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FCC & Industry Canada Certification Test Report

For the

Motorola Solutions

FX7500 RFID FIXED READER

FCC ID: UZ7FX7500

IC: 109AN-FX7500

WLL JOB# **13122-01 Rev 2**
August 22, 2013

Revised November 4, 2013

Prepared for:
Motorola Solutions
Jays Close
Viables Industrial Estate
Basingstoke
Hampshire
RG22 4PD
United Kingdom

Prepared By:

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

ACLASS ACCREDITED TESTING

Testing Certificate AT-1448

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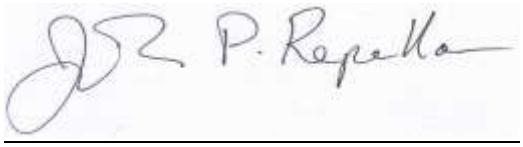

John P. Repella
Compliance Engineer

Reviewed by:

James Ritter
EMC Laboratory Manager

Abstract

This report has been prepared on behalf of Motorola Solutions to support the attached Application for Equipment Authorization. The test report and application are submitted for a Frequency Hopping Spread Spectrum Transmitter under Part 15.247 (10/2012) of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy RSS-210 (issue 8:2010) of Industry Canada. This Certification Test Report documents the test configuration and test results for the Motorola Solutions FX7500.

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 Motorola Solutions FX7500 complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under FCC Part 15.247 and Industry Canada RSS-210.

Revision History	Description of Change	Date
Rev 0	Initial Release	August 28, 2013
Rev 1	Corrected typographical errors	September 5, 2013 JR
Rev 2	Corrected typographical errors	November 4, 2013 JR

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1 Introduction

1.1 Compliance Statement

The Motorola Solutions FX7500 complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under FCC Part 15.247 (10/2012) and Industry Canada RSS-210 (issue 8:2010).

1.2 Test Scope

Tests for radiated and conducted (at antenna terminal) emissions were performed. All measurements were performed in accordance 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:	Motorola Solutions Jays Close Viables Industrial Estate Basingstoke Hampshire RG22 4PD United Kingdom
Purchase Order Number:	NP5616491
Quotation Number:	67314B
Test Dates	
Testing was performed on the following date(s):	8/19/2013-8/22/2013

1.4 Test and Support Personnel

Washington Laboratories, LTD	John P. Repella
Customer Representative	Amit Asthana, Alan Parish

1.5 Abbreviations

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

2 Equipment Under Test

2.1 EUT Identification & Description

The Motorola Solutions FX7500 is a fixed reader for RFID tags.

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	Motorola Solutions
FCC ID:	UZ7FX7500
IC:	109AN-FX7500
Model:	FX7500
FCC Rule Parts:	§15.247
Industry Canada:	RSS210 Issue 8
Frequency Range:	902.75 - 927.25MHz
Maximum Output Power:	30.00dBm (Measured at the Input to the Antenna)
Modulation:	DSB-ASK, PR-ASK
Occupied Bandwidth:	274.899 kHz
Keying:	Automatic, Manual
Type of Information:	Data
Number of Channels:	50
Power Output Level	Variable 10dBm - 31.5dBm (Professionally installed)
Antenna Connector	4 External (Reverse TNC)
Antenna Type	Dual Polarized Dipole(Horizontal and Vertical Components)
Antenna Gain:	6dBi (3.85dBd)
Interface Cables:	RS232, USB, LAN
Power Source & Voltage:	AC adapter (100-240VAC, 50-60Hz, 1.5A) DC 24V, 3.25A
Receiver spurious	38uVm @ 3m , 63.47MHz
Transmitter spurious	134uV/m @ 3m, 649.99MHz
Emissions Designator	275KGXD

2.2 Test Configuration

The FX7500 was configured for test with customer supplied software to exercise functionality. The scanner was tested with two configurations, AC power via power brick and POE Injector.

2.3 Testing Algorithm

The FX7500 was programmed for FHSS operation via Putty software provided by the customer over a LAN interface.

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

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

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

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

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

2.6 Measurement Uncertainty

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

Equation 1: Standard Uncertainty

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

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 ≤ 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
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: **Radiated/Bench Conducted Emissions**		Test Date: **08/20/2013**	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
68	HP - 85650A	ADAPTER QP	1/1/2014
72	HP - 8568B	ANALYZER SPECTRUM	1/1/2014
70	HP - 85685A	PRESELECTOR RF W/OPT 8ZE	1/1/2014
528	AGILENT - E4446A	ANALYZER SPECTRUM	2/28/2014
627	AGILENT - 8449B	AMPLIFIER 1-26GHZ	5/13/2014
337	WLL - 1.2-5GHZ	FILTER BAND PASS	4/19/2014
281	ITC - 21A-3A1	WAVEGUIDE 4.51-10.0GHZ	5/29/2014
644	SUNOL SCIENCES CORPORATION - JB1 925-833-9936	BICONALOG ANTENNA	1/11/2014
770	MEGAPHASE - EM18-NK5S1-600	50 FT HIGH FREQUENCY CABLE 1 - 18GHZ	7/5/2014
4	ARA - DRG-118/A	ANTENNA DRG 1-18GHZ	2/20/2015
519	MEGAPHASE - TM40-K1K1-72-T	CABLE COAXIAL - 72IN.LONG - 40 GHZ	12/20/2013

Test Name:	**Conducted Emissions Voltage**	Test Date:	**08/21/2013**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
125	SOLAR - 8028-50-TS-24-BNC	LISN	6/11/2014
126	SOLAR - 8028-50-TS-24-BNC	LISN	6/11/2014
69	HP - 85650A	ADAPTER QP	9/30/2013
802	HP - 8568B	SPECTRUM ANALYZER	9/30/2013
71	HP - 85685A	PRESELECTOR RF	9/30/2013
818	TESEQ - ISN T800	ISN T8	1/11/2014

4 Test Summary

The Table Below shows the results of testing for compliance with a Digital Transmission System in accordance with FCC Part 15.247:2012 and RSS210 issue 8. Full results are shown in section 5.

Table 4: Test Summary Table

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

247(a) 1(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is greater than 250 kHz, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. Additionally the maximum allowed 20dB bandwidth is 500 kHz for any channel.

From Figures 1 and 2 it is determined that:

Single pulse duration is 390.00ms in a 10 s sweep period 1 pulse occurs, and therefore the total on time is 390.00ms.

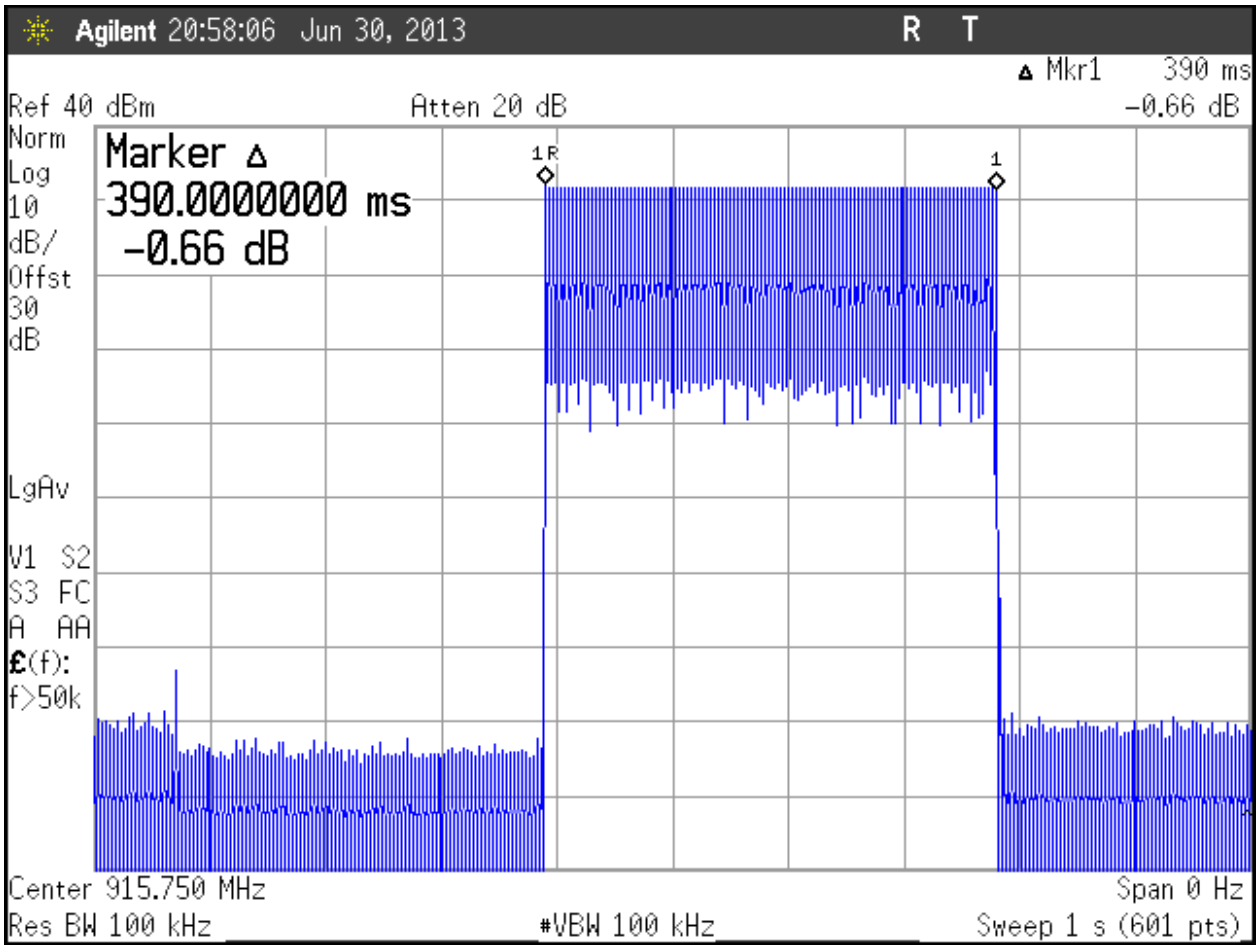

Figure 1: Duty Cycle Plot

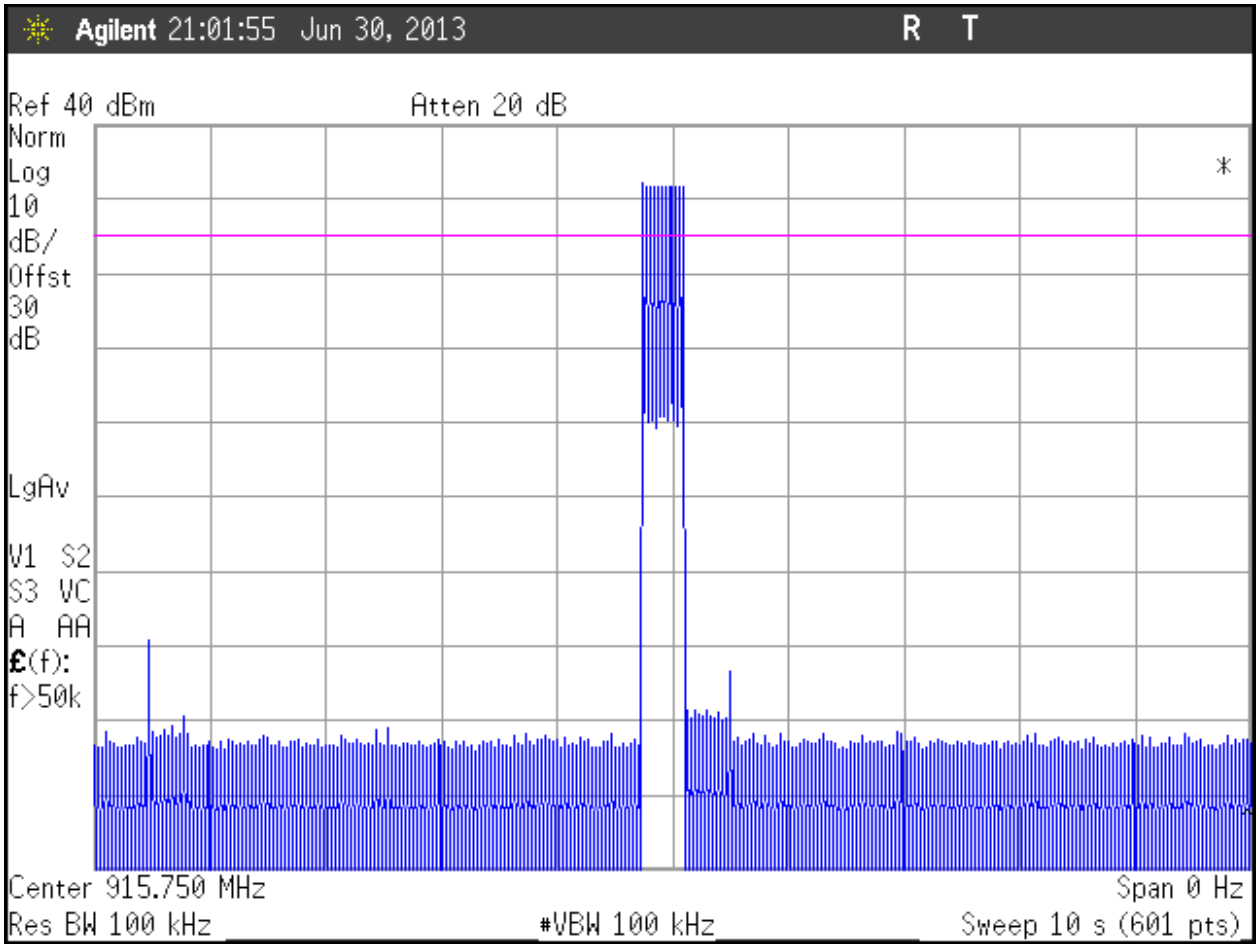

Figure 2: Total on Time

5.2 RF Power Output: (15.247 (b)(2) & RSS-210 [A8.4 (1)])

To measure the output power the hopping sequence was stopped while the frequency dwelled on a low, middle and high channel. The antenna cable 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. It should be noted that there standard installation accounts for a cable of 100ft at a loss of 1.5dBm. Maximum RF power can be set to accommodate this loss at 31.5dBm. The RF Power Output recorded in Table 5 is the RF Power fed into the antenna.

