FCC Certification Test Report

FCC Certification Test Report
for
ComSonics, Inc.
PYN22002A

February 27, 2002

Prepared for:

ComSonics, Inc.
1350 Port Republic Road
Harrisonburg, VA 22801

Prepared By:

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

FCC Certification Test Program

FCC Certification Test Report
for the
ComSonics, Inc.
433 MHz Qualifier
PYN22002A

February 27, 2002

WLL JOB# 6879

Prepared by: Brian J. Dettling
Documentation Specialist

Reviewed by: Gregory M. Snyder
Chief EMC Engineer

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 periodic intentional radiator under Part 15.231 of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for a ComSonics, Inc. 433 MHz Qualifier.

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 ComSonics, Inc. 433 MHz Qualifier complies with the limits for a periodic intentional radiator device under Part 15.231 of the FCC Rules and Regulations.

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1 Introduction

1.1 Compliance Statement

The ComSonics, Inc. 433 MHz Qualifier complies with the limits for a periodic intentional radiator device under Part 15.231 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for radiated 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.

1.3 Contract Information

Customer:	ComSonics, Inc. 1350 Port Republic Road Harrisonburg, VA 22801
Purchase Order Number:	G0882
Quotation Number:	59576

1.4 Test Dates

Testing was performed on December 3 and 5, 2001.

1.5 Test and Support Personnel

Washington Laboratories, LTD	Chad Beattie

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 ComSonics, Inc. 433 MHz Qualifier is one part of the two-part CyberTek™ Qualifier system for verifying home return path integrity. The return path integrity is measured by connecting the F-Type connector on the Qualifier to the existing cable of the house at the grounding block. The Qualifier, when manually activated, sends a request to the vehicle-mounted 27 MHz transponder unit (second part of the system, separate certification). Once the house wiring is illuminated by the transponder, the Qualifier measures the ingress.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	ComSonics, Inc.
FCC ID Number	PYN2202A
EUT Name:	433 MHz Qualifier
FCC Rule Parts:	§15.231
Frequency Range:	434 MHz
Oscillators	SAW resonator
Maximum Output Power:	<1mW
Modulation:	OOK
Bandwidth:	148kHz
Keying:	Manual
Type of Information:	Control
Number of Channels:	1
Power Output Level	Fixed
Antenna Type	Integral (PCB)
Frequency Tolerance:	N/A
Interface Cables:	None
Power Source & Voltage:	5 Vdc Battery

2.2 Test Configuration

The Qualifier was configured for continuous transmission. The measurement port was connected to a 75-ohm coax cable terminated into 75 ohms.

2.3 Testing Algorithm

The Qualifier was powered on and setup to transmit continuously. The unit was tested in 3 orthogonal planes.

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

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	12/07/00	12/07/01
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 Duty Cycle Correction

Measurements may be adjusted where pulsed RF is utilized to find the average level associated with a quantity. This calculation is applied to limits for pulsed licensed and unlicensed devices.

On time = $N_1L_1 + N_2L_2 + \ldots + N_{N-1}L_{N-1} + N_NL_N$, where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc.

- For Licensed Transmitters basic formula can be stated as 20log[Duty Cycle]
- For Unlicensed Intentional Radiators under 47CFR Part 15, all duty cycle measurements compared to a 100 millisecond period
- i.e. duty cycle = on time/100 milliseconds or period, whichever is less
- Restating the basic formula:
    - Duty cycle = $(N_1L_1 + N_2L_2 + \ldots + N_{N-1}L_{N-1} + N_NL_N)/100$ or T, whichever is less

Where T is the period of the pulse train.

The following Figures show the plots of the modulated carrier. The spectrum analyzer was set to Zero Span and the video triggered to collect the pulse train of the modulation. Calculations of the duty cycle correction factor were obtained from time data provided by the plots.

