



**DATE: 17 July 2014**

**I.T.L. (PRODUCT TESTING) LTD.**  
**FCC Radio Test Report**  
**For**

**Hachiko Technologies**

**Equipment under test:**

**Dog Collar Sensor**

**HC1**

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This report relates only to items tested.



# Measurement/Technical Report for

## Hachiko Technologies

### Dog Collar Sensor

HC1

FCC ID: 2ACPXDIAMOND

This report concerns:      Original Grant:      X

Class I Change:

Class II Change:

Equipment type:      Digital Transmission System

Limits used:      47CFR15 Section 15.247

Measurement procedure used is KDB 558074 D01 April 9, 2013 and ANSI C63.4-2003.

Application for Certification  
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Applicant for this device:  
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## 1. General Information

### 1.1 Administrative Information

Manufacturer: Hachiko Technologies

Manufacturer's Address: Sutine 9  
Tel Aviv, Israel

Manufacturer's Representative: Zohar Fox

Equipment Under Test (E.U.T): Dog Collar Sensor

Equipment Model No.: HC1

Equipment Serial No.: 10140028

Date of Receipt of E.U.T: 29.06.14

Start of Test: 29.06.14

End of Test: 11.08.14

Test Laboratory Location: I.T.L (Product Testing) Ltd.  
Kfar Bin Nun,  
ISRAEL 99780

Test Specifications: FCC Part 15, Sub-Part C



## 1.2 List of Accreditations

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), Registration No. 90715.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-1350, R-1285.
5. Industry Canada (Canada), IC File No.: 46405-4025; Site No. IC 4025B-1.

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.



### **1.3 Product Description**

Sensor for pets, BT4 based - sense for dog location by connecting to Smartphone and acquires dog coordinates.  
Once Smartphone is connected to EUT, it sends dog coordinates to a server.

### **1.4 Test Methodology**

Both conducted and radiated testing was performed according to the procedures in KDB 558074 D01 April 9, 2013 and ANSI C63.4: 2003. Radiated testing was performed at an antenna to EUT distance of 3 meters.

### **1.5 Test Facility**

The radiated emissions tests were performed at I.T.L.'s testing facility at Kfar Bin-Nun, Israel. This site is a FCC listed test laboratory (FCC Registration No. 90715, date of listing November 21, 2012).  
I.T.L.'s EMC Laboratory is also accredited by A2LA, certificate No. 1152.01.

### **1.6 Measurement Uncertainty**

#### **Conducted Emission**

Conducted Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) 0.15 – 30 MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 3.6 dB

Note: See ITL Procedure No. PM 198.

#### **Radiated Emission**

Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) for open site 30-1000MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 5.2 dB

Note: See ITL Procedure No. PM 198.



## 2. System Test Configuration

### 2.1 *Justification*

Radiated emission testing was performed in 3 orthogonal orientations. The worst case scenario was the vertical position.



## **2.2 *EUT Exercise Software***

HC-SW.

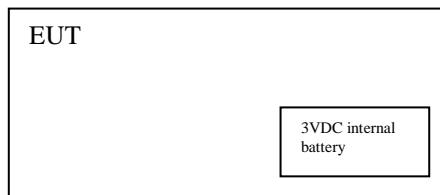
## **2.3 *Special Accessories***

No special accessories were needed in order to achieve compliance.

## **2.4 *Equipment Modifications***

No modifications were needed in order to achieve compliance

## **2.5 *Configuration of Tested System***



**Figure 1. Configuration of Tested System**



### 3. Radiated Measurement Test Set-up Photo



**Figure 2. Radiated Emission Test**



**Figure 3. Radiated Emission Test**



**Figure 4. Radiated Emission Test**



**Figure 5. Radiated Emission Test**



## 4. 6dB Minimum Bandwidth

### 4.1 Test Specification

F.C.C. Part 15, Subpart C: 15.247(a)(2)

### 4.2 Test procedure

The E.U.T was placed on a non-metallic table, 0.8 meters above the ground plane, on a remote-controlled turntable in the OATS. The test distance was 3 meters. The transmitter unit operated with normal modulation. The EMI receiver was set to 100 kHz resolution BW. The spectrum bandwidth of the transmitter unit was measured and recorded. The test was performed to measure the transmitter occupied bandwidth. The EUT was set up as shown in Figure 3, and its proper operation was checked. The transmitter occupied bandwidth was measured with the EMI receiver as frequency delta between reference points on modulation envelope. The E.U.T. was tested in three frequencies: Low, Mid and High.

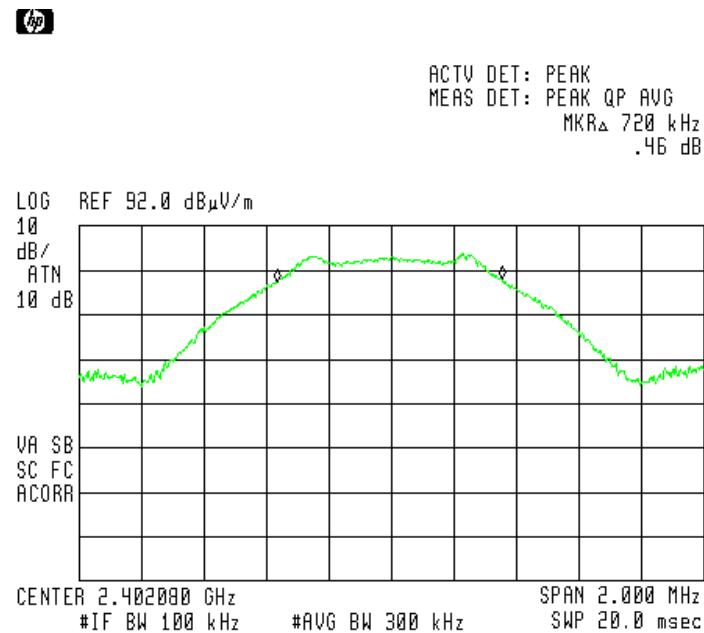
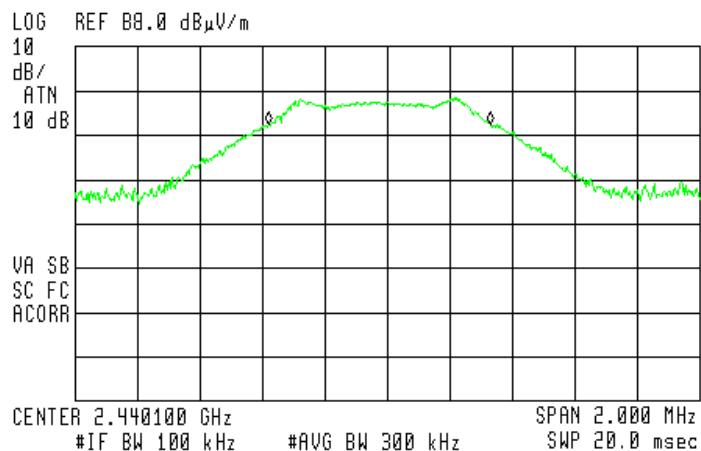


