# Test Report
# 19-1-0069003T32a-C1

| | | | |
|---|---|---|---|
| **Number of pages:** | 17 | **Date of Report:** | 2020-Nov-19 |
| **Testing company:** | CETECOM GmbH<br>Im Teelbruch 116<br>45219 Essen Germany<br>Tel. + 49 (0) 20 54 / 95 19-0<br>Fax: + 49 (0) 20 54 / 95 19-150 | **Applicant:** | WAGO KONTAKTTECHNIK GMBH & CO. KG |
| **Test Object / Tested Device(s):** | **8DIO FLD PN DC 24V 2.0A**<br>**SlimLine 765-1104/0100-0000**<br>**WAGO I/O System Field** | | |
| **Listing FCC ID:** | **2AKUE-SLIMLINE** | **ISED:** | **22322-SLIMLINE** |
| **Testing has been carried out in accordance with:** | **FCC Regulations**<br>**PART 15—RADIO FREQUENCY DEVICES**<br>**Subpart B—UNINTENTIONAL RADIATORS**<br><br>Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method and limit". | | |
| **Test Results:** | **☒ The EUT complies with the requirements in respect of all parameters subject to the test.**<br>The test results relate only to devices specified in this document | | |
| **Signatures:** | | | |

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# 1 General information

## 1.1 Disclaimer and Notes

The test results of this test report relate exclusively to the test item specified in this test report as specified in chapter 2.7. CETECOM does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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Also we refer on special conditions which the applicant should fulfill according §2.927 to §2.948, special focus regarding modification of the equipment and availability of sample equipment for market surveillance tests.

## 1.1. Summary of Test Results

| Test case | Reference in FCC ☒ | Reference in ISED ☐ | Reference in RSS-GEN ☐ | Remark | Result |
|---|---|---|---|---|---|
| AC-Power Lines Conducted Emissions | §15.107 | ICES-003, Issue 6 | RSS Gen, Issue 5, Chapter 8.8 | | N/A |
| Radiated field strength emissions 30 MHz – 1 GHz | §15.109<br>§15.33<br>§15.35 | ICES-003, Issue 6 | RSS-Gen., Issue 5 Chapter 8.9, Chapter 7.3 | | PASS |
| Radiated field strength emissions above 1 GHz | §15.109<br>§15.33<br>§15.35 | ICES-003, Issue 6 | RSS-Gen., Issue 5 Chapter 8.9, Chapter 7.3 | | PASS |

| | |
|---|---|
| PASSED | The EUT complies with the essential requirements in the standard. |
| FAILED | The EUT does not comply with the essential requirements in the standard. |
| NP | The test was not performed by the CETECOM Laboratory. |

**The current version of the Test Report 19-1-0069003T32-C1 replaces the Test Report 19-1-006903T32 dated 2020-Sep-03.**
**The replaced Test Report is herewith invalid.**

## 1.2. Summary of Test Methods

| Test case | Test method |
|---|---|
| Radiated field strength emissions 30 MHz – 1 GHz | ANSI C63.4-2014 chapter 8.2.3 |
| Radiated field strength emissions above 1 GHz | ANSI C63.4-2014 chapter 8.3 |

# 2 Administrative Data

## 2.1 Identification of the Testing Laboratory

| | |
|---|---|
| Company name: | CETECOM GmbH |
| Address: | Im Teelbruch 116<br>45219 Essen - Kettwig<br>Germany |
| Responsible for testing laboratory: | Mr. Volker Briddigkeit |
| Accreditation scope: | DAkkS Webpage |
| Test location: | CETECOM GmbH; Mündelheimer Weg 35; 40472 Düsseldorf |

## 2.2 General limits for environmental conditions

| | |
|---|---|
| Temperature: | 22±2° C |
| Relative. humidity: | 45±15% rH |
| Barometric Pressure: | 1013 hPa |

## 2.3 Test Laboratories sub-contracted

| |
|---|
| Company name: |

## 2.4 Organizational Items

| | |
|---|---|
| Order No.: | 3 |
| Responsible test manager: | Ahmed Ben Cheikh |
| Receipt of EUT: | 2020-Mar-30 |
| Date(s) of test: | 2020-Jun-30 |
| Version of template: | 14.0 |

## 2.5 Applicant's details

| | |
|---|---|
| Applicant's name: | WAGO Kontakttechnik GmbH & Co. KG |
| Address: | Hansastraße 27<br>32423 Minden<br>Germany |
| Contact Person: | Mr. Achim Brinkmann |

## 2.6 Manufacturer's details

| | |
|---|---|
| Manufacturer's name: | WAGO Kontakttechnik GmbH & Co. KG |
| Address: | see chapter 2.5 |

## 2.7 EUT: Type, S/N etc. and short descriptions used in this test report

| Short description*) | PMT Sample No. | EUT | Type | HW status | Firmware | SW status |
|---|---|---|---|---|---|---|
| EUT 1 | 19-1-00690S105 | 8DIO FLD PN DC 24V 2.0A | SlimLine 765-1104/0100-0000 | Rev. 4 | BT-FW: V1.2.0.0 | V1.0.2.0 |

*) EUT short description is used to simplify the identification of the EUT in this test report.

## 2.8 Auxiliary Equipment (AE): Type, S/N etc. and short descriptions

| Short description*) | PMT Sample No. | Auxiliary Equipment | Type | S/N | HW status | SW status |
|---|---|---|---|---|---|---|
| AE 1 | -- | Working Station | DELL Precision 3630 | l.18.11.1487 | -- | -- |
| AE2 | -- | netFIELD Technology EUT Testplate | -- | -- | -- | -- |
| AE3 | -- | Mobile Phone | Iphone 7 | DNPT3NTSHG80 | -- | -- |
| AE4 | -- | DC Power Supply | -- | 0718340214931 | -- | -- |

*) AE short description is used to simplify the identification of the auxiliary equipment in this test report.

## 2.9 Connected cables

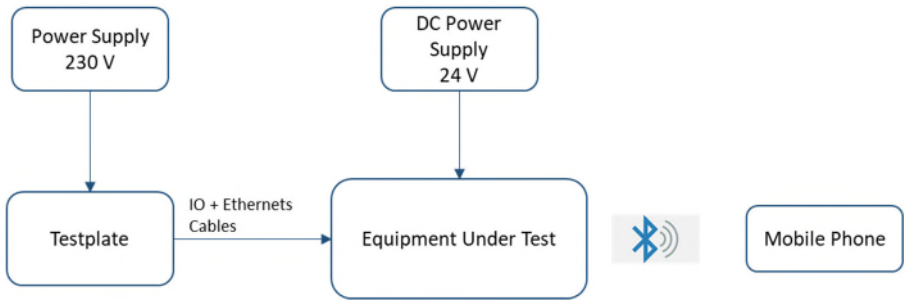
| Short description*) | PMT Sample No. | Cable | Type | Schielded | Length |
|---|---|---|---|---|---|
| CAB 1 | -- | Mains power supply | Banana Plug | No | < 1 m |
| CAB 2 | -- | IO cables | M12 – 5 Pol | Yes | 20 m |
| CAB 3 | -- | Ethernet ETH 1 | RJ45 end | Yes | 20 m |
| CAB 4 | -- | Ethernet ETH 2 | M12 end | Yes | 20 m |

*) CAB short description is used to simplify the identification of the connected cables in this test report.

## 2.10 EUT set-ups

| set-up no.*) | Combination of EUT and AE | Description |
|---|---|---|
| 1 | EUT1 + AE1 + AE2 + AE3 + AE4 | -- |

*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.




## 2.11 EUT operation modes

| EUT operating mode no.*) | Operating modes | Additional information |
|---|---|---|
| OP 1 | Continuous Data transmission between the Test plate and EUT.<br>Permanent Bluetooth connection (Mobile Phone + EUT). | -- |

*) EUT operating mode no. is used to simplify the test report.

# 3 Equipment under test (EUT)

## 3.1 General Data of Main EUT as Declared by Applicant

| | | | |
|---|---|---|---|
| **Product name** | SLIMLINE | | |
| **Kind of product** | I/O Module with Bluetooth | | |
| **Firmware** | ☐ for normal use | ☒ Special version for test execution | |
| | ☐ AC Mains | | |
| | ☒ DC | 24 V | |
| | ☐ Battery | -- | |
| **Operational conditions** | $T_{nom}$ =21 °C | $T_{min}$ =-- °C | $T_{max}$ =-- °C |
| **EUT sample type** | **Pre-Production** | | |
| **Weight** | -- | | |
| **Size** | -- | | |
| **Interfaces/Ports** | IO M12 and ethernet ports | | |
| **For further details refer Applicants Declaration & following technical documents** | | | |

## 3.2 Modifications on Test sample

| | |
|---|---|
| Additions/deviations or exclusions | none |

# 4 Measurements

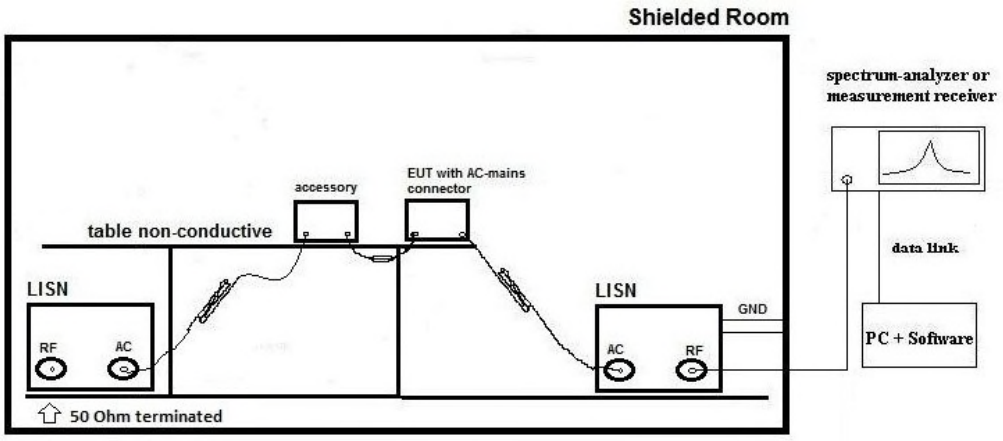
## 4.1 AC-Power Lines Conducted Emissions

### 4.1.1 Description of the general test setup and methodology, see below example:

The radio frequency voltage conducted back into the AC power line in the frequency range 150 kHz to 30 MHz has to be investigated.
Compliance should be tested by measuring the radio frequency voltage between each power line and ground at the power terminals in the stated frequency range.
A 50 Ohm / 50 µH line impedance stabilization network (LISN) is used coupling the interface to the measurement equipment.
The EUT power input leads are connected through the LISN to the AC-power source. The LISN enclosure is electrically connected to the ground plane. The measuring instrument is connected to the coaxial output of the LISN.

Tabletop devices were set-up on an 80 cm height above reference ground plane, floor standing equipment 10 cm raised above ground plane.
Measurements have been performed on each phase line and neutral line of the devices AC-power lines.
The EUT was power supplied with 120 V/60 Hz. The EUT was tested in the defined operating mode
and installed (connected) to accessory equipment according the general description of use given by the applicant.

### Schematic:




### Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

**Exploratory, preliminary measurements**
As a first step, determines the worst-case phase line (neutral or phase) as well as the most critical operating mode of the equipment. A complete frequency-sweep with PK-Detector is performed on each current-carrying conductor.

**Final measurement on critical frequencies**
For power phases and critical frequencies (Margin to AV- or QP limit lower than 3 dB) as a second step includes measurements with receivers detector set to Quasi-Peak and Average.

### Formula:

$V_C = V_R + C_L$ (1)
$M = L_T - V_C$ (2)

$V_C$ = measured Voltage –corrected value
$V_R$ = Receiver reading
$C_L$ = Cable loss
M = Margin
$L_T$ = Limit

All units are dB-units, positive margin means value is below limit.

## 4.1.2 Limit

| Frequency Range [MHz] | Class B ☐ | | Class A ☐ | |
|---|---|---|---|---|
| | QUASI-Peak [dBµV] | AVERAGE [dBµV] | QUASI-Peak [dBµV] | AVERAGE [dBµV] |
| 0.15 – 0.5 | 66 to 56* | 56 to 46* | 79 | 66 |
| 0.5 – 5 | 56 | 46 | 73 | 60 |
| 5 – 30 | 60 | 50 | 73 | 60 |

## 4.1.3 Result

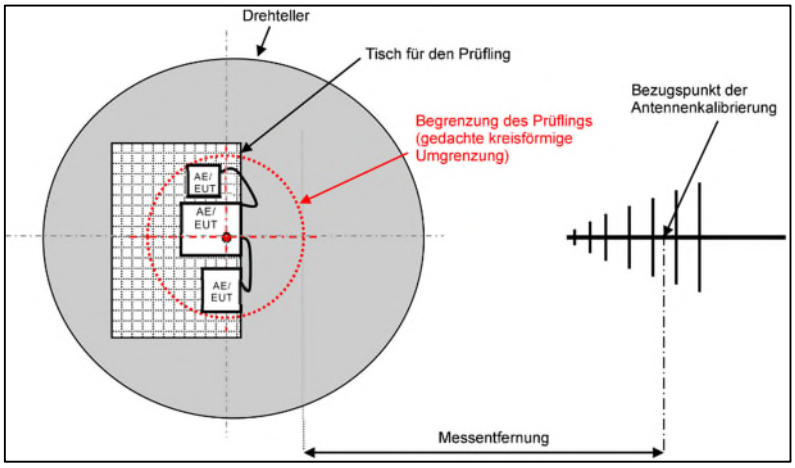
| Diagram | Mode | Power Line | Max [dBµV] | Detector | Result |
|---|---|---|---|---|---|
| -- | -- | -- | -- | Average | -- |

## 4.2 Radiated field strength emissions 30 MHz – 1 GHz

### 4.2.1 Description of the general test setup and methodology, see below example:

Evaluating the field emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a NSA-compliant semi anechoic room (SAR) recognized by the regulatory commissions.

#### Schematic:




#### Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

**Exploratory, preliminary measurements**
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 90°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and its characteristics was recorded with an EMI-receiver, broadband antenna and software.

Measurement antenna: horizontal and vertical, heights: 1,0 m and 1,82 m as worst-case determined by an exploratory emission measurements. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

**Final measurement on critical frequencies**
Based on the exploratory measurements, the most critical frequencies are re-measured by main-taining the EUT's worst-case operation mode, cable position, etc. either on 10m OATS or 3m semi-anechoic room.
First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position). The measurement antenna height between 1 m and 4 m.

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out

### Formula:

$E_C = E_R + AF + C_L + D_F - G_A$ (1)

$M = L_T - E_C$ (2)

AF = Antenna factor
$C_L$ = Cable loss
$D_F$ = Distance correction factor (if used)
$E_C$ = Electrical field – corrected value
$E_R$ = Receiver reading
$G_A$ = Gain of pre-amplifier (if used)
$L_T$ = Limit
M = Margin

All units are dB-units, positive margin means value is below limit.

## 4.2.2 Limit

| Frequency Range [MHz] | Class A ☒ (3 meters) | | Class A ☒ (10 meters) | | | |
|---|---|---|---|---|---|---|
| | Limit [µV/m] | Limit [dBµV/m] | Limit [µV/m] | Limit [dBµV/m] | Detector | RBW / VBW [kHz] |
| 30 - 88 | 282 | 49.0 | 90 | 39.0 | Quasi peak | 120 |
| 88 - 216 | 473 | 53.5 | 150 | 43.5 | Quasi peak | 120 |
| 216 - 960 | 660 | 56.4 | 210 | 46.4 | Quasi peak | 120 |
| 960 - 1000 | 944 | 59.5 | 300 | 49.5 | Quasi peak | 120 |

## 4.2.3 Result

| Diagram | Channel | Mode | Maximum Level [dBµV/m] Frequency Range 30 – 1000 MHz | Result |
|---|---|---|---|---|
| Diagram No. 3.01 | -- | OP 1 | 39.70 at 116.664 MHz (10 m distance) | OK |

Remark: for more informations and graphical plot see annex A1 **CETECOM_19_1_0069003T32a-C1_A1**

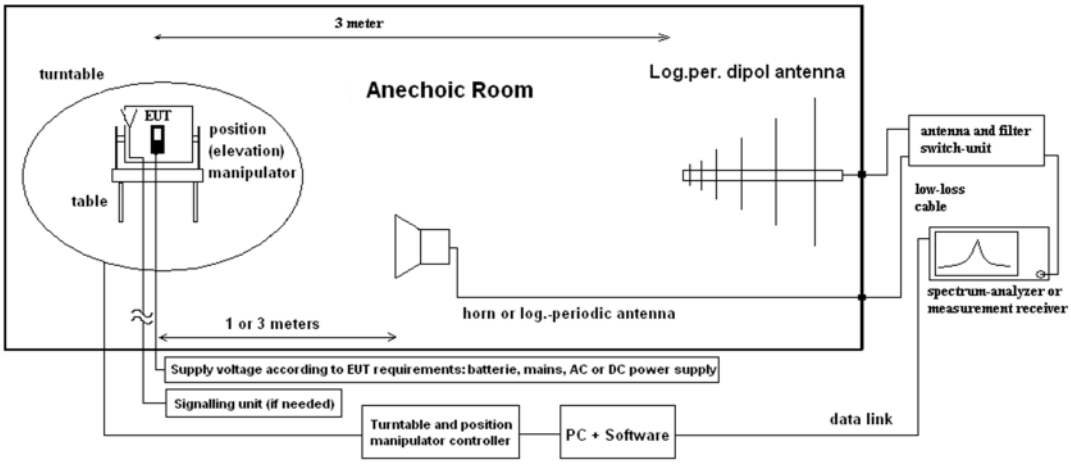
- The preliminary measurement has done inside the 3-meters semi-anechoic chamber.
- The final measurement of the critical frequencies has done in 10-meters Open Area Test Site (OATS).

## 4.3 Radiated field strength emissions above 1 GHz

### 4.3.1 Description of the general test setup and methodology, see below example:

Evaluating the emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a CISPR 16-1-4:2010 compliant fully anechoic room (FAR) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 18 GHz and 2 meter above 18 GHz. A logarithmic periodic antenna is used for the frequency range 30 MHz to 1 GHz. Horn antennas are used for frequency range 1 GHz to 40 GHz. The EUT is aligned within 3 dB beam width of the measurement antenna with three orthogonal axis measurements on the EUT.

### Schematic:




### Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

**Exploratory, preliminary measurements**
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.55 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 15°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and its characteristics was recorded with an EMI-receiver, broadband antenna and software.
The measurements are performed in horizontal and vertical polarization of the measurement antennas. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

**Final measurement on critical frequencies**
Based on the exploratory measurements, the most critical frequencies are re-measured by main-taining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself over 3-orthogonal axis and the height for EUT with large dimensions or three axis scan for portable/small equipment.

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

### Formula:

$E_C = E_R + A_F + C_L + D_F - G_A$ (1)

$M = L_T - E_C$ (2)

$E_C$ = Electrical field – corrected value
$E_R$ = Receiver reading
M = Margin
$L_T$ = Limit
$A_F$ = Antenna factor
$C_L$ = Cable loss
$D_F$ = Distance correction factor (if used)
$G_A$ = Gain of pre-amplifier (if used)

All units are dB-units, positive margin means value is below limit.

## 4.3.2 Limit

| Radiated emissions limits (3 meters) | | | | |
|---|---|---|---|---|
| **Frequency Range [MHz]** | **Limit [µV/m]** | **Limit [dBµV/m]** | **Detector** | **RBW / VBW [kHz]** |
| Above 1000 | 940 | 59.5 | Average | 1000 |
| Above 1000 | 9400 | 79.5 | Peak | 1000 |

## 4.3.3 Result

| Diagram | Channel | Mode | Maximum Level [dBµV/m] Frequency Range 1 – 12.75 GHz | Result |
|---|---|---|---|---|
| Diagram No. 4.01 | -- | OP 1 | No conspicious frequencies detected – Margin to limit > 10 dB | OK |
| Diagram No. 4.02 | -- | OP 1 | No conspicious frequencies detected – Margin to limit > 10 dB | OK |

Remark: for more informations and graphical plot see annex A1 **CETECOM_19_1_0069003T32a-C1_A1**

| Diagram | Channel | Mode | Maximum Level [dBµV/m] Frequency Range 18 – 26.5 GHz | Result |
|---|---|---|---|---|
| | | | N/A | N/A |

Remark: for more informations and graphical plot see annex A1 **CETECOM_19_1_0069003T32a-C1_A1**

## 4.4 Results from external laboratory

| | |
|---|---|
| None | - |

## 4.5 Opinions and interpretations

| | |
|---|---|
| None | - |

# 5 Equipment lists

| ID | Description | Manufacturer | SerNo | Cal Date |
|---|---|---|---|---|
| | **Shielded Room - Conducted Emission** | | | |
| 25348 | EMI Test Receiver ESR7 | Rohde & Schwarz Messgerätebau GmbH | -- | 31.05.2021 |
| 25261 | Artificial Network (LISN)<br>9 kHz – 30 MHz | Rohde & Schwarz ESH 2 -Z5 | -- | 31.07.2021 |
| | **225911 - SAC5 - Radiated Emission <1GHz** | | | **05.04.2026** |
| 25348 | EMI Test Receiver ESR7 | Rohde & Schwarz Messgerätebau GmbH | 101600 | 21.05.2021 |
| 25352 | Open Switch and control Platform OSP120 | Rohde & Schwarz Messgerätebau GmbH | 101542-rV | |
| 25358 | Semi Anechoic Chamber SAC5 | Albatross Projects GmbH | P27281-016 | 30.06.2026 |
| 25357 | Ultra-broadband antenna HL562E | Rohde & Schwarz Messgerätebau GmbH | 100824 | 13.09.2020 |
| | **225912 - SAC5 - Radiated Emission >1GHz** | | | **04.05.2026** |
| 25311 | EMI Test Receiver ESU40 | Rohde & Schwarz Messgerätebau GmbH | 100285 | 21.05.2021 |
| 25309 | Double Ridged Horn Antenna HF907 | Rohde & Schwarz Messgerätebau GmbH | 100333 | 31.08.2022 |
| 25358 | Semi Anechoic Chamber SAC5 | Albatross Projects GmbH | P27281-016 | 30.06.2026 |
| | **25211 - Open Area Test Site - Radiated Emission <1GHz** | | | **31.08.2020** |
| 25348 | EMI Test Receiver ESR7 | Rohde & Schwarz Messgerätebau GmbH | -- | 31.05.2021 |
| 25178 | Biconical Antenna | Schwarzbeck BBA9106 | -- | 31.07.2021 |

Tools used in 'P1M1'

# 6 Measurement Uncertainty valid for conducted/radiated measurements

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor **k**, such that a confidence level of approximately 95% is achieved. For uncertainty determination, each component used in the concrete measurement set-up was taken in account and it contribution to the overall uncertainty according its statistical distribution calculated.

| RF-Measurement | Reference | Frequency range | Calculated uncertainty based on a confidence level of 95% | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| Conducted emissions ($U_{CISPR}$) | CISPR 16-2-1 | 9 kHz - 150 kHz<br>150 kHz - 30 MHz | 4.0 dB<br>3.6 dB | | | | | | - |
| Radiated emissions Enclosure | CISPR 16-2-3 | 30 MHz - 1 GHz<br>1 GHz - 18 GHz | 4.2 dB<br>5.1 dB | | | | | | E-Field |
| Disturbance power | CISPR 16-2-2 | 30 MHz - 300 MHz | - | | | | | | - |
| Power Output radiated | - | 30 MHz - 4 GHz | 3.17 dB | | | | | | Substitution method |
| Power Output conducted | - | Set-up No. | Cel-C1 | Cel-C2 | BT1 | W1 | W2 | -- | |
| | | 9 kHz - 12.75 GHz | N/A | 0.60 | 0.7 | 0.25 | N/A | -- | - |
| | | 12.75 - 26.5 GHz | N/A | 0.82 | -- | N/A | N/A | -- | |
| Conducted emissions on RF-port | - | 9 kHz - 2.8 GHz | 0.70 | N/A | 0.70 | N/A | 0.69 | -- | N/A - not applicable |
| | | 2.8 GHz - 12.75 GHz | 1.48 | N/A | 1.51 | N/A | 1.43 | -- | |
| | | 12.75 GHz – 18 GHz | 1.81 | N/A | 1.83 | N/A | 1.77 | -- | |
| | | 18 GHz - 26.5 GHz | 1.83 | N/A | 1.85 | N/A | 1.79 | -- | |
| Occupied bandwidth | - | 9 kHz - 4 GHz | 0.1272 ppm (Delta Marker) | | | | | | Frequency error |
| | | | 1.0 dB | | | | | | Power |
| Emission bandwidth | - | 9 kHz - 4 GHz | 0.1272 ppm (Delta Marker) | | | | | | Frequency error |
| | - | | See above: 0.70 dB | | | | | | Power |
| Frequency stability | - | 9 kHz - 20 GHz | 0.0636 ppm | | | | | | - |
| Radiated emissions Enclosure | - | 150 kHz - 30 MHz<br>30 MHz - 1 GHz<br>1 GHz - 20 GHz | 5.0 dB<br>4.2 dB<br>3.17 dB | | | | | | Magnetic field<br>E-field<br>Substitution |

# 7 Versions of test reports (change history)

| Version | Applied changes | Date of release |
|---|---|---|
| -- | Initial release | 2020-Sep-03 |
| C1 | Correction of limit in 4.3.2 | 2020-Nov-19 |
| -- | -- | -- |

# End Of Test Report