





| RADIO REPORT FCC 47 CFR Part 15C ISED Canada RSS-247 Digital transmission systems operating within the 2400.0 MHz - 2483.5 MHz band | |
|--|--|
| Report Reference No | G0M-2108-9956-TFC247WF-V01 |
| Testing Laboratory | Eurofins Product Service GmbH |
| Address | Storkower Str. 38c 15526 Reichenwalde Germany |
| Accreditation |  <p>DAkkS - Registration number : D-PL-12092-01-03 (ISED) ISED Testing Laboratory site: 3470A DAkkS - Registration number : D-PL-12092-01-04 (FCC) FCC Filed Test Laboratory, Reg.-No.: 96970</p> |
| Applicant | Leica Geosystems AG |
| Address | Heinrich-Wild-Strasse 9435 Heerbrugg SWITZERLAND |
| Test Specification | 47 CFR Part 15C RSS-247, Issue 2, 2017-02 RSS-Gen, Issue 5, Amendment 2, 2021-02 |
| Non-Standard Test Method | None |
| Equipment under Test (EUT): | |
| Product Description | Bluetooth, WLAN and BLE Module |
| Model(s) | TiWi-BLE |
| Additional Model(s) | None |
| Brand Name(s) | None |
| Hardware Version(s) | 1.0 |
| Software Version(s) | 4.0 |
| FCC ID | RFD-BTWCO |
| IC | 3177A-BTWCO |
| Contains FCC ID | - |
| Contains IC | - |
| Test Result | PASSED |

Test Report No.: G0M-2108-9956-TFC247WF-V01

 Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

| Possible test case verdicts: | | |
|--|-----------------|---|
| Required by standard but not tested | N/T | |
| Not required by standard | N/R | |
| Not applicable to EUT | N/A | |
| Test object does meet the requirement | P(PASS) | |
| Test object does not meet the requirement | F(FAIL) | |
| Testing: | | |
| Test Lab Temperature | 20 °C - 30 °C | |
| Test Lab Humidity | 25 % - 55 % | |
| Date of receipt of test item | 2021-10-14 | |
| Report: | | |
| Compiled by | Jens Degenhardt | |
| Tested by | Jens Degenhardt |  |
| Tested and supervised by (Responsible for Test) | Florian Voigt |  |
| Approved by (+ signature) (Deputy Head of Lab) | Toralf Jahn |  |
| Date of Issue | 2022-03-24 | |
| Total number of pages | 46 | |
| General Remarks: | | |
| <p>The test results presented in this report relate only to the object tested.</p> <p>The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.</p> <p>This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.</p> | | |
| Additional Comments: | | |
| | | |

VERSION HISTORY

| Version History | | | |
|-----------------|------------|-----------------|------------|
| Version | Issue Date | Remarks | Revised By |
| 01 | 2022-03-24 | Initial Release | |

ABBREVIATIONS AND ACRONYMS

| Acronyms | |
|------------------|---|
| Acronym | Description |
| BPSK | Binary Phase Shift Keying |
| DSSS | Direct Sequence Spread Spectrum |
| EUT | Equipment Under Test |
| FCC | Federal Communications Commission |
| HT | High Throughput |
| IEEE 802.11 | MAC and PHY Layer for WiFi |
| ISED | Innovation, Science and Economic Development Canada |
| OFDM | Orthogonal Frequency Division Multiplexing |
| QAM | Quadrature Amplitude Modulation |
| QPSK | Quadrature Phase Shift Keying |
| RBW | Resolution bandwidth |
| RMS | Root mean square |
| VBW | Video bandwidth |
| V _{NOM} | Nominal supply voltage |

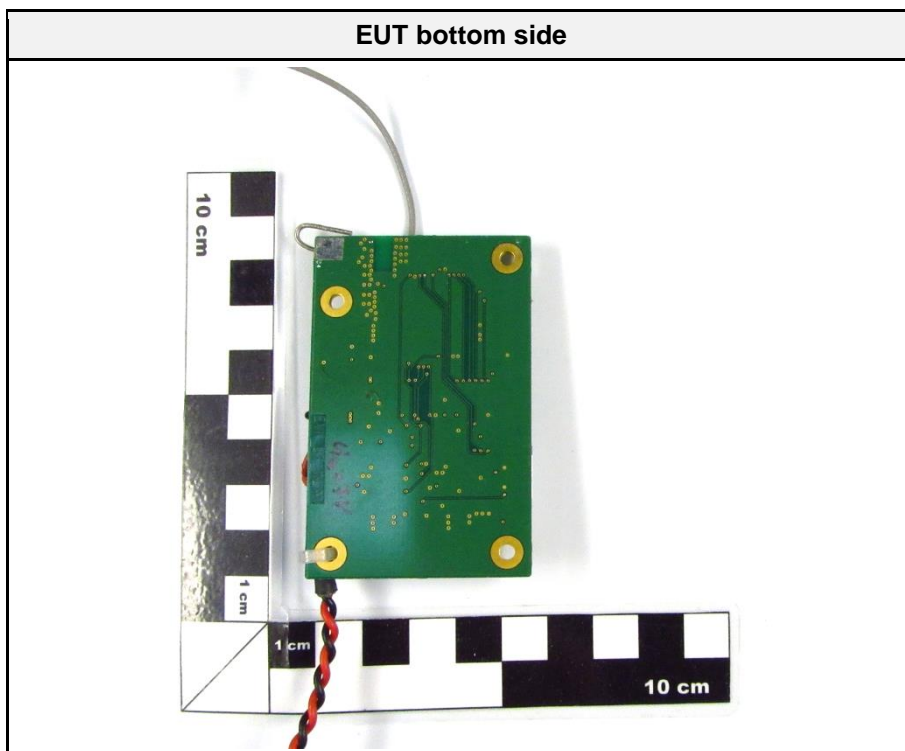
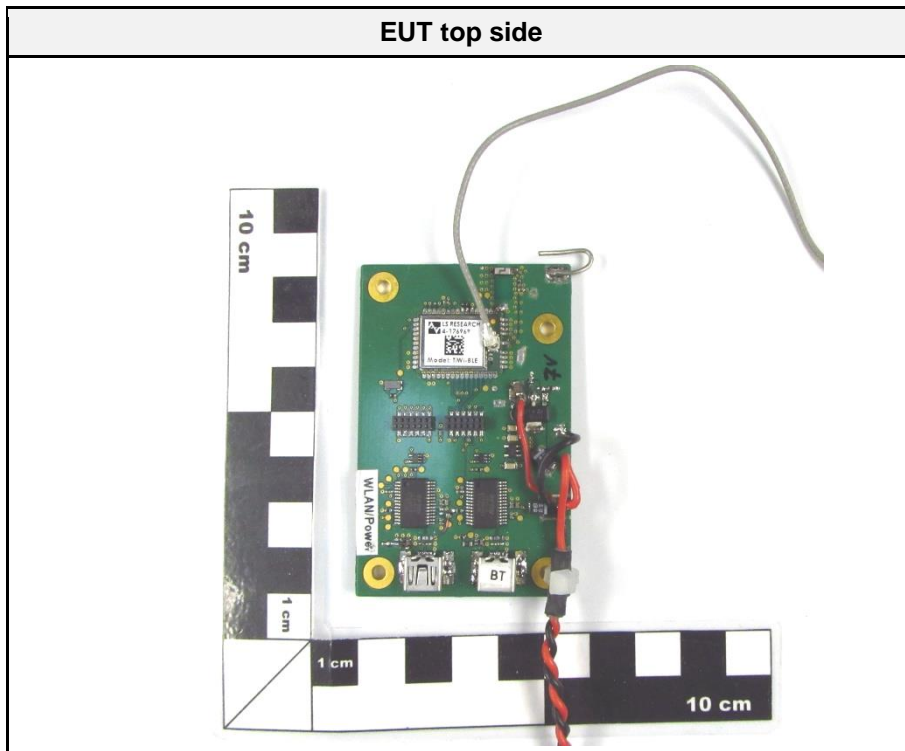
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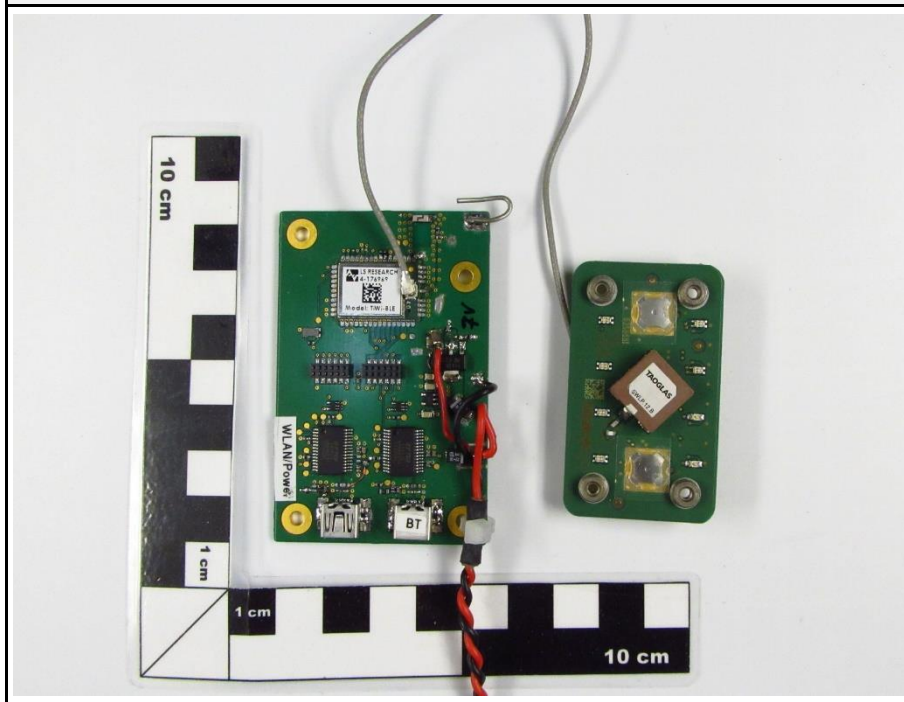
1 Equipment (Test Item) Under Test

| | | |
|--------------------------|---|---------------------------|
| Description | Bluetooth, WLAN and BLE Module | |
| Model | TiWi-BLE | |
| Additional Model(s) | None | |
| Brand Name(s) | None | |
| Serial Number(s) | None | |
| Test Sample Id(s) | 36589 | |
| Hardware Version(s) | 1.0 | |
| Software Version(s) | 4.0 | |
| PMN | Leica Geosystems AG | |
| HVIN | TIWI | |
| FVIN | N/A | |
| HMN | N/A | |
| FCC ID | RFD-BTWCO | |
| IC | 3177A-BTWCO | |
| Contains FCC ID | - | |
| Contains IC | - | |
| Equipment type | Radio Module | |
| Radio type | Transceiver | |
| Assigned frequency bands | 2400.0 MHz - 2483.5 MHz | |
| Radio technology | IEEE 802.11 b/g/n (HT20) | |
| Modulation | BPSK, QPSK, 16-QAM, 64-QAM | |
| Number of antenna ports | 1 | |
| Radio Module | Type | Bluetooth and WLAN module |
| | Model | TIWI-BLE |
| | Manufacturer | LS Research |
| | HW Version | 5 |
| | SW Version | Not specified |
| | FCC ID | RFD-BTWCO |
| | IC | 3177A-BTWCO |
| Antenna | Type | External antenna |
| | Model | SWLP.2450.12.4.B.02 |
| | Manufacturer | Taoglas |
| | Gain | 2 dBi |
| Supply Voltage | V _{NOM} | 7 VDC |
| Operating Temperature | T _{NOM} | 25 °C |
| Manufacturer | Leica Geosystems AG Heinrich-Wild-Strasse 9435 Heerbrugg SWITZERLAND | |

