Washington Laboratories, Ltd.

FCC Certification Test Report

For

GAGE WIRELESS, INC.

2.4GHZ FREQUENCY HOPPING SPREAD SPECTRUM (FHSS) TRANSCEIVER, MODEL GRC-24

FCC ID: TCX-GRC-24

WLL JOB# **8780**
August 2005

Prepared for:

Gage Wireless, Inc.
7257 Parkway Drive
Hanover, MD 21076

Prepared By:

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

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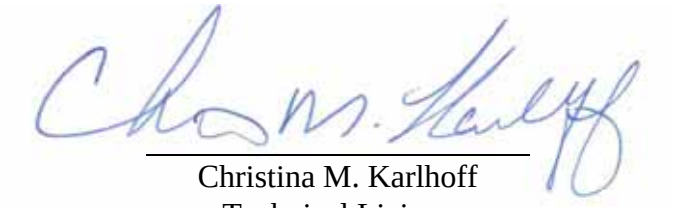
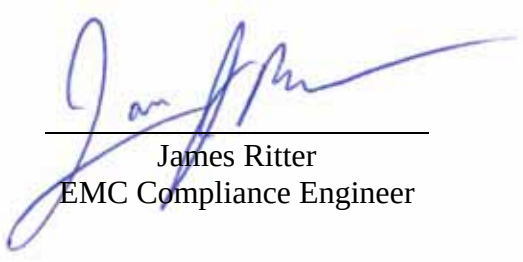


Christina M. Karlhoff
Technical Liaison

Reviewed by:



James Ritter
EMC Compliance Engineer

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Abstract

This report has been prepared on behalf of Gage Wireless, 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 Gage Wireless, Inc. 2.4GHz Frequency Hopping Spread Spectrum (FHSS) Transceiver, Model GRC-24.

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 Gage Wireless, Inc. 2.4GHz Frequency Hopping Spread Spectrum (FHSS) Transceiver, Model GRC-24 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

Compliance Statement

The Gage Wireless, Inc. 2.4GHz Frequency Hopping Spread Spectrum (FHSS) Transceiver, Model GRC-24 complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under Part 15.247 of the FCC Rules and Regulations.

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 2001 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

Contract Information

Customer:	Gage Wireless, Inc. 7257 Parkway Drive Hanover, MD 21076
Purchase Order Number:	5195-01
Quotation Number:	62087

Test Dates

Testing was performed on the following date(s): 7/11/2005 through 7/13/2005

Test and Support Personnel

Washington Laboratories, LTD	James Ritter; John Repella
Client Representative	John Russell

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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	deci**B**el
dc	**d**irect **c**urrent
EMI	**E**lectro**m**agnetic **I**nterference
EUT	**E**quipment **U**nder **T**est
FM	**F**requency **M**odulation
G	**G**iga - prefix for 10^9 multiplier
Hz	**H**ertz
IF	**I**ntermediate **F**requency
k	**k**ilo - prefix for 10^3 multiplier
M	**M**ega - prefix for 10^6 multiplier
m	**m**eter
µ	micro - prefix for 10^{-6} multiplier
NB	**N**arrow**b**and
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
RE	**R**adiated **E**missions
RF	**R**adio **F**requency
rms	**r**oot-**m**ean-**s**quare
SN	**S**erial **N**umber
S/A	**S**pectrum **A**nalyzer
V	**V**olt

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2 Equipment Under Test

EUT Identification & Description

The EUT is a 2.4 GHz Band Frequency hopping Transceiver module mounted on a PCB.

Table 3-1. Device Summary

Item	Description
Manufacturer:	Gage Wireless, Inc.
FCC ID Number	TCX-GRC-24
EUT Name:	2.4 GHz Frequency Hopping Spread Spectrum (FHSS) Transceiver
Model:	GRC-24
FCC Rule Parts:	§15.247
Frequency Range:	2402-2476 MHz
Maximum Output Power:	267mW (24.3dBm)
Modulation:	FHSS
Occupied Bandwidth:	831.49kHz
Keying:	Automatic, Manual
Type of Information:	Data (TTL level compatible signal)
Number of Channels:	75 (1 MHz channel separation)
Power Output Level	24.3 dBm (0.267 Watts)
Antenna Connector	SMA
Antenna Type	Whip (3 dBi monopole)
Interface Cables:	1
Power Source & Voltage:	120 VAC to 7.5 VDC 600ma Power Supply adapter

Test Configuration

The EUT was configured with a power/interface board to supply commands and signal. Power was from a 120 VAC to 7.5 VDC adapter that plugged into the power/interface board. This interface board also received data from a laptop PC via a DB9 RS-232 cable. The interface board sent to the combined signals to the transceiver module on a 26-pin ribbon cable.

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Testing Algorithm

To provide three stationary (high, low, center) channels a hop table script was selected from the support laptop (Hop table). It allowed one of three channels to be selected (2402 MHz, 2440 MHz, and 2476 MHz).

For testing of the hopping function, the "GAGE RADIO" icon on the support PC was selected. This program allowed the radio to hop between 75 channels.

The unit was tested in three orthogonal planes. It was determined that the unit oriented lying flat provided the worst case emissions. Those emission levels are provided in the test results data.

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.

Measurements

2.1.1 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.

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.

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3 Test Results

Duty Cycle Correction

In accordance with the FCC Public Notice DA 00-705 and Pt 15.209 the spurious radiated harmonic emissions measurements may be adjusted using a duty cycle correction factor in addition to video averaging 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)

Figures 3-1 and 3-2 show the plots of the dwell time for the transmitter. Based on this plot, the dwell time per hop is 833 µs. Therefore the total dwell time per 100 ms is 833 µs. This corresponds to a duty cycle correction of -41dB, however, the maximum allowed duty cycle correction is 20dB.

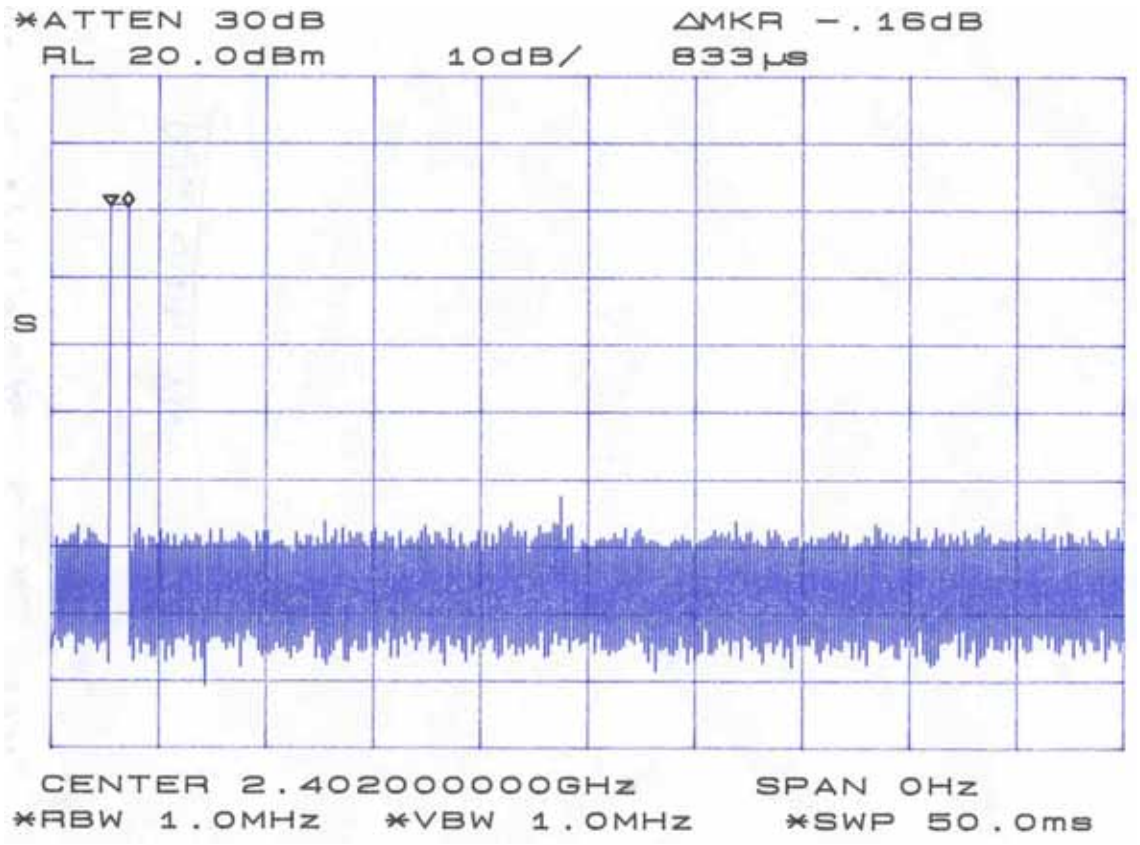

Figure 3-1. Pulse Width Plot

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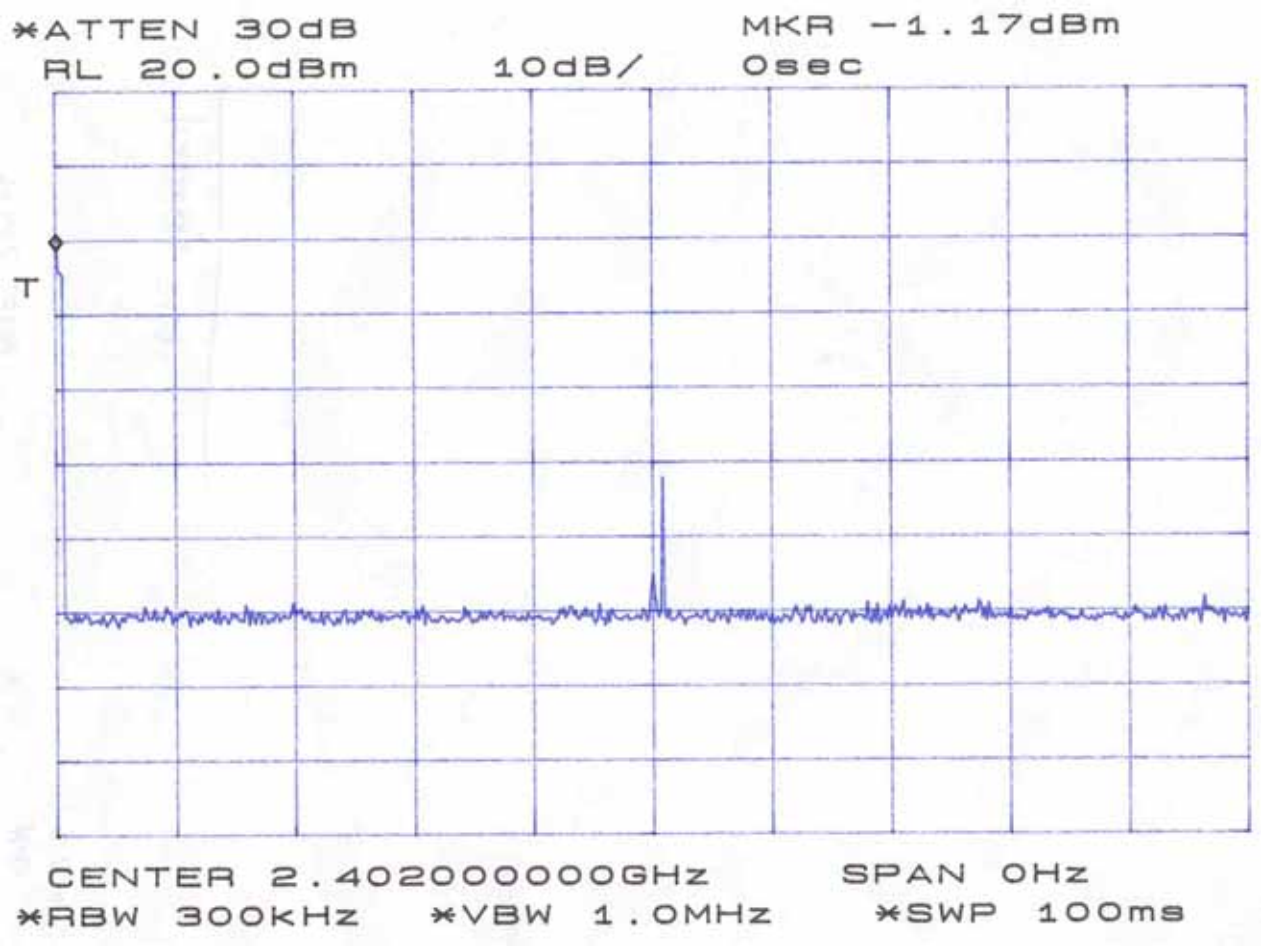

Figure 3-2. Duty Cycle Correction - 100 ms Plot

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In accordance with FCC 15.247 (a) the occupancy time of any channel shall not be greater than .4 seconds within a period of 0.4 seconds times the number of channels.

For this EUT:

75 Channels/Frequencies X 0.4 seconds = 30 seconds (Limit = .4 seconds per 30 seconds, per channel, maximum).

Test data plot: 15.827 ms/30 s. interval, based on 19 pulses of 833 µs.

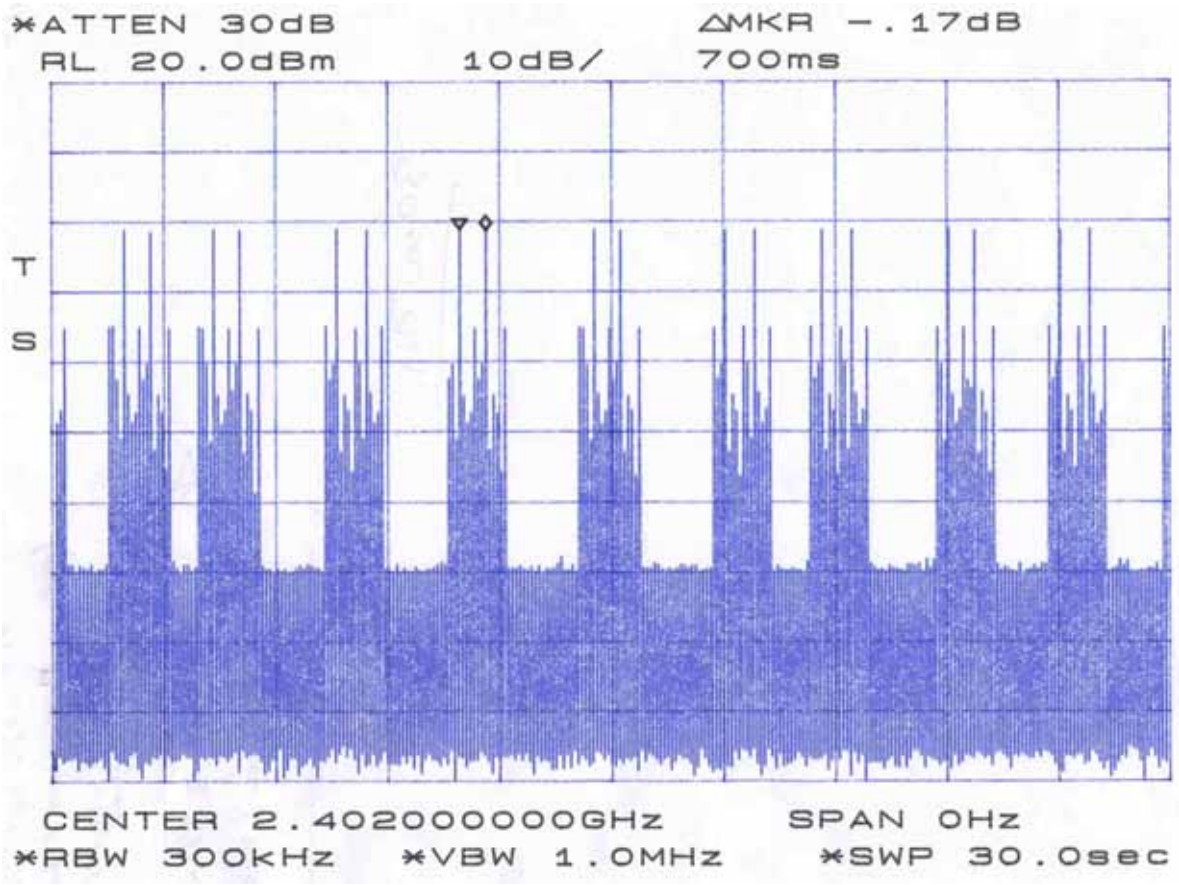

Figure 3-3. Dwell Time - 30 Second Plot

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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 measured on an oscilloscope through a RF diode detector and this level was then recreated with a substitution signal generator. The signal generator was then connected to a power meter with this reading recorded below.

