FCC Certification Test Report

FCC Certification Test Report
for
Hetronic USA, Inc.
FCC ID: LW9-GA61-V-1

March 22, 2002

Revision 1, May 2002

Prepared for:

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FCC Certification Test Program

FCC Certification Test Report
for the
Hetronic USA, Inc.
GS 610 VER-1 Vermeer
FCC ID: LW9-GA61-V-1

March 22, 2002

WLL JOB# 6893

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Abstract

This report has been prepared on behalf of Hetronic USA, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for equipment authorization under Part 90 of the FCC Rules and Regulations. Specifically, Hetronic is requesting approval using the exemption under §90.217. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for a Hetronic USA, Inc. Model: GS 610 VER-1 Vermeer Remote Control.

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 Hetronic USA, Inc. GS 610 VER-1 Vermeer Remote Control complies with the limits under Part 90 of the FCC Rules and Regulations.

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1 Introduction

1.1 Compliance Statement

The Hetronic USA, Inc. GS 610 VER-1 Vermeer Remote Control complies with the technical requirements Part 90 of the FCC Rules and Regulations. The transmitter was tested in accordance with the technical exemption of §90.217.

1.2 Test Scope

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 1992 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

Test were performed in accordance with FCC Rule Part 2, specifically the requirements stipulated in:

2.1046:	RF Power Output
2.1049:	Occupied Bandwidth
2.1051:	Spurious Emissions at Antenna Terminals
2.1053:	Field Strength of Spurious Radiation
2.1055:	Frequency Stability

1.3 Contract Information

Customer:	Hetronic USA, Inc. 4300 Highline Blvd. Building A Oklahoma City, OK 73108
Purchase Order Number:	599
Quotation Number:	59599

1.4 Test Dates

Testing was performed during November 2001.

1.5 Test and Support Personnel

Washington Laboratories, LTD	Chad Beattie, Son Nguyen

1.6 Abbreviations

A	Ampere
Ac	alternating current
AM	Amplitude Modulation
Amps	Amperes
b/s	bits per second
BW	Bandwidth
CE	Conducted Emission
cm	centimeter
CW	Continuous Wave
dB	decibel
dc	Direct current
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FM	Frequency Modulation
G	giga - prefix for 10^9 multiplier
Hz	Hertz
IF	Intermediate Frequency
k	kilo - prefix for 10^3 multiplier
M	Mega - prefix for 10^6 multiplier
m	Meter
μ	Micro - prefix for 10^{-6} multiplier
NB	Narrowband
LISN	Line Impedance Stabilization Network
RE	Radiated Emissions
RF	Radio Frequency
rms	root-mean-square
SN	Serial Number
S/A	Spectrum Analyzer
V	Volt

2 Equipment Under Test

2.1 EUT Identification & Description

The system is a radio remote control for industrial applications. The hand-held component (Vermeer) is battery powered device that allows the operator to be located safely away from the machine being controlled. The machine side of the remote system can control any number of processes or can be shut down when necessary.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Hetronic USA, Inc.
FCC ID Number	LW9-GA61-V-1
EUT Name:	Vermeer Remote Control
Model:	GS 610 VER-1
FCC Rule Parts:	§90
Frequency Range:	459 MHz
Maximum Output Power:	20mW (13dBm) Conducted
Modulation:	FM
Necessary Bandwidth:	10.08 kHz
Keying:	Manual
Type of Information:	Control
Number of Channels:	1
Power Output Level	Fixed
Antenna Type	1/8 wave monopole
Frequency Tolerance:	N/A
Emission Type(s):	F1D
Interface Cables:	None
Power Source & Voltage:	Battery V

Necessary bandwidth calculation:
B = 2M + 2DK,
Where:
M = B/2, where B = baud rate = 4800max (manufacturer spec)
D = peak frequency deviation = 2.2 kHz
K = 1.2
B = 2(4800/2) + 2(2200)(1.2) = 10.08 kHz
Emission designator = 10k1F1D

2.2 Test Configuration

The GS 610 VER-1 was configured with an antenna.

