

**FCC & Industry Canada Certification Test Report
For the
Cooper Power Systems
RFN420fL-G21 MODULE**

**FCC ID: P9X-RFN420FL-G21
IC ID: 6766A-RFN420FLG21**

**WLL JOB# 11839
March 18, 2011**

Prepared for:

**Cooper Power Systems
20201 Century Blvd. Suite 250
Germantown, MD 20874**

Prepared By:

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



Testing Certificate AT-1448

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Prepared by:



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Abstract

This report has been prepared on behalf of Cooper Power Systems 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 (10/2009) 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 the Cooper Power Systems RFN420fL-G21 Module.

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 ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

The Cooper Power Systems RFN420fL-G21 Module complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under FCC Part 15.247 and Industry Canada RSS-210.

Revision History	Description of Change	Date
Rev 0	Initial Release	March 18, 2011

Table of Contents

Abstract.....	ii
1 Introduction.....	1
1.1 Compliance Statement	1
1.2 Test Scope.....	1
1.3 Contract Information.....	1
1.4 Test Dates	1
1.5 Test and Support Personnel	1
1.6 Abbreviations.....	2
2 Equipment Under Test.....	3
2.1 EUT Identification & Description	3
2.2 Test Configuration	3
2.3 Testing Algorithm.....	4
2.4 Test Location	4
2.5 Measurements	4
2.5.1 References.....	4
2.6 Measurement Uncertainty.....	4
3 Test Equipment.....	6
4 Test Summary	8
5 Test Results.....	9
5.1 Duty Cycle Correction and Time of Occupancy.....	9
5.2 RF Power Output: (FCC Part §2.1046)	12
5.3 Occupied Bandwidth: (FCC Part §2.1049).....	18
5.4 Channel Spacing and Number of Hop Channels (FCC Part §15.247(a)(1)).....	22
5.5 Conducted Spurious Emissions at Antenna Terminals (FCC Part §2.1051)	25
5.5.1 Band Edge Compliance.....	48
5.6 Radiated Spurious Emissions: (FCC Part §2.1053).....	57
5.6.1 Test Procedure	57
5.7 Receiver Radiated Spurious Emissions: (FCC Part §15.209).....	70
5.7.1 Test Procedure	70
5.8 AC Conducted Emissions (FCC Part §15.207).....	72
5.8.1 Requirements	72
5.8.2 Test Procedure	72
5.8.3 Test Data	73

List of Tables

Table 1: Device Summary	3
Table 2: Expanded Uncertainty List.....	5
Table 3: Test Equipment List.....	6
Table 4: Test Summary Table.....	8
Table 5: Duty Cycle/time of Occupancy Results.....	9
Table 6: RF Power Output	12
Table 7: Occupied Bandwidth Results.....	19

Table 8: Channel Spacing and Number of Channels Results	24
Table 9: Spectrum Analyzer Settings	57
Table 10: Radiated Emission Test Data < 1GHz, Low Channel (Restricted Bands-covers all 3 antenna configurations).....	58
Table 11: Radiated Emission Test Data >1GHz, Low Channel (8dbi –Omni directional Antenna)	59
Table 12: Radiated Emission Test Data >1GHz, Low Channel (3dbi –Phantom Antenna).....	60
Table 13: Radiated Emission Test Data >1GHz, Low Channel (2dbi –Co-Linear Antenna)	61
Table 14: Radiated Emission Test Data < 1GHz, Center Channel (Restricted bands-covers all 3 antenna configurations).....	62
Table 15: Radiated Emission Test Data >1GHz, Center Channel (8dbi –Omni directional Antenna).....	63
Table 16: Radiated Emission Test Data >1GHz, Center Channel (3dbi –Phantom Antenna)	64
Table 17: Radiated Emission Test Data >1GHz, Center Channel (2dbi –Co-Linear Antenna) ..	65
Table 18: Radiated Emission Test Data < 1GHz, High Channel (Restricted bands-covers all 3 antenna configurations).....	66
Table 19: Radiated Emission Test Data >1GHz, High Channel (8dbi –Omni directional Antenna).....	67
Table 20: Radiated Emission Test Data >1GHz, High Channel (3dbi –Phantom Antenna).....	68
Table 21: Radiated Emission Test Data >1GHz, High Channel (2dbi –Co-Linear Antenna).....	69
Table 22: Spectrum Analyzer Settings	70
Table 23: Receiver Radiated Emission Test Data	71
Table 24: Conducted Emissions Data 120VAC, Transmit On	73
Table 25: Conducted Emissions Data 230VAC, Transmit On	74

List of Figures

Figure 1: Single Hop Duty Cycle Plot.....	10
Figure 2: Dwell time per 100ms	11
Figure 3: Time of Occupancy	12
Figure 4: RF Peak Power, High Power, Low Channel	13
Figure 5: RF Peak Power, High Power, Center Channel.....	14
Figure 6: RF Peak Power, High Power, High Channel	15
Figure 7: RF Peak Power, Low Power, Low Channel.....	16
Figure 8: RF Peak Power, Low Power, Center Channel	17
Figure 9: RF Peak Power, Low Power, High Channel	18
Figure 10: Occupied Bandwidth, Low Channel	19
Figure 11: Occupied Bandwidth, Center Channel.....	20
Figure 12: Occupied Bandwidth, High Channel.....	21
Figure 13: Channel Spacing.....	23
Figure 14: Number of Hopping Channels.....	24
Figure 15: Conducted Spurious Emissions, High Power, Low Channel 30 - 900MHz	25
Figure 16: Conducted Spurious Emissions, High Power, Low Channel 900 – 930MHz.....	26
Figure 17: Conducted Spurious Emissions, High Power, Low Channel 930-5000MHz	27
Figure 18: Conducted Spurious Emissions, High Power, Low Channel 5-9.5GHz	28
Figure 19: Conducted Spurious Emissions, High Power, Center Channel 30 - 900MHz	29

Figure 20: Conducted Spurious Emissions, High Power, Center Channel 900 – 930MHz	30
Figure 21: Conducted Spurious Emissions, High Power, Center Channel 930-5000MHz	31
Figure 22: Conducted Spurious Emissions, High Power, Center Channel 5-9.5GHz.....	32
Figure 23: Conducted Spurious Emissions, High Power, High Channel 30 - 900MHz.....	33
Figure 24: Conducted Spurious Emissions, High Power, High Channel 900 – 930MHz	34
Figure 25: Conducted Spurious Emissions, High Power, High Channel 930-5000MHz.....	35
Figure 26: Conducted Spurious Emissions, High Power, High Channel 5-9.5GHz	36
Figure 27: Conducted Spurious Emissions, Low Power, Low Channel 30 - 900MHz	37
Figure 28: Conducted Spurious Emissions, Low Power, Low Channel 900 – 930MHz	38
Figure 29: Conducted Spurious Emissions, Low Power, Low Channel 930-5000MHz	39
Figure 30: Conducted Spurious Emissions, Low Power, Low Channel 5-9.5GHz.....	40
Figure 31: Conducted Spurious Emissions, Low Power, Center Channel 30 - 900MHz.....	41
Figure 32: Conducted Spurious Emissions, Low Power, Center Channel 900 – 930MHz	42
Figure 33: Conducted Spurious Emissions, Low Power, Center Channel 930-5000MHz.....	43
Figure 34: Conducted Spurious Emissions, Low Power, Center Channel 5-9.5GHz	44
Figure 35: Conducted Spurious Emissions, Low Power, High Channel 30 - 900MHz	45
Figure 36: Conducted Spurious Emissions, Low Power, High Channel 900 – 930MHz.....	46
Figure 37: Conducted Spurious Emissions, Low Power, High Channel 930-5000MHz	47
Figure 38: Conducted Spurious Emissions, Low Power, High Channel 5-9.5GHz	48
Figure 39: Lower Band-edge, Low Channel, High Power	49
Figure 40: Lower Band-edge, Hopping Mode, High Power.....	50
Figure 41: Lower Band-edge, Low Channel, Low Power.....	51
Figure 42: Lower Band-edge, Hopping Mode, Low Power	52
Figure 43: Upper Band-edge, High Channel, High Power	53
Figure 44: Upper Band-edge, Hopping Mode, High Power	54
Figure 45: Upper Band-edge, High Channel, Low Power.....	55
Figure 46: Upper Band-edge, Hopping Mode, Low Power.....	56

1 Introduction

1.1 Compliance Statement

The Cooper Power Systems RFN420fL-G21 Module complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under FCC Part 15.247 (10/2009) 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 FCC Public Notice DA-00-705 "Measurement Guidance for Frequency Hopping Spread Spectrum Systems. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Cooper Power Systems 20201 Century Blvd. Suite 250 Germantown, MD 20874
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Purchase Order Number:	31453
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Quotation Number:	66026
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1.4 Test Dates

Testing was performed on the following date(s):	2/21/2011 to 2/25/2011
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1.5 Test and Support Personnel

Washington Laboratories, LTD	John Reidell
Client Representative	Steve Seymour

1.6 Abbreviations

A	A mpere
ac	a lternating current
AM	A mplitude Modulation
Amps	A mperes
b/s	b its per second
BW	B and W idth
CE	C onducted E mission
cm	c entimeter
CW	C ontinuous W ave
dB	d eci B el
dc	d irect current
EMI	E lectromagnetic 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 RFN420fL-G21 Module is a radio communications device designed for use in L+G Focus meters. It can also be used in Cooper Power Systems Gateways and Relay Nodes. The RFN420fL-G21 Module provides a 915 MHz radio interface to an RF mesh network

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	Cooper Power Systems
FCC ID:	P9X-RFN420FL-G21
IC:	6766A-RFN420FLG21
Model:	RFN420fL-G21
FCC Rule Parts:	§15.247
Industry Canada:	RSS210
Frequency Range:	902.75 – 927.25MHz
Maximum Output Power:	27.90dBm (616.6mW)
Modulation:	FSK
Occupied Bandwidth:	474.39kHz
Keying:	Automatic
Type of Information:	Data
Number of Channels:	50
Power Output Level	Variable from -14.23dBm to 28.07 dBm
Antenna Connector	MCX
Antenna Type	3 antennas: GH908U-PRO 900MHz Omnidirectional – 8dBi Gain TRA9023NP - Antenex Phantom 902-928MHz – 3dB Gain 915MHz Co-linear Antenna -2dB gain
Interface Cables:	None (plug in module)
Power Source & Voltage:	120/240VAC
Emission Designator	474KFXD
Highest TX spurious Emission	82.4uV/m @ 3m – 996.49MHz
Highest RX Spurious Emission	23.5uV/m @3m – 275.25MHz

2.2 Test Configuration

The Cooper Power Systems RFN420fL-G21, Equipment Under Test (EUT), was operated from a 115Vac power supply. Programming commands were sent from a support laptop via a custom RS232 adaptor board to a header on the EUT module.

2.3 Testing Algorithm

The RFN420fL-G21 was programmed for operation from a support laptop via a custom RS232 adaptor board to a header on the EUT module. UTF TeraTermPro console program was used on the support laptop to enter commands setting the EUT to the desired channel or hopping mode.

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 ACLASS under Certificate AT-1448 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

ANSI C63.4 Methods of Measurement of Radio Noise from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm \sqrt{\frac{a^2}{div_a^2} + \frac{b^2}{div_b^2} + \frac{c^2}{div_c^2} + \dots}$$

Where u_c = standard uncertainty

$a, b, c, \dots$ = individual uncertainty elements

$Div_{a, b, c}$ = the individual uncertainty element divisor based on the probability distribution

Divisor = 1.732 for rectangular distribution

Divisor = 2 for normal distribution

Divisor = 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

Where U = expanded uncertainty

k = coverage factor

$k \leq 2$ for 95% coverage (ANSI/NCSL Z540-2 Annex G)

u_c = standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in Table 2 below.

Table 2: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Conducted Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	2.63 dB
Radiated Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	4.55 dB

3 Test Equipment

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

Table 3: Test Equipment List

Test Name:	Bench Conducted RF Tests		
Asset #	Manufacturer/Model	Description	Cal. Due
618	HP - 8563A	ANALYZER SPECTRUM	6/4/2011

Test Name:	Radiated Emissions	Test Date: 2/23/2011	
Asset #	Manufacturer/Model	Description	Cal. Due
626	ARA - DRG-118/A	ANTENNA HORN	6/3/2011
627	AGILENT - 8449B	AMPLIFIER 1-26GHZ	5/7/2011
528	AGILENT - E4446A	ANALYZER SPECTRUM	9/27/2011
337	WLL - 1.2-5GHZ	FILTER BAND PASS	3/24/2012
281	ITC - 21A-3A1	WAVEGUIDE 4.51-10.0GHZ	3/24/2012
382	SUNOL SCIENCES CORPORATION - JB1	ANTENNA BICONLOG	1/12/2012
69	HP - 85650A	ADAPTER QP	7/1/2011
71	HP - 85685A	PRESELECTOR RF	7/1/2011
73	HP - 8568B	ANALYZER SPECTRUM	7/1/2011

Test Name:	Conducted Emissions Voltage	2/21/2011	
Asset #	Manufacturer/Model	Description	Cal. Due
125	SOLAR - 8028-50-TS-24-BNC	LISN	7/10/2011
126	SOLAR - 8028-50-TS-24-BNC	LISN	7/10/2011
51	HP - 11867A	LIMITER RF	CNR
69	HP - 85650A	ADAPTER QP	7/1/2011
73	HP - 8568B	ANALYZER SPECTRUM	7/1/2011
71	HP - 85685A	PRESELECTOR RF	7/1/2011
125	SOLAR - 8028-50-TS-24-BNC	LISN	7/10/2011

4 Test Summary

The Table Below shows the results of testing for compliance with a Frequency Hopping System in accordance with FCC Part 15.247 10/2009 and RSS210 issue 7. Full results are shown in section 5.

Table 4: Test Summary Table

TX Test Summary (Frequency Hopping Spread Spectrum)			
FCC Rule Part	IC Rule Part	Description	Result
15.247 (a)(1)(i)	RSS-210 [A8. 1 (c)]	20dB Bandwidth	Pass
15.247 (b)(2)	RSS-210 [A8.4 (1)]	Transmit Output Power	Pass
15.247 (a)(1)	RSS-210 [A8.1 (b)]	Channel Separation	Pass
15.247 (a)(1)(i)	RSS-210 [A8. 1 (c)]	Number of Channels =50 minimum	Pass
15.247 (a)(1)(i)	RSS-210 [A8. 1 (c)]	Time of Occupancy	Pass
15.247 (d)	RSS-210 [A8. 5]	Occupied BW / Out-of-Band Emissions (Band Edge @ 20dB below)	Pass
15.205 15.209	RSS-210 Sect.2.2	General Field Strength Limits (Restricted Bands & RE Limits)	Pass
15.207	RSS-Gen [7.2.2]	AC Conducted Emissions	NA
RX/Digital Test Summary (Frequency Hopping Spread Spectrum)			
FCC Rule Part	IC Rule Part	Description	Result
15.207	RSS-Gen [7.2.2]	AC Conducted Emissions	Pass
15.209	RSS-210 sect 2.6	General Field Strength Limits	Pass

5 Test Results

5.1 Duty Cycle Correction and Time of Occupancy

In accordance with the FCC Public Notice the average spurious radiated emissions measurements may be further adjusted 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:

$$20 \times \text{LOG} (\text{dwell time}/100 \text{ ms})$$

The following figure shows the plot of the dwell time for the transmitter. Based on this plot, the dwell time per hop is 19.5ms. The maximum total dwell time per 100ms is 39ms. This corresponds to a duty cycle correction of -8.1dB for radiated spurious emissions.

The transmitter shall have a time of occupancy for systems having a 20dB bandwidth greater than 250 kHz of no more than 0.4seconds in any 10 second period.

These tests were conducted with the RF output connected through appropriate attenuators to the input of a spectrum analyzer set to zero span mode. The unit was set to hopping mode with the spectrum analyzer set to 902.75MHz. The results are shown in the plots below.

Table 5: Duty Cycle/time of Occupancy Results

Test	Result	Limit	Pass/Fail
Dwell time per Hop	19.5ms	NA	NA
Dwell time per 100ms	-8.1dB Correction	NA	NA
Time of Occupancy	0.176 sec per 10 sec	0.4 sec per 10 sec	Pass

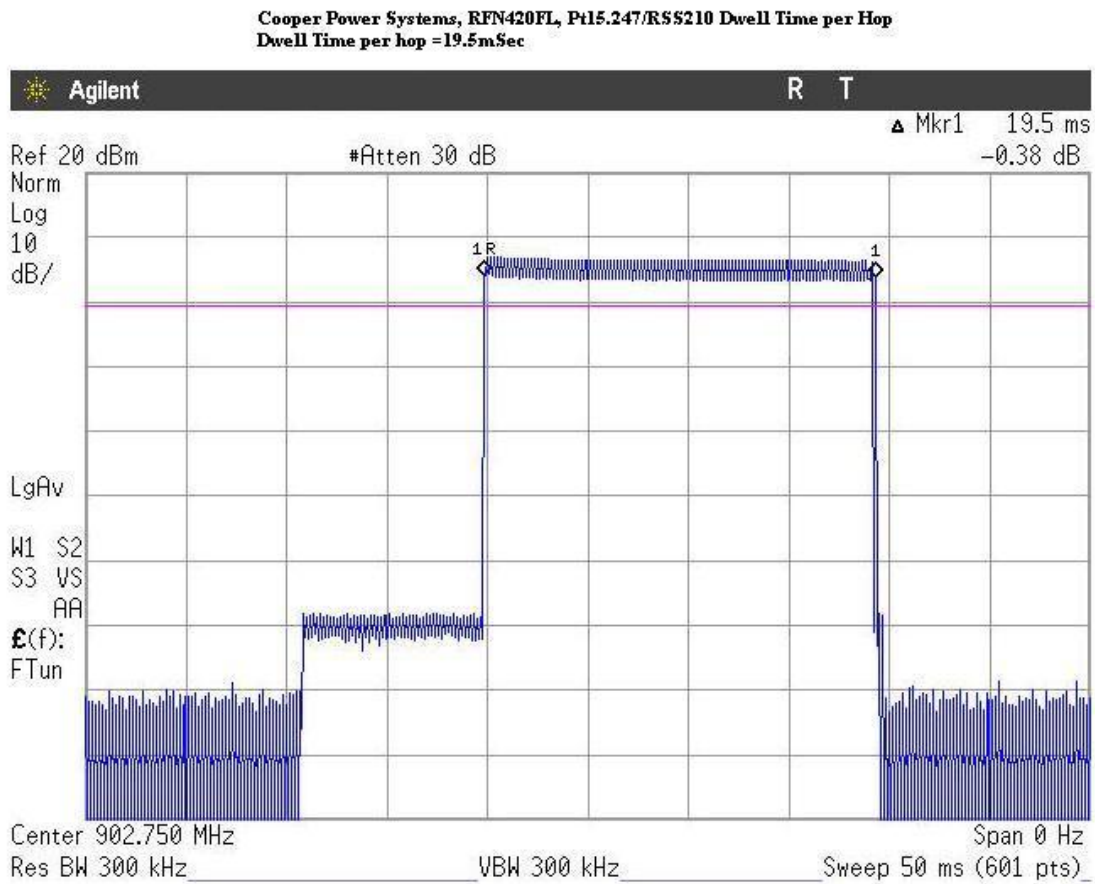


Figure 1: Single Hop Duty Cycle Plot

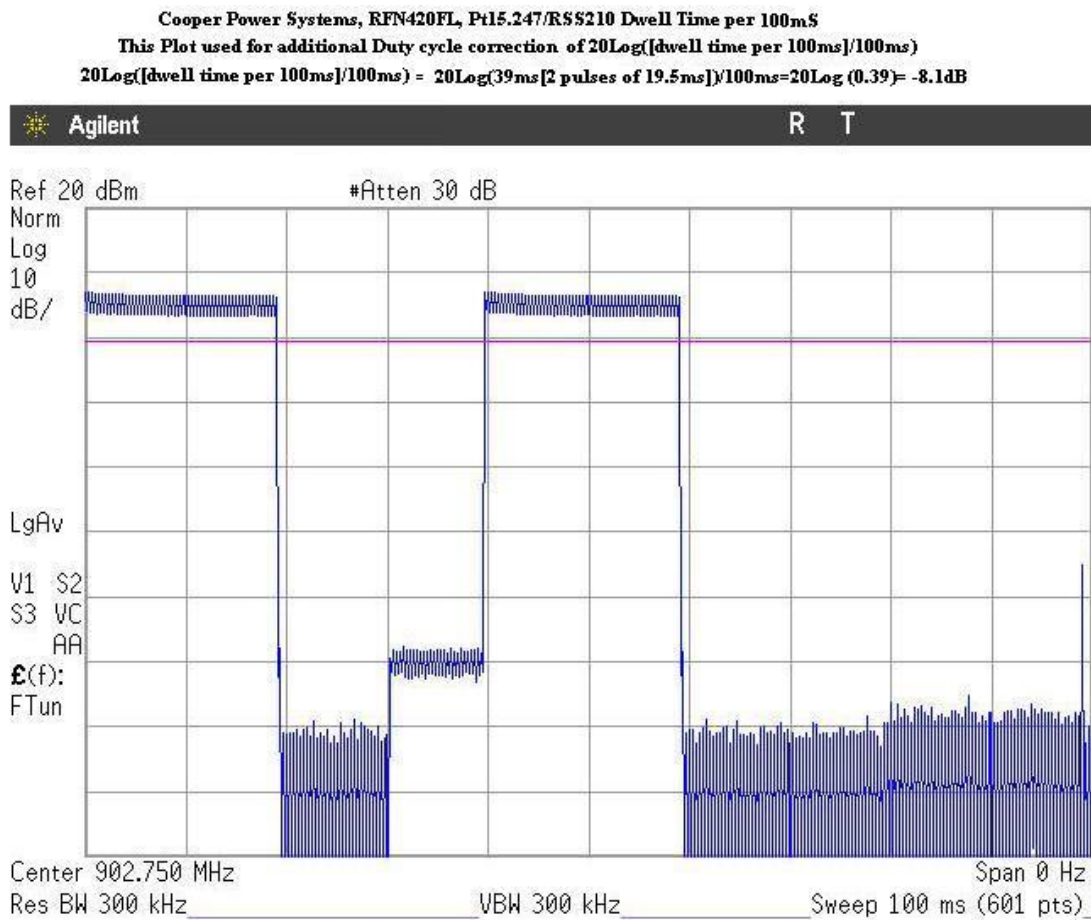


Figure 2: Dwell time per 100ms

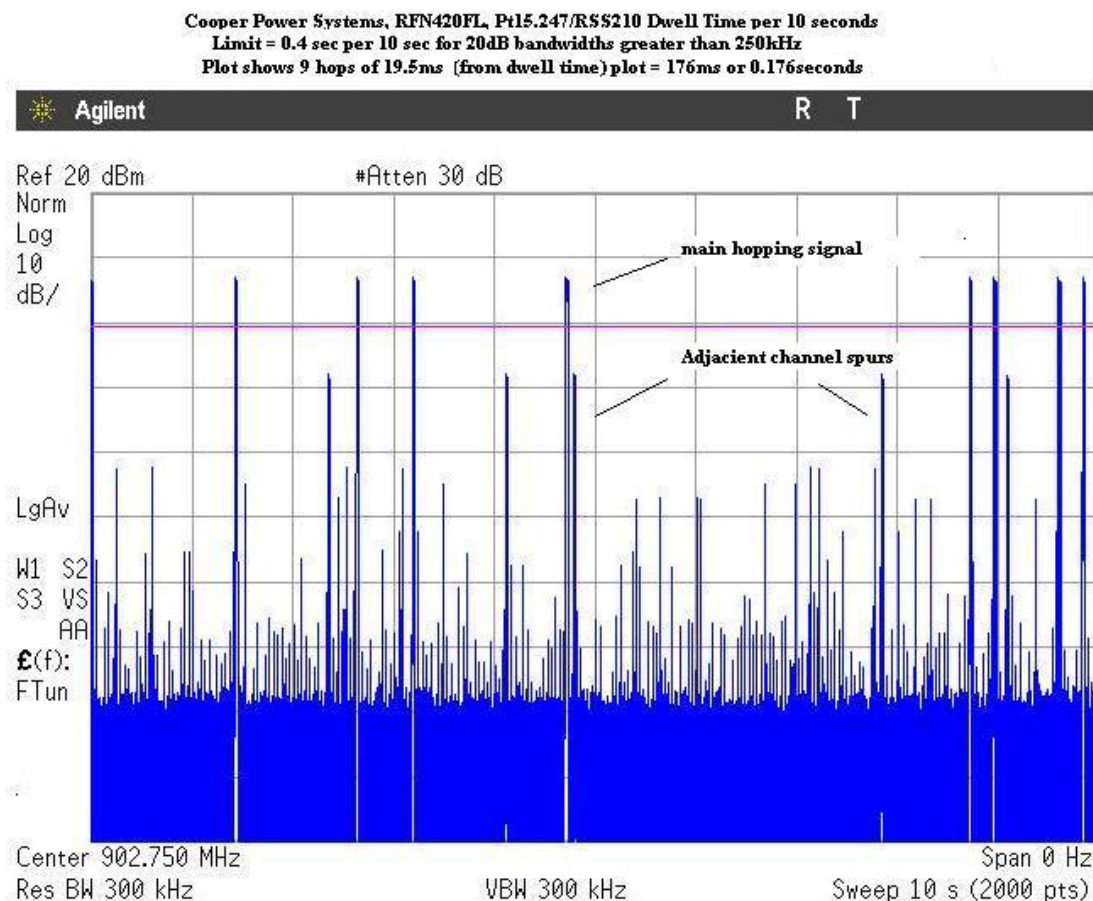


Figure 3: Time of Occupancy

5.2 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. The EUT has an adjustable output range. The highest and lowest power available is shown below.

