



DATE: 23 October 2013

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

VizBee SAS

Equipment under test:

RFID Reader

READER101

Written by:

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A. Sharabi, Test Engineer

Approved by:

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I. Raz, EMC Laboratory Manager

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This report relates only to items tested.



Measurement/Technical Report for VizBee SAS

RFID Reader

READER101

FCC ID: 2AA2YREADER101

23 October 2013

Equipment type: Spread Spectrum/Digital Device
2400-2483.5 MH

Limits used: 47CFR15 Section 15.247

Measurement procedure used is KDB 558074 D01 09, April 2013 and ANSI C63.4-2003.

Application for Certification
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TABLE OF CONTENTS

1. GENERAL INFORMATION -----	5
1.1 Administrative Information.....	5
1.2 List of Accreditations	6
1.3 Product Description	7
1.4 Test Methodology	7
1.5 Test Facility	7
1.6 Measurement Uncertainty	7
2. SYSTEM TEST CONFIGURATION-----	8
2.1 Justification.....	8
2.2 EUT Exercise Software	8
2.3 Special Accessories	8
2.4 Equipment Modifications	8
2.5 Configuration of Tested System.....	9
3. RADIATED MEASUREMENT TEST SET-UP PHOTO -----	10
4. 6 DB MINIMUM BANDWIDTH -----	12
4.1 Test procedure	12
4.2 Results table.....	14
4.3 Test Equipment Used.....	15
5. 26 DB MINIMUM BANDWIDTH-----	16
5.1 Test procedure	16
5.2 Results table.....	18
5.3 Test Equipment Used.....	19
6. MAXIMUM TRANSMITTED PEAK POWER OUTPUT -----	20
6.1 Test procedure	20
6.2 Results table.....	22
6.3 Test Equipment Used.....	23
8. BAND EDGE SPECTRUM -----	24
8.1 Test procedure	24
8.2 Results table.....	25
8.3 Test Equipment Used.....	26
9. RADIATED EMISSION, 9 KHZ – 30 MHZ -----	27
9.1 Test Specification	27
9.2 Test Procedure	27
9.3 Measured Data	27
9.4 Test Instrumentation Used, Radiated Measurements.....	28
9.5 Field Strength Calculation	29
10. SPURIOUS RADIATED EMISSION 30 – 25000 MHZ -----	30
10.1 Radiated Emission 30-25000 MHz.....	30
10.2 Test Data.....	31
10.3 Test Instrumentation Used, Radiated Measurements Above 1 GHz	38
11. TRANSMITTED POWER DENSITY -----	39
11.1 Test procedure	39
11.2 Results table.....	41
11.3 Test Equipment Used.....	42
12. AVERAGE FACTOR CALCULATION -----	43
13. ANTENNA GAIN/INFORMATION -----	44
14. R.F EXPOSURE/SAFETY-----	45
15. APPENDIX A - CORRECTION FACTORS -----	46
15.1 Correction factors for CABLE	46
15.2 Correction factors for CABLE	47
15.3 Correction factors for CABLE	48



15.4	Correction factors for LOG PERIODIC ANTENNA	49
15.5	Correction factors for LOG PERIODIC ANTENNA	50
15.6	Correction factors for BICONICAL ANTENNA	51
15.7	Correction factors for Double-Ridged Waveguide Horn.....	52
15.8	Correction factors for Horn Antenna	53
15.9	Correction factors for Horn Antenna	54
15.10	Correction factors for ACTIVE LOOP ANTENNA	55



1. General Information

1.1 Administrative Information

Manufacturer: VizBee SAS

Manufacturer's Address: 34a Rue des Vinaigriers
Paris 75010
France
Tel: +33 9 70 44 61 99
Fax: +33 33177725343

Manufacturer's Representative: Alain Blonder

Equipment Under Test (E.U.T): RFID Reader

Equipment Model No.: READER101

Equipment Serial No.: Not designated

Date of Receipt of E.U.T: 01.10.2013

Start of Test: 02.10.2013

End of Test: 08.10.13

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

Test Specifications: FCC Part 15, Subpart 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.
6. TUV Product Services, England, ASLLAS No. 97201.

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 RFID reader is used for locating persons and assets in proximity to the device, that are equipped with a Fireflies RFID tag.

1.4 Test Methodology

Both conducted and radiated testing were performed according to the procedures in KDB 558074 D01 09 April 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 September 3, 2009). I.T.L.'s EMC Laboratory is also accredited by A2LA, certificate No. 1152.01.