2.3 Testing Algorithm

The GS 610 VER-1 was operated by powering on and set for continuous transmission. 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. 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

Manufacturer & Model	Description	Serial Number	Date Calibrated	Calibration Due Date
Hewlett Packard 8564E	Spectrum Analyzer	3643A00657	4/11/01	4/11/02
Hewlett Packard 85650A	Q.P. Adapter	3303A01786	6/29/01	6/29/02
Hewlett Packard 85685A	RF Preselector	3221A01395	6/28/01	6/28/02
Hewlett Packard 8568B	Spectrum Analyzer	2634A02888	6/28/01	6/28/02
Hewlett Packard 8449B	Pre-Amplifier	3008A00729	12/7/00	12/7/01
Antenna Research Associates DRG-118/A	Horn Antenna	1010	10/20/01	10/20/02
Antenna Research Associates LPB-2520	Biconilog Antenna Site 2	1118	5/15/01	5/15/02

4 Test Results

4.1 RF Power Output: (FCC Part §2.1046)

The 50ohm output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer. The analyzer amplitude offset was adjusted to compensate for the attenuator and other losses in the system.

Table 3. RF Power Output

Frequency	Level	§90.217 Limit	Pass/Fail
459 MHz	13dBm (20mW)	120mW	Pass

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

4.2.1 Not required.

4.3 Occupied Bandwidth: (FCC Part §2.1049)

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

Under the exemption of §90.217(b), the sum of the occupied bandwidth and the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 25 kHz or more from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

At full modulation, the occupied bandwidth (30 dB) was measured at 5.43 kHz. With the worst case frequency deviation listed in Section 4.6, the total occupied bandwidth is 10.77 kHz. The following shows how this calculation was made:

> Peak Frequency Deviation = OBW + Peak frequency error over temperature + Peak frequency error over voltage

Therefore:

> Peak Frequency Deviation = 5.43 kHz + 3.323 kHz + 2.02 kHz = 10.77 kHz

All emissions outside of this frequency range are suppressed by at least 30 dB.