Figure 6. Low Channel - 2402 MHz



hp

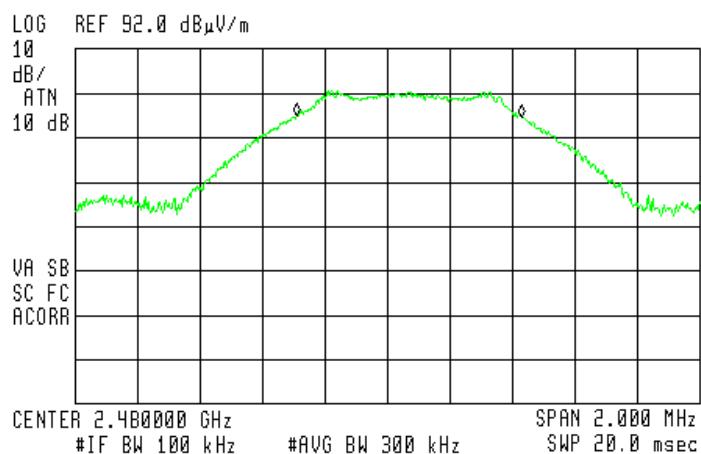
ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR<sub>A</sub> 710 kHz  
.11 dB



**Figure 7. Mid Channel - 2442 MHz**

hp

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR<sub>A</sub> 720 kHz  
-.25 dB



**Figure 8. High Channel - 2480 MHz**



### 4.3 Test Results

E.U.T Description: Dog Collar Sensor

Model: HC1

Serial Number: 10140028

Operation Frequency (MHz)	Bandwidth Reading (MHz)	Specification (MHz)
2402	0.72	>0.5
2442	0.71	>0.5
2480	0.72	>0.5

**Figure 9 6dB Minimum Bandwidth Test Results**

JUDGEMENT: Passed

TEST PERSONNEL:

Tester Signature:  Date: 29.07.14

Typed/Printed Name: I. Siboni



#### 4.4 Test Equipment Used. 6dB Minimum Bandwidth

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3906A00276	January 15, 2014	1 Year
RF Section	HP	85420E	3705A00248	January 15, 2014	1 Year
Horn Antenna	ETS	3115	29845	March 14, 2012	3 Years
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKGC19982	N/A	N/A

Figure 10 Test Equipment Used



## 5. 26dB Minimum Bandwidth

### 5.1 *Test Specification*

F.C.C. Part 15, Subpart C: 15.247(a)(2)

### 5.2 *Test procedure*

The E.U.T was placed on a non-metallic table, 0.8 meters above the ground plane, on a remote-controlled turntable in the OATS. The test distance was 3 meters.

The transmitter unit operated with normal modulation. The EMI receiver was set to 100 kHz resolution BW. The spectrum bandwidth of the transmitter unit was measured and recorded. The test was performed to measure the transmitter occupied bandwidth. The EUT was set up as shown in Figure 3, and its proper operation was checked. The transmitter occupied bandwidth was measured with the EMI receiver as frequency delta between reference points on modulation envelope. The E.U.T. was tested three frequencies: Low, Mid and High.

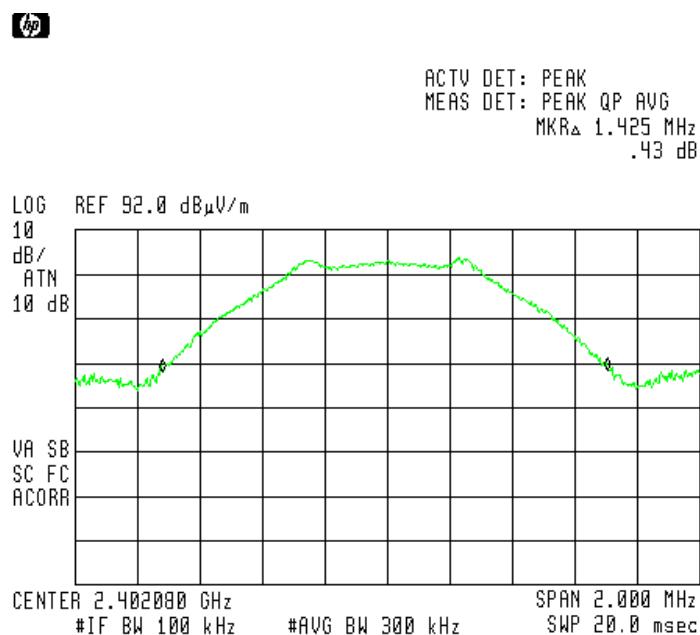


Figure 11. Low Channel 2402 MHz



10

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR<sub>Δ</sub> 1.465 MHz  
.58 dB

LOG

REF 92.0 dB $\mu$ V/m

10

dB/

ATN

10 dB

VA SB

SC FC

ACORR

CENTER 2.440000 GHz

#IF BW 100 kHz

#AVG BW 300 kHz

SPAN 2.000 MHz

SWP 20.0 msec

**Figure 12. Mid Channel - 2442 MHz**

10

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR<sub>Δ</sub> 1.415 MHz  
.27 dB

LOG

REF 92.0 dB $\mu$ V/m

10

dB/

ATN

10 dB

VA SB

SC FC

ACORR

CENTER 2.480000 GHz

#IF BW 100 kHz

#AVG BW 300 kHz

SPAN 2.000 MHz

SWP 20.0 msec

**Figure 13. High Channel - 2480 MHz**



### 5.3 Test Results

E.U.T Description: Dog Collar Sensor

Model: HC1

Serial Number: 10140028

Operation Frequency (MHz)	Bandwidth Reading (MHz)
Low	1.425
Mid	1.465
High	1.415

**Figure 14 26 dB Minimum Bandwidth Test Results**

JUDGEMENT: Passed

TEST PERSONNEL:

Tester Signature:

Date: 29.07.14

Typed/Printed Name: I. Siboni



#### 5.4 Test Equipment Used, 26 dB Minimum Bandwidth

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3906A00276	January 15, 2014	1 Year
RF Section	HP	85420E	3705A00248	January 15, 2014	1 Year
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	2 Years
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKGC19982	N/A	N/A

Figure 15 Test Equipment Used



## 6. Radiated Power Output

### 6.1 Test Specification

F.C.C. Part 15, Subpart C: 15.247(b)

### 6.2 Test procedure

The E.U.T was placed on a non-metallic table, 0.8 meters above the ground plane, on a remote-controlled turntable in the OATS. The test distance was 3 meters.

