HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

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# TEST REPORT

**ACCORDING TO: FCC 47 CFR PART 15 subpart C, section 15.249;**
**RSS-210 issue 8 Annex 2**

**FOR:**

## Visonic Ltd.
## Control Panel (Z-wave module)
## Model:PM-360
## FCC ID:WP3PMASTER360
## IC:1467C-PMASTER360

# Table of contents

# 1 Applicant information

| | |
|---|---|
| **Client name:** | Visonic Ltd. |
| **Address:** | 24 Habarzel street, Tel Aviv 69710, Israel |
| **Telephone:** | +972 3645 6832 |
| **Fax:** | +972 3645 6788 |
| **E-mail:** | Visonic Ltd. |
| **Contact name:** | 24 Habarzel street, Tel Aviv 69710, Israel |

# 2 Equipment under test attributes

| | |
|---|---|
| **Product name:** | Z-wave module of Control Panel |
| **Product type:** | Transceiver |
| **Model(s):** | PM-360 |
| **Serial number:** | 1215140369 |
| **Hardware version:** | 90-207342 |
| **Software release:** | JS-702974 |
| **Receipt date** | 04-May-15 |

# 3 Manufacturer information

| | |
|---|---|
| **Manufacturer name:** | Visonic Ltd. |
| **Address:** | 24 Habarzel street, Tel Aviv 69710, Israel |
| **Telephone:** | +972 3645 6832 |
| **Fax:** | +972 3645 6788 |
| **E-Mail:** | Visonic Ltd. |
| **Contact name:** | 24 Habarzel street, Tel Aviv 69710, Israel |

# 4 Test details

| | |
|---|---|
| **Project ID:** | 26893 |
| **Location:** | Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel |
| **Test started:** | 04-May-15 |
| **Test completed:** | 25-Aug-15 |
| **Test specification(s):** | FCC 47 CFR Part 15, subpart C, §15.249; RSS-210 issue 8 Annex 2 |

# 5 Tests summary

| Test | Status |
|---|---|
| **Transmitter characteristics** | |
| Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions | Pass |
| Section 15.249(d)/RSS-210, section A2.9, Band edge emissions | Pass |
| Section 15.207(a)/RSS-Gen, section 8.8, Conducted emission | Pass |
| Section 15.203/ RSS-Gen, Section 8.3, Antenna requirement | Pass |
| Section 15.215(c) / RSS-Gen, Section 6.6, Occupied bandwidth | Pass |

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

| | Name and Title | Date | Signature |
|---|---|---|---|
| **Tested by:** | Mr. S. Samokha, test engineer<br>Mrs. E. Pitt, test engineer | August 25, 2015 | |
| **Reviewed by:** | Mrs. M. Cherniavsky, certification engineer | October 18, 2015 | |
| **Approved by:** | Mr. M. Nikishin, EMC and Radio group manager | February 11, 2016 | |

# 6 EUT description

## 6.1 General information

The EUT, Control panel PM-360 is a wireless control panel powered via external AC/DC adaptor. The panel comprises four Visonic RF boards with below radio modules:

1. PG-2 module- communication within the alarm system in 902- 928 MHz band
2. WiFi module- modular approved FCC ID:Z64-WL18SBMOD with Visonic antenna, connected to RF PCB
a. 802.11b
b. 802.11g
c. 802.11n
3. Z-wave module with Visonic antenna connected to RF board
4. Cellular module UE910NAR modular approved with FCC ID:RI7UE910NA, IC: 5131A-UE910NA used for 3G/2G modes with Visonic antenna connected to RF board.

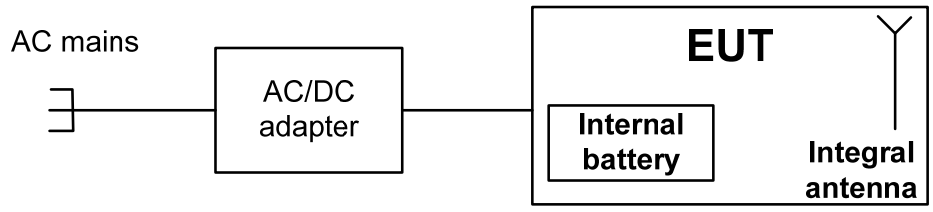
All radios could operate simalteneously.

The present test report involves the test results for certification of 902 – 928 MHz Z-wave module as a part of a composite application for certification.

## 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 | Unshielded | 2.0 |

## 6.3 Test configuration

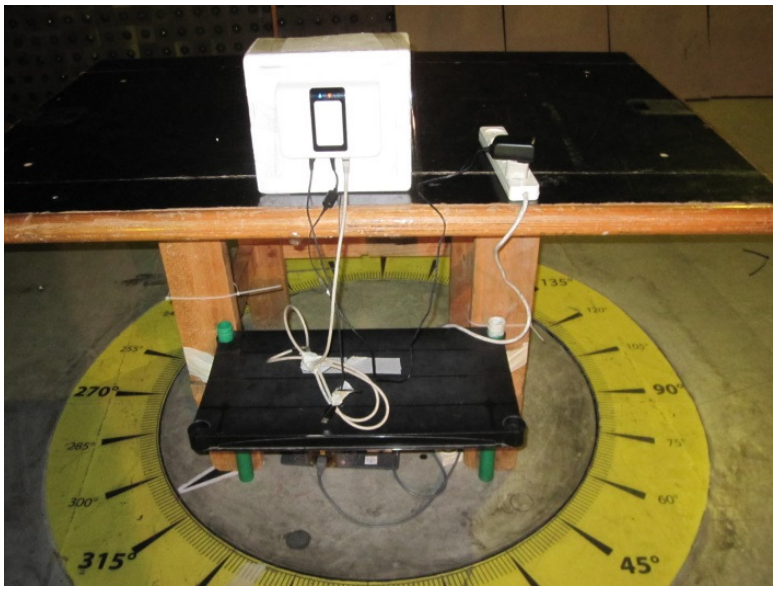



## 6.4 Changes made in the EUT

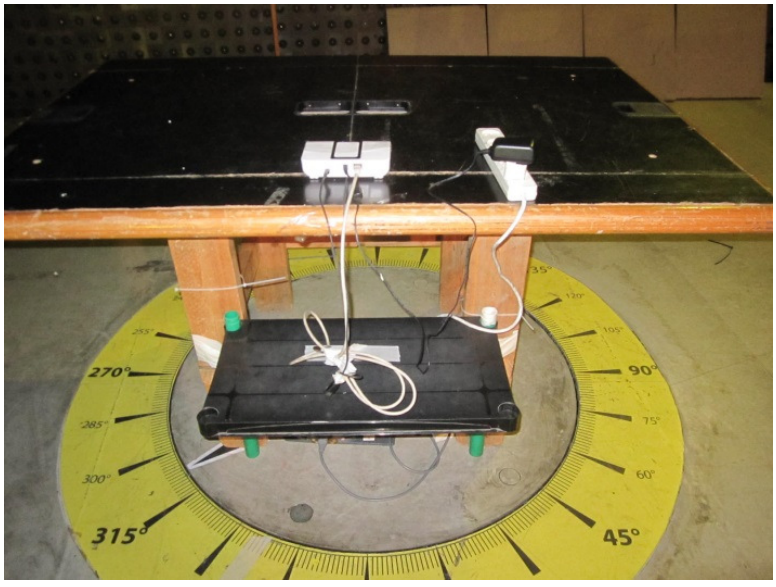
No changes were implemented in the EUT during the testing.

## 6.5 EUT test positions

**Photograph 6.5.1 EUT in vertical position**




**Photograph 6.5.2 EUT in horizontal position**



## 6.6 Transmitter characteristics

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Type of equipment** | | | | | | | |
| **V** | Stand-alone (Equipment with or without its own control provisions) | | | | | | |
| | Combined equipment (Equipment where the radio part is fully integrated within another type of equipment) | | | | | | |
| | Plug-in card (Equipment intended for a variety of host systems) | | | | | | |
| **Assigned frequency range** | 902 – 928 MHz | | | | | | |
| **Operating frequency range** | 908.4 MHz, 916 1 MHz | | | | | | |
| **Maximum field strength of carrier** | Peak 92.1 dBµV/m at 3 m distance | | | | | | |
| **Is transmitter output power variable?** | **V** | No | | | | | |
| | | Yes | | continuous variable | | | |
| | | | | stepped variable with stepsize | dB | | |
| | | | | minimum RF power | dBm | | |
| | | | | maximum RF power | dBm | | |
| **Antenna connection** | | | | | | | |
| unique coupling | standard connector | **V** | Integral | with temporary RF connector | | | |
| | | | | **V** without temporary RF connector | | | |

| **Antenna/s technical characteristics** | | | |
|---|---|---|---|
| Type | Manufacturer | Model number | Gain |
| Integral | Visonic | Built-in helical antenna | 0 dBi |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Transmitter aggregate data rate/s** | 40 kbps at 908.4 MHz; 100 kbps at 916 1 MHz | | | | | | |
| **Type of modulation** | 2FSK | | | | | | |
| **Modulating test signal (baseband)** | PRBS | | | | | | |
| **Transmitter power source** | | | | | | | |
| | Battery | **Nominal rated voltage** | | Battery type | | | |
| | DC | **Nominal rated voltage** | | | | | |
| **V** | AC mains | **Nominal rated voltage** | 120 VAC | Frequency | Hz | | |

| Test specification: | Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 11-Jun-15 | | |
| Temperature: 23 ºC | Air Pressure: 1011 hPa | Relative Humidity: 52 % | Power Supply: 120 VAC |
| Remarks: | | | |