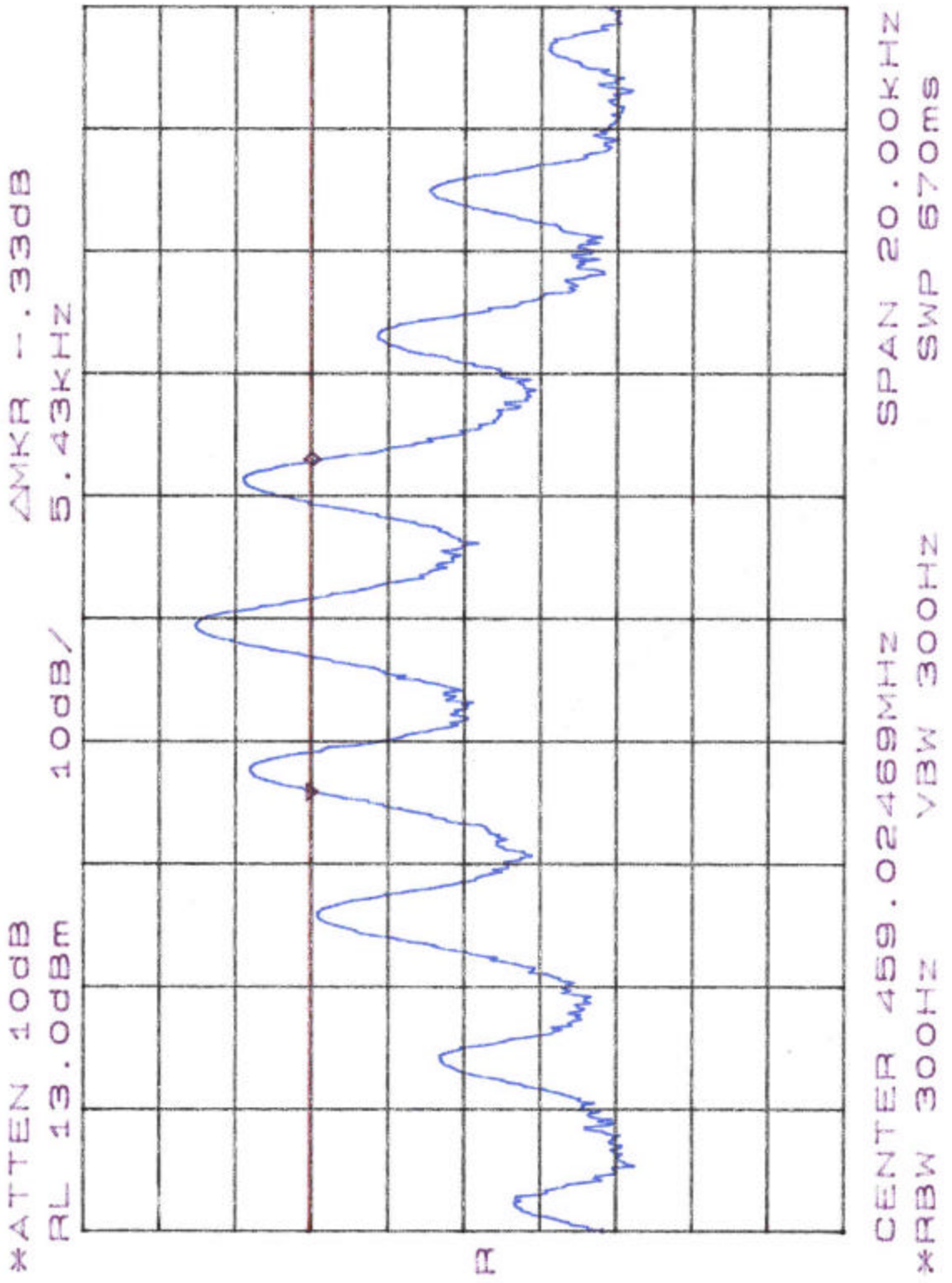

Figure 1. Occupied Bandwidth

4.4 Spurious Emissions at Antenna Terminals (FCC Part §2.1051)

The EUT was tested for spurious emissions at the antenna terminal. Conducted emissions testing was performed up to the 10th harmonic of the unit. Per §90.217 all spurious emissions must be attenuated 30 dB below the unmodulated carrier level.

The following plots show the spurious emissions detected up to 4.7GHz. All emissions were at least 40dB below the level of the fundamental frequency.

