HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

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# TEST REPORT

**ACCORDING TO:** FCC 47CFR part 15 subpart C §15.247 (FHSS) and subpart B, RSS-247 Issue 2:2017, RSS-Gen Issue 5:2018, ICES-003 Issue 6:2016

**FOR:**

## VISONIC Ltd.

## EUT: Wireless ceiling PIR presence/security detector

## Model: MP-862 PG2

## FCC ID: WP3MP862PG2

## IC: 1467C-MP862PG2

# 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:** | zurir@tycoint.com |
| **Contact name:** | Mr. Zuri Rubin |

# 2 Equipment under test attributes

| | |
|---|---|
| **Product name:** | Wireless ceiling PIR presence/security detector |
| **Product type:** | Transceiver |
| **Model:** | MP-862 PG2 |
| **Serial number:** | NA |
| **Hardware version:** | 90-208692 |
| **Software release:** | JS-703384 |
| **Receipt date** | 18-Feb-18 |

# 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:** | zurir@tycoint.com |
| **Contact name:** | Mr. Zuri Rubin |

# 4 Test details

| | |
|---|---|
| **Project ID:** | 30669 |
| **Location:** | Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel |
| **Test started:** | 28-Mar-18 |
| **Test completed:** | 10-Apr-18 |
| **Test specifications:** | FCC 47CFR part 15 subpart C § 15.247 (FHSS) and subpart B;<br>RSS-247 Issue 2:2017; RSS-Gen Issue 5:2014; ICES-003 Issue 6:2016 |

# 5 Tests summary

| Test | Status |
|---|---|
| **Transmitter characteristics** | |
| Section 15.247(a)1 / RSS-247 section 5.1(c), 20 dB bandwidth | Pass |
| Section 15.247(b) / RSS-247 section 5.4(a), Peak output power | Pass |
| Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions | Pass |
| Section 15.247(a)1 / RSS-247 section 5.1(b), Frequency separation | Pass |
| Section 15.247(a)1 / RSS-247 section 5.1(c), Number of hopping frequencies | Pass |
| Section 15.247(a)1 / RSS-247 section 5.1(c), Average time of occupancy | Pass |
| Section 15.247(i)5 / RSS-102 section 2.5, RF exposure | Pass, the exhibit to the application of certification is provided |
| Section 15.247(d) / RSS-247 section 5.5, Emissions at band edges | Pass |
| Section 15.203 / RSS-Gen section 8.3, Antenna requirements | Pass |
| Section 15.207(a) / RSS-Gen section 8.8, Conducted emission | Not required |
| **Unintentional emissions** | |
| Section 15.107/ICES-003, Section 6.1, Class B, Conducted emission at AC power port | Not required |
| Section 15.109/ RSS-Gen section 7.1.2 /ICES-003, Section 6.2, 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.

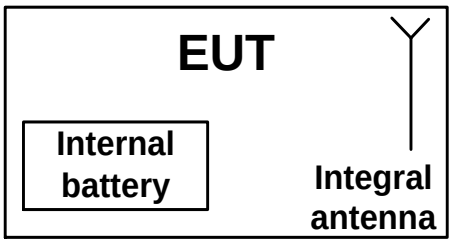
| | Name and Title | Date | Signature |
|---|---|---|---|
| **Tested by:** | Mrs. E. Pitt, test engineer | 28-Mar-18 – 10-Apr-18 |  |
| **Reviewed by:** | Mrs. Y. Rapin, technical writer | 25-Apr-18 |  |
| **Approved by:** | Mr. K. Zushchyk, projects and customer manager, EMC and radio group | 31-May-18 |  |

# 6 EUT description

## 6.1 General information

The EUT is a wireless indoor PIR detector operating in 912.750 – 919.106 MHz. The EUT is equipped with an integral antenna and is powered from 3 VDC internal battery.

## 6.2 Test configuration




## 6.3 Changes made in EUT

No changes were implemented in the EUT during the testing.

## 6.4 Transmitter characteristics

| **Type of equipment** | |
|---|---|
| X | 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) |

| **Intended use** | | **Condition of use** |
|---|---|---|
| | fixed | Always at a distance more than 2 m from all people |
| X | mobile | Always at a distance more than 20 cm from all people |
| | portable | May operate at a distance closer than 20 cm to human body |

| | | | | |
|---|---|---|---|---|
| **Assigned frequency ranges** | 902 – 928 MHz | | | |
| **Operating frequencies** | 912.750 – 919.106 MHz | | | |
| **Maximum rated output power** | At transmitter 50 Ω RF output connector | | | dBm |
| | Peak output power | | | 13.99 dBm |
| **Is transmitter output power variable?** | X | No | | |
| | | Yes | | continuous variable |
| | | | | stepped variable with stepsize dB |
| | | | | minimum RF power dBm |
| | | | | maximum RF power dBm |

| **Antenna connection** | | | | |
|---|---|---|---|---|
| unique coupling | standard connector | X | integral | with temporary RF connector |
| | | | | X without temporary RF connector |

| **Antenna/s technical characteristics** | | | |
|---|---|---|---|
| Type | Manufacturer | Model number | Gain |
| Helical | Ocean | Visonic P.N--H-302031 | -1 dBi |

| | |
|---|---|
| **Transmitter aggregate data rate/s** | 50 kbps |
| **Type of modulation** | GFSK |
| **Modulating test signal (baseband)** | PRBS |

| **Transmitter power source** | | | | | |
|---|---|---|---|---|---|
| X | Battery | **Nominal rated voltage** | 3.0 VDC | Battery type | CR123A |
| | DC | **Nominal rated voltage** | | | |
| | AC mains | **Nominal rated voltage** | | Frequency | |

| | | | |
|---|---|---|---|
| **Common power source for transmitter and receiver** | | X yes | no |
| **Spread spectrum technique used** | X | Frequency hopping (FHSS) | |
| | | Digital transmission system (DTS) | |
| | | Hybrid | |

| **Spread spectrum parameters for transmitters tested per FCC 15.247 only** | | |
|---|---|---|
| **FHSS** | Total number of hops | 50 |
| | Bandwidth per hop | 104.28 kHz |
| | Max. separation of hops | 131.7 kHz |

| Test specification: | Section 15.247(a)1, RSS-247 section 5.1(3), 20 dB bandwidth | | |
|---|---|---|---|
| Test procedure: | ANSI C63.10, section 7.8.7 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 02-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1010 hPa | Power: 3 VDC |
| Remarks: | | | |

# 7 Transmitter tests according to 47CFR part 15 subpart C and RSS-247 requirements

## 7.1 20 dB bandwidth

### 7.1.1 General

This test was performed to measure the 20 dB bandwidth of the transmitter hopping channel. Specification test limits are given in Table 7.1.1.

**Table 7.1.1 The 20 dB bandwidth limits**

| Assigned frequency, MHz | Maximum bandwidth, kHz | Modulation envelope reference points*, dBc |
|---|---|---|
| 902.0 – 928.0 | 250 | 20 |
| 2400.0 – 2483.5 | NA | |
| 5725.0 – 5850.0 | 1000 | |

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

### 7.1.2 Test procedure

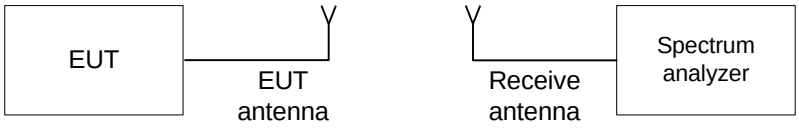
**7.1.2.1** The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.

**7.1.2.2** The EUT was set to transmit modulated carrier at maximum data rate.

**7.1.2.3** The transmitter bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.1.2 and associated plot.

**7.1.2.4** The test was repeated for each data rate and each modulation format.

**Figure 7.1.1 The 20 dB bandwidth test setup**



| Test specification: | Section 15.247(a)1, RSS-247 section 5.1(3), 20 dB bandwidth | | |
|---|---|---|---|
| Test procedure: | ANSI C63.10, section 7.8.7 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 02-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1010 hPa | Power: 3 VDC |
| Remarks: | | | |

**Table 7.1.2 The 20 dB bandwidth test results**

ASSIGNED FREQUENCY BAND: 902.0 – 928.0 MHz
DETECTOR USED: Peak
SWEEP TIME: Auto
VIDEO BANDWIDTH: ≥ RBW
MODULATION ENVELOPE REFERENCE POINTS: 20.0 dBc
FREQUENCY HOPPING: Disabled

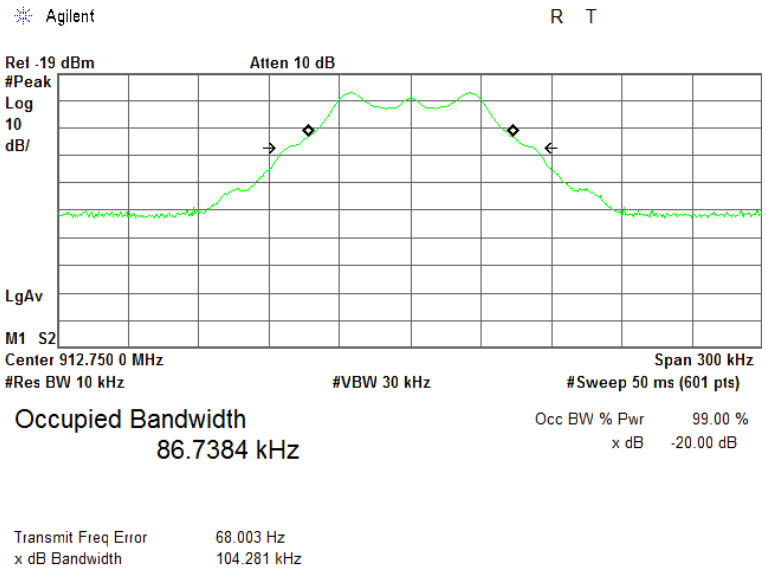
| Carrier frequency, MHz | Type of modulation | Data rate, kbps | Symbol rate, Msymbols/s | 20 dB bandwidth, kHz | Limit, kHz | Margin, kHz | Verdict |
|---|---|---|---|---|---|---|---|
| 912.750 | QPSK | 50 | NA | 104.28 | 250 | -145.72 | Pass |
| 915.863 | | | | 103.87 | 250 | -146.13 | Pass |
| 919.106 | | | | 104.03 | 250 | -145.97 | Pass |

**Reference numbers of test equipment used**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| HL 3818 | HL 4136 | | | | | | | |

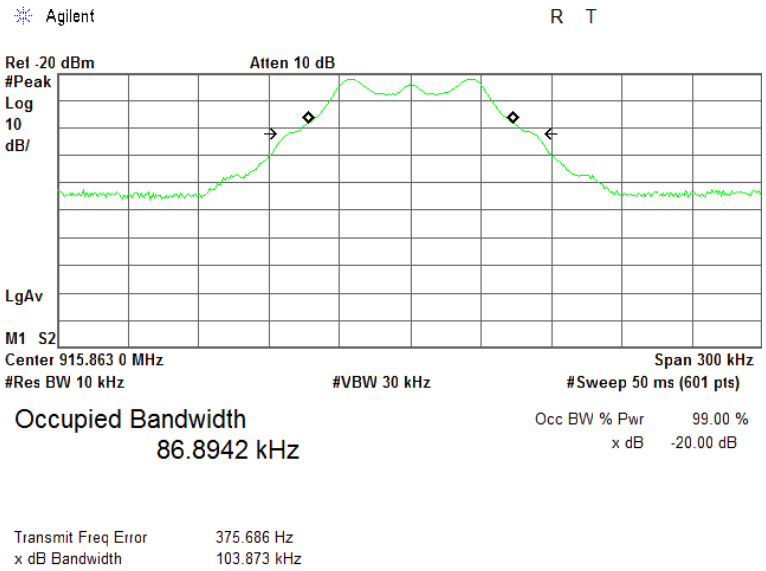
Full description is given in Appendix A.

**Plot 7.1.1 The 20 dB bandwidth test result at low frequency**

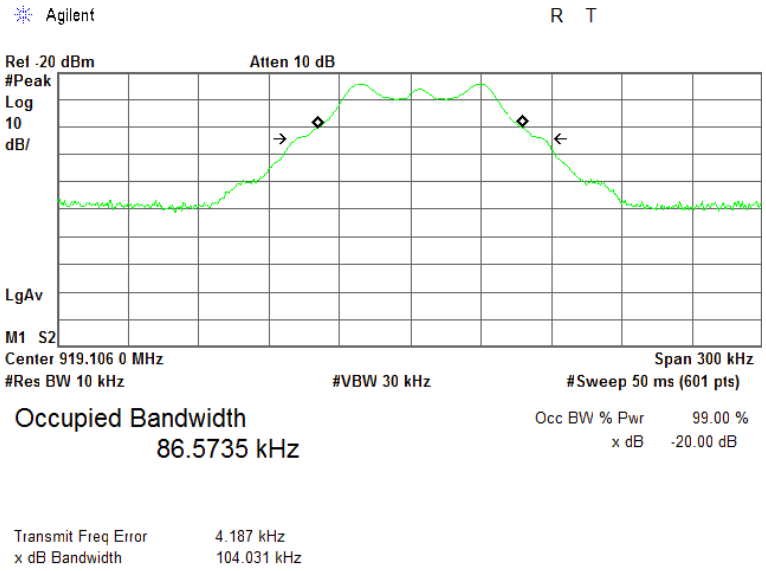


| Test specification: | Section 15.247(a)1, RSS-247 section 5.1(3), 20 dB bandwidth | | |
|---|---|---|---|
| Test procedure: | ANSI C63.10, section 7.8.7 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 02-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1010 hPa | Power: 3 VDC |
| Remarks: | | | |

**Plot 7.1.2 The 20 dB bandwidth test result at mid frequency**




**Plot 7.1.3 The 20 dB bandwidth test result at high frequency**



| Test specification: | Section 15.247(a)1, Frequency separation | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 02-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1010 hPa | Power: 3 VDC |
| Remarks: | | | |

## 7.2 Carrier frequency separation

### 7.2.1 General

This test was performed to measure frequency separation between the peaks of adjacent channels. Specification test limits are given in Table 7.2.1.

**Table 7.2.1 Carrier frequency separation limits**

| Assigned frequency range, MHz | Carrier frequency separation | |
|---|---|---|
| | Output power 30 dBm | Output power 21 dBm |
| 902.0 – 928.0 | 25 kHz or 20 dB bandwidth of the hopping channel, whichever is greater | 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater |
| **2400.0 – 2483.5** | | |
| 5725.0 – 5850.0 | | |

### 7.2.2 Test procedure

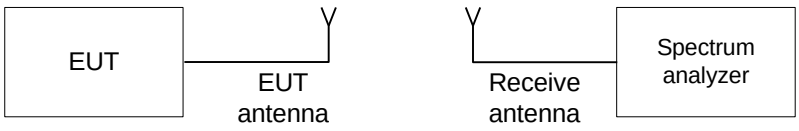
**7.2.2.1** The EUT was set up as shown in Figure 7.2.1, energized with frequency hopping function enabled and its proper operation was checked.

**7.2.2.2** The spectrum analyzer span was set to capture the carrier frequency and both of adjacent channels, the lower and the higher. The resolution bandwidth was set wider than 1 % of the frequency span.

**7.2.2.3** The spectrum analyzer was set in max hold mode and allowed trace to stabilize.

**7.2.2.4** The frequency separation between the peaks of adjacent channels was measured as provided in Table 7.2.2 and associated plots.

