HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

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# TEST REPORT

**ACCORDING TO: FCC 47 CFR PART 15 subpart C, section 15.249 and subpart B**

**FOR:**

## SCR Engineers Ltd.
## LD Module
## Model: LD-BU-MODULE
## FCC ID:AMULDBUMODULE

# Table of contents

# 1 Applicant information

| | |
|---|---|
| **Client name:** | SCR Engineers Ltd. |
| **Address:** | 6 Haomanut street, Industrial zone, P.O.B. 13564, Netanya 42138, Israel |
| **Telephone:** | +972 73 240 6053 |
| **Fax:** | +972 9865 0703 |
| **E-mail:** | zeevk@scr.co.il |
| **Contact name:** | Mr. Zeev Kapelnik |

# 2 Equipment under test attributes

| | |
|---|---|
| **Product name:** | LD module |
| **Product type:** | Transceiver |
| **Model(s):** | LD-BU-MODULE |
| **Hardware version:** | Rev.100 |
| **Receipt date** | 1/22/2012 |

# 3 Manufacturer information

| | |
|---|---|
| **Manufacturer name:** | SCR Engineers Ltd. |
| **Address:** | 6 Haomanut street, Industrial zone, P.O.B. 13564, Netanya 42138, Israel |
| **Telephone:** | +972 73 240 6053 |
| **Fax:** | +972 9865 0703 |
| **E-Mail:** | zeevk@scr.co.il |
| **Contact name:** | Mr. Zeev Kapelnik |

# 4 Test details

| | |
|---|---|
| **Project ID:** | 22779 |
| **Location:** | Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel |
| **Test started:** | 1/22/2012 |
| **Test completed:** | 1/26/2012 |
| **Test specification(s):** | FCC 47 CFR Part 15, subpart C, §15.249; subpart B §15.109 |

# 5 Tests summary

| Test | Status |
|---|---|
| **Transmitter characteristics** | |
| Section 15.249(a)(d, Field strength of emissions | Pass |
| Section 15.249(d), Band edge emissions | Pass |
| Section 15.203, Antenna requirement | Pass |
| Section 15.215(c), Occupied bandwidth | Pass |
| Section 15.207(a), Conducted emission | Not required |
| **Unintentional emissions** | |
| Section 15.107, Conducted emission at AC power port | Not required |
| Section 15.109, Radiated emission | Pass |

Testing was completed against all relevant requirements of the test standard. The results obtained indicate that the product under test complies in full with the requirements tested.
The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

This test report replaces the previously issued test report identified by Doc ID:SCRRAD_FCC.22779.

| | Name and Title | Date | Signature |
|---|---|---|---|
| **Tested by:** | Mrs. E. Pitt, test engineer | January 26, 2012 |  |
| **Reviewed by:** | Mrs. M. Cherniavsky, certification engineer | February 15, 2012 |  |
| **Approved by:** | Mr. M. Nikishin, EMC and radio group manager | March 16, 2012 |  |

# 6 EUT description

## 6.1 General information

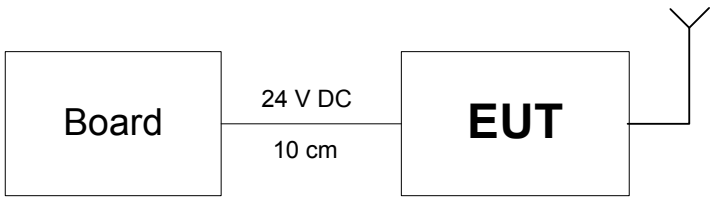
The EUT, LD (long distance) module, is a part of BU500/ BU500E LD base units used to collect messages from tags and send them to central management system.

The model BU500 is a LD base unit with RS-485 network interface, the model BU500E – LD base unit with 10BASE-T/100BASE-TX Ethernet network interface.

## 6.2 Changes made in EUT

No changes were performed in the EUT.

## 6.3 Test configuration



## 6.4 Transmitter characteristics

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Type of equipment** | | | | | | | |
| **V** | Stand-alone (Equipment with or without its own control provisions) | | | | | | |
| | Combined equipment (Equipment where the radio part is fully integrated within another type of equipment) | | | | | | |
| | Plug-in card (Equipment intended for a variety of host systems) | | | | | | |
| **Assigned frequency range** | 2400 – 2483.5 MHz | | | | | | |
| **Operating frequency range** | 2405 – 2480 MHz | | | | | | |
| **RF channel spacing** | 5 MHz | | | | | | |
| **Maximum field strength of carrier** | 105.8 dBµV/m at 3 m distance | | | | | | |
| **Is transmitter output power variable?** | **V** | No | | | | | |
| | | Yes | | continuous variable | | | |
| | | | | stepped variable with stepsize | dB | | |
| | | | | minimum RF power | dBm | | |
| | | | | maximum RF power | dBm | | |
| **Antenna connection** | | | | | | | |
| unique coupling | standard connector | **V** | Integral | with temporary RF connector | | | |
| | | | | **V** without temporary RF connector | | | |

**Antenna/s technical characteristics**

| Type | Manufacturer | Model number | Gain |
|---|---|---|---|
| Integral | SCR Engineers Ltd. | NA | 10 dBi |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Transmitter aggregate data rate/s** | 250 kbps | | | | | | |
| **Type of modulation** | QPSK | | | | | | |
| **Modulating test signal (baseband)** | PRBS | | | | | | |
| **Transmitter power source** | | | | | | | |
| | Battery | **Nominal rated voltage** | | Battery type | | | |
| **V** | DC | **Nominal rated voltage** | 24 V | | | | |
| | AC mains | **Nominal rated voltage** | | Frequency | Hz | | |

| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

# 7 Transmitter tests according to 47CFR part 15 subpart C requirements

## 7.1 Field strength of emissions

### 7.1.1 General

This test was performed to measure field strength of fundamental and spurious emissions from the EUT. Specification test limits are given in Table 7.1.1, Table 7.1.2, Table 7.1.3.

**Table 7.1.1 Radiated fundamental emission limits**

| Fundamental frequency, MHz | Field strength at 3 m, dB(μV/m) | | |
|---|---|---|---|
| | Peak | Average | Quasi-Peak |
| 2400 – 2483.5 | 114.0 | 94.0 | NA |

**Table 7.1.2 Harmonics limits**

| Fundamental frequency, MHz | Field strength at 3 m, dB(μV/m) | |
|---|---|---|
| | Peak | Average |
| 2400 – 2483.5 | 74.0 | 54.0 |

**Table 7.1.3 Radiated spurious emissions limits (other than harmonics)**

| Frequency, MHz | Field strength at 3 m, dB(μV/m)* | | | |
|---|---|---|---|---|
| | Peak | Quasi Peak | Average | Attenuation below carrier |
| 0.009 – 0.090 | 148.5 – 128.5 | NA | 128.5 – 108.5** | 50 dBc (whichever is the less stringent) |
| 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 | | |
| Above 1000 | 74.0 | NA | 54.0 | |

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

$$Lim_{S2} = Lim_{S1} + 40 \log (S_1/S_2),$$

where $S_1$ and $S_2$ – standard defined and test distance respectively in meters.

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

*Note:* The above 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 but not exceeding 40 GHz for intentional radiators operated below 10 GHz and up to the fifth harmonic of the highest fundamental frequency but not exceeding 100 GHz for intentional radiators operated above 10 GHz.

| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

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

**7.1.2.1** The EUT was set up as shown in Figure 7.1.1, energized and the performance check was conducted.

**7.1.2.2** The measurements were performed in three EUT orthogonal positions. The EUT antenna was always installed in vertical position.

**7.1.2.3** The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated $360^0$ and the measuring antenna was rotated around its vertical axis.

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

**7.1.3 Test procedure for spurious emission field strength measurements above 30 MHz**

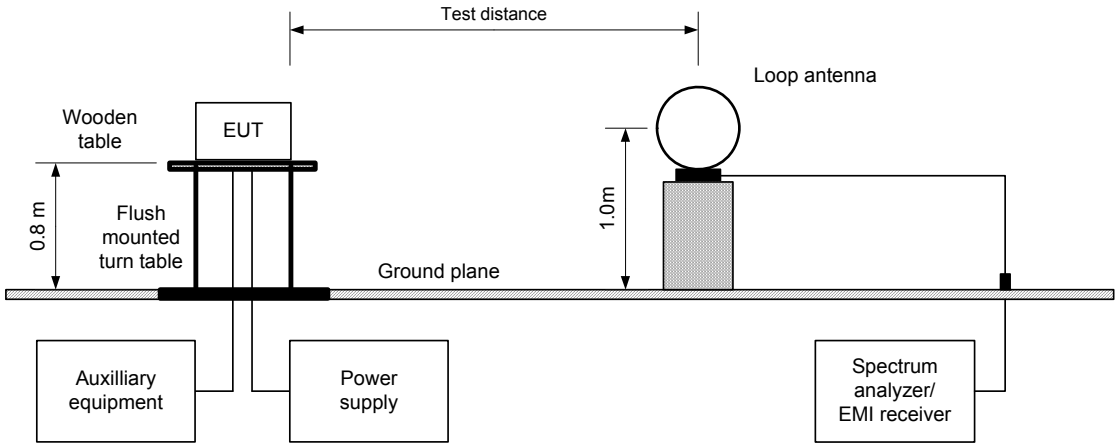
**7.1.3.1** The EUT was set up as shown in Figure 7.1.2, energized and the performance check was conducted.

**7.1.3.2** The measurements were performed in three EUT orthogonal positions. The EUT antenna was always installed in vertical position.

**7.1.3.3** The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated $360^0$, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.

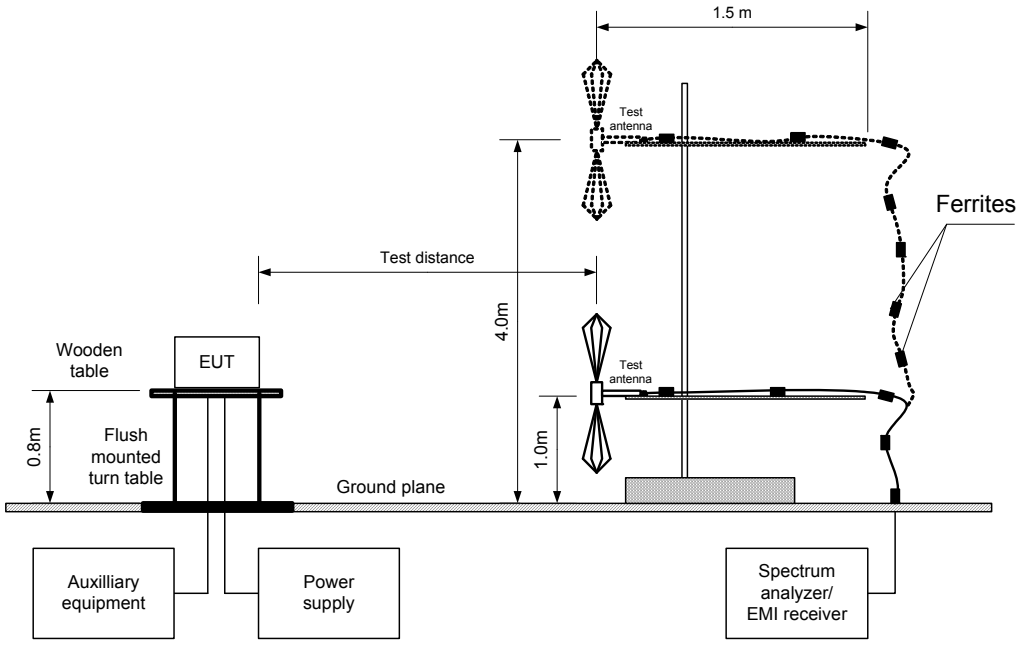
**7.1.3.4** The worst test results (the lowest margins) were recorded in the associated tables and shown in the associated plots

**Figure 7.1.1 Setup for spurious emission field strength measurements below 30 MHz**



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

**Figure 7.1.2 Setup for spurious emission field strength measurements above 30 MHz**



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

**Table 7.1.4 Field strength of fundamental emission**

TEST DISTANCE: 3 m
EUT POSITION: Typical with antenna in vertical position
MODULATION: QPSK
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
INVESTIGATED FREQUENCY RANGE: 0.009 – 25000 MHz
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 1.0 kHz (9 kHz – 150 kHz)
9.0 kHz (150 kHz – 30 MHz)
120 kHz (30 MHz – 1000 MHz)
1.0 MHz (above 1000 MHz)
VIDEO BANDWIDTH: ≥ Resolution bandwidth
TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)

| F, MHz | Antenna | | Azimuth, degrees* | Peak field strength | | | Avr factor, dB | Average field strength | | | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pol. | Height, m | | Measured, dB(μV/m) | Limit, dB(μV/m) | Margin, dB** | | Measured, dB(μV/m) | Limit, dB(μV/m) | Margin, dB** | |
| 2405.0 | V | 1.10 | 4 | 104.1 | 114.0 | -9.9 | 40.9 | 61.2 | 94.0 | -32.8 | Pass |
| 2445.0 | V | 1.10 | 5 | 105.6 | 114.0 | -8.4 | 40.9 | 62.7 | 94.0 | -31.3 | Pass |
| 2480.0 | V | 1.05 | 5 | 105.8 | 114.0 | -8.2 | 40.9 | 62.7 | 94.0 | -31.3 | Pass |

*- EUT front panel refers to 0 degrees position of turntable.
**- Margin, dB =Measured (calculated) value, dB(μV/m) - Limit, dB(μV/m).

**Table 7.1.5 Radiated spurious emissions vs calculated limit**

| Frequency, MHz | Field strength dB(μV/m) | Limit dB(μV/m) | Margin, dB** | Verdict |
|---|---|---|---|---|
| 30.193816 | 43.55 | 54.1 | -10.6 | Pass |
| 42.187800 | 35.95 | 54.1 | -18.2 | Pass |
| 47.998200 | 31.05 | 54.1 | -23.1 | Pass |
| 108.001600 | 38.04 | 54.1 | -16.1 | Pass |
| 119.994700 | 38.05 | 54.1 | -16.1 | Pass |

*- Margin, dB =Measured (calculated) value, dB(μV/m) - Limit, dB(μV/m).

