Washington Laboratories, Ltd.

FCC & Industry Canada Certification Test Report

For the

Cervis, Inc.

SmaRT 206 Base Unit

FCC ID: LOBSBU200

IC ID: 7955A-SBU200

WLL JOB# **10359-01 Rev2**
January 8, 2009

Prepared for:

Cervis, Inc.
170 Thorn Hill Road
Warrendale, PA 15086

Prepared By:

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

ACCREDITED

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Prepared by: James Ritter
Compliance Engineer

Reviewed by: Steven D. Koster
EMC Operations Manager

Abstract

This report has been prepared on behalf of Cervis, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Digital Transmission System under Part 15.247 (9/2007) 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 Cervis, Inc. SmaRT 206 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 the American Association for Laboratory Accreditation (A2LA) under Certificate 2675.01 as an independent FCC test laboratory.

The Cervis, Inc. SmaRT 206 Base Unit complies with the limits for a Digital Transmission System under FCC Part 15.247 and Industry Canada RSS-210e issue 7.

Revision History

Revision 1 Issued: January 5, 2009	On Page 48-51 'Tables 6,7,8: Radiated Emissions Tests Data' Removed inadvertent QP label on SA Reading column headings.
Revision 2 Issued: January 8, 2009	On Page 53-57 'Tables 10: Conducted Emissions Tests Data' added test data

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1 Introduction

1.1 Compliance Statement

The Cervis, Inc. SmaRT 206 Base Unit complies with the limits for a Digital Transmission System under FCC Part 15.247 (7/2008) and Industry Canada RSS-210e issue7.

1.2 Test Scope

Tests for radiated and conducted (at antenna terminal) emissions were performed. All measurements were performed in accordance Knowledge Data Base (KDB) publication number 558074 entitled "Measurement of Digital Transmission Systems operating under Section 15.247". The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Cervis, Inc. 170 Thorn Hill Road Warrendale, PA 15086
Purchase Order Number:	48654
Quotation Number:	64112

1.4 Test Dates

Testing was performed on the following date(s):	4/8/2008-1/8/2009

1.5 Test and Support Personnel

Washington Laboratories, LTD	James Ritter and John Reidell
Client Representative	Anthony Di Tommaso

1.6 Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	**Amp**eres
b/s	**b**its per **s**econd
BW	**B**and**W**idth
CE	**C**onducted **E**mission
cm	**C**enti**m**eter
CW	**C**ontinuous **W**ave
dB	**Decibel**
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
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
M	**M**ega - prefix for 10^6 multiplier
m	**M**eter
µ	**m**icro - prefix for 10^{-6} multiplier
NB	**N**arrow**b**and
QP	**Q**uasi-**P**eak
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

2 Equipment Under Test

2.1 EUT Identification & Description

The Cervis, Inc. SmaRT 206 Base Unit is a remote controller transceiver for mobile operations that receives data from a remote handheld device indicating what buttons were pushed on the handheld device.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Cervis, Inc.
FCC ID:	LOBSBU200
IC:	7955A-SBU200
Model:	smaRT 206 Base Unit
FCC Rule Parts:	§15.247
Industry Canada:	RSS210
Frequency Range:	2405-2480MHz
Maximum Output Power:	1.73mW (2.38dBm)
Modulation:	DSSS (OQPSK)
Occupied Bandwidth:	1.72MHz
Keying:	Automatic, Manual
Type of Information:	Digital Data
Number of Channels:	16
Power Output Level	Fixed
Antenna Connector	Internal MHL (not user accessible)
Antenna Type	Embedded (Centurion NanoBlue-IP04)
Interface Cables:	1 combined I/O, DC power, and Maintenance comm. Cable (maintenance section not normally provided)
Power Source & Voltage:	12VDC Automotive Battery

2.2 Test Configuration

The SmaRT 206 Base Unit was configured as a standalone unit. Two unit types were supplied, one with an Internal Antenna and a second with the antenna replaced by a SMA connector for conducted measurements. 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.

2.3 Testing Algorithm

The SmaRT 206 Base Unit was programmed via a customer supplied application download to repeatedly transmit at one of three channels, 2405MHz, 2440MHz, and 2480MHz. Two modes of operation were selectable, One mode was normal timing mode with one 8 byte packet of 2msec transmitted every 110msec. The second mode sent data every 5msec, this mode was used for radiated measurements for ease of testing. The Cervis, Inc. SmaRT 206 Base Unit, Equipment Under Test (EUT), was operated from a 12VDC lab power supply. The EUT also had a receiver mode to allow for RSS210 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. 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 the American Association for Laboratory Accreditation (A2LA) under Certificate 2675.01 as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

FCC Publication KDB 558074, New Guidance on Measurements for Digital Transmission Systems in Section 15.247.

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

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

WLL Asset #	Manufacturer Model/Type	Function	Cal. Due
00475	WILTRON, 75N50 DETECTOR	RF DETECTOR	02/16/2009
00461	TEKTRONIX, TDS-5104	OSCILLOSCOPE; 1GHZ, 4 CH, DPO	07/27/2008
00641	HQ POWER	0-50V 5AMP DC SUPPLY	CNR
00473	Fluke 111	True RMS Multimeter	07/25/2008
00618	HP 8563A	ANALYZER, SPECTRUM	03/06/2009
00069	HP, 85650A	ADAPTER, QP	07/06/2008
00073	HP, 8568B	ANALYZER, SPECTRUM	07/06/2008
00071	HP, 85685A	PRESELECTOR, RF	07/06/2008
00066	HP, 8449B	PRE-AMPLIFIER, RF. 1-26.5GHZ	08/02/2008
00001	A.H., SYSTEMS, SAS-200/518	ANTENNA, LP, 1-18GHZ	04/05/2009
00644	SUNOL SCIENCE JB1	BICONALOG ANTENNA	11/27/2009
00004	ARA, DRG-118/A	ANTENNA, DRG, 1-18GHZ	02/02/2009

4 Test Summary

The Table Below shows the results of testing for compliance with a Digital Transmission System in accordance with FCC Part 15.247:2007 and RSS210e issue 7. Full results are shown in section 5.

Table 3: Test Summary Table

TX Test Summary (Digital Transmission Systems)			
FCC Rule Part	**IC Rule Part**	**Description**	**Result**
15.247 (a)(2)	RSS-210 [A8. 2(a)]	6dB Bandwidth	Pass
15.247 (b)(3)	RSS-210 [A8.4 (4)]	Transmit Output Power	Pass
15.247 (e)	RSS-210 [A8.2 (b)]	Power Spectral Density	Pass
15.247 (d)	RSS-210 [A8. 5]	Out-of-Band Emissions (Band Edge @ 20dB below)	Pass
15.205 15.209	RSS-210 [A8. 5]	General Field Strength Limits (Restricted Bands & RE Limits)	Pass
15.207	RSS-Gen [7.2.2]	AC Conducted Emissions	Pass
RX/Digital Test Summary (Digital Transmission Systems)			
FCC Rule Part	**IC Rule Part**	**Description**	**Result**
15.207	RSS-Gen [7.2.2]	AC Conducted Emissions	Not Applicable- Battery powered
15.209	RSS-Gen [7.2.3.2]	General Field Strength Limits (Restricted Bands & RE Limits)	Pass

5 Test Results

5.1 RF Power Output: (FCC Part 15.247(b)(3), RSS210 Annex 8.4 (4))

The output power was measured 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. The resolution bandwidth was set at 2MHz to encompass the 6dB bandwidth of the transmit signal.

Table 4. RF Power Output

Frequency	Level	Limit	Pass/Fail
Low Channel: 2405MHz	2.33 dBm	30 dBm	Pass
Mid Channel: 2440MHz	2.38 dBm	30 dBm	Pass
High Channel: 2480MHz	2.33 dBm	30 dBm	Pass

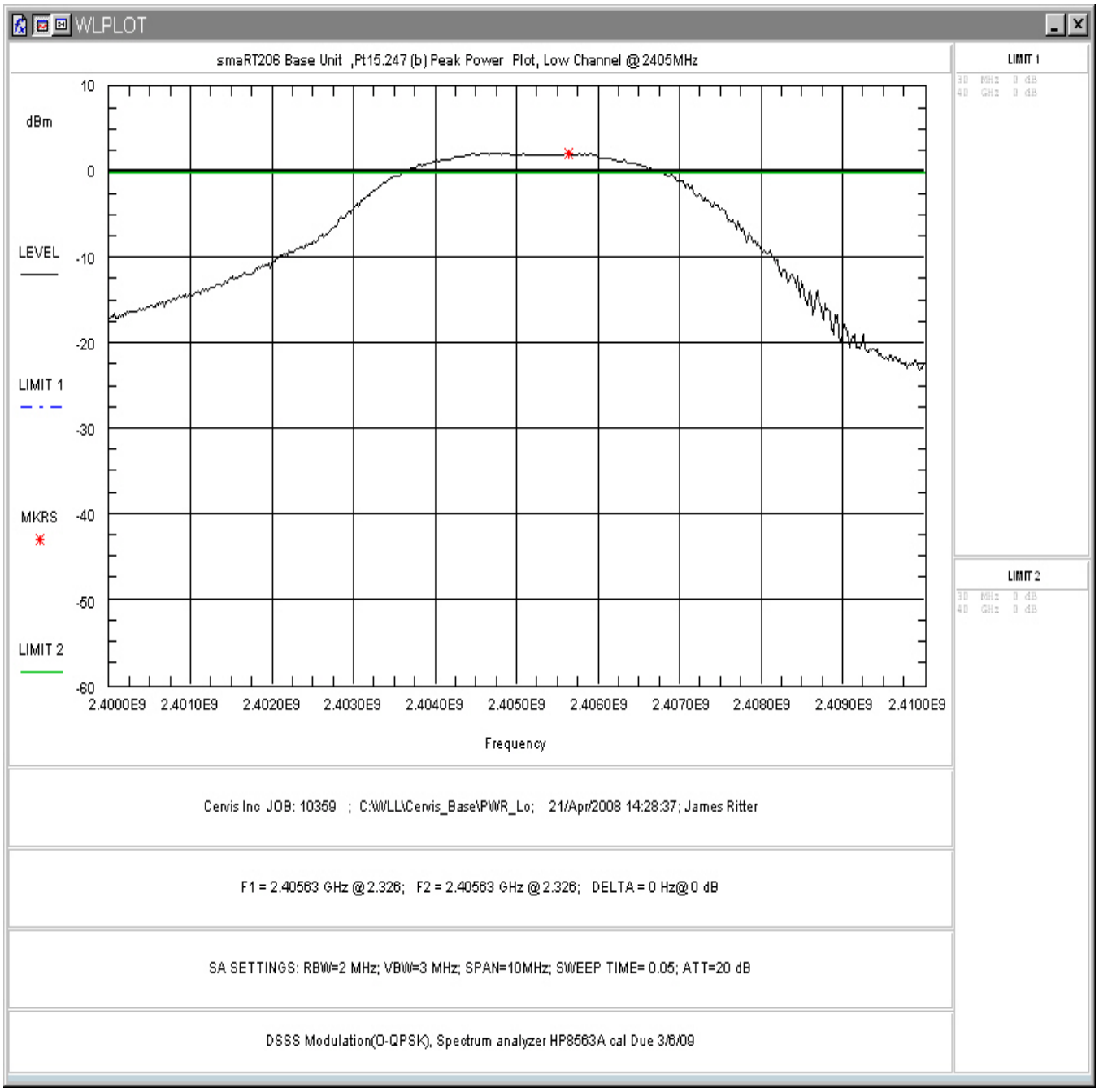

Figure 5-1. RF Peak Power, Low Channel

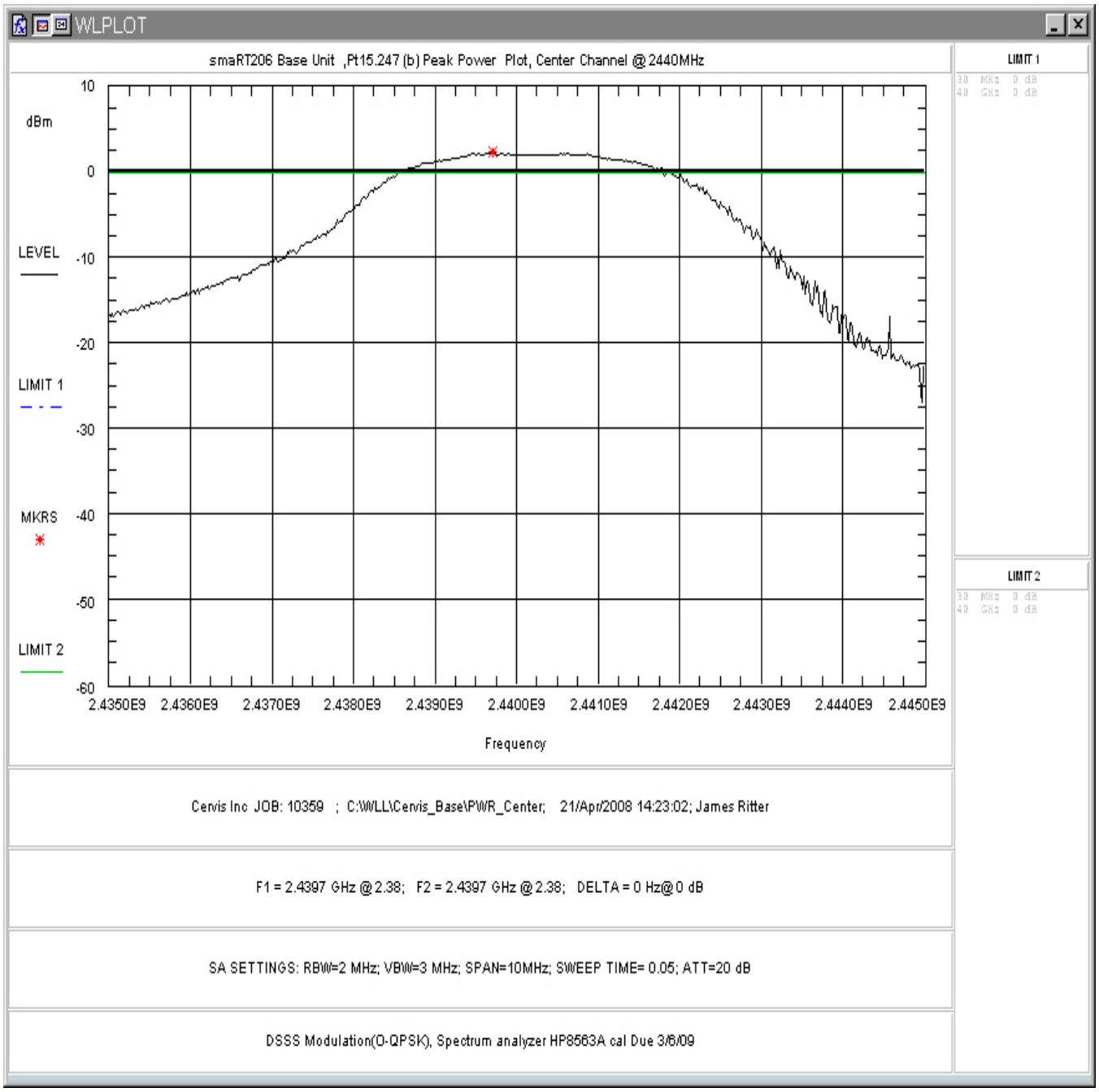

Figure 5-2. RF Peak Power, Mid Channel

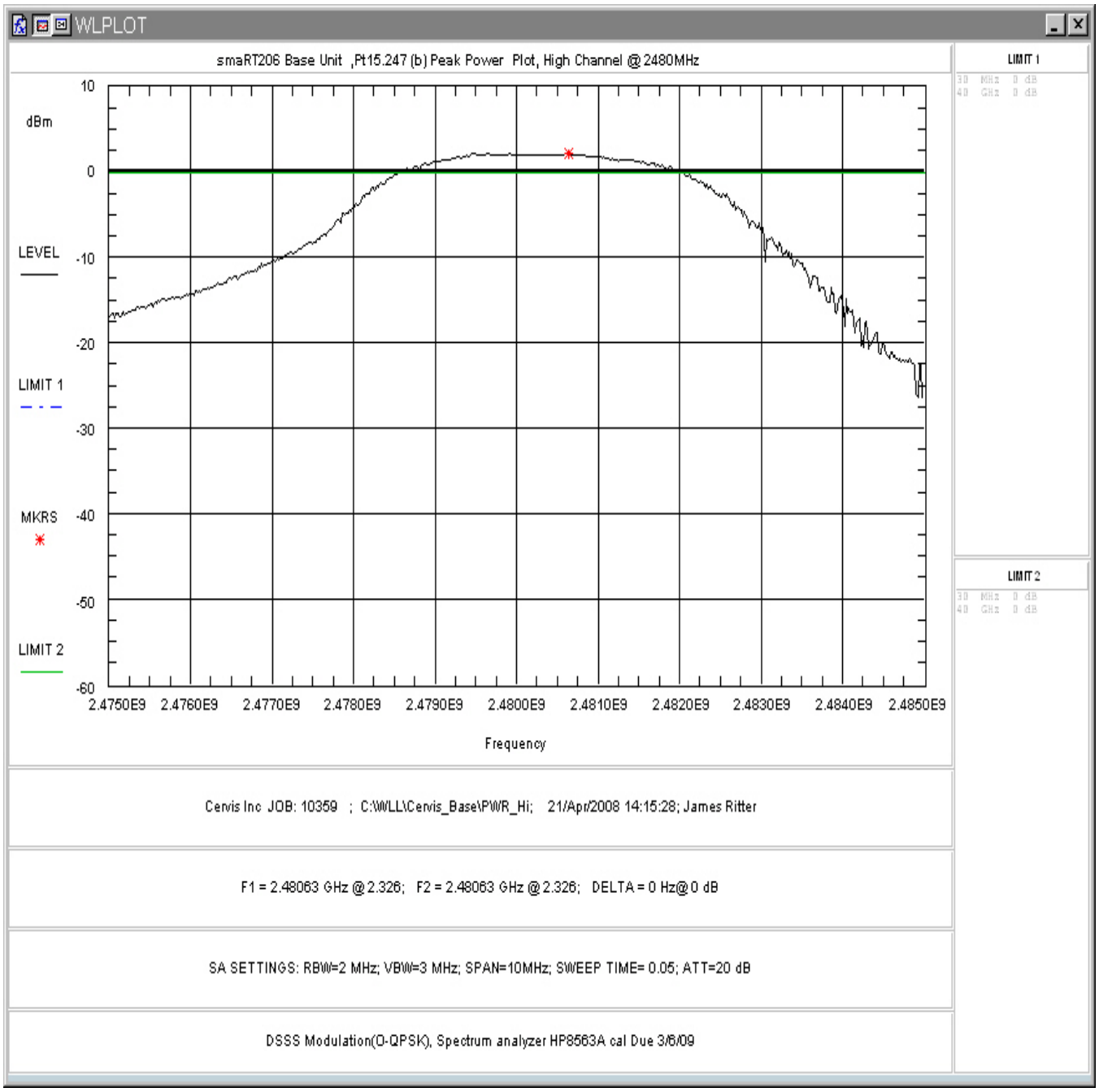

Figure 5-3. RF Peak Power, High Channel

5.2 Occupied Bandwidth: (FCC Part §15.247 (a)(2), RSS210 Annex 8.2 (a))

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

For Digital Systems, FCC Part 15.247 requires the maximum 6 dB bandwidth be at least 500kHz.

