Washington Laboratories, Ltd.

FCC Certification Test Report
For the
Symbol Technologies, Inc.
RD11440

FCC ID: H9PRD11440

WLL JOB# **9081-01**
March 24, 2006

Revision 1: April 14, 2006

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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Documentation Specialist

Reviewed by: Gregory M. Snyder
Chief EMC Engineer

Abstract

This report has been prepared on behalf of Symbol Technologies, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Licensed Transmitter under Part 90.353 of the FCC Rules. This Certification Test Report documents the test configuration and test results for a Symbol Technologies, Inc. Model RD11440.

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. RD11440 complies with the limits for a Licensed Transmitter device under FCC Part 90.353.

Revision 1 of this report addresses issues noted during the TCB review. Section 4.1 and Table 5 have been amended.

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1 Introduction

1.1 Compliance Statement

The Symbol Technologies, Inc. RD11440 complies with the limits for a Licensed Transmitter device under FCC Part 90.353 for a non-multilateration LMS system.

1.2 Test Scope

Tests for radiated and conducted (at antenna terminal) emissions were performed. All measurements were performed in accordance with FCC Part 90 Subpart M and the methods described in TIA/EIA-603. 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
Purchase Order Number:	4500536341
Quotation Number:	62746

1.4 Test Dates

Testing was performed on the following date(s):	February 20 to February 27, 2006

1.5 Test and Support Personnel

Washington Laboratories, LTD	James Ritter, Steve Dovell
Client Representative	Alan Parrish

2 Equipment Under Test

2.1 EUT Identification & Description

The Symbol Technologies, Inc. RD11440 is an advanced RFID Reader that supports Class 0, Class 1 and GEN 2 Electronic Product Code (EPC) protocol, in the UHF frequency band. The unit with the 20 Watt power amplifier is designed for operation as a non-multilateration under FCC Part 90 Subpart M. The reader consists of two modules within the housing assembly:

- RF Transceiver Module (RFTM)
- Digital Control Module (DCM)

and a separate module for the 20 Watt amplifier.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Symbol Technologies, Inc.
FCC ID:	H9PRD11440
Model:	RD11440
FCC Rule Parts:	§90
Frequency Range:	910.75M – 920.75MHz
Maximum Output Power:	19.23 Watts (ERP)
Modulation:	ASK
Occupied Bandwidth:	182.121kHz
Keying:	Automatic
Type of Information:	Data
Number of Channels:	50
Power Output Level	Fixed
Antenna Connector	BNC
Antenna Type	Flat panel antenna
Emission Type(s):	F1D
Emission Designator:	183KF2D
Power Source & Voltage:	24Vdc from 115 Vac source

2.2 Test Configuration

The RD11440 was configured as shown in the following table:

Description	Manufacturer	Model	S/N
Transceiver Unit	Symbol	XR400	C80507AF82804560
Power AMP	Symbol	CAPTRON 900-PA	N/A
1000 MHz Low Pass Filter	Microlab/FXR	LA10F	01867
Power Supply	Globetek	GT-211331-7224	024771 26/04

The following support equipment was used during testing:

Description	Manufacturer
Fan Unit	NA
10/100 BaseT Hub	Netgear
24VDC Power Supply Card	Symbol

The test configuration is illustrated in the diagram below.

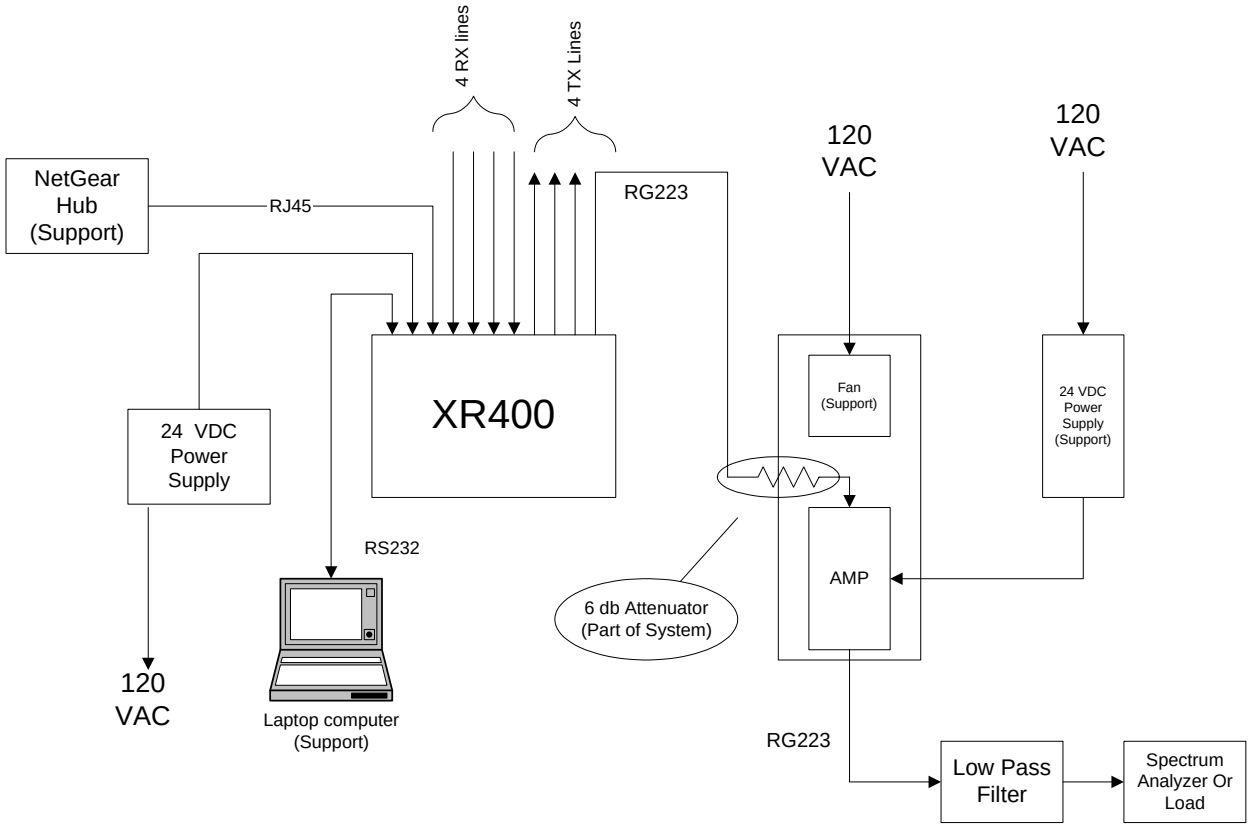

Figure 2-1. Test Configuration.

2.3 Testing Algorithm

The RD11440 was operated by using a support laptop via RS232 to send tuning channel commands the XR400 unit using Symbol ART software. The unit is capable of being set from channel 6 (610.75MHz) to channel 26 (920.75MHz). During the conducted tests the unit was set to the low, middle, and high channel. Power of the unit was also set to the maximum of (256 13) using the ART software.

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

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

Land Mobile FM or PM Communications Equipment Measurement and Performance Standards (ANSI/TIA/EIA-603-93)

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.

3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

Table 2: Test Equipment List

WLL Asset #	Manufacturer Model/Type	Function	Cal. Due
0072	HP 8568B	SPECTRUM ANALYZER	7/5/2006
0382	SUNOL JB1	BICONILOG ANTENNA	1/6/2006
0070	HP 85685A	RF PRESELECTOR	7/25/2006
0004	ARA DRG118/A	MICROWAVE HORN ANTENNA	2/2/2007
0034	EMCO BIA-30	BICON ANTENNA 30 – 200MHz	6/14/2006
0029	EMCO 3146A	LOG ANTENNA 200 -1000MHz	6/28/2006
0001	A.H. SYSTEMS SAS-200/518	LOG ANTENNA 1 -18GHz	3/11/2006
0066	HEWLETT-PACKARD 8449B	MICROWAVE PREAMP	6/14/2006
0068	HEWLETT-PACKARD 85650A	QUASI-PEAK ADAPTER	6/30/2006
0159	HEWLETT-PACKARD 8648A	SIGNAL GENERATOR	8/12/2006
0257	HEWLETT-PACKARD 8672A	SIGNAL GENERATOR	3/04/2006
NA	HEWLETT-PACKARD 8563A	SPECTRUM ANALYZER	4/27/2006
0117	RACAL DANA	FREQUENCY COUNTER	5/16/2006
0473	FLUKE, 111	MULTIMETER W/CURRENT CLAMP	5/14/2006
0361	GLOBAL SPECIALTIES, 1337	SUPPLY, POWER, DC	CNR
0254	TENNEY, TR64	ENVIRONMENTAL CHAMBER	10/6/2006

4 Test Results

4.1 RF Power Output: (FCC Part §2.1046)

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 was setup to transmit an un-modulated signal. The output power at the antenna terminal was then measured and recorded.

The antenna specified for use with the RD11440 system is a 6dBi antenna. Per §90.205(k) LMS systems operating pursuant to subpart M are authorized a maximum of 30 watts ERP.

Table 3 lists the power measurements for the RD11440 along with the calculated ERP levels using a 6 dBi antenna for informational purposes.