**Table 7.1.6 Average factor calculation**

| Transmission pulse | | Transmission burst | | Transmission train duration, ms | Average factor, dB |
|---|---|---|---|---|---|
| Duration, ms | Period, ms | Duration, ms | Period, ms | | |
| 0.9 | 102.5 | NA | NA | NA | -40.9 |

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

**Reference numbers of test equipment used**

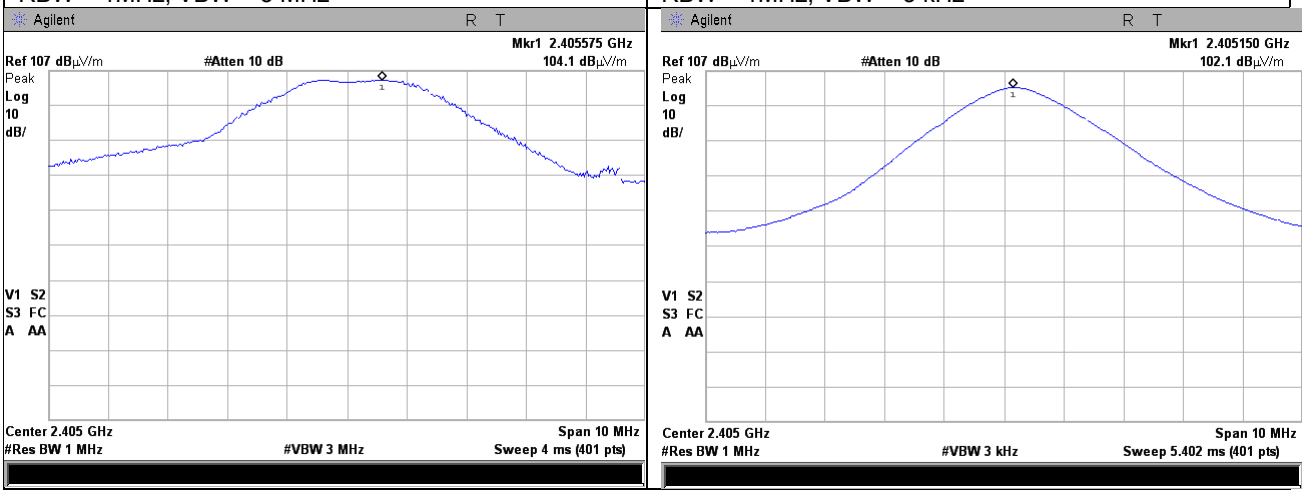
| HL 0446 | HL 0521 | HL 0604 | HL 0768 | HL 1984 | HL 2871 | HL 3623 | |
|---|---|---|---|---|---|---|---|

Full description is given in Appendix A.

| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

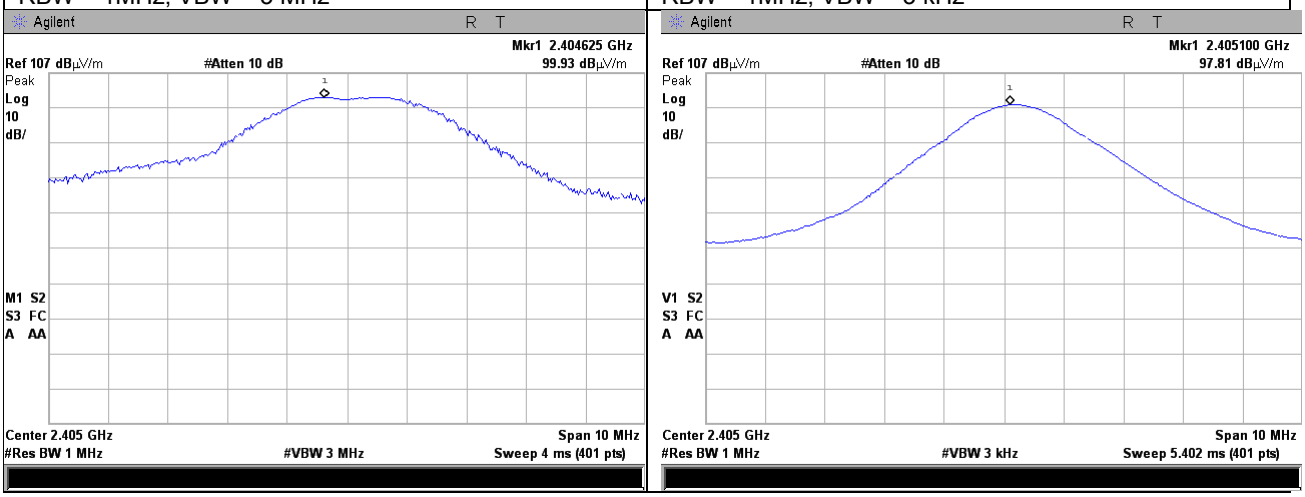
**Plot 7.1.1 Radiated emission measurements at the low fundamental frequency**

| | |
|---|---|
| TEST SITE: | Semi anechoic chamber |
| TEST DISTANCE: | 3 m |
| ANTENNA POLARIZATION: | Vertical |
| EUT POSITION: | 3 orthogonal (X/ Y/ Z) |
| INPUT VOLTAGE: | Unom |
| RBW = 1MHz, VBW = 3 MHz | RBW = 1MHz, VBW = 3 kHz |




**Plot 7.1.2 Radiated emission measurements at the low fundamental frequency**

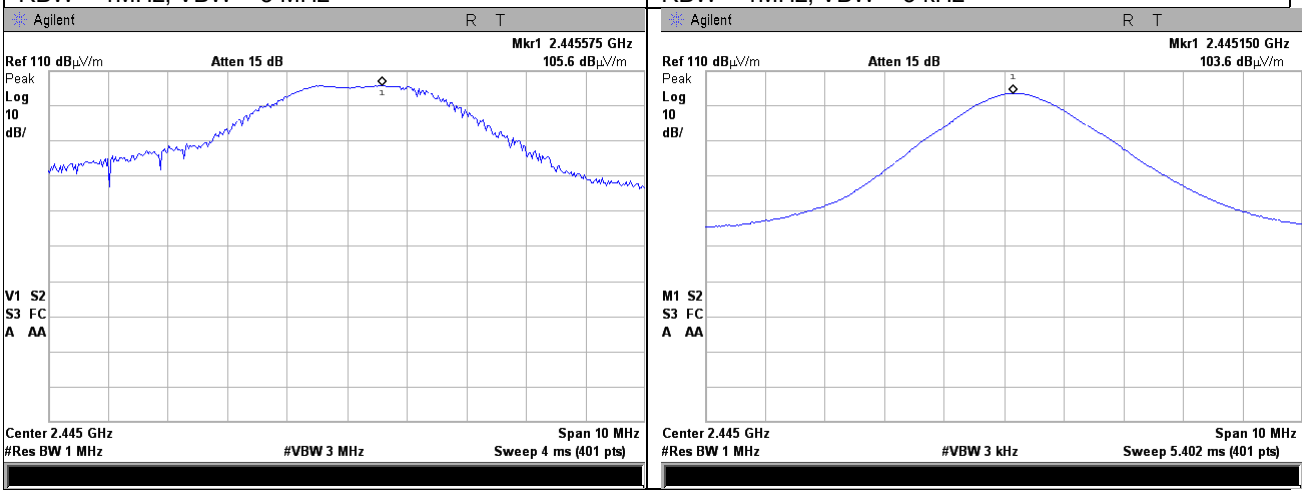
| | |
|---|---|
| TEST SITE: | Semi anechoic chamber |
| TEST DISTANCE: | 3 m |
| ANTENNA POLARIZATION: | Horizontal |
| EUT POSITION: | 3 orthogonal (X/ Y/ Z) |
| INPUT VOLTAGE: | Unom |
| RBW = 1MHz, VBW = 3 MHz | RBW = 1MHz, VBW = 3 kHz |



| **Test specification:** | **Section 15.249(a)(d), Field strength of emissions** | | |
|---|---|---|---|
| **Test procedure:** | ANSI C63.4, Section 13.1.4 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 1/22/2012 | | |
| **Temperature:** 21 ºC | **Air Pressure:** 1016 hPa | **Relative Humidity:** 38 % | **Power Supply:** 24 VDC |
| **Remarks:** | | | |

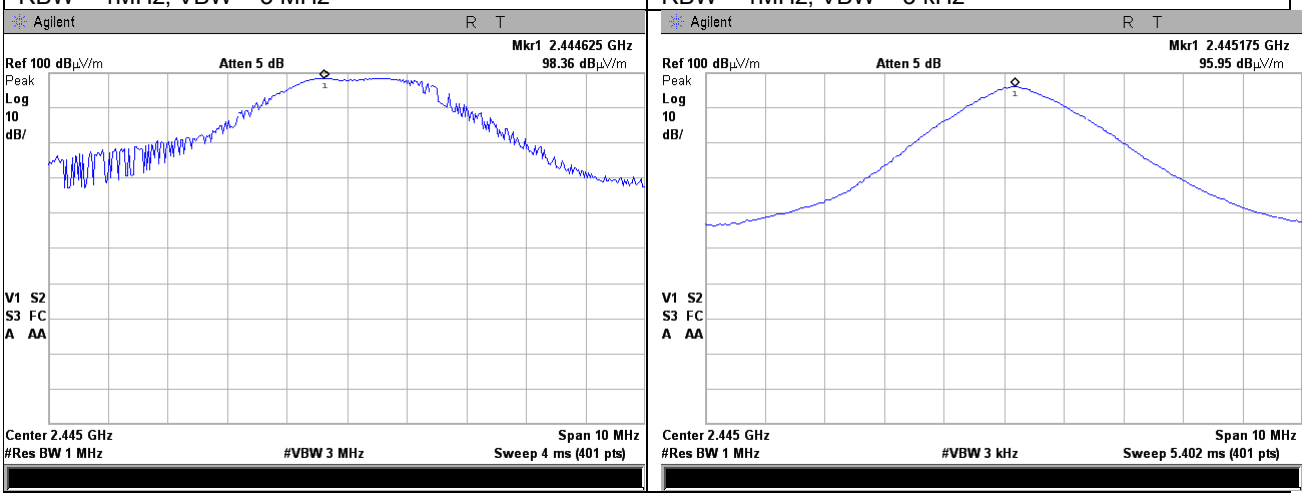
**Plot 7.1.3 Radiated emission measurements at the mid fundamental frequency**

| | |
|---|---|
| TEST SITE: | Semi anechoic chamber |
| TEST DISTANCE: | 3 m |
| ANTENNA POLARIZATION: | Vertical |
| EUT POSITION: | 3 orthogonal (X/ Y/ Z) |
| INPUT VOLTAGE: | Unom |
| RBW = 1MHz, VBW = 3 MHz | RBW = 1MHz, VBW = 3 kHz |




**Plot 7.1.4 Radiated emission measurements at the mid fundamental frequency**

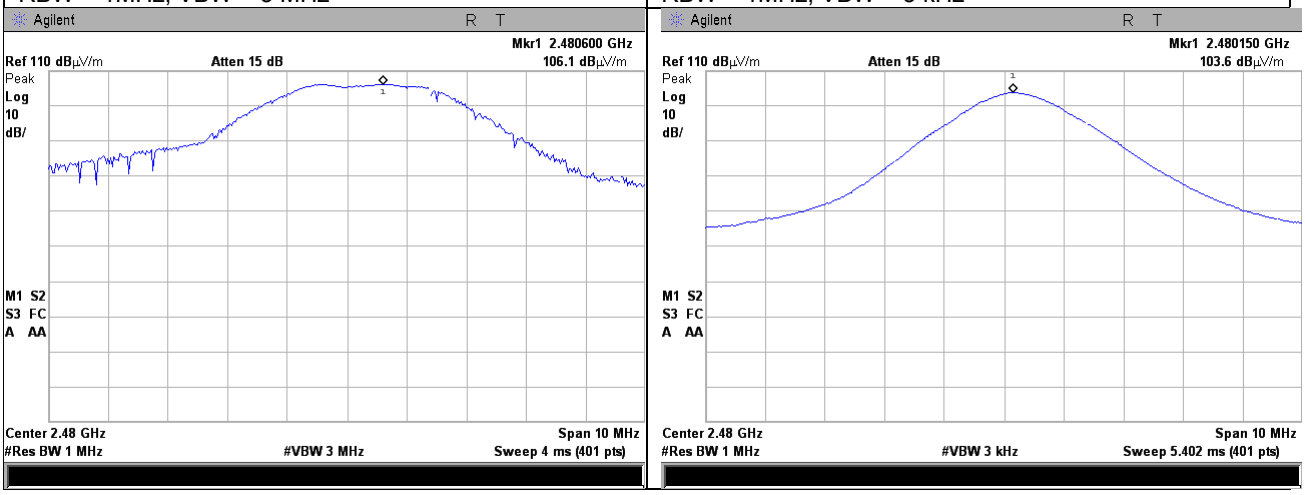
| | |
|---|---|
| TEST SITE: | Semi anechoic chamber |
| TEST DISTANCE: | 3 m |
| ANTENNA POLARIZATION: | Horizontal |
| EUT POSITION: | 3 orthogonal (X/ Y/ Z) |
| INPUT VOLTAGE: | Unom |
| RBW = 1MHz, VBW = 3 MHz | RBW = 1MHz, VBW = 3 kHz |



| **Test specification:** | **Section 15.249(a)(d), Field strength of emissions** | | |
|---|---|---|---|
| **Test procedure:** | ANSI C63.4, Section 13.1.4 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 1/22/2012 | | |
| **Temperature:** 21 ºC | **Air Pressure:** 1016 hPa | **Relative Humidity:** 38 % | **Power Supply:** 24 VDC |
| **Remarks:** | | | |

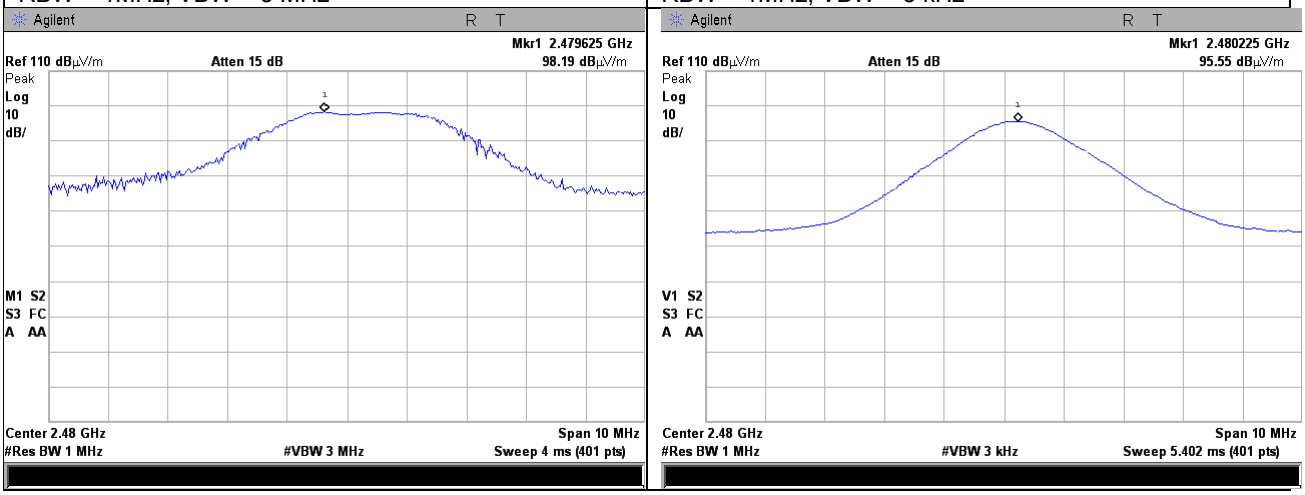
**Plot 7.1.5 Radiated emission measurements at the high fundamental frequency**

| | |
|---|---|
| TEST SITE: | Semi anechoic chamber |
| TEST DISTANCE: | 3 m |
| ANTENNA POLARIZATION: | Vertical |
| EUT POSITION: | 3 orthogonal (X/ Y/ Z) |
| INPUT VOLTAGE: | Unom |
| RBW = 1MHz, VBW = 3 MHz | RBW = 1MHz, VBW = 3 kHz |