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

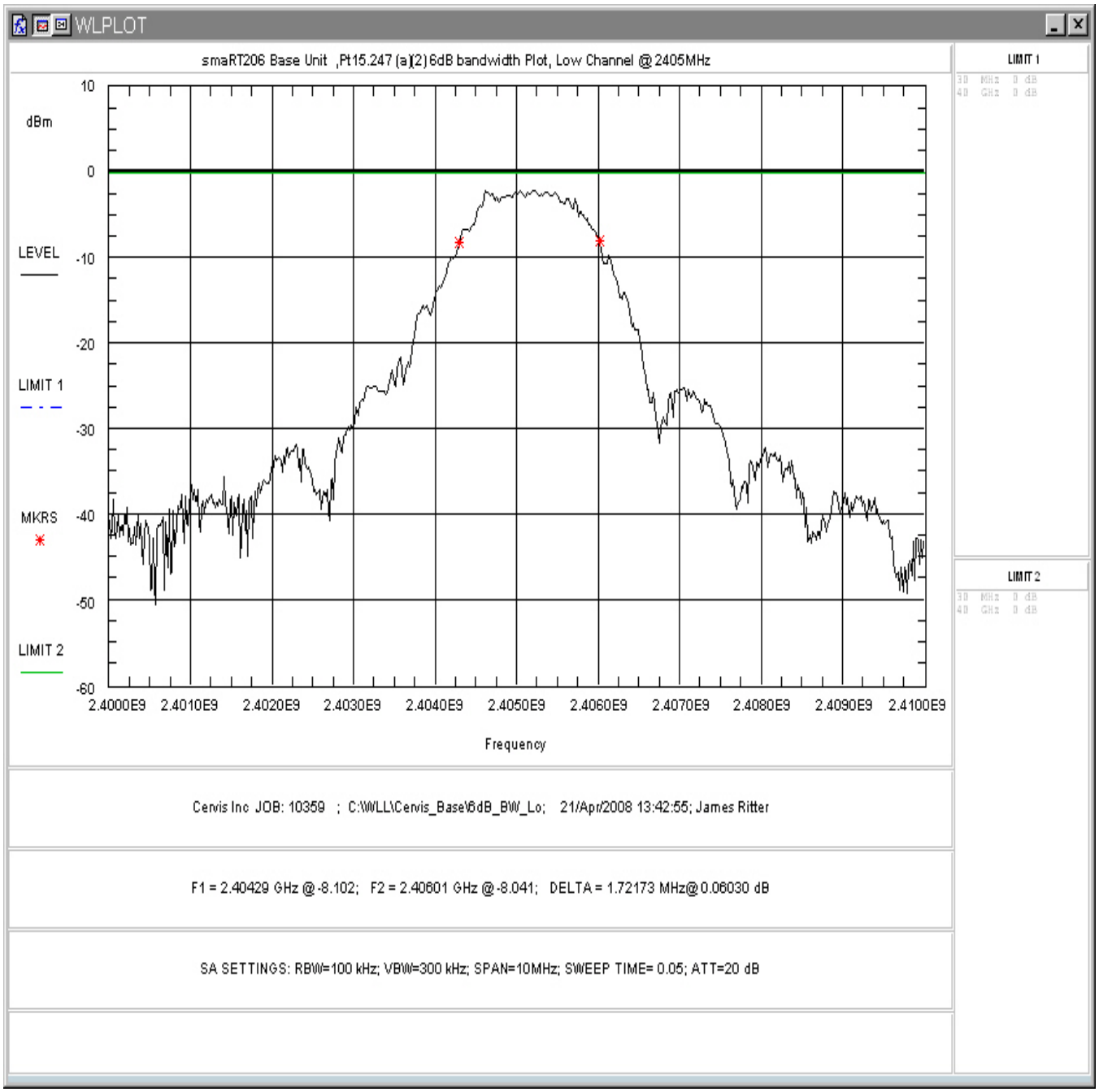

Figure 5-4. Occupied Bandwidth, Low Channel

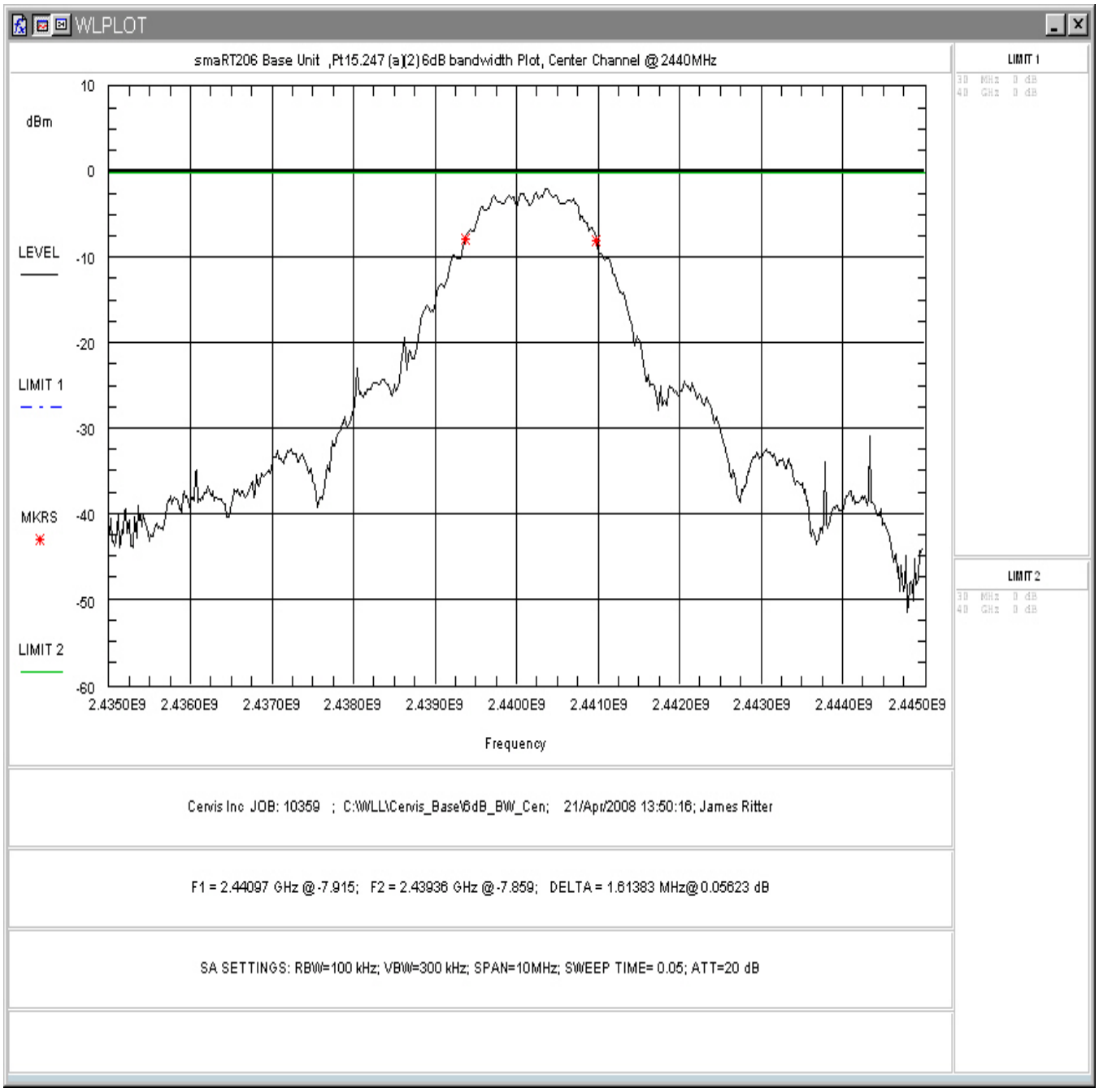

Figure 5-5. Occupied Bandwidth, Mid Channel

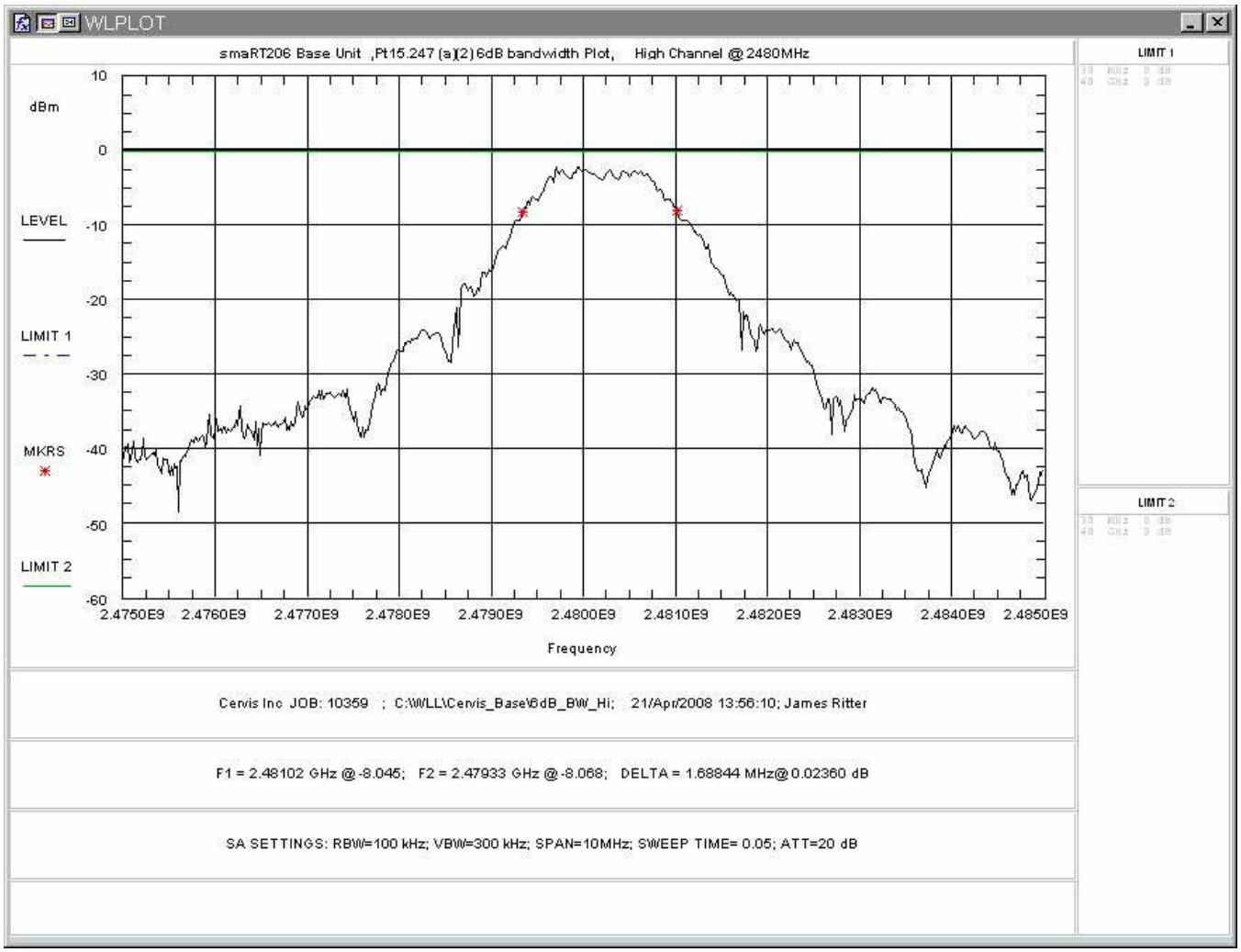

Figure 5-6. Occupied Bandwidth, High Channel

Table 5 provides a summary of the Occupied Bandwidth Results.

Table 5. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Low Channel: 2405MHz	1.72MHz	500kHz minimum	Pass
Mid Channel: 2440MHz	1.61MHz	500kHz minimum	Pass
High Channel: 2480MHz	1.69MHz	500kHz minimum	Pass

5.3 RF Peak Power Spectral Density (FCC Part§15.247(e) , RSS-210, Annex 8.2 (b))

For digitally modulated systems, 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 during any time interval of continuous transmission.

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.

The highest peak within the transmission was located and measured for the upper, middle and lower channels. Plots of the PSD were taken as shown in Figure 5-7 Through Figure 5-9 below.

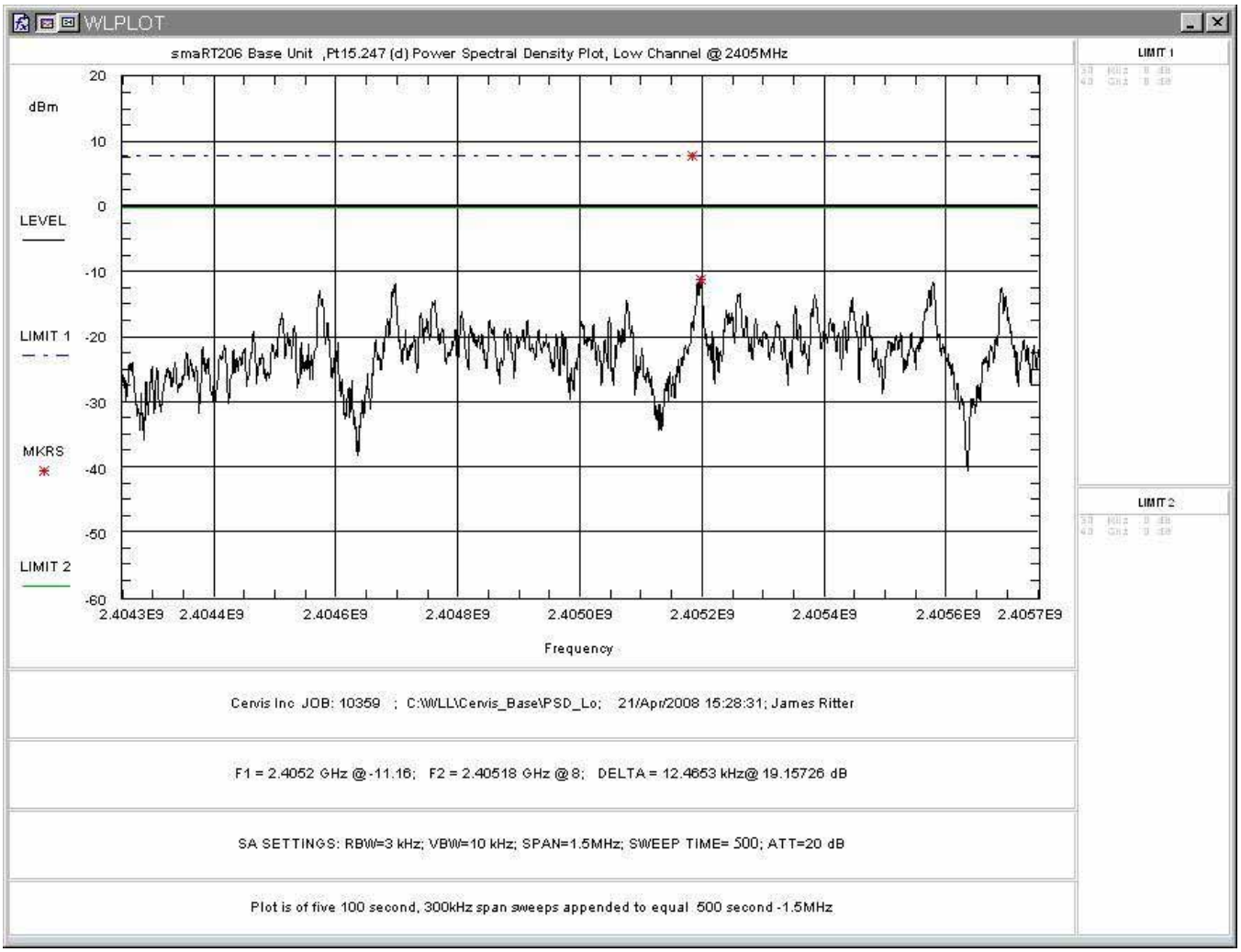

Figure 5-7. RF Peak Power Spectral Density, Low Channel

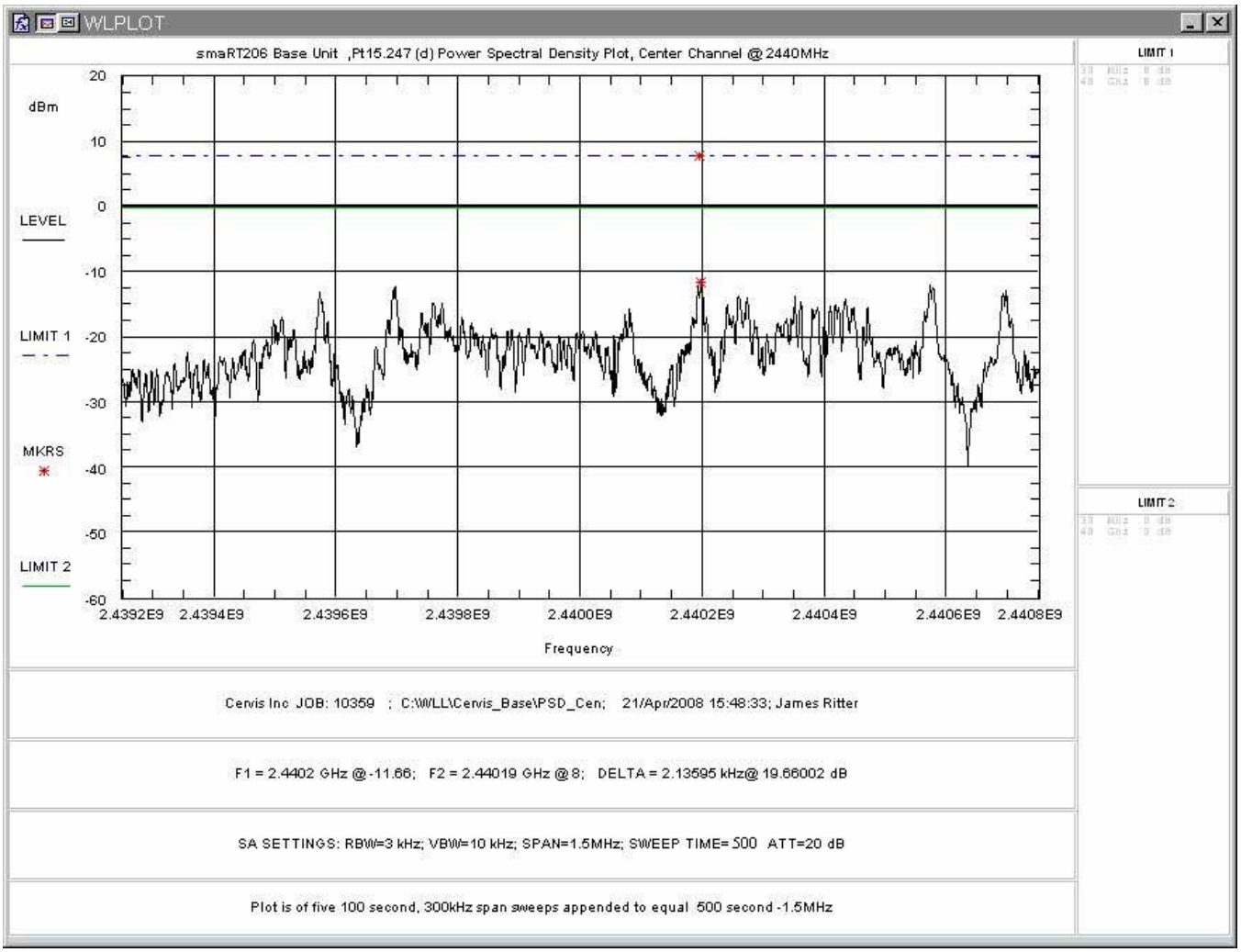

Figure 5-8. RF Peak Power Spectral Density, Center Channel

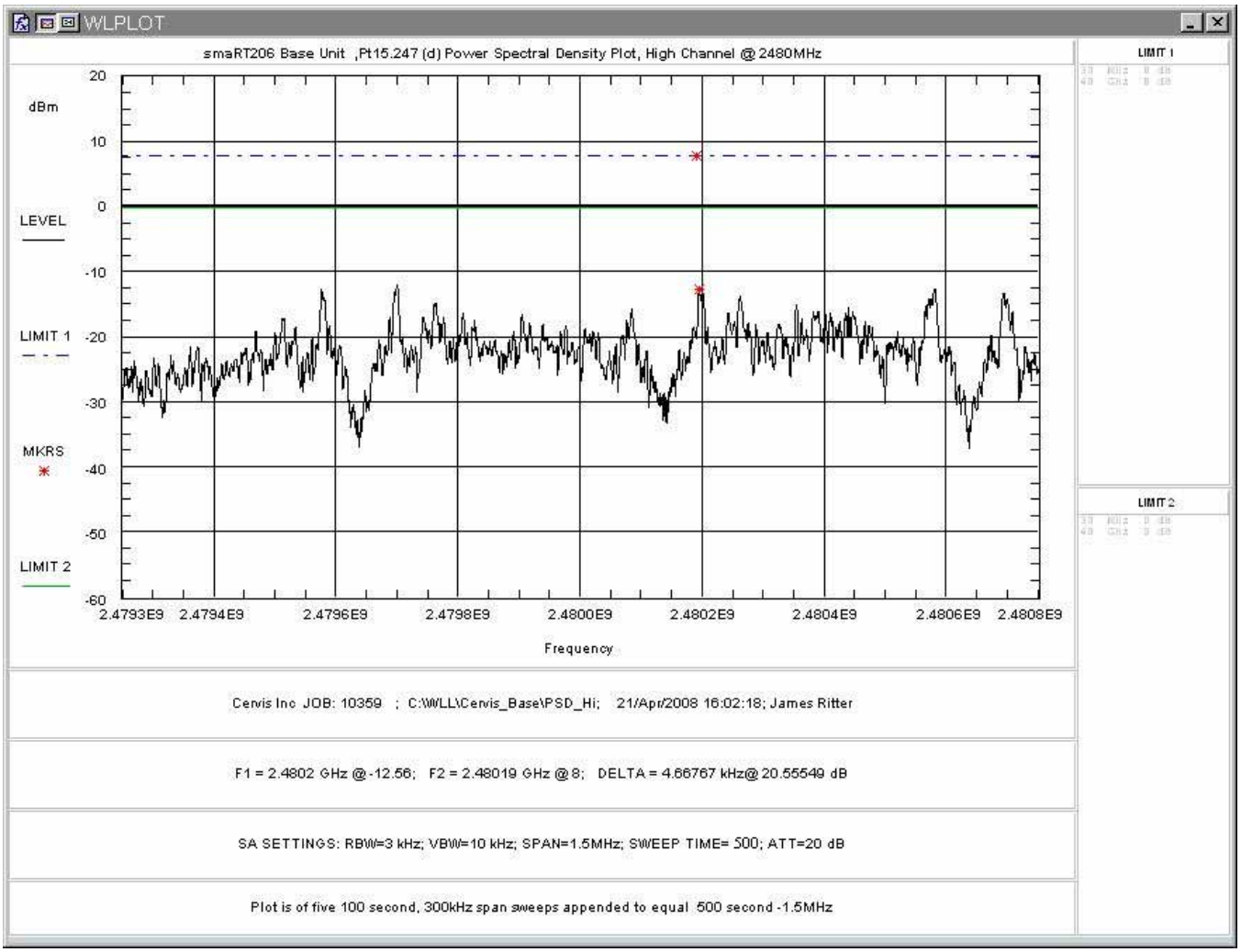

Figure 5-9. RF Peak Power Spectral Density, High Channel

5.4 Conducted Band Edge Measurements at Antenna Terminals

The following Plots show a close-up view of the signal at the lowest and highest channels in regards to the band edges to show compliance with the 20dBc requirement. Measurements were taken at the antenna terminal and coupled into a spectrum analyzer. All cable and attenuator losses were taken into account. A resolution bandwidth of 100kHz was used for these measurements.

