# Test Report
# 21-1-0116001T02a-C1

DAkkS Deutsche Akkreditierungsstelle
D-PL-12047-01-01
D-PL-12047-01-03
D-PL-12047-01-04

| | | | |
|---|---|---|---|
| **Number of pages:** | 15 | **Date of Report:** | 2023-May-23 |
| **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:** | Alois Kober GmbH |
| **Test Object / Tested Device(s):** | **E&P levelsystem**<br>**E&P levelsystem Main unit** | | |
| **FCC ID:** | 2A5AD-4100970 | **ISED ID:** | N/A |

**Testing has been carried out in accordance with:**

**Title 47 CFR, Chapter I**
**FCC Regulations, Subchapter A**
Subpart B: §15.109 (Class B limits)

**ISED Regulations**
ICES-003, Issue 6 (Class B limits)

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.**
The test results relate only to devices specified in this document
Test report 21-1-0116001T02a-C1 is replacing original report 21-1-0116001T02a, dated 2022-Jan-06.
The replaced test report gets invalid herewith.

**Signatures:**

| | |
|---|---|
| Dipl.-Ing. Ninovic Perez | B.Sc. Hicham Laayouni |
| Test Lab Manager | Test manager |
| Authorization of test report | Responsible of test report |

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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.

## 1.2 Summary of Test Results

| Test case | Reference in FCC ☒ | Reference in ISED ☒ | Reference in RSS-GEN ☒ | Remark | Result |
|---|---|---|---|---|---|
| Radiated field strength emissions 30 MHz – 1 GHz | §15.109<br>§15.33<br>§15.35 | ICES-003,<br>Issue 6 | RSS-Gen., Issue 5<br>Chapter 8.9,<br>Chapter 7.3 | -- | PASS |
| Radiated field strength emissions above 1 GHz | §15.109<br>§15.33<br>§15.35 | ICES-003,<br>Issue 6 | RSS-Gen., Issue 5<br>Chapter 8.9,<br>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. |

## 1.3 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 Ninovic Perez |
| Accreditation scope: | DAkkS Webpage |
| Test location: | CETECOM GmbH; Im Teelbruch 116 ;45219 Essen - Kettwig |

## 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.: | 21-1-0116001 |
| Responsible test manager: | B.Sc. Hicham Laayouni |
| Receipt of EUT: | 2021-Dec-06 |
| Date(s) of test: | 2021-Dec-08 |
| Version of template: | 14.0 |

## 2.5 Applicant's details

| | |
|---|---|
| Applicant's name: | Alois Kober GmbH |
| Address: | Ichenhauser Str. 14<br>89359 Kötz<br>Bavaria<br>Germany |
| Contact Person: | Mr. Sebastian Weis |
| Contact Person's Email: | sebastian.weis@alko-tech.com |

## 2.6 Manufacturer's details

| | |
|---|---|
| Manufacturer's name: | Q.E.F. electronic innovations |
| Address: | Marconiweg 2A<br>3417 XK Montfoort<br>The Netherlands (NL) |

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

| Short description*) | PMT Sample No. | Product | Model | Type | S/N | HW status | SW status |
|---|---|---|---|---|---|---|---|
| EUT 1 | 21-1-01160S02_C01 | E&P levelsystem | E&P levelsystem Main unit | Main unit Camper/Caravan | -- | Rev. 1.9 | V3.14 |

*) 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 |
|---|---|---|---|---|---|---|
| AE1 | 21-1-01160S04_C01 | E&P levelsystem | E&P levelsystem Touchpanel | 0117 | V1.5 | V1.11.xW |

*) 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 | Connectors | Length |
|---|---|---|---|---|
| CAB 1 | 21-1-01160S11_01 | Power cable | n/a | 270 cm |
| CAB 2 | 21-1-01160S10_C01 | 4 pin cable | 4-Pin to 4-Pin-connector | 980 cm |

*) 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 | EUTA + AE1 + CAB1 + CAB2 | Used for Radiated measurements. |

