

# TEST REPORT

ACCORDING TO: FCC 47CFR part 15 subpart C §15.247 (Hybrid);  
RSS-247 Issue 2, RSS-Gen Issue 5

FOR:

**ARAD TECHNOLOGIES**

**Digital Water meter**

**Model: INTERPRETER LR9**

**FCC ID: VIDLR9INTR**

**IC: 10232A-LR9INTER**

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## 1 Applicant information

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**Contact name:** Mr.Vily Negreanu

## 2 Equipment under test attributes

**Product name:** Digital Water meter  
**Product type:** Transceiver  
**Model(s):** INTERPRETER LR9  
**Trade mark:** Allegro IOT  
**Serial number:** 70B3D5A9F0000B52  
**Hardware version:** 06.01  
**Software release:** 1A.XX  
**Receipt date:** 09-Jan-20

## 3 Manufacturer information

**Manufacturer name:** ARAD TECHNOLOGIES  
**Address:** POB 537, HaMada 4, Yokneam Ind. Zone, Yokneam Ilit 20692, Israel  
**Telephone:** 04-9935222 Ext.277  
**Fax:** 04-9935227  
**E-Mail:** [viorel.negreanu@aradtec.com](mailto:viorel.negreanu@aradtec.com)  
**Contact name:** Mr.Vily Negreanu

## 4 Test details

**Project ID:** 36321  
**Location:** Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel  
**Test started:** 12-Jan-20  
**Test completed:** 19-Jan-20  
**Test specification(s):** FCC 47CFR part 15 subpart C §15.247 (Hybrid)  
RSS-247 Issue 2:2017, RSS-Gen Issue 5 with Am.1:2019

## 5 Tests summary

| Test                                                                          | Status                                                            |
|-------------------------------------------------------------------------------|-------------------------------------------------------------------|
| <b>Transmitter characteristics</b>                                            |                                                                   |
| FCC section 15.247(a)1/ RSS-247 section 5.1(3), 20 dB bandwidth               | Pass                                                              |
| FCC section 15.247(a)1/ RSS-247 section 5.1(2), Frequency separation          | Pass                                                              |
| FCC section 15.247(a)1/ RSS-247 section 5.1(3), Number of hopping frequencies | Pass                                                              |
| FCC section 15.247(a)1/ RSS-247 section 5.1(3), Average time of occupancy     | Pass                                                              |
| FCC section 15.247(b)/ RSS-247 section 5.4(1), Peak output power              | Pass                                                              |
| FCC Section 15.247(e)/ RSS-247 section 5.4(1), Peak spectral density          | Pass                                                              |
| FCC section 15.247(c)/ RSS-247 section 5.5, Radiated spurious emissions       | Pass                                                              |
| FCC section 15.247(c)/ RSS-247 section 5.5, Emissions at band edges           | Pass                                                              |
| FCC section 15.247(i)5/ RSS-102 section 2.5, RF exposure                      | Pass, the exhibit to the application of certification is provided |
| FCC section 15.203/ RSS-Gen section 6.8, Antenna requirements                 | Pass                                                              |

Testing was completed against all relevant requirements of the test standard. The results obtained indicate that the product under test complies in full with the requirements tested.

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

This test report supersedes the previously issued test report identified by Doc ID:ARARAD\_FCC.36321\_Hybrid.

|                     | Name and Title                                    | Date                  | Signature                                                                             |
|---------------------|---------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|
| <b>Tested by:</b>   | Mr. A. Morozov test engineer EMC & Radio          | 12-Jan-20 – 19-Jan-20 |  |
| <b>Reviewed by:</b> | Mrs. S Peysahov Sheynin test engineer EMC & Radio | 24-Sep-20             |  |
| <b>Approved by:</b> | Mr. S. Samokha, technical manager, EMC & Radio    | 24-Sep-20             |  |

## 6 EUT description

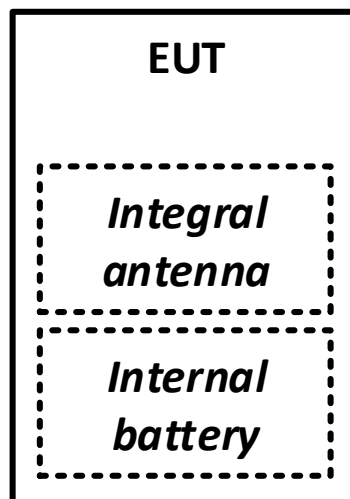
Note: The following data in this clause is provided by the customer and represents his sole responsibility

### 6.1 General information

Battery powered Digital Water Meter comprising a built-in long range (LoRaWAN) radio module operating in 902.0 -928.0 MHz frequency range.

### 6.2 Test configuration

#### ***EUT***



### 6.3 Changes made in EUT

No changes were implemented in the EUT during the testing.

## 6.4 Transmitter characteristics

|                                              |                                                                                                          |                                                           |        |                     |                                |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|--------|---------------------|--------------------------------|
| <b>Type of equipment</b>                     |                                                                                                          |                                                           |        |                     |                                |
| 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)                                          |                                                           |        |                     |                                |
| <b>Intended use</b>                          |                                                                                                          | <b>Condition of use</b>                                   |        |                     |                                |
|                                              | 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 |        |                     |                                |
| <b>Assigned frequency range</b>              |                                                                                                          | 902 - 928 MHz                                             |        |                     |                                |
| <b>Operating frequency</b>                   |                                                                                                          | 902.3- 914.9 MHz                                          |        |                     |                                |
| <b>Maximum rated output power</b>            |                                                                                                          | <b>Peak output power</b>                                  |        | 20.28 dBm           |                                |
| <b>Is transmitter output power variable?</b> |                                                                                                          | X                                                         | No     |                     |                                |
|                                              |                                                                                                          |                                                           | Yes    | continuous variable |                                |
|                                              |                                                                                                          | stepped variable with stepsize                            |        | dB                  |                                |
|                                              |                                                                                                          | minimum RF power                                          |        | dBm                 |                                |
|                                              |                                                                                                          | maximum RF power                                          |        | dBm                 |                                |
| <b>Antenna connection</b>                    |                                                                                                          |                                                           |        |                     |                                |
| unique coupling                              |                                                                                                          | standard connector                                        |        | X                   | integral                       |
|                                              |                                                                                                          |                                                           |        | X                   | without temporary RF connector |
| <b>Antenna/s technical characteristics</b>   |                                                                                                          |                                                           |        |                     |                                |
| <b>Type</b>                                  |                                                                                                          | <b>Manufacturer</b>                                       |        | <b>Model number</b> |                                |
| Custom made                                  |                                                                                                          | Arad Technologies                                         |        | ANT00064            |                                |
|                                              |                                                                                                          |                                                           |        | Gain                |                                |
|                                              |                                                                                                          |                                                           |        | (-3) – 0 dBi        |                                |
| <b>Modulation</b>                            |                                                                                                          | LoRa                                                      |        |                     |                                |
| <b>Transmitter aggregate data rate/s</b>     |                                                                                                          | 980 bps / 5470 bps                                        |        |                     |                                |
| <b>Modulating test signal (baseband)</b>     |                                                                                                          | PRBS                                                      |        |                     |                                |
| <b>Transmitter power source</b>              |                                                                                                          |                                                           |        |                     |                                |
| X                                            | Battery                                                                                                  | <b>Nominal rated voltage</b>                              | 3.6VDC | <b>Battery type</b> | TL4920                         |
|                                              | DC                                                                                                       | <b>Nominal rated voltage</b>                              | VDC    |                     |                                |
|                                              | AC mains                                                                                                 | <b>Nominal rated voltage</b>                              | VAC    | <b>Frequency</b>    |                                |
| <b>Spread spectrum technique used</b>        |                                                                                                          | Frequency hopping (FHSS)                                  |        |                     |                                |
|                                              |                                                                                                          | Digital transmission system (DTS)                         |        |                     |                                |
|                                              |                                                                                                          | X                                                         | Hybrid |                     |                                |

|                                                                                   |                         |                        |                |
|-----------------------------------------------------------------------------------|-------------------------|------------------------|----------------|
| Test specification: Section 15.247(a)(1), RSS-247 section 5.1(c), 20 dB bandwidth |                         |                        |                |
| Test procedure: ANSI C63.10 section 7.8.7                                         |                         |                        |                |
| Test mode: Compliance                                                             |                         | Verdict: PASS          |                |
| Date(s): 14-Jan-20                                                                |                         |                        |                |
| Temperature: 25 °C                                                                | Relative Humidity: 41 % | Air Pressure: 1025 hPa | Power: 3.6 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 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                                         |

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

#### 7.1.2 Test procedure

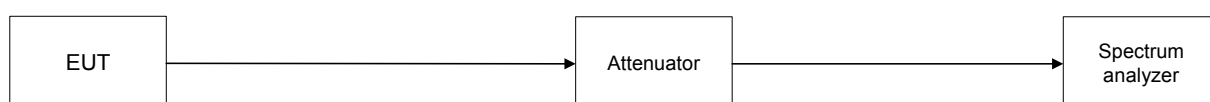
7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.

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(c), 20 dB bandwidth |                         |                        |                |
| Test procedure: ANSI C63.10 section 7.8.7                                         |                         |                        |                |
| Test mode: Compliance                                                             |                         | Verdict: PASS          |                |
| Date(s): 14-Jan-20                                                                |                         |                        |                |
| Temperature: 25 °C                                                                | Relative Humidity: 41 % | Air Pressure: 1025 hPa | Power: 3.6 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  
 MODULATING SIGNAL: PRBS  
 FREQUENCY HOPPING: Disabled

| Carrier frequency, MHz | Type of modulation | Data rate, bps | 20 dB bandwidth, kHz | Limit, kHz | Margin, kHz | Verdict |
|------------------------|--------------------|----------------|----------------------|------------|-------------|---------|
| Low frequency          |                    |                |                      |            |             |         |
| 902.3                  | LoRa               | 980            | 139.1                | 250.0      | -110.90     | Pass    |
|                        |                    | 5470           | 145.3                | 250.0      | -104.70     | Pass    |
| Mid frequency          |                    |                |                      |            |             |         |
| 908.6                  | LoRa               | 980            | 139.0                | 250.0      | -111.00     | Pass    |
|                        |                    | 5470           | 145.7                | 250.0      | -104.30     | Pass    |
| High frequency         |                    |                |                      |            |             |         |
| 914.9                  | LoRa               | 980            | 138.1                | 250.0      | -111.90     | Pass    |
|                        |                    | 5470           | 144.6                | 250.0      | -105.40     | Pass    |

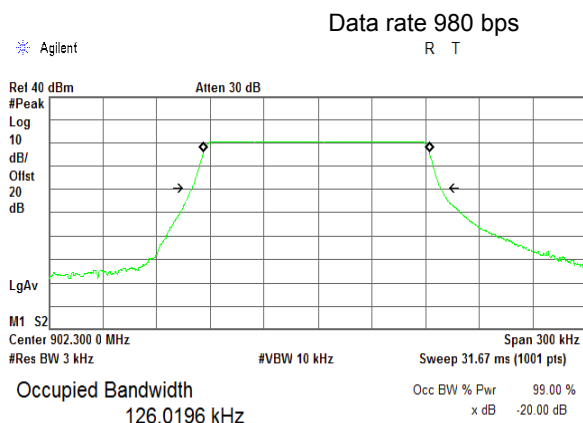
## Reference numbers of test equipment used

|         |         |  |  |  |  |  |  |  |
|---------|---------|--|--|--|--|--|--|--|
| HL 3442 | HL 3818 |  |  |  |  |  |  |  |
|---------|---------|--|--|--|--|--|--|--|

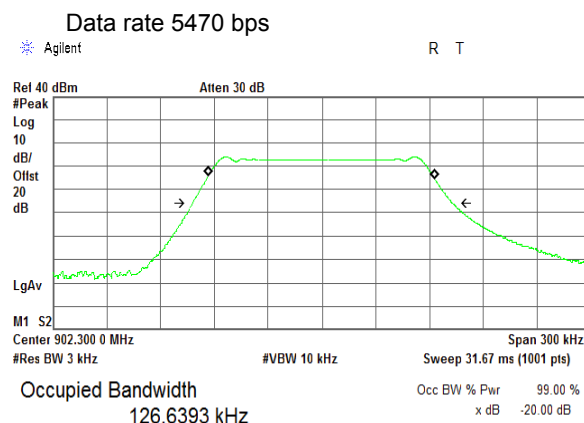
Full description is given in Appendix A.

|                                                                                   |                         |                        |                |
|-----------------------------------------------------------------------------------|-------------------------|------------------------|----------------|
| Test specification: Section 15.247(a)(1), RSS-247 section 5.1(c), 20 dB bandwidth |                         |                        |                |
| Test procedure: ANSI C63.10 section 7.8.7                                         |                         |                        |                |
| Test mode: Compliance                                                             |                         | Verdict: PASS          |                |
| Date(s): 14-Jan-20                                                                |                         |                        |                |
| Temperature: 25 °C                                                                | Relative Humidity: 41 % | Air Pressure: 1025 hPa | Power: 3.6 VDC |
| Remarks:                                                                          |                         |                        |                |

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

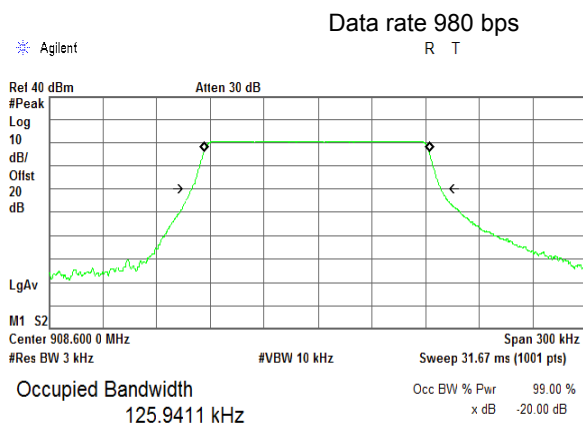


Transmit Freq Error -721.964 Hz  
x dB Bandwidth 139.065 kHz

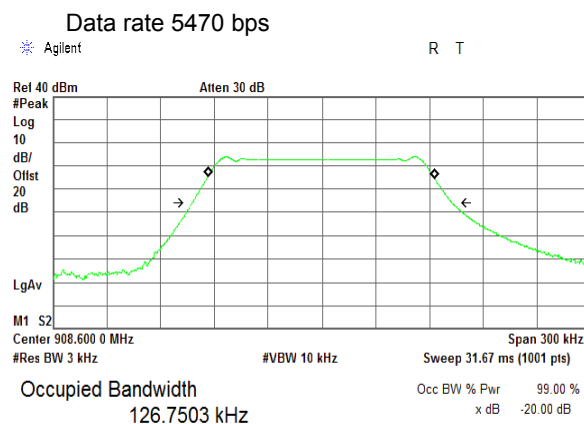


Transmit Freq Error -243.261 Hz  
x dB Bandwidth 145.322 kHz

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



Transmit Freq Error -700.638 Hz  
x dB Bandwidth 139.031 kHz



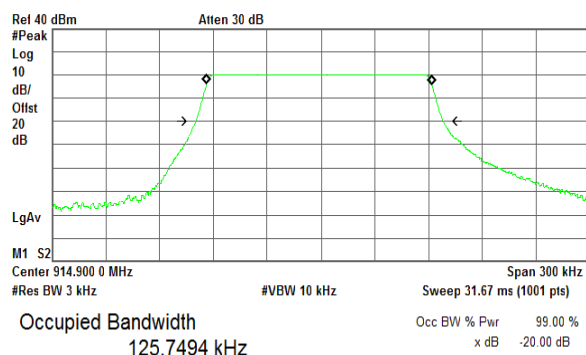
Transmit Freq Error -304.299 Hz  
x dB Bandwidth 145.715 kHz

|                                                                                          |                                |                               |                       |
|------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(a)(1), RSS-247 section 5.1(c), 20 dB bandwidth |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10 section 7.8.7                                         |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                             |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 14-Jan-20                                                                |                                |                               |                       |
| <b>Temperature:</b> 25 °C                                                                | <b>Relative Humidity:</b> 41 % | <b>Air Pressure:</b> 1025 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                          |                                |                               |                       |