Table 6: RF Power Output

Frequency	Power Setting	Level	Limit	Pass/Fail
Low Channel: 902.75MHz	High	27.32 dBm	30 dBm	Pass
Center Channel: 914.75MHz	High	27.77 dBm	30 dBm	Pass
High Channel: 927.25MHz	High	27.90 dBm	30 dBm	Pass
Low Channel: 902.75MHz	Low	-14.23 dBm	30 dBm	Pass
Center Channel: 914.75MHz	Low	-12.98 dBm	30 dBm	Pass
High Channel: 927.25MHz	Low	-14.23 dBm	30 dBm	Pass

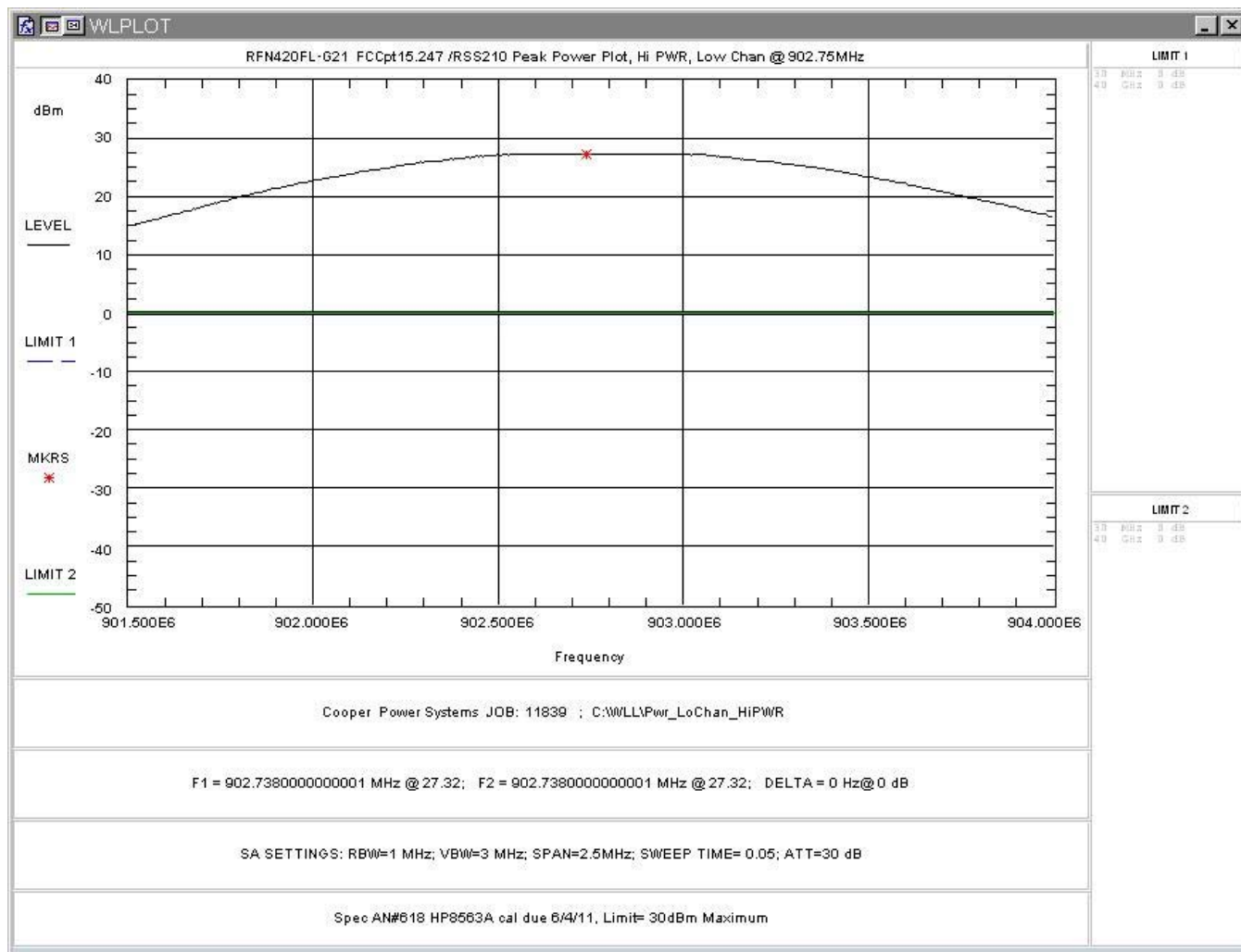


Figure 4: RF Peak Power, High Power, Low Channel

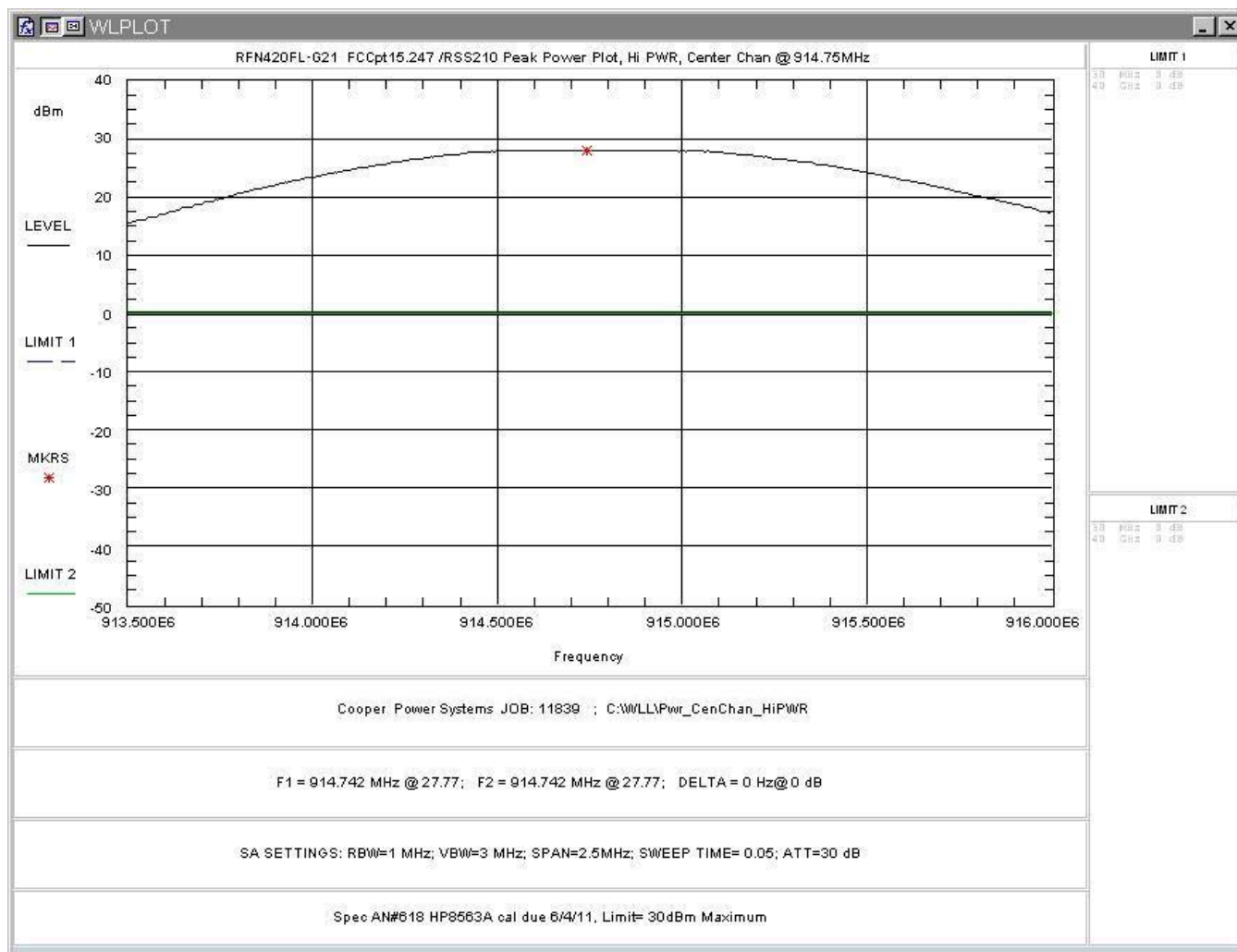


Figure 5: RF Peak Power, High Power, Center Channel

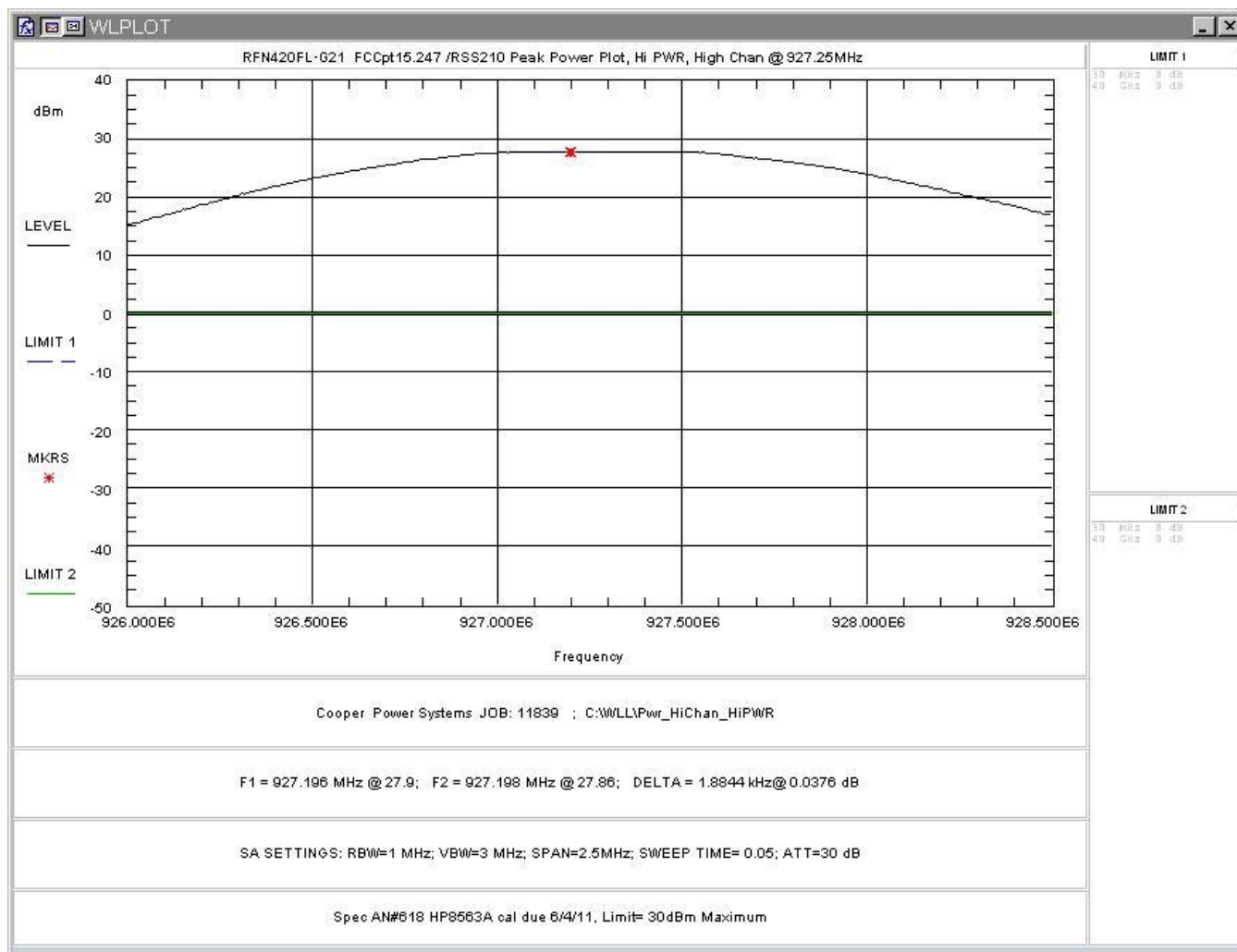


Figure 6: RF Peak Power, High Power, High Channel

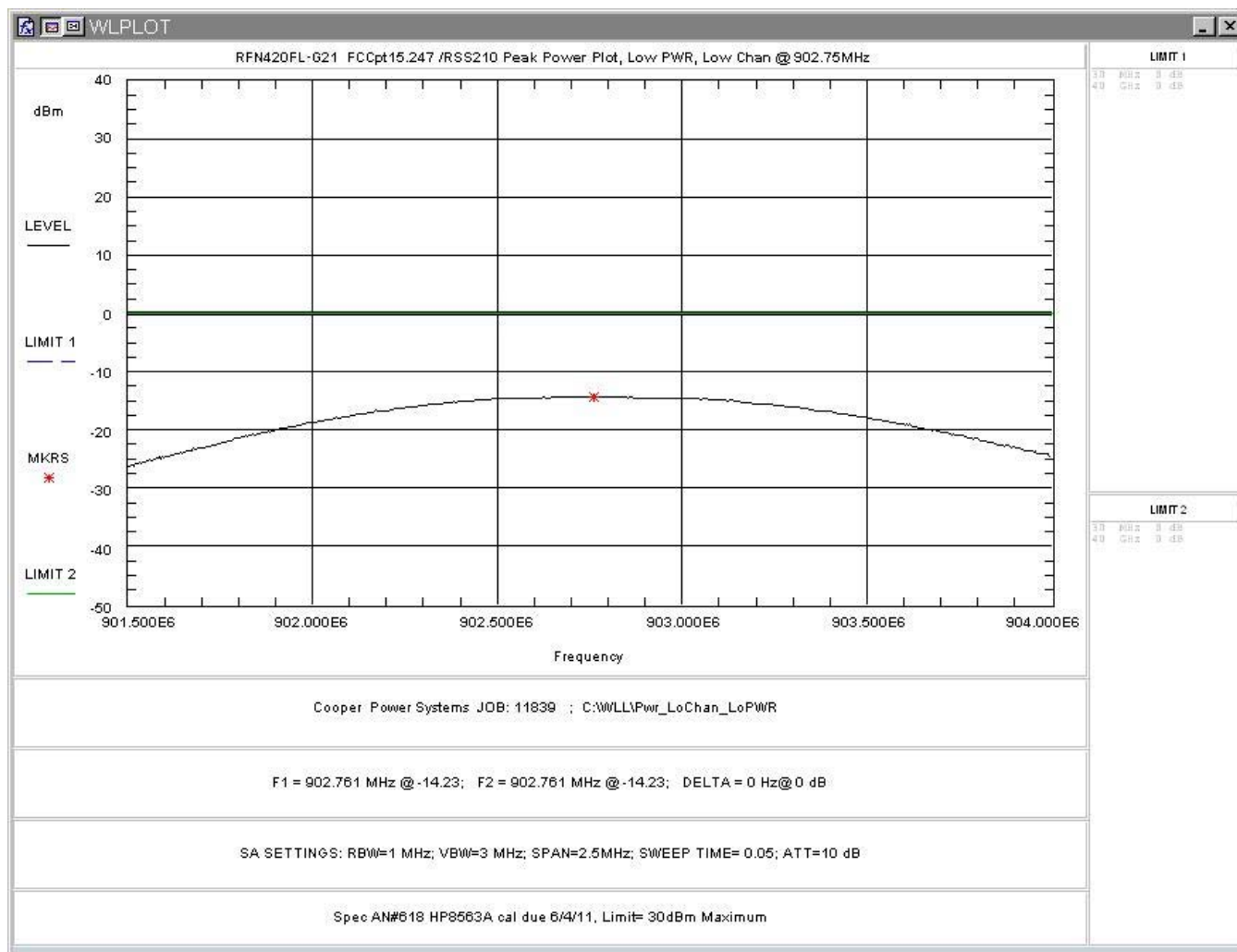


Figure 7: RF Peak Power, Low Power, Low Channel

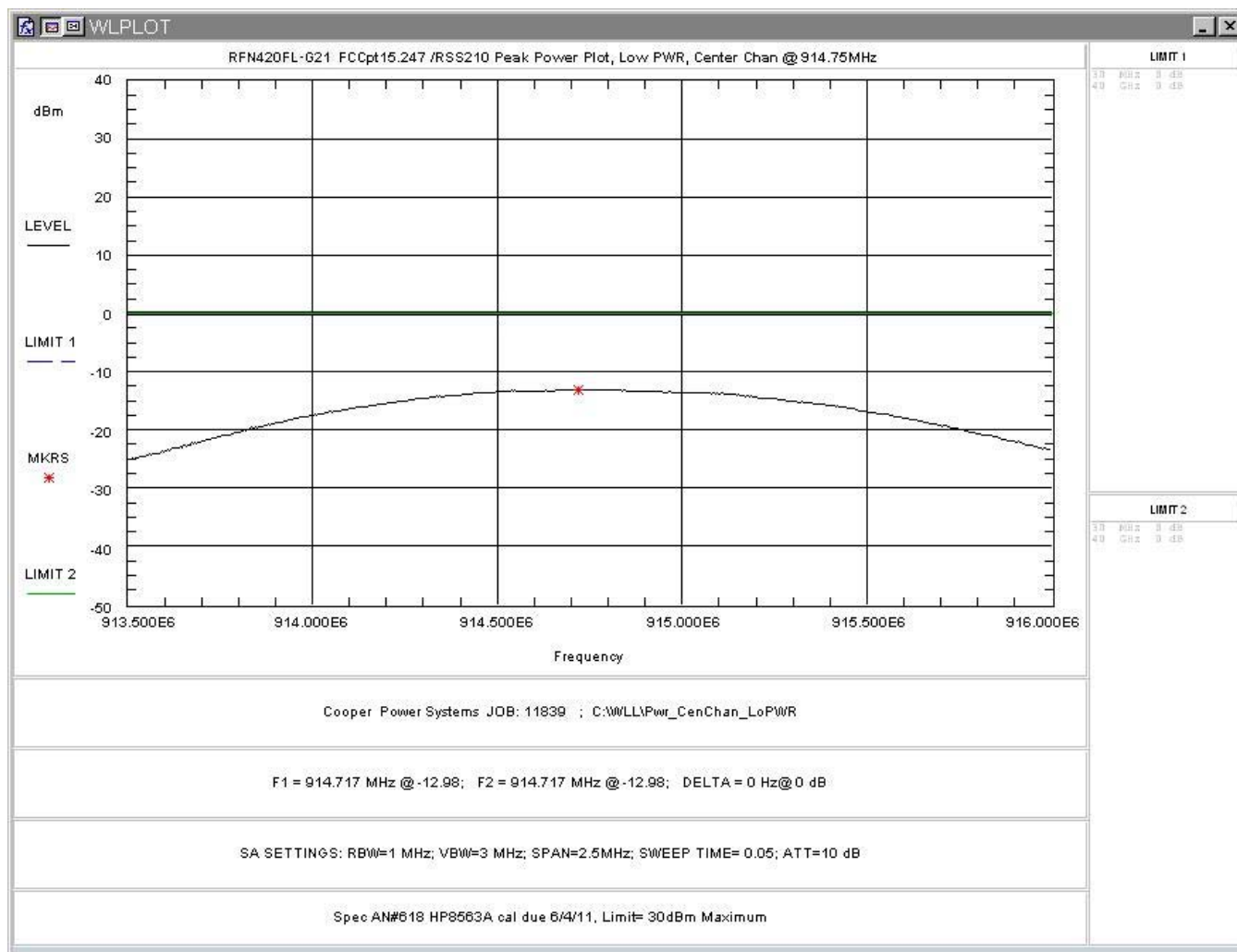


Figure 8: RF Peak Power, Low Power, Center Channel

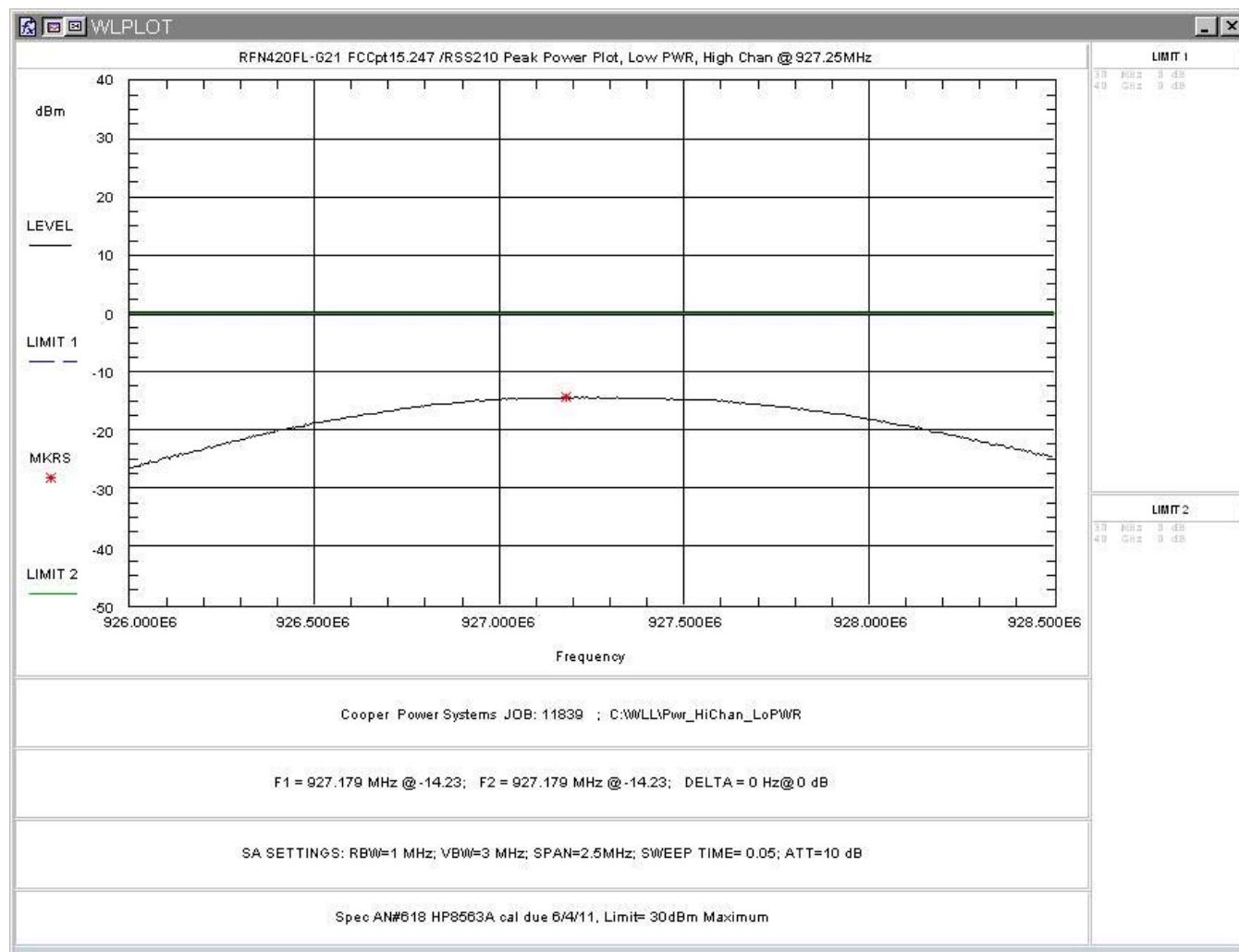


Figure 9: RF Peak Power, Low Power, High Channel

5.3 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 500kHz.

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

Table 7 provides a summary of the Occupied Bandwidth Results.

Table 7: Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Low Channel: 902.75MHz	474.39kHz	500 kHz	Pass
Center Channel: 914.75MHz	473.65kHz	500 kHz	Pass
High Channel: 927.25MHz	472.06kHz	500 kHz	Pass