Table 3-2. RF Power Output

Frequency	Level dBm (*Watts*)	Limit dBm (*Watts*)	Results
Low Channel 2402 MHz	24.1 (*0.256*)	30 (*1*)	Pass
Mid Channel 2440 MHz	24.3 (*0.267*)	30 (*1*)	Pass
High Channel 2476 MHz	24.2 (*0.263*)	30 (*1*)	Pass

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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:

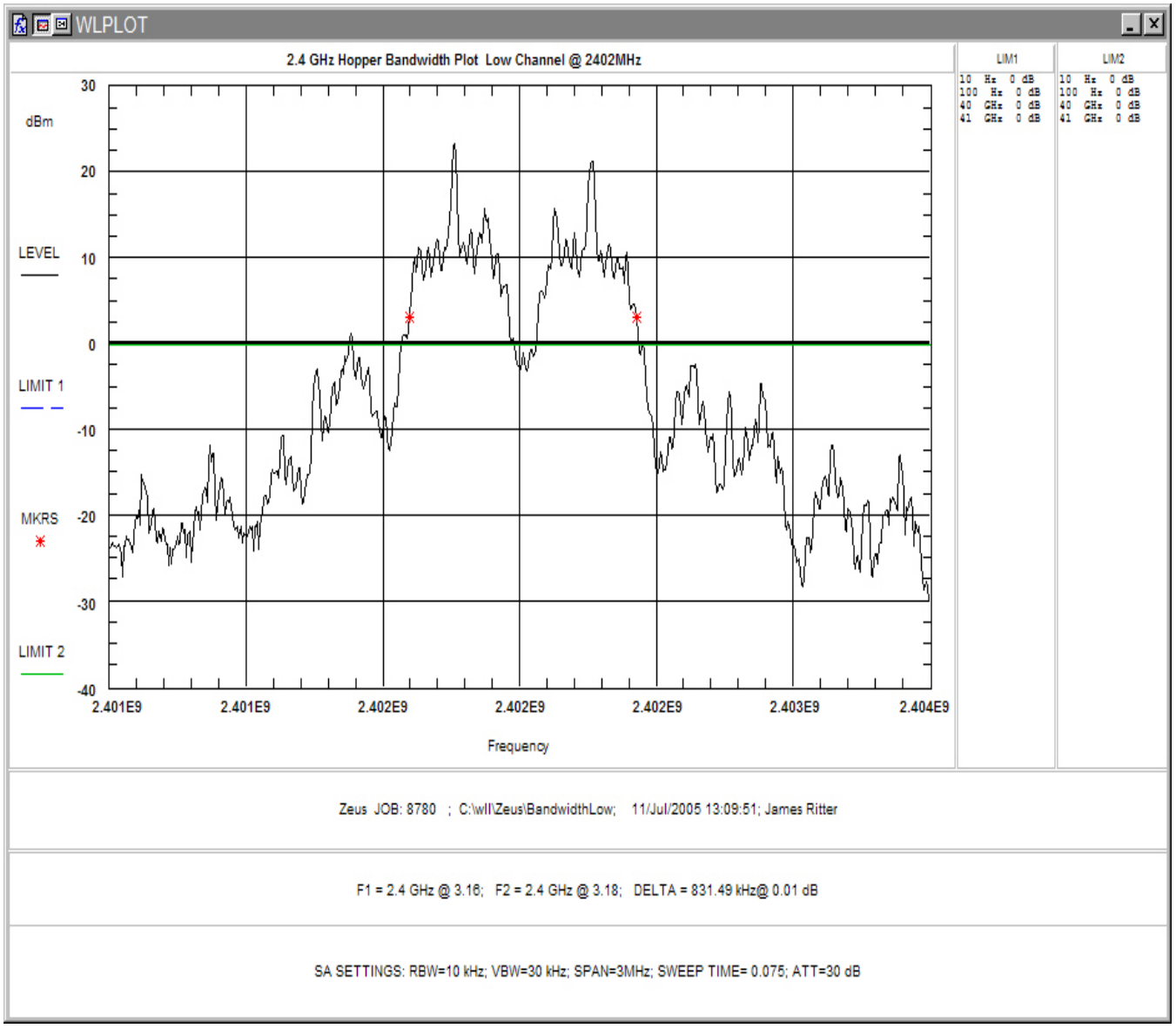

Figure 3-4. Occupied Bandwidth, Low Channel

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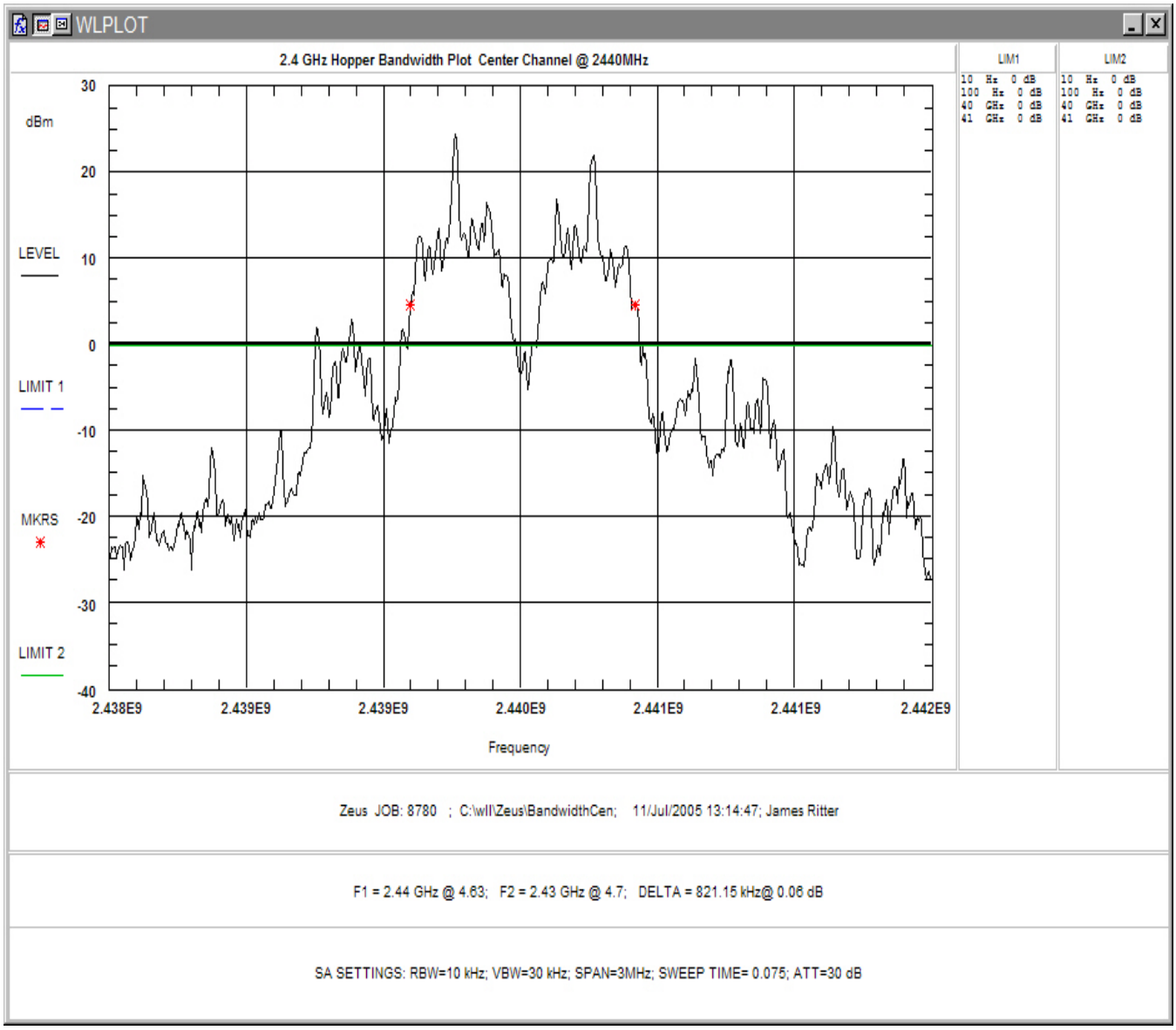

Figure 3-5. Occupied Bandwidth, Mid Channel

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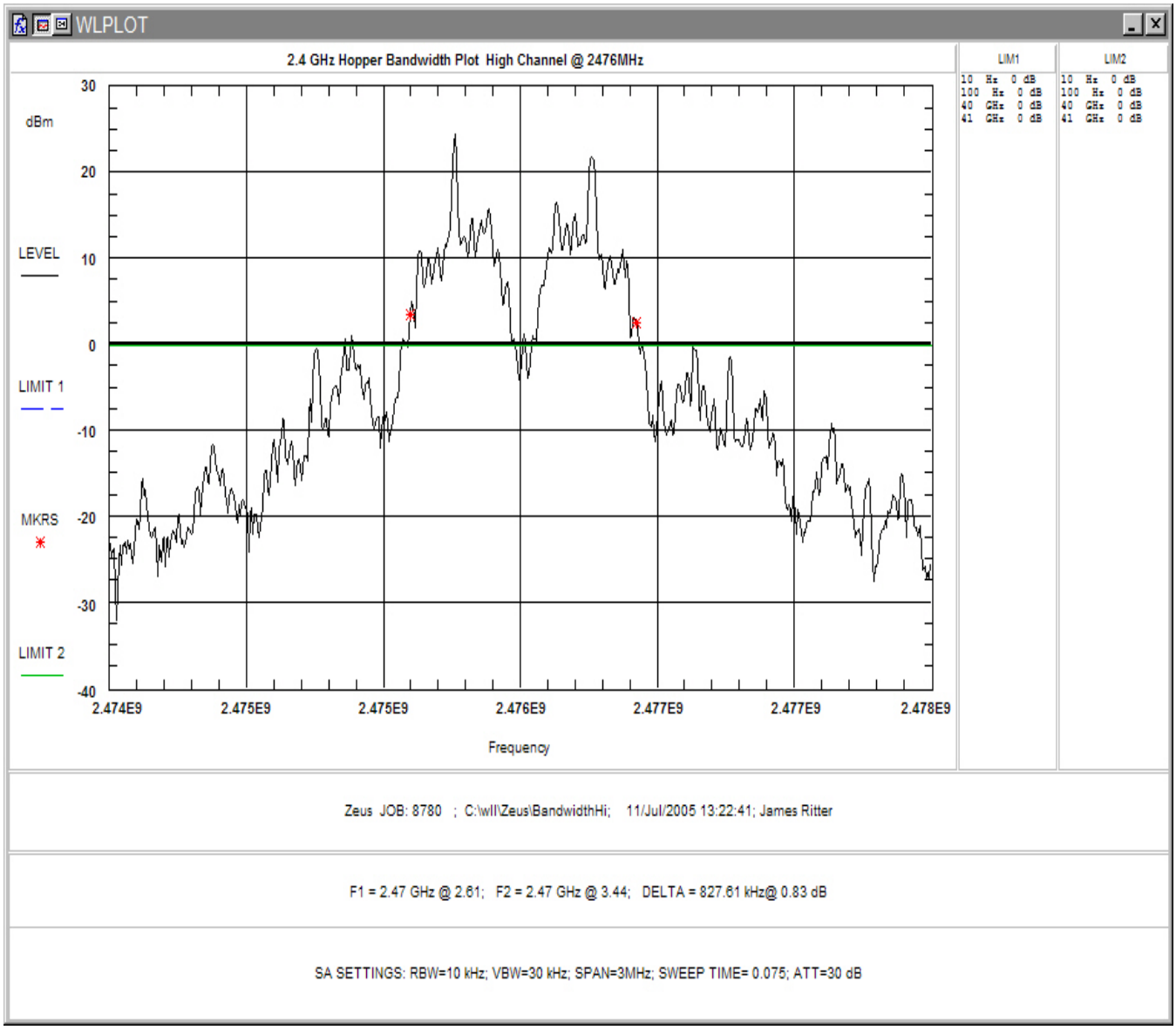

Figure 3-6. Occupied Bandwidth, High Channel

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Table 3-3 provides a summary of the Occupied Bandwidth Results.

Table 3-3. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Results
Low Channel 2402MHz	831.49 kHz	1 MHz	Pass
Mid Channel 2440MHz	821.15 kHz	1 MHz	Pass
High Channel 2476MHz	827.61 kHz	1 MHz	Pass

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

Per the FCC requirements, frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or a 20 dB bandwidth, whichever is greater. The maximum 20dB bandwidth measured is 831.49 kHz so the channel spacing must be more than 831.49 kHz. In addition, for a 2.4 GHz device 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 30 kHz and the video bandwidth was set to 1 MHz. The channel spacing of 2 adjacent channels was measured using a spectrum analyzer span setting of 3 MHz. 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 1.02 MHz and the number of channels used is 75 [The modulation method causes two peaks to be seen per channel, for a total of 150 channels graphically represented on the plots].

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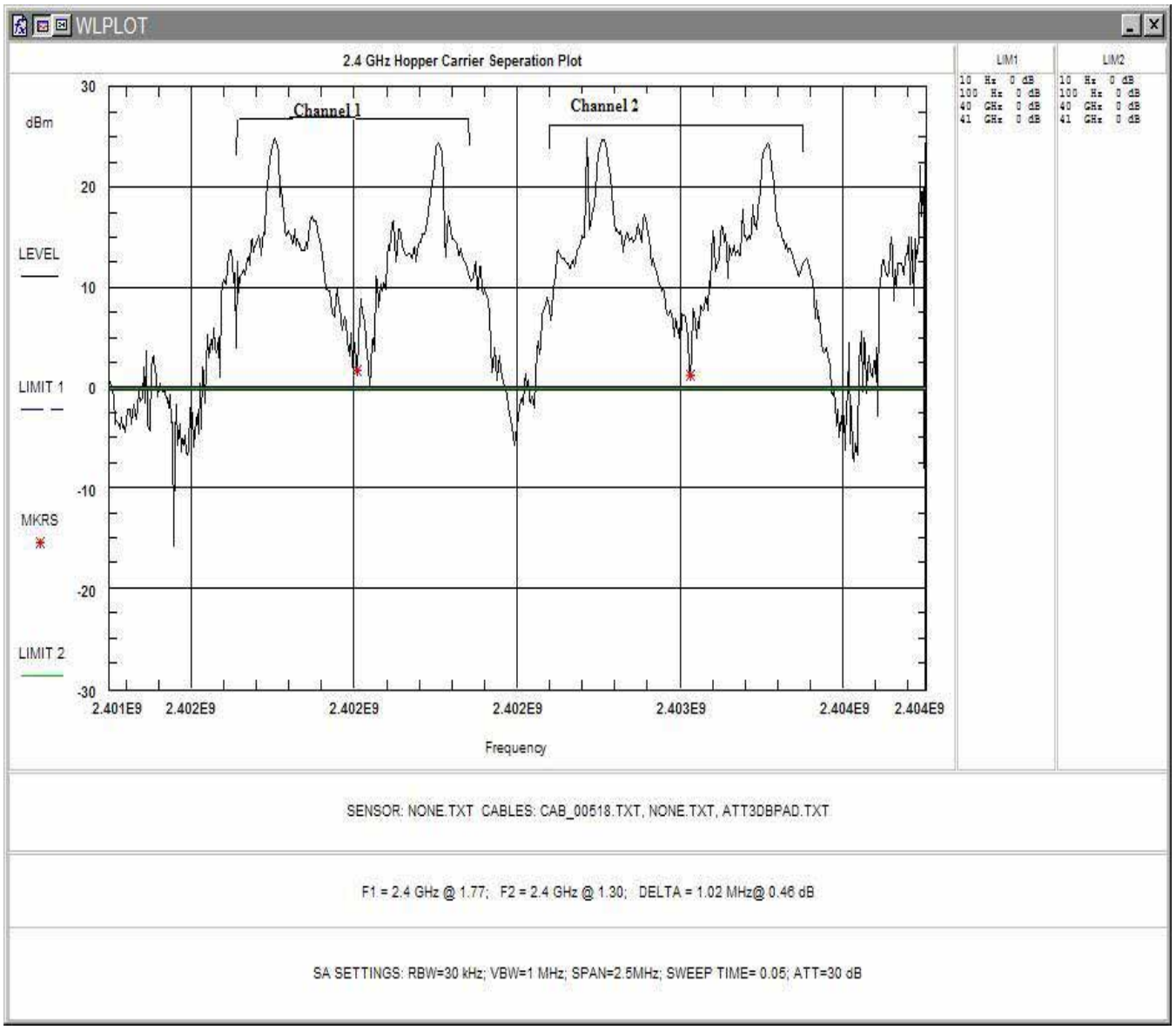

Figure 3-7, Channel Spacing, 1020 kHz

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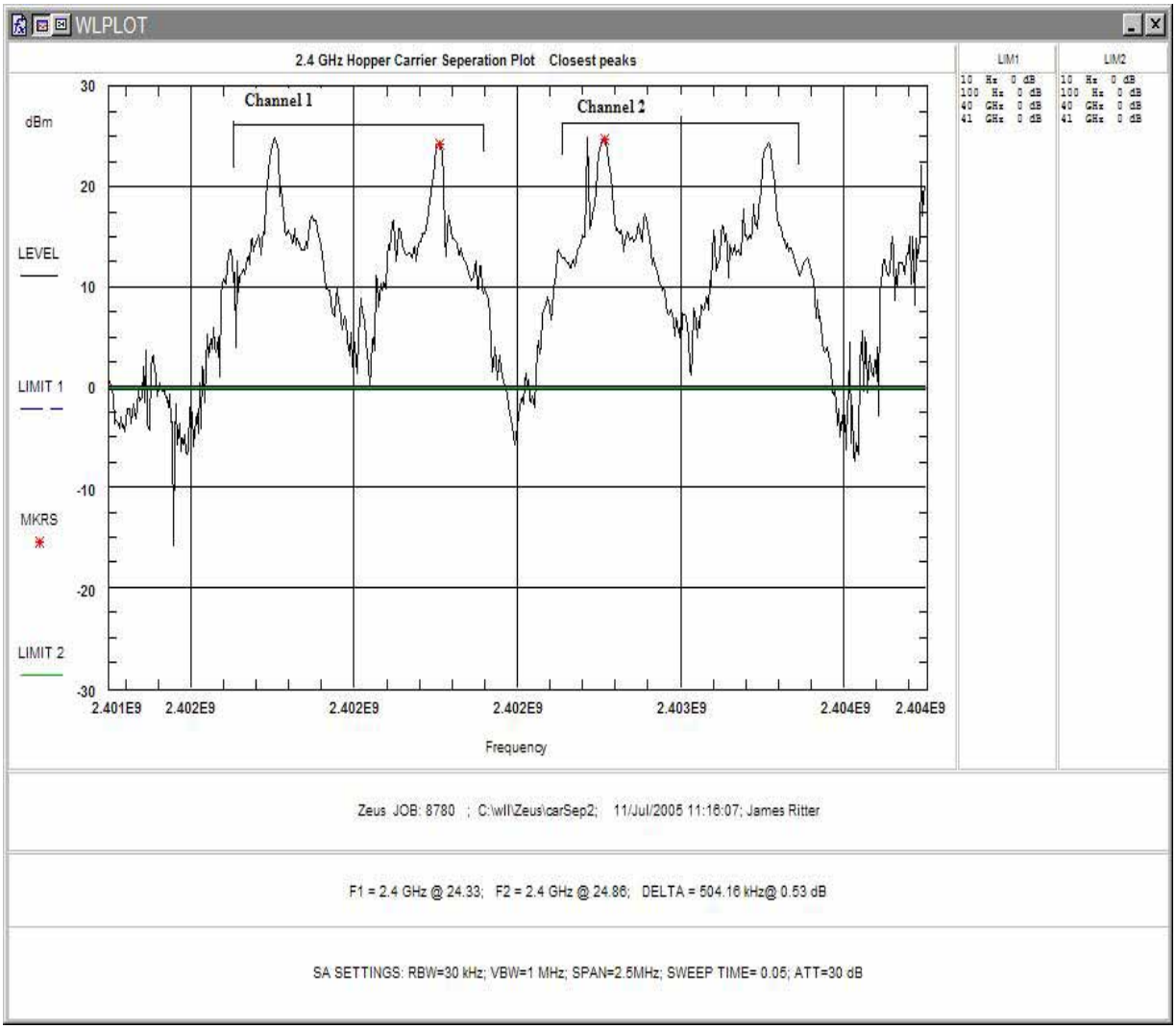

