FCC Certification Test Report

FCC Certification Test Report
FCC Rule Part 15.231
for
OHSUNG Electronics Co., LTD
FCC ID: OZ5HNS1030302

June 25, 2001

Prepared for:
OHSUNG Electronics Co., LTD
181 Gongdang-Dong Gumi-City,
Kyungbuk, Korea

Prepared By:

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

FCC Certification Test Program

FCC Certification Test Report
for the
OHSUNG Electronics Co., LTD
HRMC-9 Remote Control
OZ5HNS1030302

June 25, 2001

WLL JOB# 6455

Prepared by: _____
Michael F. Violette, P.E.
President

Reviewed by: _____
Greg Snyder, NARTE-Certified EMC Test Engineer
Chief EMC Engineer

Abstract

This report has been prepared on behalf of Ohsung Electronics Co., Ltd to support the attached Application for Equipment Authorization. The test report and application are submitted for a Low Power 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 Ohsung Electronics Co., Ltd HRMC-9 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 Ohsung Electronics Co., Ltd HRMC-9 Remote Control complies with the limits for a Low Power 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 Ohsung Electronics Co., Ltd HRMC-9 Remote Control complies with the limits for a Low Power Periodic Intentional Radiator device under Part 15.231 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for radiated emissions and bandwidth 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: Ohsung Electronics Co., Ltd
181 Dongdang-Dong Gumi-City
Kyungbuk, Korea

Quotation Number: 59128

1.4 Test Dates

Testing was performed on June 20, 2001.

1.5 Test and Support Personnel

Washington Laboratories, LTD: Michael F. Violette

Customer Representative: Vishram Pandit

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

Table 1. Device Information

ITEM	DESCRIPTION
Manufacturer:	Ohsung Electronics Co., Ltd
FCC ID Number	OZ5HNS1030302
EUT Name:	Remote Control
Model:	HRMC-9
FCC Rule Parts:	§15.231
Frequency Range:	418 MHz
Maximum Output Power:	6.2 dBm (typical)
Modulation:	Pulsed
Necessary Bandwidth:	328 kHz
Keying:	Manual
Type of Information:	Control
Number of Channels:	1
Power Output Level	Fixed
Antenna Type	Integral
Frequency Tolerance:	NA%
Emission Type(s):	Pulsed
Interface Cables:	N/A
Power Source & Voltage:	3 VDC Battery

2.2 Test Configuration

The HRMC-9 was fixtured in an X, Y and Z direction on a turntable.

2.3 Testing Algorithm

The HRMC-9 was operated for continuous transmission by holding down the command button on the keypad.

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. The measurement uncertainty of the data contained herein is ±2.3 dB.

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

The following table shows a list of the test equipment used for measurements along with the calibration information.

Table 2: Test Equipment List

Equipment	Serial Number	Date Calibrated	Calibration Due
Antenna Research Associates, Inc. Biconical Log Periodic Antenna LPB-2520A (Site 2)	1118	5/21/01	5/21/02
Hewlett-Packard Spectrum Analyzer: HP 8568B (Site 2)	2926U07140	7/3/00	7/03/01
Hewlett-Packard Quasi-Peak Adapter: HP 85650A (Site 2)	2811A01283	7/3/00	7/03/01
Hewlett-Packard RF Preselector: HP 85685A (Site 2)	3221A01395	7/3/00	7/03/01
Hewlett-Packard Spectrum Analyzer: HP 8564E	3643A00657	4/11/01	4/11/02
Hewlett-Packard Preamplifier: HP 8449B	3008A00729	12/07/00	12/07/01
Hewlett-Packard Preamplifier: HP 8449B	3008A00385	09/07/00	09/07/01
Antenna Research Associates, Inc. Horn Antenna DRG-118/A	1010	9/10/99	9/10/01

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 Unlicensed Intentional Radiators under 47CFR Part 15, all duty cycle measurements are 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.

