



# RF - TEST REPORT

- FCC Part 15B -

**Type / Model Name** : Vehicle Tag / KNX-T3.6

**Product Description** : Tracking System for intra-logistics vehicles

**Applicant** : Kinexon Inc.

**Address** : 25 Broadway Floor 9

NEW YORK, NY 10004, USA

**Manufacturer** : Kinexon GmbH

**Address** : Schellingstraße 35

80799 MÜNCHEN, GERMANY

**Test Result** according to the standards  
listed in clause 1 test standards:

**POSITIVE**

**Test Report No. :** T46318-00-04FX

22. September 2021

Date of issue



Deutsche  
Akkreditierungsstelle  
D-PL-12030-01-03  
D-PL-12030-01-04

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# 1 TEST STANDARDS

The tests were performed according to following standards:

## **FCC Rules and Regulations Part 15 Subpart B - Unintentional Radiators (September 2019)**

Part 15, Subpart B, Section 15.107

AC Line conducted emission

☐ Class A device

☒ Class B device

Part 15, Subpart B, Section 15.109

Radiated emission, general requirements

☐ Class A device

☒ Class B device

ANSI C63.4: 2014

Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

CISPR 16-4-2: 2011 + A1: 2014  
EN 55016-4-2: 2011

Uncertainty in EMC measurement

## **ISED Canada Rules and Regulations - Information Technology Equipment (Including Digital Apparatus)**

ICES-003, Issue 7, October 15, 2020

AC Power Line Conducted Emissions

☐ Class A device

☒ Class B device

ICES-003, Issue 7, October 15, 2020

Radiated emission

☐ Class A device

☒ Class B device

ANSI C63.4: 2014

Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

## 2 SUMMARY

### 2.1 General remarks

### 2.2 Summary for all EMC tests

| FCC Rule Part | ISED Standard    | Description                       |
|---------------|------------------|-----------------------------------|
| 15.107        | ICES-003/RSS-Gen | AC power line conducted emissions |
| 15.109        | ICES-003/RSS-Gen | Radiated Emissions                |

| Type of test                                      | Test result |
|---------------------------------------------------|-------------|
| Emission:                                         |             |
| A4 Conducted emission (AC mains power / DC power) | passed      |
| A5 Radiated emission (< 1 GHz)                    | passed      |
| SER 3 Radiated emission (> 1 GHz)                 | passed      |

### 2.3 Final assessment

The equipment under test fulfills the requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 01 April 2020

Testing concluded on : 15 May 2020

Checked by:

Tested by:

\_\_\_\_\_  
Klaus Gegenfurtner  
Teamleader Radio

\_\_\_\_\_  
Franz-Xaver Schrettenbrunner  
Radio Team

### **3 EQUIPMENT UNDER TEST**

#### **3.1 Information provided by the Client**

Please note, we do not take any responsibility for information provided by the client or his representative which may have an influence on the validity of the test results.

#### **3.2 Sampling**

The customer is responsible for the choice of sample. Sample configuration, start-up and operation is carried out by the customer or according to his/her instructions.

#### **3.3 Photo documentation of the EUT – Detailed photos see ATTACHMENT A**

#### **3.4 Power supply system utilised**

Power supply voltage : 9 – 30 V DC  
Test voltage : 24 V DC

All tests were carried out with a supply voltage of 120 V, 60 Hz unless otherwise stated.

#### **3.5 Highest internal frequency**

Highest internal frequency : 6489.6 MHz

#### **3.6 Short description of the Equipment under Test (EUT)**

The technology is an UWB Real Time Location System (RTLS) which is used in an indoor industrial environment. The tag is installed on forklifts, trolleys, cranes or other industrial vehicular devices. The EUT communicates with further devices in order to obtain information on the tag position. The equipped vehicles can be globally localized in a factory wide coordinate system.

Number of tested samples: 1  
Serial number: 60815  
UWB driver version: 4.27.0

#### **3.7 EUT operation mode**

The equipment under test was operated during the measurement under the following conditions:

- Operation mode 1: stand-by mode, waiting for UWB signal

---

### 3.8 EUT configuration

(The CDF filled by the applicant can be viewed at the test laboratory.)

The following peripheral devices and interface cables were connected during the measurements:

|             |               |                  |                     |               |               |
|-------------|---------------|------------------|---------------------|---------------|---------------|
| - ---       |               |                  | Model : ---         |               |               |
| <b>Port</b> | <b>Cable</b>  | <b>Screening</b> | <b>Transmission</b> | <b>Status</b> | <b>Length</b> |
| 1           | DC power line | unshielded       | analogue            | active        | 2.0 m         |

**Modifications during the EMC test:** **None**

## **4 TEST ENVIRONMENT**

### **4.1 Address of the test laboratory**

**CSA Group Bayern GmbH  
Ohmstrasse 1-4  
94342 STRASSKIRCHEN  
GERMANY**

### **4.2 Environmental conditions**

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15 - 35 °C

Humidity: 30 - 60 %

Atmospheric pressure: 86 - 106 kPa

### **4.3 Statement of the measurement uncertainty**

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor  $k = 2$ . The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 2011 + A1 / 2014 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

### **4.4 Conformity Decision Rule**

The conformity decision rule is based on the ILAC G8 published at the time of reporting.

### **4.5 Measurement protocol for FCC and ISED**

#### **4.5.1 General information**

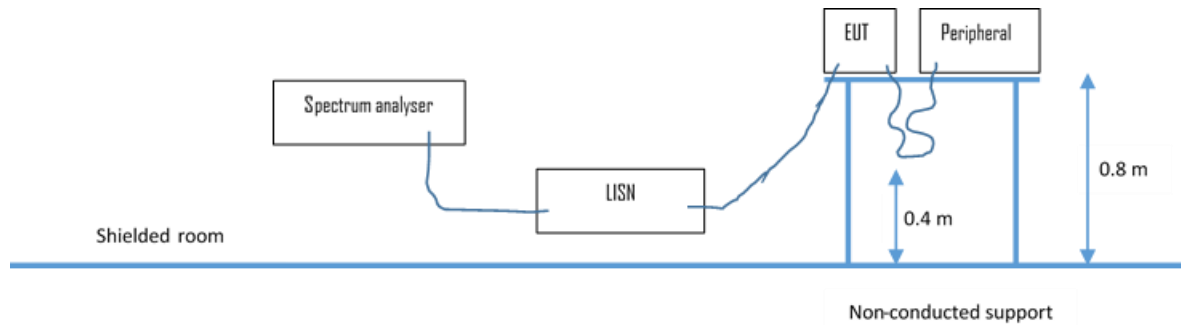
CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

**FCC: DE 0011  
ISED: DE0009**

## 4.5.2 Details of test procedures

### 4.5.2.1 Conducted emission

Test setup according ANSI C63.4



### Description of measurement

The final level, expressed in dB $\mu$ V, is arrived at by taking the reading directly from the Spectrum analyser. This level is compared to the limit.