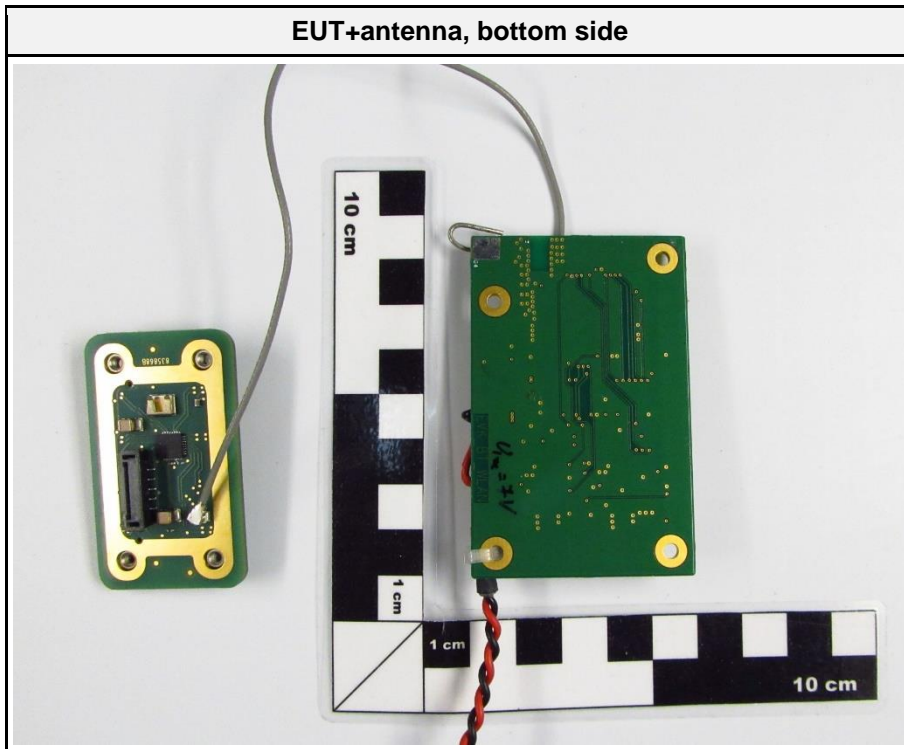
1.1 Photos – Equipment External



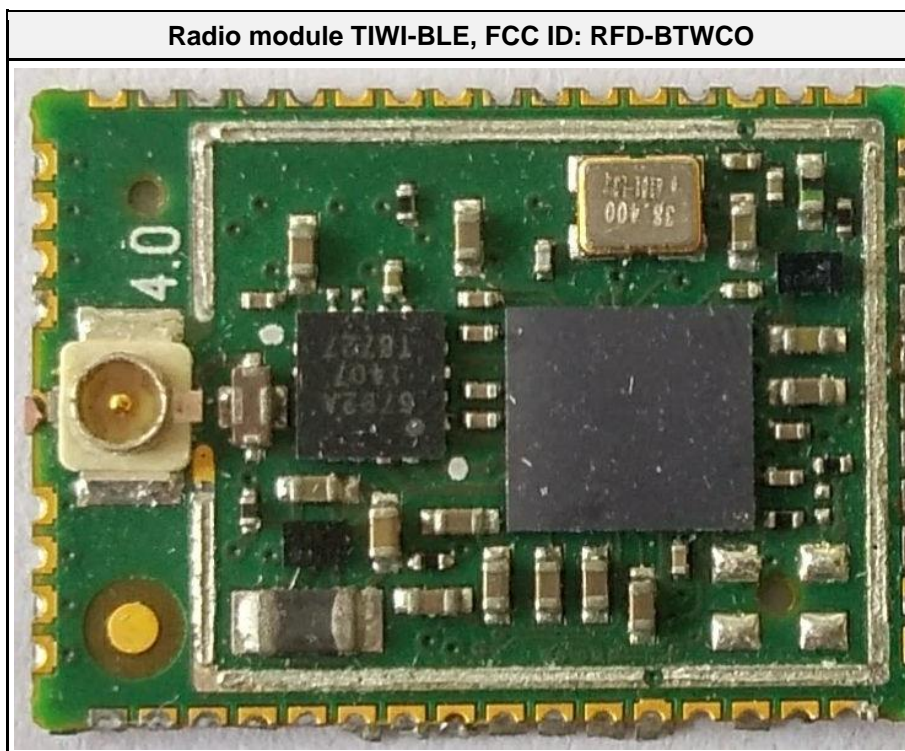
EUT + antenna, top side

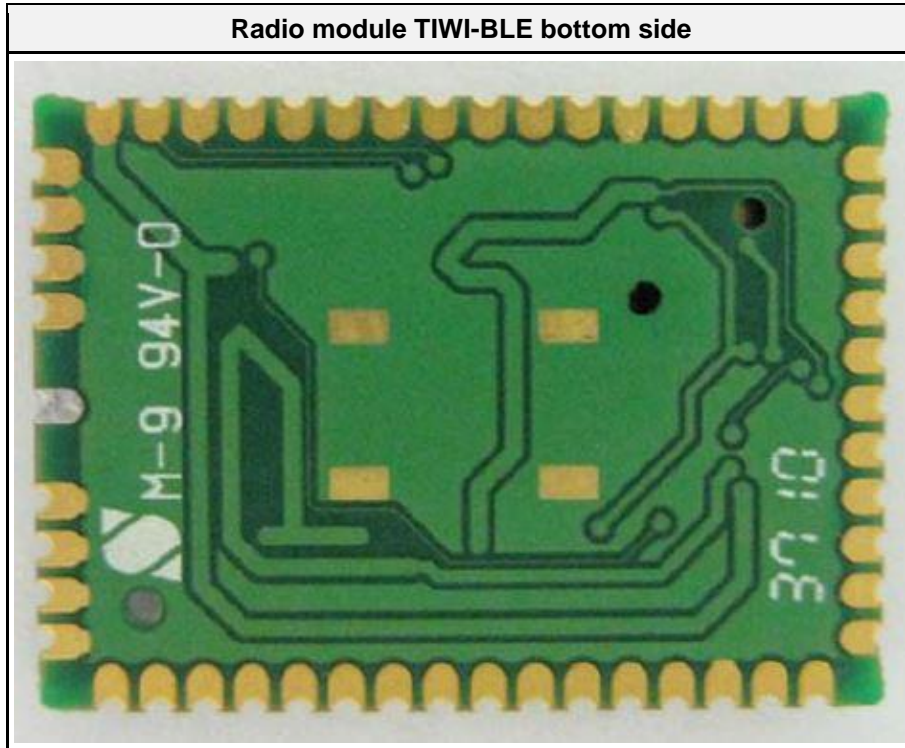


EUT+antenna, bottom side



1.2 Photos – Equipment Internal





1.3 Support Equipment

| Product Type | Device | Manufacturer | Model | Comment |
|--------------|---------------------|----------------|----------------------------|----------------|
| SFT | Tiwi WLAN tool | LS research | Tiwi WLAN tool V5.2.0.0 | Test mode tool |
| AE | Laptop | Lenovo | T440 | SN:PC01B76F |
| AE | USB over fiber | mk messtechnik | optoUSB-2.0 | Transceiver |
| Description: | | | | |
| AE | Auxiliary Equipment | | | |
| SIM | Simulator | | | |
| CBL | Connecting Cable | | | |
| SFT | Software | | | |
| Comment: | | | | |

1.4 Test Modes

| Mode | Description |
|---|---|
| HT20 (IEEE 802.11n) | Mode = Transmit Modulation = OFDM Bandwidth = 20 MHz Power setting (1 Simultaneous Tx) = 15 CLPC (Software setting) Data rate (1 Simultaneous Tx) = 7.2 Mbps MCS (1 Simultaneous Tx) = 0 Duty cycle = 28% |
| Receive | Mode = Receive |
| Comment: Test mode has been selected as the worst case by evaluation of conducted peak output power listed in the original test report G0M-1410-4214-TFC247WF-V01 issued on 2015-05-12 by Eurofins Product Service GmbH | |

1.5 Test Frequencies

| Designator | Mode | Channel | Frequency [MHz] |
|------------|---------|---------|-----------------|
| F1 | Tx | 1 | 2412 |
| F2 | Tx / Rx | 6 | 2437 |
| F3 | Tx | 11 | 2462 |

1.6 Sample emission level calculation

The following is a description of terms and a sample calculation, as appears in the radiated emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

Reading:

This is the reading obtained on the spectrum analyzer in dBµV. Any external preamplifiers used are taken into account through internal analyzer settings.

A.F.:

This is the antenna factor for the receiving antenna. It is a conversion factor, which converts electric fields strengths to voltages, which can be measured directly on the spectrum analyzer. It is treated as a loss in dB. Cable losses have been included with the A.F. to simplify the calculations. The antenna factor is used in calculations as follows:

$$\text{Reading on Analyzer (dB}\mu\text{V)} + \text{A.F. (dB/m)} = \text{Net field strength (dB}\mu\text{V/m)}$$

Net:

This is the net field strength measurement (as shown above).

Limit:

This is the FCC Class B radiated emission limit (in units of dBµV/m). The FCC limits are given in units of µV/m. The following formula is used to convert the units of µV/m to dBµV/m:

$$\text{Limit (dB}\mu\text{V/m)} = 20 \cdot \log(\mu\text{V/m})$$

Margin:

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example only:

| | | | | | | |
|----------------------|---|---------------|---|---------------------------|---|-----------|
| Reading + AF | = | Net Reading | : | Net reading - FCC limit | = | Margin |
| +21.5 dBµV + 26 dB/m | | = 47.5 dBµV/m | | 47.5 dBµV/m - 57.0 dBµV/m | | = -9.5 dB |

2 Result Summary

| FCC 47 CFR Part 15C, ISED RSS-247 | | | | |
|--|---|------------------|--------|---------|
| Product Standard Reference | Requirement | Reference Method | Result | Remarks |
| ISED RSS-Gen, Issue 5 A2 (section 6.7) | Occupied Bandwidth | ANSI C63.10-2013 | N/R | |
| FCC § 15.247(a)(2) ISED RSS-247, Issue 2 (section 5.2) | 6 dB Bandwidth | ANSI C63.10-2013 | N/T | |
| FCC § 15.247(b) ISED RSS-247, Issue 2 (section 5.4) | Maximum peak conducted power | ANSI C63.10-2013 | N/T | |
| FCC § 15.247(e) ISED RSS-247, Issue 2 (section 5.2) | Power spectral density | ANSI C63.10-2013 | N/T | |
| FCC § 15.207 ISED RSS-247, Issue 2 (section 3.1) | AC power line conducted emissions | ANSI C63.10-2013 | N/T | |
| FCC § 15.247(d) ISED RSS-247, Issue 2 (section 5.5) | Band edge compliance | ANSI C63.10-2013 | N/T | |
| FCC § 15.247(d) ISED RSS-247, Issue 2 (section 5.5) | Conducted spurious emissions | ANSI C63.10-2013 | N/T | |
| FCC § 15.247(d) FCC § 15.209 ISED RSS-Gen, Issue 5 A2 (section 6.13) | Transmitter radiated spurious emissions | ANSI C63.10-2013 | PASS | |
| ISED RSS-247, Issue 2 (section 3.1) | Receiver radiated spurious emissions | ANSI C63.4-2014 | PASS | |
| Comment: | | | | |

| Possible Test Case Verdicts | |
|-----------------------------|--|
| PASS | Test object does meet the requirements |
| FAIL | Test object does not meet the requirements |
| N/T | Required by standard but not tested |
| N/R | Not required by standard for the test object |

3 Test Conditions and Results

3.1 Test Conditions and Results - Transmitter radiated emissions

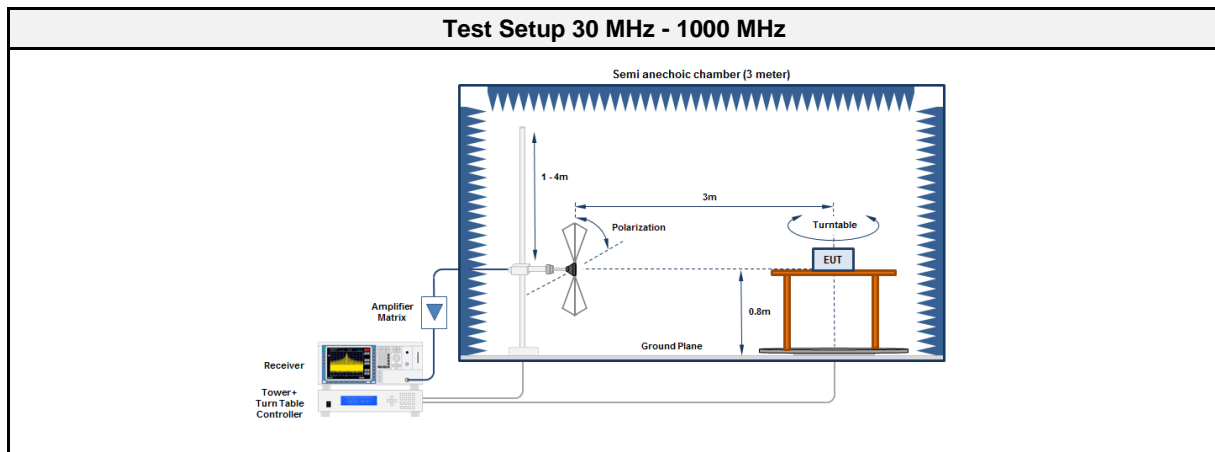
3.1.1 Information

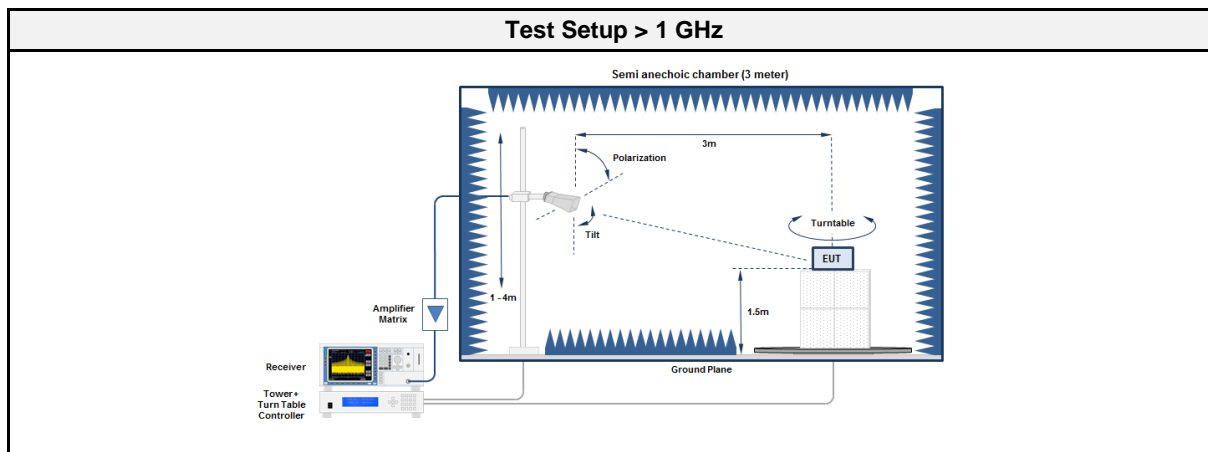
| Test Information | |
|-------------------------|--|
| Reference | FCC § 15.247(d); FCC § 15.209; ISED RSS-Gen, Issue 5 A2 (section 6.13) |
| Measurement Uncertainty | ± 5.95 dB |
| Measurement Method | ANSI C63.10 6.4, 6.5, 6.6, 11.12 |
| Operator | Jens Degenhardt, Florian Voigt |
| Date | 2021-11-26 - 2021-12-09 |

3.1.2 Limits

| Limits | | | |
|-----------------------|------------|---|--------------------------|
| Frequency range [MHz] | Detector | Field strength [$\mu\text{V}/\text{m}$] | Measurement distance [m] |
| 0.009 - 0.09 | Average | 2400/F[kHz] | 300 |
| 0.09 - 0.110 | Quasi-Peak | 2400/F[kHz] | 300 |
| 0.110 - 0.490 | Average | 2400/F[kHz] | 300 |
| 0.490 - 1.705 | Quasi-Peak | 24000/F[kHz] | 30 |
| 1.705 - 30.0 | Quasi-Peak | 30 | 30 |
| 30 - 88 | Quasi-Peak | 100 | 3 |
| 88 - 216 | Quasi-Peak | 150 | 3 |
| 216 - 960 | Quasi-Peak | 200 | 3 |
| 960 - 1000 | Quasi-Peak | 500 | 3 |
| >1000 | Average | 500 | 3 |

3.1.3 Setup





3.1.4 Equipment

| Test Software | | | |
|---------------|------------------|------------|----------|
| Description | Manufacturer | Name | Version |
| EMC Software | DARE Instruments | RadiMation | 2020.1.8 |

| Test Equipment 30 - 1000 MHz | | | | | |
|------------------------------|--------------|----------------|------------|-----------|----------|
| Description | Manufacturer | Model | Identifier | Cal. Date | Cal. Due |
| Anechoic Chamber | Frankonia | AC1 | EF00062 | 2021-02 | 2024-02 |
| Measurement Receiver | Agilent | N9038A-526/WXP | EF01070 | 2021-07 | 2022-07 |
| Antenna | R&S | HK 116 | EF00030 | 2021-05 | 2024-05 |
| Antenna | R&S | HL 223 | EF00212 | 2019-05 | 2022-05 |

| Test Equipment > 1 GHz | | | | | |
|------------------------|--------------------|------------|------------|-----------|----------|
| Description | Manufacturer | Model | Identifier | Cal. Date | Cal. Due |
| Anechoic chamber | Frankonia | AC 2 | EF01616 | 2021-09 | 2022-09 |
| Spectrum analyzer | R&S | FSU43 | EF01631 | 2021-07 | 2022-07 |
| Horn antenna | Schwarzbeck | BBHA 9120B | EF01678 | 2021-03 | 2022-03 |
| Horn Antenna | Schwarzbeck | HWRD 650 | EF01679 | 2021-03 | 2022-03 |
| Antenna | Amplifier Research | AT4560 | EF00302 | 2021-06 | 2023-06 |

3.1.5 Procedure

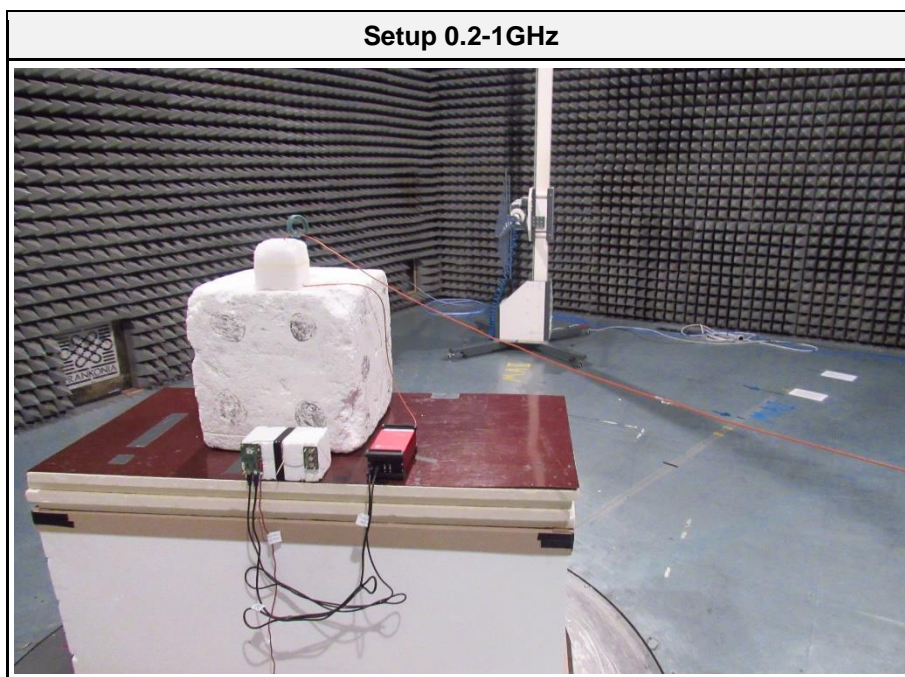
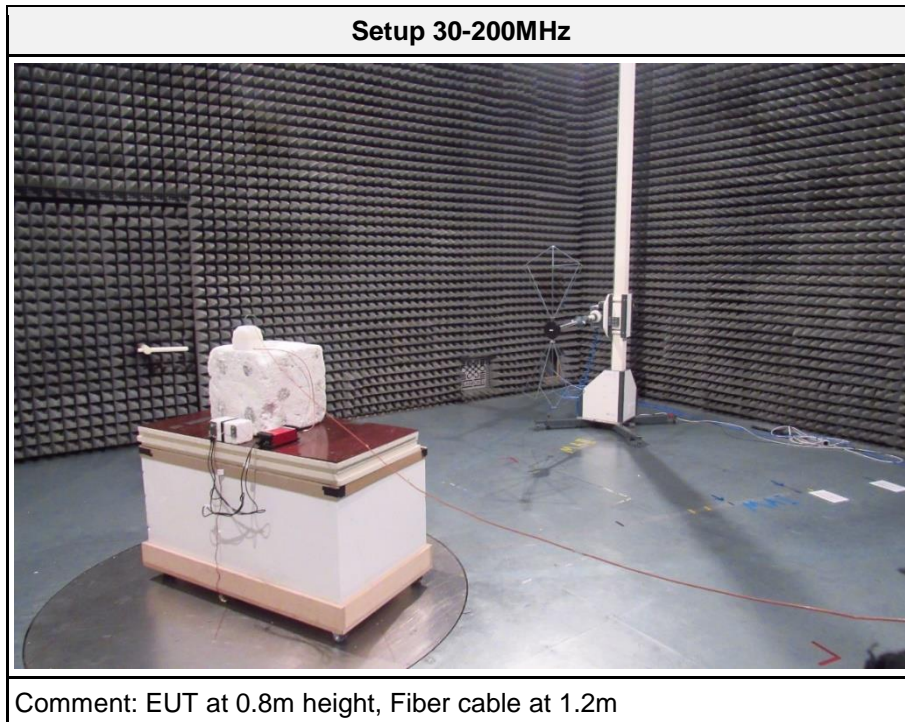
| Test Procedure 30 MHz - 1000 MHz |
|---|
| <ol style="list-style-type: none"> EUT is placed on a non conducting support at the center of a turn table 0.8 m above the ground EUT set to test mode The receiver is set to peak detection with max hold The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m All significant emissions are measured again using the corresponding final detector |

| Test Procedure > 1 GHz |
|---|
| <ol style="list-style-type: none"> EUT is placed on a non conducting support at the center of a turn table 1.5 m above the ground EUT set to test mode The receiver is set to peak detection with max hold The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m All significant emissions are measured again using the corresponding final detector |