Table 5: RF Power Output

Frequency /Input to Antenna Port	Level	Limit	Pass/Fail
Low Channel: 902.75MHz	30.00dBm	30 dBm	Pass
Mid Channel: 915.75MHz	29.90dBm	30 dBm	Pass
High Channel: 927.25MHz	29.98dBm	30 dBm	Pass

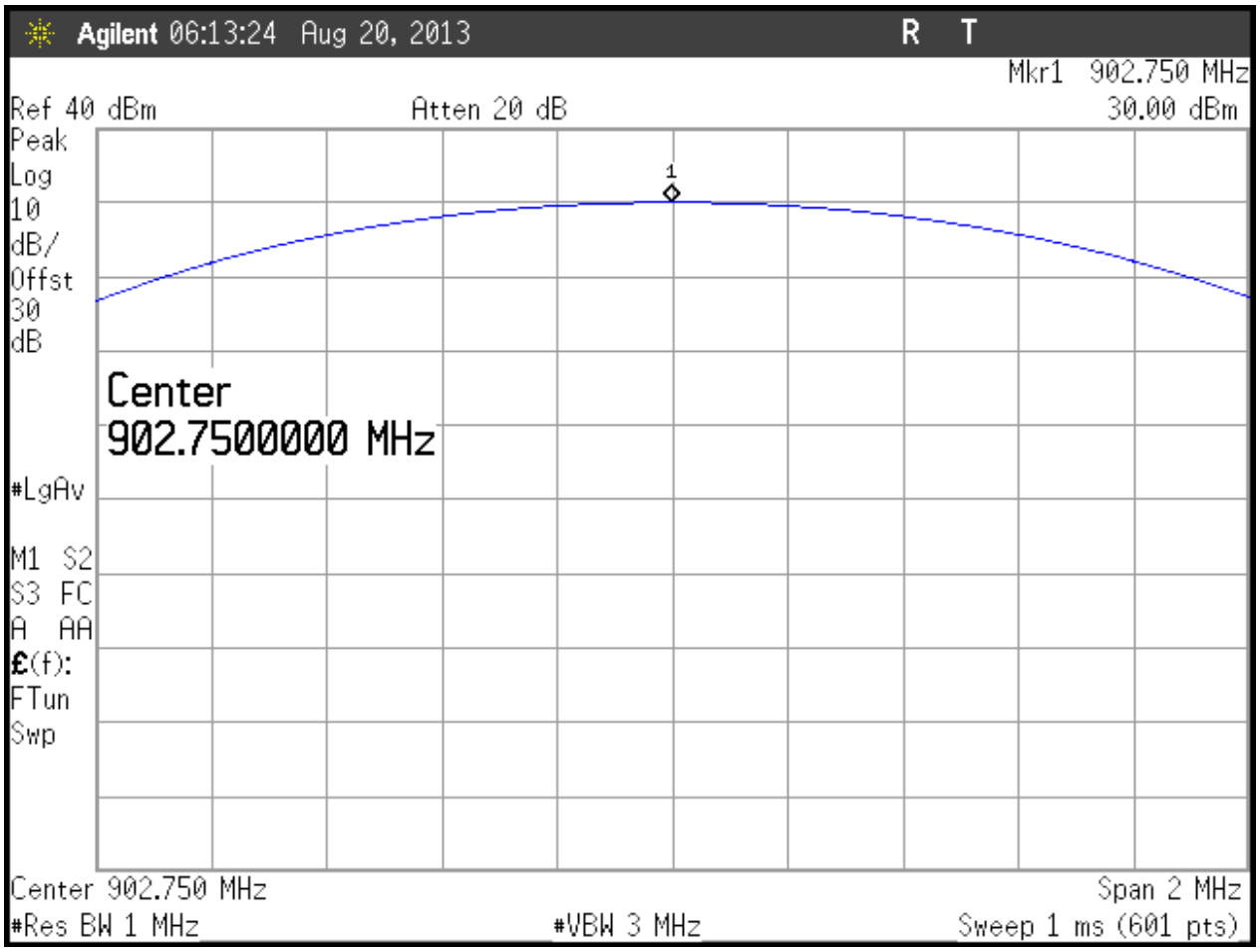

Figure 3: RF Peak Power, Low Channel

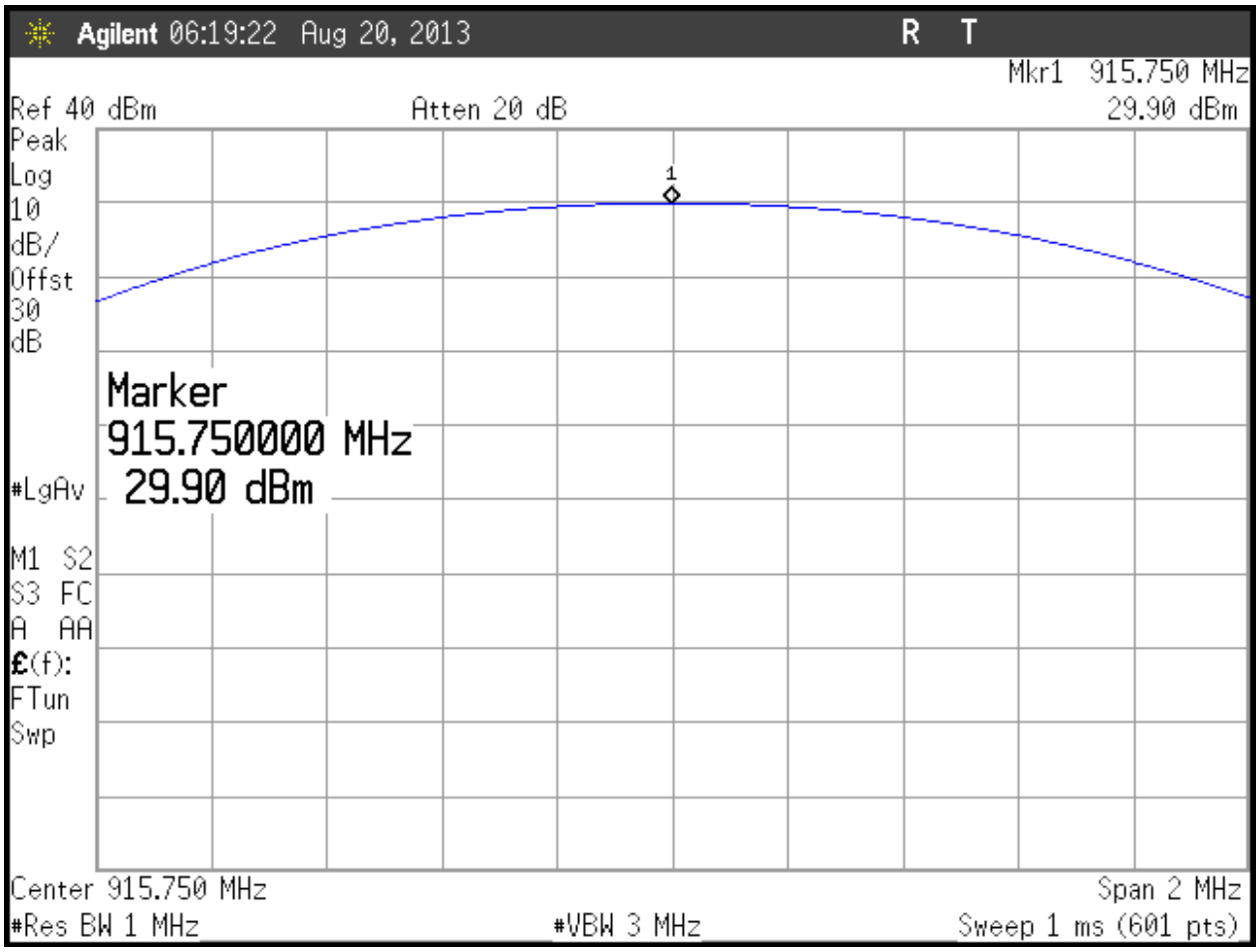

Figure 4: RF Peak Power, Mid Channel

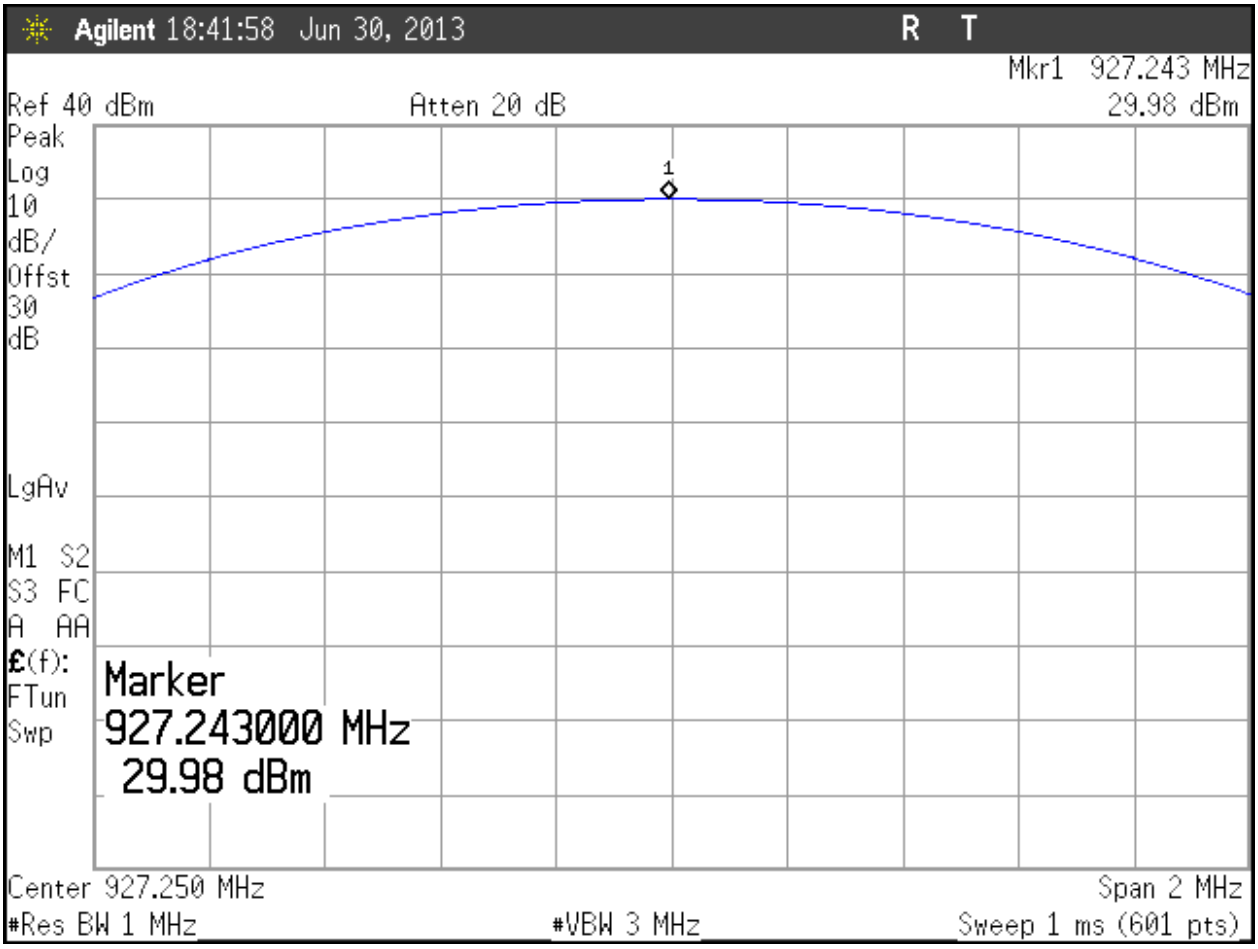

Figure 5: RF Peak Power, High Channel

5.3 Occupied Bandwidth: (15.247 (a) (1) (i) & RSS-210 [A8. 1 (c)])

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer. For Frequency Hopping Spread Spectrum Systems, FCC Part 15.247 requires the maximum 20 dB bandwidth not exceed 500 kHz.

At full modulation, the occupied bandwidth was measured as shown in the plots below. Table 6 provides a summary of the Occupied Bandwidth Results.

Table 6: Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Low Channel: 902.75MHz	264.215kHz	500KHz	Pass
Mid Channel: 915.75MHz	263.544kHz	500KHz	Pass
High Channel: 927.25MHz	274.899kHz	500KHz	Pass

