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FCC & Industry Canada Certification Test Report

For the

Matric Limited

CAN Bridge 500

FCC ID: K5B-CB500SR

IC ID: 3926A-CB500SR

WLL JOB# **10825**
April 8, 2009

Prepared for:

Matric Limited
2099 Hill City Road
Seneca, PA 16346

Prepared By:

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

ACCREDITED
Testing Certificate 2675.01

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FCC ID: K5B-CB500SR
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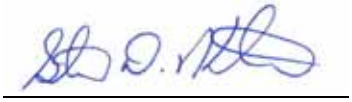
March 31, 2009

WLL JOB# 10825

Prepared by:

John P. Repella
EMC Compliance Engineer

Reviewed by:



Steven D. Koster
EMC Operations Manager

Abstract

This report has been prepared on behalf of Matric Limited to support the attached Application for Equipment Authorization. The test report and application are submitted for a Digitally Modulated Transmitter under Part 15.247 (10/2008) 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 CAN Bridge 500.

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 Matric Limited CAN Bridge 500 complies with the limits for a Digitally Modulated Transmission System under FCC Part 15.247 and Industry Canada RSS-210.

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1 Introduction

1.1 Compliance Statement

The Matric Limited CAN Bridge 500 complies with the limits for a Digitally Modulated Transmitter device under FCC Part 15.247 (10/2008) and Industry Canada RSS-210 issue 7.

1.2 Test Scope

Tests for radiated and conducted (at antenna terminal) emissions were performed. All measurements were performed in accordance with KDB Publication 558074 and the 2003 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Matric Limited 2099 Hill City Road Seneca, PA 16346
Purchase Order Number:	169895
Quotation Number:	64453A

1.4 Test Dates

Testing was performed on the following date(s):	3/03/09-3/19/09

1.5 Test and Support Personnel

Washington Laboratories, LTD	John P. Repella
Client Representative	Rick Rogers

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 Matric Limited CAN Bridge 500 functions as a wireless link that transfers CAN messages. Using the Wireless CAN Bridge, nodes on either side of a wireless link can communicate at a typical separation of 500 feet. Since actual CAN messages are transferred, the Wireless CAN Bridge supports any type of CAN bus standard.

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	Matric Limited
FCC ID:	K5B-CB500SR
IC:	IC: 3926A-CB500SR
Model:	CAN Bridge 500
FCC Rule Parts:	§15.247
Industry Canada:	RSS210
Frequency Range:	2405-2480MHz
Maximum Output Power:	1.12 mW (0.5 dBm) Conducted at antenna port
Modulation:	FSK
Occupied Bandwidth:	761.8 kHz
Keying:	Automatic
Type of Information:	CAN Bus Data
Number of Channels:	16
Power Output Level	Fixed
Antenna Connector	Reverse SMA
Antenna Type	full wave coaxial dipole
Antenna Gain	5.5dBi
Interface Cables:	5-pin DIN Com Port, Power
Power Source & Voltage:	7-30VDC
Receiver Spurious (worst Case)	65.7 µV/m @ 3m (54.66MHz)
Transmitter Spurious (worst Case)	276 uV/m @ 3m (12.4GHz w/Transmitter @2480MHz)
Emission Designator	761K8F1D

2.2 Test Configuration

The CAN Bridge 500 was configured with a lab power supply and controlled with a support laptop PC.

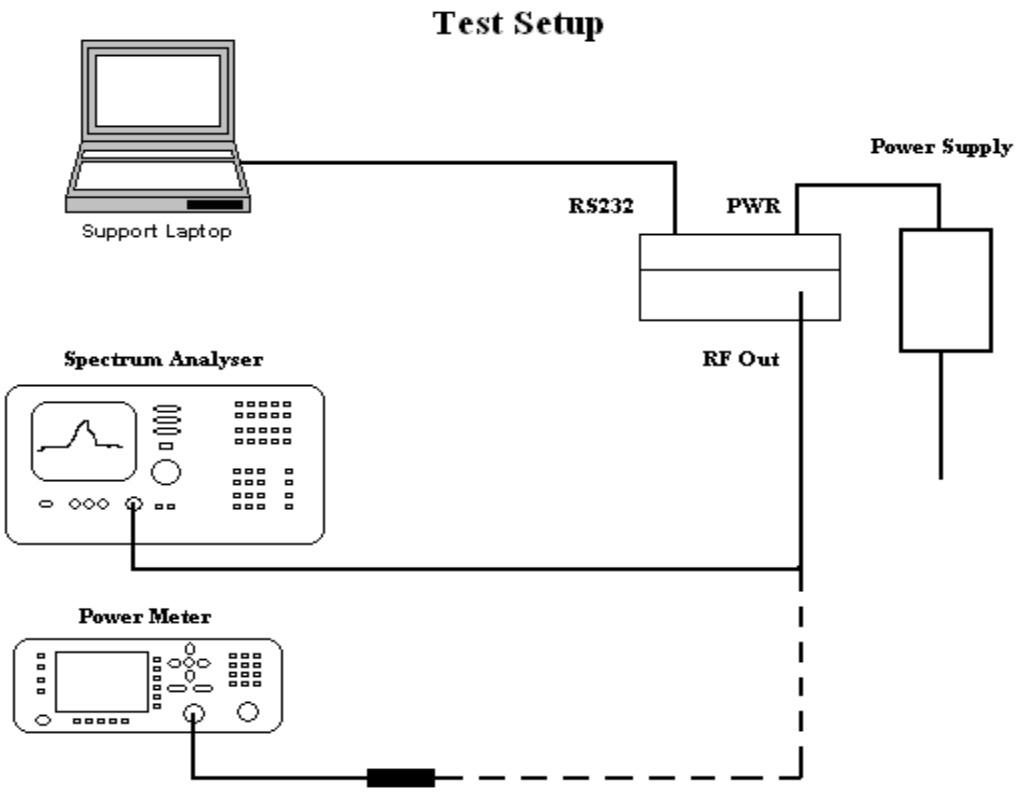

Figure 2-1: Test Configuration

2.3 Testing Algorithm

The CAN Bridge 500 was connected to a support PC via the serial port and setup for continuous transmission. The channel under test was set by sending commands via hyper-terminal.

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

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

KDB558074: "Measurement of Digital Transmission Systems operating under Section 15.247."

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 ±4.5 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 = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 4.55$ 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

Typical Equipment List

Test Name: **Conducted Emissions Voltage**		Test Date:	**03/19/2009**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
125	Solar, 8028-50-TS-24-BNC	LISN	07/01/2009
126	Solar, 8028-50-TS-24-BNC	LISN	07/01/2009
53	HP, 11947A	Limiter, Transient	04/09/2009
68	HP, 85650A	Adapter, QP	07/07/2009
72	HP, 8568B	Analyzer, Spectrum	07/03/2009
70	HP, 85685A	Preselector, RF w/opt 8ZE	07/07/2009
Test Name: **Radiated Emissions**		Test Date:	**03/9/2009**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
644	Sunol Science JB1	BiConalog Antenna	12/29/2009
4	ARA, DRG-118/A	Antenna, DRG, 1-18GHz	02/06/2011
69	HP, 85650A	Adapter, QP	07/09/2009
73	HP, 8568B	Analyzer, Spectrum	07/08/2009
71	HP, 85685A	Preselector, RF w/opt 8ZE	07/09/2009
528	Agilent, E4446A	Analyzer, Spectrum	04/24/2009
66	HP, 8449B	Pre-Amplifier, RF. 1-26.5GHz	07/15/2009
640	MegaPhase, TM40-K1K5-36	1-40GHz Cable	09/29/2009
Test Name: **Bench Emissions**		Test Date:	**03/19/2009**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
474	HP, 8563E	Analyzer, Spectrum	02/03/2011

4 Test Summary

The Table Below shows the results of testing for compliance with a Digital Transmission System (DTS) in accordance with FCC Part 15.247:2008 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	Pass
15.209	RSS-Gen [7.2.3.2]	General Field Strength Limits (Restricted Bands & RE Limits)	Pass

5 Test Results

5.1 Occupied Bandwidth: (FCC Part §15.247 (a)(2) & RSS-210 [A8. 2(a)])

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

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

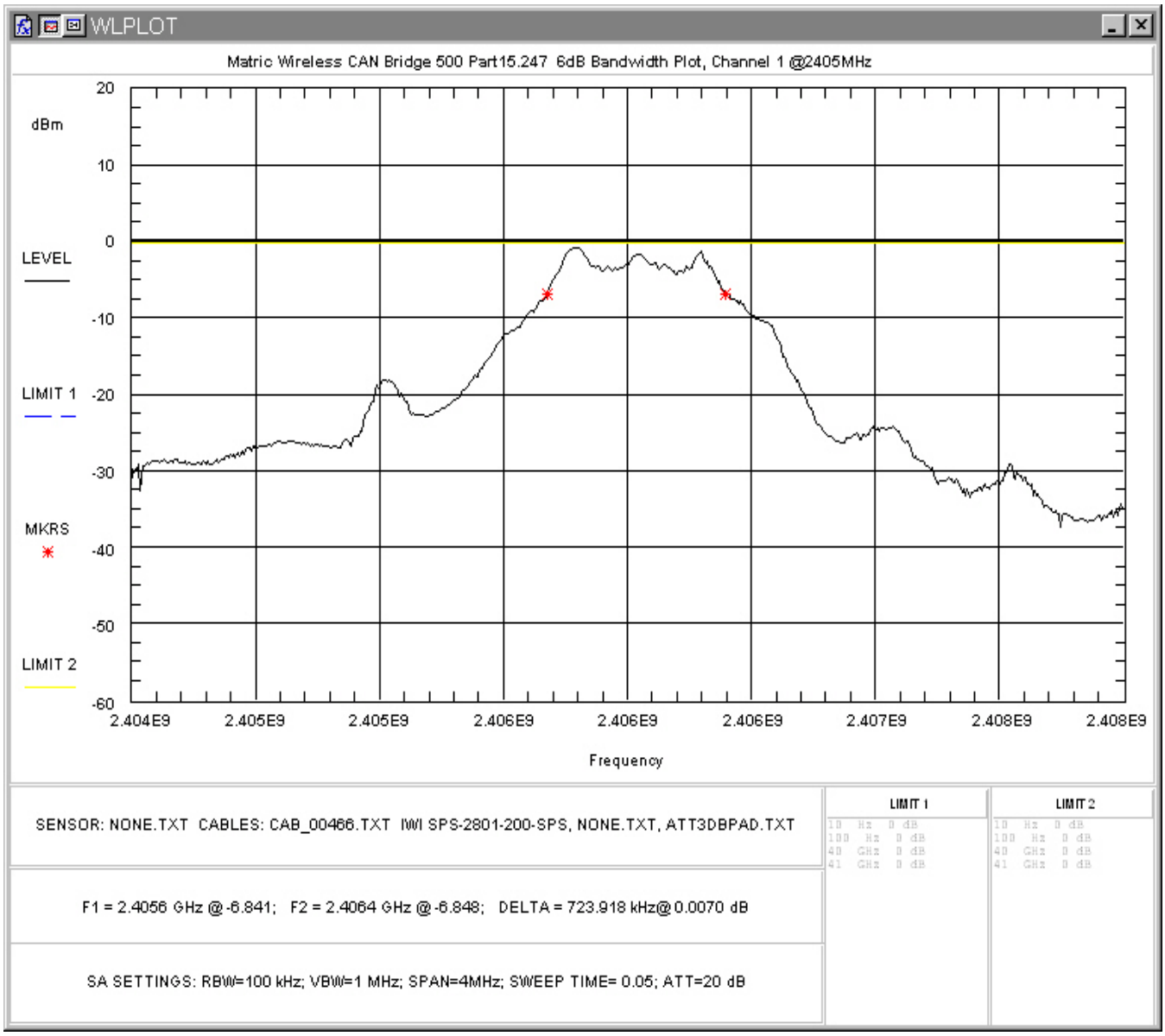

Figure 5-1: Occupied Bandwidth, Low Channel

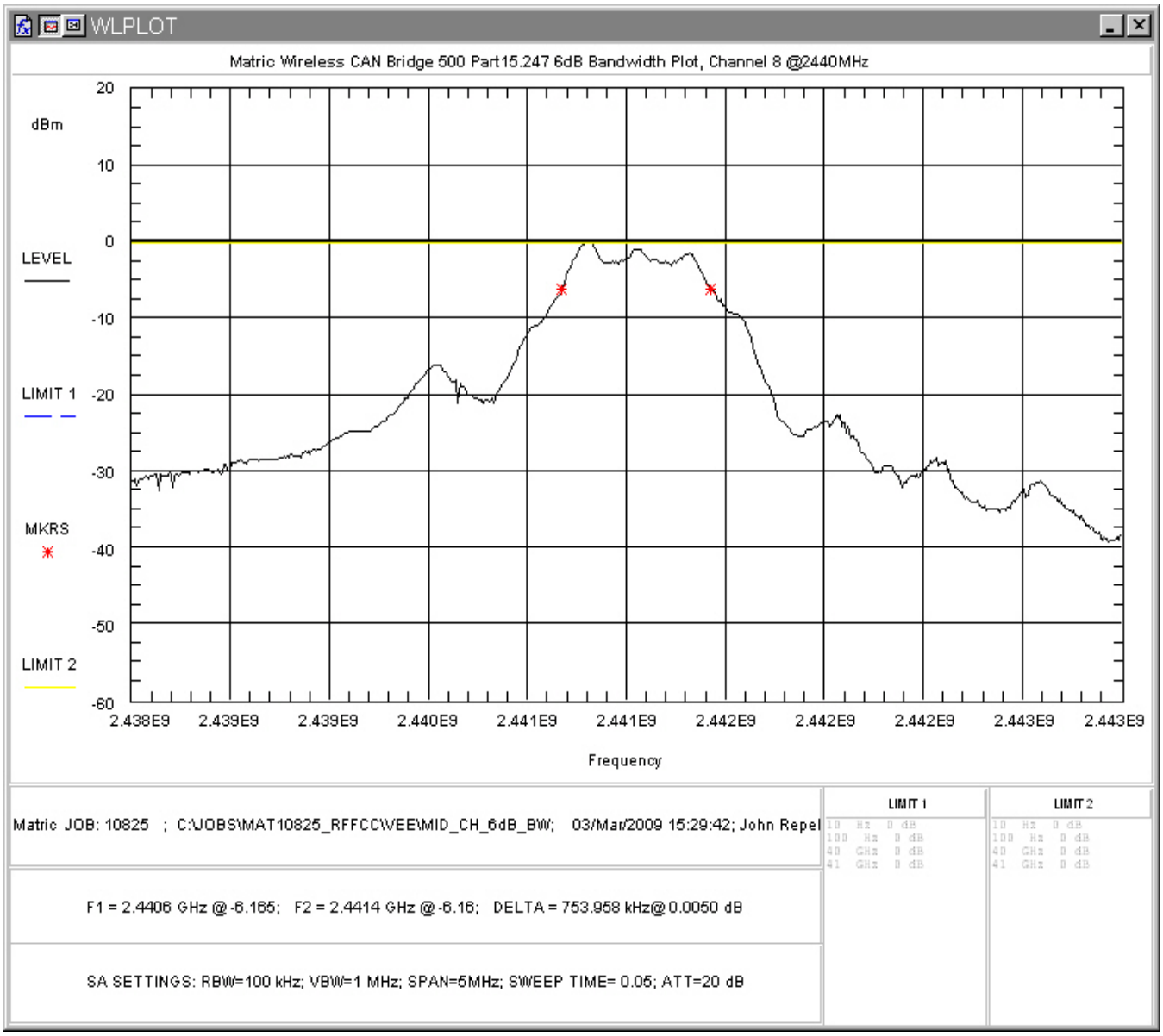

Figure 5-2: Occupied Bandwidth, Mid Channel

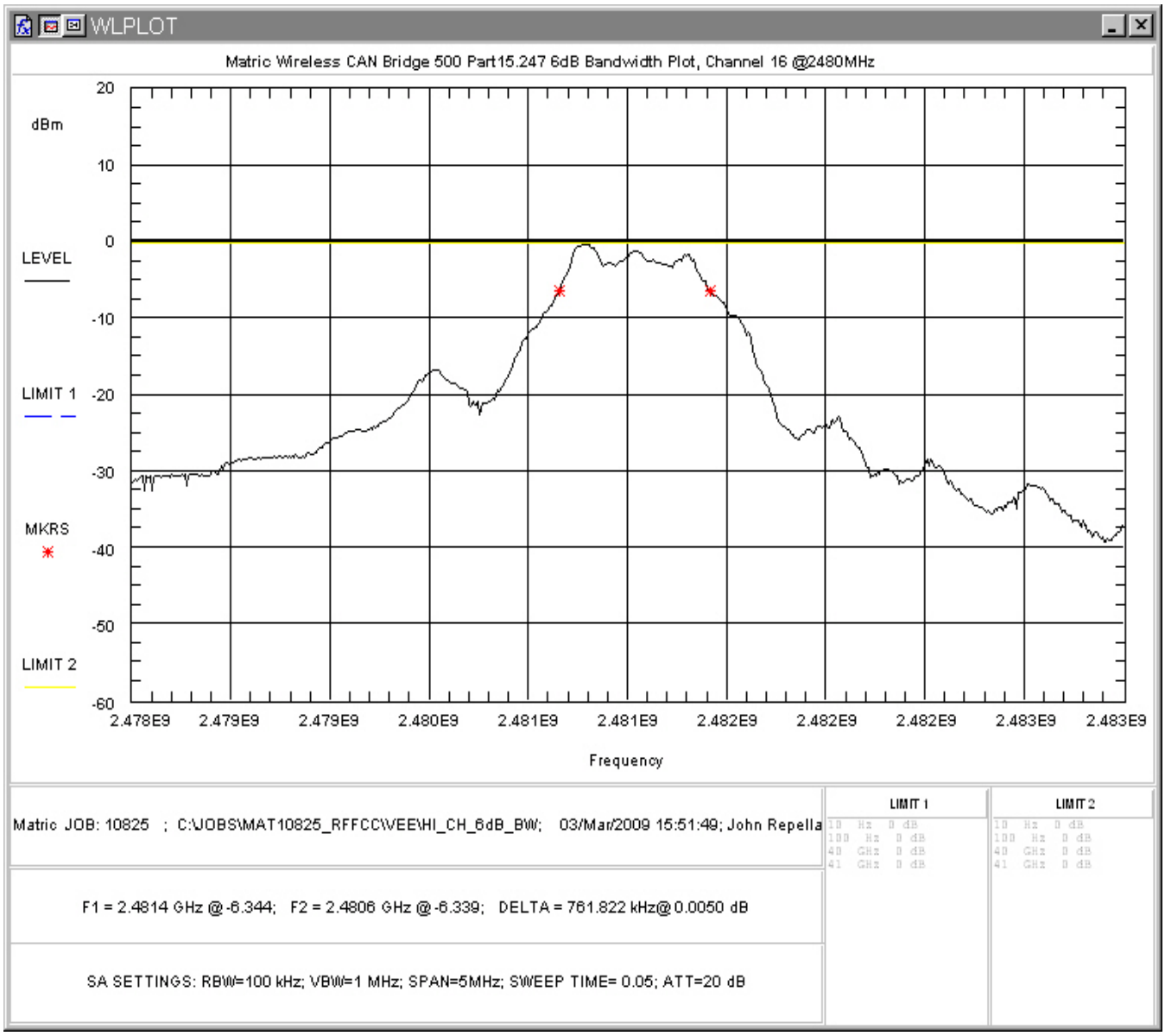

Figure 5-3: Occupied Bandwidth, High Channel

Table 4 provides a summary of the Occupied Bandwidth Results.