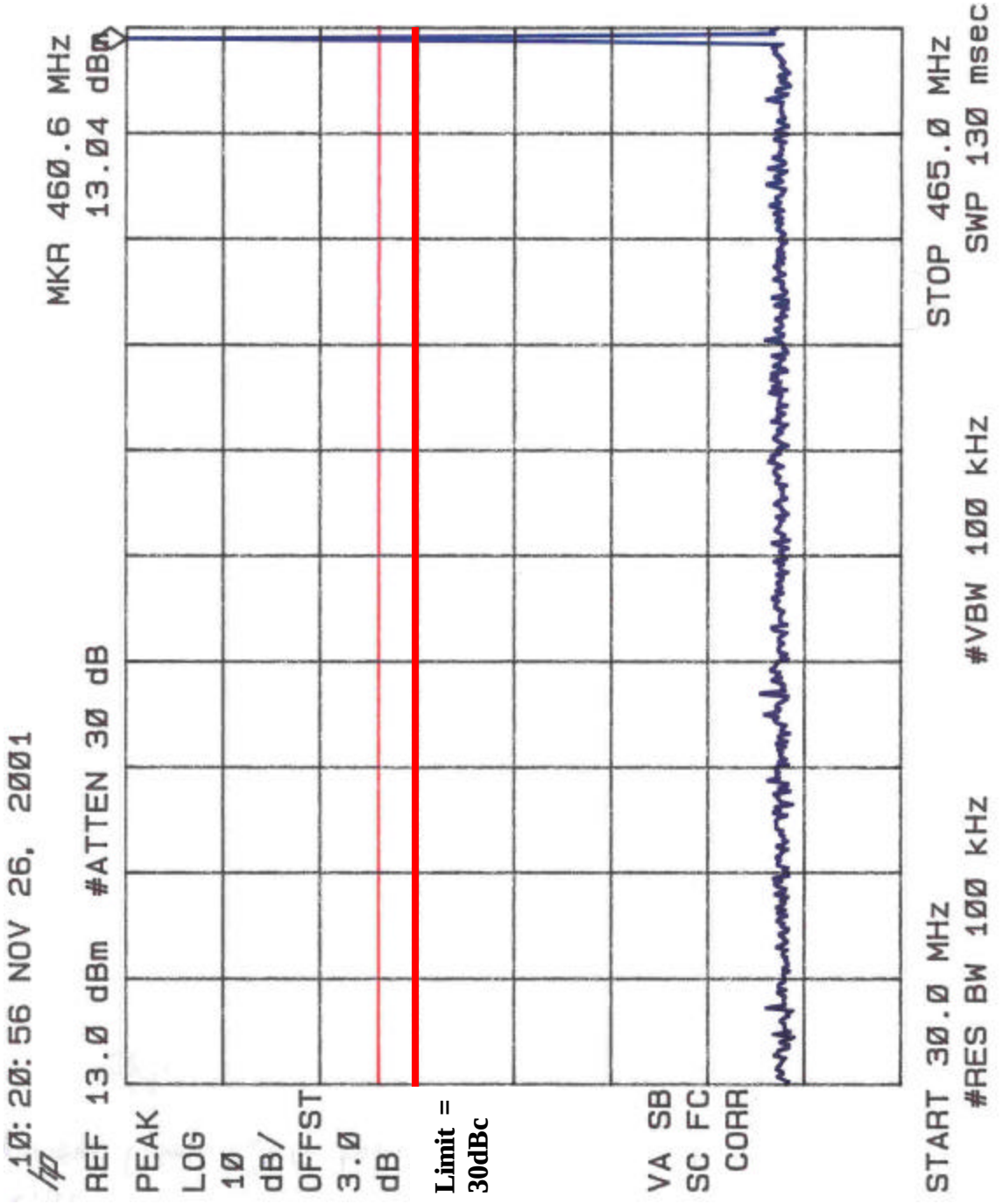

Table 4. Conducted Spurious Emissions, 30 MHz to 465 MHz

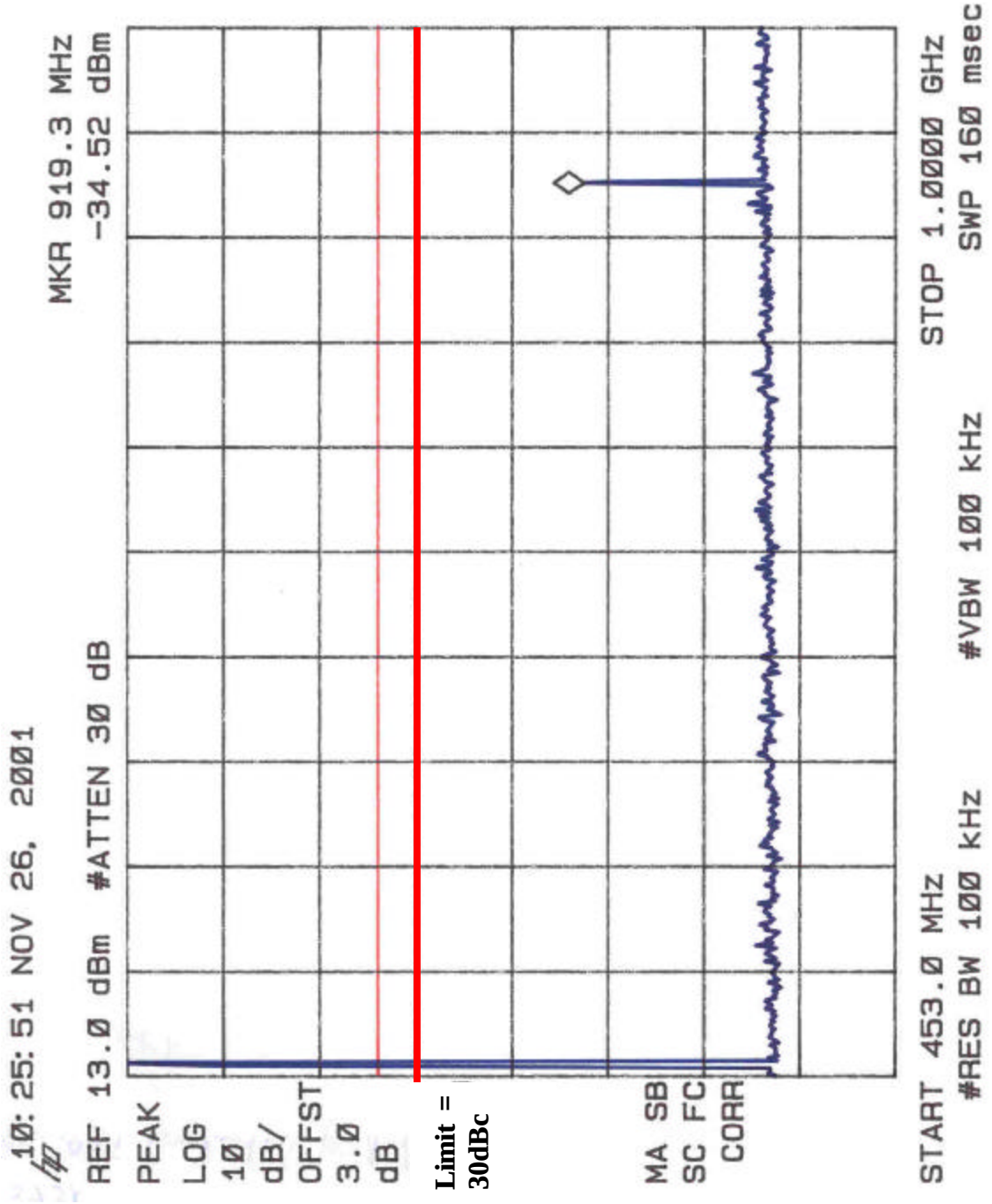

Table 5. Conducted Spurious Emissions, 453 MHz to 1 GHz

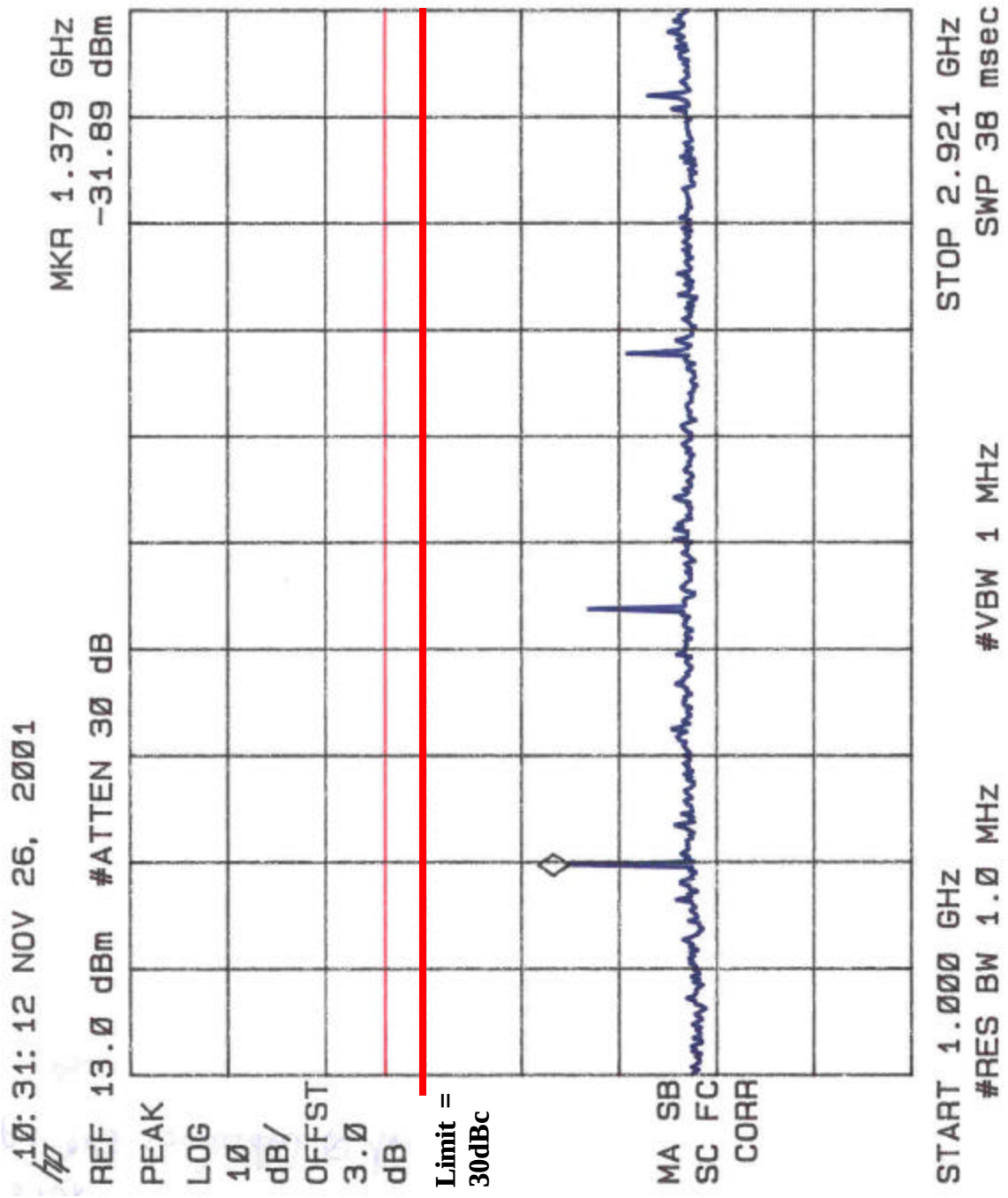

Table 6. Conducted Spurious Emissions, 1 GHz to 2.921 GHz

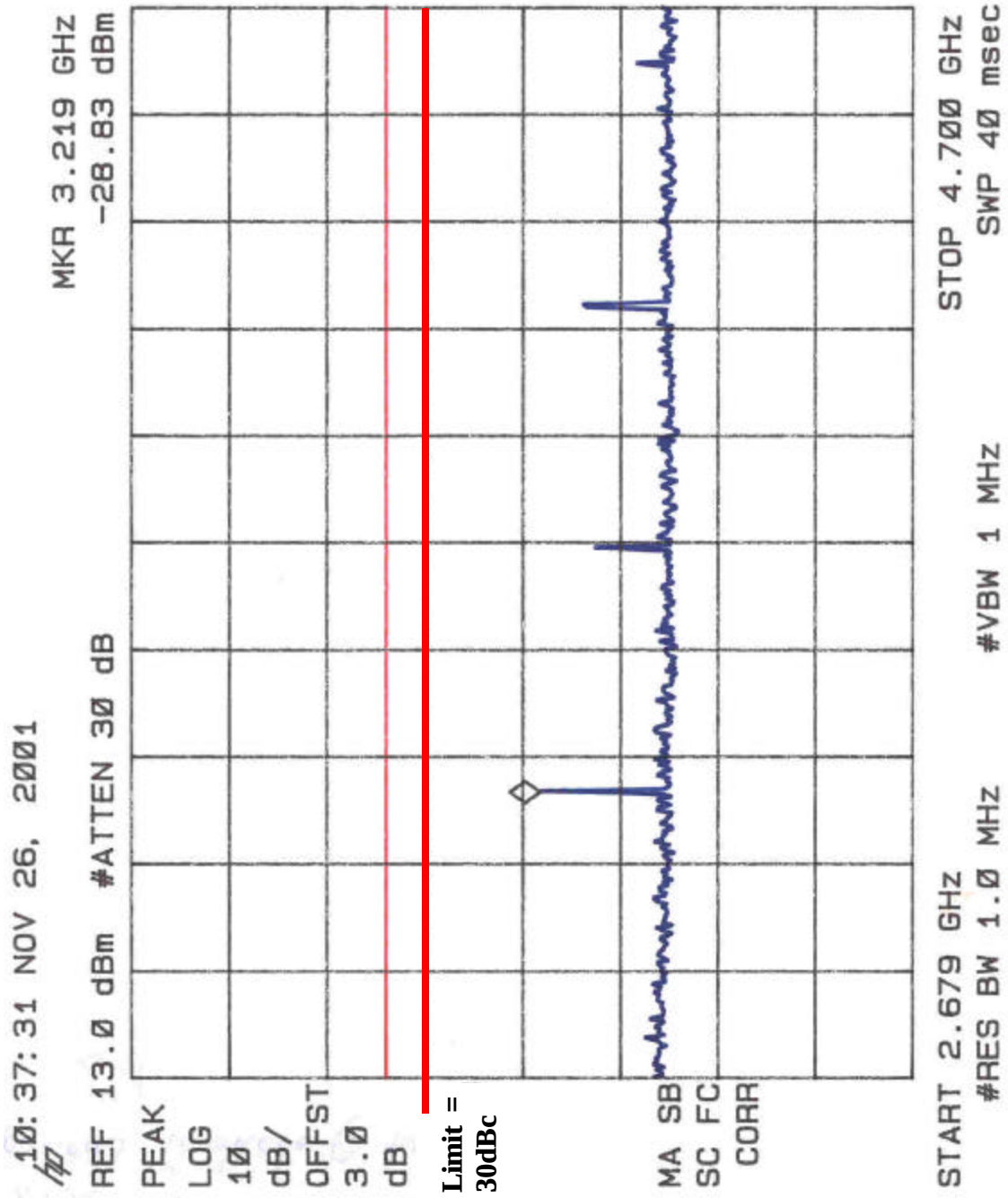

Table 7. Conducted Spurious Emissions, 2.679 GHz to 4.7 GHz

4.5 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 8. Radiated Spurious Emissions Limits

Frequency	Fundamental	Harmonic Level (-dBc or E-Field)
Fundamental	N/A	
Harmonics		-17dBm
FCC Mask	C	C

