Washington Laboratories, Ltd.

FCC & Industry Canada Certification Test Report
For the
Axiometric, LLC
902 - 928 MHz Gateway II Ethernet

FCC ID: VE4-GW2-DC
IC ID: TBD

WLL JOB# **9684**
March 28, 2008

Prepared for:

Axiometric, LLC
10718 Vista Road
Columbia, MD 21044

Prepared By:

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7560 Lindbergh Drive
Gaithersburg, Maryland 20879

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Prepared by: Brian J. Dettling
Documentation Specialist

Reviewed by: Steven D. Koster
EMC Operations Manager

Abstract

This report has been prepared on behalf of Axiometric, LLC to support the attached Application for Equipment Authorization. The test report and application are submitted for a Frequency Hopping Spread Spectrum Transmitter under Part 15.247 (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 Axiometric, LLC 902 - 928 MHz Gateway II Ethernet.

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 Axiometric, LLC 902 - 928 MHz Gateway II Ethernet complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under FCC Part 15.247 and Industry Canada RSS-210.

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Compliance Statement

The Axiometric, LLC 902 - 928 MHz Gateway II Ethernet complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under FCC Part 15.247 (9/2007) and Industry Canada RSS-210.

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:	Axiometric, LLC 10718 Vista Road Columbia, MD 21044
Quotation Number:	63677

1.4 Test Dates

Testing was performed on the following date(s):	6/11-18/2007

1.5 Test and Support Personnel

Washington Laboratories, LTD	James Ritter
Client Representative	Frank Moody

1.6 Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	**Amp**ere**s**
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	**d**eci**B**el
dc	**d**irect **c**urrent
EMI	**E**lectro**m**agnetic **I**nterference
EUT	**E**quipment **U**nder **T**est
FM	**F**requency **M**odulation
G	**g**iga - prefix for 10^9 multiplier
Hz	**H**ertz
IF	**I**ntermediate **F**requency
k	**k**ilo - prefix for 10^3 multiplier
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 Axiometric, LLC Gateway II Transceiver Unit acts as the central controller of the Axiometric, LCC mesh wireless network. It sends synchronization and configuration information to the mesh nodes, and collects information from the nodes. The Gateway II communicates to the mesh nodes via a frequency hopping spread spectrum RF link in the 902 MHz to 928 MHz ISM band. There are 2 configuration options with this transceiver Unit:

The Gateway II provides a backhaul RF link for the collected data by a wired Ethernet link. In this option power to the Gateway 2 is provided over the LAN cable via a LAN power injector.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Axiometric, LLC
FCC ID:	VE4-GW2-DC
IC:	TBD
Model:	902 - 927 MHz Gateway II Ethernet
FCC Rule Parts:	§15.247
Industry Canada:	RSS210
Frequency Range:	902.5-927MHz
Maximum Output Power:	189mW (22.7dBm)
Modulation:	FHSS FSK
20dB Bandwidth:	180 kHz
Keying:	Automatic
Type of Information:	Data
Number of Channels:	50
Power Output Level	Fixed
Antenna Type	5.5 dBi Whip
Interface Cables:	None
Power Source & Voltage:	7-30VDC over LAN Port

2.2 Test Configuration

The Gateway II Transceiver Unit was configured with a 5.5 dBi Whip Antenna and programmed via a test port inside the enclosure that connected to a support laptop for test programming (this port is not normally connected).

2.3 Testing Algorithm

The Gateway II Transceiver Unit was programmed via support laptop to continuously transmit on 902.5, 915 and 927MHz. The unit was also programmed to hop it its normal operating mode.

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 NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

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

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

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 ±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

Conducted Emissions

Asset #	Manufacturer/Model	Description	Cal. Due
00069	HP, 85650A	ADAPTER, QP	6/26/2007
00071	HP, 85685A	PRESELECTOR, RF	6/26/2007
00073	HP, 8568B	ANALYZER, SPECTRUM	6/26/2007
00053	HP, 11947A	LIMITER, TRANSIENT	4/9/2008
00125	SOLAR, 8028-50-TS-24-BNC	LISN	2/1/2008
00126	SOLAR, 8028-50-TS-24-BNC	LISN	2/1/2008

Radiated Emissions

Asset #	Manufacturer/Model	Description	Cal. Due
00618	HP 8563A	ANALYZER, SPECTRUM	2/9/2008
00066	HP, 8449B	PRE-AMPLIFIER, RF. 1-26.5GHZ	6/22/2007
00004	ARA, DRG-118/A	ANTENNA, DRG, 1-18GHZ	2/2/2009
00069	HP, 85650A	ADAPTER, QP	6/26/2007
00073	HP, 8568B	ANALYZER, SPECTRUM	6/26/2007
00071	HP, 85685A	PRESELECTOR, RF	6/26/2007
00007	ARA, LPB-2520	ANTENNA, BICONILOG ANTENNA	6/7/2008

Bench Conducted Emissions

Asset #	Manufacturer/Model	Description	Cal. Due
00074	HP, 8593A	ANALYZER, SPECTRUM	2/7/2008
00541	MEGAPHASE, LLC TM40-K1K1-36	CABLE, 36" BENCH TEST CABLE	9/11/2007
00528	AGILENT, E4446A	ANALYZER, SPECTRUM	2/15/2008

4 Test Results

4.1 Duty Cycle Correction

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

The duty cycle correction factor is calculated by:

20 x LOG (dwell time/100 ms)

The following figure shows the plot of the dwell time for the transmitter. Based on this plot, the dwell time per hop is 108msec.

No Duty cycle correction is allowed

In Accordance with FCC Part 15.247 (a)(i) systems operating in the 902-928 MHz band with a bandwidth of less than 250kHz and 50 hopping channels shall transmit no more than 0.4 seconds in any 20 second period. The following figures demonstrate compliance.

Axiometric LLC, Gateway II Transceiver Unit, Part 15.247 Time of Occupancy On time for a single Hop
Frequency 902.5MHz used. On time for a single Hop= 108ms
Note (No additional Radiated duty cycle correction allowed for On times greater than 100ms)

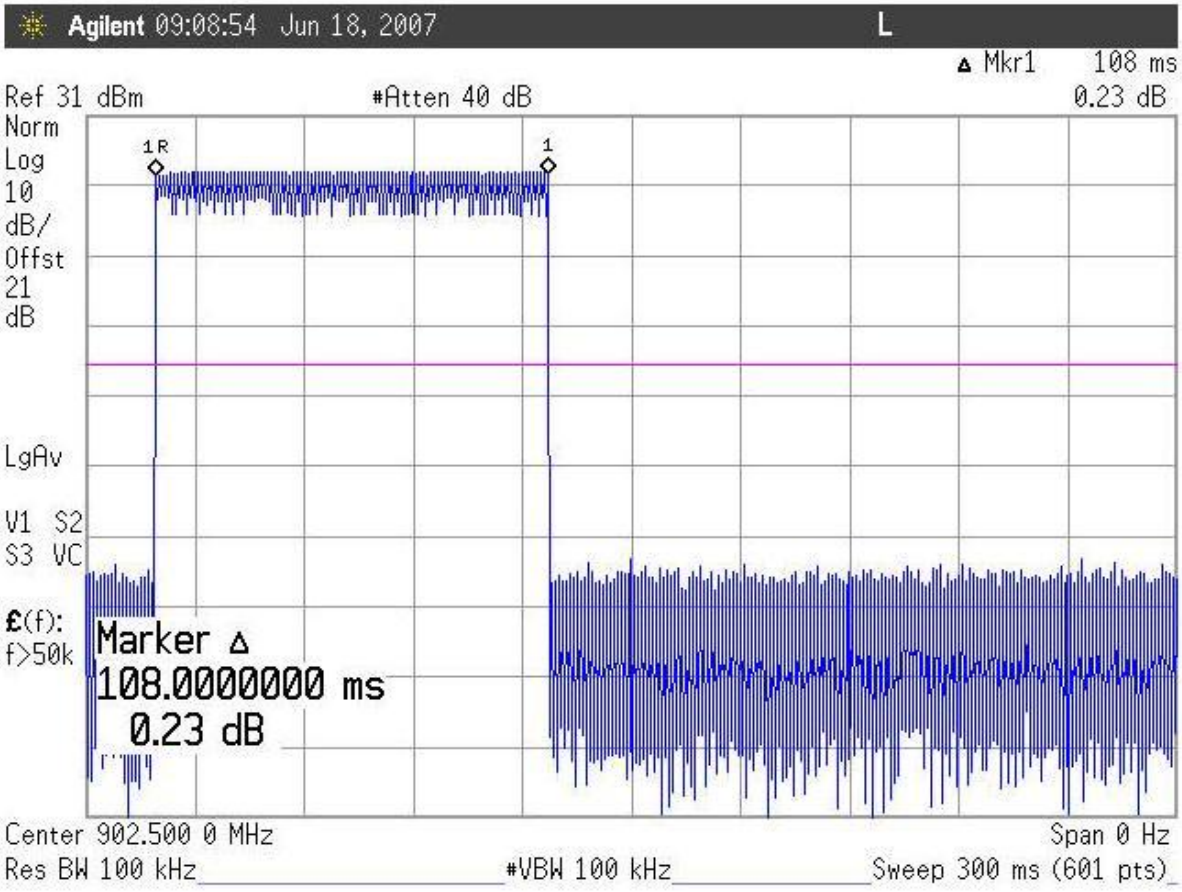

Figure 4-1. Duty Cycle Plot

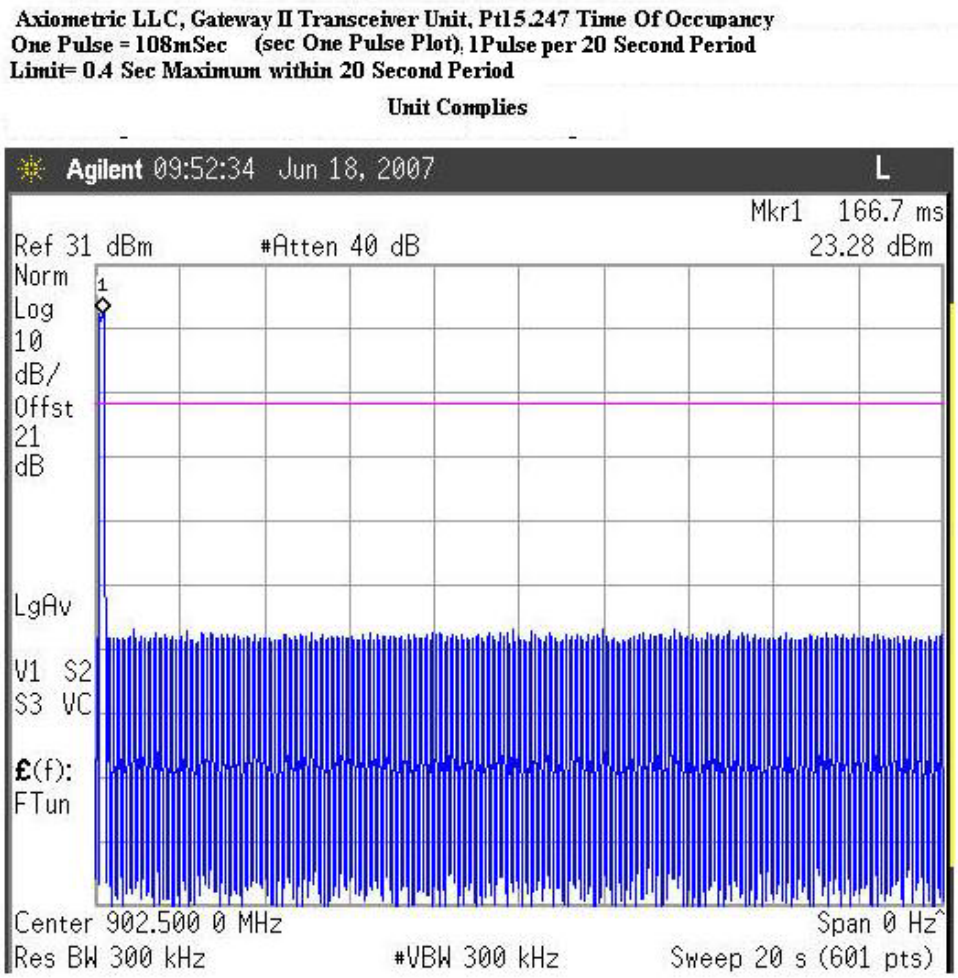

Figure 4-2. Time of Occupancy

4.2 RF Power Output: (FCC Part §2.1046)

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

Table 3. RF Power Output

Frequency	Level	Limit	Pass/Fail
Low Channel: 902.5MHz	22.75 dBm	30 dBm	Pass
Mid Channel: 915.0MHz	22.77 dBm	30 dBm	Pass
High Channel: 927.0MHz	22.50 dBm	30 dBm	Pass

