



*FCC PART 15, SUBPART C
TEST METHOD: ANSI C63.4-1992
TEST REPORT*

for

WATERHOUND

Model: WCK100

Prepared for

**DYNAQUIP CONTROLS
10 HARRIS INDUSTRIAL PARK
ST. CLAIR, MISSOURI 63077**

Prepared by: *Kyle Fujimoto*

KYLE FUJIMOTO

Approved by: *Scott McCutchan*

SCOTT McCUTCHAN

**COMPATIBLE ELECTRONICS INC.
114 OLINDA DRIVE
BREA, CALIFORNIA 92823
(714) 579-0500**

DATE: AUGUST 10, 1999

	REPORT BODY	APPENDICES				TOTAL
		<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	
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1	Conducted Emissions Test Setup
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GENERAL REPORT SUMMARY

This electromagnetic emission test report is generated by Compatible Electronics Inc., which is an independent testing and consulting firm. The test report is based on testing performed by Compatible Electronics personnel according to the measurement procedures described in the test specifications given below and in the "Test Procedures" section of this report.

The measurement data and conclusions appearing herein relate only to the sample tested and this report may not be reproduced in any form unless done so in full with the written permission of Compatible Electronics.

This report must not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

Device Tested: WaterHound
Model: WCK100
S/N: N/A

Product Description: See Expository Statement.

Modifications: The EUT was not modified during the testing.

Manufacturer: DynaQuip Controls
10 Harris Industrial Park
St. Clair, Missouri 63077

Test Date: August 5, 1999

Test Specifications: EMI requirements
CFR Title 47, Part 15 Subpart C, Sections 15.205 and 15.231

Test Procedure: ANSI C63.4: 1992

Test Deviations: The test procedure was not deviated from during the testing.

SUMMARY OF TEST RESULTS

TEST	DESCRIPTION	RESULTS
1	Conducted RF Emissions, 450 kHz - 30 MHz	This test was not performed because the EUT runs off two "AA" battery only and cannot be powered by any device that runs off of the AC public mains.
2	Radiated RF Emissions, 10 kHz - 4200 MHz	Complies with the limits of CFR Title 47, Part 15, Subpart B and Subpart C, sections 15.205 and 15.231



1. PURPOSE

This document is a qualification test report based on the Electromagnetic Interference (EMI) tests performed on the WaterHound Model: WCK100. The EMI measurements were performed according to the measurement procedure described in ANSI C63.4: 1992. The tests were performed in order to determine whether the electromagnetic emissions from the equipment under test, referred to as EUT hereafter, are within the specification limits defined by CFR Title 47, Part 15, Subpart B and Subpart C, sections 15.205 and 15.231.



2. ADMINISTRATIVE DATA

2.1 Location of Testing

The EMI tests described herein were performed at the test facility of Compatible Electronics, 114 Olinda Drive, Brea, California 92823.

2.2 Traceability Statement

The calibration certificates of all test equipment used during the test are on file at the location of the test. The calibration is traceable to the National Institute of Standards and Technology (NIST).

2.3 Cognizant Personnel

DynaQuip Controls

Michael J. Purvis Design Engineer

Compatible Electronics Inc.

Kyle Fujimoto Test Engineer

Scott McCutchan Lab Manager

2.4 Date Test Sample was Received

The test sample was received on August 5, 1999.

2.5 Disposition of the Test Sample

The test sample was returned to DynaQuip Controls on August 10, 1999.

2.6 Abbreviations and Acronyms

The following abbreviations and acronyms may be used in this document.

RF	Radio Frequency
EMI	Electromagnetic Interference
EUT	Equipment Under Test
P/N	Part Number
S/N	Serial Number
HP	Hewlett Packard
ITE	Information Technology Equipment
CML	Corrected Meter Limit
LISN	Line Impedance Stabilization Network



3. APPLICABLE DOCUMENTS

The following documents are referenced or used in the preparation of this EMI Test Report.

SPEC	TITLE
CFR Title 47, Subpart C	FCC Rules – Radio frequency devices (including digital devices) – Intentional Radiators
ANSI C63.4 1992	Methods of measurement of radio-noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz



4. DESCRIPTION OF TEST CONFIGURATION

4.1 Description of Test Configuration - EMI

Setup and operation of the equipment under test.