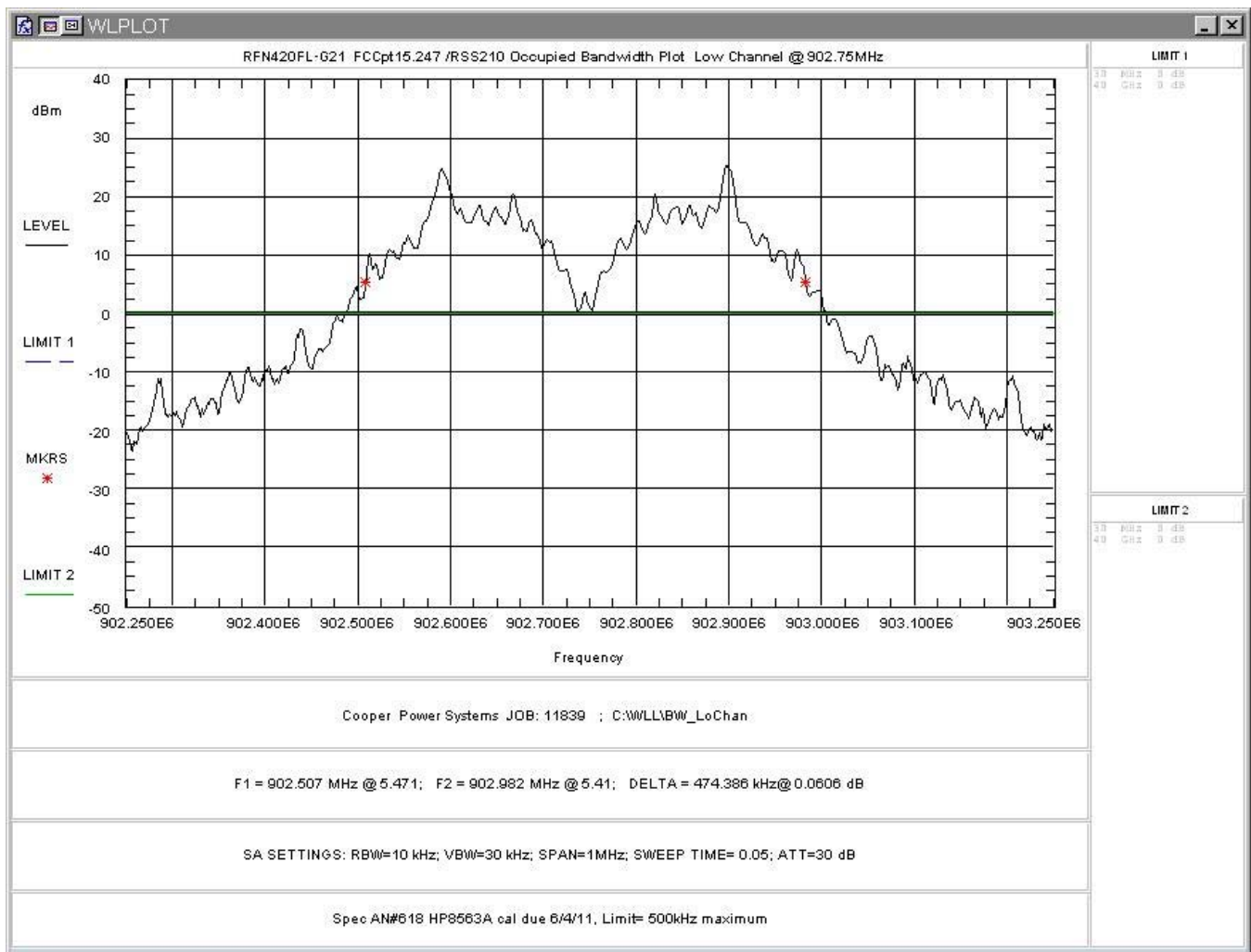


Figure 10: Occupied Bandwidth, Low Channel

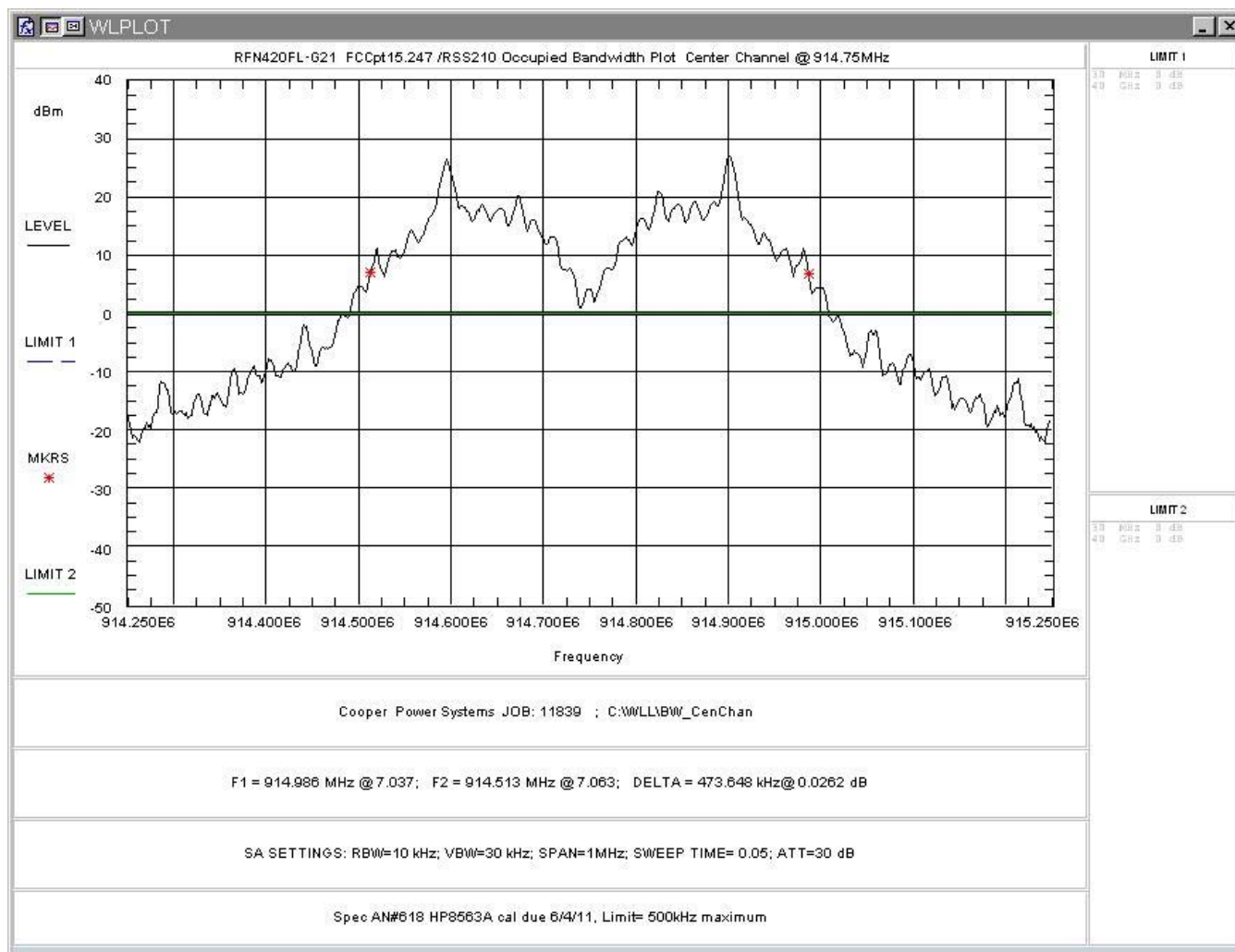


Figure 11: Occupied Bandwidth, Center Channel

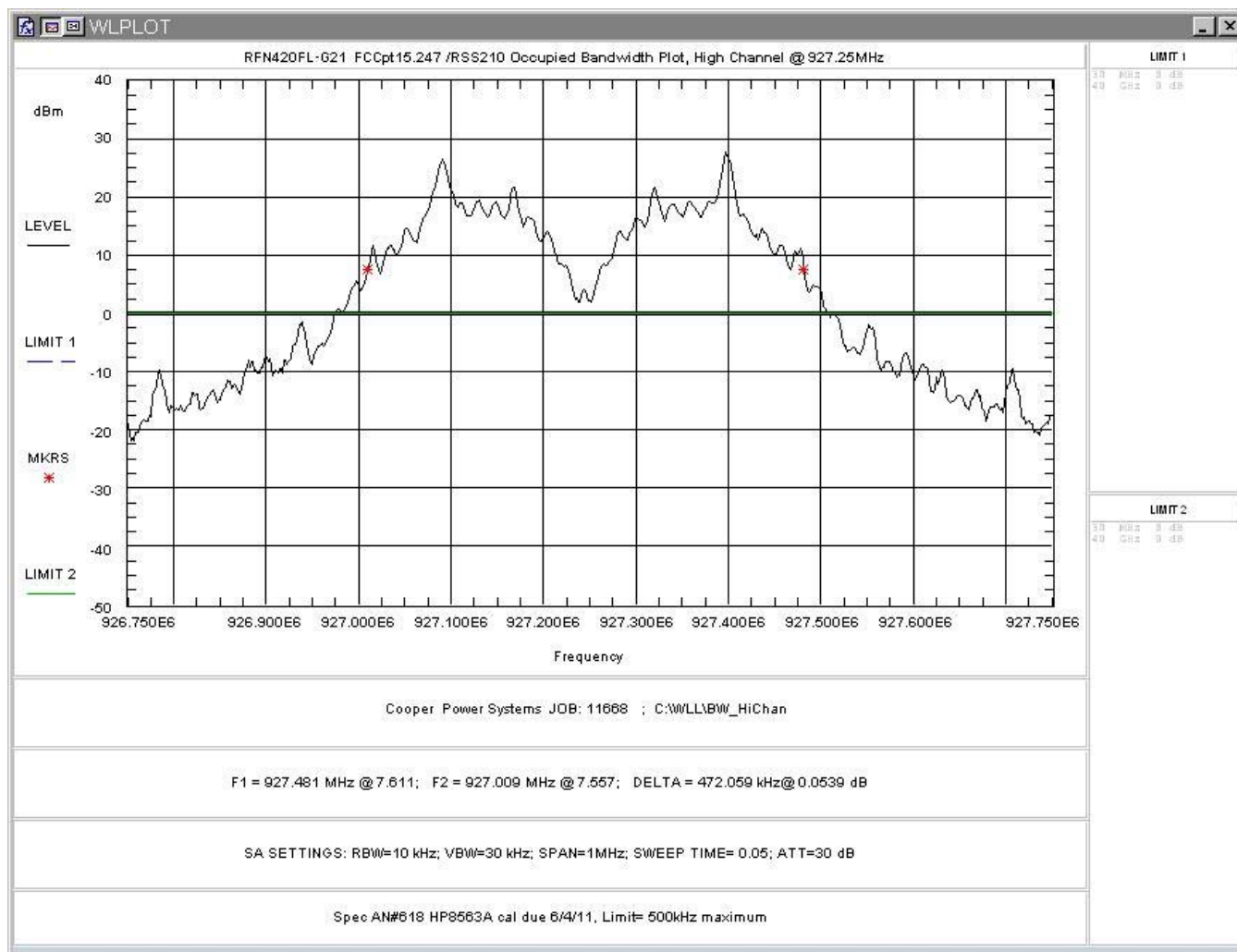


Figure 12: Occupied Bandwidth, High Channel

5.4 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 474.39kHz so the channel spacing must be more than 474.39kHz. In addition, for a 902-928MHz transmitter with an occupied bandwidth greater than 250kHz the minimum number of hopping channels shall be 25.

The EUT antenna was removed and the cable was connected directly into a spectrum analyzer through a 20 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 30 kHz. The channel spacing of 2 adjacent channels was measured using a spectrum analyzer span setting of 1MHz. Also, the number of hopping channels was measured from 902-928MHz using a RBW/VBW setting of 100kHz.

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

Note: in the following plots each channel is composed of 2 distinct peaks.

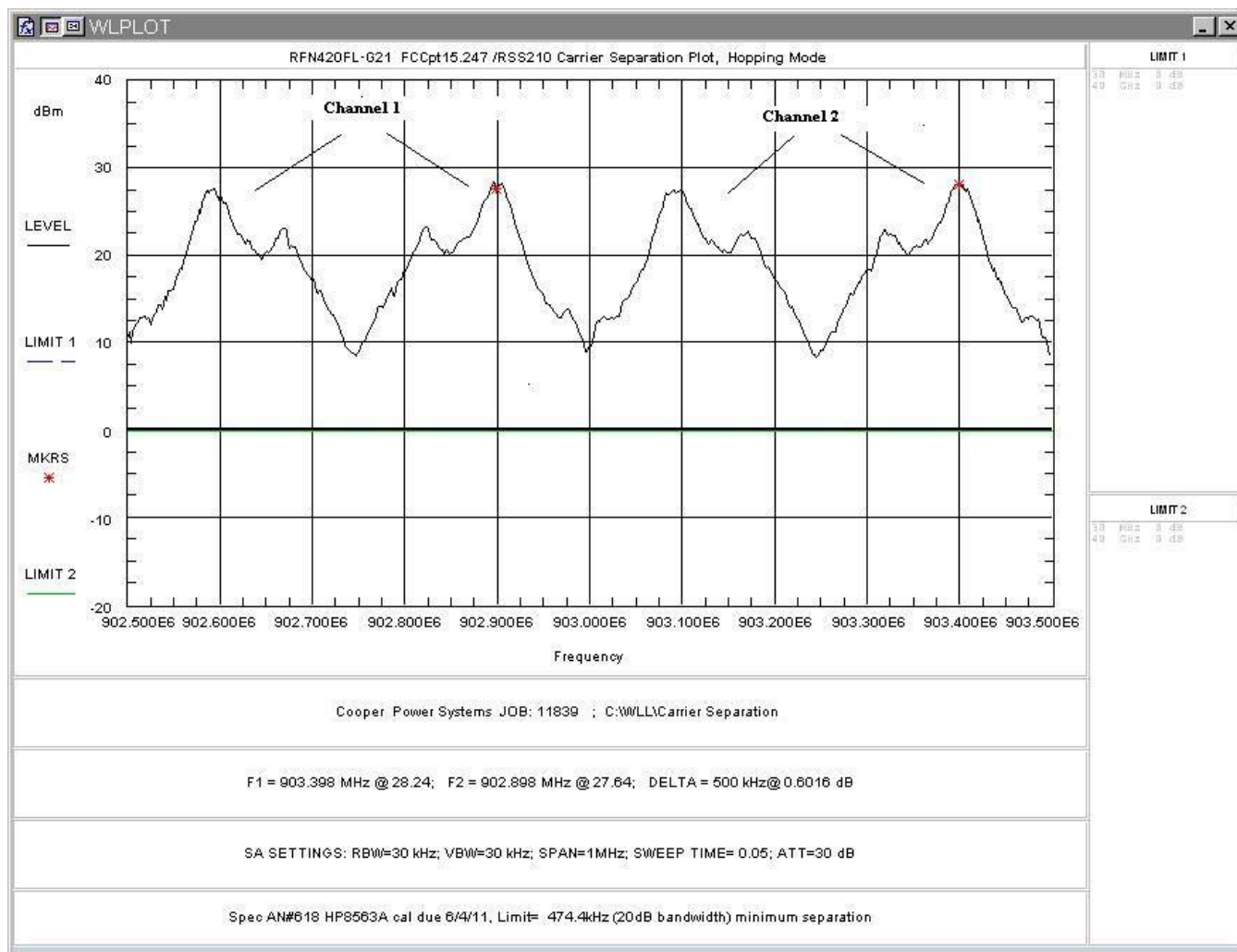


Figure 13: Channel Spacing

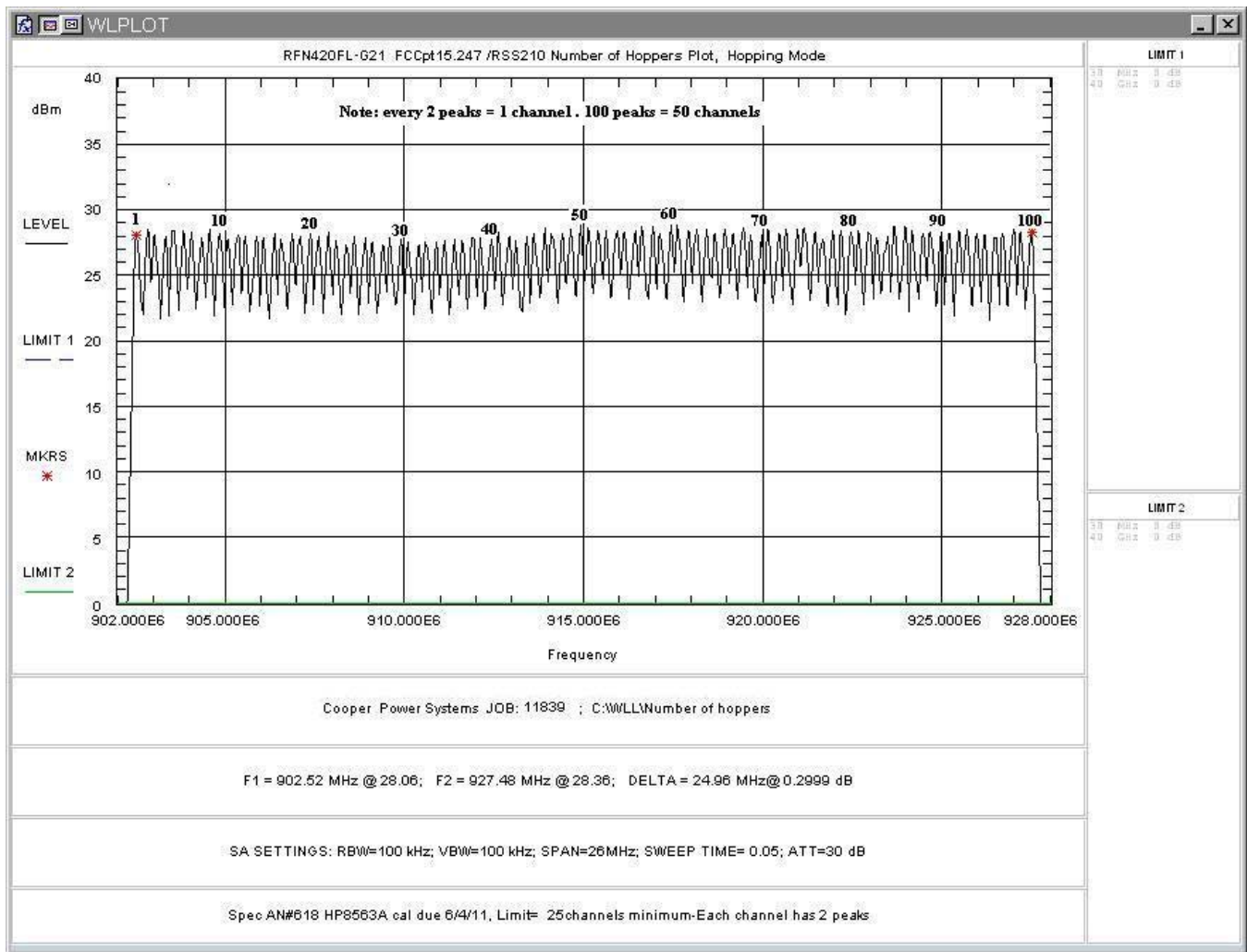


Figure 14: Number of Hopping Channels

Table 8: Channel Spacing and Number of Channels Results

Frequency	Result	Limit	Pass/Fail
Channel Spacing	500kHz	474.39kHz minimum	Pass
Number of channels	50 channels	25 channels minimum	Pass

5.5 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.