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

Data rate 980 bps

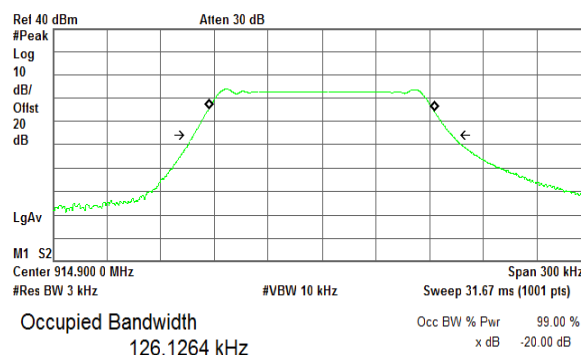
\* Agilent



Transmit Freq Error -806.338 Hz  
x dB Bandwidth 138.130 kHz

Data rate 5470 bps

\* Agilent



Transmit Freq Error -195.424 Hz  
x dB Bandwidth 144.593 kHz

|                                                                                                    |                                |                               |                       |
|----------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> <b>Section 15.247(a)1, RSS-247 section 5.1(b), Frequency separation</b> |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10 section 7.8.3                                                   |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                                       |                                | <b>Verdict:</b> <b>PASS</b>   |                       |
| <b>Date(s):</b> 19-Jan-20                                                                          |                                |                               |                       |
| <b>Temperature:</b> 23 °C                                                                          | <b>Relative Humidity:</b> 53 % | <b>Air Pressure:</b> 1016 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                                    |                                |                               |                       |

## 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,<br>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 |

### 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



|                                                                                             |                                |                               |                       |
|---------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(a)1, RSS-247 section 5.1(b), Frequency separation |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10 section 7.8.3                                            |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                                |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 19-Jan-20                                                                   |                                |                               |                       |
| <b>Temperature:</b> 23 °C                                                                   | <b>Relative Humidity:</b> 53 % | <b>Air Pressure:</b> 1016 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                             |                                |                               |                       |

Table 7.2.2 Carrier frequency separation test results

ASSIGNED FREQUENCY: 902.0 – 928.0 MHz  
 MODULATION: LoRa  
 MODULATING SIGNAL: PRBS  
 DETECTOR USED: Peak  
 RESOLUTION BANDWIDTH:  $\geq 1\%$  of the span  
 VIDEO BANDWIDTH:  $\geq$  RBW  
 FREQUENCY HOPPING: Enabled

BIT RATE: 980 bps  
 20 dB BANDWIDTH: 139.1 kHz

| Carrier frequency separation, kHz | Limit, kHz | Margin, kHz* | Verdict |
|-----------------------------------|------------|--------------|---------|
| 200                               | 139.1      | 60.9         | Pass    |

BIT RATE: 5470 bps  
 20 dB BANDWIDTH: 145.7 kHz

| Carrier frequency separation, kHz | Limit, kHz | Margin, kHz* | Verdict |
|-----------------------------------|------------|--------------|---------|
| 200                               | 145.7      | 54.3         | Pass    |

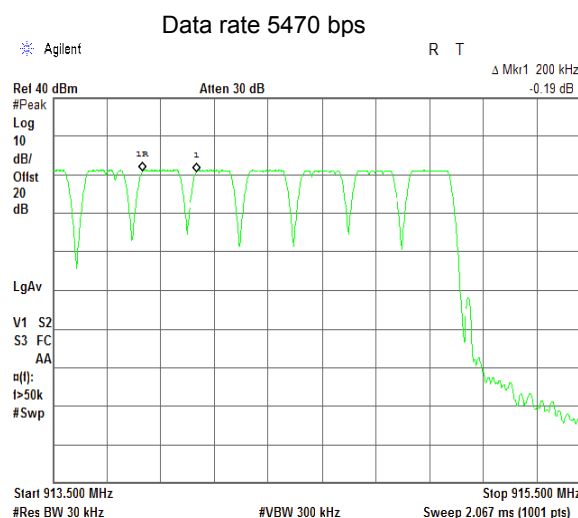
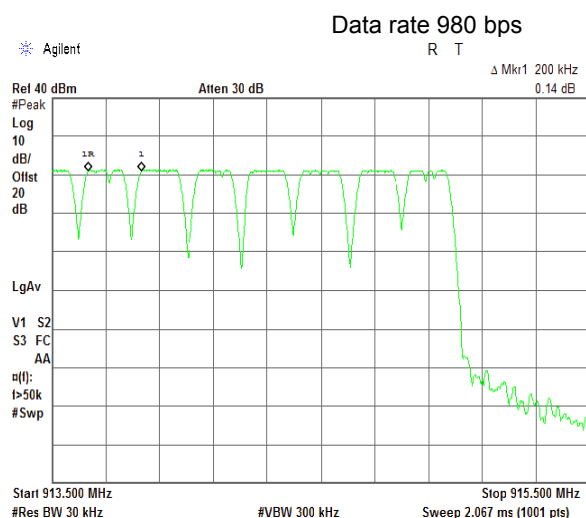
\* - Margin = Carrier frequency separation – specification limit.

#### Reference numbers of test equipment used

|         |         |  |  |  |  |  |  |
|---------|---------|--|--|--|--|--|--|
| HL 3442 | HL 3818 |  |  |  |  |  |  |
|---------|---------|--|--|--|--|--|--|

Full description is given in Appendix A.

Plot 7.2.1 Carrier frequency separation



|                                                                                                      |                                |                               |                       |
|------------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(a)1, RSS-247 section 5.1(c), Number of hopping frequencies |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10 section 7.8.3                                                     |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                                         |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 19-Jan-20                                                                            |                                |                               |                       |
| <b>Temperature:</b> 23 °C                                                                            | <b>Relative Humidity:</b> 53 % | <b>Air Pressure:</b> 1016 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                                      |                                |                               |                       |

## 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.

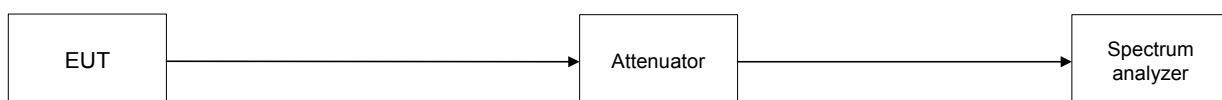
Table 7.3.1 Minimum number of hopping frequencies

| 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) |

### 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





|                                                                                                      |                                |                               |                       |
|------------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(a)1, RSS-247 section 5.1(c), Number of hopping frequencies |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10 section 7.8.3                                                     |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                                         |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 19-Jan-20                                                                            |                                |                               |                       |
| <b>Temperature:</b> 23 °C                                                                            | <b>Relative Humidity:</b> 53 % | <b>Air Pressure:</b> 1016 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                                      |                                |                               |                       |

Table 7.3.2 Hopping frequencies test results

ASSIGNED FREQUENCY: 902.0 – 928.0 MHz  
 MODULATION: LoRa  
 MODULATING SIGNAL: PRBS  
 DETECTOR USED: Peak  
 RESOLUTION BANDWIDTH:  $\geq 1\%$  of the span  
 VIDEO BANDWIDTH:  $\geq$  RBW  
 FREQUENCY HOPPING: Enabled

BIT RATE: 980 bps

| Number of hopping frequencies | Minimum number of hopping frequencies | Margin* | Verdict |
|-------------------------------|---------------------------------------|---------|---------|
| 64                            | 50                                    | 14      | Pass    |

BIT RATE: 5470 bps

| Number of hopping frequencies | Minimum number of hopping frequencies | Margin* | Verdict |
|-------------------------------|---------------------------------------|---------|---------|
| 64                            | 50                                    | 14      | Pass    |

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

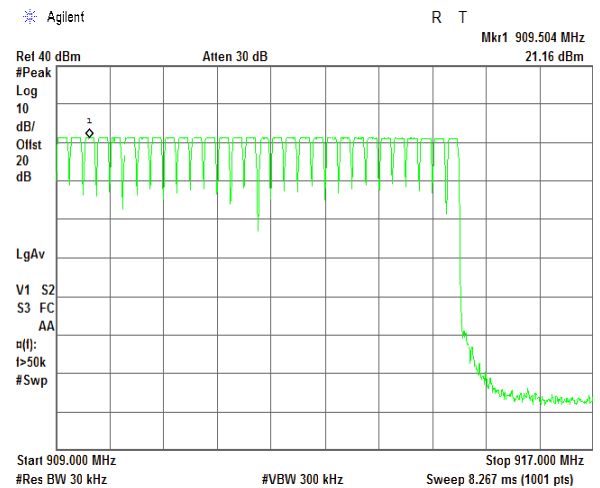
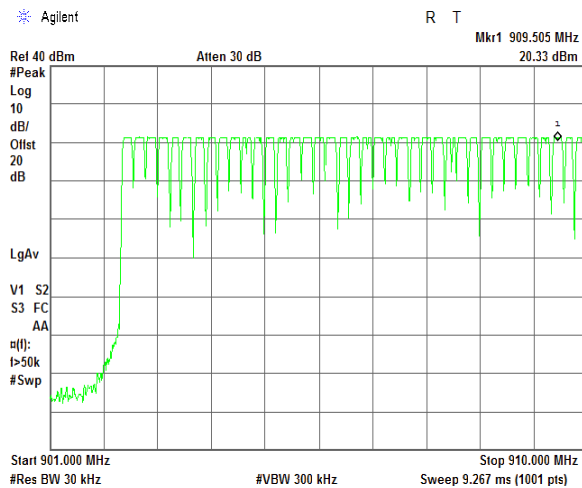
#### Reference numbers of test equipment used

|         |         |  |  |  |  |  |  |
|---------|---------|--|--|--|--|--|--|
| HL 3442 | HL 3818 |  |  |  |  |  |  |
|---------|---------|--|--|--|--|--|--|

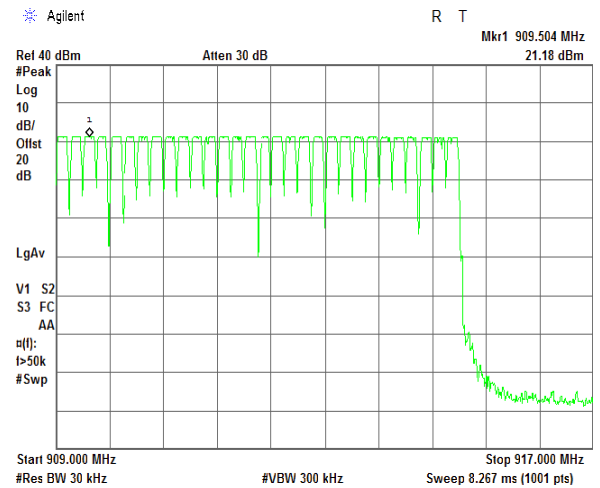
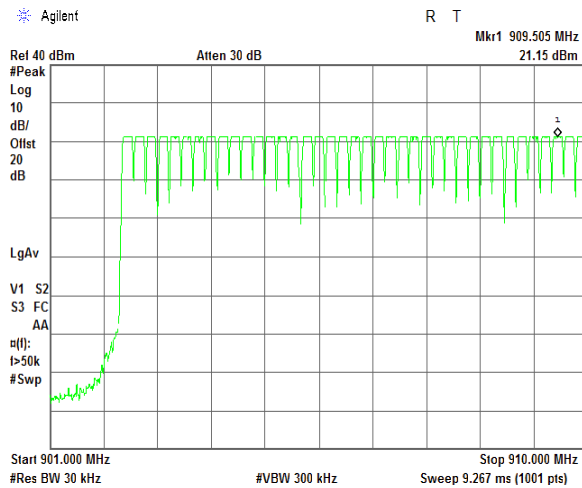
Full description is given in Appendix A.

|                                                                                                      |                                |                               |                       |
|------------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(a)1, RSS-247 section 5.1(c), Number of hopping frequencies |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10 section 7.8.3                                                     |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                                         |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 19-Jan-20                                                                            |                                |                               |                       |
| <b>Temperature:</b> 23 °C                                                                            | <b>Relative Humidity:</b> 53 % | <b>Air Pressure:</b> 1016 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                                      |                                |                               |                       |

**Plot 7.3.1 Number of hopping frequencies with bit rate 980 bps**



**Plot 7.3.2 Number of hopping frequencies with bit rate 5470 bps**



|                                                                                                 |                                |                               |                       |
|-------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(a), RSS-247 section 5.1(c), Average time of occupancy |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10 section 7.8.4                                                |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                                    |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 19-Jan-20                                                                       |                                |                               |                       |
| <b>Temperature:</b> 23 °C                                                                       | <b>Relative Humidity:</b> 53 % | <b>Air Pressure:</b> 1016 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                                 |                                |                               |                       |

## 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                          |

### 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





|                                                                                                 |                                |                               |                       |
|-------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(a), RSS-247 section 5.1(c), Average time of occupancy |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10 section 7.8.4                                                |                                |                               |                       |
| <b>Test mode:</b>                                                                               | Compliance                     | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b>                                                                                 | 19-Jan-20                      |                               |                       |
| <b>Temperature:</b> 23 °C                                                                       | <b>Relative Humidity:</b> 53 % | <b>Air Pressure:</b> 1016 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                                 |                                |                               |                       |

Table 7.4.2 Average time of occupancy test results

ASSIGNED FREQUENCY: 902.0 – 928.0 MHz  
 MODULATION: LoRa  
 MODULATING SIGNAL: PRBS  
 DETECTOR USED: Peak  
 RESOLUTION BANDWIDTH: 30 kHz  
 VIDEO BANDWIDTH: 300 kHz  
 NUMBER OF HOPPING FREQUENCIES: 1  
 INVESTIGATED PERIOD: 21 s  
 FREQUENCY HOPPING: Enabled

| Carrier frequency, MHz | Single transmission duration, s | Number of transmissions within investigated period | Average time of occupancy*, s | Bit rate, bps | Limit, s | Margin, s** | Verdict |
|------------------------|---------------------------------|----------------------------------------------------|-------------------------------|---------------|----------|-------------|---------|
| 914.9                  | 0.33                            | 1                                                  | 0.33                          | 980           | 0.4      | -0.07       | Pass    |
| 914.9                  | 0.33                            | 1                                                  | 0.33                          | 5470          | 0.4      | -0.07       | Pass    |

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

\*\* - Margin = Average time of occupancy – specification limit.