The transmitter unit operated with normal modulation. The EMI receiver was set to 1 MHz resolution BW. The EUT was set up as shown in Figure 3, and its proper operation was checked.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

The E.U.T. was tested in three operating channels and frequencies (1 (2.402 GHz); 8 (2.442 GHz); 14 (2.480 GHz)).

Radiated output power levels were measured at selected operation frequencies and the results were converted to power level according to the formula as shown below:

$$P = \frac{(E_{V/m} \times d)^2}{(30 \times G)} \text{ [W]}$$

E- Field Strength (v/m)

d- Distance from transmitter (m)

G- Antenna gain

P- Peak power (W)

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 2.402300 GHz  
B6.46 dB $\mu$ V/m

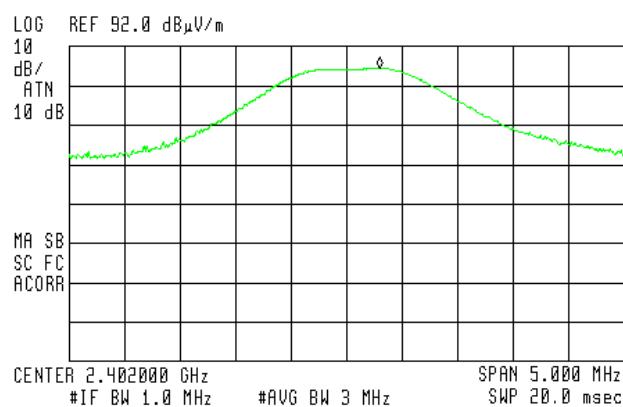




Figure 16 Low Channel – 2402.00 MHz - Vertical

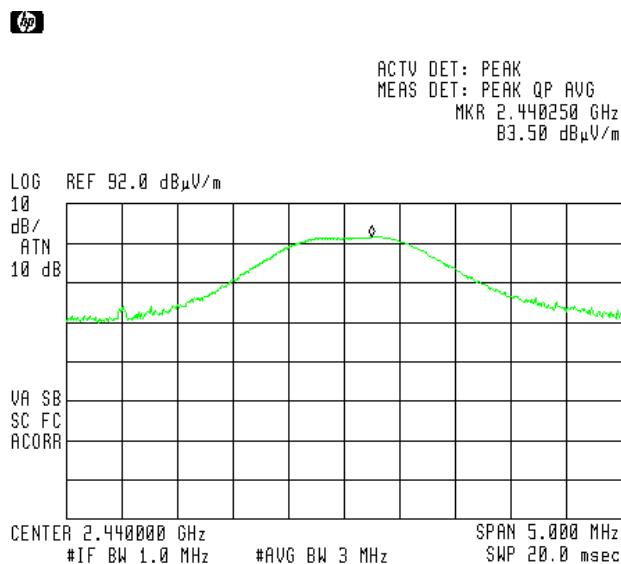


Figure 17 Mid Channel – 2442.00 MHz - Vertical

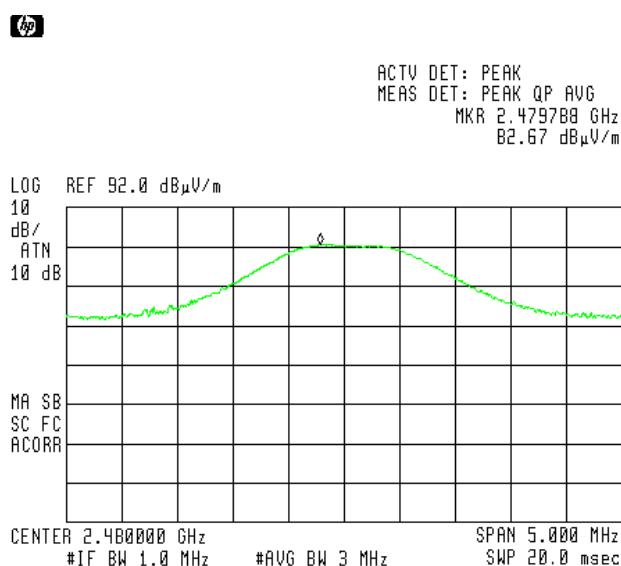


Figure 18 High Channel – 2480.00 MHz - Vertical



### 6.3 Results Calculation

E.U.T. Description: Dog Collar Sensor

Model No.: HC1

Serial Number: 10140028

Specification: F.C.C. Part 15, Subpart C

Operating Frequency (MHZ)	Field Strength (dBuV/m)	Polarization	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	86.46	V	-8.69	30	-38.69
Mid	83.50	V	-14.72	30	-44.72
High	82.67	V	-14.72	30	-44.72

**Figure 19 Radiated Power Output**

JUDGEMENT: Passed

TEST PERSONNEL:

Tester Signature: I. Siboni Date: 29.07.14

Typed/Printed Name: I. Siboni



#### 6.4 **Test Equipment Used, Radiated Maximum Power Output**

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
Receiver	HP	85422E	3906A00276	January 15, 2014	1 year
RF Section	HP	85420E	3705A00248	January 15, 2014	1 year
Antenna-Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	2 years
Horn Antenna	ETS	3115	29845	March 14, 2012	3 years
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKGC19982	N/A	N/A

**Figure 20 Test Equipment Used**



## 7. Band Edge

[In Accordance with section 15.247(d)]

### 7.1 Test procedure

The E.U.T was placed on a non-metallic table, 0.8 meters above the ground plane, on a remote-controlled turntable in the OATS. The test distance was 3 meters.

The transmitter unit operated with normal modulation. The EMI receiver was set to 1 MHz resolution BW. The EUT was set up as shown in Figure 3, and its proper operation was checked.

The EMI receiver was adjusted to the transmission channel at the maximum radiated level. The display line was set to 20 dBc and the EMI receiver was set to the band edge frequencies.

Maximum power level below 2400 MHz and above 2483.5 MHz was measured relative to power level at 2402 MHz, and 2480MHz correspondingly.