# 7 Transmitter tests according to 47CFR part 15 subpart C and RSS-210 Annex 2 requirements

## 7.1 Field strength of emissions

### 7.1.1 General

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

**Table 7.1.1 Radiated fundamental emission limits**

| Fundamental frequency, MHz | Field strength at 3 m, dB(μV/m) | | |
|---|---|---|---|
| | Peak | Average | Quasi-Peak |
| 902 – 928 | NA | NA | 94 |

**Table 7.1.2 Harmonics limits**

| Fundamental frequency, MHz | Field strength at 3 m, dB(μV/m) | |
|---|---|---|
| | Peak | Average |
| 902 – 928 | 74.0 | 54.0 |

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

| Frequency, MHz | Field strength at 3 m, dB(μV/m)* | | | |
|---|---|---|---|---|
| | Peak | Quasi Peak | Average | Attenuation below carrier |
| 0.009 – 0.090 | 148.5 – 128.5 | NA | 128.5 – 108.5** | 50 dBc (whichever is the less stringent) |
| 0.090 – 0.110 | NA | 108.5 – 106.8** | NA | |
| 0.110 – 0.490 | 126.8 – 113.8 | NA | 106.8 – 93.8** | |
| 0.490 – 1.705 | NA | 73.8 – 63.0** | NA | |
| 1.705 – 30.0* | | 69.5 | | |
| 30 – 88 | | 40.0 | | |
| 88 – 216 | | 43.5 | | |
| 216 – 960 | | 46.0 | | |
| 960 - 1000 | | 54.0 | | |
| Above 1000 | 74.0 | NA | 54.0 | |

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

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

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

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

*Note:* The above field strength limits applied from the lowest radio frequency generated in the device, without going below 9 kHz up to the tenth harmonic of the highest fundamental frequency but not exceeding 40 GHz for intentional radiators operated below 10 GHz and up to the fifth harmonic of the highest fundamental frequency but not exceeding 100 GHz for intentional radiators operated above 10 GHz.

| Test specification: | Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 11-Jun-15 | | |
| Temperature: 23 ºC | Air Pressure: 1011 hPa | Relative Humidity: 52 % | Power Supply: 120 VAC |
| Remarks: | | | |

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

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

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

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

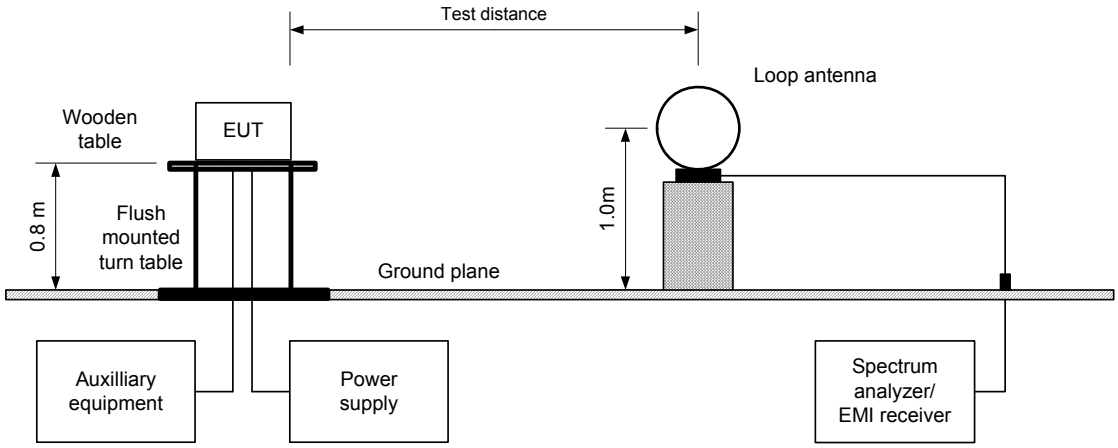
**7.1.3 Test procedure for spurious emission field strength measurements above 30 MHz**

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

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

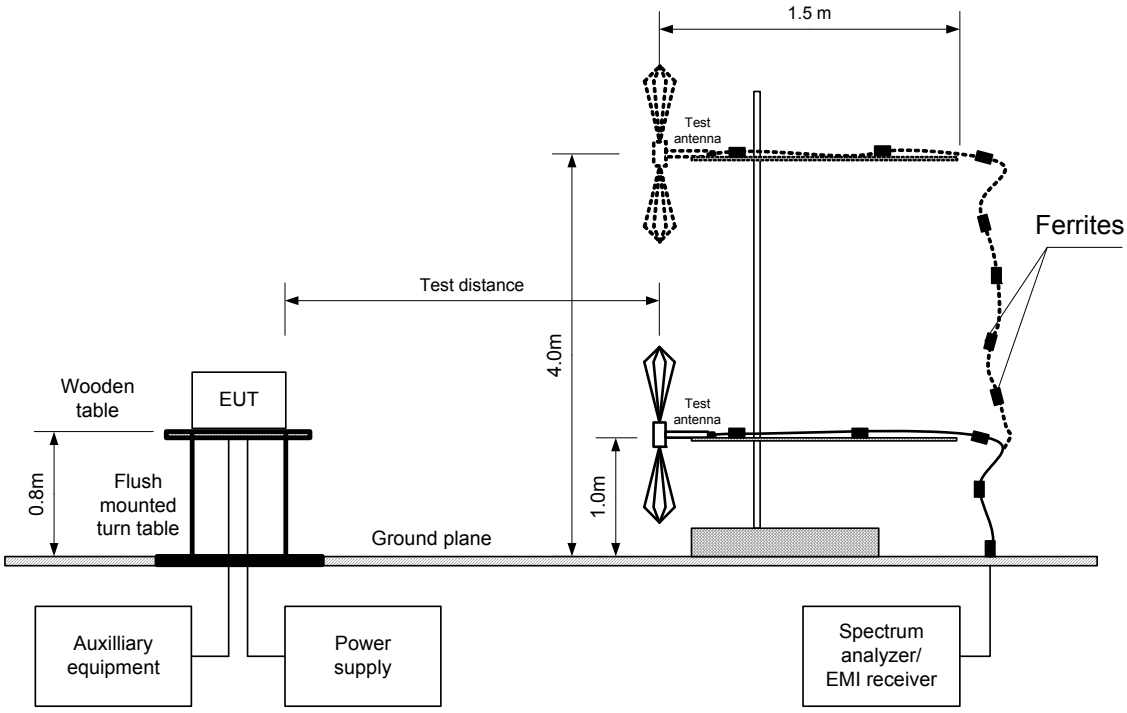
**7.1.3.3** The worst test results (the lowest margins) were recorded in the associated tables and shown in the associated plots

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



| Test specification: | Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 11-Jun-15 | | |
| Temperature: 23 ºC | Air Pressure: 1011 hPa | Relative Humidity: 52 % | Power Supply: 120 VAC |
| Remarks: | | | |

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



| **Test specification:** | **Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions** | | |
|---|---|---|---|
| **Test procedure:** | ANSI C63.4, Section 13.1.4 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 11-Jun-15 | | |
| **Temperature:** 23 ºC | **Air Pressure:** 1011 hPa | **Relative Humidity:** 52 % | **Power Supply:** 120 VAC |
| **Remarks:** | | | |

**Table 7.1.4 Field strength of fundamental emission and spurious emissions**

| | |
|---|---|
| TEST DISTANCE: | 3 m |
| EUT POSITION: | Vertical and Horizontal |
| MODULATION: | 2FSK |
| MODULATING SIGNAL: | PRBS |
| INVESTIGATED FREQUENCY RANGE: | 0.009 – 10000 MHz |
| DETECTOR USED: | Peak |
| RESOLUTION BANDWIDTH: | 1.0 kHz (9 kHz – 150 kHz)<br>9.0 kHz (150 kHz – 30 MHz)<br>120 kHz (30 MHz – 1000 MHz)<br>1.0 MHz (above 1000 MHz) |
| VIDEO BANDWIDTH: | ≥ Resolution bandwidth |
| TEST ANTENNA TYPE: | Active loop (9 kHz – 30 MHz)<br>Biconilog (30 MHz – 1000 MHz)<br>Double ridged guide (above 1000 MHz) |

**Fundamental emission**

| Frequency, MHz | Antenna | | Azimuth, degrees* | Peak emission, dB(μV/m) | Quasi-peak | | | Verdict |
|---|---|---|---|---|---|---|---|---|
| | Pol. | Height, m | | | Measured emission, dB(μV/m) | Limit, dB(μV/m) | Margin, dB** | |
| 908.4 | Hor | 1.4 | 142 | 92.0 | 91.7 | 94.0 | -2.3 | Pass |
| 916.1 | Hor | 1.5 | 34 | 92.5 | 92.1 | 94.0 | -1.9 | Pass |

**Spurious emissions**

| F, MHz | Antenna | | Azimuth, degrees* | Peak field strength | | | Avr factor, dB | Average field strength | | | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pol. | Height, m | | Measured, dB(μV/m) | Limit, dB(μV/m) | Margin, dB** | | Measured, dB(μV/m) | Limit, dB(μV/m) | Margin, dB** | |
| **Spurious emissions** | | | | | | | | | | | |
| 1888.95 | Hor | 2.0 | 10 | 48.01 | 74 | -25.99 | NA | 44.88 | 54 | -9.12 | Pass |

*- EUT front panel refers to 0 degrees position of turntable.
**- Margin, dB =Measured (calculated) value, dB(μV/m)-Limit, dB(μV/m).
*** The EUT vertical position considered as the worst case.

