FCC & Industry Canada Certification Test Report
For the
Two Technologies
PLAT2008

FCC ID: RYJ-PLAT2008
IC ID: 6103A-PLAT2008

WLL JOB# **10387**
May 26, 2008

Revised July 17, 2008

Prepared for:

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ACCREDITED
Testing Certificate 2675.01

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May 6, 2008

Revised July 17, 2008

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Abstract

This report has been prepared on behalf of Two Technologies 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 (9/2007) of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy RSS-210 of Industry Canada. This Certification Test Report documents the test configuration and test results for a Two Technologies PLAT2008.

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 Two Technologies PLAT2008 complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under FCC Part 15.247 and Industry Canada RSS-210.

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1 Introduction

1.1 Compliance Statement

The Two Technologies PLAT2008 complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under FCC Part 15.247 (9/2007) and Industry Canada RSS-210e issue 7.

1.2 Test Scope

Tests for radiated and conducted (at antenna terminal) emissions were performed. All measurements were performed in accordance with 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:	Two Technologies 419 Sargon Way Horsham, PA, 19044 USA
Purchase Order Number:	NA
Quotation Number:	64239

1.4 Test Dates

Testing was performed on the following date(s):	4/26/08 – 5/8/08

1.5 Test and Support Personnel

Washington Laboratories, LTD	Steven Dovell/James Ritter
Client Representative	Phil Lanese

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	**Decibel**
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 Two Technologies PLAT2008 is a wireless electric metering system for monitoring of electrical usage.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Two Technologies
FCC ID:	RYJ-PLAT2008
IC:	6103A-PLAT2008
Model:	PLAT2008
FCC Rule Parts:	§15.247
Industry Canada:	RSS210
Frequency Range:	2402 – 2480MHz
Maximum Output Power:	1.07mW (0.302dBm)
Modulation:	FSK FHSS
Occupied Bandwidth:	1.072MHz
Keying:	Automatic, Manual
Type of Information:	Data
Number of Channels:	79
Power Output Level	Fixed
Antenna Connector	None
Antenna Type	Integral
Interface Cables:	None
Power Source & Voltage:	15VDC NiMH batteries (7.5V x 2)

2.2 Test Configuration

The PLAT2008 was configured with a FUTABA radio pack (FCC ID: RYJ-FDQ02T) and an internal WLAN (Summit FCC ID: RYJ-SDMCF10G). The unit was powered from 15VDC (2 x 7.5VDC) replaceable NiMH batteries.

2.3 Testing Algorithm

The PLAT2008 is a handheld computer and was configured by using an internal test program. This program allowed the unit to transmit /receive on one of 3 channels (Low: 2402MHz, Center: 2440MHz, & High: 2480MHz). The unit was also programmed to hop on 79 channels with its normal pseudorandom rate.

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

2.6 Measurement Uncertainty

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

The following measurement uncertainty calculation is provided:

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

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

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

3 Test Equipment

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

Table 2: Test Equipment List

WLL Asset #	Manufacturer Model/Type	Function	Cal. Due
00004	ARA, DRG-118/A	Antenna, DRG, 1-18GHz	2/2/2009
00474	HP, 8563E	Analyzer, Spectrum	9/7/2008
00069	HP, 85650A	ADAPTER, QP	7/6/2008
00071	HP, 85685A	PRESELECTOR, RF	7/6/2008
00073	HP, 8568B	ANALYZER, SPECTRUM	7/6/2008
00618	HP 8563A	ANALYZER, SPECTRUM	3/7/2009
00522	HP, 8449B	PRE-AMPLIFIER, 1-26.5GHZ	7/27/2008
00382	SUNOL, JB1	ANTENNA, BICONLOG	1/30/2009

4 Test Summary

The Table Below shows the results of testing for compliance with a Digital Transmission System in accordance with FCC Part 15.247:2007 and RSS210e issue 7. Full results are shown in section 5.

Table 3: 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 min)	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)	
15.207	RSS-Gen [7.2.2]	AC Conducted Emissions	N/A – Battery Operated
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 – Battery operated
15.209	RSS-Gen [7.2.3.2]	General Field Strength Limits (Restricted Bands & RE Limits)	Pass

5 Test Results

5.1 RF Power Output: (15.247 (b)(1),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 4. RF Power Output

Frequency	Level	Limit	Pass/Fail
Low Channel: 2402MHz	-2.51	30 dBm	Pass
Mid Channel: 2440MHz	0.151	30 dBm	Pass
High Channel: 2480MHz	0.3201	30 dBm	Pass

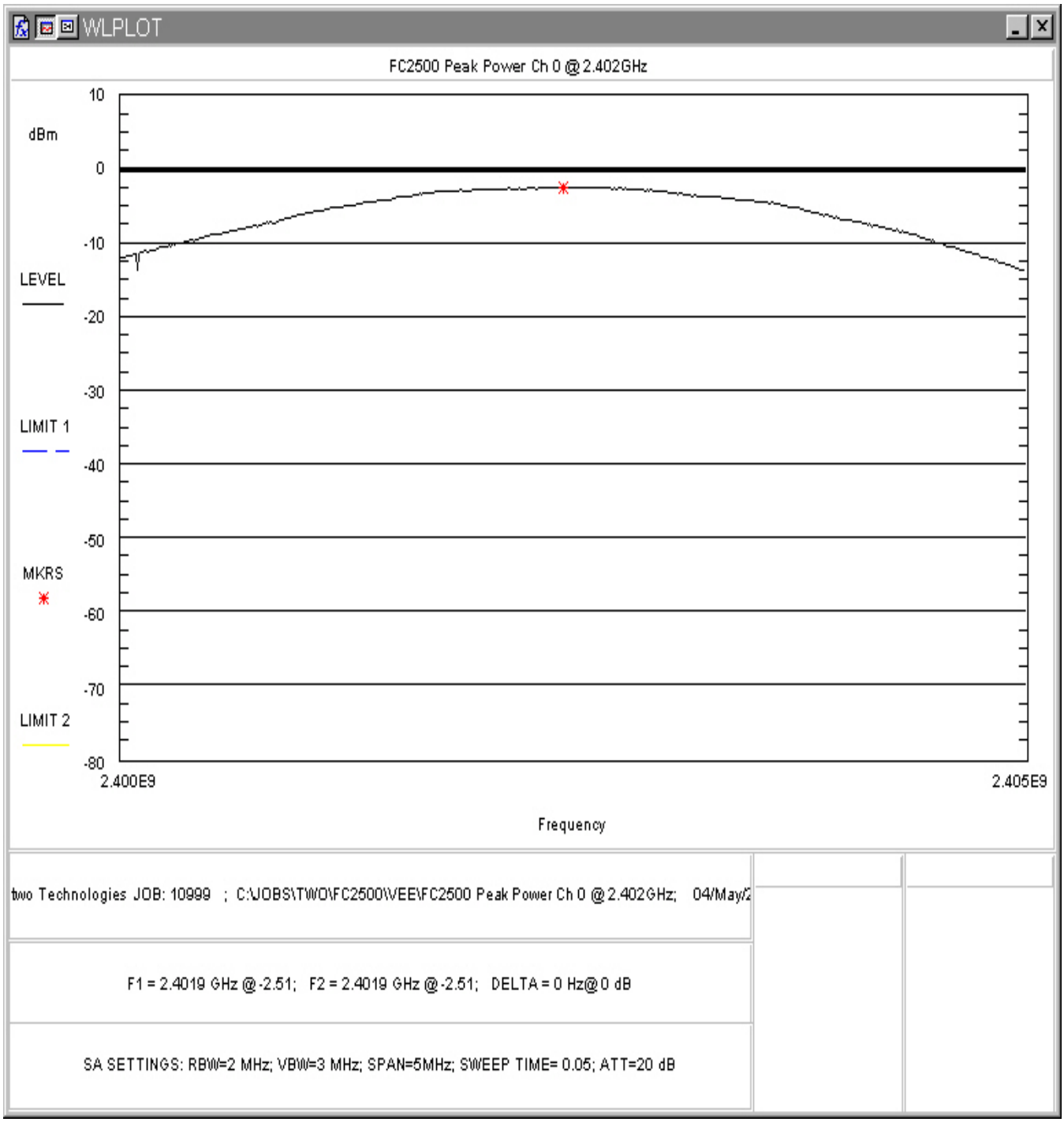

Figure 5-1. RF Peak Power, Low Channel

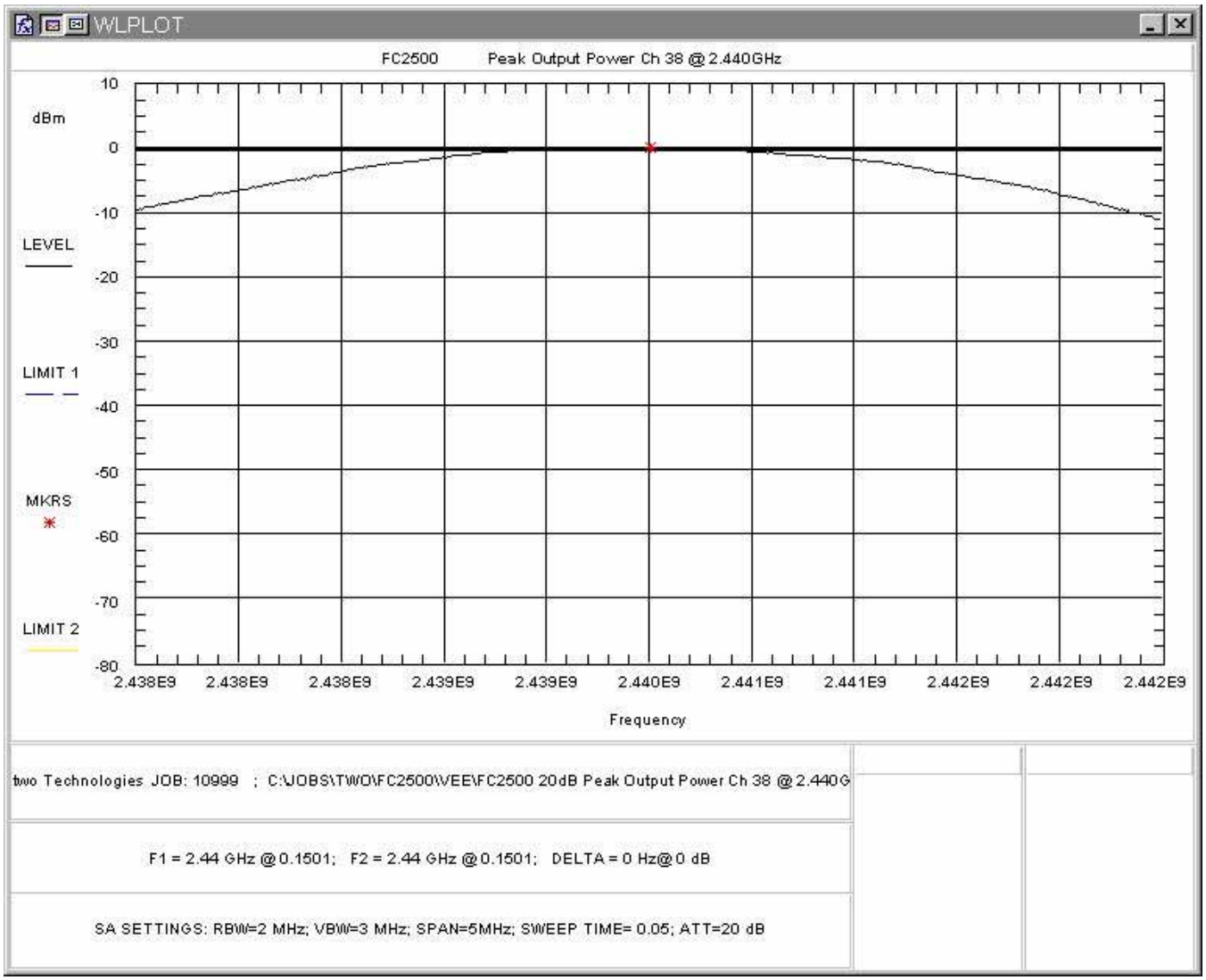

Figure 5-2. RF Peak Power, Mid Channel

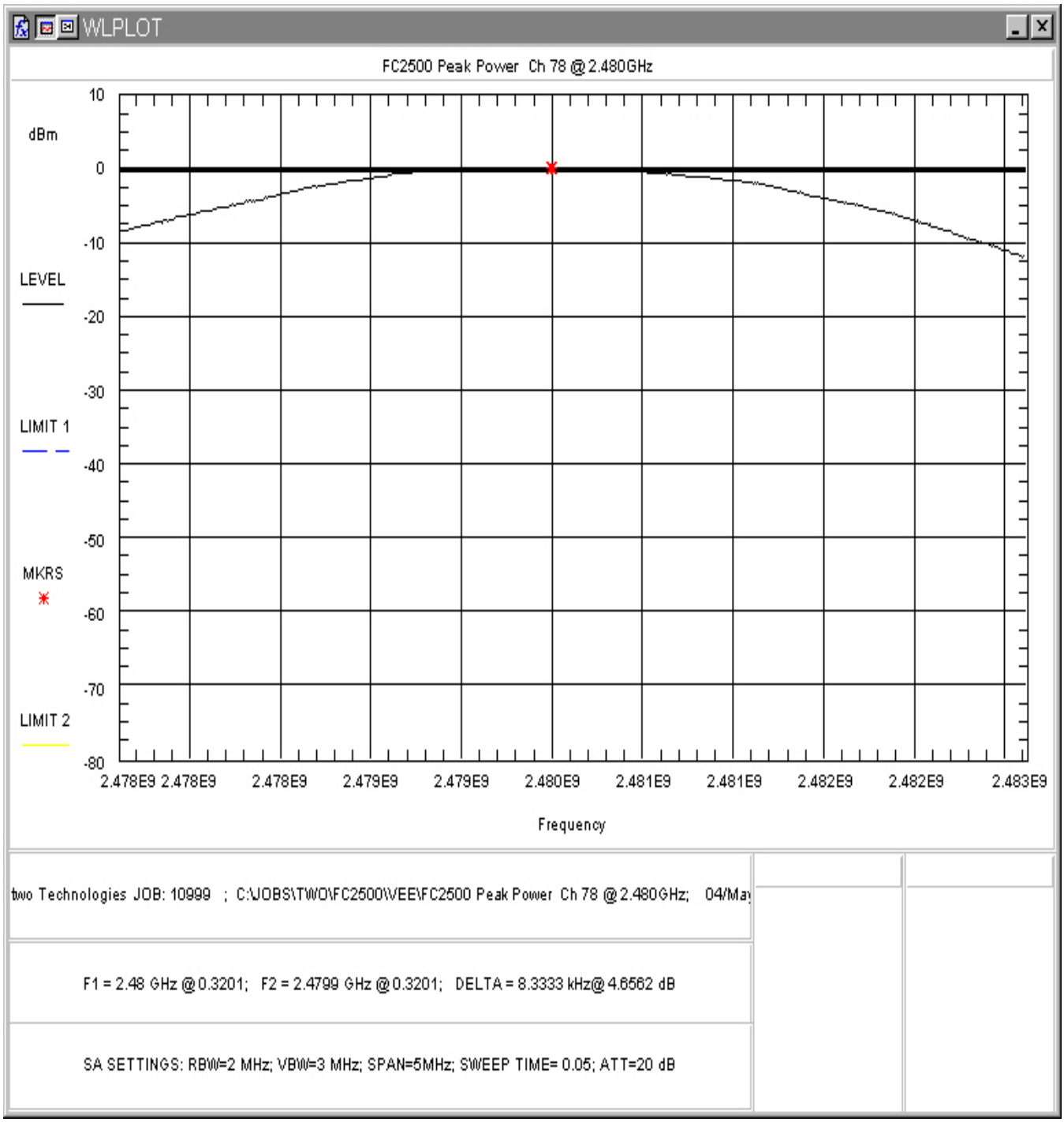

Figure 5-3. RF Peak Power, High Channel

5.2 Occupied Bandwidth: (FCC Part §2.1049)

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

For Frequency Hopping Spread Spectrum Systems, FCC Part 15.247 requires the Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

