

**DATE: 09 February 2009**

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**I.T.L. (PRODUCT TESTING) LTD.**

# **FCC Radio Test Report**

**for**

**BioControl Medical (B.C.M.) Ltd.**

**Equipment under test:**

**1. Programming Wand + 2. Communication Interface**

**Programming Wand Model 4320  
Communication Interface Model 4320**

Written by:



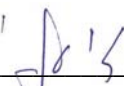
D. Shidlow, Documentation

Approved by:



A. Sharabi, Test Engineer

Approved by:



I. Raz, EMC Laboratory Manager

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This report relates only to items tested.

## Measurement/Technical Report for BioControl Medical (B.C.M.) Ltd.

### 1. Programming Wand + 2. Communication Interface

**FCC ID: W250010**

This report concerns:                      Original Grant:                      X  
Class I Change:  
Class II Change:

Equipment type:

Limits used:  
47CFR15 Section 15.201; 209

Measurement procedure used is ANSI C63.4-2003.

Application for Certification  
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# TABLE OF CONTENTS

<b>1.</b>	<b>GENERAL INFORMATION-----</b>	<b>4</b>
1.1	Administrative Information .....	4
1.2	List of Accreditations .....	5
1.3	Product Description .....	6
1.4	Test Methodology .....	6
1.5	Test Facility .....	6
1.6	Measurement Uncertainty .....	6
<b>2.</b>	<b>SYSTEM TEST CONFIGURATION-----</b>	<b>7</b>
2.1	Justification .....	7
2.2	EUT Exercise Software .....	7
2.3	Special Accessories .....	7
2.4	Equipment Modifications .....	7
2.5	Configuration of Tested System .....	8
<b>3.</b>	<b>CONDUCTED EMISSION DATA-----</b>	<b>9</b>
3.1	Test Specification .....	9
3.2	Test Procedure .....	9
3.3	Measured Data .....	9
3.4	Test Instrumentation Used, Conducted Measurement .....	14
<b>4.</b>	<b>FIELD STRENGTH OF FUNDAMENTAL-----</b>	<b>15</b>
4.1	Test Specification .....	15
4.2	Test Procedure .....	15
4.3	Measured Data .....	15
4.4	Test Instrumentation Used, Field Strength of Fundamental .....	18
<b>5.</b>	<b>SPURIOUS RADIATED EMISSION, 9 KHZ – 30 MHZ-----</b>	<b>19</b>
5.1	Test Specification .....	19
5.2	Test Procedure .....	19
5.3	Measured Data .....	19
5.4	Test Instrumentation Used, Radiated Measurements .....	21
5.5	Field Strength Calculation .....	21
<b>6.</b>	<b>SPURIOUS RADIATED EMISSION 30 – 1000 MHZ-----</b>	<b>22</b>
6.1	Test Specification .....	22
6.2	Test Procedure .....	22
6.3	Test Data .....	23
6.4	Test Instrumentation Used, Radiated Measurements .....	28
6.5	Field Strength Calculation .....	29
<b>7.</b>	<b>SPURIOUS RADIATED EMISSION ABOVE 1 GHZ-----</b>	<b>30</b>
7.1	Radiated Emission Above 1 GHz .....	30
7.2	Test Data .....	31
7.3	Test Instrumentation Used, Radiated Measurements Above 1 GHz .....	36
<b>8.</b>	<b>APPENDIX A - CORRECTION FACTORS-----</b>	<b>37</b>
8.1	Correction factors for CABLE .....	37
8.2	Correction factors for CABLE .....	38
8.3	Correction factors for CABLE .....	39
12.6	Correction factors for LOG PERIODIC ANTENNA .....	40
8.4	Correction factors for LOG PERIODIC ANTENNA .....	41
8.5	Correction factors for BICONICAL ANTENNA .....	42
8.6	Correction factors for Double-Ridged Waveguide Horn .....	43
8.7	Correction factors for ACTIVE LOOP ANTENNA .....	44

# 1. General Information

## 1.1 Administrative Information

Manufacturer:	BioControl Medical (B.C.M.) Ltd.
Manufacturer's Address:	3 Geron St. P.O.B. 2713 Yahud 56100 Israel Tel: +972-3-632-2126 Fax: +972-3-632-2125
Manufacturer's Representative:	Nir Schain Mark Fichman
Equipment Under Test (E.U.T):	1. Programming Wand + 2. Communication Interface
Equipment Model No.:	1. 4320    2. 4320
Equipment Serial No.:	1. 333    2. 153
Date of Receipt of E.U.T:	25.11.08
Start of Test:	25.11.08
End of Test:	26.11.08
Test Laboratory Location:	I.T.L (Product Testing) Ltd. Kfar Bin Nun, ISRAEL 99780
Test Specifications:	See Section 2

## **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.
6. TUV Product Services, England, ASLLAS No. 97201.
7. Nemko (Norway), Authorization No. ELA 207.

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**

The BioControl Medical communication set, referred to as the EUT in this report, is made up of a communication interface and a programming wand.

The communication set is used in conjunction with the Cardiofit Implantable Stimulator(CIS) to non-invasively set and adjust the stimulation parameters(through wireless communication) of the CIS. The communication set is a part of the 5300 programmer, which is comprised of a communication set connected to a portable laptop computer through the parallel port of the laptop. The laptop is an IBM ThinkPad model T40, OS Windows XP. The model 5300 programmer is running dedicated CardioFit programming software – Unified Physician Programmer.

