FCC Certification Test Report

FCC Certification Test Report for Zeus Technology Systems, Inc. Q5L-ZRC-20

Revision 1

August 20, 2003

Prepared for:

Zeus Technology Systems, Inc.
7257 Parkway Drive
Hanover, MD 21076

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

FCC Certification Test Program

FCC Certification Test Report
for the
Zeus Technology Systems, Inc.
ZRC-20 2.4GHz FHSS Transmitter Module
Q5L-ZRC-20

Revision 1

August 20, 2003

WLL JOB# 7580

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Reviewed by: Gregory M. Snyder
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Abstract

This report has been prepared on behalf of Zeus Technology Systems, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Frequency Hopping Spread Spectrum Transmitter under Part 15.247 of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for a Zeus Technology Systems, Inc. ZRC-20 2.4GHz FHSS Transmitter Module.

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 Zeus Technology Systems, Inc. ZRC-20 2.4GHz FHSS Transmitter Module complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under Part 15.247 of the FCC Rules and Regulations.

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1 Introduction

1.1 Compliance Statement

The Zeus Technology Systems, Inc. ZRC-20 2.4GHz FHSS Transmitter Module complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under Part 15.247 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for radiated and conducted (at antenna terminal) emissions were performed. All measurements were performed in accordance with FCC Public Notice DA 00-705 and the 1992 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Zeus Technology Systems, Inc. 7257 Parkway Drive Hanover, MD 21076
Purchase Order Number:	324602
Quotation Number:	60617-A

1.4 Test Dates

Testing was performed from May 2, 2003 to May 6, 2003.

1.5 Test and Support Personnel

Washington Laboratories, LTD	James Ritter
Customer	John Russell

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 Zeus Technology Systems, Inc. ZRC-20 Transmitter Module is a 2.4GHz band FHSS data transceiver which can be operated both indoors and outdoors. It transmits and receives data on frequencies in the license-free 2.4 GHz Industrial, Scientific, and Medical (ISM) frequency band. Data rates up to 115Kb/s can be supported. It is designed to be built into a wide variety of application devices requiring data communication up to several miles.

Several ZRC-20 transceivers can be configured into a wireless network with some functioning as relays. that provides ~26dbm output to the antenna port. A client-manufactured 8dbi omni-directional antenna was used for testing. The ZRC-20 uses FHSS technology across 75 channels and uses a 12-pin header to connect to the source device.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Zeus Technology Systems, Inc.
FCC ID Number	Q5L-ZRC-20
EUT Name:	2.4GHz FHSS Transmitter Module
Model:	ZRC-20
FCC Rule Parts:	§15.247
Frequency Range:	2401.9 – 2475.9MHz
Maximum Output Power:	398mW (26dBm)
Occupied Bandwidth:	625 kHz
Keying:	Automatic
Type of Information:	Data
Number of Channels:	75
Power Output Level	Fixed
Antenna Connector	4” antenna cable with reverse SMA adaptor
Antenna Type	8dBi Omni Antenna
Interface Cables:	12-pin header
Power Source & Voltage:	12Vdc from battery

2.2 Test Configuration

The ZRC-20 was configured with a 9600 baud digital link 2x4 adapter board which plugged into the transmitter module via the 12-pin header. Power to the device is provided by a 12 volt battery through the adapter board. An 8dbi omni-directional antenna was connected to the SMA Antenna Port. Channels were selected for testing to represent a High, Middle, and Low setting across the frequency range. A laptop PC was used to select the channel (in non-hopping mode) using a Com port to the link adapter.

2.3 Testing Algorithm

The ZRC-20 was programmed for FHSS operation via Hyperterminal at 9600 baud. For non-hopping operation the client provided a separate DOS program to set the unit to a High, Mid and Low channel for testing.

Worst case emission levels are provided in the test results data.

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

FCC Public Notice DA 00-705, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

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

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 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:

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

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 = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.

3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

Table 2: Test Equipment List

Manufacturer	Model/Type	Function	Identification	Cal. Due
HP	8568B	Spectrum Analyzer	2634A02888	7/03/03
HP	85650A	Quasi-Peak Adapter	3303A01786	7/05/03
HP	85685A	RF Preselector	3221A01395	5/17/03
HP	8564E	Spectrum Analyzer	3643A00657	5/18/03
Solar	8012-50-R-24BNC	LISN	8379493	6/20/03
ARA	LPB-2520	BiconiLog Antenna	1044	6/19/03
HP	8449B	Pre-Amplifier	3008A00729	2/11/04
NARDA	V638	Standard Gain Horn	00210	7/22/04

4 Test Results

4.1 Duty Cycle Correction

In accordance with the FCC Public Notice the spurious radiated emissions measurements may be adjusted if using a duty cycle correction factor if the dwell time per channel of the hopping signal is less than 100 ms.

The duty cycle correction factor is calculated by:

20 x LOG (dwell time/100 ms)

The following figure shows the plot of the dwell time for the transmitter. Based on this plot, the dwell time per hop is 3.25ms. This corresponds to a duty cycle correction of 29.7. However, according to the theory of operation, the worst case data packet length is 11ms which would correspond to a duty cycle correction of 19.2dB.

Based on an 11ms dwell time and since there are 75 channels, and all channels have to be used equally, it will be approximately 825ms before the hop could return to this channel. Over a period of 30 seconds this would occur 36.36 times and therefore the maximum dwell time over a 30 second period would be 36.36 x 11ms = 400ms.

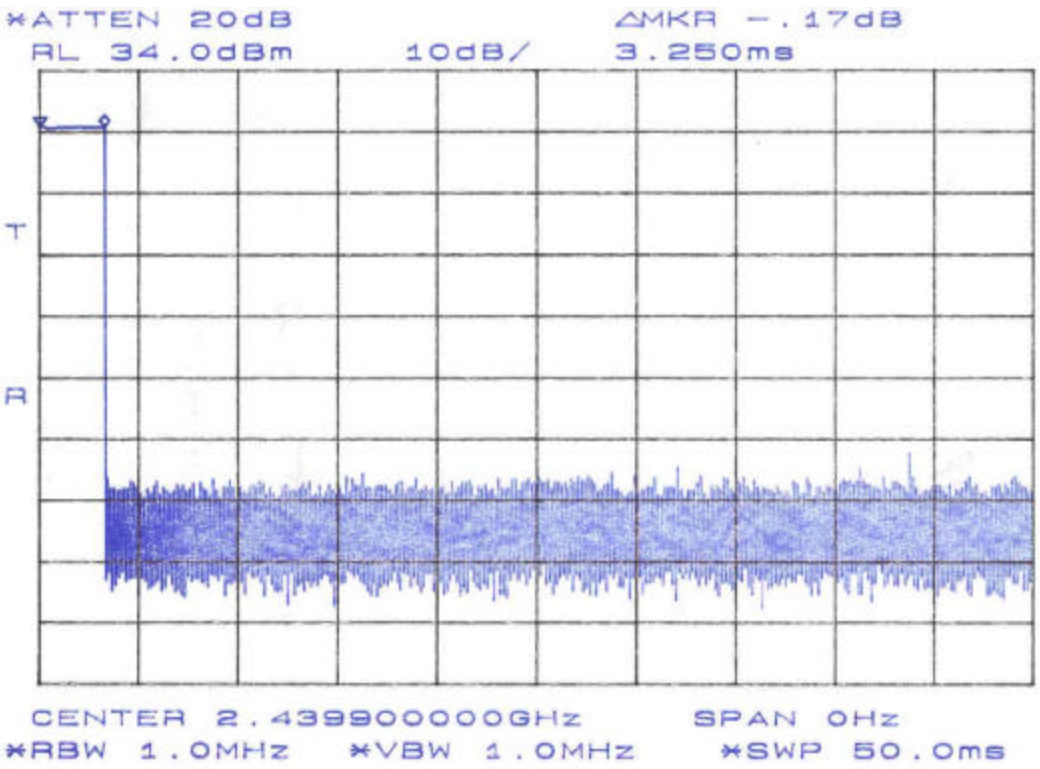

Figure 4-1. Duty Cycle Plot

4.2 RF Power Output: (FCC Part §2.1046)

To measure the output power the hopping sequence was stopped while the frequency dwelled on a low, high and middle channel. The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system.

Table 3. RF Power Output

Frequency	Level	Limit	Pass/Fail
Low Channel 2401.9 MHz	26 dBm	30 dBm	Pass
Mid Channel 2439.9 MHz	25.67 dBm	30 dBm	Pass
High Channel 2475.9 MHz	23.83 dBm	30 dBm	Pass