4.5.1 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. Both the horizontal and vertical field components were measured.

After measuring the spurious emissions, the transmitter was replaced with a substitution transmit antenna and emission level was determined using the substitution method as described in ANSI/TIA/EIA-603, Section 2.2.12.

During the emissions testing the EUT antenna was in place and the unit was tested in all 3 orthogonal planes. The worst case emissions are listed in the data table.

Table 9: Spurious Radiated Emission Test Data

FCC 3M RADIATED SPURIOUS EMISSIONS DATA - SITE 2
PART 90

CLIENT: Hetronic
MODEL NO: GS609 VER-1
TYPE/PART: FCC Pt 90
DATE: 11.15.01
BY: Chad M. Beattie
JOB #: 6893X

Frequency MHz	Polarity H/V	Substitution Level dBm	Tx Ant Gain (Ref. to 1/2 wave dipole)	Emission Level (dBm)	Limit Mask C (dBm)	Margin (dB)
918.05	V	-50.9	4.1	-46.8	-17.0	-29.8
1377.09	V	-40.0	4.9	-35.1	-17.0	-18.1
1836.12	H	-46.7	4.3	-42.4	-17.0	-25.4
2295.15	H	-31.7	3.9	-27.8	-17.0	-10.8
2754.16	H	-28.5	3.7	-24.8	-17.0	-7.8
3213.19	H	-30.0	4.0	-26.0	-17.0	-9.0
3672.24	V	-31.0	4.5	-26.5	-17.0	-9.5
4131.25	H	-32.6	5.1	-27.5	-17.0	-10.5
4590.25	H	-45.0	5.8	-39.2	-17.0	-22.2

4.6 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 via a 4.5V battery.

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 is the reference frequency at ambient for the radio.

At ambient: 459.0251600 MHz

Table 10. Frequency Deviation as a Function of Temperature

Temperature (Celsius)	Frequency (MHz)	Deviation (Hz)
-30	459.02083700	3323.00
-20	459.02325300	1907.00
-10	459.02452900	631.00
0	459.02475200	408.00
10	459.02475500	405.00
20	459.02503000	130.00
30	459.02434000	820.00
40	459.02320000	1960.00
50	459.02109000	3070.00

Table 11. Frequency Deviation as a Function of Voltage

Channel	Voltage (Volts DC)	Frequency (MHz)	Deviation (Hz)
459.025M	4.5 (Rated)	459.02516000	0.0
	3.825	459.02314000	2020.0
	5.175	459.02523600	76.0