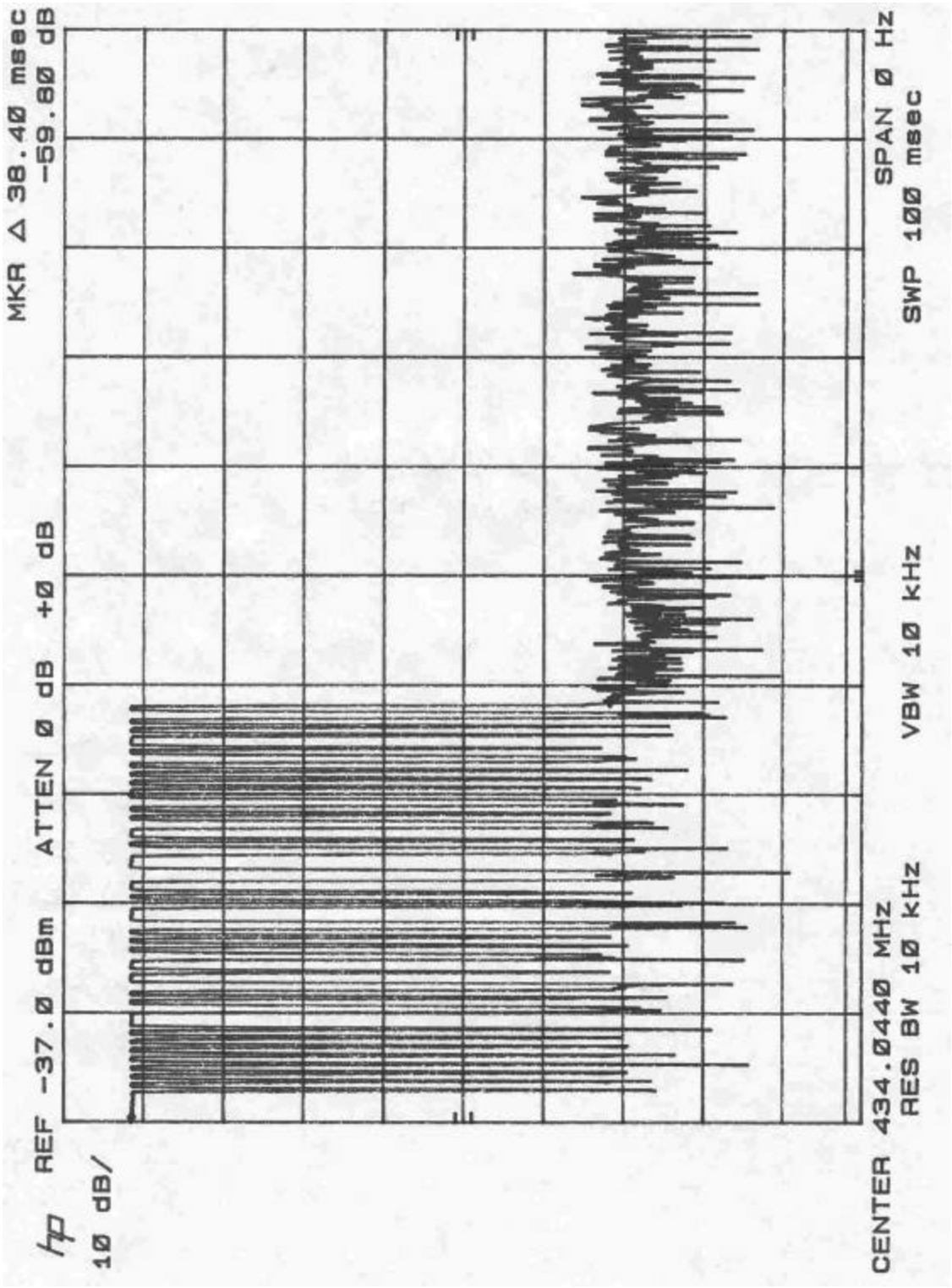

Figure 1. Duty Cycle Plots Full Period

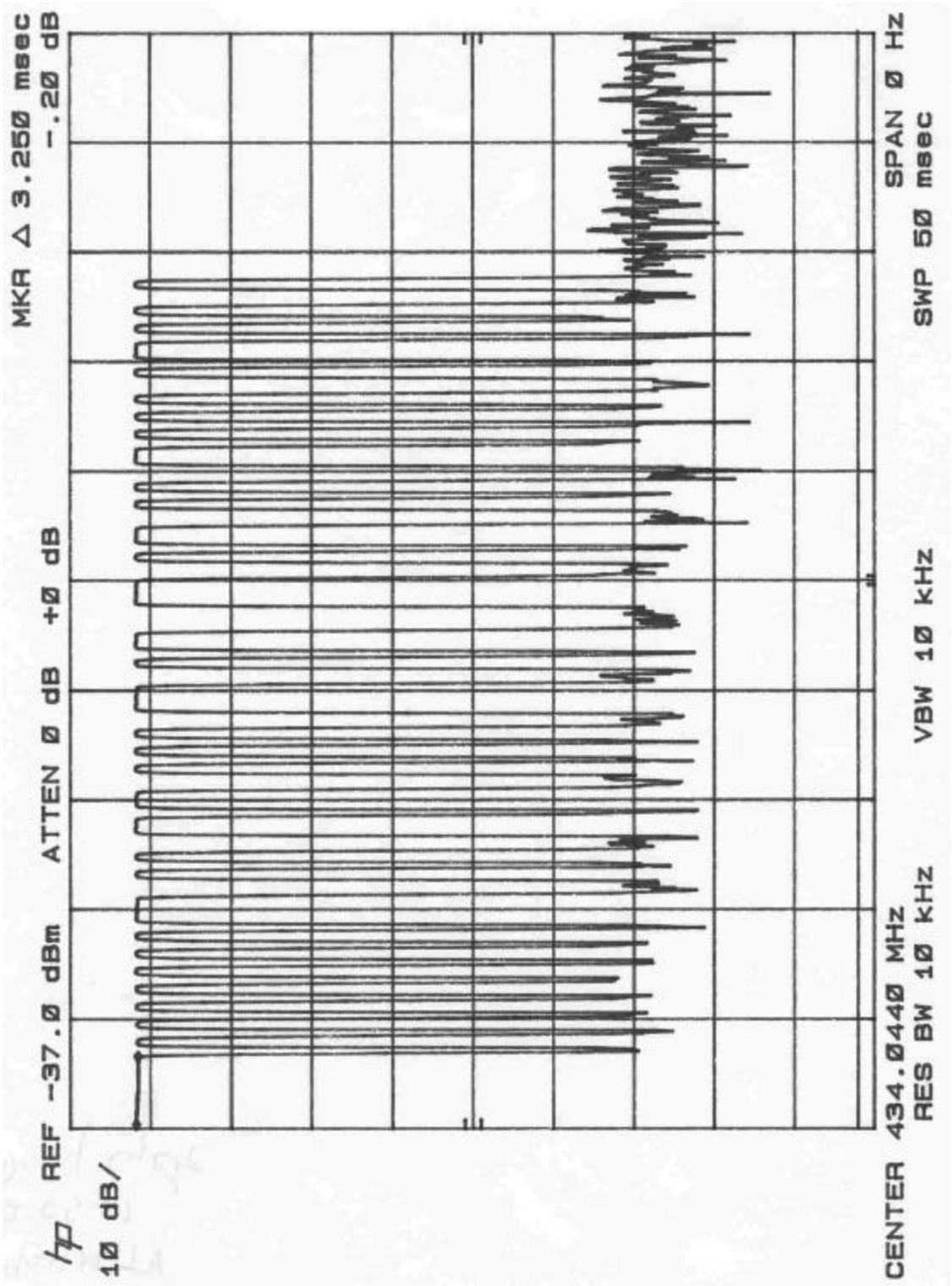

