

TEST REPORT

Title 47-Telecommunication


Chapter I - Federal Communications Commission

Subchapter A - General

Part 15 - Radio Frequency Devices

Subpart B - Unintentional Radiators

Report Reference No. 372228-2TRFFCC

Tested by
(name, function and signature) D. Guarnone (project handler) 

Approved by
(name, function and signature) P. Barbieri (verifier) 

Date of issue 2019-07-23

Testing Laboratory **Nemko Spa**

Address Via del Carroccio, 4 – 20853 Biassono (MB) – Italy

Testing location Nemko Spa

Address Via del Carroccio, 4 – 20853 Biassono (MB) – Italy

Registration number: 481407

Applicant's name **NCS Lab Srl**

Address Via Pola Esterna 4/12
41012 Carpi Modena (Italy)

Test specification:

Standard FCC CFR 47 Part 15 Subpart B

§15.107 – Conducted limits ☐

§15.109 – Radiated emission limits ☒

Test procedure Nemko WM L0077, WM L0177 and WM L1002

Test Report Form No. FCCTRF

TRF Originator Nemko Spa

Master TRF 2014-03

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Test item description **Inertial/Magnetic sensor and USB receiver**

Trade Mark Tattile

Manufacturer NCS Lab Srl

Address of manufacturer Via Pola Esterna 4/12 41012 Carpi Modena (Italy)

Model Gateway


Ratings 5 V DC (internal battery)

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The test report merely corresponds to the tested sample.

The phase of sampling / collection of equipment under test is carried out by the customer.

| | | |
|--------------------------|-----------------------|-------------------|
| Test Report No. : | 372228-2TRFFCC | 2019-07-23 |
| | | Date of issue |

| Short description of the EuT | Copy of marking plate |
|---|---|
| <p>The E.U.T is a WISE (Wireless Inertial Sensor) an inertial measurement unit that incorporates 3D accelerometers, gyroscopes and magnetometers.</p> <p>The wireless protocol developed for the transmission allow 2 types of transmission:</p> <p>Bluetooth Low Energy (BLE): 2402-2480 MHz</p> <p>Compliant with the IEEE 802.15.4 PHY standard: 2405-2480 MHz</p> |  |
| <p>Number of tested samples: 1</p> <p>Serial number: 000011</p> <p>Internal operating frequency: <108 MHz</p> <p>Class: B</p> <p>Device type: Table Top</p> <p>Accessories and detachable parts included: The E.U.T. is composed by a single unit</p> <p>Other options included: --</p> | |
| <p>Testing</p> <p>Date of receipt of test sample: 2019-07-08</p> <p>Testing commenced on: 2019-07-08</p> <p>Testing concluded on: 2019-07-23</p> | |
| <p>Possible test case verdicts:</p> <p>test case does not apply to the test object: N (Not applicable)</p> <p>test object does meet the requirement: P (Pass)</p> <p>test object does not meet the requirement: F (Fail)</p> | |
| <p>Symbols used in this test report</p> <p><input checked="" type="checkbox"/> The crossed square indicates that the listed condition or equipment is applicable for this report.</p> <p><input type="checkbox"/> The empty square indicates that the listed condition or equipment is not applicable for this report.</p> <p>The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.</p> | |

| | |
|---|-------------|
| Verdict according to the standards listed at page 5: | Pass |
|---|-------------|

| PROJECT HISTORY | | |
|-----------------|---------------------------------------|------------|
| Report number | Modification to the report / comments | Date |
| 372228-2TRFFCC | First release | 2019-07-23 |
| -- | -- | -- |
| -- | -- | -- |
| -- | -- | -- |
| REMARKS | | |
| | | |

| PRODUCT VARIANTS | | |
|------------------|-----------------------------------|---------------------------|
| Variant model | Difference against the main model | Additional test performed |
| -- | -- | -- |
| -- | -- | -- |
| -- | -- | -- |
| -- | -- | -- |
| REMARKS | | |
| | | |

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1 TEST STANDARDS

The tests were performed according to following standards and procedures.

NEMKO WM L0177: General routines for using instruments at Nemko

NEMKO WM L1002: Measurement Uncertainty - Policy and Statement

NEMKO WM L0077: General routines to perform EMC tests

FCC CFR 47 Part 15 Subpart B (10–1–15 Edition)

Code of Federal Regulations – Title 47 – Part 15 Radio Frequency Devices – Subpart B Unintentional radiation

The main standard above contains references to other standards, which are listed below.