### **1.4 Test Methodology**

Both conducted and radiated testing were performed according to the procedures in 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 August 22, 2006). I.T.L.'s EMC Laboratory is also accredited by A2LA, certificate No. 1152.01.

### **1.6 Measurement Uncertainty**

Conducted Emission

The uncertainty for this test is  $\pm 2$  dB.

Radiated Emission

The Open Site complies with the  $\pm 4$  dB Normalized Site Attenuation requirements of ANSI C63.4-2003. In accordance with Paragraph 5.4.6.1 of this standard, this tolerance includes instrumentation calibration errors, measurement technique errors, and errors due to site anomalies.

## **2. System Test Configuration**

### **2.1 Justification**

The system was configured for testing in a typical fashion (as a customer would normally use it).

The communication set was connected to 5300 programmer laptop LPT(parallel port). In a normal configuration, the ASK (Amplitude Shift Keying) modulation signal is connected to the communication set, that makes the wand transmit energy to the CardioFit device. For testing purpose, the ASK modulation signal was sourced from an arbitrary waveform generator instead of the laptop to make the communication set transmit a similar signal. No exercise software was needed in this case, since the transmitter was triggered from the arbitrary waveform generator. The transmitted signal from the wand was used for final testing.

### **2.2 EUT Exercise Software**

No exercise software was needed, since the transmitter was triggered from the arbitrary waveform generator.

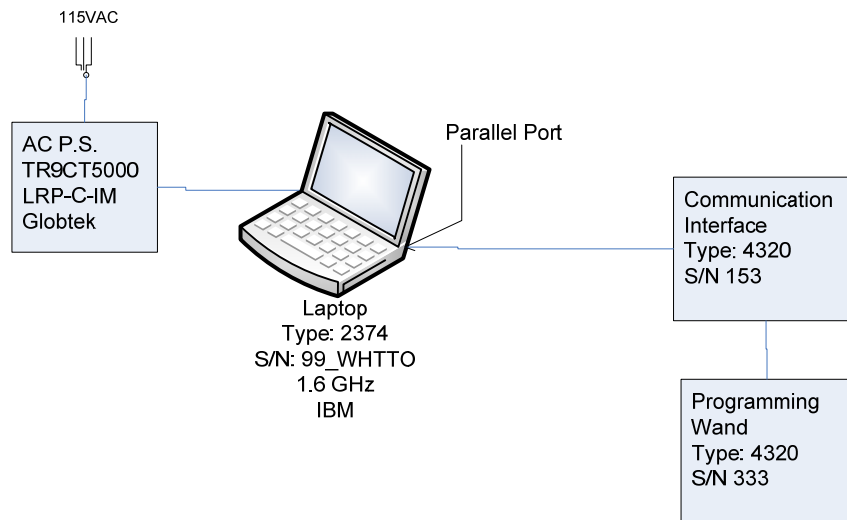
### **2.3 Special Accessories**

No special accessories were needed to achieve compliance.

### **2.4 Equipment Modifications**

No modifications were necessary in order o achieve compliance.

## 2.5 Configuration of Tested System



**Figure 1. Configuration of Tested System**



### 3. Conducted Emission Data

#### 3.1 Test Specification

F.C.C., Part 15, Subpart C

#### 3.2 Test Procedure

The E.U.T operation mode and test set-up are as described in Section 3.1. In order to minimize background noise interference, the conducted emission testing was performed inside a shielded room, with the E.U.T placed on an 0.8 meter high wooden table, 0.4 meter from the room's vertical wall.

The E.U.T was powered from 115 V AC / 60 Hz via a 50 Ohm / 50  $\mu$ Hn Line Impedance Stabilization Network (LISN) on the phase and neutral lines. The LISN's were grounded to the shielded room ground plane (floor), and were kept at least 0.8 meters from the nearest boundary of the E.U.T

The center of the E.U.T AC cable was folded back and forth, in order to form a bundle less than 0.40 meters and a total cable length of 1 meter.

The emission voltages at the LISN's outputs were measured using a computerized receiver, complying with CISPR 16 requirements. The specification limits are loaded to the receiver via a 3.5" floppy disk and are displayed on the receiver's spectrum display.

A frequency scan between 0.15 and 30 MHz was performed at 9 kHz I.F. band width, and using peak detection.

The spectral components having the highest level on each line were measured using a quasi-peak and average detector.

#### 3.3 Measured Data

JUDGEMENT: Passed by 14.2 dB

The margin between the emission levels and the specification limit was, in the worst case, 14.2 dB for the phase line at 0.21 MHz and 18.5 dB for the neutral line at 1.18 MHz.

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

The details of the highest emissions are given in *Figure 2* to *Figure 5*.