Figure 2. Duty Cycle Plot "On Time" 3.25mS Pulse

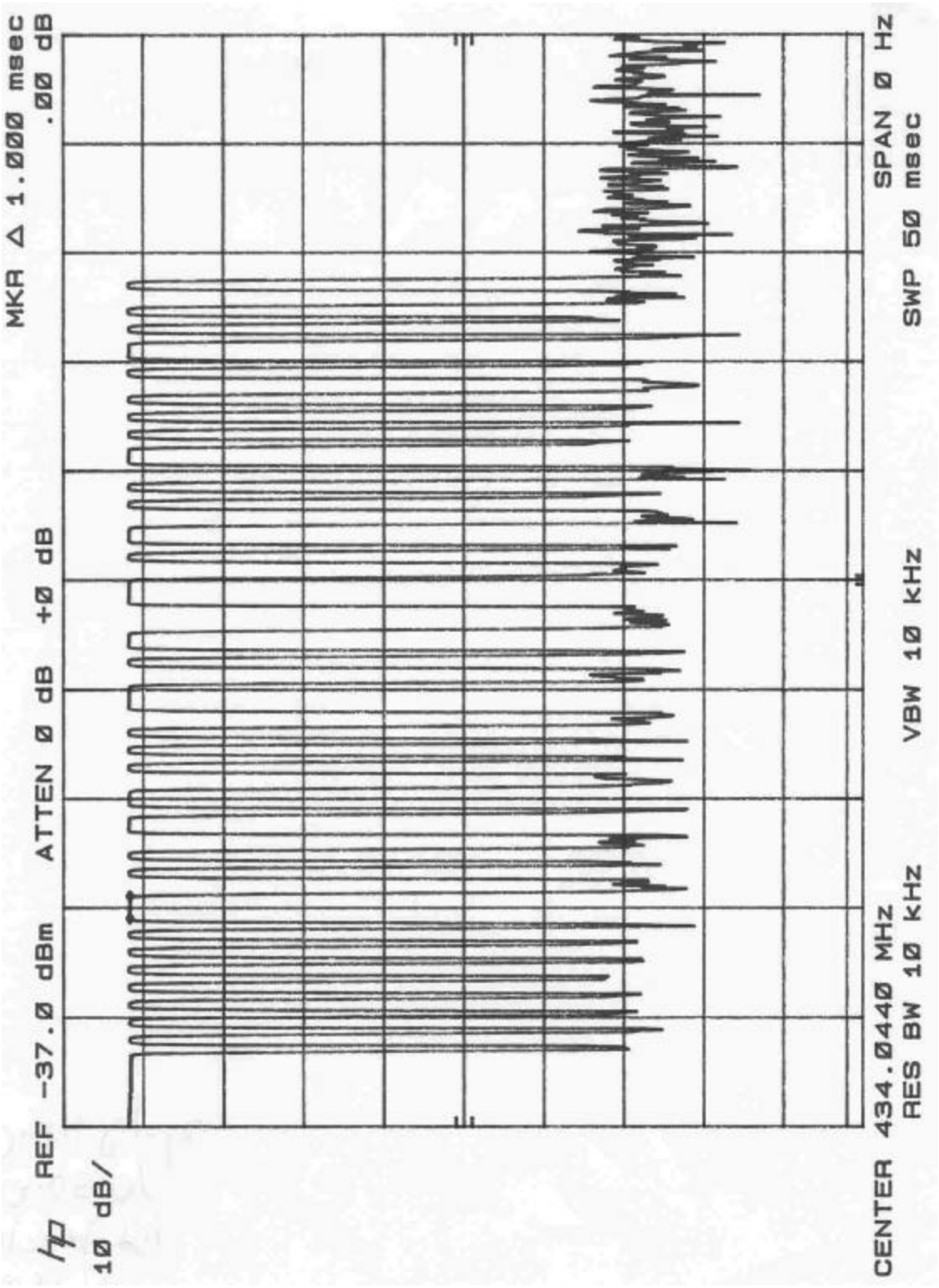

Figure 3. Duty Cycle Plot "On Time" 1mS Pulse