To convert between dB $\mu$ V and  $\mu$ V, the following conversions apply:

$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

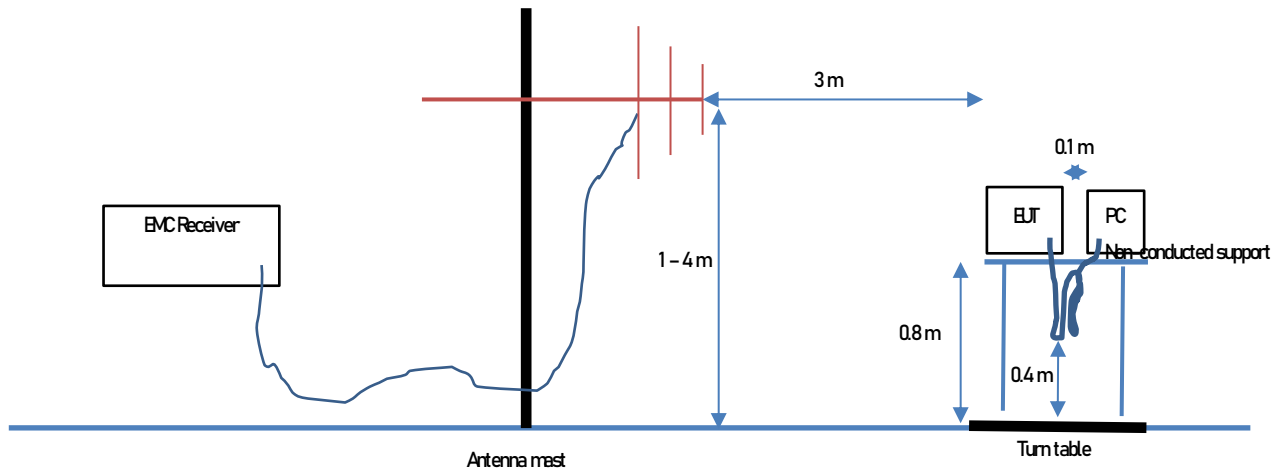
Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50  $\Omega$  / 50  $\mu$ H (CISPR 16) characteristics. The receiver is protected by means of an impedance matched pulse limiter connected directly to the RF input. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emission is re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.



## 4.5.2.2 Radiated emission

### 4.5.2.2.1 OATS1 test site (30 MHz - 1 GHz)

Test setup according ANSI C63.4



### Description of measurement

Spurious emission from the EUT is measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 metre non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is established in accordance with ANSI C63.4. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area.

The antenna is positioned 3 or 10 metres horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres, measurement scans are made with both horizontal and vertical antenna polarization planes and the EUT is rotated 360 degrees.

The final level is calculated in a calculation sheet by taking the reading from the EMI receiver (Level dBμV) and adding the correction factors and cable loss factor (Factor dB) on to it. The limit is subtracted from this result in order to provide the limit margin listed in the measurement protocols.

Example:

| Frequency<br>(MHz) | Reading<br>(dBμV) | + | Correction*<br>(dB/m) | = | Level<br>(dBμV/m) | - | Limit<br>(dBμV/m) | = | Dlimit<br>(dB) |
|--------------------|-------------------|---|-----------------------|---|-------------------|---|-------------------|---|----------------|
| 719.0              | 75.0              | + | 32.6                  | = | 107.6             | - | 110.0             | = | -2.4           |

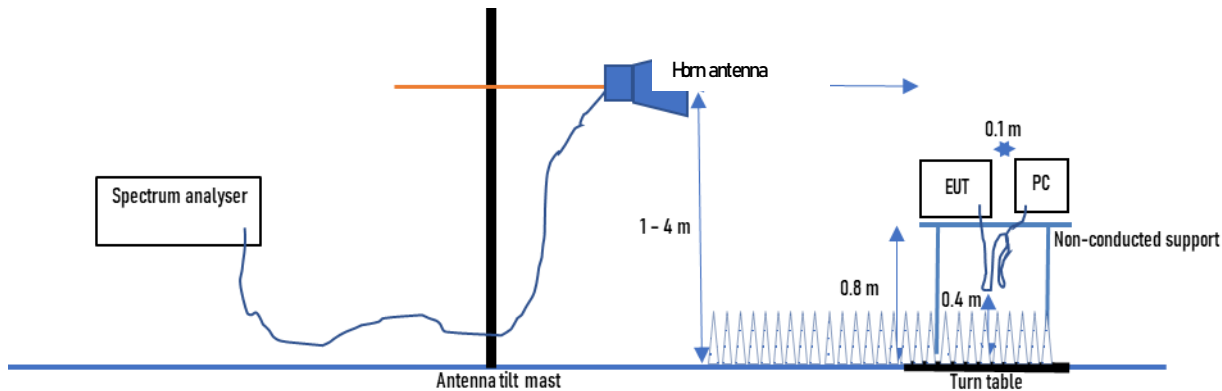
\*Correction Factor = Antenna Factor + Cable Attenuation = 30 dB/m + 2.6 dB = 32.6 dB/m

The resolution bandwidth during the measurement is as follows:

30 MHz – 1000 MHz: RBW: 120 kHz

#### 4.5.2.2.2 Anechoic chamber 1, 1000 MHz – 18000 MHz

Test setup according ANSI C63.4



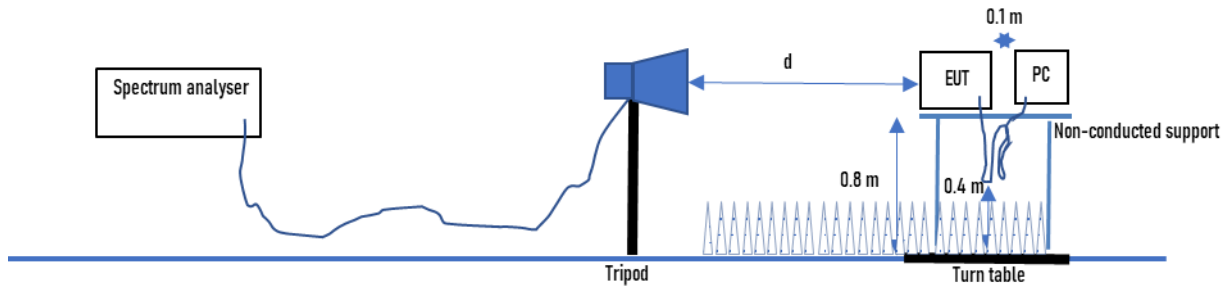
#### Description of measurement

Radiated emission from the EUT are measured in the frequency range of 1 GHz to the maximum frequency as specified in 47 CFR Part 15 Subpart A section 15.33, using a tuned receiver (spectrum analyser) and appropriate linearly polarized antennas. Table top equipment is placed on a 0.65 X 1.0 metre non-conducting table 80 centimetres above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12).

The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion, so they are at least 40 centimetres from the ground plane. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyser set to a peak detector function and a RBW= 1 MHz and VBW = 3 MHz. All tests are performed at a test distance of 3 metres. Hand-held or body-worn devices are rotated around three orthogonal axes in order to determine the position, angle and configuration having the maximum emission. The antenna height is then adjusted from 1 m to 4 m maximizing the measured value. The antenna is mounted to a boresight axis, so the antenna centre always points to the EUT. The turntable is rotated 360° until the spectrum analyser displays the maximum level at the observed frequency. The antenna height is then adjusted from 1 m to 4 m maximizing the measured value. The turntable is re-adjusted to re-affirm the maximum emission value which is then recorded. This procedure is repeated for all frequencies of interest.

#### 4.5.2.2.3 Anechoic chamber 1, 18 GHz – 40 GHz

Test setup according ANSI C63.4



#### Description of measurement

Radiated emission from the EUT are measured in the frequency range of 1 GHz to the maximum frequency as specified in 47 CFR Part 15 Subpart A section 15.33, using a tuned receiver (spectrum analyser) and appropriate linearly polarized antennas. Table top equipment is placed on a 0.65 X 1.0 metre non-conducting table 80 centimetres above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12).

The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion, so they are at least 40 centimetres from the ground plane. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyser set to a peak detector function and an RBW= 1 MHz and VBW = 3 MHz. All tests are performed at a test distance of 3 metres. Hand-held or body-worn devices are rotated around three orthogonal axes in order to determine the position, angle and configuration having the maximum emission. The turntable is rotated 360° until the spectrum analyser displays the maximum level at the observed frequency, the maximum emission value is then recorded. This procedure is repeated for all frequencies of interest.