**Plot 7.1.6 Radiated emission measurements at the high fundamental frequency**

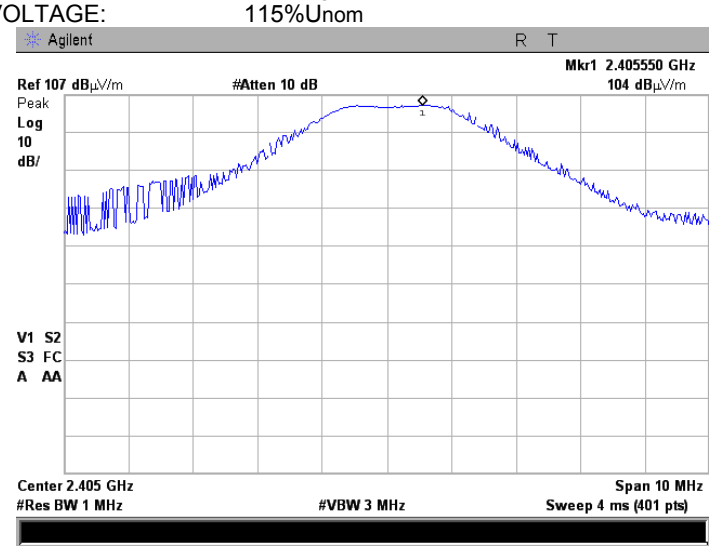
| | |
|---|---|
| TEST SITE: | Semi anechoic chamber |
| TEST DISTANCE: | 3 m |
| ANTENNA POLARIZATION: | Horizontal |
| EUT POSITION: | 3 orthogonal (X/ Y/ Z) |
| INPUT VOLTAGE: | Unom |
| RBW = 1MHz, VBW = 3 MHz | RBW = 1MHz, VBW = 3 kHz |



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

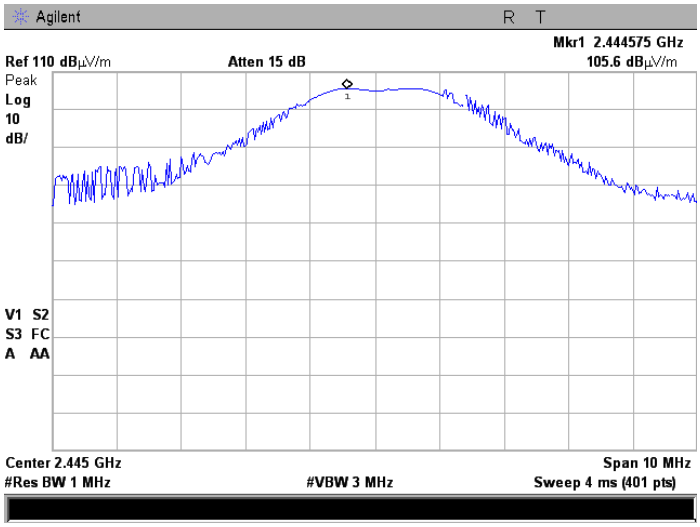
**Plot 7.1.7 Radiated emission measurements at the at the low fundamental frequency**

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: 3 orthogonal (X/ Y/ Z)
INPUT VOLTAGE: 115%Unom




**Plot 7.1.8 Radiated emission measurements at the at the mid fundamental frequency**

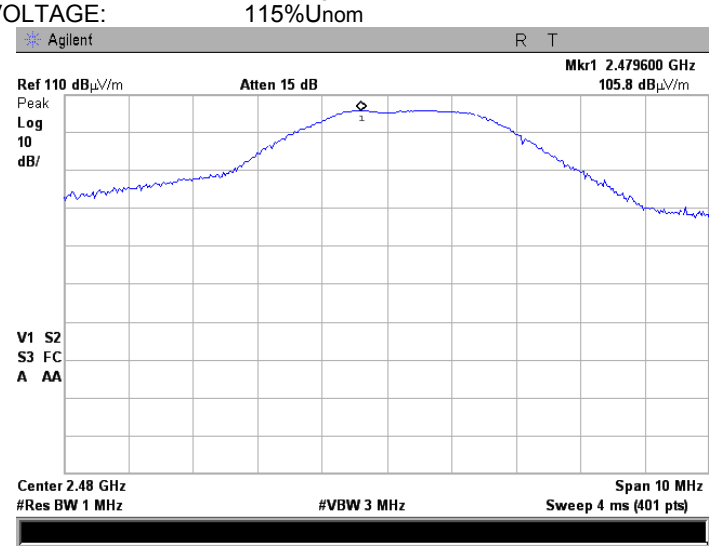
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: 3 orthogonal (X/ Y/ Z)
INPUT VOLTAGE: 115%Unom



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

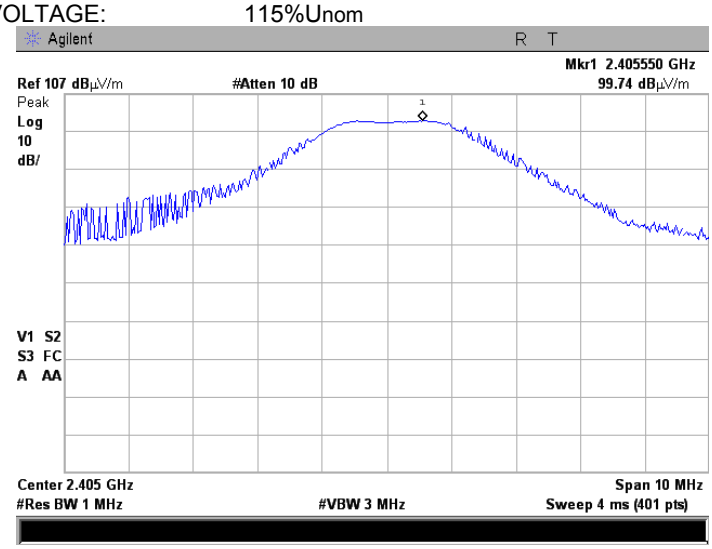
**Plot 7.1.9 Radiated emission measurements at the at the high fundamental frequency**

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: 3 orthogonal (X/ Y/ Z)
INPUT VOLTAGE: 115%Unom




**Plot 7.1.10 Radiated emission measurements at the at the low fundamental frequency**

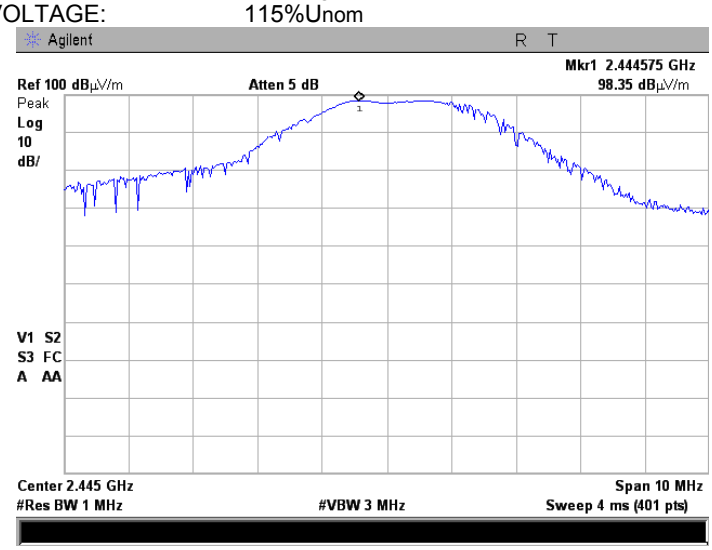
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: 3 orthogonal (X/ Y/ Z)
INPUT VOLTAGE: 115%Unom



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

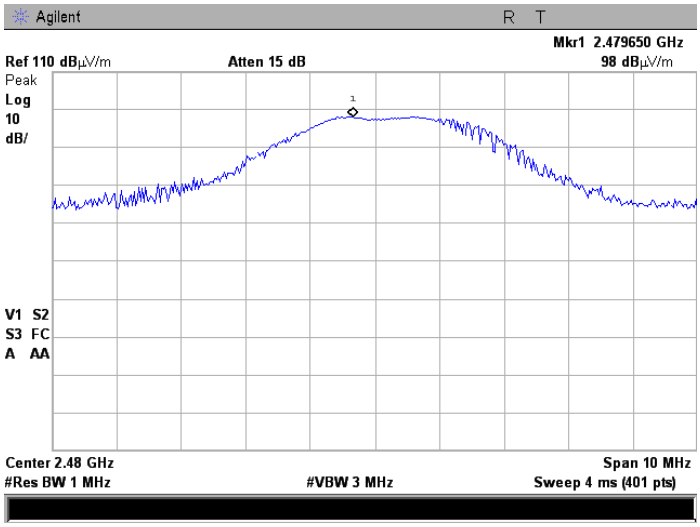
**Plot 7.1.11 Radiated emission measurements at the at the mid fundamental frequency**

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: 3 orthogonal (X/ Y/ Z)
INPUT VOLTAGE: 115%Unom




**Plot 7.1.12 Radiated emission measurements at the at the high fundamental frequency**

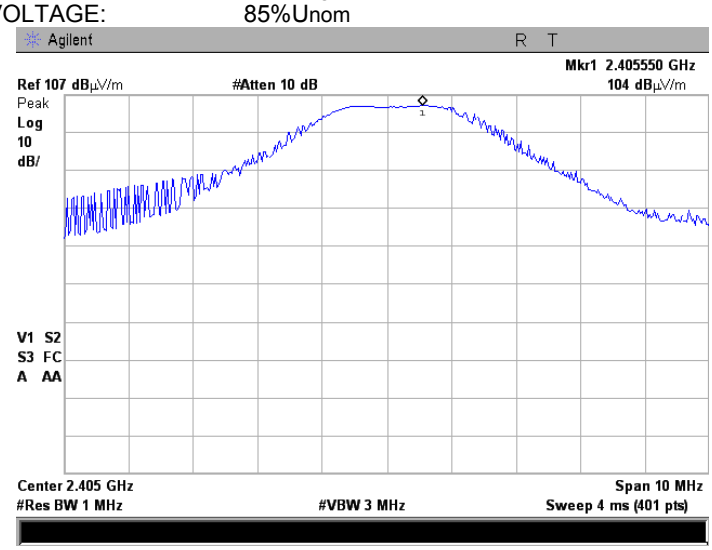
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: 3 orthogonal (X/ Y/ Z)
INPUT VOLTAGE: 115%Unom



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

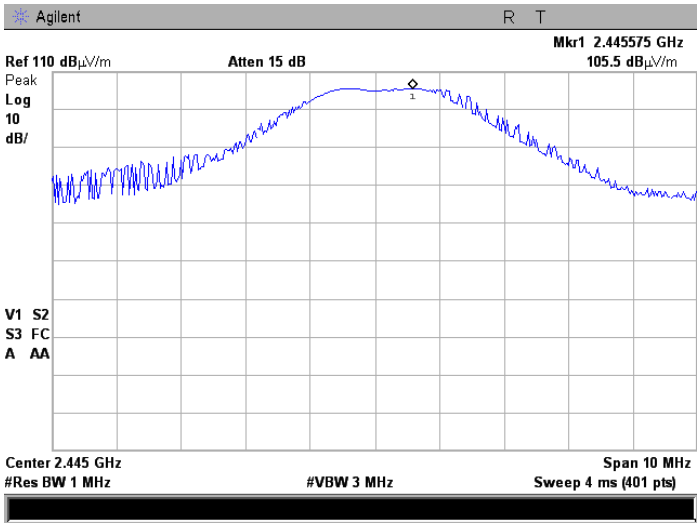
**Plot 7.1.13 Radiated emission measurements at the at the low fundamental frequency**

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: 3 orthogonal (X/ Y/ Z)
INPUT VOLTAGE: 85%Unom




**Plot 7.1.14 Radiated emission measurements at the at the mid fundamental frequency**

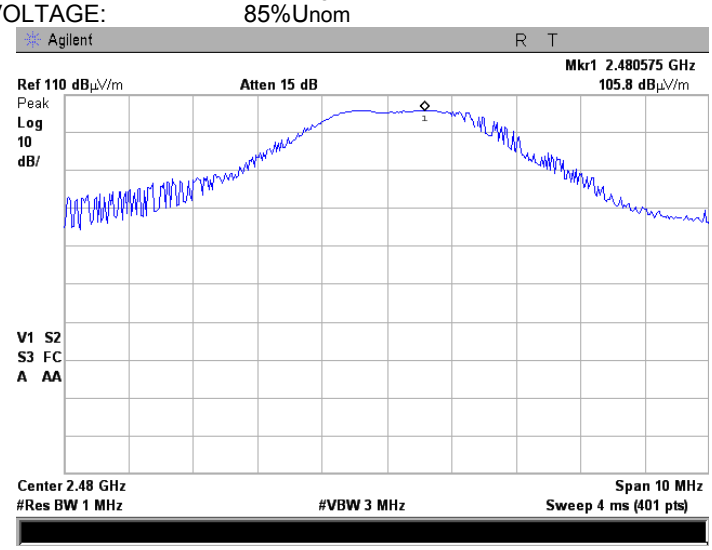
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: 3 orthogonal (X/ Y/ Z)
INPUT VOLTAGE: 85%Unom



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

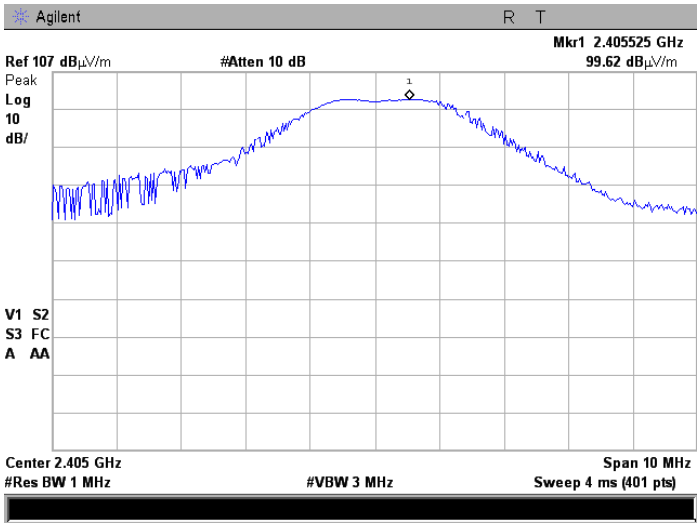
**Plot 7.1.15 Radiated emission measurements at the at the high fundamental frequency**

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: 3 orthogonal (X/ Y/ Z)
INPUT VOLTAGE: 85%Unom




**Plot 7.1.16 Radiated emission measurements at the at the low fundamental frequency**

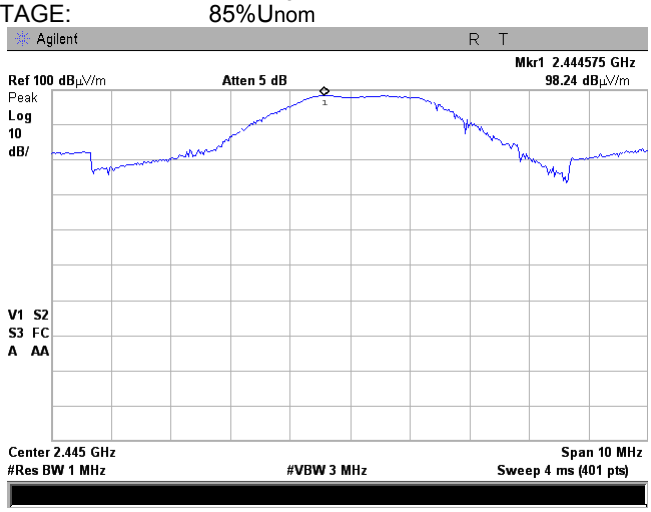
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: 3 orthogonal (X/ Y/ Z)
INPUT VOLTAGE: 85%Unom