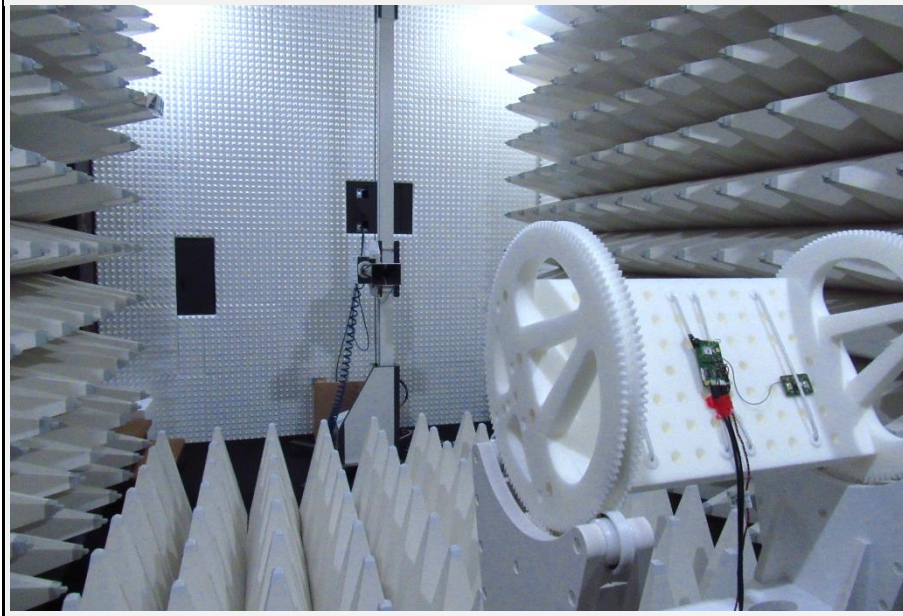
3.1.6 Results

| Test Results - HT20 | | | | | | |
|---------------------|----------------|----------------------|------|------|----------------------|-------------|
| Channel [MHz] | Emission [MHz] | Level [dB μ V/m] | Det. | Pol. | Limit [dB μ V/m] | Margin [dB] |
| 2412 | 240.0295 | 42.80 | pk | ver | 46.00 | -03.25 |
| 2412 | 240.0295 | 38.50 | qpk | ver | 46.00 | -07.50 |
| 2412 | 2389.9 | 62.66 | pk | hor | 74.00 | -11.34 |
| 2412 | 2389.9 | 47.44 | avg | hor | 54.00 | -06.56 |
| 2412 | 2493.8 | 54.06 | pk | ver | 74.00 | -19.94 |
| 2412 | 2493.8 | 41.45 | avg | ver | 54.00 | -12.55 |
| 2412 | 19296 | 52.43 | pk | hor | 74.00 | -21.57 |
| 2412 | 19296 | 49.16 | avg | hor | 54.00 | -04.84 |
| 2437 | 240.0384 | 41.70 | pk | ver | 46.00 | -04.28 |
| 2437 | 240.0384 | 38.10 | qpk | ver | 46.00 | -07.95 |
| 2437 | 2389.8 | 44.14 | pk | hor | 74.00 | -29.86 |
| 2437 | 2389.8 | 33.28 | avg | hor | 54.00 | -20.72 |
| 2437 | 2484.4 | 41.28 | pk | hor | 74.00 | -32.72 |
| 2437 | 2484.4 | 33.31 | avg | hor | 54.00 | -20.69 |
| 2437 | 19496 | 50.47 | pk | hor | 74.00 | -23.53 |
| 2437 | 19496 | 46.14 | avg | hor | 54.00 | -07.86 |
| 2462 | 240.0336 | 41.50 | pk | ver | 46.00 | -04.46 |
| 2462 | 240.0336 | 36.80 | qpk | ver | 46.00 | -09.22 |
| 2462 | 2484.2 | 71.94 | pk | ver | 74.00 | -02.06 |
| 2462 | 19696 | 49.37 | pk | ver | 74.00 | -24.63 |
| 2462 | 19696 | 42.04 | avg | ver | 54.00 | -11.96 |

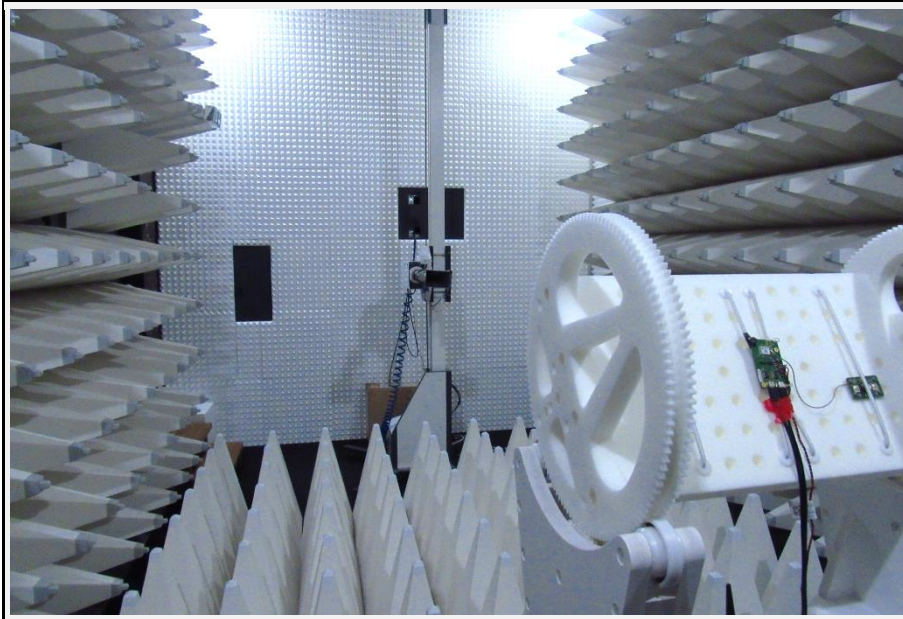
3.1.7 Setup Photos



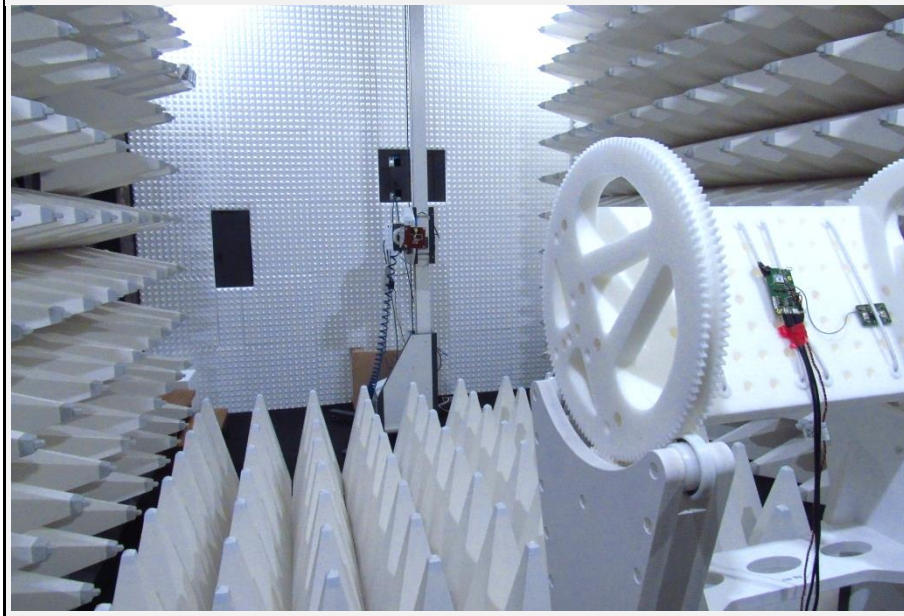
Setup 1-8GHz



Setup 8-18GHz



Setup 18-26.5GHz



3.2 Test Conditions and Results - Receiver radiated emissions

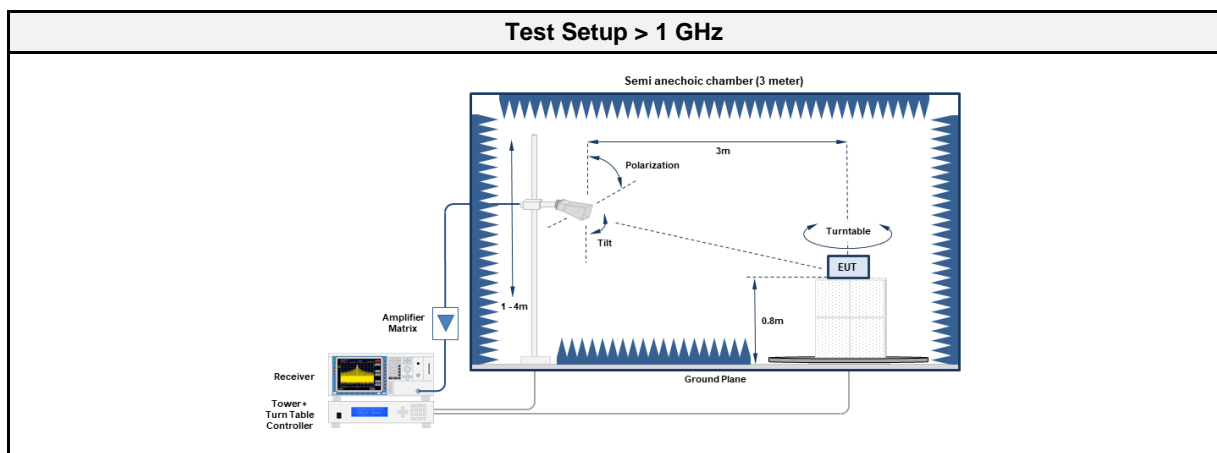
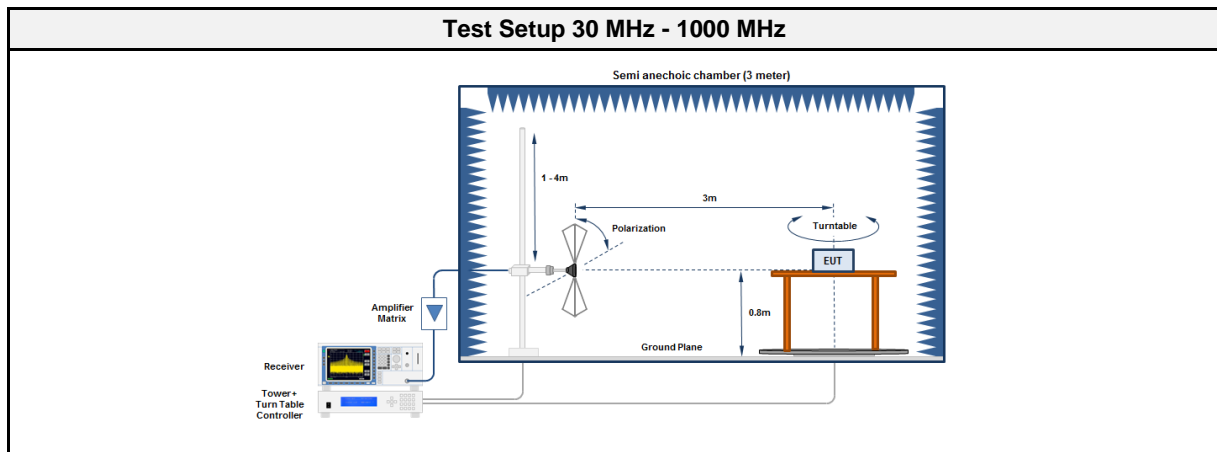
3.2.1 Information

| Test Information | |
|-------------------------|-------------------------------------|
| Reference | ISED RSS-247, Issue 2 (section 3.1) |
| Measurement Uncertainty | ± 5.95 dB |
| Measurement Method | ANSI C63.4-2014 8.1-8.3 |
| Operator | Jens Degenhardt |
| Date | 2021-12-13 + 2021-12-13 |

3.2.2 Limits

| Limits | | | |
|-----------------------|------------|------------------------------------|--------------------------|
| Frequency range [MHz] | Detector | Field strength [$\mu\text{V/m}$] | Measurement distance [m] |
| 30 - 88 | Quasi-Peak | 100 | 3 |
| 88 - 216 | Quasi-Peak | 150 | 3 |
| 216 - 960 | Quasi-Peak | 200 | 3 |
| 960 - 1000 | Quasi-Peak | 500 | 3 |
| >1000 | Average | 500 | 3 |

3.2.3 Setup



3.2.4 Equipment

| Test Software | | | |
|---------------|------------------|------------|----------|
| Description | Manufacturer | Name | Version |
| EMC Software | DARE Instruments | RadiMation | 2020.1.8 |

| Test Equipment 30 - 1000 MHz | | | | | |
|------------------------------|--------------|----------------|------------|-----------|----------|
| Description | Manufacturer | Model | Identifier | Cal. Date | Cal. Due |
| Anechoic Chamber | Frankonia | AC1 | EF00062 | 2021-02 | 2024-02 |
| Measurement Receiver | Agilent | N9038A-526/WXP | EF01070 | 2021-07 | 2022-07 |
| Antenna | R&S | HK 116 | EF00030 | 2021-05 | 2024-05 |
| Antenna | R&S | HL 223 | EF00212 | 2019-05 | 2022-05 |

| Test Equipment > 1 GHz | | | | | |
|------------------------|--------------|----------------|------------|-----------|----------|
| Description | Manufacturer | Model | Identifier | Cal. Date | Cal. Due |
| Anechoic Chamber | Frankonia | AC1 | EF00062 | 2021-02 | 2024-02 |
| Measurement Receiver | Agilent | N9038A-526/WXP | EF01070 | 2021-07 | 2022-07 |
| Horn antenna | Schwarzbeck | BBHA 9120D | EF00018 | 2019-10 | 2022-10 |
| Horn Antenna | Schwarzbeck | HWRD 650 | EF01679 | 2021-03 | 2022-03 |