**Reference numbers of test equipment used**

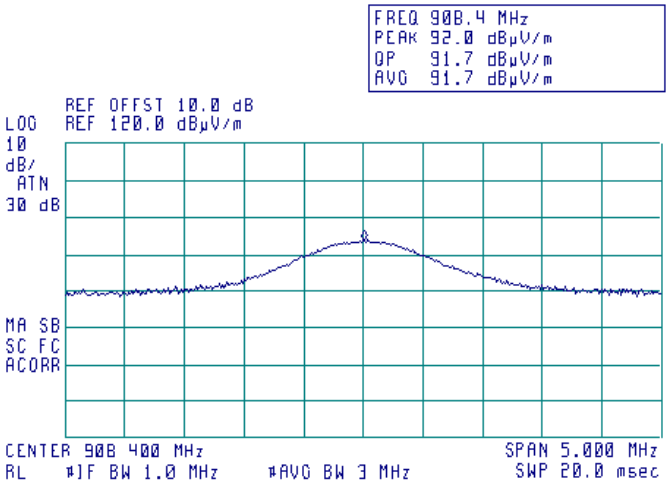
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HL 0446 | HL 0604 | HL 1984 | HL 4353 | HL 4575 | HL 4922 | | |

Full description is given in Appendix A.

| **Test specification:** | **Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions** | | |
|---|---|---|---|
| **Test procedure:** | ANSI C63.4, Section 13.1.4 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 11-Jun-15 | | |
| **Temperature:** 23 ºC | **Air Pressure:** 1011 hPa | **Relative Humidity:** 52 % | **Power Supply:** 120 VAC |
| **Remarks:** | | | |

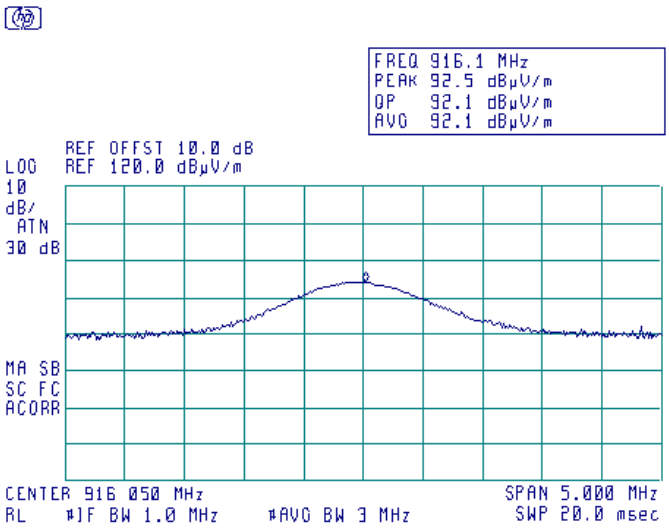
**Plot 7.1.1 Radiated emission measurements at low fundamental frequency**

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
EUT PLANE: Vertical and Horizontal
ANTENNA POLARIZATION: Vertical and horizontal




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

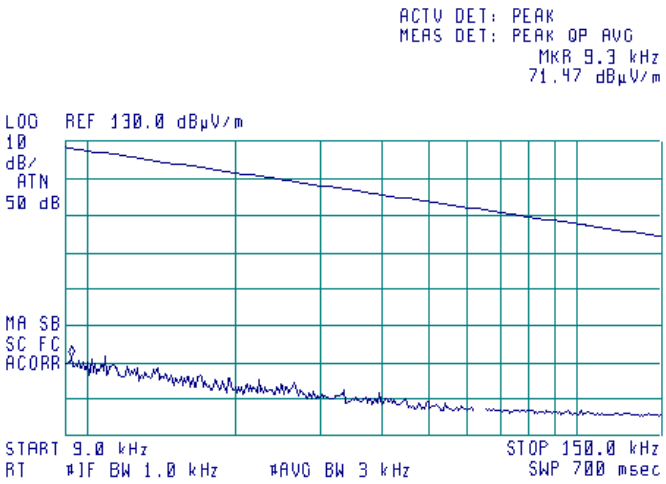
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
EUT PLANE: Vertical and Horizontal
ANTENNA POLARIZATION: Vertical and Horizontal



| Test specification: | Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 11-Jun-15 | | |
| Temperature: 23 ºC | Air Pressure: 1011 hPa | Relative Humidity: 52 % | Power Supply: 120 VAC |
| Remarks: | | | |

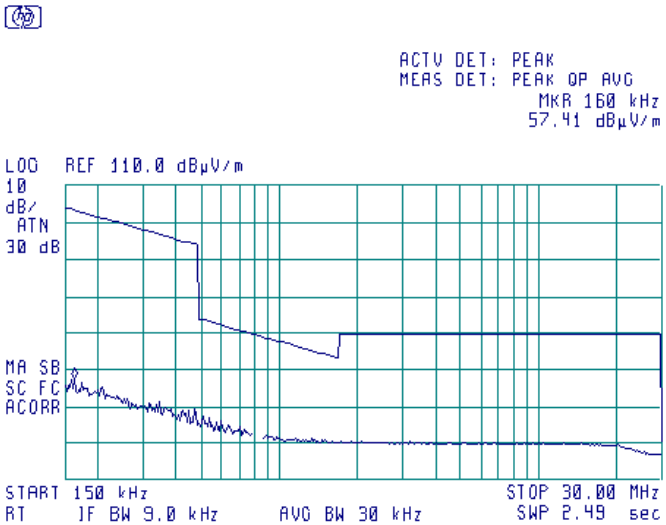
**Plot 7.1.3 Radiated emission measurements from 9 to 150 kHz at the low and high carrier frequency**

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




**Plot 7.1.4 Radiated emission measurements from 0.15 to 30 MHz at the low and high carrier frequency**

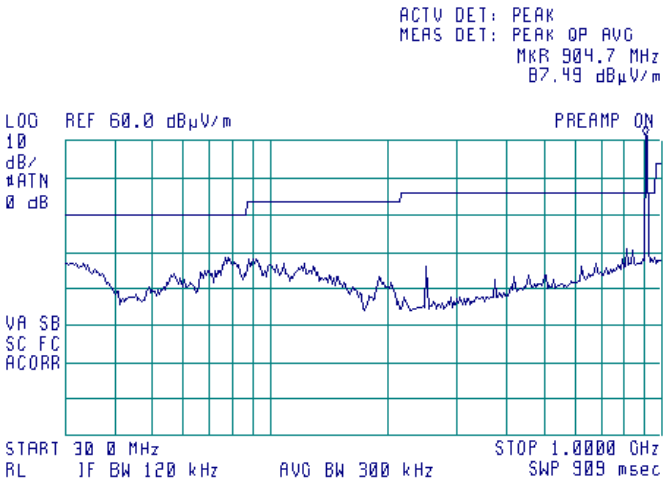
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical (Vertical/ Horizontal)



| Test specification: | Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 11-Jun-15 | | |
| Temperature: 23 ºC | Air Pressure: 1011 hPa | Relative Humidity: 52 % | Power Supply: 120 VAC |
| Remarks: | | | |

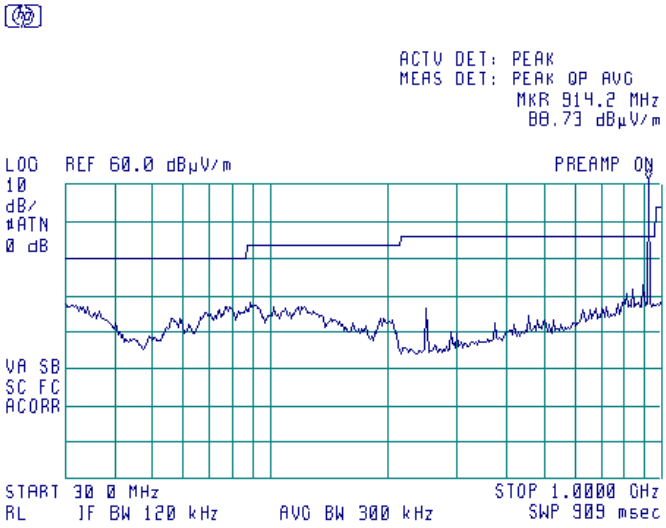
**Plot 7.1.5 Radiated emission measurements from 30 to 1000 MHz at the low carrier frequency**

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




**Plot 7.1.6 Radiated emission measurements from 30 to 1000 MHz at the high carrier frequency**

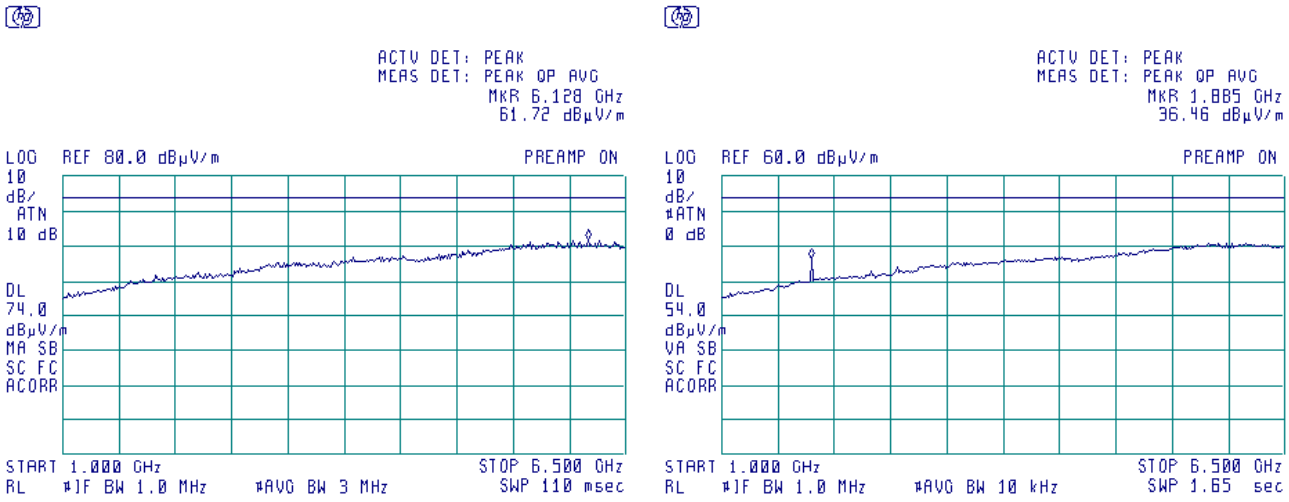
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



| Test specification: | Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 11-Jun-15 | | |
| Temperature: 23 ºC | Air Pressure: 1011 hPa | Relative Humidity: 52 % | Power Supply: 120 VAC |
| Remarks: | | | |

