

# Test Report

**Test report no.:** 21116498-25418-0

**Date of issue:** 2022-08-15

**Test result:** The test item - passed - and complies with the listed standards.

## Applicant

Symeo GmbH

## Manufacturer

Symeo GmbH

## Test Item

BSW200291

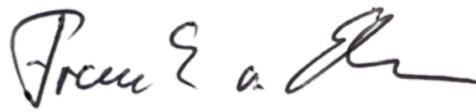
## Electromagnetic Compatibility Testing according to:

### 47 CFR Part 15

Radio frequency devices,  
Subpart B – Unintentional Radiators  
(§15.107, §15.109)

Tested by  
(name, function, signature)

Frank von Ehren  
Lab Manager EMC



signature

Approved by  
(name, function, signature)

Florian Schmidt  
Head of Department EMC



signature

| <b>Applicant and Test item details</b> |   |
|--|---|
| <b>Applicant</b>                       | <i>Symeo GmbH</i><br><i>Prof.-Messerschmitt-Str. 3</i><br><i>85579, Neubiberg, Germany</i><br><i>Phone:</i> +49 89 6607796-0<br><i>Fax:</i> +49 89 6607796-190<br><i>E-Mail:</i> <a href="mailto:info@symeo.com">info@symeo.com</a><br><i>Homepage:</i> <a href="http://www.symeo.com">http://www.symeo.com</a> |
| <b>Manufacturer</b>                    | <i>Symeo GmbH</i><br><i>Prof.-Messerschmitt-Str. 3</i><br><i>85579, Neubiberg, Germany</i><br><i>Phone:</i> +49 89 6607796-0<br><i>Fax:</i> +49 89 6607796-190<br><i>E-Mail:</i> <a href="mailto:info@symeo.com">info@symeo.com</a><br><i>Homepage:</i> <a href="http://www.symeo.com">http://www.symeo.com</a> |
| <b>Test item description</b>           | LPR-1DHP-291  |
| <b>Model/Type reference</b>            | BSW200291   |

### **Disclaimer and Notes**

The content of this test report relates to the mentioned test sample(s) only.  
 Without a written permit of IBL-Lab GmbH, this test report shall not be reproduced, except in full.

Copyright ©: All rights reserved by IBL-Lab GmbH

Within this test report, a  point /  comma is used as a decimal separator.  
 If otherwise, a detailed note is added adjected to its use.

Decision rule based on simple acceptance without guard bands, binary statement, based on mutually agreed uncertainty tolerances with expansion factor k=2.

## 1 TABLE OF CONTENTS

|         |                                      |    |
|---------|--------------------------------------|----|
| 1       | TABLE OF CONTENTS.....               | 3  |
| 2       | GENERAL INFORMATION .....            | 4  |
| 2.1     | Administrative details.....          | 4  |
| 2.2     | Possible test case verdicts .....    | 4  |
| 2.3     | Observations.....                    | 4  |
| 2.4     | Opinions and interpretations.....    | 4  |
| 2.5     | Revision History .....               | 4  |
| 3       | ENVIRONMENTAL & TEST CONDITIONS..... | 5  |
| 3.1     | Environmental conditions .....       | 5  |
| 4       | TEST STANDARDS AND REFERENCES .....  | 5  |
| 5       | EQUIPMENT UNDER TEST (EUT).....      | 6  |
| 5.1     | EUT A .....                          | 6  |
| 6       | Associated equipment (AE) .....      | 7  |
| 6.1     | AE 1 .....                           | 7  |
| 7       | SUMMARY OF TEST RESULTS.....         | 8  |
| 8       | TEST RESULTS .....                   | 9  |
| 8.1     | Conducted emission (§15.107).....    | 9  |
| 8.2     | Radiated emission (§15.109).....     | 15 |
| 9       | MEASUREMENT UNCERTAINTY .....        | 25 |
| Annex A | .....                                | 26 |
| Annex B | .....                                | 29 |
| Annex C | .....                                | 33 |

## 2 GENERAL INFORMATION

### 2.1 Administrative details

|                                 |   |
|---------------------------------|---|
| Testing laboratory              | <b>IBL-Lab GmbH</b><br>Heinrich-Hertz-Allee 7<br>66386 Sankt Ingbert / Germany<br>Fon: +49 6894 38938-0<br>Fax: +49 6894 38938-99<br>URL: <a href="http://www.ib-lenhardt.de">www.ib-lenhardt.de</a><br>E-Mail: <a href="mailto:info@ib-lenhardt.de">info@ib-lenhardt.de</a>  |
| Accreditation                   | The testing laboratory is accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025:2018.<br><br>Scope of testing and registration number:<br>• Electromagnetic Compatibility <a href="#">D-PL-21375-01-02</a><br>• Electromagnetic Compatibility and Telecommunication (FCC requirements) <a href="#">D-PL-21375-01-03</a><br><br>Website DAkkS: <a href="https://www.dakks.de/">https://www.dakks.de/</a><br><br>The Deutsche Akkreditierungsstelle GmbH (DAkkS) is also a signatory to the <a href="#">ILAC Mutual Recognition Arrangement</a> |
| Testing location                | <b>IBL-Lab GmbH</b><br>Heinrich-Hertz-Allee 7<br>66386 St. Ingbert / Germany  |
| Date of receipt of test samples | 2022-08-09  |
| Start – End of tests            | 2022-08-09 – 2022-08-12   |

### 2.2 Possible test case verdicts

|   |                      |
|---|----------------------|
| Test sample meets the requirements          | passed               |
| Test sample does not meet the requirements  | failed               |
| Test case does not apply to the test sample | n/a (not applicable) |
| Test case not performed                     | n/p (not performed)  |

### 2.3 Observations

No additional observations other than the reported observations within this test report have been made.

### 2.4 Opinions and interpretations

No appropriate opinions or interpretations according ISO/IEC 17025:2017.