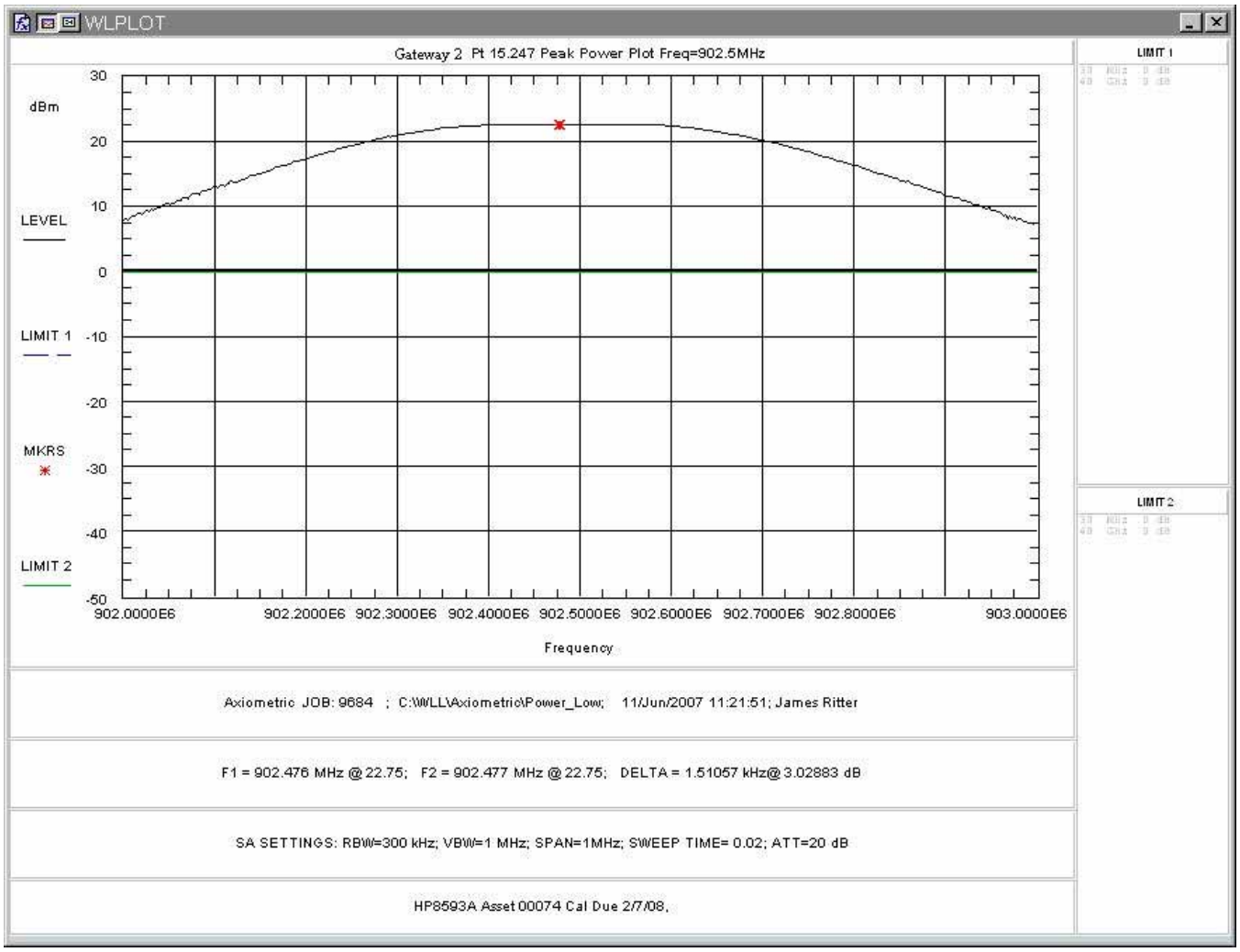

Figure 4-3. RF Peak Power, Low Channel

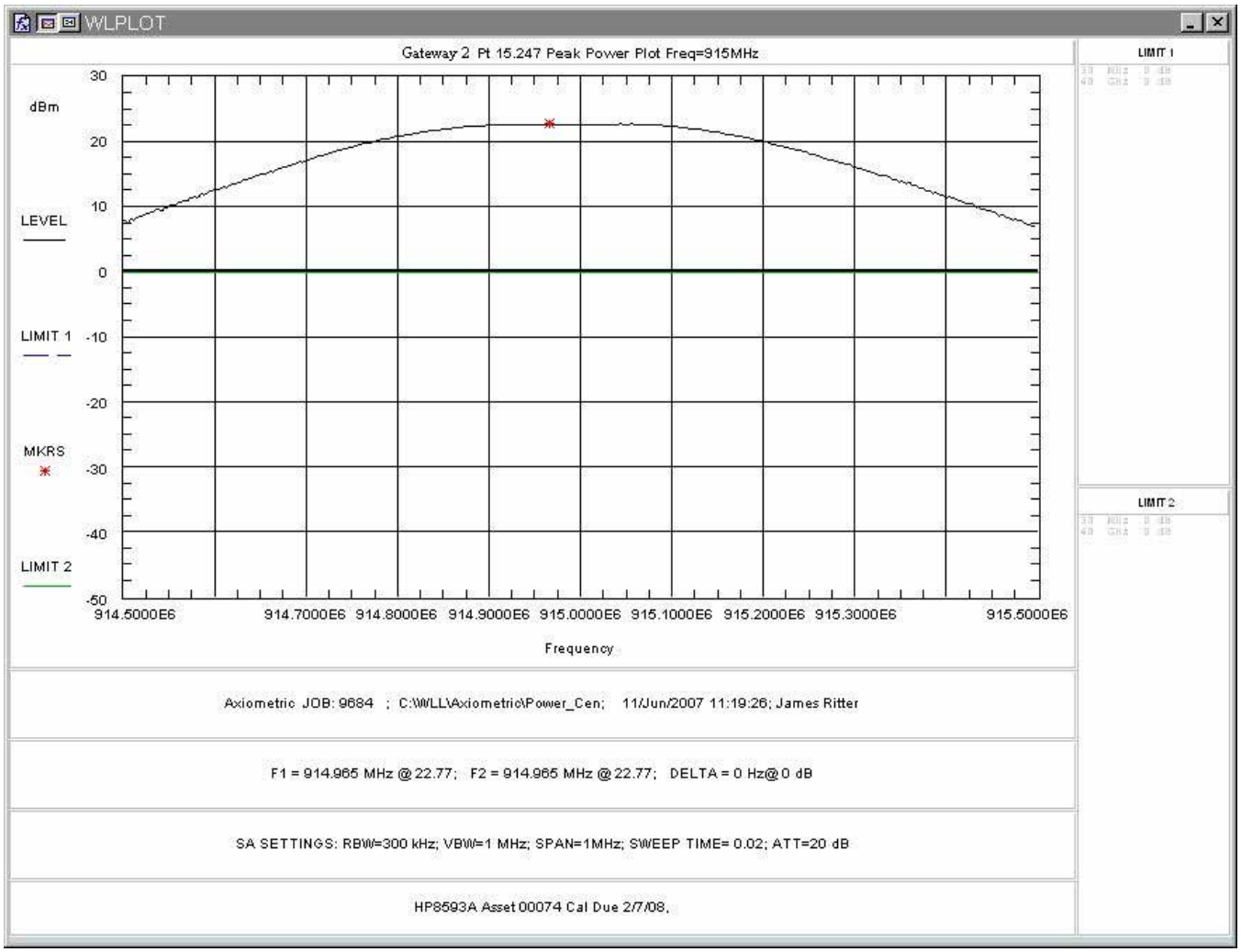

Figure 4-4. RF Peak Power, Mid Channel

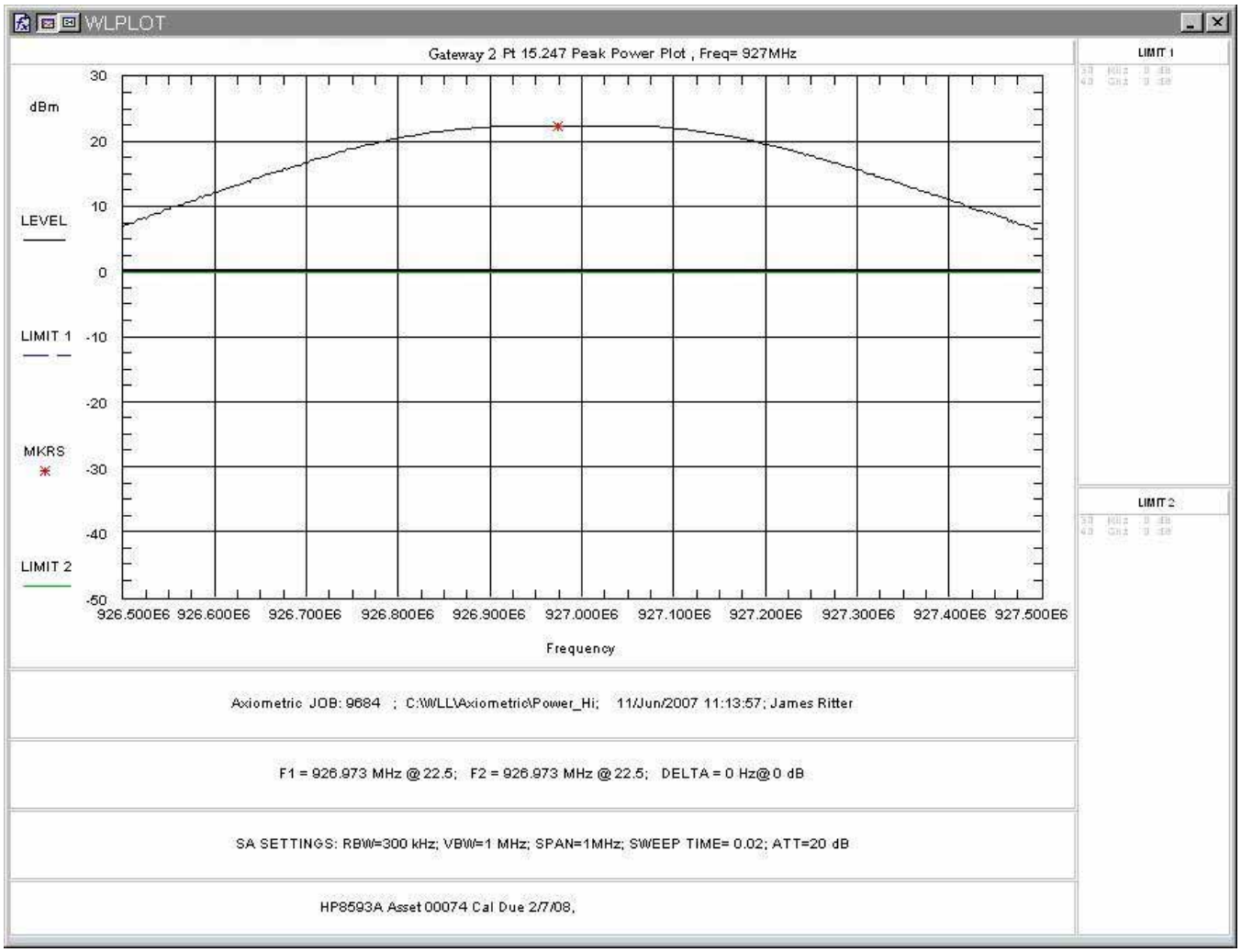

Figure 4-5. RF Peak Power, High Channel

4.3 Occupied Bandwidth: (FCC Part §2.1049)

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

For Frequency Hopping Spread Spectrum Systems, FCC Part 15.247 requires the maximum 20 dB bandwidth not exceed 250kHz.