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

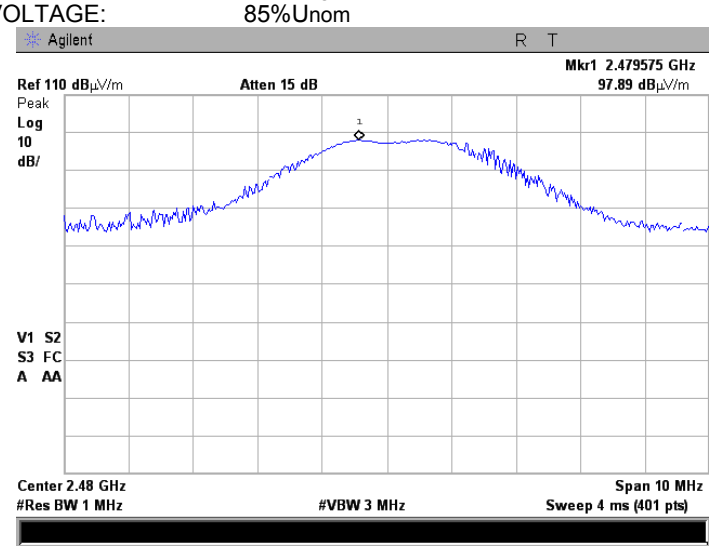
**Plot 7.1.17 Radiated emission measurements at the at the mid fundamental frequency**

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: 3 orthogonal (X/ Y/ Z)
INPUT VOLTAGE: 85%Unom




**Plot 7.1.18 Radiated emission measurements at the at the high fundamental frequency**

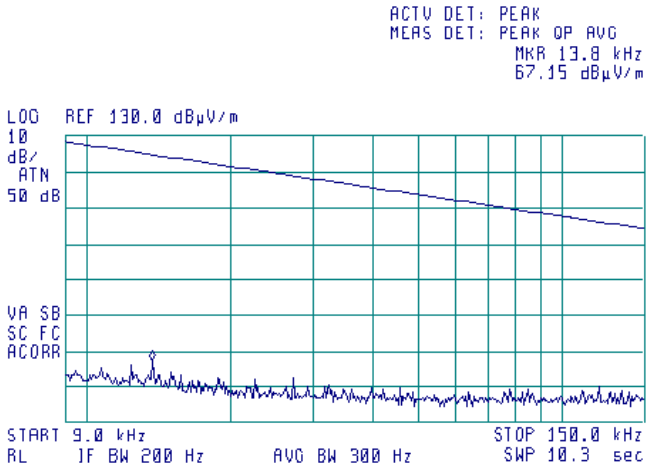
TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Horizontal
EUT POSITION: 3 orthogonal (X/ Y/ Z)
INPUT VOLTAGE: 85%Unom



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

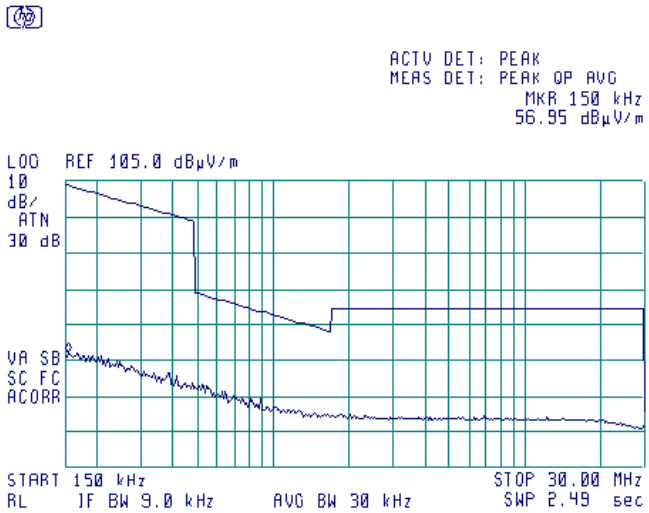
**Plot 7.1.19 Radiated emission measurements from 9 to 150 kHz**

| | |
|---|---|
| TEST SITE: | Semi anechoic chamber |
| TEST DISTANCE: | 3 m |
| ANTENNA POLARIZATION: | Vertical |
| EUT POSITION: | Typical |
| OPERATING FREQUENCY | Low; Mid; High |




**Plot 7.1.20 Radiated emission measurements from 0.15 to 30 MHz**

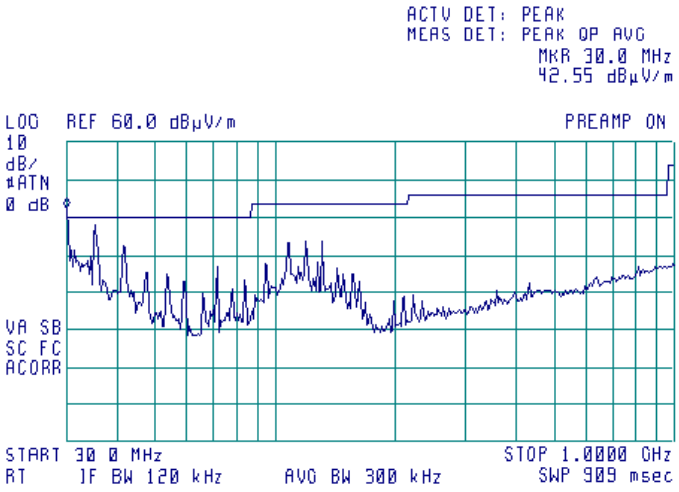
| | |
|---|---|
| TEST SITE: | Semi anechoic chamber |
| TEST DISTANCE: | 3 m |
| ANTENNA POLARIZATION: | Vertical |
| EUT POSITION: | Typical |
| OPERATING FREQUENCY | Low; Mid; High |



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

**Plot 7.1.21 Radiated emission measurements from 30 to 1000 MHz**

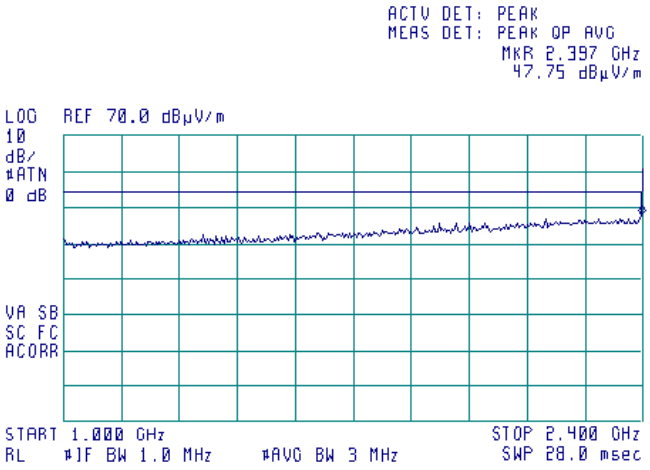
| | |
|---|---|
| TEST SITE: | Semi anechoic chamber |
| TEST DISTANCE: | 3 m |
| ANTENNA POLARIZATION: | Vertical and Horizontal |
| EUT POSITION: | Typical |
| OPERATING FREQUENCY: | Low; Mid; High |



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

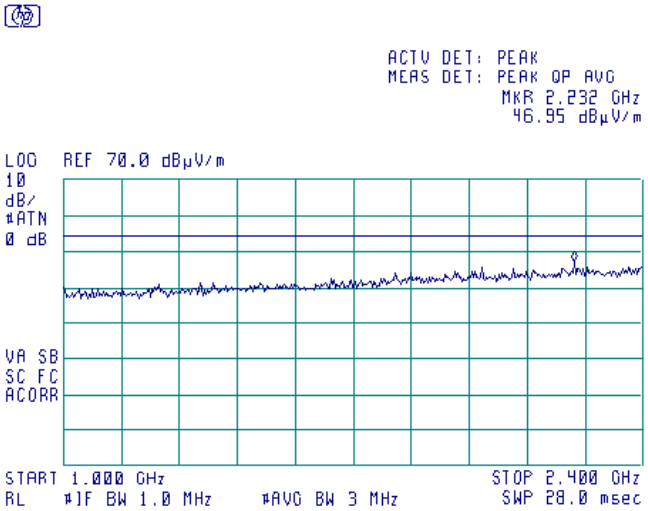
**Plot 7.1.22 Radiated emission measurements at low frequency from 1 to 2.4 MHz**

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical




**Plot 7.1.23 Radiated emission measurements at mid frequency from 1 to 2.4 MHz**

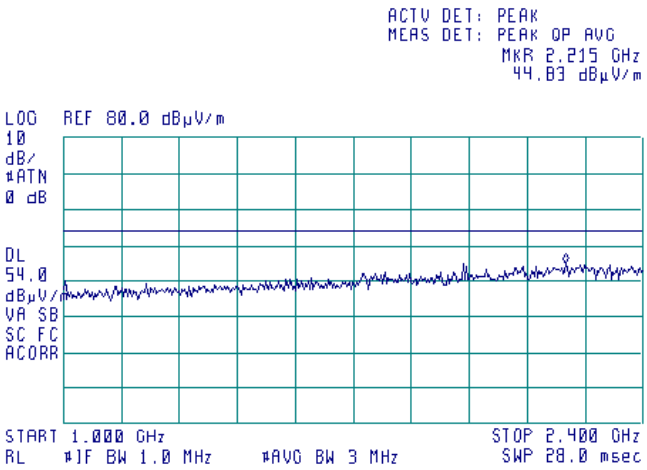
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

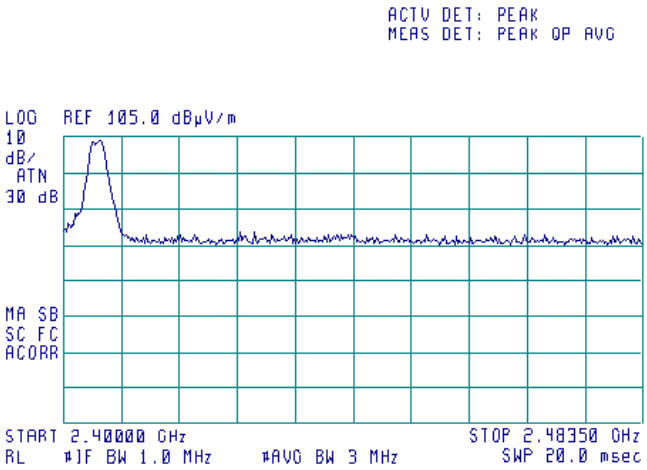
**Plot 7.1.24 Radiated emission measurements at high frequency from 1 to 2.4 MHz**

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical




**Plot 7.1.25 Radiated emission measurements at low frequency from 2.4 to 2.4835 MHz**

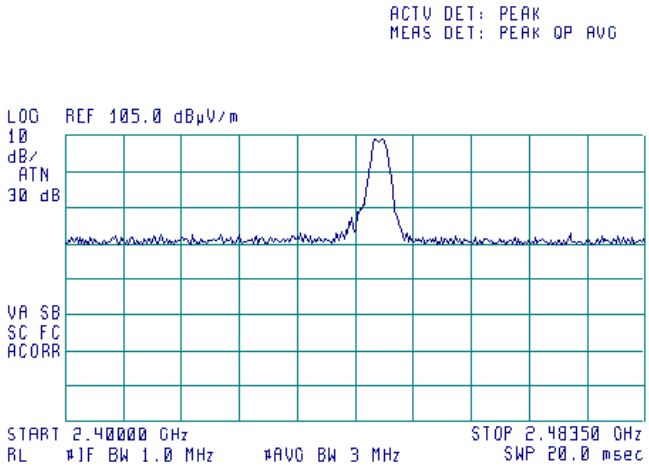
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

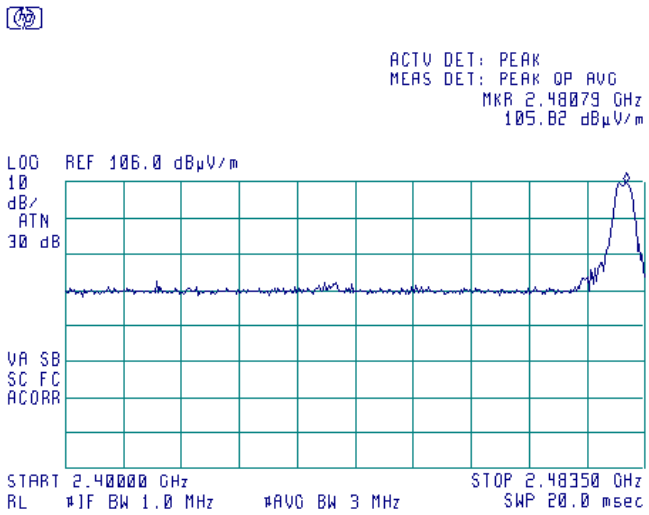
**Plot 7.1.26 Radiated emission measurements at mid frequency from 2.4 to 2.4835 MHz**

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical




**Plot 7.1.27 Radiated emission measurements at high frequency from 2.4 to 2.4835 MHz**

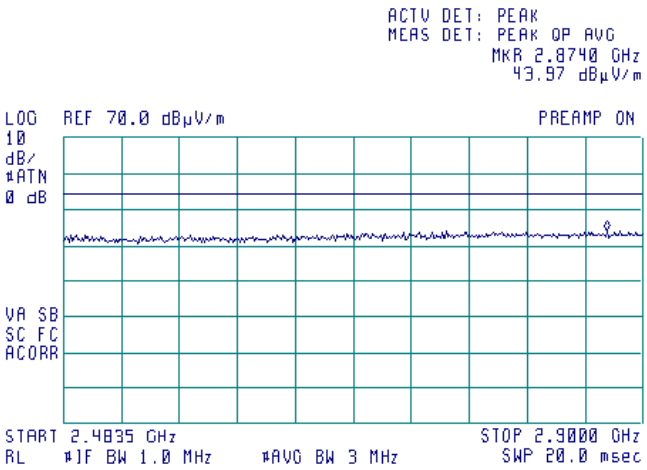
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

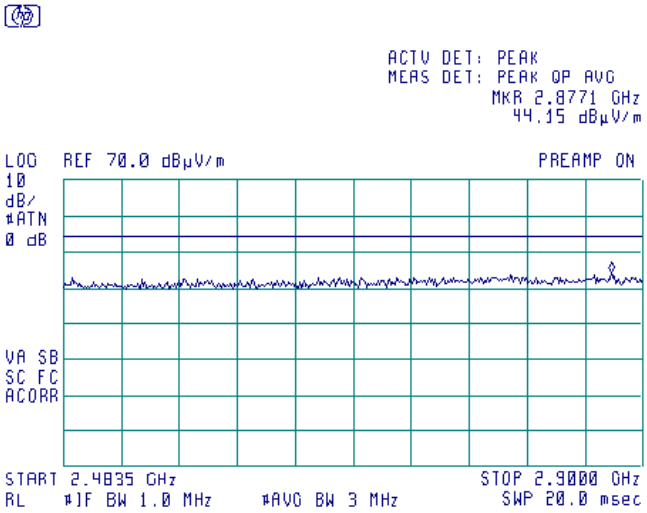
**Plot 7.1.28 Radiated emission measurements at low frequency from 2483.5 to 2.9 MHz**