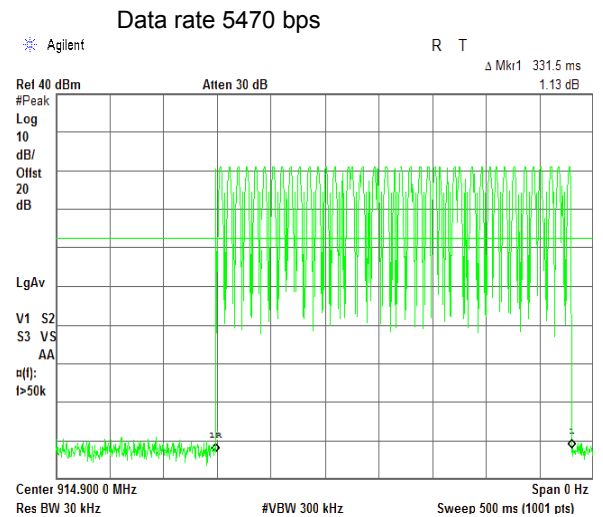
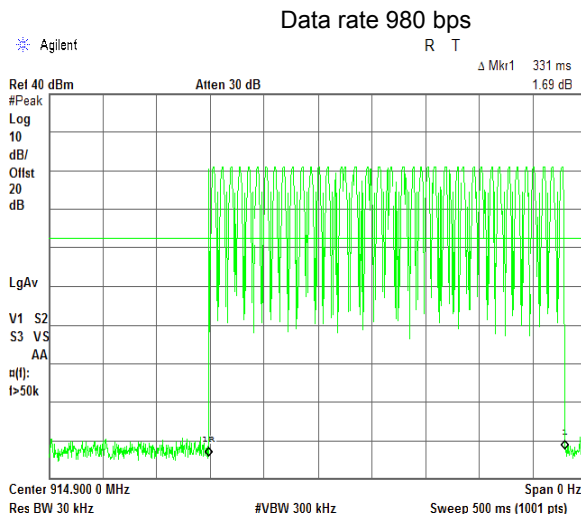
**Reference numbers of test equipment used**

|         |         |  |  |  |  |  |  |
|---------|---------|--|--|--|--|--|--|
| HL 3442 | HL 3818 |  |  |  |  |  |  |
|---------|---------|--|--|--|--|--|--|

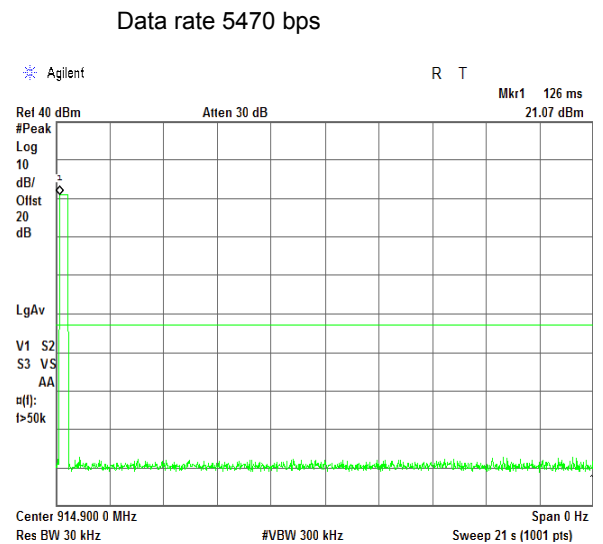
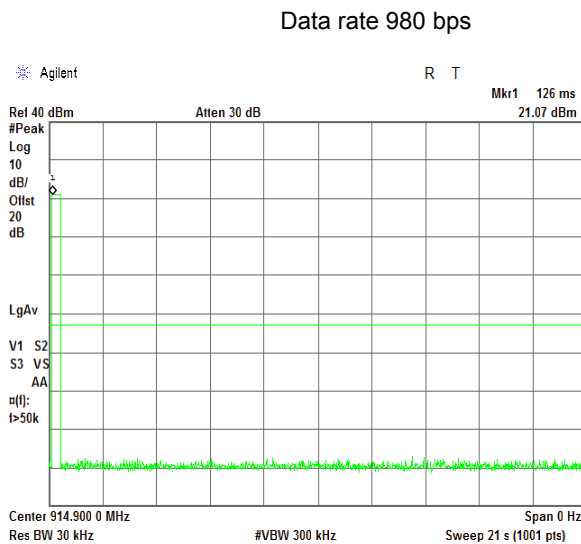
Full description is given in Appendix A.

|                                                                                                 |                                |                               |                       |
|-------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(a), RSS-247 section 5.1(c), Average time of occupancy |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10 section 7.8.4                                                |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                                    |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 19-Jan-20                                                                       |                                |                               |                       |
| <b>Temperature:</b> 23 °C                                                                       | <b>Relative Humidity:</b> 53 % | <b>Air Pressure:</b> 1016 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                                 |                                |                               |                       |

Plot 7.4.1 Single transmission duration



Plot 7.4.2 Number of transmission within 21 s



|                                                                                         |                                |                               |                       |
|-----------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(b), RSS-247 section 5.4(a), Peak output power |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10 section 7.8.5                                        |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                            |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 19-Jan-20                                                               |                                |                               |                       |
| <b>Temperature:</b> 22 °C                                                               | <b>Relative Humidity:</b> 54 % | <b>Air Pressure:</b> 1016 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                         |                                |                               |                       |

## 7.5 Peak output power

### 7.5.1 General

This test was performed to measure the maximum peak output power at the transmitter RF antenna connector. 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)                    |                           |

\*- 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.

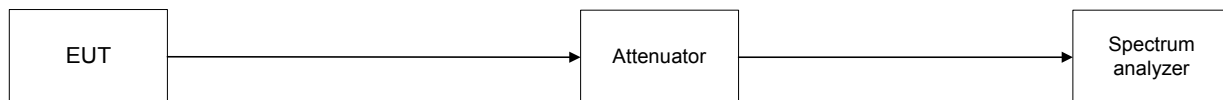
### 7.5.2 Test procedure

**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 for 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. The spectrum analyzer trace was allowed to stabilize and the maximum peak output power was measured as provided in Table 7.5.2 and associated plots.

Figure 7.5.1 Peak output power test setup





|                                                                                         |                                |                               |                       |
|-----------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(b), RSS-247 section 5.4(a), Peak output power |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10 section 7.8.5                                        |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                            | <b>Verdict:</b> PASS           |                               |                       |
| <b>Date(s):</b> 19-Jan-20                                                               |                                |                               |                       |
| <b>Temperature:</b> 22 °C                                                               | <b>Relative Humidity:</b> 54 % | <b>Air Pressure:</b> 1016 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                         |                                |                               |                       |

Table 7.5.2 Peak output power test results

ASSIGNED FREQUENCY: 902.0 – 928.0 MHz  
 MODULATION: LoRa  
 MODULATING SIGNAL: PRBS  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
 DETECTOR USED: Peak  
 RESOLUTION BANDWIDTH: 3 kHz  
 VIDEO BANDWIDTH: 30 kHz  
 FREQUENCY HOPPING: Disabled  
 NUMBER OF FREQUENCY HOPPING CHANNELS: 64

BIT RATE: 980 bps

| Carrier frequency, MHz | Spectrum analyzer reading, dBm | External attenuation, dB | Cable loss, dB | Peak output power, dBm | Limit, dBm | Margin*, dB | Verdict |
|------------------------|--------------------------------|--------------------------|----------------|------------------------|------------|-------------|---------|
| 902.3                  | 20.28                          | NA                       | NA             | 20.28                  | 24.0       | -3.72       | Pass    |
| 908.6                  | 20.14                          | NA                       | NA             | 20.14                  | 24.0       | -3.86       | Pass    |
| 914.9                  | 20.00                          | NA                       | NA             | 20.00                  | 24.0       | -4.00       | Pass    |

BIT RATE: 5470 bps

| Carrier frequency, MHz | Spectrum analyzer reading, dBm | External attenuation, dB | Cable loss, dB | Peak output power, dBm | Limit, dBm | Margin*, dB | Verdict |
|------------------------|--------------------------------|--------------------------|----------------|------------------------|------------|-------------|---------|
| 902.3                  | 20.13                          | NA                       | NA             | 20.13                  | 24.0       | -3.87       | Pass    |
| 908.6                  | 20.00                          | NA                       | NA             | 20.00                  | 24.0       | -4.00       | Pass    |
| 914.9                  | 19.87                          | NA                       | NA             | 19.87                  | 24.0       | -4.13       | Pass    |

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

#### Reference numbers of test equipment used

|         |         |  |  |  |  |  |  |
|---------|---------|--|--|--|--|--|--|
| HL 3442 | HL 3818 |  |  |  |  |  |  |
|---------|---------|--|--|--|--|--|--|

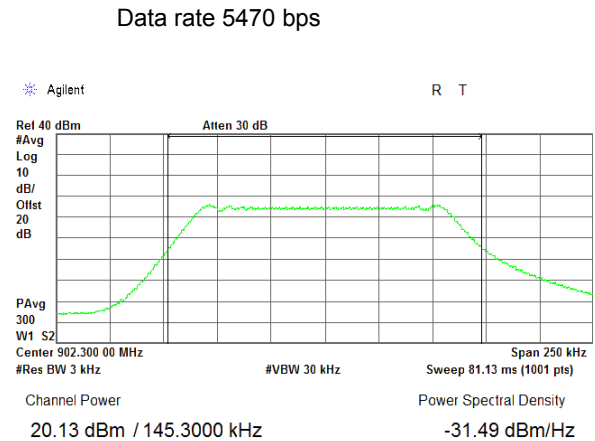
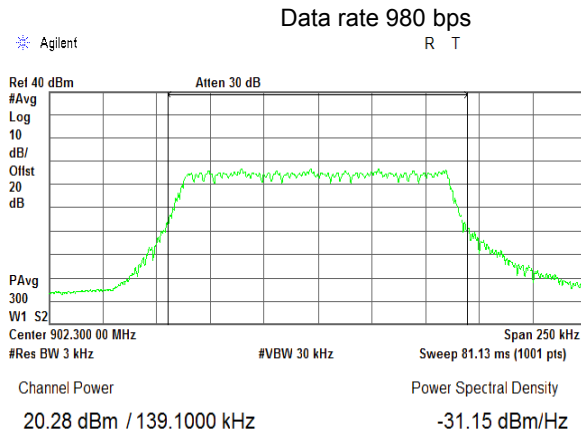
Full description is given in Appendix A.



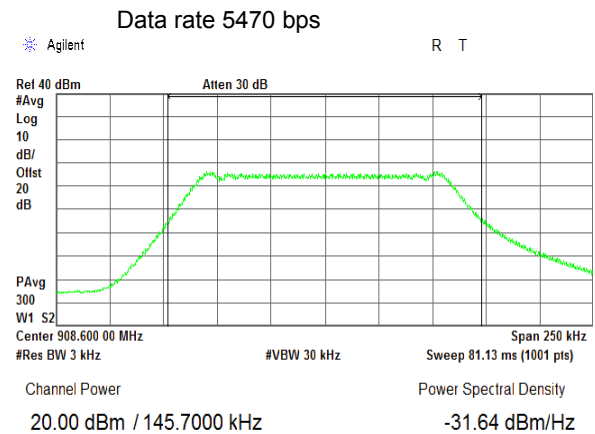
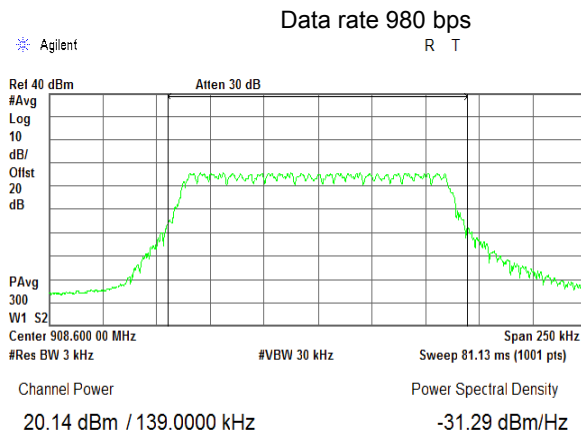
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|                                                                                  |                         |                        |                |
|----------------------------------------------------------------------------------|-------------------------|------------------------|----------------|
| Test specification: Section 15.247(b), RSS-247 section 5.4(a), Peak output power |                         |                        |                |
| Test procedure: ANSI C63.10 section 7.8.5                                        |                         |                        |                |
| Test mode: Compliance                                                            |                         | Verdict: PASS          |                |
| Date(s): 19-Jan-20                                                               |                         |                        |                |
| Temperature: 22 °C                                                               | Relative Humidity: 54 % | Air Pressure: 1016 hPa | Power: 3.6 VDC |
| Remarks:                                                                         |                         |                        |                |

Plot 7.5.1 Peak output power at low frequency



Plot 7.5.2 Peak output power at mid frequency

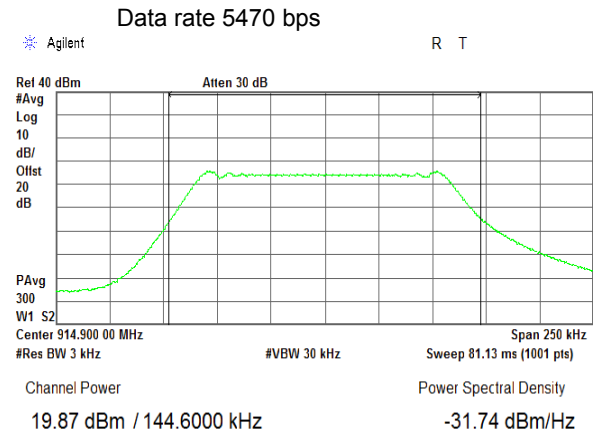
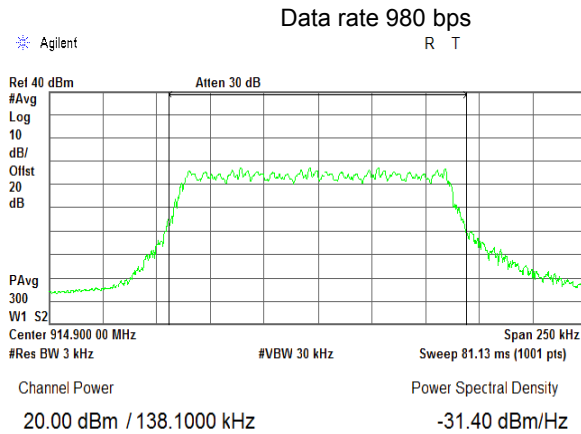




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|                     |                         |                                                              |                |
|---------------------|-------------------------|--------------------------------------------------------------|----------------|
| Test specification: |                         | Section 15.247(b), RSS-247 section 5.4(a), Peak output power |                |
| Test procedure:     |                         | ANSI C63.10 section 7.8.5                                    |                |
| Test mode:          |                         | Verdict: PASS                                                |                |
| Date(s):            |                         |                                                              |                |
| 19-Jan-20           |                         |                                                              |                |
| Temperature: 22 °C  | Relative Humidity: 54 % | Air Pressure: 1016 hPa                                       | Power: 3.6 VDC |
| Remarks:            |                         |                                                              |                |

Plot 7.5.3 Peak output power at high frequency



|                                                                                          |                                |                               |                       |
|------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(d), RSS-247 section 5.4(a), Peak power density |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10, section 11.10.5                                      |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                             |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 12-Jan-20                                                                |                                |                               |                       |
| <b>Temperature:</b> 22 °C                                                                | <b>Relative Humidity:</b> 48 % | <b>Air Pressure:</b> 1024 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                          |                                |                               |                       |

## 7.6 Peak spectral power density

### 7.6.1 General

This test was performed to measure the peak spectral power density at the transmitter RF antenna connector. Specification test limits are given in Table 7.6.1.