*) 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 | Data communication | • IDLE mode active: frequency band 902-915MHz<br>• Data comunicaion between EUT 1 and AE2over CAB1 |

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

# 3 Equipment under test (EUT)

## 3.1 General Data of EUT 1 as Declared by Applicant

| | | | |
|---|---|---|---|
| **Product name EUt** | E&P levelsystem | | |
| **Kind of product** | Main unit Camper/Caravan | | |
| **Firmware** | ☐ for normal use | ☒ Special version for test execution | |
| | ☐ AC Mains | - | |
| | ☒ DC Mains | 12VDC | |
| | ☐ Battery | - | |
| **Operational conditions** | $T_{nom}$ =23 °C | $T_{min}$ = -40 °C | $T_{max}$ = 70 °C |
| **EUT sample type** | **Pre-Production** | | |
| **Weight** | 0.2 kg | | |
| **Size** | 14 cm x 8.5 cm x 3 cm | | |
| **Interfaces/Ports** | 9-Pin connection | | |
| **For further details refer Applicants Declaration & following technical documents** | | | |
| **For further details regarding radio parameters, please refer to radio Core Specification** | | | |

## 3.2 Modifications on Test sample

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

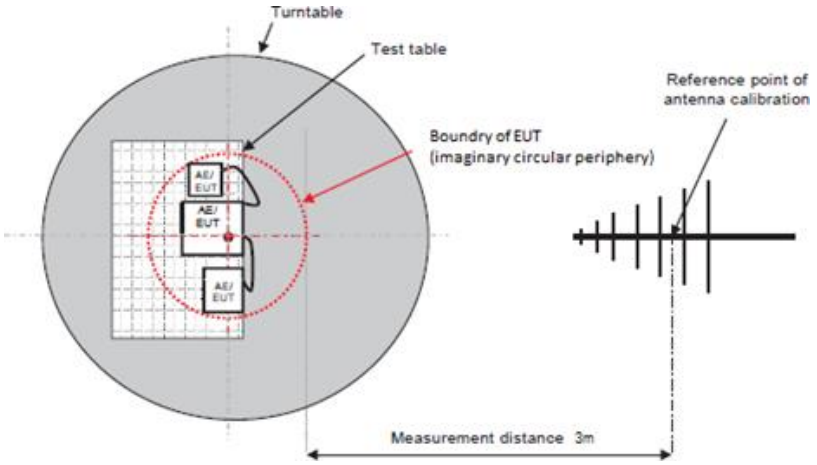
# 4 Measurements

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

### 4.1.1 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.

## 4.1.2 Limit

| Frequency Range [MHz] | Class B ☒ (3 meters) | | Class A ☐ (10 meters) | | | |
|---|---|---|---|---|---|---|
| | Limit [µV/m] | Limit [dBµV/m] | Limit [µV/m] | Limit [dBµV/m] | Detector | RBW / VBW [kHz] |
| 30 - 88 | 100 | 40.0 | 90 | 39.0 | Quasi peak | 100 / 300 |
| 88 - 216 | 150 | 43.5 | 150 | 43.5 | Quasi peak | 100 / 300 |
| 216 - 960 | 200 | 46.0 | 210 | 46.4 | Quasi peak | 100 / 300 |
| 960 - 1000 | 500 | 54.0 | 300 | 49.5 | Quasi peak | 100 / 300 |

## 4.1.3 Result

| Diagram | Channel | Mode | Maximum Level [dBµV/m] Frequency Range 30 – 1000 MHz | Result |
|---|---|---|---|---|
| 3.01_laying | -- | op. 1 | 39.16dBµV/m @ 193.47MHz | Passed |
| 3.02_Standing | -- | op. 1 | 43.35dBµV/m @ 96.74MHz | Passed |