**Figure 7.2.1 Carrier frequency separation test setup**



| Test specification: | Section 15.247(a)1, Frequency separation | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 02-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1010 hPa | Power: 3 VDC |
| Remarks: | | | |

**Table 7.2.2 Carrier frequency separation test results**

ASSIGNED FREQUENCY: 902-928 MHz
MODULATION: QPSK
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: ≥ 1% of the span
VIDEO BANDWIDTH: ≥ RBW
FREQUENCY HOPPING: Enabled
20 dB BANDWIDTH: 104.28 kHz

| Carrier frequency separation, kHz | Limit, kHz | Margin* | Verdict |
|---|---|---|---|
| 131.7 | 104.28 | 27.42 | Pass |

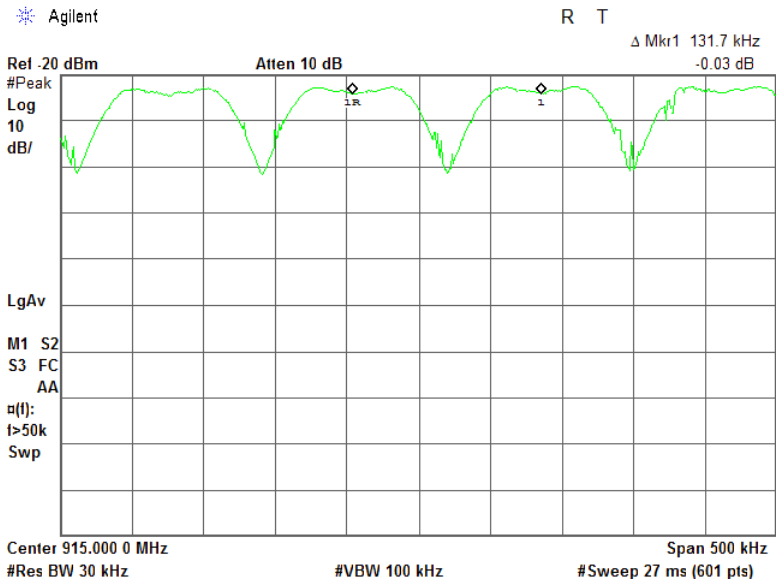
* - Margin = Carrier frequency separation – specification limit.

**Reference numbers of test equipment used**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HL 3818 | HL 4136 | | | | | | |

Full description is given in Appendix A.

**Plot 7.2.1 Carrier frequency separation**



| Test specification: | Section 15.247(a)1, Number of hopping frequencies | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 02-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1010 hPa | Power: 3 VDC |
| Remarks: | | | |

## 7.3 Number of hopping frequencies

### 7.3.1 General

This test was performed to calculate the number of hopping frequencies used by the EUT. Specification test limits are given in Table 7.3.1.

**Table 7.3.1 Minimum number of hopping frequencies**

| Assigned frequency range, MHz | Number of hopping frequencies |
|---|---|
| **902.0 – 928.0** | **50 (if the 20 dB bandwidth is less than 250 kHz)<br>25 (if the 20 dB bandwidth is 250 kHz or greater)** |
| 2400.0 – 2483.5 | 15 |
| 5725.0 – 5850.0 | 75 |

### 7.3.2 Test procedure

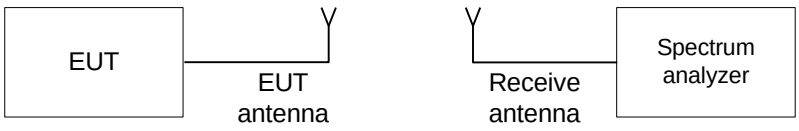
**7.3.2.1** The EUT was set up as shown in Figure 7.3.1, energized with frequency hopping function enabled and its proper operation was checked.

**7.3.2.2** Initially the spectrum analyzer span was set equal to frequency band of operation and the resolution bandwidth was set wider than 1 % of the frequency span. If the separate hopping channels were not clearly resolved the frequency band of operation was broken to sections and the resolution bandwidth was set wider than 1 % of the frequency span of each section.

**7.3.2.3** The spectrum analyzer was set in max hold mode and allowed trace to stabilize.

**7.3.2.4** The number of frequency hopping channels was calculated as provided in Table 7.3.2 and associated plots.

**Figure 7.3.1 Hopping frequencies test setup**



| Test specification: | Section 15.247(a)1, Number of hopping frequencies | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 02-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1010 hPa | Power: 3 VDC |
| Remarks: | | | |

**Table 7.3.2 Hopping frequencies test results**

ASSIGNED FREQUENCY: 902.0 – 928.0 MHz
MODULATION: GFSK
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: ≥ 1% of the span
VIDEO BANDWIDTH: ≥ RBW
FREQUENCY HOPPING: Enabled

| Number of hopping frequencies | Minimum number of hopping frequencies | Margin* | Verdict |
|---|---|---|---|
| 50 | 50 | 0 | Pass |

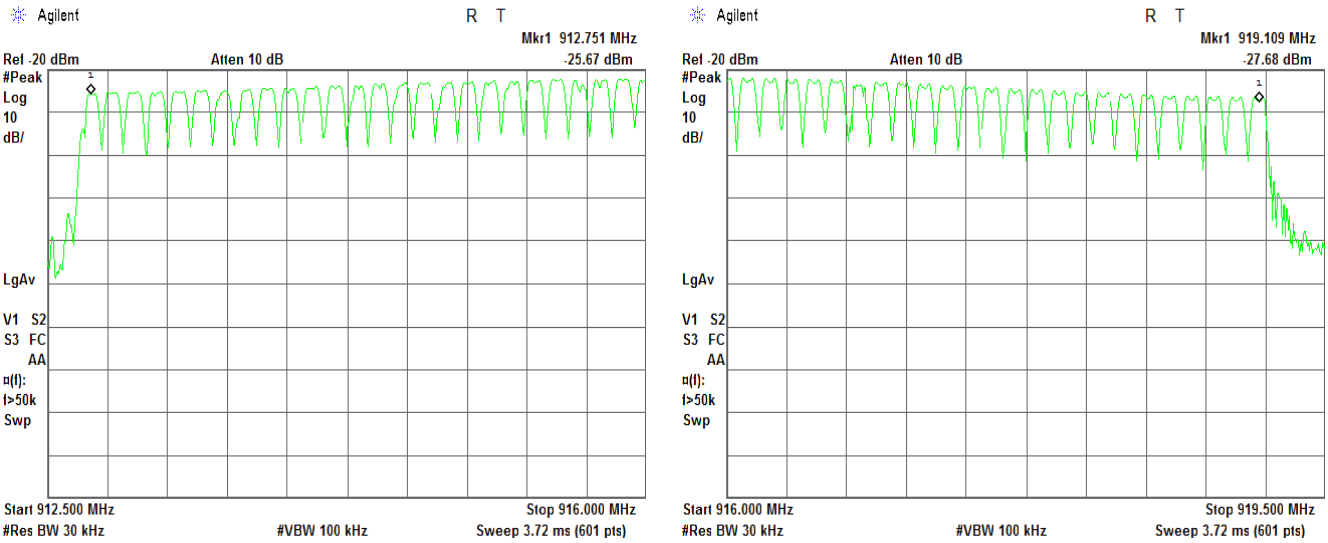
* - Margin = Number of hopping frequencies – Minimum number of hopping frequencies.

**Reference numbers of test equipment used**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HL 3818 | HL 4136 | | | | | | |

Full description is given in Appendix A.

**Plot 7.3.1 Number of hopping frequencies**



| Test specification: | Section 15.247(a)1, Average time of occupancy | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 03-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1009 hPa | Power: 3 VDC |
| Remarks: | | | |

## 7.4 Average time of occupancy

### 7.4.1 General

This test was performed to calculate the average time of occupancy (dwell time) on any frequency channel of the EUT. Specification test limits are given in Table 7.4.1.

**Table 7.4.1 Average time of occupancy limits**

| Assigned frequency range, MHz | Maximum average time of occupancy, s | Investigated period, s | Number of hopping frequencies |
|---|---|---|---|
| 902.0 – 928.0 | 0.4 | 20.0 | ≥ 50 |
| 902.0 – 928.0 | 0.4 | 10.0 | < 50 |
| 2400.0 – 2483.5 | 0.4 | 0.4 × N | N (≥ 15) |
| 5725.0 – 5850.0 | 0.4 | 30.0 | ≥ 75 |

### 7.4.2 Test procedure

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

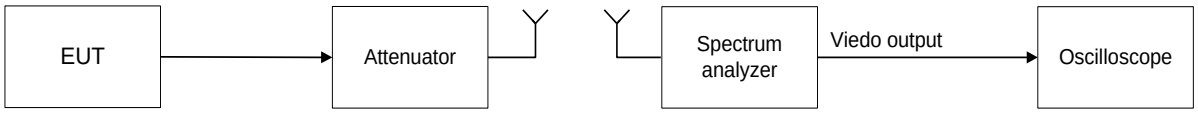
**7.4.2.2** The spectrum analyzer span was set to zero centered on a hopping channel.

**7.4.2.3** The single transmission duration and period were measured with oscilloscope.

**7.4.2.4** The average time of occupancy was calculated as the single transmission time multiplied by the investigated period and divided by the single transmission period.

**7.4.2.5** The test was repeated at each data rate and modulation type as provided in Table 7.4.2 and associated plots.

**Figure 7.4.1 Average time of occupancy test setup**



| **Test specification:** | **Section 15.247(a)1, Average time of occupancy** | | |
|---|---|---|---|
| **Test procedure:** | Public notice DA 00-705 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 03-Apr-18 | | |
| **Temperature:** 23 ºC | **Relative Humidity:** 55 % | **Air Pressure:** 1009 hPa | **Power:** 3 VDC |
| **Remarks:** | | | |

**Table 7.4.2 Average time of occupancy test results**

ASSIGNED FREQUENCY: 902-928 MHz
MODULATION: GFSK
DETECTOR USED: Peak
NUMBER OF HOPPING FREQUENCIES: 50
INVESTIGATED PERIOD: 20s
FREQUENCY HOPPING: Enabled

| Carrier frequency, MHz | Single transmission duration, ms | Number transmission during 20 s | Average time of occupancy*, s | Bit rate, kbps | Symbol rate, Msymbol/s | Limit, s | Margin, s** | Verdict |
|---|---|---|---|---|---|---|---|---|
| 915.863 | 4.0 | 1 | 0.004 | 50 | NA | 0.4 | -0.396 | Pass |

* - Average time of occupancy = (Single transmission duration × Investigated period) / (Single transmission period × number of hopping channels).
** - Margin = Average time of occupancy – specification limit.

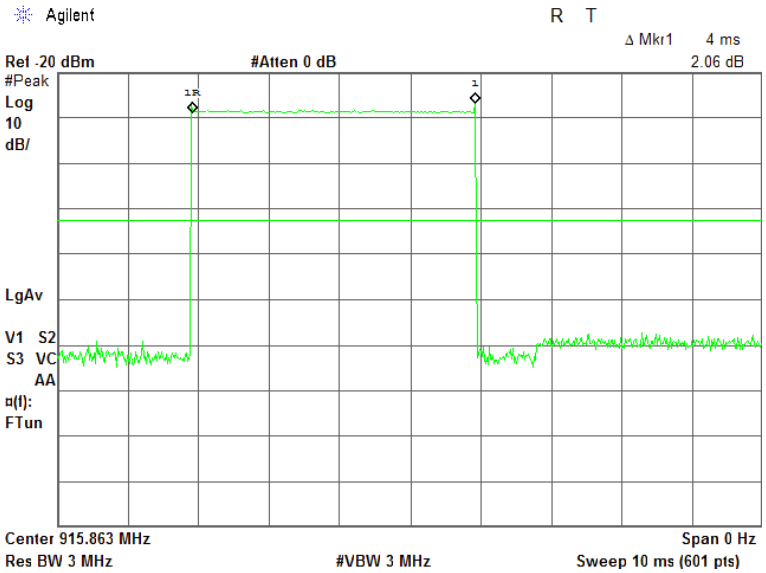
**Reference numbers of test equipment used**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HL 3818 | | | | | | | |

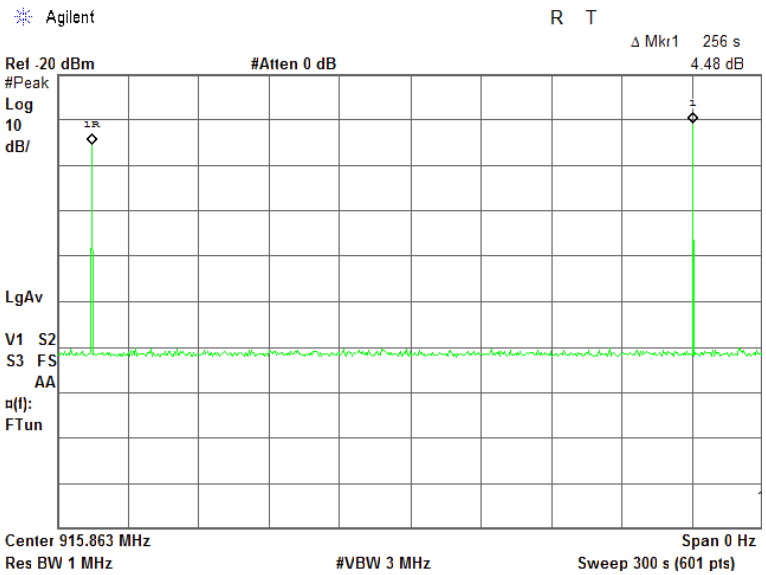
Full description is given in Appendix A.

| Test specification: | Section 15.247(a)1, Average time of occupancy | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 03-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1009 hPa | Power: 3 VDC |
| Remarks: | | | |

**Plot 7.4.1 Single transmission duration**




**Plot 7.4.2 Number transmission**



| **Test specification:** | **Section 15.247(b), Peak output power** | | |
|---|---|---|---|
| **Test procedure:** | Public notice DA 00-705 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 28-Mar-18 | | |
| **Temperature:** 23 ºC | **Relative Humidity:** 48 % | **Air Pressure:** 1007 hPa | **Power:** 3 VDC |
| **Remarks:** | | | |

## 7.5 Peak output power

### 7.5.1 General

This test was performed to measure the maximum peak output power radiated by transmitter. Specification test limits are given in Table 7.5.1.

**Table 7.5.1 Peak output power limits**

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

*- Equivalent field strength limit was calculated from the peak output power as follows: E=sqrt(30×P×G)/r, where *P* is peak output power in Watts, *r* is antenna to EUT distance in meters and *G* is transmitter antenna gain in dBi.
**- The limit is provided in terms of conducted RF power at the antenna connector. If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power limit shall be reduced below the stated value as follows:

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

### 7.5.2 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 EUT was adjusted to produce maximum available to end user RF output power.

**7.5.2.3** The frequency span of spectrum analyzer was set approximately 5 times wider than 20 dB bandwidth of the EUT and the resolution bandwidth was set wider than 20 dB bandwidth of the EUT. To find maximum radiation the turntable was rotated $360^0$ and the measuring antenna height was swept in both vertical and horizontal polarizations.

**7.5.2.4** The maximum field strength of the EUT carrier frequency was measured as provided in Table 7.5.2 and associated plots.