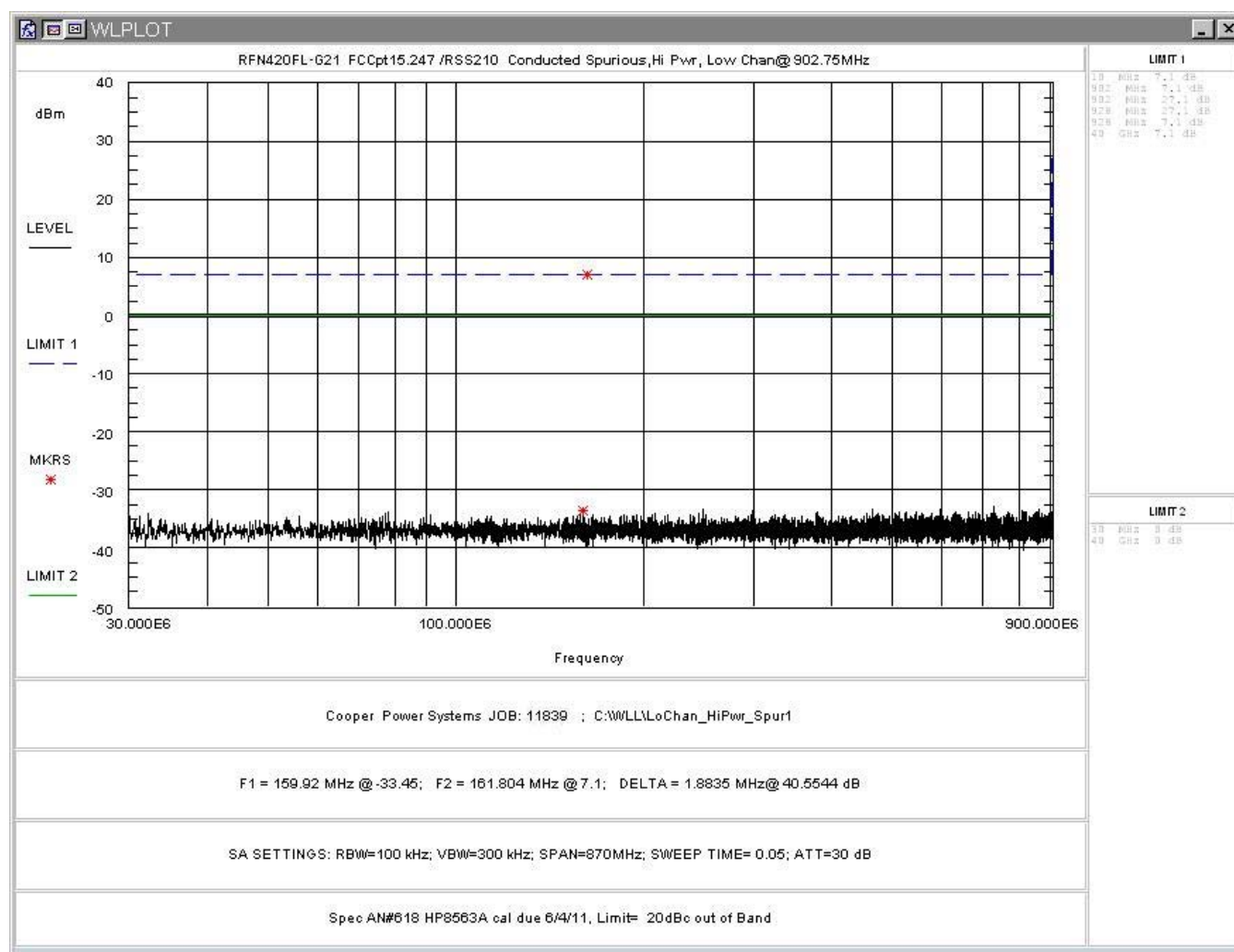


Figure 15: Conducted Spurious Emissions, High Power, Low Channel 30 - 900MHz

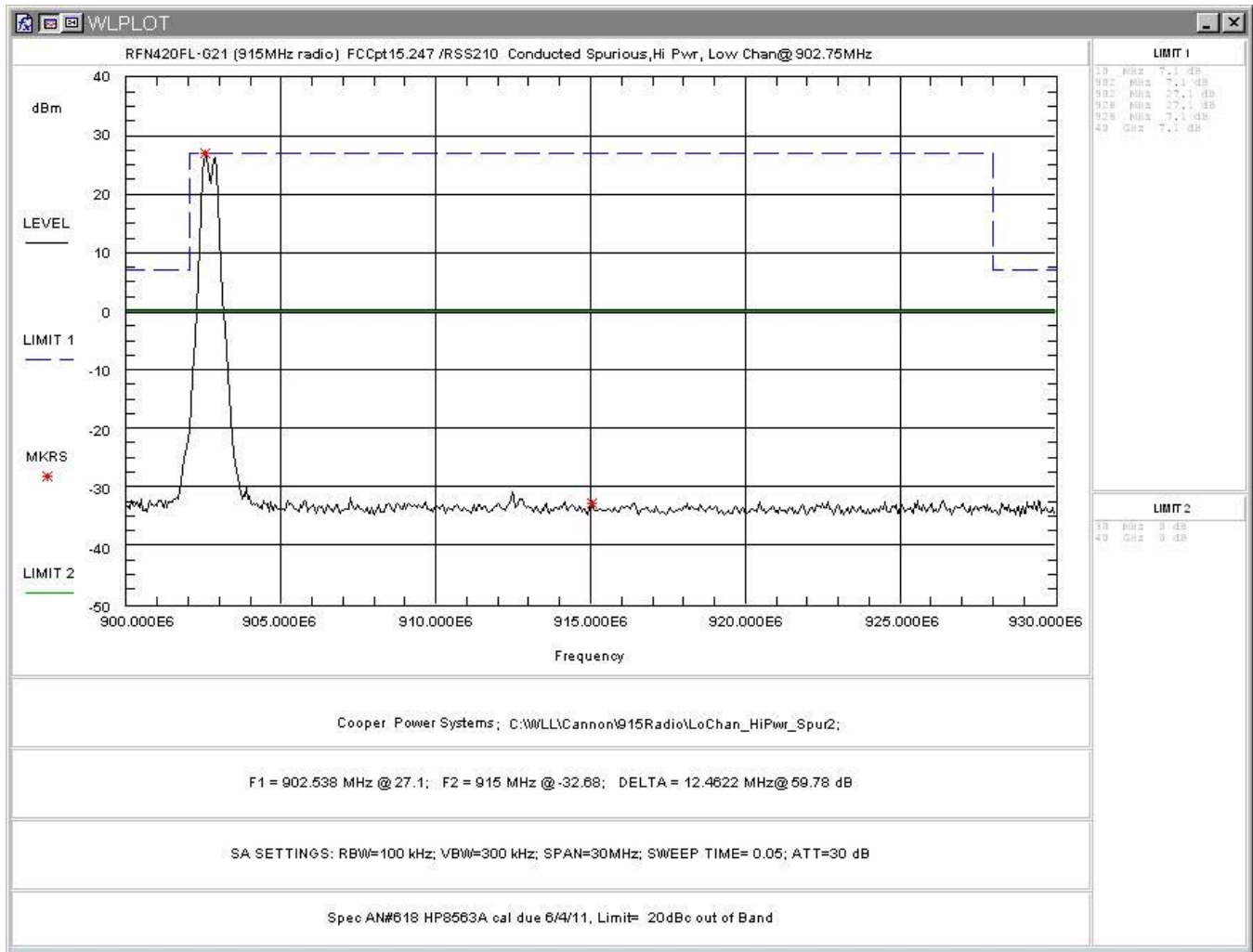


Figure 16: Conducted Spurious Emissions, High Power, Low Channel 900 – 930MHz

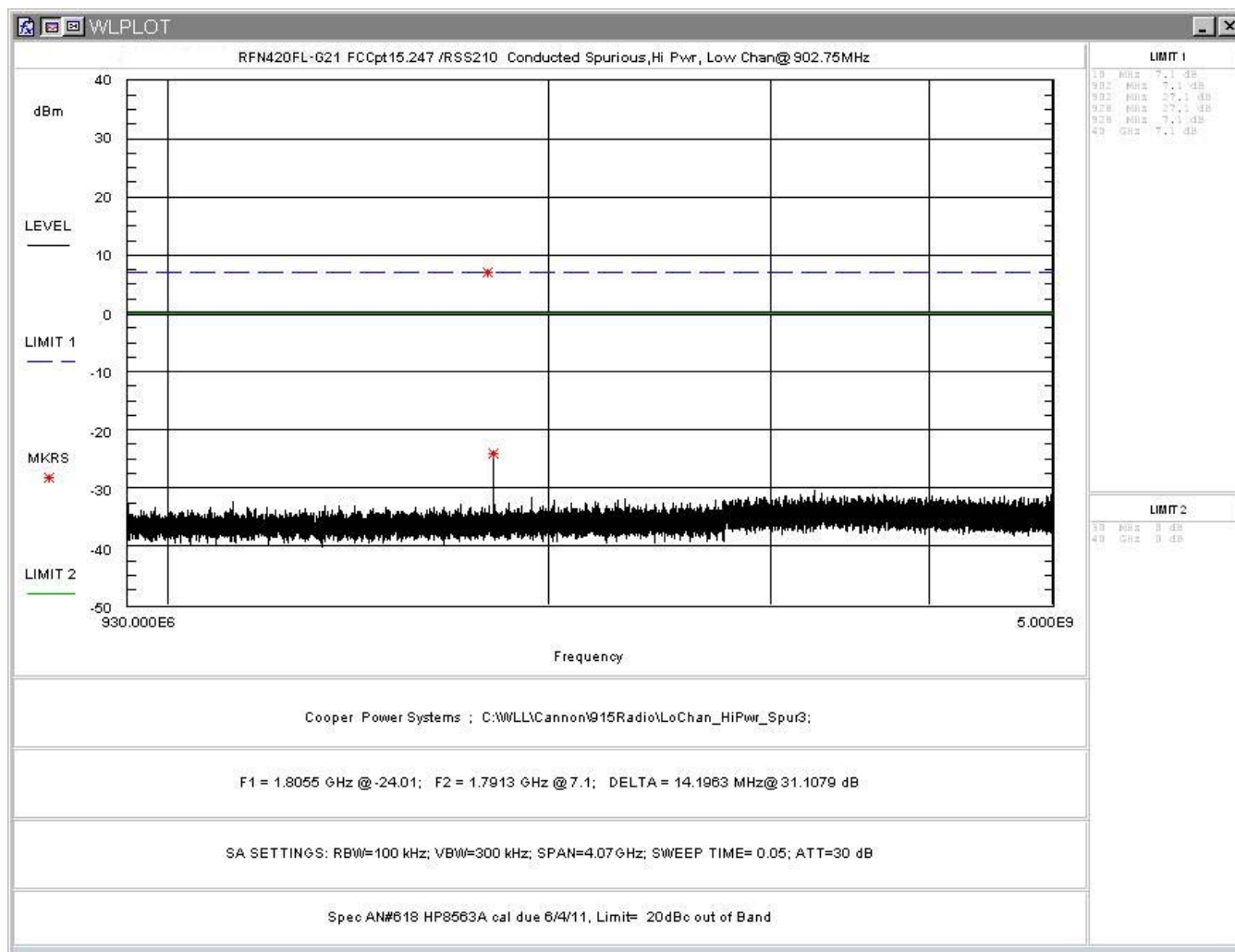


Figure 17: Conducted Spurious Emissions, High Power, Low Channel 930-5000MHz

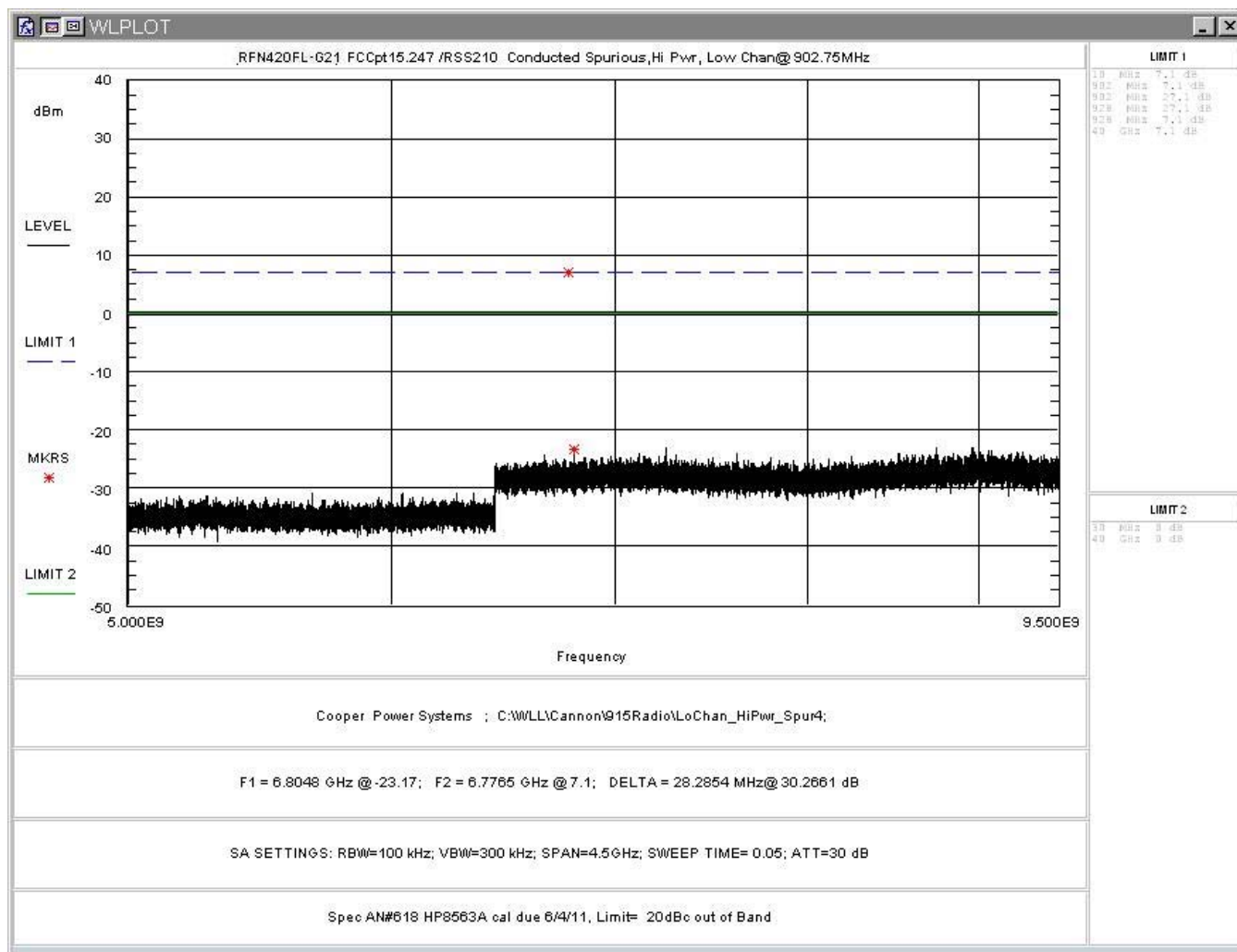


Figure 18: Conducted Spurious Emissions, High Power, Low Channel 5-9.5GHz

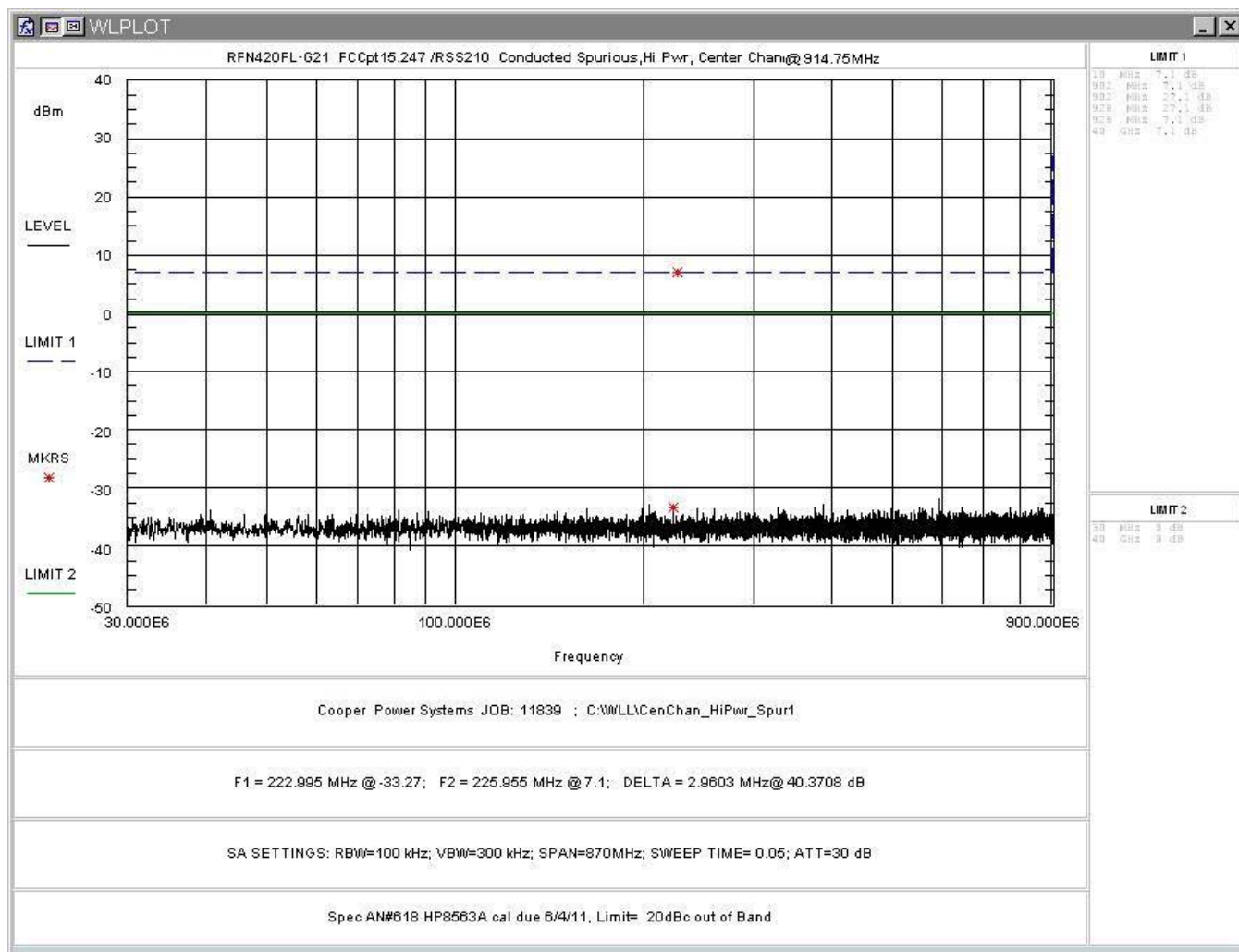


Figure 19: Conducted Spurious Emissions, High Power, Center Channel 30 - 900MHz

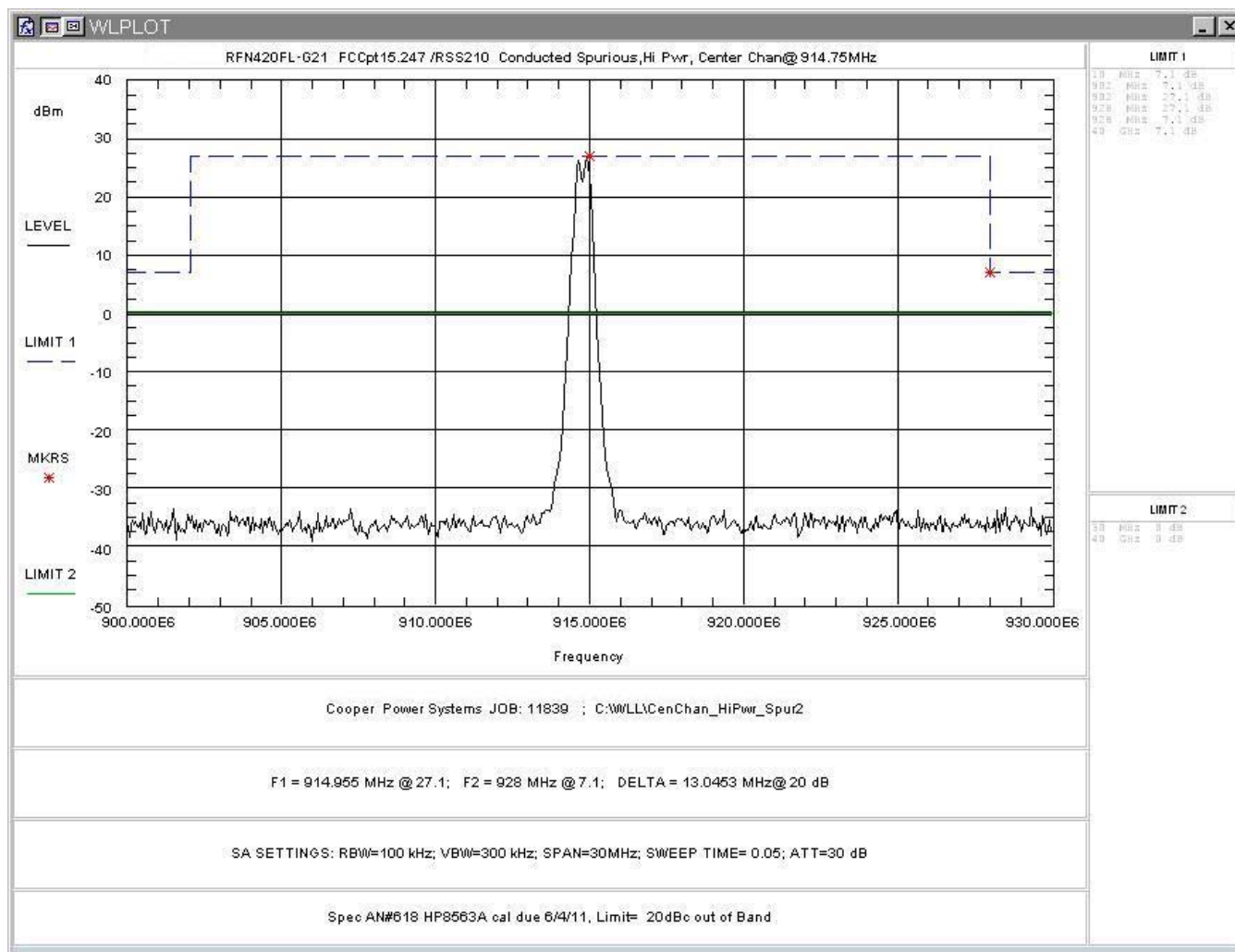


Figure 20: Conducted Spurious Emissions, High Power, Center Channel 900 – 930MHz

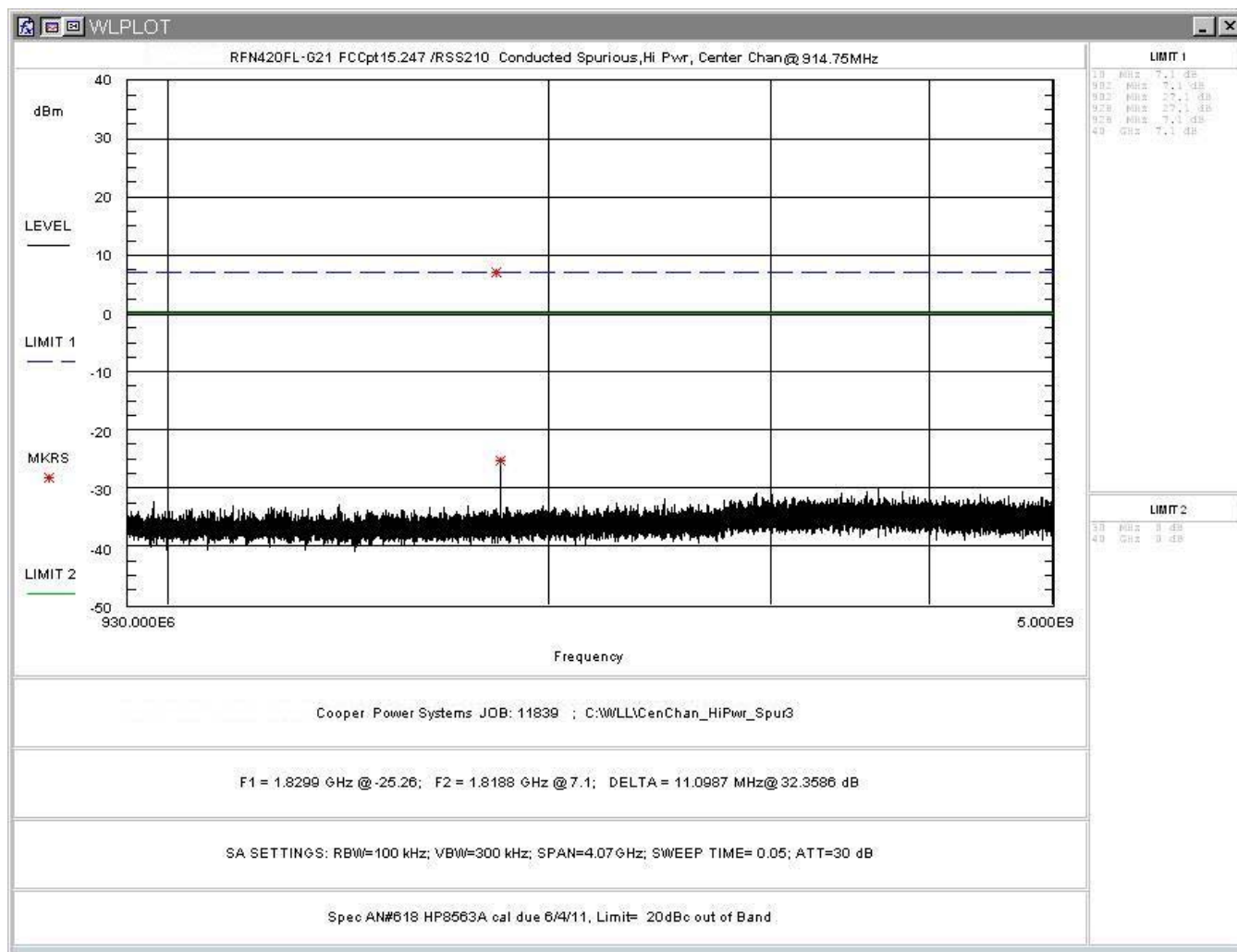


