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**DATE: 26 March 2014**

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

# FCC Radio Test Report

**for**

# Panoramic Power Ltd.

**Equipment under test:**

# Wireless Power Sensor

# PAN-42-US

Written by: _____
R. Pinchuck, Documentation

Approved by: _____
A. Sharabi, Test Engineer

Approved by: _____
I. Raz, EMC Laboratory Manager

# Measurement/Technical Report for Panoramic Power Ltd.

**Equipment under test:**

## Wireless Power Sensor

# PAN-42-US

### FCC ID: Z9M-PAN-4-2

| | |
|---|---|
| This report concerns: | Original Grant: x<br>Class I change:<br>Class II change: |
| Equipment Type: | Digital Transmission System |
| Limits used: | 47CFR15 Section 15.249 |

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


Application for Certification prepared by:

R. Pinchuck
ITL (Product Testing) Ltd.
Kfar Bin Nun
D.N. Shimshon 99780
Israel
Tel: +972-8-918-6117
Fax: +972-8-915-3101
Email: rpinchuck@itl.co.il

Applicant for this device: (different from "prepared by")

Adi Shamir
Panoramic Power Ltd.
20 Atir Yeda St.
Kfar Saba, 44643
Israel
Tel: 972-9-766-7600
Fax: 972-9-766-7610
Email: adi@panpwr.com

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# 1. General Information

## *1.1 Administrative Information*

| | |
|---|---|
| Manufacturer: | Panoramic Power Ltd. |
| Manufacturer's Address: | 20 Atir Yeda St., Kfar Saba<br>44643, Israel<br>Tel: +972-9-766-7600<br>Fax: +972-9-766-7610 |
| Manufacturer's Representative: | Yael Alali |
| Equipment Under Test (E.U.T): | Wireless Power Sensor |
| Equipment Model No.: | PAN-42-US |
| Equipment Serial No.: | Not Designated |
| Date of Receipt of E.U.T: | 18.03.14 |
| Start of Test: | 18.03.14 |
| End of Test: | 23.03.14 |
| Test Laboratory Location: | I.T.L (Product Testing) Ltd.<br>Kfar Bin Nun,<br>ISRAEL 99780 |
| Test Specifications: | FCC Part 15, Subpart C,<br>Section 15.249 |

### *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

The PAN-42 wireless power sensor provides high accuracy real time power measurements and advanced power quality measurements for main power monitoring, sub-metering and for the metering of large devices. Designed for demanding electrical applications, supporting industry accuracy standards, PAN-42 enables the metering of power, voltage, current, power factor and power quality measurement data. Information is sent wirelessly, through Panoramic's Bridge unit, to Panoramic's advanced cloud-based analytics platform. The data is then used to provide customers with actionable analytics and real-time dashboards and alerts. PAN-42 complements the Panoramic Power sensor family (PAN-10, PAN-12 and PAN -14) that is used for more granular monitoring of individual circuits and devices. Together they deliver a comprehensive range of metering and monitoring tools to reduce energy costs and maximize energy efficiency.

## 1.4 Test Methodology

Conducted and radiated testing was 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 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):

± 4.96 dB

Note: See ITL Procedure No. PM 198.

# 2. System Test Configuration

## 2.1 Justification

The E.U.T. was tested in normal operation mode set to transmit in 915MHz within the 902 – 928 MHz frequency band.

Since unit can be installed in different orientations, unit was scanned in 3 different orientations to determent worst-case radiation.

## 2.2 Special Accessories

No special accessories were needed to achieve compliance.

## 2.3 Equipment Modifications

No special modifications were needed to achieve compliance.

## 2.4 Configuration of Tested System

The configuration of the tested system is described below.