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

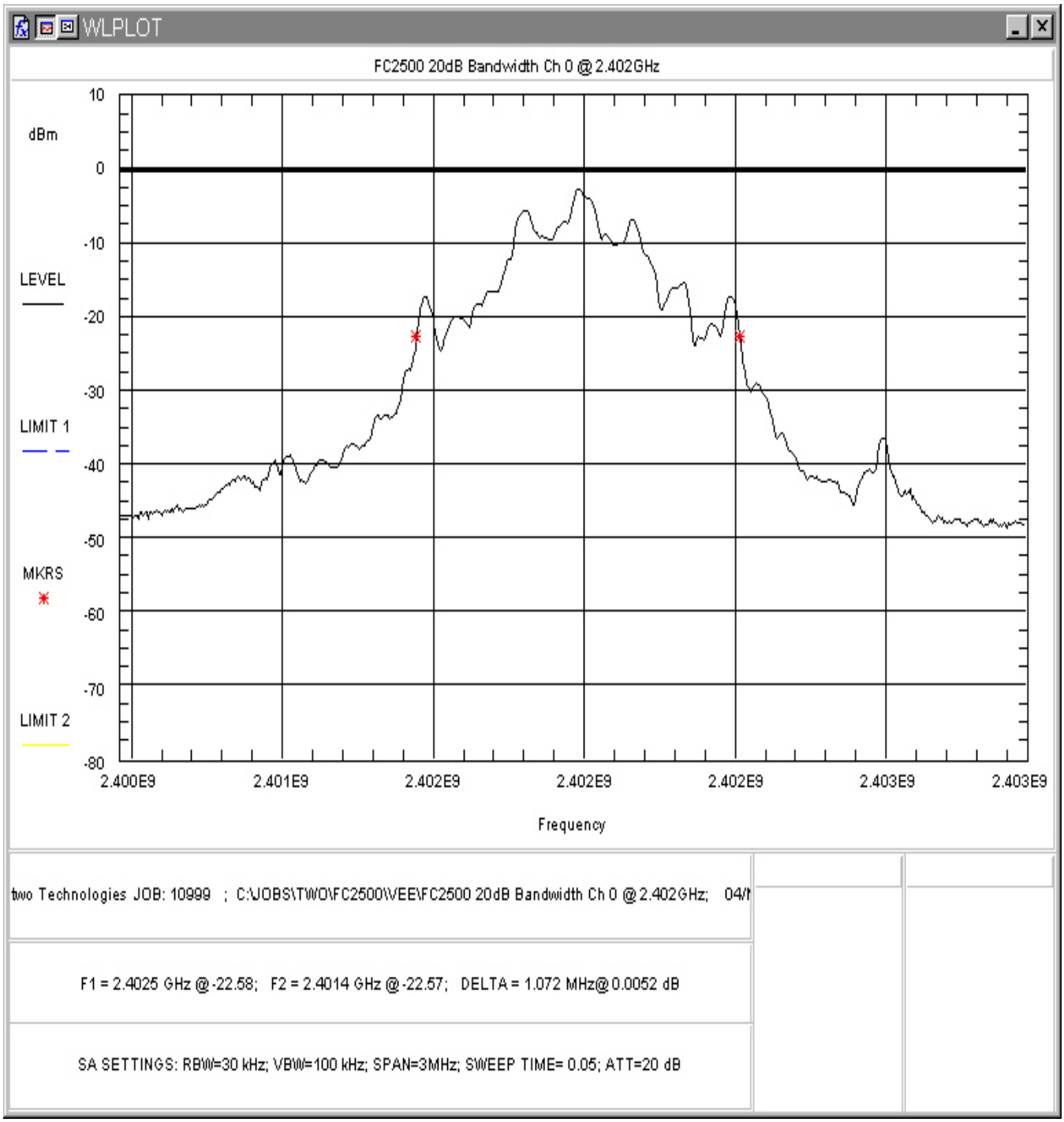

Figure 5-4. Occupied Bandwidth, Low Channel

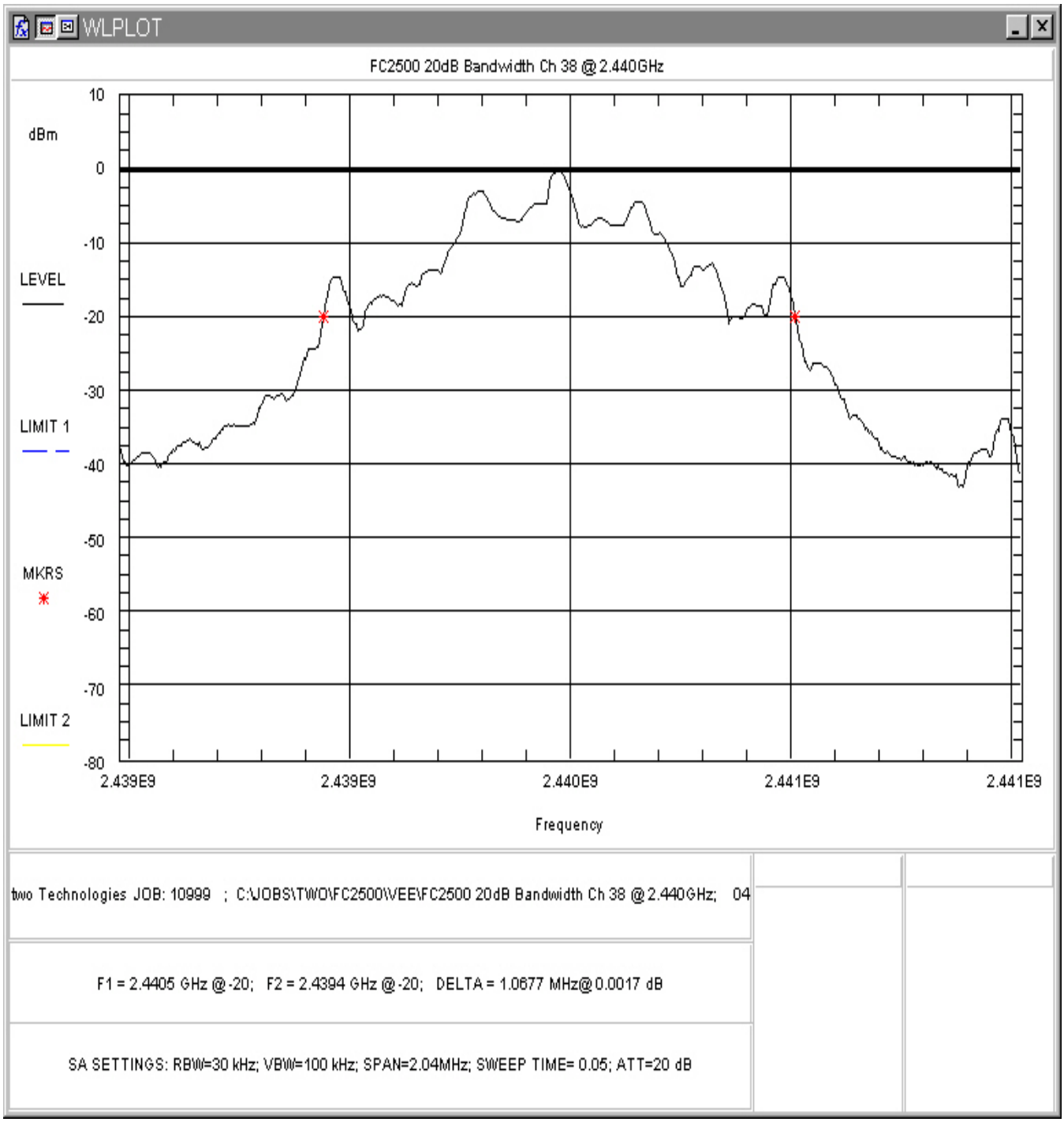

Figure 5-5. Occupied Bandwidth, Mid Channel

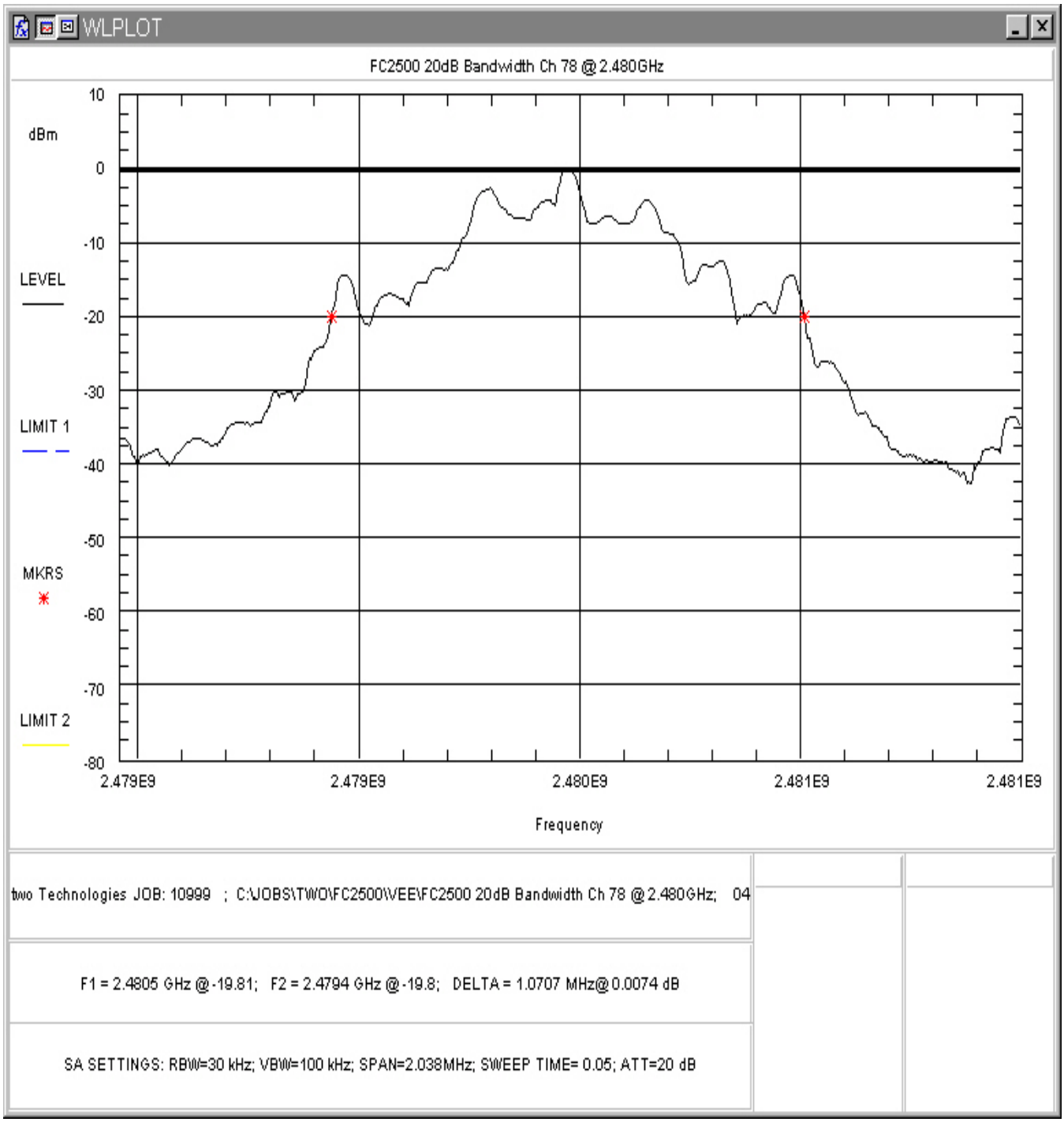

Figure 5-6. Occupied Bandwidth, High Channel

Table 5 provides a summary of the Occupied Bandwidth Results.

Table 5. Occupied Bandwidth Results

Frequency	Bandwidth	Pass/Fail
Low Channel: 2402MHz	1.072MHz	Pass
Mid Channel: 2440MHz	1.0677MHz	Pass
High Channel: 2480MHz	1.0707MHz	Pass

5.3 RF Peak Power Spectral Density (§15.247(e) and RSS-210, Annex 8.2)

For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system.

The highest peak within the transmission was located and measured for the upper and lower channels. Plots of the PSD were taken as shown in Figure 5-7 through Figure 5-9 below. Table 6 provides a summary of the data.

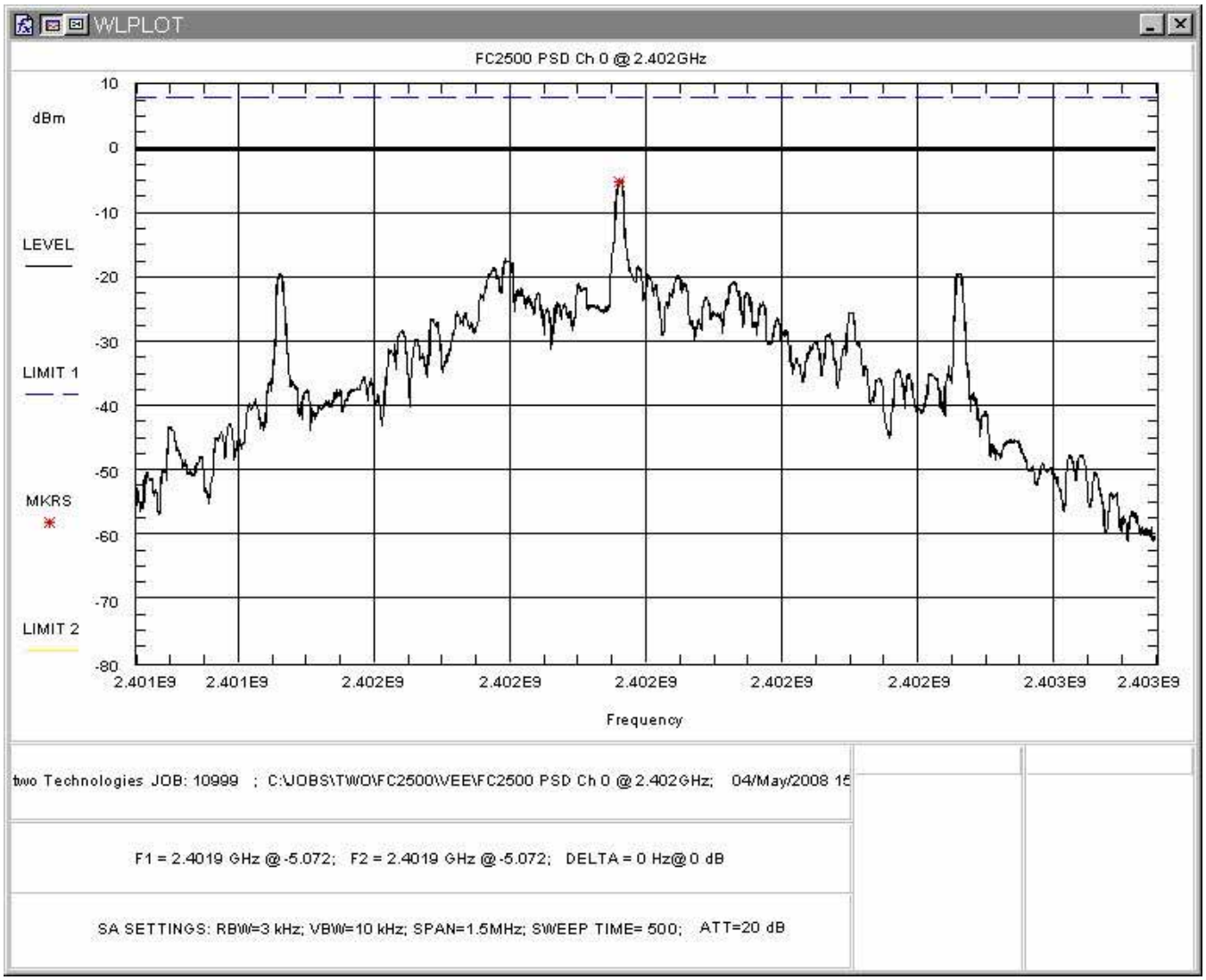

Figure 5-7. PSD Ch0 @ 2.402GHz

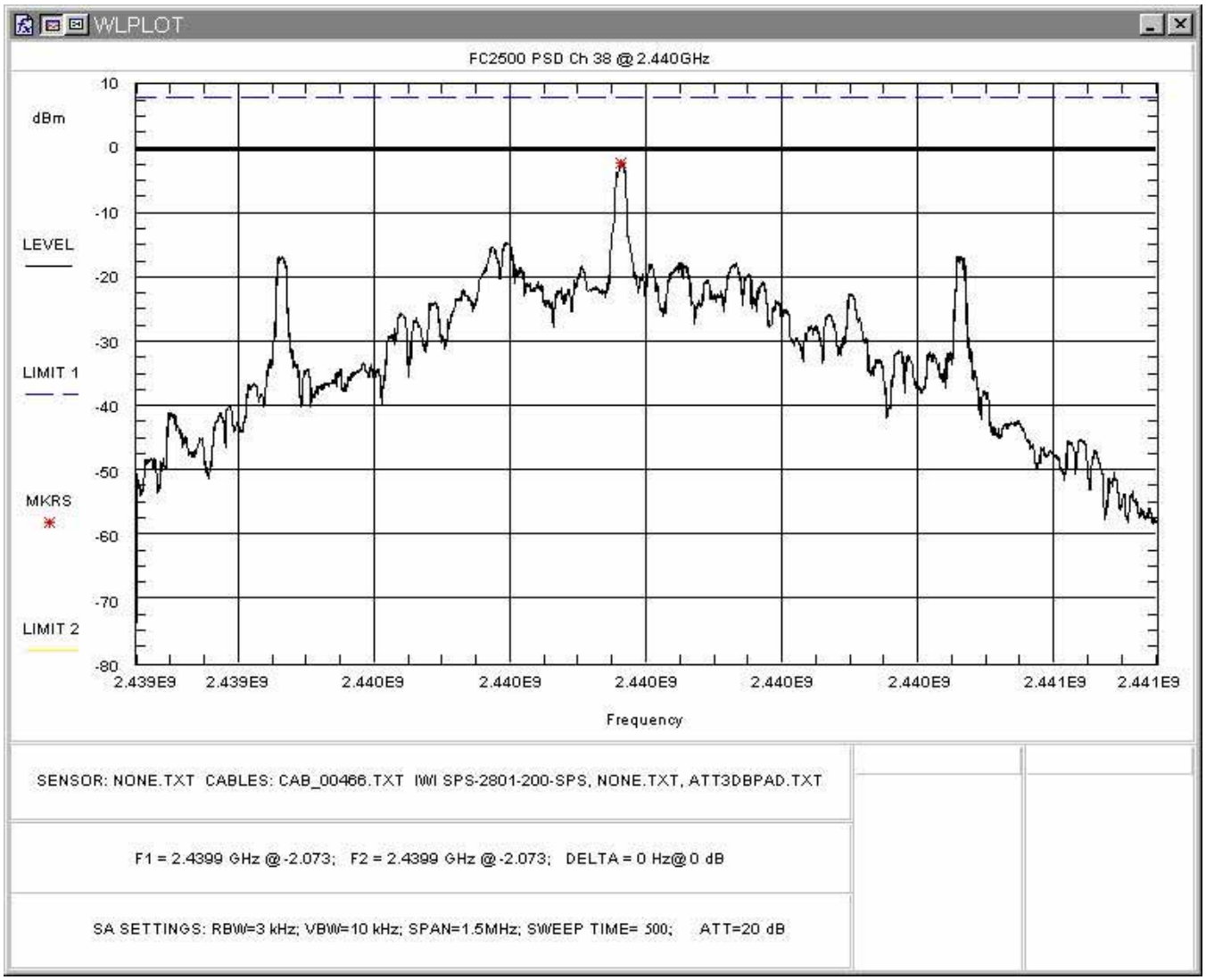

Figure 5-8. PSD Ch38 @ 2.440GHz

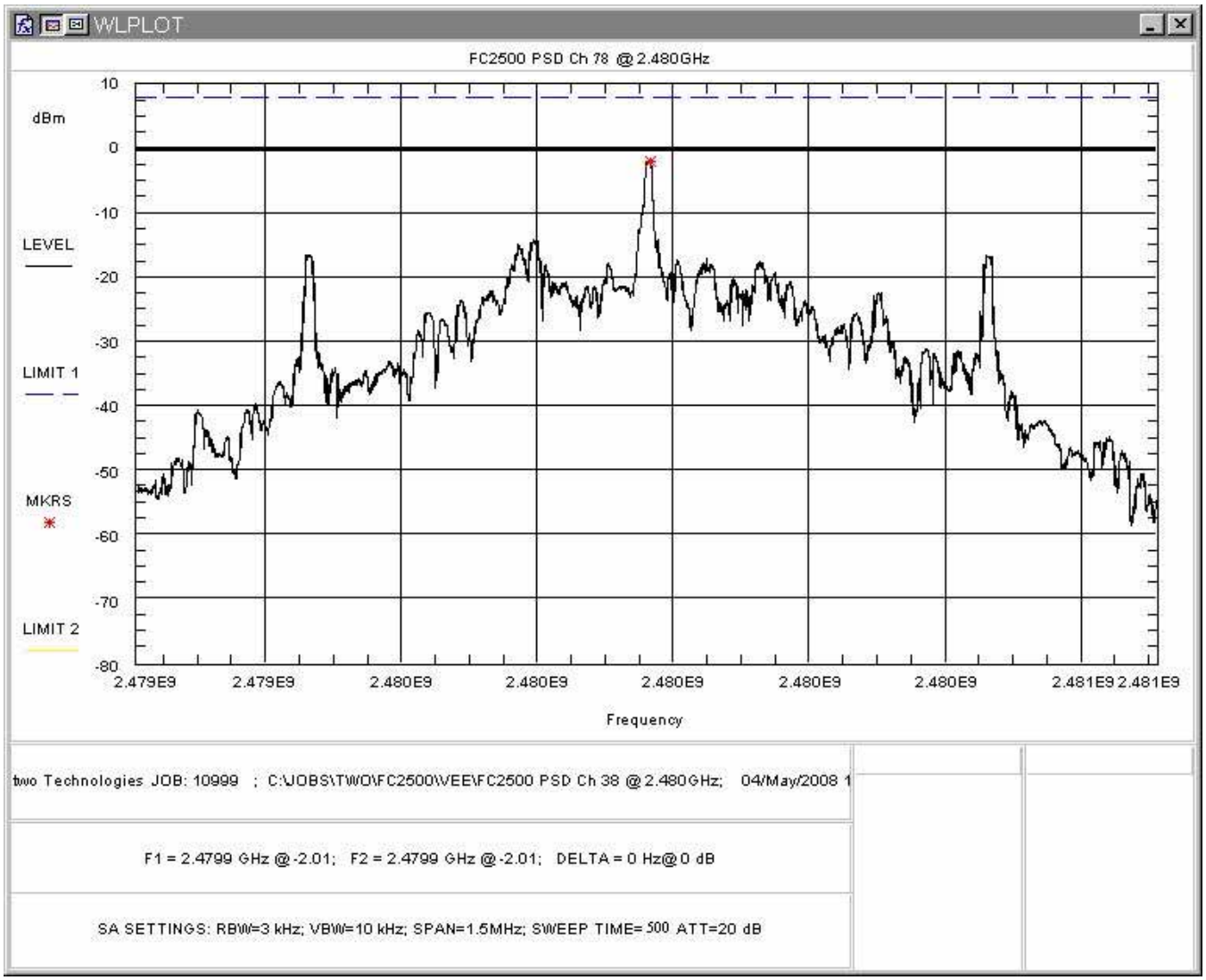

Figure 5-9. PSD Ch78 @ 2.480GHz

Table 6. RF Power Spectral Density

Frequency	Level (dBm)	Limit (dBm)	Pass/Fail
2402MHz	-5.072	8	Pass
2440MHz	-2.073	8	Pass
2480MHz	-2.01	8	Pass

5.4 Channel Spacing and Number of Hop Channels (FCC Part §15247(a)(1) RSS-210 [A8. 1 (c)])

Per the FCC requirements, For Frequency Hopping Spread Spectrum Systems, FCC Part 15.247 requires the Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

The output of the FC2500 is well under the limit 125 mW specification and therefore the channels must be separated by two-thirds of the 20dB bandwidth. The maximum 20dB bandwidth measured 1.072MHz. Therefore the channel spacing must be at least 714.667 kHz.

