Washington Laboratories, Ltd.

FCC & Industry Canada Certification Test Report
For the
Structured Mining Systems, Inc
SmaRT BU-901H Base Unit

FCC ID: LOBSBU900
IC ID: TBD

WLL Report # **9957-01 Rev 1**
February 5, 2008

Prepared for:

Structured Mining Systems, Inc
180 Pine Meadow Drive
Wexford, PA 15090

Prepared By:

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

FCC & Industry Canada Certification Test Report
for the
Structured Mining Systems, Inc
SmaRT BU-901H Base Unit
FCC ID: LOBSBU900
IC ID: TBD

WLL Report # **9957-01 Rev 1**
February 5, 2008

Prepared by: Steven Dovell
Compliance Engineer

Reviewed by: Steven D. Koster
EMC Operations Manager

Abstract

This report has been prepared on behalf of Structured Mining Systems, Inc to support the attached Application for Equipment Authorization. The test report and application are submitted for a Digitally Modulated Transmitter under Part 15.247 of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy RSS-210 of Industry Canada. This Certification Test Report documents the test configuration and test results for a Structured Mining Systems, Inc SmaRT BU-901H Base Unit.

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. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. 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 Structured Mining Systems, Inc SmaRT BU-901H Base Unit complies with the limits for a Digitally Modulated Transmitter device under FCC Part 15.247 and Industry Canada RSS-210.

 © 2008 Washington Laboratories, Ltd.

Table of Contents

List of Tables

List of Figures

 © 2008 Washington Laboratories, Ltd.

 © 2008 Washington Laboratories, Ltd.

1 Introduction

1.1 Compliance Statement

The Structured Mining Systems, Inc SmaRT BU-901H Base Unit complies with the limits for a Digitally Modulated Transmitter device under FCC Part 15.247 and Industry Canada RSS-210.

1.2 Test Scope

Tests for radiated and conducted (AC and at the antenna terminal) emissions were performed. All measurements were performed in accordance with FCC Public Notice DA 00-705 and the 2003 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation unless a different measurement technique is specified by the FCC.

1.3 Contract Information

Customer:	Structured Mining Systems, Inc 180 Pine Meadow Drive Wexford, PA 15090
Purchase Order Number:	47410
Quotation Number:	63572A

1.4 Test Dates

Testing was performed on the following date(s):	October 24 and October 25, 2007

1.5 Test and Support Personnel

Washington Laboratories, LTD	Steven Dovell
Client Representative	Christopher J. McKinney

© 2008 Washington Laboratories, Ltd.

2 Equipment Under Test

2.1 EUT Identification & Description

The Structured Mining Systems, Inc SmaRT BU-901H Base Unit functions as a short Range Radio Controller

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Structured Mining Systems, Inc.
FCC ID:	LOBSBU900
IC:	TBD
Model:	SmaRT BU-901H Base Unit
FCC Rule Parts:	Pt.15.247
Industry Canada:	RSS210
Frequency Range:	906-924MHz
Maximum Output Power:	2.085dBm
Modulation:	BPSK
Occupied Bandwidth:	744kHz (6dB BW)
Keying:	Manual
Type of Information:	Data
Number of Channels:	10
Power Output Level	Fixed
Antenna Type	Integral (chip antenna)- Antenna Factor corp. ANT-916-SP
Antenna Gain	-1dBi
Interface Cables:	None
Power Source & Voltage:	12VDC

2.2 Test Configuration

The SmaRT BU-901H Base Unit was configured as a DC powered stand alone unit. It has the SmaRT Download/Debug cable, equipped with one female DB-9 connector for the PC or laptop, one female Deutsch® connector for the SmaRT Base Unit, and several flying leads for inputs, outputs and power. Power was provide by a laboratory supply.

2.3 Testing Algorithm

The SmaRT BU-901H Base Unit was programmed to transmit on 906, 914, and 924 MHz with continuous transmissions and modulation via a laptop computer running HyperTerminal.

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. The Industry Canada OATS numbers

© 2008 Washington Laboratories, Ltd.

are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. 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 KDB 558074

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.

© 2008 Washington Laboratories, Ltd.

Table 2: Test Equipment List

Test Name:	**Radiated Emissions**	Test Date:	**10/25/2007**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00618	HP 8563A	ANALYZER, SPECTRUM	2/9/2008
00337	WLL, 1.2-5GHZ	FILTER, BAND PASS	3/2/2008
00004	ARA, DRG-118/A	ANTENNA, DRG, 1-18GHZ	2/2/2009
00522	HP, 8449B	PRE-AMPLIFIER, 1-26.5GHZ	7/27/2008
00069	HP, 85650A	ADAPTER, QP	7/6/2008
00007	ARA, LPB-2520	ANTENNA, BICONILOG ANTENNA	6/7/2008
00073	HP, 8568B	ANALYZER, SPECTRUM	7/6/2008
00071	HP, 85685A	PRESELECTOR, RF	7/6/2008
000642	HQ POWER	0-50V 5AMP DC SUPPLY	CNR

 © 2008 Washington Laboratories, Ltd.

4 Test Results

4.1 RF Power Output: (FCC Part §2.1046/RSS-210)

To measure the output power the unit was set to the 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 906MHz	2.09dBm	30 dBm	Pass
Mid Channel 914MHz	2.0dBm	30 dBm	Pass
High Channel 924MHz	1.58dBm	30 dBm	Pass

© 2008 Washington Laboratories, Ltd.

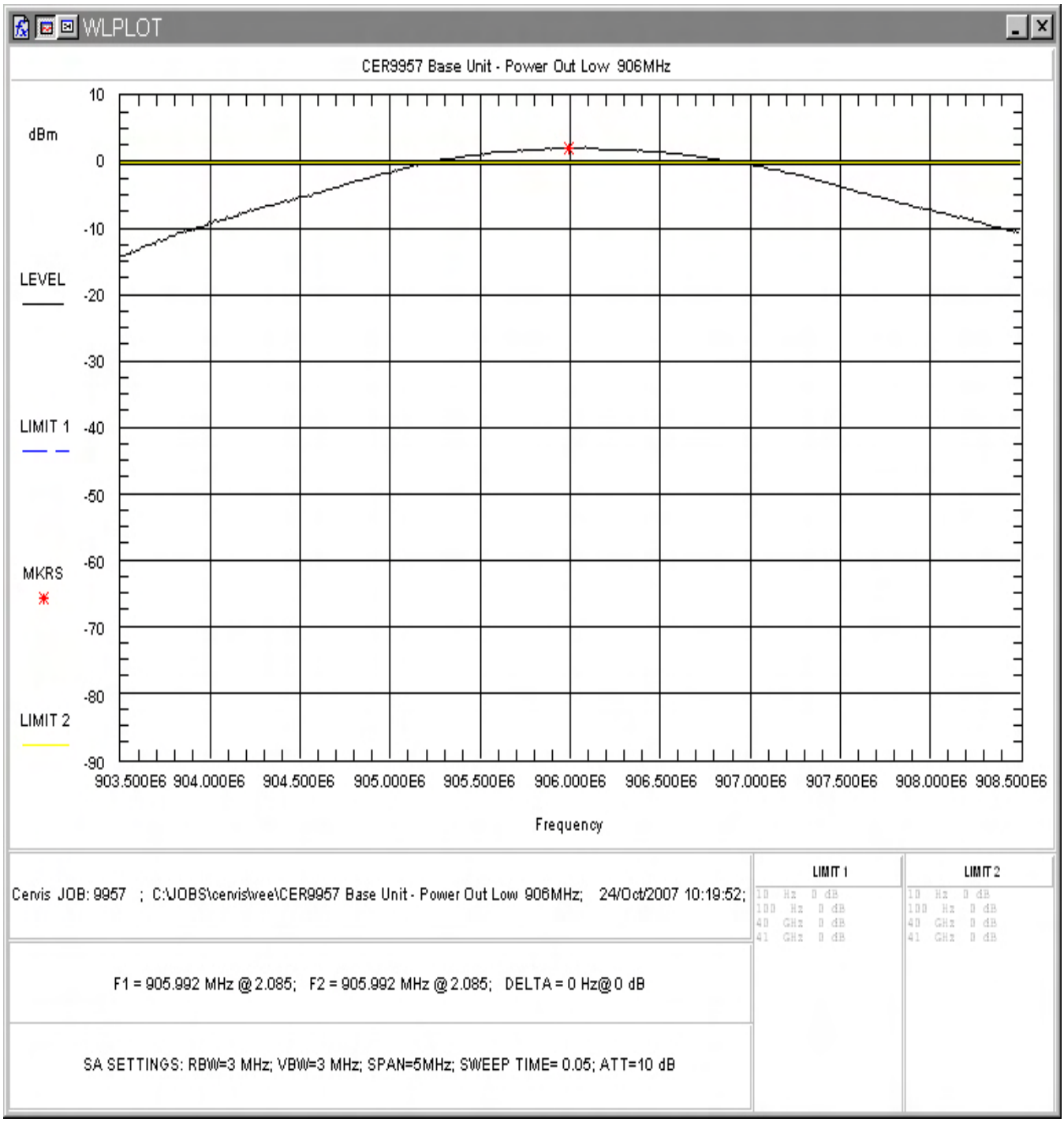

Figure 4-1. RF Peak Power, Low Channel

 © 2008 Washington Laboratories, Ltd.

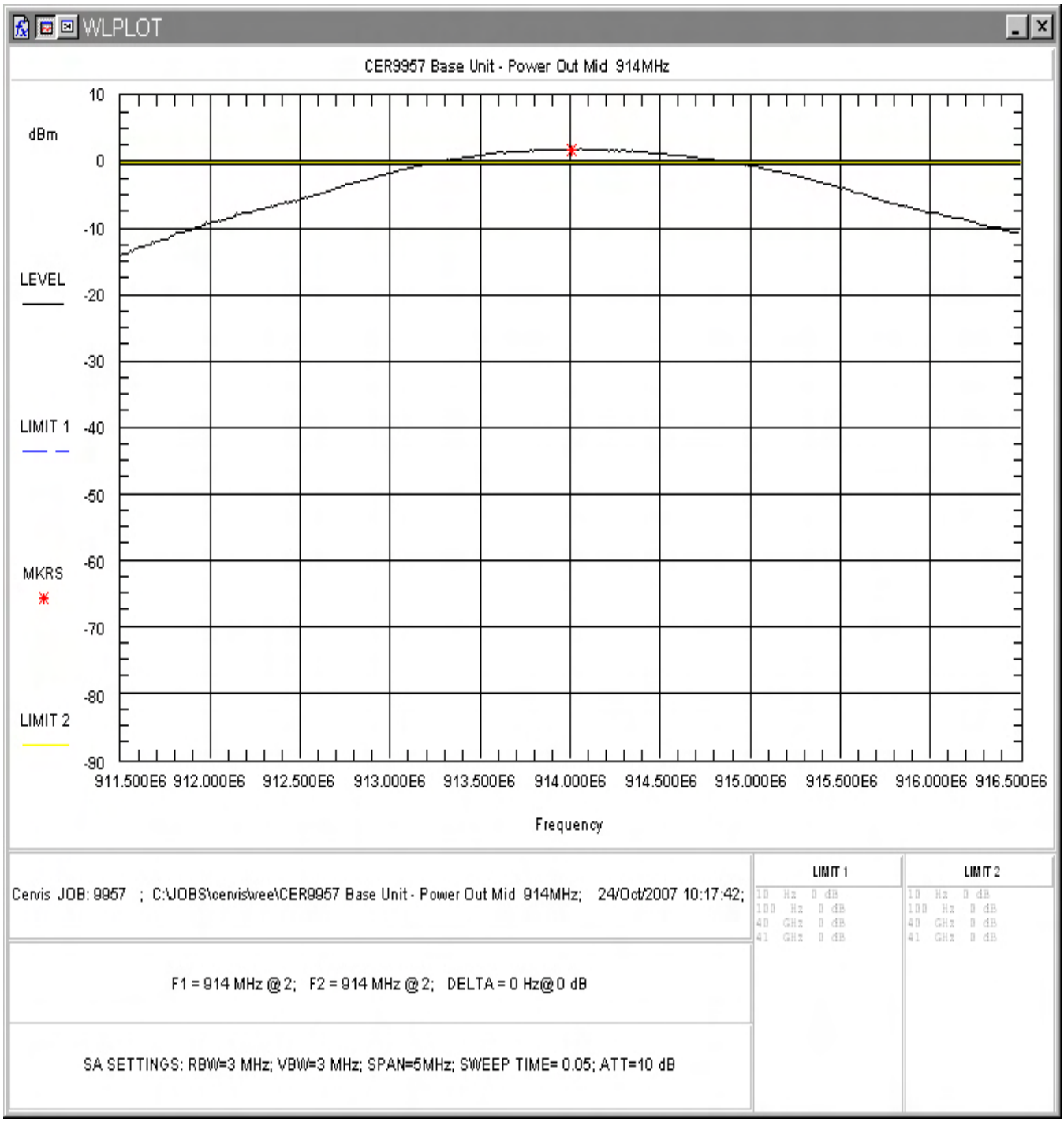

Figure 4-2. RF Peak Power, Mid Channel

 © 2008 Washington Laboratories, Ltd.