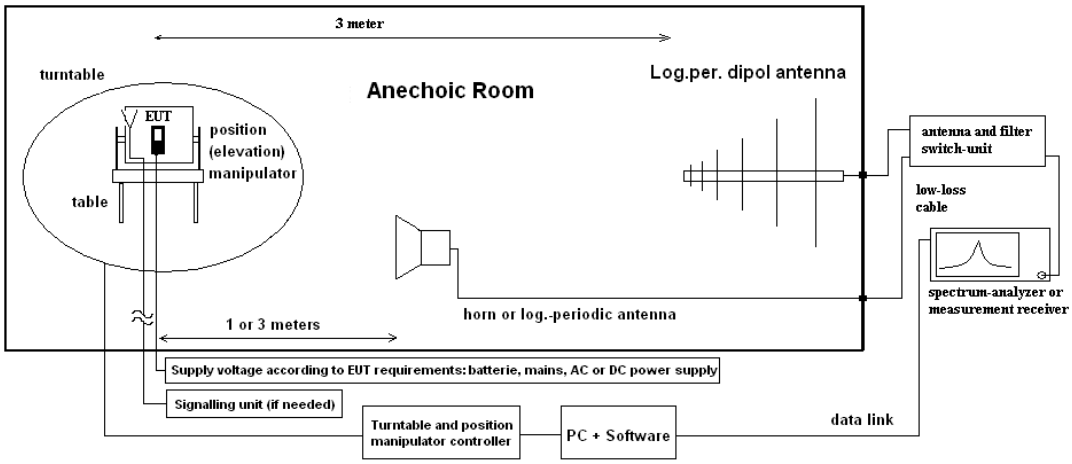
Remark: for more informations and graphical plot see annex A1 **CETECOM_TR21_1_0116001T02a-C1-A1**

## 4.2 Radiated field strength emissions above 1 GHz

### 4.2.1 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.

## 4.2.2 Limit

| Radiated emissions limits (3 meters) | | | | |
|---|---|---|---|---|
| **Frequency Range [MHz]** | **Limit [µV/m]** | **Limit [dBµV/m]** | **Detector** | **RBW / VBW [kHz]** |
| Above 1000 | 500 | 54 | Average | 1000 |
| Above 1000 | 5000 | 74 | Peak | 1000 |

## 4.2.3 Result

| Diagram | Mode | Maximum Level [dBµV/m] Frequency Range 1 – 15 GHz | Result |
|---|---|---|---|
| 4.01_Laying | op. 1 | 64.15dBµV/m @ 14.74GHz | Passed |

Remark: for more informations and graphical plot see annex A1 **CETECOM_TR21_1_0116001T02a-C1-A1**

| Diagram | Mode | Maximum Level [dBµV/m] Frequency Range 15 – 26,5GHz | Result |
|---|---|---|---|
| 4.02 | op. 1 | 64.29dBµV/m @ 26.08GHz | Passed |

Remark: for more informations and graphical plot see annex A1 **CETECOM_TR21_1_0116001T02a-C1-A1**

## 4.3 Results from external laboratory

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

## 4.4 Opinions and interpretations

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

# 5 Equipment lists

| ID | Description | Manufacturer | SerNo | Cal due date |
|---|---|---|---|---|
| | **120901 - SAC - Radiated Emission <1GHz** | | | |
| 20574 | Biconilog Hybrid Antenna BTA-L | Frankonia GmbH | 980026L | 03.05.2022 |
| 20620 | EMI Test Receiver ESU26 | Rohde & Schwarz Messgerätebau GmbH | 100362 | 21.06.2022 |
| 20482 | filter matrix Filter matrix SAR 1 | CETECOM GmbH | - | |
| 20885 | Power Supply EA3632A | Agilent Technologies Deutschland GmbH | 75305850 | |
| 20487 | System CTC NSA-Verification SAR-EMI System EMI field (SAR) NSA | ETS-Lindgren Gmbh | - | 23.03.2022 |
| | **120904 - FAC1 - Radiated Emissions** | | | |
| 20341 | Digital Multimeter Fluke 112 | Fluke Deutschland GmbH | 81650455 | 25.05.2022 |
| 20720 | EMC32 [FAC] | Rohde & Schwarz Messgerätebau GmbH | V10.xx | |
| 20489 | EMI Test Receiver ESU40 | Rohde & Schwarz Messgerätebau GmbH | 1000-30 | 23.06.2022 |
| 20254 | High Pass Filter 5HC 2600/12750-1.5KK (GSM1800/1900/DECT) | Trilithic | 23042 | |
| 20868 | High Pass Filter AFH-07000 | AtlanTecRF | 16071300004 | |
| 20291 | High Pass Filter WHJ 2200-4EE (GSM 850/900) | Wainwright Instruments GmbH | 14 | |
| 20020 | Horn Antenna 3115 | EMCO Elektronik GmbH | 9012-3629 | 08.04.2023 |
| 20302 | Horn Antenna BBHA9170 (Meas 1) | Schwarzbeck Mess-Elektronik OHG | 155 | 15.04.2023 |
| 20512 | Notch Filter WRCA 800/960-02/40-6EEK (GSM 850) | Wainwright Instruments GmbH | 24 | |
| 20290 | Notch Filter WRCA 901,9/903,1SS (GSM 900) | Wainwright Instruments GmbH | 3RR | |
| 20122 | Notch Filter WRCB 1747/1748 (GSM 1800) | Wainwright Instruments GmbH | 12 | |
| 20121 | Notch Filter WRCB 1879,5/1880,5EE (GSM 1900) | Wainwright Instruments GmbH | 15 | |
| 20448 | Notch Filter WRCT 1850.0/2170.0-5/40-10SSK (WCDMA-FDD II) | Wainwright Instruments GmbH | 5 | |
| 20066 | Notch Filter WRCT 1900/2200-5/40-10EEK (WCDMA - FDDI) | Wainwright Instruments GmbH | 5 | |
| 20449 | Notch Filter WRCT 824.0/894.0-5/40-8SSK (WCDMA FDD V) | Wainwright Instruments GmbH | 1 | |

| ID | Description | Manufacturer | SerNo | Cal due date |
|---|---|---|---|---|
| 20611 | Power Supply E3632A | Agilent Technologies Deutschland GmbH | KR 75305854 | |
| 20338 | Pre-Amplifier 100MHz - 26GHz JS4-00102600-38-5P | Miteq Inc. | 838697 | |
| 20484 | Pre-Amplifier 2,5GHz - 18GHz AMF-5D-02501800-25-10P | Miteq Inc. | 1244554 | |
| 20287 | Pre-Amplifier 25MHz - 4GHz AMF-2D-100M4G-35-10P | Miteq Inc. | 379418 | |
| 20670 | Radio Communication Tester CMU200 | Rohde & Schwarz Messgerätebau GmbH | 106833 | 16.06.2022 |
| 20690 | Spectrum Analyzer FSU | Rohde & Schwarz Messgerätebau GmbH | 100302/026 | 23.06.2022 |
| 20439 | UltraLog-Antenna HL 562 | Rohde & Schwarz Messgerätebau GmbH | 100248 | 10.03.2023 |
| 20828 | Netgear Nighthawk x4S | NETGEAR Ireland International Ltd | 5K5188590067B | |
| 20732 | Signal- and Spectrum Analyzer FSW67 | Rohde & Schwarz Messgerätebau GmbH | 104023 | 27.06.2022 |

# 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 ($U_{CISPR}$) | - | 9 kHz - 150 kHz<br>150 kHz - 30 MHz | 4.0 dB<br>3.6 dB | | | | | | - |
| 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 | 5.01dB | | | | | | Magnetic field strength |
| | | 30 MHz - 1 GHz<br>1 GHz - 18 GHz<br>18-26.5 GHz | 5.83 dB<br>4.91 dB<br>5.06 dB | | | | | | Electrical Field strength |

# 7 Versions of test reports (change history)

| Version | Applied changes | Date of release |
|---|---|---|
| -- | Initial release | 2022-Jan-06 |
| C1 | Chapter 2.11 updated | 2023-Mai-23 |

# End Of Test Report