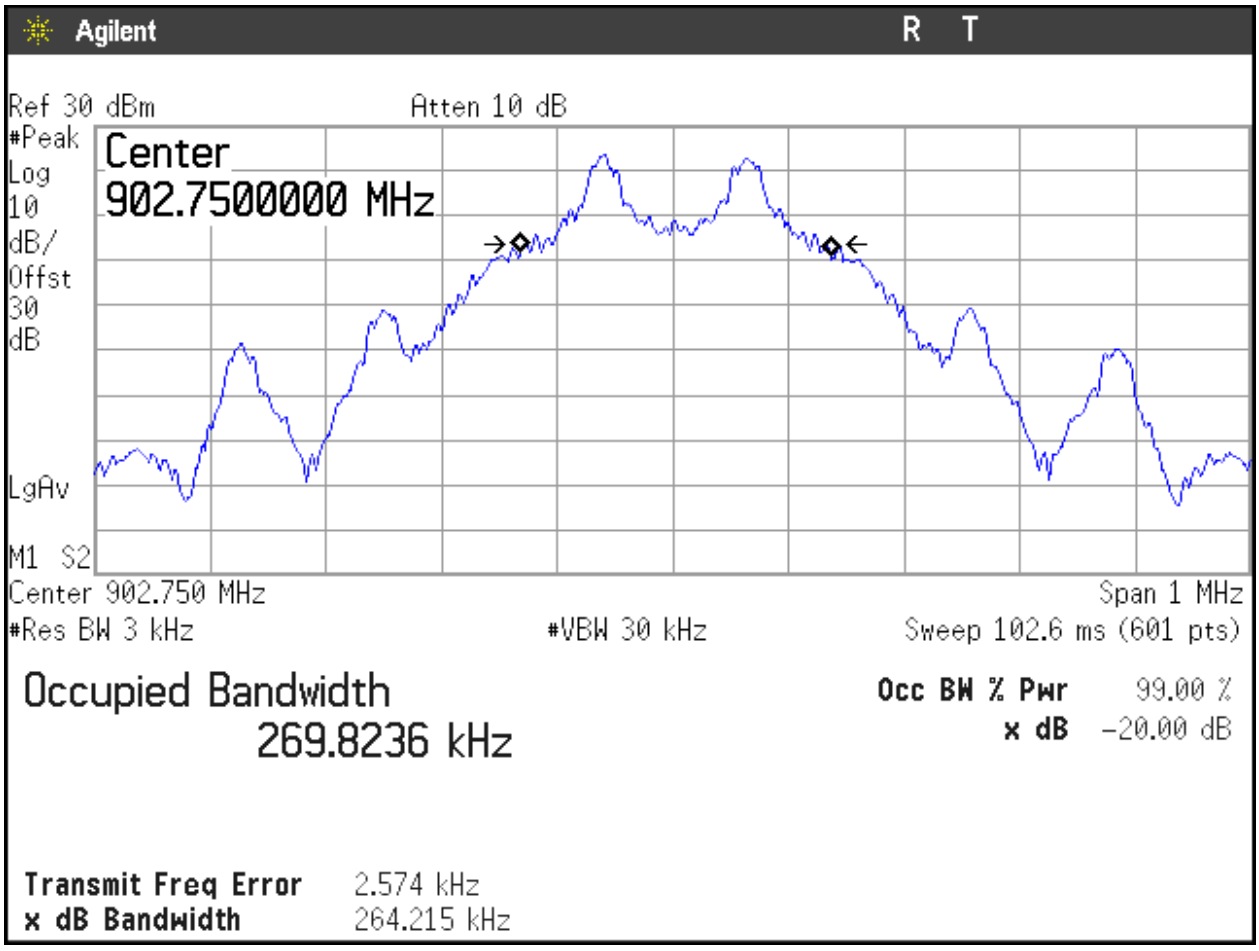

Figure 6: Occupied Bandwidth, Low Channel

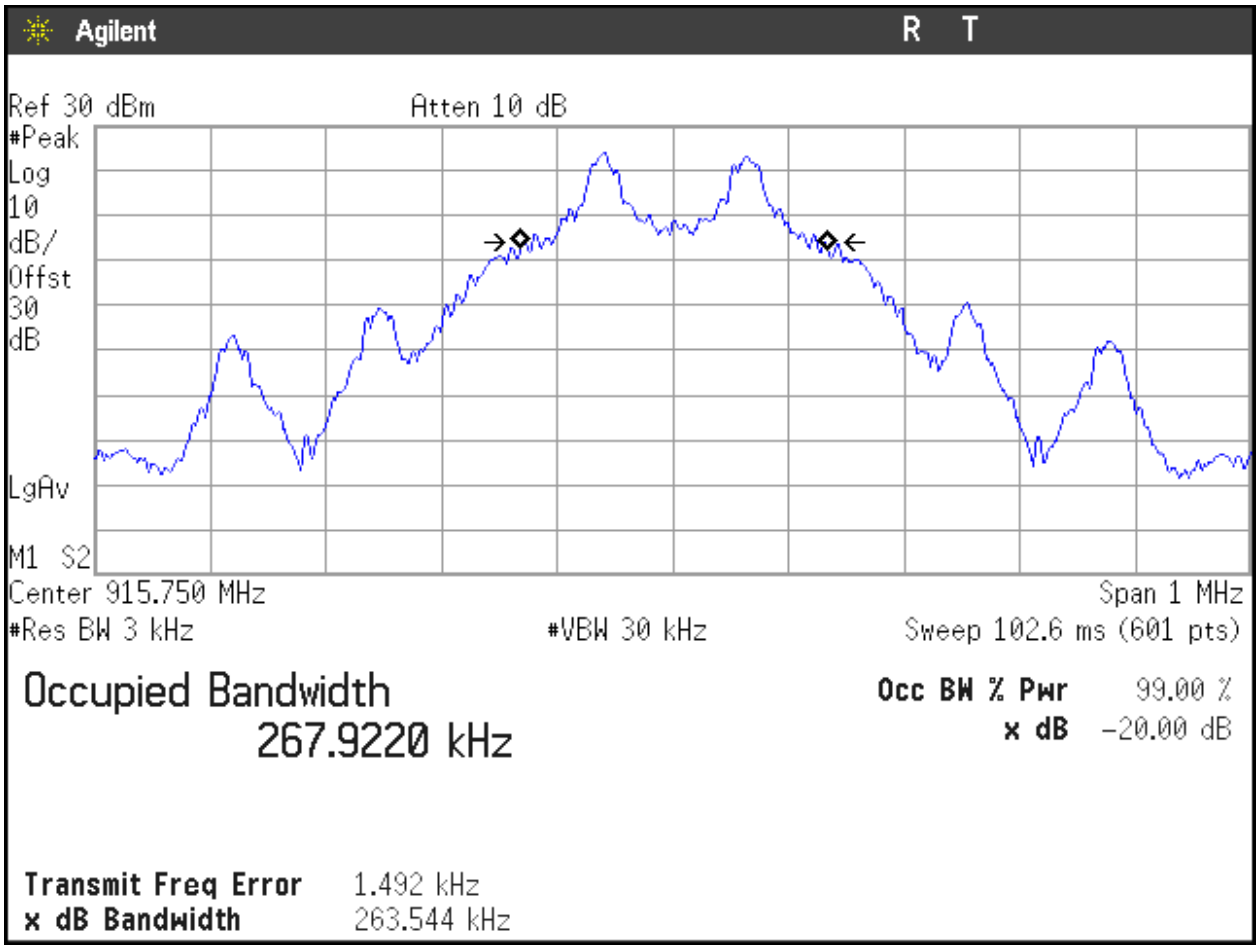

Figure 7: Occupied Bandwidth, Mid Channel

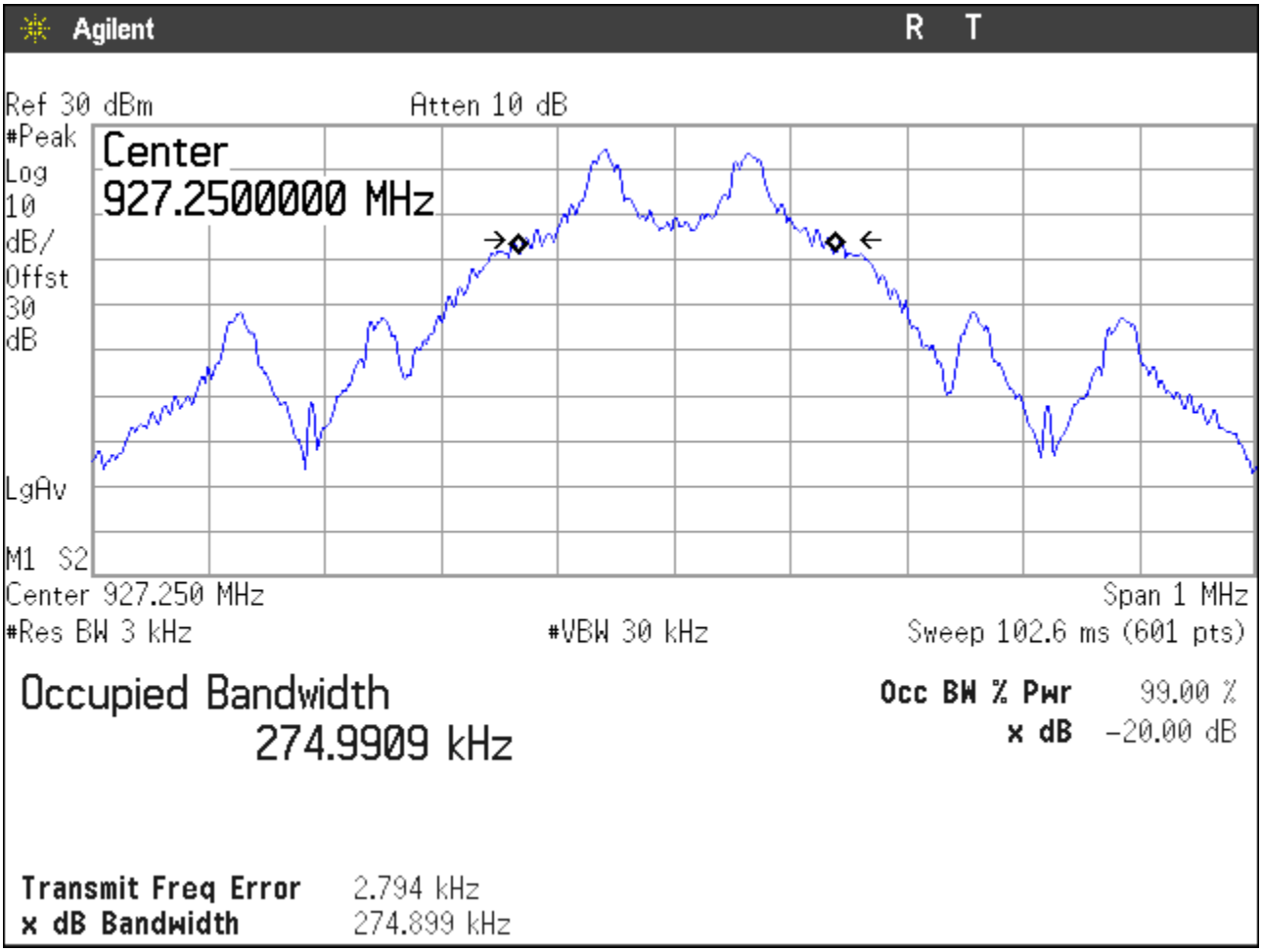

Figure 8: Occupied Bandwidth, High Channel

5.4 Channel Spacing and Number of Hop Channels (FCC 15. 247(a)(1) & RSS-210 [A8.1 (b)]

Per the FCC requirements, frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the measured 20 dB bandwidth, whichever is greater. The maximum 20dB bandwidth measured is 274.89 kHz. In addition, for a 902-928MHz transmitter with a bandwidth greater than 250kHz the number of hopping channels shall greater than 25.

The EUT antenna was removed and the cable was connected directly into a spectrum analyzer through a 10 dB attenuator. An offset was programmed into the spectrum analyzer to compensate for the loss of the external attenuator. The spectrum analyzer resolution bandwidth was set to 100 kHz and the video bandwidth was set to 100 kHz. The channel spacing of 2 adjacent channels was measured using a spectrum analyzer span setting of 500 kHz. Also, the number of hopping channels was measured from 900MHz to 930MHz.

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

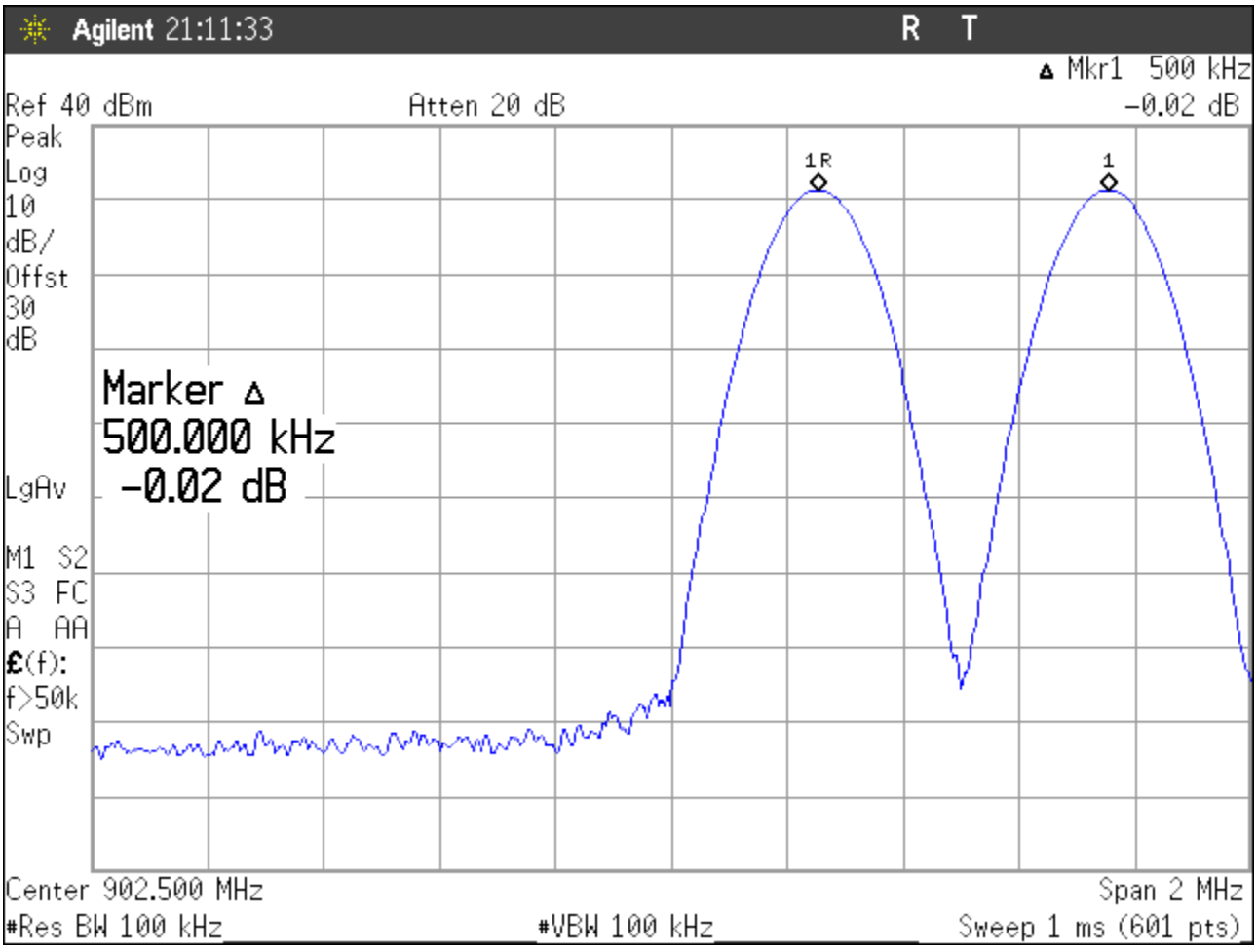

Figure 9: Channel Spacing

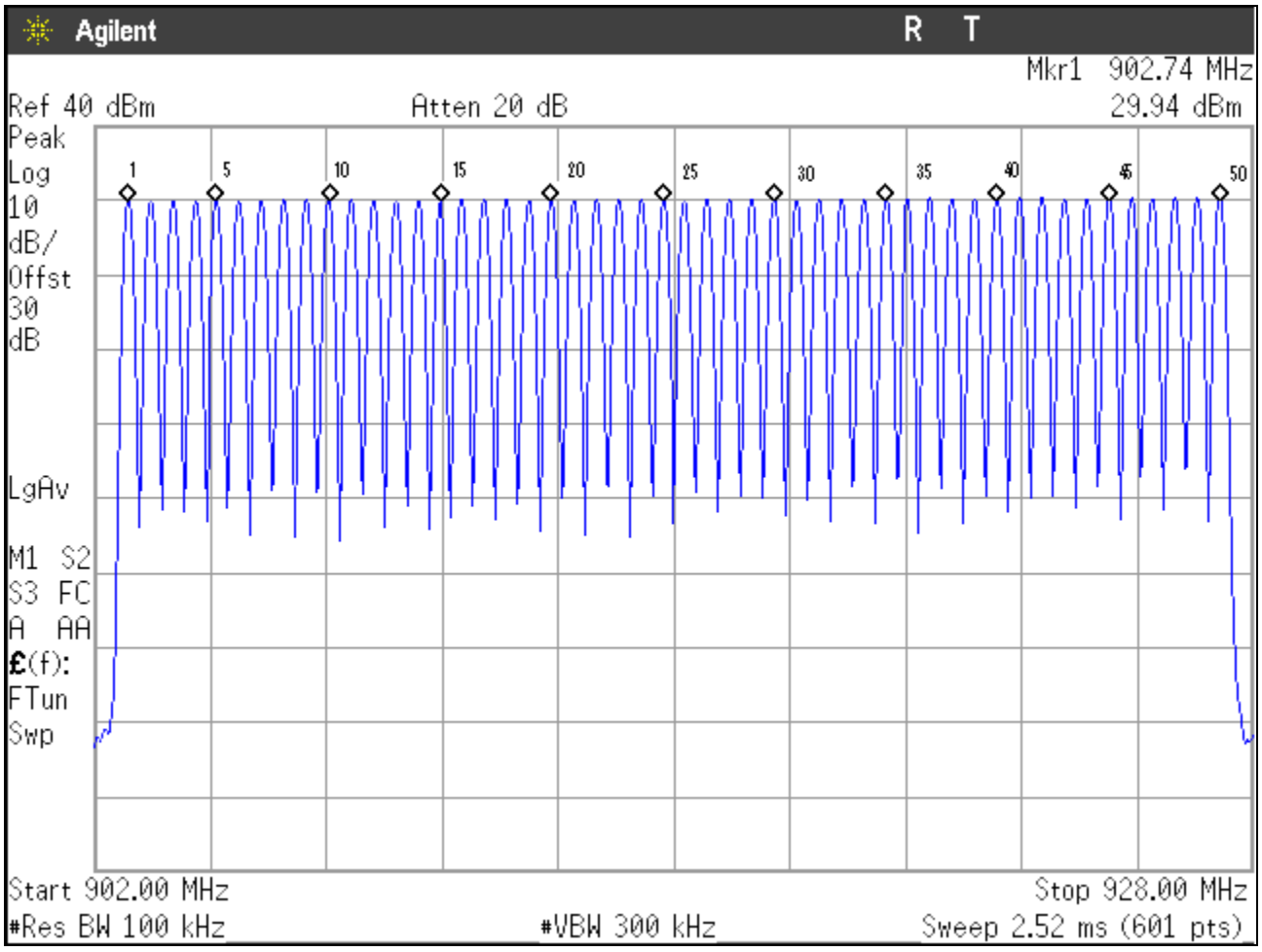

Figure 10: Number of Channels

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

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

The EUT antenna was removed and the cable was connected directly into a spectrum analyzer through a 10 dB attenuator. An offset was programmed into the spectrum analyzer to compensate for the loss of the external attenuator. The spectrum analyzer resolution bandwidth was set to 100 kHz and the video bandwidth was set to 300 kHz. The amplitude of the EUT carrier frequency was measured to determine the emissions limit (20 dB below the carrier frequency amplitude). The emissions outside of the allocated frequency band were then scanned from 30 MHz up to the tenth harmonic of the carrier.

