

JUSTIFICATION TEST REPORT

ACCORDING TO: FCC CFR 47 part 15 subpart C, §15.247 and subpart B;
RSS-210 issue 8 Annex 8, ICES-003 Issue 4:2004

FOR:

LogiTag Systems Ltd.

UHF RFID reader

Part number: LogiRead-UX1-NA

**Contains: FCC ID:PI403B,
IC:1931B-EUSB**

**Contains: FCC ID:QV5MERCURY5E,
IC:5407A-MERCURY5E**

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Table of contents

| | | |
|-----|----------------------------------------------------------------------------------------------|----|
| 1 | Applicant information..... | 3 |
| 2 | Equipment under test attributes | 3 |
| 3 | Manufacturer information | 3 |
| 4 | Test details..... | 3 |
| 5 | Tests summary..... | 4 |
| 6 | EUT description..... | 5 |
| 6.1 | General information..... | 5 |
| 6.2 | Changes made in EUT..... | 5 |
| 7 | Transmitter tests according to 47CFR part 15 subpart C and RSS-210 Annex 8 requirements..... | 6 |
| 7.1 | Peak output power | 6 |
| 7.2 | Field strength of spurious emissions | 10 |
| 7.3 | Unintentional radiated emission measurements..... | 24 |
| 8 | APPENDIX A Test equipment and ancillaries used for tests..... | 29 |
| 9 | APPENDIX B Measurement uncertainties..... | 30 |
| 10 | APPENDIX C Test laboratory description | 31 |
| 11 | APPENDIX D Specification references | 31 |
| 12 | APPENDIX E Test equipment correction factors..... | 32 |
| 13 | APPENDIX F Abbreviations and acronyms..... | 38 |



1 Applicant information

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E-mail: golank@Logi-tag.com
Contact name: Mr. Golan Kormian

2 Equipment under test attributes

Product name: UHF RFID reader
Part number: LogiRead-UX1-NA
Serial number: UX1NA00001
Hardware version: B02
Software release: V1.05
Receipt date: 3/25/2012

3 Manufacturer information

Manufacturer name: LogiTag Systems Ltd.
Address: 2 Hamelacha street, Poleg Industrial Zone, Netanya 42504, Israel
Telephone: +972 9835 4848
Fax: +972 9865 6262
E-Mail: golank@Logi-tag.com
Contact name: Mr. Golan Kormian

4 Test details

Project ID: 23127
Location: Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started: 3/25/2012
Test completed: 4/24/2012
Test specification(s): FCC CFR47 part 15 subp.C §15.247, subp.B §15.109;
RSS-210 issue 8 Annex 8, ICES-003:2004



5 Tests summary

| Test | Status |
|----------------------------------------------------------------------|--------|
| Transmitter characteristics | |
| Section 15.247(b), RSS-210 section A8.4, Peak output power | Pass |
| Section 15.247(c), RSS-210 section A8.5, Radiated spurious emissions | Pass |
| Unintentional emissions | |
| Section 15.109 class B, ICES-003, Section 5.5, Radiated emission | Pass |

The device contains two modular approved transmitters:

- 1) FCC ID:PI403B, IC:1931B-EUSB and
- 2) FCC ID:QV5MERCURY5E, IC:5407A-MERCURY5E.

Only relevant tests for Application for certification of Class II permissive change were conducted. The peak output test was performed for FCC ID:QV5MERCURY5E, IC:5407A-MERCURY5E module to check the higher output power of 2 approved modules.

The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

| | Name and Title | Date | Signature |
|---------------------|----------------------------------------------|----------------|-----------|
| Tested by: | Mrs. E. Pitt, test engineer | April 24, 2012 | |
| Reviewed by: | Mrs. M. Cherniavsky, certification engineer | April 29, 2012 | |
| Approved by: | Mr. M. Nikishin, EMC and Radio group manager | April 30, 2012 | |



6 EUT description

6.1 General information

The EUT, UHF RFID Reader, is a system for read and write operations for UHF RFID transponders.

The device contains two modular approved transmitters FCC ID:PI403B, IC:1931B-EUSB (2402-2480 MHz) and FCC ID:QV5MERCURY5E, IC:5407A-MERCURY5E (902.75 – 927.25 MHz).

It can be operated by host computer with Bluetooth link support.

The device is powered by rechargeable LI-PO battery, can be charged by 5V/3A adaptor or USB connection to host.

6.2 Changes made in EUT

No changes were performed in the EUT.



| | | | |
|----------------------------|--|----------------------------------------------------------------------|--|
| Test specification: | | Section 15.247(b), RSS-210 section A8.4(1), Peak output power | |
| Test procedure: | | Public notice DA 00-705 | |
| Test mode: | | Compliance | |
| Date(s): | | 4/24/2012 | |
| Temperature: 23 °C | | Air Pressure: 1012 hPa | |
| | | Relative Humidity: 47 % | |
| | | Power Supply: 5 VDC | |
| Remarks: | | | |

7 Transmitter tests according to 47CFR part 15 subpart C and RSS-210 Annex 8 requirements

7.1 Peak output power

7.1.1 General

This test was performed to measure the maximum peak output power radiated by transmitter. Specification test limits are given in Table 7.1.1.

Table 7.1.1 Peak output power limits

| Assigned frequency range, MHz | Peak output power* | | Equivalent field strength limit @ 3m, dB(μV/m)* | Maximum antenna gain, dBi |
|-------------------------------|------------------------------|-----------------------------|-------------------------------------------------|---------------------------|
| | W | dBm | | |
| 902.0 – 928.0 | 0.25 (<50 hopping channels) | 24.0(<50 hopping channels) | 125.2 (<50 hopping channels) | 6.0* |
| | 1.0 (≥50 hopping channels) | 30.0 (≥50 hopping channels) | 131.2 (≥50 hopping channels) | |
| 2400.0 – 2483.5 | 0.125 (<75 hopping channels) | 21.0(<75 hopping channels) | 122.2 (<75 hopping channels) | |
| | 1.0 (≥75 hopping channels) | 30.0 (≥75 hopping channels) | 131.2 (≥75 hopping channels) | |
| 5725.0 – 5850.0 | 1.0 | 30.0 | 131.2 | |

*- Equivalent field strength limit was calculated from the peak output power as follows: $E = \sqrt{(30 \times P \times G)/r}$, where P is peak output power in Watts, r is antenna to EUT distance in meters and G is transmitter antenna gain in dBi.

** - The limit is provided in terms of conducted RF power at the antenna connector. If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power limit shall be reduced below the stated value as follows:

- by 1 dB for every 3 dB that the directional gain of antenna exceeds 6 dBi for fixed point-to-point transmitters operate in 2400-2483.5 MHz band;
- without any corresponding reduction for fixed point-to-point transmitters operate in 5725-5850 MHz band;
- by the amount in dB that the directional gain of antenna exceeds 6 dBi for the rest of transmitters.

7.1.2 Test procedure

7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.

7.1.2.2 The EUT was adjusted to produce maximum available to end user RF output power.

7.1.2.3 The frequency span of spectrum analyzer was set approximately 5 times wider than 20 dB bandwidth of the EUT and the resolution bandwidth was set wider than 20 dB bandwidth of the EUT. To find maximum radiation the turntable was rotated 360° and the measuring antenna height was swept in both vertical and horizontal polarizations.

7.1.2.4 The maximum field strength of the EUT carrier frequency was measured as provided in Table 7.1.2 and associated plots.

7.1.2.5 The maximum peak output power was calculated from the field strength of carrier as follows:

$$P = (E \times d)^2 / (30 \times G),$$

where P is the peak output power in W, E is the field strength in V/m, d is the test distance and G is the transmitter numeric antenna gain over an isotropic radiator.

The above equation was converted in logarithmic units for 3 m test distance:

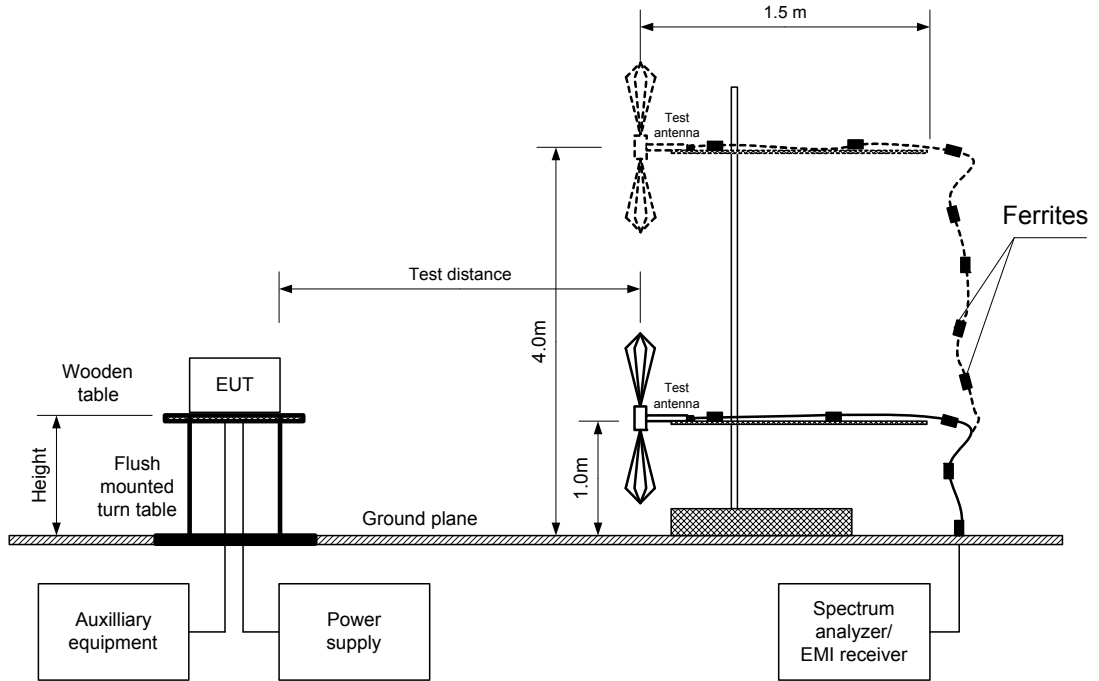
$$\text{Peak output power in dBm} = \text{Field strength in dB}(\mu\text{V/m}) - \text{Transmitter antenna gain in dBi} - 95.2 \text{ dB}$$

7.1.2.6 The worst test results (the lowest margins) were recorded in Table 7.1.2.



| | | | |
|----------------------------|----------------------------------------------------------------------|--------------------------------|----------------------------|
| Test specification: | Section 15.247(b), RSS-210 section A8.4(1), Peak output power | | |
| Test procedure: | Public notice DA 00-705 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 4/24/2012 | | |
| Temperature: 23 °C | Air Pressure: 1012 hPa | Relative Humidity: 47 % | Power Supply: 5 VDC |
| Remarks: | | | |

Figure 7.1.1 Setup for carrier field strength measurements





| | | | |
|----------------------------|-------------------------------|----------------------------------------------------------------------|----------------------------|
| Test specification: | | Section 15.247(b), RSS-210 section A8.4(1), Peak output power | |
| Test procedure: | | Public notice DA 00-705 | |
| Test mode: | | Compliance | |
| Date(s): | | 4/24/2012 | |
| Temperature: 23 °C | Air Pressure: 1012 hPa | Relative Humidity: 47 % | Power Supply: 5 VDC |
| Remarks: | | | |

Table 7.1.2 Peak output power test results

ASSIGNED FREQUENCY BAND: 902-928MHz
TEST DISTANCE: 3 m
TEST SITE: Semi anechoic chamber
EUT HEIGHT: 0.8 m
DETECTOR USED: Peak
TEST ANTENNA TYPE: Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 1 MHz
VIDEO BANDWIDTH: 3 MHz
FREQUENCY HOPPING: Disabled

| Frequency, MHz | Field strength, dB(µV/m) | Antenna polarization | Antenna height, m | Azimuth, degrees* | EUT antenna gain, dBi | Peak output power, dBm** | Limit, dBm | Margin, dB*** | Verdict |
|----------------|--------------------------|----------------------|-------------------|-------------------|-----------------------|--------------------------|------------|---------------|---------|
| 908.76 | 122.9 | V | 1.2 | 0 | 4 | 23.7 | 30 | -6.3 | Pass |

*- EUT front panel refer to 0 degrees position of turntable.