1.6 Measurement Uncertainty

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 screening was performed in 3 orthogonal orientations. The worst case orientation was the vertical position as wall mounted.

2.2 ***EUT Exercise Software***

No special exercise software was used.

2.3 ***Special Accessories***

No special accessories were needed to achieve compliance.

2.4 ***Equipment Modifications***

No modifications were necessary in order to achieve compliance.



2.5 Configuration of Tested System

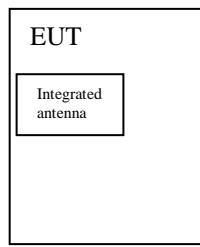


Figure 1. Configuration of Tested System

3. Radiated Measurement Test Set-up Photo

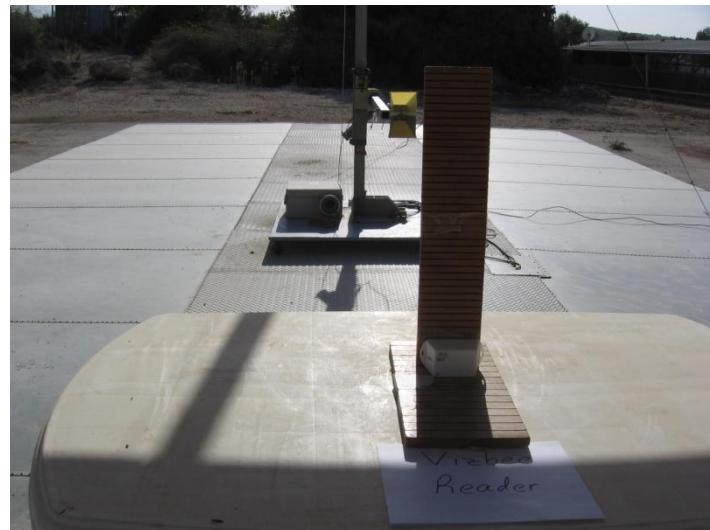


Figure 2. Radiated Emission Test

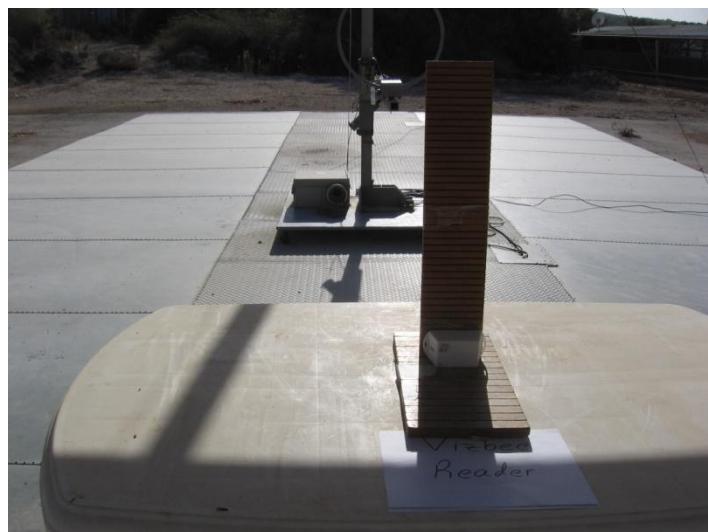


Figure 3. Radiated Emission Test

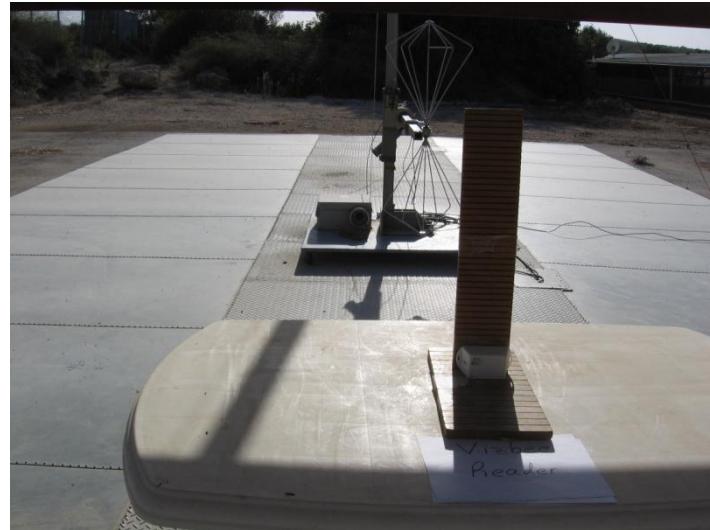


Figure 4. Radiated Emission Test

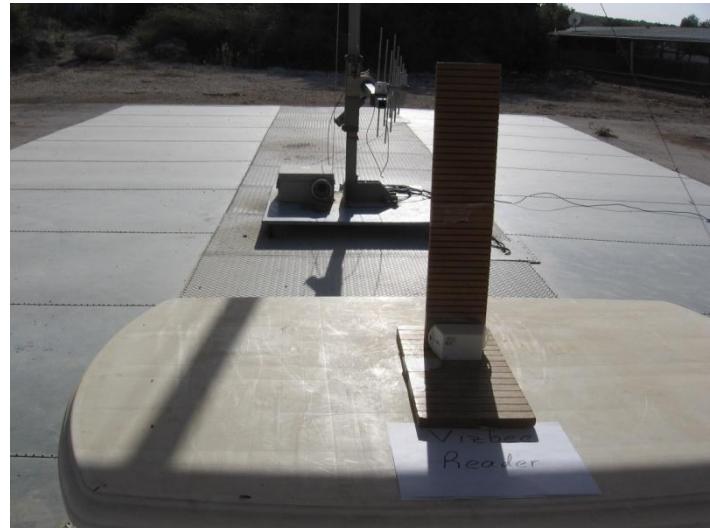


Figure 5. Radiated Emission Test

4. 6 dB Minimum Bandwidth

4.1 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.

The E.U.T was tested at 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 spectrum bandwidth of the E.U.T. at the point of 6 dB below maximum peak power was measured and recorded.

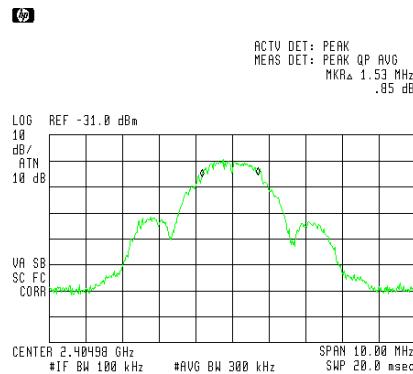


Figure 6 — Low Channel



4