TEST PERSONNEL:

Tester Signature:  Date: 09.02.09

Typed/Printed Name: A. Sharabi

## Conducted Emission

E.U.T Description 1. Programming Wand + 2.  
Communication Interface  
Type 1. 4320 2. 4320  
Serial Number: 1. 333 2. 153

Specification: F.C.C., Part 15, Subpart C  
Lead: Phase  
Detectors: Peak, Quasi-peak, Average

Signal Number	Frequency (MHz)	Peak (dBuV)	QP (dBuV)	QP Delta L 1 (dB)	Avg (dBuV)	Av Delta L 2 (dB)	Corr (dB)
1	0.150000	50.0	47.9	-18.1	23.7	-32.3	0.0
2	0.213125	41.4	40.0	-23.1	38.9	-14.2	0.0
3	0.752153	34.1	32.9	-23.1	29.5	-16.5	0.0
4	1.178953	35.9	32.3	-23.6	28.5	-17.5	0.0
5	2.570675	36.0	32.8	-23.2	27.2	-18.8	0.0
6	10.047500	41.1	35.9	-24.1	29.6	-20.4	0.0

**Figure 2. Detectors: Peak, Quasi-peak, AVERAGE .**

*Note: QP Delta/Av Delta refer 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.*

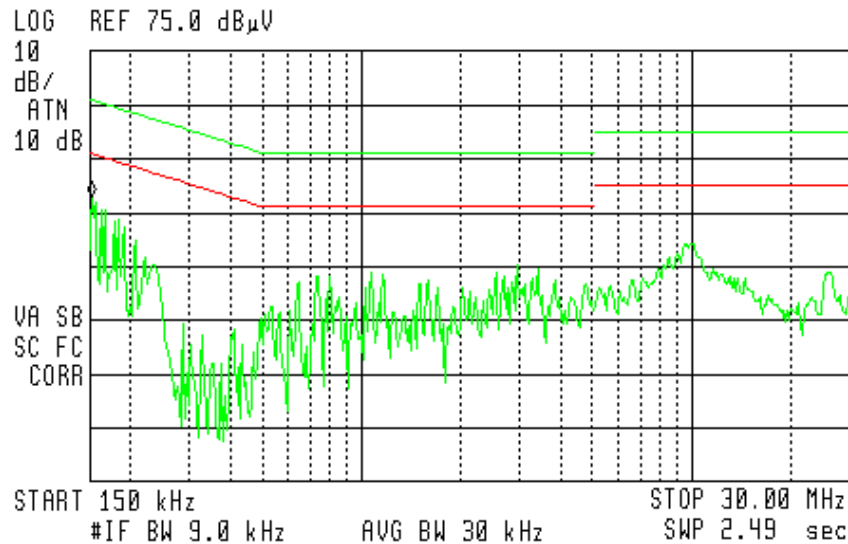
## Conducted Emission

E.U.T Description 1. Programming Wand + 2.  
Communication Interface  
Type 1. 4320 2. 4320  
Serial Number: 1. 333 2. 153

Specification: F.C.C., Part 15, Subpart C  
Lead: Phase  
Detectors: Peak, Quasi-peak, Average



ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 150 kHz  
47.87 dB $\mu$ V



**Figure 3. Detectors: Peak, Quasi-peak, Average**

## Conducted Emission

E.U.T Description 1. Programming Wand + 2.  
Communication Interface  
Type 1. 4320 2. 4320  
Serial Number: 1. 333 2. 153

Specification: F.C.C., Part 15, Subpart C  
Lead: Neutral  
Detectors: Peak, Quasi-peak, Average

Signal Number	Frequency (MHz)	Peak (dBuV)	QP (dBuV)	QP Delta L 1 (dB)	Avg (dBuV)	Av Delta L 2 (dB)	Corr (dB)
1	0.207787	39.4	35.6	-27.8	34.0	-19.4	0.0
2	0.751375	36.7	33.7	-22.3	20.4	-25.6	0.0
3	1.181642	35.5	33.2	-22.8	27.5	-18.5	0.0
4	2.566020	33.3	33.4	-22.6	27.1	-18.9	0.0
5	2.891485	31.3	28.5	-27.5	25.0	-21.0	0.0
6	3.004925	36.8	25.9	-30.1	21.4	-24.6	0.0
7	9.937855	40.1	34.7	-25.3	28.6	-21.4	0.0

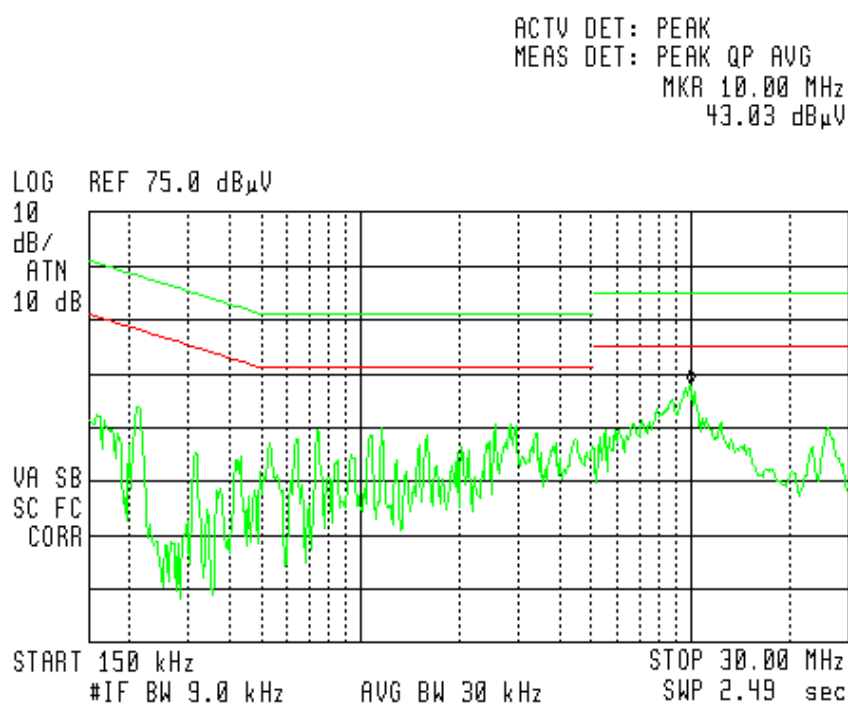
**Figure 4. Detectors: Peak, Quasi-peak, AVERAGE**