**Plot 7.1.7 Radiated emission measurements from 1000 to 6500 MHz at the low carrier frequency**

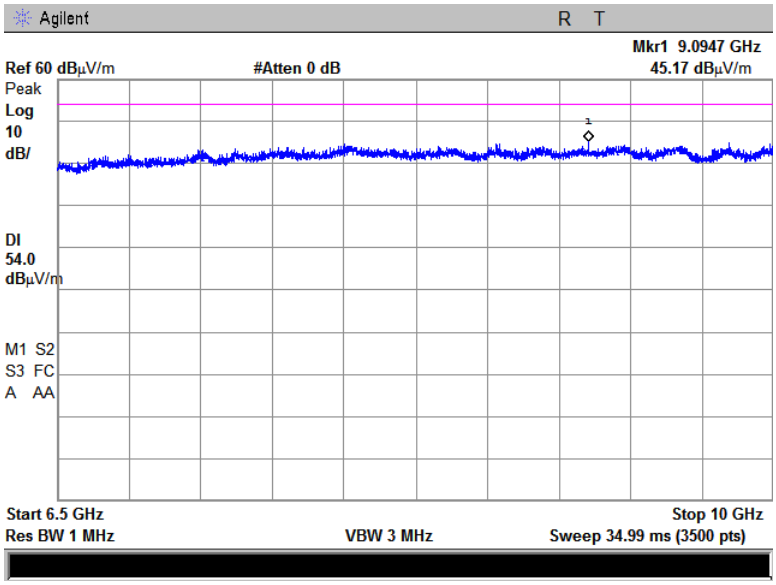
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal




1.8 GHz – external signal

**Plot 7.1.8 Radiated emission measurements from 6500 to 10000 MHz at the low carrier frequency**

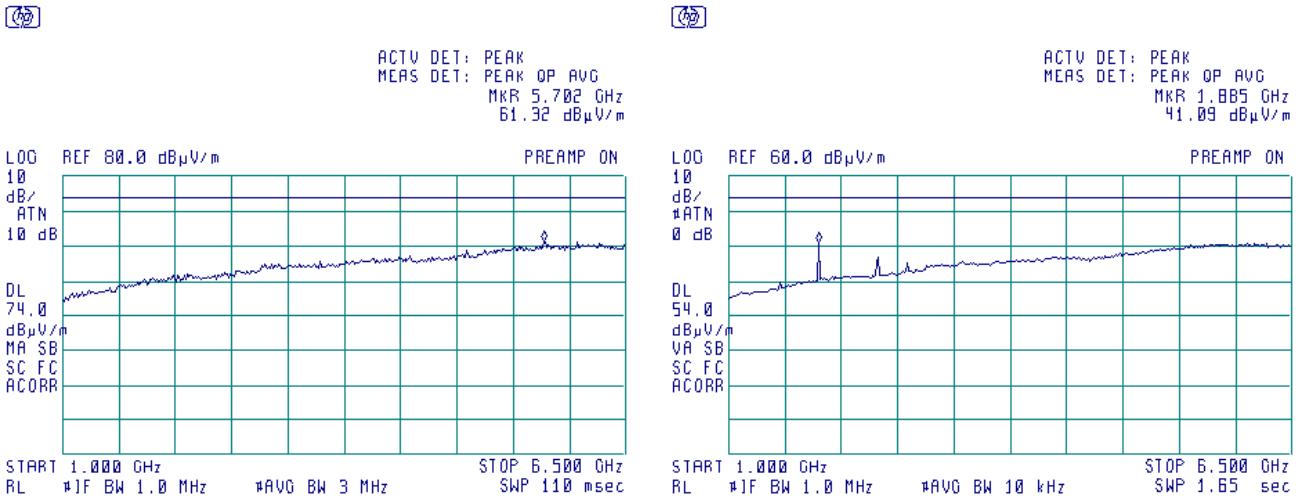
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



| Test specification: | Section 15.249(a)(d)/RSS-210, section A2.9, Field strength of emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 11-Jun-15 | | |
| Temperature: 23 ºC | Air Pressure: 1011 hPa | Relative Humidity: 52 % | Power Supply: 120 VAC |
| Remarks: | | | |

**Plot 7.1.9 Radiated emission measurements from 1000 to 6500 MHz at the high carrier frequency**

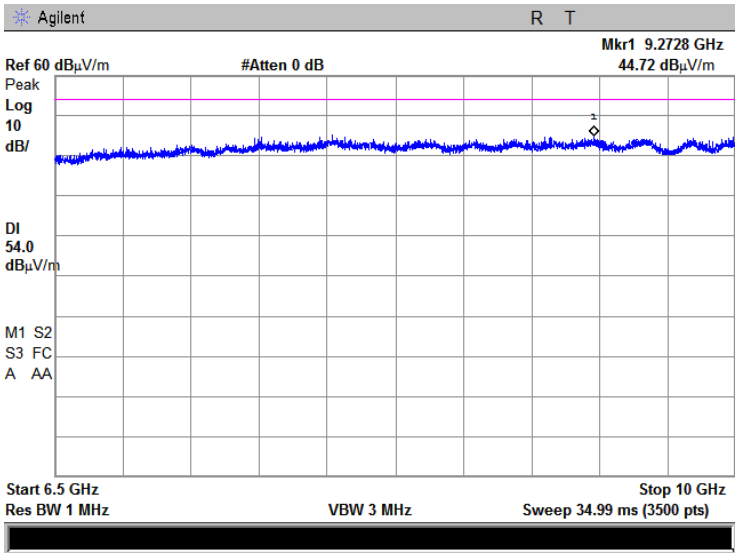
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal




1.8 GHz – external signal

**Plot 7.1.10 Radiated emission measurements from 6500 to 10000 MHz at the high carrier frequency**

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



| Test specification: | Section 15.249(d)/RSS-210, section A2.9, Band edge emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 11-Jun-15 | | |
| Temperature: 23 ºC | Air Pressure: 1011 hPa | Relative Humidity: 55 % | Power Supply: 120 VAC |
| Remarks: | | | |

## 7.2 Band edge emission

### 7.2.1 General

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

**Table 7.2.1 Band edge emission limits**

| Frequency band, MHz | Field strength limit at 3 m, dBµV/m | | Attenuation below carrier, dBc |
|---|---|---|---|
| | Peak | QP | |
| 902.000 - 928.000 | NA | 46.0 | 50 |

### 7.2.2 Test procedure

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

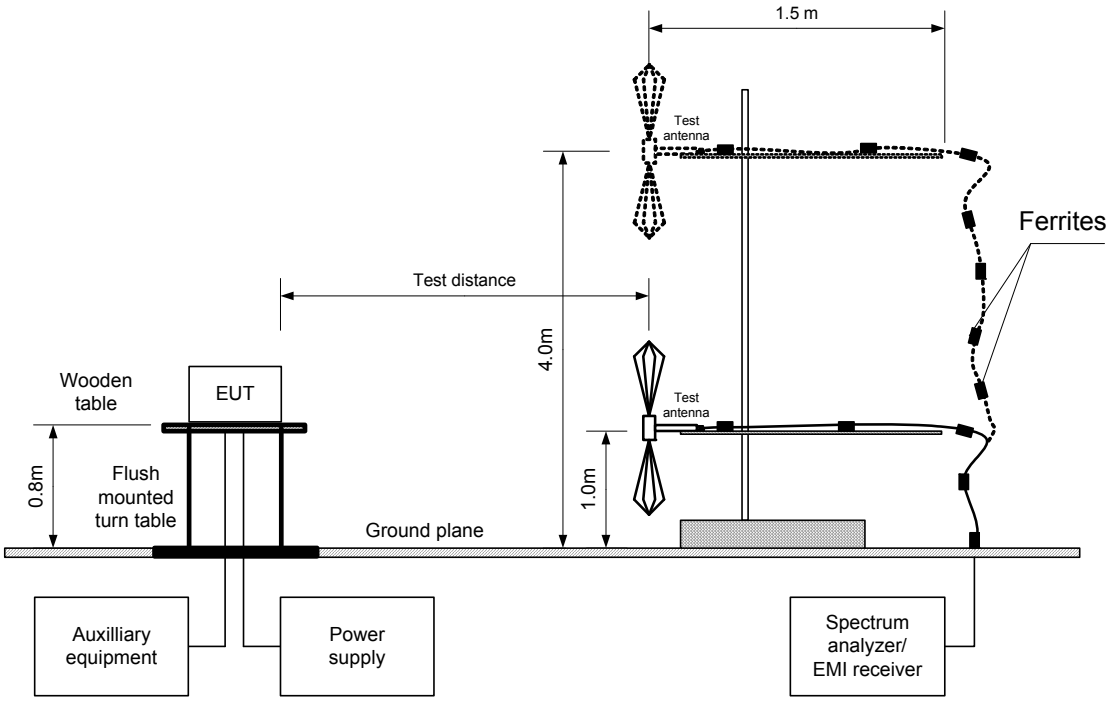
**7.2.2.2** The spectrum analyzer frequency span was set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure peak measurements. Spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.

