Washington Laboratories, Ltd.

FCC & Industry Canada Certification Test Report
For the
Comsonics, Inc.
Qualifier X-Ray VMD

FCC ID: PYN2007VMD
IC ID: 4261A-2007VMD

WLL JOB# **9898**
August 10, 2007

Revision 1 February 6, 2008

Prepared for:

Comsonics, Inc.
1350 Port Republic Rd.
Harrisonburg, VA 22801

Prepared By:

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

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Prepared by: James Ritter
Compliance Engineer

Reviewed by: Steven D. Koster
EMC Operations Manager

Abstract

This report has been prepared on behalf of Comsonics, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Licensed Transmitter under Part 90 of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy RSS-119 of Industry Canada. This Certification Test Report documents the test configuration and test results for a Comsonics, Inc. Qualifier X-Ray VMD.

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 NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The Comsonics, Inc. Qualifier X-Ray VMD complies with the limits for a Licensed Transmitter device under FCC Part 90 and Industry Canada RSS-119.

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1 Introduction

1.1 Compliance Statement

The Comsonics, Inc. Qualifier X-Ray VMD complies with the limits for a Licensed Transmitter device under FCC Part 90.35 and Industry Canada RSS-119.

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 and the 2003 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Comsonics, Inc. 1350 Port Republic Rd. Harrisonburg, VA 22801
Purchase Order Number:	16736
Quotation Number:	63690

1.4 Test Dates

Testing was performed on the following date(s):	7/16/2007 to 7/20/2007

1.5 Test and Support Personnel

Washington Laboratories, LTD	James Ritter
Client Representative	Randy Smith

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 Comsonics, Inc. Qualifier X-Ray VMD is a 27 MHz Ingression Measurement Transmitter (IMT) and is one part of the two-part Qualifier X-Ray system for verifying home return path integrity. The return path integrity is measured by connecting the F-Type connector on the Qualifier X-Ray HHD to the existing cable of the house at the grounding block. The HHD, when manually activated, sends a request to the vehicle-mounted 27 MHz VMD unit to transmit a single CW Pulse. Once the house wiring is illuminated by the VMD, the Qualifier HHD measures the ingress.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Comsonics, Inc.
FCC ID:	PYN2007VMD
IC:	4261A-2007VMD
Model:	Qualifier X-Ray VMD
FCC Rule Parts:	§90.35
Industry Canada:	RSS-119
Frequency Range:	27.45-27.49 MHz
Maximum Output Power:	5W (37dBm) conducted Peak
Modulation:	None
Necessary Bandwidth:	0hz as per pt 2.202
Keying:	Manual
Type of Information:	Single CW Pulse
Number of Channels:	3
Power Output Level	Fixed
Antenna Connector	BNC
Frequency Tolerance:	20 ppm
Emission Type(s):	N0N (zero)
Interface Cables:	None
Power Source & Voltage:	12VDC

2.2 Test Configuration

The Qualifier X-Ray VMD was configured with 13.8VDC provided from a Lab power supply. The antenna port was connected to an RF Load.

2.3 Testing Algorithm

The Qualifier X-Ray VMD was configured by the manufacturer to continuously transmit at one of three channels. The channels were selected by a front panel pushbutton switch.

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 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

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

Land Mobile FM or PM Communications Equipment Measurement and Performance Standards (ANSI/TIA/EIA-603-93)

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
00069	HP, 85650A	ADAPTER, QP	7/6/2008
00073	HP, 8568B	ANALYZER, SPECTRUM	7/6/2008
00071	HP, 85685A	PRESELECTOR, RF	7/6/2008
00007	ARA, LPB-2520	ANTENNA, BICONILOG ANTENNA	6/7/2008
00034	EMCO, BIA-30	ANTENNA, BICONICAL	2/28/2008
00159	HP, 8648A	GENERATOR, RF SIGNAL	8/1/2008
00117	RACAL DANA 1992	COUNTER, FREQUENCY	5/8/2008
00360	GLOBAL SPECIALTIES, 1337	SUPPLY POWER, DC	CNR 00:00:00

4 Test Results

4.1 Duty Cycle Correction

As The EUT only transmits one CW pulse (1.048 seconds) when activated no Duty cycle correction was used.

4.2 RF Power Output: (FCC Part §2.1046)

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 carrier was unmodulated (Normal operation)

Bandreject and or high pass filters were installed to suppress the carrier to assure that measuring instrumentation would remain linear and that dynamic range requirements were met.

Table 3. RF Power Output

Frequency	Level
27.45 MHz	37.0 dBm peak
27.47 MHz	36.9 dBm peak
27.49 MHz	36.9 dBm peak

