



# Test Report

## 22-1-0131901T003a-C01



Deutsche  
Akkreditierungsstelle  
D-PL-12047-01-01  
D-PL-12047-01-03  
D-PL-12047-01-04

|  |   |                 |                |
|--|---|-----------------|----------------|
| Number of pages:                                 | 31  | Date of Report: | 2023-Mar-31    |
| Testing company:                                 | <p>cetecom advanced GmbH<br/>Im Teelbruch 116<br/>45219 Essen Germany<br/>Tel. + 49 (0) 20 54 / 95 19-0<br/>Fax: + 49 (0) 20 54 / 95 19-150</p>   | Applicant:      | BBC Bircher AG |
| Product:   | Wireless Transmission System  |                 |                |
| Model:   | XRF-TI  |                 |                |
| FCC ID:  | TBZ-XRFTI9  | IC:             | 5904A-XRFTI9   |
| Testing has been carried out in accordance with: | <p><b>FCC Regulations</b><br/><b>Title 47 CFR, Chapter I, Subchapter A, Part 15</b><br/><b>Subpart C Intentional Radiators</b><br/>§ 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz</p> <p><b>ISED-Regulations</b><br/><b>Radio Standards Specification</b><br/><b>RSS-Gen, Issue 5</b><br/>General Requirements for Compliance of Radio Apparatus<br/><b>RSS-247, Issue 2</b><br/>Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Device</p> |                 |                |
| Tested Technology:                               | SRD   |                 |                |
| Test Results:                                    | <p><input checked="" type="checkbox"/> <b>The EUT complies with the requirements in respect of all parameters subject to the test.</b></p> <p>The test results relate only to devices specified in this document</p> <p>The current version of Test Report 22-1-0131901T003a-C01 replaces the test report 22-1-0131903T003a dated 2023-Feb-10. The replaced test report is herewith invalid.</p>  |                 |                |
| Signatures:                                      | <div><br/>Dipl.-Ing. Ninovic Perez<br/>Test Lab Manager<br/>Authorization of test report</div> <div><br/>Timo Franke<br/>Test Manager<br/>Responsible of test report</div>  |                 |                |

## Table of Contents

|  |    |
|--|----|
| Table of Annex.....  | 3  |
| 1 General information .....  | 4  |
| 1.1 Disclaimer and Notes.....  | 4  |
| 1.2 Attestation.....   | 4  |
| 1.3 Summary of Test Results .....                                      | 5  |
| 1.4 Summary of Test Methods .....                                      | 6  |
| 2 Administrative Data .....  | 7  |
| 2.1 Identification of the Testing Laboratory .....                     | 7  |
| 2.2 General limits for environmental conditions.....                   | 7  |
| 2.3 Test Laboratories sub-contracted.....                              | 7  |
| 2.4 Organizational Items .....   | 7  |
| 2.5 Applicant's details .....  | 7  |
| 2.6 Manufacturer's details .....                                       | 7  |
| 2.7 Equipment under Test (EUT) .....                                   | 8  |
| 2.8 Untested Variant (VAR) .....                                       | 8  |
| 2.9 Auxiliary Equipment (AE) .....                                     | 8  |
| 2.10 Connected cables (CAB).....                                       | 8  |
| 2.11 Software (SW).....  | 8  |
| 2.12 EUT set-ups.....  | 8  |
| 2.13 EUT operation modes .....   | 8  |
| 3 Equipment under test (EUT) .....                                     | 9  |
| 3.1 General Data of Main EUT as Declared by Applicant.....             | 9  |
| 3.2 Detailed Technical data of Main EUT as Declared by Applicant ..... | 9  |
| 3.3 Modifications on Test sample.....                                  | 9  |
| 4 Measurements.....  | 10 |
| 4.1 Duty-Cycle .....   | 10 |
| 4.2 Peak output power (Sweep) .....                                    | 11 |
| 4.3 Power spectral density .....                                       | 12 |
| 4.4 Minimum Emission Bandwidth 6 dB.....                               | 13 |
| 4.5 Occupied Channel Bandwidth 99%.....                                | 14 |
| 4.6 Emissions in non-restricted frequency bands.....                   | 15 |
| 4.7 Radiated field strength emissions below 30 MHz .....               | 17 |
| 4.8 Radiated field strength emissions 30 MHz – 1 GHz .....             | 21 |
| 4.9 Radiated field strength emissions above 1 GHz .....                | 23 |
| 4.10 Radiated Band-Edge emissions.....                                 | 25 |
| 4.11 Equipment lists .....   | 27 |
| 5 Results from external laboratory.....                                | 29 |

|   |   |    |
|---|---|----|
| 6 | Opinions and interpretations.....                                       | 29 |
| 7 | List of abbreviations .....   | 29 |
| 8 | Measurement Uncertainty valid for conducted/radiated measurements ..... | 30 |
| 9 | Versions of test reports (change history) .....                         | 31 |

| Table of Annex                                 |                             |                                   |             |
|--|-----------------------------|-----------------------------------|-------------|
| Annex No.                                      | Contents                    | Reference Description             | Total Pages |
| <b>Annex 1</b>                                 | Test result diagrams        | <b>TR22-1-0131901T003a-C01-A1</b> | 19          |
| <b>Annex 2</b>                                 | Internal photographs of EUT | <b>Provided by applicant</b>      |             |
| <b>Annex 3</b>                                 | External photographs of EUT | <b>TR22-1-0131901T003a-C01-A3</b> | 5           |
| <b>Annex 4</b>                                 | Test set-up photographs     | <b>TR22-1-0131901T003a-C01-A4</b> | 6           |
| The listed attachments are separate documents. |                             |                                   |             |

# 1 General information

## 1.1 Disclaimer and Notes

The test results of this test report relate exclusively to the test item specified in this test report as specified in chapter 2.7. cetecom advanced 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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Also we refer on special conditions which the applicant should fulfill according §2.927 to §2.948, special focus regarding modification of the equipment and availability of sample equipment for market surveillance tests.

## 1.2 Attestation

I declare that all measurements were performed by me or under my supervision and that all measurements have been performed and are correct to my best knowledge and belief to Industry Canada standards. All of the above requirements are met in accordance with enumerated standards.

### 1.3 Summary of Test Results

The EUT integrates a BLE transmitter. Other implemented wireless technologies were not considered within this test report.

| Test case  | Reference Clause<br>FCC ☒ | Reference<br>Clause ISSED ☒                          | Page | Remark | Result |
|--|---------------------------|--|------|--------|--------|
| <a href="#">Duty-Cycle</a>                                       | §15.35(c)                 | RSS-Gen Issue 5, §8.2                                | 10   | --     | PASSED |
| <a href="#">Minimum Emission Bandwidth 6 dB</a>                  | §15.247 5.2(a)            | RSS-247, §5.2(a)<br>RSS-Gen Issue 5, §6.7            | 13   | --     | PASSED |
| <a href="#">Occupied Channel Bandwidth 99%</a>                   | 2.1049(h)                 | RSS-Gen Issue 5, §6.7                                | 14   | --     | PASSED |
| <a href="#">Peak output power (Sweep)</a>                        | §15.247(b)(3)             | RSS-247, §5.4(d)                                     | 11   | --     | PASSED |
| Transmitter Peak output power radiated                           | §15.247(b)(4)(c)(i)       | RSS-247, §5.4(d)                                     | --   | --     | N/A    |
| <a href="#">Emissions in non-restricted frequency bands</a>      | §15.247(d)                | RSS-247, §5.5  | 16   | --     | PASSED |
| <a href="#">Radiated Band-Edge emissions</a>                     | §15.205(b)<br>§15.247(d)  | RSS-Gen: Issue 5<br>§8.9, §8.10<br>RSS-247, §5.5     | 26   | --     | PASSED |
| <a href="#">Power spectral density</a>                           | §15.247(e)                | RSS-247, §5.2(b)                                     | 12   | --     | PASSED |
| <a href="#">Radiated field strength emissions below 30 MHz</a>   | §15.205(a)<br>§15.209(a)  | RSS-Gen: Issue 5<br>§8.9 Table 6                     | 20   | --     | PASSED |
| <a href="#">Radiated field strength emissions 30 MHz – 1 GHz</a> | §15.209<br>§15.247(d)     | RSS-Gen: Issue 5<br>§8.9 Table 5<br>RSS-247, §5.5    | 22   | --     | PASSED |
| <a href="#">Radiated field strength emissions above 1 GHz</a>    | §15.209(a)<br>§15.247(d)  | RSS-Gen: Issue 5:<br>§8.9 Table 5+7<br>RSS-247, §5.5 | 24   | --     | PASSED |
| AC-Power Lines Conducted Emissions                               | §15.207                   | RSS-Gen Issue 5:<br>§8.8 Table 4                     | --   | --     | N/A    |

PASSED

The EUT complies with the essential requirements in the standard.