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

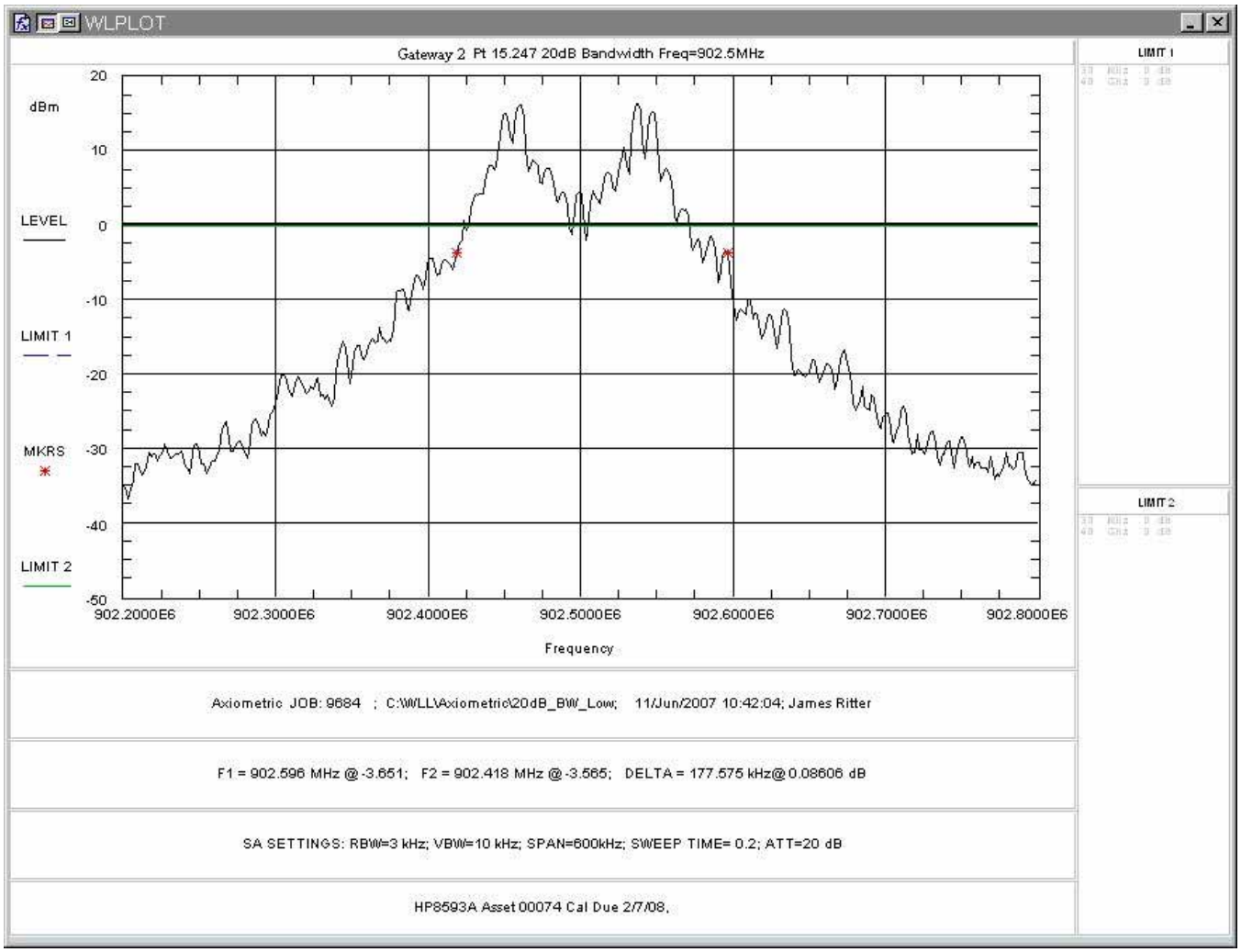

Figure 4-6. Occupied Bandwidth, Low Channel

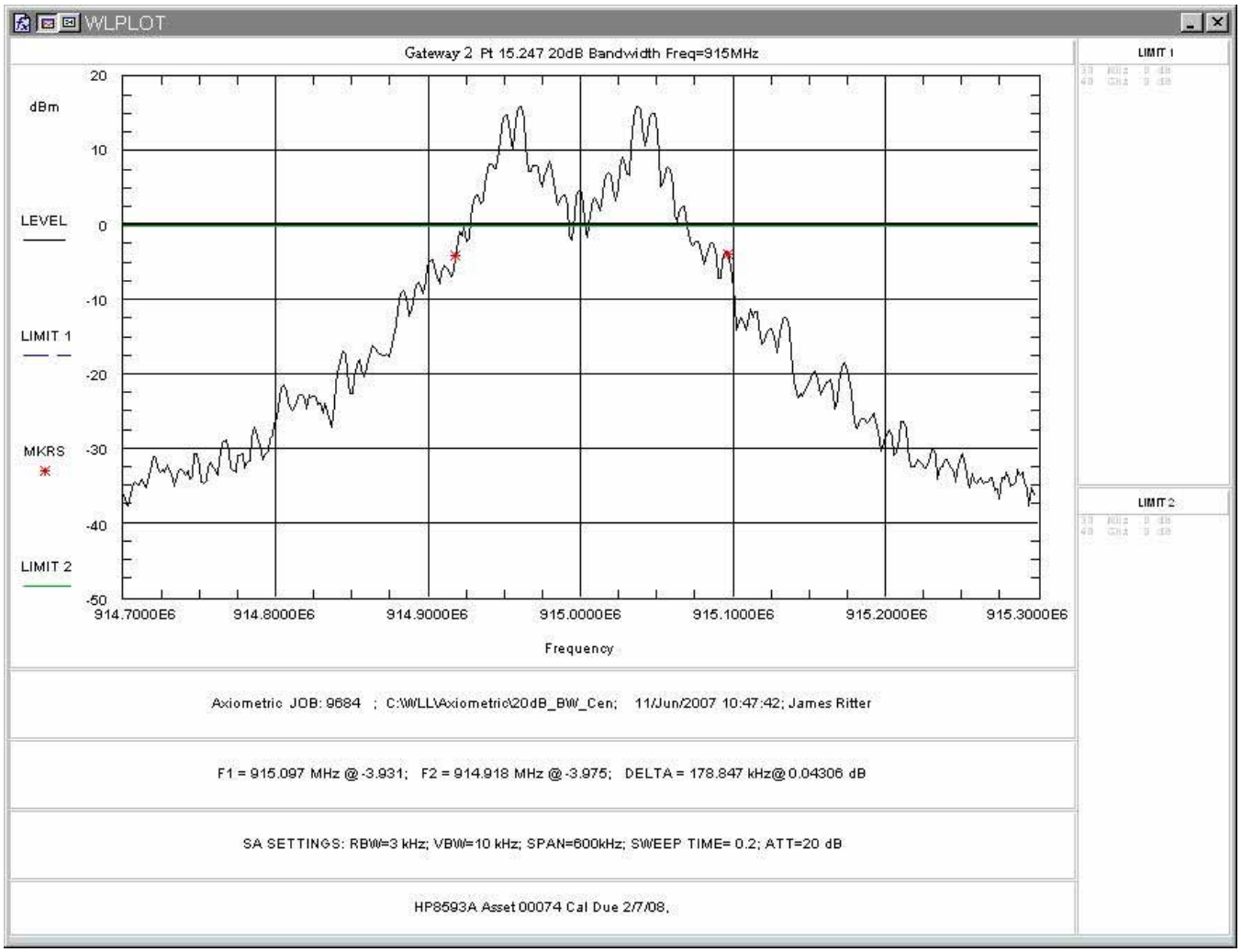

Figure 4-7. Occupied Bandwidth, Mid Channel

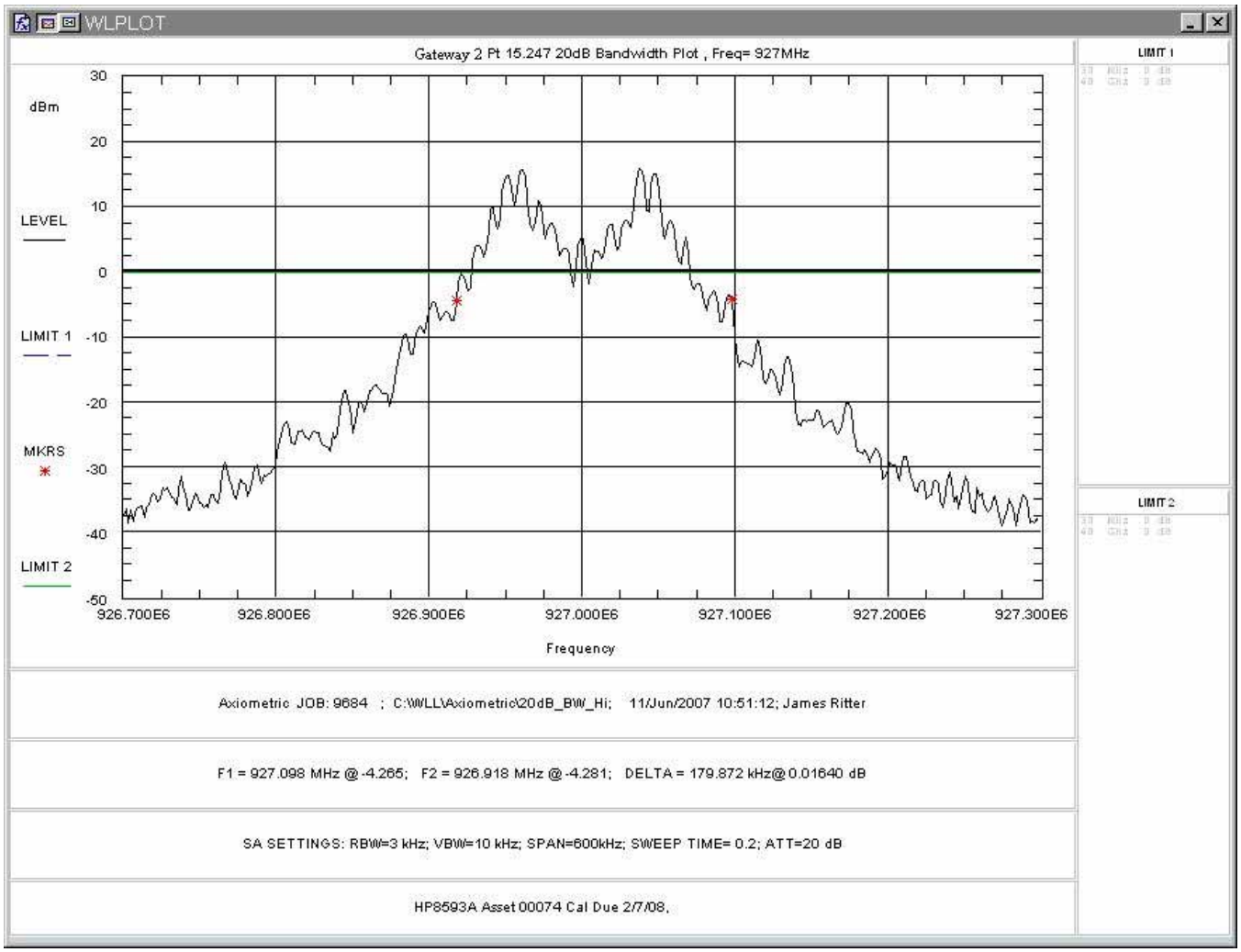

Figure 4-8. Occupied Bandwidth, High Channel

Table 4 provides a summary of the Occupied Bandwidth Results.

Table 4. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Low Channel: 902.5MHz	177.6 kHz	250 kHz	Pass
Mid Channel: 915.0MHz	178.9 kHz	250 kHz	Pass
High Channel: 927.0MHz	179.9 kHz	250 kHz	Pass

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

Per the FCC requirements, frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20 dB bandwidth, whichever is greater. The maximum 20dB bandwidth measured is 179.9kHz so the channel spacing must be more than 179.9kHz. In addition, for a 900-928MHz with a 20dB Bandwidth less than 250 kHz the number of hopping channels shall at least 50 channels.

The EUT antenna was removed and the cable was connected directly into a spectrum analyzer through a 10 dB attenuator. An offset was programmed into the spectrum analyzer to compensate for the loss of the external attenuator. The spectrum analyzer resolution bandwidth was set to 30 kHz and the video bandwidth was set to 100 kHz. The channel spacing of 2 adjacent channels was measured using a spectrum analyzer span setting of 1.5MHz.

The following are plots of the channel spacing and number of hopping channels data. The channel spacing was measured to be 500 kHz and the number of channels used is 50.

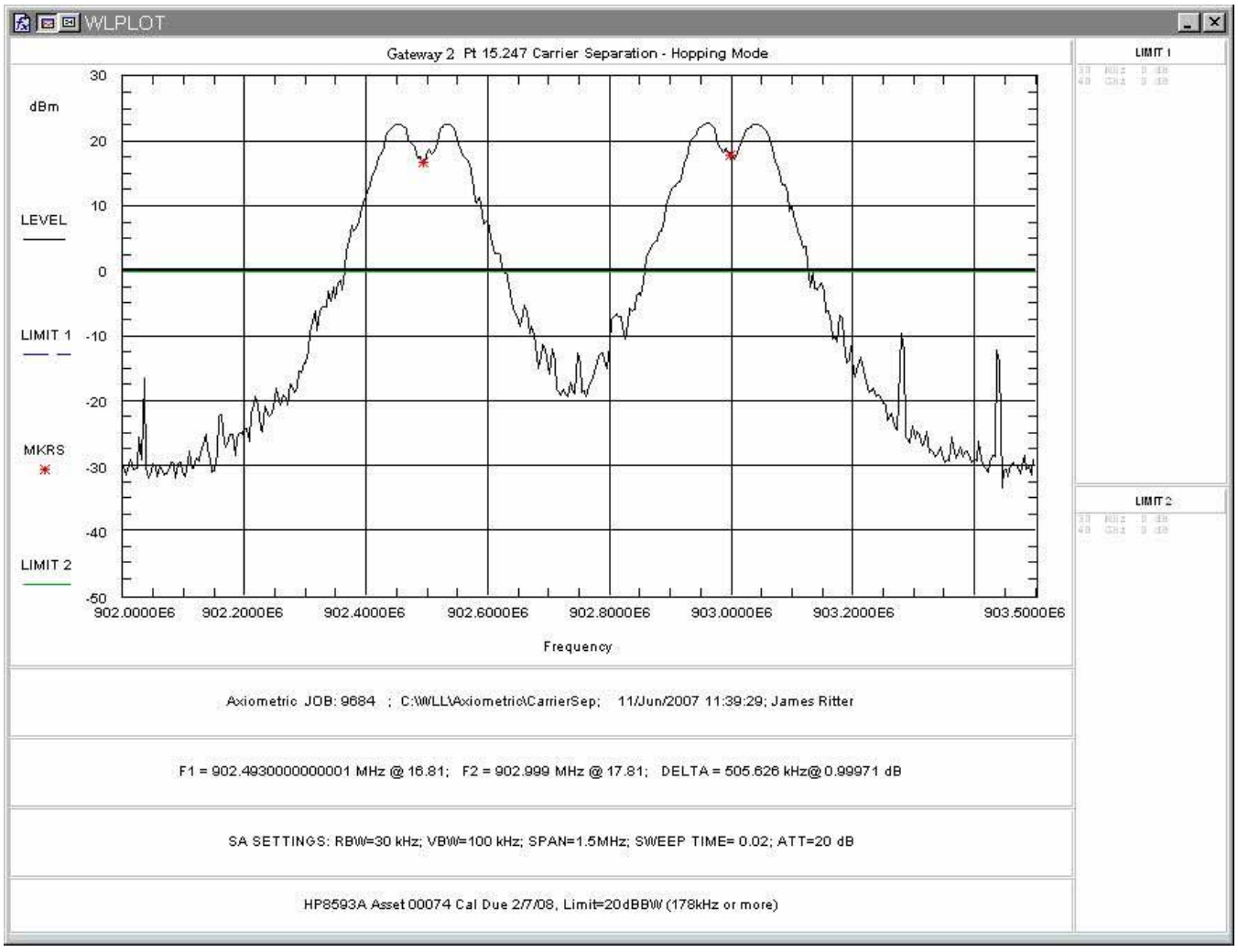

Figure 4-9. Channel Spacing, 500kHz

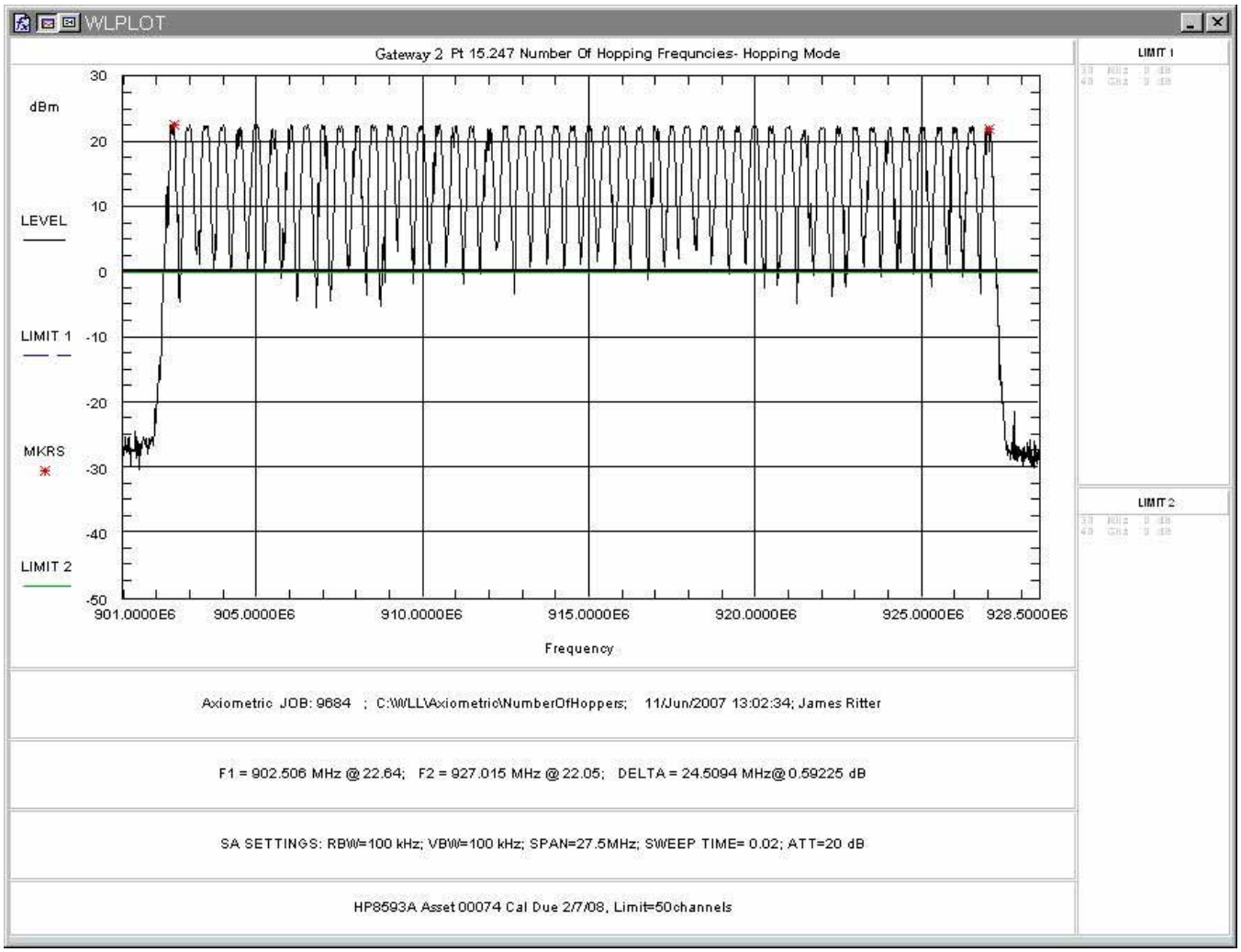

Figure 4-10. Number of Channels

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

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

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

The following are plots of the conducted spurious emissions data.