The following are plots of the conducted spurious emissions data. No emissions exceeded the limit.

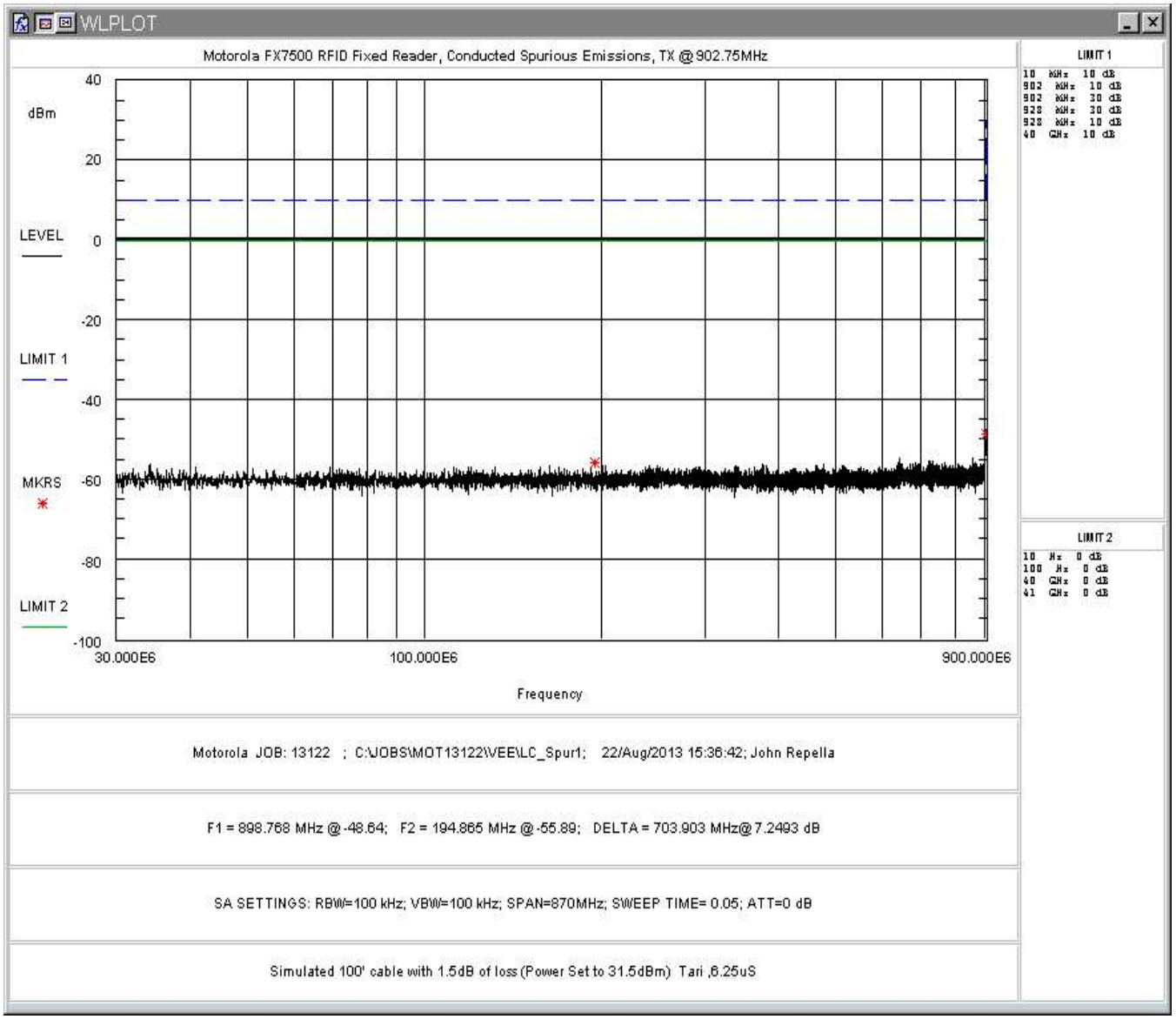

Figure 11: Conducted Spurious Emissions, Low Channel 30 - 900MHz

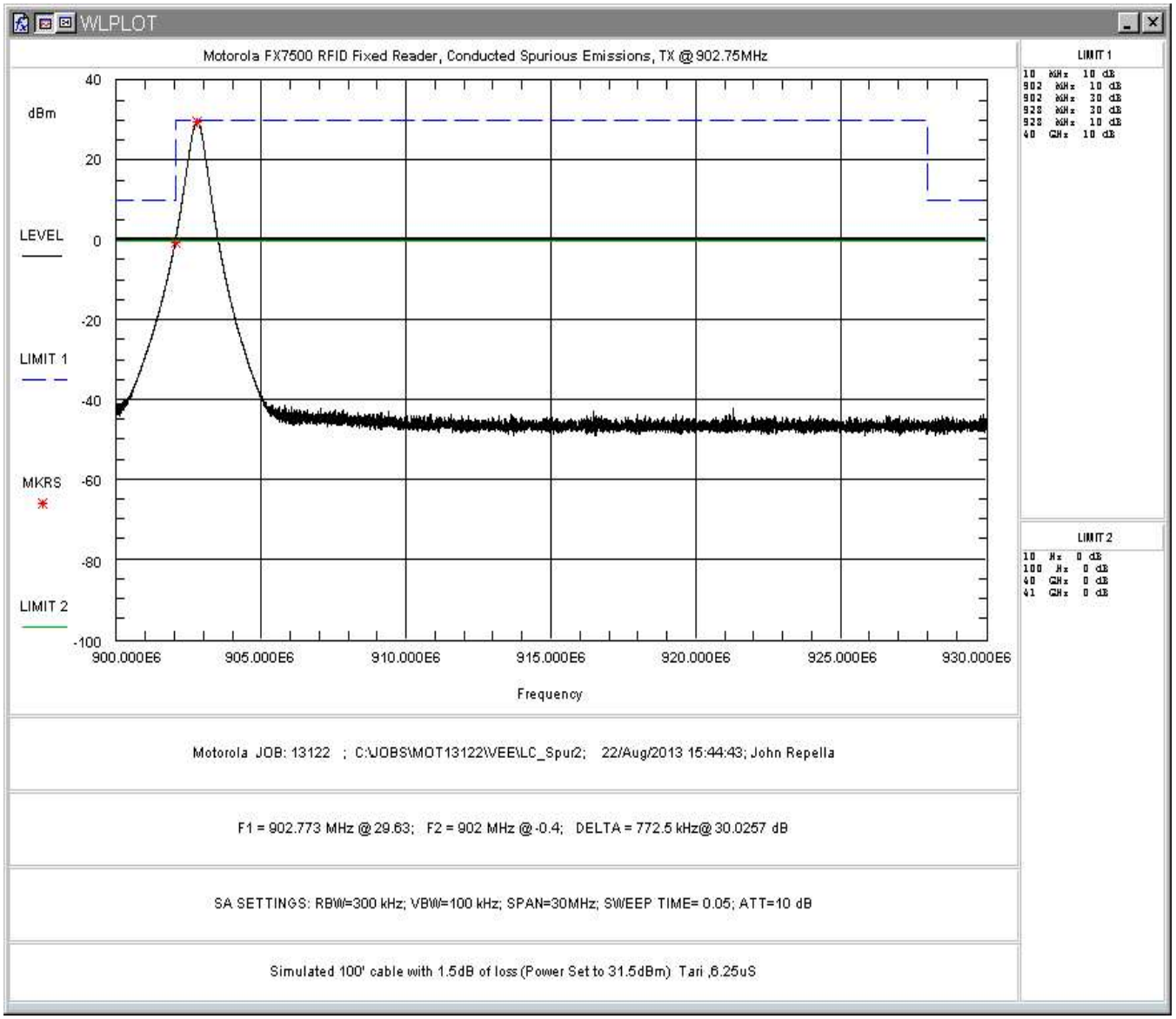

Figure 12: Conducted Spurious Emissions, Low Channel 900MHz – 930MHz

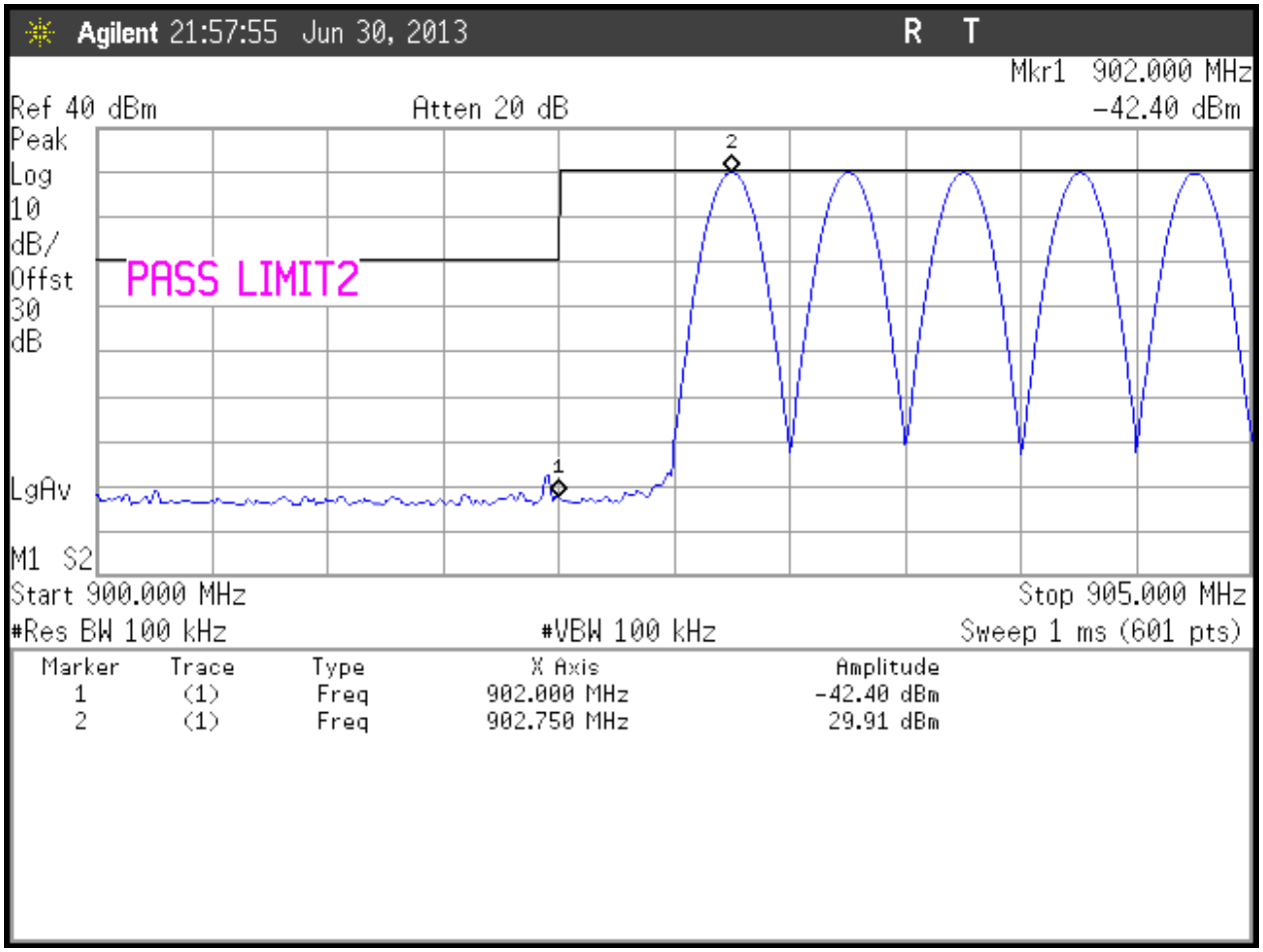

Figure 13: Band Edge Plot (Hopping), Low Channel TX @902.75MHz

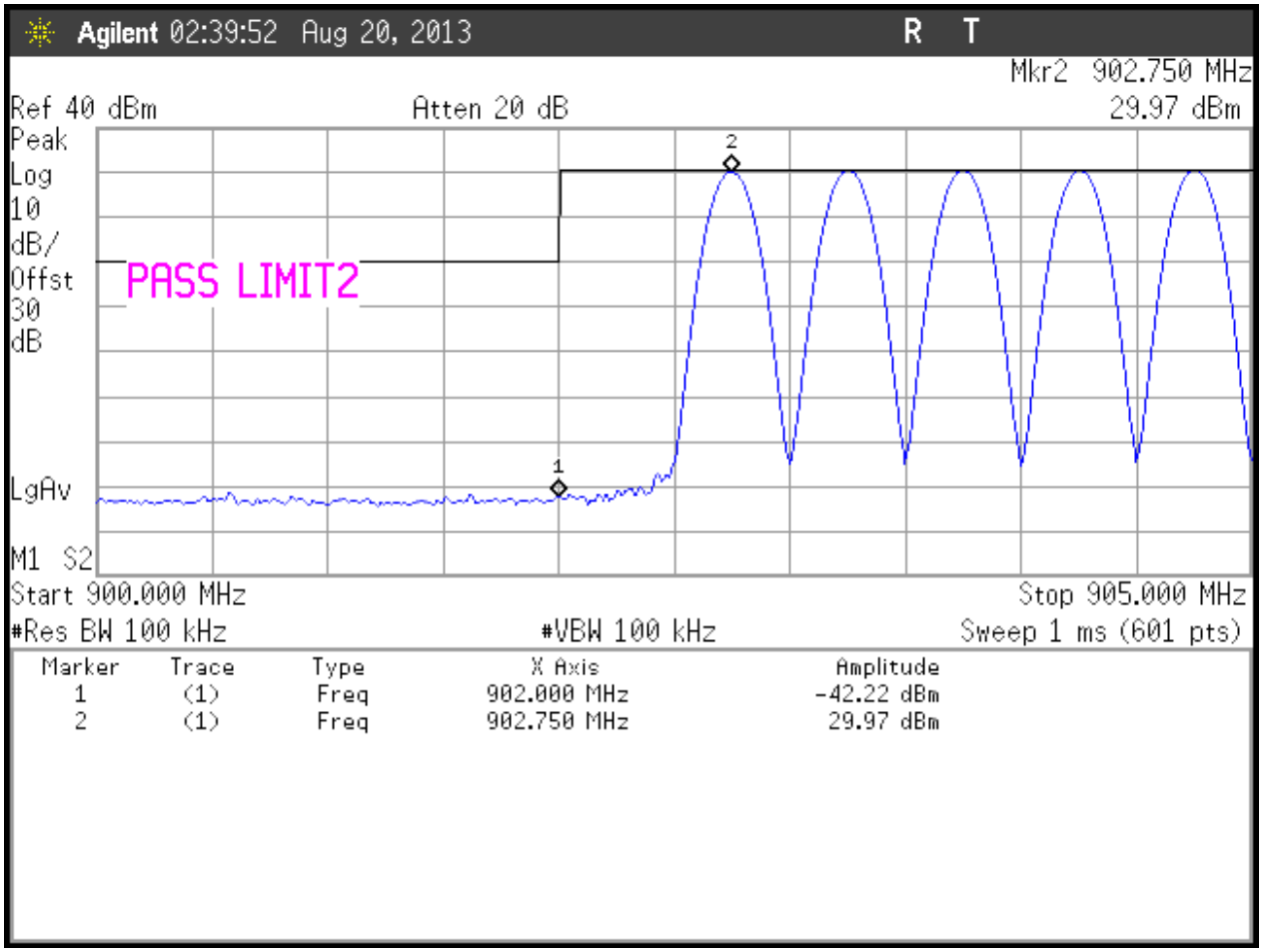

Figure 14: Band Edge Plot (Non-Hopping), Low Channel TX @902.75MHz

Note : multiple channels shown above are the result of channels being turned on one at a time (in max hold) to show that no spurs occur from alternate or adjacent channels.

