

## TEST REPORT

ACCORDING TO: FCC CFR 47 part 15 subpart C, §15.225 and subpart B

FOR:

**LogiTag Systems Ltd.**

**System for automating reordering  
operations with RFID reader**

**Product name: StockBox**

**Part numbers: LT-SB-G001,  
LT-SB-001**

**FCC ID:Z97-STB01**

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## 1 Applicant information

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## 2 Equipment under test attributes

**Product type:** System for automating reordering operations with RFID reader  
**Product name:** StockBox  
**Part number:** LT-SB-G001  
**Serial number:** SBG001  
**Hardware version:** A01  
**Software release:** 28-10-2011  
**Receipt date:** 10/9/2011

## 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:** 22570  
**Location:** Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel  
**Test started:** 10/24/2011  
**Test completed:** 11/09/2011  
**Test specification(s):** FCC CFR 47 part 15 subpart C, §15.225 and subpart B class B

## 5 Tests summary

| Test                                                        | Status |
|-------------------------------------------------------------|--------|
| <b>Transmitter characteristics</b>                          |        |
| Sections 15.225(a) (b) (c), In band radiated emissions      | Pass   |
| Sections 15.225(d), Out of band radiated emissions          | Pass   |
| Section 15.225(e), Frequency stability                      | Pass   |
| Section 15.207(a), Conducted emission                       | Pass   |
| Section 15.215(c), Occupied bandwidth                       | Pass   |
| Section 15.203, Antenna requirements                        | Pass   |
| <b>Unintentional emissions</b>                              |        |
| Section 15.107 Class B, Conducted emission at AC power port | Pass   |
| Section 15.109 Class B, 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.

|                     | Name and Title                                                   | Date              | Signature                                                                                                                                                                      |
|---------------------|------------------------------------------------------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Tested by:</b>   | Mr. I. Sloushch, test engineer<br>Mr. A. Tseitlin, test engineer | November 9, 2011  | <br> |
| <b>Reviewed by:</b> | Mrs. M. Cherniavsky, certification engineer                      | November 13, 2011 |                                                                                           |
| <b>Approved by:</b> | Mr. M. Nikishin, EMC and Radio group manager                     | November 14, 2011 |                                                                                           |

## 6 EUT description

### 6.1 General information

The EUT, RFID reader operating at 13.56 MHz frequency, is a part of the StockBox system containing the following elements in the common enclosure:

- switching board MUX with 8 channels output, antenna input connector and channels control connected to the reader;
- controller based on Microchip chip, controlling the reader and MUX with RS232 connection to the reader; contains relays, RS232, Ethernet and GPRS connections to the external world;
- 2 antennas 13.56 MHz main frequency, connected to the MUX outputs 1 and 2;
- GPRS module connects to controller with antenna connector at the StockBox panel connectors. The GPRS module, manufactured by Telit Communications S.p.A., is modular approved under FCC ID:RI7GE864. The EUT part number LT-SB-G001 containing the GPRS module was tested as the whole model. The EUT part number which does not include the GPRS module is LT-SB-001.

The system is powered from the mains via 12 V/0.5A power supply adaptor, manufactured by Shenzhen FUJIA Appliance, model FJ-SW 1201000E.

### 6.2 Ports and lines

| Port type | Port description | Connected from  | Connected to  | Qty. | Cable type | Cable length, m |
|-----------|------------------|-----------------|---------------|------|------------|-----------------|
| Power     | AC power         | AC mains        | AC/DC adaptor | 1    | NA         | NA              |
| Power     | DC power         | AC/DC adaptor   | EUT           | 1    | Unshielded | 2               |
| Signal    | RS-232           | PC              | EUT           | 1    | Shielded   | 3               |
| Signal    | LAN              | Switch Ethernet | EUT           | 1    | FTP        | 10              |
| Signal    | LAN              | Switch Ethernet | PC            | 1    | FTP        | 2               |
| RF        | Antenna          | Antenna         | EUT           | 2    | Shielded   | 3               |

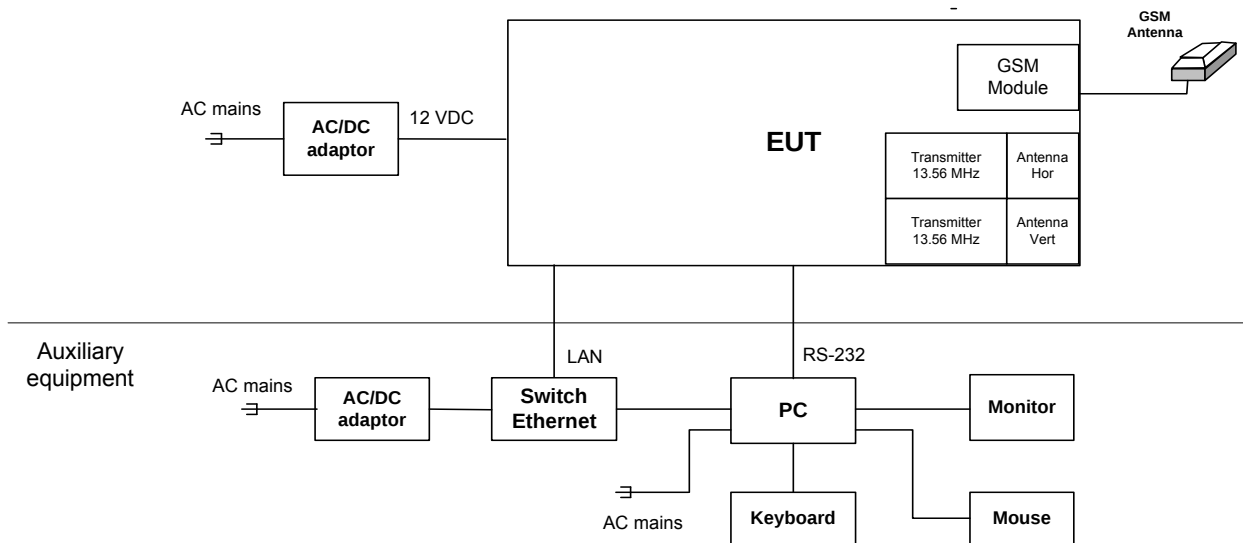
### 6.3 Support and test equipment

| Description     | Manufacturer | Model number | Serial number      |
|-----------------|--------------|--------------|--------------------|
| PC              | NA           | NA           | NA                 |
| Monitor         | ViewSonic    | P775         | KP73701102         |
| Keyboard        | Compaq       | 269513-BB6   | B17520R39IQA<br>Q5 |
| Mouse           | Microsoft    | X08-70400    | 4240747-4          |
| Switch Ethernet | TP-LINK      | TLSF1005D    | 11184103784        |
| AC/DC adapter   | TP-LINK      | TO90060-2C1  | NA                 |

### 6.4 Operating frequencies

| Source | Frequency, MHz |     |      |
|--------|----------------|-----|------|
| Tx     | 13.56          | 800 | 1800 |
| Clock  | 16             | 25  |      |

## 6.5 Test configuration



## 6.6 Transmitter characteristics

|                                                                                                                                              |                                             |                                                           |                                                          |     |
|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-----------------------------------------------------------|----------------------------------------------------------|-----|
| <b>Type of equipment</b>                                                                                                                     |                                             |                                                           |                                                          |     |
| <input type="checkbox"/> Stand-alone (Equipment with or without its own control provisions)                                                  |                                             |                                                           |                                                          |     |
| <input checked="" type="checkbox"/> Combined equipment (Equipment where the radio part is fully integrated within another type of equipment) |                                             |                                                           |                                                          |     |
| <input type="checkbox"/> Plug-in card (Equipment intended for a variety of host systems)                                                     |                                             |                                                           |                                                          |     |
| <b>Intended use</b>                                                                                                                          |                                             | <b>Condition of use</b>                                   |                                                          |     |
| <input type="checkbox"/> fixed                                                                                                               |                                             | Always at a distance more than 2 m from all people        |                                                          |     |
| <input checked="" type="checkbox"/> mobile                                                                                                   |                                             | Always at a distance more than 20 cm from all people      |                                                          |     |
| <input type="checkbox"/> portable                                                                                                            |                                             | May operate at a distance closer than 20 cm to human body |                                                          |     |
| <b>Assigned frequency ranges</b>                                                                                                             |                                             | 13.553 – 13.567 MHz                                       |                                                          |     |
| <b>Operating frequencies</b>                                                                                                                 |                                             | 13.56 MHz                                                 |                                                          |     |
| <b>Is transmitter output power variable?</b>                                                                                                 |                                             | <input checked="" type="checkbox"/> X                     | <input type="checkbox"/> No                              |     |
|                                                                                                                                              |                                             | <input type="checkbox"/> Yes                              | <input type="checkbox"/> continuous variable             |     |
|                                                                                                                                              |                                             |                                                           | <input type="checkbox"/> stepped variable with stepsize  | dB  |
|                                                                                                                                              |                                             |                                                           | <input type="checkbox"/> minimum RF power                | dBm |
|                                                                                                                                              |                                             |                                                           | <input type="checkbox"/> maximum RF power                | dBm |
| <b>Antenna connection</b>                                                                                                                    |                                             |                                                           |                                                          |     |
| <input type="checkbox"/> unique coupling                                                                                                     | <input type="checkbox"/> standard connector | <input checked="" type="checkbox"/> X                     | <input type="checkbox"/> integral                        |     |
|                                                                                                                                              |                                             | <input checked="" type="checkbox"/> X                     | <input type="checkbox"/> without temporary RF connector  |     |
| <b>Type of modulation</b>                                                                                                                    |                                             | AM                                                        |                                                          |     |
| <b>Transmitter power source</b>                                                                                                              |                                             |                                                           |                                                          |     |
| <input checked="" type="checkbox"/> X                                                                                                        | AC mains                                    | <b>Nominal rated voltage</b>                              | 120 VAC via AC/DC adapter                                |     |
| <b>Common power source for transmitter and receiver</b>                                                                                      |                                             | <input checked="" type="checkbox"/> X                     | <input type="checkbox"/> yes <input type="checkbox"/> No |     |

|                            |                               |                                                               |                              |
|----------------------------|-------------------------------|---------------------------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Sections 15.225(a) (b) (c), In band radiated emissions</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Sections 5.3 and 13.1.4                           |                              |
| <b>Test mode:</b>          | Compliance                    | <b>Verdict:</b>                                               | <b>PASS</b>                  |
| <b>Date(s):</b>            | 10/25/2011                    |                                                               |                              |
| <b>Temperature:</b> 23 °C  | <b>Air Pressure:</b> 1015 hPa | <b>Relative Humidity:</b> 42 %                                | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                                               |                              |

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

### 7.1 In band radiated emissions

#### 7.1.1 General

This test was performed to measure field strength of fundamental emission and modulation products from the EUT within the assigned band. Specification test limits are given in Table 7.1.1.

Table 7.1.1 Radiated emission limits

| Frequency,<br>MHz | Field strength at 30 m distance* |          | Field strength at 3 m distance* |            |
|-------------------|----------------------------------|----------|---------------------------------|------------|
|                   | μV/m                             | dB(μV/m) | μV/m                            | dB(μV/m)** |
| 13.110 – 13.410   | 106                              | 40.5     | 10600                           | 80.5       |
| 13.410 – 13.553   | 334                              | 50.5     | 33400                           | 90.5       |
| 13.553 – 13.567   | 15848                            | 84.0     | 1584800                         | 124.0      |
| 13.567 – 13.710   | 334                              | 50.5     | 33400                           | 90.5       |
| 13.710 – 14.010   | 106                              | 40.5     | 10600                           | 80.5       |

\*- The limit is provided in quasi peak values.

\*\* - 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  $S_1$  and  $S_2$  – standard defined and test distance respectively in meters.