The EUT antenna was removed and the cable was connected directly into a spectrum analyzer through a 3 dB attenuator. The spectrum analyzer resolution bandwidth was set to 30 kHz and the video bandwidth was set to 100kHz. The channel spacing of 2 adjacent channels was measured on the spectrum analyzer. The following are plots of the channel spacing and number of hopping channels data. The channel spacing was measured to be 1MHz and the number of channels used is 79.

Figure 5-10. Channel Spacing, 1.001MHz

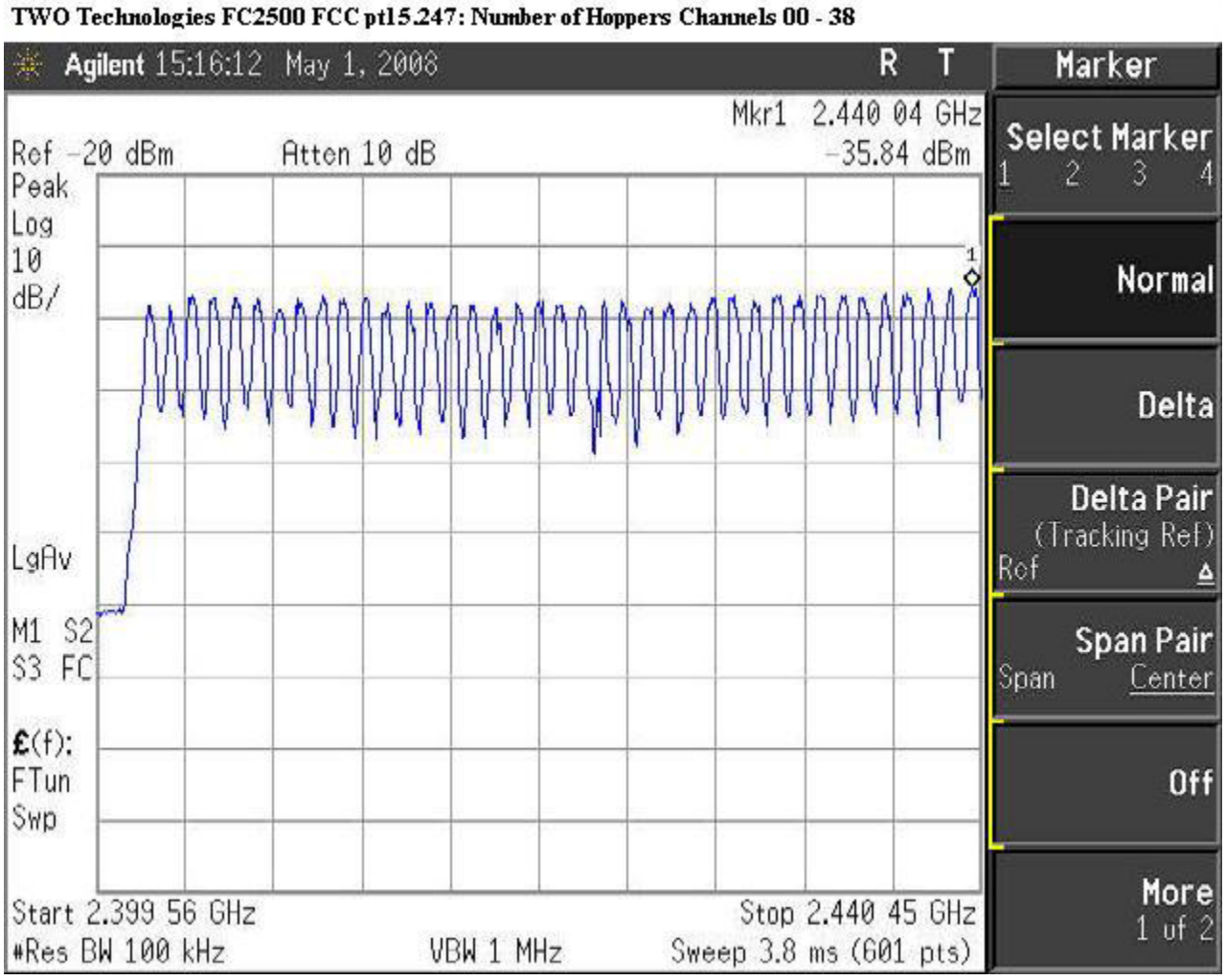

Figure 5-11. Number of Channels (0 – 38)

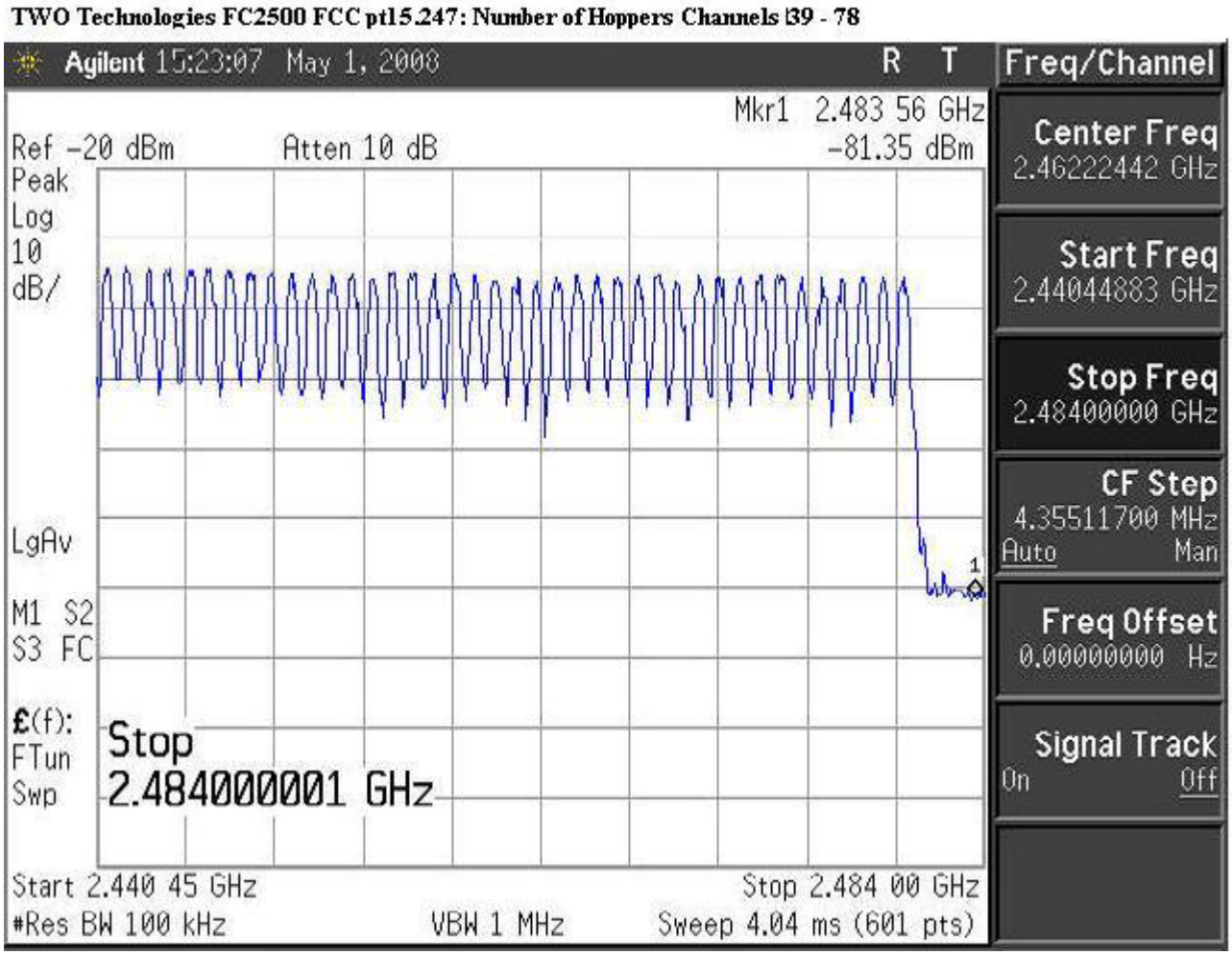

Figure 5-12. Number of Channels (39 – 78)

5.5 Duty Cycle Correction 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)

The following figure shows the plot of the dwell time for the transmitter. Based on this plot, the dwell time per hop is 209msec.

No Duty cycle correction is allowed.

No duty cycle correction was used in the spurious radiated emissions testing and is therefore not recorded.

In accordance with FCC 15.247(a)(1)(iii) the occupancy time of any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds times the number of channels.

For this EUT:

79 Channels/Frequencies X 0.4 seconds = 31.6 seconds (Limit = 0.4 seconds per 31.6 seconds, per channel).

The following occupancy times are calculated from data shown in Figure 5-13 through Figure 5-15.

Each pulse is 353.7µs wide, reference Figure 5-13

The pulses occur every 1.25ms, reference Figure 5-14

There are 66 Pulses / 31.6 seconds, reference Figure 5-15

This results in a total occupancy time of 23.3ms in any 31.6 seconds.

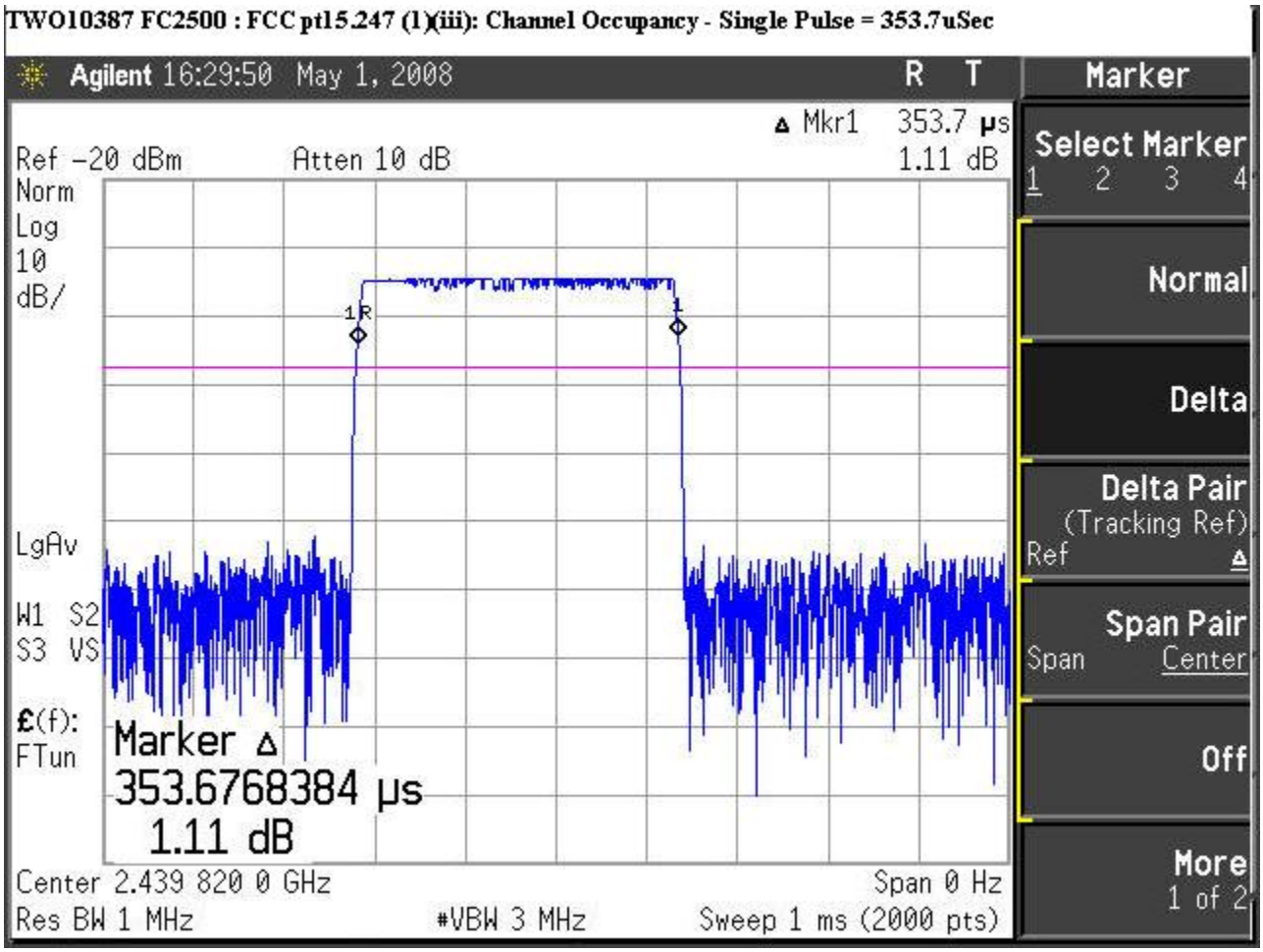

Figure 5-13. Time of Occupancy, Single Pulse

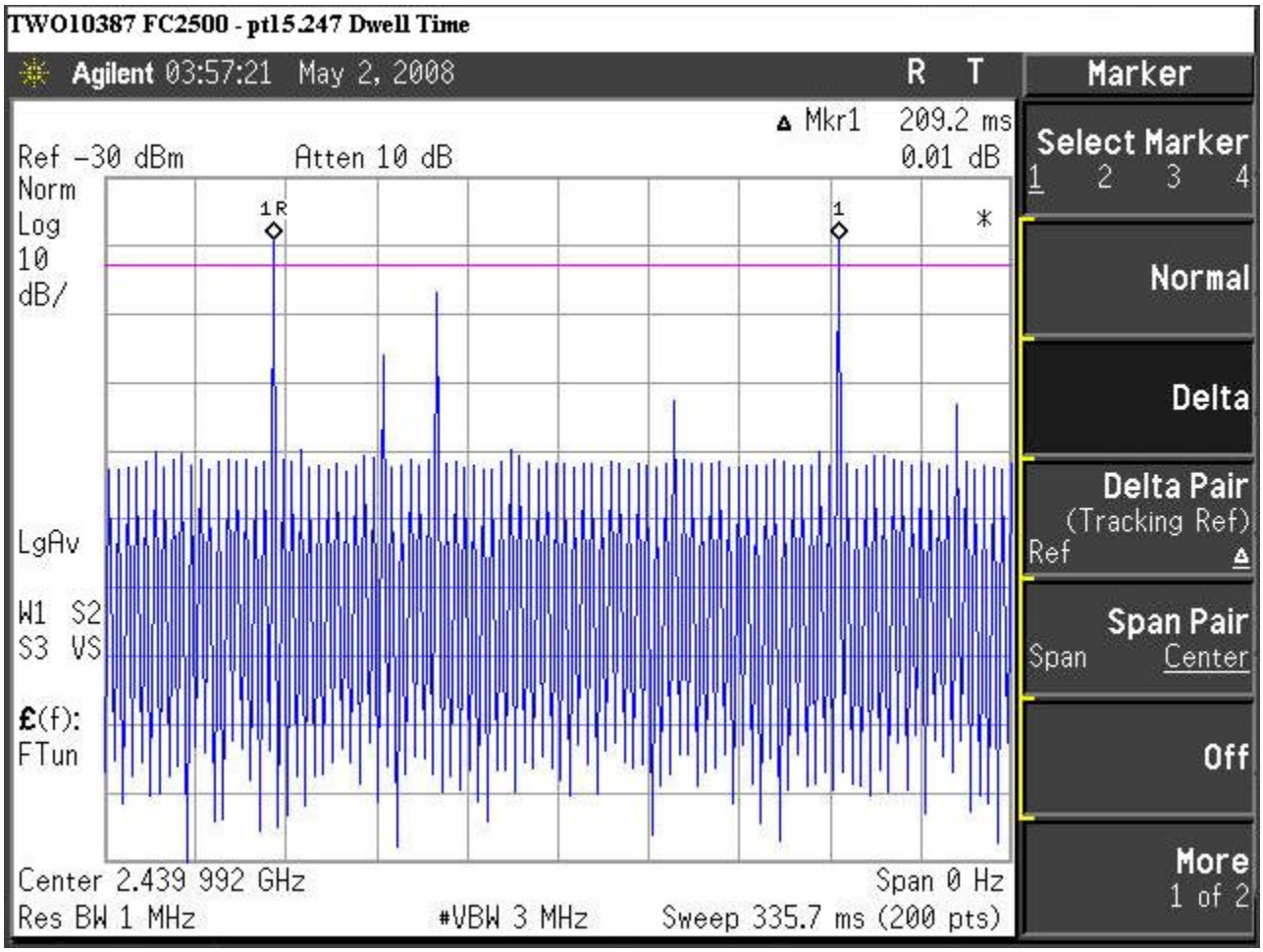

Figure 5-14. Dwell Time

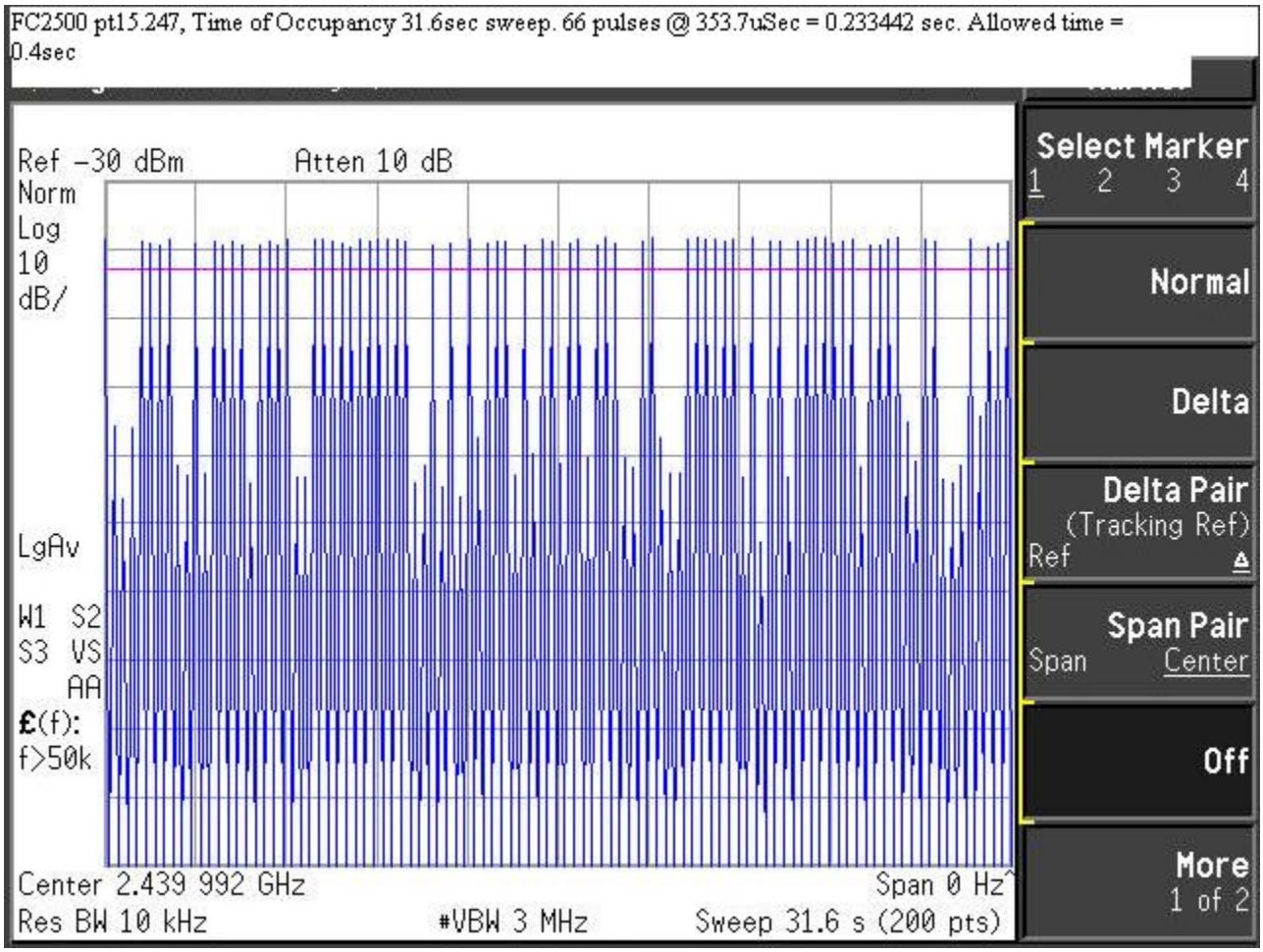

Figure 5-15. Time of Occupancy, 31.6 second Dwell Time

5.6 Conducted Spurious Emissions at Antenna Terminals (15.247 (d), RSS-210 [A8. 5])

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 3 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 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.