Table 4: Occupied Bandwidth Results

Frequency	Bandwidth
Low Channel: 2405MHz	723.918kHz
Mid Channel: 2441MHz	753.958kHz
High Channel: 2480MHz	761.822kHz

5.2 RF Power Output: (FCC Part §15.247 (b)(3) & RSS-210 [A8.4(4)])

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

Table 5: RF Power Output

Frequency	Level	Limit	Pass/Fail
Low Channel: 2405MHz	-0.16 dBm	30 dBm	Pass
Mid Channel: 2440MHz	0.50 dBm	30 dBm	Pass
High Channel: 2480MHz	0.34 dBm	30 dBm	Pass

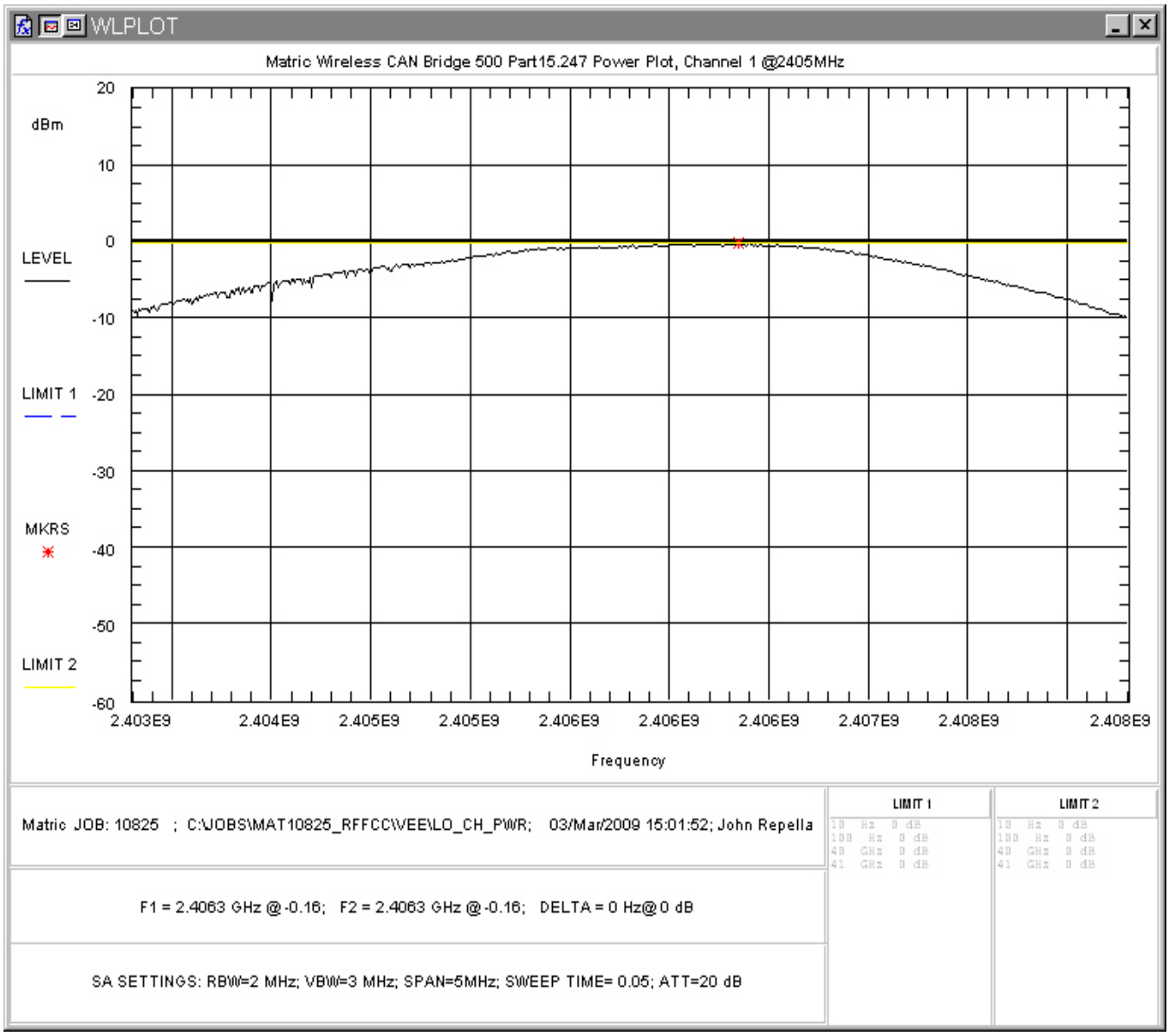

Figure 5-4: RF Peak Power, Low Channel

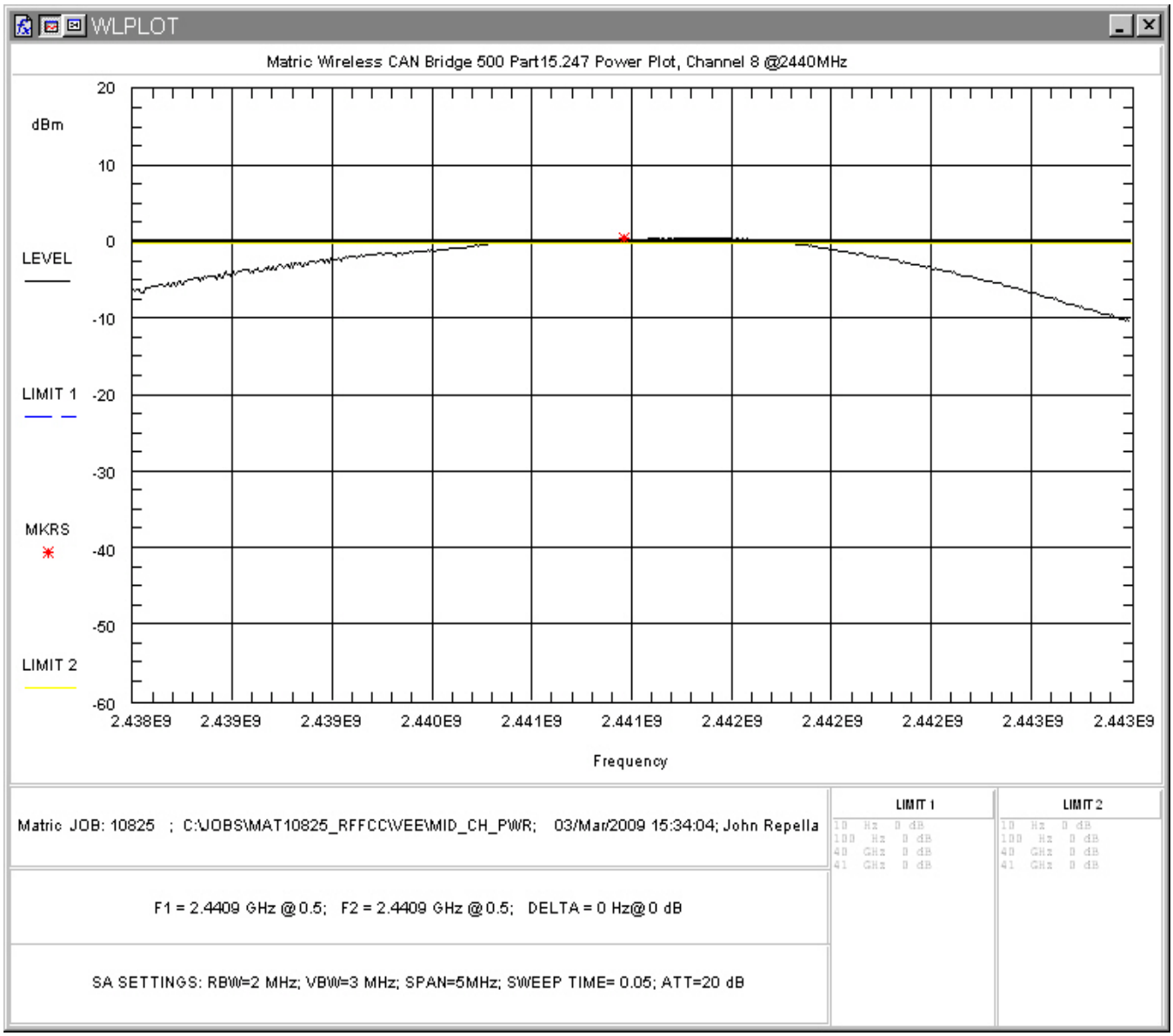

Figure 5-5: RF Peak Power, Mid Channel

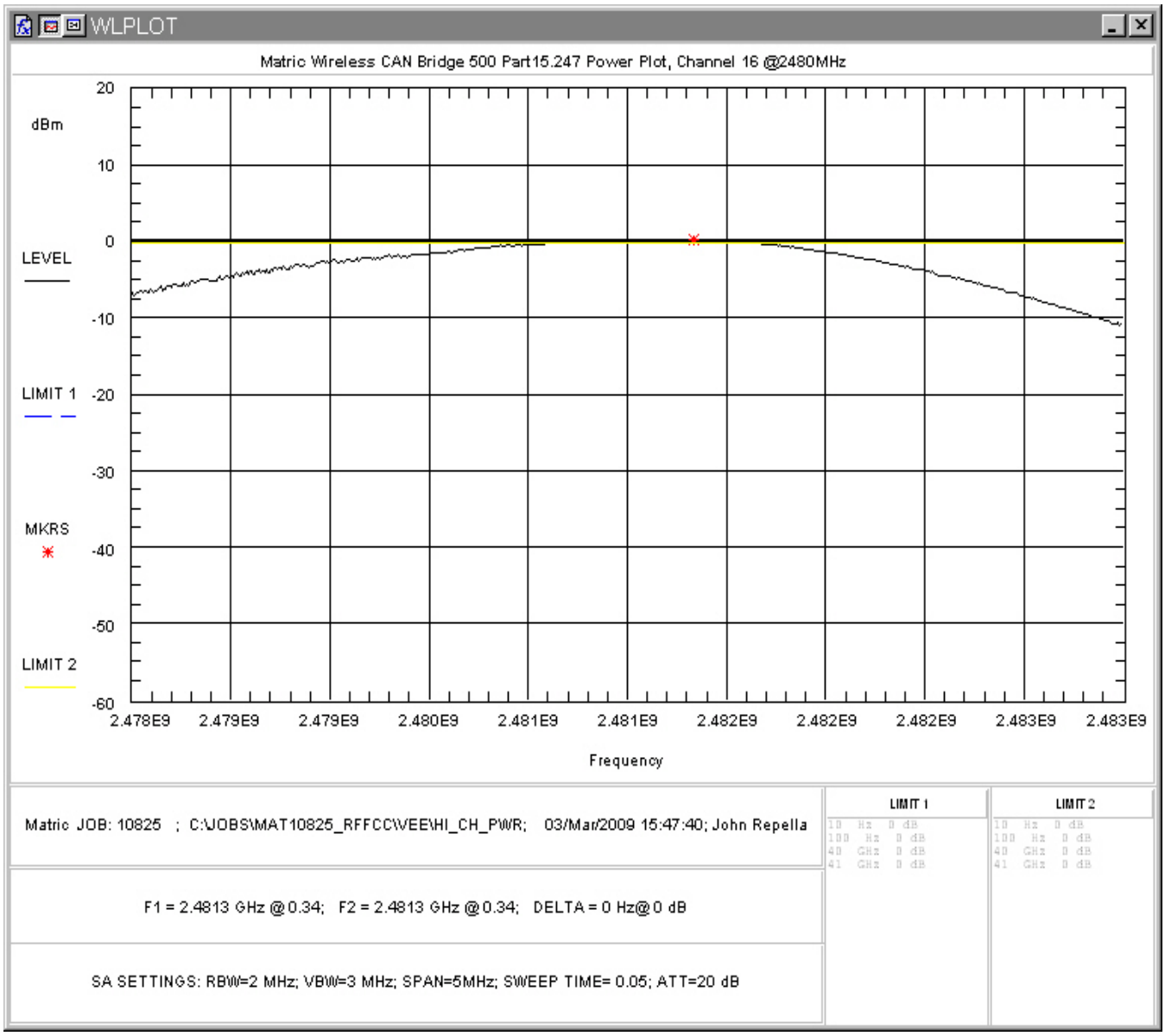

Figure 5-6: RF Peak Power, High Channel

5.3 RF Peak Power Spectral Density (§15.247 (e) & RSS-210 [A8.2 (b)])

For Digital Transmission 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 and lower channels. Plots of the PSD were taken as below. Table 6 provides a summary of the data.

Table 6: Power Spectral Density Results

Frequency	Level (dBm)	Limit (dBm)	Pass/Fail
Low Channel: 2405MHz	-7.66	8	Pass
Mid Channel: 2441MHz	-6.614	8	Pass
High Channel: 2480MHz	-7.00	8	Pass

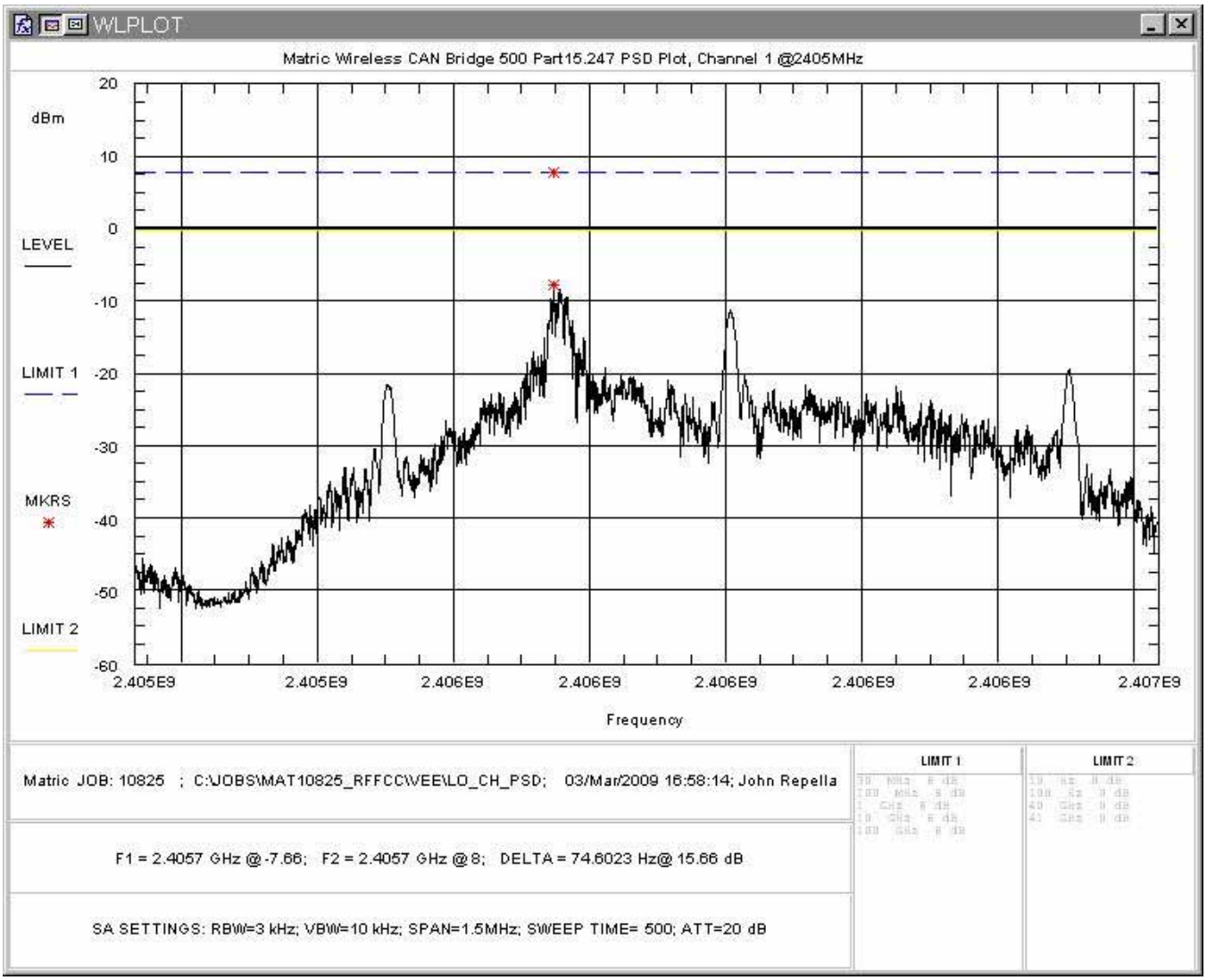

Figure 5-7: Power Spectral Density, Low Channel

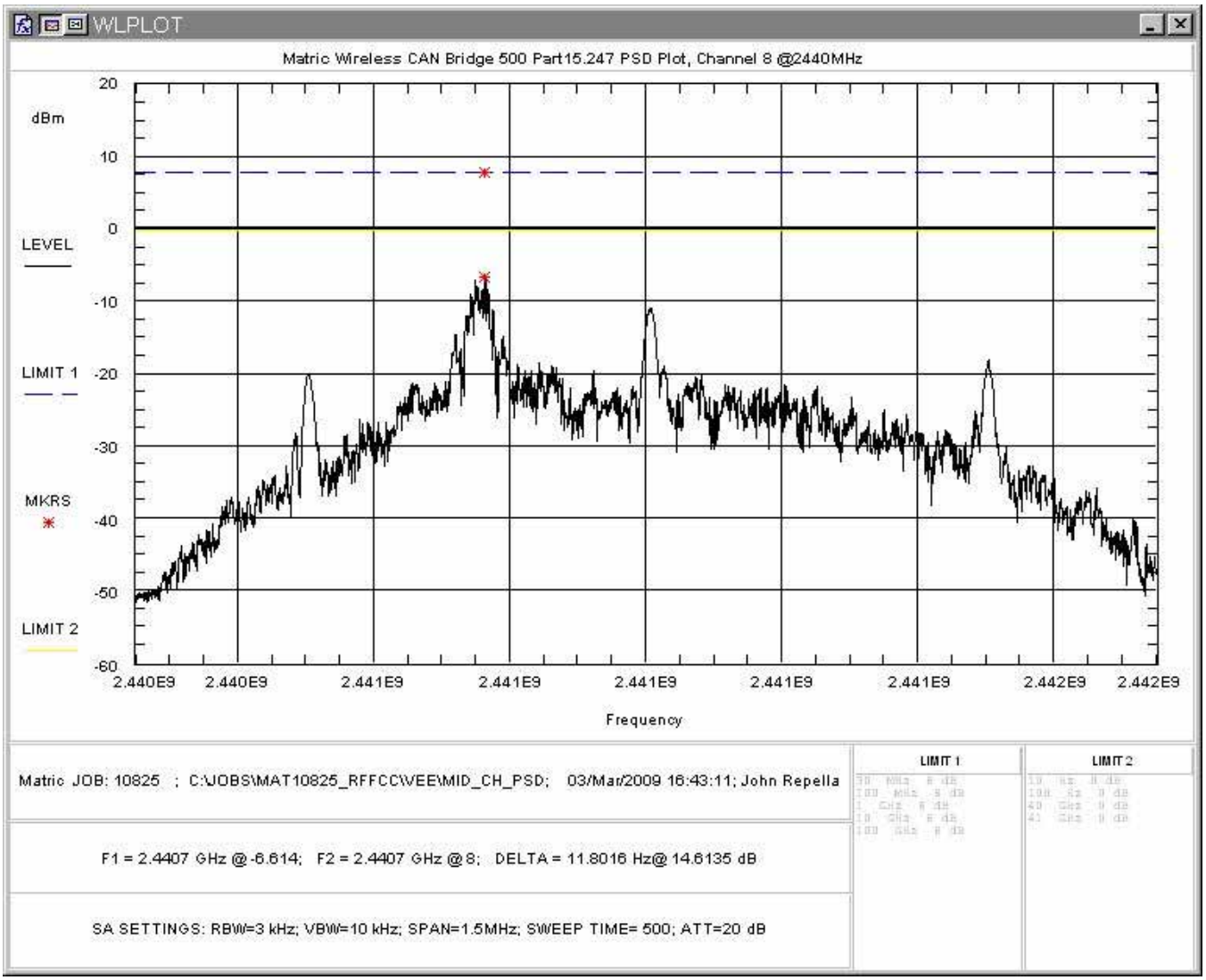

Figure 5-8: Power Spectral Density, Center Channel

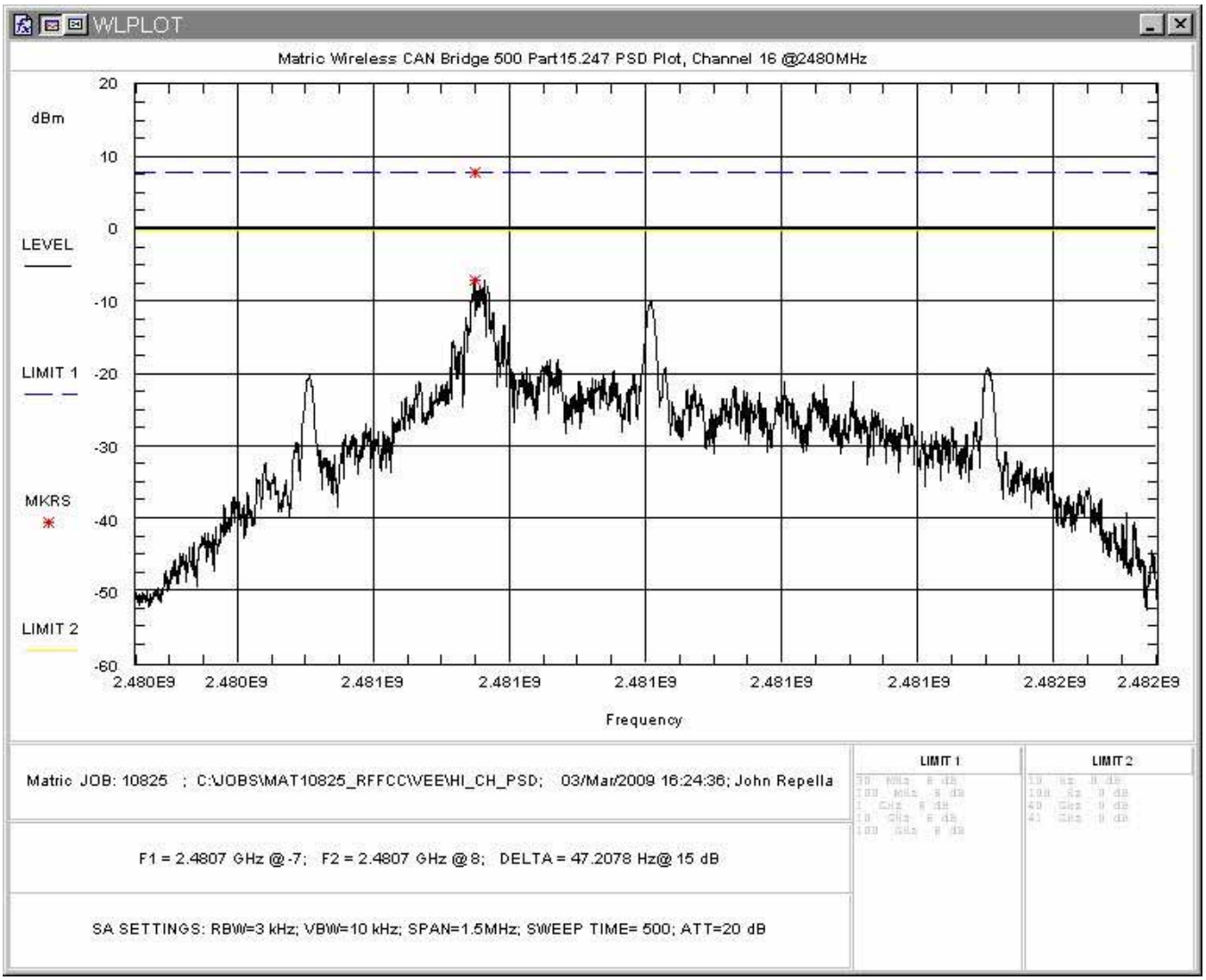

Figure 5-9: Power Spectral Density, High Channel

5.4 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.

