

## TEST REPORT

Test report no.: 1-8503/19-01-02

### Testing laboratory

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**Accredited Testing Laboratory:**

The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAKKS)

The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

### Applicant

**Ingenico Group**

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### Manufacturer

**Ingenico Group**

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26958 Valence Cedex 9 / FRANCE

### Test standard/s

FCC - Title 47 CFR Part 15      FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

RSS - 247 Issue 2      Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices

For further applied test standards please refer to section 3 of this test report.

### Test Item

**Kind of test item:**      **Communication dongle**

**Model name:**      **Xtra module**

**FCC ID:**      **XKB-XTRAWIBTC**

**IC:**      **2586D-XTRAWIBTC**

**Frequency:**      DTS band 2400 MHz to 2483.5 MHz

**Technology tested:**      Bluetooth® + EDR

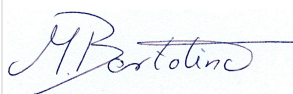
**Antenna:**      Integrated flex antenna

**Power supply:**      110 V AC & 5 V DC by mains adapter / battery

**Temperature range:**      0°C to +40°C

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

### Test report authorized:



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Lab Manager  
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### Test performed:



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Mihail Dorongovskij  
Lab Manager  
Radio Communications & EMC

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## 2 General information

### 2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

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### 2.2 Application details

|                                    |            |
|------------------------------------|------------|
| Date of receipt of order:          | 2019-08-26 |
| Date of receipt of test item:      | 2019-08-27 |
| Start of test:                     | 2019-08-27 |
| End of test:                       | 2019-11-04 |
| Person(s) present during the test: | -/-        |

### 2.3 Test laboratories sub-contracted

None

### 3 Test standard/s, references and accreditations

| Test standard              | Date          | Description                                                                                                                          |
|----------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------|
| FCC - Title 47 CFR Part 15 | -/-           | FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices                                      |
| RSS - 247 Issue 2          | February 2017 | Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices       |
| RSS - Gen Issue 5          | April 2018    | Spectrum Management and Telecommunications Radio Standards Specification<br>- General Requirements for Compliance of Radio Apparatus |

| Guidance         | Version | Description                                                                                                                                                                              |
|------------------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| KDB 558074 D01   | v05r02  | GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES |
| ANSI C63.4-2014  | -/-     | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz                      |
| ANSI C63.10-2013 | -/-     | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices                                                                                           |

| Accreditation    | Description                                                                                                                                               |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| D-PL-12076-01-04 | Telecommunication and EMC Canada<br><a href="https://www.dakks.de/as/ast/d/D-PL-12076-01-04.pdf">https://www.dakks.de/as/ast/d/D-PL-12076-01-04.pdf</a>   |
| D-PL-12076-01-05 | Telecommunication FCC requirements<br><a href="https://www.dakks.de/as/ast/d/D-PL-12076-01-05.pdf">https://www.dakks.de/as/ast/d/D-PL-12076-01-05.pdf</a> |



## 4 Test environment

|                             |                                     |                                                                                                                                                            |
|-----------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Temperature :               | $T_{nom}$<br>$T_{max}$<br>$T_{min}$ | +22 °C during room temperature tests<br>No tests under extreme temperature conditions required.<br>No tests under extreme temperature conditions required. |
| Relative humidity content : |                                     | 55 %                                                                                                                                                       |
| Barometric pressure :       |                                     | 1021 hpa                                                                                                                                                   |
| Power supply :              | $V_{nom}$<br>$V_{max}$<br>$V_{min}$ | 110 V AC & 5 V DC by mains adapter / battery<br>No tests under extreme voltage conditions required.<br>No tests under extreme voltage conditions required. |

## 5 Test item

### 5.1 General description

|                   |   |                                                                    |  |  |
|-------------------|---|--------------------------------------------------------------------|--|--|
| Kind of test item | : | Communication dongle                                               |  |  |
| Model name        | : | Xtra module                                                        |  |  |
| HMN               | : | Lane/7000<br>Lane/8000                                             |  |  |
| PMN               | : | XTRA module                                                        |  |  |
| HVIN              | : | MODU/7003 WiFi/BT<br>MODU/7005 WiFi/BT<br>MODU/8005 WiFi/BT        |  |  |
| FVIN              | : | n/a                                                                |  |  |
| S/N serial number | : | Rad.      Host LANE7000:      Module: 183132213091023807491902<br> |  |  |

## 5.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup and EUT photos are included in test report:

- 1-8503/19-01-01\_AnnexA
- 1-8503/19-01-01\_AnnexB
- 1-8503/19-01-01\_AnnexD

## 6 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

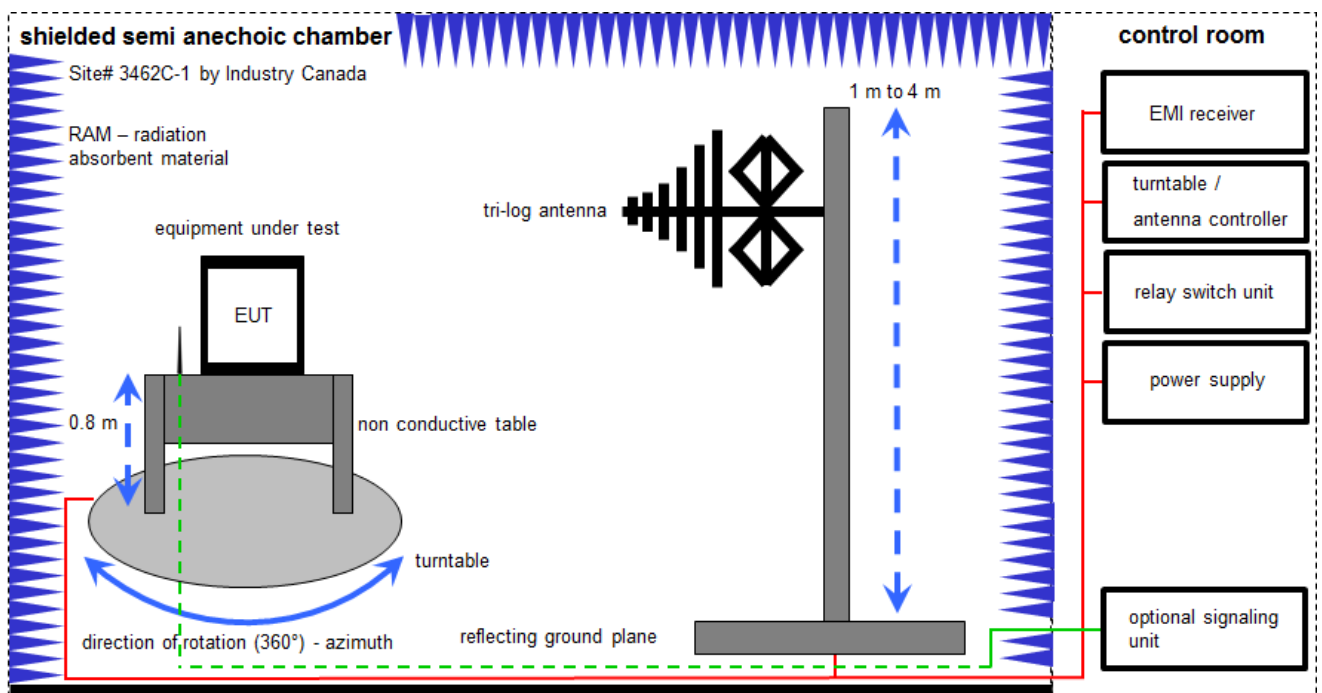
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

### **Agenda:** Kind of Calibration

|      |                                            |     |                                                      |
|------|--------------------------------------------|-----|------------------------------------------------------|
| k    | calibration / calibrated                   | EK  | limited calibration                                  |
| ne   | not required (k, ev, izw, zw not required) | zw  | cyclical maintenance (external cyclical maintenance) |
| ev   | periodic self verification                 | izw | internal cyclical maintenance                        |
| Ve   | long-term stability recognized             | g   | blocked for accredited testing                       |
| vlk! | Attention: extended calibration interval   |     |                                                      |
| NK!  | Attention: not calibrated                  | *)  | next calibration ordered / currently in progress     |

## 6.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 30 MHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are conform to specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: tri-log antenna 10 meter; EMC32 software version: 10.30.0

FS = UR + CL + AF (FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

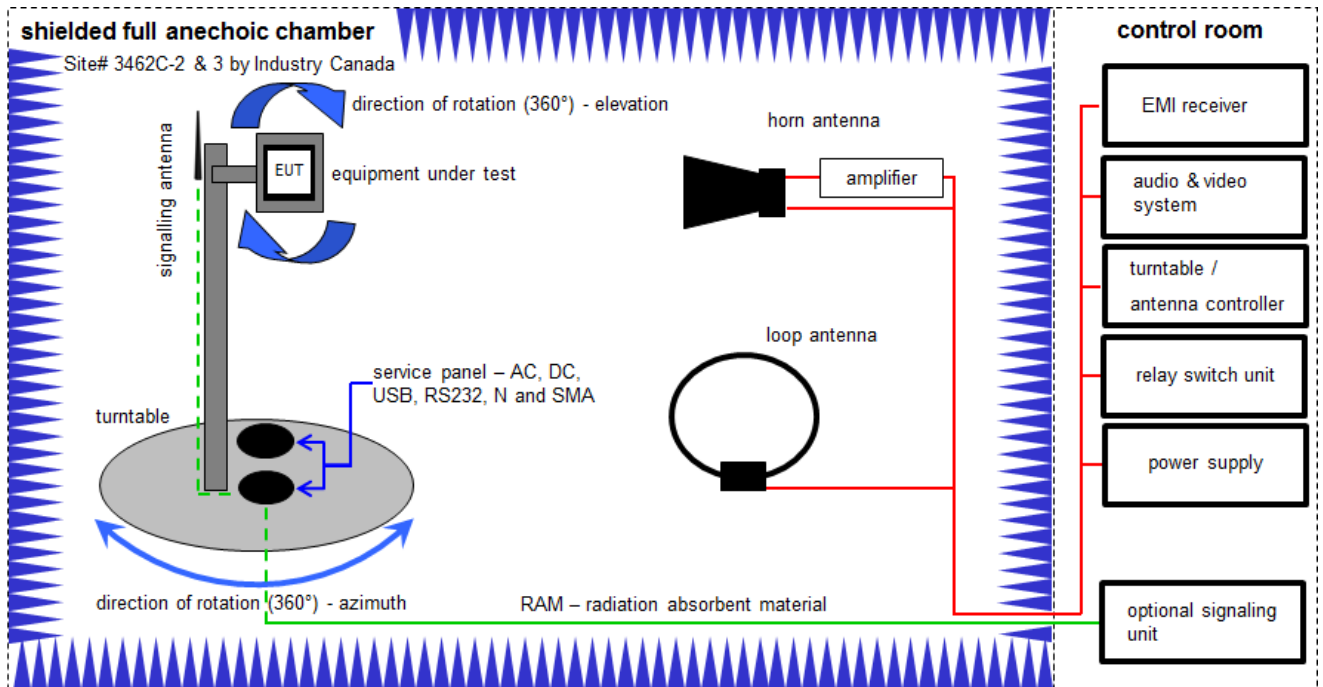
Example calculation:

$$FS [dB\mu V/m] = 12.35 [dB\mu V/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dB\mu V/m] \quad (35.69 \mu V/m)$$

### Equipment table:

| No. | Lab / Item | Equipment                                    | Type             | Manufacturer                | Serial No. | INV. No.  | Kind of Calibration | Last Calibration | Next Calibration |
|-----|------------|----------------------------------------------|------------------|-----------------------------|------------|-----------|---------------------|------------------|------------------|
| 1   | A          | Switch-Unit                                  | 3488A            | HP                          | 2719A14505 | 300000368 | ev                  | -/-              | -/-              |
| 2   | A          | Meßkabine 1                                  | HF-Absorberhalle | MWB AG 300023               | -/-        | 300000551 | ne                  | -/-              | -/-              |
| 3   | A          | Antenna Tower                                | Model 2175       | ETS-Lindgren                | 64762      | 300003745 | izw                 | -/-              | -/-              |
| 4   | A          | Positioning Controller                       | Model 2090       | ETS-Lindgren                | 64672      | 300003746 | izw                 | -/-              | -/-              |
| 5   | A          | Turntable Interface-Box                      | Model 105637     | ETS-Lindgren                | 44583      | 300003747 | izw                 | -/-              | -/-              |
| 6   | A          | TRILOG Broadband Test-Antenna 30 MHz - 3 GHz | VULB9163         | Schwarzbeck Mess-Elektronik | 371        | 300003854 | vKI!                | 24.11.2017       | 23.11.2020       |
| 7   | A          | EMI Test Receiver                            | ESR3             | Rohde & Schwarz             | 102587     | 300005771 | k                   | 21.05.2019       | 20.05.2020       |

## 6.2 Shielded fully anechoic chamber



Measurement distance: horn antenna 3 meter; loop antenna 3 meter / 1 meter

FS = UR + CA + AF (FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

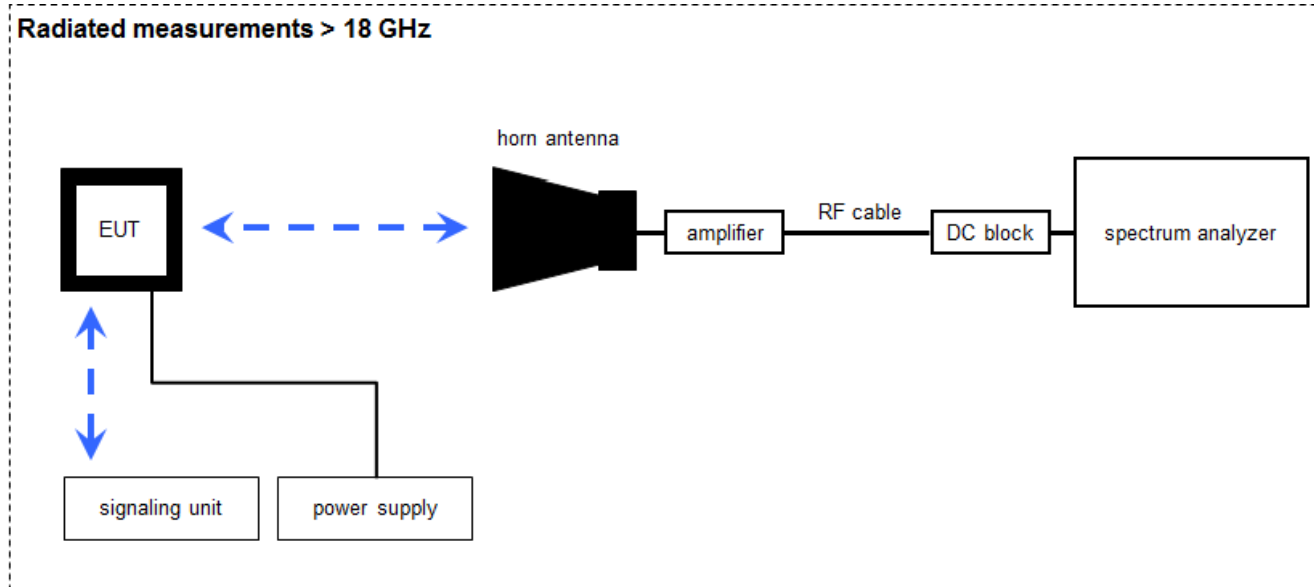
Example calculation:

FS [dBμV/m] = 40.0 [dBμV/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dBμV/m] (71.61 μV/m)

### Equipment table:

| No. | Lab / Item | Equipment                                      | Type                            | Manufacturer         | Serial No. | INV. No.  | Kind of Calibration | Last Calibration | Next Calibration |
|-----|------------|------------------------------------------------|---------------------------------|----------------------|------------|-----------|---------------------|------------------|------------------|
| 1   | A          | Active Loop Antenna 9 kHz to 30 MHz            | 6502                            | EMCO                 | 2210       | 300001015 | vIKI!               | 13.06.2019       | 12.06.2021       |
| 2   | A, B, C    | Anechoic chamber                               | FAC 3/5m                        | MWB / TDK            | 87400/02   | 300000996 | ev                  | -/-              | -/-              |
| 3   | B, C       | Double-Ridged Waveguide Horn Antenna 1-18.0GHz | 3115                            | EMCO                 | 9107-3697  | 300001605 | vIKI!               | 27.02.2019       | 26.02.2021       |
| 4   | A, B, C    | Switch / Control Unit                          | 3488A                           | HP                   | *          | 300000199 | ne                  | -/-              | -/-              |
| 5   | C          | Band Reject filter                             | WRCG2400/2483-2375/2505-50/10SS | Wainwright           | 11         | 300003351 | ev                  | -/-              | -/-              |
| 6   | A, B, C    | EMI Test Receiver 20Hz- 26,5GHz                | ESU26                           | R&S                  | 100037     | 300003555 | k                   | 14.09.2018       | 13.12.2019       |
| 7   | B, C       | Broadband Amplifier 0.5-18 GHz                 | CBLU5184540                     | CERNEX               | 22049      | 300004481 | ev                  | -/-              | -/-              |
| 8   | A, B, C    | 4U RF Switch Platform                          | L4491A                          | Agilent Technologies | MY50000037 | 300004509 | ne                  | -/-              | -/-              |
| 9   | A, B, C    | NEXIO EMV-Software                             | BAT EMC V3.19.1.9               | EMCO                 | -/-        | 300004682 | ne                  | -/-              | -/-              |
| 10  | A, B, C    | PC                                             | ExOne                           | F+W                  | -/-        | 300004703 | ne                  | -/-              | -/-              |
| 11  | B, C       | RF-Amplifier                                   | AMF-6F06001800-30-10P-R         | NARDA-MITEQ Inc      | 2011572    | 300005241 | ev                  | -/-              | -/-              |

### 6.3 Radiated measurements > 18 GHz



Measurement distance: horn antenna 50 cm

$$FS = UR + CA + AF$$

(FS-field strength; UR-voltage at the receiver; CA-loss signal path & distance correction; AF-antenna factor)

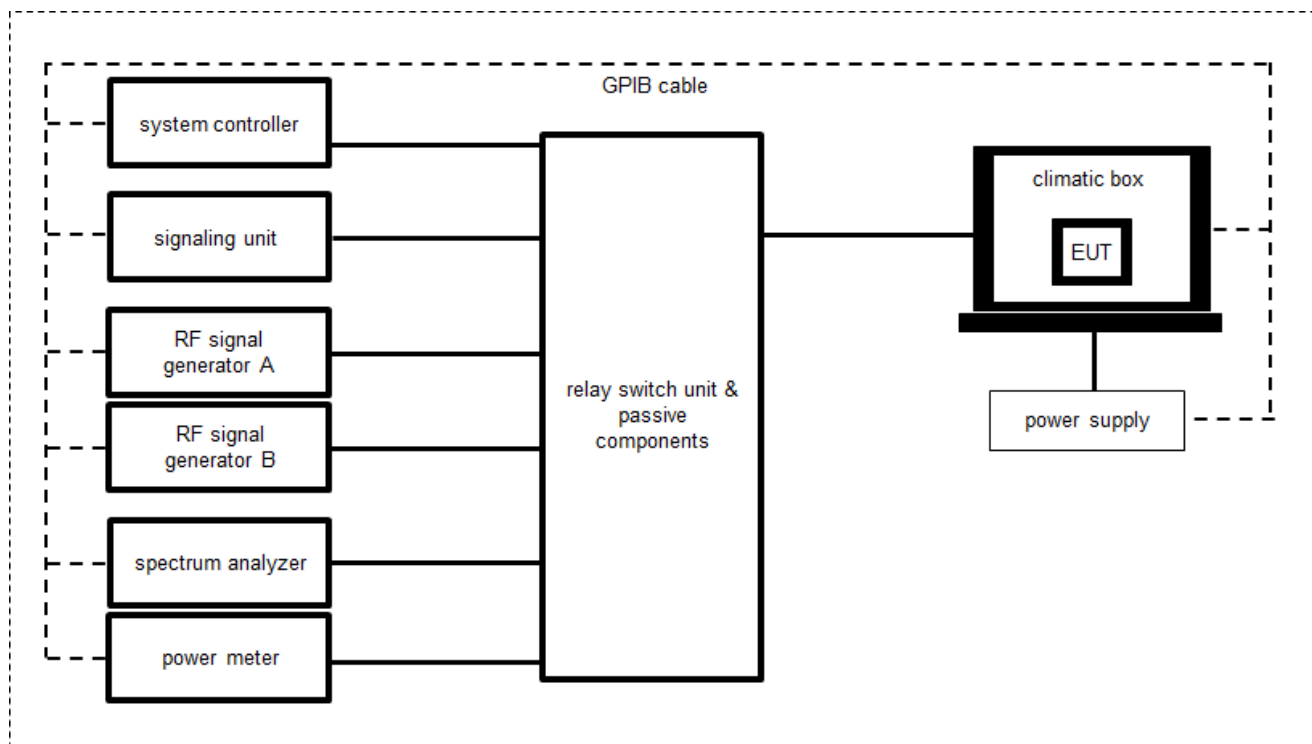
Example calculation:

$$FS \text{ [dB}\mu\text{V/m]} = 40.0 \text{ [dB}\mu\text{V/m]} + (-60.1) \text{ [dB]} + 36.74 \text{ [dB/m]} = 16.64 \text{ [dB}\mu\text{V/m]} \text{ (6.79 } \mu\text{V/m)}$$

#### Equipment table:

| No. | Lab / Item | Equipment                                | Type              | Manufacturer   | Serial No.       | INV. No.  | Kind of Calibration | Last Calibration | Next Calibration |
|-----|------------|------------------------------------------|-------------------|----------------|------------------|-----------|---------------------|------------------|------------------|
| 1   | A          | Microwave System Amplifier, 0.5-26.5 GHz | 83017A            | HP             | 00419            | 300002268 | ev                  | -/-              | -/-              |
| 2   | A          | Std. Gain Horn Antenna 18.0-26.5 GHz     | 638               | Narda          | 01096            | 300000486 | vIKI!               | 13.12.2017       | 12.12.2019       |
| 3   | A          | Signal Analyzer 40 GHz                   | FSV40             | R&S            | 101042           | 300004517 | k                   | 17.12.2018       | 16.12.2019       |
| 4   | A          | RF-Cable                                 | ST18/SMAM/SMAM/48 | Huber & Suhner | Batch no. 600918 | 400001182 | ev                  | -/-              | -/-              |
| 5   | A          | DC-Blocker 0.1-40 GHz                    | 8141A             | Inmet          | -/-              | 400001185 | ev                  | -/-              | -/-              |

## 6.4 Conducted measurements Bluetooth system



$$OP = AV + CA$$

(OP-output power; AV-analyzer value; CA-loss signal path)

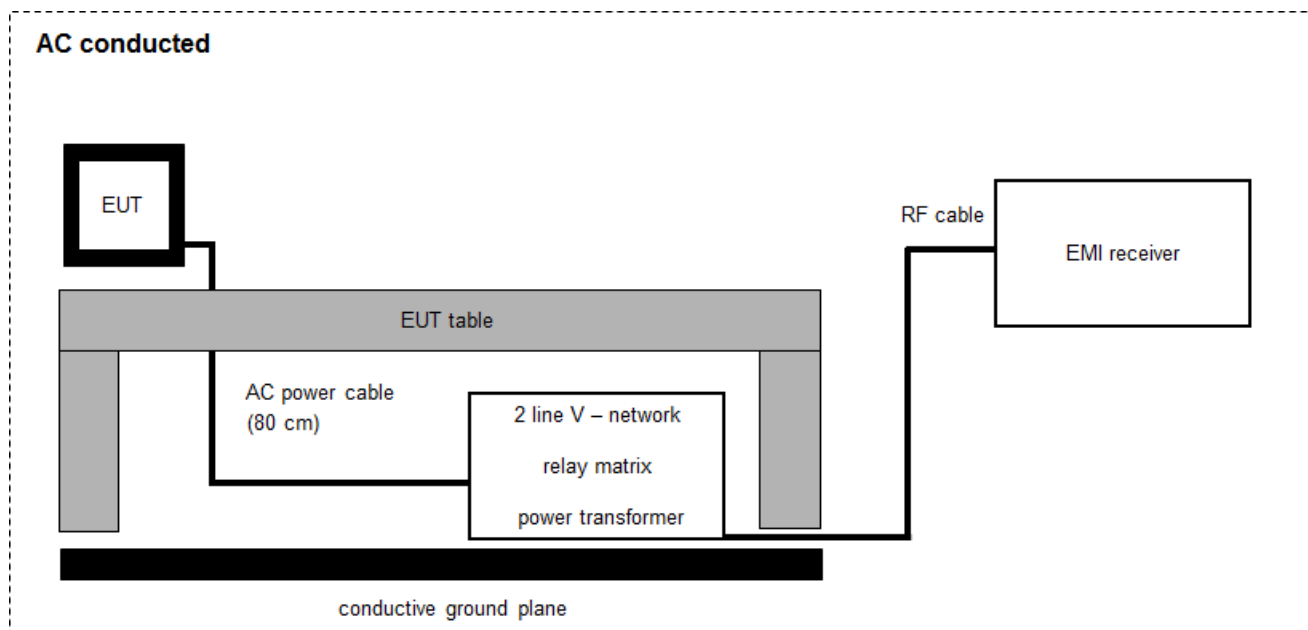
### Example calculation:

$$OP \text{ [dBm]} = 6.0 \text{ [dBm]} + 11.7 \text{ [dB]} = 17.7 \text{ [dBm]} \text{ (58.88 mW)}$$

### Equipment table:

| No. | Lab / Item | Equipment                                             | Type            | Manufacturer         | Serial No.       | INV. No.  | Kind of Calibration | Last Calibration | Next Calibration |
|-----|------------|-------------------------------------------------------|-----------------|----------------------|------------------|-----------|---------------------|------------------|------------------|
| 1   | A          | USB/GPIB interface                                    | 82357B          | Agilent Technologies | MY52103346       | 300004390 | ne                  | -/-              | -/-              |
| 2   | A          | PC Laboratory                                         | Exone           | Fröhlich + Walter    | S2642279-03 / 10 | 300004179 | ne                  | -/-              | -/-              |
| 3   | A          | Wireless Connectivity Tester                          | CMW270          | Rohde & Schwarz      | 100683           | 300005133 | k                   | 03.01.2018       | 02.01.2020       |
| 4   | A          | Spectrum Analyzer                                     | FSV30           | Rohde & Schwarz      | 103809           | 300005359 | vIKI!               | 17.12.2018       | 16.12.2020       |
| 5   | A          | Relay Switch Matrix                                   | RSM-1           | CTC advanced GmbH    | 0001             | 400001355 | ev                  | 14.06.2019       | 13.06.2020       |
| 6   | A          | Tester Software RadioStar (C.BER2 for BT Conformance) | Version 1.0.0.X | CTC advanced GmbH    | 0001             | 400001380 | ne                  | -/-              | -/-              |

## 6.5 AC conducted



$$FS = UR + CF + VC$$

(FS-field strength; UR-voltage at the receiver; CR-loss of the cable and filter; VC-correction factor of the ISN)

Example calculation:

$$FS [dB\mu V/m] = 37.62 [dB\mu V/m] + 9.90 [dB] + 0.23 [dB] = 47.75 [dB\mu V/m] (244.06 \mu V/m)$$

### Equipment table:

| No. | Lab / Item | Equipment                                 | Type    | Manufacturer         | Serial No. | INV. No.  | Kind of Calibration | Last Calibration | Next Calibration |
|-----|------------|-------------------------------------------|---------|----------------------|------------|-----------|---------------------|------------------|------------------|
| 1   | A          | Two-line V-Network (LISN) 9 kHz to 30 MHz | ESH3-Z5 | R&S                  | 892475/017 | 300002209 | vIKI!               | 13.12.2017       | 12.12.2019       |
| 2   | A          | RF-Filter-section                         | 85420E  | HP                   | 3427A00162 | 300002214 | NK!                 | -/-              | -/-              |
| 3   | A          | Hochpass 150 kHz                          | EZ-25   | R&S                  | 100010     | 300003798 | ev                  | -/-              | -/-              |
| 4   | A          | MXE EMI Receiver 20 Hz to 26,5 GHz        | N9038A  | Agilent Technologies | MY51210197 | 300004405 | k                   | 12.12.2018       | 11.12.2019       |

## 7 Sequence of testing

### 7.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

#### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, it is placed on a table with 0.8 m height.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

#### Premeasurement\*

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

#### Final measurement

- Identified emissions during the pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

\*Note: The sequence will be repeated three times with different EUT orientations.

## 7.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

### Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

### Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position  $\pm 45^\circ$  and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

### 7.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

#### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

#### Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

#### Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

## 7.4 Sequence of testing radiated spurious above 18 GHz

### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate (e.g. 0.5 m).
- The EUT is set into operation.

### Premeasurement

- The test antenna is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.