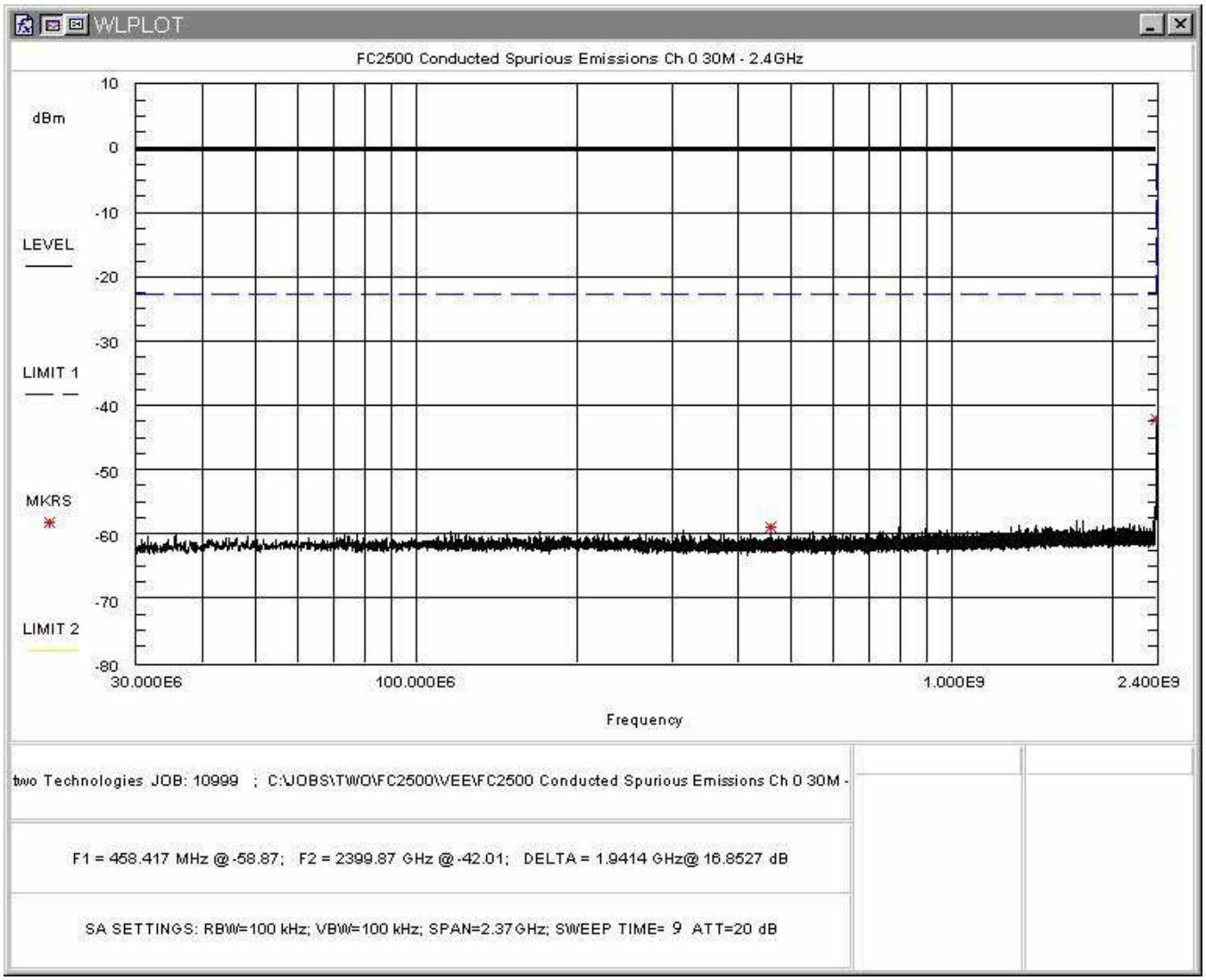

Figure 5-16. Conducted Spurious Emissions, Low Channel 30M – 2400GHz

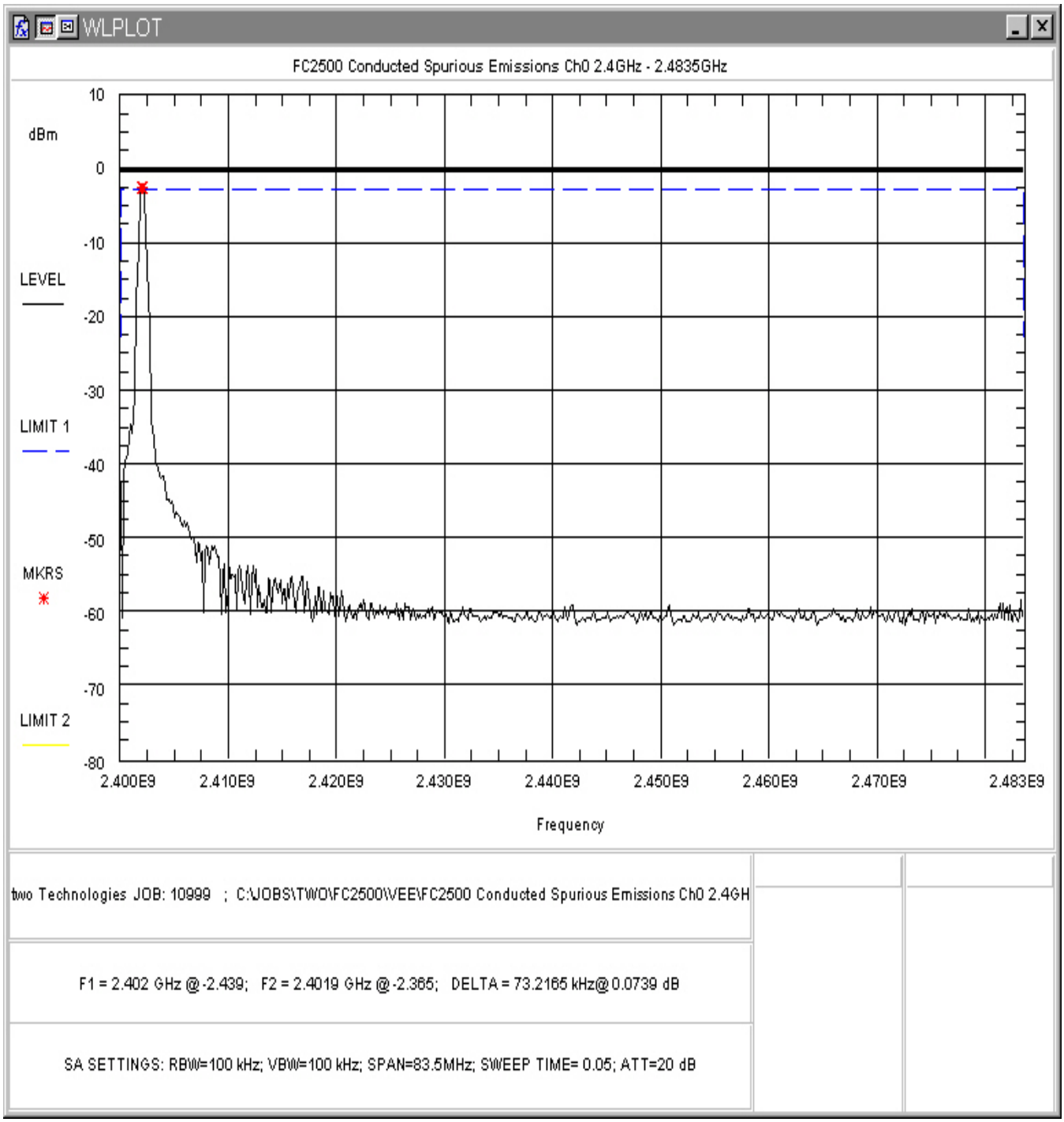

Figure 5-17. Conducted Spurious Emissions, Low Channel 2400 – 2483.5MHz

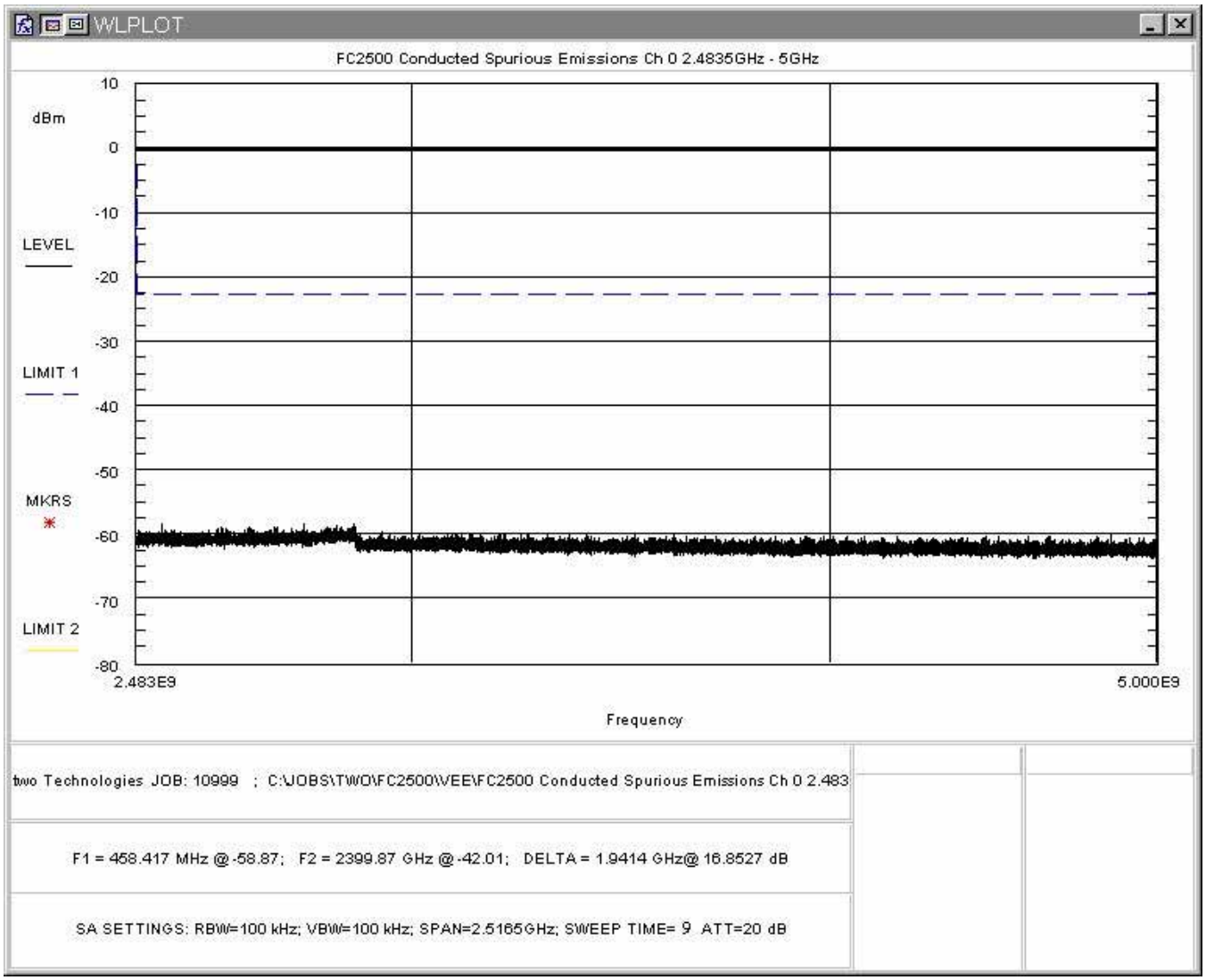

Figure 5-18. Conducted Spurious Emissions, Low Channel 2483.5 –5000 MHz

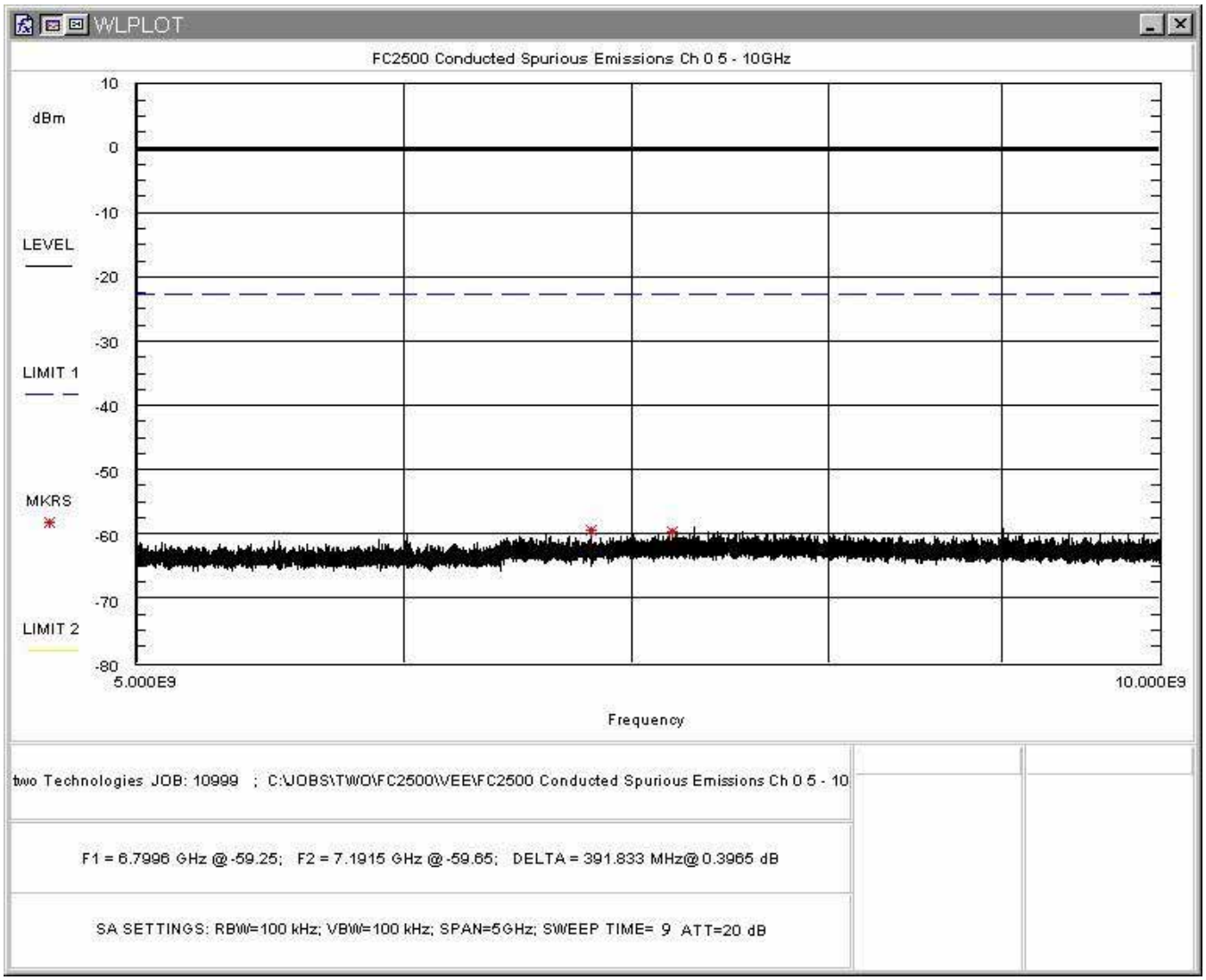

Figure 5-19. Conducted Spurious Emissions, Low Channel 5 - 10GHz

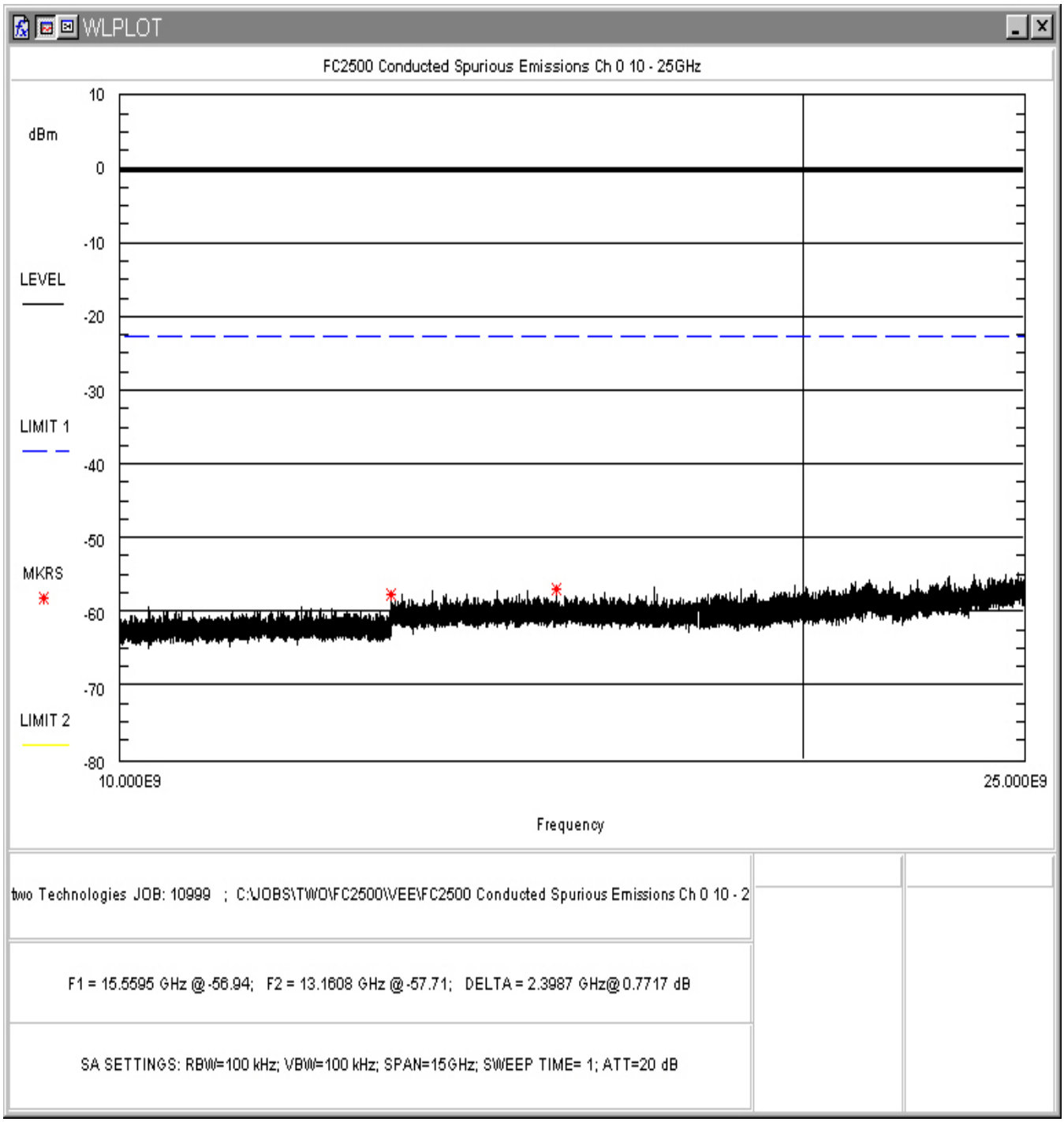

Figure 5-20. Conducted Spurious Emissions, Low Channel 10 – 25GHz

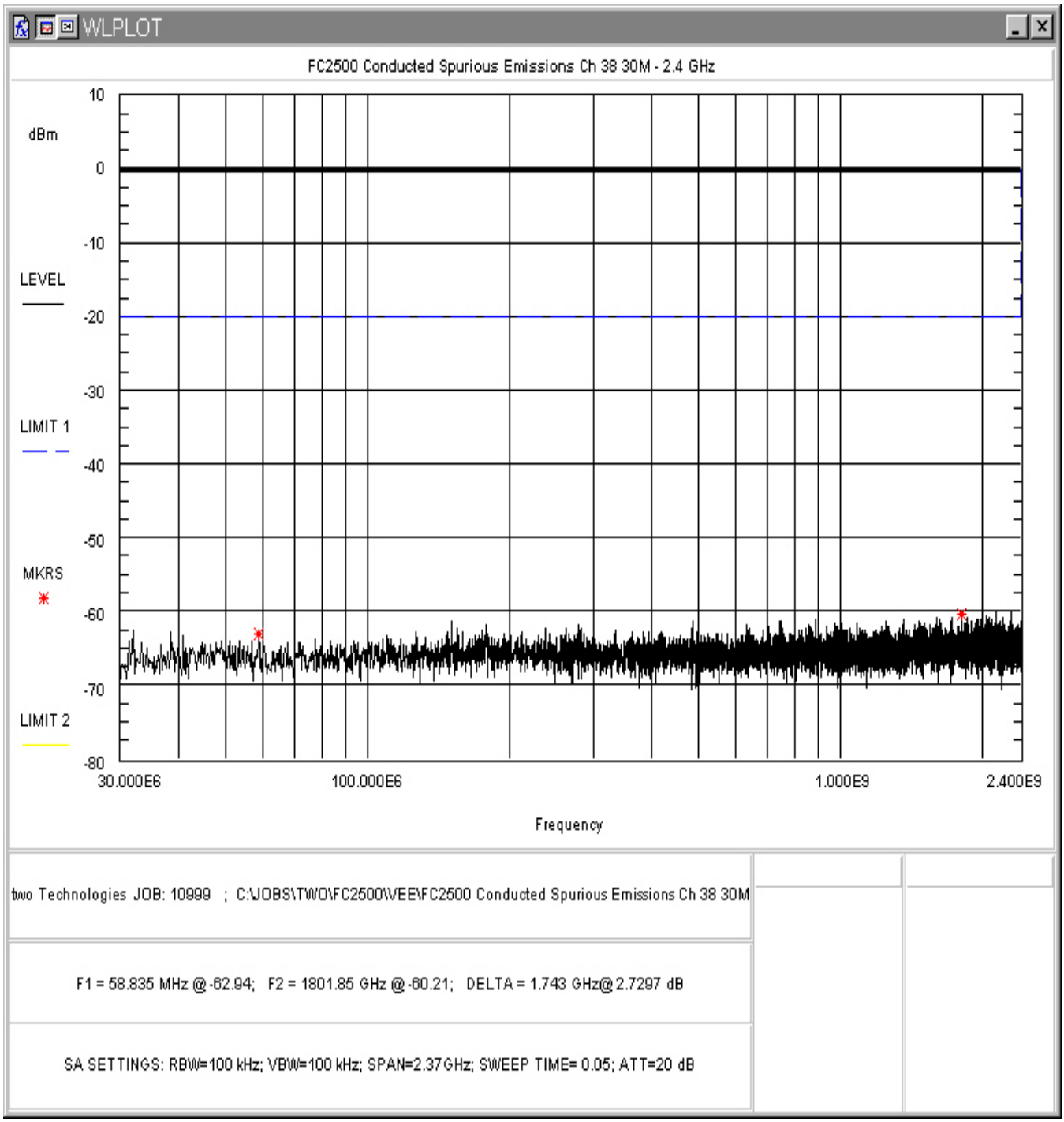

Figure 5-21. Conducted Spurious Emissions, Mid Channel 30M – 2400GHz