Figure 3-8, Channel Spacing, 504 kHz

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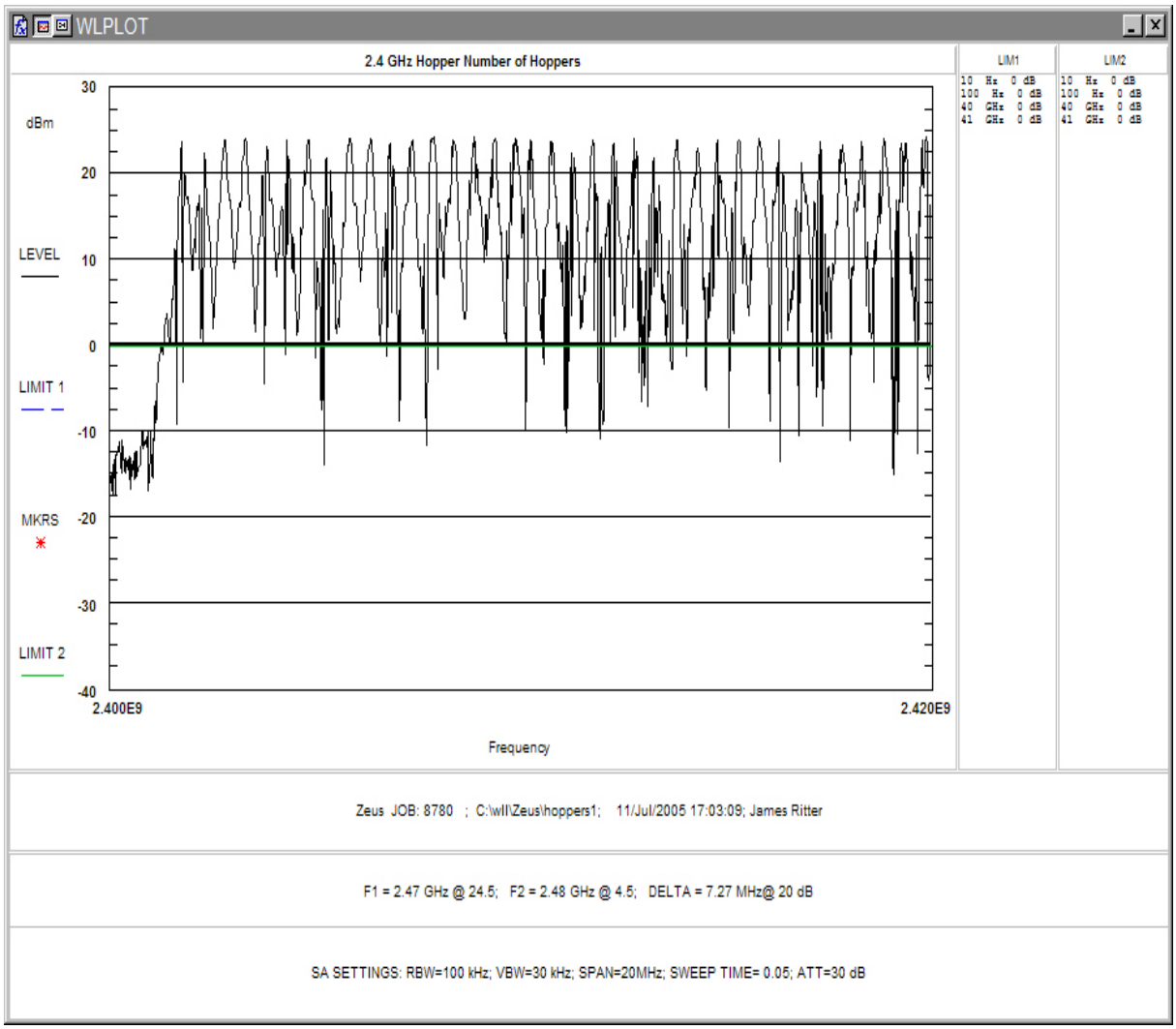

Figure 3-9, Number of Hoppers, Plot 1

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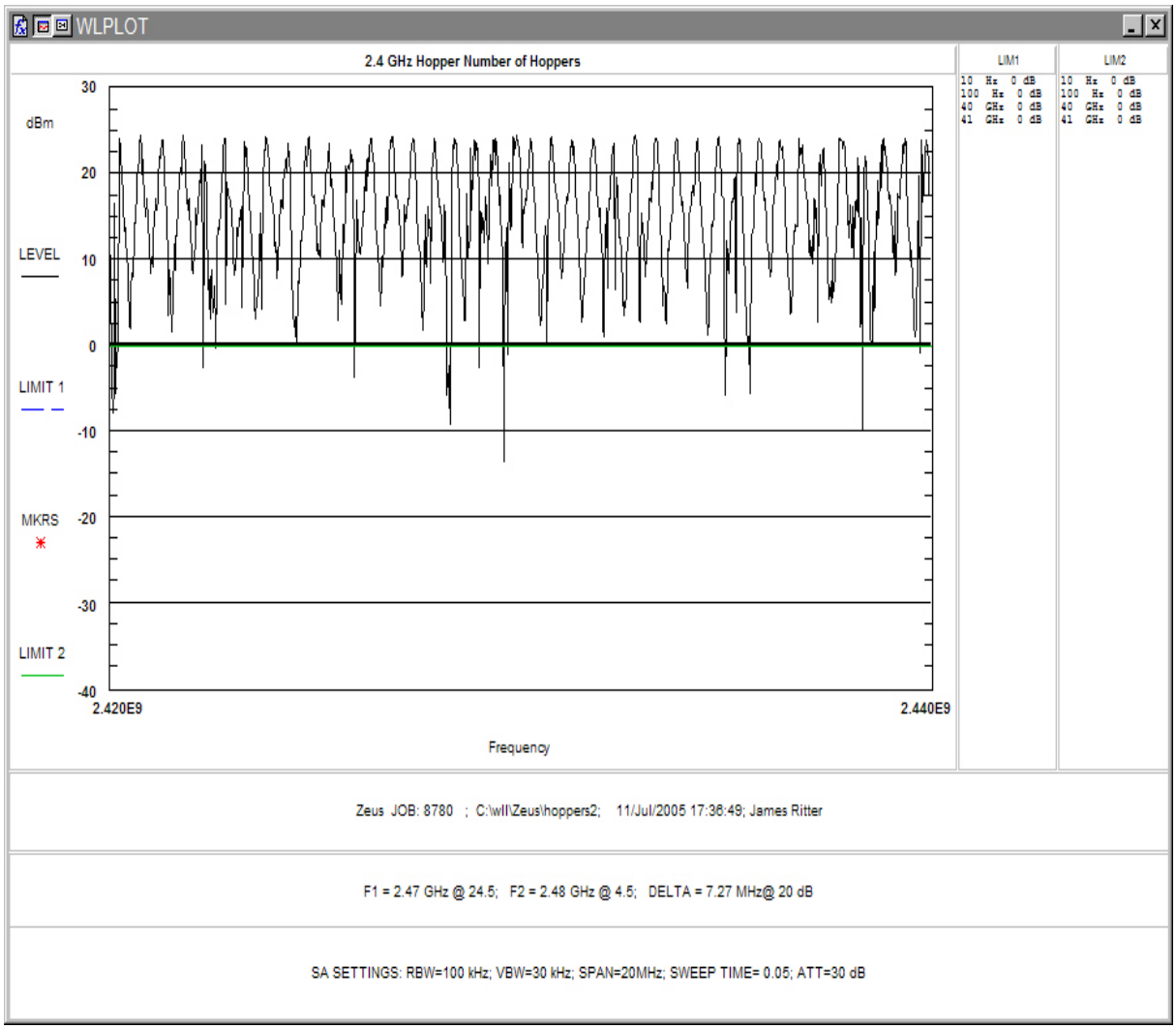

Figure 3-10, Number of Hoppers, Plot 2

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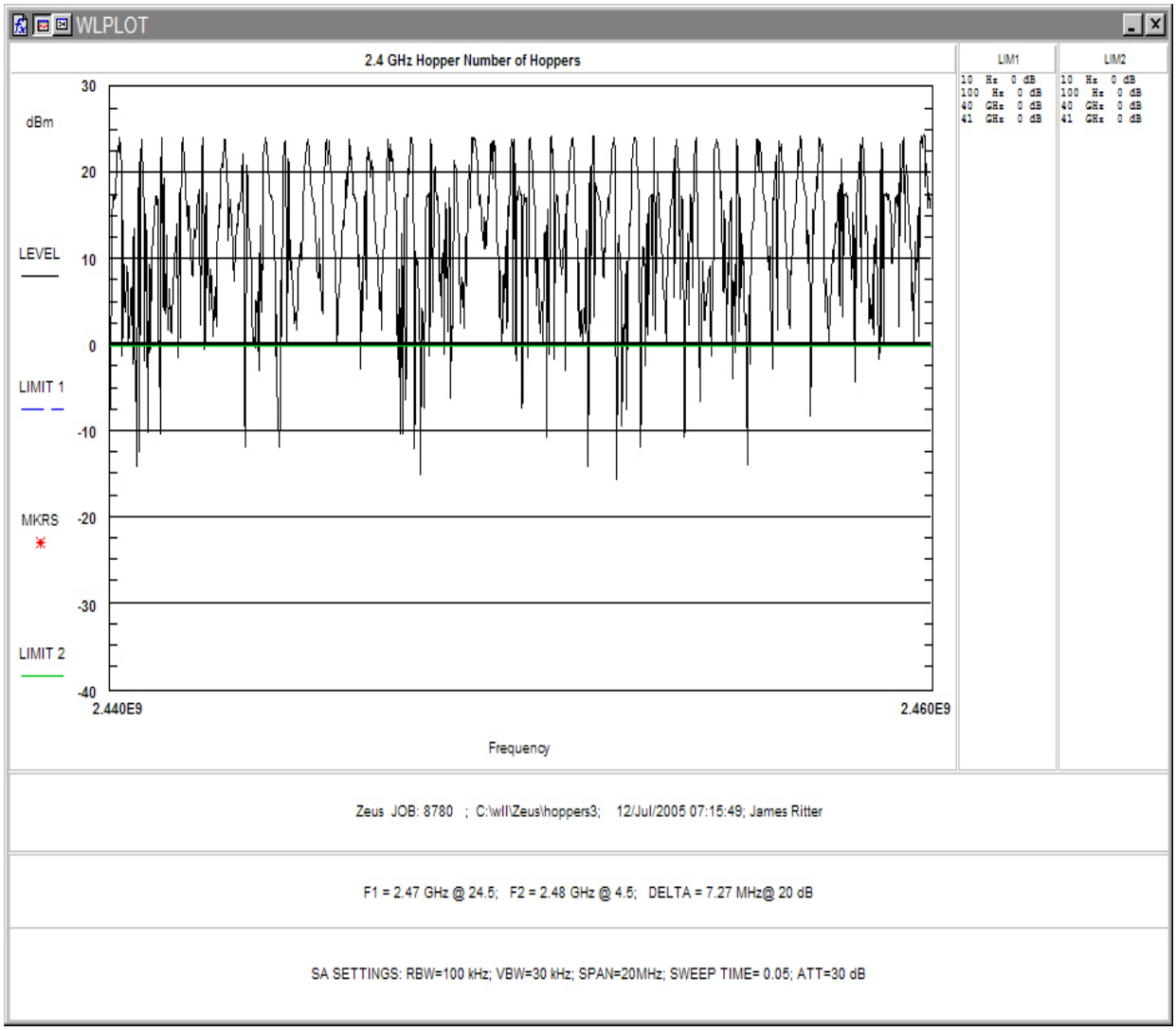

Figure 3-11, Number of Hoppers, Plot 3

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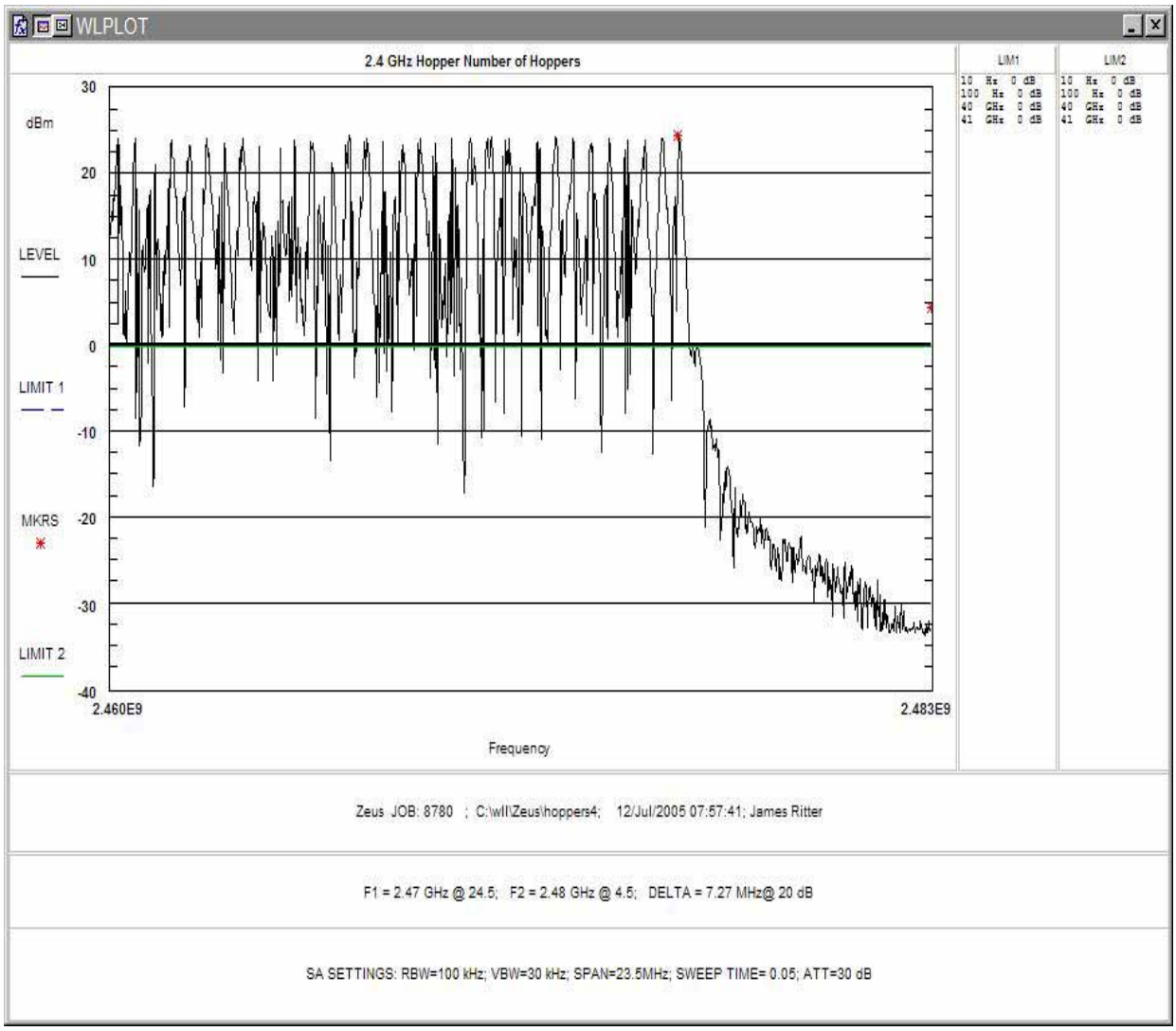

Figure 3-12, Number of Hoppers, Plot 4

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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. The last 4 plots shown are close-up scans of the band edges with the unit operating in both stationary and hopping modes.