### Final measurement

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

## 8 Measurement uncertainty

| Measurement uncertainty                                  |                                          |
|----------------------------------------------------------|------------------------------------------|
| Test case                                                | Uncertainty                              |
| Antenna gain                                             | ± 3 dB                                   |
| Carrier frequency separation                             | ± 21.5 kHz                               |
| Number of hopping channels                               | -/-                                      |
| Time of occupancy                                        | According BT Core specification          |
| Spectrum bandwidth                                       | ± 21.5 kHz absolute; ± 15.0 kHz relative |
| Maximum output power                                     | ± 1 dB                                   |
| Detailed conducted spurious emissions @ the band edge    | ± 1 dB                                   |
| Band edge compliance radiated                            | ± 3 dB                                   |
| Spurious emissions conducted                             | ± 3 dB                                   |
| Spurious emissions radiated below 30 MHz                 | ± 3 dB                                   |
| Spurious emissions radiated 30 MHz to 1 GHz              | ± 3 dB                                   |
| Spurious emissions radiated 1 GHz to 12.75 GHz           | ± 3.7 dB                                 |
| Spurious emissions radiated above 12.75 GHz              | ± 4.5 dB                                 |
| Spurious emissions conducted below 30 MHz (AC conducted) | ± 2.6 dB                                 |

## 9 Summary of measurement results

|                                     |                                                                                                                          |
|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/>            | No deviations from the technical specifications were ascertained                                                         |
| <input type="checkbox"/>            | There were deviations from the technical specifications ascertained                                                      |
| <input checked="" type="checkbox"/> | This test report is only a partial test report.<br>The content and verdict of the performed test cases are listed below. |

| TC Identifier | Description                       | Verdict    | Date       | Remark |
|---------------|-----------------------------------|------------|------------|--------|
| RF-Testing    | CFR Part 15<br>RSS - 247, Issue 2 | See table! | 2019-12-04 | -/-    |

| Test specification clause                             | Test case                                               | Temperature conditions | Power source voltages | Mode                         | C                                                                                                                 | NC                                                                               | NA                                                                               | NP                                                                                                                | Remark |
|-------------------------------------------------------|---------------------------------------------------------|------------------------|-----------------------|------------------------------|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--------|
| §15.247(b)(4)<br>RSS - 247 / 5.4.(f)(ii)              | Antenna gain                                            | Nominal                | Nominal               | GFSK                         | <input checked="" type="checkbox"/>                                                                               | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                                                          | -/-    |
| §15.247(a)(1)<br>RSS - 247 / 5.1.(b)                  | Carrier frequency separation                            | Nominal                | Nominal               | GFSK                         | <input type="checkbox"/>                                                                                          | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         | <input checked="" type="checkbox"/>                                                                               | *      |
| §15.247(a)(1)<br>RSS - 247 / 5.1 (d)                  | Number of hopping channels                              | Nominal                | Nominal               | GFSK                         | <input type="checkbox"/>                                                                                          | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         | <input checked="" type="checkbox"/>                                                                               | *      |
| §15.247(a)(1) (iii)<br>RSS - 247 / 5.1 (c)            | Time of occupancy (dwell time)                          | Nominal                | Nominal               | GFSK<br>Pi/4 DQPSK<br>8 DPSK | <input type="checkbox"/>                                                                                          | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         | <input checked="" type="checkbox"/>                                                                               | *      |
| §15.247(a)(1)<br>RSS - 247 / 5.1 (a)                  | Spectrum bandwidth of a FHSS system bandwidth           | Nominal                | Nominal               | GFSK<br>Pi/4 DQPSK<br>8 DPSK | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/>                                  | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> | <input checked="" type="checkbox"/><br><input checked="" type="checkbox"/><br><input checked="" type="checkbox"/> | *      |
| §15.247(b)(1)<br>RSS - 247 / 5.4 (b)                  | Maximum output power                                    | Nominal                | Nominal               | GFSK<br>Pi/4 DQPSK<br>8 DPSK | <input checked="" type="checkbox"/><br><input checked="" type="checkbox"/><br><input checked="" type="checkbox"/> | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/>                                  | -/-    |
| §15.247(d)<br>RSS - 247 / 5.5                         | Detailed spurious emissions @ the band edge - conducted | Nominal                | Nominal               | GFSK<br>Pi/4 DQPSK<br>8 DPSK | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/>                                  | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> | <input checked="" type="checkbox"/><br><input checked="" type="checkbox"/><br><input checked="" type="checkbox"/> | *      |
| §15.205<br>RSS - 247 / 5.5 RSS - Gen                  | Band edge compliance radiated                           | Nominal                | Nominal               | GFSK<br>Pi/4 DQPSK<br>8 DPSK | <input checked="" type="checkbox"/><br><input checked="" type="checkbox"/><br><input checked="" type="checkbox"/> | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/>                                  | -/-    |
| §15.247(d)<br>RSS - 247 / 5.5                         | Spurious emissions conducted                            | Nominal                | Nominal               | GFSK<br>Pi/4 DQPSK<br>8 DPSK | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/>                                  | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> | <input type="checkbox"/><br><input type="checkbox"/><br><input type="checkbox"/> | <input checked="" type="checkbox"/><br><input checked="" type="checkbox"/><br><input checked="" type="checkbox"/> | *      |
| §15.209(a)<br>RSS - Gen                               | Spurious emissions radiated below 30 MHz                | Nominal                | Nominal               | GFSK                         | <input checked="" type="checkbox"/>                                                                               | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                                                          | -/-    |
| §15.247(d)<br>RSS - 247 / 5.5<br>§15.109<br>RSS - Gen | Spurious emissions radiated 30 MHz to 1 GHz             | Nominal                | Nominal               | GFSK<br>RX mode              | <input checked="" type="checkbox"/>                                                                               | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                                                          | -/-    |
| §15.247(d)<br>RSS - 247 / 5.5<br>§15.109<br>RSS - Gen | Spurious emissions radiated above 1 GHz                 | Nominal                | Nominal               | GFSK<br>RX mode              | <input checked="" type="checkbox"/>                                                                               | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                                                          | -/-    |
| §15.107(a)<br>§15.207                                 | Conducted emissions                                     | Nominal                | Nominal               | GFSK<br>RX mode              | <input checked="" type="checkbox"/>                                                                               | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                         | <input type="checkbox"/>                                                                                          | -/-    |

|  |                                |  |  |  |  |  |  |  |  |
|--|--------------------------------|--|--|--|--|--|--|--|--|
|  | below 30 MHz<br>(AC conducted) |  |  |  |  |  |  |  |  |
|--|--------------------------------|--|--|--|--|--|--|--|--|

\* See test report no. 1-1633\_16-01-02-B, because the Bluetooth RF part between the XTRA WiFi/BT (this test report) and the XTRA module MODU/7002 WiFi/BT (test report no. 1-1633\_16-01-02-B) is the same. Therefore only output power verification and radiated tests were performed.

**Notes:**

|          |           |           |               |           |                |           |               |
|----------|-----------|-----------|---------------|-----------|----------------|-----------|---------------|
| <b>C</b> | Compliant | <b>NC</b> | Not compliant | <b>NA</b> | Not applicable | <b>NP</b> | Not performed |
|----------|-----------|-----------|---------------|-----------|----------------|-----------|---------------|

## 10 Additional comments

*The Bluetooth® word mark and logos are owned by the Bluetooth SIG Inc. and any use of such marks by CTC advanced GmbH is under license.*

Reference documents: 1-8503\_19-01-02\_log1\_conducted.pdf  
ICO-OPE-04028 BT\_DUT Mode agreement\_procedure.pdf  
Test report no. 1-1633\_16-01-02-B

Special test descriptions: The radiated spurious emissions tests between 30 MHz and 1 GHz were performed with one Xtra module in a LANE8000 host and one Xtra module in a LANE7000 host. Both hosts were in the semi-anechoic chamber at the same time and the modules were always transmitting in the same mode and on the same channel. This represents the worst case and therefore covers both possible Xtra module use cases.  
As the Xtra module will be only used in LANE8000 and LANE7000 hosts, the module can be only used for this two use cases. All other tests were performed with a module stand-alone configuration. For 30 MHz to 1 GHz spurious tests the stand-alone configuration was not compliant due to unshielded cables which were used for the stand-alone test setup and are not part of the end product.

Configuration descriptions: TX tests: were performed with x-DH5 packets and static PRBS pattern payload.  
RX/Standby tests: BT test mode enabled, scan enabled, TX Idle

Test mode: ☒ Bluetooth Test mode loop back enabled  
(EUT is controlled over CBT/CMU/CMW)  
  
☐ Special software is used.  
EUT is transmitting pseudo random data by itself

Antennas and transmit operating modes: ☒ Operating mode 1 (single antenna)  

- Equipment with 1 antenna,
- Equipment with 2 diversity antennas operating in switched diversity mode by which at any moment in time only 1 antenna is used,
- Smart antenna system with 2 or more transmit/receive chains, but operating in a mode where only 1 transmit/receive chain is used)

## 11 Measurement results

### 11.1 Antenna gain

#### Measurement:

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module. For normal Bluetooth® devices, the GFSK modulation is used.

| Measurement parameters (radiated) |                      |
|-----------------------------------|----------------------|
| Detector                          | Peak                 |
| Sweep time                        | Auto                 |
| Resolution bandwidth              | 3 MHz                |
| Video bandwidth                   | 3 MHz                |
| Span                              | 5 MHz                |
| Trace mode                        | Max hold             |
| Test setup                        | See sub clause 6.2 B |
| Measurement uncertainty           | See sub clause 8     |

| Measurement parameters (conducted) |                                                                                          |
|------------------------------------|------------------------------------------------------------------------------------------|
| External result file               | 1-8503_19-01-02_log1_conducted.pdf<br>Common2G4 Peak Output Power conducted<br>3MHz_3MHz |
| Test setup                         | See sub clause 6.4 A                                                                     |
| Measurement uncertainty            | See sub clause 8                                                                         |

#### Limits:

| FCC                                                               | IC |
|-------------------------------------------------------------------|----|
| 6 dBi / > 6 dBi output power and power density reduction required |    |

#### Results:

| T <sub>nom</sub>                                       | V <sub>nom</sub> | lowest<br>channel<br>2402 MHz | middle<br>channel<br>2441 MHz | highest<br>channel<br>2480 MHz |
|--------------------------------------------------------|------------------|-------------------------------|-------------------------------|--------------------------------|
| Conducted power [dBm]<br>Measured with GFSK modulation |                  | -2.0                          | 2.3                           | 1.5                            |
| Radiated power [dBm]<br>Measured with GFSK modulation  |                  | 3.0                           | 7.1                           | 8.0                            |
| Gain [dBi]<br>Calculated                               |                  | 5.0                           | 4.8                           | 6.5                            |

## 11.2 Maximum output power

### Description:

Measurement of the maximum output power conducted and radiated. EUT in single channel mode. The measurement is performed according to the ANSI C63.10.

| Measurement parameters  |                                                                                                |
|-------------------------|------------------------------------------------------------------------------------------------|
| External result file    | 1-8503_19-01-02_log1_conducted.pdf<br>FCC Part 15.247 Maximum Peak Conducted Output Power FHSS |
| Test setup              | See sub clause 6.4 A                                                                           |
| Measurement uncertainty | See sub clause 8                                                                               |

### Limits:

| FCC                                                                                                                                          | IC |
|----------------------------------------------------------------------------------------------------------------------------------------------|----|
| Maximum output power                                                                                                                         |    |
| [Conducted: 0.125 W – antenna gain max. 6 dBi]<br>Systems using more than 75 hopping channels:<br>Conducted: 1.0 W – antenna gain max. 6 dBi |    |

**Results:**

| Modulation | Maximum output power conducted [dBm] |          |          |
|------------|--------------------------------------|----------|----------|
| Frequency  | 2402 MHz                             | 2441 MHz | 2480 MHz |
| GFSK       | -2.6                                 | 1.7      | 0.9      |
| Pi/4 DQPSK | -0.6                                 | 2.9      | 2.0      |
| 8 DPSK     | -0.4                                 | 3.1      | 2.3      |

**Results:** Extracted from test report no. 1-1633\_16-01-02-B

| Modulation | Maximum output power conducted [dBm] |          |          |
|------------|--------------------------------------|----------|----------|
| Frequency  | 2402 MHz                             | 2441 MHz | 2480 MHz |
| GFSK       | -2.5                                 | 1.1      | 1.5      |
| Pi/4 DQPSK | -1.3                                 | 1.8      | 1.7      |
| 8 DPSK     | -0.8                                 | 2.1      | 1.9      |

### 11.3 Band edge compliance radiated

#### Description:

Measurement of the radiated band edge compliance. The EUT is turned in the position that results in the maximum level at the band edge. Then a sweep over the corresponding restricted band is performed. The EUT is set to single channel mode and the transmit channel is channel 00 for the lower restricted band and channel 78 for the upper restricted band. The measurement is repeated for all modulations. Measurement distance is 3m.