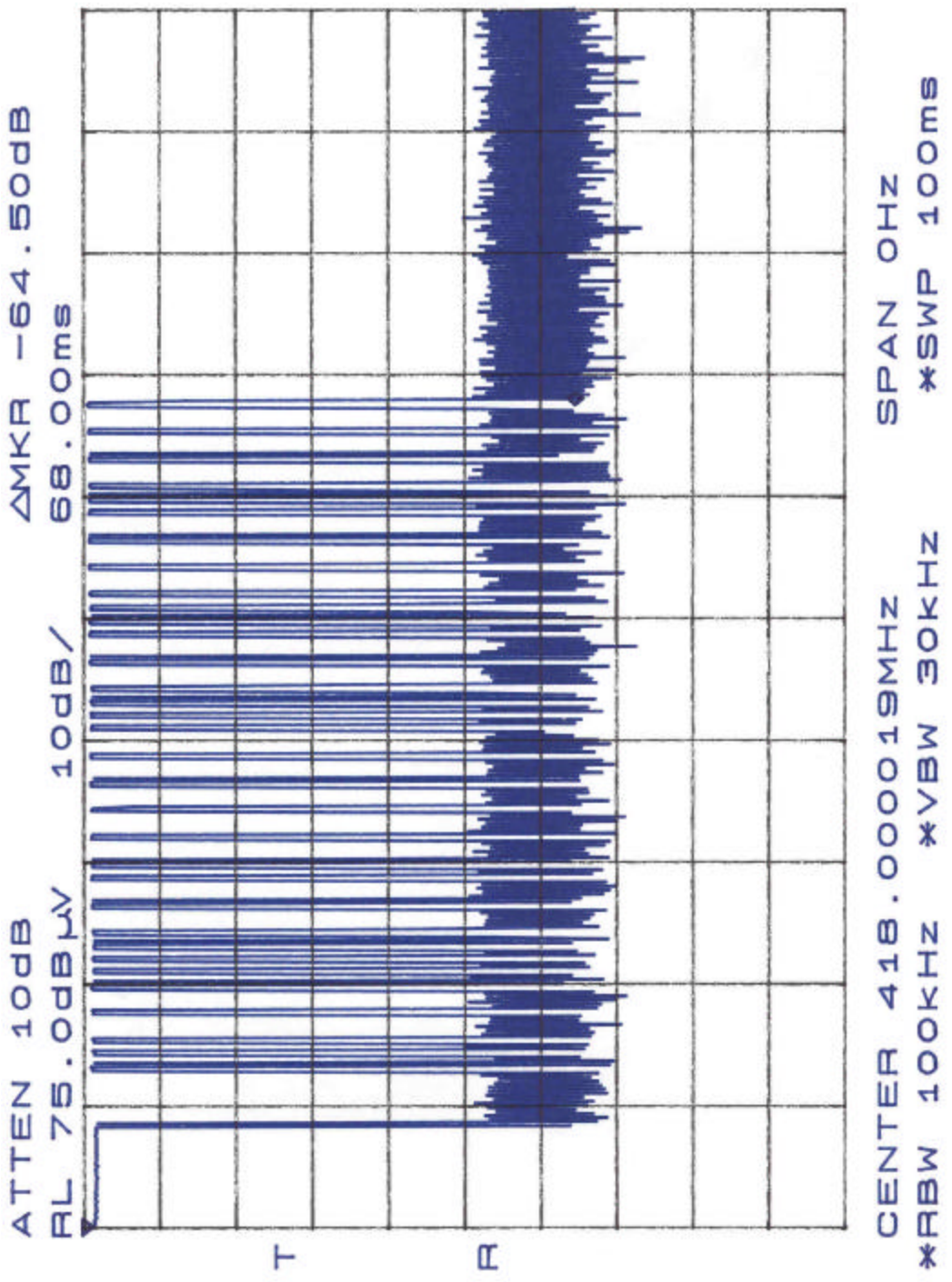

Figure 1. Duty Cycle Plots Full Period

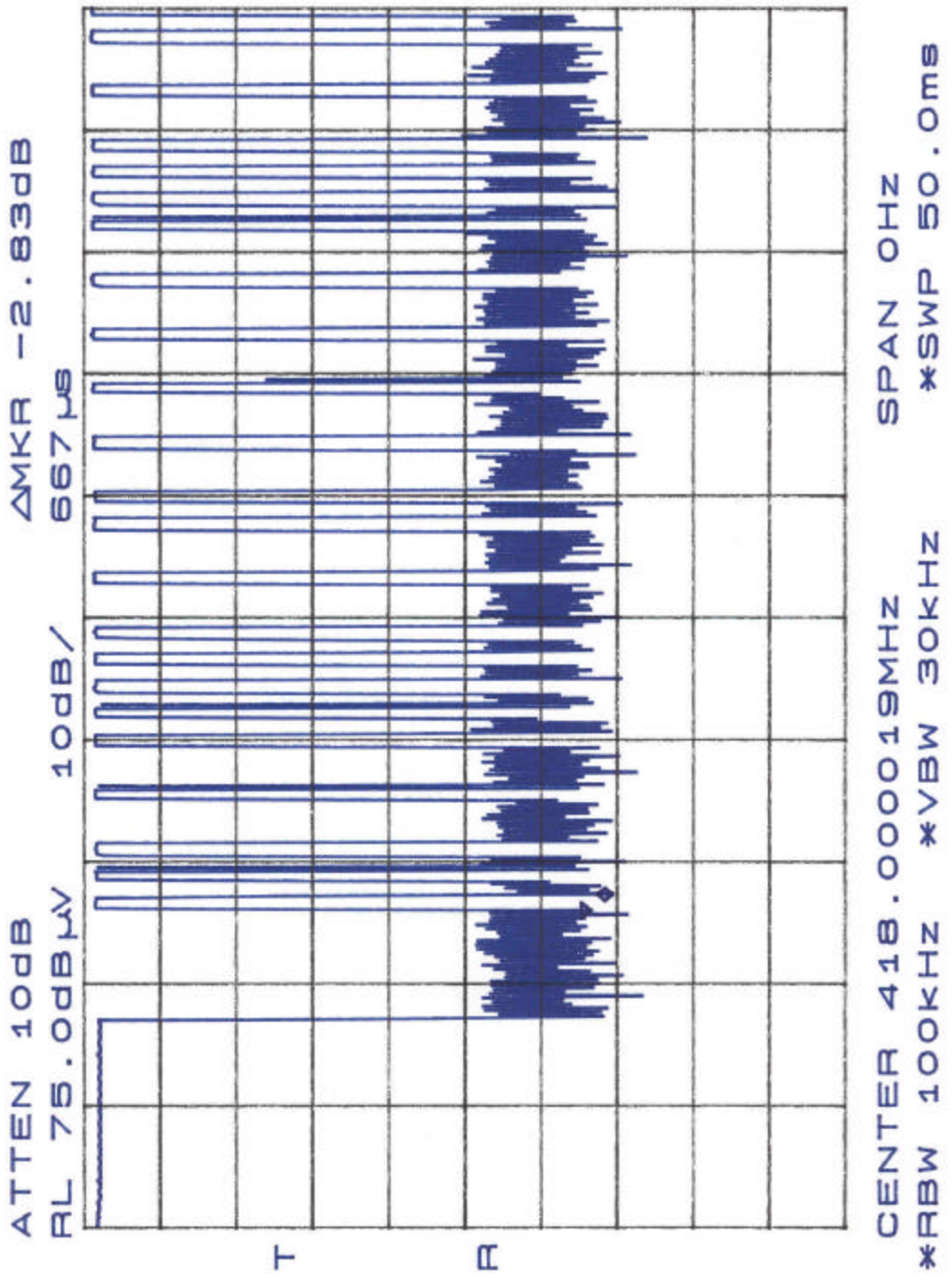

Figure 2. Duty Cycle Plot "On Time"

From the data in Figure 1 and Figure 2, the following calculations are made.

On Time Per Code Group:

8.67 ms + (667 us X 33) = 8.67 ms + 22.011 ms = 30.68 ms

Off Time Per Code Group:

4.33 ms + (330 us X 15) + 1,5msX17) + 32.33ms = 67.11 ms

Total Time Per Code Group:

30.68 ms + 67.11 ~ 100 ms

Table 3. Duty Cycle Correction

Measurement Time	Total ON Time	Duty Cycle (%)	Duty Cycle (dB)
100 ms	30.68 ms	30.68%	10.3

4.2 RF Power Output: (FCC Part §2.1046)

Not Required.

4.3 Modulation Characteristics: (FCC Part §2.1047)

Not Required.

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 no greater than the limits shown in the following Table.

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

At full modulation, the occupied bandwidth was measured as provided in Figure 3 below.