### 2.5 Revision History

-1 Initial Version

### 3 ENVIRONMENTAL & TEST CONDITIONS

#### 3.1 Environmental conditions

|                     |                         |
|---------------------|-------------------------|
| Temperature         | 20°C ± 5°C (see below)  |
| Relative humidity   | 25-75% r.H. (see below) |
| Barometric Pressure | 860-1060 mbar           |

### 4 TEST STANDARDS AND REFERENCES

| Test standard (accredited) | Description   |
|----------------------------|---|
| 47 CFR Part 15             | Radio frequency devices,<br>Subpart B – Unintentional Radiators<br>(§15.107, §15.109) |

| Reference        | Description   |
|------------------|---|
| ANSI C63.4-2014  | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |
| ANSI C63.10-2013 | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices  |

## 5 EQUIPMENT UNDER TEST (EUT)

### 5.1 EUT A

#### 5.1.1 Product description\*

|                        |  |
|------------------------|--|
| Test item description* | LPR-1DHP-291   |
| Intended use*          | The LPR-1DHP-291 radar system performs 1D distance measurements for short, medium and long ranges. |

\*: as declared by applicant

#### 5.1.2 Description of test item

|                  |                              |
|------------------|------------------------------|
| Model name*      | BSW200291                    |
| Serial number*   | EM4AJN0010                   |
| Hardware status* | ---                          |
| Firmware status* | BR2019-184-gf6c2ac8.devel_sr |

\*: as declared by applicant

#### 5.1.3 Technical data of test item

|                             |  |            |
|-----------------------------|--|------------|
| Operational frequency band* | 57.0 - 64.0GHz                           |            |
| Antenna*                    | integrated, beam width = $\pm 2,5^\circ$ |            |
| Power supply*               | By external DC                           |            |
| Power supply range*         | DC 11 – 36 V                             |            |
| Nominal supply voltage*     | DC 24 V                                  |            |
| Ports*                      | Classification*                          | Direction* |
|                             | DC mains                                 | input      |
|                             | Wired network,<br>shielded               | in/output  |

\*: as declared by applicant

#### 5.1.4 Additional information

|     |
|-----|
| --- |
|-----|

## 6 Associated equipment (AE)

### 6.1 AE 1

#### Product description

Notebook

#### Description

|                 |                       |
|-----------------|-----------------------|
| Model name      | DELL Latitude E5570   |
| Serial number   | 2Z9QRF2               |
| Hardware status | --                    |
| Software status | Windows 10 Pro 64 Bit |

## 7 SUMMARY OF TEST RESULTS

### Test specification

FCC 47 CFR Part 15

| Clause  | Requirement / Test case  | Chapter | Test Conditions | Result / Remark | Verdict |
|---------|--------------------------|---------|-----------------|-----------------|---------|
| §15.107 | Conducted limits         | 8.1     | normal          | Class B         | passed  |
| §15.109 | Radiated emission limits | 8.2     | normal          | Class B         | passed  |

### Comments and observations

---

## 8 TEST RESULTS

### 8.1 Conducted emission (§15.107)

#### 8.1.1 Test plan

|                       |                 |
|-----------------------|-----------------|
| <b>Test setup</b>     | EUT A + AE 1    |
| <b>Operating mode</b> | EMC test mode   |
| <b>Port</b>           | AC mains        |
| <b>LCL</b>            | ---             |
| <b>Limit</b>          | §15.107 Class B |
| <b>Verdict</b>        | passed *        |

\* see measurement results in section 8.1.5

|                 |     |
|-----------------|-----|
| <b>Comment:</b> | --- |
|-----------------|-----|

### 8.1.2 Conducted limits (§15.107)

#### Description & Limits

§ 15.107 Conducted limits.

(a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

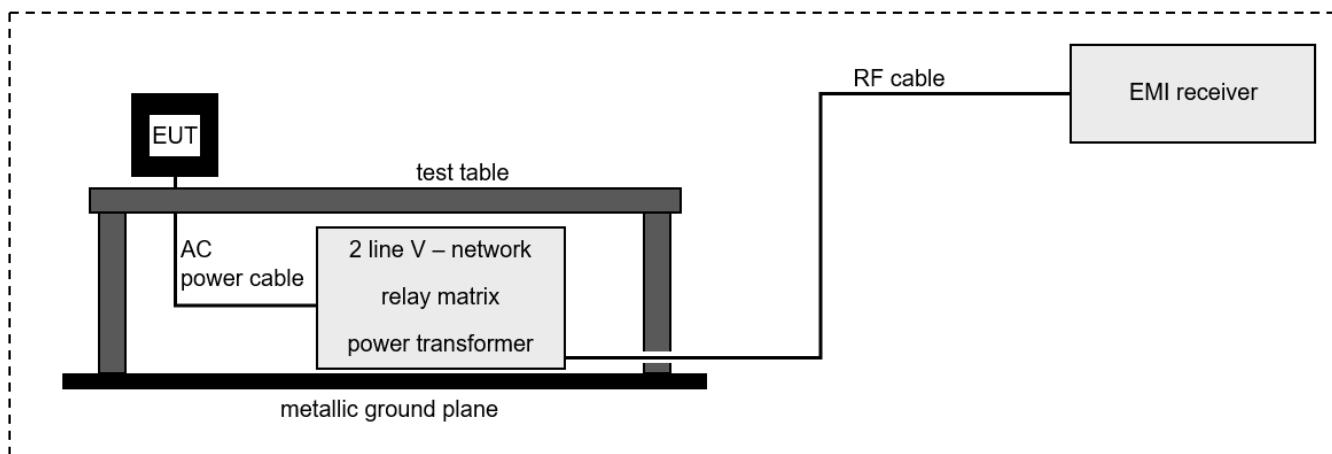
| Frequency<br>[MHz] | Conducted limit<br>[dB $\mu$ V] |           |
|--------------------|---------------------------------|-----------|
|                    | Quasi-Peak                      | Average   |
| 0.15 – 0.5         | 66 to 56*                       | 56 to 46* |
| 0.5 – 5.0          | 56                              | 46        |
| 5.0 – 30           | 60                              | 50        |

\*Decreases with the logarithm of the frequency.

(b) For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50 ohms LISN. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency<br>[MHz] | Conducted limit<br>[dB $\mu$ V] |         |
|--------------------|---------------------------------|---------|
|                    | Quasi-Peak                      | Average |
| 0.15 – 0.5         | 79                              | 66      |
| 0.5 – 30           | 73                              | 60      |

### 8.1.3 Test Setup Description



EMC32 software version: 11.10.00

FS = UR + CL + AF

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

Example calculation:

$$\text{FS [dB}\mu\text{V]} = 12.35 \text{ [dB}\mu\text{V]} + 1.90 \text{ [dB]} + 16.80 \text{ [dB]} = 31.05 \text{ [dB}\mu\text{V} (35.69 \mu\text{V})$$

#### List of test equipment used:

| # | Equipment                        | Type                       | Serial number | Internal number | Calibrated until | Used for test                       |
|---|----------------------------------|----------------------------|---------------|-----------------|------------------|-------------------------------------|
| 1 | EMI Test Receiver                | Rohde & Schwarz ESW 26     | 101481        | LAB000236       | 2023-07-07       | <input checked="" type="checkbox"/> |
| 2 | Open Switch and Control Platform | Rohde & Schwarz OSP-B200S2 | 101443        | LAB000239       | n/a              | <input checked="" type="checkbox"/> |
| 4 | Two-line V-Network               | Rohde & Schwarz ENV216     | 102597        | LAB000220       | 2022-09-17       | <input checked="" type="checkbox"/> |

## 8.1.4 Measurement procedure

### Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.  
In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, ... necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, ... are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

### Pre-scan

- The EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

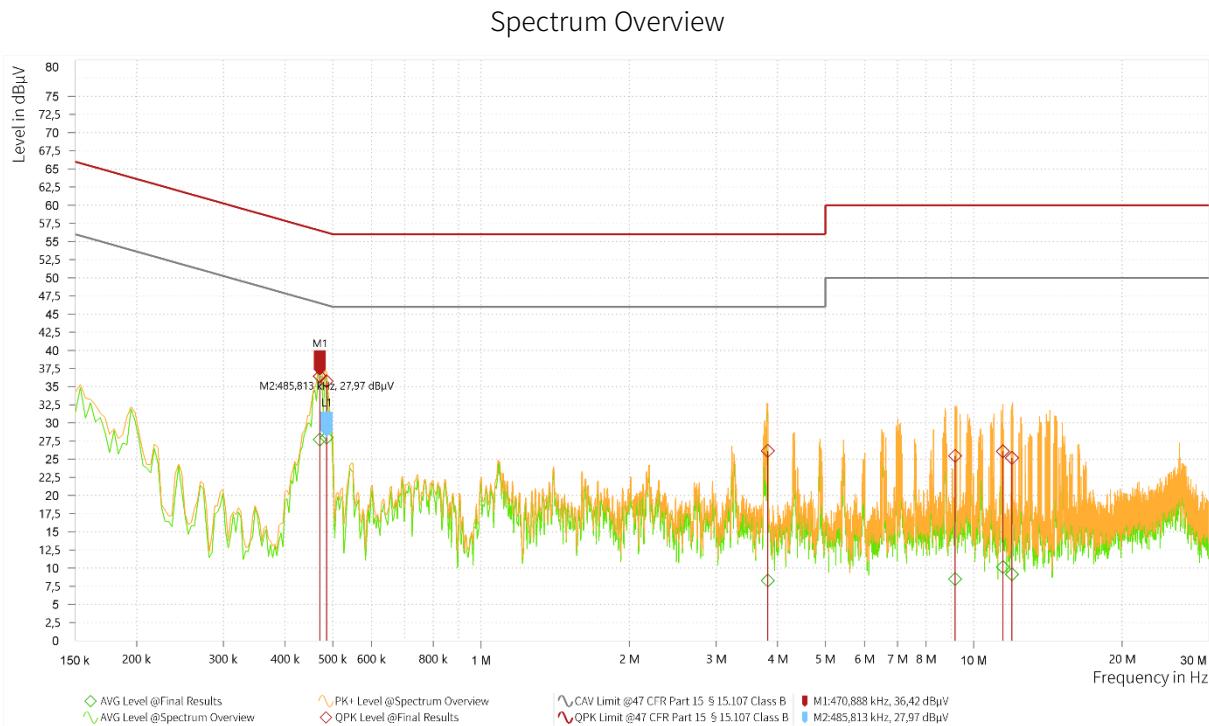
### Final measurement

- Significant emissions found during the pre-scan will be maximized by the EMI-software based on evaluated data during the pre-scan.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C63.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, and settings of measuring equipment is recorded.

Detailed requirements can be found in e.g. ANSI C63.4

## 8.1.5 Measurement results

### 8.1.5.1 Test result on phase line

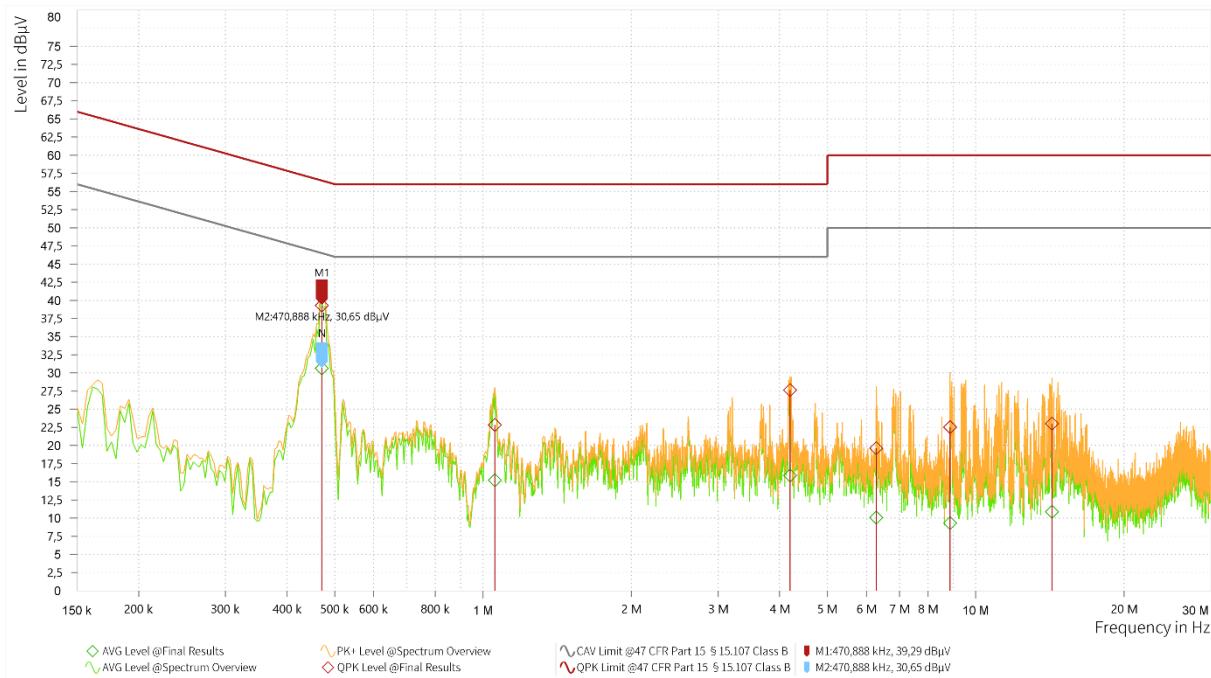


## EMI Final Results

| Frequency [MHz] | QPK Level [dBμV] | QPK Limit [dBμV] | QPK Margin [dB] | AVG Level [dBμV] | AVG: CAV Limit [dBμV] | AVG Margin [dB] | Correction [dB] | Line | Meas. BW [kHz] | Meas. Time [ms] |
|-----------------|------------------|------------------|-----------------|------------------|-----------------------|-----------------|-----------------|------|----------------|-----------------|
| 0,471           | 36,42            | 56,50            | 20,08           | 27,70            | 46,50                 | 18,80           | 10,08           | L1   | 9,000          | 15.000.000      |
| 0,486           | 35,73            | 56,24            | 20,51           | 27,97            | 46,24                 | 18,27           | 10,08           | L1   | 9,000          | 15.000.000      |
| 3,818           | 26,14            | 56,00            | 29,86           | 8,29             | 46,00                 | 37,71           | 9,93            | L1   | 9,000          | 15.000.000      |
| 9,172           | 25,45            | 60,00            | 34,55           | 8,49             | 50,00                 | 41,51           | 10,14           | L1   | 9,000          | 15.000.000      |
| 11,463          | 26,09            | 60,00            | 33,91           | 10,14            | 50,00                 | 39,86           | 10,24           | L1   | 9,000          | 15.000.000      |
| 11,952          | 25,18            | 60,00            | 34,82           | 9,13             | 50,00                 | 40,87           | 10,26           | L1   | 9,000          | 15.000.000      |

### 8.1.5.2 Test result on neutral line

Spectrum Overview



## EMI Final Results

| Frequency [MHz] | QPK Level [dB $\mu$ V] | QPK Limit [dB $\mu$ V] | QPK Margin [dB] | AVG Level [dB $\mu$ V] | AVG: CAV Limit [dB $\mu$ V] | AVG Margin [dB] | Correction [dB] | Line | Meas. BW [kHz] | Meas. Time [ms] |
|-----------------|------------------------|------------------------|-----------------|------------------------|-----------------------------|-----------------|-----------------|------|----------------|-----------------|
| 0,471           | 39,29                  | 56,50                  | 17,21           | 30,65                  | 46,50                       | 15,85           | 10,08           | N    | 9,000          | 15.000,000      |
| 1,057           | 22,85                  | 56,00                  | 33,15           | 15,21                  | 46,00                       | 30,79           | 9,92            | N    | 9,000          | 15.000,000      |
| 4,198           | 27,64                  | 56,00                  | 28,36           | 15,88                  | 46,00                       | 30,12           | 9,96            | N    | 9,000          | 15.000,000      |
| 6,280           | 19,61                  | 60,00                  | 40,39           | 10,06                  | 50,00                       | 39,94           | 10,05           | N    | 9,000          | 15.000,000      |
| 8,870           | 22,53                  | 60,00                  | 37,47           | 9,32                   | 50,00                       | 40,68           | 10,14           | N    | 9,000          | 15.000,000      |
| 14,284          | 23,01                  | 60,00                  | 36,99           | 10,88                  | 50,00                       | 39,12           | 10,35           | N    | 9,000          | 15.000,000      |

## 8.2 Radiated emission (§15.109)

### 8.2.1 Test plan

|                       |                     |
|-----------------------|---------------------|
| <b>Test setup</b>     | EUT A + AE 1 + AE 2 |
| <b>Operating mode</b> | EMC test mode       |
| <b>Limit</b>          | §15.109 Class B     |
| <b>Verdict</b>        | passed*             |

\* see measurement results in section 8.2.5

**Comment:** ---

### 8.2.2 Frequency range of radiated measurements (§15.33)

| <b>Highest frequency generated or used in the device or on which the device operates or tunes</b> | <b>Upper frequency of measurement range (MHz)</b>                    |
|---|--|
| Below 1.705 MHz   | 30 MHz   |
| 1.705 – 108 MHz   | 1000 MHz   |
| 108 – 500 MHz   | 2000 MHz   |
| 500 – 1000 MHz  | 5000 MHz   |
| Above 1000 MHz  | 5th harmonic of the highest frequency or 40 GHz, whichever is lower. |

### 8.2.3 Radiated emission limits (§15.109)

#### Description & Limits

§ 15.109 Radiated emission limits.

(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

| Frequency<br>[MHz] | Field Strength<br>[ $\mu$ V/m] / [dB $\mu$ V/m] | Measurement distance<br>[m] |
|--------------------|---|-----------------------------|
| 30 – 88            | 100 / 40.0                                      | 3                           |
| 88 – 216           | 150 / 43.5                                      | 3                           |
| 216 – 960          | 200 / 46.0                                      | 3                           |
| 960 – 40 000       | 500 / 54.0                                      | 3                           |

(b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the following:

| Frequency<br>[MHz] | Field Strength<br>[ $\mu$ V/m] / [dB $\mu$ V/m] | Measurement distance<br>[m] |
|--------------------|---|-----------------------------|
| 30 – 88            | 90 / 39.1                                       | 3                           |
| 88 – 216           | 150 / 43.5                                      | 3                           |
| 216 – 960          | 210 / 46.4                                      | 3                           |
| 960 – 40 000       | 300 / 49.5                                      | 3                           |

#### Note

Measurements with the peak detector are also suitable to demonstrate compliance of an EUT, as long as the required resolution bandwidth is used, because peak detection will yield amplitudes equal to or greater than amplitudes measured with RMS detector. The measurement data from a spectrum analyser peak detector will represent the worst-case results (see ANSI C63.10).

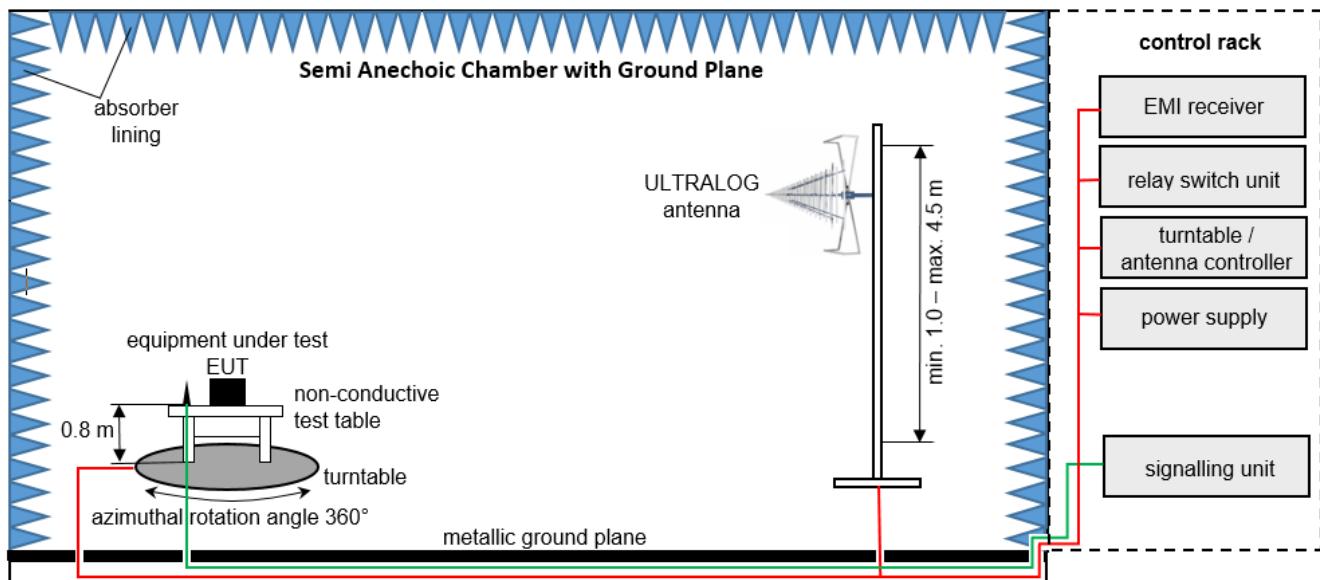
#### Typical test distances

Up to 18 GHz: 3.00 m  
 18 – 40 GHz: 0.50 m

## 8.2.4 Test Setup Description

### 8.2.4.1 Semi Anechoic Chamber with Ground Plane

Radiated measurements are performed in vertical and horizontal plane in the frequency range 30 MHz to 1 GHz in a Semi Anechoic Chamber with a metallic ground plane. The EUT is positioned on a non-conductive test table with a height of 0.80 m above the metallic ground plane that covers the whole chamber. The receiving antennas conform to specification ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices. These antennas can be moved over the height range between 1.0 m and 4.5 m in order to search for maximum field strength emitted from the EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by a spectrum analyzer where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: ULTRALOG antenna 3 meter

EMC32 software version: 11.10.00

FS = UR + CL + AF

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

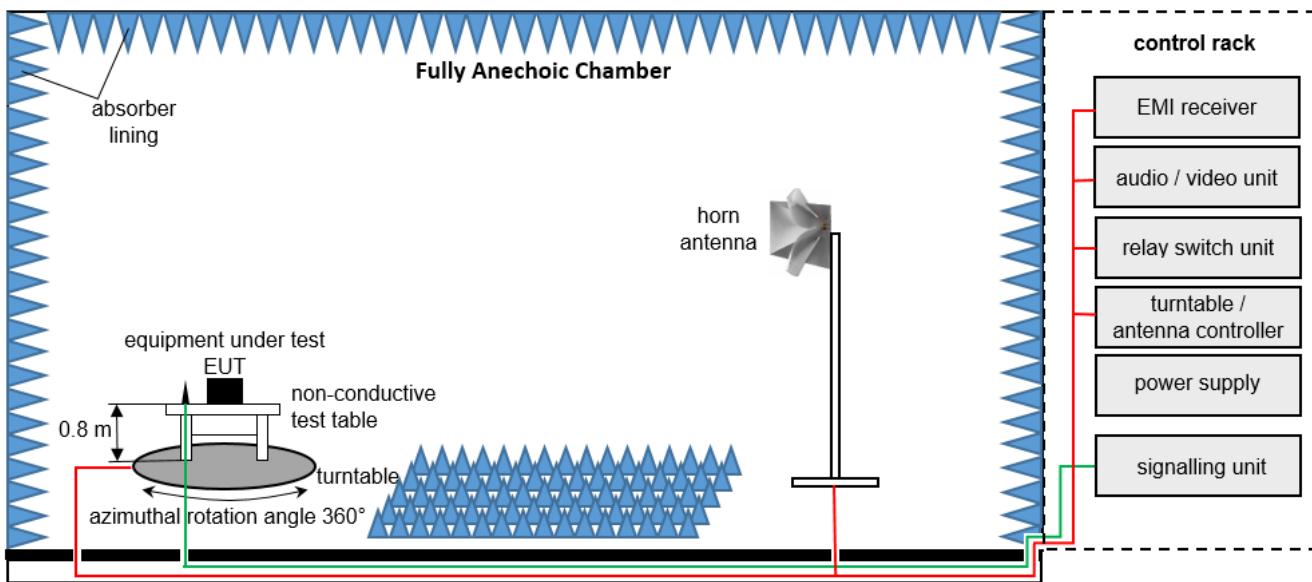
#### Example calculation:

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

#### List of test equipment used:

| # | Equipment                        | Type                       | Serial number | Internal number | Calibrated until | Used for test                       |
|---|----------------------------------|----------------------------|---------------|-----------------|------------------|-------------------------------------|
| 1 | EMI Test Receiver                | Rohde & Schwarz ESW 26     | 101481        | LAB000236       | 2022-07-07       | <input checked="" type="checkbox"/> |
| 2 | Open Switch and Control Platform | Rohde & Schwarz OSP-B200S2 | 101443        | LAB000239       | n/a              | <input checked="" type="checkbox"/> |
| 3 | Antenna                          | Rohde & Schwarz HL562E     | 102001        | LAB000123       | 2023-07-05       | <input checked="" type="checkbox"/> |

## 8.2.4.2 Fully Anechoic Chamber



Measurement distance: horn antenna 3 meter

EMC32 software version: 11.10.00

FS = UR + CA + AF

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

Example calculation:

$$\text{FS [dB}\mu\text{V/m]} = 40.0 \text{ [dB}\mu\text{V/m]} + (-35.8) \text{ [dB]} + 32.9 \text{ [dB/m]} = 37.1 \text{ [dB}\mu\text{V/m]} (71.61 \mu\text{V/m})$$

List of test equipment used:

| # | Equipment                        | Type                       | Serial number | Internal number | Calibrated until | Used for test                       |
|---|----------------------------------|----------------------------|---------------|-----------------|------------------|-------------------------------------|
| 1 | EMI Test Receiver                | Rohde & Schwarz ESW 26     | 101481        | LAB000236       | 2022-07-07       | <input checked="" type="checkbox"/> |
| 2 | Open Switch and Control Platform | Rohde & Schwarz OSP-B200S2 | 101443        | LAB000239       | n/a              | <input checked="" type="checkbox"/> |
| 3 | Antenna                          | Rohde & Schwarz HF907      | 102899        | LAB000151       | 2023-04-23       | <input checked="" type="checkbox"/> |
| 4 | Pre-Amplifier                    | Schwarzbeck BBV 9718 C     | 84            | LAB000169       | n/a              | <input checked="" type="checkbox"/> |

## 8.2.5 Test Setup Description

### 8.2.5.1 Radiated spurious emissions from 30 MHz to 1 GHz

#### Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.
- In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, ... necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, ... are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

#### Pre-scan

- Turntable performs an azimuthal rotation from 0° to 315° in 45° steps.
- Antenna polarisation is changed (H-V / V-H) and antenna height is changed from 1 meter to 4 meters.
- For each turntable step / antenna polarisation / antenna height the EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

#### Final measurement

- Significant emissions found during the pre-scan will be maximized by the EMI-software based on evaluated data during the pre-scan by rotating the turntable and changing antenna height and polarisation.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C63.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position, antenna polarisation and settings of measuring equipment is recorded.

Detailed requirements can be found in e.g. ANSI C63.4

### 8.2.5.2 Radiated spurious emissions from 1 GHz to 18 GHz

#### Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.  
In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, ... necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, ... are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

#### Pre-scan

- Turntable performs an azimuthal rotation from 0° to 315° in 45° steps.
- Antenna polarisation is changed (H-V / V-H) and antenna height is changed from 1 meter to 4 meters.
- For each turntable step / antenna polarisation / antenna height the EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

#### Final measurement

- Significant emissions found during the pre-scan will be maximized by the EMI-software based on evaluated data during the pre-scan by rotating the turntable and changing antenna height and polarisation.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C63.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position, antenna polarisation and settings of measuring equipment is recorded.

Detailed requirements can be found in e.g. ANSI C63.4

### 8.2.5.3 Radiated spurious emissions above 18 GHz

#### Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- Additional equipment, cables, ... necessary for testing, are positioned like under normal operation.
- EUT is powered on and set into operation.
- Test distance depends on EUT size and test antenna size (farfield conditions shall be met).

#### Pre-scan

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

#### Final measurement

- Significant emissions found during the pre-scan will be maximized, i.e. position and antenna orientation causing the highest emissions with Peak and RMS detector
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C63.4).
- Final plot showing measurement data, levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit is recorded.

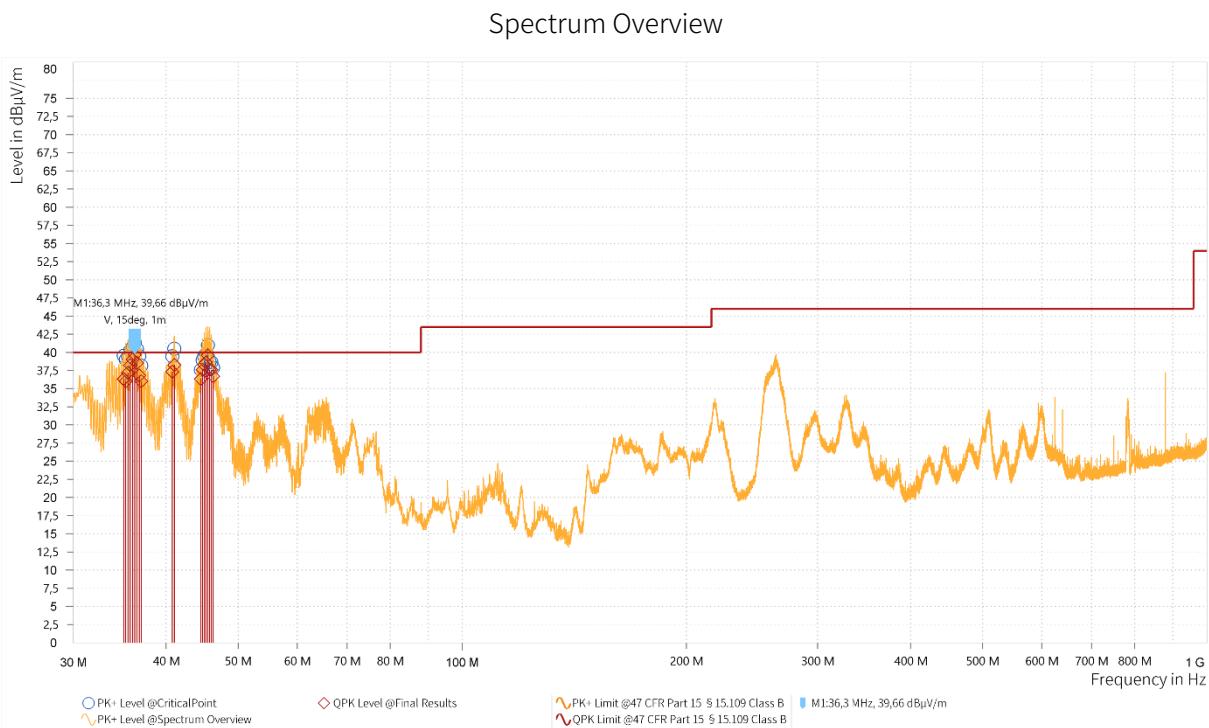
#### Note

- In case of measurements with external harmonic mixers (e.g. above 50 GHz) special care is taken to avoid possible overloading of the external mixer's input.
- As external harmonic mixers may generate false images, care is taken to ensure that any emission measured by the spectrum analyzer is indeed radiated from the EUT and not internally generated by the external harmonic mixer. Signal identification feature of spectrum analyzer is used to eliminate/reduce images of the external harmonic mixer.

Detailed requirements can be found in e.g. ANSI C63.4

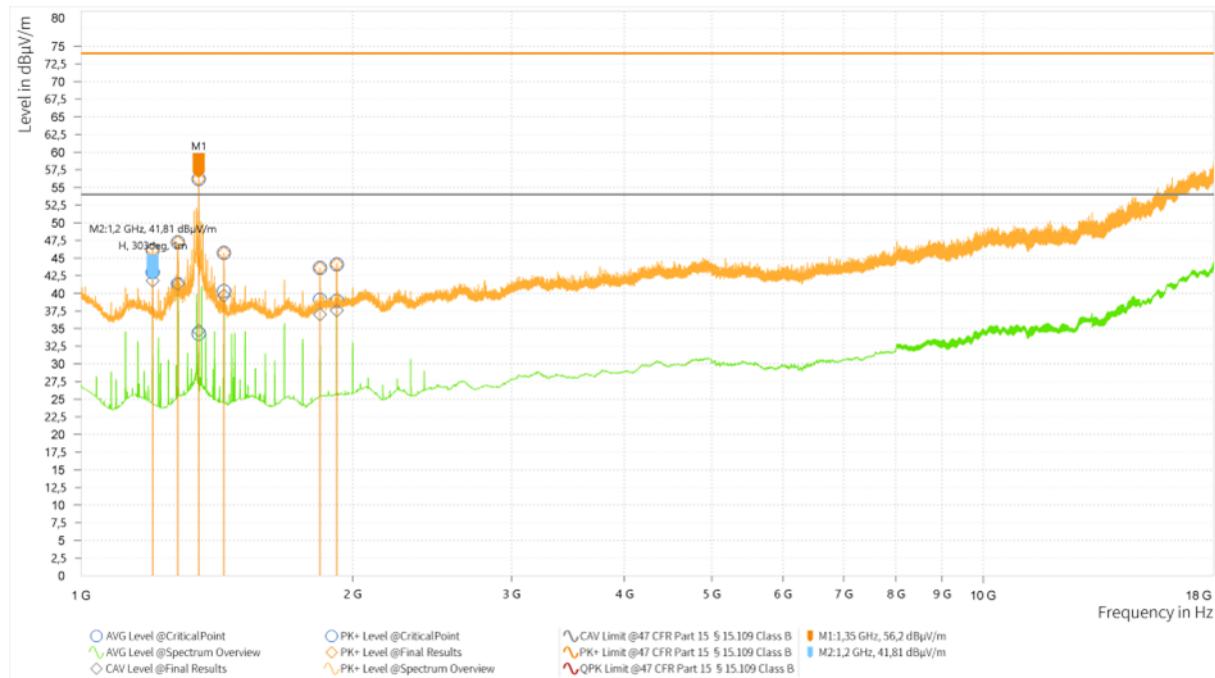
## 8.2.6 Measurement results

### 8.2.6.1 Test result 30 ... 1000 MHz



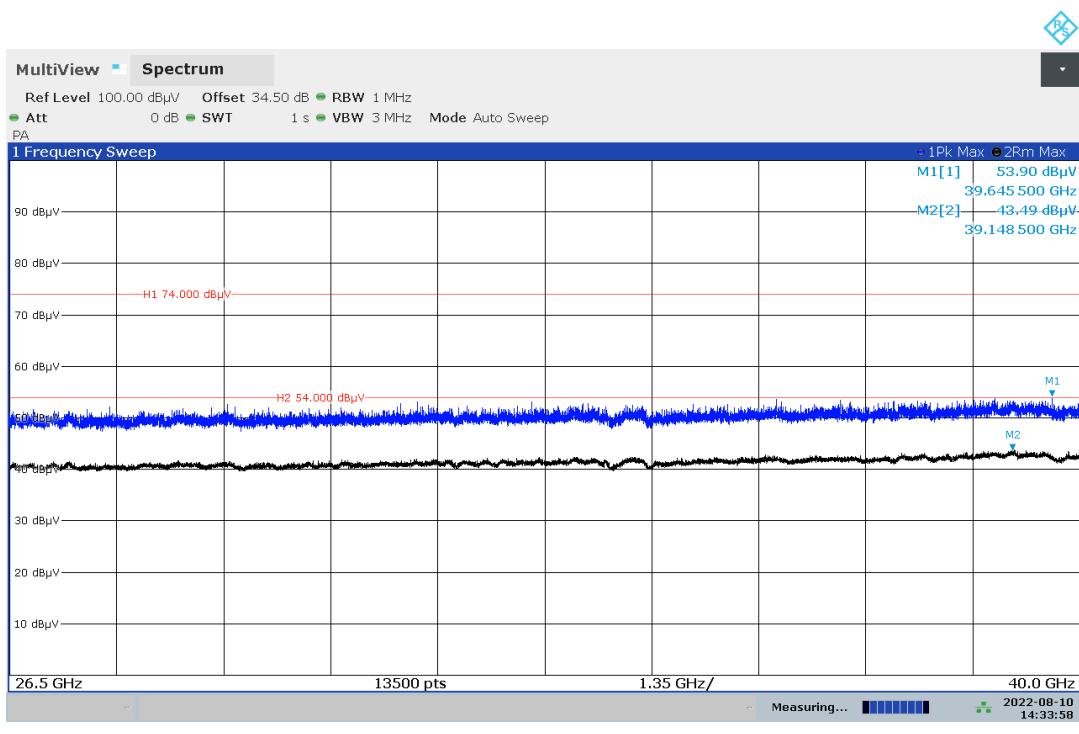
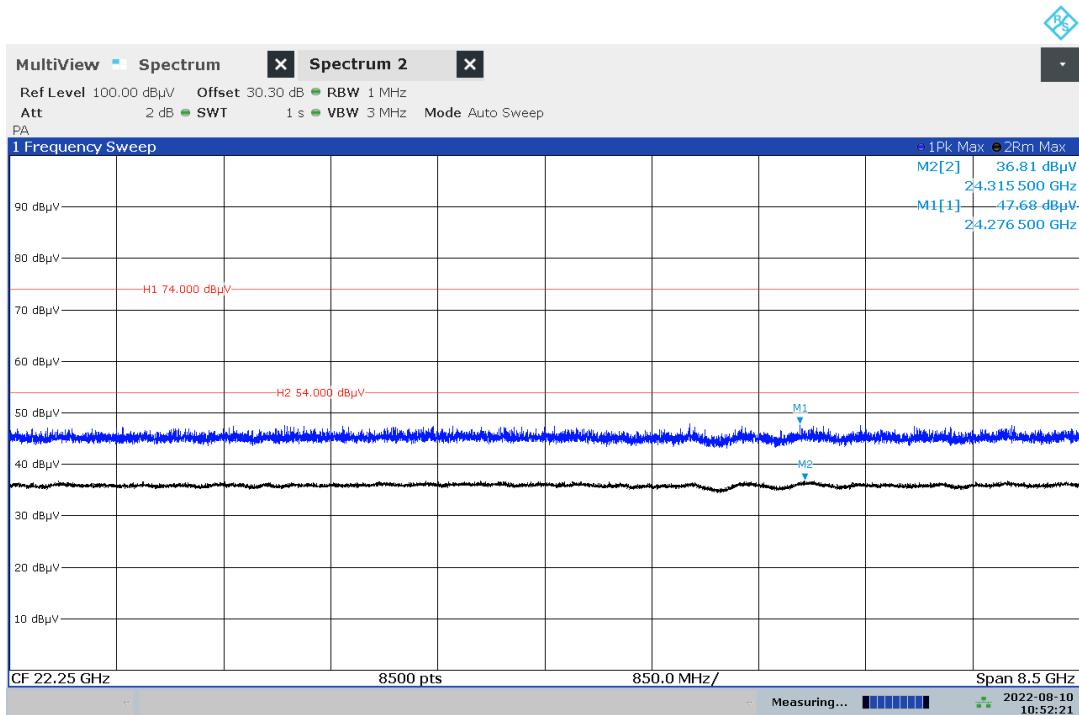
| Frequency [MHz] | QPK Level [dBμV/m] | QPK Limit [dBμV/m] | QPK Margin [dB] | Correction [dB] | Polarization | Azimuth [deg] | Antenna Height [m] | Meas. BW [kHz] | Meas. Time [ms] |
|-----------------|--------------------|--------------------|-----------------|-----------------|--------------|---------------|--------------------|----------------|-----------------|
| 35,070          | 36,33              | 40,00              | 3,67            | 17,68           | V            | 38            | 1,04               | 120,000        | 15.000,000      |
| 35,310          | 36,02              | 40,00              | 3,98            | 17,56           | V            | 38            | 1,04               | 120,000        | 15.000,000      |
| 35,550          | 37,19              | 40,00              | 2,81            | 17,43           | V            | 3             | 1,04               | 120,000        | 15.000,000      |
| 35,790          | 38,22              | 40,00              | 1,78            | 17,31           | V            | 22            | 1                  | 120,000        | 15.000,000      |
| 36,060          | 39,03              | 40,00              | 0,97            | 17,16           | V            | 47            | 1                  | 120,000        | 15.000,000      |
| 36,300          | 39,66              | 40,00              | 0,34            | 17,01           | V            | 15            | 1                  | 120,000        | 15.000,000      |
| 36,540          | 38,53              | 40,00              | 1,47            | 16,87           | V            | 19            | 1                  | 120,000        | 15.000,000      |
| 36,810          | 36,82              | 40,00              | 3,18            | 16,70           | V            | 26            | 1                  | 120,000        | 15.000,000      |
| 37,050          | 36,01              | 40,00              | 3,99            | 16,56           | V            | 14            | 1                  | 120,000        | 15.000,000      |
| 40,770          | 37,31              | 40,00              | 2,69            | 14,34           | V            | 143           | 1                  | 120,000        | 15.000,000      |
| 41,010          | 38,27              | 40,00              | 1,73            | 14,20           | V            | 19            | 1,08               | 120,000        | 15.000,000      |
| 44,520          | 36,32              | 40,00              | 3,68            | 11,82           | V            | 219,5653      | 1                  | 120,000        | 15.000,000      |
| 44,760          | 37,60              | 40,00              | 2,40            | 11,65           | V            | 219,5738      | 1                  | 120,000        | 15.000,000      |
| 45,000          | 38,30              | 40,00              | 1,70            | 11,48           | V            | 224           | 1                  | 120,000        | 15.000,000      |
| 45,240          | 38,63              | 40,00              | 1,37            | 11,31           | V            | 227,5171      | 1                  | 120,000        | 15.000,000      |
| 45,750          | 37,59              | 40,00              | 2,41            | 10,94           | V            | 224           | 1                  | 120,000        | 15.000,000      |
| 45,990          | 37,60              | 40,00              | 2,40            | 10,76           | V            | 240           | 1                  | 120,000        | 15.000,000      |
| 46,260          | 36,71              | 40,00              | 3,29            | 10,60           | V            | 202           | 1,04               | 120,000        | 15.000,000      |

### 8.2.6.2 Test result 1 ... 18 GHz



| Frequency [MHz] | PK+ Level [dBμV/m] | PK+ Limit [dBμV/m] | PK+ Margin [dB] | CAV Level [dBμV/m] | CAV Limit [dBμV/m] | CAV Margin [dB] | Correction [dB] | Polarization | Azimuth [deg] | Antenna Height [m] | Meas. BW [kHz] |
|-----------------|--------------------|--------------------|-----------------|--------------------|--------------------|-----------------|-----------------|--------------|---------------|--------------------|----------------|
| 1.200,000       | 46,14              | 74,00              | 27,86           | 41,81              | 54,00              | 12,19           | -2,80           | H            | 303           | 1                  | 1.000,000      |
| 1.280,000       | 47,22              | 74,00              | 26,78           | 41,33              | 54,00              | 12,67           | -2,35           | H            | 93            | 1                  | 1.000,000      |
| 1.350,000       | 56,20              | 74,00              | 17,80           | 34,73              | 54,00              | 19,27           | -1,77           | H            | 105           | 1                  | 1.000,000      |
| 1.440,000       | 45,72              | 74,00              | 28,28           | 39,66              | 54,00              | 14,34           | -1,37           | V            | 333           | 1                  | 1.000,000      |
| 1.840,000       | 43,59              | 74,00              | 30,41           | 37,00              | 54,00              | 17,00           | 0,88            | V            | 225           | 1                  | 1.000,000      |
| 1.920,000       | 44,09              | 74,00              | 29,91           | 37,58              | 54,00              | 16,42           | 1,41            | H            | 90            | 1                  | 1.000,000      |

## 8.2.6.3 Test result 18 ... 40 GHz



## 9 MEASUREMENT UNCERTAINTY

| # | Test  | Measurement uncertainty  |  |
|---|---|--|--|
| 1 | Conducted emissions<br>CISPR 16-4-2                         | 2.21 dB  |  |
| 2 | Radiated emissions<br>CISPR 16-4-2                          | 30 ... 1000 MHz<br>1 ... 18 GHz  | 3.68dB<br>3.64 dB  |
| 3 | Harmonics / Flicker<br>EN / IEC 61000-4-15                  | Current AC 350uA-320mA / 50Hz-5kHz<br>Current AC 350mA-2.2A / 50Hz-5kHz<br>Current AC 2.5A-10A / 50Hz-1kHz<br>Current AC 2A-80A / 50Hz-1kHz<br>Resistor DC<br>Inductance<br>Short-term flicker severity<br>Maximum steady state voltage<br>Maximum absolute voltage change<br>Maximum time duration during observation<br>Voltage AC 1V-1000V / 16Hz-10kHz | 0.24 %<br>0.40 %<br>0.27 %<br>0.20 %<br>0.23 %<br>0.23 %<br>0.24 %<br>0.24 %<br>0.24 %<br>0.24 %<br>0.20 % |
| 4 | Radio frequency electromagnetic field<br>EN / IEC 61000-4-3 | 1.98 dB  |  |
| 5 | Electrical fast transients / Burst<br>EN / IEC 61000-4-4    | Peak Voltage<br>Rise time<br>Duration<br>Frequency oscilloscope  | 6.05 %<br>186 ps<br>1602 ps<br>0.014 %   |
| 6 | Surges<br>EN / IEC 61000-4-5                                | Peak current<br>Front & Rise time<br>Duration<br>Frequency oscilloscope<br>Peak voltage<br>Front & Rise time<br>Duration   | 3.67 %<br>76000 ps<br>76000 ps<br>0.014 %<br>4.87 %<br>4600 ps<br>4600 ps                                  |
| 7 | Conducted disturbances<br>EN / IEC 61000-4-6                | 3.47 dB  |  |
| 8 | Voltage dips and interruptions<br>EN / IEC 61000-4-11       | Voltage AC 1mV-1000V<br>Current AC<br>Inrush Current<br>Rise / Fall time<br>Duration   | 4.95 %<br>3.82 %<br>3.71 %<br>18.4 ns<br>46000 ps  |

---

**END OF TEST REPORT**