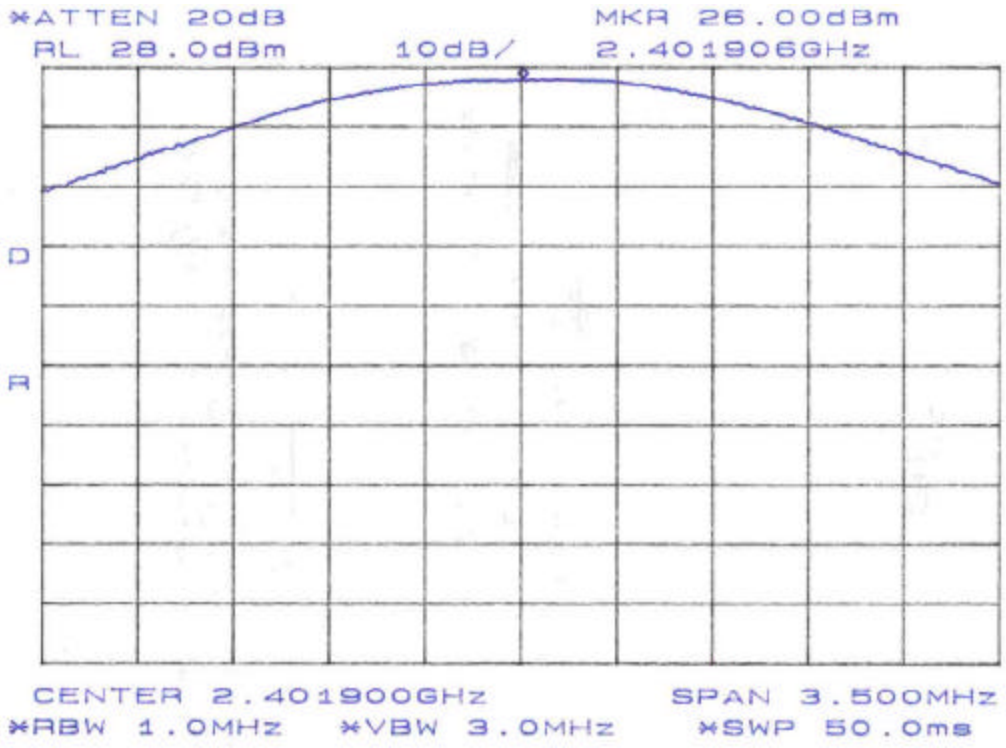

Figure 4-2. RF Peak Power, Low Channel

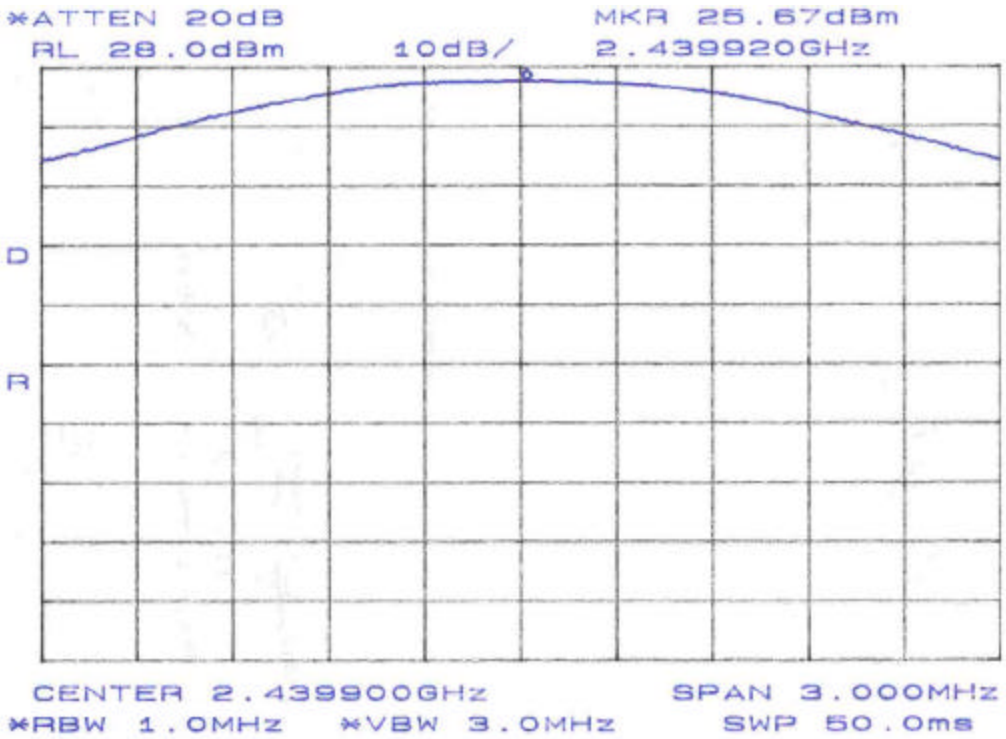

Figure 4-3. RF Peak Power, Mid Channel

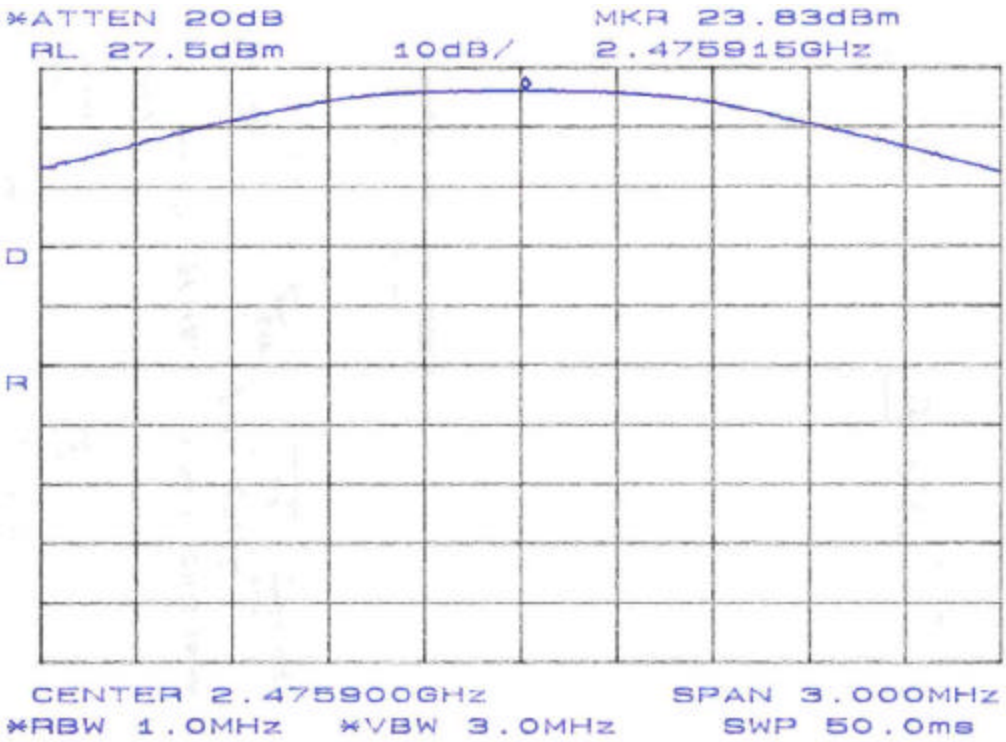

Figure 4-4. RF Peak Power, High Channel

4.3 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer.

For Frequency Hopping Spread Spectrum Systems, FCC Part 15.247 requires the maximum 20 dB bandwidth not exceed 1MHz.

At full modulation, the occupied bandwidth was measured as shown:

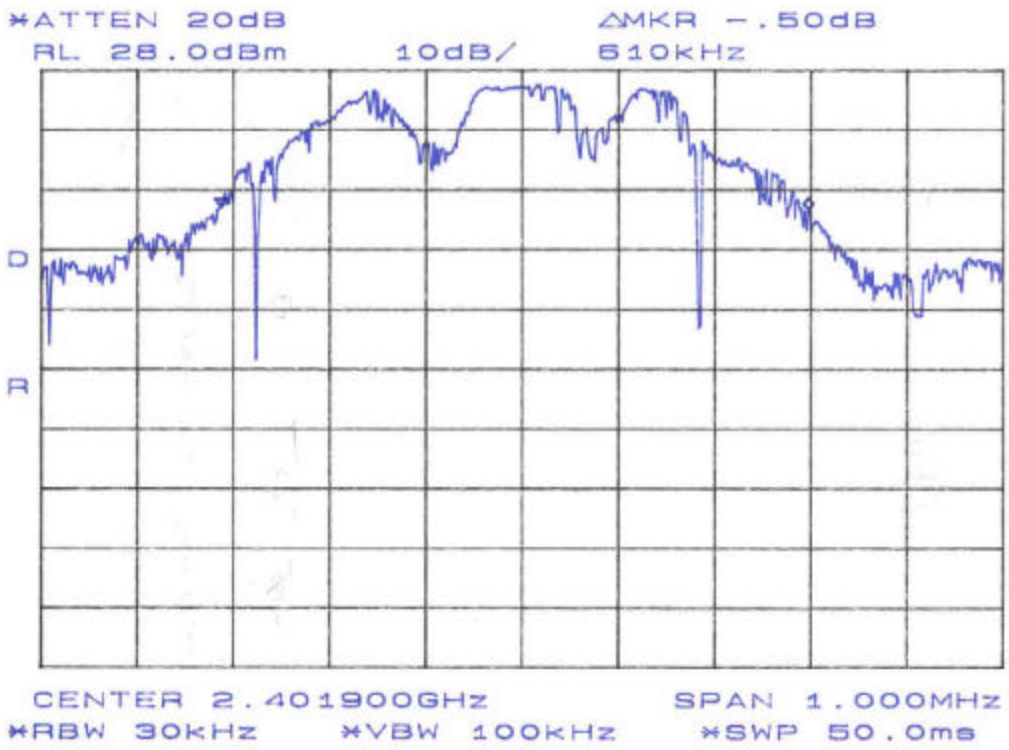

Figure 4-5. Occupied Bandwidth, Low Channel

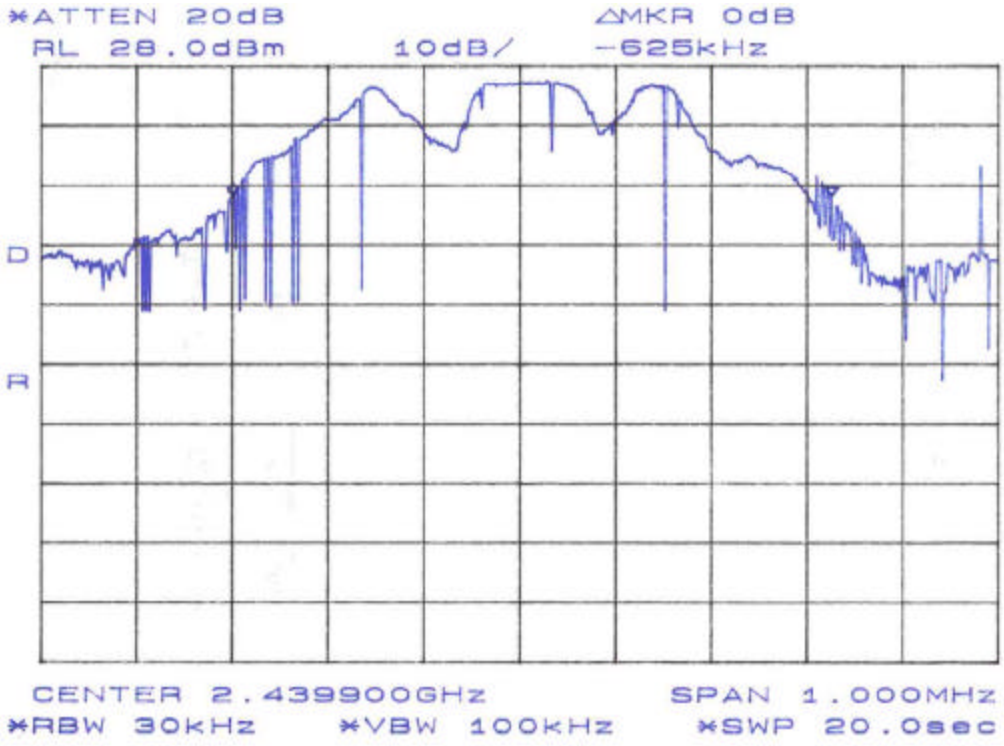

Figure 4-6. Occupied Bandwidth, Mid Channel

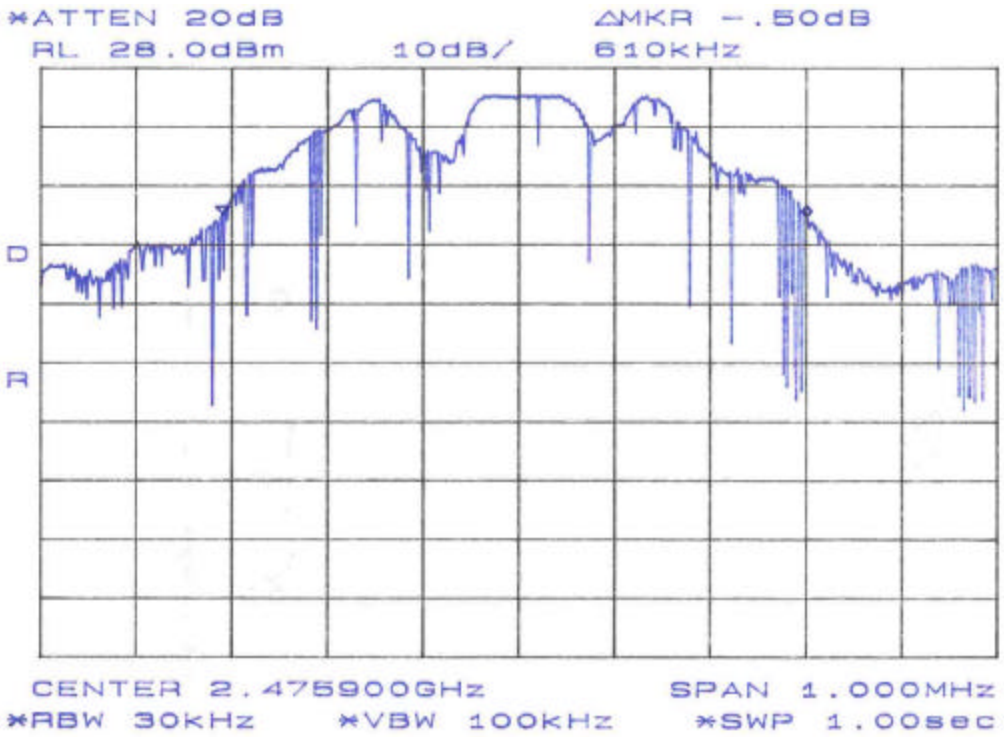

Figure 4-7. Occupied Bandwidth, High Channel

Table 4 provides a summary of the Occupied Bandwidth Results.