#### 7.1.2 Test procedure

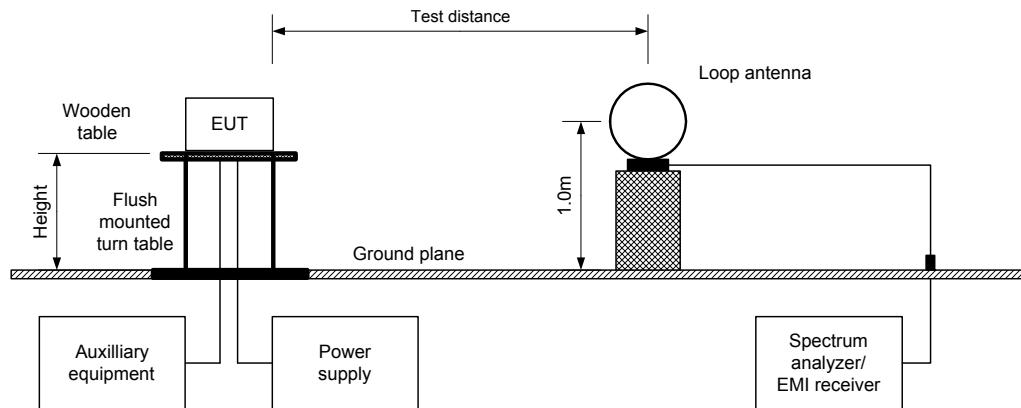
**7.1.2.1** The EUT was set up as shown in Figure 7.1.1 energized and the performance check was conducted.

**7.1.2.2** The specified frequency range was investigated with loop antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna was rotated around its vertical axis and the measuring antenna polarization was switched from vertical to horizontal.

**7.1.2.3** The worst test results (the lowest margins) were recorded in Table 7.1.2 and shown in the associated plots.

|                            |                               |                                                               |                              |
|----------------------------|-------------------------------|---------------------------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Sections 15.225(a) (b) (c), In band radiated emissions</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Sections 5.3 and 13.1.4                           |                              |
| <b>Test mode:</b>          | Compliance                    | <b>Verdict:</b>                                               | <b>PASS</b>                  |
| <b>Date(s):</b>            | 10/25/2011                    |                                                               |                              |
| <b>Temperature:</b> 23 °C  | <b>Air Pressure:</b> 1015 hPa | <b>Relative Humidity:</b> 42 %                                | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                                               |                              |

Figure 7.1.1 Setup for in band radiated emission measurements



|                            |                                                               |                                |                              |
|----------------------------|---------------------------------------------------------------|--------------------------------|------------------------------|
| <b>Test specification:</b> | <b>Sections 15.225(a) (b) (c), In band radiated emissions</b> |                                |                              |
| <b>Test procedure:</b>     | ANSI C63.4, Sections 5.3 and 13.1.4                           |                                |                              |
| <b>Test mode:</b>          | Compliance                                                    | <b>Verdict:</b>                | <b>PASS</b>                  |
| <b>Date(s):</b>            | 10/25/2011                                                    |                                |                              |
| <b>Temperature:</b> 23 °C  | <b>Air Pressure:</b> 1015 hPa                                 | <b>Relative Humidity:</b> 42 % | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                                                               |                                |                              |

**Table 7.1.2 In band radiated emission test results**

TEST DISTANCE: 3 m  
 EUT POSITION: Typical  
 MODULATION: Unmodulated  
 MODULATING SIGNAL: ID code  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
 INVESTIGATED FREQUENCY RANGE: 13.110 – 14.010 MHz  
 RESOLUTION BANDWIDTH: 9.0 kHz  
 VIDEO BANDWIDTH: 30.0 kHz

| Carrier frequency, MHz |      | Peak emission, dB(μV/m)     |                 | Quasi-peak  |   |    | Antenna polarization | Azimuth**, degrees | Verdict |  |  |  |
|------------------------|------|-----------------------------|-----------------|-------------|---|----|----------------------|--------------------|---------|--|--|--|
|                        |      | Measured emission, dB(μV/m) | Limit, dB(μV/m) | Margin, dB* |   |    |                      |                    |         |  |  |  |
| Unom                   |      |                             |                 |             |   |    |                      |                    |         |  |  |  |
| 13.56                  | 66.8 | 66.4                        | 124             | -57.6       | V | 23 | Pass                 |                    |         |  |  |  |
| 115%Unom               |      |                             |                 |             |   |    |                      |                    |         |  |  |  |
| 13.56                  | 66.7 | 66.3                        | 124             | -57.7       | V | 25 |                      |                    |         |  |  |  |
| 85%Unom                |      |                             |                 |             |   |    |                      |                    |         |  |  |  |
| 13.56                  | 66.6 | 66.3                        | 124             | -57.7       | V | 21 |                      |                    |         |  |  |  |

\*- Margin = Measured emission - specification limit.

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

**Reference numbers of test equipment used**

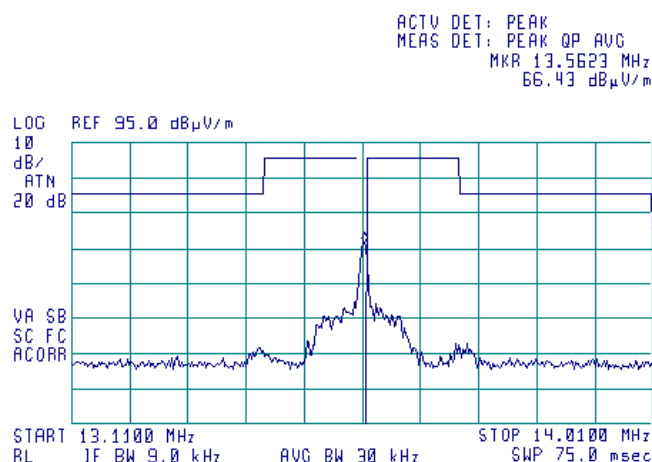
|         |         |         |         |  |  |  |  |
|---------|---------|---------|---------|--|--|--|--|
| HL 0521 | HL 1915 | HL 2871 | HL 3123 |  |  |  |  |
|---------|---------|---------|---------|--|--|--|--|

Full description is given in Appendix A.

|                            |                               |                                                               |                              |
|----------------------------|-------------------------------|---------------------------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Sections 15.225(a) (b) (c), In band radiated emissions</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Sections 5.3 and 13.1.4                           |                              |
| <b>Test mode:</b>          |                               | Compliance                                                    | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 10/25/2011                                                    |                              |
| <b>Temperature:</b> 23 °C  | <b>Air Pressure:</b> 1015 hPa | <b>Relative Humidity:</b> 42 %                                | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                                               |                              |

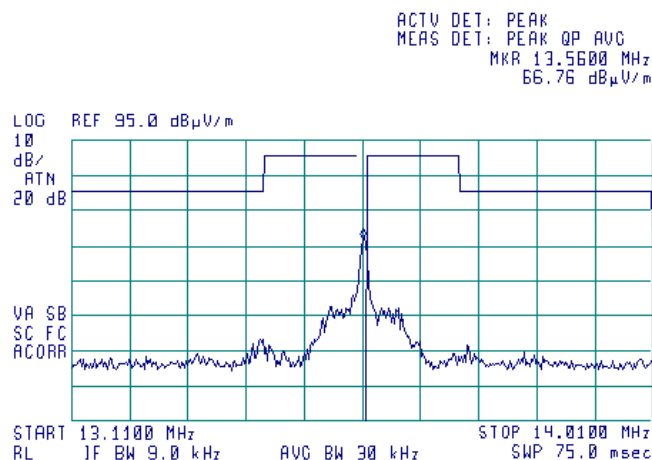
#### Plot 7.1.1 Fundamental emission test result

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
DETECTOR: Peak hold  
INPUT VOLTAGE: Unom



#### Plot 7.1.2 Fundamental emission test result

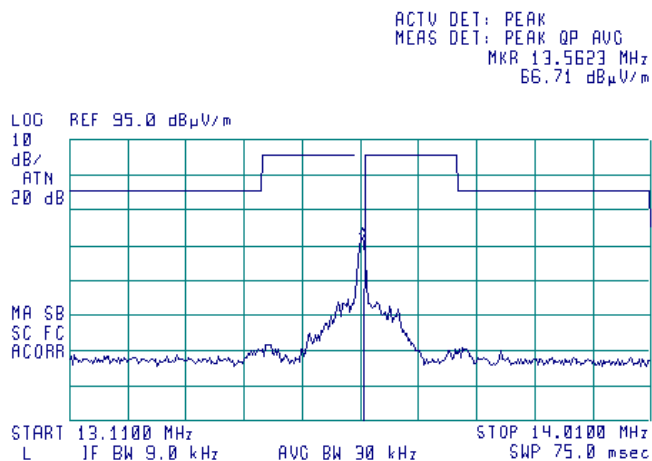
TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
DETECTOR: Peak hold  
INPUT VOLTAGE: 115%Unom



|                            |                               |                                                               |                              |
|----------------------------|-------------------------------|---------------------------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Sections 15.225(a) (b) (c), In band radiated emissions</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Sections 5.3 and 13.1.4                           |                              |
| <b>Test mode:</b>          |                               | Compliance                                                    | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 10/25/2011                                                    |                              |
| <b>Temperature:</b> 23 °C  | <b>Air Pressure:</b> 1015 hPa | <b>Relative Humidity:</b> 42 %                                | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                                               |                              |

### Plot 7.1.3 Fundamental emission test result

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
DETECTOR: Peak hold  
INPUT VOLTAGE: 85%Unom



|                                                                               |                               |                                |                              |
|-------------------------------------------------------------------------------|-------------------------------|--------------------------------|------------------------------|
| <b>Test specification: Sections 15.225(d), Out of band radiated emissions</b> |                               |                                |                              |
| <b>Test procedure:</b> ANSI C63.4, Sections 5.3 and 13.1.4                    |                               |                                |                              |
| <b>Test mode:</b>                                                             | Compliance                    | <b>Verdict:</b>                | <b>PASS</b>                  |
| <b>Date(s):</b>                                                               | 10/25/2011                    |                                |                              |
| <b>Temperature:</b> 23 °C                                                     | <b>Air Pressure:</b> 1015 hPa | <b>Relative Humidity:</b> 42 % | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>                                                               |                               |                                |                              |

## 7.2 Out of band radiated 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 emission limits

| Frequency, MHz | Field strength at 3 m within restricted bands, dB(μV/m)*** |                 |                 |
|----------------|------------------------------------------------------------|-----------------|-----------------|
|                | Peak                                                       | Quasi Peak      | Average         |
| 0.009 – 0.090  | 148.5 – 128.5                                              | NA              | 128.5 – 108.5** |
| 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            |                 |

\*- 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.

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

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

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

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

### 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 loop antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna was rotated around its vertical axis and the measuring antenna polarization was switched from vertical to horizontal.