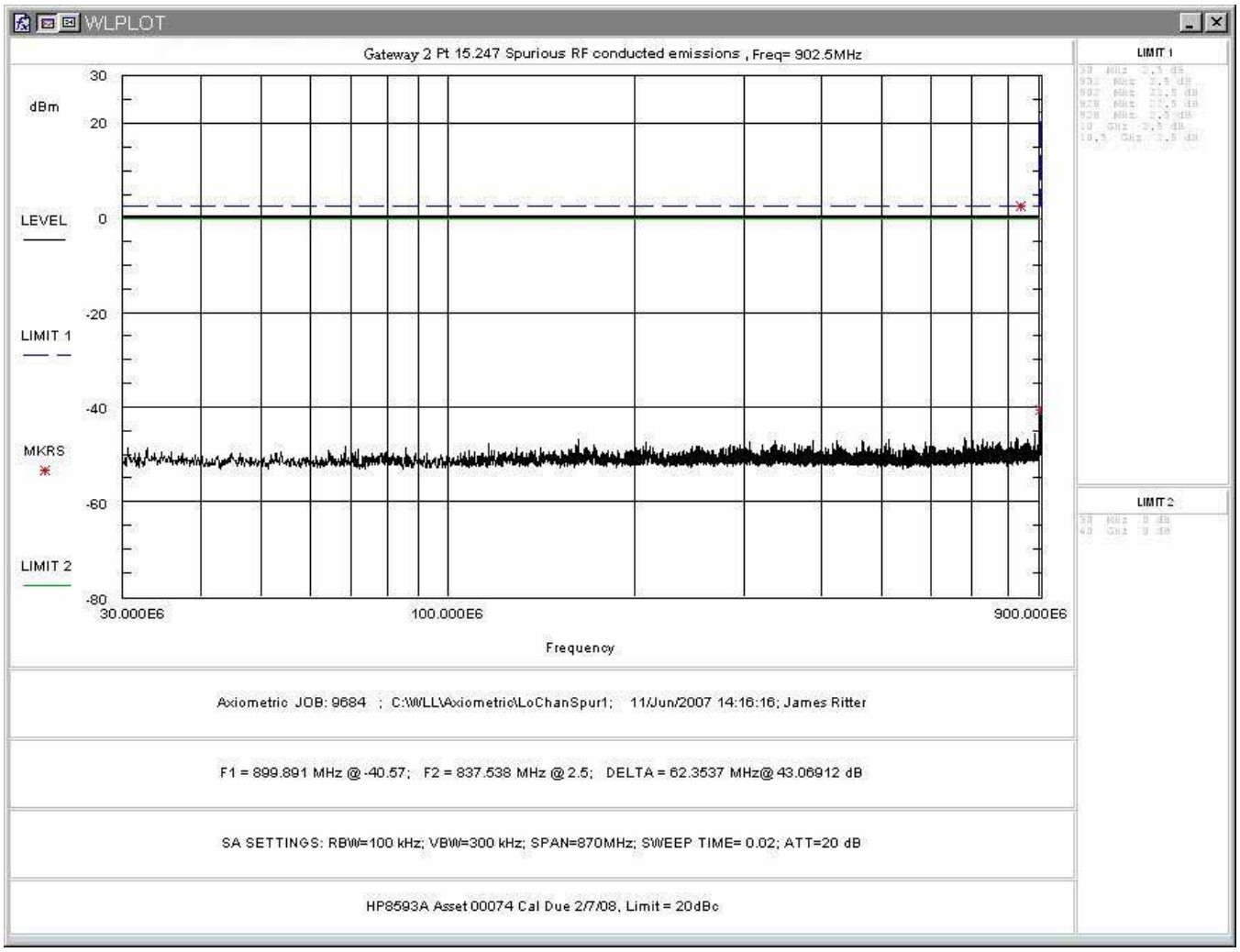

Figure 4-11. Conducted Spurious Emissions, Low Channel 30 - 900MHz

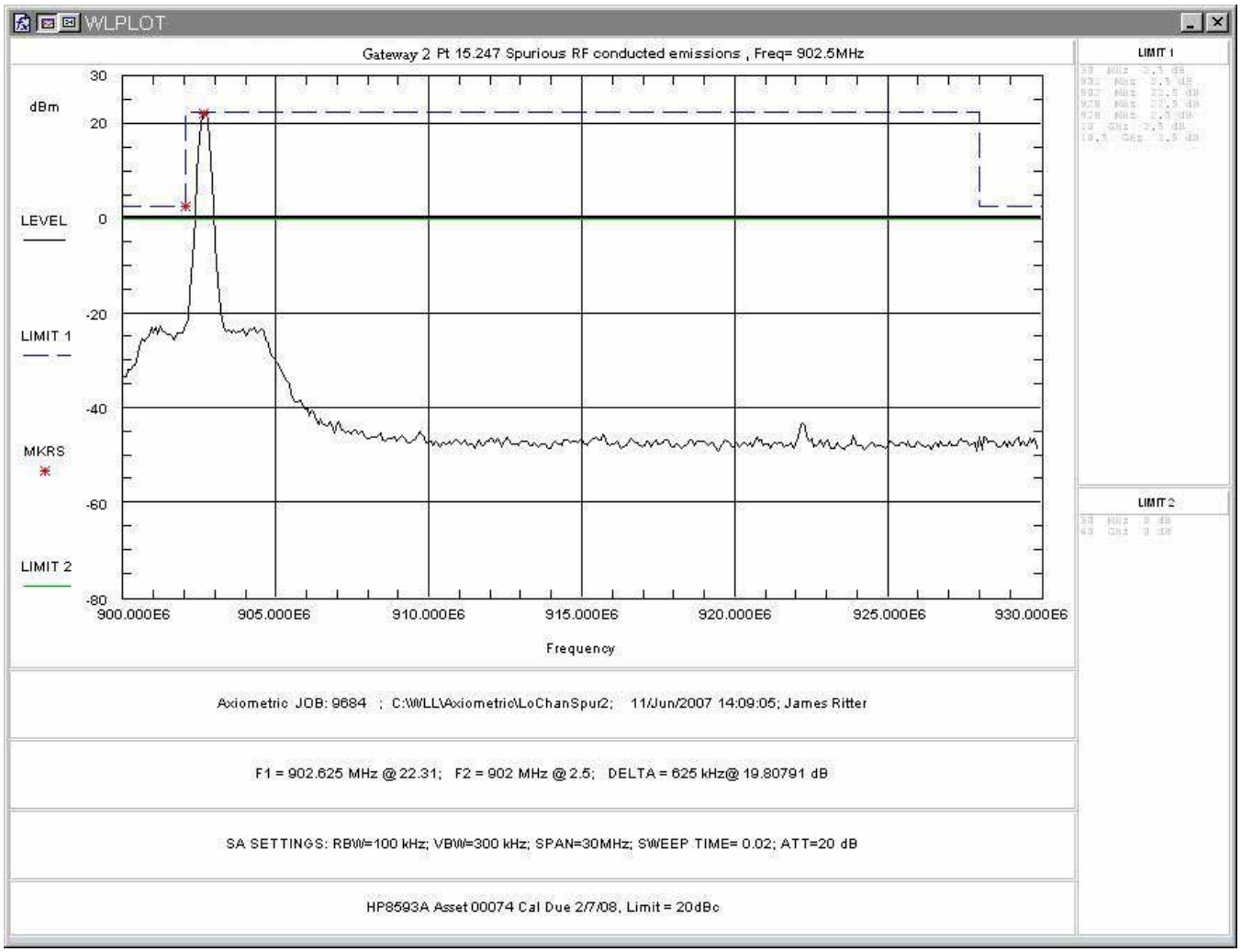

Figure 4-12. Conducted Spurious Emissions, Low Channel 900MHz-930MHz

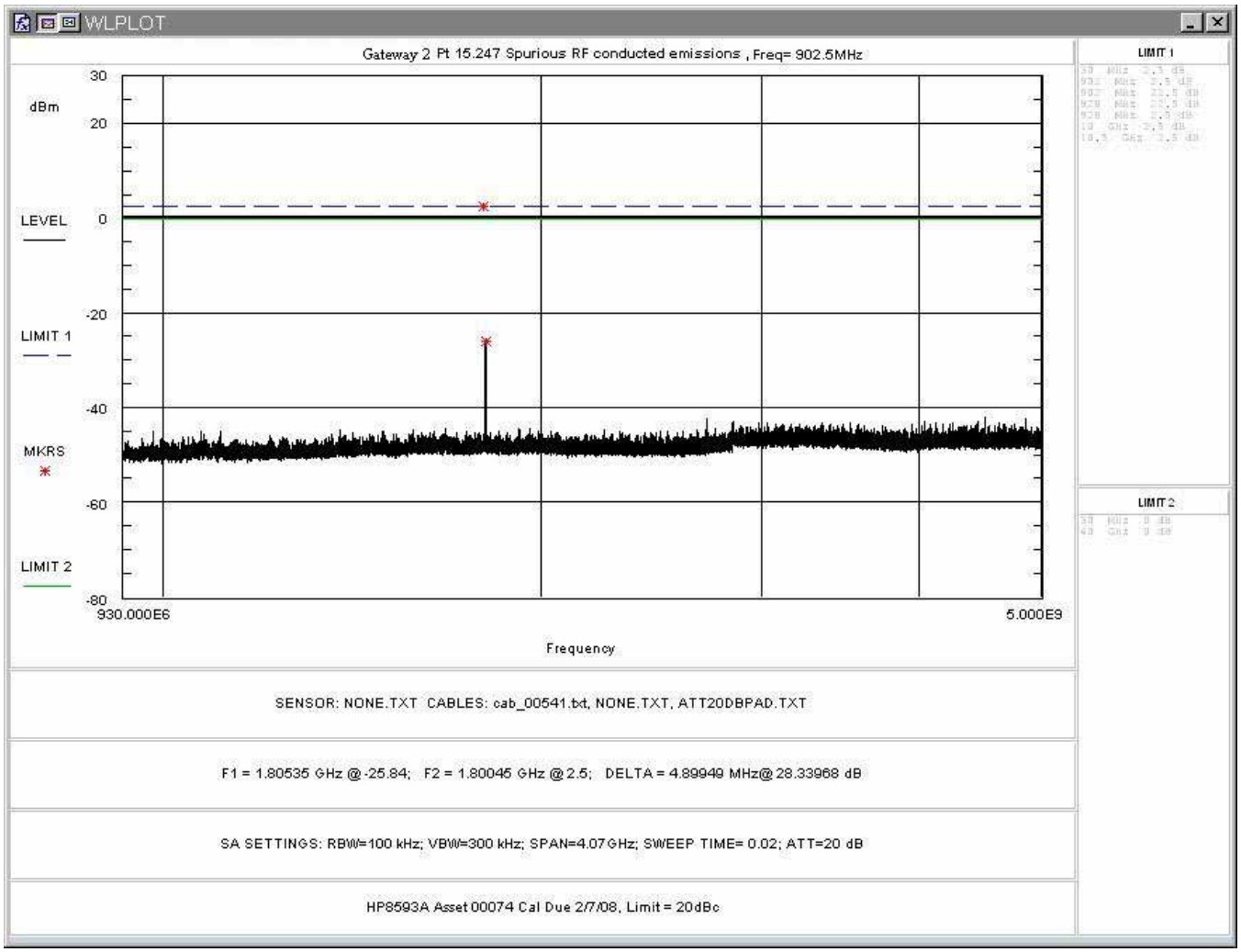

Figure 4-13. Conducted Spurious Emissions, Low Channel 930MhHz – 5GHz

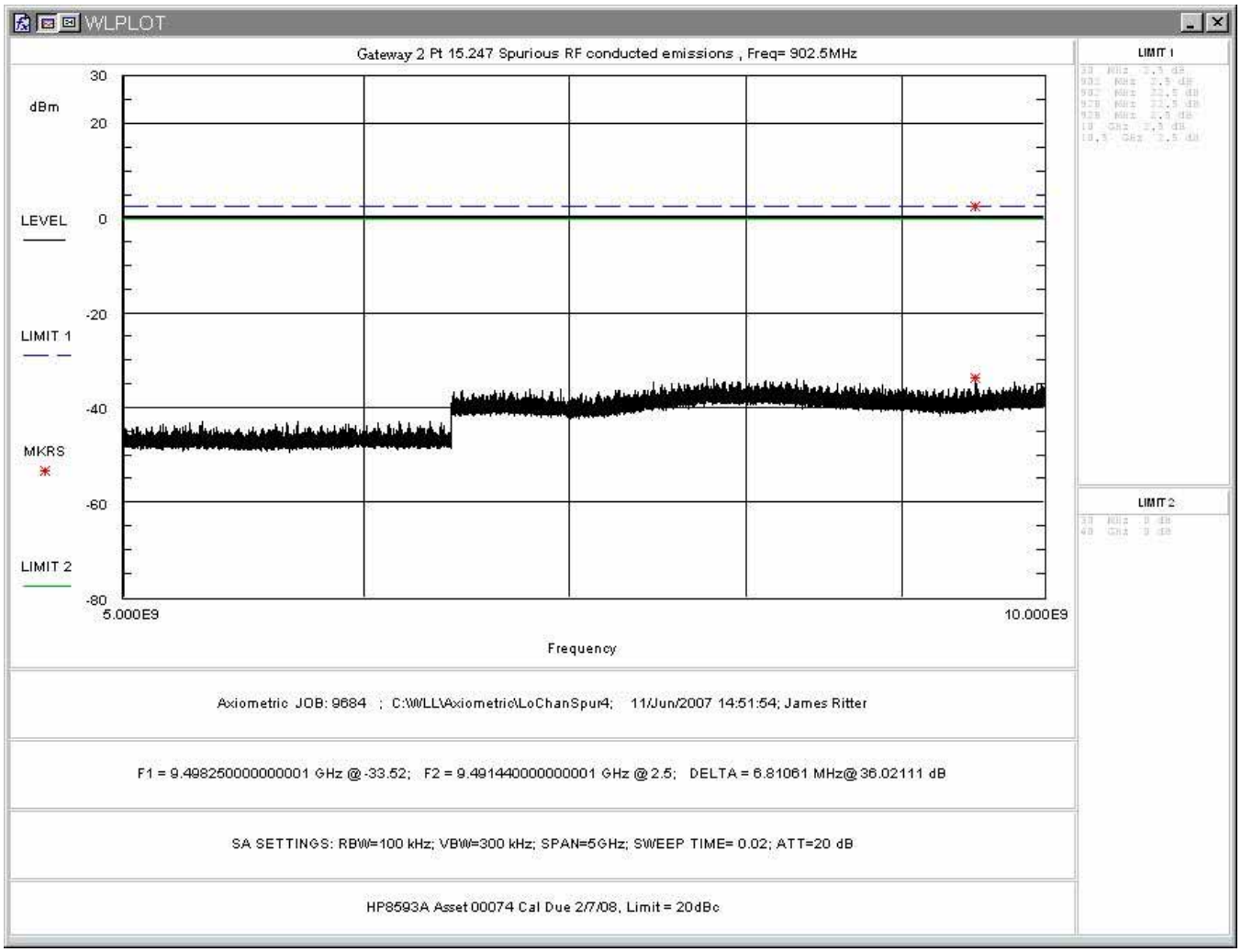

Figure 4-14. Conducted Spurious Emissions, Low Channel 5 - 10GHz

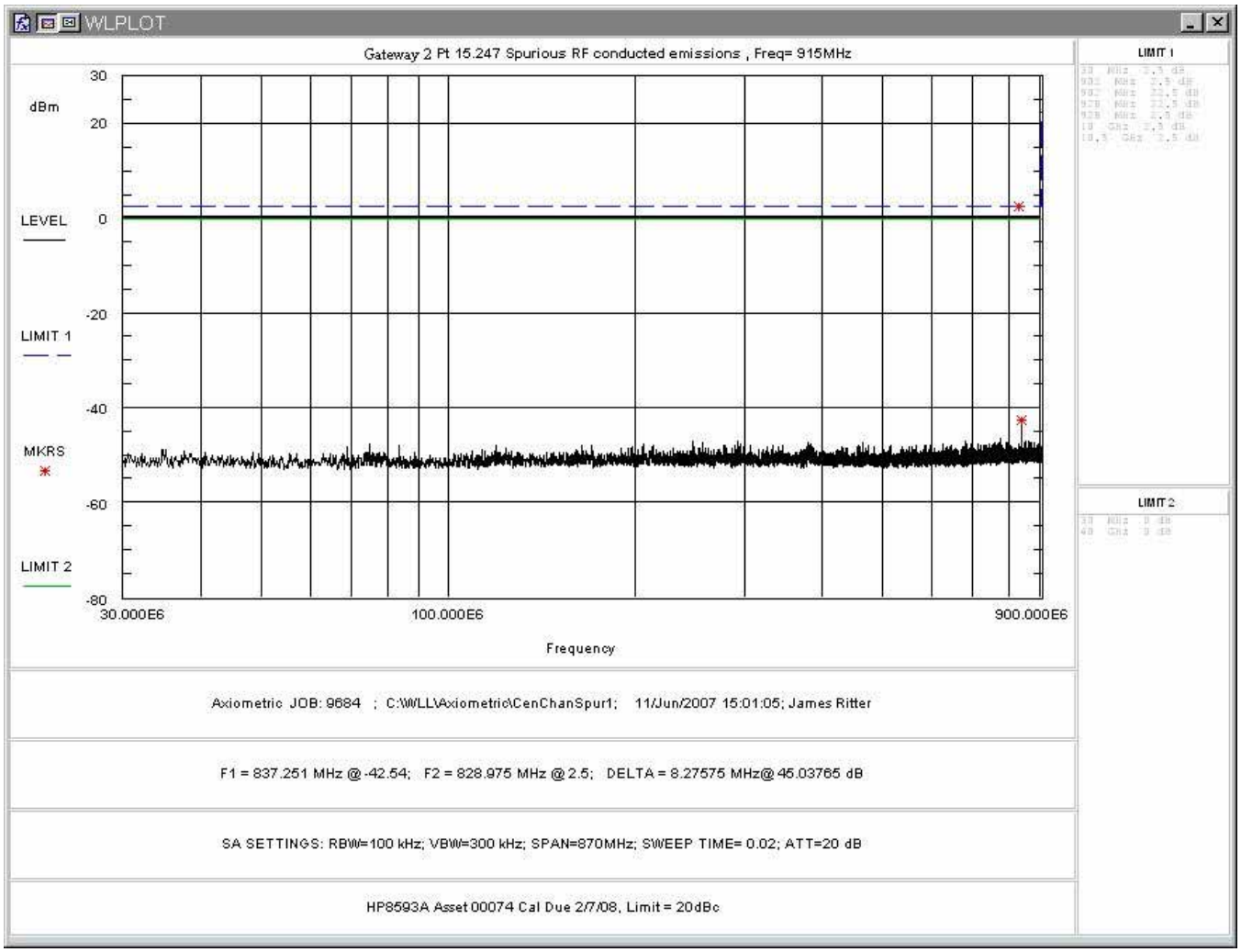

Figure 4-15. Conducted Spurious Emissions, Mid Channel 30 - 900MHz

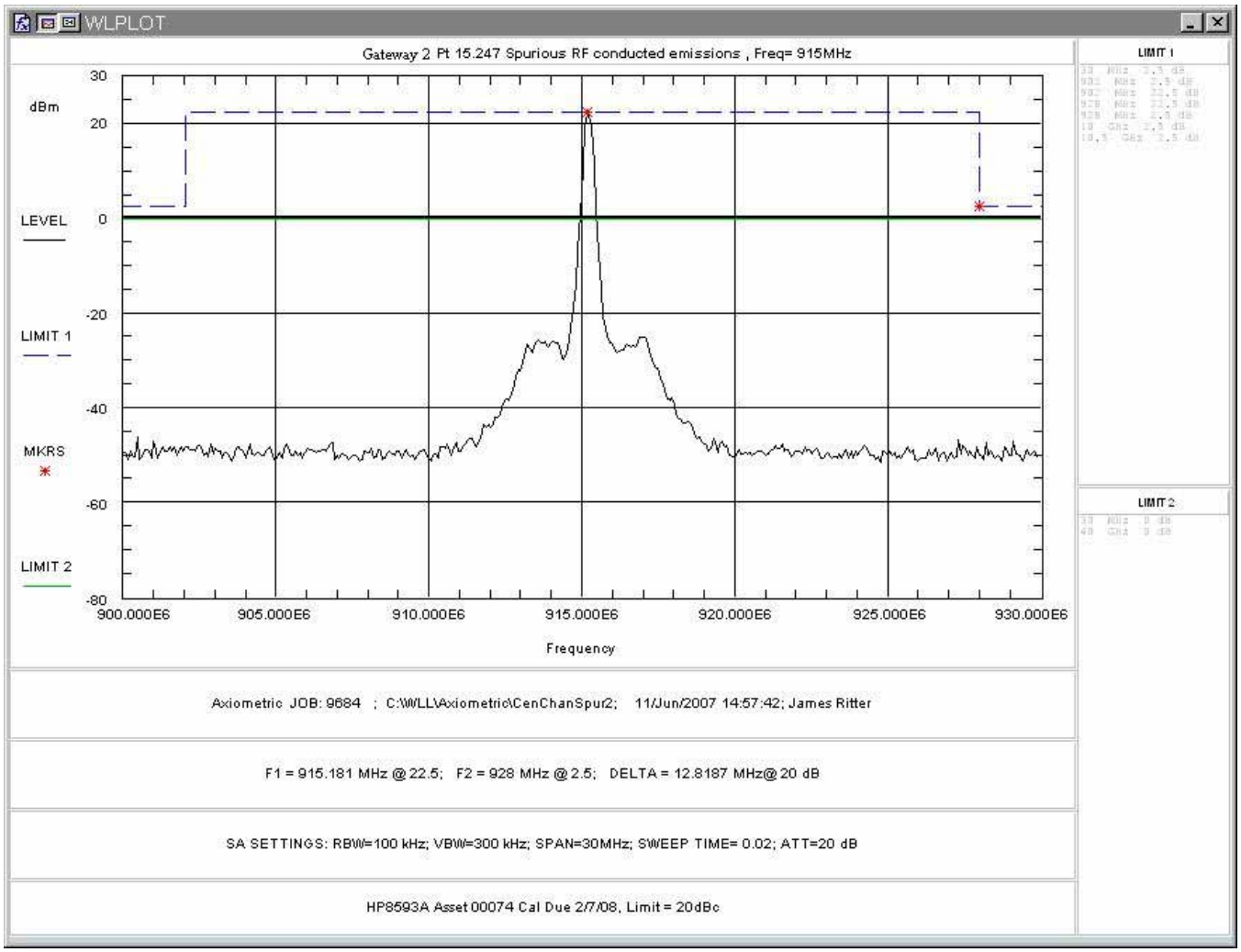

Figure 4-16. Conducted Spurious Emissions, Mid Channel 900 - 930MHz

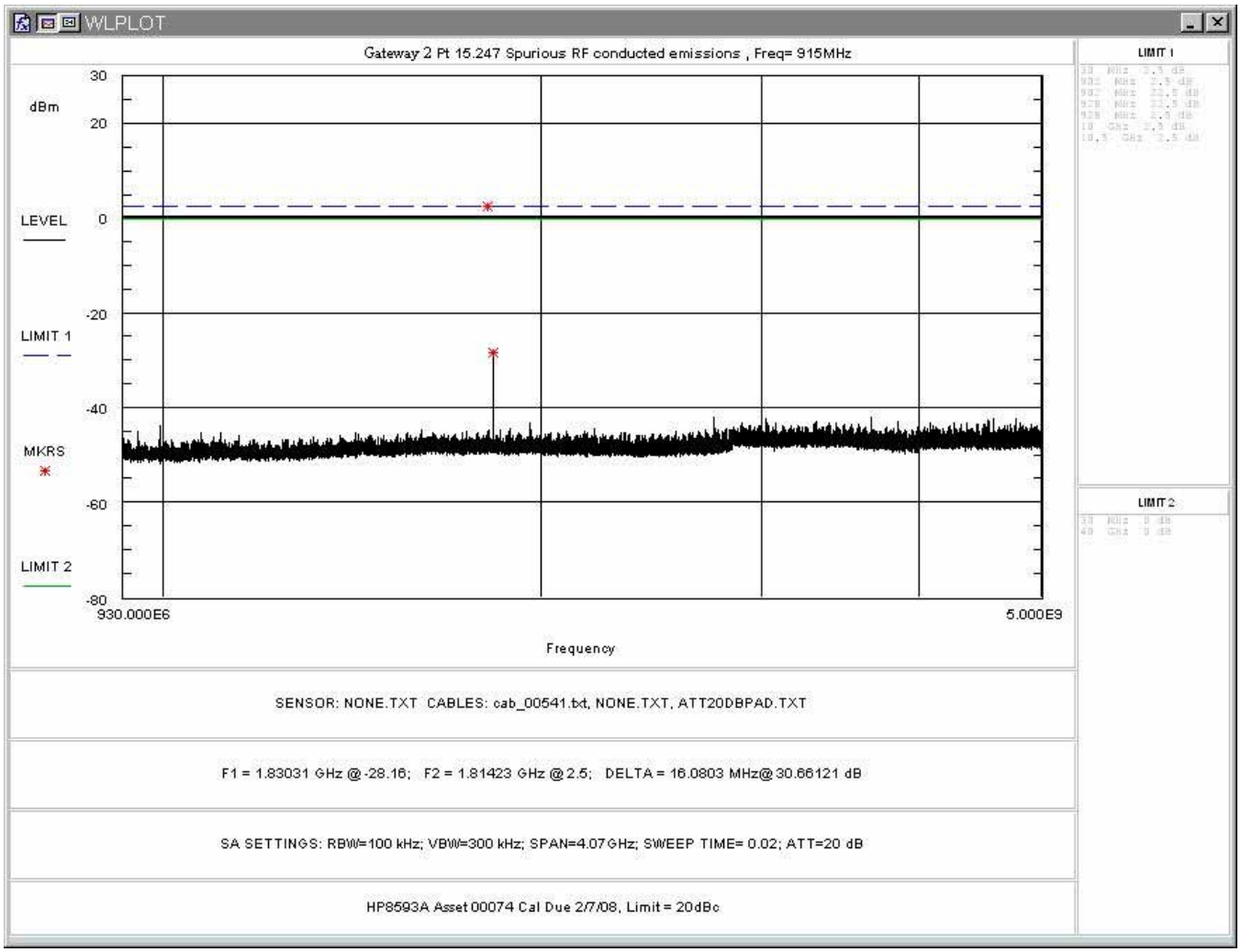

Figure 4-17. Conducted Spurious Emissions, Mid Channel 930MHz – 5GHz

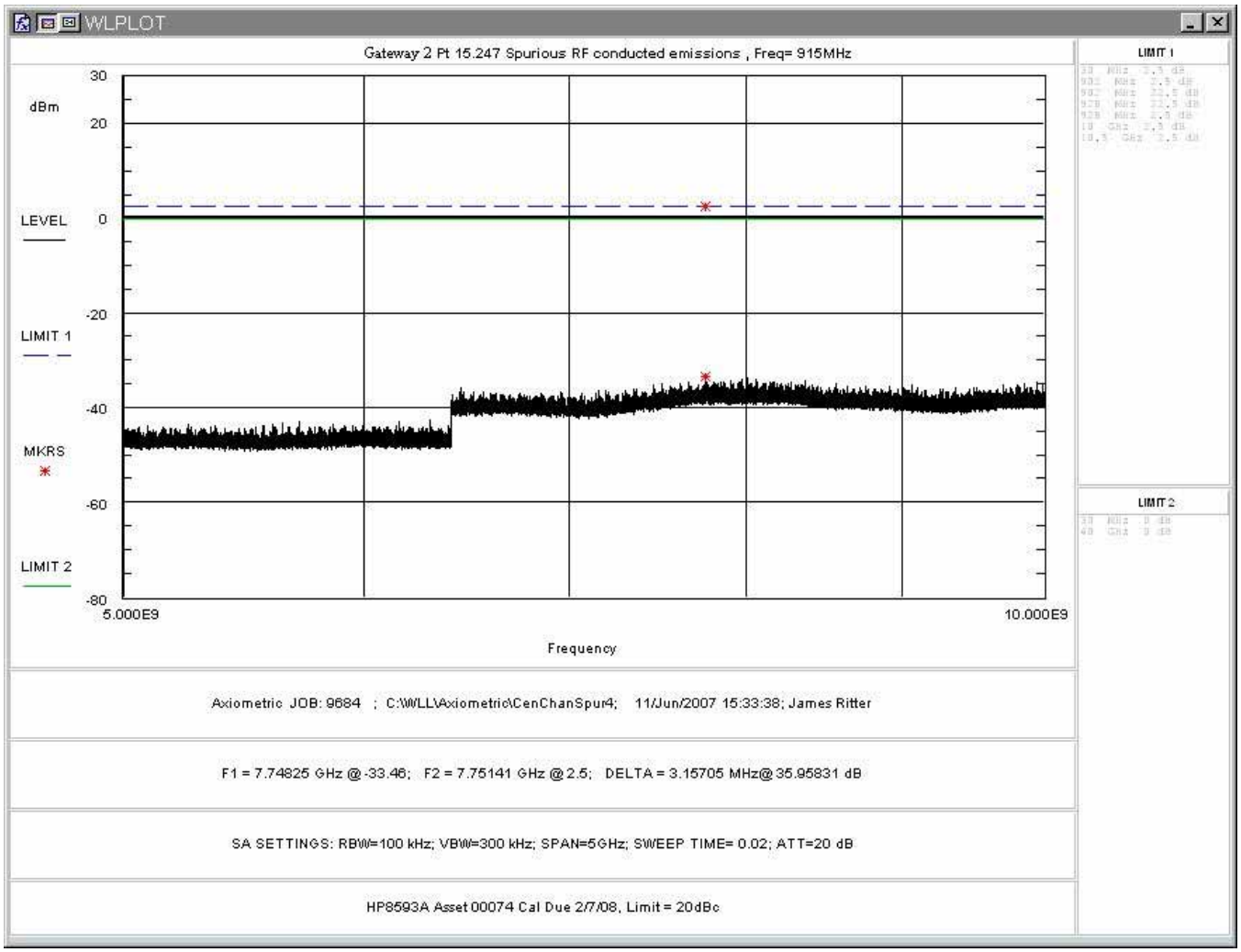

Figure 4-18. Conducted Spurious Emissions, Mid Channel 5 – 10GHz

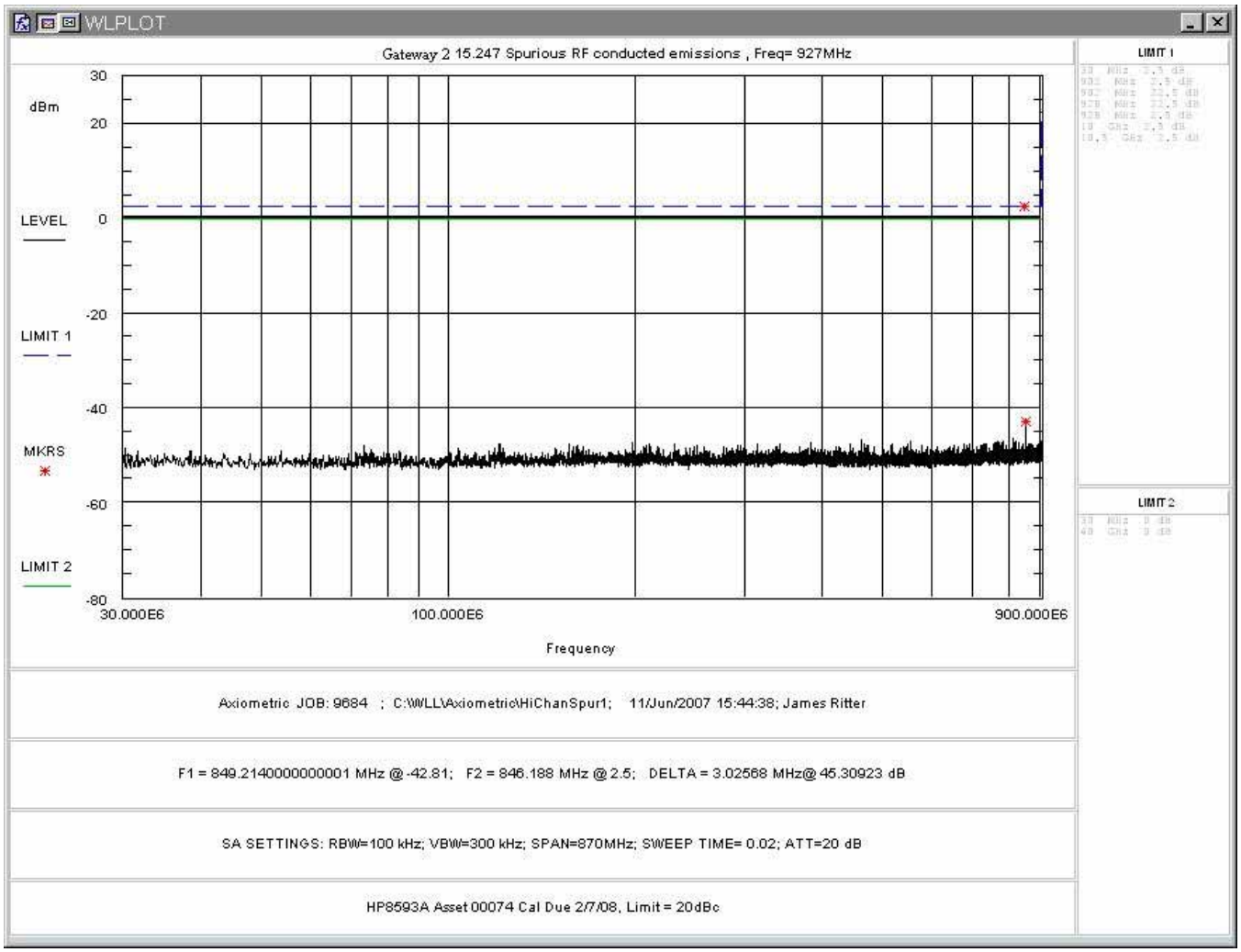

Figure 4-19. Conducted Spurious Emissions, High Channel 30 - 900MHz

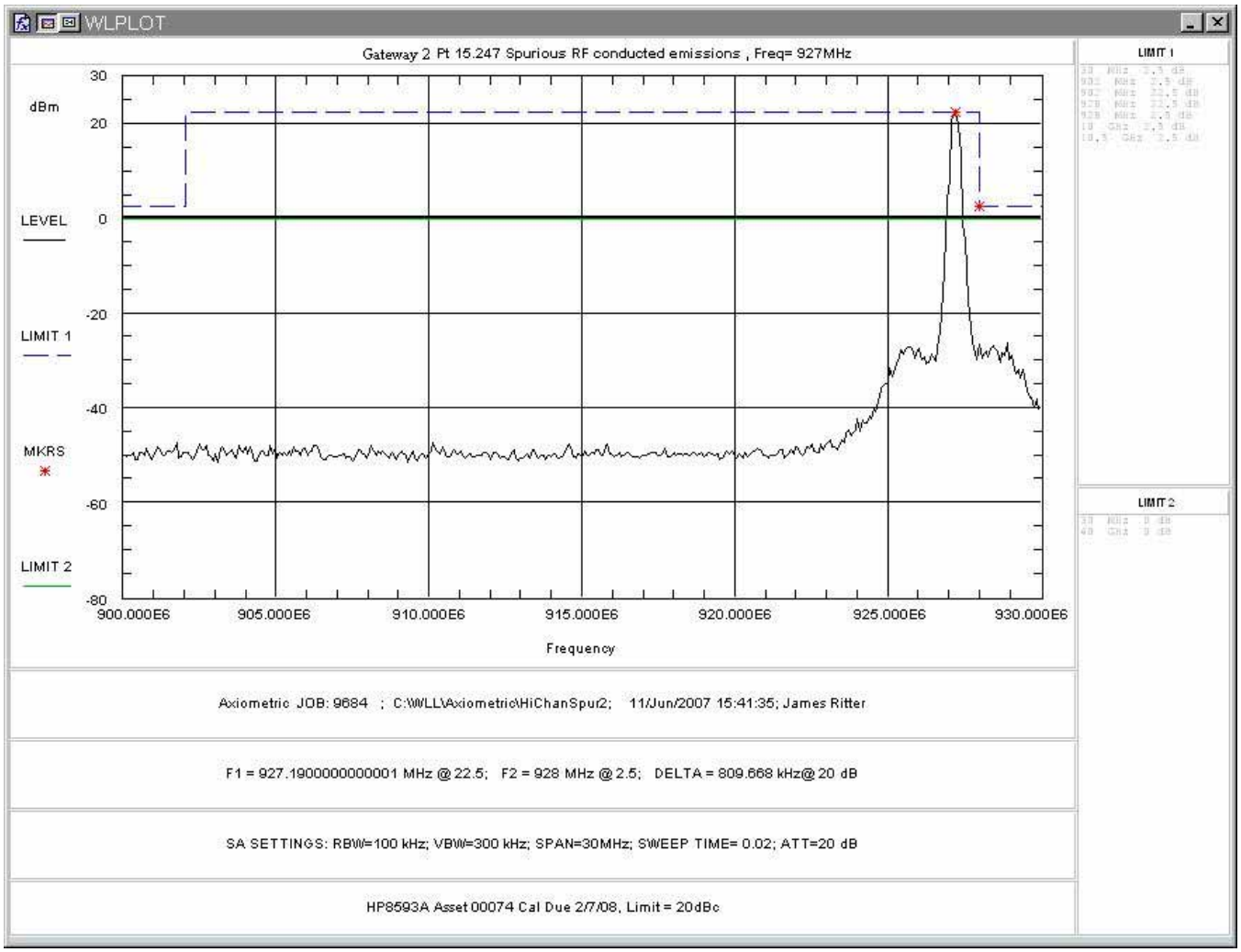

Figure 4-20. Conducted Spurious Emissions, High Channel 900 – 930MHz

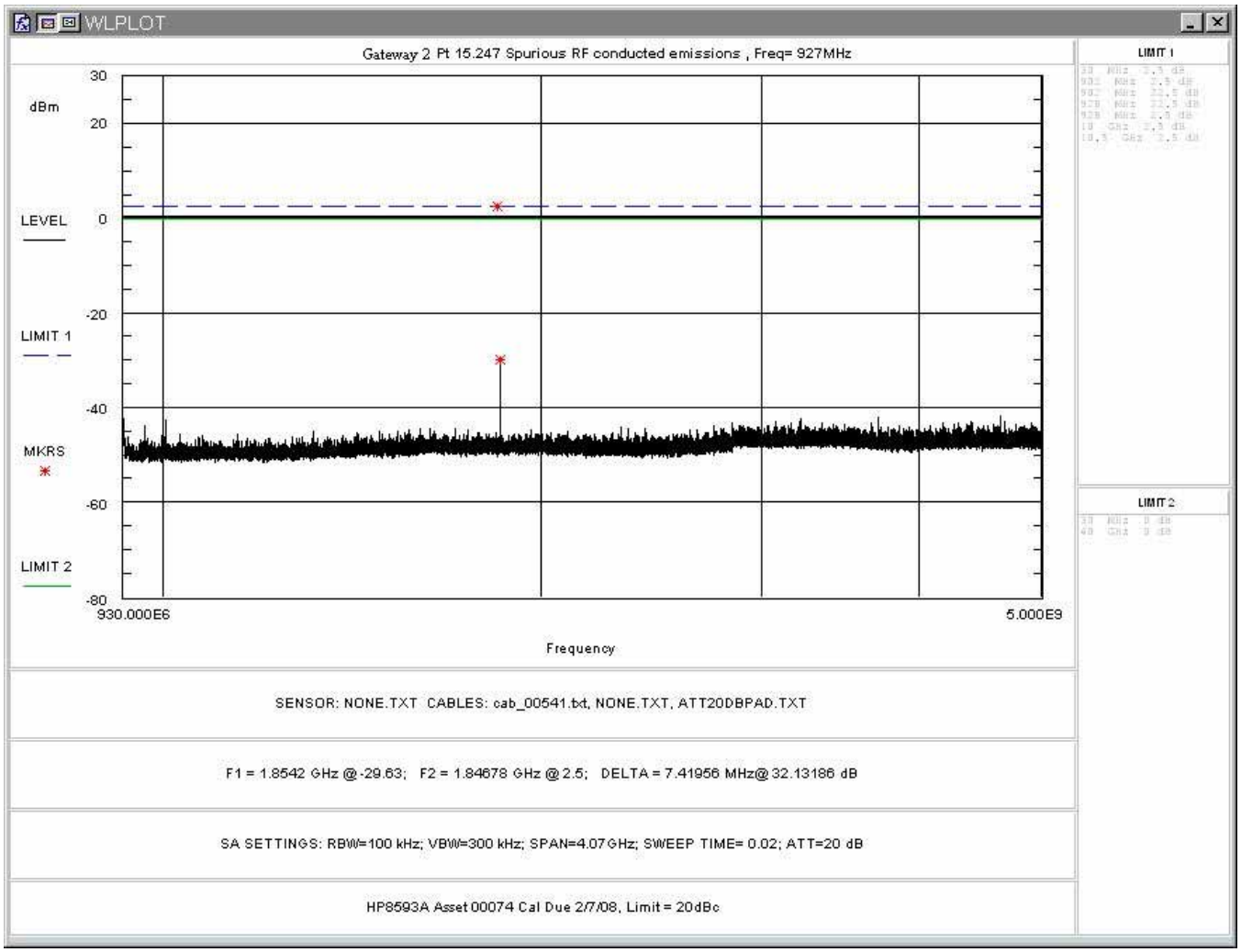

Figure 4-21. Conducted Spurious Emissions, High Channel 930MHz - 5GHz

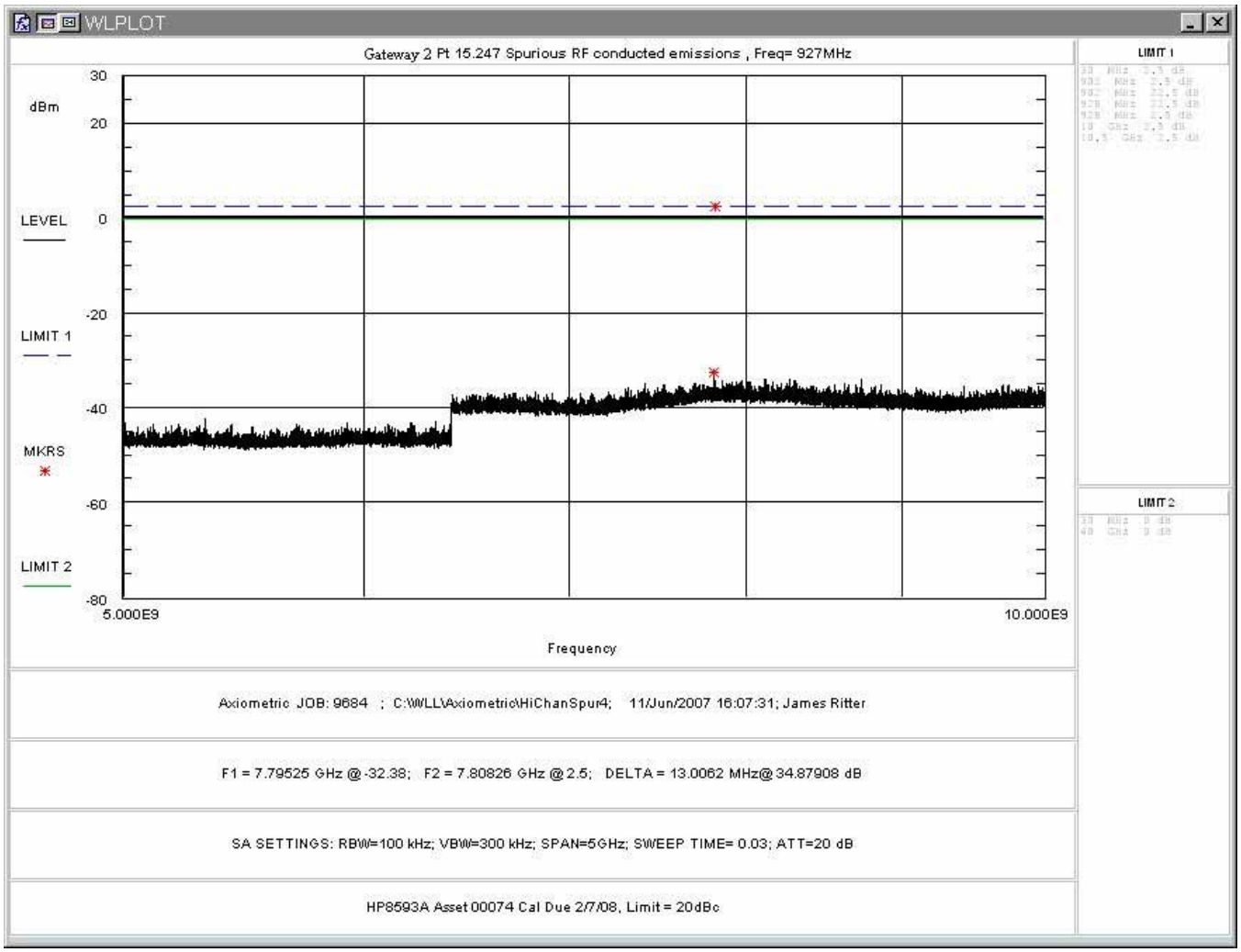

Figure 4-22. Conducted Spurious Emissions, High Channel 5 - 10GHz

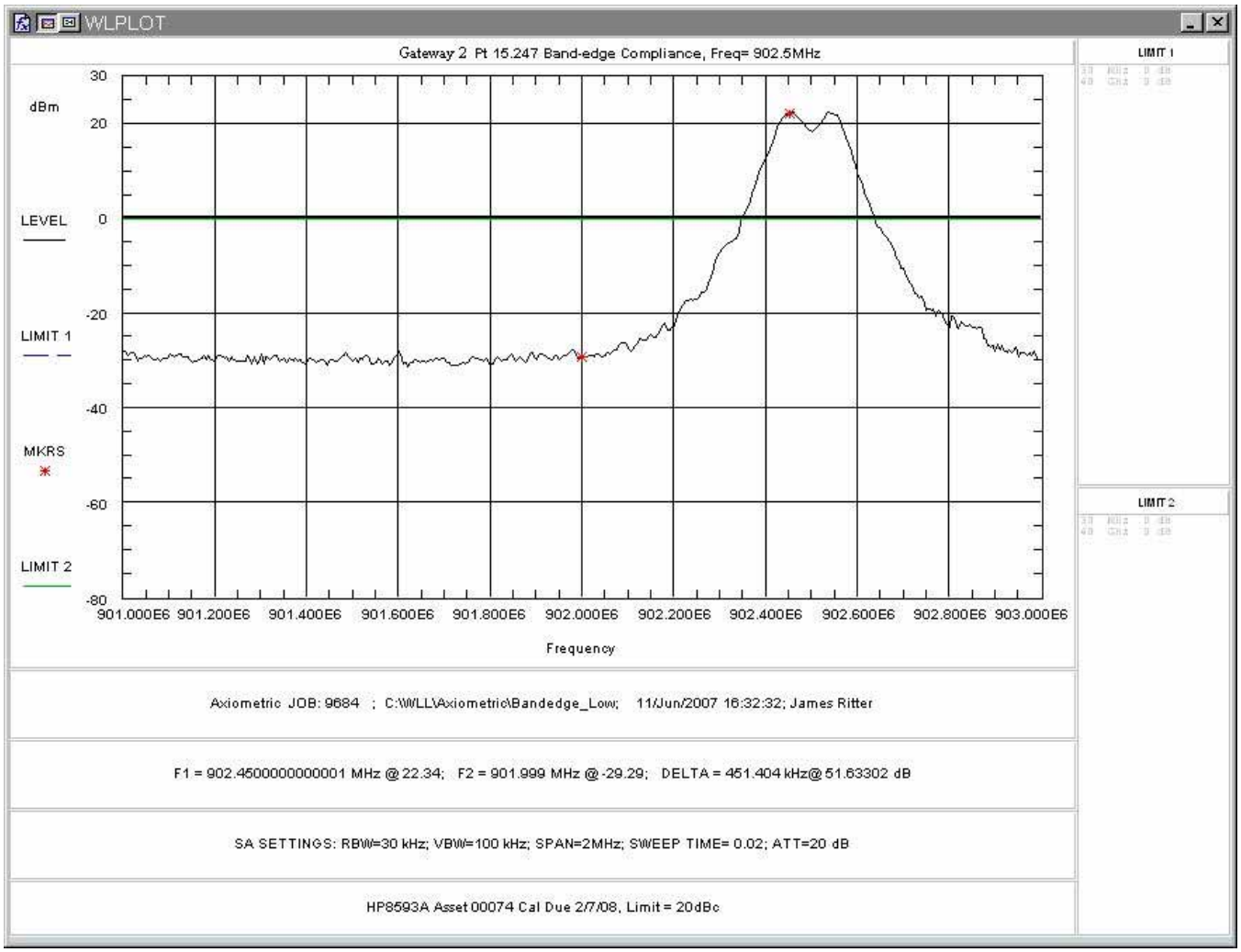

