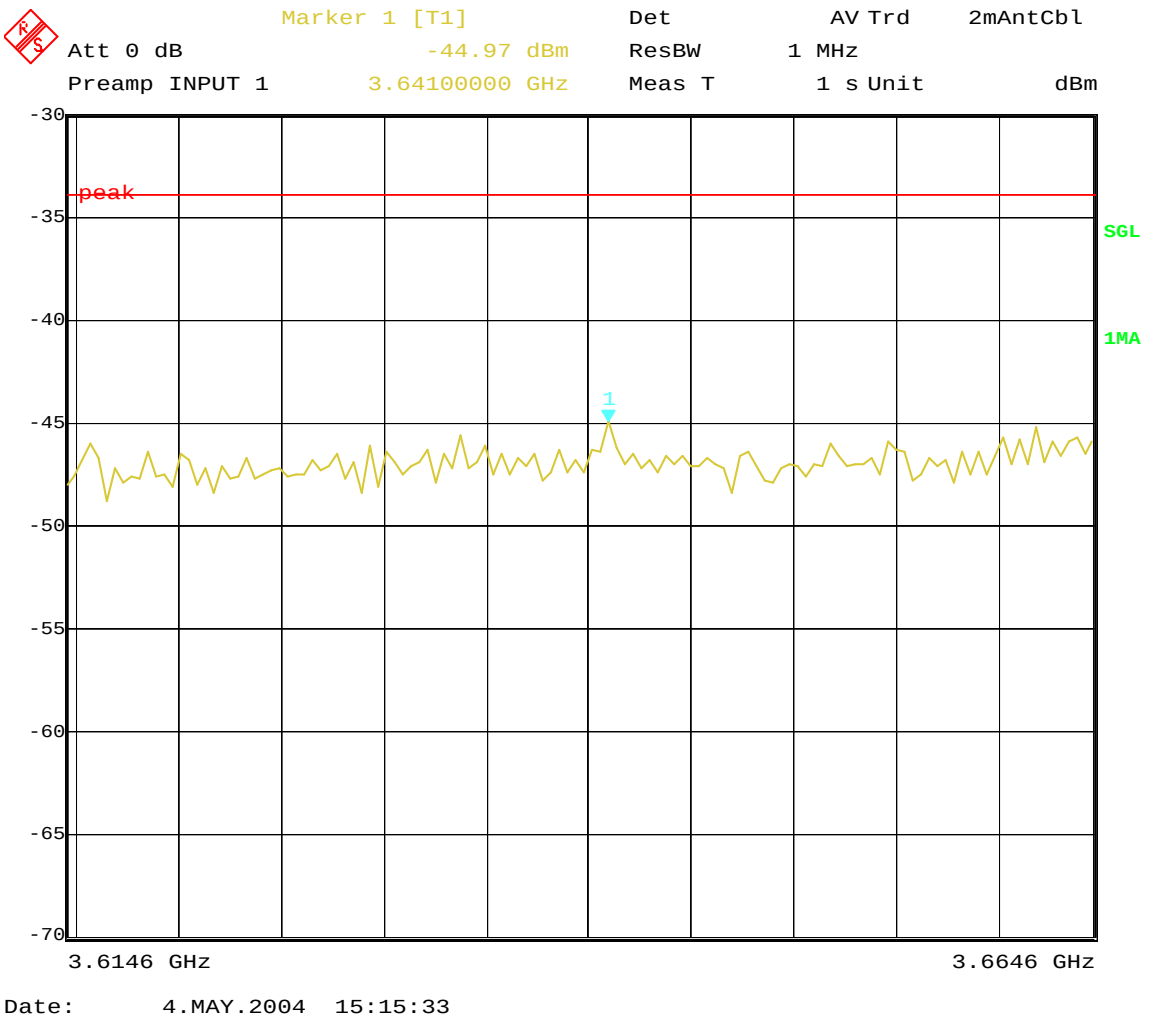

Figure 4-38. Peak Emissions, Code 8, Vertical

4.6 Conducted Emissions, §15.207

The EUT was placed on an 80 cm high 1 x 1.5 m non-conductive table above a ground plane. Power to the EUT was provided through a Solar Corporation 50 Ω/50 µH Line Impedance Stabilization Network bonded to a 3 x 2 meter ground plane. The LISN has its AC input supplied from a filtered AC power source. Power and data cables were moved about to obtain maximum emissions.

The 50 Ω output of the LISN was connected to the input of the spectrum analyzer and the emissions in the frequency range of 150 kHz to 30 MHz were measured. The detector function was set to quasi-peak or peak, as appropriate, and the resolution bandwidth during testing was at least 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth.

Data is recorded in Table 5.

Table 5: Conducted Emissions Test Data Sheet

CLIENT:	Motorola	DATE:	5/5/2004
MODEL:	UWB Device	JOB #:	7959
TESTER:	James Ritter	TEST STANDARD:	FCC Part 15
TEST VOLTAGE:	120 VAC	TEST SITE:	CSITE2_CE
CLASS:	FCC_B		

LINE 1 - NEUTRAL

Frequency MHz	Level QP dBuV	Cable Loss dB	Limit QP dBuV	Margin QP dB	Level AVG dBuV	Cable Loss dB	Limit AVG dBuV	Margin AVG dB
0.180	36.7	10.7	64.5	-17.1	21.6	10.7	54.5	-22.2
0.245	29.1	10.7	61.9	-22.1	17.8	10.7	51.9	-23.4
1.160	26.2	11.0	56.0	-18.8	17.5	11.0	46.0	-17.5
2.015	20.5	11.2	56.0	-24.3	15.8	11.2	46.0	-19.0
3.117	20.8	11.3	56.0	-23.9	12.1	11.3	46.0	-22.6
15.175	17.7	12.3	60.0	-30.0	11.5	12.3	50.0	-26.2
19.248	17.2	12.5	60.0	-30.3	11.7	12.5	50.0	-25.8

LINE 2 – PHASE

Frequency MHz	Level QP dBuV	Cable Loss dB	Limit QP dBuV	Margin QP dB	Level AVG dBuV	Cable Loss dB	Limit AVG dBuV	Margin AVG dB
0.180	35.4	10.7	64.5	-18.4	17.6	10.7	54.5	-26.2
0.245	28.7	10.7	61.9	-22.5	15.1	10.7	51.9	-26.1
1.160	21.4	11.0	56.0	-23.6	14.8	11.0	46.0	-20.2
2.015	16.4	11.2	56.0	-28.4	9.8	11.2	46.0	-25.0
3.117	18.0	11.3	56.0	-26.7	6.9	11.3	46.0	-27.8
15.175	15.6	12.3	60.0	-32.1	10.9	12.3	50.0	-26.8
19.248	15.0	12.5	60.0	-32.5	10.6	12.5	50.0	-26.9