



EMC - TEST REPORT

Type / Model Name : BMW FBD5S

Product Description : UWB LIN gateway for comfort access function in vehicles

Applicant : Continental Automotive GmbH

Address : Siemensstraße 12

93055 REGENSBURG, GERMANY

Manufacturer : Continental Automotive GmbH

Address : Siemensstraße 12

93055 REGENSBURG, GERMANY

| | |
|---|-----------------|
| Test Result according to the standards listed in clause 1 test standards: | POSITIVE |
|---|-----------------|

| | | |
|-------------------|-----------------------|-------------------|
| Test Report No. : | T46615-00-03FX | 18. November 2020 |
| | | Date of issue |



Deutsche
Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

Contents

| | | |
|----------|---|-----------|
| 1 | <u>TEST STANDARDS</u> | 3 |
| 2 | <u>SUMMARY</u> | 4 |
| 2.1 | General remarks | 4 |
| 2.2 | Summary for all EMC tests | 4 |
| 2.3 | Final assessment | 4 |
| 3 | <u>EQUIPMENT UNDER TEST</u> | 5 |
| 3.1 | Information provided by the Client | 5 |
| 3.2 | Sampling | 5 |
| 3.1 | Photo documentation of the EUT – Detailed photos see ATTACHMENT A1 and A2 | 5 |
| 3.2 | Power supply system utilised | 5 |
| 3.3 | Highest internal frequency | 5 |
| 3.4 | Short description of the Equipment under Test (EUT) | 5 |
| 3.5 | EUT operation mode | 5 |
| 3.6 | EUT configuration | 6 |
| 4 | <u>TEST ENVIRONMENT</u> | 7 |
| 4.1 | Address of the test laboratory | 7 |
| 4.2 | Environmental conditions | 7 |
| 4.3 | Statement of the measurement uncertainty | 7 |
| 4.4 | Conformity Decision Rule | 7 |
| 4.5 | Measurement protocol for FCC and ISED | 7 |
| 5 | <u>TEST CONDITIONS AND RESULTS</u> | 12 |
| 5.1 | Conducted emission | 12 |
| 5.2 | Radiated emission < 1 GHz (electric field) | 15 |
| 5.3 | Radiated emission > 1 GHz (electric field) | 17 |
| 6 | <u>USED TEST EQUIPMENT AND ACCESSORIES</u> | 21 |
| 7 | <u>DETAILED MEASUREMENT UNCERTAINTY</u> | 22 |
| 7.1 | Overview | 22 |
| 7.2 | Definitions and symbols | 22 |
| 7.3 | Measurement uncertainty | 22 |

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 | <input type="checkbox"/> Class A device | <input checked="" type="checkbox"/> Class B device |
|------------------------------------|----------------------------|---|--|

| | | | |
|------------------------------------|---|---|--|
| Part 15, Subpart B, Section 15.109 | Radiated emission, general requirements | <input type="checkbox"/> Class A device | <input checked="" type="checkbox"/> 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 6, January 19, 2016 | AC Power Line Conducted Emissions | <input type="checkbox"/> Class A device | <input checked="" type="checkbox"/> Class B device |
|-------------------------------------|-----------------------------------|---|--|

| | | | |
|-------------------------------------|-------------------|---|--|
| ICES-003, Issue 6, January 19, 2016 | Radiated emission | <input type="checkbox"/> Class A device | <input checked="" type="checkbox"/> 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 EMI requirements cited in clause 1 test standards.

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

Testing commenced on : 03 September 2020

Testing concluded on : 04 September 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 his/her instructions.

3.1 Photo documentation of the EUT – Detailed photos see ATTACHMENT A1 and A2

3.2 Power supply system utilised

Power supply voltage : 12 VDC

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

3.3 Highest internal frequency

Highest internal frequency : 55.2 MHz (internal oscillator) / 8.5 GHz (UWB)

3.4 Short description of the Equipment under Test (EUT)

The FBD5s is a wireless UWB transceiver with LIN gateway for comfort access function in vehicles. 4 FBD5s anchors are mounted at the outer body of a vehicle. 2 further anchors (FBD5) are mounted inside the vehicle and provide BLE functionality for data transfer and security purposes between smartphone or ID tag. The anchors are connected to a central control unit and paired with a smartphone or wearable ID tag. The FBD5s can also communicate among each other for an initialization procedure. After initialization and training procedure the distance between FBD5s and smartphone or ID tag is measured and the position in relation to the vehicle is determined. The vehicle is unlocked, locked or started in case the smartphone or ID tag is in a permitted area around or inside the vehicle.

Number of tested samples: 1
Serial number: LM889 (App Mode/Normal Mode)

3.5 EUT operation mode

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

- App Mode/Normal Mode: UWB in stand-by mode (awaiting signal for activation)

3.6 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:

- DC feed cable, pin plug Model : ---
- _____ Model : _____
- _____ Model : _____

| Port | Cable | Screening | Transmission | Status | Length |
|------|---------------|------------|--------------|--------|--------|
| 1 | DC power line | unshielded | analogue | active | 1.0 m |

Modifications during the EMC test: None

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.

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

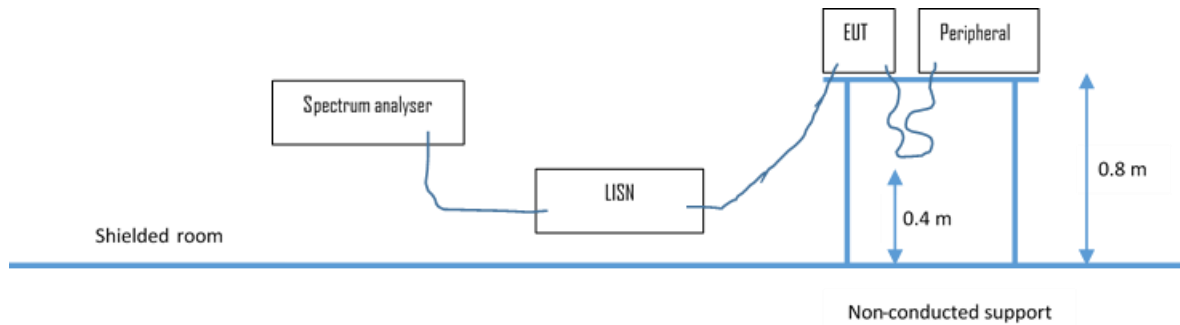
CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

**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 μ V, is arrived at by taking the reading directly from the Spectrum analyser. This level is compared to the limit.

To convert between dB μ V and μ V, the following conversions apply:

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

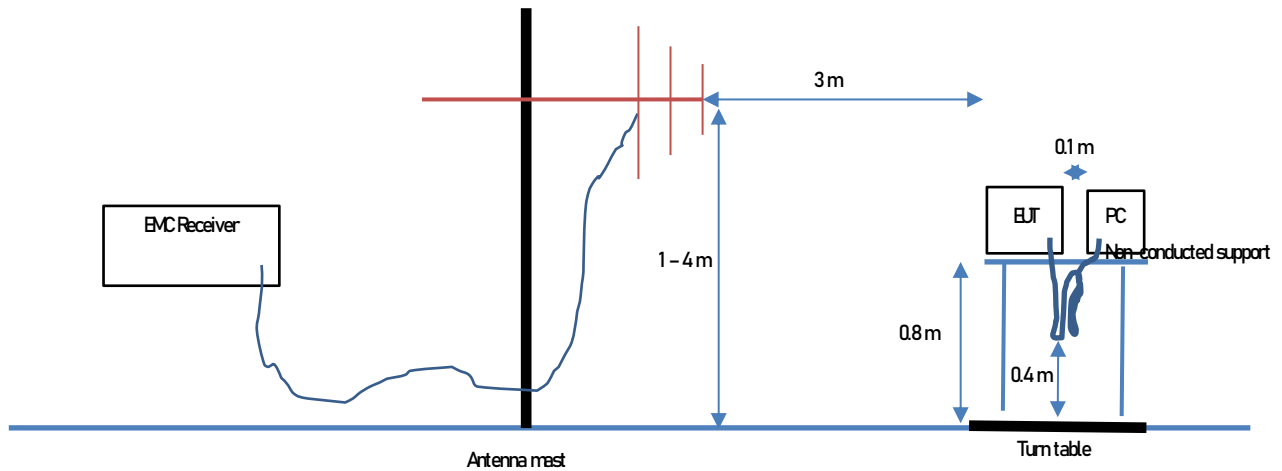
$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

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 Ω / 50 μ 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 dB μ V) 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 (MHz) | Reading (dB μ V) | + | Correction* (dB/m) | = | Level (dB μ V/m) | - | Limit (dB μ V/m) | = | Dlimit (dB) |
|-----------------|----------------------|---|--------------------|---|----------------------|---|----------------------|---|-------------|
| 719.0 | 75.0 | + | 32.6 | = | 107.6 | - | 110.0 | = | -2.4 |

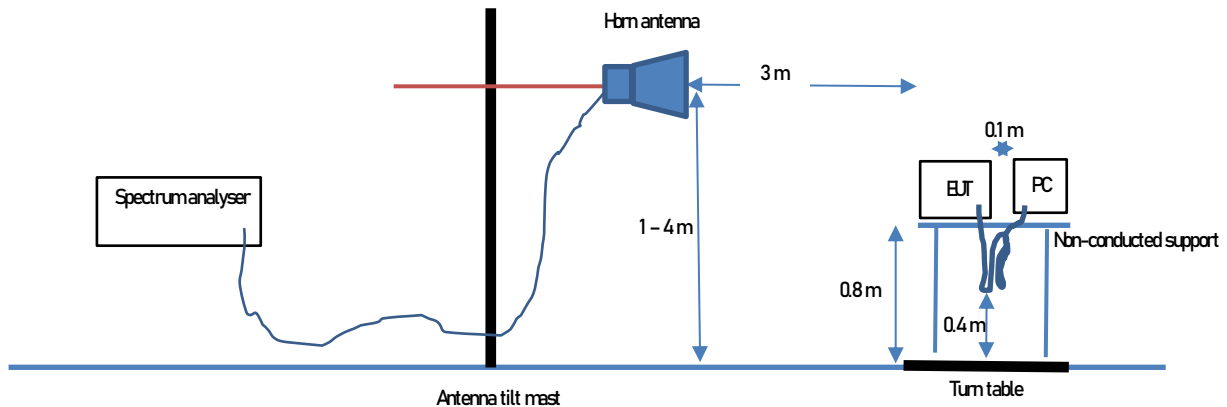
*Correction Factor = Antenna Factor + Cable Attenuation = 30 dB/m + 2.6 dB = 32.6 dB/m

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



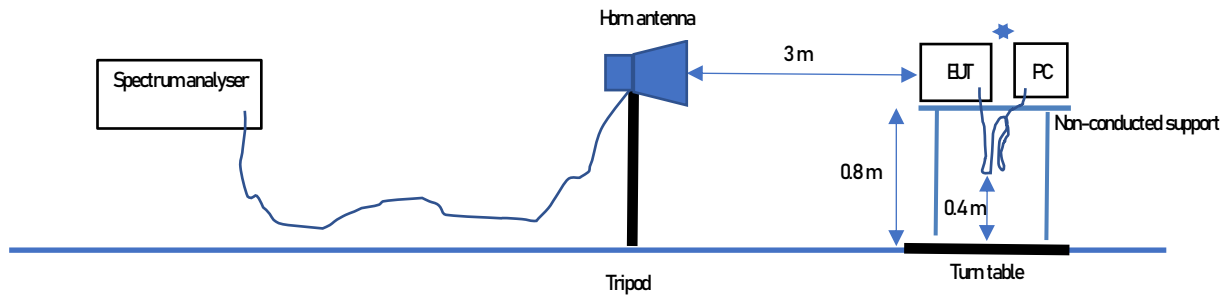
Description of measurement

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

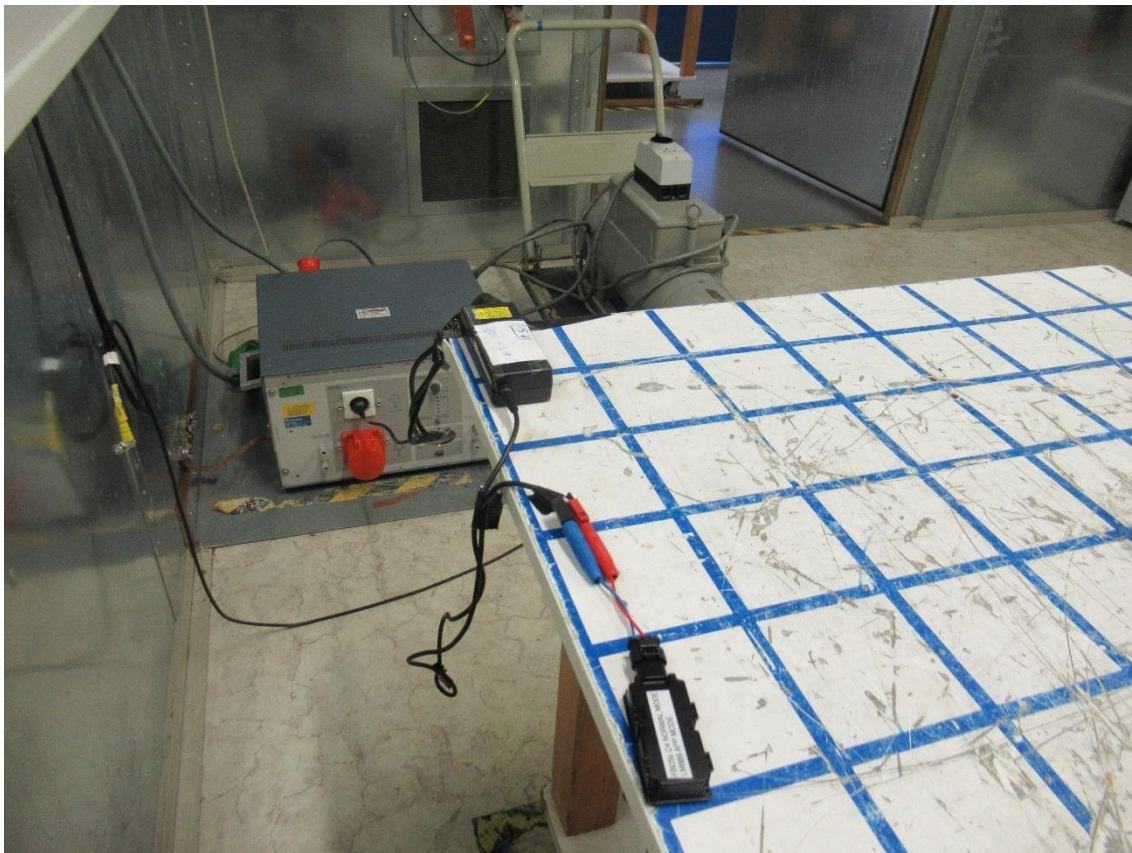
5.1 Conducted emission

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 -27.6 dB at 0.915

The requirements are **FULFILLED**.

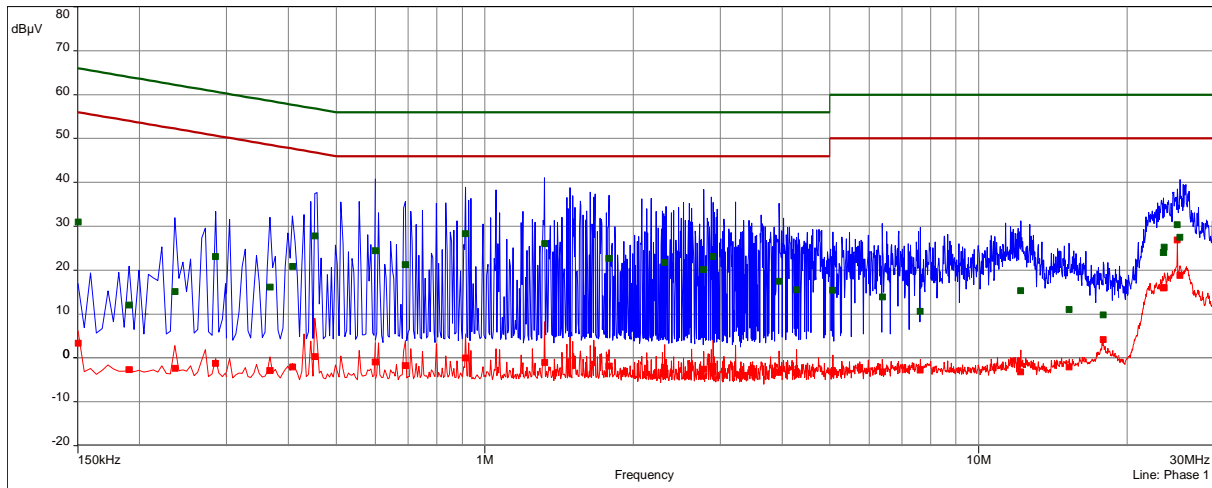
Remarks: For detailed results, please see the following page(s).
For description of the measurement see 4.5.2

5.1.4 Test protocol

Test point: L1
 Operation mode: App Mode/Normal Mode
 Remarks: None
 Date: 03.09.2020
 Tested by: Josef Knab

Result: passed

- FCC/FCC Part 15B (15.107) B - Average/
- FCC/FCC Part 15B (15.107) B - QPeak/
- Meas.Peak (Phase 1)
- Mes. CISPR AVG (Phase 1)
- QuasiPeak (Finals) (Phase 1)
- CISPR AV (Finals) (Phase 1)



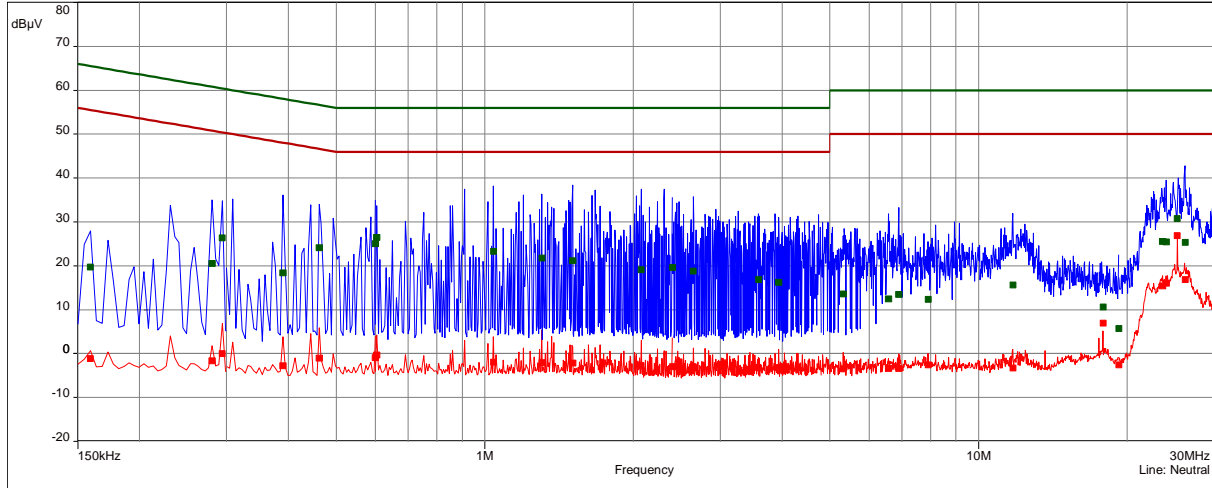
FCC/FCC Part 15B (15.107)B

| freq | QP | margin | limit | AV | margin | limit | corr |
|--------|--------|--------|-------|--------|--------|-------|------|
| MHz | dB(µV) | dB | dB | dB(µV) | dB | dB | dB |
| 0.150 | 31.1 | -35.0 | 66.0 | 3.4 | -52.6 | 56.0 | 10.1 |
| 0.191 | 12.1 | -51.9 | 64.0 | -2.6 | -56.6 | 54.0 | 10.1 |
| 0.236 | 15.2 | -47.0 | 62.3 | -2.3 | -54.5 | 52.3 | 10.1 |
| 0.285 | 23.2 | -37.5 | 60.7 | -1.2 | -51.8 | 50.7 | 10.1 |
| 0.368 | 16.2 | -42.4 | 58.6 | -2.8 | -51.4 | 48.6 | 10.2 |
| 0.408 | 20.9 | -36.8 | 57.7 | -2.0 | -49.7 | 47.7 | 10.2 |
| 0.453 | 27.9 | -29.0 | 56.8 | 0.3 | -46.5 | 46.8 | 10.2 |
| 0.600 | 24.5 | -31.5 | 56.0 | -0.9 | -46.9 | 46.0 | 10.2 |
| 0.690 | 21.4 | -34.7 | 56.0 | -1.7 | -47.7 | 46.0 | 10.2 |
| 0.915 | 28.4 | -27.6 | 56.0 | 0.0 | -46.0 | 46.0 | 10.2 |
| 1.322 | 26.2 | -29.9 | 56.0 | -1.0 | -47.0 | 46.0 | 10.3 |
| 1.785 | 22.7 | -33.3 | 56.0 | -1.8 | -47.8 | 46.0 | 10.3 |
| 2.312 | 21.8 | -34.2 | 56.0 | -2.3 | -48.3 | 46.0 | 10.3 |
| 2.778 | 20.2 | -35.8 | 56.0 | -2.6 | -48.6 | 46.0 | 10.3 |
| 2.900 | 23.2 | -32.8 | 56.0 | -1.9 | -47.9 | 46.0 | 10.3 |
| 3.944 | 17.5 | -38.5 | 56.0 | -3.2 | -49.2 | 46.0 | 10.4 |
| 4.281 | 15.6 | -40.4 | 56.0 | -3.3 | -49.3 | 46.0 | 10.4 |
| 5.070 | 15.5 | -44.5 | 60.0 | -3.2 | -53.2 | 50.0 | 10.5 |
| 6.380 | 14.0 | -46.0 | 60.0 | -3.1 | -53.1 | 50.0 | 10.6 |
| 7.626 | 10.7 | -49.3 | 60.0 | -2.7 | -52.7 | 50.0 | 10.6 |
| 12.188 | 15.4 | -44.6 | 60.0 | -3.1 | -53.1 | 50.0 | 10.9 |
| 15.225 | 11.1 | -48.9 | 60.0 | -2.0 | -52.0 | 50.0 | 11.2 |
| 17.867 | 9.9 | -50.1 | 60.0 | 4.3 | -45.7 | 50.0 | 11.4 |
| 23.709 | 24.1 | -35.9 | 60.0 | 16.0 | -34.0 | 50.0 | 11.6 |
| 23.772 | 25.3 | -34.7 | 60.0 | 16.1 | -33.9 | 50.0 | 11.6 |
| 25.293 | 30.4 | -29.6 | 60.0 | 26.9 | -23.1 | 50.0 | 11.7 |
| 25.577 | 27.6 | -32.4 | 60.0 | 18.8 | -31.2 | 50.0 | 11.7 |

Test point: N
 Operation mode: App Mode/Normal Mode
 Remarks: None
 Date: 03.09.2020
 Tested by: Josef Knab

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 | QP | margin | limit | AV | margin | limit | corr |
|--------|--------|--------|-------|--------|--------|-------|------|
| MHz | dB(µV) | dB | dB | dB(µV) | dB | dB | dB |
| 0.159 | 19.8 | -45.7 | 65.5 | -1.1 | -56.6 | 55.5 | 10.1 |
| 0.281 | 20.6 | -40.2 | 60.8 | -1.6 | -52.4 | 50.8 | 10.1 |
| 0.294 | 26.4 | -34.0 | 60.4 | 0.0 | -50.4 | 50.4 | 10.1 |
| 0.390 | 18.4 | -39.7 | 58.1 | -2.7 | -50.8 | 48.1 | 10.2 |
| 0.462 | 24.2 | -32.5 | 56.7 | -1.0 | -47.7 | 46.7 | 10.2 |
| 0.600 | 25.1 | -30.9 | 56.0 | -0.9 | -46.9 | 46.0 | 10.2 |
| 0.605 | 26.6 | -29.4 | 56.0 | -0.2 | -46.2 | 46.0 | 10.2 |
| 1.041 | 23.3 | -32.7 | 56.0 | -1.9 | -47.9 | 46.0 | 10.2 |
| 1.304 | 21.8 | -34.2 | 56.0 | -2.0 | -48.0 | 46.0 | 10.2 |
| 1.506 | 21.2 | -34.8 | 56.0 | -2.1 | -48.1 | 46.0 | 10.3 |
| 2.078 | 19.2 | -36.8 | 56.0 | -2.8 | -48.8 | 46.0 | 10.3 |
| 2.397 | 19.7 | -36.3 | 56.0 | -2.9 | -48.9 | 46.0 | 10.3 |
| 2.643 | 18.8 | -37.2 | 56.0 | -2.9 | -48.9 | 46.0 | 10.3 |
| 3.584 | 16.9 | -39.1 | 56.0 | -3.2 | -49.2 | 46.0 | 10.4 |
| 3.935 | 16.3 | -39.7 | 56.0 | -3.1 | -49.1 | 46.0 | 10.4 |
| 5.322 | 13.7 | -46.3 | 60.0 | -3.4 | -53.4 | 50.0 | 10.5 |
| 6.573 | 12.6 | -47.5 | 60.0 | -3.3 | -53.3 | 50.0 | 10.5 |
| 6.893 | 13.6 | -46.4 | 60.0 | -3.3 | -53.3 | 50.0 | 10.6 |
| 7.901 | 12.4 | -47.6 | 60.0 | -2.5 | -52.5 | 50.0 | 10.6 |
| 11.738 | 15.7 | -44.4 | 60.0 | -3.2 | -53.2 | 50.0 | 10.8 |
| 17.867 | 10.7 | -49.3 | 60.0 | 7.0 | -43.0 | 50.0 | 11.2 |
| 19.200 | 5.8 | -54.2 | 60.0 | -2.5 | -52.5 | 50.0 | 11.2 |
| 23.592 | 25.6 | -34.4 | 60.0 | 15.5 | -34.5 | 50.0 | 11.3 |
| 23.988 | 25.6 | -34.5 | 60.0 | 16.1 | -33.9 | 50.0 | 11.3 |
| 25.293 | 30.9 | -29.2 | 60.0 | 27.0 | -23.1 | 50.0 | 11.2 |
| 26.193 | 25.4 | -34.6 | 60.0 | 16.9 | -33.1 | 50.0 | 11.2 |

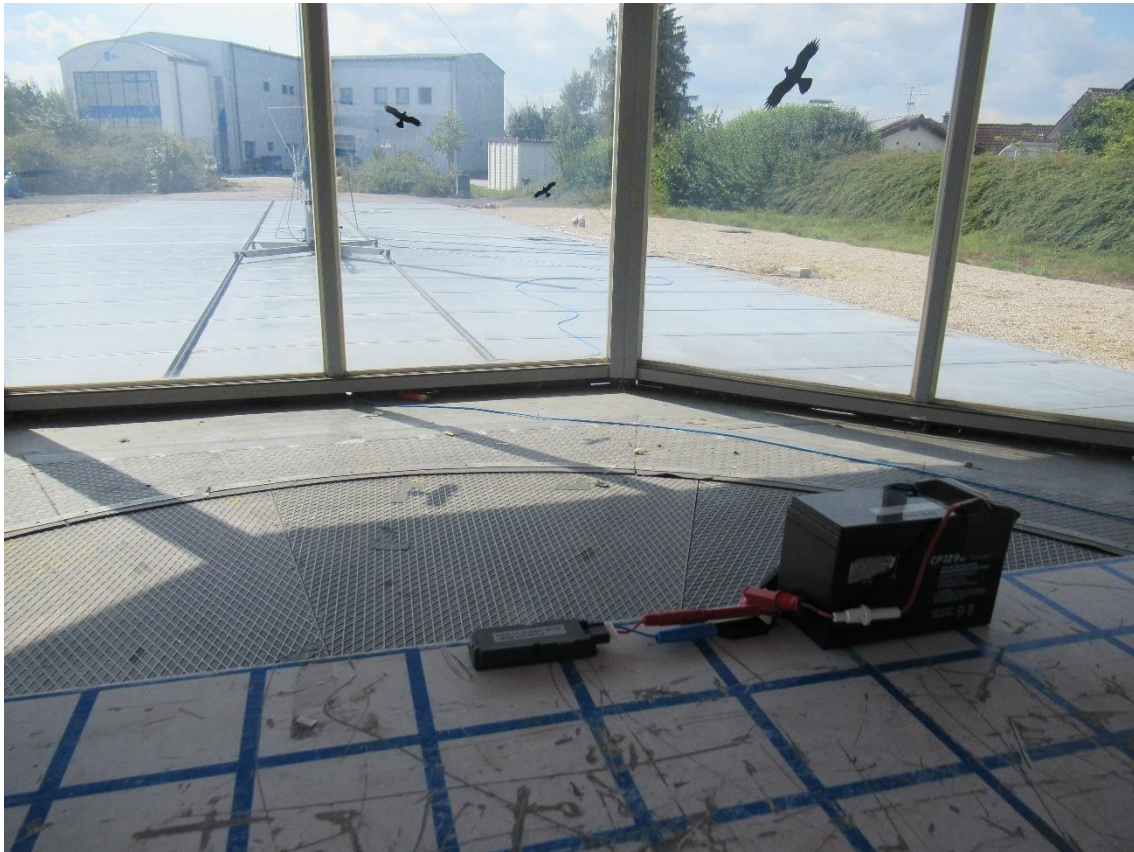
5.2 Radiated emission < 1 GHz (electric field)

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: 10 m

5.2.2 Photo documentation of the test setup



5.2.3 Test result

Frequency range: 30 MHz - 1000 MHz
Min. limit margin: -9.8 dB at 200 MHz

The requirements are **FULFILLED**.

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

For description of the measurement see 4.5.2.

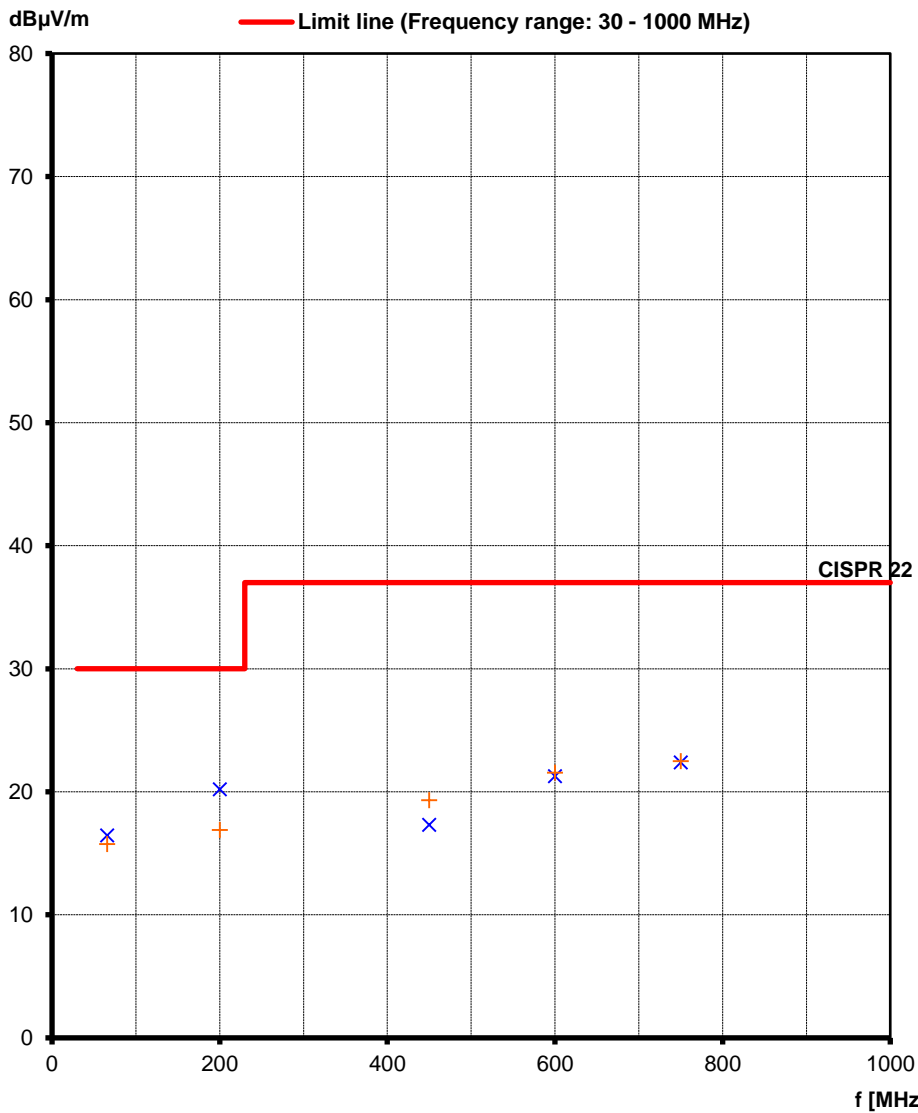
5.2.4 Test protocol

Operation mode: App Mode/Normal Mode
 Remarks: None
 Date: 03.09.2020
 Tested by: Josef Knab

Result: passed

| Frequency (MHz) | Reading Vert. (dB μ V) | Reading Hor. (dB μ V) | Correct. Vert. (dB/m) | Correct. Hor. (dB/m) | Level Vert. (dB μ V/m) | Level Hor. (dB μ V/m) | Limit (dB μ V/m) | Dlimit (dB) |
|-----------------|----------------------------|---------------------------|-----------------------|----------------------|----------------------------|---------------------------|----------------------|-------------|
| 65.89 | 5.5 | 4.8 | 11.0 | 11.0 | 16.5 | 15.8 | 30.0 | -13.5 |
| 200.00 | 7.4 | 4.1 | 12.8 | 12.8 | 20.2 | 16.9 | 30.0 | -9.8 |
| 450.00 | -2.9 | -0.9 | 20.2 | 20.2 | 17.3 | 19.3 | 37.0 | -17.7 |
| 600.00 | -2.3 | -2.0 | 23.6 | 23.6 | 21.3 | 21.6 | 37.0 | -15.4 |
| 750.00 | -2.9 | -2.8 | 25.3 | 25.3 | 22.4 | 22.5 | 37.0 | -14.5 |

Note: No emissions above noise level could be detected.



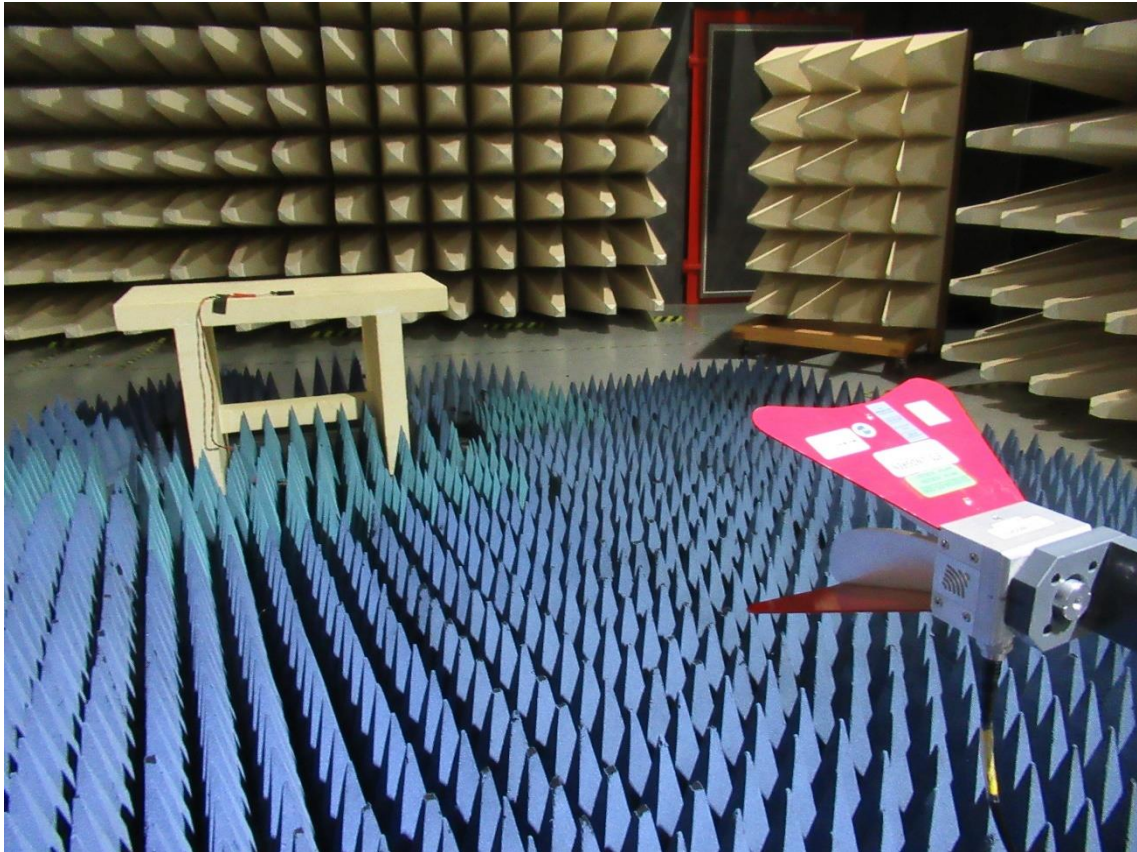
5.3 Radiated emission > 1 GHz (electric field)

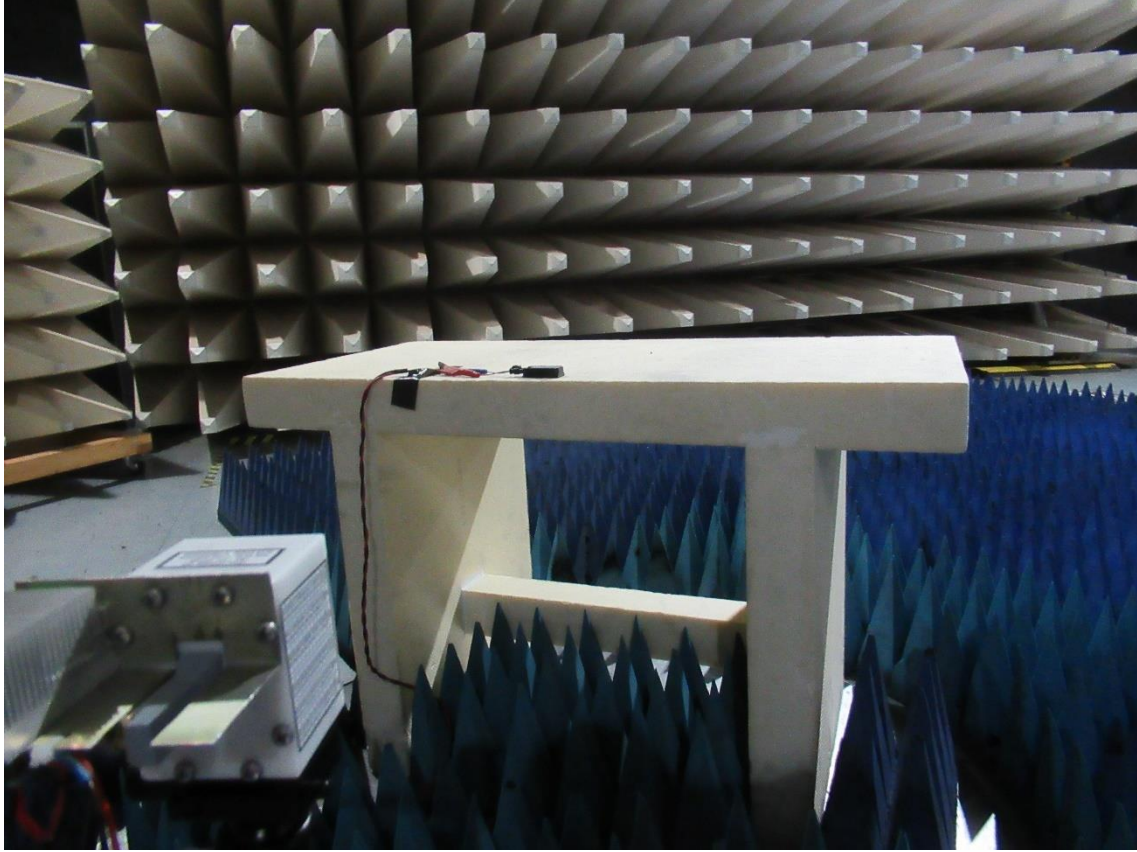
For test instruments and accessories used see section 6 Part **SER 3**.

5.3.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 3 m (f < 18 GHz)
1 m (f > 18 GHz)

5.3.2 Photo documentation of the test setup





5.3.3 Test result

The requirements are **FULFILLED**.

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

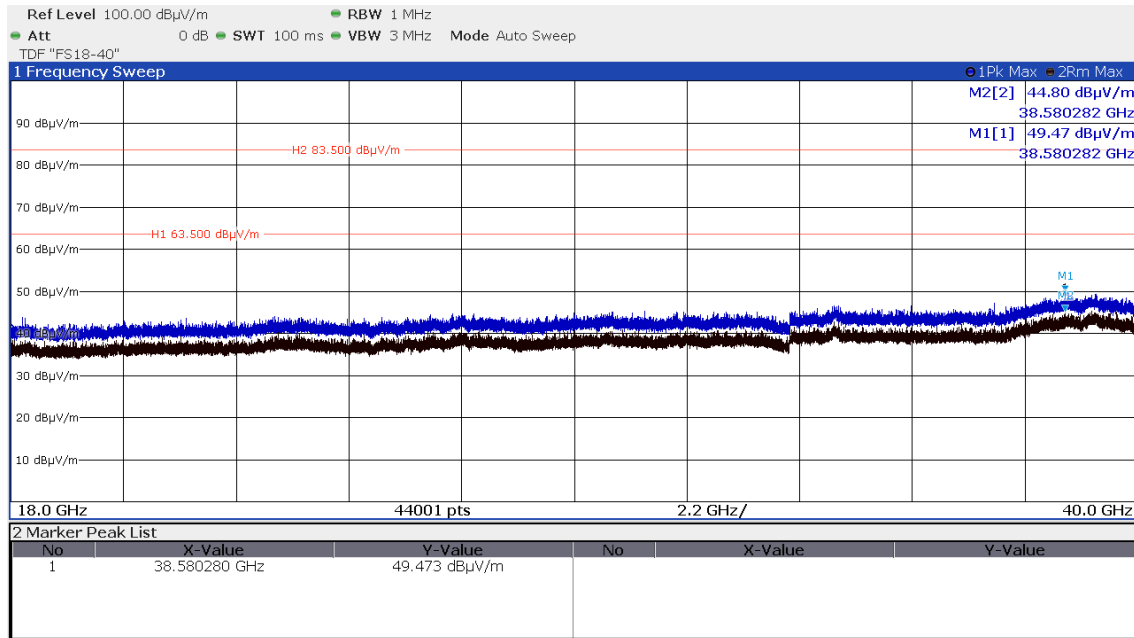
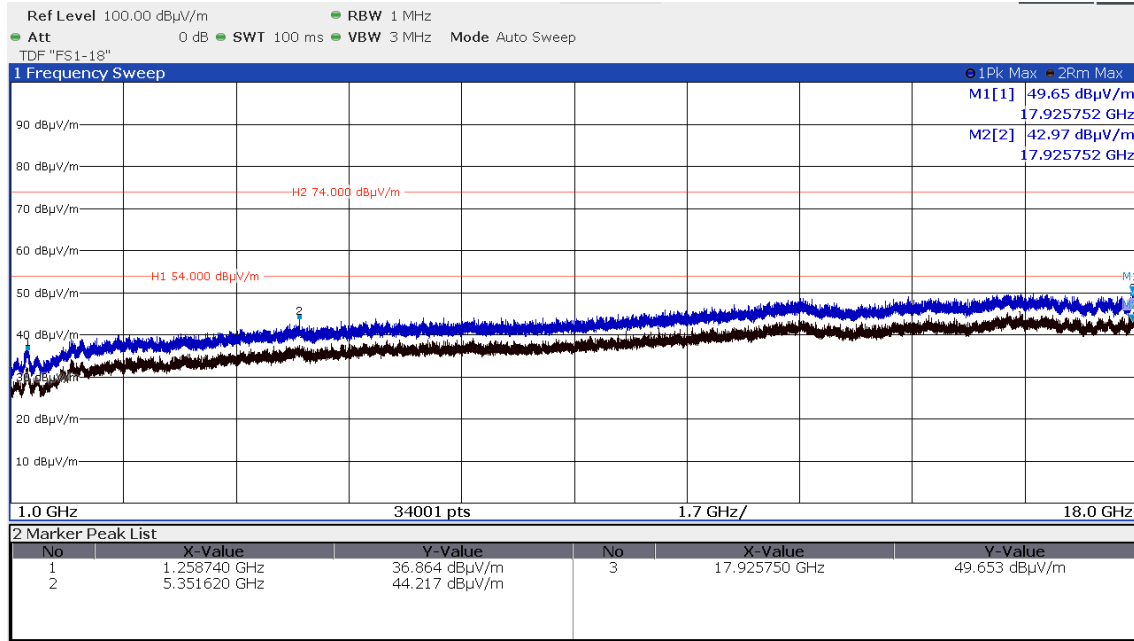
For description of the measurement see 4.5.2.

5.3.4 Test protocol

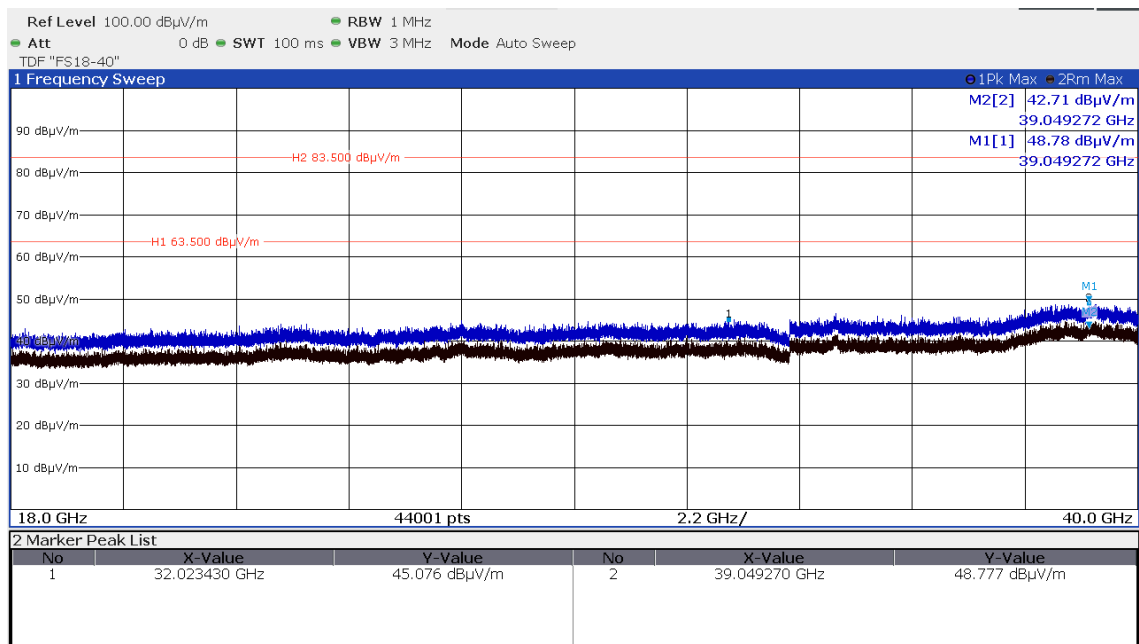
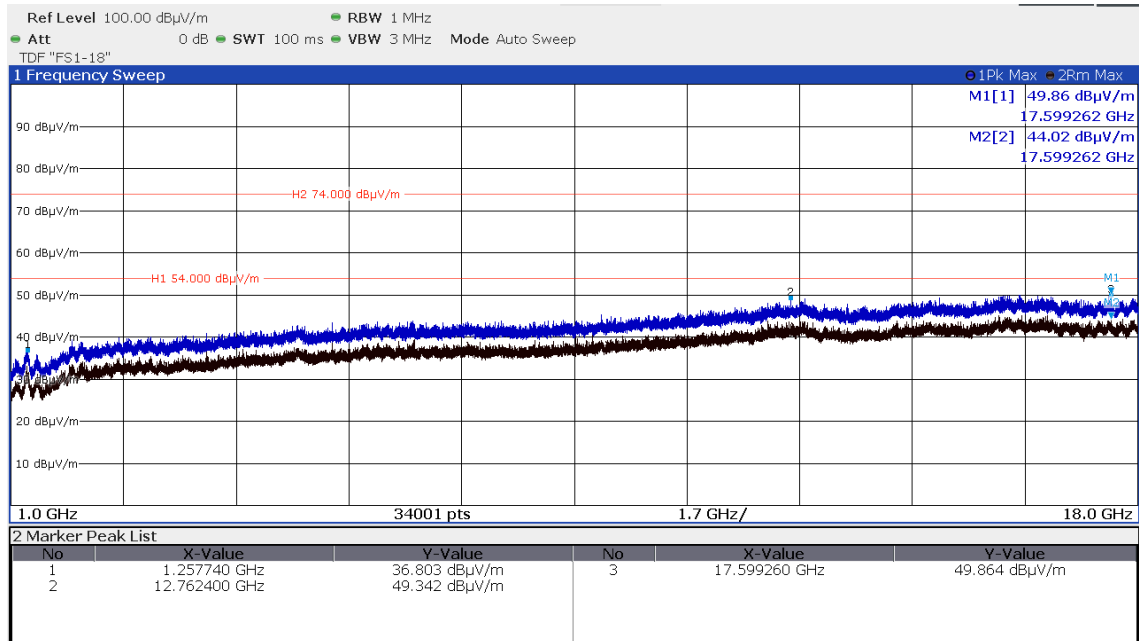
Operation mode: App Mode/Normal Mode
 Remarks: None
 Date: 04.09.2020
 Tested by: Josef Knab

Result: passed

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. | Last Verif. |
|---------|------------------------|--------------------------|---------------------------|-----------------|-------------|-------------|-------------|-------------|
| A 4 | BAT-EMC 3.19.1.24 | Nexio Software | EMCO Elektronik GmbH | 01-02/68-13-001 | | | | |
| | ESCI | EMI Test Receiver | Rohde & Schwarz München | 02-02/03-15-001 | 24/06/2021 | 24/06/2020 | | |
| | 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 | | | | |
| | 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 |
| A 5 | ESVS 30 | EMI Test Receiver | Rohde & Schwarz München | 02-02/03-05-006 | 15/07/2021 | 15/07/2020 | | |
| | VULB 9168 | Trilog Broadband Antenn | Schwarzbeck Mess-Elektron | 02-02/24-05-005 | 19/09/2020 | 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 | | | | |
| | KK-SD_7/8-2X21N-33,0M | RF Cable 33 m | Huber + Suhner AG | 02-02/50-15-028 | | | | |
| SER 3 | FSW43 | Spectrum Analyser | Rohde & Schwarz München | 02-02/11-15-001 | 02/04/2021 | 02/04/2020 | | |
| | AMF-6D-01002000-22-10P | RF Amplifier | MITEQ, Inc. | 02-02/17-15-004 | | | | |
| | LNA-40-18004000-33-5P | Amplifier 18-40 GHz | MITEQ, Inc. | 02-02/17-20-002 | | | | |
| | 3117 | Horn Antenna 1 - 18 GH | EMCO Elektronik GmbH | 02-02/24-05-009 | 18/06/2021 | 18/06/2020 | | |
| | BBHA 9170 | SHF-EHF Horn Antenna | Schwarzbeck Mess-Elektron | 02-02/24-05-013 | 19/05/2023 | 19/05/2020 | 14/01/2021 | 14/01/2020 |
| | 18N-20 | Coax Attenuator 20dB | Tactron Elektronik | 02-02/50-17-003 | | | | |
| | BAM 4.5-P | Antenna Mast | matur GmbH | 02-02/50-17-024 | | | | |
| | NCD | Controller for Antenna M | matur GmbH | 02-02/50-17-025 | | | | |
| | KK-SF106-2X11N-6,5M | RF Cable | Huber + Suhner | 02-02/50-18-016 | | | | |
| | BAT-EMC 3.19.1.24 | Nexio Software | EMCO Elektronik GmbH | 02-02/68-13-001 | | | | |

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] |
|--|-----------------|
| Conducted disturbance | + 2.53 / - 2.77 |
| Radiated disturbance (electric field) | |
| - 10 m test distance | + 3.16 / - 3.22 |
| - 3 m test distance | + 3.16 / - 3.22 |
| - Frequency range: 30 MHz – 200 MHz | |
| Radiated disturbance (electric field) | |
| - 10 m test distance | + 4.51 / - 4.51 |
| - 3 m test distance | + 4.51 / - 4.51 |
| - Frequency range: 200 MHz – 1000 MHz | |
| Radiated disturbance (electric field) | |
| - 3 m test distance | + 5.07 / - 3.70 |
| - Frequency range: 1 GHz – 30 GHz | |