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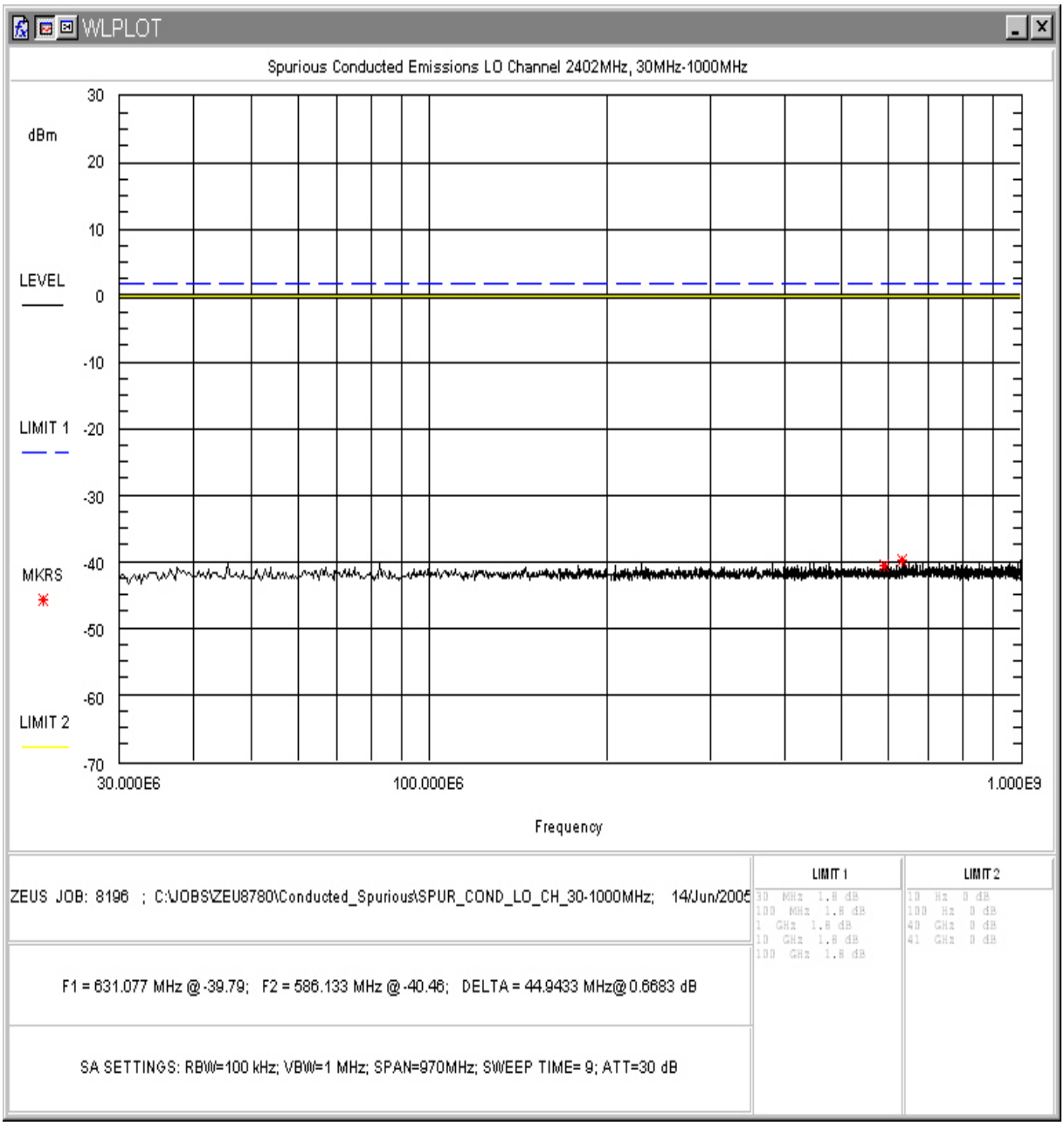

Figure 3-13. Conducted Spurious Emissions, Low Channel 30 - 1000MHz

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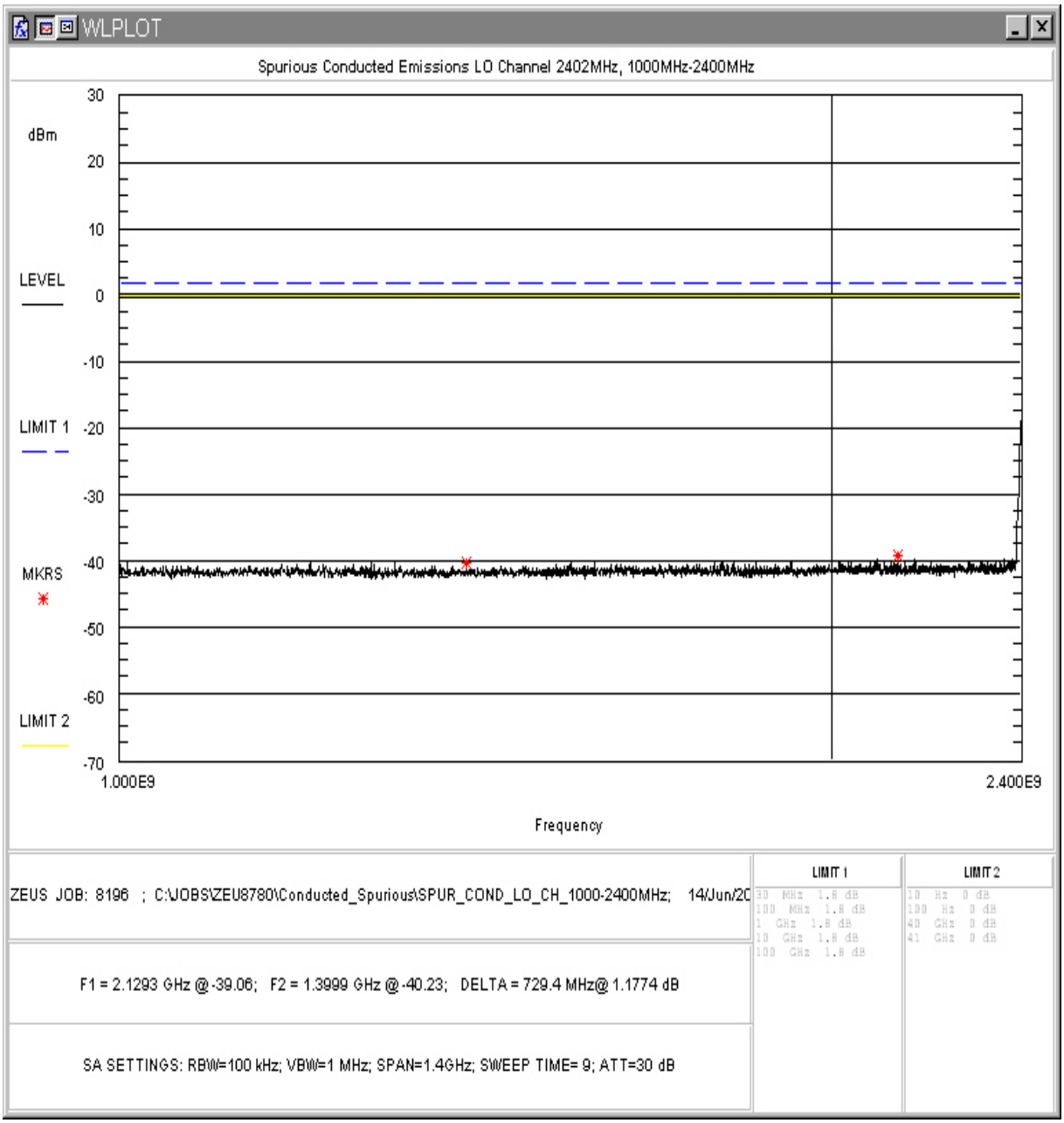

Figure 3-14. Conducted Spurious Emissions, Low Channel 1 – 2.4GHz

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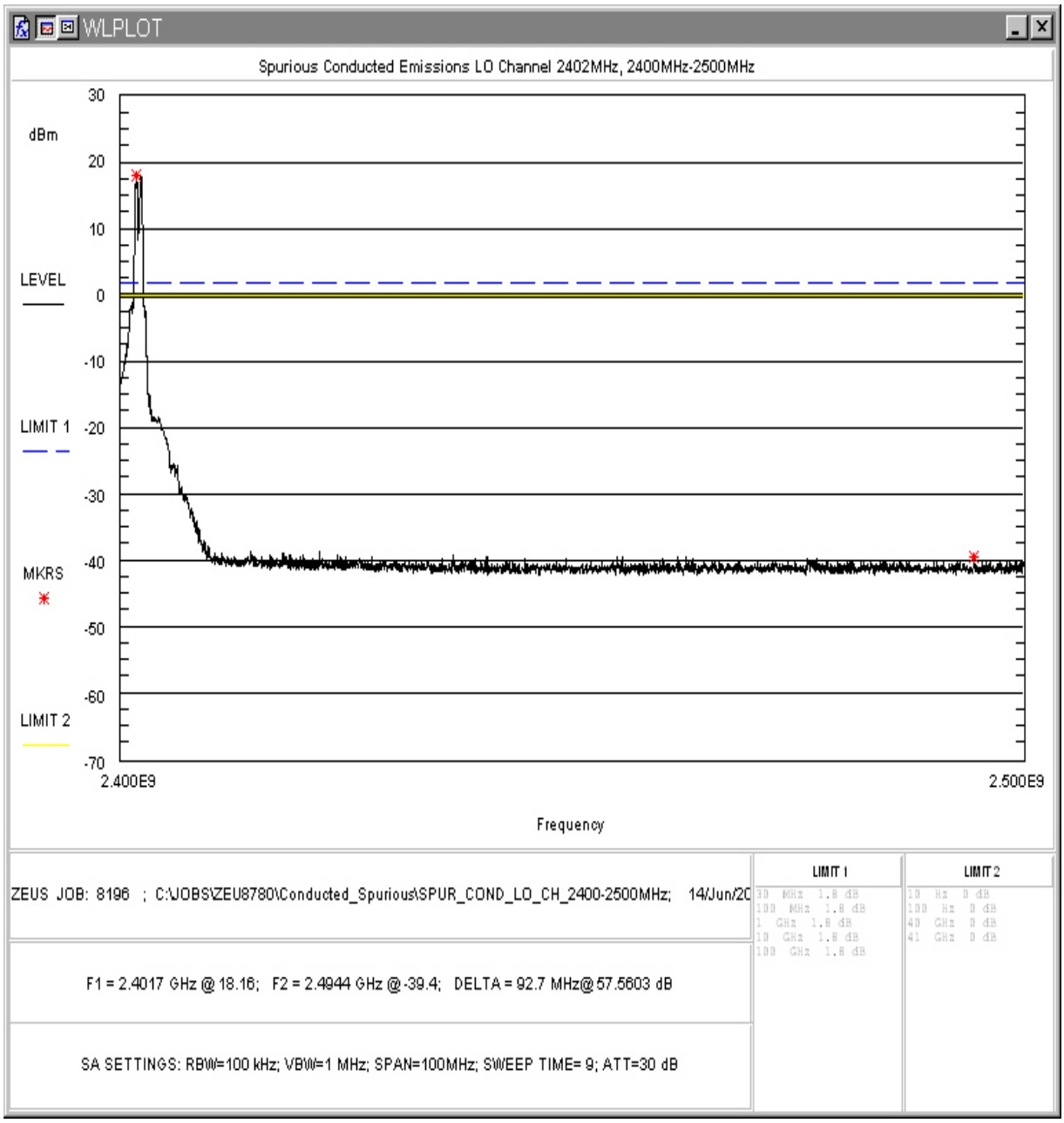

Figure 3-15. Conducted Spurious Emissions, Low Channel 2.4 – 2.5GHz

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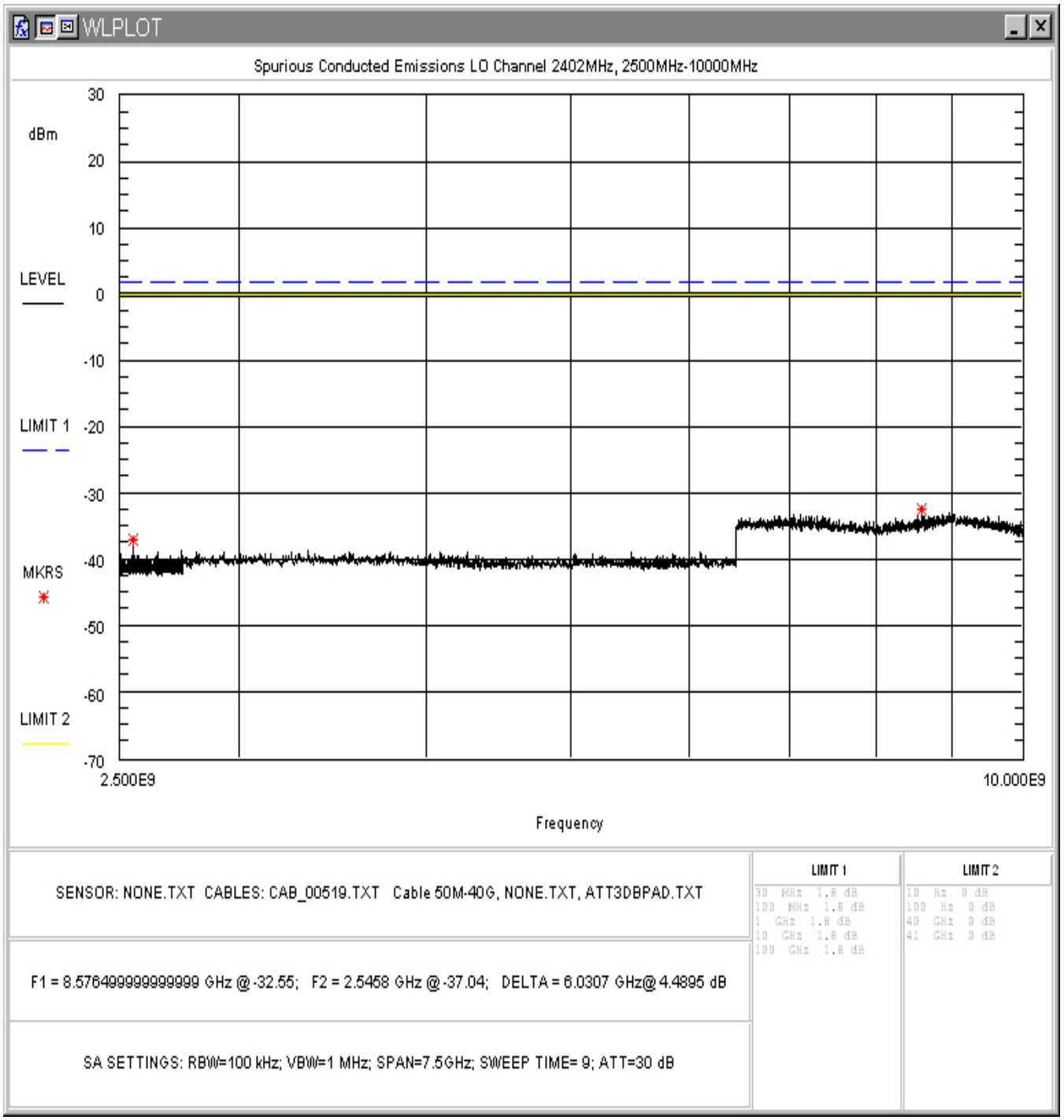

Figure 3-16. Conducted Spurious Emissions, Low Channel 2.5 - 10GHz

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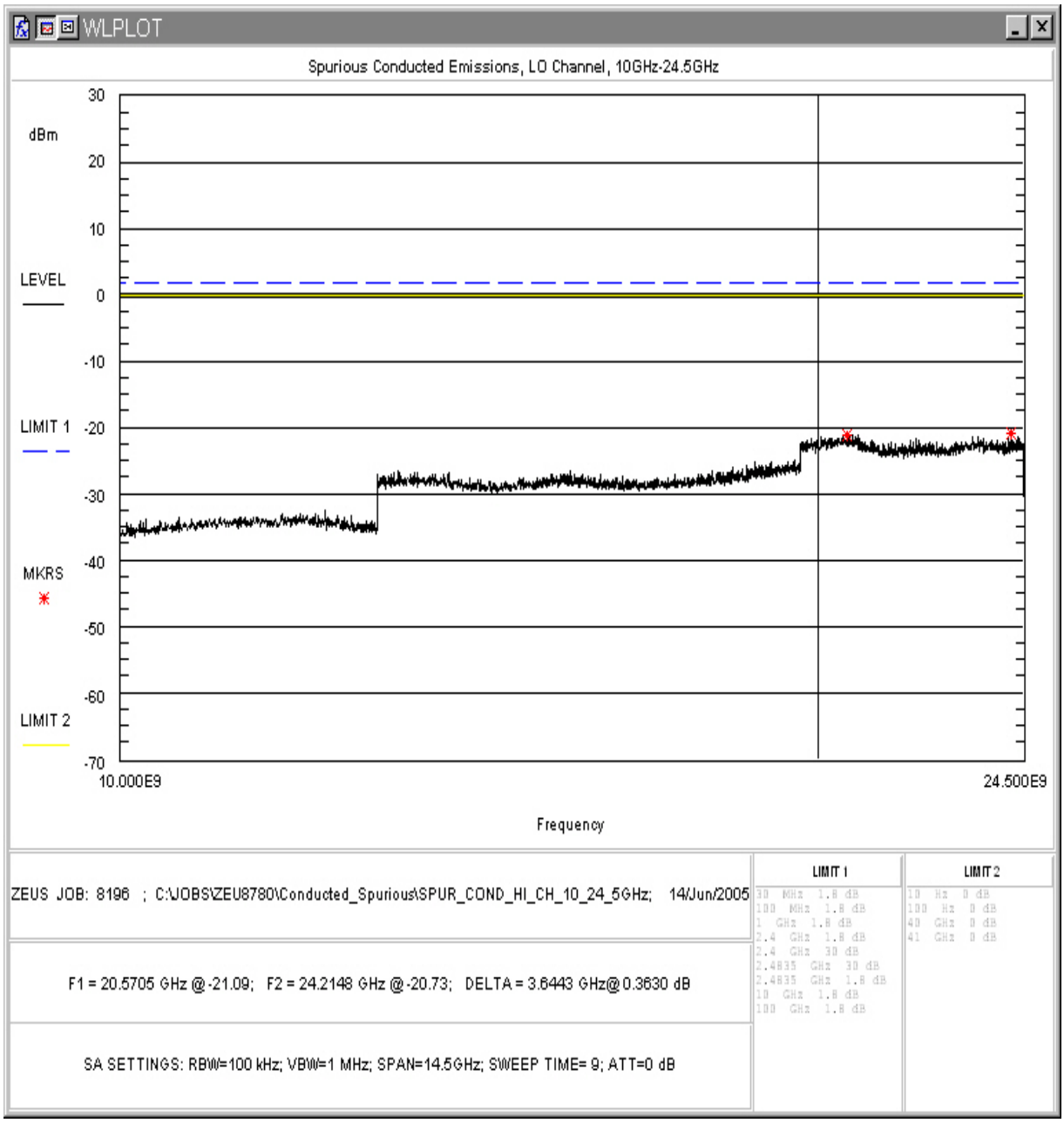