**7.2.2.3** The worst test results (the lowest margins) were recorded in Table 7.2.2 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 in Table 7.2.2 and shown in the associated plots.

|                     |                                                    |                         |                       |
|---------------------|----------------------------------------------------|-------------------------|-----------------------|
| Test specification: | Sections 15.225(d), Out of band radiated emissions |                         |                       |
| Test procedure:     | ANSI C63.4, Sections 5.3 and 13.1.4                |                         |                       |
| Test mode:          | Compliance                                         | Verdict: PASS           |                       |
| Date(s):            | 10/25/2011                                         |                         |                       |
| Temperature: 23 °C  | Air Pressure: 1015 hPa                             | Relative Humidity: 42 % | Power Supply: 120 VAC |
| Remarks:            |                                                    |                         |                       |

Figure 7.2.1 Radiated emissions below 30 MHz test set up

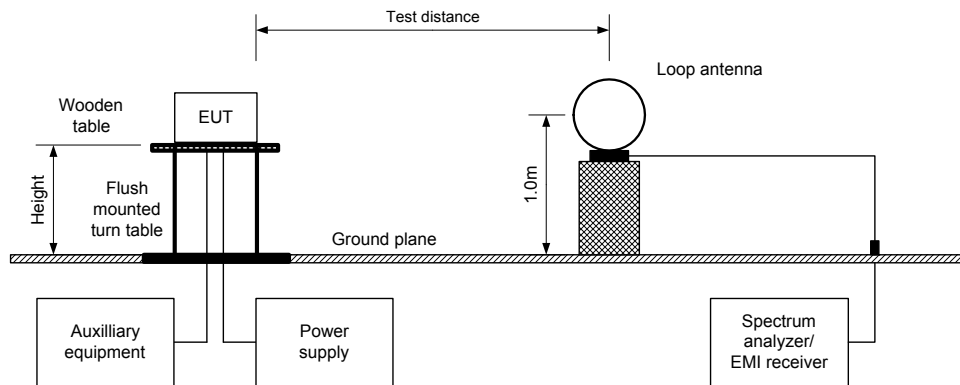
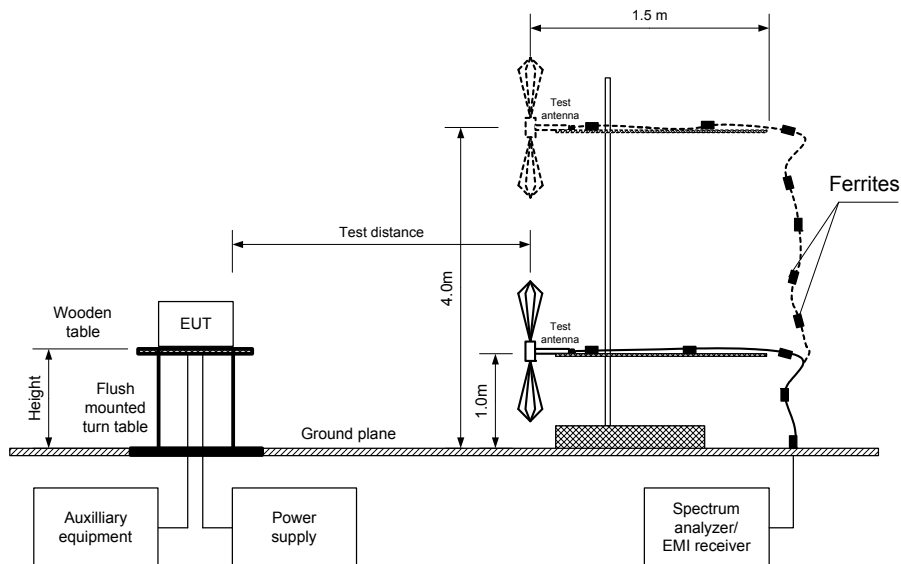


Figure 7.2.2 Radiated emissions above 30 MHz test set up



|                            |                               |                                                           |                              |
|----------------------------|-------------------------------|-----------------------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Sections 15.225(d), Out of band radiated emissions</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Sections 5.3 and 13.1.4                       |                              |
| <b>Test mode:</b>          | Compliance                    | <b>Verdict:</b>                                           | <b>PASS</b>                  |
| <b>Date(s):</b>            | 10/25/2011                    |                                                           |                              |
| <b>Temperature:</b> 23 °C  | <b>Air Pressure:</b> 1015 hPa | <b>Relative Humidity:</b> 42 %                            | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                                           |                              |

**Table 7.2.2 Out of band radiated emissions test results**

TEST DISTANCE: 3 m  
 EUT POSITION: Typical  
 MODULATION: AM  
 MODULATING SIGNAL: ID code  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
 INVESTIGATED FREQUENCY RANGE: 0.009 – 1000 MHz  
 RESOLUTION BANDWIDTH: 0.2 kHz (9 kHz – 150 kHz)  
 9.0 kHz (150 kHz – 30 MHz)  
 120 kHz (30 MHz – 1000 MHz)  
 VIDEO BANDWIDTH: ≥ Resolution bandwidth  
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)  
 Biconilog (30 MHz – 1000 MHz)

| 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* |                      |                   |                                |         |
| 81.36          | 41.13                   | 39.31                       | 40.5            | -1.19       | V                    | 1.2               | 360                            | Pass    |
| 94.92          | 40.69                   | 38.69                       | 43.5            | -4.81       | V                    | 1                 | 220                            |         |
| 108.48         | 38.09                   | 35.51                       | 43.5            | -7.99       | V                    | 1                 | 87                             |         |
| 122.04         | 41.65                   | 38.62                       | 43.5            | -4.88       | V                    | 1                 | 360                            |         |
| 135.59         | 40.00                   | 38.50                       | 43.5            | -5.00       | V                    | 1.4               | 145                            |         |
| 189.82         | 31.00                   | 29.40                       | 43.5            | -14.10      | V                    | 1.4               | 362                            |         |
| 399.99         | 45.35                   | 44.31                       | 46.00           | -1.69       | V                    | 1.4               | 195                            |         |

\*- Margin = Measured emission - specification limit.

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

**Reference numbers of test equipment used**

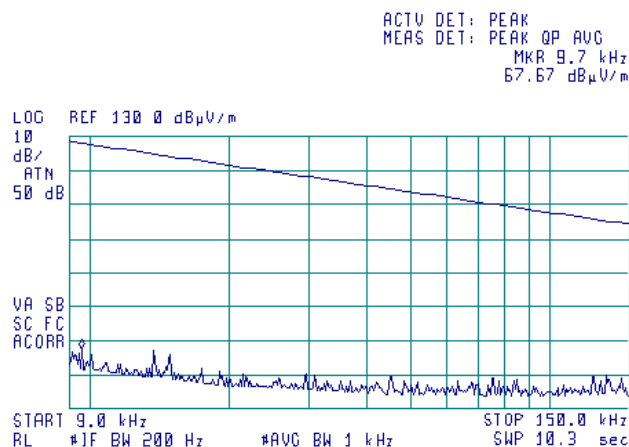
|         |         |         |         |         |  |  |  |
|---------|---------|---------|---------|---------|--|--|--|
| HL 0446 | HL 0521 | HL 0604 | HL 2871 | HL 3623 |  |  |  |
|---------|---------|---------|---------|---------|--|--|--|

Full description is given in Appendix A.

|                            |                               |                                                           |                              |
|----------------------------|-------------------------------|-----------------------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Sections 15.225(d), Out of band radiated emissions</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Sections 5.3 and 13.1.4                       |                              |
| <b>Test mode:</b>          |                               | Compliance                                                | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 10/25/2011                                                |                              |
| <b>Temperature:</b> 23 °C  | <b>Air Pressure:</b> 1015 hPa | <b>Relative Humidity:</b> 42 %                            | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                                           |                              |

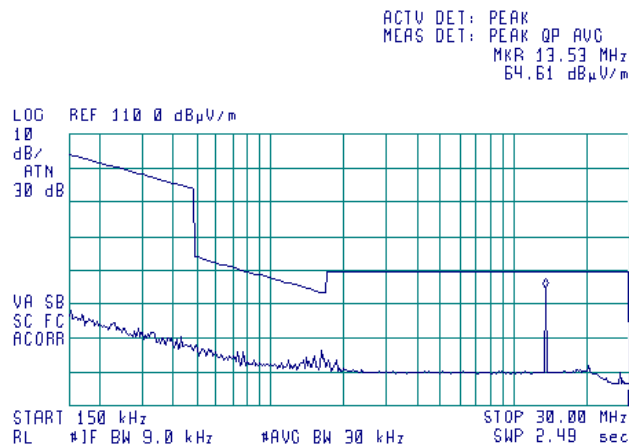
**Plot 7.2.1 Radiated emission measurements from 9 to 150 kHz**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal  
DETECTOR: Peak hold



**Plot 7.2.2 Radiated emission measurements from 0.15 to 30 MHz**

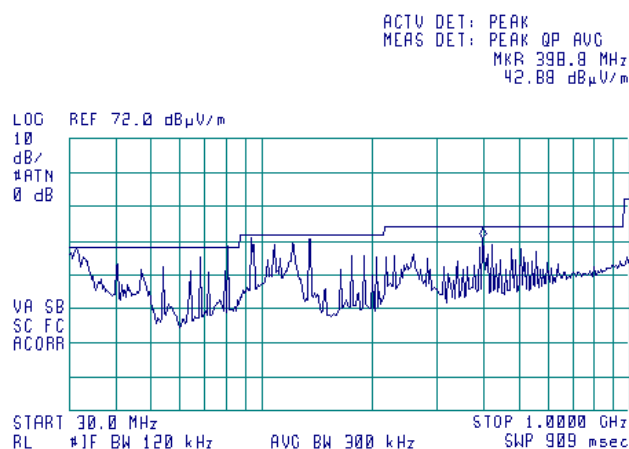
TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal  
DETECTOR: Peak hold



|                            |                               |                                                           |                              |
|----------------------------|-------------------------------|-----------------------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Sections 15.225(d), Out of band radiated emissions</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Sections 5.3 and 13.1.4                       |                              |
| <b>Test mode:</b>          |                               | Compliance                                                | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 10/25/2011                                                |                              |
| <b>Temperature:</b> 23 °C  | <b>Air Pressure:</b> 1015 hPa | <b>Relative Humidity:</b> 42 %                            | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                                           |                              |

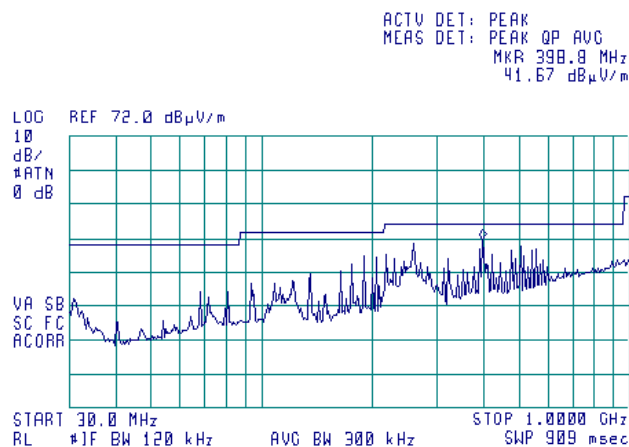
**Plot 7.2.3 Radiated emission measurements from 30 to 1000 MHz**

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



**Plot 7.2.4 Radiated emission measurements from 30 to 1000 MHz**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Horizontal  
DETECTOR: Peak hold



|                            |                               |                                               |                              |
|----------------------------|-------------------------------|-----------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Section 15.225(e), Frequency stability</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Section 13.1.6                    |                              |
| <b>Test mode:</b>          |                               | Compliance                                    | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 10/25/2011                                    |                              |
| <b>Temperature:</b> 23 °C  | <b>Air Pressure:</b> 1015 hPa | <b>Relative Humidity:</b> 42 %                | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                               |                              |

## 7.3 Frequency stability test

### 7.3.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.3.1.

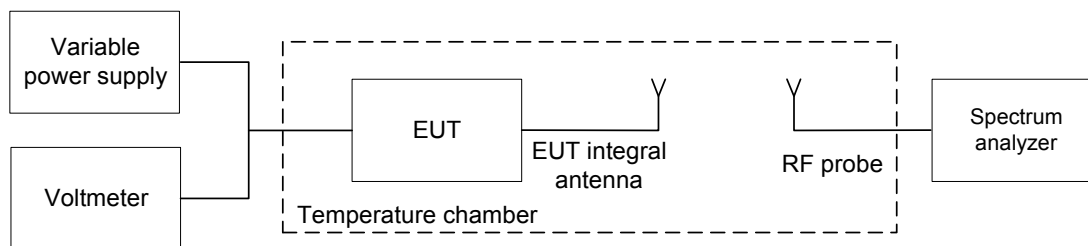
Table 7.3.1 Frequency stability limits

| Assigned frequency, MHz | Maximum allowed frequency displacement |       |
|-------------------------|----------------------------------------|-------|
|                         | %                                      | Hz    |
| 13.560                  | ± 0.01 %                               | ±1356 |

### 7.3.2 Test procedure

- 7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.
- 7.3.2.2 The EUT power was turned off. Temperature within test chamber was set to the required one and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.
- 7.3.2.3 The EUT was powered on and carrier frequency was measured at start up moment and then after 2, 5 and 10 minutes. The EUT was powered off.
- 7.3.2.4 The above procedure was repeated at the rest of the test temperatures and voltages as provided in Table 7.3.2.
- 7.3.2.5 Frequency displacement was calculated and compared with the limit as provided in Table 7.3.2.