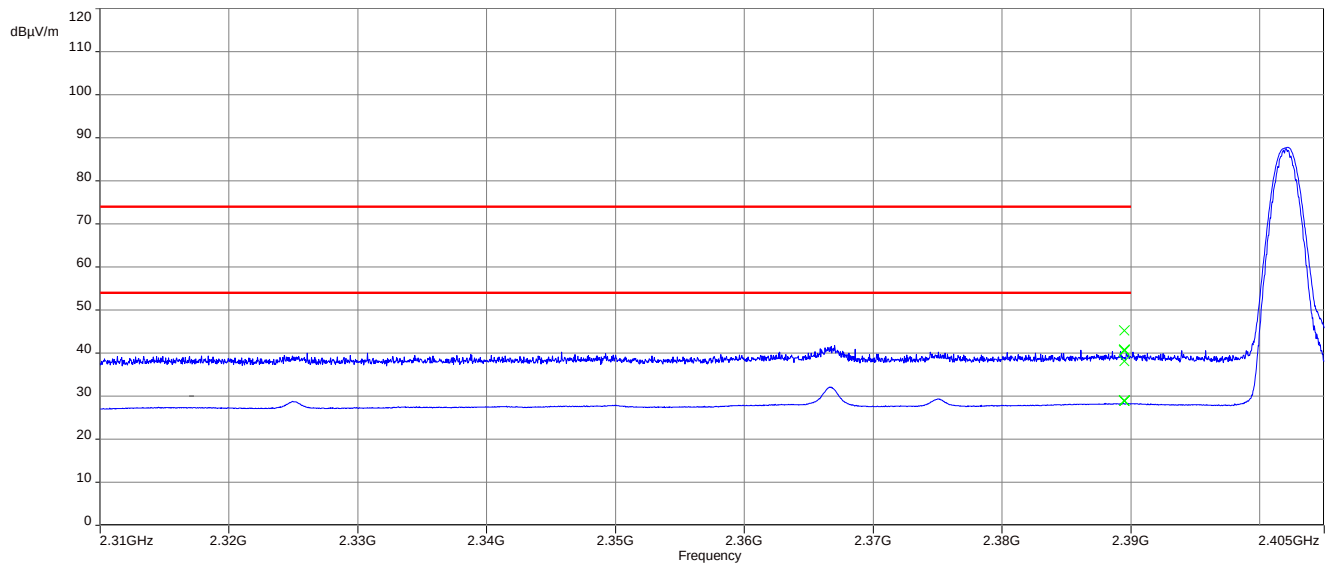
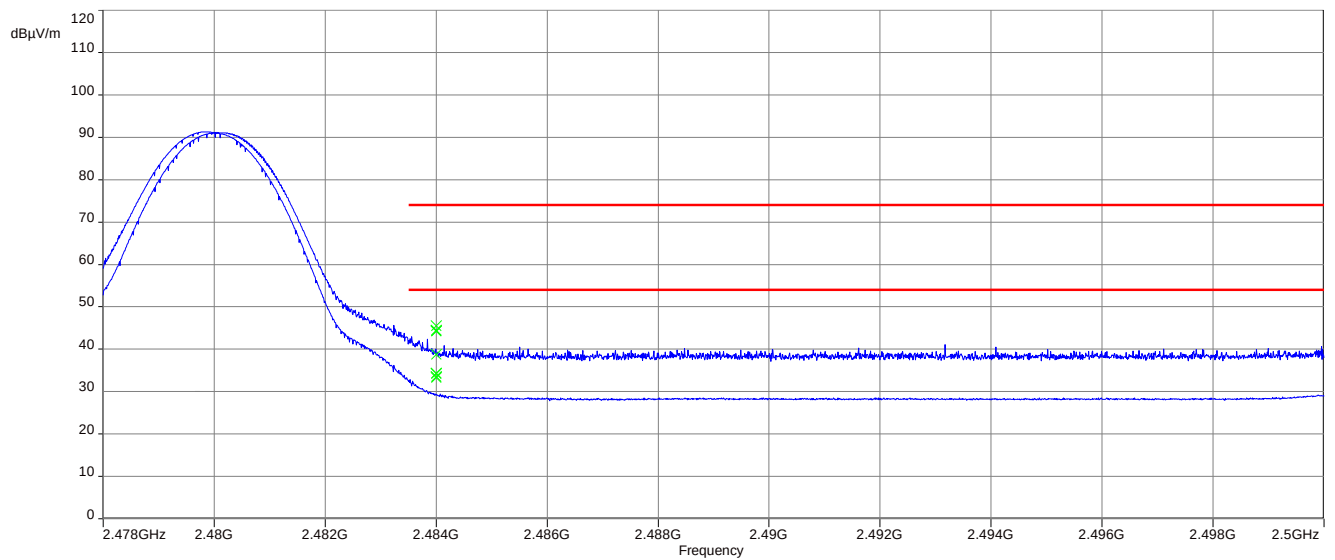
| Measurement parameters  |                                                            |
|-------------------------|------------------------------------------------------------|
| Detector                | Peak / RMS                                                 |
| Sweep time              | Auto                                                       |
| Resolution bandwidth    | 1 MHz                                                      |
| Video bandwidth         | 3 MHz                                                      |
| Span                    | Lower Band: 2370 – 2400 MHz<br>Upper Band: 2480 – 2500 MHz |
| Trace mode              | Max hold                                                   |
| Test setup              | See sub clause 6.2 B                                       |
| Measurement uncertainty | See sub clause 8                                           |

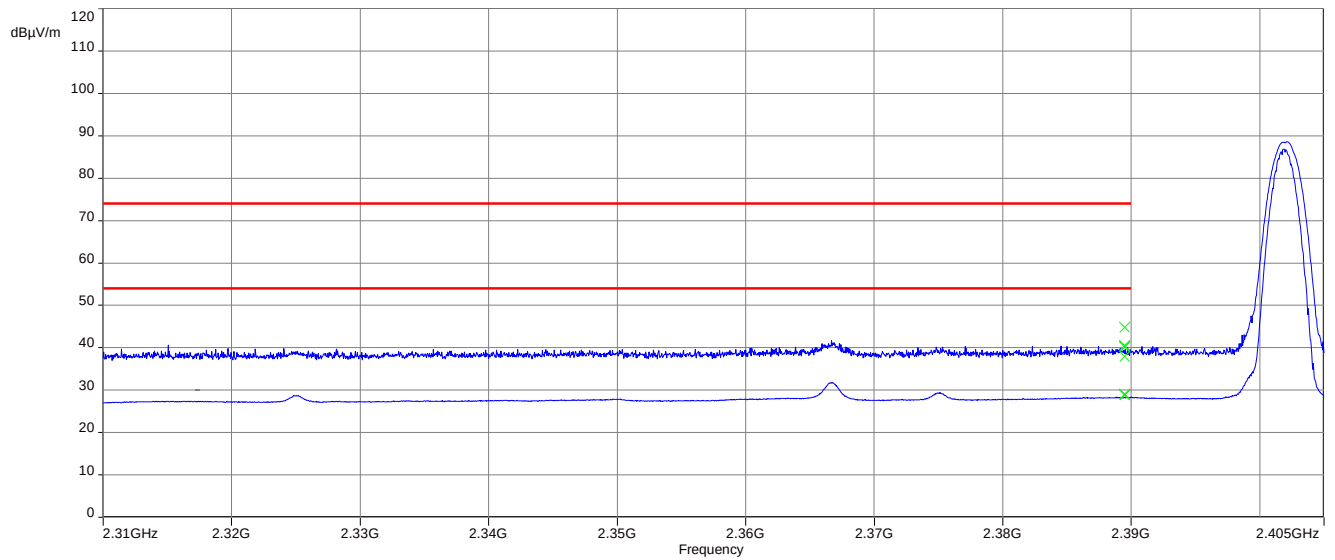
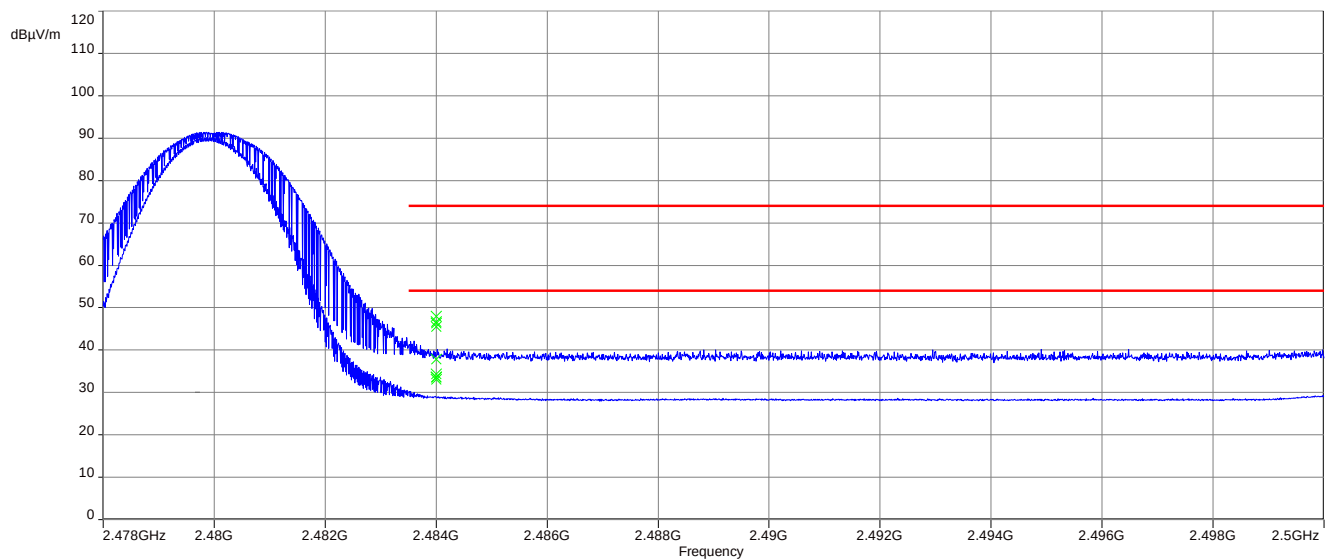
#### Limits:

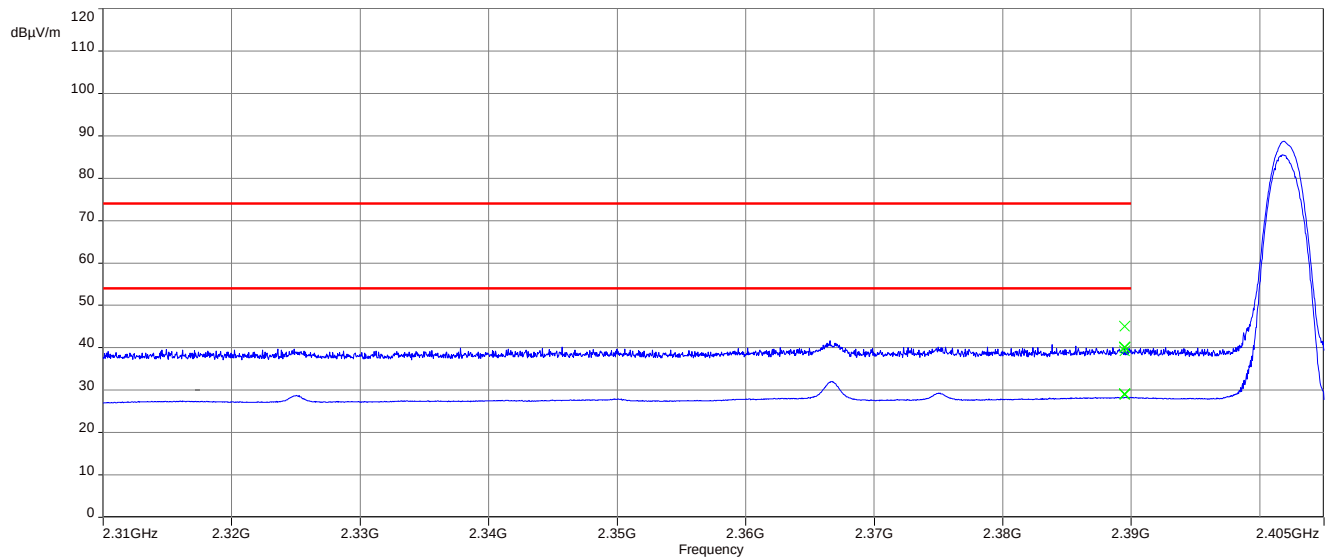
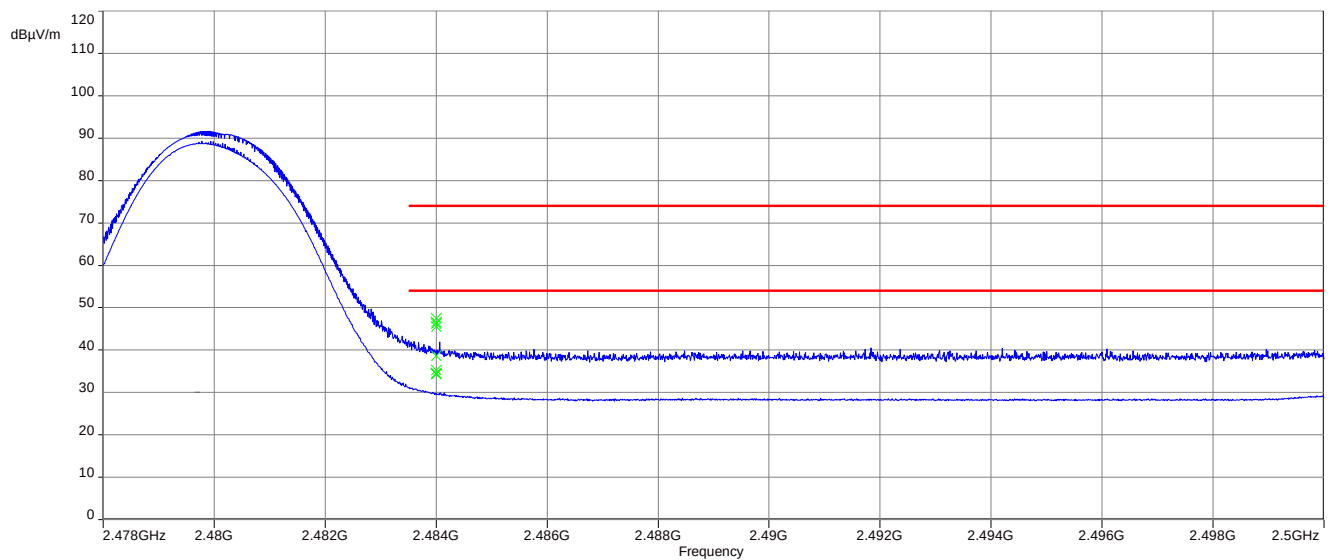
| FCC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | IC |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Band edge compliance radiated                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |    |
| In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)). |    |
| 54 dBµV/m AVG<br>74 dBµV/m Peak                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |    |

#### Results:

| Scenario              | Band edge compliance radiated [dBµV/m] |                    |                    |
|-----------------------|----------------------------------------|--------------------|--------------------|
| Modulation            | GFSK                                   | Pi/4 DQPSK         | 8DPSK              |
| Lower restricted band | < 54 AVG / < 74 PP                     | < 54 AVG / < 74 PP | < 54 AVG / < 74 PP |
| Upper restricted band | < 54 AVG / < 74 PP                     | < 54 AVG / < 74 PP | < 54 AVG / < 74 PP |

**Plots:****Plot 1:** Lower band edge, GFSK modulation, vertical & horizontal polarization**Plot 2:** Upper band edge, GFSK modulation, vertical & horizontal polarization

**Plot 3:** Lower band edge, Pi/4 DQPSK modulation, vertical & horizontal polarization**Plot 4:** Upper band edge, Pi/4 DQPSK modulation, vertical & horizontal polarization

**Plot 5:** Lower band edge, 8 DPSK modulation, vertical & horizontal polarization**Plot 6:** Upper band edge, 8 DPSK modulation, vertical & horizontal polarization

## 11.4 Spurious emissions radiated below 30 MHz

### Description:

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The EUT is set to single channel mode and the transmit channels are 00; 39 and 78. The measurement is performed in the mode with the highest output power. The limits are recalculated to a measurement distance of 3 m according the ANSI C63.10.

