FCC & Industry Canada Certification Test Report
For the
Eka Systems Inc.
SiP radio module

P9X-900SIP
6766A-900SIP

WLL JOB# EKA**11322 Rev. 2**
April 30, 2010

Re-issued June 1, 2010

Prepared for:

Eka Systems Inc.
20201 Century Blvd. Suite 250
Germantown, MD 20874

Prepared By:

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

ACCREDITED

Testing Certificate 2675.01

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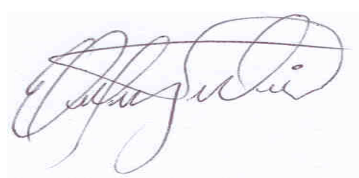

Elmer Rodriguez
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Reviewed by:

Steven D. Koster
EMC Operations Manager

Abstract

This report has been prepared on behalf of Eka Systems Inc. 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 (7/2008) of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy RSS-210 of Industry Canada. This Certification Test Report documents the test configuration and test results for the Eka Systems Inc. SiP 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 the American Association for Laboratory Accreditation (A2LA) under Certificate 2675.01 as an independent FCC test laboratory.

The Eka Systems Inc. SiP radio module complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under FCC Part 15.247 and Industry Canada RSS-210.

Revision History	Description of Change	Date
Rev 0	Initial Release	April 30, 2010
Rev 1	Added TX/RX spurious info etc. to table	May 25, 2010
Rev 2	Completed edits to address TCB comments. Incorrect reference to DTS system, erroneous statement of max output power.	June 1, 2010

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1 Introduction

1.1 Compliance Statement

The Eka Systems Inc. SiP radio module complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under FCC Part 15.247 (7/2008) and Industry Canada RSS-210. This device was tested as a limited module approval. This module was tested with three different types of antennas.

1.2 Test Scope

Tests for radiated and conducted (at antenna terminal) emissions were performed. All measurements were performed in accordance with FCC Public Notice DA-00-705 “Measurement Guidance for Frequency Hopping Spread Spectrum Systems. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Eka Systems Inc. 20201 Century Blvd. Suite 250 Germantown, MD 20874
Purchase Order Number:	31209
Quotation Number:	65330A

1.4 Test Dates

Testing was performed on the following date(s):

1.5 Test and Support Personnel

Washington Laboratories, LTD	Elmer Rodriguez; James Ritter
Client Representative	Steve Seymour

1.6 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 Eka Systems Inc. SiP radio module is a 900SiP radio module that provides a 915MHz radio interface for Eka's wireless products.

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	Eka Systems Inc.
FCC ID:	P9X-900SiP
IC:	6766A-900SiP
Model:	SiP radio module
FCC Rule Parts:	§15.247 (Limited Module)
Industry Canada:	RSS210
Frequency Range:	902MHz – 928MHz
Maximum Output Power:	27.4dBm (0.5546 Watts)
Modulation:	FSK
Occupied Bandwidth:	473.1kHz
Keying:	Automatic, Manual
Type of Information:	Data
Number of Channels:	50
Power Output Level	Fixed
Antenna Connector	N-type Female, 06:RA MMCX
Antenna Type	TRA9023NP - Antenex Phantom 902-928MHz – 3dB Gain GH908U-PRO 900MHz Omnidirectional – 8dBi Gain UGM WPIANTFR4AR120003 902-928MHz – 2.8dBi Gain
Interface Cables:	Serial
Power Source & Voltage:	3.5VDC (3.3VDC to SiP module)
Tx Spurious	1212.2 μV/m @ 3 meters
Rx Spurious	198.4 μV/m @ 3 meters
Emissions designator	473KFXD

2.2 Test Configuration

The SiP radio module was configured to transmit using the operating software – 76.8kb/s and 153.6kb/s

2.3 Testing Algorithm

The SiP radio module was programmed to transmit frequencies using the operating software – 76.8kb/s and 153.6kb/s.

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 the American Association for Laboratory Accreditation (A2LA) under Certificate 2675.01 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

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

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

Radiated Emissions

WLL Asset #	Manufacturer Model/Type	Function	Cal. Due
00618	HP - 8563A	ANALYZER SPECTRUM	6/1/2010
00066	HP - 8449B	PRE-AMPLIFIER RF. 1-26.5GHZ	7/21/2010
00337	WLL - 1.2-5GHZ	FILTER BAND PASS	3/24/2012
00066	HP - 8449B	PRE-AMPLIFIER RF. 1-26.5GHZ	7/21/2010
00626	ARA - DRG-118/A	ANTENNA HORN	6/3/2011
00644	SUNOL SCIENCES CORPORATION - JB1 925-833-9936	BICONALOG ANTENNA	12/29/2010
00069	HP - 85650A	ADAPTER QP	6/28/2010
00071	HP - 85685A	PRESELECTOR RF	6/28/2010
00073	HP - 8568B	ANALYZER SPECTRUM	6/28/2010

Bench Conducted

WLL Asset #	Manufacturer Model/Type	Function	Cal. Due
00618	HP - 8563A	ANALYZER SPECTRUM	6/1/2010

4 Test Results

The Table Below shows the results of testing for compliance with a Frequency Hopping Spread Spectrum System in accordance with FCC part 15.247: 2007 and RSS210e issue 7.

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)		20dB Bandwidth	Pass
	RSS-210 [A8. 1 (c)]	99% Occupied 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]	Out-of-Band Emissions (Band Edge @ 20dB below)	Pass
15.205 15.209	RSS-210 [A8. 5]	General Field Strength Limits (Restricted Bands & RE Limits)	Pass
15.207	RSS-Gen [7.2.2]	AC Conducted Emissions	N/A
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	N/A
15.209	RSS-Gen [7.2.3.2]	General Field Strength Limits	Pass

4.1 Duty Cycle Correction

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)

The following figure shows the plot of the dwell time for the transmitter. Based on this plot, the dwell time per hop is 19ms. There are 50 channels; the total dwell time per 100ms is 38ms. This corresponds to a duty cycle correction of 8.4dB; however, the maximum allowed duty cycle correction is 20dB.

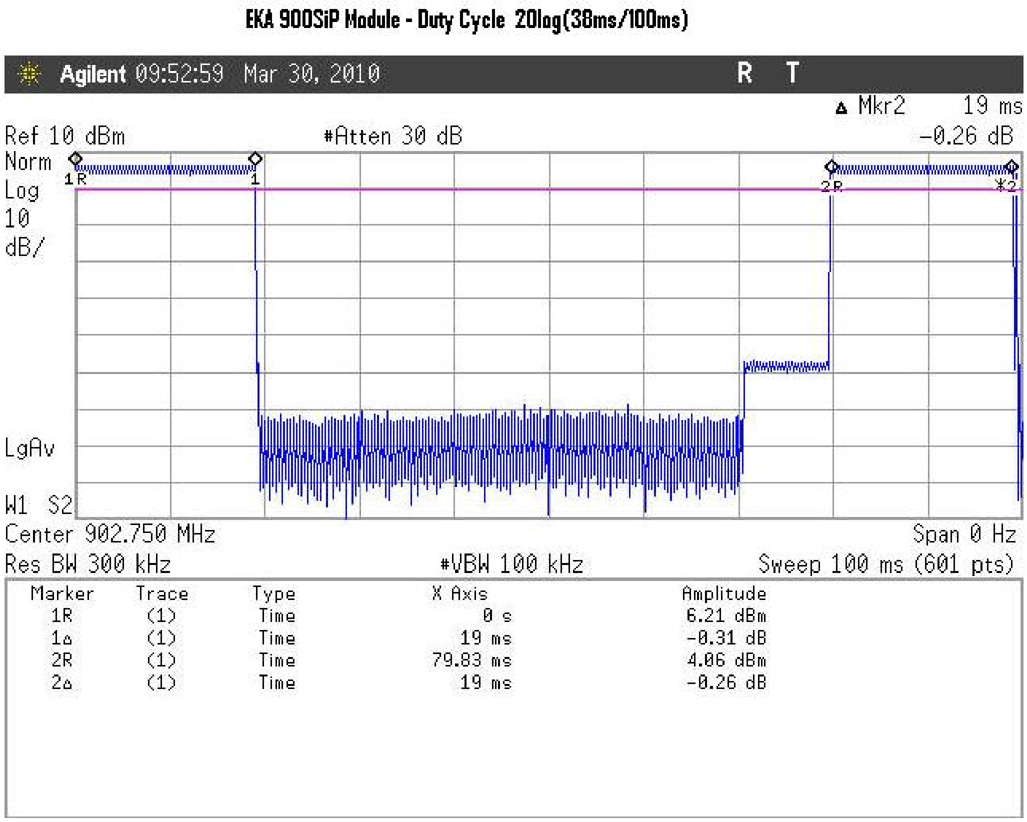

Figure 1: Duty Cycle Plot

4.2 RF Power Output: (FCC Part §2.1046) & RSS-210[A8.4(1)]

To measure the output power the hopping sequence was stopped while the frequency dwelled on a low, high and middle channel. The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system.