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical




**Plot 7.1.29 Radiated emission measurements at mid frequency from 2483.5 to 2.9 MHz**

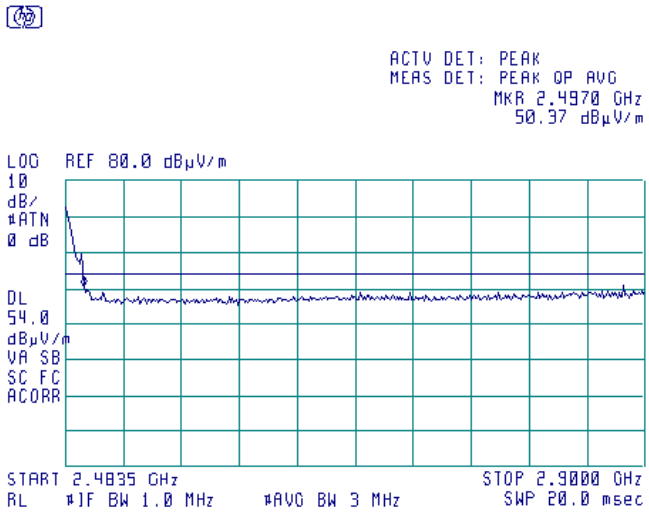
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

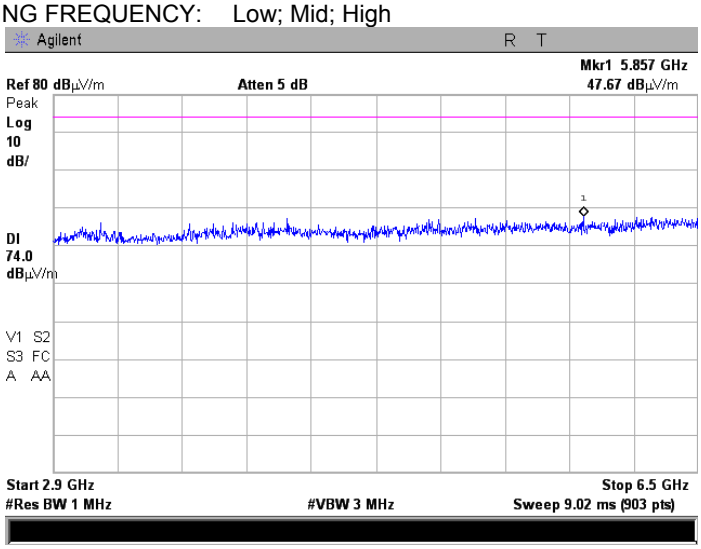
**Plot 7.1.30 Radiated emission measurements at high frequency from 2483.5 to 2.9 MHz**

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical




**Plot 7.1.31 Radiated emission measurements from 2.9 to 6.5 MHz**

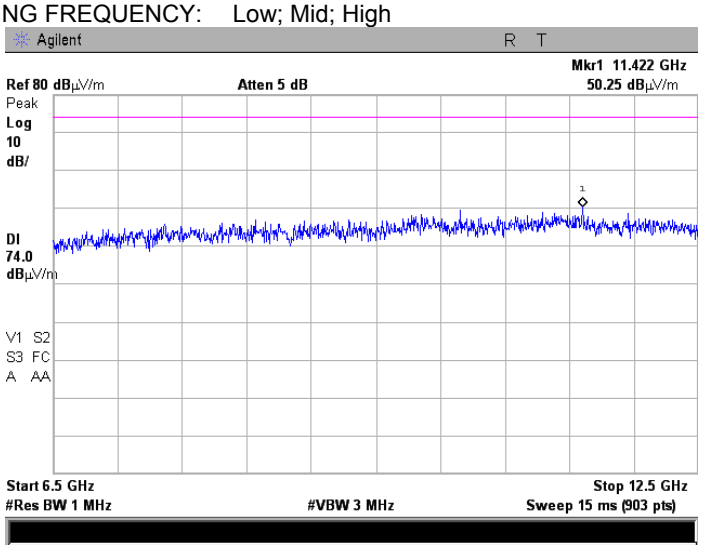
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
OPERATING FREQUENCY: Low; Mid; High



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

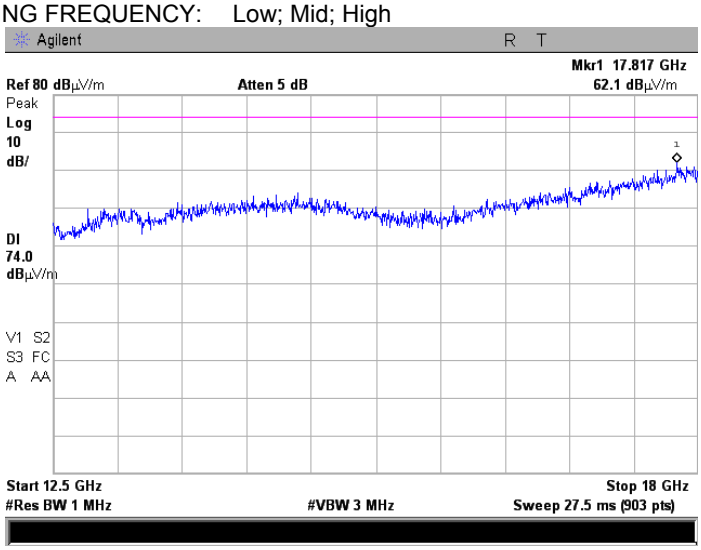
**Plot 7.1.32 Radiated emission measurements from 6.5 to 12.5 GHz**

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
OPERATING FREQUENCY: Low; Mid; High




**Plot 7.1.33 Radiated emission measurements from 12.5 to 18.0 GHz**

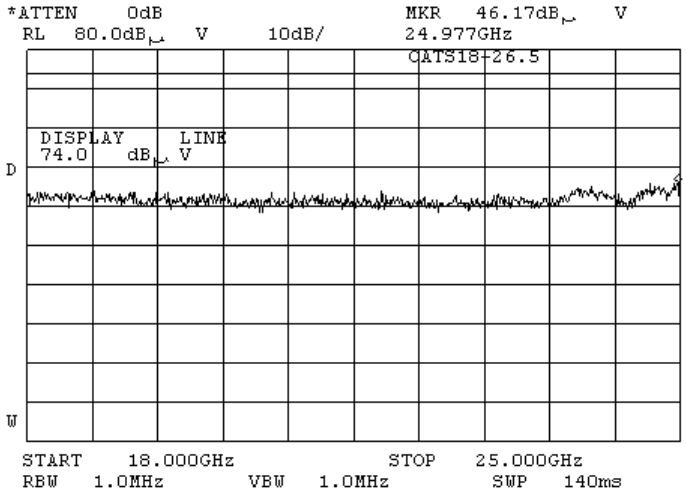
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
OPERATING FREQUENCY: Low; Mid; High



| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

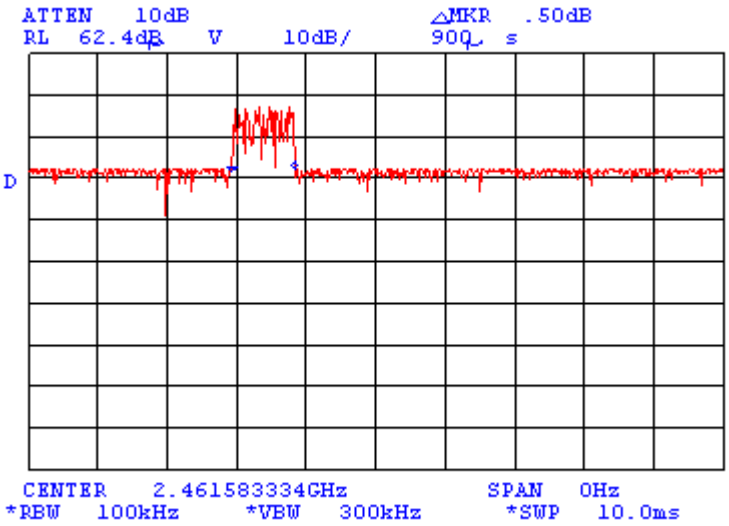
**Plot 7.1.34 Radiated emission measurements from 18.0 to 25 GHz**

TEST SITE: OATS
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
OPERATING FREQUENCY: Low; Mid; High

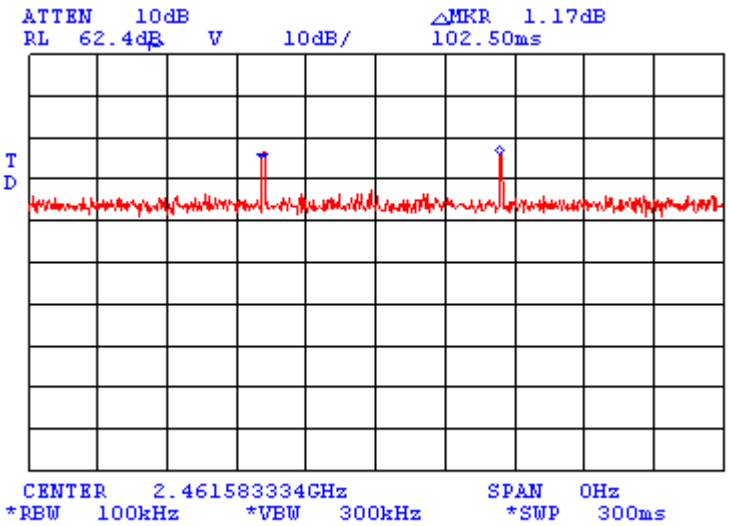


| Test specification: | Section 15.249(a)(d), Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 38 % | Power Supply: 24 VDC |
| Remarks: | | | |

**Plot 7.1.35 Transmission pulse duration**




**Plot 7.1.36 Transmission pulse period**



| Test specification: | Section 15.249(d), Band edge emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 36 % | Power Supply: 24 VDC |
| Remarks: | | | |

## 7.2 Band edge emission

### 7.2.1 General

This test was performed to verify the EUT band edge emission including all associated side bands was attenuated at least 50 dB below the unmodulated carrier level or below the general spurious emission limit. Specification test limits are given in Table 7.2.1.

**Table 7.2.1 Band edge emission limits**

| Frequency band, MHz | Field strength limit at 3 m, dBµV/m | | Attenuation below carrier, dBc |
|---|---|---|---|
| | Peak | Average | |
| 2400-2483.5 | 74.0 | 54.0 | 50 |

### 7.2.2 Test procedure

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

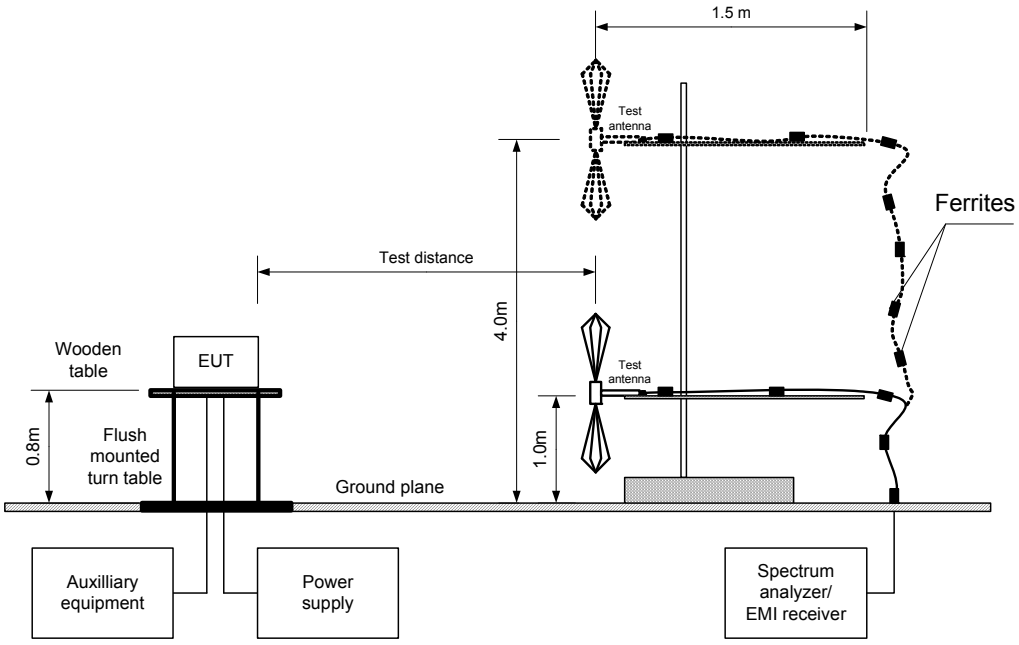
**7.2.2.2** The spectrum analyzer frequency span was set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure peak measurements. Spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.

**7.2.2.3** The frequency of modulation envelope points beyond which power level drops below the band edge emission limit was measured.

**7.2.2.4** The test results were recorded in Table 7.2.2 and shown in the associated plots.

| Test specification: | Section 15.249(d), Band edge emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 36 % | Power Supply: 24 VDC |
| Remarks: | | | |

**Figure 7.2.1 Band edge emission measurement set up**



| **Test specification:** | **Section 15.249(d), Band edge emissions** | | |
|---|---|---|---|
| **Test procedure:** | ANSI C63.4, Section 13.1.4 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 1/22/2012 | | |
| **Temperature:** 21 ºC | **Air Pressure:** 1016 hPa | **Relative Humidity:** 36 % | **Power Supply:** 24 VDC |
| **Remarks:** | | | |

**Table 7.2.2 Band edge emission test results**

OPERATING FREQUENCY RANGE: 2400 – 2483.5MHz
DETECTOR USED: Peak hold
MODULATION: QPSK
BIT RATE: 250 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

| **Modulation envelope** | | **Band edge limit, MHz** | **Margin, kHz*** ** | **Verdict** |
|---|---|---|---|---|
| **Edge** | **Frequency, MHz*** | | | |
| Low | 2402.850 | 2400.000 | -2850.000 | Pass |
| High | 2483.200 | 2483.500 | 300.000 | Pass |

* - Measured frequency beyond which the emission dropped 50 dB below the carrier emission or below the field strength limit whichever was a less stringent
** - Margin = Band edge limit – Band edge frequency

**Reference numbers of test equipment used**

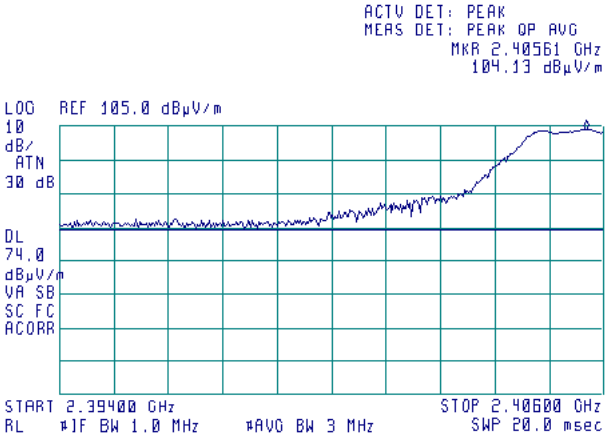
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HL 0521 | HL 2871 | HL 2432 | | | | | |

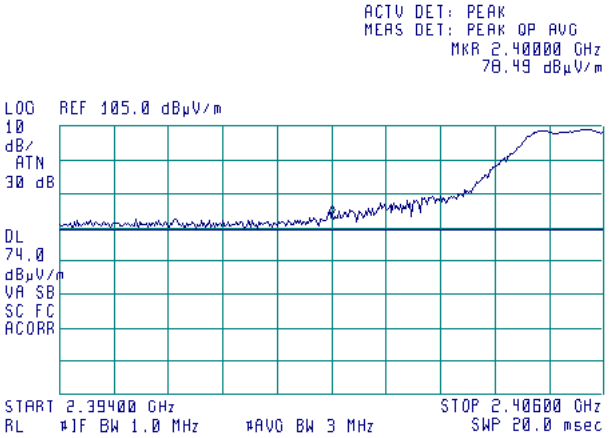
Full description is given in Appendix A.