Close-up plots of the 2400- 2483.5MHz band edges are provided to show compliance at both of these points

The following are plots of the conducted spurious emissions data.

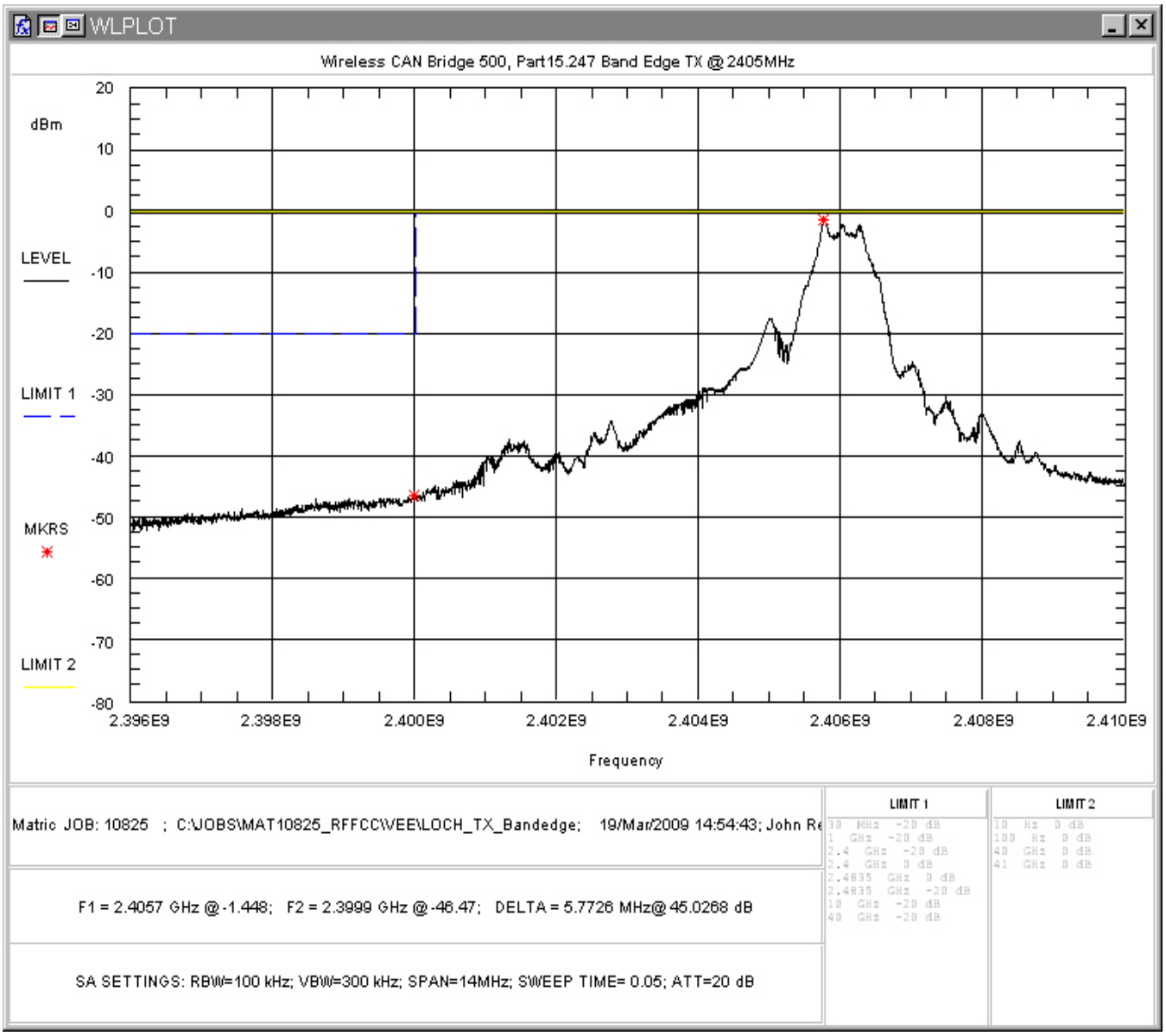

Figure 5-10: Lower Band Edge Plot

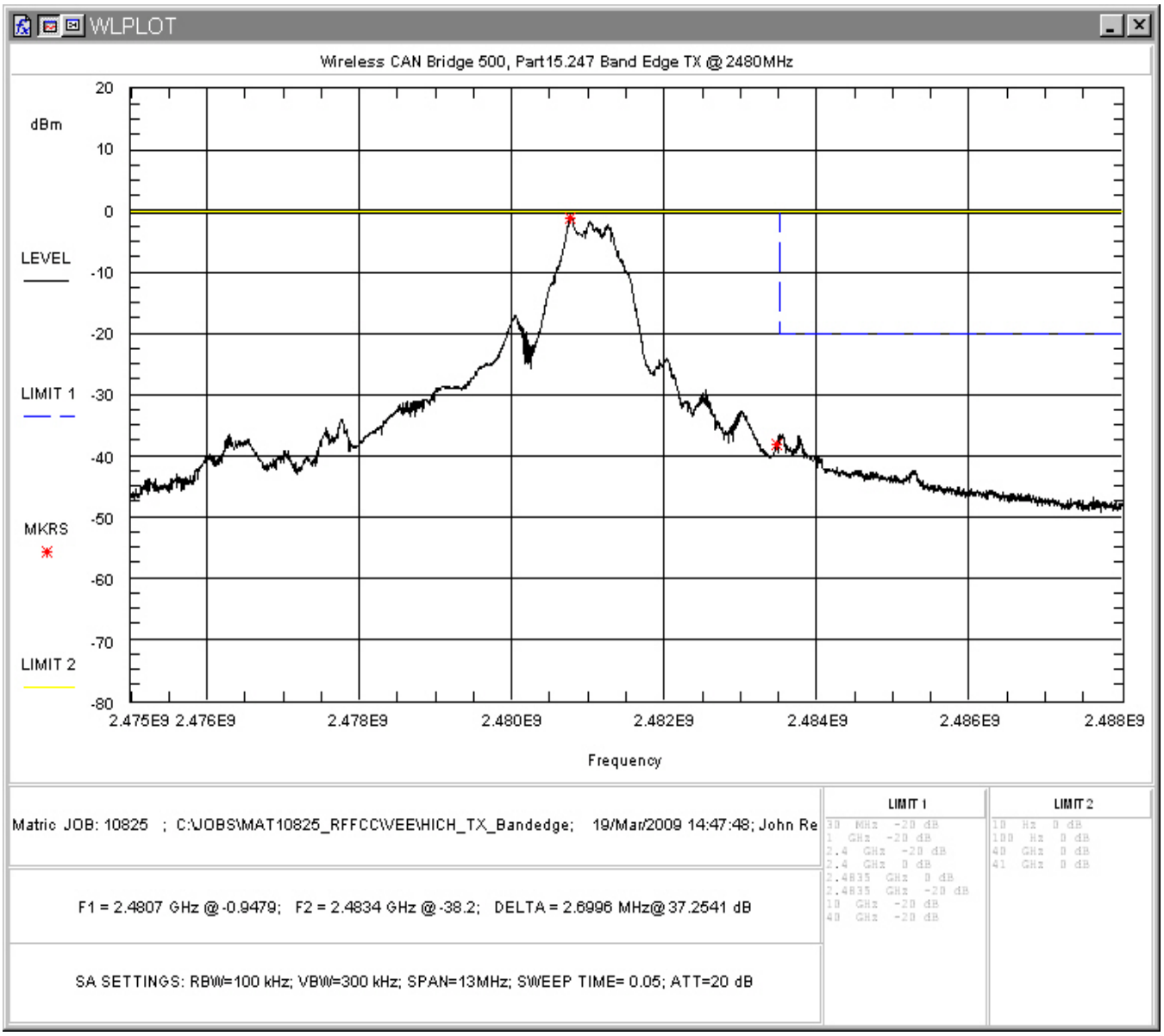

Figure 5-11: Upper Band Edge Plot

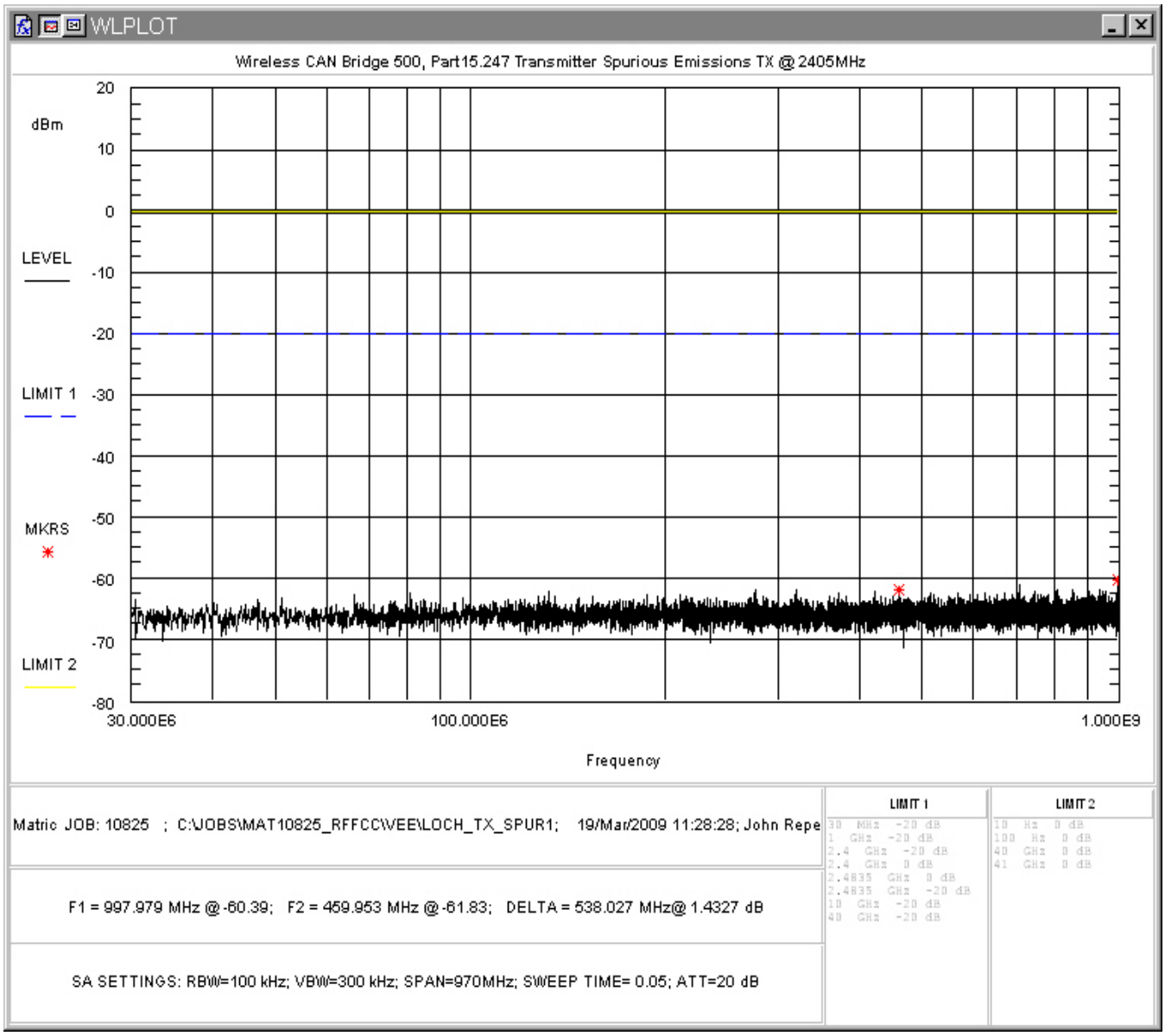

Figure 5-12: Conducted Spurious Emissions, Low Channel 30 - 1000MHz

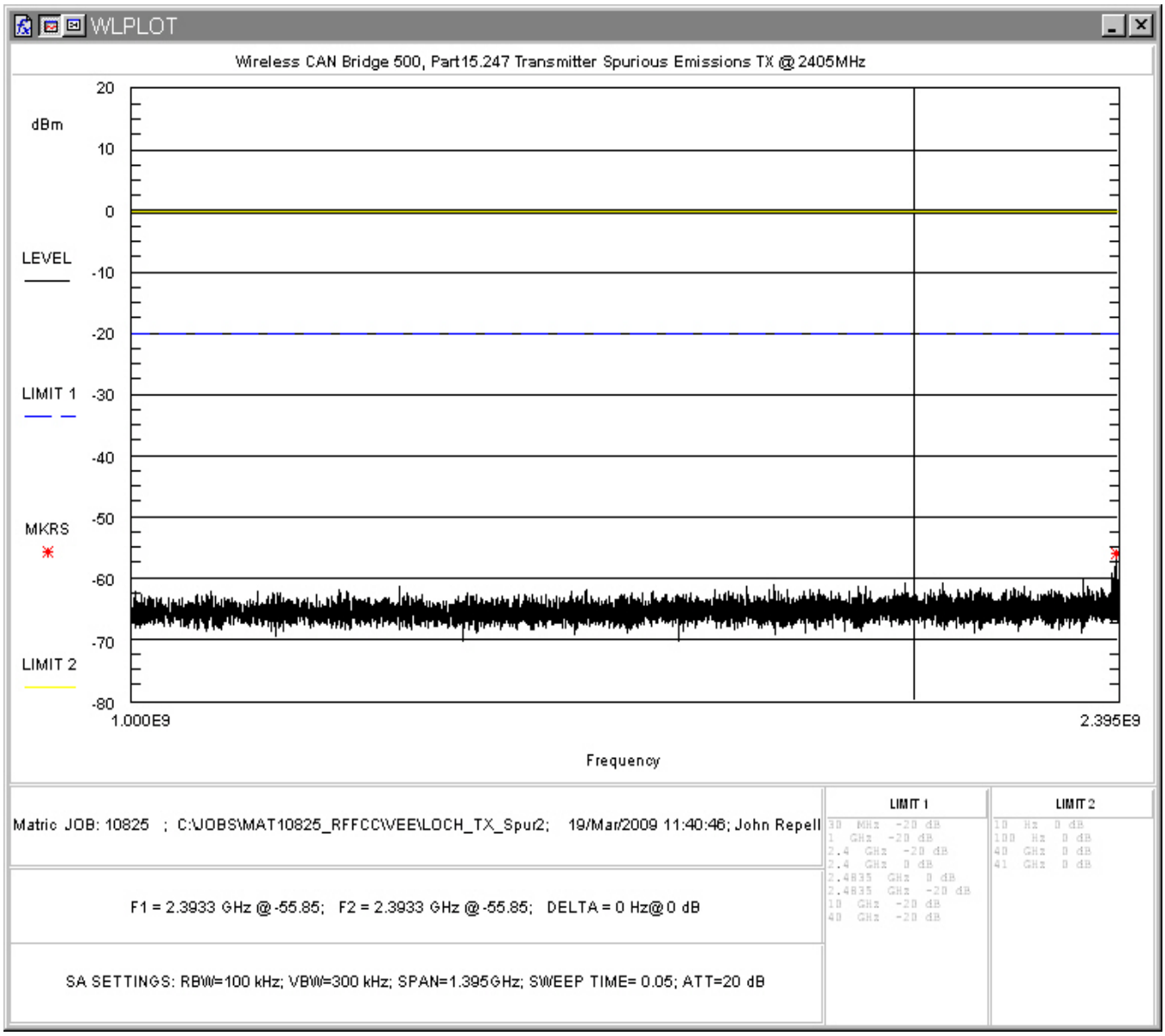

Figure 5-13: Conducted Spurious Emissions, Low Channel 1 – 2.395GHz

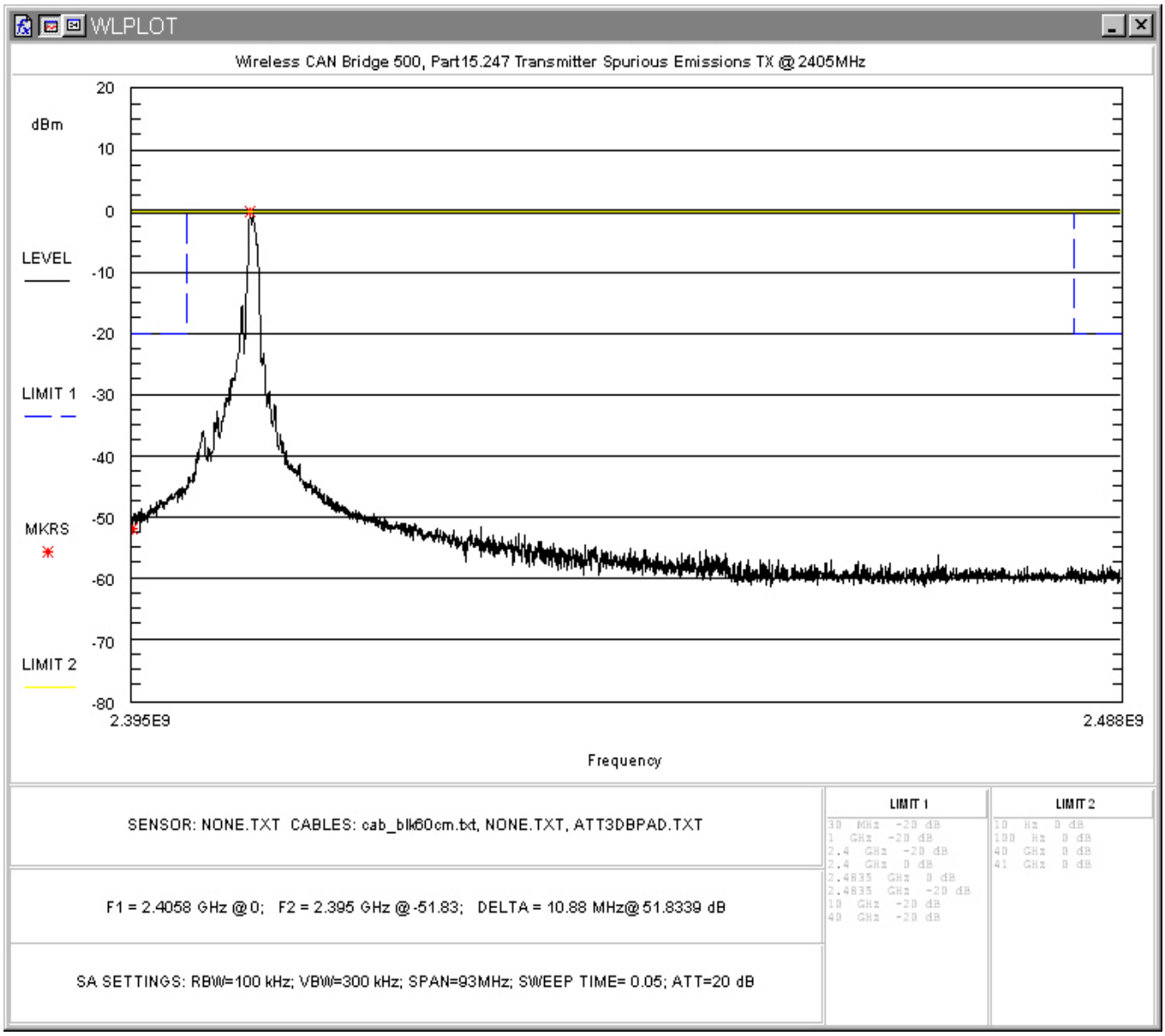