Figure 4-23. Lower Band Edge –Low Channel

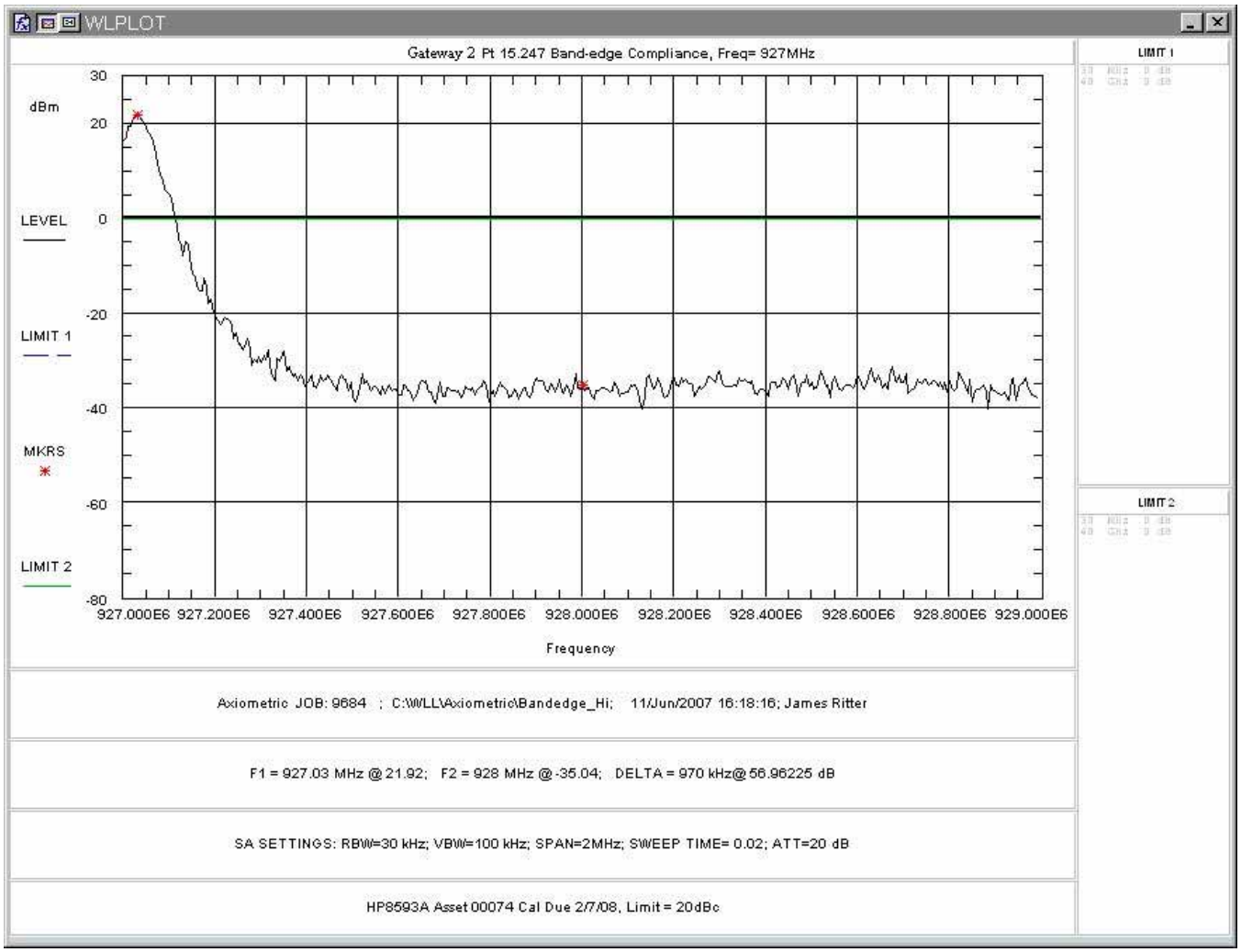

Figure 4-24. Upper Band Edge –Hi Channel

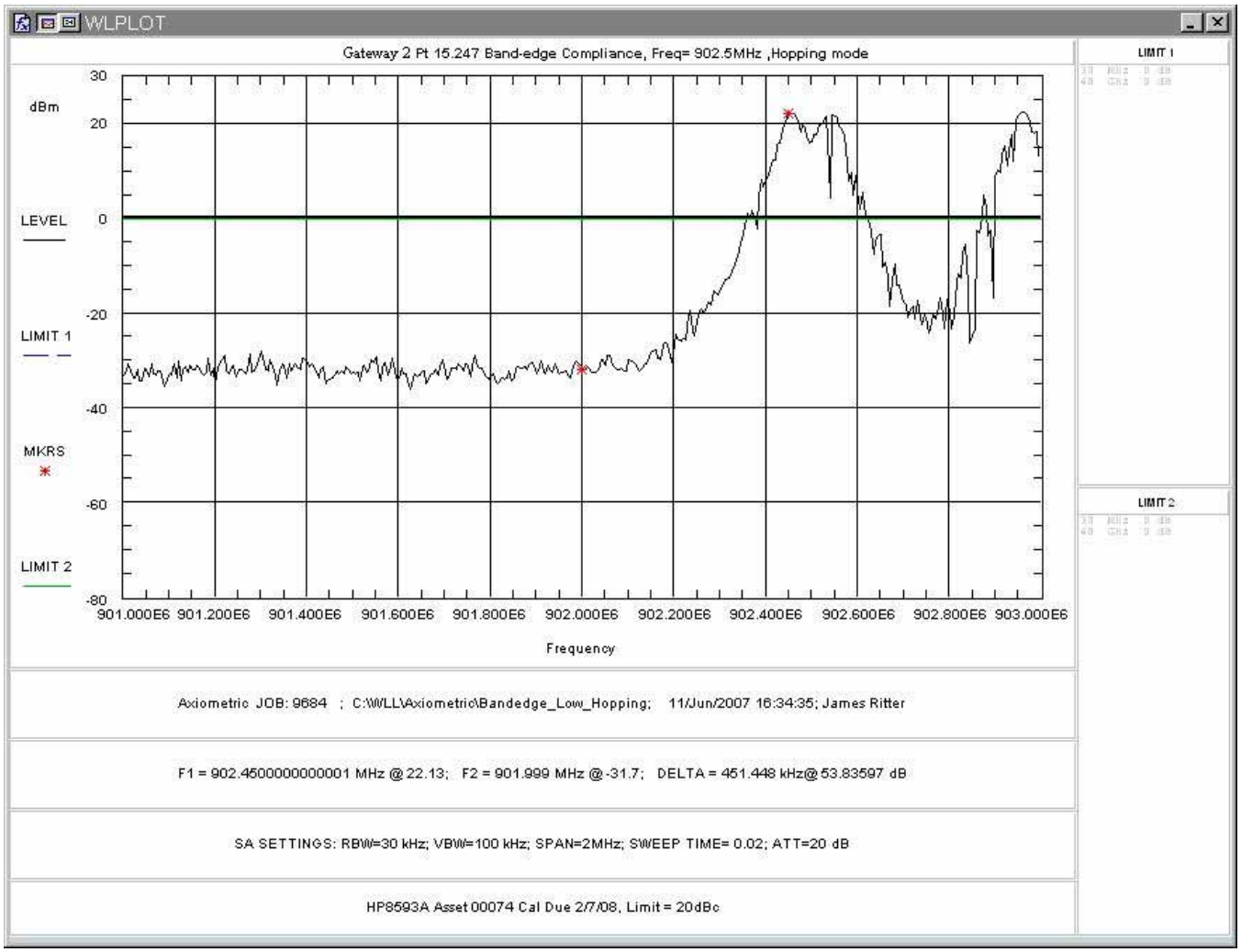

Figure 4-25. Lower Band Edge- Hopping Mode

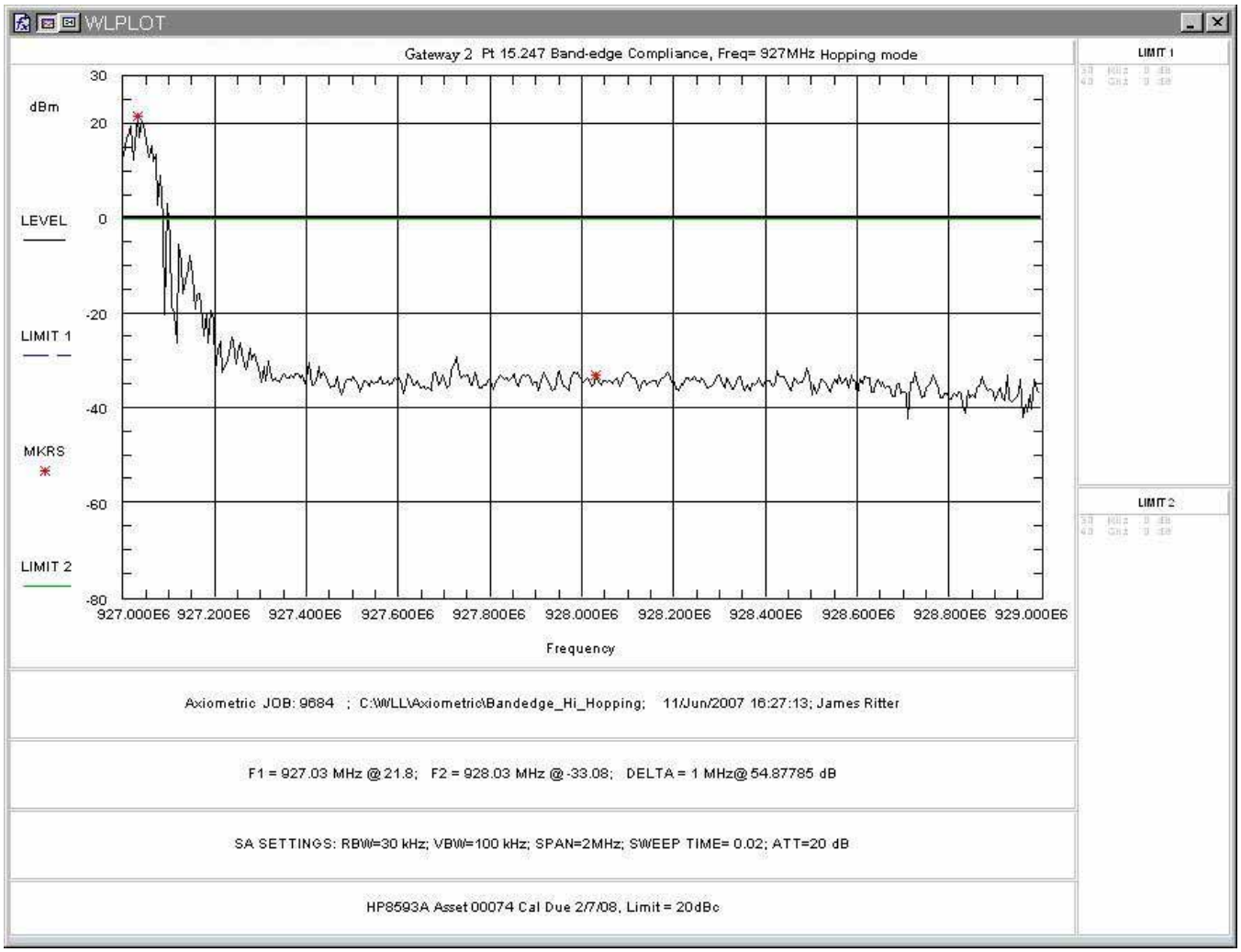

Figure 4-26. Upper Band Edge- Hopping Mode

4.6 Radiated Spurious Emissions: (FCC Part §2.1053)

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

4.6.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-2003. 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)

Table 5: Radiated Emission Test Data- Low Channel @ 902.5MHz

(Restricted Bands)

Transmitting at 902.5MHz w/ 5.5dBi whip antenna **Unit mounts Vertically**

<1000MHz

Frequency (MHz)	Pol. H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
75.120	V	180.0	1.2	21.6	7.4	1.5	0.0	30.5	33.6	100.0	-9.5
110.820	V	190.0	1.3	12.8	11.2	1.7	0.0	25.7	19.2	150.0	-17.9
119.825	V	180.0	1.3	16.4	11.8	1.7	0.0	29.9	31.2	150.0	-13.6
125.000	V	270.0	1.3	13.2	11.4	2.1	0.0	26.7	21.6	150.0	-16.8
150.000	V	90.0	1.3	26.8	9.1	2.1	0.0	38.0	79.4	150.0	-5.5
162.980	V	270.0	1.4	14.5	10.1	2.3	0.0	26.9	22.1	150.0	-16.6
244.200	V	170.0	1.6	11.8	13.1	2.9	0.0	27.8	24.6	200.0	-18.2
275.000	V	180.0	1.6	8.9	15.0	3.0	0.0	26.9	22.1	200.0	-19.1
325.000	V	90.0	1.4	10.1	14.5	3.2	0.0	27.8	24.6	200.0	-18.2
400.000	V	180.0	1.4	16.1	15.7	3.8	0.0	35.6	60.3	200.0	-10.4
980.440	V	180.0	1.5	19.2	22.4	6.8	0.0	48.4	262.0	500.0	-5.6