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

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

| **Test specification:** | **Section 15.249(d)/RSS-210, section A2.9, Band edge emissions** | | |
|---|---|---|---|
| **Test procedure:** | ANSI C63.4, Section 13.1.4 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 11-Jun-15 | | |
| **Temperature:** 23 ºC | **Air Pressure:** 1011 hPa | **Relative Humidity:** 55 % | **Power Supply:** 120 VAC |
| **Remarks:** | | | |

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



| **Test specification:** | **Section 15.249(d)/RSS-210, section A2.9, Band edge emissions** | | |
|---|---|---|---|
| **Test procedure:** | ANSI C63.4, Section 13.1.4 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 11-Jun-15 | | |
| **Temperature:** 23 ºC | **Air Pressure:** 1011 hPa | **Relative Humidity:** 55 % | **Power Supply:** 120 VAC |
| **Remarks:** | | | |

**Table 7.2.2 Band edge emission test results**

OPERATING FREQUENCY RANGE: 902-928 MHz
DETECTOR USED: Peak hold
RESOLUTION BANDWIDTH: 120 kHz
VIDEO BANDWIDTH: 300 kHz
MODULATION: 2FSK

| **Modulation envelope** | | **Measured peak emission, dBµV/m** | **Measured QP emission, dBµV/m** | **QP limit, dBµV/m** | **Margin, dB *** | **Verdict** |
|---|---|---|---|---|---|---|
| **Edge** | **Frequency, MHz** | | | | | |
| Low | 902 | 30.59 | NA | 46.0 | -15.41 | Pass |
| High | 928 | 30.91 | NA | 46.0 | -15.09 | Pass |

* - Margin, dB = Measured value– Limit

**Reference numbers of test equipment used**

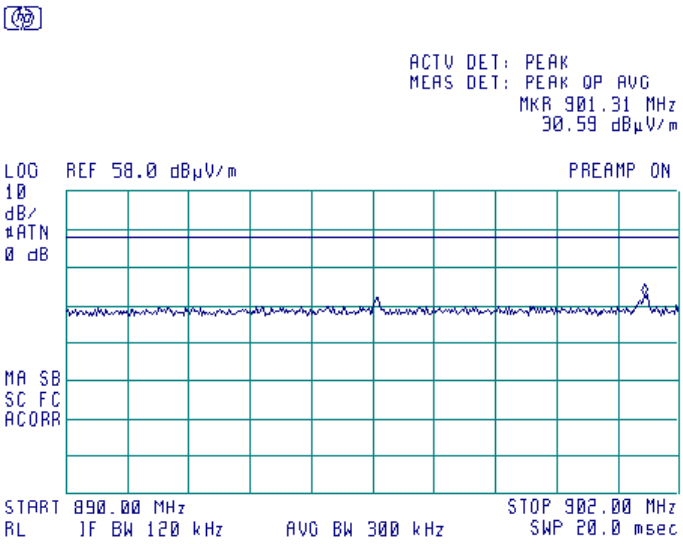
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HL 0521 | HL 0604 | HL 4353 | HL 4722 | | | | |

Full description is given in Appendix A.

| Test specification: | Section 15.249(d)/RSS-210, section A2.9, Band edge emissions | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 11-Jun-15 | | |
| Temperature: 23 ºC | Air Pressure: 1011 hPa | Relative Humidity: 55 % | Power Supply: 120 VAC |
| Remarks: | | | |

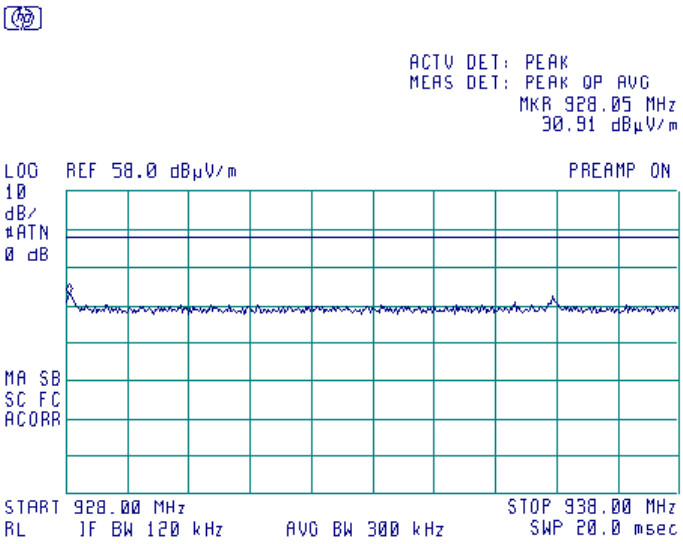
**Plot 7.2.1 Low band edge emission test result**

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




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

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



| Test specification: | Section 15.207(a)/RSS-Gen, section 8.8, Conducted emission | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.3 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 27-Apr-15 | | |
| Temperature: 22.0 ºC | Air Pressure: 1011 hPa | Relative Humidity: 39 % | Power Supply: 120 VAC |
| Remarks: | | | |

## 7.3 Conducted emissions

### 7.3.1 General

This test was performed to measure common mode conducted emissions at the power port. Specification test limits are given in Table 7.3.1.

**Table 7.3.1 Limits for conducted emissions**

| Frequency, 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.

### 7.3.2 Test procedure

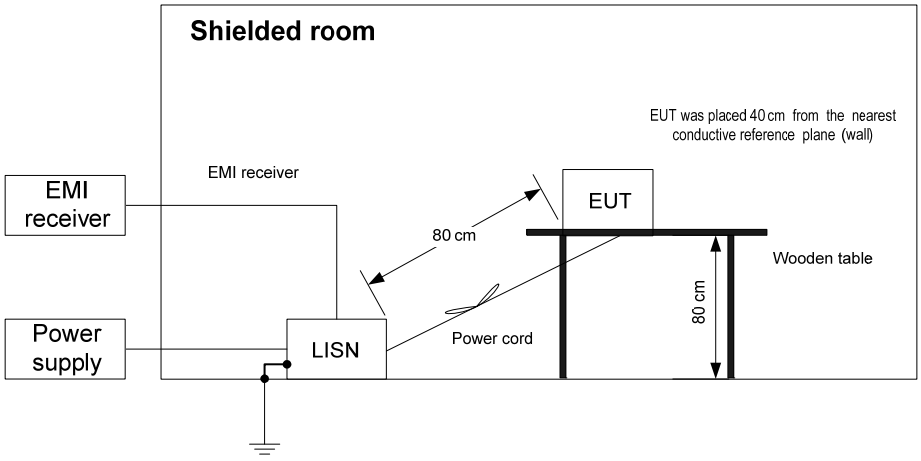
**7.3.2.1** The EUT was set up as shown in Figure 7.3.1, energized and the performance check was conducted.

**7.3.2.2** The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 7.3.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

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

**7.3.2.4** The worst test results (the lowest margins) were recorded in Table 7.3.2 and shown in the associated plots.

**Figure 7.3.1 Setup for conducted emission measurements, table-top equipment**



| **Test specification:** | **Section 15.207(a)/RSS-Gen, section 8.8, Conducted emission** | | |
|---|---|---|---|
| **Test procedure:** | ANSI C63.4, Section 13.1.3 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 27-Apr-15 | | |
| **Temperature:** 22.0 ºC | **Air Pressure:** 1011 hPa | **Relative Humidity:** 39 % | **Power Supply:** 120 VAC |
| **Remarks:** | | | |

**Table 7.3.2 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* | | |
| 0.150 | 53.02 | 51.09 | 66.00 | -14.91 | 38.45 | 56.00 | -17.55 | L1 | Pass |
| 0.160 | 50.67 | 43.35 | 65.48 | -22.13 | 28.74 | 55.48 | -26.74 | | |
| 0.189 | 47.92 | 42.50 | 64.05 | -21.55 | 26.00 | 54.05 | -28.05 | | |
| 0.409 | 37.40 | 32.88 | 57.68 | -24.80 | 23.67 | 47.68 | -24.01 | | |
| 7.805 | 29.73 | 25.47 | 60.00 | -34.53 | 17.33 | 50.00 | -32.67 | | |
| 0.150 | 52.73 | 50.78 | 65.96 | -15.18 | 35.23 | 55.96 | -20.73 | L2 | Pass |
| 0.163 | 52.86 | 43.57 | 65.35 | -21.78 | 22.17 | 55.35 | -33.18 | | |
| 0.194 | 48.54 | 45.03 | 63.88 | -18.85 | 26.95 | 53.88 | -26.93 | | |
| 0.280 | 39.65 | 37.42 | 60.85 | -23.43 | 18.12 | 50.85 | -32.73 | | |
| 0.510 | 28.69 | 25.27 | 56.00 | -30.73 | 13.29 | 46.00 | -32.71 | | |
| 0.597 | 27.47 | 21.83 | 56.00 | -34.17 | 10.33 | 46.00 | -35.67 | | |

*- Margin = Measured emission - specification limit.