Table 4. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Low Channel 2401.9 MHz	610 kHz	1 MHz	Pass
Mid Channel 2439.9 MHz	625 kHz	1 MHz	Pass
High Channel 2475.9 MHz	610 kHz	1 MHz	Pass

4.4 Channel Spacing and Number of Hop Channels (FCC Part §15247(a)(1)

Per the FCC requirements, frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20 dB bandwidth, whichever is greater. The maximum 20dB bandwidth measured is 625kHz so the channel spacing must be more than 625kHz. In addition, for a 2.4GHz the number of hopping channels shall be stated.

The EUT antenna was removed and the cable was connected directly into a spectrum analyzer through a 10 dB attenuator. An offset was programmed into the spectrum analyzer to compensate for the loss of the external attenuator. The spectrum analyzer resolution bandwidth was set to 100 kHz and the video bandwidth was set to 100 kHz. The channel spacing of 2 adjacent channels was measured using a spectrum analyzer span setting of 2.3MHz. Also, the number of hopping channels was measured from 2.4GHz to 2.5GHz.

The following are plots of the channel spacing and number of hopping channels data. The channel spacing was measured to be 989kHz and the number of channels used is 75.

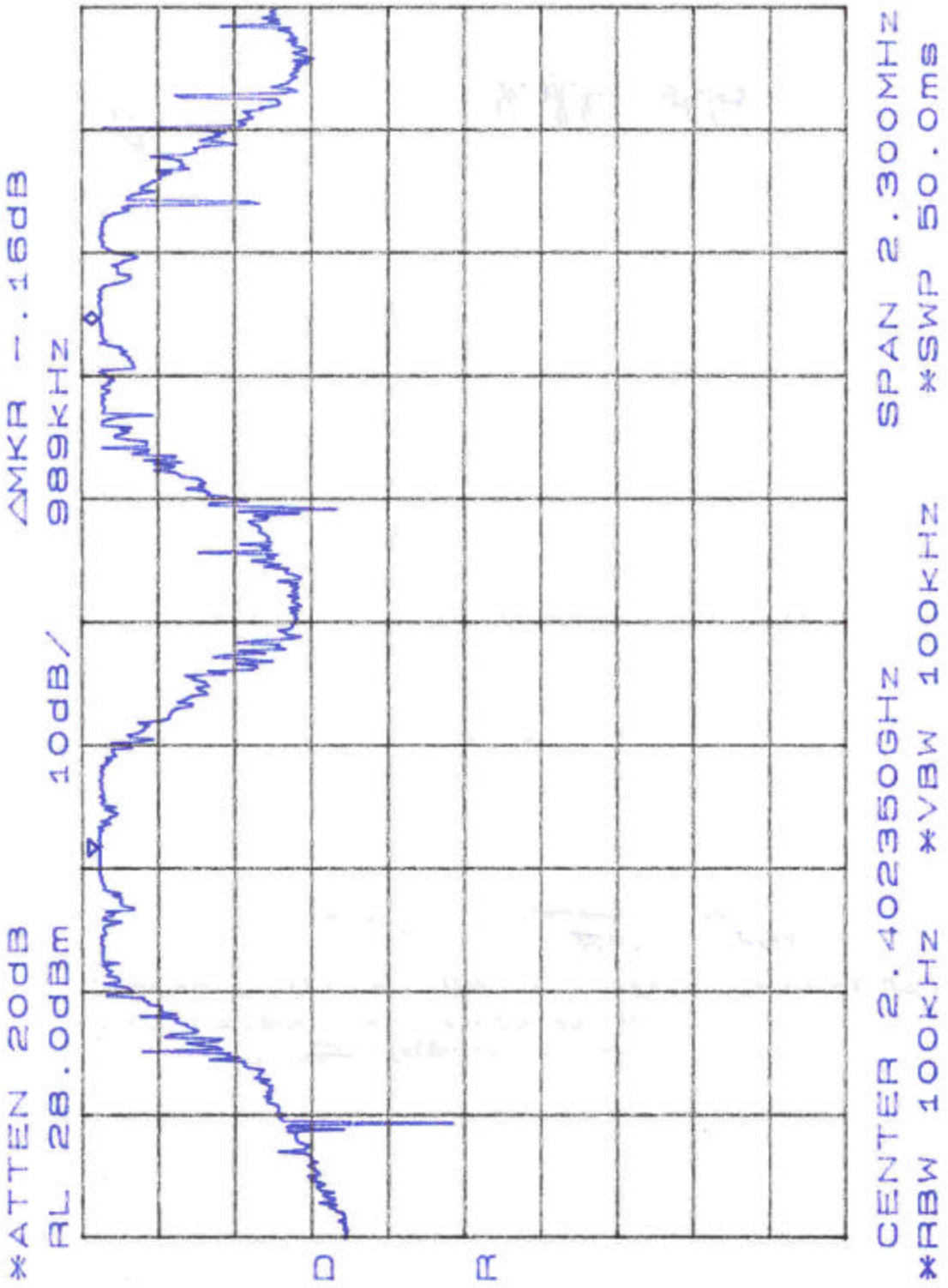

Figure 4-8, Channel Spacing, 989kHz

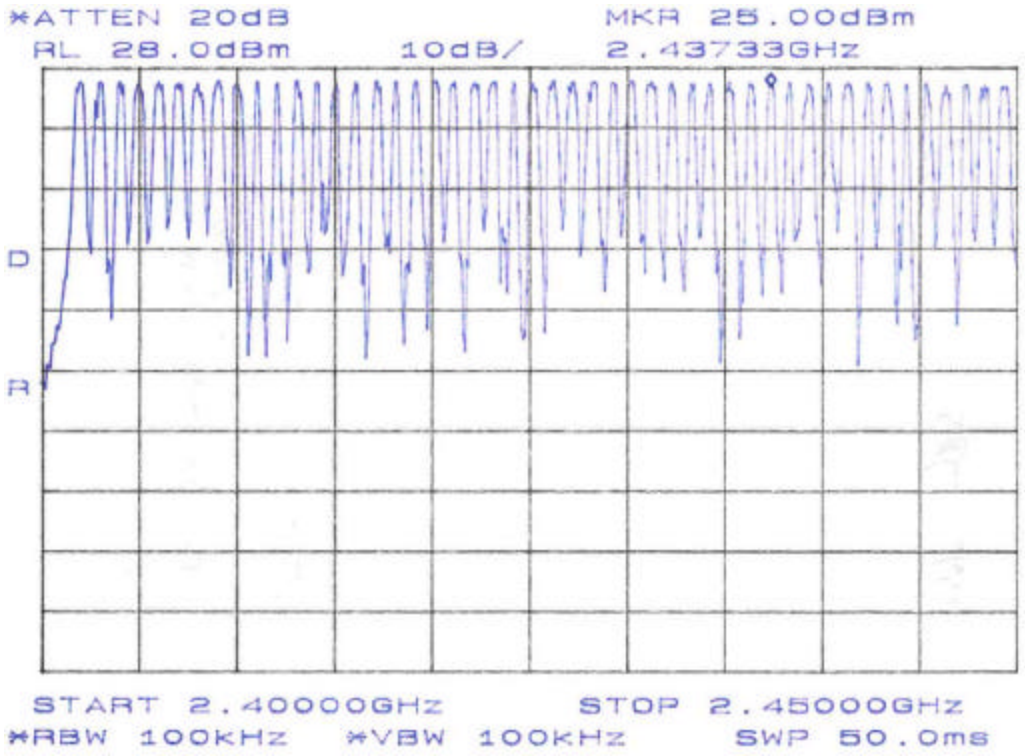

Figure 4-9, Number of Channels, Plot 1

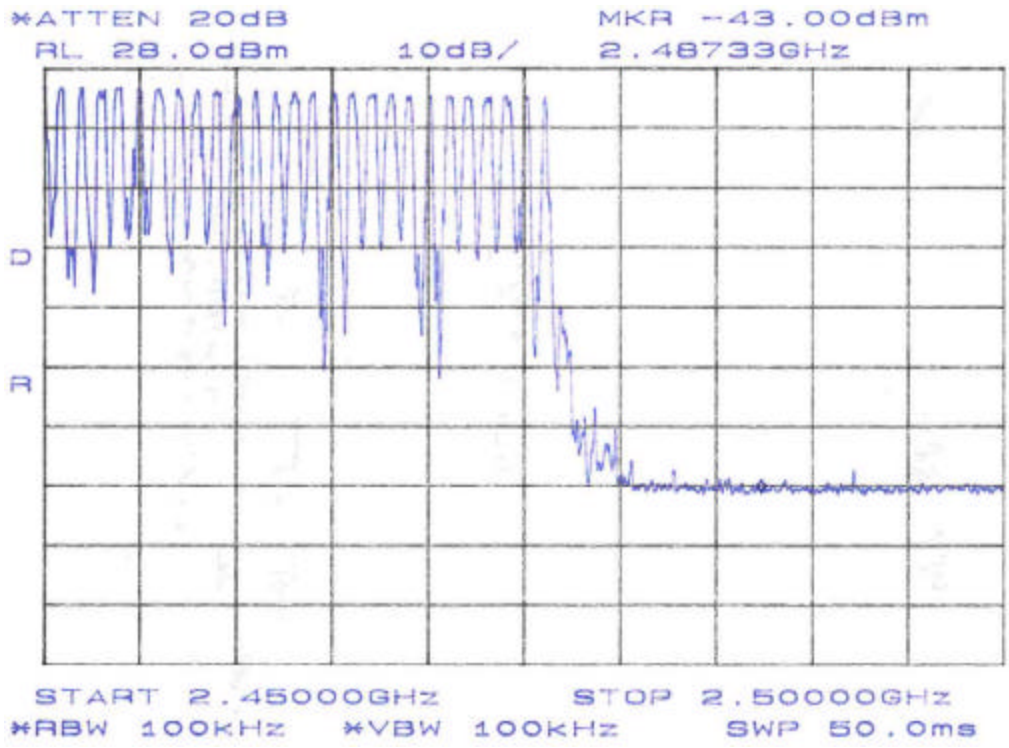

Figure 4-10, Number of Channels, Plot 2

4.5 Conducted Spurious Emissions at Antenna Terminals (FCC Part §2.1051)

The EUT must comply with requirements for spurious emissions at antenna terminals. Per §15.247(c) all spurious emissions in any 100 kHz bandwidth outside the frequency band in which the spread spectrum device is operating shall be attenuated 20 dB below the highest power level in a 100 kHz bandwidth within the band containing the highest level of the desired power.