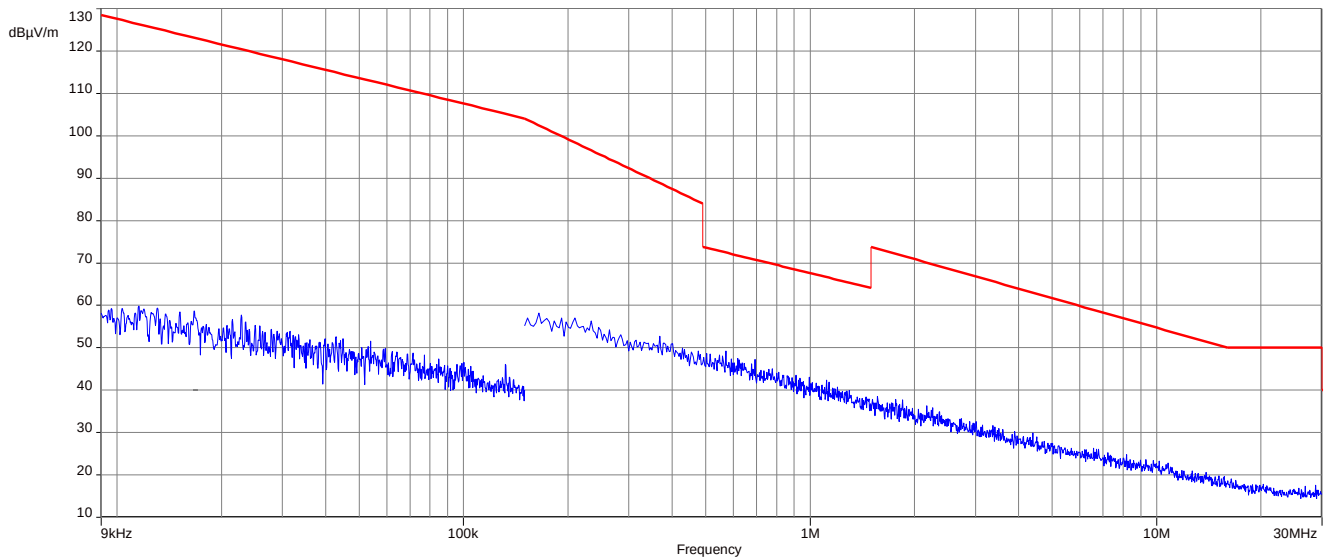
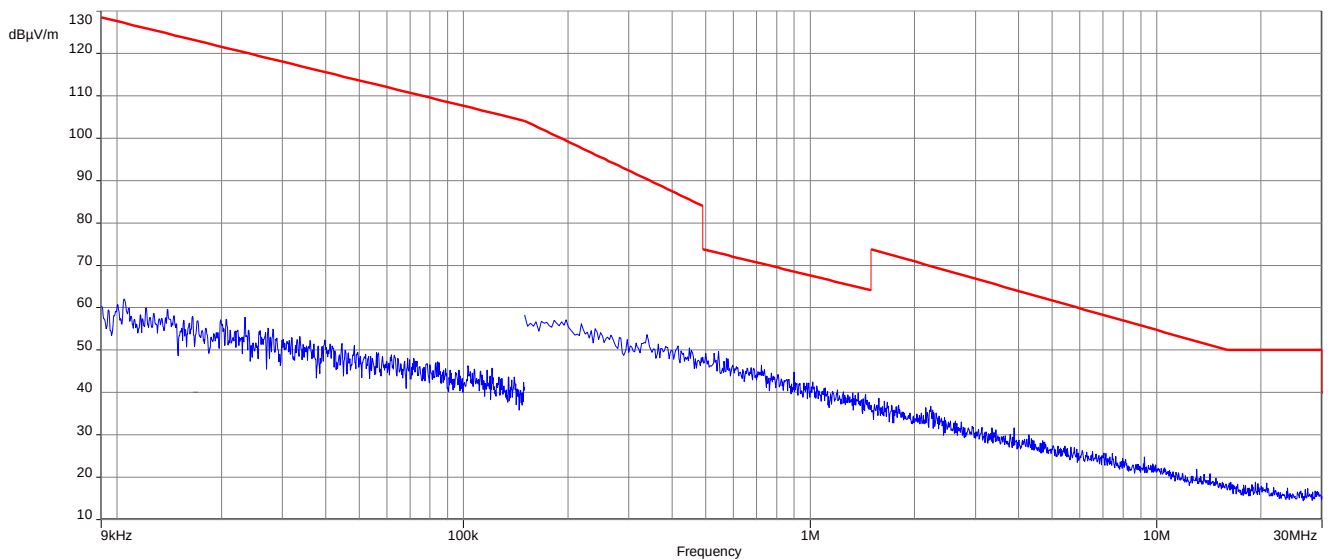
| Measurement parameters  |                                            |
|-------------------------|--------------------------------------------|
| Detector                | Peak / Quasi peak                          |
| Sweep time              | Auto                                       |
| Resolution bandwidth    | F < 150 kHz: 200 Hz<br>F > 150 kHz: 9 kHz  |
| Video bandwidth         | F < 150 kHz: 1 kHz<br>F > 150 kHz: 100 kHz |
| Span                    | 9 kHz to 30 MHz                            |
| Trace mode              | Max hold                                   |
| Test setup              | See sub clause 6.2 A                       |
| Measurement uncertainty | See sub clause 8                           |

### Limits:

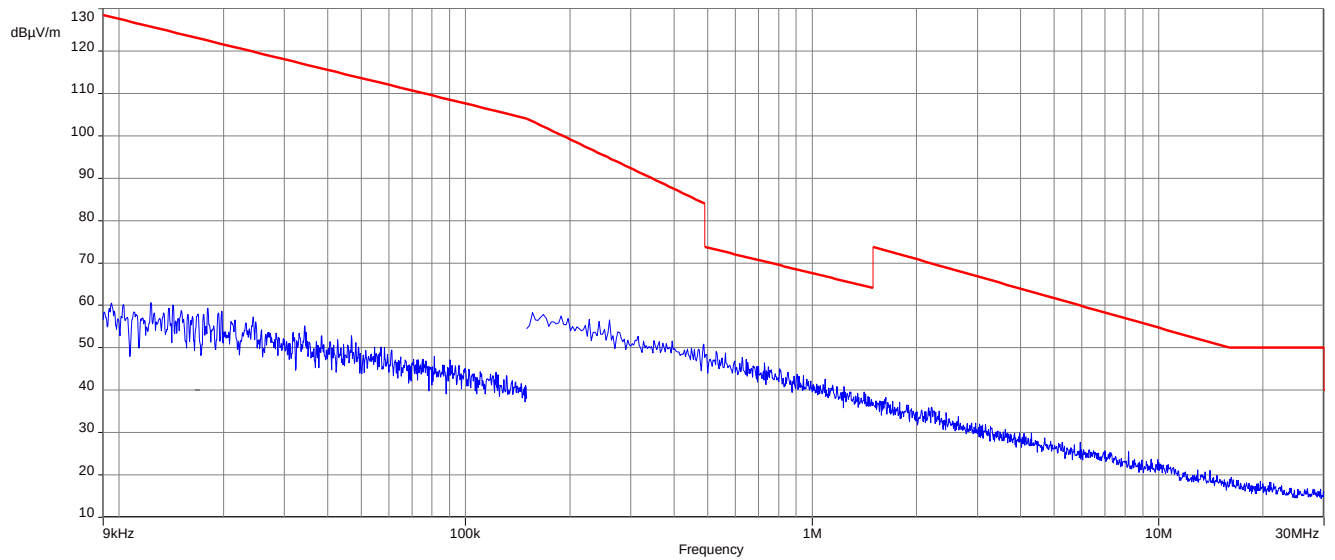
| FCC                                         |                               | IC                   |
|---------------------------------------------|-------------------------------|----------------------|
| TX spurious emissions radiated below 30 MHz |                               |                      |
| Frequency (MHz)                             | Field strength (dB $\mu$ V/m) | Measurement distance |
| 0.009 – 0.490                               | 2400/F(kHz)                   | 300                  |
| 0.490 – 1.705                               | 24000/F(kHz)                  | 30                   |
| 1.705 – 30.0                                | 30                            | 30                   |

### Results:

| TX spurious emissions radiated below 30 MHz [dB $\mu$ V/m]  |          |                      |
|-------------------------------------------------------------|----------|----------------------|
| F [MHz]                                                     | Detector | Level [dB $\mu$ V/m] |
| All detected emissions are more than 20 dB below the limit. |          |                      |
|                                                             |          |                      |
|                                                             |          |                      |

**Plots:****Plot 1: 9 kHz to 30 MHz, channel 00, transmit mode****Plot 2: 9 kHz to 30 MHz, channel 39, transmit mode**

**Plot 3:** 9 kHz to 30 MHz, channel 78, transmit mode



## 11.5 Spurious emissions radiated 30 MHz to 1 GHz

### Description:

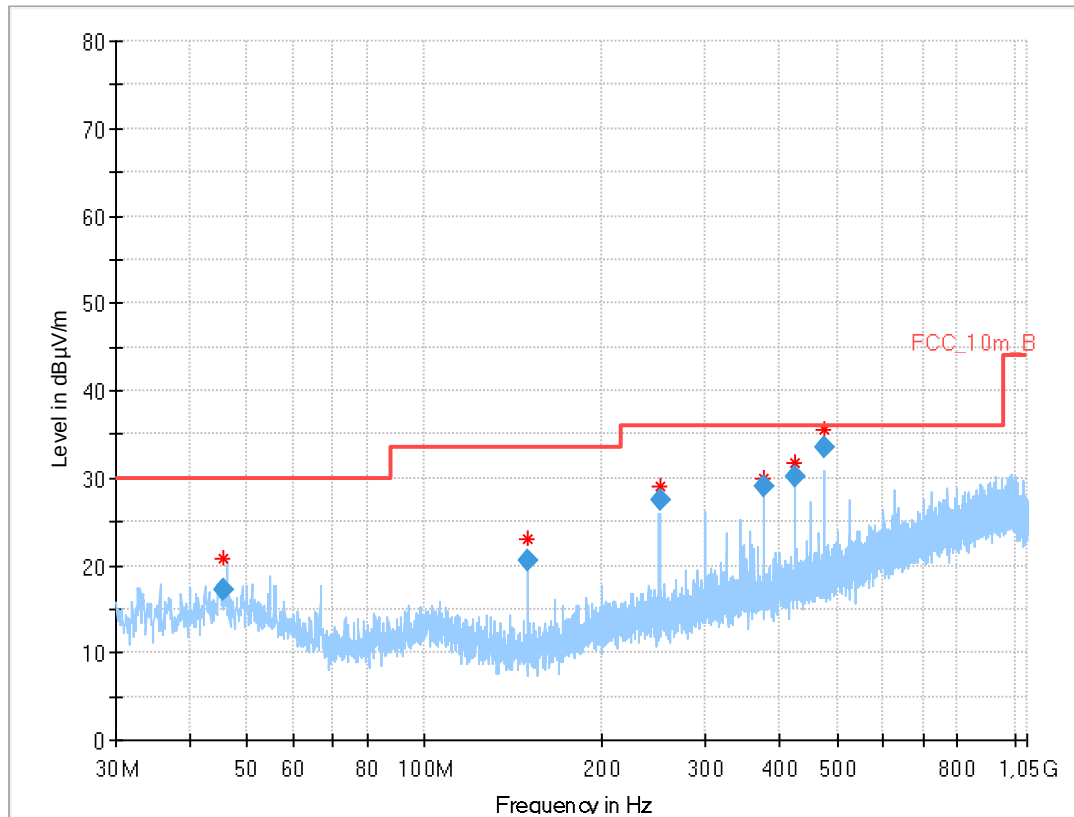
Measurement of the radiated spurious emissions in transmit mode. The EUT is set to single channel mode and the transmit channel is channel 00, channel 39 and channel 78. The measurement is performed in the mode with the highest output power.

| Measurement parameters  |                                                                                                             |
|-------------------------|-------------------------------------------------------------------------------------------------------------|
| Detector                | Peak / Quasi Peak                                                                                           |
| Sweep time              | Auto                                                                                                        |
| Resolution bandwidth    | 120 kHz                                                                                                     |
| Video bandwidth         | 3 x RBW                                                                                                     |
| Span                    | 30 MHz to 1 GHz                                                                                             |
| Trace mode              | Max hold                                                                                                    |
| Measured modulation     | <input type="checkbox"/> GFSK <input type="checkbox"/> Pi/4 DQPSK <input checked="" type="checkbox"/> 8DPSK |
| Test setup              | See sub clause 6.1 A                                                                                        |
| Measurement uncertainty | See sub clause 8                                                                                            |

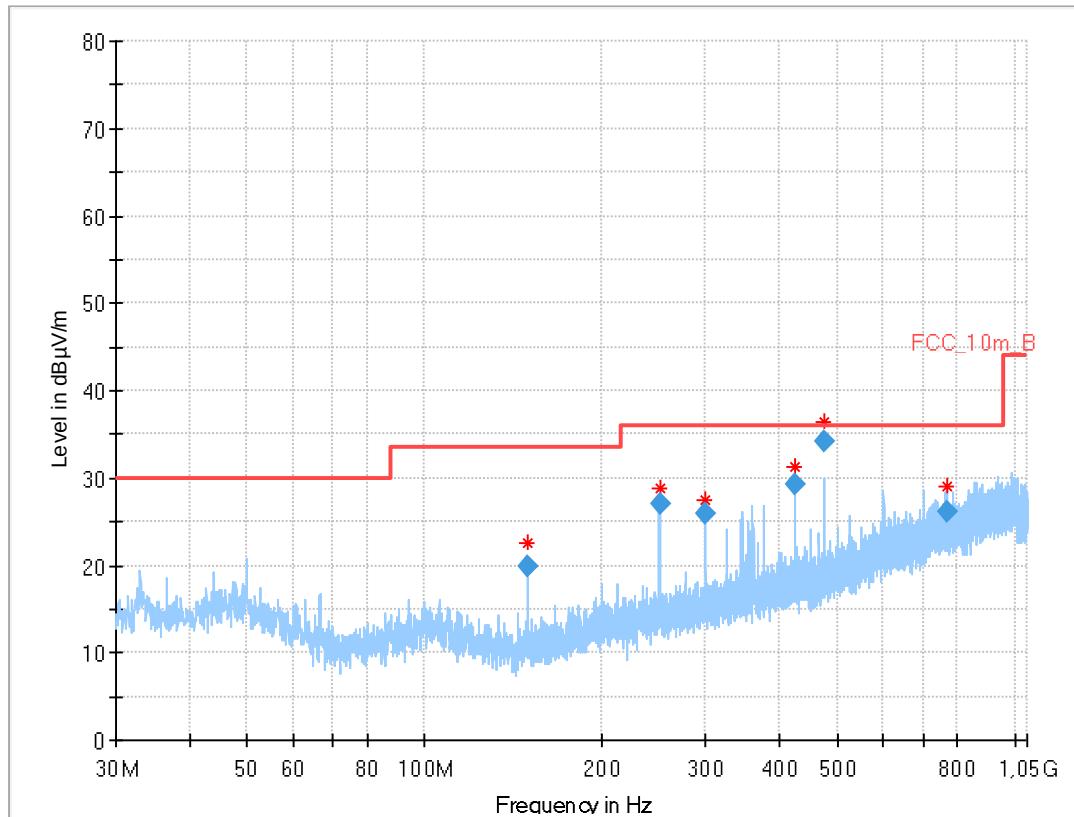
The modulation with the highest output power was used to perform the transmitter spurious emissions. If spurious were detected a re-measurement was performed on the detected frequency with each modulation.