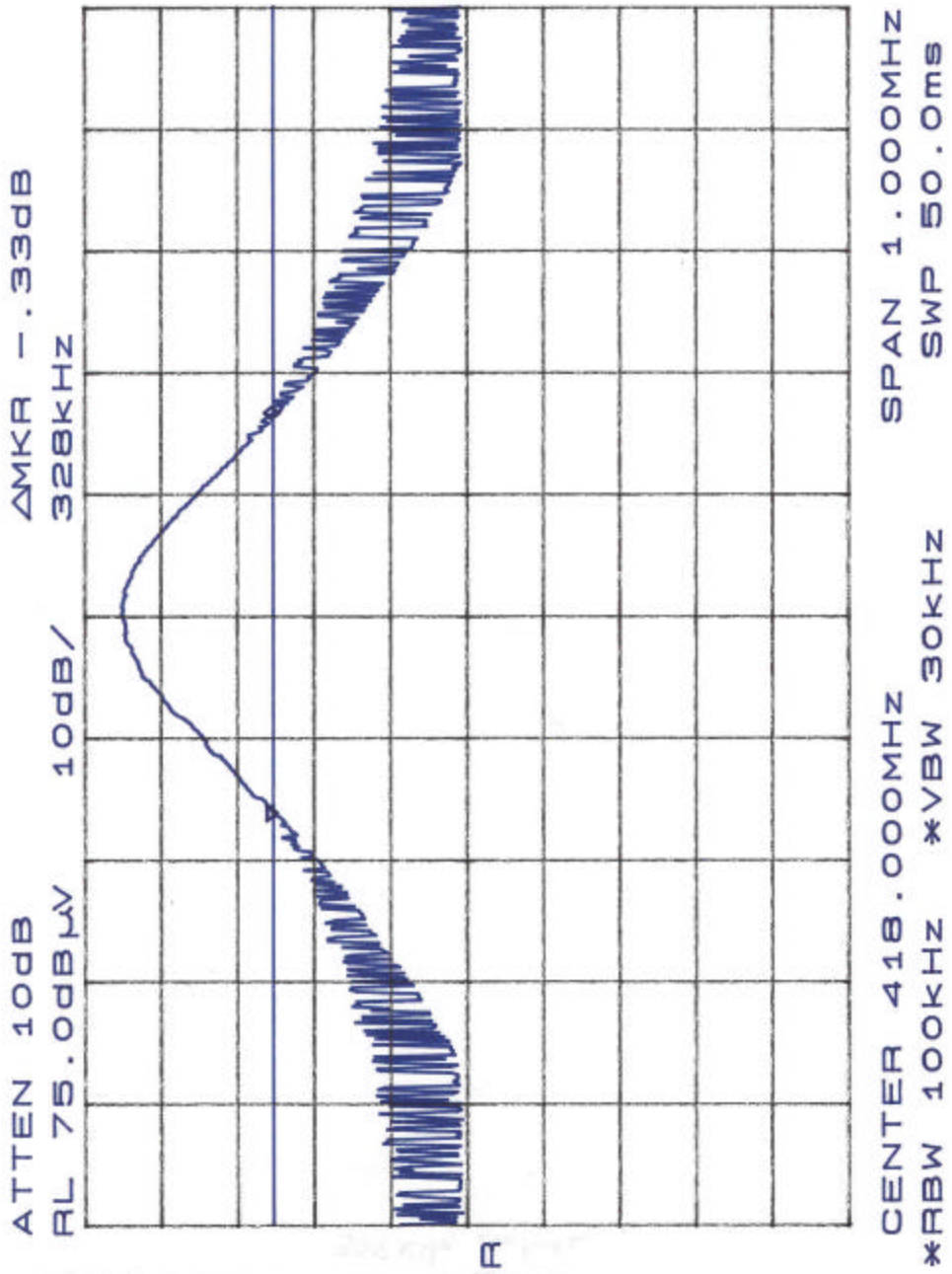

Figure 3. Occupied Bandwidth

Table 4. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
418 MHz	328 kHz	1.048 MHz	Pass

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

Not required.

4.6 Radiated Spurious Emissions: §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 uV/m	Spurious Emissions uV/m
Fundamental	10334	
Harmonics		1033.4
Restricted Band Emissions		500
FCC Mask	None	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 6a: Radiated Emissions Test Data

TYPE/PART: HRMC-9
DATE: 6/20/01
BY: Mike Violette
JOB #: 6455RFFCC
Tx Frequency: 418 MHz X-AXIS

Frequency	Polarity	Az	Ant Ht	SA Level (QP)	AFc	E-Field	Duty Cycle Correction	E-Field	Limit	Margin	
MHz	H/V	Deg	m	dBuV	dB/m	DBuV/m	Factor	uV/m	uV/m	dB	
417.98	V	90	1.0	52.30	19.0	71.3	10.3	1127.6	10334.7	-19.2	
835.98	V	90	1.0	16.00	27.2	43.2	10.3	44.2	1033.5	-27.4	
417.99	H	90	1.0	62.60	19.0	81.6	10.3	3691.1	10334.7	-8.9	
835.98	H	90	1.0	25.20	27.2	52.4	10.3	127.4	1033.5	-18.2	