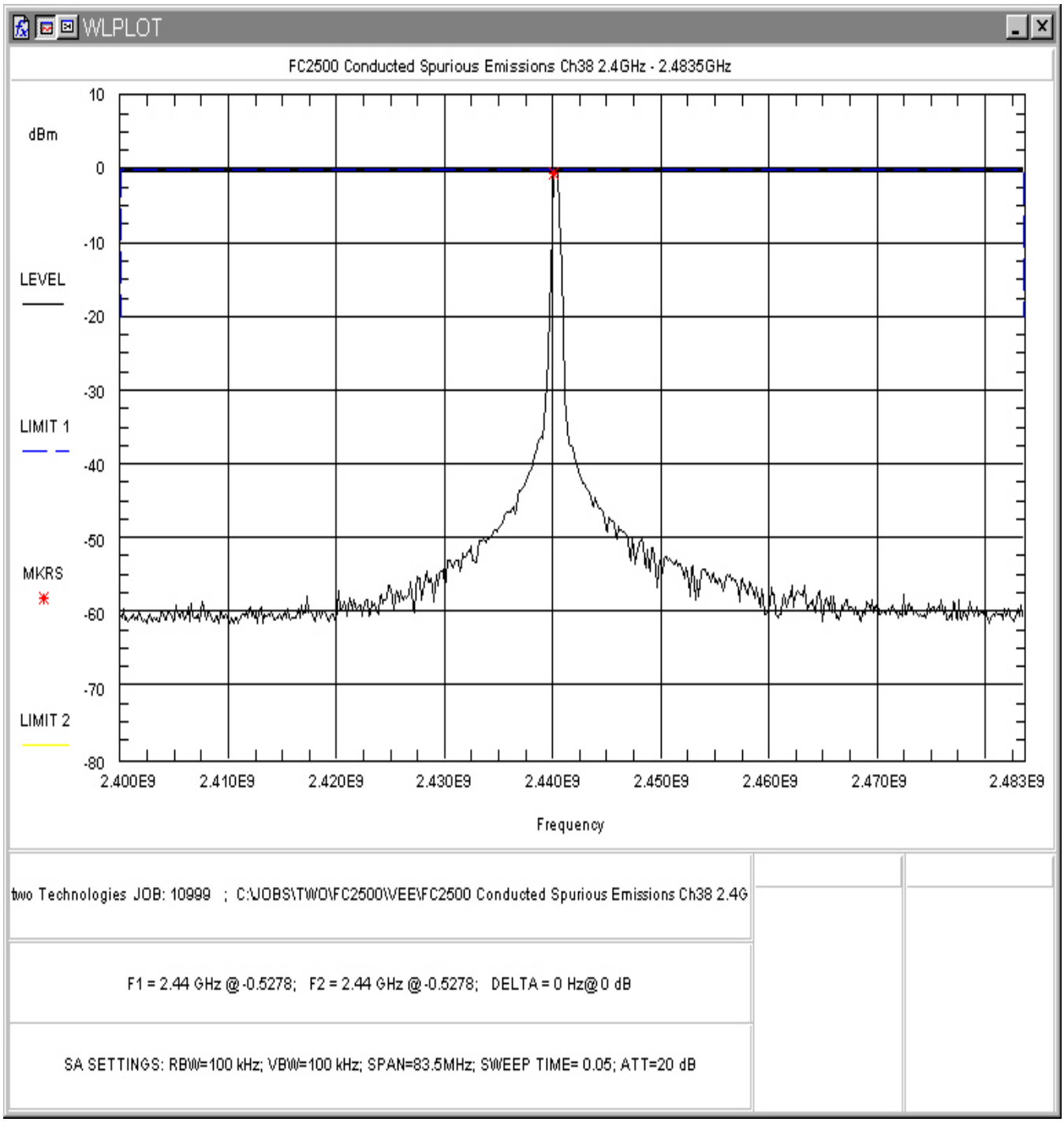

Figure 5-22. Conducted Spurious Emissions, Mid Channel 2400 – 2483.5MHz

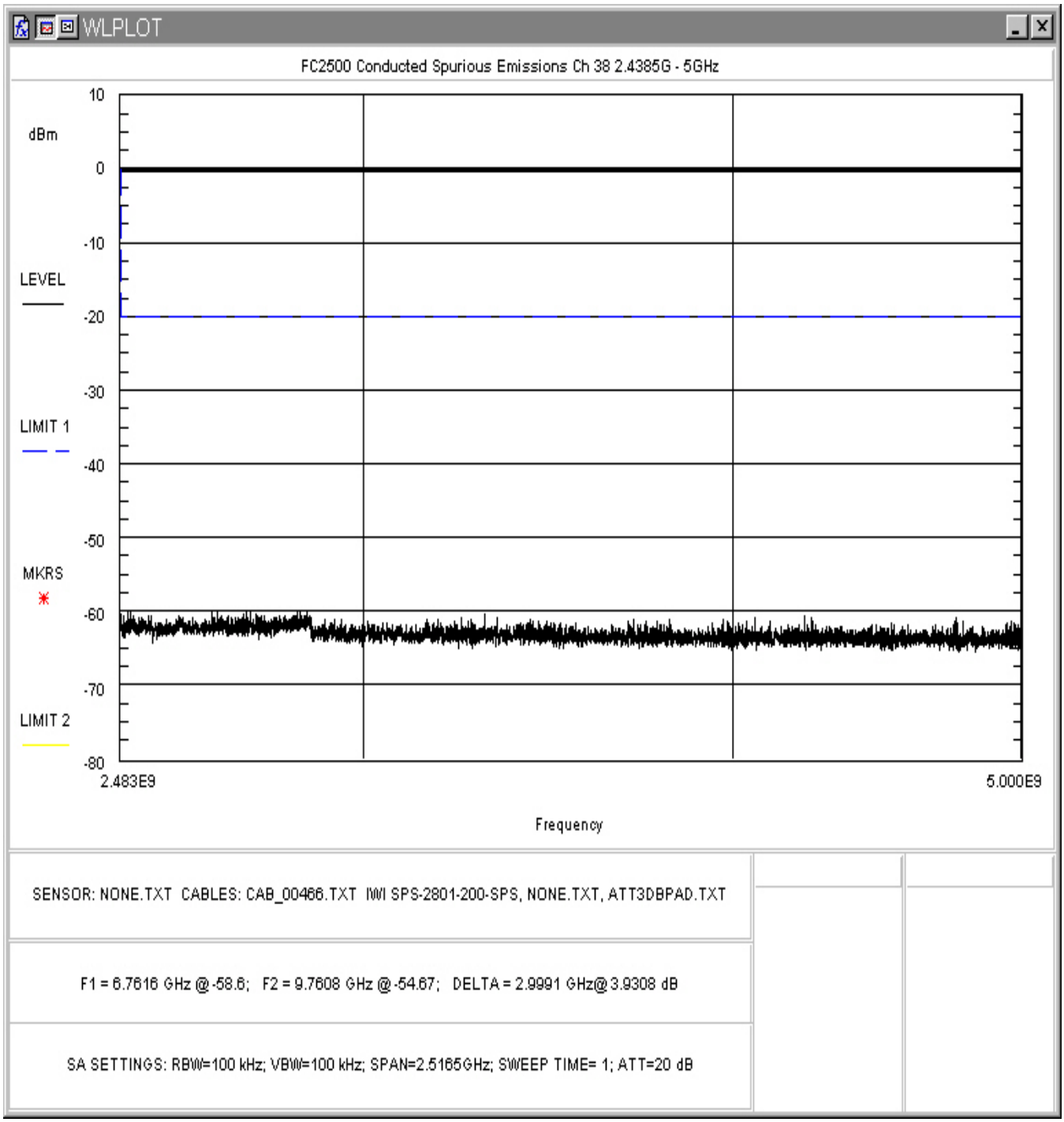

Figure 5-23. Conducted Spurious Emissions, Mid Channel 2483.5 –5000 MHz

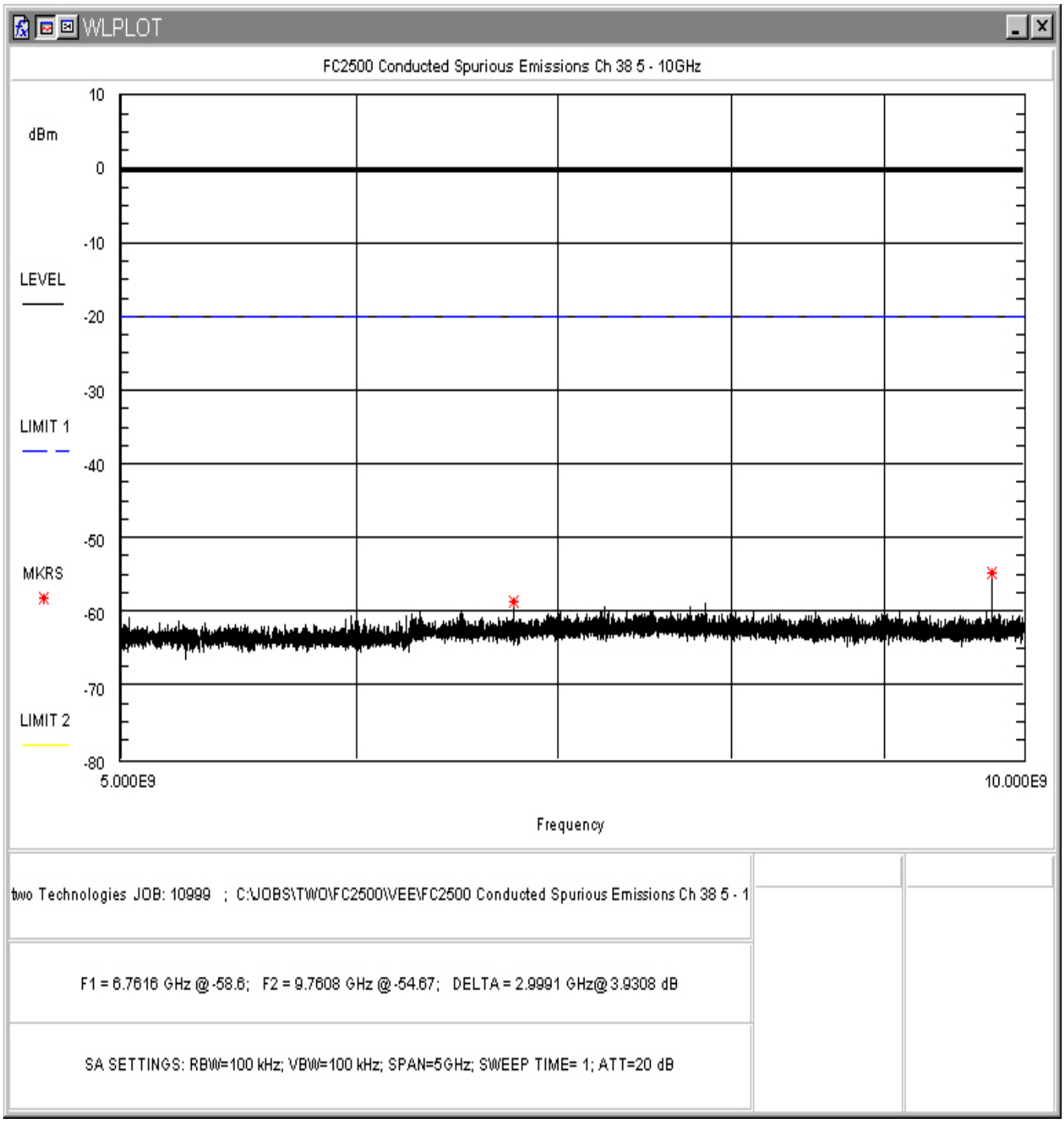

Figure 5-24. Conducted Spurious Emissions, Mid Channel 5 - 10GHz

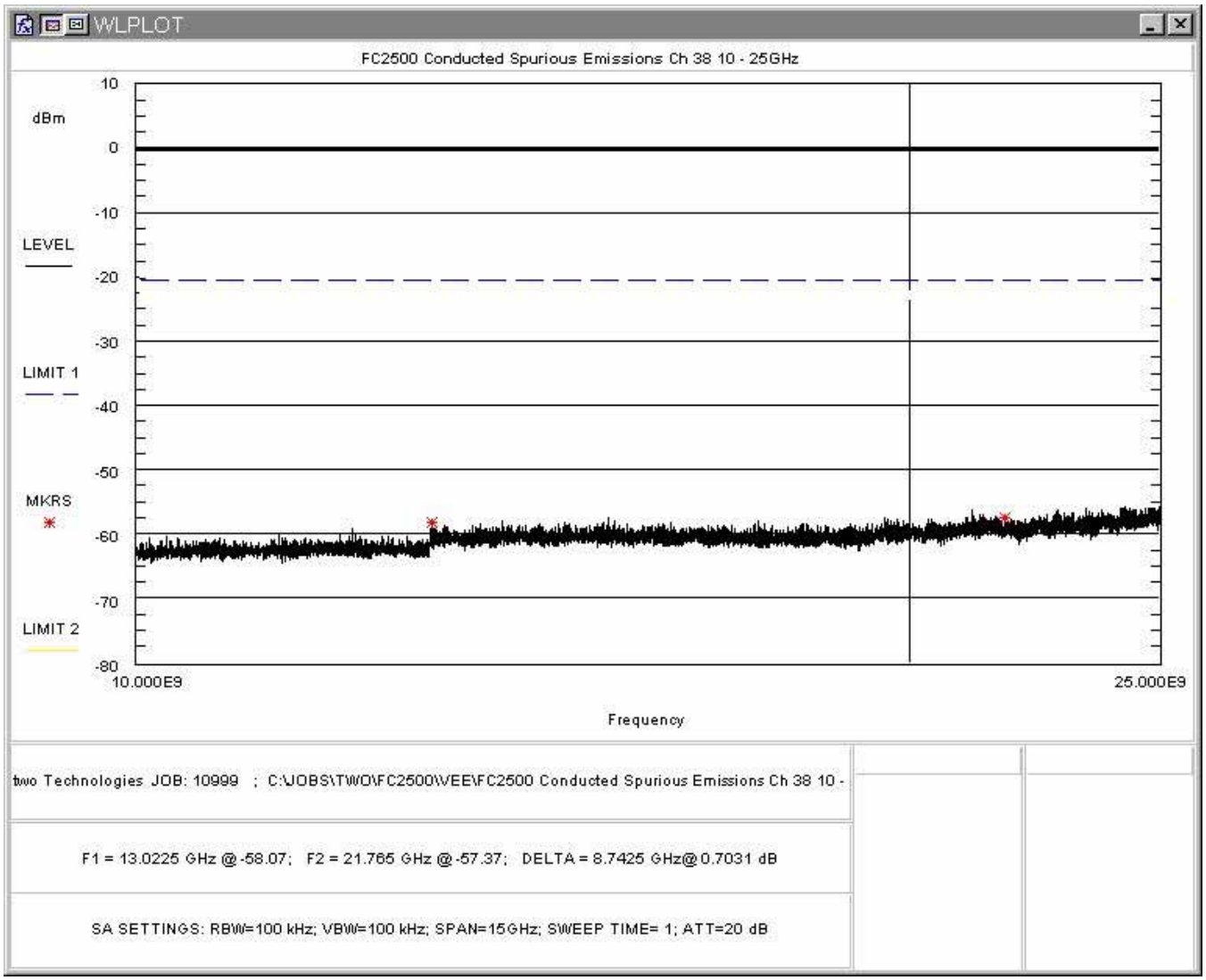

Figure 5-25. Conducted Spurious Emissions, Mid Channel 10 – 25GHz

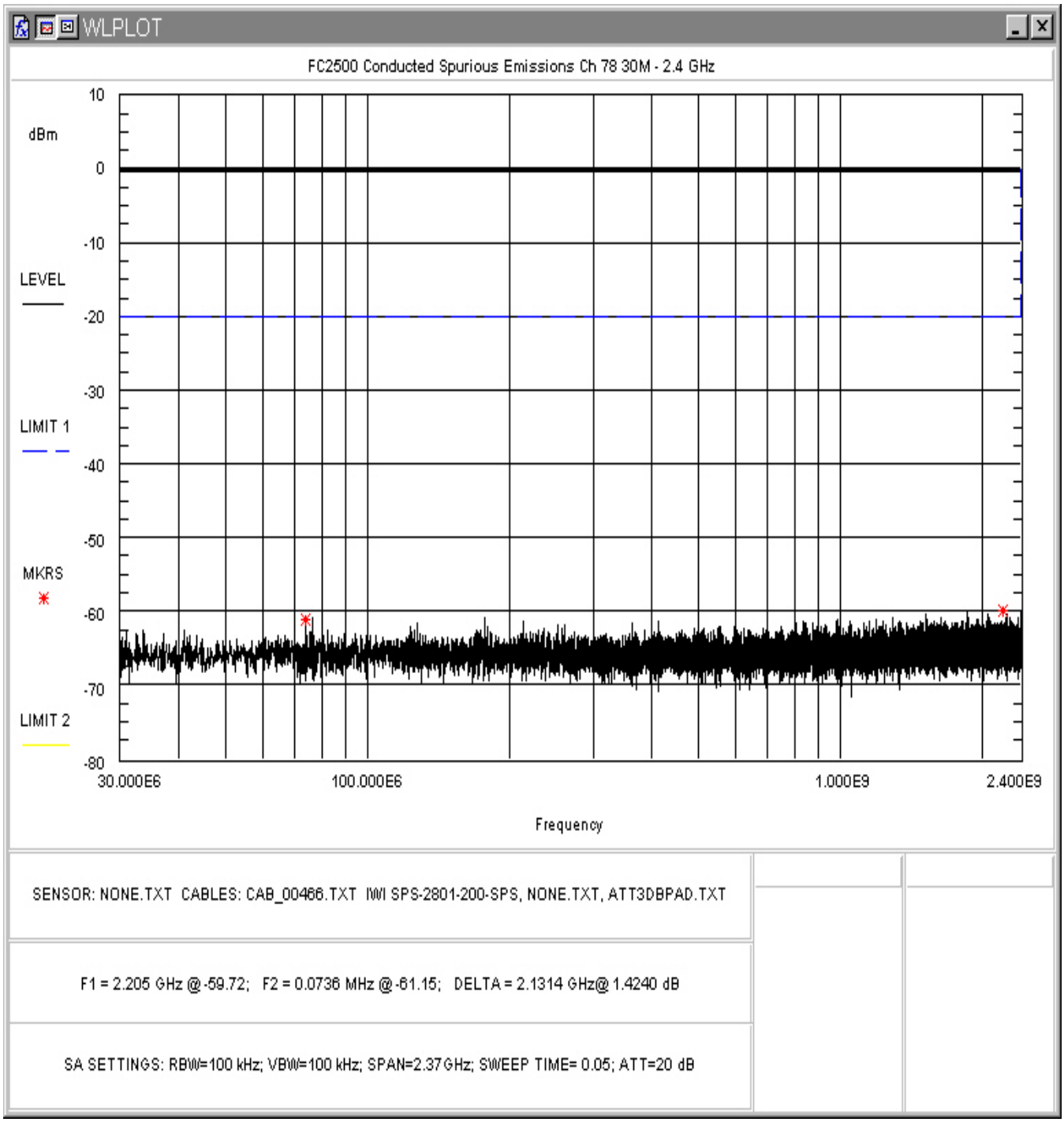

Figure 5-26. Conducted Spurious Emissions, High Channel 30M – 2400GHz

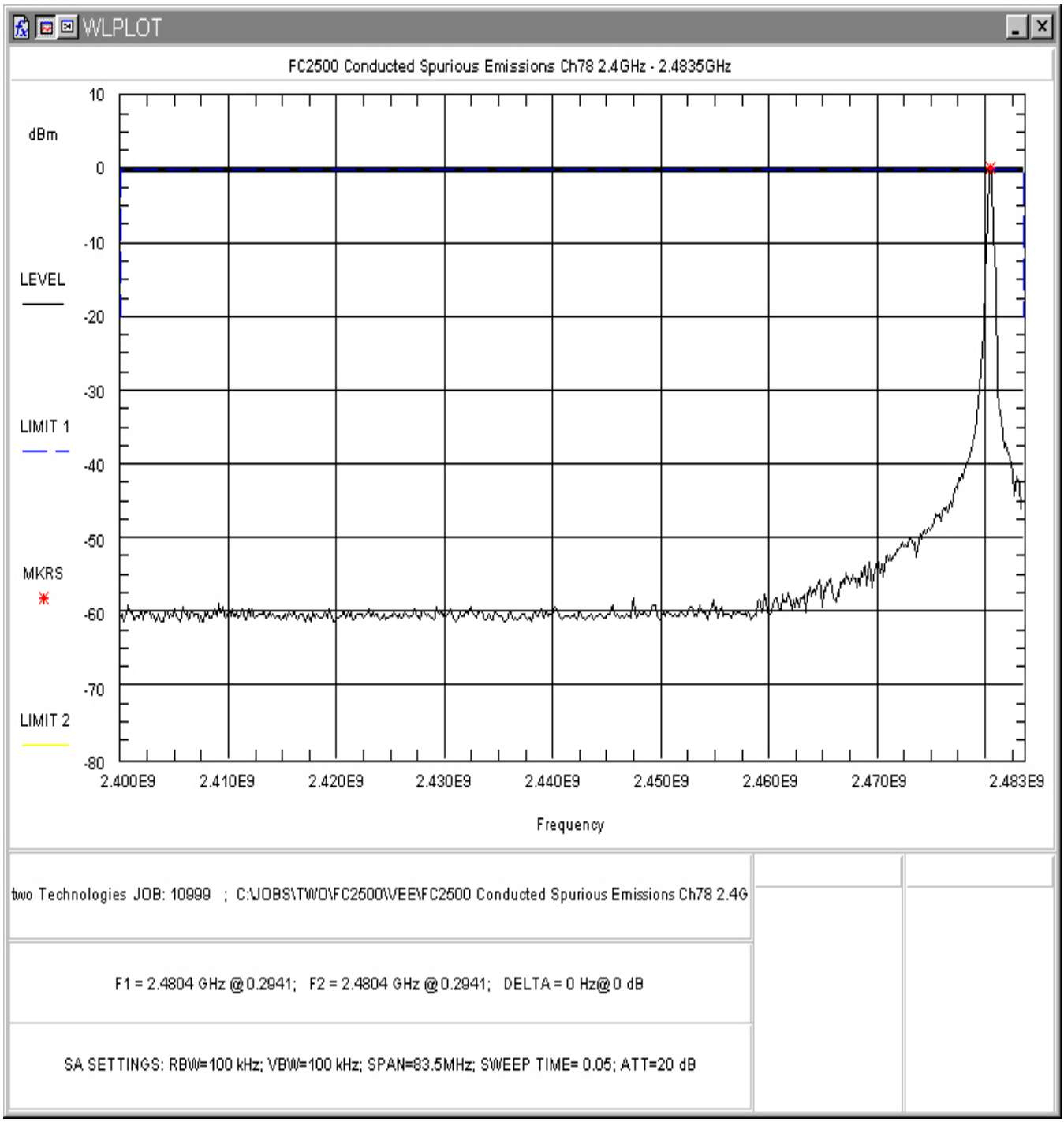

Figure 5-27. Conducted Spurious Emissions, High Channel 2400 – 2483.5MHz