Figure 5-14: Conducted Spurious Emissions, Low Channel 2.395 – 2.488GHz

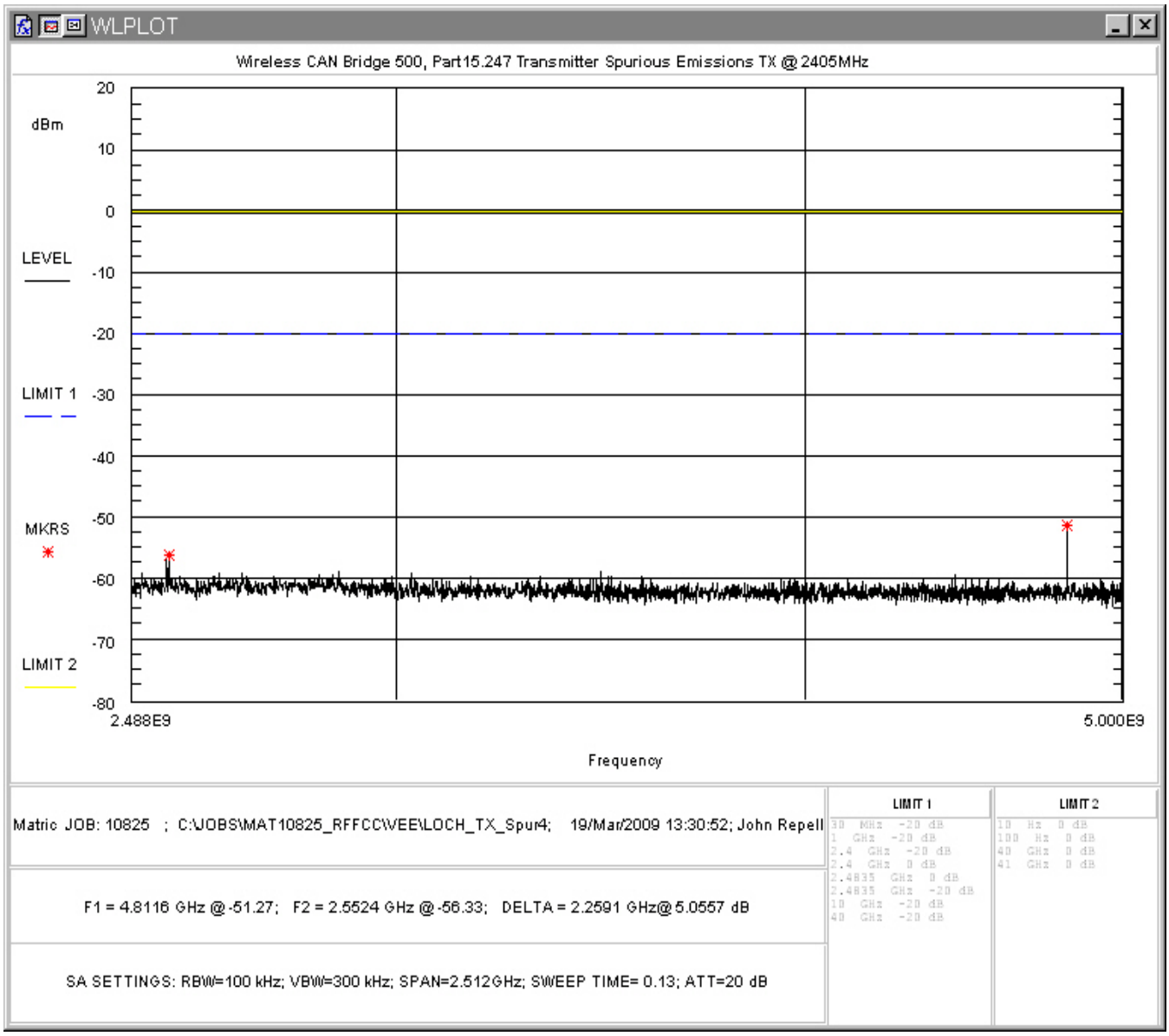

Figure 5-15: Conducted Spurious Emissions, Low Channel 2.488 - 5GHz

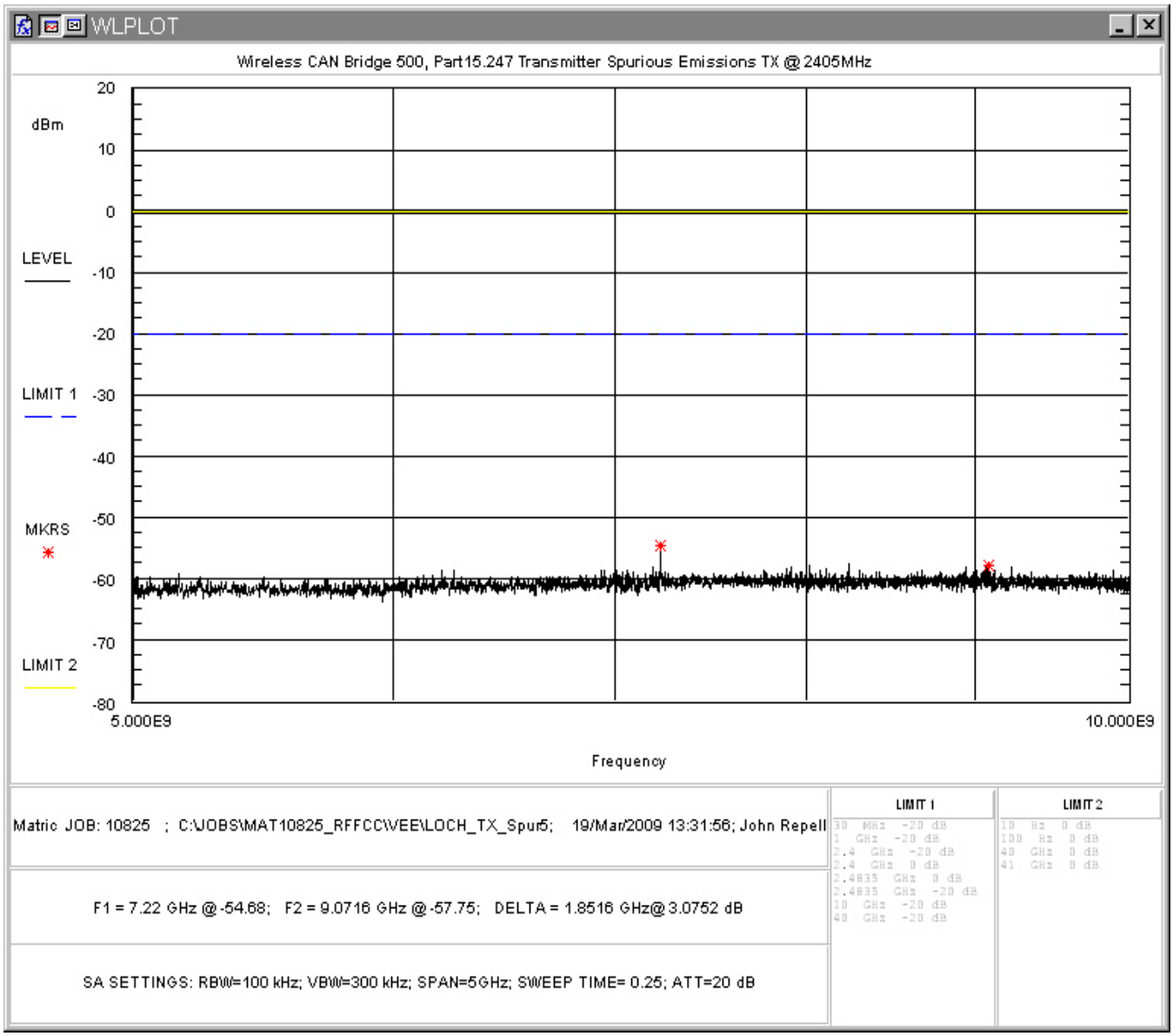

Figure 5-16: Conducted Spurious Emissions, Low Channel 5-10GHz

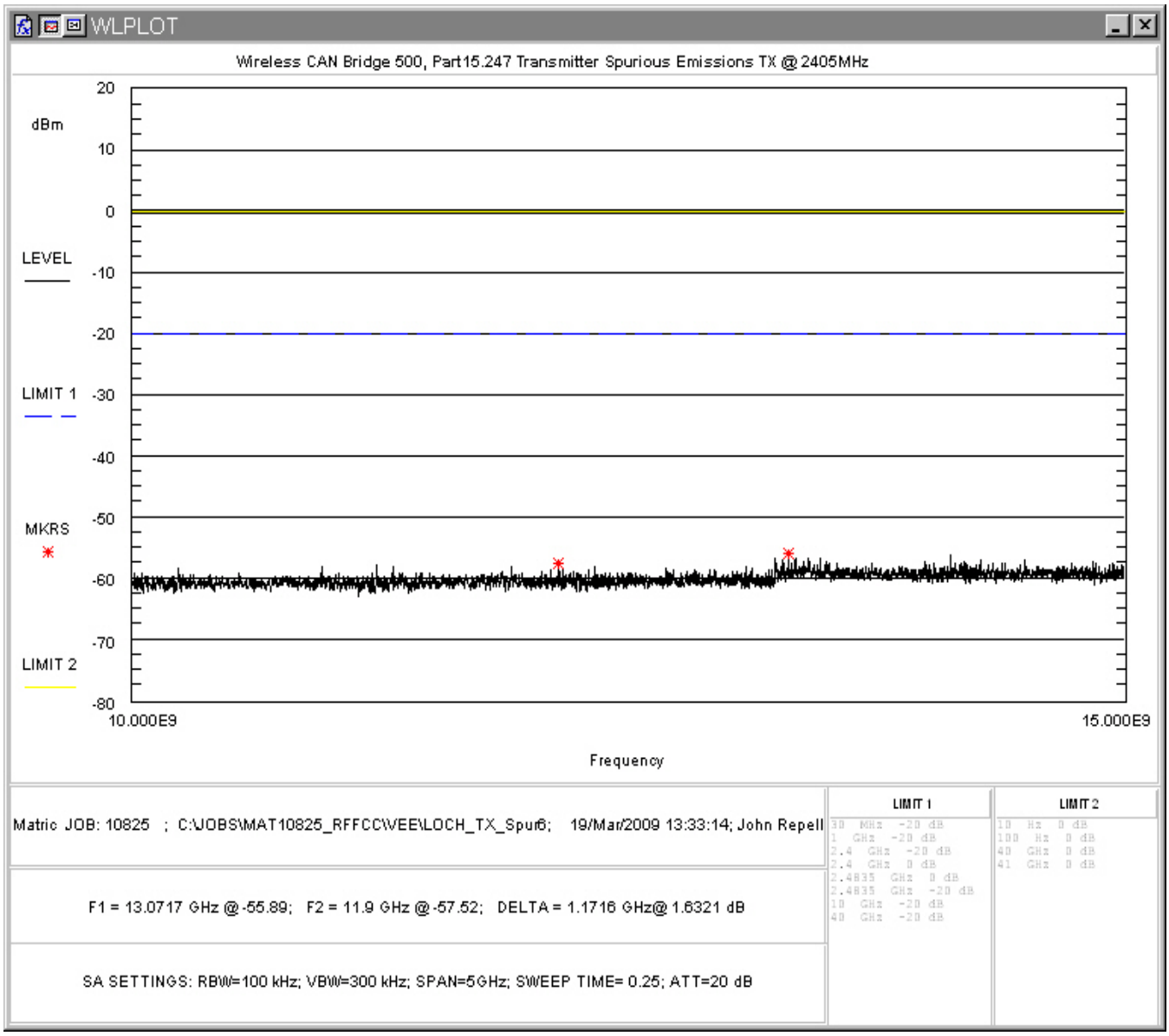

Figure 5-17: Conducted Spurious Emissions, Low Channel 10-15GHz

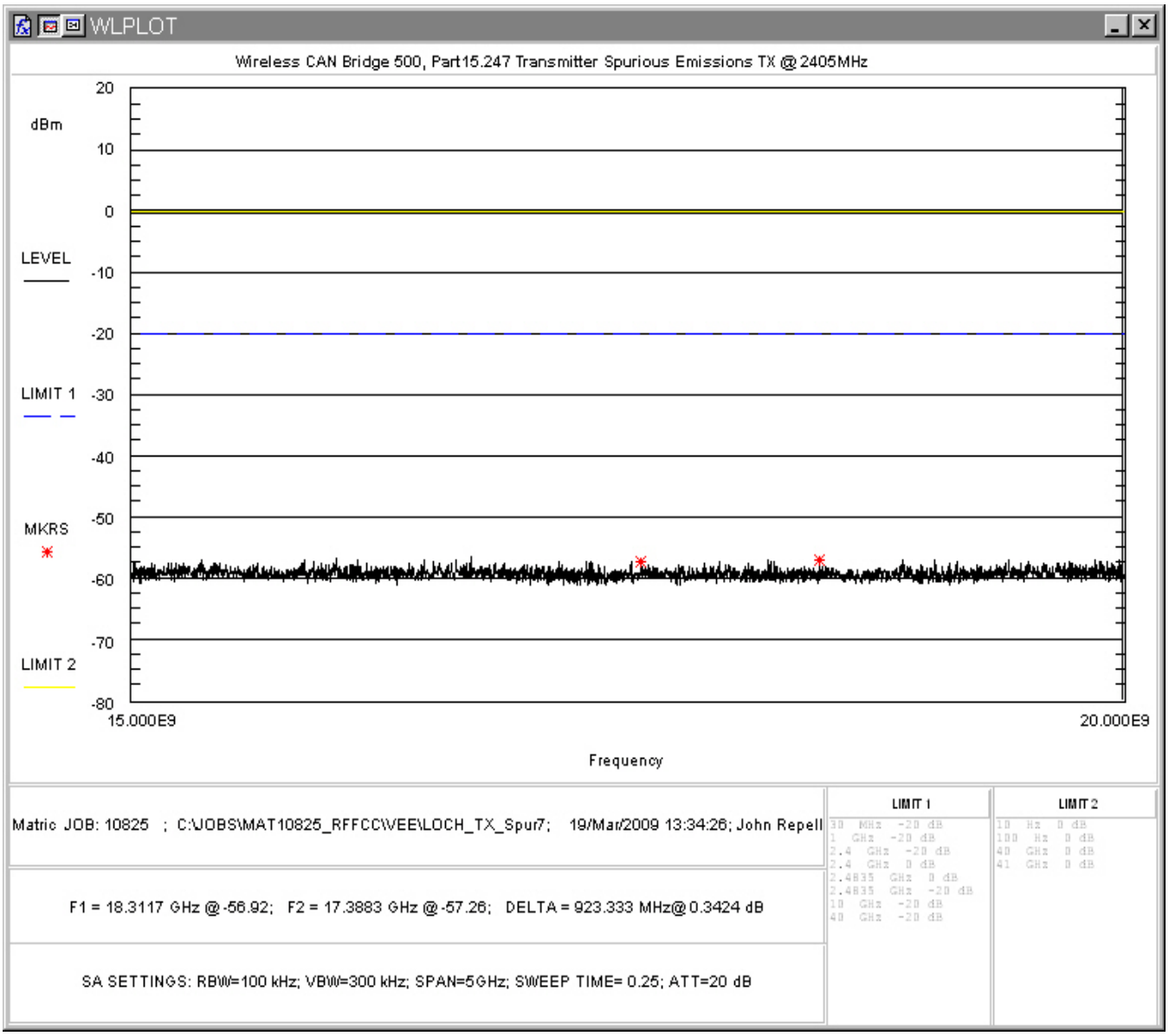

Figure 5-18: Conducted Spurious Emissions, Low Channel 15-20GHz

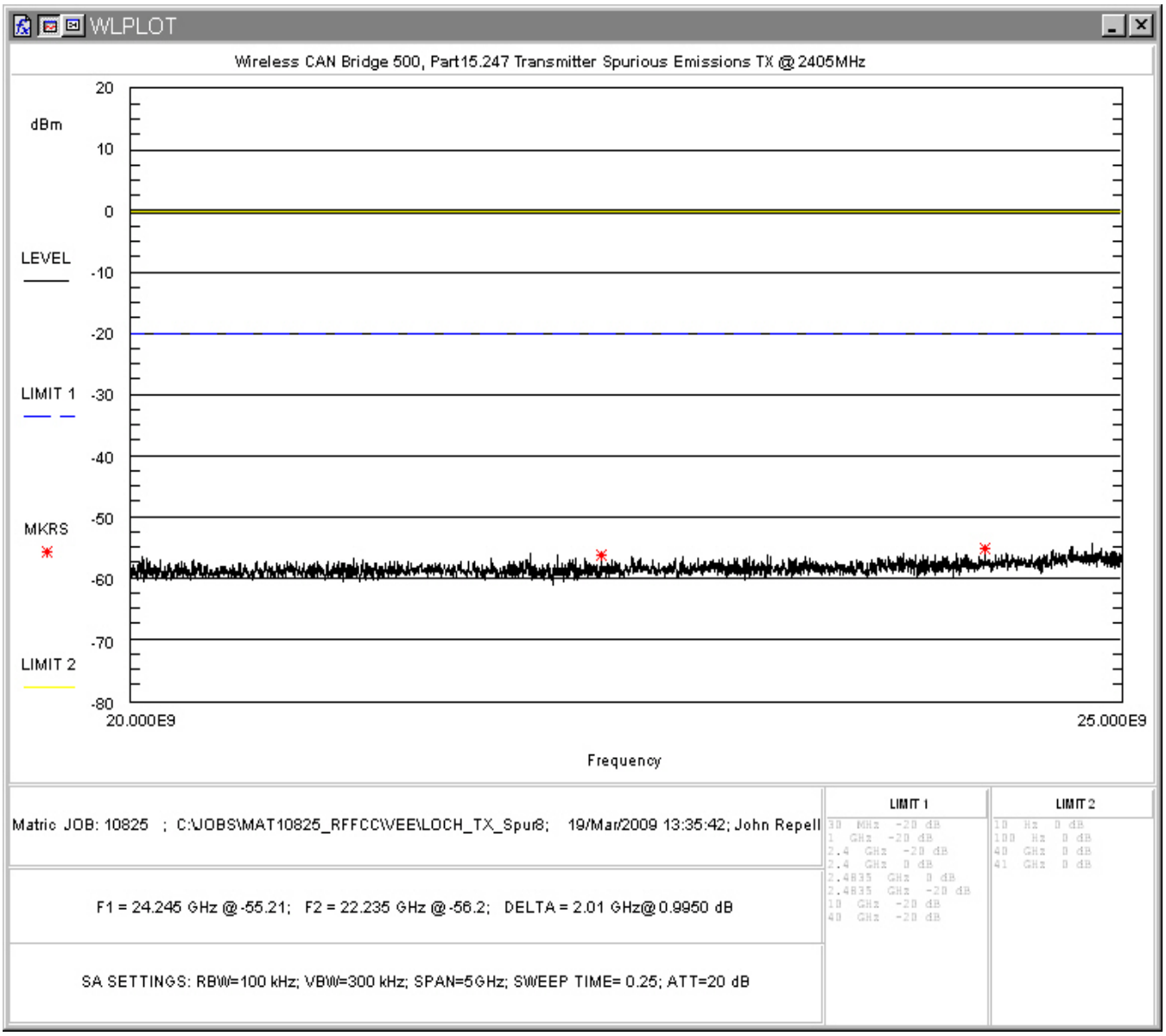

Figure 5-19: Conducted Spurious Emissions, Low Channel 20-25GHz