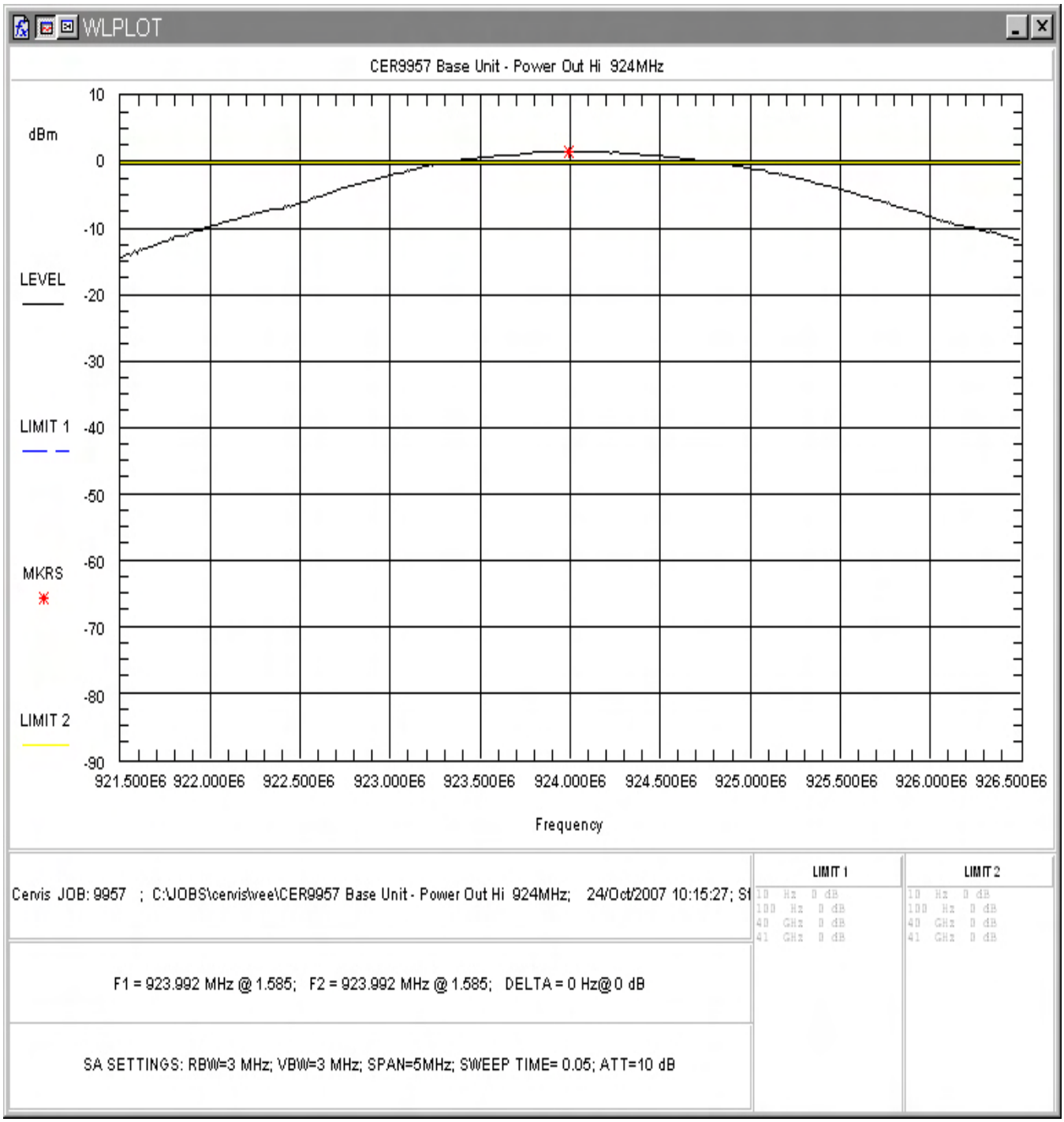

Figure 4-3. RF Peak Power, High Channel

 © 2008 Washington Laboratories, Ltd.

4.2 Power Spectral Density (FCC Part 15.247/RSS-210)

For DSSS devices, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band.

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.

Following are plots of the Power Spectral Density emissions for the Low, Middle and High channels.

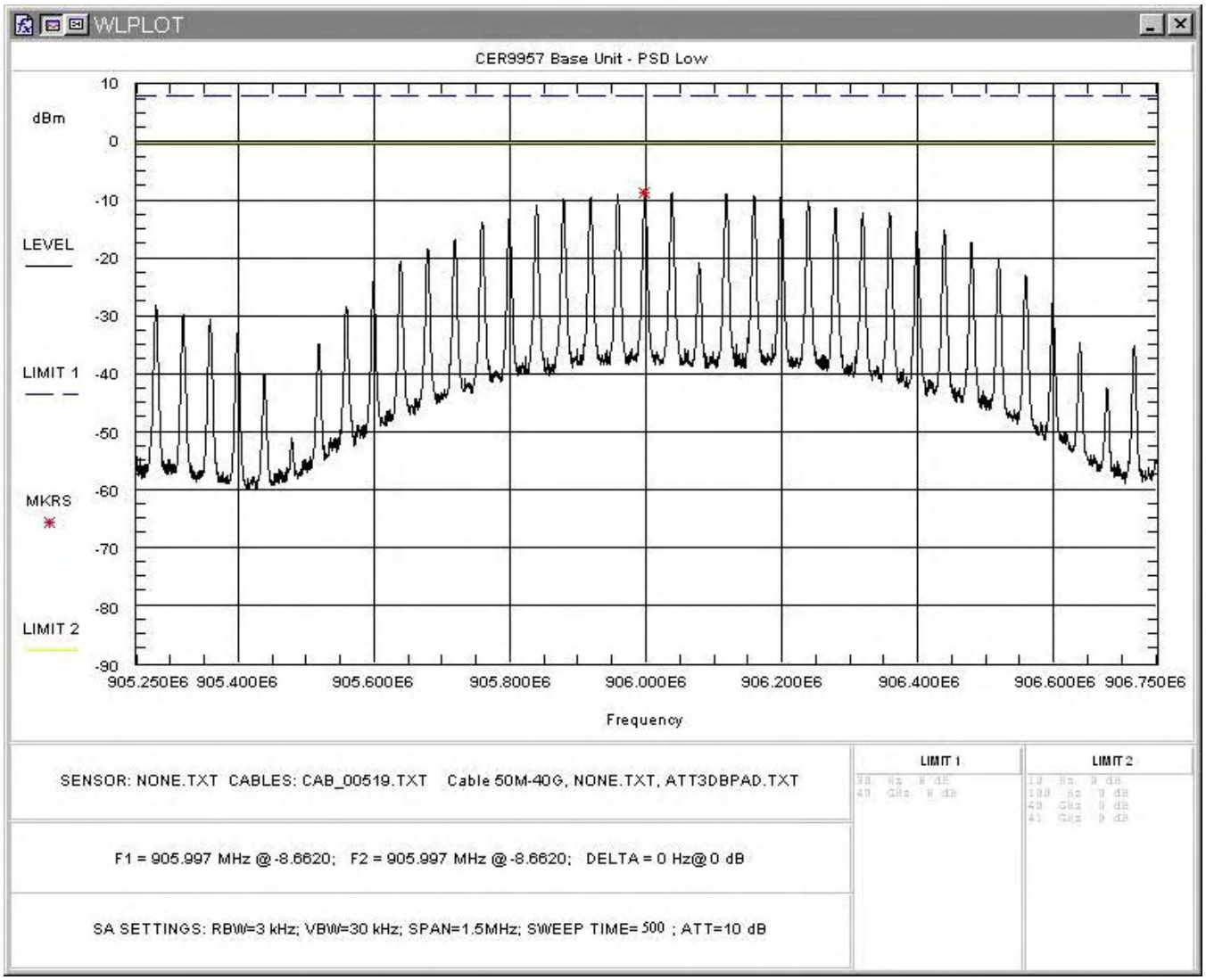

Figure 4-4: Power Spectral Density Plot, Low Channel

 © 2008 Washington Laboratories, Ltd.

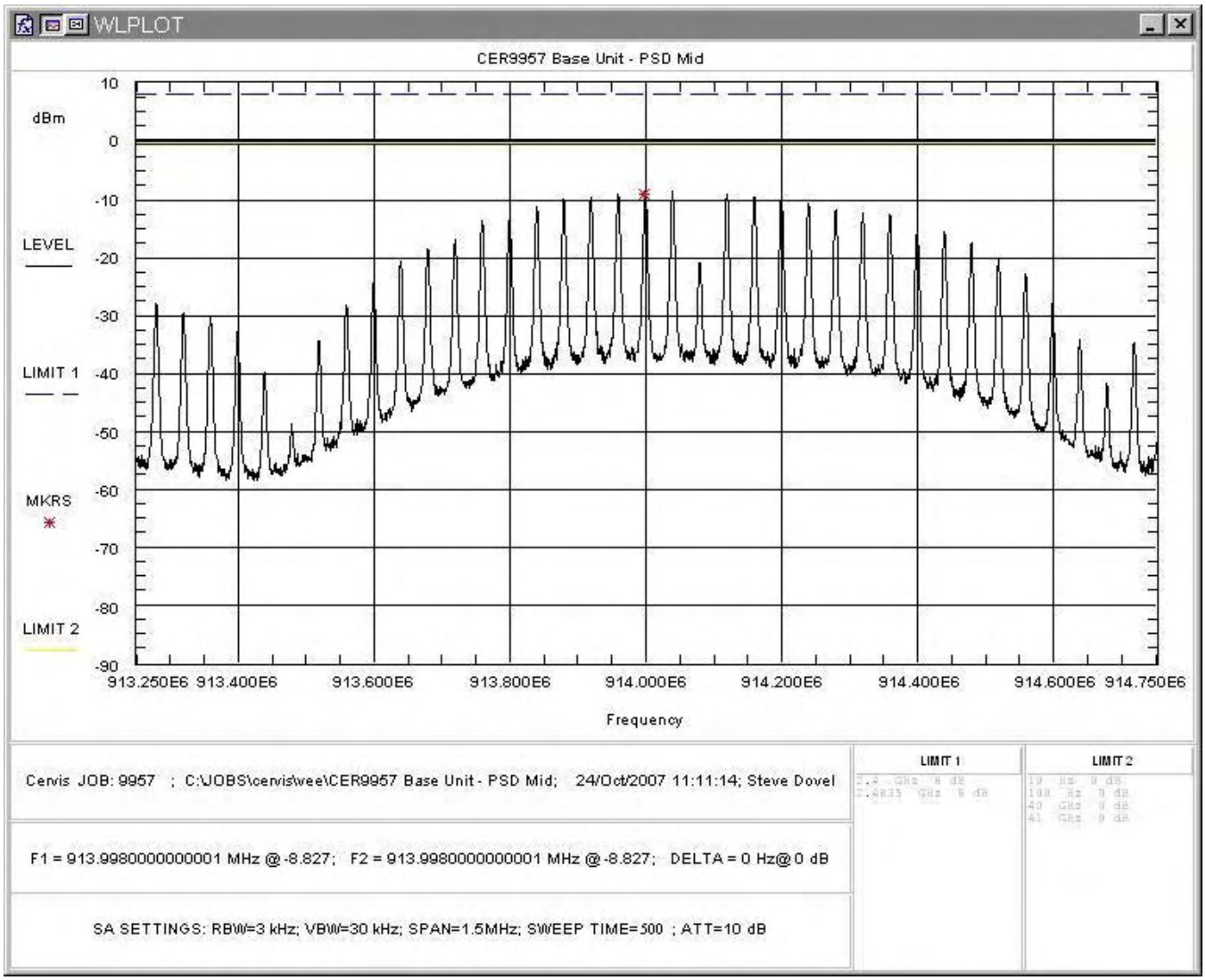

Figure 4-5: Power Spectral Density Plot, Center Channel

 © 2008 Washington Laboratories, Ltd.

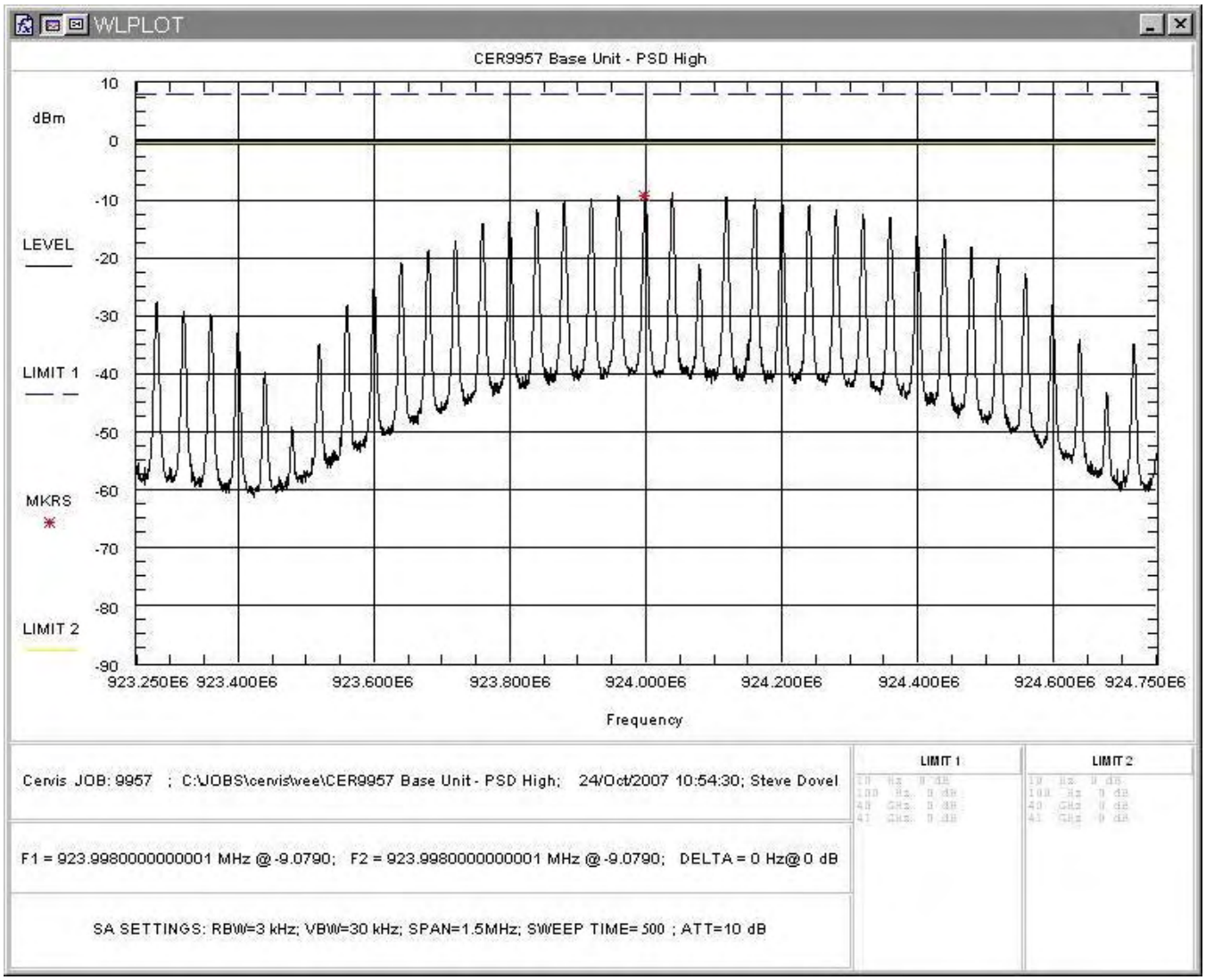

Figure 4-6: Power Spectral Density Plot, High Channel

4.3 Occupied Bandwidth: (FCC Part §2.1049/IC RSS-210)

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

For Digitally Modulated Systems, FCC Part 15.247 requires the minimum 6 dB bandwidth be at least 500 kHz.

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

 © 2008 Washington Laboratories, Ltd.