The EUT antenna was removed and the cable was connected directly into a spectrum analyzer through a 10 dB attenuator. An offset was programmed into the spectrum analyzer to compensate for the loss of the external attenuator. The spectrum analyzer resolution bandwidth was set to 100 kHz and the video bandwidth was set to 100 kHz. The amplitude of the EUT carrier frequency was measured to determine the emissions limit (20 dB below the carrier frequency amplitude). The emissions outside of the allocated frequency band were then scanned from 30 MHz up to the tenth harmonic of the carrier.

The following are plots of the conducted spurious emissions data.

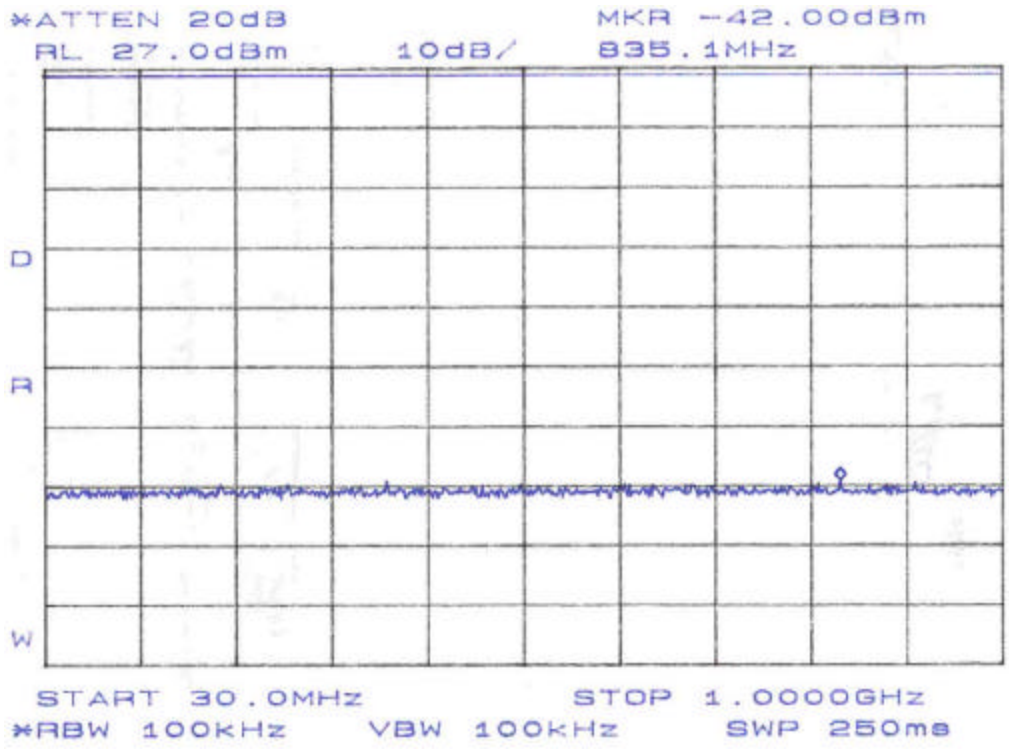