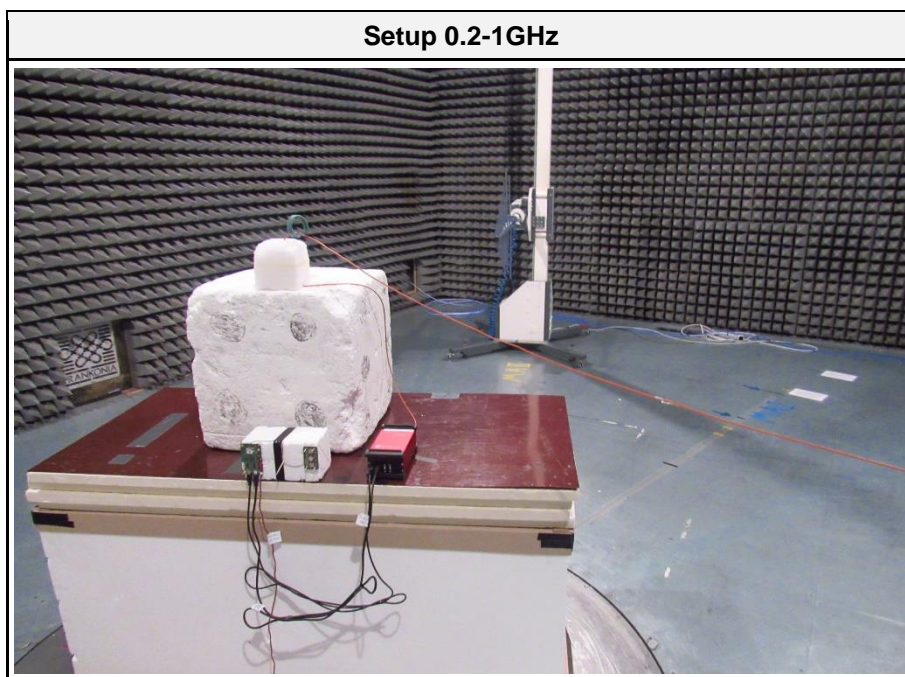
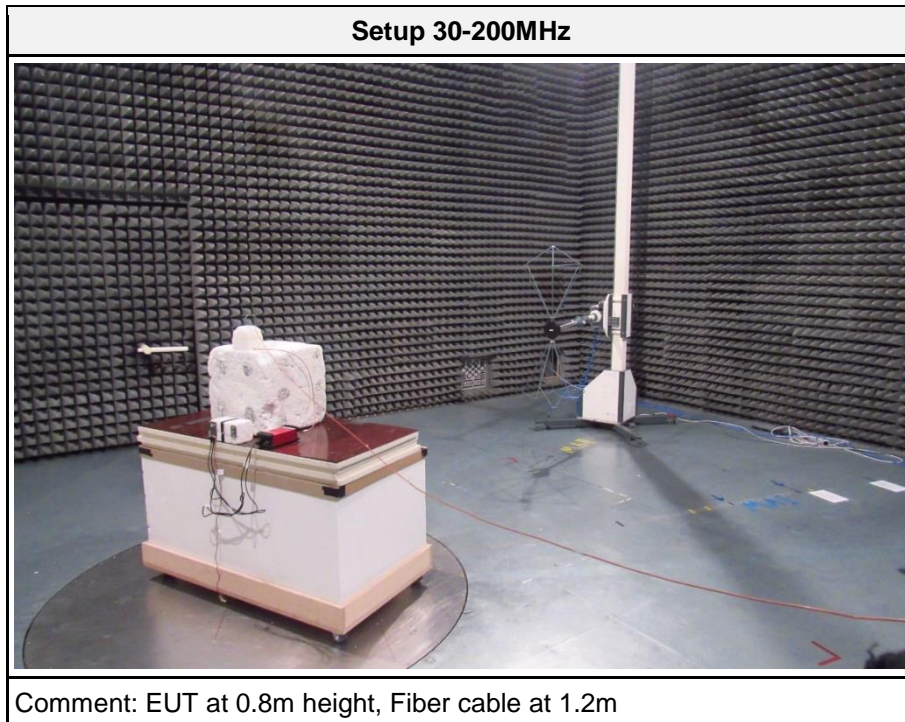
3.2.5 Procedure

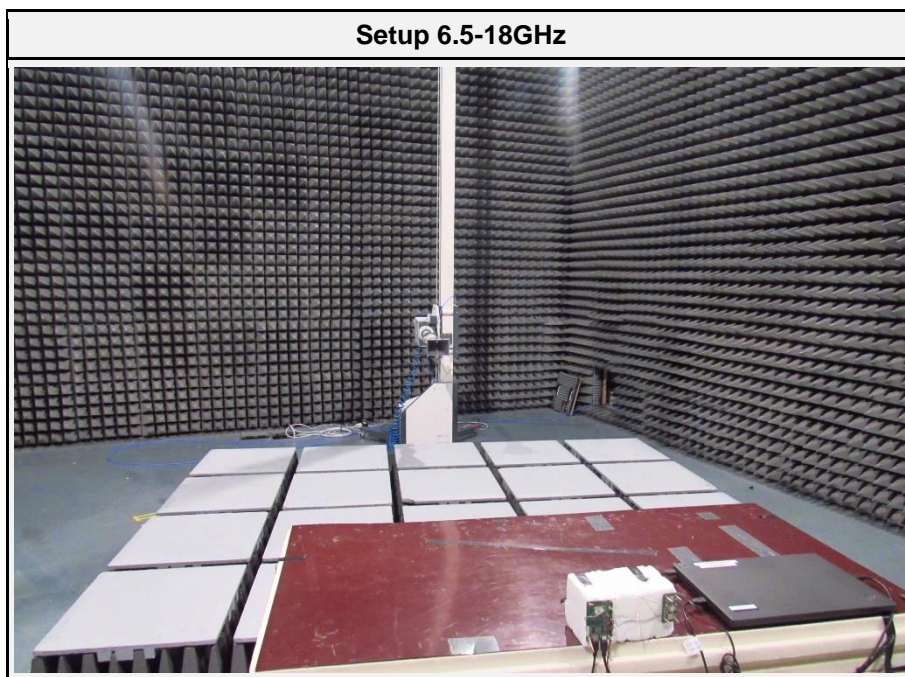
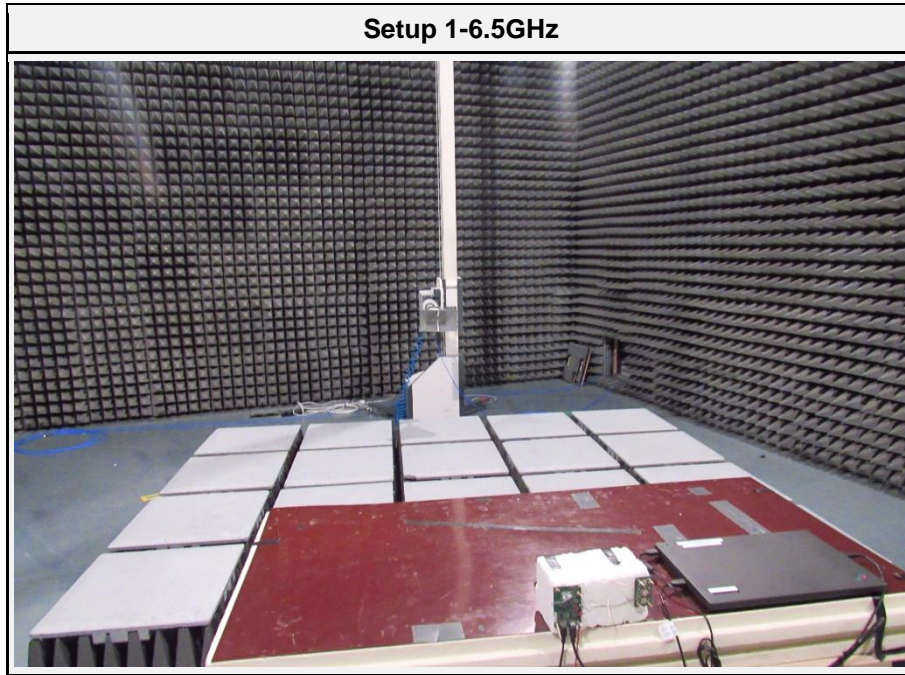
| Test Procedure |
|---|
| <ol style="list-style-type: none"> 1. EUT is placed on a non conducting support at the center of a turn table 0.8 m above the ground 2. EUT is set to test mode 3. The receiver is set to peak detection with max hold 4. The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m 5. All significant emissions are measured again using the corresponding final detector |

3.2.6 Results

| Test Results | | | | | | |
|---------------|----------------|----------------|------|------|----------------|-------------|
| Channel [MHz] | Emission [MHz] | Level [dBμV/m] | Det. | Pol. | Limit [dBμV/m] | Margin [dB] |
| 2437 | 37.6797 | 04.80 | qpk | hor | 40.00 | -35.16 |
| 2437 | 422.5003 | 25.60 | qpk | ver | 46.00 | -20.44 |
| 2437 | 502.5562 | 24.10 | qpk | ver | 46.00 | -21.89 |
| 2437 | 1996 | 44.99 | pk | hor | 74.00 | -29.01 |
| 2437 | 1996 | 36.23 | avg | hor | 53.98 | -17.75 |
| 2437 | 9748 | 42.70 | pk | hor | 74.00 | -31.30 |
| 2437 | 9748 | 39.34 | avg | hor | 53.98 | -14.64 |

3.2.7 Setup Photos





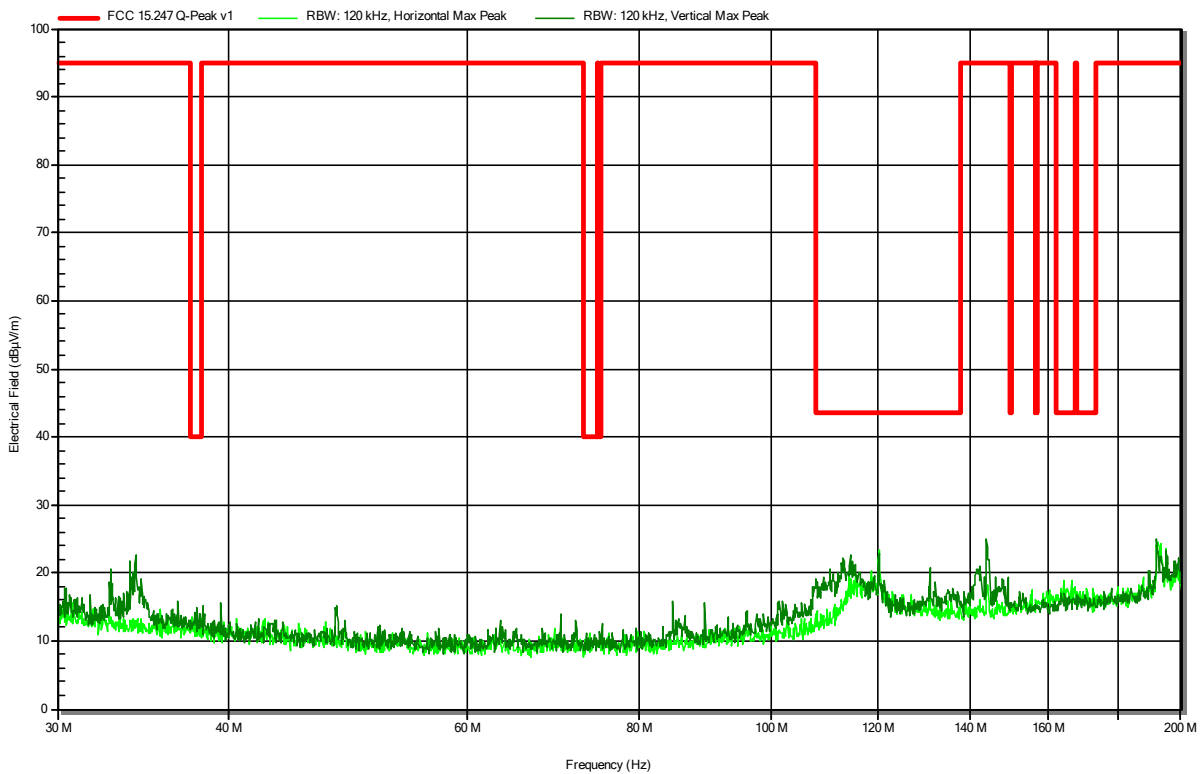
ANNEX A Transmitter spurious emissions

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Rohde & Schwarz HK 116
 Measurement distance: 3 m
 Mode: Tx; 2412MHz, HT20
 Test Date: 2021-12-09
 Note:

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RadiMation

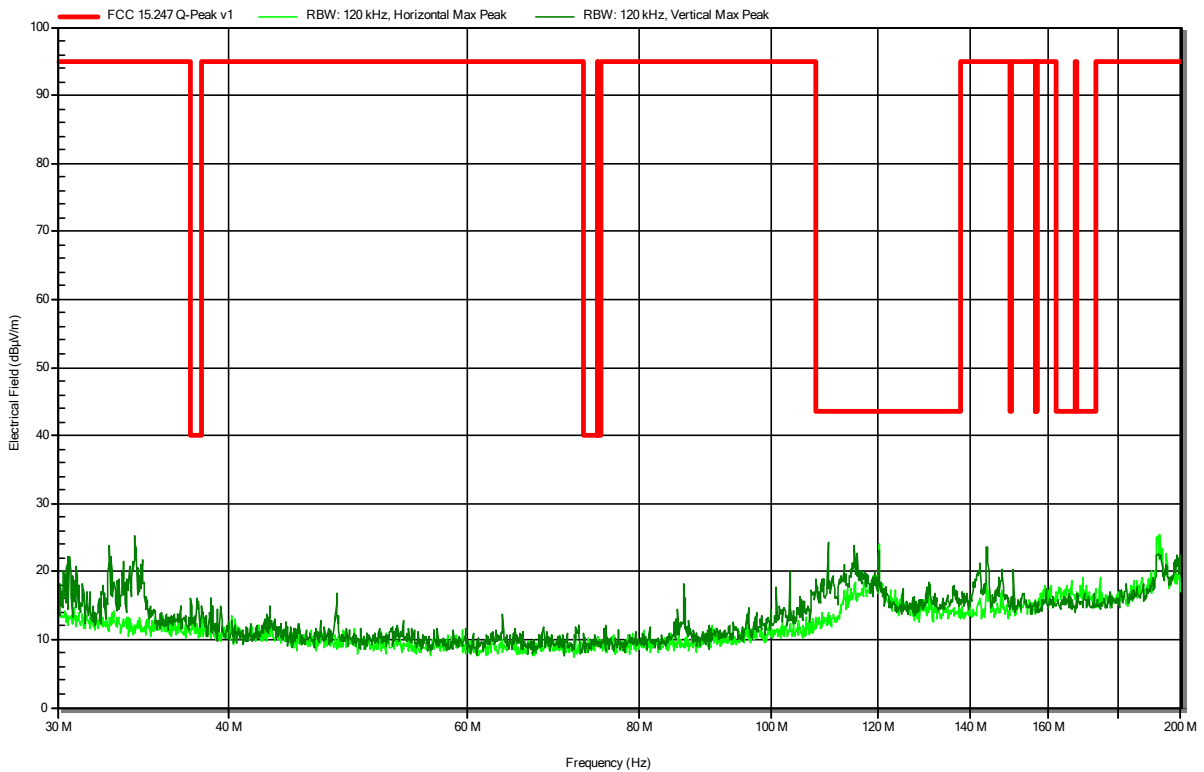


Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Rohde & Schwarz HK 116
 Measurement distance: 3 m
 Mode: Tx; 2437MHz, HT20
 Test Date: 2021-12-09
 Note:

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RadiMation

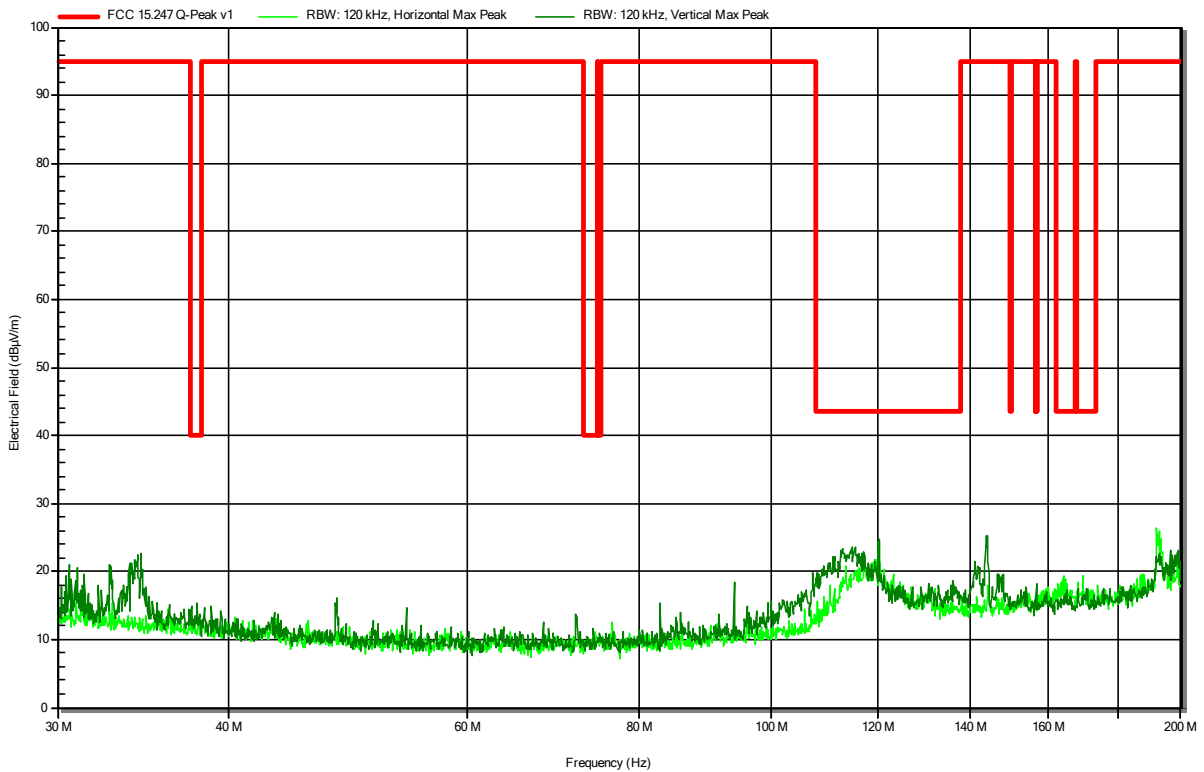


Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Rohde & Schwarz HK 116
 Measurement distance: 3 m
 Mode: Tx; 2462MHz, HT20
 Test Date: 2021-12-09
 Note:

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RadiMation

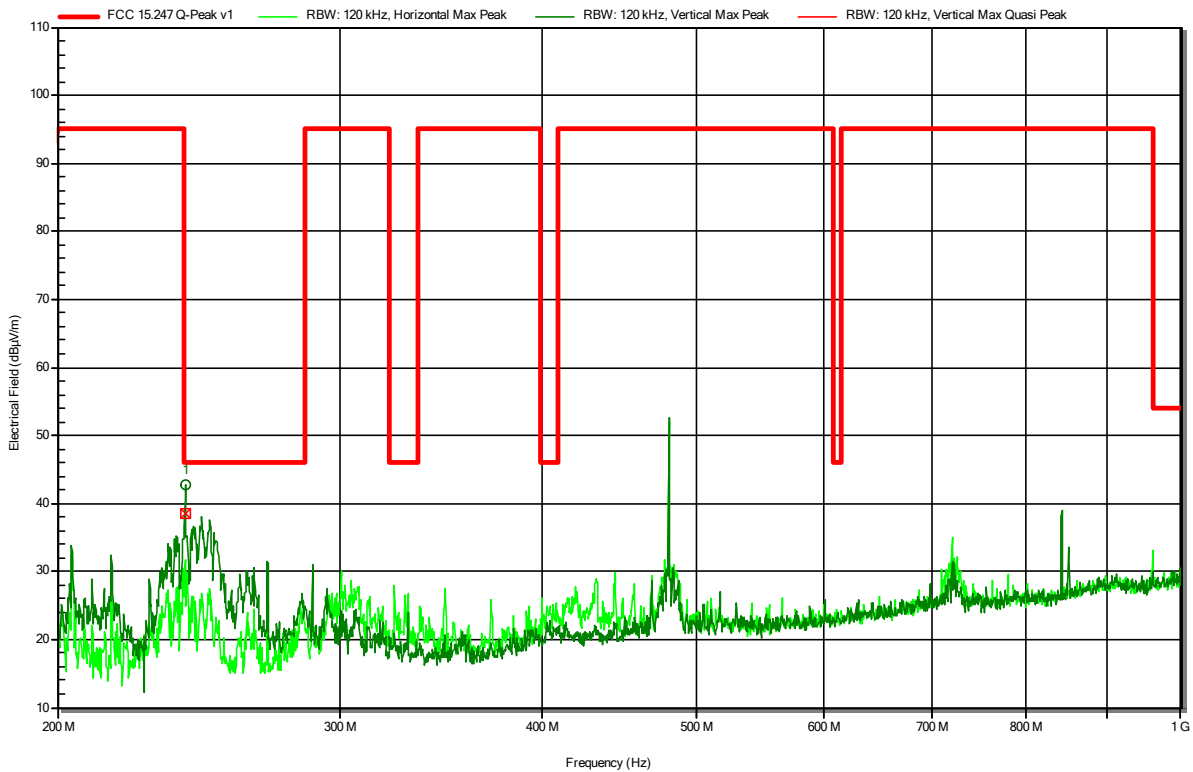


Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Rohde & Schwarz HL 223
 Measurement distance: 3 m
 Mode: Tx; 2412MHz, HT20
 Test Date: 2021-12-09
 Note:

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RadiMation



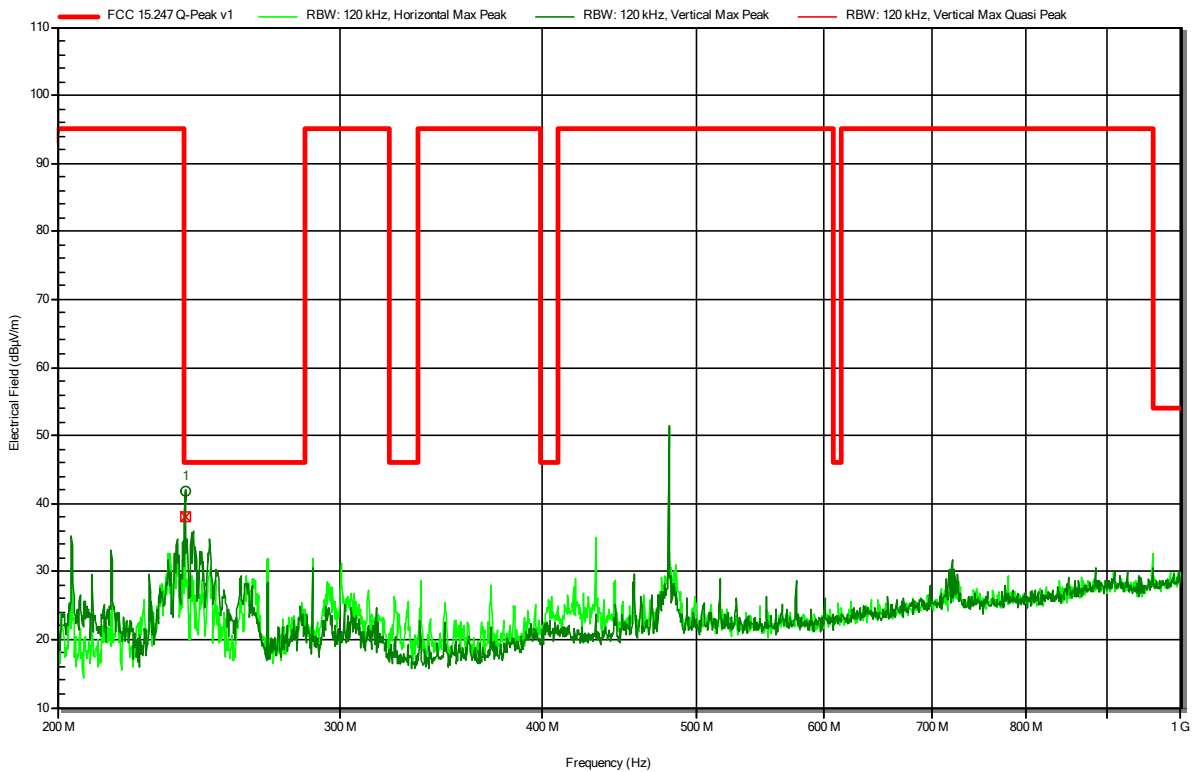
| Frequency | Quasi-Peak | Quasi-Peak Limit | Quasi-Peak Difference | Quasi-Peak Status | Polarization |
|--------------|-------------|------------------|-----------------------|-------------------|--------------|
| 240.0295 MHz | 38.5 dBµV/m | 46 dBµV/m | -7.5 dB | Pass | Vertical |

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Rohde & Schwarz HL 223
 Measurement distance: 3 m
 Mode: Tx; 2437MHz, HT20
 Test Date: 2021-12-09
 Note:

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RadiMation



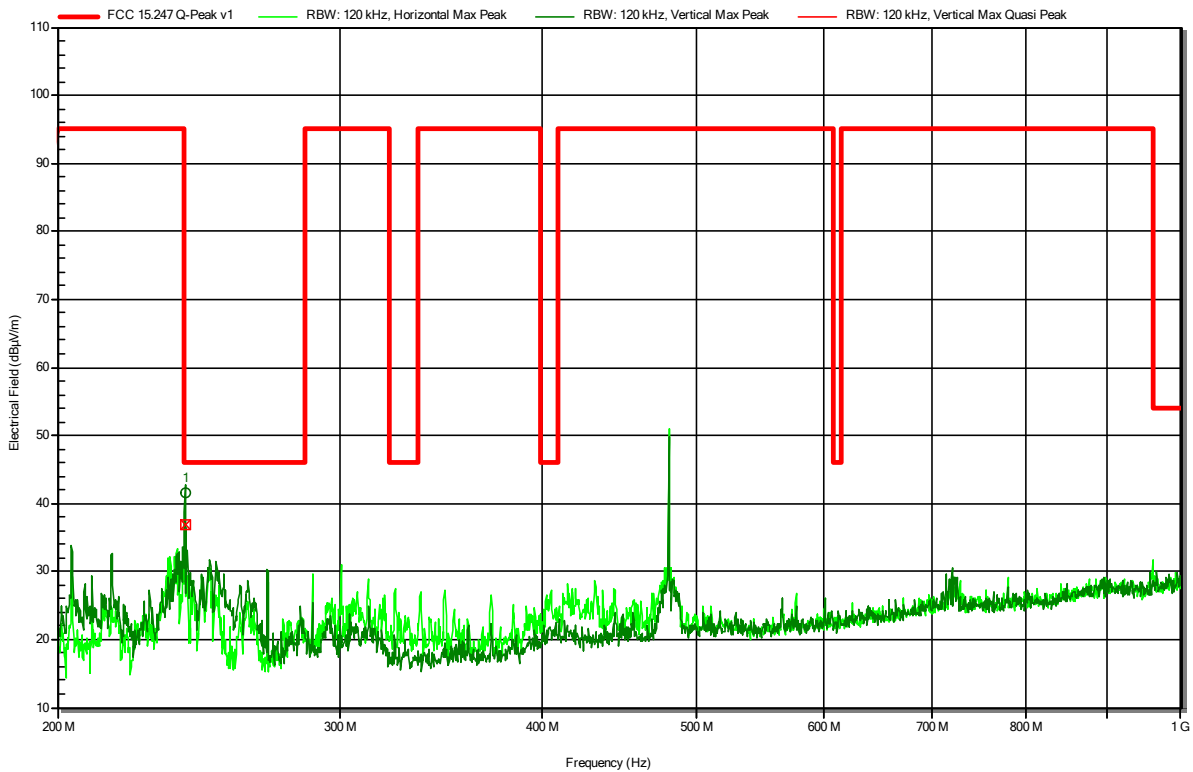
| Frequency | Quasi-Peak | Quasi-Peak Limit | Quasi-Peak Difference | Quasi-Peak Status | Polarization |
|--------------|-------------|------------------|-----------------------|-------------------|--------------|
| 240.0384 MHz | 38.1 dBµV/m | 46 dBµV/m | -7.95 dB | Pass | Vertical |

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Rohde & Schwarz HL 223
 Measurement distance: 3 m
 Mode: Tx; 2462MHz, HT20
 Test Date: 2021-12-09
 Note:

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RadiMation



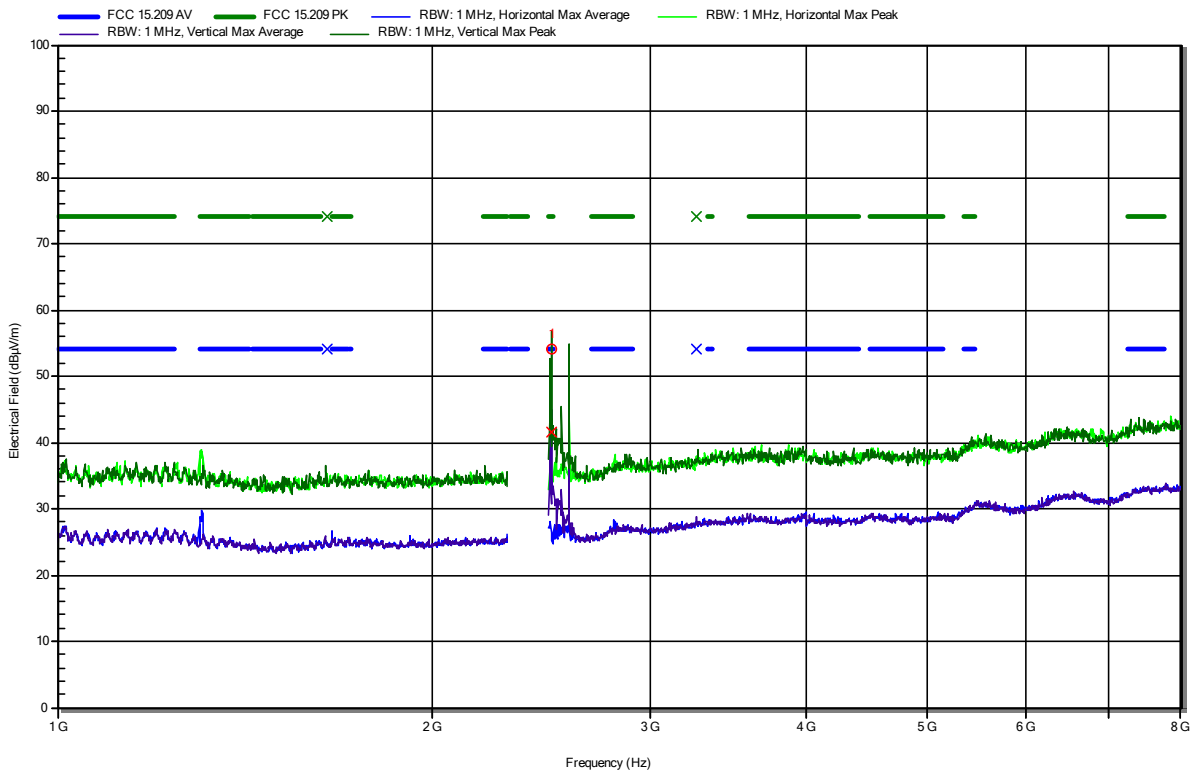
| Frequency | Quasi-Peak | Quasi-Peak Limit | Quasi-Peak Difference | Quasi-Peak Status | Polarization |
|--------------|-------------|------------------|-----------------------|-------------------|--------------|
| 240.0336 MHz | 36.8 dBµV/m | 46 dBµV/m | -9.22 dB | Pass | Vertical |

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; 2412MHz, HT20
 Test Date: 2021-11-26
 Note:

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RadiMation



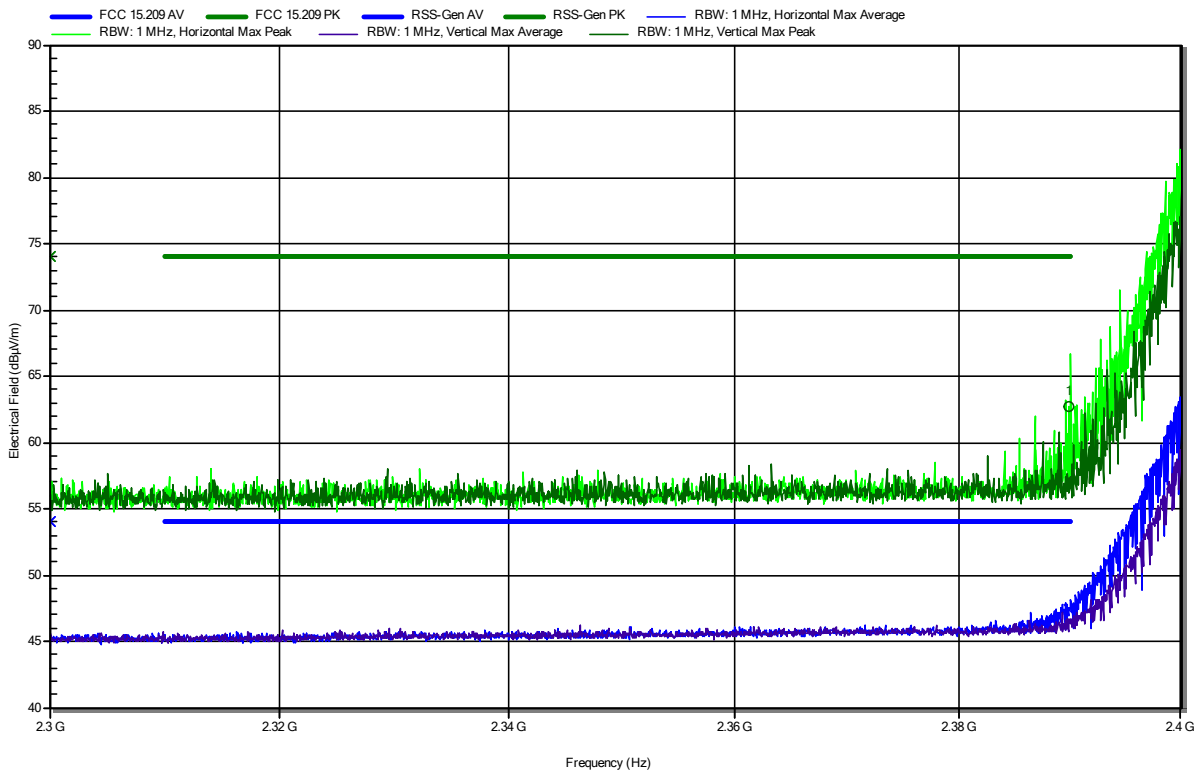
| Frequency | Peak | Peak Limit | Peak Difference | Peak Status | Polarization |
|------------|--------------|---------------|--------------------|----------------|--------------|
| 2.4938 GHz | 54.06 dBµV/m | 74 dBµV/m | -19.94 dB | Pass | Vertical |
| Frequency | Average | Average Limit | Average Difference | Average Status | Polarization |
| 2.4938 GHz | 41.45 dBµV/m | 54 dBµV/m | -12.55 dB | Pass | Vertical |

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; 2412MHz, HT20
 Test Date: 2021-11-26
 Note: lower bandedge

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RadiMation



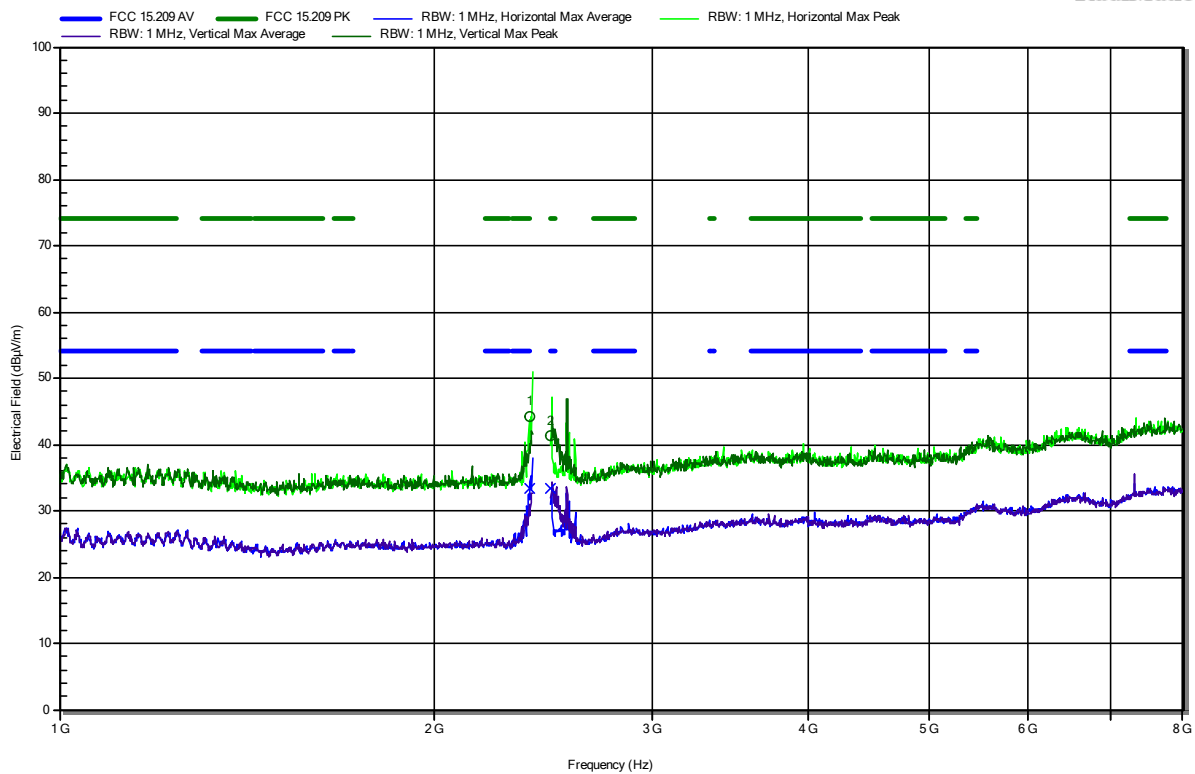
| Frequency | Peak | Peak Limit | Peak Difference | Peak Status | Polarization |
|------------|--------------|---------------|--------------------|----------------|--------------|
| 2.3899 GHz | 62.66 dBµV/m | 74 dBµV/m | -11.34 dB | Pass | Horizontal |
| Frequency | Average | Average Limit | Average Difference | Average Status | Polarization |
| 2.3899 GHz | 47.44 dBµV/m | 54 dBµV/m | -6.56 dB | Pass | Horizontal |

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; 2437MHz, HT20
 Test Date: 2021-11-26
 Note:

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RadiMation



| Frequency | Peak | Peak Limit | Peak Difference | Peak Status | Polarization |
|------------|--------------|------------|-----------------|-------------|--------------|
| 2.3898 GHz | 44.14 dBµV/m | 74 dBµV/m | -29.86 dB | Pass | Horizontal |
| 2.4844 GHz | 41.28 dBµV/m | 74 dBµV/m | -32.72 dB | Pass | Horizontal |

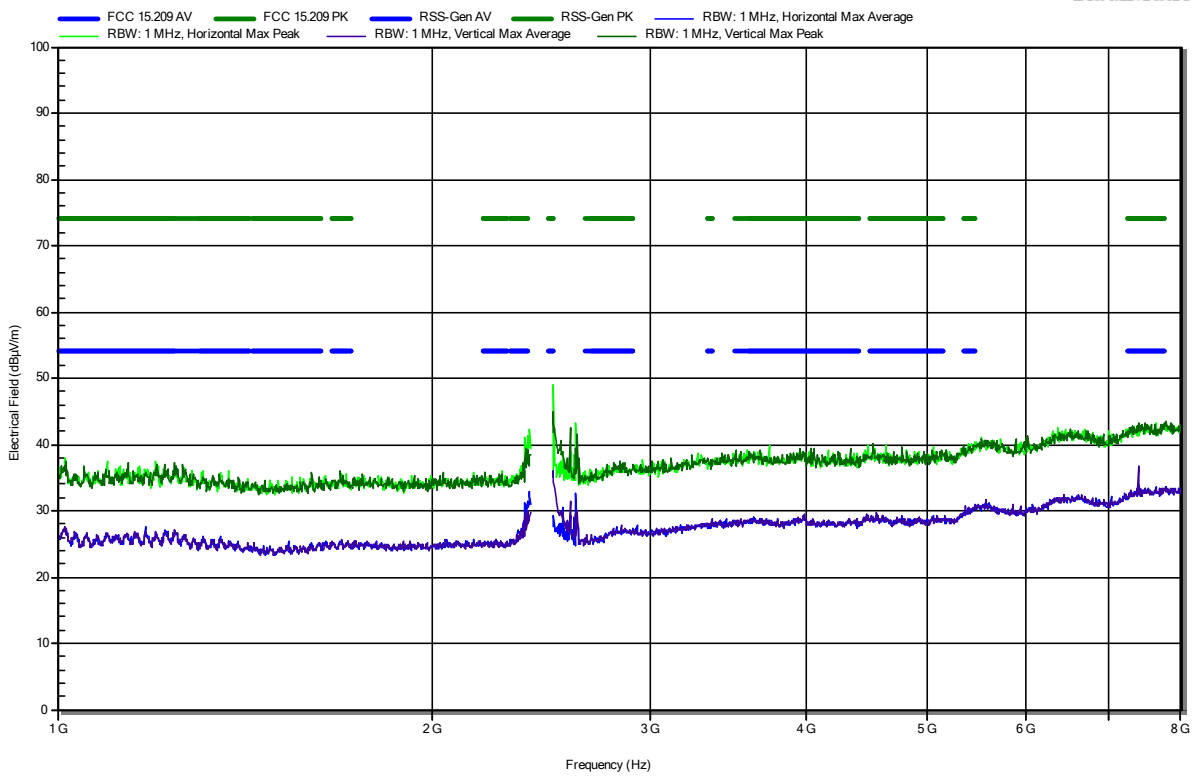
| Frequency | Average | Average Limit | Average Difference | Average Status | Polarization |
|------------|--------------|---------------|--------------------|----------------|--------------|
| 2.3898 GHz | 33.28 dBµV/m | 54 dBµV/m | -20.72 dB | Pass | Horizontal |
| 2.4844 GHz | 33.31 dBµV/m | 54 dBµV/m | -20.69 dB | Pass | Horizontal |

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; 2462MHz, HT20
 Test Date: 2021-11-26
 Note:

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RadiMation

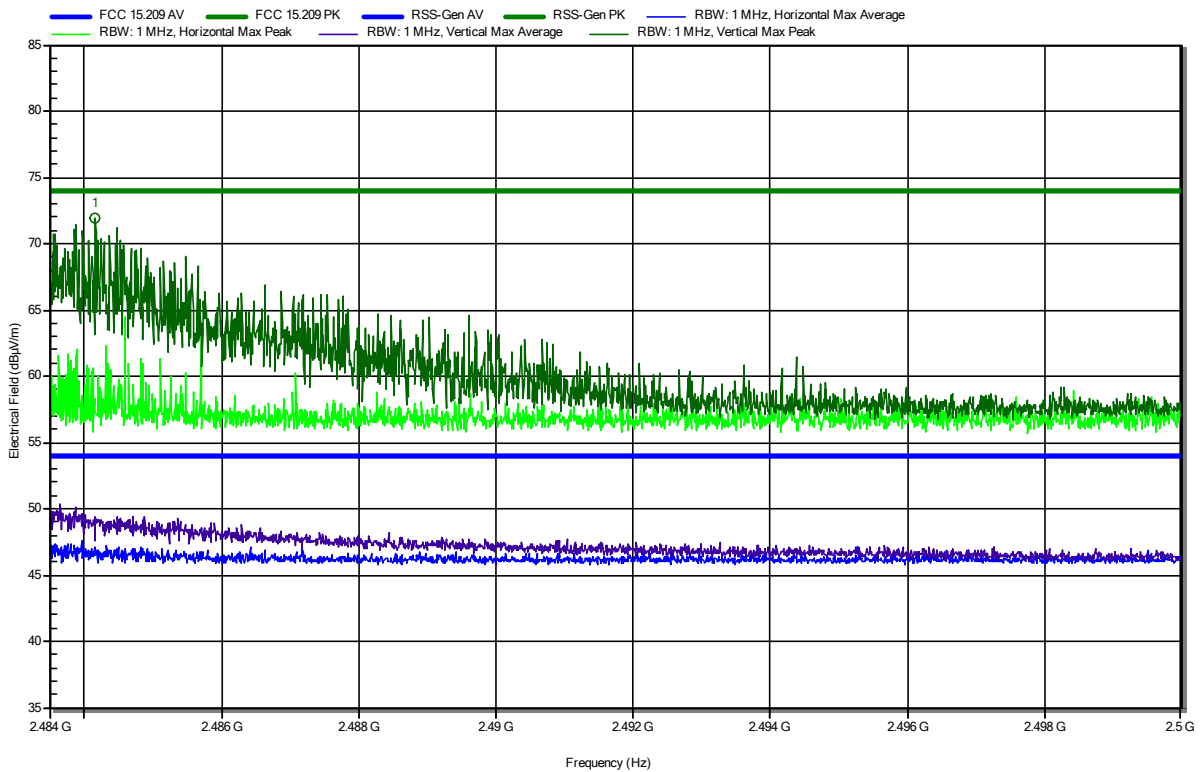


Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; 2462MHz, HT20
 Test Date: 2021-11-26
 Note: upper bandedge

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RadiMation



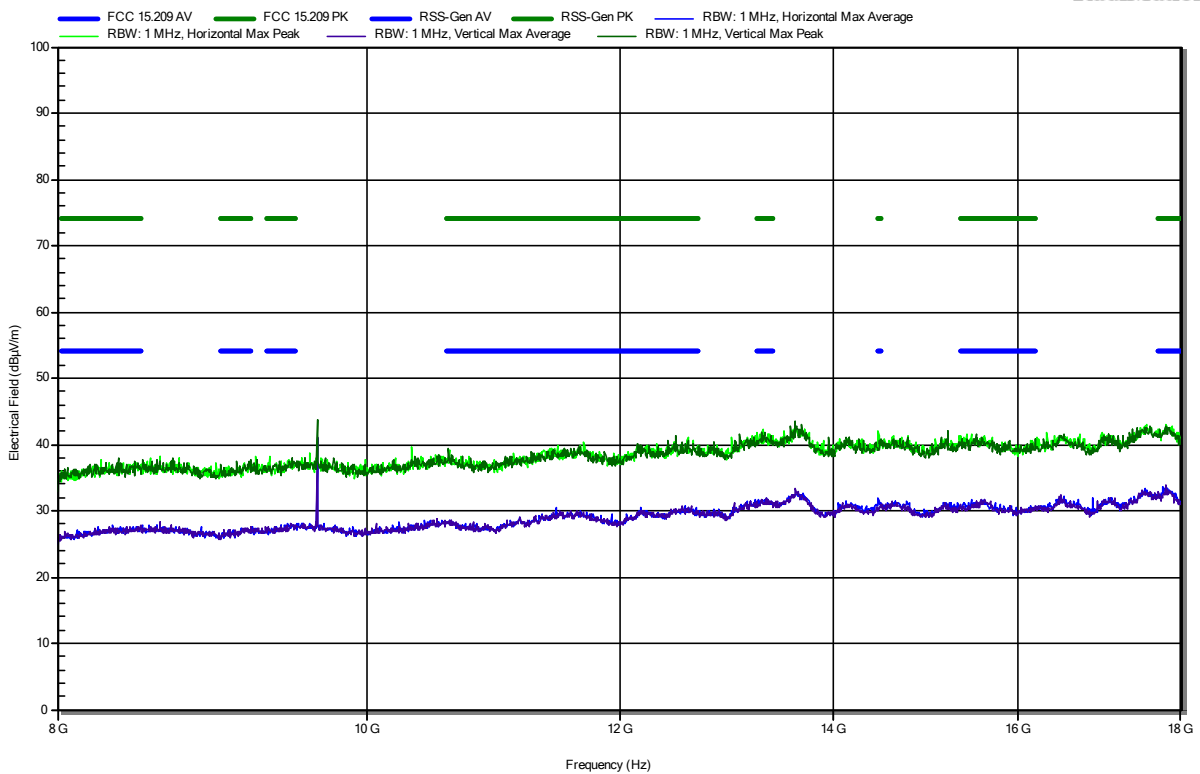
| Frequency | Peak | Peak Limit | Peak Difference | Peak Status | Polarization |
|------------|--------------|------------|-----------------|-------------|--------------|
| 2.4842 GHz | 71.94 dBµV/m | 74 dBµV/m | -2.06 dB | Pass | Vertical |