Figure 7.3.1 Frequency stability test setup



|                            |                               |                                               |                              |
|----------------------------|-------------------------------|-----------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Section 15.225(e), Frequency stability</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Section 13.1.6                    |                              |
| <b>Test mode:</b>          |                               | Compliance                                    | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 10/25/2011                                    |                              |
| <b>Temperature:</b> 23 °C  | <b>Air Pressure:</b> 1015 hPa | <b>Relative Humidity:</b> 42 %                | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                               |                              |

Table 7.3.2 Frequency stability test results

OPERATING FREQUENCY: 13.560 MHz  
 NOMINAL POWER VOLTAGE: 120 VAC  
 TEMPERATURE STABILIZATION PERIOD: 20 min  
 POWER DURING TEMPERATURE TRANSITION: Off  
 SPECTRUM ANALYZER MODE: Counter  
 RESOLUTION BANDWIDTH: 9KHz  
 VIDEO BANDWIDTH: 30KHz  
 MODULATION: Unmodulated

| Temperature, °C | Voltage, V   | Frequency, MHz |                     |                     |                      | Max frequency drift, Hz |          | Limit, Hz | Margin, Hz | Verdict |
|-----------------|--------------|----------------|---------------------|---------------------|----------------------|-------------------------|----------|-----------|------------|---------|
|                 |              | Start up       | 2 <sup>nd</sup> min | 5 <sup>th</sup> min | 10 <sup>th</sup> min | Positive                | Negative |           |            |         |
| -20             | nominal      | 13.558875      | 13.558875           | 13.558875           | 13.559000            | 125.00                  | 0.00     | ±1356     | 1231.00    | Pass    |
| 20              | nominal+15%  | 13.558875      | 13.558875           | 13.558875           | 13.558875            | 0.00                    | 0.00     |           | 1356.00    |         |
| 20              | nominal      | 13.558875      | 13.558875           | 13.558875           | 13.558875*           | NA                      | NA       |           | NA         |         |
| 20              | nominal -15% | 13.558875      | 13.558750           | 13.558875           | 13.558875            | 0.00                    | 125.00   |           | 1231.00    |         |
| 50              | nominal      | 13.558875      | 13.558875           | 13.558875           | 13.558875            | 0.00                    | 0.00     |           | 1356.00    |         |

\* - Reference frequency

**Reference numbers of test equipment used**

|         |         |         |  |  |  |  |  |
|---------|---------|---------|--|--|--|--|--|
| HL 2952 | HL 3001 | HL 3286 |  |  |  |  |  |
|---------|---------|---------|--|--|--|--|--|

Full description is given in Appendix A.

|                            |                                              |                                |                              |
|----------------------------|----------------------------------------------|--------------------------------|------------------------------|
| <b>Test specification:</b> | <b>Section 15.207(a), Conducted emission</b> |                                |                              |
| <b>Test procedure:</b>     | ANSI C63.4, Section 13.1.3                   |                                |                              |
| <b>Test mode:</b>          | Compliance                                   | <b>Verdict:</b>                | <b>PASS</b>                  |
| <b>Date(s):</b>            | 11/1/2011                                    |                                |                              |
| <b>Temperature:</b> 23 °C  | <b>Air Pressure:</b> 1018 hPa                | <b>Relative Humidity:</b> 40 % | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                                              |                                |                              |

## 7.4 Conducted emissions

### 7.4.1 General

This test was performed to measure common mode conducted emissions at the power port. Specification test limits are given in Table 7.4.1.

**Table 7.4.1 Limits for conducted emissions**

| Frequency,<br>MHz | Class B limit, dB(μV) |          |
|-------------------|-----------------------|----------|
|                   | QP                    | AVRG     |
| 0.15 - 0.5        | 66 - 56*              | 56 - 46* |
| 0.5 - 5.0         | 56                    | 46       |
| 5.0 - 30          | 60                    | 50       |

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

### 7.4.2 Test procedure

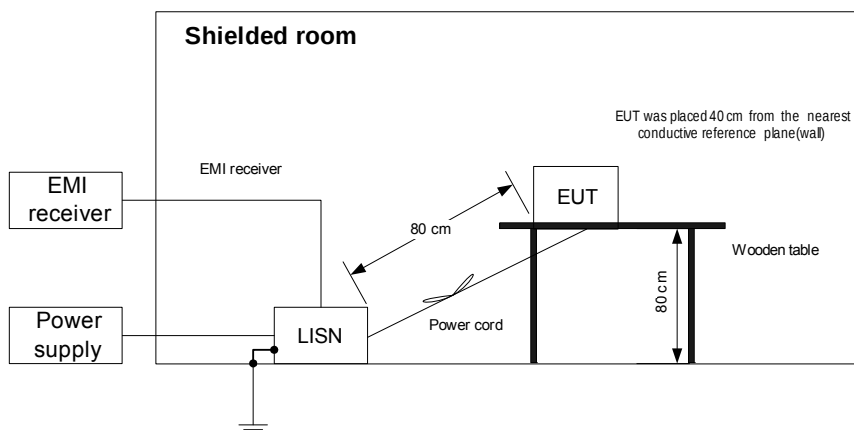
**7.4.2.1** The EUT was set up as shown in Figure 7.4.1 and associated photographs, energized and the performance check was conducted.

**7.4.2.2** The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 7.4.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

**7.4.2.3** The position of the device cables was varied to determine maximum emission level.

**7.4.2.4** The worst test results (the lowest margins) were recorded in Table 7.4.2 and shown in the associated plots.

**Figure 7.4.1 Setup for conducted emission measurements, table-top equipment**



|                            |                               |                                              |                              |
|----------------------------|-------------------------------|----------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Section 15.207(a), Conducted emission</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Section 13.1.3                   |                              |
| <b>Test mode:</b>          |                               | Compliance                                   | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 11/1/2011                                    |                              |
| <b>Temperature:</b> 23 °C  | <b>Air Pressure:</b> 1018 hPa | <b>Relative Humidity:</b> 40 %               | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                              |                              |

Table 7.4.2 Conducted emission test results

LINE: AC mains  
 EUT OPERATING MODE: Transmit  
 EUT SET UP: TABLE-TOP  
 TEST SITE: SHIELDED ROOM  
 DETECTORS USED: PEAK / QUASI-PEAK / AVERAGE  
 FREQUENCY RANGE: 150 kHz - 30 MHz  
 RESOLUTION BANDWIDTH: 9 kHz

| Frequency, MHz | Peak emission, dB(μV) | Quasi-peak                |               |             | Average                   |               |             | Line ID | Verdict |
|----------------|-----------------------|---------------------------|---------------|-------------|---------------------------|---------------|-------------|---------|---------|
|                |                       | Measured emission, dB(μV) | Limit, dB(μV) | Margin, dB* | Measured emission, dB(μV) | Limit, dB(μV) | Margin, dB* |         |         |
| 0.178710       | 52.97                 | 50.82                     | 64.60         | -13.78      | 36.76                     | 54.60         | -17.84      | L1      | Pass    |
| 0.575575       | 48.59                 | 45.83                     | 56.00         | -10.17      | 31.61                     | 46.00         | -14.39      |         |         |
| 1.057170       | 49.70                 | 46.63                     | 56.00         | -9.37       | 33.20                     | 46.00         | -12.80      |         |         |
| 1.145625       | 52.37                 | 49.19                     | 56.00         | -6.81       | 36.29                     | 46.00         | -9.71       |         |         |
| 1.204000       | 55.40                 | 52.90                     | 56.00         | -3.10       | 39.70                     | 46.00         | -6.30       |         |         |
| 11.715785      | 55.08                 | 49.41                     | 60.00         | -10.59      | 37.57                     | 50.00         | -12.43      |         |         |
| 0.177625       | 50.52                 | 47.99                     | 64.65         | -16.66      | 30.35                     | 54.65         | -24.30      | L2      | Pass    |
| 0.574825       | 50.94                 | 48.42                     | 56.00         | -7.58       | 33.64                     | 46.00         | -12.36      |         |         |
| 0.621900       | 46.46                 | 44.32                     | 56.00         | -11.68      | 28.02                     | 46.00         | -17.98      |         |         |
| 0.994575       | 48.59                 | 46.36                     | 56.00         | -9.64       | 34.32                     | 46.00         | -11.68      |         |         |
| 1.146165       | 54.40                 | 52.40                     | 56.00         | -3.60       | 40.00                     | 46.00         | -6.00       |         |         |
| 11.889755      | 56.31                 | 50.32                     | 60.00         | -9.68       | 35.86                     | 50.00         | -14.14      |         |         |

\*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

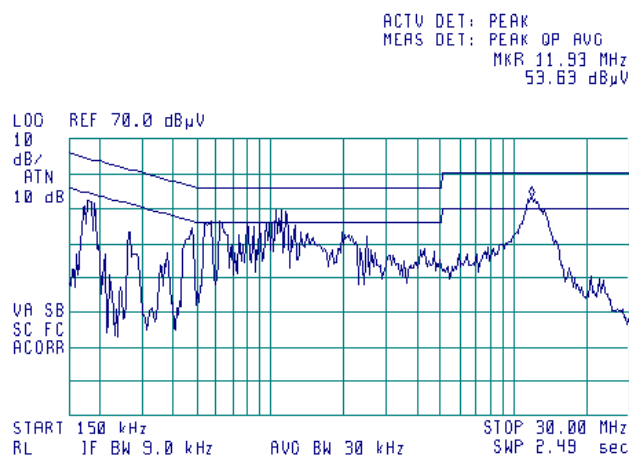
|         |         |         |         |         |  |  |  |
|---------|---------|---------|---------|---------|--|--|--|
| HL 0787 | HL 1425 | HL 1513 | HL 2888 | HL 3612 |  |  |  |
|---------|---------|---------|---------|---------|--|--|--|

Full description is given in Appendix A.

|                            |                               |                                              |                              |
|----------------------------|-------------------------------|----------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Section 15.207(a), Conducted emission</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Section 13.1.3                   |                              |
| <b>Test mode:</b>          |                               | Compliance                                   | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 11/1/2011                                    |                              |
| <b>Temperature:</b> 23 °C  | <b>Air Pressure:</b> 1018 hPa | <b>Relative Humidity:</b> 40 %               | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                              |                              |