**-. Peak output power was calculated from the field strength of carrier as follows: $P = (E \times d)^2 / (30 \times G)$, where P is the peak output power in W, E is the field strength in V/m, d is the test distance in meters and G is the transmitter numeric antenna gain over an isotropic radiator. The above equation was converted in logarithmic units for 3 m test distance: *Peak output power in dBm = Field strength in dB(µV/m) - Transmitter antenna gain in dBi - 95.2 dB*

***- Margin = Peak output power – specification limit.

Reference numbers of test equipment used

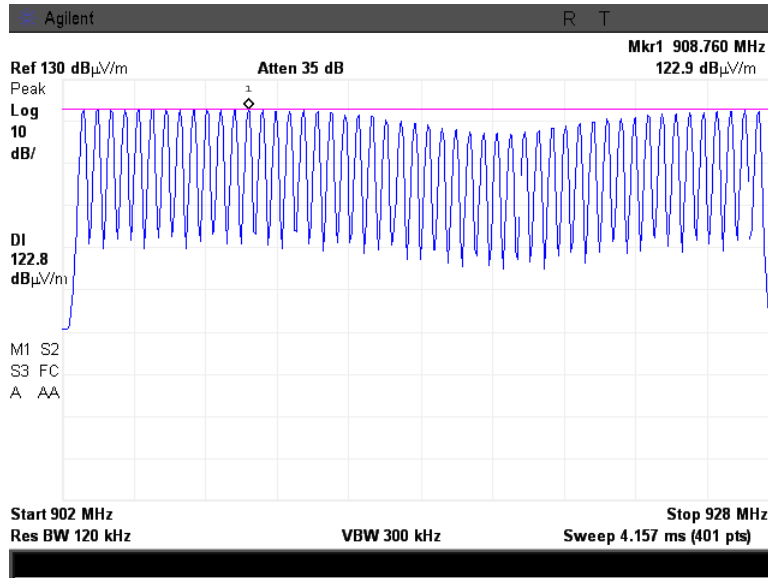
| | | | | | | | |
|---------|---------|---------|---------|--|--|--|--|
| HL 0521 | HL 0604 | HL 2871 | HL 3617 | | | | |
|---------|---------|---------|---------|--|--|--|--|

Full description is given in Appendix A.

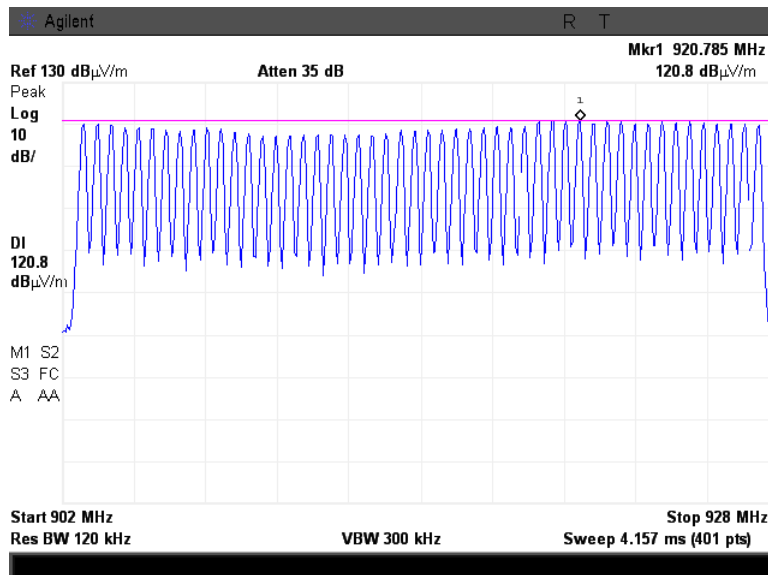


| | | | |
|------------------------------------------------------------------------------------------|-------------------------------|--------------------------------|----------------------------|
| Test specification: Section 15.247(b), RSS-210 section A8.4(1), Peak output power | | | |
| Test procedure: Public notice DA 00-705 | | | |
| Test mode: Compliance | Verdict: PASS | | |
| Date(s): 4/24/2012 | | | |
| Temperature: 23 °C | Air Pressure: 1012 hPa | Relative Humidity: 47 % | Power Supply: 5 VDC |
| Remarks: | | | |

Plot 7.1.1 Field strength of carrier at vertical antenna polarization



Plot 7.1.2 Field strength of carrier at horizontal antenna polarization





| | | | |
|----------------------------|---------------------------------------------------------------------------------|--------------------------------|----------------------------|
| Test specification: | Section 15.247(c), RSS-210 section A8.5, Radiated spurious emissions | | |
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 3/25/2012 - 4/24/2012 | | |
| Temperature: 22 °C | Air Pressure: 1017 hPa | Relative Humidity: 50 % | Power Supply: 5 VDC |
| Remarks: | | | |

7.2 Field strength of spurious emissions

7.2.1 General

This test was performed to measure field strength of spurious emissions from the EUT. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Radiated spurious emissions limits

| Frequency, MHz | Field strength at 3 m within restricted bands, dB(μV/m) ^{***} | | | Attenuation of field strength of spurious versus carrier outside restricted bands, dBc ^{***} |
|----------------------------------|------------------------------------------------------------------------|-----------------------------|-----------------------------|-------------------------------------------------------------------------------------------------------|
| | Peak | Quasi Peak | Average | |
| 0.009 – 0.090 | 148.5 – 128.5 | NA | 128.5 – 108.5 ^{**} | 20.0 |
| 0.090 – 0.110 | NA | 108.5 – 106.8 ^{**} | NA | |
| 0.110 – 0.490 | 126.8 – 113.8 | NA | 106.8 – 93.8 ^{**} | |
| 0.490 – 1.705 | NA | 73.8 – 63.0 ^{**} | NA | |
| 1.705 – 30.0* | | 69.5 | | |
| 30 – 88 | | 40.0 | | |
| 88 – 216 | | 43.5 | | |
| 216 – 960 | | 46.0 | | |
| 960 - 1000 | | 54.0 | | |
| 1000 – 10 th harmonic | 74.0 | NA | 54.0 | |

*- The limit for 3 m test distance was calculated using the inverse square distance extrapolation factor as follows:

$$\text{Lim}_{S_2} = \text{Lim}_{S_1} + 40 \log (S_1/S_2),$$

where S₁ and S₂ – standard defined and test distance respectively in meters.

** - The limit decreases linearly with the logarithm of frequency.

*** - The field strength limits applied from the lowest radio frequency generated in the device, without going below 9 kHz up to the tenth harmonic of the highest fundamental frequency.

7.2.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and the performance check was conducted.

7.2.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated around its vertical axis.

7.2.2.3 The worst test results (the lowest margins) were recorded and shown in the associated plots.

7.2.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.2.3.1 The EUT was set up as shown in Figure 7.2.2, energized and the performance check was conducted.

7.2.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.

7.2.3.3 The worst test results (the lowest margins) were recorded and shown in the associated plots.



| | | | |
|----------------------------|---------------------------------------------------------------------------------|--------------------------------|----------------------------|
| Test specification: | Section 15.247(c), RSS-210 section A8.5, Radiated spurious emissions | | |
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 3/25/2012 - 4/24/2012 | | |
| Temperature: 22 °C | Air Pressure: 1017 hPa | Relative Humidity: 50 % | Power Supply: 5 VDC |
| Remarks: | | | |

Figure 7.2.1 Setup for spurious emission field strength measurements below 30 MHz

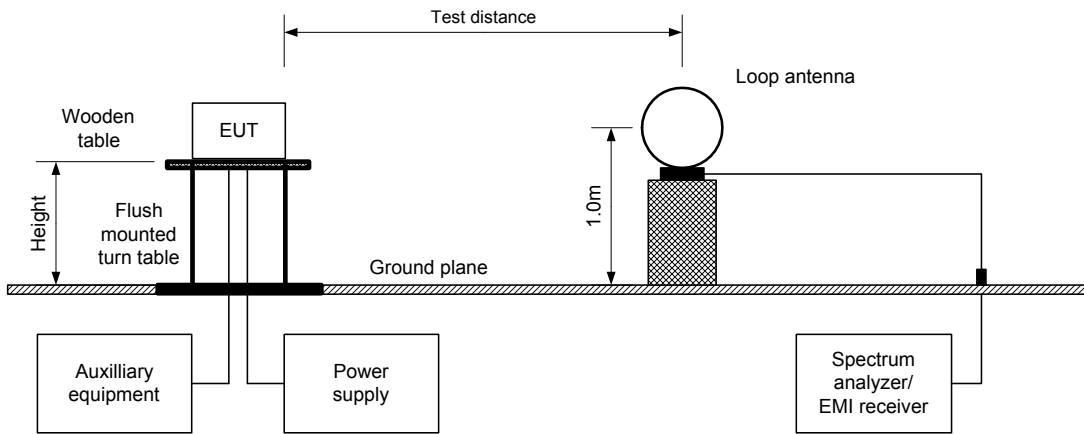
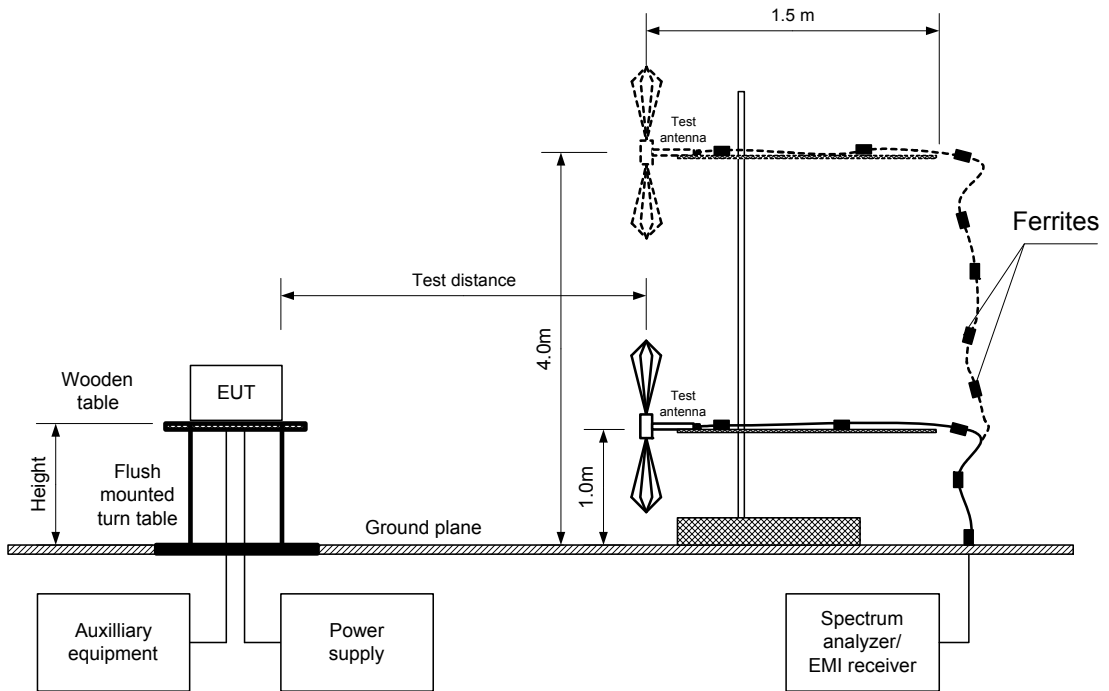


Figure 7.2.2 Setup for spurious emission field strength measurements above 30 MHz





| | | | |
|----------------------------|---------------------------------------------------------------------------------|--------------------------------|----------------------------|
| Test specification: | Section 15.247(c), RSS-210 section A8.5, Radiated spurious emissions | | |
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: PASS | |
| Date(s): | 3/25/2012 - 4/24/2012 | | |
| Temperature: 22 °C | Air Pressure: 1017 hPa | Relative Humidity: 50 % | Power Supply: 5 VDC |
| Remarks: | | | |

Table 7.2.2 Field strength of emissions outside restricted bands

ASSIGNED FREQUENCY BANDS: 902-928 MHz
2400-2483.5 MHz

INVESTIGATED FREQUENCY RANGE: 0.009 - 25000 MHz

TEST DISTANCE: 3 m

TRANSMITTER OUTPUT POWER SETTINGS: Maximum

DETECTOR USED: Peak

RESOLUTION BANDWIDTH: 100 kHz

VIDEO BANDWIDTH: 300 kHz

TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)

| Frequency, MHz | Field strength of spurious, dB(µV/m) | Antenna polarization | Antenna height, m | Azimuth, degrees* | Field strength of carrier, dB(µV/m) | Attenuation below carrier, dBc | Limit, dBc | Margin, dB** | Verdict |
|----------------|--------------------------------------|----------------------|-------------------|-------------------|-------------------------------------|--------------------------------|------------|--------------|---------|
| 1810 | 58.43 | V | 1.1 | 63 | 122.9 | 64.47 | 20.0 | 44.47 | Pass |

*- EUT front panel refers to 0 degrees position of turntable.