75.120	H	0.0	2.5	18.5	7.4	1.5	0.0	27.4	23.5	100.0	-12.6
110.820	H	180.0	3.0	13.5	11.2	1.7	0.0	26.4	20.8	150.0	-17.2
119.825	H	180.0	3.0	13.2	11.8	1.7	0.0	26.7	21.6	150.0	-16.8
125.000	H	180.0	3.5	18.3	11.4	2.1	0.0	31.8	38.9	150.0	-11.7
150.000	H	180.0	1.8	28.0	9.1	2.1	0.0	39.2	91.2	150.0	-4.3
275.000	H	270.0	3.3	7.6	15.0	3.0	0.0	25.6	19.1	200.0	-20.4
325.000	H	170.0	1.7	9.4	14.5	3.2	0.0	27.1	22.6	200.0	-18.9
400.000	H	90.0	1.9	12.5	15.7	3.8	0.0	32.0	39.8	200.0	-14.0
980.440	H	270.0	2.0	16.2	22.4	6.8	0.0	45.4	185.5	500.0	-8.6

>1000MHz

Frequency (MHz)	Pol. 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											
1094.600	V	0.0	1.0	57.8	25.0	1.3	37.5	46.6	213.1	5000.0	-27.4
1695.330	V	180.0	1.0	47.8	27.2	1.5	36.8	39.7	96.7	5000.0	-34.3
2707.500	V	270.0	1.0	52.0	29.5	1.5	36.0	47.0	223.9	5000.0	-27.0
3610.000	V	290.0	1.0	51.2	30.7	2.5	35.6	48.8	274.8	5000.0	-25.2
4512.500	V	180.0	1.0	42.7	32.0	3.3	35.5	42.5	133.7	5000.0	-31.5
5415.000	V	180.0	1.0	46.7	33.5	3.8	35.6	48.4	261.9	5000.0	-25.6
8122.500	V	190.0	1.0	42.5	37.4	6.1	35.8	50.2	322.0	5000.0	-23.8
9025.000	V	180.0	1.0	44.8	38.0	4.8	36.1	51.5	377.2	5000.0	-22.4
1094.600	H	180.0	1.0	54.6	25.0	1.3	37.5	43.4	147.1	5000.0	-30.6
1695.330	H	180.0	1.0	48.7	27.2	1.5	36.8	40.6	106.9	5000.0	-33.4
2707.500	H	190.0	1.0	47.8	29.5	1.5	36.0	42.8	138.5	5000.0	-31.1