Figure 4-11. Conducted Spurious Emissions, Low Channel 30 - 1000MHz

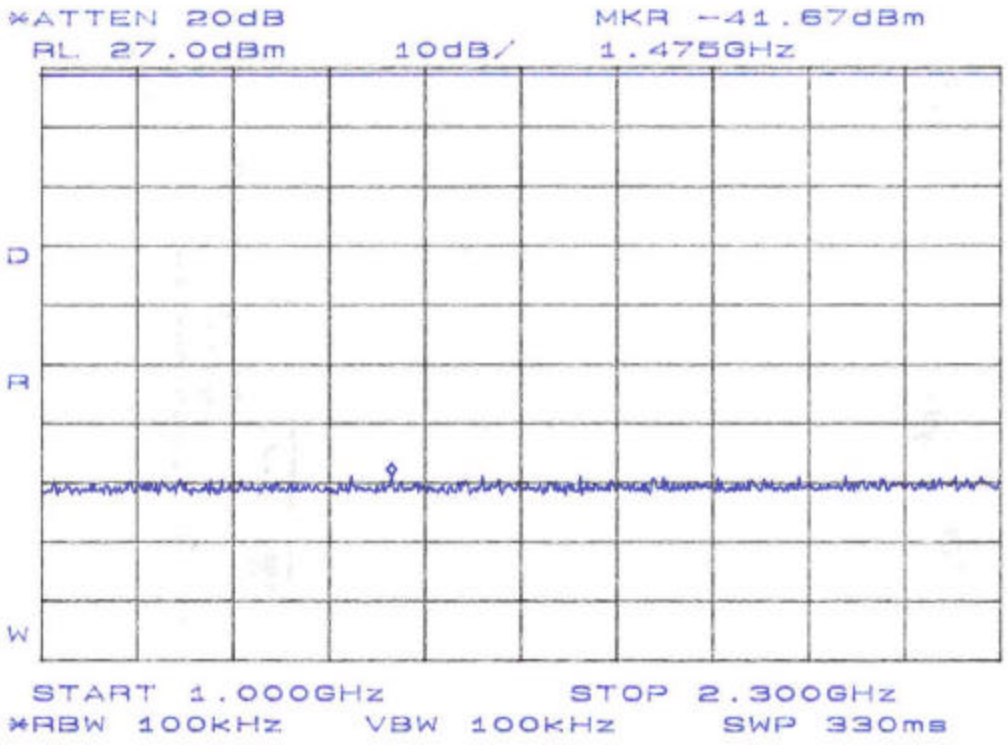

Figure 4-12. Conducted Spurious Emissions, Low Channel 1 – 2.3GHz

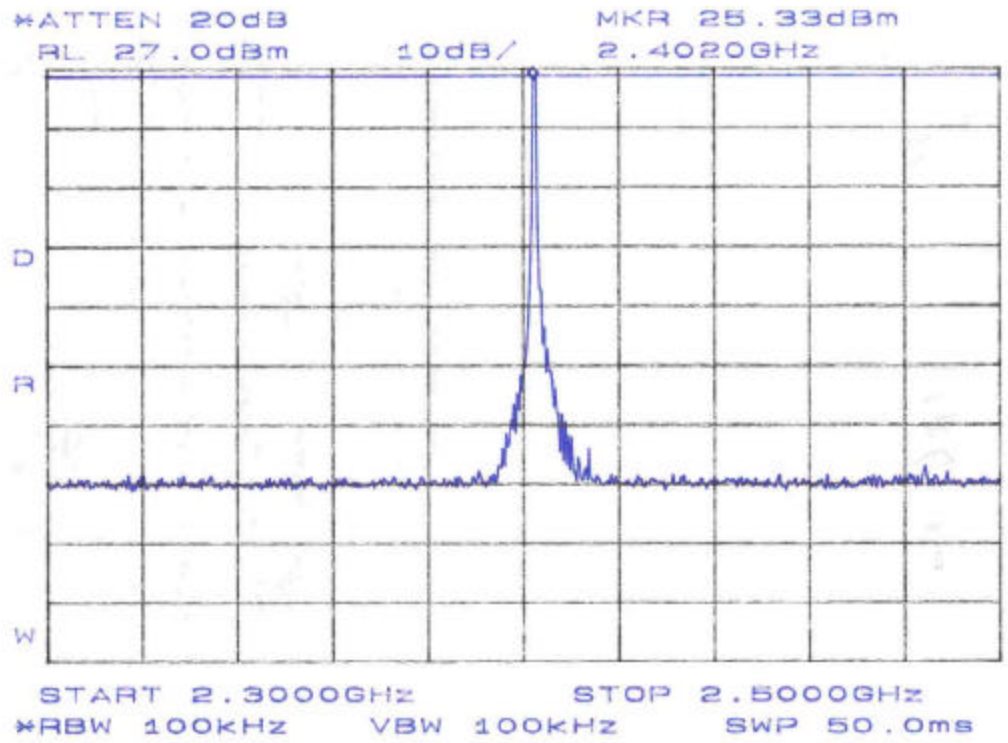

Figure 4-13. Conducted Spurious Emissions, Low Channel 2.3 – 2.5GHz

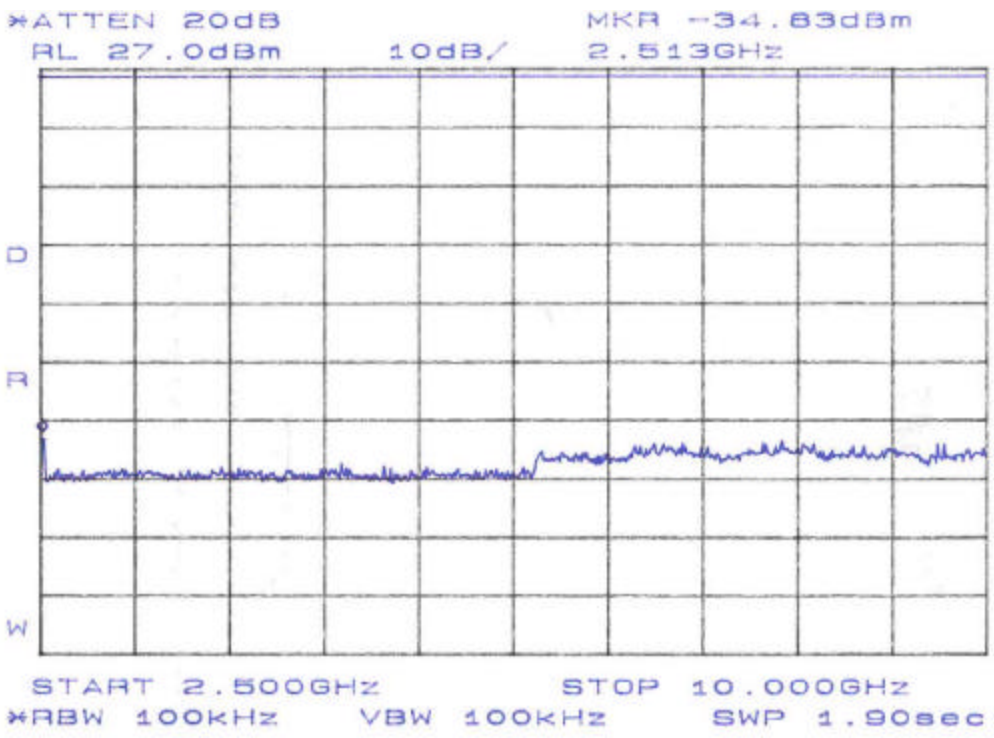

Figure 4-14. Conducted Spurious Emissions, Low Channel 2.5 - 10GHz

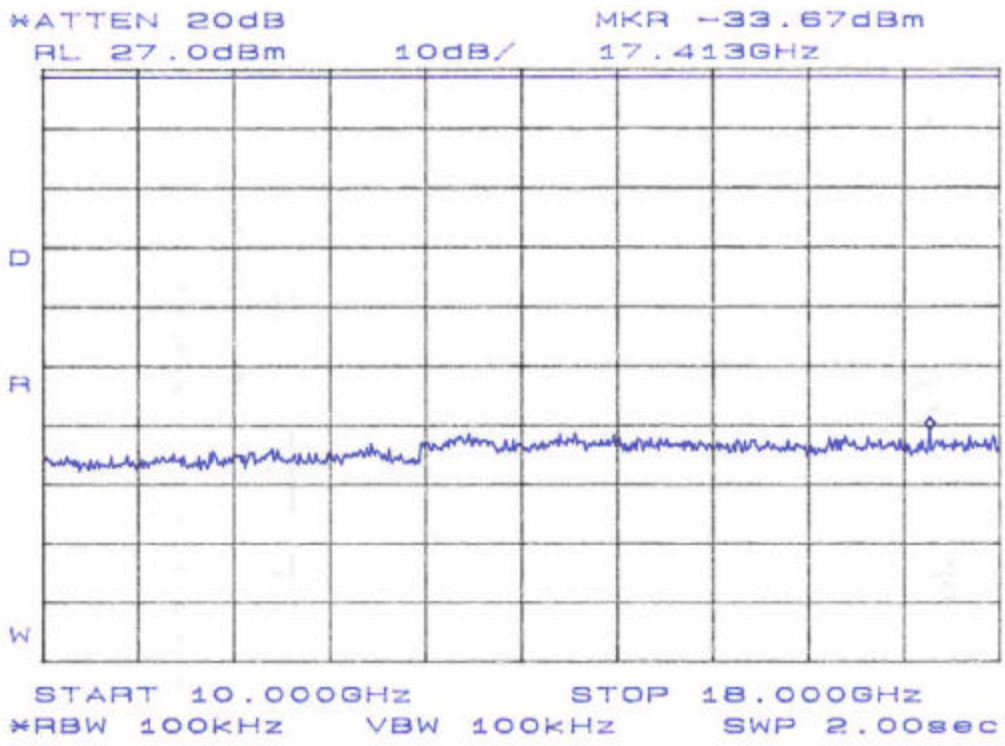

Figure 4-15. Conducted Spurious Emissions, Low Channel 10 - 18GHz

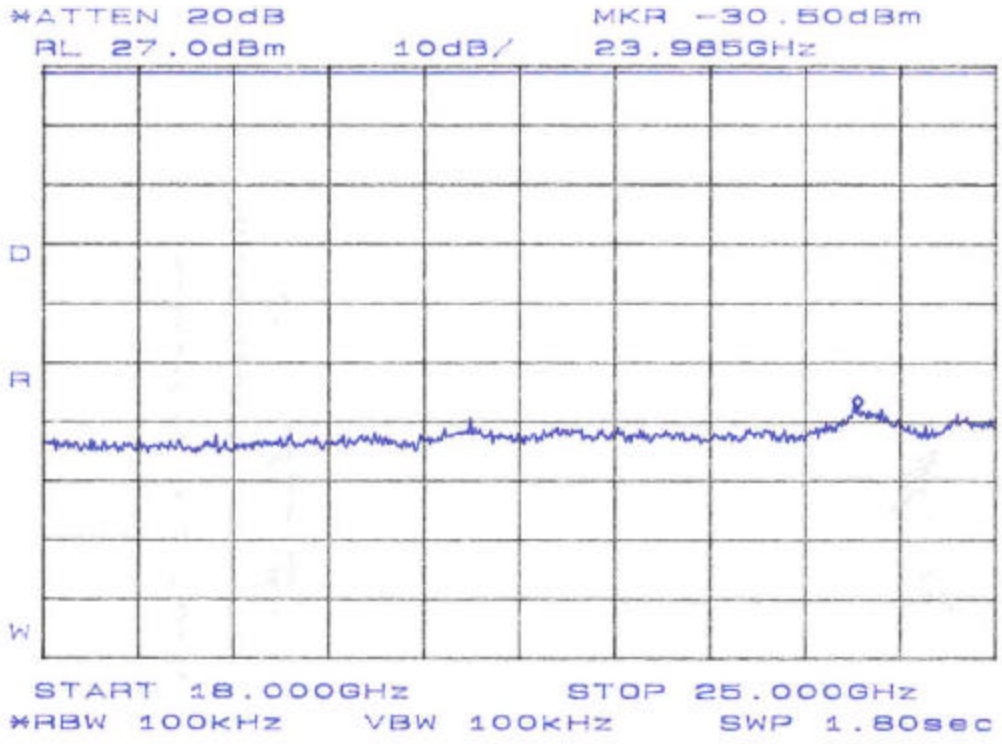

Figure 4-16. Conducted Spurious Emissions, Low Channel 18 - 25GHz

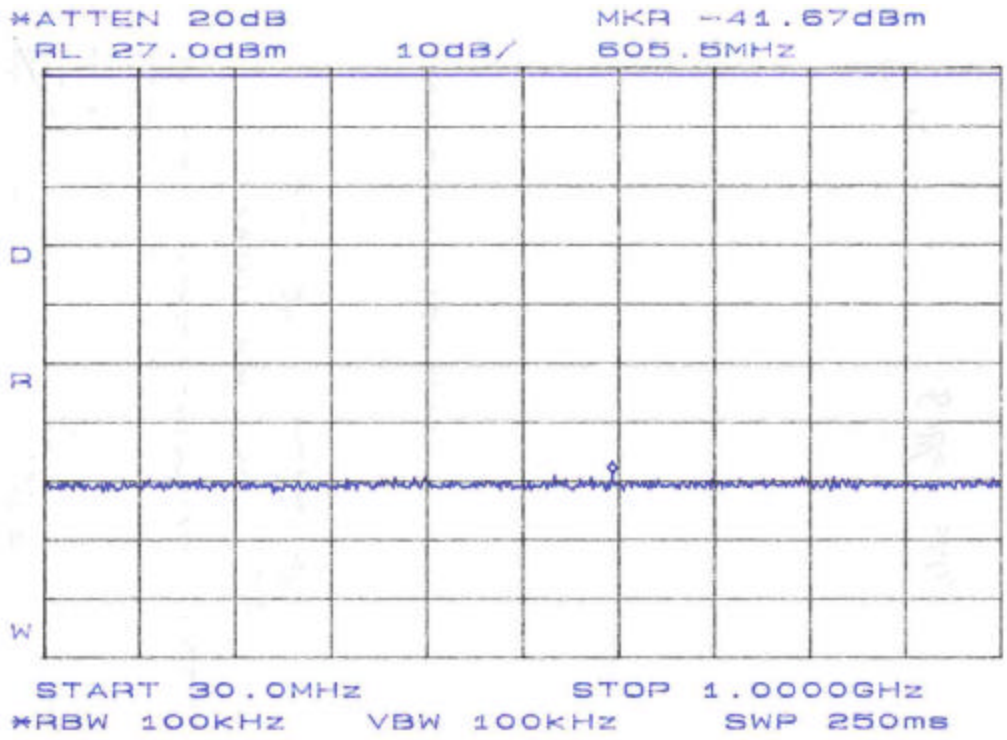

Figure 4-17. Conducted Spurious Emissions, Mid Channel 30 - 1000MHz

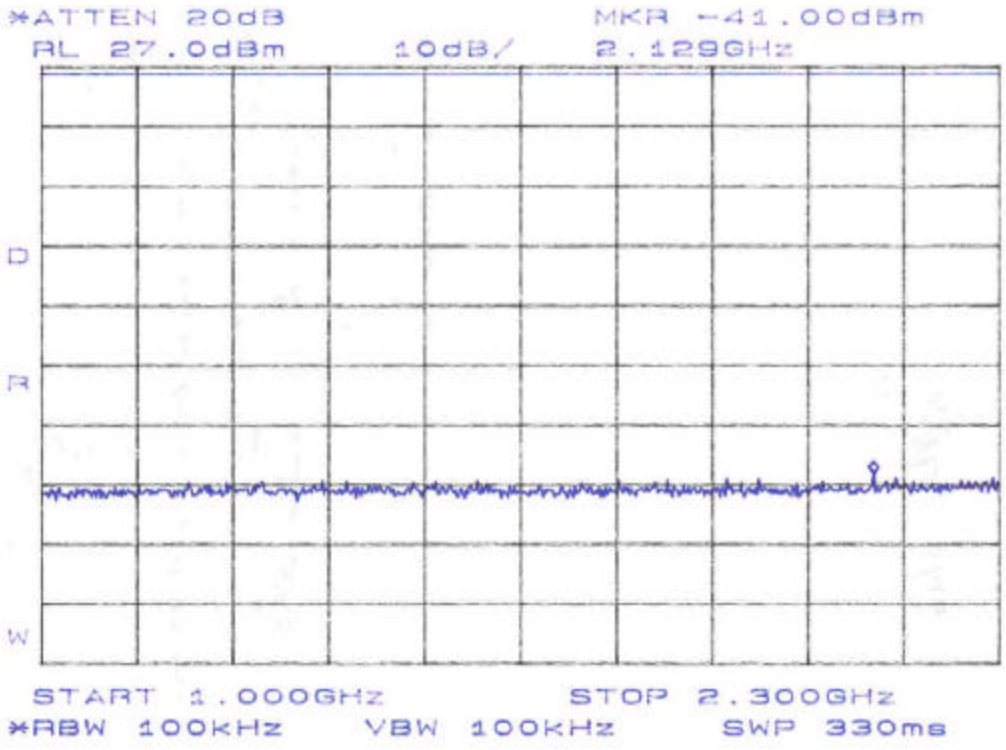