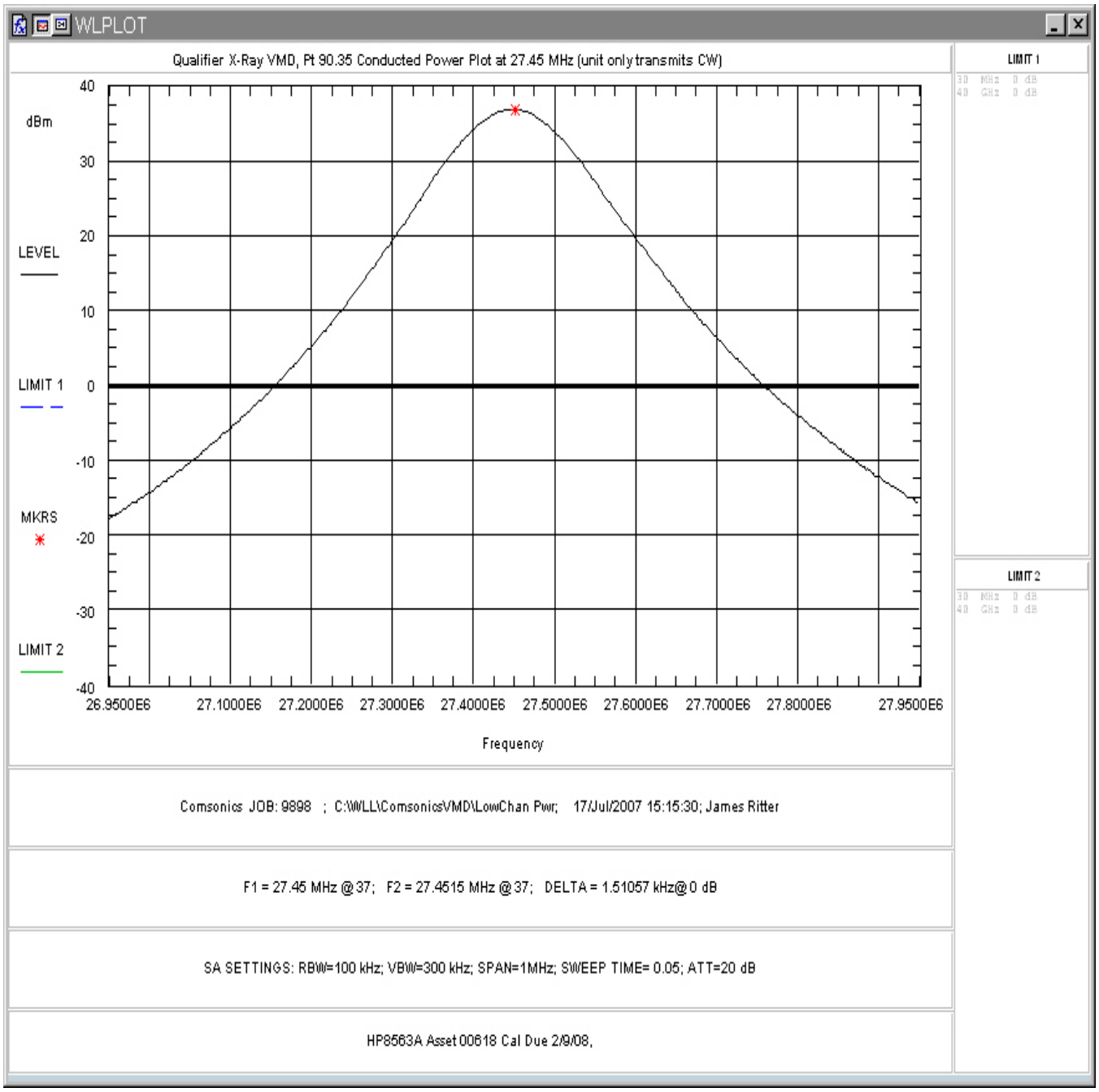

Figure 4-1. RF Peak Power, Low Channel

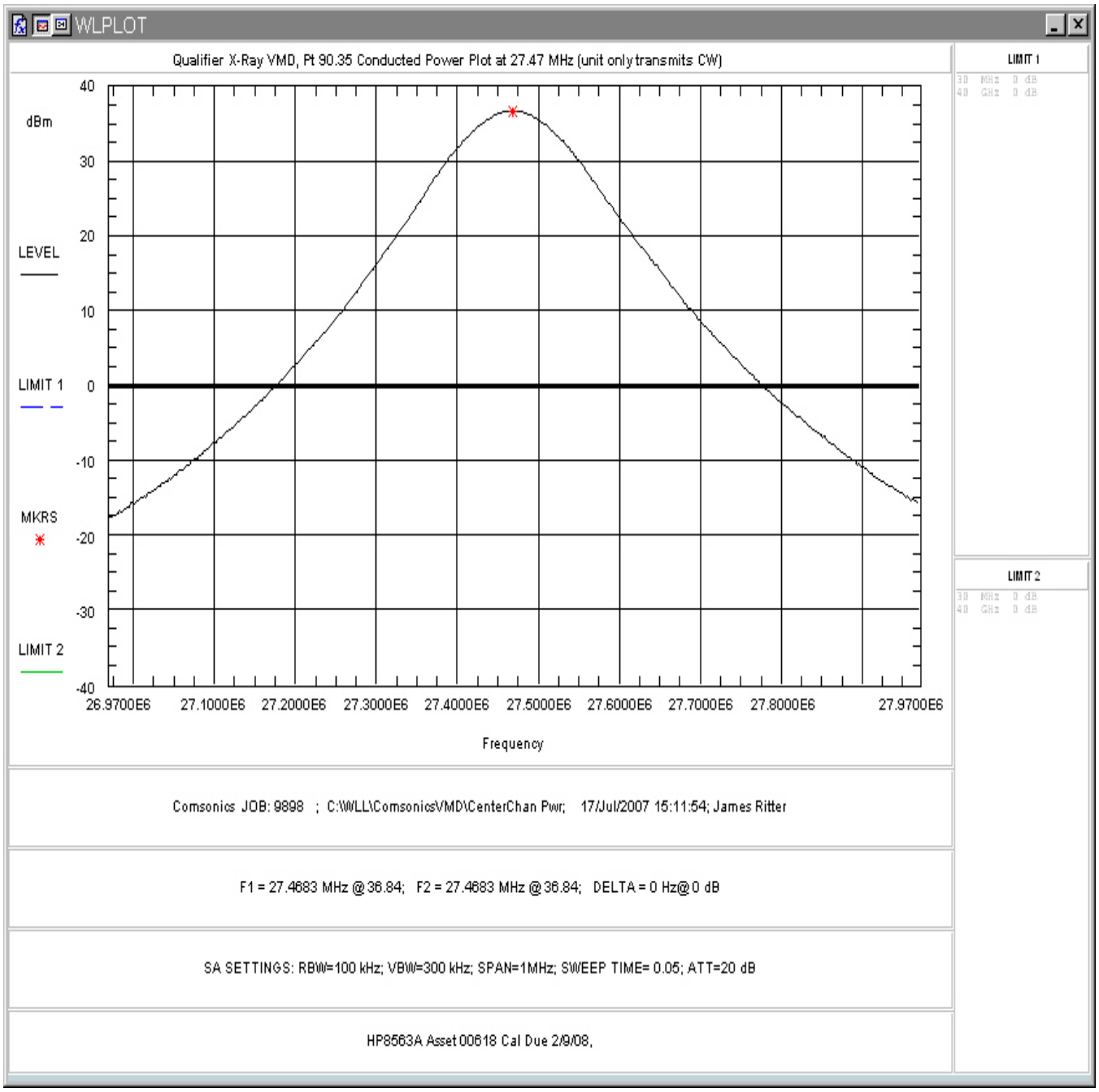

Figure 4-2. RF Peak Power, Mid Channel

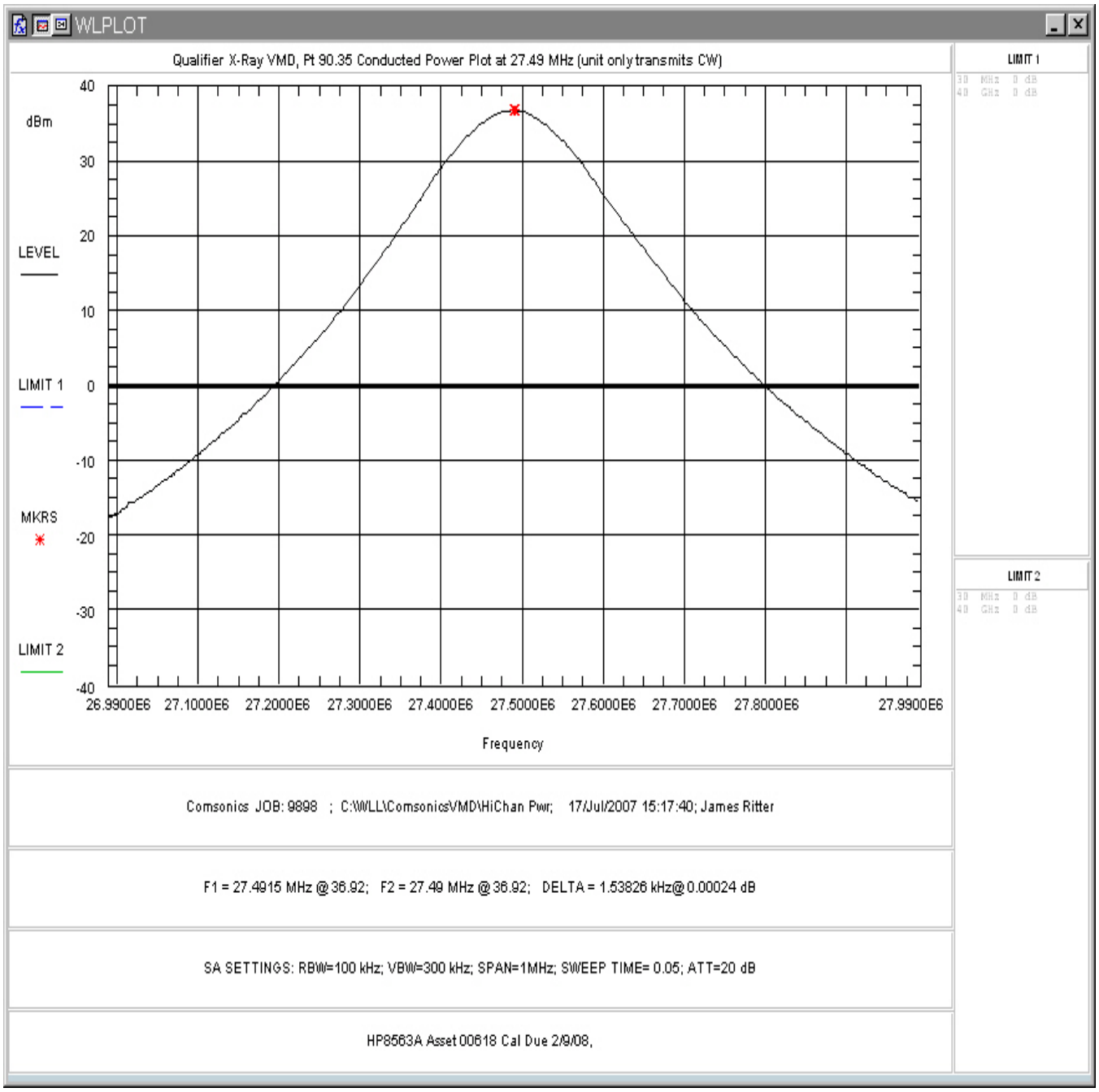

Figure 4-3. RF Peak Power, High Channel

4.3 Modulation Characteristics: (FCC Part §2.1047); Audio Frequency Response

As the EUT only operates with a single non-modulated pulse, no audio frequency response was recorded.