Frequency (MHz)	Pol. 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)
3610.000	H	200.0	1.0	54.2	30.7	2.5	35.6	51.8	388.2	5000.0	-22.2
4512.500	H	170.0	1.0	42.5	32.0	3.3	35.5	42.4	131.1	5000.0	-31.6
5415.000	H	190.0	1.0	51.8	33.5	3.8	35.6	53.5	474.5	5000.0	-20.5
8122.500	H	180.0	1.0	42.8	37.4	6.1	35.8	50.5	334.4	5000.0	-23.5
9025.000	H	180.0	1.0	47.0	38.0	4.8	36.1	53.7	484.3	5000.0	-20.3
Average											
1094.600	V	0.0	1.0	47.0	25.0	1.3	37.5	35.8	61.3	500.0	-18.2
1695.330	V	180.0	1.0	34.8	27.2	1.5	36.8	26.7	21.6	500.0	-27.3
2707.500	V	270.0	1.0	49.3	29.5	1.5	36.0	44.3	164.6	500.0	-9.6
3610.000	V	290.0	1.0	48.3	30.7	2.5	35.6	45.9	198.2	500.0	-8.0
4512.500	V	180.0	1.0	33.2	32.0	3.3	35.5	33.0	44.8	500.0	-21.0
5415.000	V	180.0	1.0	40.7	33.5	3.8	35.6	42.4	131.3	500.0	-11.6
8122.500	V	190.0	1.0	32.0	37.4	6.1	35.8	39.7	96.1	500.0	-14.3
9025.000	V	180.0	1.0	36.1	38.0	4.8	36.1	42.8	138.1	500.0	-11.2
1094.600	H	180.0	1.0	43.0	25.0	1.3	37.5	31.8	38.7	500.0	-22.2
1695.330	H	180.0	1.0	33.9	27.2	1.5	36.8	25.8	19.5	500.0	-28.2
2707.500	H	190.0	1.0	42.7	29.5	1.5	36.0	37.7	76.5	500.0	-16.3
3610.000	H	200.0	1.0	52.2	30.7	2.5	35.6	49.8	308.3	500.0	-4.2
4512.500	H	170.0	1.0	31.7	32.0	3.3	35.5	31.6	37.8	500.0	-22.4
5415.000	H	190.0	1.0	46.7	33.5	3.8	35.6	48.4	261.9	500.0	-5.6
8122.500	H	180.0	1.0	32.0	37.4	6.1	35.8	39.7	96.1	500.0	-14.3
9025.000	H	180.0	1.0	36.2	38.0	4.8	36.1	42.9	139.7	500.0	-11.1