Table 5: RF High Power Output

Frequency	Level	Limit	Pass/Fail
Low Channel: 902.75MHz	27.44 dBm	30 dBm	Pass
Mid Channel: 914.75MHz	27.11 dBm	30 dBm	Pass
High Channel: 927.25MHz	26.27 dBm	30 dBm	Pass

Table 6: RF Low Power Output

Frequency	Level	Limit	Pass/Fail
Low Channel: 902.75MHz	-20.65 dBm	30 dBm	Pass
Mid Channel: 914.75MHz	-21.15 dBm	30 dBm	Pass
High Channel: 927.25MHz	-21.48 dBm	30 dBm	Pass

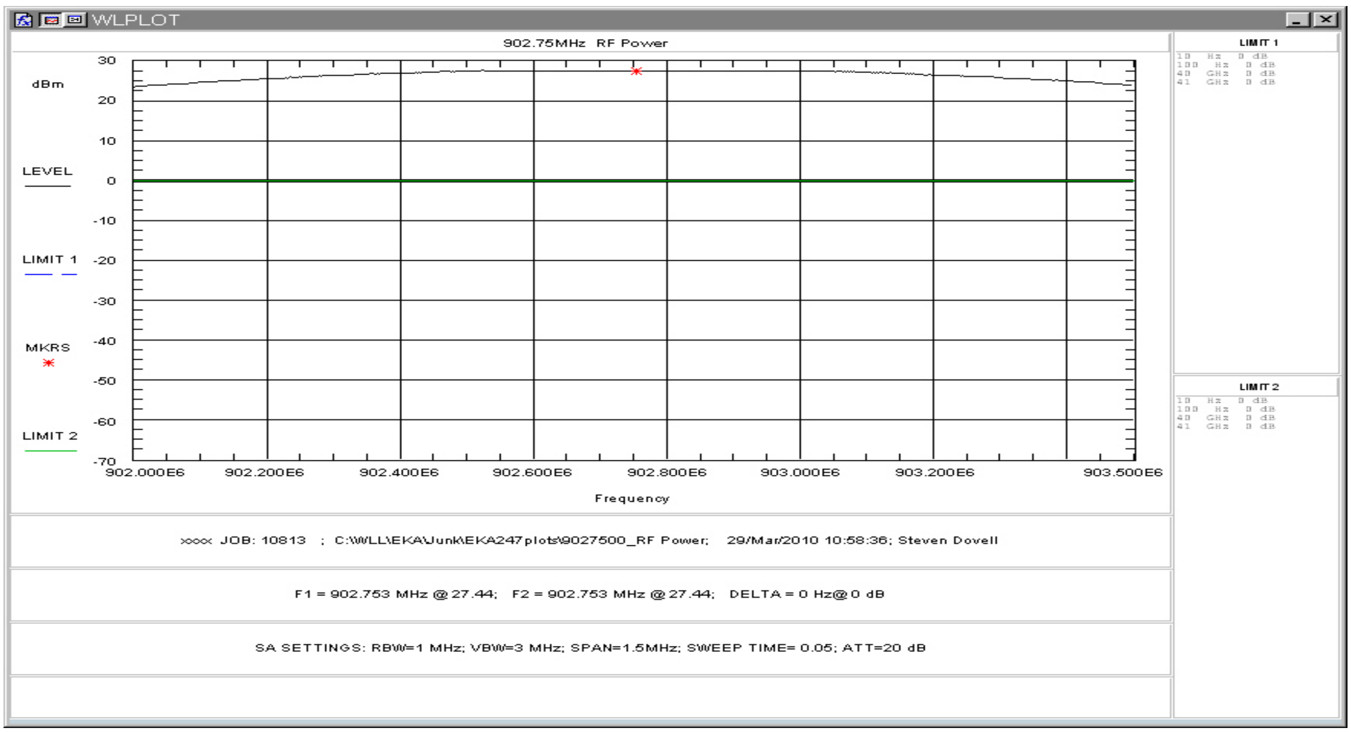

Figure 2: RF Peak High Power, Low Channel

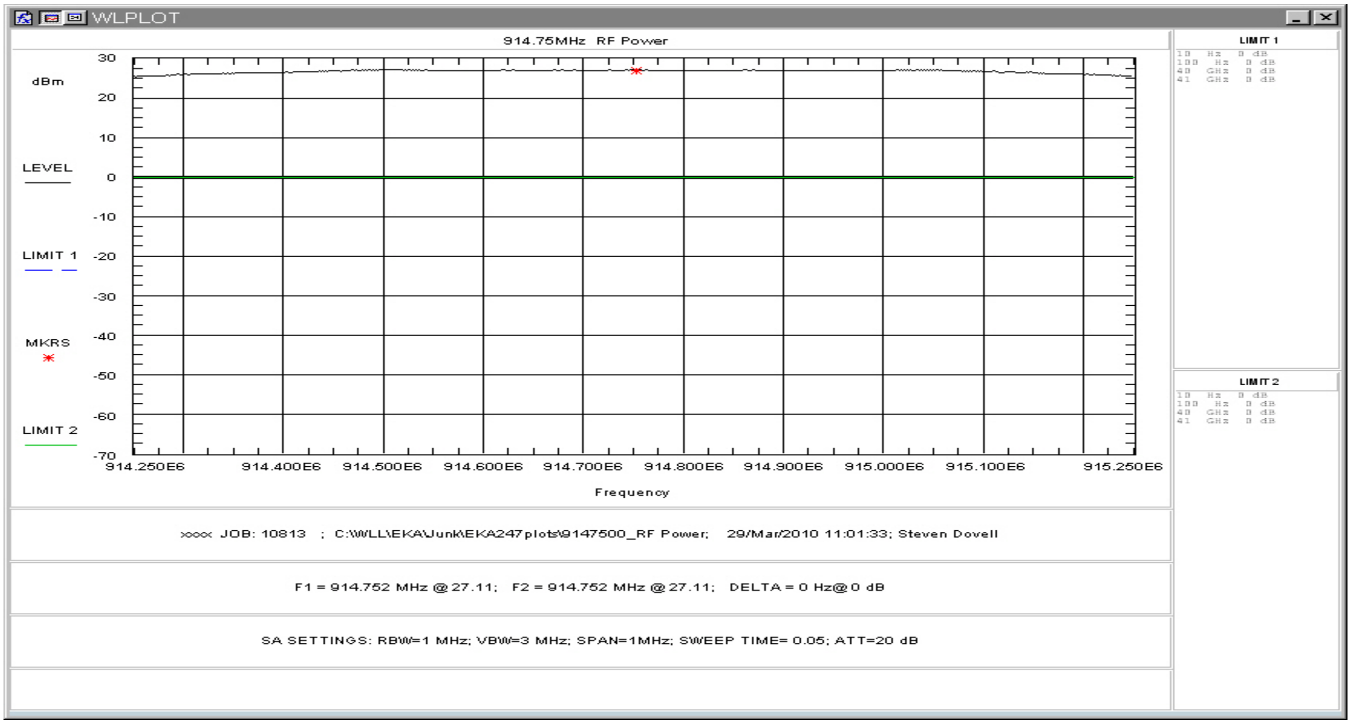

Figure 3: RF Peak High Power, Mid Channel

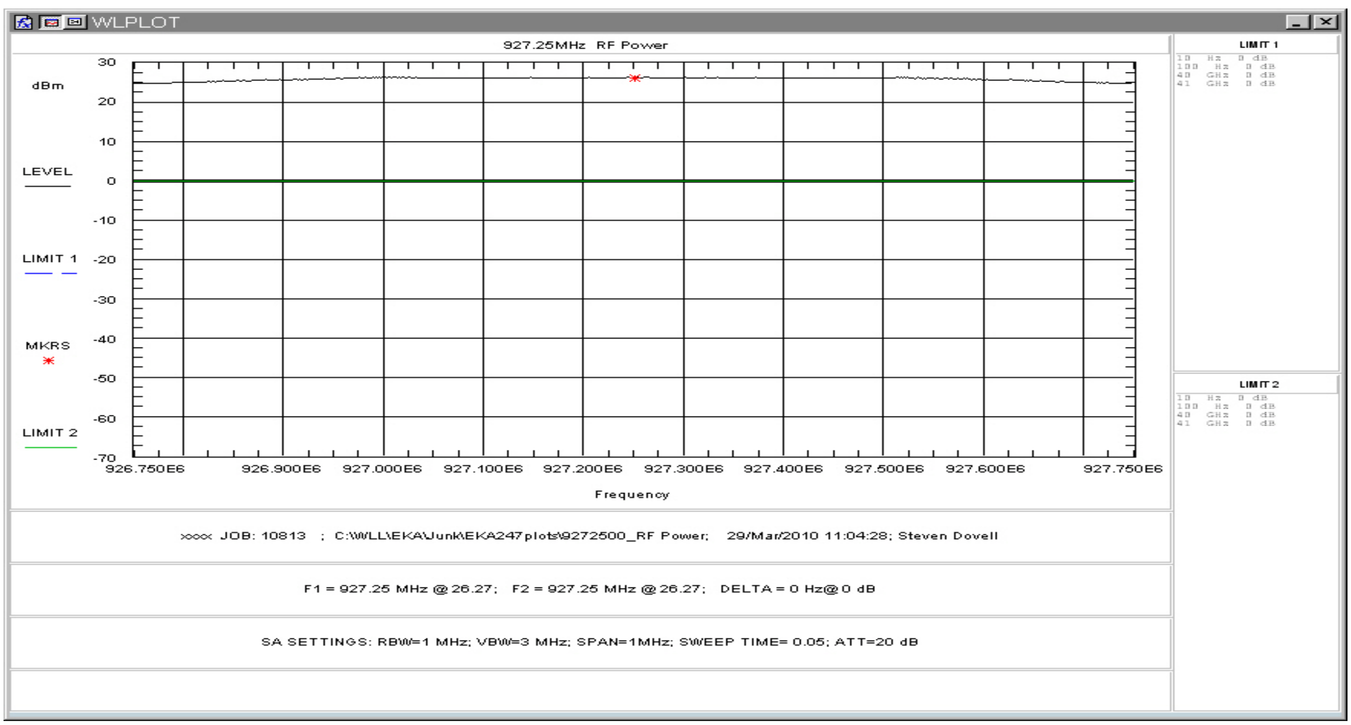

Figure 4: RF Peak High Power, High Channel

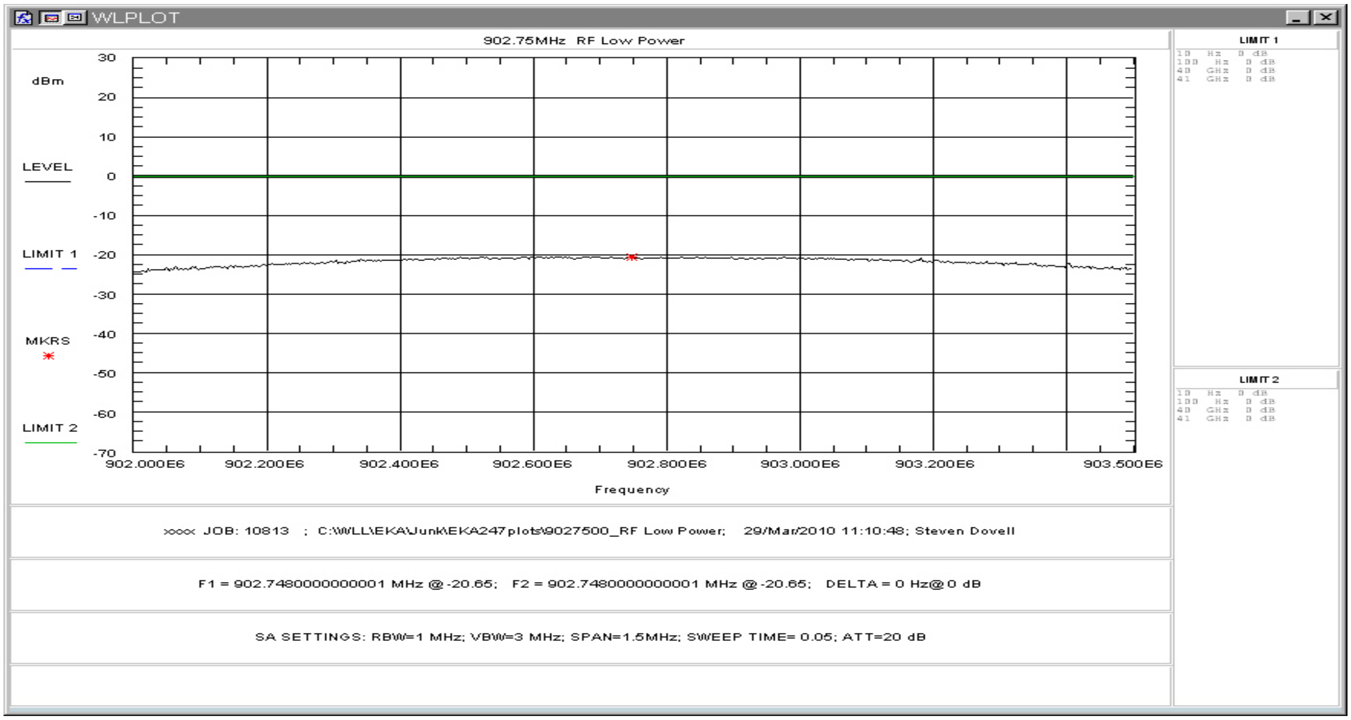

Figure 5: RF Peak Low Power, Low Channel

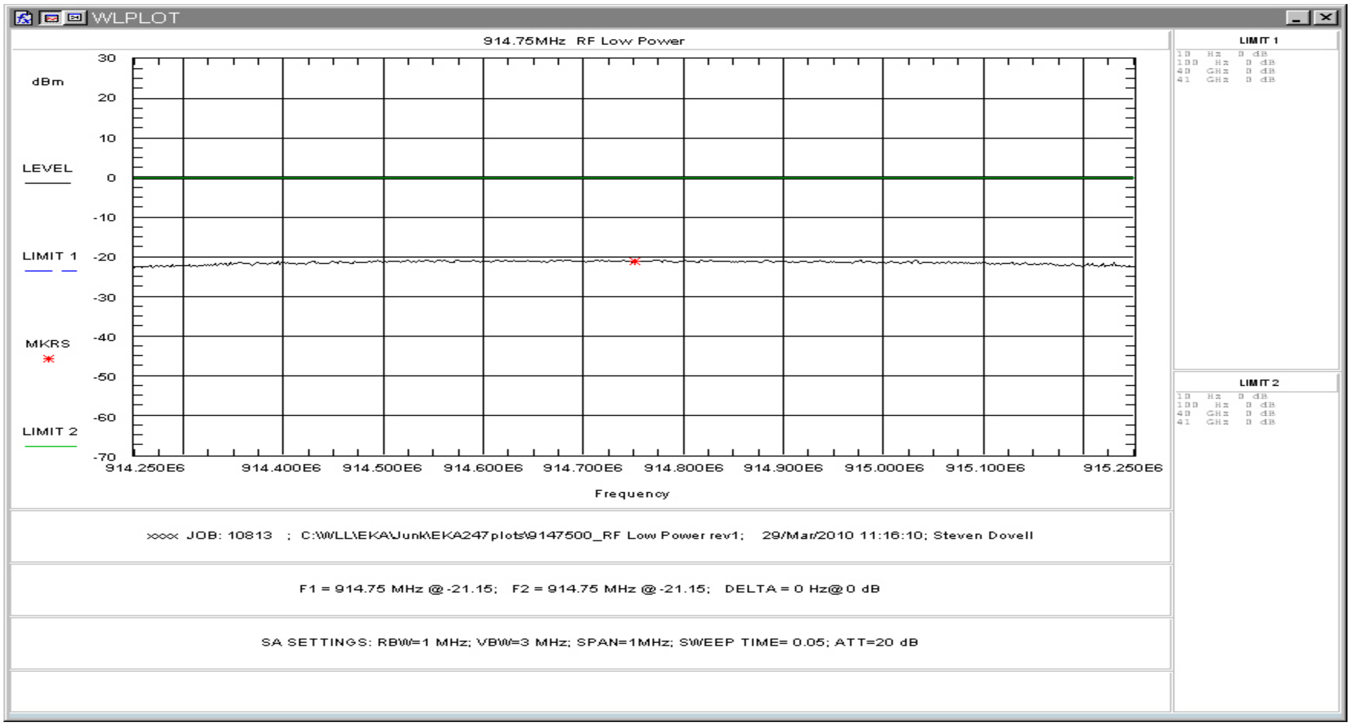

Figure 6: RF Peak Low Power, Mid Channel

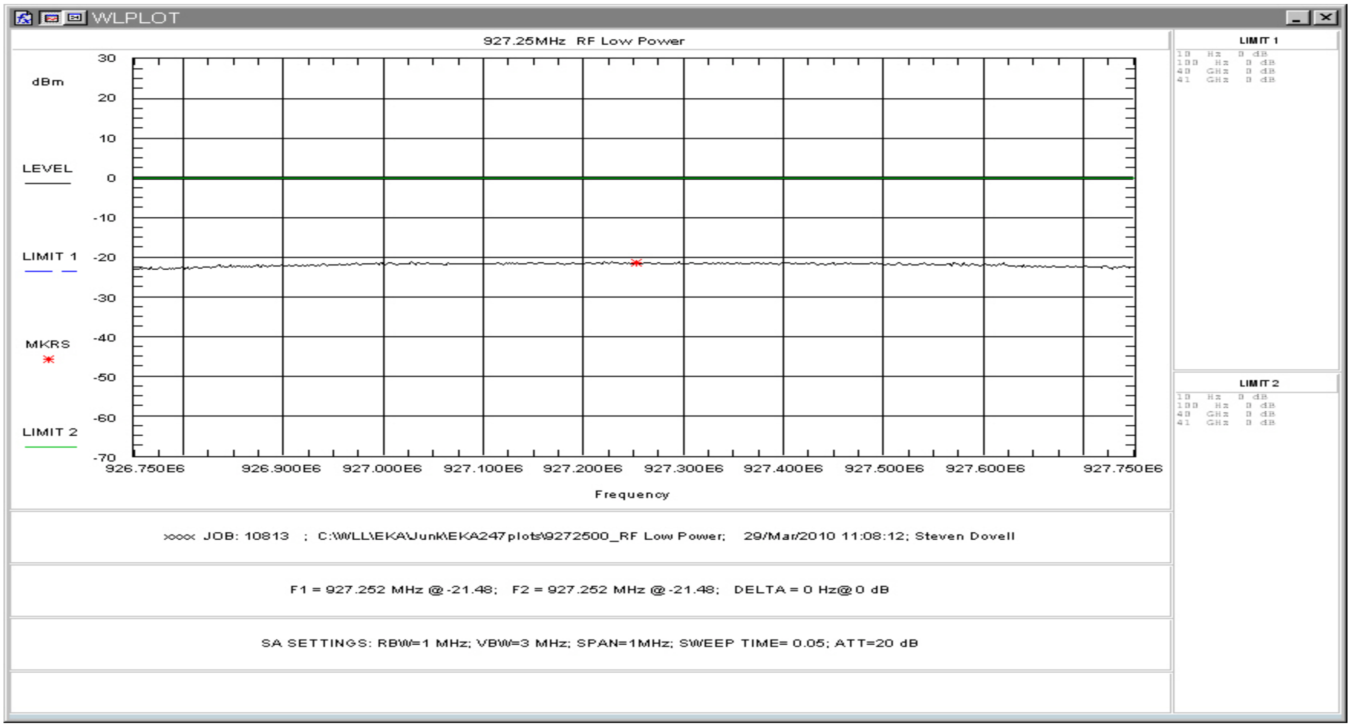

Figure 7: RF Peak Low Power, High Channel

4.3 99% Occupied Bandwidth: (For Industry Canada – Certification Filing)

The 99% Occupied Bandwidth Measurement was performed by coupling the output of the EUT to the input of a spectrum analyzer using the following procedure:

The spectrum analyzer was set to a resolution and video bandwidth far greater than the emission bandwidth and the peak of the signal was set to the top line of the analyzer using a sampling detector.

The analyzer resolution bandwidth was then reduced to between 1 and 3 % of the approximate emission bandwidth with the video bandwidth set to approximately 3 times the resolution bandwidth.

The marker was then placed on the trace at the point left of center that displays a value that is 20 dB below the value of the reference level. The delta marker is evoked and placed at the point to the right of center that displays 0 dB differential. The frequency differential is the occupied bandwidth. This result was used as part of the emission designator calculation.