4.4 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer via an attenuator. The emissions must conform to the mask of 90.210(c).

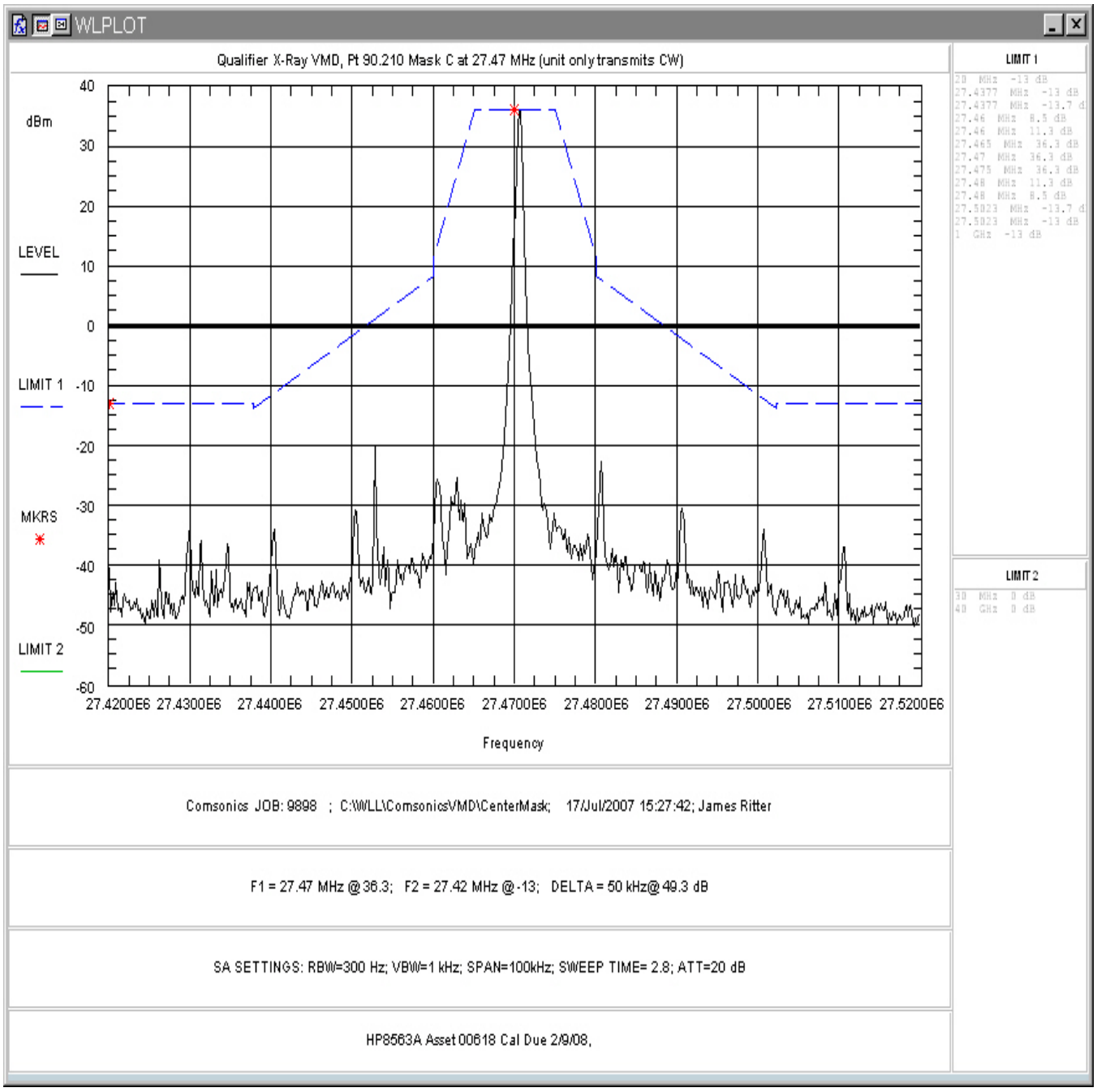

Figure 4-4. Occupied Bandwidth

Table 4 provides a summary of the Occupied Bandwidth Results.

Table 4. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
27.45 MHz	See Figure 4-7	90.210(c)	Pass

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

The EUT must comply with requirements for spurious emissions at antenna terminals. The limits are shown in the following table

Table 5. Conducted Spurious Emission Limits

Frequency	Fundamental	Harmonic Limit (-dBc)
Fundamental		
Harmonics		Mask: 90.210(c)

The following are plots of the conducted spurious emissions data.