Figure 3-17. Conducted Spurious Emissions, Low Channel 10 – 24.5GHz

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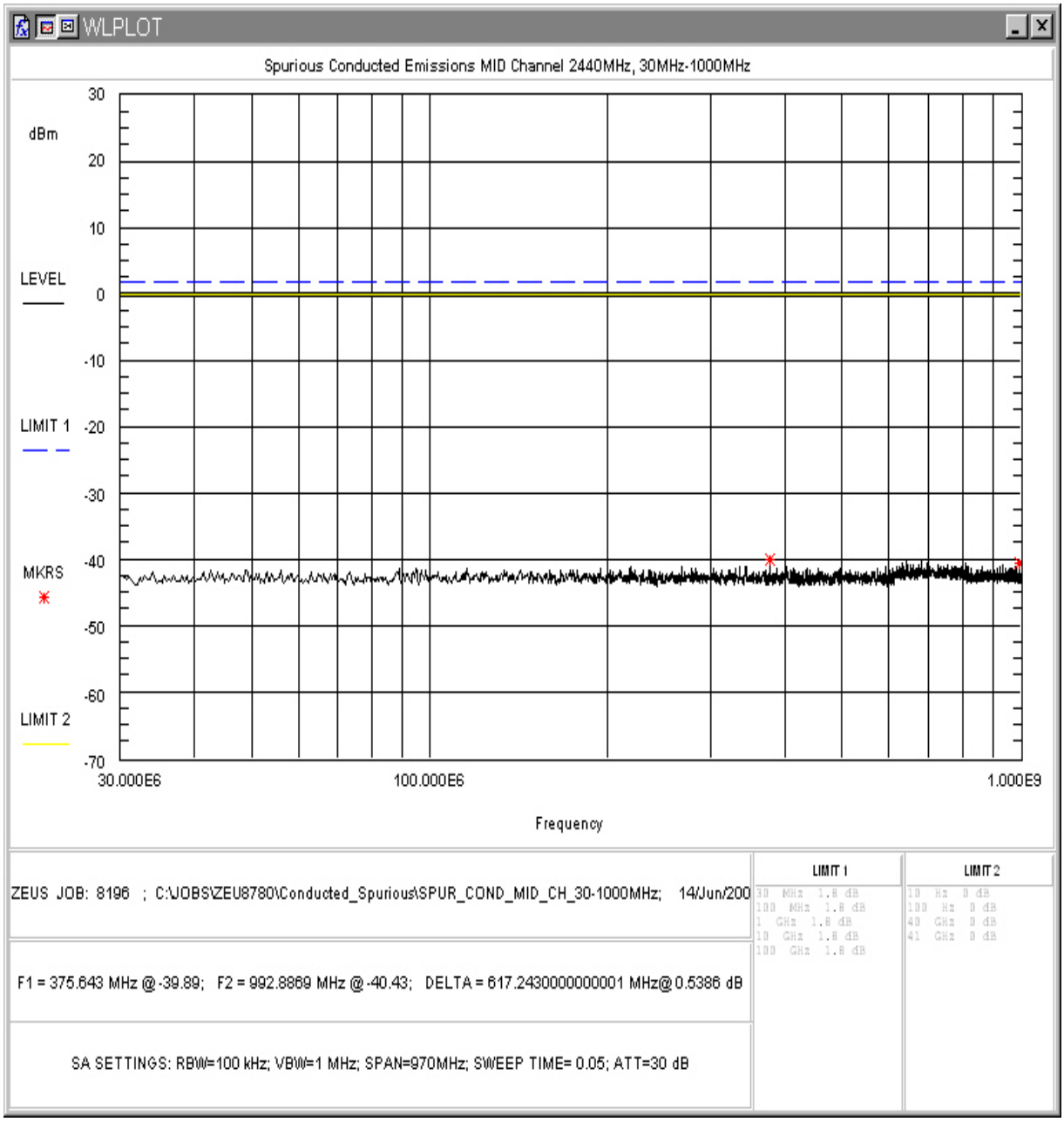

Figure 3-18. Conducted Spurious Emissions, Mid Channel 30 - 1000MHz

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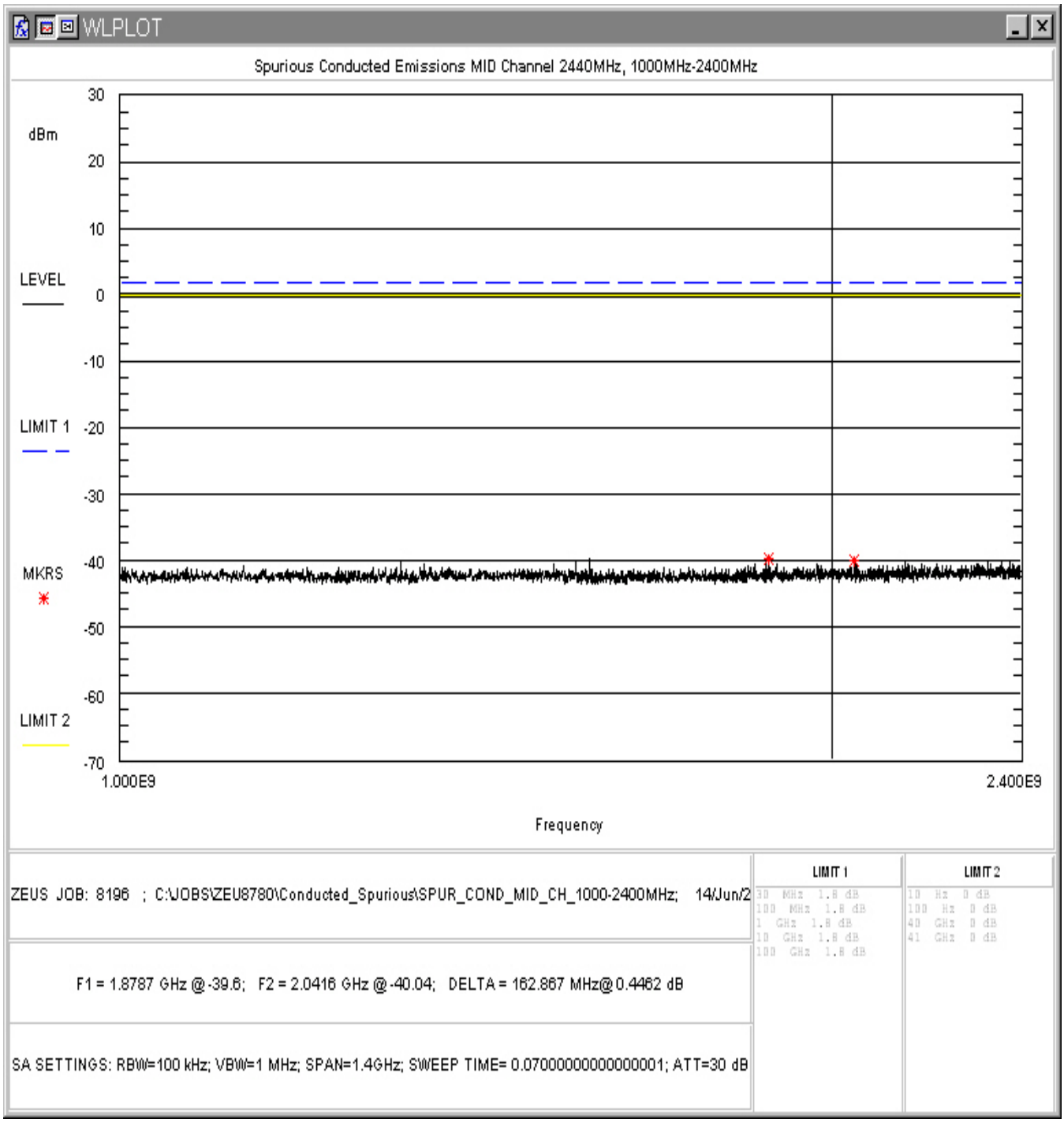

Figure 3-19. Conducted Spurious Emissions, Mid Channel 1 – 2.4GHz

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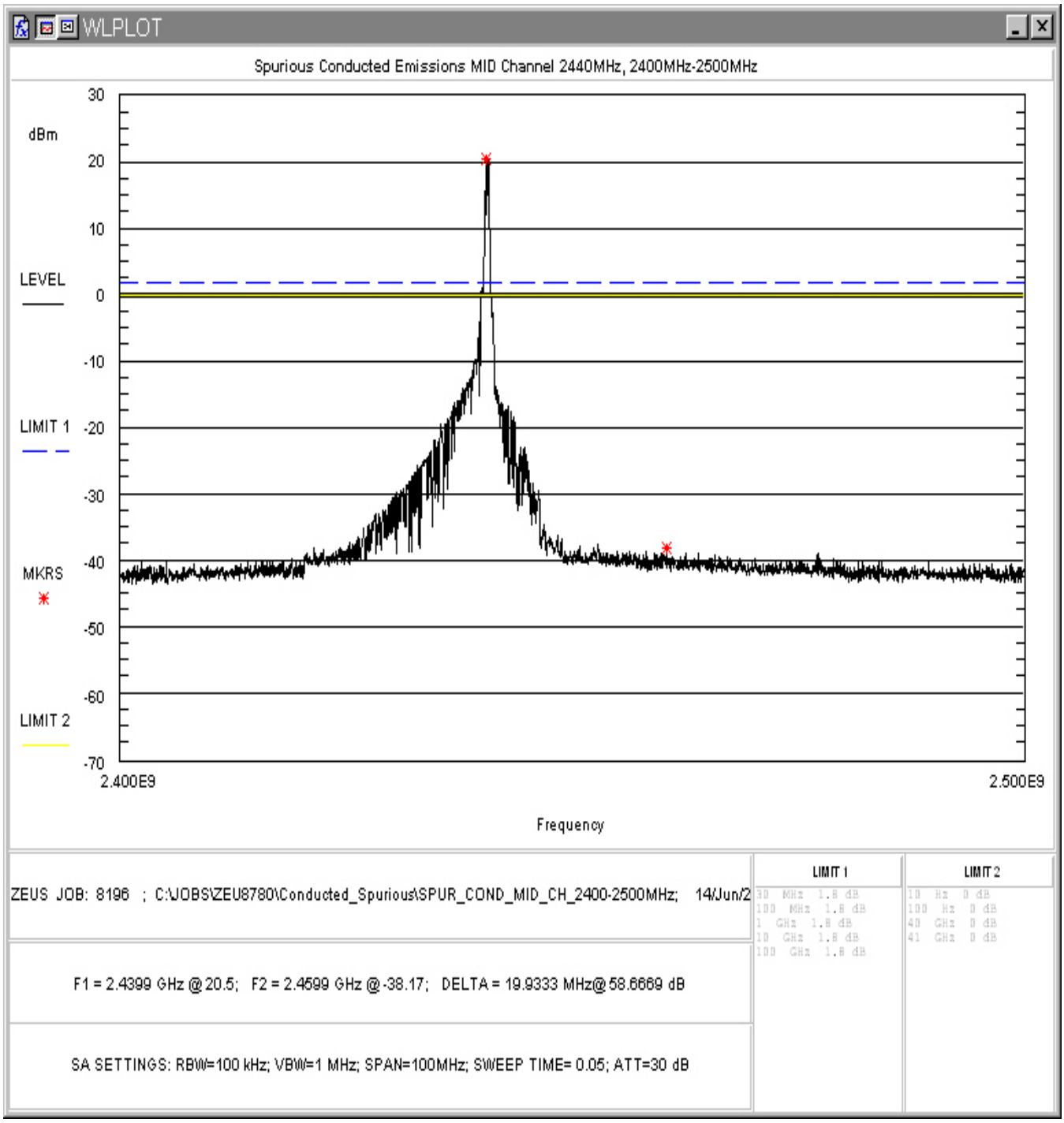

Figure 3-20. Conducted Spurious Emissions, Mid Channel 2.4 – 2.5GHz

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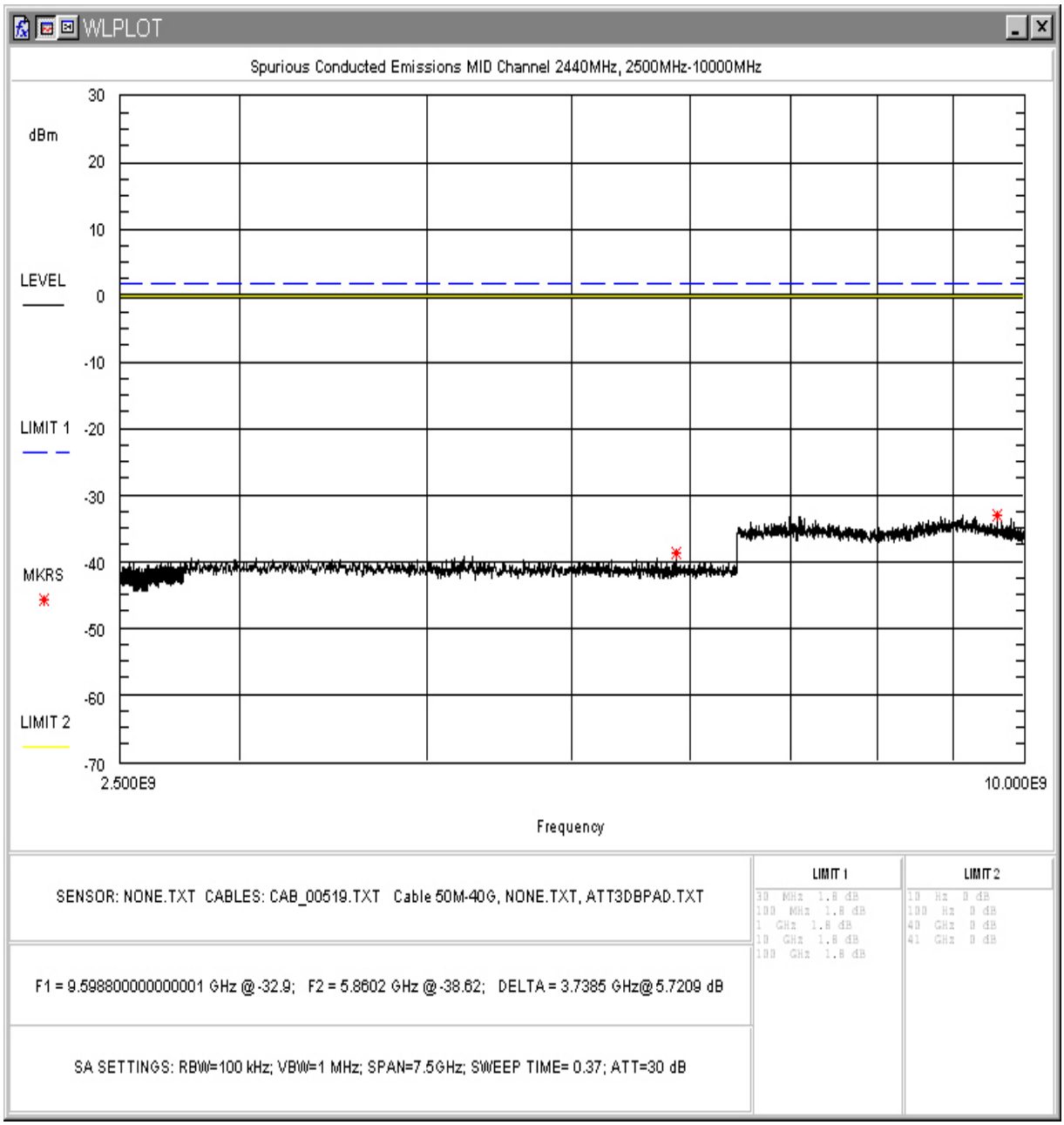

Figure 3-21. Conducted Spurious Emissions, Mid Channel 2.5 - 10GHz

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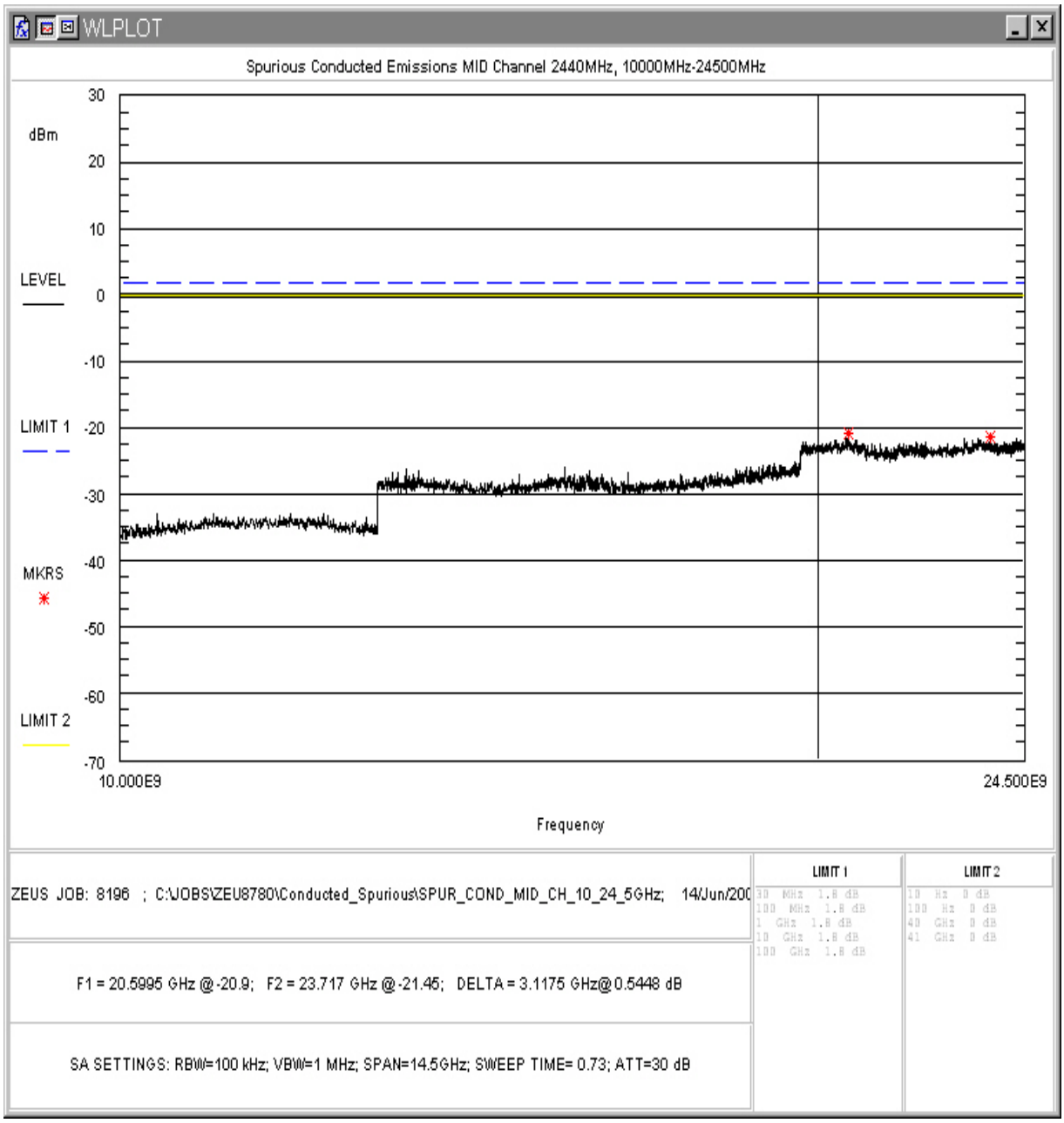