Table 6: Radiated Emission Test Data- Low Channel @ 915MHz

(Restricted Bands)

Transmitting at 915MHz w/ 5.5dBi whip antenna **Unit mounts Vertically**

<1000MHz

Frequency (MHz)	Pol. H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
75.120	V	180.0	1.2	21.6	7.4	1.5	0.0	30.5	33.6	100.0	-9.5
110.820	V	190.0	1.3	12.8	11.2	1.7	0.0	25.7	19.2	150.0	-17.9
119.825	V	180.0	1.3	16.4	11.8	1.7	0.0	29.9	31.2	150.0	-13.6
125.000	V	270.0	1.3	13.2	11.4	2.1	0.0	26.7	21.6	150.0	-16.8
150.000	V	90.0	1.3	26.8	9.1	2.1	0.0	38.0	79.4	150.0	-5.5
162.980	V	270.0	1.4	14.5	10.1	2.3	0.0	26.9	22.1	150.0	-16.6
244.200	V	170.0	1.6	11.8	13.1	2.9	0.0	27.8	24.6	200.0	-18.2
275.000	V	180.0	1.6	8.9	15.0	3.0	0.0	26.9	22.1	200.0	-19.1
325.000	V	90.0	1.4	10.1	14.5	3.2	0.0	27.8	24.6	200.0	-18.2
400.000	V	180.0	1.4	16.1	15.7	3.8	0.0	35.6	60.3	200.0	-10.4
992.940	V	90.0	2.5	17.3	22.5	6.8	0.0	46.6	214.2	500.0	-7.4
75.120	H	0.0	2.5	18.5	7.4	1.5	0.0	27.4	23.5	100.0	-12.6
110.820	H	180.0	3.0	13.5	11.2	1.7	0.0	26.4	20.8	150.0	-17.2
119.825	H	180.0	3.0	13.2	11.8	1.7	0.0	26.7	21.6	150.0	-16.8
125.000	H	180.0	3.5	18.3	11.4	2.1	0.0	31.8	38.9	150.0	-11.7
150.000	H	180.0	1.8	28.0	9.1	2.1	0.0	39.2	91.2	150.0	-4.3
275.000	H	270.0	3.3	7.6	15.0	3.0	0.0	25.6	19.1	200.0	-20.4
325.000	H	170.0	1.7	9.4	14.5	3.2	0.0	27.1	22.6	200.0	-18.9
400.000	H	90.0	1.9	12.5	15.7	3.8	0.0	32.0	39.8	200.0	-14.0
992.940	H	2.3	0.0	12.3	22.5	6.8	0.0	41.6	120.5	500.0	-12.4

>1000MHz

Frequency (MHz)	Pol. 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											
1092.230	V	180.0	1.0	53.0	25.0	1.3	37.5	41.7	122.1	5000.0	-32.2
1676.055	V	180.0	1.0	47.5	27.1	1.5	36.8	39.3	92.5	5000.0	-34.7
2745.000	V	200.0	1.0	46.7	29.6	1.5	36.0	41.8	122.4	5000.0	-32.2
3660.000	V	270.0	1.0	50.2	30.8	2.5	35.5	47.9	249.1	5000.0	-26.1
4575.000	V	180.0	1.0	43.7	32.1	3.4	35.5	43.7	152.3	5000.0	-30.3
7320.000	V	180.0	1.0	44.2	37.1	4.5	35.8	50.0	316.4	5000.0	-24.0
8235.000	V	200.0	1.0	43.0	37.5	5.9	35.9	50.5	336.0	5000.0	-23.5
9150.000	V	180.0	1.0	45.0	38.1	4.8	36.2	51.8	388.9	5000.0	-22.2
1092.230	H	0.0	1.0	53.8	25.0	1.3	37.5	42.6	134.4	5000.0	-31.4
1676.055	H	0.0	1.0	47.0	27.1	1.5	36.8	38.8	87.4	5000.0	-35.2
2745.000	H	180.0	1.0	48.8	29.6	1.5	36.0	43.9	157.0	5000.0	-30.1

Frequency (MHz)	Pol. 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)
3660.000	H	190.0	1.0	52.5	30.8	2.5	35.5	50.3	325.7	5000.0	-23.7
4575.000	H	180.0	1.0	43.5	32.1	3.4	35.5	43.5	149.4	5000.0	-30.5
7320.000	H	180.0	1.0	46.7	37.1	4.5	35.8	52.5	421.9	5000.0	-21.5
8235.000	H	180.0	1.0	43.5	37.5	5.9	35.9	51.0	355.9	5000.0	-23.0
9150.000	H	190.0	1.0	49.3	38.1	4.8	36.2	56.1	640.2	5000.0	-17.9
Average											
1092.230	V	180.0	1.0	43.8	25.0	1.3	37.5	32.5	42.3	500.0	-21.4
1676.055	V	180.0	1.0	35.8	27.1	1.5	36.8	27.7	24.1	500.0	-26.3
2745.000	V	200.0	1.0	39.2	29.6	1.5	36.0	34.3	51.6	500.0	-19.7
3660.000	V	270.0	1.0	46.0	30.8	2.5	35.5	43.8	154.1	500.0	-10.2
4575.000	V	180.0	1.0	36.5	32.1	3.4	35.5	36.5	66.7	500.0	-17.5
7320.000	V	180.0	1.0	34.8	37.1	4.5	35.8	40.7	108.0	500.0	-13.3
8235.000	V	200.0	1.0	32.0	37.5	5.9	35.9	39.5	94.7	500.0	-14.5
9150.000	V	180.0	1.0	35.1	38.1	4.8	36.2	41.9	124.4	500.0	-12.1
1092.230	H	0.0	1.0	39.7	25.0	1.3	37.5	28.4	26.3	500.0	-25.6
1676.055	H	0.0	1.0	35.3	27.1	1.5	36.8	27.2	22.8	500.0	-26.8
2745.000	H	180.0	1.0	43.3	29.6	1.5	36.0	38.4	83.3	500.0	-15.6
3660.000	H	190.0	1.0	49.8	30.8	2.5	35.5	47.6	239.5	500.0	-6.4
4575.000	H	180.0	1.0	34.7	32.1	3.4	35.5	34.7	54.0	500.0	-19.3
7320.000	H	180.0	1.0	40.3	37.1	4.5	35.8	46.2	203.4	500.0	-7.8
8235.000	H	180.0	1.0	32.1	37.5	5.9	35.9	39.6	95.8	500.0	-14.4
9150.000	H	190.0	1.0	40.5	38.1	4.8	36.2	47.3	231.6	500.0	-6.7

Table 7: Radiated Emission Test Data- Low Channel @ 927MHz

(Restricted Bands)

Transmitting at 927MHz w/ 5.5dBi whip antenna **Unit mounts Vertically**

<1000MHz

Frequency (MHz)	Pol. H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
75.120	V	180.0	1.2	21.6	7.4	1.5	0.0	30.5	33.6	100.0	-9.5
110.820	V	190.0	1.3	12.8	11.2	1.7	0.0	25.7	19.2	150.0	-17.9
119.825	V	180.0	1.3	16.4	11.8	1.7	0.0	29.9	31.2	150.0	-13.6
125.000	V	270.0	1.3	13.2	11.4	2.1	0.0	26.7	21.6	150.0	-16.8
150.000	V	90.0	1.3	26.8	9.1	2.1	0.0	38.0	79.4	150.0	-5.5
162.980	V	270.0	1.4	14.5	10.1	2.3	0.0	26.9	22.1	150.0	-16.6
244.200	V	170.0	1.6	11.8	13.1	2.9	0.0	27.8	24.6	200.0	-18.2
275.000	V	180.0	1.6	8.9	15.0	3.0	0.0	26.9	22.1	200.0	-19.1
325.000	V	90.0	1.4	10.1	14.5	3.2	0.0	27.8	24.6	200.0	-18.2
400.000	V	180.0	1.4	16.1	15.7	3.8	0.0	35.6	60.3	200.0	-10.4
966.016	V	180.0	1.5	18.3	22.3	6.8	0.0	47.4	233.5	500.0	-6.6
75.120	H	0.0	2.5	18.5	7.4	1.5	0.0	27.4	23.5	100.0	-12.6
110.820	H	180.0	3.0	13.5	11.2	1.7	0.0	26.4	20.8	150.0	-17.2
119.825	H	180.0	3.0	13.2	11.8	1.7	0.0	26.7	21.6	150.0	-16.8
125.000	H	180.0	3.5	18.3	11.4	2.1	0.0	31.8	38.9	150.0	-11.7
150.000	H	180.0	1.8	28.0	9.1	2.1	0.0	39.2	91.2	150.0	-4.3
275.000	H	270.0	3.3	7.6	15.0	3.0	0.0	25.6	19.1	200.0	-20.4
325.000	H	170.0	1.7	9.4	14.5	3.2	0.0	27.1	22.6	200.0	-18.9
400.000	H	90.0	1.9	12.5	15.7	3.8	0.0	32.0	39.8	200.0	-14.0
993.028	H	180.0	1.4	13.9	22.5	6.8	0.0	43.2	144.8	500.0	-10.8

>1000MHz

Frequency (MHz)	Pol. 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											
2781.000	V	200.0	1.0	46.3	29.6	1.5	36.0	41.5	118.4	5000.0	-32.5
3708.000	V	180.0	1.0	50.3	30.8	2.6	35.5	48.2	257.8	5000.0	-25.8
4635.000	V	170.0	1.0	44.8	32.2	3.4	35.5	44.9	176.6	5000.0	-29.0
7416.000	V	180.0	1.0	46.7	37.1	4.8	35.8	52.8	436.2	5000.0	-21.2
8343.000	V	90.0	1.0	42.8	37.5	5.8	35.9	50.2	324.8	5000.0	-23.7
1093.000	V	10.0	1.0	52.3	25.0	1.3	37.5	41.1	113.1	5000.0	-32.9
2781.000	H	180.0	1.0	47.7	29.6	1.5	36.0	42.9	139.1	5000.0	-31.1
3708.000	H	180.0	1.0	51.8	30.8	2.6	35.5	49.7	306.4	5000.0	-24.3
4635.000	H	170.0	1.0	44.5	32.2	3.4	35.5	44.6	170.0	5000.0	-29.4
7416.000	H	180.0	1.0	46.5	37.1	4.8	35.8	52.6	427.7	5000.0	-21.4
8343.000	H	180.0	1.0	42.7	37.5	5.8	35.9	50.1	318.9	5000.0	-23.9

Frequency (MHz)	Pol. 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)
1093.000	H	200.0	1.0	51.2	25.0	1.3	37.5	39.9	99.3	5000.0	-34.0
Average											
2781.000	V	200.0	1.0	39.0	29.6	1.5	36.0	34.2	51.1	500.0	-19.8
3708.000	V	180.0	1.0	46.7	30.8	2.6	35.5	44.6	169.1	500.0	-9.4
4635.000	V	170.0	1.0	34.0	32.2	3.4	35.5	34.1	50.8	500.0	-19.9
7416.000	V	180.0	1.0	36.5	37.1	4.8	35.8	42.6	135.3	500.0	-11.4
8343.000	V	90.0	1.0	31.5	37.5	5.8	35.9	38.9	88.1	500.0	-15.1
1093.000	V	10.0	1.0	42.8	25.0	1.3	37.5	31.6	37.9	500.0	-22.4
2781.000	H	180.0	1.0	41.2	29.6	1.5	36.0	36.3	65.6	500.0	-17.6
3708.000	H	180.0	1.0	42.5	30.8	2.6	35.5	40.4	104.6	500.0	-13.6
4635.000	H	170.0	1.0	34.2	32.2	3.4	35.5	34.3	51.8	500.0	-19.7
7416.000	H	180.0	1.0	35.3	37.1	4.8	35.8	41.4	117.8	500.0	-12.6
8343.000	H	180.0	1.0	31.7	37.5	5.8	35.9	39.1	90.2	500.0	-14.9
1093.000	H	200.0	1.0	41.3	25.0	1.3	37.5	30.1	31.9	500.0	-23.9

4.7 Conducted Emissions

4.7.1 Requirements

Test Arrangement: Table Top

Compliance Standard: FCC Part 15.207

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

4.7.2 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 peripherals were placed on the table in accordance with ANSI C63.4-2001. 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.

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

4.7.3 Test Data

Table 11 and 12 provide the test results for phase and neutral line power line conducted emissions. Tests were performed at 120VAC via the LAN power injector for the power over ethernet.

Table 8: Conducted Emission Test Data Configuration 2

Used Power supply AC/DC -Linksys AM-12500 ser # CY006021 to supply power to LAN Power injector

LINE 1 – NEUTRAL 120 VAC

Frequency (MHz)	Level QP (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Limit QP (dBµV)	Level Corr (dBµV)	Margin QP (dB)	Level AVG (dBµV)	Cable Loss (dB)	Level Corr (dBµV)	Limit AVG (dBµV)	Margin AVG (dB)
0.150	40.0	10.1	0.4	66.0	50.5	-15.5	3.3	10.1	13.8	56.0	-42.2
0.264	37.6	10.2	0.2	61.3	48.0	-13.3	8.2	10.2	18.6	51.3	-32.7
1.600	15.2	10.5	0.4	56.0	26.1	-29.9	8.4	10.5	19.3	46.0	-26.7
12.746	24.4	11.9	2.4	60.0	38.7	-21.3	19.5	11.9	33.8	50.0	-16.2
17.693	22.3	12.2	3.6	60.0	38.2	-21.8	18.5	12.2	34.4	50.0	-15.6
23.120	24.6	12.5	4.9	60.0	42.0	-18.0	21.4	12.5	38.8	50.0	-11.2
26.608	24.8	12.7	5.6	60.0	43.1	-16.9	21.9	12.7	40.2	50.0	-9.8
28.680	24.5	12.8	6.1	60.0	43.3	-16.7	21.3	12.8	40.1	50.0	-9.9

LINE 2 – Phase 120 VAC

Frequency (MHz)	Level QP (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Limit QP (dBµV)	Level Corr (dBµV)	Margin QP (dB)	Level AVG (dBµV)	Cable Loss (dB)	Level Corr (dBµV)	Limit AVG (dBµV)	Margin AVG (dB)
0.150	40.3	10.1	0.8	66.0	51.2	-14.8	2.5	10.1	13.4	56.0	-42.6
0.264	38.5	10.2	0.4	61.3	49.1	-12.2	5.3	10.2	15.9	51.3	-35.4
1.600	16.3	10.5	0.3	56.0	27.1	-28.9	8.7	10.5	19.5	46.0	-26.5
12.746	25.6	11.9	1.8	60.0	39.3	-20.7	21.0	11.9	34.7	50.0	-15.3
17.693	25.9	12.2	2.7	60.0	40.9	-19.1	20.3	12.2	35.3	50.0	-14.7
23.120	23.1	12.5	3.9	60.0	39.5	-20.5	20.7	12.5	37.1	50.0	-12.9
26.608	27.1	12.7	4.6	60.0	44.4	-15.6	24.2	12.7	41.5	50.0	-8.5
28.680	28.5	12.8	5.1	60.0	46.3	-13.7	25.9	12.8	43.7	50.0	-6.3