Washington Laboratories, Ltd.
www.wll.com
7560 Lindbergh Drive . Gaithersburg, MD 20879
301.216.1500 . info@wll.com

FCC & Industry Canada Certification Test Report
(Limited Modular Approval)
For the
Mueller Systems
Repeater Radio Module

FCC ID: SM6-RMXR
IC ID: 9235A-RMXR

WLL JOB# **12449-01 Rev 2**
July 31, 2012
Revised October 12, 2012

Prepared for:

Mueller Systems
48 Leona Drive
Middleboro, MA, 02346 USA

Prepared By:
Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

ACLASS ACCREDITED TESTING

Testing Certificate AT-1448

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Prepared by:

James Ritter
EMC Compliance Engineer

Reviewed by:

Michael Violette, P.E.
President

Abstract

This report has been prepared on behalf of Mueller Systems to support the attached Application for Equipment Authorization. The test report and application are submitted for a limited modular Frequency Hopping Spread Spectrum Transmitter under Part 15.247 (10/2010) of the FCC Rules and Spectrum Management and Telecommunications Policy RSS-210 issue 8 of Industry Canada. This Certification Test Report documents the test configuration and test results for a Mueller Systems Repeater Radio 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 Mueller Systems Repeater Radio Module complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under FCC Part 15.247.

Revision History	Description of Change	Date
Rev 0	Initial Release	July 31, 2012
Rev 1	Corrected FCC references to state part 15.247(10/2010) Corrected page Numbering.	October 10, 2012 JR
Rev 2	Added Gain of 4.8dBi for PCB trace antenna in Table 1	October 12, 2012 JR

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1 Introduction

1.1 Compliance Statement

The Mueller Systems Repeater Radio Module complies with the limits for a modular Frequency Hopping Spread Spectrum Transmitter device under FCC Part 15.247 (10/2010).

1.2 Test Scope

Tests for radiated and conducted (at antenna terminal) emissions were performed in the host device. All measurements were performed in accordance with FCC Public Notice DA 00-705, "Filing and Measurement Guidelines 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:	Mueller Systems 48 Leona Drive Middleboro, MA, 02346 USA
Quotation Number:	801661

1.4 Test Dates

Testing was performed on the following date(s):	2/29/2012 to 7/26/1012

1.5 Test and Support Personnel

Washington Laboratories, LTD	James Ritter, Steven Dovell
Client Representative	David Splitz

1.6 Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	**Amp**eres
b/s	**b**its per **s**econd
BW	**B**and**W**idth
CE	**C**onducted **E**mission
cm	**c**enti**m**eter
CW	**C**ontinuous **W**ave
dB	**d**eci**B**el
dc	**d**irect **c**urrent
EMI	**E**lectro**m**agnetic **I**nterference
EUT	**E**quipment **U**nder **T**est
FM	**F**requency **M**odulation
G	**g**iga - prefix for 10^9 multiplier
Hz	**H**ertz
IF	**I**ntermediate **F**requency
k	**k**ilo - prefix for 10^3 multiplier
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
M	**M**ega - prefix for 10^6 multiplier
m	**m**eter
µ	**m**icro - prefix for 10^{-6} multiplier
NB	**N**arrow**b**and
QP	**Q**uasi-**P**eak
RE	**R**adiated **E**missions
RF	**R**adio **F**requency
rms	**r**oot-**m**ean-**s**quare
SN	**S**erial **N**umber
S/A	**S**pectrum **A**nalyzer
V	**V**olt

2 Equipment Under Test

2.1 EUT Identification & Description

The Mueller Systems Repeater Radio Module is a 902.5- 927.35MHz FHSS technology. The system uses 2 modes of operation data mode which uses 50 channels from 902.5 to 927MHz. The system also has a hailing mode to awaken units that are sleeping (these units go into a sleep mode when inactive). The hailing frequencies consist of 50 hailing channels from 902.65 to 927.35MHz. Both of these modes use FHSS technology. The characteristics (power & bandwidth) of the hailing channels are identical to the data channels and are produced from the same RF circuitry. For more detailed information refer to the theory of operation.

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	Mueller Systems
FCC ID:	SM6-RMXR
IC ID:	9235A-RMXR
Model:	Repeater Radio Module
FCC Rule Parts:	§15.247
Frequency Range:	902.5-927.35MHz
Maximum Output Power: (conducted at antenna port)	29.7 dBm (933mW)
Modulation:	FM
Occupied Bandwidth:	43.11 kHz
Keying:	Automatic
Type of Information:	Data
Number of Channels:	50Hailing and 50 Acquisition channels
Power Output Level	User adjustable 19-29.7dBm
Antenna Connector	RPSMA
Antenna Type	2.5dBi Omni whip antenna, 3dBi Omni antenna, 0dBi Fixed monopole, 1.5dBi 8.5 turn Helical antenna, 4.8dbi PCB Trace antenna
Interface:	DB9 , RPSMA connector for 902.5-927 whip antenna,
Emission Designator	63K1FXD
Power Source & Voltage:	3.5VDC provided from host unit
Highest TX Spurious Emission	2782.50MHz: 411uV/m @ 3m
Highest RX Spurious Emission	126.45MHz: 30.7uV/m @ 3m

2.2 Modification

None.

2.3 Test Configuration

The Repeater Radio Module was operated as a standalone unit connected to a 3.5VDC power supply (AC mains testing was performed through a host device connected to the 120VAC public

mains). Commands were sent to the Repeater Radio Module using a 3 pin to USB port connected to a support laptop using Windows HyperTerminal program.

2.4 Testing Algorithm

The Repeater Radio Module was programmed via an external 3 pin programming port on the EUT to a USB port on the support laptop. The support laptop used HyperTerminal to command the EUT to transmit on the lowest, center, and highest channels. Commands were also sent to allow the unit to transmit in a hopping fashion. The unit was preloaded with a typical data payload to transmit.

Worst case emission levels are provided in the test results data.

2.5 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.

2.6 Measurements

2.6.1 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

2.7 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

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

Where u_c = standard uncertainty

a, b, c,.. = 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: **Conducted Antenna Port**		Test Date:	**3/1/2012**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
474	HP, 8563E	ANALYZER, SPECTRUM	04/13/2013
528	AGILENT, E4446A	ANALYZER, SPECTRUM	08/30/2012

Test Name: **Radiated Emissions**		Test Date:	**7/11/2012**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
742	PENN ENGINEERING - WR284	2.2-4.15GHZ BANDPASS FILTER	5/29/2014
280	ITC - 21C-3A1	WAVEGUIDE 3.45-11.0GHZ	5/29/2014
337	WLL - 1.2-5GHZ	FILTER BAND PASS	4/19/2014
281	ITC - 21A-3A1	WAVEGUIDE 4.51-10.0GHZ	5/29/2014
627	AGILENT - 8449B	AMPLIFIER 1-26GHZ	5/24/2013
528	AGILENT - E4446A	ANALYZER SPECTRUM	8/30/2012
4	ARA - DRG-118/A	ANTENNA DRG 1-18GHZ	2/15/2013
644	SUNOL SCIENCES CORPORATION - JB1 925-833-9936	BICONALOG ANTENNA	1/12/2013
69	HP - 85650A	ADAPTER QP	6/27/2013
73	HP - 8568B	ANALYZER SPECTRUM	6/27/2013
71	HP - 85685A	PRESELECTOR RF	6/27/2013

Test Name: **Conducted Emissions Voltage**		Test Date:	**07/26/2012**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
68	HP - 85650A	ADAPTER QP	7/1/2013
72	HP - 8568B	ANALYZER SPECTRUM	7/1/2013
53	HP - 11947A	LIMITER TRANSIENT	3/28/2013
125	SOLAR - 8028-50-TS-24-BNC	LISN	6/28/2013
126	SOLAR - 8028-50-TS-24-BNC	LISN	6/28/2013

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 (10/2010), RSS210 issue 8, and RSS-Gen issue 3. 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 RSS-Gen 7.2.2	General Field Strength Limits (Restricted Bands & RE Limits)	Pass
15.207	RSS-Gen [7.2.4]	AC Conducted Emissions	Pass
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 2.5	General Field Strength Limits	Pass

5 Test Results

5.1 Duty Cycle and Time of Occupancy

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

The duty cycle correction factor is calculated by:

20 x LOG (dwell time/100 ms)

5.1.1 Data Mode Timing

As the Maximum Dwell time of this device is approximately 200ms no duty cycle correction is allowed.

FCC part 15.247 requires that for hopping signals with an occupied bandwidth less than 250 kHz the limit is 0.4 seconds dwell time per 20 seconds

The following figures show the plot of the dwell time and time of occupancy for the transmitter. Based on this plot, the dwell time per hop is 200ms. As the unit is on a channel once in a 20 second period the time of occupancy is 200ms per 20 seconds, thus complying with the 0.4 second requirement.

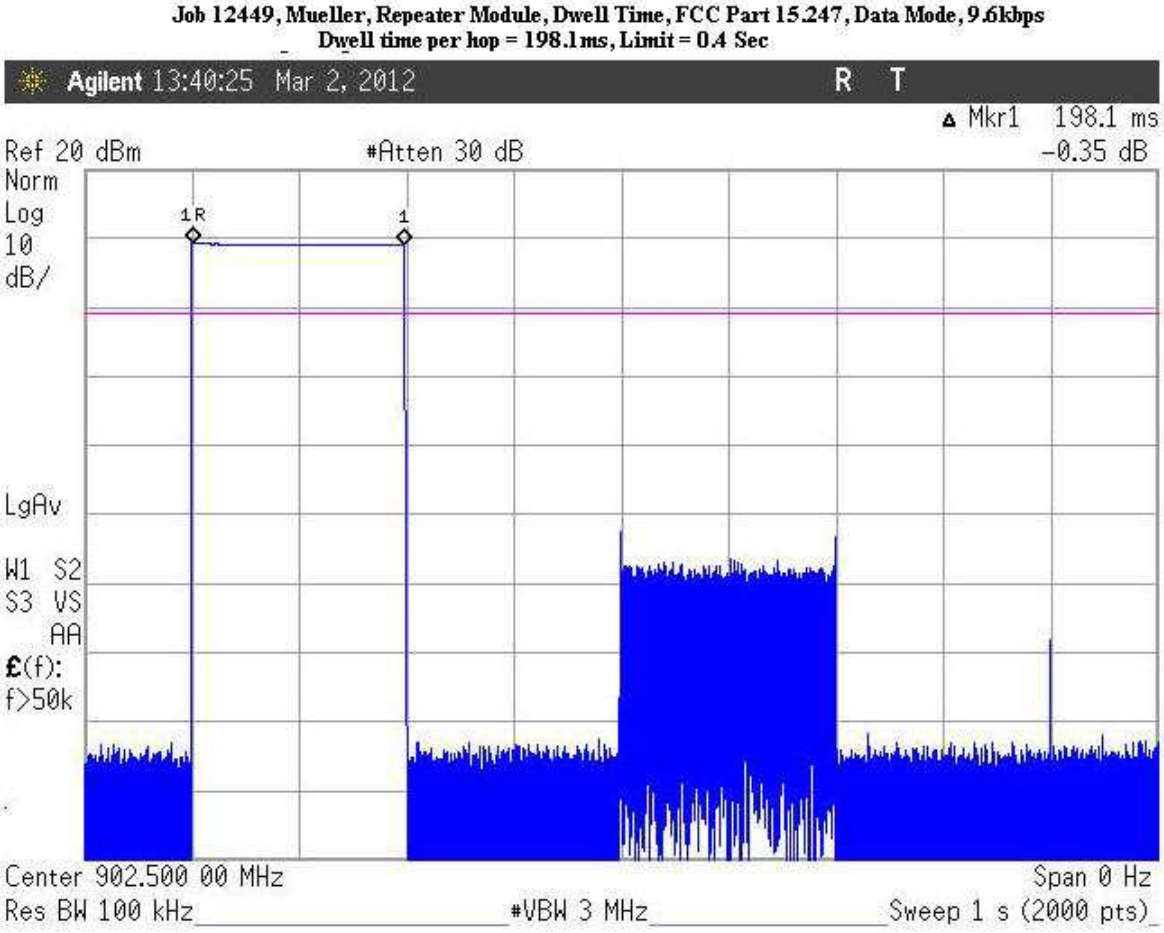

Figure 1: Duty Cycle Plot (Data Mode 9.6kbps)

Job 12449, Mueller, Repeater Module, Time of Occupancy per 20 Seconds, FCC Part15.247, Data Mode, 9.6kbps
1 Pulse per 20seconds of 198.1ms (from dwell time plot)= 198.1ms total, Limit = 0.4Sec per 20Sec Maximum

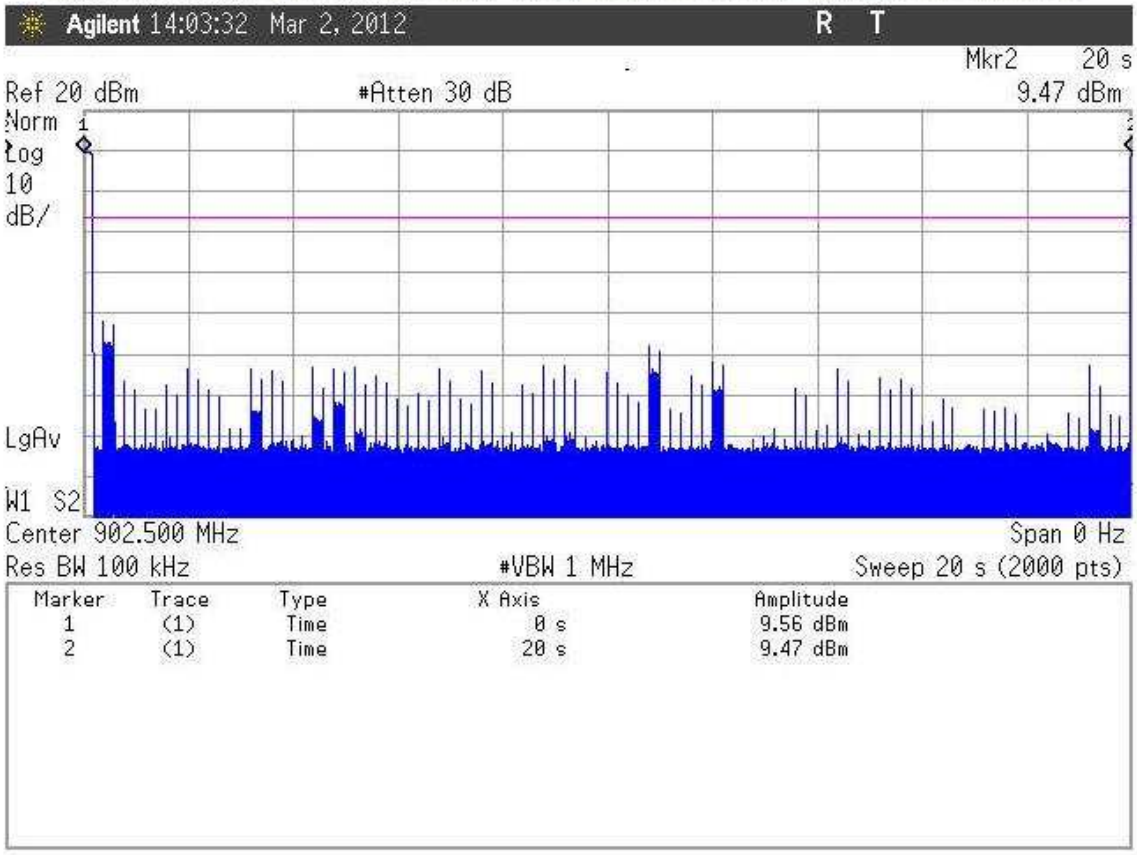

Figure 2: Time of Occupancy Plot (Data Mode 9.6kbps)

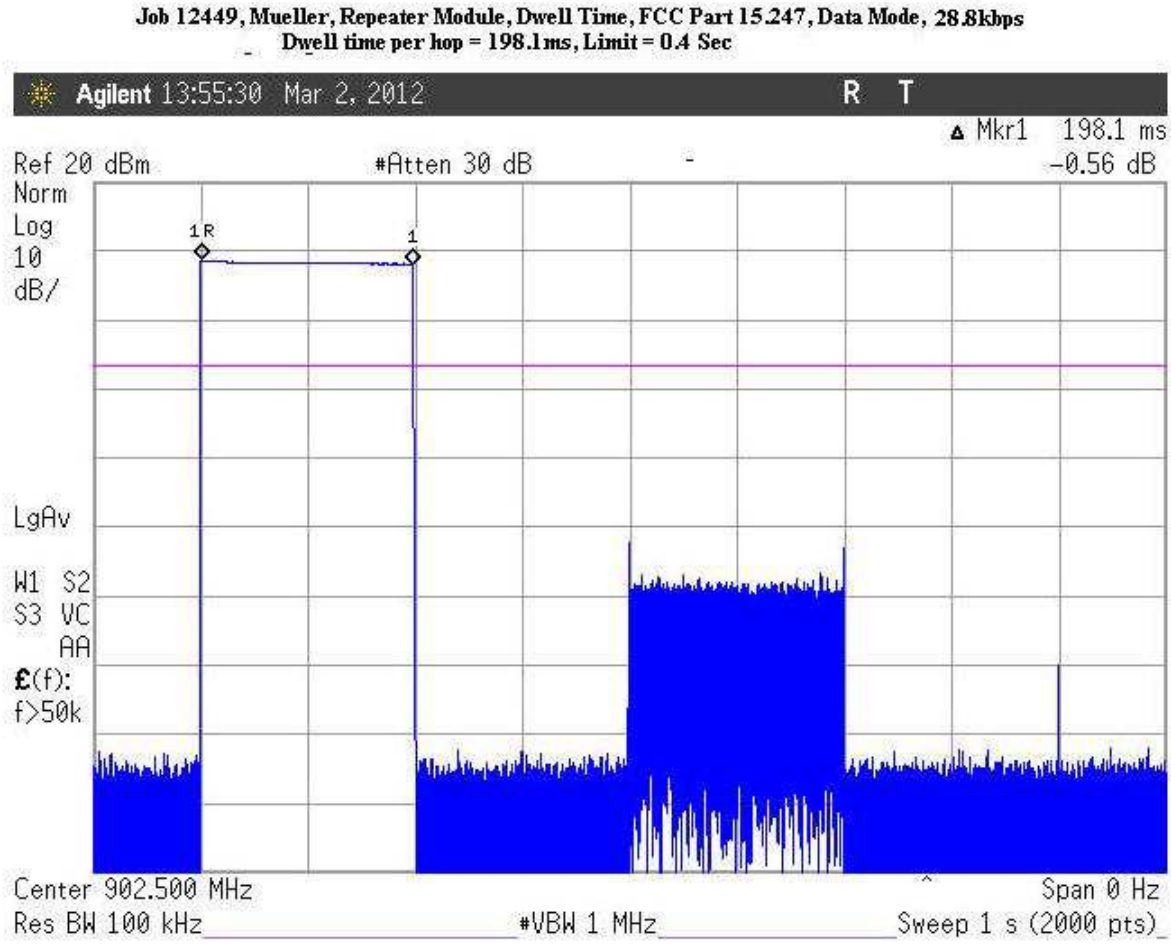

Figure 3: Duty Cycle Plot (Data Mode 28.8bps)

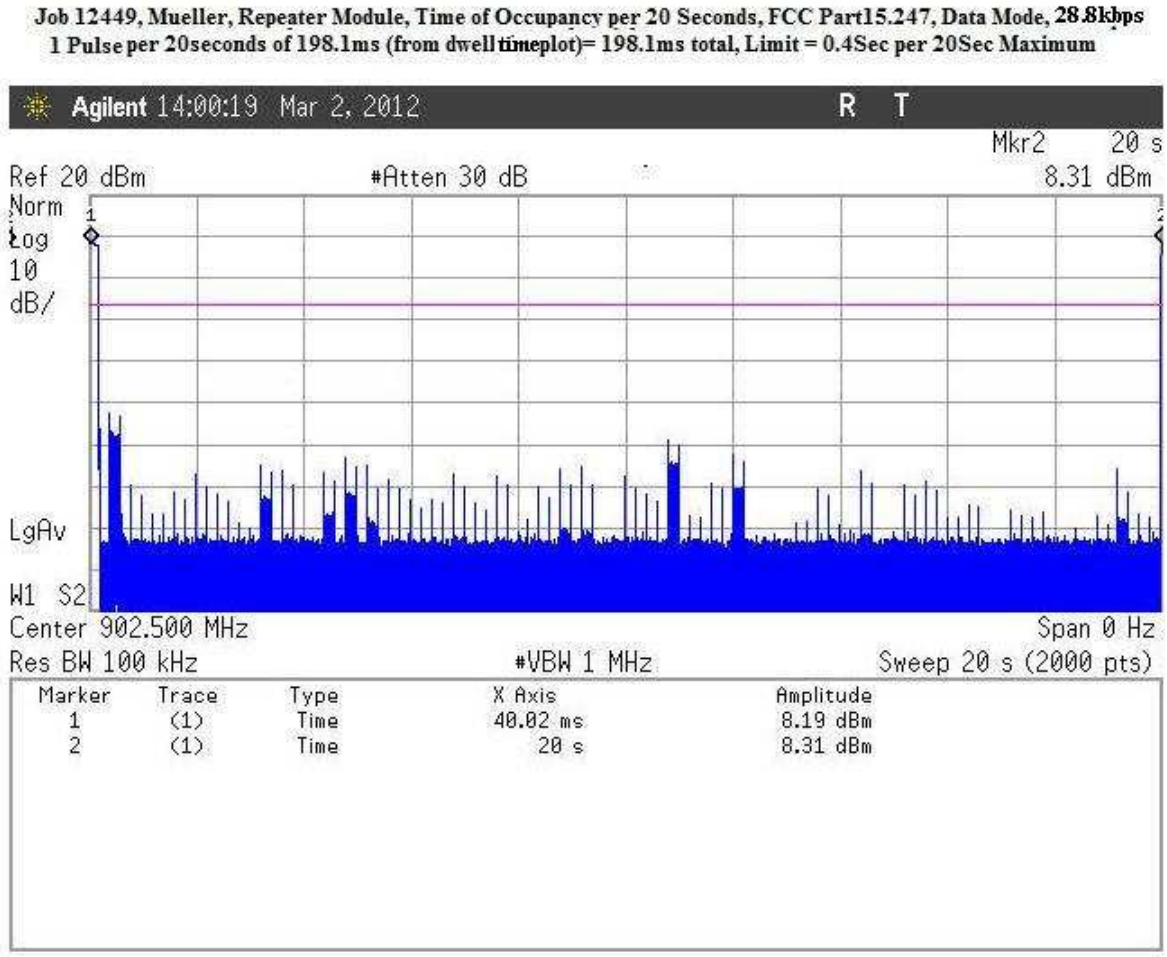

Figure 4: Time of Occupancy Plot (Data Mode 28.8kbps)

5.1.2 Hailing Mode Timing

As the Maximum Dwell time of this device in hailing 400ms no duty cycle correction is allowed.

FCC part 15.247 requires that for hopping signals with an occupied bandwidth less than 250 kHz the limit is 0.4 seconds dwell time per 20 seconds

The following figures show the plot of the dwell time and time of occupancy for the transmitter. Based on this plot, the dwell time per hop is 392.2ms. As the unit is on a hailing channel once in a 20 second period the time of occupancy is 392.2ms per 20 seconds, thus complying with the 0.4 second requirement.

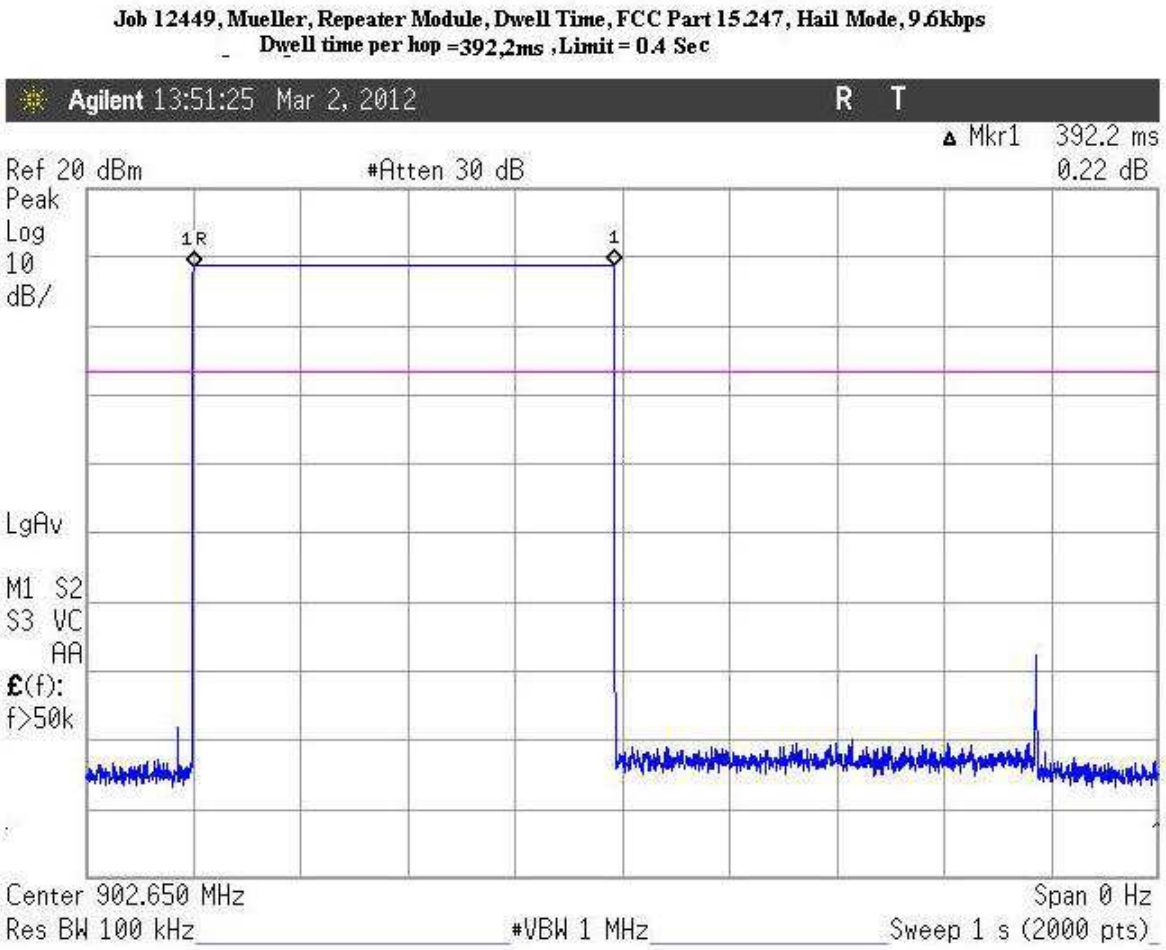

Figure 5 Hailing Channel Duty Cycle Plot

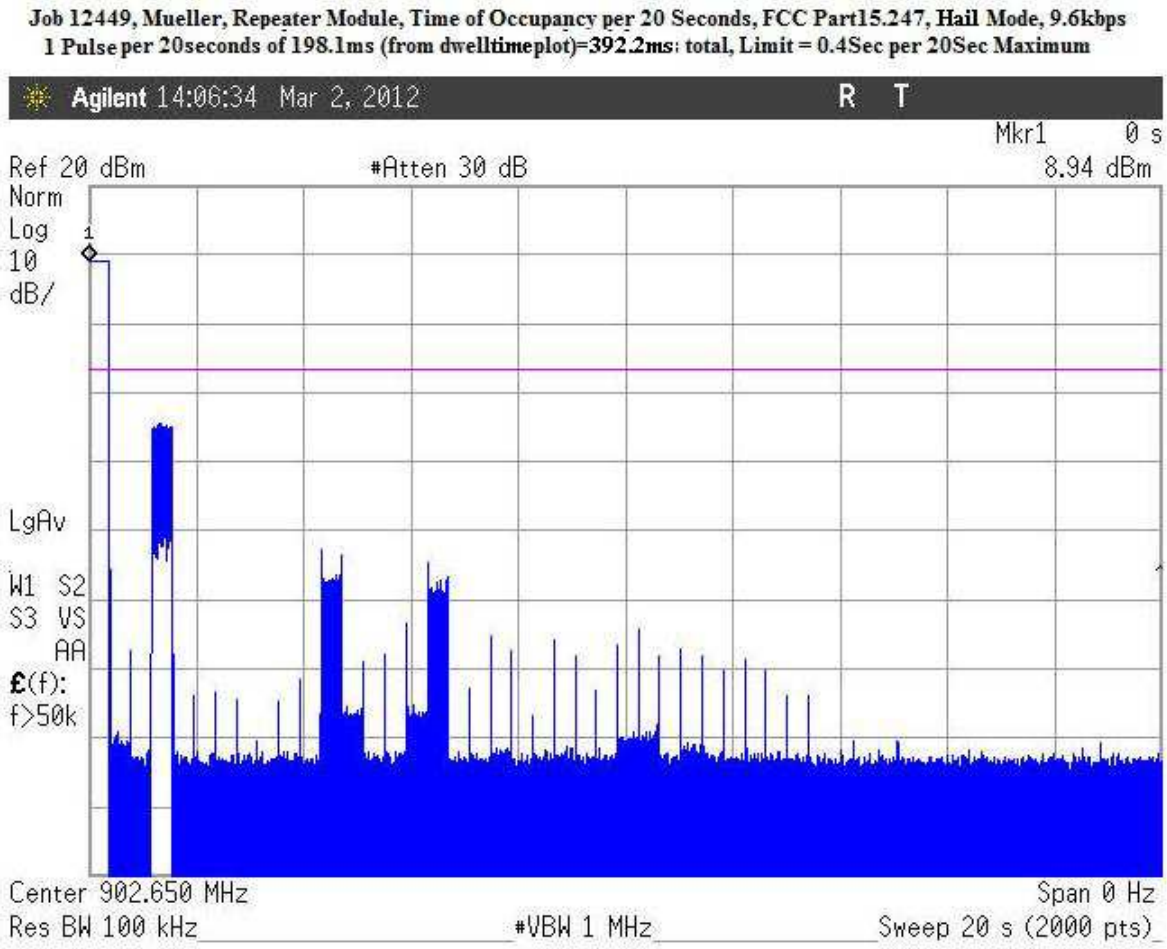

Figure 6 Hailing Channel Time of Occupancy Plot

5.2 RF Power Output: (FCC Part §2.1046)

To measure the output power the hopping sequence was stopped while the frequency dwelled on the lowest, middle and highest 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, cable, and other losses in the system. As the EUT has adjustable power settings, the lowest and highest settings were observed.

Table 5: Data Channel RF Power Output

Frequency	High Power Level	Low Power Level	Limit	Pass/Fail
Low Channel: 902.5MHz	29.07dBm	19.74dBm	30dBm	Pass
Mid Channel: 915.0MHz	29.07dBm	19.57dBm	30dBm	Pass
High Channel: 927.0MHz	29.7dBm	19.07dBm	30dBm	Pass

Table 6 Hailing Channel RF Power Output

Frequency	High Power Level	Low Power Level	Limit	Pass/Fail
Low Channel: 902.65MHz	29.40dBm	19.82dBm	30dBm	Pass
Center Channel: 915.35MHz	29.16dBm	19.57dBm	30dBm	Pass
High Channel: 927.35MHz	29.7dBm	19.24dBm	30dBm	Pass