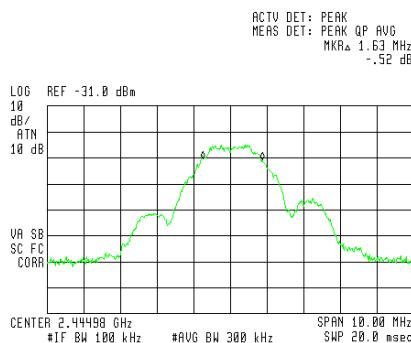


Figure 7 — Mid Channel

5

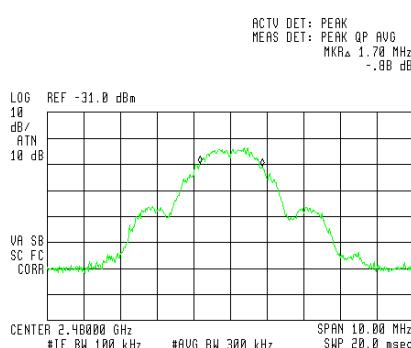


Figure 8 — High Channel



4.2 Results table

E.U.T Description: RFID Reader

Model No.: READER101

Serial Number: Not designated

Specification: F.C.C. Part 15, Subpart C: (15.247-a2)

Operation Frequency (MHz)	Modulation Mbps	Reading (MHz)	Specification (MHz)
2404.00	6	1.53	0.5
2444.00	6	1.63	0.5
2480.00	6	1.70	0.5

Figure 9 6 dB Minimum Bandwidth

JUDGEMENT: Passed

TEST PERSONNEL:

Tester Signature:  Date: 30 10.13

Typed/Printed Name: A. Sharabi



4.3 Test Equipment Used.

6 dB Minimum Bandwidth

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	February 26, 2013	1 Year
RF Filter Section	HP	85420E	3705A00248	February 26, 2013	1 Year
Antenna Biconical	EMCO	3104	2606	August 30, 2013	1 Year
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	1 Year
Horn Antenna	ETS	3115	29845	March 14, 2012	2 Years
Horn Antenna	ARA	SWH-28	1007	January 26, 2011	3 Years
Low Noise Amplifier	Narda	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, 2013	1 Year
Spectrum Analyzer	HP	8564E	3442A00275	February 28, 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	JPKG19982	N/A	N/A

Figure 10 Test Equipment Used

5. 26 dB Minimum Bandwidth

5.1 *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.