### Limits:

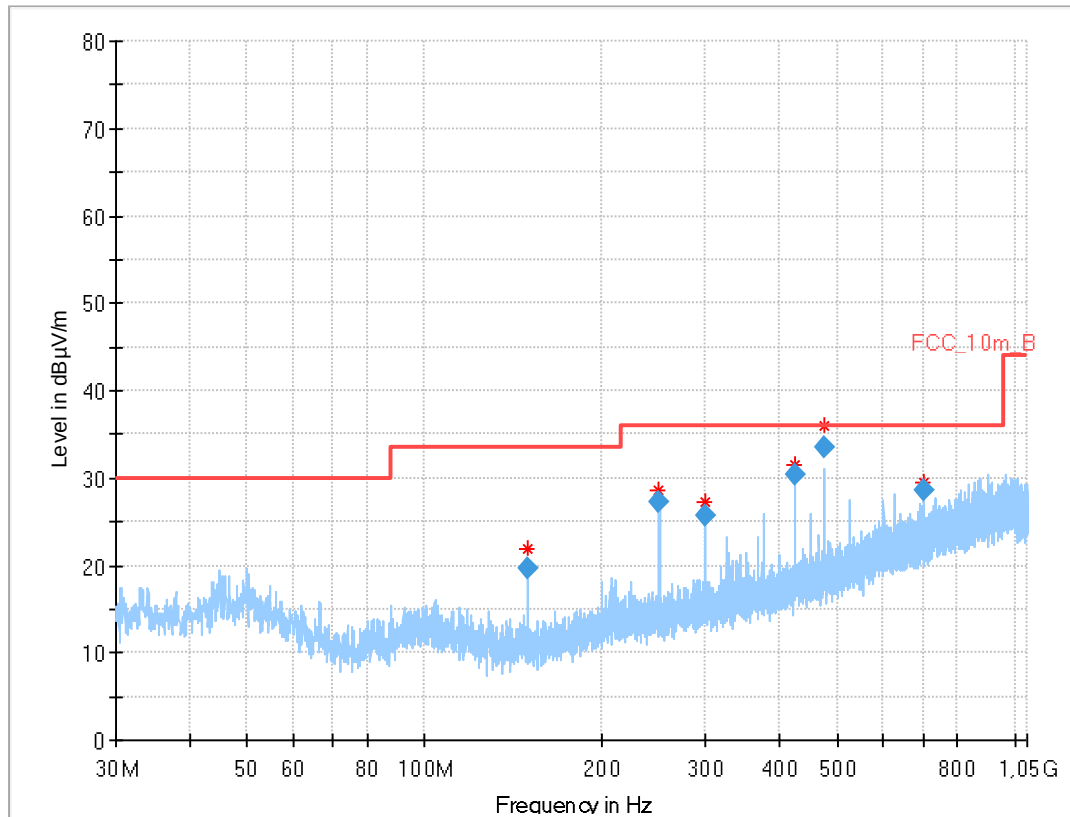
| FCC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         | IC                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------------------|
| TX spurious emissions radiated                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                         |                      |
| In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)). |                         |                      |
| §15.209                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |                      |
| Frequency (MHz)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Field strength (dBμV/m) | Measurement distance |
| 30 - 88                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 30.0                    | 10                   |
| 88 – 216                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 33.5                    | 10                   |
| 216 – 960                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 36.0                    | 10                   |
| Above 960                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 54.0                    | 3                    |

**Plots:** Transmit mode**Plot 1:** 30 MHz to 1 GHz, TX mode, channel 00, vertical & horizontal polarization**Final results:**

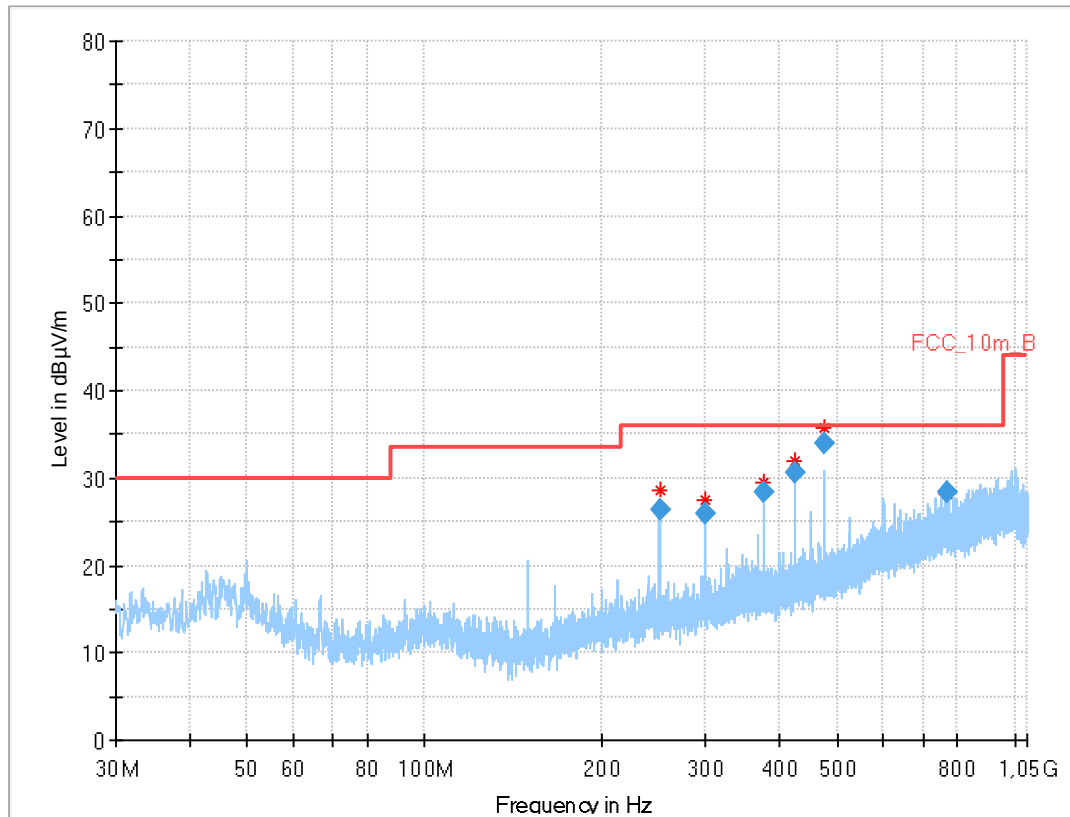
| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|------------|
| 45.747          | 17.21              | 30.0           | 12.79       | 1000            | 120             | 107.0       | V   | 157.0         | 15         |
| 150.000         | 20.49              | 33.5           | 13.01       | 1000            | 120             | 104.0       | V   | 157.0         | 10         |
| 250.005         | 27.38              | 36.0           | 8.62        | 1000            | 120             | 98.0        | V   | 22.0          | 14         |
| 375.000         | 29.15              | 36.0           | 6.85        | 1000            | 120             | 155.0       | H   | -5.0          | 16         |
| 425.000         | 30.21              | 36.0           | 5.79        | 1000            | 120             | 170.0       | H   | -22.0         | 17         |
| 475.005         | 33.53              | 36.0           | 2.47        | 1000            | 120             | 170.0       | H   | 286.0         | 18         |

**Plot 2:** 30 MHz to 1 GHz, TX mode, channel 39, vertical & horizontal polarization**Final results:**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|------------|
| 149.985         | 19.92              | 33.5           | 13.58       | 1000            | 120             | 137.0       | V   | 193.0         | 10         |
| 250.011         | 27.01              | 36.0           | 8.99        | 1000            | 120             | 133.0       | V   | 8.0           | 14         |
| 300.008         | 26.00              | 36.0           | 10.00       | 1000            | 120             | 101.0       | V   | 247.0         | 15         |
| 424.994         | 29.33              | 36.0           | 6.67        | 1000            | 120             | 170.0       | H   | -18.0         | 17         |
| 475.006         | 34.18              | 36.0           | 1.82        | 1000            | 120             | 170.0       | H   | 292.0         | 18         |
| 766.646         | 26.15              | 36.0           | 9.85        | 1000            | 120             | 101.0       | H   | -10.0         | 23         |

**Plot 3:** 30 MHz to 1 GHz, TX mode, channel 78, vertical & horizontal polarization**Final results:**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|------------|
| 150.010         | 19.72              | 33.5           | 13.78       | 1000            | 120             | 134.0       | V   | 195.0         | 10         |
| 249.997         | 27.35              | 36.0           | 8.65        | 1000            | 120             | 103.0       | V   | 16.0          | 14         |
| 300.012         | 25.81              | 36.0           | 10.19       | 1000            | 120             | 98.0        | V   | 247.0         | 15         |
| 424.993         | 30.40              | 36.0           | 5.60        | 1000            | 120             | 127.0       | H   | -17.0         | 17         |
| 475.022         | 33.62              | 36.0           | 2.38        | 1000            | 120             | 170.0       | H   | 292.0         | 18         |
| 700.005         | 28.59              | 36.0           | 7.41        | 1000            | 120             | 150.0       | H   | 84.0          | 21         |

**Plots:** Receiver mode**Plot 1:** 30 MHz to 1 GHz, RX / idle – mode, vertical & horizontal polarization**Final results:**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|------------|
| 250.004         | 26.33              | 36.0           | 9.67        | 1000            | 120             | 130.0       | V   | 22.0          | 14         |
| 300.010         | 25.93              | 36.0           | 10.07       | 1000            | 120             | 98.0        | V   | 247.0         | 15         |
| 375.014         | 28.30              | 36.0           | 7.70        | 1000            | 120             | 151.0       | H   | -3.0          | 16         |
| 425.006         | 30.70              | 36.0           | 5.30        | 1000            | 120             | 139.0       | H   | -18.0         | 17         |
| 475.018         | 33.97              | 36.0           | 2.03        | 1000            | 120             | 170.0       | H   | 292.0         | 18         |
| 766.672         | 28.47              | 36.0           | 7.53        | 1000            | 120             | 122.0       | H   | 67.0          | 23         |

## 11.6 Spurious emissions radiated above 1 GHz

### Description:

Measurement of the radiated spurious emissions in transmit mode. The EUT is set to single channel mode and the transmit channel is channel 00, channel 39 and channel 78. The measurement is performed in the mode with the highest output power.

| Measurement parameters  |                                                                                                             |
|-------------------------|-------------------------------------------------------------------------------------------------------------|
| Detector                | Peak / RMS                                                                                                  |
| Sweep time              | Auto                                                                                                        |
| Resolution bandwidth    | 1 MHz                                                                                                       |
| Video bandwidth         | 3 x RBW                                                                                                     |
| Span                    | 1 GHz to 26 GHz                                                                                             |
| Trace mode              | Max hold                                                                                                    |
| Measured modulation     | <input type="checkbox"/> GFSK <input type="checkbox"/> Pi/4 DQPSK <input checked="" type="checkbox"/> 8DPSK |
| Test setup              | See sub clause 6.2 C (1 GHz - 18 GHz)<br>See sub clause 6.3 A (18 GHz - 26 GHz)                             |
| Measurement uncertainty | See sub clause 8                                                                                            |

The modulation with the highest output power was used to perform the transmitter spurious emissions. If spurious were detected a re-measurement was performed on the detected frequency with each modulation.

### Limits:

| FCC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         | IC                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------------------|
| TX spurious emissions radiated                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                         |                      |
| In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)). |                         |                      |
| §15.209                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |                      |
| Frequency (MHz)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Field strength (dBµV/m) | Measurement distance |
| Above 960                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 54.0                    | 3                    |

**Results:** Transmitter mode

| TX spurious emissions radiated [dBµV/m] |          |                |          |          |                |          |          |                |
|-----------------------------------------|----------|----------------|----------|----------|----------------|----------|----------|----------------|
| 2402 MHz                                |          |                | 2441 MHz |          |                | 2480 MHz |          |                |
| F [MHz]                                 | Detector | Level [dBµV/m] | F [MHz]  | Detector | Level [dBµV/m] | F [MHz]  | Detector | Level [dBµV/m] |
| -/-                                     | Peak     | -/-            | 4882     | Peak     | 56.3           | 4960     | Peak     | 55.0           |
|                                         | AVG      | -/-            |          | AVG      | 26.2*          |          | AVG      | 24.9*          |
| -/-                                     | Peak     | -/-            | -/-      | Peak     | -/-            | -/-      | Peak     | -/-            |
|                                         | AVG      | -/-            |          | AVG      | -/-            |          | AVG      | -/-            |
| -/-                                     | Peak     | -/-            | -/-      | Peak     | -/-            | -/-      | Peak     | -/-            |
|                                         | AVG      | -/-            |          | AVG      | -/-            |          | AVG      | -/-            |

\*) Average emission adjusting factor:

$$F = 20 * \log (\text{dwell time} / 100 \text{ ms})$$

The dwell time of the longest possible Bluetooth transmission (DH5-packet) is 3.125 ms.