**- Margin = Attenuation below carrier – specification limit.

Table 7.2.3 Field strength of spurious emissions above 1 GHz within restricted bands

| Frequency, MHz | Antenna | | Azimuth, degrees* | Peak field strength(VBW=3 MHz) | | | Average field strength(VBW=10 Hz) | | | | Verdict |
|-----------------------------|--------------|-----------|-------------------|--------------------------------|-----------------|--------------|-----------------------------------|----------------------|-----------------|---------------|---------|
| | Polarization | Height, m | | Measured, dB(µV/m) | Limit, dB(µV/m) | Margin, dB** | Measured, dB(µV/m) | Calculated, dB(µV/m) | Limit, dB(µV/m) | Margin, dB*** | |
| 902-928 MHz band | | | | | | | | | | | |
| 3659.08 | V | 1.1 | 75 | 45.28 | 74 | -28.72 | 45.28 | 36.35 | 54 | -17.65 | Pass |
| 2400-2483.5 MHz band | | | | | | | | | | | |
| 4863.90 | V | 1.1 | 90 | 53.27 | 74 | -20.73 | 53.27 | 13.86 | 54 | -40.14 | Pass |

*- EUT front panel refers to 0 degrees position of turntable.

**- Margin = Measured field strength - specification limit.

***- Margin = Calculated field strength - specification limit,

where Calculated field strength = Measured field strength + average factor.

Table 7.2.4 Average factor calculation

| Transmission pulse (915.2 MHz) | | Transmission pulse (2.4 GHz) | | Average factor(915 MHz) dB | Average factor(2.4 GHz) dB |
|--------------------------------|------------|------------------------------|------------|-------------------------------|-------------------------------|
| Duration, ms | Period, ms | Duration, ms | Period, ms | | |
| 35.75 | 115.5 | 0.1125 | 10.5 | -8.93 | -39.41 |

*- Average factor was calculated as follows

for pulse train shorter than 100 ms:

$$Average\ factor = 20 \times \log_{10} \left(\frac{Pulse\ duration}{Pulse\ period} \times \frac{Burst\ duration}{Train\ duration} \times Number\ of\ bursts\ within\ pulse\ train \right)$$

for pulse train longer than 100 ms:

$$Average\ factor = 20 \times \log_{10} \left(\frac{Pulse\ duration}{Pulse\ period} \times \frac{Burst\ duration}{100\ ms} \times Number\ of\ bursts\ within\ 100\ ms \right)$$



| | | | | | |
|----------------------------|--|---------------------------------------------------------------------------------|--|--------------------------------|----------------------------|
| Test specification: | | Section 15.247(c), RSS-210 section A8.5, Radiated spurious emissions | | | |
| Test procedure: | | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | | |
| Test mode: | | Compliance | | Verdict: PASS | |
| Date(s): | | 3/25/2012 - 4/24/2012 | | | |
| Temperature: 22 °C | | Air Pressure: 1017 hPa | | Relative Humidity: 50 % | Power Supply: 5 VDC |
| Remarks: | | | | | |

Table 7.2.5 Field strength of spurious emissions below 1 GHz within restricted bands

| Frequency, MHz | Peak emission, dB(µV/m) | Quasi-peak | | | Antenna polarization | Antenna height, m | Turn-table position**, degrees | Verdict |
|----------------|-------------------------|-----------------------------|-----------------|-------------|----------------------|-------------------|--------------------------------|---------|
| | | Measured emission, dB(µV/m) | Limit, dB(µV/m) | Margin, dB* | | | | |
| 38.1 | 36.1 | 30.1 | 40 | -3.9 | V | 1.1 | 30 | Pass |
| 249.5 | 38.4 | 34.3 | 46 | -11.7 | V | 1.1 | 75 | |

*- Margin = Measured emission - specification limit.

** - EUT front panel refer to 0 degrees position of turntable.

Table 7.2.6 Restricted bands

| MHz | MHz | MHz | MHz | MHz | GHz |
|-------------------|---------------------|-----------------------|-----------------|---------------|---------------|
| 0.09 - 0.11 | 8.37625 - 8.38675 | 73 - 74.6 | 399.9 - 410 | 2690 - 2900 | 10.6 - 12.7 |
| 0.495 - 0.505 | 8.41425 - 8.41475 | 74.8 - 75.2 | 608 - 614 | 3260 - 3267 | 13.25 - 13.4 |
| 2.1735 - 2.1905 | 12.29 - 12.293 | 108 - 121.94 | 960 - 1240 | 3332 - 3339 | 14.47 - 14.5 |
| 4.125 - 4.128 | 12.51975 - 12.52025 | 123 - 138 | 1300 - 1427 | 3345.8 - 3358 | 15.35 - 16.2 |
| 4.17725 - 4.17775 | 12.57675 - 12.57725 | 149.9 - 150.05 | 1435 - 1626.5 | 3600 - 4400 | 17.7 - 21.4 |
| 4.20725 - 4.20775 | 13.36 - 13.41 | 156.52475 - 156.52525 | 1645.5 - 1646.5 | 4500 - 5150 | 22.01 - 23.12 |
| 6.215 - 6.218 | 16.42 - 16.423 | 156.7 - 156.9 | 1660 - 1710 | 5350 - 5460 | 23.6 - 24 |
| 6.26775 - 6.26825 | 16.69475 - 16.69525 | 162.0125 - 167.17 | 1718.8 - 1722.2 | 7250 - 7750 | 31.2 - 31.8 |
| 6.31175 - 6.31225 | 16.80425 - 16.80475 | 167.72 - 173.2 | 2200 - 2300 | 8025 - 8500 | 36.43 - 36.5 |
| 8.291 - 8.294 | 25.5 - 25.67 | 240 - 285 | 2310 - 2390 | 9000 - 9200 | Above 38.6 |
| 8.362 - 8.366 | 37.5 - 38.25 | 322 - 335.4 | 2483.5 - 2500 | 9300 - 9500 | |

Reference numbers of test equipment used

| | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| HL 0446 | HL 0521 | HL 0604 | HL 0768 | HL 1984 | HL 2387 | HL 2871 | HL 2909 |
| HL 3533 | HL 3535 | HL 3617 | HL 3901 | | | | |

Full description is given in Appendix A.

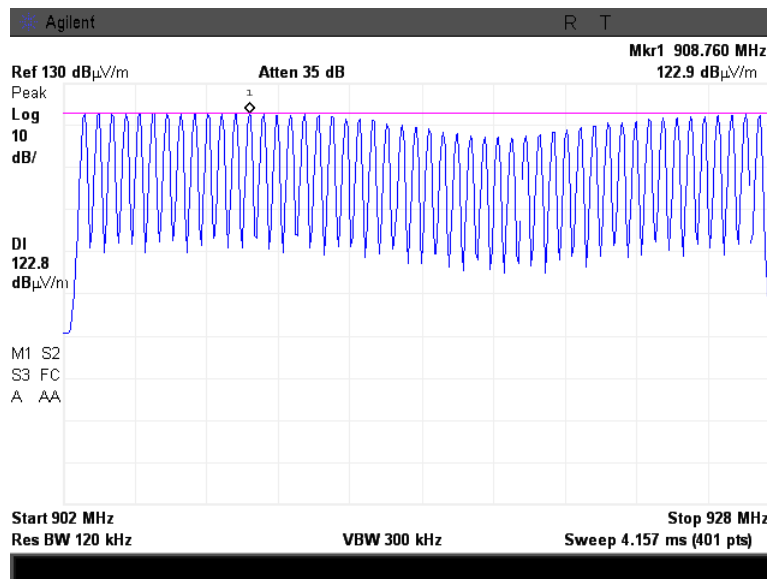


HERMON LABORATORIES

| | | | |
|----------------------------|---------------------------------------------------------------------------------|--------------------------------|----------------------------|
| Test specification: | Section 15.247(c), RSS-210 section A8.5, Radiated spurious emissions | | |
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 3/25/2012 - 4/24/2012 | | |
| Temperature: 22 °C | Air Pressure: 1017 hPa | Relative Humidity: 50 % | Power Supply: 5 VDC |
| Remarks: | | | |

Plot 7.2.1 Radiated emission measurements at carrier frequencies, 902-928 MHz band

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical& horizontal





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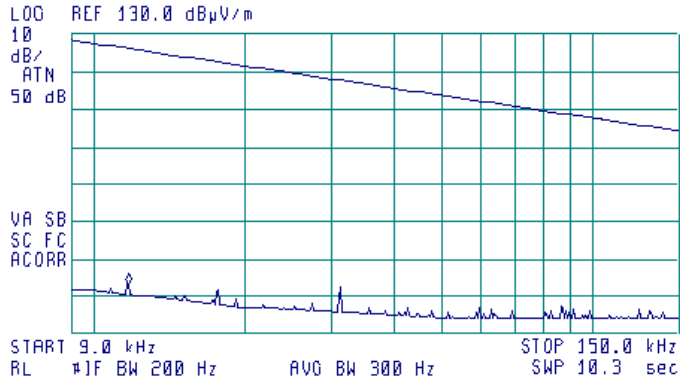
| | | | |
|----------------------------|---------------------------------------------------------------------------------|--------------------------------|----------------------------|
| Test specification: | Section 15.247(c), RSS-210 section A8.5, Radiated spurious emissions | | |
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 3/25/2012 - 4/24/2012 | | |
| Temperature: 22 °C | Air Pressure: 1017 hPa | Relative Humidity: 50 % | Power Supply: 5 VDC |
| Remarks: | | | |

Plot 7.2.2 Radiated emission measurements from 9 to 150 kHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 11.7 kHz
63.21 dBµV/m

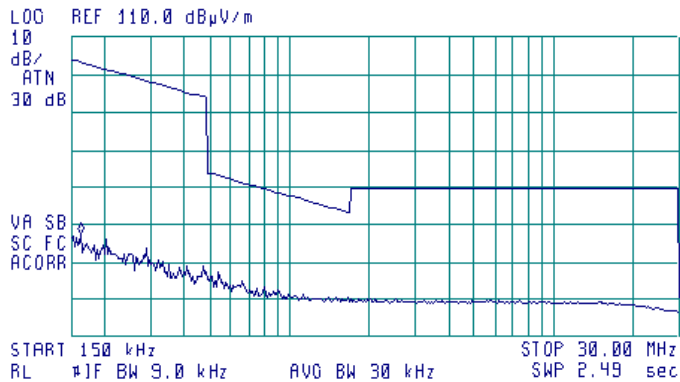


Plot 7.2.3 Radiated emission measurements from 0.15 to 30 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 160 kHz
57.37 dBµV/m