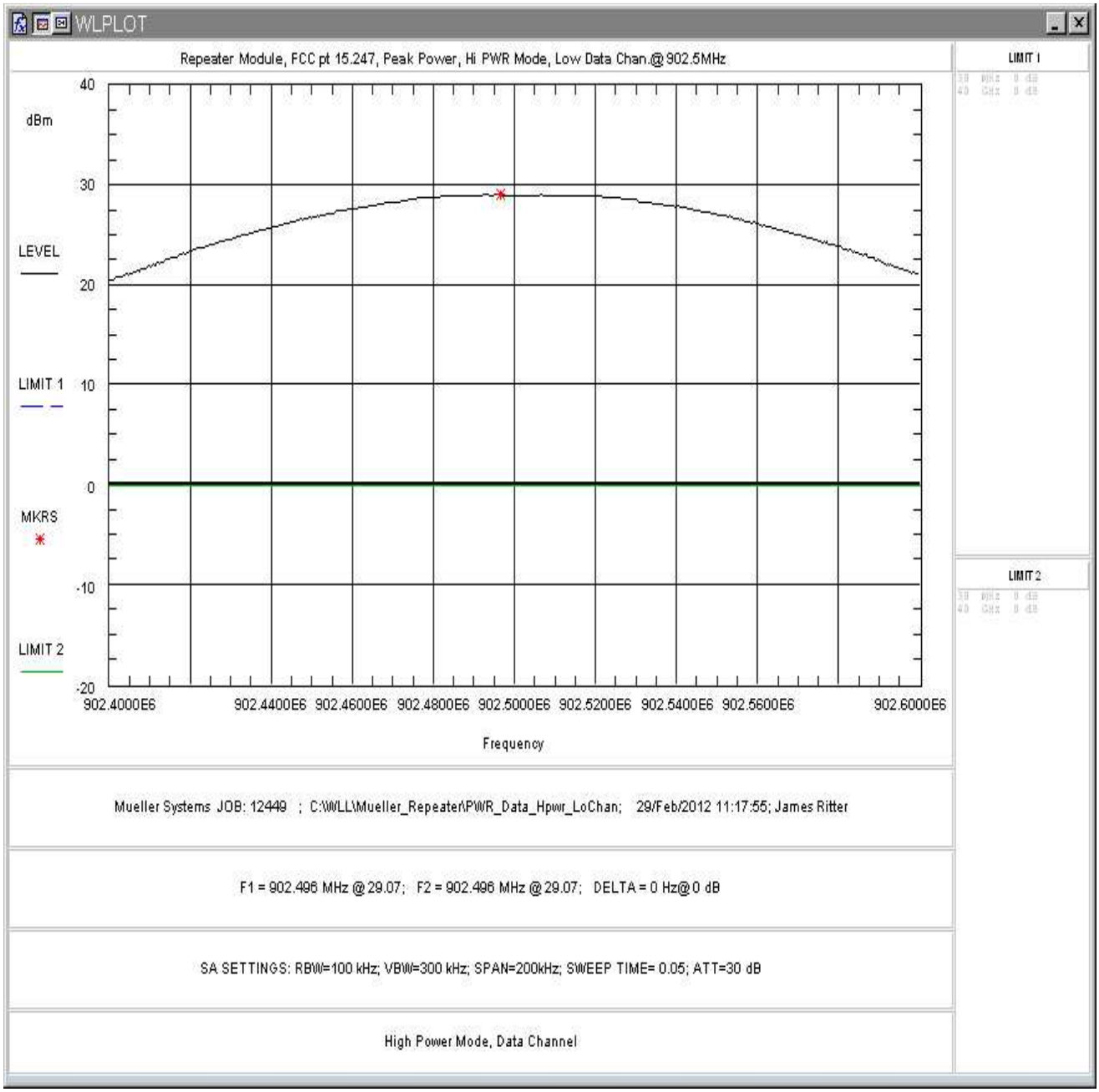

Figure 7: Data Channel RF Peak Power, High Pwr, Low Channel

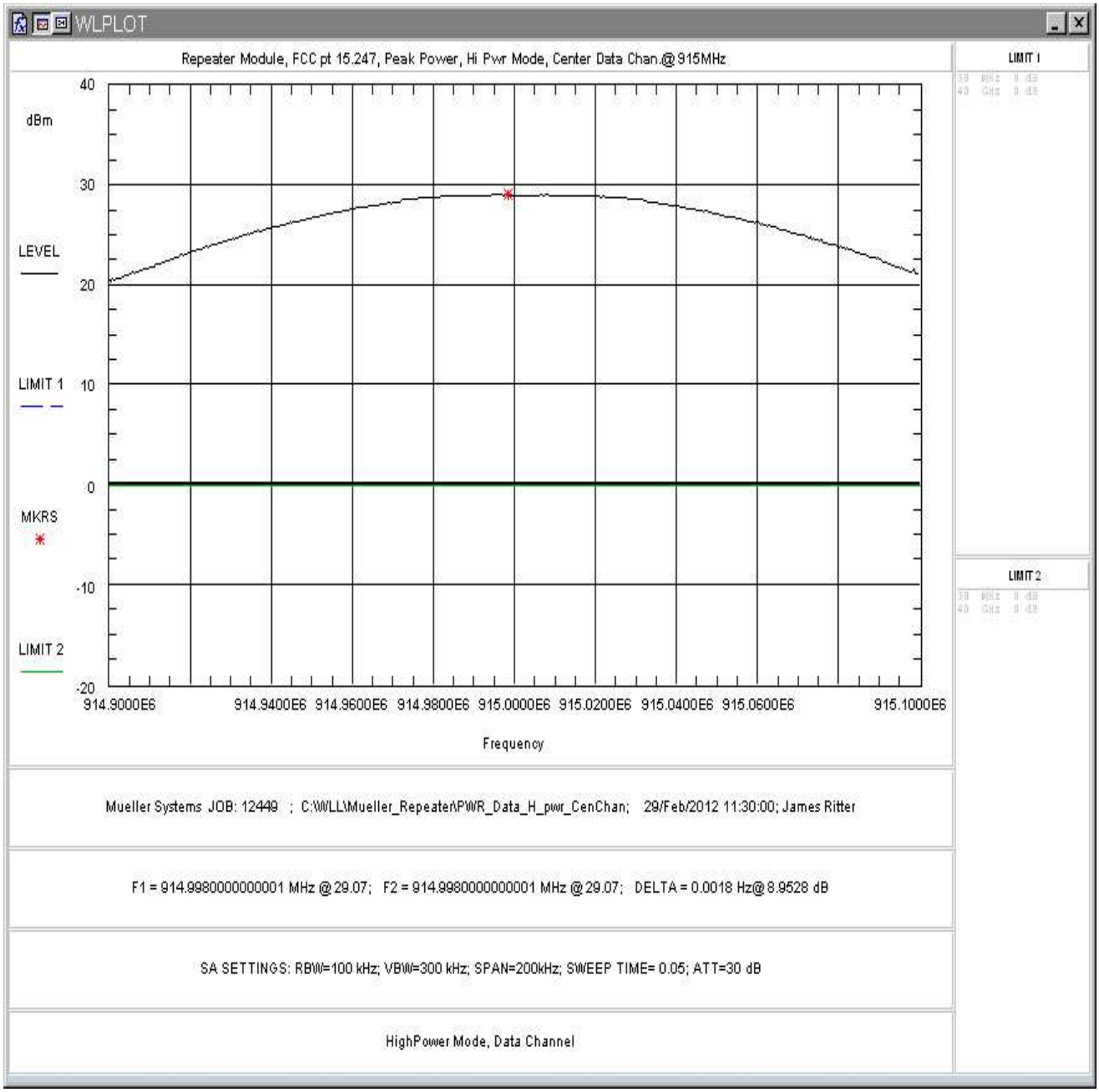

Figure 8: Data Channel RF Peak Power, High Pwr, Center Channel

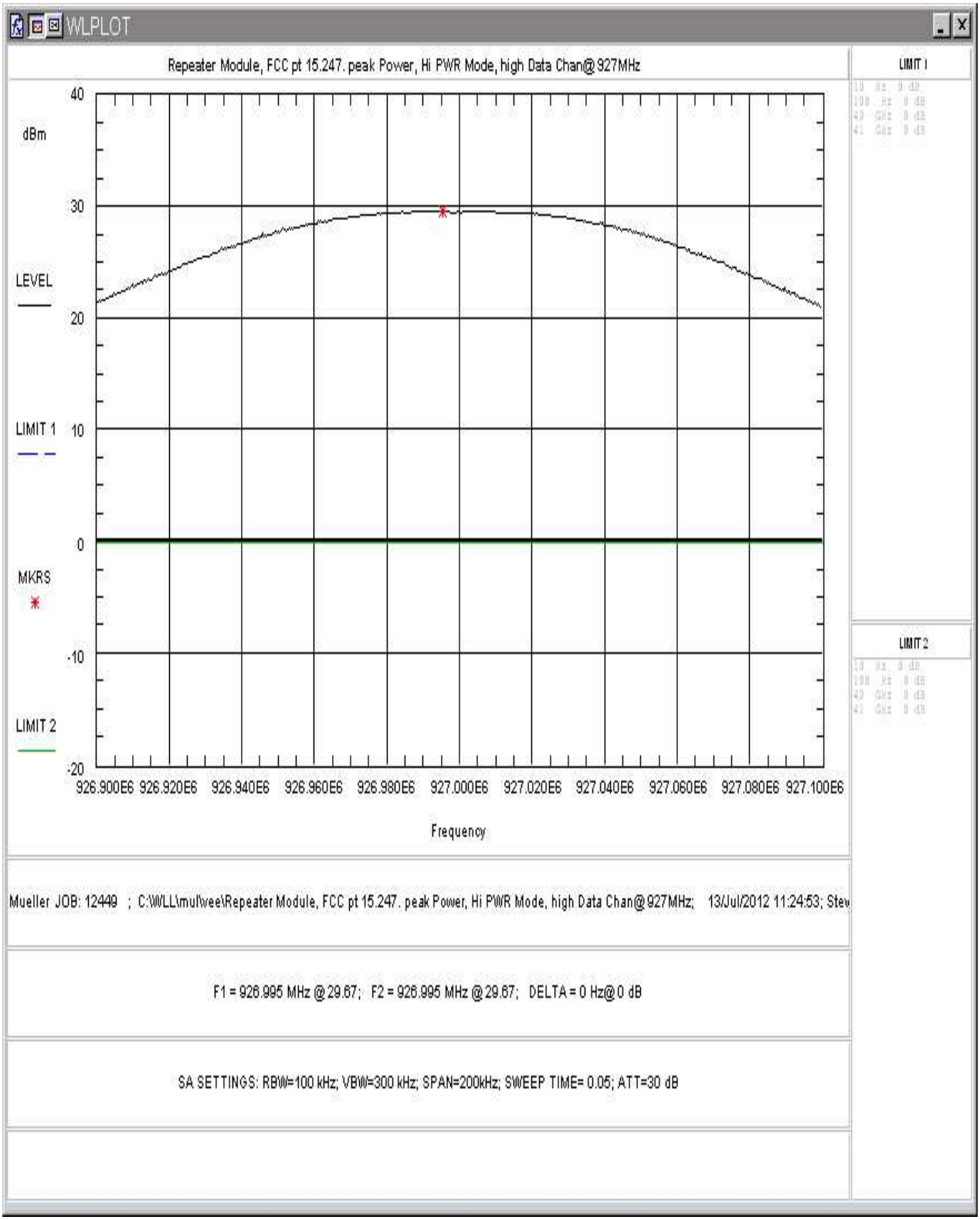

Figure 9: Data Channel RF Peak Power, High Pwr, High Channel

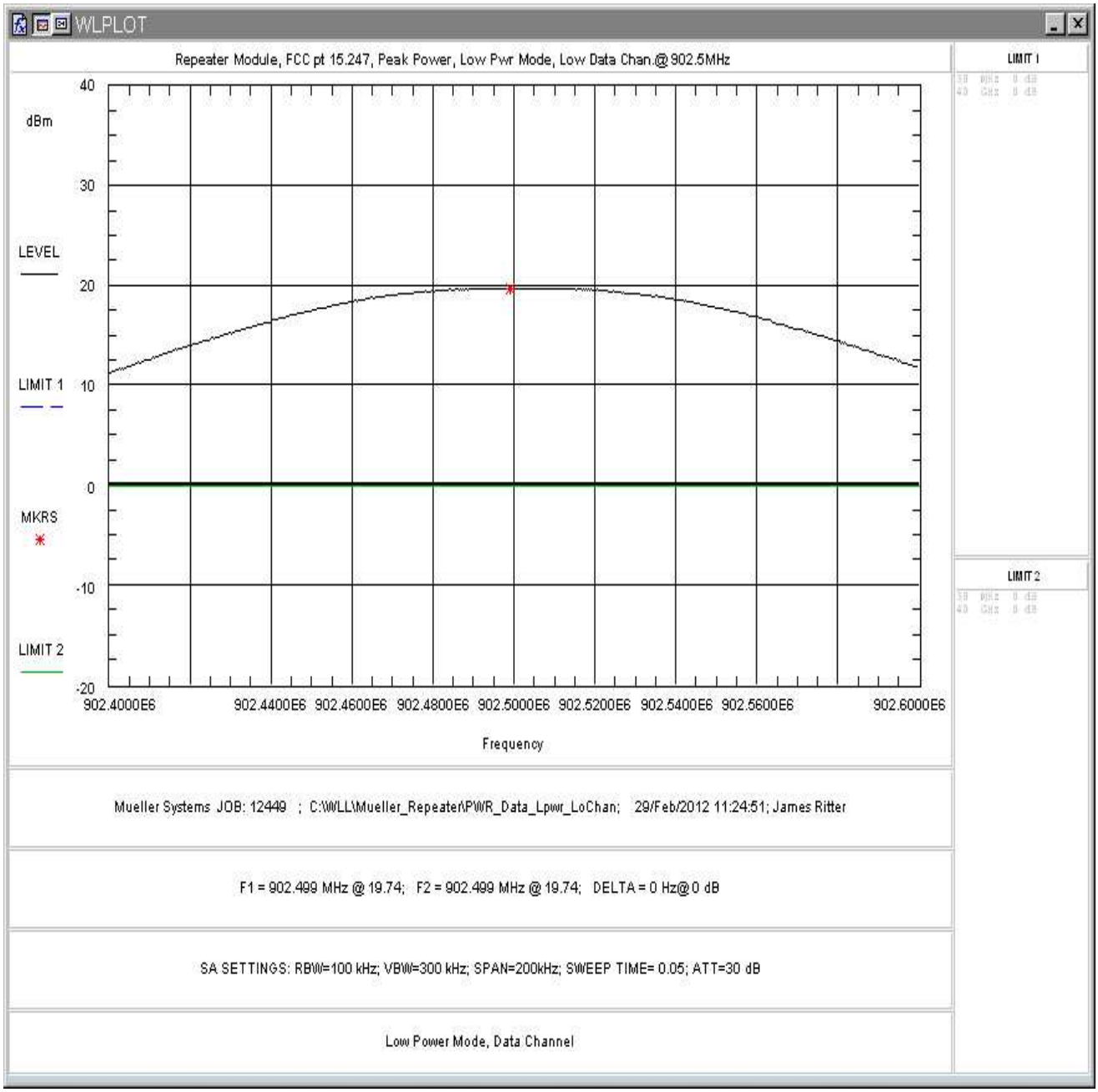

Figure 10: Data Channel RF Peak Power, Low Pwr, Low Channel

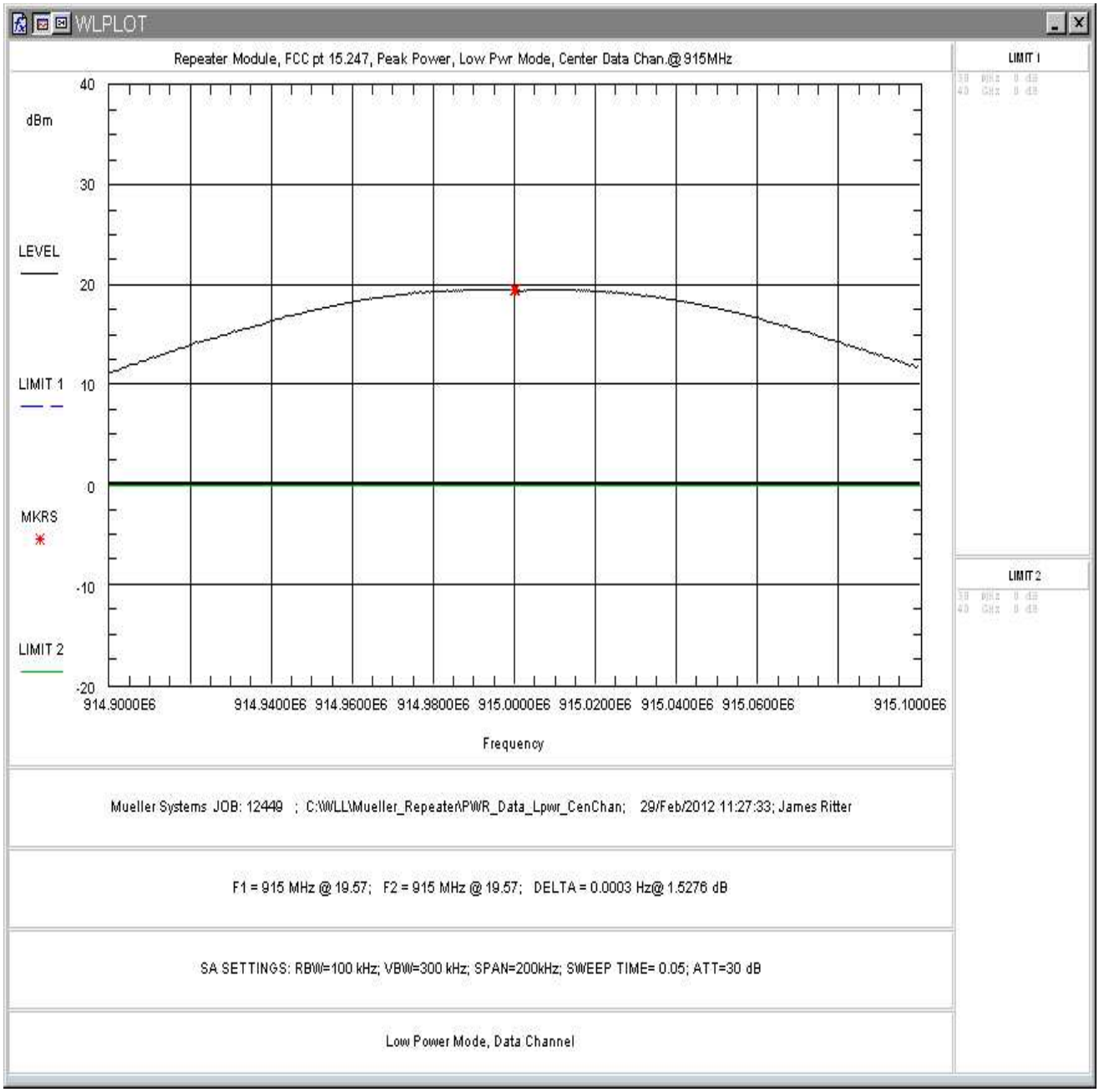

Figure 11: Data Channel RF Peak Power, Low Pwr, Center Channel

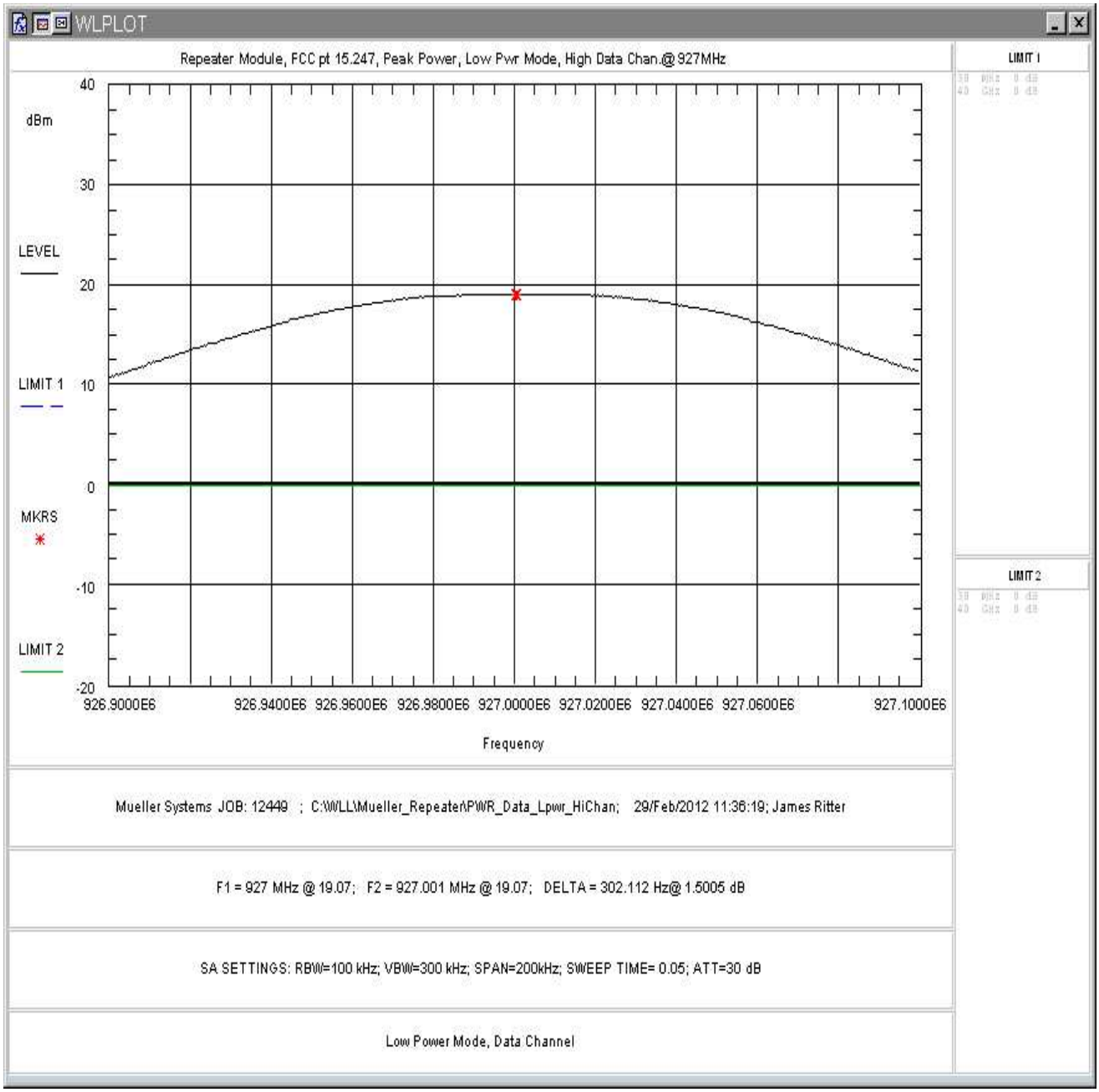

Figure 12: Data Channel RF Peak Power, Low Pwr, High Channel

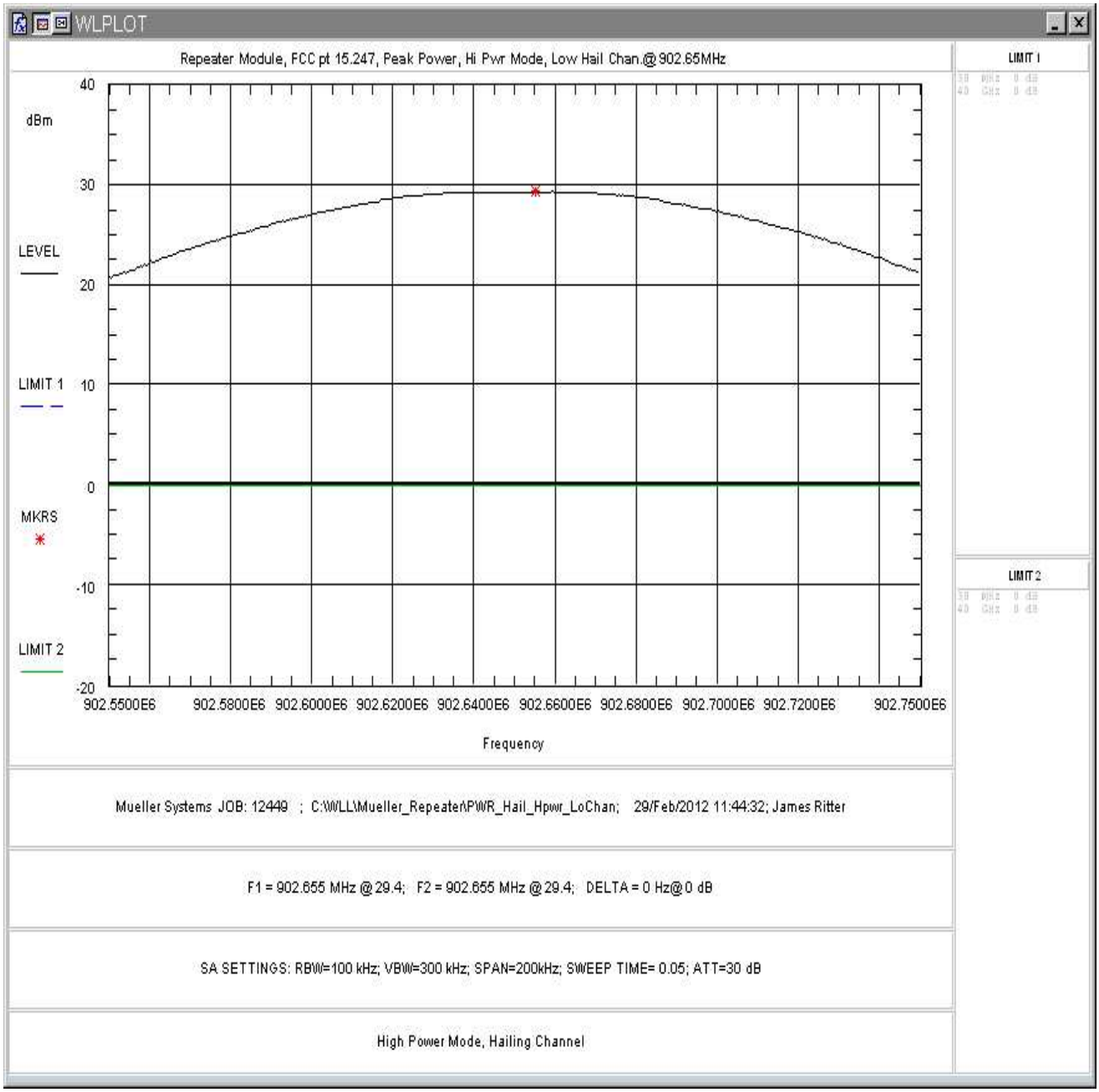

Figure 13 Hailing Channel RF Peak Power, High Pwr, Low Channel

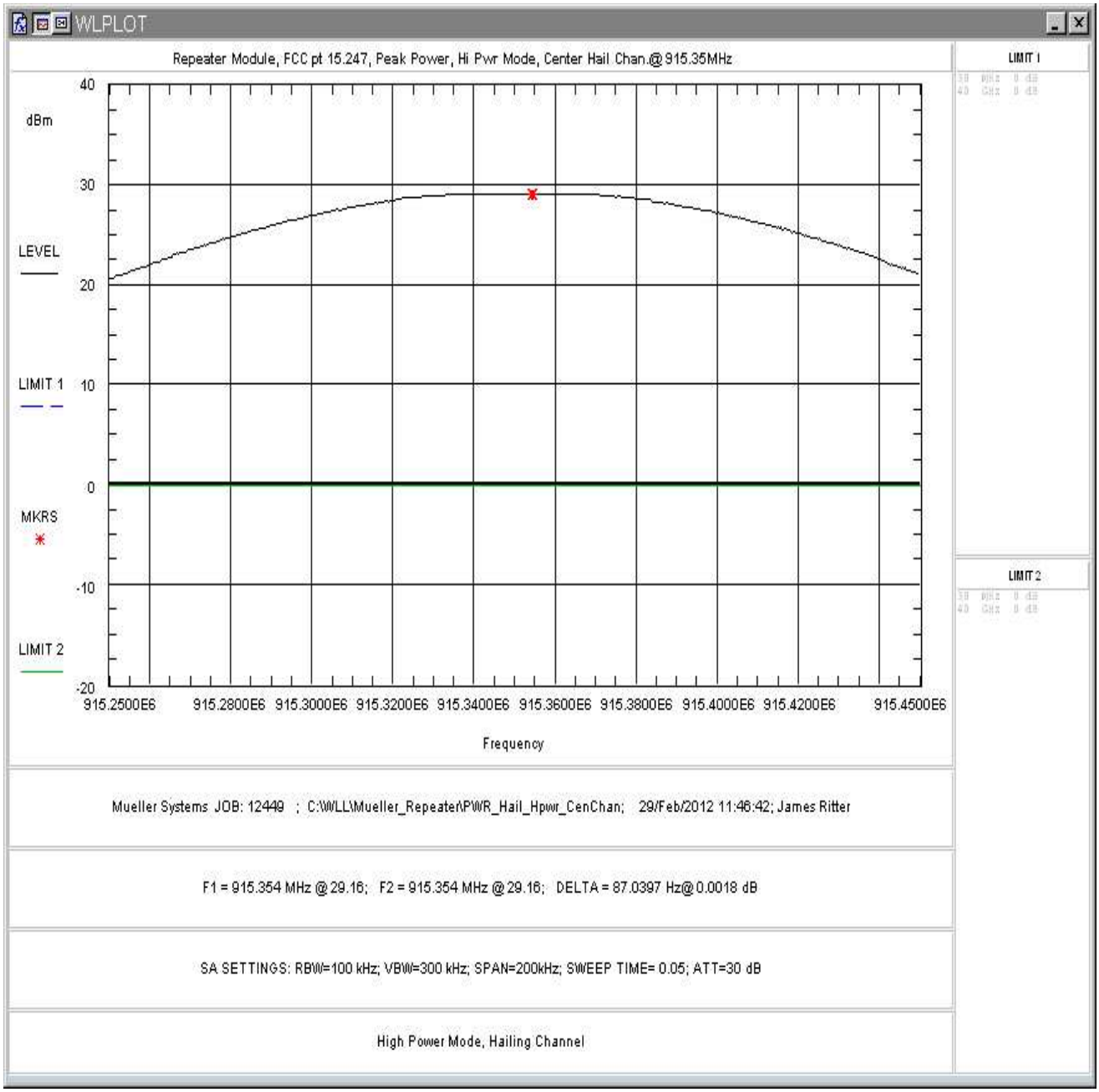

Figure 14 Hailing Channel RF Peak Power, High Pwr, Center Channel

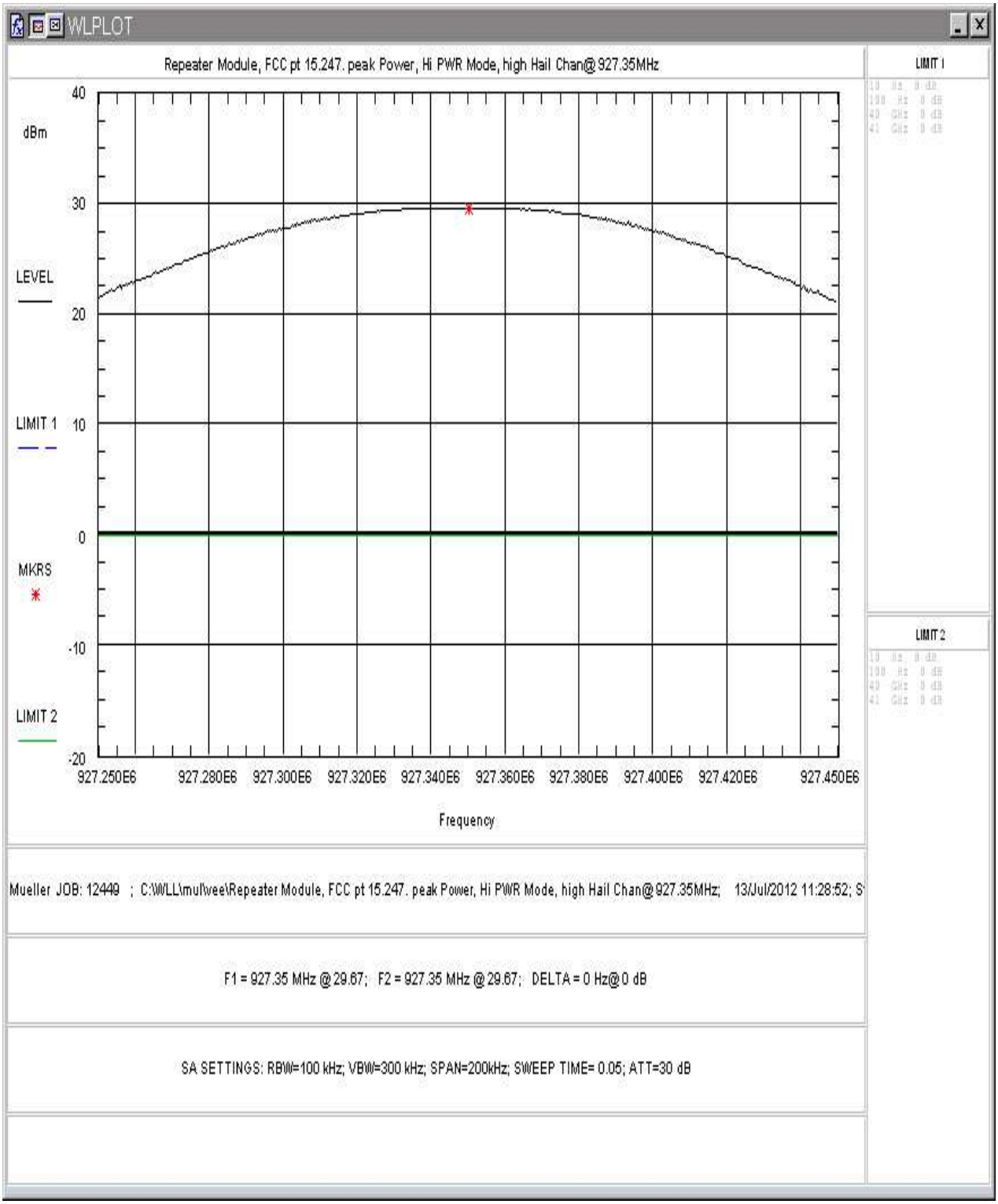

Figure 15 Hailing Channel RF Peak Power, High Pwr, High Channel

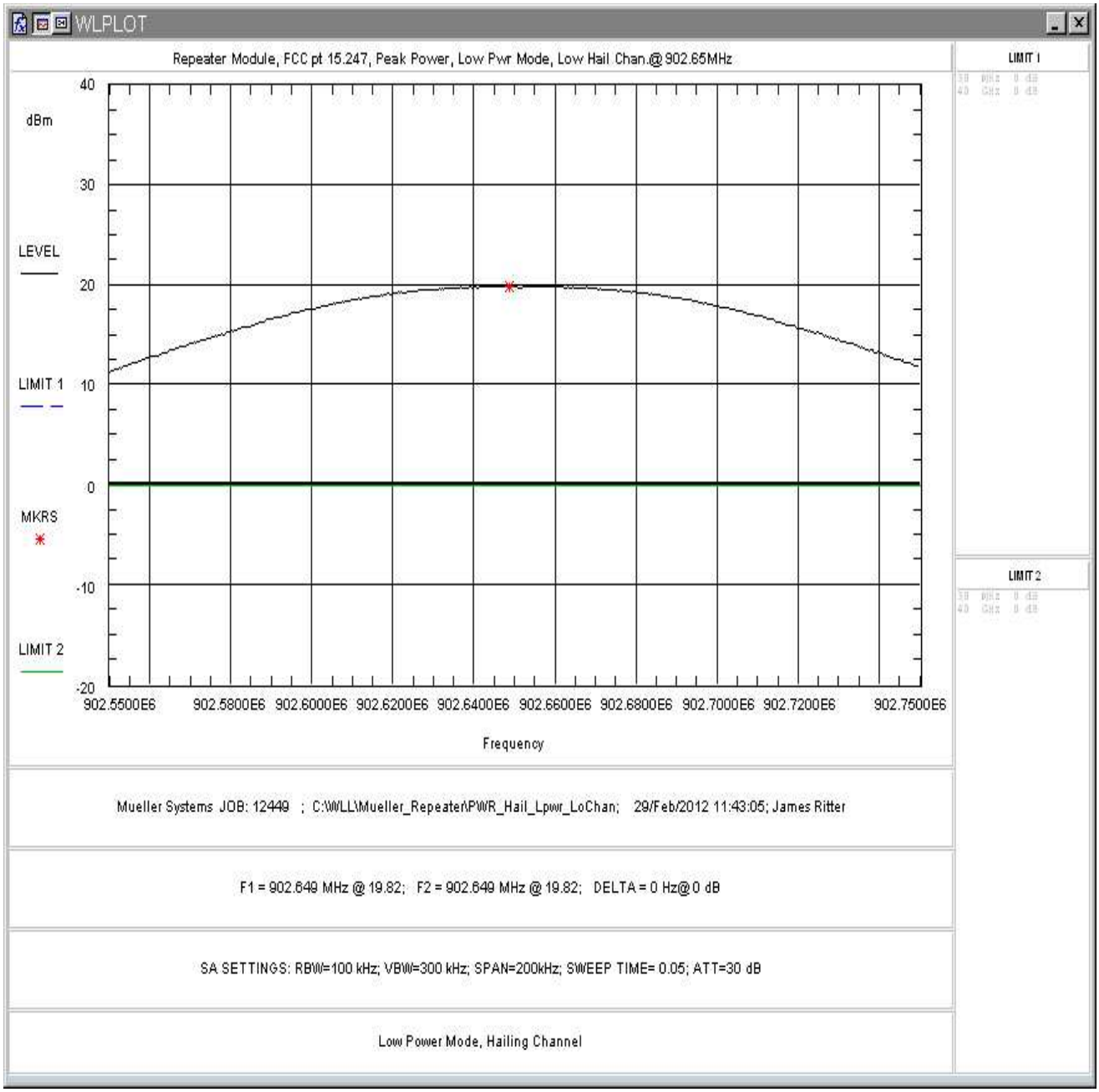

Figure 16 Hailing Channel RF Peak Power, Low Pwr, Low Channel

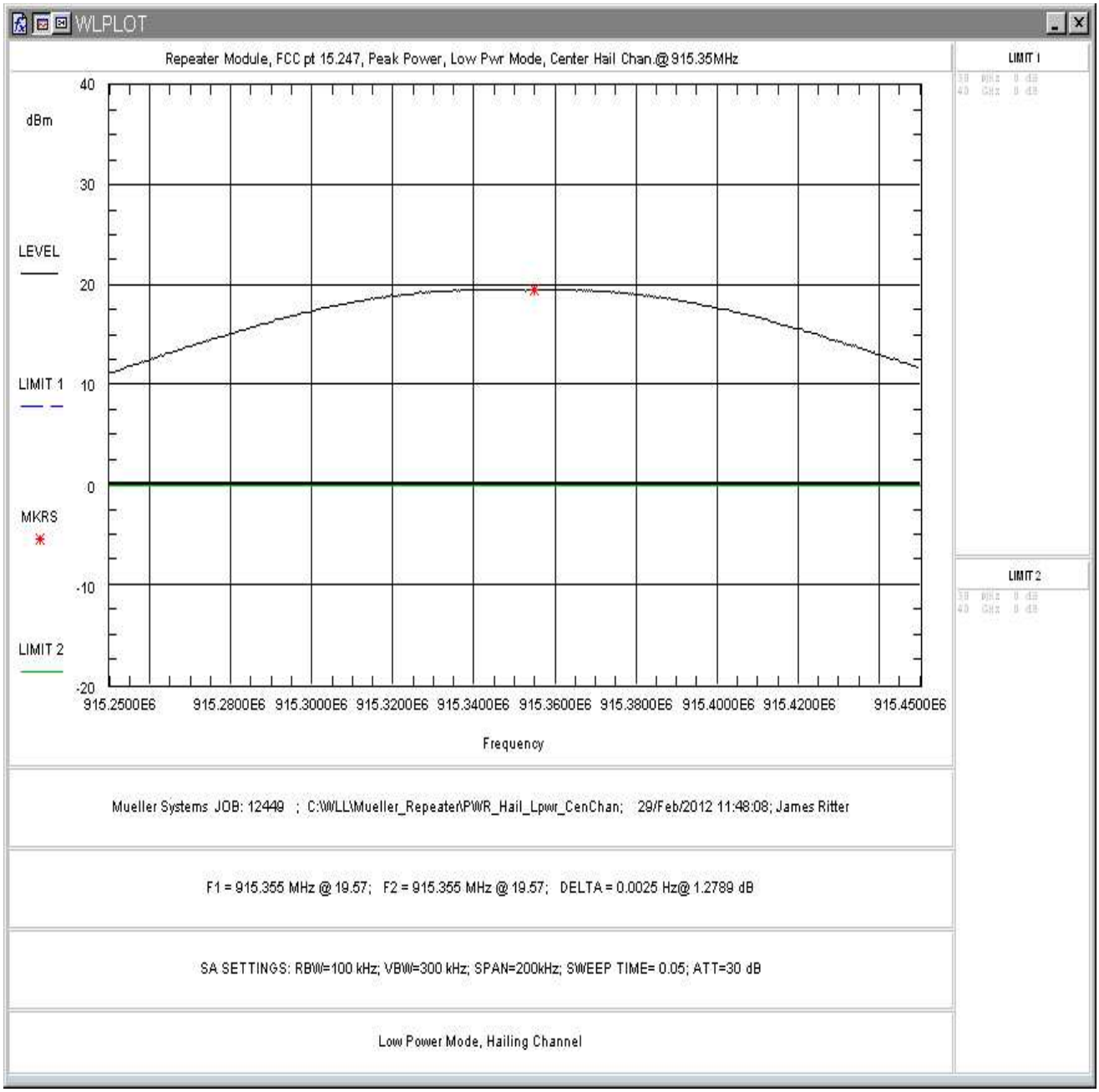

Figure 17 Hailing Channel RF Peak Power, Low Pwr, Center Channel

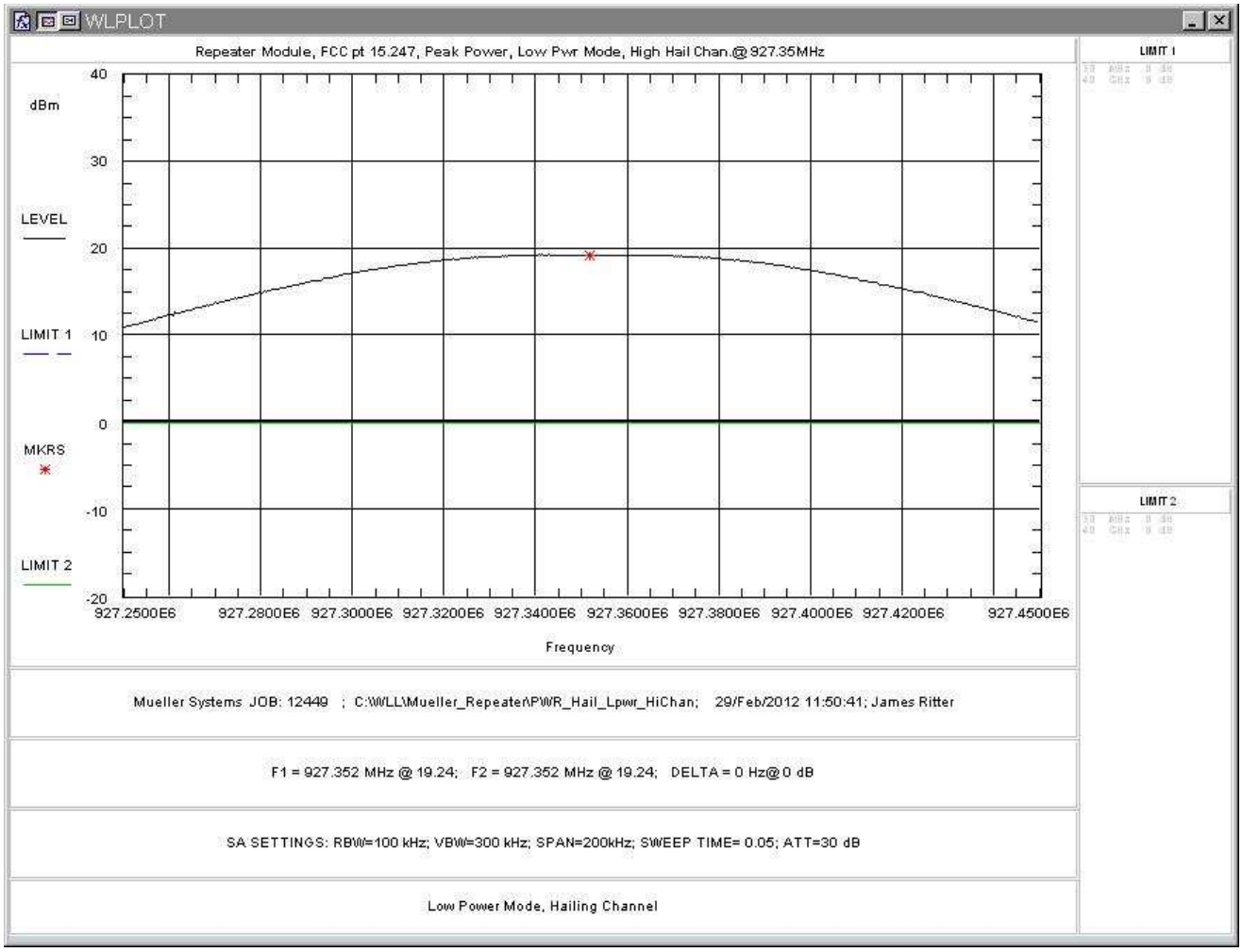

Figure 18 Hailing Channel RF Peak Power, Low Pwr, High Channel

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, operating in the 902-928MHz frequency range, FCC Part 15.247 requires that devices with occupied bandwidths less than 250kHz have a minimum of 50 hopping channels.

The Hailing channels operate at a single transmission rate 9.6kbps, the data channels can operate at either 9.6 or 28.8kbps (negotiated by network). The Occupied bandwidth was verified in all available data rates.

Table 7 and Table 8 provide a summary of the Occupied Bandwidth Results.