Table 7.6.1 Peak spectral power density limits

| Assigned frequency range,<br>MHz | Measurement bandwidth,<br>kHz | Peak spectral power density,<br>dBm |
|----------------------------------|-------------------------------|-------------------------------------|
| 902.0 – 928.0                    | 3.0                           | 8.0                                 |

### 7.6.2 Test procedure

**7.6.2.1** The EUT was set up as shown in Figure 7.6.1, energized and its proper operation was checked.

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

**7.6.2.3** The frequency span of spectrum analyzer was set to capture the entire 6 dB band of the transmitter, in peak hold mode with resolution bandwidth set to 3.0 kHz, video bandwidth wider than resolution bandwidth, auto sweep time and sufficient number of sweeps was allowed for trace stabilization. The spectrum lines spacing was verified to be wider than 3 kHz. Otherwise the resolution bandwidth was reduced until individual spectrum lines were resolved and the power of individual spectrum lines was integrated over 3 kHz band.

**7.6.2.4** The peak of emission was zoomed with span set just wide enough to capture the emission peak area and sweep time was set equal to span width divided by resolution bandwidth. Spectrum analyzer was set in peak hold mode, sufficient number of sweeps was allowed for trace stabilization and peak spectral power density was measured as provided in Table 7.6.2 and associated plots.

Figure 7.6.1 Peak spectral power density test setup





|                                                                                          |                                |                               |                       |
|------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(d), RSS-247 section 5.4(a), Peak power density |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10, section 11.10.5                                      |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                             | <b>Verdict:</b> PASS           |                               |                       |
| <b>Date(s):</b> 12-Jan-20                                                                |                                |                               |                       |
| <b>Temperature:</b> 22 °C                                                                | <b>Relative Humidity:</b> 48 % | <b>Air Pressure:</b> 1024 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                          |                                |                               |                       |

Table 7.6.2 Peak spectral power density test results

ASSIGNED FREQUENCY: 902.0 – 928.0 MHz  
 MODULATION: LoRa  
 MODULATING SIGNAL: PRBS  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
 DETECTOR USED: Average  
 RESOLUTION BANDWIDTH: 3 kHz  
 VIDEO BANDWIDTH: 10 kHz

BIT RATE: 980 bps

| Carrier frequency, MHz | Spectrum analyzer reading, dBm | External attenuation, dB | Cable loss, dB | Peak power density, dB(mW/3 kHz) | Limit, dBm | Margin*, dB | Verdict |
|------------------------|--------------------------------|--------------------------|----------------|----------------------------------|------------|-------------|---------|
| 902.3                  | 6.35                           | NA                       | NA             | 6.35                             | 8.0        | -1.65       | Pass    |
| 908.6                  | 6.09                           | NA                       | NA             | 6.09                             | 8.0        | -1.91       | Pass    |
| 914.9                  | 6.14                           | NA                       | NA             | 6.14                             | 8.0        | -1.86       | Pass    |

BIT RATE: 5470 bps

| Carrier frequency, MHz | Spectrum analyzer reading, dBm | External attenuation, dB | Cable loss, dB | Peak power density, dB(mW/3 kHz) | Limit, dBm | Margin*, dB | Verdict |
|------------------------|--------------------------------|--------------------------|----------------|----------------------------------|------------|-------------|---------|
| 902.3                  | 5.84                           | NA                       | NA             | 5.84                             | 8.0        | -2.16       | Pass    |
| 908.6                  | 5.88                           | NA                       | NA             | 5.88                             | 8.0        | -2.12       | Pass    |
| 914.9                  | 5.93                           | NA                       | NA             | 5.93                             | 8.0        | -2.07       | Pass    |

\* - Margin = Peak power density – specification limit.

#### Reference numbers of test equipment used

|         |         |  |  |  |  |  |  |
|---------|---------|--|--|--|--|--|--|
| HL 3442 | HL 3818 |  |  |  |  |  |  |
|---------|---------|--|--|--|--|--|--|

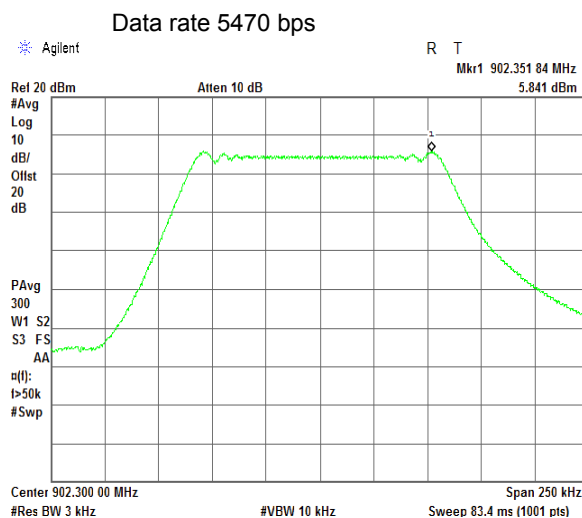
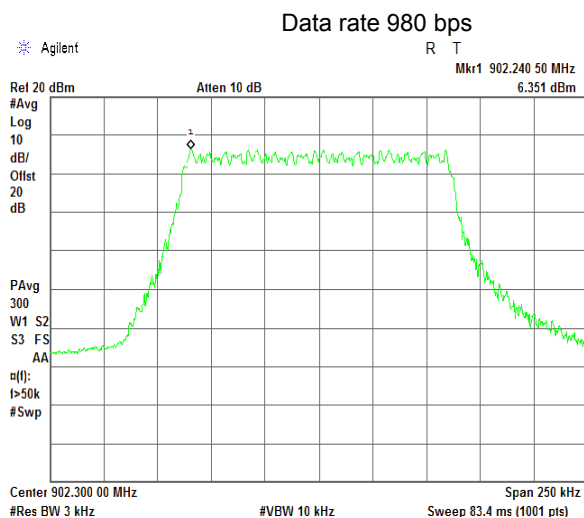
Full description is given in Appendix A.



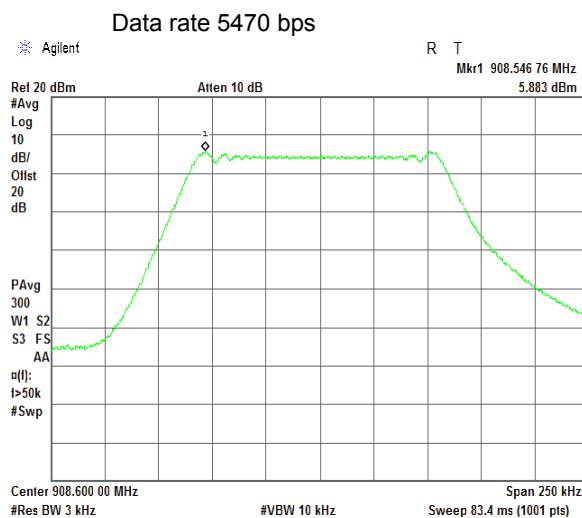
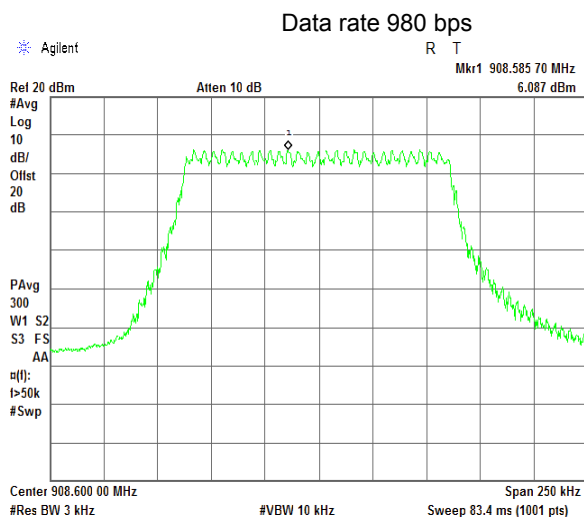
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|                                                                                   |                         |                        |                |
|-----------------------------------------------------------------------------------|-------------------------|------------------------|----------------|
| Test specification: Section 15.247(d), RSS-247 section 5.4(a), Peak power density |                         |                        |                |
| Test procedure: ANSI C63.10, section 11.10.5                                      |                         |                        |                |
| Test mode: Compliance                                                             |                         | Verdict: PASS          |                |
| Date(s): 12-Jan-20                                                                |                         |                        |                |
| Temperature: 22 °C                                                                | Relative Humidity: 48 % | Air Pressure: 1024 hPa | Power: 3.6 VDC |
| Remarks:                                                                          |                         |                        |                |

Plot 7.6.1 Peak spectral power density at low frequency

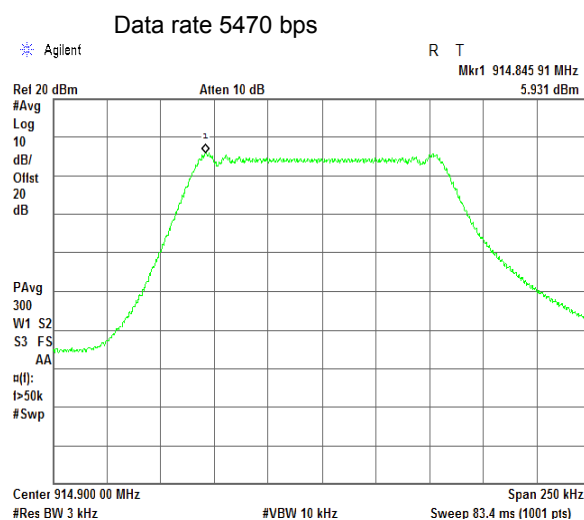
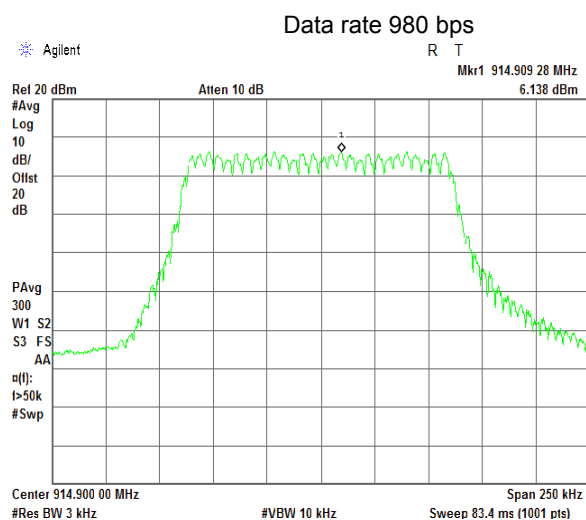


Plot 7.6.2 Peak spectral power density at mid frequency



|                                                                                          |                                |                               |                       |
|------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(d), RSS-247 section 5.4(a), Peak power density |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10, section 11.10.5                                      |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                             |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 12-Jan-20                                                                |                                |                               |                       |
| <b>Temperature:</b> 22 °C                                                                | <b>Relative Humidity:</b> 48 % | <b>Air Pressure:</b> 1024 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                          |                                |                               |                       |

Plot 7.6.3 Peak spectral power density at high frequency





|                                                                                         |                         |                        |                |
|-----------------------------------------------------------------------------------------|-------------------------|------------------------|----------------|
| Test specification: Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions |                         |                        |                |
| Test procedure: ANCI C63.10 section 6.5 & 6.6                                           |                         |                        |                |
| Test mode: Compliance                                                                   |                         | Verdict: PASS          |                |
| Date(s): 12-Jan-20                                                                      |                         |                        |                |
| Temperature: 22 °C                                                                      | Relative Humidity: 48 % | Air Pressure: 1024 hPa | Power: 3.6 VDC |
| Remarks:                                                                                |                         |                        |                |

## 7.7 Field strength of spurious emissions

### 7.7.1 General

This test was performed to measure field strength of spurious emissions from the EUT. Specification test limits are given in Table 7.7.1

Table 7.7.1 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 <sup>th</sup> harmonic | 74.0                                                     | NA              | 54.0            |                                                                                           |

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

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

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

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

\*\*\* - 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.

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

7.7.2.1 The EUT was set up as shown in Figure 7.7.1 energized and the performance check was conducted.

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

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

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

7.7.3.1 The EUT was set up as shown in Figure 7.7.2, Figure 7.7.3, energized and the performance check was conducted.

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

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

|                                                                                         |                         |                        |                |
|-----------------------------------------------------------------------------------------|-------------------------|------------------------|----------------|
| Test specification: Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions |                         |                        |                |
| Test procedure: ANCI C63.10 section 6.5 & 6.6                                           |                         |                        |                |
| Test mode: Compliance                                                                   |                         | Verdict: PASS          |                |
| Date(s): 12-Jan-20                                                                      |                         |                        |                |
| Temperature: 22 °C                                                                      | Relative Humidity: 48 % | Air Pressure: 1024 hPa | Power: 3.6 VDC |
| Remarks:                                                                                |                         |                        |                |

Figure 7.7.1 Setup for spurious emission field strength measurements below 30 MHz