Table 7: 99% Occupied Bandwidth Results

Frequency	Bandwidth (kHz)
Low Channel: 902.5MHz	469.6
Center Channel: 915MHz	470.7
High Channel: 927MHz	473.1

Figure 8: 99% Occupied Bandwidth, Low Channel

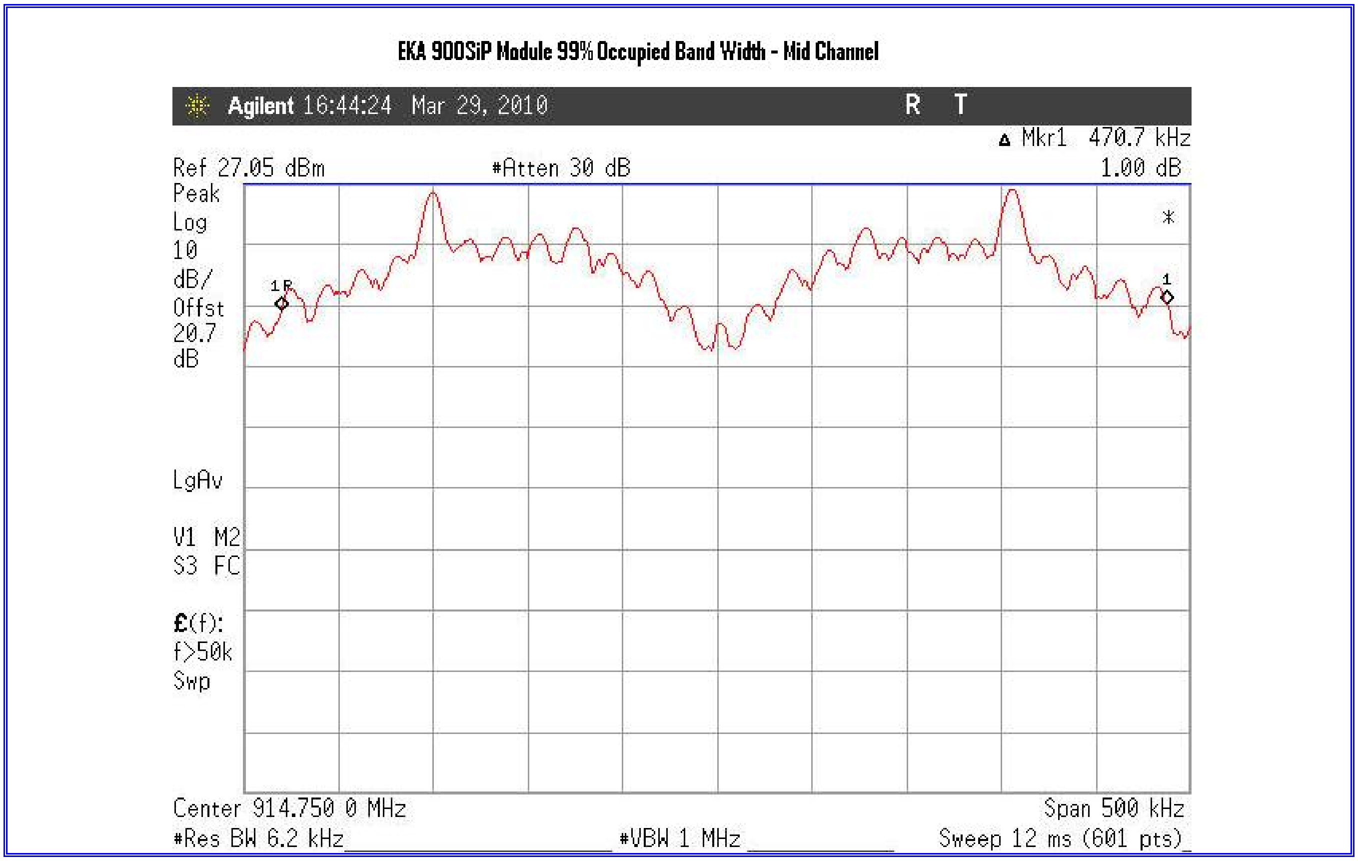

Figure 9: 99% Occupied Bandwidth, Mid Channel

Figure 10: 99% Occupied Bandwidth, High Channel

4.4 20dB Emission Bandwidth: (FCC Part §2.1049)

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

For Frequency Hopping Spread Spectrum Systems, FCC Part 15.247 requires the maximum 20 dB bandwidth not exceed 1MHz.