Table 3. RF Power Output

Frequency	Output Power (dBm)	Output Power (Watts)	Antenna Gain dBi	EIRP Watts	ERP Watts	ERP Limit Watts
Low Channel 910.75MHz	38.87	7.71	6	30.69	18.70	30
Mid Channel 915.75MHz	38.66	7.35	6	29.24	17.83	30
High Channel 920.75MHz	38.99	7.93	6	31.55	19.23	30

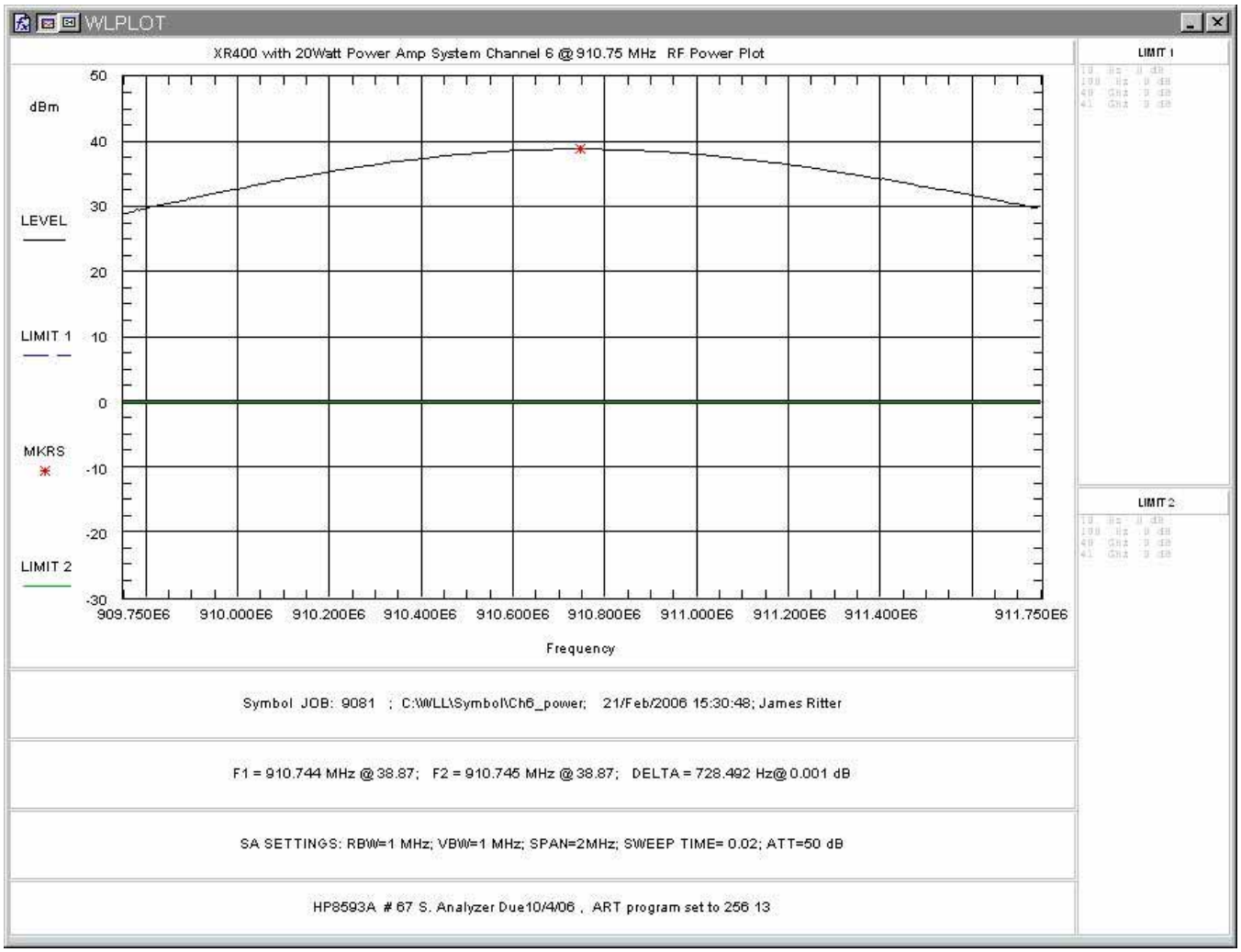

Figure 4-1. RF Peak Power, Channel 6

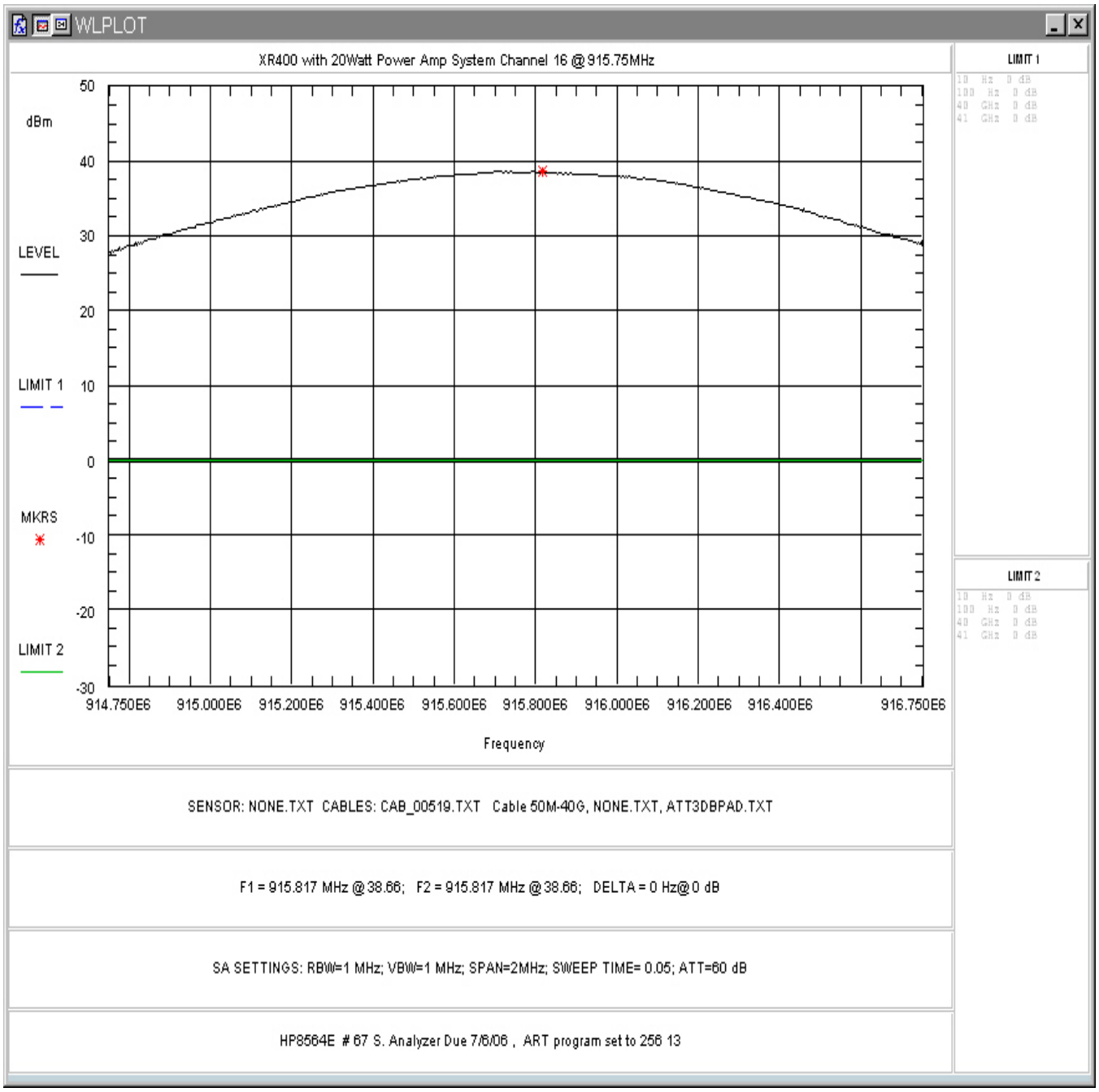

Figure 4-2. RF Peak Power, Channel 16

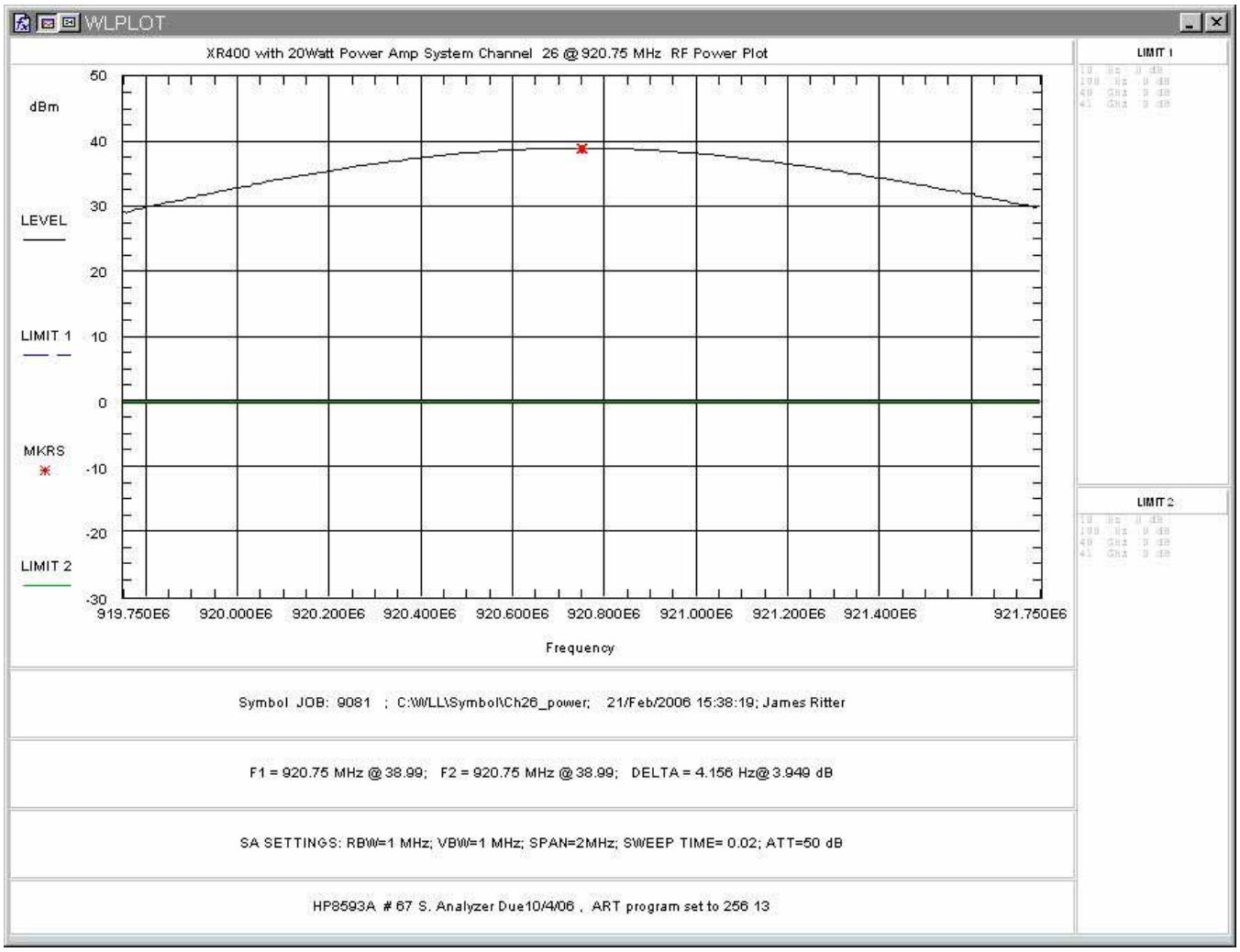

Figure 4-3. RF Peak Power, Channel 26

4.2 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer via a direct connection through an attenuator.