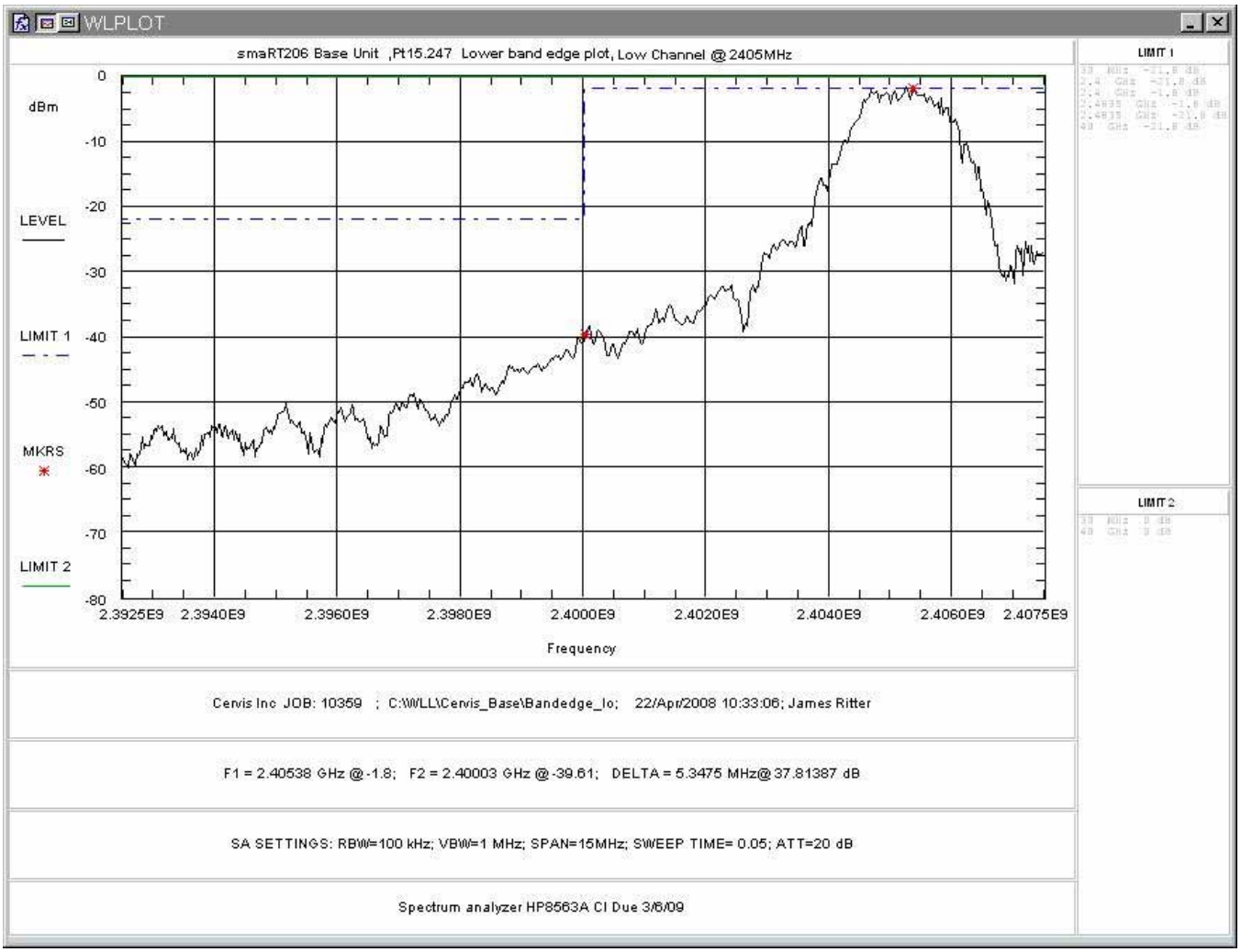

Figure 5-10. Conducted Band Edge, Low Channel

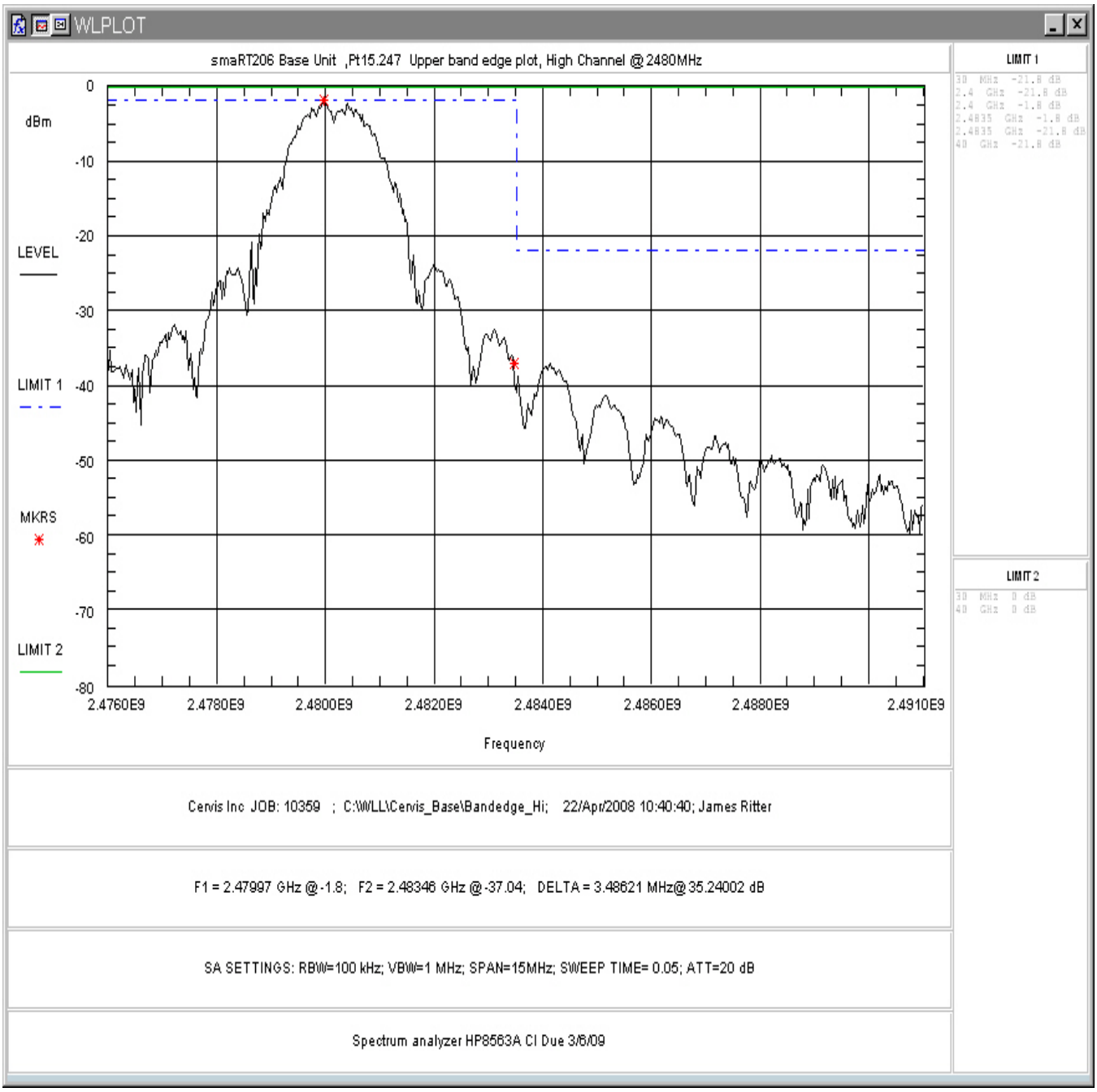

Figure 5-11. Conducted Band Edge, High Channel

5.5 Conducted Spurious Emissions at Antenna Terminals (FCC Part §15.247 (d), RSS210 Annex 8.5)

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 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.