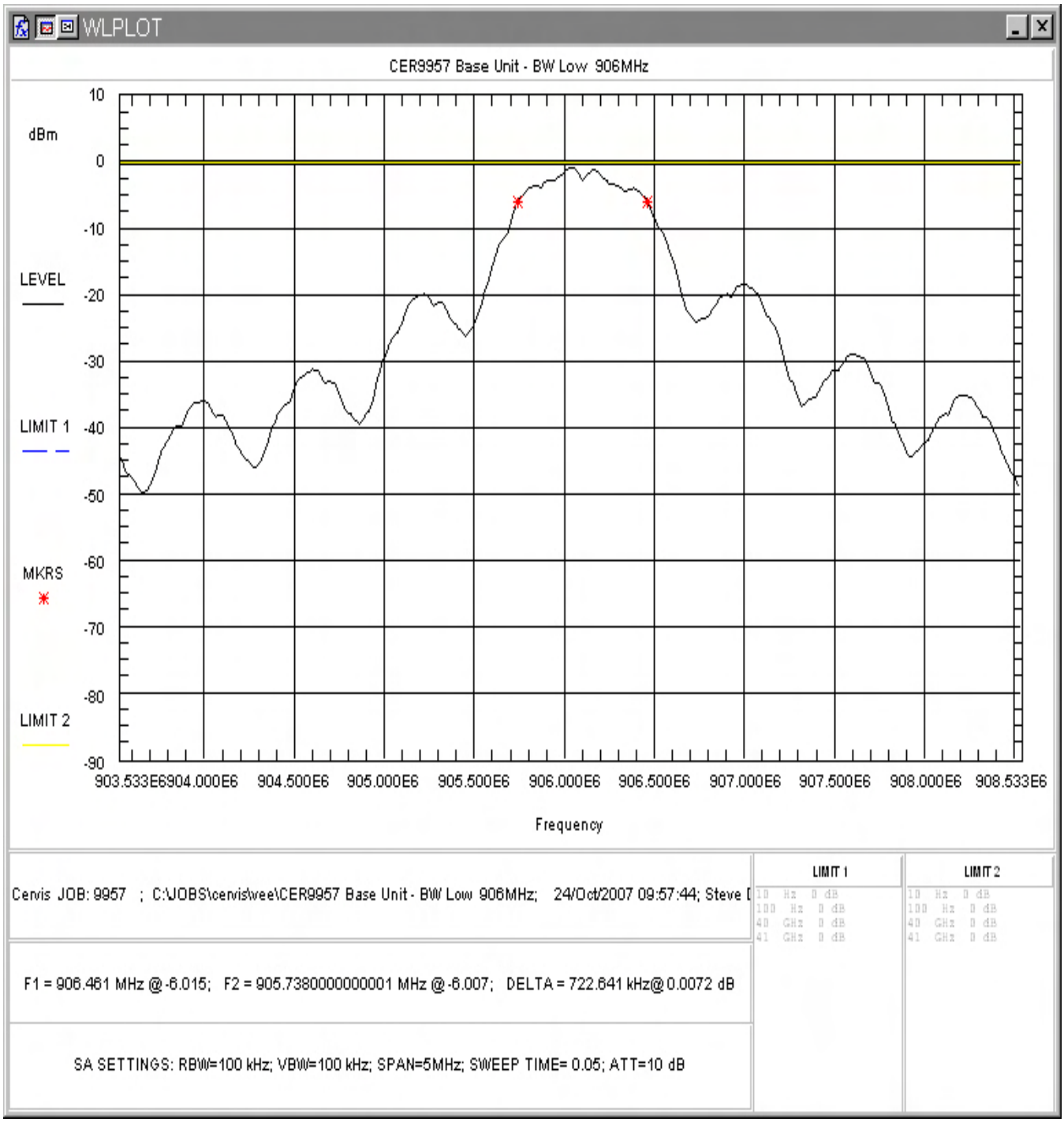

Figure 4-7. 6dB Occupied Bandwidth, Low Channel

 © 2008 Washington Laboratories, Ltd.

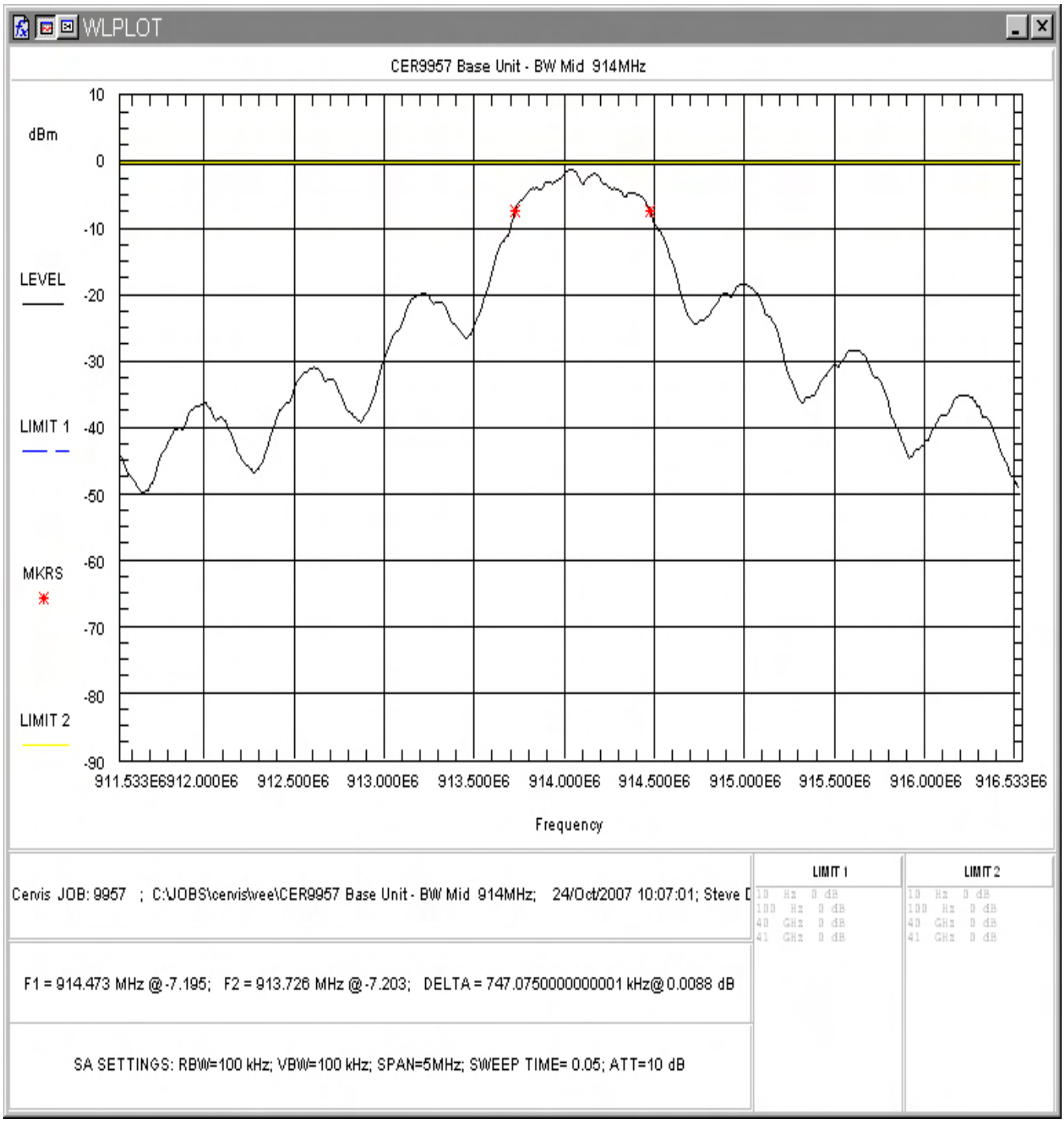

Figure 4-8. 6dB Occupied Bandwidth, Mid Channel

 © 2008 Washington Laboratories, Ltd.

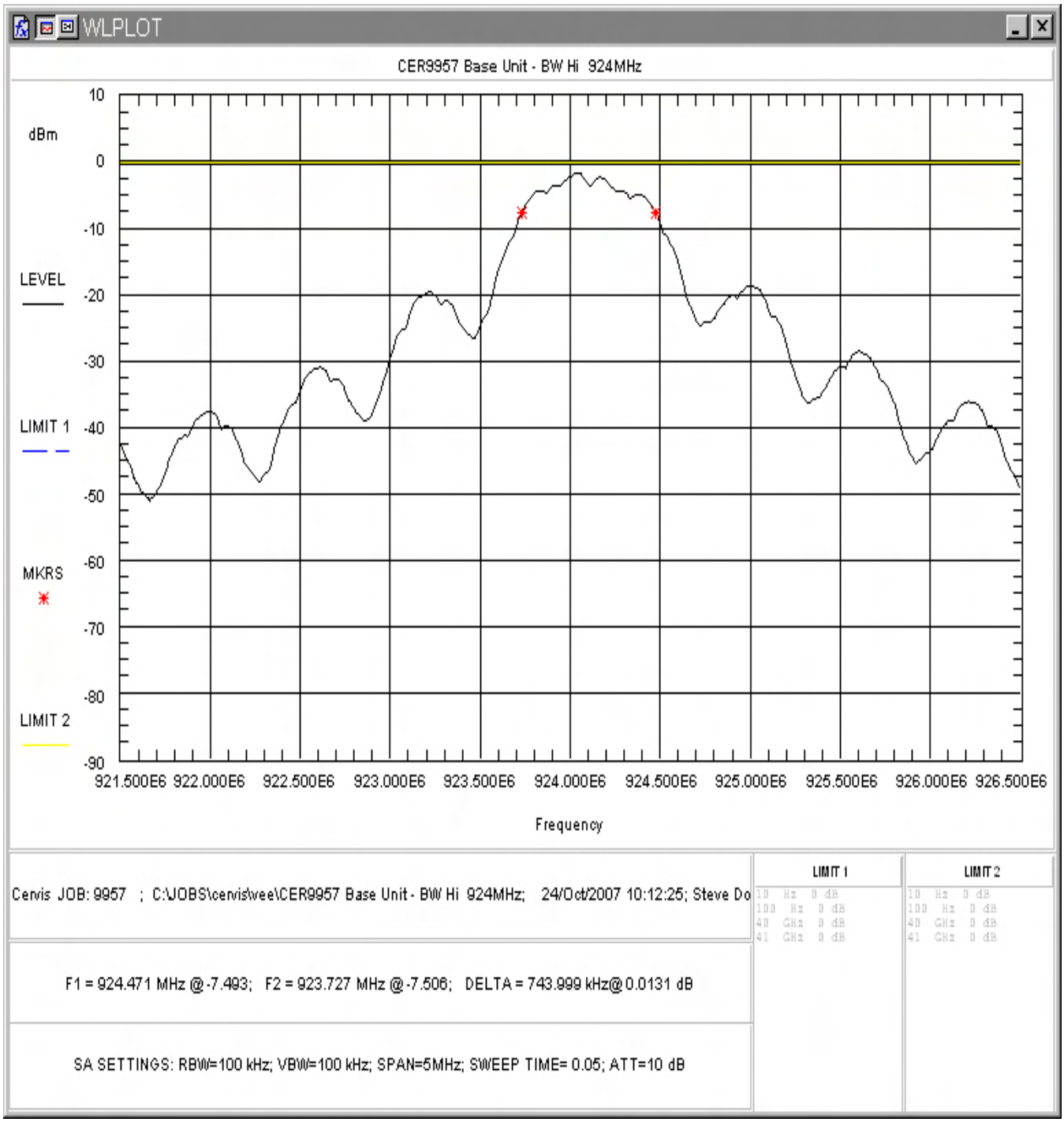

Figure 4-9. 6dB Occupied Bandwidth, High Channel

 © 2008 Washington Laboratories, Ltd.

Table 4 provides a summary of the Occupied Bandwidth Results.

Table 4. Occupied Bandwidth Results

6dB Bandwidth

Frequency	Bandwidth	Limit (Minimum)	Pass/Fail
Low Channel 906MHz	722.6kHz	500kHz	Pass
Mid Channel 914MHz	747.1kHz	500kHz	Pass
High Channel 924MHz	744kHz	500kHz	Pass

4.4 Conducted Spurious Emissions at Antenna Terminals (FCC Pt §2.1051/IC RSS-210)

The EUT must comply with requirements for spurious emissions at antenna terminals. Per §15.247(c) and RSS-210 Section 6.2.2(o)(e1) 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 3 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.

© 2008 Washington Laboratories, Ltd.

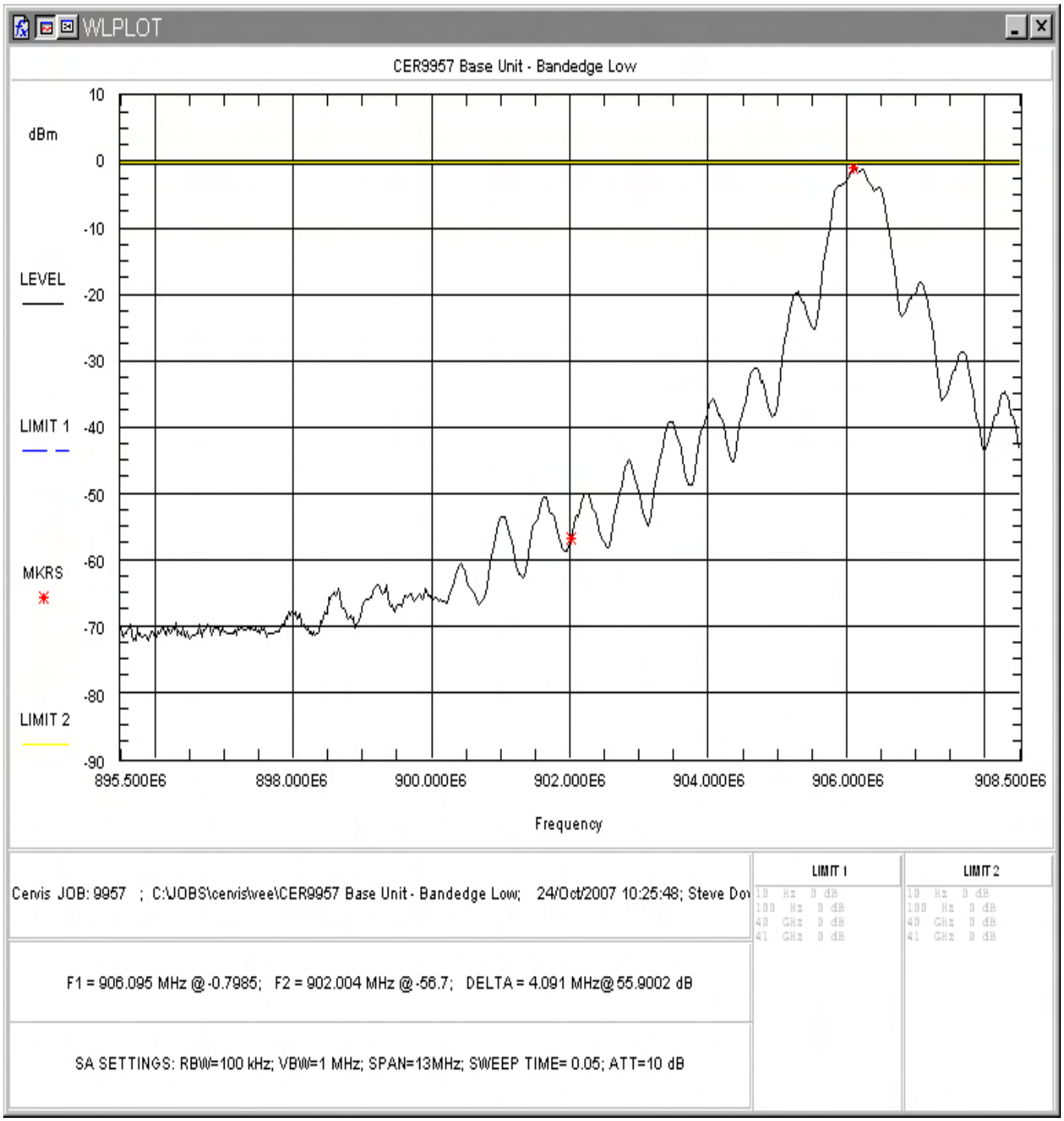

Figure 4-10. Conducted Spurious Emissions, Low Channel Band Edge

 © 2008 Washington Laboratories, Ltd.