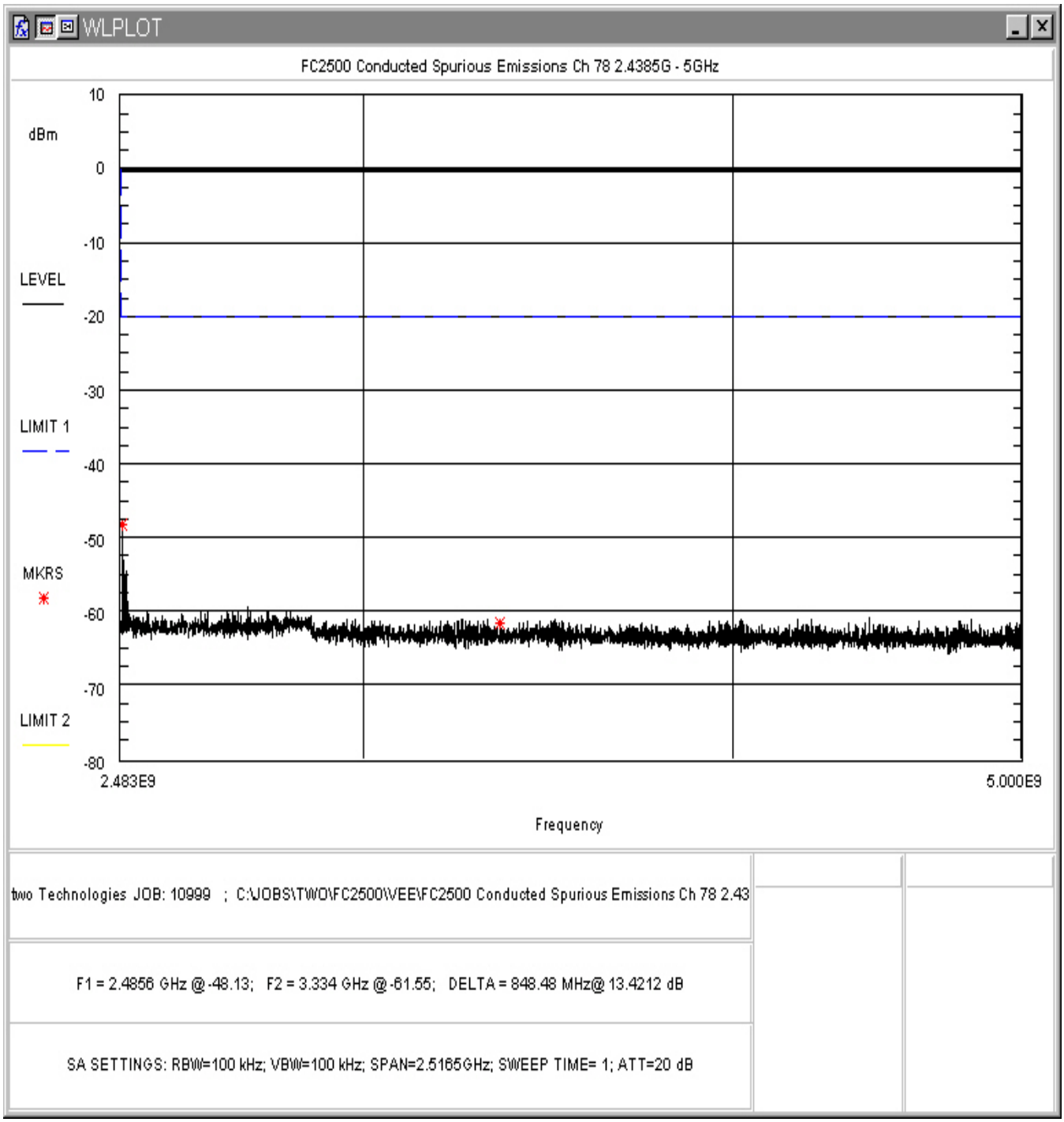

Figure 5-28. Conducted Spurious Emissions, High Channel 2483.5 –5000 MHz

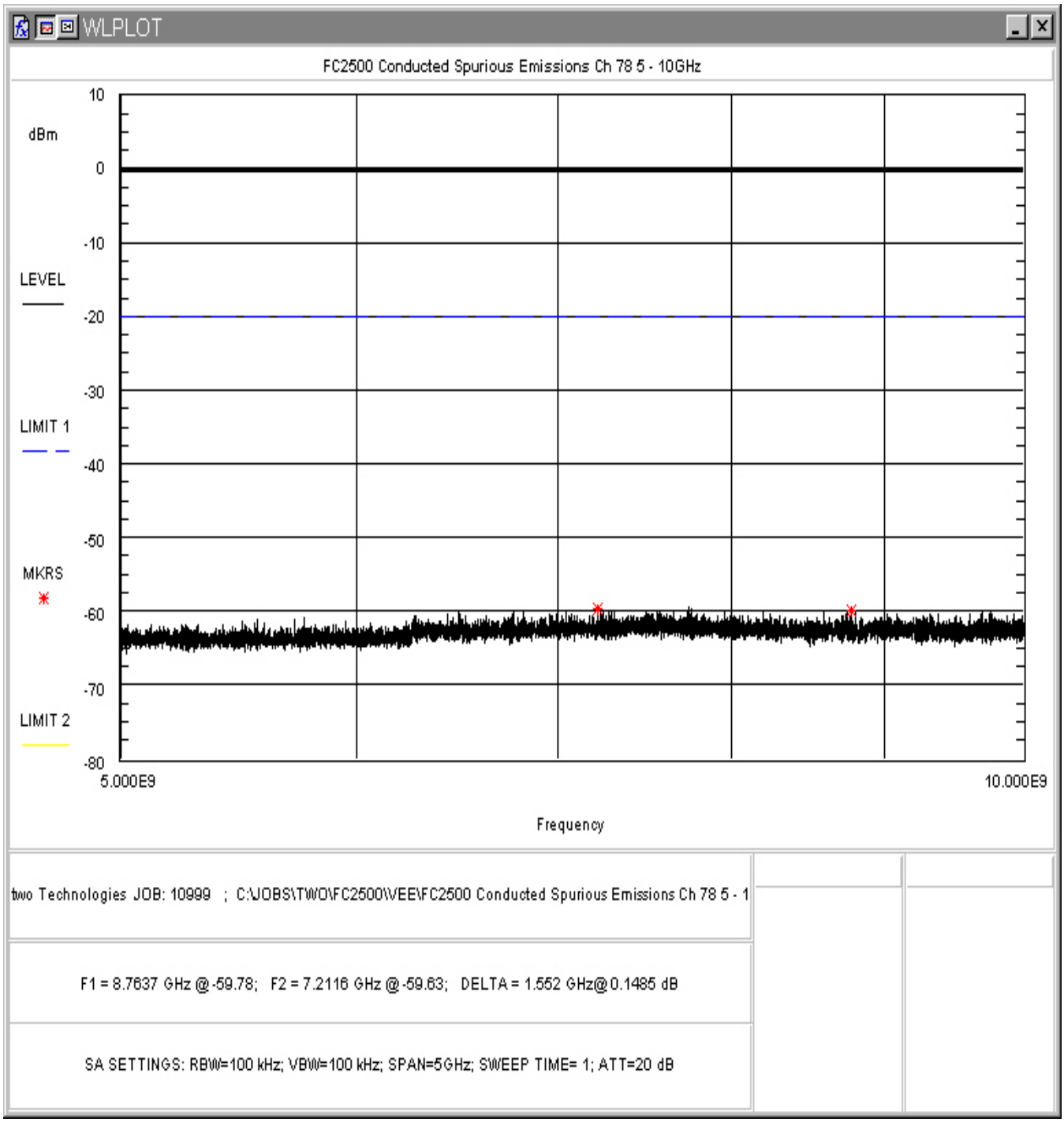

Figure 5-29. Conducted Spurious Emissions, High Channel 5 - 10GHz

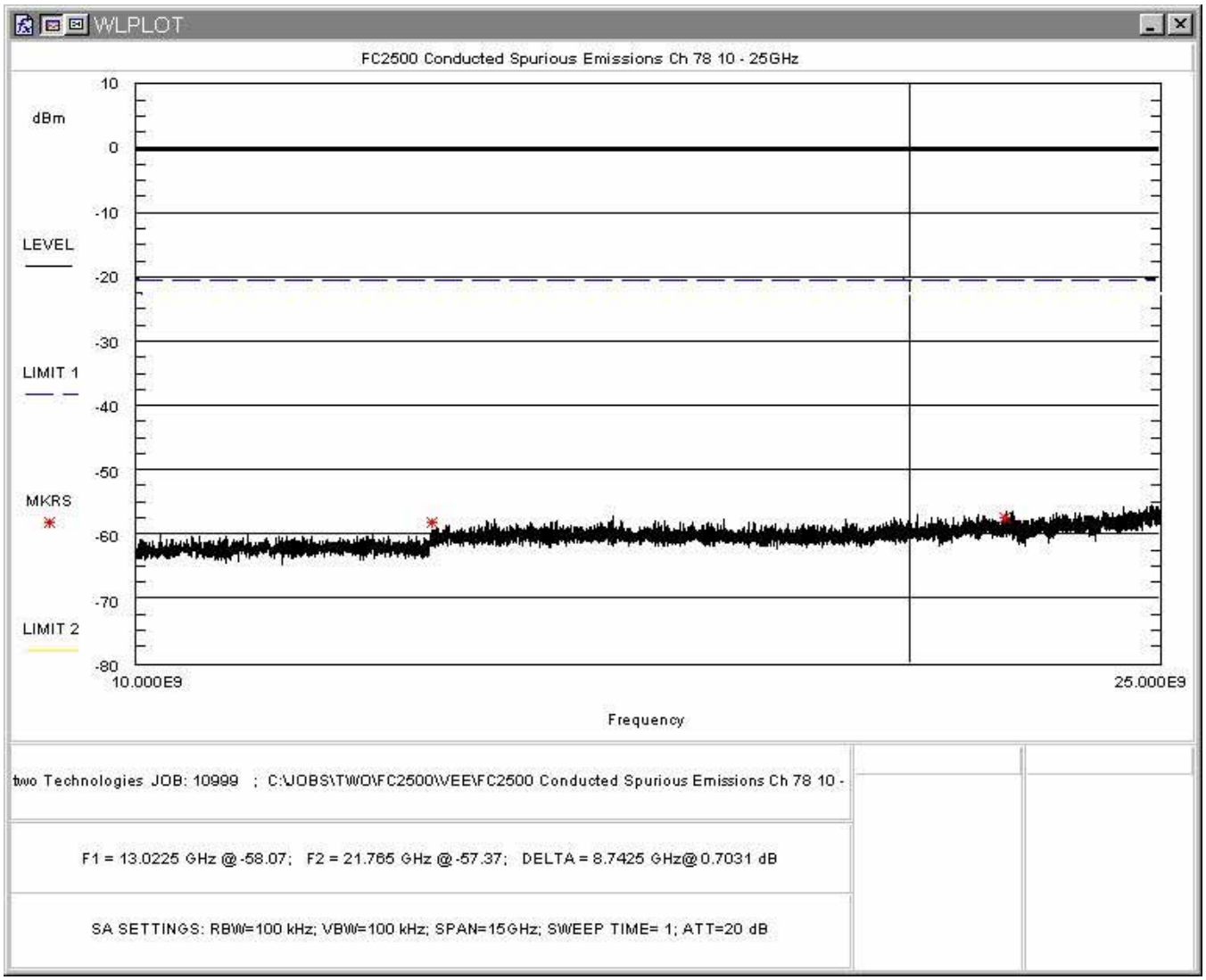

Figure 5-30. Conducted Spurious Emissions, High Channel 10 – 25GHz

5.7 Conducted Band Edge Emissions at Antenna Terminals: 15.247(d), RSS-210 [A8. 5]

The following plots show close-up plots of the allowable band edges with the EUT in both the stationary and hopping modes of operation. The EUT shall be 20dBc at the band edges in a 100kHz resolution bandwidth .