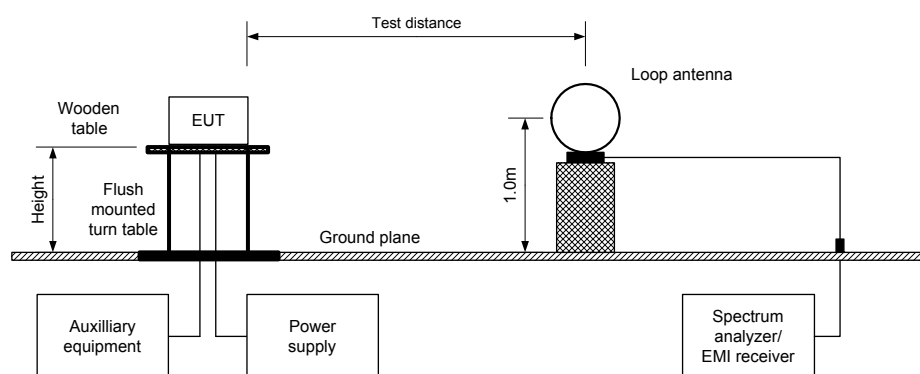
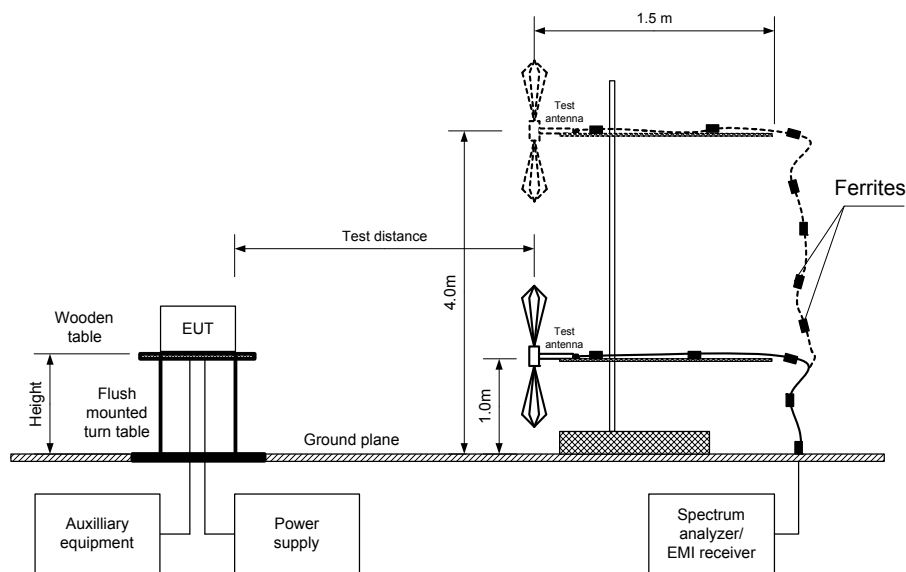
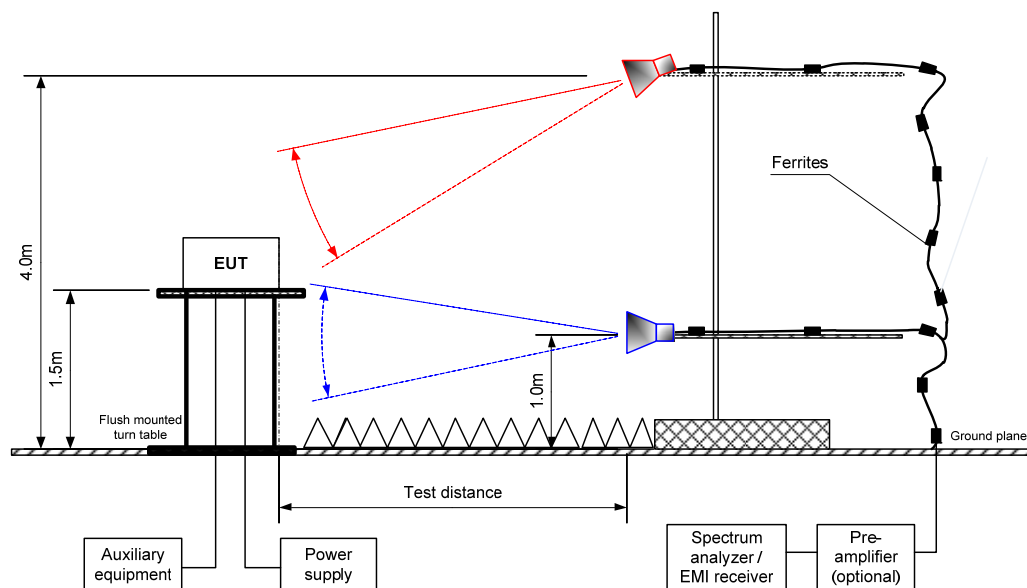


Figure 7.7.2 Setup for spurious emission field strength measurements in 30 – 1000 MHz



|                                                                                                |                                |                               |                       |
|------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions |                                |                               |                       |
| <b>Test procedure:</b> ANCI C63.10 section 6.5 & 6.6                                           |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                                   |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 12-Jan-20                                                                      |                                |                               |                       |
| <b>Temperature:</b> 22 °C                                                                      | <b>Relative Humidity:</b> 48 % | <b>Air Pressure:</b> 1024 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                                |                                |                               |                       |

Figure 7.7.3 Setup for spurious emission field strength measurements above 1000 MHz





|                                                                                                |                                |                               |                       |
|------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions |                                |                               |                       |
| <b>Test procedure:</b> ANCI C63.10 section 6.5 & 6.6                                           |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                                   |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 12-Jan-20                                                                      |                                |                               |                       |
| <b>Temperature:</b> 22 °C                                                                      | <b>Relative Humidity:</b> 48 % | <b>Air Pressure:</b> 1024 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                                |                                |                               |                       |

Table 7.7.2 Field strength of emissions outside restricted bands

ASSIGNED FREQUENCY: 902.0 – 928.0 MHz  
 INVESTIGATED FREQUENCY RANGE: 0.009 – 9500 MHz  
 TEST DISTANCE: 3 m  
 MODULATION: LoRa  
 MODULATING SIGNAL: PRBS  
 BIT RATE: 980 bps  
 DUTY CYCLE: 100 %  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
 DETECTOR USED: Peak  
 RESOLUTION BANDWIDTH: 100 kHz  
 VIDEO BANDWIDTH: 300 kHz  
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)  
 Biconilog (30 MHz – 1000 MHz)  
 Double ridged guide (above 1000 MHz)

| Double ended guide (above 1000 MHz) |                                      |                      |                   |                   |                                     |                                |            |              |         |
|-------------------------------------|--------------------------------------|----------------------|-------------------|-------------------|-------------------------------------|--------------------------------|------------|--------------|---------|
| Frequency, MHz                      | Field strength of spurious, dB(μV/m) | Antenna polarization | Antenna height, m | Azimuth, degrees* | Field strength of carrier, dB(μV/m) | Attenuation below carrier, dBc | Limit, dBc | Margin, dB** | Verdict |
| Low carrier frequency 902.3 MHz     |                                      |                      |                   |                   |                                     |                                |            |              |         |
| 1804.383                            | 47.29                                | Vertical             | 1.54              | 147               | 113.56                              | 66.27                          | 20.0       | 46.27        | Pass    |
| 6313.400                            | 47.97                                | Vertical             | 1.54              | 307               |                                     | 65.59                          |            | 45.59        |         |
| Mid carrier frequency 908.6 MHz     |                                      |                      |                   |                   |                                     |                                |            |              |         |
| 1817.133                            | 46.41                                | Vertical             | 1.79              | 192               | 113.08                              | 66.67                          | 20.0       | 46.67        | Pass    |
| 6359.817                            | 46.65                                | Vertical             | 3.37              | 358               |                                     | 66.43                          |            | 46.43        |         |
| High carrier frequency 914.9 MHz    |                                      |                      |                   |                   |                                     |                                |            |              |         |
| 1829.600                            | 45.12                                | Vertical             | 2.06              | 298               | 112.55                              | 67.43                          | 20.0       | 47.43        | Pass    |
| 5489.133                            | 46.27                                | Vertical             | 2.33              | 138               |                                     | 66.28                          |            | 46.28        |         |
| 6403.583                            | 50.03                                | Vertical             | 1.54              | 167               |                                     | 62.52                          |            | 42.52        |         |

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

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



|                                                                                                |                                |                               |                       |
|------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions |                                |                               |                       |
| <b>Test procedure:</b> ANCI C63.10 section 6.5 & 6.6                                           |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                                   |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 12-Jan-20                                                                      |                                |                               |                       |
| <b>Temperature:</b> 22 °C                                                                      | <b>Relative Humidity:</b> 48 % | <b>Air Pressure:</b> 1024 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                                |                                |                               |                       |

Table 7.7.3 Field strength of spurious emissions above 1 GHz within restricted bands

ASSIGNED FREQUENCY: 902.0 – 928.0 MHz  
 INVESTIGATED FREQUENCY RANGE: 1000 - 9500 MHz  
 TEST DISTANCE: 3 m  
 MODULATION: LoRa  
 MODULATING SIGNAL: PRBS  
 BIT RATE: 980 bps  
 DUTY CYCLE: 100 %  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
 DETECTOR USED: Peak  
 RESOLUTION BANDWIDTH: 1000 kHz  
 TEST ANTENNA TYPE: Double ridged guide

| Frequency,<br>MHz                | Antenna      |              | Azimuth,<br>degrees* | Peak field strength(VBW=3 MHz) |                    |                 | Average field strength(VBW=10 Hz) |                         |                    |                  | Verdict |
|----------------------------------|--------------|--------------|----------------------|--------------------------------|--------------------|-----------------|-----------------------------------|-------------------------|--------------------|------------------|---------|
|                                  | Polarization | Height,<br>m |                      | Measured,<br>dB(μV/m)          | Limit,<br>dB(μV/m) | Margin,<br>dB** | Measured,<br>dB(μV/m)             | Calculated,<br>dB(μV/m) | Limit,<br>dB(μV/m) | Margin,<br>dB*** |         |
| Low carrier frequency 902.3 MHz  |              |              |                      |                                |                    |                 |                                   |                         |                    |                  |         |
| 2706.583                         | Vertical     | 1.28         | 223                  | 52.88                          | 74.0               | -21.12          | 49.32                             | NA                      | 54.0               | -4.68            | Pass    |
| 3609.000                         | Vertical     | 1.54         | 281                  | 41.24                          | 74.0               | -32.76          | 31.40                             | NA                      | 54.0               | -22.60           |         |
| 5413.267                         | Vertical     | 2.06         | 37                   | 44.91                          | 74.0               | -29.09          | 33.66                             | NA                      | 54.0               | -20.34           |         |
| Mid carrier frequency 908.6 MHz  |              |              |                      |                                |                    |                 |                                   |                         |                    |                  |         |
| 2725.500                         | Horizontal   | 2.32         | 220                  | 53.53                          | 74.0               | -20.47          | 50.31                             | NA                      | 54.0               | -3.69            | Pass    |
| 3633.933                         | Vertical     | 2.32         | 0                    | 40.34                          | 74.0               | -33.66          | 28.98                             | NA                      | 54.0               | -25.02           |         |
| 5451.450                         | Vertical     | 1.28         | 168                  | 44.18                          | 74.0               | -29.82          | 34.91                             | NA                      | 54.0               | -19.09           |         |
| High carrier frequency 914.9 MHz |              |              |                      |                                |                    |                 |                                   |                         |                    |                  |         |
| 2744.767                         | Vertical     | 2.06         | 261                  | 52.85                          | 74.0               | -21.15          | 51.12                             | NA                      | 54.0               | -2.88            | Pass    |
| 3659.367                         | Vertical     | 2.07         | 198                  | 41.11                          | 74.0               | -32.89          | 32.42                             | NA                      | 54.0               | -21.58           |         |
| 7319.183                         | Vertical     | 1.28         | 336                  | 48.72                          | 74.0               | -25.28          | 35.00                             | NA                      | 54.0               | -19.00           |         |
| 9152.017                         | Vertical     | 2.58         | 179                  | 47.16                          | 74.0               | -26.84          | 34.68                             | NA                      | 54.0               | -19.32           |         |

\*- 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 7.7.4 Average factor calculation

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

\*- Average factor was calculated as follows

for pulse train shorter than 100 ms:

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

for pulse train longer than 100 ms:

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



|                                                                                                |                                |                               |                       |
|------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions |                                |                               |                       |
| <b>Test procedure:</b> ANCI C63.10 section 6.5 & 6.6                                           |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                                   |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 12-Jan-20                                                                      |                                |                               |                       |
| <b>Temperature:</b> 22 °C                                                                      | <b>Relative Humidity:</b> 48 % | <b>Air Pressure:</b> 1024 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                                |                                |                               |                       |

Table 7.7.5 Field strength of spurious emissions below 1 GHz within restricted bands

|                                    |                               |
|------------------------------------|-------------------------------|
| ASSIGNED FREQUENCY:                | 902.0 – 928.0MHz              |
| INVESTIGATED FREQUENCY RANGE:      | 0.009 – 1000 MHz              |
| TEST DISTANCE:                     | 3 m                           |
| MODULATION:                        | LoRa                          |
| MODULATING SIGNAL:                 | PRBS                          |
| BIT RATE:                          | 980 bps                       |
| DUTY CYCLE:                        | 100 %                         |
| TRANSMITTER OUTPUT POWER SETTINGS: | Maximum                       |
| RESOLUTION BANDWIDTH:              | 0.2 kHz (9 kHz – 150 kHz)     |
|                                    | 9.0 kHz (150 kHz – 30 MHz)    |
|                                    | 120 kHz (30 MHz – 1000 MHz)   |
| VIDEO BANDWIDTH:                   | > Resolution bandwidth        |
| TEST ANTENNA TYPE:                 | Active loop (9 kHz – 30 MHz)  |
|                                    | Biconilog (30 MHz – 1000 MHz) |

| Frequency, MHz                   | Peak emission, dB(μV/m) | Quasi-peak                  |                 |             | Antenna polarization | Antenna height, m | Turn-table position**, degrees | Verdict |
|----------------------------------|-------------------------|-----------------------------|-----------------|-------------|----------------------|-------------------|--------------------------------|---------|
|                                  |                         | Measured emission, dB(μV/m) | Limit, dB(μV/m) | Margin, dB* |                      |                   |                                |         |
| Low carrier frequency 902.3 MHz  |                         |                             |                 |             |                      |                   |                                |         |
| No emissions were found          |                         |                             |                 |             |                      |                   |                                | Pass    |
| Mid carrier frequency 908.6 MHz  |                         |                             |                 |             |                      |                   |                                |         |
| No emissions were found          |                         |                             |                 |             |                      |                   |                                | Pass    |
| High carrier frequency 914.9 MHz |                         |                             |                 |             |                      |                   |                                |         |
| No emissions were found          |                         |                             |                 |             |                      |                   |                                | Pass    |

\*- Margin = Measured emission - specification limit.