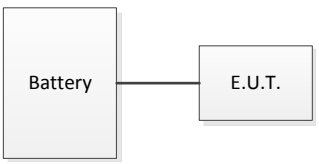


**Figure 1. Configuration of Tested System – Radiated Emission**

# 3. Conducted and Radiated Measurements Test Setup Photos


**Figure 2. Conducted Emission Test**

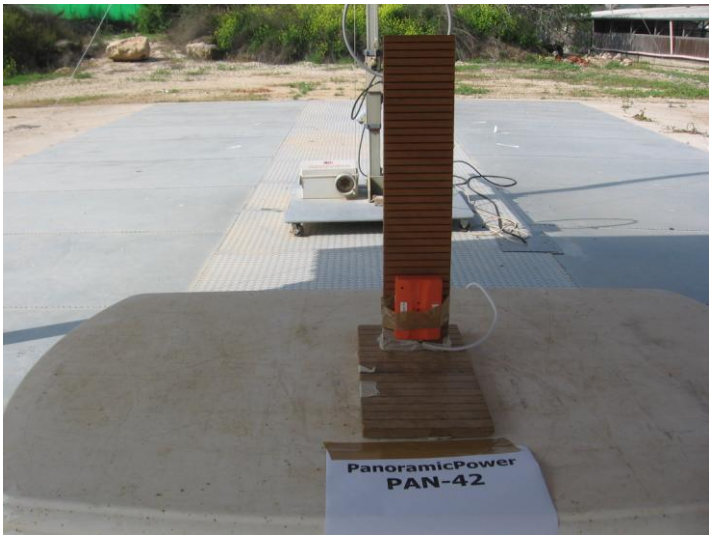


**Figure 3. Radiated Emission Test**


**Figure 4. Radiated Emission Test**


**Figure 5. Radiated Emission Test**


**Figure 6. Radiated Emission Test**

# 4. Conducted Emission from AC Mains

## 4.1 Test Specification

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

## 4.2 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 a 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 via a 50 Ohm / 50 µHn 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.

## 4.3 Measured Data

JUDGEMENT: Passed by 14.45dB

The margin between the emission levels and the specification limit is, in the worst case, 17.86dB for the phase line at 1.27MHz and 14.45dB at 0.346MHz for the neutral line.

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

The details of the highest emissions are given in *Figure* 7 to *Figure 10*.

TEST PERSONNEL:

Tester Signature: _____ Date: 21.05.14

Typed/Printed Name: D. Yadidi

# Conducted Emission

| | |
|---|---|
| E.U.T Description | Wireless Power Sensor |
| Type | PAN-42-US |
| Serial Number: | Not Designated |

| | |
|---|---|
| Specification: | FCC Part 15, Subpart C |
| Lead: | Phase |
| Detectors: | Quasi-peak, Average |

EDIT PEAK LIST (Final Measurement Results)

Trace1: CE22BQP
Trace2: CE22BAP
Trace3: ---

| | TRACE | FREQUENCY | LEVEL dBµV | DELTA LIMIT dB |
|---|---|---|---|---|
| 1 | Quasi Peak | 154 kHz | 36.55 | -29.22 |
| 1 | Quasi Peak | 190 kHz | 36.89 | -27.14 |
| 1 | Quasi Peak | 234 kHz | 40.91 | -21.39 |
| 2 | Average | 234 kHz | 23.63 | -28.67 |
| 1 | Quasi Peak | 314 kHz | 34.66 | -25.20 |
| 1 | Quasi Peak | 338 kHz | 37.21 | -22.03 |
| 2 | Average | 346 kHz | 25.54 | -23.51 |
| 2 | Average | 462 kHz | 25.23 | -21.41 |
| 1 | Quasi Peak | 466 kHz | 38.52 | -18.06 |
| 1 | Quasi Peak | 570 kHz | 36.40 | -19.59 |
| 2 | Average | 578 kHz | 24.88 | -21.11 |
| 2 | Average | 694 kHz | 25.19 | -20.80 |
| 2 | Average | 926 kHz | 24.86 | -21.14 |
| 1 | Quasi Peak | 1.038 MHz | 37.94 | -18.05 |
| 2 | Average | 1.042 MHz | 24.52 | -21.47 |
| 1 | Quasi Peak | 1.158 MHz | 37.72 | -18.27 |
| 1 | Quasi Peak | 1.27 MHz | 38.13 | -17.86 |
| 2 | Average | 1.27 MHz | 23.24 | -22.75 |
| 2 | Average | 1.502 MHz | 21.64 | -24.35 |
| 2 | Average | 2.082 MHz | 21.62 | -24.37 |

Date: 23.MAR.2014 10:10:36

**Figure 7. Detectors: Quasi-Peak, AVERAGE**

*Note: QP Delta/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.*

# Conducted Emission

| | |
|---|---|
| E.U.T Description | Wireless Power Sensor |
| Type | PAN-42-US |
| Serial Number: | Not Designated |

| | |
|---|---|
| Specification: | FCC Part 15, Subpart C |
| Lead: | Phase |
| Detectors: | Quasi-peak, Average |

