FCC Certification Test Report

FCC Certification Test Report
for
ComSonics, Inc.
PYN22002B

November 22, 2002

Prepared for:

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

Prepared By:

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7560 Lindbergh Drive
Gaithersburg, Maryland 20879

FCC Certification Test Program

FCC Certification Test Report
for the
ComSonics, Inc.
101208-001 Qualifier
PYN22002B

November 22, 2002

WLL JOB# 7276

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Reviewed by: Michael Violette
President

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. 101208-001 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. 101208-001 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. 101208-001 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:	G2112
Quotation Number:	60288

1.4 Test Dates

Testing was performed from October 3, 2002 to November 11, 2002.

1.5 Test and Support Personnel

Washington Laboratories, LTD	Ken Gemmell

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
LISN	Line Impedance Stabilization Network
M	Mega - prefix for 10^6 multiplier
m	Meter
μ	micro - prefix for 10^{-6} multiplier
NB	Narrowband
QP	Quasi-Peak
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. 101208-001 Qualifier meter is one part of the two-part CyberTek™ Qualifier system for verifying home return path integrity, which is a measure of how much "leakage" the cable system exhibits. This is measured by illuminating the cable system with a 27 MHz signal (from a separate vehicle-mounted transmitter, FCC ID: PYN12002A) and quantifying the amount of energy coupled into the system.

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 meter, when manually activated, transmits a request code at 434MHz to the vehicle-mounted 27 MHz transponder unit (second part of the system, separate FCC certification FCC ID: PYN12002A). Once the house wiring is illuminated by the transponder, the Qualifier meter measures the ingress.

The Qualifier meter contains an integral, PCB mounted antenna which can not be change by the end user.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	ComSonics, Inc.
FCC ID Number	PYN22002B
EUT Name:	Qualifier
Model:	101208-001
FCC Rule Parts:	§15.231
Frequency Range:	434MHz
Maximum Output Power:	<1mW
Modulation:	OOK
Occupied Bandwidth:	139 kHz
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:	5Vdc Battery

2.2 Test Configuration

The 101208-001 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 101208-001 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

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 = $0.5\ (2^2 + 1^2 + 4^2)^{1/2}$ = ±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/Type	Function	Identification	Cal. Due
HP	8568B	Spectrum Analyzer	2634A02888	7/03/03
HP	85650A	Quasi-Peak Adapter	3303A01786	7/05/03
ARA	LPB-2520	BiconiLog Antenna	1044	6/19/03
ARA	DRG-118/A	Antenna	1010	11/28/02
HP	85685A	RF Preselector	3221A01395	5/17/03

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.