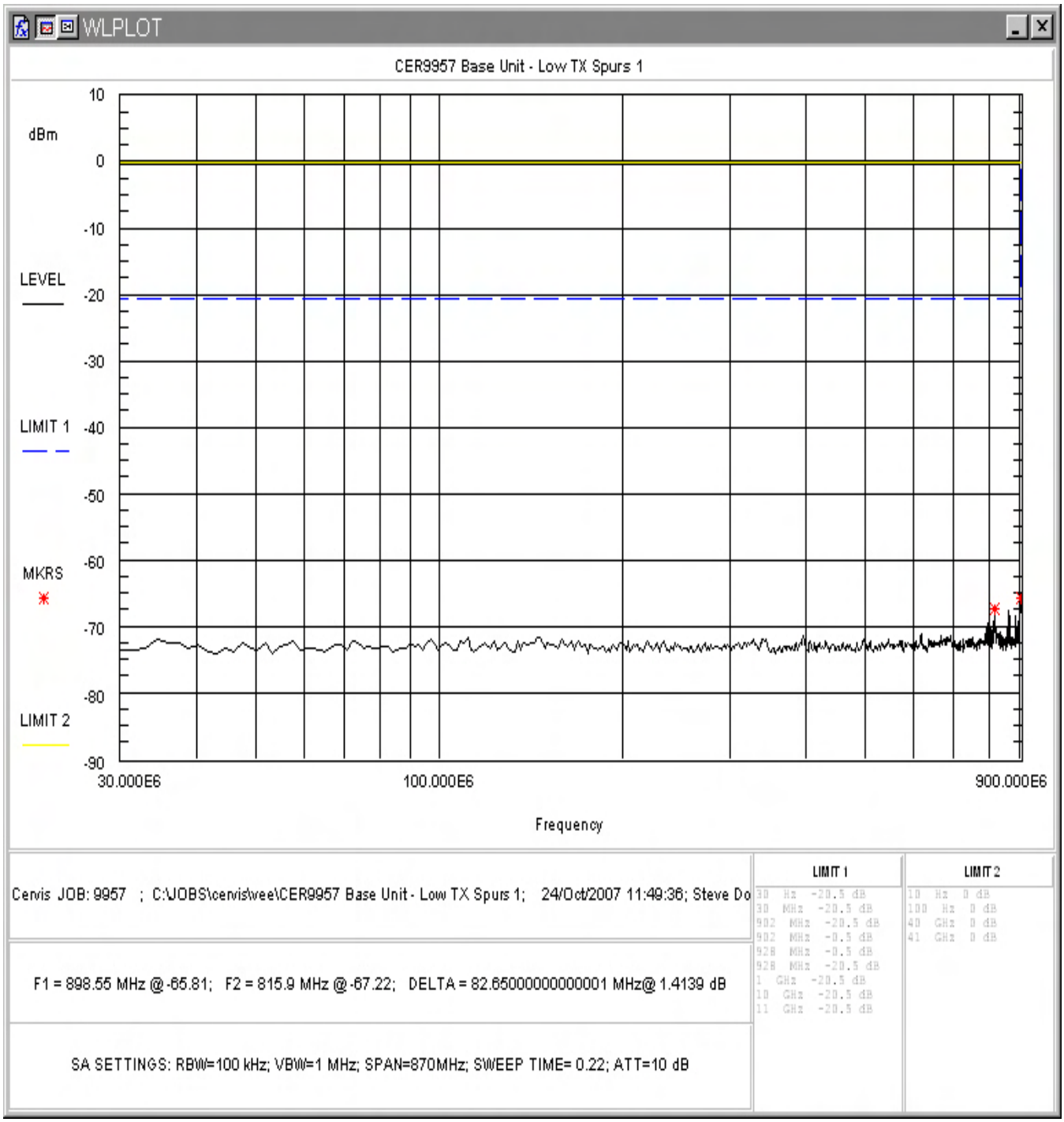

Figure 4-11. Conducted Spurious Emissions, Low Channel 30 – 900MHz

 © 2008 Washington Laboratories, Ltd.

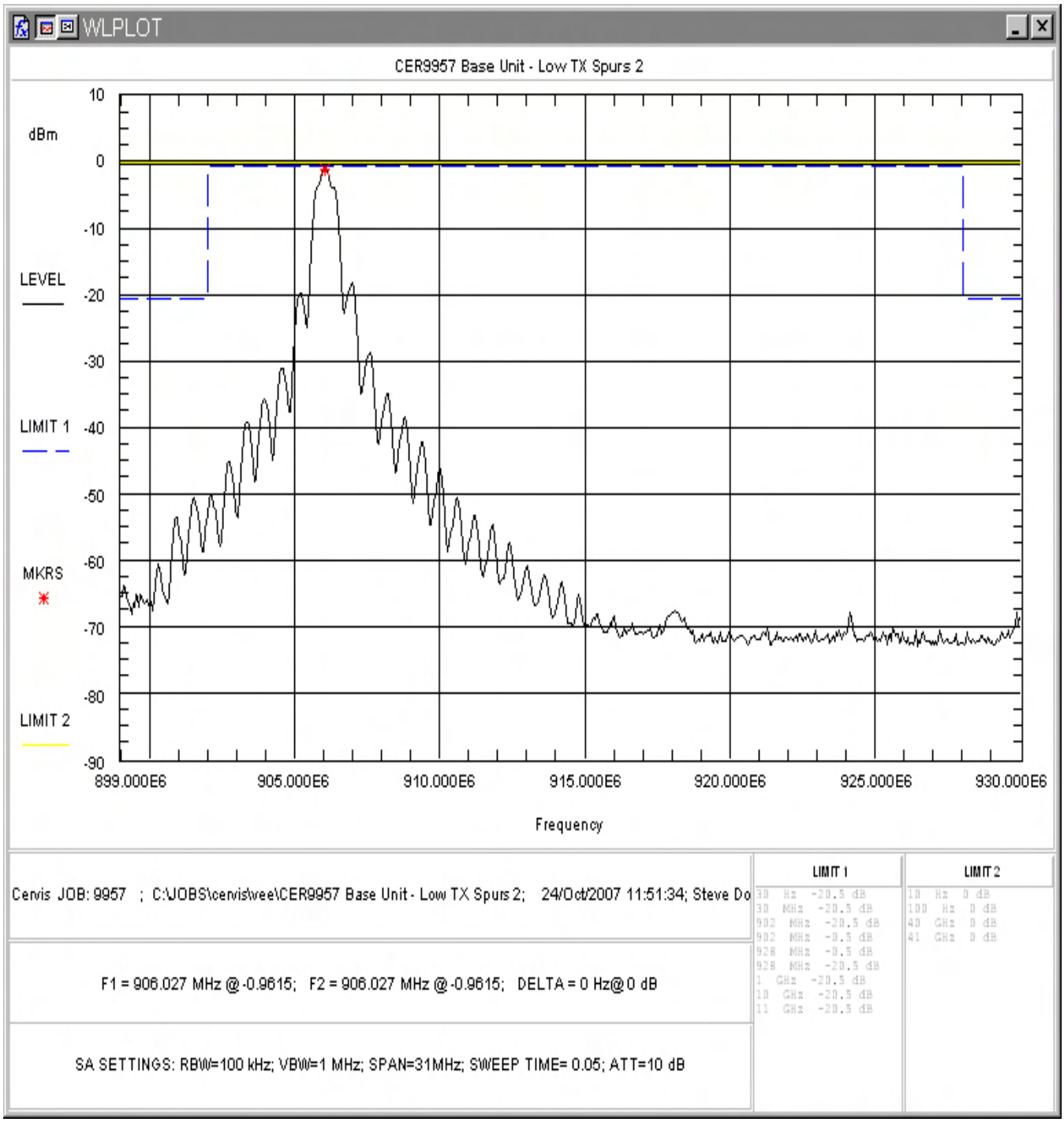

Figure 4-12. Conducted Spurious Emissions, Low Channel 899 – 930MHz

 © 2008 Washington Laboratories, Ltd.

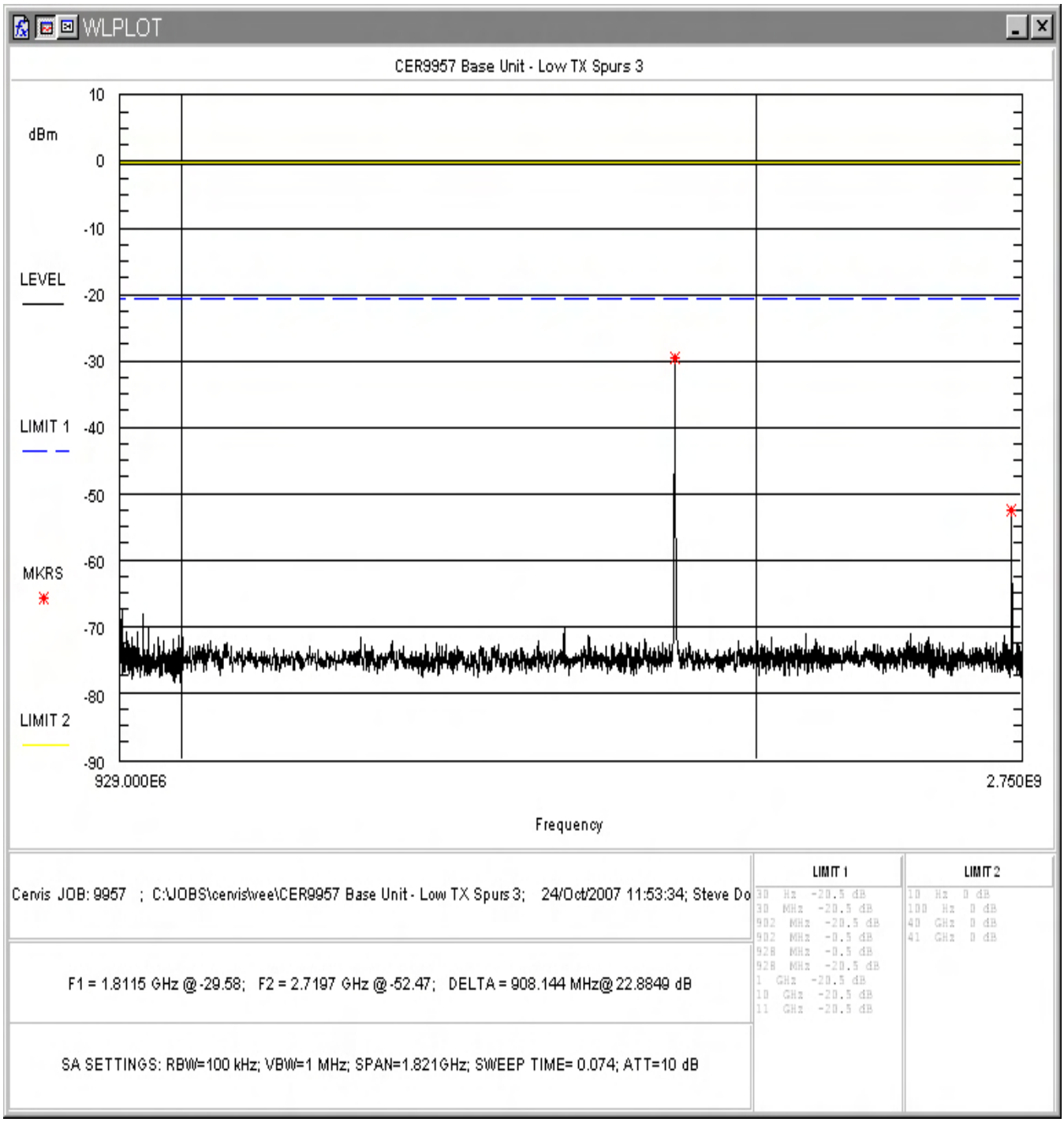

Figure 4-13. Conducted Spurious Emissions, Low Channel 929MHz – 2.75GHz

 © 2008 Washington Laboratories, Ltd.

