Washington Laboratories, Ltd.

# FCC Certification Test Report
# For the
# Mine Safety Appliance
# FireHawk M7 2.4 GHz HUD Transceiver
# FCC ID: P9R-10075344

WLL REPORT# **10069 Rev 1**
**December 19, 2007**

Prepared for:

**Mine Safety Appliance**
**1000 Cranberry Woods Drive**
**Cranberry Township, PA 16066**

Prepared By:

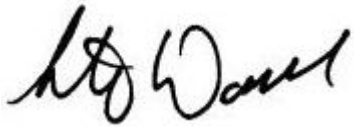
Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

# FCC Certification Test Report
# For the
# Mine Safety Appliance
# FireHawk M7 2.4 GHz HUD Transceiver
# FCC ID: P9R-10075344

**12/19/2007**

WLL REPORT# **10069 Rev 1**

Prepared by:



Steven Dovell
Compliance Engineer

Reviewed by:

Steven D. Koster
EMC Operations Manager

# Abstract

This report has been prepared on behalf of Mine Safety Appliance to support the attached Application for Equipment Authorization. The test report and application are submitted for a Digital Transmission System Transmitter under Part 15.247 of the FCC Rules and Regulations.

This Certification Test Report documents the test configuration and test results for a Mine Safety Appliance FireHawk M7 2.4 GHz HUD Transceiver operating in the 802.11b mode.

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. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The Mine Safety Appliance FireHawk M7 2.4 GHz HUD Transceiver complied with the limits for a Digital Transmission System Transmitter device under FCC Part 15.247.

# Table of Contents



# List of Tables



# List of Figures



# 1 Introduction

## 1.1 Compliance Statement

The Mine Safety Appliance FireHawk M7 2.4 GHz HUD Transceiver complied with the limits for a Digital Transmission System Transmitter device under FCC Part 15.247.

## 1.2 Test Scope Summary

Tests for radiated and conducted (at antenna terminal) emissions were performed. All measurements were performed in accordance Knowledge Data Base (KDB) publication number 558074 entitled "Measurement of Digital Transmission Systems operating under Section 15.247". The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

| Test Specification | Specific Description | Date Completed | Result | Modifications? (Y/N) |
|---|---|---|---|---|
| CFR47 Part 2.1046 | RF Power Output | 10/4/07 | Complied | No |
| CFR47 Part 2.1049 | Occupied Bandwidth | 10/4/07 | Complied | No |
| CFR47 Part 2.1051 | Conducted Spurious Emissions at Antenna Terminals | 10/4/07 | Complied | No |
| CFR47 Part 2.1053 | Radiated Spurious Emissions | 10/22/07 | Complied | No |
| CFR47 Part 15.247 | Power Spectral Density | 10/4/07 | Complied | No |

## 1.3 Contract Information

Customer: Mine Safety Appliance
1000 Cranberry Woods Drive
Cranberry Township, PA 16066

Quotation Number: 63621

## 1.4 Test and Support Personnel

Washington Laboratories, LTD Steven Dovell

Client Representative Greg Imblum

# 2 Equipment Under Test

## 2.1 EUT Identification & Description

**FireHawk® M7 HUD** - The Heads-Up Display (HUD) similar in appearance and function to the existing HUD (P9R-10031511) device. The HUD is worn by fire-fighters on the face piece of their Self Contained Breathing Apparatus (SCBA). The HUD is designed to display the status of their air supply, PASS alarm and battery power. The HUD uses multi-colored LEDs to indicate the remaining air supply in a bar graph format. There are additional LEDs to indicate a PASS alarm, low battery indication and an evacuation signal. The LEDs are visible through the facemask so the fire-fighter can see the status indicators while working hands free. The HUD contains a Low-Frequency (27KHz) receiver. This receiver is used to wake the HUD out of standby mode and initiate paring for the 2.4GHz transceiver between the HUD and the Control Module

**Table 1. Device Summary**

| ITEM | DESCRIPTION |
|---|---|
| Manufacturer: | Mine Safety Appliance |
| FCC ID: | P9R-10075344 |
| Model: | FireHawk M7 2.4 GHz HUD Transceiver |
| FCC Rule Parts: | §15.247 |
| Frequency Range: | 2405 - 2480MHz |
| Maximum Output Power: | 0.132mW |
| Modulation: | DSSS |
| Occupied Bandwidth: | 1.6332MHz (6dB BW) |
| Keying: | Automatic |
| Type of Information: | Data 802.11b |
| Number of Channels: | 16 |
| Power Output Level | Fixed |
| Antenna Type | Integral (50Ω, unbalanced SMD chip) 1.5dBi |
| Interface Cables: | None |
| Power Source & Voltage: | 3 AAA Batteries (4.5VDC) |

## 2.2 Test Configuration

The EUT was configured with the following components:

**Table 2: EUT Test Configuration**

| Description | Manufacturer/Model Number | Serial Number | Revision |
|---|---|---|---|
| FireHawk M7 HUD | Mine Safety Appliances | N/A | 6 |

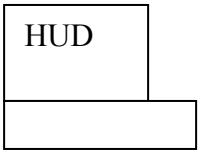



**Figure 1: Radiated Emissions Configuration**

The FireHawk M7 HUD was tested in a standalone configuration. No external connections are available or required to operate the EUT. No interaction between the HUD and the remainder of the system.

## 2.3 Testing Algorithm

The EUT was configured to constantly transmit channel 1, channel 8 or channel 16, modulated.

## 2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

## 2.5 Measurements

### 2.5.1 References

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

KDB558074: "Measurement of Digital Transmission Systems operating under Section 15.247."

## 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:

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

**Table 3: Test Equipment List**

| Test Name:**Radiated Emissions** | | | Test Date: **10/18/2007** |
|---|---|---|---|
| **Asset #** | **Manufacturer/Model** | **Description** | **Cal. Due** |
| 00382 | SUNOL, JB1 | ANTENNA, BICONLOG | 2/2/2008 |
| 00068 | HP, 85650A | ADAPTER, QP | 7/6/2008 |
| 00072 | HP, 8568B | ANALYZER, SPECTRUM | 7/6/2008 |
| 00070 | HP, 85685A | PRESELECTOR, RF W/OPT 8ZE | 7/6/2008 |
| 00618 | HP 8563A | ANALYZER, SPECTRUM | 2/9/2008 |
| 00522 | HP, 8449B | PRE-AMPLIFIER, 1-26.5GHZ | 7/27/2008 |
| 00425 | ARA, DRG-118/A | ANTENNA, DRG, 1-18GHZ | 8/8/2009 |
| 74 | HP, 8593A | ANALYZER, SPECTRUM | 2/7/2008 |
| 640 | MEGAPHASE, TM40-K1K5-36 | 1G-40GHZ RIGHT ANGLE | 9/11/2008 |

# 4 Test Results

## 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)

Duty cycle correction was not required.

## 4.2 RF Power Output: (FCC Part §2.1046)

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**

| Channel | Frequency | dBm | Limit | mWatts | Pass/Fail |
|---|---|---|---|---|---|
| 1 | 2405MHz | -8.8 | +30dBm | 0.132 | Pass |
| 8 | 2440MHz | -11.1 | +30dBm | 0.078 | Pass |
| 16 | 2480MHz | -12.2 | +30dBm | 0.060 | Pass |

**Test Engineer(s):** Steven Dovell

**Test Date(s):** 10/4/07

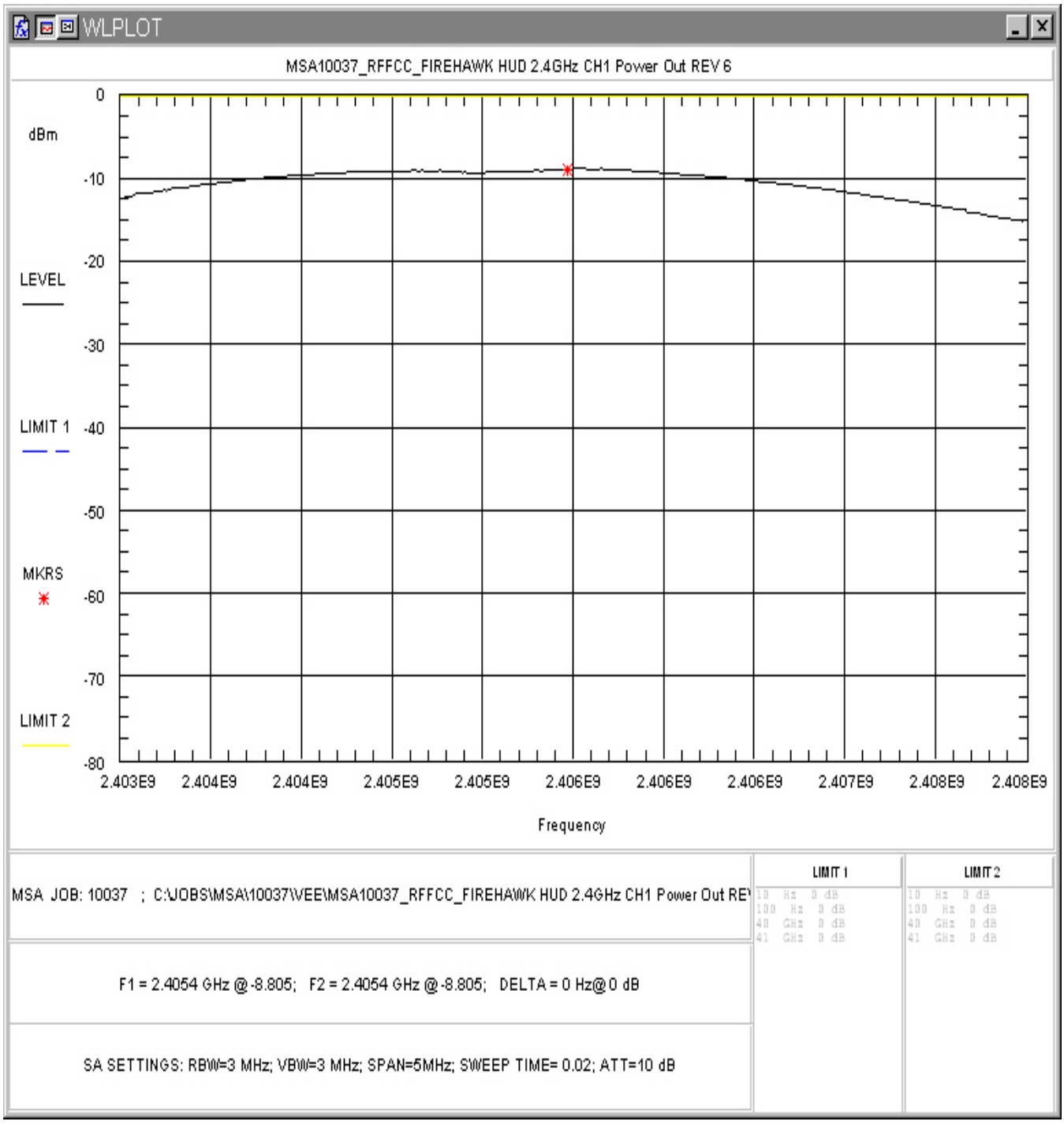



**Figure 2: RF Peak Power, Low Channel**

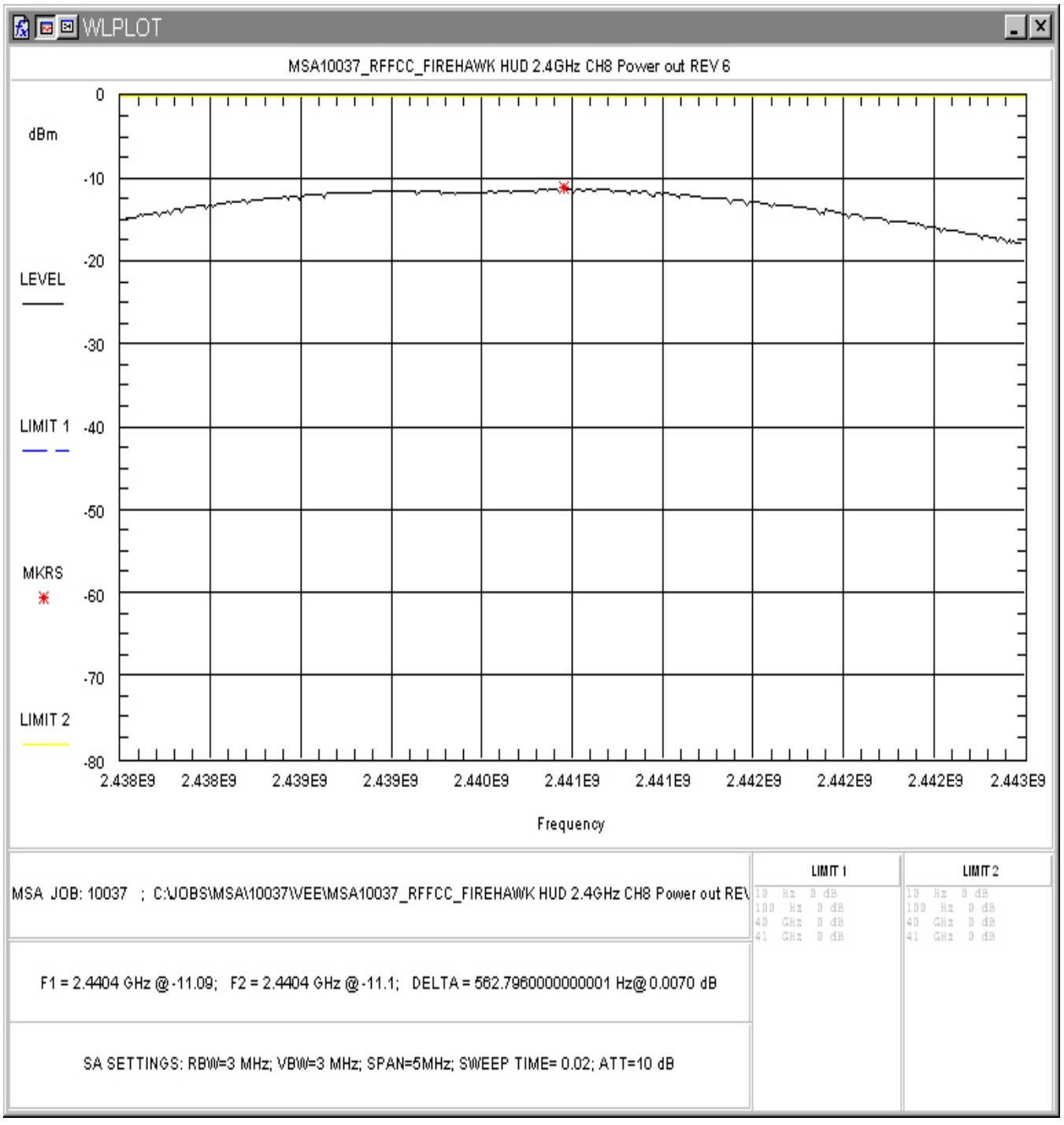



**Figure 3: RF Peak Power, Mid Channel**

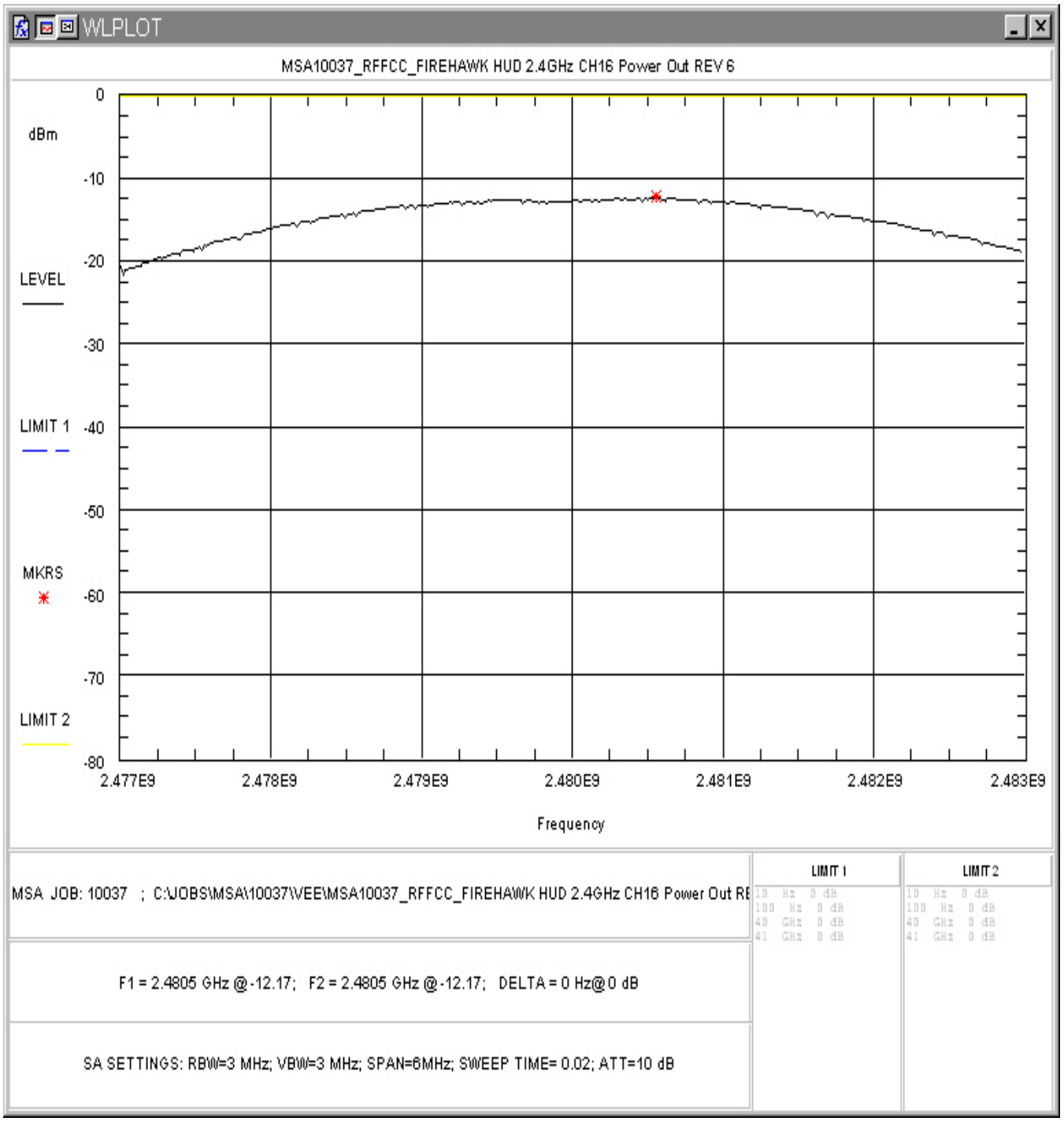



**Figure 4: Peak Power, High Channel**

## 4.3 Occupied Bandwidth: (FCC Part §2.1049)

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

For Direct Sequence spread spectrum Systems, FCC Part 15.247 requires the maximum -6 dB bandwidth must be greater the 500kHz.