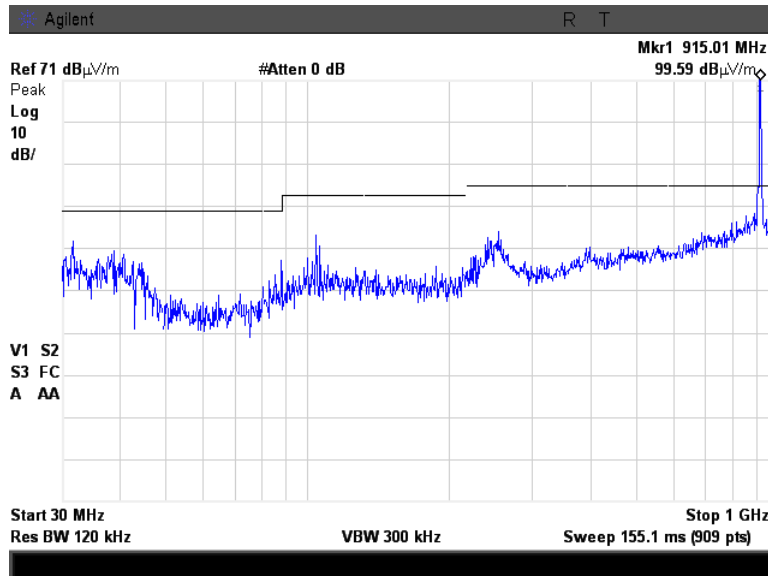
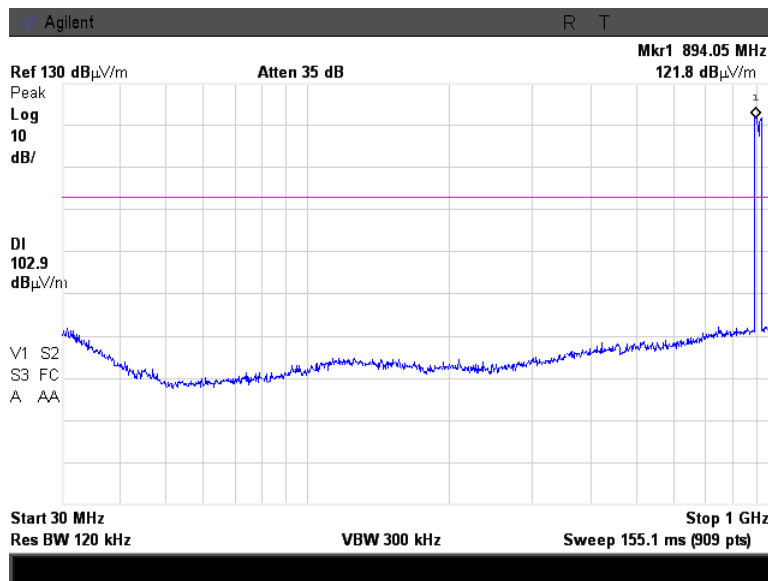




| | | | |
|----------------------------|---------------------------------------------------------------------------------|--------------------------------|----------------------------|
| Test specification: | Section 15.247(c), RSS-210 section A8.5, Radiated spurious emissions | | |
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 3/25/2012 - 4/24/2012 | | |
| Temperature: 22 °C | Air Pressure: 1017 hPa | Relative Humidity: 50 % | Power Supply: 5 VDC |
| Remarks: | | | |

Plot 7.2.4 Radiated emission measurements from 30 to 1000 MHz

TEST SITE: Anechoic chamber
 TEST DISTANCE: 3 m
 ANTENNA POLARIZATION: Vertical and Horizontal

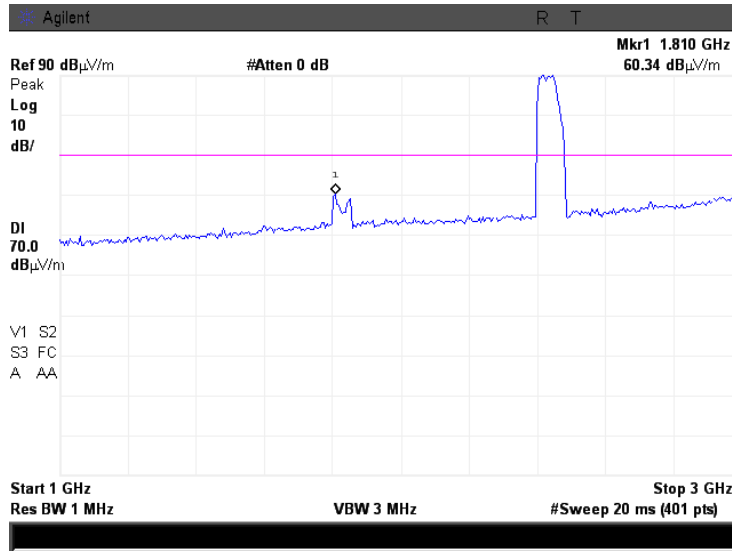




| | | | |
|----------------------------|---------------------------------------------------------------------------------|--------------------------------|----------------------------|
| Test specification: | Section 15.247(c), RSS-210 section A8.5, Radiated spurious emissions | | |
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 3/25/2012 - 4/24/2012 | | |
| Temperature: 22 °C | Air Pressure: 1017 hPa | Relative Humidity: 50 % | Power Supply: 5 VDC |
| Remarks: | | | |

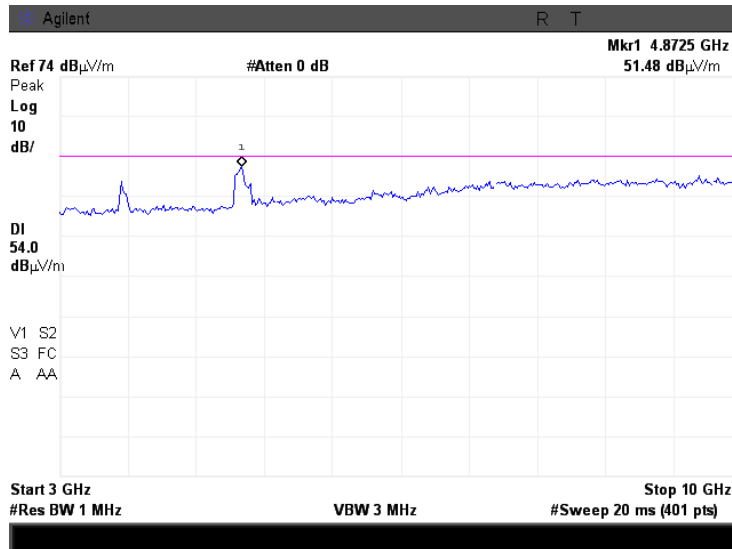
Plot 7.2.5 Radiated emission measurements from 1000 to 3000 MHz

TEST SITE: Anechoic chamber
 TEST DISTANCE: 3 m
 ANTENNA POLARIZATION: Vertical and Horizontal



Plot 7.2.6 Radiated emission measurements from 3000 to 10000 MHz

TEST SITE: Anechoic chamber
 TEST DISTANCE: 3 m
 ANTENNA POLARIZATION: Vertical and Horizontal



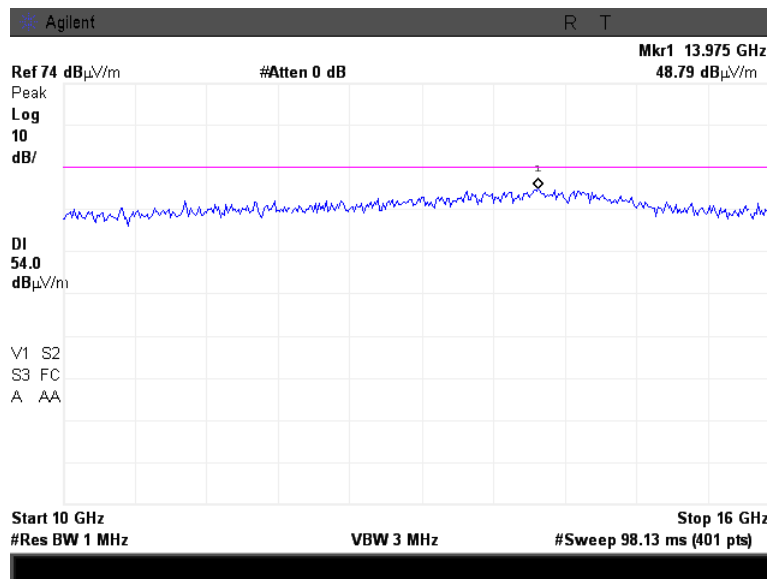


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| | | | |
|----------------------------|---------------------------------------------------------------------------------|--------------------------------|----------------------------|
| Test specification: | Section 15.247(c), RSS-210 section A8.5, Radiated spurious emissions | | |
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 3/25/2012 - 4/24/2012 | | |
| Temperature: 22 °C | Air Pressure: 1017 hPa | Relative Humidity: 50 % | Power Supply: 5 VDC |
| Remarks: | | | |

Plot 7.2.7 Radiated emission measurements from 10000 to 16000 MHz

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



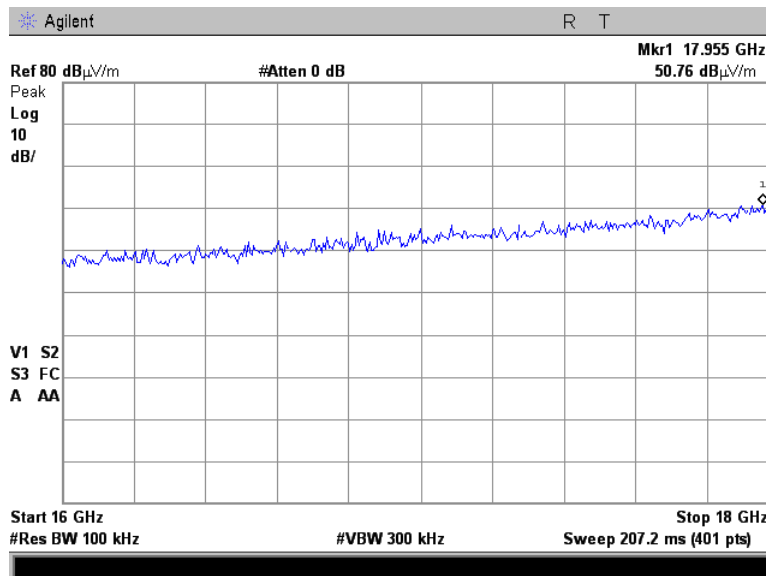
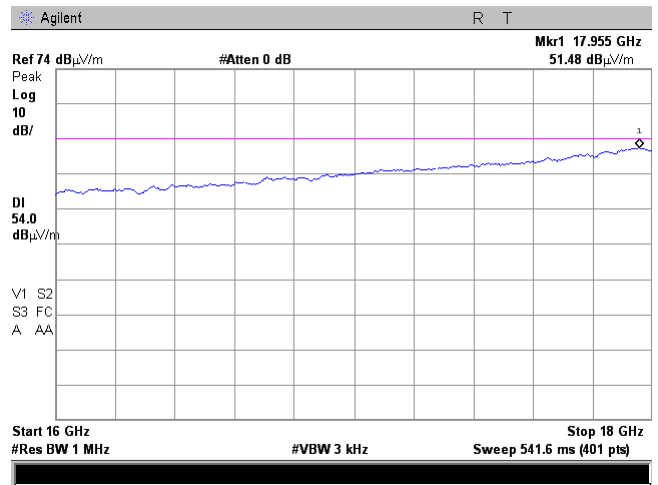
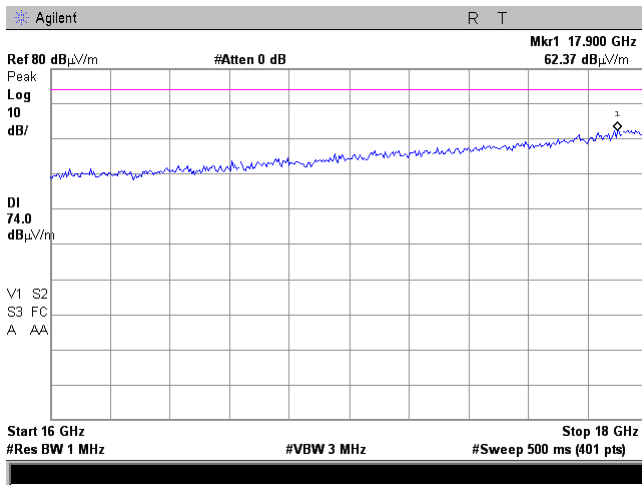


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| | | | |
|----------------------------|-------------------------------|---------------------------------------------------------------------------------|----------------------------|
| Test specification: | | Section 15.247(c), RSS-210 section A8.5, Radiated spurious emissions | |
| Test procedure: | | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | |
| Test mode: | | Verdict: PASS | |
| Date(s): | | 3/25/2012 - 4/24/2012 | |
| Temperature: 22 °C | Air Pressure: 1017 hPa | Relative Humidity: 50 % | Power Supply: 5 VDC |
| Remarks: | | | |