*Note: QP Delta/Av Delta refer 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.*

## Conducted Emission

E.U.T Description 1. Programming Wand + 2.  
Communication Interface  
Type 1. 4320 2. 4320  
Serial Number: 1. 333 2. 153

Specification: F.C.C., Part 15, Subpart C  
Lead: Neutral  
Detectors: Peak, Quasi-peak, Average



**Figure 5 Conducted Emission: NEUTRAL**  
**Detectors: Peak, Quasi-peak, Average**

### 3.4 Test Instrumentation Used, Conducted Measurement

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
LISN	Fischer	FCC-LISN-2A	127	March 8, 2008	1 Year
LISN	Fischer	FCC-LISN-2A	128	March 8, 2008	1 Year
EMI Receiver	HP	85422E	3906A00276	November 17, 2008	1 Year
RF Filter Section	HP	85420E	3705A00248	November 16, 2008	1 Year
Printer	HP	LaserJet 2200	JPKG19982	N/A	N/A

## 4. Field Strength of Fundamental

### 4.1 Test Specification

F.C.C., Part 15, Subpart C, Section 15.209

### 4.2 Test Procedure

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

The E.U.T. was placed on a non-conductive table, 0.8 meters above the O.A.T.S. ground plane.

The EMI receiver was set to the E.U.T. Fundamental Frequency.

The distance between the E.U.T. and test antenna was 3 meters.

The turntable and antenna were adjusted for maximum level reading on the EMI receiver. The loop antenna was rotated on its vertical axis. The antenna height (center of loop) was 1 meter.

### 4.3 Measured Data

JUDGEMENT: Passed by 22.03 dB

The EUT met the FCC Part 15, Subpart C, Section 15.209 specification requirements.

The details of the highest emissions are given in Figure 7.

TEST PERSONNEL:

Tester Signature: 

Date: 09.02.09

Typed/Printed Name: A. Sharabi

## Field Strength of Fundamental

E.U.T Description 1. Programming Wand + 2.  
Communication Interface  
Type 1. 4320 2. 4320  
Serial Number: 1. 333 2. 153

Specification: F.C.C., Part 15, Subpart C, 15.209

Test Distance: 3 meters

Detector: Peak

Freq.	Peak Reading	Average Factor	AVG Result	AVG Specification	Margin
(kHz)	(dB $\mu$ V/m)	(dB)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB)
27	96.94	0	96.94	118.97	-22.03

**Figure 6. Field Strength of Fundamental. Antenna Polarization: HORIZONTAL/VERTICAL.  
Detector: Peak**

### Notes:

1. 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.
2. "Peak Reading" (dB $\mu$ V/m) included the "Correction Factors".
3. "Correction Factors" (dB) = Test Antenna Correction Factor(dB) + Cable Loss.
4. "Average Factor =  $20 \log(1) = 0$  dB (according to 15.209(d))
5. "Average Result" (dB $\mu$ V/m)=Peak Reading dB $\mu$ V/m)+Average factor (dB)

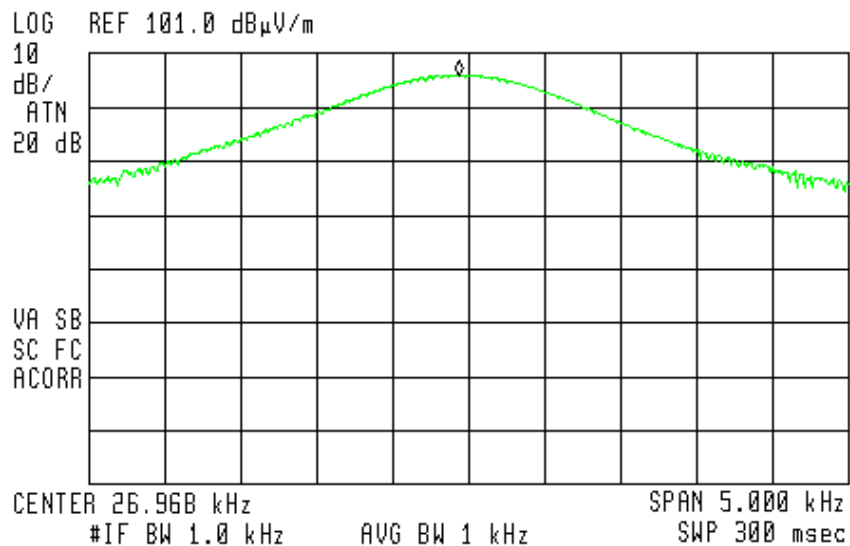


## Field Strength of Fundamental

E.U.T Description 1. Programming Wand + 2.  
Communication Interface  
Model Number 1. 4320 2. 4320  
Serial Number: 1. 333 2. 153