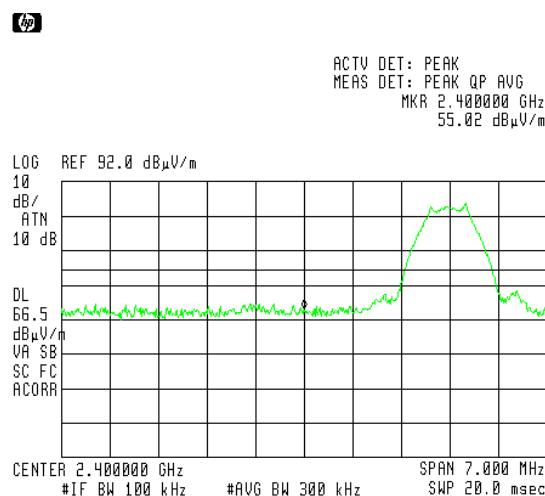
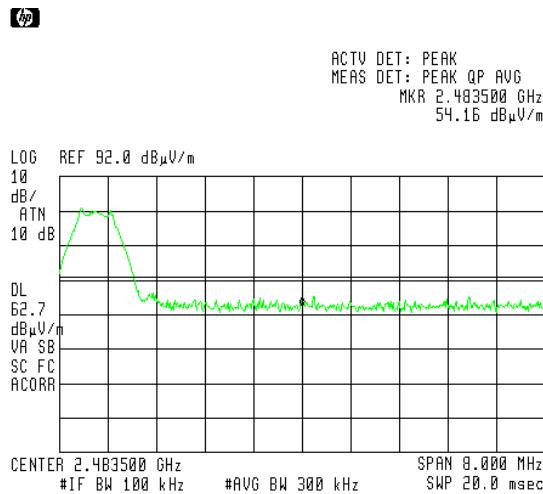


Figure 21 Lower Band Edge



**Figure 22 Upper Band Edge**



## 7.2 Results table

E.U.T. Description: Dog Collar Sensor  
Model No.: HC1  
Serial Number: 10140028  
Specification: F.C.C. Part 15, Subpart C (15.247 (d))

Operation Frequency (MHz)	Band Edge Frequency (MHz)	Spectrum Level (dBuV/m)	Specification (dBuV/m)	Margin (dB)
2402	2400.0	55.02	66.5	-11.48
2480	2483.5	54.16	62.7	-8.54

**Figure 23 Band Edge**

JUDGEMENT: Passed by 8.54 dB

TEST PERSONNEL:

Tester Signature:  Date: 29.07.14

Typed/Printed Name: I. Siboni



### 7.3 Test Equipment Used, Band Edge Spectrum

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
Receiver	HP	85422E	3906A00276	January 15, 2014	1 year
RF Section	HP	85420E	3705A00248	January 15, 2014	1 year
Antenna-Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	1 years
Horn Antenna	ETS	3115	29845	March 14, 2012	3 years
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKGC19982	N/A	N/A

Figure 24 Test Equipment Used



## 8. Radiated Emission, 9 kHz – 30 MHz

### 8.1 Test Specification

9 kHz-30 MHz, FCC, Part 15, Subpart C, Section 209

### 8.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 3.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The configuration tested is shown in Figure 3.1.

The frequency range 9 kHz-30 MHz was scanned.

The emissions were measured using a computerized EMI receiver complying with CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver via a 3.5" floppy disk.

In the frequency range 9 kHz-30MHz, the loop antenna was rotated on its vertical axis. The antenna height (center of loop) was 1 meter at a distance of 3 meters.

### 8.3 Measured Data

JUDGEMENT: Passed

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 209 specification.

The results for all three channels were the same.

No signals were detected in the frequency range of 9 kHz – 30 MHz.

TEST PERSONNEL: 

Tester Signature: \_\_\_\_\_

Date: 29.07.14

Typed/Printed Name: I. Siboni



#### 8.4 Test Instrumentation Used, Radiated Measurements

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3906A00276	January 15, 2014	1 year
RF Section	HP	85420E	3705A00248	January 15, 2014	1 year
Active Loop Antenna	EMCO	6502	9506-2950	November 4, 2013	1 year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKGC19982	N/A	N/A

Figure 25 Test Equipment Used



## 8.5 **Field Strength Calculation**

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$FS = RA + AF + CF$$

FS: Field Strength [dB $\mu$ V/m]

RA: Receiver Amplitude [dB $\mu$ V]

AF: Receiving Antenna Correction Factor [dB/m]

CF: Cable Attenuation Factor [dB]

Example:  $FS = 30.7 \text{ dB}\mu\text{V (RA)} + 14.0 \text{ dB (AF)} + 0.9 \text{ dB (CF)} = 45.6 \text{ dB}\mu\text{V}$

No external pre-amplifiers are used.



## 9. Spurious Radiated Emission 30 – 1000 MHz

### 9.1 ***Test Specification***

30 MHz-1000 MHz, F.C.C., Part 15, Subpart C

### 9.2 ***Test Procedure***

The E.U.T. operation mode and test set-up are as described in Section 3.

See Section 3.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground.

The frequency range 30 MHz-1000 MHz was scanned and the list of the highest emissions was verified and updated accordingly.

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

The emissions were measured using a computerized EMI receiver complying with CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver via a 3.5" floppy disk.

In the frequency range 30-1000 MHz, the readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

Verification of the E.U.T emissions was based on the following methods:

Turning the E.U.T on and off.

Using a frequency span less than 10 MHz.

Observation of the signal level during turntable rotation. Background noise is not affected by the rotation of the E.U.T.

The E.U.T. was tested in three operating channels and frequencies (1 (2.402 GHz); 8 (2.442 GHz); 14 (2.480 GHz)).



### 9.3 **Test Data**

JUDGEMENT: Passed

The EUT met the requirements of the F.C.C. Part 15, Subpart C specification.  
The results for all three operation channels were the same.

The signals in the band 30 MHz – 1.0 GHz were below the spectrum analyzer noise level, at least 20 dB below the specification limit.

TEST PERSONNEL: 

Tester Signature: \_\_\_\_\_ Date: 29.07.14

Typed/Printed Name: I. Siboni



#### 9.4 Test Instrumentation Used, Radiated Measurements

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3906A00276	January 15, 2014	1 year
RF Section	HP	85420E	3705A00248	January 15, 2014	1 year
Antenna Bioconical	EMCO	3104	2606	August 30, 2013	2 years
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	2 years
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKGC19982	N/A	N/A

Figure 26 Test Equipment Used



## 9.5 **Field Strength Calculation**

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$[\text{dB}\mu\text{v}/\text{m}] \text{ FS} = \text{RA} + \text{AF} + \text{CF}$$

FS: Field Strength [dB $\mu$ v/m]

RA: Receiver Amplitude [dB $\mu$ v]

AF: Receiving Antenna Correction Factor [dB/m]

CF: Cable Attenuation Factor [dB]

Example: FS = 30.7 dB $\mu$ V (RA) + 14.0 dB (AF) + 0.9 dB (CF) = 45.6 dB $\mu$ V

No external pre-amplifiers are used.



## 10. Spurious Radiated Emission Above 1 GHz

### 10.1 Radiated Emission Above 1 GHz

The E.U.T operation mode and test set-up are as described in Section 3.

See Section 3.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The configuration tested is shown in Figure 3.1.

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

In the frequency range 1-2.9 GHz, a computerized EMI receiver complying to CISPR 16 requirements was used.