Table 7 Data Channel Occupied Bandwidth Results

Frequency	9.6kbps Bandwidth	28.8kbps Bandwidth
Low Channel: 902.5MHz	40.9kHz	62.3kHz
Mid Channel: 915.0MHz	41.5kHz	62.7kHz
High Channel: 927.0MHz	41.8kHz	63.1kHz

Table 8: Hailing Channel Occupied Bandwidth Results

Frequency	9.6kbps Bandwidth
Low Channel: 902.65MHz	40.9kHz
Mid Channel: 915.35MHz	41.4kHz
High Channel: 927.35MHz	41.7kHz

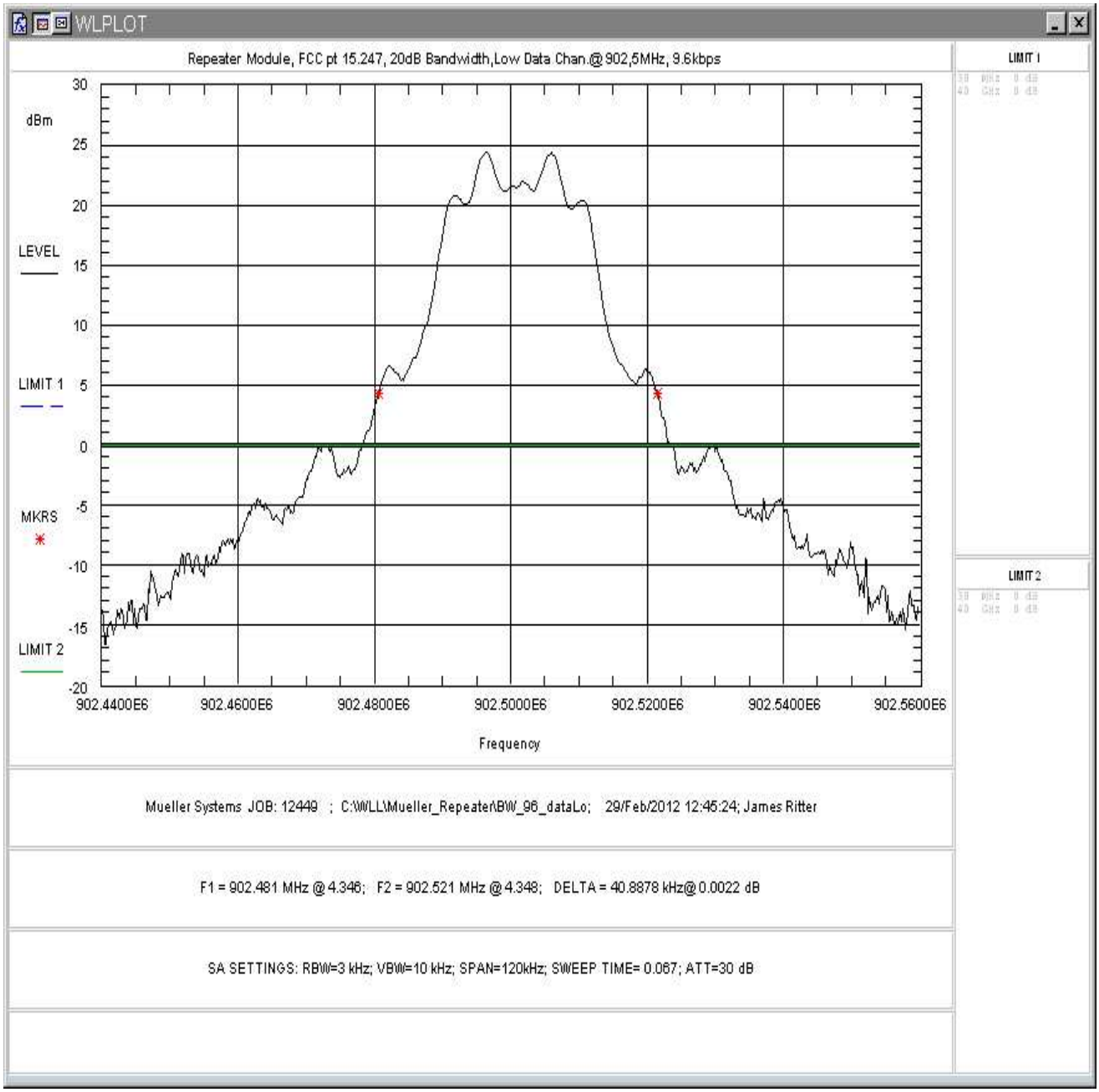

Figure 19: Data Channel Occupied Bandwidth, 9.6kbps, Low Channel

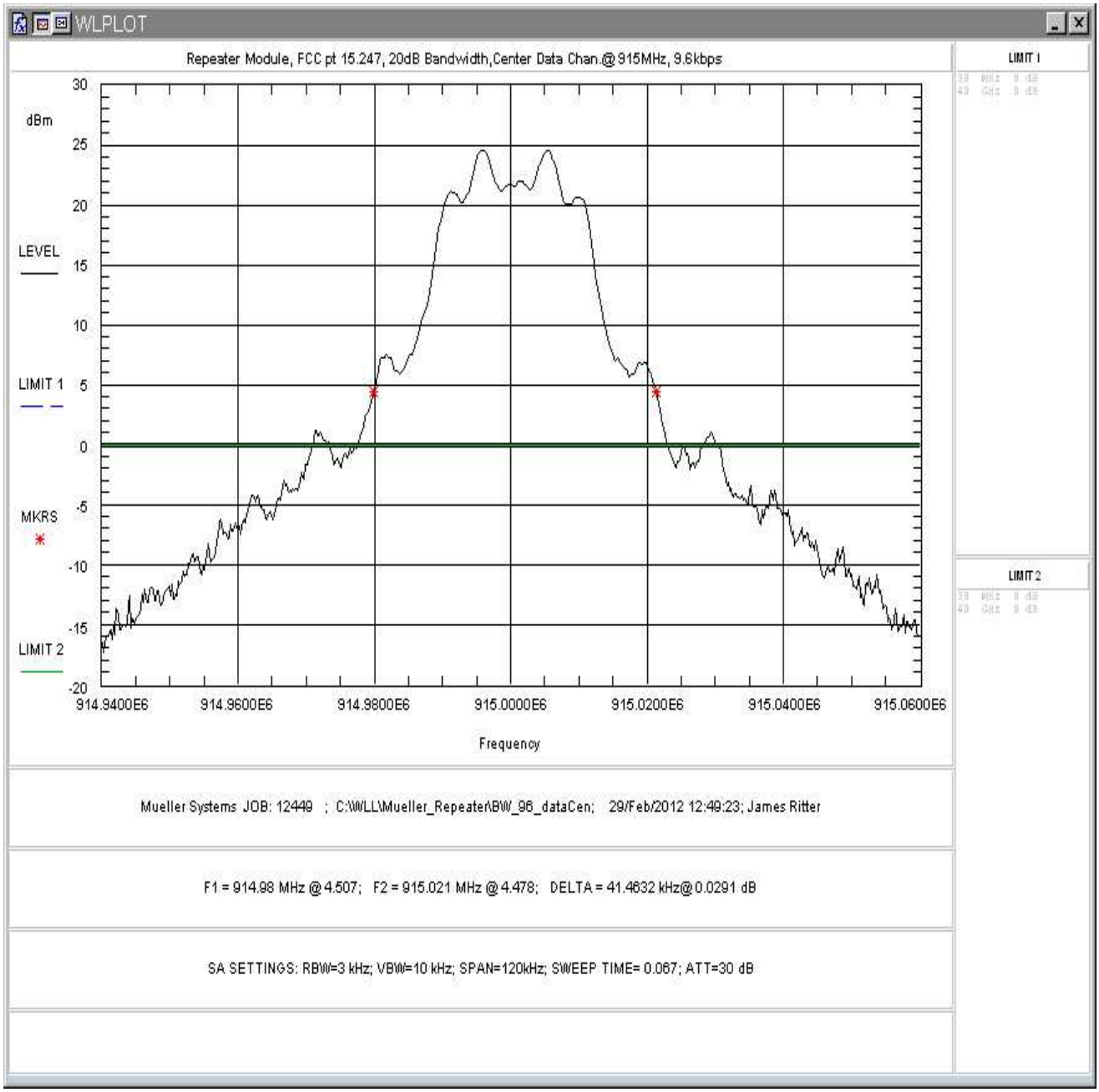

Figure 20: Data Channel Occupied Bandwidth, 9.6kbps, Center Channel

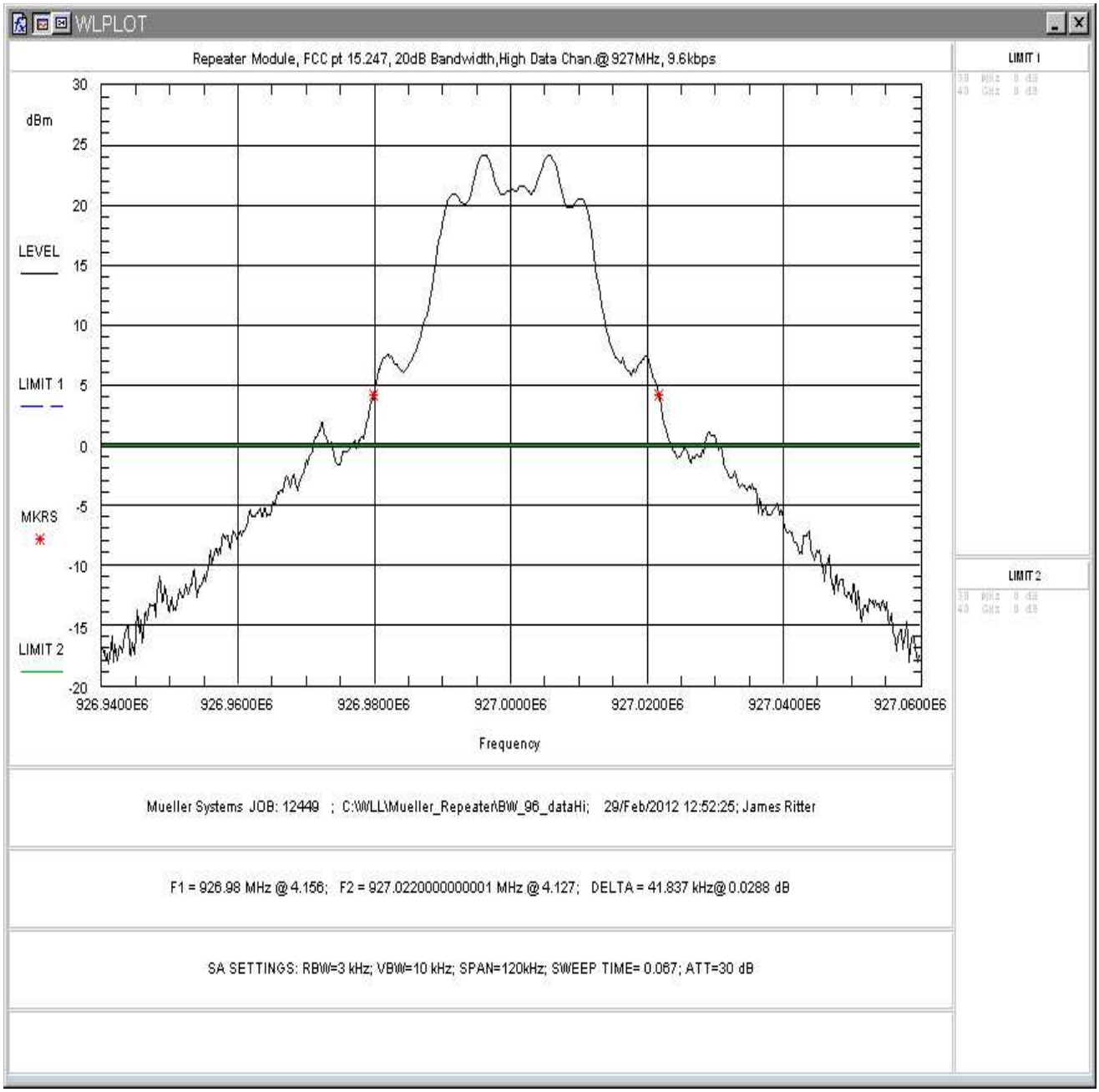

Figure 21: Data Channel Occupied Bandwidth, 9.6kbps, High Channel

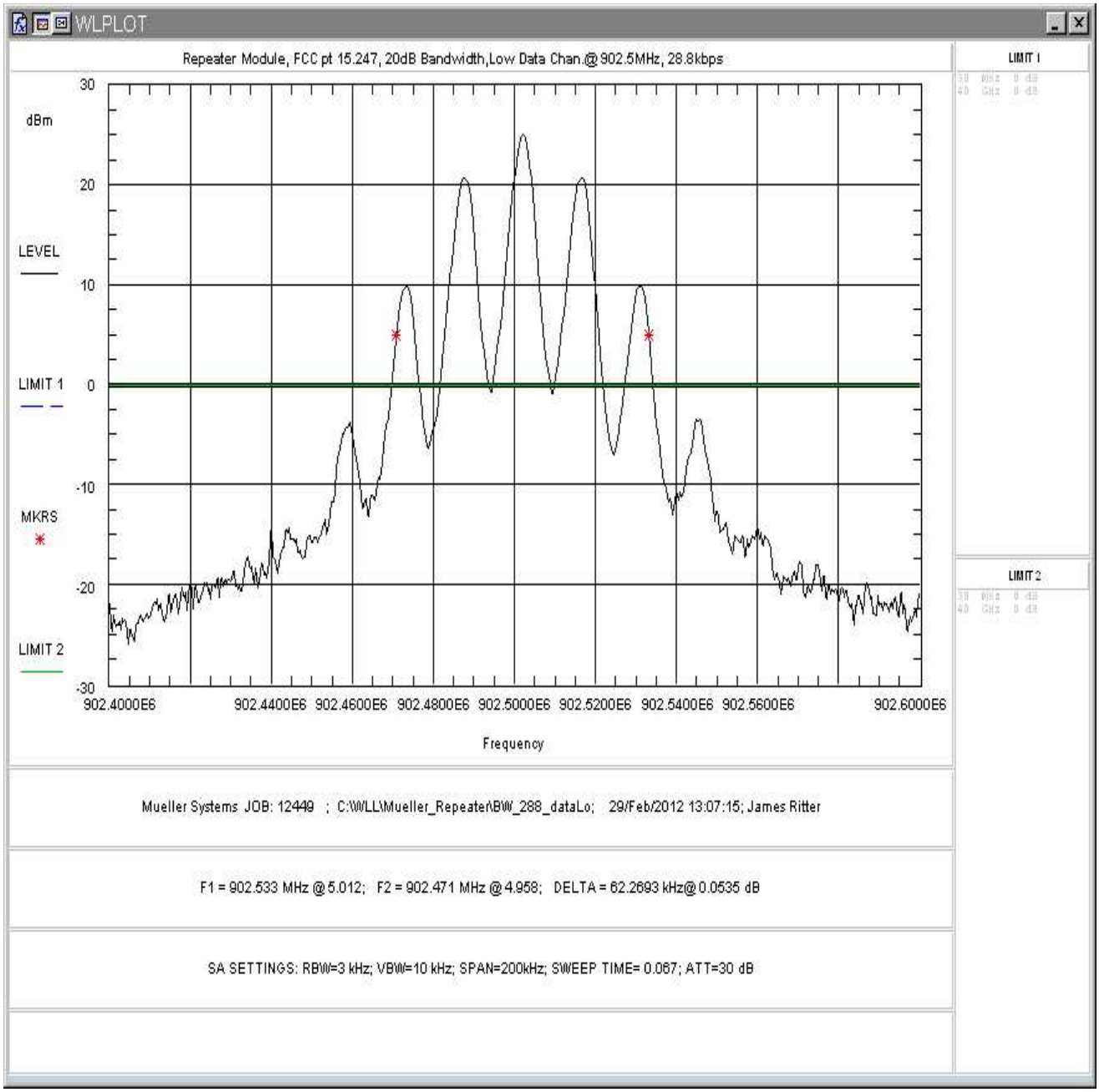

Figure 22: Data Channel Occupied Bandwidth, 28.8kbps, Low Channel

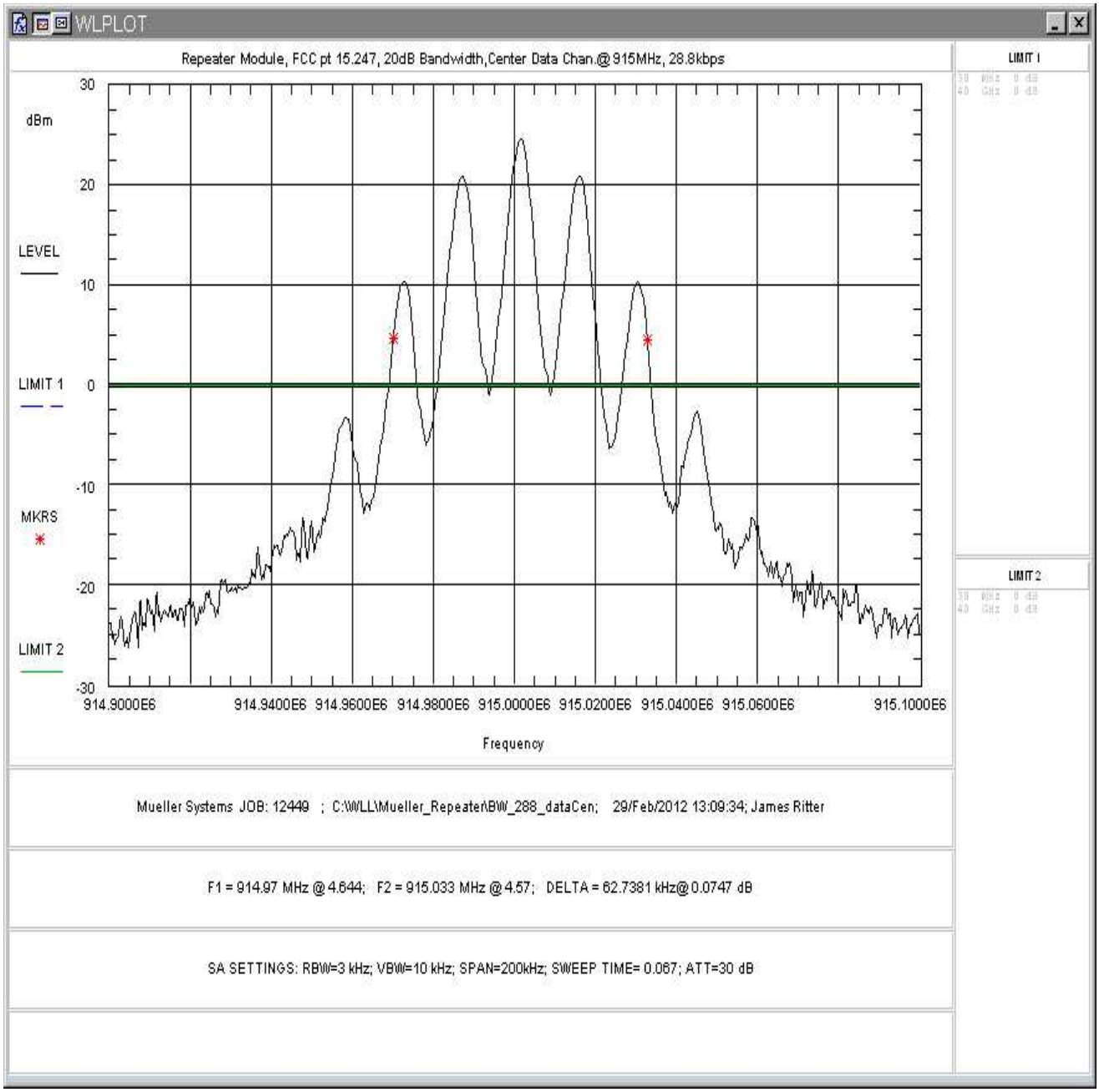

Figure 23: Data Channel Occupied Bandwidth, 28.8kbps, Center Channel

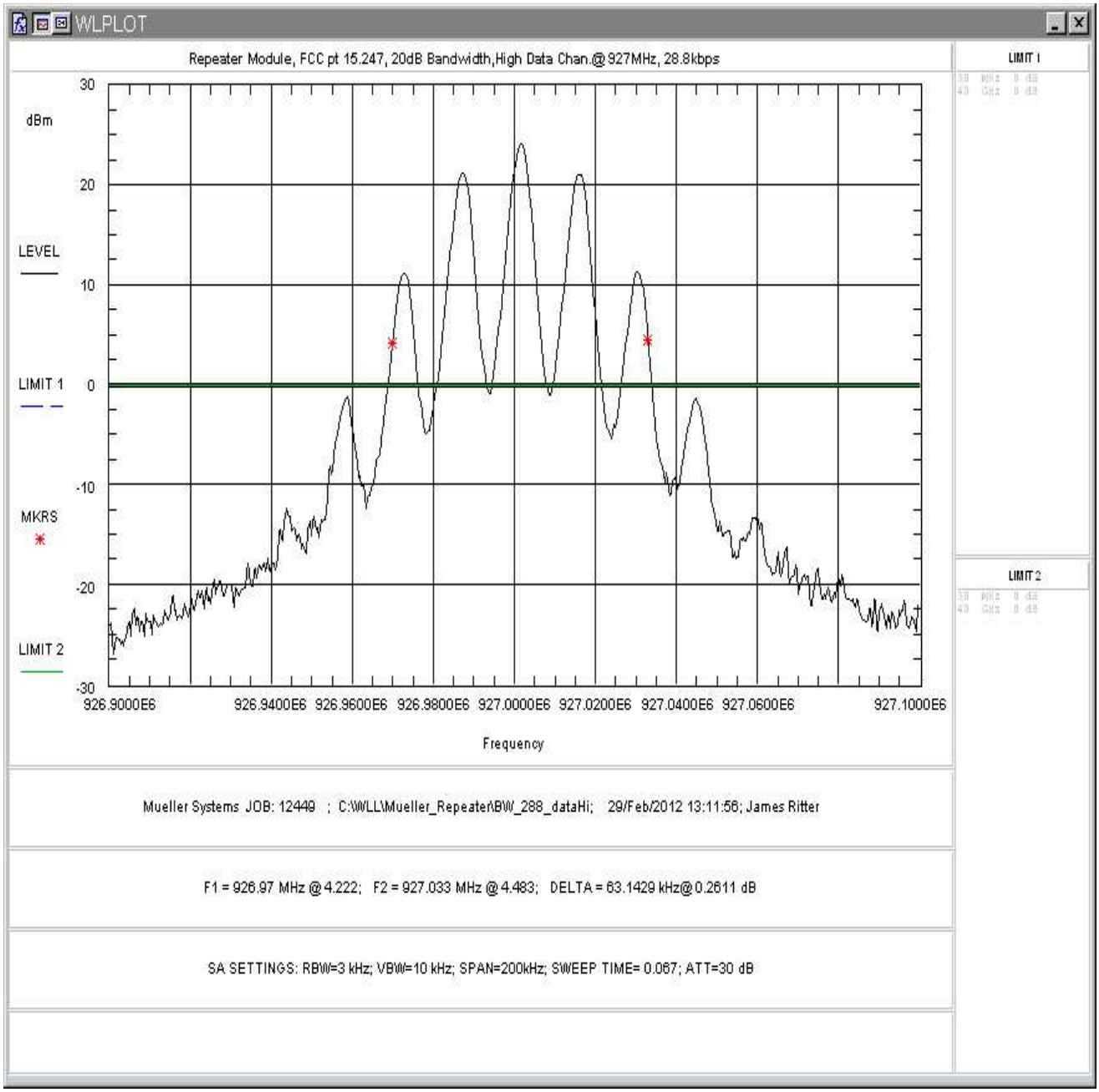

Figure 24: Data Channel Occupied Bandwidth, 28.8kbps, High Channel

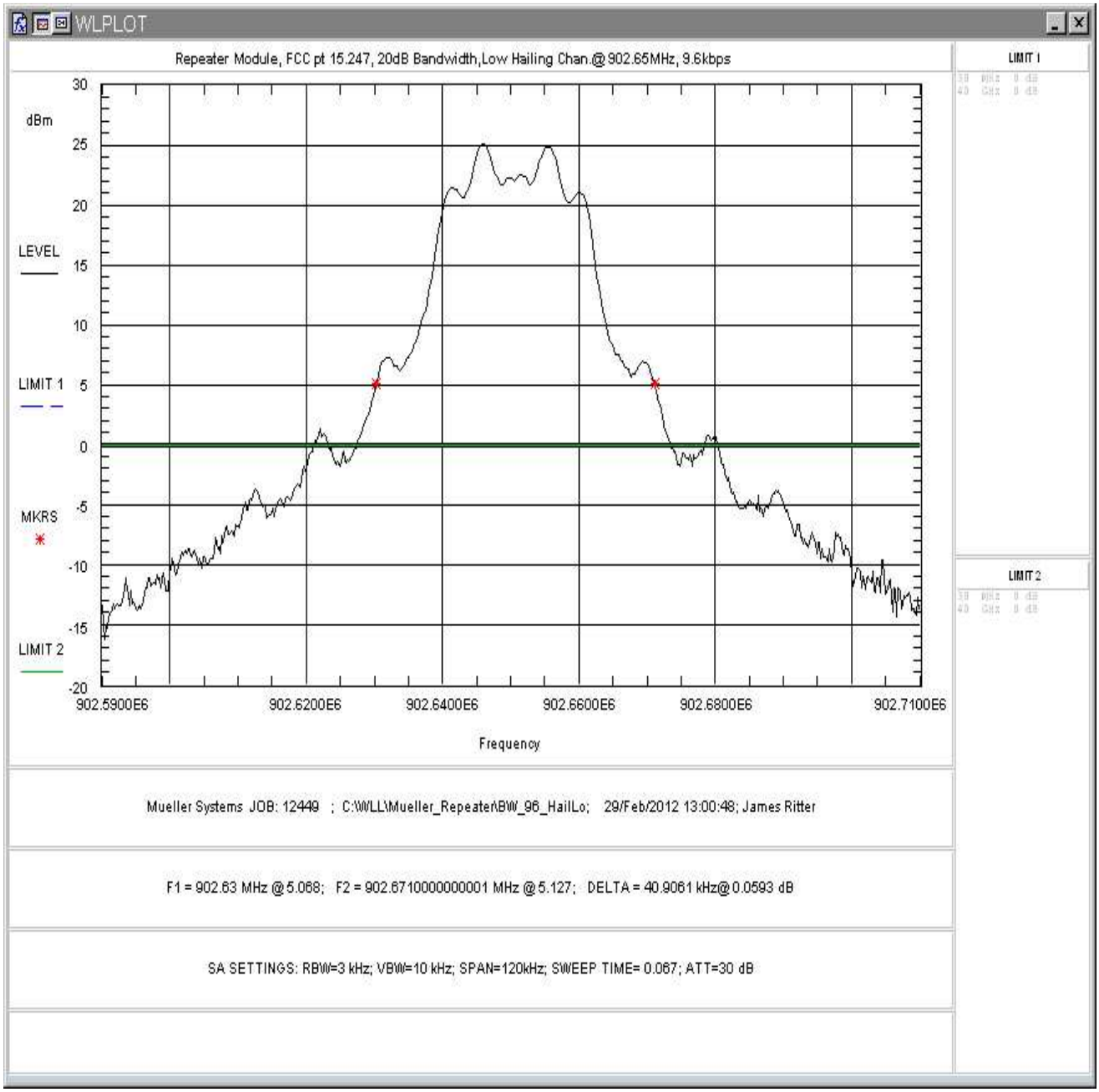

Figure 25 Hailing Channel Occupied Bandwidth, Low Channel

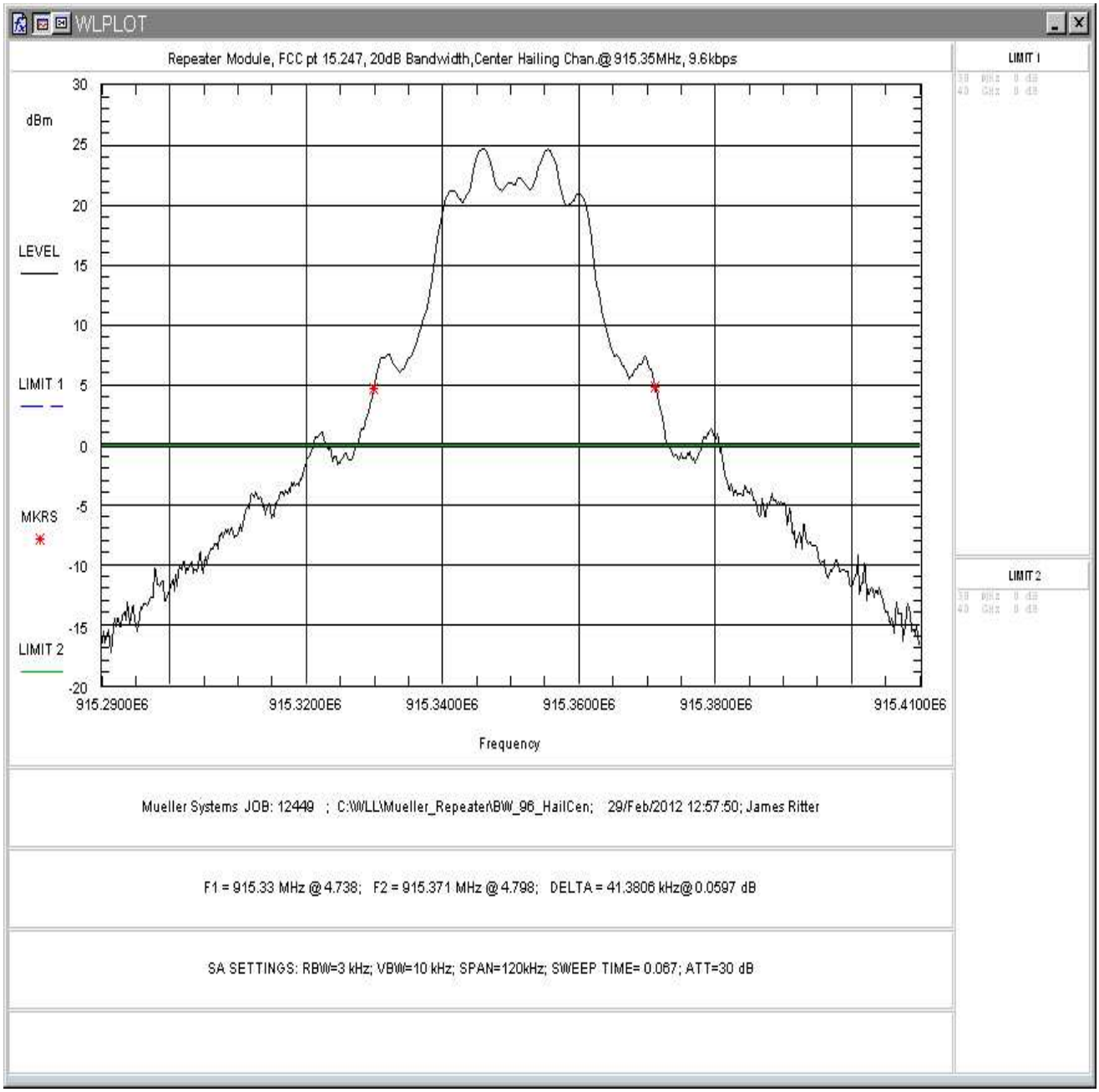

Figure 26 Hailing Channel Occupied Bandwidth, Center Channel

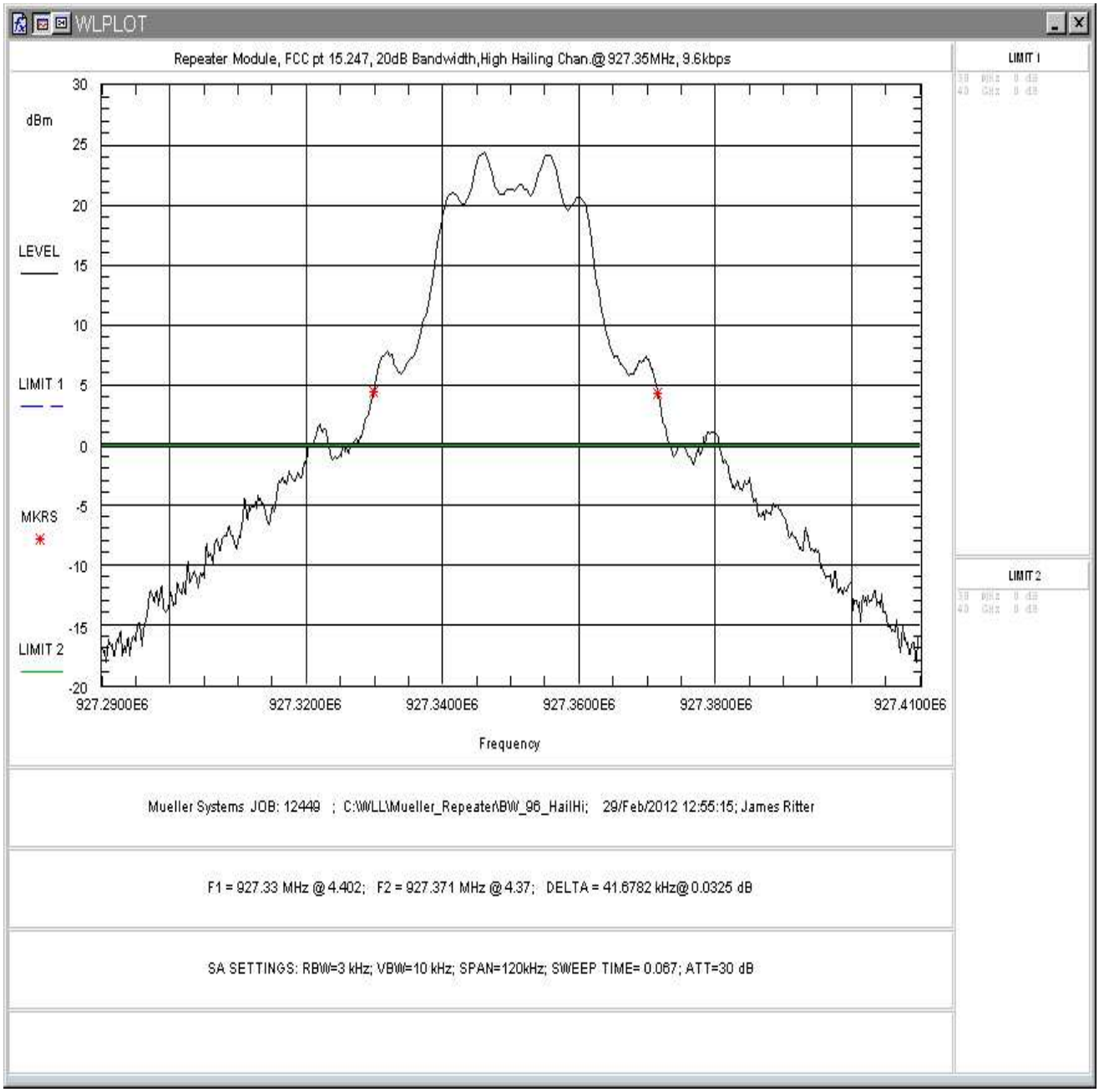

Figure 27 Hailing Channel Occupied Bandwidth, High Channel

5.4 Channel Spacing and Number of Hop Channels (FCC Part §15.247(a)(1))

Per the FCC requirements, frequency hopping systems operating in the 902-928MHz 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 63.14 kHz for Data channels (28.8kbps mode) and 41.68 kHz for hailing mode. The channel spacing must be more than 63.14 kHz for Data mode and 41.68 kHz for Hailing mode. In addition, Part 15.247 requires that devices with occupied bandwidths less than 250 kHz have a minimum of 50 hopping channels.

The EUT antenna was removed and the cable was connected directly into a spectrum analyzer through a calibrated cable and attenuator. An offset was programmed into the spectrum analyzer to compensate for the loss of the external attenuator/cable. The spectrum analyzer resolution bandwidth was set to 100 kHz and the video bandwidth was set to 300 kHz. The channel spacing of 2 adjacent channels was measured using a spectrum analyzer span setting of 2MHz. Also, the number of hopping channels was measured within the 902-928MHz frequency range.

The following are plots of the channel spacing and number of hopping channels data. The channel spacing was measured to be 250 kHz (minimum) for Data channels and 150 kHz (minimum) for Hailing channels and the number of hopping channels is 50 for each mode of operation.

Note: The Data channel plan for this unit has a typical channel spacing of 500 kHz between channels; however, 2 channels have been removed at 909MHz and 921MHz. These channels have been replaced with 2 channels at 902.25MHz and 908.25MHz thus giving a 250 kHz channel spacing between 904MHz -904.5MHz and 908MHz-908.5MHz. This still remains in compliance.

In addition the hailing channels are not evenly dispersed within the band with the closest hailing channels spaced 150 kHz apart. Worst case spacing are shown in plots below.

Table 9: Channel spacing and number of hopping channels summary

Test	Result	Limit	Pass/Fail
Data Channel spacing	250kHz channel spacing between 904MHz - 904.5MHz and 908MHz-908.5MHz. 500kHz between other channels	63.14kHz Minimum	Pass
Number of Channels	50 channels	50 channels minimum	Pass
Hailing Channel Spacing	The closest channels are spaced 150kHz	41.68kHz Minimum	Pass
Number of Hailing Channels	50 channels	50 channels minimum	Pass