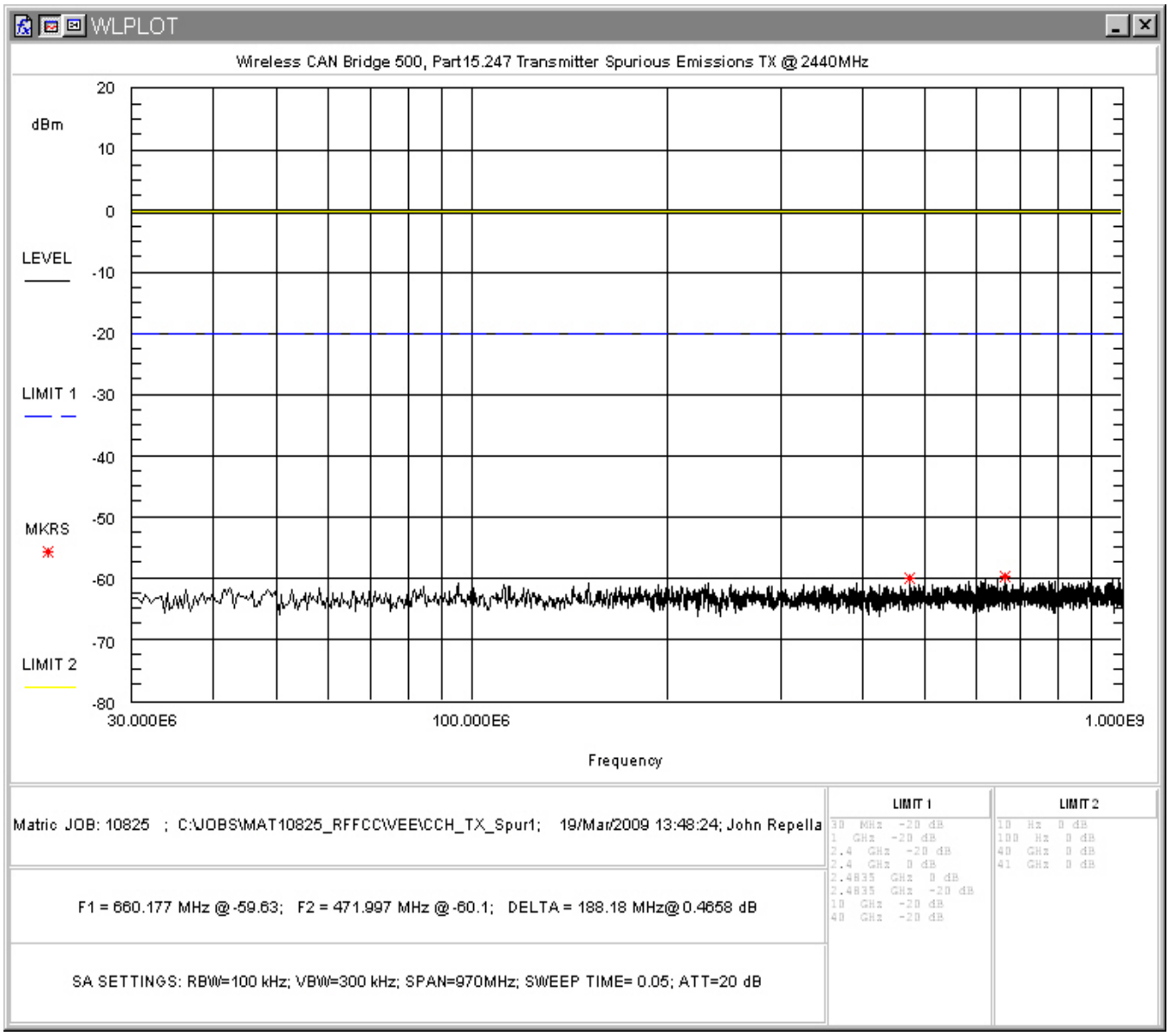

Figure 5-20: Conducted Spurious Emissions, Mid Channel 30 - 1000MHz

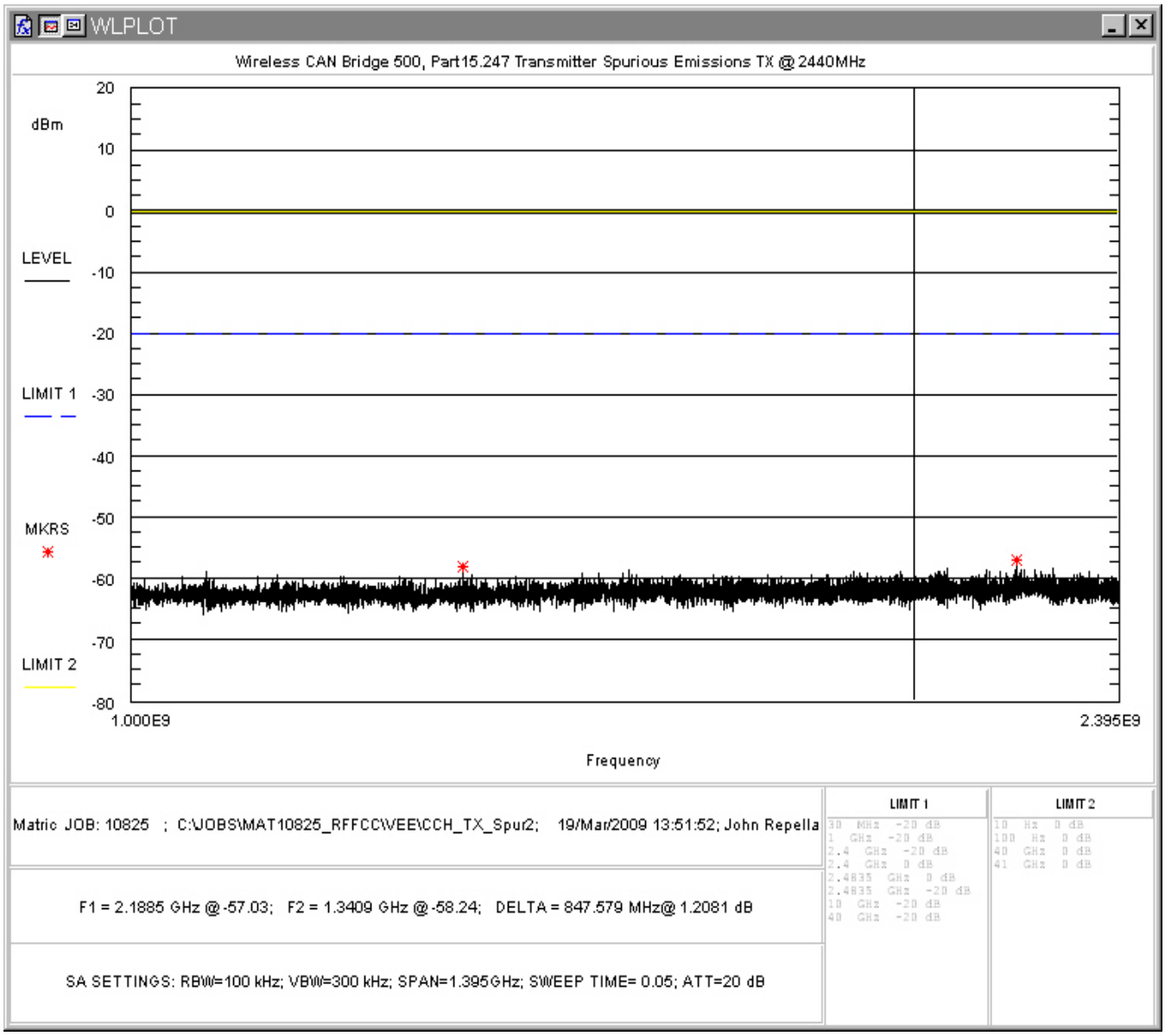

Figure 5-21: Conducted Spurious Emissions, Mid Channel 1 – 2.395GHz

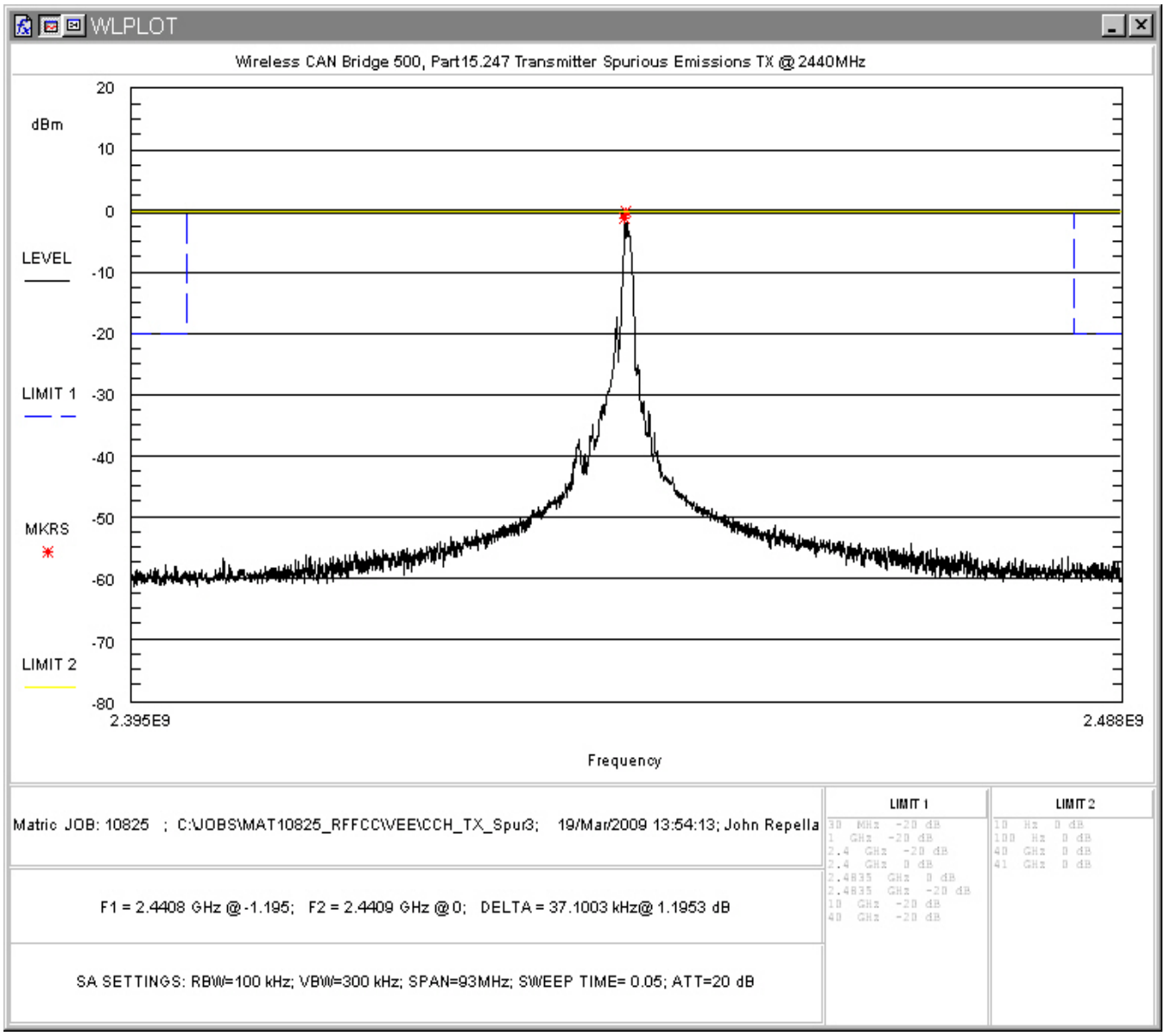

Figure 5-22: Conducted Spurious Emissions, Mid Channel 2.395 – 2.488GHz

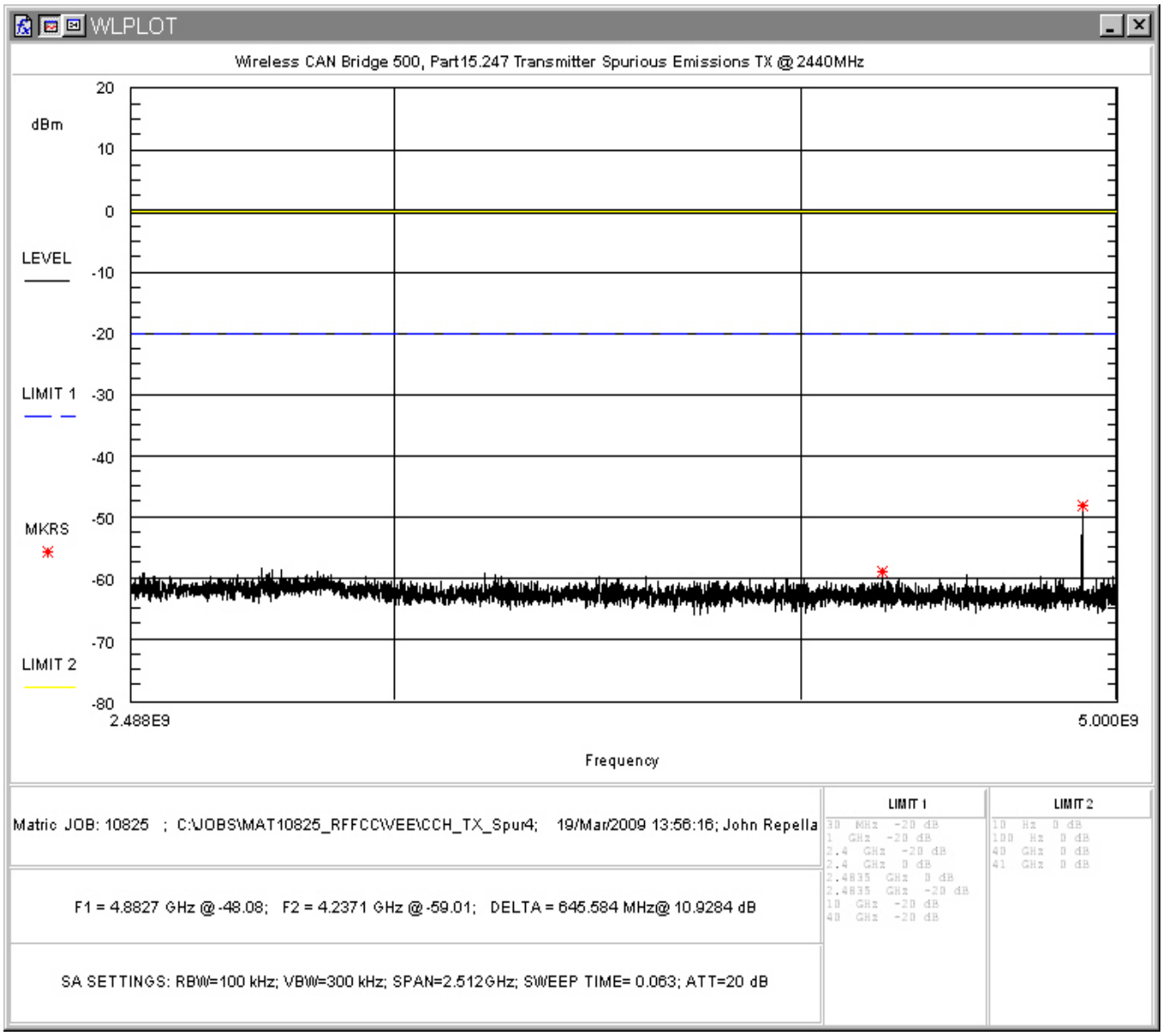

Figure 5-23: Conducted Spurious Emissions, Mid Channel 2.488 - 5GHz

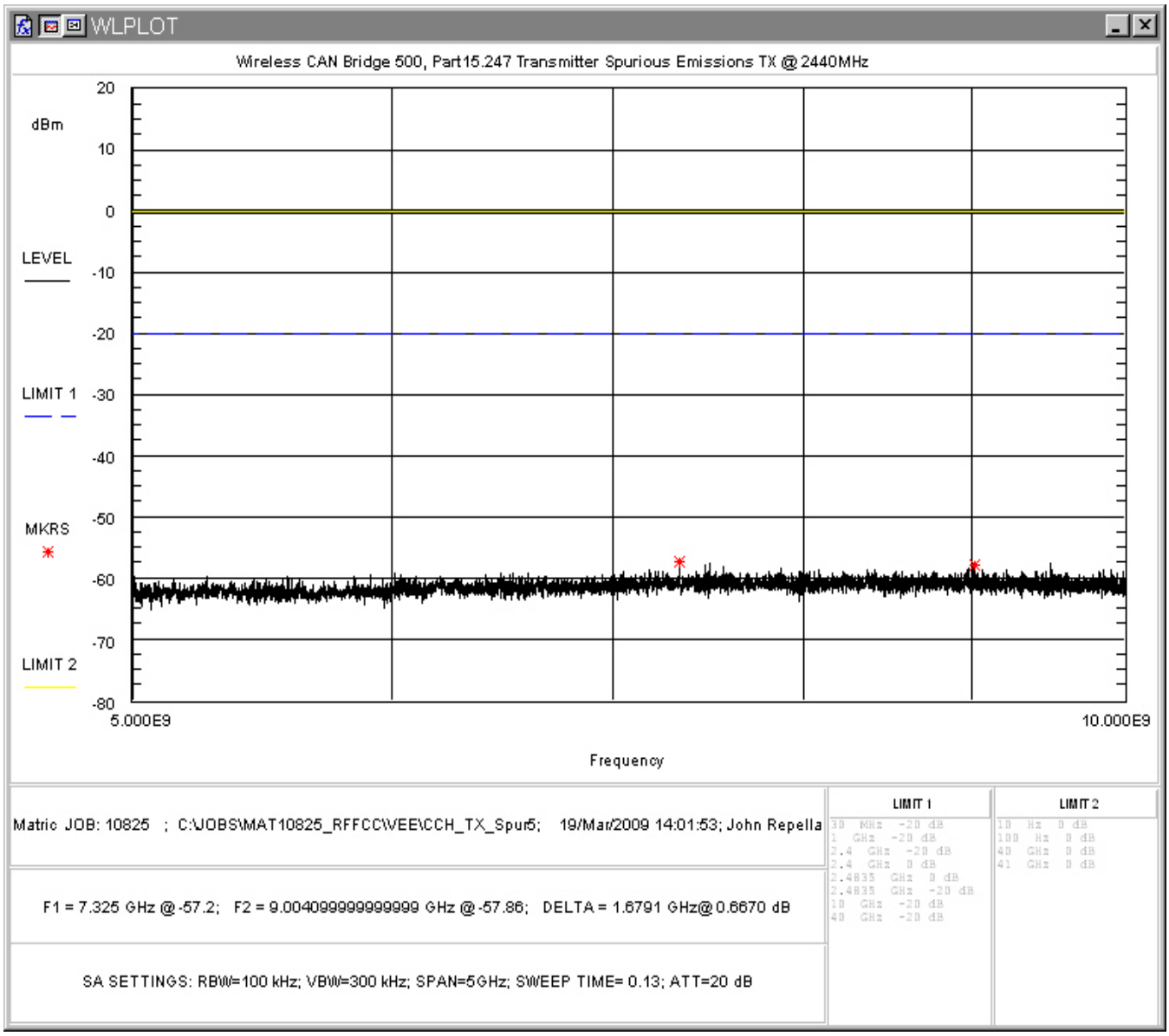

Figure 5-24: Conducted Spurious Emissions, Mid Channel 5 - 10GHz

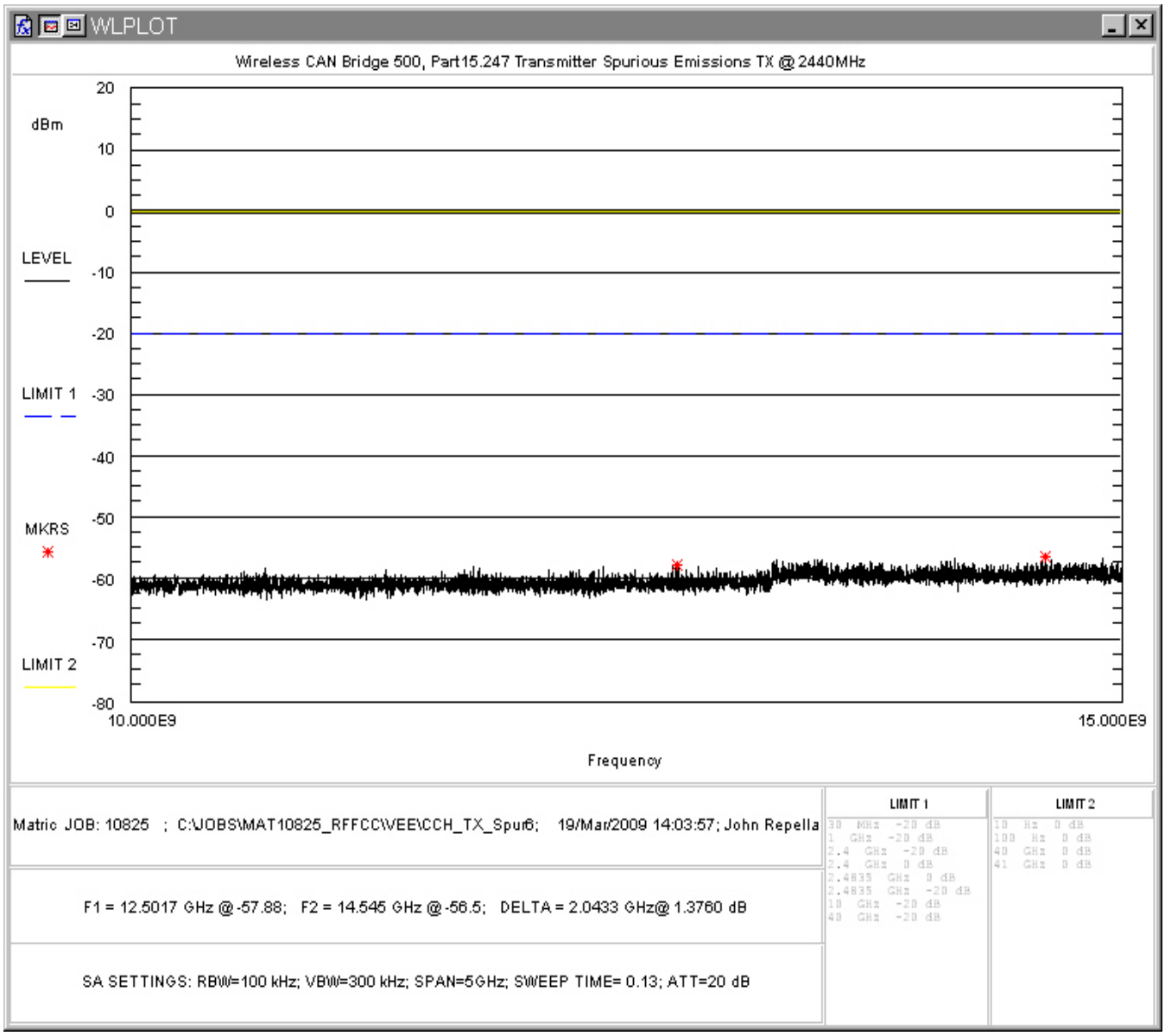