The E.U.T was tested at 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 spectrum bandwidth of the E.U.T. at the point of 26 dB below maximum peak power was measured and recorded.

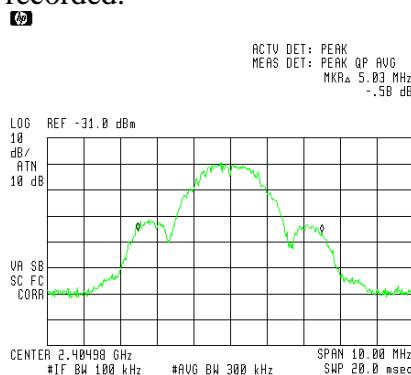


Figure 11 — Low Channel

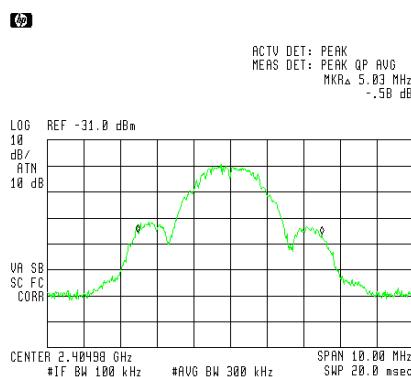


Figure 12 — Mid Channel

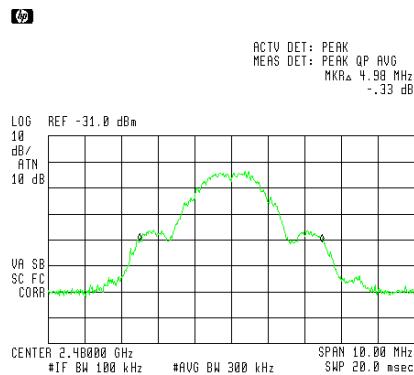


Figure 13 — High Channel



5.2 Results table

E.U.T Description: RFID Reader

Model No.: READER101

Serial Number: Not designated

Specification: F.C.C. Part 15, Subpart C: (15.247-a2)

Operation Frequency (MHz)	Modulation Mbps	Reading (MHz)	Specification (MHz)
2404.00	6	5.03	N/A
2444.00	6	5.03	N/A
2480.00	6	4.98	N/A

Figure 14 26 dB Minimum Bandwidth

JUDGEMENT: Passed

TEST PERSONNEL:

Tester Signature: 

Date: 30.10.13

Typed/Printed Name: A. Sharabi



5.3 Test Equipment Used.

26 dB Minimum Bandwidth

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	February 26, 2013	1 Year
RF Filter Section	HP	85420E	3705A00248	February 26, 2013	1 Year
Antenna Biconical	EMCO	3104	2606	August 30, 2013	1 Year
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	1 Year
Horn Antenna	ETS	3115	29845	March 14, 2012	2 Years
Horn Antenna	ARA	SWH-28	1007	January 26, 2011	3 Years
Low Noise Amplifier	Narda	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, 2013	1 Year
Spectrum Analyzer	HP	8564E	3442A00275	February 28, 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 15 Test Equipment Used



6. Maximum Transmitted Peak Power Output

6.1 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.

The E.U.T was tested at 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 E.U.T. was tested at low, mid and high channels at 20MHz.

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:

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

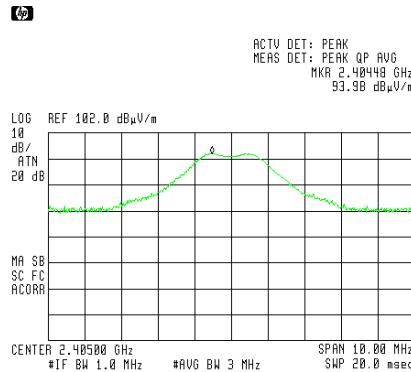


Figure 16 , Low channel , Vertical

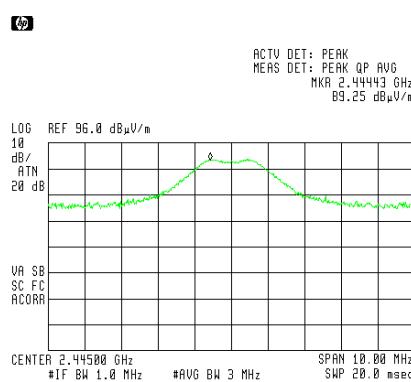


Figure 17, Mid channel , Vertical

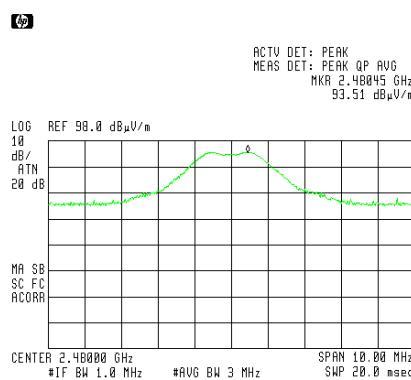


Figure 18 , High Channel, Vertical



6.2 Results table

E.U.T. Description: RFID Reader
Model No.: READER101
Serial Number: Not designated
Specification: F.C.C. Part 15, Subpart C Section 15.247(b)

Operation Frequency (MHz)	Power (dBuV/m)	Power (mW)	Specification (mW)	Margin (dB)
2404.00	93.98	0.40	1000	-999.60
2444.00	89.25	0.14	1000	-999.86
2480.00	93.51	0.37	1000	-999.63

Figure 19 Maximum Peak Power Output

JUDGEMENT: Passed by 999.6 dB

TEST PERSONNEL:

Tester Signature:  Date: 30 10.13

Typed/Printed Name: A. Sharabi



6.3 Test Equipment Used.

Peak Power Output

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	February 26, 2013	1 Year
RF Filter Section	HP	85420E	3705A00248	February 26, 2013	1 Year
Antenna Biconical	EMCO	3104	2606	August 30, 2013	1 Year
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	1 Year
Horn Antenna	ETS	3115	29845	March 14, 2012	2 Years
Horn Antenna	ARA	SWH-28	1007	January 26, 2011	3 Years
Low Noise Amplifier	Narda	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, 2013	1 Year
Spectrum Analyzer	HP	8564E	3442A00275	February 28, 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 20 Test Equipment Used

8. Band Edge Spectrum

[In Accordance with section 15.247(c)]

8.1 *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.

The E.U.T was tested at 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 E.U.T. was tested at low, mid and high channels at 20MHz.

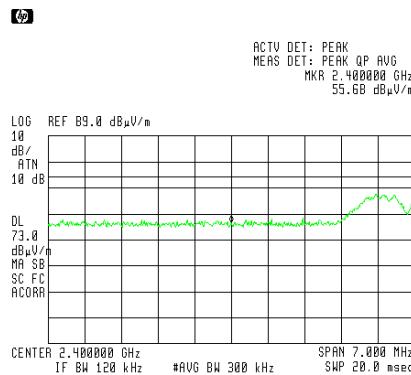


Figure 21 —Lower Band Edge

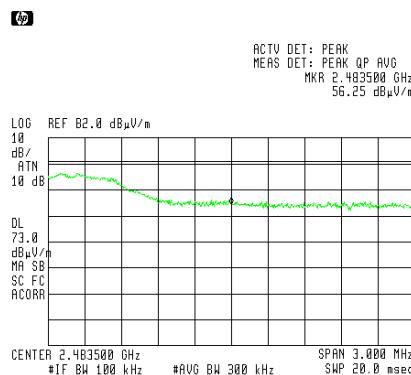


Figure 22 —Upper Band Edge



8.2 Results table

E.U.T. Description: RFID Reader

Model No.: READER101

Serial Number: Not designated

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

Operation Frequency (MHz)	Band Edge Frequency (MHz)	Spectrum Level (dBc)	Specification (dBc)	Margin (dB)
2404	2400	55.68	73.0	-17.32
2480	2483.5	56.25	73.0	-16.75

Figure 23 Band Edge Spectrum

JUDGEMENT: Passed by 16.75dB

TEST PERSONNEL:

Tester Signature:  Date: 30.10.13

Typed/Printed Name: A. Sharabi



8.3 Test Equipment Used.

Band edge Spectrum

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	February 26, 2013	1 Year
RF Filter Section	HP	85420E	3705A00248	February 26, 2013	1 Year
Antenna Biconical	EMCO	3104	2606	August 30, 2013	1 Year
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	1 Year
Horn Antenna	ETS	3115	29845	March 14, 2012	2 Years
Horn Antenna	ARA	SWH-28	1007	January 26, 2011	3 Years
Low Noise Amplifier	Narda	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, 2013	1 Year
Spectrum Analyzer	HP	8564E	3442A00275	February 28, 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 24 Test Equipment Used

9. Radiated Emission, 9 kHz – 30 MHz

9.1 Test Specification

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

9.2 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.