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

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

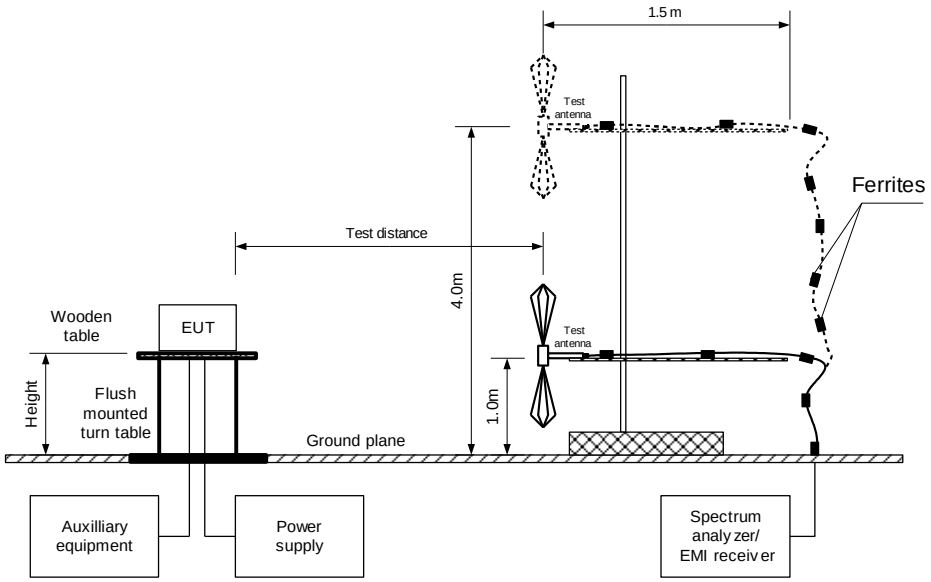
where P is the peak output power in W, E is the field strength in V/m, d is the test distance and G is the transmitter numeric antenna gain over an isotropic radiator.
The above equation was converted in logarithmic units for 3 m test distance:

Peak output power in dBm = Field strength in dB(μV/m) - Transmitter antenna gain in dBi – 95.2 dB

**7.5.2.6** The worst test results (the lowest margins) were recorded in Table 7.5.2.

| **Test specification:** | **Section 15.247(b), Peak output power** | | |
|---|---|---|---|
| **Test procedure:** | Public notice DA 00-705 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 28-Mar-18 | | |
| **Temperature:** 23 ºC | **Relative Humidity:** 48 % | **Air Pressure:** 1007 hPa | **Power:** 3 VDC |
| **Remarks:** | | | |

**Figure 7.5.1 Setup for carrier field strength measurements**



| **Test specification:** | **Section 15.247(b), Peak output power** | | |
|---|---|---|---|
| **Test procedure:** | Public notice DA 00-705 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 28-Mar-18 | | |
| **Temperature:** 23 ºC | **Relative Humidity:** 48 % | **Air Pressure:** 1007 hPa | **Power:** 3 VDC |
| **Remarks:** | | | |

**Table 7.5.2 Peak output power test results**

ASSIGNED FREQUENCY: 902-928 MHz
TEST DISTANCE: 3 m
TEST SITE: Semi anechoic chamber
DETECTOR USED: Peak
TEST ANTENNA TYPE: Biconilog (30 MHz – 1000 MHz)
MODULATION: GFSK
BIT RATE: 50 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
DETECTOR USED: Peak
EUT 20 dB BANDWIDTH: 104.28 kHz
RESOLUTION BANDWIDTH: 1 MHz
VIDEO BANDWIDTH: More than RBW
FREQUENCY HOPPING: Disabled
NUMBER OF FREQUENCY HOPPING CHANNELS: 50

| Frequency, MHz | Field strength, dB(µV/m) | Antenna polarization | Antenna height, m | Azimuth, degrees* | EUT antenna gain, dBi | Peak output power, dBm** | Limit, dBm | Margin, dB*** | Verdict |
|---|---|---|---|---|---|---|---|---|---|
| 912.7518 | 106.86 | Horizontal | 1.45 | 175.0 | -1 | 12.66 | 30 | -17.34 | Pass |
| 915.8683 | 110.37 | Horizontal | 1.96 | -180.0 | -1 | 16.17 | 30 | -13.83 | Pass |
| 919.1194 | 108.19 | Horizontal | 1.95 | -169.0 | -1 | 13.99 | 30 | -16.01 | Pass |

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

******- Peak output power was calculated from the field strength of carrier as follows: $P = (E \times d)^2 / (30 \times G)$,

where P is the peak output power in W, E is the field strength in V/m, d is the test distance in meters and G is the transmitter numeric antenna gain over an isotropic radiator. The above equation was converted in logarithmic units for 3 m test distance:

*Peak output power in dBm = Field strength in dB(µV/m) - Transmitter antenna gain in dBi – 95.2 dB*

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

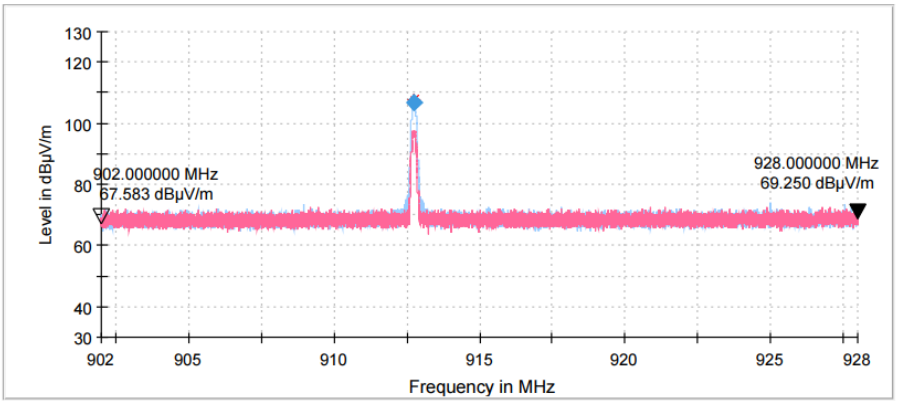
**Reference numbers of test equipment used**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HL 3615 | HL 4277 | HL 4360 | HL 5288 | | | | |

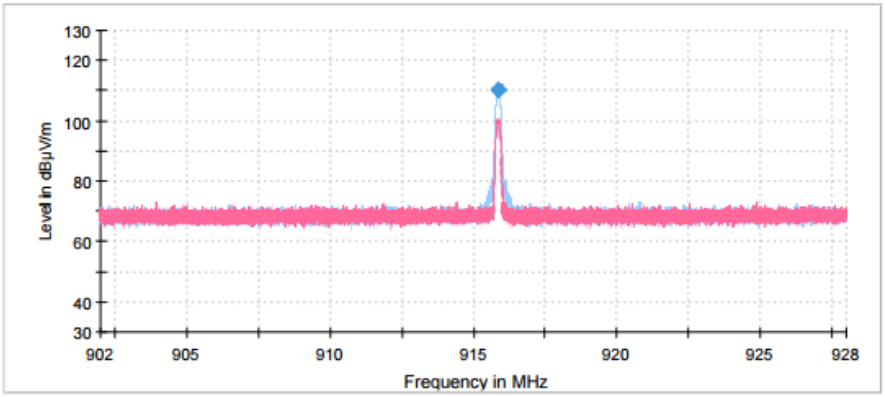
Full description is given in Appendix A.

| Test specification: | Section 15.247(b), Peak output power | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 28-Mar-18 | | |
| Temperature: 23 ºC | Relative Humidity: 48 % | Air Pressure: 1007 hPa | Power: 3 VDC |
| Remarks: | | | |

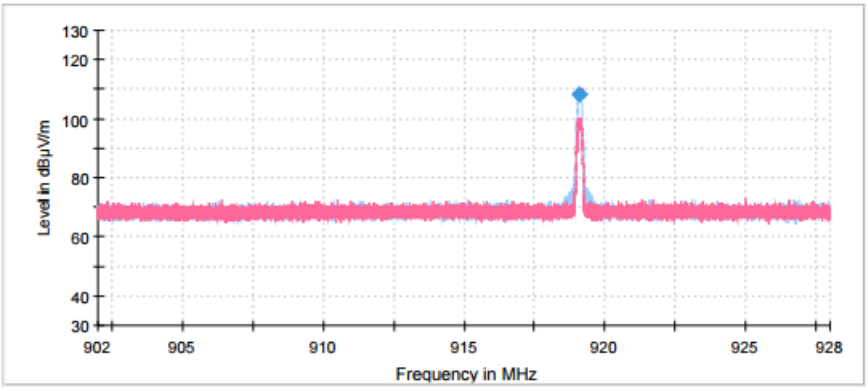
**Plot 7.5.1 Field strength of carrier at low frequency**




**Plot 7.5.2 Field strength of carrier at mid frequency**




**Plot 7.5.3 Field strength of carrier at high frequency**



| **Test specification:** | **Section 15.247(c), Radiated spurious emissions** | | |
|---|---|---|---|
| **Test procedure:** | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 08-Apr-18 | | |
| **Temperature:** 23 ºC | **Relative Humidity:** 55 % | **Air Pressure:** 1007 hPa | **Power:** 3 VDC |
| **Remarks:** | | | |

## 7.6 Field strength of spurious emissions

### 7.6.1 General

This test was performed to measure field strength of spurious emissions from the EUT. Specification test limits are given in Table 7.6.1.

**Table 7.6.1 Radiated spurious emissions limits**

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

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

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

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

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

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

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

**7.6.2.1** The EUT was set up as shown in Figure 7.6.1, energized and the performance check was conducted.

**7.6.2.2** 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.

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

### 7.6.3 Test procedure for spurious emission field strength measurements above 30 MHz

**7.6.3.1** The EUT was set up as shown in Figure 7.6.2, Figure 7.6.3, energized and the performance check was conducted.

**7.6.3.2** 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.

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

| Test specification: | Section 15.247(c), Radiated spurious emissions | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 08-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1007 hPa | Power: 3 VDC |
| Remarks: | | | |

**Figure 7.6.1 Setup for spurious emission field strength measurements below 30 MHz**

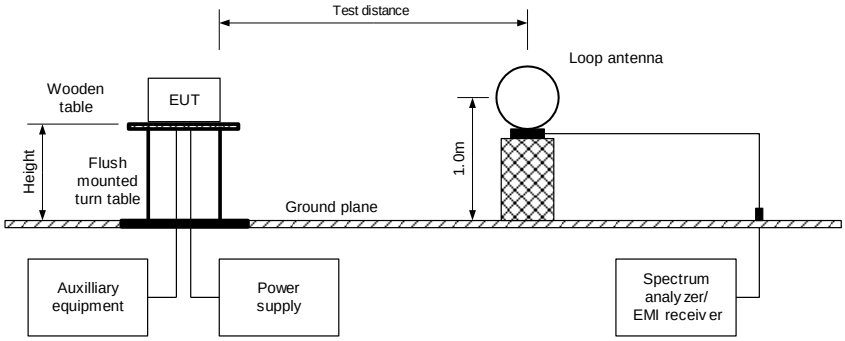



**Figure 7.6.2 Setup for spurious emission field strength measurements from 30 to 1000 MHz**

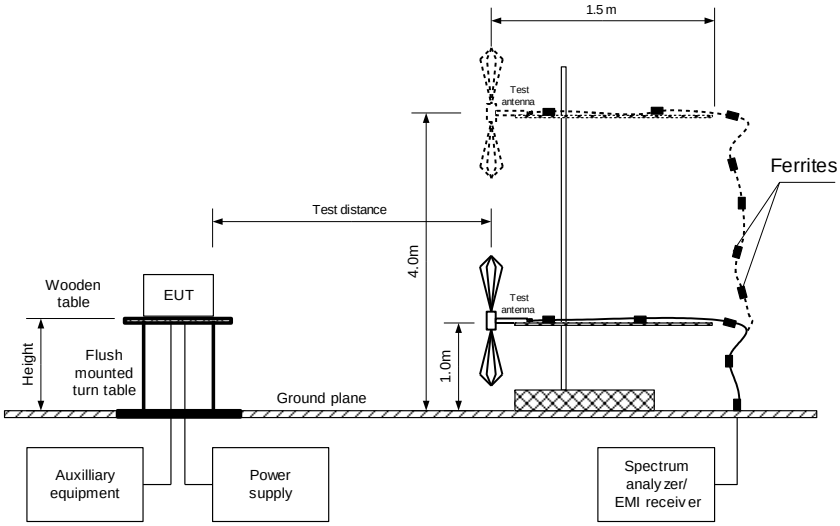
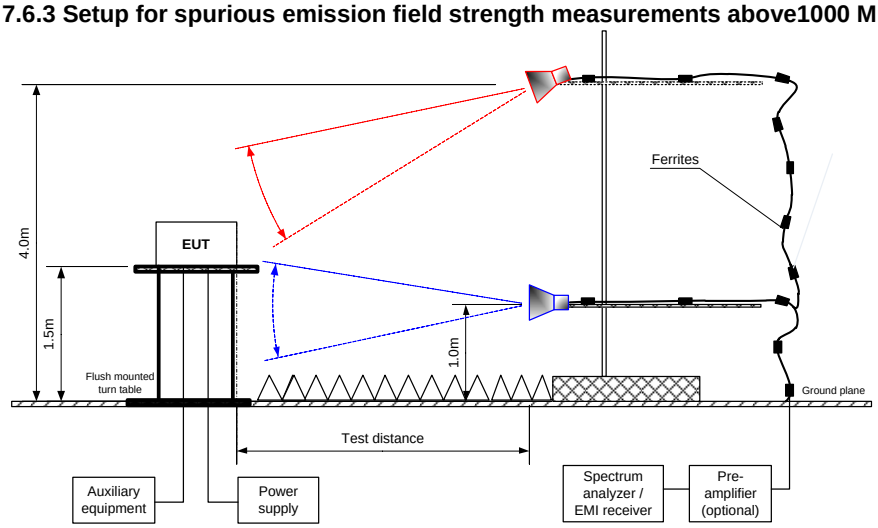



**Figure 7.6.3 Setup for spurious emission field strength measurements above1000 MHz**



| **Test specification:** | **Section 15.247(c), Radiated spurious emissions** | | |
|---|---|---|---|
| **Test procedure:** | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 08-Apr-18 | | |
| **Temperature:** 23 ºC | **Relative Humidity:** 55 % | **Air Pressure:** 1007 hPa | **Power:** 3 VDC |
| **Remarks:** | | | |

**Table 7.6.2 Field strength of emissions outside restricted bands**

ASSIGNED FREQUENCY: 902-928 MHz
INVESTIGATED FREQUENCY RANGE: 0.009 -10000 MHz
TEST DISTANCE: 3 m
MODULATION: GFSK
BIT RATE: 50 Kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 1 MHz
VIDEO BANDWIDTH: 3 MHz
TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)
FREQUENCY HOPPING: Disabled

| Frequency, MHz | Field strength of spurious, dB(μV/m) | Antenna polarization | Antenna height, m | Azimuth, degrees* | Field strength of carrier, dB(μV/m) | Attenuation below carrier, dBc | Limit, dBc | Margin, dB** | Verdict |
|---|---|---|---|---|---|---|---|---|---|
| **Low carrier frequency** | | | | | | | | | |
| 1825.6675 | 59.69 | H | 1.55 | 39.0 | 106.86 | 47.17 | 20.0 | 27.17 | Pass |
| 5476.3925 | 62.84 | H | 1.55 | -2.0 | | 44.02 | | 24.02 | |
| 6388.9700 | 57.29 | H | 2.09 | -79.0 | | 49.57 | | 29.57 | |
| **Mid carrier frequency** | | | | | | | | | |
| 1831.8100 | 60.14 | H | 2.12 | 15.0 | 110.37 | 50.23 | 20.0 | 30.23 | Pass |
| 5495.3200 | 62.99 | H | 2.67 | 131.0 | | 47.38 | | 27.38 | |
| 6411.0300 | 59.34 | H | 1.38 | 139.0 | | 51.03 | | 31.03 | |
| **High carrier frequency** | | | | | | | | | |
| 1838.2450 | 56.86 | H | 1.29 | 174.0 | 108.19 | 51.35 | 20.0 | 31.35 | Pass |
| 5514.8325 | 59.43 | H | 2.68 | 125.0 | | 48.76 | | 28.76 | |

*****- EUT front panel refers to 0 degrees position of turntable.
******- Margin = Attenuation below carrier – specification limit.

**Reference numbers of test equipment used**

| HL 1915 | HL 3615 | HL 4277 | HL 4339 | HL 4360 | HL 4933 | HL 5111 | HL 5288 |
|---|---|---|---|---|---|---|---|

Full description is given in Appendix A.

| **Test specification:** | **Section 15.247(c), Radiated spurious emissions** | | |
|---|---|---|---|
| **Test procedure:** | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 08-Apr-18 | | |
| **Temperature:** 23 ºC | **Relative Humidity:** 55 % | **Air Pressure:** 1007 hPa | **Power:** 3 VDC |
| **Remarks:** | | | |

**Table 7.6.3 Field strength of spurious emissions above 1 GHz within restricted bands**

ASSIGNED FREQUENCY: 902-928 MHz
INVESTIGATED FREQUENCY RANGE: 1000 – 10000 MHz
TEST DISTANCE: 3 m
MODULATION: GFSK
BIT RATE: 50 Kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 1000 kHz
TEST ANTENNA TYPE: Double ridged guide
FREQUENCY HOPPING: Disabled

| Frequency, MHz | Antenna | | Azimuth, degrees* | Peak field strength(VBW=3 MHz) | | | Average field strength | | | | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Polarization | Height, m | | Measured, dB(μV/m) | Limit, dB(μV/m) | Margin, dB** | Measured, dB(μV/m) | Calculated, dB(μV/m) | Limit, dB(μV/m) | Margin, dB*** | |
| **Low carrier frequency** | | | | | | | | | | | |
| 2738.2450 | H | 1.81 | -92.0 | 66.58 | 74.00 | -7.42 | 66.58 | 38.58 | 54.00 | -15.42 | Pass |
| 36508225 | H | 1.56 | -40.0 | 61.63 | 74.00 | -12.37 | 61.63 | 33.63 | 54.00 | -20.37 | |
| 4563.6075 | V | 1.60 | 17.0 | 63.12 | 74.00 | -10.88 | 63.12 | 35.12 | 54.00 | -18.88 | |
| 8214.9175 | V | 1.56 | -30.0 | 57.20 | 74.00 | -16.80 | 57.20 | 29.20 | 54.00 | -24.80 | |
| **Mid carrier frequency** | | | | | | | | | | | |
| 2747.8125 | H | 1.84 | 60.0 | 68.26 | 74.00 | -5.74 | 68.26 | 40.26 | 54.00 | -13.74 | Pass |
| 3663.6075 | H | 2.37 | 111.0 | 66.49 | 74.00 | -7.51 | 66.49 | 38.49 | 54.00 | -15.51 | |
| 4579.5250 | V | 1.57 | 155.0 | 64.32 | 74.00 | -9.68 | 64.32 | 36.32 | 54.00 | -17.68 | |
| 8242.8275 | V | 1.84 | 115.0 | 58.91 | 74.00 | -15.09 | 58.91 | 30.91 | 54.00 | -23.09 | |
| 9158.6225 | V | 2.47 | 135.0 | 60.43 | 74.00 | -13.57 | 60.43 | 32.43 | 54.00 | -21.57 | |
| **High carrier frequency** | | | | | | | | | | | |
| 2757.4650 | H | 1.84 | 39.0 | 65.67 | 74.00 | -8.33 | 65.67 | 37.67 | 54.00 | -16.33 | Pass |
| 3676.3925 | H | 2.12 | 80.0 | 58.49 | 74.00 | -15.51 | 58.49 | 30.49 | 54.00 | -23.51 | |
| 4595.6125 | V | 1.56 | 142.0 | 58.28 | 74.00 | -15.72 | 58.28 | 30.28 | 54.00 | -23.72 | |

*****- EUT front panel refers to 0 degrees position of turntable.
******- Margin = Measured field strength - specification limit.
***- Margin = Calculated field strength - specification limit,
where Calculated field strength = Measured field strength + average factor.