Figure 4-18. Conducted Spurious Emissions, Mid Channel 1 – 2.3GHz

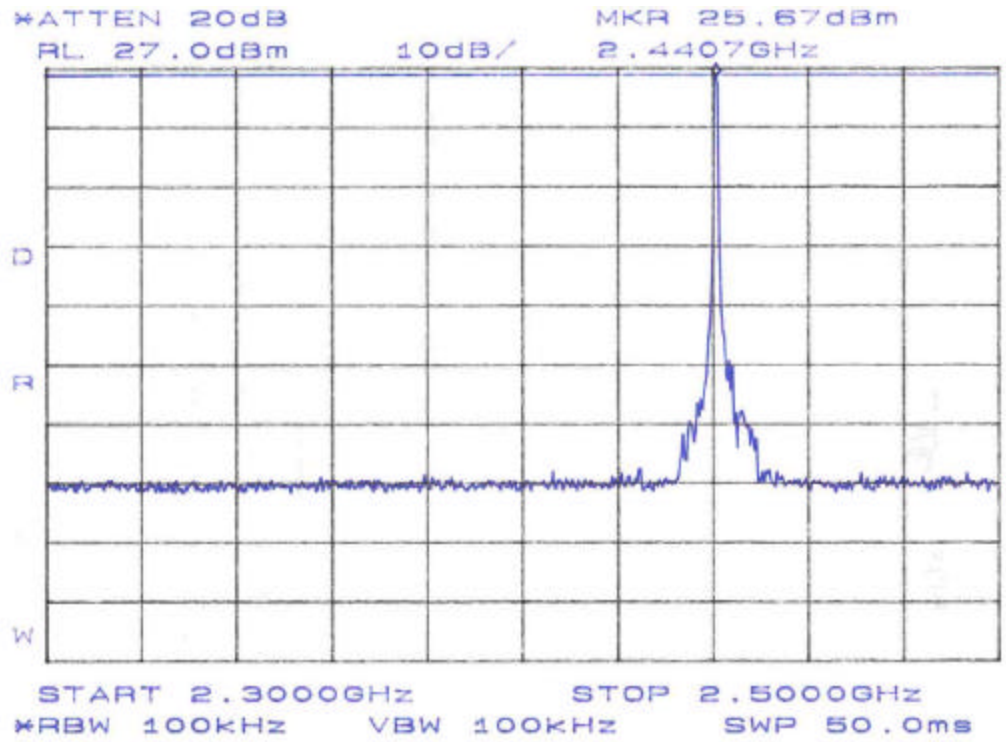

Figure 4-19. Conducted Spurious Emissions, Mid Channel 2.3 – 2.5GHz

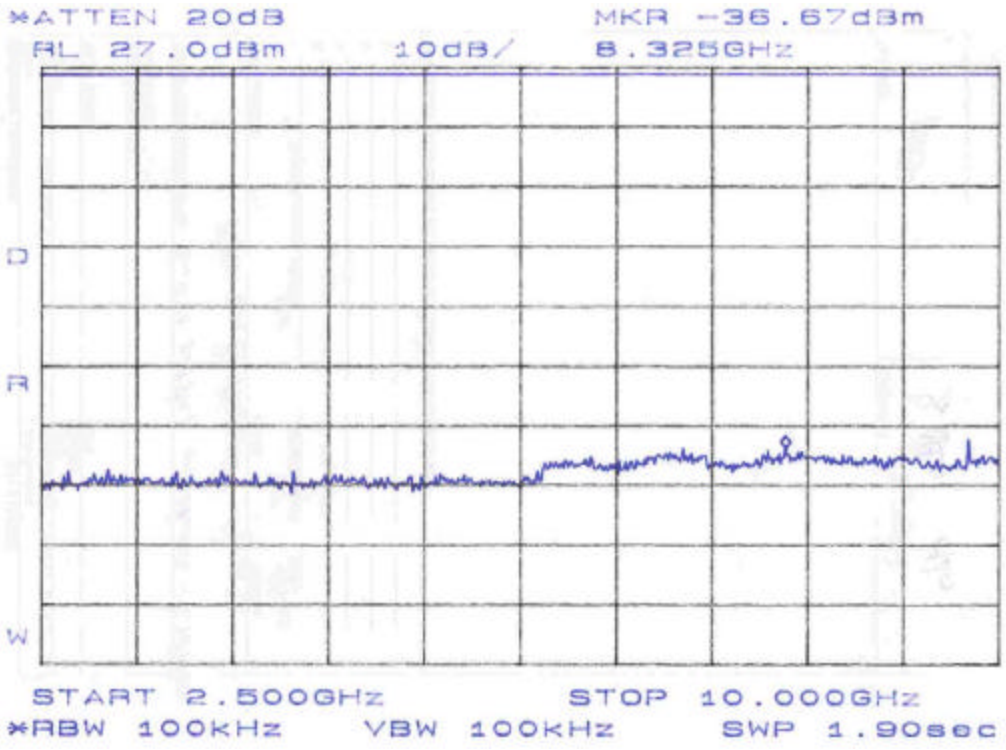

Figure 4-20. Conducted Spurious Emissions, Mid Channel 2.5 - 10GHz

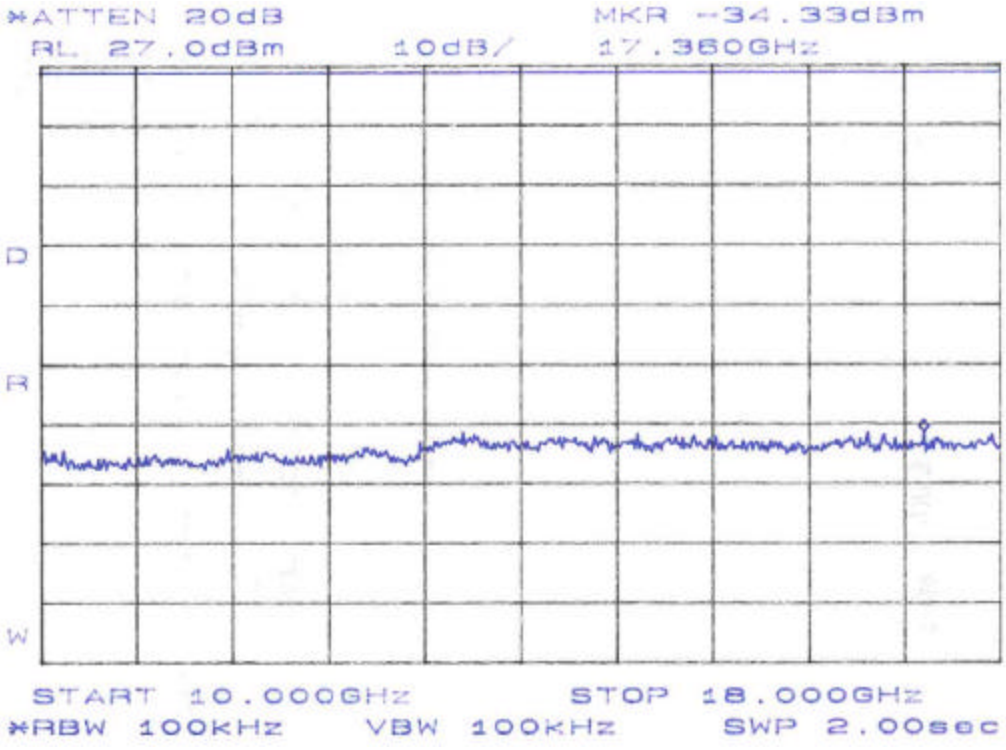

Figure 4-21. Conducted Spurious Emissions, Mid Channel 10 - 18GHz

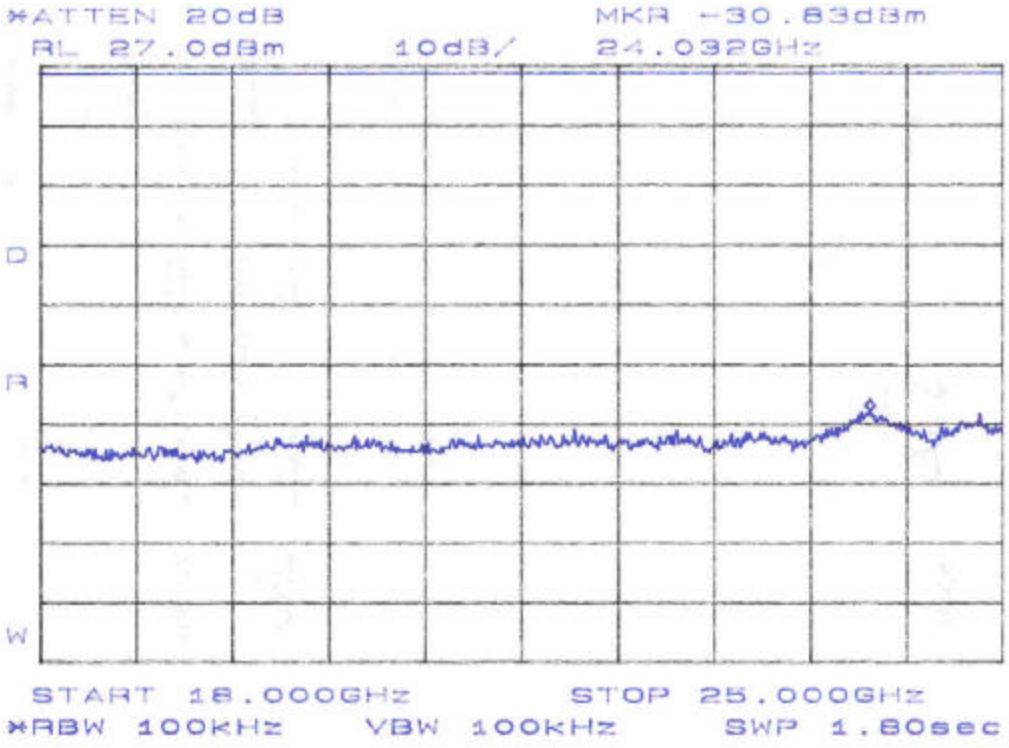

Figure 4-22. Conducted Spurious Emissions, Mid Channel 18 - 25GHz

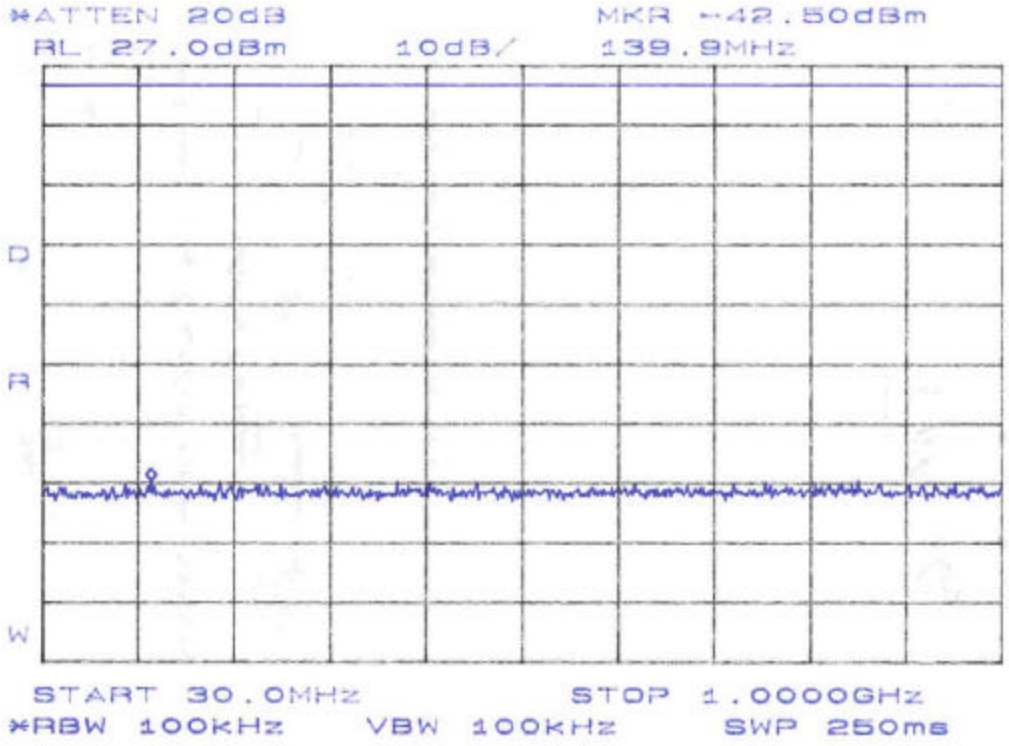

Figure 4-23. Conducted Spurious Emissions, High Channel 30 - 1000MHz

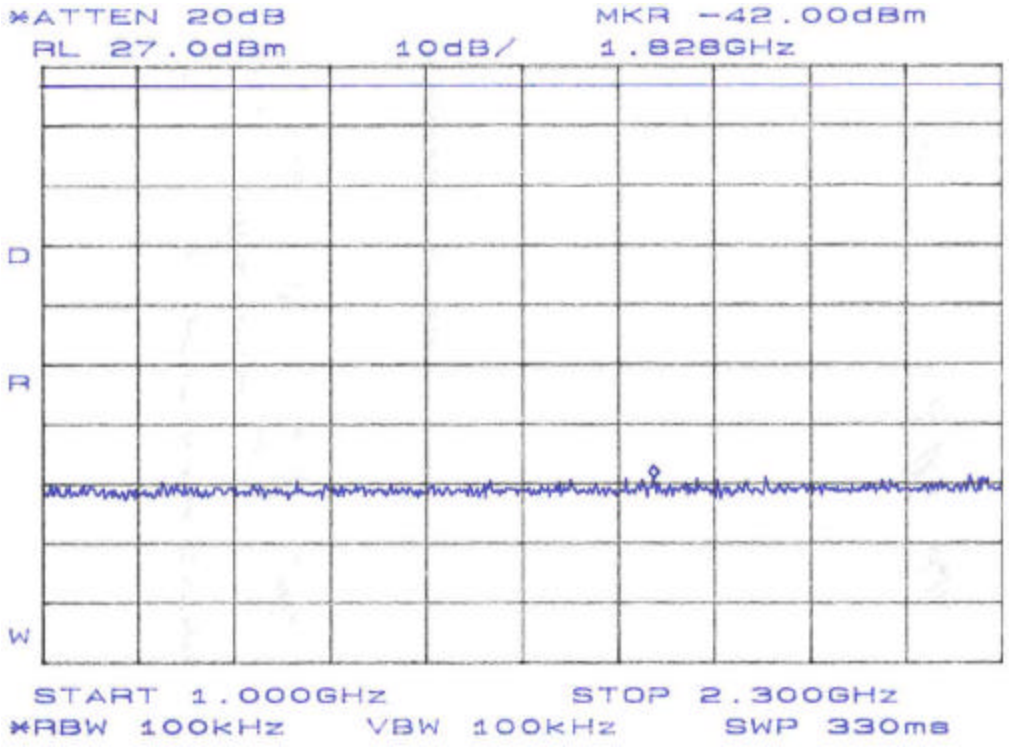

Figure 4-24. Conducted Spurious Emissions, High Channel 1 – 2.3GHz