Peak Measurements Above 1 GHz

Frequency	Polarity	Azi	Ant Ht	SA Level (Peak)	AFc	E-Field	Duty Cycle Correction	E-Field	Limit	Margin	
MHz	H/V	Deg	m	dBuV	dB/m	DBuV/m	Factor	uV/m	uV/m	dB	
1253.94	V	270	1.0	55.5	-10.6	44.9	10.3	53.5	1033.5	-25.7	
1671.92	V	315	1.0	51.8	-7.9	43.9	10.3	47.9	500.0	-20.4	
2089.90	V	135	1.0	48.7	-6.0	42.7	10.3	41.8	1033.5	-27.9	
2507.88	V	0	1.0	46.2	-5.2	41.0	10.3	34.2	1033.5	-29.6	
2925.86	V	0	1.0	43.2	-4.6	38.6	10.3	26.1	1033.5	-32.0	NF
3343.84	V	0	1.0	45.0	-4.0	41.0	10.3	34.2	1033.5	-29.6	NF
3761.82	V	0	1.0	44.7	-3.5	41.2	10.3	34.9	500.0	-23.1	NF
4179.80	V	0	1.0	45.2	-3.1	42.1	10.3	38.9	500.0	-22.2	NF
1253.94	H	0	1.0	57.7	-10.6	47.1	10.3	68.9	1033.5	-23.5	
1671.92	H	0	1.0	52.3	-7.9	44.4	10.3	50.8	500.0	-19.9	
2089.90	H	315	1.0	49.0	-6.0	43.0	10.3	43.3	1033.5	-27.6	
2507.88	H	0	1.0	44.0	-5.2	38.8	10.3	26.6	1033.5	-31.8	
2925.86	H	0	1.0	46.3	-4.6	41.7	10.3	37.4	1033.5	-28.8	
3343.84	H	0	1.0	43.0	-4.0	39.0	10.3	27.1	1033.5	-31.6	NF
3761.82	H	0	1.0	42.0	-3.5	38.5	10.3	25.6	500.0	-25.8	NF
4179.80	H	0	1.0	43.5	-3.1	40.4	10.3	32.0	500.0	-23.9	NF

NF= Noise Floor

Table 7b: Radiated Emissions Test Data

TYPE/PART: HRMC-9
DATE: 6/20/01
BY: Mike Violette
Tx Frequency: 418 MHz **Y-Axis**

FREQ	POL	Azimuth	Ant Height	SA LEVEL (QP)	AFc	E-FIELD	Duty Cycle Correction	E-FIELD	LIMIT	MARGIN
MHz	H/V	Degree	m	dBuV	dB/m	dBuV/m	Factor	uV/m	uV/m	dB
417.98	V	90	1.0	49.70	19.0	68.7	10.3	835.9	10334.7	-21.8
835.98	V	0	1.0	14.00	27.2	41.2	10.3	35.1	1033.5	-29.4
417.99	H	0	1.0	63.20	19.0	82.2	10.3	3955.1	10334.7	-8.3
835.98	H	90	1.0	21.30	27.2	48.5	10.3	81.3	1033.5	-22.1

Peak Measurements Above 1 GHz

FREQ	POL	Azimuth	Ant Height	SA LEVEL (PEAK)	AFc	E-FIELD	Duty Cycle Correction	E-FIELD	LIMIT	MARGIN	
MHz	H/V	Degree	m	dBuV	dB/m	dBuV/m	Factor	uV/m	uV/m	dB	
1253.94	V	315	1.0	56.0	-10.6	45.4	10.3	56.6	1033.5	-25.2	
1671.92	V	90	1.0	59.0	-7.9	51.1	10.3	109.8	500.0	-13.2	
2089.90	V	135	1.0	48.0	-6.0	42.0	10.3	38.6	1033.5	-28.6	
2507.88	V	0	1.0	46.2	-5.2	41.0	10.3	34.2	1033.5	-29.6	
2925.86	V	315	1.0	44.3	-4.6	39.7	10.3	29.6	1033.5	-30.9	
3343.84	V	0	1.0	47.0	-4.0	43.0	10.3	43.0	1033.5	-27.6	NF
3761.82	V	0	1.0	46.0	-3.5	42.5	10.3	40.5	500.0	-21.8	NF
4179.80	V	0	1.0	42.0	-3.1	38.9	10.3	26.9	500.0	-25.4	NF
1253.94	H	0	1.0	59.3	-10.6	48.7	10.3	82.8	1033.5	-21.9	NF
1671.92	H	45	1.0	51.7	-7.9	43.8	10.3	47.4	500.0	-20.5	NF
2089.90	H	90	1.0	50.5	-6.0	44.5	10.3	51.5	1033.5	-26.1	NF
2507.88	H	45	1.0	43.2	-5.2	38.0	10.3	24.2	1033.5	-32.6	NF
2925.86	H	0	1.0	45.7	-4.6	41.1	10.3	34.8	1033.5	-29.5	NF
3343.84	H	0	1.0	46.2	-4.0	42.2	10.3	39.2	1033.5	-28.4	NF
3761.82	H	0	1.0	46.0	-3.5	42.5	10.3	40.5	500.0	-21.8	NF
4179.80	H	0	1.0	43.7	-3.1	40.6	10.3	32.7	500.0	-23.7	NF