The E.U.T. was operated at the low, mid and high channels using a peak detector.

9.3 Measured Data

JUDGEMENT: Passed by more than 20dB.

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

TEST PERSONNEL:

Tester Signature: 

Date: 30.10.13

Typed/Printed Name: A. Sharabi



9.4 **Test Instrumentation Used, Radiated Measurements**

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3906A00276	February 26, 2013	1 year
RF Section	HP	85420E	3705A00248	February 26, 2013	1 year
Active Loop Antenna	EMCO	6502	9506-2950	October 21, 2012	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



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:

$$FS = RA + AF + CF$$

FS: Field Strength [dB μ V/m]
RA: Receiver Amplitude [dB μ 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.

10. Spurious Radiated Emission 30 – 25000 MHz

10.1 Radiated Emission 30-25000 MHz

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 with 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 operated at the low, mid and high channels using a peak detector.



10.2 Test Data

JUDGEMENT: Passed by 10.7dB

For the operation frequency of 2404 MHz, the margin between the emission level and the specification limit is in the worst case 15.2dB at the frequency of 4826 MHz, vertical polarization.

For the operation frequency of 2444 MHz, the margin between the emission level and the specification limit is in the worst case 12.2dB at the frequency of 4874 MHz, horizontal polarization.

For the operation frequency of 2480 MHz, the margin between the emission level and the specification limit is 10.7dB in the worst case at the frequency of 4924 MHz, horizontal polarization.

The results for all modulations were the same.

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 25* to *Figure 30*.

TEST PERSONNEL:

Tester Signature: 

Date: 30.10.13

Typed/Printed Name: A. Sharabi



Radiated Emission Above 1 GHz

E.U.T Description RFID Reader
Type READER101
Serial Number: Not designated

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
Operation Frequency: 2404 MHz

Freq. (MHz)	Polarity (H/V)	Peak Amp (dB μ V/m)	Peak. Specification (dB μ V/m)	Peak. Margin (dB)
2390.0	H	45.9	74.0	-28.1
2390.0	V	46.4	74.0	-27.6
4826.0	H	56.0	74.0	-18.0
4826.0	V	58.8	74.0	-15.2

**Figure 25. 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 RFID Reader
Type READER101
Serial Number: Not designated

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: 2404 MHz

Freq. (MHz)	Polarity (H/V)	Average Amp (dB μ V/m)	Average Specification (dB μ V/m)	Peak. Margin (dB)
2390.0	H	-2.0	54.0	-56.0
2390.0	V	-1.5	54.0	-55.5
4826.0	H	8.1	54.0	-45.9
4826.0	V	10.9	54.0	-43.1

**Figure 26. 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



Radiated Emission Above 1 GHz

E.U.T Description RFID Reader
Type READER101
Serial Number: Not designated

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
Operation Frequency: 2444 MHz

Freq. (MHz)	Polarity (H/V)	Peak Amp (dB μ V/m)	Peak. Specification (dB μ V/m)	Peak. Margin (dB)
4874.0	H	61.8	74.0	-12.2
4874.0	V	61.3	74.0	-12.7

**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 RFID Reader
Type READER101
Serial Number: Not designated

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: 2444 MHz

Freq. (MHz)	Polarity (H/V)	Average Amp (dB μ V/m)	Average Specification (dB μ V/m)	Peak. Margin (dB)
4874.0	H	13.9	54.0	-40.1
4874.0	V	13.4	54.0	-40.6

**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



Radiated Emission Above 1 GHz

E.U.T Description RFID Reader
Type READER101
Serial Number: Not designated

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
Operation Frequency: 2480 MHz

Freq. (MHz)	Polarity (H/V)	Peak Amp (dB μ V/m)	Peak. Specification (dB μ V/m)	Peak. Margin (dB)
2483.50	H	51.0	74.0	-23.0
2483.50	V	52.2	74.0	-21.8
4924.00	H	63.3	74.0	-10.7
4924.00	V	62.9	74.0	-11.1