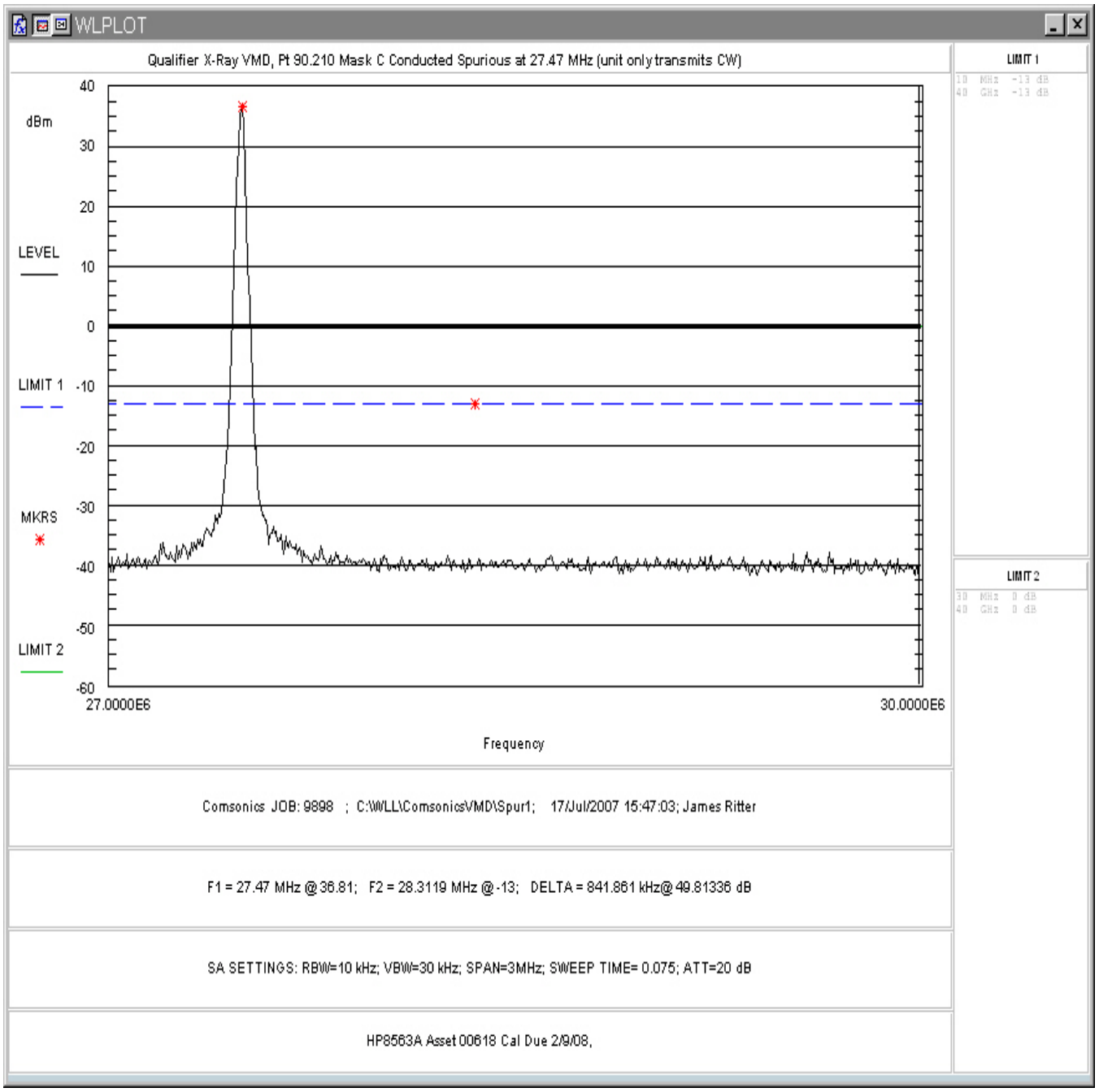

Figure 4-5. Conducted Spurious Emissions, Center Channel 27 - 30MHz

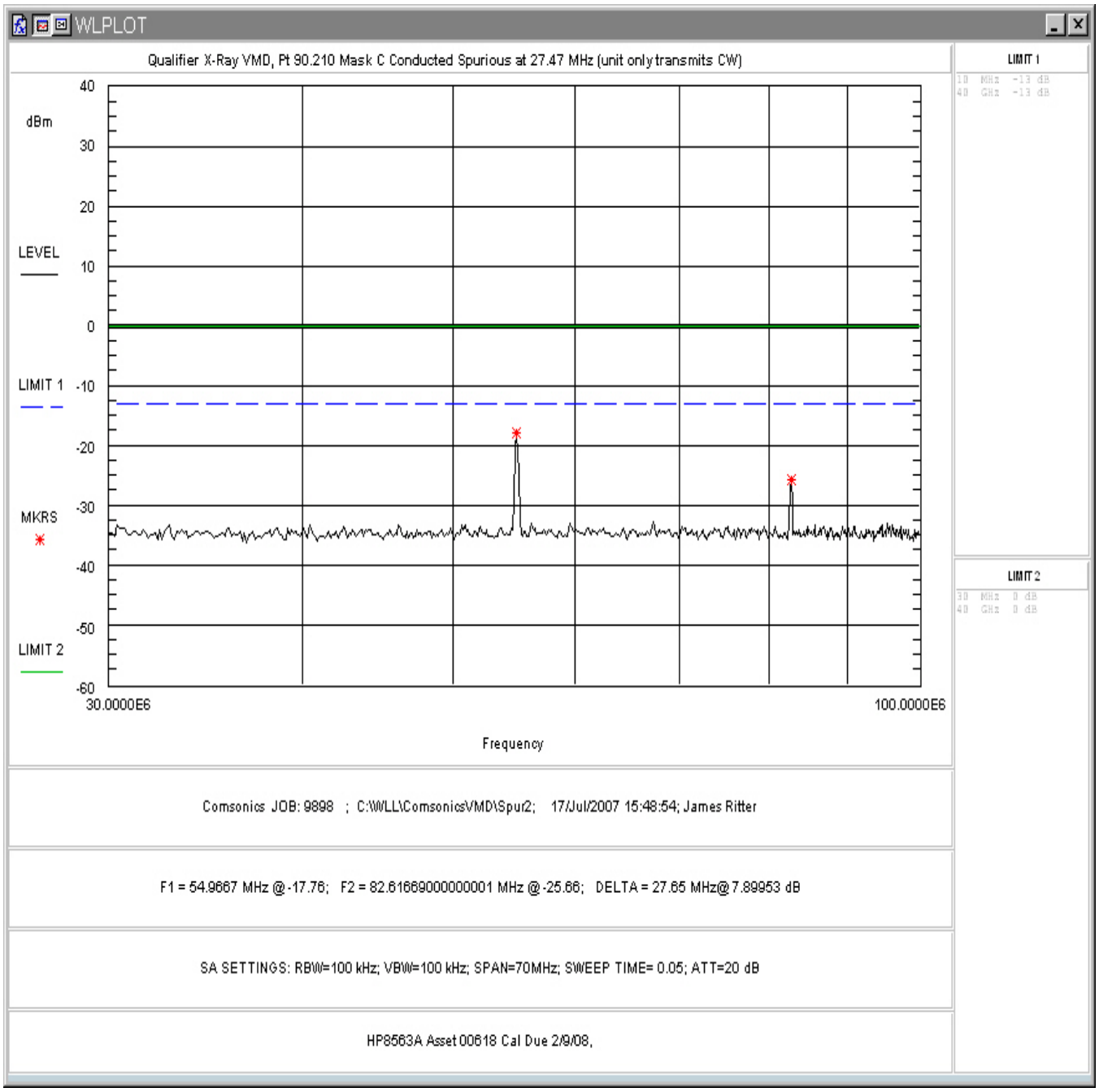

Figure 4-6. Conducted Spurious Emissions, Center Channel 30 – 100MHz

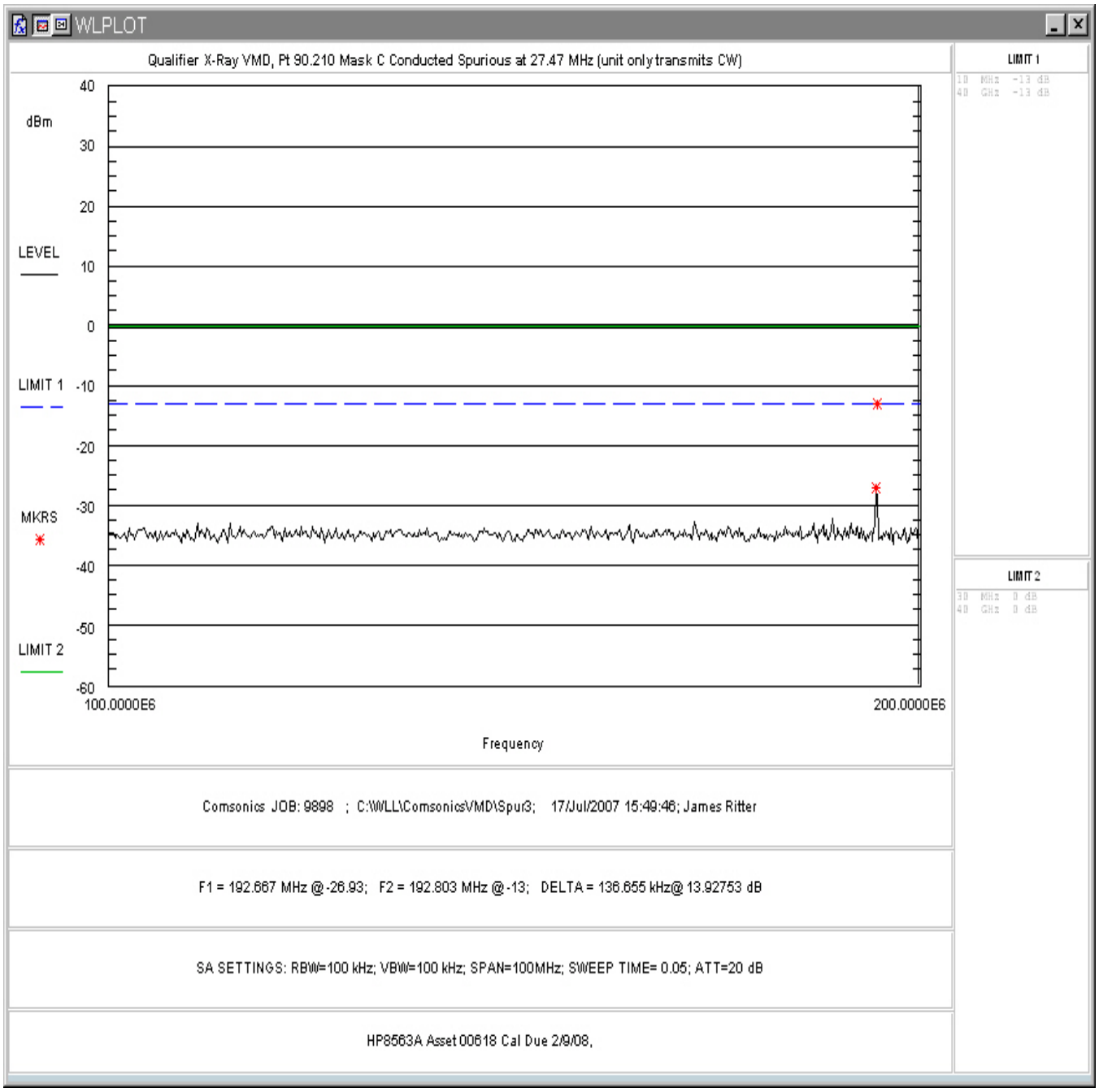

Figure 4-7. Conducted Spurious Emissions, Center Channel 100 – 200MHz