**Reference numbers of test equipment used**

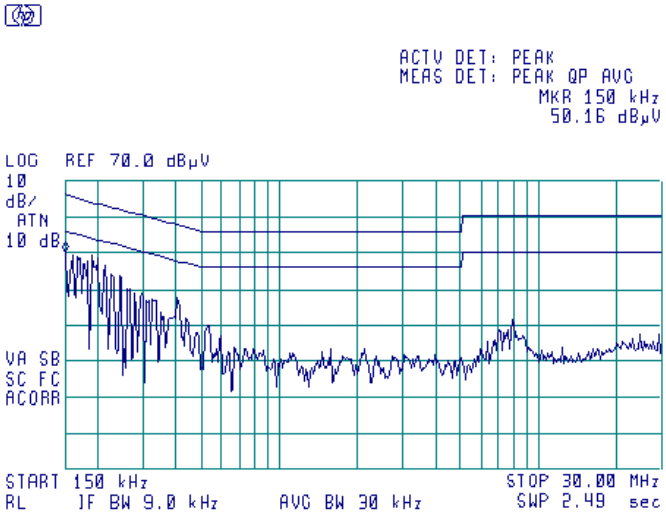
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HL 0447 | HL 1425 | HL 1513 | HL 3612 | HL 3774 | HL 4527 | | |

Full description is given in Appendix A.

| Test specification: | Section 15.207(a)/RSS-Gen, section 8.8, Conducted emission | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.3 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 27-Apr-15 | | |
| Temperature: 22.0 ºC | Air Pressure: 1011 hPa | Relative Humidity: 39 % | Power Supply: 120 VAC |
| Remarks: | | | |

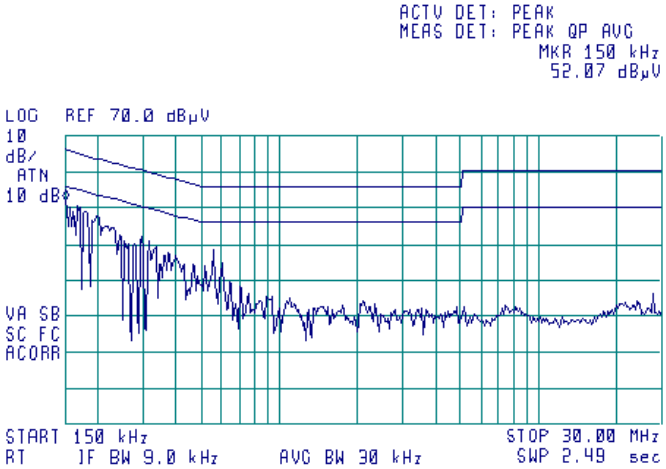
**Plot 7.3.1 Conducted emission measurements**

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




**Plot 7.3.2 Conducted emission measurements**

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



| **Test specification:** | **Section 15.203 / RSS-Gen, Section 7.1.4, Antenna requirement** | | |
|---|---|---|---|
| **Test procedure:** | Visual inspection / supplier declaration | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 25-Aug-15 | | |
| **Temperature:** 24 ºC | **Air Pressure:** 1010 hPa | **Relative Humidity:** 56 % | **Power Supply:** 120 VAC |
| **Remarks:** | | | |

## 7.4 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 7.4.1.

**Table 7.4.1 Antenna requirements**

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

**Photograph 7.4.1 Antenna assembly**

| Test specification: | Section 15.215(c) / RSS-Gen, section 6.6, Occupied bandwidth | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.7 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 29-Jun-15 | | |
| Temperature: 23.5 ºC | Air Pressure: 1010 hPa | Relative Humidity: 46 % | Power Supply: 120 VAC |
| Remarks: | | | |

## 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 according to FCC §15.215**

| Assigned frequency, MHz | Modulation envelope reference points*, dBc |
|---|---|
| 902 - 928 | 20.0 |

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

**Table 7.5.2 Occupied bandwidth limits according to RSS-Gen**

| Assigned frequency, MHz | Modulation envelope reference points*, % |
|---|---|
| 902 - 928 | 99.0 |

### 7.5.2 Test procedure

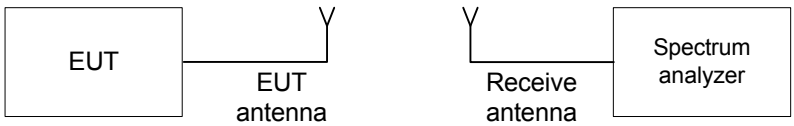
**7.5.2.1** The EUT was set up as shown in Figure 7.5.1, energized and its proper operation was checked.

**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 7.5.3 and 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**



| **Test specification:** | **Section 15.215(c) / RSS-Gen, section 6.6, Occupied bandwidth** | | |
|---|---|---|---|
| **Test procedure:** | ANSI C63.4, Section 13.1.7 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 29-Jun-15 | | |
| **Temperature:** 23.5 ºC | **Air Pressure:** 1010 hPa | **Relative Humidity:** 46 % | **Power Supply:** 120 VAC |
| **Remarks:** | | | |

**Table 7.5.3 Occupied bandwidth test results**

ASSIGNED FREQUENCY BAND 902 – 928 MHz
DETECTOR USED: Peak hold
RESOLUTION BANDWIDTH: 10 kHz
VIDEO BANDWIDTH: 30 kHz
MODULATING SIGNAL: Enable

MODULATION ENVELOPE REFERENCE POINTS: 20 dBc

| Band edge | OBW, kHz | Cross point frequency, MHz | Modulation band edge, MHz | Assigned band edge, MHz | Verdict |
|---|---|---|---|---|---|
| Low | 104.05 | 908.339 | 908.339 | 902.0 | Pass |
| High | 112.50 | 916.050 | 916.050 | 928.0 | Pass |

MODULATION ENVELOPE REFERENCE POINTS: 99%

| Band edge | OBW, kHz | Cross point frequency, MHz | Modulation band edge, MHz | Assigned band edge, MHz | Verdict |
|---|---|---|---|---|---|
| Low | 85.0614 | NA | NA | NA | Pass |
| High | 85.3719 | NA | NA | NA | Pass |

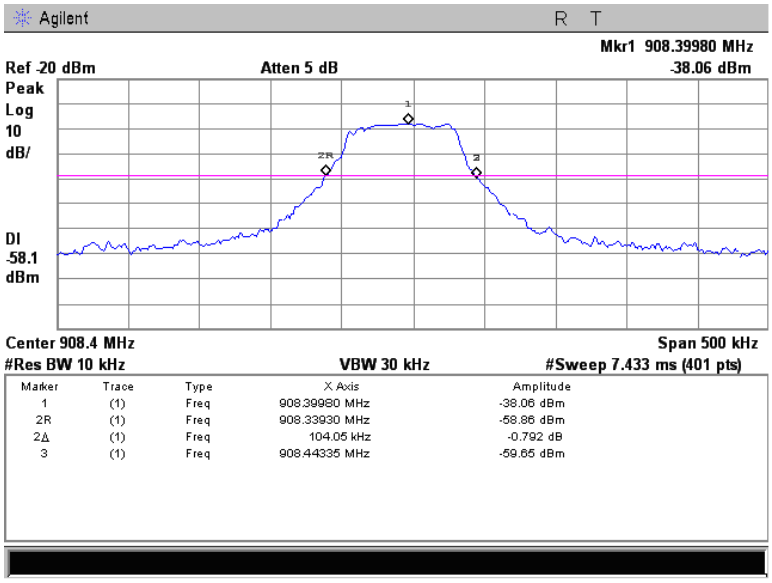
**Reference numbers of test equipment used**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| HL 2909 | HL 4273 | | | | | | | |

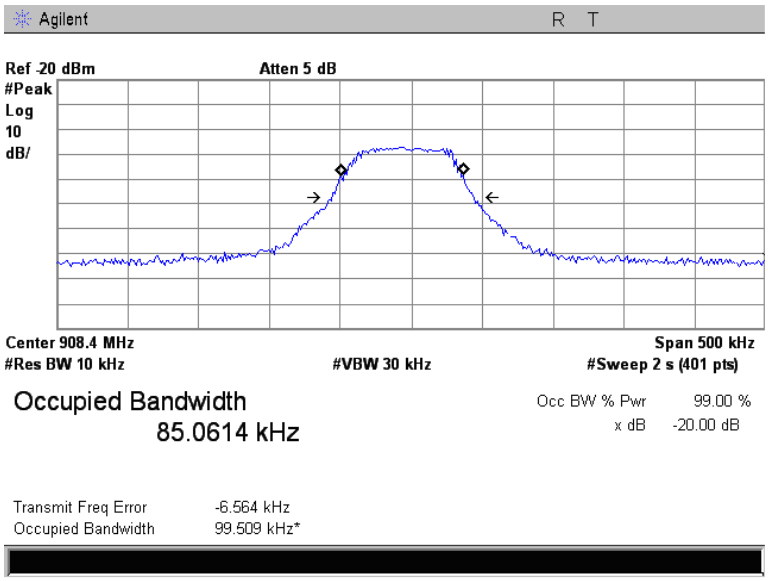
Full description is given in Appendix A.

| Test specification: | Section 15.215(c) / RSS-Gen, section 6.6, Occupied bandwidth | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.7 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 29-Jun-15 | | |
| Temperature: 23.5 ºC | Air Pressure: 1010 hPa | Relative Humidity: 46 % | Power Supply: 120 VAC |
| Remarks: | | | |