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ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 26.906 kHz  
96.94 dB $\mu$ V/m



**Figure 7. Field Strength of Fundamental  
Detector: Peak**

$$L_{im300m} = 20 \log 2400/27 = 38.97 \text{ dB}\mu\text{V/m}$$

$$L_{im3m} = L_{im300m} + 40 \log 300/3 = 38.97 + 80 = 118.97 \text{ dB}\mu\text{V/m}$$

#### 4.4 Test Instrumentation Used, Field Strength of Fundamental

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3906A00276	November 17, 2008	1 year
EMI Receiver Filter Section	HP	85420E	3705A00248	November 16, 2008	1 year
Active Loop Antenna	EMCO	6502	9506-2950	October 15, 2008	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

## 5. Spurious Radiated Emission, 9 kHz – 30 MHz

### 5.1 Test Specification

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

### 5.2 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 to 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.

The E.U.T. was operated at the frequency of 27 kHz. This frequency was measured using a peak detector.

### 5.3 Measured Data

JUDGEMENT: Passed by 42.2 dB

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

The margin between the emission level and the specification limit is 42.2 dB in the worst case at the frequency of 80.70 MHz.

See details in *Figure 8*.

TEST PERSONNEL:

Tester Signature: 

Date: 09.02.09

Typed/Printed Name: A. Sharabi

## Radiated Emission, 9 kHz-30 MHz

E.U.T Description 1. Programming Wand + 2.  
Communication Interface  
Type 1. 4320 2. 4320  
Serial Number: 1. 333 2. 153

Specification: FCC Part 15, Subpart C, Section 209

Frequency range: 9 kHz to 30 MHz

Antenna: 3 meters distance

Detectors: Peak, Average

Frequency (kHz)	Peak Reading (dBμV/m)	Average Factor (dBμV/m)	Average Result (dBμV/m)	Average Specification (dBμV/m)	Margin (dB)
53.00	65.6	0	65.6	113.1	-47.5
80.70	67.3	0	67.3	109.5	-42.2
107.75	59.8	0	59.8	107.0	-47.2

**Figure 8. Radiated Emission. Detectors: Peak, Quasi-peak**

### Notes:

1. 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.
2. "Peak Reading" (dBμV/m) included the "Correction Factors".
3. "Correction Factors" (dB) = Test Antenna Correction Factor(dB) + Cable Loss.
4. "Average Factor =  $20 \log(1) = 0$  dB (according to 15.209(d))
5. "Average Result" (dBμV/m)=Peak Reading dBμV/m)+Average factor (dB)

#### 5.4 Test Instrumentation Used, Radiated Measurements

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3906A00276	November 17, 2008	1 year
RF Section	HP	85420E	3705A00248	November 16, 2008	1 year
Active Loop Antenna	EMCO	6502	9506-2950	October 15, 2008	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

#### 5.5 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]

No external pre-amplifiers are used.

## **6. Spurious Radiated Emission 30 – 1000 MHz**

### **6.1 Test Specification**

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

### **6.2 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 configuration tested is shown in Figure 1.

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 to 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 at the operating frequency of 27 kHz.

### 6.3 Test Data


JUDGEMENT: Passed by 2.5 dB

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

The margin between the emission level and the specification limit was 2.5 dB in the worst case at the frequency of 456.76 MHz, vertical polarization.

The details of the highest emissions are given in *Figure 9* to *Figure 12*.

TEST PERSONNEL:

Tester Signature:  Date: 09.02.09

Typed/Printed Name: A. Sharabi

## Radiated Emission

E.U.T Description 1. Programming Wand + 2.  
Communication Interface  
Type 1. 4320 2. 4320  
Serial Number: 1. 333 2. 153

Specification: FCC Part 15, Subpart C

Antenna Polarization: Horizontal

Frequency range: 30 MHz to 1000 MHz

Antenna: 3 meters distance

Detectors: Peak, Quasi-peak

Signal Number	Frequency (MHz)	Peak dBuV/m	QP dBuV/m	QP Delta L 1 (dB)	Av Delta L 2 (dB)	Corr (dB)
1	134.562450	30.5	24.7	-18.8		14.1
2	211.077800	35.2	29.8	-13.7		18.3
3	240.100650	35.5	29.8	-16.2		19.8
4	261.017350	41.3	37.7	-8.3		21.6
5	364.489675	38.5	33.6	-12.4		18.4
6	456.752900	44.8	42.2	-3.8		20.5
7	495.259850	42.3	38.0	-8.0		20.9
8	729.047225	42.1	37.5	-8.5		25.6

