

# Test Report

Report Number:

**F241002E9**

Equipment under Test (EUT):

**Control unit for welding inverters**

**BCU iWave 190/230 Smart 2**

Applicant:

**Fronius International GmbH**

Manufacturer:

**Fronius International GmbH**



Deutsche  
Akkreditierungsstelle  
D-PL-17186-01-00

## References

- [1] **ANSI C63.10-2020 + Cor. 1-2023 + C63.10a-2024 + Errata to C63.10a-2024\***, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices  
\*Remark: This standard is not in accreditation scope of the laboratory yet
- [2] **FCC CFR 47 Part 15**, Radio Frequency Devices
- [3] **558074 D01 15.247 Meas Guidance v05r02 (April 2019)**, GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES
- [4] **RSS-247, Issue 4 (2025-07)** Digital Transmission Systems, Frequency Hopping Systems and Licence-Exempt Local Area Network Devices in 902-928 MHz, 2400-2483.5 MHz, 5150-5350 MHz, and 5470-5895 MHz bands
- [5] **RSS-Gen, Issue 5 Amendment 2 (2021-02)** General Requirements for Compliance of Radio Apparatus

## Test Result

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test. The complete test results are presented in the following.

“Passed” indicates that the equipment under test conforms with the relevant limits of the testing standard without taking any measurement uncertainty into account as stated in [1]. However, the measurement uncertainty is calculated and shown in this test report.

Tested and  
written by:

Signature

Reviewed and  
approved by:

Signature

**This test report is only valid in its original form.**

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The test results herein refer only to the tested sample. PHOENIX TESTLAB GmbH is not responsible for any generalisations or conclusions drawn from these test results concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page necessarily contains the PHOENIX TESTLAB Logo and the TEST REPORT NUMBER.

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# 1 Identification

## 1.1 Applicant

|                                                                |                                             |
|----------------------------------------------------------------|---------------------------------------------|
| Name:                                                          | Fronius International GmbH                  |
| Address:                                                       | Günter-Fronius-Straße 1, 4600 Wels-Thalheim |
| Country:                                                       | Austria                                     |
| Name for contact purposes:                                     | Mr. Jan HERNDLER                            |
| Phone:                                                         | +43-7242-241-0                              |
| eMail address:                                                 | herndler.jan@fronius.com                    |
| Applicant represented during the test by the following person: | Partly: Mr. Jan HERNDLER                    |

## 1.2 Manufacturer

|                                                                   |                                 |
|-------------------------------------------------------------------|---------------------------------|
| Name:                                                             | Fronius International GmbH      |
| Address:                                                          | Fronius Straße 5, 4642 Sattledt |
| Country:                                                          | Austria                         |
| Name for contact purposes:                                        | Mr. Jan HERNDLER                |
| Phone:                                                            | +43-7242-241-0                  |
| eMail address:                                                    | herndler.jan@fronius.com        |
| Manufacturer represented during the test by the following person: | Partly: Mr. Jan HERNDLER        |

## 1.3 Test Laboratory

The tests were carried out by: **PHOENIX TESTLAB GmbH**  
**Königswinkel 10**  
**32825 Blomberg**  
**Germany**

accredited by *Deutsche Akkreditierungsstelle GmbH (DAkkS)* according to DIN EN ISO/IEC 17025:2018. The accreditation is only valid for the scope of accreditation listed in the annex of the certificate D-PL-17186-01-00. FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

## 1.4 EUT (Equipment under Test)

|                            |                                    |
|----------------------------|------------------------------------|
| Test object: *             | Control unit for welding inverters |
| Model name: *              | BCU iWave 190/230 Smart 2          |
| Model number: *            | 43,0001,1788                       |
| Order number: *            | N/A                                |
| FCC ID: *                  | QKWBCU2                            |
| IC certification number: * | 12270A-BCU2                        |
| PMN: *                     | BCU iWAVE 190/230 Smart 2          |
| HVIN: *                    | V0.2B_A                            |
| FVIN: *                    | N/A                                |

\* Declared by the applicant

|                     | EUT number           |   |   |
|---------------------|----------------------|---|---|
|                     | 1                    | 2 | 3 |
| Serial number: *    | 00002375             | - | - |
| PCB identifier: *   | 4,071,879            | - | - |
| Hardware version: * | V0.2B_A              | - | - |
| Software version: * | 2.3.0-38650.79495-G2 | - | - |

\* Declared by the applicant

One EUT was used for all tests.

Note: PHOENIX TESTLAB GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

## 1.5 Technical Data of Equipment

| General EUT data                             |                                 |                                 |                                 |
|----------------------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Power supply EUT: *                          | DC                              |                                 |                                 |
| Supply voltage EUT: *                        | $U_{nom} = 24.0 \text{ V}_{DC}$ | $U_{min} = 21.6 \text{ V}_{DC}$ | $U_{max} = 26.4 \text{ V}_{DC}$ |
| Temperature range: *                         | -20 °C to +65 °C                |                                 |                                 |
| Lowest / highest internal clock frequency: * | 20 kHz / 2480 MHz               |                                 |                                 |

\* Declared by the applicant

| Ports / Connectors |               |                      |                    |                      |
|--------------------|---------------|----------------------|--------------------|----------------------|
| Identification     | Connector     |                      | Length during test | Shielding (Yes / No) |
|                    | EUT           | Ancillary            |                    |                      |
| Ethernet *         | HSD           | RJ45                 | < 100 m            | Yes (CAT6)           |
| Speednet *         | HSD           | Left open            | < 100 m            | Yes (CAT6)           |
| DC mains *         | Customized    | 4 mm laboratory plug | ≈ 2 m              | No                   |
| Internal port *    | Mini-B-USB    | Left open            | -                  | Yes                  |
| Antenna connector  | SMA connector | SMA connector        | -                  | Yes                  |

\* Declared by the applicant

| RFID part              |                                           |
|------------------------|-------------------------------------------|
| Operating frequency: * | 13.56 MHz                                 |
| Number of channels: *  | N/A                                       |
| Type of modulation: *  | ISO 14443A/B, ISO15693, ISO18092, NFCIP-2 |
| Data rate: *           | 106 kbps - 848 kbps                       |
| Antenna type: *        | PCB antenna                               |
| Antenna connector: *   | PCB connector                             |

\* Declared by the applicant

| Bluetooth® low energy / WLAN part           |                                |                                 |                                 |
|---------------------------------------------|--------------------------------|---------------------------------|---------------------------------|
| Radio module: * <sup>1</sup>                | muRata LBEE5PL2DL              |                                 |                                 |
| Antenna type: * <sup>2</sup>                | Dipole antenna                 |                                 |                                 |
| Antenna name: * <sup>2</sup>                | Taoglas GW.40                  |                                 |                                 |
| Antenna gain: * <sup>2</sup>                | 3.15 dBi (peak)                |                                 |                                 |
| Antenna connector: * <sup>2</sup>           | SMA                            |                                 |                                 |
| Supply voltage radio module: * <sup>1</sup> | $U_{nom} = 3.3 \text{ V}_{DC}$ | $U_{min} = 3.14 \text{ V}_{DC}$ | $U_{max} = 3.46 \text{ V}_{DC}$ |

\*<sup>1</sup> based on the data sheet "Type 2DL Wi-Fi® + Bluetooth® Module"

\*<sup>2</sup> based on the antenna data sheet "SPE-19-8-069-A"

| Bluetooth® low energy frequencies |          |            |          |
|-----------------------------------|----------|------------|----------|
| Channel 00                        | 2402 MHz | Channel 01 | 2404 MHz |
| Channel 02                        | 2406 MHz | Channel 03 | 2408 MHz |
| ...                               | ...      | ...        | ...      |
| ...                               | ...      | ...        | ...      |
| Channel 18                        | 2438 MHz | Channel 19 | 2440 MHz |
| ...                               | ...      | ...        | ...      |
| ...                               | ...      | ...        | ...      |
| Channel 36                        | 2474 MHz | Channel 37 | 2476 MHz |
| Channel 38                        | 2478 MHz | Channel 39 | 2480 MHz |

| Bluetooth® low energy radio mode |                                                     |
|----------------------------------|-----------------------------------------------------|
| Fulfills radio specification: *  | Bluetooth® low energy (BLE) 5.3                     |
| Type of modulation: *            | BLE (1 Mbps PHY) GFSK                               |
|                                  | BLE (2 Mbps PHY) GFSK                               |
|                                  | BLE (500 kbps coded PHY) GFSK                       |
|                                  | BLE (125 kbps coded PHY) GFSK                       |
| Operating frequency range: *     | BLE (1 Mbps PHY) 2402 – 2480 MHz                    |
|                                  | BLE (2 Mbps PHY) 2402 – 2480 MHz                    |
|                                  | BLE (500 kbps coded PHY) 2402 – 2480 MHz            |
|                                  | BLE (125 kbps coded PHY) 2402 – 2480 MHz            |
| Number of channels: *            | BLE (1 Mbps PHY) 40 (2 MHz channel spacing)         |
|                                  | BLE (2 Mbps PHY) 40 (2 MHz channel spacing)         |
|                                  | BLE (500 kbps coded PHY) 40 (2 MHz channel spacing) |
|                                  | BLE (125 kbps coded PHY) 40 (2 MHz channel spacing) |

\*1 based on the data sheet "Type 2DL Wi-Fi® + Bluetooth® Module"

| IEEE 802.11 frequencies |          |           |          |
|-------------------------|----------|-----------|----------|
| 20 MHz                  |          | 40 MHz    |          |
| Channel 1               | 2412 MHz | -         | -        |
| Channel 2               | 2417 MHz | -         | -        |
| Channel 3               | 2422 MHz | Channel 3 | 2422 MHz |
| Channel 4               | 2427 MHz | Channel 4 | 2427 MHz |
| Channel 5               | 2432 MHz | Channel 5 | 2432 MHz |
| Channel 6               | 2437 MHz | Channel 6 | 2437 MHz |
| Channel 7               | 2442 MHz | Channel 7 | 2442 MHz |
| Channel 8               | 2447 MHz | Channel 8 | 2447 MHz |
| Channel 9               | 2452 MHz | Channel 9 | 2452 MHz |
| Channel 10              | 2457 MHz | -         | -        |
| Channel 11              | 2462 MHz | -         | -        |

| IEEE 802.11 radio mode           |                                                                                    |                                                                              |                                                                                  |                                      |
|----------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------------------|
| Fulfills radio specification: *1 | IEEE 802.11 b<br>IEEE 802.11 g<br>IEEE 802.11 n (20 MHz)<br>IEEE 802.11 n (40 MHz) |                                                                              |                                                                                  |                                      |
| Radio module: *1                 | muRata LBEE5PL2DL                                                                  |                                                                              |                                                                                  |                                      |
| Antenna type: *2                 | Dipole antenna                                                                     |                                                                              |                                                                                  |                                      |
| Antenna name: *2                 | Taoglas GW.40                                                                      |                                                                              |                                                                                  |                                      |
| Antenna gain: *2                 | 3.15 dBi (peak)                                                                    |                                                                              |                                                                                  |                                      |
| Antenna connector: *2            | SMA                                                                                |                                                                              |                                                                                  |                                      |
| Supply voltage WLAN module: *1   | $U_{nom} = 3.3 V_{DC}$ $U_{min} = 3.14 V_{DC}$ $U_{max} = 3.46 V_{DC}$             |                                                                              |                                                                                  |                                      |
| Type of modulation: *1           | IEEE 802.11b                                                                       | DSSS (1 Mbps<br>DSSS (2 Mbps<br>DSSS (5.5/11 Mbps                            | BPSK)<br>DQPSK)<br>CCK)                                                          |                                      |
|                                  | IEEE 802.11g                                                                       | OFDM (6/9 Mbps<br>OFDM (12 / 18 Mbps<br>OFDM (24/36 Mbps<br>OFDM (48/54 Mbps | BPSK)<br>QPSK)<br>16-QAM)<br>64-QAM)                                             |                                      |
|                                  | IEEE 802.11n 20 MHz<br>(Spatial Stream: 1)                                         | MCS0<br>MCS1/2<br>MCS3/4<br>MCS5/6/7                                         | OFDM (7 Mbps<br>OFDM (14 – 22 Mbps<br>OFDM (28 – 43 Mbps<br>OFDM (58 - 72 Mbps   | BPSK)<br>QPSK)<br>16-QAM)<br>64-QAM) |
|                                  | IEEE 802.11n 40 MHz<br>(Spatial Stream: 2)                                         | MCS0<br>MCS1/2<br>MCS3/4<br>MCS5/6/7                                         | OFDM (15 Mbps<br>OFDM (30 / 45 Mbps<br>OFDM (60 – 90 Mbps<br>OFDM (120 - 150Mbps | BPSK)<br>QPSK)<br>16-QAM)<br>64-QAM) |
|                                  | IEEE 802.11b                                                                       | 2412 – 2462 MHz                                                              |                                                                                  |                                      |
| Operating frequency range: *1    | IEEE 802.11g                                                                       | 2412 – 2462 MHz                                                              |                                                                                  |                                      |
|                                  | IEEE 802.11n 20 MHz                                                                | 2412 – 2462 MHz                                                              |                                                                                  |                                      |
|                                  | IEEE 802.11n 40 MHz                                                                | 2422 – 2452 MHz                                                              |                                                                                  |                                      |
|                                  | IEEE 802.11b                                                                       | 11 (5 MHz channel spacing)                                                   |                                                                                  |                                      |
| Number of channels: *1           | IEEE 802.11g                                                                       | 11 (5 MHz channel spacing)                                                   |                                                                                  |                                      |
|                                  | IEEE 802.11n 20 MHz                                                                | 11 (5 MHz channel spacing)                                                   |                                                                                  |                                      |
|                                  | IEEE 802.11n 40 MHz                                                                | 9 (5 MHz channel spacing)                                                    |                                                                                  |                                      |

\*1 based on the data sheet "Type 2DL Wi-Fi® + Bluetooth® Module"

\*2 based on the antenna data sheet "SPE-19-8-069-A"

### 1.5.1 Ancillary Equipment / Equipment used for testing

| Equipment used for testing |                       |
|----------------------------|-----------------------|
| Test laptop *              | Fujitsu Lifebook S760 |
| -                          | -                     |

\* Provided by the laboratory

### 1.6 Dates

|                                 |            |
|---------------------------------|------------|
| Date of receipt of test sample: | 08.07.2025 |
| Start of test:                  | 11.07.2025 |
| End of test:                    | 14.07.2025 |

## 2 Operational States

### 2.1 Description of function of the EUT

The EUT is a steering unit for welding inverters.  
Bluetooth® LE and WLAN are used for data communication.  
NFC is used for access control.

#### 2.1.1 Operation modes

An ethernet connection to the test notebook was established and the test modes were set in terminal sessions.

| Operation mode # | Radio technology | Frequency [MHz] | Channel / Band | Modulation / Mode | Data rate | Power setting  |
|------------------|------------------|-----------------|----------------|-------------------|-----------|----------------|
| 1                | Bluetooth® LE    | 2440            | 19             | GFSK              | 2 Mbps    | "0x03 (3 dBm)" |
|                  | NFC              | 13.56           | -              | CW                | -         | default        |
| 2                | IEEE 802.11 b    | 2437            | 6              | BPSK              | 1 Mbps    | "10 dBm"       |
|                  | NFC              | 13.56           | -              | CW                | -         | default        |

#### 2.1.2 Block Diagram (Radiated)



### 3 Additional Information

The EUT was not labeled as required by FCC / IC.

This test report contains the simultaneous transmission of WLAN / NFC and BLE / NFC only.  
The technology-specific test cases are documented in these test reports:

F241002E6    NFC  
F241002E7    BLE  
F2410024E8    WLAN

Wanted signals and their harmonics are not the scope of this report

### 4 Overview

| Application                | Frequency range [MHz] | FCC 47 CFR Part 15 section [2]         | RSS-247 [4]<br>RSS-Gen [5] | Tested EUT | Status      |
|----------------------------|-----------------------|----------------------------------------|----------------------------|------------|-------------|
| Maximum unwanted emissions | 0.009 – 26500 *1 2    | 15.247 (d)<br>15.205 (a)<br>15.209 (a) | 8.9 [5]                    | 1          | Passed *1 2 |

\*1: Only the worst-case data rates based on pretests were tested. Only maximum unwanted emissions above 30 MHz were tested.

\*2 As declared by the applicant the highest radio frequency is 2.480 GHz.  
Therefore, the radiated emission measurement must be carried out up to 10<sup>th</sup> of the highest radio clock frequency in this case 26.5 GHz.

## 5 Results

### 5.1.1 Radiated: 30 MHz to 1 GHz

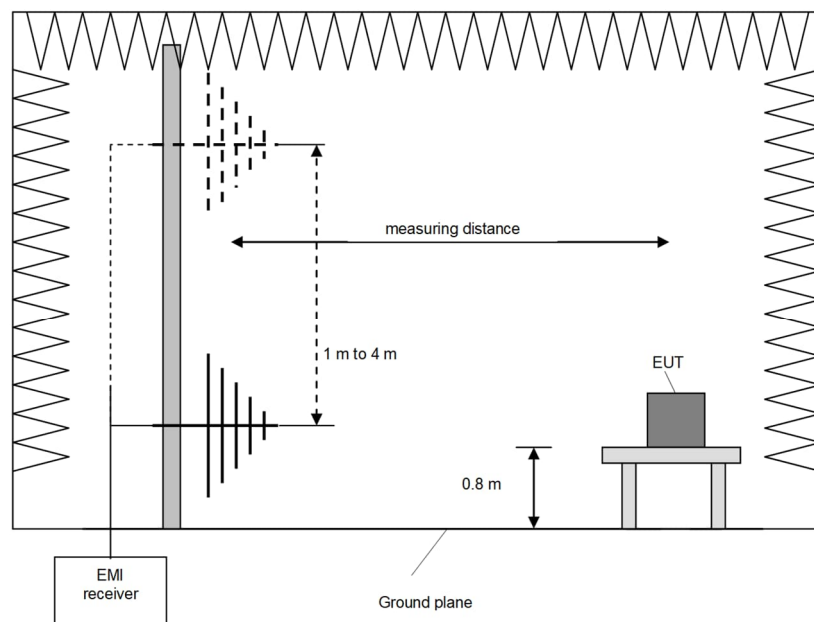
#### 5.1.1.1 Preliminary and final measurement 30 MHz to 1 GHz

The preliminary and final measurements are performed in a semi-anechoic chamber with a metal ground plane at a measuring distance of 3 meters. Table-top devices are set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices are placed directly on the turntable / ground plane. The setup of the equipment under test is in accordance with [1].

During the tests the EUT is rotated in the range of 0 ° to 360 °, the measuring antenna is set to horizontal and vertical polarization and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions.

The resolution bandwidth of the EMI receiver is set to the following values:

| Test                    | Frequency range | Step-size | Resolution bandwidth | Measuring time | Detector     |
|-------------------------|-----------------|-----------|----------------------|----------------|--------------|
| Preliminary measurement | 30 MHz to 1 GHz | 30 kHz    | 120 kHz              | -              | Peak Average |
| Frequency peak search   | $\pm 120$ kHz   | 10 kHz    | 120 kHz              | 1 s            | Peak         |
| Final measurement       | 30 MHz to 1 GHz | -         | 120 kHz              | 1 s            | QuasiPeak    |



Procedure preliminary measurement:

The following procedure is used:

- 1) Set the measuring antenna to 1 m height.
- 2) Monitor the frequency range at horizontal polarization of the measuring antenna and an EUT / turntable azimuth of 0 °.
- 3) Rotate the EUT by 360° to maximize the detected signals.
- 4) Repeat steps 2 to 3 with the vertical polarization of the measuring antenna.
- 5) Increase the height of the measuring antenna for 0.5 m and repeat steps 2 to 4 until the final height of 4 m is reached.
- 6) The highest values for each frequency are saved by the software, including the measuring antenna height and polarization and the turntable azimuth for that value.

Procedure final measurement:

The following procedure is used:

- 1) Select the highest frequency peaks (lowest margin to the limit) for the final measurement.
- 2) The software determines the exact peak frequencies by doing a partial scan with reduced step size of the pre-scan of the selected peaks.
- 3) If the EUT is portable or ceiling mounted, find the worst-case EUT orientation (x, y, z) for the final test.
- 4) The worst-case measuring antenna height is found via varying the height by  $\pm 0.5$  m from the value obtained in the preliminary measurement while monitoring the emission level.
- 5) The worst-case turntable position is found via varying the turntable azimuth by  $\pm 30^\circ$  from the value obtained in the preliminary measurement while monitoring the emission level.
- 6) The final measurement is performed at the worst-case measuring antenna height and the worst-case turntable azimuth.
- 7) Steps 2 to 6 are repeated for each frequency peak selected in step 1.

## 5.1.2 Radiated: 1 GHz to 40 GHz

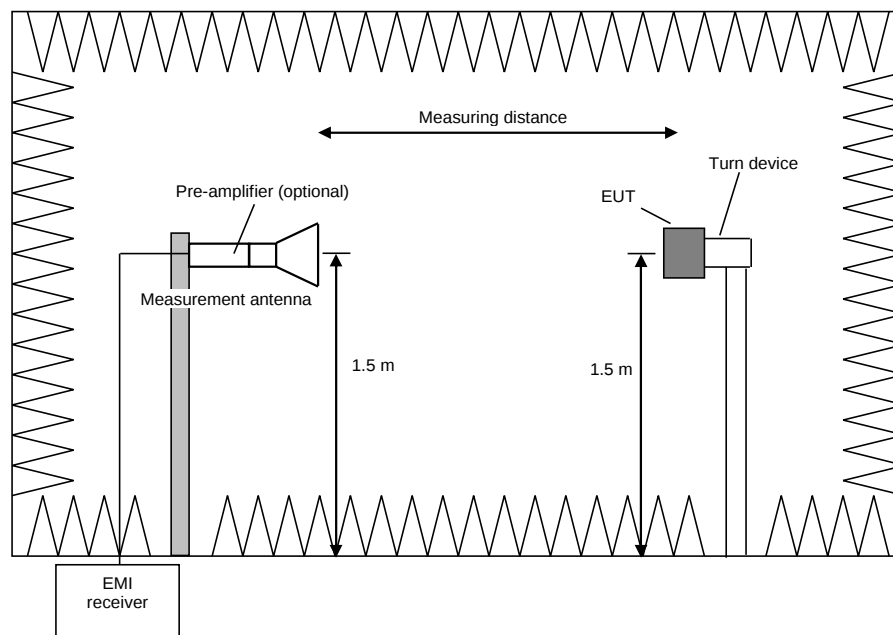
### 5.1.2.1 Preliminary and final measurement 1 GHz to 40 GHz

The preliminary and final measurements are performed in a fully anechoic chamber at a measuring distance of 3 meters. Table-top devices are set up on a non-conducting turn device at the height of 1.5 m. The setup of the equipment under test is in accordance with [1].

During the tests the EUT is rotated in the range of 0 ° to 360 ° and the measuring antenna is set to horizontal and vertical polarization to find the maximum level of emissions. After these steps, the measurement is repeated after reorientating the EUT in 30 ° steps.

The resolution bandwidth of the EMI receiver is set to the following values:

| Test                    | Frequency range | Step-size | Resolution bandwidth | Measuring time | Detector     |
|-------------------------|-----------------|-----------|----------------------|----------------|--------------|
| Preliminary measurement | 1 GHz - 40 GHz  | 250 kHz   | 1 MHz                | -              | Peak Average |
| Final measurement       | 1 GHz - 40 GHz  | -         | 1 MHz                | 100 ms         | Peak Average |



Procedure preliminary measurement:

The following procedure is used:

- 1) Monitor the frequency range at horizontal polarisation of the measuring antenna and an EUT / turntable azimuth of 0 °.
- 2) Rotate the EUT by 360° to maximize the detected signals.
- 3) Repeat steps 1 to 2 with the vertical polarisation of the measuring antenna.
- 4) Repeat steps 1 to 3 with the EUT reorientated by an angle of 30° (60°, 90°, 120° and 150°), according to 6.6.5.4 in [1].
- 5) The highest values for each frequency are saved by the software, including the measuring antenna polarization, the turntable azimuth and the turn device elevation for that value.

Procedure final measurement:

The following procedure is used:

- 1) Set the turntable and the turn device to the position which leads to the highest emission for the first frequency identified in the preliminary measurements.
- 2) Set the measurement antenna to the polarisation which leads to the highest emission for the first frequency identified in the preliminary measurements.
- 3) Set the spectrum analyser to EMI mode with Peak and Average detector activated.
- 4) The worst-case turntable position is found via varying the turntable azimuth by  $\pm 30^\circ$  from the value obtained in the preliminary measurement while monitoring the emission level.
- 5) The final measurement is performed at the worst-case turntable azimuth.
- 6) Repeat steps 1 to 5 for each frequency detected during the preliminary measurements.

### 5.1.2.2 Test results (30 MHz – 1 GHz)

|                      |       |
|----------------------|-------|
| Ambient temperature: | 23 °C |
| Relative humidity:   | 63 %  |

|            |                |
|------------|----------------|
| Date:      | 14.07.2025     |
| Tested by: | D. BRUSCHINSKI |

**Position of EUT:** For tests for f between 30 MHz to 1 GHz, the EUT was set-up on a table with a height of 80 cm. The distance between EUT and antenna was 3 m.

**Cable guide:** For detailed information of test set-up and the cable guide refer to the pictures in annex A of this test report.

**Test record:** Plots for each frequency range are submitted below.

**Remark:** Only the nominal position was tested. Only the worst-case data rates based on pretests were tested.

**Calculations:**

Result [dBμV/m] = Reading [dBμV] + Correction [dB/m]

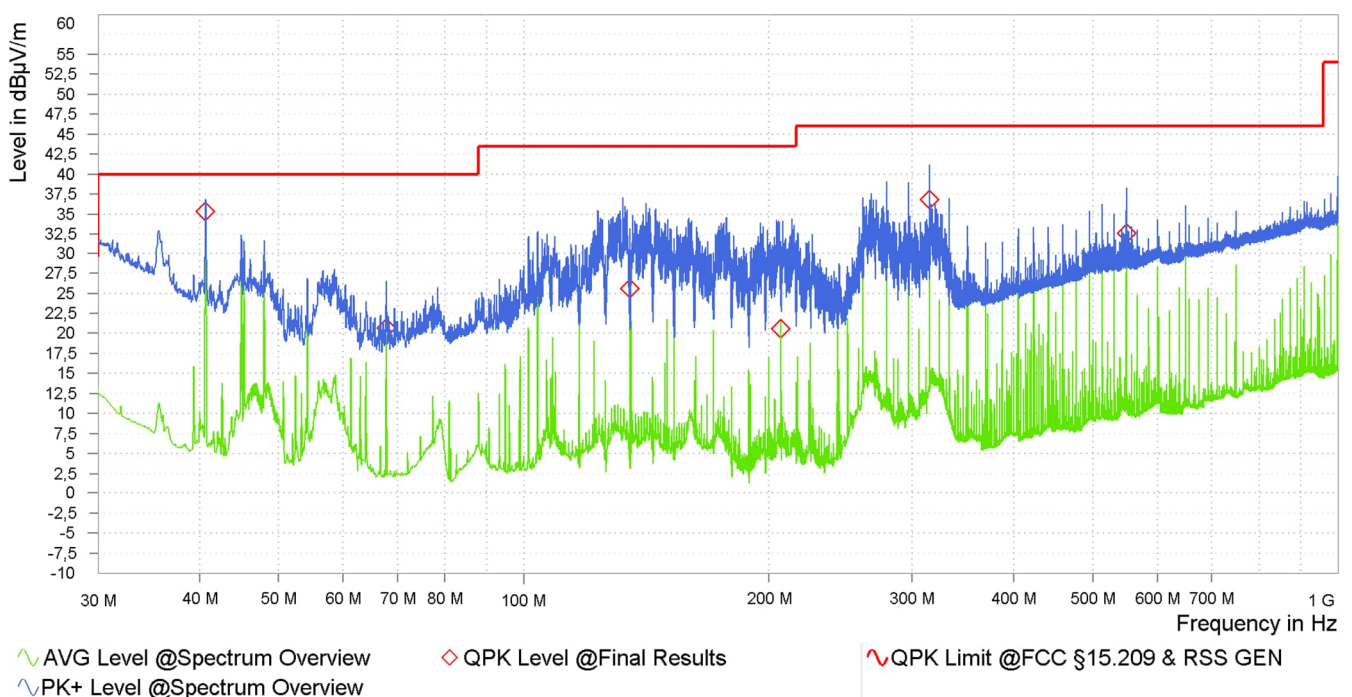
Correction [dB/m] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB]

Margin [dB] = Limit [dBμV/m] - Result [dBμV/m]

The measured points and the limit line in the following diagram refer to the standard measurement of the emitted interference in compliance with the above-mentioned standard. The measured points marked with “◇” are the measured results of the standard subsequent measurement in a semi-anechoic chamber.

#### Worst case plot:

Spurious emissions from 30 MHz to 1 GHz (operation mode 2 – WLAN / NFC):



### Result tables:

Operation mode 1 (BLE / NFC):

| Frequency [MHz] | Result (QP) [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Correction [dB/m] | Polarization (H/V) | Azimuth [deg] | Height [m] |
|-----------------|----------------------|----------------|-------------|-------------------|--------------------|---------------|------------|
| 40.680          | 32.89                | 40.00          | 7.11        | 19.85             | V                  | 277           | 1.00       |
| 48.000          | 29.02                | 40.00          | 10.98       | 14.90             | V                  | 370           | 1.00       |
| 104.010         | 31.76                | 43.50          | 11.74       | 17.56             | V                  | 203           | 1.14       |
| 315.000         | 32.16                | 46.00          | 13.84       | 19.37             | H                  | 141           | 1.04       |
| 650.010         | 32.17                | 46.00          | 13.83       | 26.64             | V                  | 10            | 1.00       |
| 945.000         | 32.65                | 46.00          | 13.35       | 29.82             | V                  | 8             | 1.07       |

Operation mode 2 (WLAN / NFC):

| Frequency [MHz] | Result (QP) [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Correction [dB/m] | Polarization (H/V) | Azimuth [deg] | Height [m] |
|-----------------|----------------------|----------------|-------------|-------------------|--------------------|---------------|------------|
| 40.680          | 35.31                | 40.00          | 4.69        | 19.85             | V                  | 281           | 1.00       |
| 67.800          | 20.62                | 40.00          | 19.38       | 14.08             | V                  | 227           | 1.30       |
| 135.000         | 25.61                | 43.50          | 17.89       | 16.32             | H                  | 276           | 1.50       |
| 207.000         | 20.54                | 43.50          | 22.96       | 16.14             | H                  | 109           | 1.31       |
| 315.000         | 36.84                | 46.00          | 9.16        | 19.37             | H                  | 135           | 1.10       |
| 550.020         | 32.56                | 46.00          | 13.44       | 24.79             | V                  | 251           | 1.02       |

Test result: Passed

|                                                        |
|--------------------------------------------------------|
| Test equipment (please refer to chapter 7 for details) |
| 2 – 8, 10 - 11                                         |

### 5.1.2.3 Test results (radiated 1 GHz to 40 GHz)

|                      |               |
|----------------------|---------------|
| Ambient temperature: | 22 °C - 23 °C |
| Relative humidity:   | 52 % - 64 %   |

|            |                         |
|------------|-------------------------|
| Date:      | 11.07.2025 / 14.07.2025 |
| Tested by: | D. BRUSCHINSKI          |

Position of EUT: For tests for f between 1 GHz and the 10<sup>th</sup> harmonic, the EUT was set-up on a positioner device with a height of 150 cm. The distance between EUT and antenna was 3 m.

Cable guide: For detailed information of test set-up and the cable guide refer to the pictures in annex A of this test report.

Test record: Plots for each frequency range are submitted below.

Remark: Only the worst-case data rates based on pretests were tested.

Calculation:

Max Peak [dBμV/m] = Reading [dBμV] + Correction [dB/m]

Average [dBμV/m] = Reading [dBμV] + Correction [dB/m]

Correction [dB/m] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB] + DCCF\* [dB]  
\* (if applicable – only for Average values, that are fundamental related)

Margin [dB] = Limit [dBμV/m] – Max Peak | Average [dBμV/m]

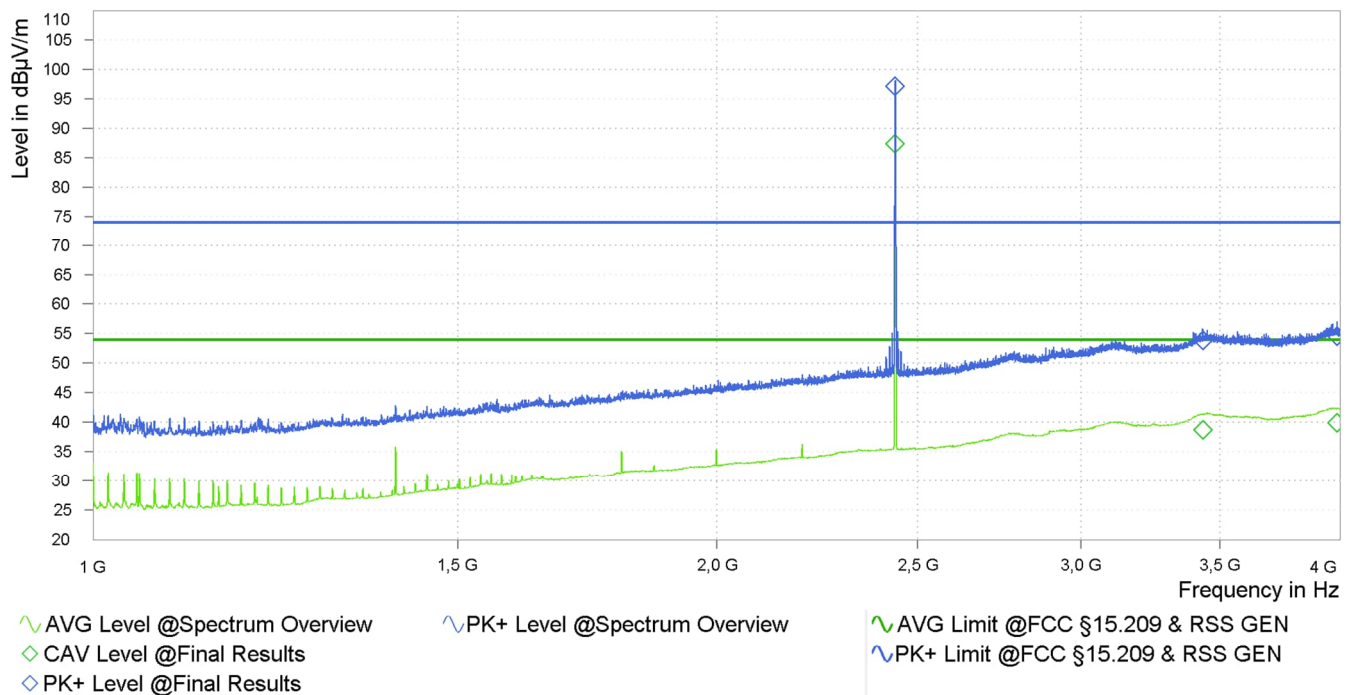
The curves in the diagram only represent the maximum measured value for each frequency point of all preliminary measurements, which were carried out with various EUT and antenna positions.

The top measured curve represents the peak measurement. The measured points marked with "◇" are frequency points for the final peak detector measurement. These values are indicated in the following table. The bottom measured curve represents the average measurement. The measured points marked with "◊" are frequency points for the final average detector measurement.

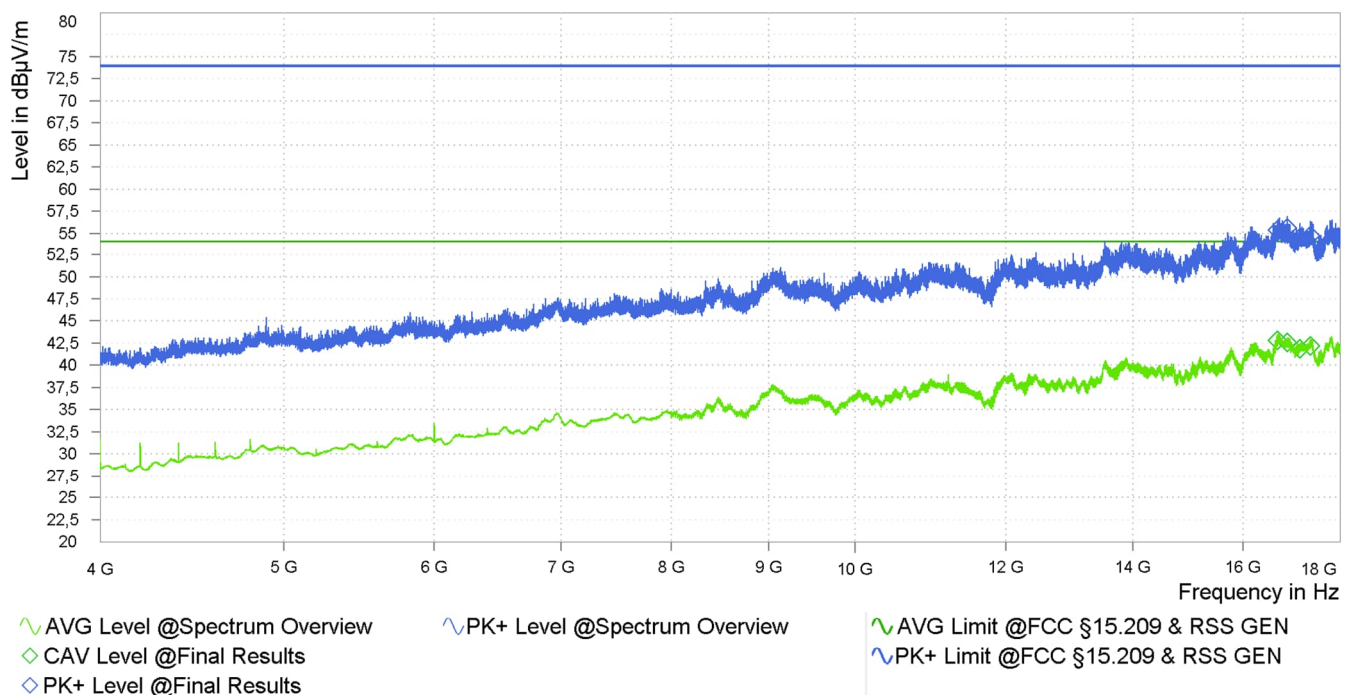
The results are presented on the following pages.

### Worst case plots:

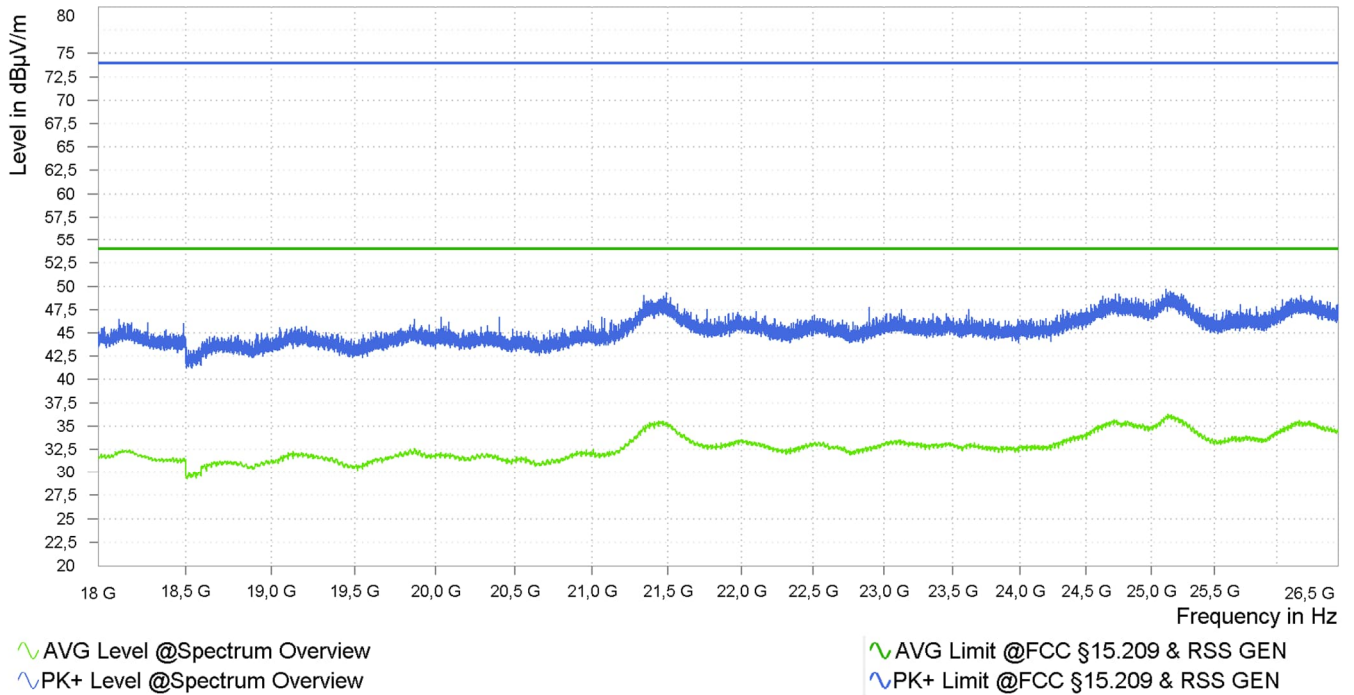
Spurious emissions from 1 GHz to 4 GHz (operation mode 1 – BLE / NFC):



Spurious emissions from 4 GHz to 18 GHz (operation mode 1 – BLE / NFC):



Spurious emissions from 18 GHz to 26.5 GHz (operation mode 1 – BLE / NFC):



## Result tables:

Operation mode 1 (BLE / NFC):

| Frequency [MHz] | MaxPeak [dB(μV/m)] | Average [dB(μV/m)] | Limit [dB(μV/m)] | Margin [dB] | Pol [H/V] | Azimuth [deg] | Elevation [deg] | Correction [dB/m] |
|-----------------|--------------------|--------------------|------------------|-------------|-----------|---------------|-----------------|-------------------|
| 2440.00         | 97.13              | -                  | Fundamental      | -           | V         | 197           | 93              | 34.61             |
| 2440.00         | -                  | 94.70 *            | Fundamental      | -           | V         | 196           | 96              | 41.91 *           |
| 3434.25         | 53.85              | -                  | 74.0             | 20.15       | H         | 110           | 5               | 39.40             |
| 3434.25         | -                  | 38.74              | 54.0             | 15.26       | H         | 113           | 1               | 39.40             |
| 3987.00         | 54.59              | -                  | 74.0             | 19.41       | V         | 164           | 75              | 40.03             |
| 3987.00         | -                  | 39.96              | 54.0             | 14.04       | V         | 164           | 75              | 40.03             |
| 16689.50        | 55.39              | -                  | 74.0             | 18.61       | V         | 321           | 30              | 27.29             |
| 16689.50        | -                  | 42.78              | 54.0             | 11.22       | V         | 321           | 30              | 27.29             |
| 16891.00        | 55.64              | -                  | 74.0             | 18.36       | H         | 351           | 0               | 27.20             |
| 16891.00        | -                  | 42.59              | 54.0             | 11.41       | H         | 351           | 0               | 27.20             |
| 17149.25        | 54.48              | -                  | 74.0             | 19.52       | H         | 28            | 0               | 27.79             |
| 17149.25        | -                  | 41.86              | 54.0             | 12.14       | H         | 28            | 0               | 27.79             |
| 17369.50        | 54.70              | -                  | 74.0             | 19.30       | V         | 284           | 0               | 28.28             |
| 17369.50        | -                  | 42.16              | 54.0             | 11.84       | V         | 284           | 0               | 28.28             |

\* This result was corrected by the  $DCCF_{Fieldstrength}$  which is determined in test report F241002E7.

Operation mode 2 (WLAN / NFC):

| Frequency<br>[MHz] | MaxPeak<br>[dB(μV/m)] | Average<br>[dB(μV/m)] | Limit<br>[dB(μV/m)] | Margin<br>[dB] | Pol<br>[H/V] | Azimuth<br>[deg] | Elevation<br>[deg] | Correction<br>[dB/m] |
|--------------------|-----------------------|-----------------------|---------------------|----------------|--------------|------------------|--------------------|----------------------|
| 2438.00            | 100.13                | -                     | Fundamental         |                | V            | 151              | 81                 | 34.60                |
| 2438.00            | -                     | 97.18                 | Fundamental         |                | V            | 154              | 84                 | 34.60                |
| 3516.25            | 53.11                 | -                     | 74.0                | 20.89          | H            | 140              | 351                | 39.17                |
| 3516.25            | -                     | 38.40                 | 54.0                | 15.60          | H            | 138              | 9                  | 39.17                |
| 3936.50            | 55.00                 | -                     | 74.0                | 19.00          | V            | 104              | 33                 | 39.79                |
| 3936.50            | -                     | 39.66                 | 54.0                | 14.34          | V            | 113              | 42                 | 39.79                |
| 16711.25           | 55.50                 | -                     | 74.0                | 18.50          | H            | 83               | 120                | 27.40                |
| 16711.25           | -                     | 42.65                 | 54.0                | 11.35          | H            | 102              | 120                | 27.40                |

Test result: Passed

Test equipment (please refer to chapter 7 for details)

1 – 9, 12 – 15

## 6 Measurement Uncertainties

| Conducted measurements                               |                                                       |                                                   |
|------------------------------------------------------|-------------------------------------------------------|---------------------------------------------------|
| Measurement method                                   | Standard used for calculating measurement uncertainty | Expanded measurement uncertainty (95 %) $U_{lab}$ |
| Frequency error                                      | ETSI TR 100 028                                       | $4.5 \times 10^{-8}$                              |
| Bandwidth measurements                               | -                                                     | $9.0 \times 10^{-8}$                              |
| Conducted emissions using a spectrum analyzer        |                                                       |                                                   |
| < 3.6 GHz                                            | ETSI TR 100 028                                       | 2.3 dB                                            |
| 3.6 – 8 GHz                                          | ETSI TR 100 028                                       | 2.8 dB                                            |
| 8 – 22 GHz                                           | ETSI TR 100 028                                       | 3.2 dB                                            |
| 22 – 40 GHz                                          | ETSI TR 100 028                                       | 3.6 dB                                            |
| Power measurements                                   |                                                       |                                                   |
| Power meter                                          | ETSI TR 100 028                                       | 0.9 dB                                            |
| Conducted emissions from 150 kHz to 30 MHz with LISN |                                                       |                                                   |
|                                                      | CISPR 16-4-2                                          | 2.8 dB                                            |

| Radiated measurements                                                 |                 |                      |
|-----------------------------------------------------------------------|-----------------|----------------------|
| Frequency error                                                       |                 |                      |
| (Semi-) Anechoic chamber                                              | ETSI TR 100 028 | $4.5 \times 10^{-8}$ |
| OATS                                                                  | ETSI TR 100 028 | $4.5 \times 10^{-8}$ |
| Test fixture                                                          | ETSI TR 100 028 | $4.5 \times 10^{-8}$ |
| Bandwidth measurements                                                |                 |                      |
| (Semi-) Anechoic chamber                                              | -               | $9.0 \times 10^{-8}$ |
| OATS                                                                  | -               | $9.0 \times 10^{-8}$ |
| Test fixture                                                          | -               | $9.1 \times 10^{-8}$ |
| Radiated field strength M20                                           |                 |                      |
| CBL6112B @ 3 m<br>30 MHz – 1 GHz                                      | CISPR 16-4-2    | 5.3 dB               |
| R&S HL050 @ 3 m                                                       |                 |                      |
| 1 – 6 GHz                                                             | CISPR 16-4-2    | 5.1 dB               |
| 6 – 18 GHz                                                            | CISPR 16-4-2    | 5.4 dB               |
| Flann Standard Gain Horns<br>12 – 40 GHz                              | -               | 5.9 dB               |
| Radiated field strength M276                                          |                 |                      |
| R&S HL562E @ 3 m<br>30 MHz – 1 GHz                                    | CISPR 16-4-2    | 4.8 dB               |
| R&S HL050 @ 3 m                                                       |                 |                      |
| 1 – 6 GHz                                                             | CISPR 16-4-2    | 5.1 dB               |
| 6 – 18 GHz                                                            | CISPR 16-4-2    | 5.4 dB               |
| Flann Standard Gain Horns<br>12 – 40 GHz                              | -               | 5.9 dB               |
| OATS                                                                  |                 |                      |
| Field strength measurements below 30 MHz on OATS without ground plane | -               | 4.4 dB               |

## 7 Test Equipment used for Tests

| No. | Test equipment                           | Type                           | Manufacturer       | Serial No.                   | PM. No. | Cal. Date                 | Cal Due |
|-----|------------------------------------------|--------------------------------|--------------------|------------------------------|---------|---------------------------|---------|
| 1   | Log.-Per. antenna<br>850 MHz - 26.5 GHz  | HL050                          | Rohde & Schwarz    | 100908                       | 482977  | 22.09.2022                | 09.2025 |
| 2   | EMC test software                        | Elektra V5.10.00               | Rohde & Schwarz    | -                            | 483755  | Calibration not necessary |         |
| 3   | RF switch matrix                         | OSP220                         | Rohde & Schwarz    | 101391                       | 482976  | Calibration not necessary |         |
| 4   | Turntable                                | TT3.0-3t                       | Maturo             | 825/2612/.01                 | 483224  | Calibration not necessary |         |
| 5   | Antenna support tilt<br>mast             | BAM 4.5-P-10kg                 | Maturo             | 222/2612.01                  | 483225  | Calibration not necessary |         |
| 6   | Controller                               | NCD                            | Maturo             | 474/2612.01                  | 483226  | Calibration not necessary |         |
| 7   | Semi anechoic<br>chamber M276            | SAC5-2                         | Albatross Projects | C62128-A540-<br>A138-10-0006 | 483227  | Calibration not necessary |         |
| 8   | EMI receiver /<br>Spectrum analyser      | ESW44                          | Rohde & Schwarz    | 101828                       | 482979  | 21.02.2024                | 02.2026 |
| 9   | Positioner                               | TG1.5-10kg                     | Maturo             | 110/2648.01                  | 483042  | Calibration not necessary |         |
| 10  | Attenuator 6 dB                          | WA2-6                          | Weinschel          | -                            | 482793  | Calibration not necessary |         |
| 11  | Ultralog antenna                         | HL562E                         | Rohde & Schwarz    | 101079                       | 482978  | 24.04.2024                | 04.2027 |
| 12  | Low noise amplifier<br>10 MHz - 18 GHz   | LNA-30-<br>00101800-25-<br>10P | Narda-Miteq        | 2110917                      | 482967  | 20.02.2024                | 02.2026 |
| 13  | Low noise amplifier<br>18 GHz - 26.5 GHz | LNA-30-<br>18002650-20-<br>10P | Narda-Miteq        | 2110911                      | 482969  | 19.02.2024                | 02.2026 |
| 14  | Standard gain horn<br>18 GHz - 26 GHz    | 20240-20                       | Flann              | 266399                       | 483026  | Calibration not necessary |         |
| 15  | High-pass filter                         | WHKX4.0/18G-<br>8SS            | Wainwright         | 1                            | 480587  | Calibration not necessary |         |

## 8 Test site Verification

| Test equipment                | PM. No. | Frequency range | Type of validation | According to                                   | Val. Date  | Val Due    |
|-------------------------------|---------|-----------------|--------------------|------------------------------------------------|------------|------------|
| Semi anechoic chamber<br>M276 | 483227  | 30 – 1000 MHz   | NSA                | ANSI C63.4-2014<br>ANSI C63.4a-2017            | 01.03.2023 | 28.02.2026 |
| Semi anechoic chamber<br>M276 | 483227  | 1 -18 GHz       | SVSWR              | CISPR 16-1-4 + Cor1:2010 +<br>A1:2012 +A2:2017 | 28.02.2023 | 27.02.2026 |

## 9 Report History

| Report Number | Date       | Comment             |
|---------------|------------|---------------------|
| F241002E9     | 23.01.2026 | Initial Test Report |
| -             | -          | -                   |
| -             | -          | -                   |

## 10 List of Annexes

Annex A

Test Setup Photos

5 pages

----- end of test report -----