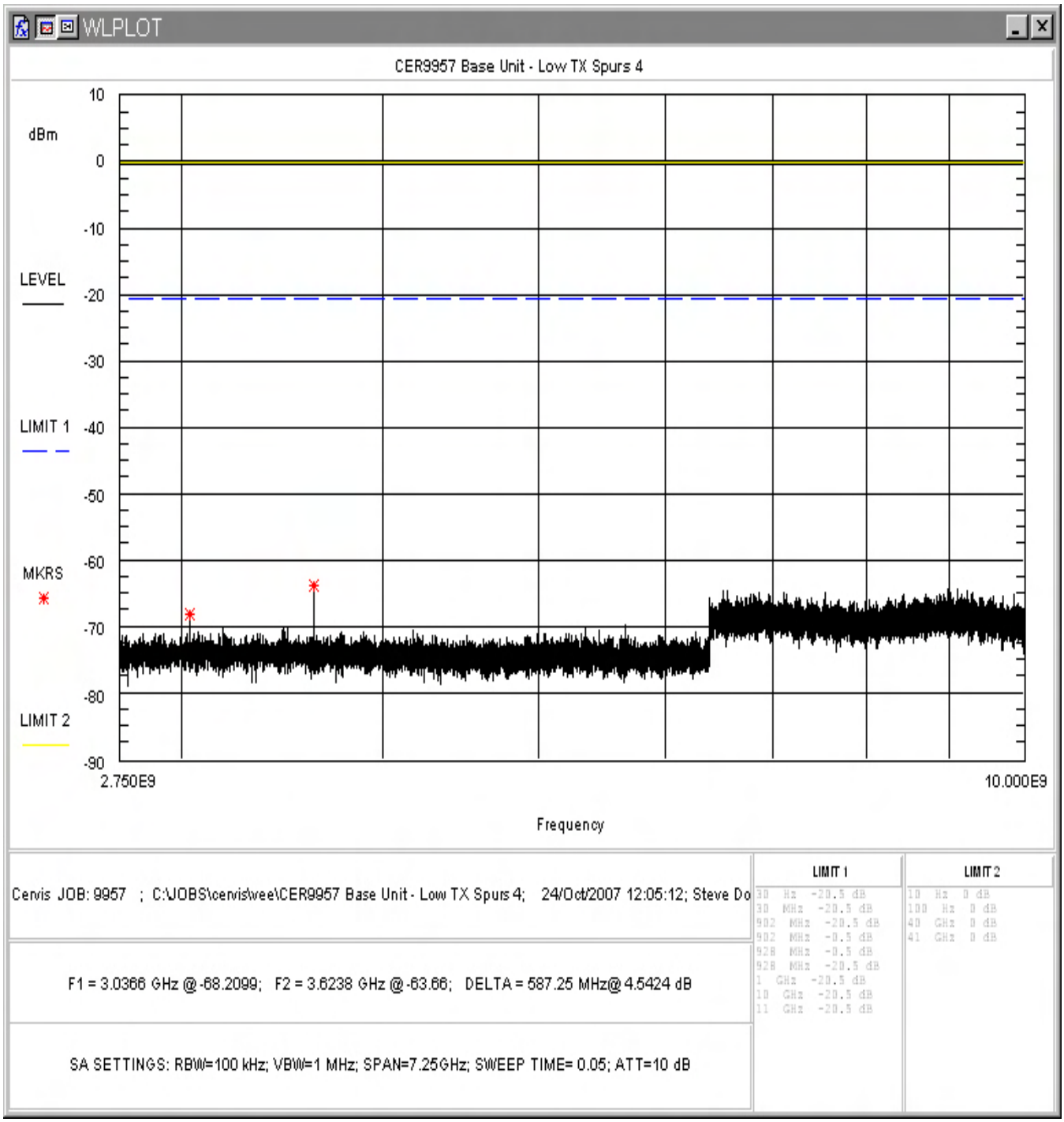

Figure 4-14. Conducted Spurious Emissions, Low Channel 2.75 - 10GHz

 © 2008 Washington Laboratories, Ltd.

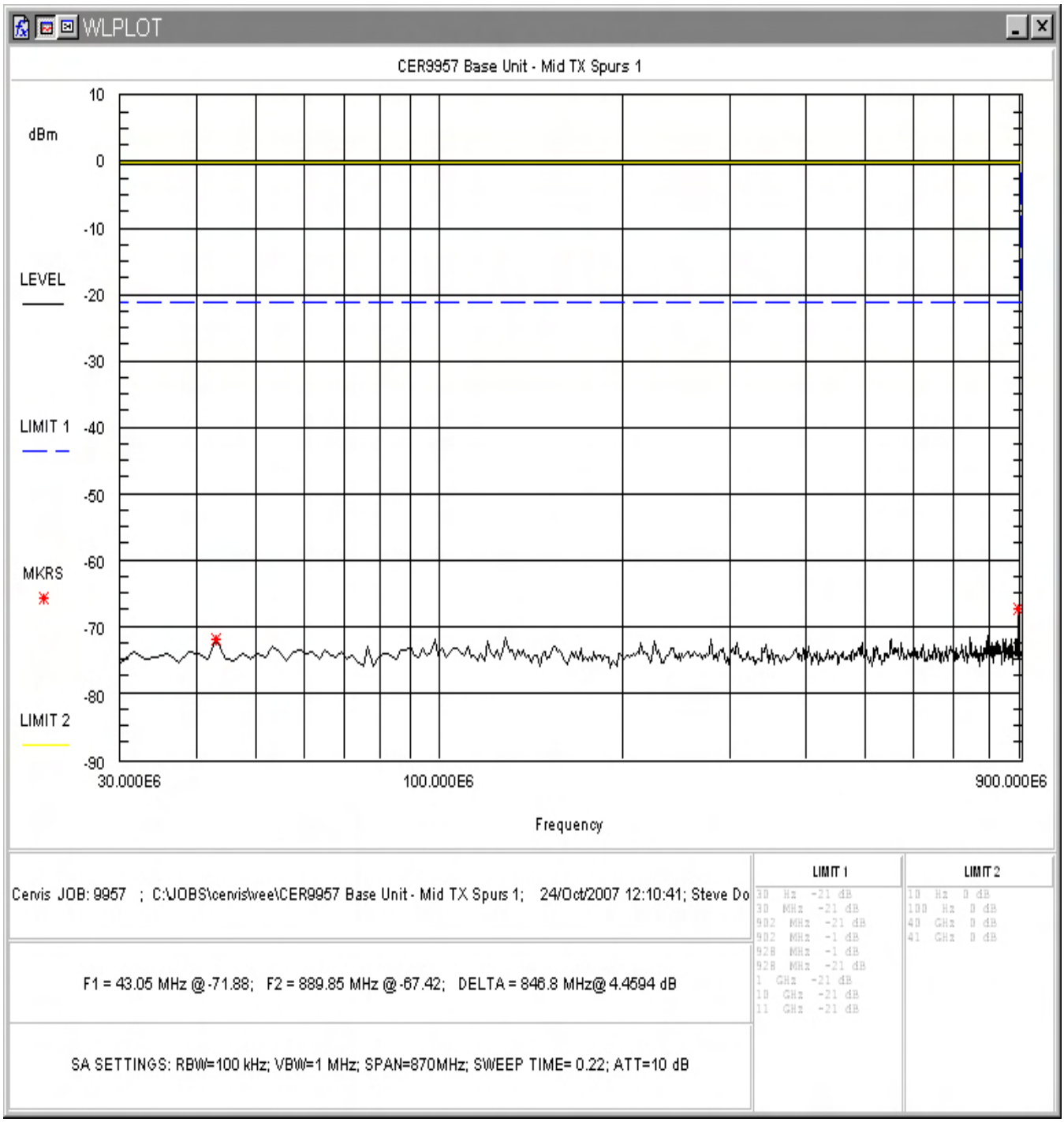

Figure 4-15. Conducted Spurious Emissions, Center Channel 30-900MHz

 © 2008 Washington Laboratories, Ltd.

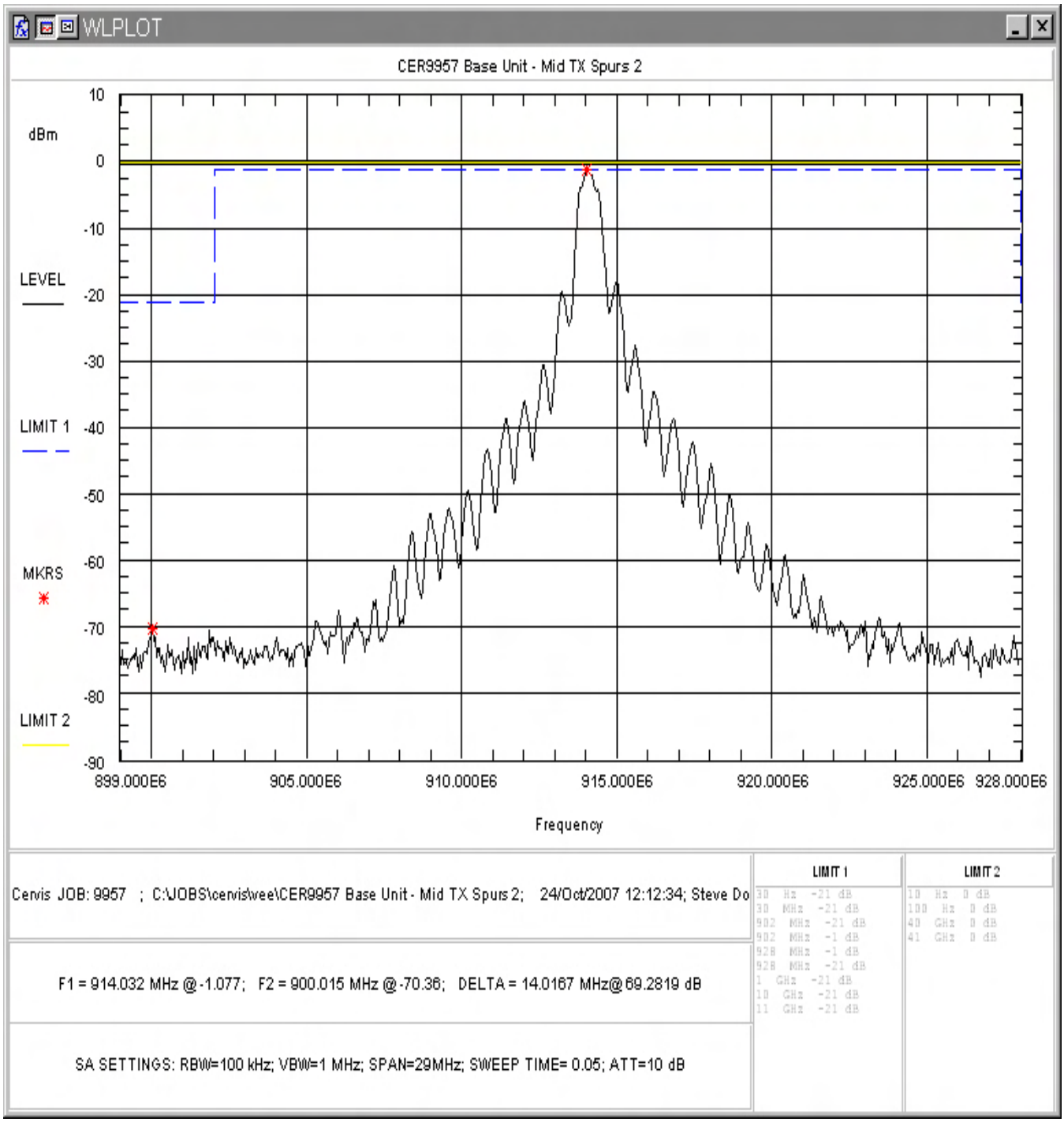

Figure 4-16. Conducted Spurious Emissions, Center Channel 899 – 928MHz

 © 2008 Washington Laboratories, Ltd.

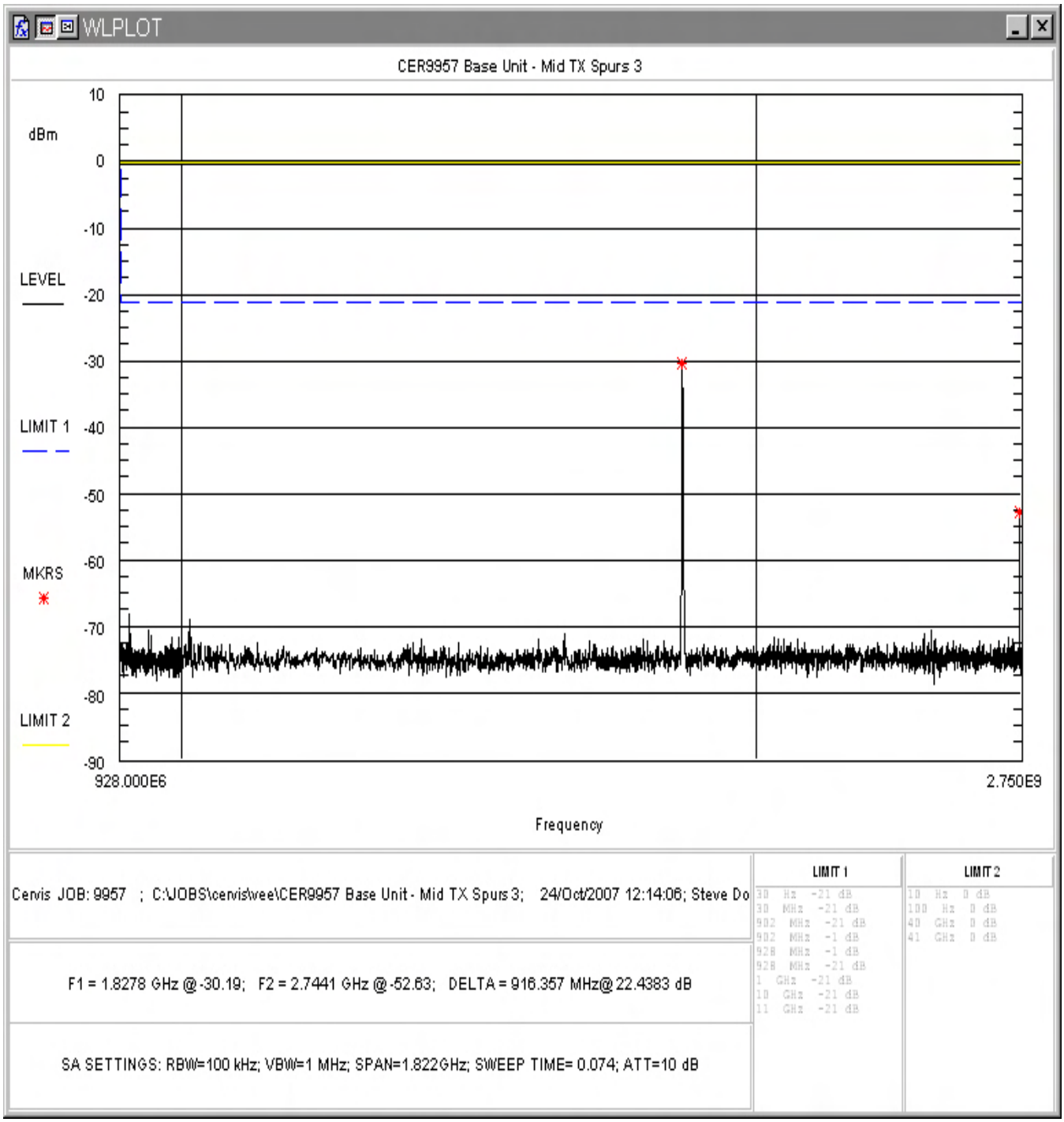

Figure 4-17. Conducted Spurious Emissions, Center Channel 928MHz – 2.75GHz

 © 2008 Washington Laboratories, Ltd.