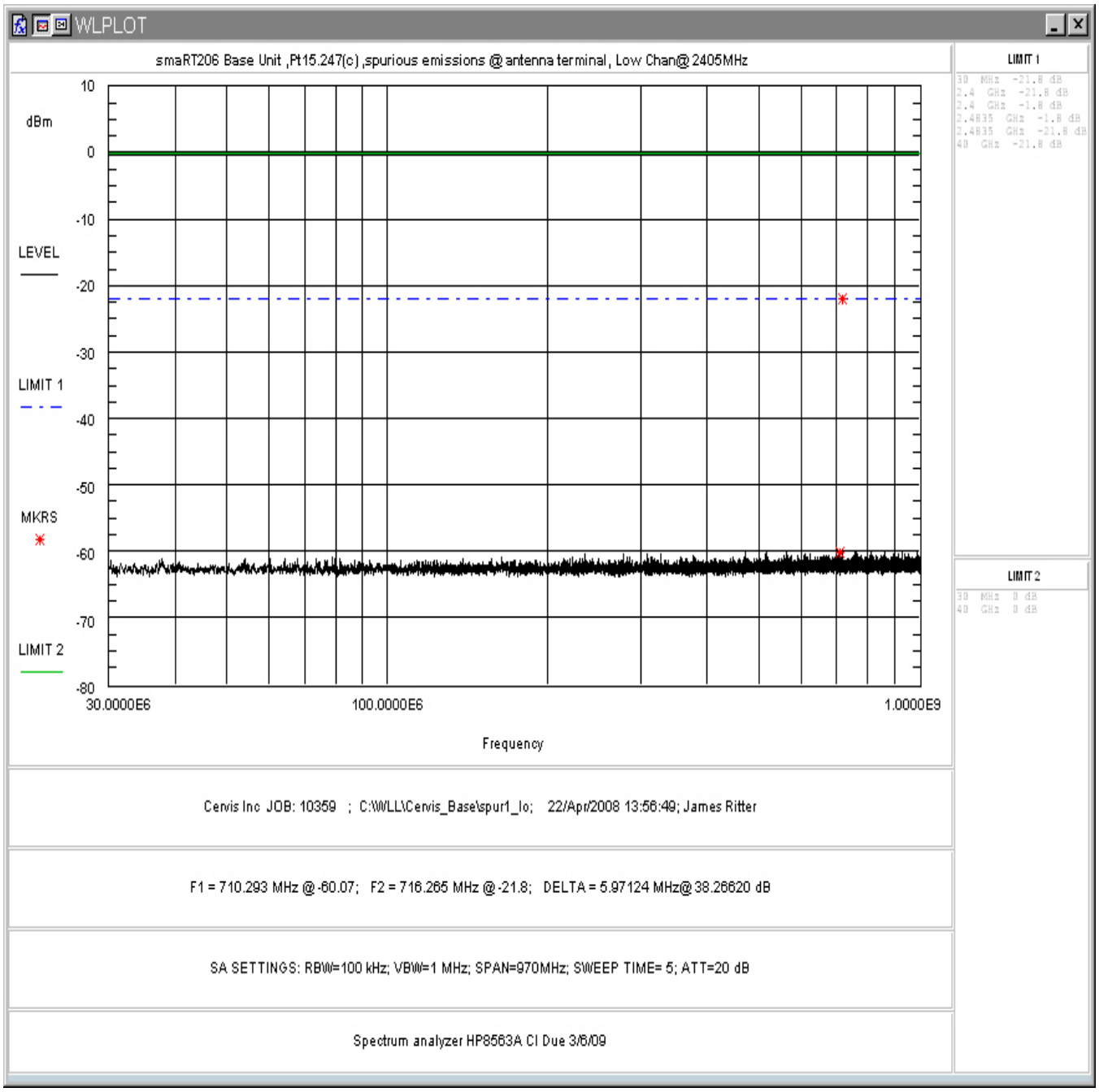

Figure 5-12. Conducted Spurious Emissions, Low Channel 30 - 1000MHz

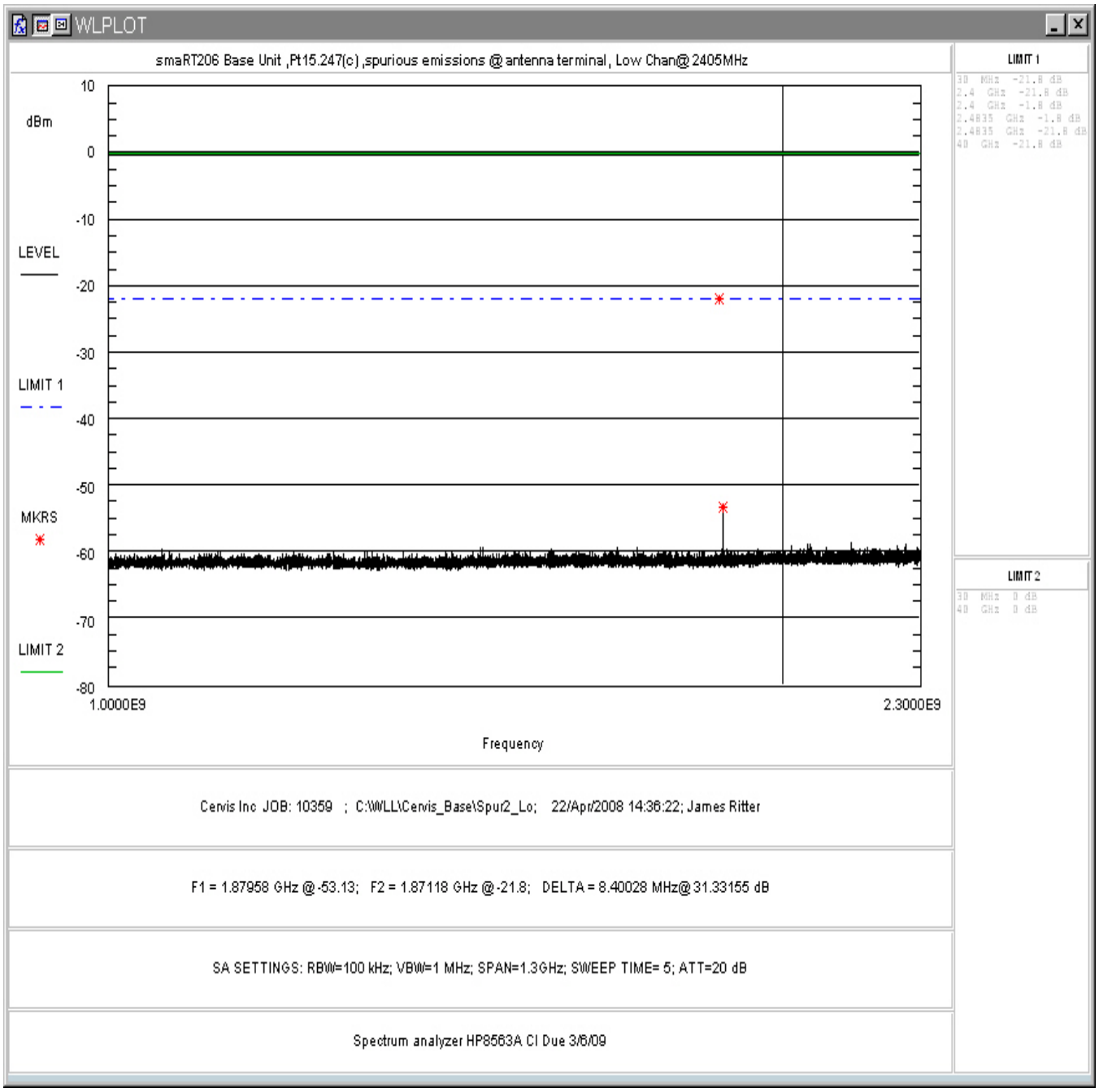

Figure 5-13. Conducted Spurious Emissions, Low Channel 1 – 2.3GHz

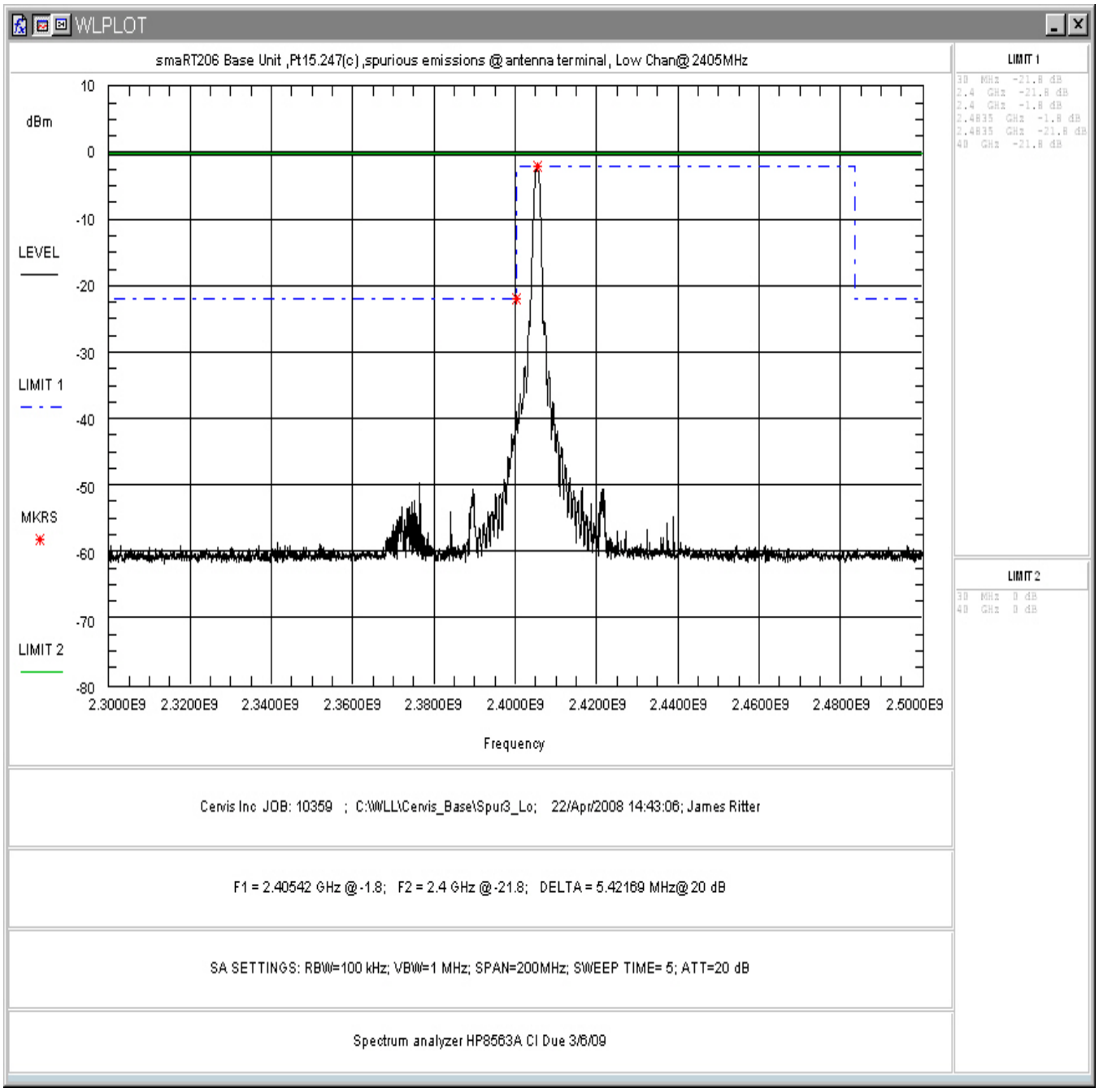

Figure 5-14. Conducted Spurious Emissions, Low Channel 2.3 – 2.5GHz

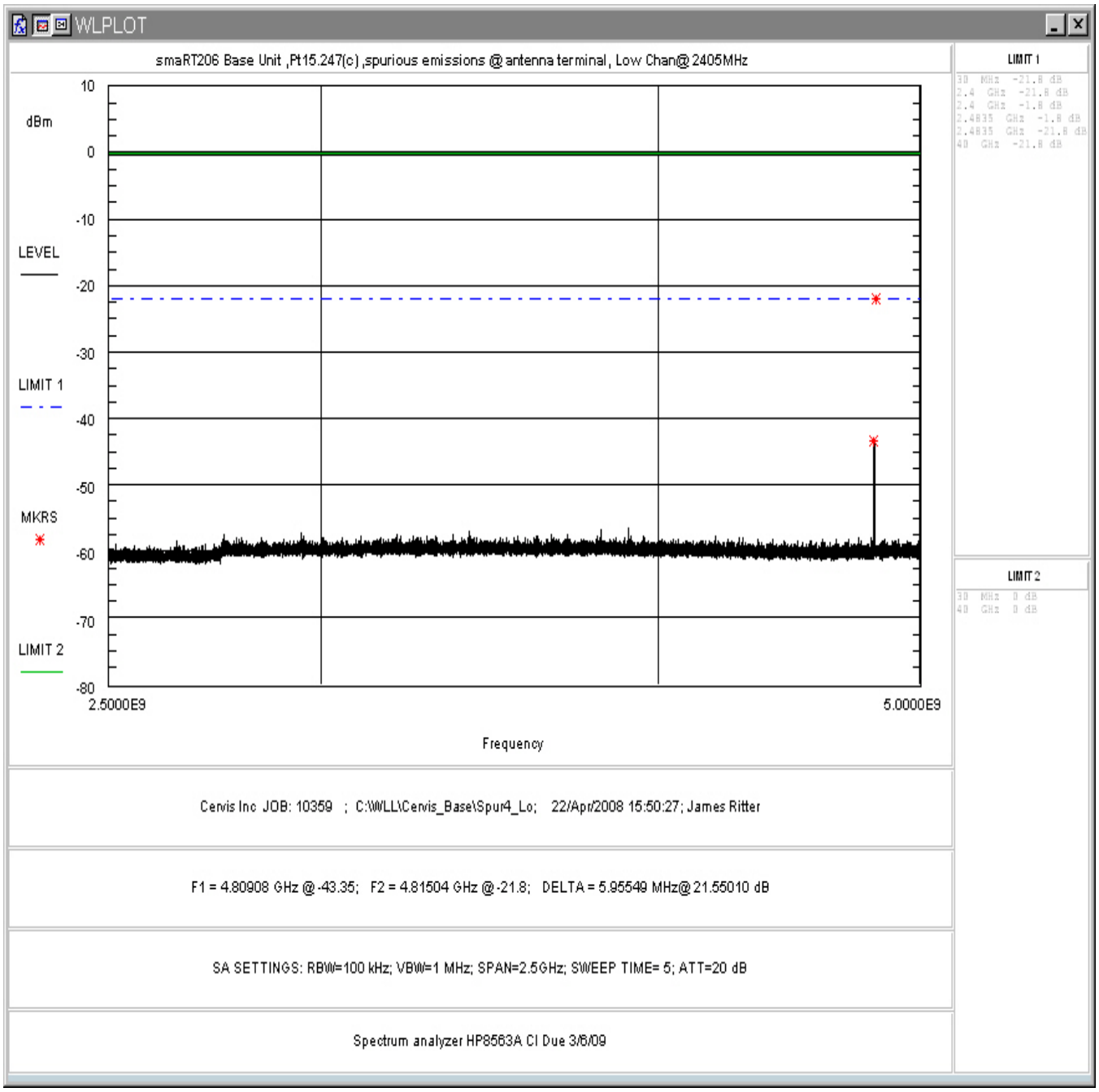

Figure 5-15. Conducted Spurious Emissions, Low Channel 2.5 - 5GHz

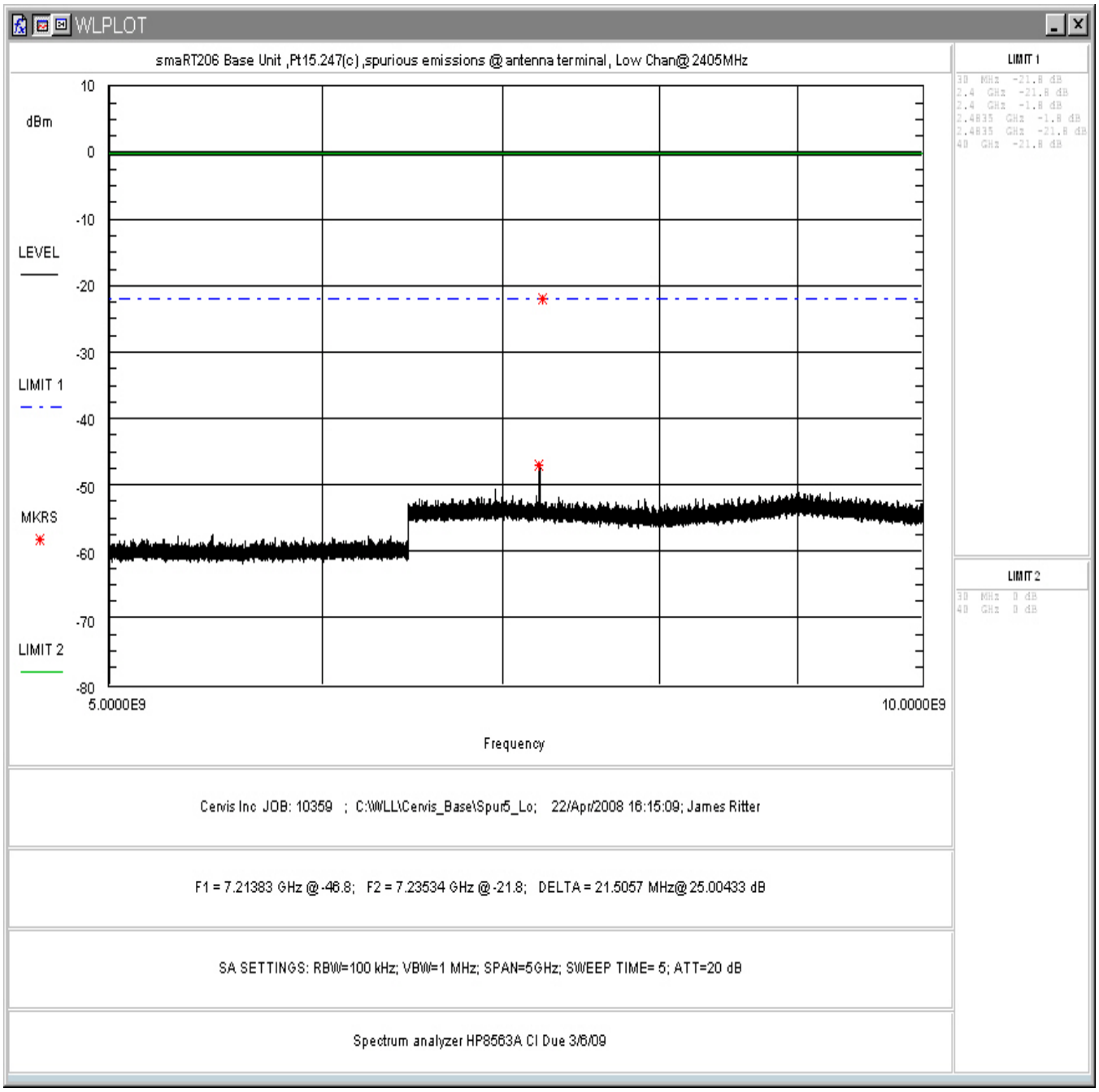

Figure 5-16. Conducted Spurious Emissions, Low Channel 5 - 10GHz

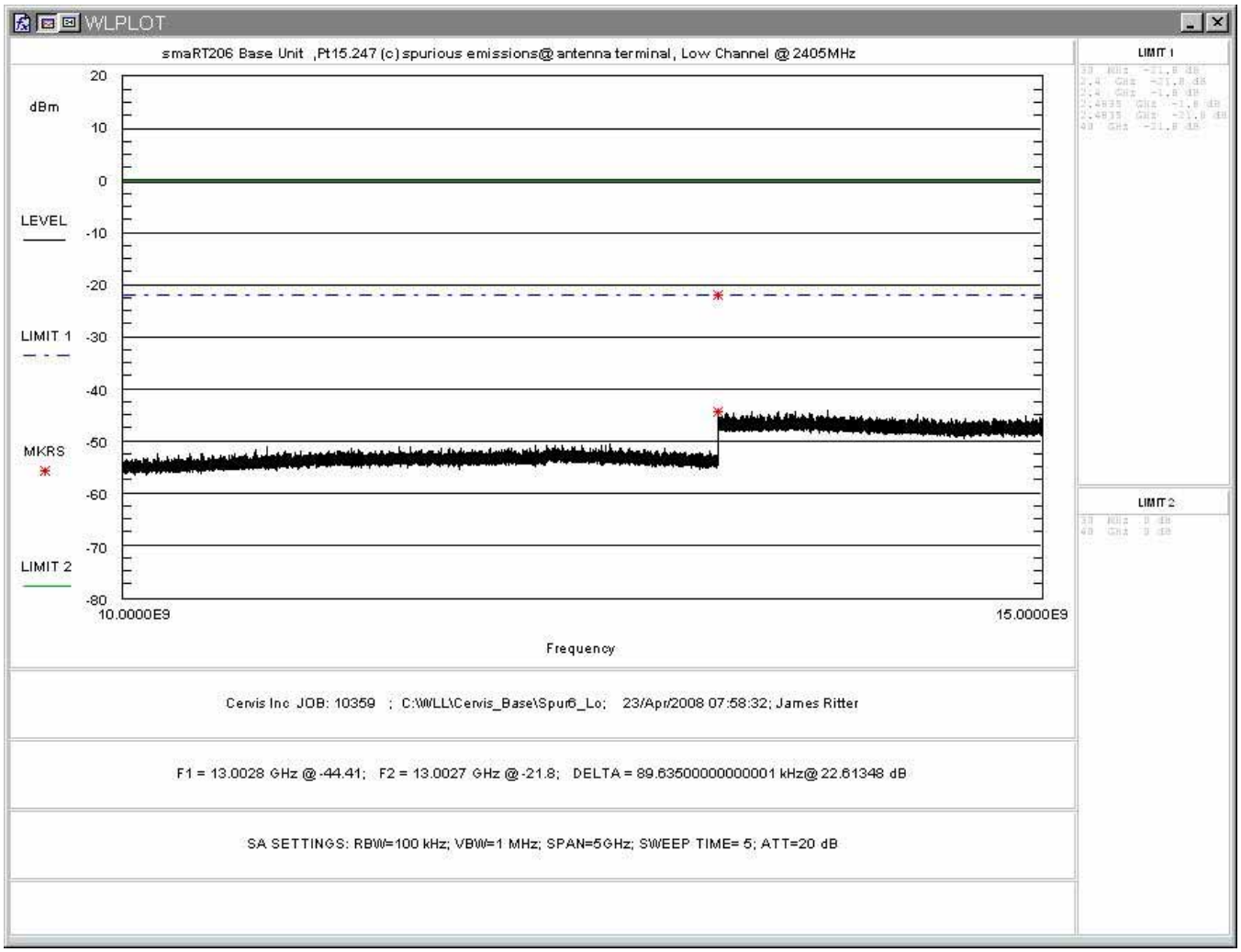

Figure 5-17. Conducted Spurious Emissions, Low Channel 10 - 15GHz

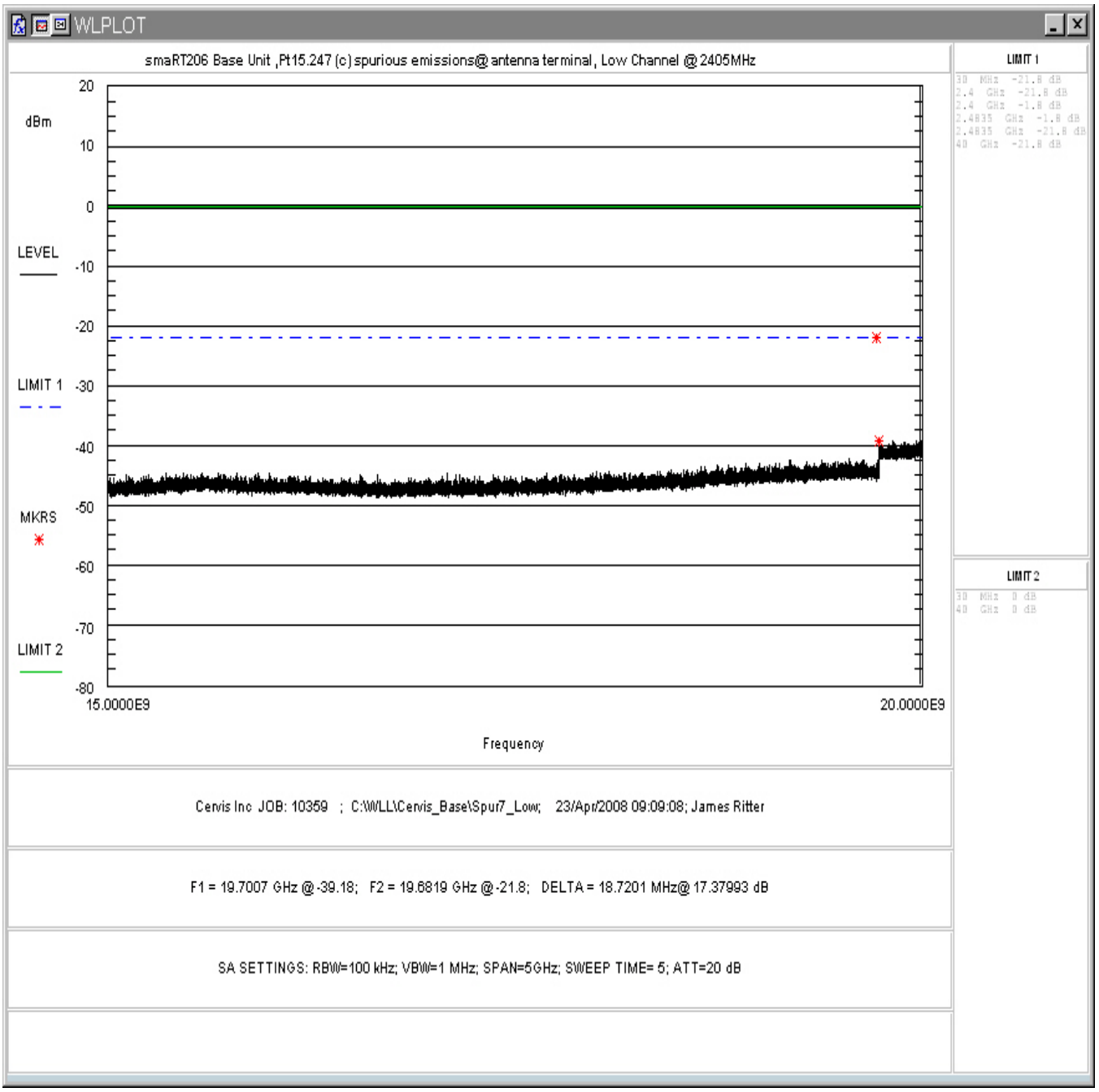

Figure 5-18. Conducted Spurious Emissions, Low Channel 15 -20GHz

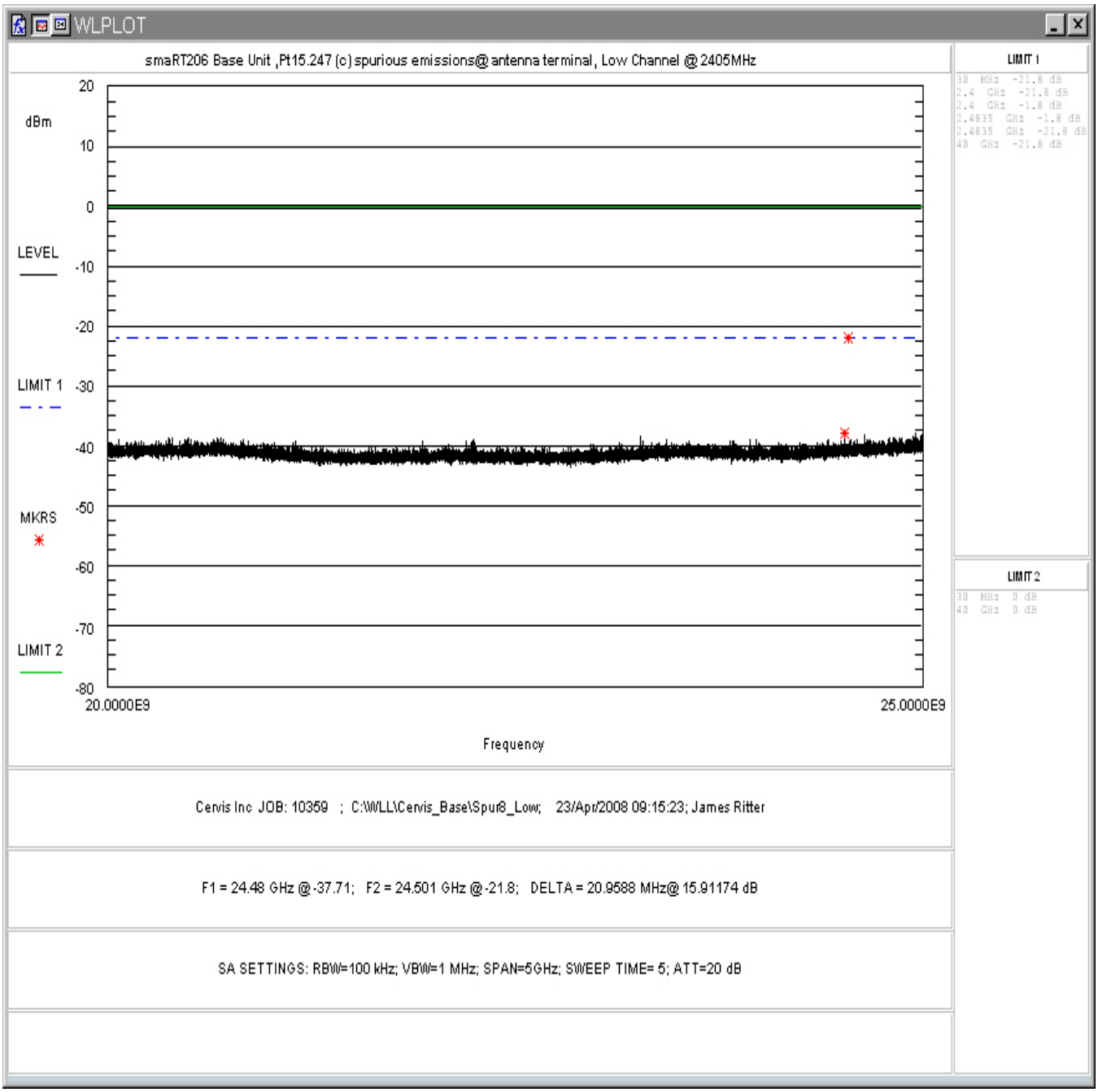

Figure 5-19. Conducted Spurious Emissions, Low Channel 20- 25GHz

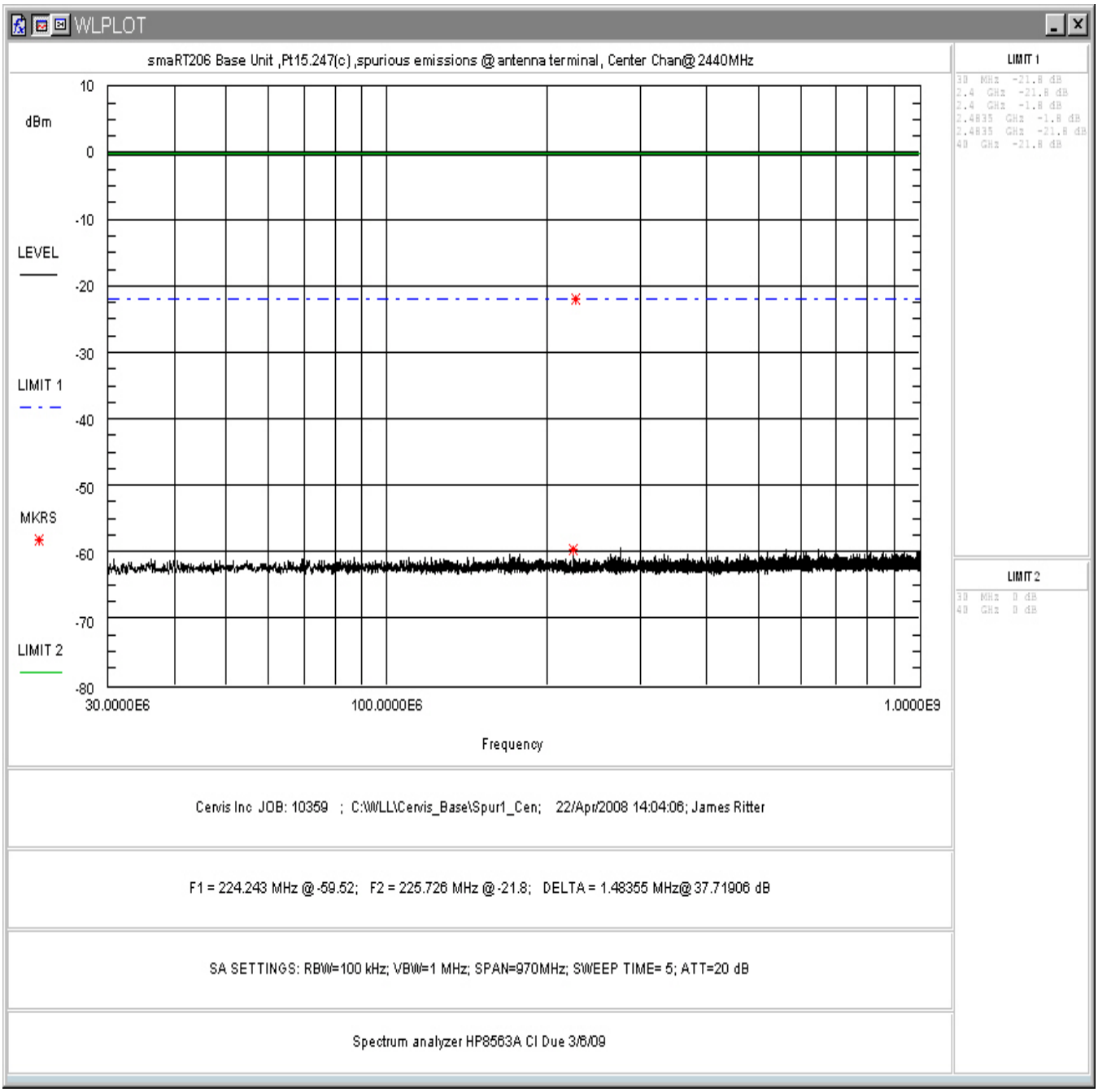

Figure 5-20. Conducted Spurious Emissions, Mid Channel 30 - 1000MHz

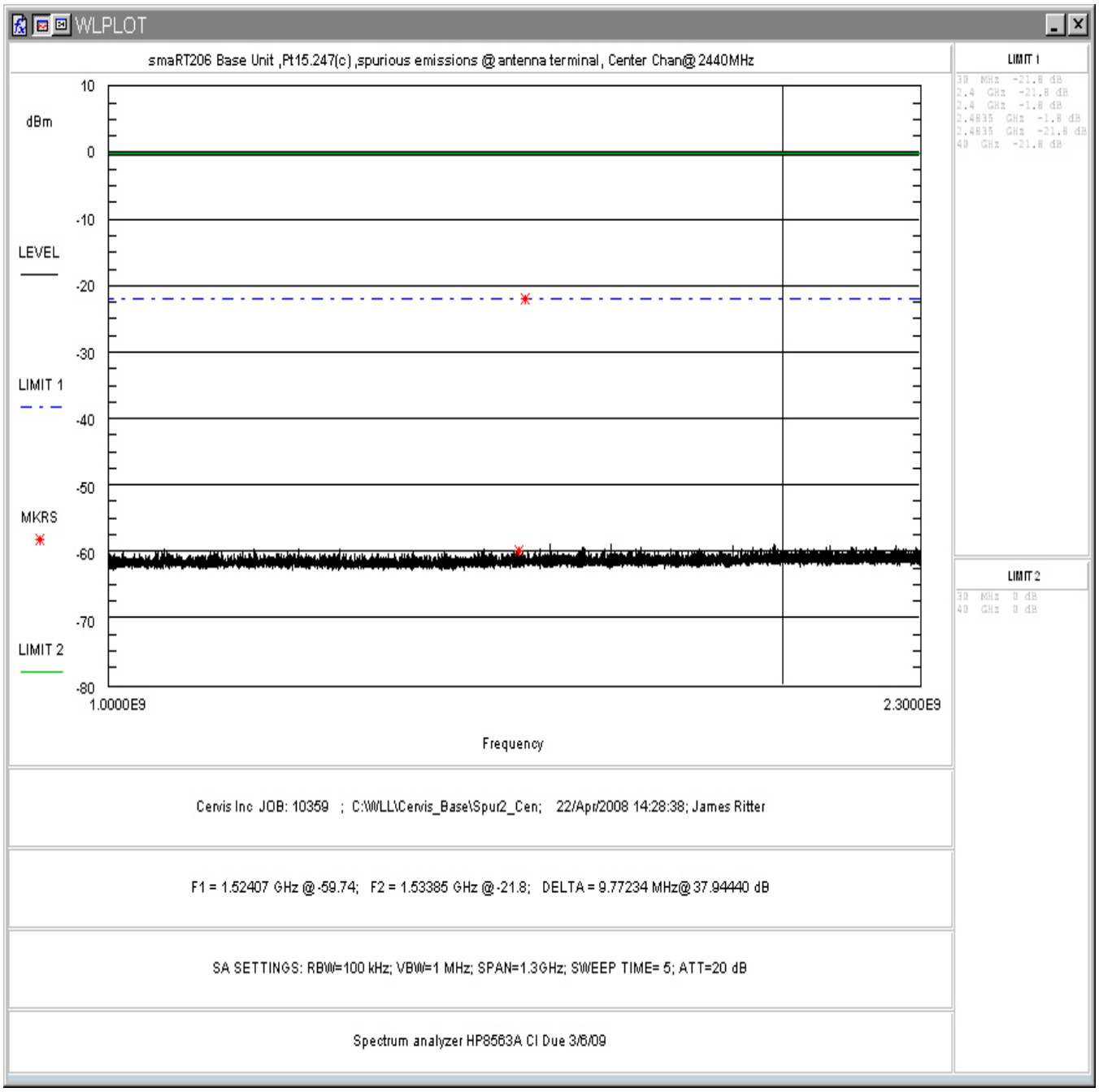

Figure 5-21. Conducted Spurious Emissions, Mid Channel 1 – 2.3GHz

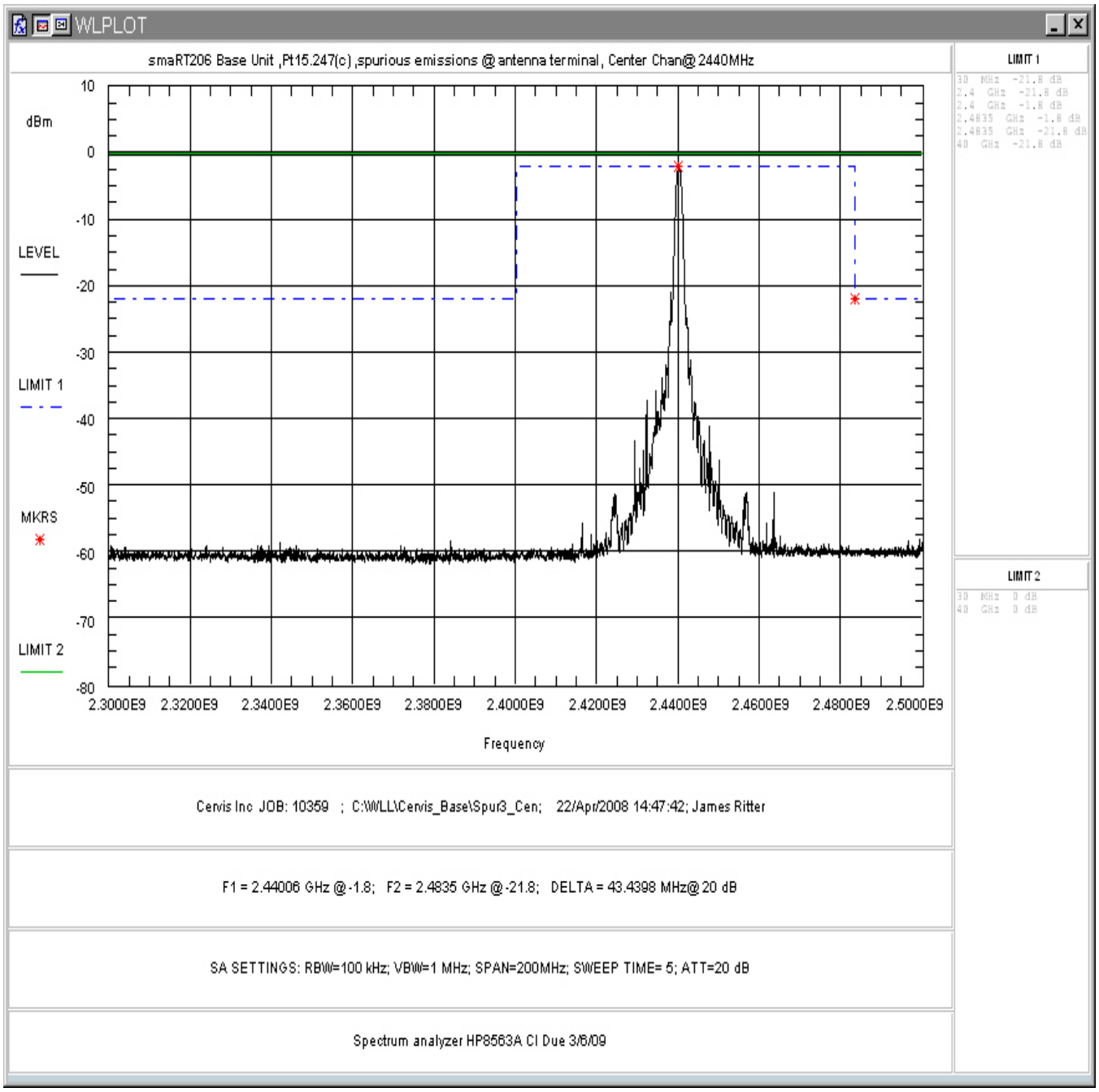

Figure 5-22. Conducted Spurious Emissions, Mid Channel 2.3 – 2.5GHz

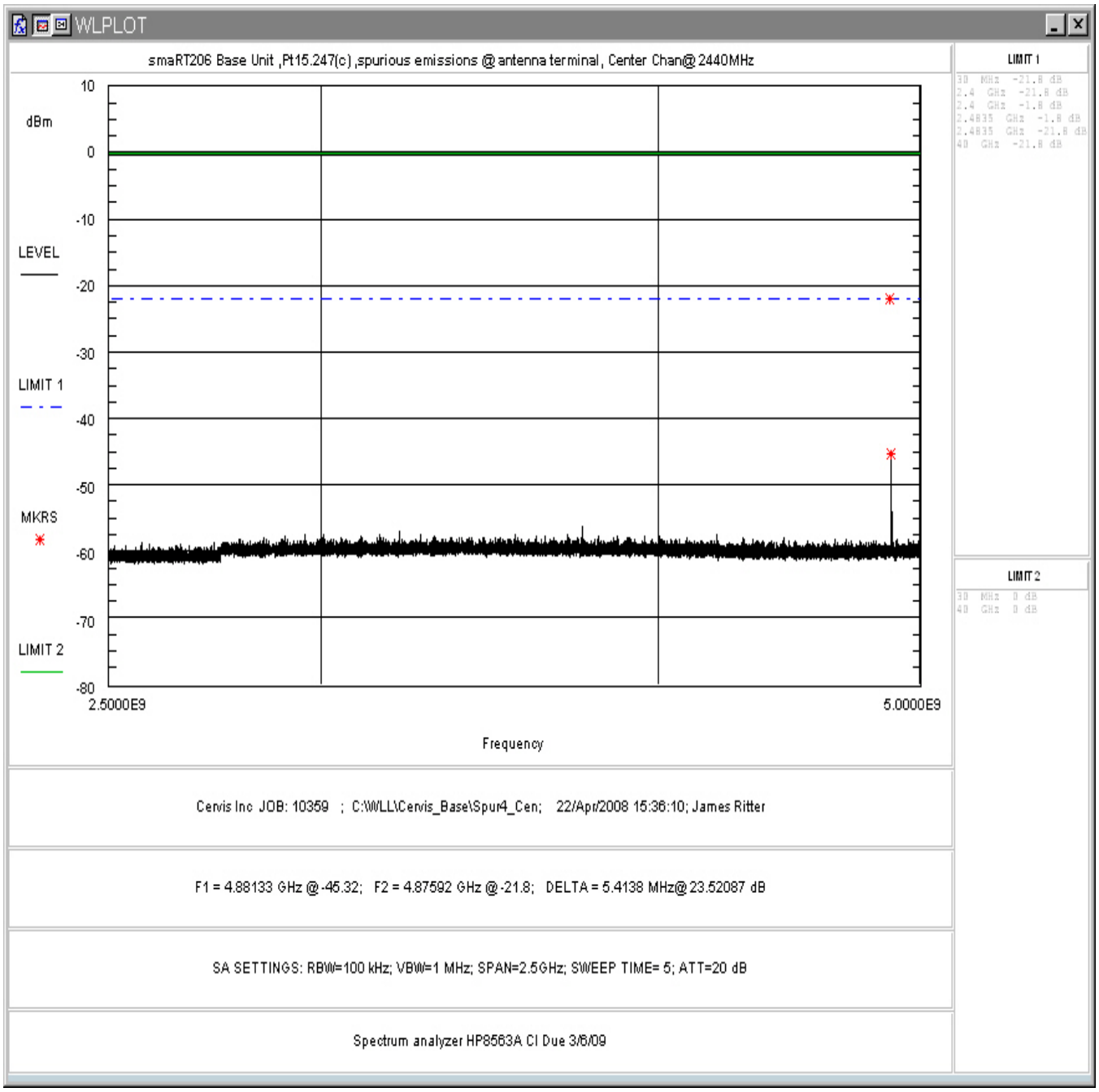

Figure 5-23. Conducted Spurious Emissions, Mid Channel 2.5 - 5GHz

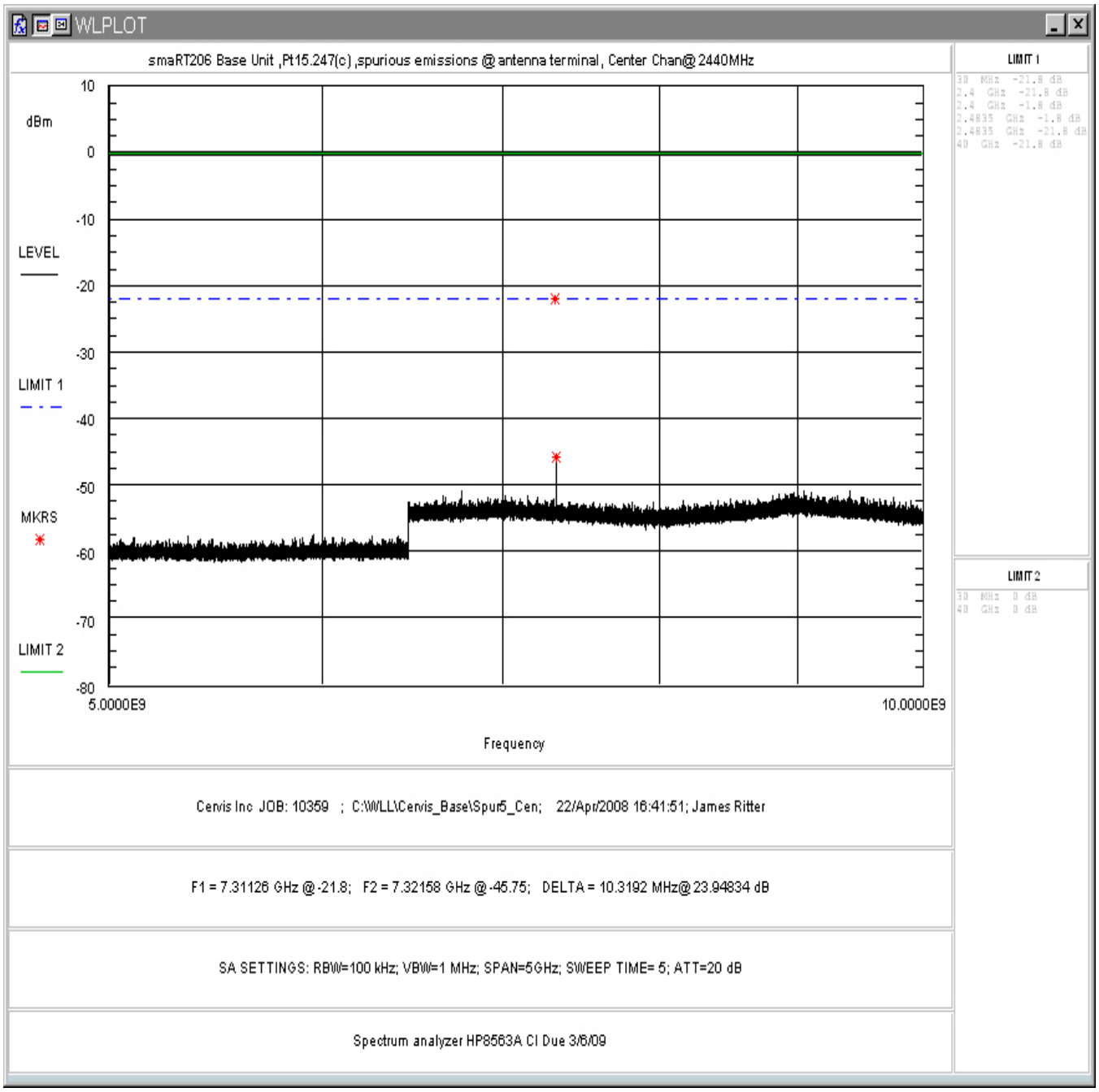

Figure 5-24. Conducted Spurious Emissions, Mid Channel 5 - 10GHz

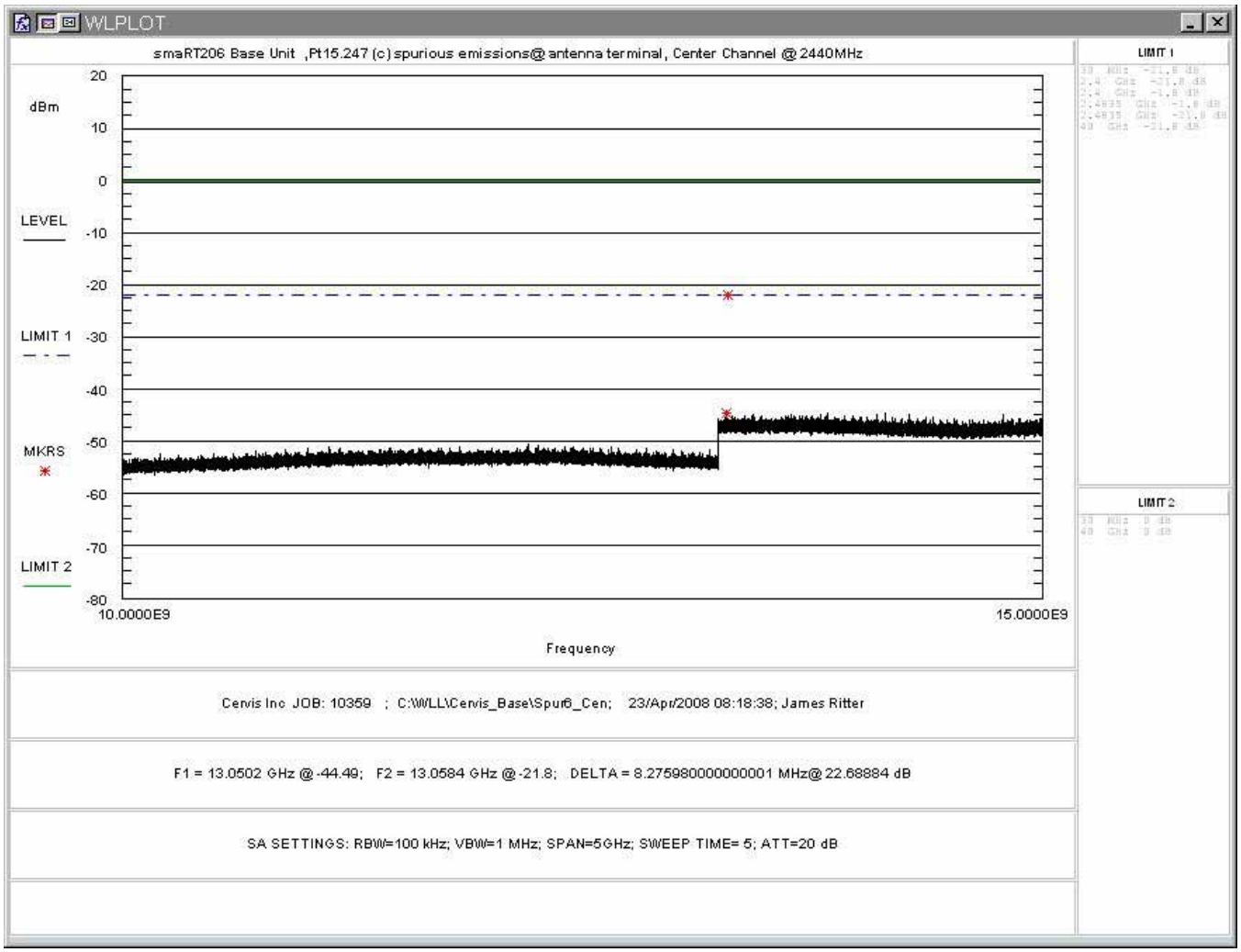

Figure 5-25. Conducted Spurious Emissions, Mid Channel 10 - 15GHz

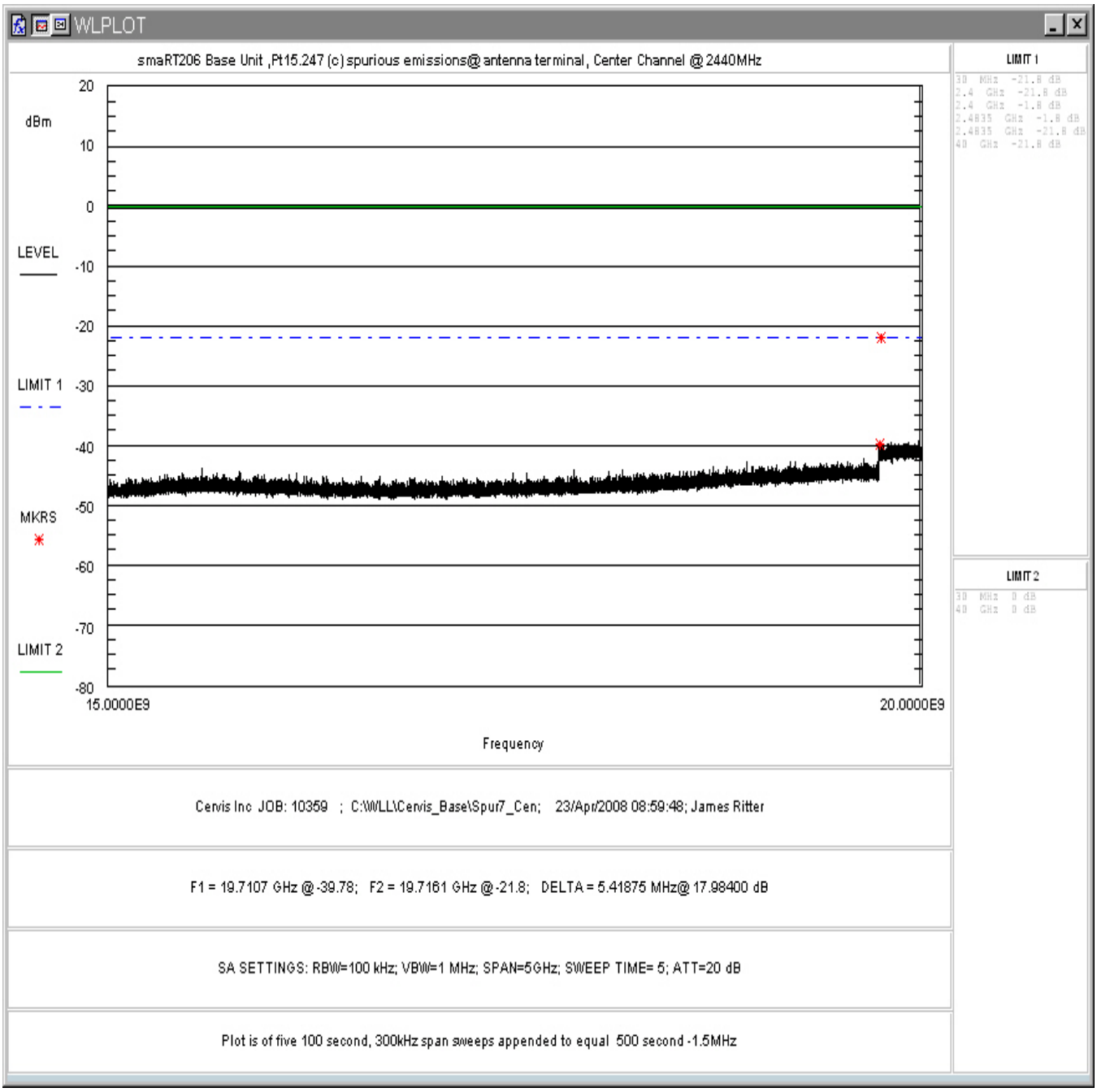

Figure 5-26. Conducted Spurious Emissions, Mid Channel 15 - 20GHz

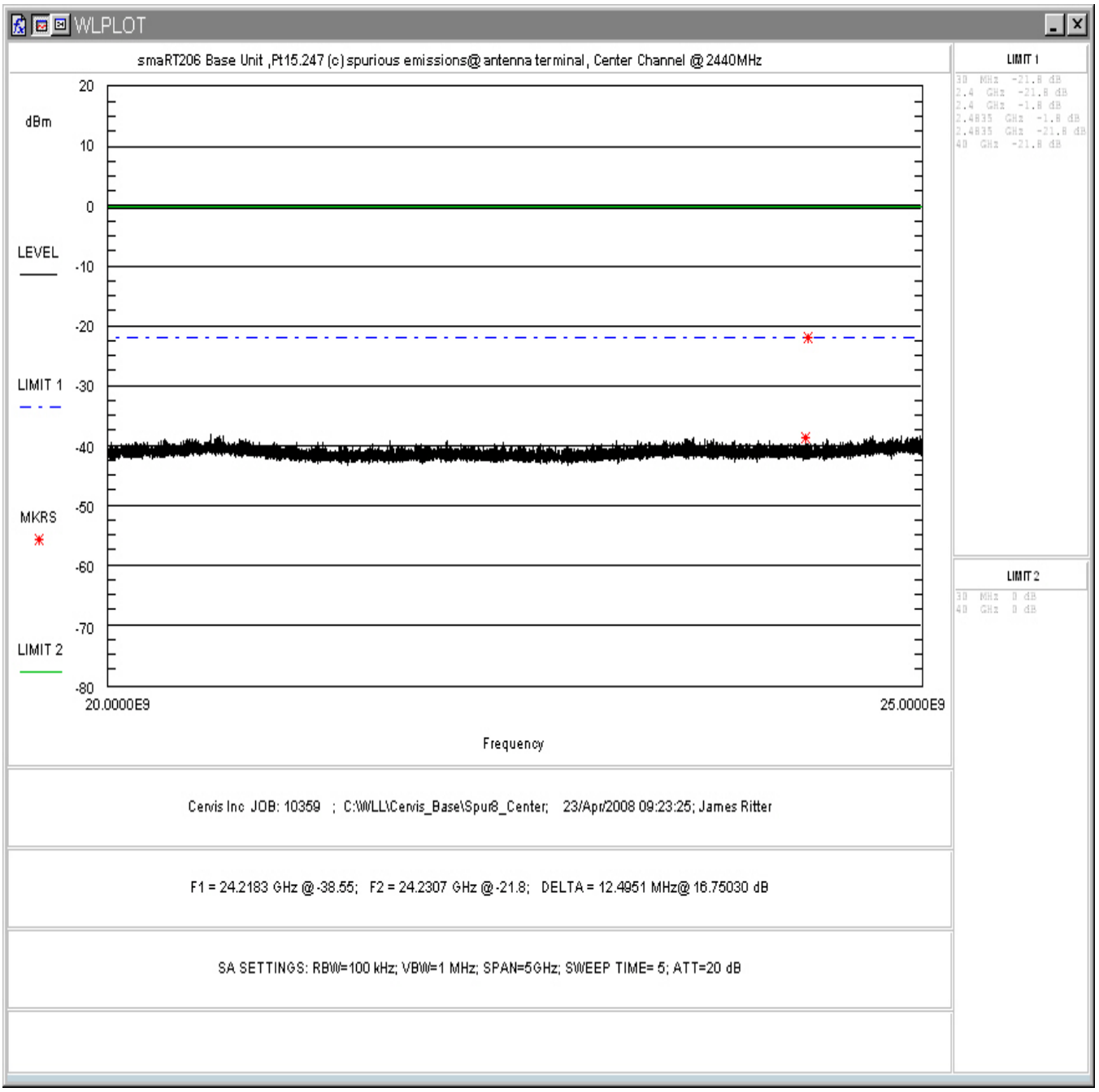

Figure 5-27. Conducted Spurious Emissions, Mid Channel 20 - 25GHz

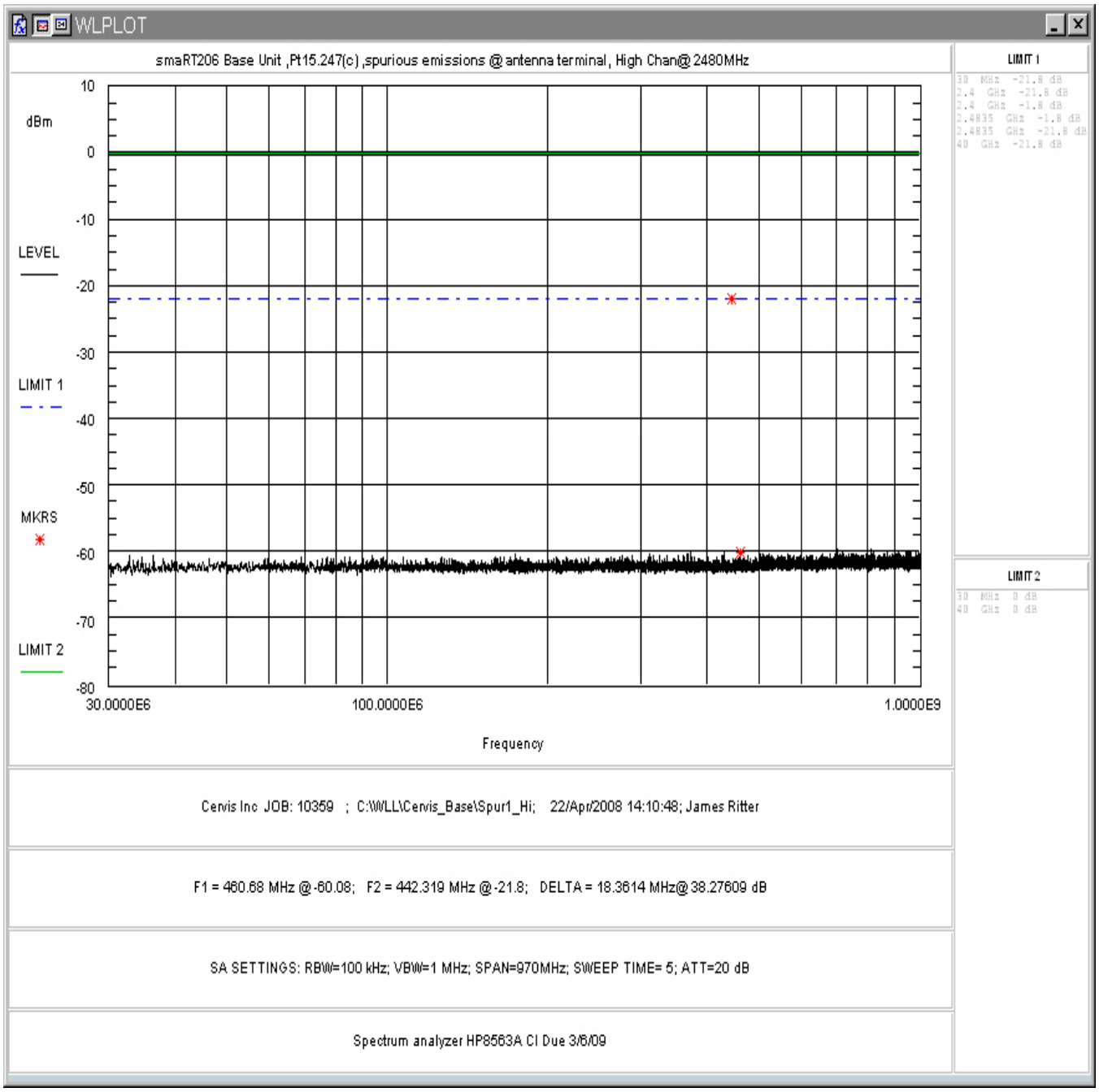

Figure 5-28. Conducted Spurious Emissions, High Channel 30 - 1000MHz

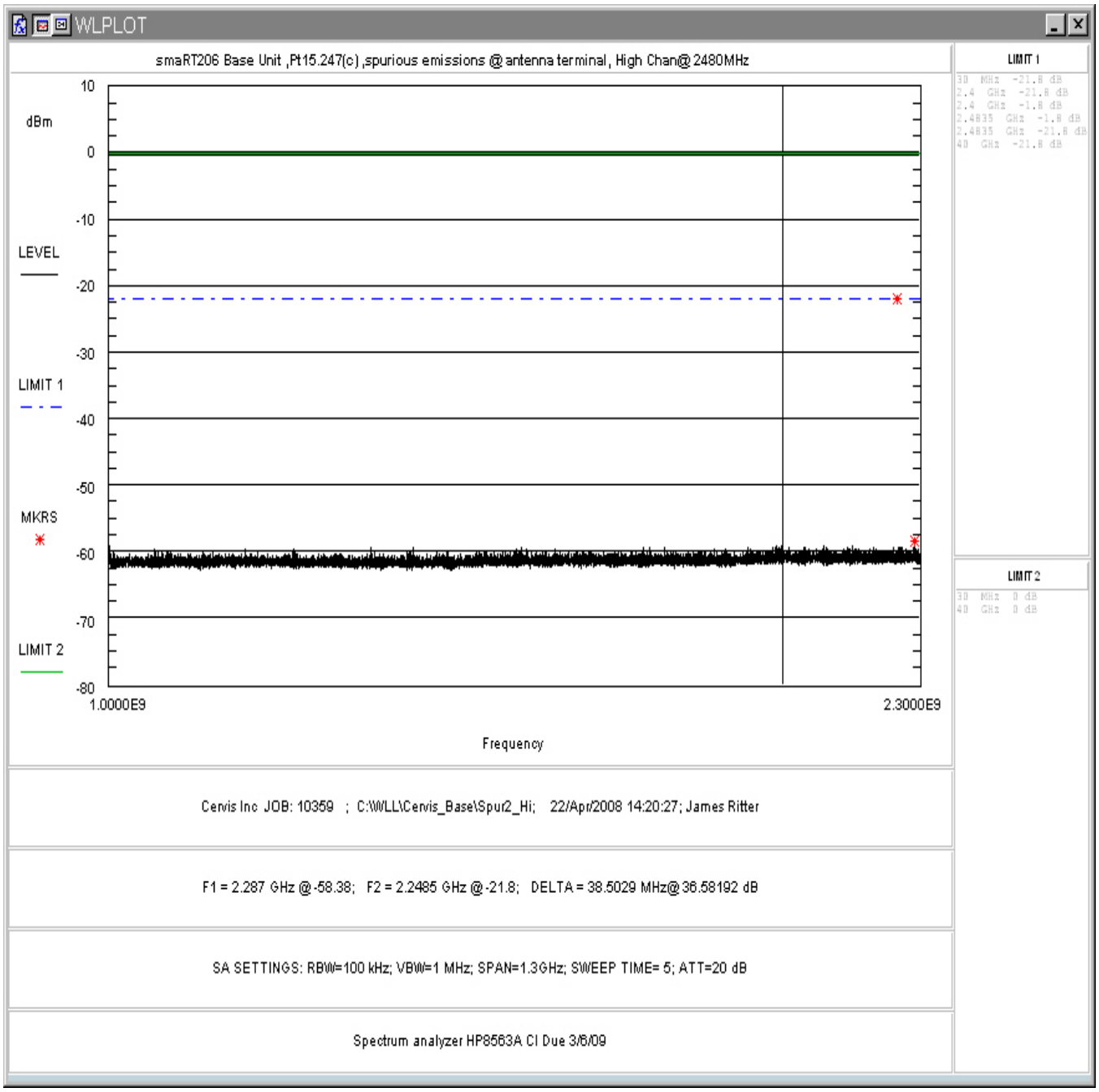

Figure 5-29. Conducted Spurious Emissions, High Channel 1 – 2.3GHz

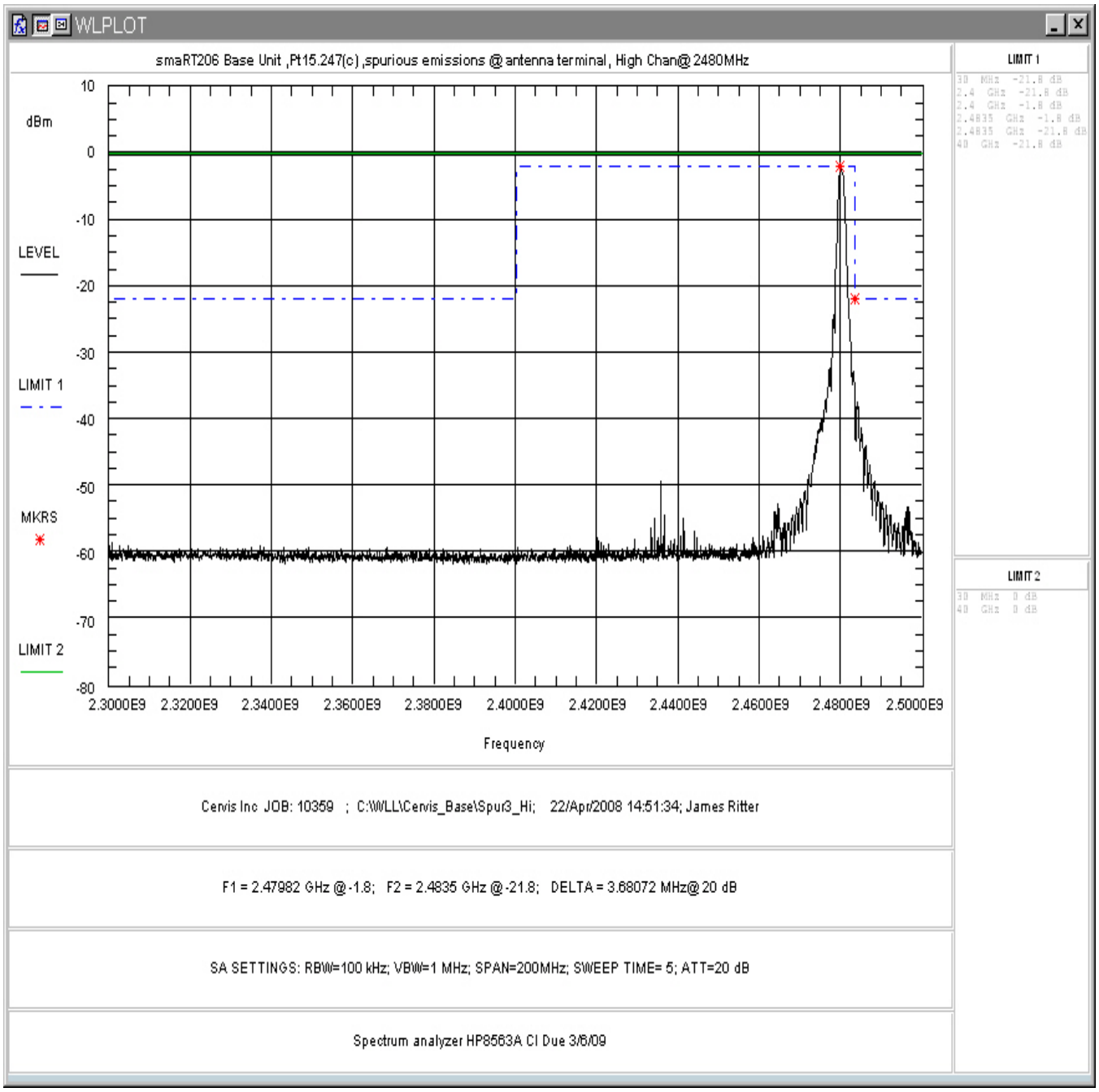

Figure 5-30. Conducted Spurious Emissions, High Channel 2.3 – 2.5GHz

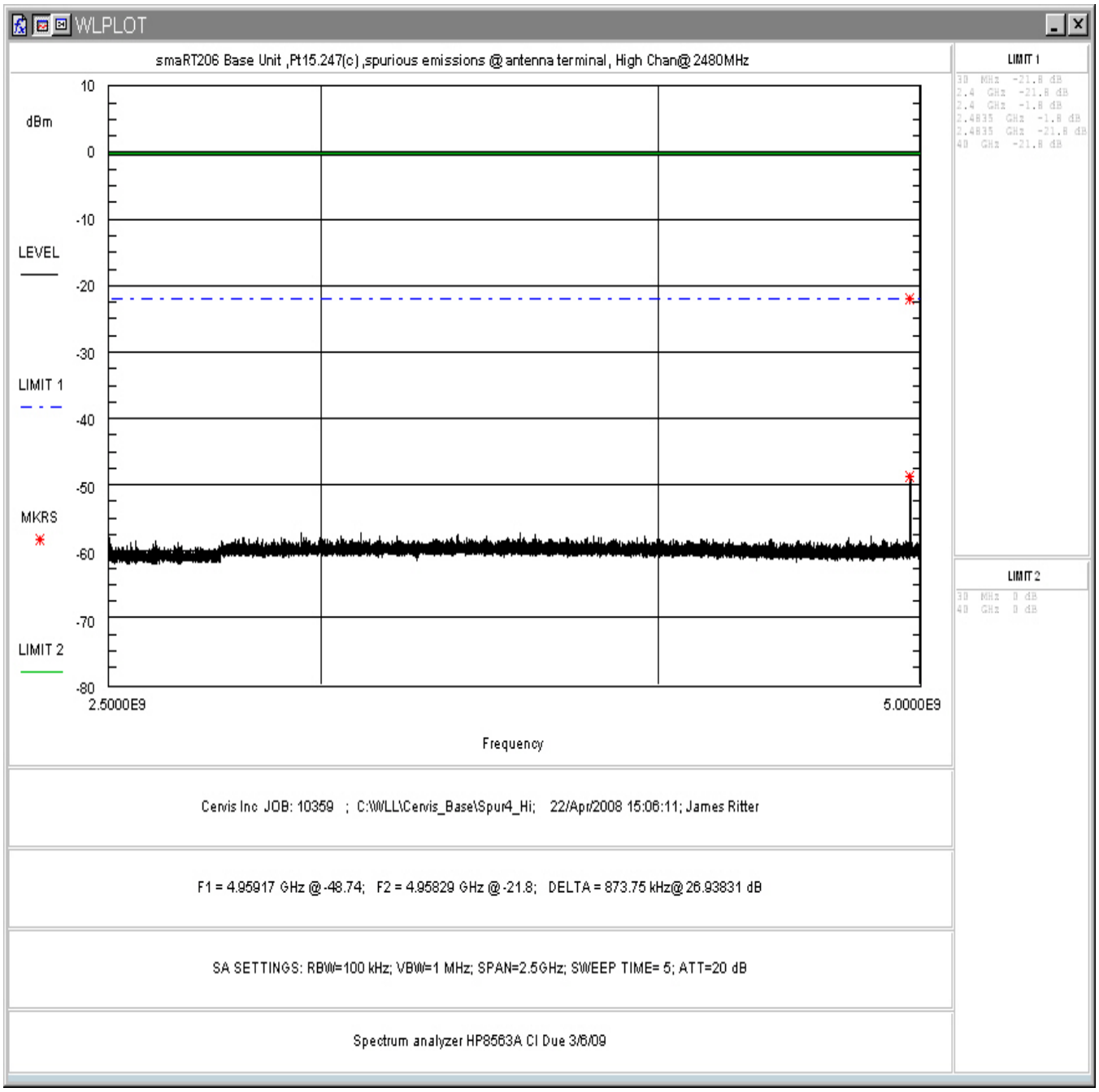

Figure 5-31. Conducted Spurious Emissions, High Channel 2.5 - 5GHz

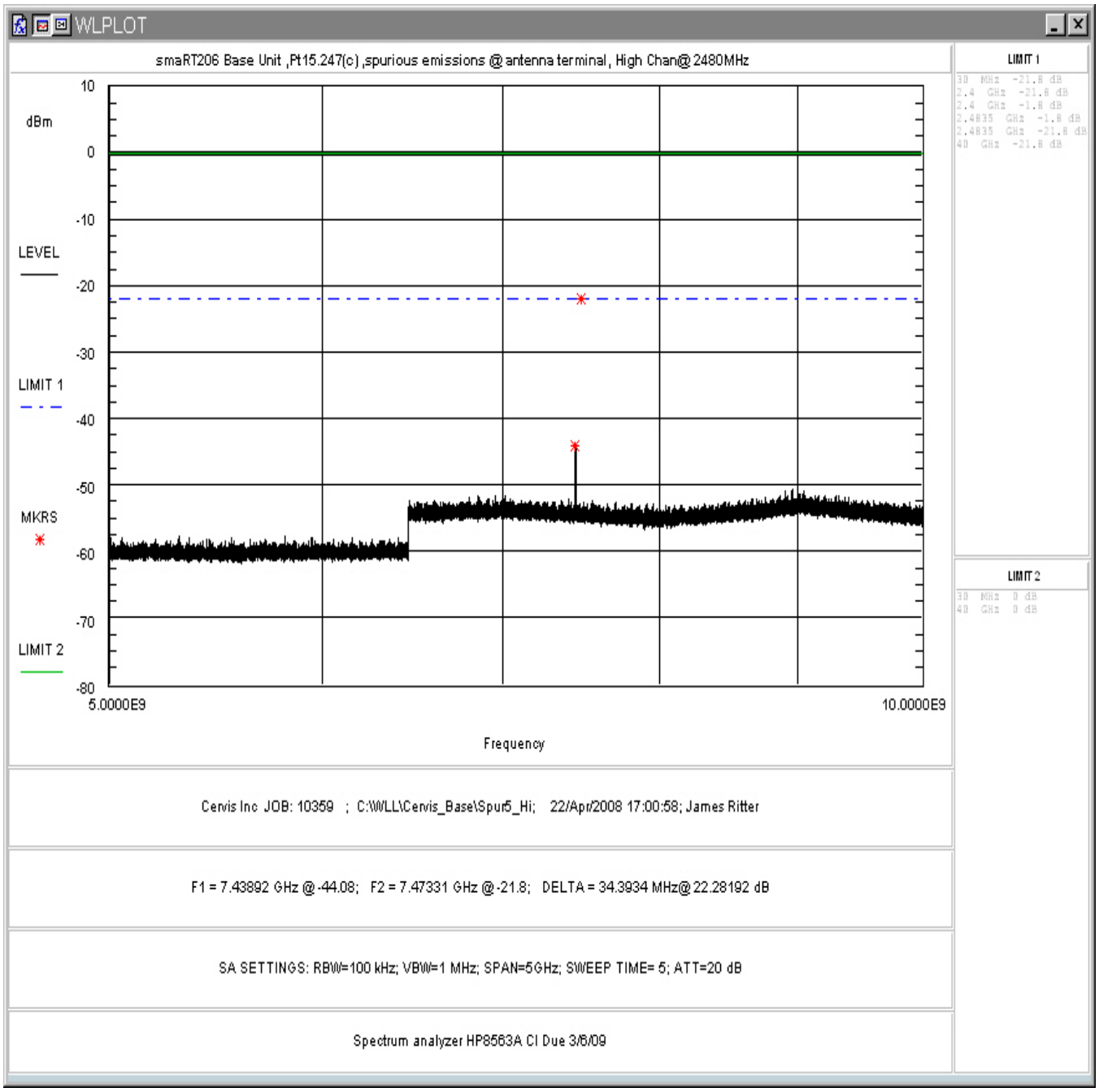

Figure 5-32. Conducted Spurious Emissions, High Channel 5 - 10GHz

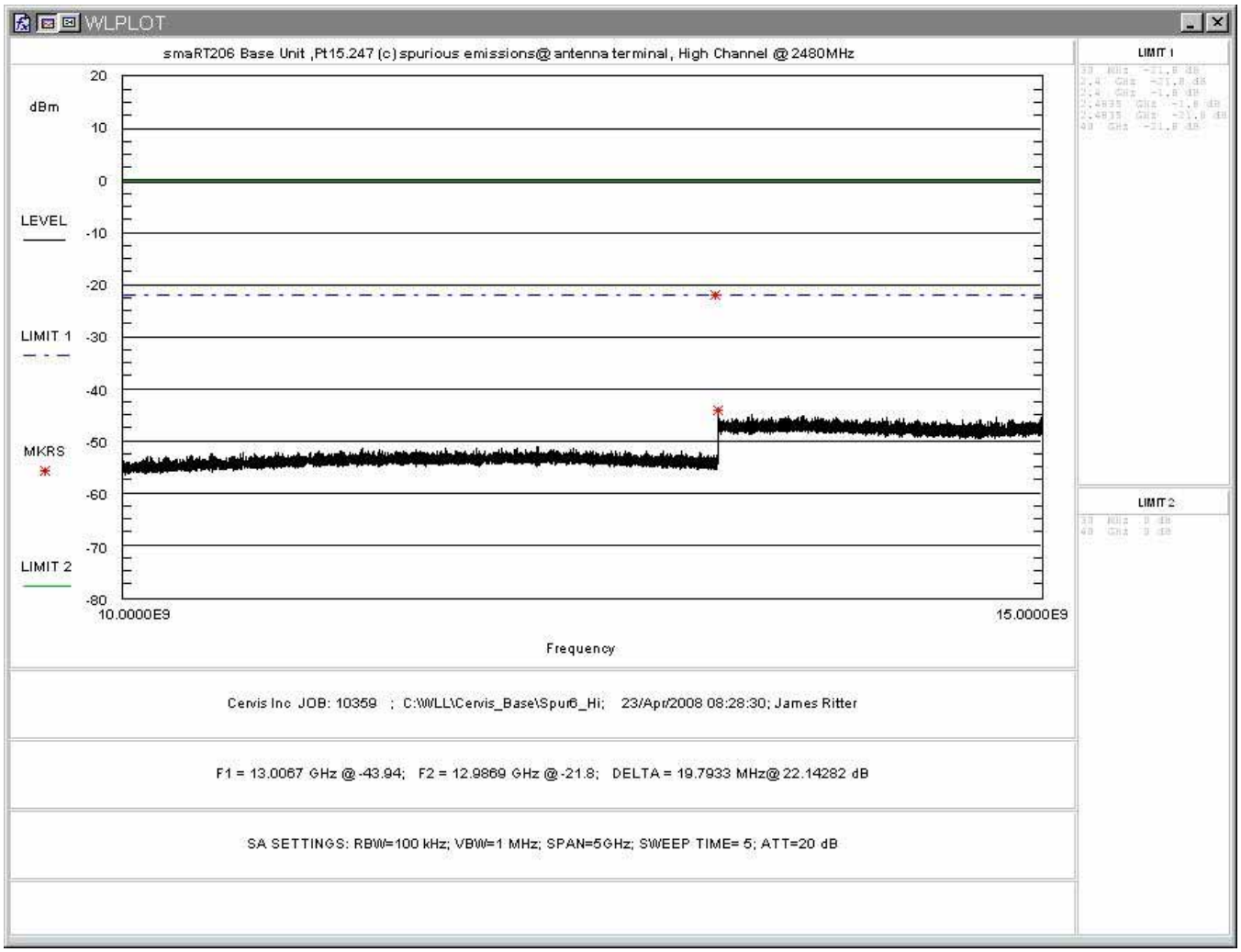

Figure 5-33. Conducted Spurious Emissions, High Channel 10 – 15 GHz

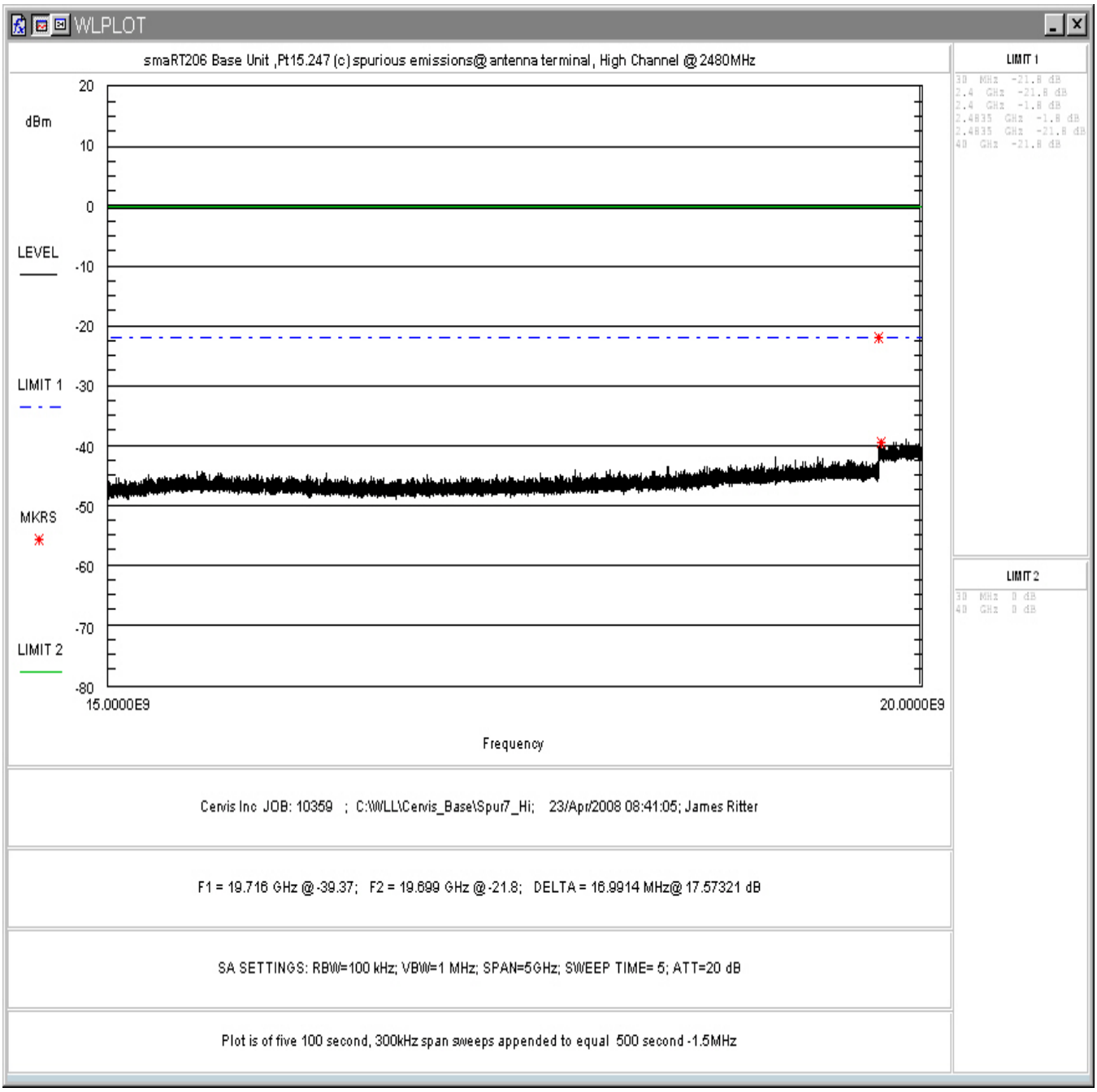

Figure 5-34. Conducted Spurious Emissions, High Channel 15 - 20GHz

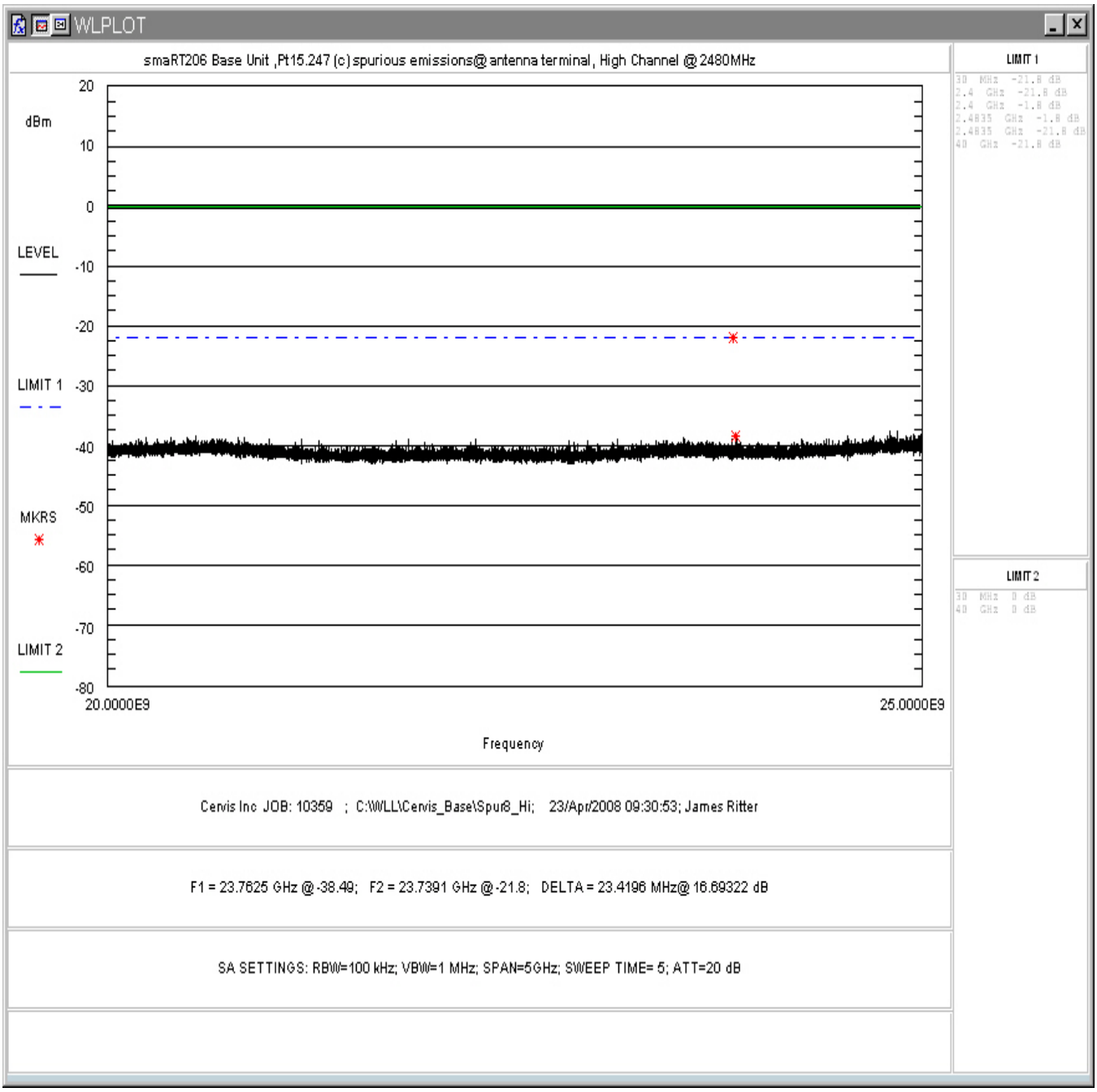

Figure 5-35. Conducted Spurious Emissions, High Channel 20 - 25GHz

5.6 Transmit Radiated Spurious Emissions: (FCC Part §15.205, §15.207, RSS210 (A.5))

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.

5.6.1 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 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)

5.6.2 Test Summary

The EUT complied with the requirements for radiated emissions FCC part 15.247 and IC RSS-210e issue 7.

5.6.3 Duty Cycle Plots

FCC Part 15.35 allows a Duty Cycle correction for transmit signals that are less than 100mSec in duration. The following plots show this correction to be used in radiated emissions measurement and can not exceed 20dB. The calculation is:

10LOG(On Time per 100ms/100ms)

10LOG(860us/100ms)=20.655dB (20dB maximum used)

A diode detector connected to an oscilloscope was used to capture this measurement. The pulse characteristics are shown in the following figures. The pulse signal is “on” for 860us at a repetition rate of 103.2 ms. The duty cycle correction factor is in excess of 20dB, so a maximum correction of 20dB is used in the radiated emissions data tables.