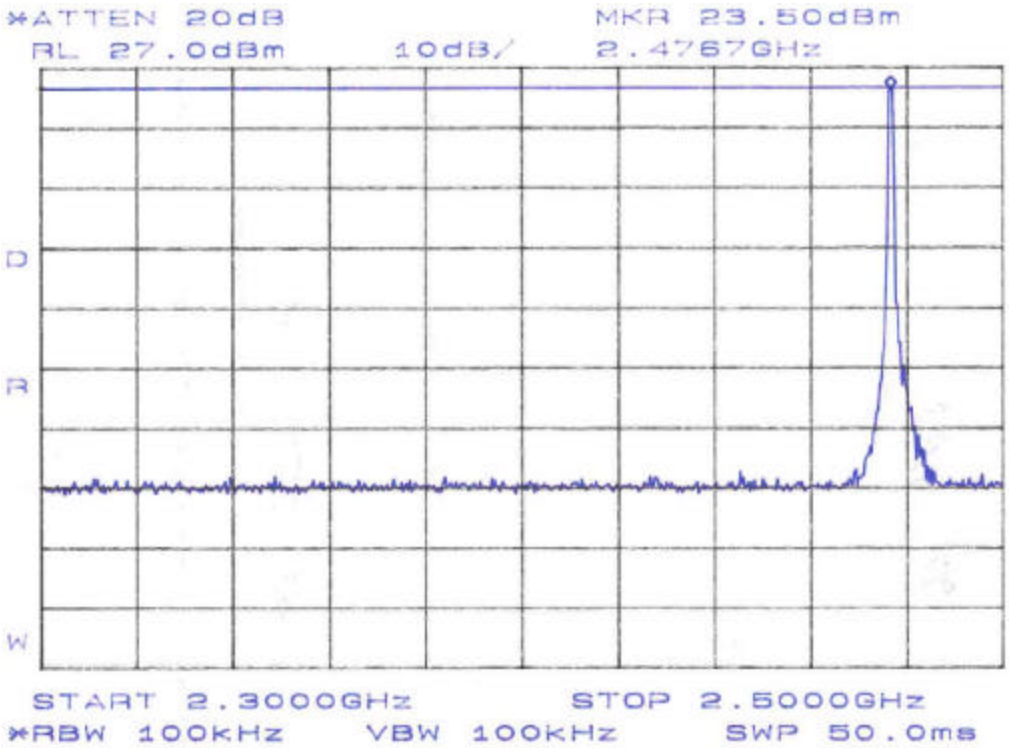

Figure 4-25. Conducted Spurious Emissions, High Channel 2.3 – 2.5GHz

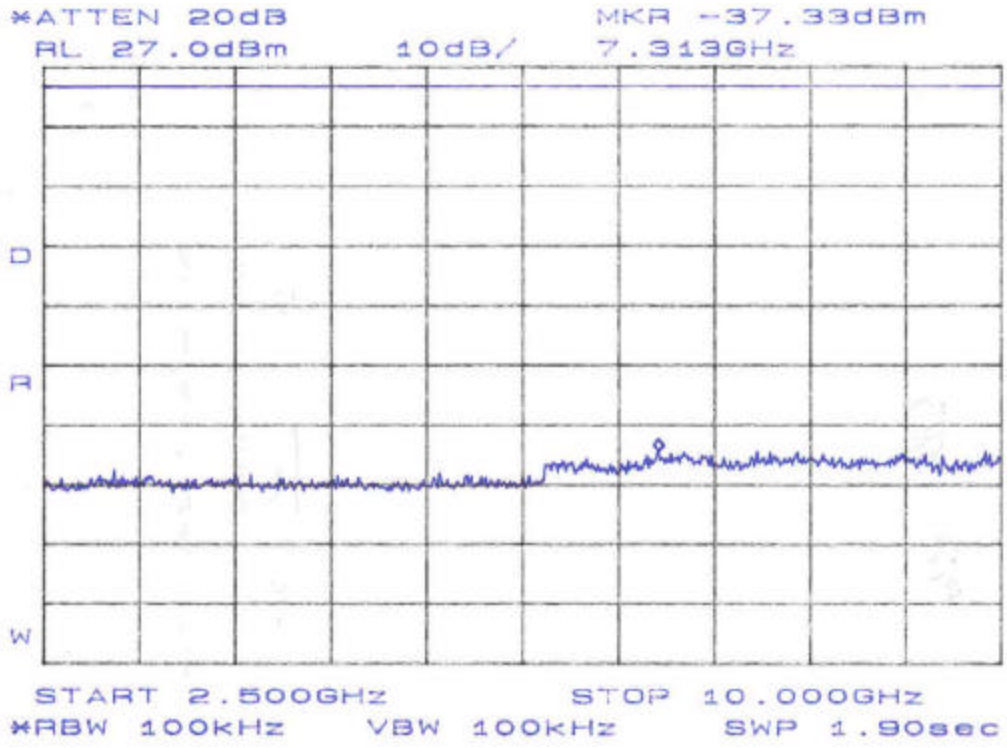

Figure 4-26. Conducted Spurious Emissions, High Channel 2.5 - 10GHz

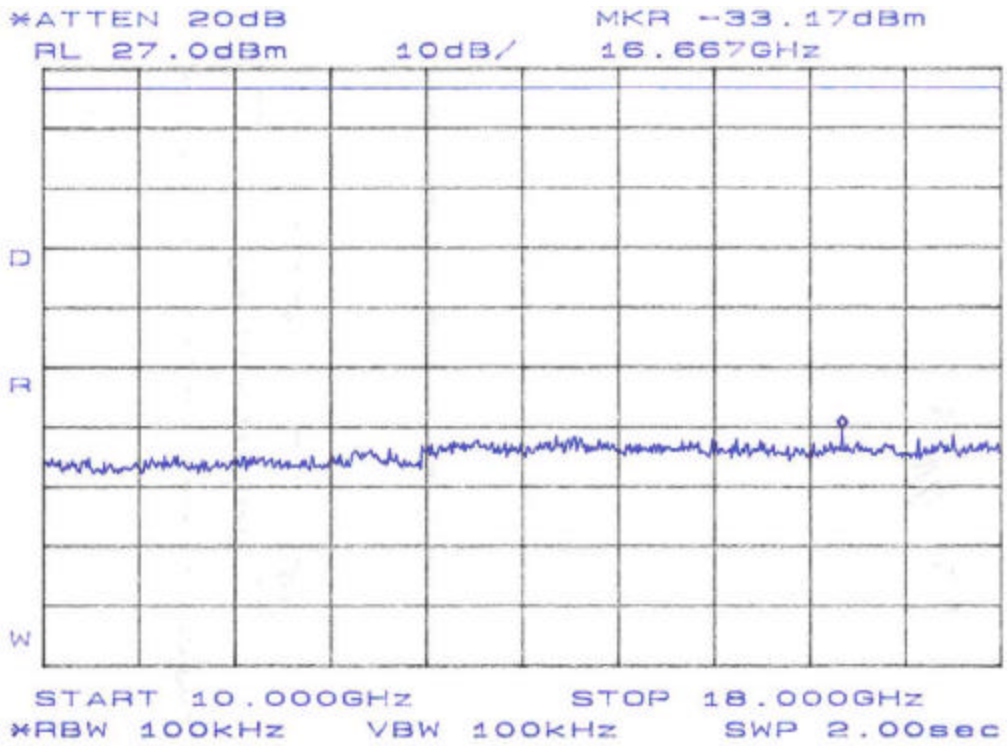

Figure 4-27. Conducted Spurious Emissions, High Channel 10 - 18GHz

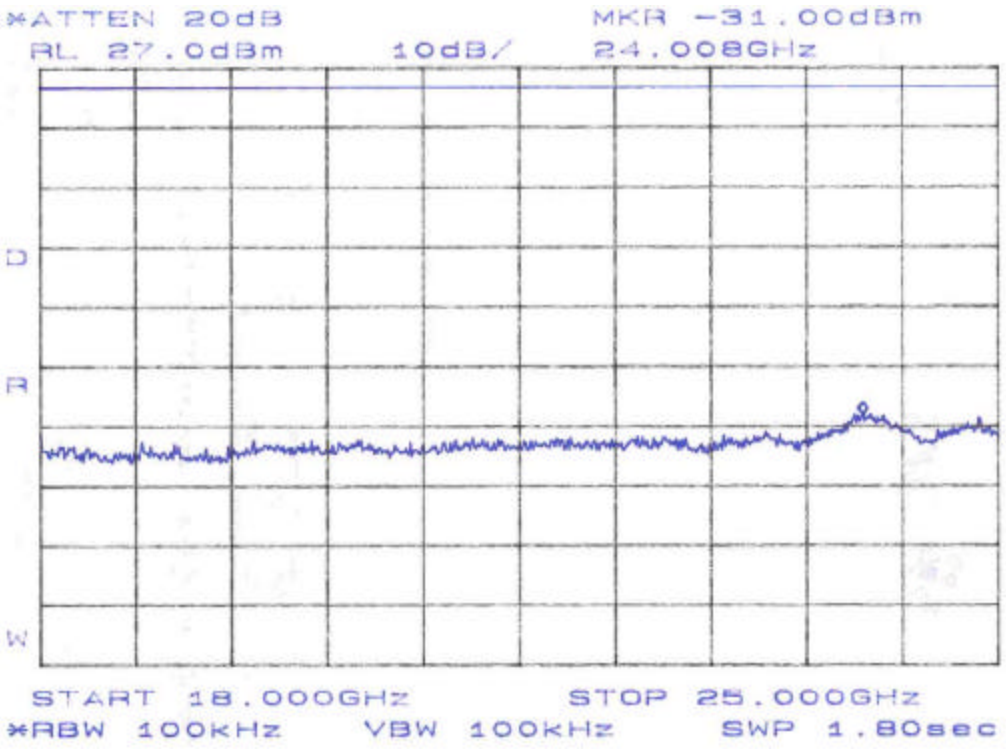

Figure 4-28. Conducted Spurious Emissions, High Channel 18 - 25GHz

4.6 Radiated Spurious Emissions: (FCC Part §2.1053)

The EUT must comply with the requirements for radiated spurious emissions that fall within the restricted bands. These emissions must meet the limits specified in §15.209 and §15.35(b) for peak measurements.