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



|                                                                                                |                                |                               |                       |
|------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions |                                |                               |                       |
| <b>Test procedure:</b> ANCI C63.10 section 6.5 & 6.6                                           |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                                   |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 12-Jan-20                                                                      |                                |                               |                       |
| <b>Temperature:</b> 22 °C                                                                      | <b>Relative Humidity:</b> 48 % | <b>Air Pressure:</b> 1024 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                                |                                |                               |                       |

Table 7.7.6 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 7.7.7 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    |

Reference numbers of test equipment used

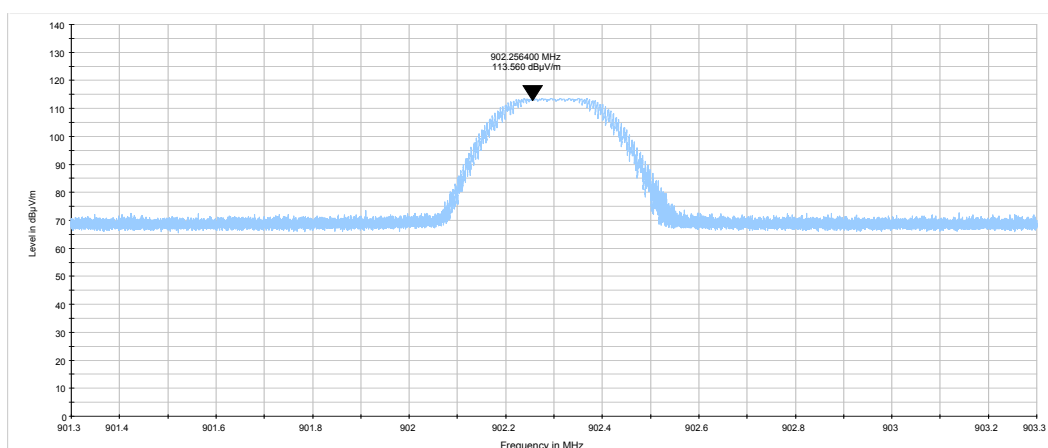
|         |         |         |         |         |         |  |  |
|---------|---------|---------|---------|---------|---------|--|--|
| HL 0446 | HL 3903 | HL 4933 | HL 5288 | HL 5372 | HL 5665 |  |  |
|---------|---------|---------|---------|---------|---------|--|--|

Full description is given in Appendix A.

|                                                                                         |                         |                        |                |
|-----------------------------------------------------------------------------------------|-------------------------|------------------------|----------------|
| Test specification: Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions |                         |                        |                |
| Test procedure: ANCI C63.10 section 6.5 & 6.6                                           |                         |                        |                |
| Test mode: Compliance                                                                   |                         | Verdict: PASS          |                |
| Date(s): 12-Jan-20                                                                      |                         |                        |                |
| Temperature: 22 °C                                                                      | Relative Humidity: 48 % | Air Pressure: 1024 hPa | Power: 3.6 VDC |
| Remarks:                                                                                |                         |                        |                |

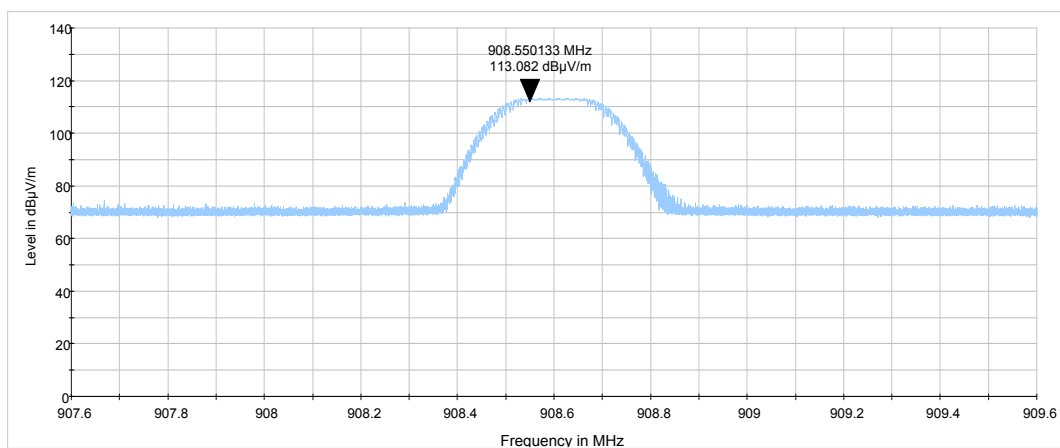
**Plot 7.7.1 Radiated emission measurements at the low carrier frequency**

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



**Plot 7.7.2 Radiated emission measurements at the mid carrier frequency**

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



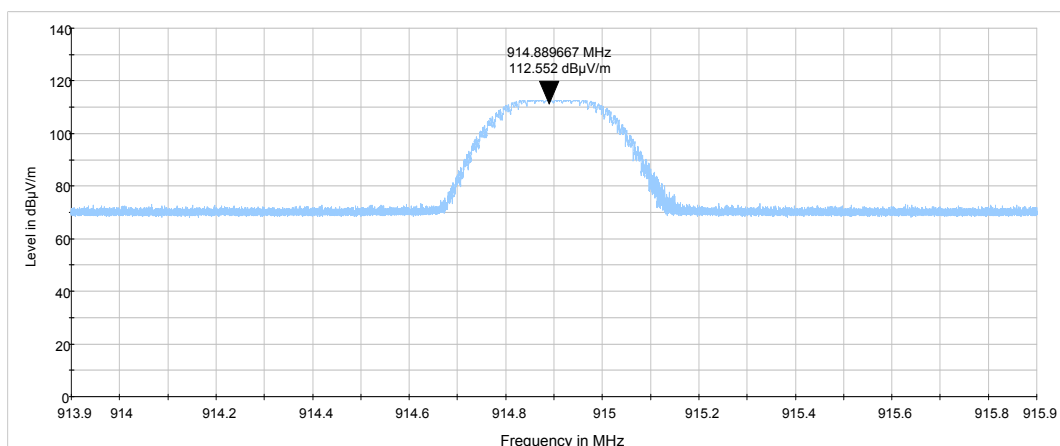


HERMON LABORATORIES

|                                                                                         |                         |                        |                |
|-----------------------------------------------------------------------------------------|-------------------------|------------------------|----------------|
| Test specification: Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions |                         |                        |                |
| Test procedure: ANCI C63.10 section 6.5 & 6.6                                           |                         |                        |                |
| Test mode: Compliance                                                                   |                         | Verdict: PASS          |                |
| Date(s): 12-Jan-20                                                                      |                         |                        |                |
| Temperature: 22 °C                                                                      | Relative Humidity: 48 % | Air Pressure: 1024 hPa | Power: 3.6 VDC |
| Remarks:                                                                                |                         |                        |                |

Plot 7.7.3 Radiated emission measurements at the high carrier frequency

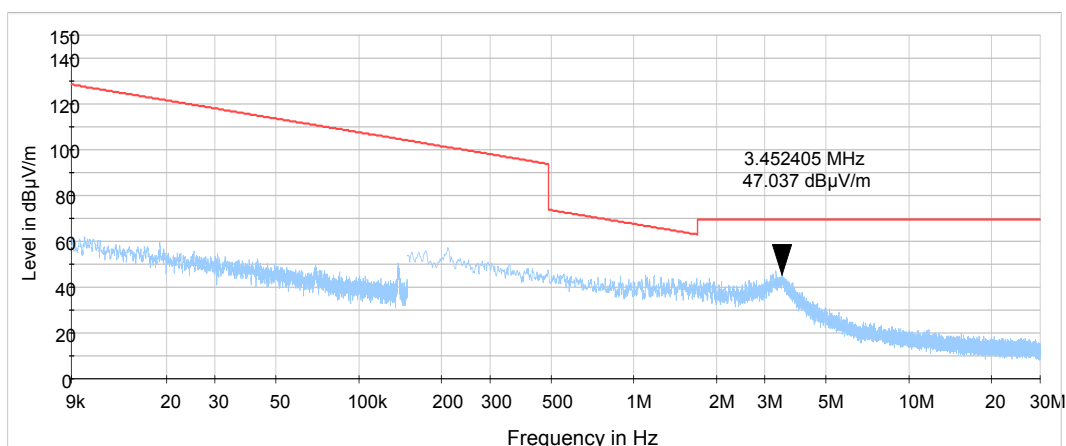
TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and horizontal



|                                                                                                |                                |                               |                       |
|------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions |                                |                               |                       |
| <b>Test procedure:</b> ANCI C63.10 section 6.5 & 6.6                                           |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                                   |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 12-Jan-20                                                                      |                                |                               |                       |
| <b>Temperature:</b> 22 °C                                                                      | <b>Relative Humidity:</b> 48 % | <b>Air Pressure:</b> 1024 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                                |                                |                               |                       |

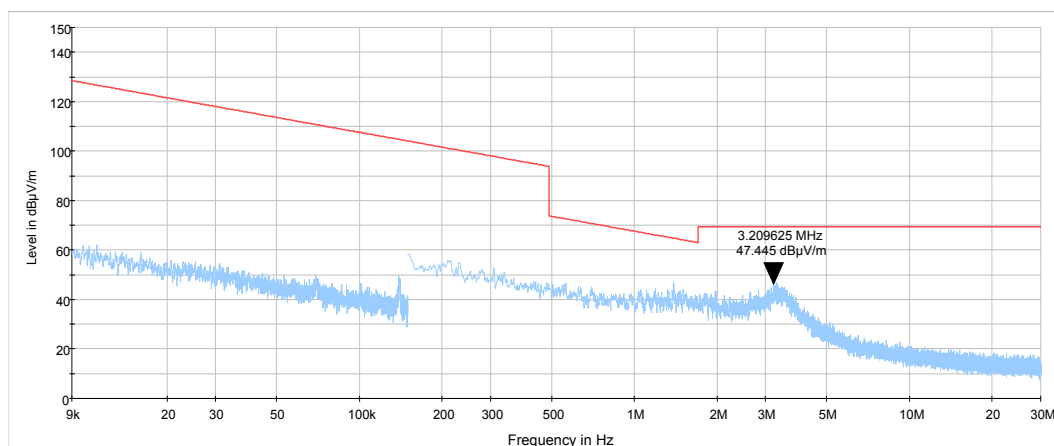
**Plot 7.7.4 Radiated emission measurements from 9 kHz to 30 MHz at the low carrier frequency**

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



**Plot 7.7.5 Radiated emission measurements from 9 kHz to 30 MHz at the mid carrier frequency**

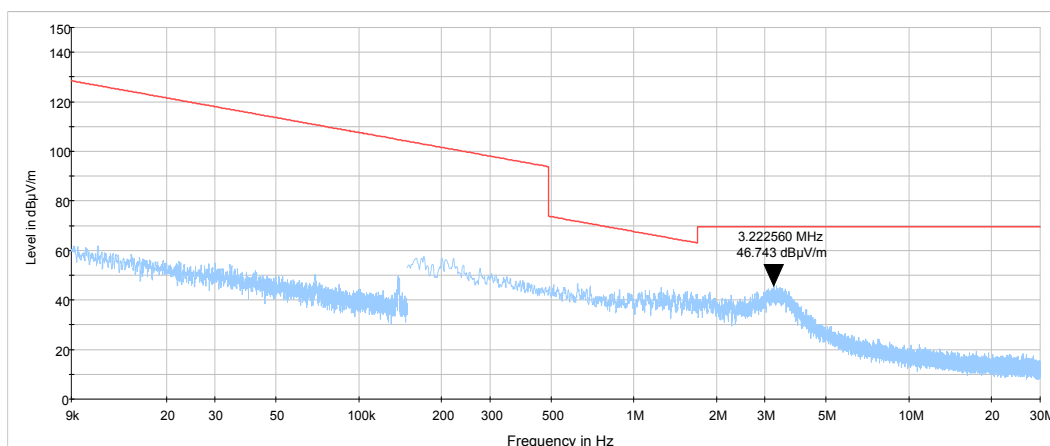
TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical



|                                                                                                |                                |                               |                       |
|------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions |                                |                               |                       |
| <b>Test procedure:</b> ANCI C63.10 section 6.5 & 6.6                                           |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                                   |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 12-Jan-20                                                                      |                                |                               |                       |
| <b>Temperature:</b> 22 °C                                                                      | <b>Relative Humidity:</b> 48 % | <b>Air Pressure:</b> 1024 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                                |                                |                               |                       |

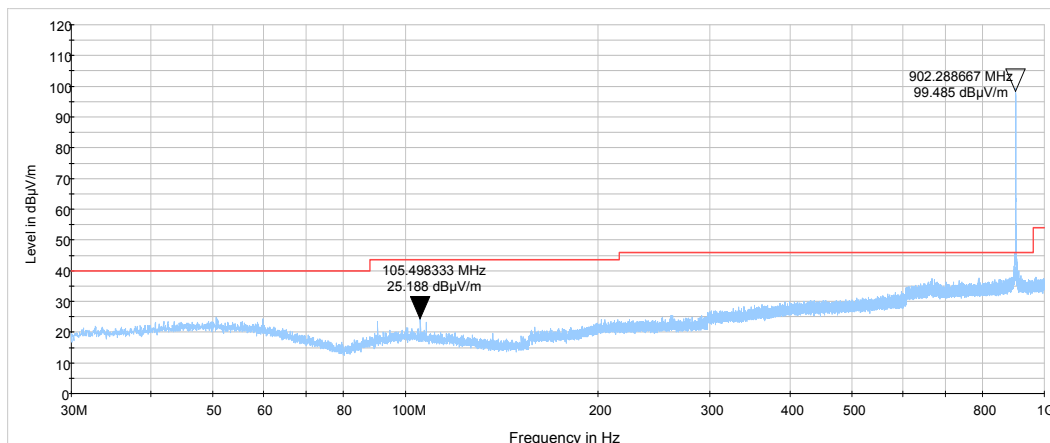
**Plot 7.7.6 Radiated emission measurements from 9 kHz to 30 MHz at the high carrier frequency**

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



**Plot 7.7.7 Radiated emission measurements from 30 to 1000 MHz at the low carrier frequency**

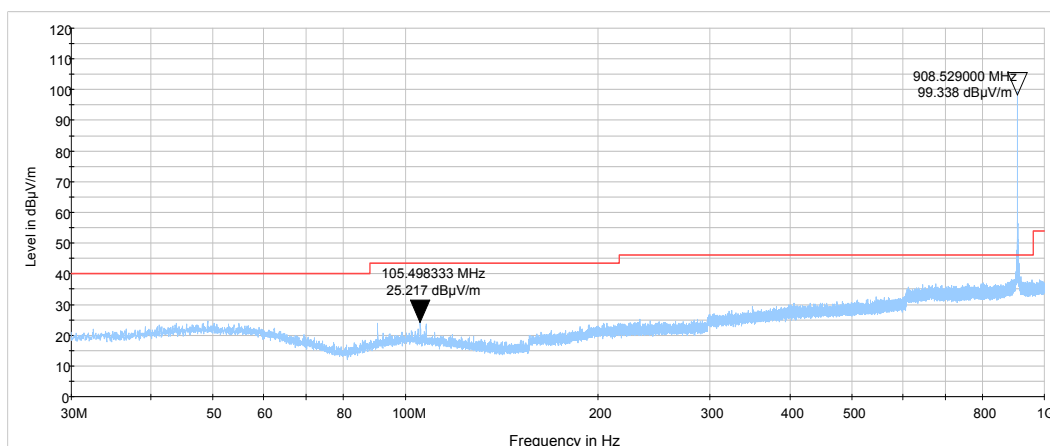
TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal



|                                                                                                |                                |                               |                       |
|------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions |                                |                               |                       |
| <b>Test procedure:</b> ANCI C63.10 section 6.5 & 6.6                                           |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                                   |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 12-Jan-20                                                                      |                                |                               |                       |
| <b>Temperature:</b> 22 °C                                                                      | <b>Relative Humidity:</b> 48 % | <b>Air Pressure:</b> 1024 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                                |                                |                               |                       |

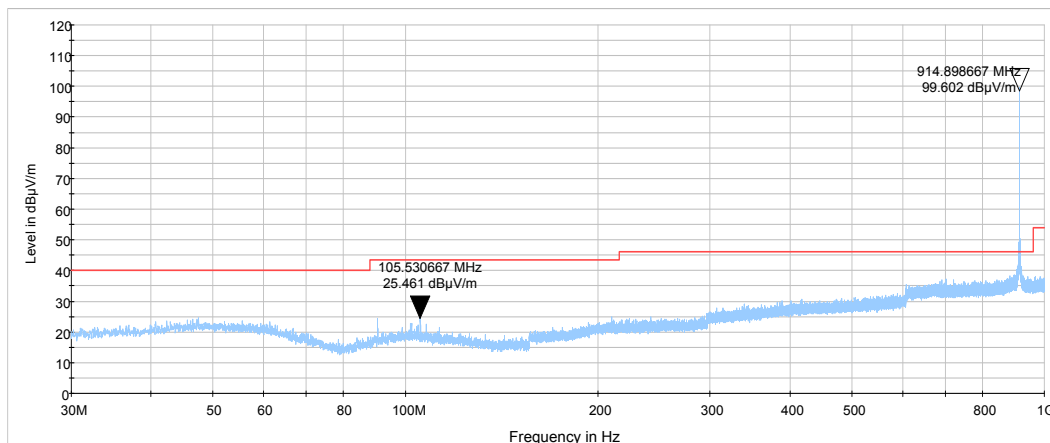
**Plot 7.7.8 Radiated emission measurements from 30 to 1000 MHz at the mid carrier frequency**