Figure 21: Conducted Spurious Emissions, High Power, Center Channel 930-5000MHz

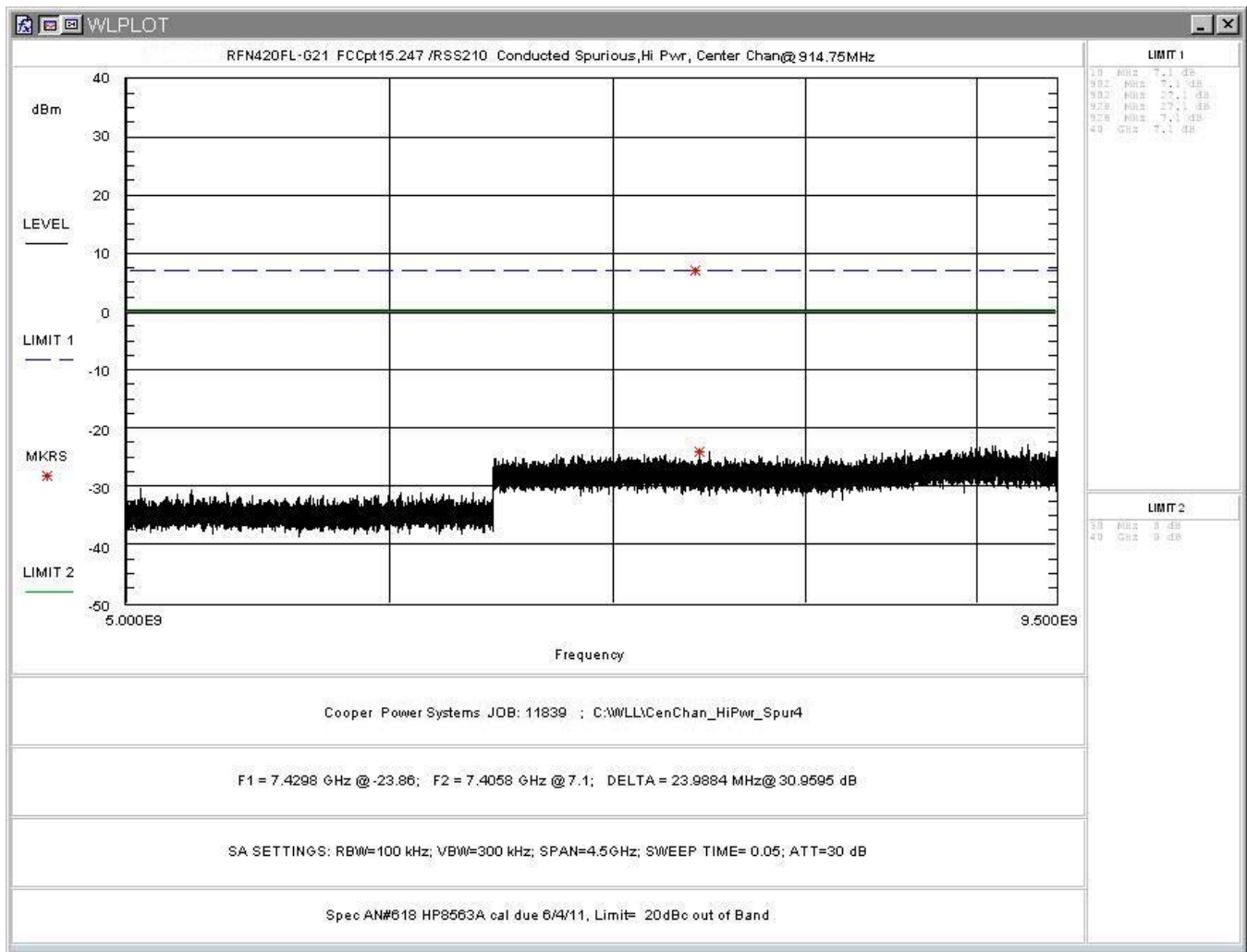


Figure 22: Conducted Spurious Emissions, High Power, Center Channel 5-9.5GHz

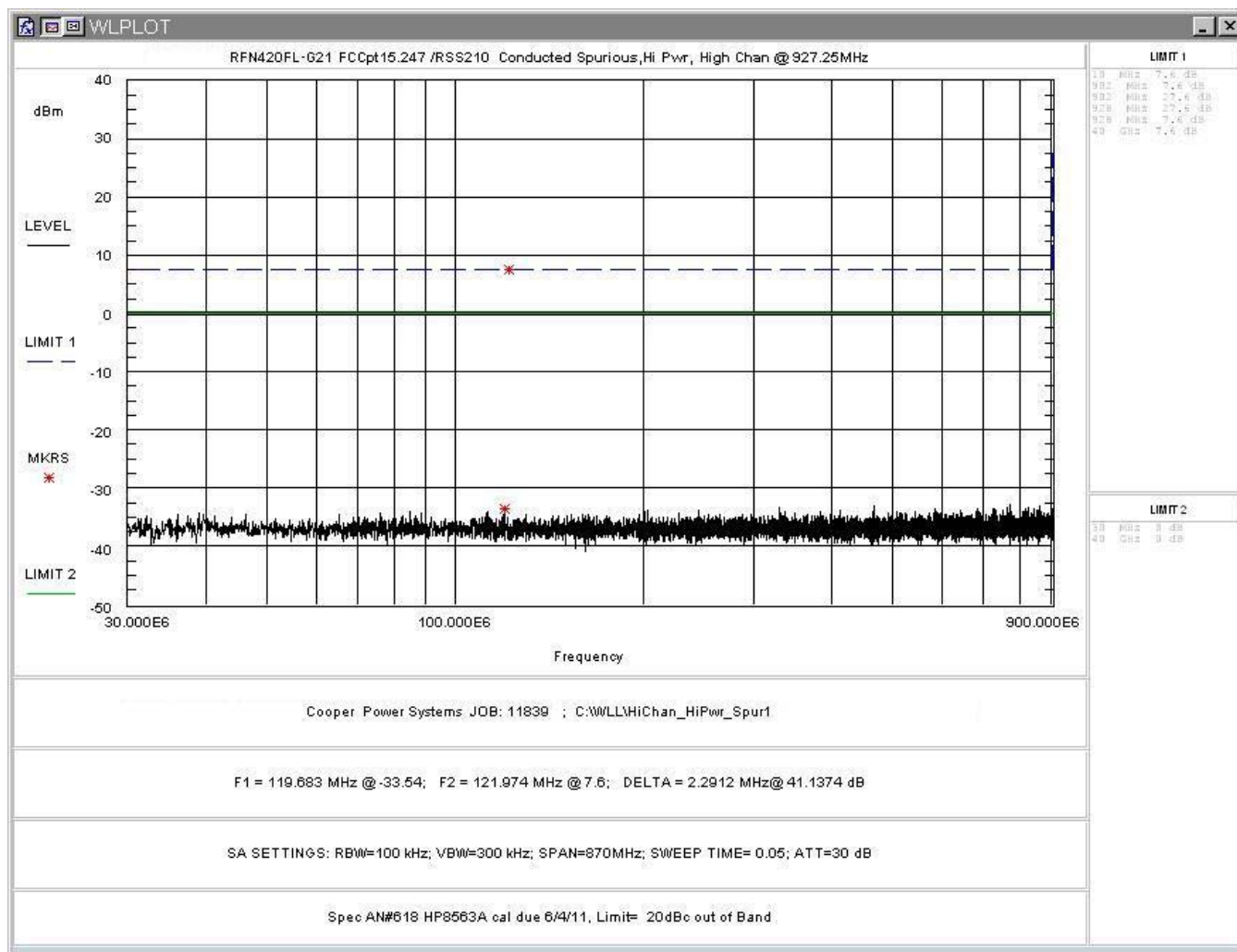


Figure 23: Conducted Spurious Emissions, High Power, High Channel 30 - 900MHz

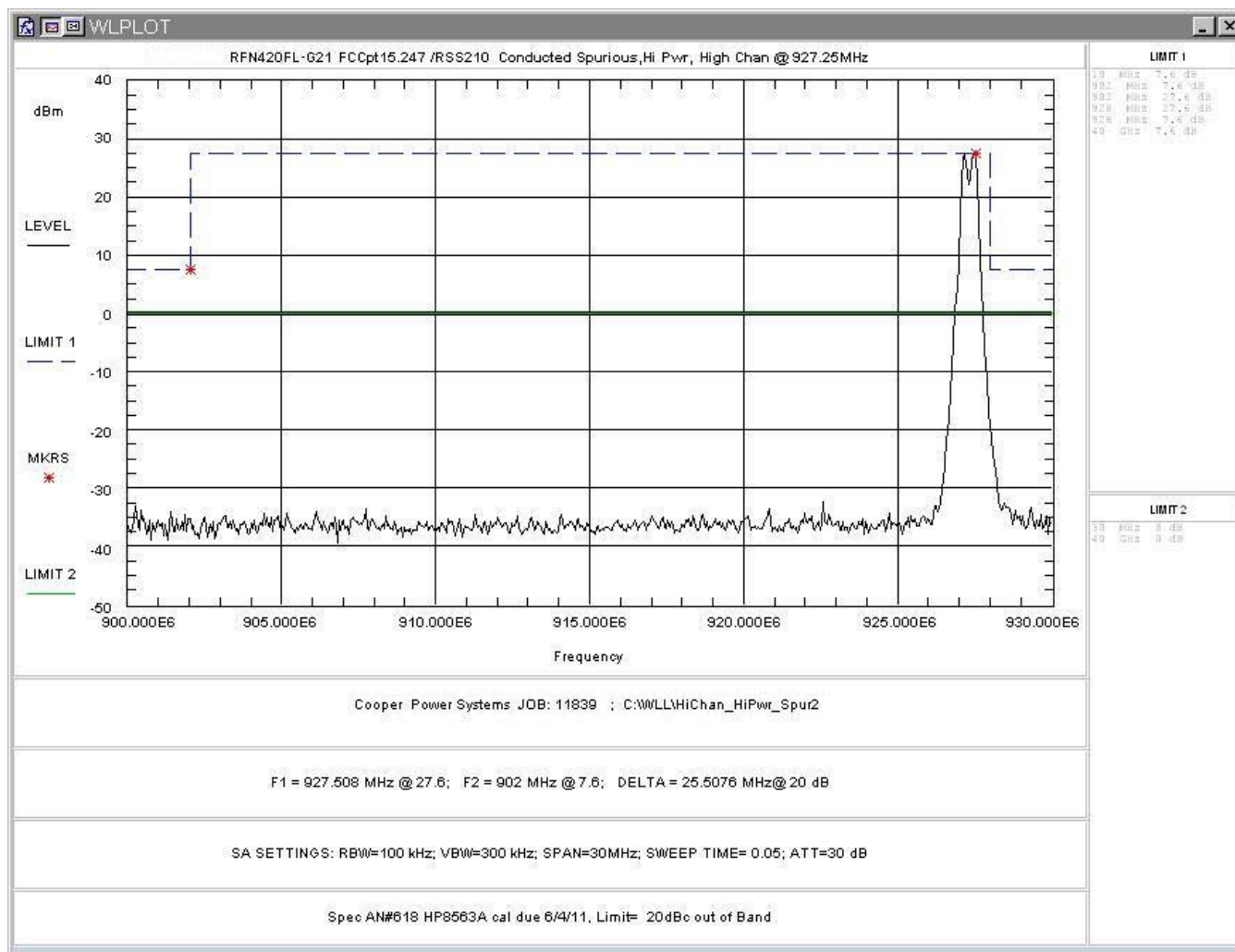


Figure 24: Conducted Spurious Emissions, High Power, High Channel 900 – 930MHz

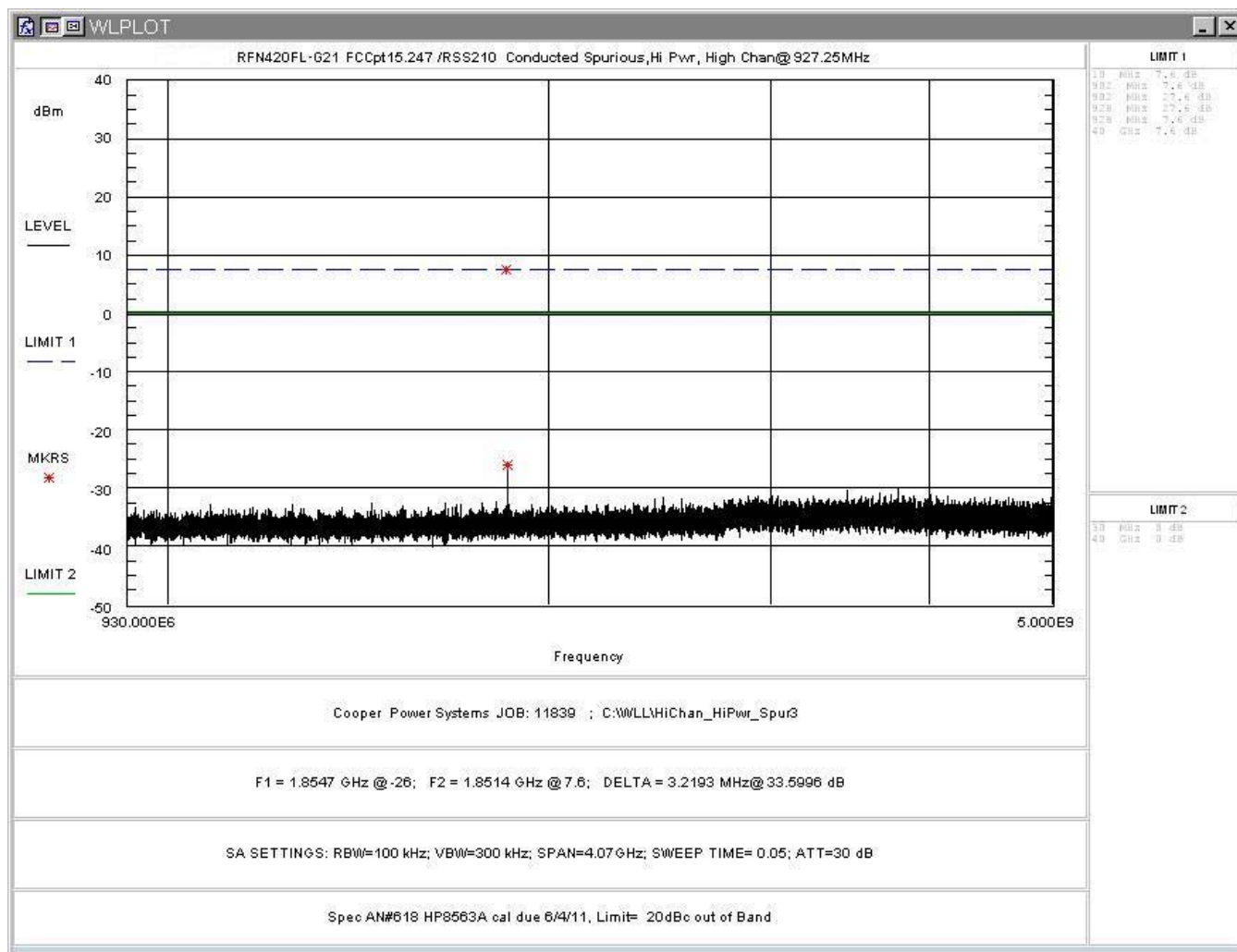


Figure 25: Conducted Spurious Emissions, High Power, High Channel 930-5000MHz

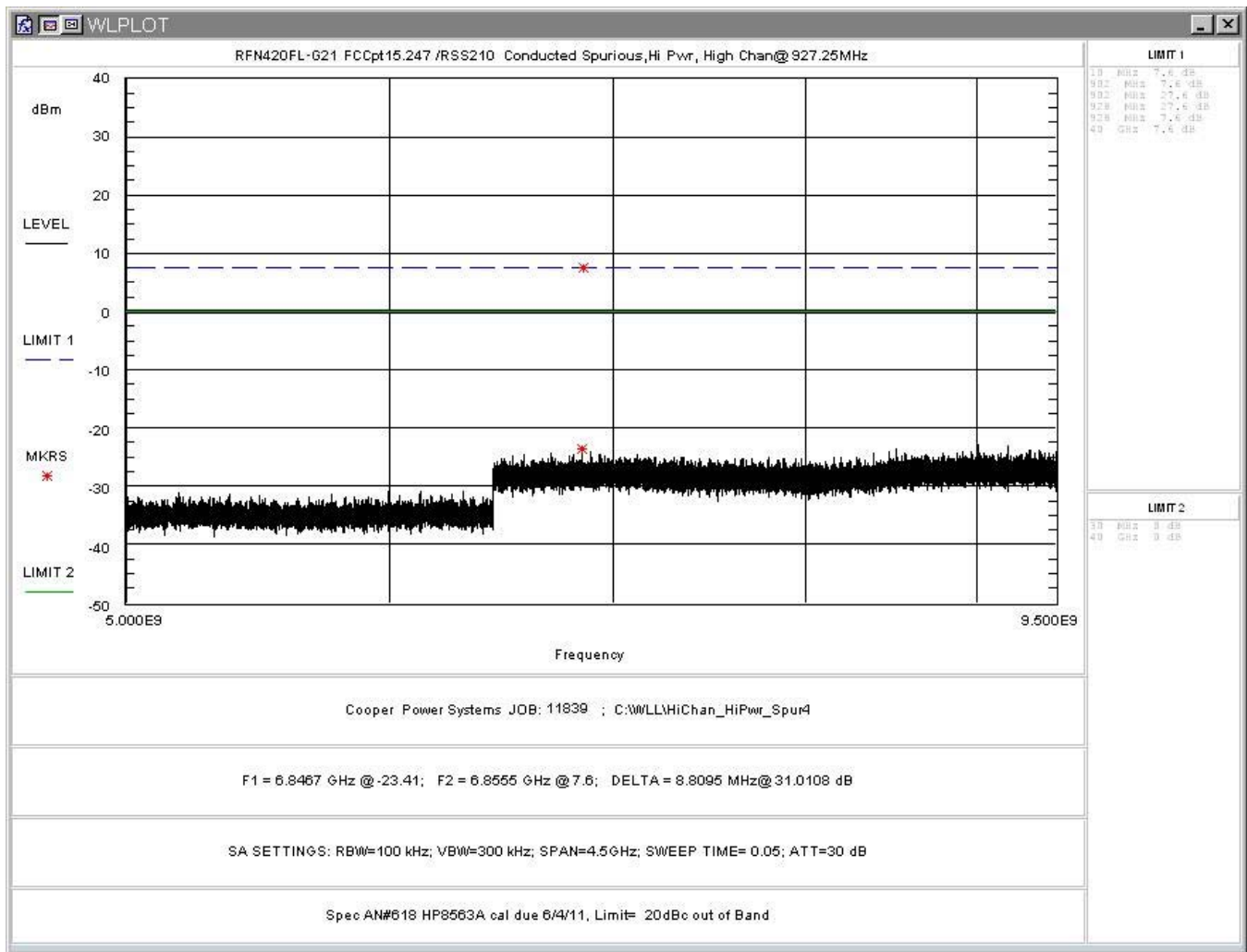


Figure 26: Conducted Spurious Emissions, High Power, High Channel 5-9.5GHz

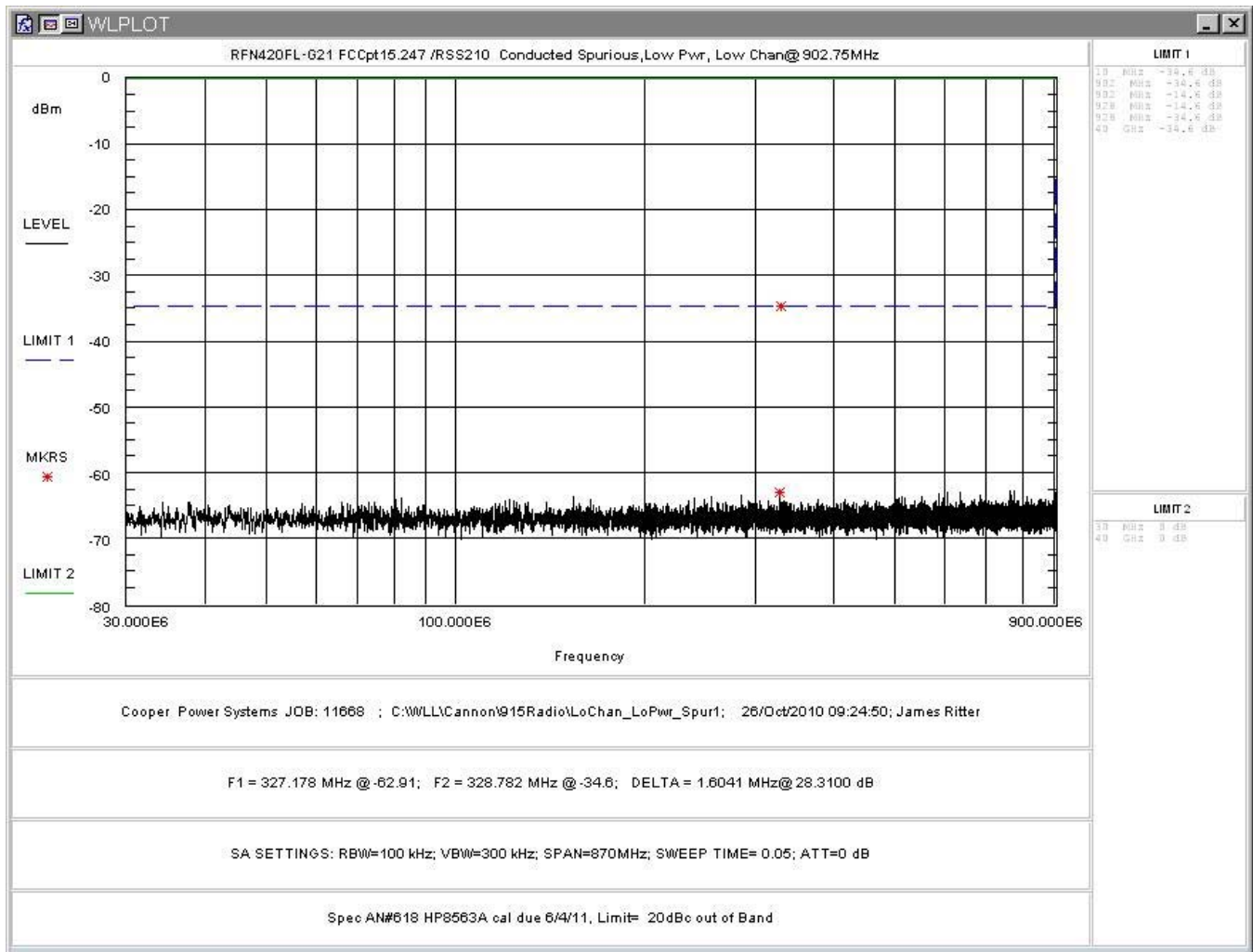
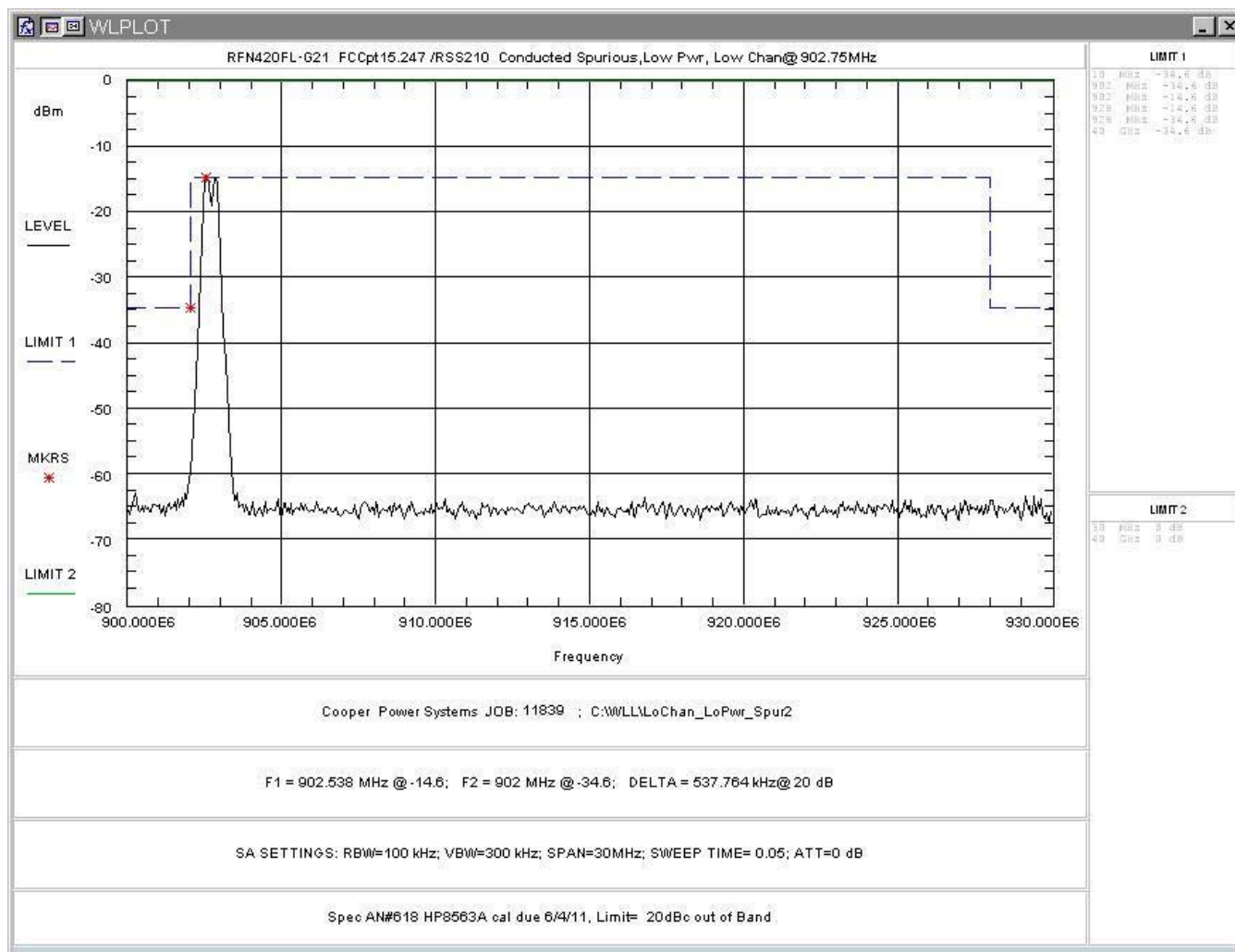