**Figure 9. Radiated Emission. Antenna Polarization: HORIZONTAL.  
Detectors: Peak, Quasi-peak**

*Note: QP Delta 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.*



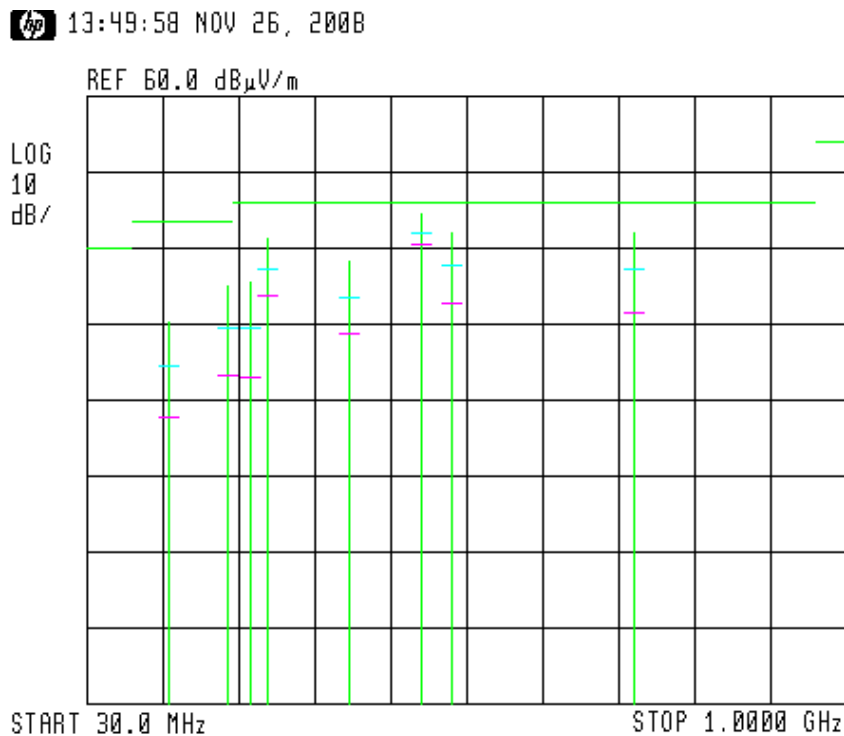
## Radiated Emission

E.U.T Description	1. Programming Wand + 2. Communication Interface
Type	1. 4320 2. 4320
Serial Number:	1. 333 2. 153

Specification: FCC Part 15, Subpart C

Antenna Polarization: Horizontal  
Antenna: 3 meters distance

Frequency range: 30 MHz to 1000 MHz  
Detectors: Peak, Quasi-peak



**Figure 10. Radiated Emission. Antenna Polarization: HORIZONTAL  
Detectors: Peak, Quasi-peak**

*Note:*

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in dB  $\mu$ V/m).
3. Peak detection is designated by the top of each vertical line.
4. Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.

## Radiated Emission

E.U.T Description 1. Programming Wand + 2.  
Communication Interface  
Type 1. 4320 2. 4320  
Serial Number: 1. 333 2. 153

Specification: FCC Part 15, Subpart C

Antenna Polarization: Vertical  
Antenna: 3 meters distance

Frequency range: 30 MHz to 1000 MHz  
Detectors: Peak, Quasi-peak

Signal Number	Frequency (MHz)	Peak dBuV/m	QP dBuV/m	QP Delta L 1 (dB)	Av Delta L 2 (dB)	Corr (dB)
1	211.032875	32.9	28.5	-15.0		18.3
2	261.001100	36.6	34.6	-11.4		21.6
3	364.511225	38.7	36.5	-9.5		18.4
4	456.759350	44.9	43.5	-2.5		20.5
5	497.147350	38.2	35.0	-11.0		21.0
6	728.993775	44.8	41.2	-4.8		25.6

**Figure 11. Radiated Emission. Antenna Polarization: VERTICAL.  
Detectors: Peak, Quasi-peak**

*Note: QP Delta 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.*

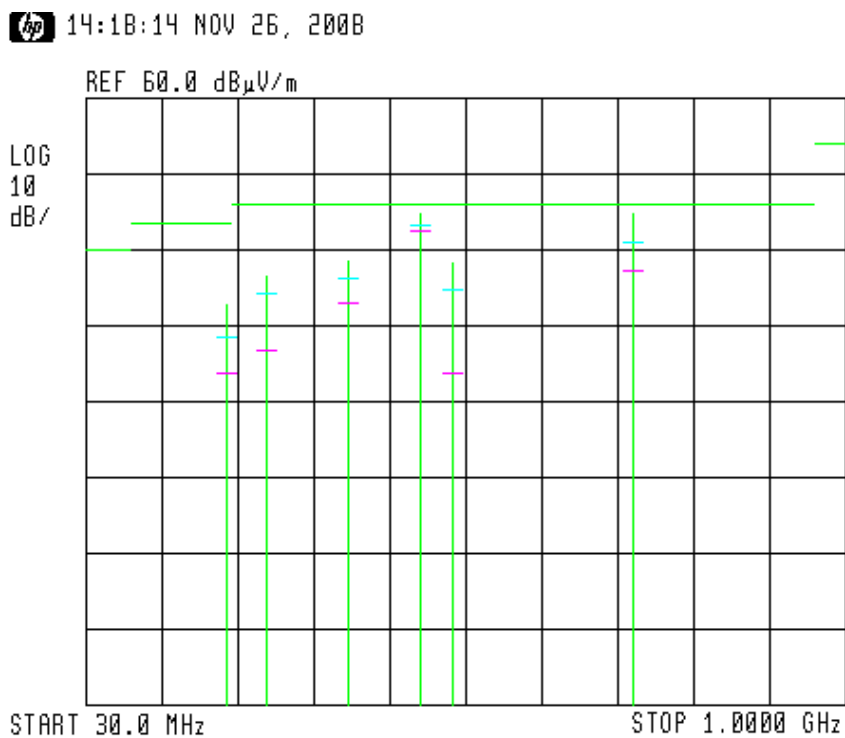
## Radiated Emission

E.U.T Description	1. Programming Wand + 2. Communication Interface
Type	1. 4320 2. 4320
Serial Number:	1. 333 2. 153