Plot 7.2.8 Radiated emission measurements from 16000 to 18000 MHz

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



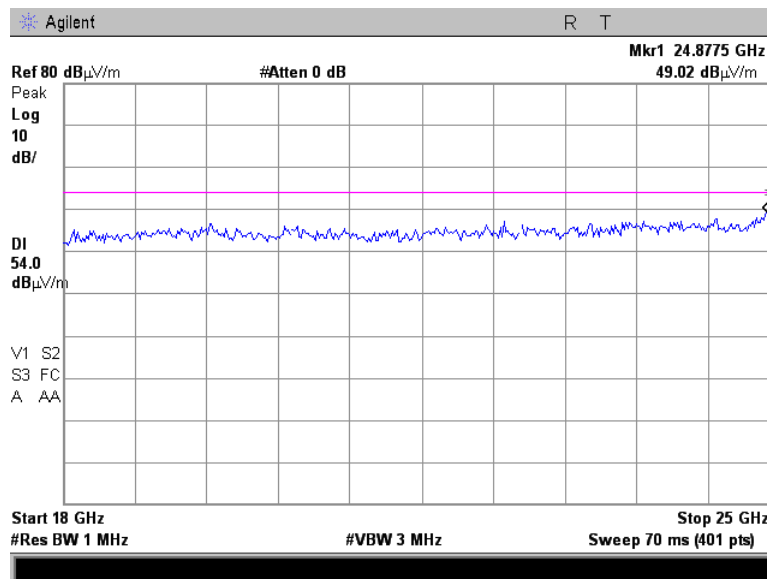


HERMON LABORATORIES

| | | | |
|----------------------------|---------------------------------------------------------------------------------|--------------------------------|----------------------------|
| Test specification: | Section 15.247(c), RSS-210 section A8.5, Radiated spurious emissions | | |
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: PASS | |
| Date(s): | 3/25/2012 - 4/24/2012 | | |
| Temperature: 22 °C | Air Pressure: 1017 hPa | Relative Humidity: 50 % | Power Supply: 5 VDC |
| Remarks: | | | |

Plot 7.2.9 Radiated emission measurements from 18000 to 25000 MHz

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



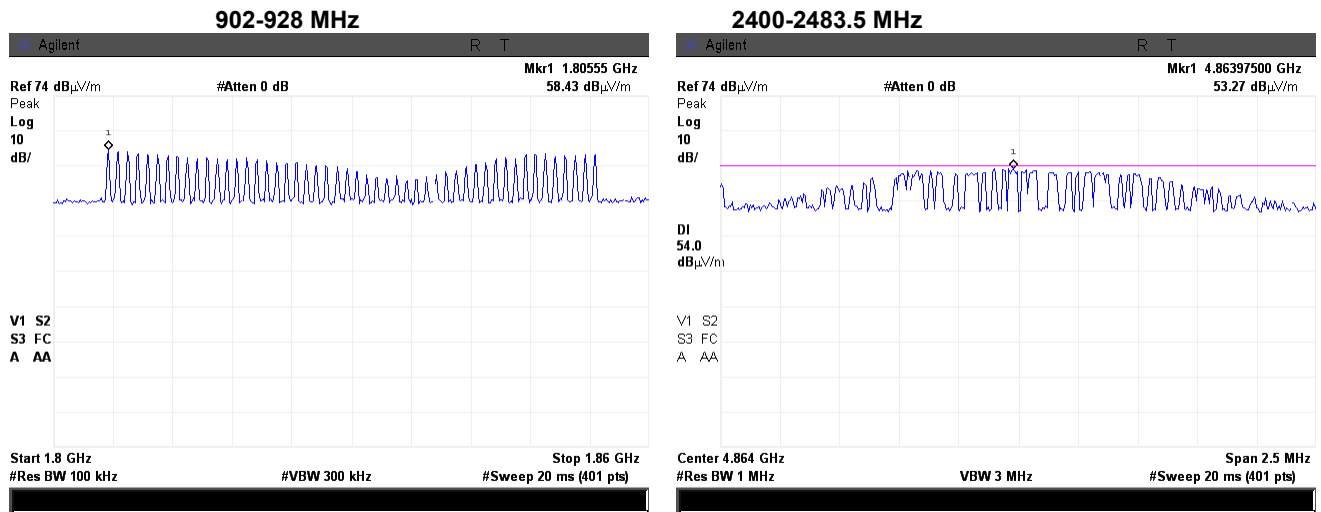


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| | | | |
|----------------------------|---------------------------------------------------------------------------------|--------------------------------|----------------------------|
| Test specification: | Section 15.247(c), RSS-210 section A8.5, Radiated spurious emissions | | |
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: PASS | |
| Date(s): | 3/25/2012 - 4/24/2012 | | |
| Temperature: 22 °C | Air Pressure: 1017 hPa | Relative Humidity: 50 % | Power Supply: 5 VDC |
| Remarks: | | | |

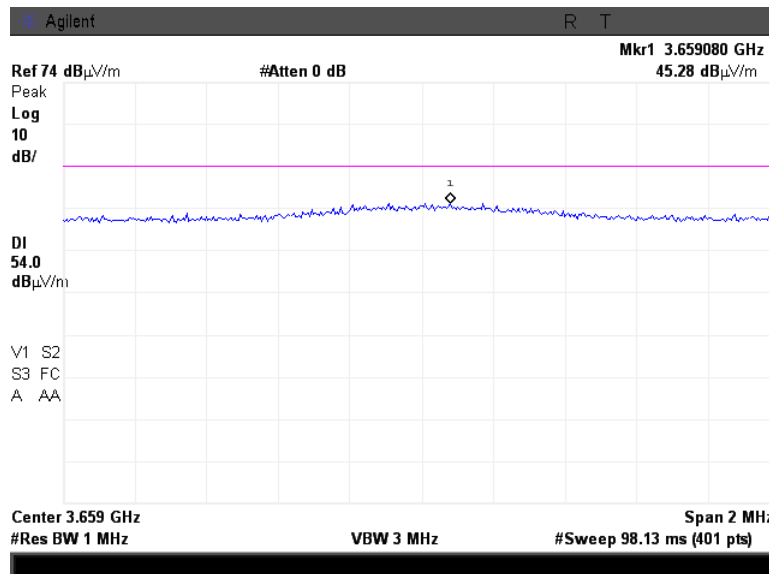
Plot 7.2.10 Radiated emission measurements at the second harmonic

TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Plot 7.2.11 Radiated emission measurements at the fourth harmonic

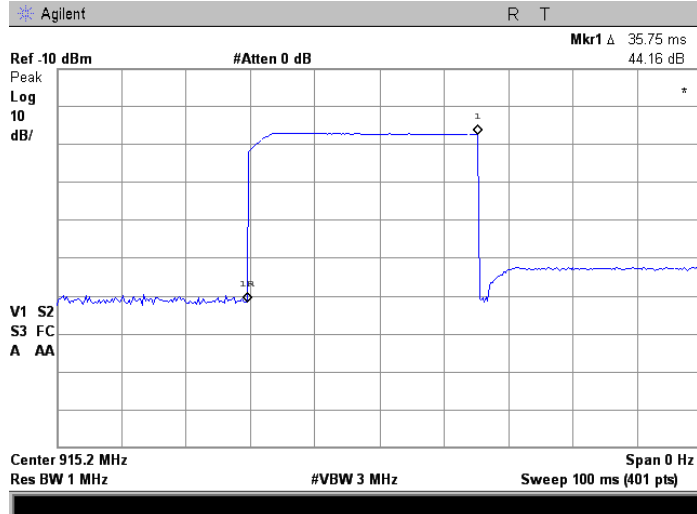
TEST SITE: Anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



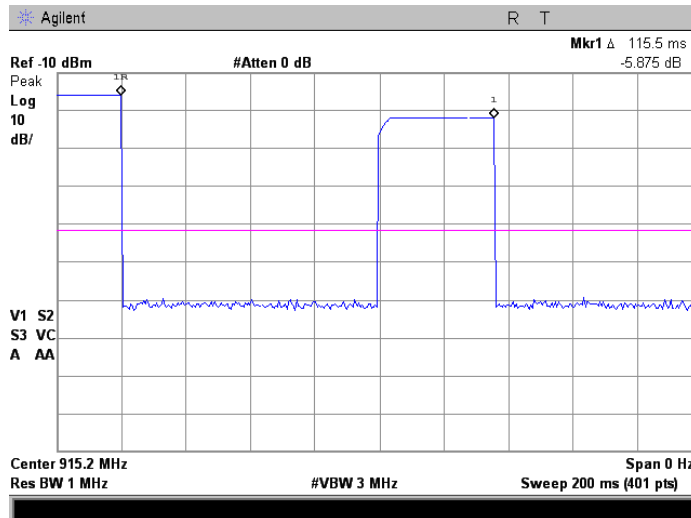


| | | | |
|----------------------------|---------------------------------------------------------------------------------|--------------------------------|----------------------------|
| Test specification: | Section 15.247(c), RSS-210 section A8.5, Radiated spurious emissions | | |
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 3/25/2012 - 4/24/2012 | | |
| Temperature: 22 °C | Air Pressure: 1017 hPa | Relative Humidity: 50 % | Power Supply: 5 VDC |
| Remarks: | | | |

Plot 7.2.12 Transmission pulse duration, 902-928 MHz



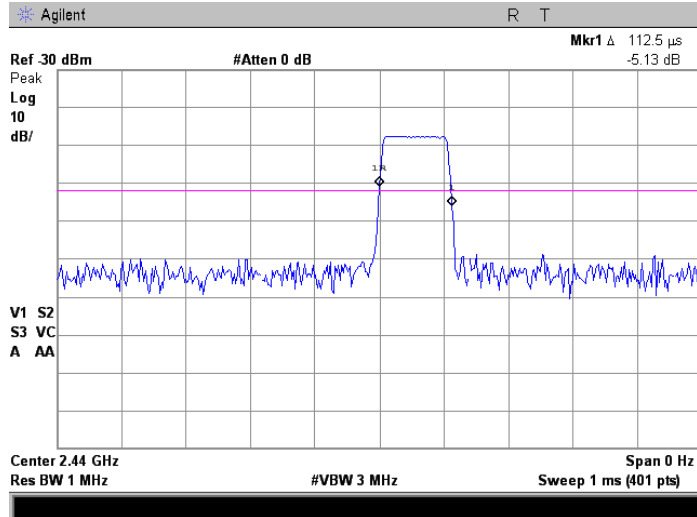
Plot 7.2.13 Transmission pulse period, 902-928 MHz



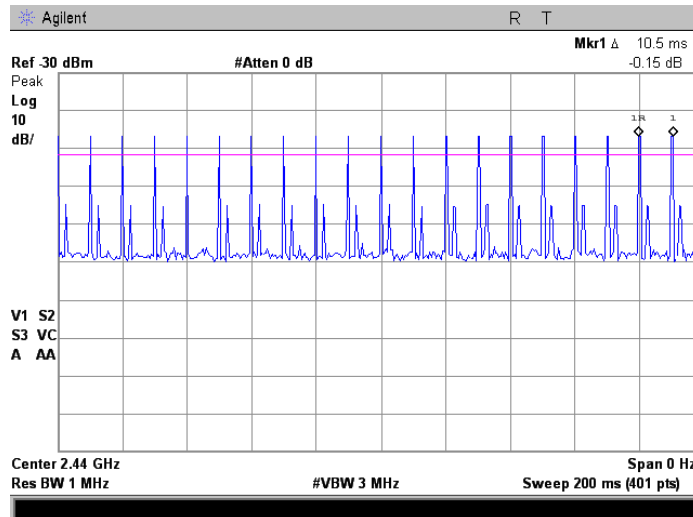


| | | | |
|----------------------------|---------------------------------------------------------------------------------|--------------------------------|----------------------------|
| Test specification: | Section 15.247(c), RSS-210 section A8.5, Radiated spurious emissions | | |
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 3/25/2012 - 4/24/2012 | | |
| Temperature: 22 °C | Air Pressure: 1017 hPa | Relative Humidity: 50 % | Power Supply: 5 VDC |
| Remarks: | | | |

Plot 7.2.14 Transmission pulse duration, 2400-2483.5 MHz



Plot 7.2.15 Transmission pulse period, 2400-2483.5 MHz





| | | | |
|----------------------------|----------------------------------------------------------------|--------------------------------|----------------------------|
| Test specification: | Section 15.109, ICES-003 section 5.5, Radiated emission | | |
| Test procedure: | ANSI C63.4, Sections 11.6 and 12.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 3/27/2012 - 3/28/2012 | | |
| Temperature: 22 °C | Air Pressure: 1015 hPa | Relative Humidity: 62 % | Power Supply: 5 VDC |
| Remarks: | | | |

7.3 Unintentional radiated emission measurements

7.3.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Radiated emission test limits according to FCC Part 15 Section 15.109

| Frequency, MHz | Class B limit, dB(µV/m) | | Class A limit, dB(µV/m) | |
|----------------|-------------------------|--------------|-------------------------|--------------|
| | 10 m distance | 3 m distance | 10 m distance | 3 m distance |
| 30 - 88 | 29.5* | 40.0 | 39.0 | 49.5* |
| 88 - 216 | 33.0* | 43.5 | 43.5 | 54.0* |
| 216 - 960 | 35.5* | 46.0 | 46.4 | 56.9* |
| Above 960 | 43.5* | 54.0 | 49.5 | 60.0* |

* The limit for test distance other than specified was calculated using the inverse linear distance extrapolation factor as follows: $Lim_{S_2} = Lim_{S_1} + 20 \log(S_1/S_2)$, where S_1 and S_2 – standard defined and test distance respectively in meters.