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

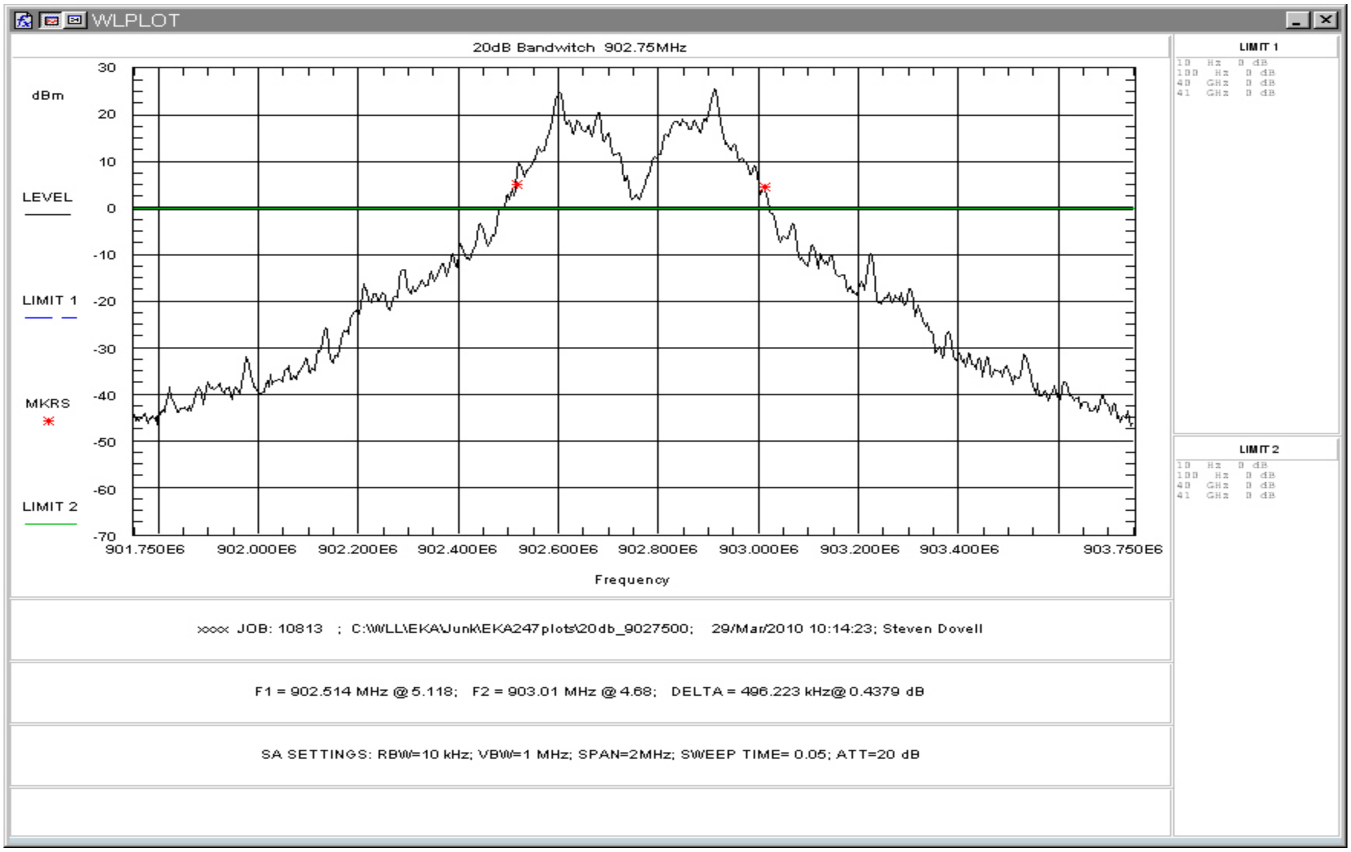

Figure 11: 20dB Bandwidth, Low Channel

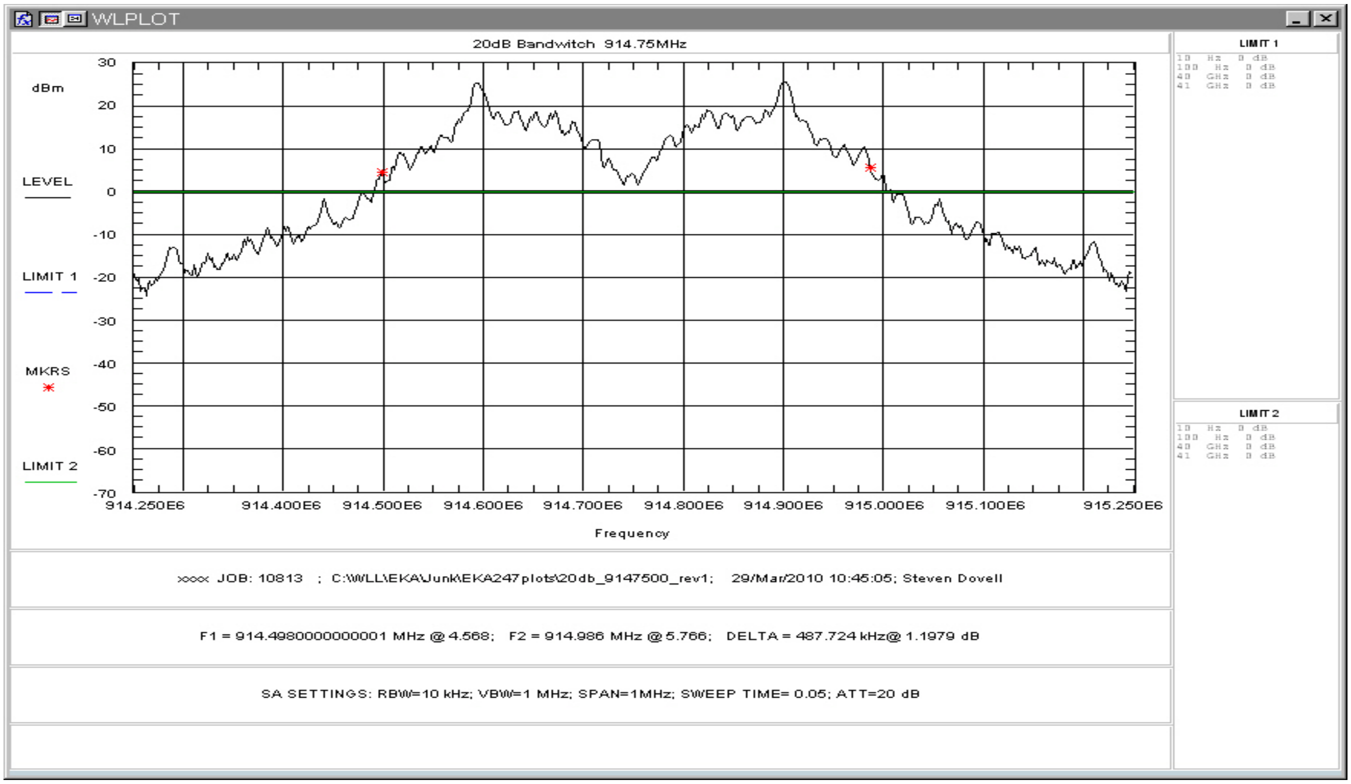

Figure 12: 20dB Bandwidth, Mid Channel

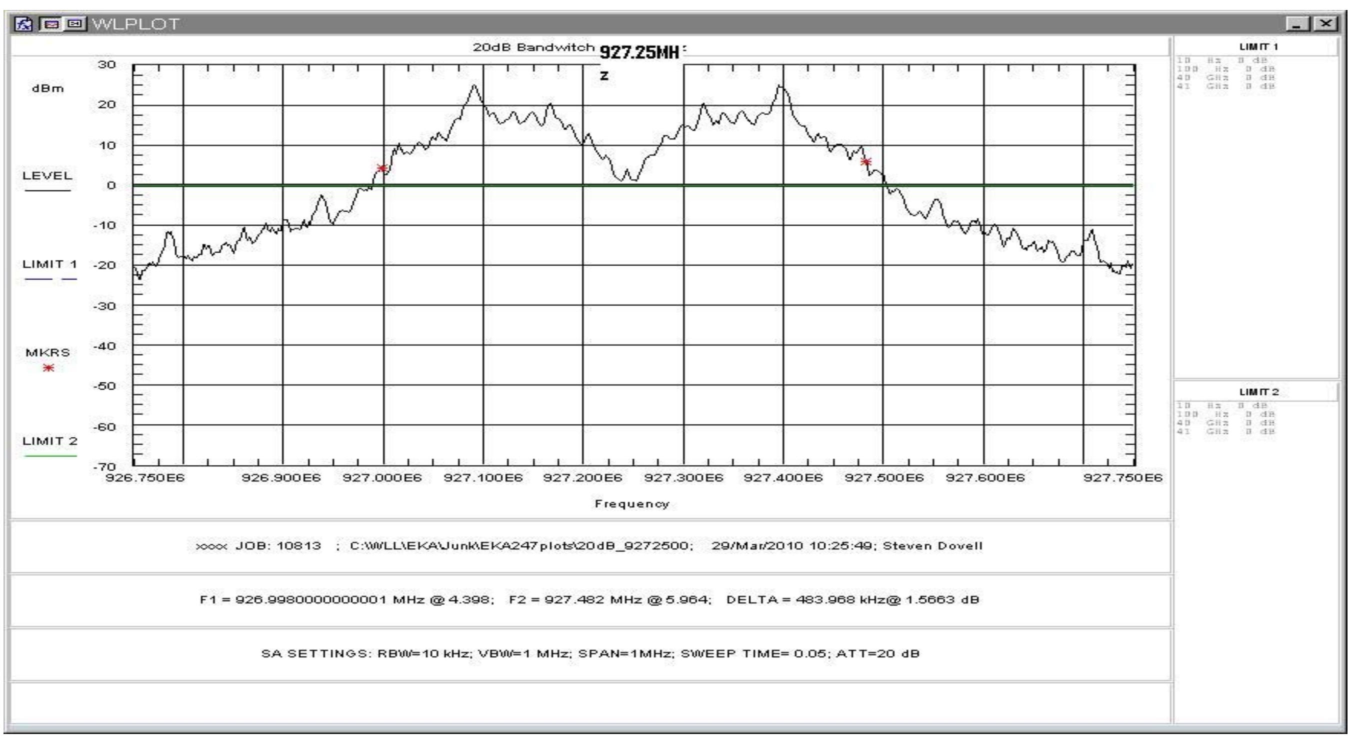

Figure 13: 20dB Bandwidth, High Channel

Table 8 provides a summary of the Occupied Bandwidth Results.

Table 8: Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Low Channel: 902.75MHz	496.233kHz	500kHz	Pass
Mid Channel: 914.75MHz	487.723kHz	500kHz	Pass
High Channel: 927.25MHz	483.968kHz	500kHz	Pass

4.5 Channel Spacing and Number of Hop Channels (FCC Part §15247(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 25kHz or the 20 dB bandwidth, whichever is greater. The maximum 20dB bandwidth measured is 496.233kHz so the channel spacing must be more than 496.233kHz

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 30 kHz and the video bandwidth was set to 1MHz. The channel spacing of 2 adjacent channels was measured using a spectrum analyzer span setting of 1MHz. Also, the number of hopping channels was measured from 902MHz to 928MHz.

The following are plots of the channel spacing and number of hopping channels data. The channel spacing was measured to be 503.33kHz and the number of channels used is 50.

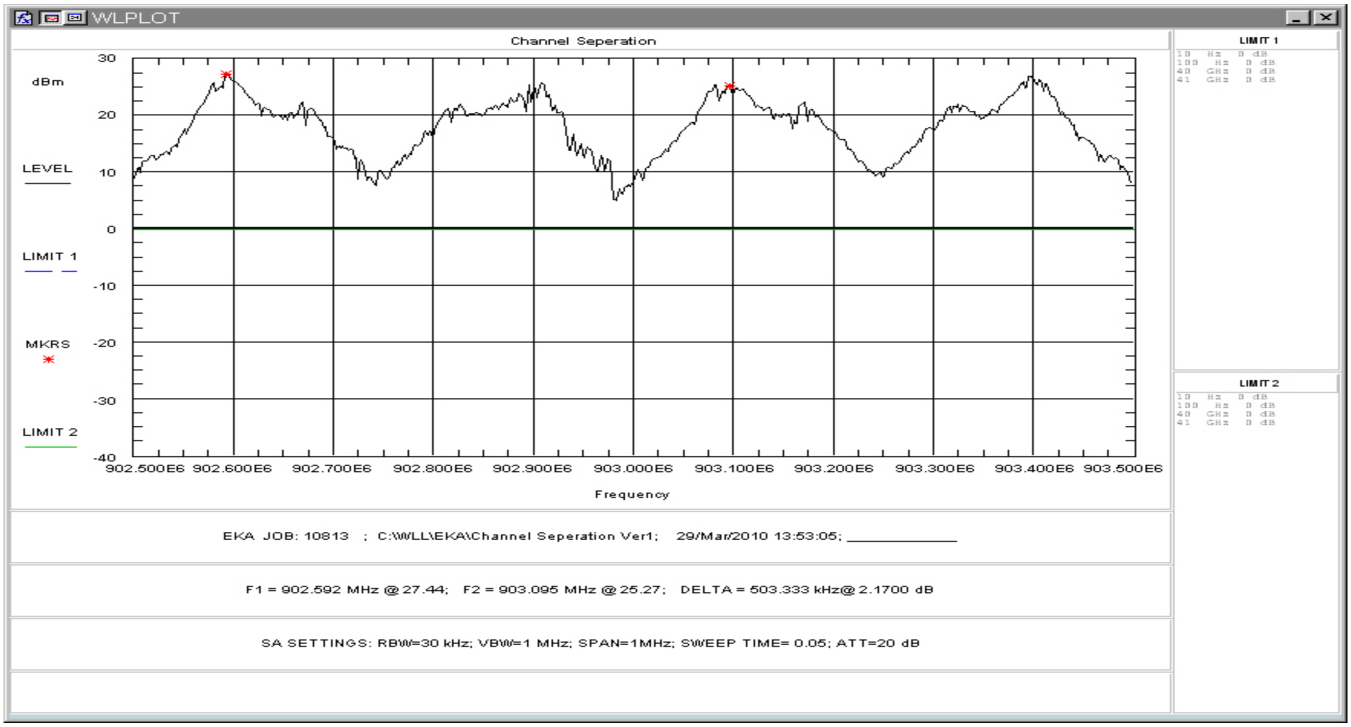

Figure 14: Channel Spacing

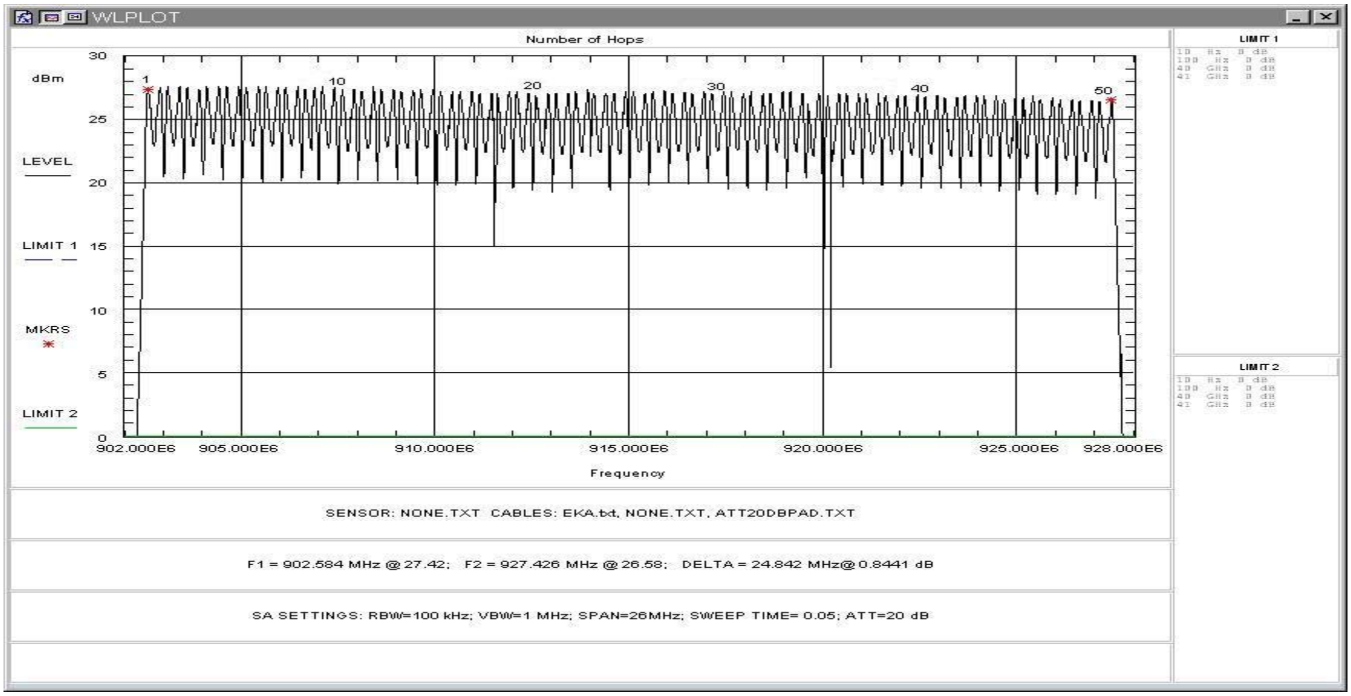

Figure 15: Number of Channels

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

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

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 1 MHz. The amplitude of the EUT carrier frequency was measured to determine the emissions limit (20 dB below the carrier frequency amplitude). The emissions outside of the allocated frequency band were then scanned from 30 MHz up to the tenth harmonic of the carrier.