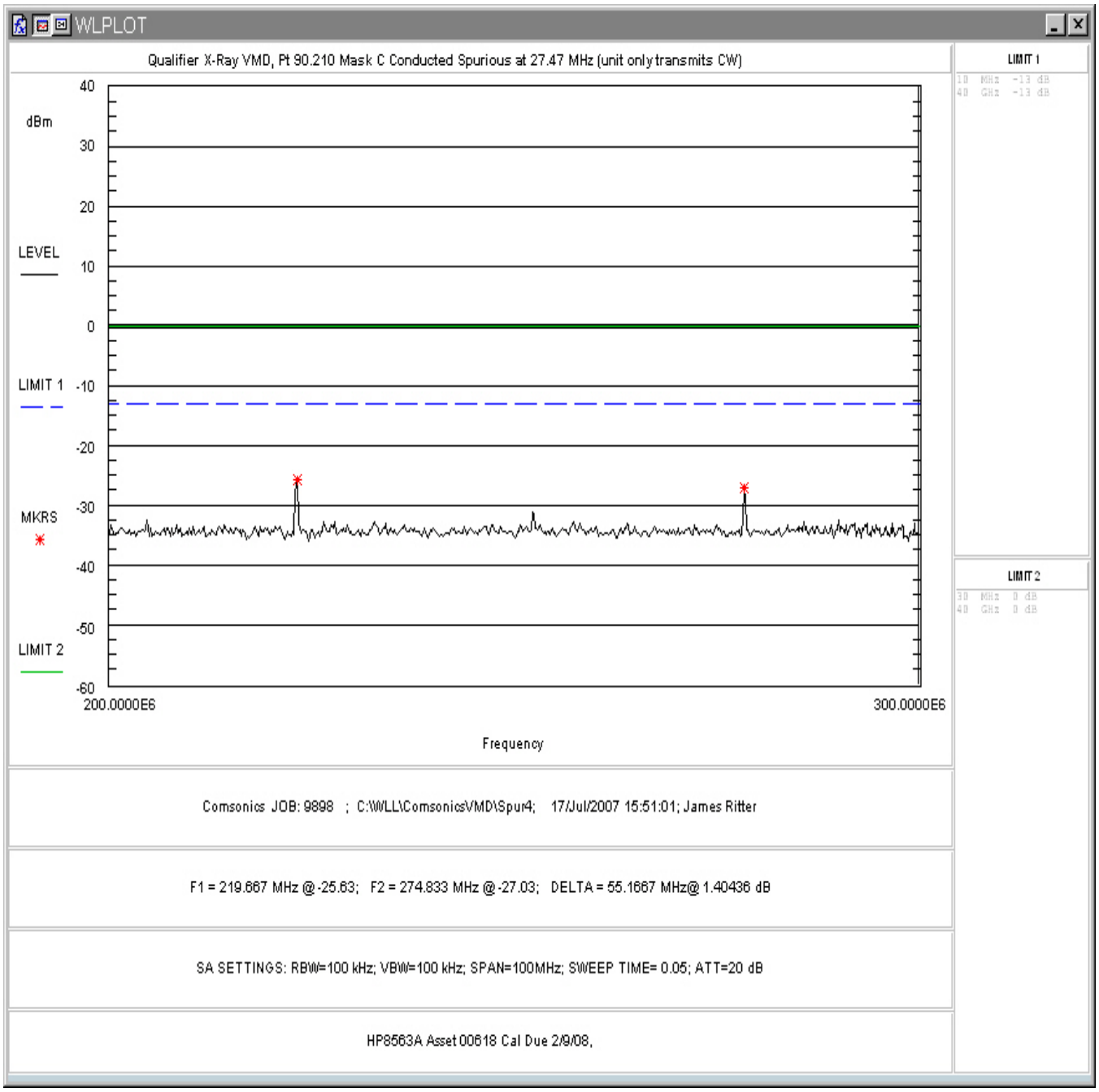

Figure 4-8. Conducted Spurious Emissions, Center Channel 200- 300MHz

4.6 Radiated Spurious Emissions: (FCC Part §2.1053)

The EUT must comply with requirements for radiated spurious emissions. The limits are as shown in the following table.

Table 6. Radiated Spurious Emissions Limits

Frequency	Fundamental	Harmonic Level (-dBc or E-Field)
Fundamental	--	
FCC Mask	90.210 (c)	90.210 (c)

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. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured. The substitution method was used in order to determine ERP results. Measurements were recorded to the 10th Harmonic.