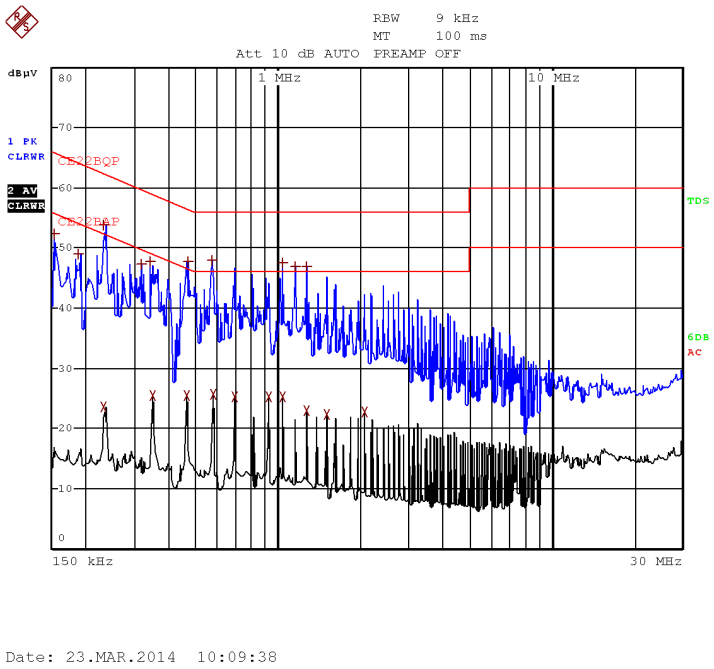


**Figure 8. Detectors: Quasi-peak, Average**

Note: Fail indication on the spectral plot results from peak detector level reading above the limit. This indication is for information only and it should not be interpreted as a test failure.

# Conducted Emission

| | |
|---|---|
| E.U.T Description | Wireless Power Sensor |
| Type | PAN-42-US |
| Serial Number: | Not Designated |

| | |
|---|---|
| Specification: | FCC Part 15, Subpart C |
| Lead: | Neutral |
| Detectors: | Quasi-peak, Average |

EDIT PEAK LIST (Final Measurement Results)

Trace1: CE22BQP
Trace2: CE22BAP
Trace3: ---

| TRACE | | FREQUENCY | LEVEL dBµV | DELTA LIMIT dB |
|---|---|---|---|---|
| 1 | Quasi Peak | 158 kHz | 36.77 | -28.79 |
| 1 | Quasi Peak | 178 kHz | 37.38 | -27.19 |
| 1 | Quasi Peak | 190 kHz | 36.64 | -27.39 |
| 1 | Quasi Peak | 210 kHz | 37.58 | -25.61 |
| 1 | Quasi Peak | 230 kHz | 43.11 | -19.33 |
| 2 | Average | 230 kHz | 26.11 | -26.33 |
| 1 | Quasi Peak | 290 kHz | 36.94 | -23.57 |
| 1 | Quasi Peak | 346 kHz | 44.60 | -14.45 |
| 2 | Average | 346 kHz | 26.53 | -22.52 |
| 1 | Quasi Peak | 398 kHz | 33.95 | -23.94 |
| 2 | Average | 462 kHz | 26.53 | -20.11 |
| 1 | Quasi Peak | 466 kHz | 38.50 | -18.07 |
| 1 | Quasi Peak | 574 kHz | 38.73 | -17.26 |
| 2 | Average | 578 kHz | 26.46 | -19.53 |
| 1 | Quasi Peak | 694 kHz | 40.05 | -15.94 |
| 2 | Average | 694 kHz | 26.44 | -19.55 |
| 2 | Average | 810 kHz | 26.21 | -19.78 |
| 2 | Average | 926 kHz | 25.81 | -20.18 |
| 2 | Average | 1.042 MHz | 25.10 | -20.89 |
| 1 | Quasi Peak | 1.154 MHz | 38.22 | -17.77 |

Date: 23.MAR.2014 10:17:19

**Figure 9. Detectors: Peak, AVERAGE**

*Note: QP Delta/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.*

# Conducted Emission

| | |
|---|---|
| E.U.T Description | Wireless Power Sensor |
| Type | PAN-42-US |
| Serial Number: | Not Designated |

| | |
|---|---|
| Specification: | FCC Part 15, Subpart C |
| Lead: | Neutral |
| Detectors: | Peak, Quasi-peak, Average |

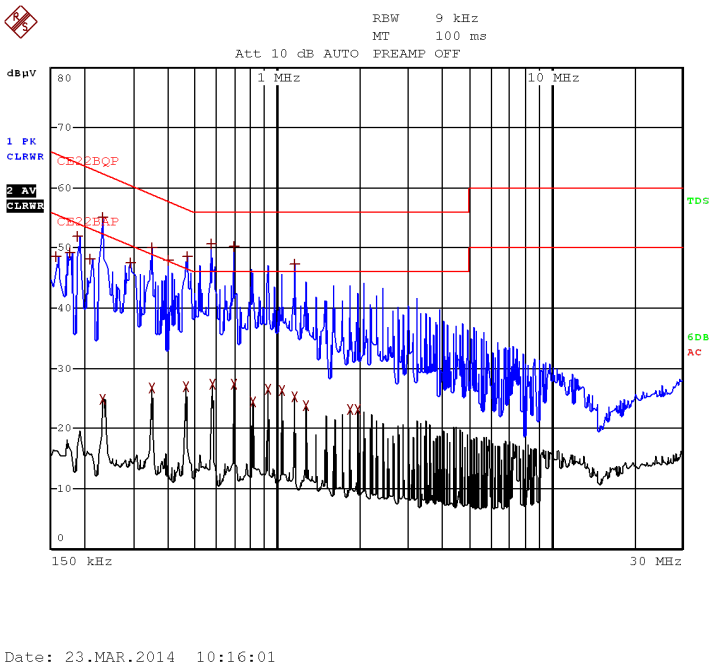


**Figure 10 Detectors: Quasi-peak, Average**

Note: Fail indication on the spectral plot results from peak detector level reading above the limit. This indication is for information only and it should not be interpreted as a test failure.