Where appropriate in frequency range 18 GHz - 40 GHz, the test distance may be reduced to 1 m in order to reduce the noise level to hold a minimum distance between noise level and limit. The limit will be adopted to the measurement distance.

## 5 TEST CONDITIONS AND RESULTS

### 5.1 Conducted emission

For test instruments and accessories used see section 6 Part A 4.

#### 5.1.1 Description of the test location

Test location:                      Shielded Room S2

#### 5.1.2 Photo documentation of the test setup



#### 5.1.3 Test result

Frequency range:                      0.15 MHz - 30 MHz  
Min. limit margin                      - 18.5 dB at 20.001 MHz

The requirements are **FULFILLED**.

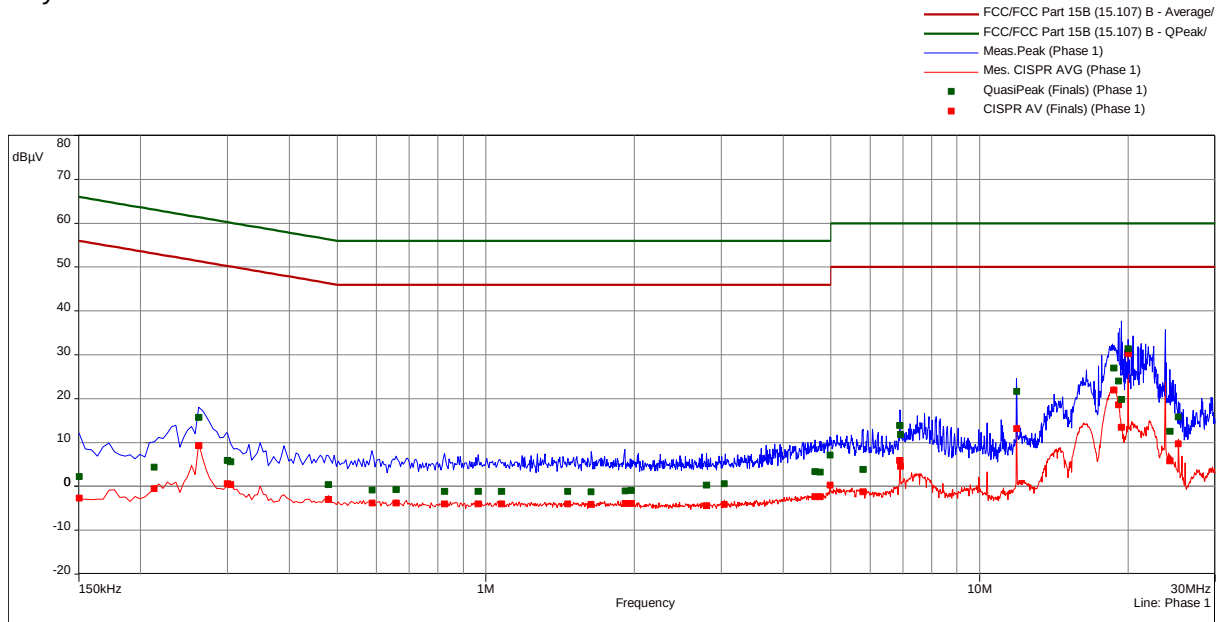
**Remarks:**                      For detailed results, please see the following page(s).

For description of the measurement see 4.5.2.

## 5.1.4 Test protocol

Test point: L1  
 Operation mode: Operation mode 1  
 Remarks: None.  
 Date: 12-05-2020  
 Tested by: Franz-Xaver Schrettenbrunner

Result: passed



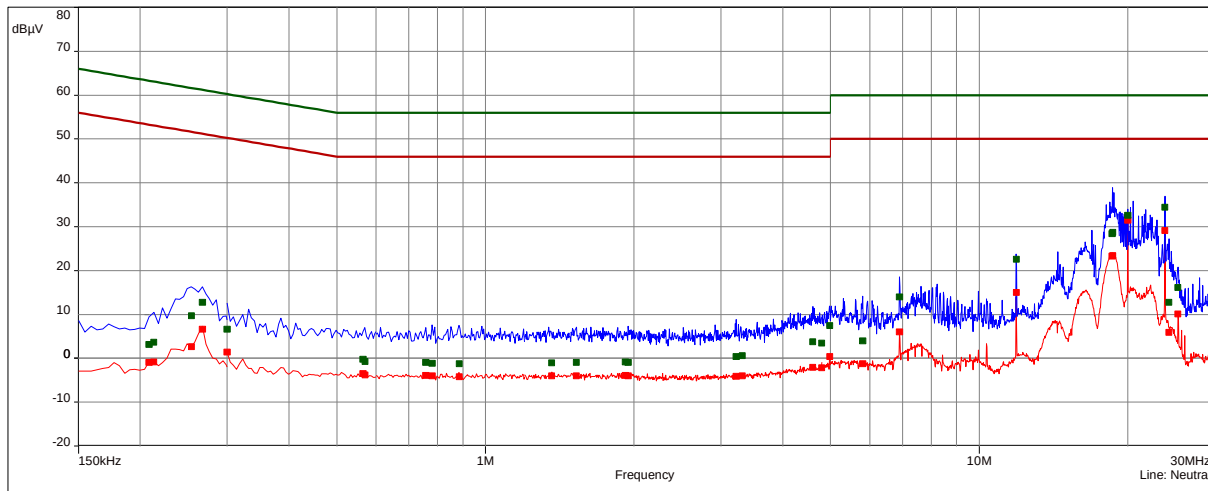
FCC/FCC Part 15B (15.107)B

| freq<br>MHz | QP<br>dB(μV) | margin<br>dB | limit<br>dB | AV<br>dB(μV) | margin<br>dB | limit<br>dB | corr<br>dB |
|-------------|--------------|--------------|-------------|--------------|--------------|-------------|------------|
| 0.150       | 2.33         | -63.67       | 66.00       | -2.58        | -58.58       | 56.00       | 10.09      |
| 0.213       | 4.42         | -58.67       | 63.09       | -0.48        | -53.56       | 53.09       | 10.11      |
| 0.263       | 15.78        | -45.57       | 61.35       | 9.40         | -41.95       | 51.35       | 10.13      |
| 0.300       | 5.97         | -54.27       | 60.24       | 0.64         | -49.60       | 50.24       | 10.14      |
| 0.305       | 5.66         | -54.46       | 60.12       | 0.44         | -49.68       | 50.12       | 10.14      |
| 0.480       | 0.48         | -55.86       | 56.34       | -2.89        | -49.23       | 46.34       | 10.16      |
| 0.588       | -0.73        | -56.73       | 56.00       | -3.77        | -49.77       | 46.00       | 10.17      |
| 0.659       | -0.63        | -56.63       | 56.00       | -3.75        | -49.75       | 46.00       | 10.18      |
| 0.825       | -1.04        | -57.04       | 56.00       | -3.97        | -49.97       | 46.00       | 10.19      |
| 0.965       | -1.03        | -57.03       | 56.00       | -3.92        | -49.92       | 46.00       | 10.20      |
| 1.077       | -1.10        | -57.10       | 56.00       | -3.95        | -49.95       | 46.00       | 10.21      |
| 1.466       | -1.06        | -57.06       | 56.00       | -3.93        | -49.93       | 46.00       | 10.26      |
| 1.637       | -1.13        | -57.13       | 56.00       | -4.02        | -50.02       | 46.00       | 10.27      |
| 1.911       | -0.96        | -56.96       | 56.00       | -3.83        | -49.83       | 46.00       | 10.27      |
| 1.970       | -0.88        | -56.88       | 56.00       | -3.87        | -49.87       | 46.00       | 10.27      |
| 2.801       | 0.31         | -55.69       | 56.00       | -4.36        | -50.36       | 46.00       | 10.34      |
| 3.044       | 0.71         | -55.29       | 56.00       | -4.02        | -50.02       | 46.00       | 10.35      |
| 4.641       | 3.47         | -52.53       | 56.00       | -2.28        | -48.28       | 46.00       | 10.43      |
| 4.754       | 3.34         | -52.66       | 56.00       | -2.35        | -48.35       | 46.00       | 10.43      |
| 4.980       | 7.16         | -48.84       | 56.00       | 0.31         | -45.69       | 46.00       | 10.44      |
| 5.813       | 3.89         | -56.11       | 60.00       | -1.21        | -51.21       | 50.00       | 10.51      |
| 6.902       | 13.97        | -46.03       | 60.00       | 6.02         | -43.98       | 50.00       | 10.60      |
| 6.906       | 11.91        | -48.09       | 60.00       | 4.68         | -45.32       | 50.00       | 10.60      |
| 11.886      | 21.77        | -38.23       | 60.00       | 13.26        | -36.74       | 50.00       | 10.93      |
| 18.695      | 27.07        | -32.93       | 60.00       | 22.07        | -27.93       | 50.00       | 11.40      |
| 19.086      | 24.09        | -35.91       | 60.00       | 18.63        | -31.37       | 50.00       | 11.42      |
| 19.390      | 19.92        | -40.08       | 60.00       | 13.55        | -36.45       | 50.00       | 11.44      |
| 20.001      | 31.45        | -28.55       | 60.00       | 30.33        | -19.67       | 50.00       | 11.46      |
| 24.290      | 12.58        | -47.42       | 60.00       | 5.86         | -44.14       | 50.00       | 11.65      |
| 25.293      | 15.94        | -44.06       | 60.00       | 9.80         | -40.20       | 50.00       | 11.68      |