Table 7.3.2 Radiated emissions limits according to ICES-003 Section 5.5, Class B

| Frequency, MHz | Limit, dB(µV/m) | |
|----------------|-----------------|--------------|
| | 10 m distance | 3 m distance |
| 30 - 230 | 30.0 | 40.0* |
| 230 - 1000 | 37.0 | 47.0* |

* The limit for 3-m test distance shall be increased by 10 dB.

7.3.2 Test procedure for measurements in semi-anechoic chamber

7.3.2.1 The EUT was set up as shown in Figure 7.3.1 and associated photograph/s, energized and the performance check was conducted.

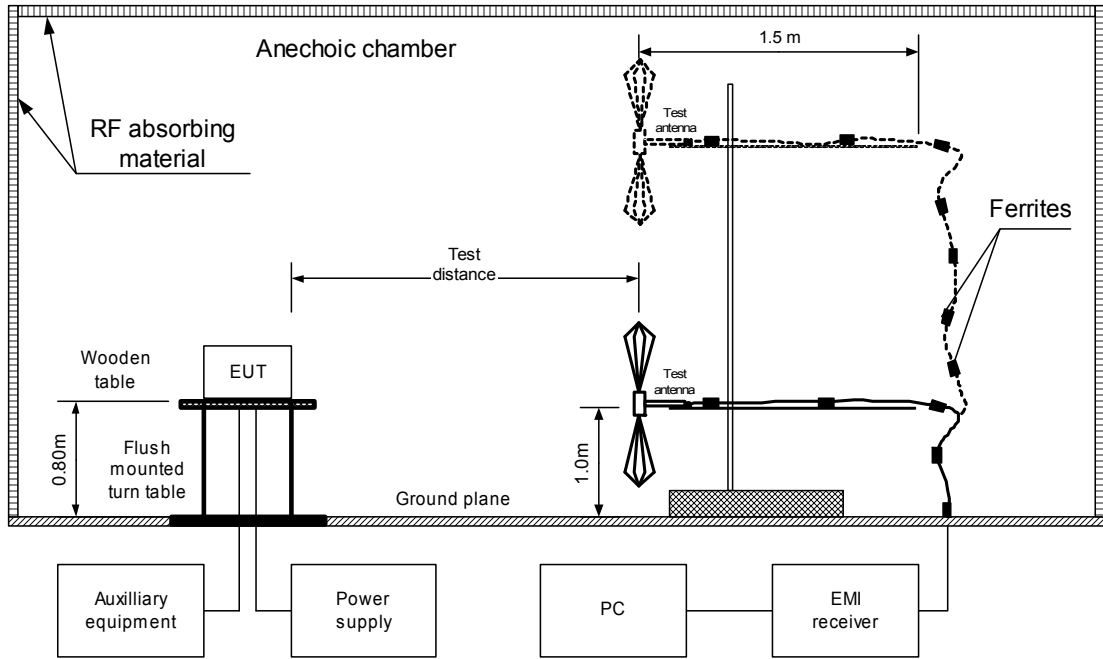
7.3.2.2 The specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal and the EUT cables position was varied.

7.3.2.3 The worst test results (the lowest margins) were recorded in Table 7.3.3 and shown in the associated plots.



| | | | |
|----------------------------|----------------------------------------------------------------|--------------------------------|----------------------------|
| Test specification: | Section 15.109, ICES-003 section 5.5, Radiated emission | | |
| Test procedure: | ANSI C63.4, Sections 11.6 and 12.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 3/27/2012 - 3/28/2012 | | |
| Temperature: 22 °C | Air Pressure: 1015 hPa | Relative Humidity: 62 % | Power Supply: 5 VDC |
| Remarks: | | | |

Figure 7.3.1 Setup for radiated emission measurements in anechoic chamber, table-top equipment





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| | | | | | |
|----------------------------|--|----------------------------------------------------------------|--|--------------------------------|----------------------------|
| Test specification: | | Section 15.109, ICES-003 section 5.5, Radiated emission | | | |
| Test procedure: | | ANSI C63.4, Sections 11.6 and 12.1.4 | | | |
| Test mode: | | Compliance | | Verdict: PASS | |
| Date(s): | | 3/27/2012 - 3/28/2012 | | | |
| Temperature: 22 °C | | Air Pressure: 1015 hPa | | Relative Humidity: 62 % | Power Supply: 5 VDC |
| Remarks: | | | | | |

Table 7.3.3 Radiated emission test results

EUT SET UP: TABLE-TOP
LIMIT: Class B
EUT OPERATING MODE: Receive / Stand-by
TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / QUASI-PEAK
FREQUENCY RANGE: 30 MHz – 1000 MHz
RESOLUTION BANDWIDTH: 120 kHz

FCC part 15

| Frequency, MHz | Peak emission, dB(µV/m) | Quasi-peak | | | Antenna polarization | Antenna height, m | Turn-table position**, degrees | Verdict |
|----------------|-------------------------|-----------------------------|-----------------|-------------|----------------------|-------------------|--------------------------------|---------|
| | | Measured emission, dB(µV/m) | Limit, dB(µV/m) | Margin, dB* | | | | |
| 55.4 | 30.0 | 24.8 | 40.0 | -15.2 | Vertical | 1.0 | 256 | Pass |
| 68.8 | 29.7 | 24.3 | 40.0 | -15.7 | Vertical | 1.0 | 270 | |
| 108.3 | 34.9 | 30.1 | 43.5 | -13.4 | Vertical | 1.0 | 210 | |
| 112.5 | 36.7 | 31.4 | 43.5 | -12.1 | Vertical | 1.0 | 230 | |
| 256.3 | 35.2 | 30.8 | 46.0 | -15.2 | Vertical | 1.0 | 210 | |

ICES-003

| Frequency, MHz | Peak emission, dB(µV/m) | Quasi-peak | | | Antenna polarization | Antenna height, m | Turn-table position**, degrees | Verdict |
|----------------|-------------------------|-----------------------------|-----------------|-------------|----------------------|-------------------|--------------------------------|---------|
| | | Measured emission, dB(µV/m) | Limit, dB(µV/m) | Margin, dB* | | | | |
| 55.4 | 30.0 | 24.8 | 40.0 | -15.2 | Vertical | 1.0 | 256 | Pass |
| 68.8 | 29.7 | 24.3 | 40.0 | -15.7 | Vertical | 1.0 | 270 | |
| 108.3 | 34.9 | 30.1 | 40.0 | -8.9 | Vertical | 1.0 | 210 | |
| 112.5 | 36.7 | 31.4 | 40.0 | -7.6 | Vertical | 1.0 | 230 | |
| 256.3 | 35.2 | 30.8 | 47.0 | -16.2 | Vertical | 1.0 | 210 | |

TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 MHz –12500 MHz
RESOLUTION BANDWIDTH: 1000 kHz

| Frequency, MHz | Peak | | | Average | | | Antenna polarization | Antenna height, m | Turn-table position**, degrees | Verdict |
|-----------------------|-----------------------------|-----------------|-------------|-----------------------------|-----------------|-------------|----------------------|-------------------|--------------------------------|---------|
| | Measured emission, dB(µV/m) | Limit, dB(µV/m) | Margin, dB* | Measured emission, dB(µV/m) | Limit, dB(µV/m) | Margin, dB* | | | | |
| No signals were found | | | | | | | | | | Pass |

*- Margin = Measured emission - specification limit.
**- EUT front panel refer to 0 degrees position of turntable.

Reference numbers of test equipment used

| | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|
| HL 0521 | HL 0604 | HL 1984 | HL 2871 | HL 2909 | HL 3533 | HL 3617 | HL 4160 |
| HL 4280 | | | | | | | |

Full description is given in Appendix A.

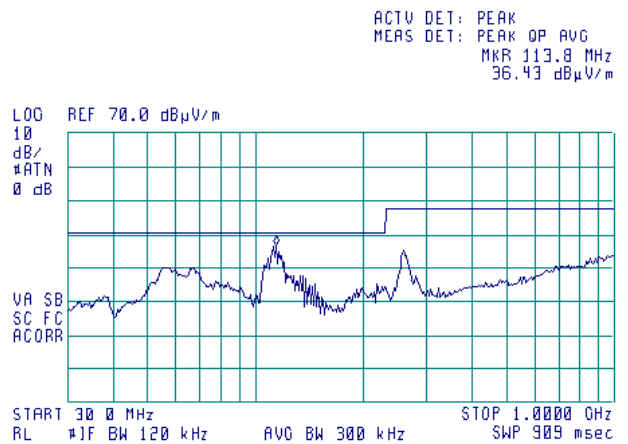
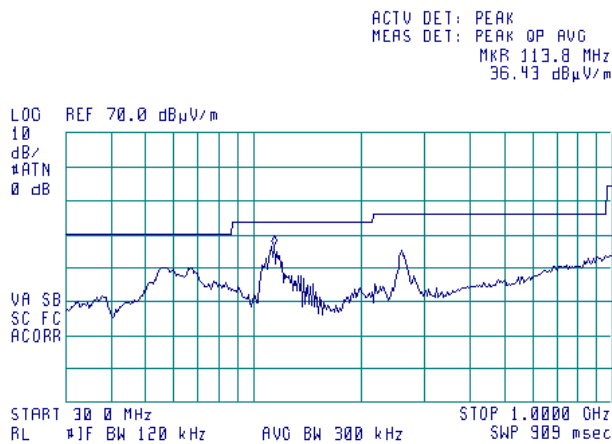


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| | | | |
|------------------------------------------------------------------------------------|-------------------------------|--------------------------------|----------------------------|
| Test specification: Section 15.109, ICES-003 section 5.5, Radiated emission | | | |
| Test procedure: ANSI C63.4, Sections 11.6 and 12.1.4 | | | |
| Test mode: Compliance | Verdict: PASS | | |
| Date(s): 3/27/2012 - 3/28/2012 | | | |
| Temperature: 22 °C | Air Pressure: 1015 hPa | Relative Humidity: 62 % | Power Supply: 5 VDC |
| Remarks: | | | |

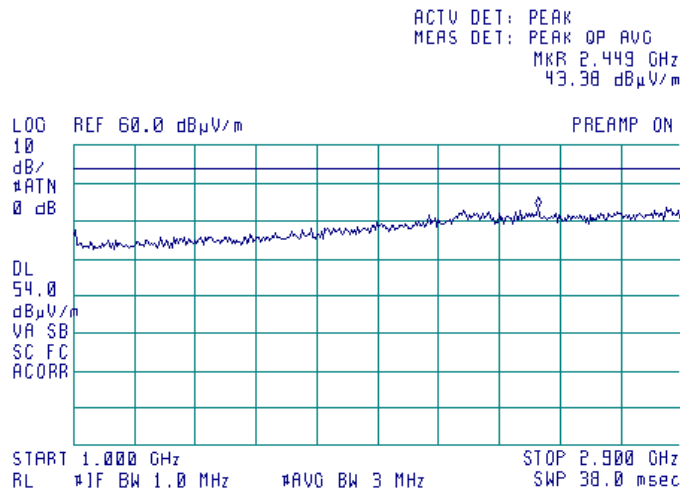
Plot 7.3.1 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive / Stand-by
ANTENNA POLARIZATION: Vertical & Horizontal



Plot 7.3.2 Radiated emission measurements in 1.0-2.9 GHz range

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive / Stand-by
ANTENNA POLARIZATION: Vertical & Horizontal