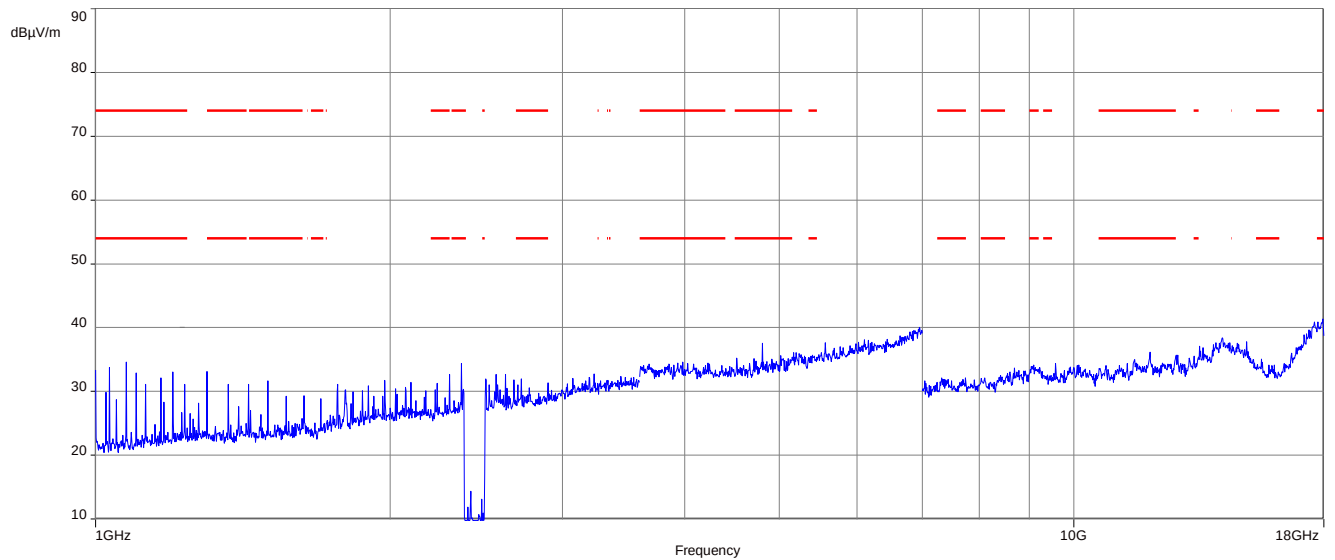
In a period of 100 ms, we have a maximum of 1 transmission and that implies a correction factor for spurious measurement emissions:

$$F = 20 * \log (1 * 3.125 / 100) = -30.1 \text{ dB}$$

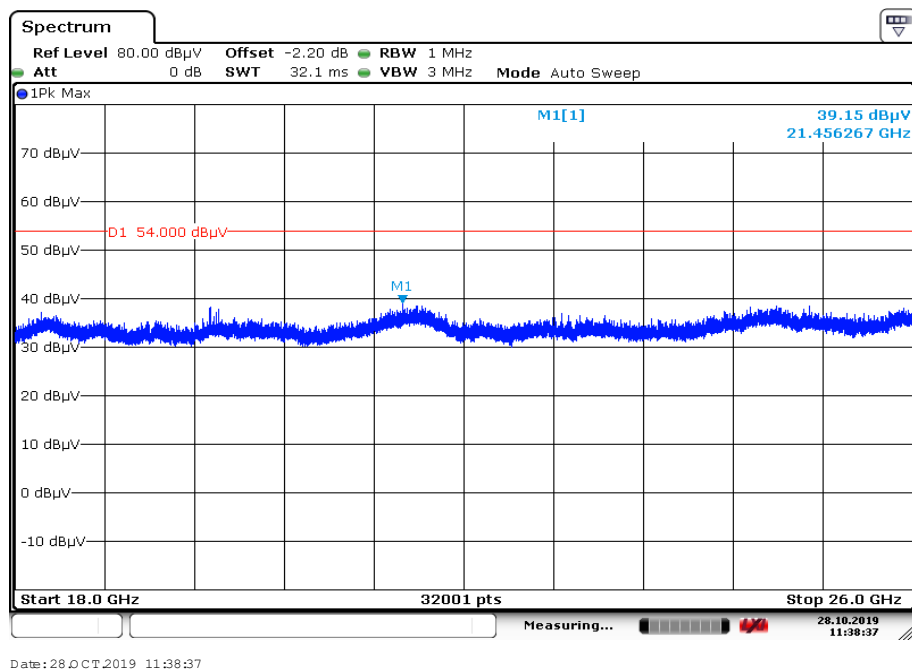
**Results:** Receiver mode

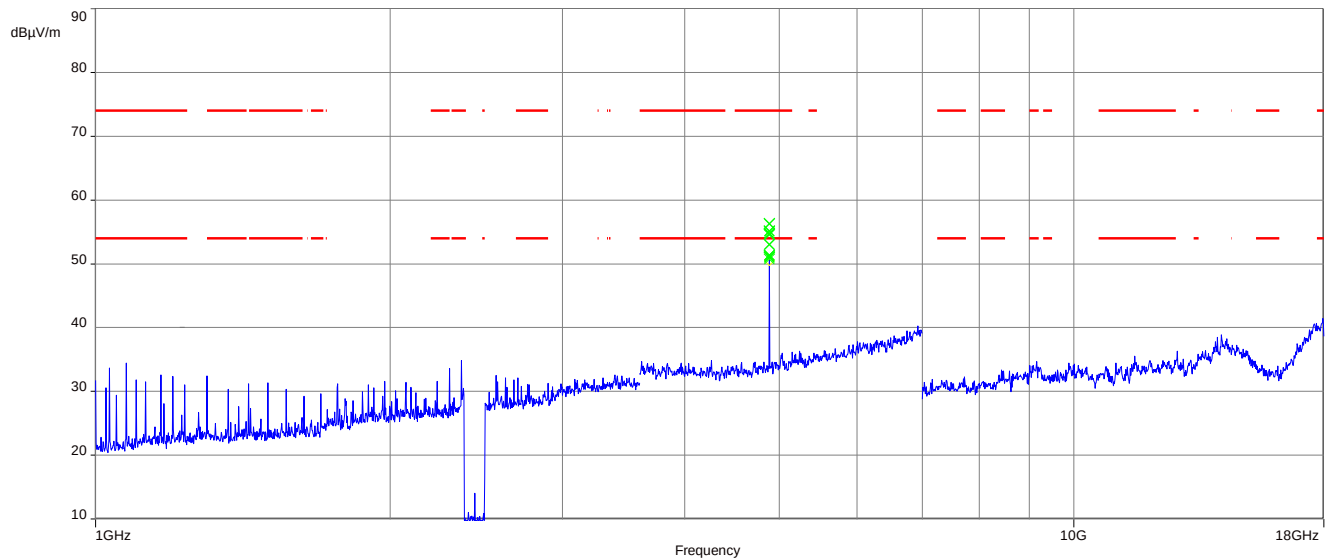
| RX spurious emissions radiated [dBµV/m]                     |          |                |
|-------------------------------------------------------------|----------|----------------|
| F [MHz]                                                     | Detector | Level [dBµV/m] |
| All detected emissions are more than 20 dB below the limit. |          |                |
| -/-                                                         | Peak     | -/-            |
|                                                             | AVG      | -/-            |

**Note:** The limit was recalculated with 20 dB / decade (Part 15.31) for all radiated spurious emissions 30 MHz to 1 GHz from 3 meter limit to a 10 meter distance. (40dB/decade for emissions < 30MHz)

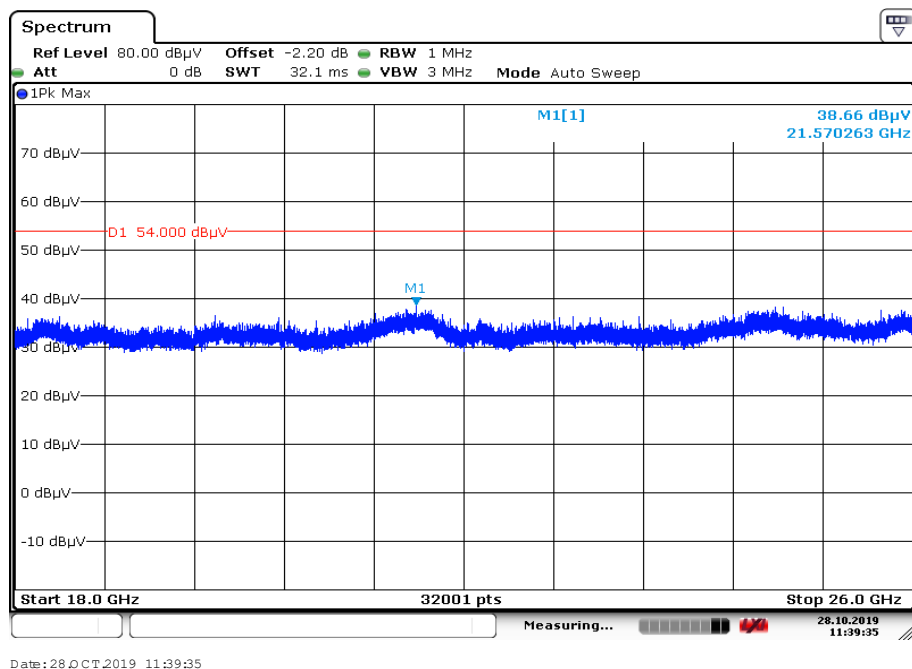
**Plots:** Transmitter mode**Plot 1:** 1 GHz to 18 GHz, TX mode, channel 00, vertical & horizontal polarization

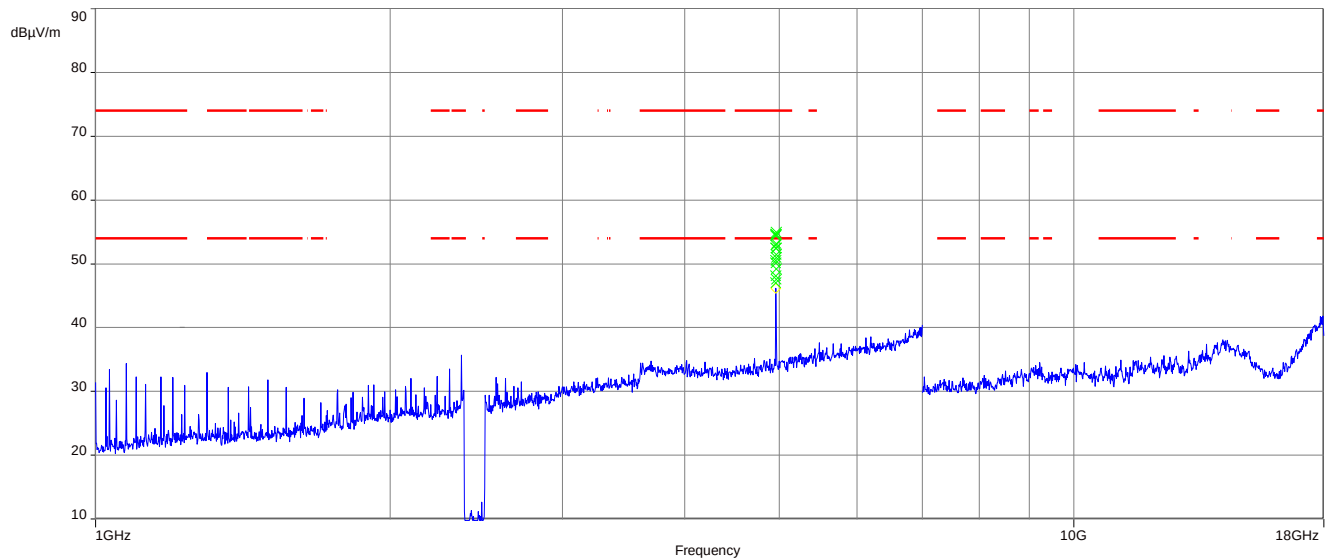
The carrier signal is notched with a 2.4 GHz band rejection filter.

**Plot 2:** 18 GHz to 26 GHz, TX mode, channel 00, vertical & horizontal polarization

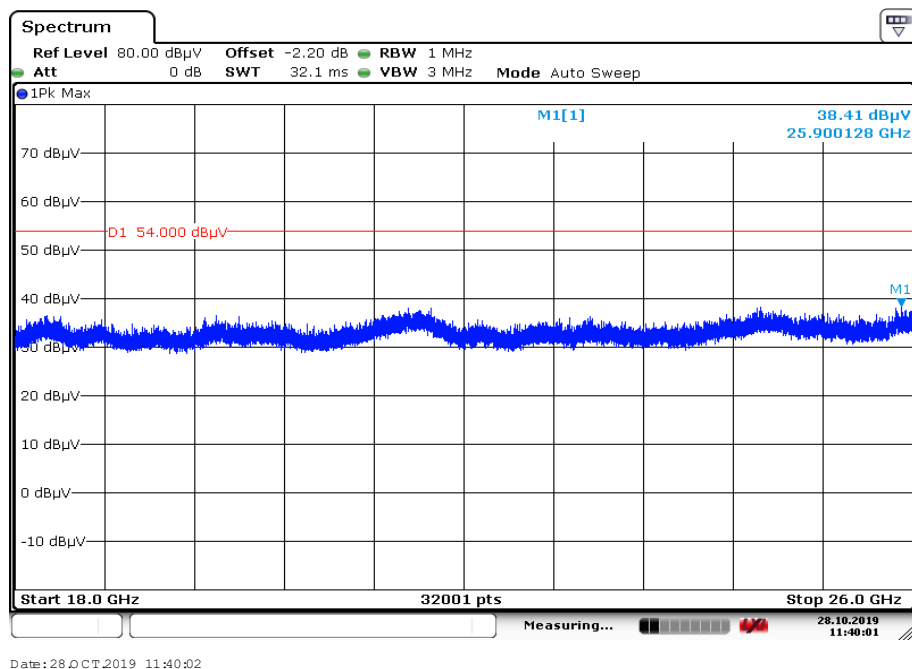
**Plot 3:** 1 GHz to 18 GHz, TX mode, channel 39, vertical & horizontal polarization

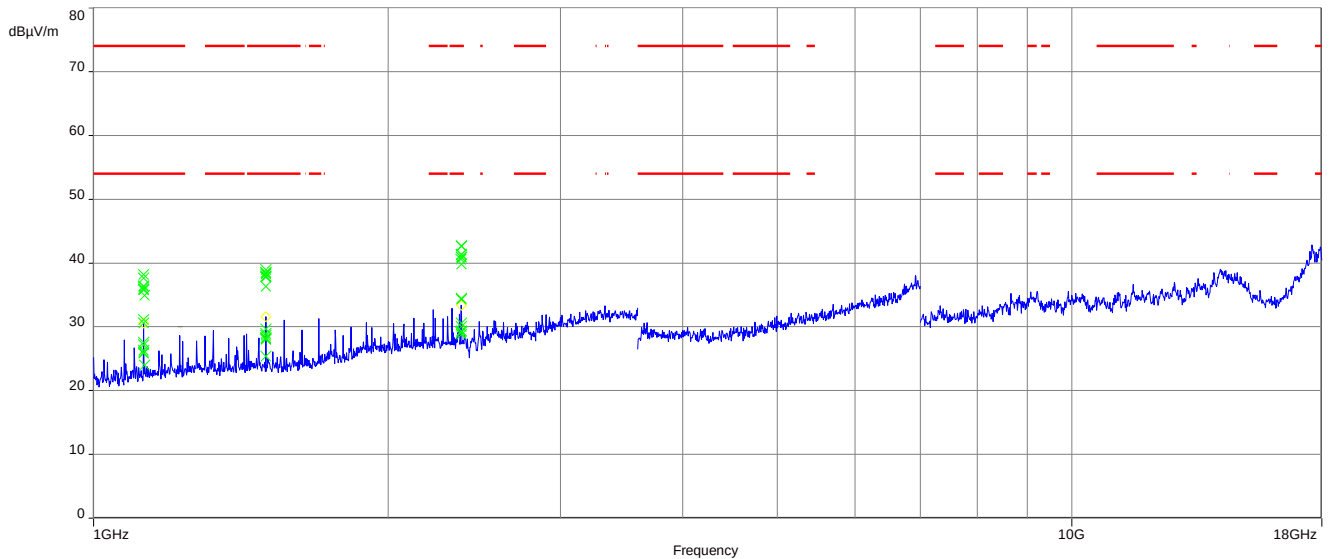
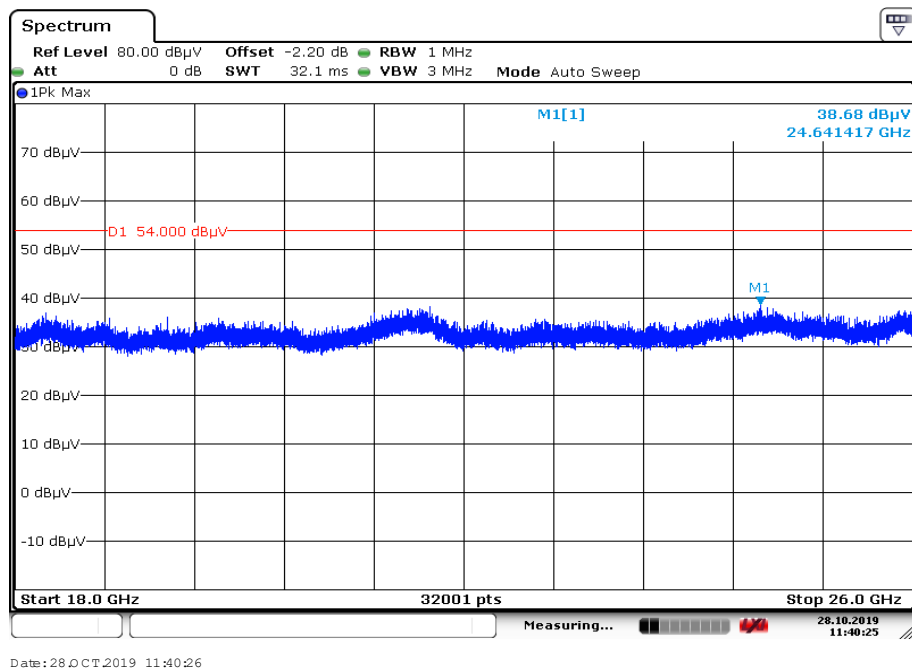
The carrier signal is notched with a 2.4 GHz band rejection filter.