Per §90.209(b)(5) the maximum authorized bandwidth for a non-multilateration LMS operation operating in the range 909.75M – 921.75MHz shall be 12MHz.

The measured occupied bandwidths measured at the low, middle, and high channels are shown in the following figures.

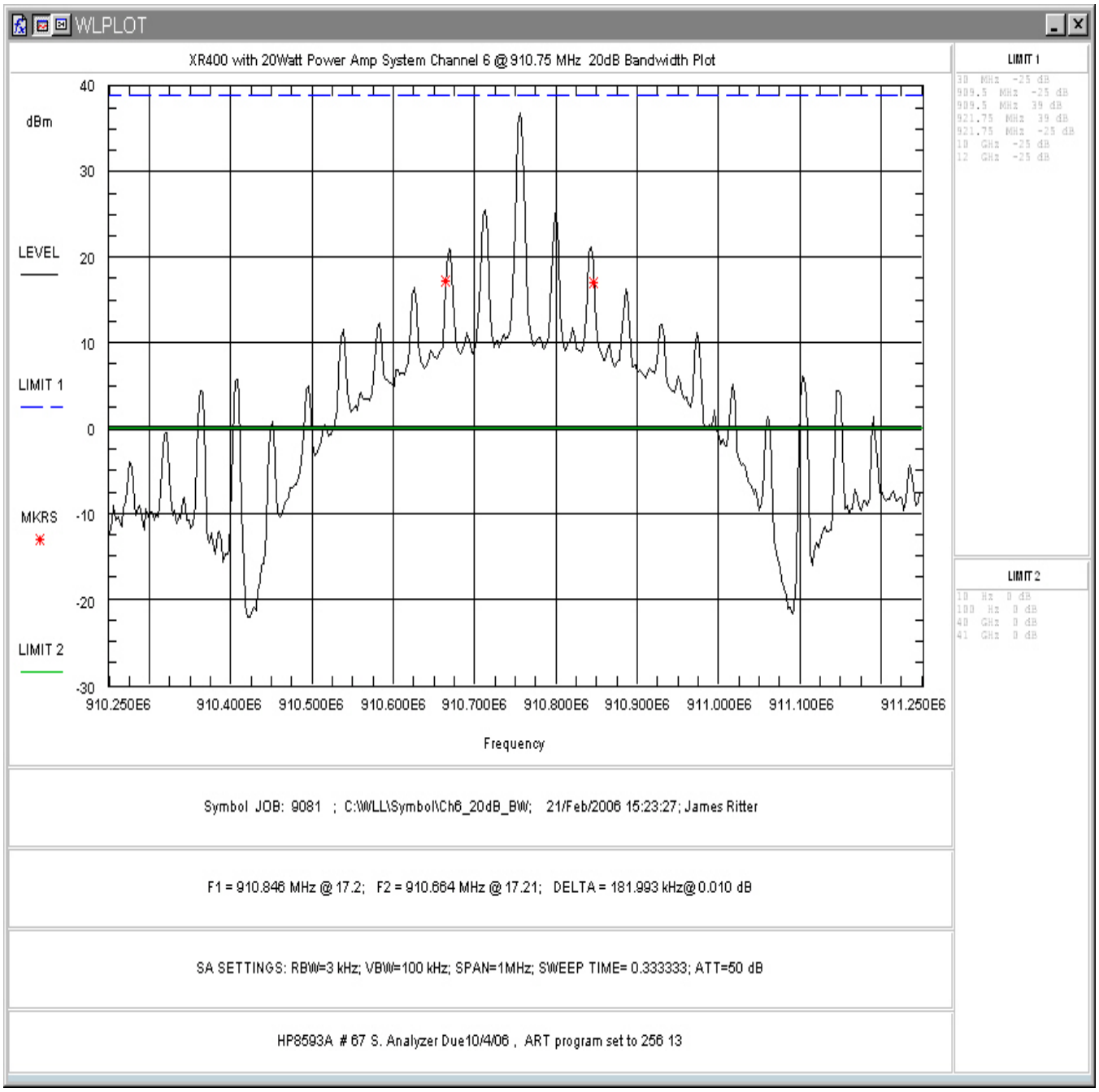

Figure 4-4. Occupied Bandwidth, Low Channel

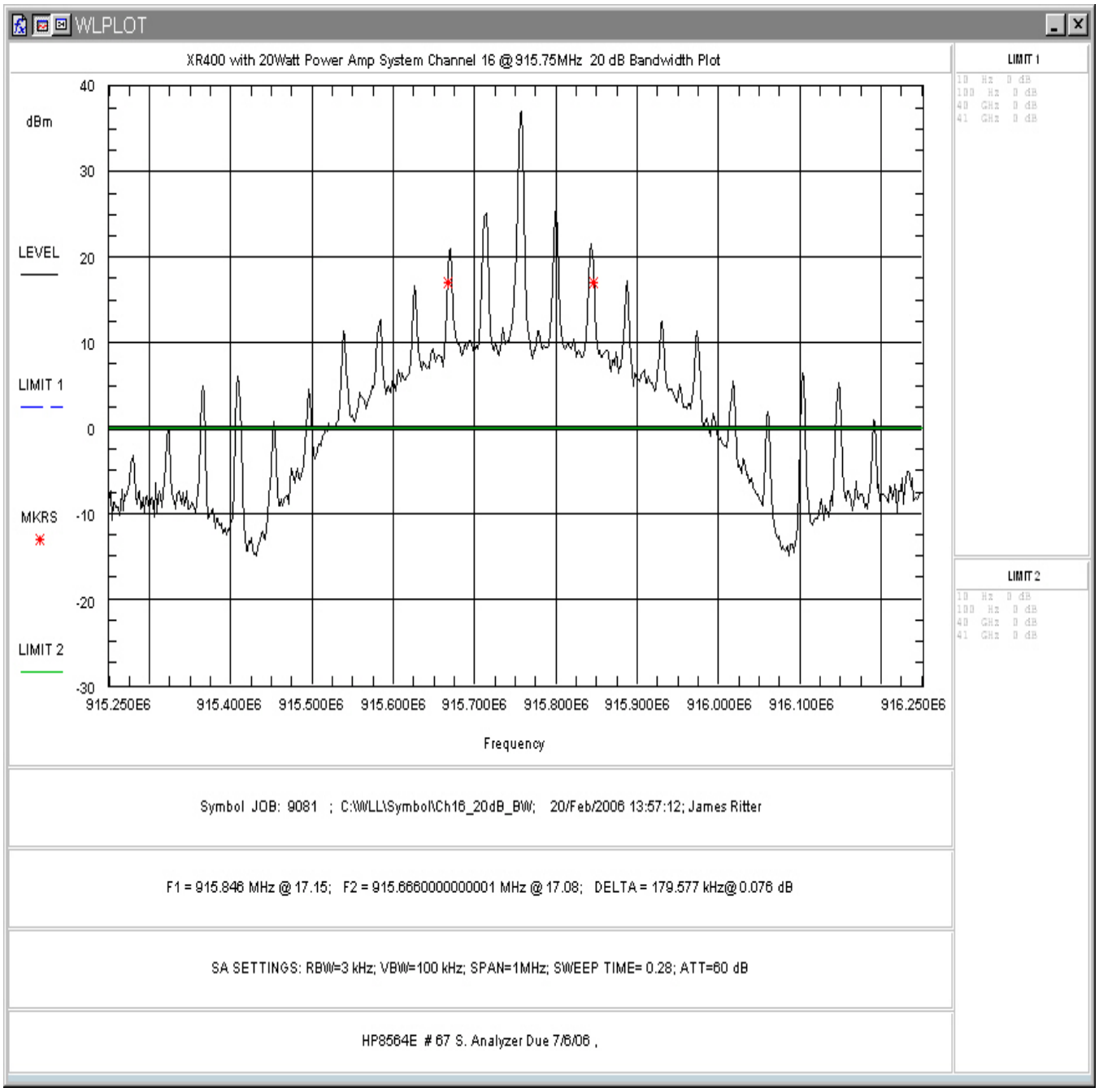

Figure 4-5. Occupied Bandwidth, Mid Channel

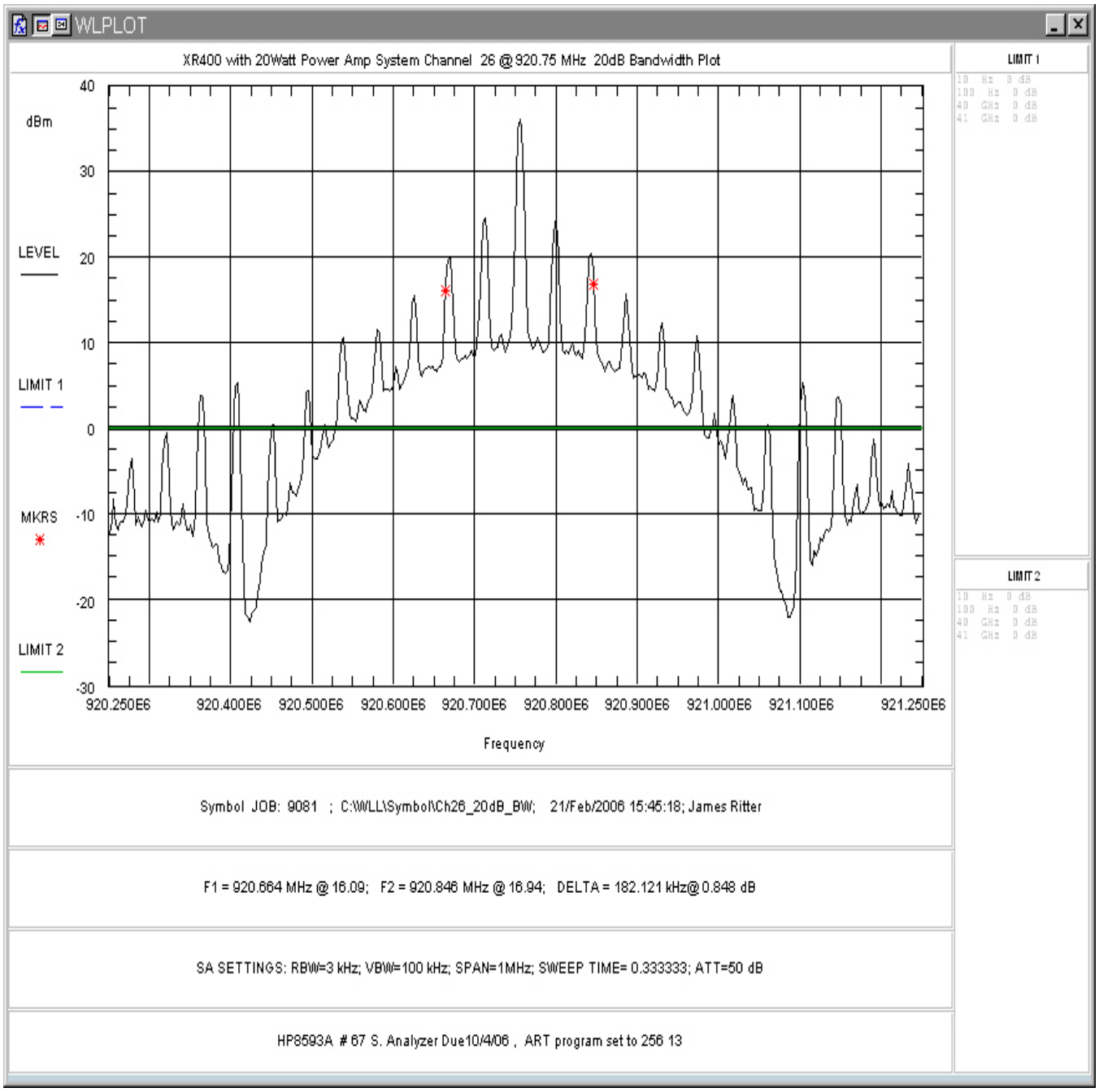

Figure 4-6. Occupied Bandwidth, High Channel

Table 4 provides a summary of the Occupied Bandwidth Results.

Table 4. Occupied Bandwidth Results

Frequency	Bandwidth
Low Channel 910.75MHz	182.993kHz
Mid Channel 915.75MHz	179.577kHz
High Channel 920.75MHz	182.121kHz

Emission designator:

Modulation = FSK, Measured Bandwidth = 182.993kHz

Designator: 183KF2D

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

The EUT must comply with requirements for spurious emissions at antenna terminals per the limit specified in §90.210(k)(3). The following specifies the limit for Emissions Mask K:

For all other transmitters authorized under subpart M that operate in the 902–928 MHz band, the peak power of any emission shall be attenuated below the power of the highest emission contained within the licensee's sub-band in accordance with the following schedule:

(i) On any frequency within the authorized bandwidth: Zero dB.

(ii) On any frequency outside the licensee's sub-band edges: 55 + 10 log(P) dB, where (P) is the highest emission (watts) of the transmitter inside the licensee's sub-band

The LMS sub-band edges for non-multilateration systems for which emissions must be attenuated are 902.00, 904.00, 909.5 and 921.75 MHz.

The output of the EUT was connected directly into a spectrum analyzer through an attenuator. All necessary offsets and corrections were programmed into the data collecton software. The spurious emissions and the emissions mask (in-band) emissions were then measured and recorded.

The following are plots of the conducted spurious emissions data. Figure 4-7 through Figure 4-12 are plots of the emissions mask. Figure 4-11 through Figure 4-15 are plots of the out-of-band spurious emissions.

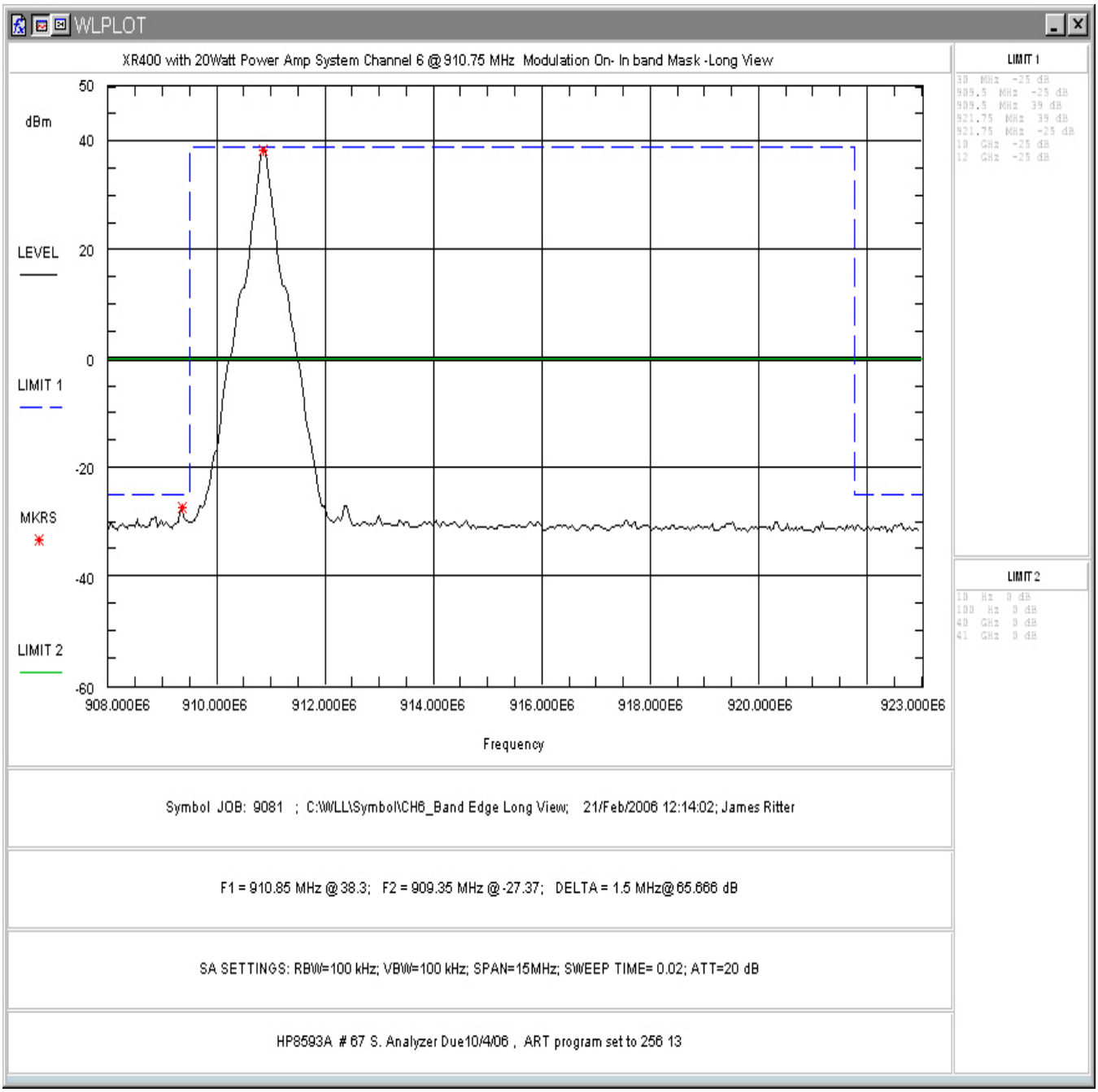

Figure 4-7. Emission Mask, §90.210(k), Low Channel @ 910.75MHz (100kHz RBW)

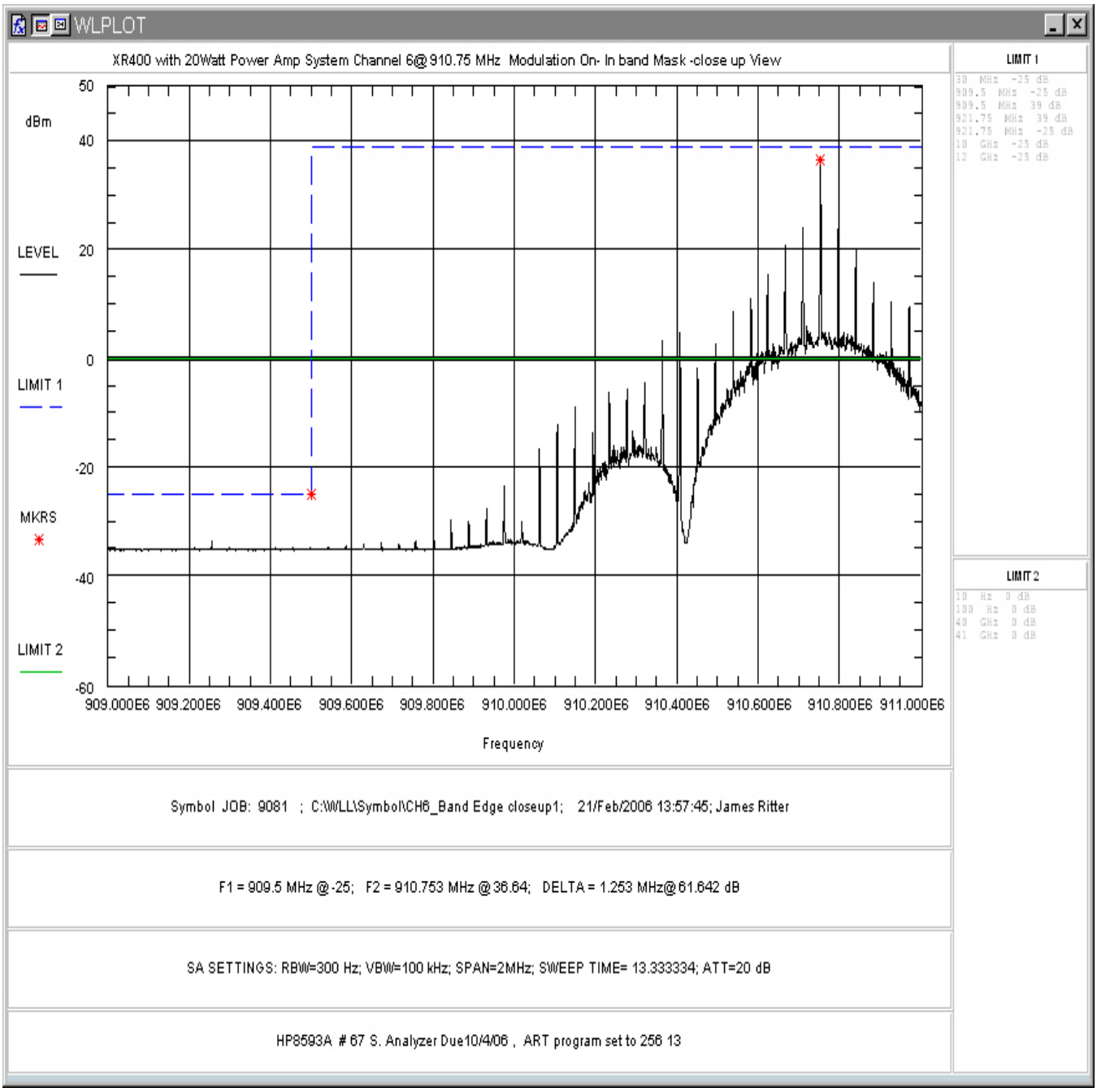

Figure 4-8. Emission Mask, §90.210(k), Low Channel @ 910.75MHz (300Hz RBW)