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck HWRD 650
 Measurement distance: 3 m
 Mode: Tx; 2412MHz, HT20
 Test Date: 2021-11-29
 Note:

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RadiMation

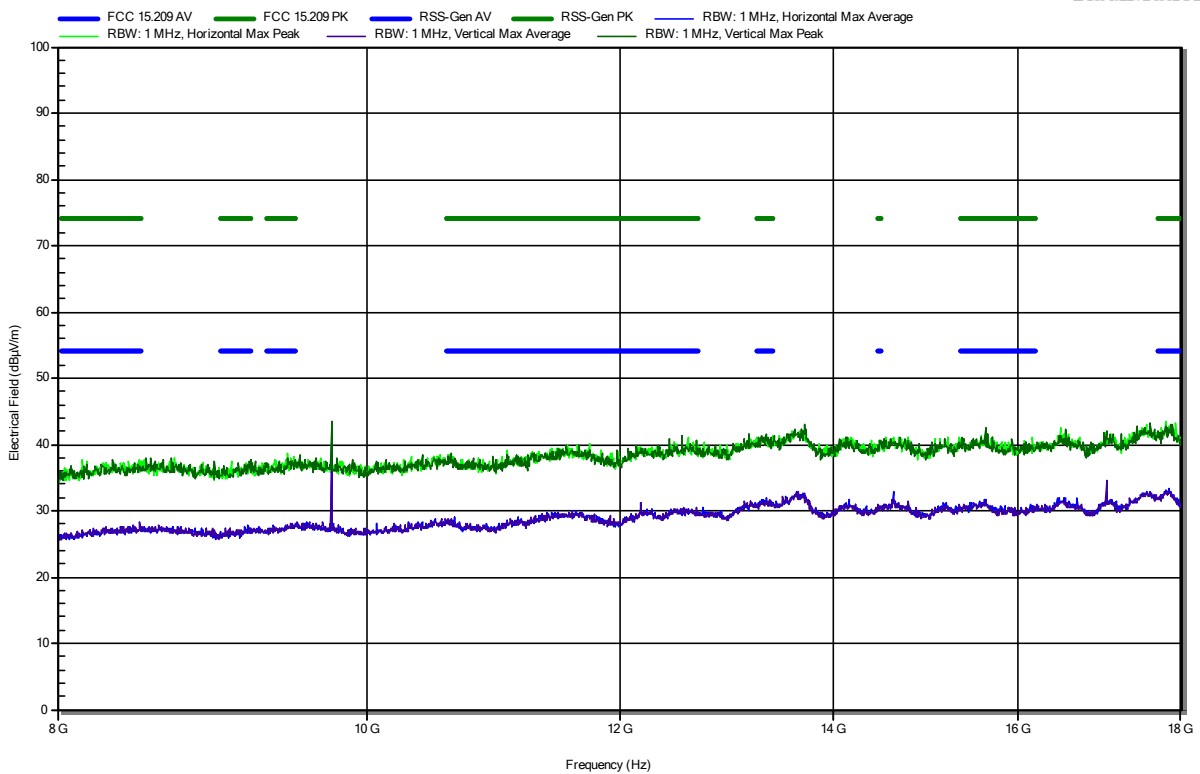


Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck HWRD 650
 Measurement distance: 3 m
 Mode: Tx; 2437MHz, HT20
 Test Date: 2021-11-29
 Note:

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RadiMation

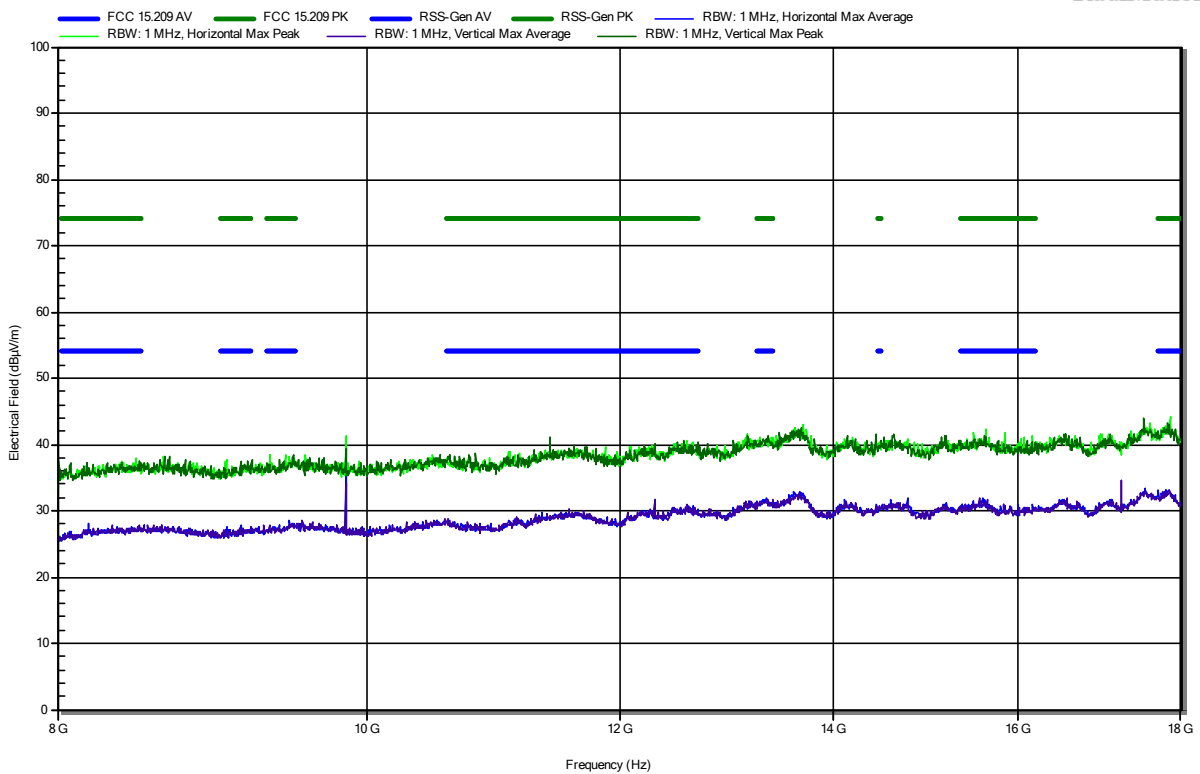


Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck HWRD 650
 Measurement distance: 3 m
 Mode: Tx; 2462MHz, HT20
 Test Date: 2021-11-29
 Note:

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RadiMation

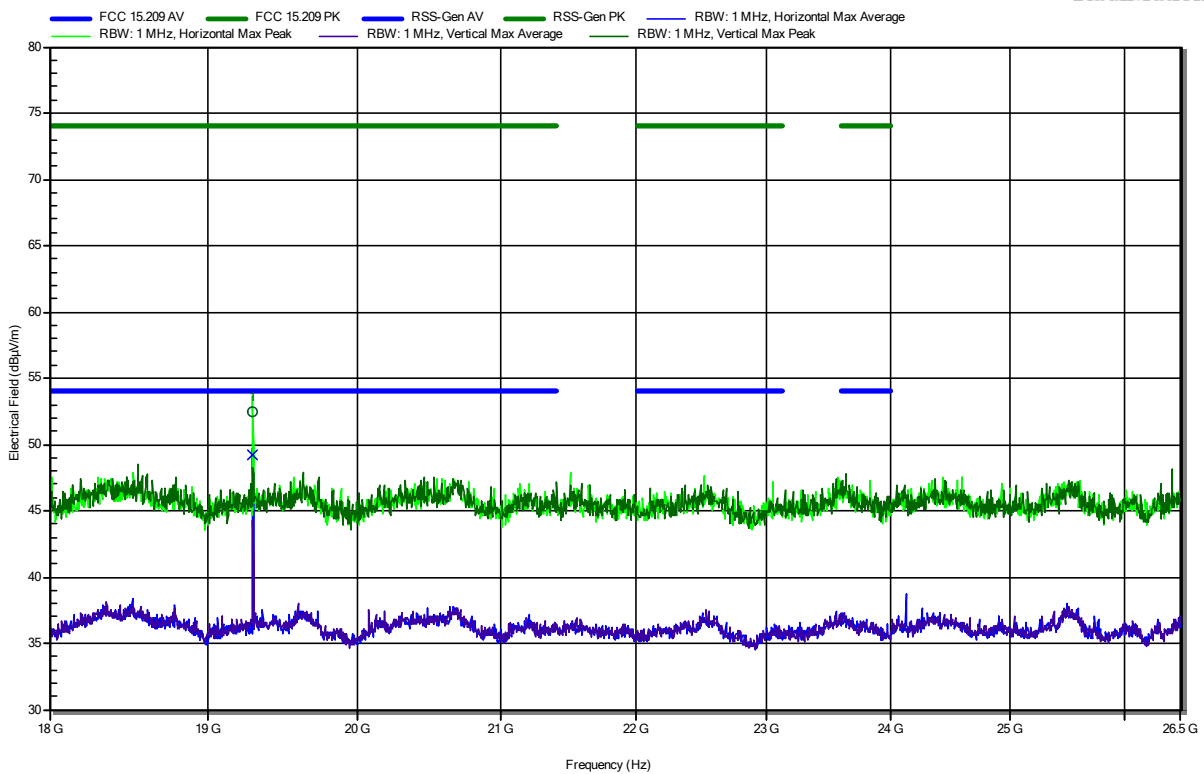


Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Amplifier Research AT4560
 Measurement distance: 3 m
 Mode: Tx; 2412MHz, HT20
 Test Date: 2021-11-29
 Note:

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RadiMation



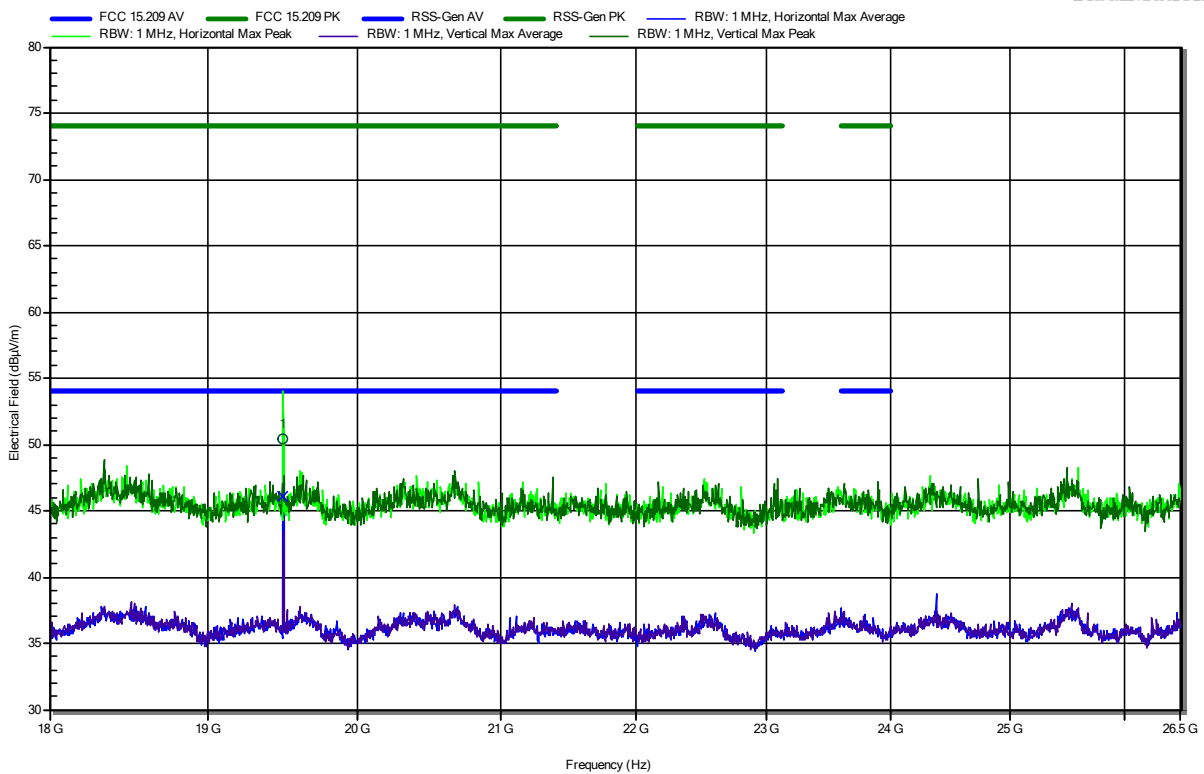
| Frequency | Peak | Peak Limit | Peak Difference | Peak Status | Polarization |
|------------|--------------|---------------|--------------------|----------------|--------------|
| 19.296 GHz | 52.43 dBµV/m | 74 dBµV/m | -21.57 dB | Pass | Horizontal |
| Frequency | Average | Average Limit | Average Difference | Average Status | Polarization |
| 19.296 GHz | 49.16 dBµV/m | 54 dBµV/m | -4.84 dB | Pass | Horizontal |

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Amplifier Research AT4560
 Measurement distance: 3 m
 Mode: Tx; 2437MHz, HT20
 Test Date: 2021-11-29
 Note:

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RadiMation



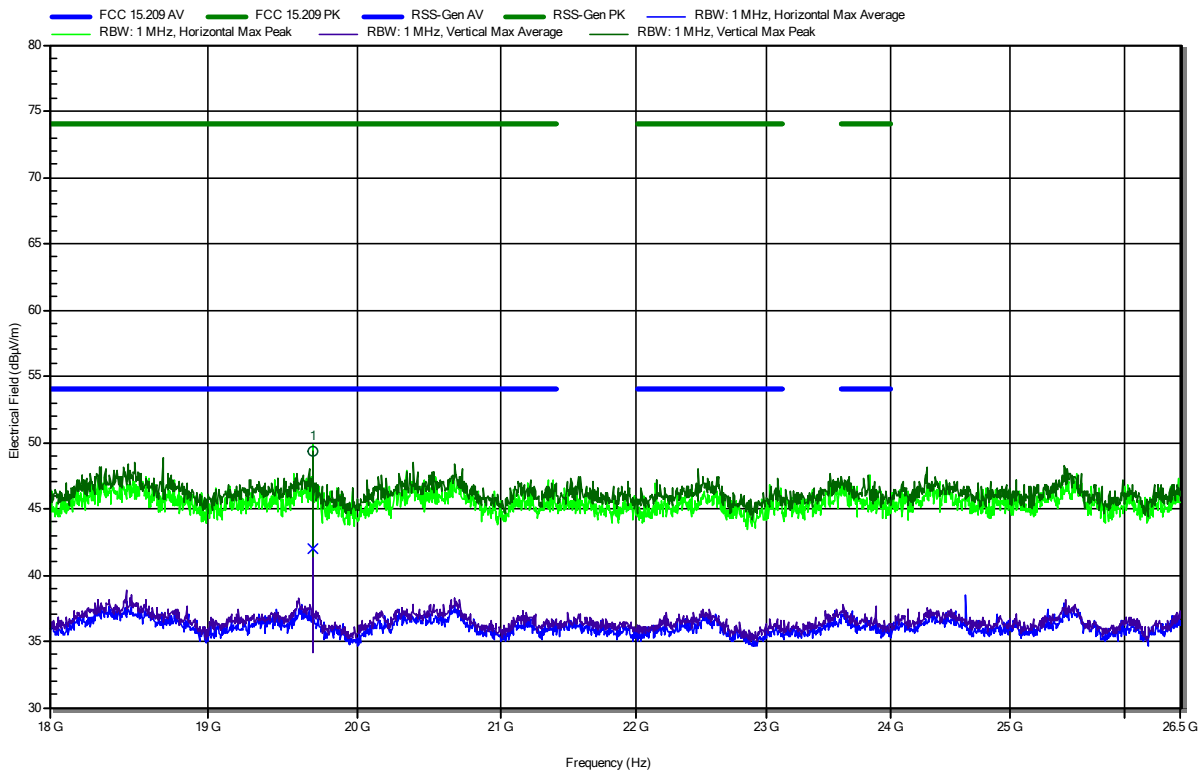
| Frequency | Peak | Peak Limit | Peak Difference | Peak Status | Polarization |
|------------|--------------|---------------|--------------------|----------------|--------------|
| 19.496 GHz | 50.47 dBµV/m | 74 dBµV/m | -23.53 dB | Pass | Horizontal |
| Frequency | Average | Average Limit | Average Difference | Average Status | Polarization |
| 19.496 GHz | 46.14 dBµV/m | 54 dBµV/m | -7.86 dB | Pass | Horizontal |