The following are plots of the conducted spurious emissions data.

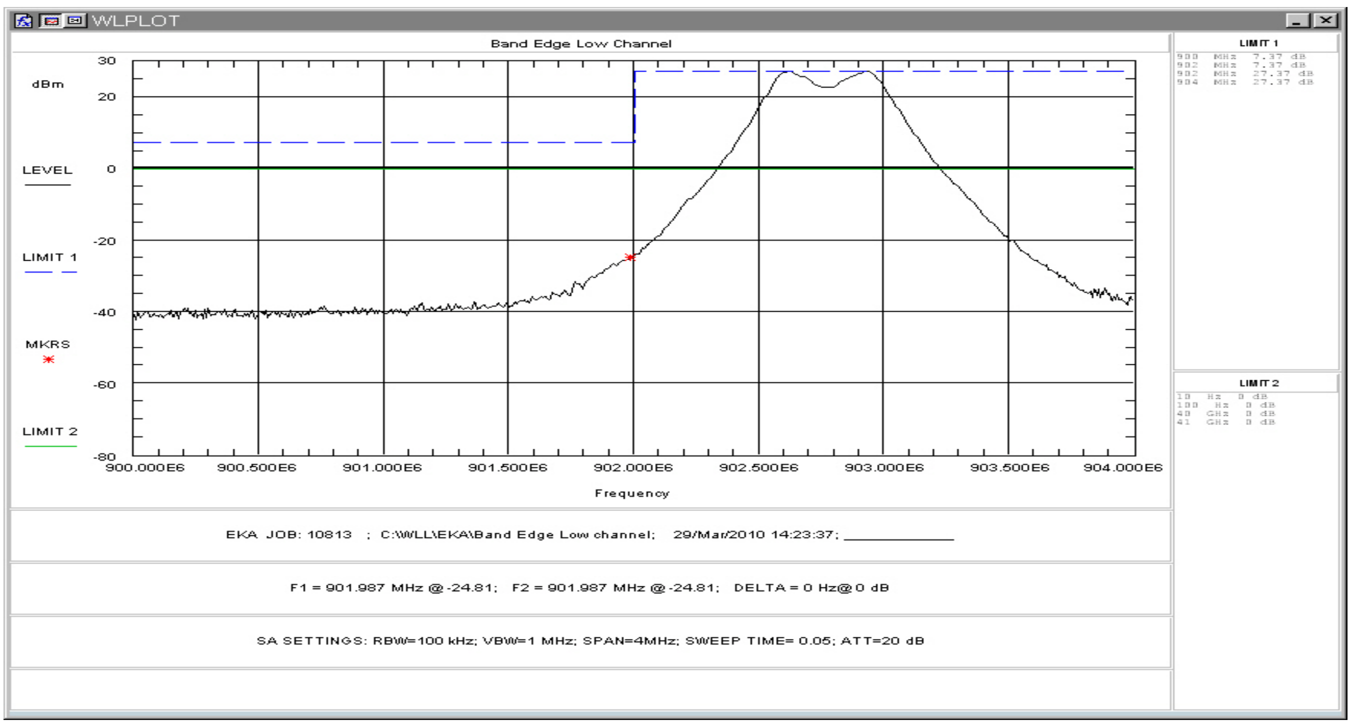

Figure 16: Conducted Spurious Emissions, Band Edge, Low channel

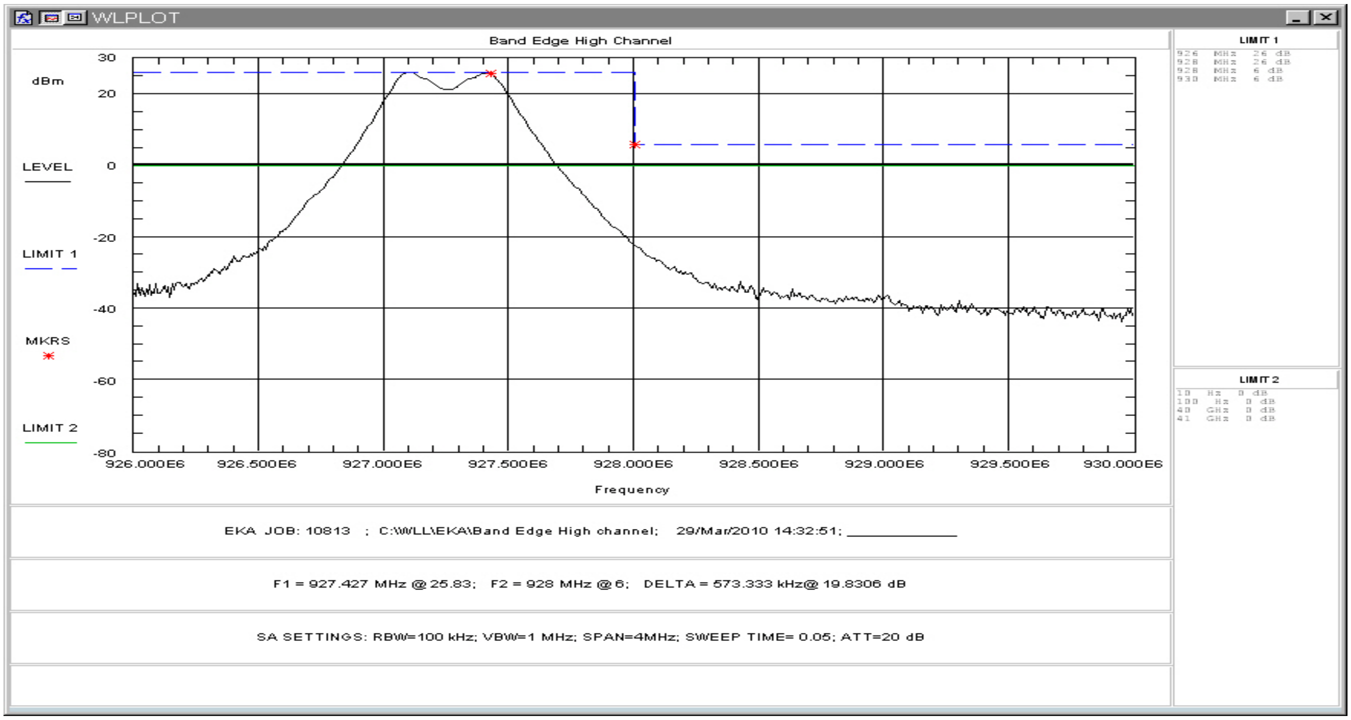

Figure 17: Conducted Spurious Emissions, Band Edge, High Channel

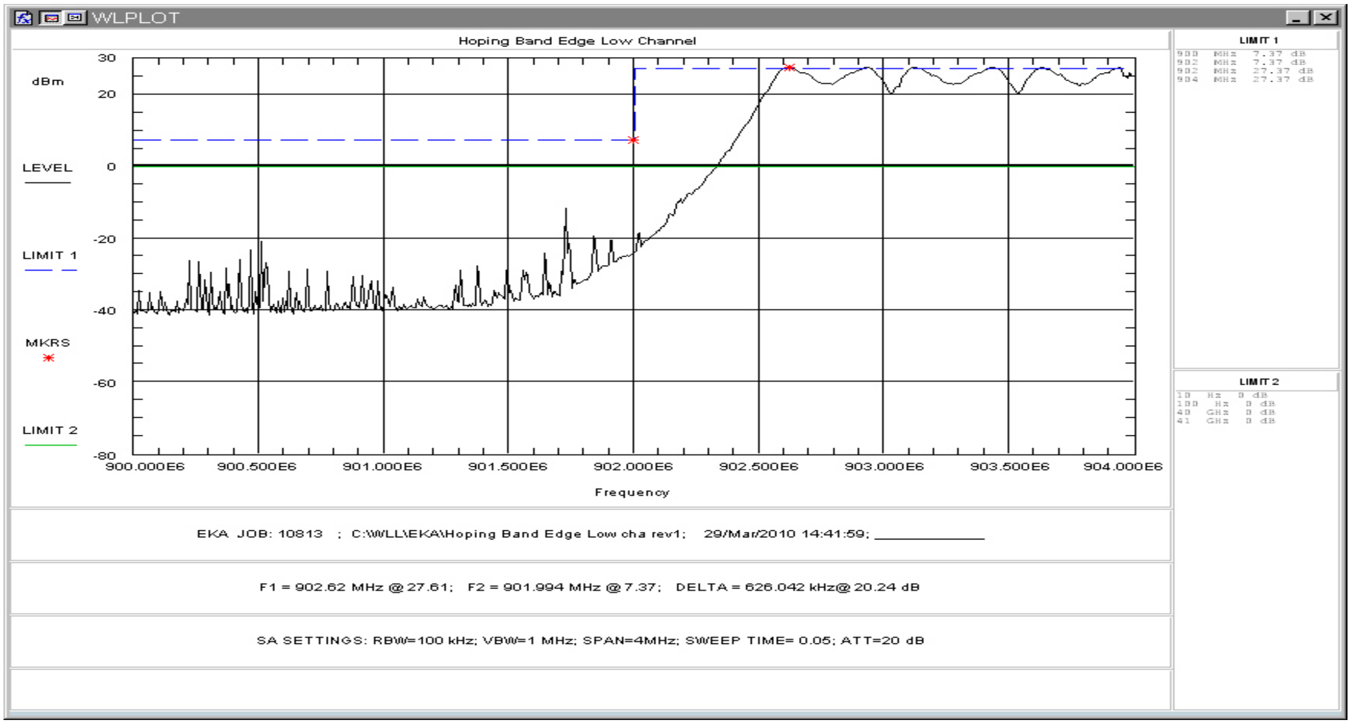

Figure 18: Conducted Spurious Emissions, Band Edge, Low Channel Hoping Mode