FAILED

The EUT does not comply with the essential requirements in the standard.

N/A

Test case does not apply to the test object.

NP

The test was not performed by the cetecom advanced laboratory.

Decision Rule: cetecom advanced GmbH follows [ILAC G8:2019 chapter 4.2.1 \(Simple Acceptance Rule\)](#).

## 1.4 Summary of Test Methods

| Test case                                       | Test method  |
|---|--|
| Duty-Cycle                                      | ANSI C63.10:2013, §11.6(b)   |
| Minimum Emission Bandwidth 6 dB                 | ANSI C63.10:2013, §6.9.2, §11.8  |
| Occupied Channel Bandwidth 99%                  | ANSI C63.10:2013, §6.9.3   |
| Peak output power (Sweep)                       | ANSI C63.10:2013, §11.9  |
| Power spectral density                          | ANSI C63.10:2013, §11.10   |
| Emissions in non-restricted frequency bands     | ANSI C63.10:2013, §11.11, §6.10.5  |
| Radiated Band-Edge emissions                    | ANSI C63.10-2013; "Marker-Delta method", §6.10.5, §11.13   |
| Transmitter Peak output power radiated          | Result calculated with measured conducted RF-power value and stated/measured antenna gain for band of interest |
| Radiated field strength emissions below 30 MHz  | ANSI C63.10-2013 §6.3, §6.4  |
| Radiated field strength emissions 30 MHz- 1 GHz | ANSI C63.4-2014 §8.2.3, ANSI C63.10-2013 §6.3, §6.5  |
| Radiated field strength emissions above 1 GHz   | ANSI C63.4-2014 §8.3, ANSI C63.10-2013 §6.3, §6.6  |
| AC-Power Lines Conducted Emissions              | ANSI C63.4-2014 §7, ANSI C63.10-2013 §6.2  |

And reference also to Test methods in KDB558074

## 2 Administrative Data

### 2.1 Identification of the Testing Laboratory

|                                     |  |
|-------------------------------------|--|
| Company name:                       | cetecom advanced GmbH                                |
| Address:                            | Im Teelbruch 116<br>45219 Essen - Kettwig<br>Germany |
| Responsible for testing laboratory: | Dipl.-Ing. Ninovic Perez                             |
| Accreditation scope:                | <b>DAkkS Webpage:</b> <a href="#">FCC ISED</a>       |
| IC Lab company No. / CAB ID:        | 3462D / DE0005                                       |
| Test location:                      | Im Teelbruch 116; 45219 Essen                        |

### 2.2 General limits for environmental conditions

|                     |           |
|---------------------|-----------|
| Temperature:        | 22±2 °C   |
| Relative. humidity: | 45±15% rH |

### 2.3 Test Laboratories sub-contracted

|               |    |
|---------------|----|
| Company name: | -- |
|---------------|----|

### 2.4 Organizational Items

|                           |                             |
|---------------------------|-----------------------------|
| Responsible test manager: | Dipl.-Ing. Christian Lorenz |
| Receipt of EUT:           | 2022-Dec-27                 |
| Date(s) of test:          | 2023-Jan-02 to 2023-Jan-05  |
| Version of template:      | 22.0901                     |

### 2.5 Applicant's details

|                         |  |
|-------------------------|--|
| Applicant's name:       | BBC Bircher AG                                     |
| Address:                | Wiesengasse 20<br>8222 Beringen<br><br>Switzerland |
| Contact Person:         | Milos Kostic                                       |
| Contact Person's Email: | milos.kostic@bircher.com                           |

### 2.6 Manufacturer's details

|                      |   |
|----------------------|---|
| Manufacturer's name: | BBC Bircher Technologies(Suzhou) Co., Ltd |
| Address:             | 215021 Suzhou Jiangsu Province            |

## 2.7 Equipment under Test (EUT)

| EUT No. *) | Sample No.        | Product                      | Model  | Type     | SN  | HW      | SW            |
|------------|-------------------|------------------------------|--------|----------|-----|---------|---------------|
| EUT 1      | 22-1-01319S24_C01 | Wireless Transmission System | XRF-TI | XRF-TI.9 | n/a | 395474B | 1.6.2400.2555 |
| EUT 2      | 22-1-01319S27_C01 | Wireless Transmission System | XRF-TI | XRF-TI.9 | n/a | 395474B | 1.6.2400.2555 |

\*) EUT short description is used to simplify the identification of the EUT in this test report.

## 2.8 Untested Variant (VAR)

| VAR No. *) | Sample No. | Product | Model | Type | SN | HW | SW |
|------------|------------|---------|-------|------|----|----|----|
|------------|------------|---------|-------|------|----|----|----|

\*) The listed additional untested model variant(s) (VAR) is/are not object of evaluation of compliance. For further information please see Annex 5: Declaration of applicant of model differences.

If the table above does not show any other line than the headline, no untested variants are available.

## 2.9 Auxiliary Equipment (AE)

| AE No. *) | Sample No.        | Auxiliary Equipment | Model | SN  | HW  | SW  |
|-----------|-------------------|---------------------|-------|-----|-----|-----|
| AE 1      | 22-1-01319S28_C01 | Lithium Battery     | N/A   | N/A | N/A | N/A |

\*) AE short description is used to simplify the identification of the auxiliary equipment in this test report. If the table above does not show any other line than the headline, no AE was used during testing nor was taken into account for evaluation

## 2.10 Connected cables (CAB)

| CAB No. *) | Sample No.        | Cable Type | Connectors / Details | Length |
|------------|-------------------|------------|----------------------|--------|
| CAB 1      | 22-1-01319S33_C01 | Cable      | U.FL to SMA          | 15 cm  |

\*) CAB short description is used to simplify the identification of the connected cables in this test report. If the table above does not show any other line than the headline, no cable was used during testing nor was taken into account for evaluation

## 2.11 Software (SW)

| SW No. *) | Sample No. | SW Name | Description | SW Status |
|-----------|------------|---------|-------------|-----------|
|-----------|------------|---------|-------------|-----------|

\*) SW short description is used to simplify the identification of the used software in this test report. If the table above does not show any other line than the headline, no SW was used during testing nor was taken into account for evaluation.

## 2.12 EUT set-ups

| set-up no. *) | Combination of EUT and AE | Description                      |
|---------------|---------------------------|----------------------------------|
| Set. 1        | EUT 1                     | Used for Radiated measurements   |
| Set. 2        | EUT 2 + CAB 1             | Used for Conducted measurements. |

\*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.

## 2.13 EUT operation modes

| EUT operating mode no. *) | Operating modes | Additional information   |
|---------------------------|-----------------|--|
| Op. 1                     | TX_mod          | EUT continuously transmitting a modulated carrier at 921.5 MHz |

\*) EUT operating mode no. is used to simplify the test report.

### 3 Equipment under test (EUT)

#### 3.1 General Data of Main EUT as Declared by Applicant

|  |   |  |                           |
|--|---|--|---------------------------|
| Firmware   | <input type="checkbox"/> for normal use     | <input checked="" type="checkbox"/> Special version for test execution |                           |
| Power supply   | <input type="checkbox"/> AC Mains           | -  |                           |
|  | <input type="checkbox"/> DC Mains           | -- V DC via -- Connector   |                           |
|  | <input checked="" type="checkbox"/> Battery | 3.6V Lithium Ion battery ER14505H                                      |                           |
| Operational conditions   | T <sub>nom</sub> =+21 °C                    | T <sub>min</sub> = -20 °C  | T <sub>max</sub> = +60 °C |
| EUT sample type  | Production                                  |  |                           |
| Weight   | 0.045 kg                                    |  |                           |
| Size [LxWxH]   | 23.5 cm x 1.5 cm x 2.0 cm                   |  |                           |
| Interfaces/Ports   |   |  |                           |
| For further details refer Applicants Declaration & following technical documents             |   |  |                           |
| For further details regarding radio parameters, please refer to Bluetooth Core Specification |   |  |                           |