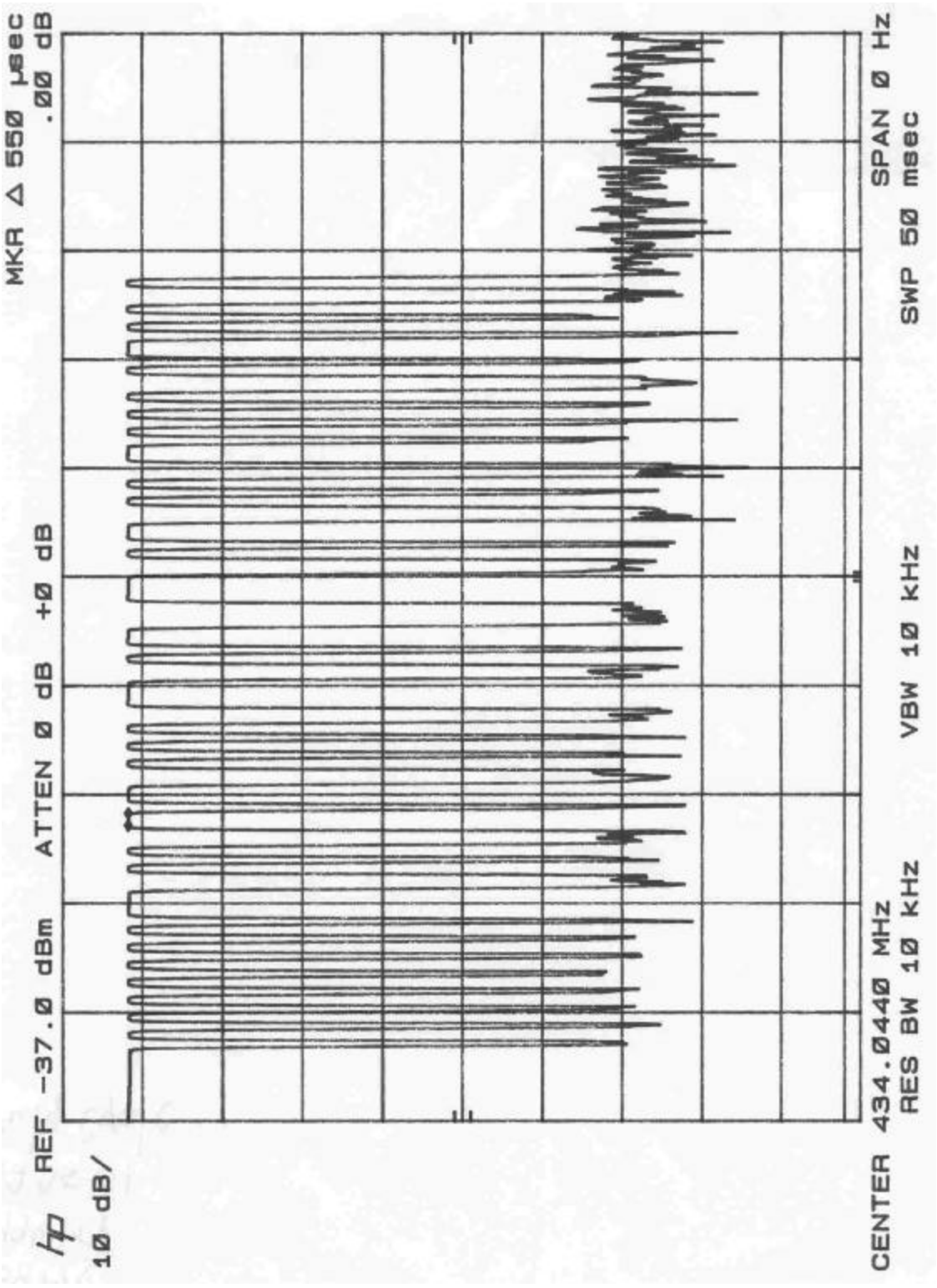

Figure 4. Duty Cycle Plot "On Time" 550uS Pulse

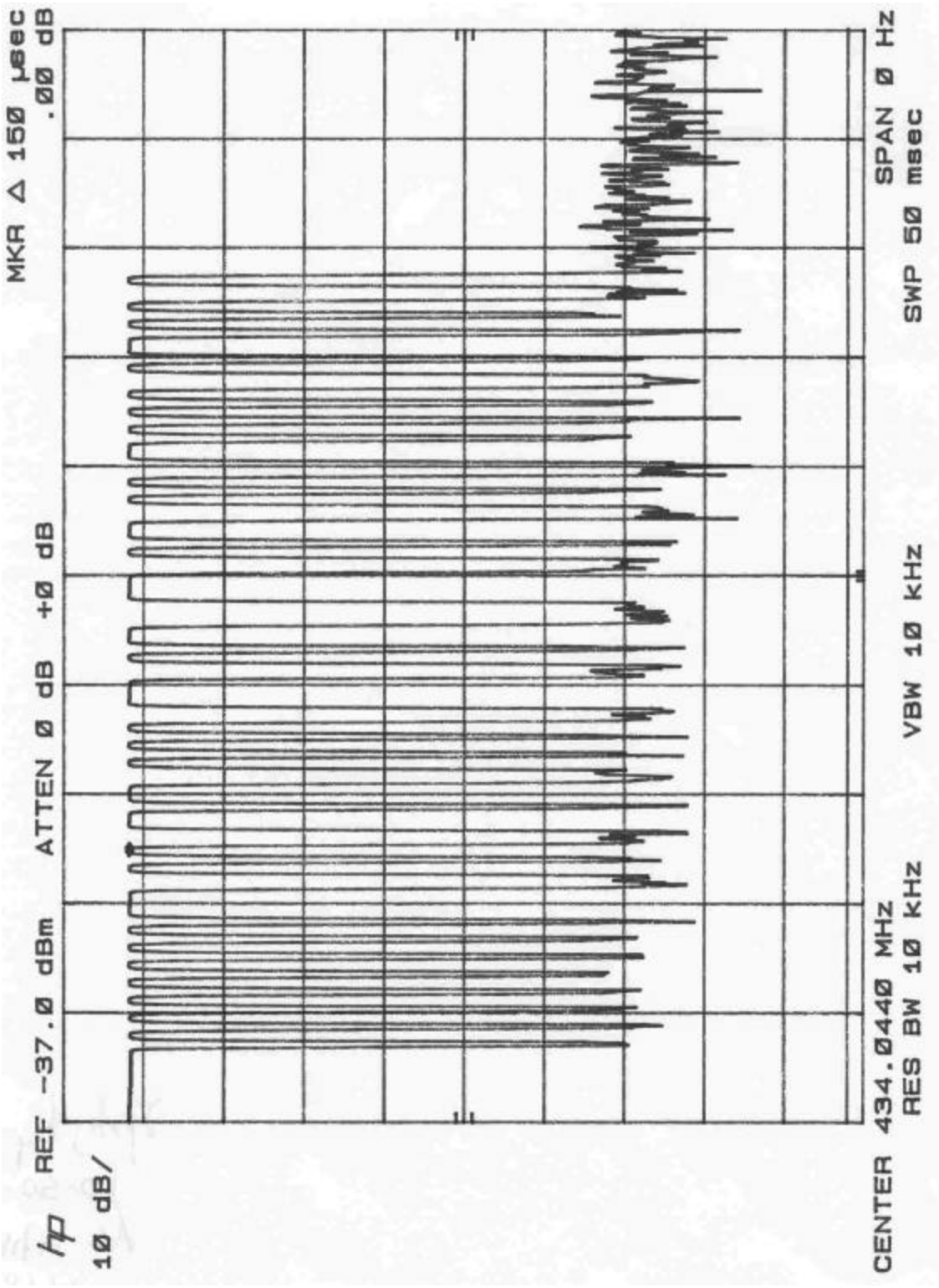

Figure 5. Duty Cycle Plot "On Time" 150uS Pulse

From the data in Figures 1 through 5, the following calculations are made.