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

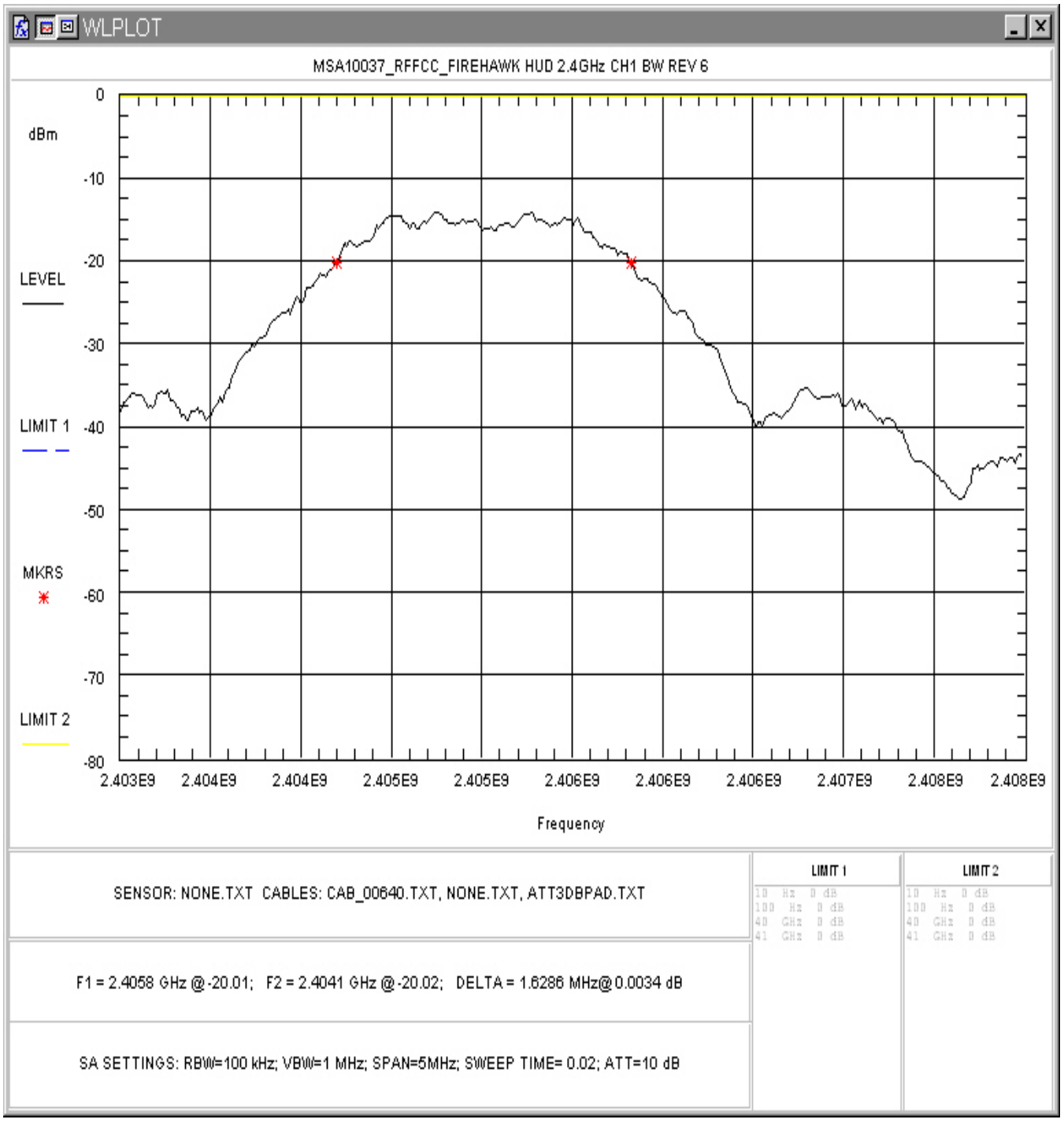



**Figure 5: Occupied Bandwidth, Low Channel**

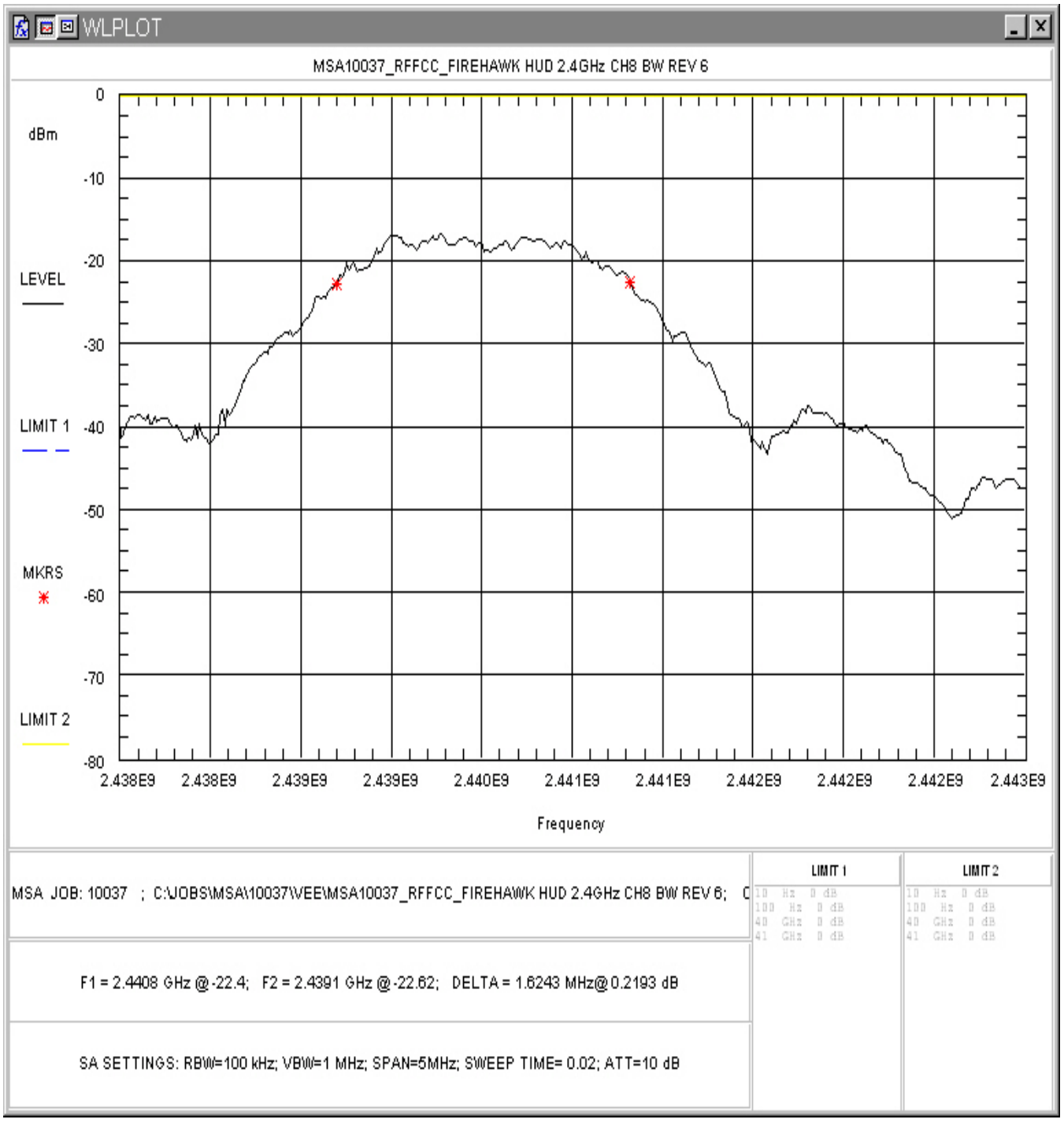



**Figure 6: Occupied Bandwidth, Mid Channel**

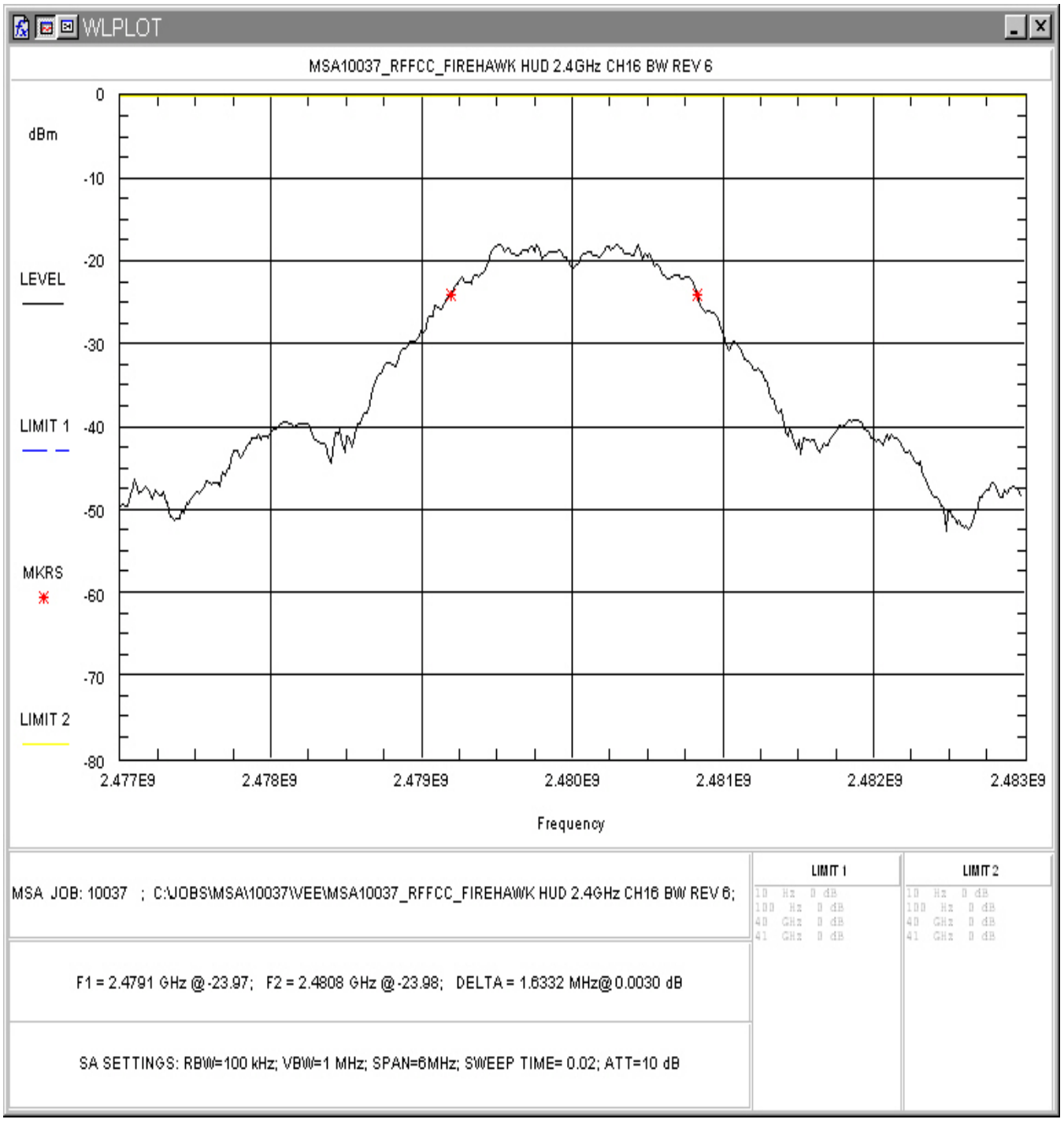



**Figure 7: Occupied Bandwidth, High Channel**

Table 5 provides a summary of the Occupied Bandwidth Results.

**Table 5. Occupied Bandwidth Results**

| Channel | Frequency | -6dB Bandwidth |
|---|---|---|
| 1 | 2405MHz | 1.6266MHz |
| 8 | 2440MHz | 1.6243MHz |
| 16 | 2480MHz | 1.6332MHz |

**Test Engineer(s):** Steven Dovell

**Test Date(s):** 10/4/07

## 4.4 Power Spectral Density (FCC Part 15.247/RSS-210)

For DSSS devices, 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.

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.