## *4.4 Test Instrumentation Used, Conducted Measurement*

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Period |
|---|---|---|---|---|---|
| Transient Limiter | HP | 11947A | 3107A01578 | February 25, 2013 | 2 Years |
| EMI Receiver | Rohde & Schwarz | ESCI7 | 100724 | December 17, 2013 | 1 Year |
| LISN | Fischer | FCC-LISN-2A | 127 | January 1, 2014 | 1 Year |

# 5. Field Strength of Fundamental

## 5.1 Test Specification

F.C.C., Part 15, Subpart C, Section 15.249(a)

## 5.2 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 (915 MHz) Peak and Quasi-peak Detection. The turntable and antenna mast were adjusted for maximum level reading on the EMI receiver. The measurement was performed for vertical and horizontal polarizations of the test antenna.

## 5.3 Test Results

JUDGEMENT: Passed by 6.32dB

The EUT met the FCC Part 15, Subpart C, Section 15.249(a) specification requirements.

See additional details in *Figure 11* to *Figure 13.*

TEST PERSONNEL:

Tester Signature: _____ Date: 30.03.14

Typed/Printed Name: A. Sharabi

# Field Strength of Fundamental

| | |
|---|---|
| E.U.T Description | Wireless Power Sensor |
| Model Number | PAN-42-US |
| Serial Number: | Not Designated |

Specification: FCC, Part 15, Subpart C 15.249(a)

Antenna Polarization: Horizontal/Vertical

Test Distance: 3 meters Detectors: Peak, Quasi-peak

| Freq. (MHz) | Pol. V/H | Peak Reading (dBµV/m) | Peak Specification (dBµV/m) | QP Reading (dBµV/m) | QP Specification (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 915.0 | H | 81.11 | 113.0 | 81.11 | 93.98 | -12.87 |
| 915.0 | V | 87.66 | 113.0 | 87.66 | 93.98 | -6.32 |

**Figure 11. Field Strength of Fundamental. Antenna Polarization: HORIZONTAL/VERTICAL. Detectors: Peak, Quasi-peak**

Note: 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 Reading" includes "Correction Factors.

"Correction Factors" = Antenna Correction Factor + Cable Loss.

"Quasi-peak Reading" includes "Correction Factors.

"Correction Factors" = Antenna Correction Factor + Cable Loss.

# Field Strength of Fundamental

| | |
|---|---|
| E.U.T Description | Wireless Power Sensor |
| Model Number | PAN-42-US |
| Serial Number: | Not Designated |

Specification: FCC, Part 15, Subpart C 15.249(a)