On Time Per Code Group:

(1)(3.25mS) + (3)(1mS) + (6)(550µS) + (23)(150µS) = 13mS

Off Time Per Code Group:

100mS – 13mS = 87mS

Total Time Per Code Group:

100mS

The data are summarized in the following table.

Table 3. Duty Cycle Correction

Measurement Time	Total ON Time	Duty Cycle (%)	Duty Cycle (dB)
100mS	13mS	13%	-17.7

4.2 RF Power Output: (FCC Part §2.1046)

Not applicable.

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

Not applicable.

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. This was accomplished via a receive antenna connected to the input of the spectrum analyzer.

FCC Part 15.231 states that the 20 dB bandwidth of the modulated carrier shall be as follows:

Frequency Range (MHz)	Occupied Bandwidth Limit
70-900 MHz	0.25%
> 900 MHz	0.5%

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

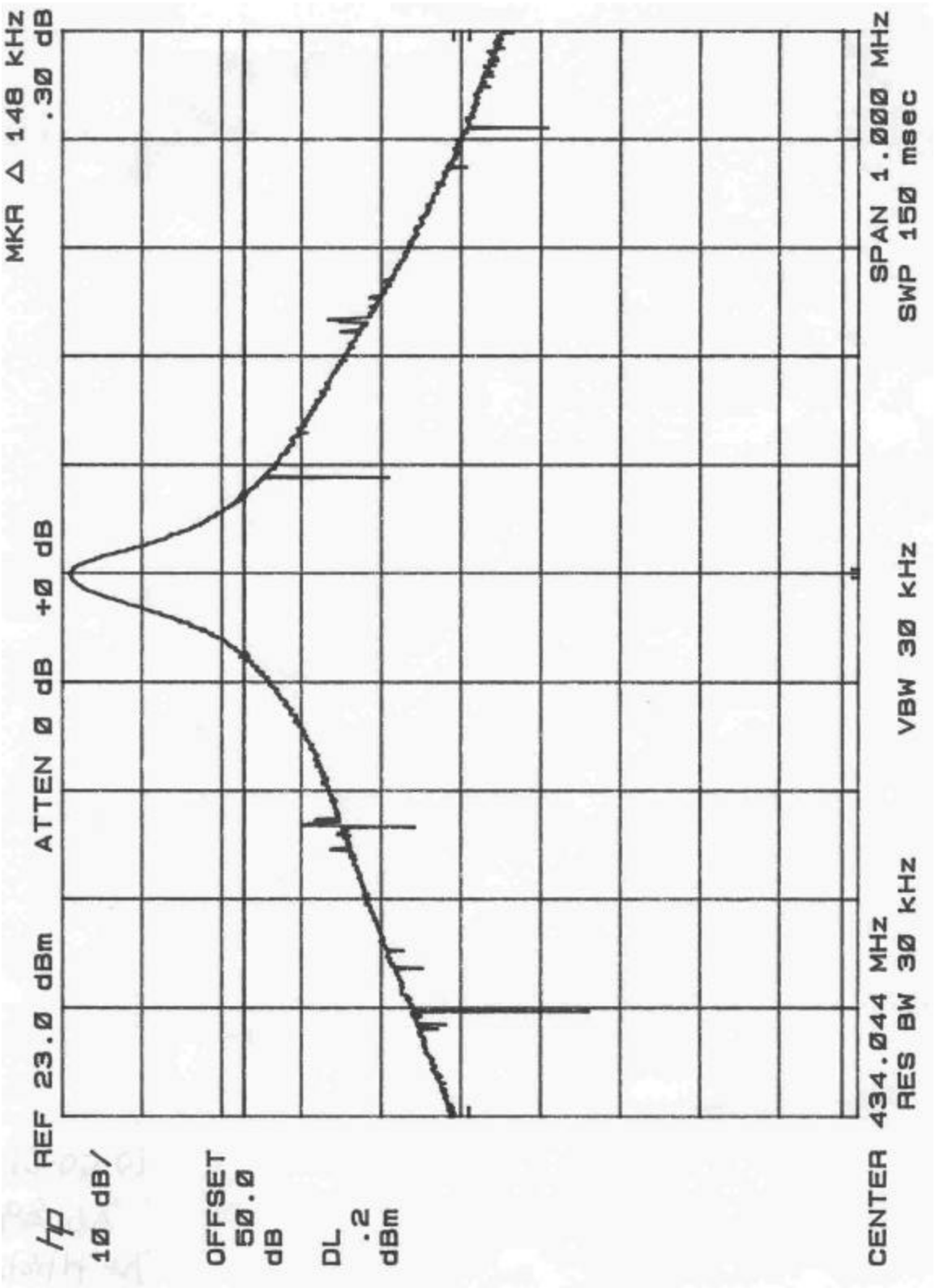

Figure 6. Occupied Bandwidth

Table 4 provides a summary of the Occupied Bandwidth Results.

Table 4. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
434.044 MHz	148 kHz	1.085 MHz	Pass

4.5 Spurious Emissions at Antenna Terminals (FCC Part §2.1051

Not applicable.

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 5. Radiated Spurious Emissions Limits

Frequency	Harmonic Level (E-Field)
Fundamental	11001 µV/m
Harmonics	1100.1 µV/m
Restricted Band Emissions: 30M to 88MHz 88M to 216MHz 216M to 960MHz > 960MHz	 100 µV/m 150 µV/m 200 µV/m 500 µV/m
FCC Mask	None