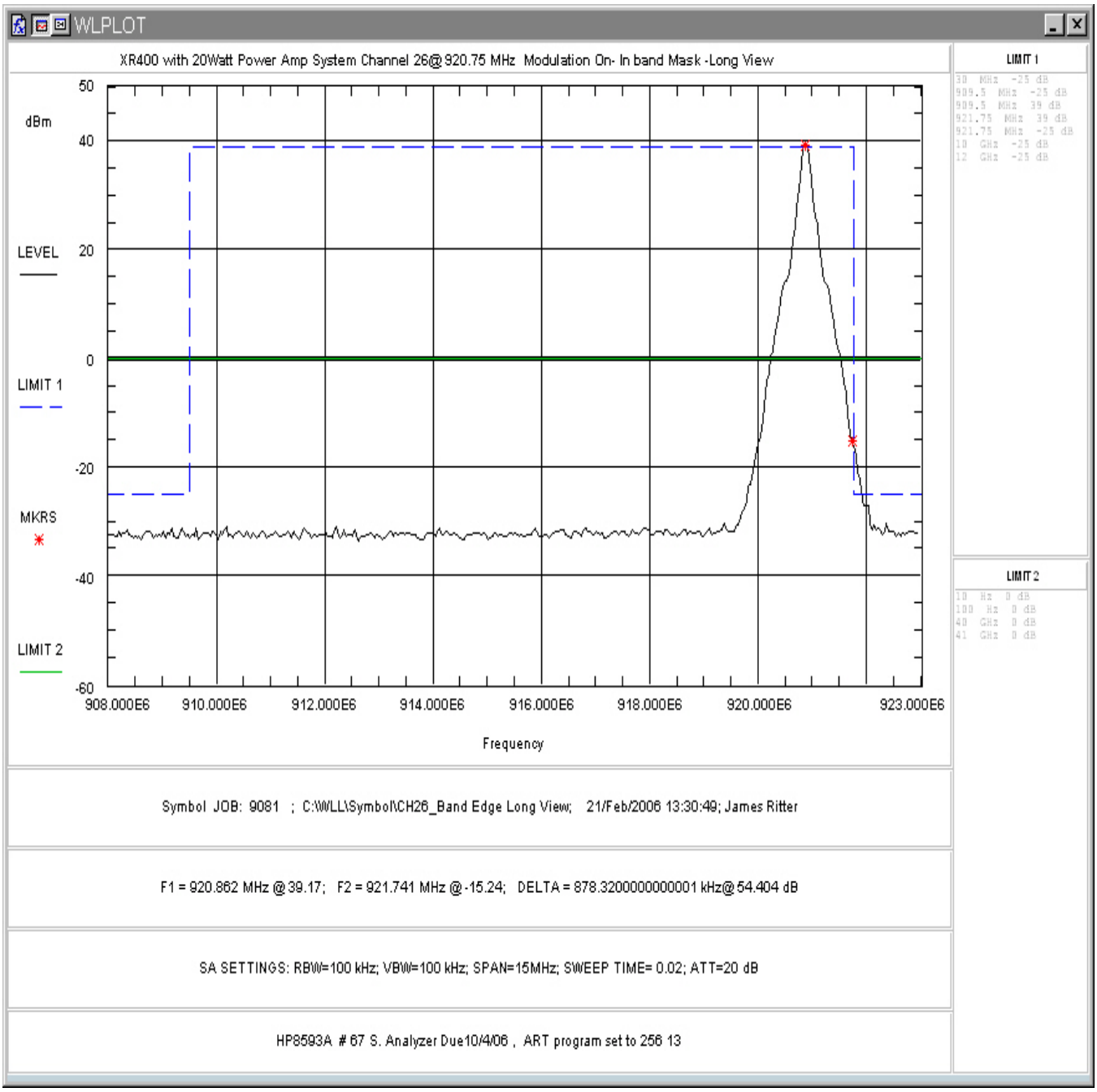

Figure 4-9. Emission Mask, §90.210(k), High Channel @ 920.75MHz (100kHz RBW)

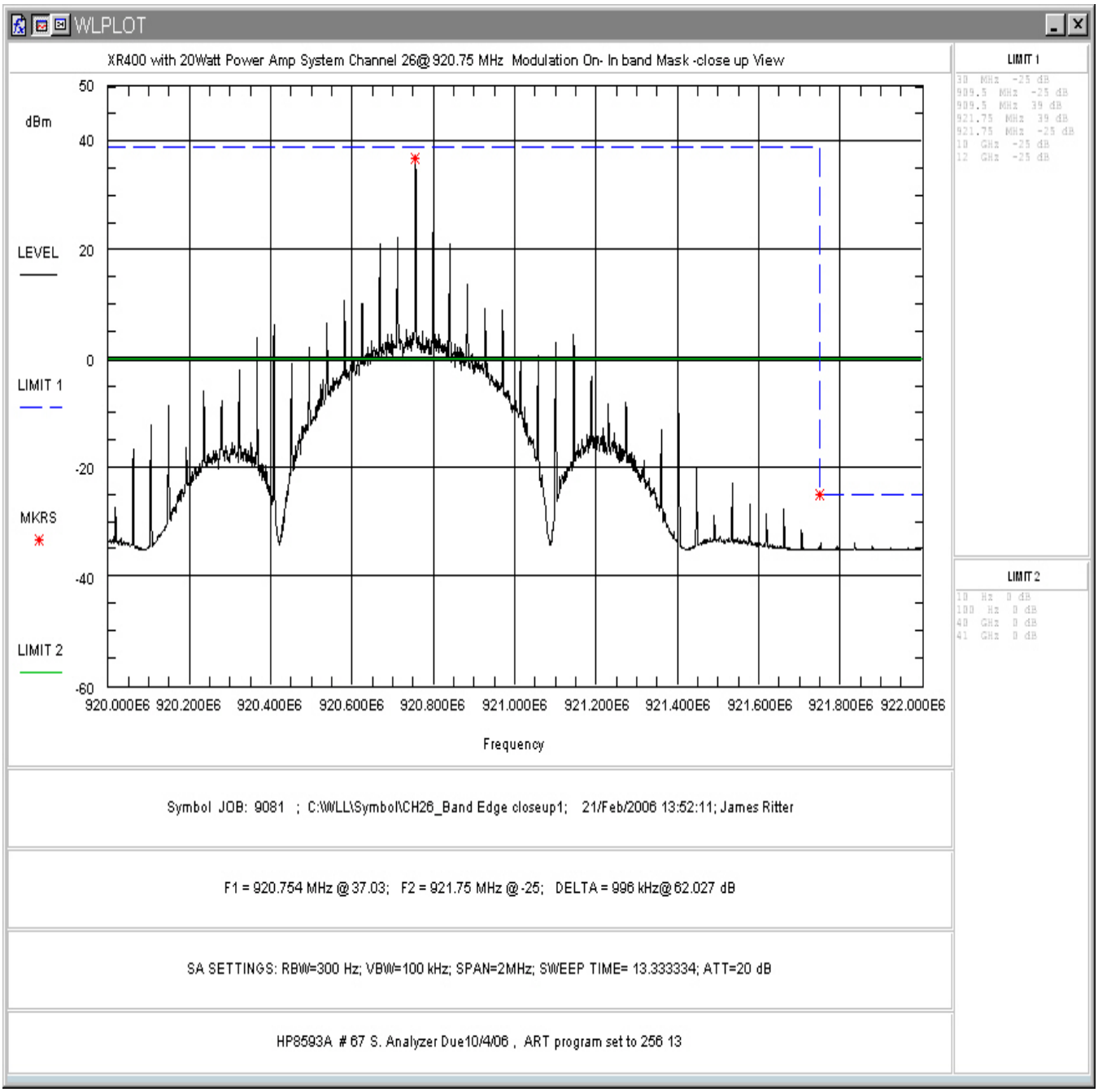

Figure 4-10. Emission Mask, §90.210(k), High Channel @ 920.75MHz (300Hz RBW)

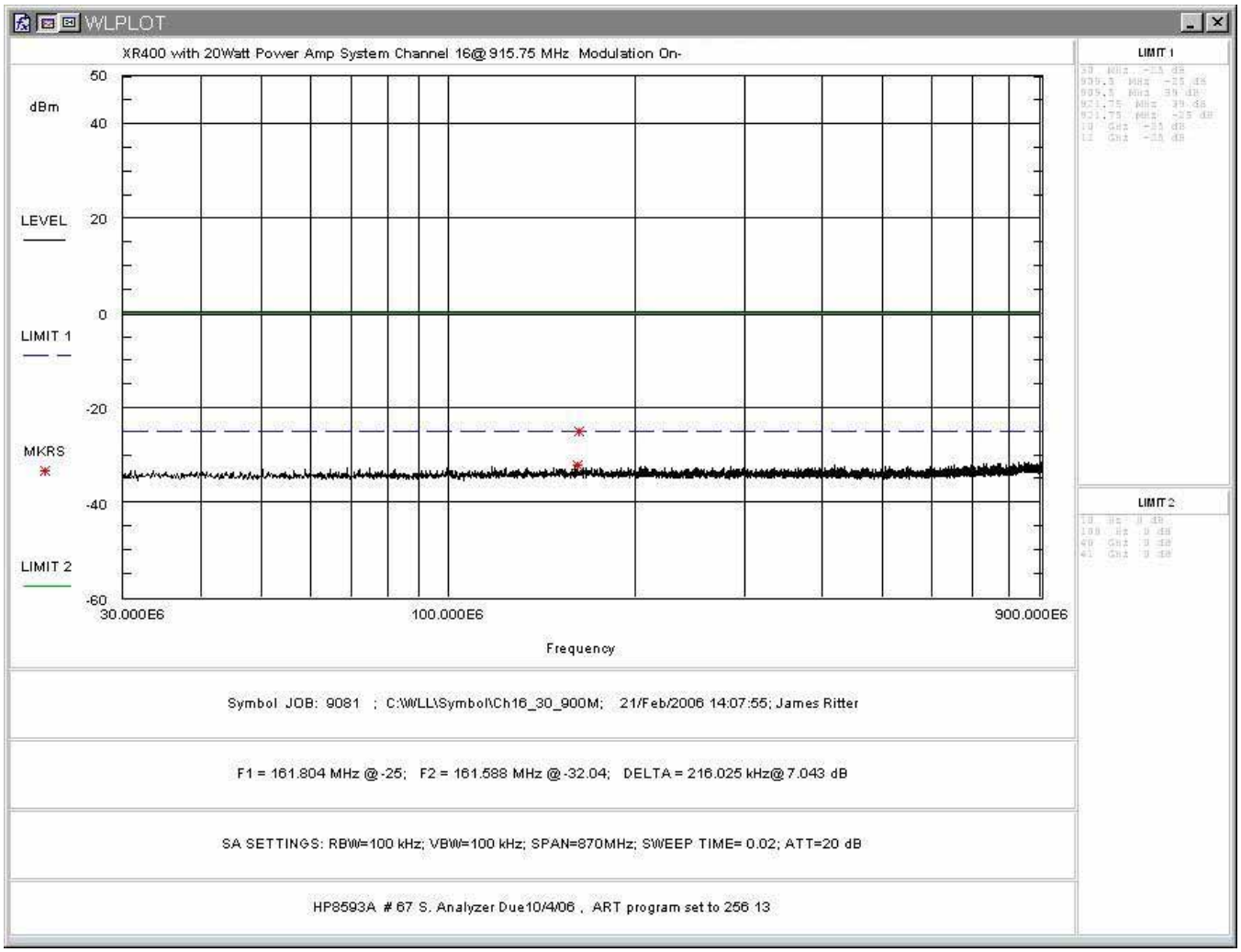

Figure 4-11. Conducted Spurious Emissions, Channel 16: 30 - 900MHz

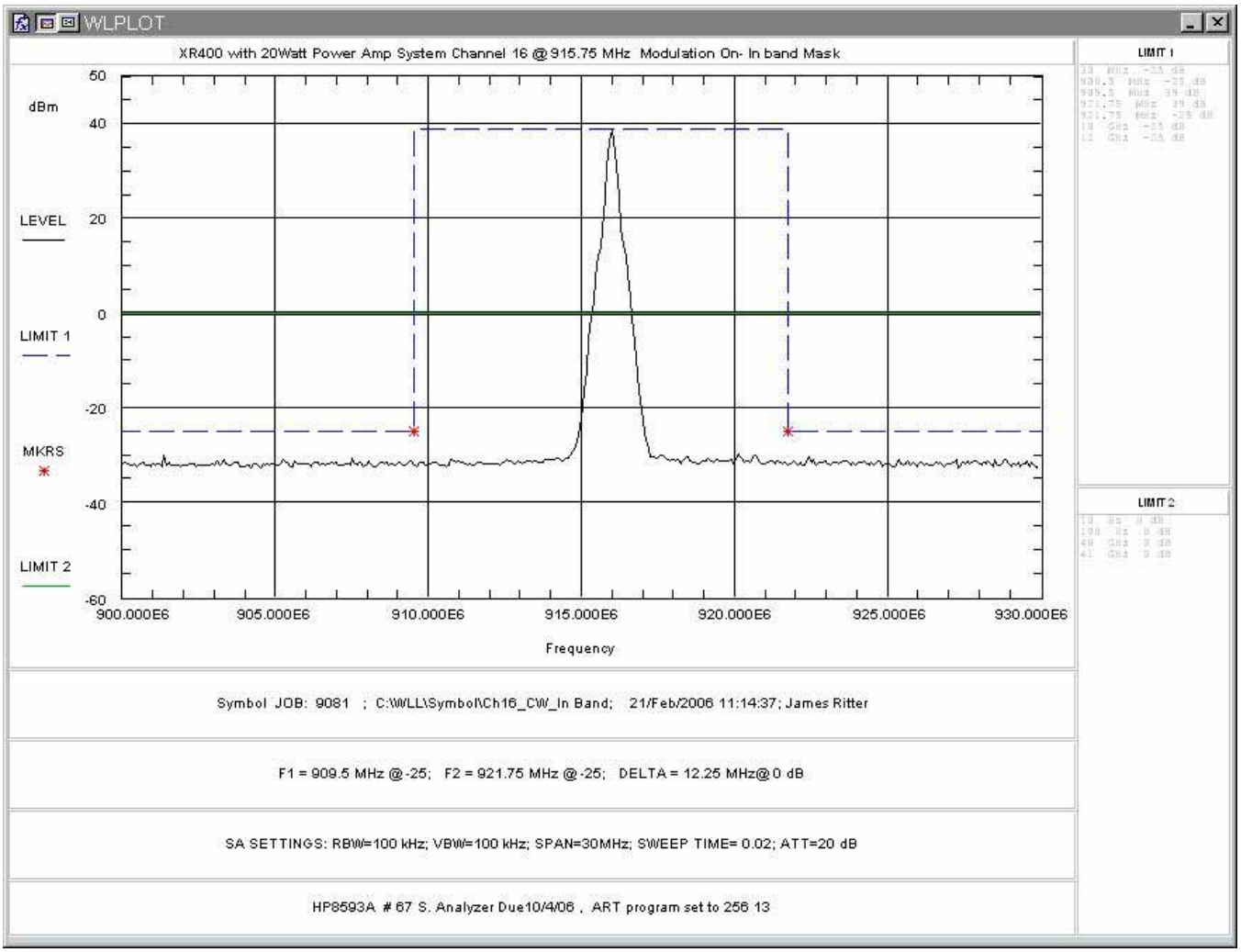

Figure 4-12. Emission Mask, §90.210(k), Mid Channel @ 915.75MHz, 900 – 930MHz

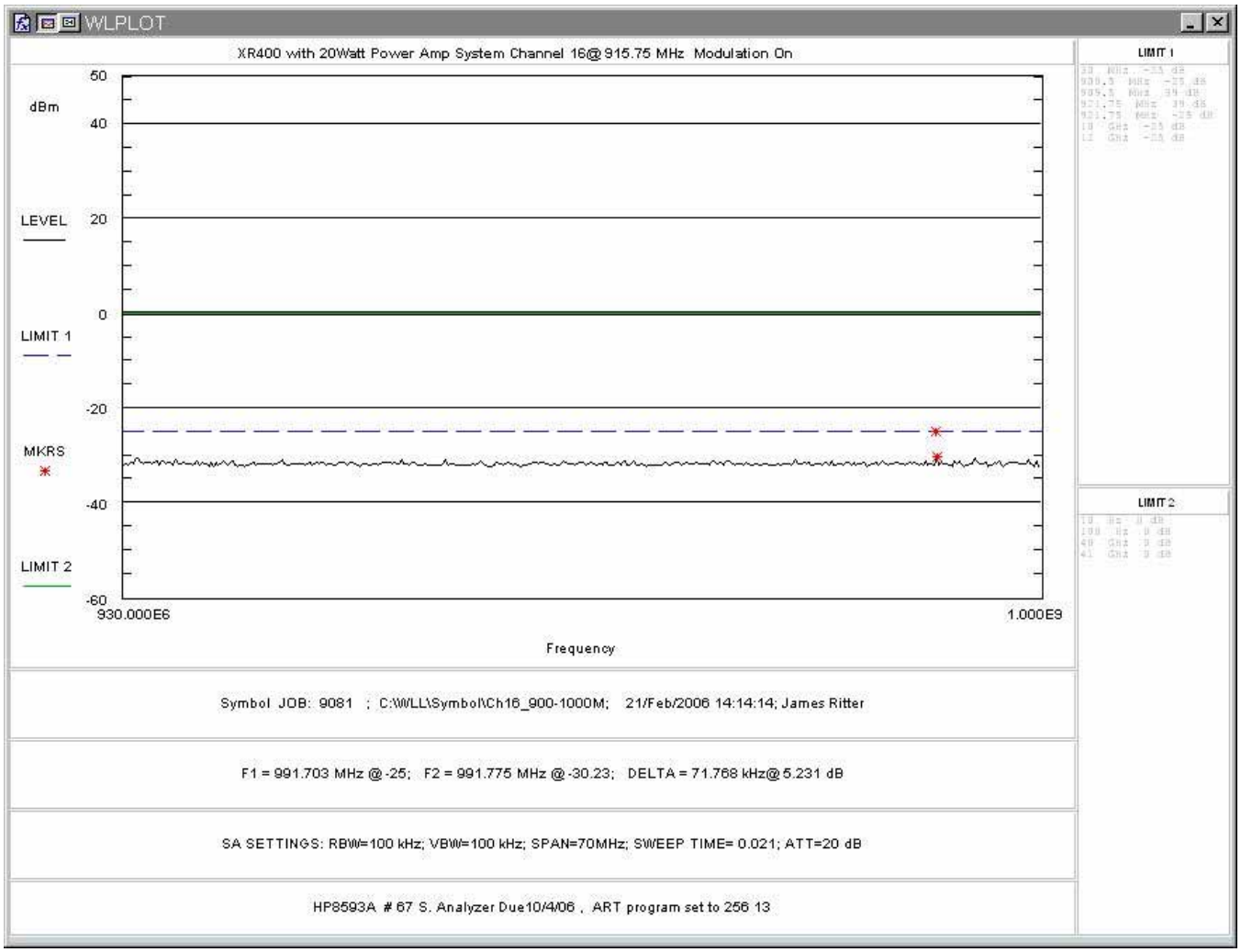

Figure 4-13. Conducted Spurious Emissions, Channel 16: 930MHz – 1GHz

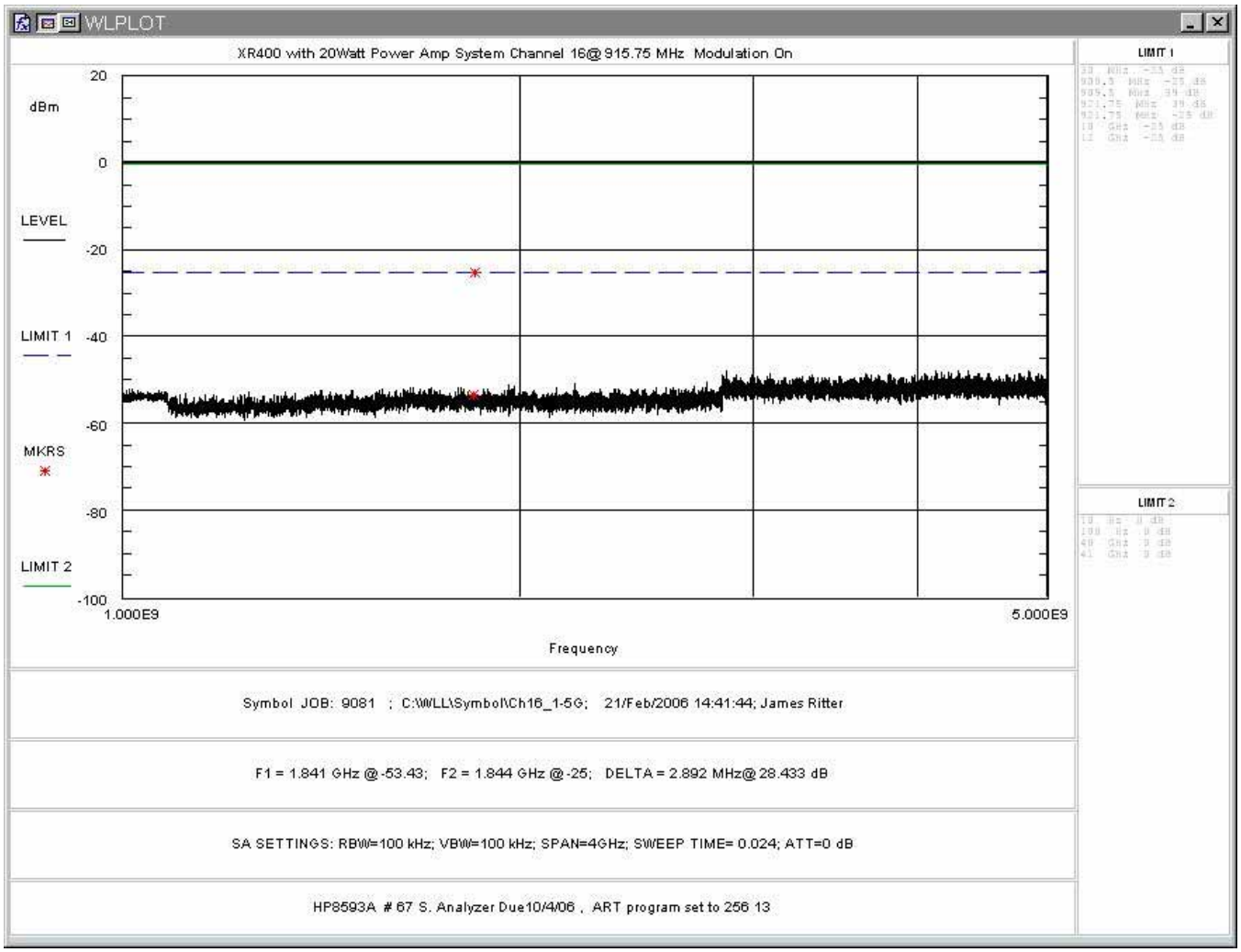

Figure 4-14. Conducted Spurious Emissions, Channel 16: 1 –5GHz

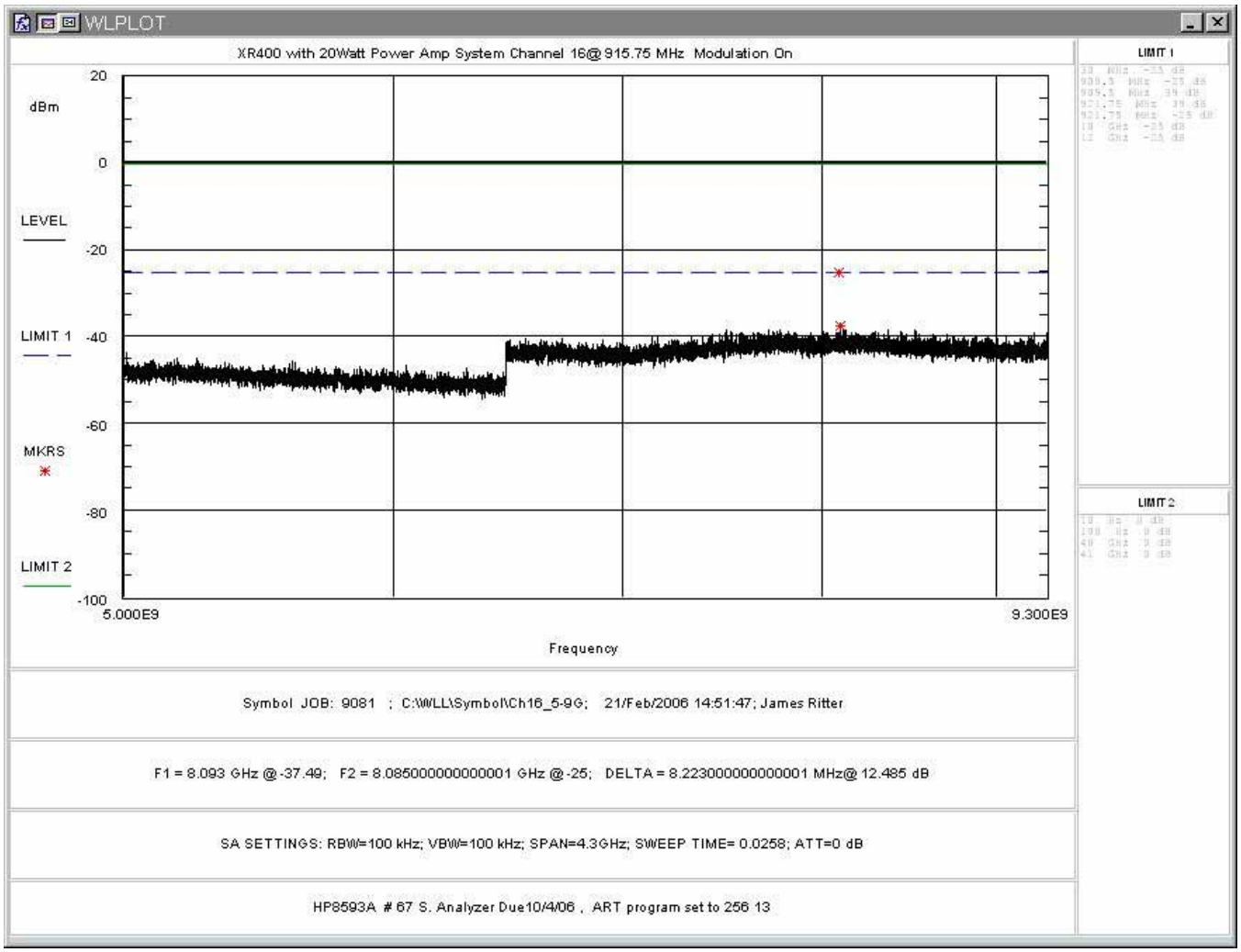

Figure 4-15. Conducted Spurious Emissions, Channel 16: 5 - 9GHz

4.4 Radiated Spurious Emissions: (FCC Part §2.1053)

The EUT must comply with the requirements for case radiated spurious emissions per the limits specified in §90.210(k)(3).

4.4.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The output of the transmitter was terminated into a 50ohm load. 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. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The spurious emission levels were measured and, using the signal substitution method, the power level of the emission was compared with the limit of FCC Part 90.210(k)(3). As the unit was tested with the output terminated the absolute limit for the spurious emissions was calculated using 55+10Log(P) dB.

Emissions were scanned up to the 10^{th} harmonic of the fundamental. The unit was tested in three orthogonal planes with the highest emissions for each emission detected reported. The signal substitution method per TIA/EIA-603 was used to obtain ERP levels.

The limit is calculated as follows:

Output Power = 39dBm

Limit = 39dBm – (55+10Log(7.925W)) = -25dBm

Table 5: Radiated Emission Test Data

CLIENT:	Symbol	DATE:	2/22/06
TESTER:	Steve Dovell	JOB #:	9081
EUT Information:		**Test Requirements:**	
EUT:	XR400 /W 20dB amp	TEST STANDARD:	FCC Part 90
Configuration:	TX on Ch16	DISTANCE:	3m
Tx Frequency:	915.75MHz	Power (Watts)	7.5
Test Equipment/Limit:			
Substitution Ant:	A0425, A0026, A0028	LIMIT:	FCC P90.210 Mask K