**Plot 7.5.1 Occupied bandwidth test result, low frequency**

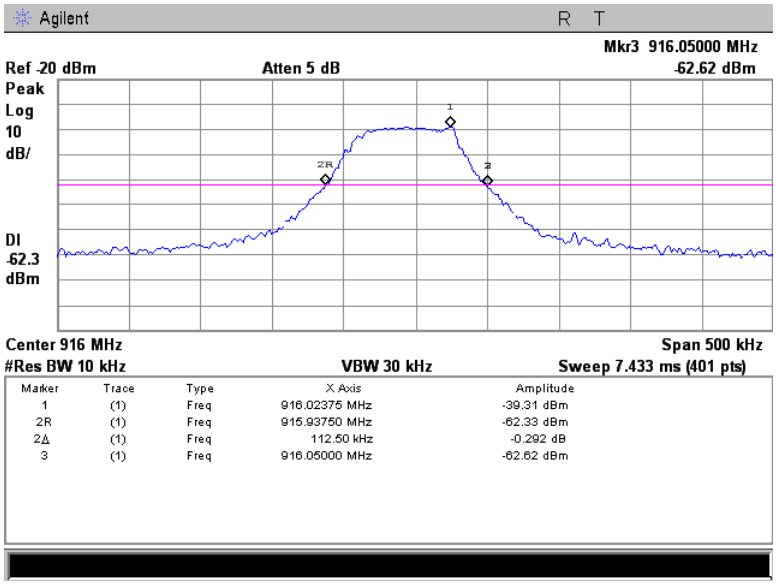



**Plot 7.5.2 Occupied bandwidth test result, low frequency (99% power)**

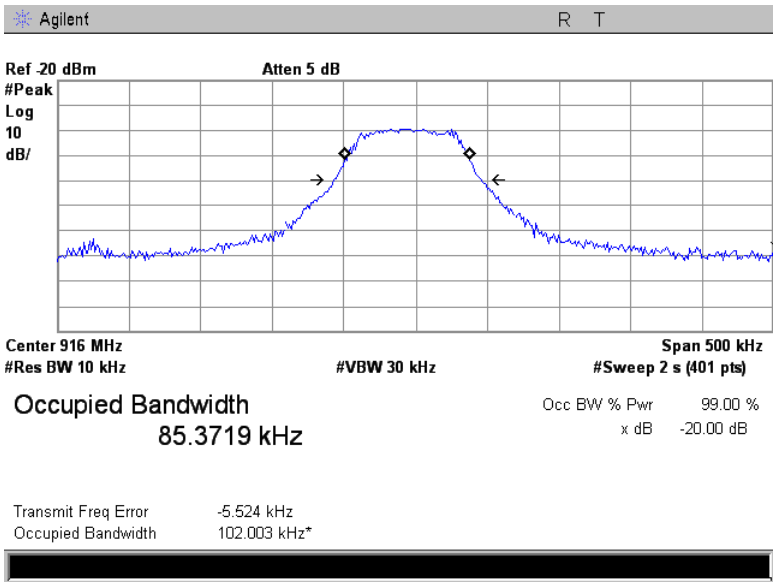


| Test specification: | Section 15.215(c) / RSS-Gen, section 6.6, Occupied bandwidth | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Section 13.1.7 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 29-Jun-15 | | |
| Temperature: 23.5 ºC | Air Pressure: 1010 hPa | Relative Humidity: 46 % | Power Supply: 120 VAC |
| Remarks: | | | |

**Plot 7.5.3 Occupied bandwidth test result, high frequency**




**Plot 7.5.4 Occupied bandwidth test result, high frequency (99% power)**



# 8 APPENDIX A Test equipment and ancillaries used for tests

| HL No | Description | Manufacturer | Model | Ser. No. | Last Cal./ Check | Due Cal./ Check |
|---|---|---|---|---|---|---|
| 0446 | Antenna, Loop, Active, 10 kHz - 30 MHz | EMCO | 6502 | 2857 | 13-Jan-15 | 13-Jan-16 |
| 0447 | LISN, 16/2, 300V RMS, 50 Ohm/50 uH + 5 Ohm, STD CISPR 16-1 | Hermon Laboratories | LISN 16 - 1 | 066 | 13-Oct-15 | 13-Oct-16 |
| 0521 | EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz | Hewlett Packard | 8546A | 3617A 00319, 3448A002 53 | 22-Oct-14 | 22-Oct-15 |
| 0604 | Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz | EMCO | 3141 | 9611-1011 | 15-May-15 | 15-May-16 |
| 1425 | EMI Receiver, 9 kHz - 2.9 GHz, System: HL1426, HL1427 | Agilent Technologies | 8542E | 3710A002 22, 3705A002 04 | 24-Dec-14 | 24-Dec-15 |
| 1513 | Cable RF, 8 m, BNC/BNC | Belden | M17/167 MIL-C-17 | 1513 | 08-Sep-15 | 08-Sep-16 |
| 1984 | Antenna, Double-Ridged Waveguide Horn, 1 to 18 GHz, 300 W | EMC Test Systems | 3115 | 9911-5964 | 17-Apr-15 | 17-Apr-16 |
| 2909 | Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz | Agilent Technologies | E4407B | MY414447 62 | 22-Feb-15 | 22-Feb-16 |
| 3612 | Cable RF, 17.5 m, N type-N type | Teldor | RG-214/U | NA | 07-Dec-14 | 07-Dec-15 |
| 3774 | Attenuator, N-type, 10 dB, DC to 18 GHz, 5 W | Mini-Circuits | BW-N10W5+ | NA | 30-Dec-14 | 30-Dec-15 |
| 4273 | Test Cable , DC-18 GHz, 1.8 m, SMA/M - N/M | Mini-Circuits | CBL-6FT-SMNM+ | 70045 | 28-May-15 | 28-May-16 |
| 4353 | Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M | MegaPhase | NC29-N1N1-244 | 12025101 003 | 15-Mar-15 | 15-Mar-16 |
| 4527 | DC block , 50 Ohm, 10 MHz to 6 GHz | Mini-Circuits | BLK-6-N+ | NA | 13-Jan-15 | 13-Jan-17 |
| 4575 | EXA Signal Analyzer, 9 kHz - 26.5 GHz | Agilent Technologies | N9010A | MY480301 10 | 05-Feb-15 | 05-Feb-16 |
| 4722 | Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M | MegaPhase | NC29-N1N1-244 | 51228701 001 | 31-Aug-15 | 31-Aug-16 |
| 4922 | Low Pass Filter, 50 Ohm, DC to 630 MHz, SMA/M-SMA/F | Mini-Circuits | VLF-630+ | NA | 01-Oct-15 | 01-Oct-17 |

# 9 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: ± 3.9 dB<br>150 kHz to 30 MHz: ± 3.8 dB |
| Radiated emissions at 10 m measuring distance<br>Horizontal polarization<br><br><br>Vertical polarization | <br>Biconilog antenna: ± 5.0 dB<br>Biconical antenna: ± 5.0 dB<br>Log periodic antenna: ± 5.1 dB<br>Double ridged horn antenna: ± 5.3 dB<br>Biconilog antenna: ± 5.5 dB<br>Biconical antenna: ± 5.5 dB<br>Log periodic antenna: ± 5.6 dB<br>Double ridged horn antenna: ± 5.8 dB |
| Radiated emissions at 3 m measuring distance<br>Horizontal polarization<br><br><br>Vertical polarization | <br>Biconilog antenna: ± 5.3 dB<br>Biconical antenna: ± 5.0 dB<br>Log periodic antenna: ± 5.3 dB<br>Double ridged horn antenna: ± 5.3 dB<br>Biconilog antenna: ± 6.0 dB<br>Biconical antenna: ± 5.7 dB<br>Log periodic antenna: ± 6.0 dB<br>Double ridged horn antenna: ± 6.0 dB |
| Conducted emissions at RF antenna connector | 9 kHz to 2.9 GHz: ± 2.6 dB<br>2.9 GHz to 6.46 GHz: ± 3.5 dB<br>6.46 GHz to 13.2 GHz: ± 4.3 dB<br>13.2 GHz to 22.0 GHz: ± 5.0 dB<br>22.0 GHz to 26.8 GHz: ± 5.5 dB<br>26.8 GHz to 40.0 GHz: ± 4.8 dB |
| Duty cycle, timing (Tx ON / OFF) and average factor measurements | ± 1.0 % |
| Occupied bandwidth | ± 8.0 % |

Hermon Laboratories is accredited by A2LA for calibration according to present requirements of ISO/IEC 17025 and NCSL Z540-1. The accreditation is granted to perform calibration of parameters that are listed in the Scope of Hermon Laboratories Accreditation.
Hermon Laboratories calibrates its reference and transfer standards by calibration laboratories accredited to ISO/IEC 17025 by a mutually recognized Accreditation Body or by a recognized national metrology institute. All reference and transfer standards used in the calibration system are traceable to national or international standards.
In-house calibration of all test and measurement equipment is performed on a regular basis according to Hermon Laboratories calibration procedures, manufacturer calibration/verification procedures or procedures defined in the relevant standards. The Hermon Laboratories test and measurement equipment is calibrated within the tolerances specified by the manufacturers and/or by the relevant standards.

# 10 APPENDIX C Test laboratory description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, safety, environmental and telecommunication testing facility.
Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47), Registration Numbers 90624 for OATS and 90623 for the anechoic chamber; by Industry Canada for electromagnetic emissions, file number IC 2186A-1 for OATS, certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, 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 IL1001.

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website: www.hermonlabs.com

Person for contact: Mr. Alex Usoskin, CEO.