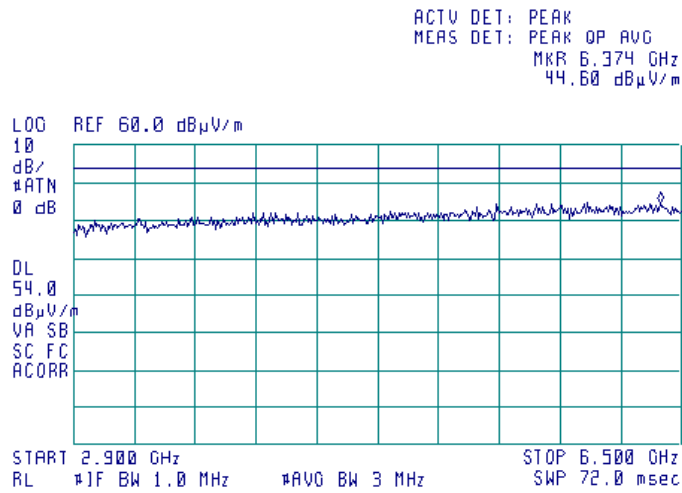


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| | | | |
|----------------------------|--|----------------------------------------------------------------|--|
| Test specification: | | Section 15.109, ICES-003 section 5.5, Radiated emission | |
| Test procedure: | | ANSI C63.4, Sections 11.6 and 12.1.4 | |
| Test mode: | | Compliance | |
| Date(s): | | 3/27/2012 - 3/28/2012 | |
| Temperature: 22 °C | | Air Pressure: 1015 hPa | |
| | | Relative Humidity: 62 % | |
| | | Power Supply: 5 VDC | |
| Remarks: | | | |

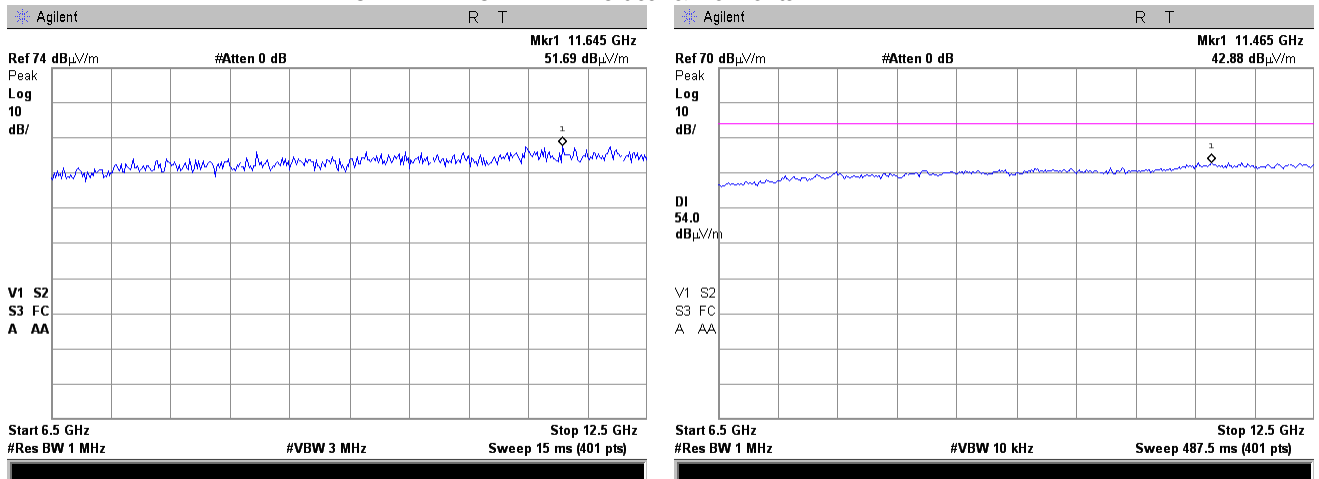
Plot 7.3.3 Radiated emission measurements in 2.9-6.5 GHz range

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive / Stand-by
ANTENNA POLARIZATION: Vertical & Horizontal



Plot 7.3.4 Radiated emission measurements in 6.5-12.5 GHz range

TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive / Stand-by
ANTENNA POLARIZATION: Vertical & Horizontal



**8 APPENDIX A Test equipment and ancillaries used for tests**

| HL No | Description | Manufacturer | Model | Ser. No. | Last Cal./ Check | Due Cal./ Check |
|-------|-----------------------------------------------------------------------|----------------------|-----------------|-----------------------------------|------------------|-----------------|
| 0446 | Antenna, Loop, Active, 10 kHz - 30 MHz | EMCO | 6502 | 2857 | 03-Jul-11 | 03-Jul-12 |
| 0521 | EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz | Hewlett Packard | 8546A | 3617A 00319, 3448A002 53 | 29-Aug-11 | 29-Sep-12 |
| 0604 | Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz | EMCO | 3141 | 9611-1011 | 11-Jan-11 | 11-Jan-13 |
| 0768 | Antenna Standard Gain Horn, 18-26.5 GHz, WR-42, 25 dB gain | Quinstar Technology | QWH-4200-BA | 110 | 03-Feb-12 | 03-Feb-15 |
| 1984 | Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W | EMC Test Systems | 3115 | 9911-5964 | 25-Nov-11 | 25-Nov-12 |
| 2387 | Filter Bandpass, 8-14 GHz | Hermon Laboratories | FBP8-14 | 2387 | 02-Oct-11 | 02-Oct-13 |
| 2871 | Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA | Huber-Suhner | 198-8155-00 | 2871 | 15-Jan-12 | 15-Jan-13 |
| 2909 | Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz | Agilent Technologies | E4407B | MY414447 62 | 08-May-11 | 08-May-12 |
| 3533 | Amplifier, low noise, 6 to 18 GHz | Quinstar Technology | QLJ-06184040-J0 | 111590010 01 | 25-Dec-11 | 25-Dec-12 |
| 3535 | Amplifier, low noise, 18 to 40 GHz | Quinstar Technology | QLJ-18404537-J0 | 111590030 01 | 11-Jul-11 | 11-Jul-12 |
| 3617 | Cable RF, 6.5 m, N type-N type, DC-6.5 GHz | Suhner Switzerland | RG 214/U | NA | 19-May-11 | 19-May-12 |
| 3901 | Microwave Cable Assembly, 40.0 GHz, 3.5 m, SMA/SMA | Huber-Suhner | SUCOFLE X 102A | 1225/2A | 08-Feb-12 | 08-Feb-13 |
| 4160 | Preamplifier, 0.1 to 18 GHz, Gain 25 dB, N-type(f) in, N-type(m) out. | Agilent Technologies | 87405C | MY470105 94 | 29-Jun-11 | 29-Jun-12 |
| 4280 | Test Cable , DC-18 GHz, 4.6 m, N/M - N/M | Mini-Circuits | APC-15FT-NMNM+ | 0763A | 23-Nov-11 | 23-Nov-12 |

**9 APPENDIX B Measurement uncertainties****Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements**

| Test description | Expanded uncertainty |
|------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Conducted carrier power at RF antenna connector | Below 12.4 GHz: ± 1.7 dB 12.4 GHz to 40 GHz: ± 2.3 dB |
| Conducted emissions at RF antenna connector | 9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB |
| Occupied bandwidth | ± 8.0 % |
| Duty cycle, timing (Tx ON / OFF) and average factor measurements | ± 1.0 % |
| Radiated emissions at 3 m measuring distance Horizontal polarization Vertical polarization | Biconilog antenna: ± 5.3 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.3 dB Double ridged horn antenna: ± 5.3 dB Biconilog antenna: ± 6.0 dB Biconical antenna: ± 5.7 dB Log periodic antenna: ± 6.0 dB Double ridged horn antenna: ± 6.0 dB |

Hermon Laboratories is accredited by A2LA for calibration according to present requirements of ISO/IEC 17025 and NCSL Z540-1. The accreditation is granted to perform calibration of parameters that are listed in the Scope of Hermon Laboratories Accreditation.

Hermon Laboratories calibrates its reference and transfer standards by calibration laboratories accredited to ISO/IEC 17025 by a mutually recognized Accreditation Body or by a recognized national metrology institute. All reference and transfer standards used in the calibration system are traceable to national or international standards.

In-house calibration of all test and measurement equipment is performed on a regular basis according to Hermon Laboratories calibration procedures, manufacturer calibration/verification procedures or procedures defined in the relevant standards. The Hermon Laboratories test and measurement equipment is calibrated within the tolerances specified by the manufacturers and/or by the relevant standards.

10 APPENDIX C Test laboratory description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, safety, environmental and telecommunication testing facility.

Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47), Registration Numbers 90624 for OATS and 90623 for the anechoic chamber; by Industry Canada for electromagnetic emissions (file numbers IC 2186A-1 for OATS, IC 2186A-2 for anechoic chamber, IC 2186A-3 for full-anechoic chamber for RE measurements above 1 GHz), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, G-27 for full-anechoic chamber for RE measurements above 1 GHz, C-845 for conducted emissions site, T-1606 for conducted emissions at telecommunication ports), has a status of a Telefication - Listed Testing Laboratory, Certificate No. L138/00. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing and environmental simulation (for exact scope please refer to Certificate No. 839.01). The FCC Designation Number is US1003.

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website: www.hermonlabs.com

Person for contact: Mr. Alex Usoskin, CEO.

11 APPENDIX D Specification references

| | |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 47CFR part 15: 2011 | Radio Frequency Devices. |
| ANSI C63.2: 1996 | American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications. |
| ANSI C63.4: 2003 | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz. |
| RSS-210 Issue 8: 2010 | Low Power Licence- Exempt Radiocommunication Devices |
| RSS-Gen Issue 3, September 2010 | General Requirements and Information for the certification of Radiocommunication Equipment |
| ICES-003 Issue 4: 2004 | Digital Apparatus |
| CAN/CSA-CEI/IEC CISPR 22: 2002 | Information Technology Equipment- Radio Disturbance Characteristics- Limits and Methods of measurement |



12 APPENDIX E Test equipment correction factors

**Antenna factor
Active loop antenna
Model 6502, S/N 2857, HL 0446**

| Frequency, MHz | Magnetic antenna factor, dB | Electric antenna factor, dB |
|----------------|-----------------------------|-----------------------------|
| 0.009 | -32.8 | 18.7 |
| 0.010 | -33.8 | 17.7 |
| 0.020 | -38.3 | 13.2 |
| 0.050 | -41.1 | 10.4 |
| 0.075 | -41.3 | 10.2 |
| 0.100 | -41.6 | 9.9 |
| 0.150 | -41.7 | 9.8 |
| 0.250 | -41.6 | 9.9 |
| 0.500 | -41.8 | 9.8 |
| 0.750 | -41.9 | 9.7 |
| 1.000 | -41.4 | 10.1 |
| 2.000 | -41.5 | 10.0 |
| 3.000 | -41.4 | 10.2 |
| 4.000 | -41.4 | 10.1 |
| 5.000 | -41.5 | 10.1 |
| 10.000 | -41.9 | 9.6 |
| 15.000 | -41.9 | 9.6 |
| 20.000 | -42.2 | 9.3 |
| 25.000 | -42.8 | 8.7 |
| 30.000 | -44.0 | 7.5 |

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field intensity in dB(μ V/m).

**Antenna factor
Standard gain horn antenna
Quinstar Technology
Model QWH
Ser.No.112, HL 0768, 0769, 0770, 0771, 0772**

| Frequency min, GHz | Frequency max, GHz | Antenna factor, dB(1/m) |
|--------------------|--------------------|-------------------------|
| 18.000 | 26.500 | 32.01 |
| 26.500 | 40.000 | 35.48 |
| 40.000 | 60.000 | 39.03 |
| 60.000 | 90.000 | 42.55 |
| 90.000 | 140.000 | 46.23 |
| 140.000 | 220.000 | 50.11 |

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field strength in dB(μ V/m).