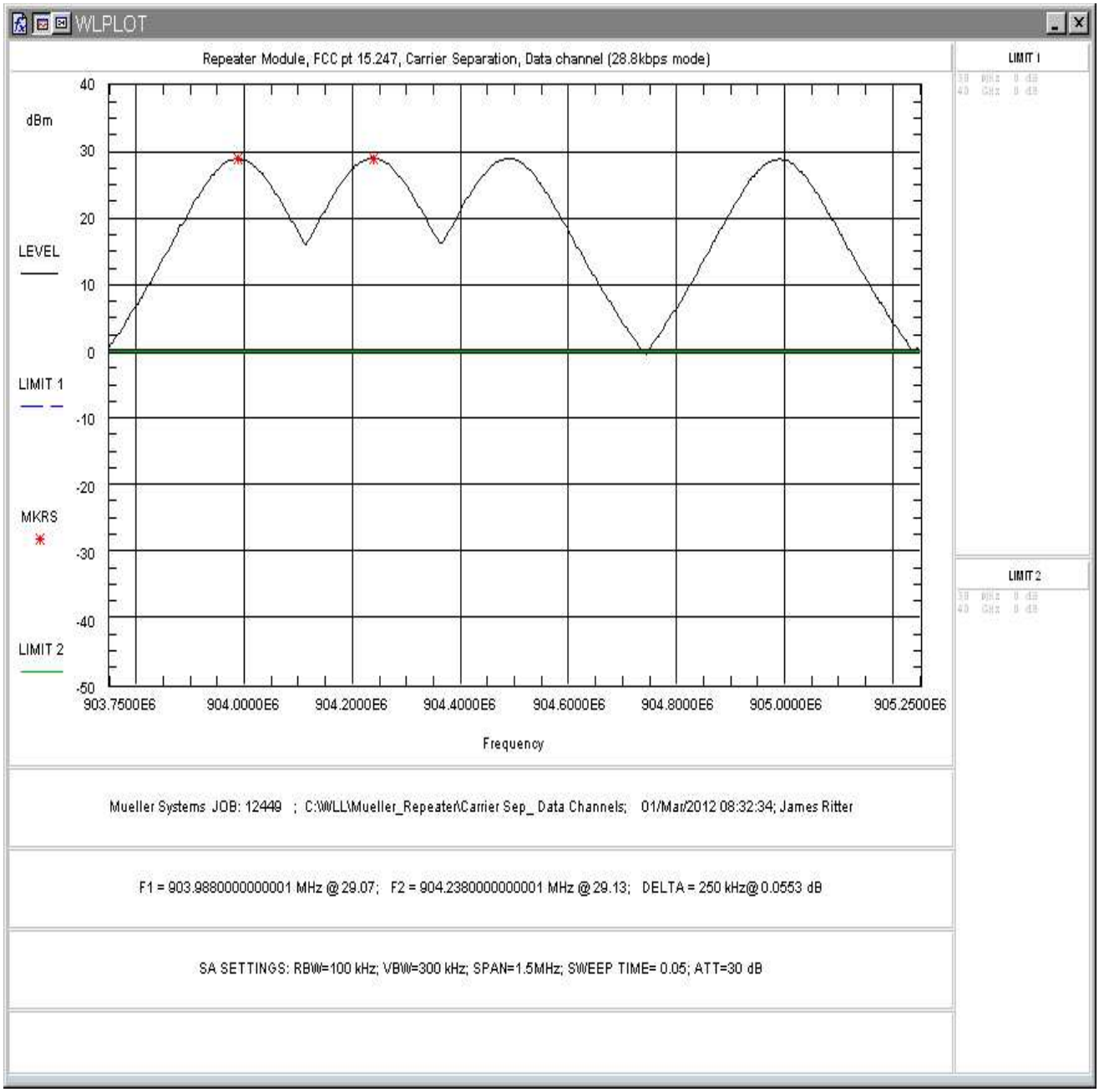

Figure 28: Data Channel Spacing, 250 kHz

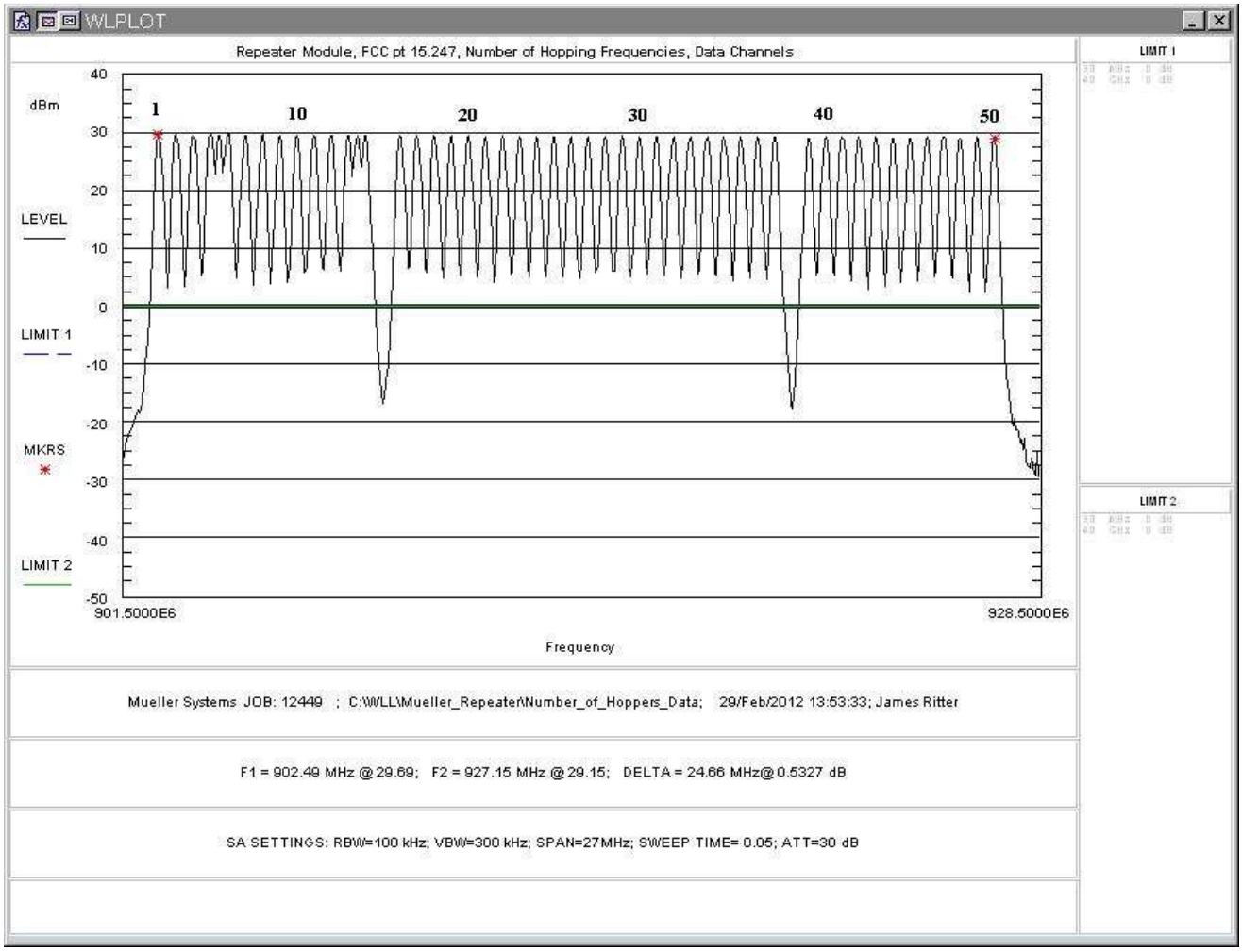

Figure 29: Data Channel Number of Channels

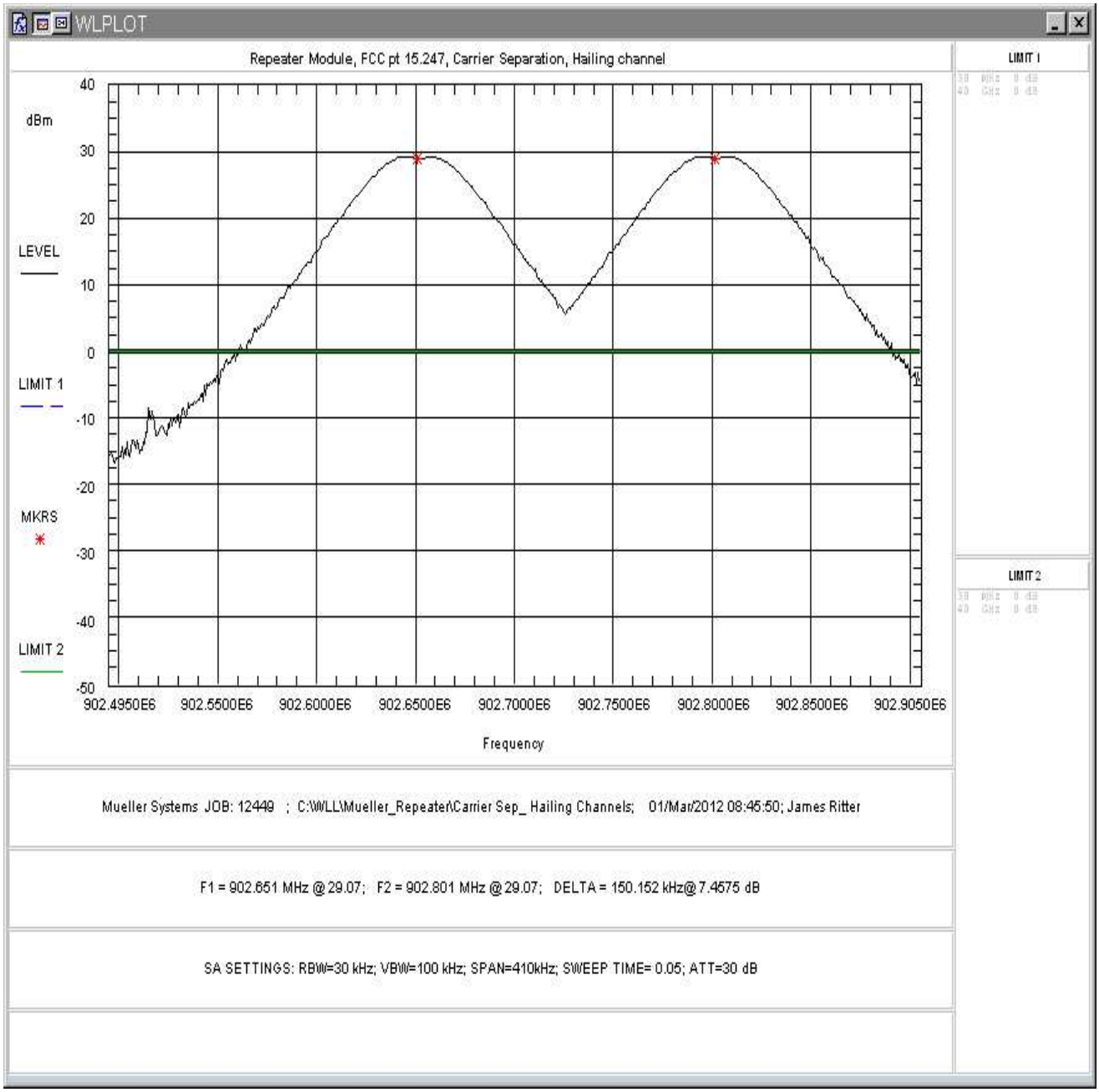

Figure 30: Hailing Channel Spacing

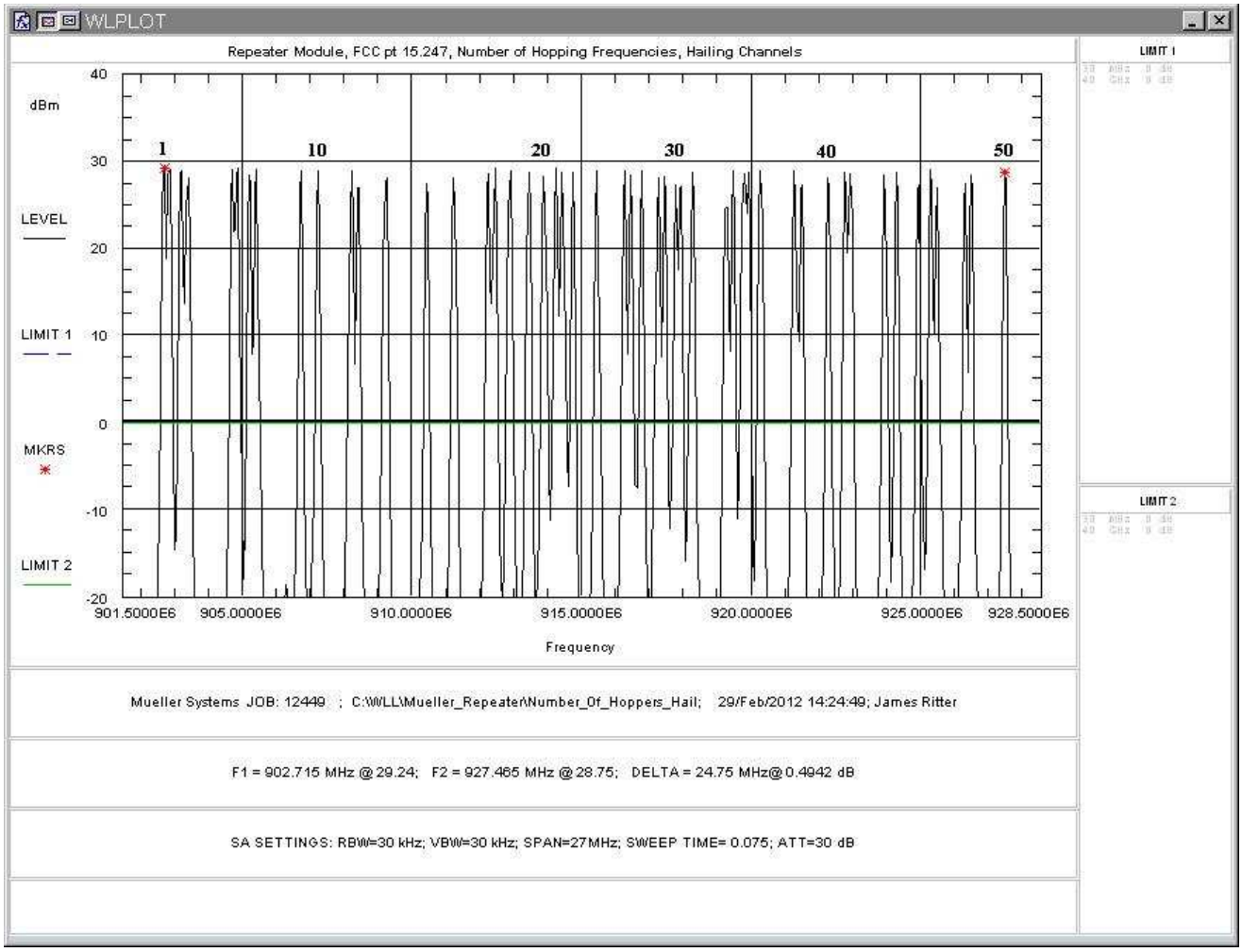

Figure 31: Number of Hailing Channels

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

The EUT must comply with requirements for spurious emissions at the antenna terminal. Per §15.247(c) all spurious emissions in any 100 kHz bandwidth outside the frequency band in which the device is operating shall be attenuated 20 dB below the highest power level in any 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 suitable 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 300 kHz. The amplitude of the EUT carrier frequency was measured to determine the emissions limit (20 dB below the maximum modulated transmit frequency amplitude). The emissions outside of the allocated frequency band were then scanned from 30 MHz up to the tenth harmonic of the carrier.

Close-up plots of the 902-928MHz band edges are provided in both the hopping and non-hopping modes for all modes of operation to show compliance at both of these points.

Based on the results of the previous tests & band-edge tests plus the fact that both the hailing & data channels have the same power and share the same RF circuitry the full conducted tests will be performed as follows:

Low Channel Testing: 902.5MHz –High and Low Power, 9.6kbps

Center Channel Testing: 915 MHz - High and Low Power, 9.6kbps

High Channel Testing: 927.35MHz - High and Low Power, 9.6kbps

(this is the low, center & highest channels of both modes combined)

The EUT complied with all requirements of FCC Part15.247 for the conducted spurious measurements performed in sections 5.5.1 and 5.5.2 of this test report.