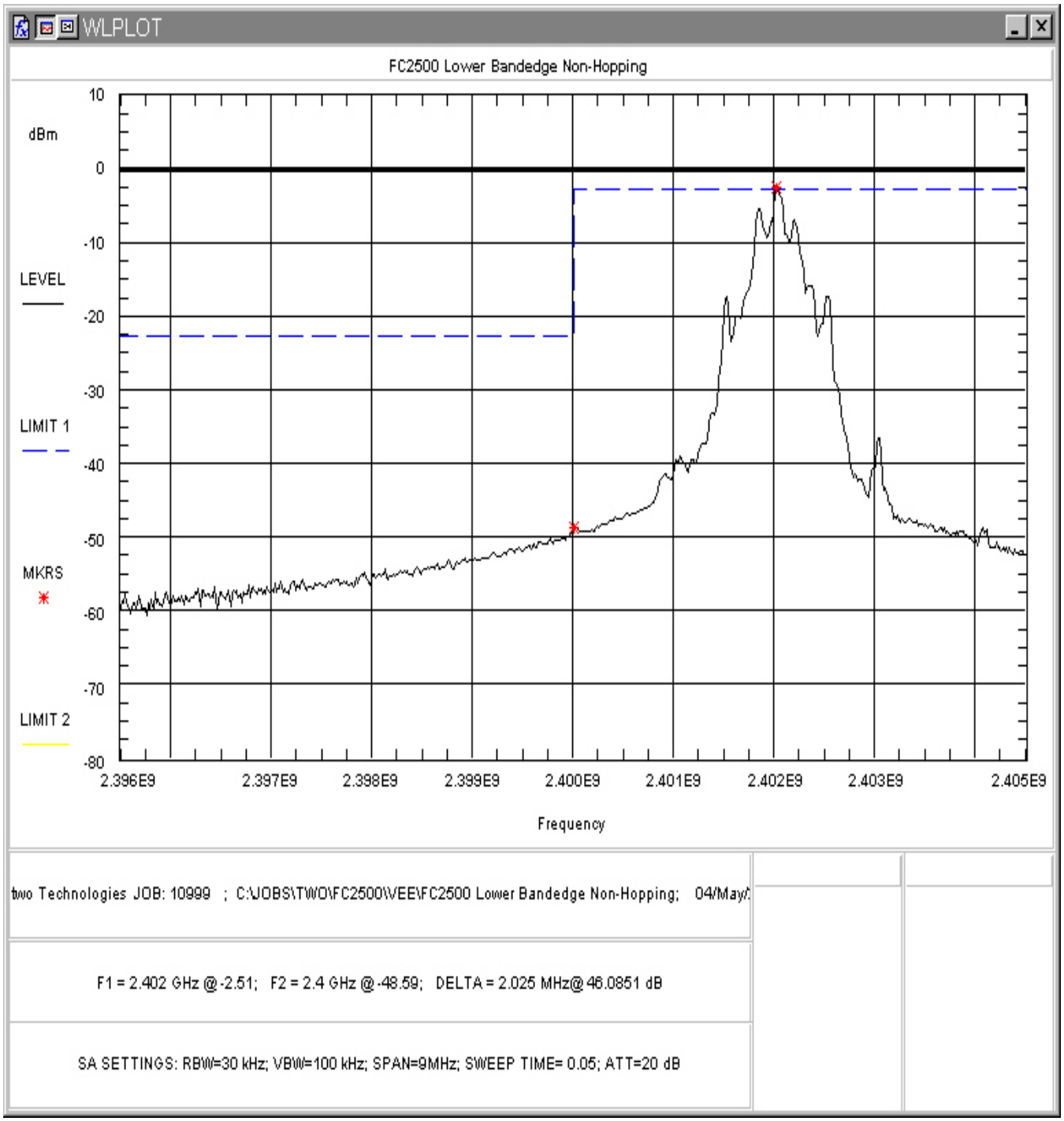

Figure 5-31. Conducted Lower Band Edge, Non-hopping Low Channel

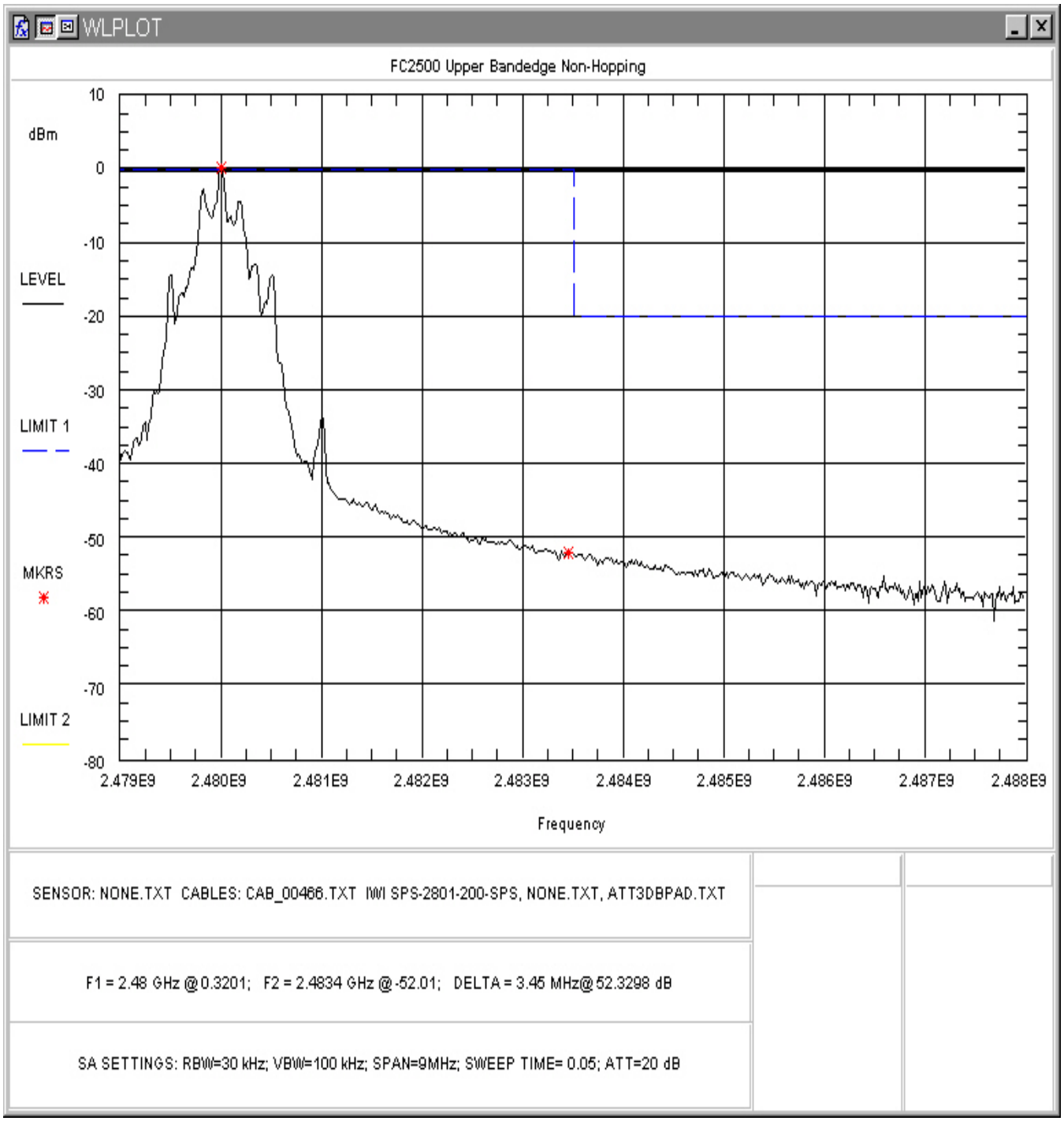

Figure 5-32. Conducted Upper Band Edge, Non-hopping High Channel

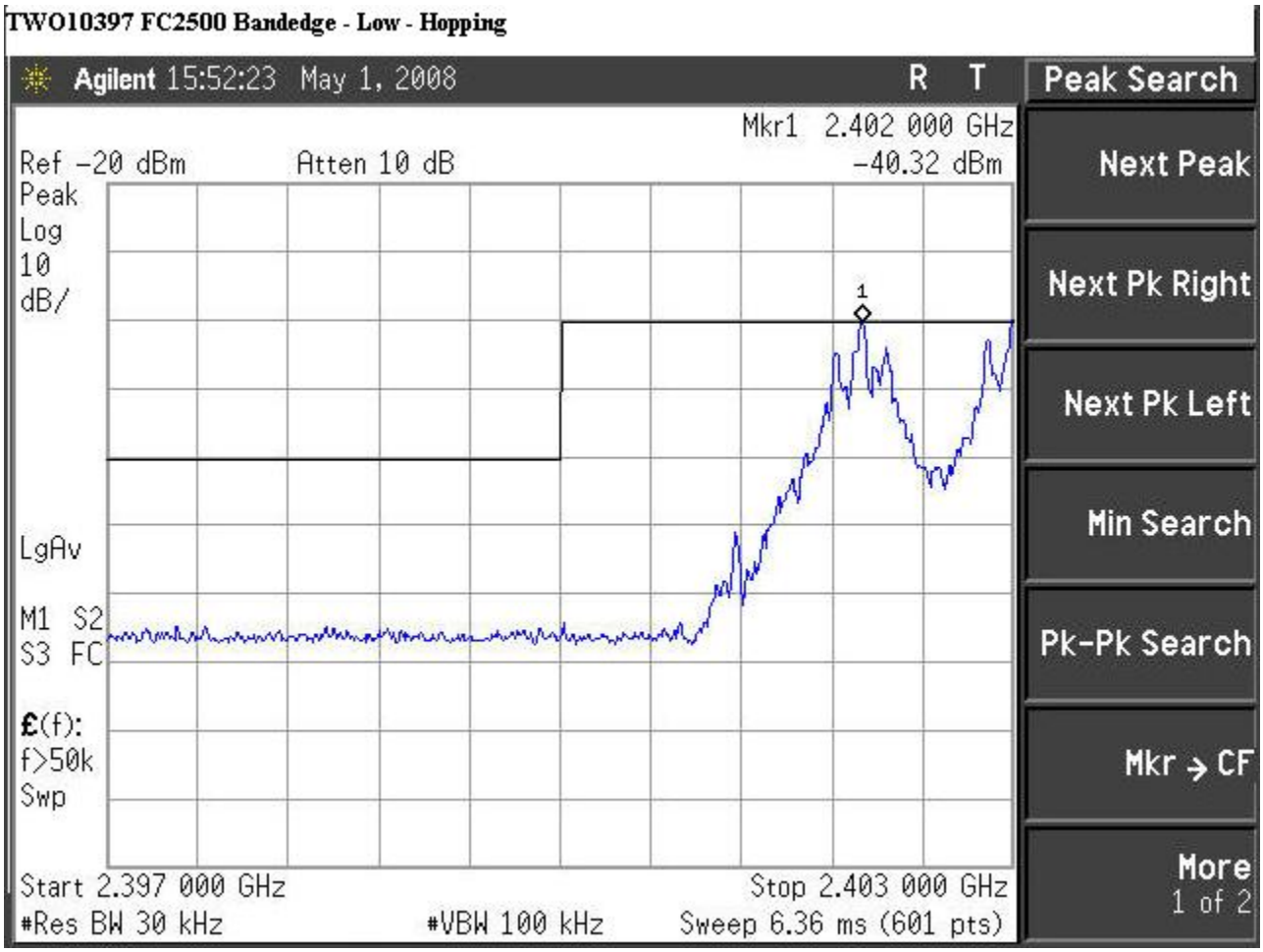

Figure 5-33. Conducted Lower Band Edge, Hopping Mode

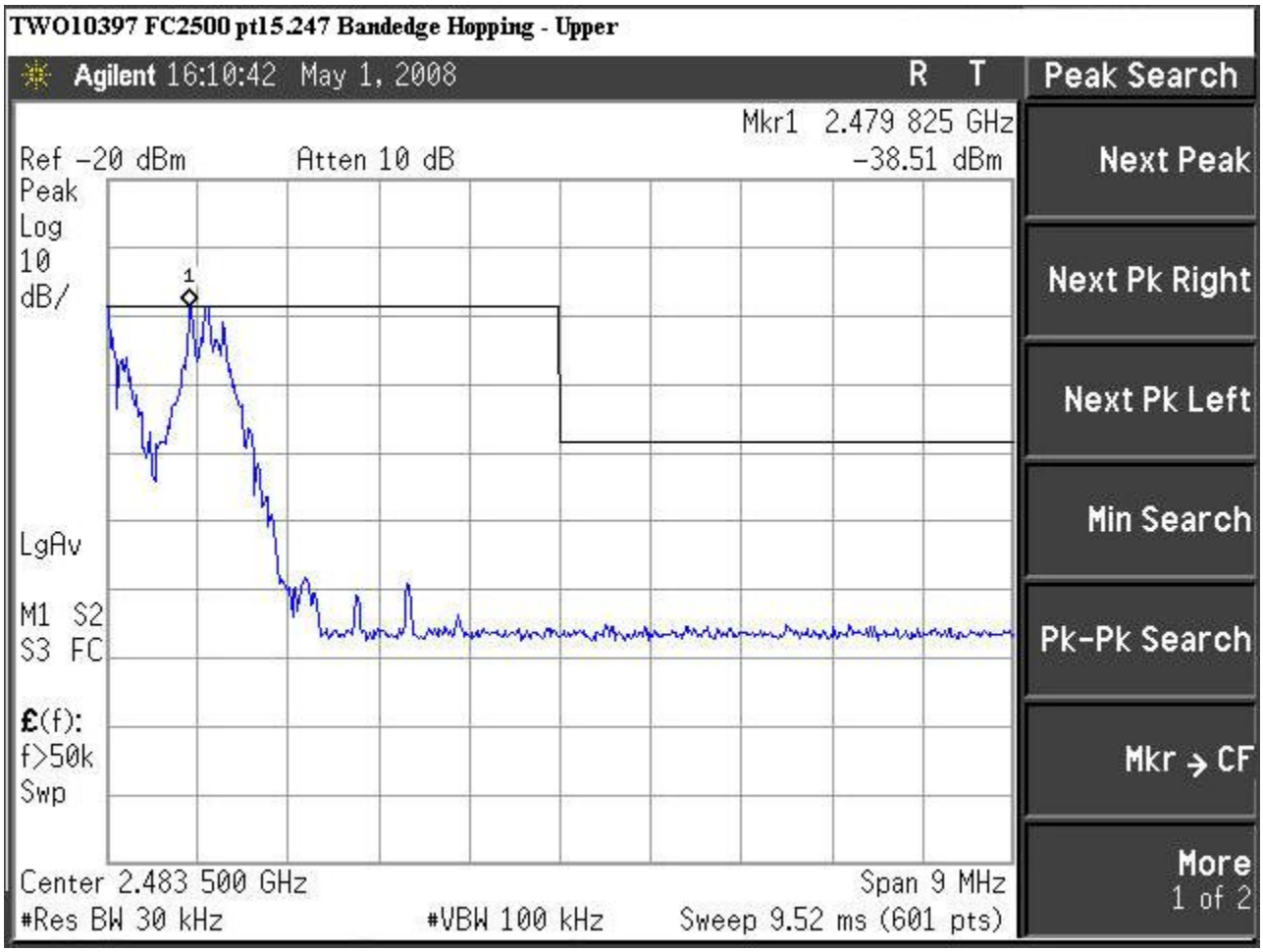

Figure 5-34. Conducted Upper Band Edge, Hopping Mode

5.8 Transmit Radiated Spurious Emissions: (FCC Part §15.205, §15.209, RSS210 (A.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 §15.209 and §15.35(b) for peak measurements.

5.8.1 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:

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

5.8.2 Test Summary

The EUT complied with the requirements for radiated emissions FCC part 15.247 and IC RSS-210e issue 7.

Table 7: Radiated Emission Test Data, Restricted Bands –Low Channel

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amplifier Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
Peak	**Unit Flat**										
4804.000	V	0.0	1.8	50.6	32.5	5.0	35.4	52.7	429.6	5000.0	-21.3
12010.000	V	180.0	2.7	44.0	40.0	8.7	35.5	57.2	724.3	5000.0	-16.8
AVG											
4804.000	V	0.0	1.8	41.1	32.5	5.0	35.4	43.2	144.6	500.0	-10.8
12010.000	V	180.0	2.7	33.5	40.0	8.7	35.5	46.7	216.2	500.0	-7.3
Peak											
4804.000	H	45.0	2.4	50.6	32.5	5.0	35.4	52.7	431.6	5000.0	-21.3
12010.000	H	180.0	2.5	44.0	40.0	8.7	35.5	57.2	724.3	5000.0	-16.8
AVG	H										
4804.000	H	45.0	2.4	36.4	32.5	5.0	35.4	38.5	84.2	500.0	-15.5
12010.000	H	180.0	2.5	33.5	40.0	8.7	35.5	46.7	216.2	500.0	-7.3
Non Harmonics											
2390.000	V	0.0	2.3	37.3	28.9	1.4	36.3	31.3	36.6	500.0	-22.7
1464.370	V	180.0	2.8	39.5	26.5	2.6	36.5	32.0	40.0	500.0	-21.9
1536.800	V	190.0	2.7	41.3	26.7	2.6	36.5	34.2	51.2	500.0	-19.8
2390.000	H	90.0	2.1	38.6	28.9	1.4	36.3	32.6	42.5	500.0	-21.4
1464.370	H	180.0	2.8	40.0	26.5	2.6	36.5	32.5	42.3	500.0	-21.4
1536.800	H	190.0	2.6	39.1	26.7	2.6	36.5	31.9	39.6	500.0	-22.0
Peak	**Unit Upright**										
4804.000	V	190.0	2.0	49.5	32.5	5.0	35.4	51.6	380.3	5000.0	-22.4
12010.000	V	180.0	2.6	43.9	40.0	8.7	35.5	57.1	716.0	5000.0	-16.9
AVG											
4804.000	V	190.0	2.0	41.0	32.5	5.0	35.4	43.1	142.9	500.0	-10.9
12010.000	V	180.0	2.6	34.0	40.0	8.7	35.5	47.2	229.0	500.0	-6.8
Peak											
4804.000	H	90.0	2.6	49.1	32.5	5.0	35.4	51.2	363.1	5000.0	-22.8
12010.000	H	180.0	2.4	44.3	40.0	8.7	35.5	57.5	749.7	5000.0	-16.5
AVG											
4804.000	H	90.0	2.6	35.8	32.5	5.0	35.4	37.9	78.5	500.0	-16.1
12010.000	H	180.0	2.4	34.2	40.0	8.7	35.5	47.4	234.4	500.0	-6.6
Non Harmonics											
2390.000	V	180.0	2.6	37.9	28.9	1.4	36.3	31.9	39.2	500.0	-22.1
1464.370	V	180.0	2.5	38.2	26.5	2.6	36.5	30.7	34.4	500.0	-23.2
1536.800	V	170.0	2.9	40.0	26.7	2.6	36.5	32.8	43.9	500.0	-21.1
2390.000	H	180.0	2.5	40.1	28.9	1.4	36.3	34.1	50.5	500.0	-19.9