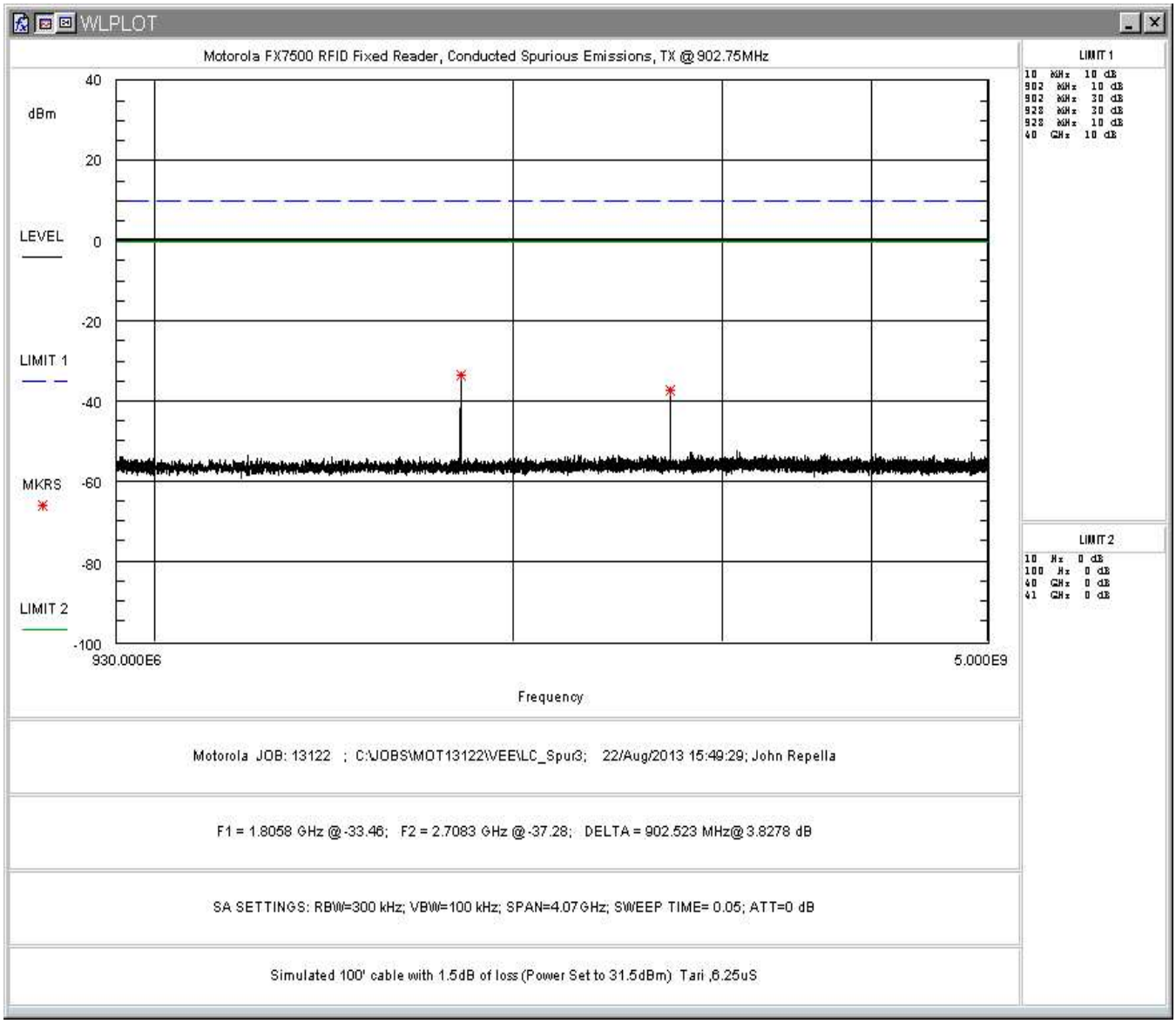

Figure 15: Conducted Spurious Emissions, Low Channel 930MHz – 5GHz

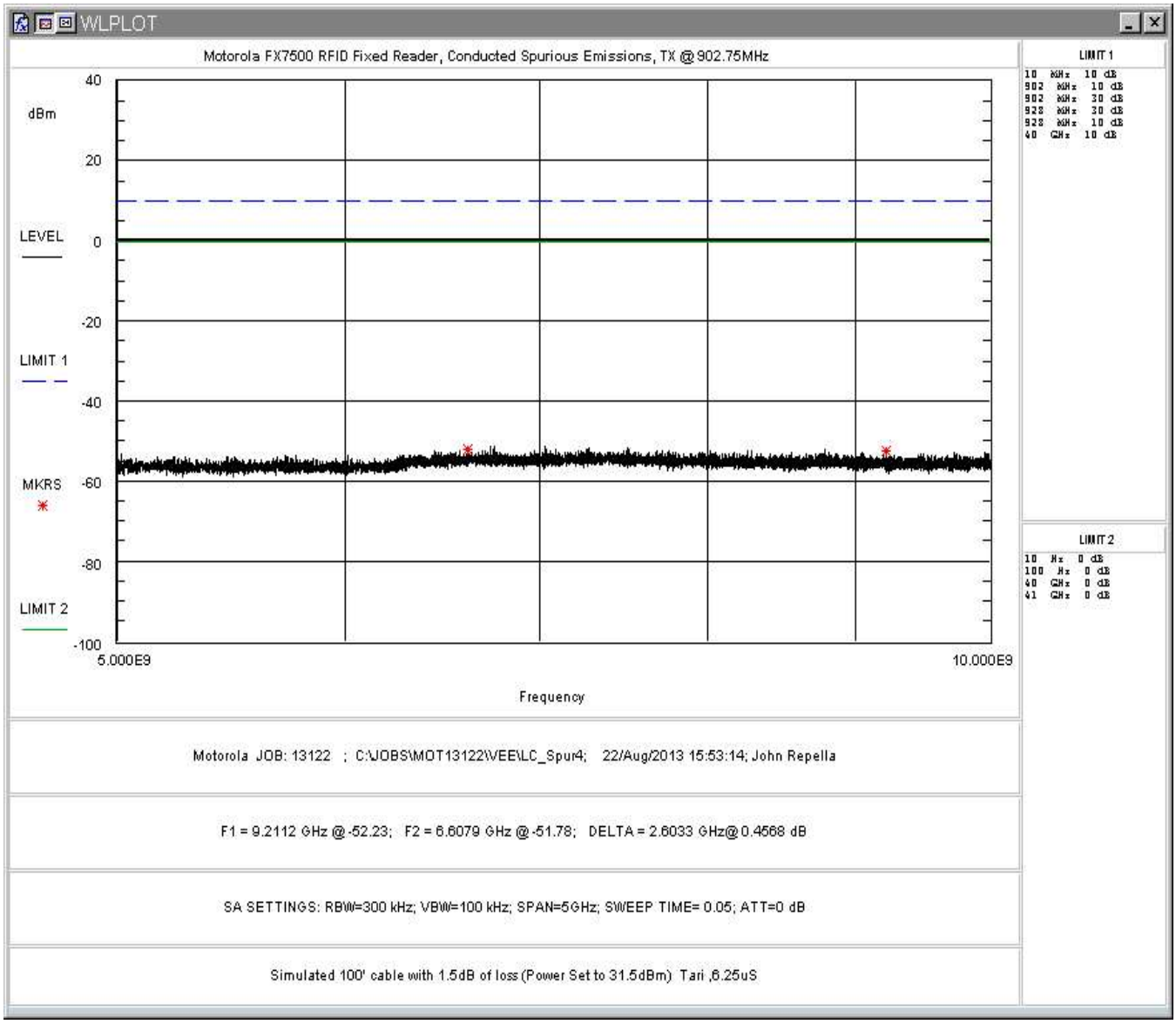

Figure 16: Conducted Spurious Emissions, Low Channel 5 - 10GHz

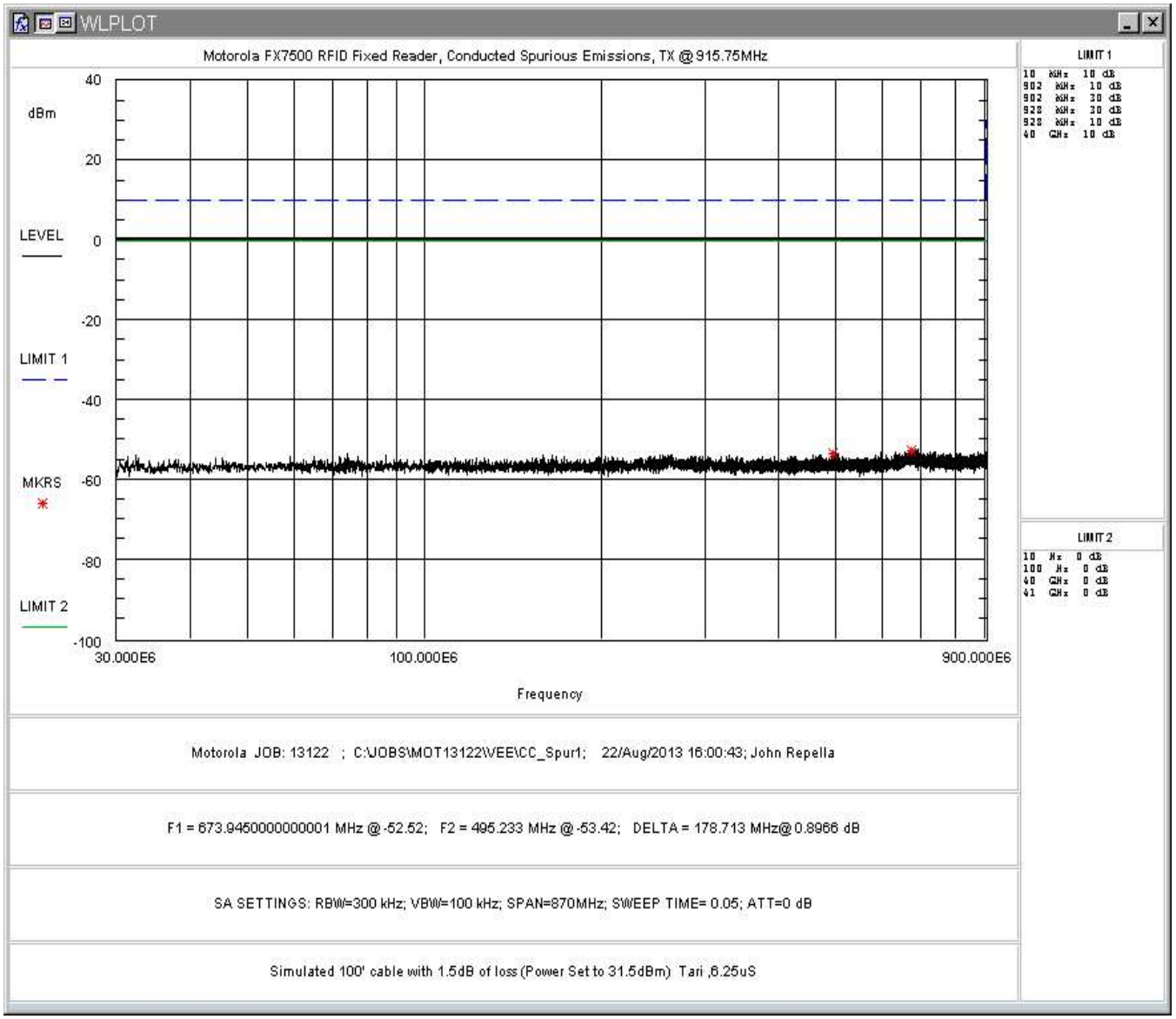

Figure 17: Conducted Spurious Emissions, Mid Channel 30 - 900MHz

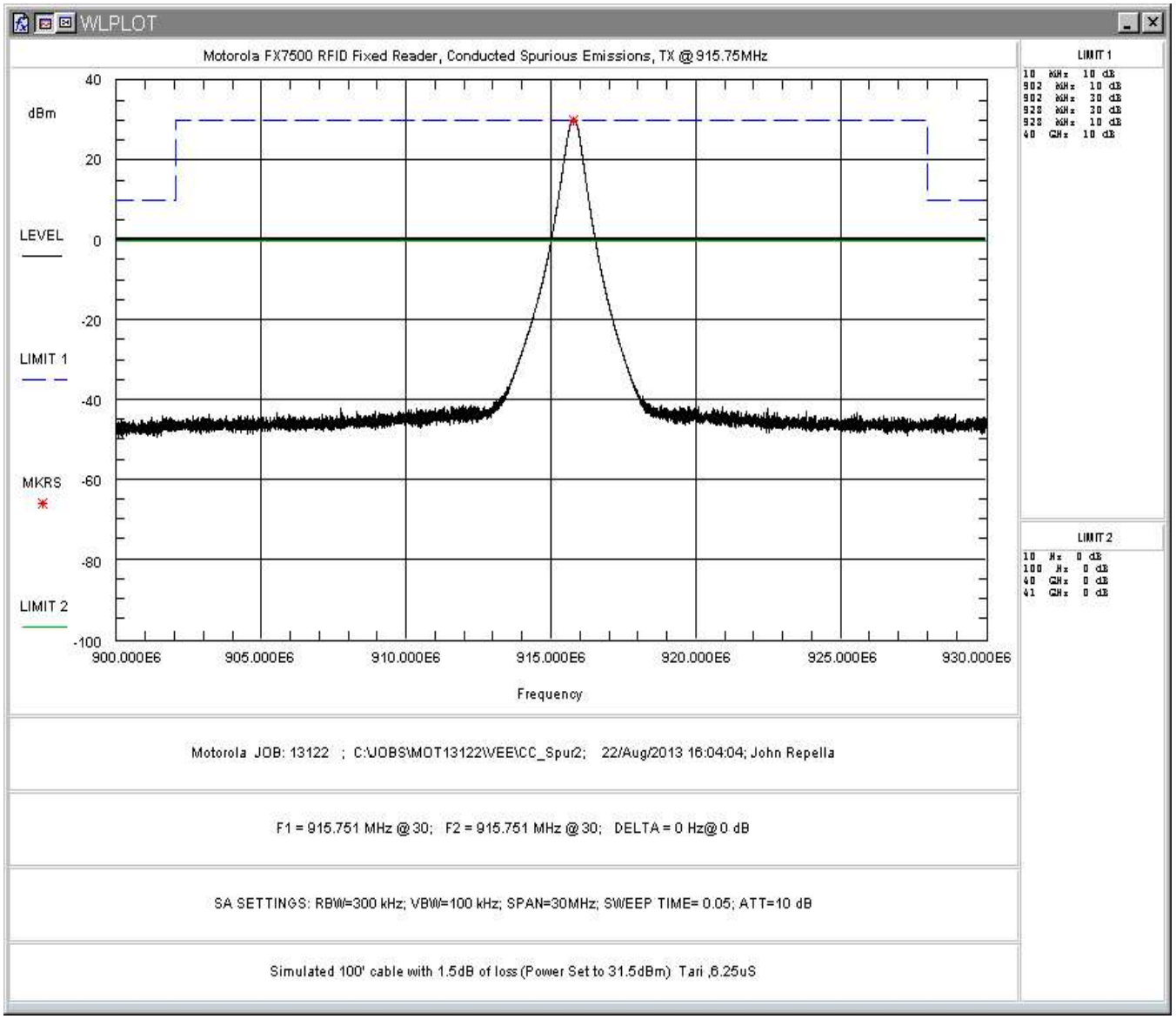

Figure 18: Conducted Spurious Emissions, Mid Channel 900MHz – 930MHz

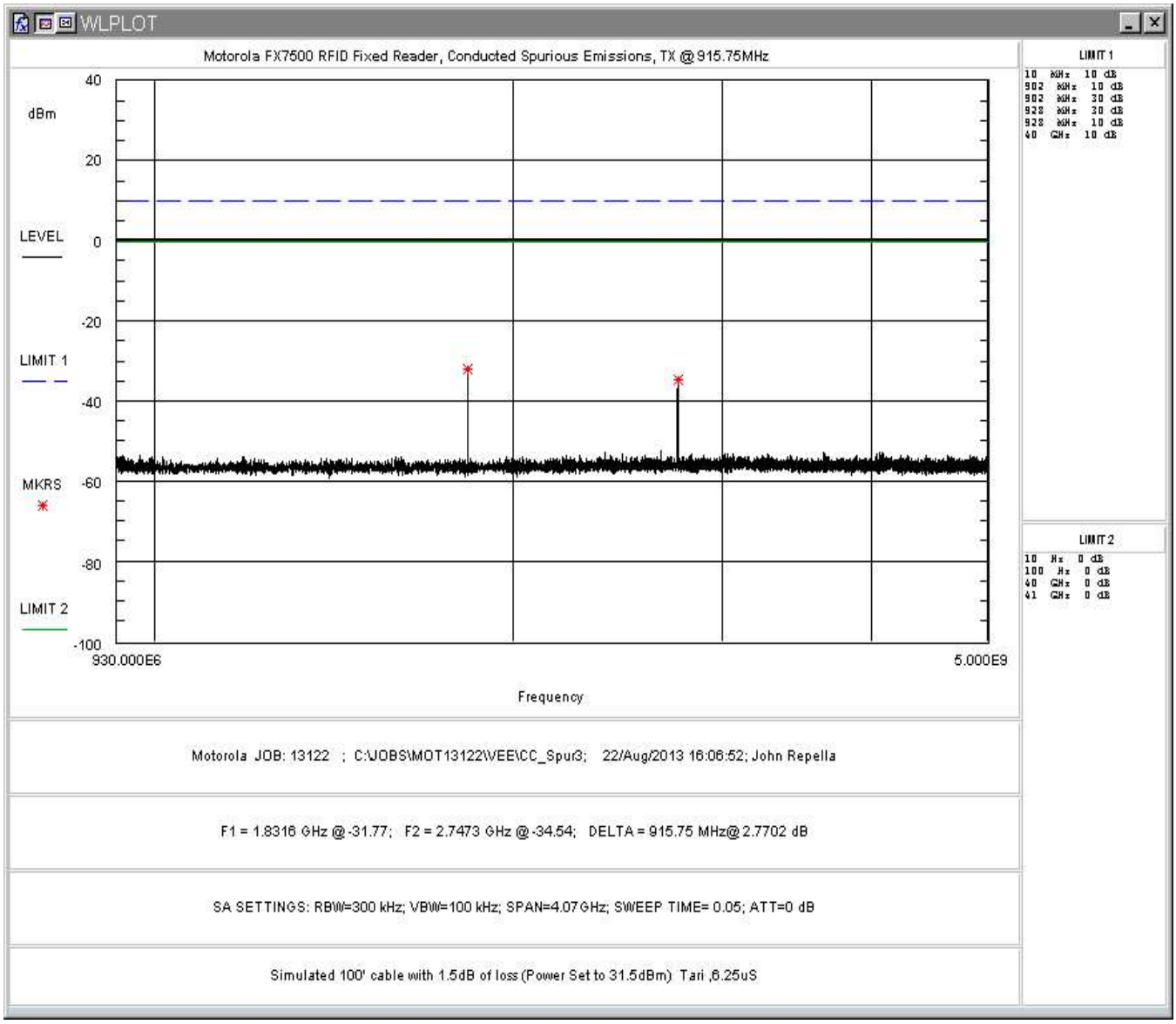

Figure 19: Conducted Spurious Emissions, Mid Channel 930MHz– 5GHz