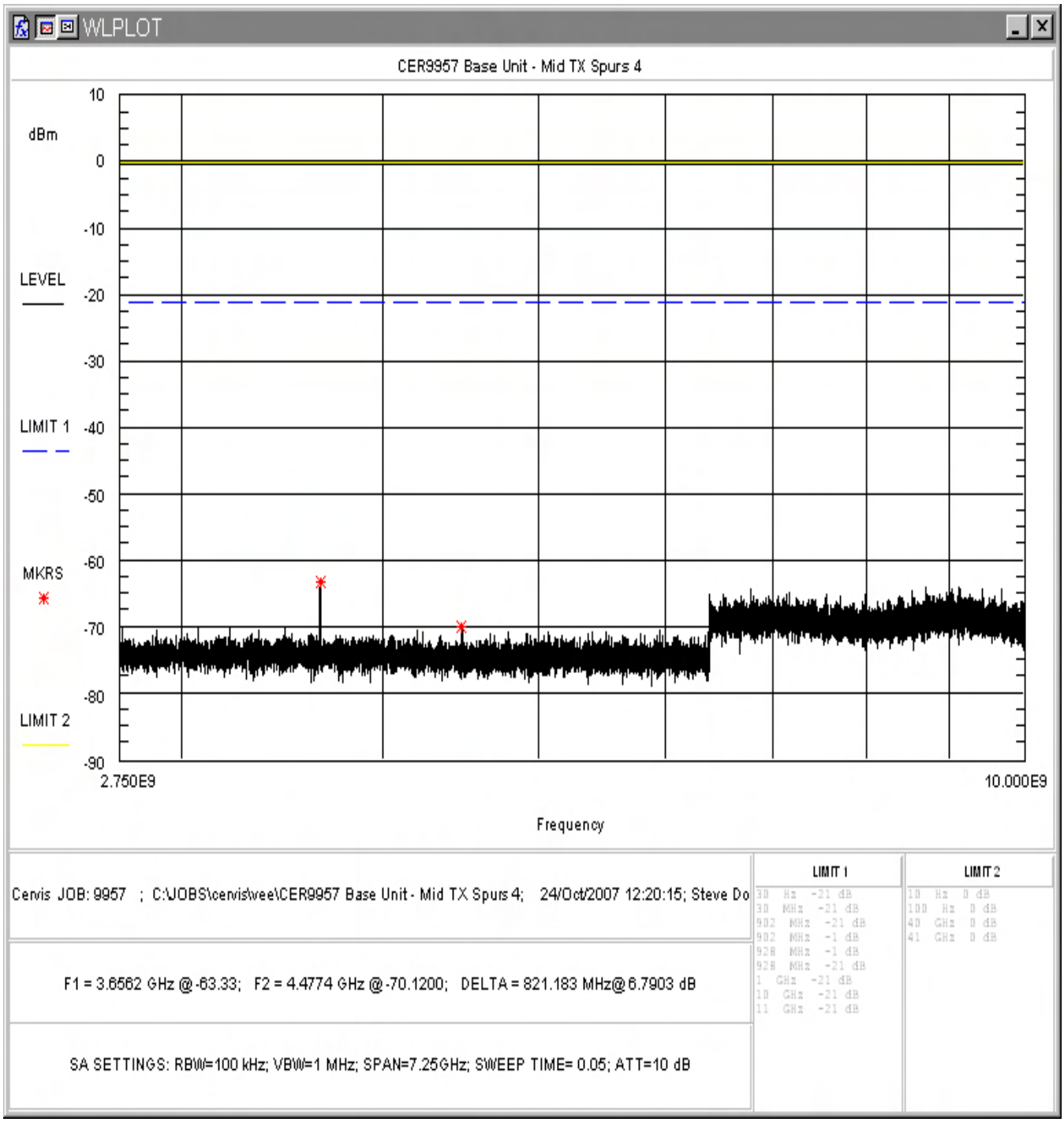

Figure 4-18. Conducted Spurious Emissions, Mid Channel 2.75 - 10GHz

 © 2008 Washington Laboratories, Ltd.

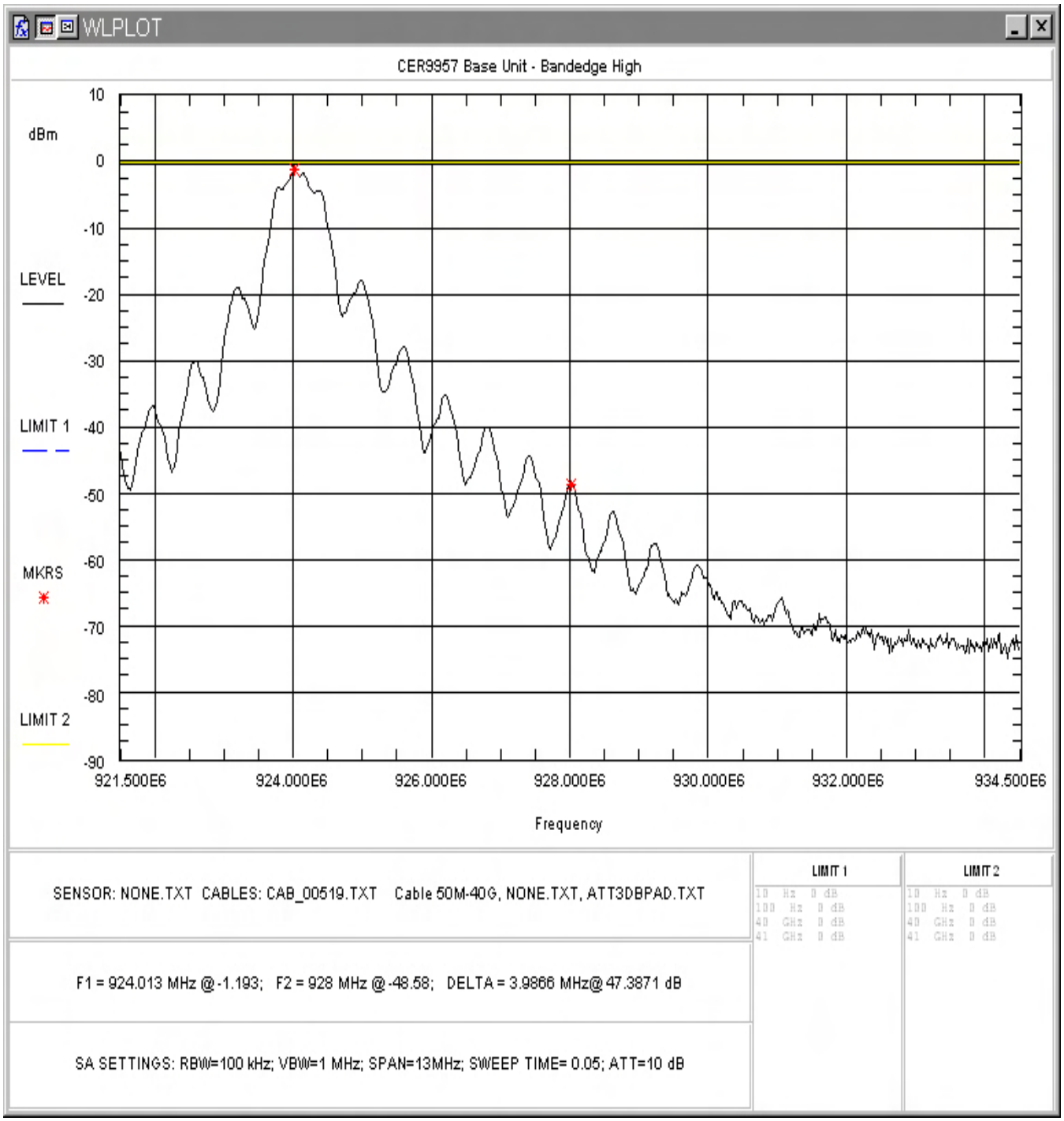

Figure 4-19. Conducted Spurious Emissions, High Channel Band Edge

 © 2008 Washington Laboratories, Ltd.

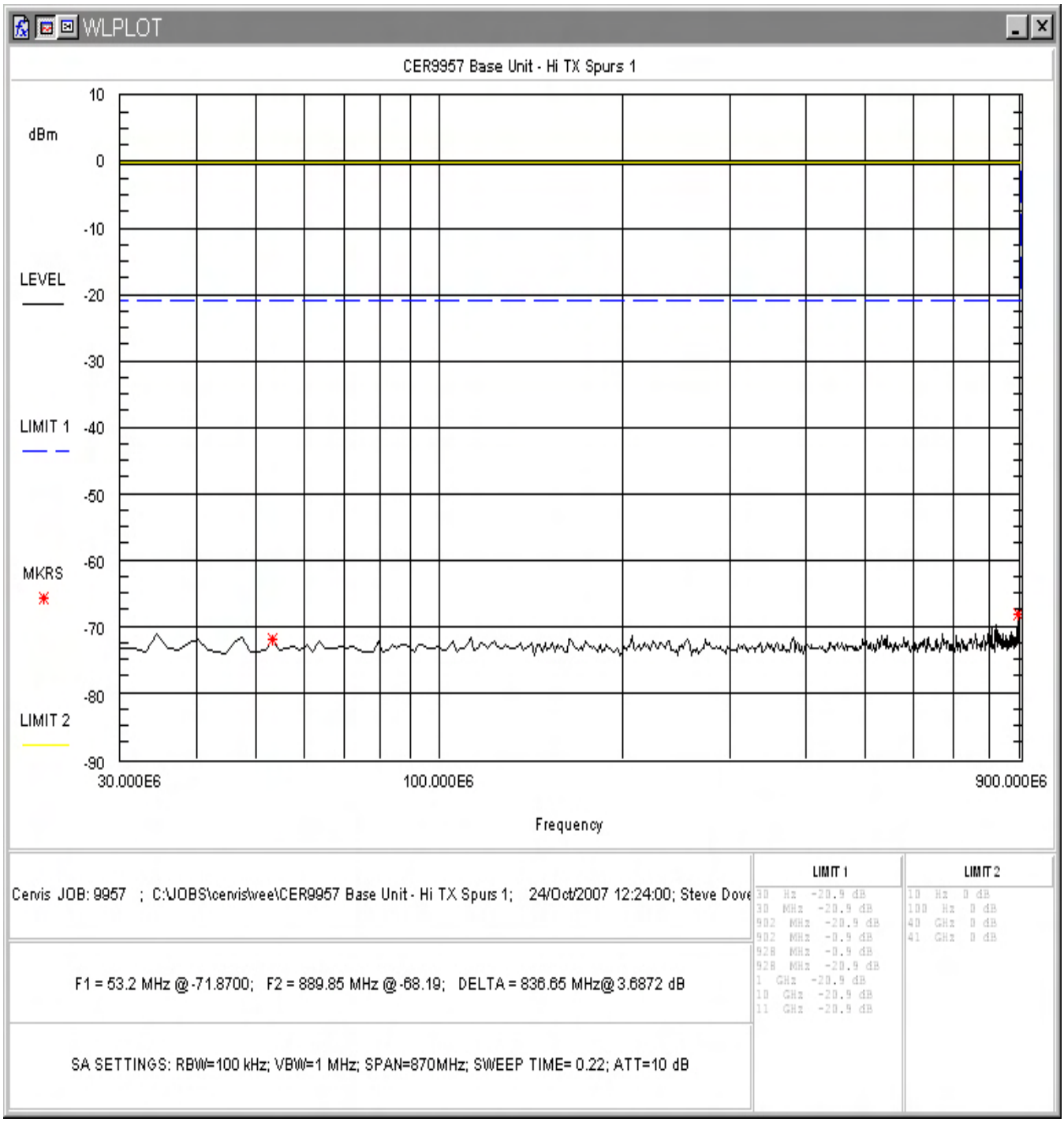

Figure 4-20. Conducted Spurious Emissions, High Channel 30MHz – 900MHz

 © 2008 Washington Laboratories, Ltd.

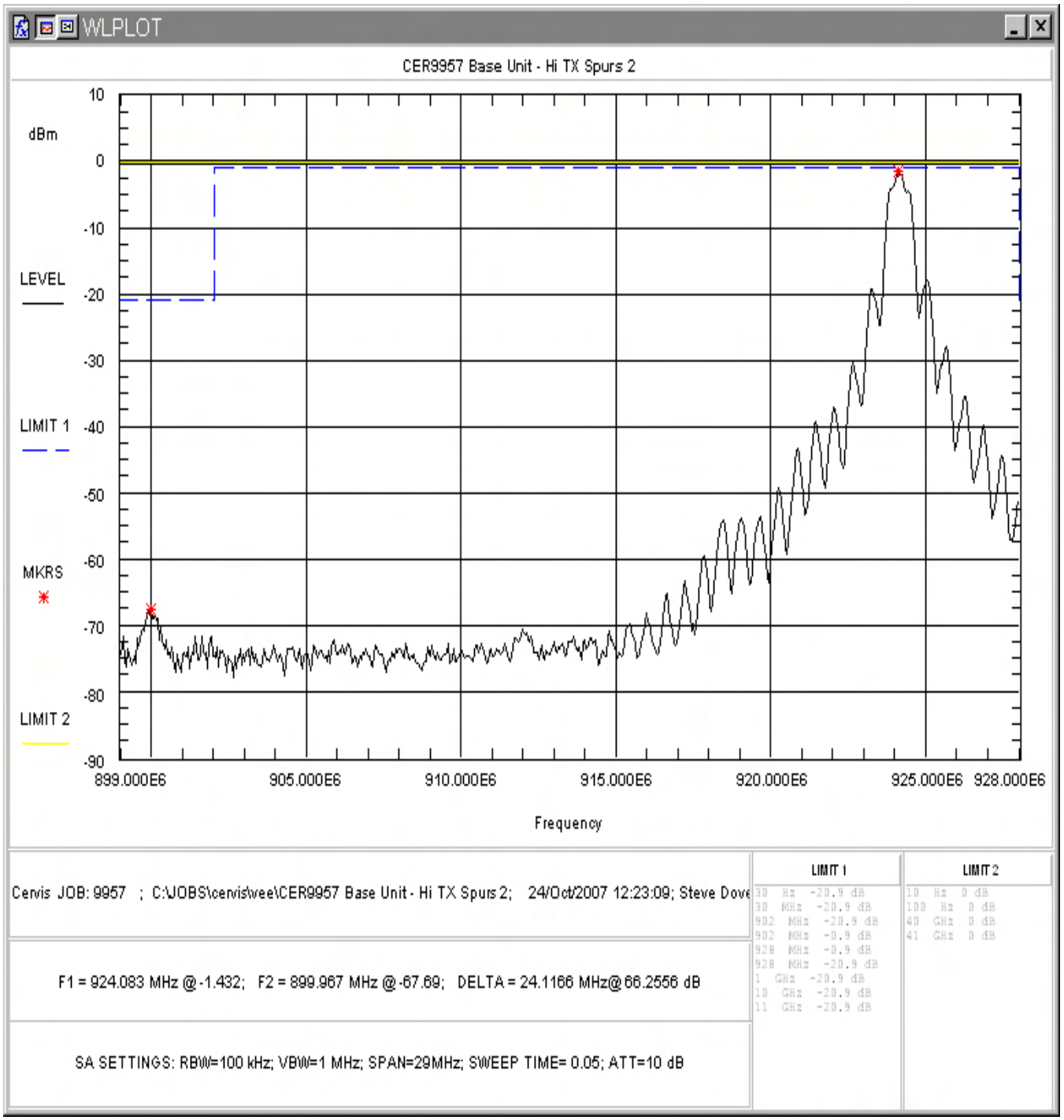

Figure 4-21. Conducted Spurious Emissions, High Channel 899 – 928MHz

 © 2008 Washington Laboratories, Ltd.