Figure 27: Conducted Spurious Emissions, Low Power, Low Channel 30 - 900MHz



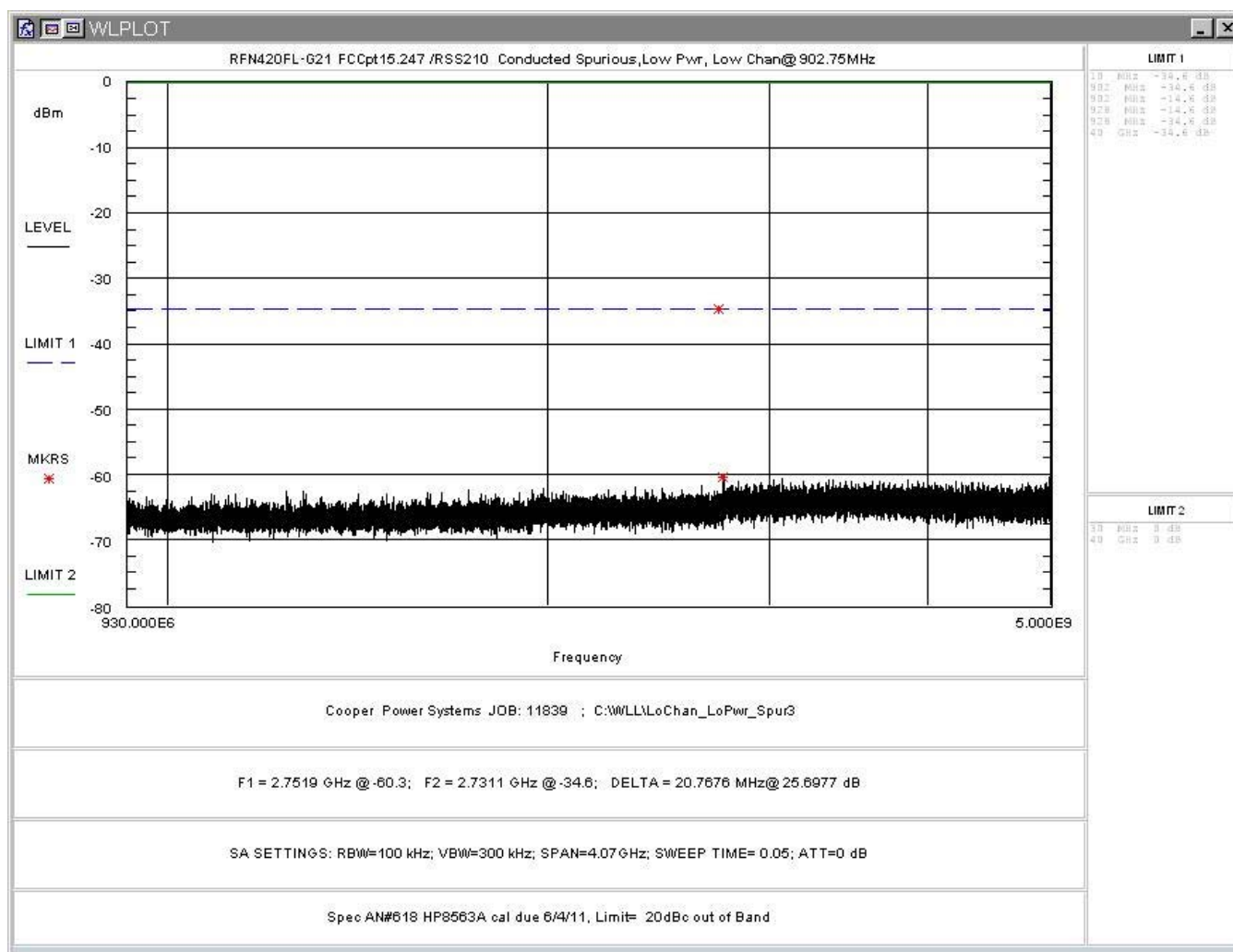


Figure 29: Conducted Spurious Emissions, Low Power, Low Channel 930-5000MHz

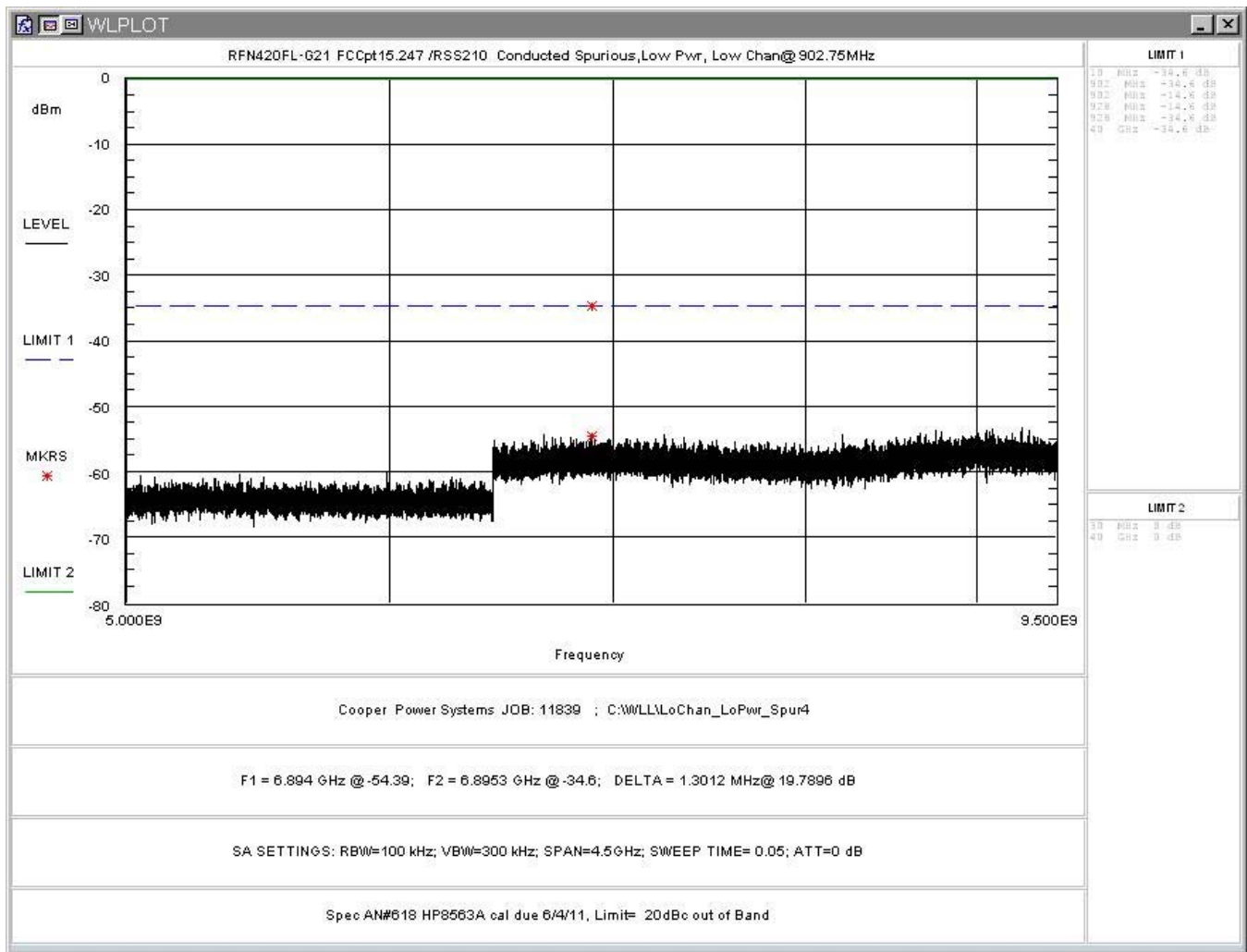


Figure 30: Conducted Spurious Emissions, Low Power, Low Channel 5-9.5GHz

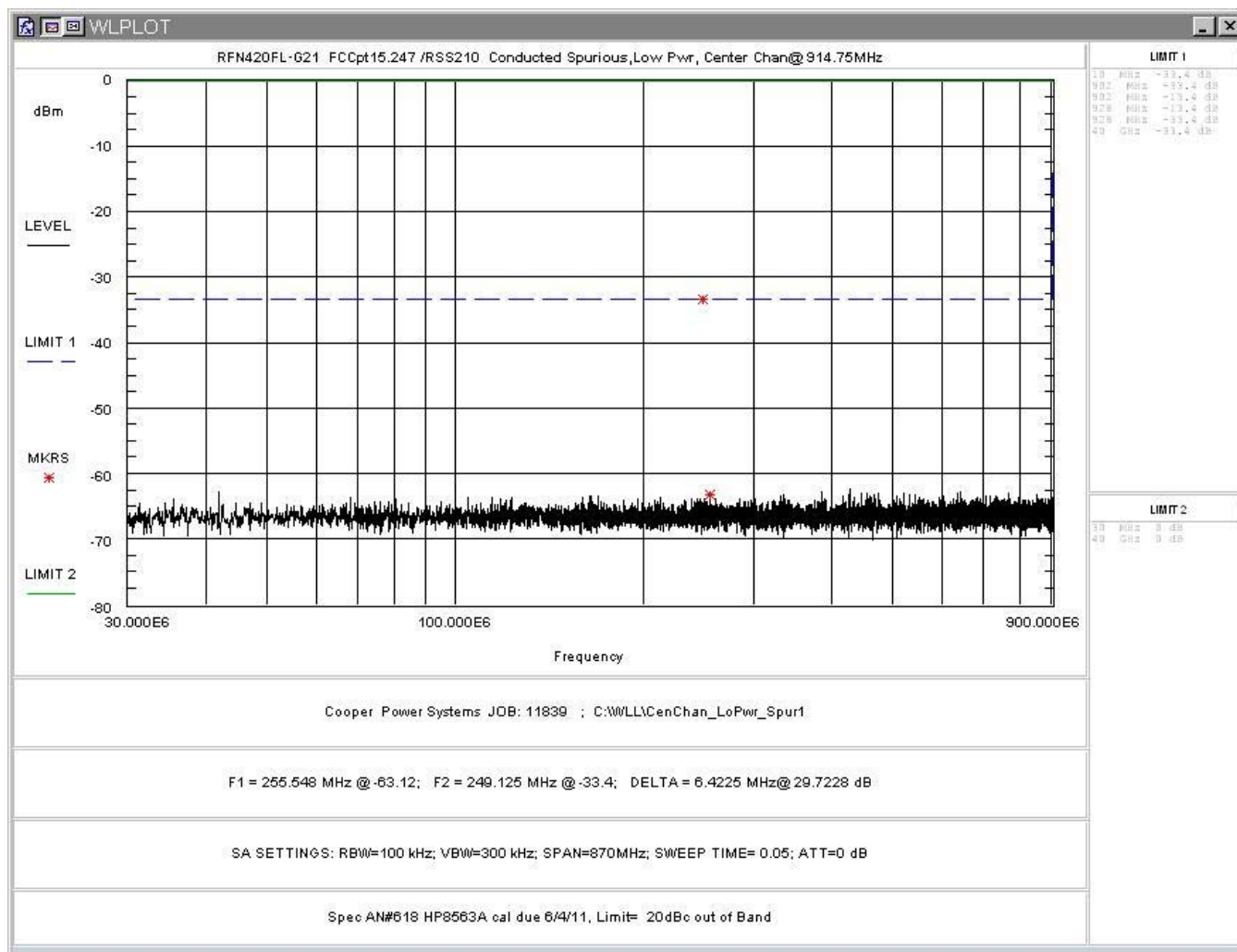


Figure 31: Conducted Spurious Emissions, Low Power, Center Channel 30 - 900MHz

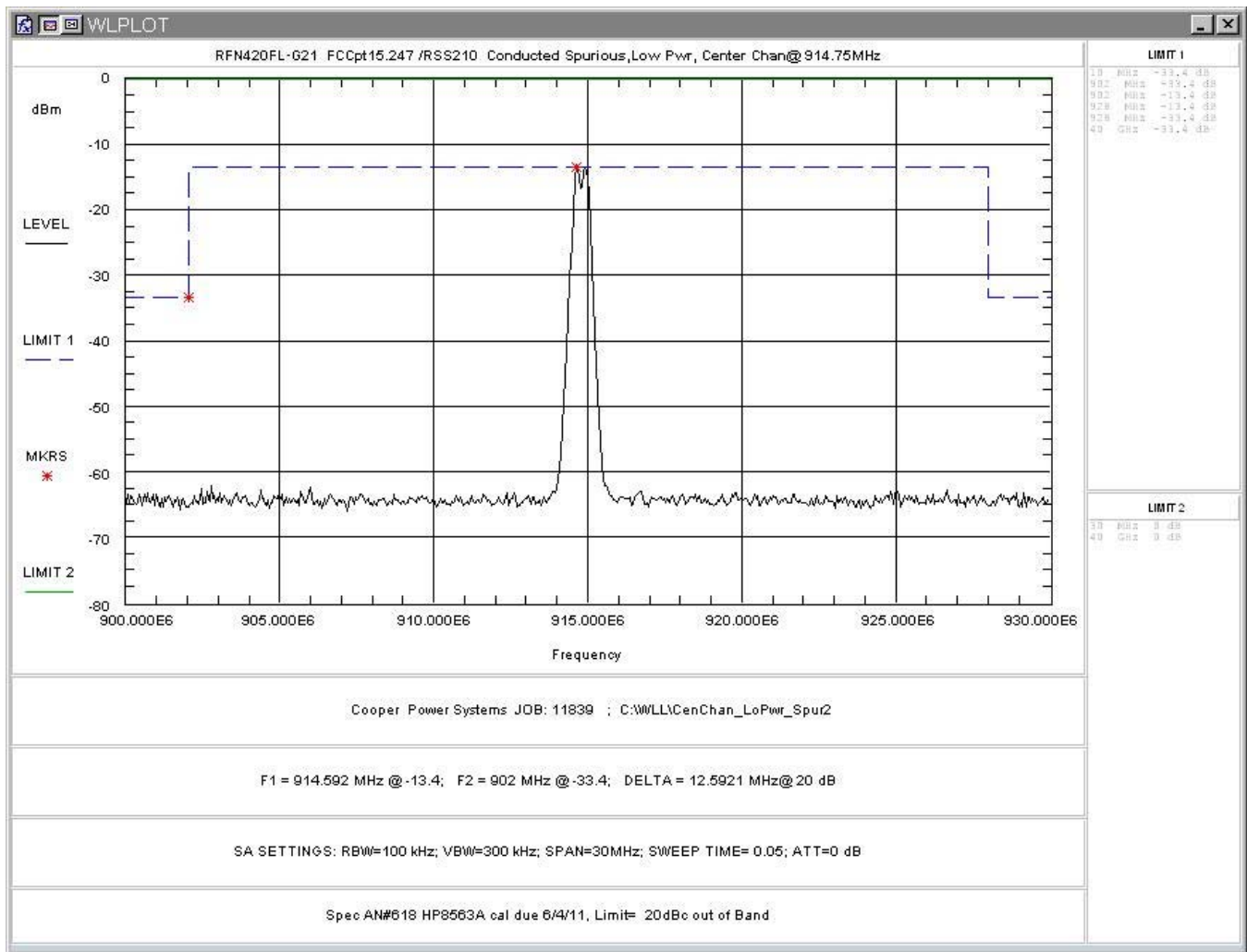


Figure 32: Conducted Spurious Emissions, Low Power, Center Channel 900 – 930MHz

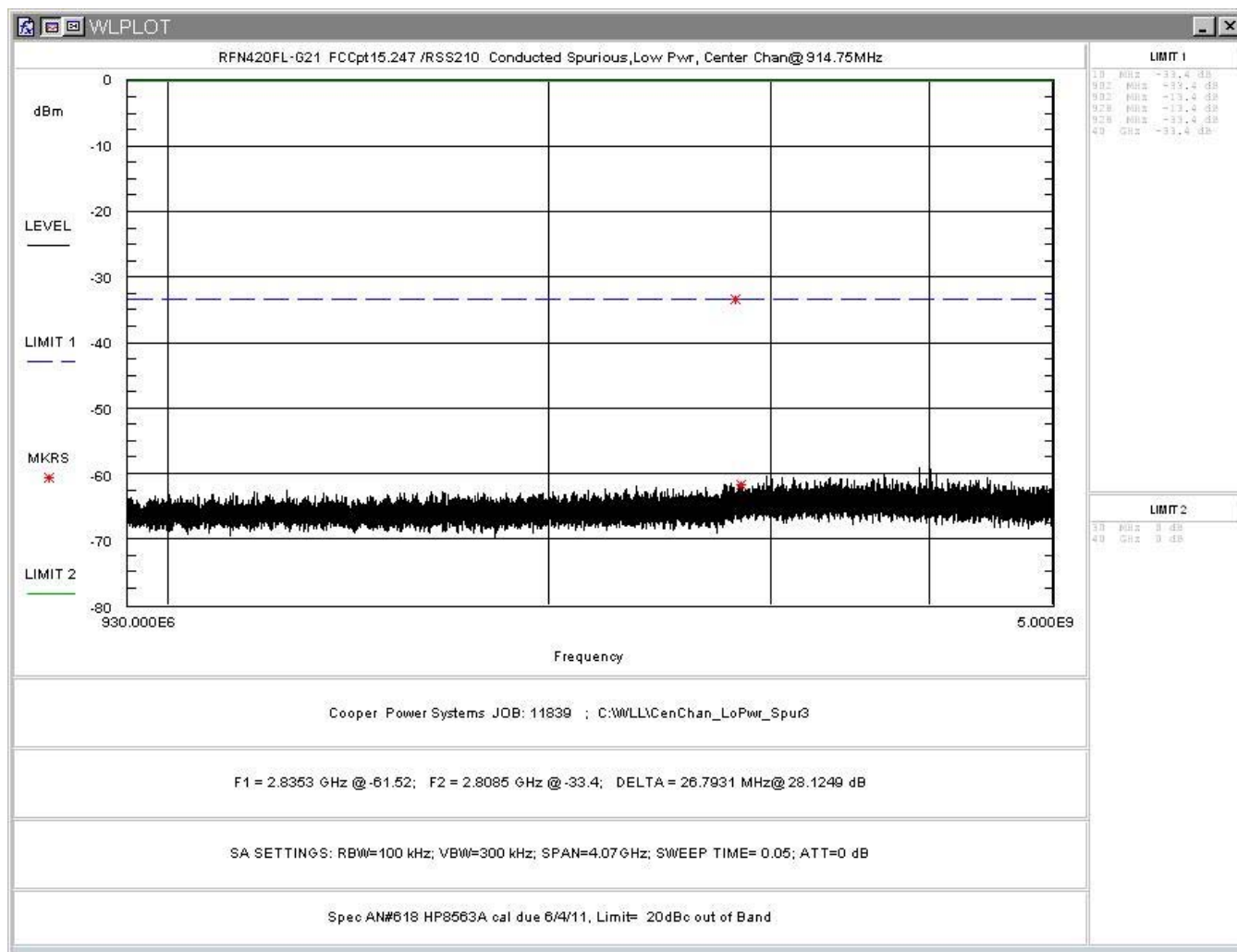


Figure 33: Conducted Spurious Emissions, Low Power, Center Channel 930-5000MHz



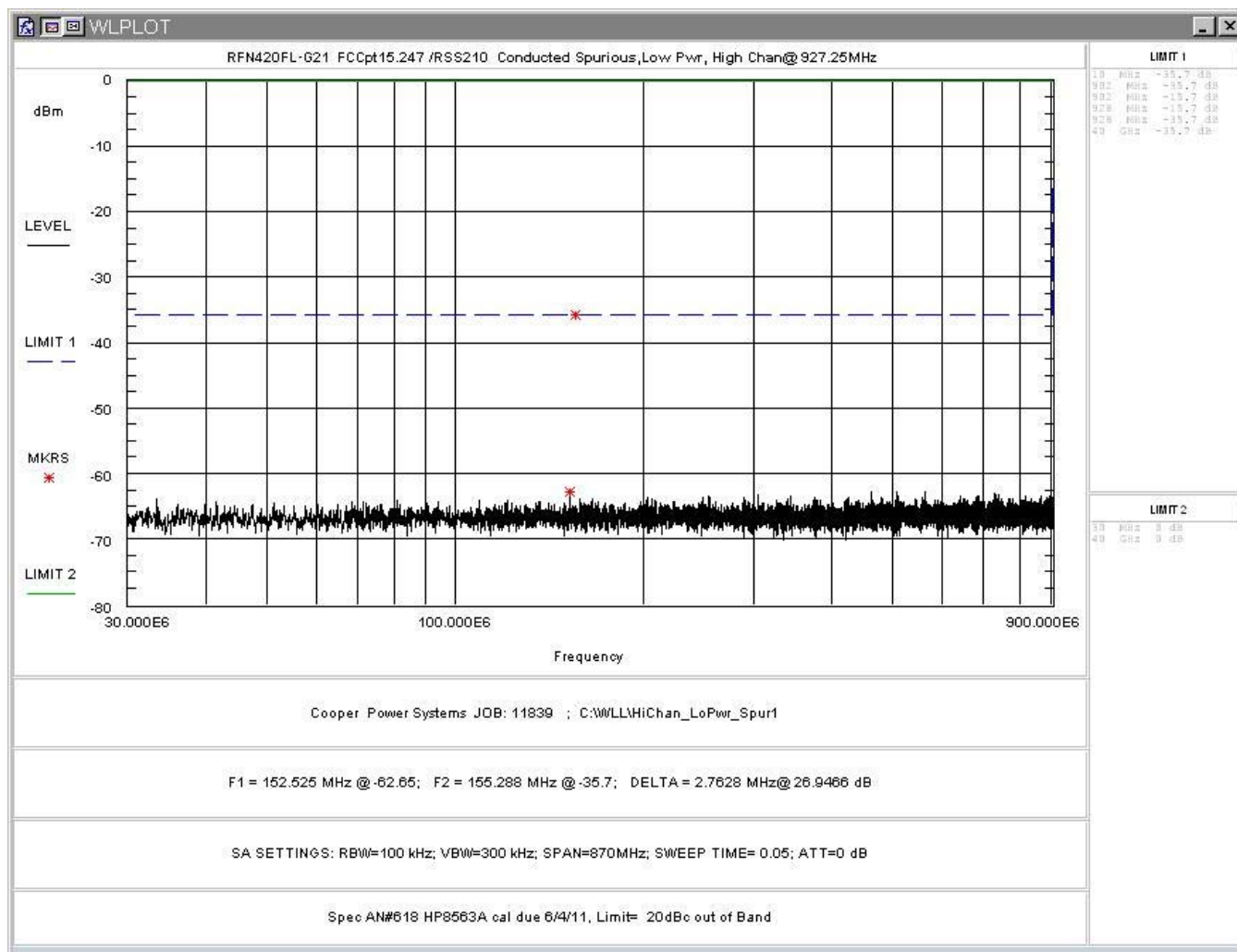


Figure 35: Conducted Spurious Emissions, Low Power, High Channel 30 - 900MHz

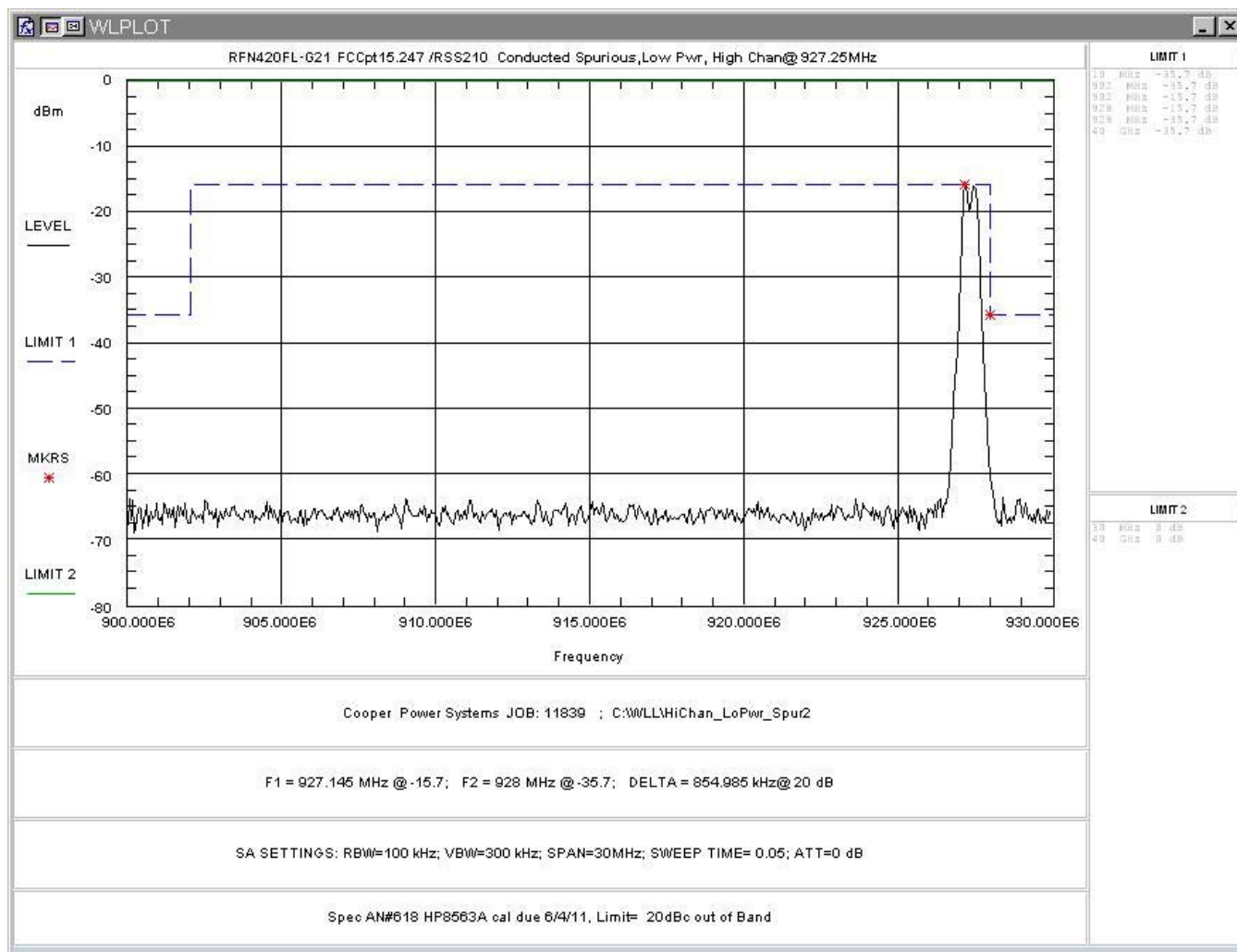


Figure 36: Conducted Spurious Emissions, Low Power, High Channel 900 – 930MHz

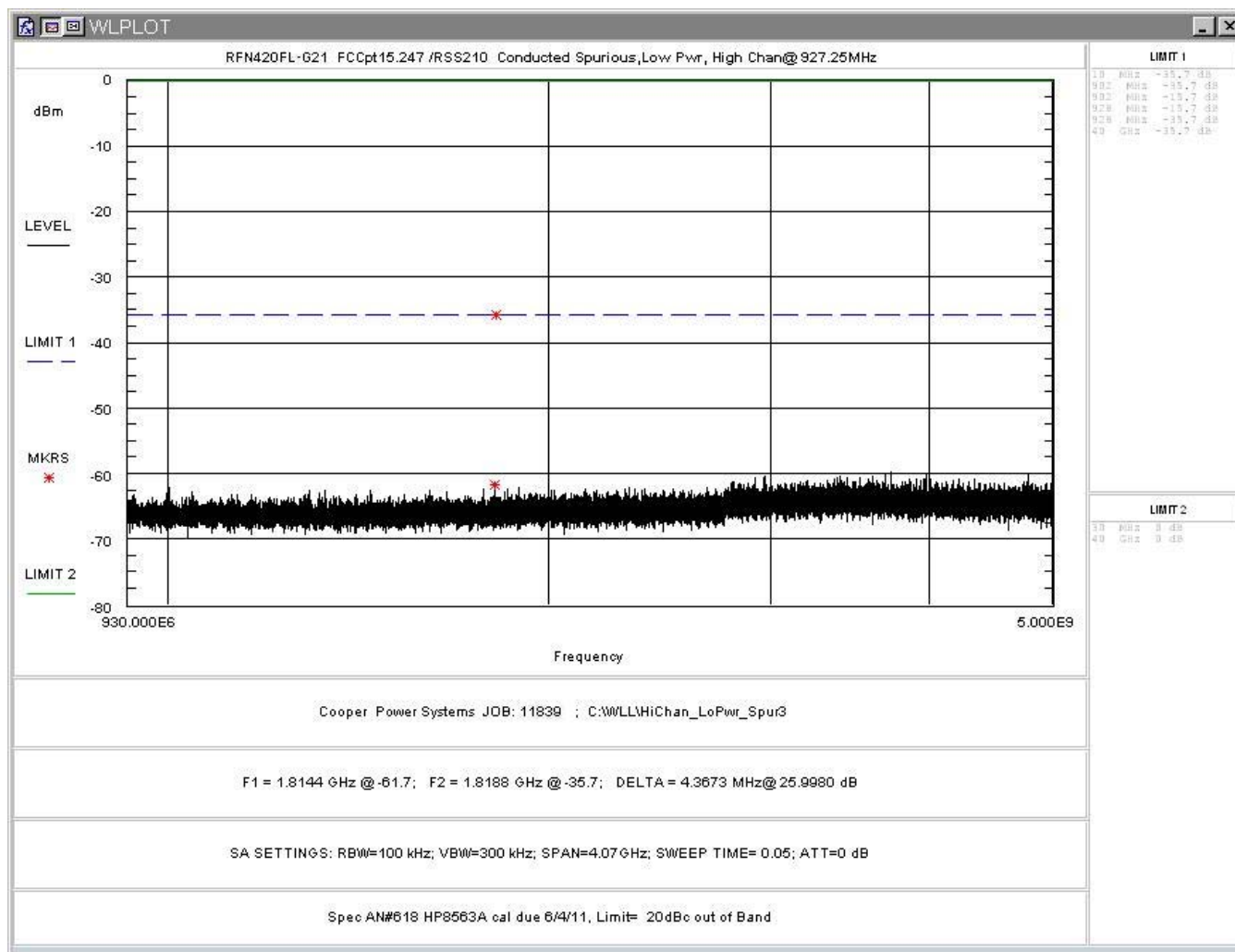


Figure 37: Conducted Spurious Emissions, Low Power, High Channel 930-5000MHz



In accordance with FCC Public Notice DA-00-705 close-up plots of the upper and lower channels in both hopping and non-hopping modes with respect to the nearest authorized band-edges are provided below. The tests were performed in the same manner as the above conducted spurious emissions tests.