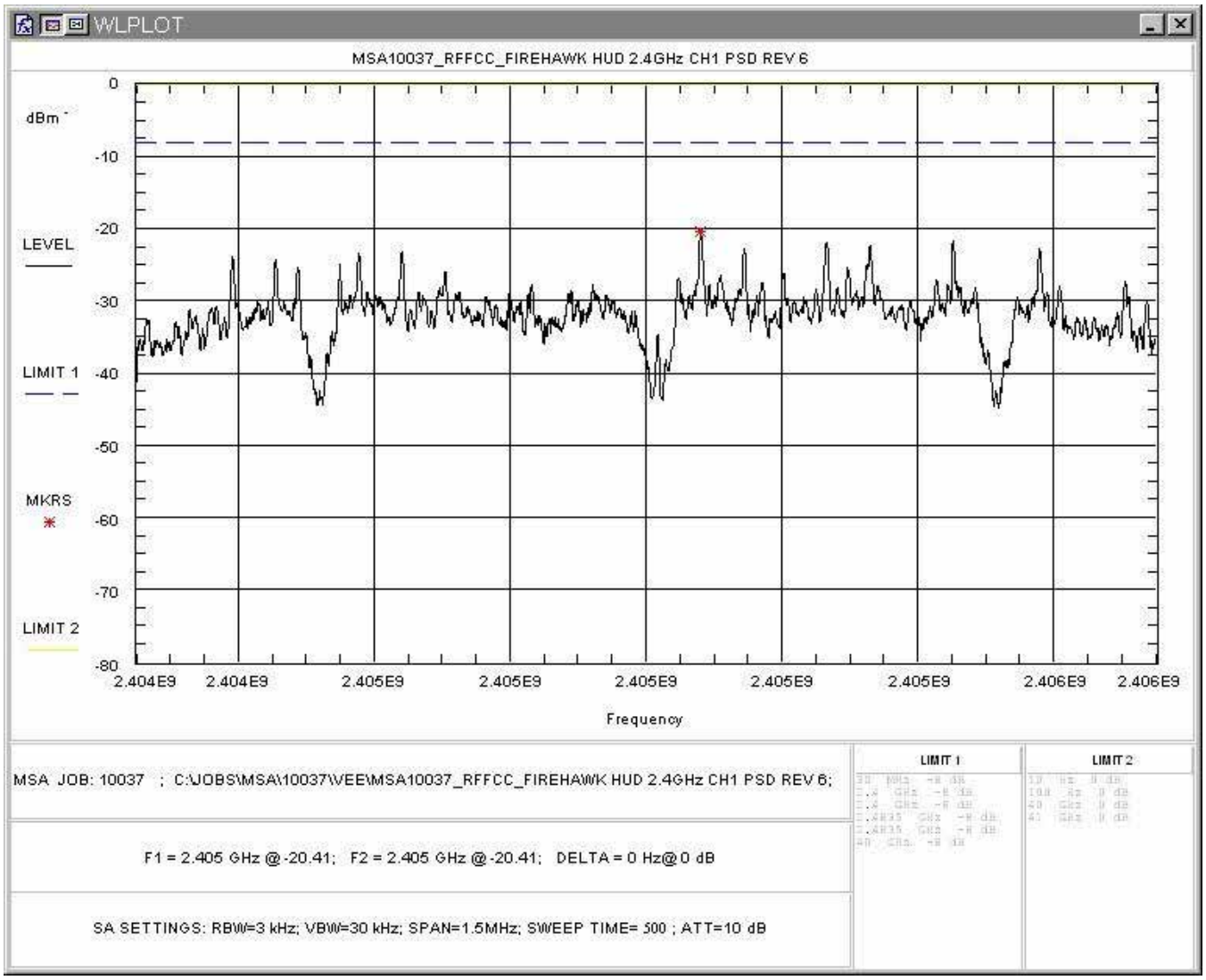



**Figure 8: Power Spectral Density Plot, Low Channel**

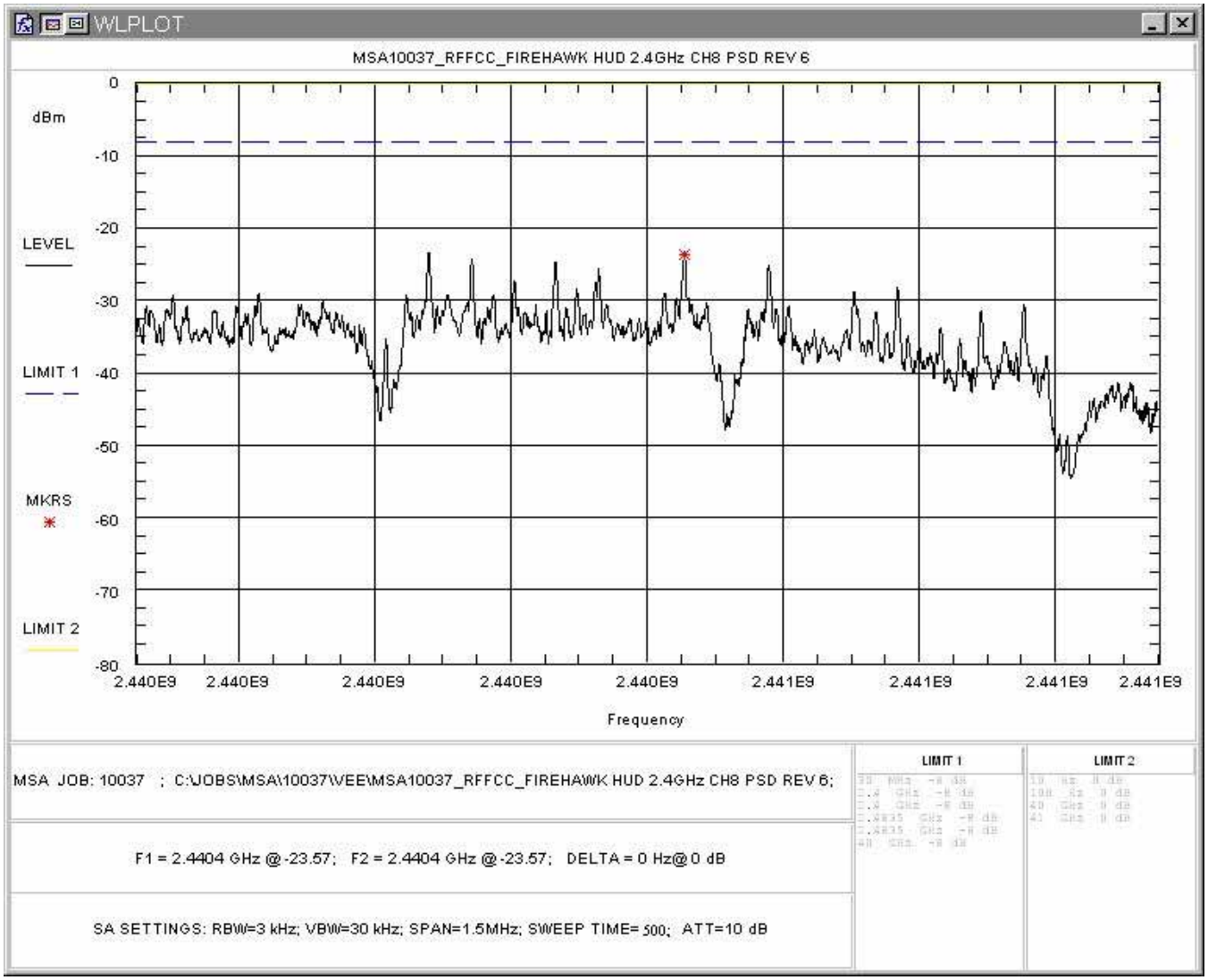



**Figure 9: Power Spectral Density Plot, Mid Channel**

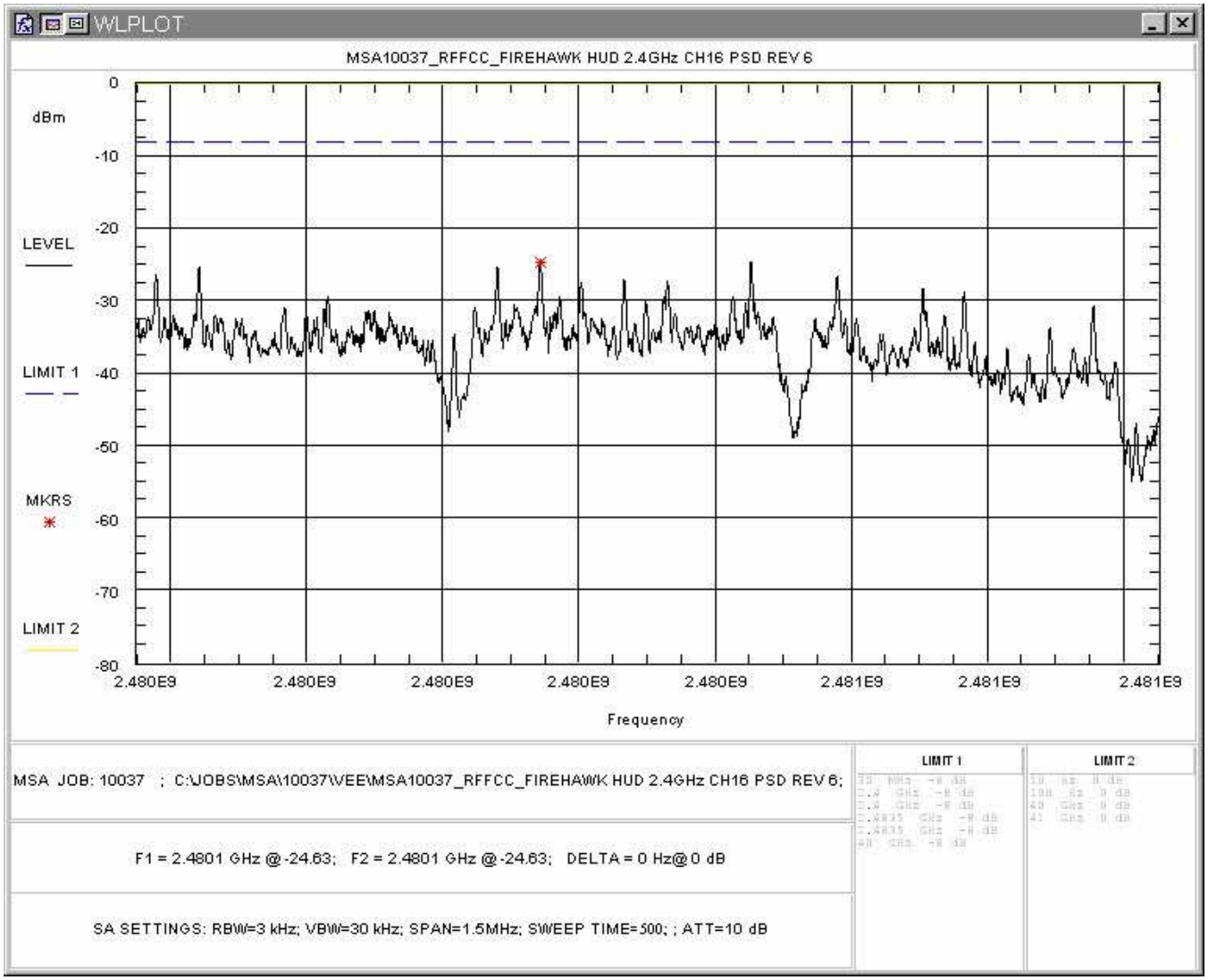



**Figure 10: Power Spectral Density Plot, High Channel**

**Table 6 Power Spectral Density results**

| Channel | Peak | Limit | Pass/Fail |
|---|---|---|---|
| 1 | -20.4dBm | +8dBm | Pass |
| 8 | -23.6dBm | +8dBm | Pass |
| 16 | -24.6dBm | +8dBm | Pass |