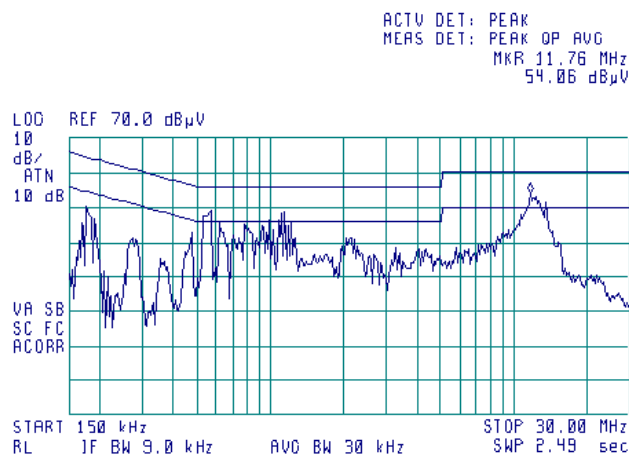
Plot 7.4.1 Conducted emission measurements

LINE: L1  
EUT OPERATING MODE: Transmit  
LIMIT: QUASI-PEAK, AVERAGE  
DETECTOR: PEAK



Plot 7.4.2 Conducted emission measurements

LINE: L2  
EUT OPERATING MODE: Transmit  
LIMIT: QUASI-PEAK, AVERAGE  
DETECTOR: PEAK



|                            |                               |                                              |                              |
|----------------------------|-------------------------------|----------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Section 15.215(c), Occupied bandwidth</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Section 13.1.7                   |                              |
| <b>Test mode:</b>          |                               | Compliance                                   | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 11/1/2011                                    |                              |
| <b>Temperature:</b> 24 °C  | <b>Air Pressure:</b> 1018 hPa | <b>Relative Humidity:</b> 36 %               | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                              |                              |

## 7.5 Occupied bandwidth test

### 7.5.1 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 7.5.1.

Table 7.5.1 Occupied bandwidth limits

| Assigned frequency, MHz | Modulation envelope reference points*, dBc |
|-------------------------|--------------------------------------------|
| 13.110 – 13.410         | 20.0                                       |
| 13.410 – 13.553         |                                            |
| 13.553 – 13.567         |                                            |
| 13.567 – 13.710         |                                            |
| 13.710 – 14.010         |                                            |

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

### 7.5.2 Test procedure

- 7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized and its proper operation was checked.
- 7.5.2.2 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.
- 7.5.2.3 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 7.5.2 and the associated plot.
- 7.5.2.4 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 7.5.1 Occupied bandwidth test setup



|                            |                               |                                              |                              |
|----------------------------|-------------------------------|----------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Section 15.215(c), Occupied bandwidth</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Section 13.1.7                   |                              |
| <b>Test mode:</b>          |                               | Compliance                                   | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 11/1/2011                                    |                              |
| <b>Temperature:</b> 24 °C  | <b>Air Pressure:</b> 1018 hPa | <b>Relative Humidity:</b> 36 %               | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                              |                              |

Table 7.5.2 Occupied bandwidth test results

ASSIGNED FREQUENCY BAND: 13.11 – 14.01 MHz  
DETECTOR USED: Peak hold  
RESOLUTION BANDWIDTH: 10 kHz  
VIDEO BANDWIDTH: 30 kHz  
MODULATION ENVELOPE REFERENCE POINTS: 20 dBc  
MODULATION: AM  
MODULATING SIGNAL: enable

| Band edge | Cross point frequency, MHz | Frequency drift, kHz |          | Modulation band edge, MHz | Assigned band edge, MHz | Verdict |
|-----------|----------------------------|----------------------|----------|---------------------------|-------------------------|---------|
|           |                            | Negative             | Positive |                           |                         |         |
| Low       | 13.5025                    | 0.125                | NA       | 13.502375                 | 13.11                   | Pass    |
| High      | 13.6100                    | NA                   | 0.125    | 13.610125                 | 14.01                   | Pass    |

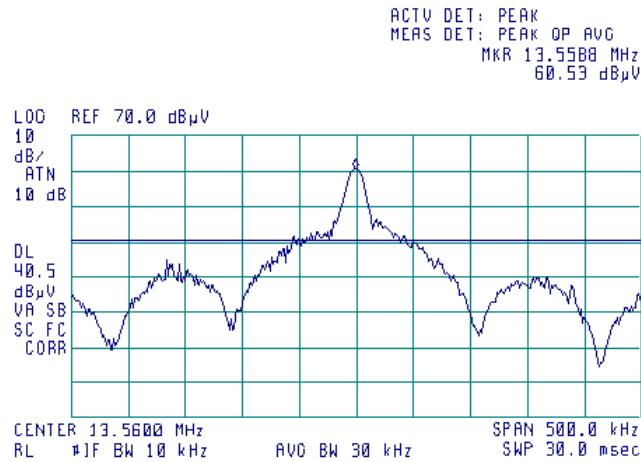
Reference numbers of test equipment used

|         |         |  |  |  |  |  |  |  |
|---------|---------|--|--|--|--|--|--|--|
| HL 1425 | HL 3618 |  |  |  |  |  |  |  |
|---------|---------|--|--|--|--|--|--|--|

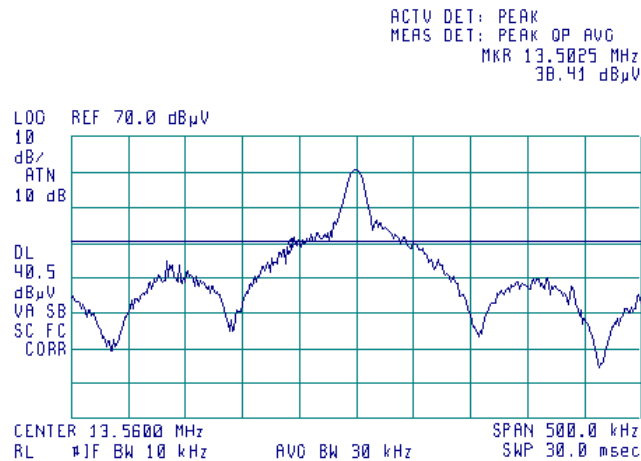
Full description is given in Appendix A.

|                            |                               |                                              |                              |
|----------------------------|-------------------------------|----------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Section 15.215(c), Occupied bandwidth</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Section 13.1.7                   |                              |
| <b>Test mode:</b>          |                               | Compliance                                   | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 11/1/2011                                    |                              |
| <b>Temperature:</b> 24 °C  | <b>Air Pressure:</b> 1018 hPa | <b>Relative Humidity:</b> 36 %               | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                              |                              |

Plot 7.5.1 Occupied bandwidth test result reference

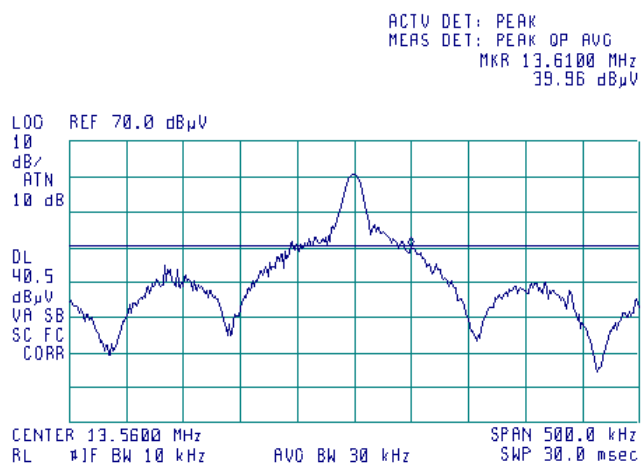


Plot 7.5.2 Occupied bandwidth test result low frequency



|                            |                               |                                              |                              |
|----------------------------|-------------------------------|----------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Section 15.215(c), Occupied bandwidth</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Section 13.1.7                   |                              |
| <b>Test mode:</b>          |                               | Compliance                                   | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 11/1/2011                                    |                              |
| <b>Temperature:</b> 24 °C  | <b>Air Pressure:</b> 1018 hPa | <b>Relative Humidity:</b> 36 %               | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                              |                              |

Plot 7.5.3 Occupied bandwidth test result high frequency



|                            |                               |                                            |                              |
|----------------------------|-------------------------------|--------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Section 15.203, Antenna requirement</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Section 13.1.7                 |                              |
| <b>Test mode:</b>          |                               | Compliance                                 | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 11/9/2011                                  |                              |
| <b>Temperature:</b> 23°C   | <b>Air Pressure:</b> 1012 hPa | <b>Relative Humidity:</b> 48 %             | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                            |                              |

## 7.6 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 7.6.1.

**Table 7.6.1 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                |         |

|                            |                               |                                                                   |                              |
|----------------------------|-------------------------------|-------------------------------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Section 15.107 Class B, AC power lines conducted emissions</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Section 11.5                                          |                              |
| <b>Test mode:</b>          |                               | Compliance                                                        | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 10/30/2011                                                        |                              |
| <b>Temperature:</b> 22 °C  | <b>Air Pressure:</b> 1015 hPa | <b>Relative Humidity:</b> 48 %                                    | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                                                   |                              |

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

### 8.1 Conducted emissions

#### 8.1.1 General

This test was performed to measure the common mode conducted emissions at the EUT power port. The specification test limits are given in Table 8.1.1.

Table 8.1.1 Limits for conducted emissions

| Frequency,<br>MHz | Class B limit,<br>dB(μV) |          | Class A limit,<br>dB(μV) |      |
|-------------------|--------------------------|----------|--------------------------|------|
|                   | QP                       | AVRG     | QP                       | AVRG |
| 0.15 - 0.5        | 66 - 56*                 | 56 - 46* | 79                       | 66   |
| 0.5 - 5.0         | 56                       | 46       | 73                       | 60   |
| 5.0 - 30          | 60                       | 50       | 73                       | 60   |

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

#### 8.1.2 Test procedure

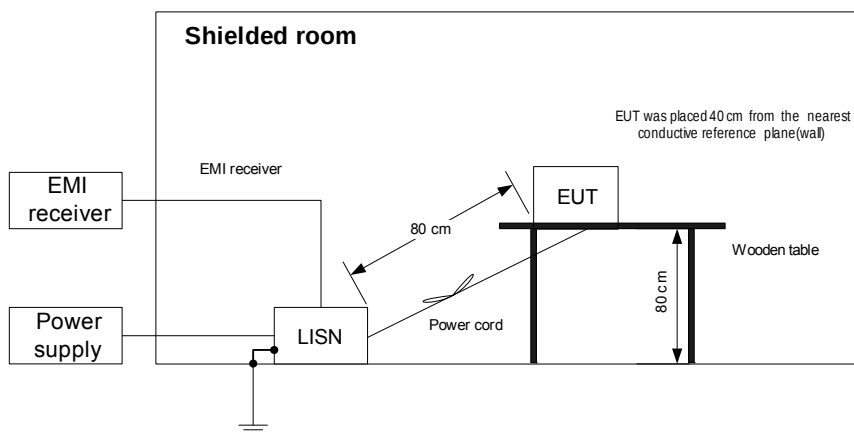
8.1.2.1 The EUT was set up as shown in Figure 8.1.1, energized and the EUT performance was checked.

8.1.2.2 The measurements were performed at the EUT power terminals with the LISN connected to the EMI receiver in the frequency range referred to in Table 8.1.2. The unused coaxial connector of the LISN was terminated with 50 Ohm.

8.1.2.3 The position of the EUT cables was varied to find the highest emission.

8.1.2.4 The worst test results with respect to the limits were recorded in Table 8.1.2 and shown in the associated plots.