Antenna factor
Biconilog antenna EMCO Model 3141
Ser.No.1011, HL 0604

| Frequency, MHz | Antenna Factor, dB(1/m) |
|----------------|-------------------------|
| 26 | 7.8 |
| 28 | 7.8 |
| 30 | 7.8 |
| 40 | 7.2 |
| 60 | 7.1 |
| 70 | 8.5 |
| 80 | 9.4 |
| 90 | 9.8 |
| 100 | 9.7 |
| 110 | 9.3 |
| 120 | 8.8 |
| 130 | 8.7 |
| 140 | 9.2 |
| 150 | 9.8 |
| 160 | 10.2 |
| 170 | 10.4 |
| 180 | 10.4 |
| 190 | 10.3 |
| 200 | 10.6 |
| 220 | 11.6 |
| 240 | 12.4 |
| 260 | 12.8 |
| 280 | 13.7 |
| 300 | 14.7 |
| 320 | 15.2 |
| 340 | 15.4 |
| 360 | 16.1 |
| 380 | 16.4 |
| 400 | 16.6 |
| 420 | 16.7 |
| 440 | 17.0 |
| 460 | 17.7 |
| 480 | 18.1 |
| 500 | 18.5 |
| 520 | 19.1 |
| 540 | 19.5 |
| 560 | 19.8 |
| 580 | 20.6 |
| 600 | 21.3 |
| 620 | 21.5 |
| 640 | 21.2 |
| 660 | 21.4 |
| 680 | 21.9 |
| 700 | 22.2 |
| 720 | 22.2 |
| 740 | 22.1 |
| 760 | 22.3 |
| 780 | 22.6 |
| 800 | 22.7 |
| 820 | 22.9 |
| 840 | 23.1 |
| 860 | 23.4 |
| 880 | 23.8 |
| 900 | 24.1 |
| 920 | 24.1 |

| Frequency, MHz | Antenna Factor, dB(1/m) |
|----------------|-------------------------|
| 940 | 24.0 |
| 960 | 24.1 |
| 980 | 24.5 |
| 1000 | 24.9 |
| 1020 | 25.0 |
| 1040 | 25.2 |
| 1060 | 25.4 |
| 1080 | 25.6 |
| 1100 | 25.7 |
| 1120 | 26.0 |
| 1140 | 26.4 |
| 1160 | 27.0 |
| 1180 | 27.0 |
| 1200 | 26.7 |
| 1220 | 26.5 |
| 1240 | 26.5 |
| 1260 | 26.5 |
| 1280 | 26.6 |
| 1300 | 27.0 |
| 1320 | 27.8 |
| 1340 | 28.3 |
| 1360 | 28.2 |
| 1380 | 27.9 |
| 1400 | 27.9 |
| 1420 | 27.9 |
| 1440 | 27.8 |
| 1460 | 27.8 |
| 1480 | 28.0 |
| 1500 | 28.5 |
| 1520 | 28.9 |
| 1540 | 29.6 |
| 1560 | 29.8 |
| 1580 | 29.6 |
| 1600 | 29.5 |
| 1620 | 29.3 |
| 1640 | 29.2 |
| 1660 | 29.4 |
| 1680 | 29.6 |
| 1700 | 29.8 |
| 1720 | 30.3 |
| 1740 | 30.8 |
| 1760 | 31.1 |
| 1780 | 31.0 |
| 1800 | 30.9 |
| 1820 | 30.7 |
| 1840 | 30.6 |
| 1860 | 30.6 |
| 1880 | 30.6 |
| 1900 | 30.6 |
| 1920 | 30.7 |
| 1940 | 30.9 |
| 1960 | 31.2 |
| 1980 | 31.6 |
| 2000 | 32.0 |

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field intensity in dB(μ V/m).



Antenna factor
Double-ridged wave guide horn antenna
Model 3115, S/N 9911-5964, HL1984

| Frequency, MHz | Antenna factor, dB(1/m) |
|----------------|-------------------------|
| 1000.0 | 24.7 |
| 1500.0 | 25.7 |
| 2000.0 | 27.6 |
| 2500.0 | 28.9 |
| 3000.0 | 31.2 |
| 3500.0 | 32.0 |
| 4000.0 | 32.5 |
| 4500.0 | 32.7 |
| 5000.0 | 33.6 |
| 5500.0 | 35.1 |
| 6000.0 | 35.4 |
| 6500.0 | 34.9 |
| 7000.0 | 36.1 |
| 7500.0 | 37.8 |
| 8000.0 | 38.0 |
| 8500.0 | 38.1 |
| 9000.0 | 39.1 |
| 9500.0 | 38.3 |
| 10000.0 | 38.6 |
| 10500.0 | 38.2 |
| 11000.0 | 38.7 |
| 11500.0 | 39.5 |
| 12000.0 | 40.0 |
| 12500.0 | 40.4 |
| 13000.0 | 40.5 |
| 13500.0 | 41.1 |
| 14000.0 | 41.6 |
| 14500.0 | 41.7 |
| 15000.0 | 38.7 |
| 15500.0 | 38.2 |
| 16000.0 | 38.8 |
| 16500.0 | 40.5 |
| 17000.0 | 42.5 |
| 17500.0 | 45.9 |
| 18000.0 | 49.4 |

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field intensity in dB(μ V/m).



Cable loss
Cable coaxial, Huber-Suhner, 18 GHz, 6.4 m, SMA - SMA, model 198-8155-00,
HL 2871

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|----------------|----------------|----------------|----------------|----------------|----------------|
| 10 | 0.12 | 5750 | 2.34 | 12000 | 3.55 |
| 30 | 0.14 | 6000 | 2.39 | 12250 | 3.61 |
| 100 | 0.27 | 6250 | 2.46 | 12500 | 3.67 |
| 250 | 0.45 | 6500 | 2.52 | 12750 | 3.74 |
| 500 | 0.63 | 6750 | 2.58 | 13000 | 3.79 |
| 750 | 0.76 | 7000 | 2.64 | 13250 | 3.82 |
| 1000 | 0.89 | 7250 | 2.68 | 13500 | 3.83 |
| 1250 | 1.01 | 7500 | 2.73 | 13750 | 3.83 |
| 1500 | 1.12 | 7750 | 2.78 | 14000 | 3.88 |
| 1750 | 1.23 | 8000 | 2.83 | 14250 | 3.93 |
| 2000 | 1.32 | 8250 | 2.88 | 14500 | 3.96 |
| 2250 | 1.41 | 8500 | 2.94 | 14750 | 4.01 |
| 2500 | 1.49 | 8750 | 2.97 | 15000 | 4.00 |
| 2750 | 1.58 | 9000 | 3.02 | 15250 | 4.01 |
| 3000 | 1.66 | 9250 | 3.07 | 15500 | 4.00 |
| 3250 | 1.73 | 9500 | 3.13 | 15750 | 4.13 |
| 3500 | 1.80 | 9750 | 3.18 | 16000 | 4.22 |
| 3750 | 1.87 | 10000 | 3.21 | 16250 | 4.29 |
| 4000 | 1.93 | 10250 | 3.26 | 16500 | 4.29 |
| 4250 | 2.01 | 10500 | 3.30 | 16750 | 4.32 |
| 4500 | 2.06 | 10750 | 3.36 | 17000 | 4.37 |
| 4750 | 2.12 | 11000 | 3.39 | 17250 | 4.45 |
| 5000 | 2.17 | 11250 | 3.44 | 17500 | 4.49 |
| 5250 | 2.24 | 11500 | 3.48 | 17750 | 4.53 |
| 5500 | 2.29 | 11750 | 3.52 | 18000 | 4.55 |



Cable loss
Cable coaxial, RG-214/U, N type-N type, 6.5 m
Suhner Switzerland, HL 3617

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|----------------|----------------|----------------|----------------|----------------|----------------|
| 10 | 0.13 | 2200 | 2.97 | 4500 | 5.10 |
| 50 | 0.33 | 2300 | 3.06 | 4600 | 5.20 |
| 100 | 0.48 | 2400 | 3.16 | 4700 | 5.34 |
| 200 | 0.71 | 2500 | 3.23 | 4800 | 5.36 |
| 300 | 0.89 | 2600 | 3.34 | 4900 | 5.48 |
| 400 | 1.04 | 2700 | 3.42 | 5000 | 5.52 |
| 500 | 1.19 | 2800 | 3.52 | 5100 | 5.61 |
| 600 | 1.32 | 2900 | 3.61 | 5200 | 5.72 |
| 700 | 1.44 | 3000 | 3.69 | 5300 | 5.81 |
| 800 | 1.56 | 3100 | 3.80 | 5400 | 5.93 |
| 900 | 1.68 | 3200 | 3.86 | 5500 | 6.08 |
| 1000 | 1.80 | 3300 | 3.98 | 5600 | 6.12 |
| 1100 | 1.90 | 3400 | 4.07 | 5700 | 6.25 |
| 1200 | 2.00 | 3500 | 4.14 | 5800 | 6.31 |
| 1300 | 2.11 | 3600 | 4.27 | 5900 | 6.41 |
| 1400 | 2.21 | 3700 | 4.36 | 6000 | 6.51 |
| 1500 | 2.30 | 3800 | 4.47 | 6100 | 6.62 |
| 1600 | 2.40 | 3900 | 4.62 | 6200 | 6.73 |
| 1700 | 2.49 | 4000 | 4.63 | 6300 | 6.86 |
| 1800 | 2.61 | 4100 | 4.76 | 6400 | 6.94 |
| 1900 | 2.69 | 4200 | 4.83 | 6500 | 7.06 |
| 2000 | 2.79 | 4300 | 4.89 | | |
| 2100 | 2.88 | 4400 | 5.04 | | |



Cable loss
Microwave Cable Assembly, Huber-Suhner, 40 GHz, 3.5 m, SMA-SMA, S/N 1225/2A
HL 3901

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|----------------|----------------|----------------|----------------|----------------|----------------|
| 10 | 0.09 | 9500 | 4.29 | 21000 | 6.67 |
| 100 | 0.41 | 10000 | 4.40 | 22000 | 6.92 |
| 500 | 0.93 | 10500 | 4.52 | 23000 | 7.00 |
| 1000 | 1.33 | 11000 | 4.64 | 24000 | 7.18 |
| 1500 | 1.63 | 11500 | 4.76 | 25000 | 7.29 |
| 2000 | 1.90 | 12000 | 4.87 | 26000 | 7.55 |
| 2500 | 2.12 | 12500 | 4.99 | 27000 | 7.70 |
| 3000 | 2.33 | 13000 | 5.11 | 28000 | 7.88 |
| 3500 | 2.50 | 13500 | 5.20 | 29000 | 8.02 |
| 4000 | 2.67 | 14000 | 5.31 | 30000 | 8.15 |
| 4500 | 2.82 | 14500 | 5.42 | 31000 | 8.35 |
| 5000 | 2.99 | 15000 | 5.51 | 32000 | 8.40 |
| 5500 | 3.16 | 15500 | 5.58 | 33000 | 8.62 |
| 6000 | 3.32 | 16000 | 5.68 | 34000 | 8.73 |
| 6500 | 3.51 | 16500 | 5.78 | 35000 | 8.78 |
| 7000 | 3.65 | 17000 | 5.91 | 36000 | 8.94 |
| 7500 | 3.79 | 17500 | 5.99 | 37000 | 9.21 |
| 8000 | 3.92 | 18000 | 6.07 | 38000 | 9.37 |
| 8500 | 4.04 | 19000 | 6.36 | 39000 | 9.45 |
| 9000 | 4.18 | 20000 | 6.49 | 40000 | 9.52 |



13 APPENDIX F Abbreviations and acronyms

| | |
|----------------|---------------------------------------------|
| A | ampere |
| AC | alternating current |
| A/m | ampere per meter |
| AM | amplitude modulation |
| AVRG | average (detector) |
| cm | centimeter |
| dB | decibel |
| dBm | decibel referred to one milliwatt |
| dB(μ V) | decibel referred to one microvolt |
| dB(μ V/m) | decibel referred to one microvolt per meter |
| dB(μ A) | decibel referred to one microampere |
| DC | direct current |
| EIRP | equivalent isotropically radiated power |
| ERP | effective radiated power |
| EUT | equipment under test |
| F | frequency |
| GHz | gigahertz |
| GND | ground |
| H | height |
| HL | Hermon laboratories |
| Hz | hertz |
| k | kilo |
| kHz | kilohertz |
| LO | local oscillator |
| m | meter |
| MHz | megahertz |
| min | minute |
| mm | millimeter |
| ms | millisecond |
| μ s | microsecond |
| NA | not applicable |
| NB | narrow band |
| OATS | open area test site |
| Ω | Ohm |
| PM | pulse modulation |
| PS | power supply |
| ppm | part per million (10^{-6}) |
| QP | quasi-peak |
| RE | radiated emission |
| RF | radio frequency |
| rms | root mean square |
| Rx | receive |
| s | second |
| T | temperature |
| Tx | transmit |
| V | volt |
| WB | wideband |

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