**Table 7.6.4 Average factor calculation**

| Transmission pulse | | Transmission burst | | Transmission train duration, ms | Average factor, dB |
|---|---|---|---|---|---|
| Duration, ms | Number pulses during 100 msec | Duration, ms | Period, ms | | |
| 4 | 1 | NA | NA | NA | -28 |

Average factor for pulse train shorter than 100 ms was calculated as follows:

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

Average factor for pulse train longer than 100 ms was calculated as follows:

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

**Reference numbers of test equipment used**

| HL 3615 | HL 4277 | HL 4339 | HL 4360 | HL 4933 | HL 5111 | HL 5288 | |
|---|---|---|---|---|---|---|---|

Full description is given in Appendix A.

| **Test specification:** | **Section 15.247(c), Radiated spurious emissions** | | |
|---|---|---|---|
| **Test procedure:** | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 08-Apr-18 | | |
| **Temperature:** 23 ºC | **Relative Humidity:** 55 % | **Air Pressure:** 1007 hPa | **Power:** 3 VDC |
| **Remarks:** | | | |

**Table 7.6.5 Field strength of spurious emissions below 1 GHz within restricted bands**

| | |
|---|---|
| ASSIGNED FREQUENCY: | 902-928 MHz |
| INVESTIGATED FREQUENCY RANGE: | 0.009 – 1000 MHz |
| TEST DISTANCE: | 3 m |
| MODULATION: | GFSK |
| BIT RATE: | 50 kbps |
| DUTY CYCLE: | 100 % |
| TRANSMITTER OUTPUT POWER SETTINGS: | Maximum |
| RESOLUTION BANDWIDTH: | 0.2 kHz (9 kHz – 150 kHz)<br>9.0 kHz (150 kHz – 30 MHz)<br>120 kHz (30 MHz – 1000 MHz) |
| VIDEO BANDWIDTH: | > Resolution bandwidth |
| TEST ANTENNA TYPE: | Active loop (9 kHz – 30 MHz)<br>Biconilog (30 MHz – 1000 MHz) |
| FREQUENCY HOPPING: | Disabled |

| **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*** | | | | |
| No spurious emissions have been found | | | | | | | | |

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

**Reference numbers of test equipment used**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HL 1915 | HL 3615 | HL 4277 | HL 4339 | HL 4360 | HL 5111 | HL 5288 | |

Full description is given in Appendix A.

| **Test specification:** | **Section 15.247(c), Radiated spurious emissions** | | |
|---|---|---|---|
| **Test procedure:** | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 08-Apr-18 | | |
| **Temperature:** 23 ºC | **Relative Humidity:** 55 % | **Air Pressure:** 1007 hPa | **Power:** 3 VDC |
| **Remarks:** | | | |

**Table 7.6.6 Restricted bands according to FCC section 15.205**

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

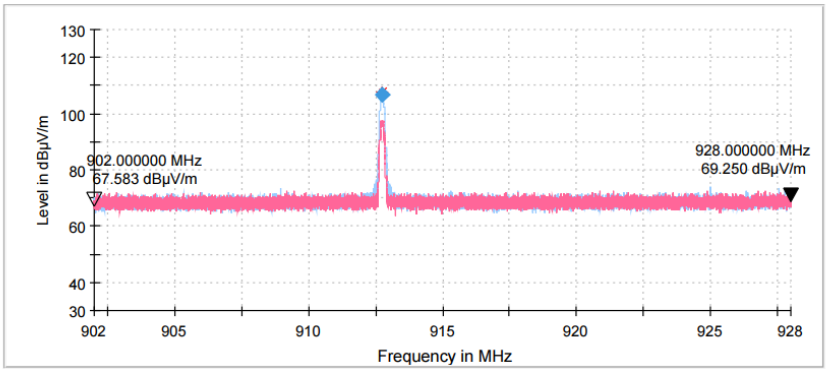
**Table 7.6.7 Restricted bands according to RSS-Gen**

| MHz | MHz | MHz | MHz | MHz | GHz |
|---|---|---|---|---|---|
| 0.09 - 0.11 | 8.291 - 8.294 | 16.80425 - 16.80475 | 399.9 - 410 | 3260 - 3267 | 10.6 - 12.7 |
| 2.1735 - 2.1905 | 8.362 - 8.366 | 25.5 - 25.67 | 608 - 614 | 3332 – 3339 | 13.25 - 13.4 |
| 3.020 – 3.026 | 8.37625 - 8.38675 | 37.5 - 38.25 | 960 – 1427 | 3345.8 – 3358 | 14.47 – 14.5 |
| 4.125 – 4.128 | 8.41425 - 8.41475 | 73 - 74.6 | 1435 – 1626.5 | 3500 – 4400 | 15.35 – 16.2 |
| 4.17725 – 4.17775 | 12.29 – 12.293 | 74.8 - 75.2 | 1645.5 – 1646.5 | 4500 – 5150 | 17.7 – 21.4 |
| 4.20725 – 4.20775 | 12.51975 – 12.52025 | 108 – 138 | 1660 - 1710 | 5350 – 5460 | 22.01 – 23.12 |
| 5.677 – 5.683 | 12.57675 – 12.57725 | 156.52475 – 156.52525 | 1718.8 - 1722.2 | 7250 - 7750 | 23.6 - 24 |
| 6.215 - 6.218 | 13.36 – 13.41 | 156.7 - 156.9 | 2200 - 2300 | 8025 – 8500 | 31.2 - 31.8 |
| 6.26775 - 6.26825 | 16.42 - 16.423 | 240 - 285 | 2310 - 2390 | 9000 - 9200 | 36.43 - 36.5 |
| 6.31175 - 6.31225 | 16.69475 - 16.69525 | 322 - 335.4 | 2655 - 2900 | 9300 - 9500 | Above 38.6 |

| Test specification: | Section 15.247(c), Radiated spurious emissions | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 08-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1007 hPa | Power: 3 VDC |
| Remarks: | | | |

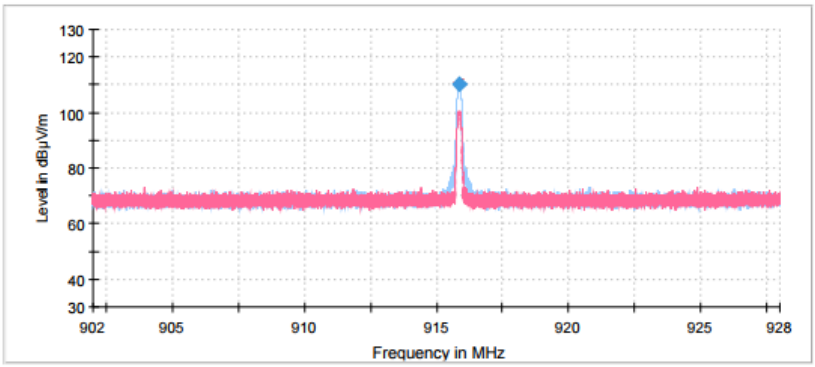
**Plot 7.6.1 Radiated emission measurements at the low carrier frequency**

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



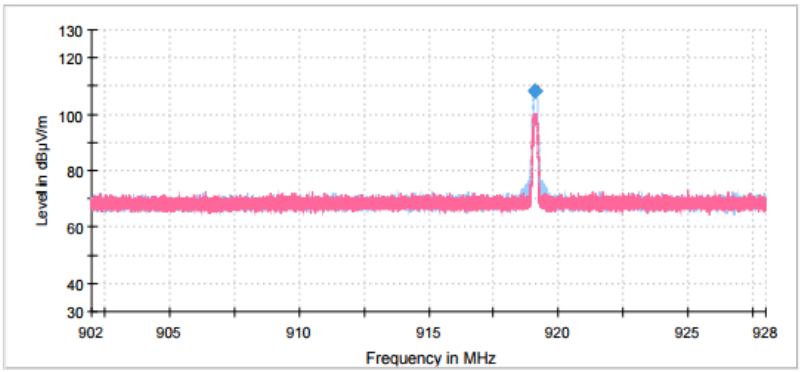

**Plot 7.6.2 Radiated emission measurements at the mid carrier frequency**

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




**Plot 7.6.3 Radiated emission measurements at the high carrier frequency**

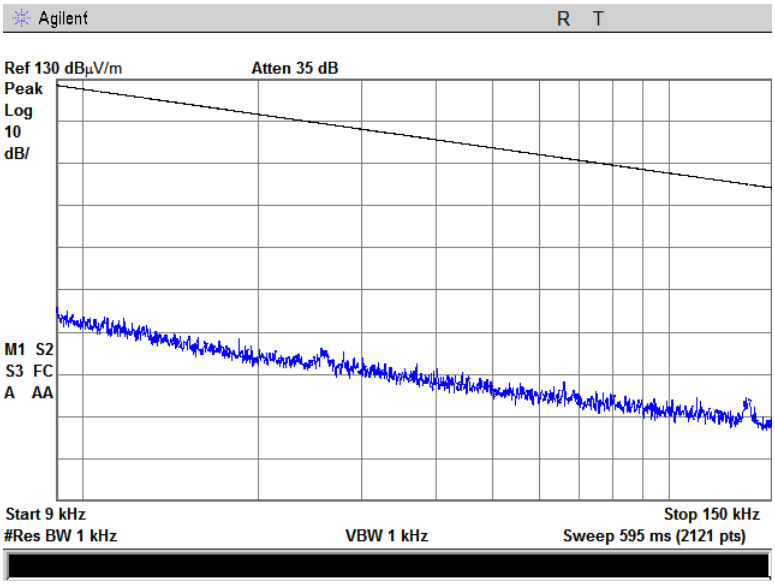
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



| Test specification: | Section 15.247(c), Radiated spurious emissions | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 08-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1007 hPa | Power: 3 VDC |
| Remarks: | | | |

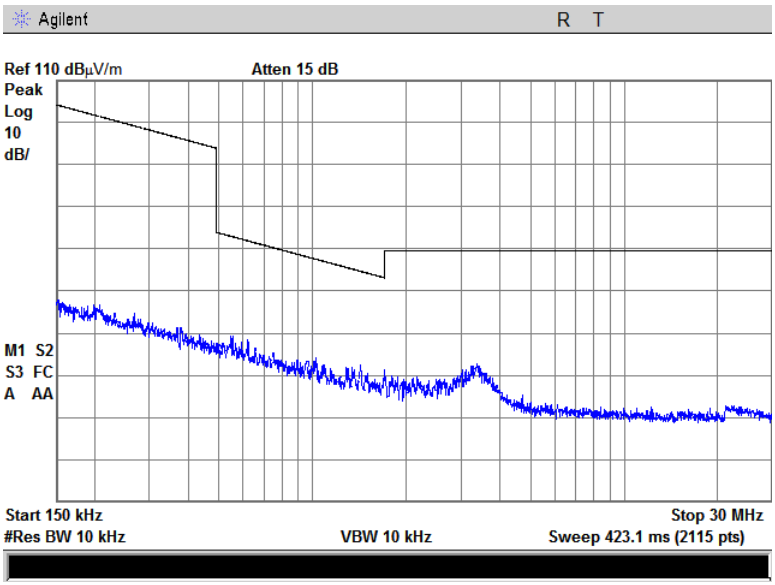
**Plot 7.6.4 Radiated emission measurements from 9 to 150 kHz at the low, mid and high carrier frequency**

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m




**Plot 7.6.5 Radiated emission measurements from 0.15 to 30 MHz at the low, mid and high carrier frequency**

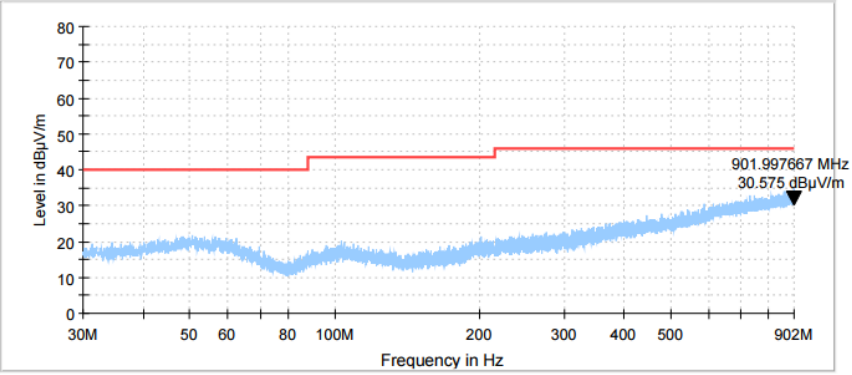
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



| Test specification: | Section 15.247(c), Radiated spurious emissions | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 08-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1007 hPa | Power: 3 VDC |
| Remarks: | | | |

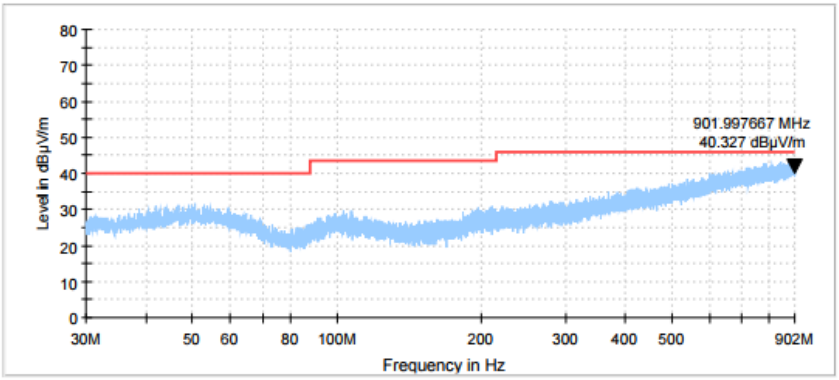
**Plot 7.6.6 Radiated emission measurements from 30 to 902 MHz at the low carrier frequency**