Test point: N  
Operation mode: Operation mode 1  
Remarks: None.  
Date: 12-05-2020  
Tested by: Franz-Xaver Schrettenbrunner

Result: passed

— FCC/FCC Part 15B (15.107) B - Average/  
— FCC/FCC Part 15B (15.107) B - QPeak/  
— Meas.Peak (Neutral)  
— Mes. CISPR AVG (Neutral)  
■ QuasiPeak (Finals) (Neutral)  
■ CISPR AV (Finals) (Neutral)



FCC/FCC Part 15B (15.107)B

| freq<br>MHz | QP<br>dB(μV) | margin<br>dB | limit<br>dB | AV<br>dB(μV) | margin<br>dB | limit<br>dB | corr<br>dB |
|-------------|--------------|--------------|-------------|--------------|--------------|-------------|------------|
| 0.209       | 3.23         | -60.04       | 63.26       | -0.85        | -54.11       | 53.26       | 10.13      |
| 0.213       | 3.78         | -59.31       | 63.09       | -0.75        | -53.84       | 53.09       | 10.13      |
| 0.254       | 9.78         | -51.86       | 61.64       | 2.69         | -48.95       | 51.64       | 10.13      |
| 0.267       | 12.87        | -48.35       | 61.21       | 6.74         | -44.47       | 51.21       | 10.13      |
| 0.300       | 6.66         | -53.58       | 60.24       | 1.52         | -48.73       | 50.24       | 10.14      |
| 0.566       | -0.18        | -56.18       | 56.00       | -3.42        | -49.42       | 46.00       | 10.17      |
| 0.570       | -0.65        | -56.65       | 56.00       | -3.69        | -49.69       | 46.00       | 10.17      |
| 0.758       | -0.87        | -56.87       | 56.00       | -3.85        | -49.85       | 46.00       | 10.19      |
| 0.780       | -1.12        | -57.12       | 56.00       | -3.96        | -49.96       | 46.00       | 10.19      |
| 0.884       | -1.21        | -57.21       | 56.00       | -4.12        | -50.12       | 46.00       | 10.20      |
| 1.362       | -0.98        | -56.98       | 56.00       | -3.95        | -49.95       | 46.00       | 10.25      |
| 1.529       | -0.88        | -56.88       | 56.00       | -3.91        | -49.91       | 46.00       | 10.27      |
| 1.920       | -0.79        | -56.79       | 56.00       | -3.79        | -49.79       | 46.00       | 10.27      |
| 1.947       | -0.88        | -56.88       | 56.00       | -3.91        | -49.91       | 46.00       | 10.27      |
| 3.219       | 0.43         | -55.57       | 56.00       | -4.09        | -50.09       | 46.00       | 10.35      |
| 3.309       | 0.66         | -55.34       | 56.00       | -3.99        | -49.99       | 46.00       | 10.35      |
| 4.601       | 3.88         | -52.12       | 56.00       | -2.00        | -48.00       | 46.00       | 10.42      |
| 4.800       | 3.50         | -52.50       | 56.00       | -2.11        | -48.11       | 46.00       | 10.42      |
| 4.980       | 7.49         | -48.51       | 56.00       | 0.49         | -45.51       | 46.00       | 10.44      |
| 5.804       | 4.00         | -56.00       | 60.00       | -1.15        | -51.15       | 50.00       | 10.49      |
| 6.902       | 14.06        | -45.94       | 60.00       | 6.09         | -43.91       | 50.00       | 10.57      |
| 11.886      | 22.67        | -37.33       | 60.00       | 15.06        | -34.94       | 50.00       | 10.81      |
| 18.569      | 28.52        | -31.48       | 60.00       | 23.33        | -26.67       | 50.00       | 11.19      |
| 18.636      | 28.76        | -31.24       | 60.00       | 23.47        | -26.53       | 50.00       | 11.20      |
| 20.001      | 32.65        | -27.35       | 60.00       | 31.54        | -18.46       | 50.00       | 11.25      |
| 23.768      | 34.50        | -25.50       | 60.00       | 29.19        | -20.81       | 50.00       | 11.26      |
| 24.231      | 12.86        | -47.14       | 60.00       | 5.98         | -44.02       | 50.00       | 11.26      |
| 25.298      | 16.19        | -43.81       | 60.00       | 10.13        | -39.87       | 50.00       | 11.24      |



## 5.2 Radiated emission < 1 GHz (electric field)

For test instruments and accessories used see section 6 Part A 5.

### 5.2.1 Description of the test location

Test location: OATS 1  
Test distance: 3 m

### 5.2.2 Photo documentation of the test setup



### 5.2.3 Test result

Frequency range: 30 MHz - 1000 MHz  
Min. limit margin - 2.5 dB at 742.49 MHz

The requirements are **FULFILLED**.

**Remarks:** For detailed results, please see the following page(s).

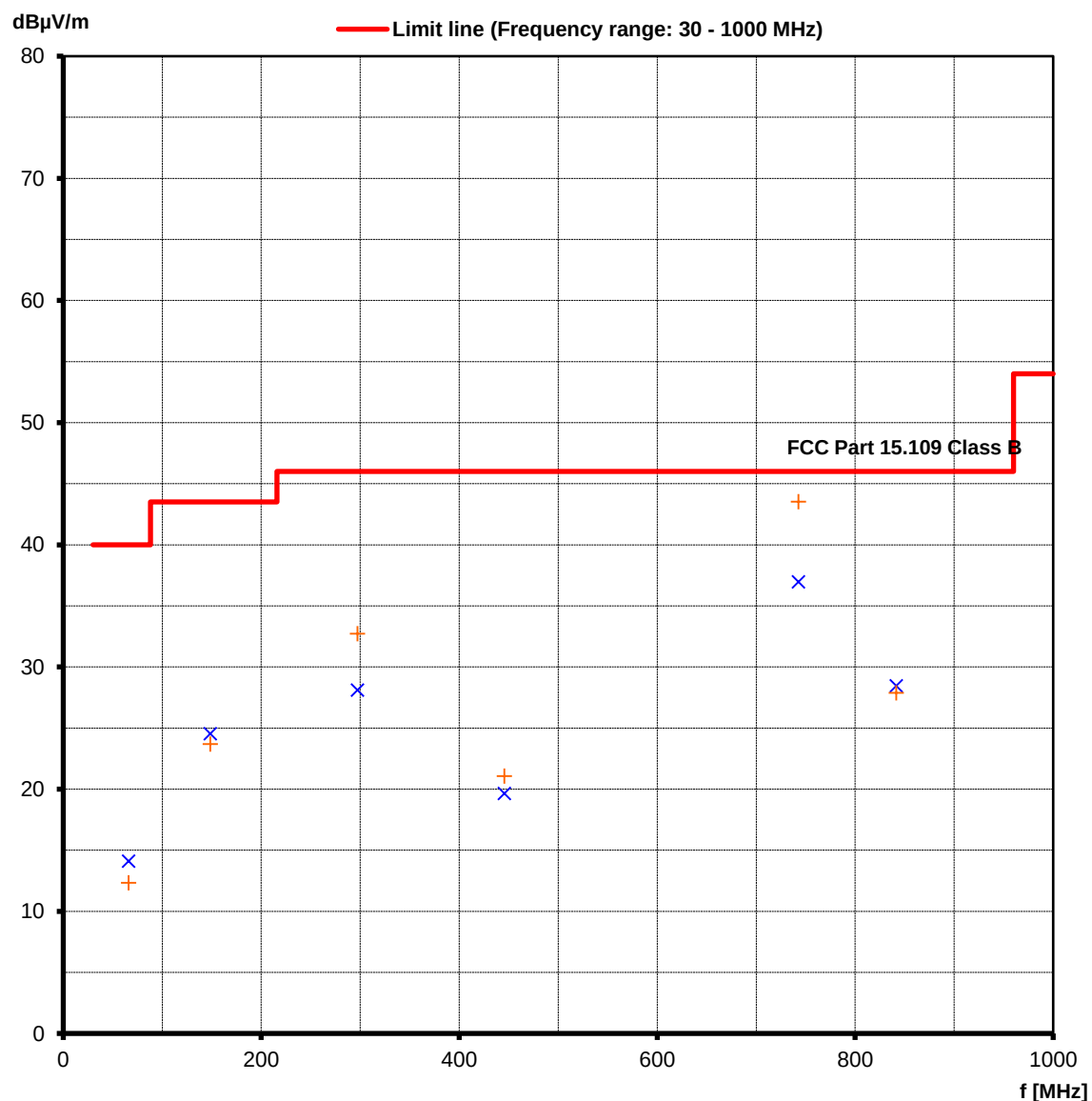
For description of the measurement see 4.5.2.

## 5.2.4 Test protocol

Operation mode: Operation mode 1  
 Remarks: None  
 Date: 03.04.2020  
 Tested by: Franz-Xaver Schrettenbrunner

Result: passed

| Frequency (MHz) | Reading Vert. (dBµV) | Reading Hor. (dBµV) | Correct. Vert. (dB) | Correct. Hor. (dB) | Level Vert. (dBµV/m) | Level Hor. (dBµV/m) | Limit (dBµV/m) | Dlimit (dB) |
|-----------------|----------------------|---------------------|---------------------|--------------------|----------------------|---------------------|----------------|-------------|
| 65,89           | -0,2                 | -1,2                | 14,3                | 13,5               | 14,1                 | 12,3                | 40,0           | -25,9       |
| 148,50          | 10,7                 | 9,0                 | 13,9                | 14,7               | 24,6                 | 23,7                | 43,5           | -18,9       |
| 297,04          | 11,4                 | 16,4                | 16,7                | 16,3               | 28,1                 | 32,7                | 46,0           | -13,3       |
| 445,55          | -1,4                 | 0,3                 | 21,1                | 20,8               | 19,7                 | 21,1                | 46,0           | -24,9       |
| 742,49          | 8,9                  | 16,0                | 28,1                | 27,5               | 37,0                 | 43,5                | 46,0           | -2,5        |
| 841,41          | -1,7                 | -1,8                | 30,2                | 29,7               | 28,5                 | 27,9                | 46,0           | -17,5       |





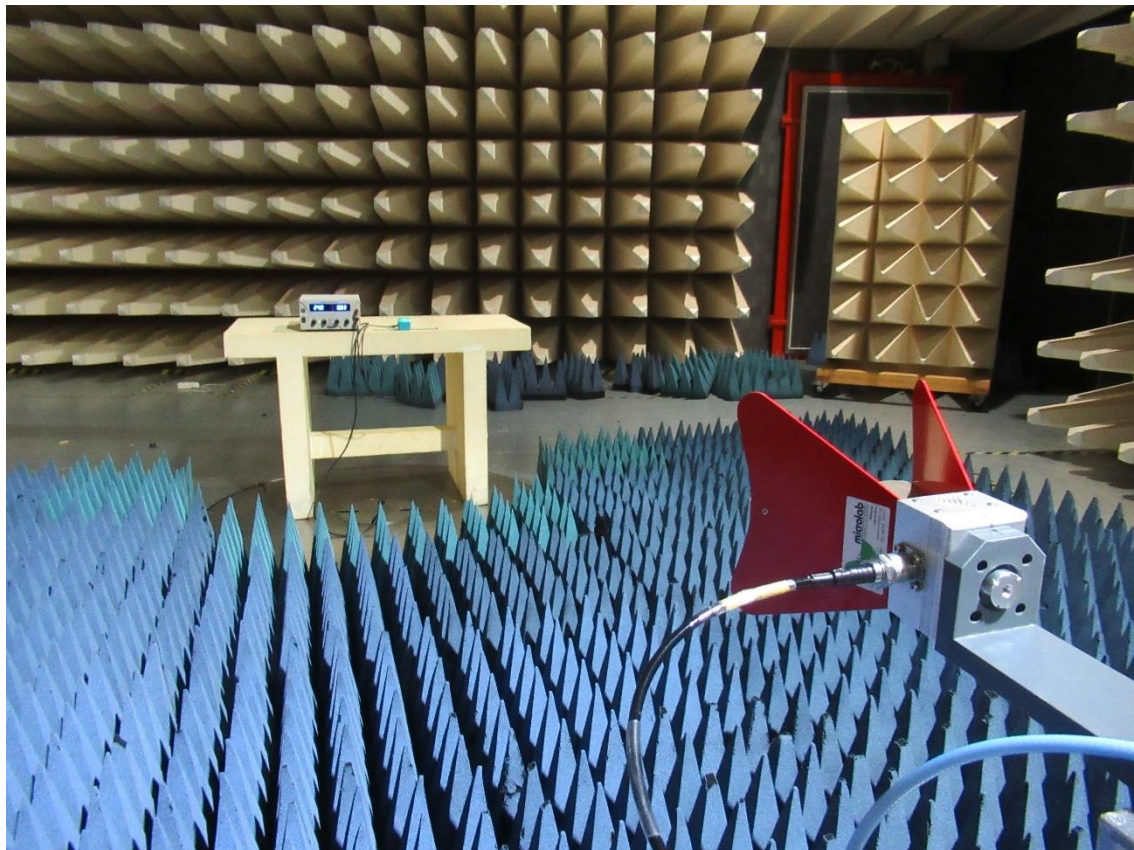
### 5.3 Radiated emission > 1 GHz (electric field)

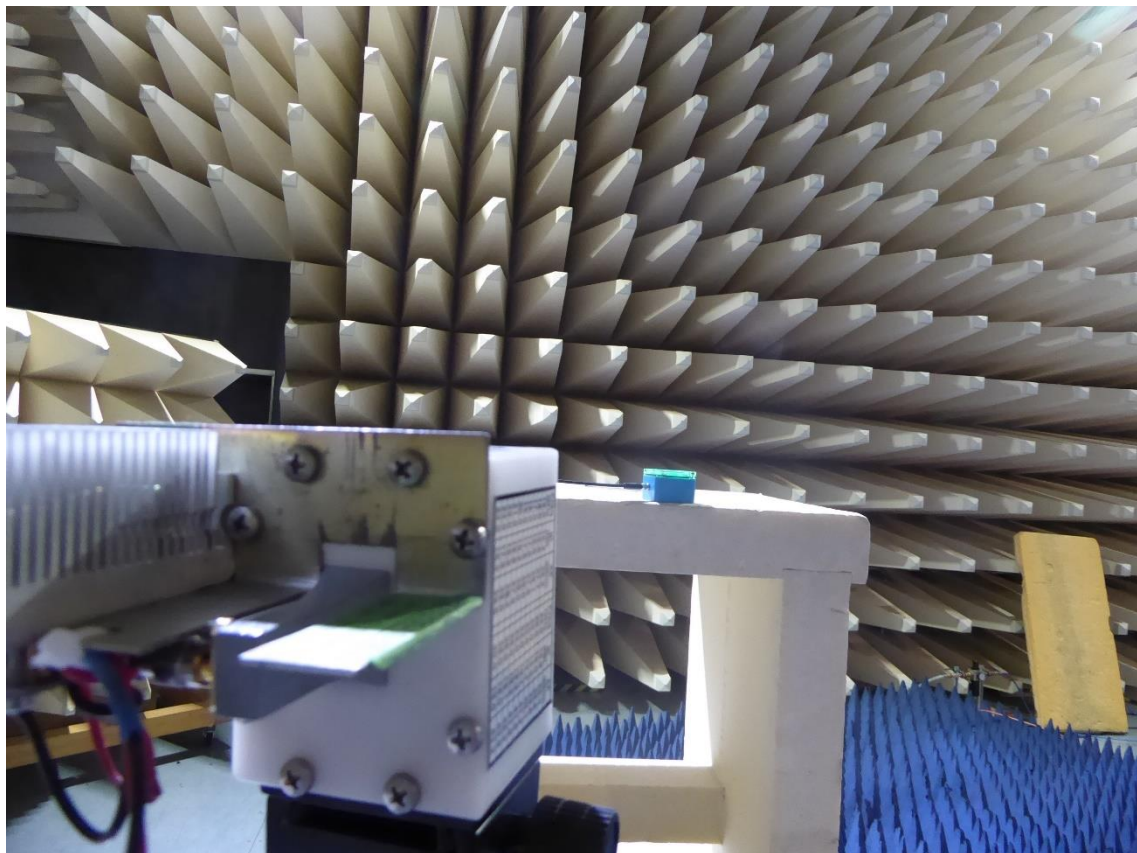
For test instruments and accessories used see section 6 Part SER 3.

#### 5.3.1 Description of the test location

Test location: Anechoic chamber 1  
Test distance: 3 m

#### 5.3.2 Photo documentation of the test setup





The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

### 5.3.3 Test result

Frequency range: 1000 MHz – 40000 MHz

The requirements are **FULFILLED**.

**Remarks:** For detailed results, please see the following page(s).

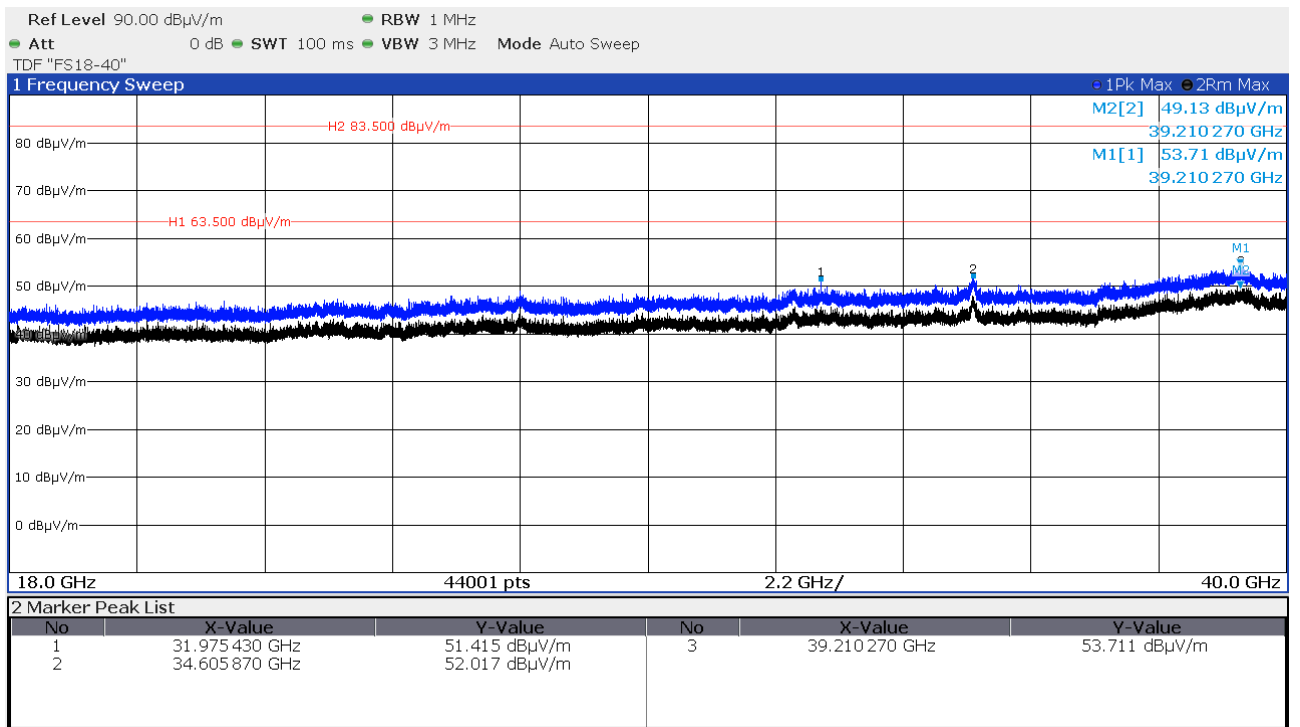
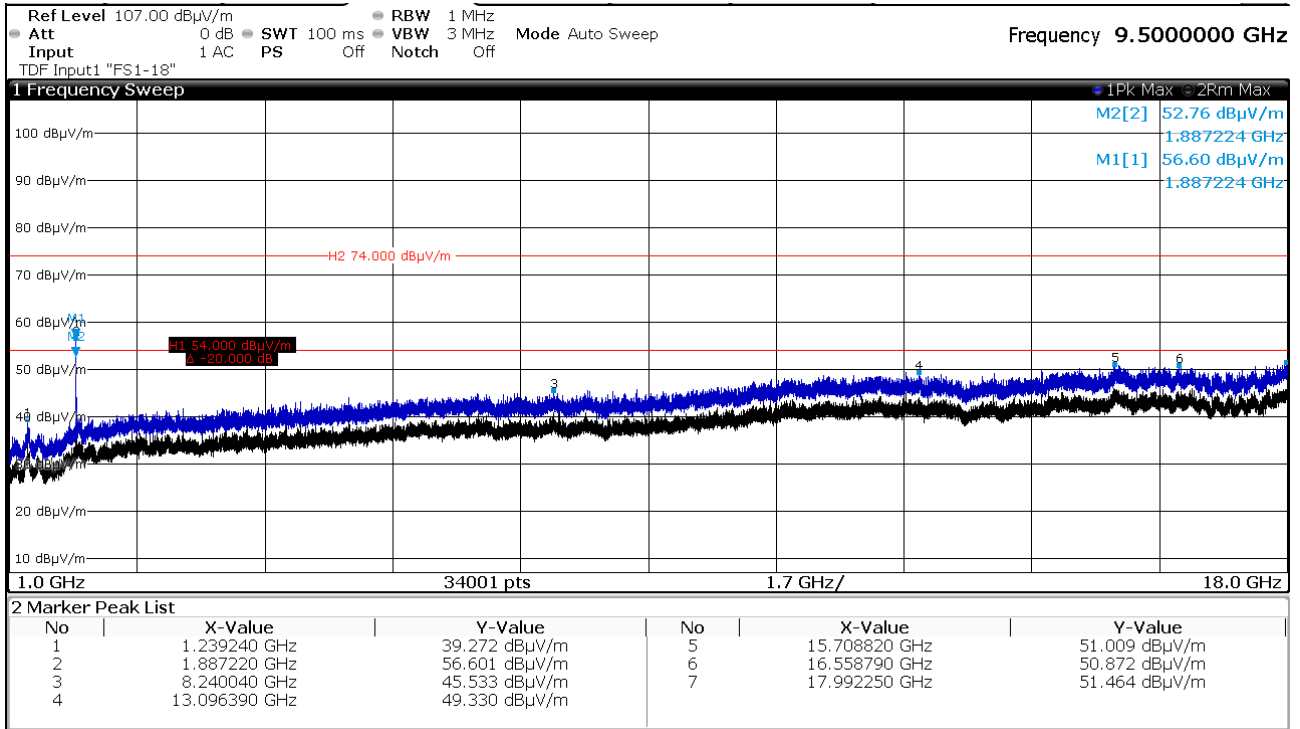
For description of the measurement see 4.5.2.

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

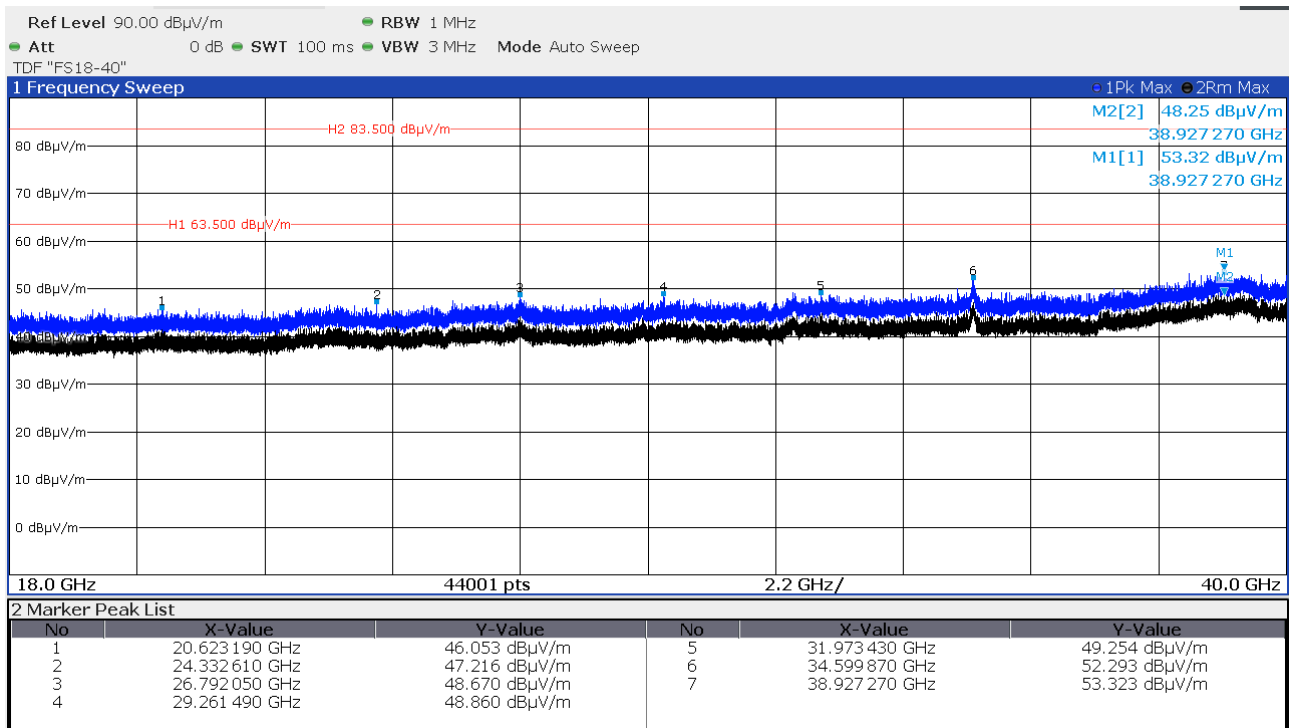
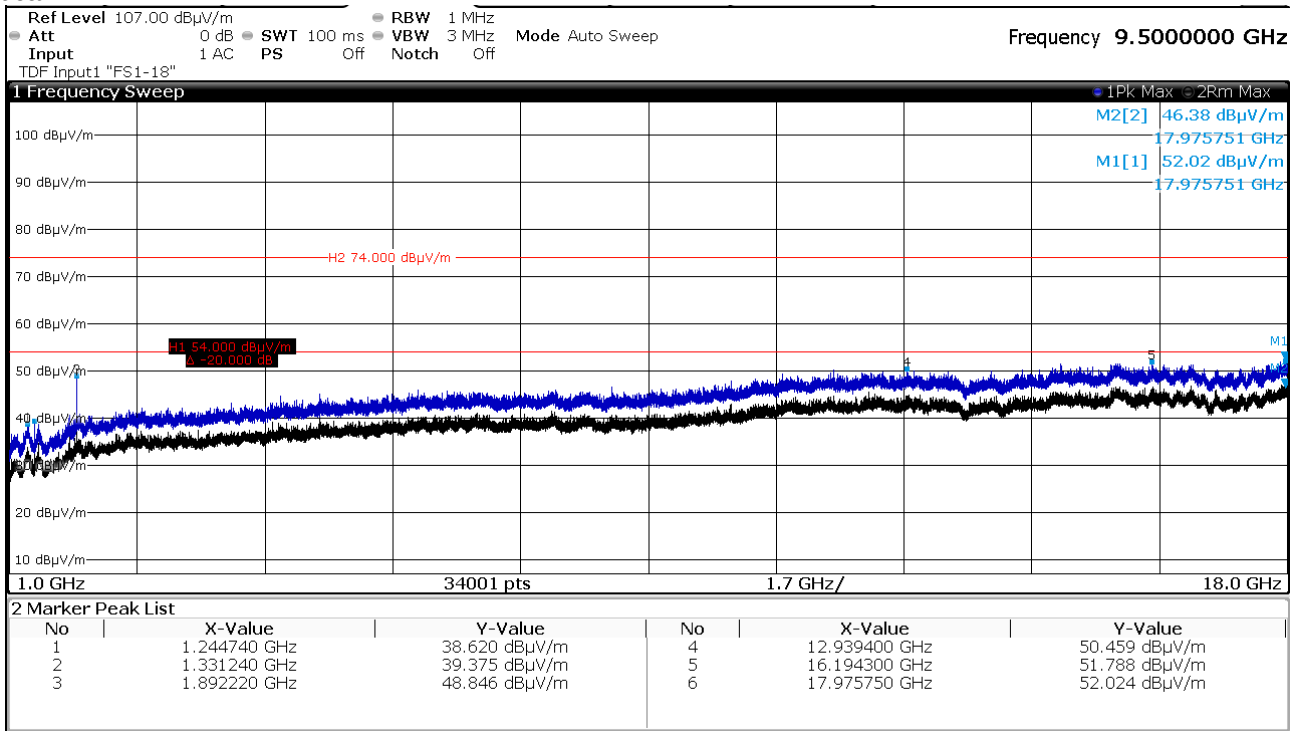


## 5.3.4 Test protocol

horizontal



vertical



## 6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used, in addition to the test accessories, are calibrated and verified regularly.

| Test ID | Model Type             | Kind of Equipment        | Manufacturer                  | Equipment No.   | Next Calib. | Last Calib. | Next Verif. |
|---------|------------------------|--------------------------|-------------------------------|-----------------|-------------|-------------|-------------|
| A 4     | BAT-EMC 3.18.0.26      | Nexio Software           | EMCO Elektronik GmbH          | 01-02/68-13-001 |             |             |             |
|         | ESCI                   | EMI Test Receiver        | Rohde & Schwarz München       | 02-02/03-15-001 | 02/07/2020  | 02/07/2019  |             |
|         | ESH 2 - Z 5            | LISN                     | Rohde & Schwarz München       | 02-02/20-05-004 | 31/10/2021  | 31/10/2019  | 04/11/2020  |
|         | 04/05/2020             |                          |                               |                 |             |             |             |
|         | N-4000-BNC             | RF Cable                 | CSA Group Bayern GmbH         | 02-02/50-05-138 |             |             |             |
|         | N-1500-N               | RF Cable                 | CSA Group Bayern GmbH         | 02-02/50-05-140 |             |             |             |
| A 5     | ESH 3 - Z 2            | Pulse Limiter            | Rohde & Schwarz München       | 02-02/50-05-155 | 13/11/2022  | 13/11/2019  | 12/11/2020  |
|         | 12/05/2020             |                          |                               |                 |             |             |             |
|         | ESVS 30                | EMI Test Receiver        | Rohde & Schwarz München       | 02-02/03-05-006 | 19/08/2020  | 19/08/2019  |             |
|         | VULB 9168              | Trilog Broadband Antenn  | Schwarzbeck Mess-Elektron     | 02-02/24-05-005 | 19/07/2020  | 19/07/2019  |             |
|         | NW-2000-NB             | RF Cable                 | Huber + Suhner                | 02-02/50-05-113 |             |             |             |
|         | KK-EF393/U-16N-21N20 m | RF Cable 20m             | Huber + Suhner                | 02-02/50-12-018 |             |             |             |
| SER 3   | KK-SD_7/8-2X21N-33,0M  | RF Cable 33 m            | Huber + Suhner AG             | 02-02/50-15-028 |             |             |             |
|         | ESW26                  | EMI Test Receiver        | Rohde & Schwarz München       | 02-02/03-17-002 | 16/01/2021  | 16/01/2020  |             |
|         | FSP 40                 | Spectrum Analyser        | Rohde & Schwarz München       | 02-02/11-11-001 | 07/10/2020  | 07/10/2019  |             |
|         | FSW43                  | Spectrum Analyser        | Rohde & Schwarz München       | 02-02/11-15-001 | 02/04/2021  | 02/04/2020  |             |
|         | AFS5-12001800-18-10P-6 | RF Amplifier 12 - 18 GHz | PARZICH GMBH                  | 02-02/17-06-002 |             |             |             |
|         | AFS4-01000400-10-10P-4 | RF Amplifier 1 - 4 GHz   | MITEQ, Inc.                   | 02-02/17-13-002 |             |             |             |
|         | AMF-4F-04001200-15-10P | RF Amplifier 4 - 12 GHz  | MITEQ, Inc.                   | 02-02/17-13-003 |             |             |             |
|         | 3117                   | Horn Antenna 1 - 18 GH   | EMCO Elektronik GmbH          | 02-02/24-05-009 | 06/06/2020  | 06/06/2019  |             |
|         | BBHA 9170              | SHF-EHF Horn Antenna     | Schwarzbeck Mess-Elektron     | 02-02/24-05-014 | 12/06/2021  | 12/06/2018  | 14/01/2021  |
|         | 14/01/2020             |                          |                               |                 |             |             |             |
|         | Sucoflex N-2000-SMA    | RF Cable                 | novotronik Signalverarbeitung | 02-02/50-05-075 |             |             |             |
|         | KMS102-0.2 m           | RF Cable                 | Tactron Elektronik            | 02-02/50-11-020 |             |             |             |

## 7 Detailed measurement uncertainty

### 7.1 Overview

Measurement instrumentation uncertainty shall be taken into account when determining compliance or non-compliance with a disturbance limit.

The measurement instrumentation uncertainty for a test laboratory shall be evaluated. The standard uncertainty  $u(x_i)$  in decibels and the sensitivity coefficient  $c_i$  shall be evaluated for the estimate  $x_i$  of each quantity. The combined standard uncertainty  $u_c(y)$  of the estimate  $y$  of the measurand shall be calculated as

$$u_c(y) = \sqrt{\sum_i c_i^2 u^2(x_i)}$$

The expanded measurement instrumentation uncertainty  $U_{lab}$  for a test laboratory shall be calculated as  $U_{lab} = 2 u_c(y)$

$$U_{lab} = 2 u_c(y)$$

Compliance or non-compliance with a disturbance limit shall be determined in the following manner:

If  $U_{lab}$  is less than or equal to  $U_{cispr}$  in the table below, then:

- compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

If  $U_{lab}$  is greater than  $U_{cispr}$  in the table below, then:

- compliance is deemed to occur if no measured disturbance, increased by  $(U_{lab} - U_{cispr})$ , exceeds the disturbance limit.
- non-compliance is deemed to occur if any measured disturbance, increased by  $(U_{lab} - U_{cispr})$ , exceeds the disturbance limit.

### 7.2 Definitions and symbols

|          |                                                                                                                      |
|----------|----------------------------------------------------------------------------------------------------------------------|
| $X_i$    | Input quantity                                                                                                       |
| $x_i$    | estimate of $X_i$                                                                                                    |
| $u(x_i)$ | standard uncertainty of $x_i$                                                                                        |
| $c_i$    | sensitivity coefficient                                                                                              |
| $u_c(y)$ | (combined) standard uncertainty of $y$                                                                               |
| $Y$      | result of a measurement, (the estimate of the measured), corrected for all recognised significant systematic effects |
| $U$      | expanded uncertainty of $y$                                                                                          |

### 7.3 Measurement uncertainty

| Measurement                                  | $U_{lab}$ [dB]  |
|----------------------------------------------|-----------------|
| <b>Conducted disturbance</b>                 | + 2.53 / - 2.77 |
| <b>Radiated disturbance (electric field)</b> |                 |
| - 10 m test distance                         | + 3.16 / - 3.22 |
| - 3 m test distance                          | + 3.16 / - 3.22 |
| - Frequency range: 30 MHz – 200 MHz          |                 |
| <b>Radiated disturbance (electric field)</b> |                 |
| - 10 m test distance                         | + 4.51 / - 4.51 |
| - 3 m test distance                          | + 4.51 / - 4.51 |
| - Frequency range: 200 MHz – 1000 MHz        |                 |
| <b>Radiated disturbance (electric field)</b> |                 |
| - 3 m test distance                          | + 5.07 / - 3.70 |
| - Frequency range: 1 GHz – 30 GHz            |                 |