#### 3.2 Detailed Technical data of Main EUT as Declared by Applicant

|  |  |                     |             |
|--|--|---------------------|-------------|
| Frequency Band   | 902 MHz – 928 MHz  |                     |             |
| Number of Channels<br>(USA/Canada -bands)  | 1 at 921.5 MHz   |                     |             |
| Nominal Channel Bandwidth  | ~600 kHz (measured)  |                     |             |
| Type of Modulation   Data Rate   | <input checked="" type="checkbox"/> GFSK   100 kbit / s                                    |                     |             |
| Other wireless options   | <input type="checkbox"/> a/n/ac mode   |                     |             |
|  | <input type="checkbox"/> b/g/n mode  |                     |             |
|  | <input type="checkbox"/> Bluetooth EDR (not tested within this report)                     |                     |             |
|  | <input type="checkbox"/> Cellular transceiver (2G/3G/4G/5G/GPS, not tested in this report) |                     |             |
|  | <input checked="" type="checkbox"/> None   |                     |             |
| Max. Conducted Output Power  | 7.89 dBm   |                     |             |
| EIRP Power (Calculated EIRP)   | 7.89 dBm + 3.42 dBi = 11.31 dBm  |                     |             |
| Antenna Type   | 915 MHz Ceramic Chip Antenna   |                     |             |
| Antenna Gain   | 3.42 dBi   |                     |             |
| FCC label attached   | No   |                     |             |
| Test firmware / software and storage location                                    | EUT  |                     |             |
| For further details refer Applicants Declaration & following technical documents |  |                     |             |
| Description of Reference Document (supplied by applicant)                        |  | Version             | Total Pages |
| Abracon_ACAG1204-915-T_2018_06.pdf   |  | Revised: 06.21.2018 | 4           |
| ExpertSystem_XRF_DE.pdf  |  | n/a                 | 4           |

#### 3.3 Modifications on Test sample

|                                    |    |
|------------------------------------|----|
| Additions/deviations or exclusions | -- |
|------------------------------------|----|

## 4 Measurements

### 4.1 Duty-Cycle

#### Testing method:

The measurement is made according to relevant reference clauses:

(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

The necessary duty-cycle correction factor is determined on nominal conditions on middle channel only. It is assumed that no noticeable changes occur when tested on other channels or climatic conditions.

#### EUT settings

The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.

Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

A special firmware program is used for test purposes. In opposite to normal operating mode a higher duty-cycle is set in order to facilitate the measurements. This is maximized at the extent possible.

The necessary duty-cycle correction factor is determined on nominal conditions on one channel in each operable frequency-band. It is assumed that no noticeable changes occur when tested on other channels or climatic conditions. The Duty-Cycle was constant, means without variations.

Formula to calculate Duty-Cycle:

|  |                        |   |
|--|------------------------|---|
| Duty cycle calculations:<br><br>$x = \frac{TX_{ON}}{TX_{ON} + TX_{OFF}}$ | Duty cycle factor: DC= | Regarding power: $10 * \log(1/x)$ dB          |
|  |                        | Regarding field strength: $20 * \log(1/x)$ dB |

☐ The results were corrected in order to evaluate for worst-case result each time when average values are necessary for example average radiated emissions or similar

☒ No correction necessary: Duty-Cycle > 98%

#### 4.1.1 Measurement Location

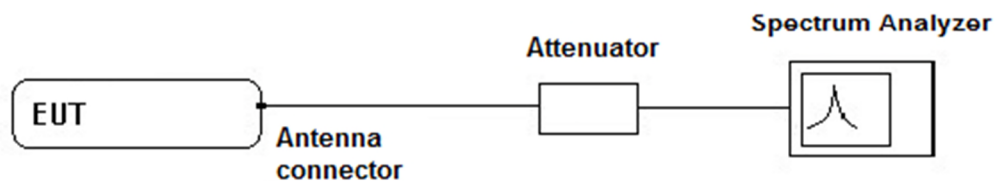
|                  |                                       |
|------------------|---------------------------------------|
| <b>Test site</b> | 120910 - Radio Laboratory 1 (TS 8997) |
|------------------|---------------------------------------|

## 4.2 Peak output power (Sweep)

### 4.2.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then connected to power meter (3) or spectrum-analyzer (4) for RF-conducted measurements. The specific attenuation loss is determined prior to the measurement within a set-up attenuation measurement. These are then taken into account by correcting the measurement readings.

#### Schematic:



#### Testing method:

The measurement is made according to relevant reference clauses:  
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

|             |  |
|-------------|--|
| Test method | Maximum peak conducted output power(RBW = DTS-bandwidth of the signal) |
| Remarks     | --   |

#### EUT settings

The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.  
Different modulation characteristics have been checked, e.g. data rates which EUT can operate

### 4.2.2 Measurement Location

|           |                                       |
|-----------|---------------------------------------|
| Test site | 120910 - Radio Laboratory 1 (TS 8997) |
|-----------|---------------------------------------|

### 4.2.3 Limit

| Frequency Range [MHz] | Limit [W] | Limit [dBm] | Detector | RBW / VBW [MHz] |
|-----------------------|-----------|-------------|----------|-----------------|
| 902 – 928             | 1         | 30          | MaxPeak  | 3 / 10          |

### 4.2.4 Result

| Diagram | Mode           | Frequency [MHz] | Max Peak Power [dBm] | Result |
|---------|----------------|-----------------|----------------------|--------|
| D003    | Op. 1 / Set. 2 | 921.36          | 7.89                 | PASSED |

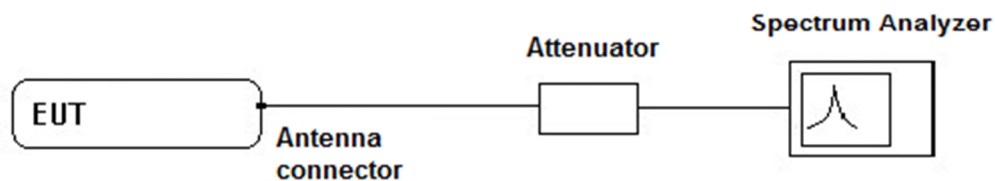
Remark: for more information and graphical plot see annex A1 **TR22-1-0131901T003a-C01-A1**

### 4.3 Power spectral density

#### 4.3.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then connected to spectrum-analyzer (4) for RF-conducted measurements. The specific attenuation loss is determined prior to the measurement within a set-up attenuation measurement. These are then taken into account by correcting the measurement readings of the spectrum-analyzer.

##### Schematic:



##### Testing method:

The measurement is made according to relevant reference clauses:  
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

|             |              |
|-------------|--------------|
| Test method | PKPSD-Method |
| Remarks     | --           |

##### EUT settings

The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.

#### 4.3.2 Measurement Location

|           |                                       |
|-----------|---------------------------------------|
| Test site | 120910 - Radio Laboratory 1 (TS 8997) |
|-----------|---------------------------------------|

#### 4.3.3 Limit

| Limit [dBm] @ 3 kHz | Detector [MaxHold] | RBW / VBW [kHz] |
|---------------------|--------------------|-----------------|
| ≤ 8                 | Peak               | 3 / 10          |

#### 4.3.4 Result

| Diagram | Mode          | Frequency [MHz] | PSD [dBm] | Result |
|---------|---------------|-----------------|-----------|--------|
| D004    | Op.1 / Set. 2 | 921.66          | 3.77      | PASSED |

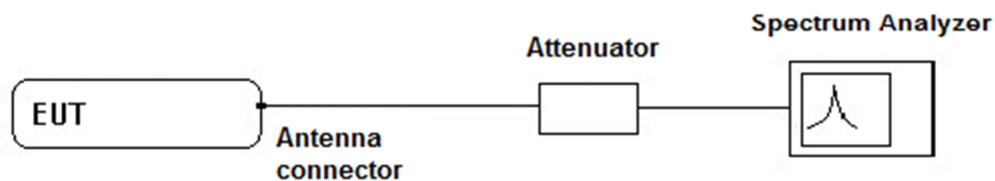
Remark: for more information and graphical plot see annex A1 **TR22-1-0131901T003a-C01-A1**

## 4.4 Minimum Emission Bandwidth 6 dB

### 4.4.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then connected to spectrum-analyzer (4) for RF-conducted measurements. The specific attenuation loss is determined prior to the measurement within a set-up attenuation measurement. These are then taken into account by correcting the measurement readings of the spectrum-analyzer.

#### Schematic:



#### Testing method:

The measurement is made according to relevant reference clauses:  
(See *Tables Summary of Test Results* and *Summary of Test Methods* on page 5)

### 4.4.2 Measurement Location

|                  |                                       |
|------------------|---------------------------------------|
| <b>Test site</b> | 120910 - Radio Laboratory 1 (TS 8997) |
|------------------|---------------------------------------|

### 4.4.3 Limit

| Limit [kHz] | Detector [MaxHold] | RBW / VBW [kHz] |
|-------------|--------------------|-----------------|
| ≥ 500       | MaxPeak            | 100 / 300       |

### 4.4.4 Result

| Diagram | Mode           | Frequency [MHz] | 6 dB bandwidth [kHz] | Result |
|---------|----------------|-----------------|----------------------|--------|
| D002    | Op. 1 / Set. 2 | 921.66          | 544.10               | PASSED |

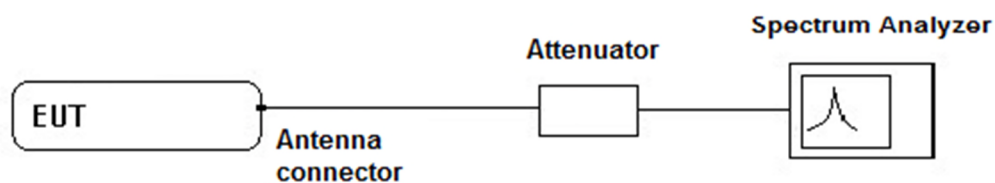
Remark: for more information and graphical plot see annex A1 **TR22-1-0131901T003a-C01-A1**

## 4.5 Occupied Channel Bandwidth 99%

### 4.5.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then connected to spectrum-analyzer (4) for RF-conducted measurements. The specific attenuation loss is determined prior to the measurement within a set-up attenuation measurement. These are then taken into account by correcting the measurement readings of the spectrum-analyzer.