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



**Plot 7.7.9 Radiated emission measurements from 30 to 1000 MHz at the high carrier frequency**

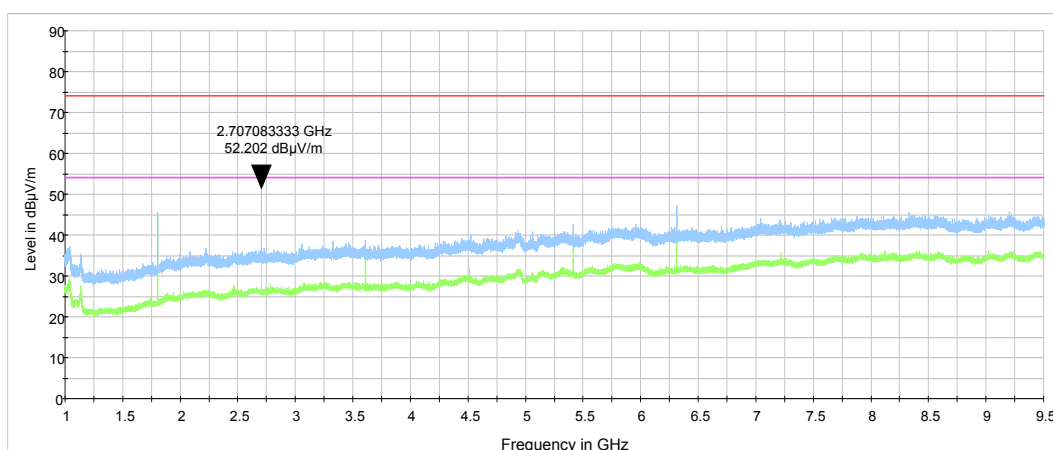
TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal



|                                                                                                |                                |                               |                       |
|------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions |                                |                               |                       |
| <b>Test procedure:</b> ANCI C63.10 section 6.5 & 6.6                                           |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                                   |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 12-Jan-20                                                                      |                                |                               |                       |
| <b>Temperature:</b> 22 °C                                                                      | <b>Relative Humidity:</b> 48 % | <b>Air Pressure:</b> 1024 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                                |                                |                               |                       |

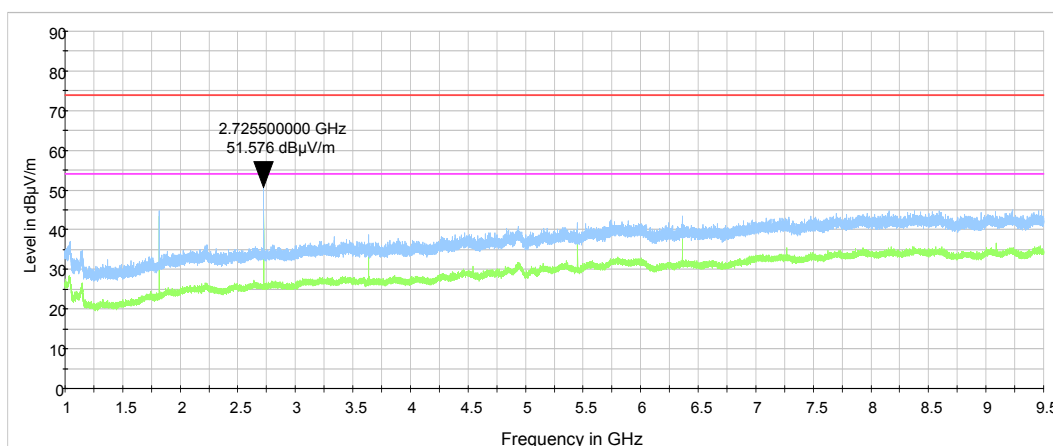
**Plot 7.7.10 Radiated emission measurements from 1000 to 9500 MHz at the low carrier frequency**

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



**Plot 7.7.11 Radiated emission measurements from 1000 to 9500 MHz at the mid carrier frequency**

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



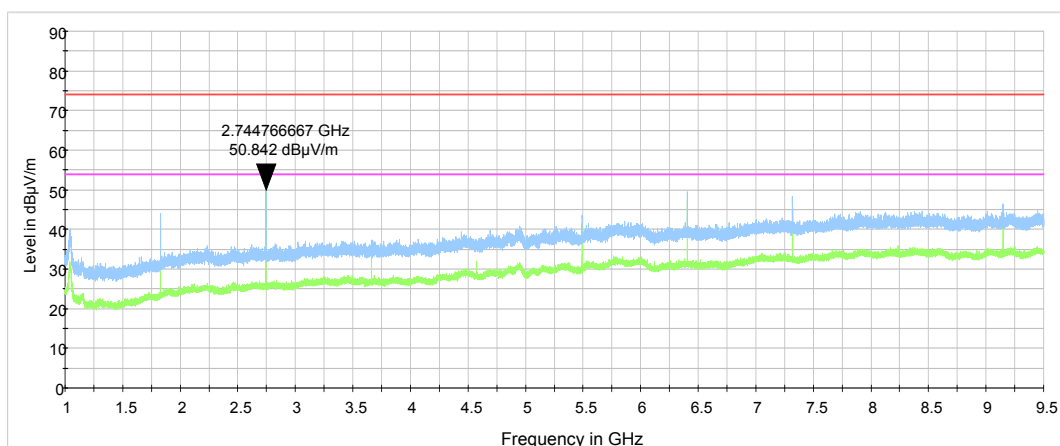


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|                                                                                         |                         |                        |                |
|-----------------------------------------------------------------------------------------|-------------------------|------------------------|----------------|
| Test specification: Section 15.247(d), RSS-247 section 5.5, Radiated spurious emissions |                         |                        |                |
| Test procedure: ANCI C63.10 section 6.5 & 6.6                                           |                         |                        |                |
| Test mode: Compliance                                                                   |                         | Verdict: PASS          |                |
| Date(s): 12-Jan-20                                                                      |                         |                        |                |
| Temperature: 22 °C                                                                      | Relative Humidity: 48 % | Air Pressure: 1024 hPa | Power: 3.6 VDC |
| Remarks:                                                                                |                         |                        |                |

Plot 7.7.12 Radiated emission measurements from 1000 to 9500 MHz at the high carrier frequency

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



|                                                                                            |                                |                               |                       |
|--------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(d), RSS-247 section 5.5, Emissions at band edges |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10 section 6.10                                            |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                               |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 14-Jan-20                                                                  |                                |                               |                       |
| <b>Temperature:</b> 25 °C                                                                  | <b>Relative Humidity:</b> 41 % | <b>Air Pressure:</b> 1025 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                            |                                |                               |                       |

## 7.8 Band edge emissions at RF antenna connector

### 7.8.1 General

This test was performed to measure band edge emissions at RF antenna connector. Specification test limits are given in Table 7.8.1.

Table 7.8.1 Band edge emission limits

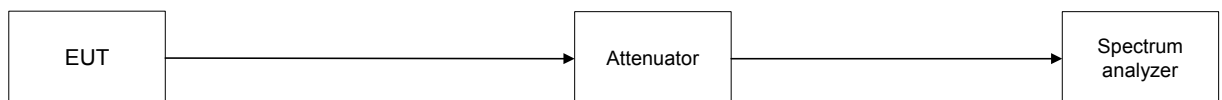
| Assigned frequency, MHz | Attenuation below carrier*, dBc |
|-------------------------|---------------------------------|
| 902.0 – 928.0           | 20.0                            |

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

### 7.8.2 Test procedure

- 7.8.2.1 The EUT was set up as shown in Figure 7.8.1, energized normally modulated at the maximum data rate with its hopping function disabled and its proper operation was checked.
- 7.8.2.2 The EUT was adjusted to produce maximum available to end user RF output power at the lowest carrier frequency.
- 7.8.2.3 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.
- 7.8.2.4 The spectrum analyzer was set in max hold mode and allowed trace to stabilize. The highest emission level within the authorized band was measured.
- 7.8.2.5 The maximum band edge emission and modulation product outside of the band were measured as provided in Table 7.8.2 and associated plots and referenced to the highest emission level measured within the authorized band.
- 7.8.2.6 The above procedure was repeated with the EUT adjusted to produce maximum RF output power at the highest carrier frequency.
- 7.8.2.7 The above procedure was repeated with the frequency hopping function enabled.

Figure 7.8.1 Band edge emission test setup





|                                                                                            |                                |                               |                       |
|--------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(d), RSS-247 section 5.5, Emissions at band edges |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10 section 6.10                                            |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                               |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 14-Jan-20                                                                  |                                |                               |                       |
| <b>Temperature:</b> 25 °C                                                                  | <b>Relative Humidity:</b> 41 % | <b>Air Pressure:</b> 1025 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                            |                                |                               |                       |

Table 7.8.2 Band edge emission test results

ASSIGNED FREQUENCY RANGE: 902.0 – 928.0 MHz  
 DETECTOR USED: Peak  
 MODULATION: LoRa  
 MODULATING SIGNAL: PRBS  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
 RESOLUTION BANDWIDTH:  $\geq 1\%$  of the span  
 VIDEO BANDWIDTH:  $\geq$  RBW

BIT RATE: 980 bps

| Frequency, MHz             | Band edge emission, dBm | Emission at carrier, dBm | Attenuation below carrier, dBc | Limit, dBc | Margin, dB* | Verdict |
|----------------------------|-------------------------|--------------------------|--------------------------------|------------|-------------|---------|
| Frequency hopping disabled |                         |                          |                                |            |             |         |
| 902.3                      | -28.29                  | 20.23                    | 48.52                          | 20.0       | 28.52       | Pass    |
| 914.9                      | -44.66                  | 19.97                    | 64.63                          |            | 44.63       |         |
| Frequency hopping enabled  |                         |                          |                                |            |             |         |
| 902.3                      | -30.42                  | 21.26                    | 51.68                          | 20.0       | 31.68       | Pass    |
| 914.9                      | -42.72                  | 21.10                    | 63.82                          |            | 43.82       |         |

BIT RATE: 5470 bps

| 0.45 dBc                   |                         |                          |                                |            |             |         |
|----------------------------|-------------------------|--------------------------|--------------------------------|------------|-------------|---------|
| Frequency, MHz             | Band edge emission, dBm | Emission at carrier, dBm | Attenuation below carrier, dBc | Limit, dBc | Margin, dB* | Verdict |
| Frequency hopping disabled |                         |                          |                                |            |             |         |
| 902.3                      | -28.25                  | 20.23                    | 48.48                          | 20.0       | 28.48       | Pass    |
| 914.9                      | -43.84                  | 19.99                    | 63.83                          |            | 43.83       |         |
| Frequency hopping enabled  |                         |                          |                                |            |             |         |
| 902.3                      | -31.72                  | 21.33                    | 53.05                          | 20.0       | 33.05       | Pass    |
| 914.9                      | -42.88                  | 21.11                    | 63.99                          |            | 43.99       |         |

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

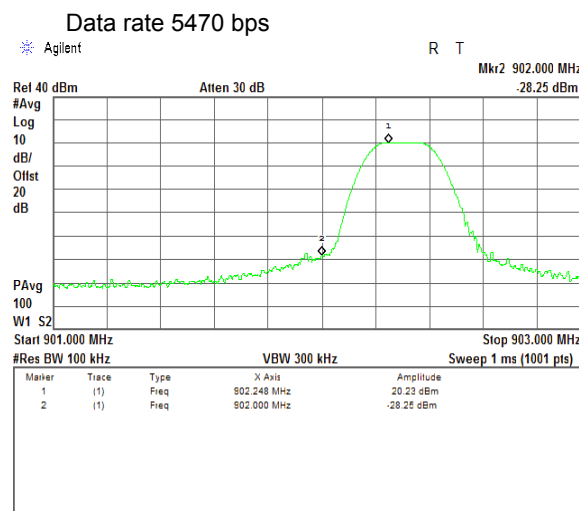
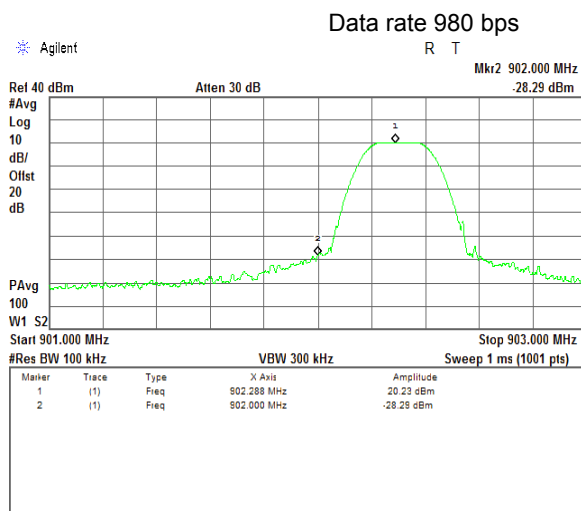
#### Reference numbers of test equipment used

|         |         |  |  |  |  |  |  |
|---------|---------|--|--|--|--|--|--|
| HL 3442 | HL 3818 |  |  |  |  |  |  |
|---------|---------|--|--|--|--|--|--|

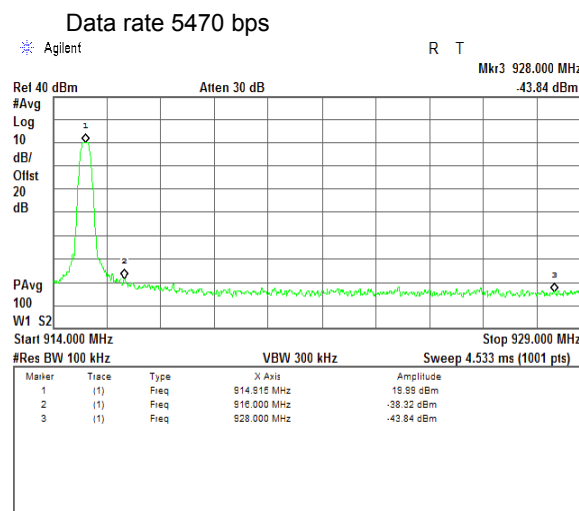
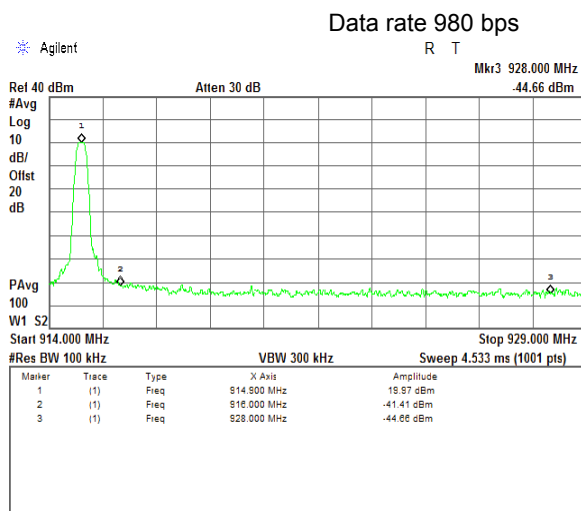
Full description is given in Appendix A.