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 ANSI C63.4-1992. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

Table 6: Radiated Emission Test Data

CLIENT: Comsonics Inc.
MODEL NO: Qualifier 433MHz
TYPE/PART: 15.231
DATE: 12.03.01
BY: Chad M. Beattie
JOB #: 6879x
Tx Frequency: 434 MHz
Antenna: PCB mounted antenna
Orientation: X-Axis

Frequency	Polarity	Azimuth	Ant Height	SA Level (Peak)	AFc	E-Field (w/Duty Cycle)	E-Field	Limit	Margin	
MHz	H/V	Degree	m	dBuV	dB/m	dBuV/m	uV/m	uV/m	dB	
434.00	V	315.00	1.3	49.3	19.4	51.0	354.1	11001.5	-29.8	
868.00	V	45.00	1.0	8.9	27.5	18.7	8.6	1100.1	-42.1	
1302.00	V	90.00	1.0	36.8	-10.3	8.8	2.8	500.0	-45.2	
1736.00	V	90.00	1.0	42.5	-7.5	17.3	7.3	1100.1	-43.6	
2170.00	V	0.00	1.0	32.5	-5.8	9.0	2.8	1100.1	-51.8	amb
2604.00	V	0.00	1.0	40.6	-5.1	17.8	7.8	1100.1	-43.0	amb
3038.00	V	0.00	1.0	29.8	-4.4	7.7	2.4	1100.1	-53.2	amb
3472.00	V	0.00	1.0	27.7	-3.9	6.1	2.0	1100.1	-54.7	amb
3906.00	V	0.00	1.0	26.2	-3.4	5.1	1.8	500.0	-48.9	amb
4340.00	V	0.00	1.0	27.2	-3.0	6.5	2.1	500.0	-47.4	amb
434.00	H	90.00	1.0	57.8	19.4	59.5	942.2	11001.5	-21.3	
868.00	H	135.00	1.0	14.6	27.5	24.4	16.6	1100.1	-36.4	
1302.00	H	90.00	1.0	39.8	-10.3	11.8	3.9	500.0	-42.2	
1736.00	H	135.00	1.0	51.5	-7.5	26.3	20.6	1100.1	-34.6	
2170.00	H	0.00	1.0	30.0	-5.8	6.5	2.1	1100.1	-54.3	amb
2604.00	H	90.00	1.0	33.8	-5.1	11.0	3.6	1100.1	-49.8	amb
3038.00	H	0.00	1.0	28.0	-4.4	5.9	2.0	1100.1	-55.0	amb
3472.00	H	0.00	1.0	29.2	-3.9	7.6	2.4	1100.1	-53.2	amb
3906.00	H	0.00	1.0	27.5	-3.4	6.4	2.1	500.0	-47.6	amb
4340.00	H	0.00	1.0	26.2	-3.0	5.5	1.9	500.0	-48.4	amb