Figure 3-22. Conducted Spurious Emissions, Mid Channel 10 – 24.5GHz

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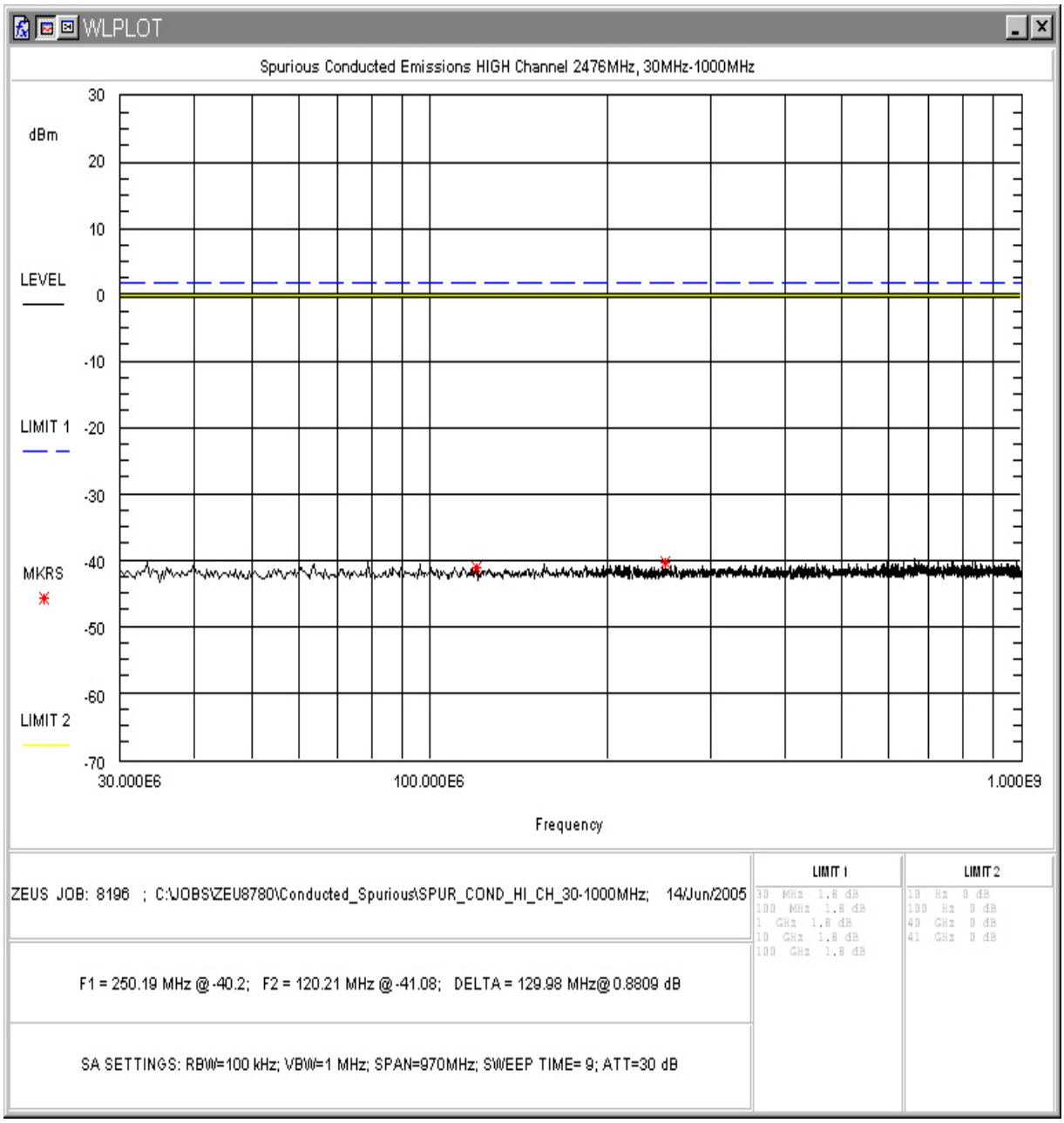

Figure 3-23. Conducted Spurious Emissions, High Channel 30 - 1000MHz

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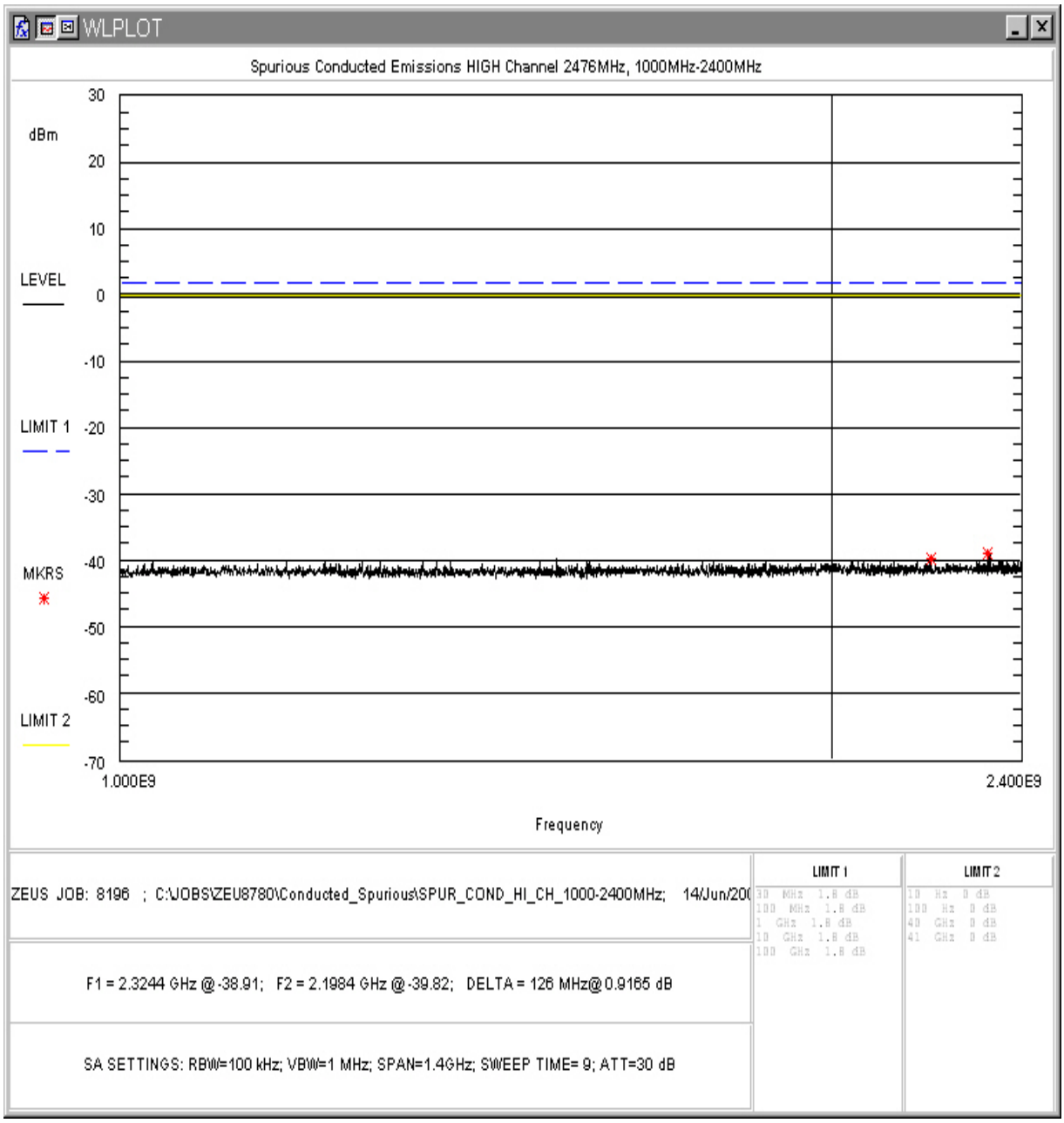

Figure 3-24. Conducted Spurious Emissions, High Channel 1 – 2.4GHz

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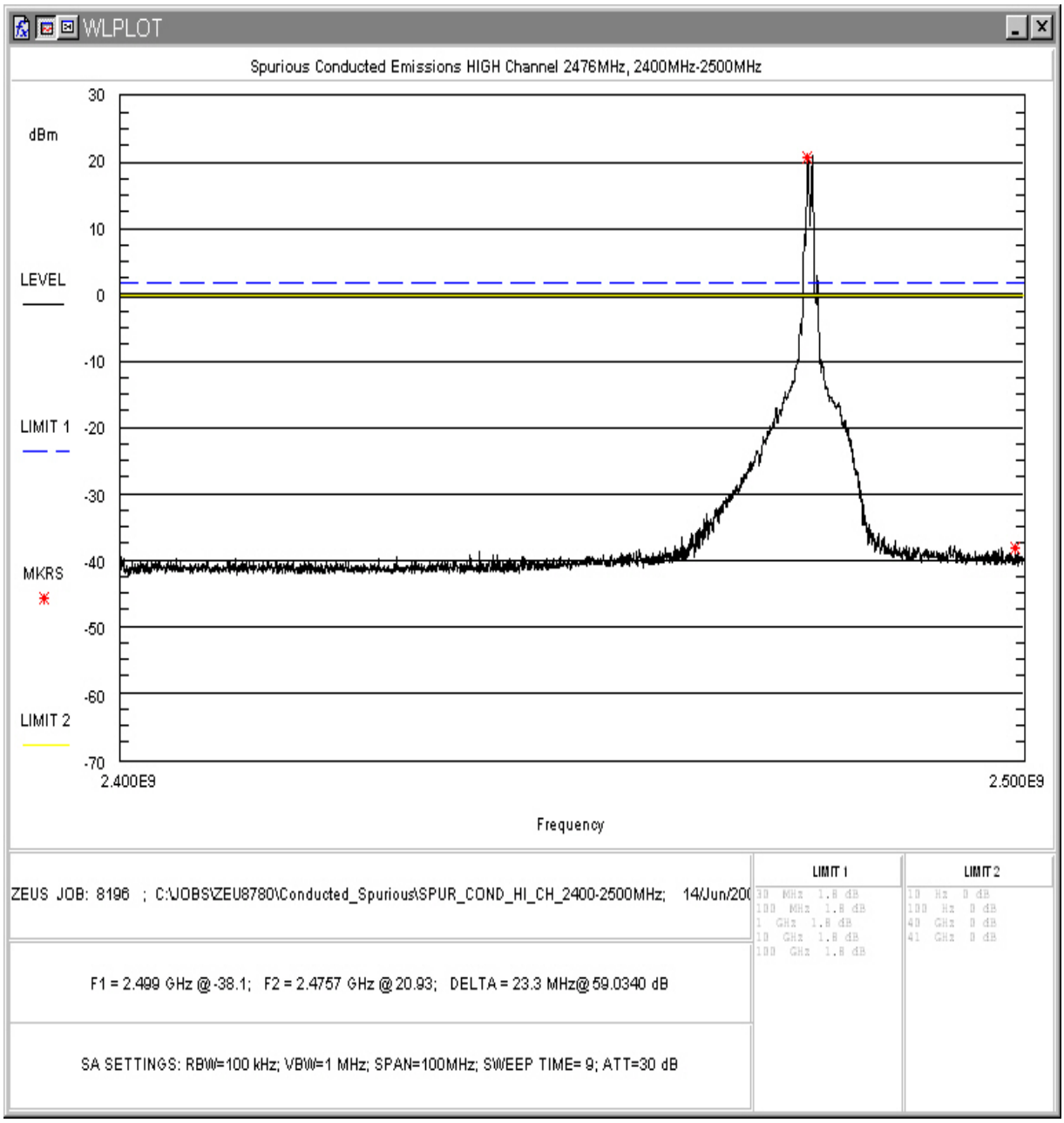

Figure 3-25. Conducted Spurious Emissions, High Channel 2.4 – 2.5GHz

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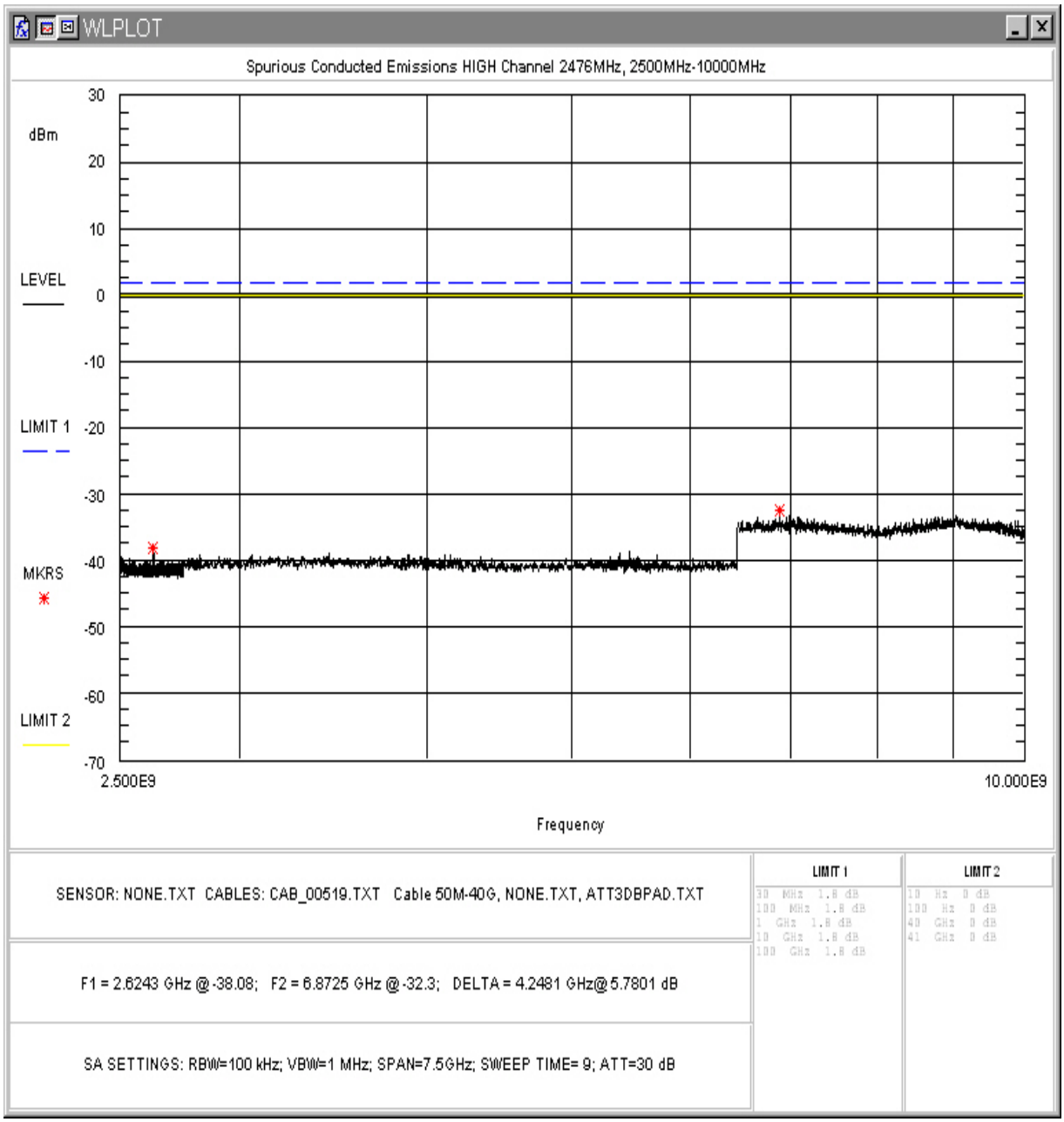