Figure 5-25: Conducted Spurious Emissions, Mid Channel 10-15GHz

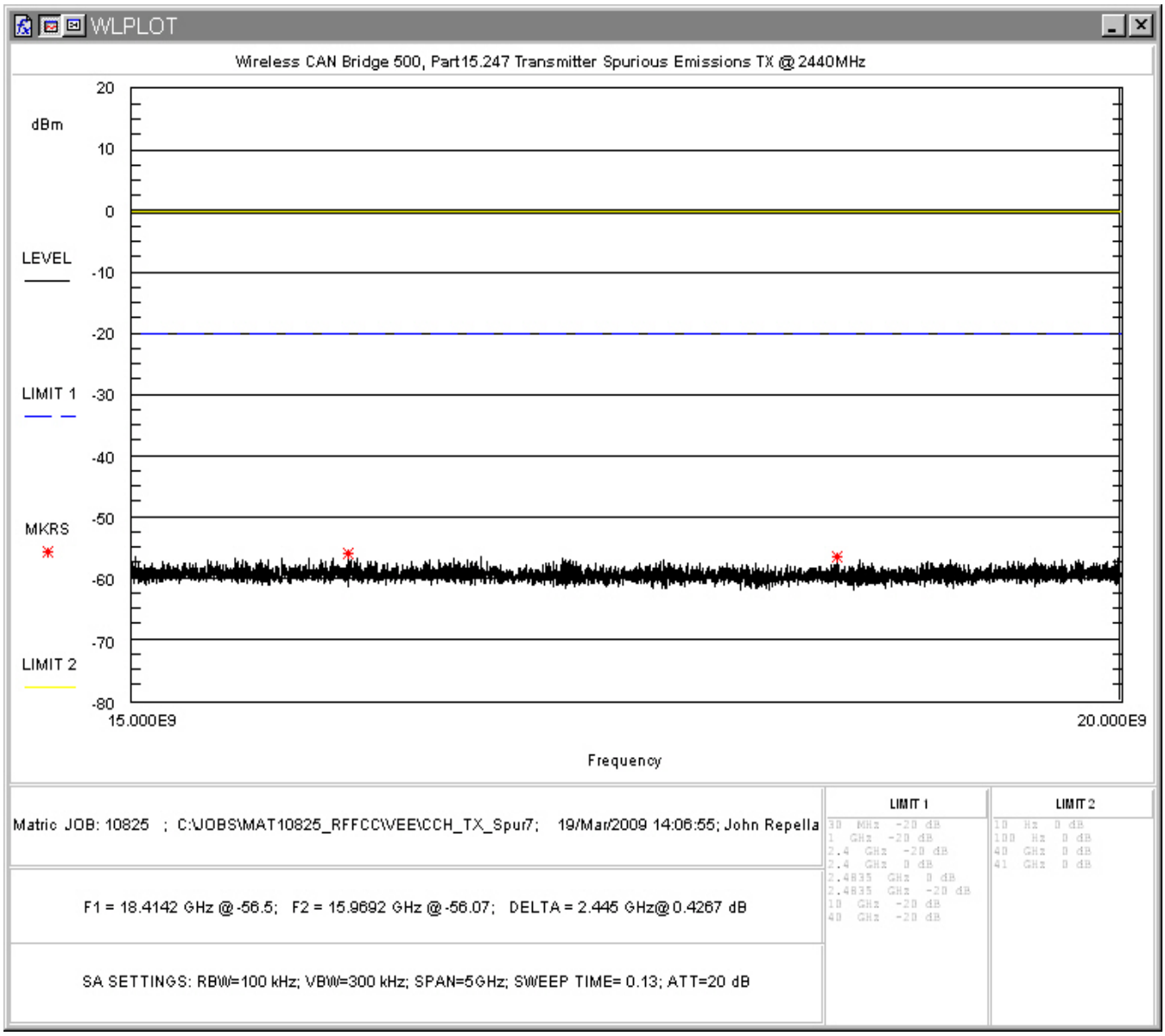

Figure 5-26: Conducted Spurious Emissions, Mid Channel 15-20GHz

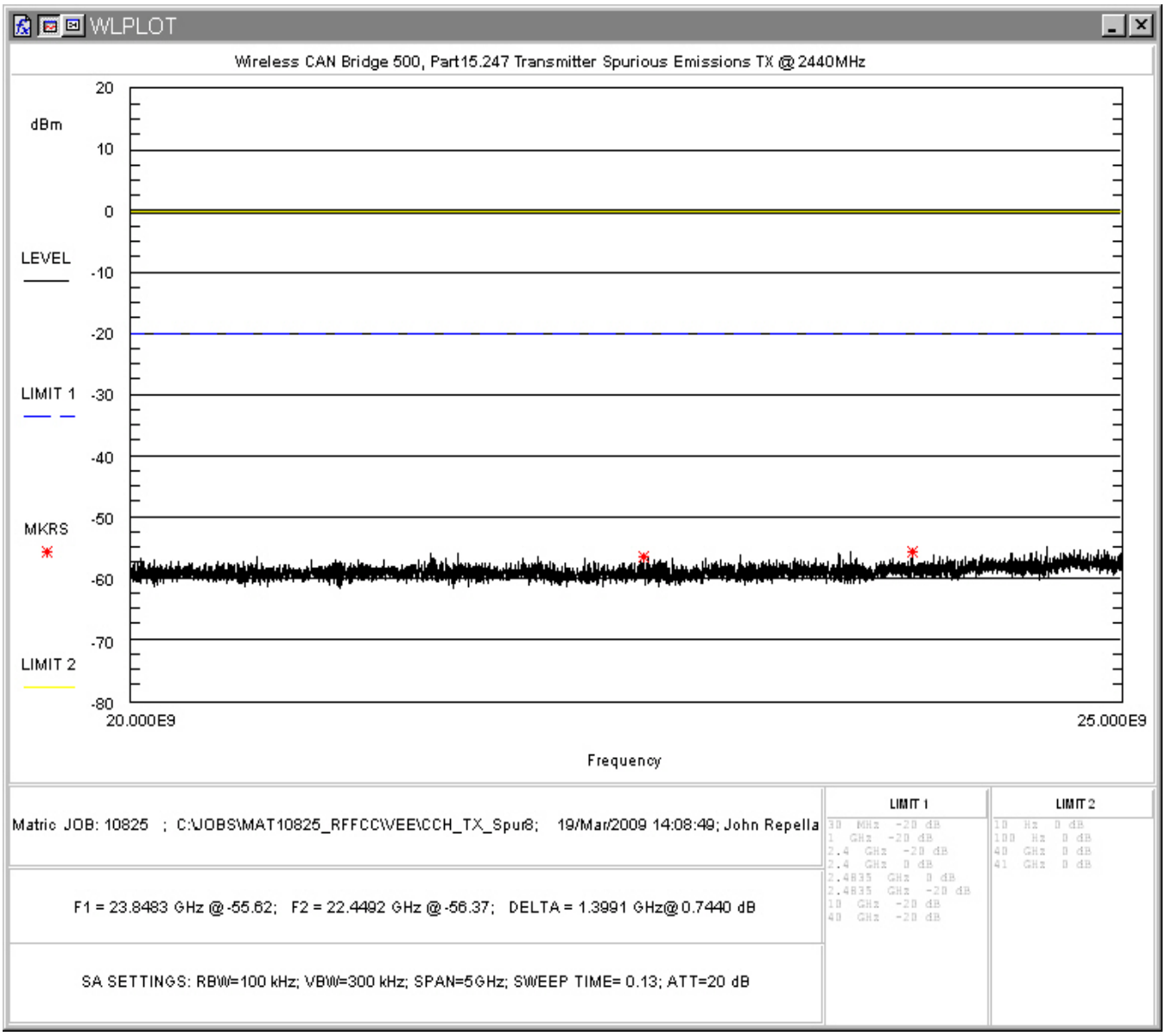

Figure 5-27: Conducted Spurious Emissions, Mid Channel 20-25GHz

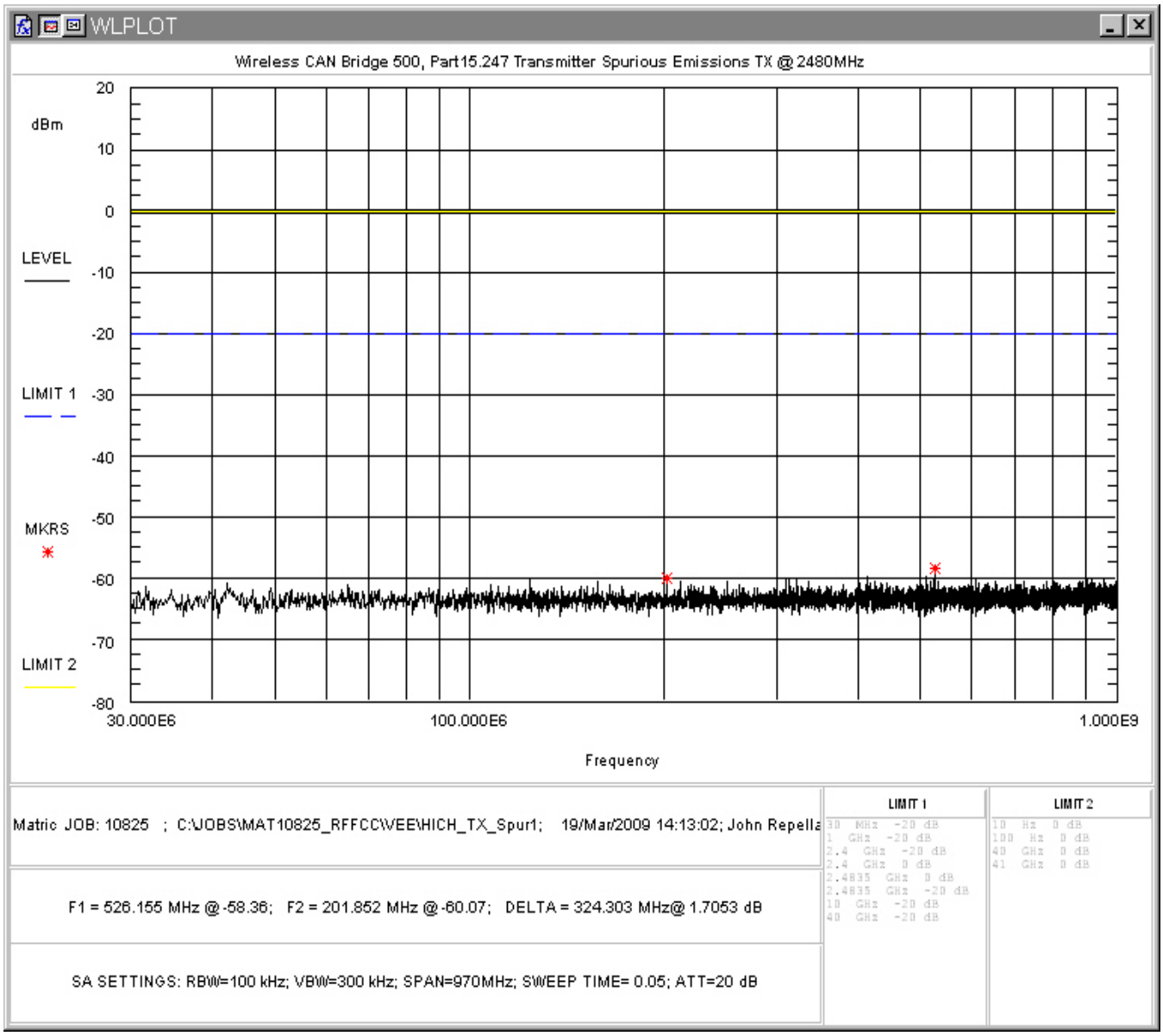

Figure 5-28: Conducted Spurious Emissions, High Channel 30 - 1000MHz

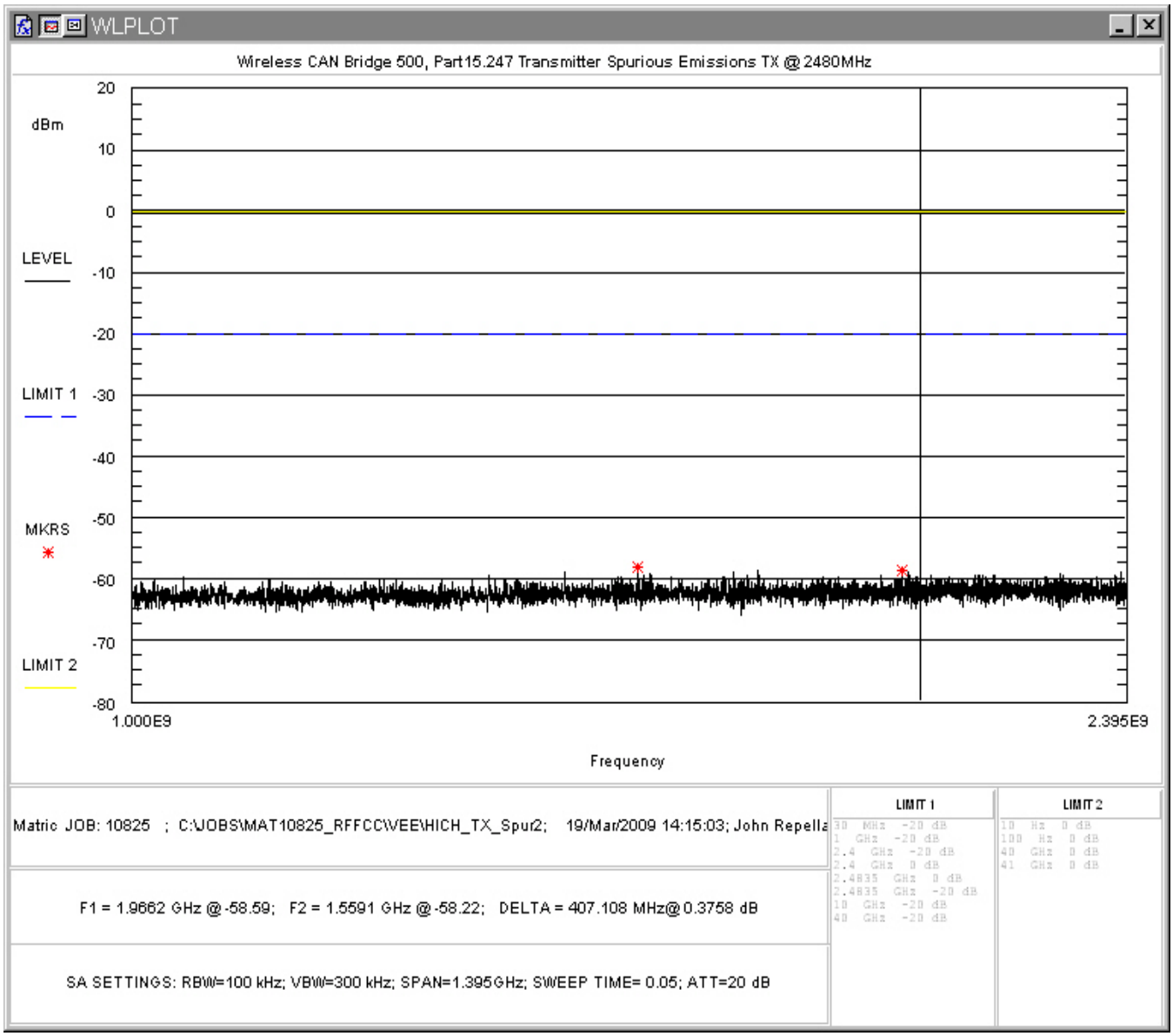

Figure 5-29: Conducted Spurious Emissions, High Channel 1 – 2.395GHz

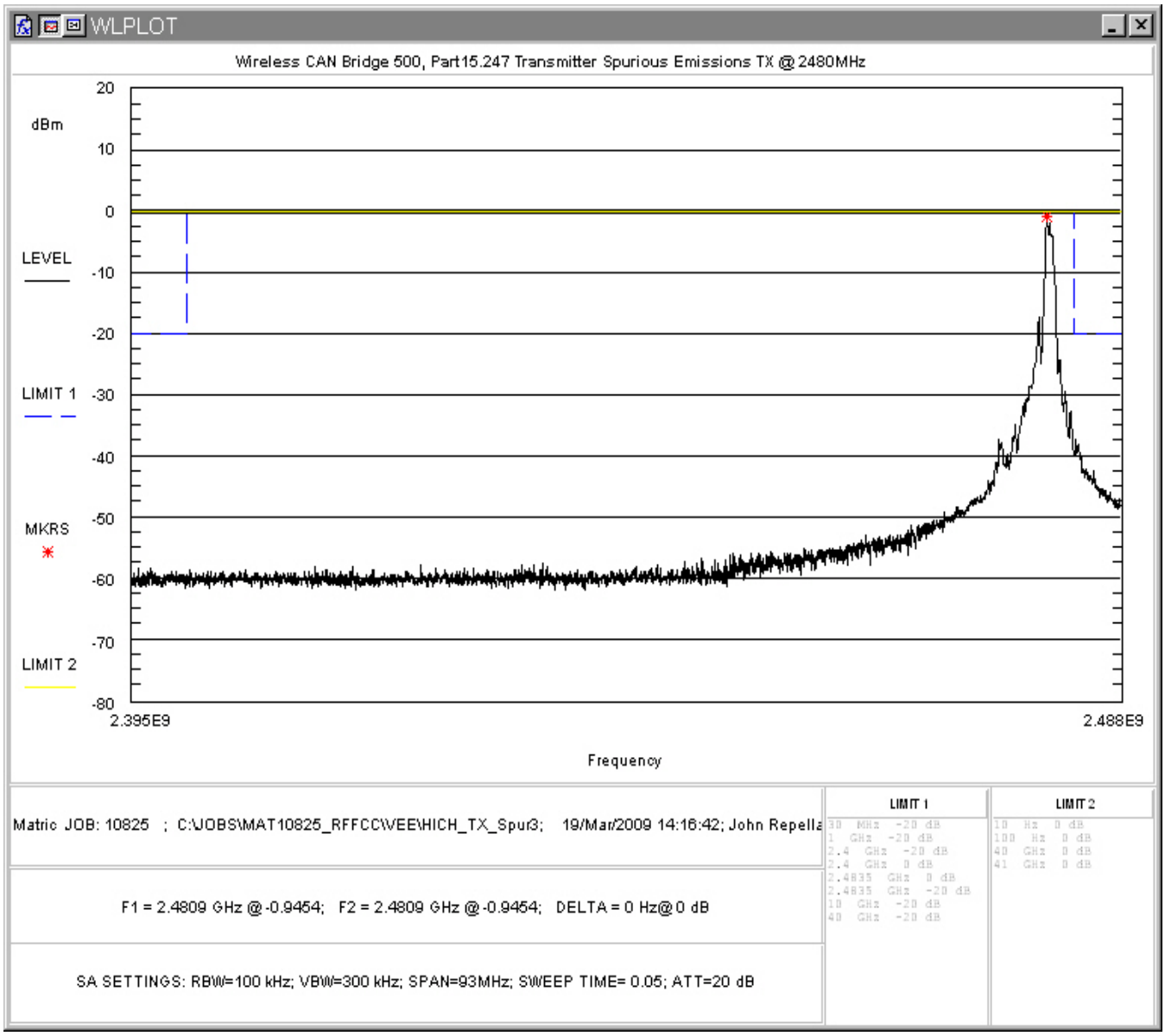

Figure 5-30: Conducted Spurious Emissions, High Channel 2.395 – 2.488GHz