Antenna Polarization: Horizontal/Vertical

Test Distance: 3 meters Detector: Peak, Quasi-peak

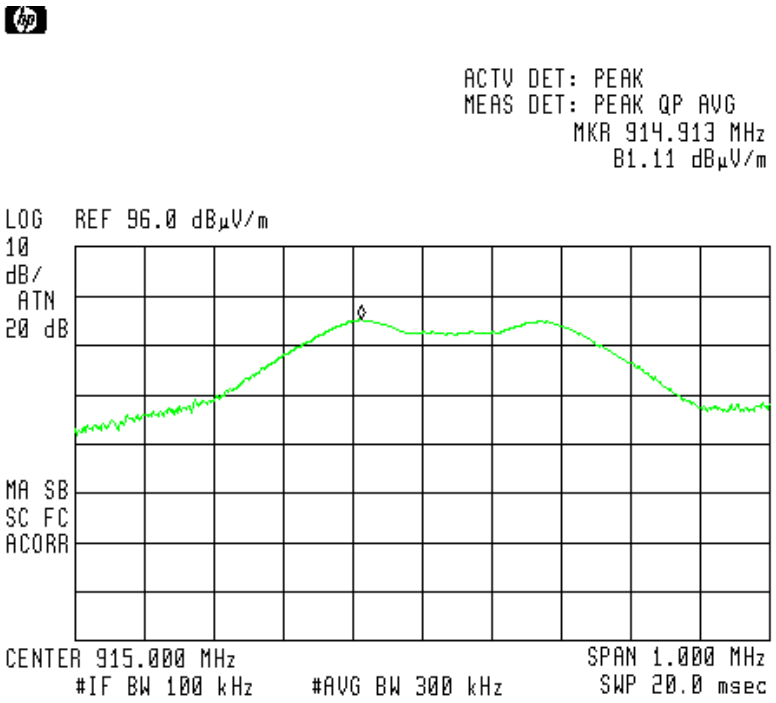


**Figure 12. 915.00 MHz Antenna Polarization Horizontal**

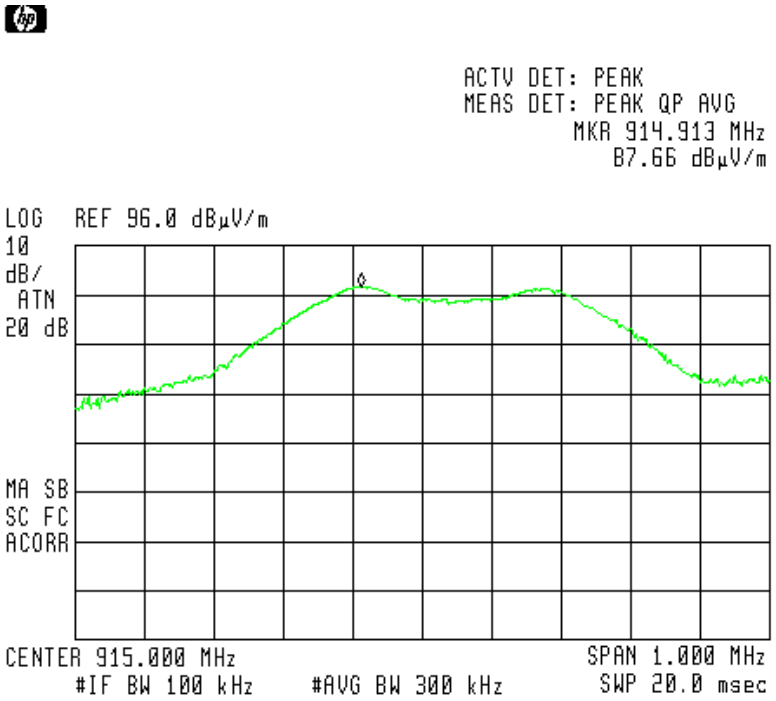


**Figure 13. 915.00 MHz Antenna Polarization Vertical**

## *5.4 Test Instrumentation Used, Field Strength of Fundamental*

| 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 | 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 |

**Figure 14 - Test Instrumentation Used**

# 6. Spurious Radiated Emission 9 kHz - 30 MHz

## *6.1 Test Specification*

F.C.C., Part 15, Subpart C, Section 15.249(b)

## *6.2 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 1.

The frequency range 9 kHz-1000 MHz was scanned and the list of the highest emissions was verified and updated accordingly.
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-30 MHz, the loop antenna was rotated on its vertical axis. The antenna height (center of loop) was 1 meter.
The E.U.T. was operated in continuous transmission to enable better detection of signals.

## *6.3 Test results*

JUDGEMENT: Passed

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

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 15.249 specification.

TEST PERSONNEL:

Tester Signature: _____ Date: 30.03.14

Typed/Printed Name: A. Sharabi

## 6.4 Test Instrumentation Used, Radiated Measurements 9 kHz – 30 MHz

| 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 15 - Test Instrumentation Used**

## 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:

$$FS = RA + AF + CF$$

FS: Field Strength [dBμv/m]
RA: Receiver Amplitude [dBμv]
AF: Receiving Antenna Correction Factor [dB/m]
CF: Cable Attenuation Factor [dB]

Example: FS = 30.7 dBμV (RA) + 14.0 dB (AF) + 0.9 dB (CF) = 45.6 dBμV

No external pre-amplifiers were used.

# 7. Spurious Radiated Emission 30 MHz- 10 GHz

## 7.1 Test Specification

F.C.C., Part 15, Subpart C, Section 15.249(b)

## 7.2 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, 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 emission levels were compared to the requirement of Section 15.249.

In the frequency range 30 MHz - 2.9 GHz, a computerized EMI receiver complying with CISPR 16 requirements was used. The specification limits and applicable correction factors are loaded to the receiver via a 3.5" floppy disk.

In the frequency range 2.9 - 10 GHz, a spectrum analyzer including a low noise amplifier was used. During peak measurements, the I.F. bandwidth was 1 MHz, and video bandwidth 3 MHz. During average measurements, the I.F. bandwidth was 1 MHz and video bandwidth was 100 Hz.

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 test distance was 3 meters.

## 7.3 Test Results

JUDGEMENT: Passed by 17.7dB

The margin between the emission level and the specification limit is 17.7dB in the worst case at the frequency of 2744MHz, vertical polarization.

The EUT met the requirements of the F.C.C. Part 15, Subpart C Section 15.249, specification.