| Test specification: | Section 15.249(d), Band edge emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 36 % | Power Supply: 24 VDC |
| Remarks: | | | |

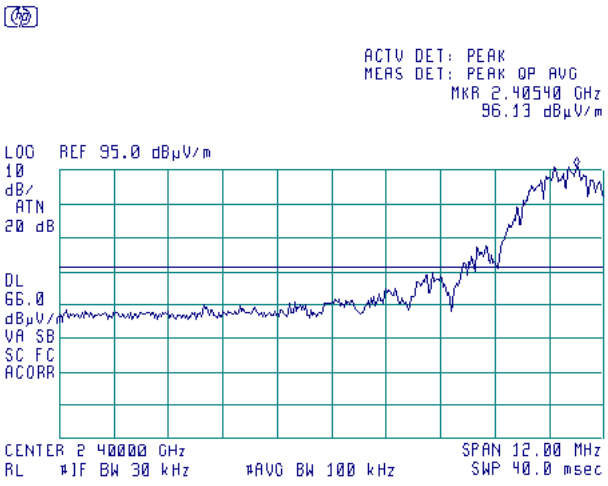
**Plot 7.2.1 Low band edge emission test result**

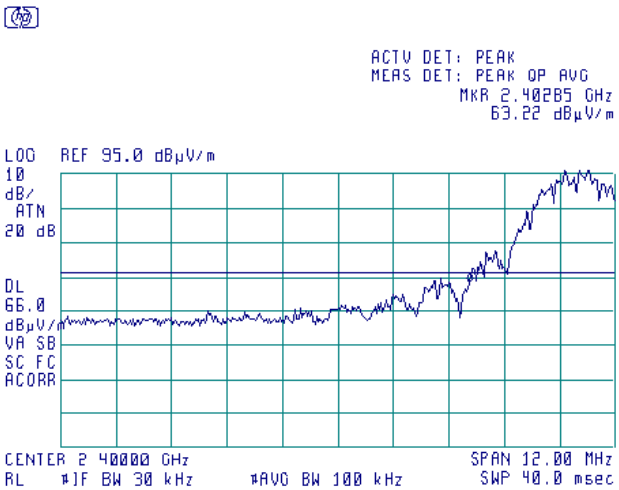
TEST SITE: Semi-anechoic chamber
FREQUENCY F min=2405 MHz
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical




Delta = 104.13 dBuV/m -74 dBuV/m = 30.13 dB



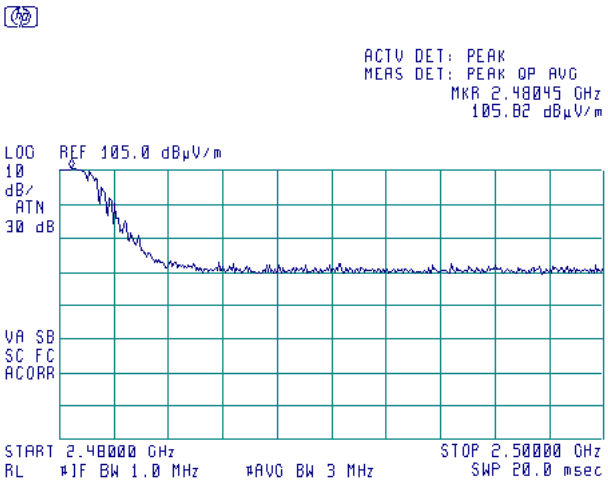



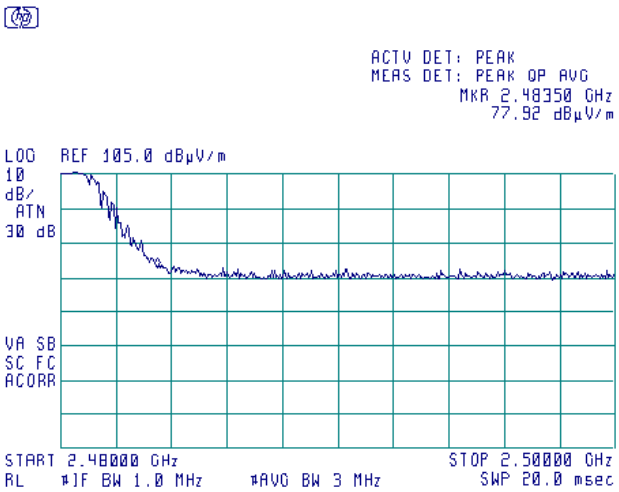

DL=96.13 dBuV/m - 30.13 dB =66 dBuV/m

| Test specification: | Section 15.249(d), Band edge emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 36 % | Power Supply: 24 VDC |
| Remarks: | | | |

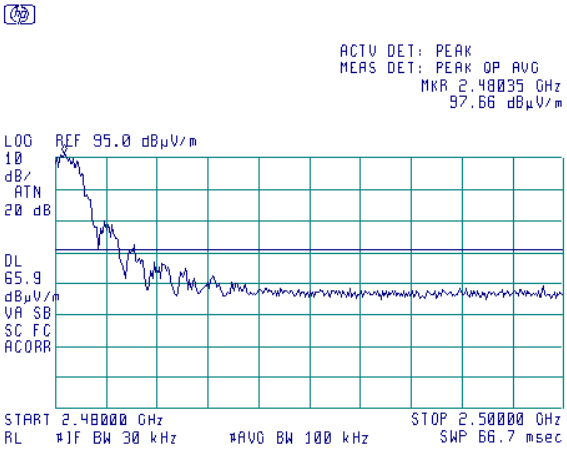
**Plot 7.2.2 High band edge emission test result**

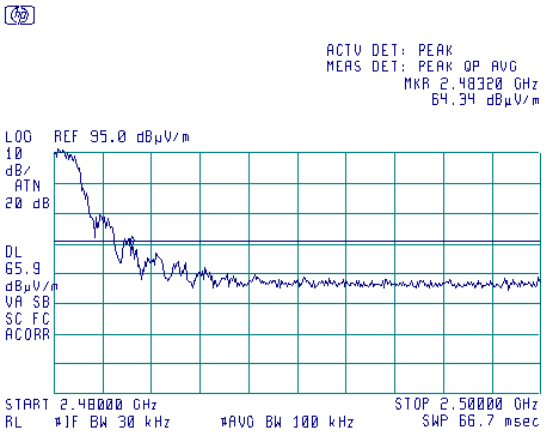
TEST SITE: Semi-anechoic chamber
FREQUENCY F max=2480 MHz
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
RBW = 1MHz, VBW = 3 MHz




Delta = 105.82 dBuV/m -74 dBuV/m = 31.82 dB




DL=97.66 dBuV/m - 31.82 dB = 65.9 dBuV/m

| Test specification: | Section 15.203, Antenna requirement | | |
|---|---|---|---|
| Test procedure: | Visual inspection / supplier declaration | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/26/2012 | | |
| Temperature: 23 ºC | Air Pressure: 1020 hPa | Relative Humidity: 44 % | Power Supply: 24 VDC |
| Remarks: | | | |

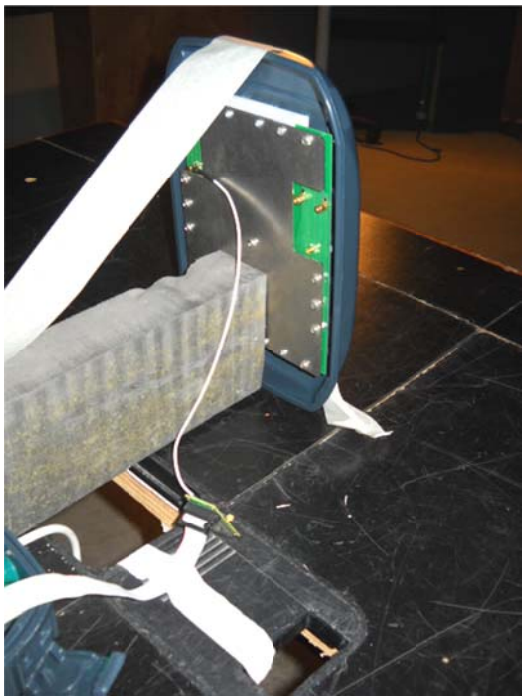
## 7.3 Antenna requirements

The EUT was verified for compliance with antenna requirements. A transmitter shall be designed to ensure that no antenna other than that furnished by the responsible party will be used with the device. It may be either permanently attached or employs a unique antenna connector for every antenna proposed for use with the EUT. This requirement does not apply to professionally installed transmitters.
The rationale for compliance with the above requirements was either visual inspection results or supplier declaration. The summary of results is provided in Table 7.3.1.

**Table 7.3.1 Antenna requirements**

| Requirement | Rationale | Verdict |
|---|---|---|
| The transmitter antenna is permanently attached | Visual inspection | Comply |
| The transmitter employs a unique antenna connector | NA | |
| The transmitter requires professional installation | NA | |

**Photograph 7.3.1 Antenna assembly**



| Test specification: | Section 15.215(c), Occupied bandwidth | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.7 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/26/2012 | | |
| Temperature: 23 ºC | Air Pressure: 1020 hPa | Relative Humidity: 44 % | Power Supply: 24 VDC |
| Remarks: | | | |

## 7.4 Occupied bandwidth test

### 7.4.1 General

This test was performed to verify that the 20 dB bandwidth of the emissions was contained within the standard specified frequency band according to FCC §15.215 requirements. Specification test limits are given in Table 7.4.1.

**Table 7.4.1 Occupied bandwidth limits**

| Assigned frequency, MHz | Modulation envelope reference points*, dBc |
|---|---|
| 902 - 928 | 20.0 |
| **2400 – 2483.5** | |
| 5725 – 5875 | |
| 24000 – 24250 | |

*- Modulation envelope reference points provided in terms of attenuation below modulated carrier.

### 7.4.2 Test procedure

**7.4.2.1** The EUT was set up as shown in Figure 7.4.1, energized and its proper operation was checked.

**7.4.2.2** The spectrum analyzer sweep time and bandwidth were set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure peak measurements. Spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.

**7.4.2.3** The peak of emission was measured. The transmitter occupied bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.4.2 and associated plot.

**7.4.2.4** Modulation bandwidth was calculated by adding of the negative frequency drift to the lower measured frequency and the positive frequency drift to the higher measured frequency. The obtained modulation bandwidth was verified to be within the allowed frequency range.

**Figure 7.4.1 Occupied bandwidth test setup**

| **Test specification:** | **Section 15.215(c), Occupied bandwidth** | | |
|---|---|---|---|
| **Test procedure:** | ANSI C63.4, Section 13.1.7 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 1/26/2012 | | |
| **Temperature:** 23 ºC | **Air Pressure:** 1020 hPa | **Relative Humidity:** 44 % | **Power Supply:** 24 VDC |
| **Remarks:** | | | |

**Table 7.4.2 Occupied bandwidth test results**

| | |
|---|---|
| ASSIGNED FREQUENCY BAND | 2400 - 2483.5 MHz |
| DETECTOR USED: | Peak hold |
| RESOLUTION BANDWIDTH: | 100 kHz |
| VIDEO BANDWIDTH: | 300 kHz |
| MODULATION ENVELOPE REFERENCE POINTS: | 20 dBc |
| MODULATION: | QPSK |
| MODULATING SIGNAL: | Enable |

| Band edge | Cross point frequency, MHz | Frequency drift, kHz | | Modulation band edge, MHz | Assigned band edge, MHz | Verdict |
|---|---|---|---|---|---|---|
| | | Negative | Positive | | | |
| Low | 2403.650 | NA | NA | 2403.650 | 2400.000 | Pass |
| High | 2481.538 | NA | NA | 2481.538 | 2483.500 | Pass |

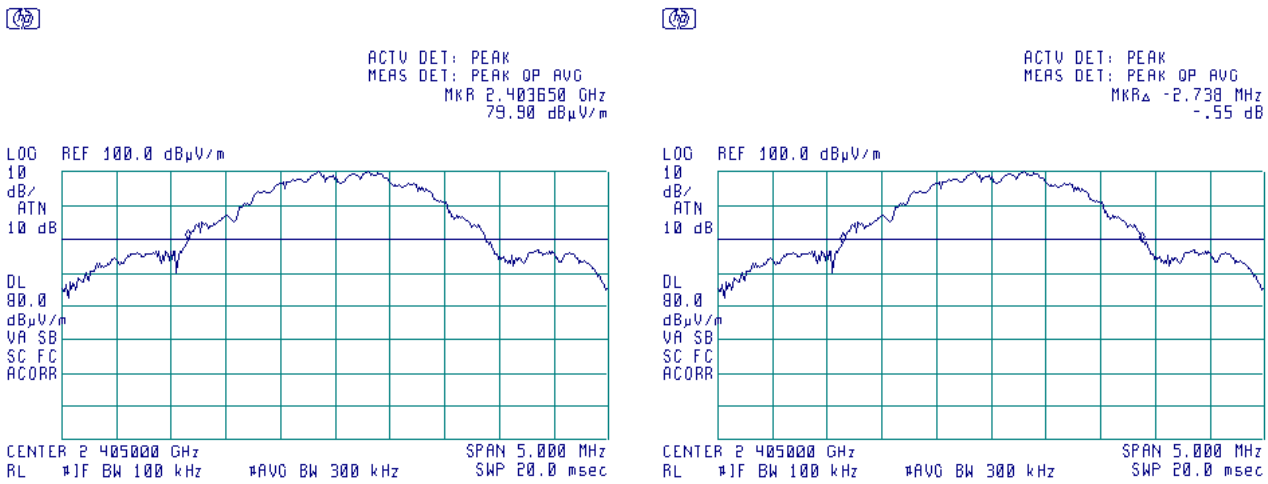
**Reference numbers of test equipment used**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| HL 0521 | HL 1984 | HL 2871 | HL 3623 | | | | | |

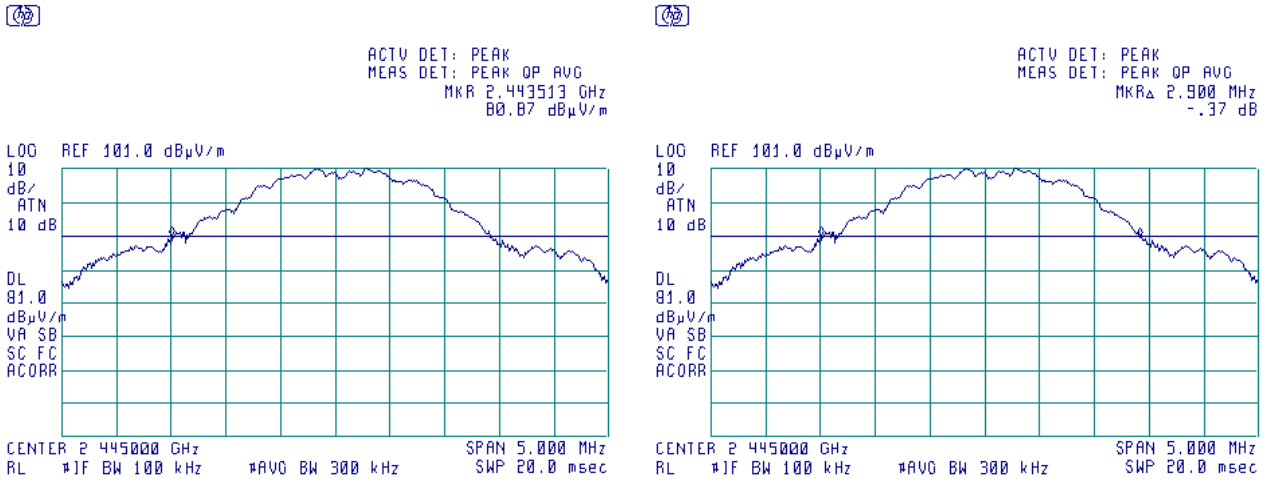
Full description is given in Appendix A.