NF = Noise Floor

Table 8c: Radiated Emissions Test Data

TYPE/PART: HRMC-9
DATE: 6/20/01
BY: Mike Violette
Tx Frequency: 418 MHz **Z-Axis**

Channel:

FREQ	POL	Azimuth	Ant Height	SA LEVEL (QP)	AFc	E-FIELD	Duty Cycle Correction	E-FIELD	LIMIT	MARGIN
MHz	H/V	Degree	m	dBuV	dB/m	dBuV/m	Factor	uV/m	uV/m	dB
417.98	V	0	1.0	59.80	19.0	78.8	10.3	2673.9	10334.7	-11.7
835.98	V	270	1.0	19.80	27.2	47.0	10.3	68.4	1033.5	-23.6
417.99	H	0	1.0	54.30	19.0	73.3	10.3	1419.6	10334.7	-17.2
835.98	H	270	1.0	12.00	27.2	39.2	10.3	27.9	1033.5	-31.4

Peak Measurements Above 1 GHz

FREQ	POL	Azimuth	Ant Height	SA LEVEL (PEAK)	AFc	E-FIELD	Duty Cycle Correction	E-FIELD	LIMIT	MRGN	
MHz	H/V	Degree	m	dBuV	dB/m	dBuV/m	Factor	uV/m	uV/m	dB	
1253.94	V	135	1.0	57.0	-10.6	46.4	10.3	63.5	1033.5	-24.2	
1671.92	V	315	1.0	57.5	-7.9	49.6	10.3	92.4	500.0	-14.7	
2089.90	V	0	1.0	52.3	-6.0	46.3	10.3	63.3	1033.5	-24.3	
2507.88	V	0	1.0	47.0	-5.2	41.8	10.3	37.5	1033.5	-28.8	
2925.86	V	315	1.0	44.0	-4.6	39.4	10.3	28.6	1033.5	-31.2	
3343.84	V	315	1.0	45.0	-4.0	41.0	10.3	34.2	1033.5	-29.6	
3761.82	V	0	1.0	43.3	-3.5	39.8	10.3	29.7	500.0	-24.5	NF
4179.80	V	0	1.0	45.0	-3.1	41.9	10.3	38.0	500.0	-22.4	NF
1253.94	H	0	1.0	55.0	-10.6	44.4	10.3	50.5	1033.5	-26.2	NF
1671.92	H	45	1.0	54.5	-7.9	46.6	10.3	65.4	500.0	-17.7	NF
2089.90	H	0	1.0	50.3	-6.0	44.3	10.3	50.3	1033.5	-26.3	NF
2507.88	H	315	1.0	46.3	-5.2	41.1	10.3	34.6	1033.5	-29.5	NF
2925.86	H	315	1.0	46.2	-4.6	41.6	10.3	36.8	1033.5	-29.0	NF
3343.84	H	0	1.0	46.7	-4.0	42.7	10.3	41.5	1033.5	-27.9	NF
3761.82	H	0	1.0	45.8	-3.5	42.3	10.3	39.6	500.0	-22.0	NF
4179.80	H	0	1.0	45.0	-3.1	41.9	10.3	38.0	500.0	-22.4	NF

NF = Noise Floor

Figure 4: Radiated Emission Test Configuration, X-Axis

Figure 5: Radiated Emission Test Configuration, Y-Axis

Figure 6: Radiated Emission Test Configuration, Z-Axis

4.7 Frequency Stability: (FCC Part §2.1055)

Not Applicable.

4.8 Transient Frequency Response (Part 90.214)

Not Applicable.

5 Transmitter Environmental Assessment, Maximum Permissible Exposure (MPE)

5.1 SCOPE

Not Applicable.