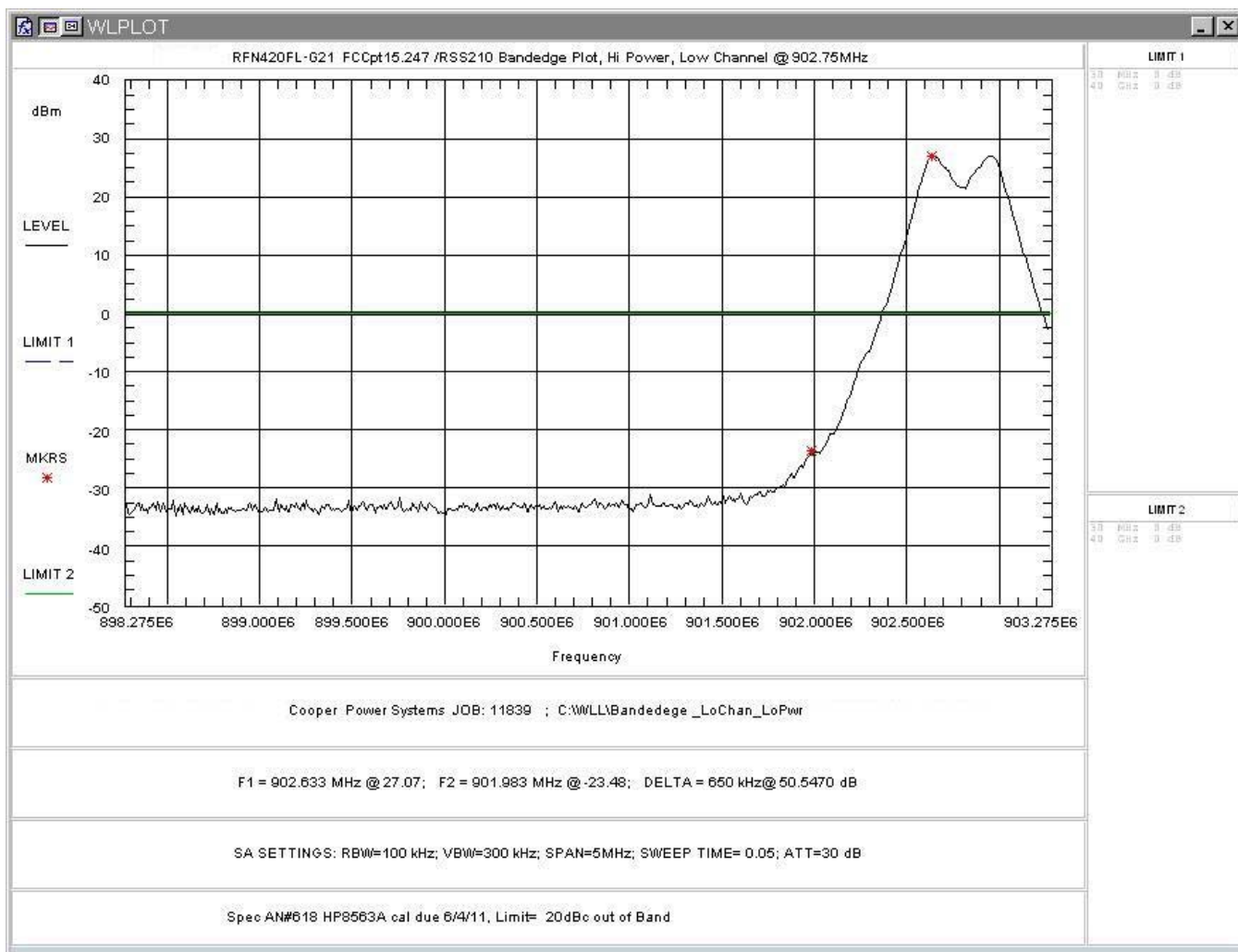


Figure 39: Lower Band-edge, Low Channel, High Power

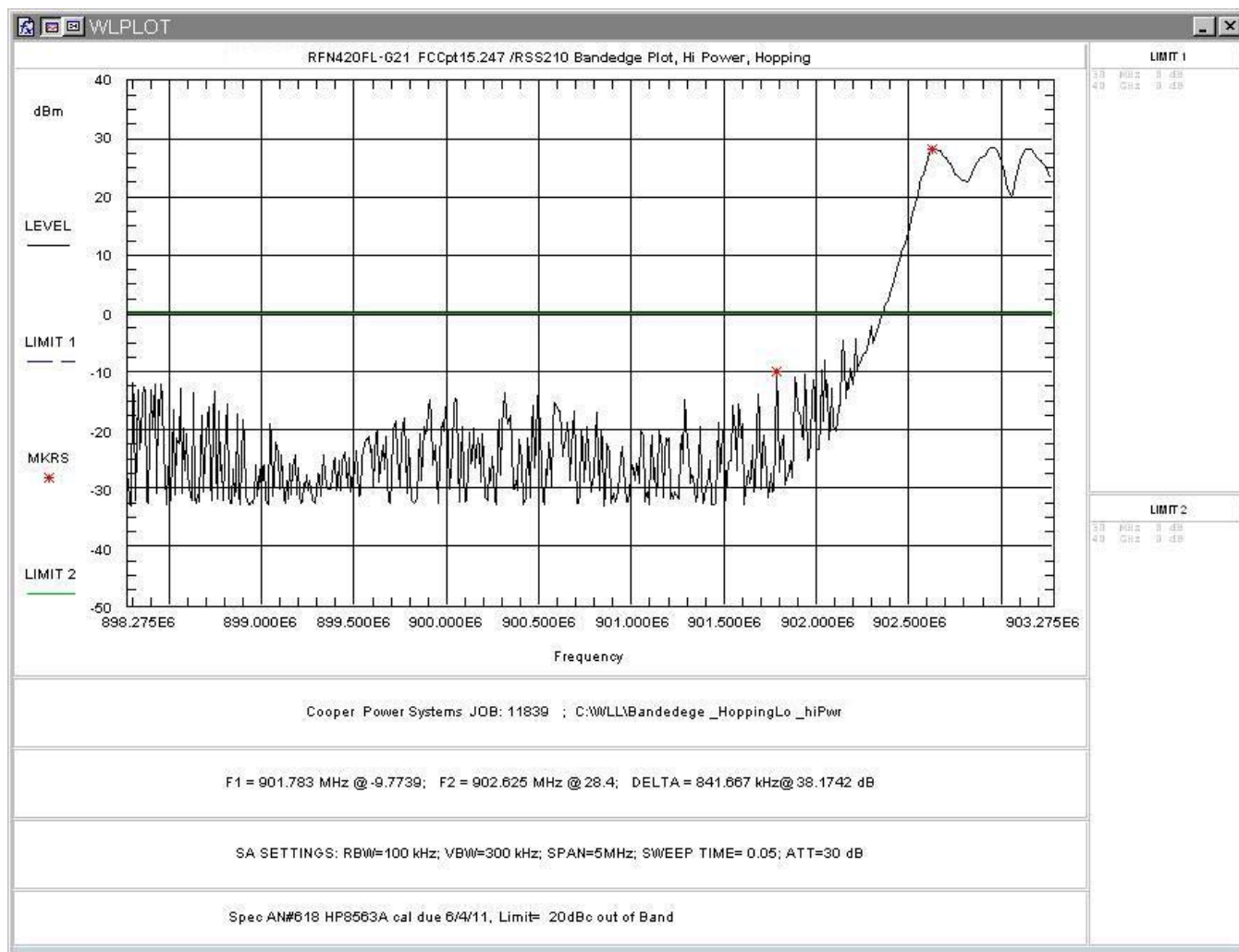


Figure 40: Lower Band-edge, Hopping Mode, High Power

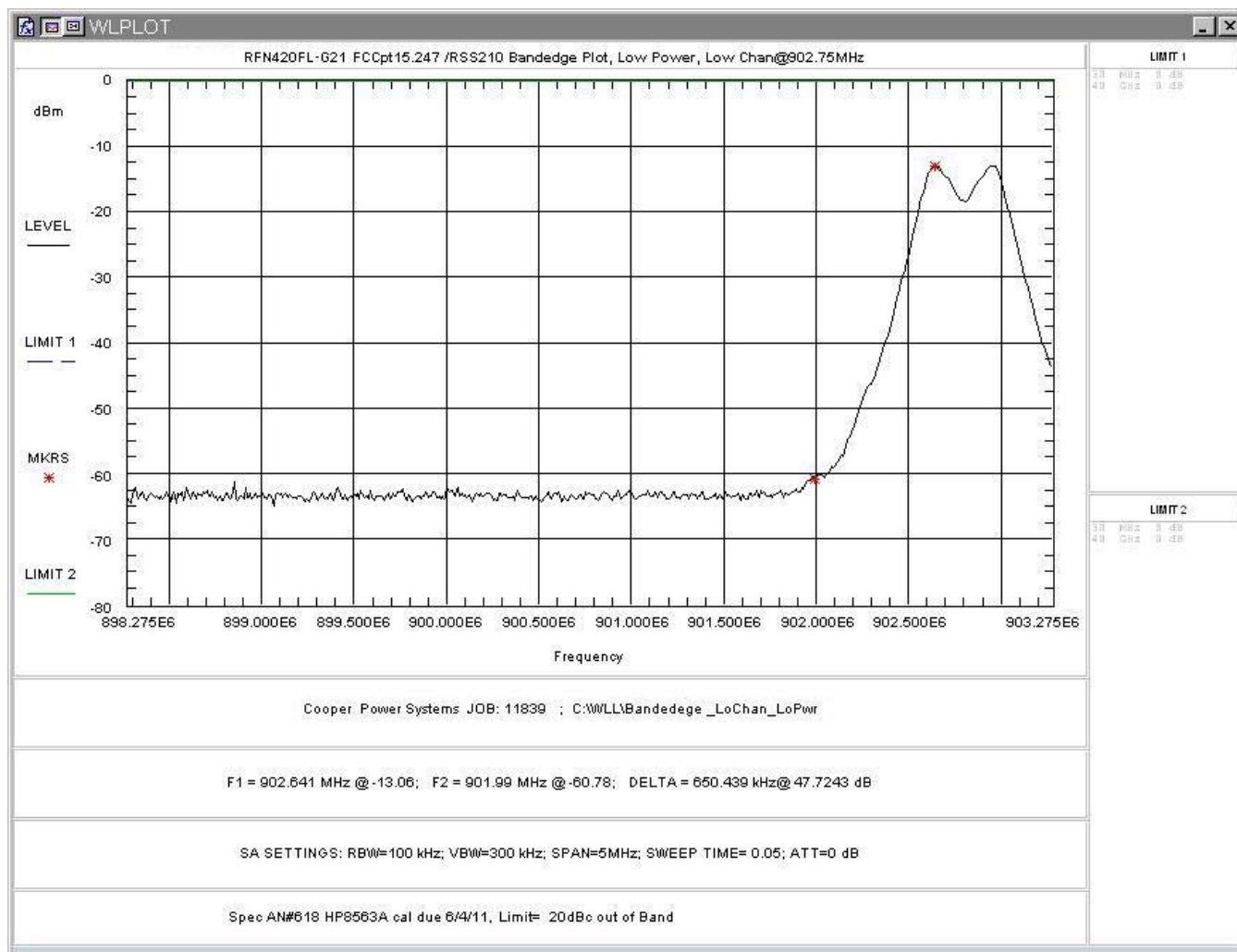


Figure 41: Lower Band-edge, Low Channel, Low Power

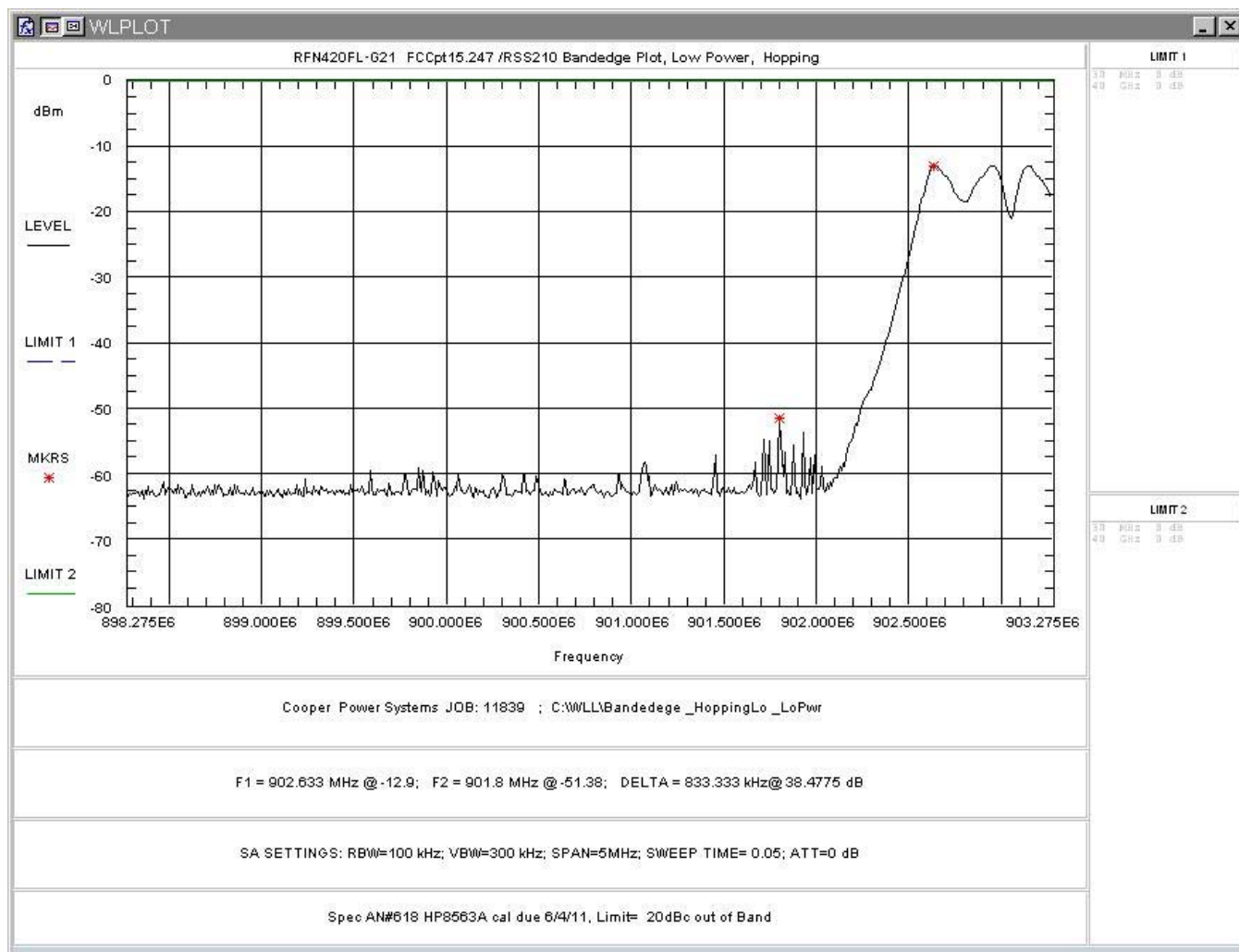


Figure 42: Lower Band-edge, Hopping Mode, Low Power

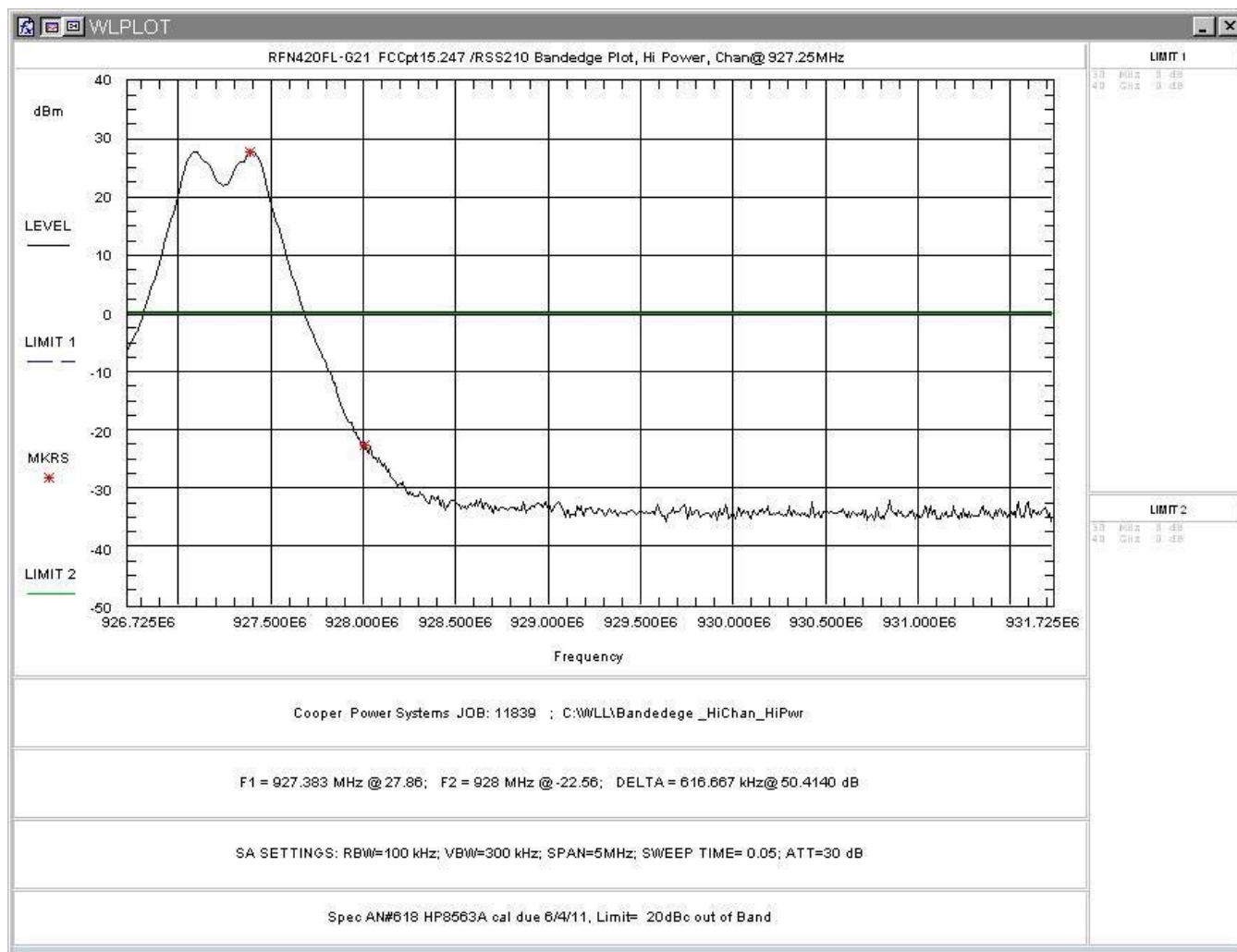


Figure 43: Upper Band-edge, High Channel, High Power

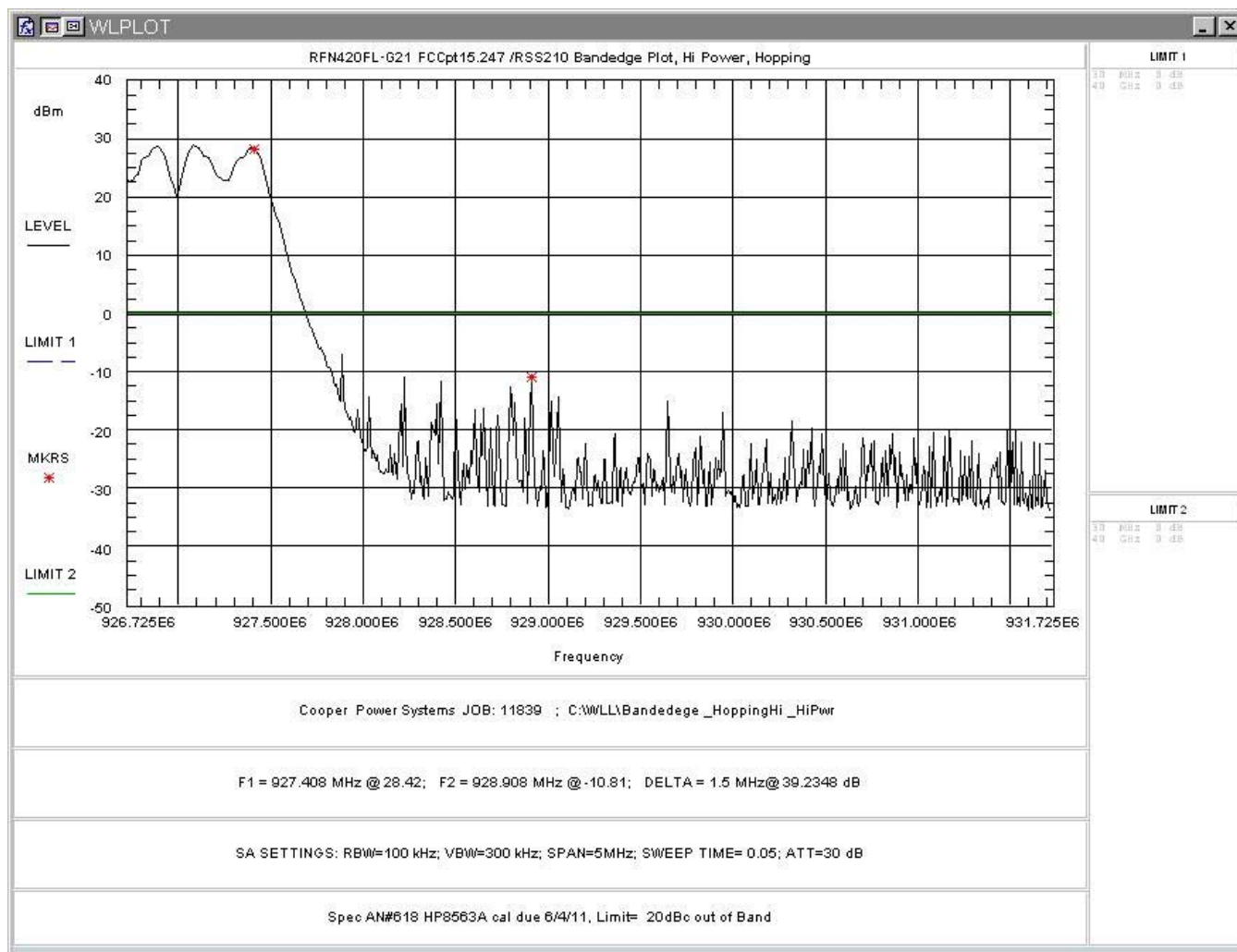


Figure 44: Upper Band-edge, Hopping Mode, High Power

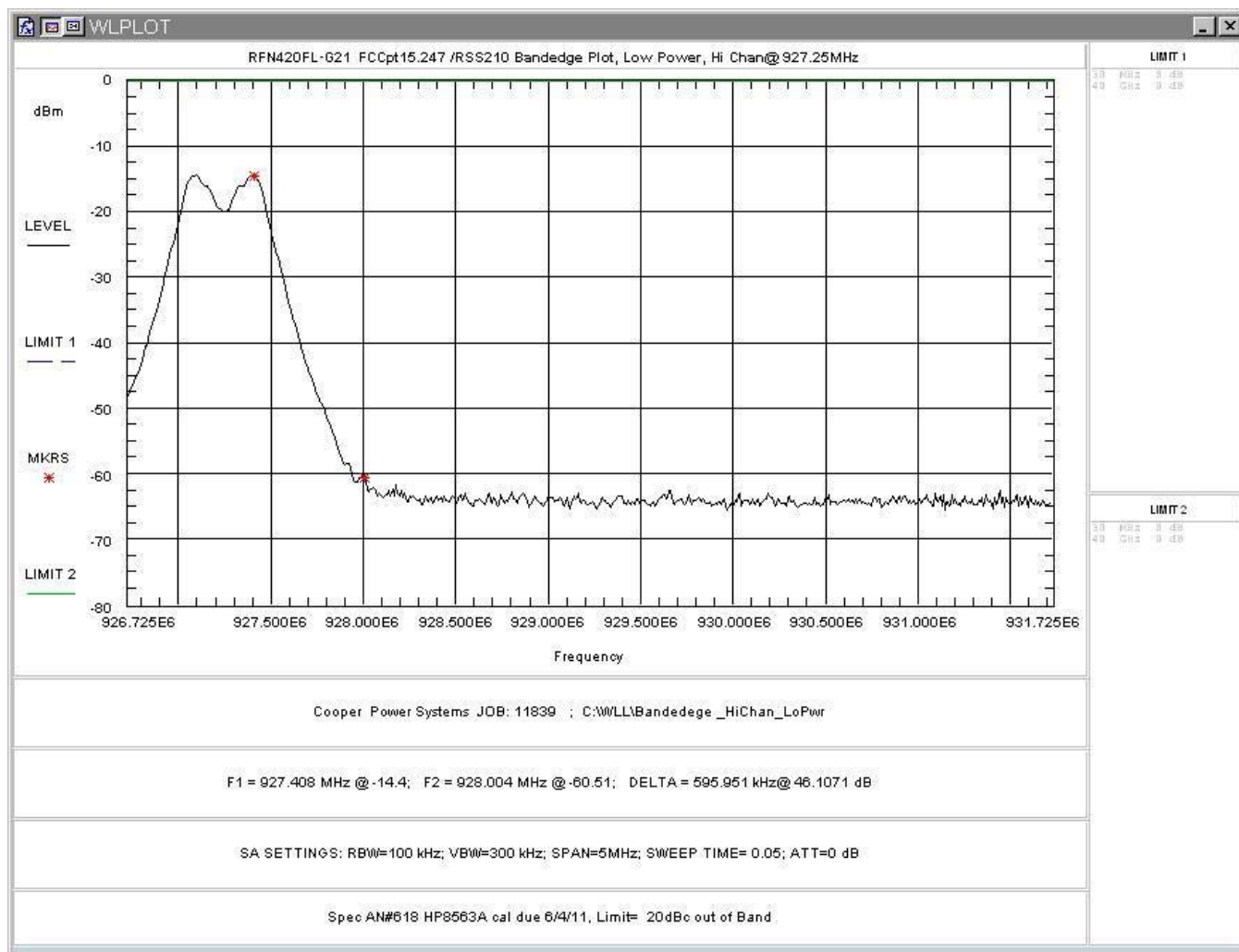


Figure 45: Upper Band-edge, High Channel, Low Power

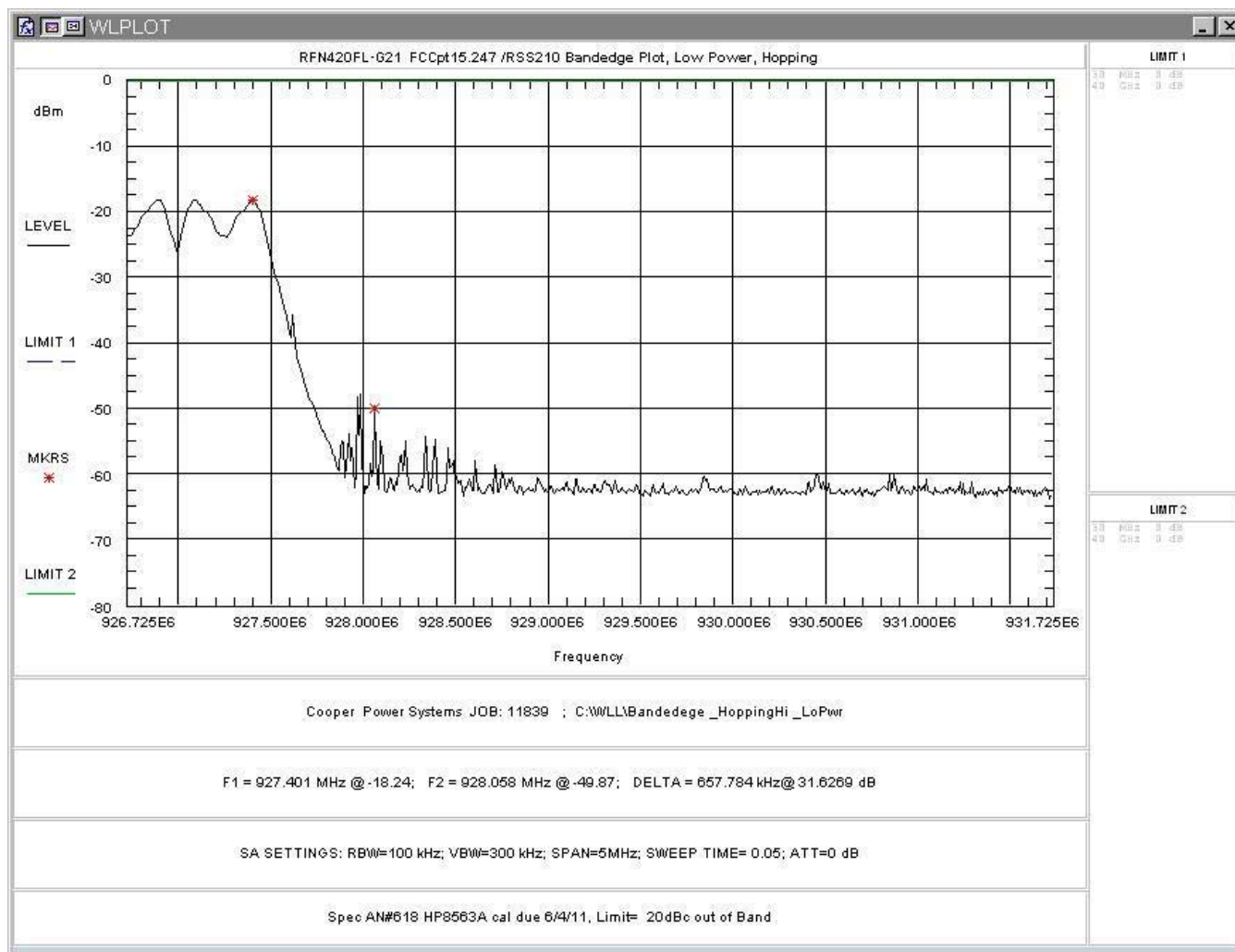


Figure 46: Upper Band-edge, Hopping Mode, Low Power

5.6 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.

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 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 unit was pre-scanned in 3 orthogonal positions with full testing performed in the worst case position. The below 1 GHz data was the same for all antenna types and was reported with the 8dBi antenna attached. Above 1GHz data was reported for each of the 3 antenna types.

From the measured conducted duty cycle and in accordance with FCC Public Notice DA 00-705, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems an additional duty cycle correction is allowed for hopping systems. This duty cycle correction has been calculated at -8.1dB and has been added to the average measurements for harmonics of the transmit frequency.

The emissions were measured using the following resolution bandwidths:

Table 9: Spectrum Analyzer Settings

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	10 Hz (Avg.), 1MHz (Peak)

**Table 10: Radiated Emission Test Data < 1GHz, Low Channel
(Restricted Bands-covers all 3 antenna configurations)**

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)
73.89	V	180.00	1.20	11.10	10.6	12.2	100.0	-18.3
75.17	V	270.00	1.00	11.40	10.6	12.5	100.0	-18.0
112.65	V	180.00	1.38	11.60	15.3	22.0	150.0	-16.7
165.59	V	10.00	1.50	9.30	14.2	14.9	150.0	-20.0
169.71	V	0.00	1.44	10.40	14.1	16.8	150.0	-19.0
171.85	V	180.00	1.68	14.90	13.9	27.7	150.0	-14.7
171.97	V	180.00	1.68	13.70	13.9	24.1	150.0	-15.9
240.13	V	180.00	2.12	12.10	13.8	19.8	200.0	-20.1
257.42	V	90.00	2.18	9.80	14.8	16.9	200.0	-21.5
266.97	V	90.00	1.74	9.60	15.9	18.9	200.0	-20.5
275.24	V	120.00	2.46	7.80	16.5	16.4	200.0	-21.7
333.73	V	180.00	2.21	7.50	17.7	18.2	200.0	-20.8
401.82	V	0.00	1.89	13.90	19.0	44.0	200.0	-13.2
996.49	V	0.00	2.22	6.60	29.2	61.8	500.0	-18.2
73.89	H	180.00	3.83	10.90	10.6	11.9	100.0	-18.5
112.65	H	180.00	3.69	8.90	15.3	16.2	150.0	-19.4
165.59	H	0.00	3.61	11.30	14.2	18.8	150.0	-18.0
171.97	H	270.00	3.20	11.80	13.9	19.4	150.0	-17.8
240.13	H	170.00	2.84	14.50	13.8	26.1	200.0	-17.7
257.42	H	270.00	3.25	6.50	14.8	11.6	200.0	-24.8
266.97	H	180.00	3.17	7.20	15.9	14.3	200.0	-22.9
333.73	H	190.00	2.20	9.90	17.7	24.0	200.0	-18.4
401.82	H	180.00	1.67	9.80	19.0	27.4	200.0	-17.3
996.49	H	180.00	1.77	8.70	29.2	78.7	500.0	-16.1

**Table 11: Radiated Emission Test Data >1GHz, Low Channel
(8dbi –Omni directional Antenna)**

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Additional Duty Cycle Correction	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
Peak									
2708.25	H	180.00	2.36	51.87	-1.6	0.0	327.0	5000.0	-23.7
3611.00	H	0.00	3.30	47.11	0.7	0.0	246.9	5000.0	-26.1
4513.75	H	170.00	2.60	44.63	2.5	0.0	228.1	5000.0	-26.8
5416.50	H	160.00	2.77	48.33	5.9	0.0	512.2	5000.0	-19.8
8124.75	H	120.00	3.28	44.52	10.1	0.0	536.7	5000.0	-19.4
9027.50	H	170.00	3.30	45.60	11.7	0.0	734.2	5000.0	-16.7
Average									
2708.25	H	180.00	2.36	44.80	-1.6	-8.1	57.0	500.0	-18.9
3611.00	H	0.00	3.30	37.81	0.7	-8.1	33.3	500.0	-23.5
4513.75	H	170.00	2.60	32.68	2.5	-8.1	22.7	500.0	-26.9
5416.50	H	160.00	2.77	35.98	5.9	-8.1	48.6	500.0	-20.2
8124.75	H	120.00	3.28	32.82	10.1	-8.1	54.9	500.0	-19.2
9027.50	H	170.00	3.30	32.50	11.7	-8.1	63.9	500.0	-17.9
Non Harmonics									
1397.57	H	120.00	3.10	36.50	-8.2	0.0	26.0	500.0	-25.7
1328.87	H	120.00	3.10	37.10	-8.7	0.0	26.4	500.0	-25.5
Peak									
2708.25	V	170.00	2.45	46.74	-1.6	0.0	181.1	5000.0	-28.8
3611.00	V	0.00	2.49	48.74	0.7	0.0	297.9	5000.0	-24.5
4513.75	V	10.00	2.08	43.47	2.5	0.0	199.6	5000.0	-28.0
5416.50	V	170.00	2.76	47.15	5.9	0.0	447.2	5000.0	-21.0
8124.75	V	180.00	3.00	44.98	10.1	0.0	565.8	5000.0	-18.9
9027.50	V	160.00	2.49	43.51	11.7	0.0	577.2	5000.0	-18.8
Average									
2708.25	V	170.00	2.45	36.24	-1.6	-8.1	21.3	500.0	-27.4
3611.00	V	0.00	2.49	37.45	0.7	-8.1	32.0	500.0	-23.9
4513.75	V	10.00	2.08	33.23	2.5	-8.1	24.2	500.0	-26.3
5416.50	V	170.00	2.76	35.95	5.9	-8.1	48.5	500.0	-20.3
8124.75	V	180.00	3.00	31.40	10.1	-8.1	46.6	500.0	-20.6
9027.50	V	160.00	2.49	31.50	11.7	-8.1	57.0	500.0	-18.9
Non Harmonics									
1397.57	V	180.00	2.50	36.20	-8.2	0.0	25.2	500.0	-26.0
1328.87	V	180.00	2.50	34.60	-8.7	0.0	19.8	500.0	-28.0

**Table 12: Radiated Emission Test Data >1GHz, Low Channel
(3dbi –Phantom Antenna)**

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Additional Duty Cycle Correction	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
Peak									
2708.25	H	170.00	2.12	52.74	-1.6	0.0	322.1	5000.0	-23.8
3611.00	H	180.00	3.04	48.01	0.7	0.0	273.9	5000.0	-25.2
4513.75	H	45.00	3.03	44.95	2.5	0.0	236.7	5000.0	-26.5
5416.50	H	270.00	3.01	48.00	5.9	0.0	493.1	5000.0	-20.1
8124.75	H	250.00	2.99	45.52	10.1	0.0	602.1	5000.0	-18.4
9027.50	H	190.00	3.13	42.63	11.7	0.0	521.6	5000.0	-19.6
Average									
2708.25	H	170.00	2.12	44.93	-1.6	-8.1	57.9	500.0	-18.7
3611.00	H	180.00	3.04	38.12	0.7	-8.1	34.5	500.0	-23.2
4513.75	H	45.00	3.03	32.65	2.5	-8.1	22.6	500.0	-26.9
5416.50	H	270.00	3.01	35.88	5.9	-8.1	48.1	500.0	-20.3
8124.75	H	250.00	2.99	32.66	10.1	-8.1	53.9	500.0	-19.3
9027.50	H	190.00	3.13	32.66	11.7	-8.1	65.1	500.0	-17.7
Non Harmonics									
1397.57	H	190.00	1.65	36.50	-8.2	0.0	26.0	500.0	-25.7
1328.87	H	180.00	1.65	35.20	-8.7	0.0	21.2	500.0	-27.4
Peak									
2708.25	V	100.00	3.16	49.77	-1.6	0.0	228.8	5000.0	-26.8
3611.00	V	270.00	3.08	47.43	0.7	0.0	256.2	5000.0	-25.8
4513.75	V	250.00	2.71	45.03	2.5	0.0	238.9	5000.0	-26.4
5416.50	V	270.00	2.98	48.23	5.9	0.0	506.4	5000.0	-19.9
8124.75	V	180.00	3.03	43.37	10.1	0.0	470.1	5000.0	-20.5
9027.50	V	10.00	2.75	44.46	11.7	0.0	643.9	5000.0	-17.8
Average									
2708.25	V	100.00	3.16	41.46	-1.6	-8.1	38.8	500.0	-22.2
3611.00	V	270.00	3.08	38.33	0.7	-8.1	35.4	500.0	-23.0
4513.75	V	250.00	2.71	32.82	2.5	-8.1	23.0	500.0	-26.7
5416.50	V	270.00	2.98	36.36	5.9	-8.1	50.8	500.0	-19.9
8124.75	V	180.00	3.03	31.83	10.1	-8.1	49.0	500.0	-20.2
9027.50	V	10.00	2.75	31.72	11.7	-8.1	58.5	500.0	-18.6
Non Harmonics									
1397.57	V	150.00	2.90	36.00	-8.2	0.0	24.6	500.0	-26.2
1328.87	V	150.00	2.90	36.82	-8.7	0.0	25.6	500.0	-25.8

**Table 13: Radiated Emission Test Data >1GHz, Low Channel
(2dbi –Co-Linear Antenna)**

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Additional Duty Cycle Correction	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
Peak									
2708.25	H	0.00	2.58	47.94	-1.6	0.0	185.4	5000.0	-28.6
3611.00	H	160.00	2.92	44.99	0.7	0.0	193.4	5000.0	-28.2
4513.75	H	270.00	2.60	45.70	2.5	0.0	258.0	5000.0	-25.7
5416.50	H	270.00	3.46	46.68	5.9	0.0	423.6	5000.0	-21.4
8124.75	H	180.00	3.05	42.81	10.1	0.0	440.8	5000.0	-21.1
9027.50	H	190.00	2.96	40.82	11.7	0.0	423.5	5000.0	-21.4
Average									
2708.25	H	0.00	2.58	36.74	-1.6	-8.1	22.5	500.0	-26.9
3611.00	H	160.00	2.92	33.83	0.7	-8.1	21.1	500.0	-27.5
4513.75	H	270.00	2.60	32.58	2.5	-8.1	22.4	500.0	-27.0
5416.50	H	270.00	3.46	34.09	5.9	-8.1	39.1	500.0	-22.1
8124.75	H	180.00	3.05	31.82	10.1	-8.1	48.9	500.0	-20.2
9027.50	H	190.00	2.96	30.92	11.7	-8.1	53.3	500.0	-19.4
Non Harmonics									
1397.57	V	130.00	3.00	36.30	-8.2	0.0	25.5	500.0	-25.9
1328.87	V	130.00	3.00	35.98	-8.7	0.0	23.2	500.0	-26.7
Peak									
2708.25	V	180.00	2.88	48.88	-1.6	0.0	206.5	5000.0	-27.7
3611.00	V	10.00	3.03	46.56	0.7	0.0	231.8	5000.0	-26.7
4513.75	V	270.00	3.10	44.51	2.5	0.0	225.0	5000.0	-26.9
5416.50	V	90.00	2.85	45.68	5.9	0.0	377.5	5000.0	-22.4
8124.75	V	270.00	3.14	42.37	10.1	0.0	419.0	5000.0	-21.5
9027.50	V	180.00	2.88	41.38	11.7	0.0	451.7	5000.0	-20.9
Average									
2708.25	V	180.00	2.88	39.98	-1.6	-8.1	32.7	500.0	-23.7
3611.00	V	10.00	3.03	35.78	0.7	-8.1	26.4	500.0	-25.6
4513.75	V	270.00	3.10	31.80	2.5	-8.1	20.5	500.0	-27.7
5416.50	V	90.00	2.85	33.85	5.9	-8.1	38.1	500.0	-22.4
8124.75	V	270.00	3.14	31.63	10.1	-8.1	47.9	500.0	-20.4
9027.50	V	180.00	2.88	31.18	11.7	-8.1	54.9	500.0	-19.2
Non Harmonics									
1397.57	V	180.00	2.85	34.90	-8.2	0.0	21.7	500.0	-27.3
1328.87	V	180.00	2.85	35.40	-8.7	0.0	21.7	500.0	-27.2