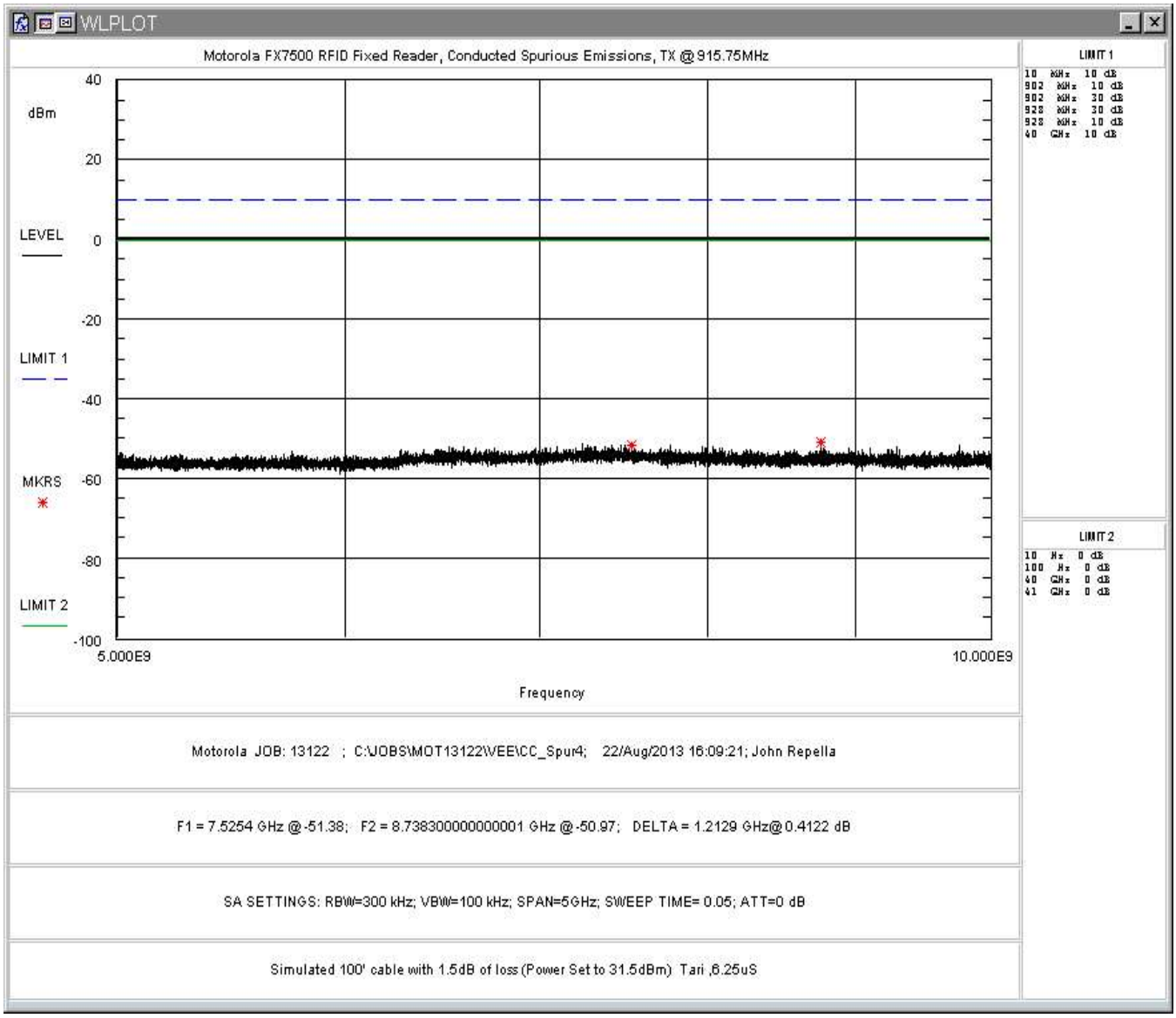

Figure 20: Conducted Spurious Emissions, Mid Channel 5 - 10GHz

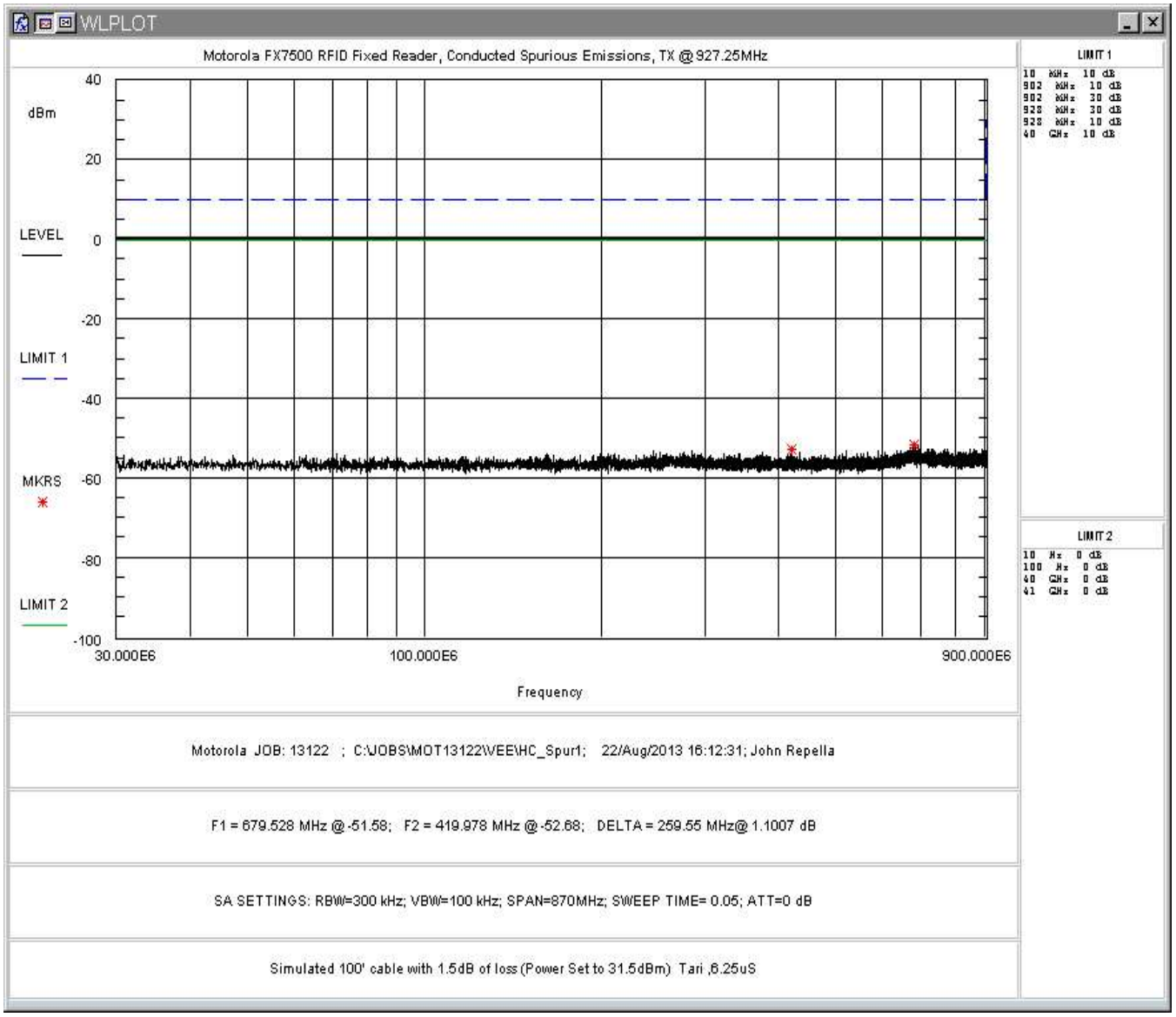

Figure 21: Conducted Spurious Emissions, High Channel 30 - 900MHz

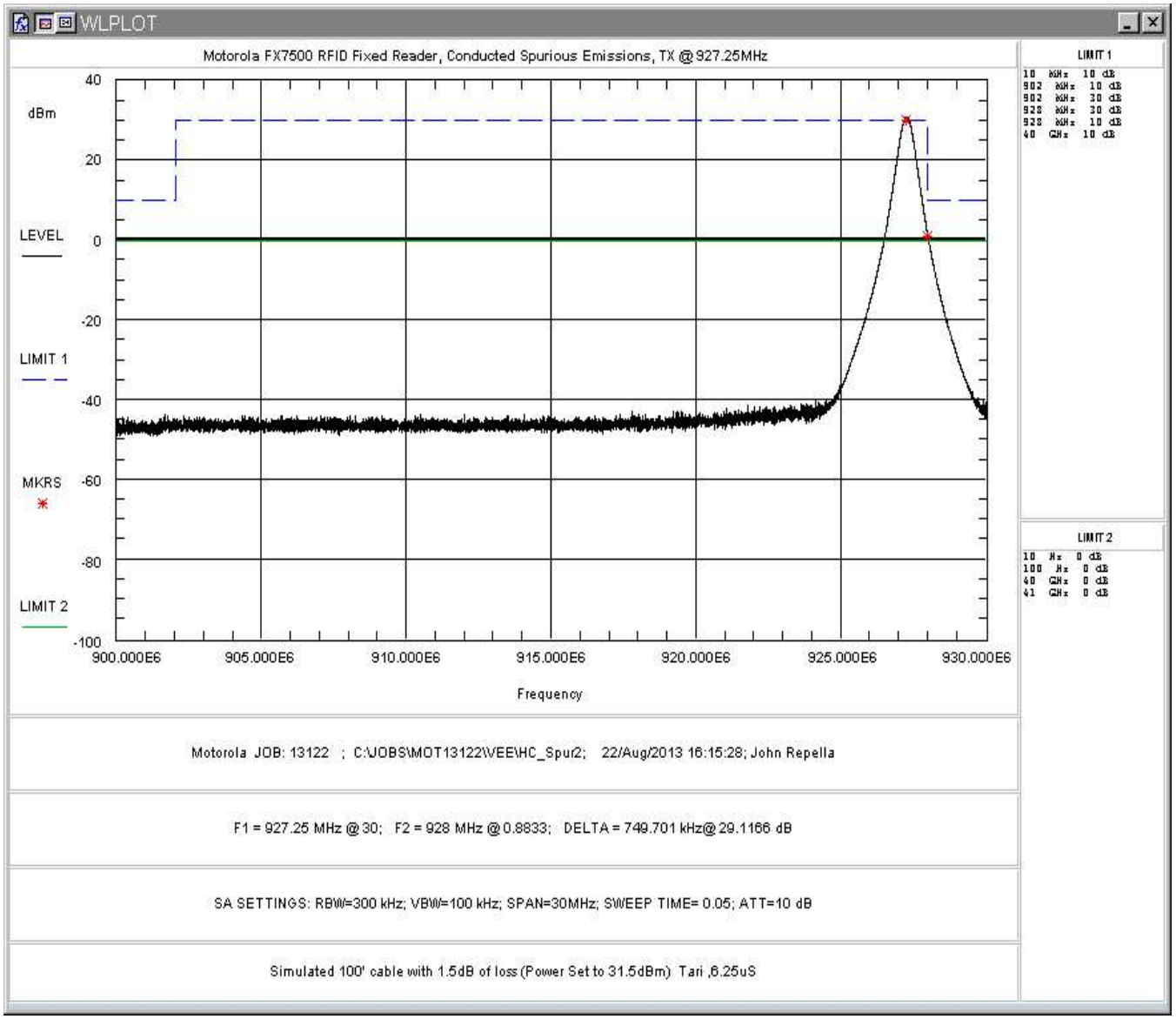

Figure 22: Conducted Spurious Emissions, High Channel 900MHz – 930MHz

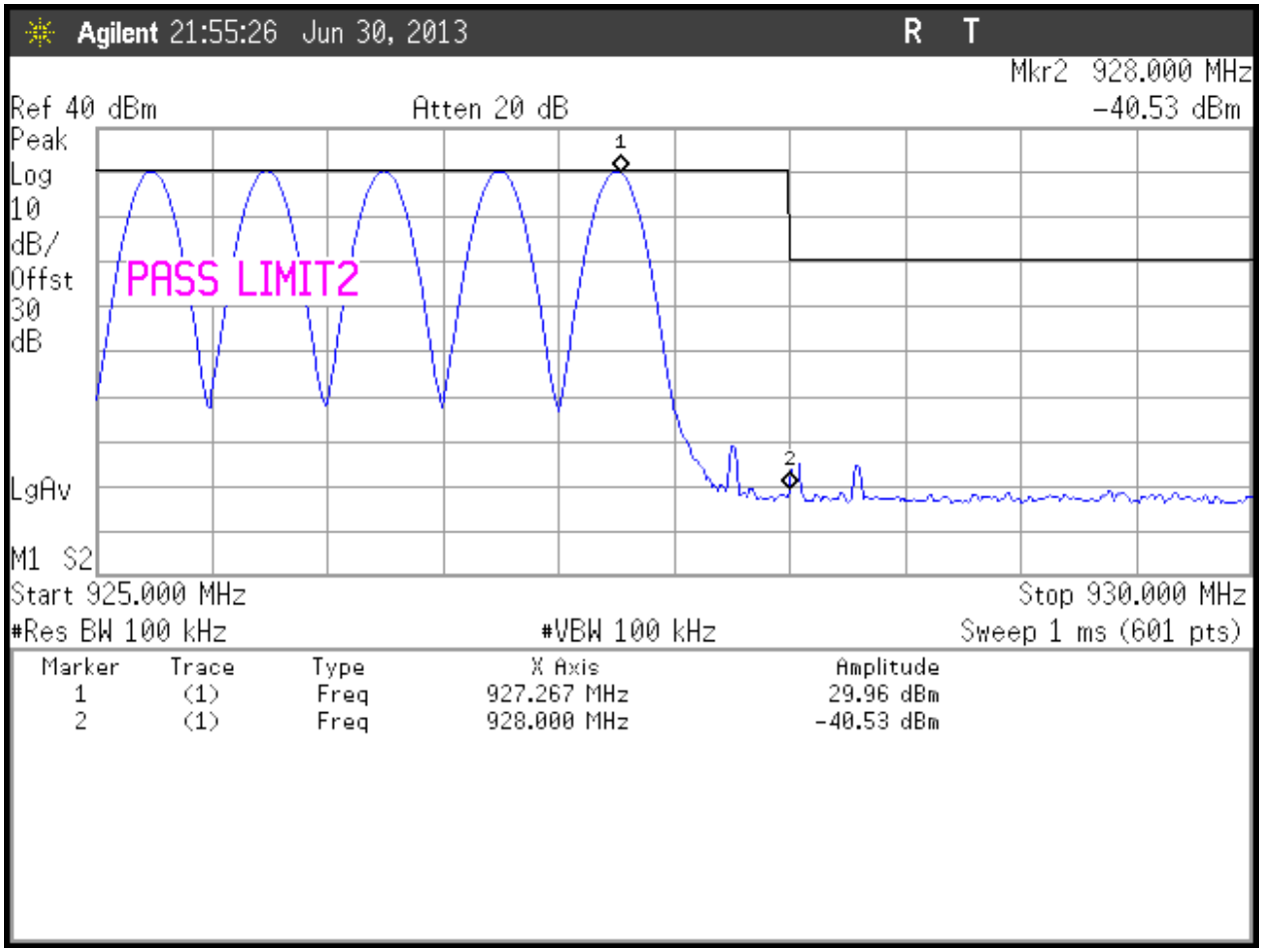

Figure 23: Band Edge Plot (Hopping), High Channel TX @927.25MHz

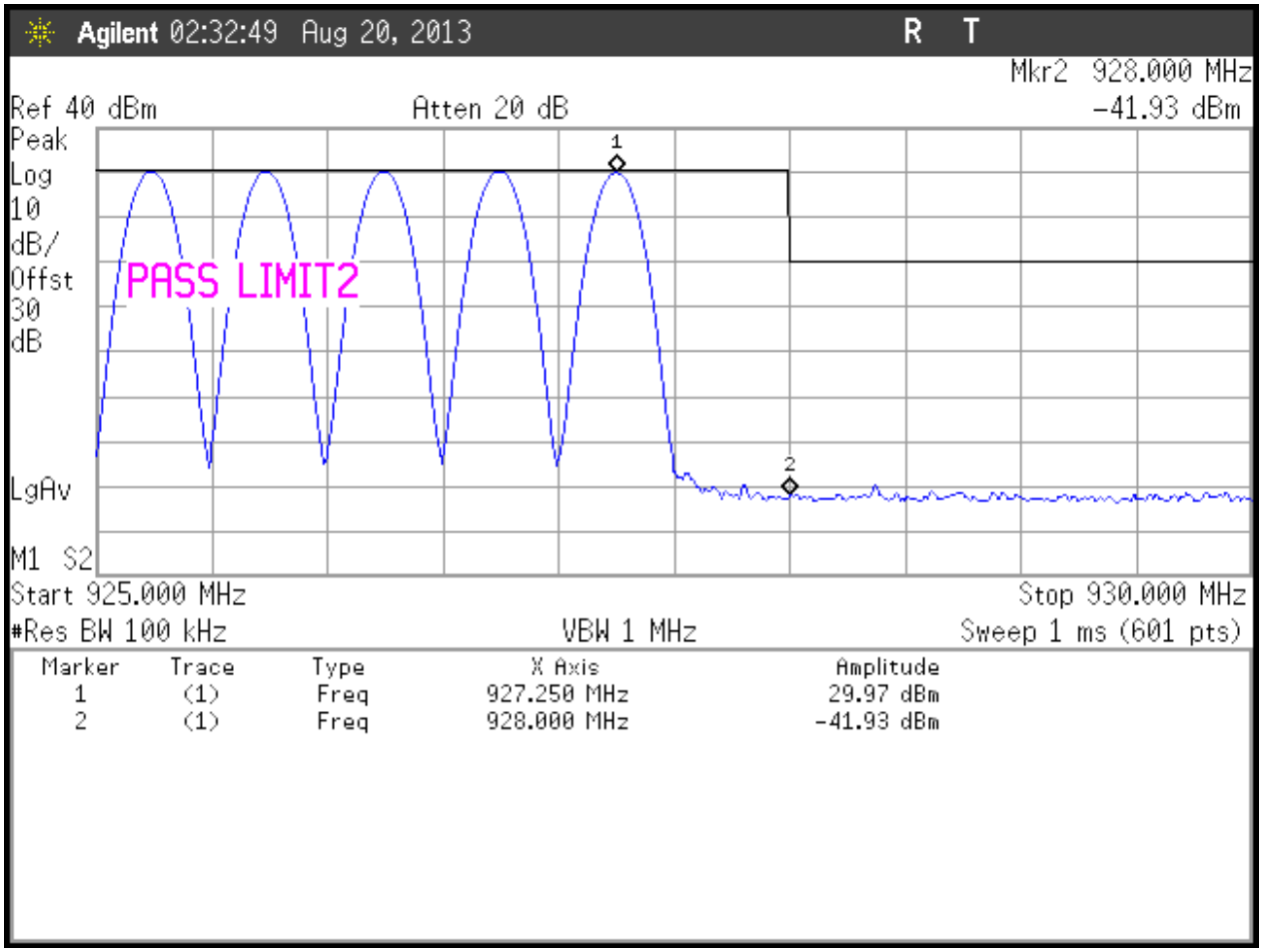

Figure 24: Band Edge Plot (Non-Hopping), High Channel TX @927.25MHz