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



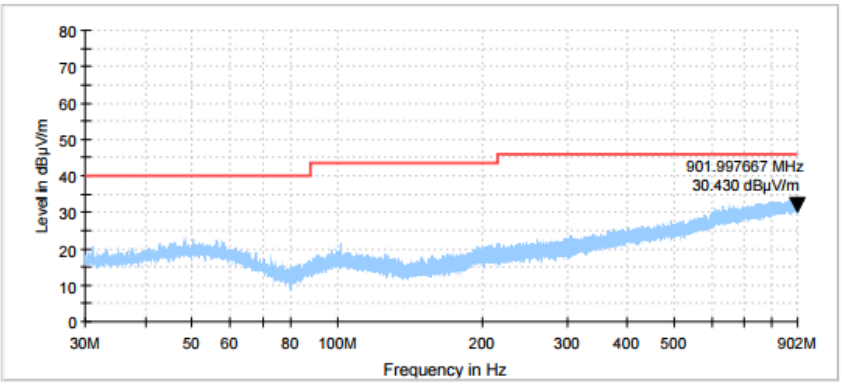

**Plot 7.6.7 Radiated emission measurements from 30 to 902 MHz at the mid carrier frequency**

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




**Plot 7.6.8 Radiated emission measurements from 30 to 902 MHz at the high carrier frequency**

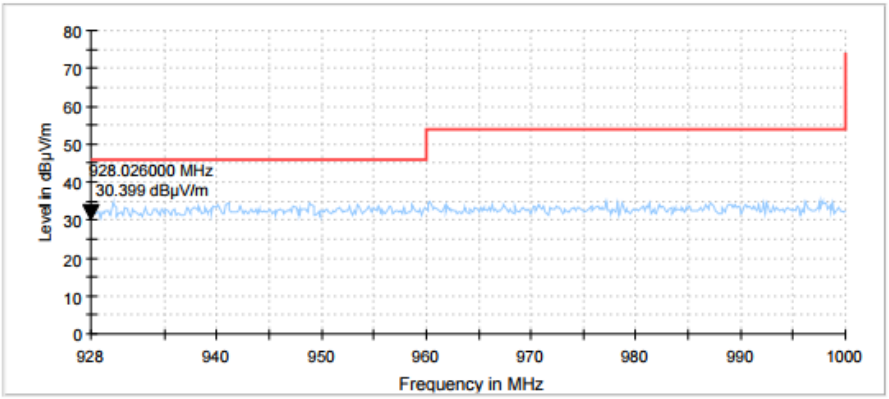
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



| Test specification: | Section 15.247(c), Radiated spurious emissions | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 08-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1007 hPa | Power: 3 VDC |
| Remarks: | | | |

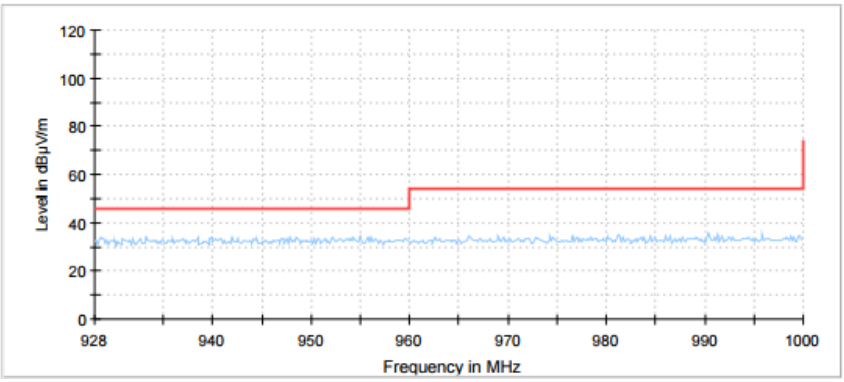
**Plot 7.6.9 Radiated emission measurements from 928 to 1000 MHz at the low carrier frequency**

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



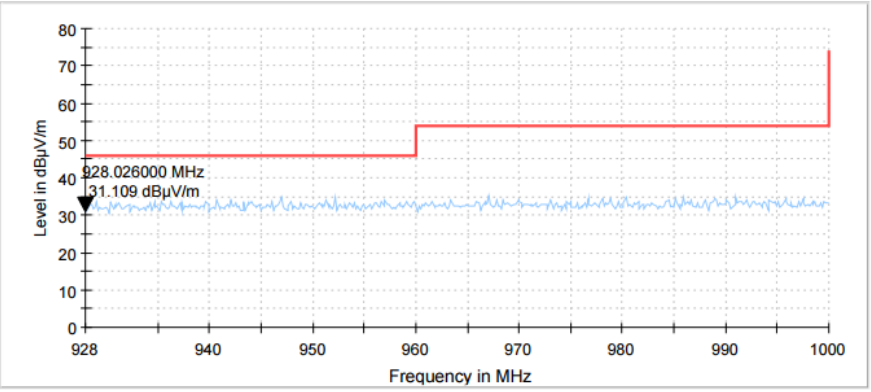

**Plot 7.6.10 Radiated emission measurements from 928 to 1000 MHz at the mid carrier frequency**

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




**Plot 7.6.11 Radiated emission measurements from 928 to 1000 MHz at the high carrier frequency**

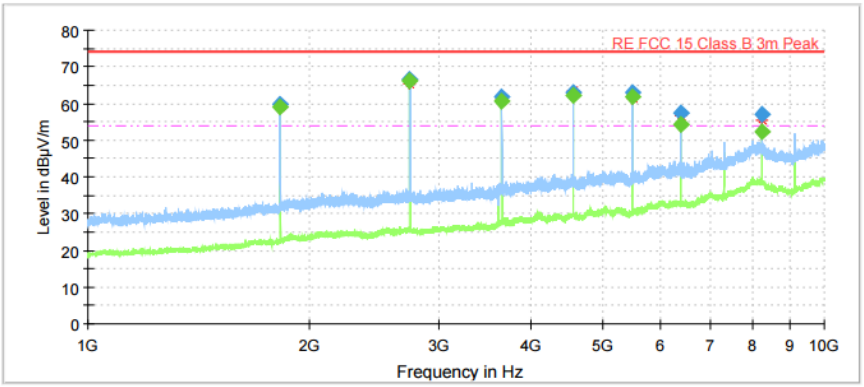
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



| Test specification: | Section 15.247(c), Radiated spurious emissions | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 08-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1007 hPa | Power: 3 VDC |
| Remarks: | | | |

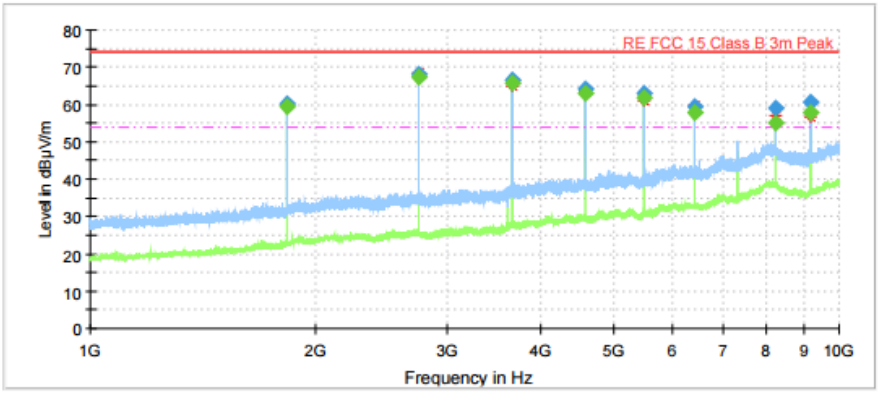
**Plot 7.6.12 Radiated emission measurements from 1000 to 10000 MHz at the low carrier frequency**

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




**Plot 7.6.13 Radiated emission measurements from 1000 to 10000 MHz at the mid carrier frequency**

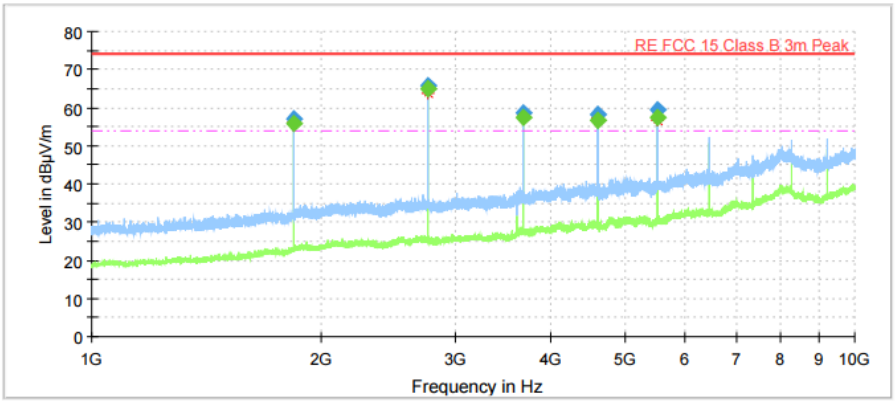
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



| Test specification: | Section 15.247(c), Radiated spurious emissions | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 08-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1007 hPa | Power: 3 VDC |
| Remarks: | | | |

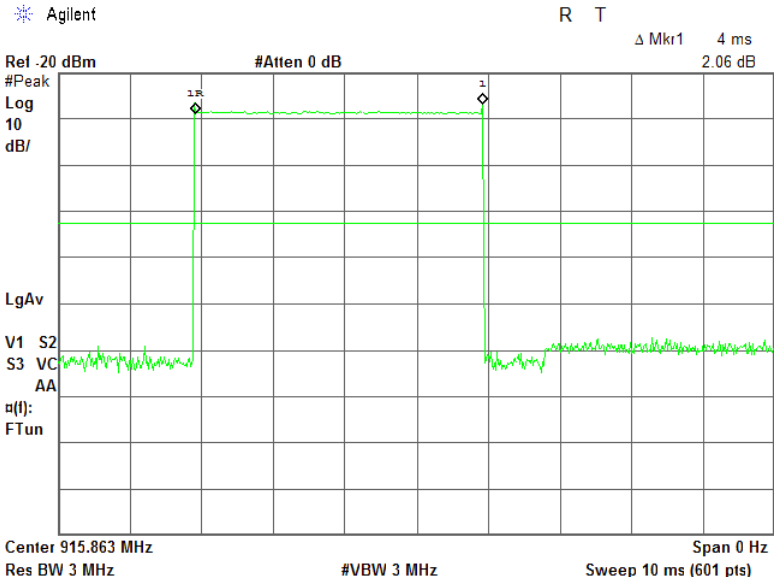
**Plot 7.6.14 Radiated emission measurements from 1000 to 10000 MHz at the high carrier frequency**

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

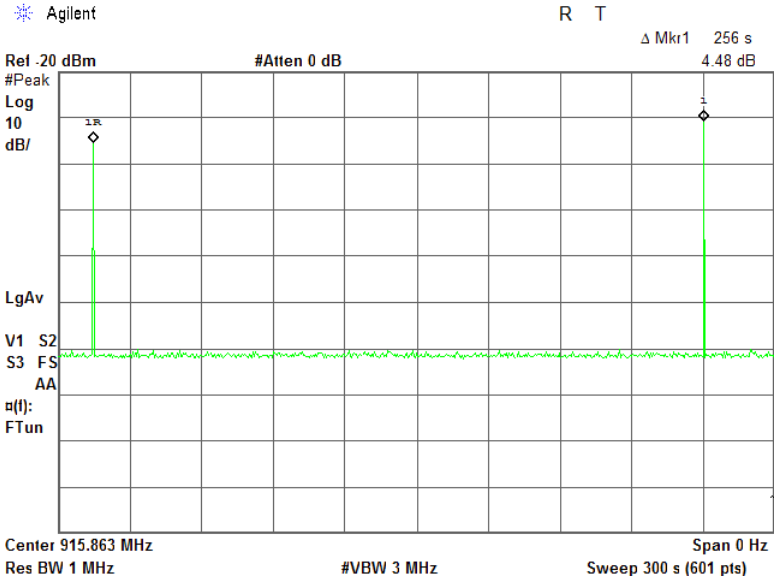


| Test specification: | Section 15.247(c), Radiated spurious emissions | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705/ 47 CFR, Section 15.247(c) / ANSI C63.4, Section 13.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 08-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1007 hPa | Power: 3 VDC |
| Remarks: | | | |

**Plot 7.6.15 Transmission pulse duration**




**Plot 7.6.16 Transmission pulse period**



| Test specification: | Section 15.247(c), Emissions at band edges | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 02-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1010 hPa | Power: 3 VDC |
| Remarks: | | | |

## 7.7 Band edge radiated emissions

### 7.7.1 General

This test was performed to measure emissions, radiated from the EUT at the assigned frequency band edges. Specification test limits are given in Table 7.7.1.

**Table 7.7.1 Band edge emission limits**

| Assigned frequency, MHz | Attenuation below carrier*, dBc | Field strength at 3 m within restricted bands, dB(µV/m) | |
|---|---|---|---|
| | | Peak | Average |
| 902.0 – 928.0 | 20.0 | 74.0 | 54.0 |
| 2400.0 – 2483.5 | | | |
| 5725.0 – 5850.0 | | | |

* - Band edge emission limit is provided in terms of attenuation below the peak of modulated carrier measured with the same resolution bandwidth.

### 7.7.2 Test procedure

**7.7.2.1** The EUT was set up as shown in Figure 7.7.1, energized normally modulated at the maximum data rate with its hopping function disabled and its proper operation was checked.

**7.7.2.2** The EUT was adjusted to produce maximum available to end user RF output power at the lowest carrier frequency.

**7.7.2.3** The spectrum analyzer span was set to capture the carrier frequency and associated modulation products. The resolution bandwidth was set wider than 1 % of the frequency span.

**7.7.2.4** The spectrum analyzer was set in max hold mode and allowed trace to stabilize. The highest emission level within the authorized band was measured.

**7.7.2.5** The maximum band edge emission and modulation product outside of the band were measured as provided in Table 7.7.2 and associated plots and referenced to the highest emission level measured within the authorized band.

**7.7.2.6** The above procedure was repeated with the EUT adjusted to produce maximum RF output power at the highest carrier frequency.

**7.7.2.7** The above procedure was repeated with the frequency hopping function enabled.

**Figure 7.7.1 Band edge emission test setup**

| **Test specification:** | **Section 15.247(c), Emissions at band edges** | | |
|---|---|---|---|
| **Test procedure:** | Public notice DA 00-705 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 02-Apr-18 | | |
| **Temperature:** 23 ºC | **Relative Humidity:** 55 % | **Air Pressure:** 1010 hPa | **Power:** 3 VDC |
| **Remarks:** | | | |

**Table 7.7.2 Band edge emission test results**

ASSIGNED FREQUENCY RANGE: 902-928 MHz
DETECTOR USED: Peak
MODULATION: GFSK
BIT RATE: 50 kbps
RESOLUTION BANDWIDTH: ≥ 1% of the span
VIDEO BANDWIDTH: ≥ RBW

| Frequency, MHz | Band edge emission, dBm | Emission at carrier, dBm | Attenuation below carrier, dBc | Limit, dBc | Margin, dB* | Verdict |
|---|---|---|---|---|---|---|
| **Frequency hopping disabled** | | | | | | |
| 902 | -87.30 | -26.20 | 61.10 | 20.0 | 41.10 | Pass |
| 928 | -87.77 | -24.89 | 62.88 | | 42.88 | |
| **Frequency hopping enabled** | | | | | | |
| 902 | -88.74 | -28.86 | 59.88 | 20.0 | 39.88 | Pass |
| 928 | -88.21 | -27.28 | 60.93 | | 40.93 | |

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

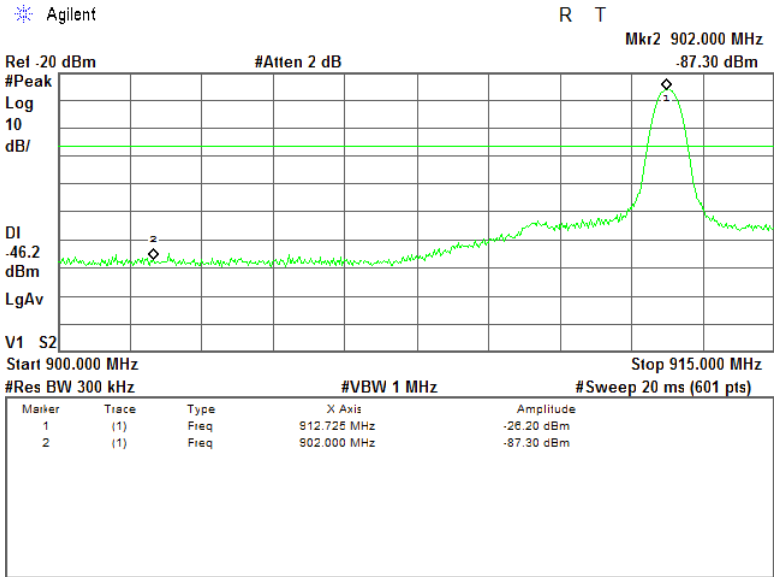
**Reference numbers of test equipment used**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HL 3818 | | | | | | | |