**Test Engineer(s):** Steven Dovell

**Test Date(s):** 10/4/07

## 4.5 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 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.

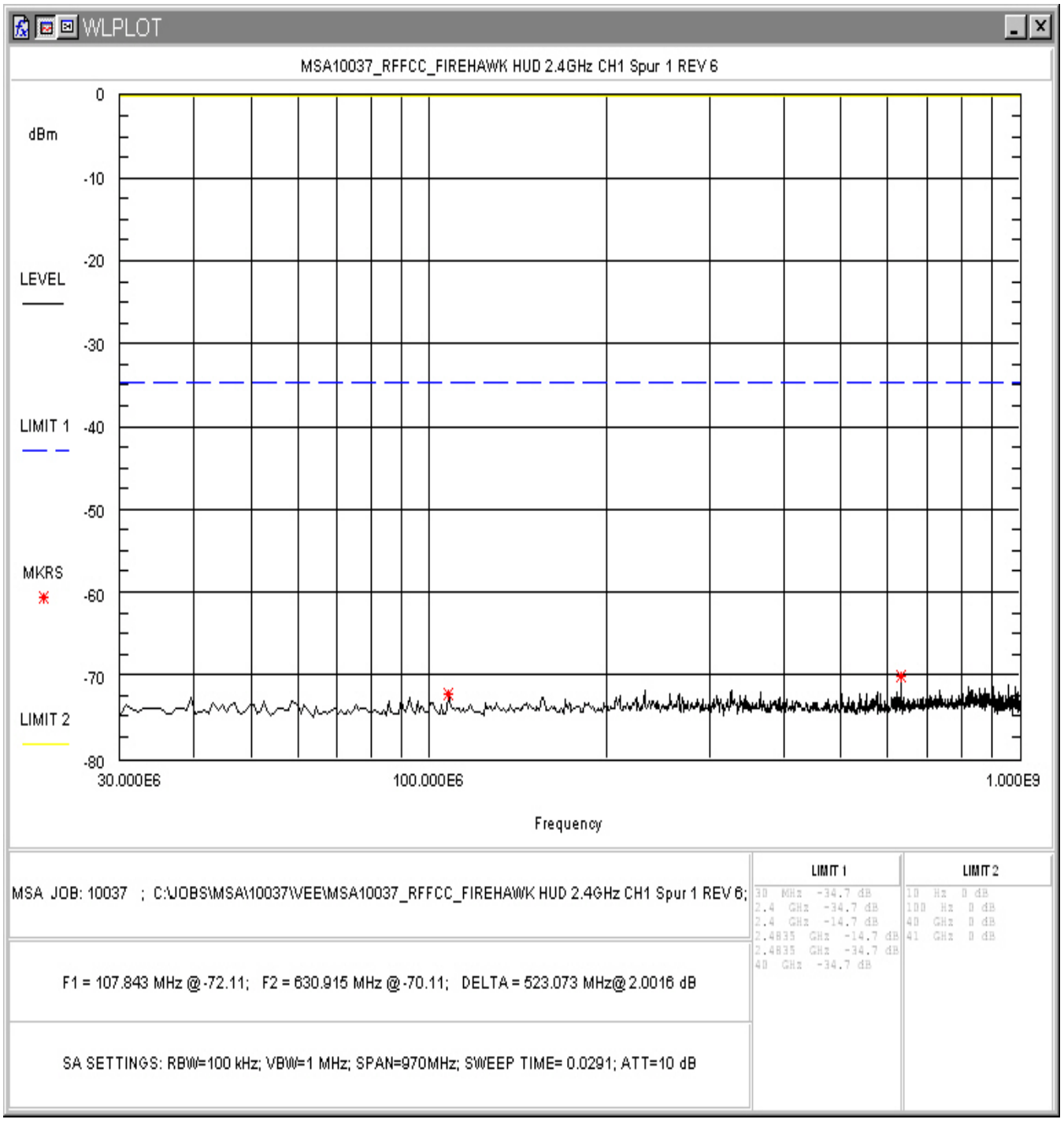



**Figure 11: Conducted Spurious Emissions, Low Channel, 30 - 1000MHz**

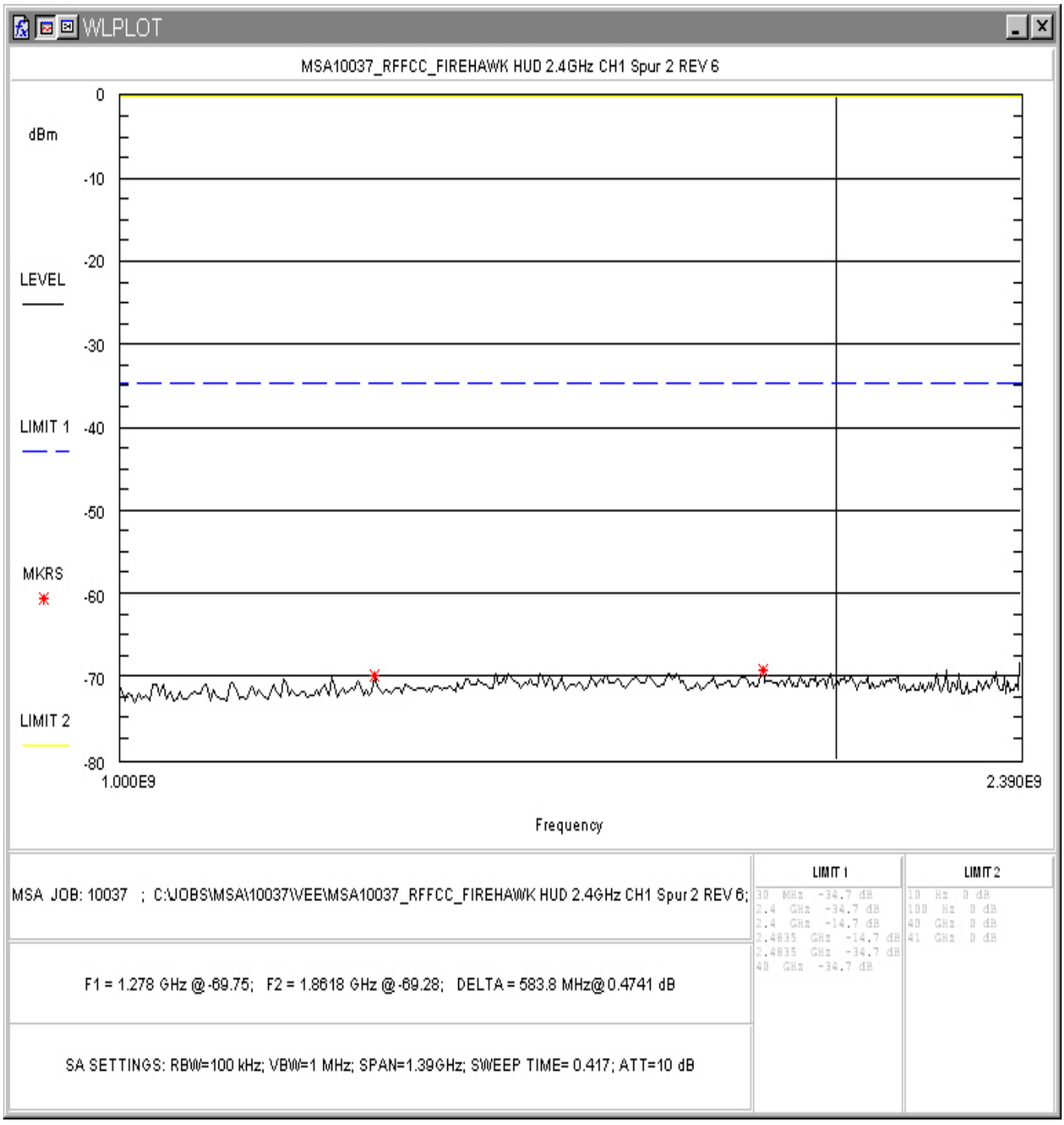



**Figure 12: Conducted Spurious Emissions, Low Channel, 1 – 2.3GHz**

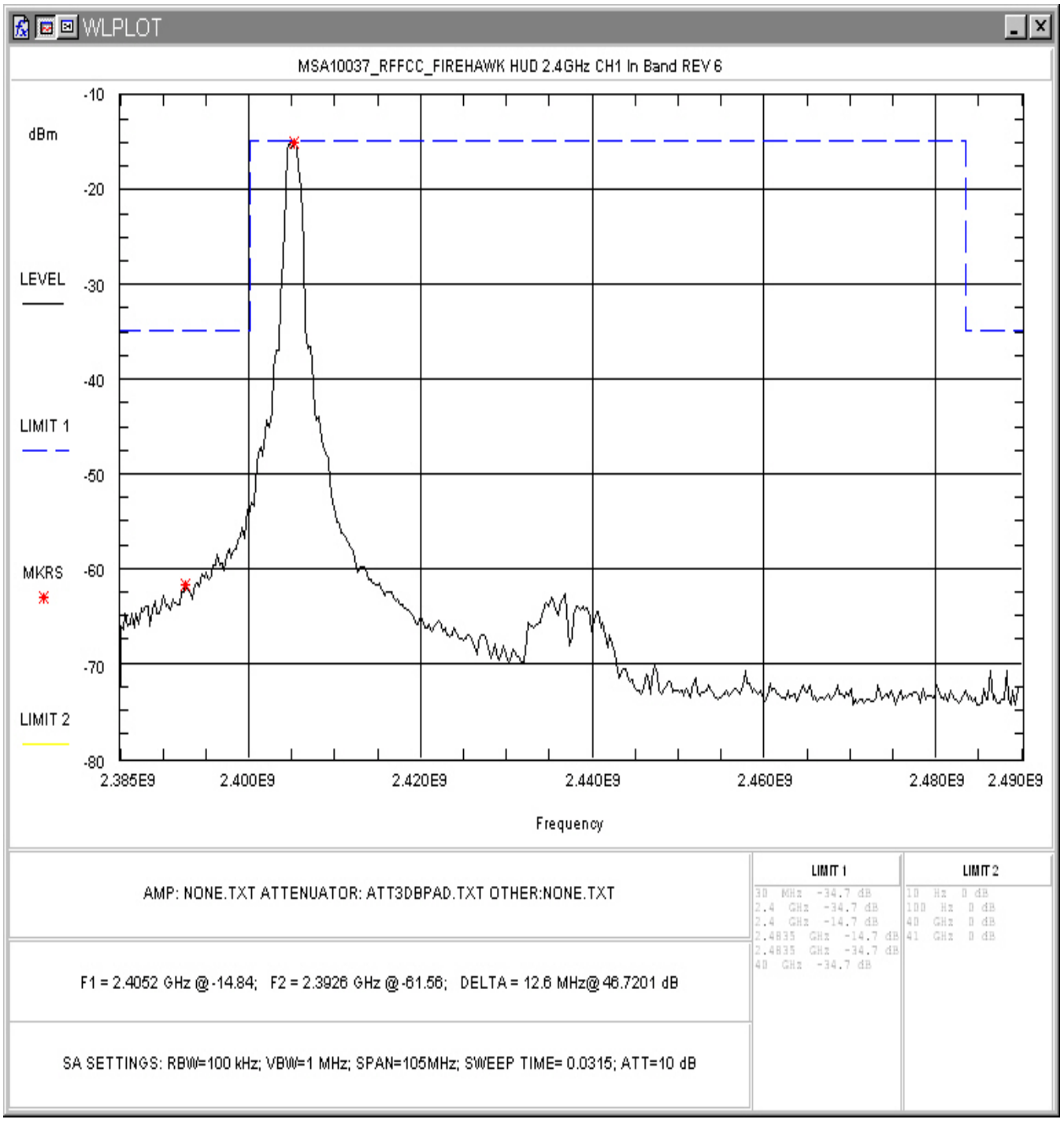



**Figure 13: Conducted Spurious Emissions, Low Channel, 2.3 – 2.5GHz**

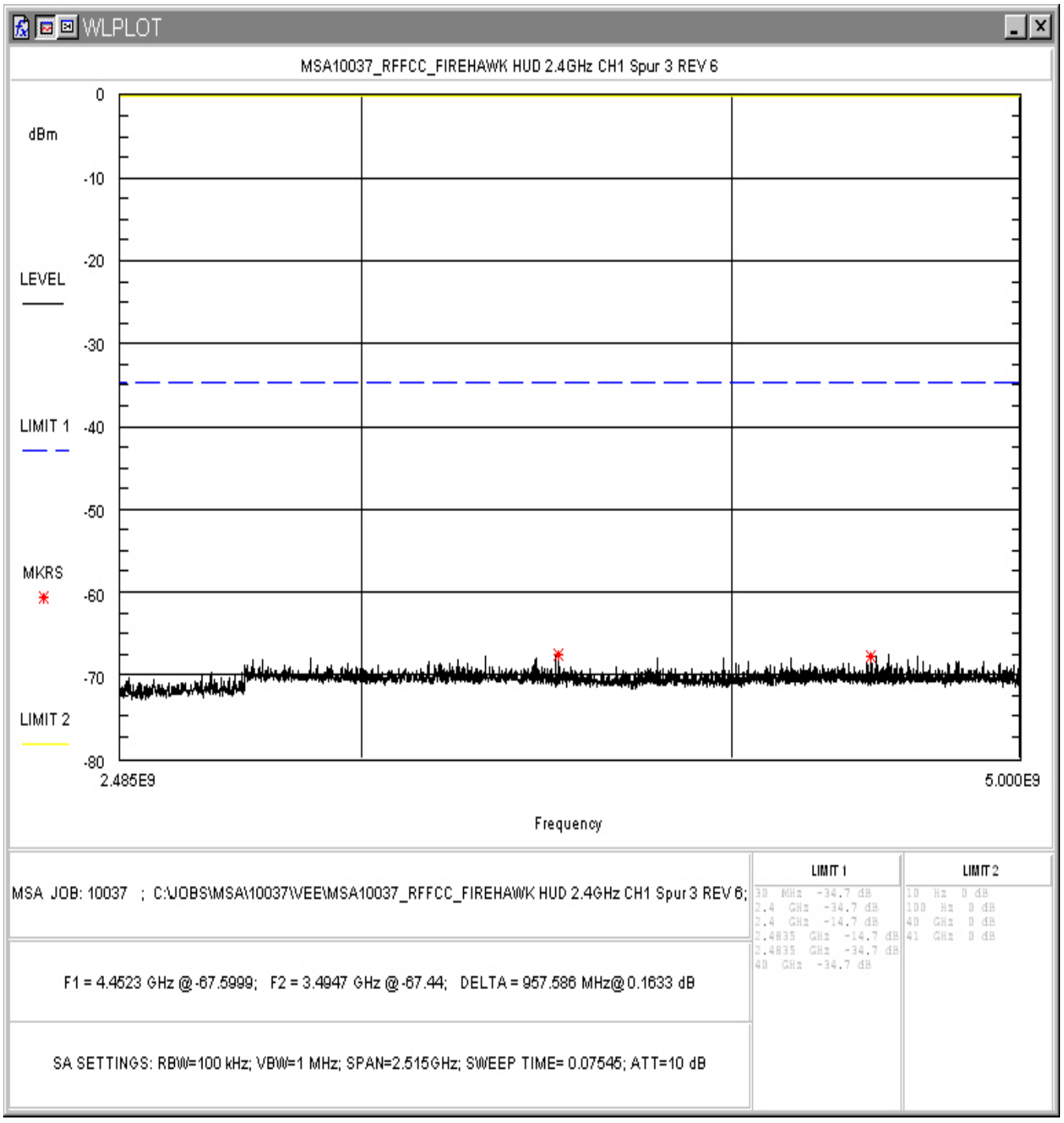



**Figure 14: Conducted Spurious Emissions, Low Channel, 2.5 - 5GHz**

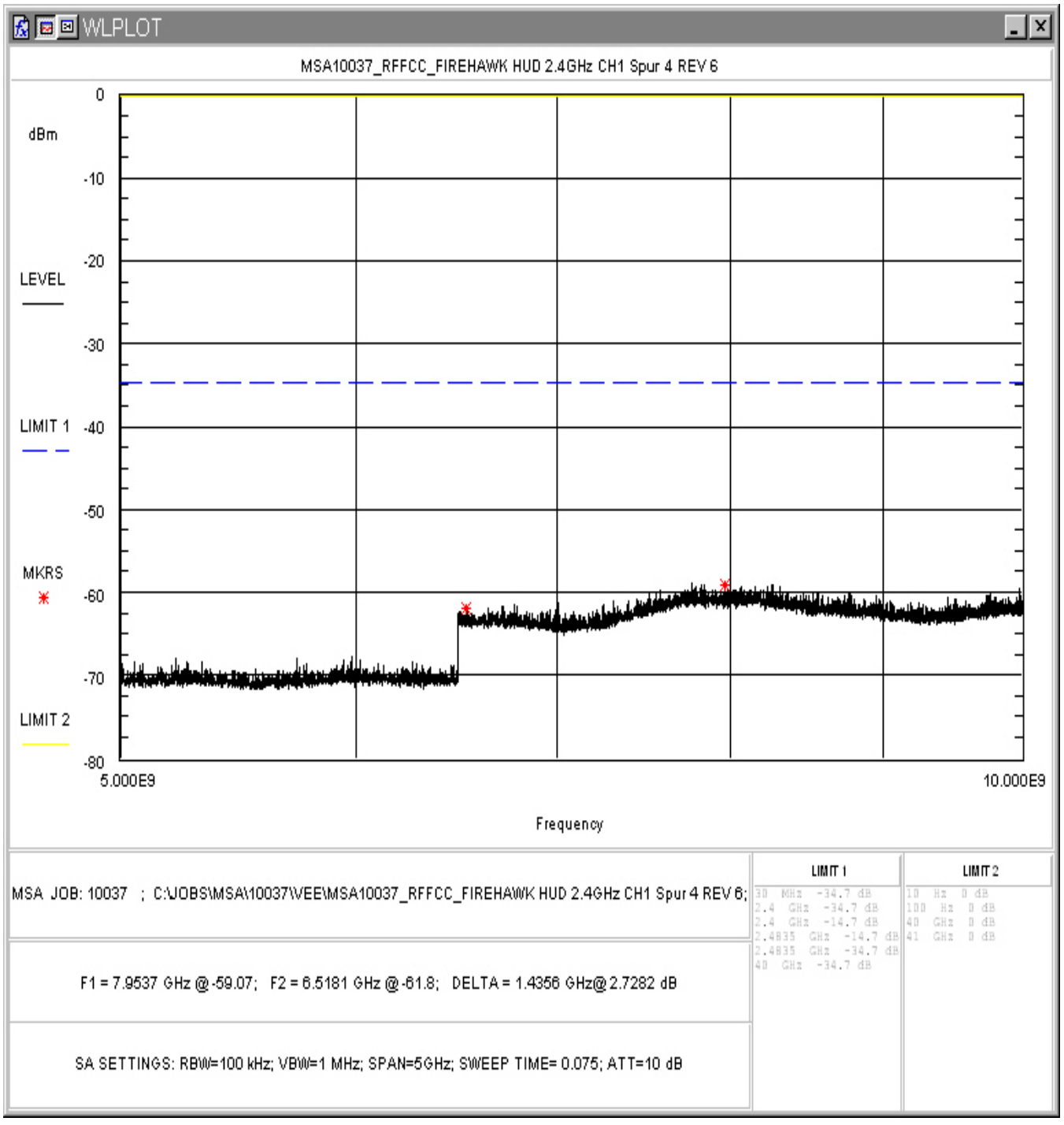



**Figure 15: Conducted Spurious Emissions, Low Channel, 5 - 10GHz**

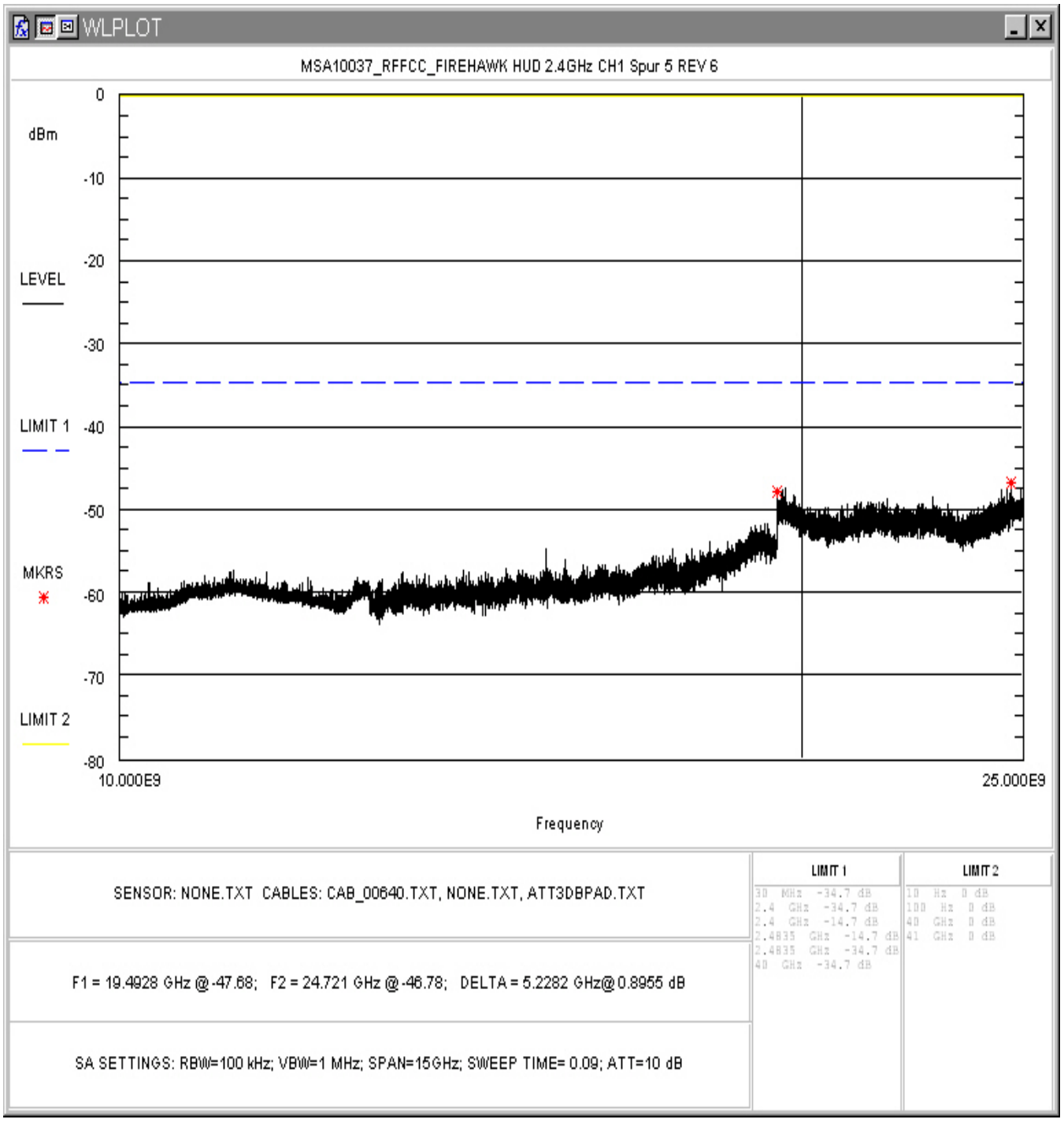



**Figure 16: Conducted Spurious Emissions, Low Channel, 10 - 25GHz**

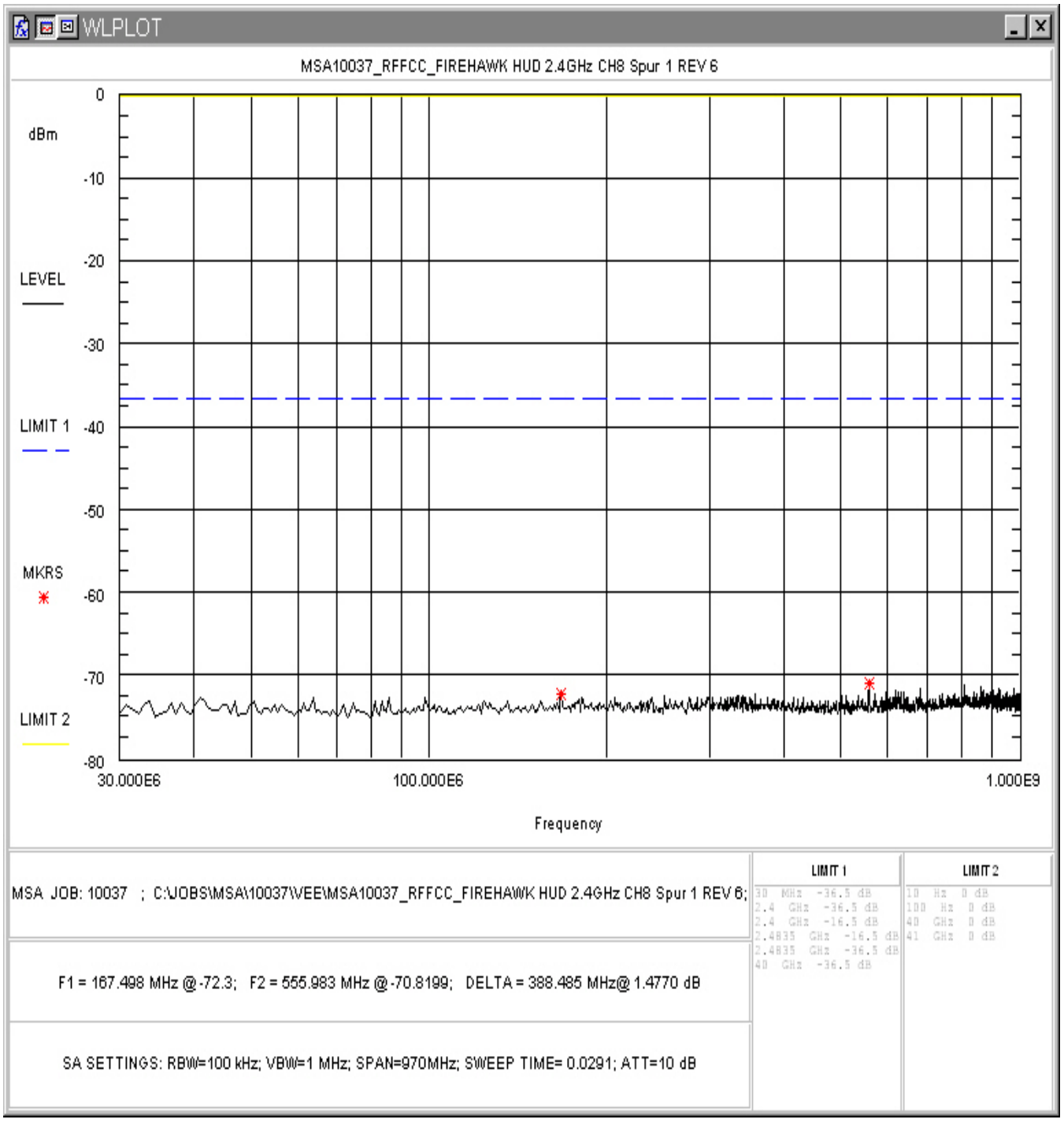



**Figure 17: Conducted Spurious Emissions, Mid Channel, 30 - 1000MHz**

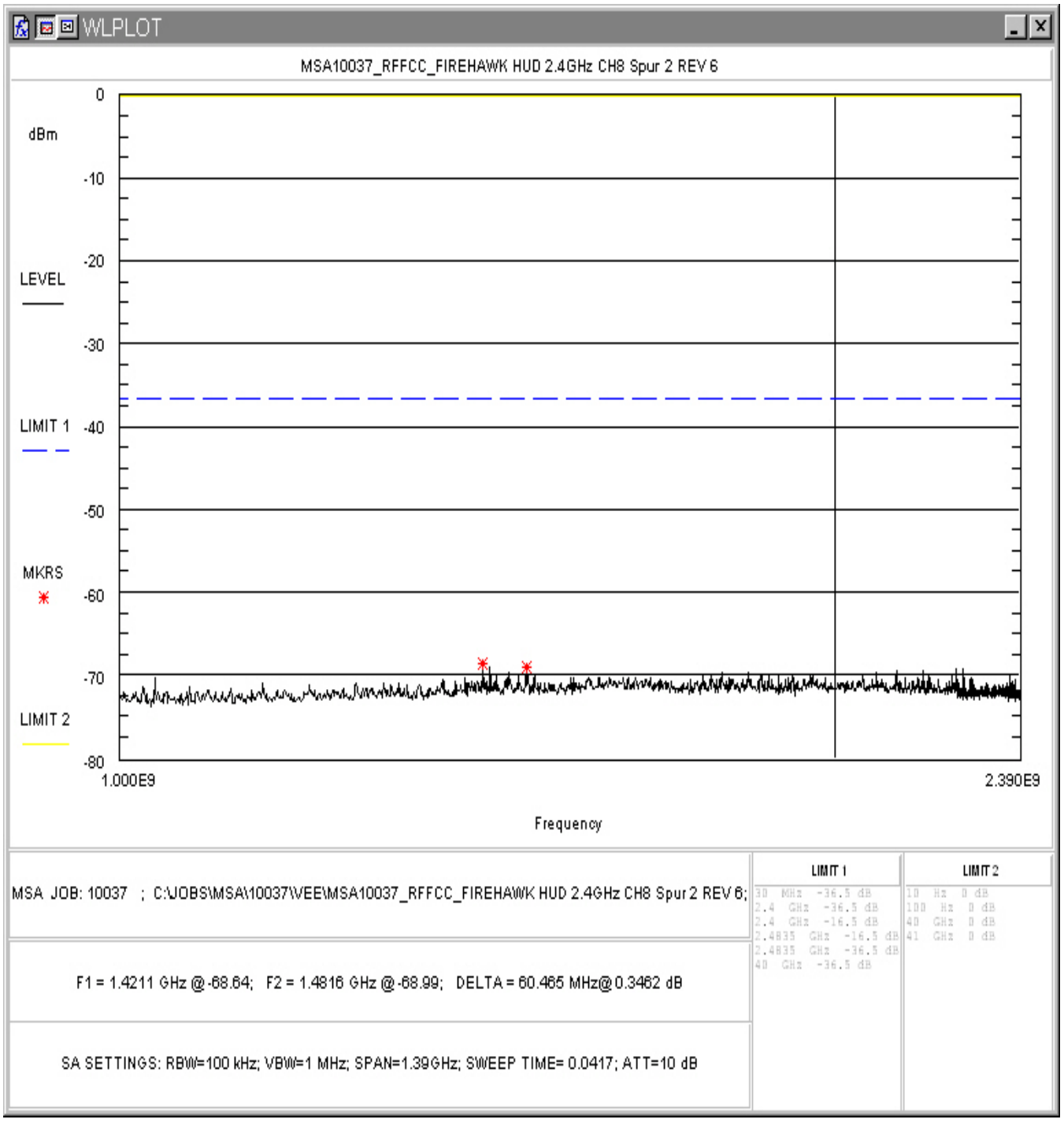