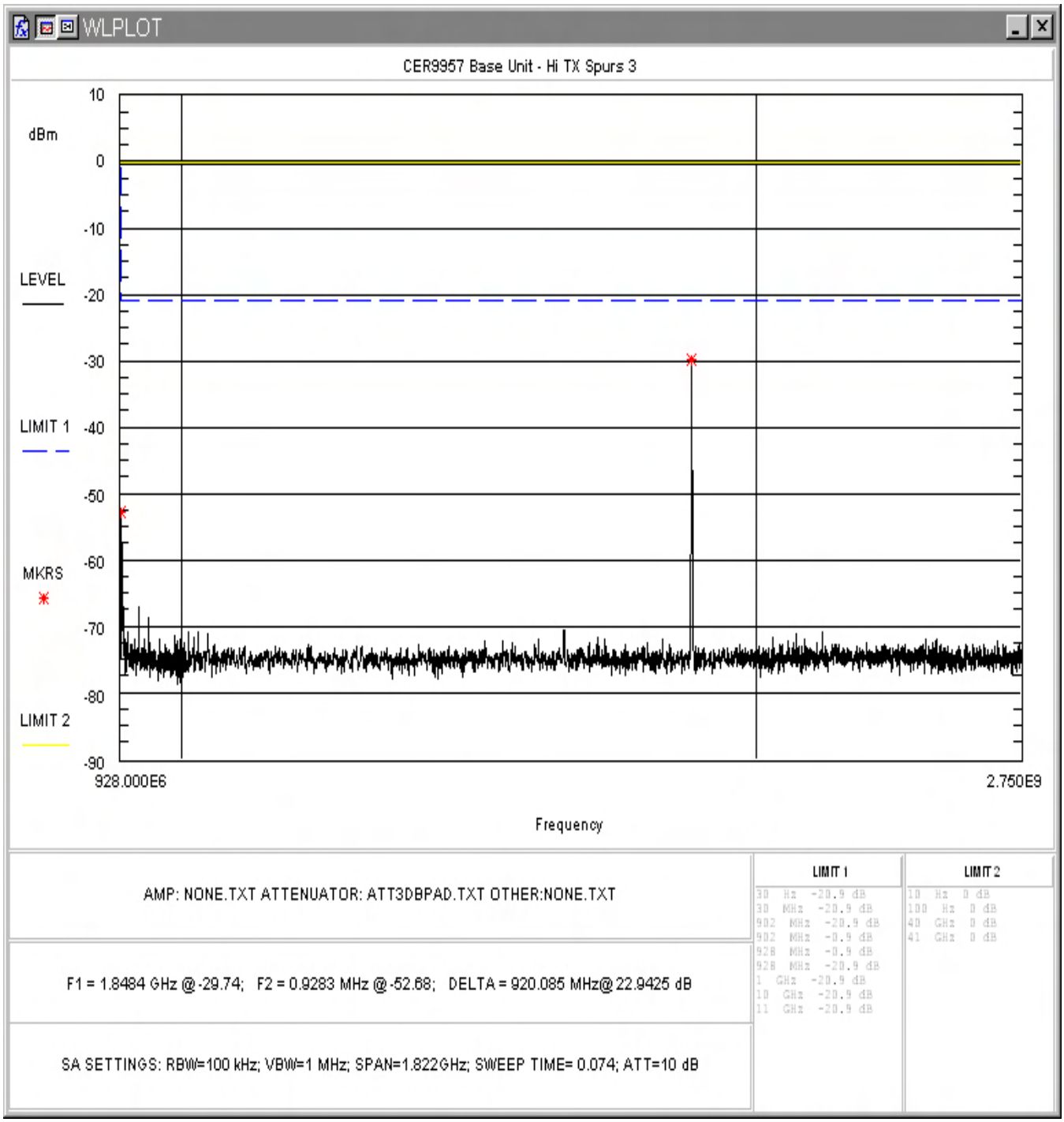

Figure 4-22. Conducted Spurious Emissions, High Channel 928MHz-2.75GHz

 © 2008 Washington Laboratories, Ltd.

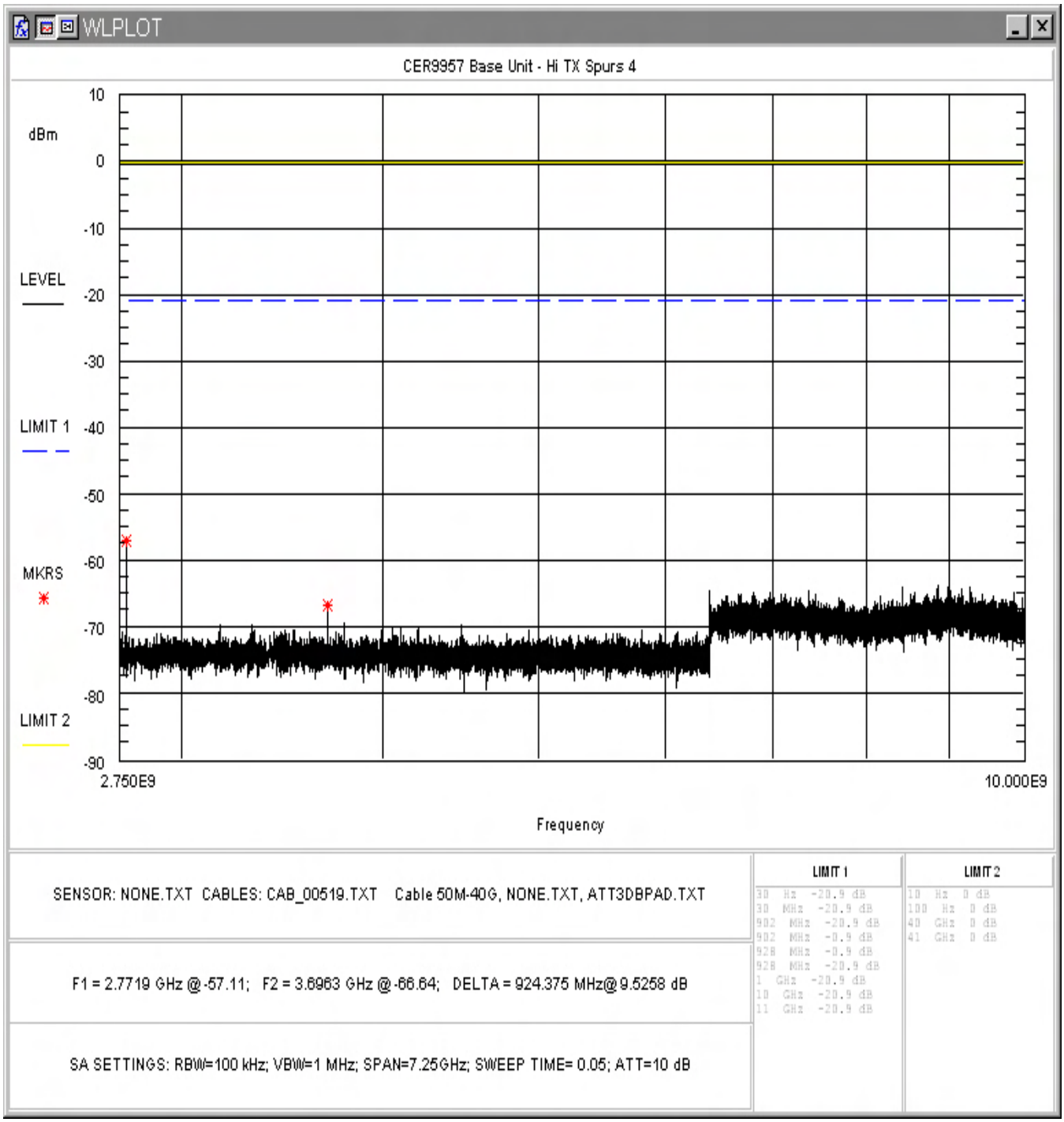

Figure 4-23. Conducted Spurious Emissions, High Channel 2.75-10GHz

 © 2008 Washington Laboratories, Ltd.

4.5 Radiated Spurious Emissions: (FCC Part §2.1053/RSS-210)

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 FCC Part 15.209 and §15.35(b) for peak measurements. These requirements are also specified in RSS-210.

4.5.1 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 C63.4-2003. 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)

The following is a sample calculation used in the data tables for calculating the final field strength of spurious emissions and comparing these levels to the specified limits.

Sample Calculation:

Spectrum Analyzer Voltage (SA Level):	VdBµV
Antenna Factor (Ant Corr):	AFdB/m
Cable Loss Correction (Cable Corr):	CCdB
Amplifier Gain:	GdB
Electric Field (Corr Level):	EdBµV/m = VdBµV + AFdB/m + CCdB - GdB
To convert to linear units:	EµV/m = antilog (EdBµV/m/20)

© 2008 Washington Laboratories, Ltd.

Table 5: 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)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
37.402	V	180.0	1.0	5.1	17.9	0.5	23.5	15.0	100.0	-16.5
123.900	V	90.0	1.0	3.0	11.5	1.6	16.1	6.4	150.0	-27.4
219.290	V	280.0	1.0	6.7	12.1	2.3	21.0	11.3	200.0	-25.0
239.980	V	180.0	1.0	2.2	13.0	2.4	17.5	7.5	200.0	-28.5
388.172	V	185.0	1.0	8.6	15.6	2.9	27.1	22.7	200.0	-18.9
570.000	V	180.0	1.0	4.7	18.5	3.5	26.7	21.6	200.0	-19.3
37.340	H	180.0	3.5	5.2	17.9	0.5	23.6	15.2	100.0	-16.4
114.300	H	250.0	2.8	2.1	11.4	1.5	15.1	5.7	150.0	-28.5
162.000	H	90.0	2.5	5.2	10.1	1.9	17.2	7.3	150.0	-26.3
257.434	H	180.0	2.0	7.7	13.8	2.4	24.0	15.8	200.0	-22.1
450.474	H	270.0	2.5	10.2	16.5	3.1	29.8	30.9	200.0	-16.2
928.570	H	180.0	2.0	5.4	22.3	4.9	32.6	42.8	200.0	-13.4

© 2008 Washington Laboratories, Ltd.

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

(Restricted Bands)

Low Channel

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
Unit Flat											
PEAK											
2718.280	V	270.0	1.0	41.3	29.5	1.7	38.0	34.5	53.0	5000.0	-39.5
3624.360	V	270.0	1.0	40.2	30.7	1.9	37.5	35.3	58.5	5000.0	-38.6
4530.820	V	0.0	1.0	37.3	32.0	2.0	37.2	34.1	51.0	5000.0	-39.8
5437.020	V	0.0	1.0	38.2	33.5	2.6	37.2	37.1	71.9	5000.0	-36.8
8155.620	V	0.0	1.0	42.0	37.4	4.7	37.7	46.4	208.7	5000.0	-27.6
9061.820	V	0.0	1.0	43.7	38.1	2.7	37.8	46.6	214.7	5000.0	-27.3
AVG											
2718.280	V	270.0	1.0	36.7	29.5	1.7	38.0	29.9	31.2	500.0	-24.1
3624.360	V	270.0	1.0	35.0	30.7	1.9	37.5	30.1	32.2	500.0	-23.8
4530.820	V	0.0	1.0	34.3	32.0	2.0	37.2	31.2	36.2	500.0	-22.8
5437.020	V	0.0	1.0	34.5	33.5	2.6	37.2	33.4	47.0	500.0	-20.5
8155.620	V	0.0	1.0	39.2	37.4	4.7	37.7	43.6	151.2	500.0	-10.4
9061.820	V	0.0	1.0	40.5	38.1	2.7	37.8	43.4	148.5	500.0	-10.5
Peak											
2718.280	H	90.0	1.0	55.7	29.5	1.7	38.0	48.9	278.3	5000.0	-25.1
3624.360	H	180.0	1.0	43.8	30.7	1.9	37.5	38.9	88.6	5000.0	-35.0
4530.820	H	0.0	1.0	37.3	32.0	2.0	37.2	34.1	51.0	5000.0	-39.8
5437.020	H	0.0	1.0	38.2	33.5	2.6	37.2	37.1	71.9	5000.0	-36.8
8155.620	H	0.0	1.0	42.0	37.4	4.7	37.7	46.4	208.7	5000.0	-27.6
9061.820	H	0.0	1.0	43.7	38.1	2.7	37.8	46.6	214.7	5000.0	-27.3
AVG											
2718.280	H	90.0	1.0	50.8	29.5	1.7	38.0	44.0	158.3	500.0	-10.0
3624.360	H	180.0	1.0	40.3	30.7	1.9	37.5	35.4	59.2	500.0	-18.5
4530.820	H	0.0	1.0	34.3	32.0	2.0	37.2	31.2	36.2	500.0	-22.8
5437.020	H	0.0	1.0	34.5	33.5	2.6	37.2	33.4	47.0	500.0	-20.5
8155.620	H	0.0	1.0	39.2	37.4	4.7	37.7	43.6	151.2	500.0	-10.4
9061.820	H	0.0	1.0	40.5	38.1	2.7	37.8	43.4	148.5	500.0	-10.5
Unit On Side											
Peak											
2718.280	V	350.0	1.0	59.2	29.5	1.7	38.0	52.4	416.4	5000.0	-21.6
3624.360	V	90.0	1.0	39.8	30.7	1.9	37.5	34.9	55.9	5000.0	-39.0
4530.570	V	95.0	1.0	41.2	32.0	2.0	37.2	38.0	79.9	5000.0	-35.9
AVG											
2718.280	V	350.0	1.0	53.8	29.5	1.7	38.0	47.0	223.6	500.0	-7.0
3624.360	V	90.0	1.0	30.7	30.7	1.9	37.5	25.8	19.6	500.0	-28.1
4530.570	V	95.0	1.0	36.3	32.0	2.0	37.2	33.1	45.4	500.0	-20.8

© 2008 Washington Laboratories, Ltd.