1464.370	H	200.0	2.5	37.3	26.5	2.6	36.5	29.8	31.0	500.0	-24.1
1536.800	H	180.0	2.9	38.2	26.7	2.6	36.5	31.0	35.7	500.0	-22.9
Peak	**Unit on side**										
4804.000	V	270.0	2.6	50.4	32.5	5.0	35.4	52.5	421.8	5000.0	-21.5
12010.000	V	0.0	2.4	44.1	40.0	8.7	35.5	57.3	732.7	5000.0	-16.7
AVG											
4804.000	V	270.0	2.6	42.5	32.5	5.0	35.4	44.6	169.9	500.0	-9.4
12010.000	V	0.0	2.4	35.2	40.0	8.7	35.5	48.4	263.0	500.0	-5.6
Peak											
4804.000	H	270.0	2.6	50.0	32.5	5.0	35.4	52.1	402.8	5000.0	-21.9
12010.000	H	180.0	2.3	43.8	40.0	8.7	35.5	57.0	707.8	5000.0	-17.0
AVG											
4804.000	H	270.0	2.6	36.8	32.5	5.0	35.4	38.9	88.1	500.0	-15.1
12010.000	H	180.0	2.3	35.1	40.0	8.7	35.5	48.3	260.0	500.0	-5.7
Non Harmonics											
2390.000	V	270.0	2.8	38.2	28.9	1.4	36.3	32.2	40.6	500.0	-21.8
1464.370	V	145.0	2.9	39.0	26.5	2.6	36.5	31.5	37.7	500.0	-22.4
1536.800	V	190.0	2.9	42.1	26.7	2.6	36.5	34.9	55.9	500.0	-19.0
1464.370	H	145.0	2.9	38.3	26.5	2.6	36.5	30.8	34.8	500.0	-23.1
2390.000	H	45.0	2.4	37.2	28.9	1.4	36.3	31.2	36.2	500.0	-22.8
1536.800	H	170.0	2.9	40.9	26.7	2.6	36.5	33.7	48.7	500.0	-20.2

Table 8: Radiated Emission Test Data, Restricted Bands –Center Channel

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amplifier Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
Peak	**Unit Flat**										
4880.000	V	270.0	3.0	49.3	32.6	5.1	35.4	51.6	379.7	5000.0	-22.4
7320.000	V	25.0	3.1	51.0	37.1	6.4	35.4	59.1	902.3	5000.0	-14.9
12200.000	V	180.0	2.8	45.0	40.0	8.5	35.4	58.2	809.3	5000.0	-15.8
AVG											
4880.000	V	270.0	3.0	36.7	32.6	5.1	35.4	39.0	88.7	500.0	-15.0
7320.000	V	25.0	3.1	37.8	37.1	6.4	35.4	45.9	197.4	500.0	-8.1
12200.000	V	180.0	2.8	34.1	40.0	8.5	35.4	47.3	230.7	500.0	-6.7
Peak											
4880.000	H	90.0	2.3	49.2	32.6	5.1	35.4	51.4	372.7	5000.0	-22.6
7320.000	H	90.0	2.1	50.8	37.1	6.4	35.4	58.9	884.8	5000.0	-15.0
12200.000	H	180.0	2.2	44.6	40.0	8.5	35.4	57.8	772.9	5000.0	-16.2
AVG											
4880.000	H	90.0	2.3	36.1	32.6	5.1	35.4	38.4	82.8	500.0	-15.6
7320.000	H	90.0	2.1	37.0	37.1	6.4	35.4	45.1	180.0	500.0	-8.9
12200.000	H	180.0	2.2	34.2	40.0	8.5	35.4	47.4	233.4	500.0	-6.6
Non Harmonics											
1503.370	V	0.0	3.0	38.2	26.6	2.6	36.5	30.9	35.1	500.0	-23.1
1575.800	V	270.0	2.5	42.5	26.8	2.7	36.5	35.5	59.7	500.0	-18.5
1503.370	H	10.0	2.9	38.0	26.6	2.6	36.5	30.7	34.3	500.0	-23.3
1575.800	H	270.0	2.3	39.2	26.8	2.7	36.5	32.2	40.8	500.0	-21.8
Peak	**Unit Upright**										
4880.000	V	45.0	2.8	48.1	32.6	5.1	35.4	50.4	329.5	5000.0	-23.6
7320.000	V	190.0	2.8	48.5	37.1	6.4	35.4	56.6	676.7	5000.0	-17.4
12200.000	V	180.0	2.4	44.2	40.0	8.5	35.4	57.4	738.1	5000.0	-16.6
AVG											
4880.000	V	45.0	2.8	35.6	32.6	5.1	35.4	37.9	78.1	500.0	-16.1
7320.000	V	190.0	2.8	36.5	37.1	6.4	35.4	44.6	170.0	500.0	-9.4
12200.000	V	180.0	2.4	35.0	40.0	8.5	35.4	48.2	255.9	500.0	-5.8
Peak											
4880.000	H	60.0	2.4	47.2	32.6	5.1	35.4	49.5	297.1	5000.0	-24.5
7320.000	H	180.0	2.5	47.9	37.1	6.4	35.4	56.0	631.5	5000.0	-18.0
12200.000	H	180.0	3.1	44.0	40.0	8.5	35.4	57.2	721.3	5000.0	-16.8

AVG											
4880.000	H	60.0	2.4	35.2	32.6	5.1	35.4	37.5	74.6	500.0	-16.5
7320.000	H	180.0	2.5	35.8	37.1	6.4	35.4	43.9	156.8	500.0	-10.1
12200.000	H	180.0	3.1	34.1	40.0	8.5	35.4	47.3	230.7	500.0	-6.7
Non Harmonics											
1503.370	V	0.0	3.0	38.2	26.6	2.6	36.5	30.9	35.1	500.0	-23.1
1575.800	V	270.0	2.5	42.5	26.8	2.7	36.5	35.5	59.7	500.0	-18.5
1503.370	H	180.0	2.9	37.4	26.6	2.6	36.5	30.1	32.0	500.0	-23.9
1575.800	H	90.0	2.3	42.0	26.8	2.7	36.5	35.0	56.3	500.0	-19.0
Peak	**Unit on Side**										
4880.000	V	0.0	2.7	50.2	32.6	5.1	35.4	52.5	419.7	5000.0	-21.5
7320.000	V	10.0	2.2	48.1	37.1	6.4	35.4	56.2	646.2	5000.0	-17.8
12200.000	V	190.0	2.5	43.8	40.0	8.5	35.4	57.0	704.9	5000.0	-17.0
AVG											
4880.000	V	0.0	2.7	37.0	32.6	5.1	35.4	39.3	91.8	500.0	-14.7
7320.000	V	10.0	2.2	36.2	37.1	6.4	35.4	44.3	164.2	500.0	-9.7
12200.000	V	190.0	2.5	34.9	40.0	8.5	35.4	48.1	253.0	500.0	-5.9
Peak											
4880.000	H	10.0	2.8	49.2	32.6	5.1	35.4	51.5	374.0	5000.0	-22.5
7320.000	H	45.0	3.0	50.0	37.1	6.4	35.4	58.1	804.2	5000.0	-15.9
12200.000	H	0.0	2.6	45.0	40.0	8.5	35.4	58.2	809.3	5000.0	-15.8
AVG											
4880.000	H	10.0	2.8	37.1	32.6	5.1	35.4	39.4	92.9	500.0	-14.6
7320.000	H	45.0	3.0	37.5	37.1	6.4	35.4	45.6	190.7	500.0	-8.4
9760.000	H	45.0	2.3	35.2	38.7	8.1	36.0	45.9	198.1	500.0	-8.0
12200.000	H	0.0	2.6	34.6	40.0	8.5	35.4	47.8	244.4	500.0	-6.2
Non Harmonics											
1503.370	V	180.0	2.9	37.0	26.6	2.6	36.5	29.7	30.6	500.0	-24.3
1575.800	V	45.0	2.6	43.1	26.8	2.7	36.5	36.1	63.9	500.0	-17.9
1503.370	H	180.0	2.6	36.1	26.6	2.6	36.5	28.8	27.5	500.0	-25.2
1575.800	H	60.0	2.3	41.8	26.8	2.7	36.5	34.8	55.0	500.0	-19.2

Table 9: Radiated Emission Test Data, Restricted Bands –High Channel

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amplifier Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
Peak	**Unit Flat**										
4960.000	V	20.0	2.5	49.8	32.7	5.1	35.4	52.2	409.7	5000.0	-21.7
7440.000	V	90.0	2.4	49.7	37.1	6.3	35.5	57.7	764.8	5000.0	-16.3
12400.000	V	0.0	2.8	44.5	40.0	8.4	35.3	57.6	760.7	5000.0	-16.4
AVG											
4960.000	V	20.0	2.5	37.0	32.7	5.1	35.4	39.4	93.5	500.0	-14.6
7440.000	V	90.0	2.4	35.0	37.1	6.3	35.5	43.0	141.3	500.0	-11.0
12400.000	V	0.0	2.8	34.1	40.0	8.4	35.3	47.2	229.7	500.0	-6.8
Peak											
4960.000	H	45.0	2.5	49.7	32.7	5.1	35.4	52.1	402.3	5000.0	-21.9
7440.000	H	20.0	3.2	47.7	37.1	6.3	35.5	55.7	606.6	5000.0	-18.3
12400.000	H	0.0	2.9	44.8	40.0	8.4	35.3	57.9	787.5	5000.0	-16.1
AVG											
4960.000	H	45.0	2.5	36.8	32.7	5.1	35.4	39.2	91.7	500.0	-14.7
7440.000	H	20.0	3.2	35.1	37.1	6.3	35.5	43.1	142.9	500.0	-10.9
12400.000	H	0.0	2.9	34.8	40.0	8.4	35.3	47.9	249.0	500.0	-6.1
Non Harmonics											
2483.500	V	180.0	2.6	42.5	29.1	1.1	36.3	36.3	65.6	500.0	-17.6
1540.670	V	180.0	2.8	42.5	26.7	2.6	36.5	35.4	58.6	500.0	-18.6
1615.200	V	200.0	2.4	41.1	27.0	2.7	36.5	34.3	51.7	500.0	-19.7
2483.500	H	20.0	2.7	40.3	29.1	1.1	36.3	34.2	51.1	500.0	-19.8
1540.670	H	180.0	2.9	43.0	26.7	2.6	36.5	35.9	62.1	500.0	-18.1
1615.200	H	200.0	2.6	41.1	27.0	2.7	36.5	34.3	51.7	500.0	-19.7
Peak	**Unit Upright**										
4960.000	V	270.0	2.2	48.5	32.7	5.1	35.4	50.9	351.6	5000.0	-23.1
7440.000	V	280.0	34.8	46.8	37.1	6.3	35.5	54.8	551.5	5000.0	-19.1
12400.000	V	45.0	2.7	44.0	40.0	8.4	35.3	57.1	718.2	5000.0	-16.9
AVG											
4960.000	V	270.0	2.2	36.3	32.7	5.1	35.4	38.7	86.6	500.0	-15.2
7440.000	V	280.0	34.8	36.8	37.1	6.3	35.5	44.8	174.4	500.0	-9.1
12400.000	V	45.0	2.7	34.3	40.0	8.4	35.3	47.4	235.1	500.0	-6.6
Peak											
4960.000	H	270.0	2.7	49.8	32.7	5.1	35.4	52.2	409.7	5000.0	-21.7
7440.000	H	180.0	2.6	46.5	37.1	6.3	35.5	54.5	530.9	5000.0	-19.5
12400.00	H	180.0	2.6	44.2	40.0	8.4	35.3	57.3	734.9	5000.0	-16.7

0											
AVG											
4960.000	H	270.0	2.7	37.2	32.7	5.1	35.4	39.6	95.4	500.0	-14.4
7440.000	H	180.0	2.6	34.7	37.1	6.3	35.5	42.7	136.0	500.0	-11.3
12400.000	H	180.0	2.6	34.2	40.0	8.4	35.3	47.3	232.4	500.0	-6.7
Non Harmonics											
2483.500	V	270.0	2.5	40.1	29.1	1.1	36.3	33.9	49.7	500.0	-20.0
1540.670	V	180.0	3.0	41.0	26.7	2.6	36.5	33.9	49.3	500.0	-20.1
1615.200	V	200.0	2.6	39.2	27.0	2.7	36.5	32.4	41.6	500.0	-21.6
2483.500	H	190.0	2.3	39.5	29.1	1.1	36.3	33.3	46.4	500.0	-20.6
1540.670	H	180.0	2.9	41.0	26.7	2.6	36.5	33.9	49.3	500.0	-20.1
1615.200	H	200.0	2.3	40.0	27.0	2.7	36.5	33.2	45.6	500.0	-20.8
Peak	**Unit On Side**										
4960.000	V	180.0	2.4	50.8	32.7	5.1	35.4	53.2	459.7	5000.0	-20.7
7440.000	V	0.0	2.8	47.7	37.1	6.3	35.5	55.7	607.5	5000.0	-18.3
12400.000	V	90.0	2.7	43.8	40.0	8.4	35.3	56.9	701.8	5000.0	-17.1
AVG											
4960.000	V	180.0	2.4	36.8	32.7	5.1	35.4	39.2	91.7	500.0	-14.7
7440.000	V	0.0	2.8	34.3	37.1	6.3	35.5	42.3	130.8	500.0	-11.6
12400.000	V	90.0	2.7	34.0	40.0	8.4	35.3	47.1	227.1	500.0	-6.9
Peak											
4960.000	H	90.0	3.0	50.3	32.7	5.1	35.4	52.7	434.0	5000.0	-21.2
7440.000	H	270.0	2.4	48.5	37.1	6.3	35.5	56.5	668.4	5000.0	-17.5
12400.000	H	180.0	2.6	44.2	40.0	8.4	35.3	57.3	734.9	5000.0	-16.7
AVG											
4960.000	H	90.0	3.0	37.0	32.7	5.1	35.4	39.4	93.5	500.0	-14.6
7440.000	H	270.0	2.4	35.2	37.1	6.3	35.5	43.2	144.6	500.0	-10.8
12400.000	H	180.0	2.6	34.2	40.0	8.4	35.3	47.3	232.4	500.0	-6.7
Non Harmonics											
2483.500	V	270.0	2.5	38.3	29.1	1.1	36.3	32.1	40.4	500.0	-21.8
1540.670	V	180.0	2.8	40.3	26.7	2.6	36.5	33.2	45.7	500.0	-20.8
1615.200	V	200.0	2.6	41.2	27.0	2.7	36.5	34.3	52.2	500.0	-19.6
2483.500	H	190.0	2.3	40.5	29.1	1.1	36.3	34.3	52.1	500.0	-19.6
1540.670	H	180.0	2.8	41.2	26.7	2.6	36.5	34.1	50.5	500.0	-19.9
1615.200	H	200.0	2.6	40.9	27.0	2.7	36.5	34.1	50.6	500.0	-19.9

5.9 Receiver Radiated Spurious Emissions: (FCC Part §15.209, RSS-Gen [7.2.3.2])

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.

5.9.1 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:

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

5.9.2 Test Summary

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

Table 10: Receiver Radiated Test Data

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amplifier Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
Unit upright											
45.000	V	345.0	1.0	10.8	10.4	1.1	0.0	22.3	13.0	100.0	-17.7
61.255	V	185.0	1.0	11.9	7.6	1.1	0.0	20.6	10.7	100.0	-19.4
234.000	V	206.0	1.8	14.4	11.2	1.3	0.0	26.9	22.2	200.0	-19.1
257.151	V	261.0	1.9	16.9	11.7	1.3	0.0	29.9	31.2	200.0	-16.1
312.050	V	157.0	1.6	20.6	13.7	1.4	0.0	35.6	60.6	200.0	-10.4
332.250	V	167.0	2.0	17.4	13.9	1.5	0.0	32.7	43.3	200.0	-13.3
1320.620	V	270.0	2.5	43.3	26.0	2.4	36.5	35.2	57.3	500.0	-18.8
2585.253	V	45.0	2.1	38.7	29.3	1.5	36.3	33.2	45.5	500.0	-20.8
63.200	H	124.0	4.0	9.4	7.8	1.1	0.0	18.3	8.2	100.0	-21.7
228.872	H	180.0	2.5	11.3	11.0	1.3	0.0	23.5	15.0	200.0	-22.5
238.400	H	990.0	1.7	8.0	11.4	1.3	0.0	20.7	10.8	200.0	-25.3
257.148	H	95.0	1.0	8.2	11.7	1.3	0.0	21.2	11.5	200.0	-24.8
286.038	H	287.0	1.4	9.1	13.3	1.3	0.0	23.7	15.3	200.0	-22.3
312.038	H	97.0	1.0	21.6	13.7	1.4	0.0	36.6	68.0	200.0	-9.4
1320.620	H	270.0	2.3	32.5	26.0	2.4	36.5	24.4	16.6	500.0	-29.6
Flat											
47.460	V	253.0	1.0	13.7	9.1	1.1	0.0	23.9	15.7	100.0	-16.1
61.255	V	358.0	1.0	12.0	7.6	1.1	0.0	20.7	10.9	100.0	-19.3
234.000	V	253.0	2.3	8.3	11.2	1.3	0.0	20.8	11.0	200.0	-25.2
257.151	V	90.0	2.3	7.1	11.7	1.3	0.0	20.1	10.1	200.0	-25.9
312.050	V	131.0	3.0	15.3	13.7	1.4	0.0	30.3	32.9	200.0	-15.7
332.250	V	145.0	2.8	6.3	13.9	1.5	0.0	21.6	12.1	200.0	-24.4
228.872	H	293.0	4.0	11.4	11.0	1.3	0.0	23.6	15.2	200.0	-22.4
238.400	H	93.0	4.0	8.8	11.4	1.3	0.0	21.5	11.9	200.0	-24.5
257.148	H	259.0	4.0	10.2	11.7	1.3	0.0	23.2	14.4	200.0	-22.8
286.038	H	41.0	3.8	12.9	13.3	1.3	0.0	27.5	23.6	200.0	-18.5
312.038	H	104.0	3.4	12.0	13.7	1.4	0.0	27.0	22.5	200.0	-19.0
On Side											
45.000	V	225.0	1.0	13.0	10.4	1.1	0.0	24.5	16.7	100.0	-15.5
61.255	V	191.0	1.0	15.0	7.6	1.1	0.0	23.7	15.4	100.0	-16.3
234.000	V	240.0	2.9	6.4	11.2	1.3	0.0	18.9	8.8	200.0	-27.1

257.151	V	31.0	1.0	8.3	11.7	1.3	0.0	21.3	11.6	200.0	-24.7
312.050	V	215.0	1.0	17.4	13.7	1.4	0.0	32.4	41.9	200.0	-13.6
332.250	V	48.0	1.0	6.0	13.9	1.5	0.0	21.3	11.6	200.0	-24.7
228.872	H	97.0	4.0	11.8	11.0	1.3	0.0	24.0	15.9	100.0	-16.0
238.400	H	0.0	4.0	9.2	11.4	1.3	0.0	21.9	12.5	100.0	-18.1
257.148	H	325.0	1.3	20.2	11.7	1.3	0.0	33.2	45.7	200.0	-12.8
286.038	H	20.0	1.0	17.6	13.3	1.3	0.0	32.2	40.6	200.0	-13.8
312.038	H	161.0	1.0	21.0	13.7	1.4	0.0	36.0	63.4	200.0	-10.0

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

5.10.1 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

5.10.2 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

5.10.3 Test Summary

The EUT is battery powered and the radio is not to be used in charge mode. This test is not applicable to battery operated units.

5.11 Transmitter Co-location

The EUT has three 2.4GHz transmitters co-located. These transmitters were simultaneously turned on and the spectrum scanned for any RF artifacts that may exceed the FCC class B limits.

5.11.1 Test Summary

The EUT produced no RF products with all transmitters turned On.