**Plot 4:** 18 GHz to 26 GHz, TX mode, channel 39, vertical & horizontal polarization

**Plot 5:** 1 GHz to 18 GHz, TX mode, channel 78, vertical & horizontal polarization

The carrier signal is notched with a 2.4 GHz band rejection filter.

**Plot 6:** 18 GHz to 26 GHz, TX mode, channel 78, vertical & horizontal polarization

**Plots:** Receiver mode**Plot 1:** 1 GHz to 18 GHz, RX / idle – mode, vertical & horizontal polarization**Plot 2:** 18 GHz to 26 GHz, RX / idle – mode, vertical & horizontal polarization

## 11.7 Spurious emissions conducted < 30 MHz

### Description:

Measurement of the conducted spurious emissions in transmit mode below 30 MHz. The EUT is set to middle channel. If critical peaks are found the lowest channel and the highest channel will be measured too. Both power lines, phase and neutral line, are measured. Found peaks are re-measured with average and quasi peak detection to show compliance to the limits.

### Measurement:

| Measurement parameter    |                             |
|--------------------------|-----------------------------|
| Detector:                | Peak - Quasi Peak / Average |
| Sweep time:              | Auto                        |
| Video bandwidth:         | 9 kHz                       |
| Resolution bandwidth:    | 100 kHz                     |
| Span:                    | 150 kHz to 30 MHz           |
| Trace mode:              | Max Hold                    |
| Test setup:              | See sub clause 6.4 – A      |
| Measurement uncertainty: | See sub clause 8            |

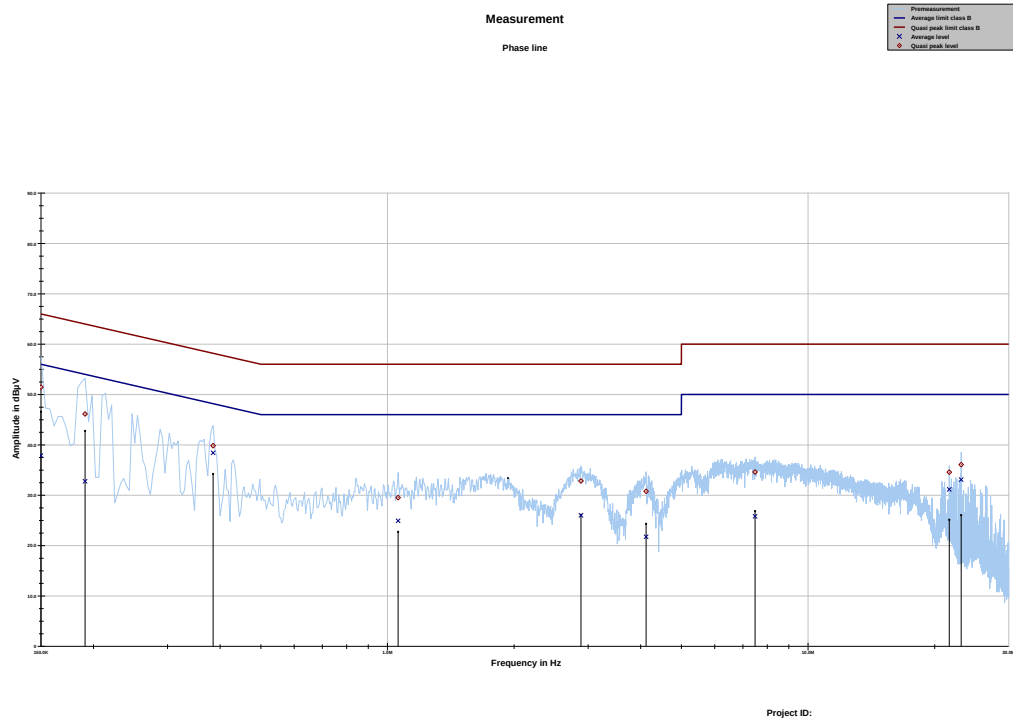
### Limits:

| Spurious Emissions Conducted < 30 MHz |                           |                        |
|---------------------------------------|---------------------------|------------------------|
| Frequency (MHz)                       | Quasi-Peak (dB $\mu$ V/m) | Average (dB $\mu$ V/m) |
| 0.15 – 0.5                            | 66 to 56*                 | 56 to 46*              |
| 0.5 – 5                               | 56                        | 46                     |
| 5 – 30.0                              | 60                        | 50                     |

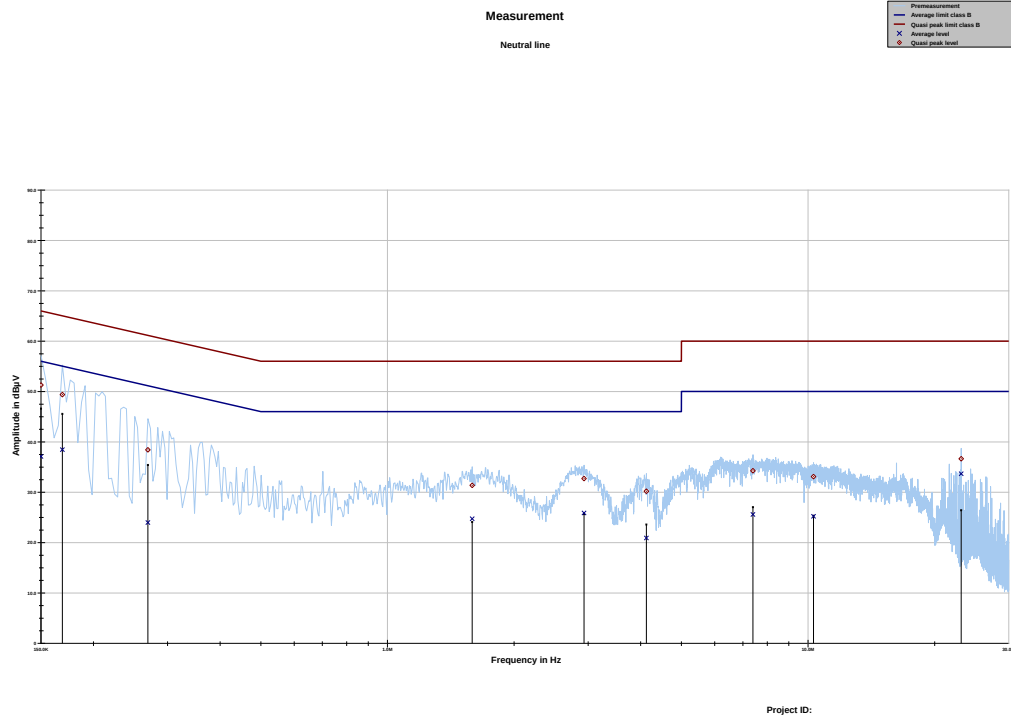
\*Decreases with the logarithm of the frequency

### Results:

| Spurious Emissions Conducted < 30 MHz [dB $\mu$ V/m]        |          |                      |
|-------------------------------------------------------------|----------|----------------------|
| F [MHz]                                                     | Detector | Level [dB $\mu$ V/m] |
| All detected emissions are more than 20 dB below the limit. |          |                      |
|                                                             |          |                      |

**Plots:****Plot 1:** 150 kHz to 30 MHz, phase line**Final results:**

| Frequency | Quasi peak level | Margin quasi peak | Limit QP | Average level | Margin average | Limit AV |
|-----------|------------------|-------------------|----------|---------------|----------------|----------|
| MHz       | dBµV             | dB                | dBµV     | dBµV          | dB             | dBµV     |
| 0.150000  | 51.44            | 14.56             | 66.000   | 37.85         | 18.15          | 56.000   |
| 0.191044  | 46.12            | 17.87             | 63.991   | 32.76         | 22.07          | 54.827   |
| 0.385069  | 39.84            | 18.33             | 58.169   | 38.42         | 10.87          | 49.284   |
| 1.060425  | 29.52            | 26.48             | 56.000   | 24.91         | 21.09          | 46.000   |
| 2.885006  | 32.81            | 23.19             | 56.000   | 26.01         | 19.99          | 46.000   |
| 4.120050  | 30.76            | 25.24             | 56.000   | 21.75         | 24.25          | 46.000   |
| 7.481906  | 34.60            | 25.40             | 60.000   | 25.80         | 24.20          | 50.000   |
| 21.664388 | 34.56            | 25.44             | 60.000   | 31.15         | 18.85          | 50.000   |
| 23.130769 | 36.07            | 23.93             | 60.000   | 33.10         | 16.90          | 50.000   |

**Plot 2:** 150 kHz to 30 MHz, neutral line**Final results:**

| Frequency | Quasi peak level | Margin quasi peak | Limit QP | Average level | Margin average | Limit AV |
|-----------|------------------|-------------------|----------|---------------|----------------|----------|
| MHz       | dBµV             | dB                | dBµV     | dBµV          | dB             | dBµV     |
| 0.150000  | 51.27            | 14.73             | 66.000   | 37.10         | 18.90          | 56.000   |
| 0.168656  | 49.37            | 15.66             | 65.026   | 38.44         | 17.02          | 55.467   |
| 0.269400  | 38.41            | 22.73             | 61.136   | 23.98         | 28.61          | 52.589   |
| 1.590262  | 31.36            | 24.64             | 56.000   | 24.73         | 21.27          | 46.000   |
| 2.933512  | 32.71            | 23.29             | 56.000   | 25.87         | 20.13          | 46.000   |
| 4.127512  | 30.20            | 25.80             | 56.000   | 20.90         | 25.10          | 46.000   |
| 7.396088  | 34.26            | 25.74             | 60.000   | 25.59         | 24.41          | 50.000   |
| 10.302731 | 33.10            | 26.90             | 60.000   | 25.22         | 24.78          | 50.000   |
| 23.130769 | 36.63            | 23.37             | 60.000   | 33.67         | 16.33          | 50.000   |

## Annex A Glossary

|                        |                                                    |
|------------------------|----------------------------------------------------|
| <b>EUT</b>             | Equipment under test                               |
| <b>DUT</b>             | Device under test                                  |
| <b>UUT</b>             | Unit under test                                    |
| <b>GUE</b>             | GNSS User Equipment                                |
| <b>ETSI</b>            | European Telecommunications Standards Institute    |
| <b>EN</b>              | European Standard                                  |
| <b>FCC</b>             | Federal Communications Commission                  |
| <b>FCC ID</b>          | Company Identifier at FCC                          |
| <b>IC</b>              | Industry Canada                                    |
| <b>PMN</b>             | Product marketing name                             |
| <b>HMN</b>             | Host marketing name                                |
| <b>HVIN</b>            | Hardware version identification number             |
| <b>FVIN</b>            | Firmware version identification number             |
| <b>EMC</b>             | Electromagnetic Compatibility                      |
| <b>HW</b>              | Hardware                                           |
| <b>SW</b>              | Software                                           |
| <b>Inv. No.</b>        | Inventory number                                   |
| <b>S/N or SN</b>       | Serial number                                      |
| <b>C</b>               | Compliant                                          |
| <b>NC</b>              | Not compliant                                      |
| <b>NA</b>              | Not applicable                                     |
| <b>NP</b>              | Not performed                                      |
| <b>PP</b>              | Positive peak                                      |
| <b>QP</b>              | Quasi peak                                         |
| <b>AVG</b>             | Average                                            |
| <b>OC</b>              | Operating channel                                  |
| <b>OCW</b>             | Operating channel bandwidth                        |
| <b>OBW</b>             | Occupied bandwidth                                 |
| <b>OOB</b>             | Out of band                                        |
| <b>DFS</b>             | Dynamic frequency selection                        |
| <b>CAC</b>             | Channel availability check                         |
| <b>OP</b>              | Occupancy period                                   |
| <b>NOP</b>             | Non occupancy period                               |
| <b>DC</b>              | Duty cycle                                         |
| <b>PER</b>             | Packet error rate                                  |
| <b>CW</b>              | Clean wave                                         |
| <b>MC</b>              | Modulated carrier                                  |
| <b>WLAN</b>            | Wireless local area network                        |
| <b>RLAN</b>            | Radio local area network                           |
| <b>DSSS</b>            | Dynamic sequence spread spectrum                   |
| <b>OFDM</b>            | Orthogonal frequency division multiplexing         |
| <b>FHSS</b>            | Frequency hopping spread spectrum                  |
| <b>GNSS</b>            | Global Navigation Satellite System                 |
| <b>C/N<sub>0</sub></b> | Carrier to noise-density ratio, expressed in dB-Hz |

## Annex B Document history

| Version | Applied changes | Date of release |
|---------|-----------------|-----------------|
| -/-     | Initial release | 2019-12-04      |

## Annex C Accreditation Certificate – D-PL-12076-01-04

| first page                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | last page                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
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<https://www.dakks.de/as/ast/d/D-PL-12076-01-04.pdf>

**Annex D Accreditation Certificate – D-PL-12076-01-05**

| first page                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | last page                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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##### END OF TEST REPORT #####