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Amplifier Research AT4560
 Measurement distance: 3 m
 Mode: Tx; 2462MHz, HT20
 Test Date: 2021-11-29
 Note:

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RadiMation



| Frequency | Peak | Peak Limit | Peak Difference | Peak Status | Polarization |
|------------|--------------|---------------|--------------------|----------------|--------------|
| 19.696 GHz | 49.37 dBµV/m | 74 dBµV/m | -24.63 dB | Pass | Vertical |
| Frequency | Average | Average Limit | Average Difference | Average Status | Polarization |
| 19.696 GHz | 42.04 dBµV/m | 54 dBµV/m | -11.96 dB | Pass | Vertical |

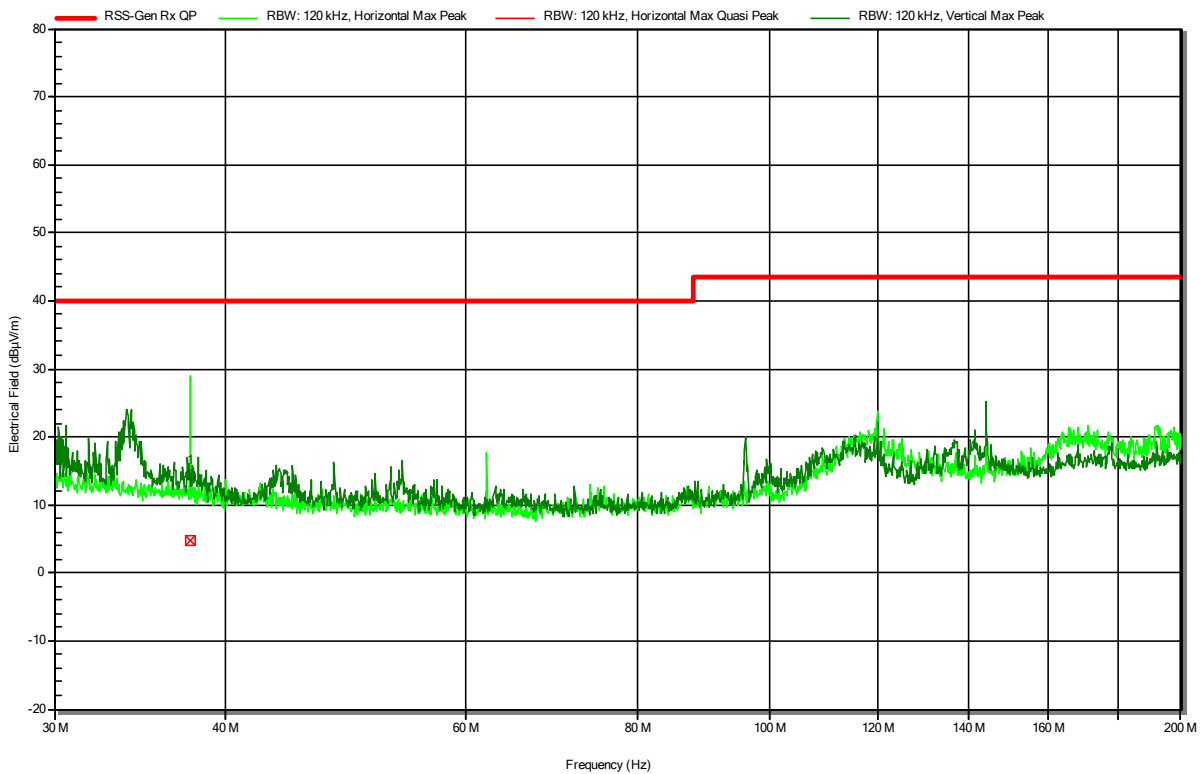
ANNEX B Receiver spurious emissions

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Rohde & Schwarz HK 116
 Measurement distance: 3 m
 Mode: Rx; Receive, CH6
 Test Date: 2021-12-13
 Note:

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RadiMation



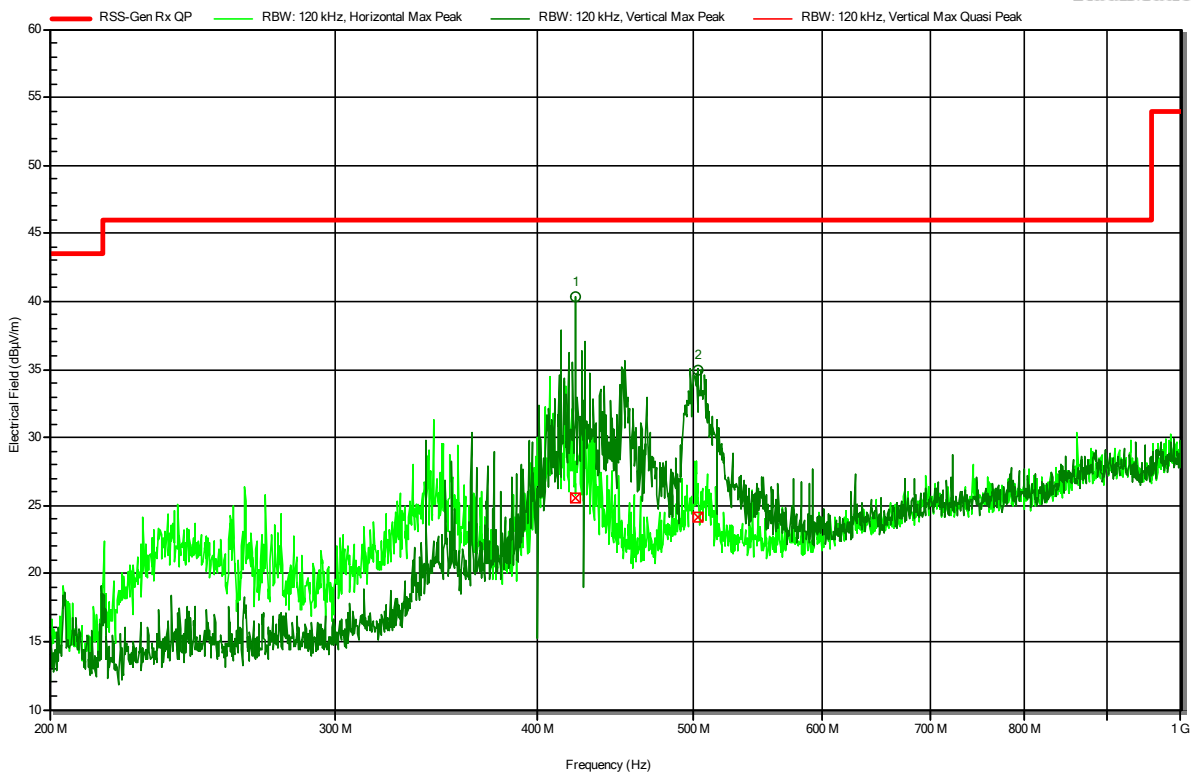
| Frequency | Quasi-Peak | Quasi-Peak Limit | Quasi-Peak Difference | Quasi-Peak Status | Polarization |
|-------------|------------|------------------|-----------------------|-------------------|--------------|
| 37.6797 MHz | 4.8 dBµV/m | 40 dBµV/m | -35.16 dB | Pass | Horizontal |

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Rohde & Schwarz HL 223
 Measurement distance: 3 m
 Mode: Rx; Receive, CH6
 Test Date: 2021-12-13
 Note:

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RadiMation



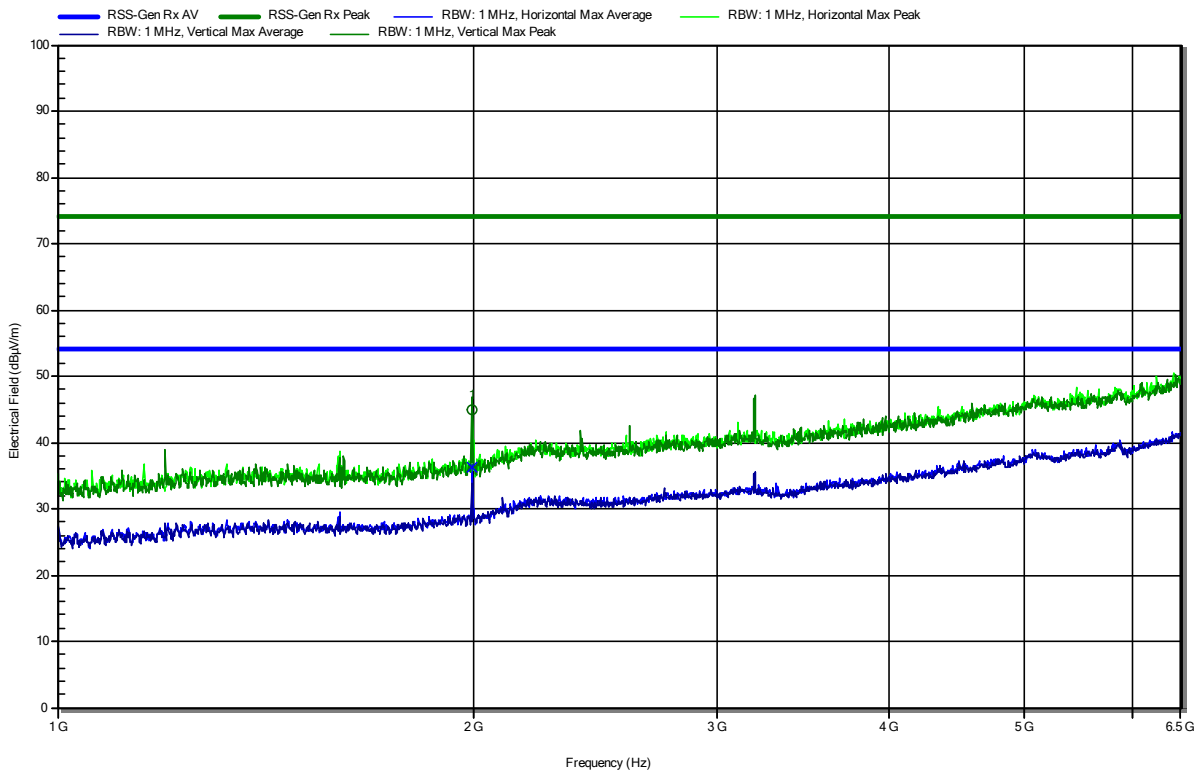
| Frequency | Quasi-Peak | Quasi-Peak Limit | Quasi-Peak Difference | Quasi-Peak Status | Polarization |
|--------------|-------------|------------------|-----------------------|-------------------|--------------|
| 422.5003 MHz | 25.6 dBµV/m | 46 dBµV/m | -20.44 dB | Pass | Vertical |
| 502.5562 MHz | 24.1 dBµV/m | 46 dBµV/m | -21.89 dB | Pass | Vertical |

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck BBHA 9120D
 Measurement distance: 3 m
 Mode: Rx; Receive, CH6
 Test Date: 2021-12-10
 Note:

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RadiMation



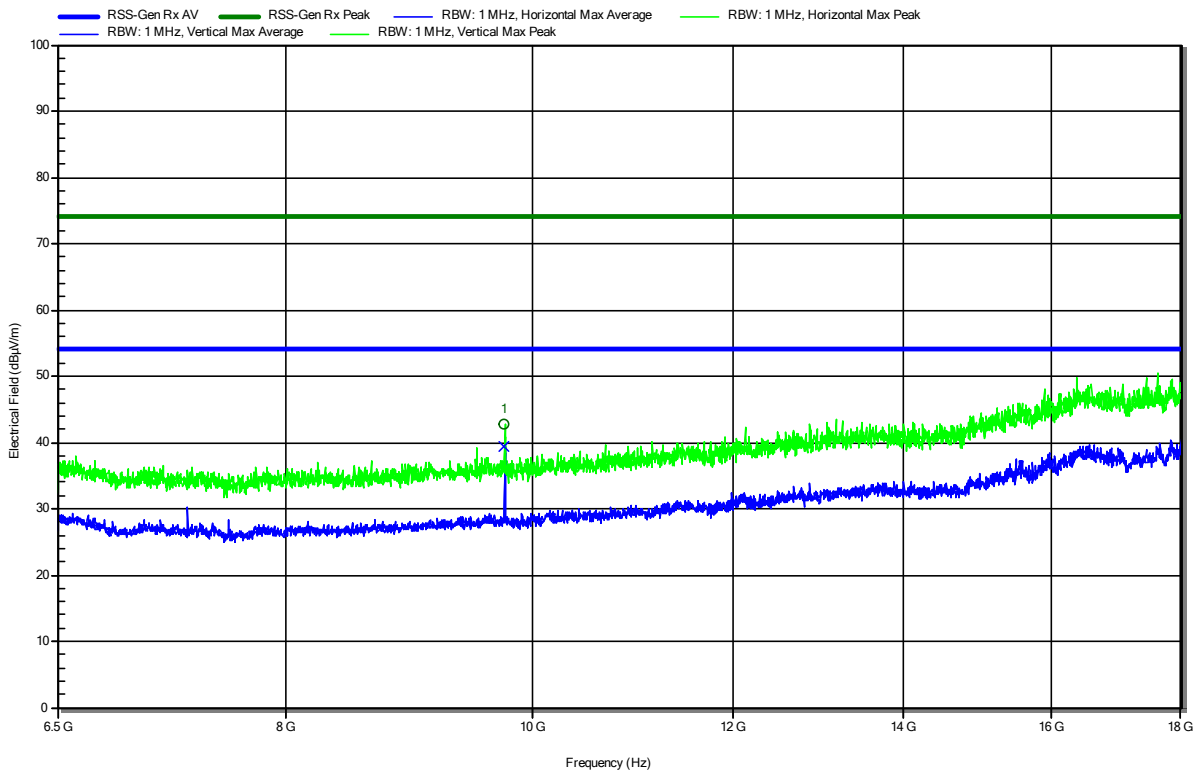
| Frequency | Peak | Peak Limit | Peak Difference | Peak Status | Polarization |
|-----------|--------------|---------------|--------------------|----------------|--------------|
| 1.996 GHz | 44.99 dBµV/m | 74 dBµV/m | -29.01 dB | Pass | Horizontal |
| Frequency | Average | Average Limit | Average Difference | Average Status | Polarization |
| 1.996 GHz | 36.23 dBµV/m | 53.98 dBµV/m | -17.75 dB | Pass | Horizontal |

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck HWRD 650
 Measurement distance: 3 m
 Mode: Rx; Receive, CH6
 Test Date: 2021-12-10
 Note:

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| Frequency | Peak | Peak Limit | Peak Difference | Peak Status | Polarization |
|-----------|--------------|---------------|--------------------|----------------|--------------|
| 9.748 GHz | 42.7 dBµV/m | 74 dBµV/m | -31.3 dB | Pass | Horizontal |
| Frequency | Average | Average Limit | Average Difference | Average Status | Polarization |
| 9.748 GHz | 39.34 dBµV/m | 53.98 dBµV/m | -14.64 dB | Pass | Horizontal |

=== END OF TEST REPORT ===

Test Report No.: G0M-2108-9956-TFC247WF-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany