



**FCC & Industry Canada Certification
Test Report**

for

**Symbol Technologies Inc.
MR100 Modular Transceiver
FCC ID: HP9MR100A
IC ID: 1549D-MR100A**

February 14, 2004

Prepared for:

**Symbol Technologies Inc.
One Symbol Plaza
Holtsville, NY 11742**

Prepared By:

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



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February 14, 2004

WLL JOB# 8355/6

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Documentation Specialist

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Chief EMC Engineer

Abstract

This report has been prepared on behalf of Symbol Technologies Inc. to support the attached Application for Equipment Authorization. Symbol Technologies request modular approval of the MR100. The test report and application are submitted for a modular Frequency Hopping Spread Spectrum Transmitter under Part 15.247 of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy RSS-210 of Industry Canada. This Certification Test Report documents the test configuration and test results for a Symbol Technologies Inc. MR100 RFID Transceiver.

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 Symbol Technologies Inc. MR100 RFID Transceiver module complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under FCC Part 15.247 and Industry Canada RSS-210.

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1 Introduction

1.1 Compliance Statement

The Symbol Technologies Inc. MR100 RFID Transceiver module complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under FCC Part 15.247 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 with FCC Public Notice DA 00-705 and the 2001 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer: Symbol Technologies Inc.
One Symbol Plaza
Holtsville, NY 11742

Quotation Number: 61906

1.4 Test Dates

Testing was performed from September 22, 2004 to November 17, 2004.

1.5 Test and Support Personnel

Washington Laboratories, LTD

Greg Snyder, James Ritter

Client Representative

Albert Owens

1.6 Abbreviations

A	Ampere
Ac	alternating current
AM	Amplitude Modulation
Amps	Amperes
b/s	bits per second
BW	Bandwidth
CE	Conducted Emission
Cm	Centimeter
CW	Continuous Wave
dB	Decibel
Dc	direct current
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FM	Frequency Modulation
G	giga - prefix for 10^9 multiplier
Hz	Hertz
IF	Intermediate Frequency
K	kilo - prefix for 10^3 multiplier
M	Mega - prefix for 10^6 multiplier
M	Meter
μ	micro - prefix for 10^{-6} multiplier
NB	Narrowband
LISN	Line Impedance Stabilization Network
RE	Radiated Emissions
RF	Radio Frequency
Rms	root-mean-square
SN	Serial Number
S/A	Spectrum Analyzer
V	Volt

2 Equipment Under Test

2.1 EUT Identification & Description

The Symbol Technologies Inc. MR100 RFID Transceiver module is a single port Reader designed for embedded applications, such as RFID printers, handhelds and applicators. The unit has adjustable output power from 15dBm to 30dBm.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Symbol Technologies Inc.
FCC ID:	HP9MR100A
IC:	1549D-MR100A
EUT Name:	RFID Transceiver
Model:	MR100
FCC Rule Parts:	§15.247
Industry Canada:	RSS210
Frequency Range:	902.75 – 927.25 MHz
Maximum Output Power:	Adjustable 15dBm to 30dBm (0.032 Watt to 1 Watt)
Modulation:	FSK
Occupied Bandwidth:	177.25kHz
Keying:	Automatic
Type of Information:	Data
Number of Channels:	50
Power Output Level	Adjustable
Antenna Connector	U.FL
Antenna Type	MAXRAD 5.25dBi Patch Antenna
Interface Cables:	None (A com port is available for programming the unit)
Power Source & Voltage:	6Vdc provided from a 120Vac adapter

2.2 Test Configuration

The MR100 module was configured with an AC/DC adapter, a support laptop, and an antenna. The antenna was placed on a plastic container raised approximately 5” above the turntable.

2.3 Testing Algorithm

The MR100 was programmed for FHSS operation via the support laptop. The computer was used to select the output power, control the frequency hopping or select continuous transmit on a selected channel. The unit was set for maximum data rate.

The antenna was positioned in three orthogonal planes during emissions testing. Worst case emission levels are provided in the test results data.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by 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

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

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

Equipment	WLL Asset #	Calibration Due
Hewlett-Packard 8568B Spectrum Analyzer	0073	7/08/05
Hewlett-Packard 85650A Quasi-Peak Adapter	0069	7/08/05
Hewlett-Packard 8593A Spectrum Analyzer	0074	8/17/05
Hewlett-Packard 8449B Microwave Preamp	0312	9/29/05
Solar Electronics 8012-50-R-24BNC LISN	0124	12/24/04
ARA LPB-2520 BiconiLog Antenna	0007	9/14/05
ARA DRG118/A Microwave Horn Antenna	0425	4/17/05
Hewlett-Packard 85685A RF Preselector	0071	7/08/05
EMCO 3110B Biconical Antenna	0026	6/22/05
EMCO 3146A Log Periodic Antenna	0029	6/24/05

4 Test Results

4.1 Occupied Bandwidth: (FCC Part §2.1049)

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

For Frequency Hopping Spread Spectrum Systems operating in the 902M – 928MHz band the maximum 20 dB channel bandwidth shall not exceed 500kHz.

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

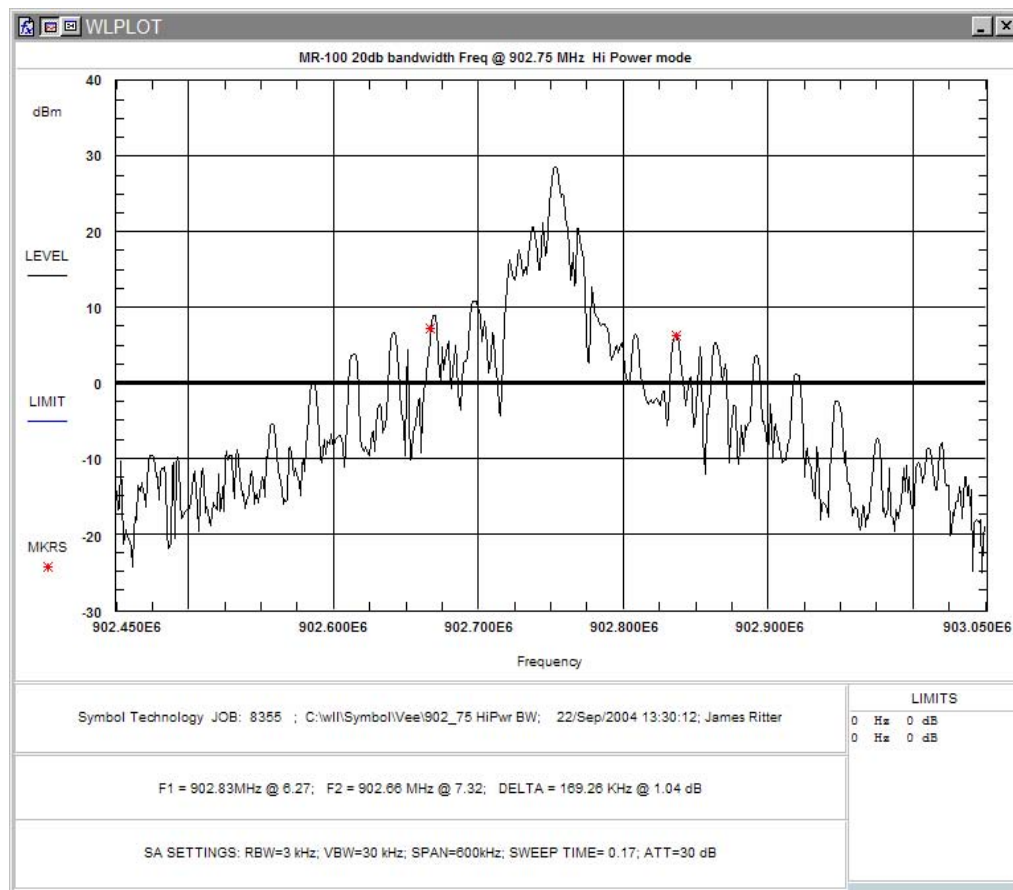


Figure 4-1. Occupied Bandwidth, Low Channel

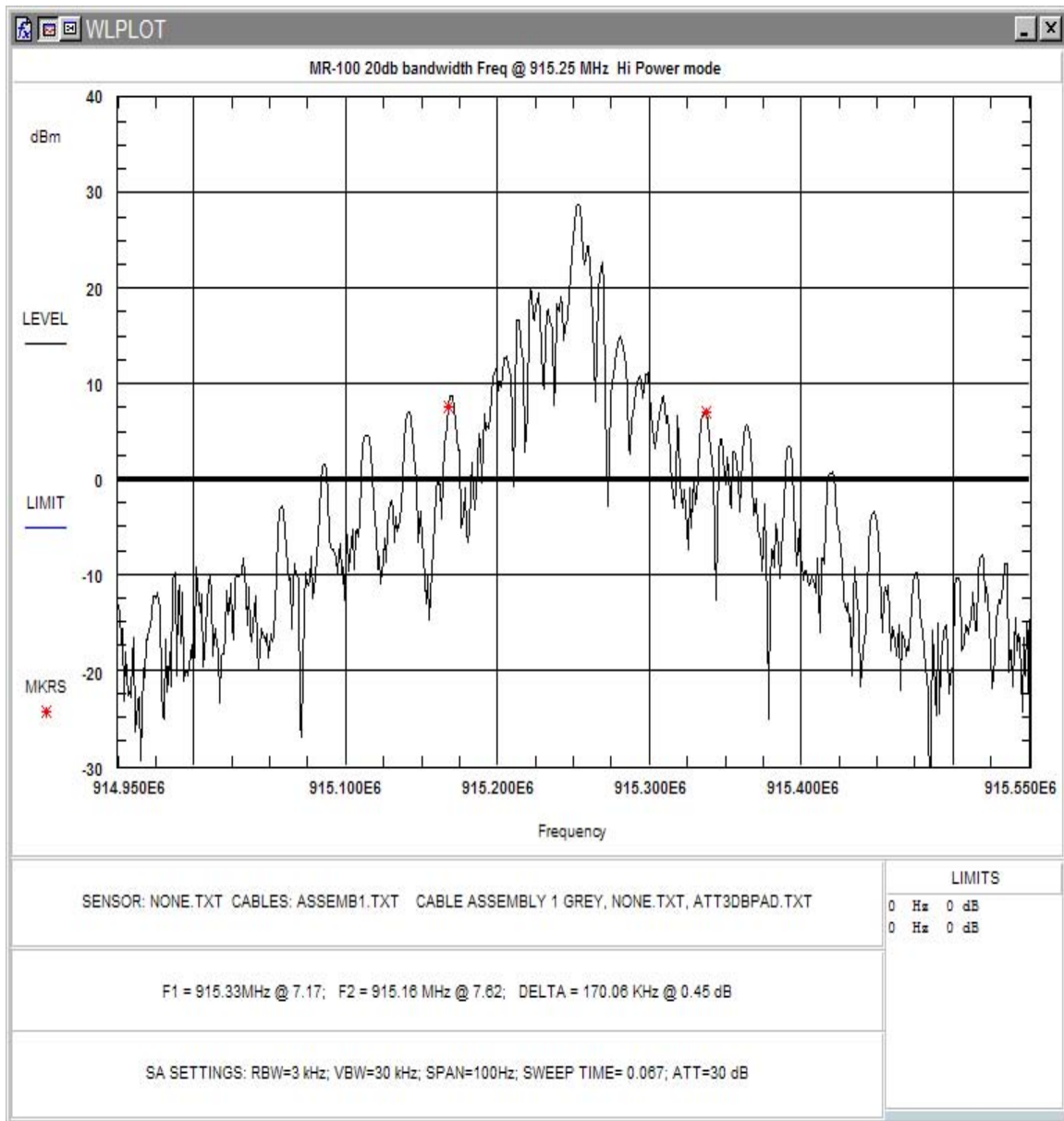


Figure 4-2. Occupied Bandwidth, Mid Channel

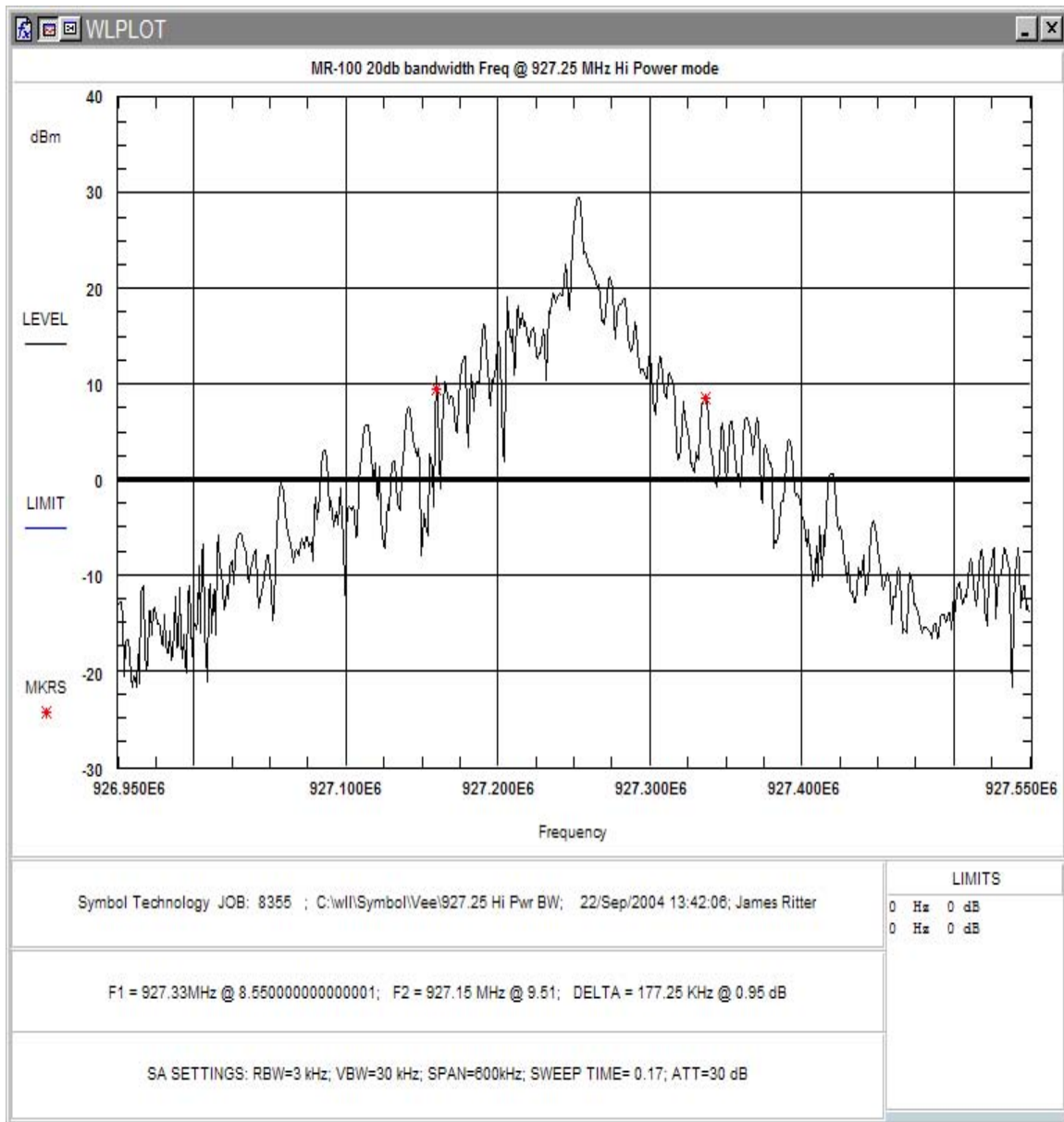


Figure 4-3. Occupied Bandwidth, High Channel

Table 3 provides a summary of the Occupied Bandwidth Results.

Table 3. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Low Channel 902.75MHz	169.26kHz	500kHz	Pass
Mid Channel 915.25MHz	170.02kHz	500kHz	Pass
High Channel 927.25MHz	177.25kHz	500kHz	Pass

4.2 Number of Hopping Frequencies: (FCC Part §15.247(a)(1)(i))

In accordance with §15.247(a)(1)(i) a frequency hopping system in the 902M – 928MHz band with a 20dB bandwidth less than 250kHz shall use at least 50 hopping frequencies.

With the unit set to the hopping mode, the number of hopping frequencies were measured. As shown in Figure 4-4 the unit uses 50 channels.

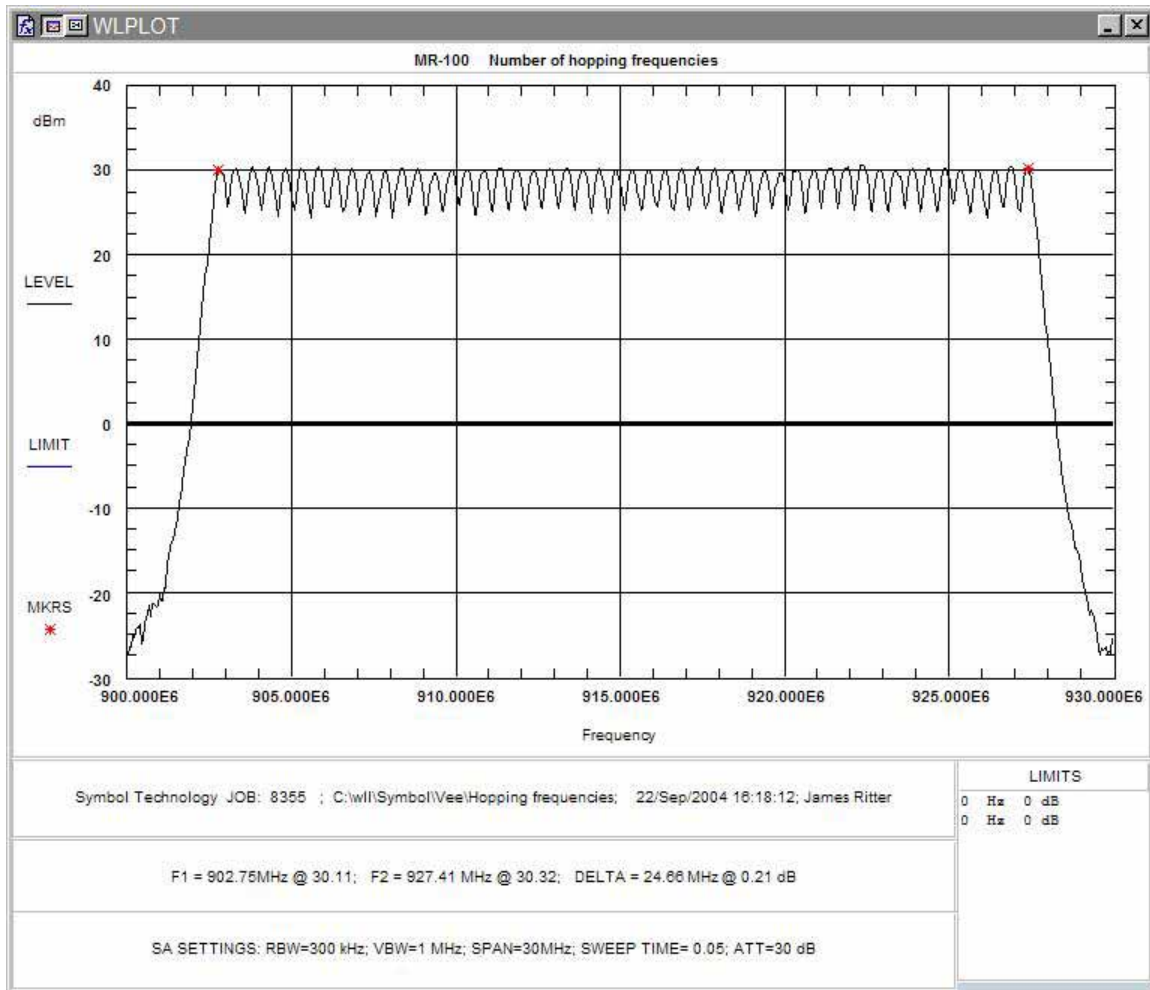


Figure 4-4. Number of Hopping Channels

4.3 Carrier Frequency Separation: (FCC Part §15.247(a)(1))

In accordance with the FCC Rules a frequency hopping system shall have hopping channel carriers frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

As the maximum 20dB channel bandwidth of the EUT was measured at 177.25kHz the channel spacing must also be greater than 177.25kHz.

Figure 4-5 is a plot of the EUT in the hopping mode which shows the spacing between adjacent channels. The carrier frequency separation was measured at 501.66kHz and therefore is compliant with the requirements.

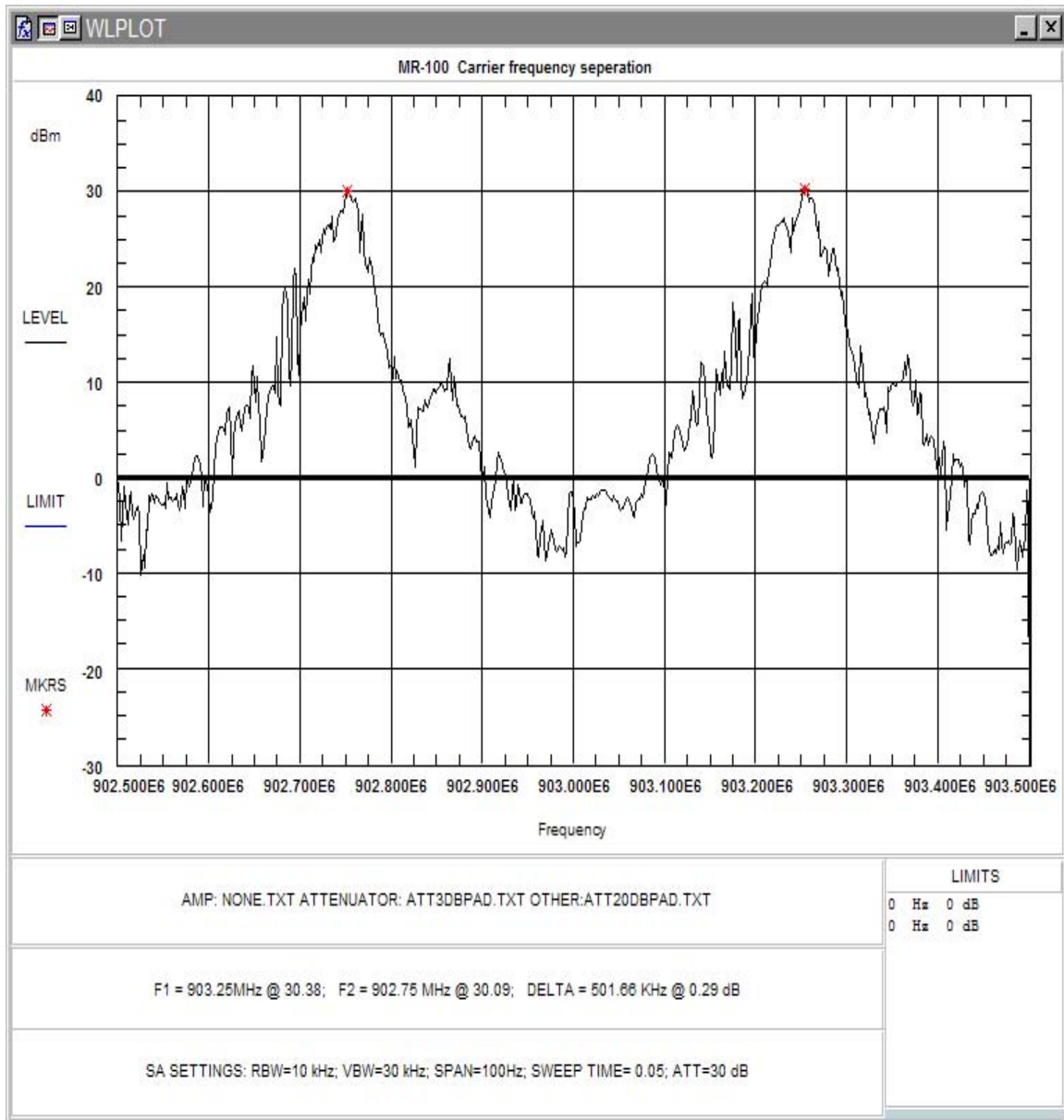


Figure 4-5. Carrier Frequency Separation

4.4 Time of Occupancy and Duty Cycle Correction: (FCC Part §15.247(a)(1)(i))

Per FCC Part 15.247(a)(1)(i), the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

Additionally, 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:

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

The dwell time of the transmitter was measured and is shown in **Error! Reference source not found..** Based on this plot the dwell time per hop is 19.15ms. The signal was then observed for a period of 20 seconds to determine the total channel occupancy time. With all channels being used equally Figure 4-7 shows that the channel will be used every 1.5 seconds (14 times/20seconds) for a total occupancy time of 257.6ms. Since only one pulse will appear on the channel in any 100ms period, the duty cycle is calculated as:

$$20 \times \text{LOG}(19.15\text{ms}/100\text{ms}) = -14.4\text{dB}$$

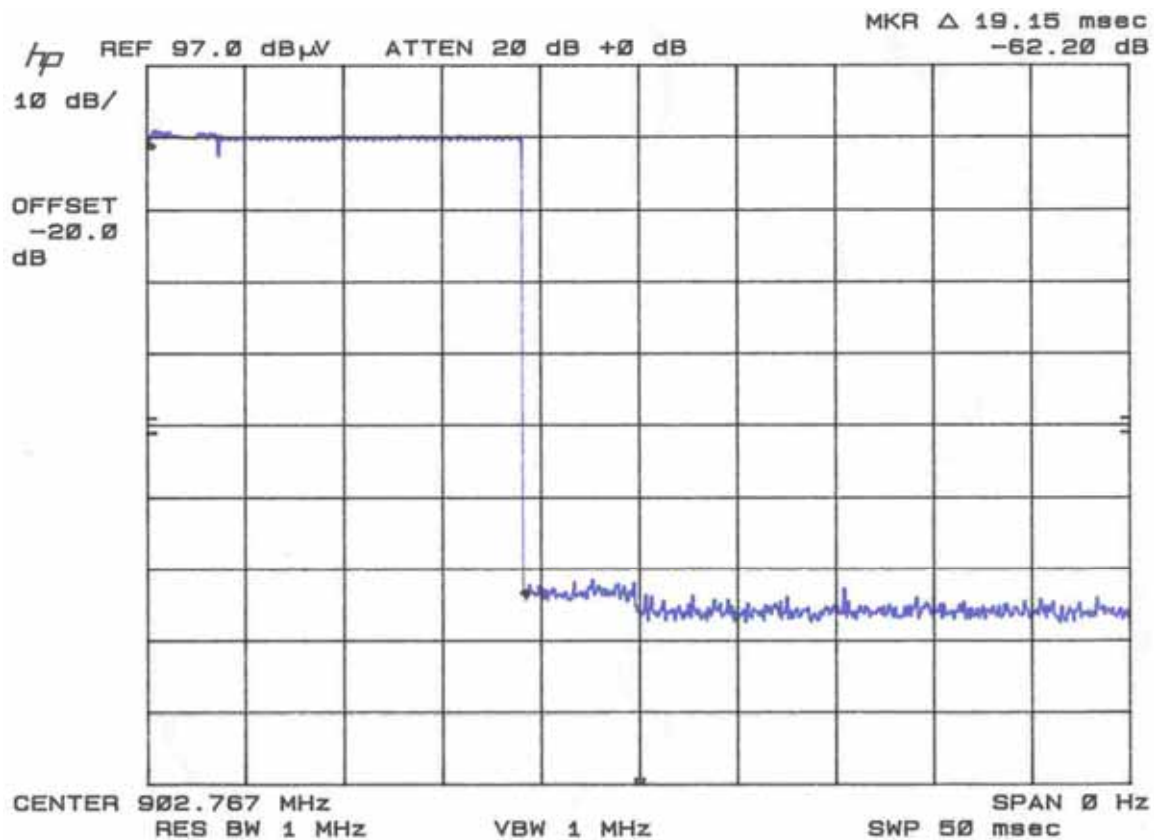


Figure 4-6. Dwell Time Plot

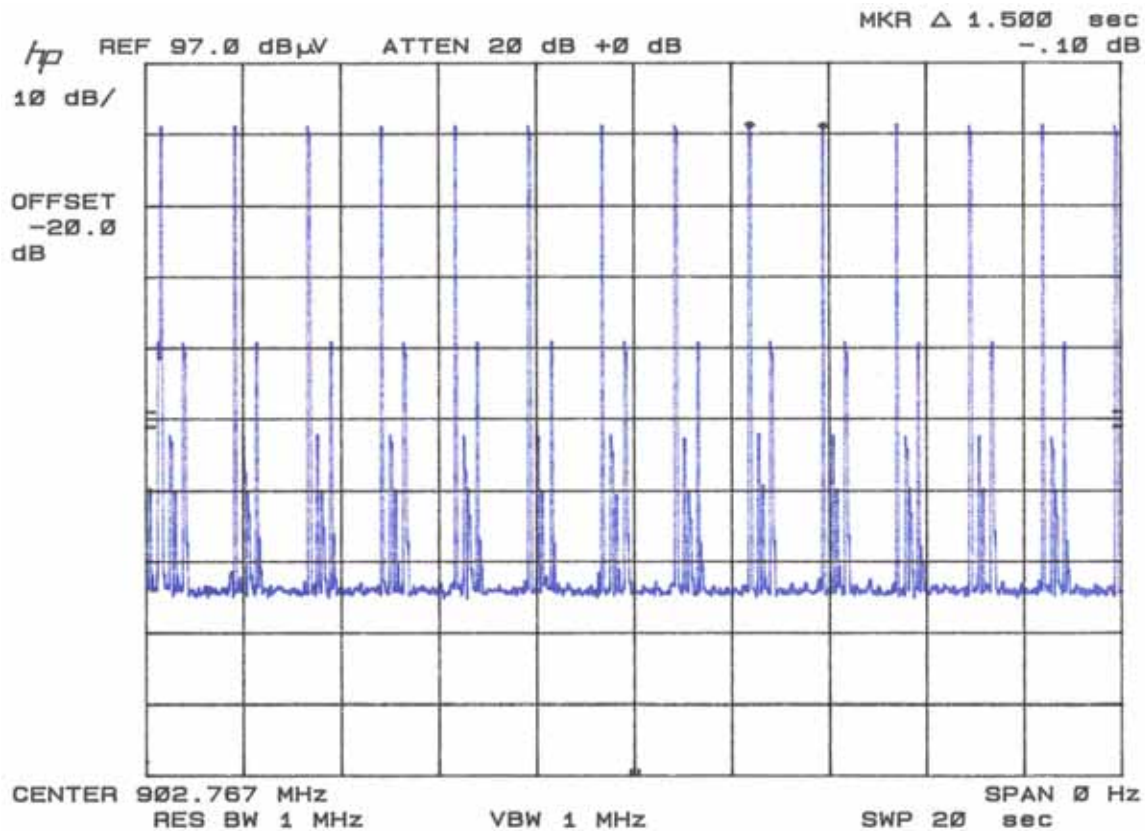


Figure 4-7. Occupancy per 20 Second Period

4.5 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 was set to the center frequency of the selected channel with a span greater than 5 times the 20dB bandwidth. The RBW was set to a value greater than the 20dB bandwidth while the VBW was set much higher than the RBW. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system. Both the Low Power (15dBm) and High Power (30dBm) settings were tested.

The limit for systems operating in the 902M – 928MHz band with at least 50 hopping channels is 1 watt.

Table 4. RF Power Output, Low Power

Frequency	Level	Limit	Pass/Fail
Low Channel 902.75MHz	14.68 dBm	30 dBm	Pass
Mid Channel 914.75MHz	15.02 dBm	30 dBm	Pass
High Channel 927.25MHz	14.68 dBm	30 dBm	Pass

Table 5. RF Power Output, High Power

Frequency	Level	Limit	Pass/Fail
Low Channel 902.75MHz	29.86 dBm	30 dBm	Pass
Mid Channel 914.75MHz	29.77 dBm	30 dBm	Pass
High Channel 927.25MHz	29.35 dBm	30 dBm	Pass

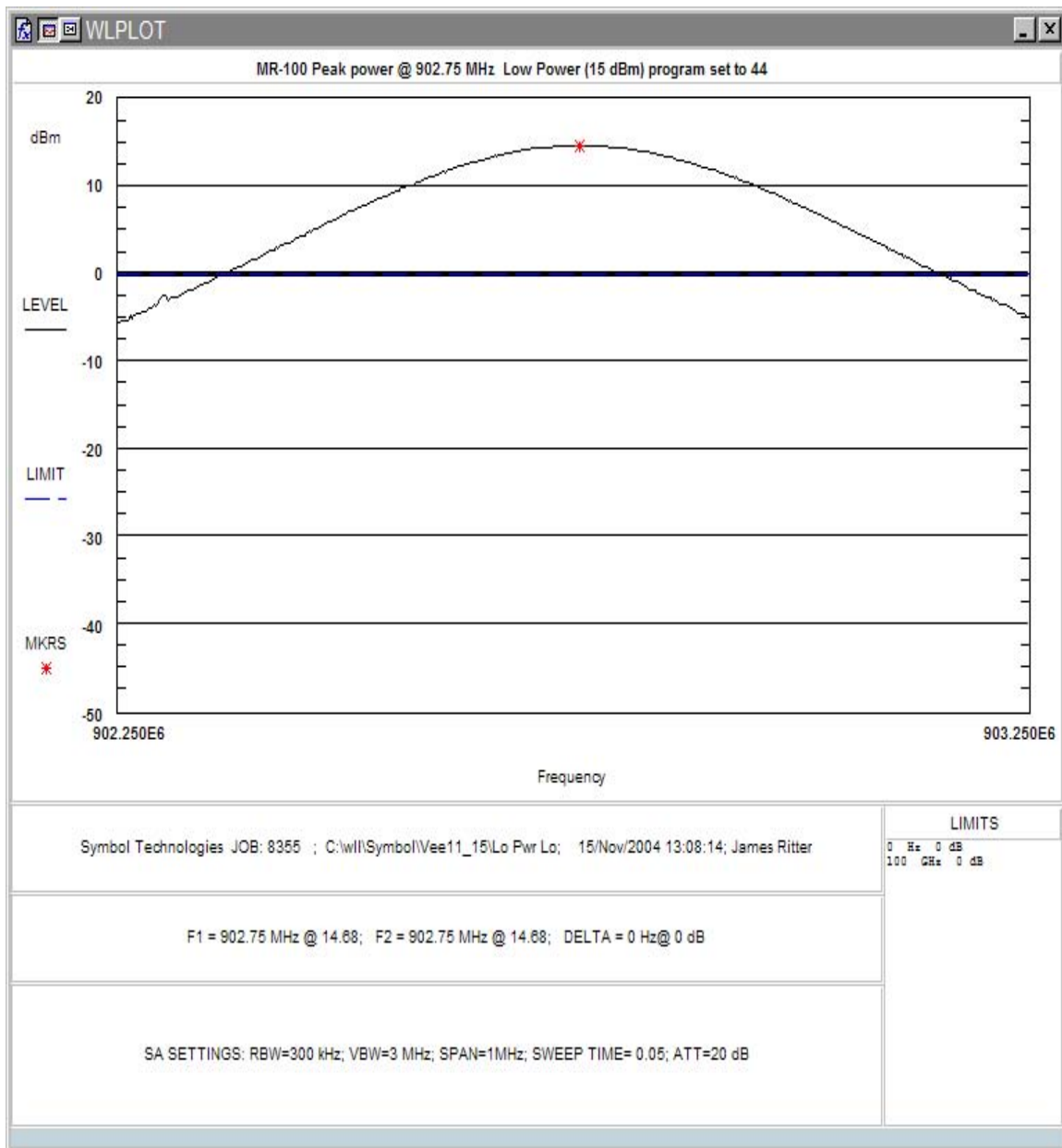


Figure 4-8. Low Power RF Peak Power, Low Channel

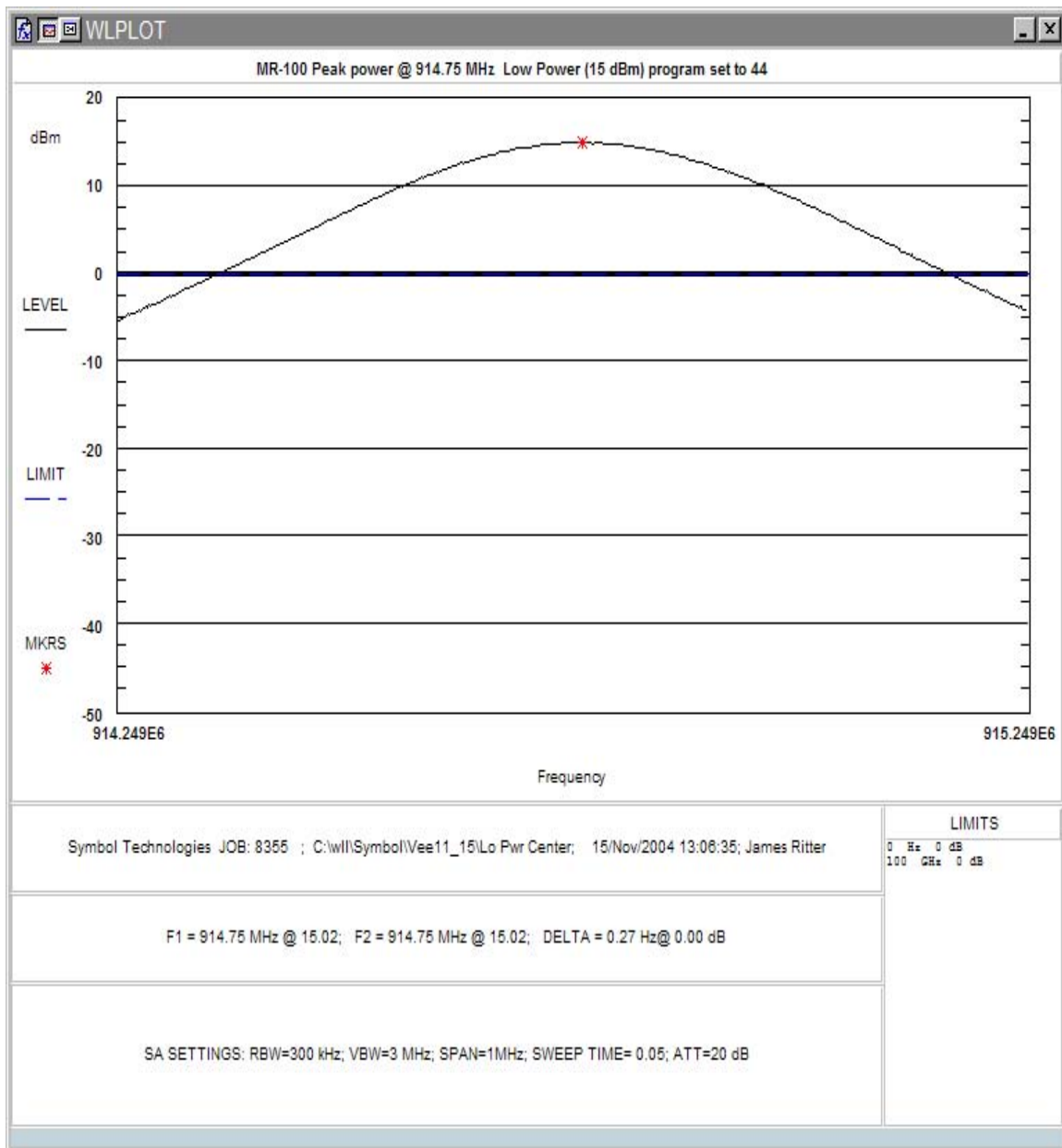


Figure 4-9. Low Power RF Peak Power, Mid Channel

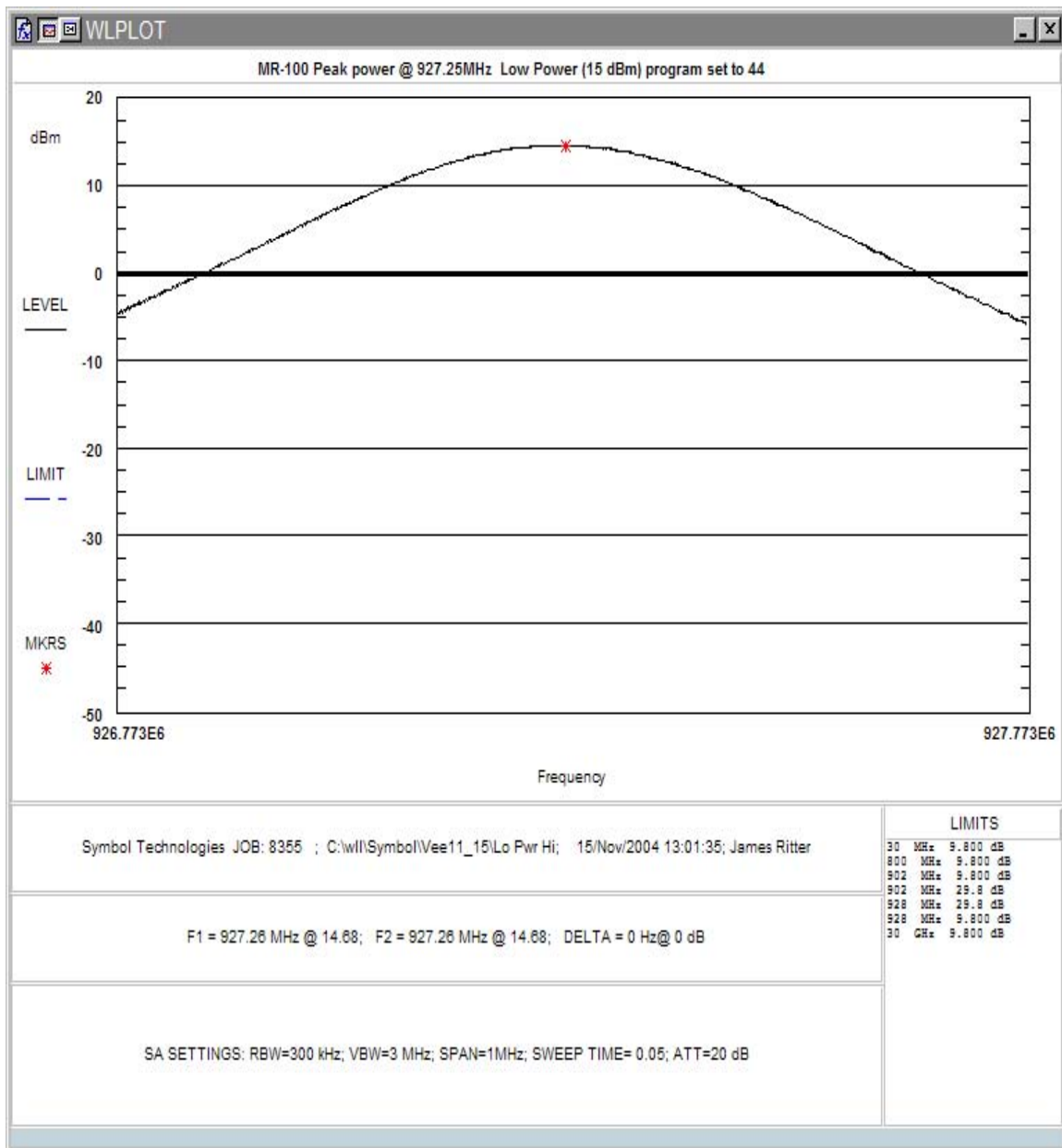


Figure 4-10. Low Power RF Peak Power, High Channel

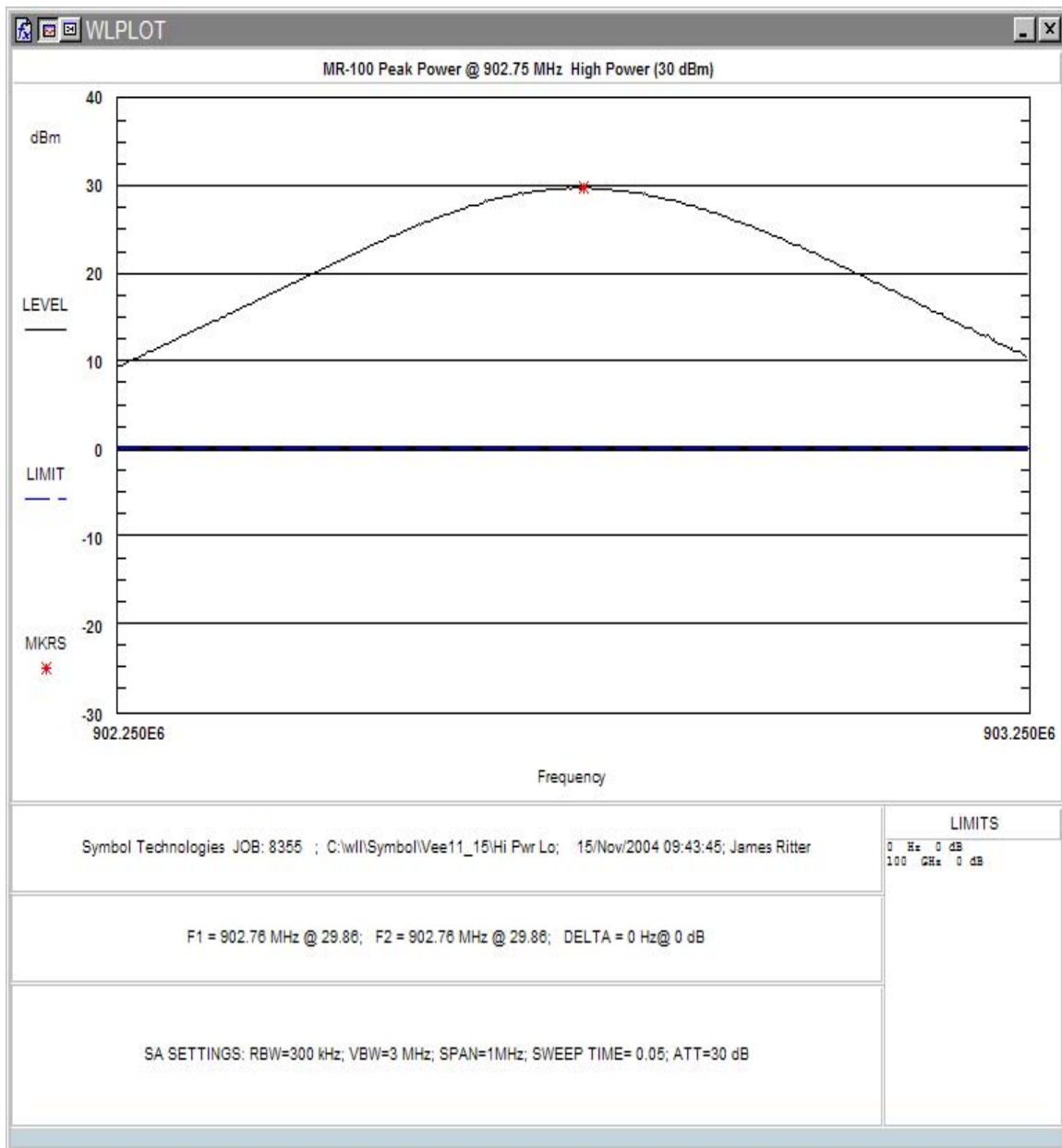


Figure 4-11. High Power RF Peak Power, Low Channel

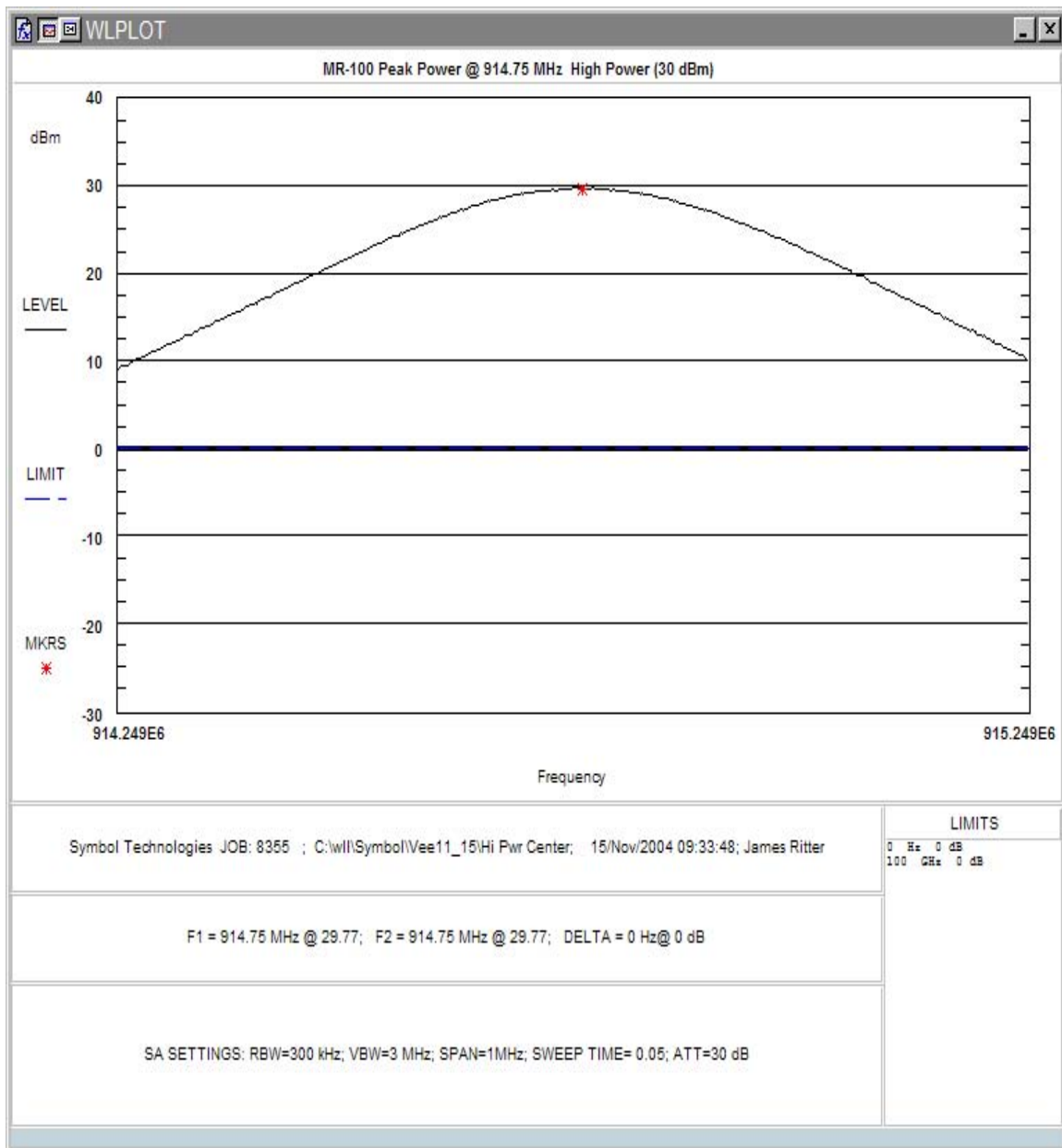


Figure 4-12. High Power RF Peak Power, Mid Channel

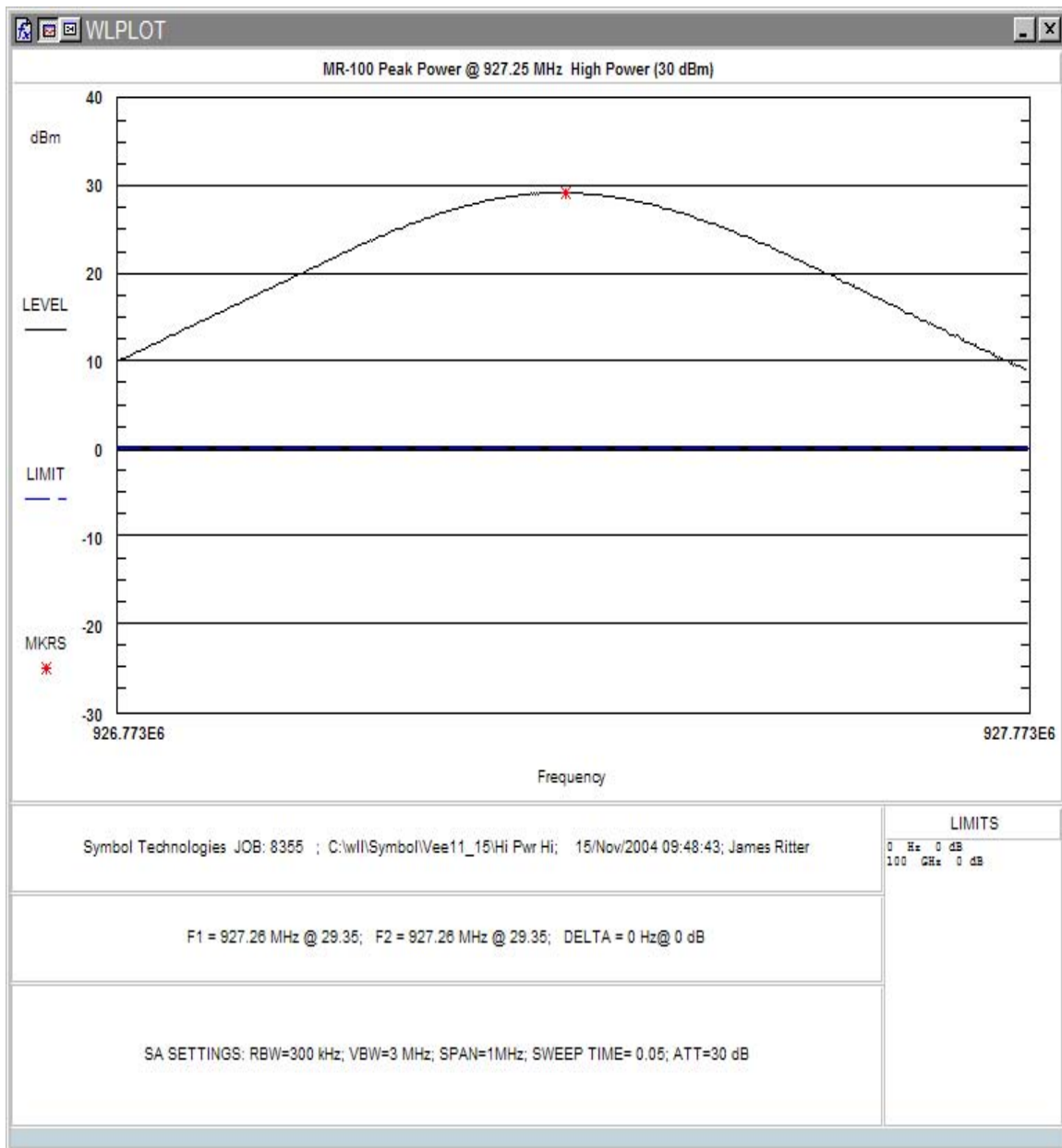


Figure 4-13. High Power RF Peak Power, High Channel

4.6 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(d) 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.

To perform the conducted spurious emissions testing, the EUT antenna was removed and the cable was connected directly into a spectrum analyzer through an attenuator. The correction for the external attenuator and test cable(s) are corrected in the data collection software. The spectrum analyzer resolution bandwidth was set to 100 kHz and the video bandwidth was set to 1 MHz. To determine the limit, the amplitude of the EUT carrier frequency was measured using the same settings. The limit was then set to 20 dB below the carrier frequency amplitude. The emissions outside of the allocated frequency band of 902M – 928MHz were then scanned from 30 MHz up to the tenth harmonic of the carrier. Both the Low Power and High Power settings were tested.

The following are plots of the conducted spurious emissions data.

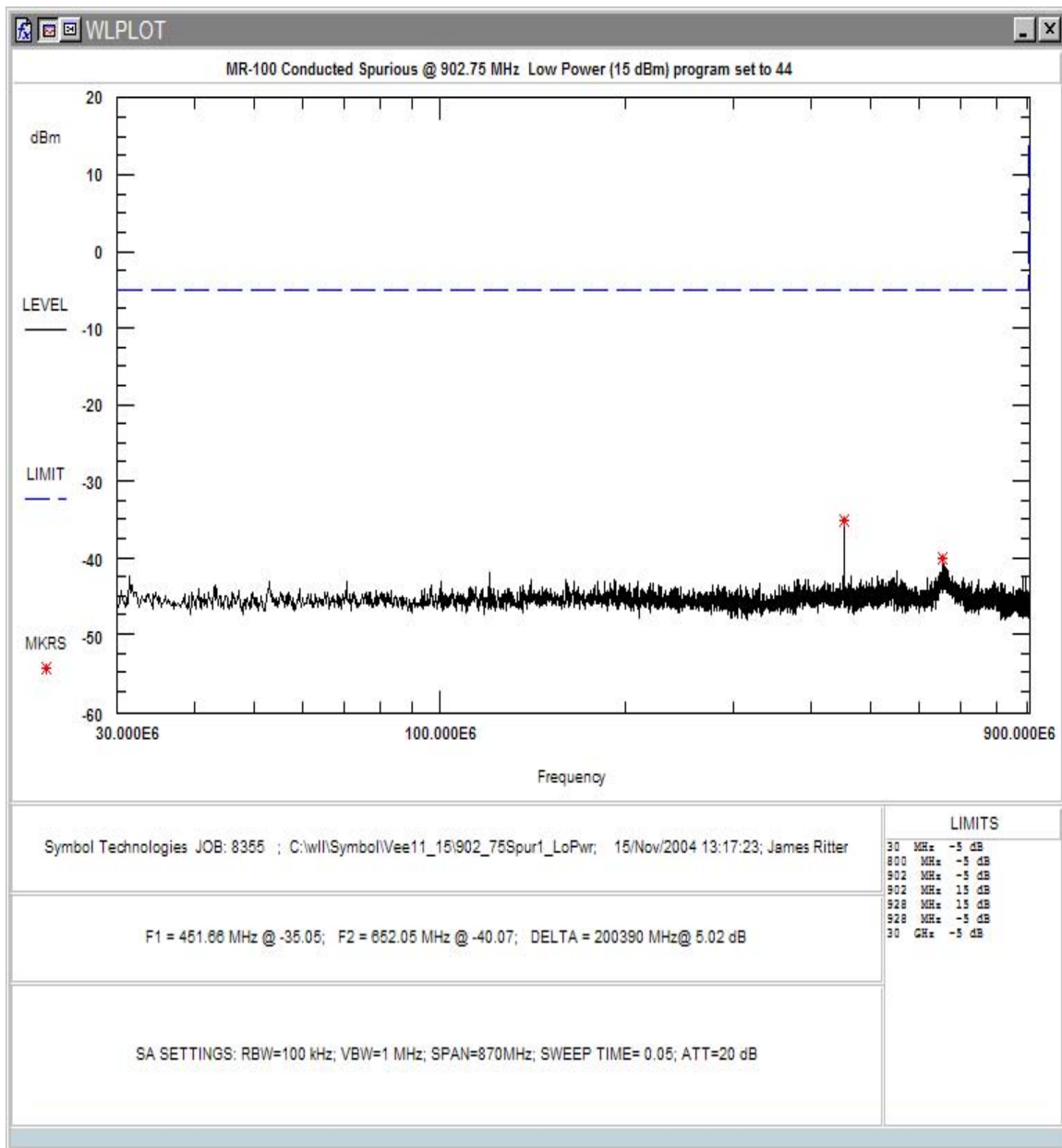


Figure 4-14. Low Power Conducted Spurious Emissions, Low Channel 30 - 900MHz

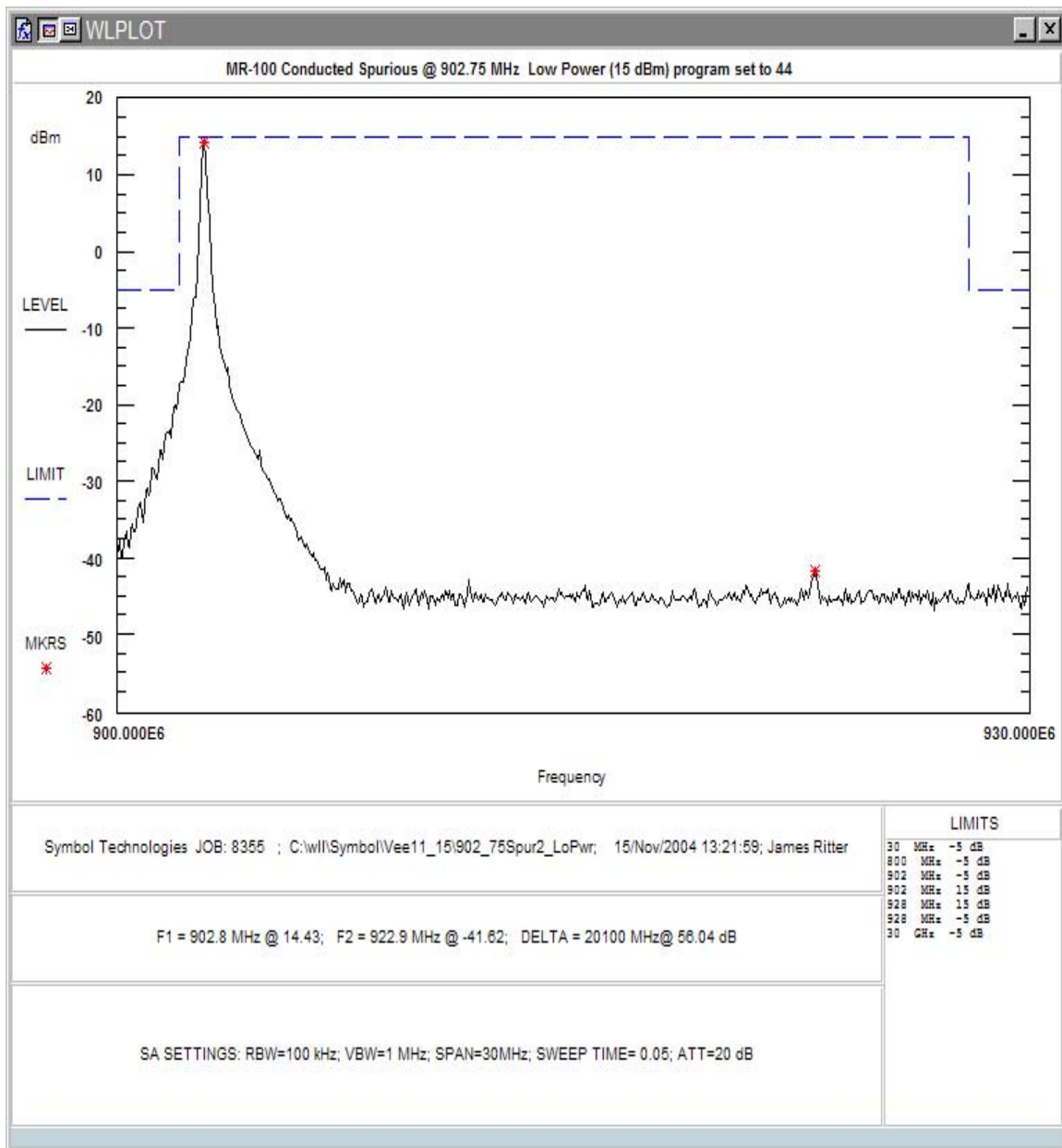


Figure 4-15. Low Power Conducted Spurious Emissions, Low Channel 900 – 930MHz

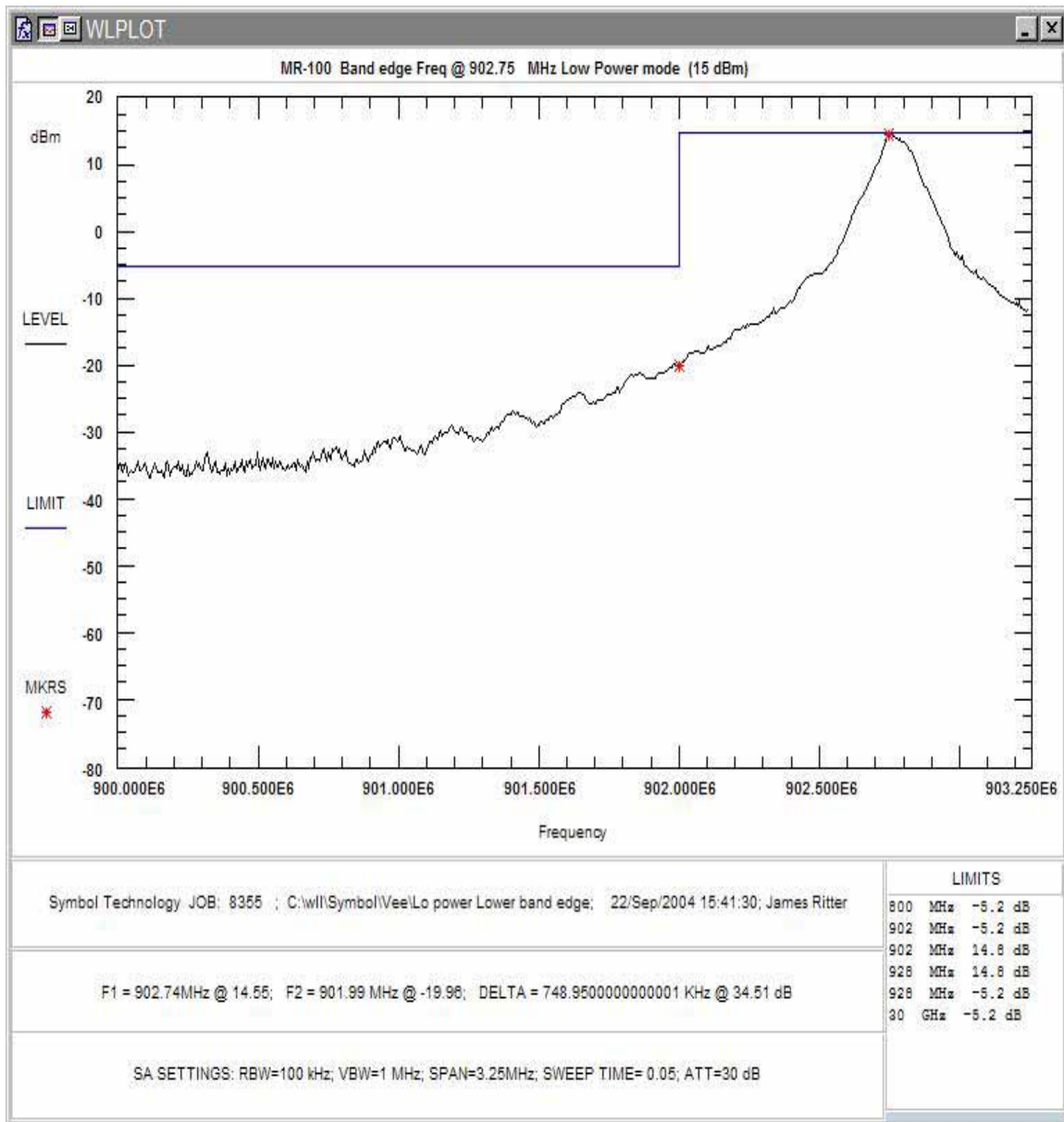


Figure 4-16. Low Power Conducted Spurious Emissions, Low Channel, Bandedge

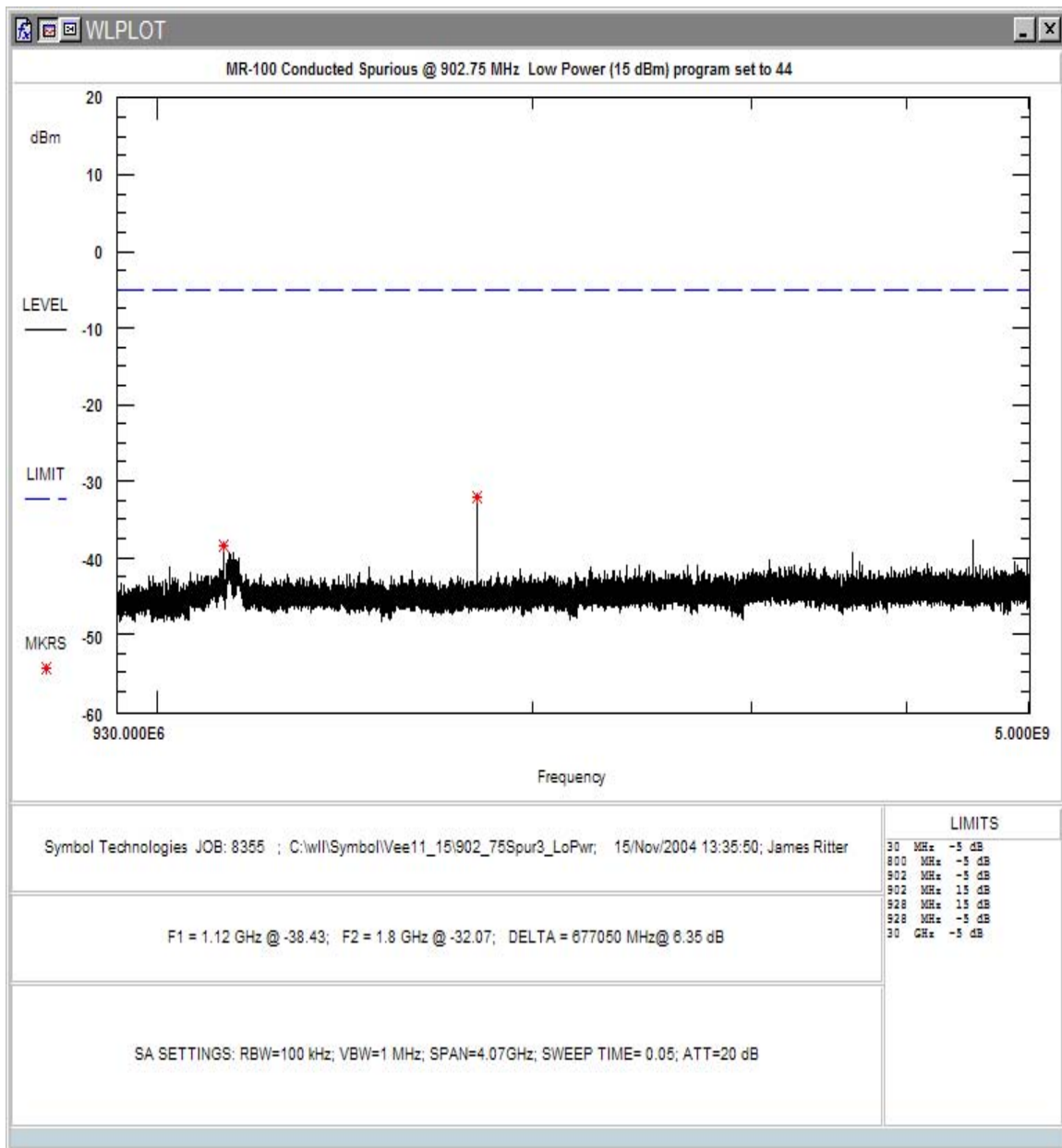


Figure 4-17. Low Power Conducted Spurious Emissions, Low Channel 930MHz – 5GHz

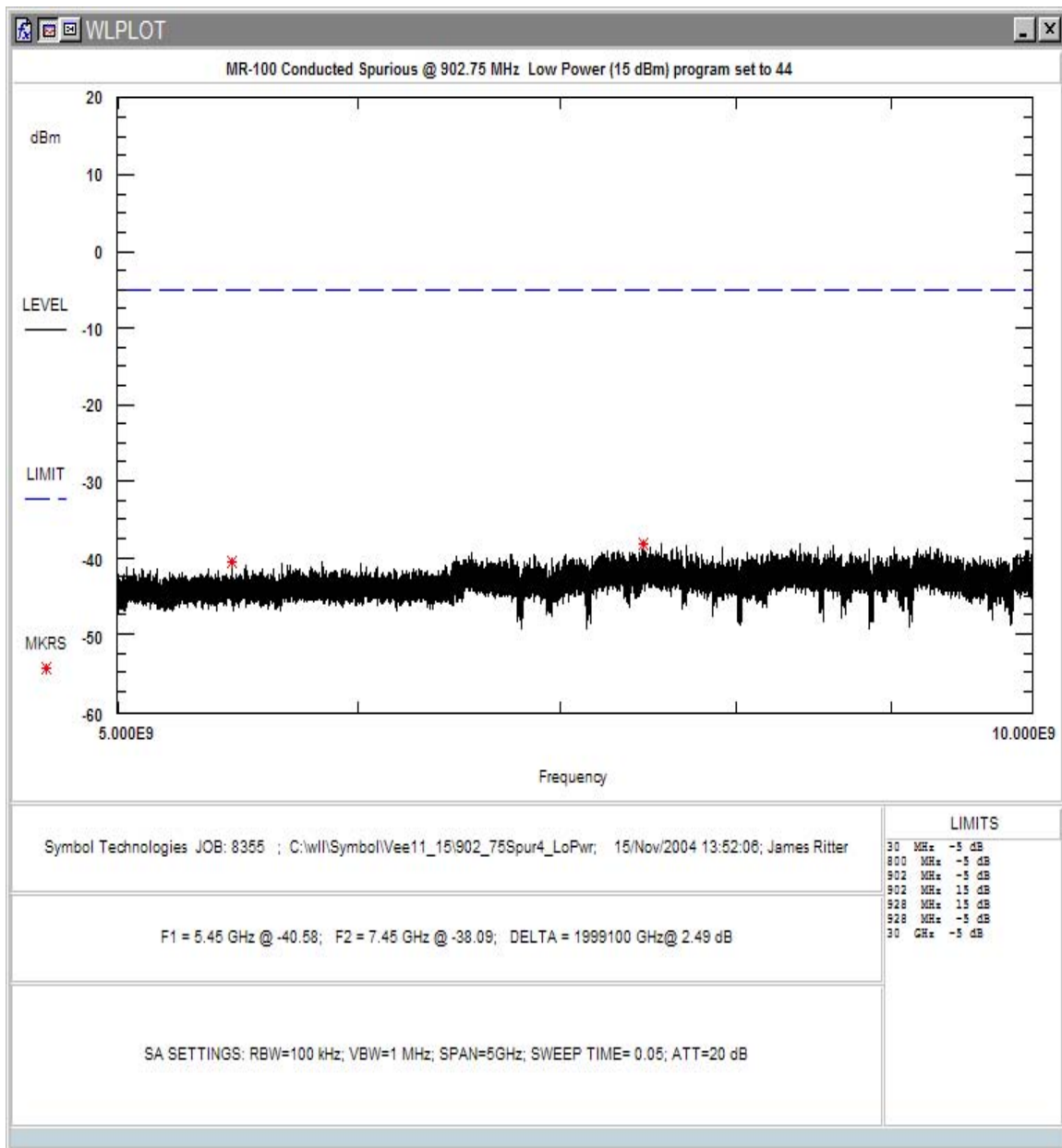


Figure 4-18. Low Power Conducted Spurious Emissions, Low Channel 5 - 10GHz

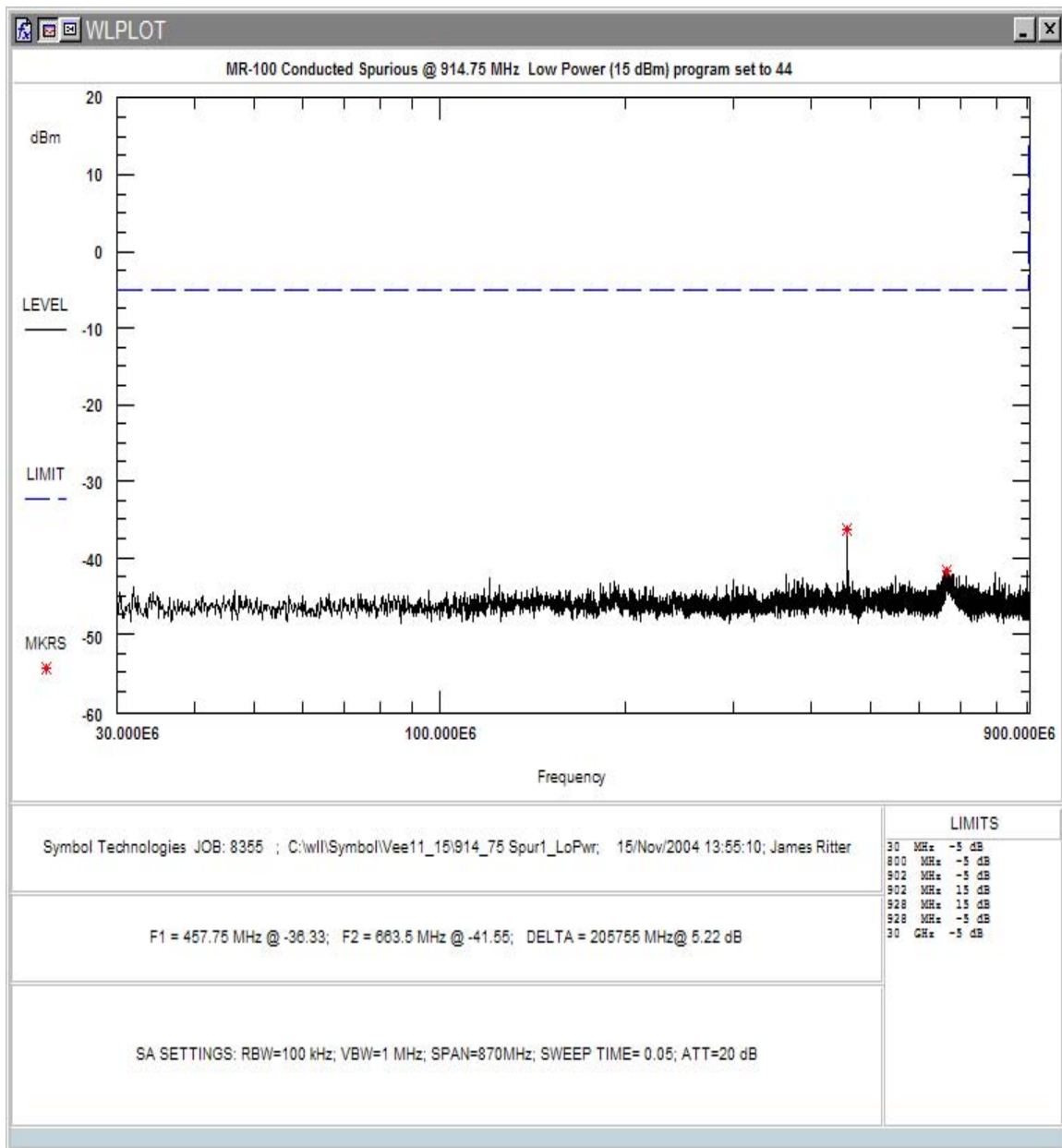


Figure 4-19. Low Power Conducted Spurious Emissions, Mid Channel 30 - 900MHz

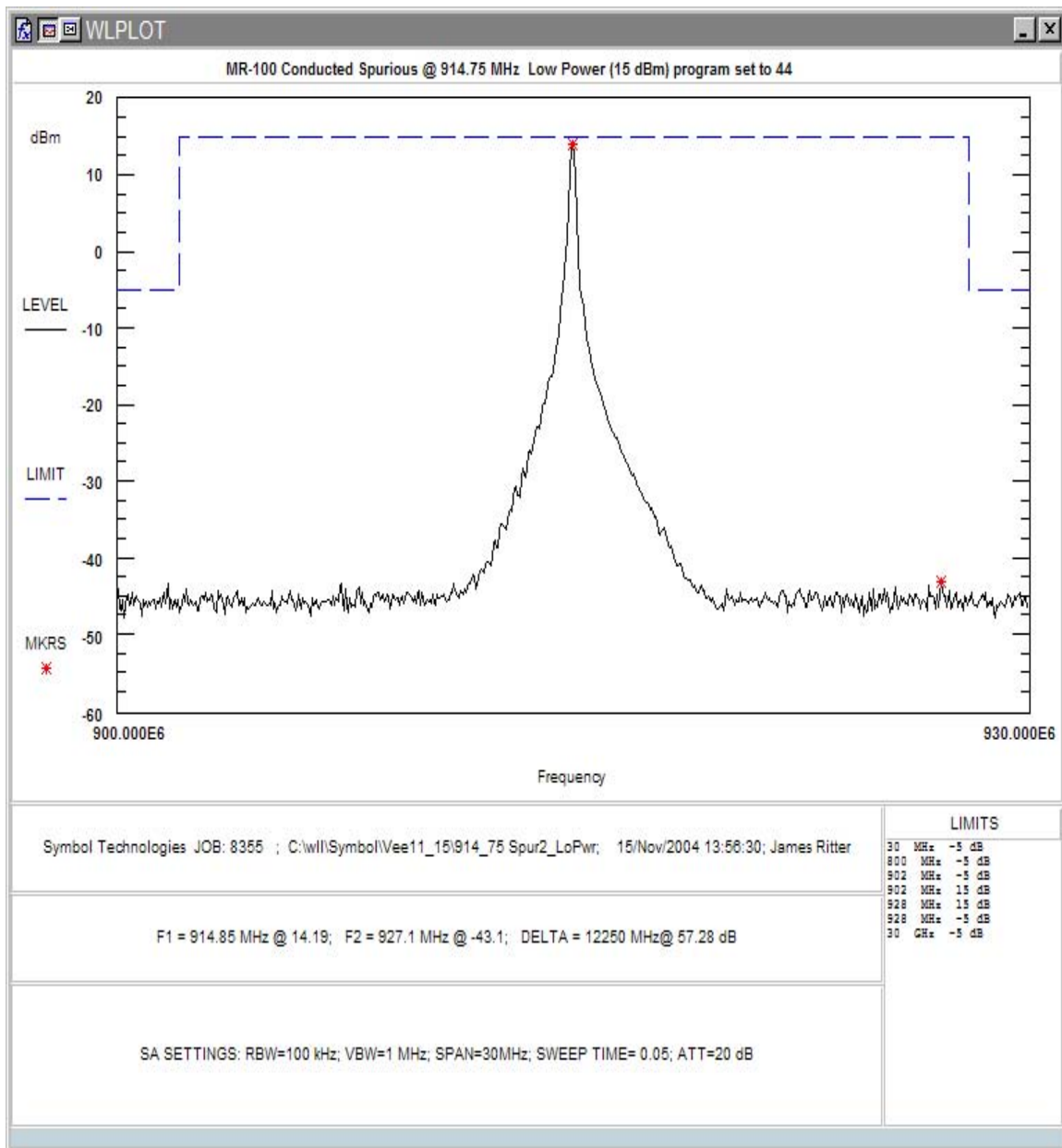


Figure 4-20. Low Power Conducted Spurious Emissions, Mid Channel 900 – 930MHz

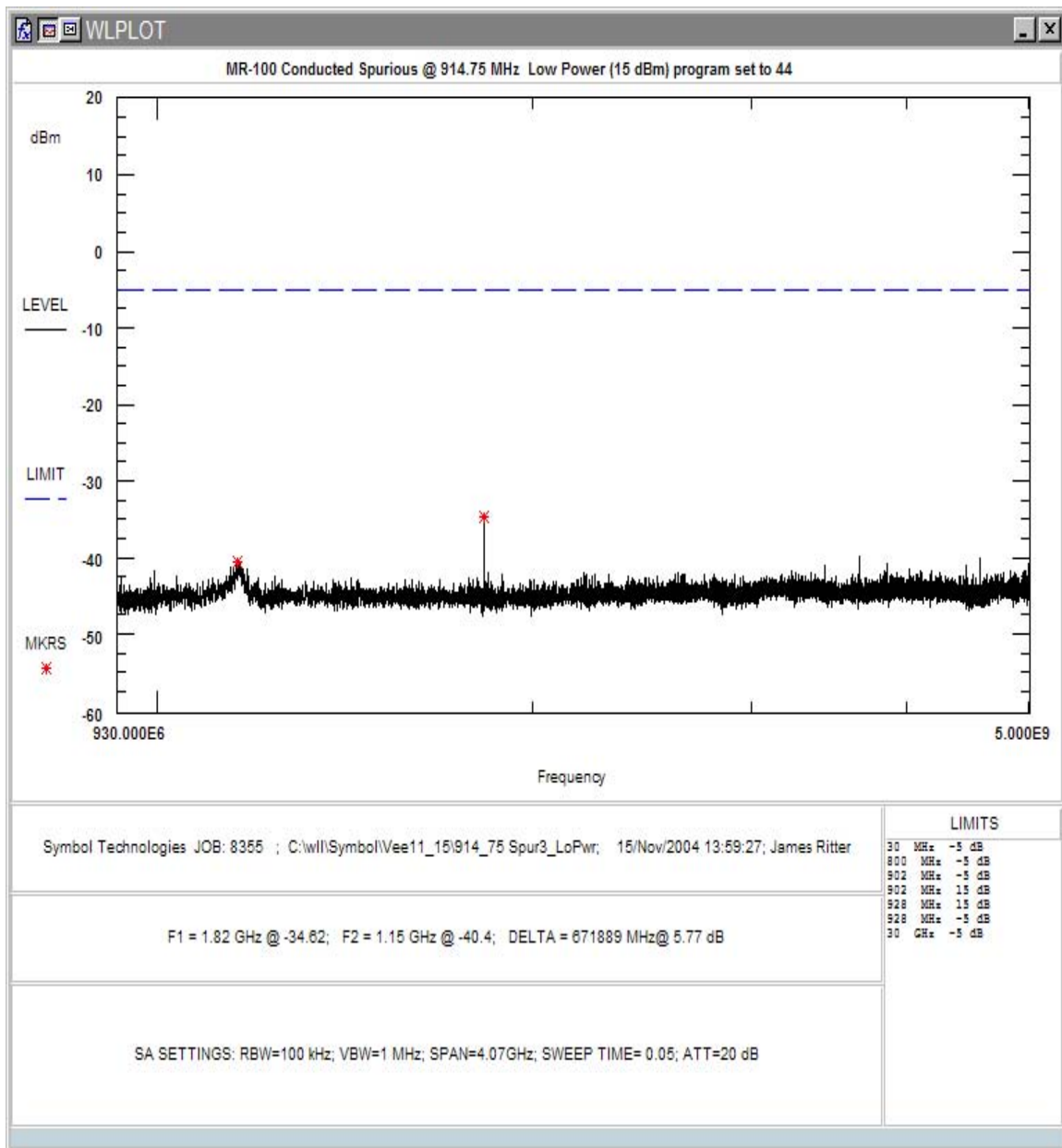


Figure 4-21. Low Power Conducted Spurious Emissions, Mid Channel 930MHz – 5GHz

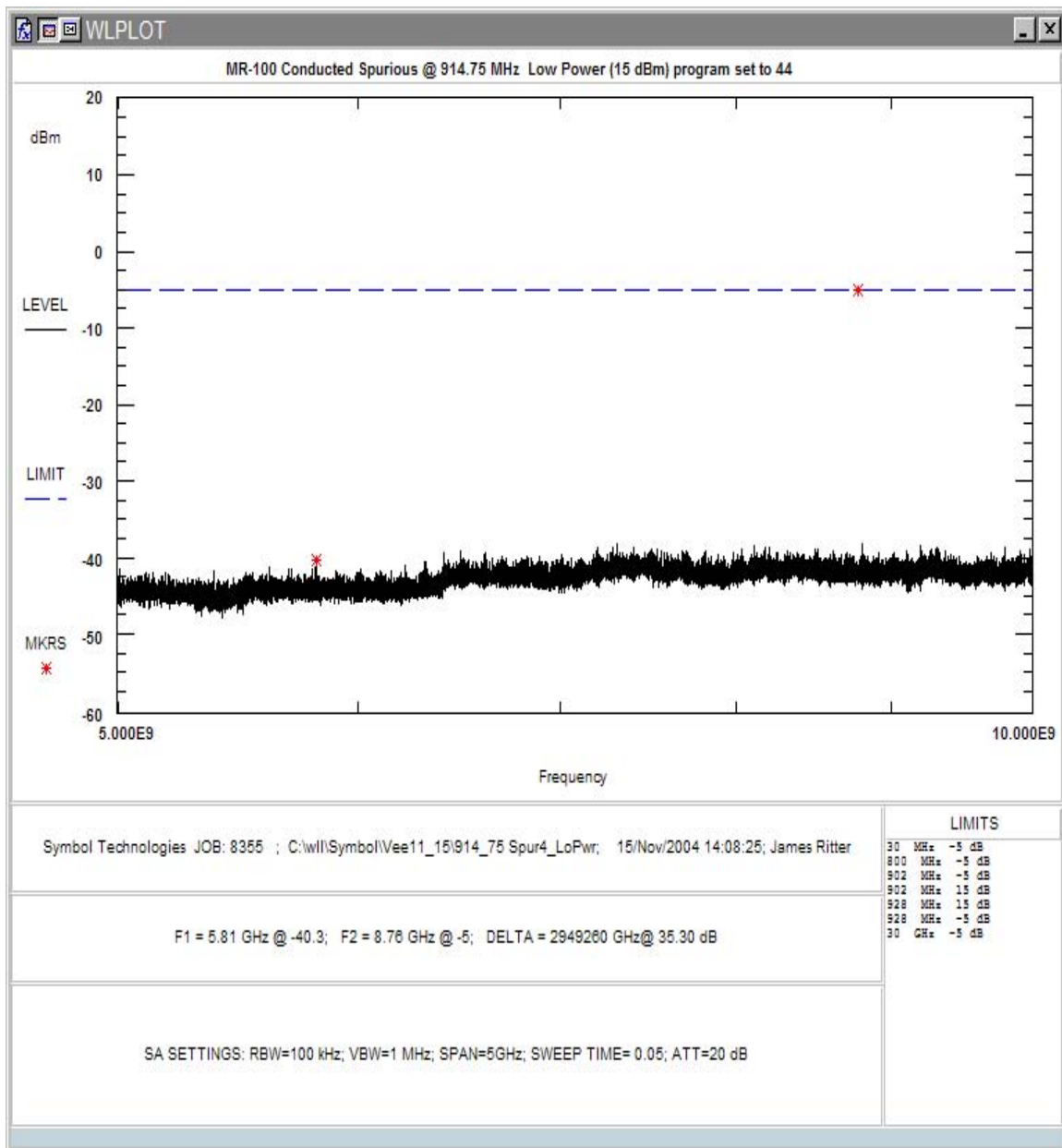


Figure 4-22. Low Power Conducted Spurious Emissions, Mid Channel 5 - 10GHz

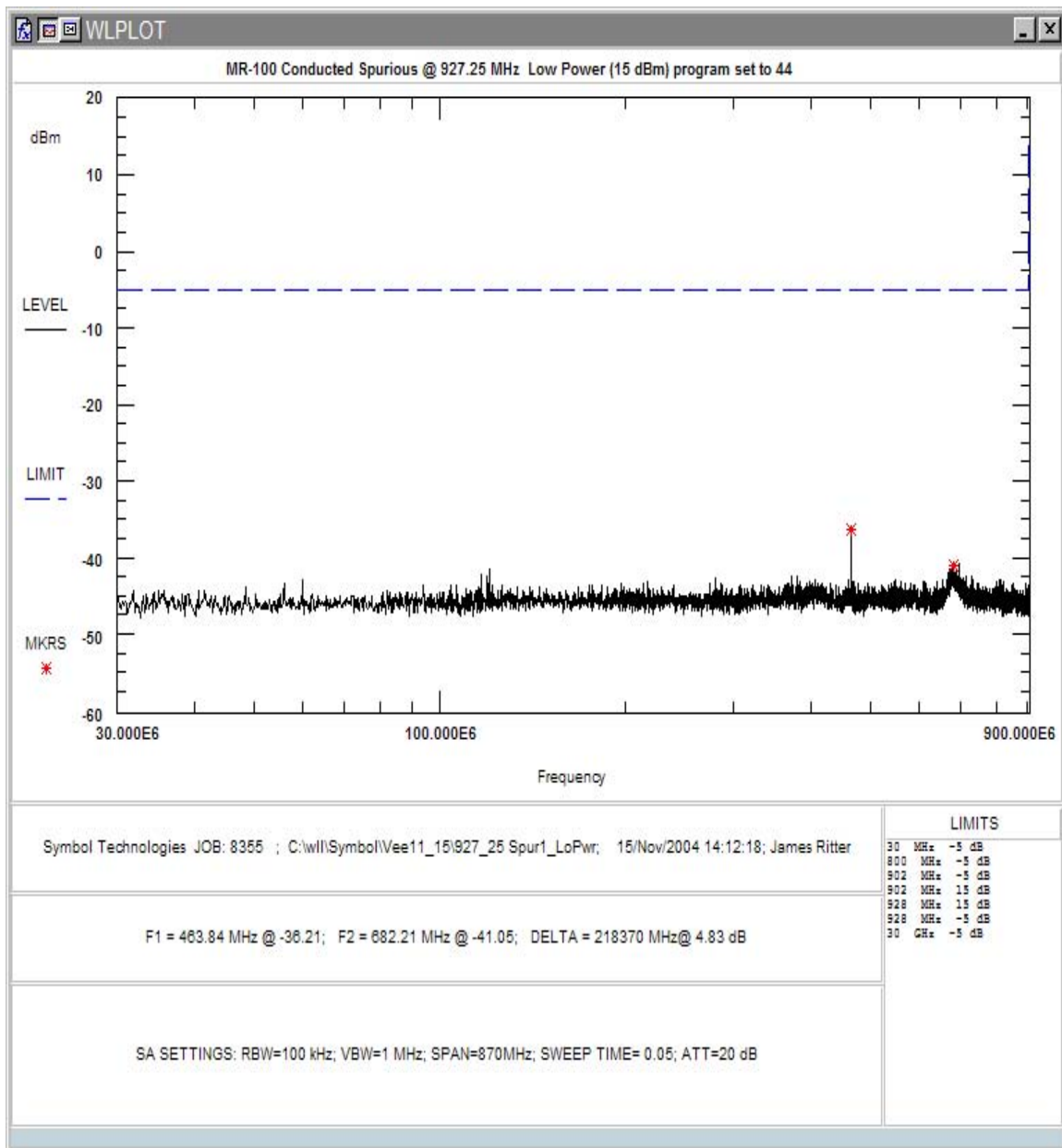


Figure 4-23. Low Power Conducted Spurious Emissions, High Channel 30 - 900MHz

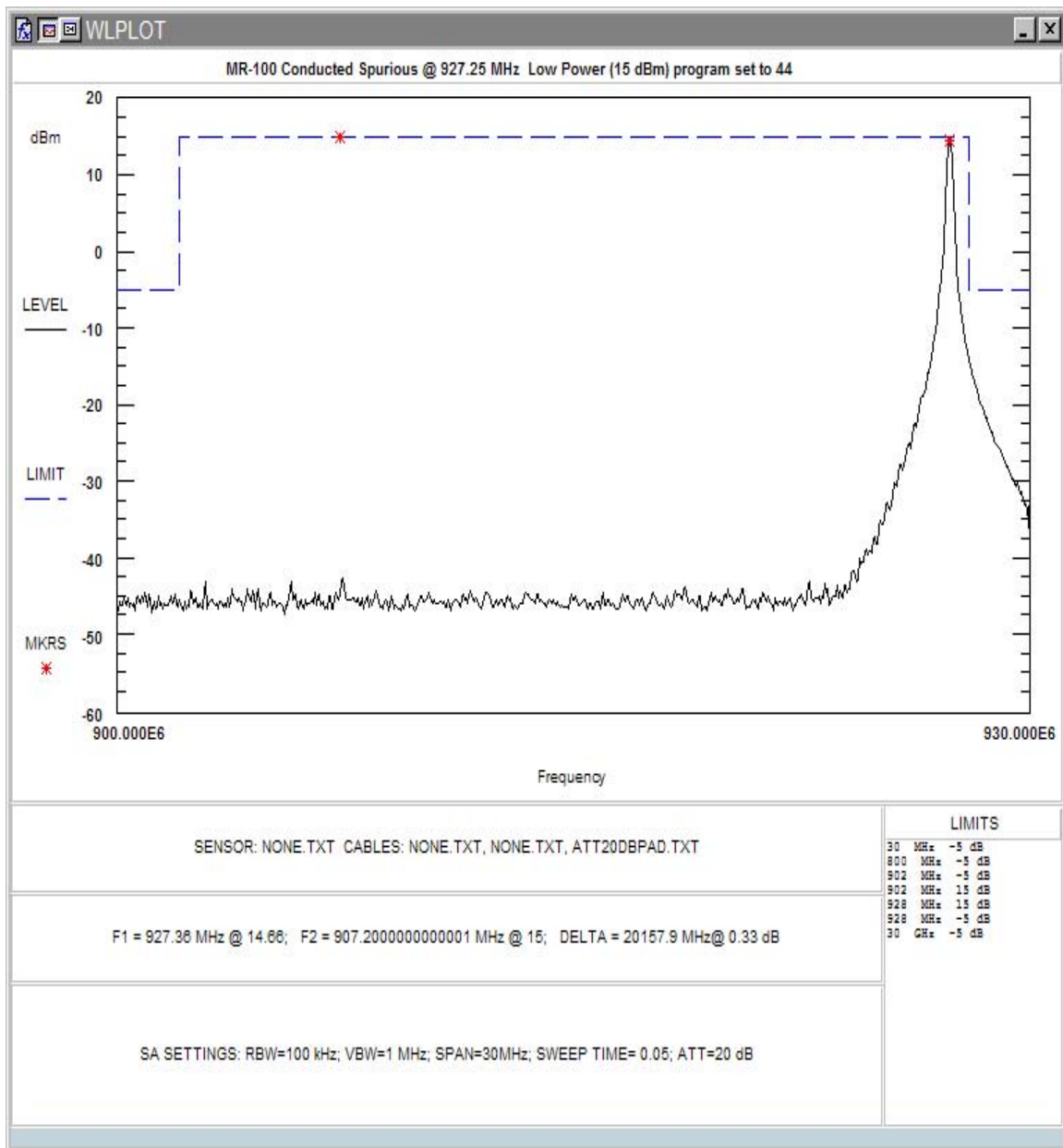


Figure 4-24. Low Power Conducted Spurious Emissions, High Channel 900 – 930MHz

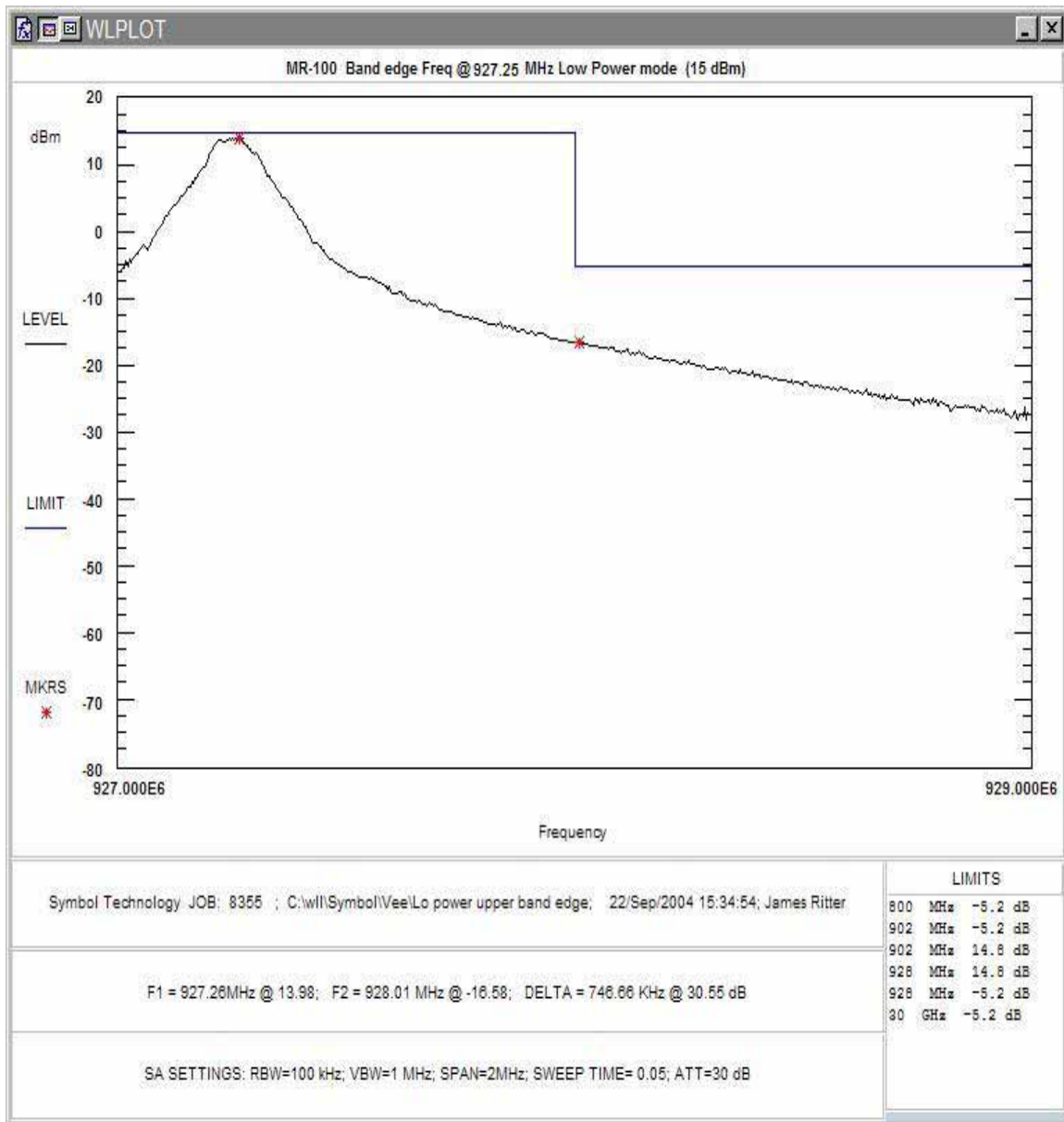


Figure 4-25. Low Power Conducted Spurious Emissions, High Channel, Bandedge

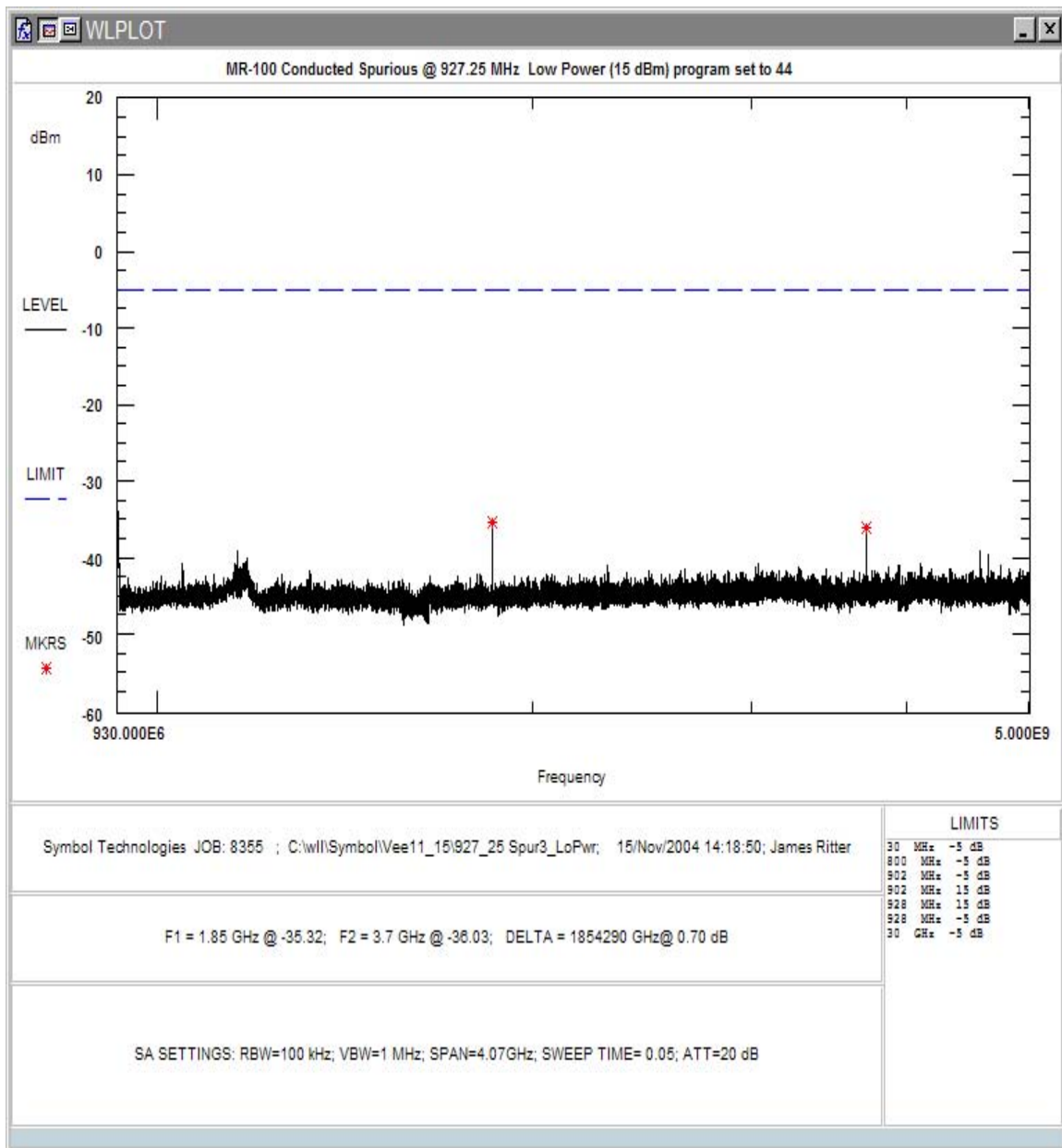


Figure 4-26. Low Power Conducted Spurious Emissions, High Channel 930MHz – 5GHz

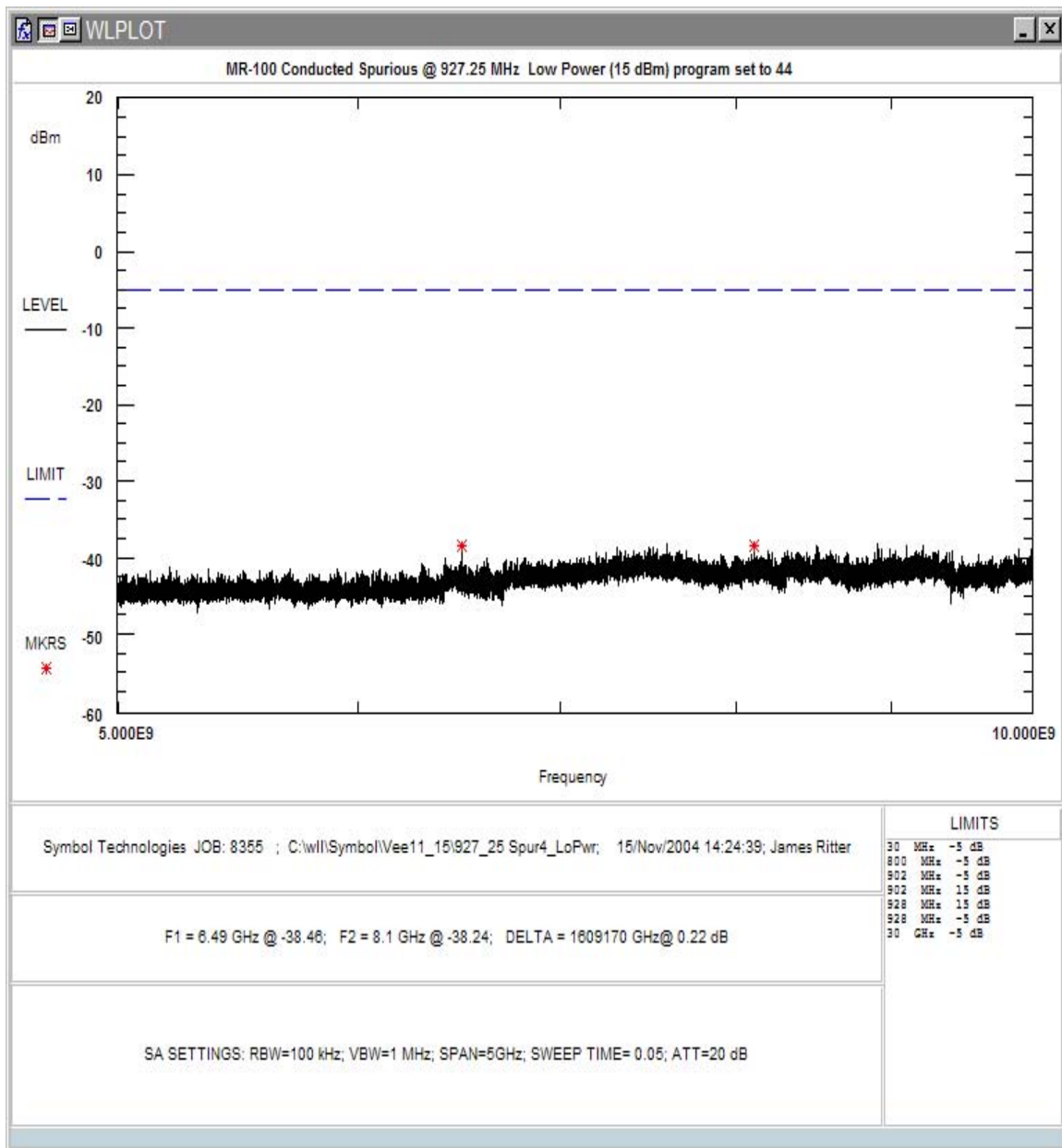


Figure 4-27. Low Power Conducted Spurious Emissions, High Channel 5 - 10GHz

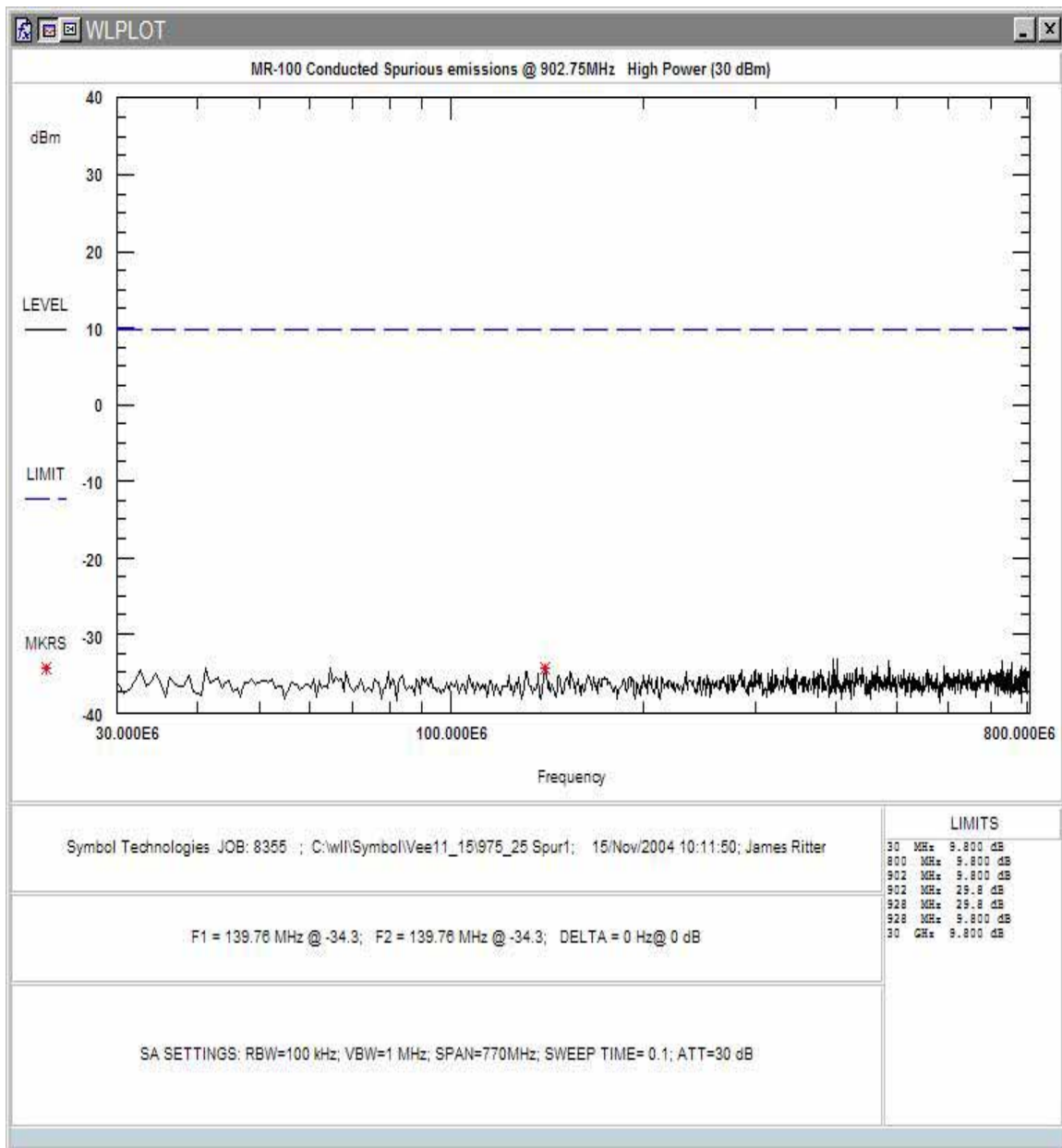


Figure 4-28. High Power Conducted Spurious Emissions, Low Channel 30 - 800MHz

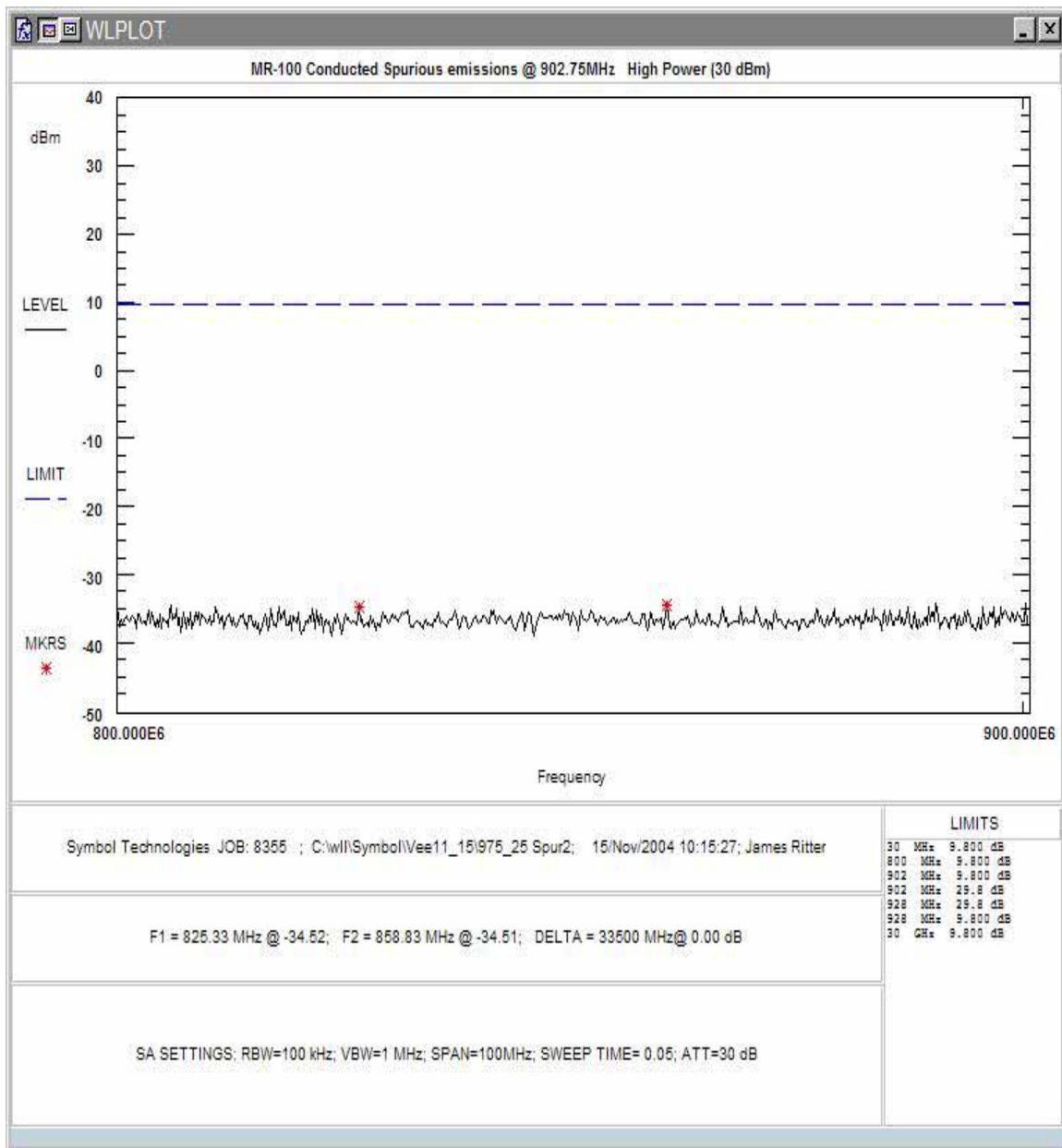


Figure 4-29. High Power Conducted Spurious Emissions, Low Channel 800 – 900MHz

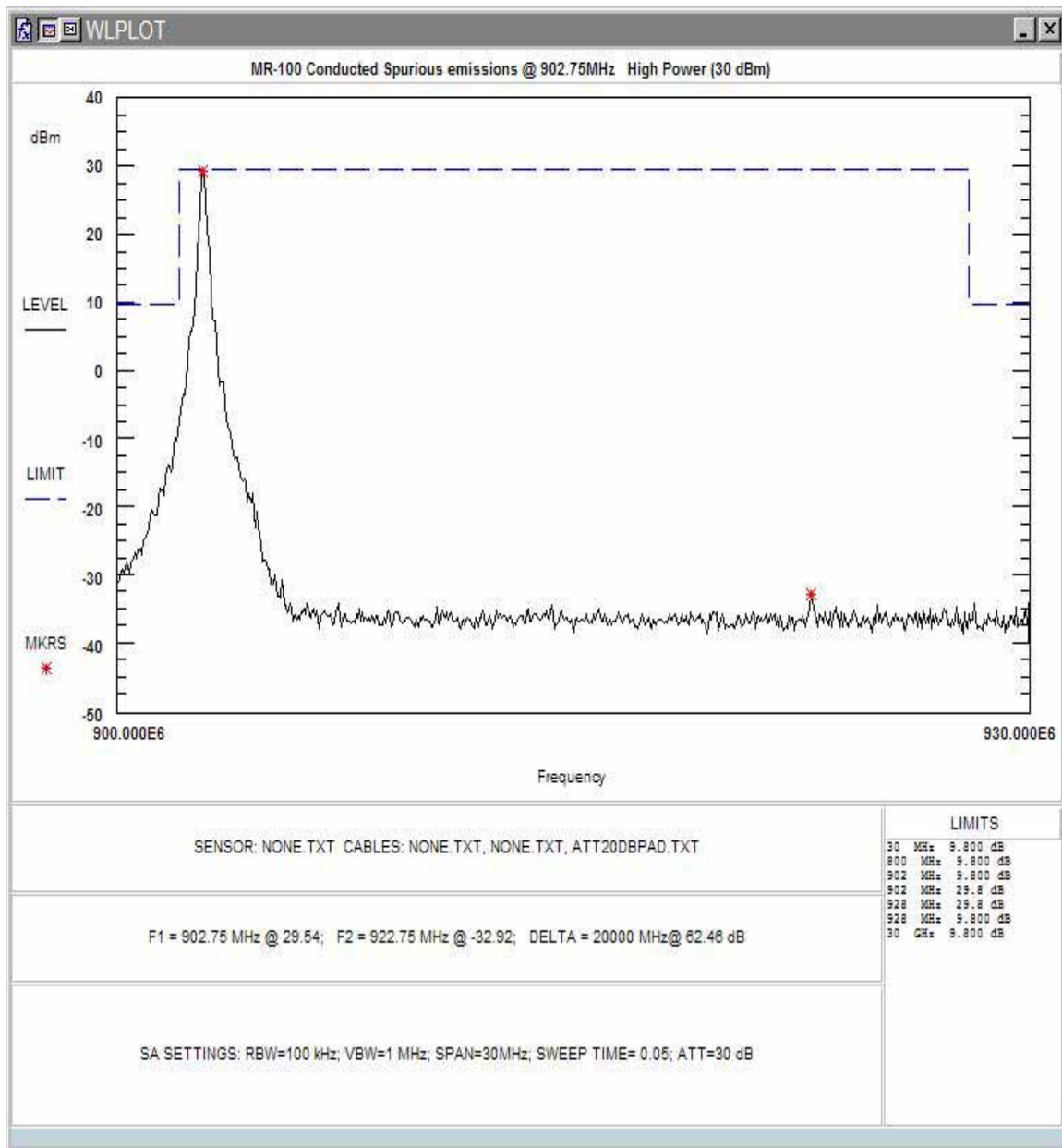


Figure 4-30. High Power Conducted Spurious Emissions, Low Channel 900 – 930MHz

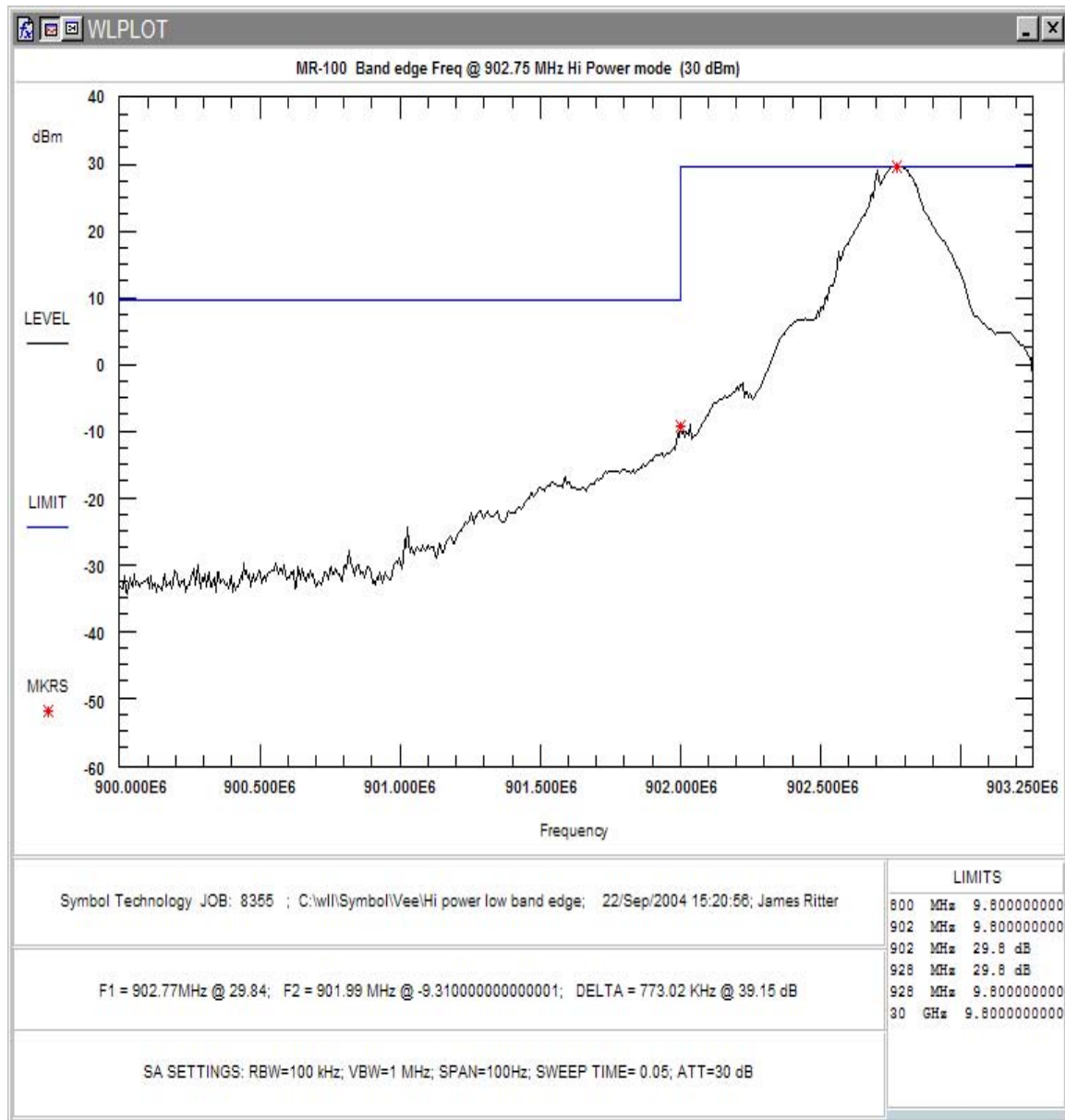


Figure 4-31. High Power Conducted Spurious Emissions, Low Channel, Bandedge

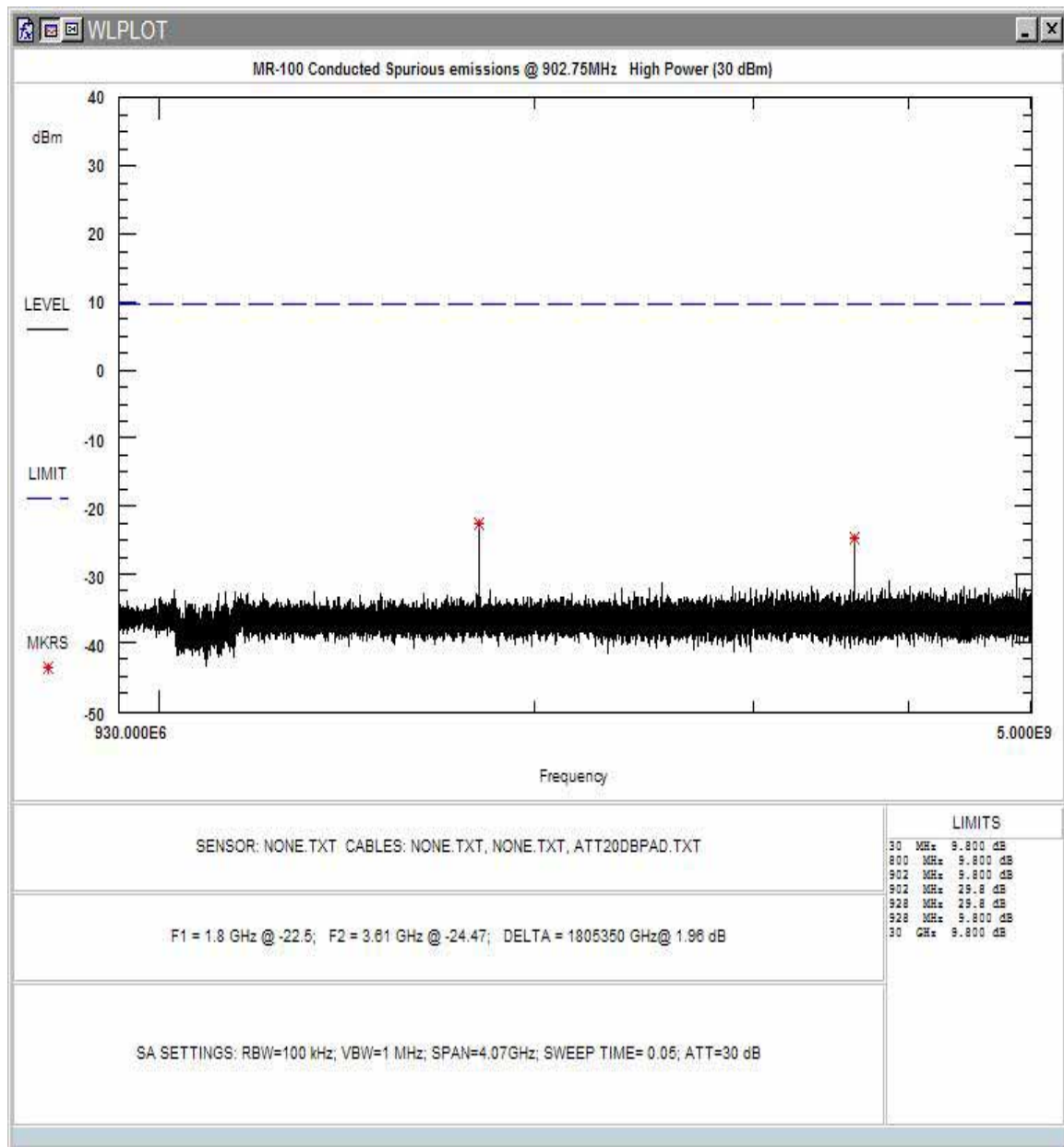


Figure 4-32. High Power Conducted Spurious Emissions, Low Channel 930MHz – 5GHz

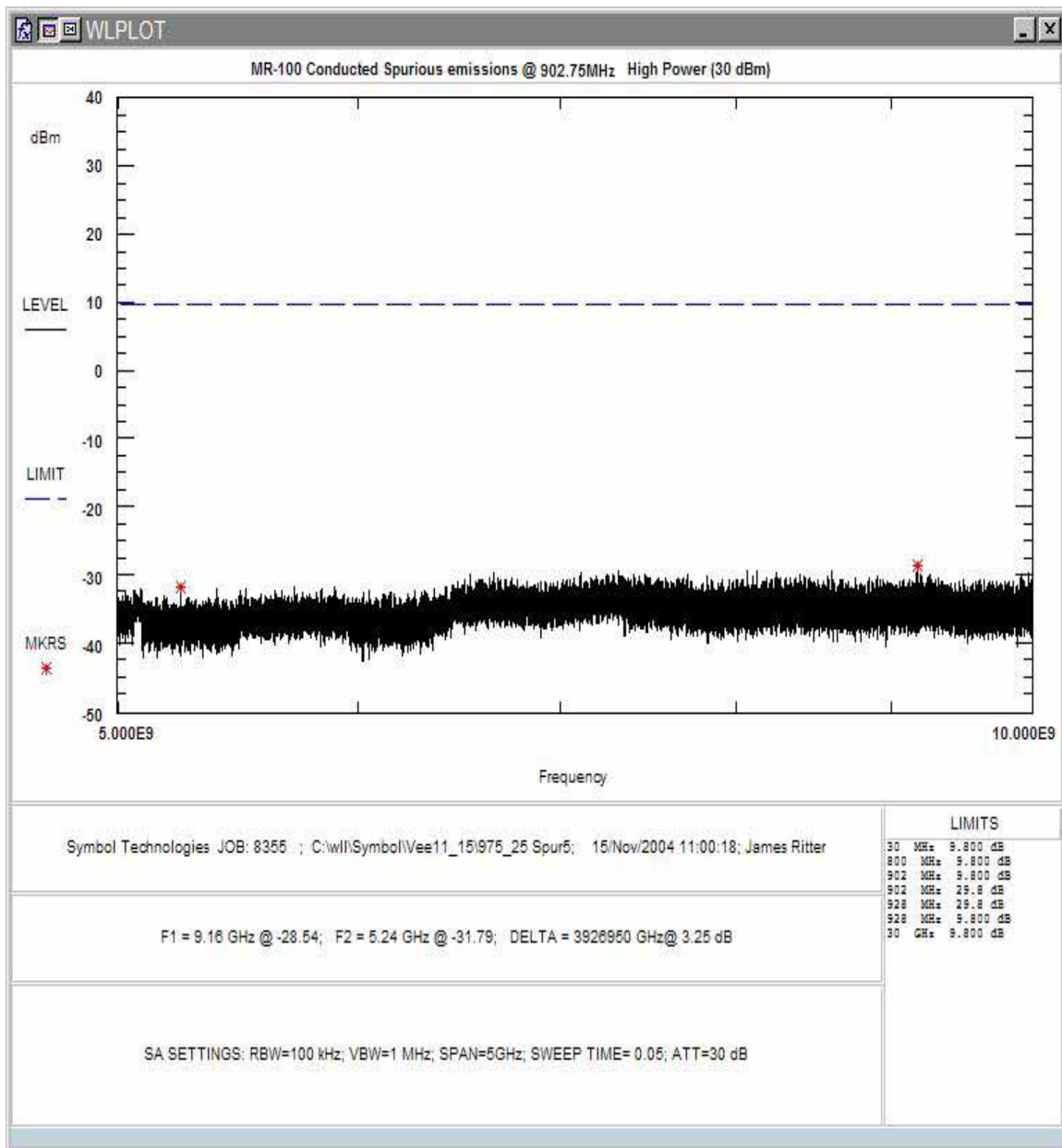


Figure 4-33. High Power Conducted Spurious Emissions, Low Channel 5 - 10GHz

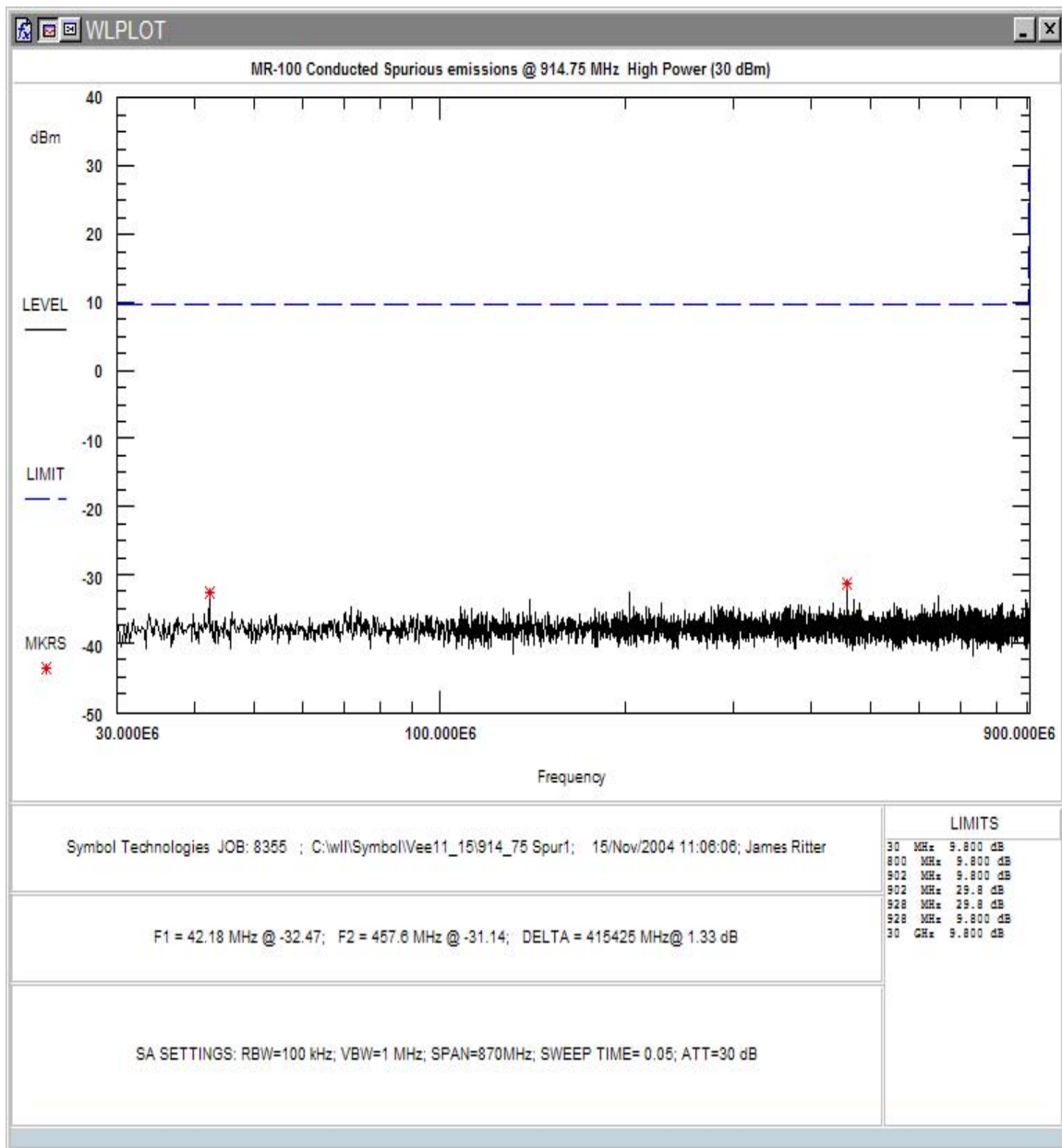


Figure 4-34. High Power Conducted Spurious Emissions, Mid Channel 30 - 900MHz

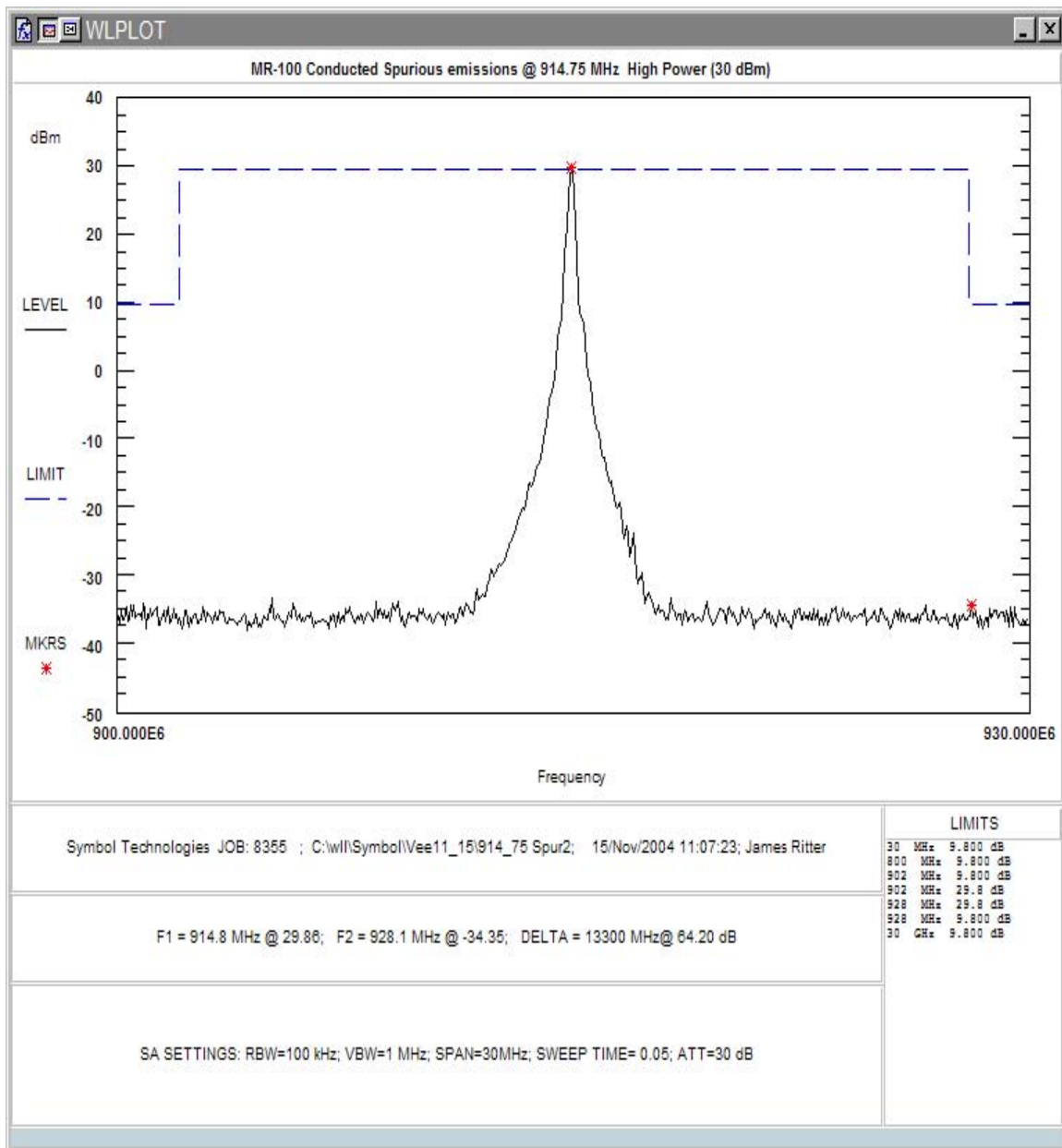


Figure 4-35. High Power Conducted Spurious Emissions, Mid Channel 900 – 930MHz

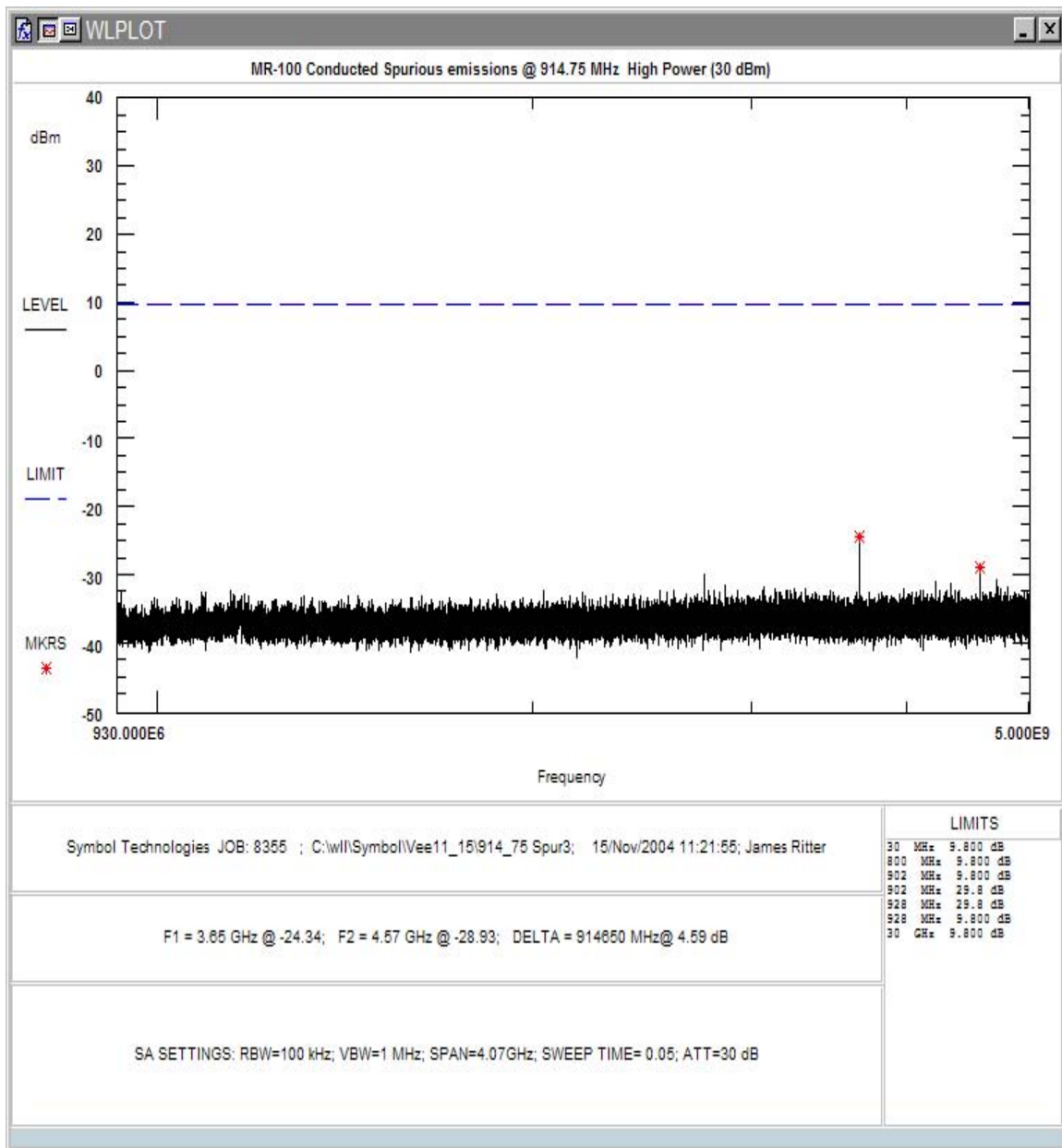


Figure 4-36. High Power Conducted Spurious Emissions, Mid Channel 930MHz – 5GHz

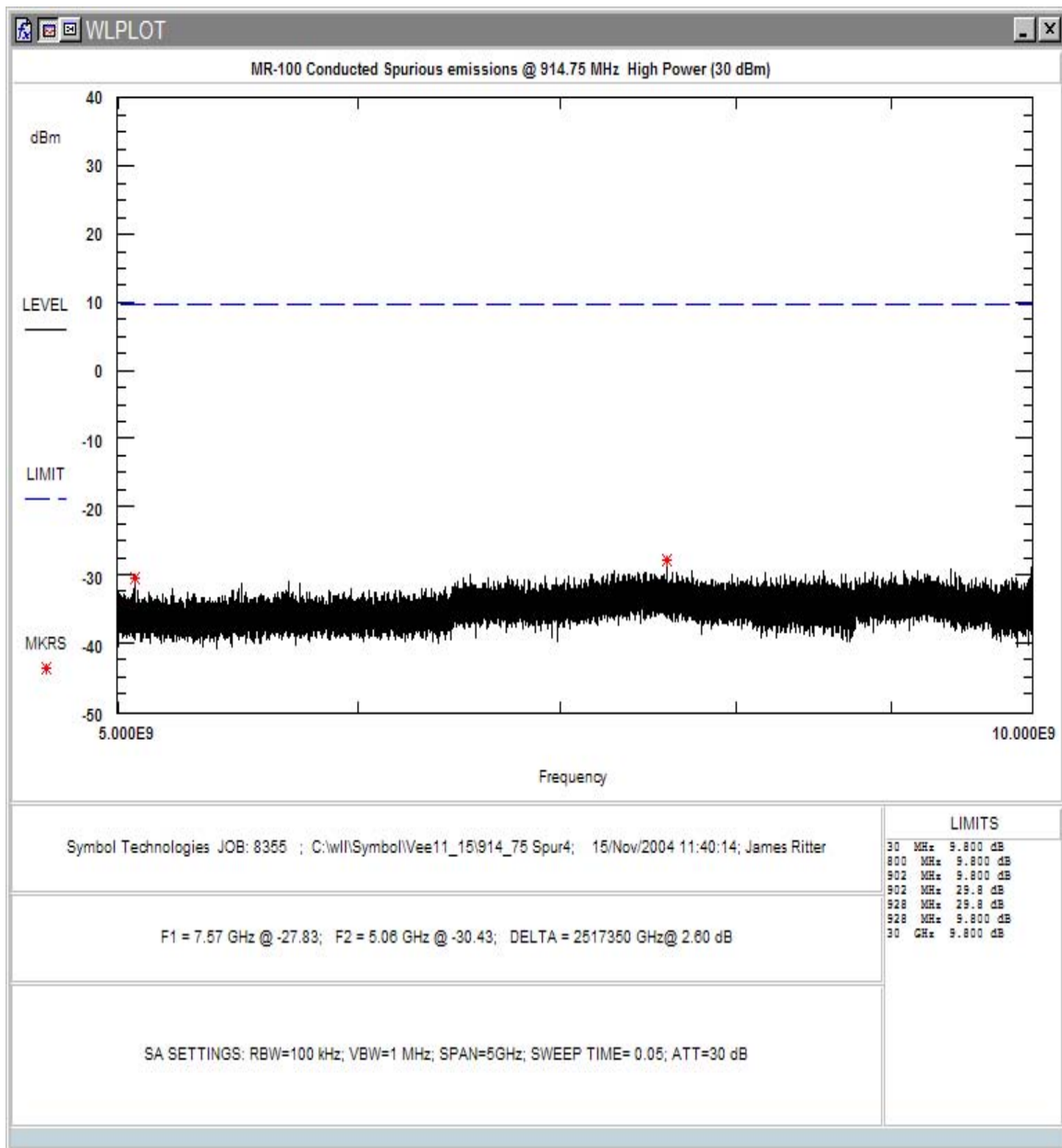


Figure 4-37. High Power Conducted Spurious Emissions, Mid Channel 5 - 10GHz

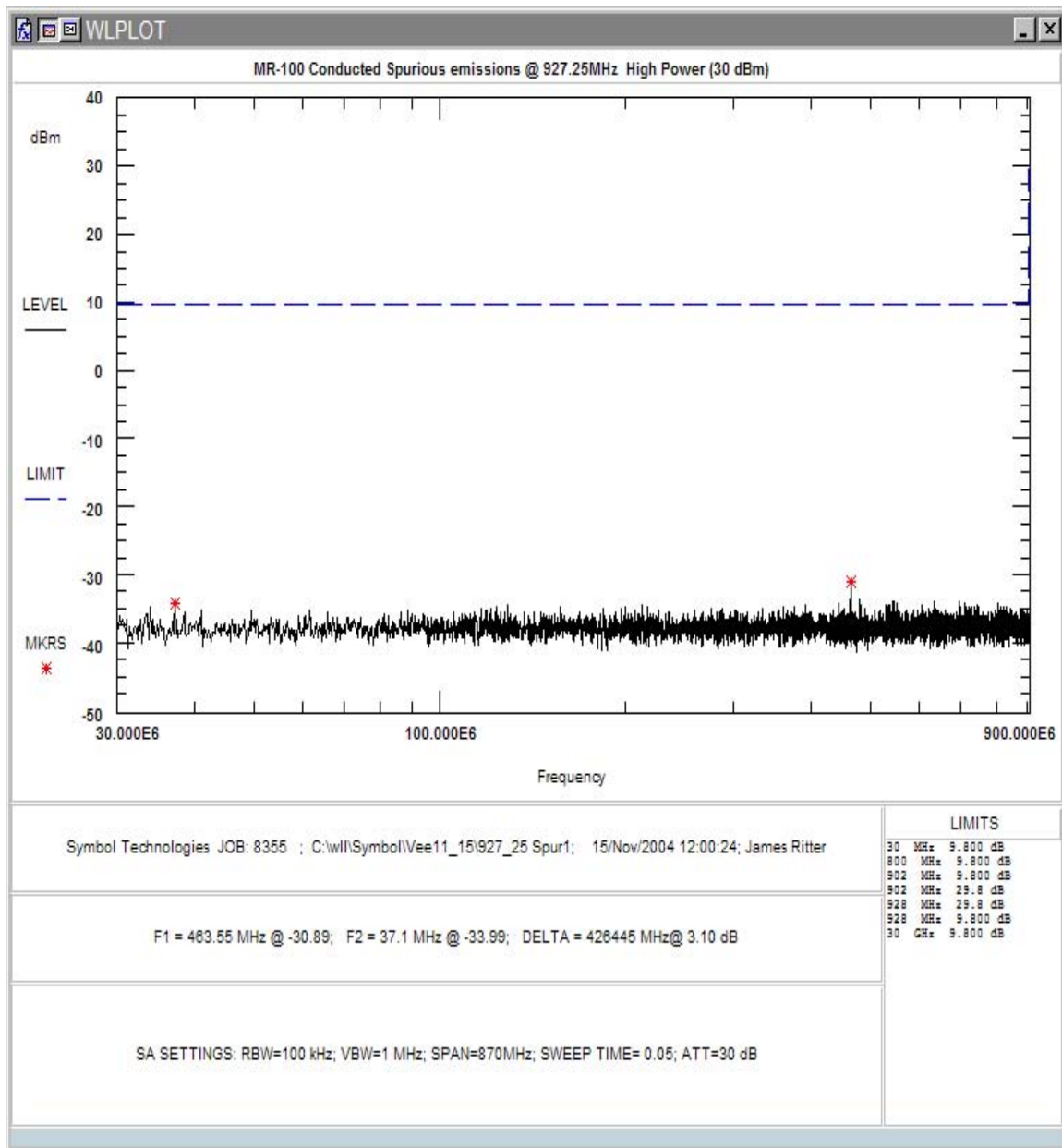


Figure 4-38. High Power Conducted Spurious Emissions, High Channel 30 - 900MHz

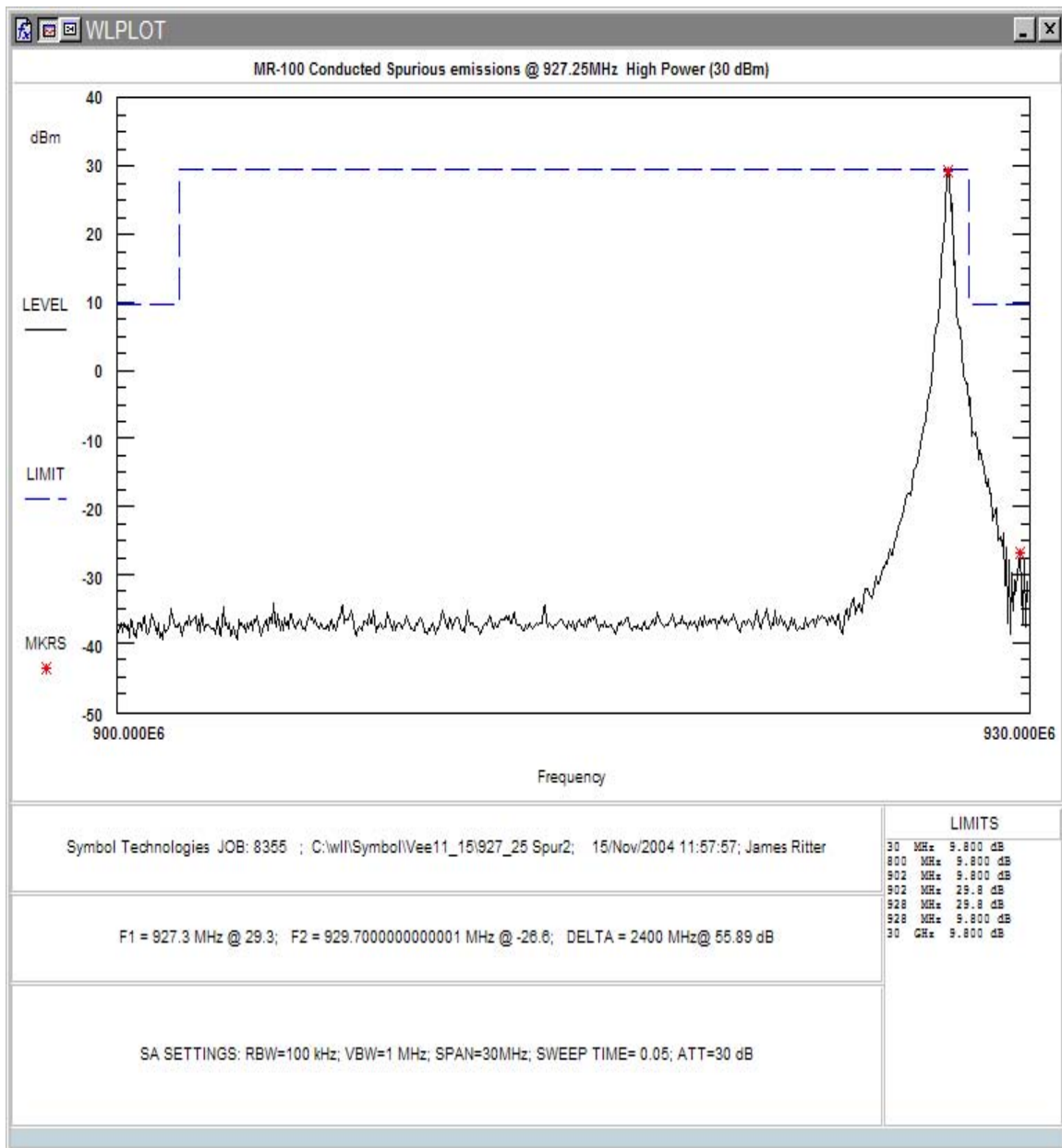


Figure 4-39. High Power Conducted Spurious Emissions, High Channel 900 – 930MHz

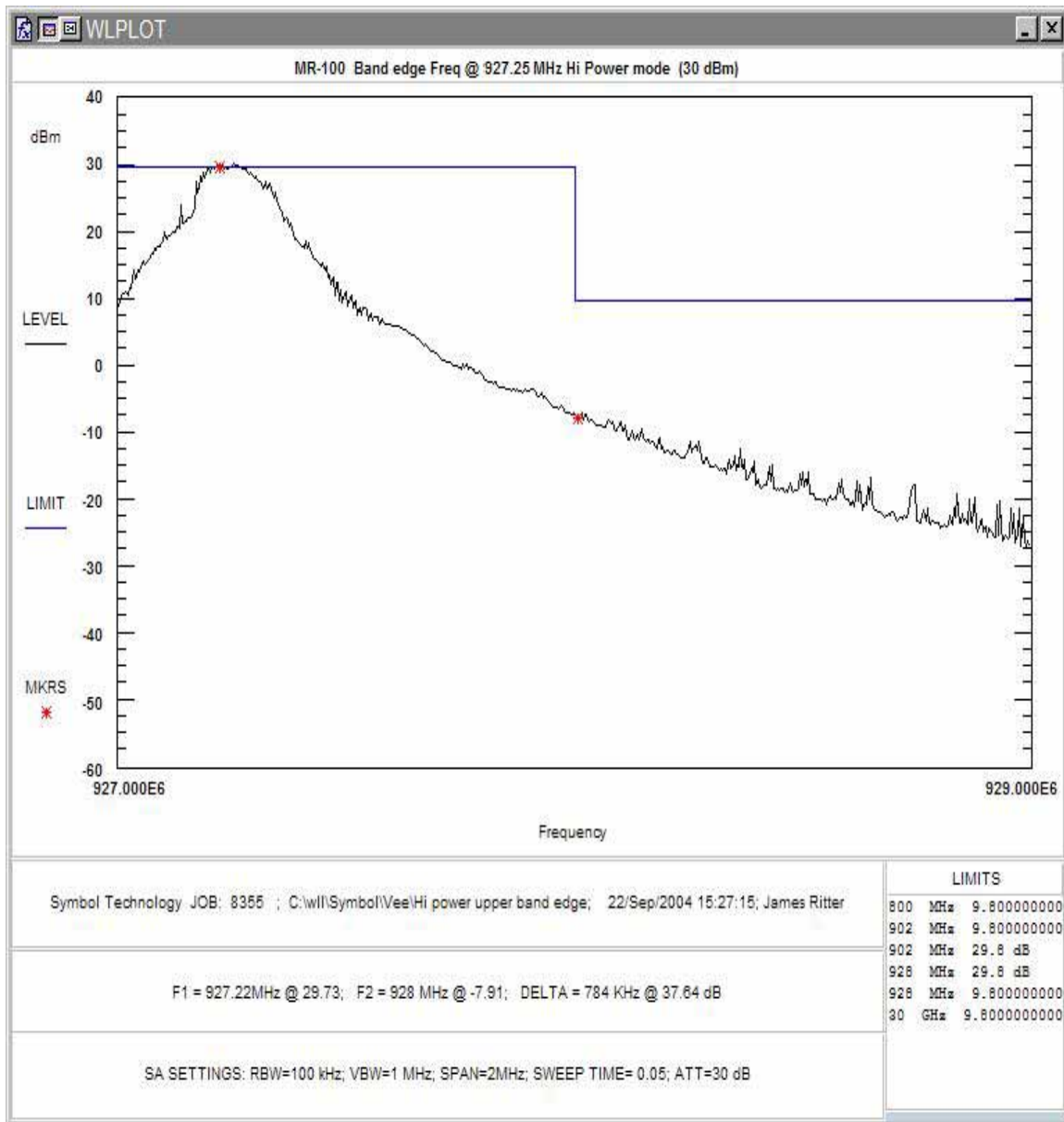


Figure 4-40. High Power Conducted Spurious Emissions, High Channel, Bandedge

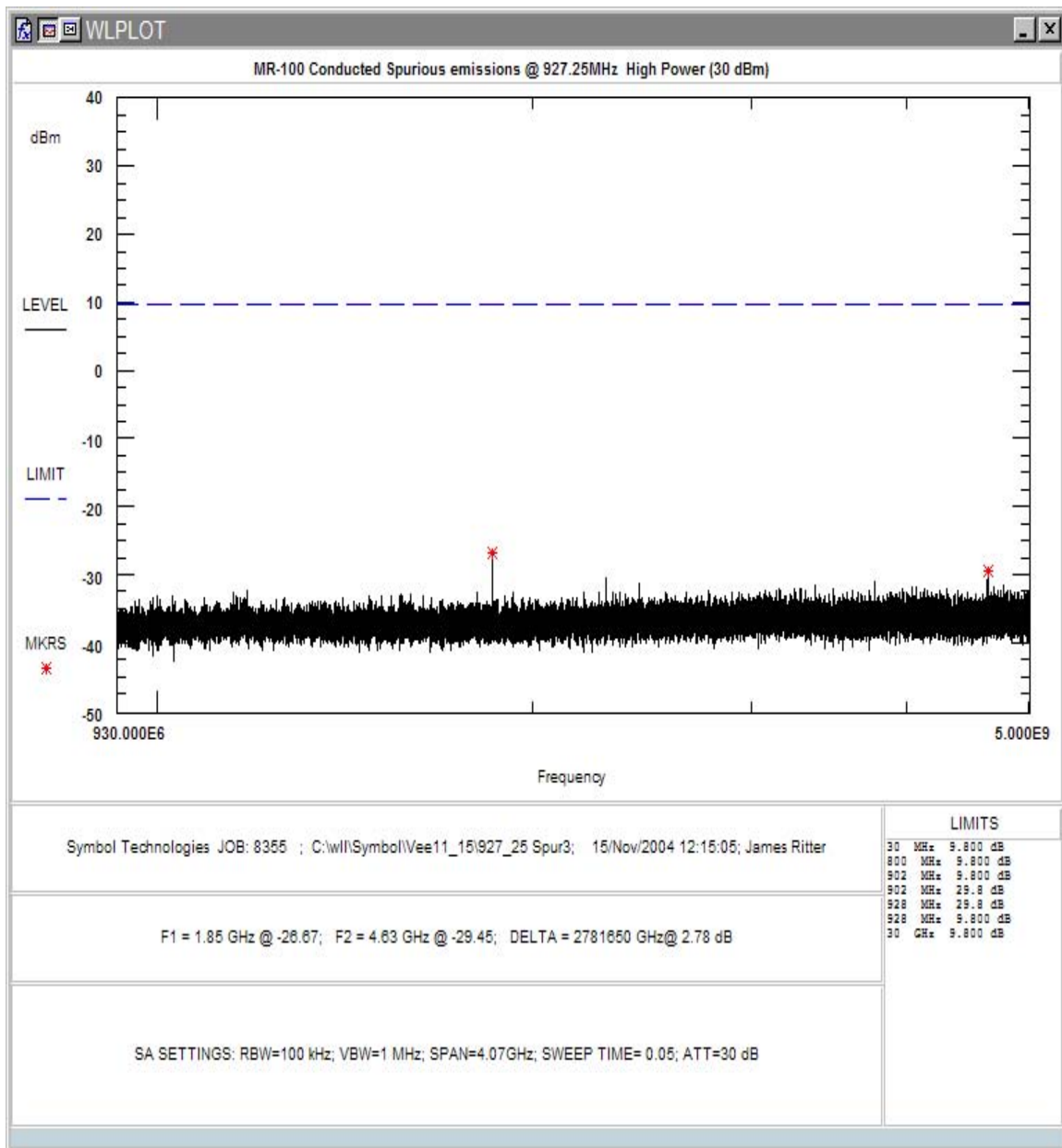


Figure 4-41. High Power Conducted Spurious Emissions, High Channel 930MHz – 5GHz

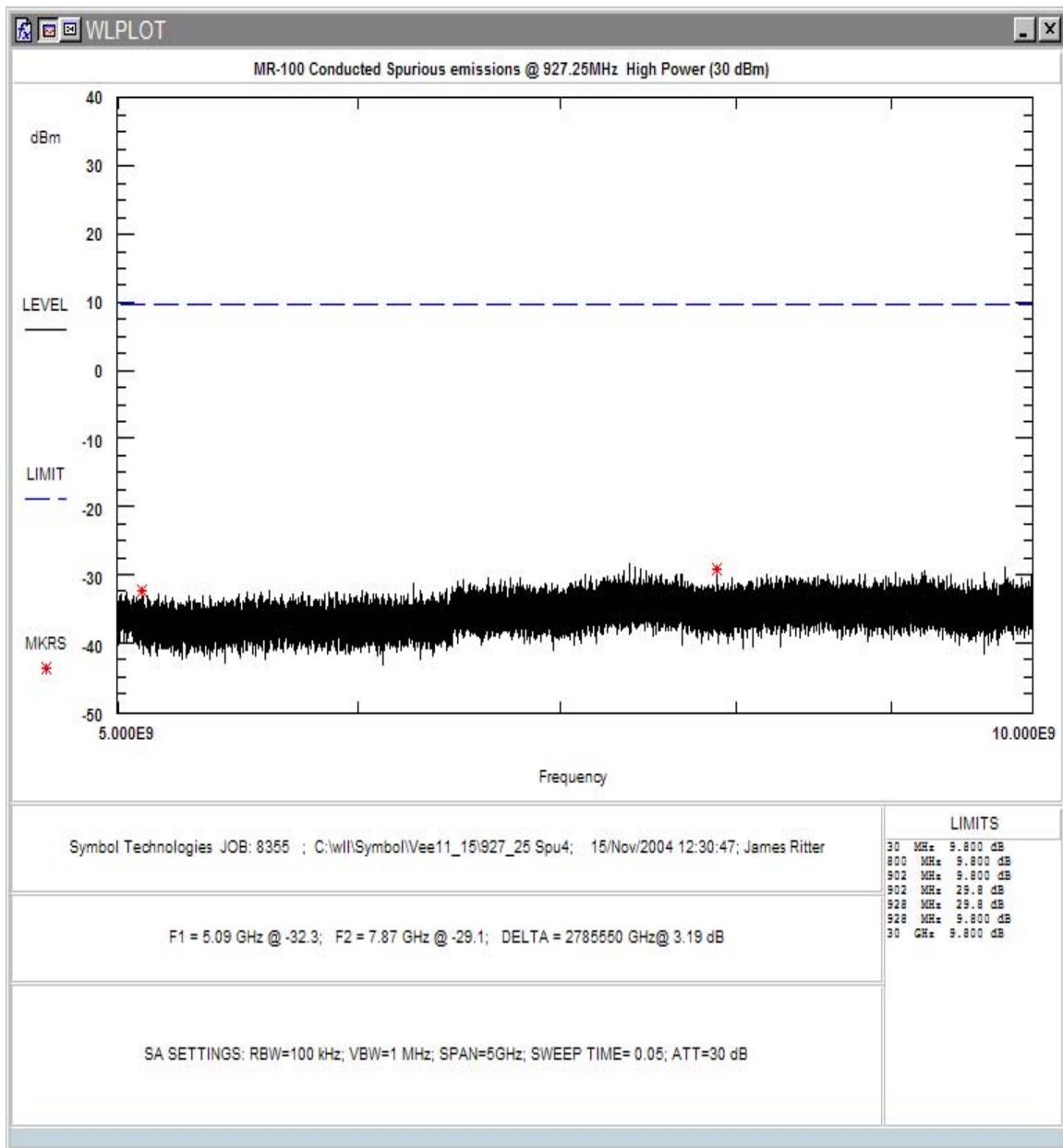


Figure 4-42. High Power Conducted Spurious Emissions, High Channel 5 - 10GHz

4.7 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.

4.7.1 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 C63.4-2001. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

Measurements were made in accordance with the procedure described in the Public Notice DA 00-705. The unit was set to the selected channel for continuous transmissions at the maximum rate. For the average measurements the VBW was set to 100Hz based on the maximum transmit on time of 19.15ms.

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	100 Hz (Avg.) 1MHz (Peak)

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

Sample Calculation:

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

Worst case data are supplied in the following tables. Testing was performed to the tenth harmonic at the highest power setting. Both peak and average measurements are listed.

Table 6: Radiated Emission Test Data, Low Channel

CLIENT:	Symbol Tech.	DATE:	11/5/2004
TESTER:	Greg Snyder	JOB #:	8355
<u>EUT Information:</u>		<u>Test Requirements:</u>	
EUT:	MR100	TEST STANDARD:	FCC Part 15
CONFIGURATION:	Low Channel 902.75MHz	DISTANCE:	3m
Antenna:	Panel Antenna	CLASS:	9
S/N:	30		
<u>Test Equipment/Limit:</u>			
ANTENNA:	A_00425	LIMIT:	15.209
CABLE:	CSITE2_HF	AMPLIFIER (dB)	A_00066

Frequency	Polarity	Az	Ant. Hght	SA Level	Ant. Corr.	Cable Corr.	Amp Gain	Duty Cycle	Corr. Level	Corr. Level	Limit	Margin
(MHz)	H/V	Deg	(m)	(dBμV)	(dB/m)	(dB)	(dB)	dB	(dBμV/m)	(μV/m)	(μV/m)	dB
Avg. (100Hz VBW)												
2708.21	V	270.0	1.0	59.0	30.3	2.9	35.6	-14.4	42.2	128.8	500.0	-11.8
2708.21	H	180.0	1.0	61.2	30.3	2.9	35.6	-14.4	44.4	166.0	500.0	-9.6
3610.95	V	0.0	1.0	59.2	31.0	2.8	35.5	-14.4	43.1	142.7	500.0	-10.9
3610.95	H	90.0	1.0	61.3	31.0	2.8	35.5	-14.4	45.2	182.4	500.0	-8.8
4513.82	V	180.0	1.0	52.5	32.6	3.7	35.7	-14.4	38.6	85.3	500.0	-15.4
4513.82	H	225.0	1.0	61.0	32.6	3.7	35.7	-14.4	47.1	226.9	500.0	-6.9
5416.43	V	225.0	1.0	45.0	34.4	4.3	35.8	-14.4	33.5	47.1	500.0	-20.5
5416.43	H	225.0	1.0	46.0	34.4	4.3	35.8	-14.4	34.5	52.8	500.0	-19.5
6319.16	V	270.0	1.0	38.7	35.9	4.2	35.6	-14.4	28.8	27.6	500.0	-25.2
6319.16	H	270.0	1.0	44.3	35.9	4.2	35.6	-14.4	34.4	52.6	500.0	-19.6
7221.90	V	225.0	1.0	42.2	37.6	4.5	35.9	-14.4	34.1	50.4	500.0	-19.9
7221.90	H	225.0	1.0	47.0	37.6	4.5	35.9	-14.4	38.9	87.7	500.0	-15.1
8124.64	V	180.0	1.0	46.7	38.4	4.9	36.1	-14.4	39.4	93.5	500.0	-14.6
8124.64	H	180.0	1.0	46.8	38.4	4.9	36.1	-14.4	39.5	94.6	500.0	-14.5
9027.28	V	180.0	1.0	47.7	39.0	4.9	36.2	-14.4	41.0	112.6	500.0	-13.0
9027.28	H	180.0	1.0	47.3	39.0	4.9	36.2	-14.4	40.6	107.5	500.0	-13.4
Peak												
2708.21	V	270.0	1.0	63.5	30.3	2.9	35.6	0.0	61.1	1135.2	5000.0	-12.9
2708.21	H	180.0	1.0	65.5	30.3	2.9	35.6	0.0	63.1	1429.1	5000.0	-10.9
3610.95	V	0.0	1.0	65.2	31.0	2.8	35.5	0.0	63.5	1494.7	5000.0	-10.5
3610.95	H	90.0	1.0	66.8	31.0	2.8	35.5	0.0	65.1	1803.3	5000.0	-8.9
4513.82	V	180.0	1.0	55.3	32.6	3.7	35.7	0.0	55.8	620.0	5000.0	-18.1
4513.82	H	225.0	1.0	63.0	32.6	3.7	35.7	0.0	63.5	1499.3	5000.0	-10.5
5416.43	V	225.0	1.0	51.3	34.4	4.3	35.8	0.0	54.2	510.0	5000.0	-19.8
5416.43	H	225.0	1.0	51.5	34.4	4.3	35.8	0.0	54.4	521.9	5000.0	-19.6
6319.16	V	270.0	1.0	51.0	35.9	4.2	35.6	0.0	55.5	596.6	5000.0	-18.5
6319.16	H	270.0	1.0	53.8	35.9	4.2	35.6	0.0	58.3	823.5	5000.0	-15.7
7221.90	V	225.0	1.0	50.0	37.6	4.5	35.9	0.0	56.3	649.8	5000.0	-17.7
7221.90	H	180.0	1.0	47.0	37.6	4.5	35.9	0.0	53.3	460.0	5000.0	-20.7
8124.64	V	180.0	1.0	46.7	38.4	4.9	36.1	0.0	53.8	490.7	5000.0	-20.2

Frequency	Polarity	Az	Ant. Hght	SA Level	Ant. Corr.	Cable Corr.	Amp Gain	Duty Cycle	Corr. Level	Corr. Level	Limit	Margin
(MHz)	H/V	Deg	(m)	(dBµV)	(dB/m)	(dB)	(dB)	dB	(dBµV/m)	(µV/m)	(µV/m)	dB
8124.64	H	180.0	1.0	46.8	38.4	4.9	36.1	0.0	53.9	496.4	5000.0	-20.1
9027.28	V	180.0	1.0	47.7	39.0	4.9	36.2	0.0	55.4	590.7	5000.0	-18.6
9027.28	H	180.0	1.0	47.3	39.0	4.9	36.2	0.0	55.0	564.1	5000.0	-19.0

Table 7: Radiated Emission Test Data, Mid Channel

CLIENT:	Symbol Tech.	DATE:	11/5/2004
TESTER:	Greg Snyder	JOB #:	8355
<u>EUT Information:</u>		<u>Test Requirements:</u>	
EUT:	MR100	TEST STANDARD:	FCC Part 15
CONFIGURATION:	Mid Channel 914.75MHz	DISTANCE:	3m
Antenna:	Panel Ant	CLASS:	9
S/N:	30		
<u>Test Equipment/Limit:</u>			
ANTENNA:	A_00425	LIMIT:	15.209
CABLE:	CSITE2_HF	AMPLIFIER (dB)	A_00066

Frequency	Polarity	Az	Ant. Hght	SA Level	Ant. Corr.	Cable Corr.	Amp Gain	Duty Cycle	Corr. Level	Corr. Level	Limit	Margin
(MHz)	H/V	Deg	(m)	(dBµV)	(dB/m)	(dB)	(dB)	dB	(dBµV/m)	(µV/m)	(µV/m)	dB
Avg. (100Hz VBW)												
2744.25	V	270.0	1.0	59.0	30.4	2.9	35.6	-14.4	42.2	129.1	500.0	-11.8
2744.25	H	180.0	1.0	59.2	30.4	2.9	35.6	-14.4	42.4	132.1	500.0	-11.6
3659.13	V	0.0	1.0	62.3	31.0	2.8	35.5	-14.4	46.2	204.9	500.0	-7.7
3659.13	H	90.0	1.0	67.8	31.0	2.8	35.5	-14.4	51.7	385.9	500.0	-2.2
4573.70	V	180.0	1.0	51.4	32.7	3.8	35.8	-14.4	37.7	77.0	500.0	-16.3
4573.70	H	225.0	1.0	60.7	32.7	3.8	35.8	-14.4	47.0	224.6	500.0	-7.0
5488.50	V	225.0	1.0	49.8	34.5	4.2	35.7	-14.4	38.4	82.9	500.0	-15.6
5488.50	H	225.0	1.0	55.5	34.5	4.2	35.7	-14.4	44.1	159.7	500.0	-9.9
6403.25	V	270.0	1.0	40.0	36.1	4.2	35.6	-14.4	30.3	32.8	500.0	-23.7
6403.25	H	270.0	1.0	48.8	36.1	4.2	35.6	-14.4	39.1	90.2	500.0	-14.9
7318.00	V	225.0	1.0	51.8	37.7	4.6	35.9	-14.4	43.8	154.1	500.0	-10.2
7318.00	H	225.0	1.0	49.0	37.7	4.6	35.9	-14.4	41.0	111.6	500.0	-13.0
8232.75	V	180.0	1.0	50.0	38.5	4.9	36.1	-14.4	42.8	137.9	500.0	-11.2
8232.75	H	180.0	1.0	48.5	38.5	4.9	36.1	-14.4	41.3	116.0	500.0	-12.7
9147.50	V	180.0	1.0	48.7	39.2	5.0	36.2	-14.4	42.2	128.7	500.0	-11.8
9147.50	H	180.0	1.0	48.7	39.2	5.0	36.2	-14.4	42.2	128.7	500.0	-11.8
Peak												

Frequency	Polarity	Az	Ant. Hght	SA Level	Ant. Corr.	Cable Corr.	Amp Gain	Duty Cycle	Corr. Level	Corr. Level	Limit	Margin
(MHz)	H/V	Deg	(m)	(dBμV)	(dB/m)	(dB)	(dB)	dB	(dBμV/m)	(μV/m)	(μV/m)	dB
2744.25	V	270.0	1.0	63.5	30.4	2.9	35.6	0.0	61.1	1137.7	5000.0	-12.9
2744.25	H	180.0	1.0	63.5	30.4	2.9	35.6	0.0	61.1	1137.7	5000.0	-12.9
3659.13	V	0.0	1.0	68.2	31.0	2.8	35.5	0.0	66.5	2120.8	5000.0	-7.4
3659.13	H	90.0	1.0	73.7	31.0	2.8	35.5	0.0	72.0	3994.8	5000.0	-1.9
4573.70	V	180.0	1.0	55.3	32.7	3.8	35.8	0.0	56.0	633.0	5000.0	-18.0
4573.70	H	225.0	1.0	63.5	32.7	3.8	35.8	0.0	64.2	1627.1	5000.0	-9.8
5488.50	V	225.0	1.0	56.0	34.5	4.2	35.7	0.0	59.0	888.0	5000.0	-15.0
5488.50	H	225.0	1.0	60.3	34.5	4.2	35.7	0.0	63.3	1456.8	5000.0	-10.7
6403.25	V	270.0	1.0	51.6	36.1	4.2	35.6	0.0	56.3	653.7	5000.0	-17.7
6403.25	H	270.0	1.0	48.8	36.1	4.2	35.6	0.0	53.5	473.6	5000.0	-20.5
7318.00	V	225.0	1.0	51.8	37.7	4.6	35.9	0.0	58.2	808.7	5000.0	-15.8
7318.00	H	180.0	1.0	49.0	37.7	4.6	35.9	0.0	55.4	585.9	5000.0	-18.6
8232.75	V	180.0	1.0	50.0	38.5	4.9	36.1	0.0	57.2	723.7	5000.0	-16.8
8232.75	H	180.0	1.0	48.5	38.5	4.9	36.1	0.0	55.7	608.9	5000.0	-18.3
9147.50	V	180.0	1.0	48.7	39.2	5.0	36.2	0.0	56.6	675.2	5000.0	-17.4
9147.50	H	180.0	1.0	48.7	39.2	5.0	36.2	0.0	56.6	675.2	5000.0	-17.4

Table 8: Radiated Emission Test Data, High Channel

CLIENT:	Symbol Tech.	DATE:	11/5/2004
TESTER:	Greg Snyder	JOB #:	8355
<u>EUT Information:</u>		<u>Test Requirements:</u>	
EUT:	MR100	TEST STANDARD:	FCC Part 15
CONFIGURATION:	Hi Channel 927.25MHz	DISTANCE:	3m
Antenna:	Panel Ant (H Polarity Only)	CLASS:	9
S/N:	30		
<u>Test Equipment/Limit:</u>			
ANTENNA:	A_00425	LIMIT:	15.209
CABLE:	CSITE2_HF	AMPLIFIER (dB)	A_00066

Frequency	Polarity	Az	Ant. Hght	SA Level	Ant. Corr.	Cable Corr.	Amp Gain	Duty Cycle	Corr. Level	Corr. Level	Limit	Margin
(MHz)	H/V	Deg	(m)	(dBμV)	(dB/m)	(dB)	(dB)	dB	(dBμV/m)	(μV/m)	(μV/m)	dB
Avg. (100Hz VBW)												
2781.75	V	270.0	1.0	58.3	30.4	2.9	35.7	-14.4	41.5	119.4	500.0	-12.4
2781.75	H	180.0	1.0	61.2	30.4	2.9	35.7	-14.4	44.4	166.7	500.0	-9.5
3709.00	V	0.0	1.0	57.5	31.1	2.8	35.5	-14.4	41.5	118.4	500.0	-12.5
3709.00	H	90.0	1.0	64.0	31.1	2.8	35.5	-14.4	48.0	250.3	500.0	-6.0
4636.25	V	180.0	1.0	47.0	32.9	3.9	35.8	-14.4	33.5	47.6	500.0	-20.4

Frequency	Polarity	Az	Ant. Hght	SA Level	Ant. Corr.	Cable Corr.	Amp Gain	Duty Cycle	Corr. Level	Corr. Level	Limit	Margin
(MHz)	H/V	Deg	(m)	(dBμV)	(dB/m)	(dB)	(dB)	dB	(dBμV/m)	(μV/m)	(μV/m)	dB
4636.25	H	225.0	1.0	57.0	32.9	3.9	35.8	-14.4	43.5	150.4	500.0	-10.4
5563.50	V	225.0	1.0	48.0	34.6	4.2	35.7	-14.4	36.7	68.3	500.0	-17.3
5563.50	H	225.0	1.0	50.9	34.6	4.2	35.7	-14.4	39.6	95.4	500.0	-14.4
6490.75	V	270.0	1.0	42.0	36.3	4.2	35.6	-14.4	32.5	42.2	500.0	-21.5
6490.75	H	270.0	1.0	42.8	36.3	4.2	35.6	-14.4	33.3	46.3	500.0	-20.7
7418.00	V	225.0	1.0	47.3	37.8	4.6	35.9	-14.4	39.4	92.9	500.0	-14.6
7418.00	H	225.0	1.0	46.7	37.8	4.6	35.9	-14.4	38.8	86.7	500.0	-15.2
8345.25	V	180.0	1.0	47.3	38.6	4.9	36.1	-14.4	40.2	101.9	500.0	-13.8
8345.25	H	180.0	1.0	47.0	38.6	4.9	36.1	-14.4	39.9	98.5	500.0	-14.1
9272.50	V	180.0	1.0	46.8	39.3	5.0	36.3	-14.4	40.5	105.4	500.0	-13.5
9272.50	H	180.0	1.0	47.1	39.3	5.0	36.3	-14.4	40.8	109.1	500.0	-13.2
Peak												
2781.75	V	270.0	1.0	64.5	30.4	2.9	35.7	0.0	62.1	1279.4	5000.0	-11.8
2781.75	H	180.0	1.0	65.7	30.4	2.9	35.7	0.0	63.3	1468.9	5000.0	-10.6
3709.00	V	0.0	1.0	63.2	31.1	2.8	35.5	0.0	61.6	1198.0	5000.0	-12.4
3709.00	H	90.0	1.0	70.2	31.1	2.8	35.5	0.0	68.6	2682.1	5000.0	-5.4
4636.25	V	180.0	1.0	51.3	32.9	3.9	35.8	0.0	52.3	410.9	5000.0	-21.7
4636.25	H	225.0	1.0	60.3	32.9	3.9	35.8	0.0	61.2	1154.1	5000.0	-12.7
5563.50	V	225.0	1.0	53.4	34.6	4.2	35.7	0.0	56.5	667.4	5000.0	-17.5
5563.50	H	225.0	1.0	55.6	34.6	4.2	35.7	0.0	58.7	859.7	5000.0	-15.3
6490.75	V	270.0	1.0	51.3	36.3	4.2	35.6	0.0	56.2	646.2	5000.0	-17.8
6490.75	H	270.0	1.0	51.3	36.3	4.2	35.6	0.0	56.2	646.2	5000.0	-17.8
7418.00	V	225.0	1.0	47.3	37.8	4.6	35.9	0.0	53.8	487.5	5000.0	-20.2
7418.00	H	180.0	1.0	46.7	37.8	4.6	35.9	0.0	53.2	454.9	5000.0	-20.8
8345.25	V	180.0	1.0	47.3	38.6	4.9	36.1	0.0	54.6	535.0	5000.0	-19.4
8345.25	H	180.0	1.0	47.0	38.6	4.9	36.1	0.0	54.3	516.8	5000.0	-19.7
9272.50	V	180.0	1.0	46.8	39.3	5.0	36.3	0.0	54.9	553.0	5000.0	-19.1
9272.50	H	180.0	1.0	47.1	39.3	5.0	36.3	0.0	55.2	572.5	5000.0	-18.8

4.8 AC Powerline Conducted Emissions: (FCC Part §15.207)

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 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 or peak, 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.

Data is recorded in Table 9.

Table 9. Conducted Emissions Test Data Sheet

CLIENT:	Symbol Technologies	DATE:	11/17/2004
TEST STANDARD:	FCC Part 15	JOB #:	8355
MODEL:	MR100 w plate antenna	CLASS:	FCC_B
TESTER:	James Ritter	TEST SITE:	CSITE2_CE
TEST VOLTAGE:	120 VAC		

LINE 1 - NEUTRAL

Frequency MHz	Level QP dBuV	Cable Loss dB	Limit QP dBuV	Level Corr dBuV	Margin QP dB	Level AVG dBuV	Cable Loss dB	Level Corr dBuV	Limit AVG dBuV	Margin AVG dB
0.16	44.3	10.7	65.7	55.0	-10.7	13.8	10.7	24.5	55.7	-31.2
0.66	38.0	10.8	56.0	48.8	-7.2	26.9	10.8	37.7	46.0	-8.3
1.39	30.0	10.9	56.0	40.9	-15.1	23.3	10.9	34.2	46.0	-11.8
2.78	28.5	11.2	56.0	39.7	-16.3	20.8	11.2	32.0	46.0	-14.0
5.83	28.1	11.6	60.0	39.7	-20.3	28.1	11.6	39.7	50.0	-10.3
6.83	32.0	11.6	60.0	43.6	-16.4	25.8	11.6	37.4	50.0	-12.6
8.16	28.8	11.8	60.0	40.6	-19.4	28.8	11.8	40.6	50.0	-9.4
23.16	26.0	12.8	60.0	38.8	-21.2	26.0	12.8	38.8	50.0	-11.2

LINE 2 – PHASE

Frequency MHz	Level QP dBuV	Cable Loss dB	Limit QP dBuV	Level Corr dBuV	Margin QP dB	Level AVG dBuV	Cable Loss dB	Level Corr dBuV	Limit AVG dBuV	Margin AVG dB
0.16	44.0	10.7	65.7	54.7	-11.0	14.4	10.7	25.1	55.7	-30.6
0.66	37.4	10.8	56.0	48.2	-7.8	28.8	10.8	39.6	46.0	-6.4
1.39	28.6	10.9	56.0	39.5	-16.5	28.6	10.9	39.5	46.0	-6.5
2.78	28.8	11.2	56.0	40.0	-16.0	28.8	11.2	40.0	46.0	-6.0
5.83	29.0	11.6	60.0	40.6	-19.4	29.0	11.6	40.6	50.0	-9.4
6.83	31.4	11.6	60.0	43.0	-17.0	31.4	11.6	43.0	50.0	-7.0
8.16	30.6	11.8	60.0	42.4	-17.6	30.6	11.8	42.4	50.0	-7.6
23.16	24.6	12.8	60.0	37.4	-22.6	24.6	12.8	37.4	50.0	-12.6