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
Peak											
2718.280	H	350.0	1.0	40.7	29.5	1.7	38.0	33.9	49.5	5000.0	-40.1
3624.360	H	90.0	1.0	43.3	30.7	1.9	37.5	38.4	83.6	5000.0	-35.5
AVG											
2718.280	H	350.0	1.0	34.7	29.5	1.7	38.0	27.9	24.8	500.0	-26.1
3624.360	H	90.0	1.0	34.5	30.7	1.9	37.5	29.6	30.4	500.0	-24.3
Unit Upright											
Peak											
2718.280	V	90.0	1.0	46.2	29.5	1.7	38.0	39.4	93.2	5000.0	-34.6
3624.360	V	0.0	1.0	43.3	30.7	1.9	37.5	38.4	83.6	5000.0	-35.5
AVG											
2718.280	V	90.0	1.0	39.3	29.5	1.7	38.0	32.5	42.1	500.0	-21.5
3624.360	V	0.0	1.0	39.5	30.7	1.9	37.5	34.6	54.0	500.0	-19.3
Peak											
2718.280	H	0.0	1.0	46.0	29.5	1.7	38.0	39.2	91.1	5000.0	-34.8
3624.360	H	180.0	1.0	39.2	30.7	1.9	37.5	34.3	52.2	5000.0	-39.6
AVG											
2718.280	H	0.0	1.0	41.7	29.5	1.7	38.0	34.9	55.5	500.0	-19.1
3624.360	H	180.0	1.0	38.2	30.7	1.9	37.5	33.3	46.5	500.0	-20.6

© 2008 Washington Laboratories, Ltd.

Mid Channel

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
Unit Flat											
PEAK											
914.200											
2742.600	H	90.0	1.0	55.8	29.6	1.7	38.0	49.0	283.0	5000.0	-24.9
3656.800	H	180.0	1.0	43.5	30.8	1.9	37.4	38.7	86.2	5000.0	-35.3
4569.000	H	0.0	1.0	38.0	32.1	2.0	37.2	34.9	55.7	5000.0	-39.1
7313.600	H	0.0	1.0	43.0	37.1	3.3	37.6	45.8	195.4	5000.0	-28.2
8227.800	H	0.0	1.0	43.3	37.5	4.5	37.7	47.5	238.4	5000.0	-26.4
9141.530	H	0.0	1.0	45.0	38.1	2.8	37.9	48.1	254.4	5000.0	-25.9
AVG											
2742.600	H	90.0	1.0	52.3	29.6	1.7	38.0	45.5	189.1	500.0	-8.4
3656.800	H	180.0	1.0	39.8	30.8	1.9	37.4	35.0	56.3	500.0	-19.0
4569.000	H	0.0	1.0	34.7	32.1	2.0	37.2	31.6	38.1	500.0	-22.4
7313.600	H	0.0	1.0	39.7	37.1	3.3	37.6	42.5	133.6	500.0	-11.5
8227.800	H	0.0	1.0	39.3	37.5	4.5	37.7	43.5	150.4	500.0	-10.4
9141.530	H	0.0	1.0	40.5	38.1	2.8	37.9	43.6	151.5	500.0	-10.4
PEAK											
913.800											
2742.600	V	270.0	1.0	41.8	29.6	1.7	38.0	35.0	56.5	5000.0	-38.9
3656.800	V	90.0	1.0	39.2	30.8	1.9	37.4	34.4	52.4	5000.0	-39.6
4569.000	V	0.0	1.0	38.0	32.1	2.0	37.2	34.9	55.7	5000.0	-39.1
7313.600	V	0.0	1.0	43.0	37.1	3.3	37.6	45.8	195.4	5000.0	-28.2
8227.800	V	0.0	1.0	43.3	37.5	4.5	37.7	47.5	238.4	5000.0	-26.4
9141.530	V	0.0	1.0	45.0	38.1	2.8	37.9	48.1	254.4	5000.0	-25.9
AVG											
2742.600	V	270.0	1.0	35.8	29.6	1.7	38.0	29.0	28.3	500.0	-24.9
3656.800	V	90.0	1.0	35.5	30.8	1.9	37.4	30.7	34.3	500.0	-23.3
4569.000	V	0.0	1.0	34.7	32.1	2.0	37.2	31.6	38.1	500.0	-22.4
7313.600	V	0.0	1.0	39.7	37.1	3.3	37.6	42.5	133.6	500.0	-11.5
8227.800	V	0.0	1.0	39.3	37.5	4.5	37.7	43.5	150.4	500.0	-10.4
9141.530	V	0.0	1.0	40.5	38.1	2.8	37.9	43.6	151.5	500.0	-10.4
Unit on Side											
Peak											
2741.400	V	120.0	1.0	56.0	29.6	1.7	38.0	49.2	289.5	5000.0	-24.7
3655.200	V	180.0	1.0	41.5	30.8	1.9	37.5	36.7	68.5	5000.0	-37.3
AVG											
2741.400	V	120.0	1.0	50.5	29.6	1.7	38.0	43.7	153.7	500.0	-10.2
3655.200	V	180.0	1.0	38.0	30.8	1.9	37.5	33.2	45.8	500.0	-20.8
Peak											
2741.400	H	220.0	1.0	60.2	29.6	1.7	38.0	53.4	469.5	5000.0	-20.5

© 2008 Washington Laboratories, Ltd.

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
3655.200	H	180.0	1.0	47.8	30.8	1.9	37.5	43.0	141.4	5000.0	-31.0
AVG											
2741.400	H	220.0	1.0	44.7	29.6	1.7	38.0	37.9	78.8	500.0	-16.0
3655.200	H	180.0	1.0	42.3	30.8	1.9	37.5	37.5	75.1	500.0	-16.5
Unit Upright											
Peak											
2741.400	H	120.0	1.0	54.2	29.6	1.7	38.0	47.4	235.3	5000.0	-26.5
3655.200	H	180.0	1.0	41.0	30.8	1.9	37.5	36.2	64.6	5000.0	-37.8
AVG											
2741.400	H	120.0	1.0	49.2	29.6	1.7	38.0	42.4	132.3	500.0	-11.5
3655.200	H	180.0	1.0	36.5	30.8	1.9	37.5	31.7	38.5	500.0	-22.3
Peak											
2741.400	V	220.0	1.0	48.5	29.6	1.7	38.0	41.7	122.1	5000.0	-32.2
3655.200	V	0.0	1.0	40.7	30.8	1.9	37.5	35.9	62.4	5000.0	-38.1
AVG											
2741.400	V	220.0	1.0	47.3	29.6	1.7	38.0	40.5	106.3	500.0	-13.4
3655.200	V	0.0	1.0	37.7	30.8	1.9	37.5	32.9	44.2	500.0	-21.1

© 2008 Washington Laboratories, Ltd.

High Channel

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
Unit Flat											
PEAK											
924.070											
2772.140	V	250.0	1.0	48.2	29.6	1.7	38.0	41.5	118.7	5000.0	-32.5
3696.210	V	180.0	1.0	39.7	30.8	1.9	37.4	35.0	56.2	5000.0	-39.0
4620.280	V	0.0	1.0	38.0	32.2	2.0	37.2	35.0	56.2	5000.0	-39.0
7392.490	V	0.0	1.0	43.0	37.1	3.5	37.6	46.0	200.5	5000.0	-27.9
8316.560	V	0.0	1.0	43.3	37.5	4.3	37.7	47.4	233.7	5000.0	-26.6
AVG											
2772.140	V	250.0	1.0	38.7	29.6	1.7	38.0	32.0	39.8	500.0	-22.0
3696.210	V	180.0	1.0	35.5	30.8	1.9	37.4	30.8	34.7	500.0	-23.2
4620.280	V	0.0	1.0	34.7	32.2	2.0	37.2	31.7	38.5	500.0	-22.3
7392.490	V	0.0	1.0	39.7	37.1	3.5	37.6	42.7	137.2	500.0	-11.2
8316.560	V	0.0	1.0	39.3	37.5	4.3	37.7	43.4	147.5	500.0	-10.6
PEAK											
2772.140	H	225.0	1.0	51.7	29.6	1.7	38.0	45.0	177.6	5000.0	-29.0
3696.210	H	180.0	1.0	47.7	30.8	1.9	37.4	43.0	141.2	5000.0	-31.0
4620.280	H	0.0	1.0	34.7	32.2	2.0	37.2	31.7	38.5	5000.0	-42.3
7392.490	H	0.0	1.0	39.7	37.1	3.5	37.6	42.7	137.2	5000.0	-31.2
8316.560	H	0.0	1.0	39.3	37.5	4.3	37.7	43.4	147.5	5000.0	-30.6
AVG											
2772.140	H	225.0	1.0	44.5	29.6	1.7	38.0	37.8	77.5	5000.0	-36.2
3696.210	H	180.0	1.0	36.5	30.8	1.9	37.4	31.8	38.9	5000.0	-42.2
4620.280	H	0.0	1.0	34.7	32.2	2.0	37.2	31.7	38.5	5000.0	-42.3
7392.490	H	0.0	1.0	39.7	37.1	3.5	37.6	42.7	137.2	5000.0	-31.2
8316.560	H	0.0	1.0	39.3	37.5	4.3	37.7	43.4	147.5	5000.0	-30.6
Unit on Side											
Peak											
2772.140	H	250.0	1.0	49.3	29.6	1.7	38.0	42.6	134.8	500.0	-11.4
3696.210	H	290.0	1.0	48.0	30.8	1.9	37.4	43.3	146.1	500.0	-10.7
AVG											
2772.140	H	250.0	1.0	39.0	29.6	1.7	38.0	32.3	41.2	5000.0	-41.7
3696.210	H	290.0	1.0	35.7	30.8	1.9	37.4	31.0	35.5	5000.0	-43.0
Peak											
2772.140	V	250.0	1.0	52.5	29.6	1.7	38.0	45.8	194.8	500.0	-8.2
3696.210	V	250.0	1.0	46.0	30.8	1.9	37.4	41.3	116.1	500.0	-12.7
AVG											
2772.140	V	250.0	1.0	46.7	29.6	1.7	38.0	40.0	99.9	5000.0	-34.0
3696.210	V	250.0	1.0	36.2	30.8	1.9	37.4	31.5	37.6	5000.0	-42.5
Unit Upright											
Peak											

© 2008 Washington Laboratories, Ltd.

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
2772.140	V	225.0	1.0	45.0	29.6	1.7	38.0	38.3	82.1	500.0	-15.7
3696.210	V	180.0	1.0	39.5	30.8	1.9	37.4	34.8	54.9	500.0	-19.2
AVG											
2772.140	V	225.0	1.0	40.7	29.6	1.7	38.0	34.0	49.9	5000.0	-40.0
3696.210	V	180.0	1.0	35.8	30.8	1.9	37.4	31.1	35.9	5000.0	-42.9
Peak											
2772.140	H	180.0	1.0	49.5	29.6	1.7	38.0	42.8	137.9	500.0	-11.2
3696.210	H	0.0	1.0	37.8	30.8	1.9	37.4	33.1	45.2	500.0	-20.9
AVG											
2772.140	H	180.0	1.0	47.2	29.6	1.7	38.0	40.5	105.8	5000.0	-33.5
3696.210	H	0.0	1.0	35.3	30.8	1.9	37.4	30.6	33.9	5000.0	-43.4

© 2008 Washington Laboratories, Ltd.

4.6 Conducted Emissions

4.6.1 Requirements

Test Arrangement: Table Top

Compliance Standard: FCC Part 15, Class B

FCC Compliance Limits		
Frequency	**Quasi-peak**	**Average**
0.15-0.5MHz	66 to 56dBµV	56 to 46dBµV
0.5 to 5MHz	56dBµV	46dBµV
0.5-30MHz	60dBµV	50dBµV

4.6.2 Test Equipment

Test Name: **Conducted Emissions (AC Power Ports)**			Test Date(s): **2/5/2008**
Asset #	**Manufacturer/Model**	**Description**	**Cal Due Date**
00069	HP, 85650A	ADAPTER, QP	7/6/2008
00073	HP, 8568B	ANALYZER, SPECTRUM	7/6/2008
00071	HP, 85685A	PRESELECTOR, RF	7/6/2008
00124	SOLAR, 8012-50-R-24-BNC	LISN	9/28/2008

4.6.3 Test Procedure

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 was supplied to the peripherals through a second LISN.

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, peak, or average 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. For average measurements the post-detector filter was set to 10 Hz.

At frequencies where quasi-peak or peak measurements comply with the average limit, no average measurements need be performed.

4.6.4 Test Data

The EUT complied with the Class B Conducted Emissions requirements. The unit was tested with an off-the-shelf power supply (wall wart) although the intended operation for this device is to be vehicle mounted and powered off the vehicles' DC power. Table 7 provides the test results for phase and neutral line power line conducted emissions.

© 2008 Washington Laboratories, Ltd.

4.6.5 Conducted Data Reduction and Reporting

At frequencies where quasi-peak or peak measurements comply with the average limit, no average measurements need be performed. The Conducted emissions level to be compared to the FCC limit is calculated as shown in the following example.

Example:

Spectrum Analyzer Voltage: VdBµV

LISN Correction Factor: LISN dB

Cable Correction Factor: CF dB

Electric Field: EdBµV = V dBµV + LISN dB + CF dB

Table 7: Conducted Emission Test Data

LINE 1 - NEUTRAL

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.151	46.2	1.3	10.2	0.4	56.8	11.9	65.9	55.9	-9.2	-44.1
0.446	37.5	31.6	10.5	0.3	48.3	42.4	56.9	46.9	-8.6	-4.5
1.410	31.2	30.0	10.6	0.3	42.1	40.9	56.0	46.0	-13.9	-5.1
3.757	26.9	24.6	11.1	0.3	38.2	35.9	56.0	46.0	-17.8	-10.1
11.624	36.5	30.3	11.4	0.2	48.2	42.0	60.0	50.0	-11.8	-8.0
17.884	36.2	27.8	11.2	0.2	47.6	39.2	60.0	50.0	-12.4	-10.8
22.803	40.8	30.8	11.7	0.2	52.7	42.7	60.0	50.0	-7.3	-7.3
29.110	35.0	24.6	12.7	0.2	47.9	37.5	60.0	50.0	-12.1	-12.5

LINE 1 - Phase

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.151	44.8	-0.3	10.2	0.1	55.1	10.0	65.9	55.9	-10.8	-45.9
0.448	40.7	32.2	10.5	0.1	51.3	42.8	56.9	46.9	-5.6	-4.1
1.410	32.0	30.7	10.6	0.2	42.8	41.5	56.0	46.0	-13.2	-4.5
3.758	28.0	25.7	11.1	0.2	39.2	36.9	56.0	46.0	-16.8	-9.1
11.624	36.7	30.8	11.4	0.2	48.3	42.4	60.0	50.0	-11.7	-7.6
17.838	35.3	26.0	11.2	0.2	46.7	37.4	60.0	50.0	-13.3	-12.6
22.800	39.2	31.2	11.7	0.2	51.2	43.2	60.0	50.0	-8.8	-6.8
29.088	33.1	23.2	12.7	0.3	46.1	36.2	60.0	50.0	-13.9	-13.8

Notes: Used Calrad 12 V AC adaptor Model # 45-752 DV1212A Ser #0283

 © 2008 Washington Laboratories, Ltd.