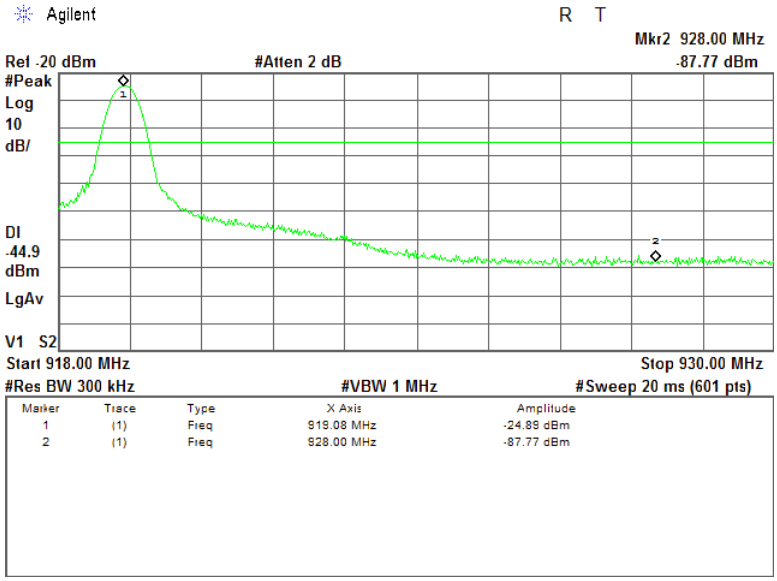
Full description is given in Appendix A.

| Test specification: | Section 15.247(c), Emissions at band edges | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 02-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1010 hPa | Power: 3 VDC |
| Remarks: | | | |

**Plot 7.7.1 The highest band edge emission at low carrier frequency with hopping function disabled**

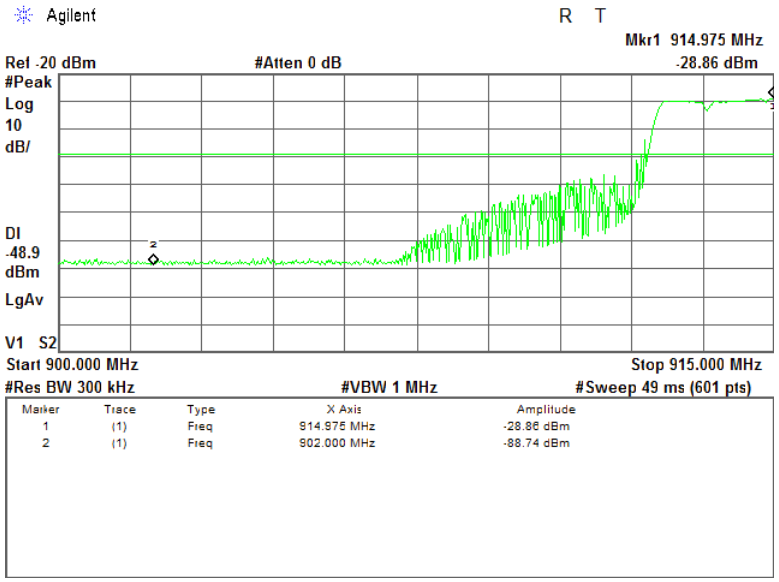



**Plot 7.7.2 The highest band edge emission at high carrier frequency with hopping function disabled**

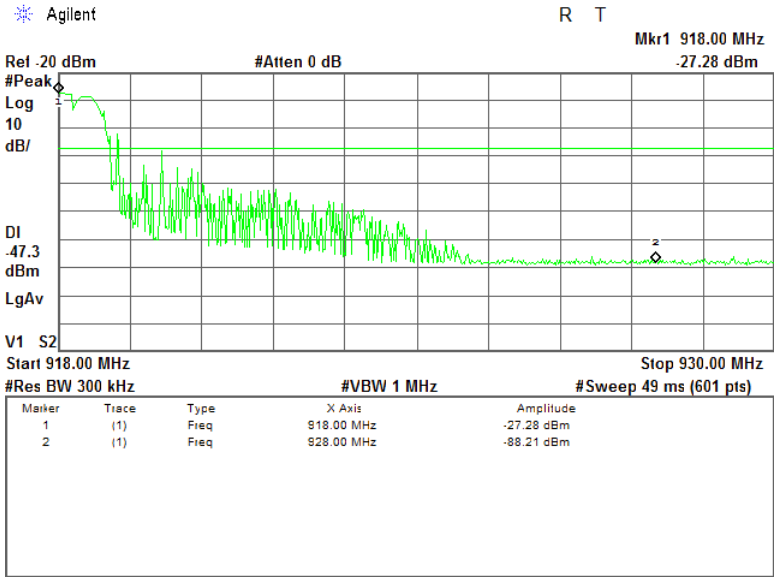


| Test specification: | Section 15.247(c), Emissions at band edges | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 02-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1010 hPa | Power: 3 VDC |
| Remarks: | | | |

**Plot 7.7.3 The highest band edge emission at low carrier frequency with hopping function enabled**




**Plot 7.7.4 The highest band edge emission at high carrier frequency with hopping function enabled**



| Test specification: | Section 15.203, Antenna requirements | | |
|---|---|---|---|
| Test procedure: | Public notice DA 00-705 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 09-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1010 hPa | Power: |
| Remarks: | | | |

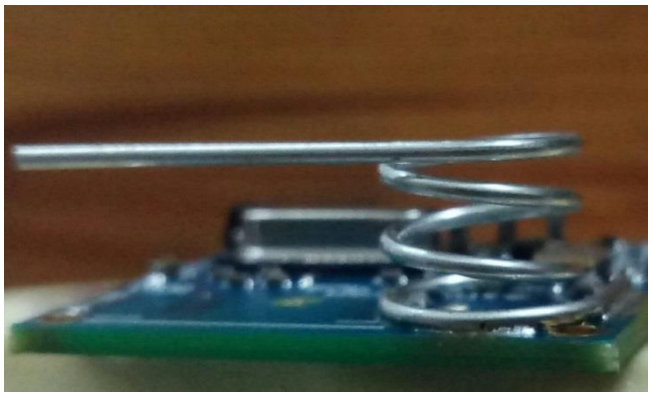
## 7.8 Antenna requirements

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 7.8.1.

**Table 7.8.1 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 7.8.1 Antenna assembly**



| **Test specification:** | **Section 15.109, Radiated emission** | | |
|---|---|---|---|
| **Test procedure:** | ANSI C63.4, Sections 11.6 and 12.1.4 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 10-Apr-18 | | |
| **Temperature:** 23 ºC | **Relative Humidity:** 55 % | **Air Pressure:** 1010 hPa | **Power:** 3 VDC |
| **Remarks:** | | | |

# 8 Unintentional emissions

## 8.1 Radiated emission measurements

### 8.1.1 General

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

**Table 8.1.1 Radiated emission test limits**

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

* The limit for test distance other than specified was calculated using the inverse linear distance extrapolation factor as follows: $Lim_{S2} = Lim_{S1} + 20 \log (S_1/S_2)$,
where $S_1$ and $S_2$ – standard defined and test distance respectively in meters.

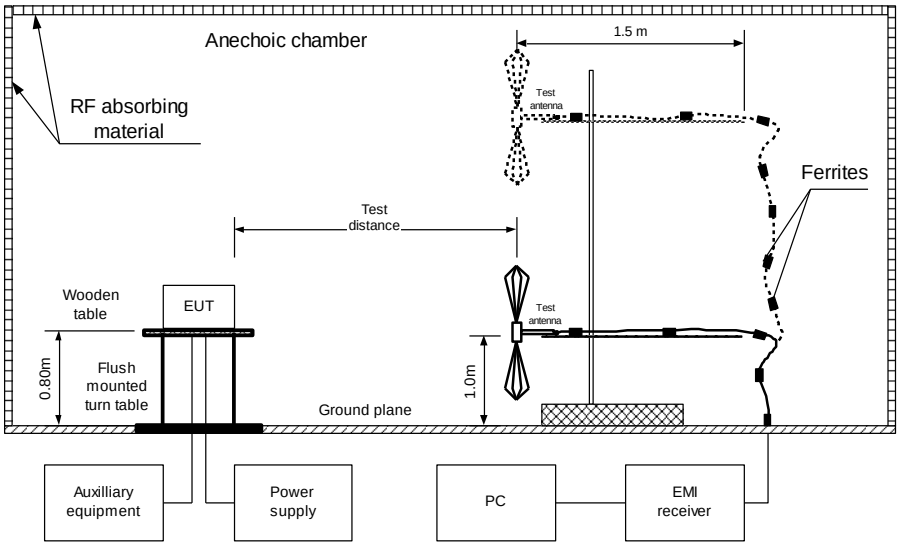
### 8.1.2 Test procedure for measurements in semi-anechoic chamber

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

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

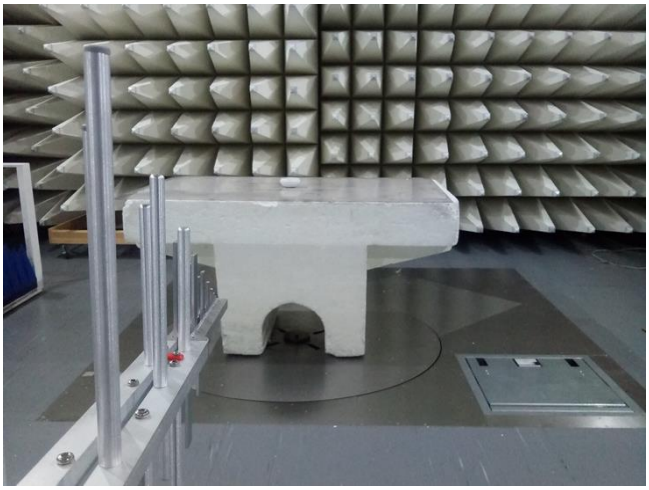
**8.1.2.3** The worst test results (the lowest margins) were recorded in Table 8.1.2 and shown in the associated plots.

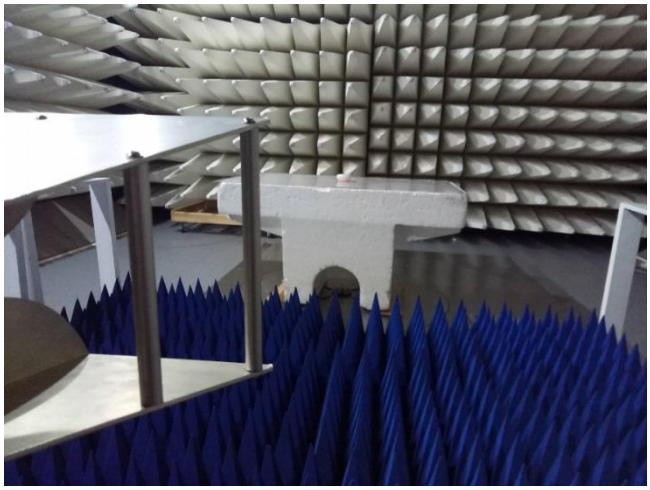
**Figure 8.1.1 Setup for radiated emission measurements in anechoic chamber, table-top equipment**



| Test specification: | Section 15.109, Radiated emission | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Sections 11.6 and 12.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 10-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1010 hPa | Power: 3 VDC |
| Remarks: | | | |

**Photograph 8.1.1 Setup for final radiated emission measurements, general view**





**Photograph 8.1.2 Setup for final radiated emission measurements, EUT cabling**

| **Test specification:** | **Section 15.109, Radiated emission** | | |
|---|---|---|---|
| **Test procedure:** | ANSI C63.4, Sections 11.6 and 12.1.4 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 10-Apr-18 | | |
| **Temperature:** 23 ºC | **Relative Humidity:** 55 % | **Air Pressure:** 1010 hPa | **Power:** 3 VDC |
| **Remarks:** | | | |

**Table 8.1.2 Radiated emission test results**

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

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

DETECTORS USED: PEAK / AVERAGE
FREQUENCY RANGE: 1000 MHz – 3000 MHz
RESOLUTION BANDWIDTH: 1000 kHz

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

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

**Reference numbers of test equipment used**

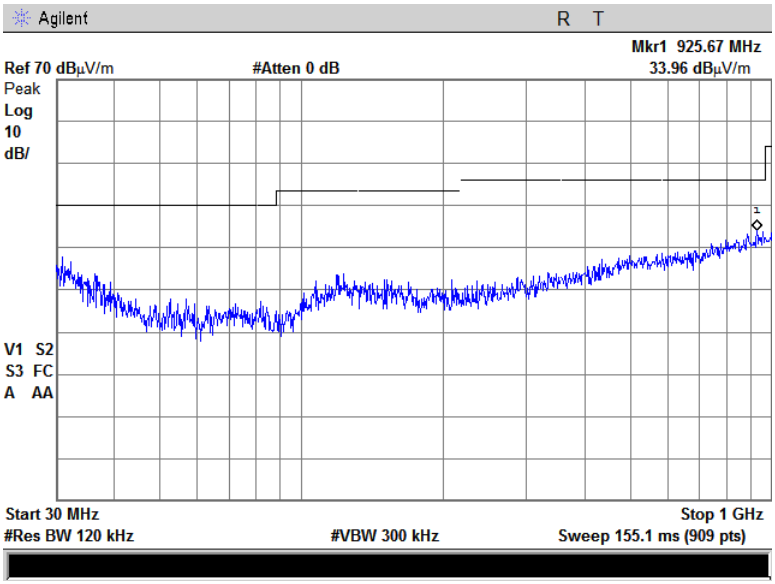
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HL 2697 | HL 3001 | HL 5107 | HL 5110 | | | | |

Full description is given in Appendix A.

| Test specification: | Section 15.109, Radiated emission | | |
|---|---|---|---|
| Test procedure: | ANSI C63.4, Sections 11.6 and 12.1.4 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 10-Apr-18 | | |
| Temperature: 23 ºC | Relative Humidity: 55 % | Air Pressure: 1010 hPa | Power: 3 VDC |
| Remarks: | | | |

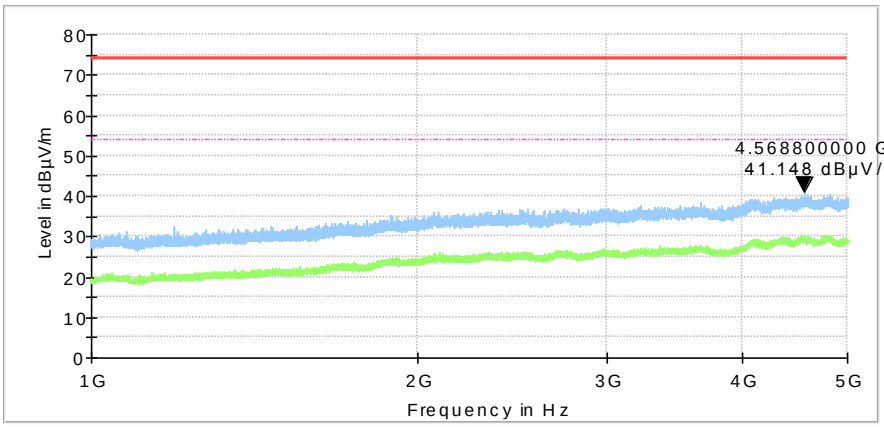
**Plot 8.1.1 Radiated emission measurements in 30 - 1000 MHz range**

| | |
|---|---|
| TEST SITE: | Anechoic chamber |
| LIMIT: | Class B |
| ANTENNA POLARIZATION: | Vertical & Horizontal |
| TEST DISTANCE: | 3 m |
| EUT OPERATING MODE: | Receive |