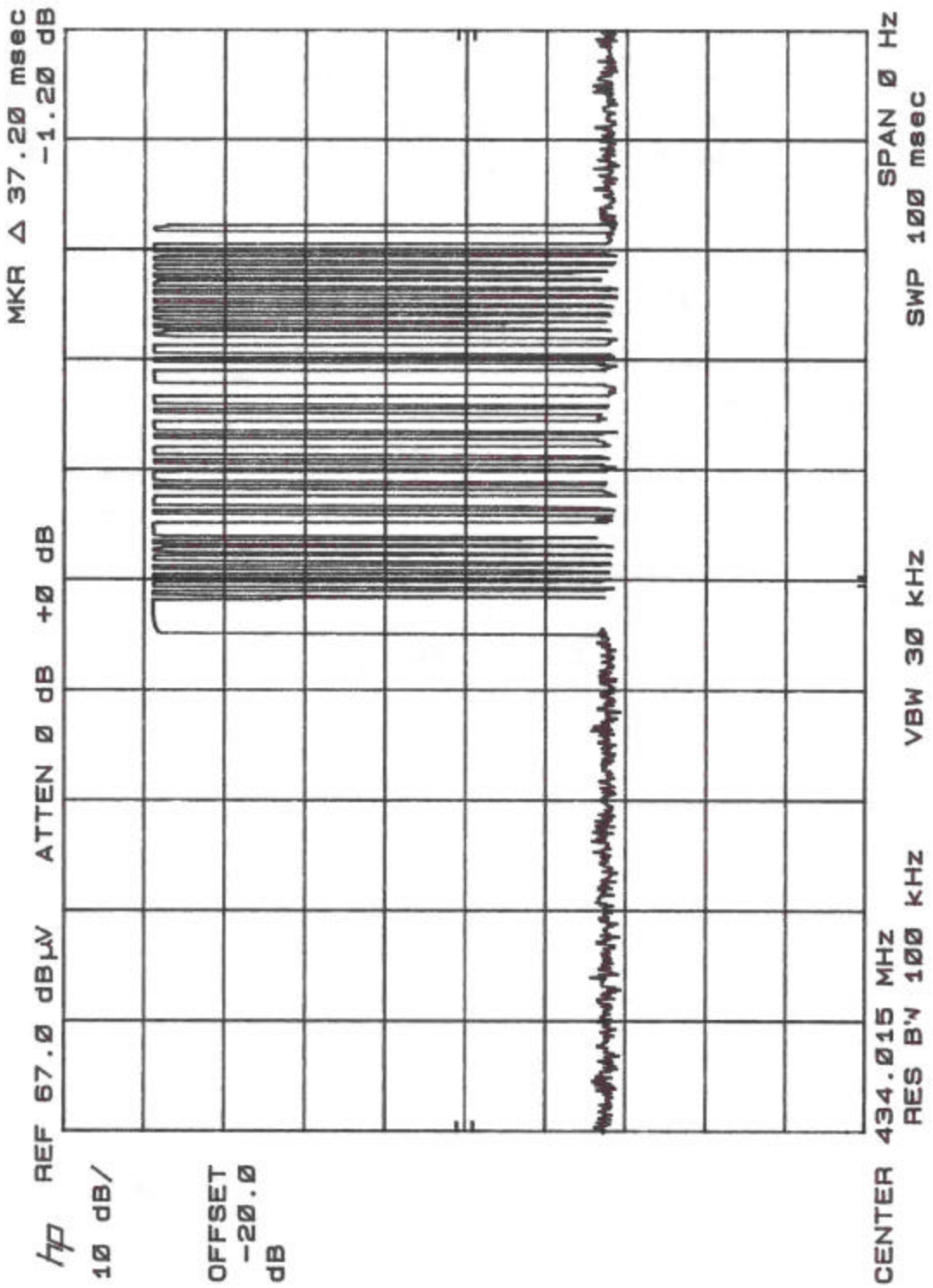

Figure 1. Duty Cycle Plot, Worst-Case

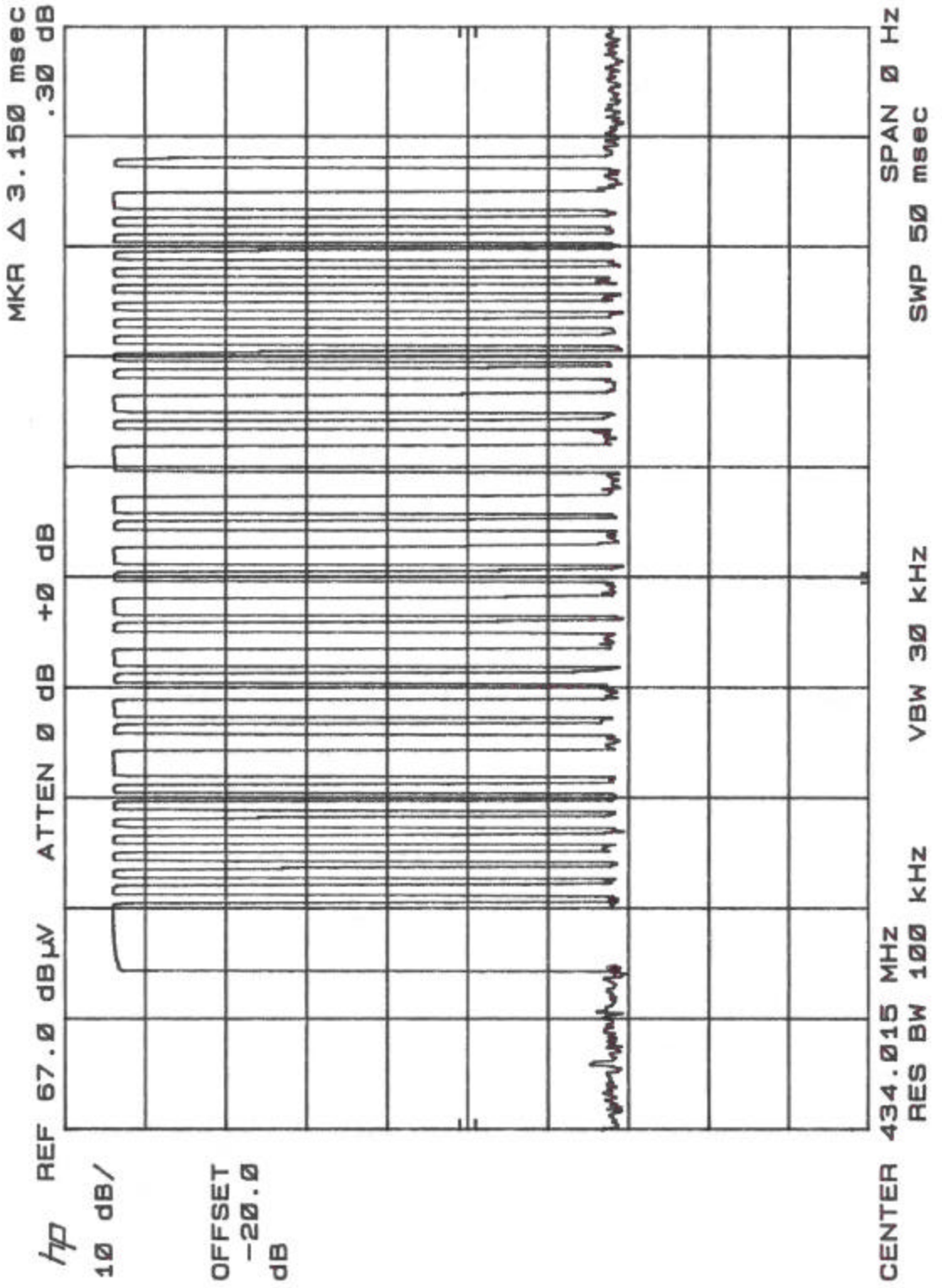

Figure 2. Duty Cycle Plot "On Time" 3.15ms Pulse

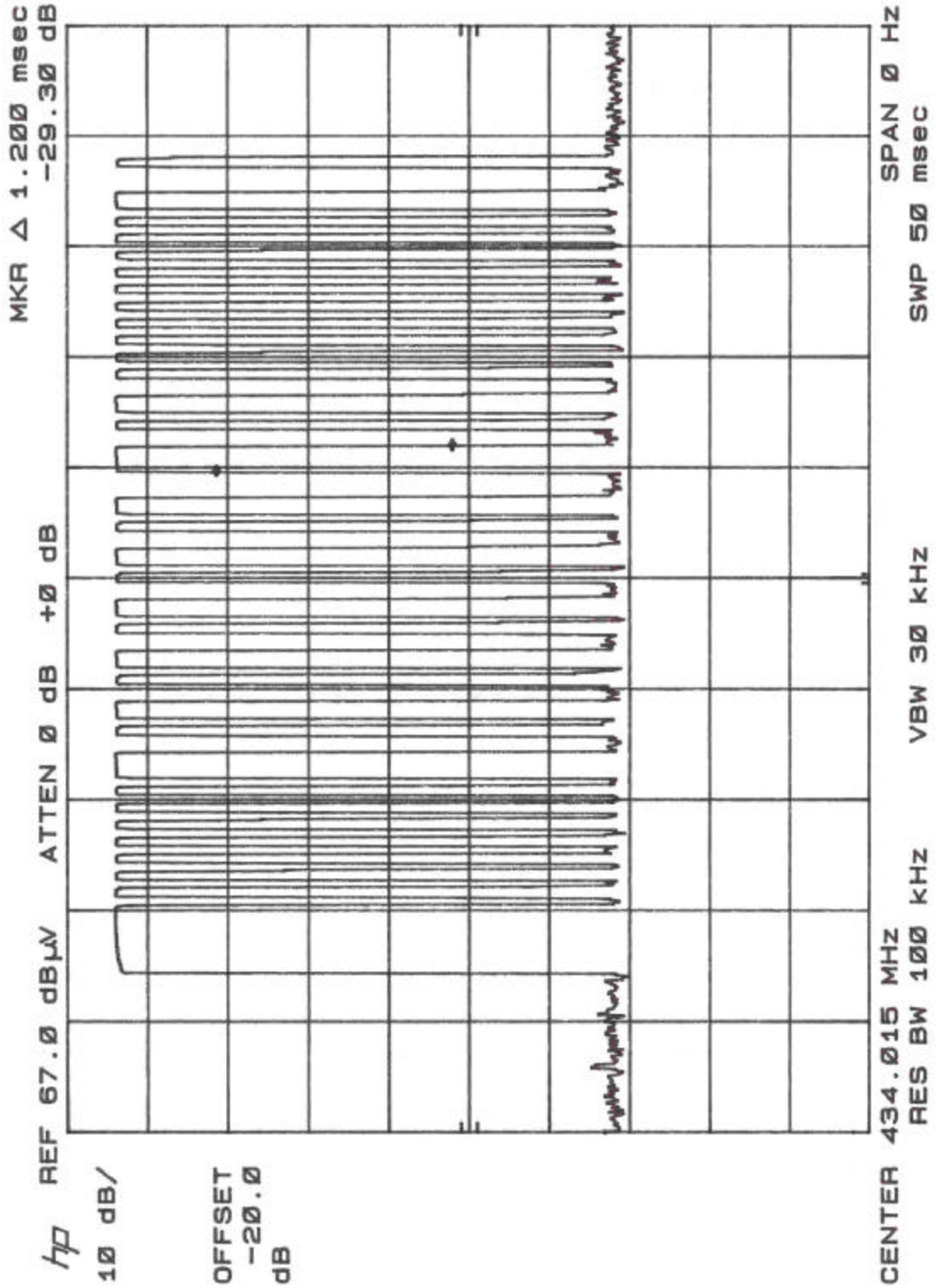

Figure 3. Duty Cycle Plot "On Time" 1.20ms Pulse