|                                                                                            |                                |                               |                       |
|--------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(d), RSS-247 section 5.5, Emissions at band edges |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10 section 6.10                                            |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                               |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 14-Jan-20                                                                  |                                |                               |                       |
| <b>Temperature:</b> 25 °C                                                                  | <b>Relative Humidity:</b> 41 % | <b>Air Pressure:</b> 1025 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                            |                                |                               |                       |

Plot 7.8.1 The lowest band edge emission at low carrier frequency with hopping function disabled

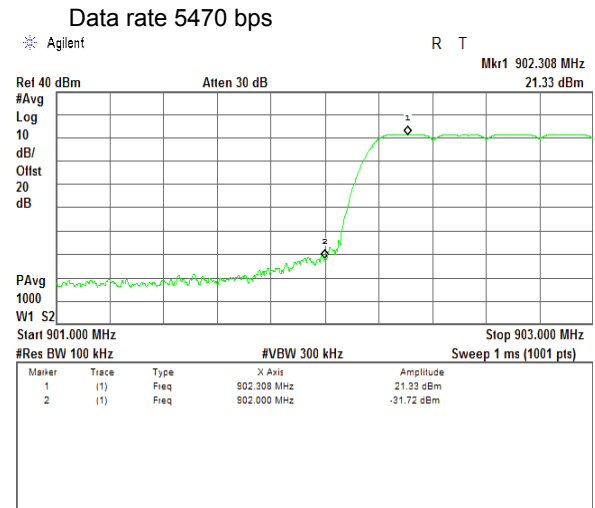
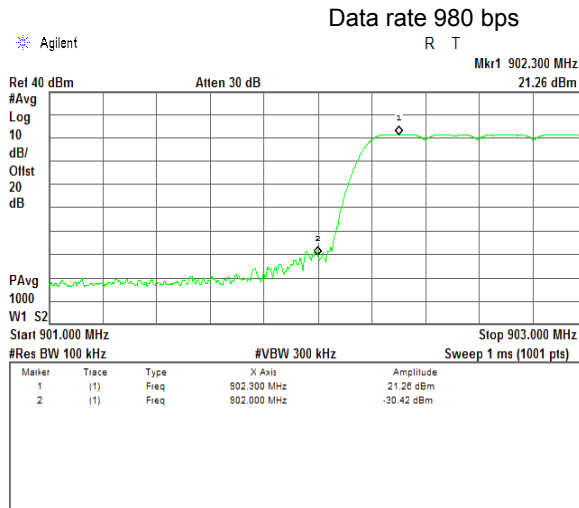


Plot 7.8.2 The highest band edge emission at high carrier frequency with hopping function disabled

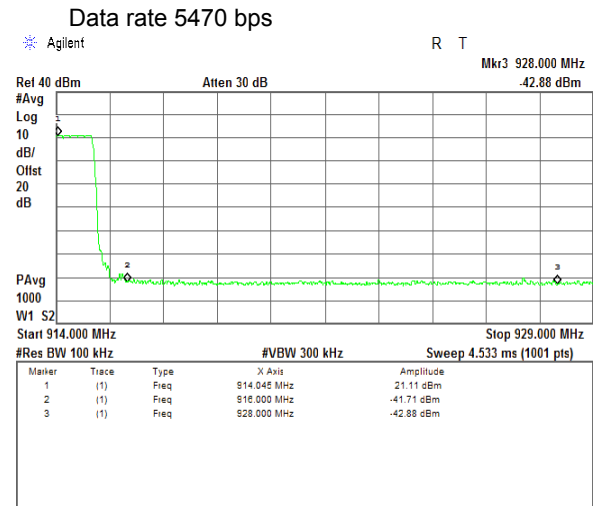
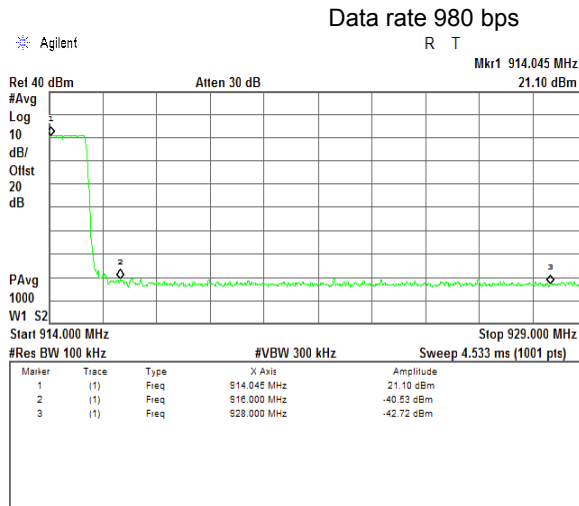


|                                                                                            |                                |                               |                       |
|--------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> Section 15.247(d), RSS-247 section 5.5, Emissions at band edges |                                |                               |                       |
| <b>Test procedure:</b> ANSI C63.10 section 6.10                                            |                                |                               |                       |
| <b>Test mode:</b> Compliance                                                               |                                | <b>Verdict:</b> PASS          |                       |
| <b>Date(s):</b> 14-Jan-20                                                                  |                                |                               |                       |
| <b>Temperature:</b> 25 °C                                                                  | <b>Relative Humidity:</b> 41 % | <b>Air Pressure:</b> 1025 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                            |                                |                               |                       |

Plot 7.8.3 The lowest band edge emission at low carrier frequency with hopping function enabled



Plot 7.8.4 The highest band edge emission at high carrier frequency with hopping function enabled





|                                                                                             |                                |                               |                       |
|---------------------------------------------------------------------------------------------|--------------------------------|-------------------------------|-----------------------|
| <b>Test specification:</b> <b>Section 15.203, RSS-Gen section 6.8, Antenna requirements</b> |                                |                               |                       |
| <b>Test procedure:</b>                                                                      |                                | Visual inspection             |                       |
| <b>Test mode:</b>                                                                           |                                | <b>Verdict:</b> <b>PASS</b>   |                       |
| <b>Date(s):</b>                                                                             |                                |                               |                       |
| 23-Aug-18                                                                                   |                                |                               |                       |
| <b>Temperature:</b> 24 °C                                                                   | <b>Relative Humidity:</b> 48 % | <b>Air Pressure:</b> 1008 hPa | <b>Power:</b> 3.6 VDC |
| <b>Remarks:</b>                                                                             |                                |                               |                       |

## 7.9 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 7.9.1.

Table 7.9.1 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                |         |

## 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 (9) kHz - 30 MHz                   | EMCO                  | 6502          | 2857       | 24-Feb-20         | 24-Feb-21        |
| 3442  | Precision Fixed Attenuator, 50 Ohm, 5 W, 20 dB, DC to 18 GHz | Mini-Circuits         | BW-S20W5+     | NA         | 25-Feb-20         | 25-Feb-21        |
| 3818  | PSA Series Spectrum Analyzer, 3 Hz- 44 GHz                   | Agilent Technologies  | E4446A        | MY48250288 | 24-Apr-20         | 24-Apr-21        |
| 3903  | Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA           | Huber-Suhner          | SUCOFLEX 102A | 1226/2A    | 06-Apr-20         | 06-Apr-21        |
| 4933  | Active Horn Antenna, 1 GHz to 18 GHz                         | COM-POWER CORPORATION | AHA-118       | 701046     | 06-Jan-20         | 06-Jan-21        |
| 5288  | Trilog Antenna, 25 MHz - 8 GHz, 100W                         | Frankonia             | ALX-8000E     | 00809      | 08-Feb-19         | 08-Feb-22        |
| 5372  | MXE EMI receiver, 3 Hz to 44 GHz                             | Keysight Technologies | N9038A        | MY57290155 | 18-Jun-20         | 18-Jun-21        |
| 5665  | Cable SF118/11N(x2)/6M, 18 GHz, 11N/11N                      | Huber-Suhner          | SF118         | 501644/118 | 23-Oct-19         | 23-Oct-20        |

\*The calibration was valid at the test time.

## 9 APPENDIX B Test equipment correction factors

HL 0446: Active Loop Antenna  
EMCO, model: 6502, s/n 2857

| Frequency, | Measured antenna factor, dBS/m | Measurement uncertainty, dB |
|------------|--------------------------------|-----------------------------|
| 10         | -33.4                          | ±1.0                        |
| 20         | -37.8                          | ±1.0                        |
| 50         | -40.5                          | ±1.0                        |
| 75         | -41.0                          | ±1.0                        |
| 100        | -41.2                          | ±1.0                        |
| 150        | -41.2                          | ±1.0                        |
| 250        | -41.1                          | ±1.0                        |
| 500        | -41.2                          | ±1.0                        |
| 750        | -41.3                          | ±1.0                        |
| 1000       | -41.3                          | ±1.0                        |

| Frequency, | Measured antenna factor, dBS/m | Measurement uncertainty, dB |
|------------|--------------------------------|-----------------------------|
| 2000       | -41.4                          | ±1.0                        |
| 3000       | -41.4                          | ±1.0                        |
| 4000       | -41.5                          | ±1.0                        |
| 5000       | -41.5                          | ±1.0                        |
| 10000      | -41.7                          | ±1.0                        |
| 15000      | -42.1                          | ±1.0                        |
| 20000      | -42.7                          | ±1.0                        |
| 25000      | -44.2                          | ±1.0                        |
| 30000      | -45.8                          | ±1.0                        |

The antenna factor shall be added to receiver reading in dB $\mu$ V to obtain field strength in dB $\mu$ A/m

HL 4933: Active Horn Antenna  
COM-POWER CORPORATION, model: AHA-118, s/n 701046

| Frequency, MHz | Measured antenna factor<br>(with preamplifier), dB/m | Frequency, MHz | Measured antenna factor<br>(with preamplifier), dB/m |
|----------------|------------------------------------------------------|----------------|------------------------------------------------------|
| 1000           | -16.1                                                | 10000          | 1.8                                                  |
| 1500           | -15.1                                                | 10500          | 1.0                                                  |
| 2000           | -10.9                                                | 11000          | 0.3                                                  |
| 2500           | -11.9                                                | 11500          | -0.5                                                 |
| 3000           | -11.1                                                | 12000          | 3.1                                                  |
| 3500           | -10.6                                                | 12500          | 1.4                                                  |
| 4000           | -8.6                                                 | 13000          | -0.3                                                 |
| 4500           | -8.3                                                 | 13500          | -0.4                                                 |
| 5000           | -5.9                                                 | 14000          | 2.5                                                  |
| 5500           | -5.7                                                 | 14500          | 2.2                                                  |
| 6000           | -3.3                                                 | 15000          | 1.9                                                  |
| 6500           | -4.0                                                 | 15500          | 0.5                                                  |
| 7000           | -2.2                                                 | 16000          | 2.1                                                  |
| 7500           | -1.7                                                 | 16500          | 1.2                                                  |
| 8000           | 1.1                                                  | 17000          | 0.6                                                  |
| 8500           | -0.8                                                 | 17500          | 3.1                                                  |
| 9000           | -1.5                                                 | 18000          | 4.2                                                  |
| 9500           | -0.2                                                 |                |                                                      |

The antenna factor shall be added to receiver reading in dB $\mu$ V to obtain field strength in dB $\mu$ V/m.

**HL 5288: Trilog Antenna**  
**Frankonia, model: ALX-8000E, s/n: 00809**  
**30-1000 MHz**

| Frequency, MHz | Antenna factor, dB/m |
|----------------|----------------------|
| 30             | 14.96                |
| 35             | 15.33                |
| 40             | 16.37                |
| 45             | 17.56                |
| 50             | 17.95                |
| 60             | 16.87                |
| 70             | 13.22                |
| 80             | 10.56                |
| 90             | 13.61                |
| 100            | 15.46                |
| 120            | 14.03                |
| 140            | 12.23                |

| Frequency, MHz | Antenna factor, dB/m |
|----------------|----------------------|
| 160            | 12.67                |
| 180            | 13.34                |
| 200            | 15.40                |
| 250            | 16.42                |
| 300            | 17.28                |
| 400            | 19.98                |
| 500            | 21.11                |
| 600            | 22.90                |
| 700            | 24.13                |
| 800            | 25.25                |
| 900            | 26.35                |
| 1000           | 27.18                |

The antenna factor shall be added to receiver reading in dB $\mu$ V to obtain field strength in dB $\mu$ V/m.

**above 1000 MHz**

| 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 dB $\mu$ V to obtain field strength in dB $\mu$ V/m.

## 10 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: $\pm 1.7$ dB<br>12.4 GHz to 40 GHz: $\pm 2.3$ dB                                                                                                                                                                                                                                             |
| Conducted emissions at RF antenna connector                                                          | 9 kHz to 2.9 GHz: $\pm 2.6$ dB<br>2.9 GHz to 6.46 GHz: $\pm 3.5$ dB<br>6.46 GHz to 13.2 GHz: $\pm 4.3$ dB<br>13.2 GHz to 22.0 GHz: $\pm 5.0$ dB<br>22.0 GHz to 26.8 GHz: $\pm 5.5$ dB<br>26.8 GHz to 40.0 GHz: $\pm 4.8$ dB                                                                                  |
| Occupied bandwidth                                                                                   | $\pm 8.0$ %                                                                                                                                                                                                                                                                                                  |
| Duty cycle, timing (Tx ON / OFF) and average factor measurements                                     | $\pm 1.0$ %                                                                                                                                                                                                                                                                                                  |
| Conducted emissions with LISN                                                                        | 9 kHz to 150 kHz: $\pm 3.9$ dB<br>150 kHz to 30 MHz: $\pm 3.8$ dB                                                                                                                                                                                                                                            |
| Radiated emissions at 3 m measuring distance<br>Horizontal polarization<br><br>Vertical polarization | Biconilog antenna: $\pm 5.3$ dB<br>Biconical antenna: $\pm 5.0$ dB<br>Log periodic antenna: $\pm 5.3$ dB<br>Double ridged horn antenna: $\pm 5.3$ dB<br>Biconilog antenna: $\pm 6.0$ dB<br>Biconical antenna: $\pm 5.7$ dB<br>Log periodic antenna: $\pm 6.0$ dB<br>Double ridged horn antenna: $\pm 6.0$ dB |

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

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

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

## 11 APPENDIX D Test laboratory description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, Radio, Safety, Environmental and Telecommunication testing facility.

Hermon Laboratories is recognized and accredited by the Federal Communications Commission (USA) for relevant parts of Code of Federal Regulations 47 (CFR 47), Test Firm Registration Number is 927748, Designation Number is IL1001; Recognized by Innovation, Science and Economic Development Canada for wireless and terminal testing (ISED), ISED #2186A, CAB identifier is IL1001; Certified by VCCI, Japan (the registration numbers are R-10808 for OATS, R-1082 for anechoic chamber, G-10869 for RE measurements above 1 GHz, C-10845 for conducted emissions site and T-11606 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, environmental simulation and calibration (for exact scope please refer to Certificate No. 839.01, 839.03 and 839.04).

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## 12 APPENDIX E

### Specification references

FCC 47CFR part 15: 2019

ANSI C63.10: 2013

RSS-247 Issue 2: 2017

RSS-Gen Issue 5 with Am.1:  
2019

Radio Frequency Devices

American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence- Exempt Local Area Network (LE-LAN) Devices

General Requirements for Compliance of Radio Apparatus

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

END OF DOCUMENT