**Plot 8.1.2 Radiated emission measurements above 1000 MHz, vertical antenna polarization**

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



# 9 APPENDIX A Test equipment and ancillaries used for tests

| HL No | Description | Manufacturer | Model | Ser. No. | Last Cal./ Check | Due Cal./ Check |
|---|---|---|---|---|---|---|
| 1915 | Antenna, Loop, Active Receiving, 1 kHz - 30 MHz | EMC Test Systems | 6507 | 1457 | 11-Feb-18 | 11-Feb-19 |
| 2697 | Antenna, 30 MHz - 3.0 GHz | Sunol Sciences. Corp. | JB3 | A022805 | 12-May-17 | 12-May-18 |
| 3001 | EMC Analyzer, 9 kHz to 3 GHz | Agilent Technologies | E7402A | US39440180 | 09-Oct-17 | 09-Oct-18 |
| 3615 | Cable RF, 6.5 m, N type-N type, DC-6 GHz | Suhner Switzerland | RG 214/U | NA | 04-Jun-17 | 04-Jun-18 |
| 3818 | PSA Series Spectrum Analyzer, 3 Hz-44 GHz | Agilent Technologies | E4446A | MY48250288 | 07-May-17 | 07-May-18 |
| 4136 | Shield Box | TESCOM CO., LTD | TC-5916A | 5916A000137 | 04-Apr-18 | 04-Apr-19 |
| 4277 | Test Cable , DC-18 GHz, 3.05 m, N/M - N/M | Mini-Circuits | APC-10FT-NMNM+ | 0748A | 10-Sep-17 | 10-Sep-18 |
| 4339 | High pass Filter, 50 Ohm, 1000 to 18000 MHz, SMA-FM / SMA-M | Micro-Tronics | HPM50115-02 | 1 | 14-May-17 | 14-May-18 |
| 4360 | EMI Test Receiver, 20 Hz to 40 GHz. | Rohde & Schwarz | ESU40 | 100322 | 26-Dec-17 | 26-Dec-18 |
| 4933 | Active Horn Antenna, 1 GHz to 18 GHz | COM-POWER CORPORATION | AHA-118 | 701046 | 04-Jan-18 | 04-Jan-19 |
| 5107 | RF cable, 18 GHz, 4.5 m, N-type | Huber-Suhner | SF106A/11N/11N/4500MM | 500845/6A | 27-Jul-17 | 27-Jul-18 |
| 5111 | RF cable, 40 GHz, 5.5 m, K-type | Huber-Suhner | SF102EA/11SK/11SK/5500MM | 502493/2EA | 09-Apr-18 | 09-Apr-19 |
| 5288 | Trilog Antenna, 25 MHz - 8 GHz, 100W | Frankonia | ALX-8000E | 809 | 21-Jan-18 | 21-Jan-19 |

# 10 APPENDIX B Test equipment correction factors

**Antenna, Loop, Active Receiving, 1 kHz - 30 MHz**
**EMC Test Systems, model: 6507, s/n 1457**

**HL 1915 Antenna factor**

| Frequency, kHz | Antenna factor, dB/m |
|---|---|
| 9 | -21.8 |
| 10 | -23.0 |
| 20 | -27.3 |
| 50 | -31.3 |
| 75 | -32.0 |
| 100 | -32.2 |
| 150 | -32.5 |
| 250 | -32.8 |
| 500 | -33.1 |
| 750 | -33.2 |

| Frequency, MHz | Antenna factor, dB/m |
|---|---|
| 1000 | -33.3 |
| 2000 | -33.7 |
| 3000 | -34.0 |
| 4000 | -34.3 |
| 5000 | -34.6 |
| 10000 | -35.4 |
| 15000 | -36.0 |
| 20000 | -36.3 |
| 25000 | -37.3 |
| 30000 | -37.8 |

The antenna factor shall be added to receiver reading in dBμV to obtain field strength in dBμV/m.

**Antenna, 30 MHz - 3.0 GHz**
**Sunol Sciences. Corp. Pleasanton, California USA, model: JB3, s/n A022805**

**HL 2697: Antenna factor**

| Frequency, MHz | Antenna factor, dB/m |
|---|---|
| 30 | 21.9 |
| 35 | 18.2 |
| 40 | 14.1 |
| 45 | 10.4 |
| 50 | 8.2 |
| 60 | 8.1 |
| 70 | 8.5 |
| 80 | 7.9 |
| 90 | 7.6 |
| 100 | 9.9 |
| 120 | 14.1 |
| 140 | 13.0 |

| Frequency, MHz | Antenna factor, dB/m |
|---|---|
| 160 | 12.4 |
| 180 | 11.4 |
| 200 | 12.4 |
| 250 | 11.4 |
| 300 | 13.4 |
| 400 | 15.8 |
| 500 | 18.0 |
| 600 | 18.1 |
| 700 | 19.6 |
| 800 | 21.0 |
| 900 | 22.4 |
| 1000 | 23.4 |

The antenna factor shall be added to receiver reading in dBμV to obtain field strength in dBμV/m.

**Active Horn Antenna, 1 GHz to 18 GHz**
**COM-POWER CORPORATION, model: AHA-118, s/n 701046**

**HL 4933: Antenna factor**

| Frequency, MHz | Measured antenna factor (with preamplifier), dB/m |
|---|---|
| 1000 | -16.1 |
| 1500 | -15.1 |
| 2000 | -10.9 |
| 2500 | -11.9 |
| 3000 | -11.1 |
| 3500 | -10.6 |
| 4000 | -8.6 |
| 4500 | -8.3 |
| 5000 | -5.9 |
| 5500 | -5.7 |
| 6000 | -3.3 |
| 6500 | -4.0 |
| 7000 | -2.2 |
| 7500 | -1.7 |
| 8000 | 1.1 |
| 8500 | -0.8 |
| 9000 | -1.5 |
| 9500 | -0.2 |

| Frequency, MHz | Measured antenna factor (with preamplifier), dB/m |
|---|---|
| 10000 | 1.8 |
| 10500 | 1.0 |
| 11000 | 0.3 |
| 11500 | -0.5 |
| 12000 | 3.1 |
| 12500 | 1.4 |
| 13000 | -0.3 |
| 13500 | -0.4 |
| 14000 | 2.5 |
| 14500 | 2.2 |
| 15000 | 1.9 |
| 15500 | 0.5 |
| 16000 | 2.1 |
| 16500 | 1.2 |
| 17000 | 0.6 |
| 17500 | 3.1 |
| 18000 | 4.2 |

The antenna factor shall be added to receiver reading in dBμV to obtain field strength in dBμV/m.

**Trilog Antenna, 25 MHz - 8 GHz, 100W**
**Frankonia, model: ALX-8000E, s/n: 00809**

**HL 5288: Antenna factor**

| Frequency, MHz | Antenna factor, dB/m |
|---|---|
| 1000 | 26.9 |
| 1100 | 28.1 |
| 1200 | 28.4 |
| 1300 | 29.6 |
| 1400 | 29.1 |
| 1500 | 30.4 |
| 1600 | 30.7 |
| 1700 | 31.5 |
| 1800 | 32.3 |
| 1900 | 32.6 |
| 2000 | 32.5 |
| 2100 | 32.9 |
| 2200 | 33.5 |
| 2300 | 33.2 |
| 2400 | 33.7 |
| 2500 | 34.6 |
| 2600 | 34.7 |
| 2700 | 34.6 |
| 2800 | 35.0 |
| 2900 | 35.5 |
| 3000 | 36.2 |
| 3100 | 36.8 |
| 3200 | 36.8 |
| 3300 | 37.0 |
| 3400 | 37.5 |
| 3500 | 38.2 |

| Frequency, MHz | Antenna factor, dB/m |
|---|---|
| 3600 | 38.9 |
| 3700 | 39.4 |
| 3800 | 39.4 |
| 3900 | 39.6 |
| 4000 | 39.7 |
| 4100 | 39.8 |
| 4200 | 40.5 |
| 4300 | 40.9 |
| 4400 | 41.1 |
| 4500 | 41.4 |
| 4600 | 41.3 |
| 4700 | 41.6 |
| 4800 | 41.9 |
| 4900 | 42.3 |
| 5000 | 42.7 |
| 5100 | 43.0 |
| 5200 | 42.9 |
| 5300 | 43.5 |
| 5400 | 43.6 |
| 5500 | 44.3 |
| 5600 | 44.7 |
| 5700 | 45.0 |
| 5800 | 45.0 |
| 5900 | 45.3 |
| 6000 | 45.9 |

The antenna factor shall be added to receiver reading in dBμV to obtain field strength in dBμV/m.

**Cable RF, 6.5 m, N type-N type, DC-6 GHz**
**Suhner Switzerland, model: RG 214/U, s/n: NA**

**HL 3615: Insertion loss**

| Set / Applied, MHz | Measured, dB | Uncertainty, dB |
|---|---|---|
| 50 | 0.31 | +0.08 / -0.08 |
| 100 | 0.45 | +0.08 / -0.08 |
| 200 | 0.66 | +0.08 / -0.08 |
| 300 | 0.83 | +0.09 / -0.09 |
| 400 | 0.98 | +0.09 / -0.09 |
| 500 | 1.12 | +0.09 / -0.09 |
| 600 | 1.26 | +0.09 / -0.09 |
| 700 | 1.38 | +0.09 / -0.09 |
| 800 | 1.50 | +0.09 / -0.09 |
| 900 | 1.63 | +0.09 / -0.09 |
| 1000 | 1.74 | +0.09 / -0.09 |
| 1100 | 1.85 | +0.09 / -0.09 |
| 1200 | 1.97 | +0.09 / -0.09 |
| 1300 | 2.08 | +0.09 / -0.09 |
| 1400 | 2.19 | +0.09 / -0.09 |
| 1500 | 2.30 | +0.09 / -0.09 |
| 1600 | 2.41 | +0.09 / -0.09 |
| 1700 | 2.53 | +0.09 / -0.09 |
| 1800 | 2.63 | +0.09 / -0.09 |
| 1900 | 2.74 | +0.09 / -0.09 |
| 2000 | 2.83 | +0.09 / -0.09 |
| 2100 | 2.93 | +0.11 / -0.11 |
| 2200 | 3.00 | +0.11 / -0.11 |
| 2300 | 3.07 | +0.11 / -0.11 |
| 2400 | 3.13 | +0.11 / -0.11 |
| 2500 | 3.19 | +0.15 / -0.15 |
| 2600 | 3.25 | +0.15 / -0.15 |
| 2700 | 3.33 | +0.15 / -0.15 |
| 2800 | 3.40 | +0.15 / -0.15 |
| 2900 | 3.48 | +0.15 / -0.15 |
| 3000 | 3.57 | +0.15 / -0.15 |
| 3100 | 3.63 | +0.17 / -0.17 |
| 3200 | 3.71 | +0.17 / -0.17 |

| Set / Applied, MHz | Measured, dB | Uncertainty, dB |
|---|---|---|
| 3300 | 3.78 | +0.17 / -0.17 |
| 3400 | 3.88 | +0.17 / -0.17 |
| 3500 | 3.96 | +0.17 / -0.17 |
| 3600 | 4.06 | +0.17 / -0.17 |
| 3700 | 4.15 | +0.17 / -0.17 |
| 3800 | 4.26 | +0.17 / -0.17 |
| 3900 | 4.36 | +0.17 / -0.17 |
| 4000 | 4.48 | +0.17 / -0.17 |
| 4100 | 4.58 | +0.22 / -0.23 |
| 4200 | 4.72 | +0.22 / -0.23 |
| 4300 | 4.80 | +0.22 / -0.23 |
| 4400 | 4.93 | +0.22 / -0.23 |
| 4500 | 5.00 | +0.22 / -0.23 |
| 4600 | 5.10 | +0.22 / -0.23 |
| 4700 | 5.20 | +0.22 / -0.23 |
| 4800 | 5.30 | +0.22 / -0.23 |
| 4900 | 5.43 | +0.22 / -0.23 |
| 5000 | 5.54 | +0.22 / -0.23 |
| 5100 | 5.65 | +0.22 / -0.23 |
| 5200 | 5.73 | +0.22 / -0.23 |
| 5300 | 5.86 | +0.22 / -0.23 |
| 5400 | 5.95 | +0.22 / -0.23 |
| 5500 | 6.05 | +0.22 / -0.23 |
| 5600 | 6.16 | +0.22 / -0.23 |
| 5700 | 6.28 | +0.22 / -0.23 |
| 5800 | 6.38 | +0.22 / -0.23 |
| 5900 | 6.53 | +0.22 / -0.23 |
| 6000 | 6.63 | +0.22 / -0.23 |
| 6100 | 6.75 | +0.22 / -0.23 |
| 6200 | 6.82 | +0.22 / -0.23 |
| 6300 | 6.93 | +0.22 / -0.23 |
| 6400 | 7.00 | +0.22 / -0.23 |
| 6500 | 7.05 | +0.22 / -0.23 |

**Test Cable , DC-18 GHz, 3.05 m, N/M - N/M**
**Mini-Circuits, model: APC-10FT-NMNM+, s/n 0748A**

**HL 4277: Insertion loss**

| Set / Applied, MHz | Measured, dB | Uncertainty, dB |
|---|---|---|
| 0.1 | 0.26 | +0.07 / -0.07 |
| 50 | 0.27 | +0.07 / -0.07 |
| 100 | 0.38 | +0.07 / -0.07 |
| 200 | 0.55 | +0.07 / -0.07 |
| 300 | 0.69 | +0.08 / -0.09 |
| 400 | 0.80 | +0.08 / -0.09 |
| 500 | 0.91 | +0.08 / -0.09 |
| 600 | 1.00 | +0.08 / -0.09 |
| 700 | 1.08 | +0.08 / -0.09 |
| 800 | 1.17 | +0.08 / -0.09 |
| 900 | 1.24 | +0.08 / -0.09 |
| 1000 | 1.32 | +0.08 / -0.09 |
| 1100 | 1.39 | +0.12 / -0.13 |
| 1200 | 1.45 | +0.12 / -0.13 |
| 1300 | 1.52 | +0.12 / -0.13 |
| 1400 | 1.58 | +0.12 / -0.13 |
| 1500 | 1.65 | +0.12 / -0.13 |
| 1600 | 1.71 | +0.12 / -0.13 |
| 1700 | 1.77 | +0.12 / -0.13 |
| 1800 | 1.82 | +0.12 / -0.13 |
| 1900 | 1.88 | +0.12 / -0.13 |
| 2000 | 1.93 | +0.12 / -0.13 |
| 2100 | 1.99 | +0.12 / -0.13 |
| 2200 | 2.05 | +0.12 / -0.13 |
| 2300 | 2.10 | +0.12 / -0.13 |
| 2400 | 2.15 | +0.12 / -0.13 |
| 2500 | 2.20 | +0.17 / -0.18 |
| 2600 | 2.25 | +0.17 / -0.18 |
| 2700 | 2.30 | +0.17 / -0.18 |
| 2800 | 2.35 | +0.17 / -0.18 |
| 2900 | 2.40 | +0.17 / -0.18 |
| 3000 | 2.44 | +0.17 / -0.18 |
| 3100 | 2.49 | +0.19 / -0.2 |
| 3200 | 2.54 | +0.19 / -0.2 |
| 3300 | 2.58 | +0.19 / -0.2 |
| 3400 | 2.62 | +0.19 / -0.2 |
| 3500 | 2.66 | +0.19 / -0.2 |
| 3600 | 2.71 | +0.19 / -0.2 |
| 3700 | 2.75 | +0.19 / -0.2 |
| 3800 | 2.79 | +0.19 / -0.2 |
| 3900 | 2.84 | +0.19 / -0.2 |
| 4000 | 2.88 | +0.19 / -0.2 |

| Set / Applied, MHz | Measured, dB | Uncertainty, dB |
|---|---|---|
| 4100 | 2.84 | +0.19 / -0.2 |
| 4200 | 2.88 | +0.19 / -0.2 |
| 4300 | 2.92 | +0.3 / -0.33 |
| 4400 | 2.96 | +0.3 / -0.33 |
| 4500 | 3.01 | +0.3 / -0.33 |
| 4600 | 3.05 | +0.3 / -0.33 |
| 4700 | 3.09 | +0.3 / -0.33 |
| 4800 | 3.13 | +0.3 / -0.33 |
| 4900 | 3.18 | +0.3 / -0.33 |
| 5000 | 3.21 | +0.3 / -0.33 |
| 5100 | 3.25 | +0.3 / -0.33 |
| 5200 | 3.30 | +0.3 / -0.33 |
| 5300 | 3.34 | +0.3 / -0.33 |
| 5400 | 3.39 | +0.3 / -0.33 |
| 5500 | 3.44 | +0.3 / -0.33 |
| 5600 | 3.48 | +0.3 / -0.33 |
| 5700 | 3.53 | +0.3 / -0.33 |
| 5800 | 3.57 | +0.3 / -0.33 |
| 5900 | 3.60 | +0.3 / -0.33 |
| 6000 | 3.65 | +0.3 / -0.33 |
| 6100 | 3.68 | +0.3 / -0.33 |
| 6200 | 3.72 | +0.3 / -0.33 |
| 6300 | 3.77 | +0.3 / -0.33 |
| 6400 | 3.83 | +0.3 / -0.33 |
| 6500 | 3.86 | +0.3 / -0.33 |
| 6600 | 3.92 | +0.3 / -0.33 |
| 6700 | 3.96 | +0.3 / -0.33 |
| 6800 | 4.00 | +0.3 / -0.33 |
| 6900 | 4.04 | +0.3 / -0.33 |
| 7000 | 4.08 | +0.3 / -0.33 |
| 7100 | 4.11 | +0.3 / -0.33 |
| 7200 | 4.16 | +0.3 / -0.33 |
| 7300 | 4.20 | +0.3 / -0.33 |
| 7400 | 4.24 | +0.3 / -0.33 |
| 7500 | 4.29 | +0.3 / -0.33 |
| 7600 | 4.33 | +0.3 / -0.33 |
| 7700 | 4.38 | +0.3 / -0.33 |
| 7800 | 4.42 | +0.3 / -0.33 |
| 7900 | 4.51 | +0.3 / -0.33 |
| 8000 | 4.52 | +0.3 / -0.33 |
| 8100 | 4.55 | +0.34 / -0.36 |
| 8200 | 4.55 | +0.34 / -0.36 |