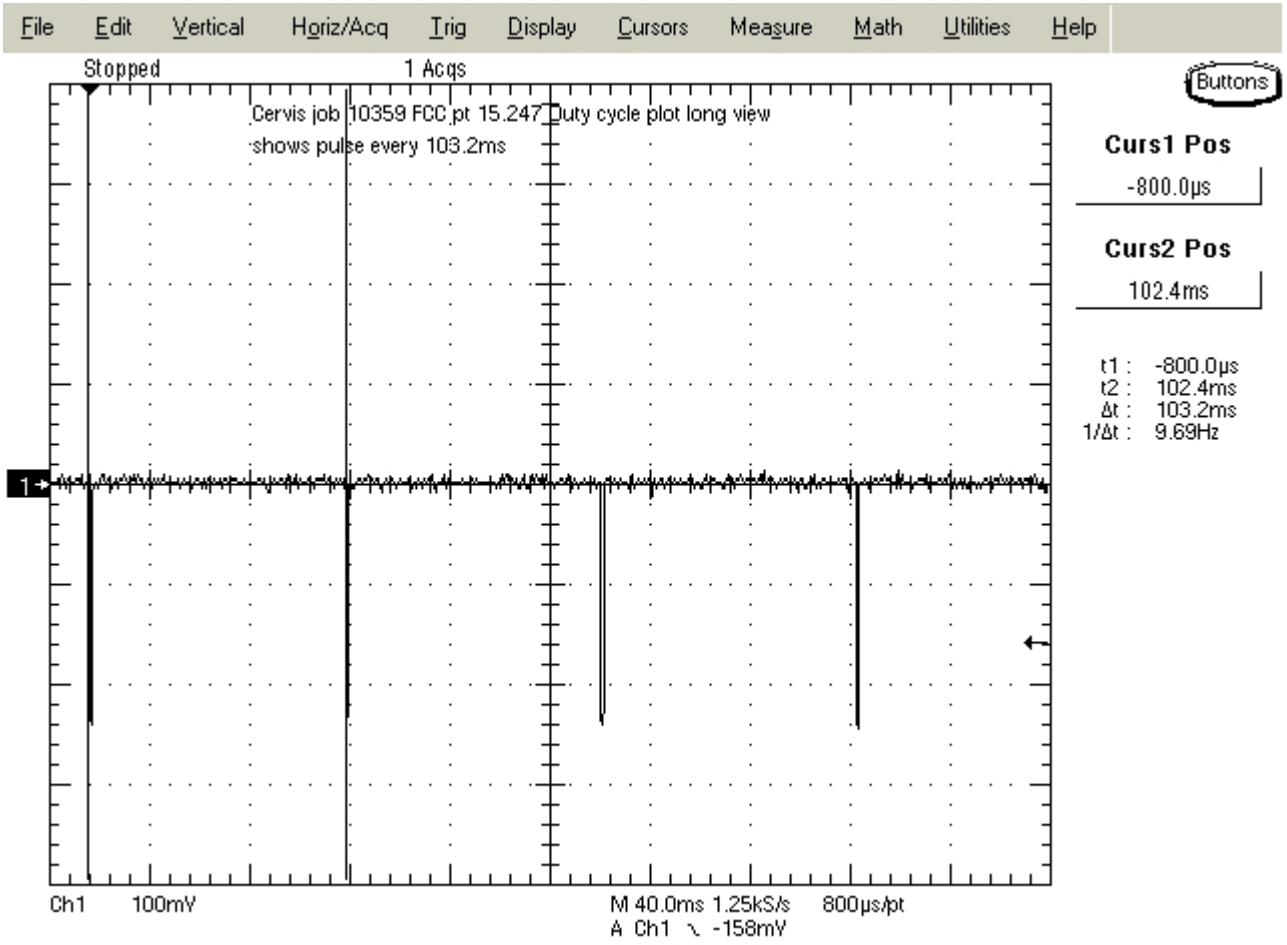

Figure 5-36. Duty Cycle- Shows Pulse Repetition Rate

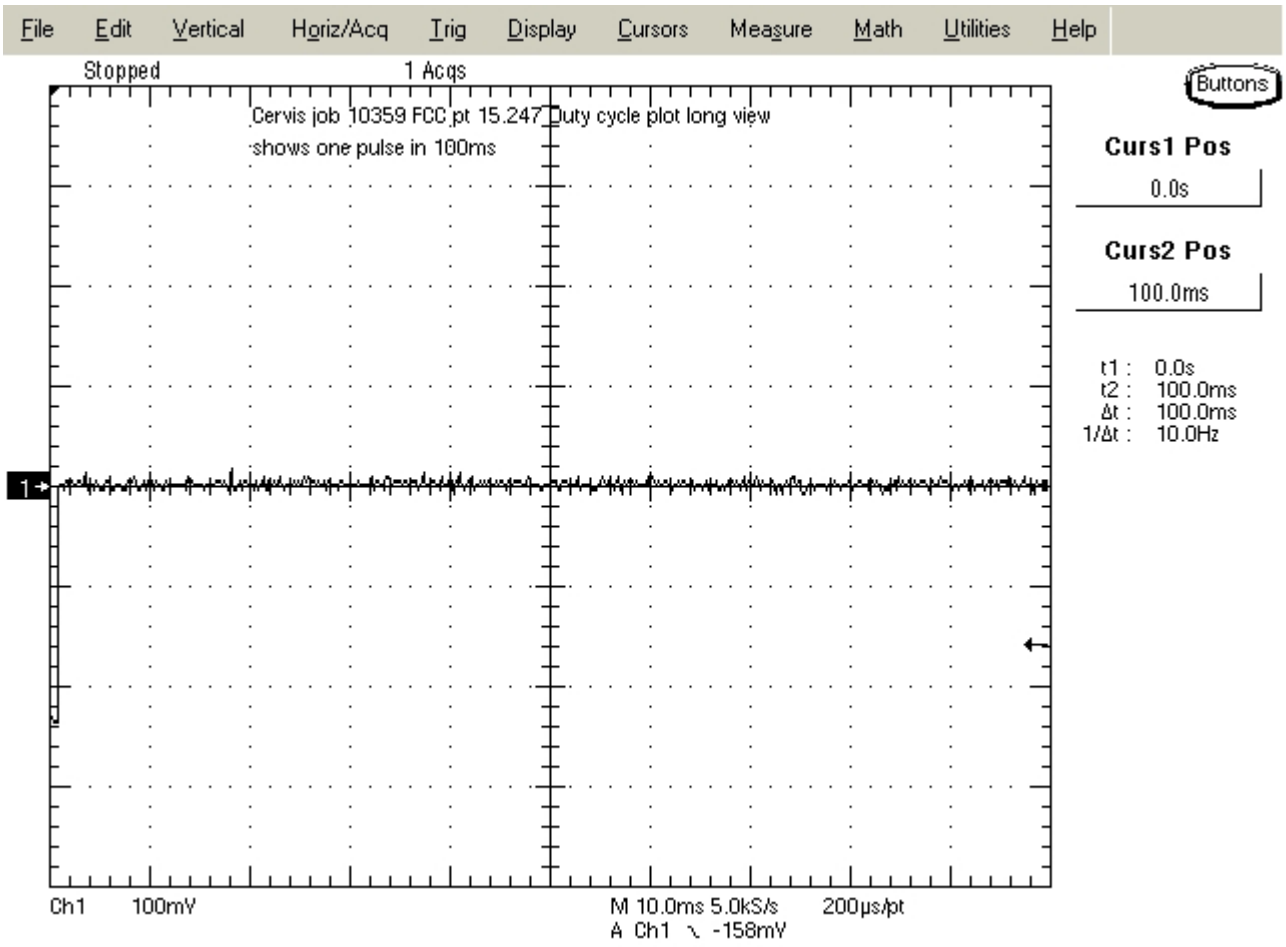

Figure 5-37. Duty Cycle- 100mSec View

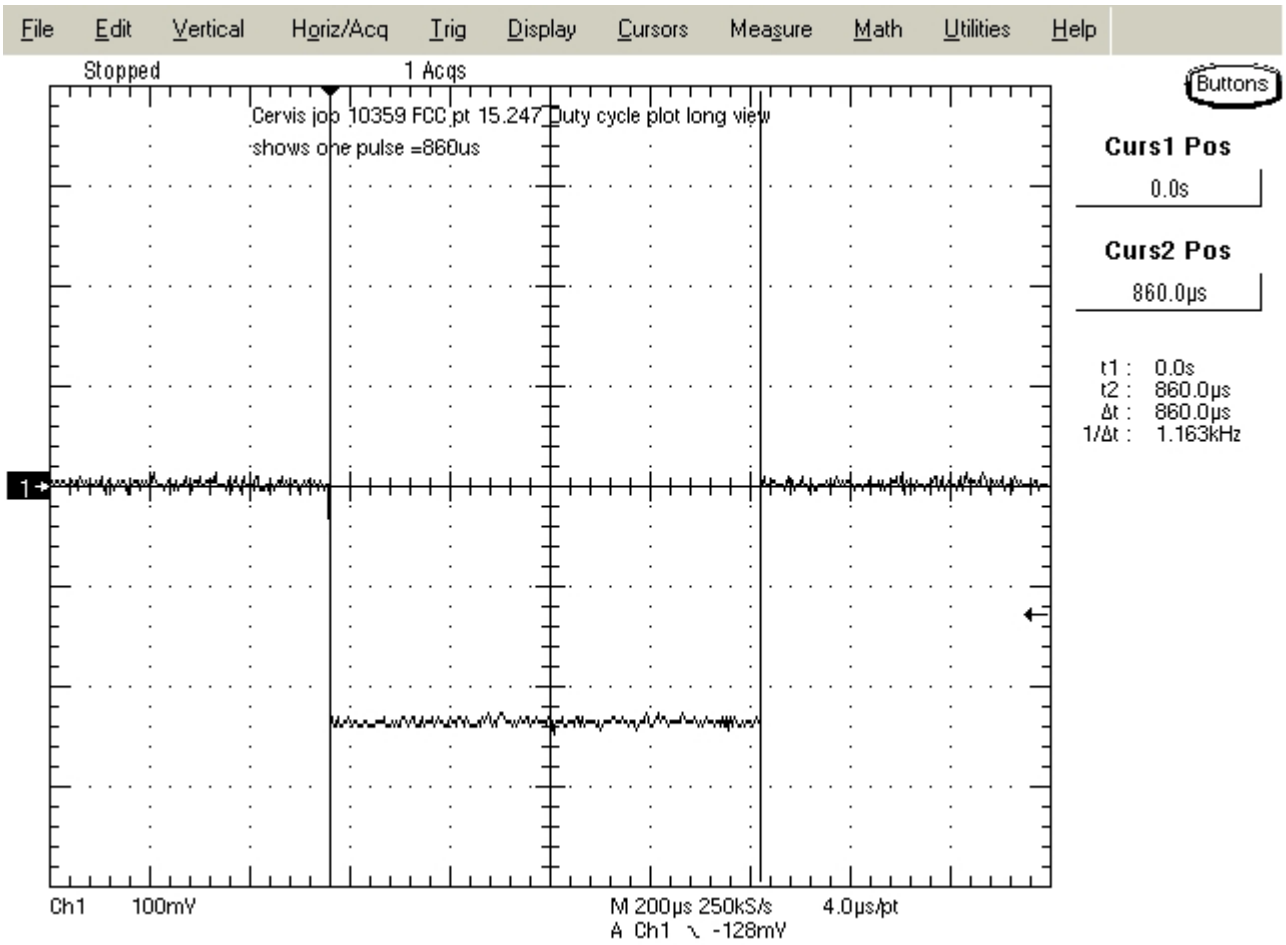

Figure 5-38. Duty Cycle- Single Pulse View

Table 6: Radiated Emission Test Data, Low Channel -2405MHz

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (dBµV)	Duty Cycle corr. (dB)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
Peak Unit Flat												
4810.000	V	180.0	3.3	61.0	0.0	32.5	2.0	35.7	59.8	978.3	5000.0	-14.2
12025.000	V	180.0	3.0	45.7	0.0	40.0	3.8	35.8	53.7	486.3	5000.0	-20.2
Average												
4810.000	V	180.0	3.3	61.0	-20.0	32.5	2.0	35.7	39.8	97.8	500.0	-14.2
12025.000	V	180.0	3.0	45.7	-20.0	40.0	3.8	35.8	33.7	48.6	500.0	-20.2
Peak												
4810.000	H	180.0	2.5	69.0	0.0	32.5	2.0	35.7	67.8	2457.3	5000.0	-6.2
12025.000	H	180.0	2.5	47.5	0.0	40.0	3.8	35.8	55.6	600.3	5000.0	-18.4
Average												
4810.000	H	180.0	2.5	69.0	-20.0	32.5	2.0	35.7	47.8	245.7	500.0	-6.2
12025.000	H	180.0	2.5	47.5	-20.0	40.0	3.8	35.8	35.6	60.0	500.0	-18.4
Peak Unit On Side												
4810.000	V	190.0	2.7	61.0	0.0	32.5	2.0	35.7	59.8	978.3	5000.0	-14.2
12025.000	V	180.0	2.7	45.7	0.0	40.0	3.8	35.8	53.7	486.3	5000.0	-20.2
Average												
4810.000	V	190.0	2.7	61.0	-20.0	32.5	2.0	35.7	39.8	97.8	500.0	-14.2
12025.000	V	180.0	2.7	45.7	-20.0	40.0	3.8	35.8	33.7	48.6	500.0	-20.2
Peak												
4810.000	H	180.0	2.6	63.5	0.0	32.5	2.0	35.7	62.3	1304.5	5000.0	-11.7
12025.000	H	180.0	2.5	45.2	0.0	40.0	3.8	35.8	53.2	459.1	5000.0	-20.7
Average												
4810.000	H	180.0	2.6	63.5	-20.0	32.5	2.0	35.7	42.3	130.5	500.0	-11.7
12025.000	H	180.0	2.5	45.2	-20.0	40.0	3.8	35.8	33.2	45.9	500.0	-20.7
Peak Unit Upright												
4810.000	V	180.0	2.6	63.3	0.0	32.5	2.0	35.7	62.1	1274.8	5000.0	-11.9
12025.000	V	180.0	2.8	48.3	0.0	40.0	3.8	35.8	56.4	660.5	5000.0	-17.6
Average												
4810.000	V	180.0	2.6	63.3	-20.0	32.5	2.0	35.7	42.1	127.5	500.0	-11.9
12025.000	V	180.0	2.8	48.3	-20.0	40.0	3.8	35.8	36.4	66.1	500.0	-17.6
Peak												
4810.000	H	180.0	1.6	58.0	0.0	32.5	2.0	35.7	56.8	692.6	5000.0	-17.2
12025.000	H	180.0	2.5	48.1	0.0	40.0	3.8	35.8	56.2	643.3	5000.0	-17.8
Average												
4810.000	H	180.0	1.6	58.0	-20.0	32.5	2.0	35.7	36.8	69.3	500.0	-17.2
12025.000	H	180.0	2.5	48.1	-20.0	40.0	3.8	35.8	36.2	64.3	500.0	-17.8

Table 7: Radiated Emission Test Data, Center Channel-2440MHz

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (dBµV)	Duty Cycle Corr. (dB)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
Peak Unit Flat												
4880.000	V	22.0	2.6	63.1	0.0	32.6	2.0	35.7	62.0	1256.1	5000.0	-12.0
7320.000	V	170.0	2.7	51.0	0.0	37.1	3.3	35.6	55.8	616.9	5000.0	-18.2
12200.000	V	190.0	2.5	48.3	0.0	40.0	4.2	35.6	56.9	697.2	5000.0	-17.1
Average	V			0.0								
4880.000	V	22.0	2.6	63.1	-20.0	32.6	2.0	35.7	42.0	125.6	500.0	-12.0
7320.000	V	170.0	2.7	51.0	-20.0	37.1	3.3	35.6	35.8	61.7	500.0	-18.2
12200.000	V	190.0	2.5	48.3	-20.0	40.0	4.2	35.6	36.9	69.7	500.0	-17.1
Peak				0.0								
4880.000	H	180.0	3.5	61.8	0.0	32.6	2.0	35.7	60.7	1085.2	5000.0	-13.3
7320.000	H	170.0	3.5	51.0	0.0	37.1	3.3	35.6	55.8	616.9	5000.0	-18.2
12200.000	H	180.0	2.6	47.7	0.0	40.0	4.2	35.6	56.2	646.2	5000.0	-17.8
Average												
4880.000	H	180.0	3.5	61.8	-20.0	32.6	2.0	35.7	40.7	108.5	500.0	-13.3
7320.000	H	170.0	3.5	51.0	-20.0	37.1	3.3	35.6	35.8	61.7	500.0	-18.2
12200.000	H	180.0	2.6	47.7	-20.0	40.0	4.2	35.6	36.2	64.6	500.0	-17.8
Peak Unit On Side												
4880.000	V	90.0	3.6	62.5	0.0	32.6	2.0	35.7	61.4	1172.2	5000.0	-12.6
7320.000	V	200.0	3.3	51.7	0.0	37.1	3.3	35.6	56.5	666.3	5000.0	-17.5
12200.000	V	180.0	3.2	48.2	0.0	40.0	4.2	35.6	56.7	684.5	5000.0	-17.3
Average	V											
4880.000	V	90.0	3.6	62.5	-20.0	32.6	2.0	35.7	41.4	117.2	500.0	-12.6
7320.000	V	200.0	3.3	51.7	-20.0	37.1	3.3	35.6	36.5	66.6	500.0	-17.5
12200.000	V	180.0	3.2	48.2	-20.0	40.0	4.2	35.6	36.7	68.4	500.0	-17.3
Peak												
4880.000	H	220.0	3.3	60.2	0.0	32.6	2.0	35.7	59.1	896.4	5000.0	-14.9
7320.000	H	90.0	4.0	51.8	0.0	37.1	3.3	35.6	56.6	678.7	5000.0	-17.3
12200.000	H	180.0	2.8	48.8	0.0	40.0	4.2	35.6	57.3	735.9	5000.0	-16.6
Average												
4880.000	H	220.0	3.3	60.2	-20.0	32.6	2.0	35.7	39.1	89.6	500.0	-14.9
7320.000	H	90.0	4.0	51.8	-20.0	37.1	3.3	35.6	36.6	67.9	500.0	-17.3
12200.000	H	180.0	2.8	48.8	-20.0	40.0	4.2	35.6	37.3	73.6	500.0	-16.6
Peak Unit Upright												
4880.000	V	90.0	3.2	63.8	0.0	32.6	2.0	35.7	62.7	1361.5	5000.0	-11.3
7320.000	V	0.0	1.5	51.3	0.0	37.1	3.3	35.6	56.1	638.5	5000.0	-17.9
12200.000	V	90.0	3.3	49.7	0.0	40.0	4.2	35.6	58.2	813.5	5000.0	-15.8
Average	V											
4880.000	V	90.0	3.2	63.8	-20.0	32.6	2.0	35.7	42.7	136.1	500.0	-11.3
7320.000	V	0.0	1.5	51.3	-20.0	37.1	3.3	35.6	36.1	63.9	500.0	-17.9
12200.000	V	90.0	3.3	49.7	-20.0	40.0	4.2	35.6	38.2	81.3	500.0	-15.8
Peak				0.0								

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (dBµV)	Duty Cycle Corr. (dB)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
4880.000	H	120.0	2.6	62.8	0.0	32.6	2.0	35.7	61.7	1213.4	5000.0	-12.3
7320.000	H	90.0	3.2	49.5	0.0	37.1	3.3	35.6	54.3	519.0	5000.0	-19.7
12200.000	H	90.0	3.2	48.0	0.0	40.0	4.2	35.6	56.5	671.2	5000.0	-17.4
Average												
4880.000	H	120.0	2.6	62.8	-20.0	32.6	2.0	35.7	41.7	121.3	500.0	-12.3
7320.000	H	90.0	3.2	49.5	-20.0	37.1	3.3	35.6	34.3	51.9	500.0	-19.7
12200.000	H	90.0	3.2	48.0	-20.0	40.0	4.2	35.6	36.5	67.1	500.0	-17.4

Table 8: Radiated Emission Test Data, High Channel 2480MHz

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (dBµV)	Duty Cycle corr. (dB)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
Peak Unit Flat												
4960.000	V	180.0	2.7	61.5	0.0	32.7	2.0	35.8	60.5	1054.4	5000.0	-13.5
7440.000	V	180.0	2.1	49.3	0.0	37.1	3.6	35.6	54.4	526.8	5000.0	-19.5
12400.000	V	180.0	2.1	48.8	0.0	40.0	4.5	35.4	57.9	782.1	5000.0	-16.1
Average												
4960.000	V	180.0	2.7	61.5	-20.0	32.7	2.0	35.8	40.5	105.4	500.0	-13.5
7440.000	V	180.0	2.1	49.3	-20.0	37.1	3.6	35.6	34.4	52.7	500.0	-19.5
12400.000	V	180.0	2.1	48.8	-20.0	40.0	4.5	35.4	37.9	78.2	500.0	-16.1
Peak												
4960.000	H	180.0	2.5	64.8	0.0	32.7	2.0	35.8	63.8	1541.8	5000.0	-10.2
7440.000	H	120.0	2.5	49.8	0.0	37.1	3.6	35.6	54.9	558.0	5000.0	-19.0
12400.000	H	180.0	2.7	48.2	0.0	40.0	4.5	35.4	57.2	727.4	5000.0	-16.7
Average												
4960.000	H	180.0	2.5	64.8	-20.0	32.7	2.0	35.8	43.8	154.2	500.0	-10.2
7440.000	H	120.0	2.5	49.8	-20.0	37.1	3.6	35.6	34.9	55.8	500.0	-19.0
12400.000	H	180.0	2.7	48.2	-20.0	40.0	4.5	35.4	37.2	72.7	500.0	-16.7
Peak Unit On Side												
4960.000	V	120.0	2.0	61.8	0.0	32.7	2.0	35.8	60.8	1095.3	5000.0	-13.2
7440.000	V	120.0	3.1	49.8	0.0	37.1	3.6	35.6	54.9	558.0	5000.0	-19.0
12400.000	V	180.0	2.8	48.3	0.0	40.0	4.5	35.4	57.4	738.3	5000.0	-16.6
Average												
4960.000	V	120.0	2.0	61.8	-20.0	32.7	2.0	35.8	40.8	109.5	500.0	-13.2
7440.000	V	120.0	3.1	49.8	-20.0	37.1	3.6	35.6	34.9	55.8	500.0	-19.0
12400.000	V	180.0	2.8	48.3	-20.0	40.0	4.5	35.4	37.4	73.8	500.0	-16.6
Peak												
4960.000	H	180.0	2.5	61.5	0.0	32.7	2.0	35.8	60.5	1054.4	5000.0	-13.5
7440.000	H	20.0	3.4	51.5	0.0	37.1	3.6	35.6	56.6	678.6	5000.0	-17.3
12400.000	H	180.0	2.3	48.2	0.0	40.0	4.5	35.4	57.3	729.9	5000.0	-16.7

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (dBµV)	Duty Cycle corr. (dB)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
Average												
4960.000	H	180.0	2.5	61.5	-20.0	32.7	2.0	35.8	40.5	105.4	500.0	-13.5
7440.000	H	20.0	3.4	51.5	-20.0	37.1	3.6	35.6	36.6	67.9	500.0	-17.3
12400.000	H	180.0	2.3	48.2	-20.0	40.0	4.5	35.4	37.3	73.0	500.0	-16.7
Peak Unit Upright												
4960.000	V	120.0	2.2	68.0	0.0	32.7	2.0	35.8	67.0	2228.5	5000.0	-7.0
7440.000	V	120.0	1.6	48.0	0.0	37.1	3.6	35.6	53.1	453.6	5000.0	-20.8
12400.000	V	120.0	2.8	48.2	0.0	40.0	4.5	35.4	57.3	729.9	5000.0	-16.7
Average												
4960.000	V	120.0	2.2	68.0	-20.0	32.7	2.0	35.8	47.0	222.9	500.0	-7.0
7440.000	V	120.0	1.6	48.0	-20.0	37.1	3.6	35.6	33.1	45.4	500.0	-20.8
12400.000	V	120.0	2.8	48.2	-20.0	40.0	4.5	35.4	37.3	73.0	500.0	-16.7
Peak												
4960.000	H	170.0	1.2	63.8	0.0	32.7	2.0	35.8	62.8	1374.1	5000.0	-11.2
7440.000	H	180.0	1.2	48.8	0.0	37.1	3.6	35.6	53.9	497.3	5000.0	-20.0
12400.000	H	180.0	2.6	47.7	0.0	40.0	4.5	35.4	56.8	689.1	5000.0	-17.2
Average												
4960.000	H	170.0	1.2	63.8	-20.0	32.7	2.0	35.8	42.8	137.4	500.0	-11.2
7440.000	H	180.0	1.2	48.8	-20.0	37.1	3.6	35.6	33.9	49.7	500.0	-20.0
12400.000	H	180.0	2.6	47.7	-20.0	40.0	4.5	35.4	36.8	68.9	500.0	-17.2

5.7 Receiver Radiated Spurious Emissions: (FCC Part §15.209, RSS-Gen [7.2.3.2])

The EUT must comply with the requirements for radiated spurious emissions from the receiver. These emissions must meet the limits specified in §15.209 and RSS-Gen.

5.7.1 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 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.)

5.7.2 Test Summary

The EUT complied with the requirements for receiver radiated emissions IC RSS-Gen. FCC does not have a receiver requirement for receivers operating above 960MHz. The unit was scanned from 30 MHz to 7500 MHz.

5.7.3 Receiver Radiated Spurious Test Data

Table 9: Receiver Radiated Test Data

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)
UNIT UPRIGHT Worst Case										
32.950	V	270.0	1.0	11.5	17.9	0.3	29.7	30.5	100.0	-10.3
43.380	V	90.0	1.0	11.1	10.9	0.7	22.7	13.7	100.0	-17.3
52.260	V	180.0	1.2	15.6	7.6	1.6	24.8	17.4	100.0	-15.2
59.370	V	180.0	1.1	14.0	7.1	3.2	24.3	16.4	100.0	-15.7
75.530	V	0.0	1.2	11.1	7.6	2.5	21.2	11.5	100.0	-18.8
151.000	V	180.0	1.3	10.1	11.8	1.1	23.0	14.1	150.0	-20.5
43.540	H	0.0	3.6	6.1	10.9	0.7	17.7	7.6	100.0	-22.3
52.160	H	270.0	3.2	10.8	7.6	1.6	20.0	10.0	100.0	-20.0
62.800	H	90.0	3.7	6.6	7.1	3.2	16.9	7.0	100.0	-23.1
74.340	H	45.0	3.4	4.8	7.6	2.6	15.0	5.6	100.0	-25.0

5.8 Conducted Emissions

5.8.1 Requirements

Test Arrangement: Table Top

Compliance Standard: FCC Part 15 (7/2008), 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

5.8.2 Test Equipment

Test Name: **Conducted Emissions Voltage**		Test Date: **01/08/2009**	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
69	HP, 85650A	Adapter, QP	07/09/2009
71	HP, 85685A	Preselector, RF	07/09/2009
73	HP, 8568B	Analyzer, Spectrum	07/08/2009
53	HP, 11947A	Limiter, Transient	04/09/2009
125	Solar, 8028-50-TS-24-BNC	LISN	07/01/2009
126	Solar, 8028-50-TS-24-BNC	LISN	07/01/2009

5.8.3 Test Procedure

The requirements of FCC Part 15 (7/2008) call for the EUT to be 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 peripherals were placed on the table in accordance with ANSI C63.4-2003. Power and data cables were moved about to obtain maximum emissions.

The 50 Ω output of the LISN was connected to the input of the spectrum analyzer and the emissions in the frequency range of 150 kHz to 30 MHz were measured. The detector function was set to quasi-peak, 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.

5.8.4 Test Data

The EUT complied with the Class B Conducted Emissions requirements. Table 10 provides the test results for phase and neutral line power line conducted emissions. **Error! Reference source not found.** and **Error! Reference source not found.** show the conducted emission test configuration.

5.8.5 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 10: 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)
0.157	44.5	4.5	10.3	0.1	55.0	15.0	65.6	55.6	-10.6	-40.6
0.556	27.7	5.2	11.0	0.1	38.8	16.3	56.0	46.0	-17.2	-29.7
0.944	35.4	-5.5	11.4	0.1	46.9	6.0	56.0	46.0	-9.1	-40.0
1.159	20.1	15.4	11.5	0.2	31.7	27.0	56.0	46.0	-24.3	-19.0
4.082	15.5	3.0	12.1	0.4	28.0	15.5	56.0	46.0	-28.0	-30.5
12.097	8.3	1.7	12.4	1.0	21.7	15.1	60.0	50.0	-38.3	-34.9

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)
0.216	41.2	1.3	10.7	0.3	52.2	12.3	63.0	53.0	-10.8	-40.7
0.299	39.7	8.1	10.8	0.3	50.8	19.2	60.3	50.3	-9.5	-31.1
0.388	38.4	0.5	10.9	0.2	49.5	11.6	58.1	48.1	-8.7	-36.6
0.876	9.4	3.1	11.3	0.1	20.8	14.5	56.0	46.0	-35.2	-31.5
1.159	23.1	19.2	11.5	0.2	34.7	30.8	56.0	46.0	-21.3	-15.2
3.740	5.2	-5.8	12.0	0.4	17.6	6.6	56.0	46.0	-38.4	-39.4

Notes: A Calrad AC adapter Model number 45-753 DV-1212A output12Vdc 1.2A, was used to power the EUT.

Test Engineer(s): John Reidell

Test Date(s): 01/08/2009