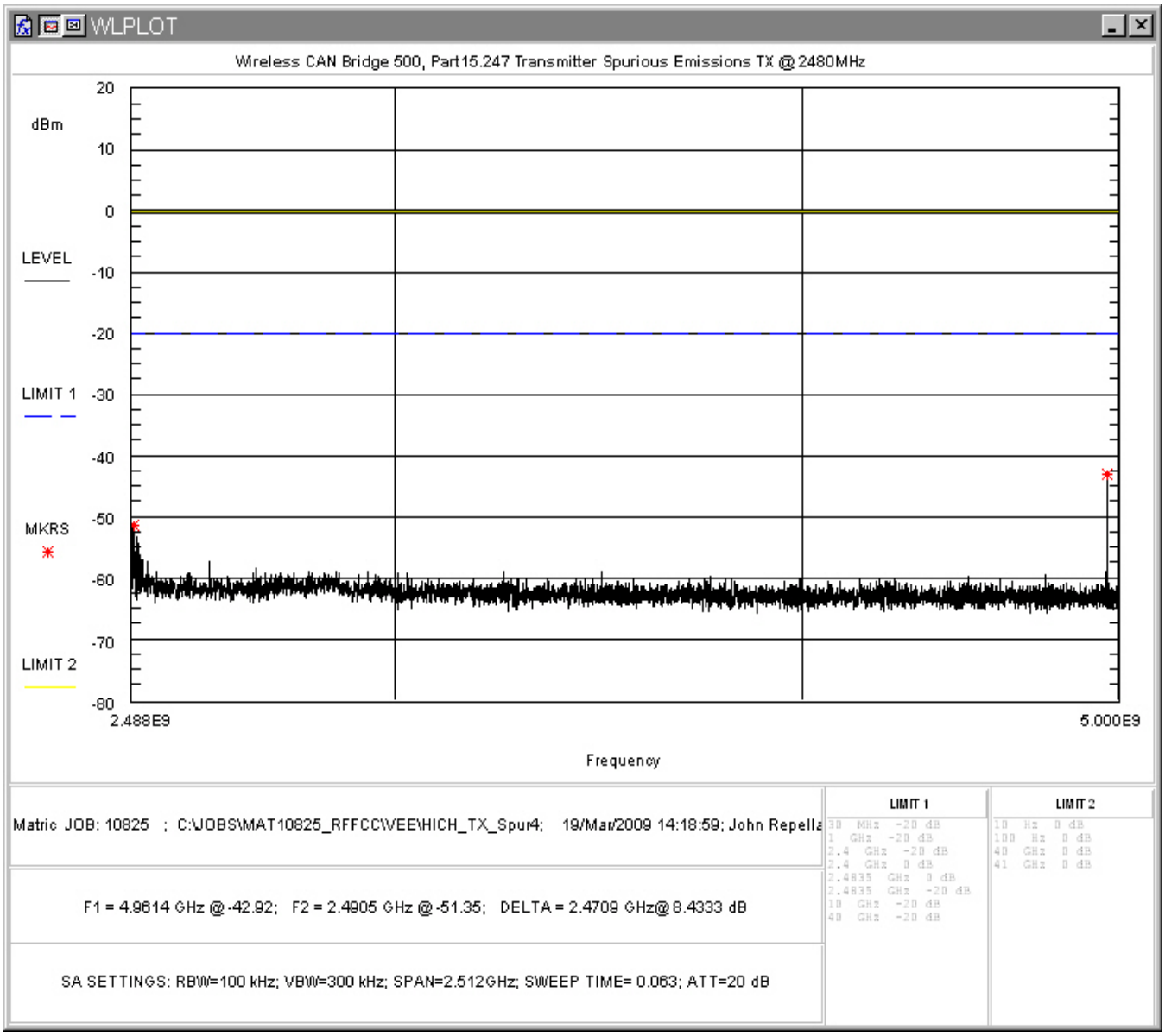

Figure 5-31: Conducted Spurious Emissions, High Channel 2.488 - 5GHz

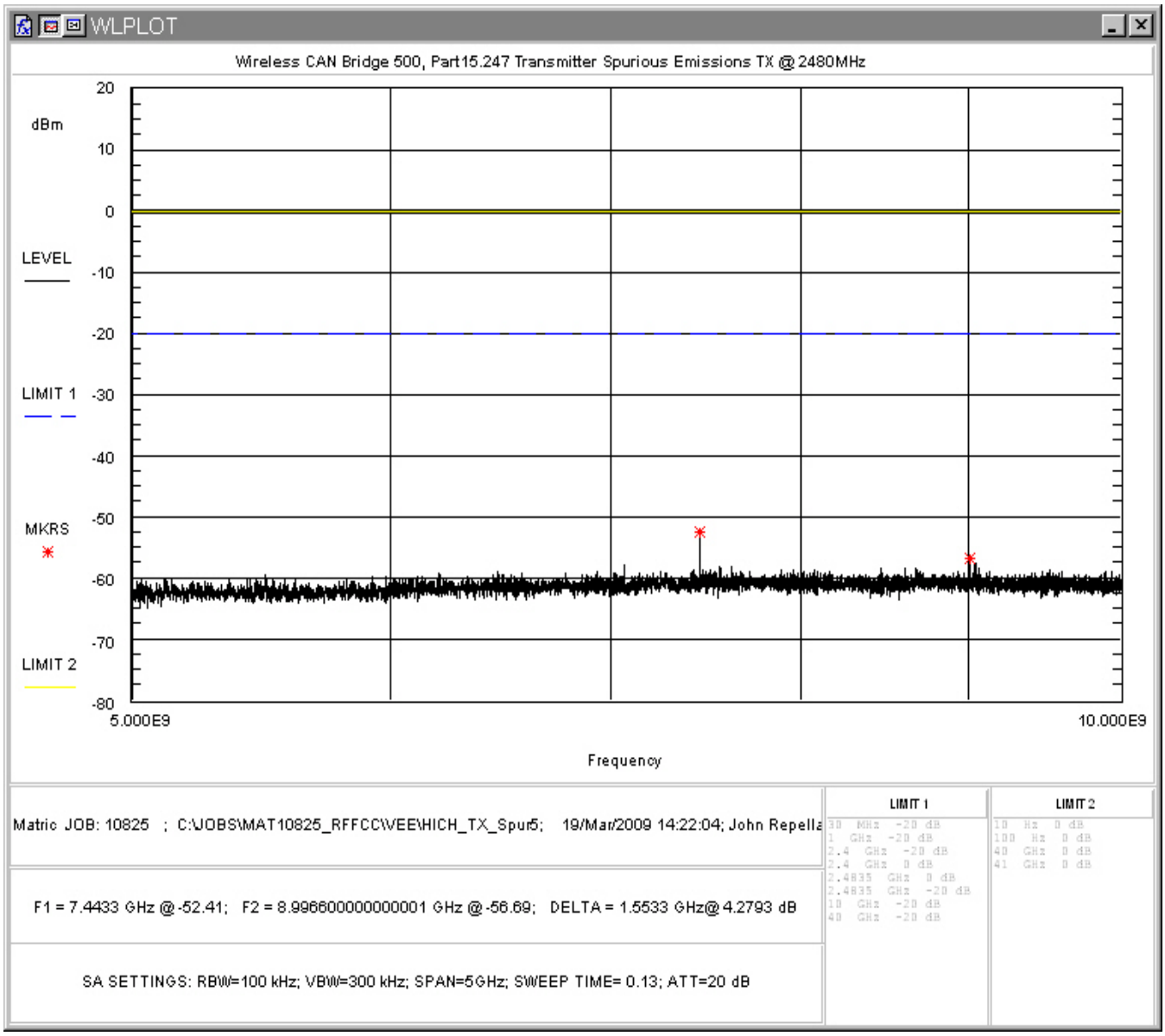

Figure 5-32: Conducted Spurious Emissions, High Channel 5 - 10GHz

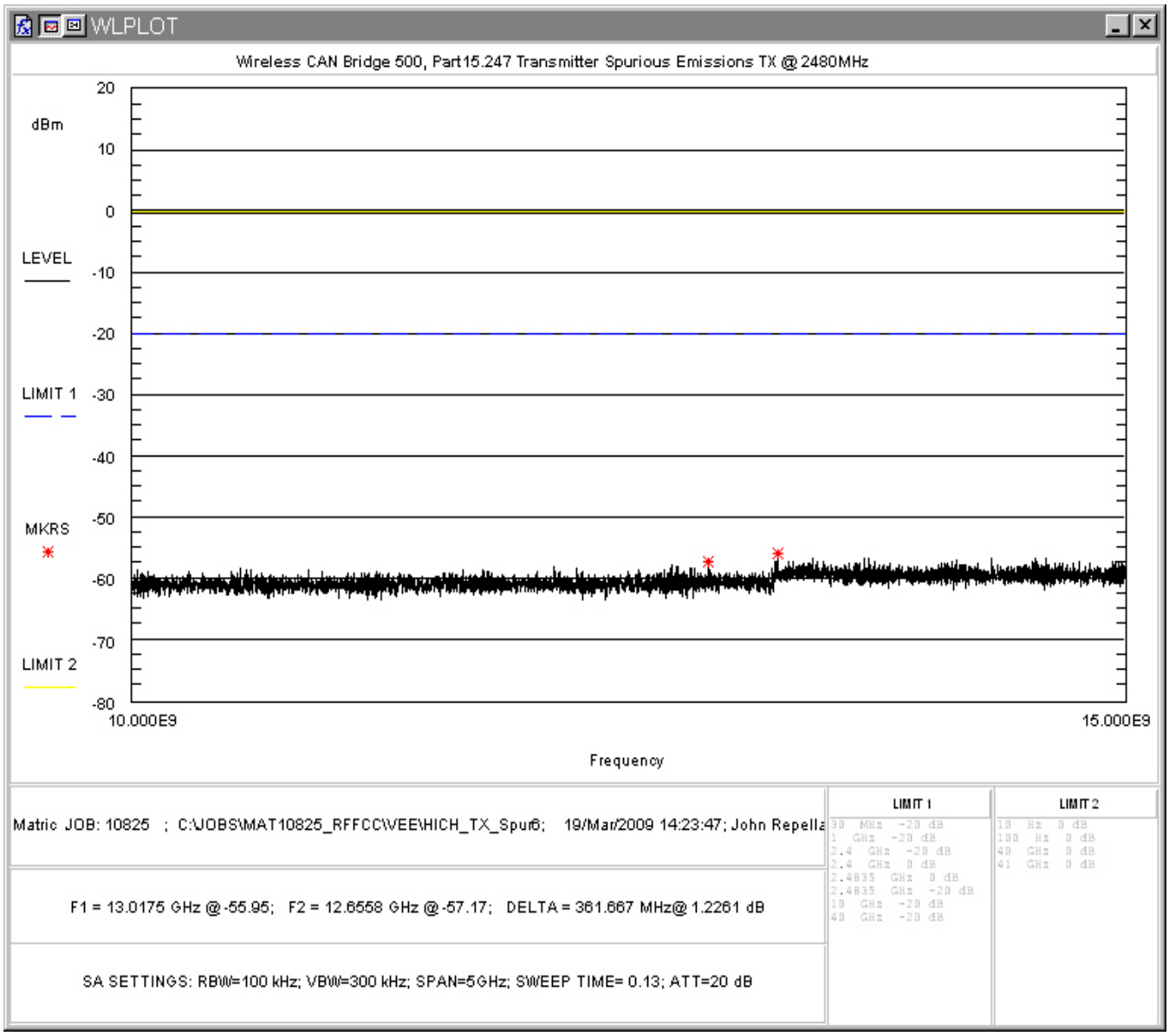

Figure 5-33: Conducted Spurious Emissions, High Channel 10 - 15GHz

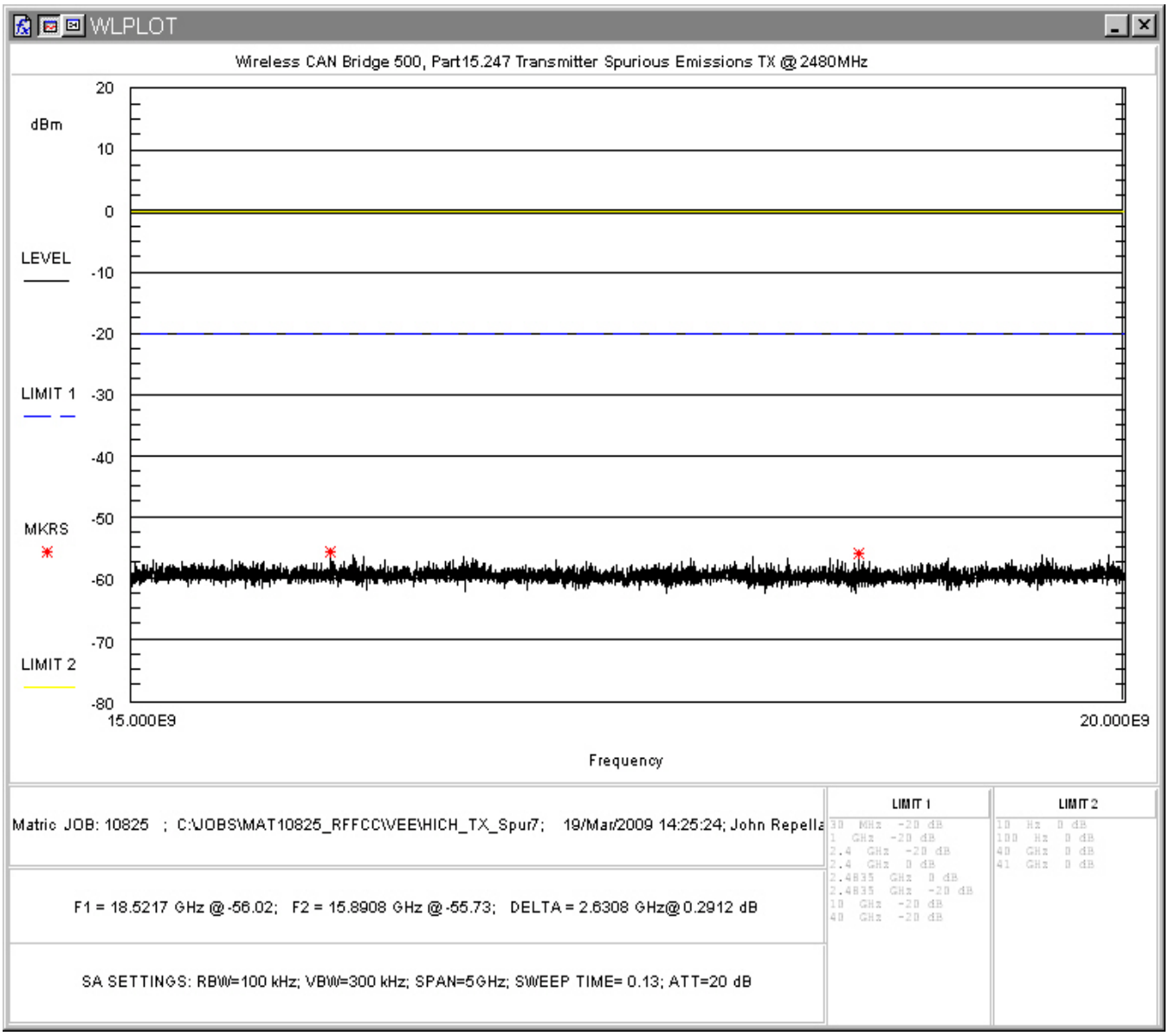

Figure 5-34: Conducted Spurious Emissions, High Channel 15-20GHz

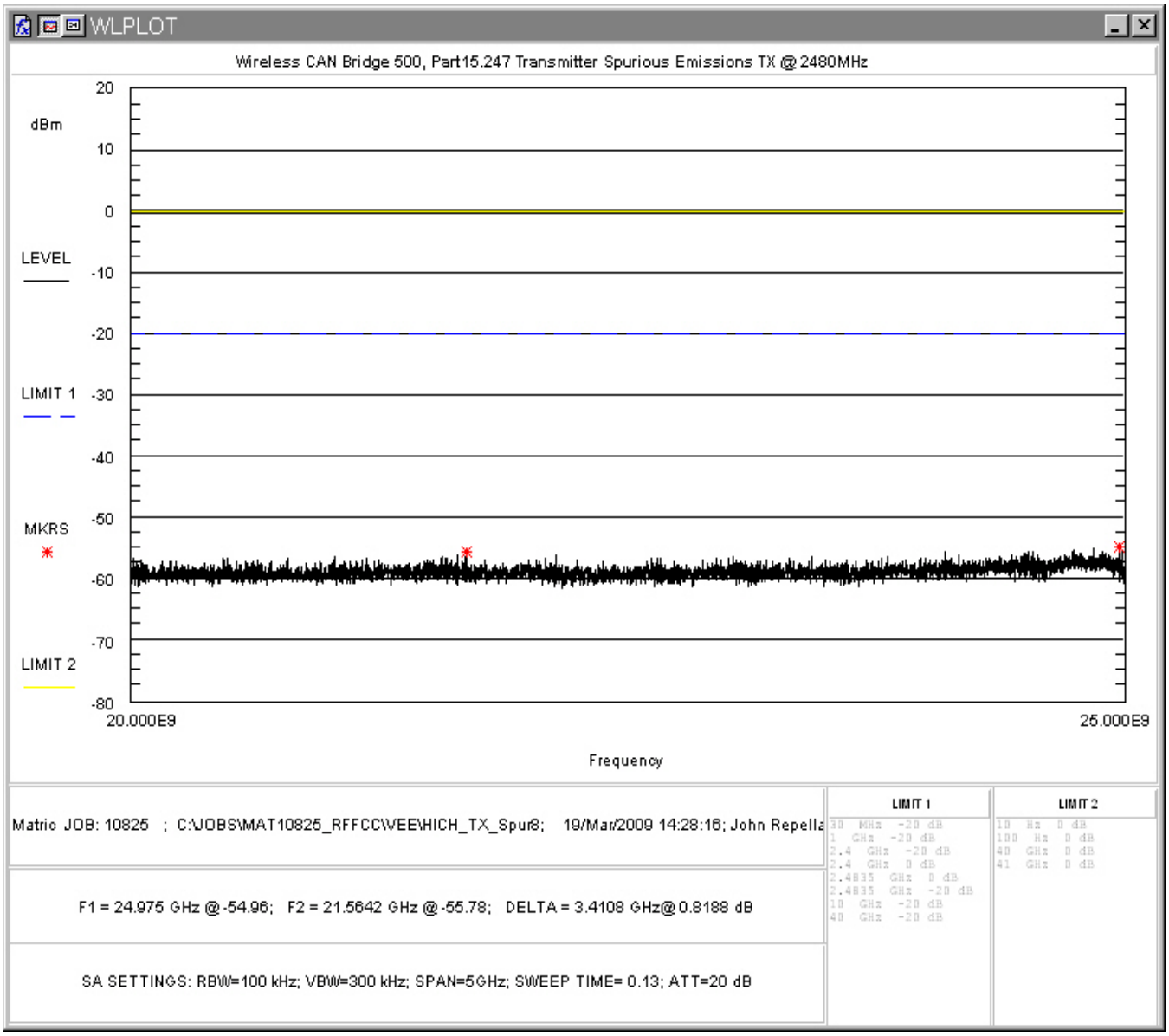

Figure 5-35: Conducted Spurious Emissions, High Channel 20-25GHz

5.5 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.