In the frequency range 2.9-25.0 GHz, a spectrum analyzer including a low noise amplifier was used. During average measurements, the IF bandwidth was 1 MHz and the video bandwidth was 100Hz. During peak measurements, the IF bandwidth was 1 MHz and the video bandwidth was 3 MHz.

The test distance was 3 meters.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

Verification of the E.U.T emissions was based on the following methods: turning the E.U.T on and off; using a frequency span less than 10 MHz; observation of the signal level during turntable rotation. (Background noise is not affected by the rotation of the E.U.T.)

The E.U.T. was tested in three operating channels and frequencies (1 (2.402 GHz); 8 (2.442 GHz); 14 (2.480 GHz)).



## 10.2 **Test Data**

JUDGEMENT: Passed by 8.24 dB

For the operation channel 1 (2.402 GHz), the margin between the emission level and the specification limit is in the worst case 8.24 dB at the frequency of 4804.0 MHz, horizontal polarization.

For the operation channel 8 (2.442 GHz), the margin between the emission level and the specification limit is in the worst case 10.29 dB at the frequency of 7320.0 MHz, horizontal polarization.

For the operation channel 14 (2.480 GHz), the margin between the emission level and the specification limit is in the worst case 9.64 dB at the frequency of 7440.0 MHz, vertical polarization.

The EUT met the requirements of the F.C.C. Part 15, Subpart C specification.

The details of the highest emissions are given in *Figure 27* to *Figure 30*.

TEST PERSONNEL:

Tester Signature: 

Date: 11.08.14

Typed/Printed Name: A. Sharabi



## Radiated Emission Above 1 GHz

E.U.T Description      Dog Collar Sensor  
Type                      HC1  
Serial Number:            10140028

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical      Frequency range: 1.0 GHz to 25.0 GHz  
Test Distance: 3 meters                              Detector: Peak

<b>Operation Frequency</b> (MHz)	<b>Freq.</b> (MHz)	<b>Polarity</b> (H/V)	<b>Peak Amp</b> (dB $\mu$ V/m)	<b>Peak. Specification</b> (dB $\mu$ V/m)	<b>Peak. Margin</b> (dB)
2402.0	2349.0	V	49.70	74.0	-24.30
	4804.0	H	58.61	74.0	-15.39
		V	58.35	74.0	-15.65
	7206.0	H	56.84	74.0	-17.16
		V	56.50	74.0	-17.50
2440.0	4880.0	H	56.15	74.0	-17.85
		V	55.68	74.0	-18.32
	7320.0	H	57.48	74.0	-16.52
		V	57.64	74.0	-16.36
2480.0	2492.0	V	50.30	74.0	-23.70
	4960.0	H	56.22	74.0	-17.78
		V	55.34	74.0	-18.66
	7440	H	58.57	74.0	-15.43
		V	58.30	74.0	-15.70

**Figure 27. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.  
Detector: Peak**

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Amp” includes correction factor.

\* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain



## Radiated Emission Above 1 GHz

E.U.T Description Dog Collar Sensor  
Type HC1  
Serial Number: 10140028

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical      Frequency range: 1.0 GHz to 25.0 GHz  
Test Distance: 3 meters      Detector: Average

Operation Frequency (MHz)	Freq. (MHz)	Polarity (H/V)	Avg Amp (dB $\mu$ V/m)	Average Specification	Peak Margin
				(dB $\mu$ V/m)	(dB)
2402.0	2349.0	V	36.70	54.0	-17.3
	4804.0	H	45.76	54.0	-8.24
	4804.0	V	45.31	54.0	-8.69
	7206.0	H	43.32	54.0	-10.68
	7206.0	V	43.39	54.0	-10.61
2440.0	4880.0	H	41.54	54.0	-12.46
	4880.0	V	41.51	54.0	-12.49
	7320.0	H	43.71	54.0	-10.29
	7320.0	V	43.70	54.0	-10.30
2480.0	2492.0	V	37.0	54.0	-17.0
	4960.0	H	41.59	54.0	-12.41
	4960.0	V	41.65	54.0	-12.35
	7440	H	44.31	54.0	-9.69
	7440	V	44.36	54.0	-9.64

**Figure 28. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.  
Detector: Average**

Notes:

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Average Amp” includes correction factor.