Figure 8.1.1 Setup for conducted emission measurements, table-top EUT



|                     |                                                            |                         |                       |      |
|---------------------|------------------------------------------------------------|-------------------------|-----------------------|------|
| Test specification: | Section 15.107 Class B, AC power lines conducted emissions |                         |                       |      |
| Test procedure:     | ANSI C63.4, Section 11.5                                   |                         |                       |      |
| Test mode:          | Compliance                                                 | Verdict:                |                       | PASS |
| Date(s):            | 10/30/2011                                                 |                         |                       |      |
| Temperature: 22 °C  | Air Pressure: 1015 hPa                                     | Relative Humidity: 48 % | Power Supply: 120 VAC |      |
| Remarks:            |                                                            |                         |                       |      |

Table 8.1.2 Conducted emission test results

LINE: AC mains  
 EUT SET UP: TABLE-TOP  
 LIMIT: Class B  
 TEST SITE: SHIELDED ROOM  
 DETECTORS USED: PEAK / QUASI-PEAK / AVERAGE  
 FREQUENCY RANGE: 150 kHz - 30 MHz  
 RESOLUTION BANDWIDTH: 9 kHz

| Frequency,<br>MHz | Peak<br>emission,<br>dB(μV) | Quasi-peak                      |                  |                | Average                         |                  |                | Line ID | Verdict |
|-------------------|-----------------------------|---------------------------------|------------------|----------------|---------------------------------|------------------|----------------|---------|---------|
|                   |                             | Measured<br>emission,<br>dB(μV) | Limit,<br>dB(μV) | Margin,<br>dB* | Measured<br>emission,<br>dB(μV) | Limit,<br>dB(μV) | Margin,<br>dB* |         |         |
| 0.178710          | 52.97                       | 50.82                           | 64.60            | -13.78         | 36.76                           | 54.60            | -17.84         | L1      | Pass    |
| 0.575575          | 48.59                       | 45.83                           | 56.00            | -10.17         | 31.61                           | 46.00            | -14.39         |         |         |
| 1.057170          | 49.70                       | 46.63                           | 56.00            | -9.37          | 33.20                           | 46.00            | -12.80         |         |         |
| 1.145625          | 52.37                       | 49.19                           | 56.00            | -6.81          | 36.29                           | 46.00            | -9.71          |         |         |
| 1.204000          | 55.40                       | 52.90                           | 56.00            | -3.10          | 39.70                           | 46.00            | -6.30          |         |         |
| 11.715785         | 55.08                       | 49.41                           | 60.00            | -10.59         | 37.57                           | 50.00            | -12.43         |         |         |
| 0.177625          | 50.52                       | 47.99                           | 64.65            | -16.66         | 30.35                           | 54.65            | -24.30         | L2      | Pass    |
| 0.574825          | 50.94                       | 48.42                           | 56.00            | -7.58          | 33.64                           | 46.00            | -12.36         |         |         |
| 0.621900          | 46.46                       | 44.32                           | 56.00            | -11.68         | 28.02                           | 46.00            | -17.98         |         |         |
| 0.994575          | 48.59                       | 46.36                           | 56.00            | -9.64          | 34.32                           | 46.00            | -11.68         |         |         |
| 1.146165          | 54.40                       | 52.40                           | 56.00            | -3.60          | 40.00                           | 46.00            | -6.00          |         |         |
| 11.889755         | 56.31                       | 50.32                           | 60.00            | -9.68          | 35.86                           | 50.00            | -14.14         |         |         |

\*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

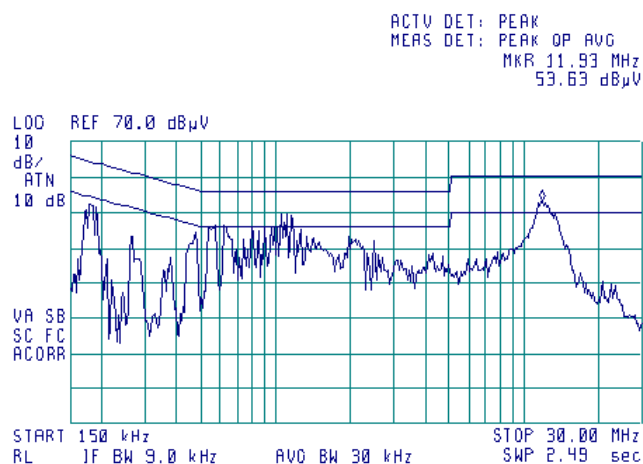
|         |         |         |         |         |  |  |  |
|---------|---------|---------|---------|---------|--|--|--|
| HL 0787 | HL 1425 | HL 1513 | HL 2888 | HL 3612 |  |  |  |
|---------|---------|---------|---------|---------|--|--|--|

Full description is given in Appendix A.

|                            |                               |                                                                   |                              |
|----------------------------|-------------------------------|-------------------------------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Section 15.107 Class B, AC power lines conducted emissions</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Section 11.5                                          |                              |
| <b>Test mode:</b>          |                               | Compliance                                                        | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 10/30/2011                                                        |                              |
| <b>Temperature:</b> 22 °C  | <b>Air Pressure:</b> 1015 hPa | <b>Relative Humidity:</b> 48 %                                    | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                                                   |                              |

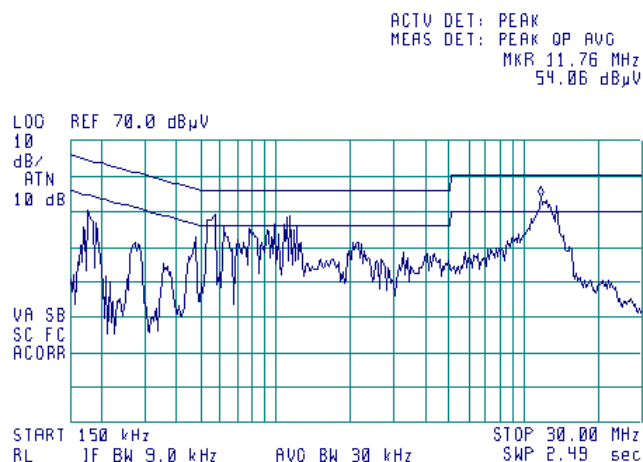
Plot 8.1.1 Conducted emission measurements

LINE: L1  
LIMIT: QUASI-PEAK, AVERAGE  
DETECTOR: PEAK



Plot 8.1.2 Conducted emission measurements

LINE: L2  
LIMIT: QUASI-PEAK, AVERAGE  
DETECTOR: PEAK



|                            |                               |                                                   |                              |
|----------------------------|-------------------------------|---------------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Section 15.109 Class B, Radiated emissions</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Section 11.6                          |                              |
| <b>Test mode:</b>          |                               | Compliance                                        | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 10/24/2011                                        |                              |
| <b>Temperature:</b> 22 °C  | <b>Air Pressure:</b> 1015 hPa | <b>Relative Humidity:</b> 48 %                    | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                                   |                              |

## 8.2 Radiated emission measurements

### 8.2.1 General

This test was performed to measure radiated emissions from the EUT enclosure. The specification test limits are given in Table 8.2.1.

Table 8.2.1 Radiated emission test limits

| Frequency,<br>MHz | Class B limit,<br>dB(μV/m) |              | Class A limit,<br>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 a test distance other than specified was calculated using the inverse linear distance extrapolation factor as follows:  $\text{Lim}_{S_2} = \text{Lim}_{S_1} + 20 \log(S_1/S_2)$ , where  $S_1$  and  $S_2$  – the standard defined and the test distance respectively in meters.

### 8.2.2 Test procedure for measurements in semi-anechoic chamber

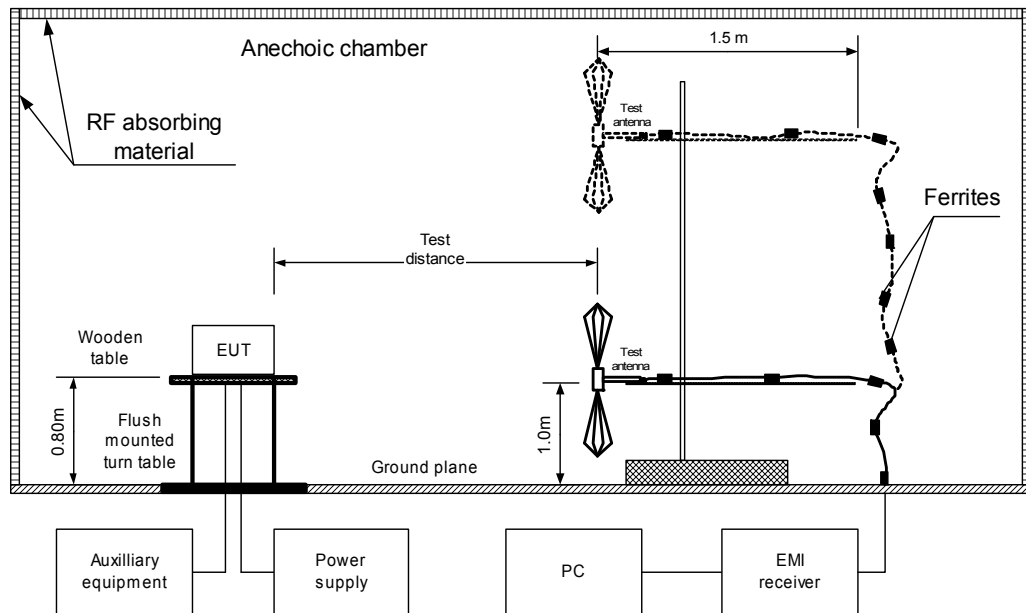
**8.2.2.1** The EUT was set up as shown in Figure 8.2.1, energized and the EUT performance was checked.

**8.2.2.2** The measurements were performed in the anechoic chamber at 3 m test distance. The specified frequency range was investigated with the antenna connected to the EMI receiver. To find the highest emission the turntable was rotated 360° and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal polarizations. The EUT cables position was varied to maximize emission.

**8.2.2.3** The worst test results with respect to the limits were recorded in Table 8.2.2 and shown in the associated plots.

|                            |                               |                                                   |                              |
|----------------------------|-------------------------------|---------------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Section 15.109 Class B, Radiated emissions</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Section 11.6                          |                              |
| <b>Test mode:</b>          |                               | Compliance                                        | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 10/24/2011                                        |                              |
| <b>Temperature:</b> 22 °C  | <b>Air Pressure:</b> 1015 hPa | <b>Relative Humidity:</b> 48 %                    | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                                   |                              |

Figure 8.2.1 Setup for radiated emission measurements in anechoic chamber, table-top EUT



|                            |                               |                                                   |                              |
|----------------------------|-------------------------------|---------------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Section 15.109 Class B, Radiated emissions</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Section 11.6                          |                              |
| <b>Test mode:</b>          |                               | Compliance                                        | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 10/24/2011                                        |                              |
| <b>Temperature:</b> 22 °C  | <b>Air Pressure:</b> 1015 hPa | <b>Relative Humidity:</b> 48 %                    | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                                   |                              |

Table 8.2.2 Radiated emission test results

EUT SET UP: TABLE-TOP  
LIMIT: Class B  
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,<br>MHz | Peak<br>emission,<br>dB(μV/m) | Quasi-peak                        |                    |                | Antenna<br>polarization | Antenna<br>height,<br>m | Turn-table<br>position**,<br>degrees | Verdict |
|-------------------|-------------------------------|-----------------------------------|--------------------|----------------|-------------------------|-------------------------|--------------------------------------|---------|
|                   |                               | Measured<br>emission,<br>dB(μV/m) | Limit,<br>dB(μV/m) | Margin,<br>dB* |                         |                         |                                      |         |
| 81.362900         | 41.13                         | 39.31                             | 40.00              | -0.69          | V                       | 1.2                     | 0                                    | Pass    |
| 94.918650         | 40.69                         | 38.69                             | 43.50              | -4.81          | V                       | 1.0                     | 220                                  |         |
| 108.479000        | 38.09                         | 35.51                             | 43.50              | -7.99          | V                       | 1.0                     | 87                                   |         |
| 122.044000        | 41.65                         | 38.62                             | 43.50              | -4.88          | V                       | 1.0                     | 0                                    |         |
| 135.593000        | 40.00                         | 38.50                             | 43.50              | -5.00          | V                       | 1.35                    | 185                                  |         |
| 189.832375        | 31.00                         | 29.40                             | 43.50              | -14.10         | V                       | 1.0                     | 230                                  |         |
| 399.992950        | 45.35                         | 44.31                             | 46.00              | -1.69          | V                       | 1.4                     | 195                                  |         |

\*- Margin = Measured emission - specification limit.

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

**Reference numbers of test equipment used**

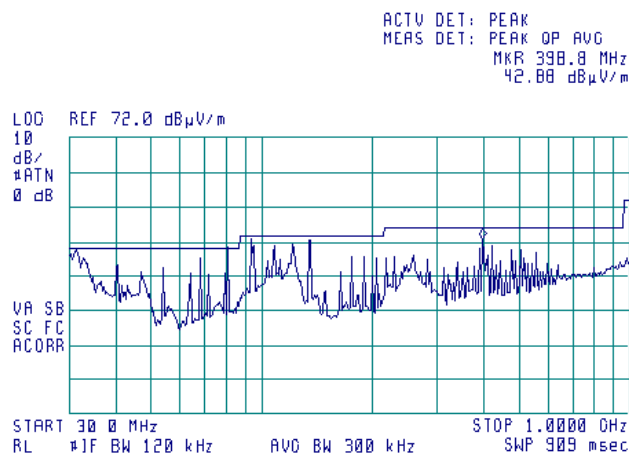
|         |         |         |         |  |  |  |  |
|---------|---------|---------|---------|--|--|--|--|
| HL 0521 | HL 0604 | HL 2871 | HL 3622 |  |  |  |  |
|---------|---------|---------|---------|--|--|--|--|

Full description is given in Appendix A.

|                            |                               |                                                   |                              |
|----------------------------|-------------------------------|---------------------------------------------------|------------------------------|
| <b>Test specification:</b> |                               | <b>Section 15.109 Class B, Radiated emissions</b> |                              |
| <b>Test procedure:</b>     |                               | ANSI C63.4, Section 11.6                          |                              |
| <b>Test mode:</b>          |                               | Compliance                                        | <b>Verdict:</b> PASS         |
| <b>Date(s):</b>            |                               | 10/24/2011                                        |                              |
| <b>Temperature:</b> 22 °C  | <b>Air Pressure:</b> 1015 hPa | <b>Relative Humidity:</b> 48 %                    | <b>Power Supply:</b> 120 VAC |
| <b>Remarks:</b>            |                               |                                                   |                              |

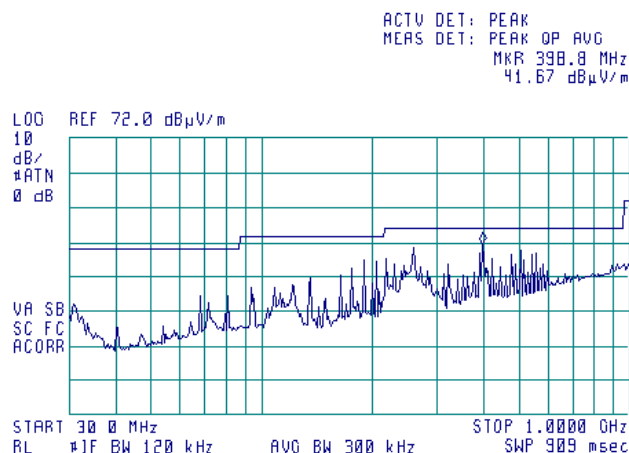
**Plot 8.2.1 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization**

TEST SITE: Anechoic chamber  
TEST DISTANCE: 3 m



**Plot 8.2.2 Radiated emission measurements in 30 - 1000 MHz range, horizontal antenna polarization**

TEST SITE: Anechoic chamber  
TEST DISTANCE: 3 m



## 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<br>00319,<br>3448A002<br>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-12       |
| 0787  | Transient Limiter 9 kHz-200 MHz                                               | Hewlett Packard      | 11947A              | 3107A018<br>77                    | 18-Oct-11        | 18-Oct-12       |
| 1425  | EMI Receiver, 9 kHz - 2.9 GHz, System: HL1426, HL1427                         | Agilent Technologies | 8542E               | 3710A002<br>22,<br>3705A002<br>04 | 24-Aug-11        | 24-Aug-12       |
| 1513  | Cable RF, 8 m, BNC/BNC                                                        | Belden               | M17/167<br>MIL-C-17 | 1513                              | 01-Sep-11        | 01-Sep-12       |
| 1915  | Antenna, Loop, Active Receiving, 10 kHz - 30 MHz                              | EMC Test Systems     | 6507                | 1457                              | 03-Jul-11        | 03-Jul-12       |
| 2871  | Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA                            | Huber-Suhner         | 198-8155-00         | 2871                              | 20-Sep-11        | 20-Sep-12       |
| 2888  | LISN Two-line V-Network 50 Ohm / 50 uH + 5 Ohm, 16A, MIL STD 461E, CISPR 16-1 | Rolf Heine           | NNB-2/16Z           | 02/10018                          | 10-Jul-11        | 10-Jul-12       |
| 2952  | Cable, RF, 18 GHz, 1.2 m, SMA-SMA                                             | Gore                 | 10020014            | NA                                | 03-Oct-11        | 03-Oct-12       |
| 3001  | EMC Analyzer, 9 kHz to 3 GHz                                                  | Agilent Technologies | E7402A              | US394401<br>80                    | 26-Dec-10        | 26-Dec-11       |
| 3123  | Microwave Cable Assembly, 18 GHz, 5.0 m, SMA - SMA                            | Huber-Suhner         | 198-9155-00         | 3123                              | 30-Dec-10        | 30-Dec-11       |
| 3286  | Temperature Chamber, (-50 to +170) °C                                         | Thermotron           | EL-8-CH-1-1-CO2     | 21-9048                           | 11-Sep-11        | 11-Sep-12       |
| 3612  | Cable RF, 17.5 m, N type-N type                                               | Teldor               | RG-214/U            | NA                                | 01-Dec-10        | 01-Dec-11       |
| 3618  | Cable RF, 2.5 m, N type-N type, DC-6.5 GHz                                    | Alpha Wire           | RG-214/U            | NA                                | 19-May-11        | 19-May-12       |
| 3622  | Cable RF, 6.0 m, N type-N type, DC-6.5 GHz                                    | Alpha Wire           | RG 214/U            | NA                                | 30-Dec-10        | 30-Dec-11       |
| 3623  | Cable RF, 6.0 m, N type-N type, DC-6.5 GHz                                    | Belden               | MIL C-17            | NA                                | 30-Dec-10        | 30-Dec-11       |

## 10 APPENDIX B Measurement uncertainties

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

| Test description                                                                                      | Expanded uncertainty                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Conducted emissions with LISN                                                                         | 9 kHz to 150 kHz: $\pm 3.9$ dB<br>150 kHz to 30 MHz: $\pm 3.8$ dB                                                                                                                                                                                                                                            |
| Radiated emissions at 10 m measuring distance<br>Horizontal polarization<br><br>Vertical polarization | Biconilog antenna: $\pm 5.0$ dB<br>Biconical antenna: $\pm 5.0$ dB<br>Log periodic antenna: $\pm 5.1$ dB<br>Double ridged horn antenna: $\pm 5.3$ dB<br>Biconilog antenna: $\pm 5.5$ dB<br>Biconical antenna: $\pm 5.5$ dB<br>Log periodic antenna: $\pm 5.6$ dB<br>Double ridged horn antenna: $\pm 5.8$ dB |
| Radiated emissions at 3 m measuring distance<br>Horizontal polarization<br><br>Vertical polarization  | Biconilog antenna: $\pm 5.3$ dB<br>Biconical antenna: $\pm 5.0$ dB<br>Log periodic antenna: $\pm 5.3$ dB<br>Double ridged horn antenna: $\pm 5.3$ dB<br>Biconilog antenna: $\pm 6.0$ dB<br>Biconical antenna: $\pm 5.7$ dB<br>Log periodic antenna: $\pm 6.0$ dB<br>Double ridged horn antenna: $\pm 6.0$ dB |
| Conducted emissions at RF antenna connector                                                           | 9 kHz to 2.9 GHz: $\pm 2.6$ dB<br>2.9 GHz to 6.46 GHz: $\pm 3.5$ dB<br>6.46 GHz to 13.2 GHz: $\pm 4.3$ dB<br>13.2 GHz to 22.0 GHz: $\pm 5.0$ dB<br>22.0 GHz to 26.8 GHz: $\pm 5.5$ dB<br>26.8 GHz to 40.0 GHz: $\pm 4.8$ 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.

## 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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website: www.hermonlabs.com

Person for contact: Mr. Alex Usoskin, CEO.

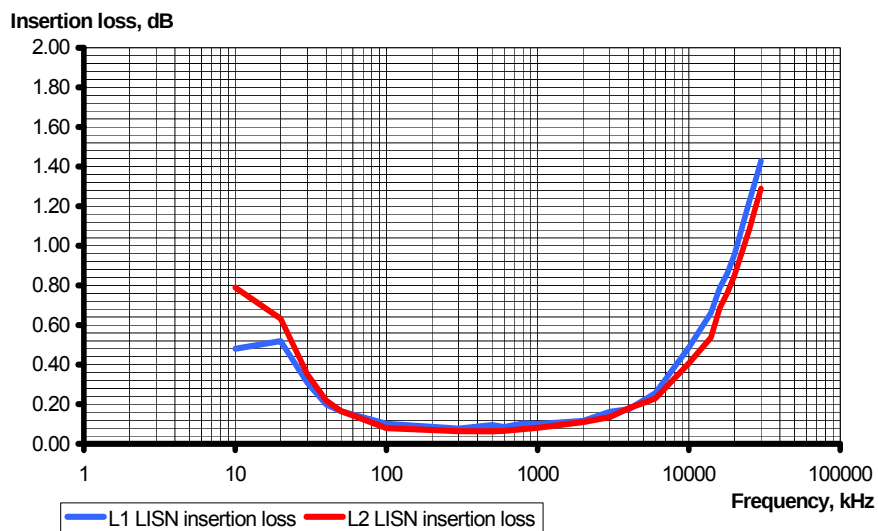
## 12 APPENDIX D Specification references

|                     |                                                                                                                                                                      |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 47CFR part 15: 2010 | 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

### Correction factor Line impedance stabilization network Model NNB-2/16Z, Rolf Heine, HL 2888

| Frequency, kHz | Insertion loss, dB |      | Measurement<br>Uncertainty, dB |
|----------------|--------------------|------|--------------------------------|
|                | L1                 | N    |                                |
| 10             | 0.48               | 0.79 | ±0.6                           |
| 20             | 0.52               | 0.63 |                                |
| 30             | 0.31               | 0.35 |                                |
| 40             | 0.20               | 0.22 |                                |
| 50             | 0.16               | 0.17 |                                |
| 100            | 0.10               | 0.08 |                                |
| 300            | 0.08               | 0.06 |                                |
| 500            | 0.10               | 0.06 |                                |
| 600            | 0.09               | 0.07 |                                |
| 800            | 0.10               | 0.07 |                                |
| 1000           | 0.10               | 0.08 |                                |
| 2000           | 0.12               | 0.11 |                                |
| 3000           | 0.16               | 0.14 |                                |
| 4000           | 0.17               | 0.18 |                                |
| 6000           | 0.26               | 0.23 |                                |
| 10000          | 0.49               | 0.41 |                                |
| 14000          | 0.66               | 0.54 |                                |
| 16000          | 0.79               | 0.69 |                                |
| 18000          | 0.86               | 0.76 |                                |
| 20000          | 0.96               | 0.85 |                                |
| 25000          | 1.22               | 1.08 |                                |
| 28000          | 1.35               | 1.21 |                                |
| 30000          | 1.43               | 1.29 |                                |



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

| Frequency,<br>MHz | Magnetic antenna factor,<br>dB | Electric antenna factor,<br>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( $\mu$ V) to convert it into field intensity in dB( $\mu$ V/m).

Antenna factor  
Active loop antenna  
EMC Test Systems  
Model 6507, S/N 1457, HL 1915

| Frequency, kHz | Measured antenna factor, dB |
|----------------|-----------------------------|
| 10             | -22.3                       |
| 20             | -27.5                       |
| 50             | -31.2                       |
| 75             | -31.8                       |
| 100            | -32.1                       |
| 150            | -32.3                       |
| 250            | -32.5                       |
| 500            | -32.8                       |
| 750            | -33.0                       |
| 1000           | -33.1                       |
| 2000           | -33.4                       |
| 3000           | -33.7                       |
| 4000           | -34.0                       |
| 5000           | -34.2                       |
| 10000          | -35.2                       |
| 15000          | -35.3                       |
| 20000          | -36.0                       |
| 25000          | -37.6                       |
| 30000          | -36.0                       |

The antenna factor shall be added to receiver reading in dB $\mu$ V to obtain field strength in dB $\mu$ A/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( $\mu$ V) to convert it into field intensity in dB( $\mu$ V/m).

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

| Frequency,<br>MHz | Cable loss,<br>dB | Frequency,<br>MHz | Cable loss,<br>dB | Frequency,<br>MHz | Cable loss,<br>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, Gore, 18 GHz, 1.2 m, SMA-SMA, S/N 10020014**  
**HL 2952**

| Frequency,<br>MHz | Cable loss,<br>dB | Frequency,<br>MHz | Cable loss,<br>dB | Frequency,<br>MHz | Cable loss,<br>dB |
|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| 10                | 0.03              | 5750              | 0.97              | 12000             | 1.50              |
| 30                | 0.05              | 6000              | 1.01              | 12250             | 1.45              |
| 100               | 0.11              | 6250              | 1.03              | 12500             | 1.48              |
| 250               | 0.19              | 6500              | 1.06              | 12750             | 1.57              |
| 500               | 0.26              | 6750              | 1.08              | 13000             | 1.51              |
| 750               | 0.32              | 7000              | 1.10              | 13250             | 1.64              |
| 1000              | 0.38              | 7250              | 1.13              | 13500             | 1.60              |
| 1250              | 0.43              | 7500              | 1.13              | 13750             | 1.63              |
| 1500              | 0.47              | 7750              | 1.21              | 14000             | 1.59              |
| 1750              | 0.53              | 8000              | 1.20              | 14250             | 1.66              |
| 2000              | 0.55              | 8250              | 1.24              | 14500             | 1.60              |
| 2250              | 0.59              | 8500              | 1.29              | 14750             | 1.65              |
| 2500              | 0.63              | 8750              | 1.23              | 15000             | 1.72              |
| 2750              | 0.66              | 9000              | 1.27              | 15250             | 1.68              |
| 3000              | 0.69              | 9250              | 1.27              | 15500             | 1.73              |
| 3250              | 0.72              | 9500              | 1.29              | 15750             | 1.70              |
| 3500              | 0.75              | 9750              | 1.30              | 16000             | 1.82              |
| 3750              | 0.78              | 10000             | 1.38              | 16250             | 1.79              |
| 4000              | 0.82              | 10250             | 1.44              | 16500             | 1.81              |
| 4250              | 0.84              | 10500             | 1.47              | 16750             | 1.91              |
| 4500              | 0.86              | 10750             | 1.45              | 17000             | 1.92              |
| 4750              | 0.90              | 11000             | 1.50              | 17250             | 1.98              |
| 5000              | 0.91              | 11250             | 1.46              | 17500             | 2.05              |
| 5250              | 0.94              | 11500             | 1.47              | 17750             | 2.04              |
| 5500              | 0.96              | 11750             | 1.44              | 18000             | 2.05              |

**Cable loss**  
**Microwave Cable Assembly, 18 GHz, 6.4 m, SMA – SMA, Huber-Suhner, model 198-9155-00**  
**HL 3123**

| Frequency,<br>MHz | Cable<br>loss, dB | Frequency,<br>MHz | Cable<br>loss, dB | Frequency,<br>MHz | Cable<br>loss, dB | Frequency,<br>MHz | Cable<br>loss, dB | Frequency,<br>MHz | Cable<br>loss, dB |
|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| 10                | 0.11              | 3600              | 1.97              | 7400              | 3.12              | 11200             | 3.90              | 15100             | 4.74              |
| 30                | 0.17              | 3700              | 1.97              | 7500              | 3.13              | 11300             | 3.93              | 15200             | 4.70              |
| 50                | 0.25              | 3800              | 2.03              | 7600              | 3.16              | 11400             | 3.88              | 15300             | 4.73              |
| 100               | 0.32              | 3900              | 2.04              | 7700              | 3.18              | 11500             | 3.87              | 15400             | 4.78              |
| 200               | 0.46              | 4000              | 2.10              | 7800              | 3.20              | 11600             | 3.90              | 15500             | 4.75              |
| 300               | 0.58              | 4100              | 1.97              | 7900              | 3.23              | 11700             | 3.86              | 15600             | 4.76              |
| 400               | 0.65              | 4200              | 1.97              | 8000              | 3.25              | 11800             | 3.88              | 15700             | 4.75              |
| 500               | 0.74              | 4300              | 2.03              | 8100              | 3.26              | 11900             | 3.86              | 15800             | 4.78              |
| 600               | 0.82              | 4400              | 2.04              | 8200              | 3.28              | 12000             | 3.89              | 15900             | 4.79              |
| 700               | 0.89              | 4500              | 2.10              | 8300              | 3.31              | 12100             | 3.94              | 16000             | 4.73              |
| 800               | 0.95              | 4600              | 1.97              | 8400              | 3.31              | 12200             | 3.92              | 16100             | 4.78              |
| 900               | 1.01              | 4700              | 1.97              | 8500              | 3.32              | 12300             | 3.96              | 16200             | 4.84              |
| 1000              | 1.07              | 4800              | 2.03              | 8600              | 3.34              | 12400             | 4.01              | 16300             | 4.90              |
| 1100              | 1.11              | 4900              | 2.04              | 8700              | 3.35              | 12500             | 4.07              | 16400             | 4.87              |
| 1200              | 1.17              | 5000              | 2.10              | 8800              | 3.37              | 12600             | 4.08              | 16500             | 4.90              |
| 1300              | 1.22              | 5100              | 2.53              | 8900              | 3.39              | 12700             | 4.17              | 16600             | 4.98              |
| 1400              | 1.27              | 5200              | 2.55              | 9000              | 3.42              | 12800             | 4.26              | 16700             | 5.05              |
| 1500              | 1.29              | 5300              | 2.60              | 9100              | 3.43              | 12900             | 4.16              | 16800             | 5.04              |
| 1600              | 1.35              | 5400              | 2.61              | 9200              | 3.51              | 13000             | 4.21              | 16900             | 5.02              |
| 1700              | 1.40              | 5500              | 2.64              | 9300              | 3.52              | 13100             | 4.24              | 17000             | 5.09              |
| 1800              | 1.44              | 5600              | 2.70              | 9400              | 3.54              | 13200             | 4.27              | 17100             | 5.07              |
| 1900              | 1.51              | 5700              | 2.67              | 9500              | 3.63              | 13300             | 4.31              | 17200             | 5.10              |
| 2000              | 1.49              | 5800              | 2.71              | 9600              | 3.61              | 13400             | 4.33              | 17300             | 5.13              |
| 2100              | 1.55              | 5900              | 2.74              | 9700              | 3.71              | 13500             | 4.25              | 17400             | 5.23              |
| 2200              | 1.58              | 6000              | 2.80              | 9800              | 3.66              | 13600             | 4.27              | 17500             | 5.21              |
| 2300              | 1.62              | 6100              | 2.79              | 9900              | 3.77              | 13700             | 4.33              | 17600             | 5.22              |
| 2400              | 1.72              | 6200              | 2.81              | 10000             | 3.75              | 13800             | 4.33              | 17700             | 5.36              |
| 2500              | 1.76              | 6300              | 2.83              | 10100             | 3.77              | 13900             | 4.31              | 17800             | 5.35              |
| 2600              | 1.78              | 6400              | 2.86              | 10200             | 3.80              | 14000             | 4.30              | 17900             | 5.45              |
| 2700              | 1.80              | 6500              | 2.88              | 10300             | 3.79              | 14100             | 4.30              | 18000             | 5.43              |
| 2800              | 1.86              | 6600              | 2.90              | 10400             | 3.87              | 14200             | 4.31              |                   |                   |
| 2900              | 1.90              | 6700              | 2.92              | 10500             | 3.83              | 14300             | 4.37              |                   |                   |
| 3000              | 1.90              | 6800              | 2.98              | 10600             | 3.88              | 14400             | 4.35              |                   |                   |
| 3100              | 1.97              | 6900              | 2.98              | 10700             | 3.86              | 14600             | 4.53              |                   |                   |
| 3200              | 1.97              | 7000              | 3.00              | 10800             | 3.87              | 14700             | 4.50              |                   |                   |
| 3300              | 2.03              | 7100              | 3.02              | 10900             | 3.90              | 14800             | 4.62              |                   |                   |
| 3400              | 2.04              | 7200              | 3.04              | 11000             | 3.84              | 14900             | 4.65              |                   |                   |
| 3500              | 2.10              | 7300              | 3.06              | 11100             | 3.88              | 15000             | 4.79              |                   |                   |

**Cable loss**  
**Cable coaxial, RG-214/U, N type-N type, 17 m**  
**Teldor, HL 3612**

| Frequency, MHz | Cable loss, dB |
|----------------|----------------|
| 0.1            | 0.05           |
| 0.5            | 0.07           |
| 1              | 0.10           |
| 3              | 0.22           |
| 5              | 0.29           |
| 10             | 0.39           |
| 30             | 0.68           |
| 50             | 0.90           |
| 100            | 1.27           |
| 150            | 1.58           |
| 200            | 1.80           |
| 250            | 2.12           |
| 300            | 2.36           |
| 350            | 2.60           |
| 400            | 2.82           |
| 450            | 2.99           |
| 500            | 3.23           |
| 550            | 3.40           |
| 600            | 3.56           |
| 650            | 3.71           |
| 700            | 3.90           |
| 750            | 4.04           |
| 800            | 4.23           |
| 850            | 4.39           |
| 900            | 4.55           |
| 950            | 4.65           |
| 1000           | 4.79           |

**Cable loss**  
**Cable coaxial, RG-214/U, N type-N type, 6 m**  
**Alpha Wire, HL 3622**

| Frequency,<br>MHz | Cable loss,<br>dB | Frequency,<br>MHz | Cable loss,<br>dB | Frequency,<br>MHz | Cable loss,<br>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,<br>MHz | Cable loss,<br>dB | Frequency,<br>MHz | Cable loss,<br>dB | Frequency,<br>MHz | Cable loss,<br>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                         |
| A/m            | ampere per meter                            |
| AM             | amplitude modulation                        |
| AVRG           | average (detector)                          |
| cm             | centimeter                                  |
| dB             | decibel                                     |
| dBm            | decibel referred to one milliwatt           |
| dB( $\mu$ V)   | decibel referred to one microvolt           |
| dB( $\mu$ V/m) | decibel referred to one microvolt per meter |
| dB( $\mu$ 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                                 |
| $\mu$ s        | microsecond                                 |
| NA             | not applicable                              |
| NB             | narrow band                                 |
| OATS           | open area test site                         |
| $\Omega$       | 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                                    |

END OF DOCUMENT