**Figure 18: Conducted Spurious Emissions, Mid Channel, 1 – 2.3GHz**

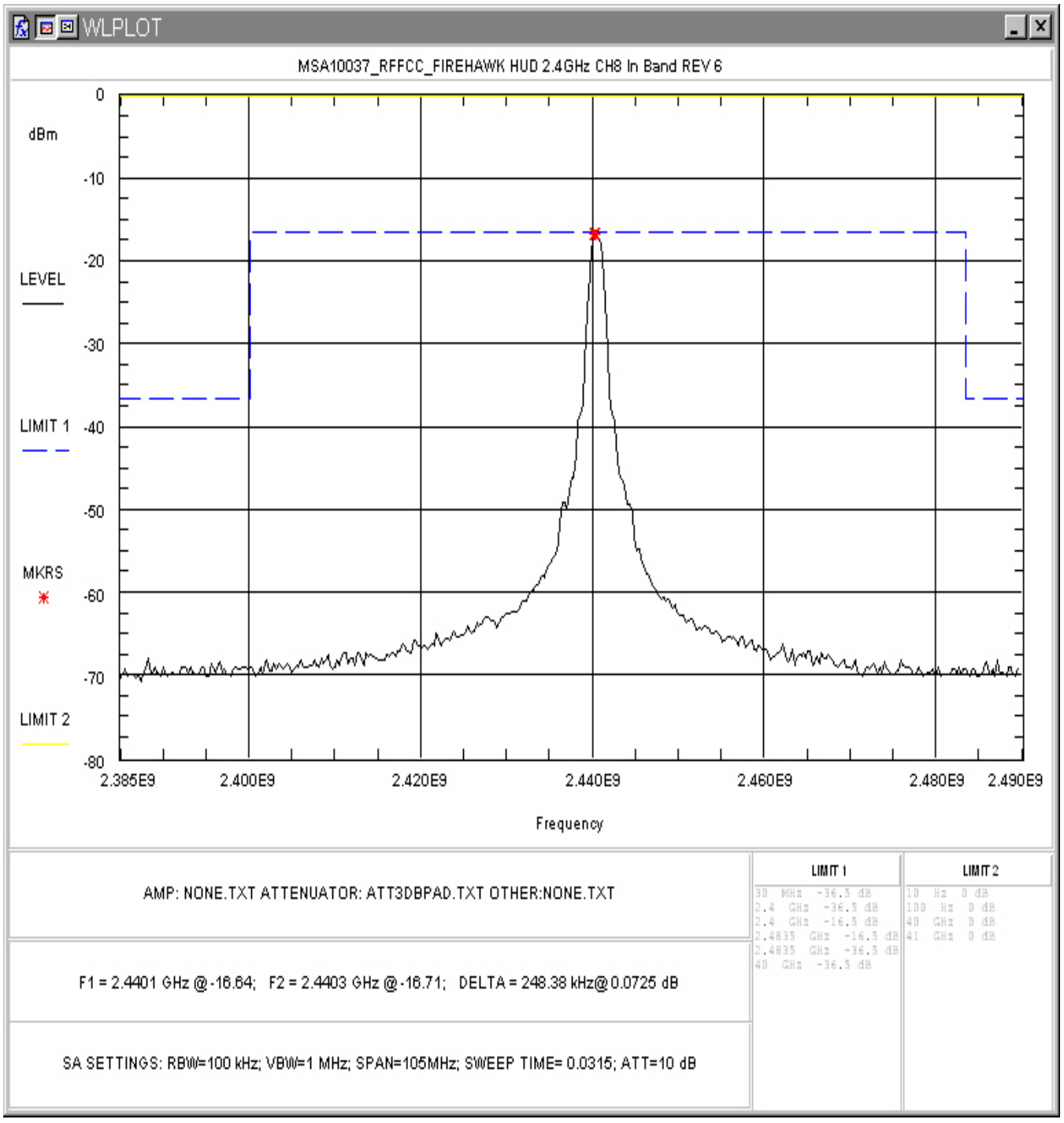



**Figure 19: Conducted Spurious Emissions, Mid Channel, 2.3 – 2.5GHz**

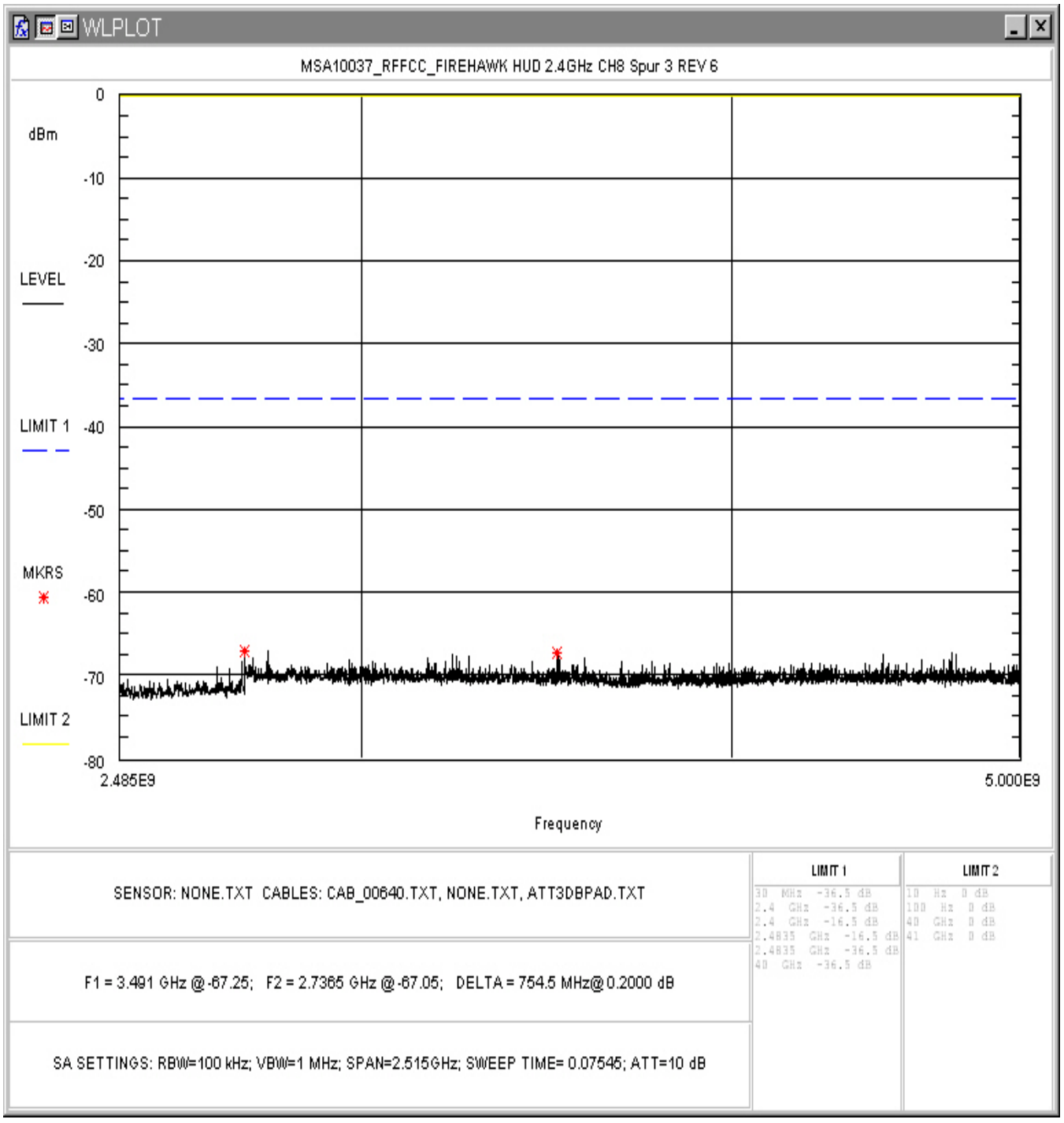



**Figure 20: Conducted Spurious Emissions, Mid Channel, 2.5 - 5GHz**

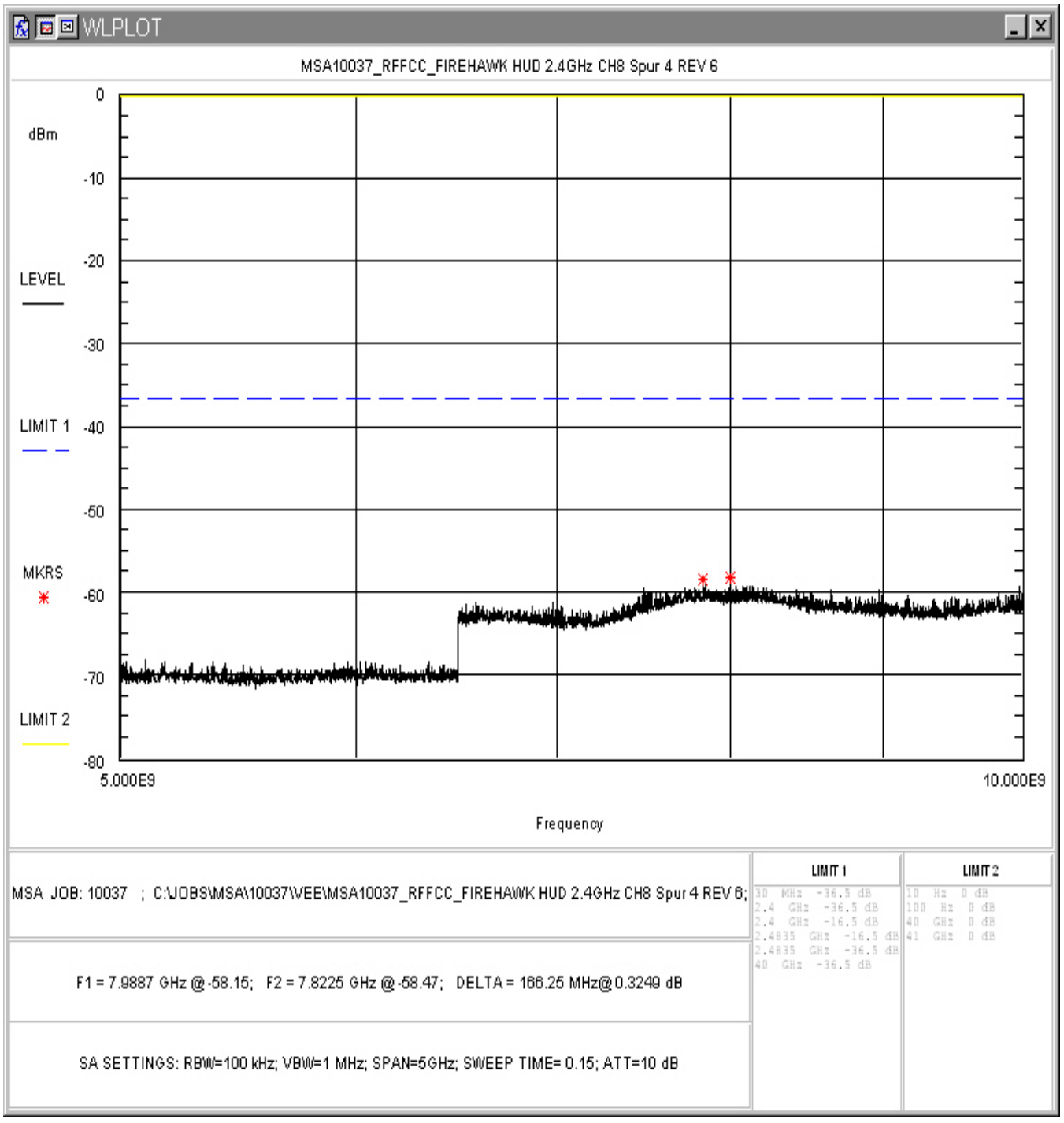



**Figure 21: Conducted Spurious Emissions, Mid Channel, 5 - 10GHz**

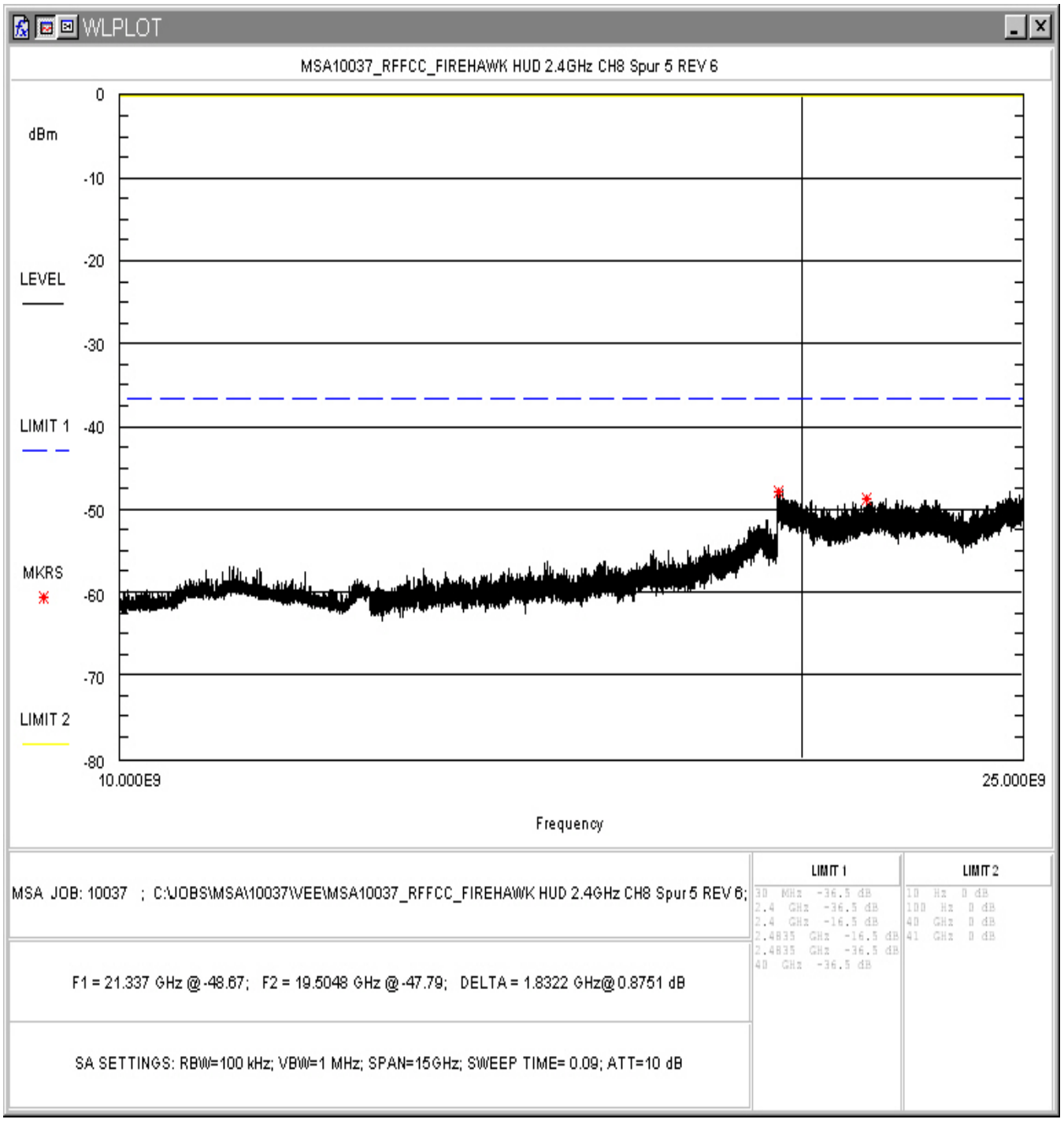



**Figure 22: Conducted Spurious Emissions, Mid Channel, 10 - 25GHz**

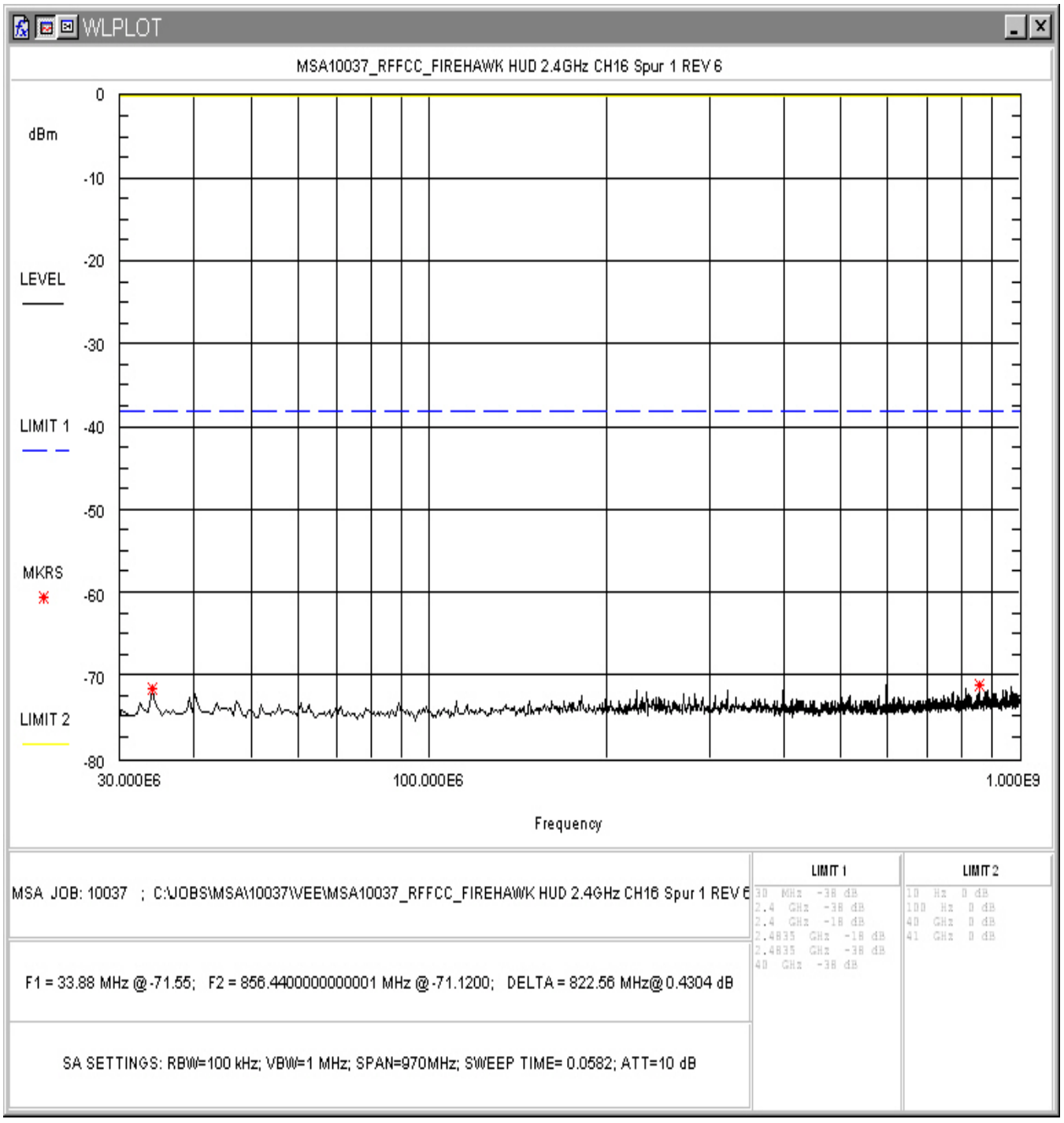



**Figure 23: Conducted Spurious Emissions, High Channel, 30 - 1000MHz**

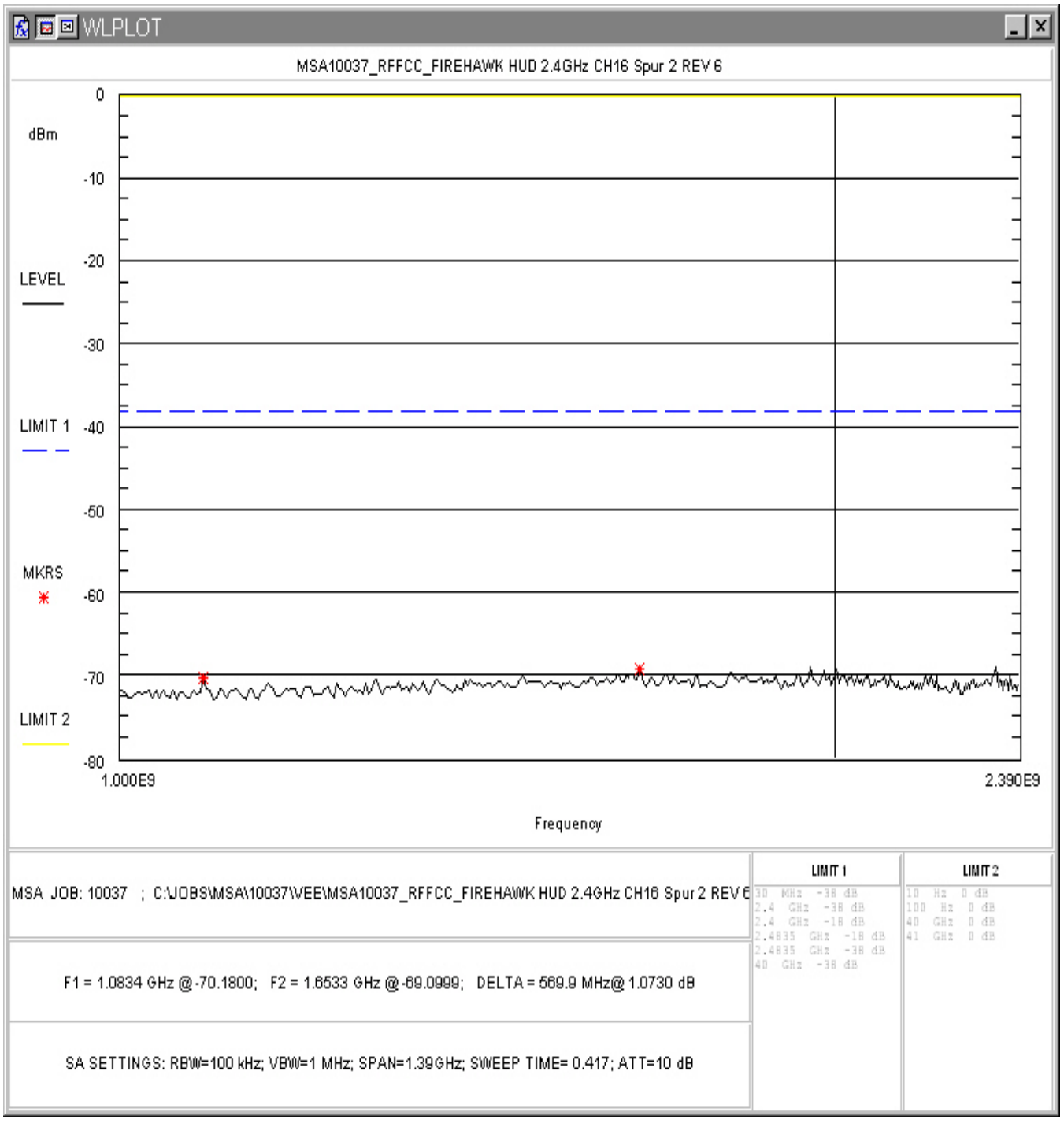



**Figure 24: Conducted Spurious Emissions, High Channel, 1 – 2.3GHz**

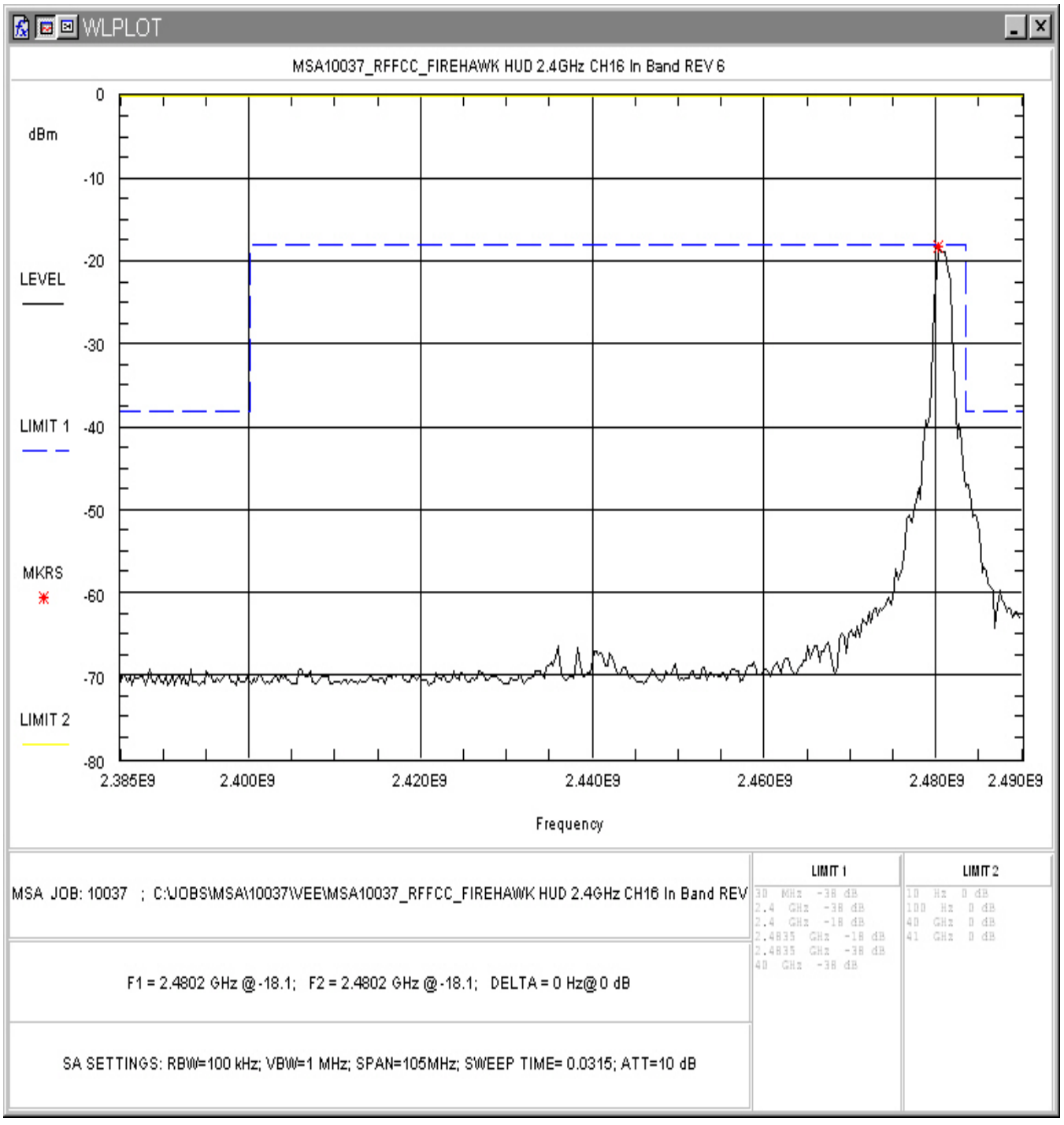



**Figure 25: Conducted Spurious Emissions, High Channel, 2.3 – 2.5GHz**

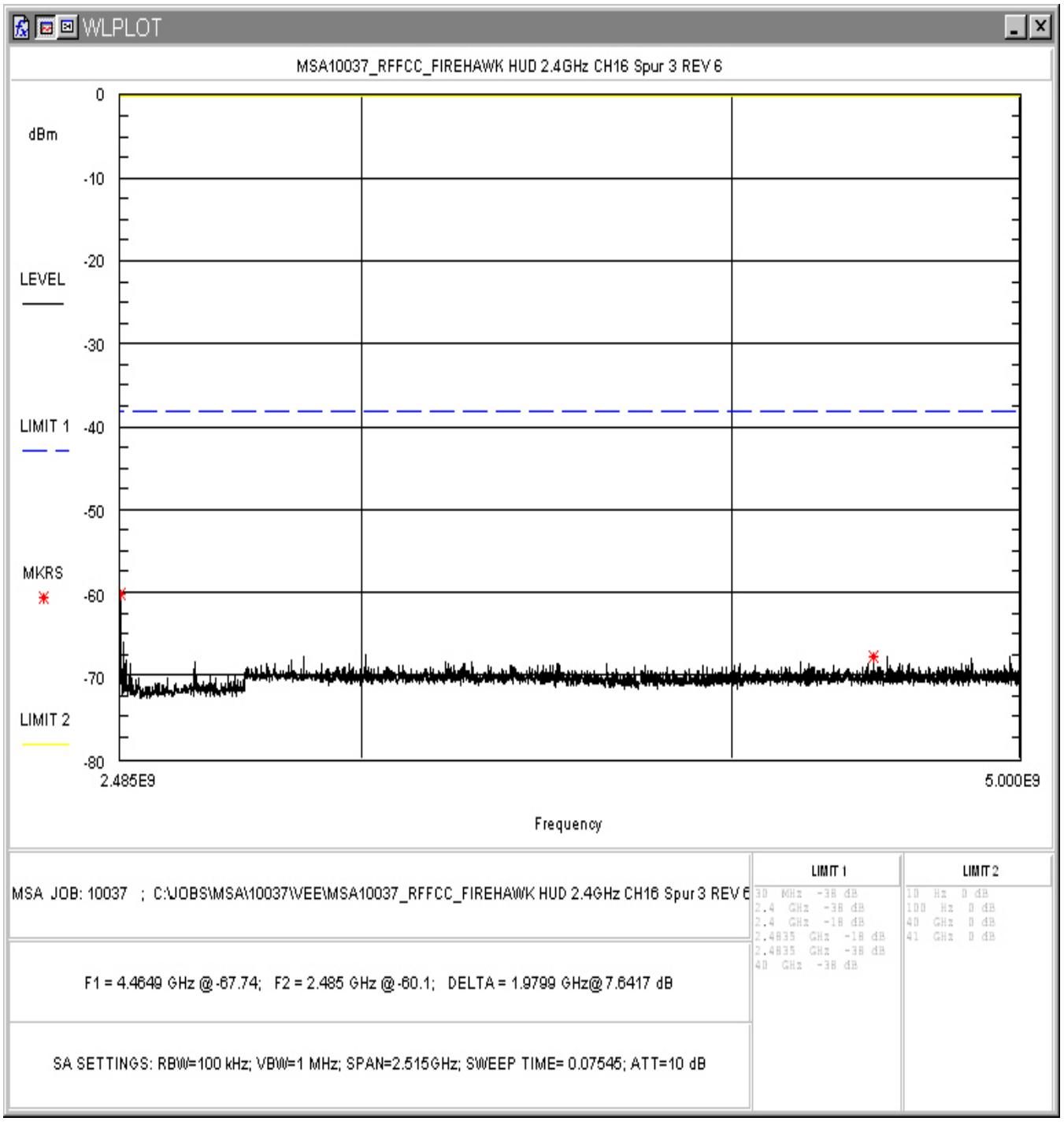



**Figure 26: Conducted Spurious Emissions, High Channel, 2.5 - 5GHz**

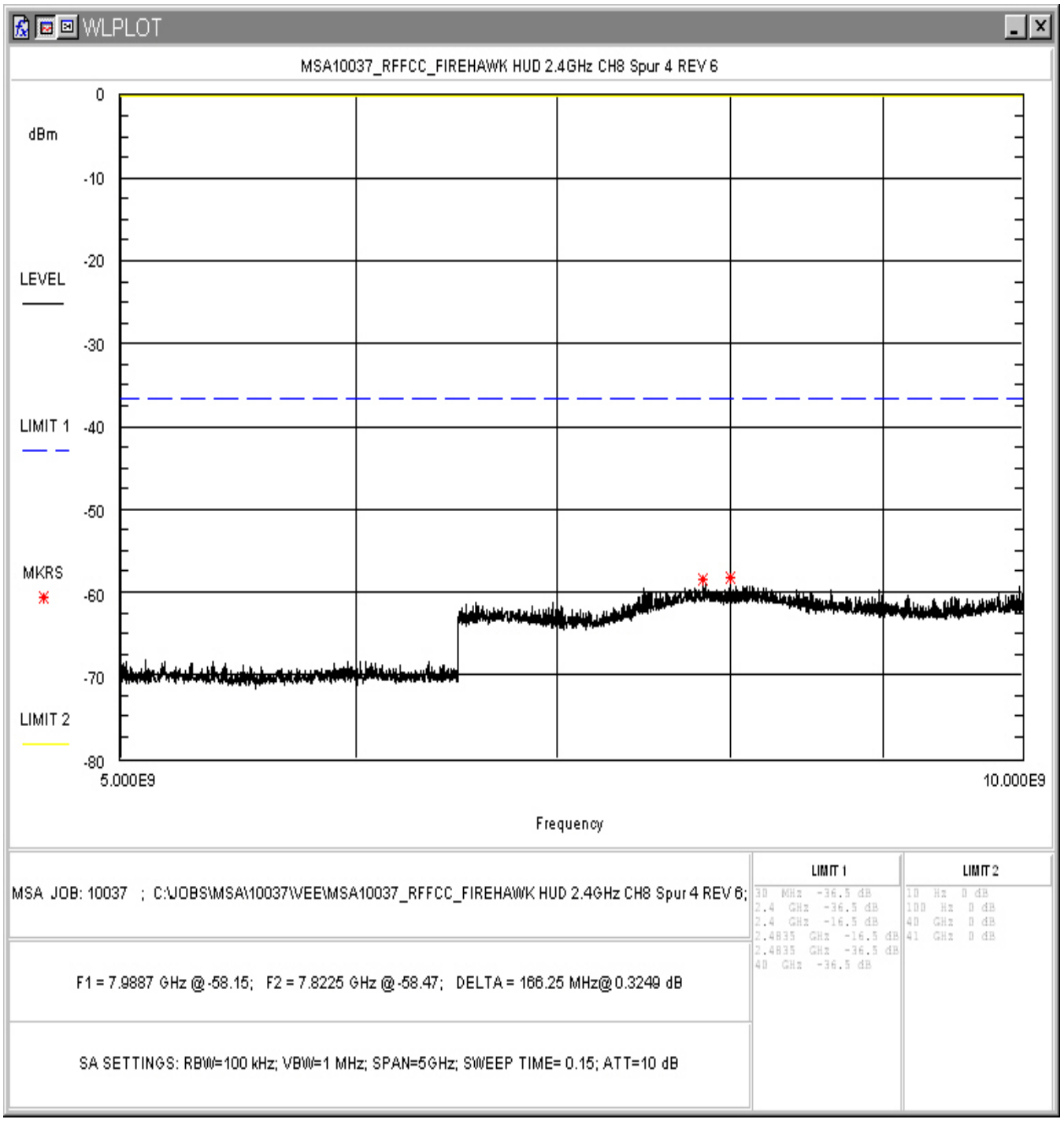