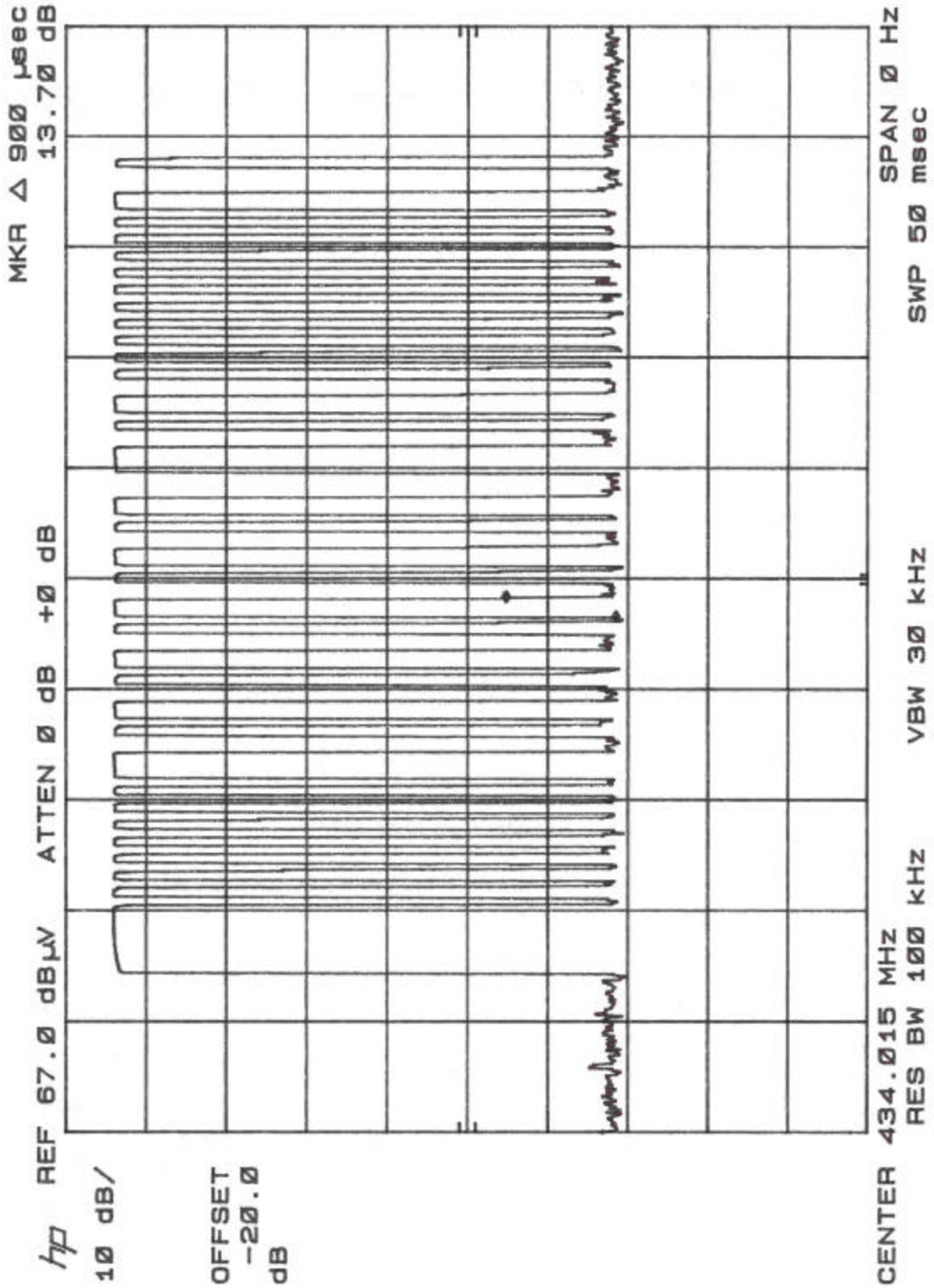

Figure 4. Duty Cycle Plot "On Time" 900us Pulse

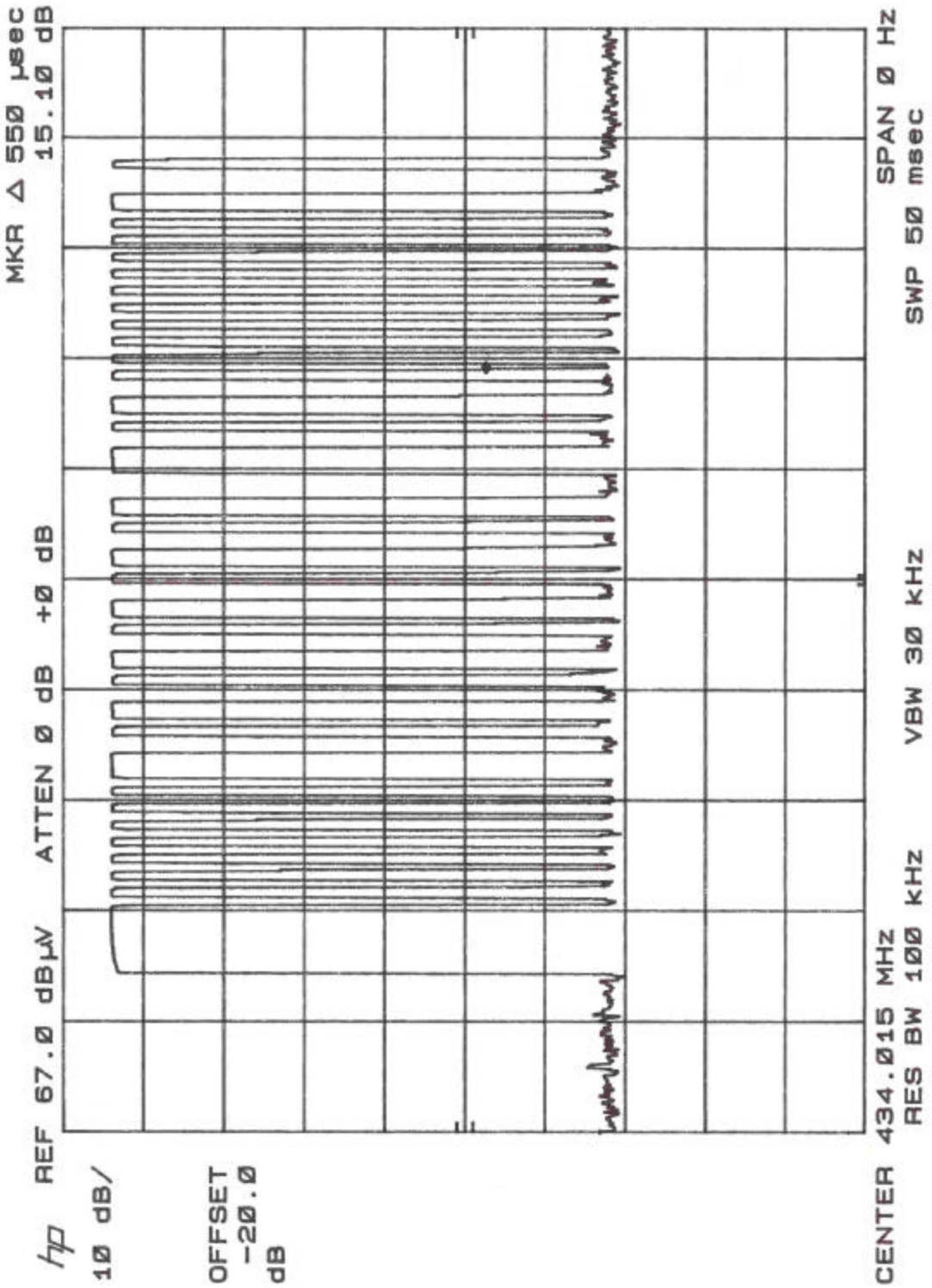

Figure 5. Duty Cycle Plot "On Time" 550us Pulse

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

Table 3. Duty Cycle Correction

CLIENT: Comsonics DATE: 10/3/2002
TESTER: Ken Gemmell JOB #: 7276
EUT Information:
EUT: Qualifier S/N: 944301

	Pulse 1 3.15 ms	Pulse 2 900 us	Pulse 3 550 us	Pulse 4 1.2 ms
Number of Pulses	1	7	24	2
Pulse Width (microseconds)	3150	900	550	1200
Total Time in (microseconds)	3150	6300	13200	2400
Total Time in (ms)	3.15	6.3	13.2	2.4
Total time for both types Pulses			25.05	
Worst Case Percent of 100 ms			25.05%	
Duty Cycle Correction Factor			-12.0 dB	

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.

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:

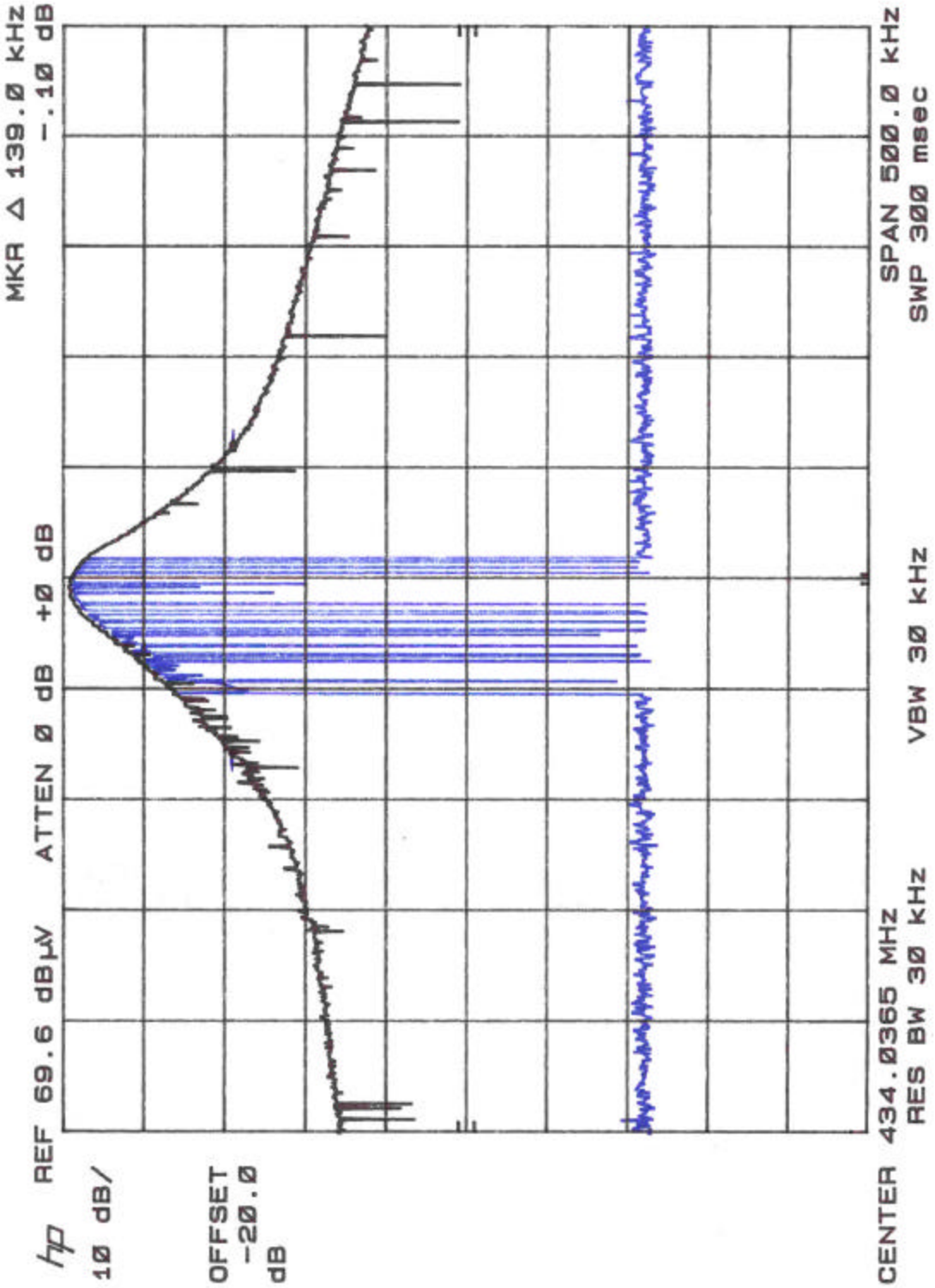

Figure 6. Occupied Bandwidth

Table 4 provides a summary of the Occupied Bandwidth Results.

Table 4. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
434.036 MHz	139 kHz	1.085MHz	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	Fundamental	Harmonic Level (-dBc or E-Field)
Fundamental	11,000 uV/m	
Harmonics		1,100 uV/m

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	DATE:	10/3/02
TESTER:	Ken Gemmell	JOB #:	7276
EUT Information:		**Test Requirements:**	
EUT:	Qualifier	TEST STANDARD:	FCC Part 15.231
CONFIGURATION:	Continuous transmit mode	DISTANCE:	3m
S/N:	944301	CLASS:	B
Low Freq Test Equip/Limit:		**High Freq Test Equip/Limit:**	
ANTENNA:	A_00007	ANTENNA:	A_00004
CABLE:	CSITE2_3m	CABLE:	CSITE1_HF
LIMIT:	LFCC_3m_Class_B		
TX Frequency	434		

Peak Data - Harmonics X Orientation

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Hght (m)	SA Level (QP) (dBuV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Duty Cycle Corr. (dB)	Corr. Level (dBuV/m)	Corr. Level (uV/m)	Limit (uV/m)	Margin dB
434.00	V	180.0	1.0	61.4	16.3	4.8	-12.0	70.5	3340.2	11000.0	-10.4
868.00	V	90.0	1.0	27.8	21.5	7.5	-12.0	44.8	174.1	1100.0	-16.0
1302.00	V	180.0	1.0	49.3	26.3	2.3	-12.0	31.9	39.2	500.0	-22.1
1736.00	V	180.0	1.0	42.2	28.0	2.4	-12.0	26.6	21.3	1100.0	-34.3
2170.00	V	180.0	1.0	44.2	29.3	2.7	-12.0	30.1	32.1	1100.0	-30.7
2604.00	V	0.0	1.0	41.2	30.1	3.1	-12.0	28.3	26.0	1100.0	-32.5
3038.00	V	0.0	1.0	42.0	30.7	3.4	-12.0	30.1	31.9	1100.0	-30.7
3472.00	V	0.0	1.0	41.8	31.2	3.6	-12.0	30.6	34.0	1100.0	-30.2
3906.00	V	0.0	1.0	41.5	31.6	3.8	-12.0	30.9	35.0	500.0	-23.1
4340.00	V	0.0	1.0	39.3	32.2	3.9	-12.0	29.4	29.5	500.0	-24.6
434.00	H	180.0	1.0	66.2	16.3	4.8	-12.0	75.3	5804.5	11000.0	-5.6
868.00	H	270.0	1.0	29.4	21.5	7.5	-12.0	46.4	209.3	1100.0	-14.4
1302.00	H	180.0	1.0	47.5	26.3	2.3	-12.0	30.1	31.9	500.0	-23.9
1736.00	H	180.0	1.0	42.4	28.0	2.4	-12.0	26.8	21.9	1100.0	-34.0
2170.00	H	180.0	1.0	43.8	29.3	2.7	-12.0	29.8	30.8	1100.0	-31.1
2604.00	H	0.0	1.0	41.2	30.1	3.1	-12.0	28.3	26.0	1100.0	-32.5
3038.00	H	0.0	1.0	41.5	30.7	3.4	-12.0	29.6	30.3	1100.0	-31.2
3472.00	H	0.0	1.0	41.1	31.2	3.6	-12.0	29.9	31.3	1100.0	-30.9
3906.00	H	0.0	1.0	40.6	31.6	3.8	-12.0	30.0	31.7	500.0	-24.0
4340.00	H	0.0	1.0	39.8	32.2	3.9	-12.0	29.9	31.3	500.0	-24.1

Table 6: Radiated Emission Test Data, continued

Peak Data - Harmonics Y - Orientation

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Hght (m)	SA Level (QP) (dBuV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Duty Cycle Corr. (dB)	Corr. Level (dBuV/m)	Corr. Level (uV/m)	Limit (uV/m)	Margin dB
434.00	V	180.0	1.0	60.5	16.3	4.8	-12.0	69.6	3011.4	11000.0	-11.3
868.00	V	90.0	1.0	26.0	21.5	7.5	-12.0	43.0	141.5	1100.0	-17.8
.1302.00	V	180.0	1.0	49.0	26.3	2.3	-12.0	31.6	37.9	500.0	-22.4
1736.00	V	180.0	1.0	42.1	28.0	2.4	-12.0	26.5	21.1	1100.0	-34.3
2170.00	V	180.0	1.0	43.7	29.3	2.7	-12.0	29.7	30.4	1100.0	-31.2
2604.00	V	0.0	1.0	41.8	30.1	3.1	-12.0	28.9	27.8	1100.0	-31.9
3038.00	V	0.0	1.0	42.3	30.7	3.4	-12.0	30.4	33.1	1100.0	-30.4
3472.00	V	0.0	1.0	41.2	31.2	3.6	-12.0	30.0	31.6	1100.0	-30.8
3906.00	V	0.0	1.0	40.6	31.6	3.8	-12.0	30.0	31.7	500.0	-24.0
4340.00	V	0.0	1.0	39.0	32.2	3.9	-12.0	29.1	28.5	500.0	-24.9
434.00	H	180.0	1.0	59.7	16.3	4.8	-12.0	68.8	2746.4	11000.0	-12.1
868.00	H	270.0	1.0	27.7	21.5	7.5	-12.0	44.7	172.1	1100.0	-16.1
1302.00	H	180.0	1.0	48.5	26.3	2.3	-12.0	31.1	35.7	500.0	-22.9
1736.00	H	180.0	1.0	42.5	28.0	2.4	-12.0	26.9	22.1	1100.0	-33.9
2170.00	H	180.0	1.0	44.0	29.3	2.7	-12.0	30.0	31.5	1100.0	-30.9
2604.00	H	0.0	1.0	41.2	30.1	3.1	-12.0	28.3	26.0	1100.0	-32.5
3038.00	H	0.0	1.0	41.6	30.7	3.4	-12.0	29.7	30.6	1100.0	-31.1
3472.00	H	0.0	1.0	40.9	31.2	3.6	-12.0	29.7	30.4	1100.0	-31.2
3906.00	H	0.0	1.0	40.3	31.6	3.8	-12.0	29.6	30.4	500.0	-24.3
4340.00	H	0.0	1.0	40.5	32.2	3.9	-12.0	30.6	33.9	500.0	-23.4

Table 6**:** Radiated Emission Test Data, continued

Peak Data - Harmonics Z - Orientation

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Hght (m)	SA Level (QP) (dBuV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Duty Cycle Corr. (dB)	Corr. Level (dBuV/m)	Corr. Level (uV/m)	Limit (uV/m)	Margin dB
434.00	V	180.0	1.0	61.4	16.3	4.8	-12.0	70.5	3334.9	11000.0	-10.4
868.00	V	90.0	1.0	24.9	21.5	7.5	-12.0	41.9	124.7	1100.0	-18.9
1302.00	V	180.0	1.0	48.2	26.3	2.3	-12.0	30.7	34.4	500.0	-23.3
1736.00	V	180.0	1.0	41.2	28.0	2.4	-12.0	25.6	19.1	1100.0	-35.2
2170.00	V	180.0	1.0	43.0	29.3	2.7	-12.0	28.9	27.9	1100.0	-31.9
2604.00	V	0.0	1.0	41.8	30.1	3.1	-12.0	28.9	28.0	1100.0	-31.9
3038.00	V	0.0	1.0	43.4	30.7	3.4	-12.0	31.5	37.5	1100.0	-29.3
3472.00	V	0.0	1.0	40.5	31.2	3.6	-12.0	29.3	29.1	1100.0	-31.5
3906.00	V	0.0	1.0	41.0	31.6	3.8	-12.0	30.4	32.9	500.0	-23.6
4340.00	V	0.0	1.0	39.4	32.2	3.9	-12.0	29.5	29.8	500.0	-24.5
434.00	H	180.0	1.0	60.1	16.3	4.8	-12.0	69.2	2879.8	11000.0	-11.6
868.00	H	270.0	1.0	27.4	21.5	7.5	-12.0	44.4	165.5	1100.0	-16.5
1302.00	H	180.0	1.0	48.7	26.3	2.3	-12.0	31.3	36.6	500.0	-22.7
1736.00	H	180.0	1.0	41.7	28.0	2.4	-12.0	26.1	20.2	1100.0	-34.7
2170.00	H	180.0	1.0	42.8	29.3	2.7	-12.0	28.7	27.4	1100.0	-32.1
2604.00	H	0.0	1.0	39.7	30.1	3.1	-12.0	26.9	22.1	1100.0	-34.0
3038.00	H	0.0	1.0	42.6	30.7	3.4	-12.0	30.7	34.3	1100.0	-30.1
3472.00	H	0.0	1.0	40.0	31.2	3.6	-12.0	28.8	27.6	1100.0	-32.0
3906.00	H	0.0	1.0	39.9	31.6	3.8	-12.0	29.3	29.1	500.0	-24.7
4340.00	H	0.0	1.0	40.6	32.2	3.9	-12.0	30.7	34.2	500.0	-23.3

4.7 Frequency Stability: (FCC Part §2.1055)

Not applicable.