Figure 3-26. Conducted Spurious Emissions, High Channel 2.5 - 10GHz

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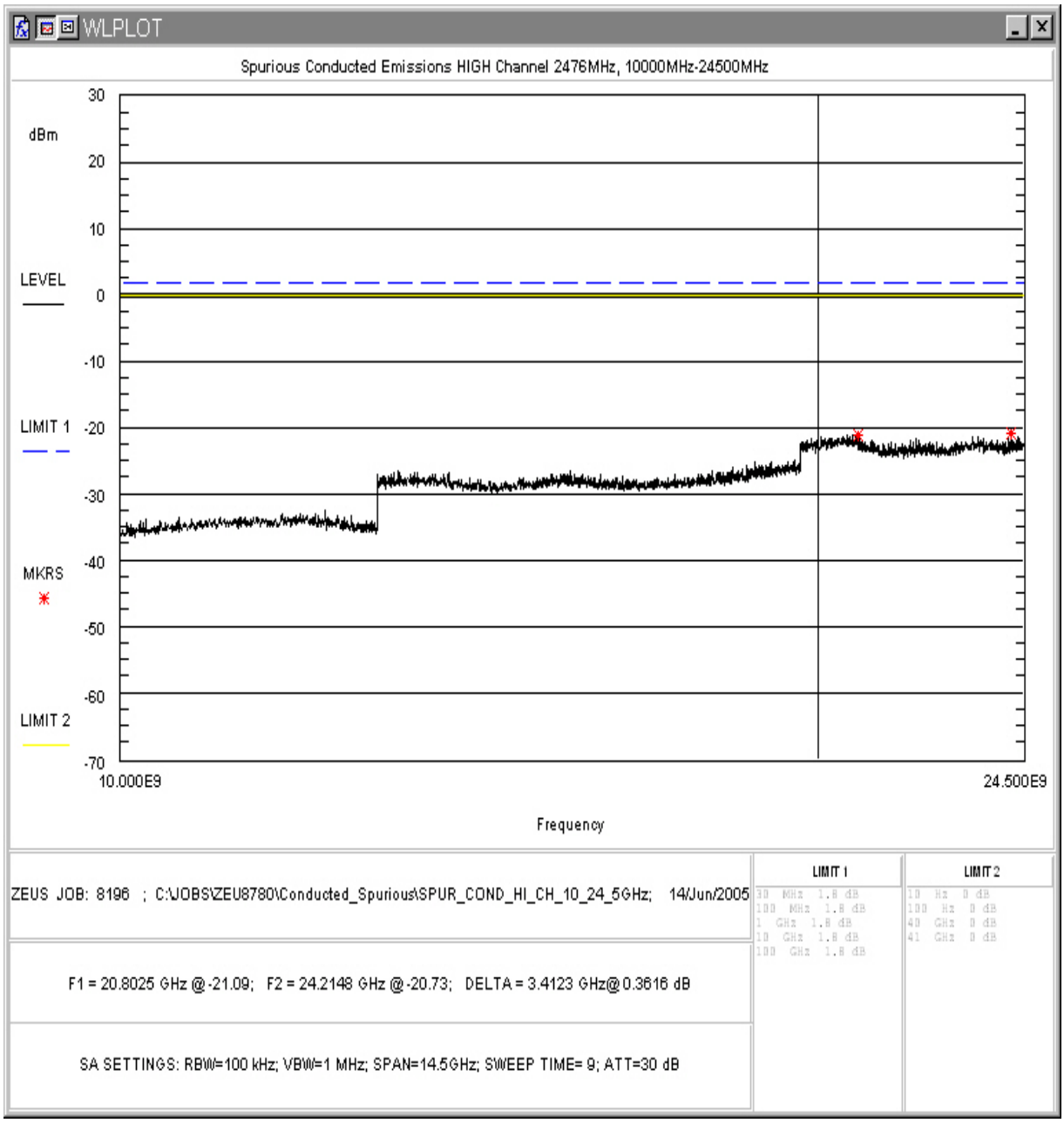

Figure 3-27. Conducted Spurious Emissions, High Channel 10 – 24.5GHz

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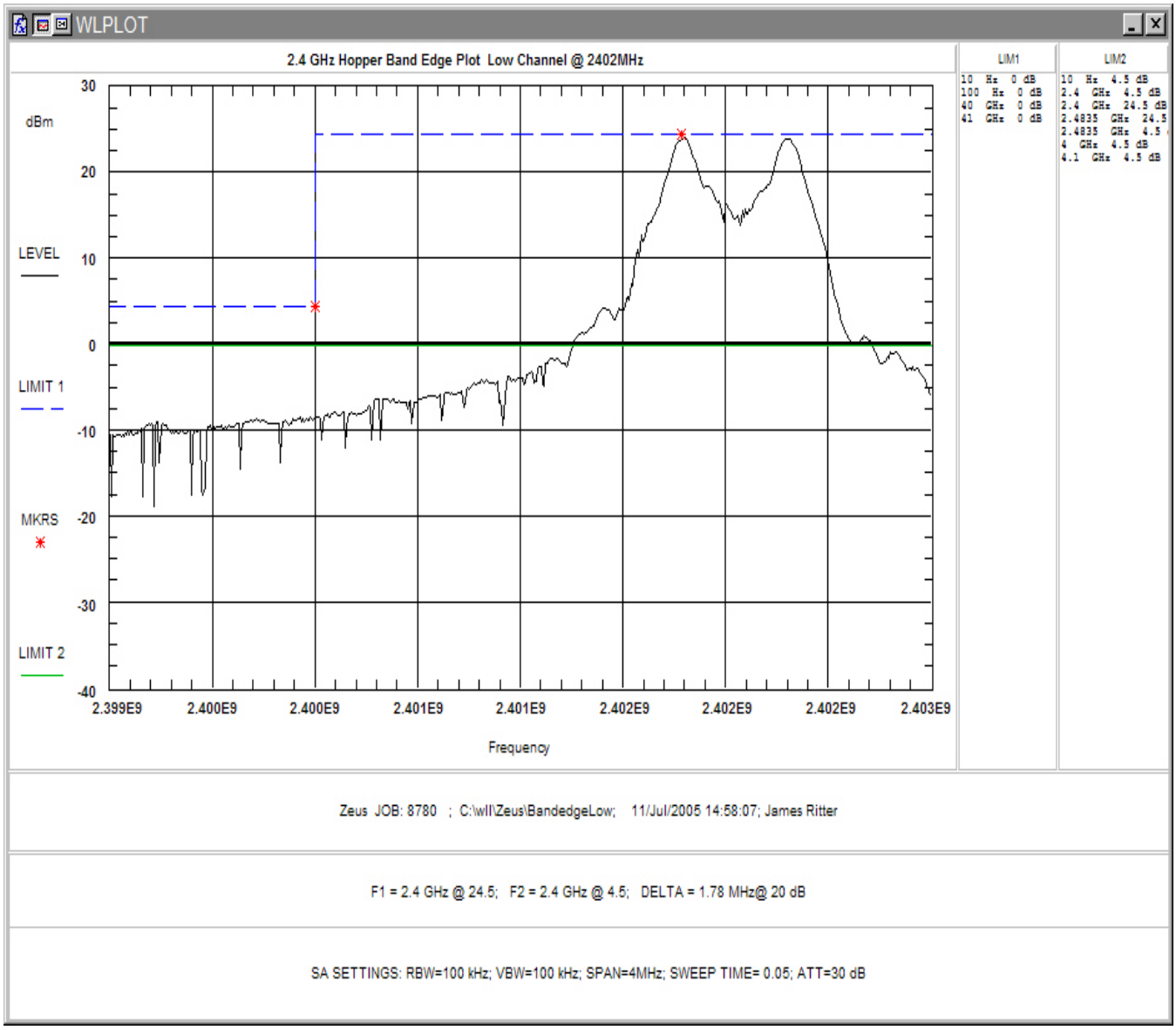

Figure 3-28. Conducted Spurious Emissions, Band Edge Low Channel

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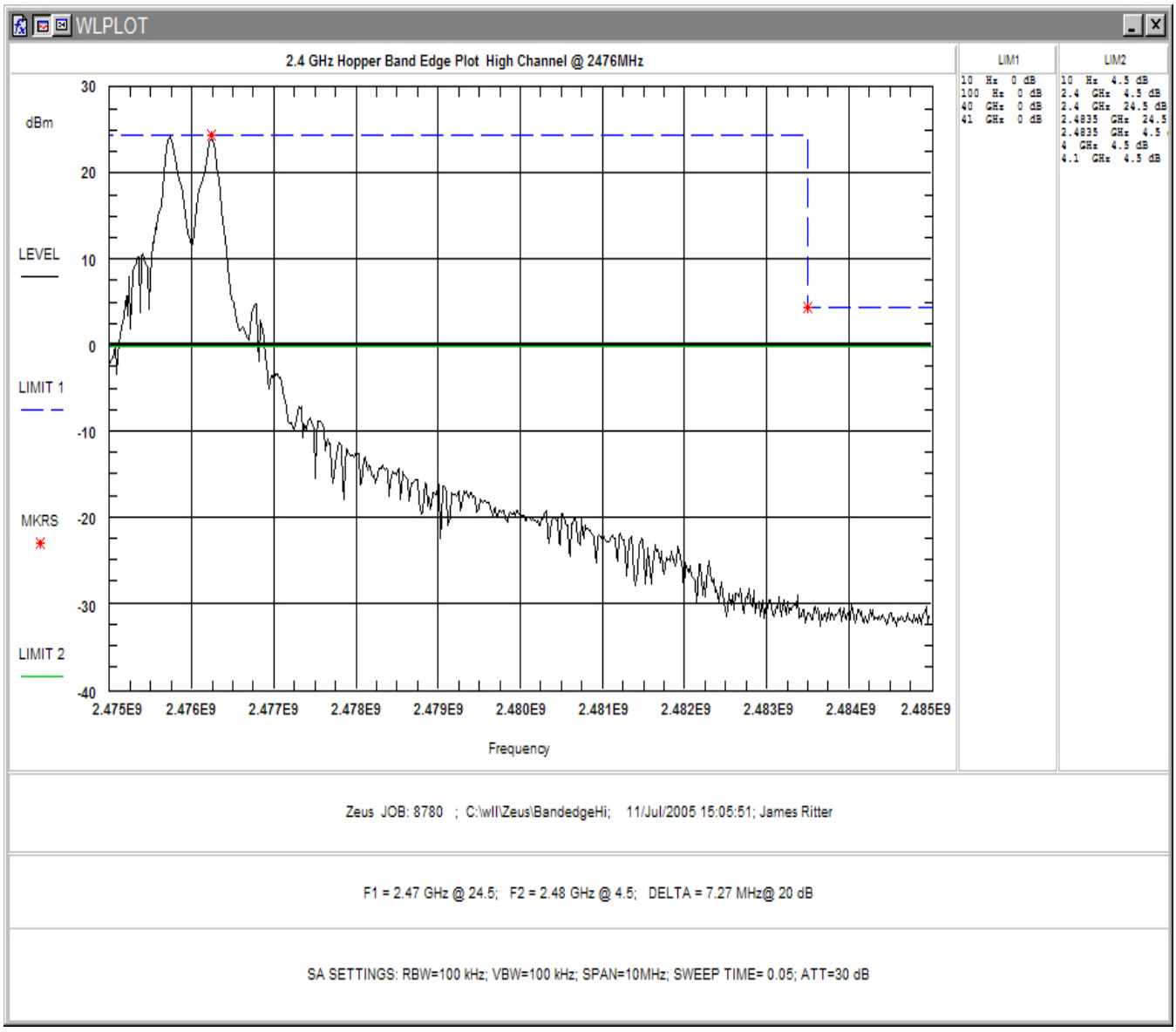

Figure 3-29. Conducted Spurious Emissions, Band Edge High Channel

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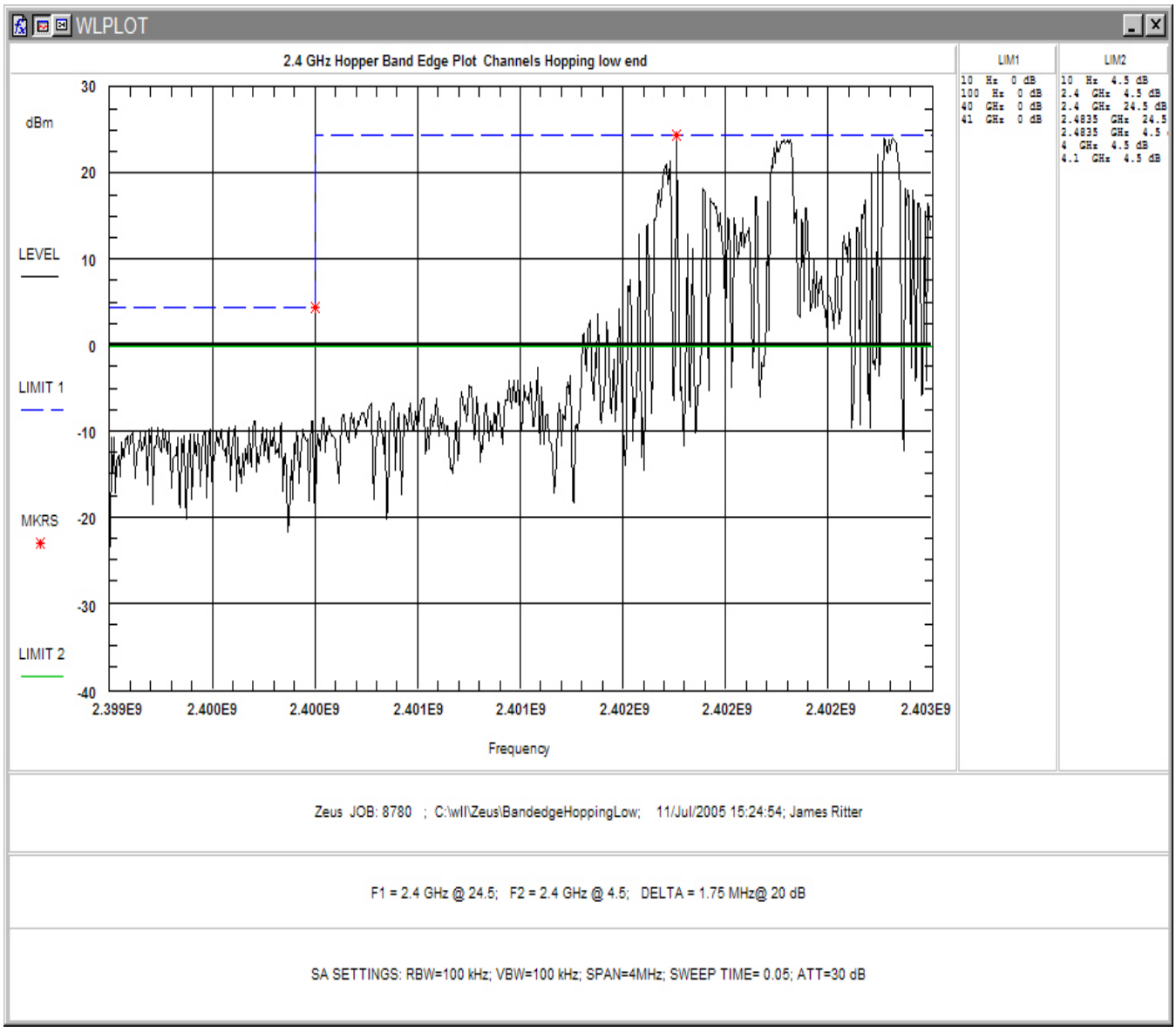

Figure 3-30. Conducted Spurious Emissions, Band Edge -Unit Hopping Low side

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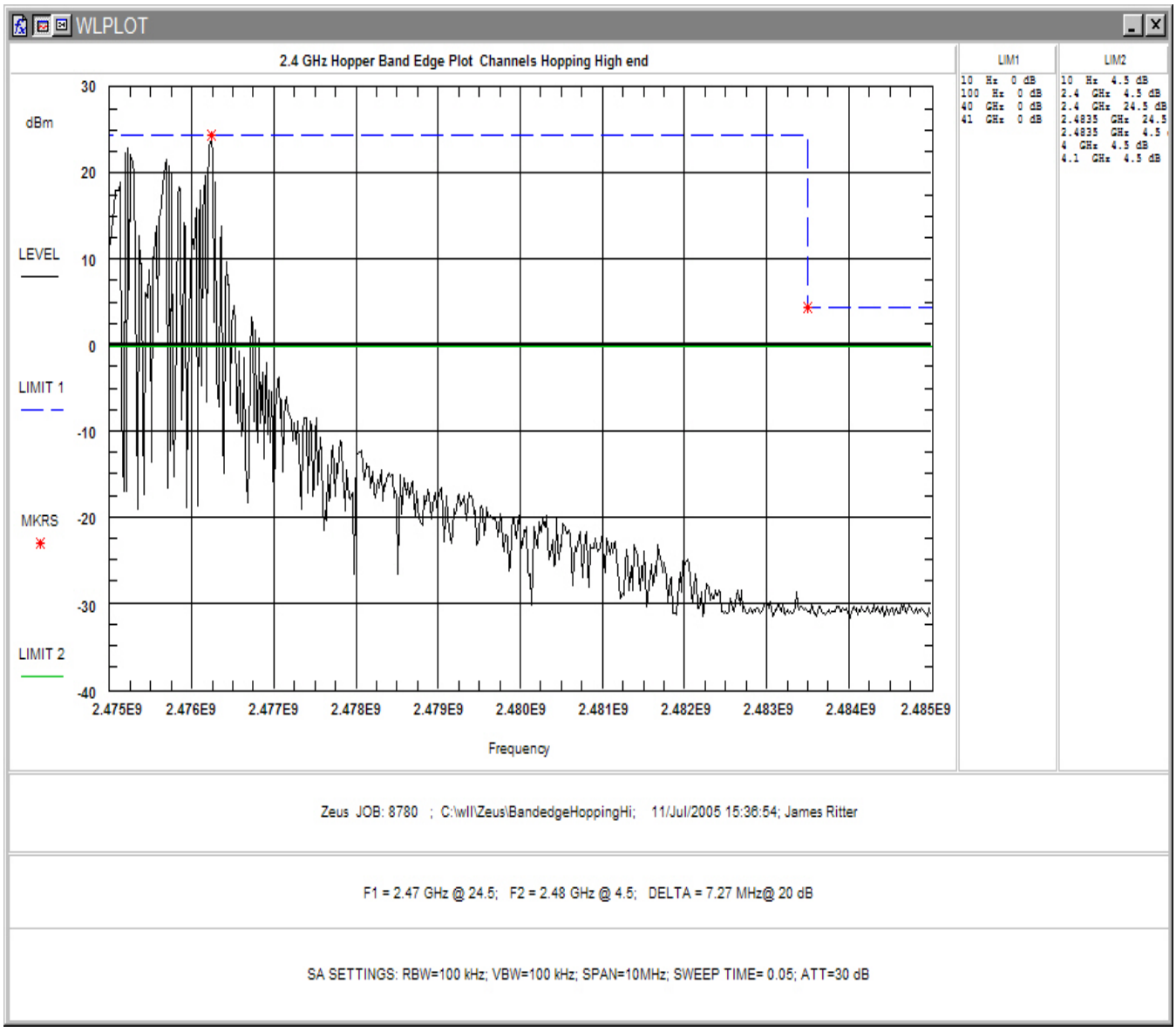

Figure 3-31. Conducted Spurious Emissions, Band Edge -Unit Hopping High Side

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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.