5.5.1 Conducted Band Edge Plots

5.5.1.1 Hailing Mode-High Power

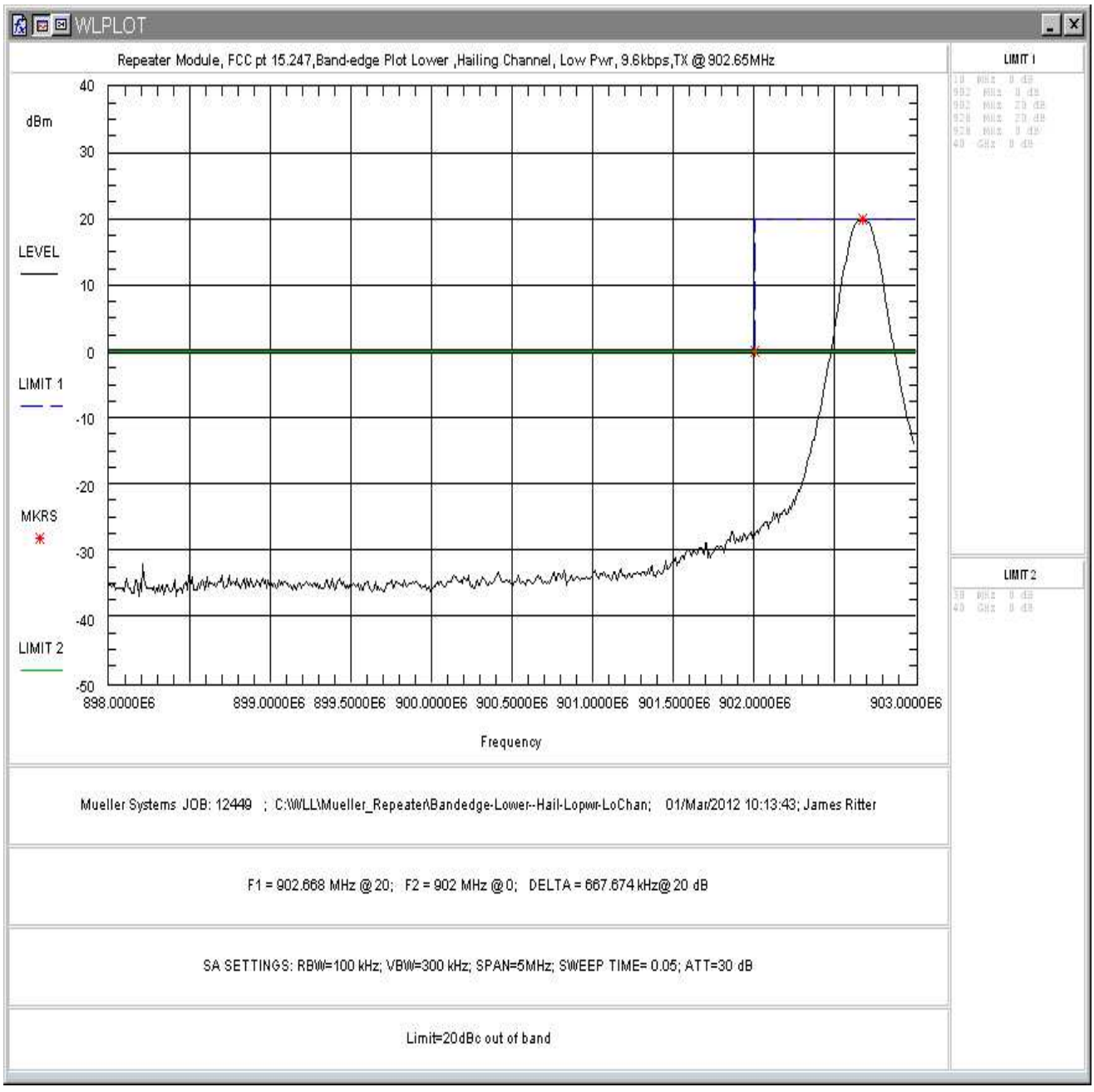

Figure 32: Lower Band-edge, Hailing, High Pwr, 9.6kbps, TX-902.65MHz

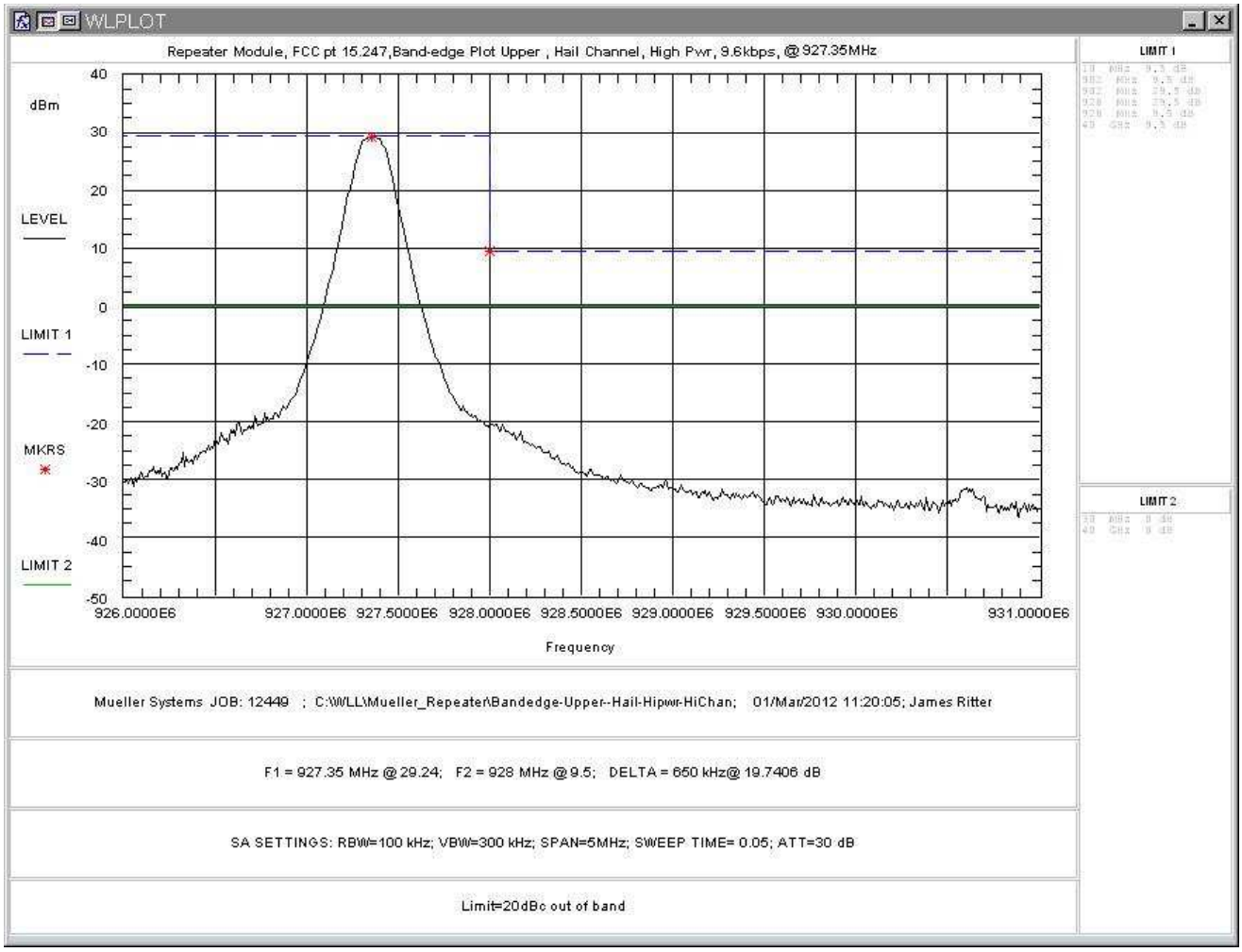

Figure 33: Upper Band-edge, Hailing, High Pwr, 9.6kbps, TX-927.35MHz

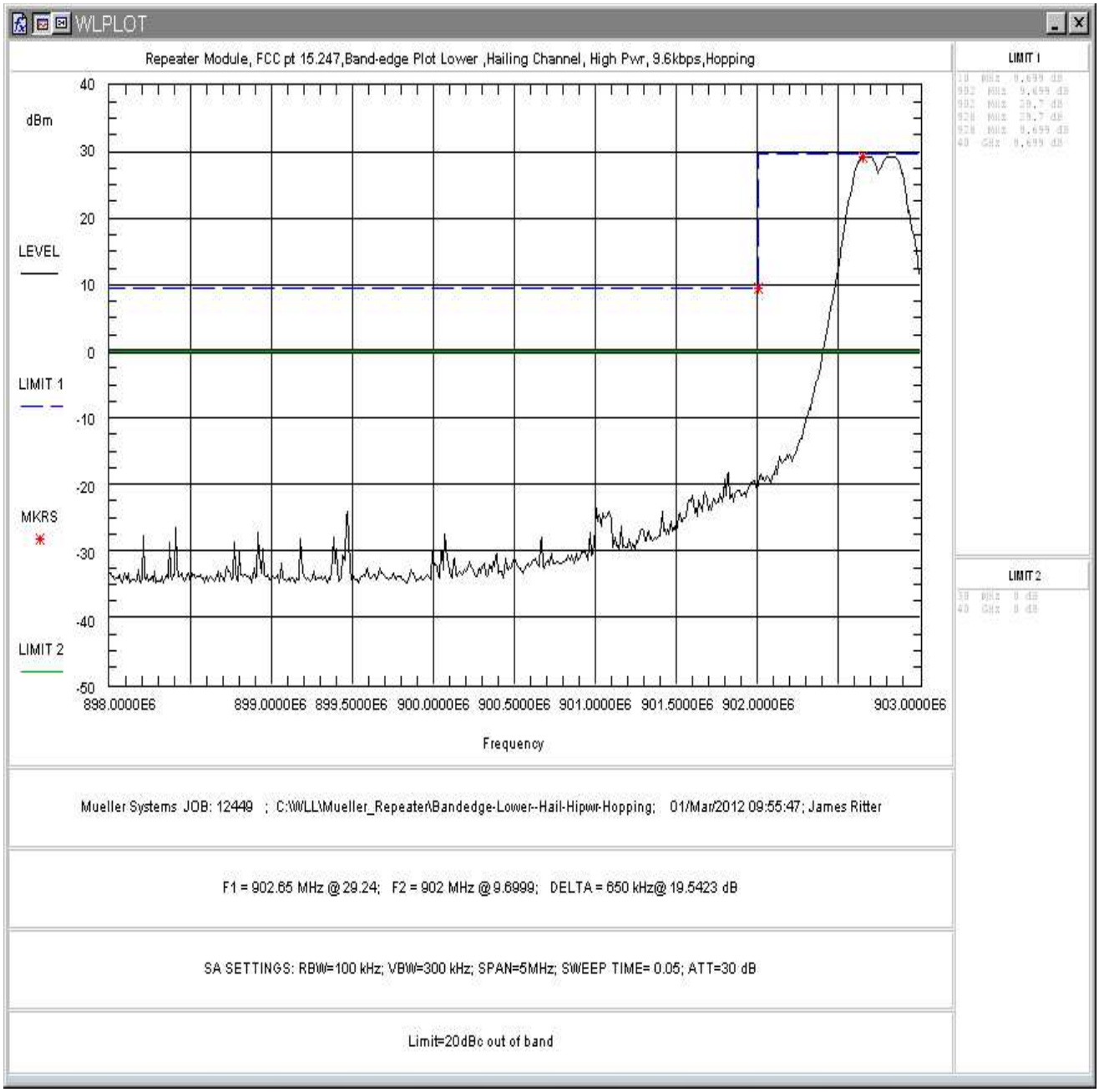

Figure 34: Lower Band-edge, Hailing, High Pwr, 9.6kbps, Hopping

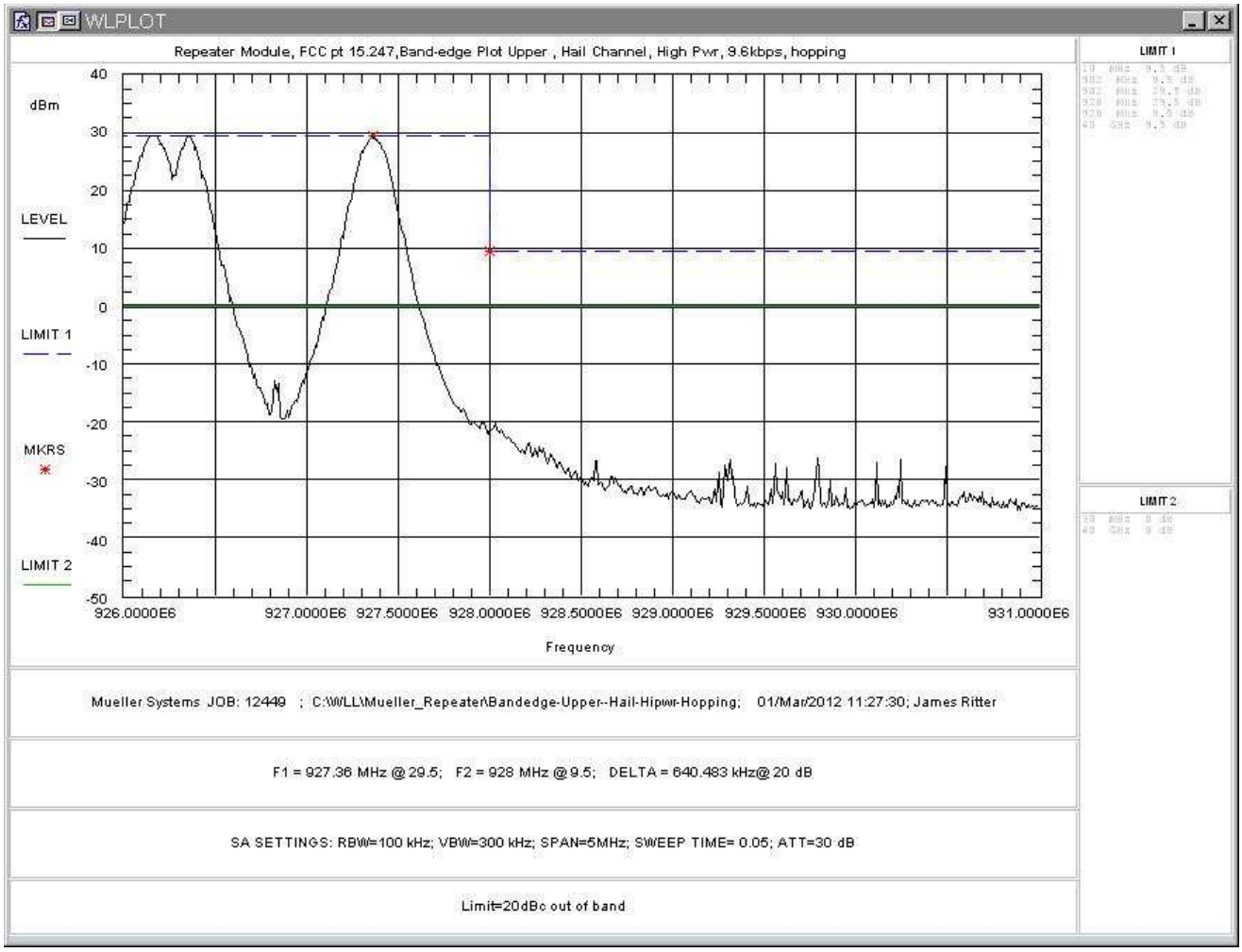

Figure 35: Upper Band-edge, Hailing, High Pwr, 9.6kbps, Hopping

5.5.1.2 Hailing Mode- Low Power

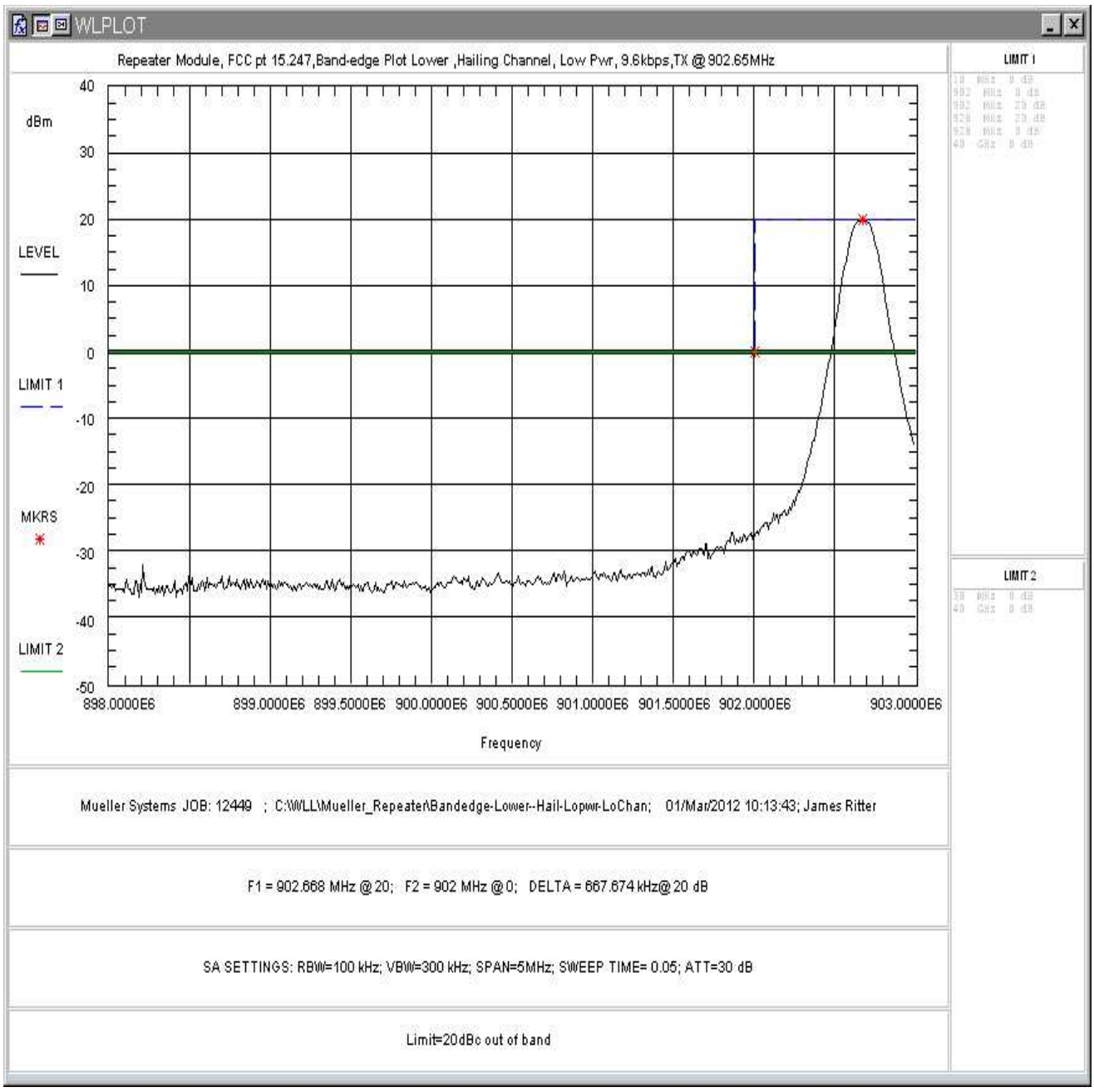

Figure 36: Lower Band-edge, Hailing, Low Pwr, 9.6kbps, TX-902.65MHz

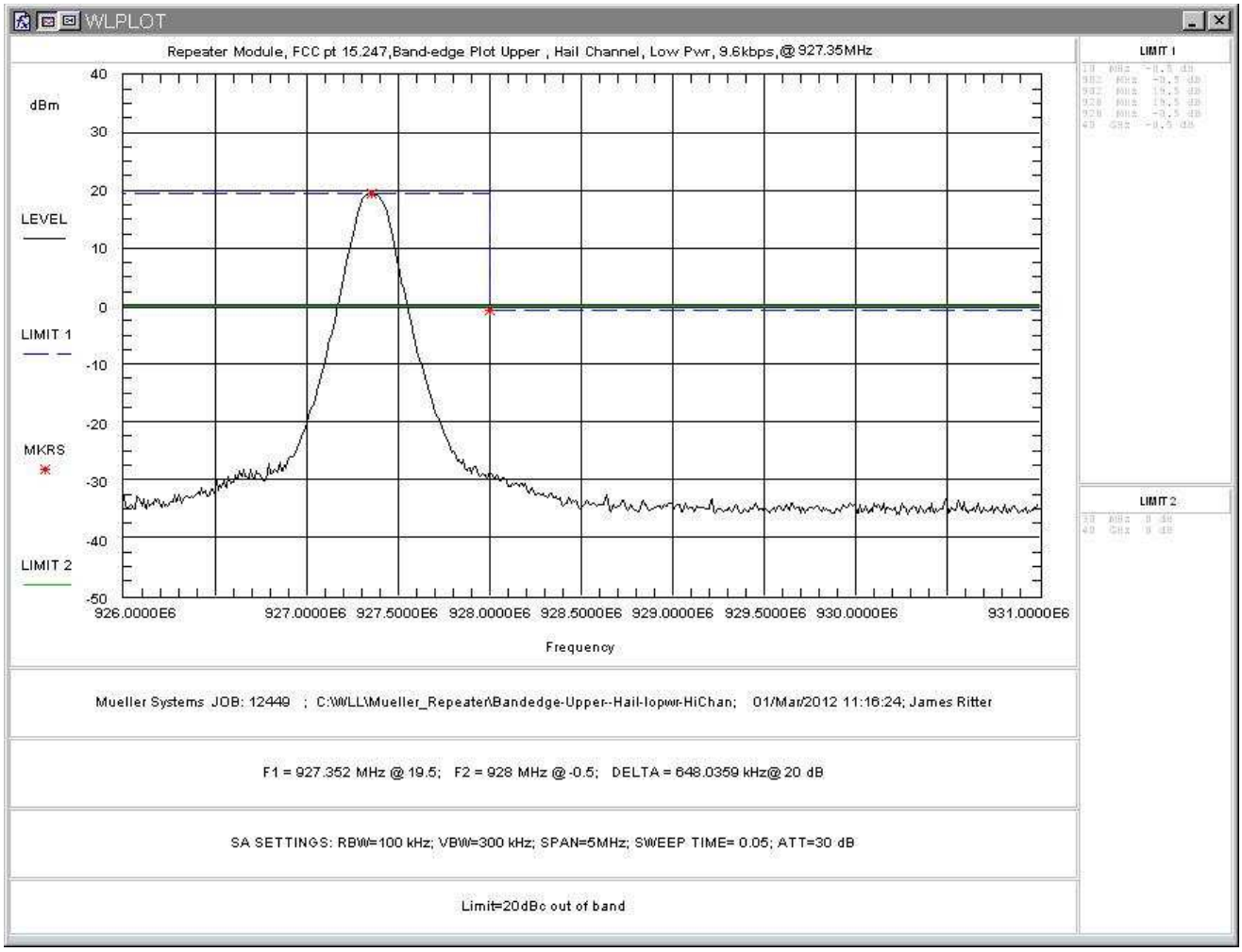

Figure 37: Upper Band-edge, Hailing, Low Pwr, 9.6kbps, TX-927.35MHz

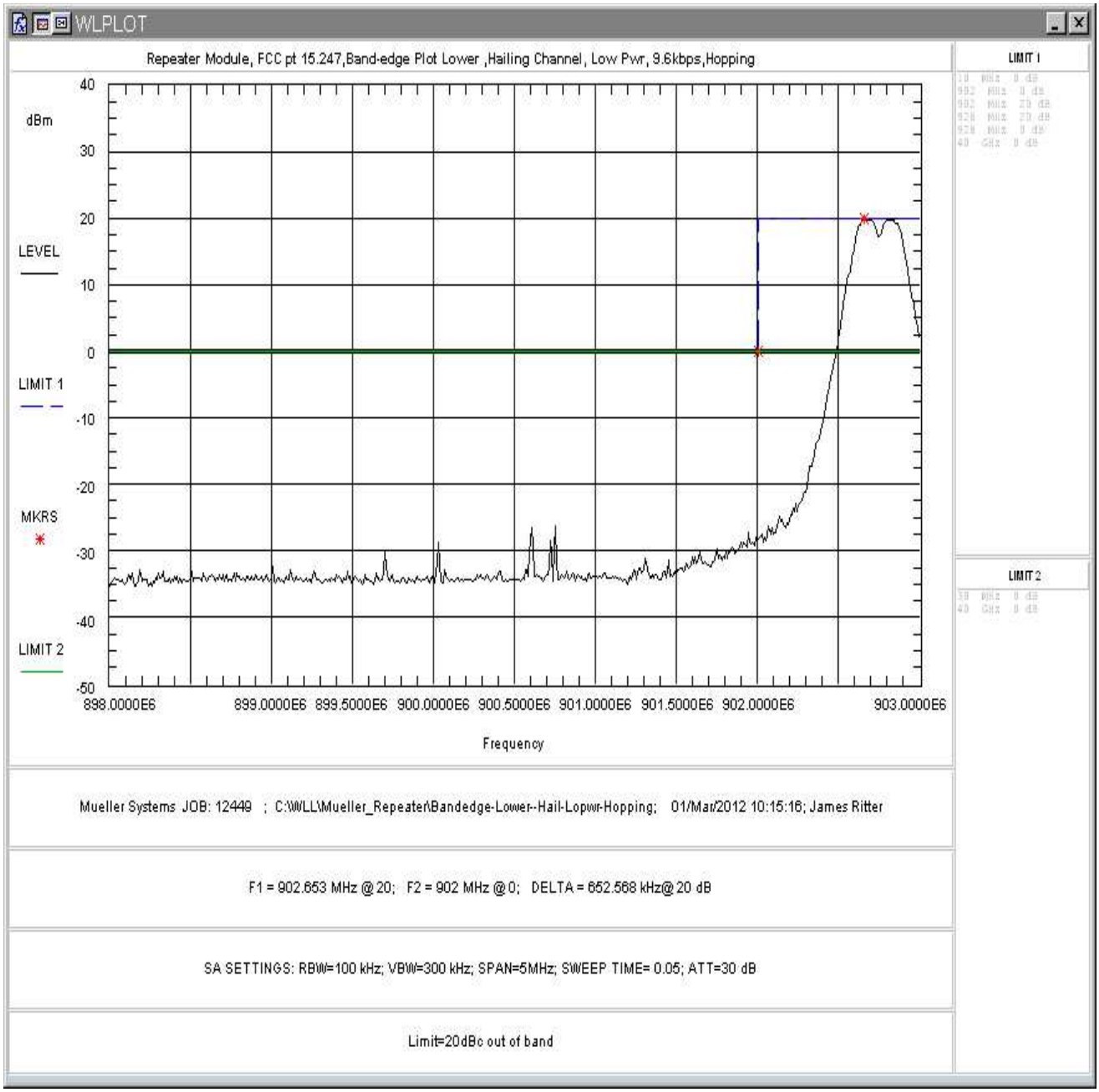

Figure 38: Lower Band-edge, Hailing, Low Pwr, 9.6kbps, Hopping

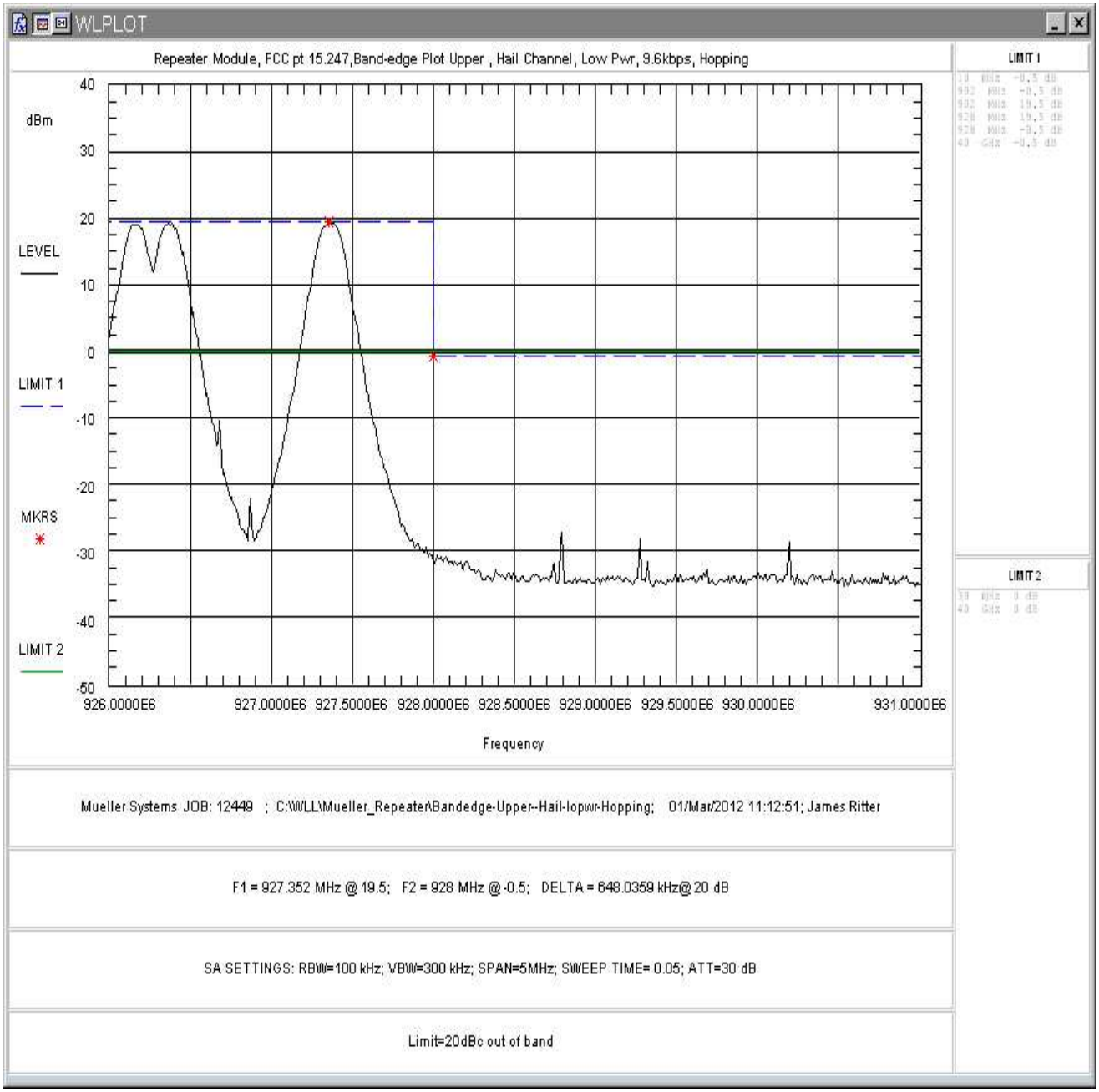

Figure 39: Upper Band-edge, Hailing, Low Pwr, 9.6kbps, Hopping

5.5.1.3 Data Mode-9.6kbps-High Power

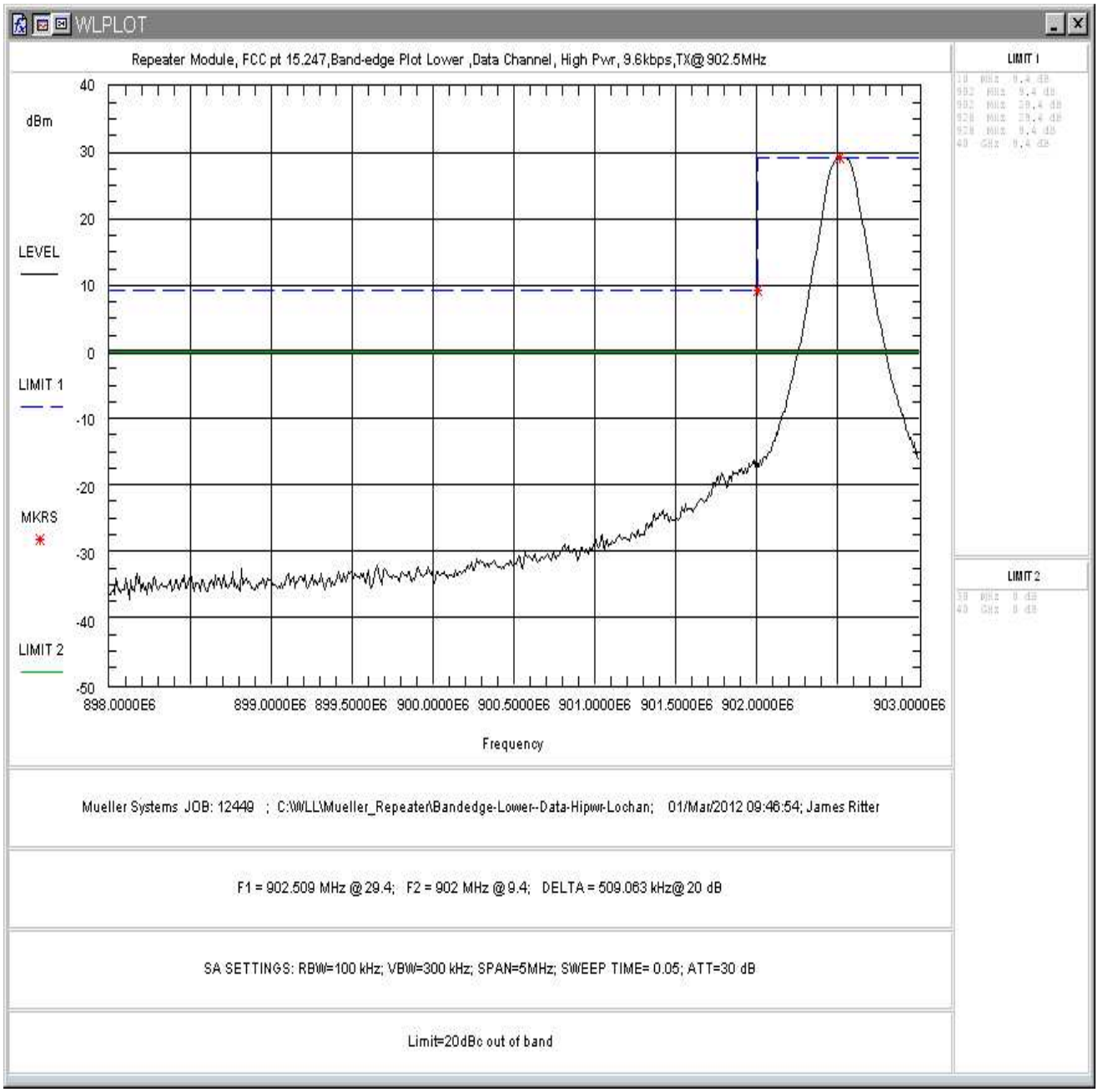

Figure 40: Lower Band-edge, Data, High Pwr, 9.6kbps, TX-902.5MHz

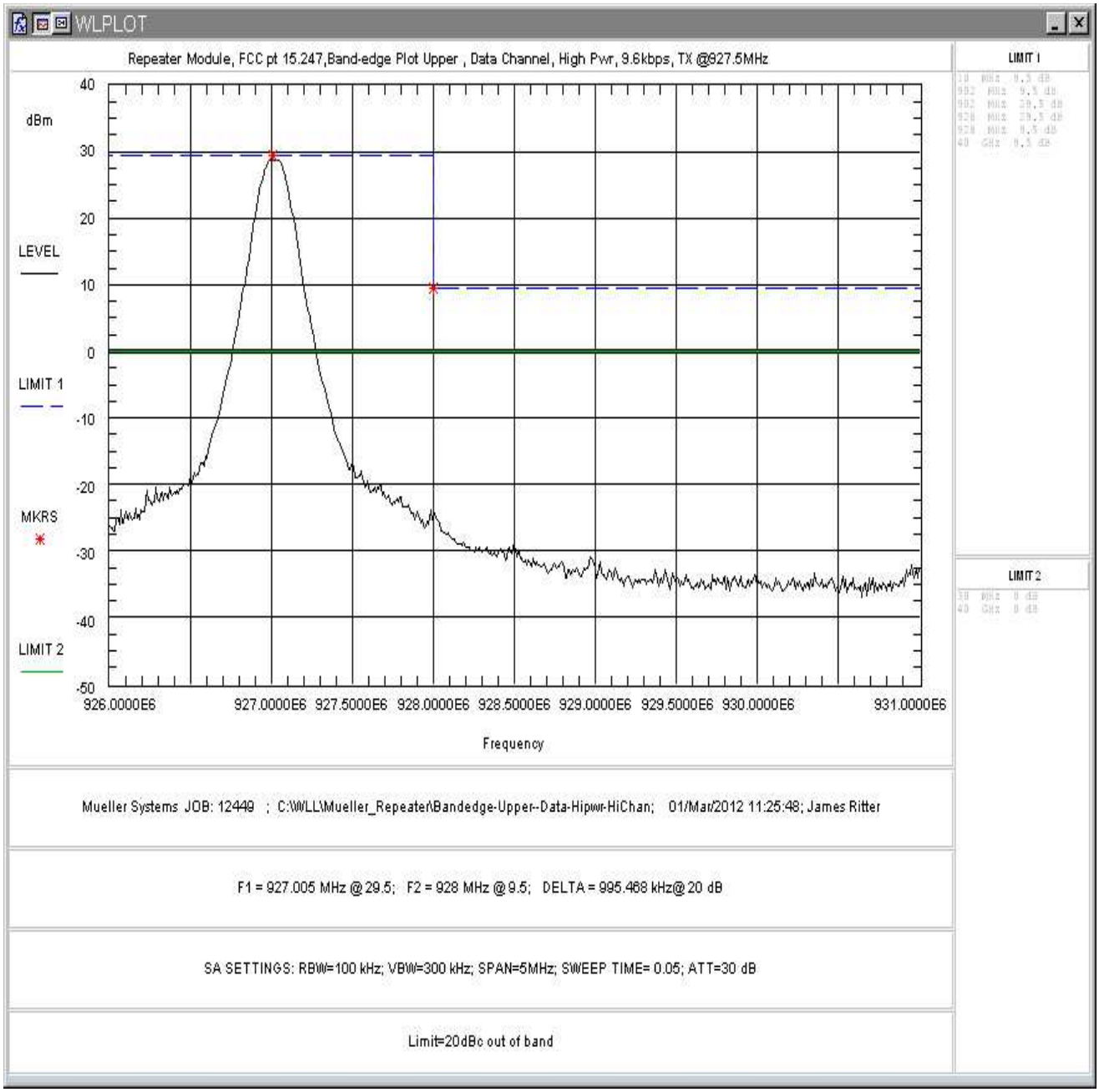

Figure 41: Upper Band-edge, Data, High Pwr, 9.6kbps, TX-927MHz

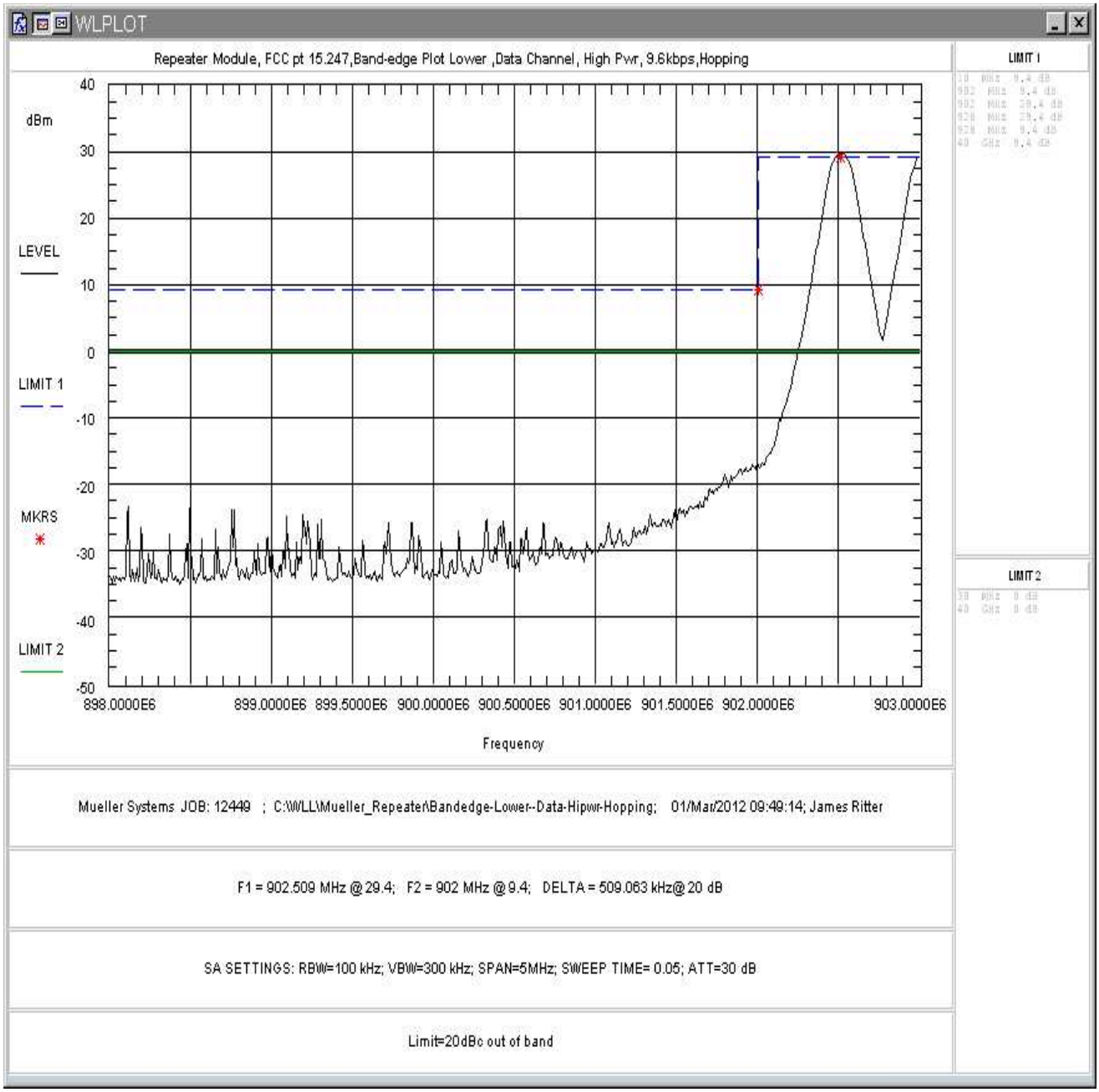

Figure 42: Lower Band-edge, Data, High Pwr, 9.6kbps, Hopping

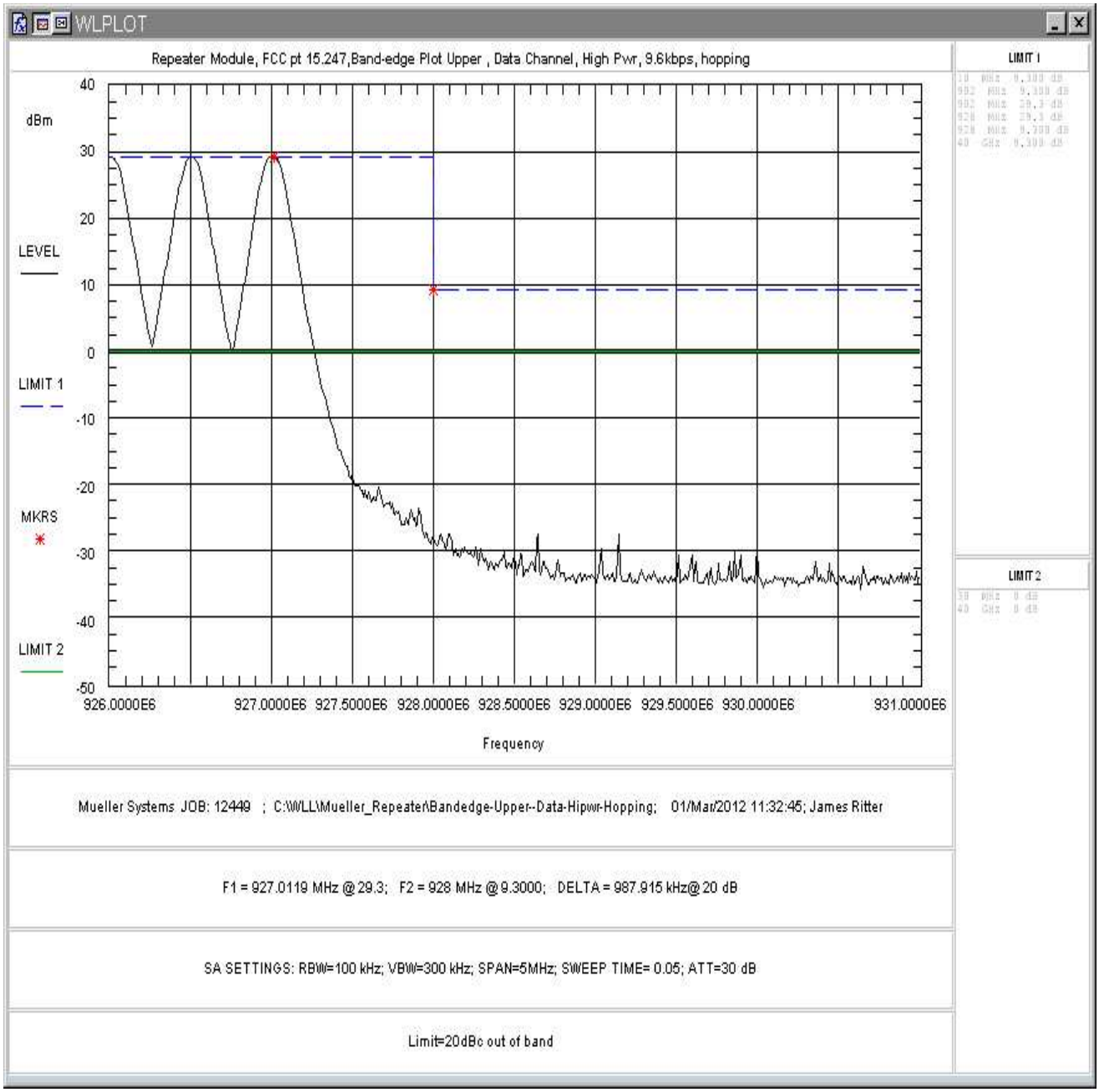

Figure 43: Upper Band-edge, Data, High Pwr, 9.6kbps, Hopping

5.5.1.4 Data Mode-9.6kbps-Low Power

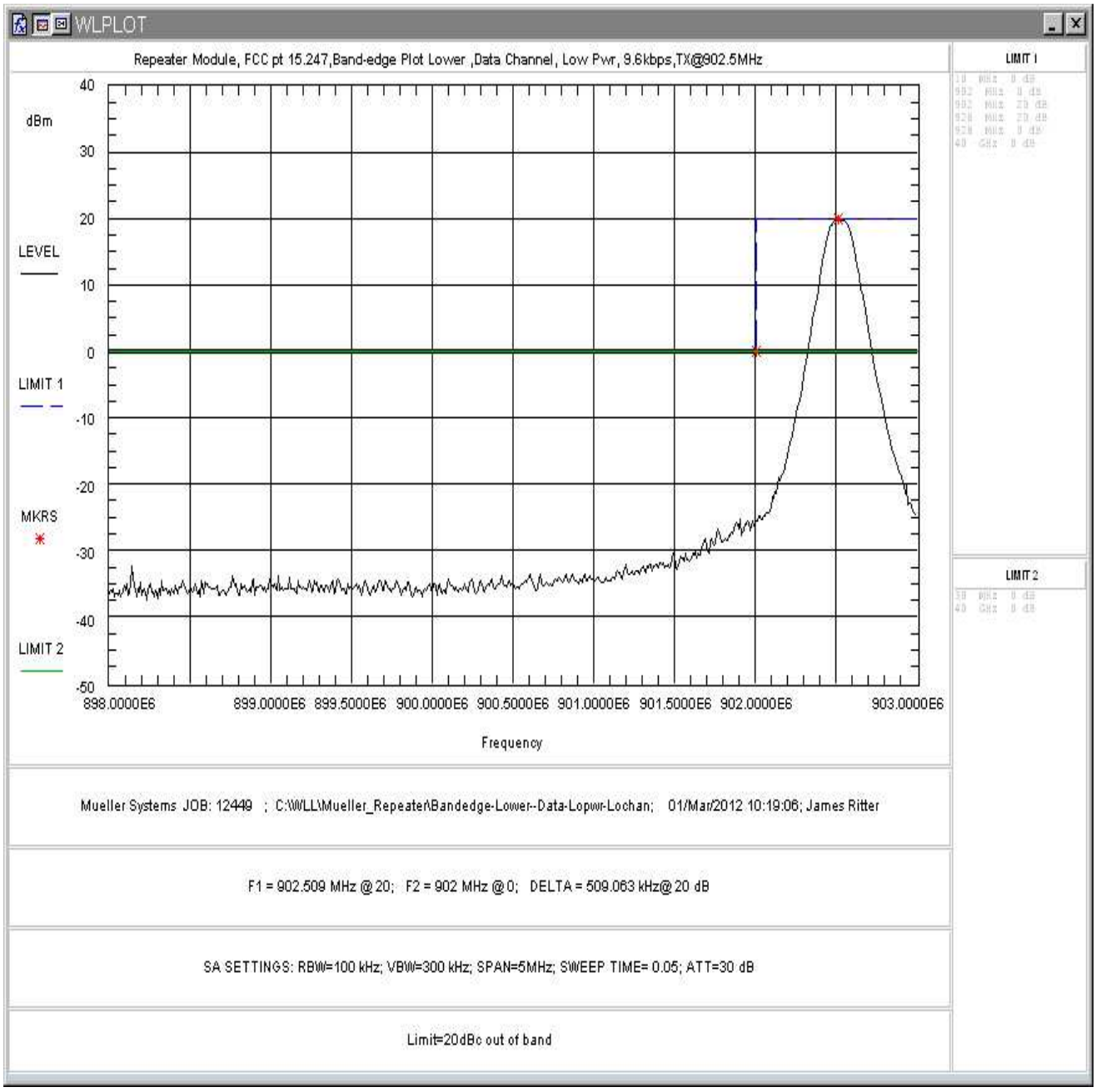

Figure 44: Lower Band-edge, Data, Low Pwr, 9.6kbps, TX-902.5MHz

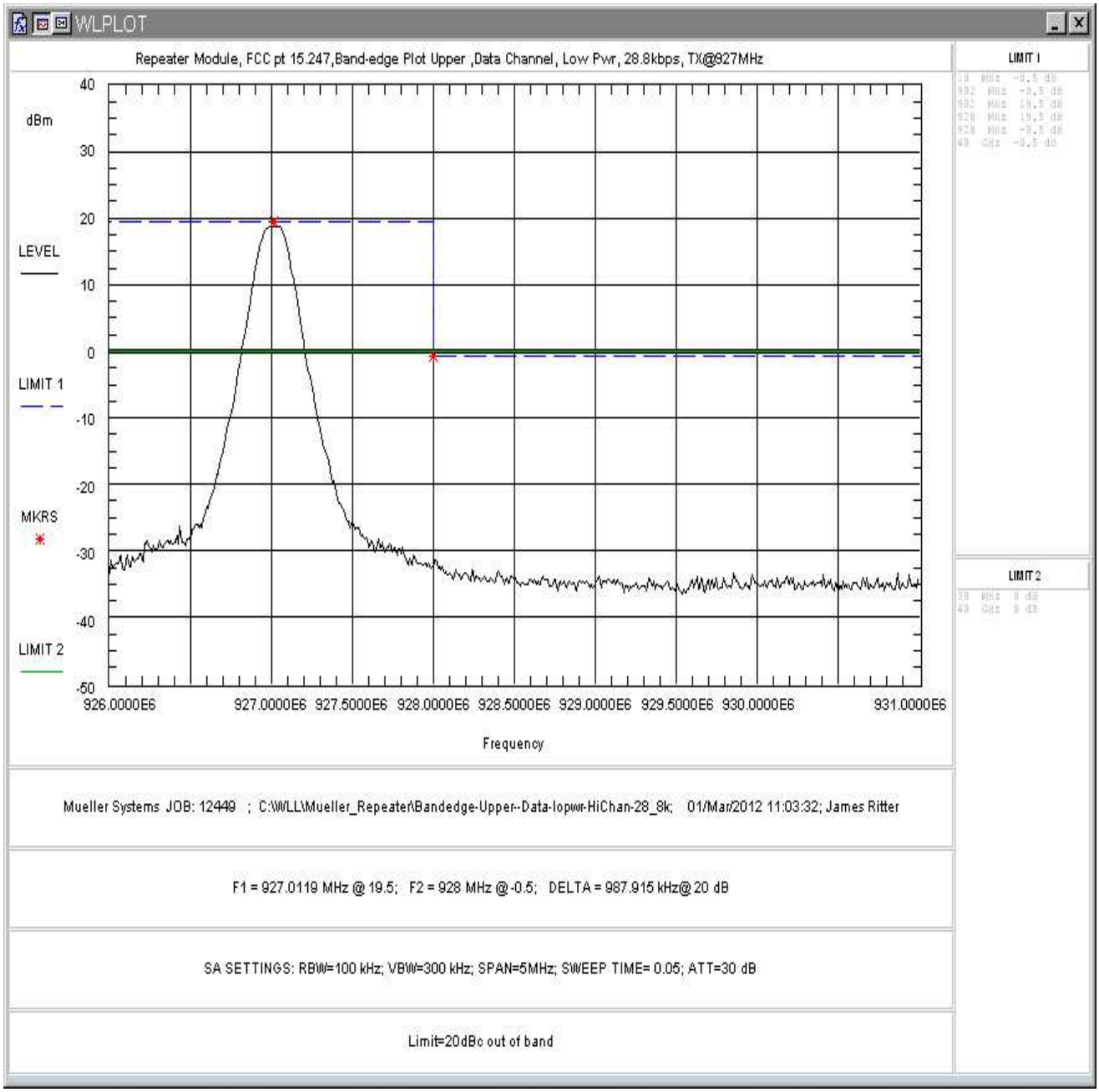

Figure 45: Upper Band-edge, Data, Low Pwr, 9.6kbps, TX-927MHz

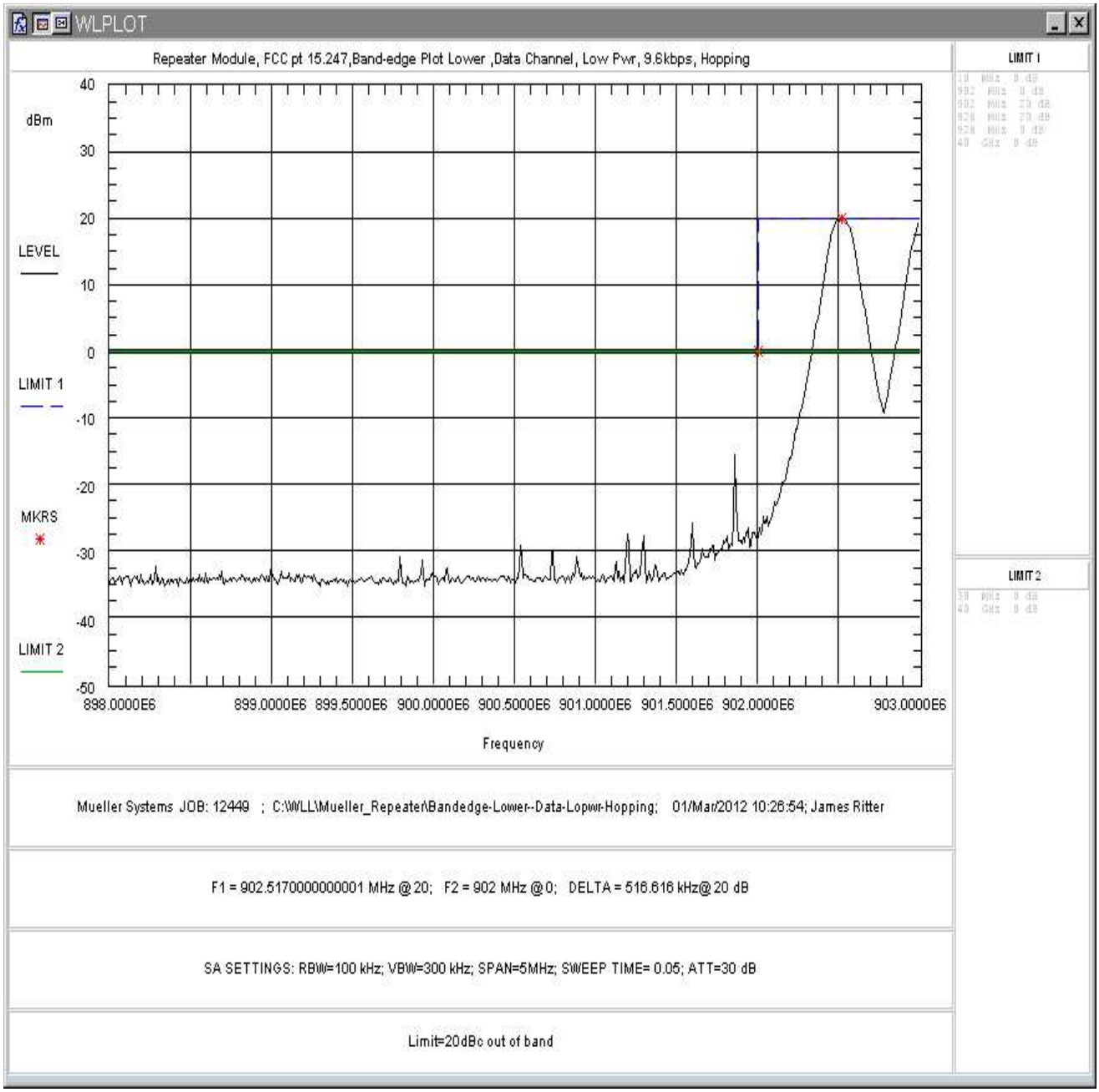

Figure 46: Lower Band-edge, Data, Low Pwr, 9.6kbps, Hopping

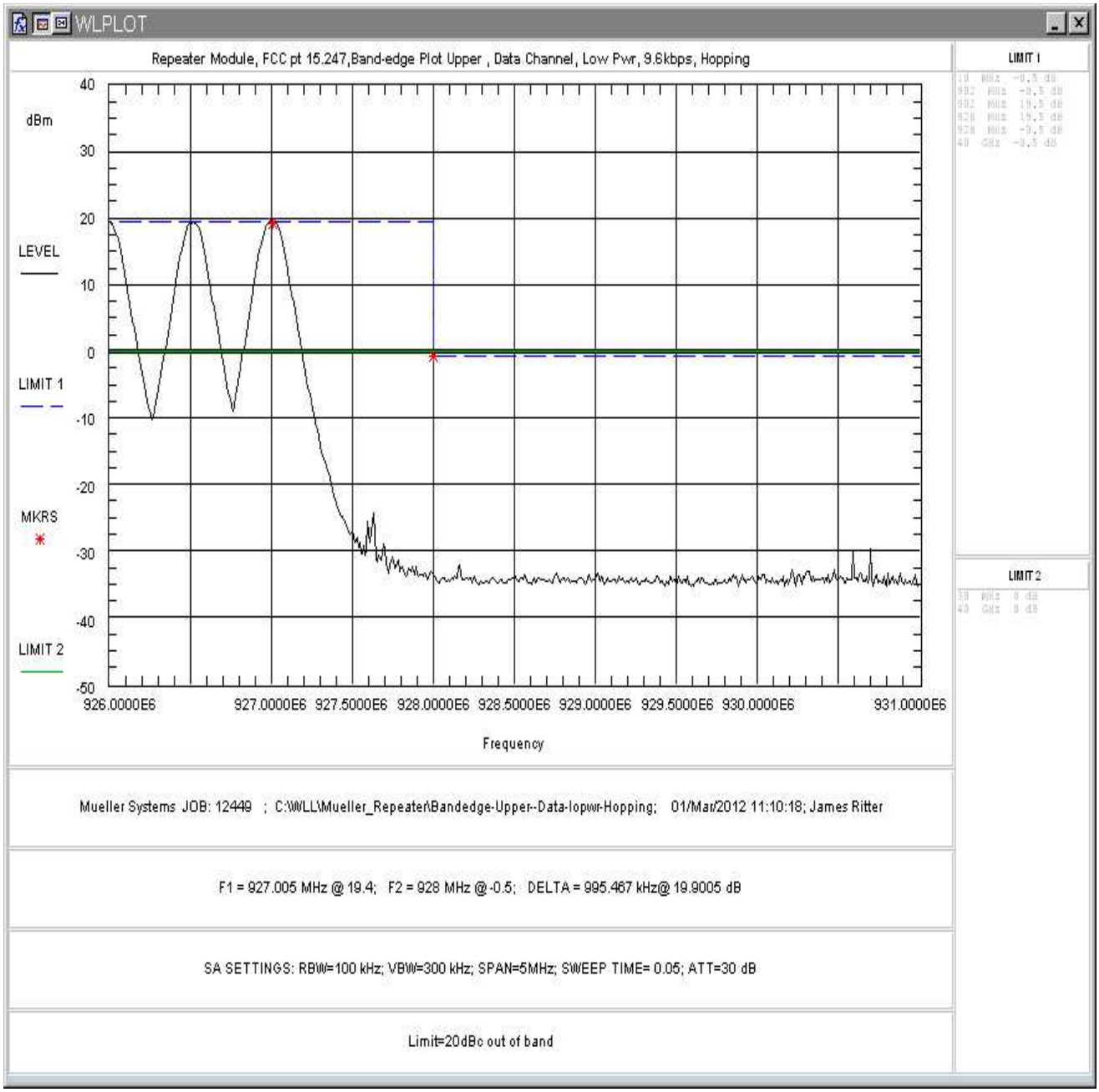

Figure 47: Upper Band-edge, Data, Low Pwr, 9.6kbps, Hopping

5.5.1.5 Data Mode-28.8kbps-High Power

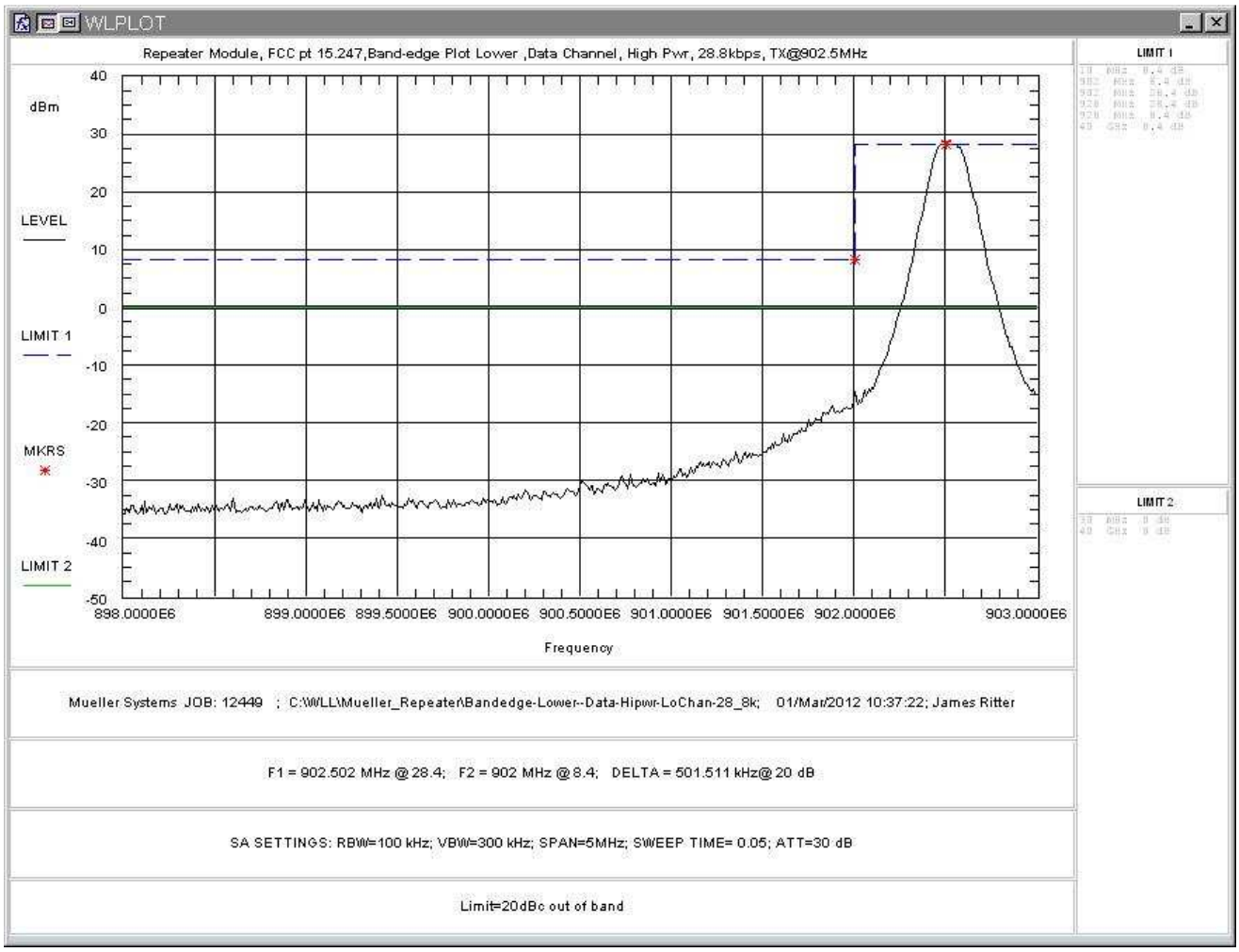

Figure 48: Lower Band-edge, Data, High Pwr, 28.8kbps, TX-902.5MHz

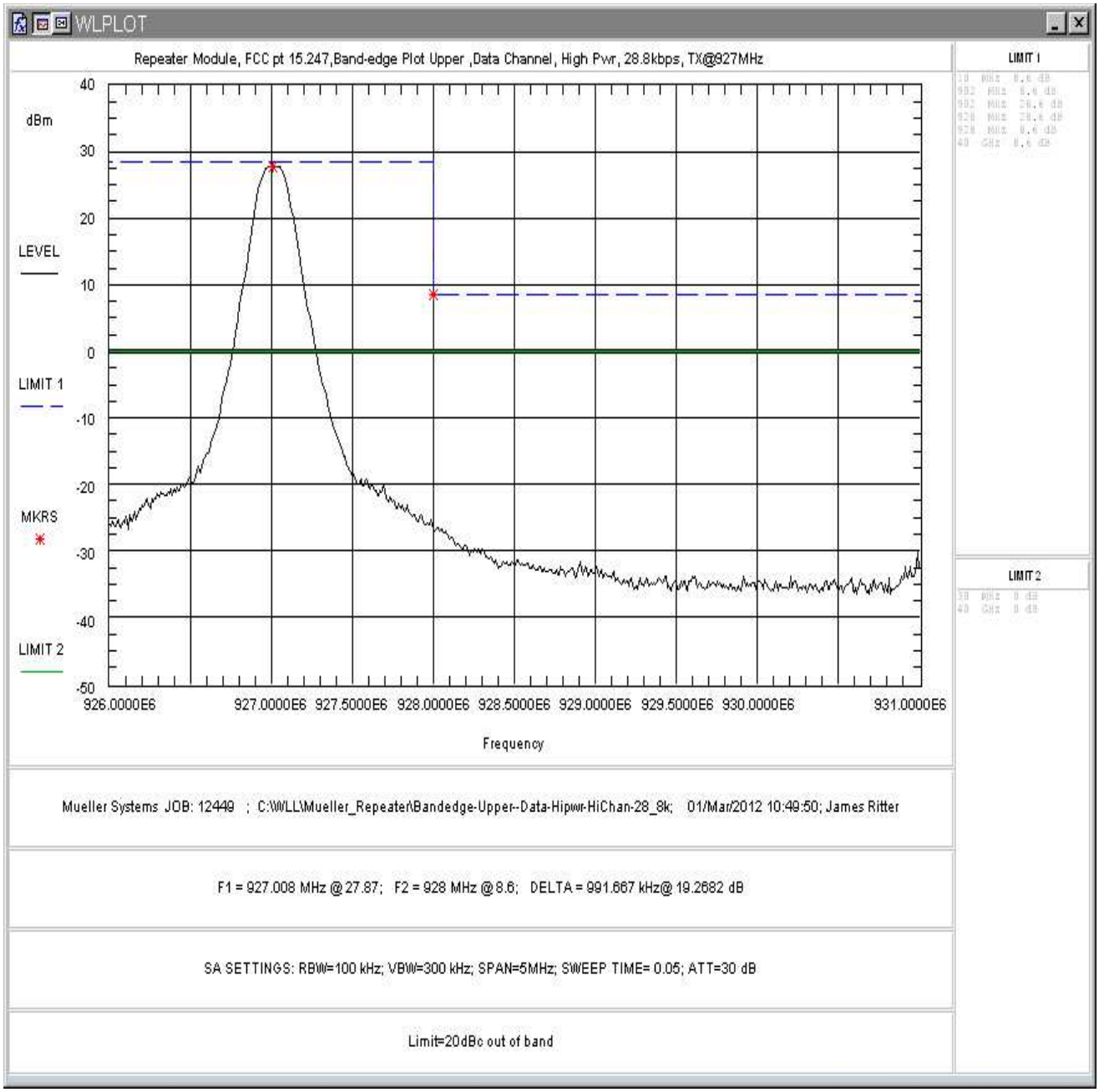

Figure 49: Upper Band-edge, Data, High Pwr, 28.8kbps, TX-927MHz

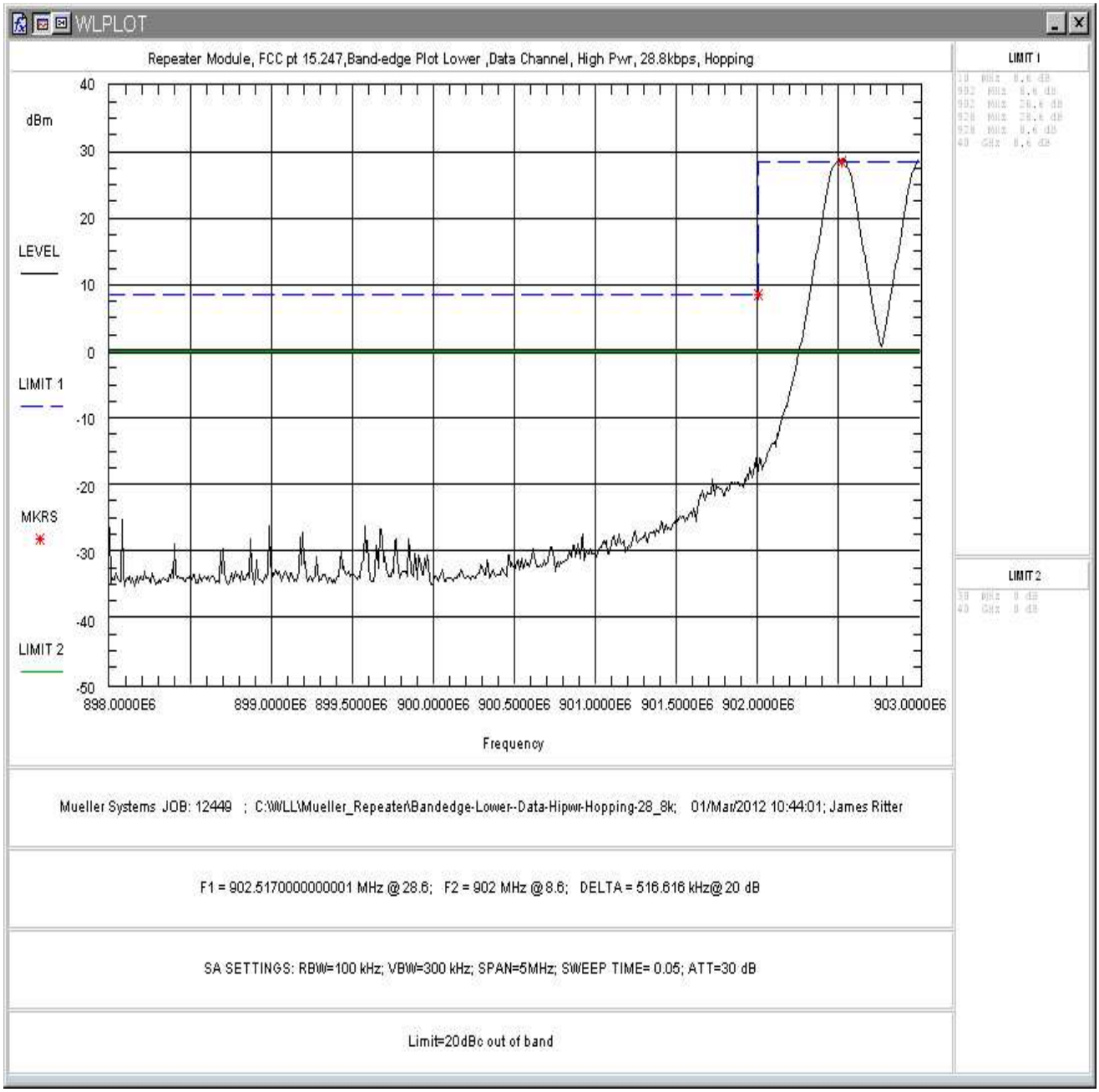

Figure 50: Lower Band-edge, Data, High Pwr, 28.8kbps, Hopping

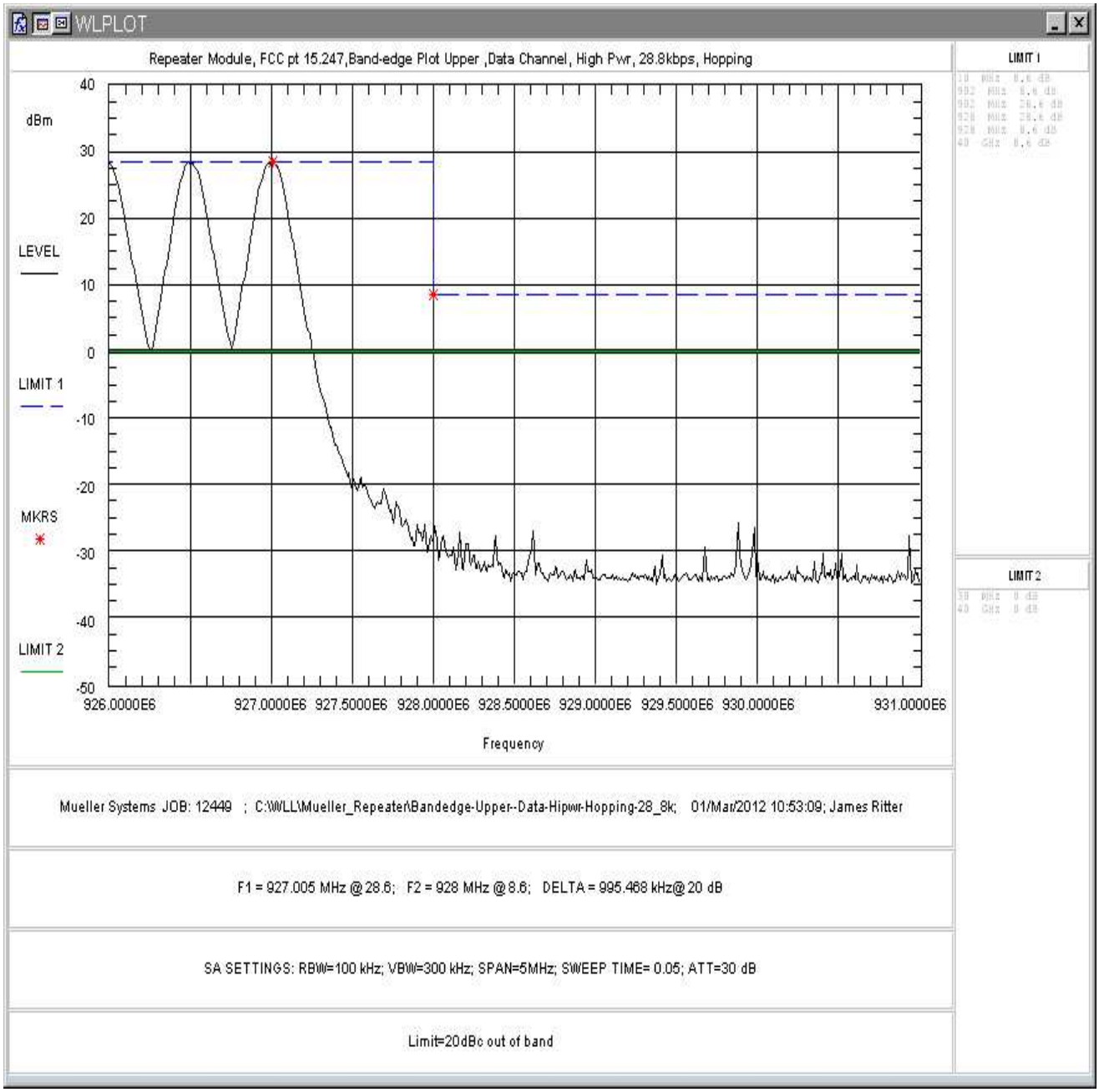

Figure 51: Upper Band-edge, Data, High Pwr, 28.8kbps, Hopping

5.5.1.6 Data Mode-28.8kbps-Low Power

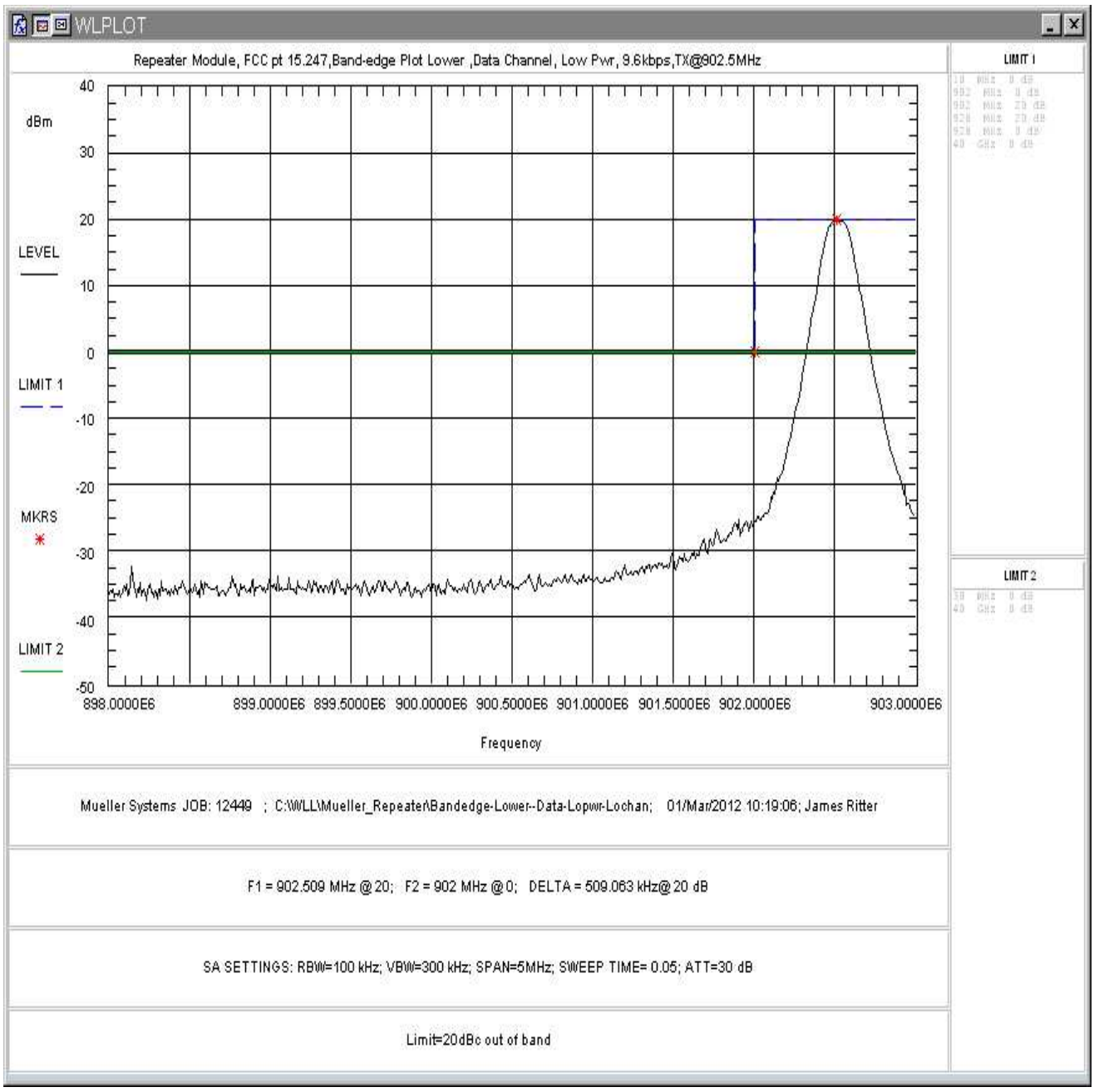

Figure 52: Lower Band-edge, Data, Low Pwr, 28.8kbps, TX-902.5MHz

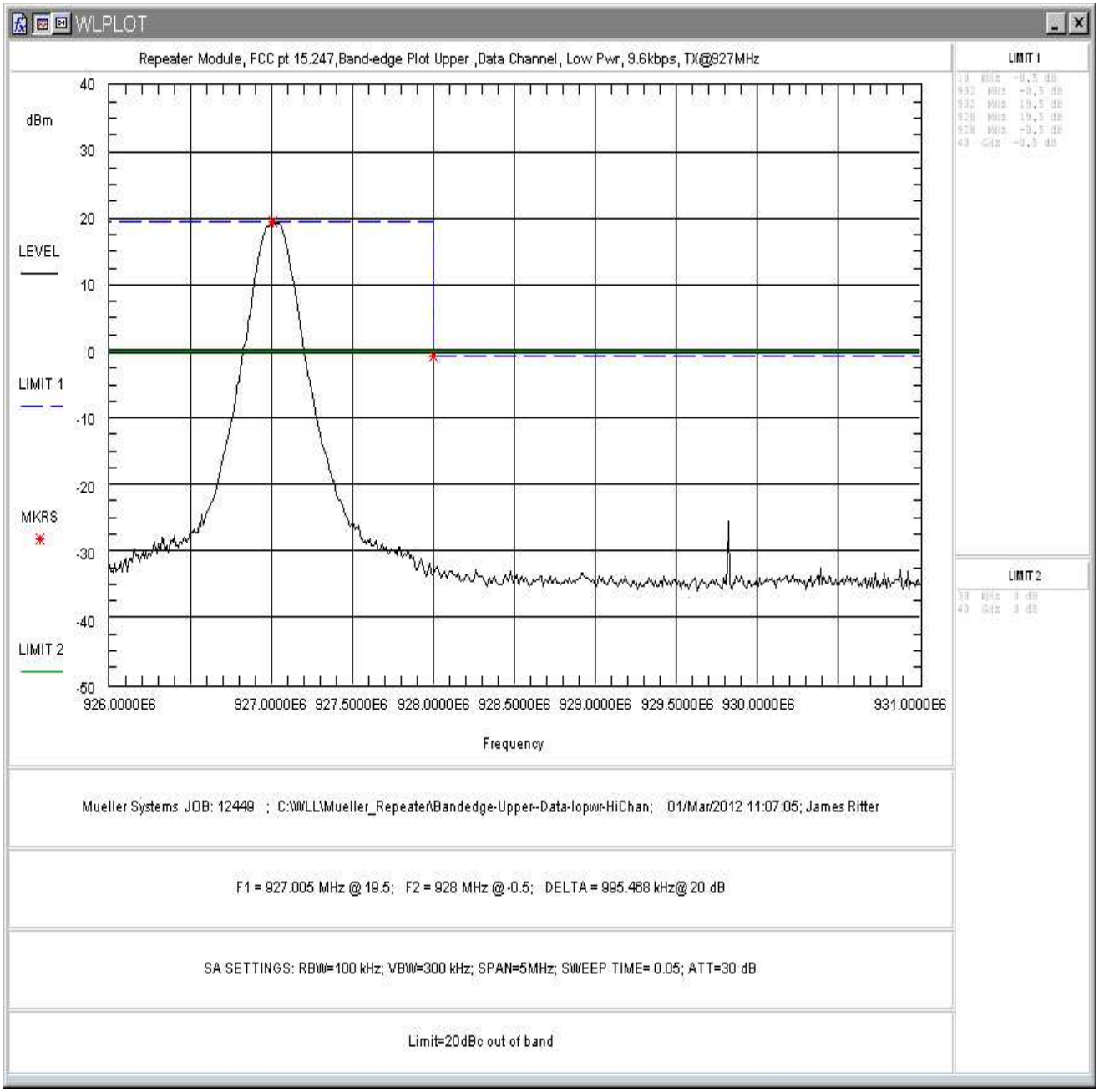

Figure 53: Upper Band-edge, Data, Low Pwr, 28.8kbps, TX-927MHz

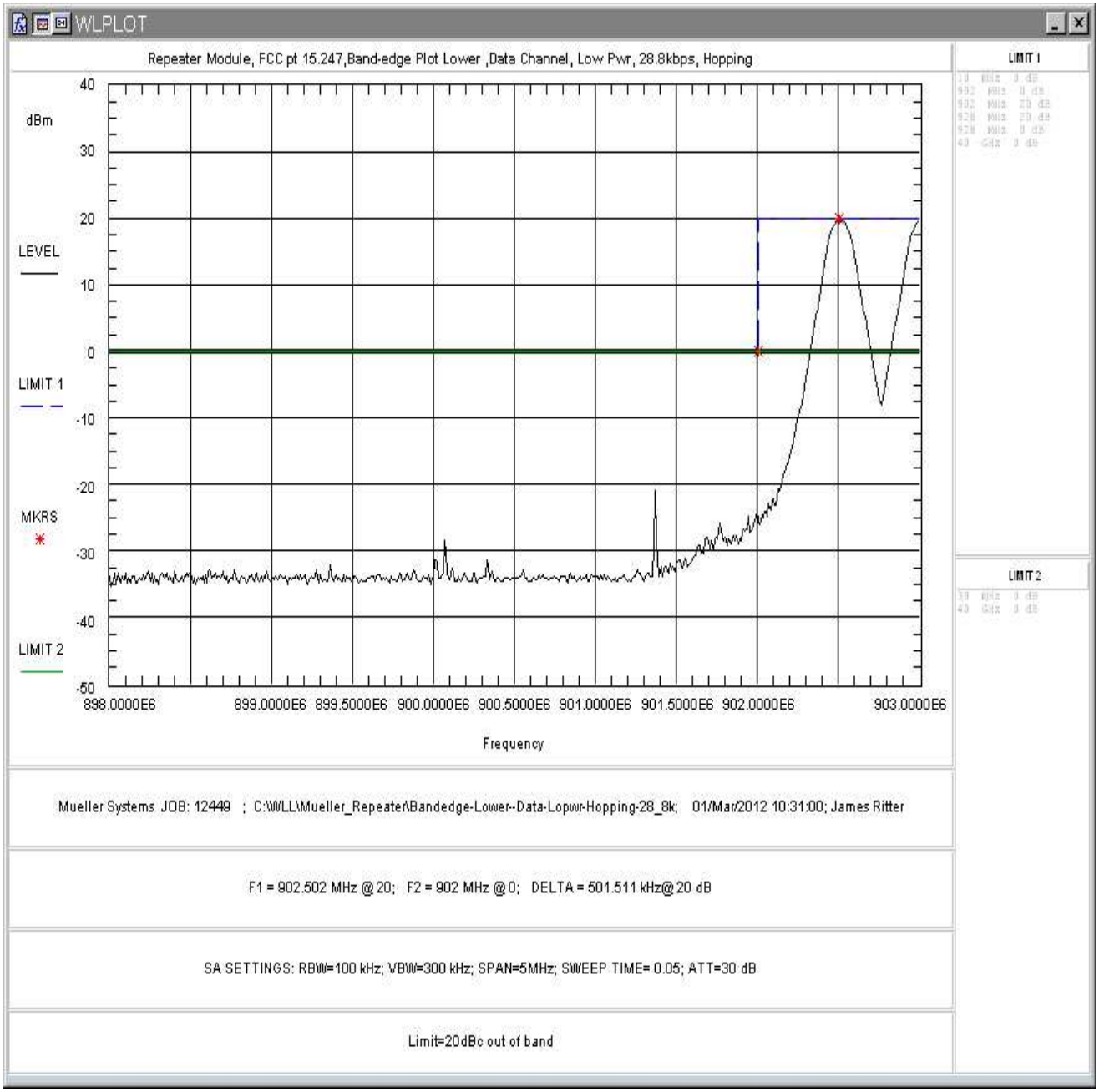

Figure 54: Lower Band-edge, Data, Low Pwr, 28.8kbps, Hopping

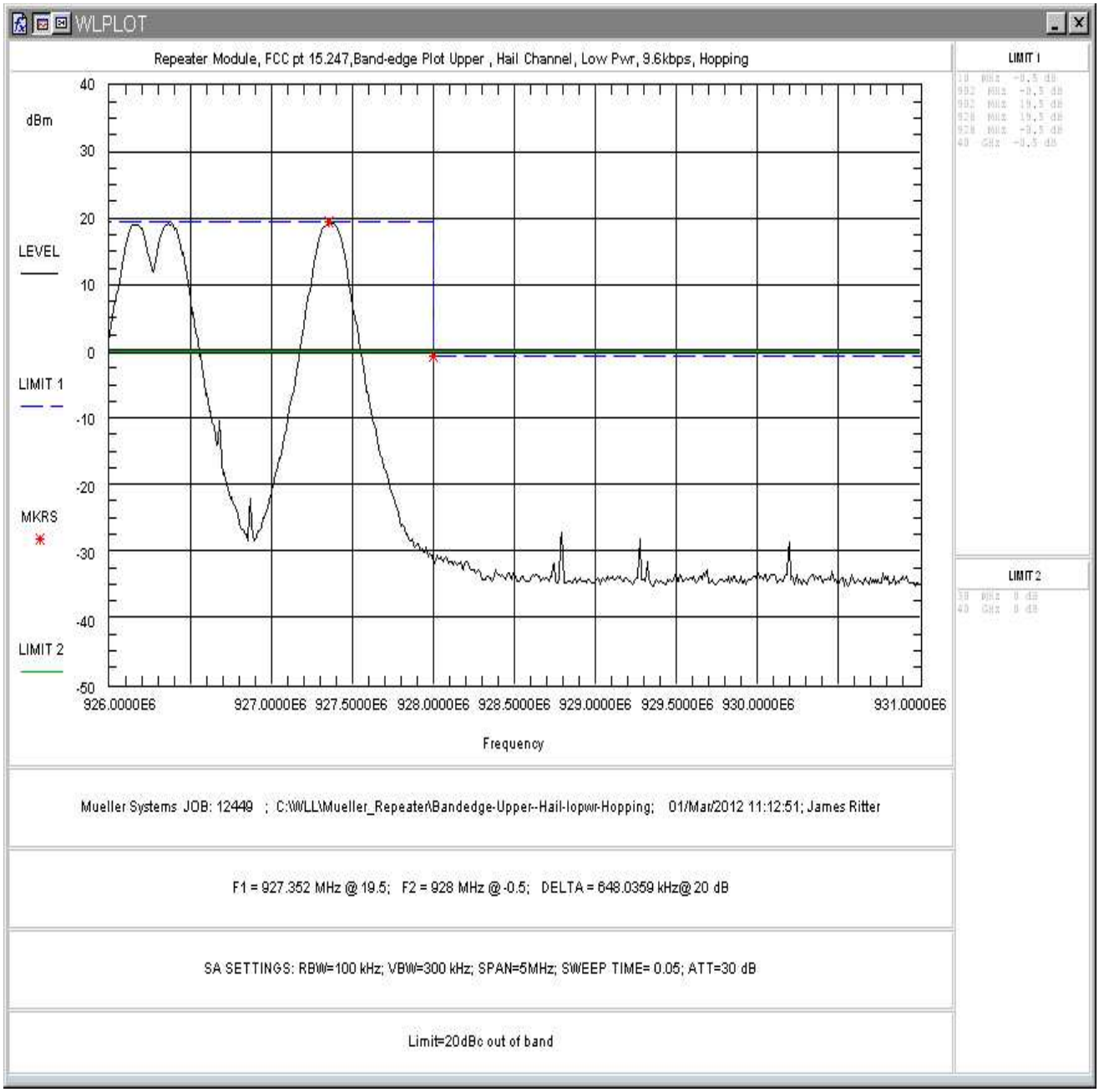

Figure 55: Upper Band-edge, Data, Low Pwr, 28.8kbps, Hopping

5.5.2 Full-Band Conducted Spurious Emissions

5.5.2.1 Low Channel 902.5MHz- High Power

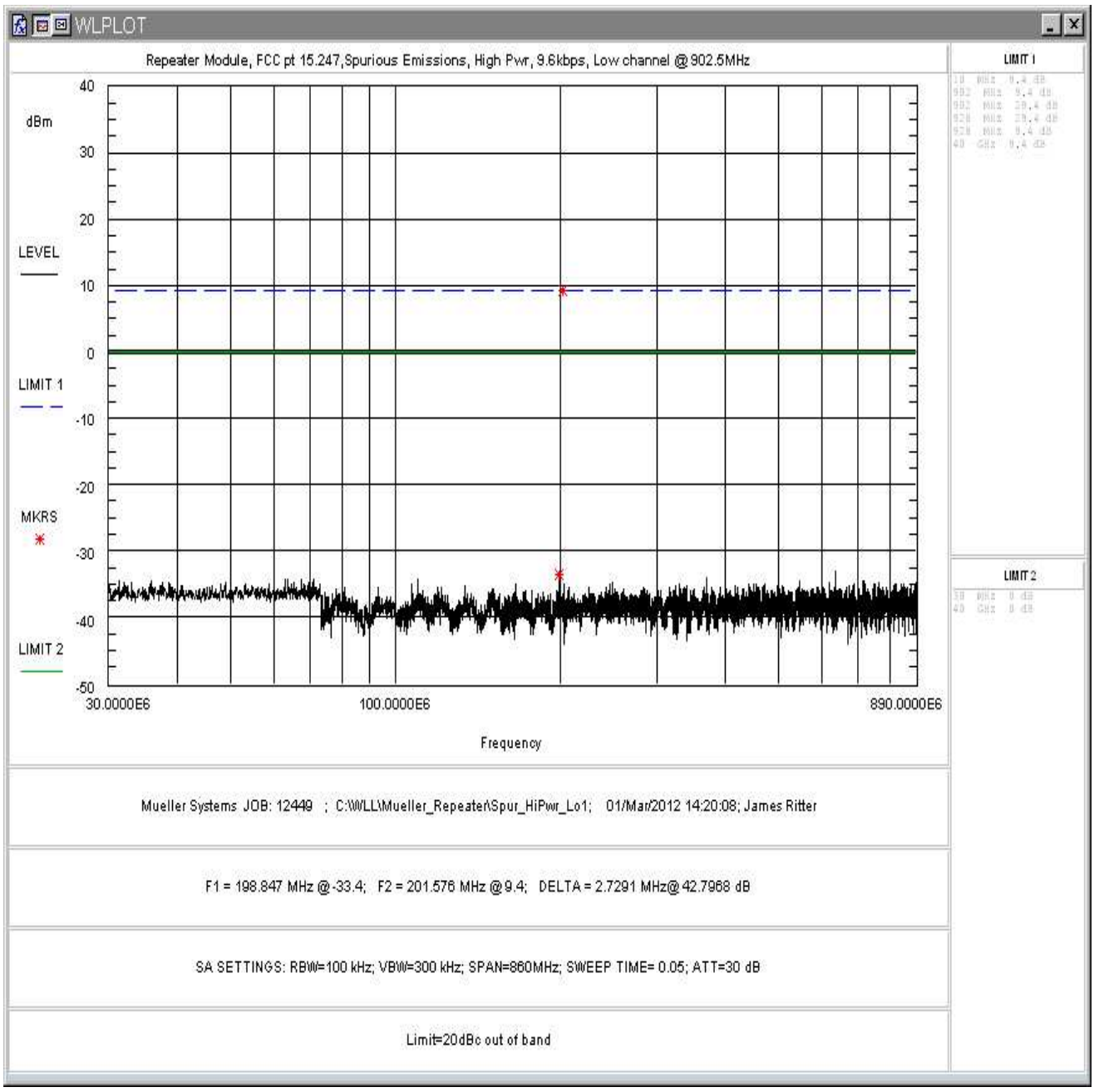

Figure 56: Spurious Emissions, Hi Pwr, TX-902.5MHz, 30-890MHz

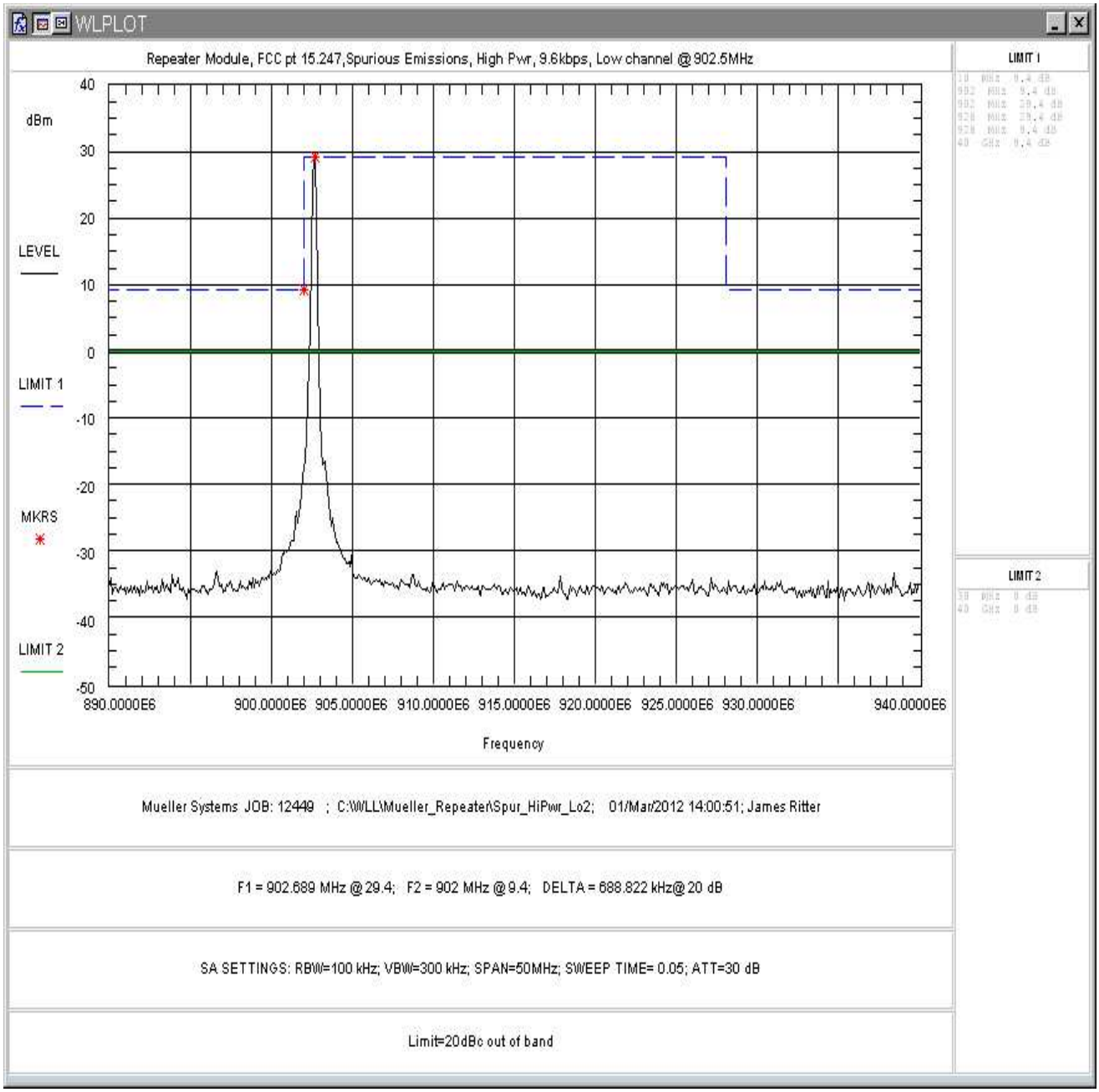

Figure 57: Spurious Emissions, High Pwr, TX-902.5MHz, 890-940MHz

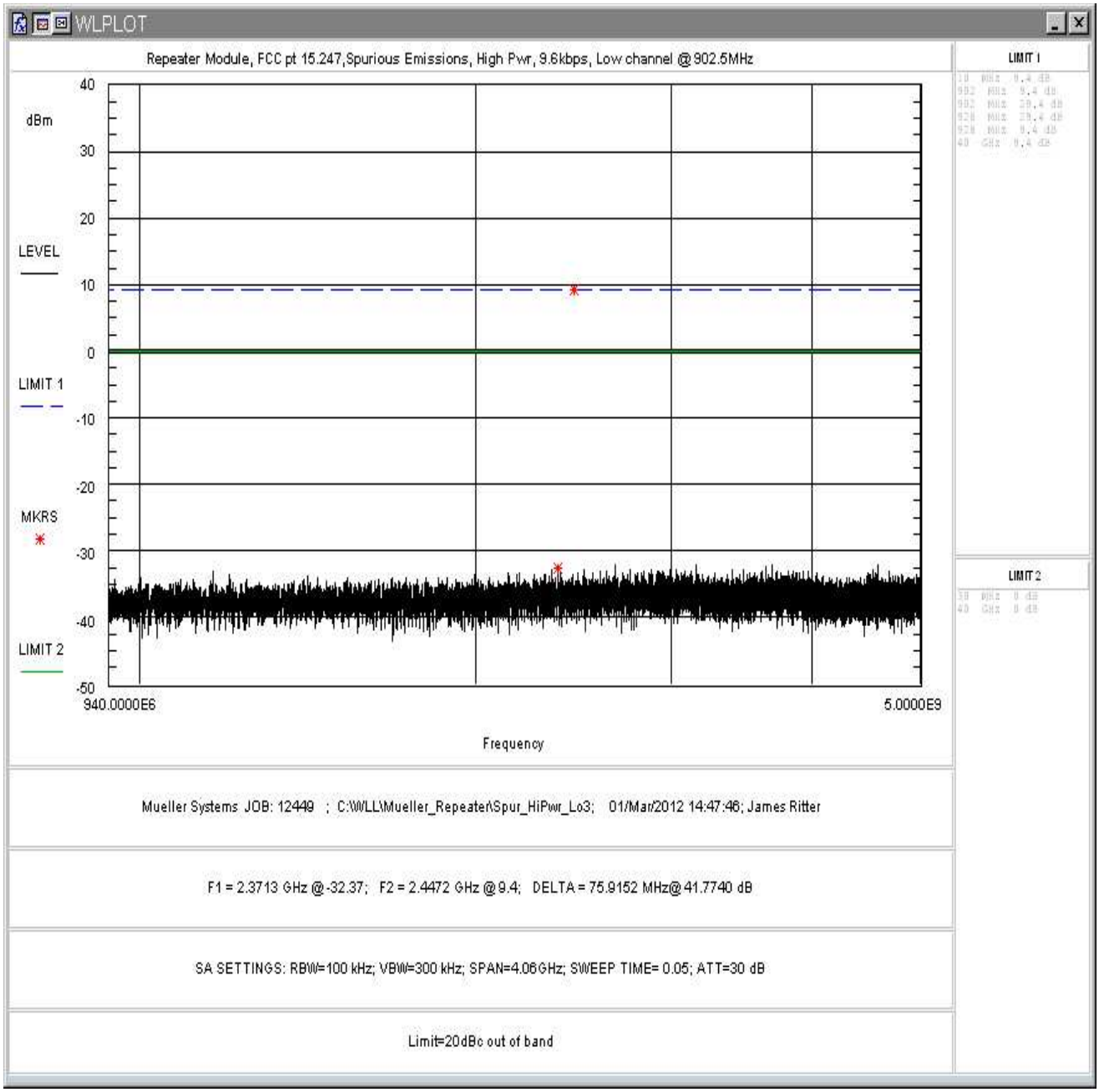

Figure 58: Spurious Emissions, High Pwr, TX-902.5MHz, 940-5000MHz

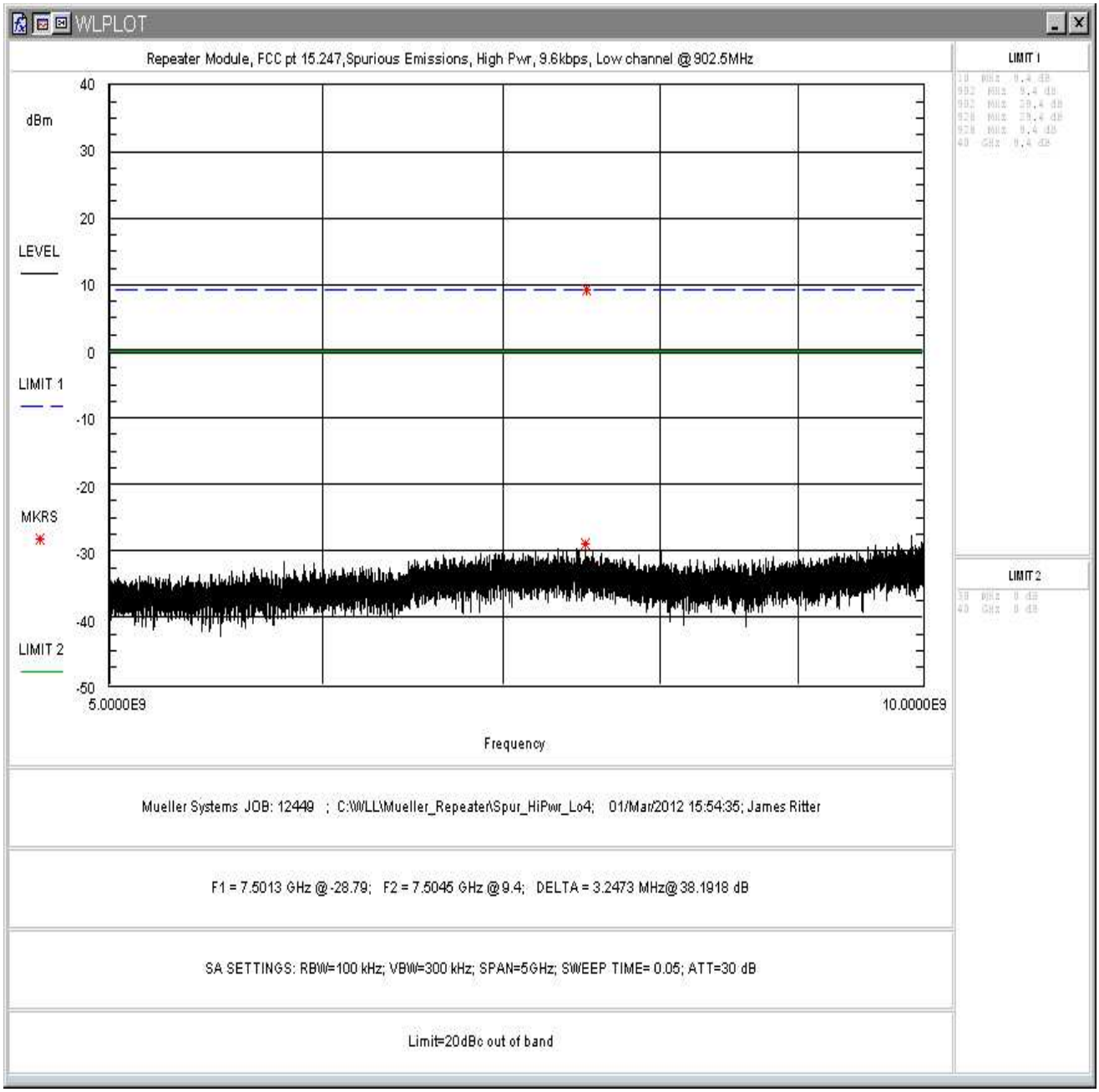

Figure 59: Spurious Emissions, High Pwr, TX-902.5MHz, 5 – 10GHz

5.5.2.2 Low Channel 902.5MHz- Low Power

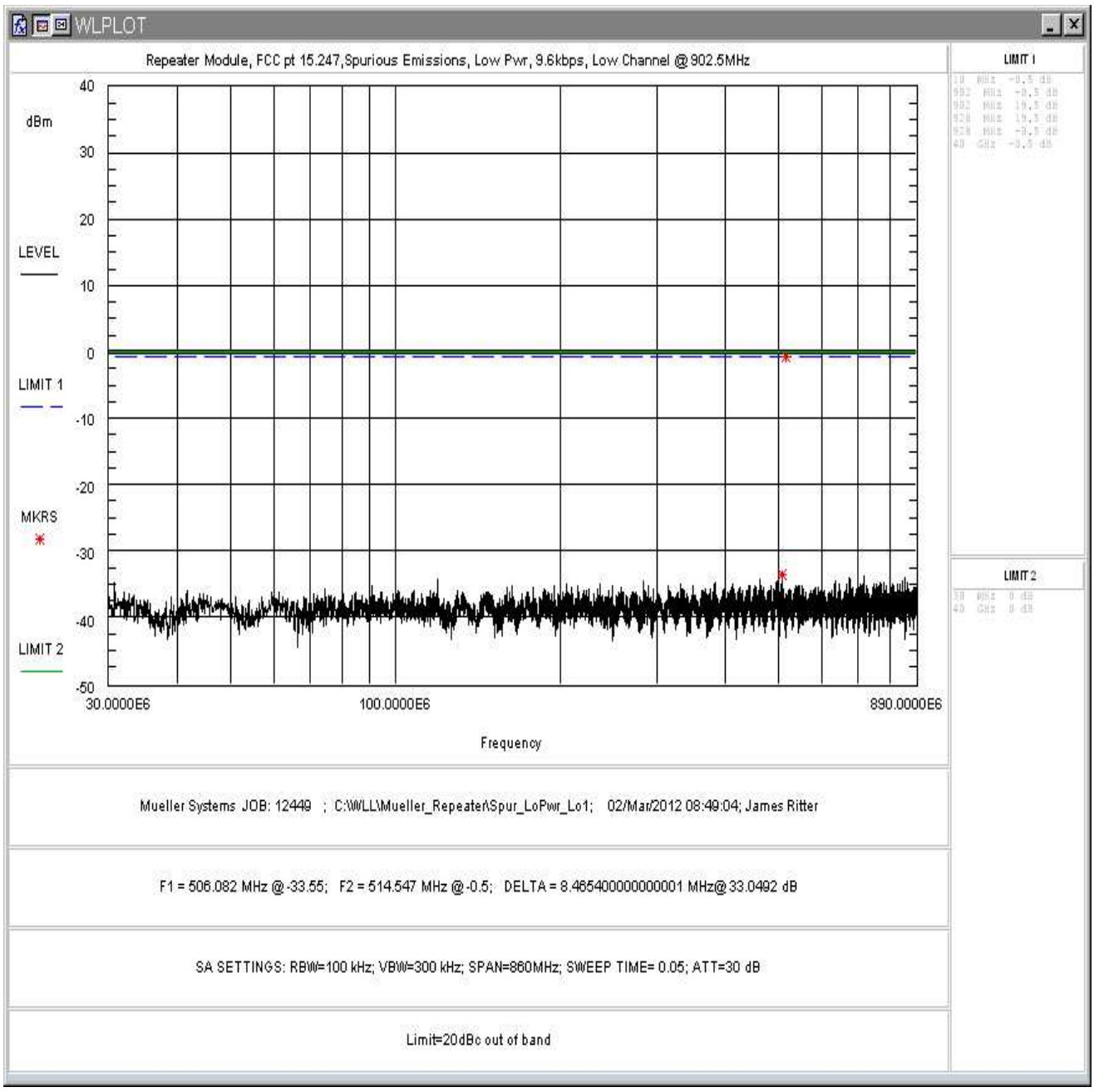

Figure 60: Spurious Emissions, Low Pwr, TX-902.5MHz, 30-890MHz

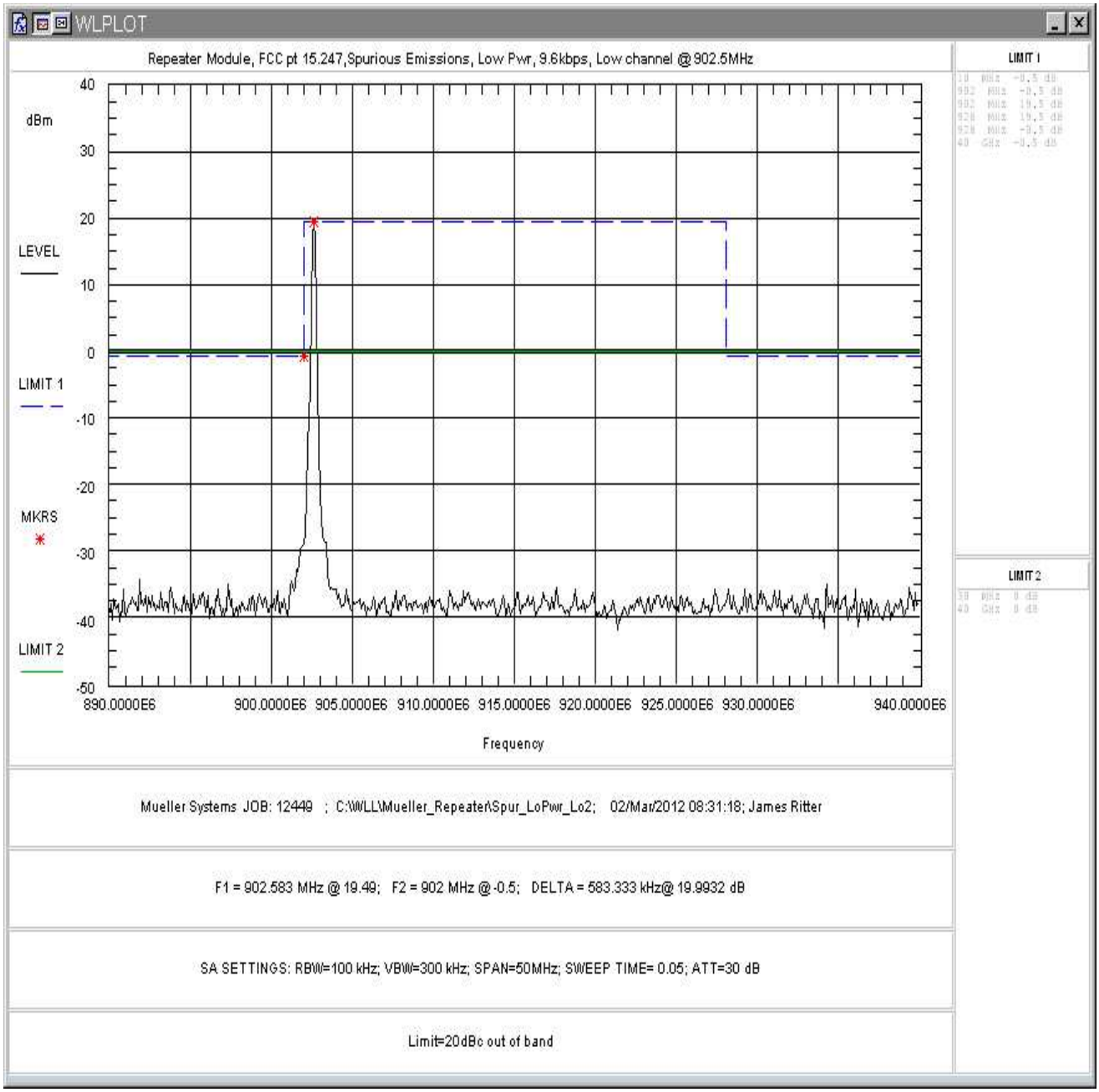

Figure 61: Spurious Emissions, Low Pwr, TX-902.5MHz, 890-940MHz

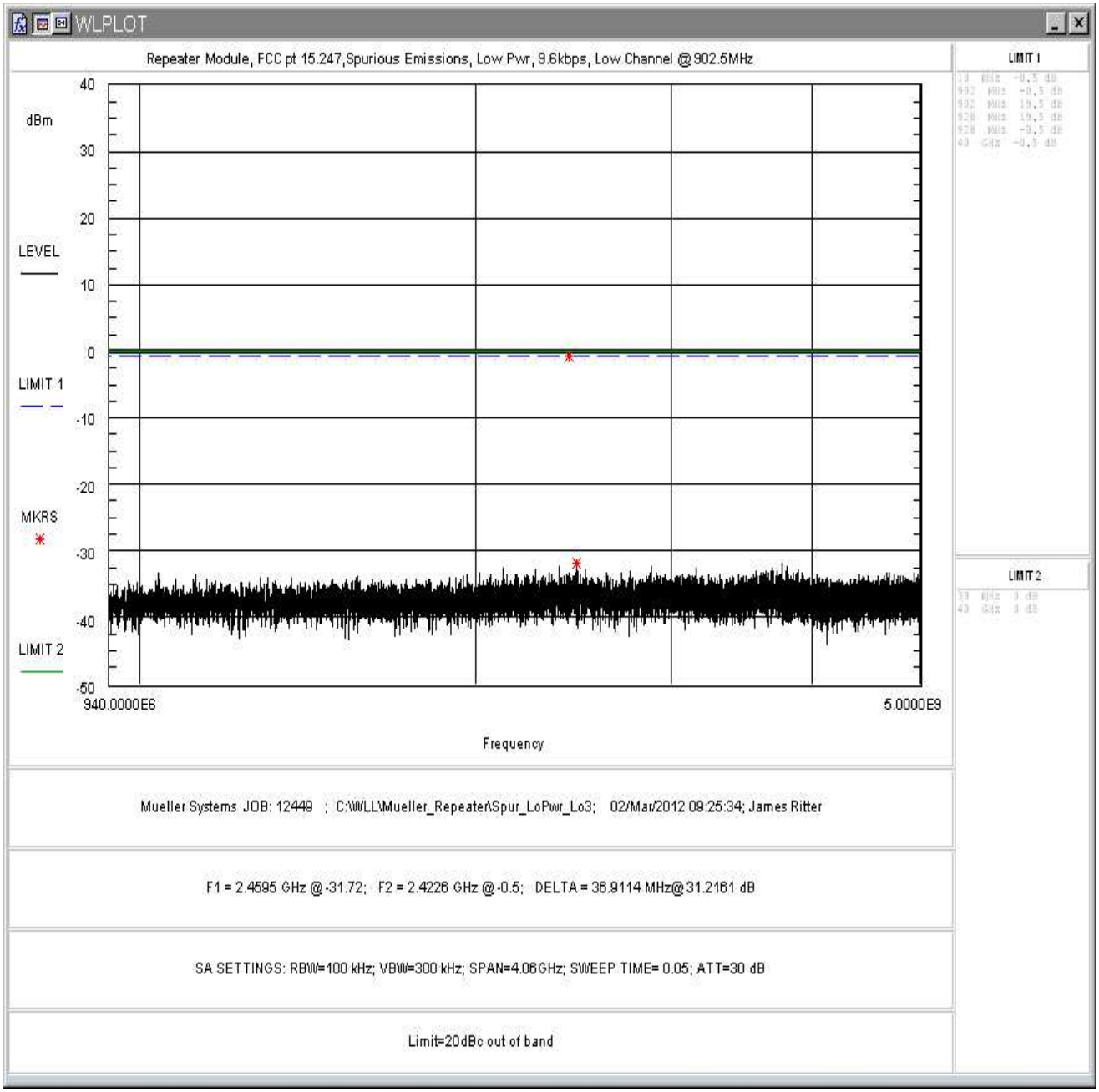

Figure 62: Spurious Emissions, Low Pwr, TX-902.5MHz, 940-5000MHz

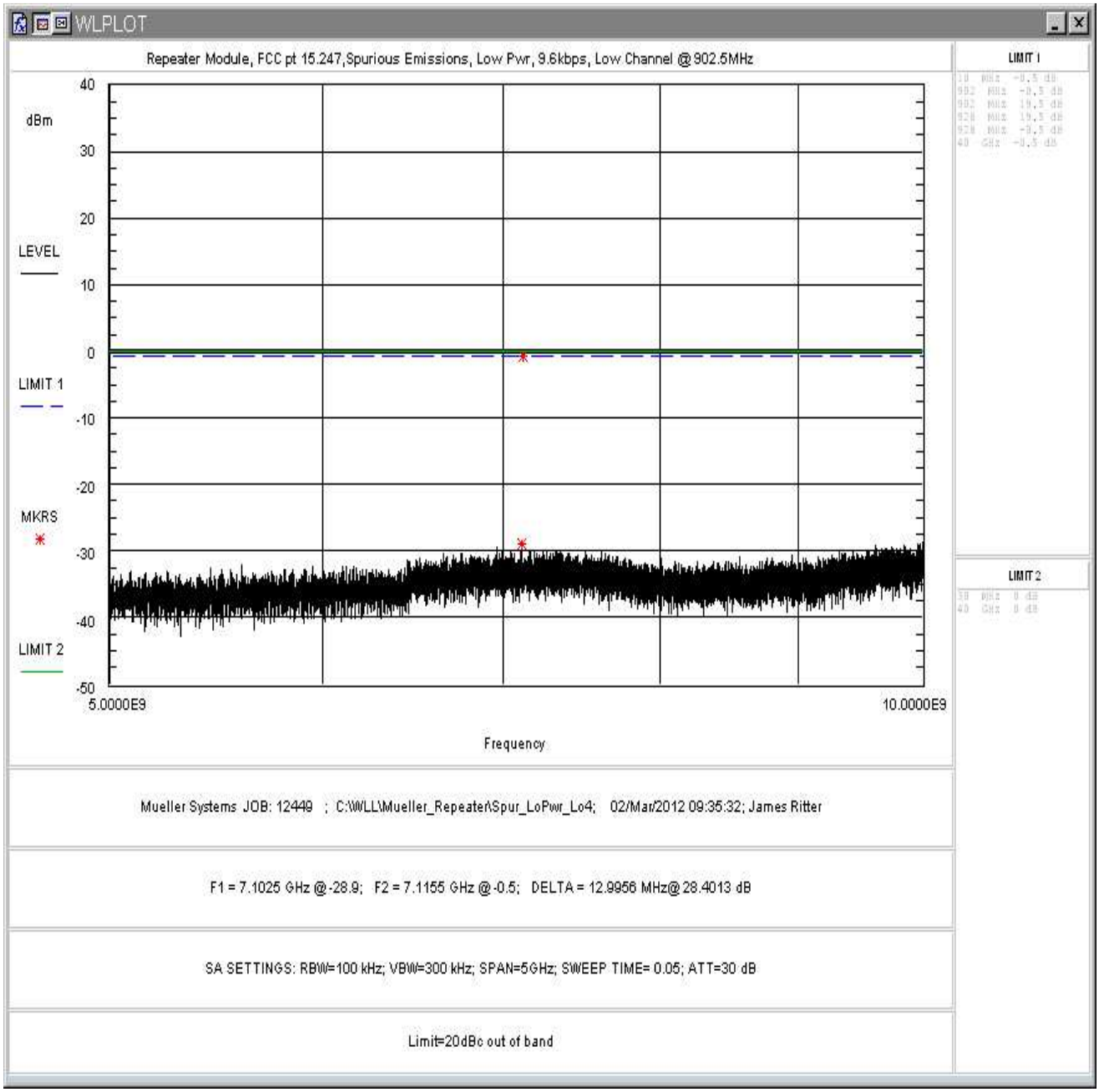

Figure 63: Spurious Emissions, Low Pwr, TX-902.5MHz, 5-10GHz

5.5.2.3 Center Channel 915MHz- High Power

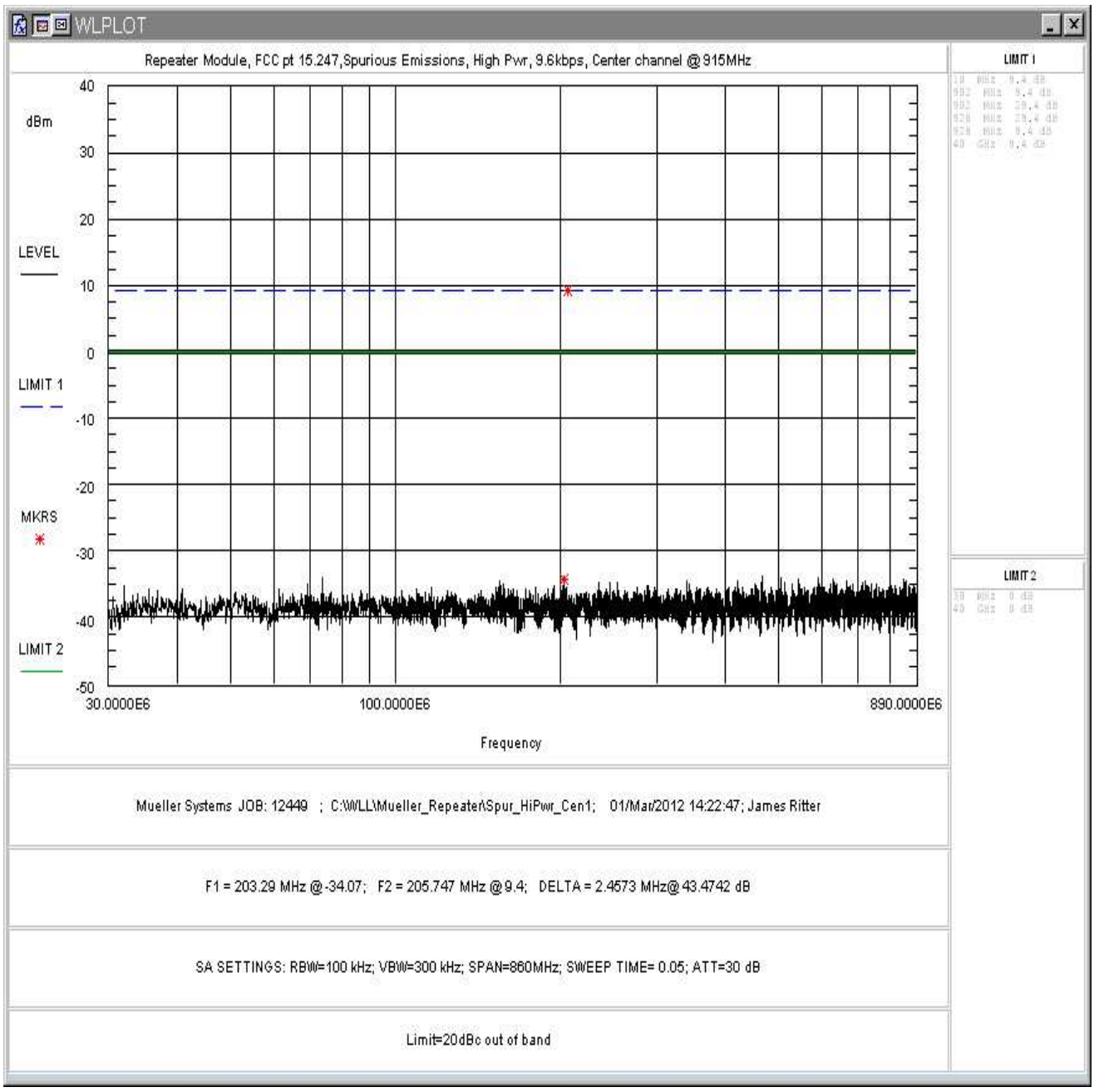

Figure 64: Spurious Emissions, Hi Pwr, TX-915MHz, 30-890MHz

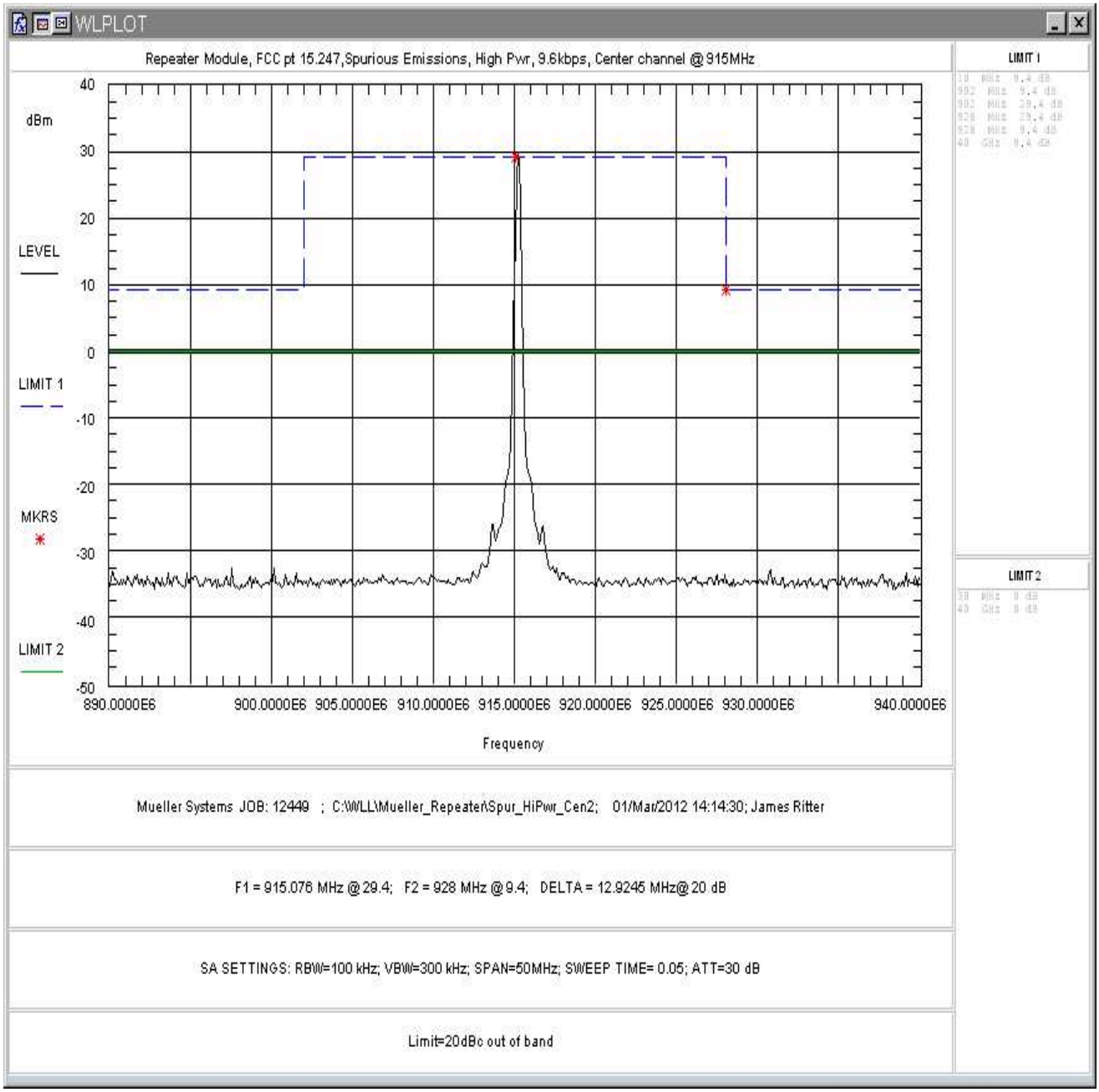

Figure 65: Spurious Emissions, High Pwr, TX-915MHz, 890-940MHz

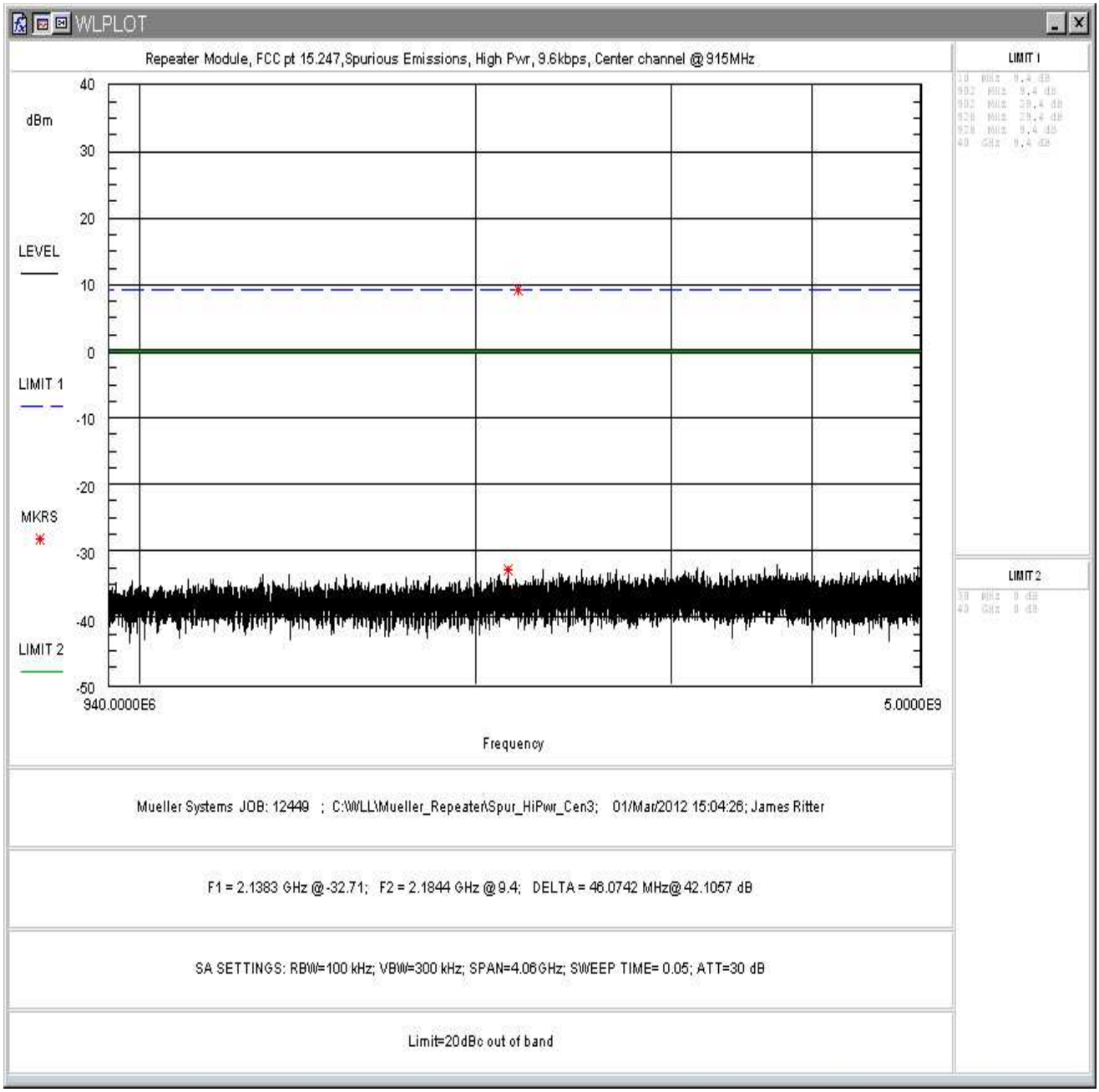

Figure 66: Spurious Emissions, High Pwr, TX-915MHz, 940-5000MHz

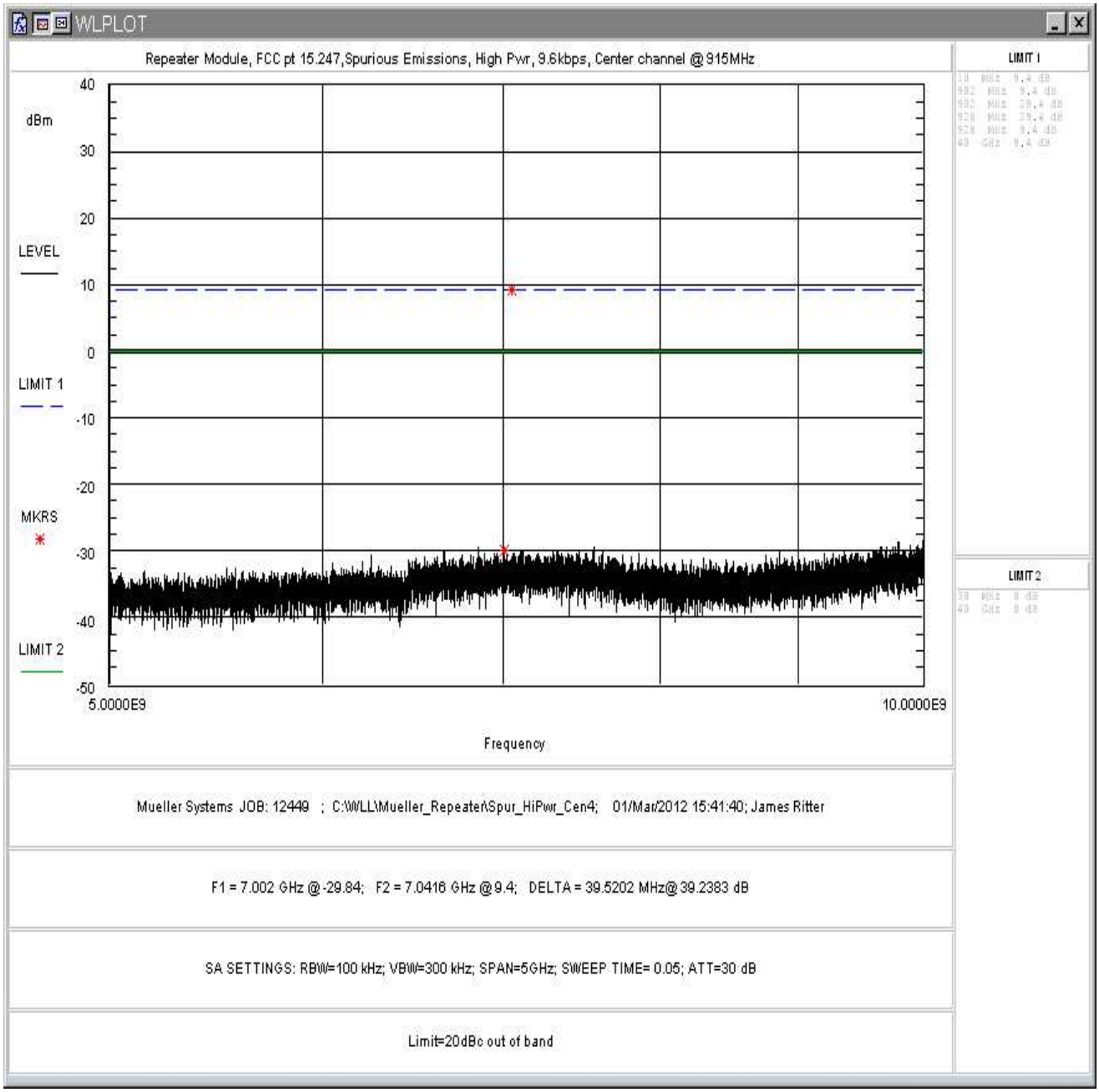

Figure 67: Spurious Emissions, High Pwr, TX-915MHz, 5-10GHz

5.5.2.4 High Channel 927.35MHz- High Power

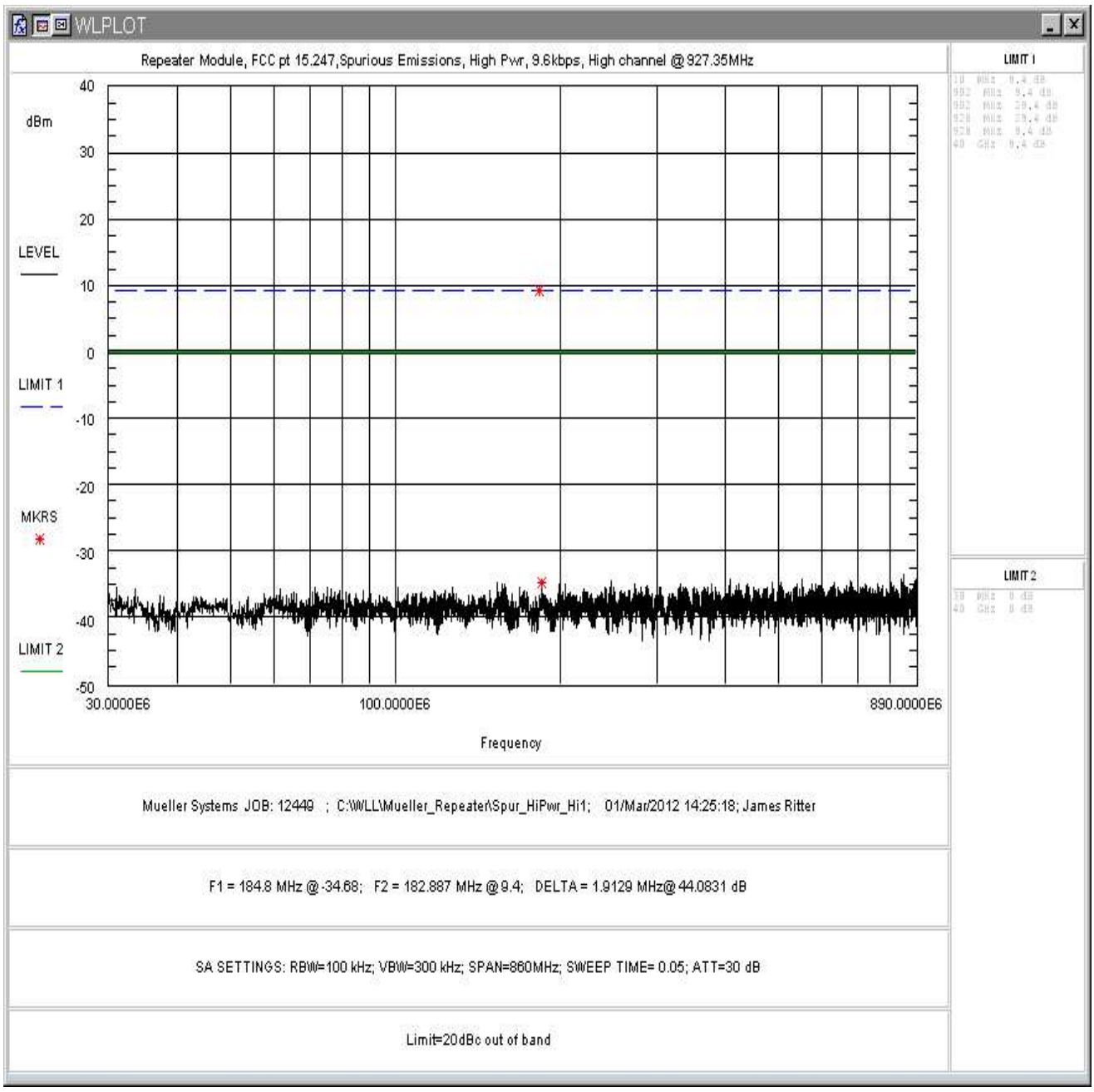

Figure 68: Spurious Emissions, High Pwr, TX-927.35MHz, 30-890MHz

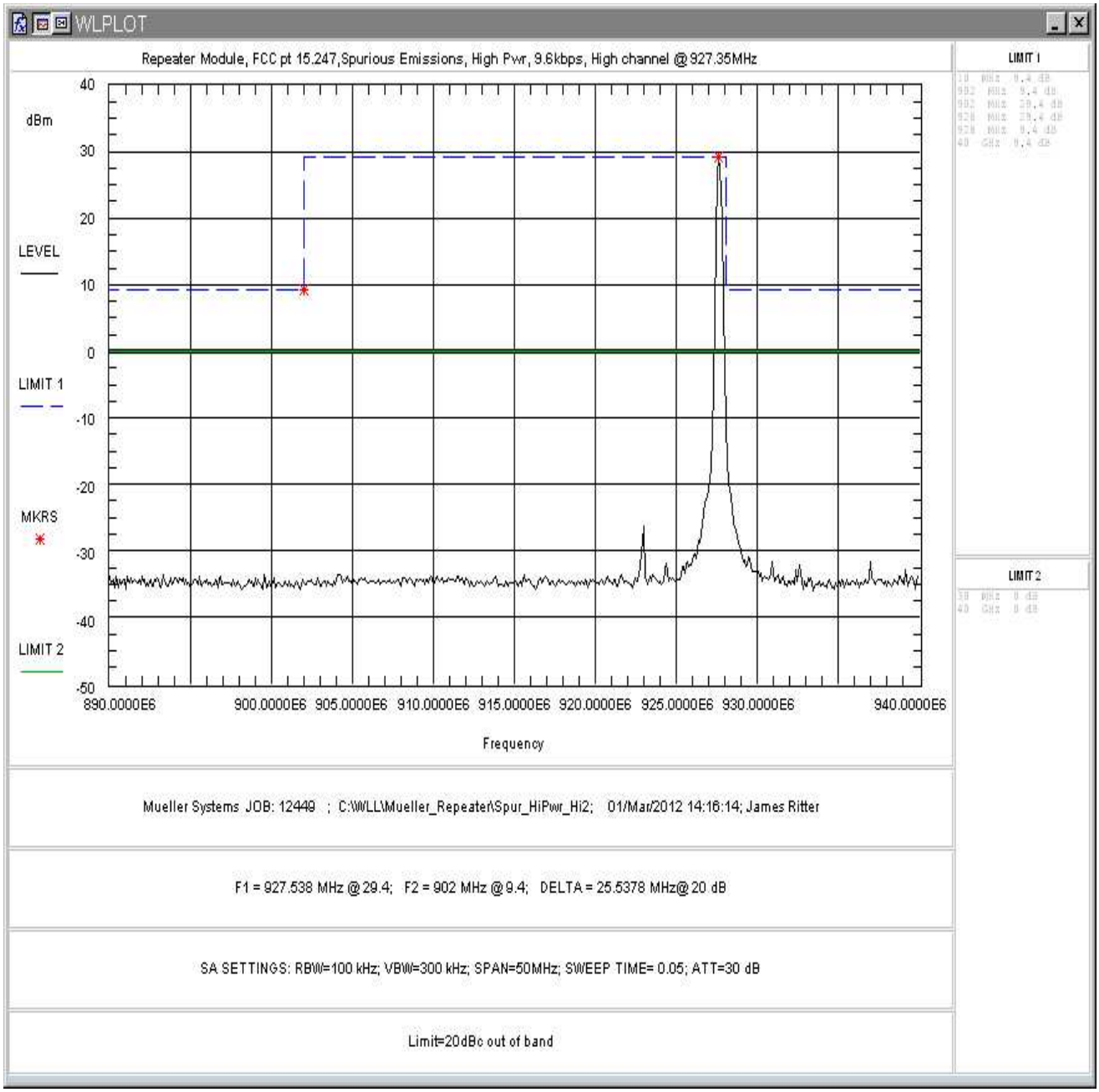

Figure 69: Spurious Emissions, Low Pwr, TX-927.35MHz, 890-940MHz

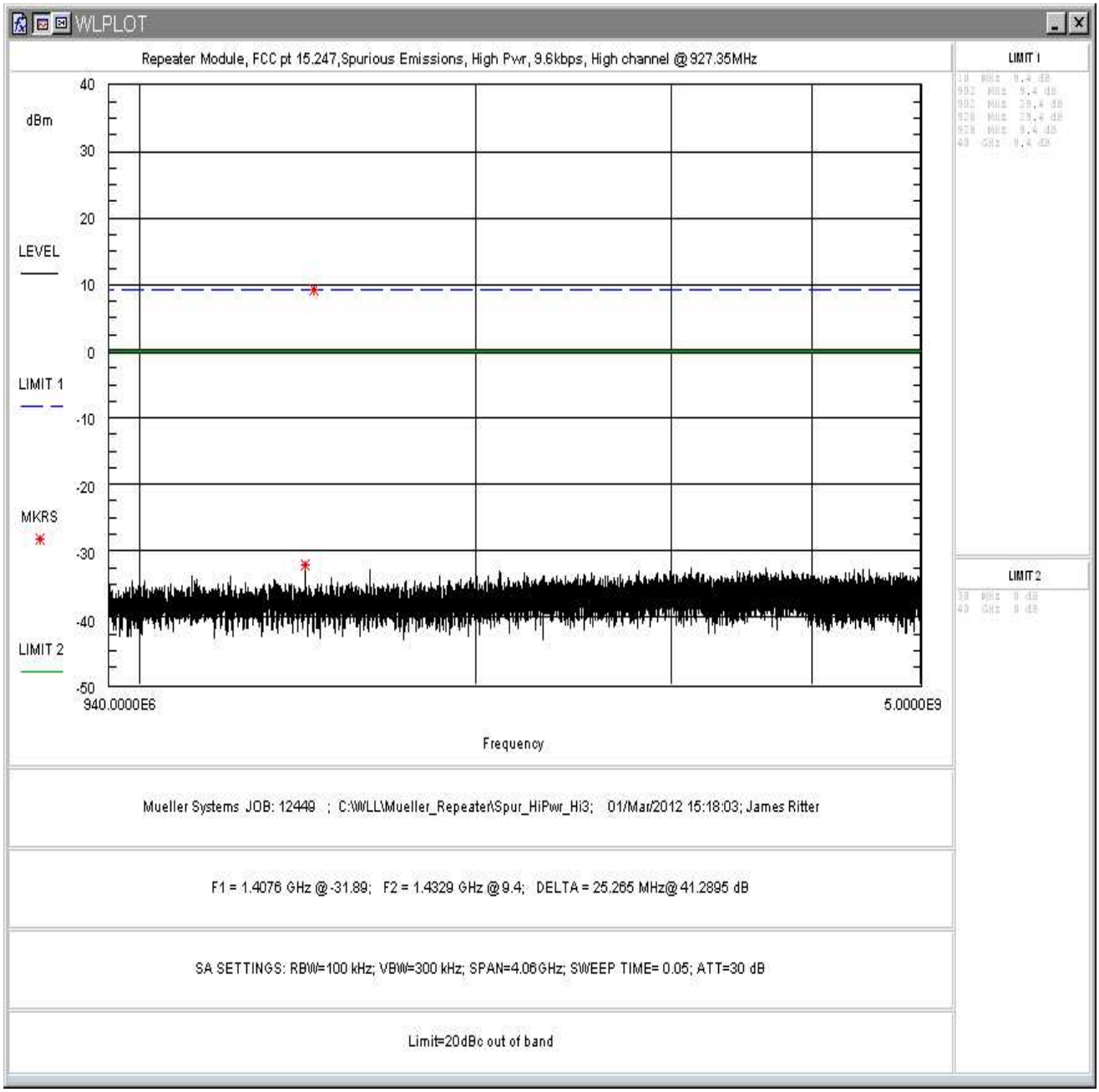

Figure 70: Spurious Emissions, Low Pwr, TX-927.35MHz, 940-5000MHz

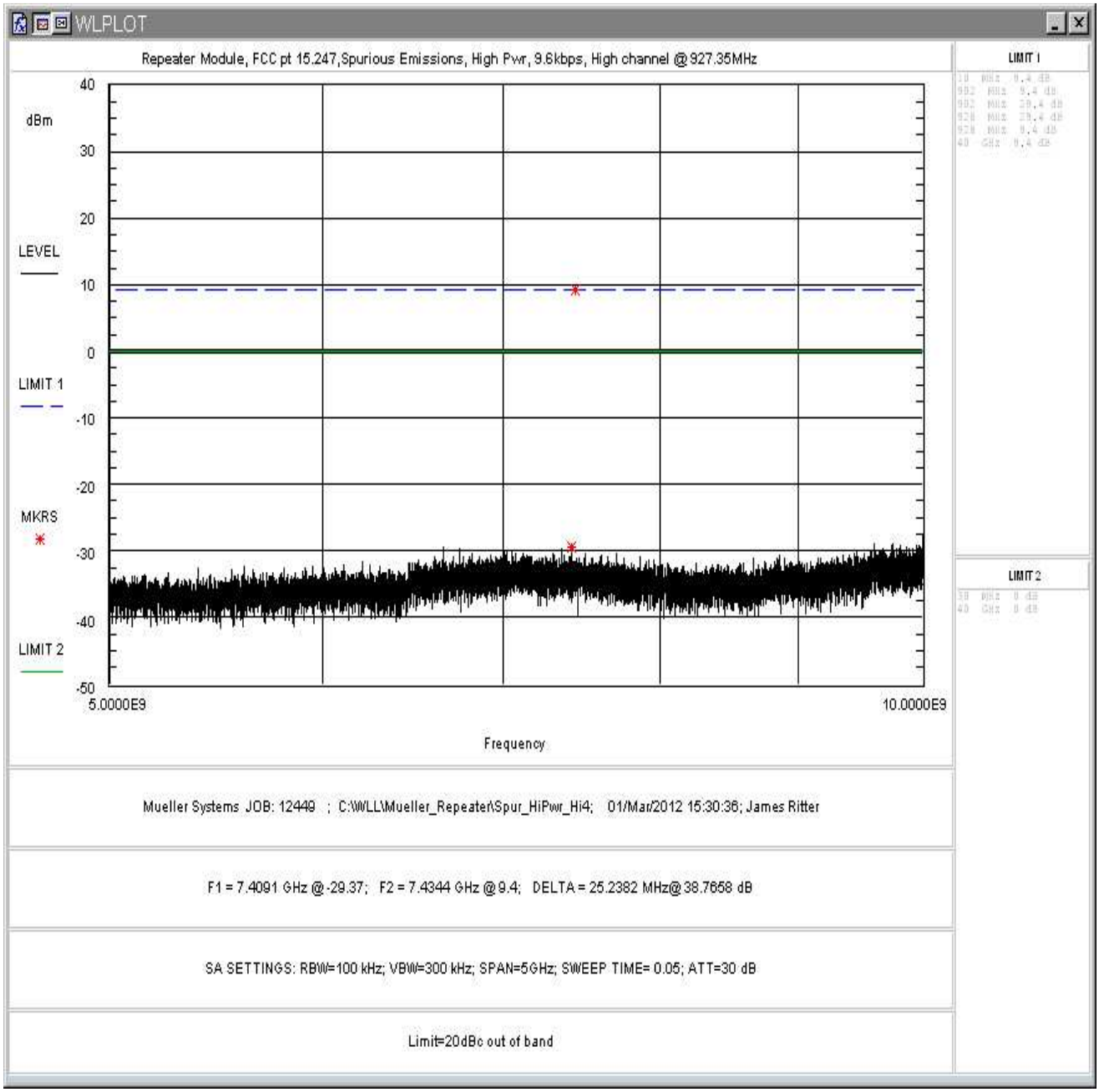

Figure 71: Spurious Emissions, Low Pwr, TX-927.35MHz, 5-10GHz

5.5.2.5 High Channel 927.35MHz- Low Power

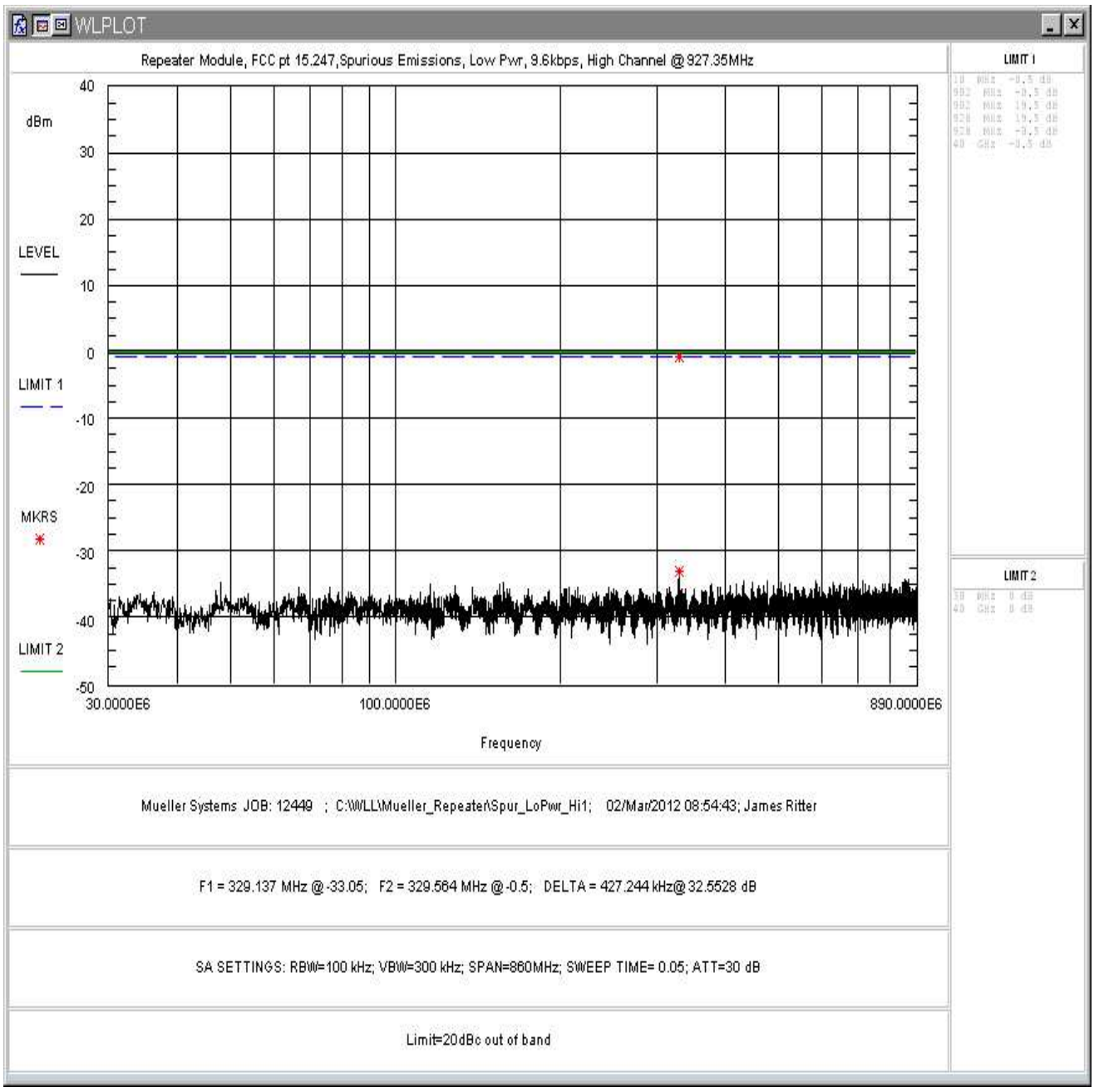

Figure 72: Spurious Emissions, Low Pwr, TX-927.35MHz, 30-890MHz

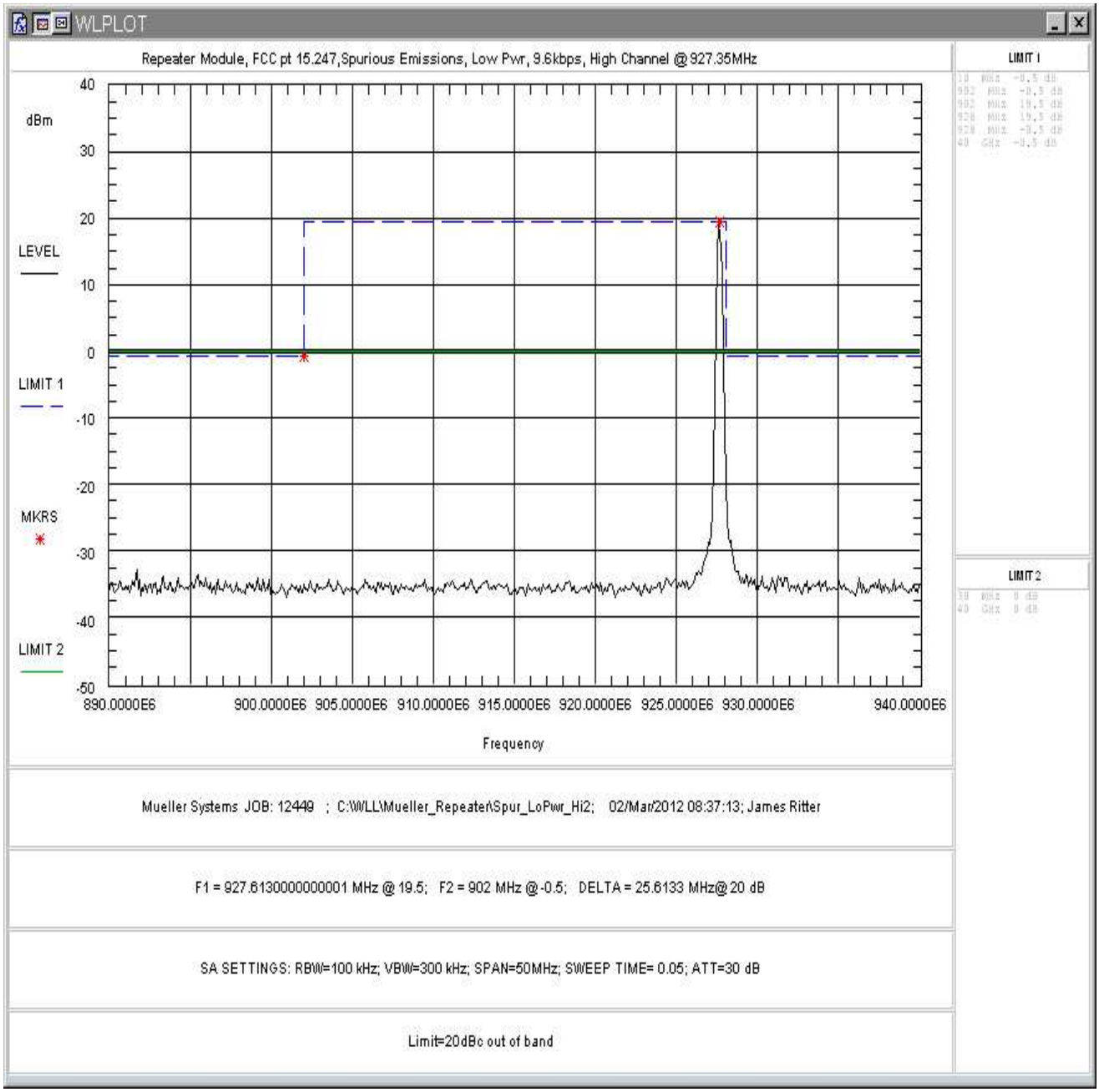

Figure 73: Spurious Emissions, Low Pwr, TX-927.35MHz, 890-940MHz

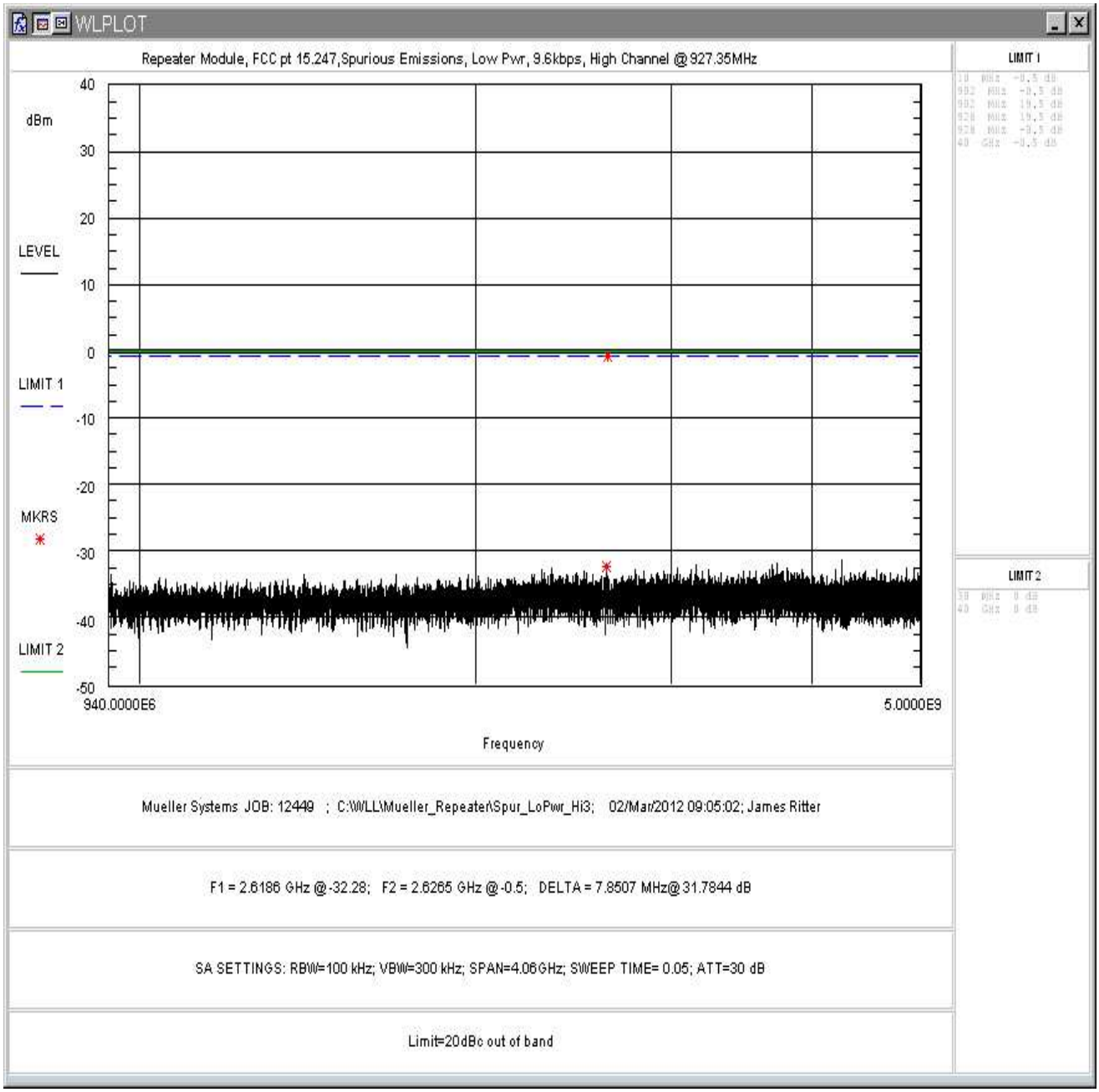

Figure 74: Spurious Emissions, Low Pwr, TX-927.35MHz, 940-5000MHz

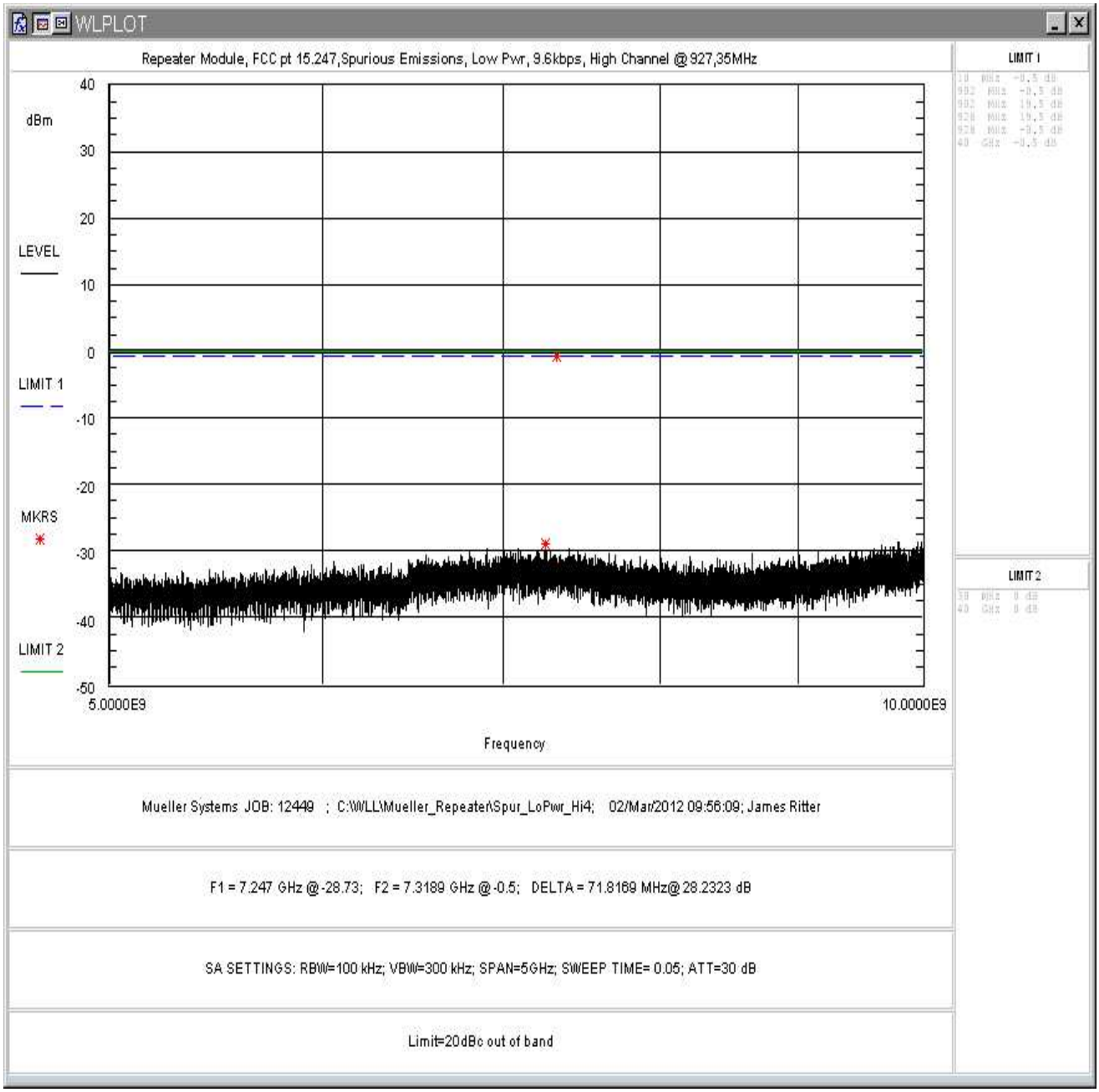

Figure 75: Spurious Emissions, Low Pwr, TX-927.35MHz, 5-10GHz

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 a 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 EUT was tested in 3 orthogonals with the worst case readings provided. Both the horizontal and vertical field components were measured. Measurements below 1 GHz include both restricted and non-restricted bands.

The emissions were measured using the following resolution bandwidths:

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

5.6.2 Areas of concern

None

Table 10: Radiated Emission Test Data, Low Frequency Data (<1GHz)

(Restricted bands only, same for all Channels)

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)
74.92	V	270.00	1.00	11.40	9.4	10.9	100.0	-19.2
