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Page 1 of 39

## Prüfbericht / Test Report

Nr. / No. TR-713277801-03 (Revision 0)

|                                             |                                                     |
|---------------------------------------------|-----------------------------------------------------|
| Auftraggeber<br><i>Applicant</i>            | Aptiv Services Deutschland GmbH                     |
| Geräteart<br><i>Type of equipment</i>       | Vehicle Radar                                       |
| Typenbezeichnung<br><i>Type designation</i> | SRR6PB2                                             |
| Seriennummer /<br><i>Serial number</i>      | 0002                                                |
| Auftragsnummer /<br><i>Order No.</i>        | 454163298                                           |
| Prüfgrundlage<br><i>Test standards</i>      | ARIB STD-T48 V2.2<br>Article 2 Paragraph 1 Item (8) |

## Summary

|                                                                                                                                                                                  |                                                |                                           |                                                  |                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-------------------------------------------|--------------------------------------------------|---------------------------------------------------|
| <b>Prüfergebnisse / Test Results</b>                                                                                                                                             | Auftragsnummer / Order No.<br><b>454163298</b> |                                           |                                                  |                                                   |
| Die Prüfungen wurden nach folgenden Vorschriften durchgeführt:<br><i>Tests were performed according to:</i><br><b>ARIB STD-T48 V2.2</b><br><b>Article 2 Paragraph 1 Item (8)</b> |                                                |                                           |                                                  |                                                   |
| <b>Durchgeführte Prüfung</b><br><i>Test performed</i>                                                                                                                            | <b>Prüfergebnis</b><br><i>Test result</i>      |                                           |                                                  |                                                   |
|                                                                                                                                                                                  | <b>Erfüllt</b><br><i>Passed</i>                | <b>Nicht erfüllt</b><br><i>Not Passed</i> | <b>Nicht zutreffend</b><br><i>Not applicable</i> | <b>Nicht durchgeführt</b><br><i>Not performed</i> |
| Antenna Power                                                                                                                                                                    | <input checked="" type="checkbox"/>            | <input type="checkbox"/>                  | <input type="checkbox"/>                         | <input type="checkbox"/>                          |
| Allowable Deviations in Antenna Power                                                                                                                                            | <input checked="" type="checkbox"/>            | <input type="checkbox"/>                  | <input type="checkbox"/>                         | <input type="checkbox"/>                          |
| Allowable Deviations in Frequency                                                                                                                                                | <input checked="" type="checkbox"/>            | <input type="checkbox"/>                  | <input type="checkbox"/>                         | <input type="checkbox"/>                          |
| Permissible Value of Occupied Bandwidth                                                                                                                                          | <input checked="" type="checkbox"/>            | <input type="checkbox"/>                  | <input type="checkbox"/>                         | <input type="checkbox"/>                          |
| Permissible Levels of Spurious Emission or Unwanted Emission Intensity                                                                                                           | <input checked="" type="checkbox"/>            | <input type="checkbox"/>                  | <input type="checkbox"/>                         | <input type="checkbox"/>                          |
| Antenna Gain                                                                                                                                                                     | <input checked="" type="checkbox"/>            | <input type="checkbox"/>                  | <input type="checkbox"/>                         | <input type="checkbox"/>                          |

### Bemerkungen / Remarks:

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Die Prüfergebnisse beziehen sich ausschließlich auf das zur Prüfung vorgestellte Prüfmuster. Ohne schriftliche Genehmigung des Prüflabors darf der Prüfbericht auszugsweise nicht vervielfältigt werden. *The test results relate only to the individual item which has been tested. Without the written approval of the test laboratory this report may not be reproduced in extracts.*

| Datum / Date | Geprüft von / Tested by                                                                                                                       | Freigabe durch / Checked by                                                                                                          | Prüfergebnis / Test Result                                                                                  |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| 2023-01-20   | <br>SIGN-ID 748040<br>Alex Fink<br>Responsible for testing | <br>SIGN-ID 751009<br>Matthias Stumpe<br>Reviewer | <input checked="" type="checkbox"/> Erfüllt / Passed<br><input type="checkbox"/> Nicht erfüllt / Not passed |

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## 1 Administrative Data

| Application details          |                                                                                       |
|------------------------------|---------------------------------------------------------------------------------------|
| Applicant:                   | Aptiv Services Deutschland GmbH<br>Am Technologiepark 1<br>42119 Wuppertal<br>Germany |
| Contact person:              | Ms. Ljiljana TRIVIC                                                                   |
| Intercompany contact:        | TÜV SÜD Product Service GmbH<br>Global Market Access<br>Mr. Thomas Ring               |
| Order number:                | 454163298                                                                             |
| Receipt of EUT:              | 2022-11-18                                                                            |
| Return of EUT:               | ---                                                                                   |
| Date(s) of test:             | 2022-11-18 to 2022-12-02                                                              |
| Note(s):                     | ---                                                                                   |
| Responsible for testing:     | Mr. Martin Steindl, Mr. Alex Fink                                                     |
| Responsible for test report: | Mr. Alex Fink                                                                         |
| Test report checked by:      | Mr. Matthias Stumpe                                                                   |

| Report details |                 |
|----------------|-----------------|
| Report number: | TR-713277801-03 |
| Revision:      | 0               |
| Issue date:    | 2023-01-20      |

## 2 Details about the Test Laboratory

| Details about the Test Laboratory |                                                                             |
|-----------------------------------|-----------------------------------------------------------------------------|
| Company name:                     | TÜV SÜD Product Service GmbH                                                |
| Address:                          | Äußere Frühlingstraße 45<br>D-94315 Straubing<br>Germany                    |
| Contact:                          | Mr. Markus Bibberger<br><br>Phone: +49 9421 5522-0<br>Fax: +49 9421 5522-99 |

### 3 Description of the Equipment Under Test

| Equipment characteristics   |                                                                                                                                     |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Type designation:           | SRR6PB2                                                                                                                             |
| Parts of the system:        | Radar ECU                                                                                                                           |
| Options and accessories:    | ---                                                                                                                                 |
| Type of equipment:          | Vehicle Radar                                                                                                                       |
| Serial number:              | 0002                                                                                                                                |
| Manufacturer:               | Aptiv Services Deutschland GmbH                                                                                                     |
| Hardware version:           | B2                                                                                                                                  |
| Software version:           | 4.0.0                                                                                                                               |
| Power supply:               | Battery supply (regulated lead-acid)<br><br>Nominal: 12.0 V<br>Minimum: 6.5 V<br>Maximum: 18.0 V<br><br>Nominal frequency: N/A - DC |
| Highest internal frequency: | --- / 76.9 GHz (radio)                                                                                                              |

#### Marking Plate(s)

• **A P T I V** •

28794717A

M# SRR6PB2

SW:4.0.0

HW:B2



R 203-XXXXXX

FCC ID: LTQSRR6PB2

#### Technical Description

The Equipment Under Test (EUT) was an Aptiv SRR6PB2. The EUT is a 76 to 77 GHz vehicular radar. The device employs a dynamic chirp modulated transmit array. Multiple receive antennas are used to determine target angular resolution through digital beam forming. When installed on a vehicle, the device will operate when the vehicle is running. The nominal operating voltage is 12.0 V DC.

Antenna gain: 13.3 dBi

##### Modulation characteristics:

b. Non-pulsed radar

The radar is a FMCW radar.

Modulation Type: Sawtooth

Sweep Bandwidth: 650 MHz

Sweep rate: 24 GHz/s

Sweep time: 27 ms

Reset time (no transmission): 23 ms

## 4 Operation Mode and Configuration of EUT

### Operation Mode(s)

The operating modes were tested with a single modulation, as provided by the manufacturer.

### List of ports and cables

| No. | Description                    | Classification <sup>1</sup> | Cable type | Cable length<br>used | maximum <sup>2</sup> |
|-----|--------------------------------|-----------------------------|------------|----------------------|----------------------|
| D1  | DC 12 V supply                 | dc power                    | Unshielded | 2 m                  | < 3 m                |
| S1  | Wiring harness (CAN, Ethernet) | signal/control port         | Unshielded | 2 m                  | < 3 m                |

### List of devices connected to EUT

| No. | Description | Type designation | Serial no. or ID | Manufacturer |
|-----|-------------|------------------|------------------|--------------|
| --- | ---         | ---              | ---              | ---          |

### List of support devices

| No. | Description       | Type designation | Serial no. or ID | Manufacturer |
|-----|-------------------|------------------|------------------|--------------|
| 1   | CAN/LIN-Interface | VN1640A          | ---              | Vector       |
| 2   | Notebook          | Latitude 5480    | ---              | Dell         |

<sup>1</sup> Ports shall be classified as ac power, dc power or signal/control port.

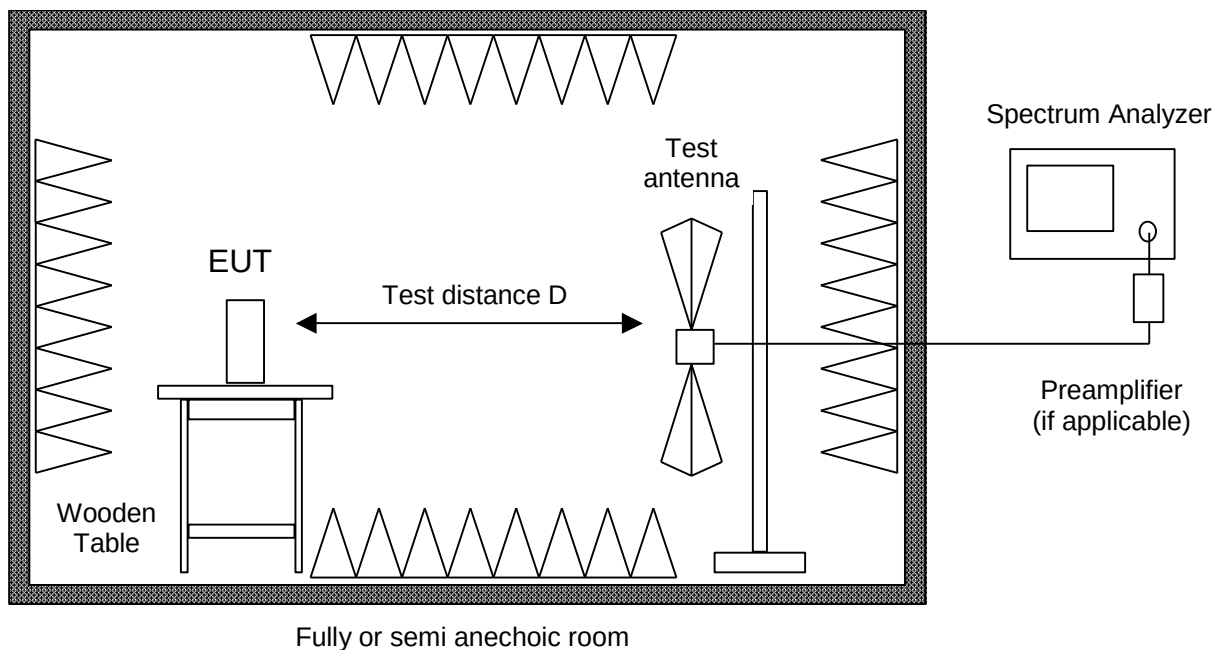
<sup>2</sup> As specified by applicant

## 5 Referenced Regulations

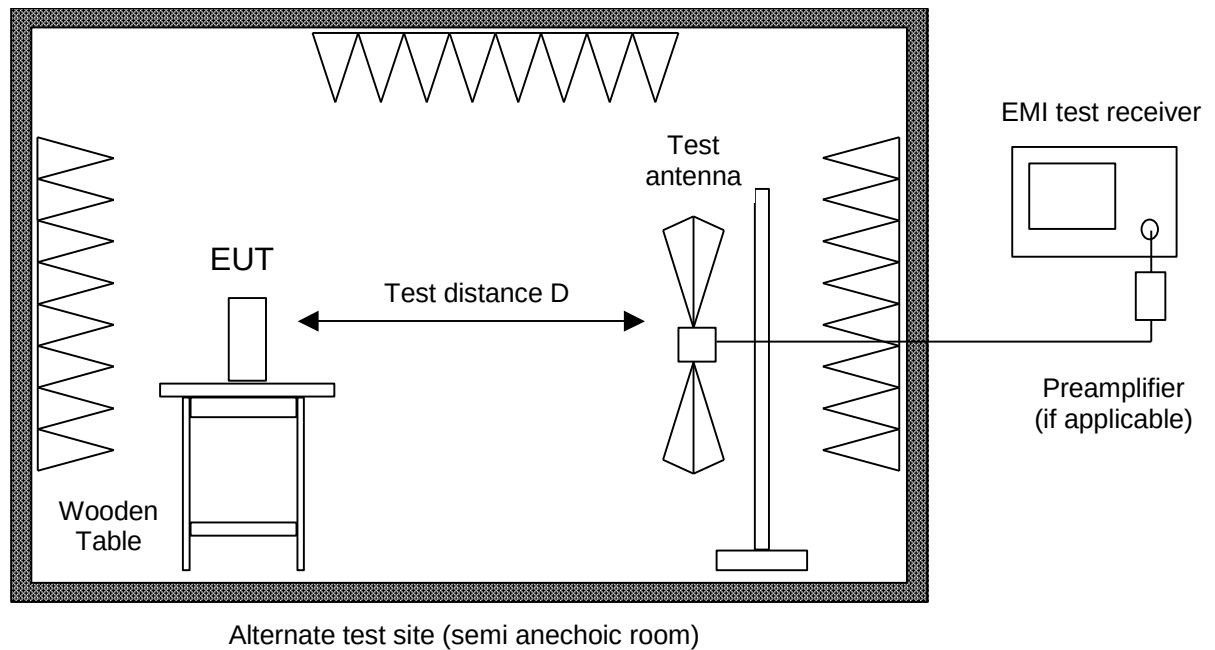
| <i>Publication</i> | <i>Title</i>                                                                                               |
|--------------------|------------------------------------------------------------------------------------------------------------|
| ARIB STD-T48 V2.2  | Millimeter-Wave Radar Equipment for Specified Low Power Radio Station<br>ARIB Standard (December 03, 2015) |

## 6 Test Setups

### Radiated Emission in Fully or Semi Anechoic Room



## Radiated Emission at Alternative Test Site



## 7 Test Results

### ARIB STD-T48 V2.2

| Section(s) | Test performed                                                         | Page | Test Result |
|------------|------------------------------------------------------------------------|------|-------------|
| 3.2(1)     | Antenna Power                                                          | 13   | Test passed |
| 3.2(2)     | Allowable Deviations in Antenna Power                                  | 15   | Test passed |
| 3.2(3)     | Allowable Deviations in Frequency                                      | 16   | Test passed |
| 3.2(4)     | Permissible Value of Occupied Bandwidth                                | 22   | Test passed |
| 3.2(5)     | Permissible Levels of Spurious Emission or Unwanted Emission Intensity | 24   | Test passed |
| 3.5(2)     | Antenna Gain                                                           | 34   | Test passed |

## 7.1 Antenna Power

|                           |                                 |
|---------------------------|---------------------------------|
| Prüfdatum / Date of test: | 2022-11-25                      |
| Prüfer / Operator:        | Martin Steindl                  |
| Messplatz / Test site:    | Semi anechoic room, cabin no. 2 |

| Prüfergebnis / Test Result          |                            |
|-------------------------------------|----------------------------|
| <input checked="" type="checkbox"/> | Erfüllt / Passed           |
| <input type="checkbox"/>            | Nicht erfüllt / Not passed |

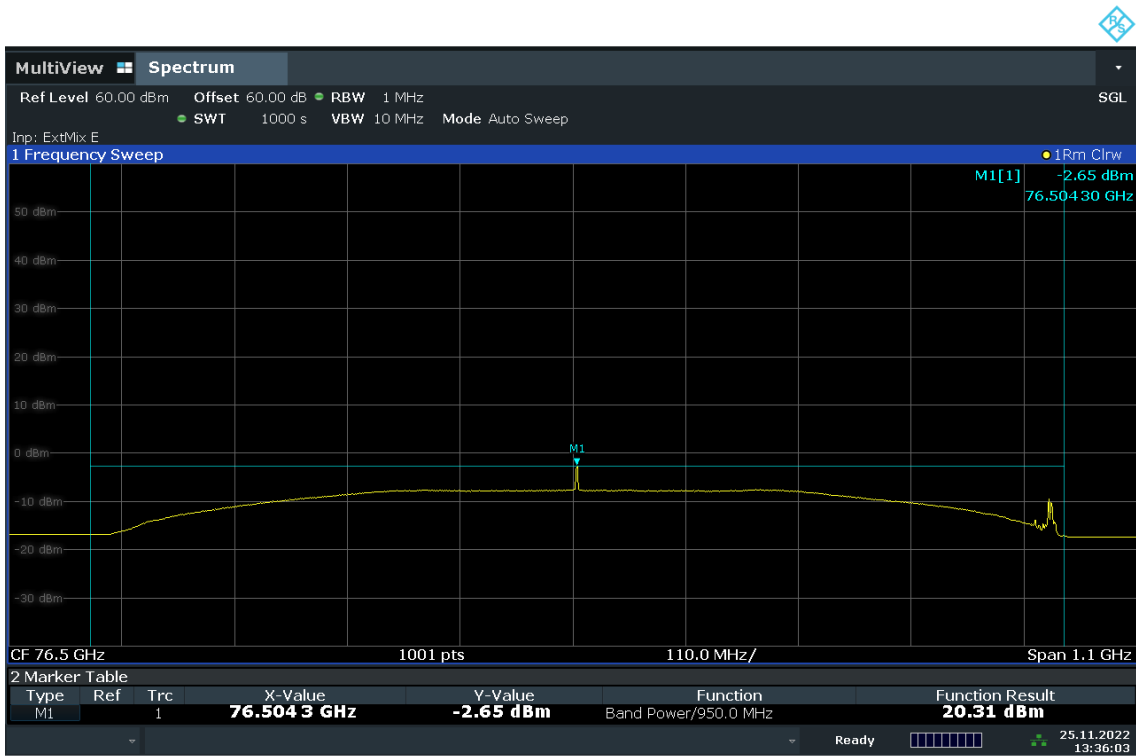
|                                                |         |
|------------------------------------------------|---------|
| Luftdruck / Barometric pressure:               | 990 hPa |
| Relative Luftfeuchtigkeit / Relative humidity: | 22 %    |
| Temperatur / Ambient temperature:              | 38 °C   |

|                                 |                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Prüfgrundlage / Specifications: | ARIB STD-T48 V2.2, section 3.2(1)                                                                                                                                                                                                                                                                                                  |
| Grenzwert / Limit:              | The antenna power shall be 10 mW or less.                                                                                                                                                                                                                                                                                          |
| Betriebsart / Operation mode:   | Transmitting continuously on frequency with modulation bandwidth as stated in table below                                                                                                                                                                                                                                          |
| Kommentar / Comment:            | Test was performed as radiated test. The test distance was 3 m. A correction factor of 60 dB and mixer conversion loss table were used to account for the test antenna gain, free-space loss and external mixer loss.<br>The rated antenna power is measured as RMS value. Antenna Gain of 13.3 dBi was declared by the applicant. |

| Measured EIRP (dBm) | Antenna Gain (dBi) | Antenna Power (dBm) | Antenna Power (mW) | Limit (mW) |
|---------------------|--------------------|---------------------|--------------------|------------|
| 20.31               | 13.30              | 7.01                | 5.02               | 10.00      |



Plots taken during measurement



13:36:04 25.11.2022

## 7.2 Allowable Deviations in Antenna Power

|                           |                                 |
|---------------------------|---------------------------------|
| Prüfdatum / Date of test: | 2022-11-25                      |
| Prüfer / Operator:        | Martin Steindl                  |
| Messplatz / Test site:    | Semi anechoic room, cabin no. 2 |

| Prüfergebnis / Test Result          |                            |
|-------------------------------------|----------------------------|
| <input checked="" type="checkbox"/> | Erfüllt / Passed           |
| <input type="checkbox"/>            | Nicht erfüllt / Not passed |

|                                                |         |
|------------------------------------------------|---------|
| Luftdruck / Barometric pressure:               | 990 hPa |
| Relative Luftfeuchtigkeit / Relative humidity: | 22 %    |
| Temperatur / Ambient temperature:              | 38 °C   |

|                                 |                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Prüfgrundlage / Specifications: | ARIB STD-T48 V2.2, section 3.2                                                                                                                                                      |
| Grenzwert / Limit:              | The tolerance of the antenna power, which is the maximum permissible tolerance from designated or rated antenna power, shall be 50 % in the upper limit and 70 % in the lower limit |
| Betriebsart / Operation mode:   | Transmitting continuously on frequency with modulation bandwidth as stated in table below                                                                                           |
| Kommentar / Comment:            | Calculation of the antenna power deviation is based on the antenna power data from section 7.1 of this test report. Calculation is relative to the maximum rated antenna power.     |

| Measured Antenna Power (mW) | Max. Rated Antenna Power (mW) | Antenna Power Deviation (%) | Limit (%) |
|-----------------------------|-------------------------------|-----------------------------|-----------|
| 5.02                        | 10.0                          | -49.8                       | -70 / +50 |

### 7.3 Allowable Deviations in Frequency

|                           |                                 |
|---------------------------|---------------------------------|
| Prüfdatum / Date of test: | 2022-12-01                      |
| Prüfer / Operator:        | Martin Steindl                  |
| Messplatz / Test site:    | Semi anechoic room, cabin no. 2 |

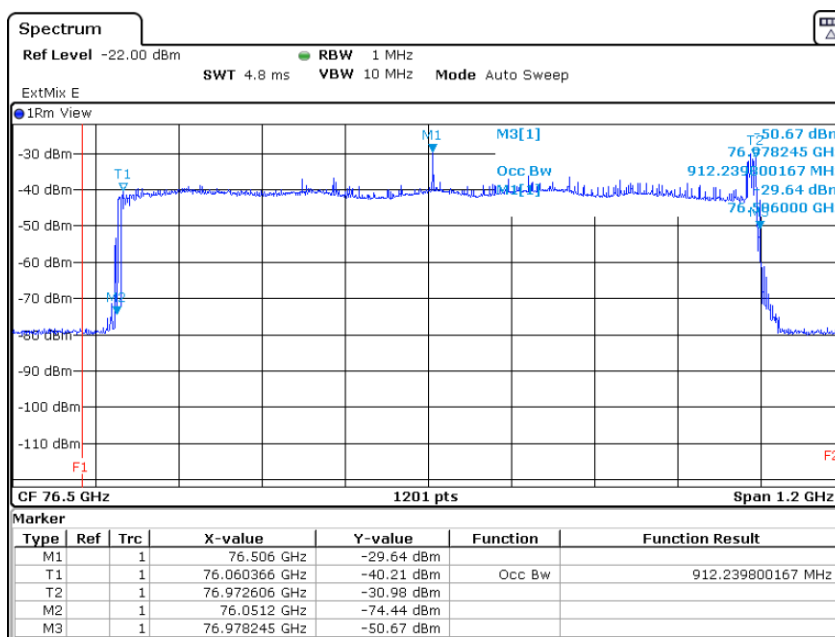
| Prüfergebnis / Test Result          |                            |
|-------------------------------------|----------------------------|
| <input checked="" type="checkbox"/> | Erfüllt / Passed           |
| <input type="checkbox"/>            | Nicht erfüllt / Not passed |

|                                                |         |
|------------------------------------------------|---------|
| Luftdruck / Barometric pressure:               | 978 hPa |
| Relative Luftfeuchtigkeit / Relative humidity: | 22 %    |
| Temperatur / Ambient temperature:              | 37 °C   |

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                             |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| Prüfgrundlage / Specifications: | ARIB STD-T48 V2.2, section 3.2(3), and<br>ORE: Article 5, and<br>NT: No. 643 in 1997                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                             |
| Grenzwert / Limit:              | <p><i>Frequency band 9 (10.5 GHz – 134 GHz):<br/>Wireless station</i></p> <p>1. Radio positioning stations</p> <p>(1) Vehicle sensing radiolocation land stations 800</p> <p>(2) Other radio positioning stations (Note 29) 5000</p> <p>2. Amateur stations 500</p> <p>3. Simple radio stations 200</p> <p>4. Earth station and Space Administration (Note 40) 100</p> <p>5. Specified low power radio stations 500</p> <p>6. Low-power data communication system radio station (Note 34)</p> <p>(1) Those in the 57 GHz – 66 GHz band</p> <p>10 mW or less 500</p> <p>more than 10 mW 20</p> <p>(2) Those of other frequencies 20</p> <p><b>7. Other radio stations (Note 21, 31, 34, 42, 48, 55) 300</b></p> <p><b>Note 34:</b> Allowable deviation of the frequency of the radio waves to be used for the next listed radio equipment:</p> <p>(2) 312 MHz – 315.25 MHz, 401 MHz – 406 MHz, 433.67 MHz – 434.17 MHz, 2400 MHz – 2483.5 MHz, 10.5 GHz – 10.55 GHz, 24.05 GHz – 24.25 GHz, 60 GHz – 61 GHz, radio equipment of the low-power radio stations using 77 GHz – 81 GHz or 76 GHz – 77 GHz frequency bands.</p> | <i>Applicable frequency deviation (ppm)</i> |
| Betriebsart / Operation mode:   | Transmission with unmodulated carrier was used for this test.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                             |
| Kommentar / Comment:            | Test was performed as radiated test. The test distance was 3 m. A correction factor of 60 dB and mixer conversion loss table were used to account for the test antenna gain, free-space loss and external mixer loss.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             |

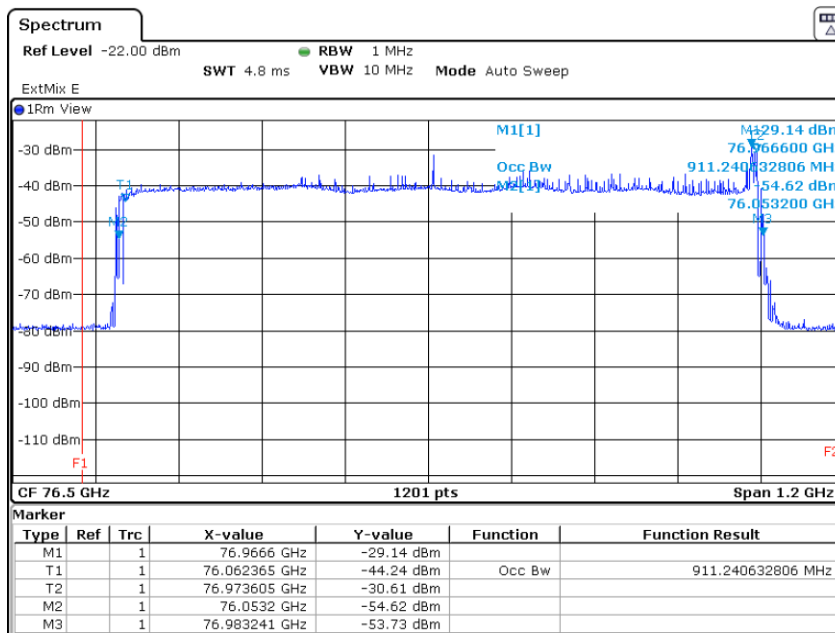
| Test result                                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| On all tested voltages and temperatures, the Occupied Bandwidth (99 %) was within the frequency range 76 to 77 GHz and so, within the designated frequency band. See plots for details |

## Plots taken during measurement



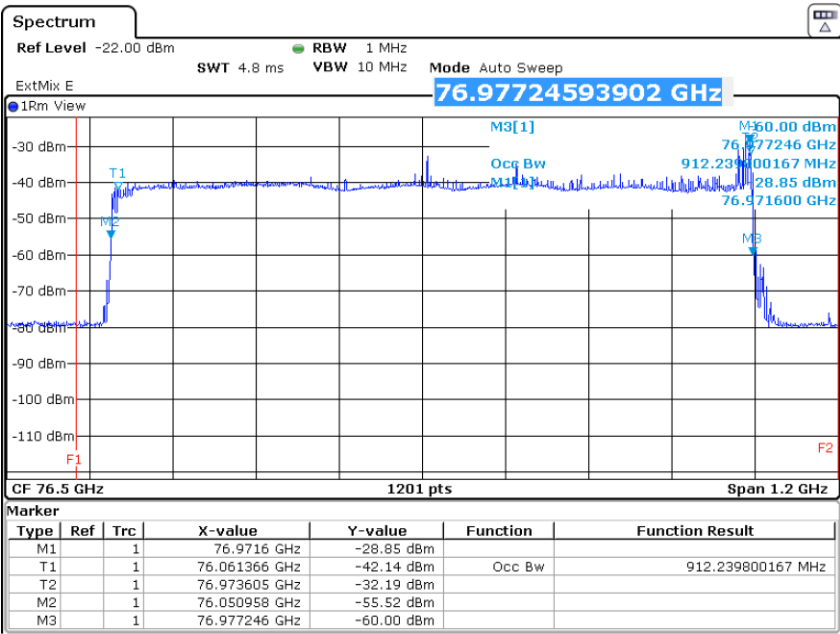
Date: 1.DEC.2022 10:06:41

-20 °C, 12 V



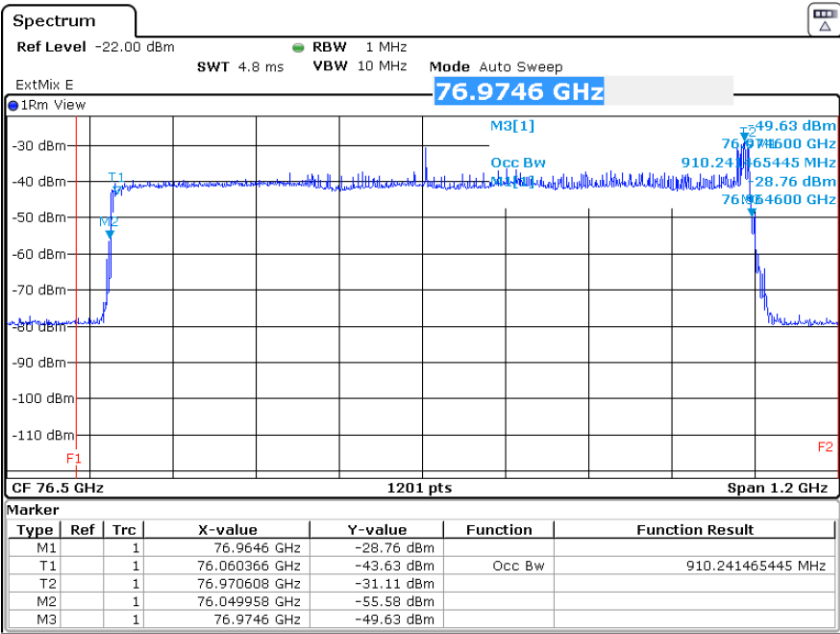
Date: 1.DEC.2022 10:35:15

-10 °C, 12 V



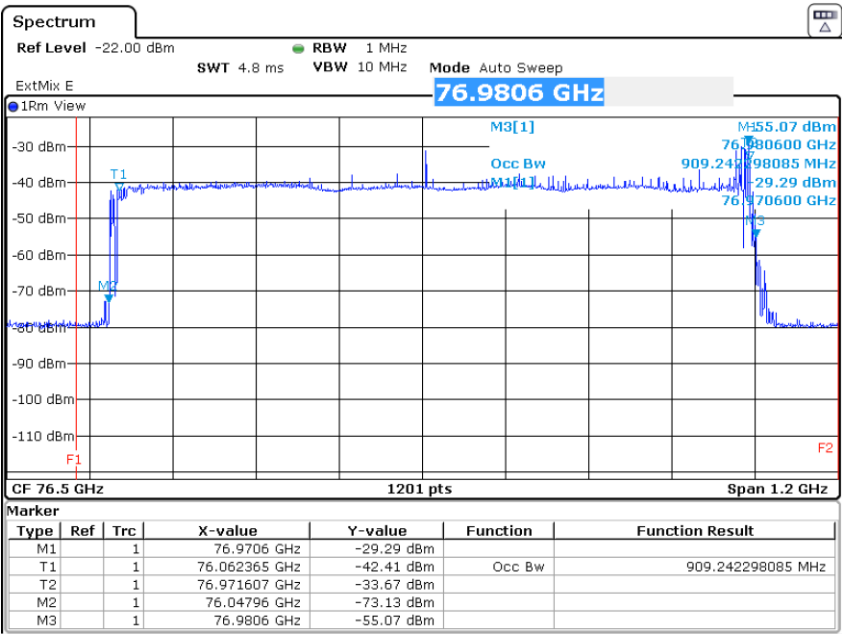
Date: 1.DEC.2022 10:59:40

0 °C, 12 V



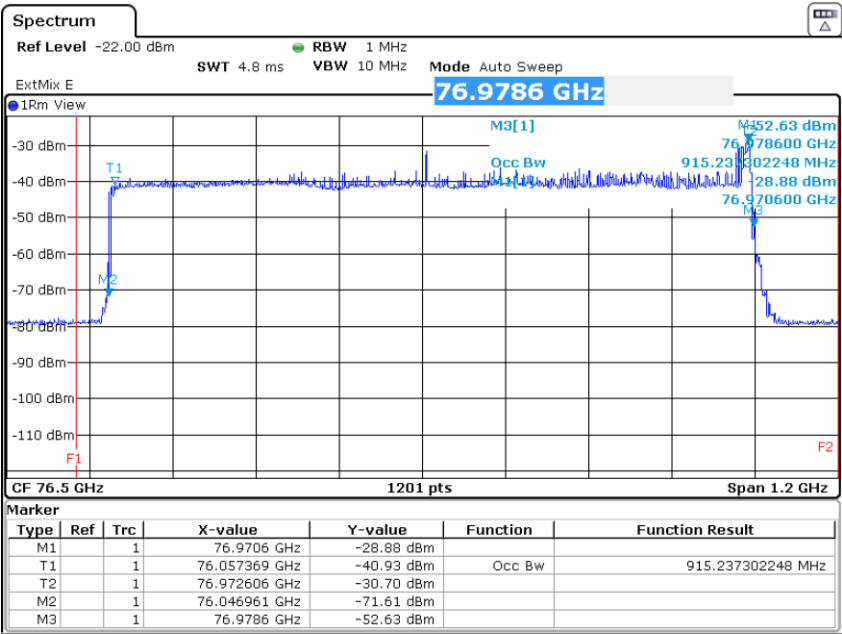
Date: 1.DEC.2022 11:29:59

10 °C, 12 V



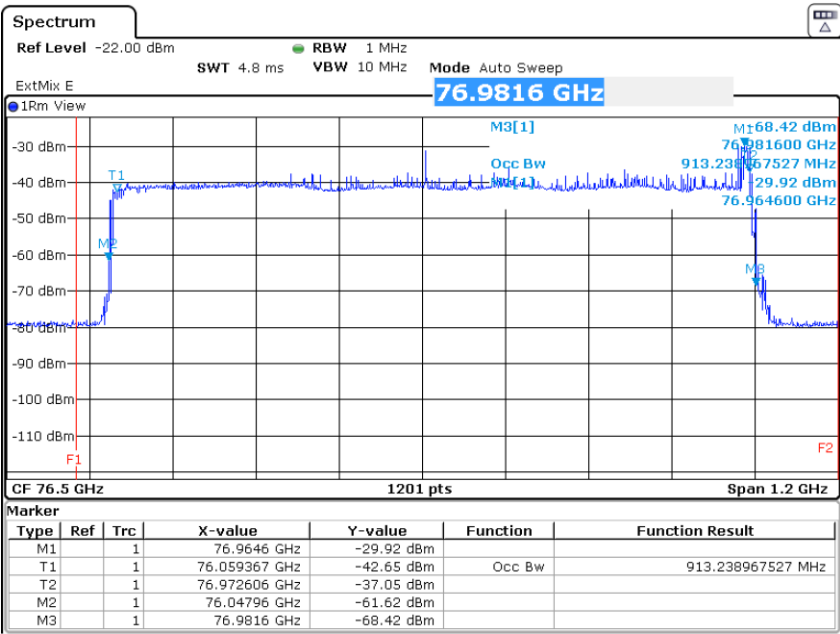
Date: 1.DEC.2022 12:17:55

20 °C, 10 V



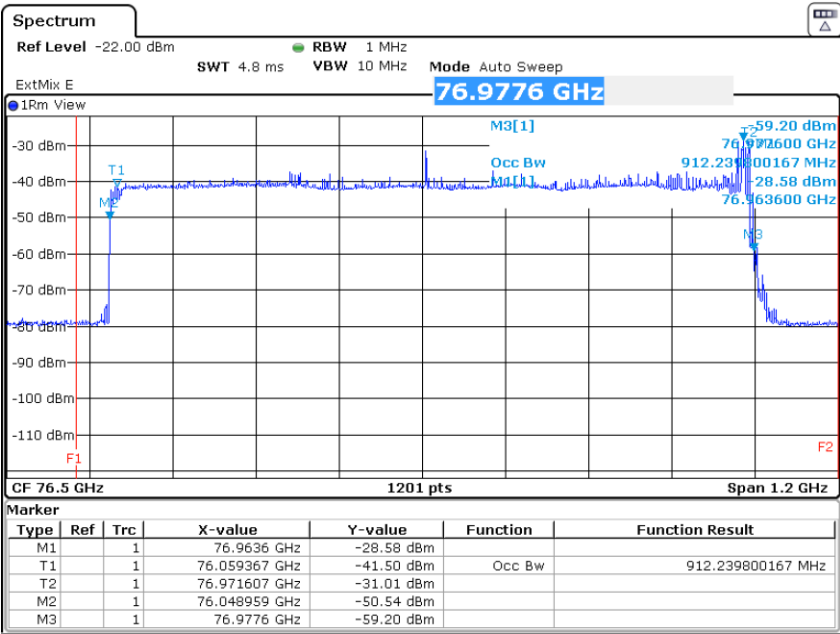
Date: 1.DEC.2022 12:16:20

20 °C, 12 V



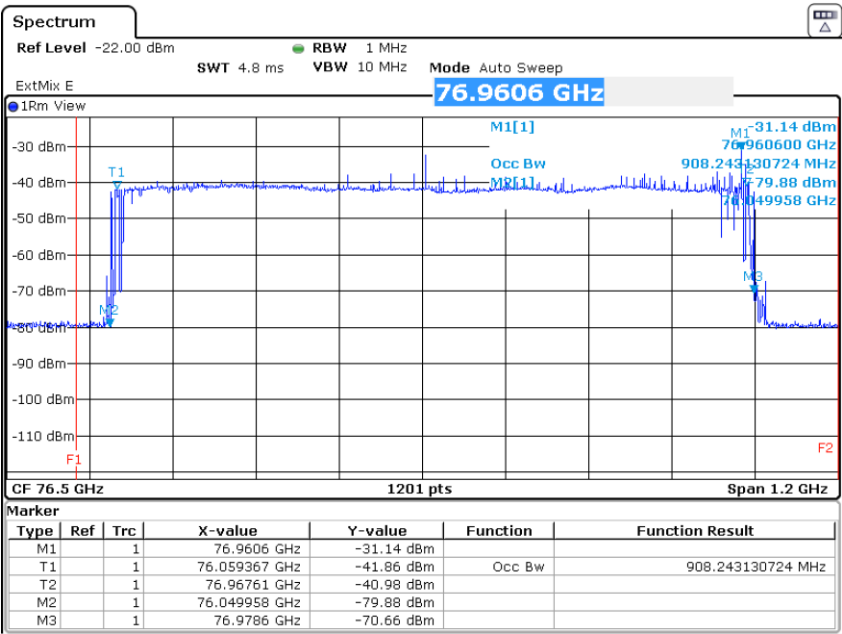
Date: 1.DEC.2022 12:19:42

20 °C, 14 V



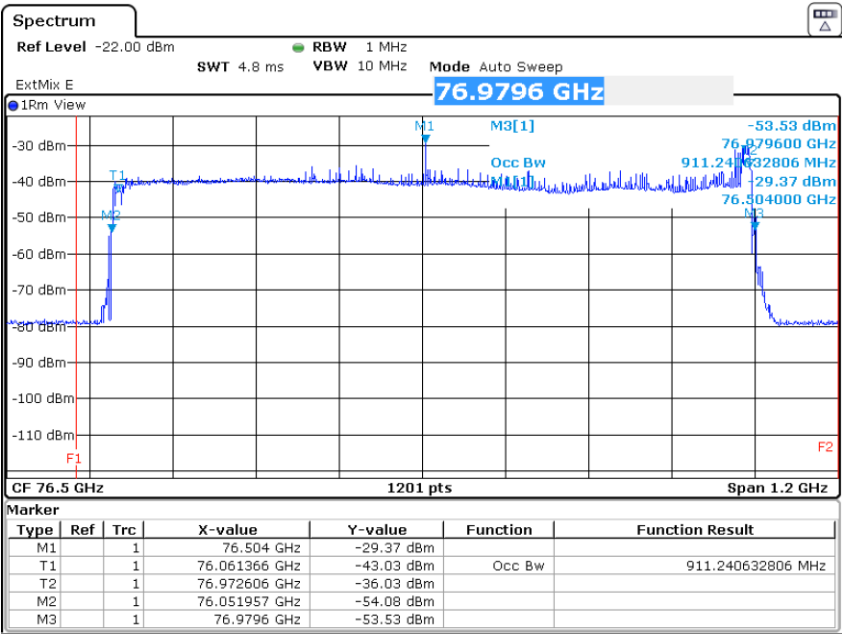
Date: 1.DEC.2022 13:05:29

30 °C, 12 V



Date: 1.DEC.2022 13:18:30

40 °C, 12 V



Date: 1.DEC.2022 13:59:47

50 °C, 12 V

## 7.4 Permissible Value of Occupied Bandwidth

|                           |                                 |
|---------------------------|---------------------------------|
| Prüfdatum / Date of test: | 2022-11-25                      |
| Prüfer / Operator:        | Martin Steindl                  |
| Messplatz / Test site:    | Semi anechoic room, cabin no. 2 |

| Prüfergebnis / Test Result          |                            |
|-------------------------------------|----------------------------|
| <input checked="" type="checkbox"/> | Erfüllt / Passed           |
| <input type="checkbox"/>            | Nicht erfüllt / Not passed |

|                                                |         |
|------------------------------------------------|---------|
| Luftdruck / Barometric pressure:               | 990 hPa |
| Relative Luftfeuchtigkeit / Relative humidity: | 22 %    |
| Temperatur / Ambient temperature:              | 38 °C   |

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Prüfgrundlage / Specifications: | ARIB STD-T48 V2.2, section 3.2(4)                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Grenzwert / Limit:              | The occupied bandwidth, which is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5 % of the total mean power of a given emission, shall be 1000 MHz or less under normal modulation condition.                                                                                                                                                                                                     |
| Betriebsart / Operation mode:   | Transmitting continuously on frequency with modulation bandwidth as stated in table below                                                                                                                                                                                                                                                                                                                                                                                                     |
| Kommentar / Comment:            | Test was performed as radiated test. The test distance was 3 m. A correction factor of 60 dB and mixer conversion loss table were used to account for the test antenna gain, free-space loss and external mixer loss. Span is wide enough to capture the channel transmission. RBW is 1 % set approx. to 1 % of anticipated EBW. VBW > RBW Trace is max hold, Detector is peak. Sweep time is set to AUTO. The 99 % OBW measurement function of the spectrum analyzer was used for this test. |

| Occupied Bandwidth (MHz) | Limit (MHz) |
|--------------------------|-------------|
| 904.549097303            | 1000        |



Plots taken during measurement



## 7.5 Permissible Levels of Spurious Emission or Unwanted Emission Intensity

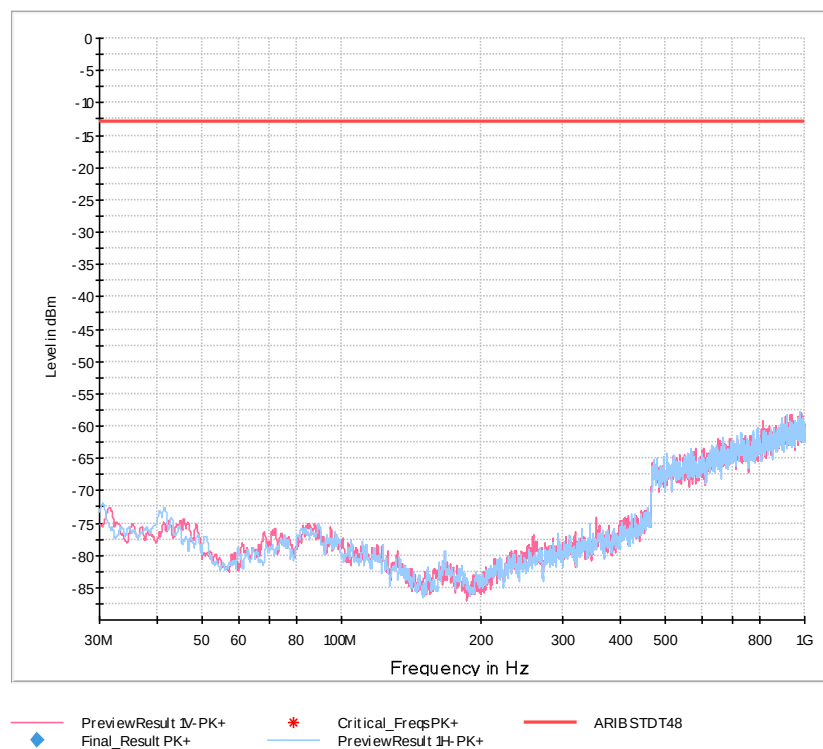
|                           |                                                                      |
|---------------------------|----------------------------------------------------------------------|
| Prüfdatum / Date of test: | 2022-11-25 to 2022-12-02                                             |
| Prüfer / Operator:        | Martin Steindl, Alex Fink                                            |
| Messplatz / Test site:    | Semi anechoic room, cabin no. 2<br>Fully anechoic room, cabin no. 11 |

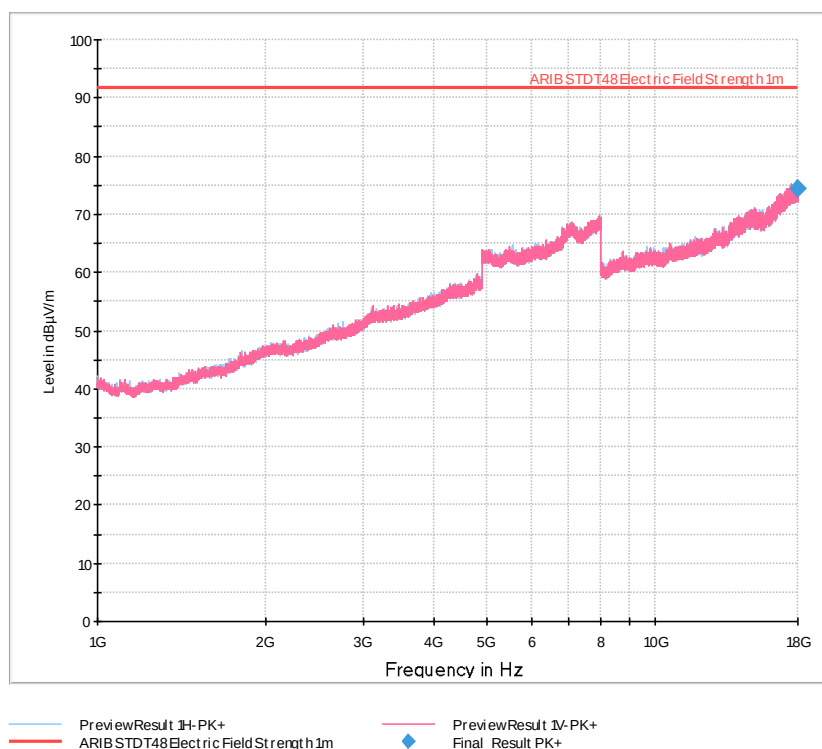
|                                     |                                   |
|-------------------------------------|-----------------------------------|
| <b>Prüfergebnis / Test Result</b>   |                                   |
| <input checked="" type="checkbox"/> | <b>Erfüllt / Passed</b>           |
| <input type="checkbox"/>            | <b>Nicht erfüllt / Not passed</b> |

|                                                |         |
|------------------------------------------------|---------|
| Luftdruck / Barometric pressure:               | 988 hPa |
| Relative Luftfeuchtigkeit / Relative humidity: | 22 %    |
| Temperatur / Ambient temperature:              | 38 °C   |

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                           |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Prüfgrundlage / Specifications: | ARIB STD-T48, section 3.2(5)                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                           |
| Grenzwert / Limit:              | b) Permissible Levels applied after 1 December 2005:                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                           |
|                                 | Permissible level of spurious emission in out-of-band domain                                                                                                                                                                                                                                                                                                                                                                                                                   | Permissible level of spurious emission in spurious domain |
|                                 | equal to or less than 100 µW                                                                                                                                                                                                                                                                                                                                                                                                                                                   | equal to or less than 50 µW                               |
| Betriebsart / Operation mode:   | This test was performed as radiated test in the frequency range 30 MHz to 300 GHz. No significant spurious emissions were observed. The test distance was 3 m in the frequency ranges 30 MHz to 1 GHz and 18 GHz to 40 GHz, 1 m in the frequency range 1 GHz to 18 GHz, 0.5 m in the frequency ranges 40 GHz to 90 GHz, 0.25 m in the frequency range 90 GHz to 110 GHz and and 170 GHz to 220 GHz and 0.10 m in the frequency range 110 GHz to 170 GHz and 220 GHz to 300 GHz |                                                           |
| Kommentar / Comment:            | The measurement below was done using EMC 32 V10.40.00 automated software.<br>See plots for details.                                                                                                                                                                                                                                                                                                                                                                            |                                                           |

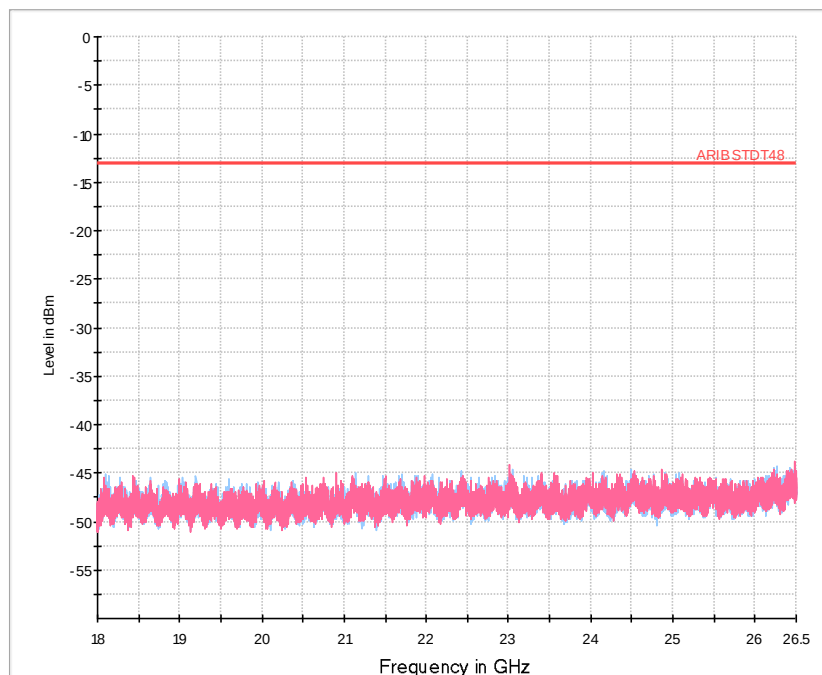
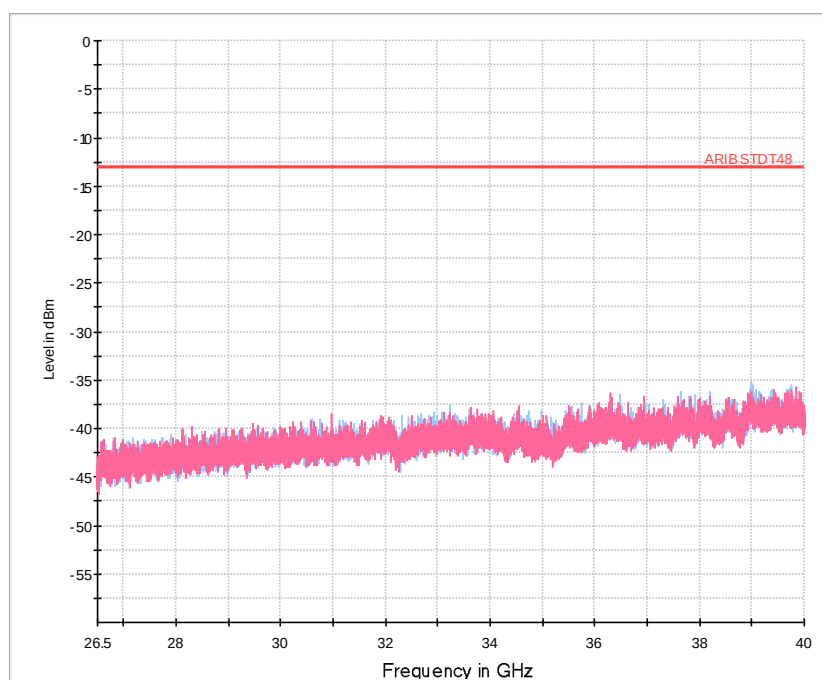
## Plots taken during measurement

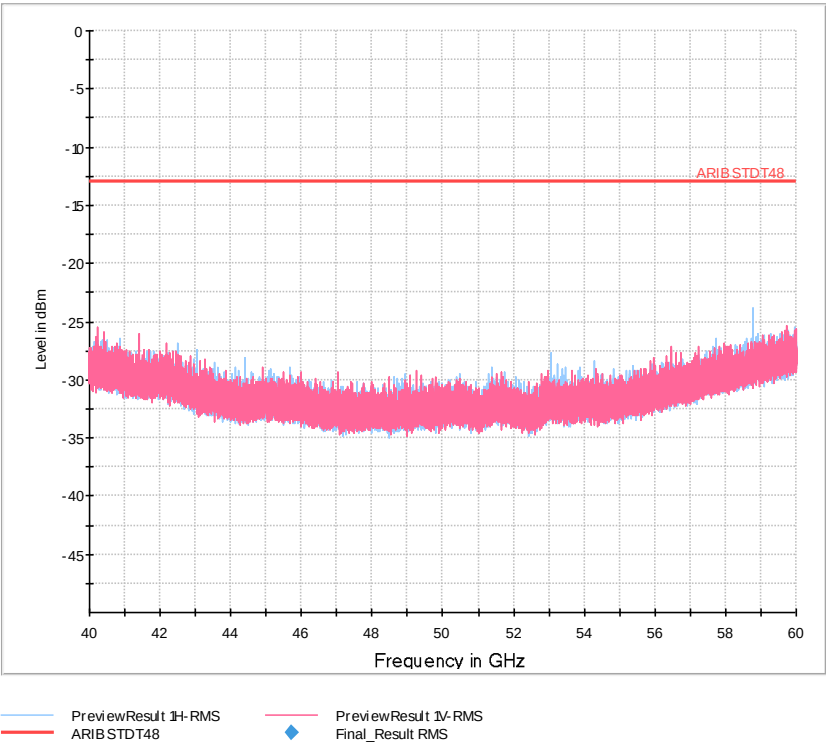




### Final Results:

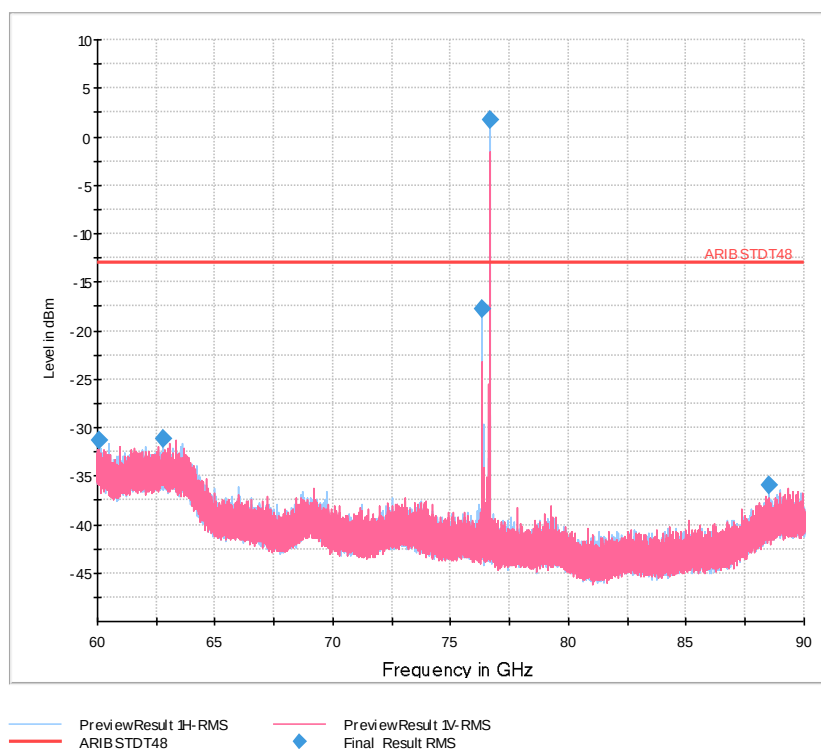
| Frequency    | MaxPeak | Limit  | Margin | Meas. Time | Bandwidth | Height | Pol | Azimuth | Corr. |
|--------------|---------|--------|--------|------------|-----------|--------|-----|---------|-------|
| MHz          | dBµV/m  | dBµV/m | dB     | ms         | kHz       | cm     |     | deg     | dB    |
| 17995.750000 | 74.48   | 91.76  | 17.28  | 1000.0     | 1000.000  | 132.0  | H   | -82.0   | 59.1  |





Final Results:

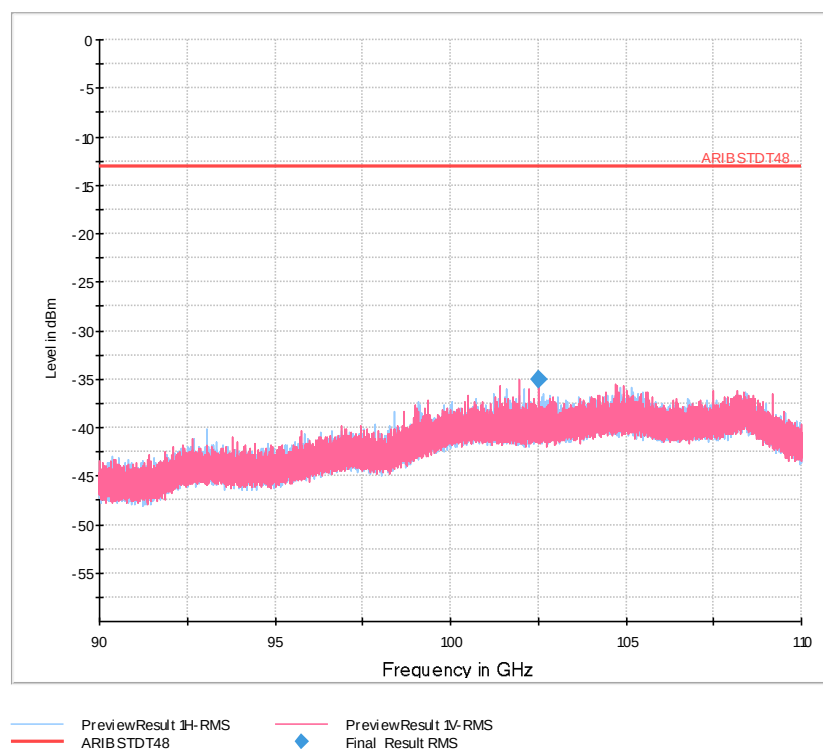
| Frequency<br>MHz | RMS<br>dBm | Limit<br>dBm | Margin<br>dB | Meas. Time<br>ms | Bandwidth<br>kHz | Height<br>cm | Pol | Azimuth<br>deg | Corr.<br>dB |
|------------------|------------|--------------|--------------|------------------|------------------|--------------|-----|----------------|-------------|
| 59970.666667     | -42.17     | -13.01       | 29.16        | 2.5              | 1000.000         | 150.0        | H   | 91.0           | -66         |



### Final Results:

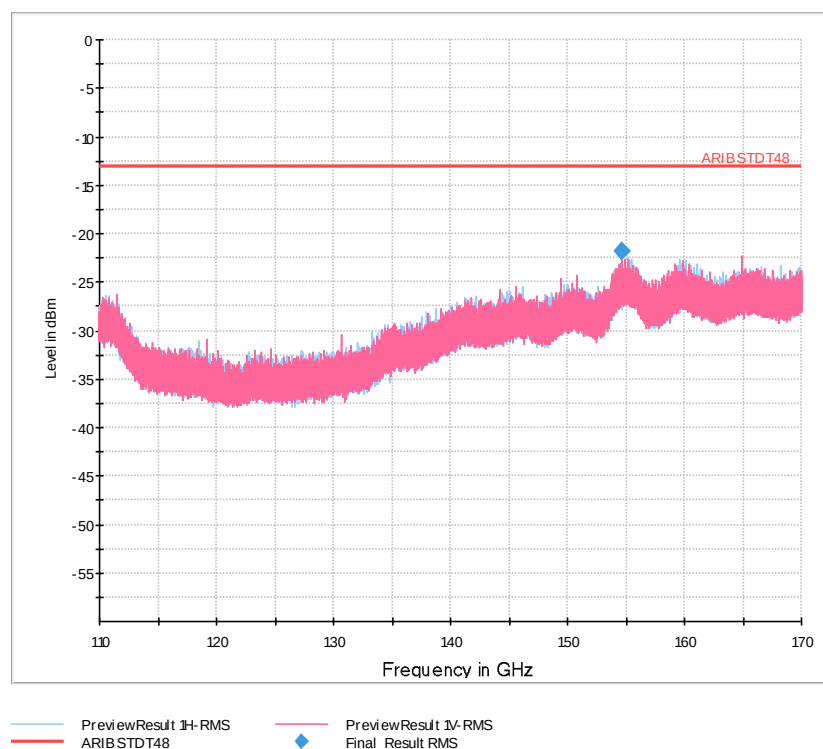
| Frequency<br>MHz | RMS<br>dBm | Limit<br>dBm | Margin<br>dB | Meas. Time<br>ms | Bandwidth<br>kHz | Height<br>cm | Pol | Azimuth<br>deg | Corr.<br>dB |
|------------------|------------|--------------|--------------|------------------|------------------|--------------|-----|----------------|-------------|
| 60072.000000     | -31.24     | -13.01       | 18.23        | 2.5              | 1000.000         | 150.0        | H   | 268.0          | -63         |
| 62796.500000     | -31.18     | -13.01       | 18.17        | 2.5              | 1000.000         | 150.0        | H   | 20.0           | -63         |
| 76352.500000     | -17.79     | #1           | #1           | 2.5              | 1000.000         | 150.0        | H   | 92.0           | -63         |
| 76640.000000     | 1.77       | #1           | #1           | 2.5              | 1000.000         | 150.0        | H   | 279.0          | -63         |
| 88526.000000     | -36.03     | -13.01       | 23.02        | 2.5              | 1000.000         | 150.0        | H   | 99.0           | -63         |

Note #1: intentional radiation, see power measurements section 7.1



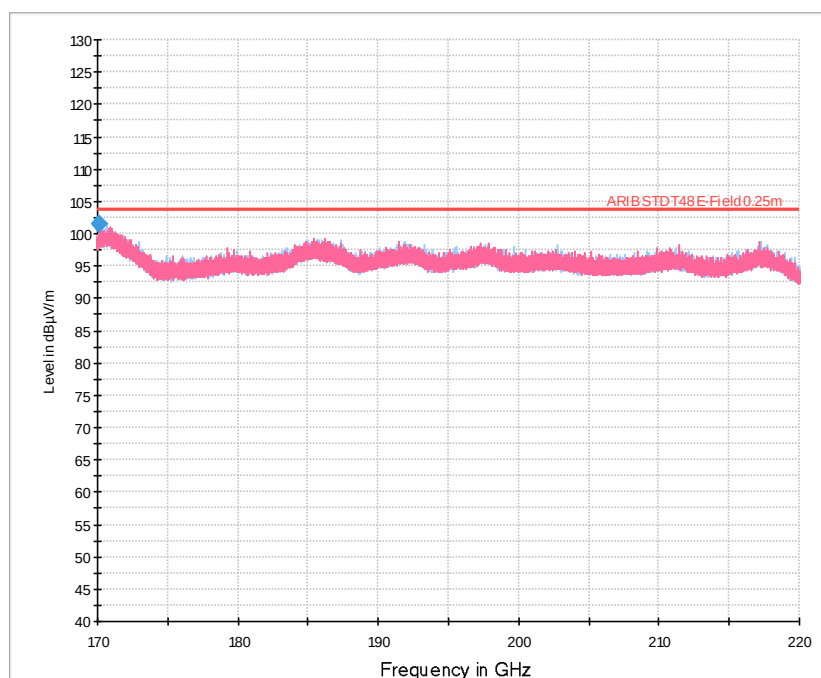
### Final Results:

| Frequency<br>MHz | RMS<br>dBm | Limit<br>dBm | Margin<br>dB | Meas. Time<br>ms | Bandwidth<br>kHz | Height<br>cm | Pol | Azimuth<br>deg | Corr.<br>dB |
|------------------|------------|--------------|--------------|------------------|------------------|--------------|-----|----------------|-------------|
| 102521.000000    | -35.01     | -13.01       | 22.00        | 2.5              | 1000.000         | 150.0        | V   | 136.0          | -67         |



### Final Results:

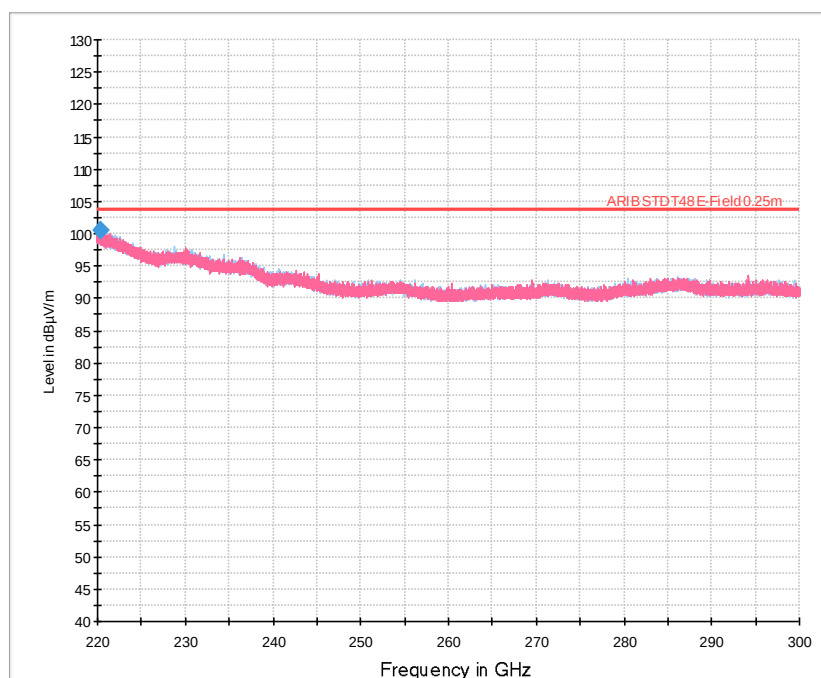
| Frequency<br>MHz | RMS<br>dBm | Limit<br>dBm | Margin<br>dB | Meas. Time<br>ms | Bandwidth<br>kHz | Height<br>cm | Pol | Azimuth<br>deg | Corr.<br>dB |
|------------------|------------|--------------|--------------|------------------|------------------|--------------|-----|----------------|-------------|
| 154638.500000    | -21.85     | -13.01       | 8.84         | 2.5              | 1000.000         | 150.0        | V   | 153.0          | -55         |



PreviewResult 1H-PK+  
 ARIB STD T48 E-Field 0.25m  
 PreviewResult 1V-PK+  
 Final\_Result PK+

### Final Results:

| Frequency     | MaxPeak | Limit  | Margin | Meas. Time | Bandwidth | Height | Pol | Azimuth | Corr. |
|---------------|---------|--------|--------|------------|-----------|--------|-----|---------|-------|
| MHz           | dBµV/m  | dBµV/m | dB     | ms         | kHz       | cm     |     | deg     | dB/m  |
| 170107.812500 | 101.40  | 103.80 | 2.40   | 5.0        | 1000.000  | 150.0  | V   | 318.0   | 55    |



### Final Results:

| Frequency     | RMS    | Limit  | Margin | Meas. Time | Bandwidth | Height | Pol | Azimuth | Corr. |
|---------------|--------|--------|--------|------------|-----------|--------|-----|---------|-------|
| MHz           | dBµV/m | dBµV/m | dB     | ms         | kHz       | cm     |     | deg     | dB/m  |
| 220400.312500 | 100.44 | 103.80 | 3.36   | 5.0        | 1000.000  | 150.0  | V   | 195.0   | 59    |

## 7.6 Antenna Gain

|                           |                                 |
|---------------------------|---------------------------------|
| Prüfdatum / Date of test: | 2022-25-11                      |
| Prüfer / Operator:        | Martin Steindl                  |
| Messplatz / Test site:    | Semi anechoic room, cabin no. 2 |

|                                     |                                   |
|-------------------------------------|-----------------------------------|
| <b>Prüfergebnis / Test Result</b>   |                                   |
| <input checked="" type="checkbox"/> | <b>Erfüllt / Passed</b>           |
| <input type="checkbox"/>            | <b>Nicht erfüllt / Not passed</b> |

|                                 |                                                                      |
|---------------------------------|----------------------------------------------------------------------|
| Prüfgrundlage / Specifications: | ARIB STD-T48 V2.2, section 3.5(2)                                    |
| Grenzwert / Limit:              | The absolute gain of the transmitting antenna shall be 40 dB or less |
| Betriebsart / Operation mode:   | ---                                                                  |
| Kommentar / Comment:            | Declaration of manufacturer                                          |

| Antenna Type          | Requirement | Peak Antenna Gain |
|-----------------------|-------------|-------------------|
| Integral planar array | < 40 dBi    | 13.3 dBi          |

## 8 Test Equipment used

| <i>T-ID</i> | <i>Designation</i>         | <i>Type</i>   | <i>Last Cal.</i> | <i>Next Cal.</i> |
|-------------|----------------------------|---------------|------------------|------------------|
| 18874       | Horn antenna               | 3160-07       | Verified         |                  |
| 18875       | Horn antenna               | 3160-08       | Verified         |                  |
| 19125       | Horn antenna               | 3160-09       | Verified         |                  |
| 40089       | Double ridged horn antenna | HF907         | 2021-02          | 2023-02          |
| 19442       | Horn antenna               | 3160-10       | Verified         |                  |
| 19946       | Horn antenna               | 24240-20      | Verified         |                  |
| 39897       | EMI test receiver          | ESW44         | 2022-04          | 2023-04          |
| 22553       | Waveguide mixer            | FS-Z170       | 2020-02          | 2023-02          |
| 25849       | Waveguide mixer            | FS-Z60        | 2020-02          | 2023-02          |
| 25850       | Waveguide mixer            | FS-Z90        | 2020-02          | 2023-02          |
| 25851       | Waveguide mixer            | FS-Z110       | 2020-02          | 2023-02          |
| 27898       | Horn antenna               | 26240-20      | Verified         |                  |
| 27899       | Horn antenna               | 27240-20      | Verified         |                  |
| 36954       | Harmonic Mixer             | FS-Z220       | 2020-02          | 2023-02          |
| 36955       | Harmonic Mixer             | FS-Z325       | 2020-02          | 2023-02          |
| 37863       | Horn antenna               | 30240-20 WG30 | Verified         |                  |
| 37864       | Horn antenna               | 32240-20 WG32 | Verified         |                  |
| 19918       | TRILOG Broadband antenna   | VULP 9163     | 2022-10          | 2025-10          |

## 9 Measurement Uncertainty Values

The measurement uncertainty in the laboratory is less than or equal to the maximum measurement uncertainty according to EN 55016-4-2: 2011 + A1 + A2 + AC and CISPR16-4-2: 2011 + A1 + A2 + Cor1 (UCISPR). This normative regulation means that the measured value is also the value to be assessed in relation to the limit value.

For a 95% confidence level, the measurement uncertainties for defined systems are:

| Radio Testing                           |      |                                     |      |
|-----------------------------------------|------|-------------------------------------|------|
| Test Name                               | kp   | Expanded Uncertainty                | Note |
| Occupied Bandwidth                      | 2.0  | $\pm 1.14 \%$                       | 2    |
| RF-Frequency error                      | 1.96 | $\pm 1 \cdot 10^{-7}$               | 7    |
| RF-Power, conducted carrier             | 2    | $\pm 0.079 \text{ dB}$              | 2    |
| RF-Power uncertainty for given BER      | 1.96 | $+0.94 \text{ dB} / -1.05$          | 7    |
| RF power, conducted, spurious emissions | 1.96 | $+1.4 \text{ dB} / -1.6 \text{ dB}$ | 7    |
| RF power, radiated                      |      |                                     |      |
| 25 MHz – 4 GHz                          | 1.96 | $+3.6 \text{ dB} / -5.2 \text{ dB}$ | 8    |
| 1 GHz – 18 GHz                          | 1.96 | $+3.8 \text{ dB} / -5.6 \text{ dB}$ | 8    |
| 18 GHz – 26.5 GHz                       | 1.96 | $+3.4 \text{ dB} / -4.5 \text{ dB}$ | 8    |
| 40 GHz – 170 GHz                        | 1.96 | $+4.2 \text{ dB} / -7.1 \text{ dB}$ | 8    |
| Spectral Power Density, conducted       | 2.0  | $\pm 0.53 \text{ dB}$               | 2    |
| Maximum frequency deviation             |      |                                     |      |
| 300 Hz – 6 kHz                          | 2    | $\pm 2.89 \%$                       | 2    |
| 6 kHz – 25 kHz                          | 2    | $\pm 0.2 \text{ dB}$                | 2    |
| Maximum frequency deviation for FM      | 2    | $\pm 2.89 \%$                       | 2    |
| Adjacent channel power 25 MHz – 1 GHz   | 2    | $\pm 2.31 \%$                       | 2    |
| Temperature                             | 2    | $\pm 0.39 \text{ K}$                | 4    |
| (Relative) Humidity                     | 2    | $\pm 2.28 \%$                       | 2    |
| DC- and low frequency AC voltage        |      |                                     |      |
| DC voltage                              | 2    | $\pm 0.01 \%$                       | 2    |
| AC voltage up to 1 kHz                  | 2    | $\pm 1.2 \%$                        | 2    |
| Time                                    | 2    | $\pm 0.6 \%$                        | 2    |

| Radio Interference Emission Testing               |    |                      |      |
|---------------------------------------------------|----|----------------------|------|
| Test Name                                         | kp | Expanded Uncertainty | Note |
| Conducted Voltage Emission                        |    |                      |      |
| 9 kHz to 150 kHz (50Ω/50μH AMN)                   | 2  | ± 3.8 dB             | 1    |
| 150 kHz to 30 MHz (50Ω/50μH AMN)                  | 2  | ± 3.4 dB             | 1    |
| 100 kHz to 200 MHz (50Ω/5μH AMN)                  | 2  | ± 3.6 dB             | 1    |
| Discontinuous Conducted Emission                  |    |                      |      |
| 9 kHz to 150 kHz (50Ω/50μH AMN)                   | 2  | ± 3.8 dB             | 1    |
| 150 kHz to 30 MHz (50Ω/50μH AMN)                  | 2  | ± 3.4 dB             | 1    |
| Conducted Current Emission                        |    |                      |      |
| 9 kHz to 200 MHz                                  | 2  | ± 3.5 dB             | 1    |
| Magnetic Fieldstrength                            |    |                      |      |
| 9 kHz to 30 MHz (with loop antenna)               | 2  | ± 3.9 dB             | 1    |
| 9 kHz to 30 MHz (large-loop antenna 2 m)          | 2  | ± 3.5 dB             | 1    |
| Radiated Emission                                 |    |                      |      |
| Test distance 1 m (ALSE)                          |    |                      |      |
| 9 kHz to 150 kHz                                  | 2  | ± 4.6 dB             | 1    |
| 150 kHz to 30 MHz                                 | 2  | ± 4.1 dB             | 1    |
| 30 MHz to 200 MHz                                 | 2  | ± 5.2 dB             | 1    |
| 200 MHz to 2 GHz                                  | 2  | ± 4.4 dB             | 1    |
| 2 GHz to 3 GHz                                    | 2  | ± 4.6 dB             | 1    |
| Test distance 3 m                                 |    |                      |      |
| 30 MHz to 300 MHz                                 | 2  | ± 4.9 dB             | 1    |
| 300 MHz to 1 GHz                                  | 2  | ± 5.0 dB             | 1    |
| 1 GHz to 6 GHz                                    | 2  | ± 4.6 dB             | 1    |
| Test distance 10 m                                |    |                      |      |
| 30 MHz to 300 MHz                                 | 2  | ± 4.9 dB             | 1    |
| 300 MHz to 1 GHz                                  | 2  | ± 4.9 dB             | 1    |
| Radio Interference Power                          |    |                      |      |
| 30 MHz to 300 MHz                                 | 2  | ± 3.5 dB             | 1    |
| Harmonic Current Emissions                        |    |                      | 4    |
| Voltage Changes, Voltage Fluctuations and Flicker |    |                      | 4    |

| Immunity Testing                                         |      |                      |      |
|----------------------------------------------------------|------|----------------------|------|
| Test Name                                                | kp   | Expanded Uncertainty | Note |
| Electrostatic Discharges                                 |      |                      | 4    |
| Radiated RF-Field                                        |      |                      |      |
| Pre-calibrated field level                               | 2    | +32.2 / -24.3 %      | 5    |
| Dynamic feedback field level                             | 2.05 | +21.2 / -17.5 %      | 3    |
| Electrical Fast Transients (EFT) / Bursts                |      |                      | 4    |
| Surges                                                   |      |                      | 4    |
| Conducted Disturbances, induced by RF-Fields             |      |                      |      |
| via CDN                                                  | 2    | +15.1 / -13.1 %      | 6    |
| via EM clamp                                             | 2    | +42.6 / -29.9 %      | 6    |
| via current clamp                                        | 2    | +43.9 / -30.5 %      | 6    |
| Power Frequency Magnetic Field                           | 2    | +20.7 / -17.1 %      | 2    |
| Pulse Magnetic Field                                     |      |                      | 4    |
| Voltage Dips, Short Interruptions and Voltage Variations |      |                      | 4    |
| Oscillatory Waves                                        |      |                      | 4    |
| Conducted Low Frequency Disturbances                     |      |                      |      |
| Voltage setting                                          | 2    | ± 0.9 %              | 2    |
| Frequency setting                                        | 2    | ± 0.1 %              | 2    |
| Electrical Transient Transmission in Road Vehicles       |      |                      | 4    |

Note 1:

The expanded uncertainty reported according to CISPR 16-4-2:2003-11 is based on a standard uncertainty multiplied by a coverage factor of  $k_p = 2$ , providing a level of confidence of  $p = 95.45\%$

Note 2:

The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of  $k_p = 2$ , providing a level of confidence of  $p = 95.45\%$

Note 3:

The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of  $k_p = 2.05$ , providing a level of confidence of  $p = 95.45\%$

Note 4:

It has been demonstrated that the used test equipment meets the specified requirements in the standard with at least a 95% confidence.

Note 5:

The expanded uncertainty reported according to IEC 61000-4-3 is based on a standard uncertainty multiplied by a coverage factor of  $k_p = 2$ , providing a level of confidence of  $p = 95.45\%$

Note 6:

The expanded uncertainty reported according to IEC 61000-4-6 is based on a standard uncertainty multiplied by a coverage factor of  $k_p = 2$ , providing a level of confidence of  $p = 95.45\%$

Note 7:

The expanded uncertainty reported according ETSI TR 100 028 V1.4.1 (all parts) to is based on a standard uncertainty multiplied by a coverage factor of  $k_p = 1.96$ , providing a level of confidence of  $p = 95.45\%$

Note 8:

The expanded uncertainty reported according to ETSI TR 102 273 V1.2.1 (all parts) is based on a standard uncertainty multiplied by a coverage factor of  $k_p = 1.96$ , providing a level of confidence of  $p = 95.45\%$

## 10 Revision History

| Revision History |             |                  |                      |
|------------------|-------------|------------------|----------------------|
| <i>Edition</i>   | <i>Date</i> | <i>Issued by</i> | <i>Modifications</i> |
| 0                | 2023-01-20  | A. Fink          | First Revision       |