| Test specification: | Section 15.215(c), Occupied bandwidth | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.7 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/26/2012 | | |
| Temperature: 23 ºC | Air Pressure: 1020 hPa | Relative Humidity: 44 % | Power Supply: 24 VDC |
| Remarks: | | | |

**Plot 7.4.1 Occupied bandwidth test result at low frequency**

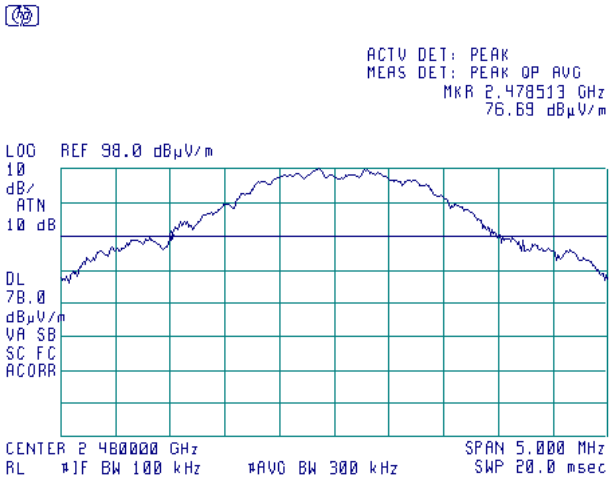


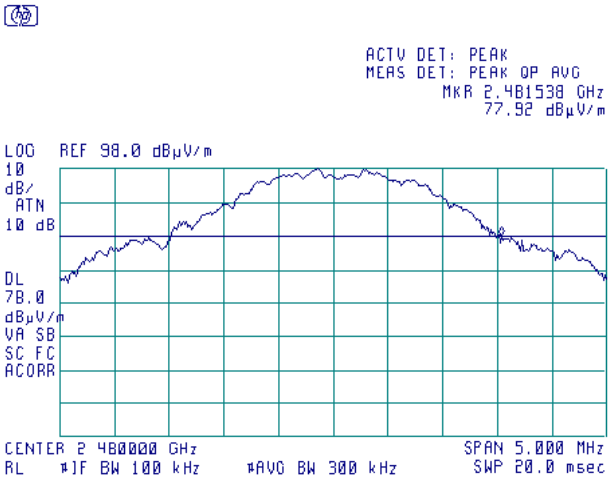

**Plot 7.4.2 Occupied bandwidth test result at mid frequency**



| Test specification: | Section 15.215(c), Occupied bandwidth | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.7 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/26/2012 | | |
| Temperature: 23 ºC | Air Pressure: 1020 hPa | Relative Humidity: 44 % | Power Supply: 24 VDC |
| Remarks: | | | |

**Plot 7.4.3 Occupied bandwidth test result at high frequency**



| Test specification: | Section 15.109, Radiated emission | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Sections 11.6 and 12.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 36 % | Power Supply: 24 VDC |
| Remarks: | | | |

# 8 Emission tests according to 47CFR part 15 subpart B requirements

## 8.1 Radiated emission measurements

### 8.1.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 8.1.1.

**Table 8.1.1 Radiated emission test limits according to FCC Part 15, Section 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* |

### 8.1.2 Test procedure

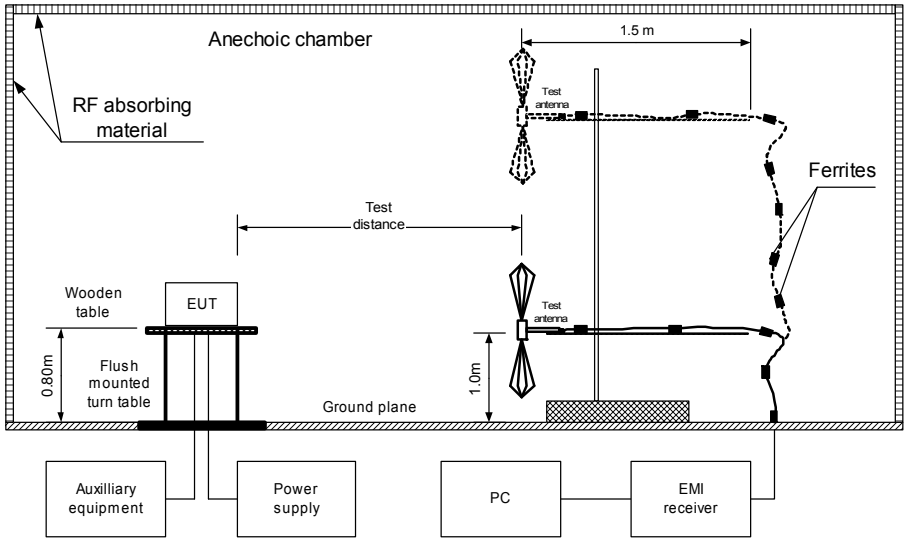
**8.1.2.1** The EUT was set up as shown in Figure 8.1.1 and associated photograph/s, energized and the performance check was conducted.

**8.1.2.2** The specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated $360^0$, 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.

**8.1.2.3** The worst test results (the lowest margins) were recorded in Table 8.1.2 and shown in the associated plots.

| Test specification: | Section 15.109, Radiated emission | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Sections 11.6 and 12.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 36 % | Power Supply: 24 VDC |
| Remarks: | | | |

**Figure 8.1.1 Setup for radiated emission measurements in anechoic chamber, table-top equipment**



| Test specification: | Section 15.109, Radiated emission | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Sections 11.6 and 12.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 36 % | Power Supply: 24 VDC |
| Remarks: | | | |

**Photograph 8.1.1 Setup for radiated emission measurements**

| **Test specification:** | **Section 15.109, Radiated emission** | | |
|---|---|---|---|
| **Test procedure:** | ANSI C63.4, Sections 11.6 and 12.1.4 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 1/22/2012 | | |
| **Temperature:** 21 ºC | **Air Pressure:** 1016 hPa | **Relative Humidity:** 36 % | **Power Supply:** 24 VDC |
| **Remarks:** | | | |

**Table 8.1.2 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

| 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* | | | | |
| 31.999600 | 32.22 | 30.68 | 40.00 | -9.32 | Vertical | 1.00 | 0 | Pass |
| 64.000000 | 22.67 | 20.60 | 40.00 | -19.40 | Vertical | 1.00 | 10 | |
| 128.000000 | 31.04 | 30.27 | 43.50 | -13.23 | Horizontal | 1.53 | 58 | |
| 160.000000 | 29.02 | 27.90 | 43.50 | -15.60 | Horizontal | 1.71 | 229 | |

TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 MHz – 25000 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 emission was found | | | | | | | | | | Pass |

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

**Reference numbers of test equipment used**

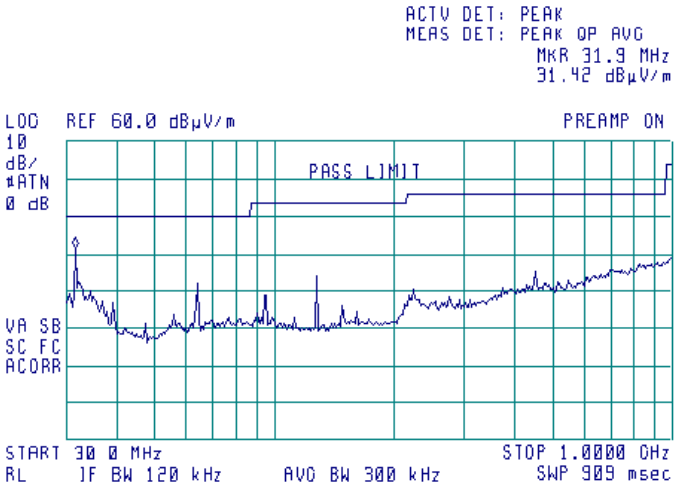
| HL 0521 | HL 0593 | HL 0594 | HL 0604 | HL 1984 | HL 2871 | HL 2909 | HL 3622 |
|---|---|---|---|---|---|---|---|

Full description is given in Appendix A.

| Test specification: | Section 15.109, Radiated emission | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Sections 11.6 and 12.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 36 % | Power Supply: 24 VDC |
| Remarks: | | | |

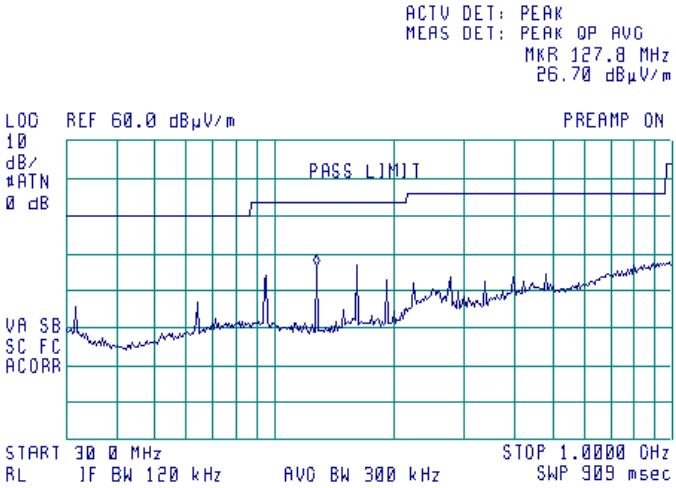
**Plot 8.1.1 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization**

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




**Plot 8.1.2 Radiated emission measurements in 30 - 1000 MHz range, horizontal antenna polarization**

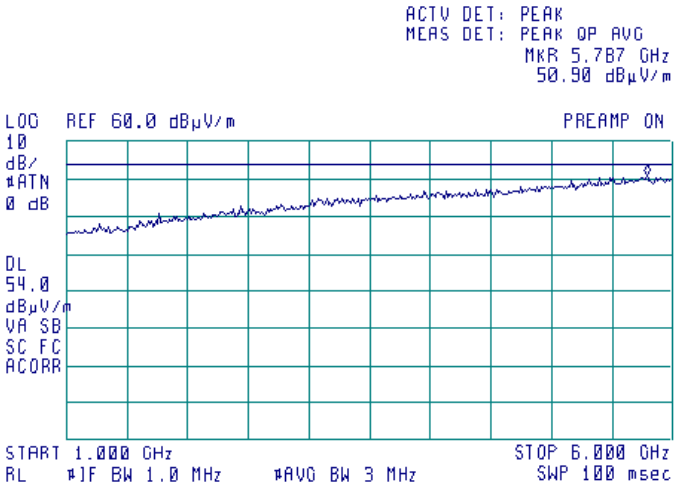
TEST SITE: Semi anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive / Stand-by

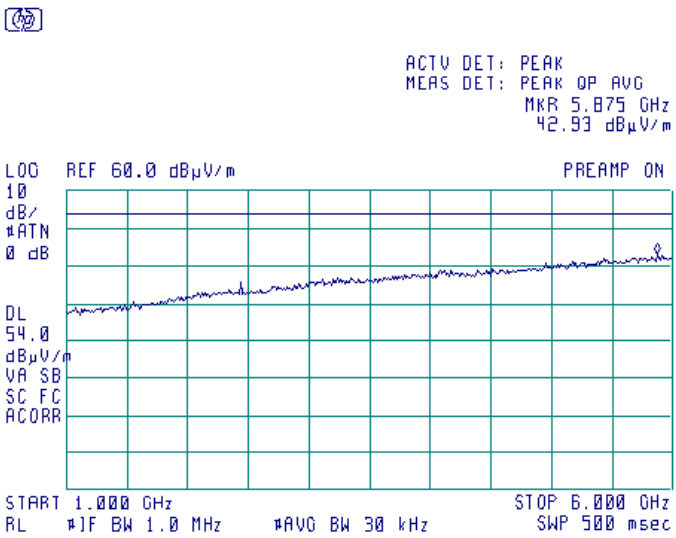


| Test specification: | Section 15.109, Radiated emission | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Sections 11.6 and 12.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 36 % | Power Supply: 24 VDC |
| Remarks: | | | |

**Plot 8.1.3 Radiated emission measurements in 1 – 6 GHz range, vertical and horizontal antenna polarization**

TEST SITE: Fully anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive / Stand-by

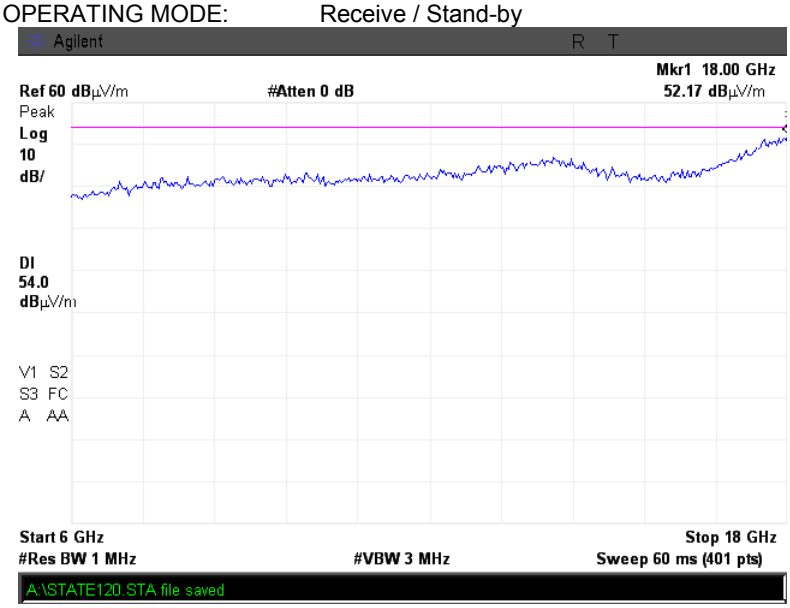


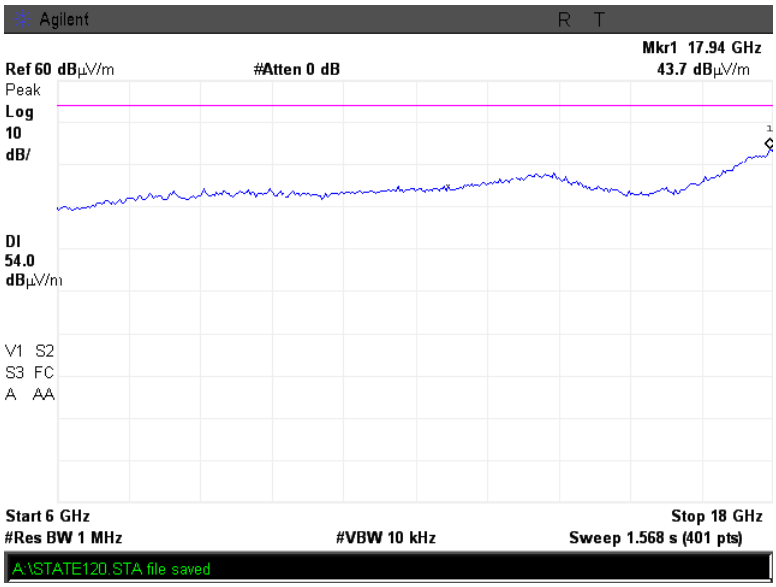



| Test specification: | Section 15.109, Radiated emission | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Sections 11.6 and 12.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 36 % | Power Supply: 24 VDC |
| Remarks: | | | |