**Figure 27: Conducted Spurious Emissions, High Channel, 5 - 10GHz**

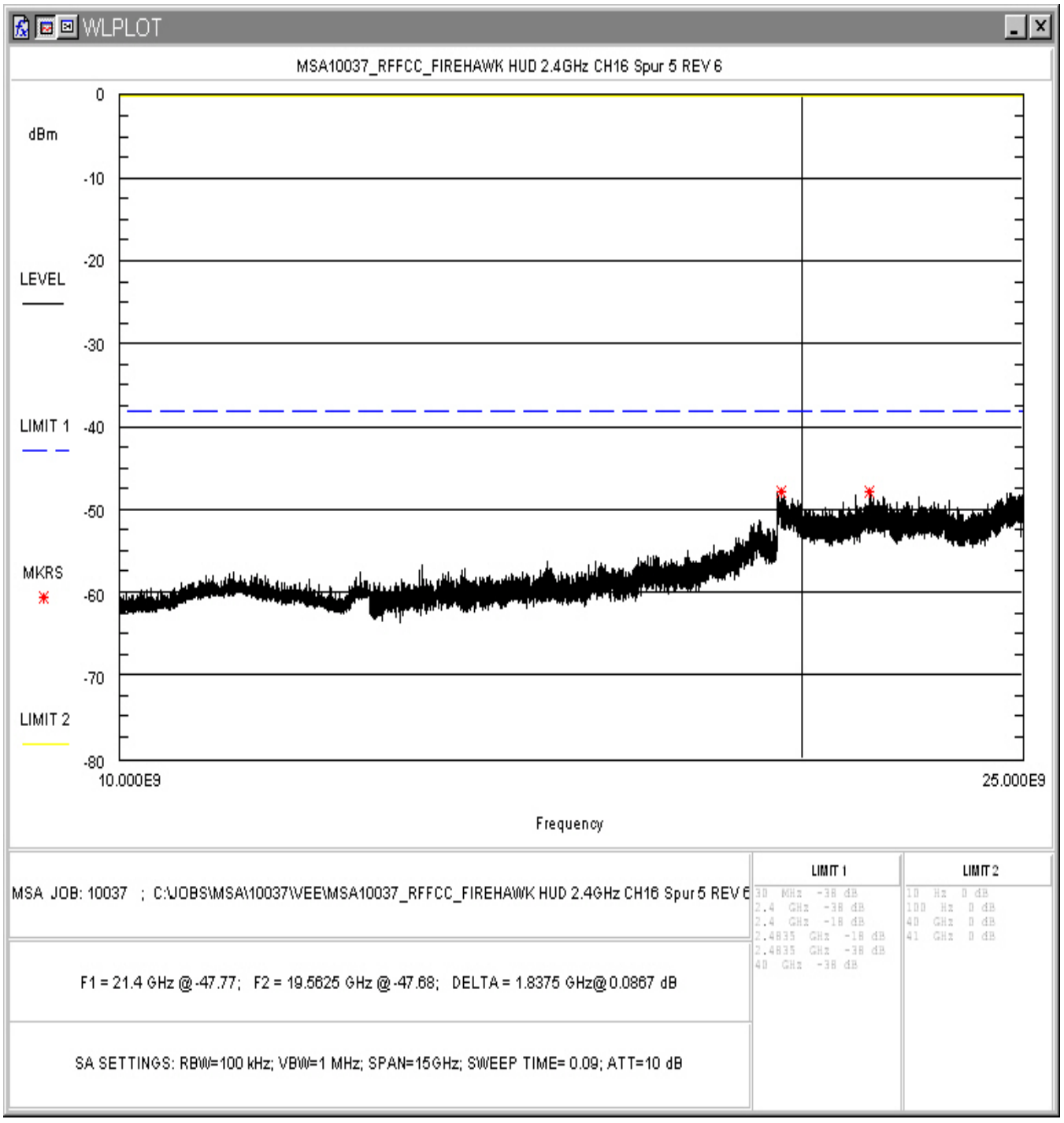



**Figure 28: Conducted Spurious Emissions, High Channel, 10 - 25GHz**

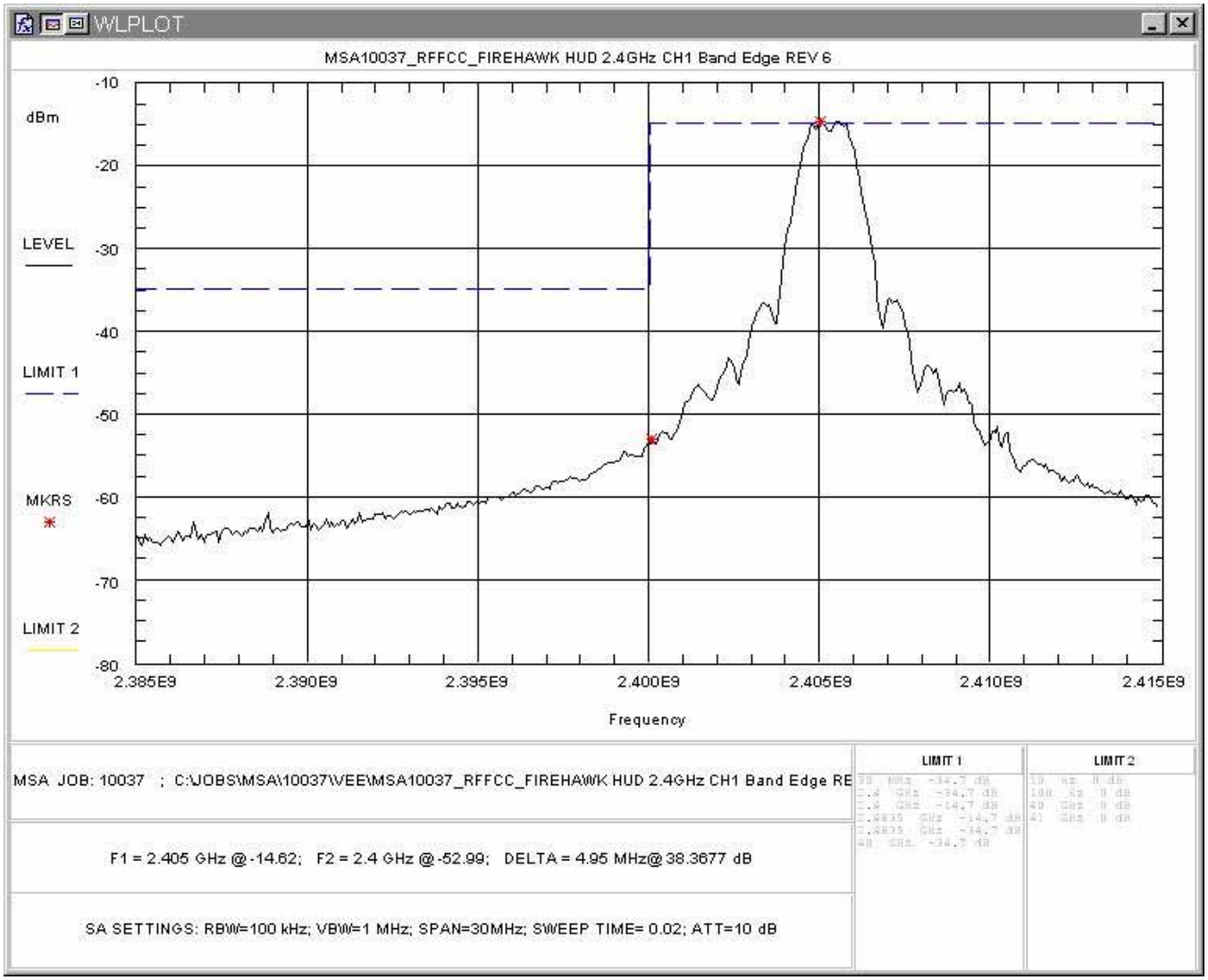



**Figure 29: Band Edge 2.4GHz**

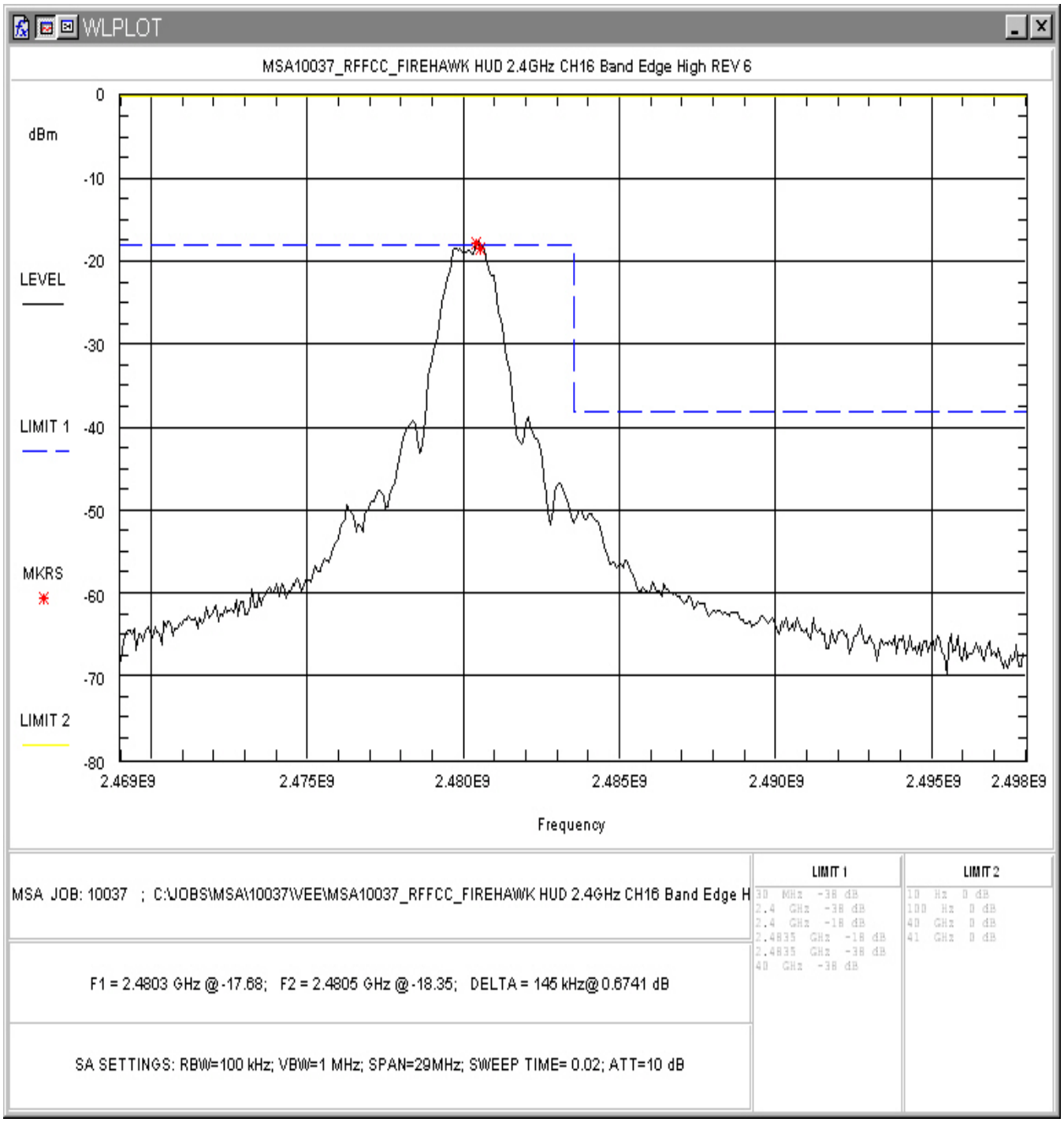



**Figure 30: Band Edge 2.485GHz**

## 4.6 Radiated Spurious Emissions: (FCC Part §2.1053)

The EUT must comply with the requirements for radiated spurious emissions that fall within the restricted bands. These emissions must meet the limits specified in §15.209 and §15.35(b) for peak measurements.

### 4.6.1 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 KDB558074. 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:

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

## Table 7: Radiated Emission Test Data, Low Frequency Data (<1GHz)

| Frequency (MHz) | Polarity H/V | Azimuth Degree | Ant. Height (m) | SA Level (QP) (dBµV) | Ant. Corr. (dB/m) | Cable Corr. (dB) | Corr. Level (dBµV/m) | Corr. Level (µV/m) | Limit (µV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 33.426 | V | 0.0 | 1.0 | 12.0 | 18.3 | 1.3 | 31.5 | 37.8 | 100.0 | -8.5 |
| 51.995 | V | 0.0 | 1.0 | 20.7 | 7.9 | 1.5 | 30.2 | 32.3 | 100.0 | -9.8 |
| 63.535 | V | 138.0 | 1.0 | 14.6 | 7.7 | 1.7 | 23.9 | 15.7 | 100.0 | -16.1 |
| 114.460 | V | 109.0 | 1.0 | 3.4 | 13.4 | 2.0 | 18.8 | 8.7 | 150.0 | -24.8 |
| 352.840 | V | 49.0 | 1.0 | 7.1 | 14.4 | 3.0 | 24.5 | 16.7 | 200.0 | -21.6 |
| 385.112 | V | 151.0 | 1.5 | 16.7 | 15.1 | 3.2 | 35.0 | 56.5 | 200.0 | -11.0 |
| 49.180 | H | 18.0 | 3.0 | 7.8 | 8.5 | 1.5 | 17.8 | 7.8 | 100.0 | -22.2 |
| 85.852 | H | 18.0 | 4.0 | 7.4 | 7.8 | 1.8 | 17.0 | 7.1 | 100.0 | -23.0 |
| 138.530 | H | 28.0 | 3.3 | 7.2 | 13.1 | 2.1 | 22.4 | 13.2 | 150.0 | -21.1 |
| 267.000 | H | 16.0 | 3.9 | 8.9 | 12.7 | 2.5 | 24.2 | 16.2 | 200.0 | -21.8 |
| 362.380 | H | 180.0 | 2.9 | 4.4 | 14.6 | 3.0 | 22.0 | 12.7 | 200.0 | -24.0 |
| 385.000 | H | 294.0 | 2.9 | 9.9 | 15.1 | 3.2 | 28.2 | 25.8 | 200.0 | -17.8 |