118.13	V	270.00	1.00	10.40	15.8	20.4	150.0	-17.3
168.00	V	170.00	1.14	7.90	14.2	12.7	150.0	-21.4
266.96	V	90.00	1.44	7.90	16.5	16.6	200.0	-21.6
401.39	V	45.00	1.30	9.60	19.9	30.0	200.0	-16.5
117.72	H	90.00	4.00	6.90	15.8	13.7	150.0	-20.8
168.00	H	45.00	3.56	13.20	14.2	23.4	150.0	-16.1
401.39	H	190.00	3.50	8.90	19.9	27.7	200.0	-17.2

Note: Emissions were common to all tested channels. The frequencies listed are the highest emitted restricted bands.

Table 11: Radiated Emission Test Data, High Frequency Data (>1GHz)

(2.5dBi Whip antenna) (Restricted Bands)
(Worst case readings are with EUT On side)

Low Channel-902.5MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2707.50	V	90.00	2.53	48.30	-1.9	210.0	5000.0	-27.5	peak
2707.50	V	90.00	2.53	43.79	-1.9	124.9	500.0	-12.0	Average
3610.00	V	45.00	2.61	46.15	-0.3	196.4	5000.0	-28.1	peak
3610.00	V	45.00	2.61	37.63	-0.3	73.6	500.0	-16.6	Average
4512.50	V	190.00	2.86	45.44	1.7	228.3	5000.0	-26.8	peak
4512.50	V	190.00	2.86	37.91	1.7	96.0	500.0	-14.3	Average
2707.50	H	45.00	3.27	50.98	-1.9	285.9	5000.0	-24.9	peak
2707.50	H	45.00	3.27	47.32	-1.9	187.6	500.0	-8.5	Average
3610.00	H	90.00	2.53	47.58	-0.3	231.5	5000.0	-26.7	peak
3610.00	H	90.00	2.53	41.87	-0.3	120.0	500.0	-12.4	Average
4512.50	H	45.00	2.60	45.24	1.7	223.2	5000.0	-27.0	peak
4512.50	H	45.00	2.60	37.21	1.7	88.5	500.0	-15.0	Average

Center Channel – 915MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2745.00	V	0.00	2.06	49.91	-1.8	253.2	5000.0	-25.9	peak
2745.00	V	0.00	2.06	43.51	-1.8	121.2	500.0	-12.3	Average
3660.00	V	90.00	2.11	43.73	0.0	153.9	5000.0	-30.2	peak
3660.00	V	90.00	2.11	34.13	0.0	51.0	500.0	-19.8	Average
4575.00	V	10.00	2.31	45.16	1.8	222.0	5000.0	-27.1	peak
4575.00	V	10.00	2.31	39.26	1.8	112.5	500.0	-13.0	Average
2745.00	H	180.00	2.11	52.18	-1.8	328.9	5000.0	-23.6	peak
2745.00	H	180.00	2.11	47.70	-1.8	196.3	500.0	-8.1	Average
3660.00	H	90.00	2.16	47.55	0.0	239.0	5000.0	-26.4	peak
3660.00	H	90.00	2.16	41.00	0.0	112.4	500.0	-13.0	Average
4575.00	H	0.00	3.17	47.42	1.8	287.9	5000.0	-24.8	peak
4575.00	H	0.00	3.17	40.47	1.8	129.4	500.0	-11.7	Average

High Hailing Channel-927.35MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2782.50	V	190.00	1.67	54.10	-1.8	411.0	5000.0	-21.7	peak
2782.05	V	90.00	2.09	47.27	-1.8	187.2	500.0	-8.5	Average
3709.40	V	0.00	2.99	46.98	0.3	231.8	5000.0	-26.7	peak
3709.40	V	0.00	2.99	37.75	0.3	80.1	500.0	-15.9	Average
4636.75	V	90.00	2.78	46.29	1.9	256.0	5000.0	-25.8	peak
4636.75	V	90.00	2.78	37.41	1.9	92.1	500.0	-14.7	Average
2782.50	H	180.00	2.13	53.90	-1.8	401.6	5000.0	-21.9	peak
2782.05	H	90.00	3.24	50.35	-1.8	266.9	500.0	-5.5	Average
3709.40	H	140.00	3.23	44.07	0.3	165.8	5000.0	-29.6	peak
3709.40	H	140.00	3.23	34.60	0.3	55.7	500.0	-19.1	Average
4636.75	H	45.00	2.07	46.33	1.9	257.2	5000.0	-25.8	peak
4636.75	H	45.00	2.07	38.32	1.9	102.3	500.0	-13.8	Average

Table 12: Radiated Emission Test Data, High Frequency Data (>1GHz)

(3dBi Omni antenna) (Restricted Bands)
(Worst case readings are with EUT On side)

Low Channel-902.5MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2707.50	V	90.0	190.7	47.6	-1.9	193.7	5000.0	-28.2	peak
2707.50	V	90.0	190.7	39.1	-1.9	72.8	500.0	-16.7	Average
3610.00	V	0.0	182.3	42.6	-0.3	130.8	5000.0	-31.6	peak
3610.00	V	0.0	182.3	35.0	-0.3	54.4	500.0	-19.3	Average
4512.50	V	125.0	1.7	42.5	1.7	162.2	5000.0	-29.8	peak
4512.50	V	125.0	1.7	31.6	1.7	46.6	500.0	-20.6	Average
2707.50	H	175.0	2.3	46.9	-1.9	179.3	5000.0	-28.9	peak
2707.50	H	175.0	2.3	40.9	-1.9	89.2	500.0	-15.0	Average
3610.00	H	185.0	2.1	45.4	-0.3	180.4	5000.0	-28.9	peak
3610.00	H	185.0	2.1	36.8	-0.3	66.9	500.0	-17.5	Average
4512.50	H	300.0	1.9	42.9	1.7	171.0	5000.0	-29.3	peak
4512.50	H	300.0	1.9	31.5	1.7	45.8	500.0	-20.8	Average

Center Channel – 915MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2745.00	V	250.0	2.0	47.2	-1.8	186.0	5000.0	-28.6	peak
2745.00	V	250.0	2.0	40.5	-1.8	85.7	500.0	-15.3	Average
3660.00	V	180.0	1.9	44.3	0.0	164.4	5000.0	-29.7	peak
3660.00	V	180.0	1.9	34.9	0.0	55.7	500.0	-19.1	Average
4575.00	V	180.0	2.1	43.6	1.8	185.5	5000.0	-28.6	peak
4575.00	V	180.0	2.1	33.8	1.8	60.0	500.0	-18.4	Average
745.00	H	125.0	1.9	48.0	-1.8	202.1	5000.0	-27.9	peak
2745.00	H	125.0	1.9	41.9	-1.8	100.2	500.0	-14.0	Average
3660.00	H	15.0	1.8	45.4	0.0	187.0	5000.0	-28.5	peak
3660.00	H	15.0	1.8	38.0	0.0	79.3	500.0	-16.0	Average
4575.00	H	200.0	1.8	43.8	1.8	189.8	5000.0	-28.4	peak
4575.00	H	200.0	1.8	35.0	1.8	68.9	500.0	-17.2	Average

High Hailing Channel-927.35MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2782.50	V	260.0	1.9	46.9	-1.8	179.2	5000.0	-28.9	peak
2782.05	V	260.0	1.9	40.7	-1.8	87.6	500.0	-15.1	Average
3709.40	V	180.0	1.9	44.1	0.3	166.9	5000.0	-29.5	peak
3709.40	V	180.0	1.9	34.9	0.3	57.8	500.0	-18.7	Average
4636.75	V	180.0	1.7	43.9	1.9	193.7	5000.0	-28.2	peak
4636.75	V	180.0	1.7	36.0	1.9	78.3	500.0	-16.1	Average
2782.50	H	125.0	1.9	48.6	-1.8	219.2	5000.0	-27.2	peak
2782.05	H	125.0	1.9	44.0	-1.8	128.5	500.0	-11.8	Average
3709.40	H	10.0	1.5	46.4	0.3	217.1	5000.0	-27.2	peak
3709.40	H	1.0	1.5	38.6	0.3	88.3	500.0	-15.1	Average
4636.75	H	180.0	2.4	42.0	1.9	156.2	5000.0	-30.1	peak
4636.75	H	180.0	2.4	33.3	1.9	57.4	500.0	-18.8	Average

Table 13: Radiated Emission Test Data, High Frequency Data (>1GHz)

(0dBi Monopole antenna) (Restricted Bands)
(Worst case readings are with EUT On side)

Low Channel-902.5MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2707.50	V	125.0	2.0	51.8	-1.9	314.2	5000.0	-24.0	peak
2707.50	V	125.0	2.0	47.7	-1.9	196.0	500.0	-8.1	Average
3610.00	V	180.0	2.0	45.8	-0.3	188.6	5000.0	-28.5	peak
3610.00	V	180.0	2.0	36.9	-0.3	67.7	500.0	-17.4	Average
4512.50	V	270.0	2.0	42.4	1.7	160.2	5000.0	-29.9	peak
4512.50	V	270.0	2.0	30.6	1.7	41.4	500.0	-21.6	Average
2707.50	H	160.0	1.8	50.1	-1.9	258.3	5000.0	-25.7	peak
2707.50	H	160.0	1.8	44.9	-1.9	142.0	500.0	-10.9	Average
3610.00	H	180.0	1.8	45.9	-0.3	190.8	5000.0	-28.4	peak
3610.00	H	180.0	1.8	36.7	-0.3	66.3	500.0	-17.5	Average