TEST PERSONNEL:

Tester Signature: _____ Date: 30.03.14

Typed/Printed Name: A. Sharabi

# Spurious Radiated Emission 30 MHz- 10 GHz

| | |
|---|---|
| E.U.T Description | Wireless Power Sensor |
| Type | PAN-42-US |
| Serial Number: | Not Designated |

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical
Frequency range: 30 MHz to 10.0 GHz
Test Distance: 3 meters
Detector: Peak

| Operation Frequency (MHz) | Freq. (MHz) | Pol. V/H | Peak Reading (dBµV/m) | Peak Specification (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|
| 915.00 | 1830.00 | H | 53.0 | 74.0 | -21.0 |
| 915.00 | 1830.00 | V | 52.4 | 74.0 | -21.6 |
| 915.00 | 2744.0 | H | 55.7 | 74.0 | -18.3 |
| 915.00 | 2744.0 | V | 56.3 | 74.0 | -17.7 |

**Figure 16. Spurious Radiated Emission**

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 Reading" includes correction factor.

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

# Spurious Radiated Emission 30 MHz- 10 GHz

| | |
|---|---|
| E.U.T Description | Wireless Power Sensor |
| Type | PAN-42-US |
| Serial Number: | Not Designated |

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical
Frequency range: 30 MHz to 10.0 GHz
Test Distance: 3 meters
Detector: Peak

| **Operation Frequency** (MHz) | **Freq.** (MHz) | **Pol.** V/H | **Average Reading** (dBµV/m) | **Average Specification** (dBµV/m) | **Margin** (dB) |
|---|---|---|---|---|---|
| 915.00 | 1830.00 | H | 12.0 | 54.0 | -42.0 |
| 915.00 | 1830.00 | V | 11.4 | 54.0 | -42.6 |
| 915.00 | 2745.0 | H | 14.7 | 54.0 | -39.3 |
| 915.00 | 2745.0 | V | 15.3 | 54.0 | -38.7 |

**Figure 17. Spurious Radiated Emission**

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 Reading" includes correction factor.

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

## 7.4 Test Instrumentation Used, Radiated Measurements 30 MHz – 10 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, 2013 | 1 Year |
| Antenna Log Periodic | ARA | LPD-2010/A | 1038 | April 2, 2013 | 1 Year |
| Horn Antenna | ETS | 3115 | 29845 | March 14, 2012 | 3 Years |
| Low Noise Amplifier | DBS MICROWAVE | LNA-DBS-0411N313 | 013 | August 21, 2013 | 1 Year |
| Spectrum Analyzer | HP | 8592L | 3826A01204 | February 28, 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 | JPKGC19982 | N/A | N/A |

**Figure 18 - Test Instrumentation Used**

## 7.5 Field Strength Calculation

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

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

FS: Field Strength [dBμv/m]
RA: Receiver Amplitude [dBμv]
AF: Receiving Antenna Correction Factor [dB/m]
CF: Cable Attenuation Factor [dB]

# 8. Band Edge Attenuation

## *8.1 Test Specification*

F.C.C., Part 15, Subpart C, Section 15.249(e)

## *8.2 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 and Peak Detection. The turntable and antenna mast were adjusted for maximum level reading on the EMI receiver. The measurement was performed for vertical and horizontal polarizations of the test antenna.

## *8.3 Test Results*

JUDGEMENT: Passed by 3.4 dB

The EUT met the FCC Part 15, Subpart C, Section 15.249(e) specification requirements.

TEST PERSONNEL:

Tester Signature: _____ Date: 30.03.14

Typed/Printed Name: A. Sharabi

# Band Edge Attenuation

| | |
|---|---|
| E.U.T Description | Wireless Power Sensor |
| Model Number | PAN-42-US |
| Serial Number: | Not Designated |

Specification: F.C.C., Part 15, Subpart C 15.249(e)

| **Freq.** (MHz) | **Reading** (dBc) | **Specification** (dBc) | **Margin** (dB) |
|---|---|---|---|
| 902.0 | -55.2 | -50 | -5.2 |
| 928.0 | -53.4 | -50 | -3.4 |