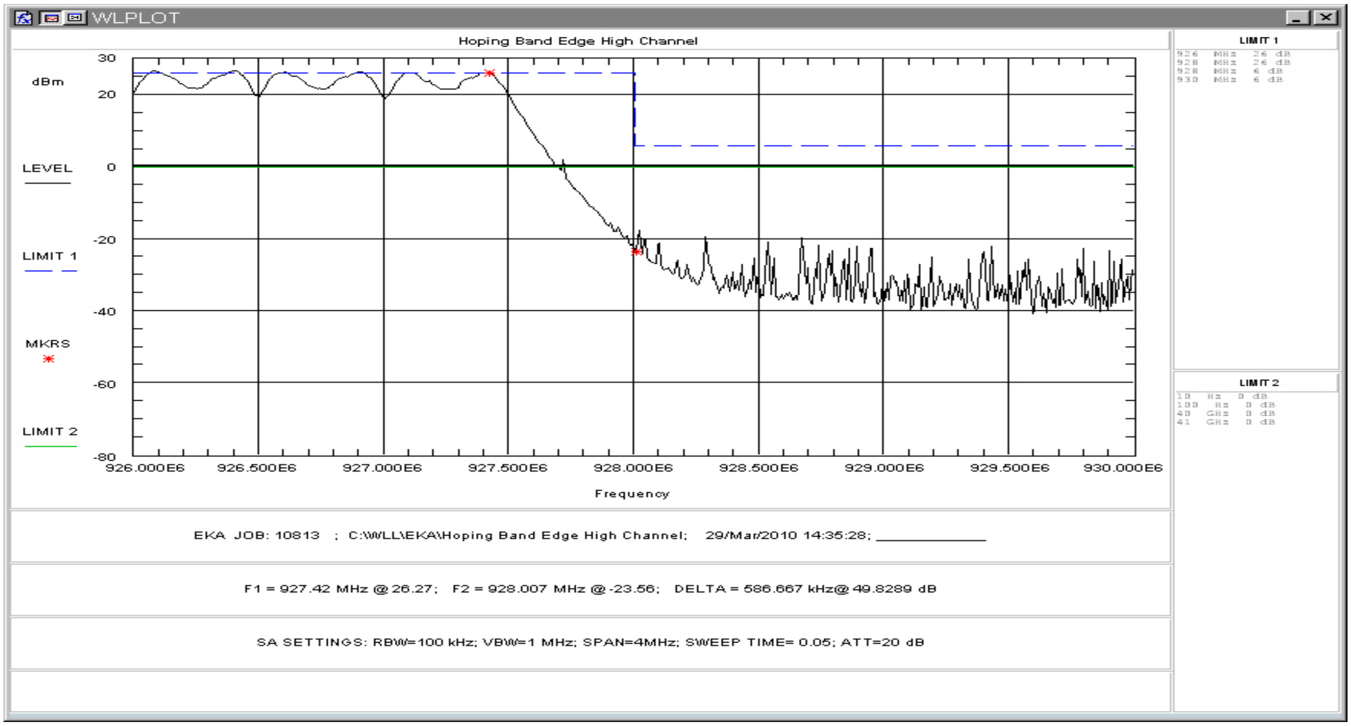

Figure 19: Conducted Spurious Emissions, Band Edge, High Channel Hoping Mode

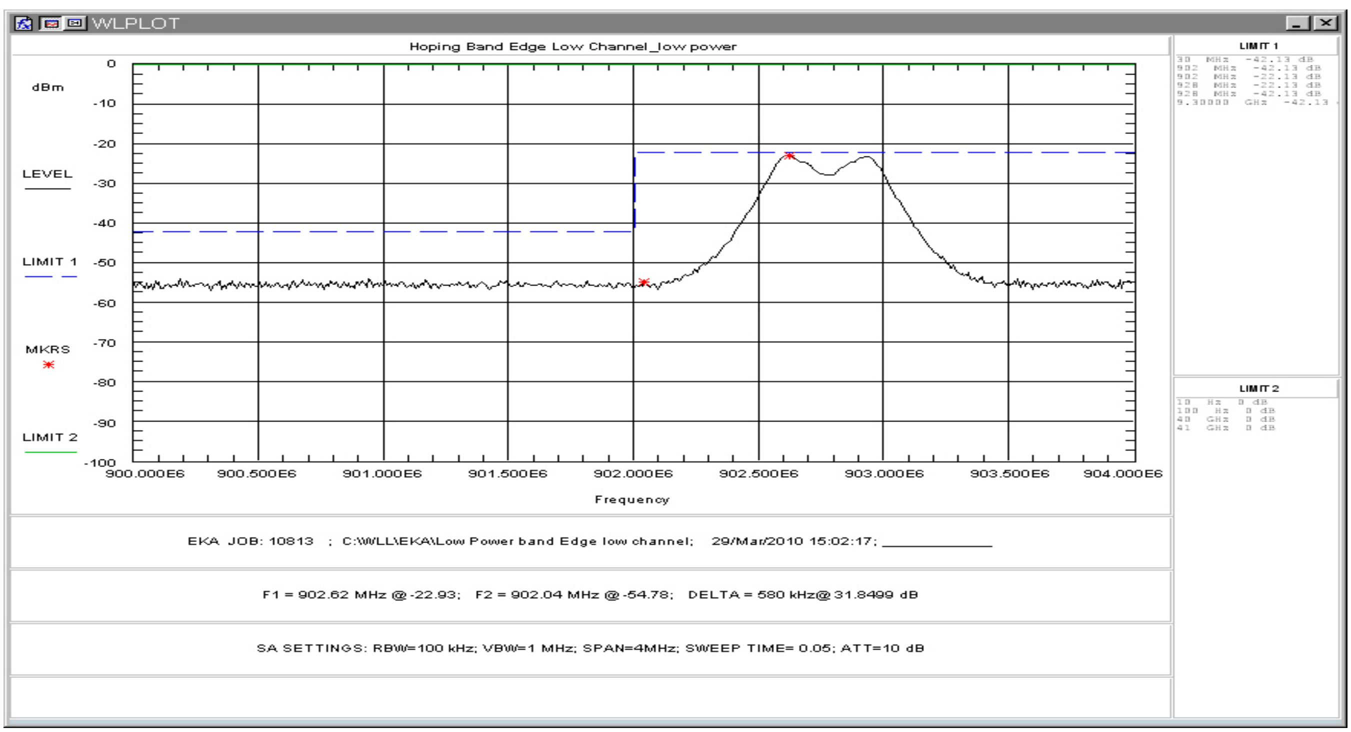

Figure 20: Conducted Spurious Emissions, Band Edge, Low Power, Low Channel

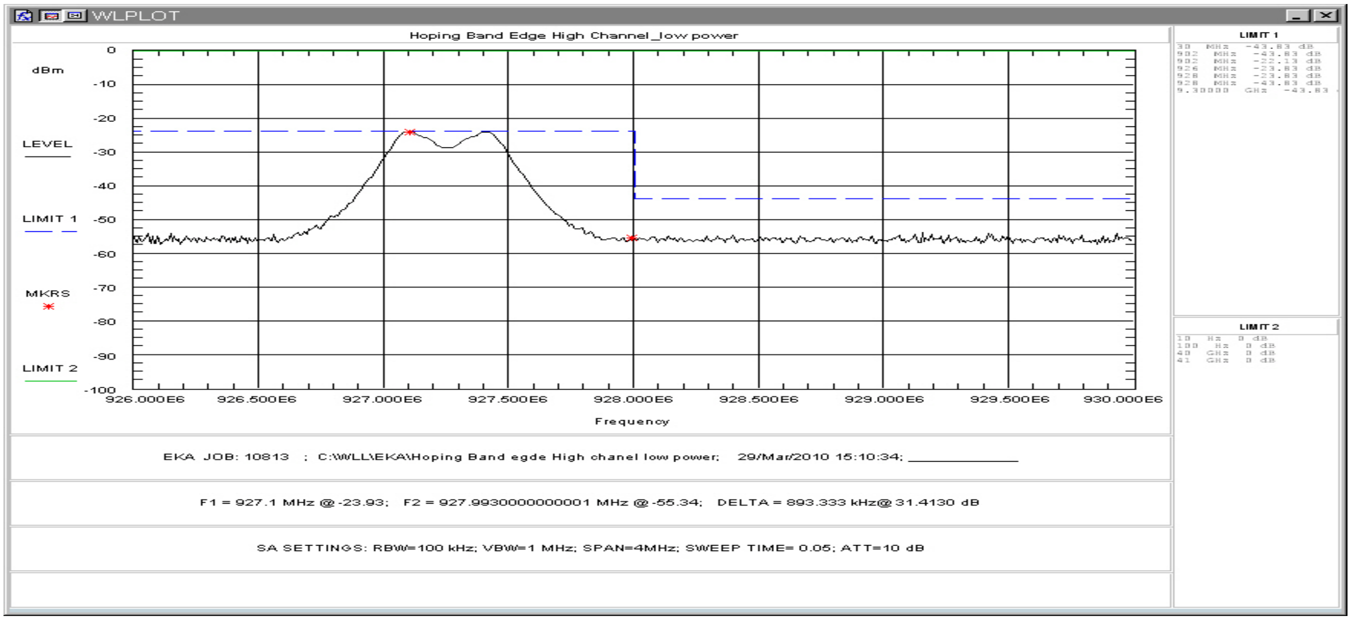

Figure 21: Conducted Spurious Emissions, Band Edge, Low Power, High Channel