Note : multiple channels shown above are the result of channels being turned on one at a time (in max hold) to show that no spurs occur from alternate or adjacent channels.

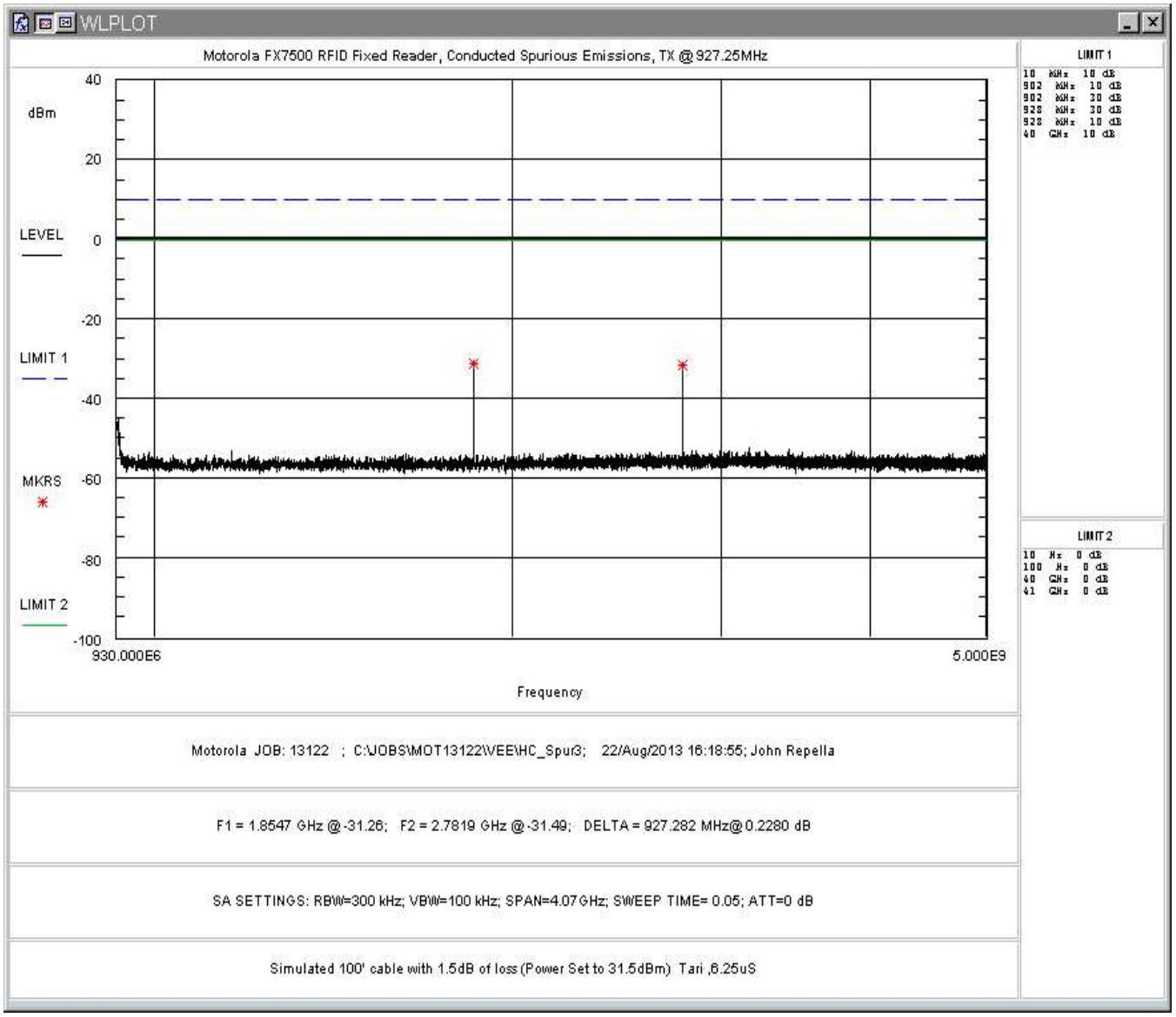

Figure 25: Conducted Spurious Emissions, High Channel 930MHz– 5GHz

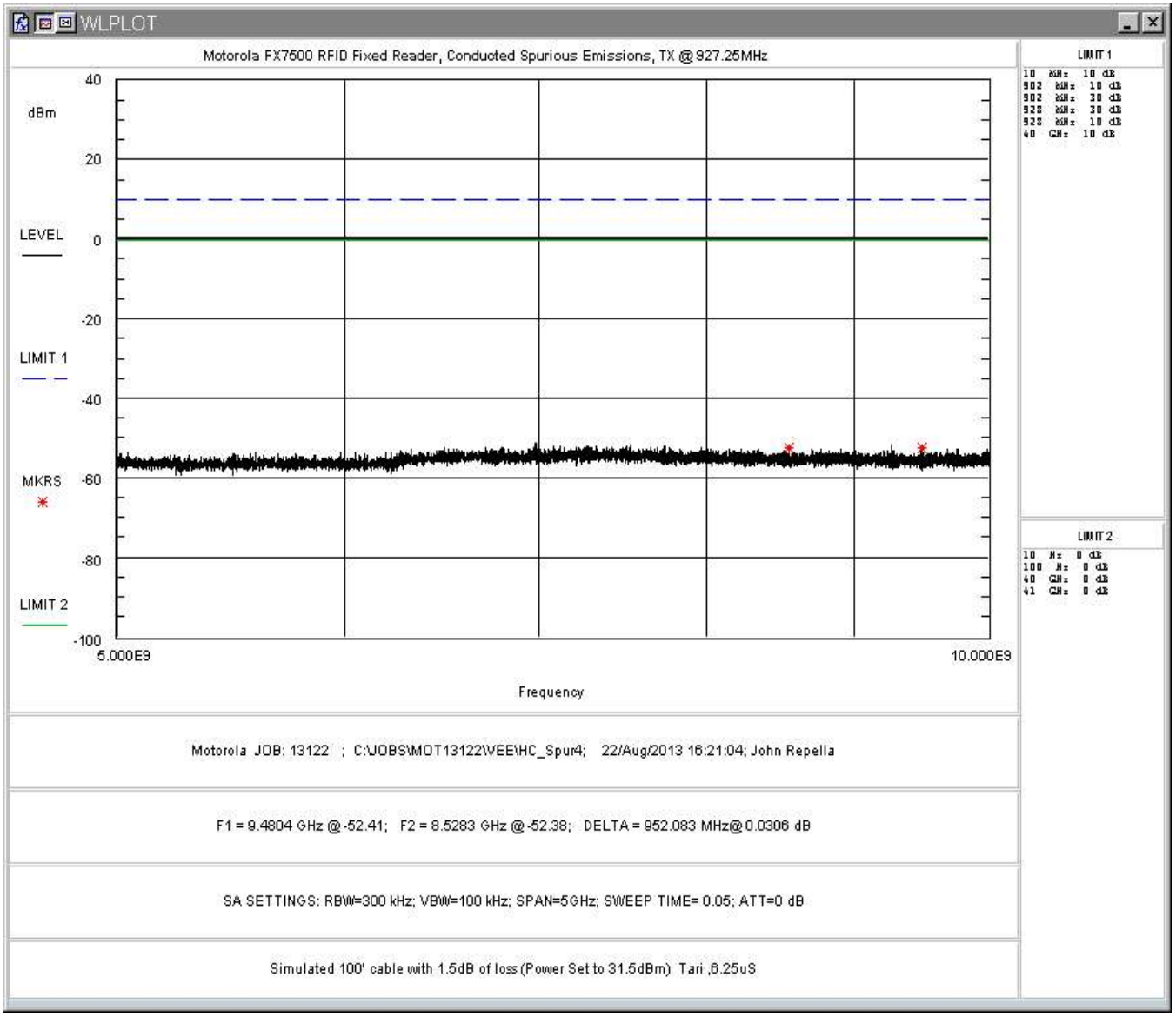

Figure 26: Conducted Spurious Emissions, High Channel 5 - 10GHz

5.6 Radiated Spurious Emissions: (FCC Part 15.205, 15.209 & RSS-210 [A8. 5])

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 §15.205, §15.209, §15.35(b) and RSS 210 Table 1 for peak measurements.