**Figure 19. Band Edge Attenuation**

# Band Edge Attenuation

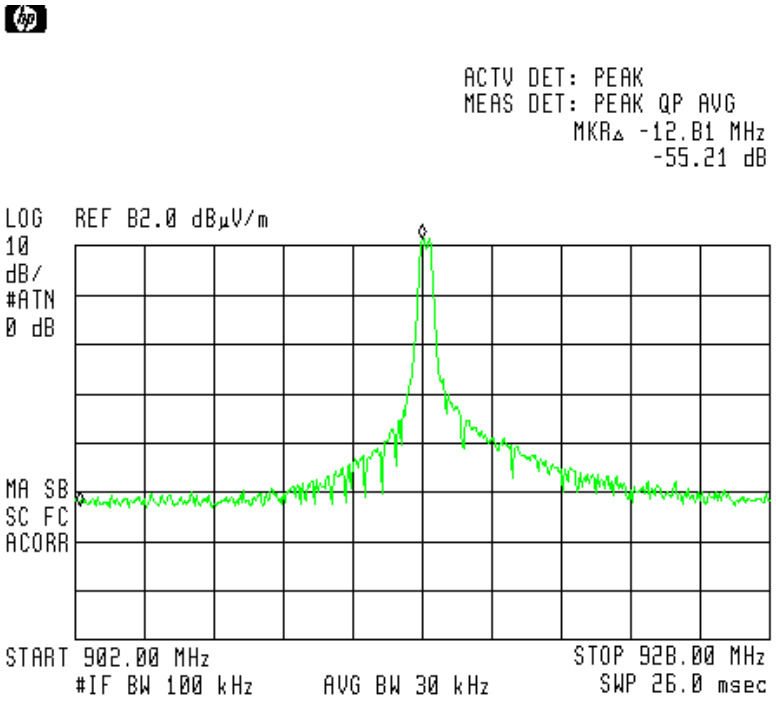


**Figure 20. Band Edge Attenuation**

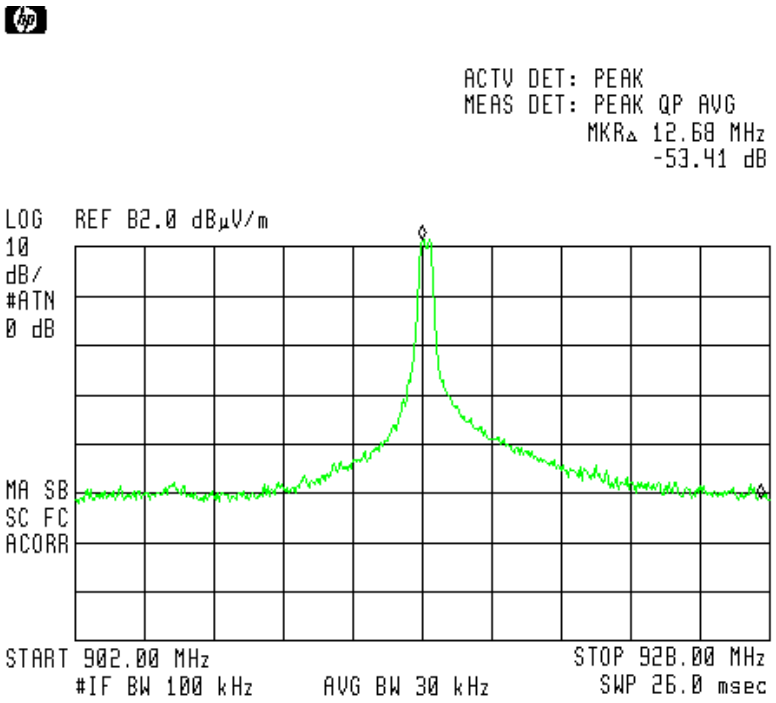


**Figure 21. Band Edge Attenuation**

## *8.4 Test Instrumentation Used, Band Edge Attenuation*

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Period |
|---|---|---|---|---|---|
| EMI Receiver | HP | 85422E | 3906A00276 | January 15, 2014 | 1Year |
| RF Filter Section | HP | 85420E | 3705A00248 | January 15, 2014 | 1Year |
| Antenna Log Periodic | ARA | LPD-2010/A | 1038 | April 2, 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 22 -Test Instrumentation Used**