4512.50	H	125.0	1.8	42.1	1.7	155.5	5000.0	-30.1	peak
4512.50	H	125.0	1.8	32.0	1.7	48.6	500.0	-20.2	Average

Center Channel – 915MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2745.00	V	95.0	1.8	47.3	-1.8	187.5	5000.0	-28.5	peak
2745.00	V	95.0	1.8	37.0	-1.8	57.4	500.0	-18.8	Average
3660.00	V	0.0	1.7	43.2	0.0	144.8	5000.0	-30.8	peak
3660.00	V	0.0	1.7	33.7	0.0	48.5	500.0	-20.3	Average
4575.00	V	0.0	1.7	40.7	1.8	132.8	5000.0	-31.5	peak
4575.00	V	0.0	1.7	30.0	1.8	38.8	500.0	-22.2	Average
2745.00	H	125.0	2.1	47.0	-1.8	182.0	5000.0	-28.8	peak
2745.00	H			39.0	-1.8	72.1	500.0	-16.8	Average
3660.00	H	90.0	2.1	42.6	0.0	135.2	5000.0	-31.4	peak
3660.00	H	90.0	2.1	33.6	0.0	48.2	500.0	-20.3	Average
4575.00	H	200.0	2.2	42.0	1.8	153.6	5000.0	-30.3	peak
4575.00	H	200.0	2.2	33.3	1.8	56.7	500.0	-18.9	Average

High Hailing Channel-927.35MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2782.50	V	0.0	2.6	48.9	-1.8	225.1	5000.0	-26.9	peak
2782.05	V	0.0	2.6	43.7	-1.8	124.1	500.0	-12.1	Average
3709.40	V	100.0	2.5	42.3	0.3	135.4	5000.0	-31.3	peak
3709.40	V	100.0	2.5	32.4	0.3	43.3	500.0	-21.3	Average
4636.75	V	0.0	2.5	43.9	1.9	193.3	5000.0	-28.3	peak
4636.75	V	0.0	2.5	34.1	1.9	63.1	500.0	-18.0	Average
2782.50	H	300.0	2.0	46.6	-1.8	172.5	5000.0	-29.2	peak
2782.05	H	300.0	2.0	40.8	-1.8	88.9	500.0	-15.0	Average
3709.40	H	90.0	1.9	42.0	0.3	130.6	5000.0	-31.7	peak
3709.40	H	90.0	1.9	31.7	0.3	39.9	500.0	-22.0	Average
4636.75	H	250.0	1.6	43.7	1.9	190.0	5000.0	-28.4	peak
4636.75	H	250.0	1.6	33.4	1.9	58.0	500.0	-18.7	Average

Table 14: Radiated Emission Test Data, High Frequency Data (>1GHz)

(1.5dBi Helical antenna) (Restricted Bands)
(Worst case readings are with EUT On side)

Low Channel-902.5MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2707.50	V	125.0	2.6	45.6	-1.9	153.5	5000.0	-30.3	peak
2707.50	V	125.0	2.6	37.9	-1.9	63.3	500.0	-18.0	Average
3610.00	V	180.0	2.5	42.8	-0.3	133.5	5000.0	-31.5	peak
3610.00	V	180.0	2.5	32.2	-0.3	39.4	500.0	-22.1	Average
4512.50	V	0.0	2.5	43.5	1.7	182.6	5000.0	-28.7	peak
4512.50	V	0.0	2.5	34.5	1.7	64.8	500.0	-17.7	Average
2707.50	H	355.0	2.0	45.8	-1.9	157.5	5000.0	-30.0	peak
2707.50	H	355.0	2.0	36.5	-1.9	54.0	500.0	-19.3	Average
3610.00	H	0.0	1.8	44.6	-0.3	164.3	5000.0	-29.7	peak
3610.00	H	0.0	1.8	33.6	-0.3	46.3	500.0	-20.7	Average
4512.50	H	175.0	1.8	42.6	1.7	164.7	5000.0	-29.6	peak
4512.50	H	175.0	1.8	32.5	1.7	51.2	500.0	-19.8	Average

Center Channel – 915MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2745.00	V	75.0	2.5	47.1	-1.8	183.9	5000.0	-28.7	peak
2745.00	V	75.0	2.5	38.5	-1.8	67.8	500.0	-17.3	Average
3660.00	V	5.0	2.6	43.3	0.0	146.5	5000.0	-30.7	peak
3660.00	V	5.0	2.6	33.6	0.0	48.0	500.0	-20.4	Average
4575.00	V	90.0	2.2	43.3	1.8	179.2	5000.0	-28.9	peak
4575.00	V	90.0	2.2	33.6	1.8	58.7	500.0	-18.6	Average
2745.00	H	125.0	2.1	46.1	-1.8	163.3	5000.0	-29.7	peak
2745.00	H	125.0	2.1	38.9	-1.8	71.3	500.0	-16.9	Average
3660.00	H	90.0	2.1	44.0	0.0	158.8	5000.0	-30.0	peak
3660.00	H	90.0	2.1	34.8	0.0	55.1	500.0	-19.2	Average
4575.00	H	90.0	2.2	43.6	1.8	185.5	5000.0	-28.6	peak
4575.00	H	90.0	2.2	31.8	1.8	47.7	500.0	-20.4	Average

High Hailing Channel-927.35MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2782.50	V	35.0	2.2	47.0	-1.8	181.5	5000.0	-28.8	peak
2782.05	V	35.0	2.2	38.2	-1.8	65.9	500.0	-17.6	Average
3709.40	V	0.0	2.0	43.6	0.3	157.1	5000.0	-30.1	peak
3709.40	V	0.0	2.0	33.6	0.3	49.7	500.0	-20.1	Average
4636.75	V	180.0	1.8	44.4	1.9	205.9	5000.0	-27.7	peak
4636.75	V	180.0	1.8	36.4	1.9	82.0	500.0	-15.7	Average
2782.50	H	350.0	1.9	47.4	-1.8	190.5	5000.0	-28.4	peak
2782.05	H	350.0	1.9	40.7	-1.8	87.4	500.0	-15.2	Average
3709.40	H	355.0	1.9	43.3	0.3	152.4	5000.0	-30.3	peak
3709.40	H	355.0	1.9	34.2	0.3	53.2	500.0	-19.5	Average
4636.75	H	95.0	2.0	44.5	1.9	208.3	5000.0	-27.6	peak
4636.75	H	95.0	2.0	35.9	1.9	77.6	500.0	-16.2	Average

Table 15: Radiated Emission Test Data, High Frequency Data (>1GHz)

(PCB Trace antenna) (Restricted Bands)
(Worst case readings are with EUT On side)

Low Channel-902.5MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2707.50	V	90.0	1.8	44.3	-1.9	131.7	5000.0	-31.6	peak
2707.50	V	90.0	1.8	32.8	-1.9	35.3	500.0	-23.0	Average
3610.00	V	80.0	2.1	45.8	-0.3	187.6	5000.0	-28.5	peak
3610.00	V	80.0	2.1	38.5	-0.3	81.4	500.0	-15.8	Average
4512.50	V	45.0	2.0	44.1	1.7	195.7	5000.0	-28.1	peak
4512.50	V	45.0	2.0	34.7	1.7	66.5	500.0	-17.5	Average
2707.50	H	180.0	1.9	45.4	-1.9	150.4	5000.0	-30.4	peak
2707.50	H	180.0	1.9	36.3	-1.9	52.7	500.0	-19.5	Average
3610.00	H	190.0	1.9	45.9	-0.3	191.3	5000.0	-28.3	peak
3610.00	H	190.0	1.9	36.6	-0.3	65.4	500.0	-17.7	Average
4512.50	H	175.0	1.9	43.9	1.7	191.2	5000.0	-28.3	peak
4512.50	H	175.0	1.9	33.4	1.7	57.1	500.0	-18.8	Average

Center Channel – 915MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2745.00	V	275.0	1.8	45.9	-1.8	158.9	5000.0	-30.0	peak
2745.00	V	275.0	1.8	37.8	-1.8	62.8	500.0	-18.0	Average
3660.00	V	350.0	1.8	44.6	0.0	169.2	5000.0	-29.4	peak
3660.00	V	350.0	1.8	34.5	0.0	53.2	500.0	-19.5	Average
4575.00	V	15.0	1.7	41.8	1.8	150.8	5000.0	-30.4	peak
4575.00	V	15.0	1.7	32.6	1.8	52.2	500.0	-19.6	Average
2745.00	H	190.0	1.7	45.3	-1.8	148.9	5000.0	-30.5	peak
2745.00	H	190.0	1.7	36.6	-1.8	54.7	500.0	-19.2	Average
3660.00	H	95.0	1.7	45.0	0.0	178.2	5000.0	-29.0	peak
3660.00	H	95.0	1.7	37.4	0.0	74.3	500.0	-16.6	Average
4575.00	H	125.0	1.6	45.2	1.8	223.0	5000.0	-27.0	peak
4575.00	H	125.0	1.6	36.8	1.8	84.8	500.0	-15.4	Average

High Hailing Channel-927.35MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2782.50	V	270.0	1.9	48.2	-1.8	208.4	5000.0	-27.6	peak
2782.05	V	270.0	1.9	41.9	-1.8	100.9	500.0	-13.9	Average
3709.40	V	180.0	1.9	46.1	0.3	208.5	5000.0	-27.6	peak
3709.40	V	180.0	1.9	37.3	0.3	76.0	500.0	-16.4	Average
4636.75	V	80.0	1.8	45.0	1.9	220.6	5000.0	-27.1	peak
4636.75	V	80.0	1.8	37.7	1.9	95.2	500.0	-14.4	Average
2782.50	H	90.0	1.8	46.8	-1.8	177.1	5000.0	-29.0	peak
2782.05	H	90.0	1.8	40.3	-1.8	83.4	500.0	-15.6	Average