**Figure 29. 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

***“Correction Factor” = Antenna Factor + Cable Loss



Radiated Emission Above 1 GHz

E.U.T Description RFID Reader
Type READER101
Serial Number: Not designated

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: 2480 MHz

Freq. (MHz)	Polarity (H/V)	Average Amp (dB μ V/m)	Average Specification (dB μ V/m)	Peak. Margin (dB)
2483.50	H	3.1	54.0	-50.9
2483.50	V	4.3	54.0	-49.7
4924.00	H	15.4	54.0	-38.6
4924.00	V	15.0	54.0	-39.0

**Figure 30. 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

**“Correction Factor” = Antenna Factor + Cable Loss



10.3 Test Instrumentation Used, Radiated Measurements Above 1 GHz

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	February 26, 2013	1 Year
RF Filter Section	HP	85420E	3705A00248	February 26, 2013	1 Year
Antenna Biconical	EMCO	3104	2606	August 30, 2013	1 Year
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	1 Year
Horn Antenna	ETS	3115	29845	March 14, 2012	2 Years
Horn Antenna	ARA	SWH-28	1007	January 26, 2011	3 Years
Low Noise Amplifier	Narda	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, 2013	1 Year
Spectrum Analyzer	HP	8564E	3442A00275	February 28, 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	JPKG C19982	N/A	N/A

11. Transmitted Power Density

[In accordance with section 15.247(d)]

11.1 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.

The E.U.T was tested at 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 spectrum analyzer was set to 3 kHz resolution BW and sweep time of 1 second for each 3 kHz “window”. The spectrum peaks were located at each of the 3 operating frequencies.

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

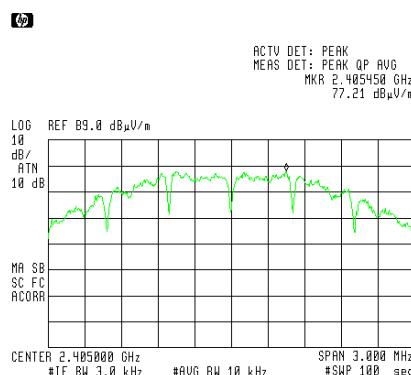


Figure 31 — Low Channel

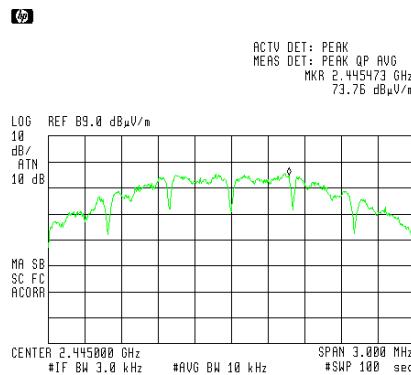


Figure 32 — Mid channel

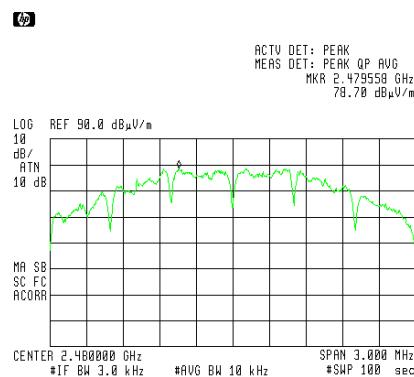


Figure 33 — High channel



11.2 Results table

E.U.T. Description: RFID Reader

Model No.: READER101

Serial Number: Not designated

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

Operation Frequency (MHz)	Reading Spectrum Analyzer (dB μ V/m)	Reading Spectrum Analyzer (mW)	Specification (mW)	Margin (mW)
2404	77.21	0.01	6.3	-6.29
2444	73.76	0.01	6.3	-6.29
2480	78.78	0.01	6.3	-6.29

Figure 34 Test Results

JUDGEMENT: Passed by 6.29 mW

TEST PERSONNEL:

Tester Signature: 

Date: 30.10.13

Typed/Printed Name: A. Sharabi



11.3 Test Equipment Used.

Transmitted Power Density

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	February 26, 2013	1 Year
RF Filter Section	HP	85420E	3705A00248	February 26, 2013	1 Year
Antenna Biconical	EMCO	3104	2606	August 30, 2013	1 Year
Antenna Log Periodic	ARA	LPD-2010/A	1038	April 2, 2013	1 Year
Horn Antenna	ETS	3115	29845	March 14, 2012	2 Years
Horn Antenna	ARA	SWH-28	1007	January 26, 2011	3 Years
Low Noise Amplifier	Narda	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, 2013	1 Year
Spectrum Analyzer	HP	8564E	3442A00275	February 28, 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 35 Test Equipment Used