Table 7: Radiated Emission Test Data, Low Frequency Data

Frequency (MHz)	Polarity H/V	Az Deg	Ant. Hght (m)	Spurious Level dBµV	Sub. Sig. Gen. Level dBm	Sub. Power Level dBm	Sub. Ant. Factor dB/m	Sub. Ant. Gain dBi	ERP Level dBm	Limit dBm	Margin dB
27.47	V	190.0	1.0	50.3	-8.5	-10.0	14.1	-15.1	-27.3	-13.0	-14.3
54.94	V	190.0	1.2	33.8	-25.1	-27.5	10.9	-5.9	-35.6	-13.0	-22.6
82.41	V	270.0	1.0	44.0	-41.3	-44.7	7.1	1.5	-45.4	-13.0	-32.4
109.88	V	180.0	1.4	36.8	-40.3	-43.8	15.0	-4.0	-50.0	-13.0	-37.0
137.35	V	165.0	1.5	42.7	-37.8	-42.0	12.8	0.1	-44.0	-13.0	-31.0
164.82	V	270.0	1.5	57.7	-16.1	-20.9	14.9	-0.3	-23.4	-13.0	-10.4
192.29	V	45.0	1.0	51.1	-22.0	-27.2	17.0	-1.1	-30.5	-13.0	-17.5
219.76	V	45.0	1.4	41.7	-28.0	-33.5	15.7	1.3	-34.3	-13.0	-21.3
247.23	V	180.0	1.6	44.6	-26.8	-32.8	15.6	2.5	-32.4	-13.0	-19.4
274.70	V	170.0	1.6	53.1	-17.0	-23.2	19.7	-0.8	-26.1	-13.0	-13.1
27.47	H	180.0	2.1	43.2	-7.7	-9.2	14.1	-15.1	-26.5	-13.0	-13.5
54.94	H	190.0	3.4	34.9	-37.1	-39.5	10.9	-5.9	-47.6	-13.0	-34.6
82.41	H	170.0	3.7	45.7	-36.1	-39.5	7.1	1.5	-40.2	-12.0	-28.2
109.88	H	180.0	3.5	40.4	-37.4	-40.9	15.0	-4.0	-47.1	-11.0	-36.1
137.35	H	180.0	3.6	50.0	-29.1	-33.3	12.8	0.1	-35.3	-10.0	-25.3
164.82	H	150.0	3.5	60.1	-16.6	-21.4	14.9	-0.3	-23.9	-13.0	-10.9
192.29	H	180.0	3.5	52.5	-25.3	-30.5	17.0	-1.1	-33.8	-13.0	-20.8
219.76	H	170.0	3.2	44.2	-27.2	-32.7	15.7	1.3	-33.5	-13.0	-20.5
247.23	H	270.0	1.0	46.5	-27.0	-33.0	15.6	2.5	-32.6	-13.0	-19.6
274.70	H	90.0	1.0	50.3	-22.3	-28.5	19.7	-0.8	-31.4	-13.0	-18.4

4.7 Frequency Stability: (FCC Part §2.1055)

Frequency as a function of temperature and voltage variation shall be maintained within the FCC-prescribed tolerances.

The temperature stability was measured with the unit in an environmental chamber used to vary the temperature of the sample. The sample was held at each temperature step to allow the temperature of the sample to stabilize.

The EUT is powered by DC voltage supplied externally. The manufacturer's power requirements for the EUT include the following:

12VDC Negative Ground

The frequency stability of the transmitter was examined at the voltage extremes and for the temperature range of -30°C to +50°C. The carrier frequency was measured while the EUT was in the temperature chamber. The reference frequency of the EUT was measured at the ambient room temperature with the frequency counter. The following are the reference frequencies at ambient for the Center Channel

Center Channel: 27.47MHz

Limit: 20ppm (.002%)

Table 8. Frequency Deviation as a Function of Temperature

Temperature (Centigrade)	Frequency (MHz)	Difference (Hz)	Deviation (%)	Limit (%)
Ambient	27.470124	0.0	0	.002
-30	27.470142	18.0	0.000066	.002
-20	27.470137	13.0	0.000047	.002
-10	27.470125	1.0	0.000004	.002
0	27.470126	2.0	0.000007	.002
10	27.470128	4.0	0.000015	.002
20	27.470125	1.0	0.000004	.002
30	27.470117	-7.0	0.000025	.002
40	27.470112	-12.0	0.000044	.002
50	27.470115	-9.0	0.000033	.002

Table 9. Frequency Deviation as a Function of Voltage

Voltage (Volts)	Voltage (Volts)	Frequency (MHz)	Difference (Hz)	Deviation (%)	Limit (%)
At rated	12VDC	27.470123	0	0.0	.002
At 85%	10.9VDC	27.470120	3	0.000011	.002
At 115%	13.8VDC	27.470118	5	0.000018	.002

5 Transmitter Environmental Assessment, Maximum Permissible Exposure (MPE)

5.1 SCOPE

This testing applies to RF transmitters used more than 20 cm of a human body.

5.2 REFERENCE

OET Bulletin 65

FCC § 1.1307, Radio Frequency Exposure

The EUT described in this report has been evaluated to the MPE limits for **General Population/Uncontrolled Environment**.

According to Section 1.1310 of the FCC rules, the uncontrolled RF exposure limit for this frequency range is $180/f^2$ (mW/cm^2). To comply with the exposure limits for this section, humans must not be too close to the transmit antenna.

For this device, the calculation is as follows: (Based on worst case power and frequency)

FCC Limit = $180/(27.47)^2$ mW/ cm^2 = 0.24 mW/ cm^2

A measurement was made at a distance of 20cm from the transmitting antenna using a W&G EMR-200 Em Radiation Meter. The device was configured to transmit at it's operating frequency continuously. The meter was moved along the vertical axis of the antenna to determine the maximum level. This level was measured at 0.029 mW/cm^2.

The antenna for this radio is located on top of a utility truck or van and is only in use while the operator is located a fair distance from the truck or van. For this reason the minimum safe distance is met by the typical mounting of the antennae EUT.