3709.40	H	95.0	1.7	45.0	0.3	184.5	5000.0	-28.7	peak
3709.40	H	95.0	1.7	37.9	0.3	81.5	500.0	-15.8	Average
4636.75	H	300.0	1.9	42.4	1.9	162.6	5000.0	-29.8	peak
4636.75	H	300.0	1.9	31.7	1.9	47.7	500.0	-20.4	Average

5.7 AC Conducted Emissions (FCC Pt.15.207)

5.7.1 Requirements

Test Arrangement: Table Top

Compliance Standard: FCC Class B

FCC Compliance Limits		
Frequency	**Quasi-peak**	**Average**
0.15 - 0.5MHz	66 to 56dBµV	56 to 46dBµV
0.5 - 5MHz	56dBµV	46dBµV
5 - 30MHz	60dBµV	50dBµV

5.7.2 Test Procedure

The EUT was placed on an 80 cm high 1 X 1.5 m non-conductive table above a ground plane. Power to the EUT was provided through a Solar Corporation 50 Ω/50 µH Line Impedance Stabilization Network bonded to a 3 X 2 meter ground plane. The LISN has its AC input supplied from a filtered AC power source. Power was supplied to the peripherals through a second LISN. The peripherals were placed on the table in accordance with ANSI C63.4-2003. 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: VdBµV

LISN Correction Factor: LISN dB

Cable Correction Factor: CF dB

Electric Field: EdBµV = V dBµV + LISN dB + CF dB

5.7.3 Test Data

The EUT complied with the Class B Conducted Emissions requirements. The repeater module was installed in a host Mueller Field Radio which ran off of 120VAC). Table 10-11 provide the test results for phase and neutral line power line conducted emissions.

Emissions were tested in the "transmit on" state with the EUT tuned to 915MHz.

Table 16: Conducted Emissions Data 120VAC, Transmit On

NEUTRAL (TX @ 915MHz)

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)
0.202	35.9	26.9	10.2	0.8	46.9	37.9	63.5	53.5	-16.7	-15.7
1.609	41.0	33.0	10.2	0.9	52.1	44.1	56.0	46.0	-3.9	-1.9
1.705	41.0	32.1	10.2	1.0	52.1	43.3	56.0	46.0	-3.9	-2.7
3.550	30.3	20.6	10.4	1.1	41.8	32.1	56.0	46.0	-14.2	-13.9
10.060	28.9	12.3	11.1	1.2	41.2	24.6	60.0	50.0	-18.8	-25.4
22.600	33.4	17.9	11.6	1.5	46.5	31.0	60.0	50.0	-13.5	-19.0
24.700	30.8	16.9	11.6	2.0	44.5	30.6	60.0	50.0	-15.5	-19.4
27.670	34.0	19.2	11.8	2.7	48.6	33.8	60.0	50.0	-11.4	-16.2

Phase

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.607	34.8	30.0	10.3	0.3	45.4	40.6	56.0	46.0	-10.6	-5.4
1.605	44.5	33.1	10.2	0.7	55.5	44.0	56.0	46.0	-0.5	-2.0
1.722	44.3	32.0	10.2	0.8	55.3	43.0	56.0	46.0	-0.7	-3.0
12.630	30.3	14.3	11.2	0.9	42.4	26.4	60.0	50.0	-17.6	-23.6
22.500	31.7	18.7	11.6	1.4	44.7	31.7	60.0	50.0	-15.3	-18.3
24.300	31.3	16.1	11.6	1.8	44.8	29.6	60.0	50.0	-15.2	-20.4
27.250	33.1	18.4	11.8	2.5	47.4	32.7	60.0	50.0	-12.6	-17.3
28.210	32.8	17.7	11.9	2.7	47.4	32.3	60.0	50.0	-12.6	-17.7

5.8 Receiver Radiated Emissions

5.8.1 *Requirements*

Test Arrangement: Table Top

RSS210 Compliance Limits for Receivers	
Frequency	**Limits**
30-88 MHz	100 µV/m
88-216 MHz	150 µV/m
216-960 MHz	200 µV/m
>960MHz	500 µV/m

5.8.2 *Test Procedure*

The requirements of call for the EUT to be placed on an 80 cm high 1 X 1.5 meters non-conductive 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. Biconical and log periodic broadband 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 output of the antenna was connected to the input of the spectrum analyzer and the emissions in the frequency range of 30 MHz to 3 GHz were measured. 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 output from the antenna was connected, via a preamplifier, to the input of the spectrum analyzer. The detector function was set to quasi-peak, peak, or average as appropriate. The measurement bandwidth of the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth.

All measurements above 1GHz were made at a distance of 3m with a Resolution Bandwidth of 1MHz and a Video bandwidth of 10Hz.

5.8.3 *Test Data*

The EUT complied with the Receiver Radiated Emissions requirements. Table 9 provides the test results for radiated emissions.

5.8.4 *Radiated Data Reduction and Reporting*

To convert the raw spectrum analyzer radiated data into a form that can be compared with the FCC limits, it is necessary to account for various calibration factors that are supplied with the antennas and other measurement accessories. These factors are included into the antenna factor (AF) column of the table and in the cable factor (CF) column of the table. The AF (in dB/m) and the CF (in dB) is algebraically added to the raw Spectrum Analyzer Voltage in dBµV to obtain

the Radiated Electric Field in dBµV/m. This logarithm amplitude is converted to a linear amplitude, then compared to the Industry Canada limit.

Example:

Spectrum Analyzer Voltage: VdBµV

Antenna Correction Factor: AFdB/m

Cable Correction Factor: CFdB

Electric Field: EdBV/m = V dBµV + AFdB/m + CFdB

To convert to linear units of measure: EdBV/m/20 Inv log

Table 17: 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)	Comments
44.22	V	180.00	1.00	13.60	10.9	16.7	100.0	-15.5	
52.83	V	90.00	1.00	17.10	8.2	18.4	100.0	-14.7	
118.13	V	270.00	1.00	10.40	15.8	20.4	150.0	-17.3	
401.39	V	45.00	1.30	9.60	19.9	30.0	200.0	-16.5	
451.03	V	0.00	1.47	11.80	21.4	45.8	200.0	-12.8	
457.69	V	10.00	1.50	10.80	21.7	42.3	200.0	-13.5	
544.03	V	180.00	1.88	9.80	23.2	44.8	200.0	-13.0	
1061.50	V	90.00	2.10	44.78	-9.9	55.4	5000.0	-39.1	peak
1061.50	V	90.00	2.10	38.10	-9.9	25.7	500.0	-25.8	average
1128.60	V	180.00	1.98	47.89	-9.1	87.1	5000.0	-35.2	peak
1128.60	V	180.00	1.98	36.55	-9.1	23.6	500.0	-26.5	average
44.22	H	0.00	4.00	6.00	10.9	7.0	100.0	-23.1	
86.20	H	180.00	3.90	13.60	9.4	14.2	100.0	-17.0	
168.00	H	45.00	3.56	13.20	14.2	23.4	150.0	-16.1	
221.17	H	180.00	3.28	14.90	14.0	27.8	200.0	-17.1	
401.39	H	190.00	3.50	8.90	19.9	27.7	200.0	-17.2	
457.69	H	90.00	2.80	7.60	21.7	29.3	200.0	-16.7	
544.03	H	90.00	1.92	9.40	23.2	42.8	200.0	-13.4	
1061.50	H	270.00	2.30	43.20	-9.9	46.2	500.0	-20.7	peak
1061.50	H	270.00	2.30	38.00	-9.9	25.4	500.0	-25.9	average
1128.60	H	0.00	2.41	45.20	-9.1	63.9	500.0	-17.9	peak
1128.60	H	0.00	2.41	35.90	-9.1	21.9	500.0	-27.2	average