**Table 14: Radiated Emission Test Data < 1GHz, Center Channel
(Restricted bands-covers all 3 antenna configurations)**

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)
37.66	V	190.00	1.00	8.50	14.6	14.3	100.0	-16.9
74.10	V	170.00	1.30	12.80	10.6	14.8	100.0	-16.6
112.69	V	160.00	1.10	13.50	15.3	27.4	150.0	-14.8
114.60	V	180.00	1.21	10.00	15.4	18.7	150.0	-18.1
163.38	V	0.00	1.30	7.30	14.3	12.1	150.0	-21.9
169.20	V	170.00	1.50	9.40	14.1	15.0	150.0	-20.0
171.84	V	0.00	1.30	15.00	13.9	28.0	150.0	-14.6
171.97	V	0.00	1.20	13.90	13.9	24.6	150.0	-15.7
242.17	V	10.00	1.68	11.00	13.9	17.6	200.0	-21.1
266.98	V	180.00	2.04	10.20	15.9	20.3	200.0	-19.9
275.00	V	90.00	2.10	6.80	16.5	14.7	200.0	-22.7
334.23	V	170.00	1.80	6.40	17.7	16.0	200.0	-21.9
405.98	V	90.00	2.35	15.40	19.1	52.9	200.0	-11.5
609.52	V	270.00	2.33	14.30	23.9	81.5	200.0	-7.8
610.14	V	270.00	2.33	13.40	24.0	73.8	200.0	-8.7
966.65	V	180.00	2.11	12.10	28.4	105.5	500.0	-13.5
973.27	V	0.00	1.96	7.50	28.7	64.4	500.0	-17.8
996.49	V	0.00	2.22	6.60	29.2	61.8	500.0	-18.2
74.10	H	180.00	4.00	9.80	10.6	10.5	100.0	-19.6
112.69	H	10.00	3.86	11.50	15.3	21.8	150.0	-16.8
114.60	H	0.00	3.80	8.20	15.4	15.2	150.0	-19.9
164.22	H	0.00	3.43	11.20	14.3	18.8	150.0	-18.1
169.94	H	180.00	2.62	11.30	14.1	18.7	150.0	-18.1
171.84	H	180.00	2.68	12.90	13.9	22.0	150.0	-16.7
242.17	H	180.00	1.96	11.50	13.9	18.6	200.0	-20.6
266.98	H	190.00	3.62	3.80	15.9	9.7	200.0	-26.3
275.00	H	0.00	3.40	5.40	16.5	12.5	200.0	-24.1
405.98	H	180.00	3.07	9.80	19.1	27.8	200.0	-17.1
609.52	H	180.00	1.90	6.60	23.9	33.6	200.0	-15.5
610.14	H	190.00	1.88	8.00	24.0	39.6	200.0	-14.1
407.18	H	190.00	3.10	8.30	19.1	23.5	200.0	-18.6
996.49	H	180.00	1.77	8.70	29.2	78.7	500.0	-16.1

**Table 15: Radiated Emission Test Data >1GHz, Center Channel
(8dbi –Omni directional Antenna)**

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Additional Duty Cycle Correction	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
Peak									
2744.25	H	160.00	2.41	48.57	-1.7	0.0	221.8	5000.0	-27.1
3659.00	H	180.00	3.03	49.64	0.8	0.0	331.0	5000.0	-23.6
4573.75	H	45.00	3.08	46.07	2.6	0.0	270.7	5000.0	-25.3
7318.00	H	45.00	2.15	43.50	9.1	0.0	425.0	5000.0	-21.4
8232.75	H	170.00	2.89	44.11	10.3	0.0	523.3	5000.0	-19.6
9147.50	H	180.00	3.17	43.54	12.0	0.0	595.7	5000.0	-18.5
Average									
2744.25	H	160.00	2.41	38.20	-1.7	-8.1	26.5	500.0	-25.5
3659.00	H	180.00	3.03	39.36	0.8	-8.1	39.9	500.0	-22.0
4573.75	H	45.00	3.08	34.29	2.6	-8.1	27.4	500.0	-25.2
7318.00	H	45.00	2.15	31.29	9.1	-8.1	41.0	500.0	-21.7
8232.75	H	170.00	2.89	31.67	10.3	-8.1	49.2	500.0	-20.1
9147.50	H	180.00	3.17	31.78	12.0	-8.1	60.5	500.0	-18.3
Non harmonics									
1196.37	H	45.00	1.36	37.47	-8.9	0.0	26.7	500.0	-25.4
1329.24	H	190.00	1.45	36.12	-8.7	0.0	23.6	500.0	-26.5
Peak									
2744.25	V	190.00	3.29	47.37	-1.7	0.0	193.2	5000.0	-28.3
3659.00	V	0.00	2.40	48.92	0.8	0.0	304.7	5000.0	-24.3
4573.75	V	220.00	2.43	44.79	2.6	0.0	233.6	5000.0	-26.6
7318.00	V	350.00	3.23	43.67	9.1	0.0	433.4	5000.0	-21.2
8232.75	V	190.00	2.26	45.13	10.3	0.0	588.5	5000.0	-18.6
9147.50	V	270.00	2.78	45.11	12.0	0.0	713.7	5000.0	-16.9
Average									
2744.25	V	190.00	3.29	38.74	-1.7	-8.1	28.1	500.0	-25.0
3659.00	V	0.00	2.40	39.40	0.8	-8.1	40.1	500.0	-21.9
4573.75	V	220.00	2.43	32.77	2.6	-8.1	23.0	500.0	-26.7
7318.00	V	350.00	3.23	31.96	9.1	-8.1	44.3	500.0	-21.1
8232.75	V	190.00	2.26	31.42	10.3	-8.1	47.8	500.0	-20.4
9147.50	V	270.00	2.78	31.92	12.0	-8.1	61.5	500.0	-18.2
Non harmonics									
1196.37	V	180.00	2.30	33.80	-8.9	0.0	17.5	500.0	-29.1
1329.24	V	180.00	2.30	34.90	-8.7	0.0	20.5	500.0	-27.7

**Table 16: Radiated Emission Test Data >1GHz, Center Channel
(3dbi –Phantom Antenna)**

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Additional Duty Cycle Correction	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
Peak									
2744.25	H	180.00	2.49	50.43	-1.7	0.0	244.9	5000.0	-26.2
3659.00	H	170.00	2.82	48.46	0.8	0.0	288.9	5000.0	-24.8
4573.75	H	270.00	3.12	44.59	2.6	0.0	228.3	5000.0	-26.8
7318.00	H	270.00	3.31	46.91	9.1	0.0	629.3	5000.0	-18.0
8232.75	H	350.00	3.20	46.42	10.3	0.0	682.7	5000.0	-17.3
9147.50	H	170.00	3.05	44.00	12.0	0.0	628.1	5000.0	-18.0
Average									
2744.25	H	180.00	2.49	41.47	-1.7	-8.1	38.5	500.0	-22.3
3659.00	H	170.00	2.82	37.75	0.8	-8.1	33.1	500.0	-23.6
4573.75	H	270.00	3.12	32.20	2.6	-8.1	21.6	500.0	-27.3
7318.00	H	270.00	3.31	34.86	9.1	-8.1	61.9	500.0	-18.2
8232.75	H	350.00	3.20	32.53	10.3	-8.1	54.3	500.0	-19.3
9147.50	H	170.00	3.05	31.81	12.0	-8.1	60.7	500.0	-18.3
Non Harmonics									
1196.37	H	180.00	2.50	36.98	-8.9	0.0	25.3	500.0	-25.9
1329.24	H	10.00	2.28	34.50	-8.7		19.6	500.0	-28.1
Peak									
2744.25	V	190.00	3.20	49.66	-1.7	0.0	224.1	5000.0	-27.0
3659.00	V	0.00	2.18	49.15	0.8	0.0	312.8	5000.0	-24.1
4573.75	V	0.00	2.19	45.59	2.6	0.0	256.1	5000.0	-25.8
7318.00	V	10.00	2.09	44.76	9.1	0.0	491.3	5000.0	-20.2
8232.75	V	180.00	3.30	44.15	10.3	0.0	525.7	5000.0	-19.6
9147.50	V	180.00	2.84	44.19	12.0	0.0	642.0	5000.0	-17.8
Average									
2744.25	V	190.00	3.20	38.19	-1.7	-8.1	26.4	500.0	-25.5
3659.00	V	0.00	2.18	39.28	0.8	-8.1	39.5	500.0	-22.0
4573.75	V	0.00	2.19	32.51	2.6	-8.1	22.4	500.0	-27.0
7318.00	V	10.00	2.09	32.55	9.1	-8.1	47.4	500.0	-20.5
8232.75	V	180.00	3.30	31.89	10.3	-8.1	50.4	500.0	-19.9
9147.50	V	180.00	2.84	31.63	12.0	-8.1	59.5	500.0	-18.5
Non Harmonics									
1196.37	V	45.00	1.53	36.73	-8.9	0.0	24.6	500.0	-26.2
1329.24	V	170.00	1.60	35.23	-8.7	0.0	21.3	500.0	-27.4

**Table 17: Radiated Emission Test Data >1GHz, Center Channel
(2dbi –Co-Linear Antenna)**

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Aditonal Duty Cycle Correction	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
Peak									
2744.25	H	180.00	3.22	47.54	-1.7	0.0	175.6	5000.0	-29.1
3659.00	H	160.00	2.60	47.30	0.8	0.0	252.8	5000.0	-25.9
4573.75	H	280.00	3.17	42.99	2.6	0.0	189.9	5000.0	-28.4
7318.00	H	260.00	3.32	45.83	9.1	0.0	555.7	5000.0	-19.1
8232.75	H	180.00	3.08	42.84	10.3	0.0	452.1	5000.0	-20.9
9147.50	H	190.00	3.30	41.92	12.0	0.0	494.4	5000.0	-20.1
Average									
2744.25	H	180.00	3.22	37.75	-1.7	-8.1	25.1	500.0	-26.0
3659.00	H	160.00	2.60	37.15	0.8	-8.1	30.9	500.0	-24.2
4573.75	H	280.00	3.17	30.84	2.6	-8.1	18.4	500.0	-28.7
7318.00	H	260.00	3.32	32.34	9.1	-8.1	46.3	500.0	-20.7
8232.75	H	180.00	3.08	32.19	10.3	-8.1	52.2	500.0	-19.6
9147.50	H	190.00	3.30	31.11	12.0	-8.1	56.0	500.0	-19.0
Non Harmonics									
1196.37	H	200.00	2.40	35.80	-8.9	0.0	22.1	500.0	-27.1
1329.24	H	210.00	2.34	35.20	-8.7	0.0	21.2	500.0	-27.4
Peak									
2744.25	V	280.00	2.73	46.52	-1.7	0.0	156.1	5000.0	-30.1
3659.00	V	270.00	2.80	49.04	0.8	0.0	308.9	5000.0	-24.2
4573.75	V	0.00	2.88	43.34	2.6	0.0	197.7	5000.0	-28.1
7318.00	V	10.00	3.23	44.86	9.1	0.0	497.0	5000.0	-20.1
8232.75	V	180.00	1.98	43.97	10.3	0.0	514.9	5000.0	-19.7
9147.50	V	170.00	2.77	45.72	12.0	0.0	765.7	5000.0	-16.3
Average									
2744.25	V	280.00	2.73	36.15	-1.7	-8.1	20.9	500.0	-27.6
3659.00	V	270.00	2.80	39.35	0.8	-8.1	39.8	500.0	-22.0
4573.75	V	0.00	2.88	32.22	2.6	-8.1	21.6	500.0	-27.3
7318.00	V	10.00	3.23	33.57	9.1	-8.1	53.3	500.0	-19.4
8232.75	V	180.00	1.98	30.86	10.3	-8.1	44.8	500.0	-21.0
9147.50	V	170.00	2.77	32.57	12.0	-8.1	66.3	500.0	-17.5
Non Harmonics									
1196.37	V	180.00	2.50	36.90	-8.9	0.0	25.0	500.0	-26.0
1329.24	V	180.00	2.47	34.90	-8.7	0.0	20.5	500.0	-27.7

Table 18: Radiated Emission Test Data < 1GHz, High Channel
(Restricted bands-covers all 3 antenna configurations)

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)
73.91	V	180.00	1.00	16.30	10.6	22.2	100.0	-13.1
75.31	V	190.00	1.00	14.90	10.6	18.7	100.0	-14.5
112.66	V	10.00	1.21	13.80	15.3	28.4	150.0	-14.5
171.61	V	0.00	1.46	12.20	14.0	20.3	150.0	-17.4
171.83	V	270.00	1.56	15.40	13.9	29.3	150.0	-14.2
240.59	V	180.00	2.18	13.30	13.8	22.7	200.0	-18.9
246.47	V	180.00	2.37	9.70	14.1	15.4	200.0	-22.3
255.57	V	170.00	2.40	10.20	14.5	17.2	200.0	-21.3
266.98	V	180.00	1.74	10.00	15.9	19.8	200.0	-20.1
334.21	V	270.00	1.54	8.60	17.7	20.6	200.0	-19.7
356.08	V	270.00	1.38	9.00	18.1	22.6	200.0	-18.9
996.49	V	0.00	2.22	6.60	29.2	61.8	500.0	-18.2
960.00	V	170.00	1.46	14.20	28.3	133.2	500.0	-11.5
983.36	V	180.00	1.43	10.50	28.8	92.7	500.0	-14.6
996.49	V	0.00	2.22	6.90	29.2	63.9	500.0	-17.9
75.31	H	190.00	3.44	9.90	10.6	10.5	100.0	-19.5
112.66	H	190.00	2.92	10.70	15.3	19.9	150.0	-17.6
171.61	H	10.00	2.75	11.40	14.0	18.6	150.0	-18.2
171.83	H	10.00	2.75	10.70	13.9	17.1	150.0	-18.9
240.59	H	290.00	2.82	10.30	13.8	16.1	200.0	-21.9
246.47	H	270.00	2.70	9.70	14.1	15.4	200.0	-22.3
255.57	H	180.00	2.80	9.60	14.5	16.1	200.0	-21.9
334.21	H	180.00	2.70	6.10	17.7	15.5	200.0	-22.2
356.08	H	180.00	2.69	6.40	18.1	16.7	200.0	-21.5
996.49	H	190.00	1.80	9.10	29.2	82.4	500.0	-15.7

**Table 19: Radiated Emission Test Data >1GHz, High Channel
(8dbi –Omni directional Antenna)**

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Additional Duty Cycle Correction	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
Peak									
2781.75	H	170.00	2.15	46.60	-1.5	0.0	180.5	5000.0	-28.9
3709.00	H	270.00	2.20	48.18	0.8	0.0	282.7	5000.0	-25.0
4636.25	H	270.00	2.60	44.26	3.3	0.0	239.6	5000.0	-26.4
7418.00	H	90.00	2.74	45.85	9.6	0.0	595.1	5000.0	-18.5
8345.25	H	290.00	2.97	43.83	9.9	0.0	484.4	5000.0	-20.3
Average									
2781.75	H	170.00	2.15	34.80	-1.5	-8.1	18.3	500.0	-28.8
3709.00	H	270.00	2.20	36.21	0.8	-8.1	28.0	500.0	-25.0
4636.25	H	270.00	2.60	31.68	3.3	-8.1	22.2	500.0	-27.1
7418.00	H	90.00	2.74	33.83	9.6	-8.1	58.7	500.0	-18.6
8345.25	H	290.00	2.97	31.75	9.9	-8.1	47.5	500.0	-20.5
Non harmonics									
1195.58	H	0.00	1.88	36.35	-8.9	0.0	23.5	500.0	-26.6
Peak									
2781.75	V	10.00	2.67	47.37	-1.5	0.0	197.2	5000.0	-28.1
3709.00	V	10.00	2.65	49.04	0.8	0.0	312.1	5000.0	-24.1
4636.25	V	180.00	2.55	42.63	3.3	0.0	198.6	5000.0	-28.0
7418.00	V	290.00	2.28	45.27	9.6	0.0	556.7	5000.0	-19.1
8345.25	V	190.00	2.76	43.98	9.9	0.0	492.9	5000.0	-20.1
Average									
2781.75	V	10.00	2.67	37.01	-1.5	-8.1	23.5	500.0	-26.5
3709.00	V	10.00	2.65	38.31	0.8	-8.1	35.7	500.0	-22.9
4636.25	V	180.00	2.55	31.86	3.3	-8.1	22.6	500.0	-26.9
7418.00	V	290.00	2.28	33.44	9.6	-8.1	56.1	500.0	-19.0
8345.25	V	190.00	2.76	31.32	9.9	-8.1	45.2	500.0	-20.9
Non harmonics									
1195.58	V	45.00	1.89	35.70	-8.9	0.0	21.8	500.0	-27.2

**Table 20: Radiated Emission Test Data >1GHz, High Channel
(3dbi –Phantom Antenna)**

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Additional Duty Cycle Correction	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
Peak									
2781.75	H	180.00	2.65	49.38	-1.5	0.0	248.6	5000.0	-26.1
3709.00	H	190.00	3.25	47.40	0.8	0.0	258.4	5000.0	-25.7
4636.25	H	270.00	2.47	42.05	3.3	0.0	185.8	5000.0	-28.6
7418.00	H	90.00	2.65	44.64	9.6	0.0	517.7	5000.0	-19.7
8345.25	H	270.00	2.95	42.10	9.9	0.0	397.0	5000.0	-22.0
Average									
2781.75	H	180.00	2.65	42.92	-1.5	-8.1	46.5	500.0	-20.6
3709.00	H	190.00	3.25	37.06	0.8	-8.1	30.9	500.0	-24.2
4636.25	H	270.00	2.47	31.35	3.3	-8.1	21.3	500.0	-27.4
7418.00	H	90.00	2.65	32.68	9.6	-8.1	51.4	500.0	-19.8
8345.25	H	270.00	2.95	31.22	9.9	-8.1	44.6	500.0	-21.0
Non Harmonics									
1195.58	H	90.00	1.89	35.49	-8.9	0.0	21.3	500.0	-27.4
Peak									
2781.75	V	180.00	2.64	52.07	-1.5	0.0	338.8	5000.0	-23.4
3709.00	V	180.00	2.21	47.07	0.8	0.0	248.8	5000.0	-26.1
4636.25	V	190.00	3.17	42.93	3.3	0.0	205.6	5000.0	-27.7
7418.00	V	170.00	2.87	44.00	9.6	0.0	481.0	5000.0	-20.3
8345.25	V	190.00	2.75	43.11	9.9	0.0	445.9	5000.0	-21.0
Average									
2781.75	V	180.00	2.64	46.27	-1.5	-8.1	68.4	500.0	-17.3
3709.00	V	180.00	2.21	35.83	0.8	-8.1	26.8	500.0	-25.4
4636.25	V	190.00	3.17	31.53	3.3	-8.1	21.8	500.0	-27.2
7418.00	V	170.00	2.87	32.51	9.6	-8.1	50.4	500.0	-19.9
8345.25	V	190.00	2.75	31.36	9.9	-8.1	45.4	500.0	-20.8
Non Harmonics									
1195.58	V	120.00	1.90	36.20	-8.9	0.0	23.1	500.0	-26.7

**Table 21: Radiated Emission Test Data >1GHz, High Channel
(2dbi –Co-Linear Antenna)**

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Additional Duty Cycle Correction	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
Peak									
2744.25	H	180.00	3.22	47.54	-1.7	0.0	175.6	5000.0	-29.1
3659.00	H	160.00	2.60	47.30	0.8	0.0	252.8	5000.0	-25.9
4573.75	H	280.00	3.17	42.99	2.6	0.0	189.9	5000.0	-28.4
7318.00	H	260.00	3.32	45.83	9.1	0.0	555.7	5000.0	-19.1
8232.75	H	180.00	3.08	42.84	10.3	0.0	452.1	5000.0	-20.9
9147.50	H	190.00	3.30	41.92	12.0	0.0	494.4	5000.0	-20.1
Average									
2744.25	H	180.00	3.22	37.75	-1.7	-8.1	25.1	500.0	-26.0
3659.00	H	160.00	2.60	37.15	0.8	-8.1	30.9	500.0	-24.2
4573.75	H	280.00	3.17	30.84	2.6	-8.1	18.4	500.0	-28.7
7318.00	H	260.00	3.32	32.34	9.1	-8.1	46.3	500.0	-20.7
8232.75	H	180.00	3.08	32.19	10.3	-8.1	52.2	500.0	-19.6
9147.50	H	190.00	3.30	31.11	12.0	-8.1	56.0	500.0	-19.0
Non Harmonics									
1196.37	H	200.00	2.40	35.80	-8.9	0.0	22.1	500.0	-27.1
1329.24	H	210.00	2.34	35.20	-8.7	0.0	21.2	500.0	-27.4
Peak									
2744.25	V	280.00	2.73	46.52	-1.7	0.0	156.1	5000.0	-30.1
3659.00	V	270.00	2.80	49.04	0.8	0.0	308.9	5000.0	-24.2
4573.75	V	0.00	2.88	43.34	2.6	0.0	197.7	5000.0	-28.1
7318.00	V	10.00	3.23	44.86	9.1	0.0	497.0	5000.0	-20.1
8232.75	V	180.00	1.98	43.97	10.3	0.0	514.9	5000.0	-19.7
9147.50	V	170.00	2.77	45.72	12.0	0.0	765.7	5000.0	-16.3
Average									
2744.25	V	280.00	2.73	36.15	-1.7	-8.1	20.9	500.0	-27.6
3659.00	V	270.00	2.80	39.35	0.8	-8.1	39.8	500.0	-22.0
4573.75	V	0.00	2.88	32.22	2.6	-8.1	21.6	500.0	-27.3
7318.00	V	10.00	3.23	33.57	9.1	-8.1	53.3	500.0	-19.4
8232.75	V	180.00	1.98	30.86	10.3	-8.1	44.8	500.0	-21.0
9147.50	V	170.00	2.77	32.57	12.0	-8.1	66.3	500.0	-17.5
Non Harmonics									
1196.37	V	180.00	2.50	36.90	-8.9	0.0	25.0	500.0	-26.0
1329.24	V	180.00	2.47	34.90	-8.7	0.0	20.5	500.0	-27.7

5.7 Receiver Radiated Spurious Emissions: (FCC Part §15.209)

The EUT must comply with the requirements for radiated spurious emissions while in receiver mode to the 3rd of the highest tunable frequency or local oscillator. These emissions must meet the limits specified in §15.209 and RSS210 section 2.6.

Test Arrangement: Table Top

Compliance Limits for Receivers	
Frequency	Limits
30-88 MHz	100 μ V/m
88-216 MHz	150 μ V/m
216-960 MHz	200 μ V/m
>960MHz	500 μ V/m

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 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 units were scanned from 30-3000MHz.

The unit was pre-scanned in 3 orthogonal positions with full testing performed in the worst case position. The data was the same for all antenna types and was reported with the 8dBi antenna attached. No emissions were noted above those shown.

The emissions were measured using the following resolution bandwidths:

Table 22: Spectrum Analyzer Settings

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	10 Hz (Avg.)

Table 23: Receiver Radiated Emission Test Data

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)
35.90	V	90.00	1.00	6.70	16.0	13.6	100.0	-17.3
53.19	V	90.00	1.10	9.00	7.9	7.0	100.0	-23.1
62.18	V	270.00	1.00	10.30	10.3	10.7	100.0	-19.4
82.79	V	170.00	1.16	10.10	10.2	10.3	100.0	-19.7
114.39	V	180.00	1.21	8.70	15.4	16.1	150.0	-19.4
133.48	V	180.00	1.31	5.60	14.8	10.5	150.0	-23.1
171.25	V	90.00	1.40	7.50	14.0	11.9	150.0	-22.0
184.69	V	270.00	1.85	6.90	13.7	10.7	150.0	-23.0
208.60	V	290.00	2.40	9.40	13.3	13.6	150.0	-20.8
235.90	V	300.00	2.51	7.80	13.6	11.8	200.0	-24.6
255.56	V	270.00	2.73	12.90	14.5	23.5	200.0	-18.6
275.25	V	180.00	2.38	8.70	16.5	18.2	200.0	-20.8
53.19	H	0.00	3.84	6.30	7.9	5.1	100.0	-25.8
62.18	H	180.00	3.48	6.60	10.3	7.0	100.0	-23.1
85.82	H	10.00	3.53	5.80	10.0	6.2	100.0	-24.2
114.39	H	90.00	3.85	6.30	15.4	12.2	150.0	-21.8
171.25	H	180.00	3.27	11.50	14.0	18.8	150.0	-18.0
208.60	H	90.00	2.97	10.40	13.3	15.3	150.0	-19.8
235.90	H	190.00	1.59	9.80	13.6	14.9	200.0	-22.6
255.56	H	10.00	1.79	7.50	14.5	12.6	200.0	-24.0
275.25	H	0.00	1.31	6.50	16.5	14.2	200.0	-23.0

5.8 AC Conducted Emissions (FCC Part §15.207)

5.8.1 Requirements

Test Arrangement: Table Top

Compliance Standard: FCC Class B

FCC Compliance Limits		
Frequency	Quasi-peak	Average
0.15 - 0.5MHz	66 to 56dB μ V	56 to 46dB μ V
0.5 - 5MHz	56dB μ V	46dB μ V
5 - 30MHz	60dB μ V	50dB μ V

5.8.2 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 μ H 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.

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: VdB μ V

LISN Correction Factor: LISN dB

Cable Correction Factor: CF dB

Electric Field: EdB μ V = V dB μ V + LISN dB + CF dB

5.8.3 Test Data

The EUT complied with the Class B Conducted Emissions requirements. This system runs off of 120 or 230VAC. Table 7 provides the test results for phase and neutral line power line conducted emissions.

As this unit contains 2 radios, Zigbee 2400MHz Band and 902-928MHz band, emissions were tested with both radios transmitting as a worst case.

Table 24: Conducted Emissions Data 120VAC, Transmit On

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	45.6	17.8	10.4	0.5	56.5	28.7	66.0	56.0	-9.5	-27.3
0.180	42.1	25.4	10.4	0.5	53.0	36.3	64.5	54.5	-11.5	-18.2
0.454	40.5	30.9	10.3	0.4	51.2	41.6	56.8	46.8	-5.6	-5.2
0.942	34.8	22.5	10.5	0.4	45.6	33.3	56.0	46.0	-10.4	-12.7
1.457	33.7	20.7	10.7	0.4	44.7	31.7	56.0	46.0	-11.3	-14.3
28.634	27.9	15.6	12.3	3.0	43.2	30.9	60.0	50.0	-16.8	-19.1

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)
0.150	45.7	9.7	10.4	0.7	56.8	20.8	66.0	56.0	-9.2	-35.2
0.180	43.0	19.3	10.4	0.7	54.1	30.4	64.5	54.5	-10.4	-24.1
0.454	23.3	11.9	10.3	0.4	34.1	22.7	56.8	46.8	-22.8	-24.2
0.742	17.4	6.2	10.4	0.4	28.2	17.0	56.0	46.0	-27.8	-29.0
14.190	21.5	11.9	11.5	1.7	34.7	25.1	60.0	50.0	-25.3	-24.9
28.413	30.8	17.1	12.3	4.3	47.4	33.7	60.0	50.0	-12.6	-16.3

Table 25: Conducted Emissions Data 230VAC, Transmit On

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)
0.269	42.2	33.6	10.4	0.5	53.0	44.4	61.1	51.1	-8.1	-6.7
0.410	41.6	28.4	10.3	0.4	52.3	39.1	57.6	47.6	-5.4	-8.6
0.797	39.3	23.2	10.4	0.4	50.1	34.0	56.0	46.0	-5.9	-12.0
1.770	37.6	17.9	10.7	0.4	48.7	29.0	56.0	46.0	-7.3	-17.0
5.254	27.5	14.9	11.1	0.4	39.0	26.4	60.0	50.0	-21.0	-23.6
28.480	25.3	14.9	12.3	3.0	40.6	30.2	60.0	50.0	-19.4	-19.8

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)
0.170	38.0	17.2	10.4	0.7	49.1	28.3	65.0	55.0	-15.8	-26.6
0.266	33.0	18.0	10.4	0.6	43.9	28.9	61.2	51.2	-17.3	-22.3
0.464	24.7	11.9	10.3	0.4	35.4	22.6	56.6	46.6	-21.2	-24.0
0.799	20.9	5.4	10.4	0.4	31.7	16.2	56.0	46.0	-24.3	-29.8
13.970	19.5	10.8	11.5	1.7	32.7	24.0	60.0	50.0	-27.3	-26.0
28.665	27.4	15.5	12.3	4.3	44.0	32.1	60.0	50.0	-16.0	-17.9