4.6.1 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.

The emissions were measured using the following resolution bandwidths:

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	<30 Hz (Avg.) 1MHz (Peak)

Table 5: Radiated Emission Test Data, Low Frequency Data (<1GHz)

CLIENT:	Zeus	DATE:	5/2/03
TESTER:	James Ritter	JOB #:	7580
EUT Information:		**Test Requirements:**	
EUT:	2.4 FHSS transmitter module	TEST STD:	FCC Part 15.247
CONFIGURATION:	transmit on	DISTANCE:	3m
		CLASS:	B
Test Equipment/Limit:			
ANTENNA:	A_00007	LIMIT:	LFCC_3m_Class_B
CABLE:	CSITE2_3m	AMPLIFIER (dB)	None

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Hght (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB
Low Chan 2401.9MHz										
37.89	V	125.0	1.0	6.3	18.0	1.3	25.6	19.2	100.0	-14.4
74.50	V	90.0	1.0	14.1	6.5	2.0	22.6	13.5	100.0	-17.4
127.27	V	90.0	1.0	12.3	10.9	2.5	25.6	19.2	150.0	-17.9
137.03	V	90.0	1.0	11.2	9.6	2.5	23.4	14.7	150.0	-20.1
149.95	V	0.0	1.3	8.4	8.7	2.7	19.8	9.8	150.0	-23.7
165.84	V	180.0	1.0	17.3	10.1	2.8	30.1	32.1	150.0	-13.4
259.36	V	45.0	1.3	8.1	12.5	3.5	24.1	16.1	200.0	-21.9
37.89	H	125.0	3.5	6.1	18.0	1.3	25.4	18.7	100.0	-14.6
74.50	H	120.0	3.2	8.1	6.5	2.0	16.6	6.7	100.0	-23.4
127.27	H	180.0	3.6	8.2	10.9	2.5	21.5	12.0	150.0	-22.0
137.03	H	190.0	3.1	7.2	9.6	2.5	19.4	9.3	150.0	-24.1
149.95	H	250.0	3.5	9.2	8.7	2.7	20.6	10.7	150.0	-22.9
165.84	H	0.0	2.0	14.3	10.1	2.8	27.1	22.7	150.0	-16.4
259.36	H	45.0	1.3	13.8	12.5	3.5	29.8	31.0	200.0	-16.2
Mid Chan 2439.9MHz										
37.89	V	180.0	1.0	9.6	18.0	1.3	28.9	28.0	100.0	-11.1
75.09	V	60.0	1.0	16.2	6.4	2.0	24.6	17.0	100.0	-15.4
127.70	V	90.0	1.0	13.2	10.8	2.5	26.5	21.1	150.0	-17.0
137.47	V	100.0	1.2	10.8	9.6	2.6	22.9	14.0	150.0	-20.6
156.52	V	125.0	1.4	9.8	8.7	2.7	21.2	11.5	150.0	-22.3
165.70	V	180.0	1.2	19.7	10.1	2.8	32.5	42.4	150.0	-11.0
259.36	V	0.0	1.4	12.1	12.5	3.5	28.1	25.5	200.0	-17.9
75.09	H	90.0	3.2	8.9	6.4	2.0	17.3	7.3	100.0	-22.7
127.70	H	180.0	3.5	5.1	10.8	2.5	18.4	8.3	150.0	-25.1
137.47	H	180.0	2.5	8.5	9.6	2.6	20.6	10.7	150.0	-22.9
156.52	H	190.0	2.8	9.6	8.7	2.7	21.0	11.2	150.0	-22.5

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Hght (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB
165.70	H	0.0	2.7	15.9	10.1	2.8	28.7	27.4	150.0	-14.8
259.36	H	0.0	1.5	12.2	12.5	3.5	28.2	25.7	200.0	-17.8
High Chan 2475.9MHz										
75.18	V	180.0	1.0	9.8	6.4	2.0	18.2	8.1	100.0	-21.8
127.67	V	190.0	1.0	16.5	10.8	2.5	29.8	30.9	150.0	-13.7
137.44	V	100.0	1.0	12.6	9.6	2.6	24.7	17.2	150.0	-18.8
156.50	V	100.0	1.2	10.7	8.7	2.7	22.1	12.7	150.0	-21.4
165.78	V	160.0	1.4	10.2	10.1	2.8	23.0	14.2	150.0	-20.5
259.36	V	180.0	1.2	17.1	12.5	3.5	33.1	45.3	200.0	-12.9
37.88	V	0.0	1.4	12.5	18.0	1.3	31.8	39.1	100.0	-8.2
75.18	H	180.0	3.8	7.7	6.4	2.0	16.1	6.4	100.0	-23.9
127.67	H	0.0	3.5	7.1	10.8	2.5	20.4	10.5	150.0	-23.1
137.44	H	180.0	3.4	5.1	9.6	2.6	17.2	7.3	150.0	-26.3
156.50	H	160.0	3.1	9.2	8.7	2.7	20.6	10.7	150.0	-22.9
165.78	H	180.0	3.0	14.2	10.1	2.8	27.0	22.5	150.0	-16.5
259.36	H	190.0	1.6	12.9	12.5	3.5	28.9	27.9	200.0	-17.1
37.88	H	180.0	1.0	6.1	18.0	1.3	25.4	18.7	100.0	-14.6

Table 6: Radiated Emission Test Data, High Frequency Data (>1GHz)

(Restricted Bands)

CLIENT:	Zeus	DATE:	5/2/03
TESTER:	James Ritter	JOB #:	7580
EUT Information:		**Test Requirements:**	
EUT:	2.4 FHSS transmitter module	TEST STD:	FCC Part 15.247
CONFIGURATION:	transmit on	DISTANCE:	3m
		CLASS:	B
Test Equipment/Limit:			
ANTENNA:	A_00004	LIMIT:	LFCC_3m_Class_B
CABLE:	CSITE2_HF	AMPLIFIER (dB)	A_00066

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Hght (m)	SA Level PEAK (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Duty Cycle db	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB
Low Channel (2401.9 MHz)												
4803.80	H	180.0	1.0	48.7	32.8	4.2	35.9	-19.2	30.5	33.5	500.0	-23.5
12009.50	H	225.0	1.0	46.0	41.3	7.7	34.7	-19.2	41.1	113.5	500.0	-12.9
19215.20	H	25.0	1.0	48.3	39.9	4.0	21.0	-19.2	52.0	398.1	5000.0	-22.0
24019.00	H	90.0	1.0	48.5	40.5	4.1	21.0	-19.2	52.9	441.6	5000.0	-21.1b
4803.80	V	270.0	1.0	49.0	41.3	7.7	34.7	-19.2	44.1	160.3	500.0	-9.9
12009.50	V	225.0	1.0	47.2	41.3	5.1	35.8	-19.2	38.5	84.1	500.0	-15.5
19215.20	V	25.0	1.0	47.1	39.9	4.0	21.0	-19.2	50.8	346.7	5000.0	-23.2
24019.00	V	90.0	1.0	45.0	40.5	4.1	21.0	-19.2	49.4	295.1	5000.0	-24.6b
Middle Channel (2439.9MHz)												
4879.80	H	180.0	1.0	48.6	32.9	4.3	36.0	-19.2	30.6	33.9	500.0	-23.4
7319.70	H	200.0	1.0	45.2	37.9	4.6	35.9	-19.2	32.5	42.2	500.0	-21.5
12199.50	H	190.0	1.0	42.2	40.7	7.4	34.9	-19.2	36.1	63.8	500.0	-17.9
19519.20	H	25.0	1.0	52.0	39.8	4.0	21.0	-19.2	55.6	602.6	5000.0	-18.4
4879.80	V	225.0	1.0	49.8	32.9	4.3	36.0	-19.2	31.8	38.9	500.0	-22.2
7319.70	V	180.0	1.0	46.4	37.9	4.6	35.9	-19.2	33.8	49.0	500.0	-20.2
12199.50	V	180.0	1.0	48.3	40.7	7.4	34.9	-19.2	42.2	128.8	500.0	-11.8
19519.20	V	25.0	1.0	50.1	39.8	4.0	21.0	-19.2	53.7	484.2	5000.0	-20.3
High Channel (2475.9MHz)												
4951.80	H	190.0	1.0	47.4	32.9	4.4	36.0	-19.2	29.5	29.9	500.0	-24.5
7427.70	H	180.0	1.0	44.8	38.0	4.6	35.9	-19.2	32.2	40.7	500.0	-21.8
12379.50	H	190.0	1.0	46.6	40.1	7.0	35.1	-19.2	39.4	93.3	500.0	-14.6
19807.20	H	25.0	1.0	54.7	39.7	4.0	21.0	-19.2	58.2	812.8	5000.0	-15.8
22283.10	H	25.0	1.0	42.6	40.7	4.1	21.0	-19.2	47.2	229.1	5000.0	-26.8b

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Hght (m)	SA Level PEAK (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Duty Cycle db	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB
4951.80	V	190.0	1.0	45.9	32.9	4.4	36.0	-19.2	28.0	25.1	500.0	-26.0
7427.70	V	180.0	1.0	43.6	38.0	4.6	35.9	-19.2	31.0	35.5	500.0	-23.0
12379.50	V	190.0	1.0	41.6	40.1	7.0	35.1	-19.2	34.4	52.5	500.0	-19.6
19807.20	V	25.0	1.0	52.0	39.7	4.0	21.0	-19.2	55.5	595.7	5000.0	-18.5
22283.10	V	25.0	1.0	40.1	40.7	4.1	21.0	-19.2	44.7	171.8	5000.0	-29.3b

Above 18GHz, measurements were taken at 30 cm test distance - Narda 638 horn ant (#210), cable assy. #2
b = ambient reading - measurements taken at 30 cm