5.5.1 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 EUT was checked in 3 orthogonals and the worst case emissions reported.

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	10 Hz (Avg.) 1MHz (Peak)

Table 7: Radiated Emission Test Data (Restricted Bands), Transmit @2405MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
Unit Flat Peak									
4811.00	V	90.00	1.40	47.10	1.5	269.8	5000.0	-25.4	
12025.00	V	0.00	1.50	45.19	12.7	787.6	5000.0	-16.1	
Ave									
4811.00	V	90.00	1.50	34.60	1.5	64.0	500.0	-17.9	
12025.00	V	0.00	1.50	32.86	12.7	190.5	500.0	-8.4	
Peak									
4811.00	H	45.00	1.50	44.50	1.5	200.0	5000.0	-28.0	
12025.00	H	0.00	1.50	44.20	12.7	702.8	5000.0	-17.0	
Ave									
4811.00	H	45.00	1.50	32.60	1.5	50.8	500.0	-19.9	
12025.00	H	0.00	1.50	33.40	12.7	202.7	500.0	-7.8	
Unit On side Peak									
4810.00	V	0.00	1.50	47.40	1.5	279.2	5000.0	-25.1	
12025.00	V	180.00	1.50	45.22	12.7	790.4	5000.0	-16.0	
Ave									
4811.00	V	0.00	1.50	36.00	1.5	75.2	500.0	-16.5	
9620.00	V	0.00	1.50	0.00	10.8	3.5	500.0	-43.2	
12025.00	V	0.00	1.50	33.00	12.7	193.6	500.0	-8.2	
Peak									
4811.00	H	90.00	1.10	47.31	1.5	276.4	5000.0	-25.1	
12025.00	H	0.00	1.10	45.10	12.7	779.5	5000.0	-16.1	
Ave									
4811.00	H	90.00	1.10	33.40	1.5	55.7	500.0	-19.1	
12025.00	H	0.00	1.10	32.60	12.7	184.9	500.0	-8.6	
Unit Upright Peak									
4811.00	V	45.00	1.50	46.01	1.5	238.0	5000.0	-26.4	
12025.00	V	0.00	1.00	40.10	12.7	438.4	5000.0	-21.1	
Ave									
4811.00	V	45.00	1.50	33.00	1.5	53.2	500.0	-19.5	
12025.00	V	0.00	1.00	32.40	12.7	180.6	500.0	-8.8	
Peak									
4811.00	H	270.00	1.10	48.83	1.5	329.2	5000.0	-23.6	
12025.00	H	0.00	1.10	44.80	12.7	753.1	5000.0	-16.4	
Ave									
4811.00	H	270.00	1.10	34.79	1.5	65.4	500.0	-17.7	
12025.00	H	0.00	1.10	32.50	12.7	182.7	500.0	-8.7	
2400.00	V	0.00	1.00	67.05	-5.1	1249.9	5000.0	-12.0	BE
2400.00	V	0.00	1.00	40.23	-5.1	57.0	500.0	-18.9	BE

Table 8: Radiated Emission Test Data (Restricted Bands), Transmit @2441MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
Unit Flat									
Peak									
4880.00	V	90.00	1.00	48.60	1.7	326.1	5000.0	-23.7	
7320.00	V	90.00	1.00	45.80	8.0	490.8	5000.0	-20.2	
12200.00	V	0.00	1.00	44.30	12.8	714.1	5000.0	-16.9	
Ave									
4880.00	V	90.00	1.00	35.40	1.7	71.3	500.0	-16.9	
7320.00	V	90.00	1.00	33.60	8.0	120.5	500.0	-12.4	
12200.00	V	0.00	1.00	33.00	12.8	194.4	500.0	-8.2	
Peak									
4880.00	H	90.00	1.00	47.00	1.7	271.2	5000.0	-25.3	
7320.00	H	0.00	1.00	45.20	8.0	458.0	5000.0	-20.8	
12200.00	H	0.00	1.00	44.20	12.8	705.9	5000.0	-17.0	
Ave									
4880.00	H	90.00	1.00	35.00	1.7	68.1	500.0	-17.3	
7320.00	H	0.00	1.00	33.40	8.0	117.7	500.0	-12.6	
12200.00	H	0.00	1.00	33.40	12.8	203.6	500.0	-7.8	
Unit On Side									
Peak									
4880.00	V	180.00	1.00	47.50	1.7	287.3	5000.0	-24.8	
7320.00	V	190.00	1.00	46.10	8.0	508.0	5000.0	-19.9	
12200.00	V	0.00	1.00	46.50	12.8	919.9	5000.0	-14.7	
Ave									
4880.00	V	180.00	1.00	38.20	1.7	98.5	500.0	-14.1	
7320.00	V	190.00	1.00	34.60	8.0	135.2	500.0	-11.4	
12200.00	V	0.00	1.00	35.00	12.8	244.8	500.0	-6.2	
Peak									
4880.00	H	180.00	1.00	47.00	1.7	271.2	5000.0	-25.3	
7320.00	H	190.00	1.00	45.20	8.0	458.0	5000.0	-20.8	
12200.00	H	0.00	1.00	44.20	12.8	705.9	5000.0	-17.0	
Ave									
4880.00	H	180.00	1.00	35.00	1.7	68.1	500.0	-17.3	
7320.00	H	190.00	1.00	33.40	8.0	117.7	500.0	-12.6	
12200.00	H	0.00	1.00	33.10	12.8	196.7	500.0	-8.1	
Unit Upright									
Peak									
4880.00	V	45.00	1.00	47.20	1.7	277.5	5000.0	-25.1	
7320.00	V	45.00	1.00	45.10	8.0	452.8	5000.0	-20.9	
12200.00	V	0.00	1.00	44.10	12.8	697.8	5000.0	-17.1	
Ave									
4880.00	V	45.00	1.00	35.20	1.7	69.7	500.0	-17.1	
7320.00	V	45.00	1.00	33.40	8.0	117.7	500.0	-12.6	

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
12200.00	V	0.00	1.00	33.20	12.8	199.0	500.0	-8.0	
Peak									
4880.00	H	270.00	1.00	46.80	1.7	265.1	5000.0	-25.5	
7320.00	H	270.00	1.00	45.20	8.0	458.0	5000.0	-20.8	
12200.00	H	0.00	1.00	44.20	12.8	705.9	5000.0	-17.0	
Ave									
4880.00	H	270.00	1.00	34.60	1.7	65.1	500.0	-17.7	
7320.00	H	270.00	1.00	33.40	8.0	117.7	500.0	-12.6	
12200.00	H	0.00	1.00	33.10	12.8	196.7	500.0	-8.1	

Table 9: Radiated Emission Test Data (Restricted Bands), Transmit @2480MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
Unit Flat									
Peak									
4960.00	V	180.00	1.00	46.10	1.8	249.3	5000.0	-26.0	
7440.00	V	180.00	1.00	45.80	8.0	487.7	5000.0	-20.2	
12400.00	V	0.00	1.00	47.10	12.8	990.7	5000.0	-14.1	
Ave									
4960.00	V	180.00	1.00	38.30	1.8	101.6	500.0	-13.8	
7440.00	V	180.00	1.00	35.00	8.0	140.7	500.0	-11.0	
12400.00	V	0.00	1.00	36.00	12.8	276.0	500.0	-5.2	
Peak									
4960.00	H	200.00	1.00	46.80	1.8	270.2	5000.0	-25.3	
7440.00	H	200.00	1.00	45.80	8.0	487.7	5000.0	-20.2	
12400.00	H	0.00	1.00	45.60	12.8	833.5	5000.0	-15.6	
Ave									
4960.00	H	200.00	1.00	36.00	1.8	77.9	500.0	-16.1	
7440.00	H	200.00	1.00	34.90	8.0	139.1	500.0	-11.1	
12400.00	H	200.00	1.00	34.90	12.8	243.2	500.0	-6.3	
Unit on Side									
Peak									
4960.00	V	170.00	1.00	47.00	1.8	276.5	5000.0	-25.1	
7440.00	V	180.00	1.00	45.20	8.0	455.2	5000.0	-20.8	
12400.00	V	0.00	1.00	47.10	12.8	990.7	5000.0	-14.1	
Ave									
4960.00	V	170.00	1.00	39.00	1.8	110.1	500.0	-13.1	
7440.00	V	180.00	1.00	35.10	8.0	142.3	500.0	-10.9	
12400.00	V	0.00	1.00	36.00	12.8	276.0	500.0	-5.2	
Peak									
4960.00	H	170.00	1.00	46.30	1.8	255.1	5000.0	-25.8	
7440.00	H	180.00	1.00	45.60	8.0	476.6	5000.0	-20.4	

12400.00	H	0.00	1.00	45.60	12.8	833.5	5000.0	-15.6	
Ave									
4960.00	H	170.00	1.00	36.20	1.8	79.7	500.0	-15.9	
7440.00	H	180.00	1.00	34.90	8.0	139.1	500.0	-11.1	
12400.00	H	0.00	1.00	35.10	12.8	248.8	500.0	-6.1	
Unit Upright									
Peak									
4960.00	V	190.00	1.00	45.30	1.8	227.4	5000.0	-26.8	
7440.00	V	190.00	1.00	44.90	8.0	439.7	5000.0	-21.1	
12400.00	V	0.00	1.00	47.00	12.8	979.3	5000.0	-14.2	
Ave									
4960.00	V	190.00	1.00	36.20	1.8	79.7	500.0	-15.9	
7440.00	V	190.00	1.00	34.90	8.0	139.1	500.0	-11.1	
12400.00	V	0.00	1.00	34.40	12.8	229.6	500.0	-6.8	
Peak									
4960.00	H	165.00	1.00	46.00	1.8	246.4	5000.0	-26.1	
7440.00	H	180.00	1.00	45.20	8.0	455.2	5000.0	-20.8	
12400.00	H	0.00	1.00	45.10	12.8	786.9	5000.0	-16.1	
Ave									
4960.00	H	165.00	1.00	36.10	1.8	78.8	500.0	-16.0	
7440.00	H	180.00	1.00	34.10	8.0	126.8	500.0	-11.9	
12400.00	H	0.00	1.00	34.20	12.8	224.4	500.0	-7.0	

5.6 Receiver Radiated Spurious Emissions: (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 RSS-Gen.

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. Additionally, as the device is portable, the emissions were checked in three orthogonal with the worst case being reported. The emissions were measured using the following resolution bandwidths:

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	100kHz	>100 kHz
>1000 MHz	1 MHz	10 Hz (Av.)

5.6.2 Test Summary

The EUT complied with the requirements for receiver radiated emissions IC RSS-Gen. Note: No emissions were seen above 1GHz.

Table 10: Radiated Emission Test Data (Receiver)

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
Unit Flat									
54.66	V	180.00	1.00	28.70	7.6	65.7	100.0	-3.7	
57.71	V	180.00	1.00	27.90	7.7	60.1	100.0	-4.4	
64.02	V	180.00	1.00	20.10	8.7	27.7	100.0	-11.2	
73.48	V	270.00	1.00	14.10	9.8	15.7	100.0	-16.1	
83.51	V	225.00	1.00	14.80	10.1	17.6	100.0	-15.1	
86.65	V	270.00	1.00	18.00	9.9	24.7	100.0	-12.1	
117.93	V	270.00	1.00	9.60	14.4	15.9	150.0	-19.5	
143.02	V	235.00	1.20	14.90	14.5	29.4	150.0	-14.2	
151.16	V	235.00	1.20	16.10	14.0	31.9	150.0	-13.4	
157.40	V	235.00	1.20	16.70	14.0	34.3	150.0	-12.8	
169.97	V	235.00	1.20	14.80	13.9	27.3	150.0	-14.8	
194.99	V	270.00	1.10	12.10	13.5	19.1	150.0	-17.9	
204.99	V	90.00	1.10	13.00	14.0	22.5	150.0	-16.5	
214.99	V	135.00	1.10	9.90	13.3	14.4	150.0	-20.3	
244.99	V	135.00	1.10	6.90	13.5	10.4	200.0	-25.7	
53.90	H	45.00	3.00	22.50	7.6	32.1	100.0	-9.9	
57.71	H	45.00	3.00	22.80	7.7	33.4	100.0	-9.5	
63.94	H	45.00	3.00	18.50	8.7	23.0	100.0	-12.8	
73.33	H	45.00	3.00	17.30	9.8	22.7	100.0	-12.9	
83.37	H	45.00	3.00	15.80	10.1	19.7	100.0	-14.1	
86.50	H	45.00	3.00	16.70	9.9	21.3	100.0	-13.4	
117.93	H	0.00	3.00	12.90	14.4	23.2	150.0	-16.2	
142.92	H	315.00	3.10	17.20	14.5	38.4	150.0	-11.8	
151.16	H	315.00	3.10	18.20	14.0	40.6	150.0	-11.3	
157.35	H	315.00	3.10	17.50	14.0	37.6	150.0	-12.0	
169.97	H	135.00	3.10	13.40	13.9	23.2	150.0	-16.2	
194.99	H	180.00	3.10	13.10	13.5	21.4	150.0	-16.9	
204.99	H	180.00	2.50	12.40	14.0	21.0	150.0	-17.1	
244.99	H	90.00	2.50	6.30	13.5	9.7	200.0	-26.3	
Unit Upright									
53.99	V	235.00	1.00	20.60	7.6	25.8	100.0	-11.8	
57.71	V	235.00	1.00	26.60	7.7	51.8	100.0	-5.7	
64.02	V	235.00	1.00	14.40	8.7	14.4	100.0	-16.9	
73.48	V	235.00	1.00	15.00	9.8	17.4	100.0	-15.2	
83.51	V	270.00	1.00	13.40	10.1	15.0	100.0	-16.5	

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
86.65	V	270.00	1.00	18.30	9.9	25.6	100.0	-11.8	
117.93	V	270.00	1.00	5.30	14.4	9.7	150.0	-23.8	
143.02	V	270.00	1.50	10.70	14.5	18.1	150.0	-18.4	
151.30	V	90.00	1.50	12.80	14.0	21.8	150.0	-16.8	
157.58	V	90.00	1.50	16.80	14.0	34.8	150.0	-12.7	
170.13	V	135.00	1.50	14.90	13.9	27.6	150.0	-14.7	
194.99	V	135.00	1.50	12.90	13.5	20.9	150.0	-17.1	
204.99	V	135.00	1.50	9.50	14.0	15.0	150.0	-20.0	
214.99	V	135.00	1.50	9.00	13.3	13.0	150.0	-21.2	
244.99	V	90.00	1.00	7.60	13.5	11.3	200.0	-25.0	
53.99	H	180.00	2.50	19.60	7.6	23.0	100.0	-12.8	
57.72	H	180.00	2.50	20.40	7.7	25.3	100.0	-11.9	
63.99	H	45.00	2.50	15.60	8.7	16.5	100.0	-15.7	
73.32	H	135.00	2.50	21.30	9.8	35.9	100.0	-8.9	
83.51	H	180.00	2.10	13.70	10.1	15.5	100.0	-16.2	
86.65	H	0.00	2.10	17.60	9.9	23.6	100.0	-12.5	
117.93	H	0.00	1.40	8.80	14.4	14.5	150.0	-20.3	
143.02	H	135.00	1.60	15.40	14.5	31.2	150.0	-13.7	
151.30	H	135.00	1.60	14.80	14.0	27.5	150.0	-14.8	
157.58	H	135.00	1.50	20.30	14.0	52.1	150.0	-9.2	
170.00	H	135.00	1.30	17.80	13.9	38.6	150.0	-11.8	
194.99	H	180.00	1.50	16.30	13.5	31.0	150.0	-13.7	
204.99	H	180.00	1.30	11.80	14.0	19.6	150.0	-17.7	
214.99	H	315.00	1.20	9.50	13.3	13.8	150.0	-20.7	
244.99	H	135.00	1.20	12.00	13.5	18.8	200.0	-20.6	
Unit on Side									
53.99	V	225.00	1.00	18.60	7.6	20.5	100.0	-13.8	
57.71	V	225.00	1.00	22.30	7.7	31.5	100.0	-10.0	
64.02	V	90.00	1.00	11.70	8.7	10.5	100.0	-19.6	
73.48	V	90.00	1.00	18.00	9.8	24.6	100.0	-12.2	
83.51	V	315.00	1.10	15.50	10.1	19.1	100.0	-14.4	
86.65	V	315.00	1.10	18.20	9.9	25.3	100.0	-11.9	
117.93	V	315.00	1.10	9.40	14.4	15.5	150.0	-19.7	
143.02	V	90.00	1.10	13.40	14.5	24.7	150.0	-15.7	
151.30	V	315.00	1.10	11.40	14.0	18.6	150.0	-18.2	
157.58	V	90.00	1.10	16.20	14.0	32.5	150.0	-13.3	
170.13	V	90.00	1.10	15.70	13.9	30.3	150.0	-13.9	
194.99	V	90.00	1.10	11.40	13.5	17.6	150.0	-18.6	
204.99	V	135.00	1.40	7.20	14.0	11.5	150.0	-22.3	
214.99	V	180.00	1.40	6.80	13.3	10.1	150.0	-23.4	
244.99	V	180.00	1.40	5.70	13.5	9.1	200.0	-26.9	
53.95	H	180.00	2.60	19.20	7.6	22.0	100.0	-13.2	

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
57.72	H	180.00	2.60	19.50	7.7	22.9	100.0	-12.8	
63.99	H	225.00	2.60	12.30	8.7	11.3	100.0	-19.0	
73.32	H	135.00	2.60	20.00	9.8	30.9	100.0	-10.2	
83.51	H	180.00	2.60	12.50	10.1	13.5	100.0	-17.4	
86.65	H	135.00	2.00	14.60	9.9	16.7	100.0	-15.5	
117.93	H	225.00	1.60	6.30	14.4	10.9	150.0	-22.8	
143.02	H	180.00	1.60	14.30	14.5	27.4	150.0	-14.8	
151.22	H	180.00	1.60	12.20	14.0	20.4	150.0	-17.3	
157.58	H	180.00	1.50	17.70	14.0	38.6	150.0	-11.8	
170.00	H	180.00	1.50	15.40	13.9	29.3	150.0	-14.2	
194.99	H	90.00	1.50	11.10	13.5	17.0	150.0	-18.9	
204.99	H	135.00	1.50	11.30	14.0	18.5	150.0	-18.2	
244.99	H	135.00	1.00	13.00	13.5	21.0	200.0	-19.6	

5.7 Conducted Emissions

5.7.1 Requirements

Test Arrangement: Table Top

Compliance Standard: FCC Part 15 (10/2008), 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

5.7.2 Test Procedure

The EUT is operated 24VDC power supply. AC conducted testing was performed on the EUT by connecting the power supply to the LISN and measurements were taken at the AC input of the power supply.

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.

5.7.3 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

5.7.4 Test Data

The EUT complied with the Class B Conducted Emissions requirements. Table 11 provides the test results for phase and neutral line power line conducted emissions.

Table 11: AC Power line Conducted Emissions

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)
0.150	45.2	23.4	10.1	0.4	55.7	33.9	66.0	56.0	-10.3	-22.1
3.434	37.1	16.2	10.7	0.4	48.2	27.3	56.0	46.0	-7.8	-18.7
0.284	34.7	20.2	10.2	0.4	45.3	30.8	60.7	50.7	-15.4	-19.9
0.526	30.2	13.0	10.2	0.1	40.5	23.3	56.0	46.0	-15.5	-22.7
15.020	25.0	12.5	11.3	1.3	37.6	25.1	60.0	50.0	-22.4	-24.9
10.652	23.7	12.0	11.1	1.0	35.9	24.2	60.0	50.0	-24.1	-25.8

LINE 2 - 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)
0.150	47.0	25.9	10.1	0.1	57.2	36.1	66.0	56.0	-8.8	-19.9
3.481	37.3	16.6	10.7	0.4	48.4	27.7	56.0	46.0	-7.6	-18.3
0.285	35.4	17.2	10.2	0.3	45.9	27.7	60.7	50.7	-14.8	-23.0
0.547	30.9	11.3	10.2	0.1	41.3	21.7	56.0	46.0	-14.7	-24.3
15.020	23.1	11.1	11.3	1.1	35.6	23.6	60.0	50.0	-24.4	-26.4
10.652	24.1	10.4	11.1	0.9	36.1	22.4	60.0	50.0	-23.9	-27.6