Frequency (MHz)	Polarity H/V	Az Deg	Ant. Hght (m)	Spur Level dBµV	Sub. Sig. Gen. Level dBm	Sub. Power Level dBm	Sub. Ant. Factor dB/m	Sub. Ant. Gain dBd	ERP Level dBm	Limit dBm	Margin dB
38.92	H	82.0	1.0	10.7	-46.7	-48.6	11.7	-11.9	-58.6	-25	-33.6
39.01	V	109.0	1.0	21.8	-49.1	-51.0	11.7	-11.9	-62.9	-25	-37.9
45.03	V	175.0	1.0	21.5	-61.1	-63.3	10.8	-9.7	-70.8	-25	-45.8
45.03	H	0.0	1.0	7.0	-60.3	-60.3	10.8	-9.7	-70.0	-25	-45.0
49.26	V	116.0	1.0	21.2	-61.1	-63.3	10.2	-8.3	-69.4	-25	-44.4
49.26	H	159.0	1.0	14.5	-54.0	-56.4	10.2	-8.3	-62.3	-25	-37.3
62.19	V	146.0	1.0	21.8	-61.9	-64.2	9.6	-5.7	-67.6	-25	-42.6
62.19	H	183.0	3.0	25.4	-48.6	-50.9	9.6	-5.7	-54.3	-25	-29.3
74.63	V	204.0	1.0	17.1	-63.7	-66.7	9.5	-4.0	-67.7	-25	-42.7
74.63	H	301.0	2.7	18.3	-57.0	-59.9	9.5	-4.0	-61.0	-25	-36.0
83.38	V	37.0	1.0	20.4	-62.8	-66.2	9.6	-3.1	-65.9	-25	-40.9
83.38	H	178.0	1.0	14.4	-60.9	-64.2	9.6	-3.1	-64.0	-25	-39.0
108.57	V	139.0	1.0	21.8	-55.3	-58.9	10.8	-2.1	-57.4	-25	-32.4
108.57	H	174.0	1.0	10.4	-63.5	-67.1	10.8	-2.1	-65.6	-25	-40.6
164.79	V	123.0	1.0	19.6	-54.0	-58.8	13.3	-0.9	-54.9	-25	-29.9
164.79	H	66.0	2.4	14.1	-65.0	-69.9	13.3	-0.9	-65.9	-25	-40.9
179.76	H	0.0	2.3	7.9	-22.5	-32.3	14.1	-1.0	-33.3	-25	-8.3
187.22	H	35.0	1.7	16.0	-22.5	-32.3	14.3	-0.9	-33.2	-25	-8.2
266.98	V	170.0	1.0	15.3	-53.5	-59.1	18.9	-2.3	-55.8	-25	-30.8
266.98	H	200.0	3.6	11.9	-65.0	-70.7	18.9	-2.3	-67.3	-25	-42.3
407.930	V	178.0	2.0	13.5	-68.2	-68.2	15.1	5.2	-63.1	-25	-38.1
407.93	H	169.0	2.5	9.8	-68.6	-68.6	15.1	5.2	-63.5	-25	-38.5
952.000	V	45.0	1.0	9.1	-54.5	-65.2	23.4	4.3	-61.0	-25	-36.0
952.00	H	182.0	1.0	12.0	-47.9	-58.5	23.4	4.3	-54.3	-25	-29.3
1125.01	H	210.0	1.0	48.9	-59.0	-64.0	25.0	4.1	-60.0	-25	-35.0
1831.65	V	38.0	1.0	73.1	-32.0	-42.0	27.9	5.5	-36.6	-25	-11.6
1831.80	H	349.0	1.0	72.0	-28.0	-38.0	27.9	5.5	-32.6	-25	-7.6
2747.23	H	82.0	1.0	59.0	-38.0	-44.6	29.7	7.2	-37.5	-25	-12.5
2747.40	V	332.0	1.0	53.9	-42.5	-48.5	29.7	7.2	-41.4	-25	-16.4
3663.00	H	167.0	1.0	52.2	-42.5	-53.1	30.5	8.9	-44.3	-25	-19.3
3663.15	V	154.0	1.0	60.2	-43.5	-53.9	30.5	8.9	-45.1	-25	-20.1
5494.52	H	331.0	1.0	43.2	-37.0	-58.9	33.9	9.0	-50.0	-25	-25.0

4.5 Frequency Stability: (FCC Part §2.1055)

Per the requirements of §90.213 fixed non-multilateration transmitters with an authorized bandwidth that is more than 40kHz from the band edge are not subject to the frequency tolerance restrictions. To show that the EUT operates more than 40kHz from the band edge 2 plots were obtained. One plot is for the low channel and the 2nd plot is for the high channel. Each plots shows that the -25dBm point is much greater than 40kHz from the band edge and therefore frequency stability testing is not required.

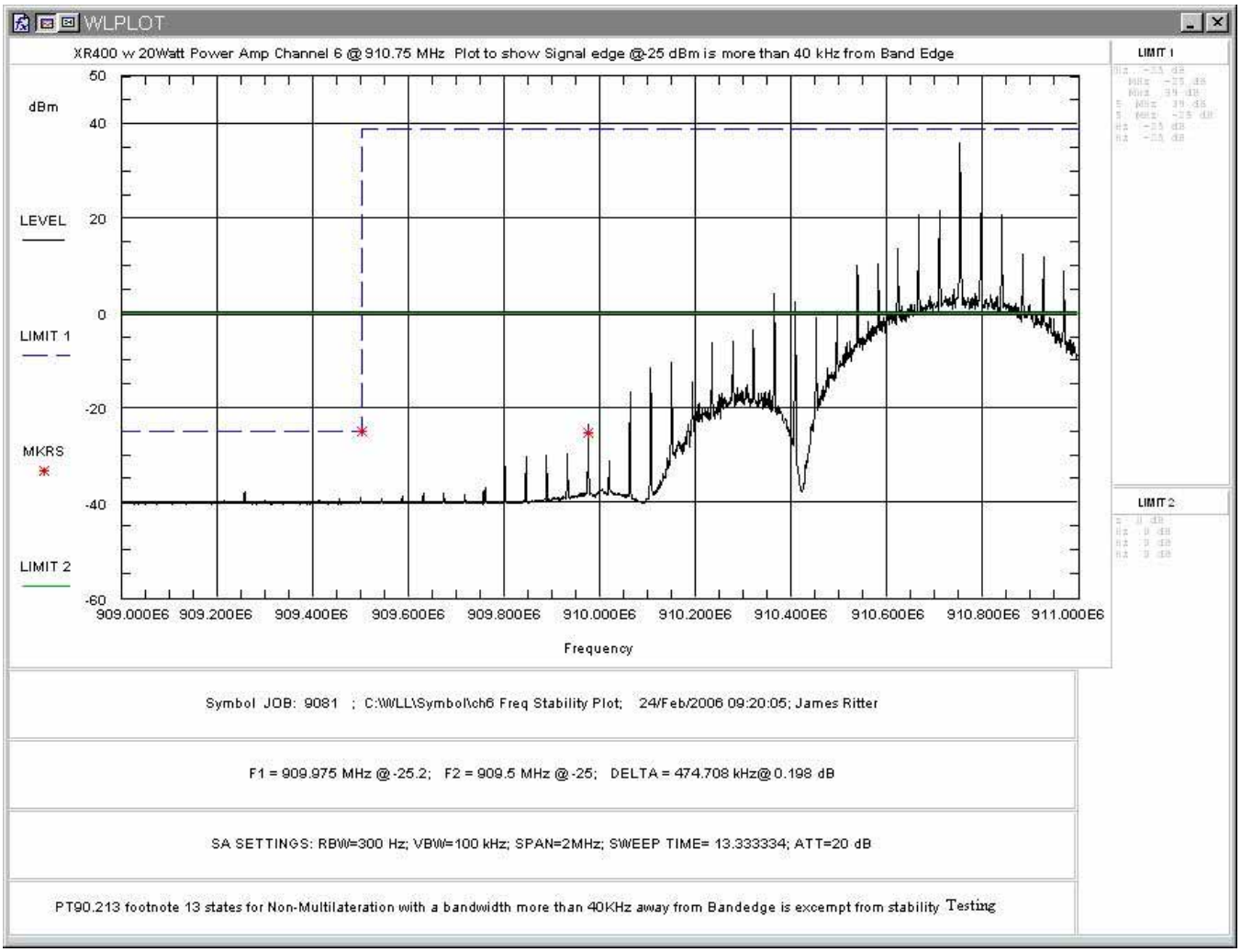

Figure 4-16, Frequency Stability Plot Showing >40kHz from Bandedge, Low Channel

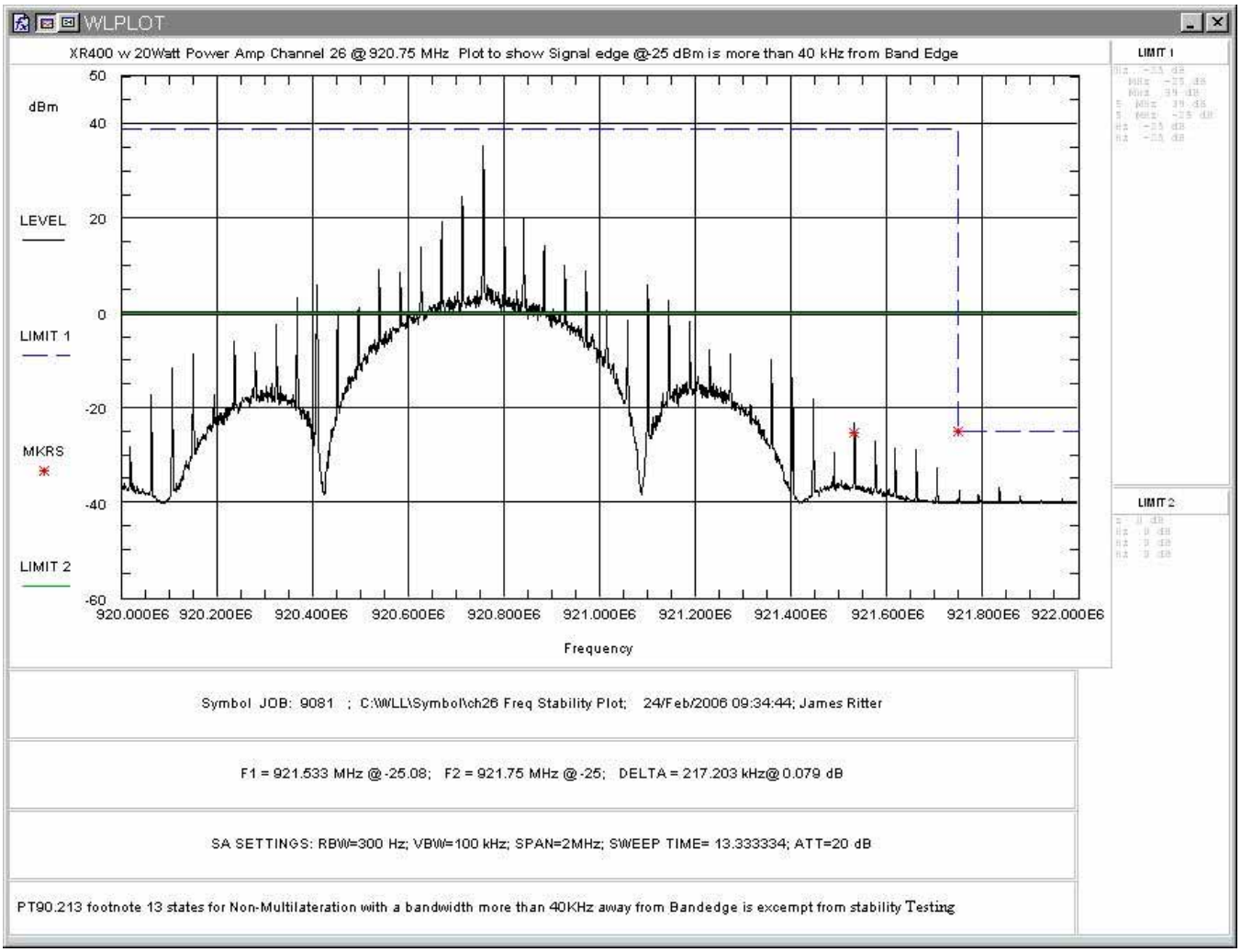

Figure 4-17, Frequency Stability Plot Showing >40kHz from Bandedge, High Channel