Specification: FCC Part 15, Subpart C

Antenna Polarization: Vertical  
Antenna: 3 meters distance

Frequency range: 30 MHz to 1000 MHz  
Detectors: Peak, Quasi-peak



**Figure 12. Radiated Emission. Antenna Polarization: VERTICAL.  
Detectors: Peak, Quasi-peak**

*Note:*

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in dB  $\mu$ V/m).
3. Peak detection is designated by the top of each vertical line.
4. Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.

#### 6.4 Test Instrumentation Used, Radiated Measurements

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3906A00276	November 17, 2008	1 year
RF Section	HP	85420E	3705A00248	November 16, 2008	1 year
Antenna Bioconical	ARA	BCD 235/B	1041	March 23, 2008	1 year
Antenna Log Periodic	ARA	LPD-2010/A	1038	November 06, 2008	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

## 6.5 **Field Strength Calculation**

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

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

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]

No external pre-amplifiers are used.

## 7. Spurious Radiated Emission Above 1 GHz

### 7.1 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 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 2.9-10.0 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 at the operating frequencies of 27 kHz.

## 7.2 Test Data

JUDGEMENT: Passed by 17.2 dB

The margin between the emission level and the specification limit is 17.2 in the worst case at the frequency of 1938.08 MHz, horizontal and vertical polarizations.

The signals in the band 2.9 – 10 GHz were below the spectrum analyzer noise level, at least 20 dB below the specification limit.

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 13* to *Figure 16*.

TEST PERSONNEL:

Tester Signature:  Date: 09.02.09

Typed/Printed Name: E. Pitt

## Radiated Emission Above 1 GHz

E.U.T Description 1. Programming Wand + 2.  
Communication Interface  
Type 1. 4320 2. 4320  
Serial Number: 1. 333 2. 153

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal

Frequency range: 1.0 GHz to 2.9 GHz

Test Distance: 3 meters

Detector: Peak

Operation Frequency: 27 kHz

Signal Number	Frequency (MHz)	Peak dBuV/m	Avg dBuV/m	Av Delta L 1 (dB)	Av Delta L 2 (dB)	Corr (dB)
1	1142.413350	46.5	28.5	-25.5		33.4
2	1158.735850	41.5	29.3	-24.7		33.5
3	1434.238713	45.7	32.4	-21.6		36.3
4	1503.059888	45.5	32.8	-21.2		36.9
5	1938.075000	49.3	36.8	-17.2		40.2

**Figure 13. Radiated Emission. Antenna Polarization: HORIZONTAL  
Detector: Peak**

### Notes:

1. Av Delta 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.
2. Peak Reading was compared to peak limit.



## Radiated Emission Above 1 GHz

E.U.T Description	1. Programming Wand + 2. Communication Interface	
Type	1. 4320	2. 4320
Serial Number:	1. 333	2. 153

Specification: FCC, Part 15, Subpart C

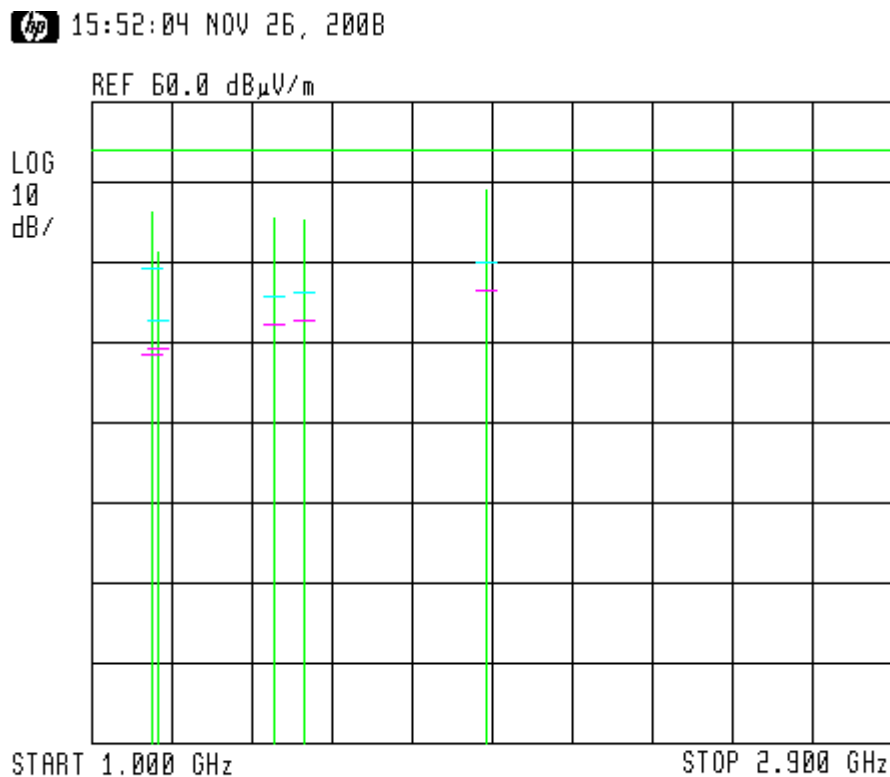
Antenna Polarization: Horizontal

Frequency range: 1.0 GHz to 2.9 GHz

Test Distance: 3 meters

Detector: Peak, Average

Operation Frequency: 27 KHz



**Figure 14. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.  
Detector: Average**

*Note:*

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in dB  $\mu$ V/m).
3. Peak detection is designated by the top of each vertical line.
4. Average detection is designated by the first dash mark (from the top) of each vertical line.