12. Average Factor Calculation

1. Burst duration = 400usec
2. Time between bursts = 3000msec
3. Pulse duration = N/A
4. pulse period = N/A

$$5. \text{ Average Factor} = 20 \log \left[\frac{\text{Pulse duration}}{\text{Pulse period}} \times \frac{\text{burst duration}}{100\text{msec}} \times \text{Num of burst within 100msec} \right]$$

$$\text{Average Factor} = 20 \log \left[\frac{0.4}{100} \right] = -47.9 \text{dB}$$

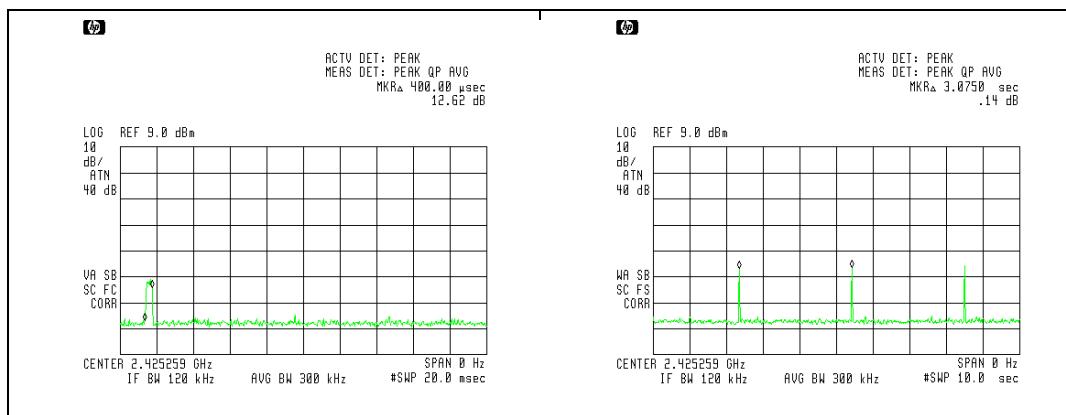


Figure 36. Duty Cycle



13. Antenna Gain/Information

The antenna gain is 2.5 dBi.

Monopole 2.4 GHz

Typical performance

Board	Frequency Range [MHz]	Avg Gain [dBi]	Max Gain [dBi]	Efficiency [%] / [dB]	Return loss min. [dB]	Impedance [Ω]	Operating Temperature [° C]
Case #1 11x40mm	2400 - 2483.5	-4.1 (Peak) -3.7 (Band edges)	2.5 (Peak) 2.1 (Band edges)	65/-0.3 (Peak) 55/-0.6 (Band edges)	-18	50	-40 to +85
Case #2 20x30mm		-4.0 (Peak) -4.3 (Band edges)	2.2 (Peak) 1.5 (Band edges)	52/-2.9 (Peak) 46/-3.4 (Band edges)	-12		



14. R.F Exposure/Safety

Typical use of the E.U.T. is in a Reader designed to be used for locating persons and assets in proximity to the device that are equipped with a RFID Tag. The typical placement of the E.U.T. is on any type of support. The typical distance between the E.U.T. and the user in the worst case application, is 20 cm.

Calculation of Maximum Permissible Exposure (MPE)

Based on Section 1.1310 Requirements

(a) FCC limits at 2440 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

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

P_t- Transmitted Power 93.98dBm (Peak) = 0.40 mW

G_T- Antenna Gain, 2.5dBi = 1.8 numeric

R- Distance from Transmitter using 20cm worst case

(c) The peak power density is:

$$S_p = \frac{0.40 \times 1.8}{4\pi(20)^2} = 0.01 \frac{mW}{cm^2}$$

(e) This is below the FCC limit.



15. APPENDIX A CORRECTION FACTORS

15.1 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".



15.2 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.*



15.3 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.



15.4 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".



15.5 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".



**15.6 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".



**15.7 Correction factors for
Horn**

Double-Ridged Waveguide

**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			



15.8 Correction factors for

Horn Antenna
Model: SWH-28
at 1 meter range.

FREQUENCY (GHz)	AFE (dB /m)	Gain (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



15.9 Correction factors for

**Horn Antenna
Model: V637**

FREQUENCY (GHz)	AFE (dB /m)	Gain (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



15.10 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