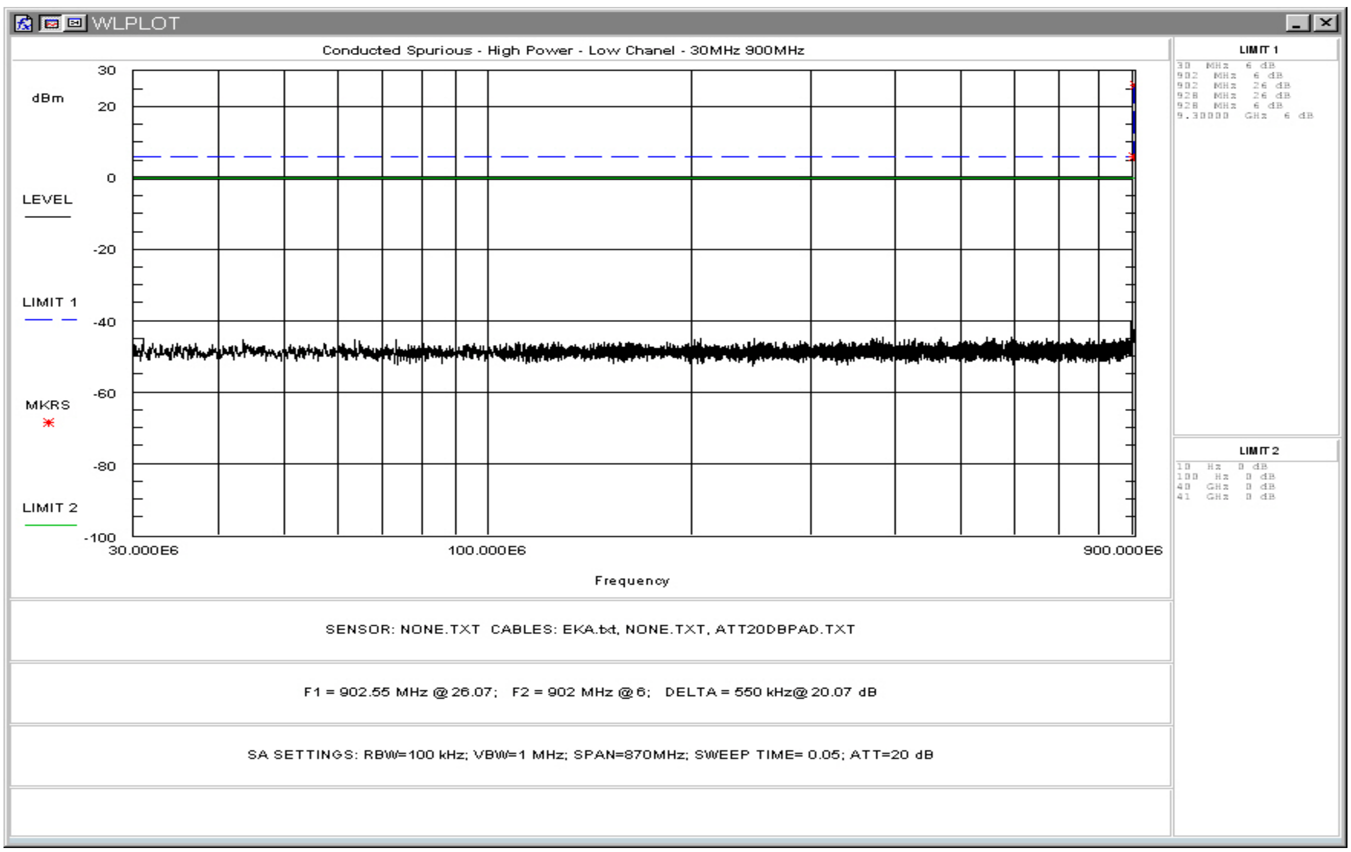

Figure 22: Conducted Spurious Emissions, High Power, Low Channel 30 - 900MHz

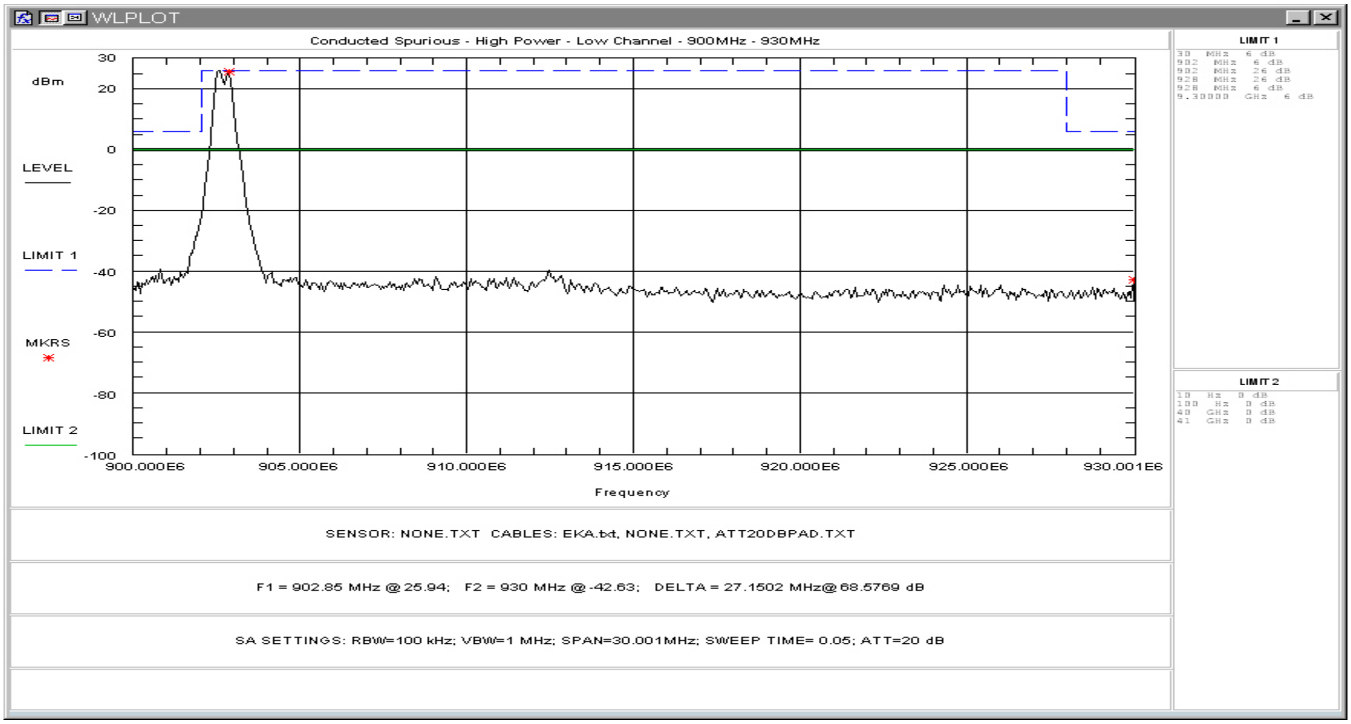

Figure 23: Conducted Spurious Emissions, High Power, Low Channel 900 – 930MHz

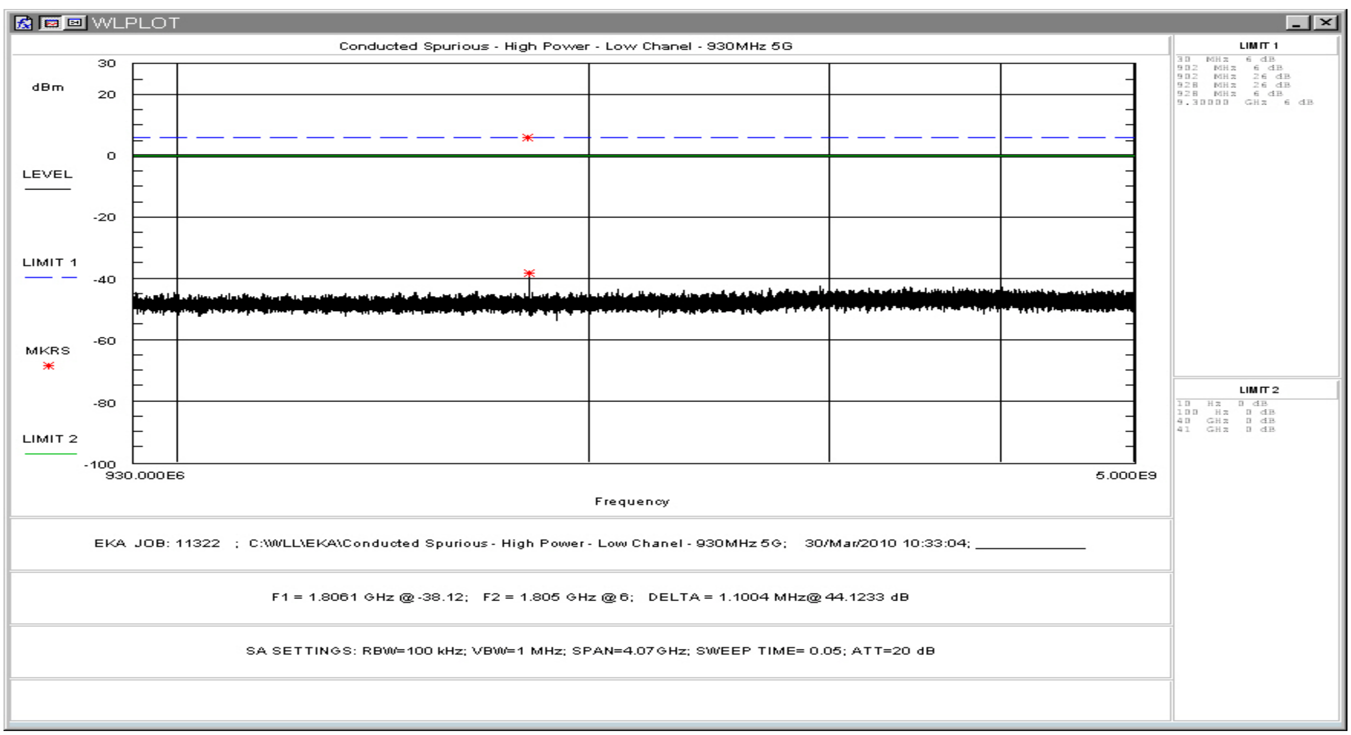

Figure 24: Conducted Spurious Emissions, High power, Low Channel 930 – 5GHz