# 11 APPENDIX D Specification references

| | |
|---|---|
| FCC 47CFR part 15: 2014 | 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: 2009 | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |
| RSS-210 Issue 8: 2010 | Low Power Licence- Exempt Radiocommunication Devices |
| RSS-Gen Issue 4: 2014 | General Requirements and Information for the Certification of Radiocommunication Equipment |

# 12 APPENDIX E Test equipment correction factors

**Correction factor**
**Line impedance stabilization network**
**Model LISN 16 - 1**
**Hermon Laboratories, HL 0447**

| Frequency, kHz | Correction factor, dB |
|---|---|
| 10 | 4.9 |
| 15 | 2.86 |
| 20 | 1.83 |
| 25 | 1.25 |
| 30 | 0.91 |
| 35 | 0.69 |
| 40 | 0.53 |
| 50 | 0.35 |
| 60 | 0.25 |
| 70 | 0.18 |
| 80 | 0.14 |
| 90 | 0.11 |
| 100 | 0.09 |
| 125 | 0.06 |
| 150 | 0.04 |

The correction factor in dB is to be added to meter readings of an interference analyzer or a spectrum analyzer.

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

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

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

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

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

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

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

**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**
**Test cable, Mini-Circuits, S/N 70045, 18 GHz, 1.8 m, SMA/M - N/M**
**CBL-6FT-SMNM+, HL 4273**

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|---|---|---|---|---|---|---|---|
| 10 | 0.09 | 4800 | 1.76 | 9800 | 2.70 | 14800 | 3.59 |
| 30 | 0.11 | 4900 | 1.78 | 9900 | 2.71 | 14900 | 3.59 |
| 50 | 0.14 | 5000 | 1.81 | 10000 | 2.73 | 15000 | 3.60 |
| 100 | 0.20 | 5100 | 1.82 | 10100 | 2.75 | 15100 | 3.63 |
| 200 | 0.30 | 5200 | 1.86 | 10200 | 2.76 | 15200 | 3.67 |
| 300 | 0.38 | 5300 | 1.89 | 10300 | 2.79 | 15300 | 3.70 |
| 400 | 0.45 | 5400 | 1.92 | 10400 | 2.81 | 15400 | 3.68 |
| 500 | 0.50 | 5500 | 1.96 | 10500 | 2.82 | 15500 | 3.70 |
| 600 | 0.55 | 5600 | 2.00 | 10600 | 2.83 | 15600 | 3.71 |
| 700 | 0.60 | 5700 | 2.03 | 10700 | 2.87 | 15700 | 3.77 |
| 800 | 0.65 | 5800 | 2.04 | 10800 | 2.87 | 15800 | 3.75 |
| 900 | 0.69 | 5900 | 2.07 | 10900 | 2.88 | 15900 | 3.77 |
| 1000 | 0.73 | 6000 | 2.10 | 11000 | 2.89 | 16000 | 3.79 |
| 1100 | 0.77 | 6100 | 2.10 | 11100 | 2.91 | 16100 | 3.85 |
| 1200 | 0.80 | 6200 | 2.11 | 11200 | 2.92 | 16200 | 3.82 |
| 1300 | 0.84 | 6300 | 2.11 | 11300 | 2.94 | 16300 | 3.83 |
| 1400 | 0.88 | 6400 | 2.14 | 11400 | 2.95 | 16400 | 3.88 |
| 1500 | 0.92 | 6500 | 2.15 | 11500 | 2.98 | 16500 | 3.89 |
| 1600 | 0.95 | 6600 | 2.15 | 11600 | 3.00 | 16600 | 3.92 |
| 1700 | 0.98 | 6700 | 2.16 | 11700 | 3.02 | 16700 | 3.88 |
| 1800 | 1.01 | 6800 | 2.19 | 11800 | 3.04 | 16800 | 3.95 |
| 1900 | 1.04 | 6900 | 2.22 | 11900 | 3.08 | 16900 | 3.91 |
| 2000 | 1.07 | 7000 | 2.24 | 12000 | 3.09 | 17000 | 3.97 |
| 2100 | 1.09 | 7100 | 2.26 | 12100 | 3.12 | 17100 | 3.92 |
| 2200 | 1.13 | 7200 | 2.29 | 12200 | 3.13 | 17200 | 3.94 |
| 2300 | 1.15 | 7300 | 2.32 | 12300 | 3.16 | 17300 | 3.94 |
| 2400 | 1.18 | 7400 | 2.36 | 12400 | 3.17 | 17400 | 3.98 |
| 2500 | 1.21 | 7500 | 2.39 | 12500 | 3.19 | 17500 | 3.93 |
| 2600 | 1.24 | 7600 | 2.41 | 12600 | 3.20 | 17600 | 3.95 |
| 2700 | 1.27 | 7700 | 2.43 | 12700 | 3.21 | 17700 | 3.96 |
| 2800 | 1.30 | 7800 | 2.46 | 12800 | 3.21 | 17800 | 3.97 |
| 2900 | 1.34 | 7900 | 2.49 | 12900 | 3.22 | 17900 | 3.96 |
| 3000 | 1.36 | 8000 | 2.52 | 13000 | 3.22 | 18000 | 3.97 |
| 3100 | 1.38 | 8100 | 2.52 | 13100 | 3.24 | | |
| 3200 | 1.41 | 8200 | 2.54 | 13200 | 3.24 | | |
| 3300 | 1.45 | 8300 | 2.59 | 13300 | 3.27 | | |
| 3400 | 1.46 | 8400 | 2.61 | 13400 | 3.28 | | |
| 3500 | 1.49 | 8500 | 2.60 | 13500 | 3.31 | | |
| 3600 | 1.51 | 8600 | 2.63 | 13600 | 3.31 | | |
| 3700 | 1.55 | 8700 | 2.65 | 13700 | 3.35 | | |
| 3800 | 1.34 | 8800 | 2.65 | 13800 | 3.37 | | |
| 3900 | 1.36 | 8900 | 2.65 | 13900 | 3.40 | | |
| 4000 | 1.38 | 9000 | 2.66 | 14000 | 3.43 | | |
| 4100 | 1.41 | 9100 | 2.66 | 14100 | 3.45 | | |
| 4200 | 1.45 | 9200 | 2.67 | 14200 | 3.46 | | |
| 4300 | 1.46 | 9300 | 2.67 | 14300 | 3.46 | | |
| 4400 | 1.49 | 9400 | 2.67 | 14400 | 3.49 | | |
| 4500 | 1.51 | 9500 | 2.68 | 14500 | 3.50 | | |
| 4600 | 1.55 | 9600 | 2.69 | 14600 | 3.50 | | |
| 4700 | 1.34 | 9700 | 2.69 | 14700 | 3.52 | | |

**Cable loss**
**Low Loss Armored Test Cable, MegaPhase, 18 GHz, 6.2 m, N type-M/N type-M,**
**NC29-N1N1-244S/N 12025101 003,**
**HL 4353**

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|---|---|---|---|
| 50 | 0.20 | 9000 | 2.71 |
| 100 | 0.27 | 9500 | 2.81 |
| 300 | 0.47 | 10000 | 2.90 |
| 500 | 0.61 | 10500 | 2.97 |
| 1000 | 0.87 | 11000 | 3.06 |
| 1500 | 1.07 | 11500 | 3.13 |
| 2000 | 1.24 | 12000 | 3.20 |
| 2500 | 1.39 | 12500 | 3.26 |
| 3000 | 1.53 | 13000 | 3.34 |
| 3500 | 1.65 | 13500 | 3.39 |
| 4000 | 1.77 | 14000 | 3.47 |
| 4500 | 1.89 | 14500 | 3.54 |
| 5000 | 1.99 | 15000 | 3.62 |
| 5500 | 2.07 | 15500 | 3.69 |
| 6000 | 2.20 | 16000 | 3.76 |
| 6500 | 2.30 | 16500 | 3.83 |
| 7000 | 2.39 | 17000 | 3.86 |
| 7500 | 2.51 | 17500 | 3.94 |
| 8000 | 2.58 | 18000 | 4.02 |
| 8500 | 2.65 | | |

**Cable loss**
**Low Loss Armored Test Cable, MegaPhase, 18 GHz, 6.2 m, N type-M/N type-M, NC29-N1N1-244, S/N 51228701001**
**HL 4722**

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|---|---|---|---|
| 50 | 0.22 | 9000 | 2.93 |
| 100 | 0.30 | 9500 | 3.06 |
| 300 | 0.52 | 10000 | 3.16 |
| 500 | 0.66 | 10500 | 3.20 |
| 1000 | 0.93 | 11000 | 3.34 |
| 1500 | 1.15 | 11500 | 3.39 |
| 2000 | 1.33 | 12000 | 3.48 |
| 2500 | 1.49 | 12500 | 3.55 |
| 3000 | 1.64 | 13000 | 3.66 |
| 3500 | 1.77 | 13500 | 3.75 |
| 4000 | 1.90 | 14000 | 3.76 |
| 4500 | 2.03 | 14500 | 3.87 |
| 5000 | 2.17 | 15000 | 3.98 |
| 5500 | 2.30 | 15500 | 4.01 |
| 6000 | 2.39 | 16000 | 4.14 |
| 6500 | 2.51 | 16500 | 4.15 |
| 7000 | 2.59 | 17000 | 4.32 |
| 7500 | 2.67 | 17500 | 4.36 |
| 8000 | 2.76 | 18000 | 4.38 |
| 8500 | 2.84 | | |

# 13 APPENDIX F Abbreviations and acronyms

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

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