#### Schematic:



#### Testing method:

The measurement is made according to relevant reference clauses:  
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

### 4.5.2 Measurement Location

|           |                                       |
|-----------|---------------------------------------|
| Test site | 120910 - Radio Laboratory 1 (TS 8997) |
|-----------|---------------------------------------|

### 4.5.3 Limit

When the occupied bandwidth limit is not stated in the applicable reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

### 4.5.4 Result

| Diagram | Mode           | Frequency [MHz] | 99% Occupied bandwidth [kHz] |
|---------|----------------|-----------------|------------------------------|
| D001    | Op. 1 / Set. 2 | 921.52          | 610.86                       |

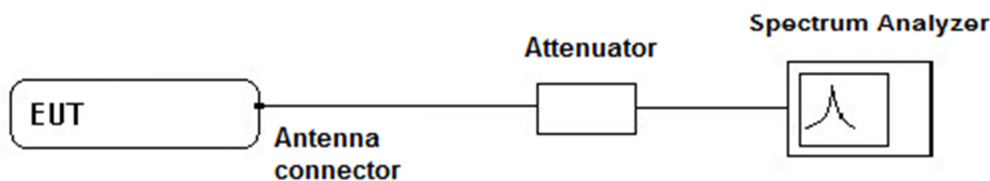
Remark: for more information and graphical plot see annex A1 **TR22-1-0131901T003a-C01-A1**

4.6 Emissions in non-restricted frequency bands

4.6.1 Description of the general conducted test setup and methodology, see below example:

The EUT’s RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then connected to spectrum-analyzer (4) for RF-conducted measurements. The specific attenuation loss is determined prior to the measurement within a set-up attenuation measurement. These are then taken into account by correcting the measurement readings of the spectrum-analyzer.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:  
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

The measurements were performed with the RBW set to 100 kHz & maximum carrier level was indicated with MAX-Hold positive peak detector using markers. Then a frequency line was set 20 or 30 dB below this measured maximum carrier level.

Then using RBW 100 kHz & spectrum analyzer span from 150 kHz to 10 GHz in three steps spurious emissions were measured with MAX-Hold positive peak detector.

EUT settings

The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.

4.6.2 Measurement Location

|           |                                       |
|-----------|---------------------------------------|
| Test site | 120910 - Radio Laboratory 1 (TS 8997) |
|-----------|---------------------------------------|

### 4.6.3 Limit

| Frequency Range [MHz] | Limit [dBc] |
|-----------------------|-------------|
| 0.15 – 10000          | -20 / -30   |

### 4.6.4 Result

Reference level

| Diagram | Mode           | Max Peak [dBm] |
|---------|----------------|----------------|
| D005_1  | Op. 1 / Set. 2 | 7.73           |

Maximum Level Peak [dBc]

| Diagram | Mode           | Frequency range [MHz] | Maximum level [dBm] | Result |
|---------|----------------|-----------------------|---------------------|--------|
| D005_2  | Op. 1 / Set. 2 | 0.150 – 30            | -62.51 @ 29.21 MHz  | PASSED |
| D005_3  | Op. 1 / Set. 2 | 30 – 1000             | -61.18 @ 973.8 MHz  | PASSED |
| D005_4  | Op. 1 / Set. 2 | 1000 – 5000           | -46.24 @ 1.842 GHz  | PASSED |
| D005_5  | Op. 1 / Set. 2 | 5000 – 10000          | -58.21 @ 7.493 GHz  | PASSED |

Remark1: every RF-Port tested separately in case on MIMO device

Remark2: for more information and graphical plot see annex A1 **TR22-1-0131901T003a-C01-A1**

Band-Edge

| Diagram | Mode           | Lower Band-Edge Pk [dBm] | Upper Band-Edge Pk [dBm] | Result |
|---------|----------------|--------------------------|--------------------------|--------|
| D005_6  | Op. 1 / Set. 2 | -64.44                   | -62.56                   | PASSED |

Remark: for more information and graphical plot see annex A1 **TR22-1-0131901T003a-C01-A1**

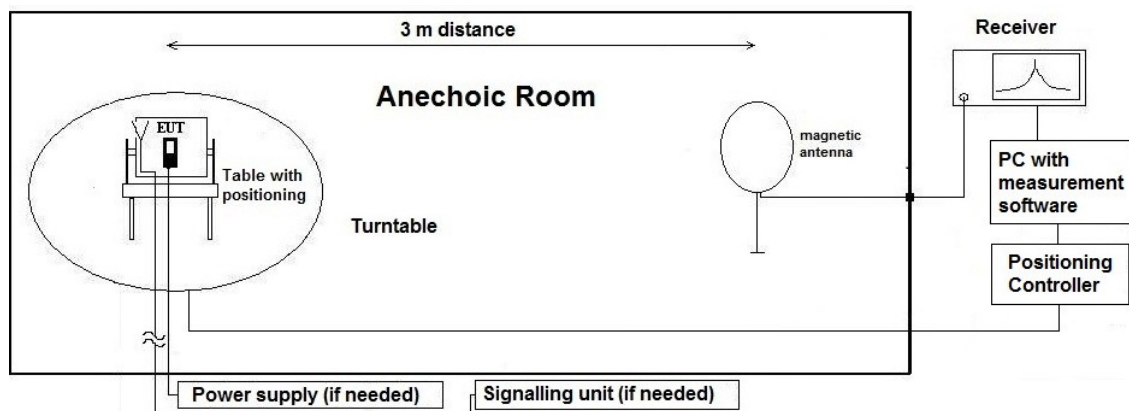
## 4.7 Radiated field strength emissions below 30 MHz

### 4.7.1 Description of the general test setup and methodology, see below example:

Evaluating the radiated field emissions are done first by an exploratory emission measurement and a final measurement for most critical frequencies determined.

The loop antenna was placed at 1 m height above ground plane and 3 m measurement distance from set-up for investigations. Because of reduced measurement distance, correction data were applied, as stated in chapter "General Limit - Radiated field strength emissions below 30 MHz". The tests are performed in the semi anechoic room recognized by the regulatory commission.

#### Schematic:



#### Testing method:

The measurement is made according to relevant reference clauses:

(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

#### Exploratory, preliminary measurements

The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (step 90°, range 0° to 360°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT), the emission spectrum was recorded.

The loop antenna was moved at least to 2-perpendicular axes (antenna vector in direction of EUT and parallel to EUT) in order to maximize the emissions. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a data reduction table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

#### Final measurement on critical frequencies

Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position).

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

#### Formula:

$$E_C = E_R + AF + C_L + D_F - G_A$$

$$M = L_T - E_C$$

AF = Antenna factor

$C_L$  = Cable loss

$D_F$  = Distance correction factor (if used)

$E_C$  = Electrical field – corrected value

$E_R$  = Receiver reading

$G_A$  = Gain of pre-amplifier (if used)

$L_T$  = Limit

M = Margin

All units are dB-units, positive margin means value is below limit.