\*      Correction Factor = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

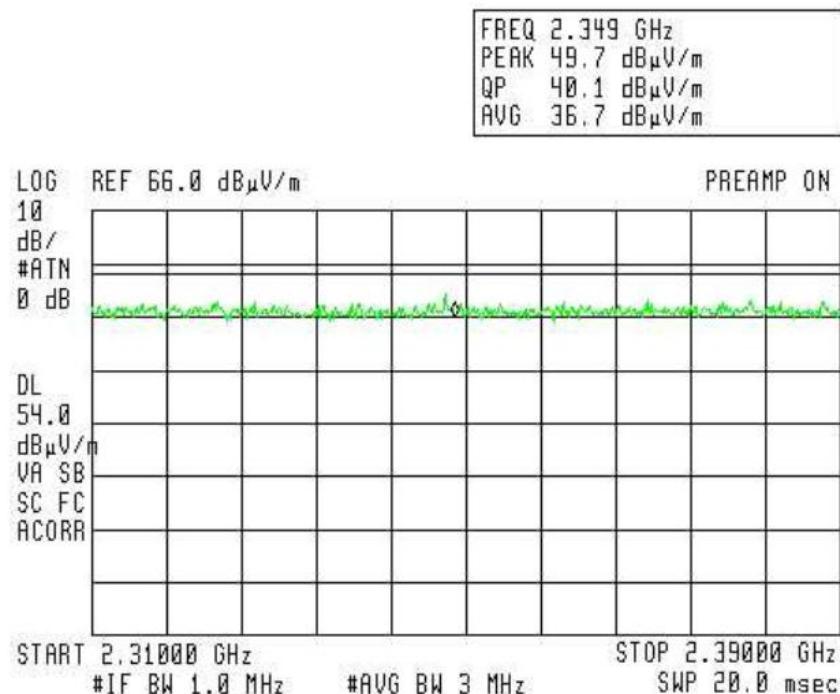


Figure 29– Lower Restricted Band Edge

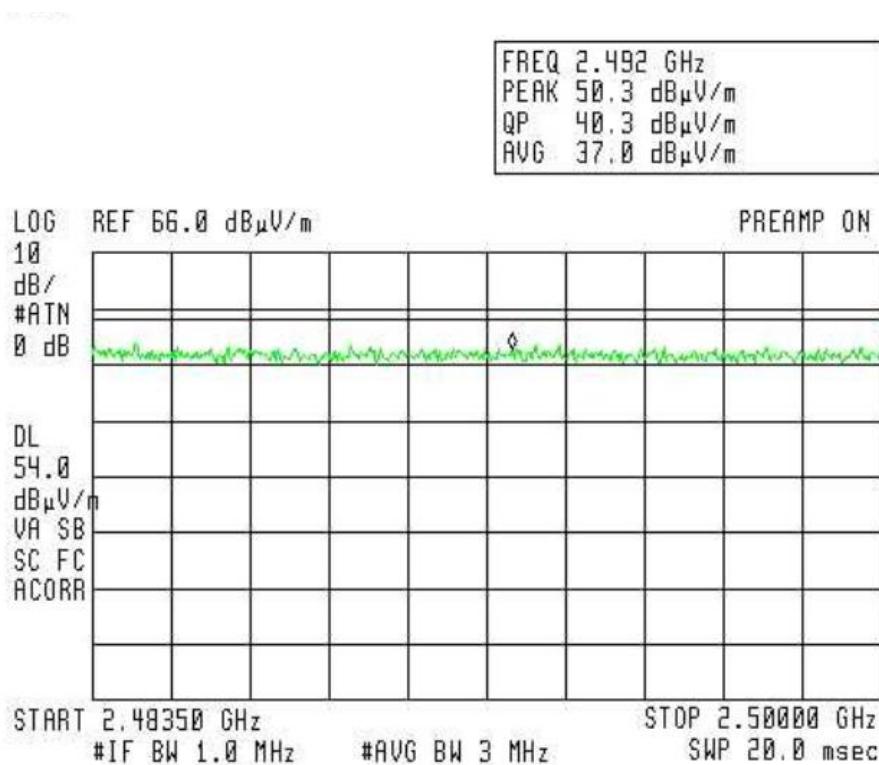


Figure 30– Upper Restricted Band Edge



### 10.3 Test Instrumentation Used, Radiated Measurements Above 1 GHz

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	January 15, 2014	1 Year
RF Filter Section	HP	85420E	3705A00248	January 15, 2014	1 Year
Antenna Biconical	EMCO	3104	2606	August 30, 2012	2 Years
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	2 Years
Double Ridged Waveguide Horn Antenna	EMCO	3115	29845	March 14, 2012	3 Years
Horn Antenna	ARA	SWH-28	1008	March 30, 2014	3 Years
Horn Antenna	ETS	3115	29845	March 14, 2012	3 Years
Low Noise Amplifier	DBS MICROWAVE	LNA-DBS-0411N313	013	August 21, 2013	1 Year
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	August 28, 2013	1 Year
Spectrum Analyzer	HP	8592L	3826A01204	February 28, 2014	1 Year
Spectrum Analyzer	HP	8546E	3442A00275	March 2, 2014	1 Year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKG19982	N/A	N/A

Figure 31 Test Equipment Used



## 11. Radiated Power Spectral Density

[In accordance with section 15.247(d)]

### 11.1 Test procedure

The E.U.T was placed on a non-metallic table, 0.8 meters above the ground plane, on a remote-controlled turntable in the OATS. The test distance was 3 meters.

The transmitter unit operated with normal modulation. The EMI receiver was set to 1 MHz resolution BW. The EUT was set up as shown in Figure 3, and its proper operation was checked.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

The E.U.T. was tested in three operating channels and frequencies (1 (2.402 GHz); 8 (2.442 GHz); 14 (2.480 GHz)).

Then the EMI receiver was set to 3 kHz resolution BW, span of 5 MHz, and sweep time of 100 seconds. The spectrum peaks were located at each of the 3 operating frequencies.

Radiated peak output power levels were converted to power level according to the formula as shown below:

$$P = \frac{(E_{V/m} \times d)^2}{(30 \times G)} \text{ [W]}$$

$$P_{out} = E(\text{dBuV/m})$$

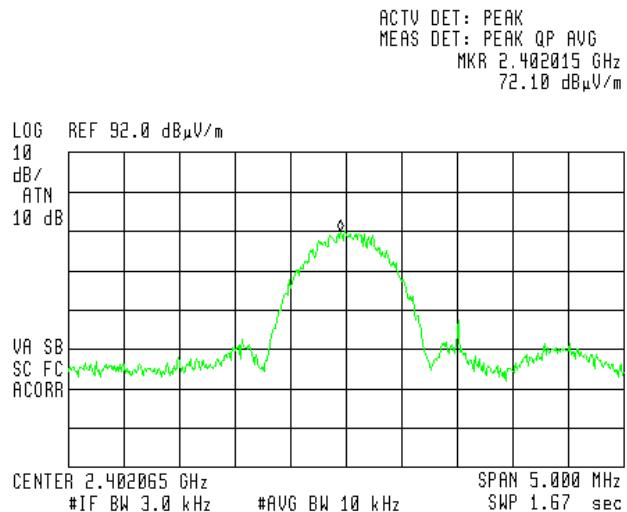


Figure 32 — 2402 MHz

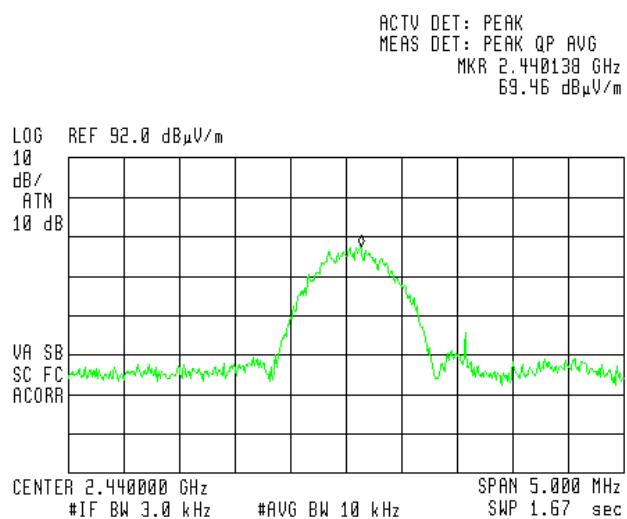
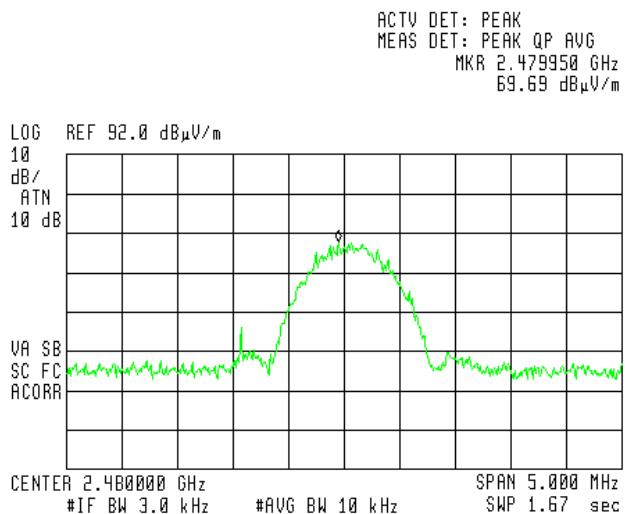