**HL 4277: Insertion loss**

| Set / Applied, MHz | Measured, dB | Uncertainty, dB |
|---|---|---|
| 8300 | 4.57 | +0.34 / -0.36 |
| 8400 | 4.60 | +0.34 / -0.36 |
| 8500 | 4.60 | +0.34 / -0.36 |
| 8600 | 4.63 | +0.34 / -0.36 |
| 8700 | 4.63 | +0.34 / -0.36 |
| 8800 | 4.64 | +0.34 / -0.36 |
| 8900 | 4.65 | +0.34 / -0.36 |
| 9000 | 4.67 | +0.34 / -0.36 |
| 9100 | 4.69 | +0.34 / -0.36 |
| 9200 | 4.71 | +0.34 / -0.36 |
| 9300 | 4.73 | +0.34 / -0.36 |
| 9400 | 4.76 | +0.34 / -0.36 |
| 9500 | 4.78 | +0.34 / -0.36 |
| 9600 | 4.81 | +0.34 / -0.36 |
| 9700 | 4.85 | +0.34 / -0.36 |
| 9800 | 4.87 | +0.34 / -0.36 |
| 9900 | 4.89 | +0.34 / -0.36 |
| 10000 | 4.93 | +0.34 / -0.36 |
| 10100 | 4.96 | +0.4 / -0.44 |
| 10200 | 4.99 | +0.4 / -0.44 |
| 10300 | 5.02 | +0.4 / -0.44 |
| 10400 | 5.05 | +0.4 / -0.44 |
| 10500 | 5.08 | +0.4 / -0.44 |
| 10600 | 5.11 | +0.4 / -0.44 |
| 10700 | 5.14 | +0.4 / -0.44 |
| 10800 | 5.17 | +0.4 / -0.44 |
| 10900 | 5.19 | +0.4 / -0.44 |
| 11000 | 5.22 | +0.4 / -0.44 |
| 11100 | 5.25 | +0.4 / -0.44 |
| 11200 | 5.28 | +0.4 / -0.44 |
| 11300 | 5.31 | +0.4 / -0.44 |
| 11400 | 5.34 | +0.4 / -0.44 |
| 11500 | 5.38 | +0.4 / -0.44 |
| 11600 | 5.41 | +0.4 / -0.44 |
| 11700 | 5.45 | +0.4 / -0.44 |
| 11800 | 5.49 | +0.4 / -0.44 |
| 11900 | 5.53 | +0.4 / -0.44 |
| 12000 | 5.56 | +0.4 / -0.44 |
| 12100 | 5.60 | +0.4 / -0.44 |
| 12200 | 5.63 | +0.4 / -0.44 |
| 12300 | 5.68 | +0.4 / -0.44 |
| 12400 | 5.72 | +0.4 / -0.44 |
| 12500 | 5.75 | +0.47 / -0.52 |
| 12600 | 5.80 | +0.47 / -0.52 |
| 12700 | 5.84 | +0.47 / -0.52 |
| 12800 | 5.93 | +0.47 / -0.52 |
| 12900 | 5.94 | +0.47 / -0.52 |
| 13000 | 5.98 | +0.47 / -0.52 |
| 13100 | 6.03 | +0.47 / -0.52 |

| Set / Applied, MHz | Measured, dB | Uncertainty, dB |
|---|---|---|
| 13200 | 6.09 | +0.47 / -0.52 |
| 13300 | 6.17 | +0.47 / -0.52 |
| 13400 | 6.27 | +0.47 / -0.52 |
| 13500 | 6.37 | +0.47 / -0.52 |
| 13600 | 6.49 | +0.47 / -0.52 |
| 13700 | 6.57 | +0.47 / -0.52 |
| 13800 | 6.60 | +0.47 / -0.52 |
| 13900 | 6.61 | +0.47 / -0.52 |
| 14000 | 6.59 | +0.47 / -0.52 |
| 14100 | 6.57 | +0.47 / -0.52 |
| 14200 | 6.54 | +0.47 / -0.52 |
| 14300 | 6.53 | +0.47 / -0.52 |
| 14400 | 6.49 | +0.47 / -0.52 |
| 14500 | 6.48 | +0.47 / -0.52 |
| 14600 | 6.46 | +0.47 / -0.52 |
| 14700 | 6.46 | +0.47 / -0.52 |
| 14800 | 6.49 | +0.47 / -0.52 |
| 14900 | 6.51 | +0.47 / -0.52 |
| 15000 | 6.54 | +0.47 / -0.52 |
| 15100 | 6.57 | +0.47 / -0.52 |
| 15200 | 6.62 | +0.47 / -0.52 |
| 15300 | 6.64 | +0.47 / -0.52 |
| 15400 | 6.68 | +0.47 / -0.52 |
| 15500 | 6.71 | +0.47 / -0.52 |
| 15600 | 6.78 | +0.47 / -0.52 |
| 15700 | 6.79 | +0.47 / -0.52 |
| 15800 | 6.82 | +0.47 / -0.52 |
| 15900 | 6.88 | +0.47 / -0.52 |
| 16000 | 6.89 | +0.47 / -0.52 |
| 16100 | 6.96 | +0.47 / -0.52 |
| 16200 | 6.97 | +0.47 / -0.52 |
| 16300 | 7.02 | +0.47 / -0.52 |
| 16400 | 7.07 | +0.47 / -0.52 |
| 16500 | 7.12 | +0.47 / -0.52 |
| 16600 | 7.17 | +0.47 / -0.52 |
| 16700 | 7.20 | +0.47 / -0.52 |
| 16800 | 7.22 | +0.47 / -0.52 |
| 16900 | 7.23 | +0.47 / -0.52 |
| 17000 | 7.24 | +0.47 / -0.52 |
| 17100 | 7.27 | +0.47 / -0.52 |
| 17200 | 7.28 | +0.47 / -0.52 |
| 17300 | 7.28 | +0.47 / -0.52 |
| 17400 | 7.30 | +0.47 / -0.52 |
| 17500 | 7.34 | +0.47 / -0.52 |
| 17600 | 7.35 | +0.47 / -0.52 |
| 17700 | 7.39 | +0.47 / -0.52 |
| 17800 | 7.41 | +0.47 / -0.52 |
| 17900 | 7.41 | +0.47 / -0.52 |
| 18000 | 7.44 | +0.47 / -0.52 |

**RF cable, 18 GHz, 6 m, N-type**
**Huber-Suhner, SF106A/11N/11N/4500MM, s/n 500845/6A**

**HL 5107: Insertion loss**

| Set / Applied, MHz | Measured, dB | Uncertainty, dB |
|---|---|---|
| 0.1 | 0.01 | ±0.07 |
| 50 | 0.16 | ±0.07 |
| 100 | 0.23 | ±0.07 |
| 200 | 0.31 | ±0.08 |
| 300 | 0.38 | ±0.08 |
| 400 | 0.44 | ±0.08 |
| 500 | 0.50 | ±0.08 |
| 600 | 0.55 | ±0.08 |
| 700 | 0.59 | ±0.08 |
| 800 | 0.63 | ±0.08 |
| 900 | 0.67 | ±0.08 |
| 1000 | 0.71 | ±0.08 |
| 1100 | 0.74 | ±0.08 |
| 1200 | 0.78 | ±0.08 |
| 1300 | 0.81 | ±0.08 |
| 1400 | 0.84 | ±0.08 |
| 1500 | 0.87 | ±0.08 |
| 1600 | 0.90 | ±0.08 |
| 1700 | 0.93 | ±0.08 |
| 1800 | 0.96 | ±0.08 |
| 1900 | 0.98 | ±0.08 |
| 2000 | 1.01 | ±0.08 |
| 2500 | 1.14 | ±0.10 |
| 3000 | 1.26 | ±0.10 |
| 3500 | 1.37 | ±0.10 |
| 4000 | 1.47 | ±0.10 |
| 4500 | 1.57 | ±0.10 |

| Set / Applied, MHz | Measured, dB | Uncertainty, dB |
|---|---|---|
| 5000 | 1.67 | ±0.10 |
| 5500 | 1.76 | ±0.10 |
| 6000 | 1.86 | ±0.10 |
| 6500 | 1.94 | ±0.10 |
| 7000 | 2.02 | ±0.13 |
| 7500 | 2.09 | ±0.13 |
| 8000 | 2.15 | ±0.13 |
| 8500 | 2.21 | ±0.13 |
| 9000 | 2.28 | ±0.13 |
| 9500 | 2.35 | ±0.13 |
| 10000 | 2.41 | ±0.13 |
| 10500 | 2.47 | ±0.13 |
| 11000 | 2.54 | ±0.13 |
| 11500 | 2.59 | ±0.13 |
| 12000 | 2.67 | ±0.13 |
| 12500 | 2.73 | ±0.18 |
| 13000 | 2.80 | ±0.18 |
| 13500 | 2.85 | ±0.18 |
| 14000 | 2.92 | ±0.18 |
| 14500 | 2.98 | ±0.18 |
| 15000 | 3.04 | ±0.22 |
| 15500 | 3.09 | ±0.22 |
| 16000 | 3.15 | ±0.22 |
| 16500 | 3.20 | ±0.22 |
| 17000 | 3.25 | ±0.22 |
| 17500 | 3.31 | ±0.22 |
| 18000 | 3.36 | ±0.27 |

**RF cable, 40 GHz, 5.5 m, K-type**
**Huber-Suhner, SF102EA/11SK/11SK/5500MM, *s/n* 502493/2EA,**

**HL 5111: Insertion loss**

| Set / Applied, MHz | Measured, dB | Uncertainty, dB |
|---|---|---|
| 100 | 0.70 | ±0.07 |
| 200 | 0.99 | ±0.08 |
| 300 | 1.21 | ±0.08 |
| 500 | 1.56 | ±0.08 |
| 1000 | 2.20 | ±0.08 |
| 1500 | 2.69 | ±0.08 |
| 2000 | 3.11 | ±0.08 |
| 2500 | 3.50 | ±0.10 |
| 3000 | 3.85 | ±0.10 |
| 3500 | 4.16 | ±0.10 |
| 4000 | 4.47 | ±0.10 |
| 4500 | 4.74 | ±0.10 |
| 5000 | 5.03 | ±0.10 |
| 5500 | 5.30 | ±0.10 |
| 6000 | 5.57 | ±0.10 |
| 6500 | 5.76 | ±0.10 |
| 7000 | 6.00 | ±0.10 |
| 7500 | 6.20 | ±0.10 |
| 8000 | 6.44 | ±0.10 |
| 8500 | 6.67 | ±0.10 |
| 9000 | 6.82 | ±0.10 |
| 9500 | 7.04 | ±0.10 |
| 10000 | 7.18 | ±0.10 |
| 10500 | 7.36 | ±0.10 |
| 11000 | 7.55 | ±0.10 |
| 11500 | 7.75 | ±0.10 |
| 12000 | 7.90 | ±0.10 |
| 12500 | 8.08 | ±0.13 |
| 13000 | 8.19 | ±0.13 |
| 13500 | 8.39 | ±0.13 |
| 14000 | 8.58 | ±0.13 |
| 14500 | 8.76 | ±0.18 |
| 15000 | 8.92 | ±0.18 |
| 15500 | 9.03 | ±0.18 |
| 16000 | 9.18 | ±0.18 |
| 16500 | 9.34 | ±0.18 |
| 17000 | 9.51 | ±0.18 |
| 17500 | 9.66 | ±0.18 |
| 18000 | 9.80 | ±0.18 |
| 18500 | 9.94 | ±0.23 |
| 19000 | 10.05 | ±0.23 |
| 19500 | 10.22 | ±0.23 |

| Set / Applied, MHz | Measured, dB | Uncertainty, dB |
|---|---|---|
| 20000 | 10.32 | ±0.23 |
| 20500 | 10.48 | ±0.23 |
| 21000 | 10.60 | ±0.23 |
| 21500 | 10.73 | ±0.23 |
| 22000 | 10.87 | ±0.23 |
| 22500 | 10.97 | ±0.29 |
| 23000 | 11.09 | ±0.29 |
| 23500 | 11.26 | ±0.29 |
| 24000 | 11.37 | ±0.29 |
| 24500 | 11.50 | ±0.29 |
| 25000 | 11.61 | ±0.23 |
| 25500 | 11.72 | ±0.23 |
| 26000 | 11.87 | ±0.23 |
| 26500 | 11.99 | ±0.23 |
| 27000 | 12.09 | ±0.33 |
| 27500 | 12.24 | ±0.33 |
| 28000 | 12.34 | ±0.40 |
| 28500 | 12.47 | ±0.40 |
| 29000 | 12.61 | ±0.40 |
| 29500 | 12.70 | ±0.40 |
| 30000 | 12.86 | ±0.40 |
| 30500 | 12.92 | ±0.33 |
| 31000 | 13.09 | ±0.33 |
| 31500 | 13.16 | ±0.33 |
| 32000 | 13.33 | ±0.33 |
| 32500 | 13.40 | ±0.33 |
| 33000 | 13.62 | ±0.33 |
| 33500 | 13.70 | ±0.33 |
| 34000 | 13.88 | ±0.33 |
| 34500 | 13.97 | ±0.40 |
| 35000 | 14.05 | ±0.40 |
| 35500 | 14.23 | ±0.40 |
| 36000 | 14.25 | ±0.40 |
| 36500 | 14.46 | ±0.40 |
| 37000 | 14.49 | ±0.33 |
| 37500 | 14.72 | ±0.33 |
| 38000 | 14.77 | ±0.33 |
| 38500 | 14.97 | ±0.33 |
| 39000 | 15.04 | ±0.33 |
| 39500 | 15.22 | ±0.33 |
| 40000 | 15.63 | ±0.47 |

# 11 APPENDIX C Measurement uncertainties

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

| Test description | Expanded uncertainty |
|---|---|
| Conducted carrier power at RF antenna connector | Below 12.4 GHz: ± 1.7 dB<br>12.4 GHz to 40 GHz: ± 2.3 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 |
| Occupied bandwidth | ± 8.0 % |
| Duty cycle, timing (Tx ON / OFF) and average factor measurements | ± 1.0 % |
| Conducted emissions with LISN | 9 kHz to 150 kHz: ± 3.9 dB<br>150 kHz to 30 MHz: ± 3.8 dB |
| Radiated emissions at 3 m measuring distance<br>Horizontal polarization<br><br><br><br>Vertical polarization | <br>Biconilog antenna: ± 5.3 dB<br>Biconical antenna: ± 5.0 dB<br>Log periodic antenna: ± 5.3 dB<br>Double ridged horn antenna: ± 5.3 dB<br>Biconilog antenna: ± 6.0 dB<br>Biconical antenna: ± 5.7 dB<br>Log periodic antenna: ± 6.0 dB<br>Double ridged horn antenna: ± 6.0 dB |

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.

# 12 APPENDIX D 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 recognized and accredited by the Federal Communications Commission (USA) for 1, 2, 15, 18 parts of Code of Federal Regulations 47 (CFR 47), Test Firm Registration Number is 927748, Designation Number is IL1001; registered 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, G-869 for RE measurements above 1 GHz, C-845 for conducted emissions site, T-1606 for conducted emissions at telecommunication ports). 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).

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# 13 APPENDIX E Specification references

| | |
|---|---|
| FCC 47CFR part 15: 2017 | Radio Frequency Devices. |
| ANSI C63.2: 2016 | American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications. |
| ANSI C63.4: 2014 | 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. |
| ANSI C63.10: 2013 | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices |
| RSS-247: 2017, Issue 2 | Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices |
| RSS-Gen: 2018, Issue 5 | General Requirements for Compliance of Radio Apparatus |
| ICES-003: 2016, Issue 6 | Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement |
| Public notice DA 00- 705: 2000 | Filing and measurement guidelines for frequency hopping spread spectrum systems. |

# 14 APPENDIX F Abbreviations and acronyms

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

END OF DOCUMENT