5.6.1 Test Procedure

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

The emissions were measured using the following resolution bandwidths:

Table 7: Spectrum Analyzer Settings

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

Table 8: Radiated Emission Test Data, Low Frequency Data (<1GHz)

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
34.48	V	270.00	1.00	8.70	18.4	22.6	100.0	-12.9	
42.08	V	225.00	1.00	11.90	12.9	17.4	100.0	-15.2	
49.03	V	180.00	1.00	18.70	8.8	23.8	100.0	-12.5	
70.50	V	180.00	1.00	18.70	9.2	24.7	100.0	-12.1	
71.50	V	225.00	1.00	20.40	9.2	30.3	100.0	-10.4	
73.80	V	180.00	1.00	13.70	9.2	14.0	100.0	-17.1	
76.06	V	180.00	1.00	15.50	9.2	17.2	100.0	-15.3	
124.79	V	225.00	1.00	12.30	15.5	24.5	150.0	-15.7	
250.00	V	180.00	1.00	14.90	14.1	28.2	200.0	-17.0	
300.00	V	0.00	1.50	8.20	16.3	16.8	200.0	-21.5	
325.00	V	180.00	1.50	15.00	17.2	40.6	200.0	-13.9	
350.00	V	0.00	1.50	10.00	17.7	24.3	200.0	-18.3	
375.00	V	180.00	1.50	14.90	18.7	47.7	200.0	-12.5	
400.00	V	180.00	1.50	7.30	19.2	21.1	200.0	-19.5	
450.00	V	180.00	1.50	6.80	20.8	23.9	200.0	-18.5	
250.00	V	180.00	1.00	14.90	14.1	28.2	200.0	-17.0	
300.00	V	0.00	1.50	8.20	16.3	16.8	200.0	-21.5	
325.00	V	180.00	1.50	15.00	17.2	40.6	200.0	-13.9	
350.00	V	0.00	1.50	10.00	17.7	24.3	200.0	-18.3	
375.00	V	180.00	1.50	14.90	18.7	47.7	200.0	-12.5	
400.00	V	180.00	1.50	7.30	19.2	21.1	200.0	-19.5	
450.00	V	180.00	1.50	6.80	20.8	23.9	200.0	-18.5	
499.50	V	90.00	1.90	5.10	21.9	22.3	200.0	-19.0	
624.00	V	90.00	1.51	9.30	26.4	61.2	200.0	-10.3	
649.98	V	0.00	1.00	14.30	27.1	117.5	200.0	-4.6	QP
699.99	V	0.00	1.00	10.50	27.5	79.4	200.0	-8.0	
902.00	V	0.00	1.40	11.90	28.7	107.7	200.0	-5.4	Band Edge TX @ 902.25MHz
928.00	V	0.00	1.40	12.90	28.4	115.6	200.0	-4.8	Band Edge TX @ 927.25MHz
37.52	H	90.00	3.50	6.20	16.2	13.2	100.0	-17.6	
43.76	H	180.00	3.50	5.80	11.7	7.5	100.0	-22.5	
49.03	H	180.00	3.50	15.00	8.8	15.6	100.0	-16.2	
54.19	H	180.00	3.20	11.90	7.7	9.6	100.0	-20.4	
60.45	H	135.00	3.20	18.40	8.1	21.2	100.0	-13.5	
63.47	H	135.00	3.20	25.10	8.5	47.9	100.0	-6.4	
66.77	H	135.00	3.20	18.60	8.9	23.7	100.0	-12.5	
70.85	H	135.00	3.20	19.40	9.2	26.8	100.0	-11.4	
119.01	H	270.00	3.20	14.00	15.3	29.3	150.0	-14.2	
122.78	H	270.00	3.20	13.20	15.4	26.8	150.0	-14.9	
124.79	H	270.00	2.60	15.40	15.5	35.0	150.0	-12.6	
250.00	H	180.00	2.10	21.80	14.1	62.4	200.0	-10.1	
300.00	H	180.00	2.50	9.20	16.3	18.8	200.0	-20.5	

325.00	H	180.00	2.50	7.70	17.2	17.5	200.0	-21.2	
375.00	H	45.00	2.10	8.50	18.7	22.8	200.0	-18.9	
400.00	H	45.00	2.10	5.00	19.2	16.2	200.0	-21.8	
450.00	H	90.00	2.10	6.80	20.8	23.9	200.0	-18.5	
499.50	H	135.00	1.70	6.80	21.9	27.2	200.0	-17.3	
649.99	H	270.00	1.50	15.50	27.1	134.9	200.0	-3.4	QP
902.00	H	90.00	1.00	11.20	28.7	99.4	200.0	-6.1	Band Edge TX @ 902.25MHz
928.00	H	90.00	1.00	13.50	28.4	123.9	200.0	-4.2	Band Edge TX @ 927.25MHz

Table 9: Radiated Emission Test Data, High Frequency Data (>1GHz) (Restricted Bands)

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
TX at 902.75MHz									
4513.75	V	0.00	2.20	49.60	4.3	495.3	5000.0	-20.1	P
4513.75	V	0.00	2.20	43.20	4.3	237.1	500.0	-6.5	A
8124.75	V	0.00	2.20	40.49	13.7	515.1	5000.0	-19.7	P
8124.75	V	0.00	2.20	28.87	13.7	135.2	500.0	-11.4	A
TX at 915.25MHz									
4578.75	V	0.00	2.20	48.87	4.6	472.3	5000.0	-20.5	P
4578.75	V	0.00	2.20	42.92	4.6	238.1	500.0	-6.4	A
8241.75	V	0.00	2.20	40.60	14.0	536.0	5000.0	-19.4	P
8241.75	V	0.00	2.20	29.00	14.0	141.0	500.0	-11.0	A
TX at 927.25MHz									
4636.25	V	0.00	2.20	46.65	5.0	383.1	5000.0	-22.3	P
4636.25	V	0.00	2.20	40.57	5.0	190.2	500.0	-8.4	A
8345.25	V	0.00	2.20	40.50	13.8	521.3	5000.0	-19.6	P
8345.25	V	0.00	2.20	28.82	13.8	135.8	500.0	-11.3	A
TX at 902.75MHz									
4513.75	H	0.00	2.60	49.80	4.3	506.8	5000.0	-19.9	P
4513.75	H	0.00	2.60	44.30	4.3	269.1	500.0	-5.4	A
8124.75	H	0.00	2.60	40.40	13.7	509.8	5000.0	-19.8	P
8124.75	H	0.00	2.60	28.80	13.7	134.1	500.0	-11.4	A
TX at 915.25MHz									
4576.25	H	0.00	2.60	48.80	4.6	467.9	5000.0	-20.6	P
4576.25	H	0.00	2.60	42.10	4.6	216.3	500.0	-7.3	A
8237.25	H	0.00	2.60	40.50	14.0	529.6	5000.0	-19.5	P
8237.25	H	0.00	2.60	29.00	14.0	140.9	500.0	-11.0	A
TX at 927.25MHz									
4636.25	H	0.00	2.60	46.30	5.0	367.9	5000.0	-22.7	P
4636.25	H	0.00	2.60	40.20	5.0	182.3	500.0	-8.8	A
8345.25	H	0.00	2.60	40.20	13.8	503.6	5000.0	-19.9	P
8345.25	H	0.00	2.60	28.60	13.8	132.5	500.0	-11.5	A

P= peak Measurement, A = Average Measurement

5.7 Receiver Radiated Spurious Emissions: (§15.209, RSS-Gen [7.2.3.2] & RSS-210 sect 2.6)

The EUT must comply with the requirements for radiated spurious emissions from the receiver. These emissions must meet the limits specified in §15.209 and RSS-Gen.

5.7.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The emissions were measured using the following resolution bandwidths:

The Unit was tested with the RS232 and USB cable options.

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

5.7.2 Test Summary

The EUT complied with the requirements for receiver radiated emissions FCC 15.209 and IC RSS-Gen. Receiver Radiated Spurious Test Data.

Table 10: 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
34.48	V	270.00	1.00	0.00	18.4	8.3	100.0	-21.6	
42.08	V	225.00	1.00	3.40	12.9	6.6	100.0	-23.7	
49.03	V	180.00	1.00	6.50	8.8	5.8	100.0	-24.7	
54.19	V	180.00	1.00	11.80	7.7	9.5	100.0	-20.5	
70.50	V	180.00	1.00	18.70	9.2	24.7	100.0	-12.1	
71.50	V	225.00	1.00	20.40	9.2	30.3	100.0	-10.4	
73.80	V	180.00	1.00	13.70	9.2	14.0	100.0	-17.1	
76.06	V	180.00	1.00	15.50	9.2	17.2	100.0	-15.3	
124.79	V	225.00	1.00	12.30	15.5	24.5	150.0	-15.7	
250.00	V	180.00	1.00	14.90	14.1	28.2	200.0	-17.0	
300.00	V	0.00	1.50	5.30	16.3	12.0	200.0	-24.4	
374.42	V	0.00	1.50	10.90	18.7	30.1	200.0	-16.5	
375.00	V	180.00	1.50	9.10	18.7	24.5	200.0	-18.3	
400.00	V	180.00	1.50	7.30	19.2	21.1	200.0	-19.5	
450.00	V	180.00	1.50	6.80	20.8	23.9	200.0	-18.5	
250.00	V	180.00	1.00	14.90	14.1	28.2	200.0	-17.0	
300.00	V	0.00	1.50	5.30	16.3	12.0	200.0	-24.4	
374.42	V	0.00	1.50	10.90	18.7	30.1	200.0	-16.5	
375.00	V	180.00	1.50	9.10	18.7	24.5	200.0	-18.3	
400.00	V	180.00	1.50	7.30	19.2	21.1	200.0	-19.5	
450.00	V	180.00	1.50	6.80	20.8	23.9	200.0	-18.5	
499.50	V	90.00	1.90	5.10	21.9	22.3	200.0	-19.0	
37.52	H	90.00	3.50	6.20	16.2	13.2	100.0	-17.6	
43.76	H	180.00	3.50	5.80	11.7	7.5	100.0	-22.5	
49.03	H	180.00	3.50	15.00	8.8	15.6	100.0	-16.2	
54.19	H	180.00	3.20	11.90	7.7	9.6	100.0	-20.4	
60.45	H	135.00	3.20	17.40	8.1	18.9	100.0	-14.5	
63.47	H	135.00	3.20	23.10	8.5	38.0	100.0	-8.4	
66.77	H	135.00	3.20	18.60	8.9	23.7	100.0	-12.5	
70.85	H	135.00	3.20	19.40	9.2	26.8	100.0	-11.4	
119.01	H	270.00	3.20	14.00	15.3	29.3	150.0	-14.2	
122.78	H	270.00	3.20	13.20	15.4	26.8	150.0	-14.9	
124.79	H	270.00	2.60	15.40	15.5	35.0	150.0	-12.6	
250.00	H	180.00	2.10	21.80	14.1	62.4	200.0	-10.1	
300.00	H	180.00	2.50	9.20	16.3	18.8	200.0	-20.5	
325.00	H	180.00	2.50	7.70	17.2	17.5	200.0	-21.2	
375.00	H	45.00	2.10	8.50	18.7	22.8	200.0	-18.9	
400.00	H	45.00	2.10	5.00	19.2	16.2	200.0	-21.8	
450.00	H	90.00	2.10	6.80	20.8	23.9	200.0	-18.5	
499.50	H	135.00	1.70	6.80	21.9	27.2	200.0	-17.3	

5.8 AC Conducted Emissions (FCC Pt.15.207, RSS-Gen [7.2.2])

5.8.1 Requirements

Test Arrangement: Table Top

Compliance Standard: FCC Class B

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

5.8.2 Test Procedure

The EUT was placed on an 80 cm high 1 X 1.5 m non-conductive table above a ground plane. Power to the EUT was provided through a Solar Corporation 50 Ω/50 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

5.8.3 Test Data

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

Table 11: Conducted Emissions Test Data

NEUTRAL

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.233	26.8	16.8	10.2	0.2	37.2	27.2	62.3	52.3	-25.1	-25.1
0.354	25.5	15.4	10.2	0.2	35.9	25.8	58.9	48.9	-23.0	-23.1
1.670	19.7	2.9	10.2	0.3	30.2	13.4	56.0	46.0	-25.8	-32.6
10.930	15.0	7.6	11.2	0.3	26.4	19.0	60.0	50.0	-33.6	-31.0
17.460	19.5	9.7	11.4	0.8	31.8	22.0	60.0	50.0	-28.2	-28.0
19.050	19.7	8.7	11.5	0.9	32.1	21.1	60.0	50.0	-27.9	-28.9

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)
0.232	29.1	16.1	10.2	0.1	39.3	26.3	62.4	52.4	-23.0	-26.0
0.354	26.5	15.6	10.2	0.3	37.0	26.1	58.9	48.9	-21.9	-22.8
1.670	22.0	4.7	10.2	0.3	32.5	15.2	56.0	46.0	-23.5	-30.8
10.930	19.3	6.5	11.2	0.3	30.7	17.9	60.0	50.0	-29.3	-32.1
17.460	23.1	10.2	11.4	0.5	35.1	22.2	60.0	50.0	-24.9	-27.8
19.050	17.8	7.7	11.5	0.6	29.9	19.8	60.0	50.0	-30.1	-30.2

POE Injector

NEUTRAL

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.202	38.2	23.6	10.2	0.0	48.4	33.8	63.5	53.5	-15.1	-19.7
1.813	41.1	30.9	10.2	0.3	51.5	41.4	56.0	46.0	-4.5	-4.6
2.385	39.5	31.6	10.1	0.3	49.9	42.0	56.0	46.0	-6.1	-4.0
3.056	35.2	27.4	10.3	0.3	45.8	38.0	56.0	46.0	-10.2	-8.0
15.007	36.5	30.5	11.3	0.4	48.3	42.3	60.0	50.0	-11.7	-7.7
17.693	35.9	31.0	11.4	0.5	47.9	43.0	60.0	50.0	-12.1	-7.0

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)
0.202	39.5	23.8	10.2	0.2	49.9	34.2	63.5	53.5	-13.7	-19.4
1.813	41.5	31.8	10.2	0.3	52.0	42.3	56.0	46.0	-4.0	-3.7
2.385	40.2	31.3	10.1	0.3	50.6	41.7	56.0	46.0	-5.4	-4.3
3.056	35.2	27.9	10.3	0.3	45.8	38.5	56.0	46.0	-10.2	-7.5
15.007	34.6	29.9	11.3	0.6	46.6	41.9	60.0	50.0	-13.4	-8.1
17.693	35.8	30.9	11.4	0.8	48.1	43.2	60.0	50.0	-11.9	-6.8