## Table 8: Radiated Emission Test Data, High Frequency Data (>1GHz)

## Low Channel (Restricted Bands)

| Frequency (MHz) | Polarity H/V | Az Deg | Ant. Height (m) | SA Level (dBµV) | Ant. Corr. (dB/m) | Cable Corr. (dB) | Amp Gain (dB) | Corr. Level (dBµV/m) | Corr. Level (µV/m) | Limit (µV/m) | Margin (dB) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X | | | | | | | | | | | | |
| 4810.000 | V | 85.0 | 1.0 | 42.0 | 32.8 | 2.0 | 37.2 | 39.6 | 96.0 | 5000.0 | -34.3 | Peak |
| 4810.000 | V | 85.0 | 1.0 | 34.3 | 32.8 | 2.0 | 37.2 | 32.0 | 39.7 | 500.0 | -22.0 | Avg |
| 12025.000 | V | 180.0 | 1.0 | 37.7 | 39.7 | 3.8 | 37.8 | 43.4 | 147.5 | 0.0 | -10.6 | Peak |
| 12025.000 | V | 180.0 | 1.0 | 34.5 | 39.7 | 3.8 | 37.8 | 40.2 | 102.4 | 0.0 | -13.8 | Avg |
| 4810.000 | H | 180.0 | 1.0 | 44.3 | 32.8 | 2.0 | 37.2 | 42.0 | 125.6 | 5000.0 | -32.0 | Peak |
| 4810.000 | H | 180.0 | 1.0 | 34.5 | 32.8 | 2.0 | 37.2 | 32.1 | 40.5 | 500.0 | -21.8 | Avg |
| 12025.000 | H | 180.0 | 1.0 | 37.7 | 39.7 | 3.8 | 37.8 | 43.4 | 147.5 | 0.0 | -10.6 | Peak |
| 12025.000 | H | 180.0 | 1.0 | 34.5 | 39.7 | 3.8 | 37.8 | 40.2 | 102.4 | 0.0 | -13.8 | Avg |
| Y | | | | | | | | | | | | |
| 4810.000 | V | 200.0 | 1.0 | 41.7 | 32.8 | 2.0 | 37.2 | 39.3 | 92.8 | 5000.0 | -34.6 | Peak |
| 4810.000 | V | 200.0 | 1.0 | 34.3 | 32.8 | 2.0 | 37.2 | 32.0 | 39.7 | 500.0 | -22.0 | Avg |
| 12025.000 | V | 180.0 | 1.0 | 37.7 | 39.7 | 3.8 | 37.8 | 43.4 | 147.5 | 0.0 | -10.6 | Peak |
| 12025.000 | V | 180.0 | 1.0 | 34.5 | 39.7 | 3.8 | 37.8 | 40.2 | 102.4 | 0.0 | -13.8 | Avg |
| 4810.000 | H | 185.0 | 1.0 | 44.7 | 32.8 | 2.0 | 37.2 | 42.3 | 131.0 | 5000.0 | -31.6 | Peak |
| 4810.000 | H | 185.0 | 1.0 | 36.2 | 32.8 | 2.0 | 37.2 | 33.8 | 49.3 | 500.0 | -20.1 | Avg |
| 12025.000 | H | 180.0 | 1.0 | 37.7 | 39.7 | 3.8 | 37.8 | 43.4 | 147.5 | 0.0 | -10.6 | Peak |
| 12025.000 | H | 180.0 | 1.0 | 34.5 | 39.7 | 3.8 | 37.8 | 40.2 | 102.4 | 0.0 | -13.8 | Avg |
| Z | | | | | | | | | | | | |
| 4810.000 | V | 180.0 | 1.0 | 41.7 | 32.8 | 2.0 | 37.2 | 39.3 | 92.8 | 5000.0 | -34.6 | Peak |
| 4810.000 | V | 180.0 | 1.0 | 34.3 | 32.8 | 2.0 | 37.2 | 32.0 | 39.7 | 500.0 | -22.0 | Avg |
| 12025.000 | V | 180.0 | 1.0 | 37.7 | 39.7 | 3.8 | 37.8 | 43.4 | 147.5 | 0.0 | -10.6 | Peak |
| 12025.000 | V | 180.0 | 1.0 | 34.5 | 39.7 | 3.8 | 37.8 | 40.2 | 102.4 | 0.0 | -13.8 | Avg |
| 4810.000 | H | 90.0 | 1.0 | 42.2 | 32.8 | 2.0 | 37.2 | 39.8 | 98.3 | 5000.0 | -34.1 | Peak |
| 4810.000 | H | 90.0 | 1.0 | 34.8 | 32.8 | 2.0 | 37.2 | 32.4 | 41.9 | 500.0 | -21.5 | Avg |
| 12025.000 | H | 180.0 | 1.0 | 37.7 | 39.7 | 3.8 | 37.8 | 43.4 | 147.5 | 0.0 | -10.6 | Peak |
| 12025.000 | H | 180.0 | 1.0 | 34.5 | 39.7 | 3.8 | 37.8 | 40.2 | 102.4 | 0.0 | -13.8 | Avg |

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

## Mid Channel (Restricted Bands)

| Frequency (MHz) | Polarity H/V | Az Deg | Ant. Height (m) | SA Level (dBµV) | Ant. Corr. (dB/m) | Cable Corr. (dB) | Amp Gain (dB) | Corr. Level (dBµV/m) | Corr. Level (µV/m) | Limit (µV/m) | Margin (dB) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X | | | | | | | | | | | | |
| 4880.000 | V | 90.0 | 1.0 | 39.8 | 33.0 | 2.0 | 37.2 | 37.6 | 76.3 | 5000.0 | -36.3 | Peak |
| 4880.000 | V | 90.0 | 1.0 | 34.2 | 33.0 | 2.0 | 37.2 | 32.0 | 39.9 | 500.0 | -22.0 | Avg |
| 7320.000 | V | 0.0 | 1.0 | 36.5 | 36.9 | 3.3 | 37.6 | 39.1 | 90.5 | 5000.0 | -34.8 | Peak |
| 7320.000 | V | 0.0 | 1.0 | 33.3 | 36.9 | 3.3 | 37.6 | 35.9 | 62.6 | 500.0 | -18.0 | Avg |
| 12200.000 | V | 0.0 | 1.0 | 38.3 | 39.8 | 4.2 | 37.5 | 44.7 | 172.3 | 5000.0 | -29.3 | Peak |
| 12200.000 | V | 0.0 | 1.0 | 34.3 | 39.8 | 4.2 | 37.5 | 40.7 | 108.7 | 500.0 | -13.3 | Avg |
| 4880.000 | H | 90.0 | 1.0 | 44.5 | 33.0 | 2.0 | 37.2 | 42.3 | 130.6 | 5000.0 | -31.7 | Peak |
| 4880.000 | H | 90.0 | 1.0 | 37.0 | 33.0 | 2.0 | 37.2 | 34.8 | 55.1 | 500.0 | -19.2 | Avg |
| 7320.000 | H | 0.0 | 1.0 | 36.5 | 36.9 | 3.3 | 37.6 | 39.1 | 90.5 | 5000.0 | -34.8 | Peak |
| 7320.000 | H | 0.0 | 1.0 | 33.3 | 36.9 | 3.3 | 37.6 | 35.9 | 62.6 | 500.0 | -18.0 | Avg |
| 12200.000 | H | 0.0 | 1.0 | 38.3 | 39.8 | 4.2 | 37.5 | 44.7 | 172.3 | 5000.0 | -29.3 | Peak |
| 12200.000 | H | 0.0 | 1.0 | 34.3 | 39.8 | 4.2 | 37.5 | 40.7 | 108.7 | 500.0 | -13.3 | Avg |
| Y | | | | | | | | | | | | |
| 4880.000 | V | 200.0 | 1.0 | 47.7 | 33.0 | 2.0 | 37.2 | 45.5 | 188.7 | 5000.0 | -28.5 | Peak |
| 4880.000 | V | 200.0 | 1.0 | 38.3 | 33.0 | 2.0 | 37.2 | 36.1 | 64.0 | 500.0 | -17.9 | Avg |
| 7320.000 | V | 0.0 | 1.0 | 37.2 | 36.9 | 3.3 | 37.6 | 39.8 | 97.8 | 5000.0 | -34.2 | Peak |
| 7320.000 | V | 0.0 | 1.0 | 32.0 | 36.9 | 3.3 | 37.6 | 34.6 | 53.9 | 500.0 | -19.3 | Avg |
| 12200.000 | V | 0.0 | 1.0 | 37.8 | 39.8 | 4.2 | 37.5 | 44.2 | 162.7 | 5000.0 | -29.8 | Peak |
| 12200.000 | V | 0.0 | 1.0 | 34.0 | 39.8 | 4.2 | 37.5 | 40.4 | 105.0 | 500.0 | -13.6 | Avg |
| 4880.000 | H | 90.0 | 1.0 | 45.7 | 33.0 | 2.0 | 37.2 | 43.5 | 149.9 | 5000.0 | -30.5 | Peak |
| 4880.000 | H | 90.0 | 1.0 | 37.3 | 33.0 | 2.0 | 37.2 | 35.1 | 57.0 | 500.0 | -18.9 | Avg |
| 7320.000 | H | 0.0 | 1.0 | 37.1 | 36.9 | 3.3 | 37.6 | 39.7 | 97.0 | 5000.0 | -34.2 | Peak |
| 7320.000 | H | 0.0 | 1.0 | 32.0 | 36.9 | 3.3 | 37.6 | 34.6 | 53.9 | 500.0 | -19.3 | Avg |
| 12200.000 | H | 0.0 | 1.0 | 37.8 | 39.8 | 4.2 | 37.5 | 44.2 | 162.7 | 5000.0 | -29.8 | Peak |
| 12200.000 | H | 0.0 | 1.0 | 34.0 | 39.8 | 4.2 | 37.5 | 40.4 | 105.0 | 500.0 | -13.6 | Avg |
| Z | | | | | | | | | | | | |
| 4880.000 | V | 180.0 | 1.0 | 44.0 | 33.0 | 2.0 | 37.2 | 41.8 | 123.3 | 5000.0 | -32.2 | Peak |
| 4880.000 | V | 180.0 | 1.0 | 36.3 | 33.0 | 2.0 | 37.2 | 34.1 | 50.8 | 500.0 | -19.9 | Avg |
| 7320.000 | V | 0.0 | 1.0 | 36.3 | 36.9 | 3.3 | 37.6 | 38.9 | 88.5 | 5000.0 | -35.0 | Peak |
| 7320.000 | V | 0.0 | 1.0 | 33.2 | 36.9 | 3.3 | 37.6 | 35.8 | 61.9 | 500.0 | -18.1 | Avg |
| 12200.000 | V | 0.0 | 1.0 | 37.2 | 39.8 | 4.2 | 37.5 | 43.6 | 151.8 | 5000.0 | -30.4 | Peak |
| 12200.000 | V | 0.0 | 1.0 | 34.3 | 39.8 | 4.2 | 37.5 | 40.7 | 108.7 | 500.0 | -13.3 | Avg |
| 4880.000 | H | 220.0 | 1.0 | 44.2 | 33.0 | 2.0 | 37.2 | 42.0 | 126.1 | 5000.0 | -32.0 | Peak |
| 4880.000 | H | 220.0 | 1.0 | 36.8 | 33.0 | 2.0 | 37.2 | 34.6 | 53.8 | 500.0 | -19.4 | Avg |
| 7320.000 | H | 0.0 | 1.0 | 36.2 | 36.9 | 3.3 | 37.6 | 38.8 | 87.5 | 5000.0 | -35.1 | Peak |
| 7320.000 | H | 0.0 | 1.0 | 33.3 | 36.9 | 3.3 | 37.6 | 35.9 | 62.6 | 500.0 | -18.0 | Avg |
| 12200.000 | H | 0.0 | 1.0 | 37.8 | 39.8 | 4.2 | 37.5 | 44.2 | 162.7 | 5000.0 | -29.8 | Peak |
| 12200.000 | H | 0.0 | 1.0 | 34.3 | 39.8 | 4.2 | 37.5 | 40.7 | 108.7 | 500.0 | -13.3 | Avg |

## Table 10: Radiated Emission Test Data, High Frequency Data (>1GHz)

## Hi Channel (Restricted Bands)

| Frequency (MHz) | Polarity H/V | Az Deg | Ant. Height (m) | SA Level (dBµV) | Ant. Corr. (dB/m) | Cable Corr. (dB) | Amp Gain (dB) | Corr. Level (dBµV/m) | Corr. Level (µV/m) | Limit (µV/m) | Margin (dB) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X | | | | | | | | | | | | |
| 4960.000 | V | 180.0 | 1.0 | 41.3 | 33.2 | 2.0 | 37.2 | 39.3 | 92.3 | 5000.0 | -34.7 | Peak |
| 4960.000 | V | 180.0 | 1.0 | 34.8 | 33.2 | 2.0 | 37.2 | 32.8 | 43.7 | 500.0 | -21.2 | Avg |
| 7440.000 | V | 0.0 | 1.0 | 38.0 | 37.0 | 3.6 | 37.6 | 41.0 | 112.4 | 5000.0 | -33.0 | Peak |
| 7440.000 | V | 0.0 | 1.0 | 33.5 | 37.0 | 3.6 | 37.6 | 36.5 | 67.0 | 500.0 | -17.5 | Avg |
| 12400.000 | V | 0.0 | 1.0 | 37.7 | 39.8 | 4.5 | 37.1 | 44.9 | 176.6 | 5000.0 | -29.0 | Peak |
| 12400.000 | V | 0.0 | 1.0 | 34.3 | 39.8 | 4.5 | 37.1 | 41.5 | 119.4 | 500.0 | -12.4 | Avg |
| 4960.000 | H | 45.0 | 1.0 | 42.8 | 33.2 | 2.0 | 37.2 | 40.8 | 109.7 | 5000.0 | -33.2 | Peak |
| 4960.000 | H | 45.0 | 1.0 | 36.2 | 33.2 | 2.0 | 37.2 | 34.2 | 51.3 | 500.0 | -19.8 | Avg |
| 7440.000 | H | 0.0 | 1.0 | 36.5 | 37.0 | 3.6 | 37.6 | 39.5 | 94.6 | 5000.0 | -34.5 | Peak |
| 7440.000 | H | 0.0 | 1.0 | 33.3 | 37.0 | 3.6 | 37.6 | 36.3 | 65.4 | 500.0 | -17.7 | Avg |
| 12400.000 | V | 0.0 | 1.0 | 38.0 | 39.8 | 4.5 | 37.1 | 45.2 | 182.8 | 5000.0 | -28.7 | Peak |
| 12400.000 | V | 0.0 | 1.0 | 34.3 | 39.8 | 4.5 | 37.1 | 41.5 | 119.4 | 500.0 | -12.4 | Avg |
| Y | | | | | | | | | | | | |
| 4960.000 | V | 180.0 | 1.0 | 43.7 | 33.2 | 2.0 | 37.2 | 41.7 | 121.7 | 5000.0 | -32.3 | Peak |
| 4960.000 | V | 180.0 | 1.0 | 36.7 | 33.2 | 2.0 | 37.2 | 34.7 | 54.4 | 500.0 | -19.3 | Avg |
| 7440.000 | V | 0.0 | 1.0 | 37.2 | 37.0 | 3.6 | 37.6 | 40.2 | 102.5 | 5000.0 | -33.8 | Peak |
| 7440.000 | V | 0.0 | 1.0 | 34.0 | 37.0 | 3.6 | 37.6 | 37.0 | 70.9 | 500.0 | -17.0 | Avg |
| 12400.000 | V | 0.0 | 1.0 | 38.0 | 39.8 | 4.5 | 37.1 | 45.2 | 182.8 | 5000.0 | -28.7 | Peak |
| 12400.000 | V | 0.0 | 1.0 | 34.2 | 39.8 | 4.5 | 37.1 | 41.4 | 118.0 | 500.0 | -12.5 | Avg |
| 4960.000 | H | 95.0 | 1.0 | 44.0 | 33.2 | 2.0 | 37.2 | 42.0 | 126.0 | 5000.0 | -32.0 | Peak |
| 4960.000 | H | 95.0 | 1.0 | 37.0 | 33.2 | 2.0 | 37.2 | 35.0 | 56.3 | 500.0 | -19.0 | Avg |
| 7440.000 | H | 0.0 | 1.0 | 36.7 | 37.0 | 3.6 | 37.6 | 39.7 | 96.8 | 5000.0 | -34.3 | Peak |
| 7440.000 | H | 0.0 | 1.0 | 33.3 | 37.0 | 3.6 | 37.6 | 36.3 | 65.4 | 500.0 | -17.7 | Avg |
| 12400.000 | V | 0.0 | 1.0 | 37.8 | 39.8 | 4.5 | 37.1 | 45.0 | 178.6 | 5000.0 | -28.9 | Peak |
| 12400.000 | V | 0.0 | 1.0 | 33.8 | 39.8 | 4.5 | 37.1 | 41.0 | 112.7 | 500.0 | -12.9 | Avg |
| Z | | | | | | | | | | | | |
| 4960.000 | V | 90.0 | 1.0 | 41.7 | 33.2 | 2.0 | 37.2 | 39.7 | 96.7 | 5000.0 | -34.3 | Peak |
| 4960.000 | V | 90.0 | 1.0 | 34.7 | 33.2 | 2.0 | 37.2 | 32.7 | 43.2 | 500.0 | -21.3 | Avg |
| 7440.000 | V | 0.0 | 1.0 | 37.2 | 37.0 | 3.6 | 37.6 | 40.2 | 102.5 | 5000.0 | -33.8 | Peak |
| 7440.000 | V | 0.0 | 1.0 | 34.0 | 37.0 | 3.6 | 37.6 | 37.0 | 70.9 | 500.0 | -17.0 | Avg |
| 12400.000 | V | 0.0 | 1.0 | 38.0 | 39.8 | 4.5 | 37.1 | 45.2 | 182.8 | 5000.0 | -28.7 | Peak |
| 12400.000 | V | 0.0 | 1.0 | 34.2 | 39.8 | 4.5 | 37.1 | 41.4 | 118.0 | 500.0 | -12.5 | Avg |
| 4960.000 | H | 120.0 | 1.0 | 44.0 | 33.2 | 2.0 | 37.2 | 42.0 | 126.0 | 5000.0 | -32.0 | Peak |
| 4960.000 | H | 120.0 | 1.0 | 37.0 | 33.2 | 2.0 | 37.2 | 35.0 | 56.3 | 500.0 | -19.0 | Avg |
| 7440.000 | H | 0.0 | 1.0 | 36.7 | 37.0 | 3.6 | 37.6 | 39.7 | 96.8 | 5000.0 | -34.3 | Peak |
| 7440.000 | H | 0.0 | 1.0 | 33.3 | 37.0 | 3.6 | 37.6 | 36.3 | 65.4 | 500.0 | -17.7 | Avg |
| 12400.000 | V | 0.0 | 1.0 | 37.8 | 39.8 | 4.5 | 37.1 | 45.0 | 178.6 | 5000.0 | -28.9 | Peak |
| 12400.000 | V | 0.0 | 1.0 | 33.8 | 39.8 | 4.5 | 37.1 | 41.0 | 112.7 | 500.0 | -12.9 | Avg |