Orientation: Y-Axis

Frequency	Polarity	Azimuth	Ant Height	SA Level (Peak)	AFc	E-Field (w/Duty Cycle)	E-Field	Limit	Margin	
MHz	H/V	Degree	m	dBuV	dB/m	dBuV/m	uV/m	uV/m	dB	
434.00	V	90.00	1.0	47.6	19.4	49.3	291.2	11001.5	-31.5	
868.00	V	180.00	1.0	7.8	27.5	17.6	7.6	1100.1	-43.2	
1302.00	V	135.00	1.0	37.0	-10.3	9.0	2.8	500.0	-45.0	
1736.00	V	315.00	1.0	41.0	-7.5	15.8	6.1	1100.1	-45.1	
2170.00	V	0.00	1.0	30.5	-5.8	7.0	2.2	1100.1	-53.8	amb
2604.00	V	0.00	1.0	38.8	-5.1	16.0	6.3	1100.1	-44.8	amb
3038.00	V	0.00	1.0	27.8	-4.4	5.7	1.9	1100.1	-55.2	amb
3472.00	V	0.00	1.0	27.5	-3.9	5.9	2.0	1100.1	-54.9	amb
3906.00	V	0.00	1.0	30.0	-3.4	8.9	2.8	500.0	-45.1	amb
4340.00	V	0.00	1.0	28.8	-3.0	8.1	2.6	500.0	-45.8	amb
434.00	H	135.00	3.0	53.2	19.4	54.9	554.8	11001.5	-25.9	
868.00	H	180.00	2.4	10.4	27.5	20.2	10.3	1100.1	-40.6	
1302.00	H	135.00	1.0	40.8	-10.3	12.8	4.4	500.0	-41.2	
1736.00	H	180.00	1.0	55.5	-7.5	30.3	32.6	1100.1	-30.6	
2170.00	H	0.00	1.0	32.7	-5.8	9.2	2.9	1100.1	-51.6	
2604.00	H	90.00	1.0	34.0	-5.1	11.2	3.6	1100.1	-49.6	
3038.00	H	0.00	1.0	28.0	-4.4	5.9	2.0	1100.1	-55.0	amb
3472.00	H	0.00	1.0	28.2	-3.9	6.6	2.1	1100.1	-54.2	amb
3906.00	H	0.00	1.0	27.8	-3.4	6.7	2.2	500.0	-47.3	amb
4340.00	H	0.00	1.0	27.0	-3.0	6.3	2.1	500.0	-47.6	amb

Orientation: Z-Axis

Frequency MHz	Polarity H/V	Azimuth Degree	Ant Height m	SA Level (Peak) dBuV	AFc dB/m	E-Field (w/Duty Cycle) dBuV/m	E-Field uV/m	Limit uV/m	Margin dB	
434.00	V	180.00	1.7	53.9	19.4	55.6	601.4	11001.5	-25.2	
868.00	V	270.00	1.7	14.1	27.5	23.9	15.7	1100.1	-36.9	
1302.00	V	135.00	1.0	45.8	-10.3	17.8	7.8	500.0	-36.2	
1736.00	V	180.00	1.0	49.3	-7.5	24.1	16.0	1100.1	-36.8	
2170.00	V	180.00	1.0	32.2	-5.8	8.7	2.7	1100.1	-52.1	
2604.00	V	0.00	1.0	28.5	-5.1	5.7	1.9	1100.1	-55.1	amb
3038.00	V	0.00	1.0	26.3	-4.4	4.2	1.6	1100.1	-56.7	amb
3472.00	V	0.00	1.0	28.7	-3.9	7.1	2.3	1100.1	-53.7	amb
3906.00	V	0.00	1.0	27.8	-3.4	6.7	2.2	500.0	-47.3	amb
4340.00	V	0.00	1.0	28.2	-3.0	7.5	2.4	500.0	-46.4	amb
434.00	H	315.00	1.0	59.2	19.4	60.9	1107.0	11001.5	-19.9	
868.00	H	135.00	1.0	15.0	27.5	24.8	17.4	1100.1	-36.0	
1302.00	H	180.00	1.0	36.3	-10.3	8.3	2.6	500.0	-45.7	
1736.00	H	90.00	1.0	47.0	-7.5	21.8	12.3	1100.1	-39.1	
2170.00	H	0.00	1.0	30.2	-5.8	6.7	2.2	1100.1	-54.1	amb
2604.00	H	90.00	1.0	33.8	-5.1	11.0	3.6	1100.1	-49.8	
3038.00	H	0.00	1.0	27.5	-4.4	5.4	1.9	1100.1	-55.5	amb
3472.00	H	0.00	1.0	29.7	-3.9	8.1	2.5	1100.1	-52.7	amb
3906.00	H	0.00	1.0	27.3	-3.4	6.2	2.0	500.0	-47.8	amb
4340.00	H	0.00	1.0	28.5	-3.0	7.8	2.5	500.0	-46.1	amb

4.7 Frequency Stability: (FCC Part §2.1055)

Not applicable.

5 Transmitter Environmental Assessment, Maximum Permissible Exposure (MPE)

Not applicable.