Specifics of the EUT and Peripherals Tested

The WaterHound Model: WCK100 (EUT) had a 234 cm cable connected to it. The other end of the cable had two contacts, which were placed in a cup of water. The contacts being placed in a cup of water allowed the EUT to continuously transmit. The final radiated data was taken in the mode above. Please see Appendix D for the data sheets.



4.1.1 Cable Construction and Termination

Cable 1

This is a 2.34 meter unshielded cable connecting the EUT to a cup of water. It has two contacts placed in a cup of water and is hard wired at the EUT end. The cable was bundled to a length of 1 meter.



5. LISTS OF EUT, ACCESSORIES AND TEST EQUIPMENT

5.1 EUT and Accessory List

EQUIPMENT	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID
WATERHOUND (EUT)	DYNAQUIP CONTROLS	WCK100	N/A	ONCWCK100
CUP OF WATER	N/A	N/	N/A	N/A



5.2 EMI Test Equipment

EQUIPMENT TYPE	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	CAL. DATE	CAL. DUE DATE
Spectrum Analyzer	Hewlett Packard	8566B	3638A08784	Nov. 16, 1998	Nov. 16, 1999
Preamplifier	Com Power	PA-102	1017	Jan. 16, 1998	Jan. 16, 1999
Quasi-Peak Adapter	Hewlett Packard	85650A	3303A01688	June 23, 1998	June 23, 1999
Biconical Antenna	Com Power	AB-100	1548	Oct. 15, 1998	Oct. 15, 1999
Log Periodic Antenna	Com Power	AL-100	1117	Oct. 15, 1998	Oct. 15, 1999
Antenna Mast	Com Power	AM-100	N/A	N/A	N/A
Turntable	Com Power	TT-100	N/A	N/A	N/A
Computer	Hewlett Packard	HP98561A	2522A05178	N/A	N/A
Printer	Hewlett Packard	2225A	2925S33268	N/A	N/A
Plotter	Hewlett Packard	7440A	8726K38417	N/A	N/A
Microwave Preamplifier	Hewlett Packard	8449B	3008A008766	Jan. 30, 1999	Jan. 30, 2000
Horn Antenna	Antenna Research	DRG-118/A	1053	Dec. 8, 1995	N/A
Loop Antenna	Com-Power	AL-130	25309	April 13, 1999	April 13, 2000



6. TEST SITE DESCRIPTION

6.1 Test Facility Description

Please refer to section 2.1 and 7.1 of this report for EMI test location.

6.2 EUT Mounting, Bonding and Grounding

The EUT was mounted on a 1.0 by 1.5 meter non-conductive table 0.8 meters above the ground plane.

The EUT was not grounded.



7. TEST PROCEDURES

The following sections describe the test methods and the specifications for the tests. Test results are also included in this section.

7.1 Radiated Emissions (Spurious and Harmonics) Test

The spectrum analyzer was used as a measuring meter along with the quasi-peak adapter. Amplifiers were used to increase the sensitivity of the instrument. The Com Power Preamplifier Model: PA-102 was used for frequencies from 30 MHz to 1 GHz, and the Hewlett Packard Microwave Preamplifier Model: 8449B was used for frequencies above 1 GHz. The spectrum analyzer was used in the peak detect mode with the "Max Hold" feature activated. In this mode, the spectrum analyzer records the highest measured reading over all the sweeps. The quasi-peak adapter was used only for those readings which are marked accordingly on the data sheets. The measurement bandwidths and transducers used for the radiated emissions test were:

FREQUENCY RANGE	EFFECTIVE MEASUREMENT BANDWIDTH	TRANSDUCER
10 kHz to 150 kHz	200 Hz	Active Loop Antenna
150 kHz to 30 MHz	9 kHz	Active Loop Antenna
30 MHz to 300 MHz	120 kHz	Biconical Antenna
300 MHz to 1 GHz	120 kHz	Log Periodic Antenna
1 GHz to 4.2 GHz	1 MHz	Horn Antenna

The open field test site of Compatible Electronics, Inc. was used for radiated emission testing. This test site is set up according to ANSI C63.4: 1992. Please see section 6.2 of this report for mounting, bonding and grounding of the EUT. The turntable supporting the EUT is remote controlled using a motor. The turntable permits EUT rotation of 360 degrees in order to maximize emissions. Also, the antenna mast allows height variation of the antenna from 1 meter to 4 meters. Data was collected in the worst case (highest emission) configuration of the EUT. At each reading, the EUT was rotated 360 degrees and the antenna height was varied from 1 to 4 meters (for E field radiated field strength). The gunsight method was used when measuring with the horn antenna in order to ensure accurate results.

The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT. The EUT was tested at a 3 meter test distance to obtain final test data.



7.2 Bandwidth of the Fundamental

The -20 dB bandwidth was checked to see that it was within 0.25% of the fundamental frequency for the transmitter. A plot of the -20 dB bandwidth is in Appendix D.



8. CONCLUSIONS

The WaterHound Model: WCK100 meets all of the specification limits defined in CFR Title 47, Part 15, Subpart C, sections 15.205 and 15.231.





APPENDIX A

MODIFICATIONS TO THE EUT



MODIFICATIONS TO THE EUT

The modifications listed below were made to the EUT to pass FCC 15.231 specifications.

All the rework described below was implemented during the test in a method that could be reproduced in all the units by the manufacturer.

Modifications:

No modifications were made to the EUT.





APPENDIX B

***ADDITIONAL MODELS COVERED
UNDER THIS REPORT***



ADDITIONAL MODELS COVERED UNDER THIS REPORT

USED FOR THE PRIMARY TEST

WaterHound
Model: WCK100
S/N: N/A

There were no additional models covered under this report.





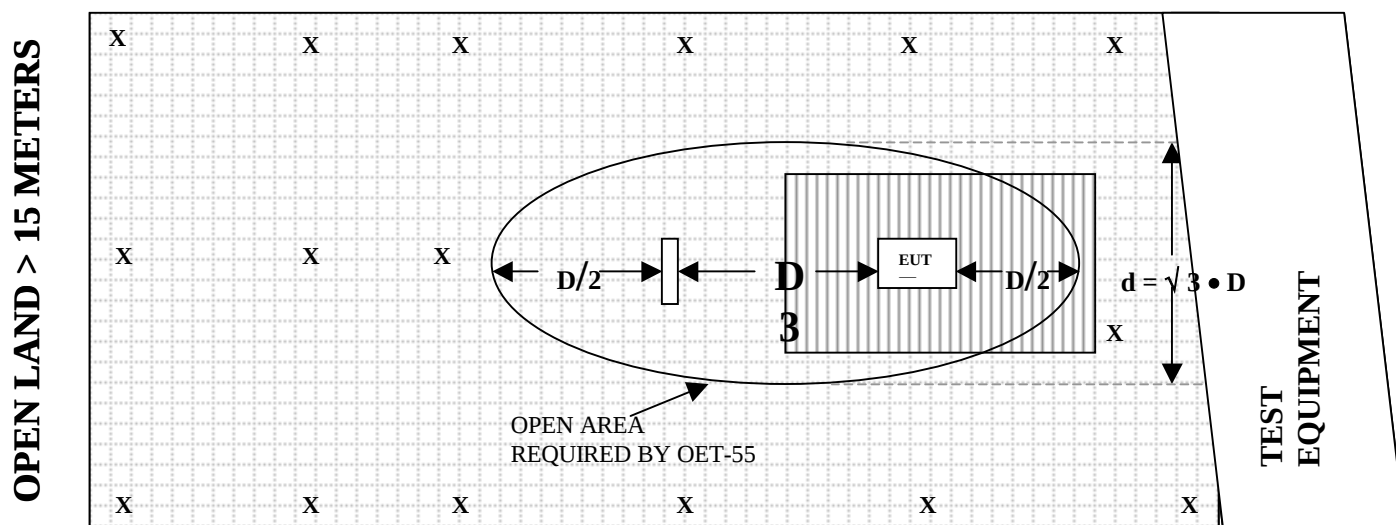
APPENDIX C

DIAGRAMS, CHARTS AND PHOTOS

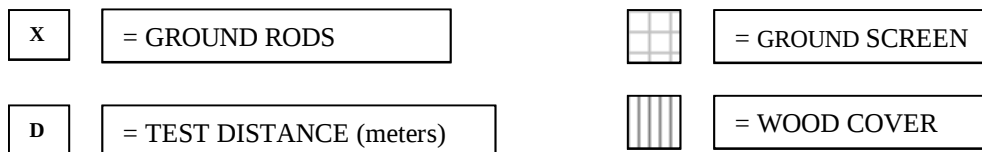


FIGURE 1: PLOT MAP AND LAYOUT OF RADIATED SITE

OPEN LAND > 15 METERS



OPEN LAND > 15 METERS





FRONT VIEW

DYNAQUIP CONTROLS

WATERHOUND

MODEL: WCK100

FCC SUBPART C - RADIATED EMISSIONS – 8-5-99

**PHOTOGRAPH SHOWING THE EUT CONFIGURATION
FOR MAXIMUM EMISSIONS**





REAR VIEW

DYNAQUIP CONTROLS

WATERHOUND

MODEL: WCK100

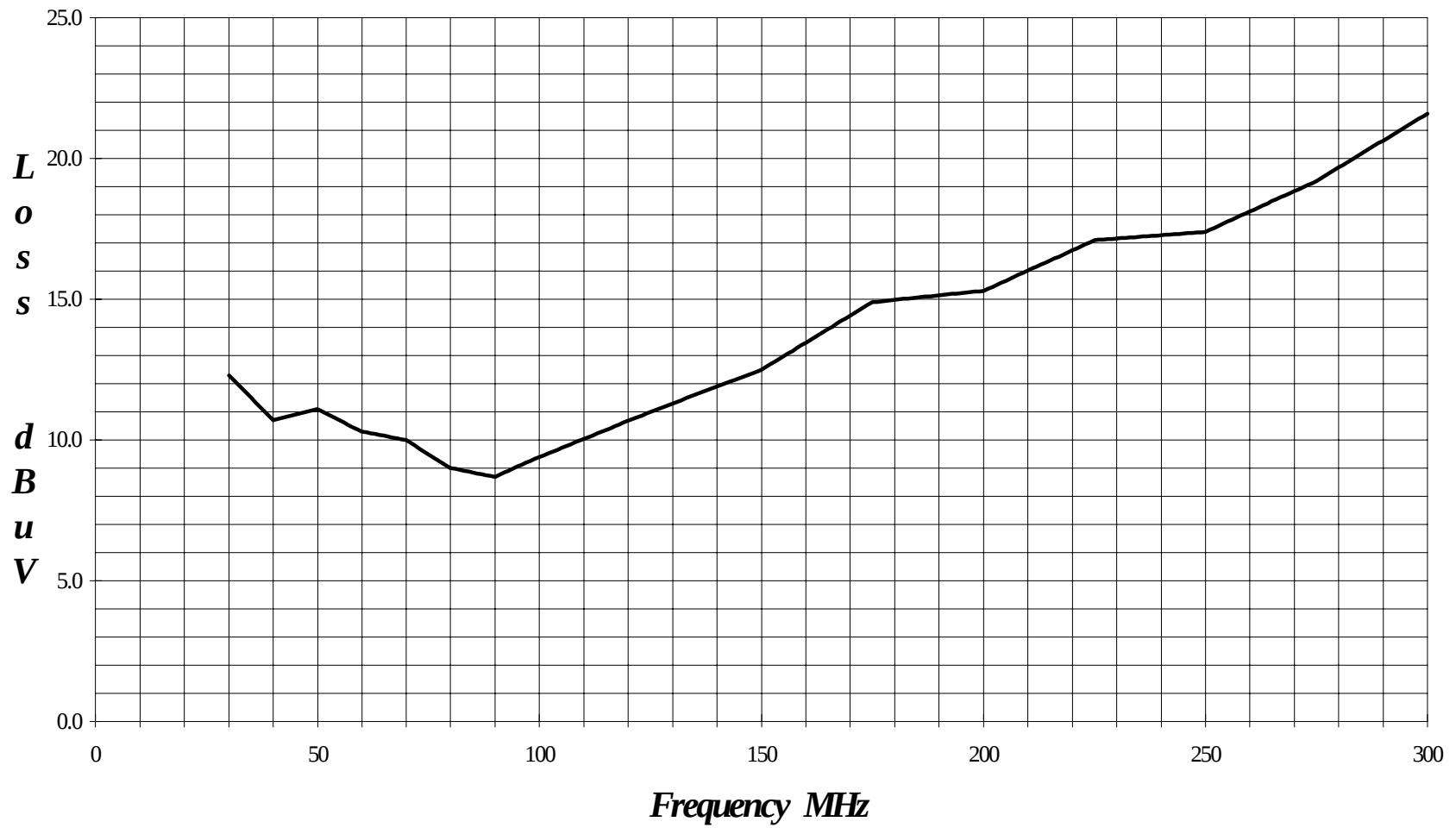
FCC SUBPART C - RADIATED EMISSIONS – 8-5-99

**PHOTOGRAPH SHOWING THE EUT CONFIGURATION
FOR MAXIMUM EMISSIONS**



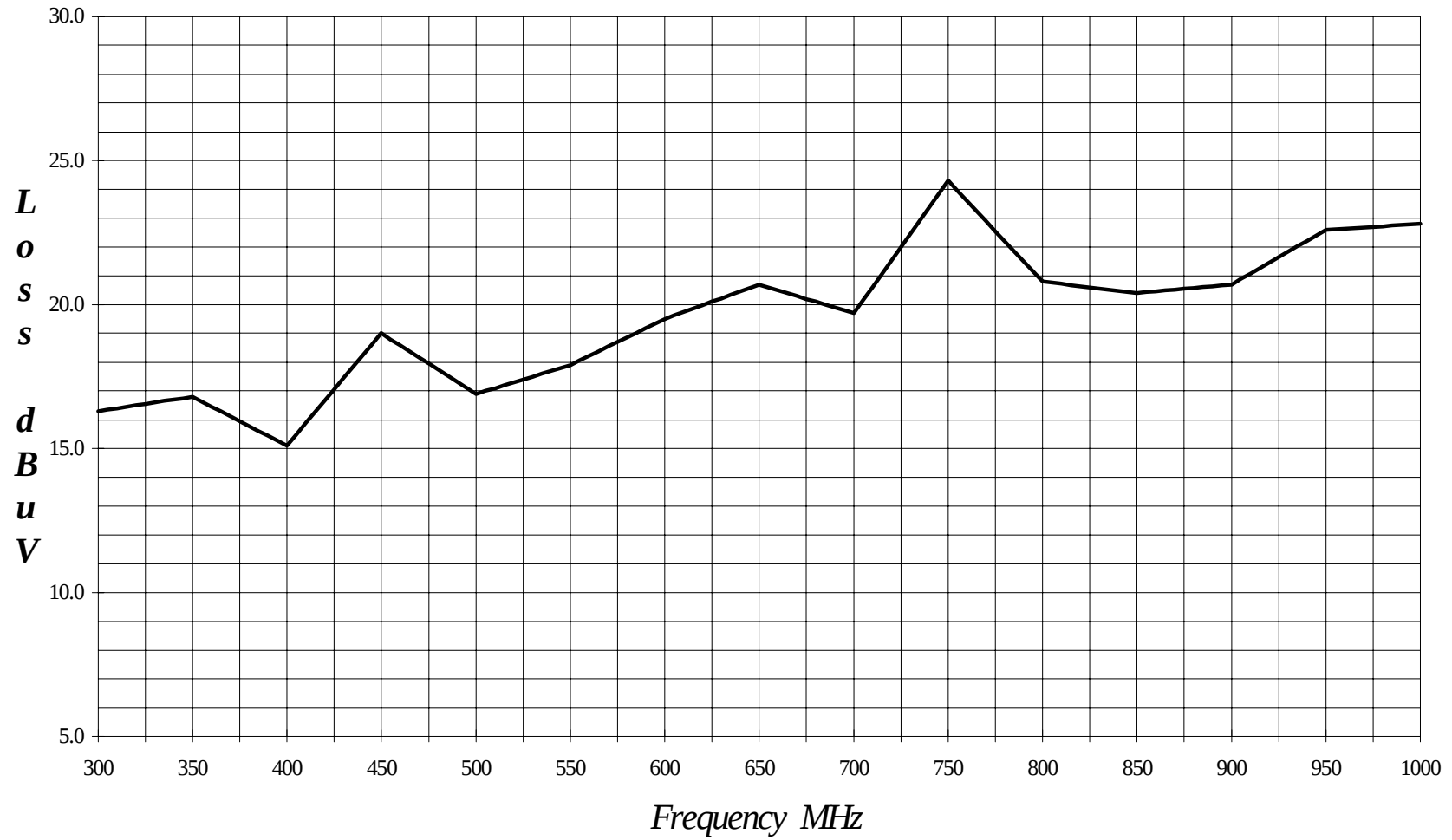
Cal: 10/15/98

LAB "D" BICONICAL ANTENNA AB-100 S/N 01548



Cal: 10/15/98

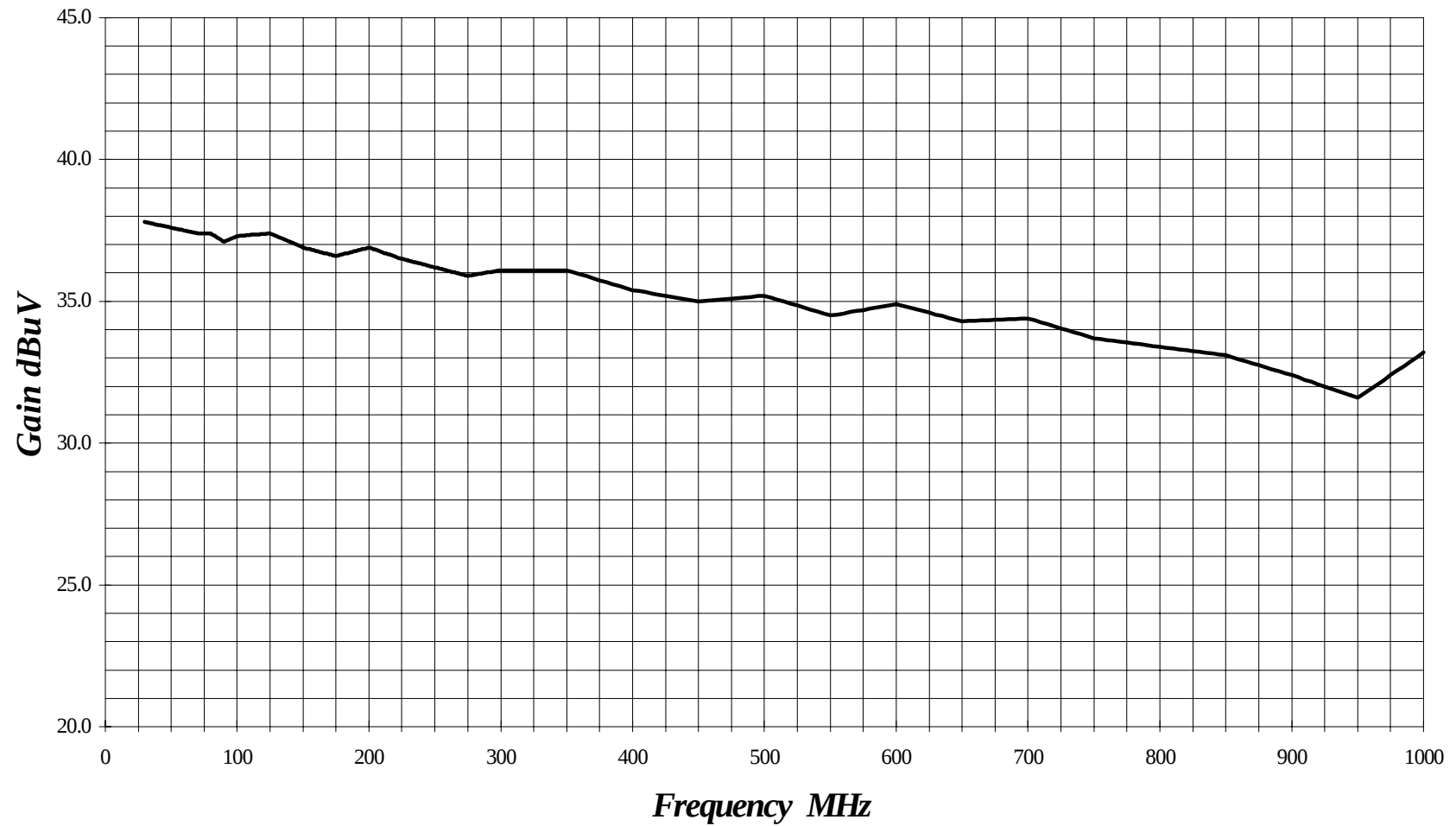
LAB "D" LOG PERIODIC ANTENNA AL-100 S/N 01117



Lab "D" Effective: 1/16/99

Effective Gain = Preamplifier Gain – Cable Loss

PREAMPLIFIER EFFECTIVE GAIN AT 3 METERS PA-102 S/N: 1017



HEWLETT PACKARD 8449B

MICROWAVE PREAMPLIFIER

S/N: 3008A008766

CALIBRATION DATE: JANUARY 30, 1999

FREQUENCY (GHz)	FACTOR (dB)	FREQUENCY (GHz)	FACTOR (dB)
1.0	36.9	9.5	34.3
1.1	36.3	10.0	33.7
1.2	36.4	10.5	34.1
1.3	36.2	11.0	33.7
1.4	36.3	11.5	34.0
1.5	35.7	12.0	33.9
1.6	35.9	12.5	34.4
1.7	35.7	13.0	32.9
1.8	35.6	13.5	31.6
1.9	35.5	14.0	31.8
2.0	35.4	14.5	31.9
2.5	35.6	15.0	32.2
3.0	35.2	15.5	32.8
3.5	35.2	16.0	32.4
4.0	34.3	16.5	32.1
4.5	34.1	17.0	32.3
5.0	34.3	17.5	30.3
5.5	33.0	18.0	31.5
6.0	34.1	18.5	31.2
6.5	34.5	19.0	32.2
7.0	34.3	19.5	32.0
7.5	33.9	20.0	32.0
8.0	34.5	20.5	33.2
8.5	34.5	21.0	30.9
9.0	34.4	22.0	32.1



E-FIELD ANTENNA FACTOR CALIBRATION

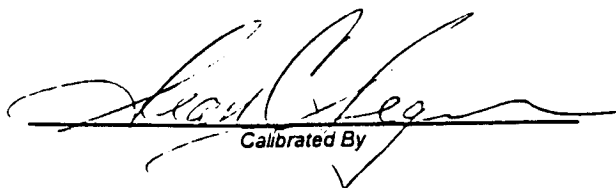
$$E(\text{dB V/m}) = V_o(\text{dB V}) + AFE(\text{dB/m})$$

Model number : DRG-118/A

Frequency GHz	AFE dB/m	Gain dBi
1	22.3	8.0
2	26.7	9.5
3	29.7	10.1
4	29.5	12.8
5	32.3	12.0
6	32.4	13.4
7	36.1	11.0
8	37.4	10.9
9	36.8	12.5
10	39.5	10.7
11	39.6	11.5
12	39.8	12.0
13	39.7	12.8
14	41.8	11.3
15	41.9	11.9
16	38.1	16.3
17	41.0	13.9
18	46.5	8.9

Serial number : 1053
Job number : 96-092
Remarks : 3 meter calibration
Standards : LPD-118/A, TE-1000

Temperature : 72° F
Humidity : 56 %
Traceability : A01887
Date : December 08, 1995


Calibrated By

Com-Power Corporation

(949) 587-9800

Antenna Calibration

Antenna Type:		Loop Antenna	
Model:		AL-130	
Serial Number:		25309	
Calibration Date:		4/13/99	
Frequency MHz	Magnetic (dB/m)	Electric dB/m	
0.01	-40.6	10.9	
0.02	-41.5	10.0	
0.03	-39.9	11.6	
0.04	-40.2	11.3	
0.05	-41.5	10.0	
0.06	-41.1	10.4	
0.07	-41.3	10.2	
0.08	-41.6	9.9	
0.09	-41.7	9.8	
0.1	-41.7	9.8	
0.2	-44.0	7.5	
0.3	-41.6	9.9	
0.4	-41.6	9.9	
0.5	-41.7	9.8	
0.6	-41.5	10.0	
0.7	-41.4	10.1	
0.8	-41.5	10.0	
0.9	-41.6	9.9	
1	-41.2	10.3	
2	-40.5	11.0	
3	-40.8	10.7	
4	-41.0	10.5	
5	-40.5	11.0	
6	-40.5	11.0	
7	-40.7	10.8	
8	-40.8	10.7	
9	-40.1	11.4	
10	-40.4	11.1	
12	-41.0	10.5	
14	-42.1	9.4	
15	-42.3	9.2	
16	-42.7	8.8	
18	-41.0	10.5	
20	-41.1	10.4	
25	-43.4	8.1	
30	-45.3	6.2	