3.1.1 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. 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	300 Hz (Avg.) Based on 7ms on time 1MHz (Peak)

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Table 3-4: Radiated Emission Test Data, Low Frequency Data (<1GHz)

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amplifier Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB
111.810	V	190.0	1.2	9.8	10.3	1.7	0.0	21.8	12.3	150.0	-21.7
193.670	V	220.0	1.2	4.9	9.5	2.1	0.0	16.5	6.7	150.0	-27.0
43.240	V	180.0	1.0	4.3	15.5	1.1	0.0	20.9	11.1	100.0	-19.1
159.780	V	0.0	1.0	9.5	8.8	1.9	0.0	20.2	10.3	150.0	-23.3
184.430	V	0.0	1.3	6.4	9.4	2.0	0.0	17.8	7.8	150.0	-25.7
216.340	V	180.0	1.3	4.3	11.0	2.2	0.0	17.5	7.5	200.0	-28.5
256.940	V	20.0	1.4	3.9	11.9	2.5	0.0	18.2	8.1	200.0	-27.8
298.420	V	180.0	1.6	5.7	12.8	2.7	0.0	21.2	11.4	200.0	-24.9
327.988	V	0.0	2.2	4.6	13.4	2.8	0.0	20.8	10.9	200.0	-25.2
397.460	V	180.0	3.0	9.8	14.3	3.1	0.0	27.2	22.9	200.0	-18.8
431.984	V	270.0	1.4	8.6	15.5	3.3	0.0	27.4	23.3	200.0	-18.7
497.480	V	0.0	1.6	15.6	16.5	3.6	0.0	35.8	61.6	200.0	-10.2
798.440	V	220.0	3.0	1.7	20.0	4.9	0.0	26.6	21.3	200.0	-19.5
111.810	H	245.0	3.0	12.8	10.3	1.7	0.0	24.8	17.4	150.0	-18.7
193.670	H	270.0	1.6	9.8	9.5	2.1	0.0	21.4	11.7	150.0	-22.1
43.240	H	180.0	3.5	2.5	15.5	1.1	0.0	19.1	9.0	100.0	-20.9
159.780	H	120.0	2.6	12.5	8.8	1.9	0.0	23.2	14.5	150.0	-20.3
184.833	H	90.0	1.5	14.4	9.4	2.0	0.0	25.8	19.6	150.0	-17.7
216.609	H	90.0	1.5	13.3	11.0	2.2	0.0	26.5	21.3	200.0	-19.5
257.430	H	180.0	2.3	14.6	11.9	2.5	0.0	29.0	28.1	200.0	-17.1
298.420	H	250.0	2.5	8.5	12.8	2.7	0.0	24.0	15.8	200.0	-22.1
327.988	H	90.0	1.7	10.3	13.4	2.8	0.0	26.5	21.1	200.0	-19.5
397.460	H	270.0	2.0	9.2	14.3	3.1	0.0	26.6	21.4	200.0	-19.4
431.984	H	180.0	3.0	7.0	15.5	3.3	0.0	25.8	19.4	200.0	-20.3
497.480	H	190.0	2.2	9.8	16.5	3.6	0.0	30.0	31.6	200.0	-16.0
798.440	H	190.0	1.5	3.5	20.0	4.9	0.0	28.4	26.2	200.0	-17.7
159.450	H	145.0	2.8	10.9	8.7	1.9	0.0	21.6	12.0	150.0	-21.9

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Table 3-5: Radiated Emission Test Data, High Frequency Data (>1GHz), Low Channel (Restricted Bands)

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (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
2402 MHz Peak unit flat												
4804.000	V	120.0	1.0	47.0	33.3	3.5	35.9	0.0	47.9	247.5	5000.0	-26.1
12010.00	V	180.0	1.0	48.8	41.5	5.0	35.7	0.0	59.6	959.0	5000.0	-14.3
19216.00	V	90.0	1.0	49.6	39.7	0.6	34.3	0.0	55.6	604.2	50000.0	-38.4
4804.000	H	45.0	1.0	52.5	33.3	3.5	35.9	0.0	53.4	466.1	5000.0	-20.6
12010.00	H	200.0	1.0	48.0	41.5	5.0	35.7	0.0	58.8	871.6	5000.0	-15.2
19216.00	H	90.0	1.0	49.2	39.7	0.6	34.3	0.0	55.2	577.0	50000.0	-38.8
Avg												
4804.000	V	120.0	1.0	35.1	33.3	3.5	35.9	-20.0	16.0	6.3	500.0	-38.0
12010.00	V	180.0	1.0	34.2	41.5	5.0	35.7	-20.0	25.0	17.7	500.0	-29.0
19216.00	V	100.0	1.0	38.2	39.7	0.6	34.3	-20.0	24.2	16.2	5000.0	-49.8
4804.000	H	45.0	1.0	36.0	33.3	3.5	35.9	-20.0	16.9	7.0	500.0	-37.1
12010.00	H	200.0	1.0	36.2	41.5	5.0	35.7	-20.0	27.0	22.4	500.0	-27.0
19216.00	H	100.0	1.0	38.4	39.7	0.6	34.3	-20.0	24.4	16.6	5000.0	-49.6
2402 Peak unit on side												
4804.000	V	180.0	1.0	48.9	33.3	3.5	35.9	0.0	49.8	308.0	5000.0	-24.2
12010.00	V	0.0	1.0	48.2	41.5	5.0	35.7	0.0	59.0	891.9	5000.0	-15.0
19216.00	V	90.0	1.0	49.6	39.7	0.6	34.3	0.0	55.6	604.2	50000.0	-38.4
4804.000	H	165.0	1.0	48.1	33.3	3.5	35.9	0.0	49.0	280.9	5000.0	-25.0
12010.00	H	0.0	1.0	47.3	41.5	5.0	35.7	0.0	58.1	804.1	5000.0	-15.9
19216.00	H	100.0	1.0	38.3	39.7	0.6	34.3	-20.0	24.3	16.5	5000.0	-49.7
Avg												
4804.000	V	180.0	1.0	36.2	33.3	3.5	35.9	-20.0	17.1	7.1	500.0	-36.9
12010.00	V	0.0	1.0	34.4	41.5	5.0	35.7	-20.0	25.2	18.2	500.0	-28.8
19216.00	V	100.0	1.0	38.2	39.7	0.6	34.3	-20.0	24.2	16.2	5000.0	-49.8

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Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (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
4804.000	H	165.0	1.0	38.2	33.3	3.5	35.9	-20.0	19.1	9.0	500.0	-34.9
12010.00	H	0.0	1.0	36.2	41.5	5.0	35.7	-20.0	27.0	22.4	500.0	-27.0
19216.00	H	100.0	1.0	38.4	39.7	0.6	34.3	-20.0	24.4	16.6	5000.0	-49.6

Notes: Measurements above 18 GHz performed at 30 cm. No other signals noted in restricted bands.

Table 3-6: Radiated Emission Test Data, High Frequency Data (>1GHz), Middle Channel (Restricted Bands)

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amplifier Gain (dB)	Duty Cycle (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB
2440MHz Peak unit flat												
4880.000	V	190.0	1.0	52.5	33.4	3.5	35.9	0.0	53.5	475.3	5000.0	-20.4
7320.000	V	190.0	1.0	57.8	37.7	4.5	35.8	0.0	64.2	1628.9	5000.0	-9.7
12200.00	V	0.0	1.0	46.0	41.3	5.2	35.5	0.0	56.9	701.8	5000.0	-17.1
19520.00	V	90.0	1.0	49.6	39.7	0.6	34.5	0.0	55.4	587.4	50000.0	-38.6
4880.000	H	180.0	1.0	53.2	33.4	3.5	35.9	0.0	54.2	515.2	5000.0	-19.7
7320.000	H	0.0	1.0	55.7	37.7	4.5	35.8	0.0	62.1	1273.2	5000.0	-11.9
12200.00	H	0.0	1.0	45.1	41.3	5.2	35.5	0.0	56.0	632.7	5000.0	-18.0
19520.00	H	90.0	1.0	49.5	39.7	0.6	34.5	0.0	55.3	580.7	50000.0	-38.7
Avg												
4880.000	V	190.0	1.0	37.8	33.4	3.5	35.9	-20.0	18.8	8.7	500.0	-35.1
7320.000	V	190.0	1.0	42.4	37.7	4.5	35.8	-20.0	28.8	27.7	500.0	-25.1
12200.00	V	0.0	1.0	35.6	41.3	5.2	35.5	-20.0	26.5	21.2	500.0	-27.5
19520.00	V	90.0	1.0	36.7	39.7	0.6	34.5	-20.0	22.4	13.3	5000.0	-51.5
4880.000	H	180.0	1.0	36.3	33.4	3.5	35.9	-20.0	17.4	7.4	500.0	-36.6
7320.000	H	45.0	1.0	38.1	37.7	4.5	35.8	-20.0	24.5	16.8	500.0	-29.5
12200.00	H	0.0	1.0	35.3	41.3	5.2	35.5	-20.0	26.2	20.5	500.0	-27.8
19520.00	H	90.0	1.0	36.0	39.7	0.6	34.5	-20.0	21.8	12.3	5000.0	-52.2

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Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amplifier Gain (dB)	Duty Cycle (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB
2440 Peak unit on side												
4880.000	V	180.0	1.0	53.5	33.4	3.5	35.9	0.0	54.5	533.3	5000.0	-19.4
7320.000	V	200.0	1.0	56.6	37.7	4.5	35.8	0.0	63.0	1418.7	5000.0	-10.9
12200.00	V	0.0	1.0	46.1	41.3	5.2	35.5	0.0	57.0	709.9	5000.0	-17.0
19520.00	V	90.0	1.0	49.6	39.7	0.6	34.5	0.0	55.4	587.4	50000.0	-38.6
4880.000	H	200.0	1.0	53.0	33.4	3.5	35.9	0.0	54.0	503.4	5000.0	-19.9
7320.000	H	180.0	1.0	55.5	37.7	4.5	35.8	0.0	61.9	1249.9	5000.0	-12.0
12200.00	H	0.0	1.0	45.3	41.3	5.2	35.5	0.0	56.2	647.4	5000.0	-17.8
19520.00	H	90.0	1.0	49.5	39.7	0.6	34.5	0.0	55.3	580.7	50000.0	-38.7
Avg												
4880.000	V	180.0	1.0	37.9	33.4	3.5	35.9	-20.0	18.9	8.8	500.0	-35.0
7320.000	V	200.0	1.0	42.6	37.7	4.5	35.8	-20.0	29.0	28.3	500.0	-24.9
12200.00	V	0.0	1.0	35.3	41.3	5.2	35.5	-20.0	26.2	20.5	500.0	-27.8
19520.00	V	90.0	1.0	36.7	39.7	0.6	34.5	-20.0	22.4	13.3	5000.0	-51.5
4880.000	H	200.0	1.0	36.0	33.4	3.5	35.9	-20.0	17.0	7.1	500.0	-36.9
7320.000	H	180.0	1.0	38.3	37.7	4.5	35.8	-20.0	24.7	17.3	500.0	-29.2
12200.00	H	0.0	1.0	35.7	41.3	5.2	35.5	-20.0	26.6	21.4	500.0	-27.4
19520.00	H	90.0	1.0	36.0	39.7	0.6	34.5	-20.0	21.8	12.3	5000.0	-52.2

Notes: Measurements above 18 GHz performed at 30 cm. No other signals noted in restricted bands.

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Table 3-7: Radiated Emission Test Data, High Frequency Data (>1GHz), High Channel (Restricted Bands)

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (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
2476 MHz peak unit flat												
4954.000	V	120.0	1.0	50.7	33.6	3.6	36.0	0.0	51.9	395.4	5000.0	-22.0
7428.000	V	165.0	1.0	48.9	37.8	4.8	35.8	0.0	55.7	608.0	5000.0	-18.3
12380.00	V	0.0	1.0	45.5	41.1	5.3	35.3	0.0	56.5	670.9	5000.0	-17.4
19808.00	V	180.0	1.0	50.3	39.7	0.6	34.7	0.0	55.9	622.3	50000.0	-38.1
22284.00	V	180.0	1.0	48.8	40.5	0.7	34.3	0.0	55.7	610.7	50000.0	-38.3
4954.000	H	90.0	1.0	58.7	33.6	3.6	36.0	0.0	59.9	988.6	5000.0	-14.1
7428.000	H	170.0	1.0	47.4	37.8	4.8	35.8	0.0	54.1	509.2	5000.0	-19.8
12380.00	H	0.0	1.0	46.1	41.1	5.3	35.3	0.0	57.1	718.1	5000.0	-16.9
19808.00	H	180.0	1.0	50.3	39.7	0.6	34.7	0.0	55.9	622.3	50000.0	-38.1
22284.00	H	180.0	1.0	49.0	40.5	0.7	34.3	0.0	55.9	622.8	50000.0	-38.1
Avg												
4954.000	V	120.0	1.0	42.5	33.6	3.6	36.0	-20.0	23.7	15.2	500.0	-30.3
7428.000	V	165.0	1.0	35.6	37.8	4.8	35.8	-20.0	22.4	13.1	500.0	-31.6
12380.00	V	0.0	1.0	34.8	41.1	5.3	35.3	-20.0	25.8	19.6	500.0	-28.1
19808.00	V	180.0	1.0	39.5	39.7	0.6	34.7	-20.0	25.1	17.9	5000.0	-48.9
22284.00	V	180.0	1.0	38.8	40.5	0.7	34.3	-20.0	25.7	19.2	5000.0	-48.3
4954.000	H	90.0	1.0	41.8	33.6	3.6	36.0	-20.0	23.0	14.2	500.0	-30.9
7428.000	H	170.0	1.0	36.4	37.8	4.8	35.8	-20.0	23.2	14.4	500.0	-30.8
12380.00	H	0.0	1.0	34.2	41.1	5.3	35.3	-20.0	25.2	18.3	500.0	-28.7
19808.00	H	180.0	1.0	39.5	39.7	0.6	34.7	-20.0	25.1	17.9	5000.0	-48.9
22284.00	H	180.0	1.0	38.9	40.5	0.7	34.3	-20.0	25.8	19.5	5000.0	-48.2
2476 Peak unit on side												
4954.000	V	180.0	1.0	57.1	33.6	3.6	36.0	0.0	58.3	822.3	5000.0	-15.7
7428.000	V	190.0	1.0	47.1	37.8	4.8	35.8	0.0	53.9	493.0	5000.0	-20.1
12380.00	V	0.0	1.0	44.6	41.1	5.3	35.3	0.0	55.6	604.9	5000.0	-18.3

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Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (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
19808.00	V	180.0	1.0	50.3	39.7	0.6	34.7	0.0	55.9	622.3	50000.0	-38.1
22284.00	V	180.0	1.0	48.8	40.5	0.7	34.3	0.0	55.7	610.7	50000.0	-38.3
4954.000	H	90.0	1.0	57.7	33.6	3.6	36.0	0.0	58.9	882.1	5000.0	-15.1
7428.000	H	180.0	1.0	49.0	37.8	4.8	35.8	0.0	55.7	612.9	5000.0	-18.2
12380.00	H	0.0	1.0	46.0	41.1	5.3	35.3	0.0	57.0	710.7	5000.0	-16.9
19808.00	H	180.0	1.0	50.3	39.7	0.6	34.7	0.0	55.9	622.3	50000.0	-38.1
22284.00	H	180.0	1.0	48.8	40.2	0.7	34.3	0.0	55.4	590.0	50000.0	-38.6
Avg												
4954.000	V	180.0	1.0	39.6	33.6	3.6	36.0	-20.0	20.8	11.0	500.0	-33.1
7428.000	V	190.0	1.0	35.4	37.8	4.8	35.8	-20.0	22.2	12.8	500.0	-31.8
12380.00	V	0.0	1.0	35.0	41.1	5.3	35.3	-20.0	26.0	20.0	500.0	-27.9
19808.00	V	180.0	1.0	39.5	39.7	0.6	34.7	-20.0	25.1	17.9	5000.0	-48.9
22284.00	V	180.0	1.0	38.8	40.5	0.7	34.3	-20.0	25.7	19.2	5000.0	-48.3
4954.000	H	180.0	1.0	41.4	33.6	3.6	36.0	-20.0	22.6	13.5	500.0	-31.4
7428.000	H	180.0	1.0	36.0	37.8	4.8	35.8	-20.0	22.8	13.8	500.0	-31.2
12380.00	H	0.0	1.0	34.0	41.1	5.3	35.3	-20.0	25.0	17.9	500.0	-28.9
19808.00	H	180.0	1.0	39.5	39.7	0.6	34.7	-20.0	25.1	17.9	5000.0	-48.9
22284.00	H	180.0	1.0	38.8	40.2	0.7	34.3	-20.0	25.4	18.6	5000.0	-48.6

Notes: Measurements above 18 GHz performed at 30 cm. No other signals noted in restricted bands.

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4 Test Equipment

Table 3-8 shows a list of the test equipment used for measurements along with the calibration information.

Table 3-8: Test Equipment List

Asset #	Manufacturer/Model	Description	Cal. Due
382	SUNOL JB1	BICONLOG	1/6/2006
425	A.R.A DRG-118/A	HORN ANTENNA	6/30/2005
72	HEWLETT PACKARD 8568B	SPECTRUM ANALYZER W/OPT 85680B	7/1/2005
69	HEWLETT PACKARD 85650A	Q.P. ADAPTER	6/30/2006
70	HEWLETT PACKARD 85685A	RF PRESELECTOR W/OPT 8ZE	7/6/2005
210	NARDA V638	STANDARD GAIN HORN	12/25/2008
333	TEKTRONIX TDS 220	OSCILLOSCOPE	8/26/2005
475	WILTRON 75N50 DETECTOR	RF DETECTOR	8/24/2005
477	HEWLETT PACKARD-8648C	SIGNAL GENERATOR	7/15/2006
394	HEWLETT-PACKARD. 438A	POWER METER	3/21/2006
392	HEWLETT-PACKARD. 8481B	POWER SENSOR	3/21/2006
391	HEWLETT-PACKARD. 8481B	30DB ATTENUATOR	3/21/2006
26	EMCO 3110B	BICONICAL ANTENNA	12/10/2005
29	EMCO 3146A	LOG PERIODIC ANTENNA	6/24/2005
7	ANTENNA RESEARCH ASSOC. LPB-2520	BICONILOG ANTENNA	9/14/2005

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