#### 4.7.2 Sample calculation

| Raw-Value<br>[dBuV/m] | Antenna<br>factor | Distance<br>Correction<br>[dB] | Cable<br>Loss | Preamplifier | Resulting<br>correction value<br>[dB] | Final result<br>[dBuV/m] | Remarks   |
|-----------------------|-------------------|--------------------------------|---------------|--------------|---------------------------------------|--------------------------|---|
| 19.83                 | 18.9              | -70.75                         | 0.18          | --           | -51.67                                | -31.83                   | 30 to 3 m<br>correction used<br>according<br>ANSI C63.10-2013 |

Remark: This calculation is based on an example value at 458 kHz

#### 4.7.3 Measurement Location

|           |  |
|-----------|--|
| Test site | 120901 - SAC - Radiated Emission <1GHz |
|-----------|--|

#### 4.7.4 Correction factors due to reduced meas. distance ( $f < 30$ MHz):

The used correction factors when the measurement distance is reduced compared to regulatory measurement distance, are calculated according Extrapolation formulas valid for EUT's with maximum dimension of  $0.625 \times \text{Lambda}$ . Formula 2+3+4 as presented in ANSI C63.10, Chapter 6.4.4 are used for the calculations of proper extrapolation factors

| Frequency Range | f [kHz/MHz] | Lambda [m] | Far-Field Point [m] | Distance Limit accord. 15.209 [m] | 1st Condition (dmeas < Dnear-field) | 2nd Condition (Limit distance bigger dnear-field) | Distance Correction accord. Formula |
|-----------------|-------------|------------|---------------------|-----------------------------------|-------------------------------------|---|-------------------------------------|
| kHz             | 9           | 33333.33   | 5305.17             | 300                               | fulfilled                           | not fulfilled                                     | -80.00                              |
|                 | 10          | 30000.00   | 4774.65             |                                   | fulfilled                           | not fulfilled                                     | -80.00                              |
|                 | 20          | 15000.00   | 2387.33             |                                   | fulfilled                           | not fulfilled                                     | -80.00                              |
|                 | 30          | 10000.00   | 1591.55             |                                   | fulfilled                           | not fulfilled                                     | -80.00                              |
|                 | 40          | 7500.00    | 1193.66             |                                   | fulfilled                           | not fulfilled                                     | -80.00                              |
|                 | 50          | 6000.00    | 954.93              |                                   | fulfilled                           | not fulfilled                                     | -80.00                              |
|                 | 60          | 5000.00    | 795.78              |                                   | fulfilled                           | not fulfilled                                     | -80.00                              |
|                 | 70          | 4285.71    | 682.09              |                                   | fulfilled                           | not fulfilled                                     | -80.00                              |
|                 | 80          | 3750.00    | 596.83              |                                   | fulfilled                           | not fulfilled                                     | -80.00                              |
|                 | 90          | 3333.33    | 530.52              |                                   | fulfilled                           | not fulfilled                                     | -80.00                              |
|                 | 100         | 3000.00    | 477.47              |                                   | fulfilled                           | not fulfilled                                     | -80.00                              |
|                 | 125         | 2400.00    | 381.97              |                                   | fulfilled                           | not fulfilled                                     | -80.00                              |
|                 | 200         | 1500.00    | 238.73              |                                   | fulfilled                           | fulfilled   | -78.02                              |
|                 | 300         | 1000.00    | 159.16              |                                   | fulfilled                           | fulfilled   | -74.49                              |
|                 | 400         | 750.00     | 119.37              |                                   | fulfilled                           | fulfilled   | -72.00                              |
|                 | 490         | 612.24     | 97.44               |                                   | fulfilled                           | fulfilled   | -70.23                              |
|                 | 500         | 600.00     | 95.49               | 30                                | fulfilled                           | not fulfilled                                     | -40.00                              |
|                 | 600         | 500.00     | 79.58               |                                   | fulfilled                           | not fulfilled                                     | -40.00                              |
|                 | 700         | 428.57     | 68.21               |                                   | fulfilled                           | not fulfilled                                     | -40.00                              |
|                 | 800         | 375.00     | 59.68               |                                   | fulfilled                           | not fulfilled                                     | -40.00                              |
|                 | 900         | 333.33     | 53.05               |                                   | fulfilled                           | not fulfilled                                     | -40.00                              |
| MHz             | 1.00        | 300.00     | 47.75               |                                   | fulfilled                           | not fulfilled                                     | -40.00                              |
|                 | 1.59        | 188.50     | 30.00               |                                   | fulfilled                           | not fulfilled                                     | -40.00                              |
|                 | 2.00        | 150.00     | 23.87               |                                   | fulfilled                           | fulfilled   | -38.02                              |
|                 | 3.00        | 100.00     | 15.92               |                                   | fulfilled                           | fulfilled   | -34.49                              |
|                 | 4.00        | 75.00      | 11.94               |                                   | fulfilled                           | fulfilled   | -32.00                              |
|                 | 5.00        | 60.00      | 9.55                |                                   | fulfilled                           | fulfilled   | -30.06                              |
|                 | 6.00        | 50.00      | 7.96                |                                   | fulfilled                           | fulfilled   | -28.47                              |
|                 | 7.00        | 42.86      | 6.82                |                                   | fulfilled                           | fulfilled   | -27.13                              |
|                 | 8.00        | 37.50      | 5.97                |                                   | fulfilled                           | fulfilled   | -25.97                              |
|                 | 9.00        | 33.33      | 5.31                |                                   | fulfilled                           | fulfilled   | -24.95                              |
|                 | 10.00       | 30.00      | 4.77                |                                   | fulfilled                           | fulfilled   | -24.04                              |
|                 | 10.60       | 28.30      | 4.50                |                                   | fulfilled                           | fulfilled   | -23.53                              |
|                 | 11.00       | 27.27      | 4.34                |                                   | fulfilled                           | fulfilled   | -23.21                              |
|                 | 12.00       | 25.00      | 3.98                |                                   | fulfilled                           | fulfilled   | -22.45                              |
|                 | 13.56       | 22.12      | 3.52                |                                   | fulfilled                           | fulfilled   | -21.39                              |
|                 | 15.00       | 20.00      | 3.18                |                                   | fulfilled                           | fulfilled   | -20.51                              |
|                 | 15.92       | 18.85      | 3.00                |                                   | fulfilled                           | fulfilled   | -20.00                              |
|                 | 17.00       | 17.65      | 2.81                |                                   | not fulfilled                       | fulfilled   | -20.00                              |
|                 | 18.00       | 16.67      | 2.65                |                                   | not fulfilled                       | fulfilled   | -20.00                              |
|                 | 20.00       | 15.00      | 2.39                |                                   | not fulfilled                       | fulfilled   | -20.00                              |
|                 | 21.00       | 14.29      | 2.27                |                                   | not fulfilled                       | fulfilled   | -20.00                              |
|                 | 23.00       | 13.04      | 2.08                |                                   | not fulfilled                       | fulfilled   | -20.00                              |
|                 | 25.00       | 12.00      | 1.91                |                                   | not fulfilled                       | fulfilled   | -20.00                              |
|                 | 27.00       | 11.11      | 1.77                |                                   | not fulfilled                       | fulfilled   | -20.00                              |
|                 | 29.00       | 10.34      | 1.65                |                                   | not fulfilled                       | fulfilled   | -20.00                              |
|                 | 30.00       | 10.00      | 1.59                |                                   | not fulfilled                       | fulfilled   | -20.00                              |

#### 4.7.5 Limit

| Radiated emissions limits, (3 meters) |                           |                                      |              |            |           |
|---------------------------------------|---------------------------|--------------------------------------|--------------|------------|-----------|
| Frequency Range [MHz]                 | Limit [ $\mu\text{V/m}$ ] | Limit [ $\text{dB}\mu\text{V/m}$ ] * | Distance [m] | Detector   | RBW [kHz] |
| 0.009 – 0.09                          | 2400 / f [kHz]            | 67.6 – 20Log(f) (kHz)                | 300          | Pk & Avg   | 0.2       |
| 0.09 – 0.11                           | 2400 / f [kHz]            | 67.6 – 20Log(f) (kHz)                | 300          | Quasi peak | 0.2       |
| 0.11 – 0.15                           | 2400 / f [kHz]            | 67.6 – 20Log(f) (kHz)                | 300          | Pk & Avg   | 0.2       |
| 0.15 – 0.49                           | 2400 / f [kHz]            | 67.6 – 20Log(f) (kHz)                | 300          | Pk & Avg   | 9         |
| 0.49 – 1.705                          | 24000 / f [kHz]           | 87.6 – 20Log(f) (kHz)                | 30           | Quasi peak | 9         |
| 1.705 - 30                            | 30                        | 29.5                                 | 30           | Quasi peak | 9         |

\*Remark: In Canada same limits apply, just unit reference is different

#### 4.7.6 Result

| Diagram | Mode                                    | Maximum Level [ $\text{dB}\mu\text{V/m}$ ]<br>Frequency Range 0.009 – 30 MHz | Result |
|---------|---|--|--------|
| 2.01a   | Op. 1 / Set. 1 / standing <sup>2)</sup> | 19.677 @ 23.13 MHz <sup>1)</sup>   | PASSED |

Remark: for more information and graphical plot see annex A1 **TR22-1-0131901T003a-C01-A1**

Remark1: noise level

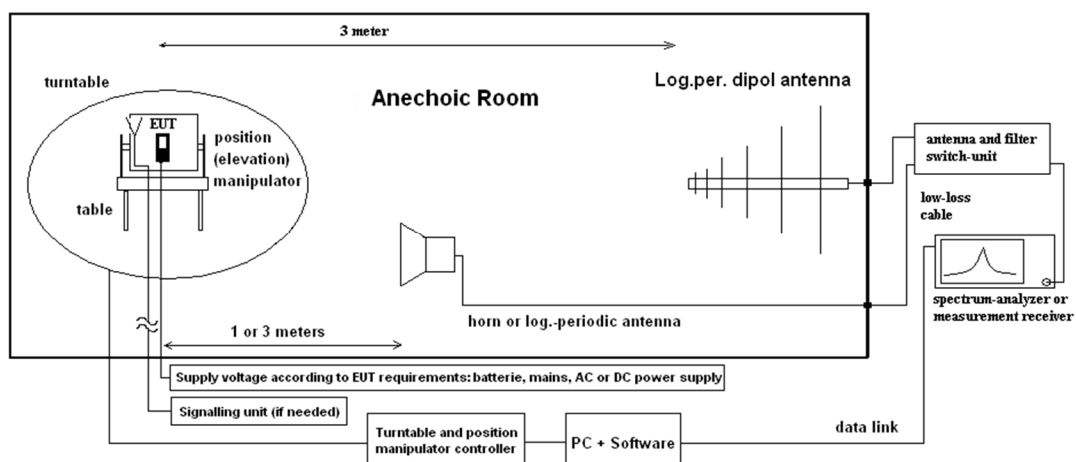
Remark2: only worst case EUT position tested. See chapter 4.10 for more information

## 4.8 Radiated field strength emissions 30 MHz – 1 GHz

### 4.8.1 Description of the general test setup and methodology, see below example:

Evaluating the emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a CISPR 16-1-4:2010 compliant semi anechoic room (SAR) and fully anechoic room (FAR) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 18 GHz and 2 meter above 18 GHz. A logarithmic periodic antenna is used for the frequency range 30 MHz to 1 GHz. Horn antennas are used for frequency range 1 GHz to 40 GHz. The EUT is aligned within 3 dB beam width of the measurement antenna with three orthogonal axis measurements on the EUT.

#### Schematic:



#### Testing method:

The measurement is made according to relevant reference clauses:

(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

#### Exploratory, preliminary measurements

The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 90°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and its characteristics was recorded with an EMI-receiver, broadband antenna and software.

Measurement antenna: horizontal and vertical, heights: 1,0 m and 1,82 m as worst-case determined by an exploratory emission measurements. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

#### Final measurement on critical frequencies

Based on the exploratory measurements, the most critical frequencies are re-measured by main-taining the EUT's worst-case operation mode, cable position, etc. either on 10m OATS or 3m semi-anechoic room.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position). The measurement antenna height between 1 m and 4 m.

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out

#### Formula:

$$E_C = E_R + AF + C_L + D_F - G_A \quad (1)$$

$$M = L_T - E_C \quad (2)$$

AF = Antenna factor

$C_L$  = Cable loss

$D_F$  = Distance correction factor (if used)

$E_C$  = Electrical field – corrected value

$E_R$  = Receiver reading

$G_A$  = Gain of pre-amplifier (if used)

$L_T$  = Limit

M = Margin

All units are dB-units, positive margin means value is below limit.

### 4.8.2 Sample calculation

| Raw-Value [dBuV/m] | Antenna factor | Distance Correction [dB] | Cable Loss | Preamplifier | Resulting correction value [dB] | Final result [dBuV/m] | Remarks |
|--------------------|----------------|--------------------------|------------|--------------|---------------------------------|-----------------------|---------|
| 32.7               | 22.25          | --                       | 3.1        | --           | 25.35                           | 58.05                 | --      |

Remark: This calculation is based on an example value at 800.4 MHz

### 4.8.3 Measurement Location

|           |                                      |
|-----------|--------------------------------------|
| Test site | 120901 - SAC - Radiated Emission <1G |
|-----------|--------------------------------------|

### 4.8.4 Limit

| Radiated emissions limits, (3 meters) |                    |                      |            |                 |
|---------------------------------------|--------------------|----------------------|------------|-----------------|
| Frequency Range [MHz]                 | Limit [ $\mu$ V/m] | Limit [dB $\mu$ V/m] | Detector   | RBW / VBW [kHz] |
| 30 - 88                               | 100                | 40.0                 | Quasi peak | 100 / 300       |
| 88 - 216                              | 150                | 43.5                 | Quasi peak | 100 / 300       |
| 216 - 960                             | 200                | 46.0                 | Quasi peak | 100 / 300       |
| 960 - 1000                            | 500                | 54.0                 | Quasi peak | 100 / 300       |

### 4.8.5 Result

| Diagram | Mode                     | Maximum Level [dB $\mu$ V/m]<br>Frequency Range 30 – 1000 MHz | Result |
|---------|--------------------------|---|--------|
| 3.01a   | Op. 1/ Set. 1 / Standing | 36.594 (PK) @ 794.1 MHz                                       | PASSED |
| 3.01b   | Op. 1 / Set. 1 / lying   | 35.872 (PK) @ 795.1 MHz                                       | PASSED |

Remark: for more information and graphical plot see annex A1 **TR22-1-0131901T003a-C01-A1**

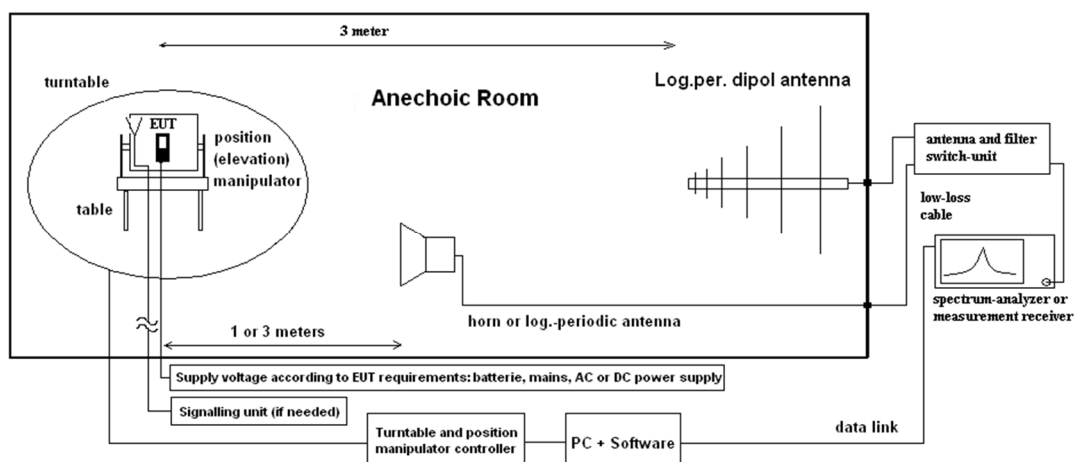
Remark1: band-stop filter for 902 MHz – 928 MHz used to prevent an overload at the EMI receiver

## 4.9 Radiated field strength emissions above 1 GHz

### 4.9.1 Description of the general test setup and methodology, see below example:

Evaluating the emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a CISPR 18-1-4:2010 compliant fully anechoic room (FAR) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 18 GHz and 2 meter above 18 GHz. A logarithmic periodic antenna is used for the frequency range 30 MHz to 1 GHz. Horn antennas are used for frequency range 1 GHz to 40 GHz. The EUT is aligned within 3 dB beam width of the measurement antenna with three orthogonal axis measurements on the EUT.

#### Schematic:



#### Testing method:

The measurement is made according to relevant reference clauses:

(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

#### Exploratory, preliminary measurements

The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.55 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 15°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and its characteristics was recorded with an EMI-receiver, broadband antenna and software.

The measurements are performed in horizontal and vertical polarization of the measurement antennas. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

#### Final measurement on critical frequencies

Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself over 3-orthogonal axis and the height for EUT with large dimensions or three axis scan for portable/small equipment.

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

#### Formula:

$$E_C = E_R + A_F + C_L + D_F - G_A \quad (1)$$

$$M = L_T - E_C \quad (2)$$

$E_C$  = Electrical field – corrected value

$E_R$  = Receiver reading

$M$  = Margin

$L_T$  = Limit

$A_F$  = Antenna factor

$C_L$  = Cable loss

$D_F$  = Distance correction factor (if used)

$G_A$  = Gain of pre-amplifier (if used)

All units are dB-units, positive margin means value is below limit.

#### 4.9.2 Sample calculation

| Raw-Value<br>[dBuV/m] | Antenna<br>factor | Distance<br>Correction<br>[dB] | Cable Loss<br>+<br>Preamplifier | Resulting<br>correction value<br>[dB] | Final result<br>[dBuV/m] | Remarks  |
|-----------------------|-------------------|--------------------------------|---------------------------------|---------------------------------------|--------------------------|--|
| 29.37                 | 41.20             | --                             | 24.28                           | 16.92                                 | 46.3                     | CableLoss and<br>PreAmp data<br>in one data<br>correction file |

Remark: This calculation is based on an example value at 10 GHz

#### 4.9.3 Measurement Location

|                      |                                    |
|----------------------|------------------------------------|
| Test site 1 – 10 GHz | 120904 - FAC1 - Radiated Emissions |
|----------------------|------------------------------------|

#### 4.9.4 Limit

| Radiated emissions limits, (3 meters) |                 |                   |          |                    |
|---------------------------------------|-----------------|-------------------|----------|--------------------|
| Frequency Range<br>[MHz]              | Limit<br>[μV/m] | Limit<br>[dBμV/m] | Detector | RBW / VBW<br>[kHz] |
| Above 1000                            | 500             | 54                | Average  | 1000 / 3000        |
| Above 1000                            | 5000            | 74                | Peak     | 1000 / 3000        |

#### 4.9.5 Result

| Diagram | Mode           | Maximum Level [dBμV/m]<br>Frequency Range 1 – 10 GHz                         | Result |
|---------|----------------|--|--------|
| 4.01    | Op. 1 / Set. 1 | 45.98 (PK) @ 4.608 GHz <sup>1)</sup><br>34.69 (AV) @ 4.608 GHz <sup>1)</sup> | PASSED |

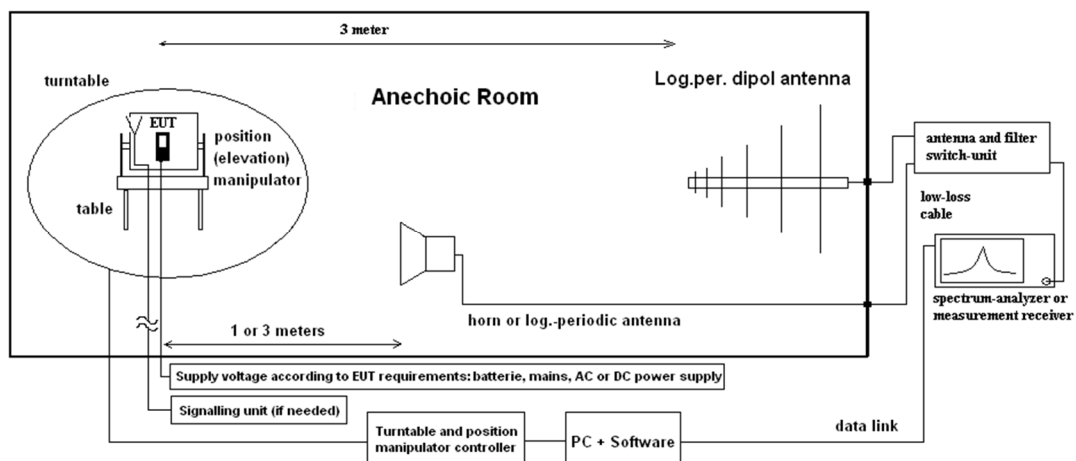
Remark: for more information and graphical plot see annex A1 TR22-1-0131901T003a-C01-A1

Remark1: emission which is closest to the limit and is not noise

## 4.10 Radiated Band-Edge emissions

### 4.10.1 Description of the general test setup and methodology, see below example:

Schematic:



### Testing method:

The measurement is made according to relevant reference clauses:

(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

For uncritical results where a measurement resolution bandwidth of 1MHz can clearly show the compliance without influencing the results, a field strength measurement was performed to show compliance.

For critical results a Marker-Delta marker method was used for showing compliance to restricted bands.

The method consists of three independent steps:

1. Step: Prior to the measurement the fundamental radiated In-Band field strength was performed. The determined value is used as reference value.
2. Step: Second step consist of finding the relative attenuation between the fundamental emission and the maximum local out-of-band emission (within 2 MHz range around the band edge either on the band-edge directly or some modulation product if the level is greater than that on the band-edge) when measured with lower resolution bandwidth.
3. .Step: The delta value recorded in step 2 will be subtracted from value recorded in step 1, thus giving the required field strength at the band-edge. This value must fulfil the requirements for radiated spurious emissions in restricted bands in FCC §15.205 with the general limits of FCC §15.209

The EUT was instructed to send with maximum power (if adjustable) according to applicants instructions.

### 4.10.2 Measurement Location

|           |                                      |
|-----------|--------------------------------------|
| Test site | 120901 - SAC - Radiated Emission <1G |
|-----------|--------------------------------------|

#### 4.10.3 Limit

| Frequency Range [MHz] | Pk Limit [dBc] | Pk Limit [dBμV/m] | Detector | RBW / VBW [kHz] |
|-----------------------|----------------|-------------------|----------|-----------------|
| 902 – 928             | -20            | 89.11             | Peak     | 100 / 300       |

#### 4.10.4 Result

Non-restricted bands near-by

| Diagram | Mode                     | Pk [dBc]  | Result |
|---------|--------------------------|---|--------|
| 9.01a   | Op. 1/ Set. 1 / standing | 105.85 dBμV/m <sup>2</sup> – ~46 dBμV/m <sup>3</sup> > 20 dBc | PASSED |
| 9.01b   | Op. 1/ Set. 1 / lying    | 105.65 dBμV/m <sup>2</sup> – ~46 dBμV/m <sup>3</sup> > 20 dBc | PASSED |

Remark: for more information and graphical plot see annex A1 **TR22-1-0131901T003a-C01-A1**

Remark1: radiated max peak level used to determine standing/lying worst case position

Remark2: carrier level

Remark3: noise level

## 4.11 Equipment lists

| ID    | Description   | Manufacturer                                   | SerNo          | CheckType | Last Check                           | Interval             | Next Check                           |
|-------|---|--|----------------|-----------|--------------------------------------|----------------------|--------------------------------------|
|       | 120901 - SAC - Radiated Emission <1GHz              |  |                | calchk    | cal: 2015-Jul-21<br>chk: 2021-Jul-27 | cal: 10Y<br>chk: 12M | cal: 2025-Jul-21<br>chk: 2022-Jul-27 |
| 20341 | Digital Multimeter Fluke 112                        | Fluke Deutschland GmbH / Glotttertal           | 81650455       | cal       | cal: 2022-May-18                     | cal: 24M             | cal: 2024-May-18                     |
| 20442 | Semi Anechoic Chamber                               | ETS-Lindgren GmbH / Taufkirchen                | -              | cnn       | cal: -<br>chk: -                     | cal: -<br>chk: -     | cal: -<br>chk: -                     |
| 20482 | filter matrix Filter matrix SAR 1                   | CETECOM GmbH                                   | -              | cnn       | cal: -<br>chk: -                     | cal: -<br>chk: -     | cal: -<br>chk: -                     |
| 20574 | Biconilog Hybrid Antenna BTA-L                      | Frankonia GmbH / Heideck                       | 980026L        | cal       | cal: 2022-Jun-15                     | cal: 36M             | cal: 2025-Jun-15                     |
| 20620 | Test Receiver ESU26                                 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 100362         | cal       | cal: 2022-Jun-08                     | cal: 12M             | cal: 2023-Jun-08                     |
| 20885 | Power Supply EA3632A                                | Agilent Technologies Deutschland GmbH          | 75305850       | cnn       | cal: -<br>chk: -                     | cal: -<br>chk: -     | cal: -<br>chk: -                     |
| 25038 | Loop Antenna HFH2-Z2                                | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 879824/13      | cal       | cal: 2022-Jul-04                     | cal: 24M             | cal: 2024-Jul-04                     |
|       | 120904 - FAC1 - Radiated Emissions                  |  |                | chk       | chk: 2022-Jun-30                     | chk: 12M             | chk: 2023-Jun-30                     |
| 20254 | High Pass Filter 5HC 2600/12750-1.5KK               | Trilithic                                      | 23042          | chk       | chk: 2022-Jun-30                     | chk: 12M             | chk: 2023-Jun-30                     |
| 20287 | Pre-Amplifier 25MHz - 4GHz AMF-2D-100MAG-3S-10P     | Miteq Inc.                                     | 379418         | chk       | chk: 2022-Jun-30                     | chk: 12M             | chk: 2023-Jun-30                     |
| 20291 | High Pass Filter WHJ 2200-4EE                       | Wainwright Instruments GmbH                    | 14             | chk       | chk: 2022-Jun-30                     | chk: 12M             | chk: 2023-Jun-30                     |
| 20338 | Pre-Amplifier 100MHz - 26GHz JS4-00102600-38-5P     | Miteq Inc.                                     | 838697         | chk       | chk: 2022-Jun-30                     | chk: 12M             | chk: 2023-Jun-30                     |
| 20439 | Ultrabroadband-Antenna HL562                        | Rohde & Schwarz Messgerätebau GmbH             | 100248         | calchk    | cal: 2017-Mar-10                     | cal: 72M<br>chk: 12M | cal: 2023-Mar-10                     |
| 20484 | Pre-Amplifier 2,5GHz - 18GHz AMF-5D-02501800-25-10P | Miteq Inc.                                     | 1244554        | chk       | chk: 2022-Jun-30                     | chk: 12M             | chk: 2023-Jun-30                     |
| 20489 | Test Receiver ESU40                                 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 100030         | cal       | cal: 2022-Jul-20                     | cal: 12M             | cal: 2023-Jul-20                     |
| 20549 | Log. Per. Antenna HL025                             | Rohde & Schwarz Messgerätebau GmbH             | 1000060        | calchk    | cal: 2021-Aug-18                     | cal: 36M<br>chk: 12M | cal: 2024-Aug-18                     |
| 20558 | Fully Anechoic Chamber 1                            | ETS-Lindgren GmbH / Taufkirchen                | -              | cnn       | cal: -<br>chk: -                     | cal: -<br>chk: -     | cal: -<br>chk: -                     |
| 20611 | Power Supply E3632A                                 | Agilent Technologies Deutschland GmbH          | KR 75305854    | cpu       |                                      |                      |                                      |
| 20690 | Spectrum Analyzer FSU                               | Rohde & Schwarz Messgerätebau GmbH             | 100302/026     | cal       | cal: 2021-May-20                     | cal: 24M             | cal: 2023-May-20                     |
| 20720 | Measurement Software EMC32 [FAC]                    | Rohde & Schwarz Messgerätebau GmbH             | V10.xx         | cnn       | cal: -<br>chk: -                     | cal: -<br>chk: -     | cal: -<br>chk: -                     |
| 20868 | High Pass Filter AFH-07000                          | AtlanTecRF                                     | 16071300004    | chk       | chk: 2021-Jun-11                     | chk: 12M             | chk: 2022-Jun-11                     |
|       | 120910 - Radio Laboratory 1 (TS 8997)               |  |                | chk       | chk: 2022-Mar-16                     | chk: 12M             | chk: 2023-Mar-16                     |
| 20866 | Signal Analyzer FSV3030                             | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 101247         | cal       | cal: 2022-Jun-20                     | cal: 12M             | cal: 2023-Jun-20                     |
|       | 120911 - Radio Laboratory 2                         |  |                | cnn       | cal: -<br>chk: -                     | cal: -<br>chk: -     | cal: -<br>chk: -                     |
| 20457 | Power Supply EA-3013 S                              | EA Elektro-Automatik GmbH & Co. KG             | 9624680        | cpu       |                                      |                      |                                      |
| 20468 | Digital Multimeter Fluke 112                        | Fluke Deutschland GmbH                         | 90090455       | cal       | cal: 2021-Jun-01                     | cal: 36M             | cal: 2024-Jun-01                     |
| 20904 | Climatic Chamber ClimeEvent C/1000/70a/5            | Weiss Umwelttechnik GmbH                       | 58226223240010 | cal       | cal: 2022-Nov-29                     | cal: 24M             | cal: 2024-Nov-29                     |

Tools used in 'P1M1'

### 4.11.1 Legend

| Note / remarks | Interval of calibration & Verification |
|----------------|--|
| 12M            | 12 months                              |
| 24M            | 24 months                              |
| 36M            | 36 months                              |
| 10Y            | 10 Years                               |

| Abbreviation Check Type | Description                                |
|-------------------------|--|
| cnn                     | Calibration and verification not necessary |
| cal                     | Calibration                                |
| calchk                  | Calibration plus intermediate Verification |
| chk                     | Verification                               |
| cpu                     | Verification before usage                  |



## 5 Results from external laboratory

None

-

## 6 Opinions and interpretations

None

-

## 7 List of abbreviations

None

-

## 8 Measurement Uncertainty valid for conducted/radiated measurements

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor **k**, such that a confidence level of approximately 95% is achieved. For uncertainty determination, each component used in the concrete measurement set-up was taken in account and its contribution to the overall uncertainty according its statistical distribution calculated.

| Issue No. | Measurement type   | Reference                  | Frequency range of measurement |            | Calculated Uncertainty based on confidence level of 95.54% | Remarks  |
|-----------|--|----------------------------|--------------------------------|------------|--|--|
|           |  |                            | Start [MHz]                    | Stop [MHz] |  |  |
| 1         | Magnetic field strength                                  | FCC15/18/22/24/27/90, ISED | 0.009                          | 30         | 4.86   | Magnetic loop antenna, Pre-amp on  |
| 2         | RF-Output power (eirp)<br>Unwanted emissions (eirp) [dB] | FCC15/18 / ISED            | 30                             | 100        | 4.57   | without Pre-Amp  |
|           |  |                            | 30                             | 100        | 4.91   | with PreAmp  |
|           |  |                            | 100                            | 1000       | 4.02   | without Pre-Amp  |
|           |  |                            | 100                            | 1000       | 4.26   | with PreAmp  |
|           |  |                            | 1000                           | 18000      | 4.36   | without Pre-Amp  |
|           |  |                            | 1000                           | 18000      | 5.23   | with PreAmp  |
|           |  |                            | 18000                          | 33000      | 4.92   | Schwarzbeck BBHA9170 (#20302) Antenna set-up non-waveguide antenna)            |
|           |  |                            | 33000                          | 50000      | 4.17   | Set-up for Q-Band (WR-22), non-wave guide antenna                              |
|           |  |                            | 40000                          | 60000      | 4.69   | Set-up U-Band (WR-19), non-waveguide antenna                                   |
|           |  |                            | 50000                          | 75000      | 4.06   | External Mixer set-up V-Band (WR-15)   |
|           |  |                            | 75000                          | 110000     | 4.17   | External Mixer set-up W-Band (WR-6)  |
|           |  |                            | 90000                          | 140000     | 5.49   | External Mixer set-up F-Band (WR-8)  |
|           |  |                            | 140000                         | 225000     | 6.22   | External Mixer set-up G-Band (WR-5)  |
|           |  |                            | 225000                         | 325000     | 7.04   | External Mixer set-up (WR-3)   |
|           |  |                            | 325000                         | 500000     | 8.84   | External Mixer set-up (WR-2.2)   |
|           |  |                            |                                |            |  |  |
| 3         | Radiated Blocking [dB]                                   | EN303883                   | 1000                           | 18000      | 2.85   | Typical set-up with microwave generator and antenna, value for 7GHz calculated |
|           |  |                            | 18000                          | 33000      | 4.66   | Typical set-up with microwave generator and antenna                            |
|           |  |                            | 33000                          | 50000      | 3.48   | WR-22 set-up   |
|           |  |                            | 50000                          | 75000      | 3.73   | WR-15 set-up   |
|           |  |                            | 75000                          | 110000     | 4.26   | WR-6 set-up  |
| 4         | Frequency Error / UWB+FCW [kHz]                          | EN303883<br>FCC 15         | 40000                          | 77000      | 276.19   | calculated for 77 GHz (FCW) carrier  |
|           |  |                            | 6000                           | 7000       | 33.92  | calculated for 6.5GHz UWB Ch.5   |
|           | Frequency Error / NFC [Hz]                               | FCC 15                     | 11.00                          | 14.00      | 20.76  | calculated for 13.56MHz NFC carrier  |
| 5         | TS 8997<br>conducted Parameters                          | FCC15/18 / ISED            | 30                             | 6000       | 1.11   | 1. Power measurement with Fast-sampling-detector                               |
|           |  |                            | 30                             | 6000       | 1.20   | 2. Power measurement with Spectrum-Analyzer                                    |
|           |  |                            | 30                             | 6000       | 1.20   | 3. Power Spectrum-Density measurement  |
|           |  |                            | 30                             | 7500       | 1.20   | 4. Conducted Spurious emissions:   |
|           |  |                            | 0.009                          | 30         | 2.56   | 5. Conducted Spurious emissions:   |
|           |  |                            | 2.4                            | 2.48       | 1.95 ppm   | 6a. Bandwidth / 2-Marker Method for 2.4GHz ISM                                 |
|           |  |                            | 5.18                           | 5.825      | 7.180 ppm  | 6b. Bandwidth / 2-Marker Method for 5GHz WLAN                                  |
|           |  |                            | 5.18                           | 5.825      | 1.099 ppm  | 7 Frequency (Marker method) for 5GHz WLAN                                      |
|           |  |                            | 30                             | 6000       | 0.11561µs  | 8 Medium-Utilization factor / Timing   |
|           |  |                            | 30                             | 6000       | 1.85   | 9 Blocking-Level of companion device   |
|           |  |                            | 30                             | 6000       | 1.62   | 9 Blocking Generator level   |
|           |  |                            |                                |            |  |  |
|           |  |                            |                                |            |  |  |
|           |  |                            |                                |            |  |  |
|           |  |                            |                                |            |  |  |
| 6         | Conducted emissions                                      | EN303883<br>FCC 15         | 0.009                          | 30         | 3.57   |  |

## 9 Versions of test reports (change history)

| Version | Applied changes   | Date of release |
|---------|---|-----------------|
| --      | Initial release   | 2023-Feb-10     |
| C01     | FCC/ID ID corrected (dot removed)<br>Maximum temperature changed to 60 °C   Data rate changed to 100 kbit / s | 2023-Mar-31     |
| --      | --  | --              |

**End Of Test Report**