Trans. Antenna Height

2 meter

Receiving Antenna Height

2 meter



APPENDIX D

DATA SHEETS





Test location: Compatible Electronics

Customer : DYNAQUIP CONTROLS

Manufacturer : DYNAQUIP CONTROLS

EUT name : WATER HOUND

Specification: Fcc_B Test distance: 3.0 mtrs

Distance correction factor($20 \times \log(\text{test}/\text{spec})$)

Test Mode :

SPURIOUS EMISSIONS - TRANSMITTER - 10 kHz TO 4200 MHz

TEMPERATURE 75 DEGREES F., RELATIVE HUMIDITY 53%

TESTED BY: Kyle Fujimoto
KYLE FUJIMOTO

Date : 8/ 5/1999

Time : 8.21

Model: WCK100

Lab: D

: 0.00

NO EMISSIONS FOUND FROM 10 kHz TO 4200 MHz IN
EITHER POLARIZATION FOR THE TRANSMITTER

RADIATED EMISSIONS (FCC SECTION 15.205 AND 15.231)

COMPANY	DYNAQUIP CONTROLS	DATE	8/5/99
EUT	WATERHOUND	DUTY CYCLE	48.00 %
MODEL	WCK100	PEAK TO AVG	-6.38 dB
S/N	N/A	TEST DIST.	3 METERS
TEST ENGINEER	James Ross	LAB	D

[illegible]

* CORRECTED READING = METER READING + ANTENNA FACTOR + CABLE LOSS - AMPLIFIER GAIN

** DELTA = SPEC LIMIT - CORRECTED READING

RADIATED EMISSIONS (FCC SECTION 15.205 AND 15.231)



**COMPATIBLE
ELECTRONICS**

COMPANY	DYNAQUIP CONTROLS	DATE	8/5/99
EUT	WATERHOUND	DUTY CYCLE	48.00 %
MODEL	WCK100	PEAK TO AVG	-6.38 dB
S/N	N/A	TEST DIST.	3 METERS
TEST ENGINEER	James Ross	LAB	D

[illegible]

* CORRECTED READING = METER READING + ANTENNA FACTOR + CABLE LOSS - AMPLIFIER GAIN
 ** DELTA = SPEC LIMIT - CORRECTED READING

RADIATED EMISSIONS (FCC SECTION 15.205 AND 15.231)

COMPANY	DYNAQUIP CONTROLS	DATE	8/5/99
EUT	WATERHOUND	DUTY CYCLE	48.00 %
MODEL	WCK100	PEAK TO AVG	-6.38 dB
S/N	N/A	TEST DIST.	3 METERS
TEST ENGINEER	James Ross	LAB	D

[illegible]

* CORRECTED READING = METER READING + ANTENNA FACTOR + CABLE LOSS - AMPLIFIER GAIN

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RADIATED EMISSIONS (FCC SECTION 15.205 AND 15.231)

COMPANY	DYNAQUIP CONTROLS	DATE	8/5/99
EUT	WATERHOUND	DUTY CYCLE	48.00 %
MODEL	WCK100	PEAK TO AVG	-6.38 dB
S/N	N/A	TEST DIST.	3 METERS
TEST ENGINEER	James Ross	LAB	D

[illegible]

* CORRECTED READING = METER READING + ANTENNA FACTOR + CABLE LOSS - AMPLIFIER GAIN
 ** DELTA = SPEC LIMIT - CORRECTED READING

NOTE: NO HARMONICS WERE FOUND AFTER THE 4TH HARMONIC

8-5-99

MKR Δ 387 kHz
-0.70 dB

BANDWIDTH OF FUNDAMENTAL 20 dB
REF 100.0 dB μ V ATTEN 10 dB

hp
10 dB/

DL
66.2
dB μ V

MARKER Δ
387 kHz
-0.70 dB

-20dB

-20dB

CORR'D

CENTER 418.06 MHz
RES BW 1 MHz

VBW 1 MHz

SPAN 1.00 MHz
SWP 20.0 msec