**Plot 8.1.4 Radiated emission measurements in 6 – 18 GHz range, vertical and horizontal antenna polarization**

TEST SITE: Fully anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive / Stand-by

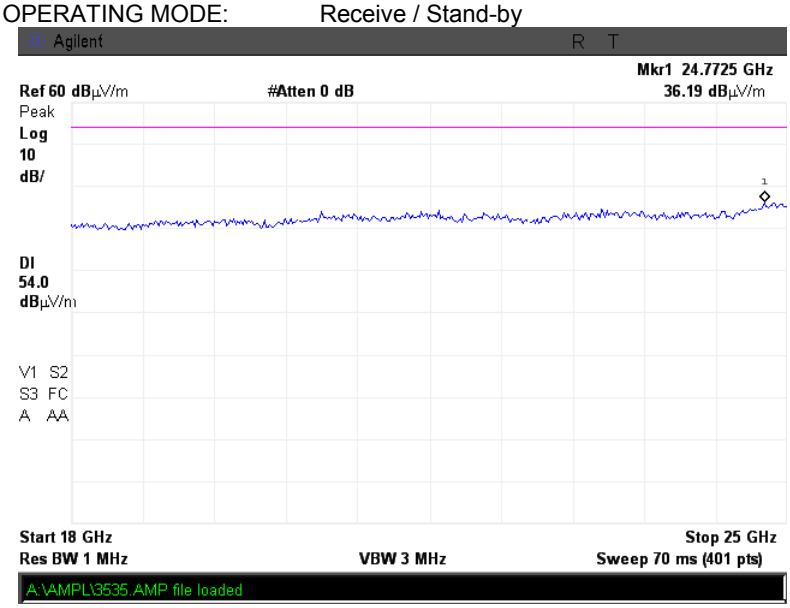


| Test specification: | Section 15.109, Radiated emission | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Sections 11.6 and 12.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 1/22/2012 | | |
| Temperature: 21 ºC | Air Pressure: 1016 hPa | Relative Humidity: 36 % | Power Supply: 24 VDC |
| Remarks: | | | |

**Plot 8.1.5 Radiated emission measurements in 18 – 25 GHz range, vertical and horizontal antenna polarization**

TEST SITE: Fully anechoic chamber
LIMIT: Class B
TEST DISTANCE: 3 m
EUT OPERATING MODE: Receive / Stand-by



# 9 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 |
| 0593 | Antenna Mast, 1-4 m Pneumatic | Madgesh | AM-F1 | 101 | 05-Feb-12 | 05-Feb-13 |
| 0594 | Turn Table FOR ANECHOIC CHAMBER flush mount d=1.2 m Pneumatic | Hermon Laboratories | TT-WDC1 | 102 | 16-Oct-11 | 16-Oct-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 | 26-Jan-11 | 26-Jan-14 |
| 1984 | Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W | EMC Test Systems | 3115 | 9911-5964 | 25-Nov-11 | 25-Nov-12 |
| 2432 | Antenna, Double-Ridged Waveguide Horn 1-18 GHz | EMC Test Systems | 3115 | 00027177 | 25-Nov-11 | 25-Nov-12 |
| 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 | MY41444762 | 08-May-11 | 08-May-12 |
| 3622 | Cable RF, 6.0 m, N type-N type, DC-6.5 GHz | Alpha Wire | RG 214/U | NA | 30-Dec-11 | 30-Dec-12 |
| 3623 | Cable RF, 6.0 m, N type-N type, DC-6.5 GHz | Belden | MIL C-17 | NA | 30-Dec-11 | 30-Dec-12 |

# 10 APPENDIX B Measurement uncertainties

**Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements**

| Test description | Expanded uncertainty |
|---|---|
| Radiated emissions at 10 m measuring distance<br>Horizontal polarization<br><br><br><br>Vertical polarization | <br>Biconilog antenna: ± 5.0 dB<br>Biconical antenna: ± 5.0 dB<br>Log periodic antenna: ± 5.1 dB<br>Double ridged horn antenna: ± 5.3 dB<br>Biconilog antenna: ± 5.5 dB<br>Biconical antenna: ± 5.5 dB<br>Log periodic antenna: ± 5.6 dB<br>Double ridged horn antenna: ± 5.8 dB |
| Radiated emissions at 3 m measuring distance<br>Horizontal polarization<br><br><br><br>Vertical polarization | <br>Biconilog antenna: ± 5.3 dB<br>Biconical antenna: ± 5.0 dB<br>Log periodic antenna: ± 5.3 dB<br>Double ridged horn antenna: ± 5.3 dB<br>Biconilog antenna: ± 6.0 dB<br>Biconical antenna: ± 5.7 dB<br>Log periodic antenna: ± 6.0 dB<br>Double ridged horn antenna: ± 6.0 dB |
| Conducted emissions at RF antenna connector | 9 kHz to 2.9 GHz: ± 2.6 dB<br>2.9 GHz to 6.46 GHz: ± 3.5 dB<br>6.46 GHz to 13.2 GHz: ± 4.3 dB<br>13.2 GHz to 22.0 GHz: ± 5.0 dB<br>22.0 GHz to 26.8 GHz: ± 5.5 dB<br>26.8 GHz to 40.0 GHz: ± 4.8 dB |
| Duty cycle, timing (Tx ON / OFF) and average factor measurements | ± 1.0 % |
| Occupied bandwidth | ± 8.0 % |

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.

# 11 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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# 12 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 |

# 13 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(μV) to convert it into field intensity in dB(μV/m).

**Antenna factor**
**Standard gain horn antenna**
**Quinstar Technology, Model QWH**
**Ser.No.110, HL 0768**

| 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(μV) to convert it into field intensity in dB(μV/m).

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

| Frequency, MHz | Antenna Factor, dB(1/m) | Frequency, MHz | Antenna Factor, dB(1/m) |
|---|---|---|---|
| 26 | 7.8 | 940 | 24.0 |
| 28 | 7.8 | 960 | 24.1 |
| 30 | 7.8 | 980 | 24.5 |
| 40 | 7.2 | 1000 | 24.9 |
| 60 | 7.1 | 1020 | 25.0 |
| 70 | 8.5 | 1040 | 25.2 |
| 80 | 9.4 | 1060 | 25.4 |
| 90 | 9.8 | 1080 | 25.6 |
| 100 | 9.7 | 1100 | 25.7 |
| 110 | 9.3 | 1120 | 26.0 |
| 120 | 8.8 | 1140 | 26.4 |
| 130 | 8.7 | 1160 | 27.0 |
| 140 | 9.2 | 1180 | 27.0 |
| 150 | 9.8 | 1200 | 26.7 |
| 160 | 10.2 | 1220 | 26.5 |
| 170 | 10.4 | 1240 | 26.5 |
| 180 | 10.4 | 1260 | 26.5 |
| 190 | 10.3 | 1280 | 26.6 |
| 200 | 10.6 | 1300 | 27.0 |
| 220 | 11.6 | 1320 | 27.8 |
| 240 | 12.4 | 1340 | 28.3 |
| 260 | 12.8 | 1360 | 28.2 |
| 280 | 13.7 | 1380 | 27.9 |
| 300 | 14.7 | 1400 | 27.9 |
| 320 | 15.2 | 1420 | 27.9 |
| 340 | 15.4 | 1440 | 27.8 |
| 360 | 16.1 | 1460 | 27.8 |
| 380 | 16.4 | 1480 | 28.0 |
| 400 | 16.6 | 1500 | 28.5 |
| 420 | 16.7 | 1520 | 28.9 |
| 440 | 17.0 | 1540 | 29.6 |
| 460 | 17.7 | 1560 | 29.8 |
| 480 | 18.1 | 1580 | 29.6 |
| 500 | 18.5 | 1600 | 29.5 |
| 520 | 19.1 | 1620 | 29.3 |
| 540 | 19.5 | 1640 | 29.2 |
| 560 | 19.8 | 1660 | 29.4 |
| 580 | 20.6 | 1680 | 29.6 |
| 600 | 21.3 | 1700 | 29.8 |
| 620 | 21.5 | 1720 | 30.3 |
| 640 | 21.2 | 1740 | 30.8 |
| 660 | 21.4 | 1760 | 31.1 |
| 680 | 21.9 | 1780 | 31.0 |
| 700 | 22.2 | 1800 | 30.9 |
| 720 | 22.2 | 1820 | 30.7 |
| 740 | 22.1 | 1840 | 30.6 |
| 760 | 22.3 | 1860 | 30.6 |
| 780 | 22.6 | 1880 | 30.6 |
| 800 | 22.7 | 1900 | 30.6 |
| 820 | 22.9 | 1920 | 30.7 |
| 840 | 23.1 | 1940 | 30.9 |
| 860 | 23.4 | 1960 | 31.2 |
| 880 | 23.8 | 1980 | 31.6 |
| 900 | 24.1 | 2000 | 32.0 |
| 920 | 24.1 | | |

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

**Antenna factor**
**Double-ridged guide horn antenna**
**Model 3115, serial number: 00027177, HL 2432**

| Frequency, MHz | Antenna factor. dB(1/m) |
|---|---|
| 1000.0 | 24.7 |
| 1500.0 | 25.7 |
| 2000.0 | 27.8 |
| 2500.0 | 28.9 |
| 3000.0 | 30.7 |
| 3500.0 | 31.8 |
| 4000.0 | 33.0 |
| 4500.0 | 32.8 |
| 5000.0 | 34.2 |
| 5500.0 | 34.9 |
| 6000.0 | 35.2 |
| 6500.0 | 35.4 |
| 7000.0 | 36.3 |
| 7500.0 | 37.3 |
| 8000.0 | 37.5 |
| 8500.0 | 38.0 |
| 9000.0 | 38.3 |
| 9500.0 | 38.3 |
| 10000.0 | 38.7 |
| 10500.0 | 38.7 |
| 11000.0 | 38.9 |
| 11500.0 | 39.5 |
| 12000.0 | 39.5 |
| 12500.0 | 39.4 |
| 13000.0 | 40.5 |
| 13500.0 | 40.8 |
| 14000.0 | 41.5 |
| 14500.0 | 41.3 |
| 15000.0 | 40.2 |
| 15500.0 | 38.7 |
| 16000.0 | 38.5 |
| 16500.0 | 39.8 |
| 17000.0 | 41.9 |
| 17500.0 | 45.8 |
| 18000.0 | 49.1 |

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μV) to convert it into field intensity in dB(μV/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 m**
**Alpha Wire, HL 3622**

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|---|---|---|---|---|---|
| 10 | 0.13 | 2100 | 2.95 | 4400 | 4.99 |
| 30 | 0.24 | 2200 | 2.99 | 4500 | 5.00 |
| 50 | 0.32 | 2300 | 3.11 | 4600 | 5.17 |
| 100 | 0.47 | 2400 | 3.16 | 4700 | 5.18 |
| 200 | 0.70 | 2500 | 3.31 | 4800 | 5.33 |
| 300 | 0.88 | 2600 | 3.36 | 4900 | 5.34 |
| 400 | 1.05 | 2700 | 3.46 | 5000 | 5.50 |
| 500 | 1.21 | 2800 | 3.52 | 5100 | 5.56 |
| 600 | 1.36 | 2900 | 3.65 | 5200 | 5.76 |
| 700 | 1.49 | 3000 | 3.70 | 5300 | 5.76 |
| 800 | 1.63 | 3100 | 3.82 | 5400 | 5.85 |
| 900 | 1.72 | 3200 | 3.88 | 5500 | 5.88 |
| 1000 | 1.84 | 3300 | 3.99 | 5600 | 5.96 |
| 1100 | 1.96 | 3400 | 4.08 | 5700 | 6.02 |
| 1200 | 2.06 | 3500 | 4.19 | 5800 | 6.06 |
| 1300 | 2.15 | 3600 | 4.28 | 5900 | 6.14 |
| 1400 | 2.28 | 3700 | 4.42 | 6000 | 6.17 |
| 1500 | 2.35 | 3800 | 4.40 | 6100 | 6.28 |
| 1600 | 2.43 | 3900 | 4.51 | 6200 | 6.36 |
| 1700 | 2.57 | 4000 | 4.62 | 6300 | 6.47 |
| 1800 | 2.62 | 4100 | 4.70 | 6400 | 6.51 |
| 1900 | 2.75 | 4200 | 4.78 | 6500 | 6.65 |
| 2000 | 2.80 | 4300 | 4.83 | | |

**Cable loss**
**Cable coaxial, MIL C-17, N type-N type, 6 m**
**Belden, HL 3623**

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|---|---|---|---|---|---|
| 10 | 0.13 | 2600 | 4.38 | 5400 | 7.76 |
| 30 | 0.25 | 2700 | 4.53 | 5500 | 7.79 |
| 50 | 0.33 | 2800 | 4.64 | 5600 | 7.88 |
| 100 | 0.49 | 2900 | 4.79 | 5700 | 7.93 |
| 200 | 0.76 | 3000 | 4.93 | 5800 | 8.05 |
| 300 | 0.97 | 3100 | 5.02 | 5900 | 8.03 |
| 400 | 1.18 | 3200 | 5.18 | 6000 | 8.07 |
| 500 | 1.38 | 3300 | 5.27 | 6100 | 8.14 |
| 600 | 1.54 | 3400 | 5.41 | 6200 | 8.21 |
| 700 | 1.71 | 3500 | 5.57 | 6300 | 8.28 |
| 800 | 1.88 | 3600 | 5.65 | 6400 | 8.35 |
| 900 | 2.04 | 3700 | 5.82 | 6500 | 8.43 |
| 1000 | 2.19 | 3800 | 5.89 | | |
| 1100 | 2.38 | 3900 | 6.02 | | |
| 1200 | 2.61 | 4000 | 6.15 | | |
| 1300 | 2.63 | 4100 | 6.26 | | |
| 1400 | 2.79 | 4200 | 6.37 | | |
| 1500 | 2.90 | 4300 | 6.52 | | |
| 1600 | 3.08 | 4400 | 6.63 | | |
| 1700 | 3.21 | 4500 | 6.74 | | |
| 1800 | 3.31 | 4600 | 6.86 | | |
| 1900 | 3.47 | 4700 | 6.98 | | |
| 2000 | 3.59 | 4800 | 7.09 | | |
| 2100 | 3.74 | 4900 | 7.17 | | |
| 2200 | 3.86 | 5000 | 7.30 | | |
| 2300 | 3.98 | 5100 | 7.41 | | |
| 2400 | 4.12 | 5200 | 7.59 | | |
| 2500 | 4.24 | 5300 | 7.71 | | |

# 14 APPENDIX F Abbreviations and acronyms

| | |
|---|---|
| A | ampere |
| AC | alternating current |
| AM | amplitude modulation |
| AVRG | average (detector) |
| cm | centimeter |
| dB | decibel |
| dBm | decibel referred to one milliwatt |
| dB(μV) | decibel referred to one microvolt |
| dB(μV/m) | decibel referred to one microvolt per meter |
| dB(μA) | 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 |
| μs | 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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