Figure 33 — 2442 MHz



**Figure 34 — 2480 MHz**



## 11.2 Results table

E.U.T. Description: Dog Collar Sensor

Model No.: HC1

Serial Number: 10140028

Specification: F.C.C. Part 15, Subpart C (15.247(d))

Operation Frequency (MHz)	Spectral Density Result (dBuV/m))	Spectral Density Result Watts	Spectral Density Result (dBm)	Specification (dBm)	Margin (dB)
2402	72.10	0.0000337	-14.72	8.0	-22.72
2442	69.46	0.0000337	-14.72	8.0	-22.72
2480	69.69	0.0000337	-14.72	8.0	-22.72

**Figure 35 Test Results**

JUDGEMENT: Passed

TEST PERSONNEL: 

Tester Signature: 

Date: 29.07.14

Typed/Printed Name: I. Siboni



### 11.3 Test Equipment Used, Transmitted Power Density

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3906A00276	January 15, 2014	1 year
RF Section	HP	85420E	3705A00248	January 15, 2014	1 year
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	2 years
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKGC19982	N/A	N/A

Figure 36 Test Equipment Used



## 12. Antenna Gain/Information

The antenna gain is -.05 dBi.



## 13. R.F Exposure/Safety

Typical use of the E.U.T. is as a dog sensor. The typical placement of the E.U.T. is attached to a dog collar. The typical distance between the E.U.T. and the user in the worst case application, is 0.5 cm.

### Calculation of Maximum Permissible Exposure (MPE)

Based on Section 1.1310 Requirements

(a) FCC limits at 2480 MHz is:  $1 \frac{mW}{cm^2}$

Using table 1 of Section 1.1310 limit for general population/uncontrolled exposures, the above level is an average over 30 minutes.

(b) The power density produced by the E.U.T. is

$P_t$ - Transmitted Power 86.46 dBuV/m (Peak) = 0.134 mW

$$S = \frac{P_t G_t}{4\pi R^2}$$

$G_t$ - Antenna Gain, -0.5 dBi = 0.89 numeric

R- Distance from Transmitter using 0.5cm worst case

(c) The peak power density is :

$$S_p = \frac{0.134 \times 0.89}{4\pi(0.5)^2} = 0.0382 \frac{mW}{cm^2}$$

(d) This is below the FCC limit.



## 14. APPENDIX B - CORRECTION FACTORS

### 14.1 Correction factors for CABLE

from EMI receiver  
to test antenna  
at 3 meter range.

FREQUENCY (MHz)	CORRECTION FACTOR (dB)	FREQUENCY (MHz)	CORRECTION FACTOR (dB)
10.0	0.3	1200.0	7.3
20.0	0.6	1400.0	7.8
30.0	0.8	1600.0	8.4
40.0	0.9	1800.0	9.1
50.0	1.1	2000.0	9.9
60.0	1.2	2300.0	11.2
70.0	1.3	2600.0	12.2
80.0	1.4	2900.0	13.0
90.0	1.6		
100.0	1.7		
150.0	2.0		
200.0	2.3		
250.0	2.7		
300.0	3.1		
350.0	3.4		
400.0	3.7		
450.0	4.0		
500.0	4.3		
600.0	4.7		
700.0	5.3		
800.0	5.9		
900.0	6.3		
1000.0	6.7		

#### NOTES:

1. The cable type is RG-214.
2. The overall length of the cable is 27 meters.
3. The above data is located in file 27MO3MO.CBL on the disk marked "Radiated Emission Tests EMI Receiver".



## 14.2 Correction factors for CABLE

from EMI receiver  
to test antenna  
at 3 meter range.

FREQUENCY (GHz)	CORRECTION FACTOR (dB)
1.0	1.2
2.0	1.6
3.0	2.0
4.0	2.4
5.0	3.0
6.0	3.4
7.0	3.8
8.0	4.2
9.0	4.6
10.0	5.0
12.0	5.8

*NOTES:*

1. The cable type is RG-8.
2. The overall length of the cable is 10 meters.



### 14.3 Correction factors for CABLE

from spectrum analyzer  
to test antenna above 2.9 GHz

FREQUENCY (GHz)	CORRECTION FACTOR (dB)	FREQUENCY (GHz)	CORRECTION FACTOR (dB)
1.0	1.9	14.0	9.1
2.0	2.7	15.0	9.5
3.0	3.5	16.0	9.9
4.0	4.2	17.0	10.2
5.0	4.9	18.0	10.4
6.0	5.5	19.0	10.7
7.0	6.0	20.0	10.9
8.0	6.5	21.0	11.2
9.0	7.0	22.0	11.6
10.0	7.5	23.0	11.9
11.0	7.9	24.0	12.3
12.0	8.3	25.0	12.6
13.0	8.7	26.0	13.0

*NOTES:*

1. The cable type is SUCOFLEX 104 E manufactured by SUHNER.
2. The cable is used for measurements above 2.9 GHz.
3. The overall length of the cable is 10 meters.



#### 14.4 Correction factors for CABLE

from EMI receiver  
to test antenna  
at 10 meter range.

FREQUENCY (MHz)	CORRECTION FACTOR (dB)	FREQUENCY (MHz)	CORRECTION FACTOR (dB)
10.0	0.3	1200.0	9.8
20.0	0.8	1400.0	10.0
30.0	0.9	1600.0	11.3
40.0	1.2	1800.0	12.2
50.0	1.4	2000.0	13.1
60.0	1.6	2300.0	14.5
70.0	1.8	2600.0	15.9
80.0	1.9	2900.0	16.4
90.0	2.0		
100.0	2.1		
150.0	2.6		
200.0	3.2		
250.0	3.8		
300.0	4.2		
350.0	4.6		
400.0	5.1		
450.0	5.3		
500.0	5.6		
600.0	6.3		
700.0	7.0		
800.0	7.6		
900.0	8.0		
1000.0	8.7		

*NOTES:*

1. The cable type is RG-214.
2. The overall length of the cable is 34 meters.
3. The above data is located in file 34M10MO.CBL on the disk marked "Radiated Emissions Tests EMI Receiver".



## 12.6 Correction factors for LOG PERIODIC ANTENNA

Type LPD 2010/A  
at 3 and 10 meter ranges.