## Radiated Emission Above 1 GHz

E.U.T Description 1. Programming Wand + 2.  
Communication Interface  
Type 1. 4320 2. 4320  
Serial Number: 1. 333 2. 153

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Vertical

Frequency range: 1.0 GHz to 2.9 GHz

Test Distance: 3 meters

Detector: Peak, Average

Operation Frequency: 27 KHz

Signal Number	Frequency (MHz)	Peak dBuV/m	Avg dBuV/m	Av Delta L 1 (dB)	Av Delta L 2 (dB)	Corr (dB)
1	1160.445850	49.8	28.0	-26.0		33.6
2	1173.663350	42.2	29.4	-24.6		33.7
3	1435.526213	41.3	30.0	-24.0		32.4
4	1500.144888	45.2	32.9	-21.1		36.9
5	1938.075000	49.5	36.8	-17.2		40.2

**Figure 15. Radiated Emission. Antenna Polarization: VERTICAL.  
Detector: Peak, Average**

### Notes:

1. Av Delta 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.
2. Peak Reading was compared to peak limit.

## Radiated Emission Above 1 GHz

E.U.T Description	1. Programming Wand + 2. Communication Interface	
Type	1. 4320	2. 4320
Serial Number:	1. 333	2. 153

Specification: FCC, Part 15, Subpart C

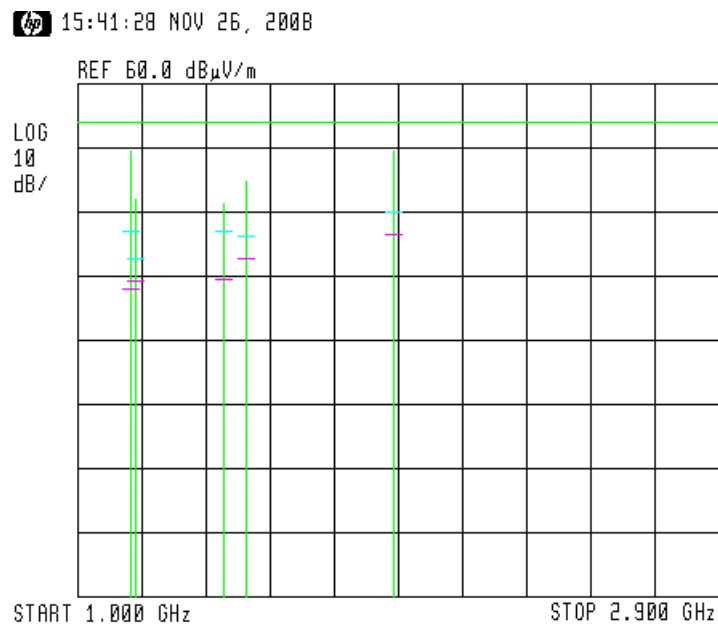
Antenna Polarization: Vertical

Frequency range: 1.0 GHz to 2.9 GHz

Test Distance: 3 meters

Detector: Peak,

Operation Frequency: 27 kHz



**Figure 16. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.  
Detector: Average**

*Note:*

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in dB  $\mu$ V/m).
3. Peak detection is designated by the top of each vertical line.
4. Average detection is designated by the first dash mark (from the top) of each vertical line.

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

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	November 27, 2008	1 Year
RF Filter Section	HP	85420E	3705A00248	November 27, 2008	1 Year
Antenna Biconical	ARA	BCD 235/B	1041	March 23, 2008	1 Year
Antenna Log Periodic	ARA	LPD-2010/A	1038	November 06, 2008	1 Year
Antenna Log Periodic	A.H. Systems	SAS-200/511	253	February 4, 2007	2 Years
Double Ridged Waveguide Horn Antenna	EMCO	3115	29845	March 16, 2008	2 Years
Low Noise Amplifier	DBS MICROWAVE	LNA-DBS-0411N313	013	November 2, 2007	1 Year
Spectrum Analyzer	HP	8592L	3826A01204	March 5, 2008	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

## 8. APPENDIX A - CORRECTION FACTORS

### 8.1 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".

**8.2 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.*

**8.3 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.

## 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".



#### 8.4 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".

**8.5 Correction factors for BICONICAL ANTENNA  
Type BCD-235/B,  
at 3 meter range**

<b>FREQUENCY</b> (MHz)	<b>APE</b> (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".

## 8.6 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			

## 8.7 Correction factors for ACTIVE LOOP ANTENNA

**Model 6502**

**S/N 9506-2950**

FREQUENCY	Magnetic Antenna Factor	Electric Antenna Factor
(MHz)	(dB)	(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