# 9. Average Factor Calculation

1. Burst duration = 0.825msec
2. Time between bursts >100msec

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

$$\text{Average Factor} = 20\log\left[\frac{0.825}{100}\right] = -41.0dB$$

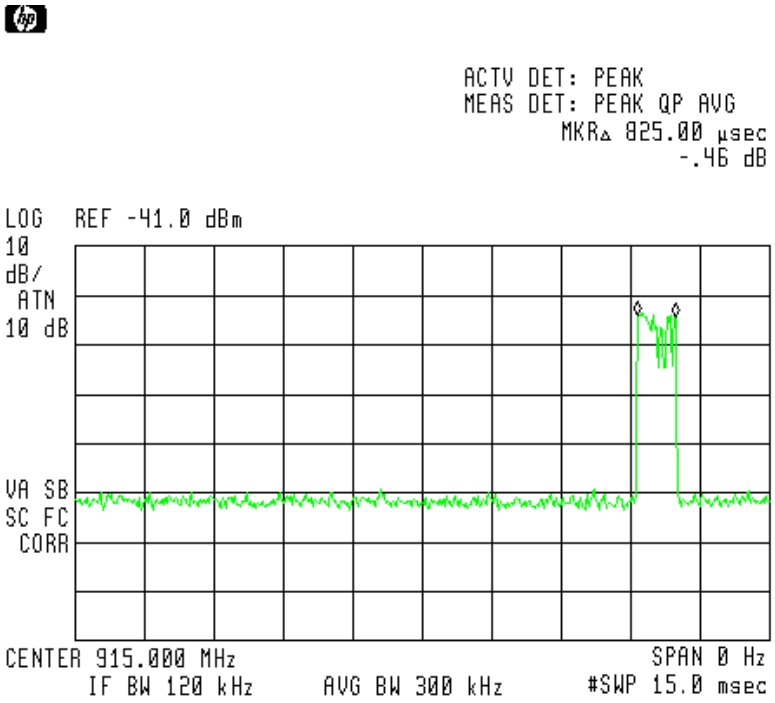


**Figure 23 Avg. Factor Pulse Duration = 0.825msec**

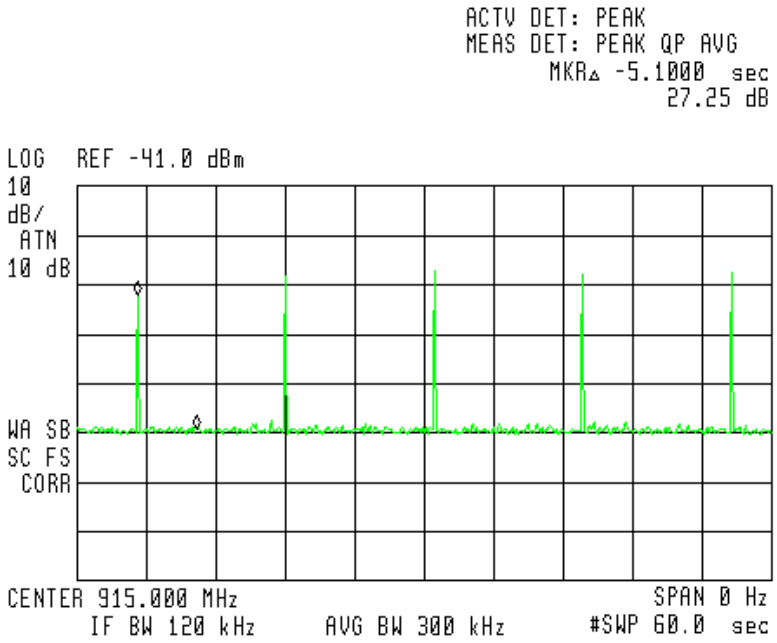


**Figure 24 Avg. Factor -Time between transmissions >100msec**

## 9.1 Test Equipment Used, Average Factor Calculation

| Instrument | Manufacturer | Model | Serial No. | Last Calibration Date | Period |
|---|---|---|---|---|---|
| EMI Receiver | HP | 85422E | 3906A00276 | January 15, 2014 | 1Year |
| RF Filter Section | HP | 85420E | 3705A00248 | January 15, 2014 | 1Year |
| Antenna Biconical | EMCO | 3104 | 2606 | August 30, 2013 | 1Year |
| Antenna Log Periodic | ARA | LPD-2010/A | 1038 | April 2, 2013 | 1 Year |
| Horn Antenna | ETS | 3115 | 29845 | March 14, 2012 | 3 Years |
| Horn Antenna | ARA | SWH-28 | 1007 | March 30, 2014 | 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, 2014 | 1 Year |
| Spectrum Analyzer | HP | 8564E | 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 | JPKGC19982 | N/A | N/A |

**Figure 25 Test Equipment Used**

# 10. APPENDIX A - CORRECTION FACTORS

## *10.1 Correction factors for CABLE*

**from EMI receiver to test antenna at 3 meter range.**

| FREQUENCY (MHz) | CORRECTION FACTOR (dB) |
|---|---|
| 10.0 | 0.3 |
| 20.0 | 0.6 |
| 30.0 | 0.8 |
| 40.0 | 0.9 |
| 50.0 | 1.1 |
| 60.0 | 1.2 |
| 70.0 | 1.3 |
| 80.0 | 1.4 |
| 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 |

| FREQUENCY (MHz) | CORRECTION FACTOR (dB) |
|---|---|
| 1200.0 | 7.3 |
| 1400.0 | 7.8 |
| 1600.0 | 8.4 |
| 1800.0 | 9.1 |
| 2000.0 | 9.9 |
| 2300.0 | 11.2 |
| 2600.0 | 12.2 |
| 2900.0 | 13.0 |

*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".*

## *10.2 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.*

## *10.3 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.*

## *10.4 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 38M3O.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".*

## *10.5 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".*

## *10.6 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".*

## *10.7 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 |

## *10.8 Correction factors for Double-Ridged Waveguide Horn*

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

| FREQUENCY (GHz) | ANTENNA FACTOR (dB 1/m) | ANTENNA 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 | | | |