### Distance of 3 meters

FREQUENCY (MHz)	AFE (dB/m)
200.0	9.1
250.0	10.2
300.0	12.5
400.0	15.4
500.0	16.1
600.0	19.2
700.0	19.4
800.0	19.9
900.0	21.2
1000.0	23.5

### Distance of 10 meters

FREQUENCY (MHz)	AFE (dB/m)
200.0	9.0
250.0	10.1
300.0	11.8
400.0	15.3
500.0	15.6
600.0	18.7
700.0	19.1
800.0	20.2
900.0	21.1
1000.0	23.2

#### NOTES:

1. Antenna serial number is 1038.
2. The above lists are located in file number 38M30.ANT for a 3 meter range, and file number 38M100.ANT for a 10 meter range.
3. The files mentioned above are located on the disk marked "Radiated Emission Test EMI Receiver".



## 14.5 Correction factors for LOG PERIODIC ANTENNA

Type SAS-200/511  
at 3 meter range.

FREQUENCY (GHz)	ANTENNA FACTOR (dB)
1.0	24.9
1.5	27.8
2.0	29.9
2.5	31.2
3.0	32.8
3.5	33.6
4.0	34.3
4.5	35.2
5.0	36.2
5.5	36.7
6.0	37.2
6.5	38.1

FREQUENCY (GHz)	ANTENNA FACTOR (dB)
7.0	38.6
7.5	39.2
8.0	39.9
8.5	40.4
9.0	40.8
9.5	41.1
10.0	41.7
10.5	42.4
11.0	42.5
11.5	43.1
12.0	43.4
12.5	44.4
13.0	44.6

### NOTES:

1. Antenna serial number is 253.
2. The above lists are located in file number SAS3M0.ANT for a 3 meter range.
3. The files mentioned above are located on the disk marked "Antenna Factors".



## 14.6 Correction factors for BICONICAL ANTENNA

### Type BCD-235/B, at 3 meter range

FREQUENCY (MHz)	AFE (dB/m)
20.0	19.4
30.0	14.8
40.0	11.9
50.0	10.2
60.0	9.1
70.0	8.5
80.0	8.9
90.0	9.6
100.0	10.3
110.0	11.0
120.0	11.5
130.0	11.7
140.0	12.1
150.0	12.6
160.0	12.8
170.0	13.0
180.0	13.5
190.0	14.0
200.0	14.8
210.0	15.3
220.0	15.8
230.0	16.2
240.0	16.6
250.0	17.6
260.0	18.2
270.0	18.4
280.0	18.7
290.0	19.2
300.0	19.9
310	20.7
320	21.9
330	23.4
340	25.1
350	27.0

#### NOTES:

1. Antenna serial number is 1041.
2. The above list is located in file 19BC10M1.ANT on the disk marked "Radiated Emissions Tests EMI Receiver".



## 14.7 Correction factors for BICONICAL ANTENNA

### Type BCD-235/B, 10 meter range

FREQUENCY (MHz)	AFE (dB/m)
30.0	12.1
40.0	10.6
50.0	10.6
60.0	8.9
70.0	8.5
80.0	9.6
90.0	9.4
100.0	9.6
110.0	10.3
120.0	10.7
130.0	12.6
140.0	12.7
150.0	12.7
160.0	13.8
170.0	13.7
180.0	14.9
190.0	13.4
200.0	13.1
210.0	14.0
220.0	14.5
230.0	15.8
240.0	16.0
250.0	16.6
260.0	16.7
270.0	18.3
280.0	18.5
290.0	19.3
300.0	20.9

#### NOTES:

1. Antenna serial number is 1041.
2. The above list is located in file 41BC10M1.ANT on the disk marked "Radiated Emissions Tests EMI Receiver".



**14.8 Correction factors for      Double-Ridged Waveguide Horn**

**Model: 3115, S/N 29845  
at 3 meter range.**

FREQUENCY (GHz)	ANTENNA FACTOR (dB 1/m)	ANTENN A Gain (dBi)	FREQUENCY (GHz)	ANTENNA FACTOR (dB 1/m)	ANTENNA Gain (dBi)
1.0	24.8	5.4	10.0	38.8	11.4
1.5	26.1	7.6	10.5	38.9	11.8
2.0	28.6	7.7	11.0	39.0	12.1
2.5	29.8	8.4	11.5	39.6	11.8
3.0	31.4	8.4	12.0	39.8	12.0
3.5	32.4	8.7	12.5	39.6	12.5
4.0	33.7	8.6	13.0	40.0	12.5
4.5	33.4	9.9	13.5	39.8	13.0
5.0	34.5	9.7	14.0	40.2	13.0
5.5	35.1	9.9	14.5	40.6	12.9
6.0	35.4	10.4	15.0	41.3	12.4
6.5	35.6	10.8	15.5	39.5	14.6
7.0	36.2	10.9	16.0	38.8	15.5
7.5	37.3	10.4	16.5	40.0	14.6
8.0	37.7	10.6	17.0	41.4	13.4
8.5	38.3	10.5	17.5	44.8	10.3
9.0	38.5	10.8	18.0	47.2	8.1
9.5	38.7	11.1			



**14.9 Correction factors for**

**Horn Antenna**

**Model: SWH-28  
at 1 meter range.**

<b>FREQUENCY</b> (GHz)	<b>AFE</b> (dB /m)	<b>Gain</b> (dB1)
18.0	40.3	16.1
19.0	40.3	16.3
20.0	40.3	16.1
21.0	40.3	16.3
22.0	40.4	16.8
23.0	40.5	16.4
24.0	40.5	16.6
25.0	40.5	16.7
26.0	40.6	16.4



**14.10 Correction factors for**

**Horn Antenna**

**Model: V637**

<b>FREQUENCY</b> (GHz)	<b>AFE</b> (dB /m)	<b>Gain</b> (dB1)
26.0	43.6	14.9
27.0	43.7	15.1
28.0	43.8	15.3
29.0	43.9	15.5
30.0	43.9	15.8
31.0	44.0	16.0
32.0	44.1	16.2
33.0	44.1	16.4
34.0	44.1	16.7
35.0	44.2	16.9
36.0	44.2	17.1
37.0	44.2	17.4
38.0	44.2	17.6
39.0	44.2	17.8
40.0	44.2	18.0



#### 14.11 Correction factors for ACTIVE LOOP ANTENNA

**Model 6502**  
**S/N 9506-2950**

FREQUENCY (MHz)	Magnetic Antenna Factor (dB)	Electric Antenna Factor (dB)
.009	-35.1	16.4
.010	-35.7	15.8
.020	-38.5	13.0
.050	-39.6	11.9
.075	-39.8	11.8
.100	-40.0	11.6
.150	-40.0	11.5
.250	-40.0	11.6
.500	-40.0	11.5
.750	-40.1	11.5
1.000	-39.9	11.7
2.000	-39.5	12.0
3.000	-39.4	12.1
4.000	-39.7	11.9
5.000	-39.7	11.8
10.000	40.2	11.3
15.000	-40.7	10.8
20.000	-40.5	11.0
25.000	-41.3	10.2
30.000	42.3	9.2