ANSI C63.4 (2014)

‘Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz’

2 SUMMARY OF TEST RESULTS

| FCC Part 15 Subpart B requirements | | | |
|------------------------------------|--------------------|--------------------|---------|
| Part | Test description | Frequency range | Verdict |
| §15.107 | Conducted emission | 150 kHz to 30 MHz | P |
| §15.109 | Radiated emission | 30 MHz to 1000 MHz | P |
| GENERAL REMARKS | | | |
| | | | |

3 EQUIPMENT UNDER TEST

3.1 Power supply system utilised

| | | | | |
|-----------------------|--------------------------|-----------------------|-------------------------------------|----------------------|
| Power supply voltage: | <input type="checkbox"/> | 230V/50 Hz / 1 ϕ | <input type="checkbox"/> | 115V/60Hz / 1 ϕ |
| | <input type="checkbox"/> | 400V/50 Hz 3PE | <input type="checkbox"/> | 400V/50 Hz 3NPE |
| | <input type="checkbox"/> | 12 V DC | <input checked="" type="checkbox"/> | 5 V DC |

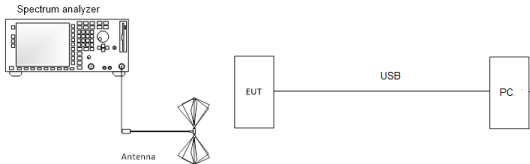
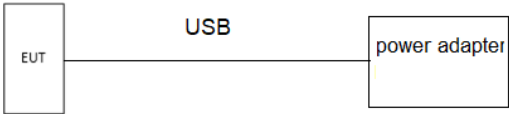
3.2 EuT operation modes

| Mode | Description |
|------|-----------------------|
| 1 | Normal operating mode |

Remarks: dedicated scripts provided by the manufacturer, running on the linux operating system of the EUT, have been used to force the EUT in the two operation modes as request by the standard.

3.3 EuT configuration modes

The EuT was configured to measure its highest possible radiation level. The test modes selected are according to EuT instruction manual.

| Mode | Description |
|------|--|
| 1 |  |
| 2 |  |

3.4 Input/Output Ports

| Port | Name | Type* | Cable Shielded | Description |
|--|-----------|-------|--------------------------|------------------|
| 0 | Enclosure | N/E | — | — |
| 1 | USB | DC | <input type="checkbox"/> | To PC connection |
| *Note: AC = AC Power Port DC = DC Power Port N/E = Non-Electrical I/O = Signal/Control Input or Output Port TP = Telecommunication Port ANT = Antenna Port | | | | |

3.5 Equipment Used During Test

| Use* | Product Type | Manufacturer | Model | Comments |
|---|--------------|--------------|-------|----------|
| AE | PC | -- | -- | |
| AE | -- | -- | -- | |
| Note: * Use EUT - Equipment Under Test AE - Auxiliary/Associated Equipment (Not Subjected to Test) SIM - Simulator (Not Subjected to Test) | | | | |

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

Nemko Spa
Via del Carroccio, 4
20853 Biassono (MB) - Italy

Tests site/benches are in accordance with applicable standard/s, and have been utilized by Nemko Spa testing engineer(s).

4.2 Environmental conditions

Unless different values are declared in the test case, following ambient conditions apply for the tests:

Ambient temperature: 18÷33 °C

Relative Humidity: 30÷60 %

Atmospheric pressure: 980÷1060 hPa

4.3 Test equipment used for the monitoring of the environmental conditions

| Equipment | Manufacturer | Model | Serial N° |
|-------------------------------|--------------|---------|--------------|
| Thermohygrometer data loggers | Testo | 175-H2 | 20012380/305 |
| Thermohygrometer data loggers | Testo | 175-H2 | 38203337/307 |
| Barometer | MSR | MSR145B | 330080 |

4.4 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report according to CISPR 16-4-2 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements" and is documented in the Nemko Spa Technical Procedure WML1002. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device. Hereafter the best measurement capability for Nemko Spa laboratory is reported:

| Test | Range | Measurement Uncertainty | Notes |
|---|--|-------------------------|-------|
| Radiated Disturbance 3m, 10m Chamber | Antenna distance 1m, 3m, 10m (30÷200) MHz | 5.0 dB | (1) |
| | Antenna distance 1m, 3m, 10m (0.2÷6) GHz | 5.2 dB | (1) |
| | Antenna distance 1m, 3m (6÷18) GHz | 5.8 dB | (1) |
| | Antenna distance 1m, 3m (18÷40) GHz | 7.2 dB | (1) |
| Conducted Disturbance | 9 kHz ÷ 150 kHz with AMN | 3.8 dB | (1) |
| | 150 kHz ÷ 30 MHz with AMN | 3.4 dB | (1) |
| | 150 kHz ÷ 30 MHz with AAN | 4.6 dB | (1) |
| | 9 kHz ÷ 30 MHz with voltage probe | 2.9 dB | (1) |
| | 9 kHz ÷ 30 MHz with current probe | 2.9 dB | (1) |

NOTES:

(1) The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$ which has been derived from the assumed normal probability distribution with infinite degrees of freedom and for a coverage probability of 95 %;

5 TEST CONDITIONS AND RESULTS

5.1 Clause 15.107 – Conducted emission

5.1.1 Photo documentation of the test set-up



5.1.2 Test method

Measurements were made on a ground plane that extends 1-meter minimum beyond all sides of the system under test. All power was connected to the system through Line Impedance Stabilization Networks (LISN). Conducted voltage measurements on mains lines were made at the output of the LISN.

5.1.3 Limits for AC mains port

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

| Frequency of emission (MHz) | Conducted limit (dB μ V) | |
|-----------------------------|------------------------------|-----------|
| | Quasi-Peak | Average |
| 0.15 to 0.50 | 66 to 56* | 59 to 46* |
| 0.50 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

*The limits decrease linearly with the logarithm of the frequency

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

| Frequency of emission (MHz) | Conducted limit (dB μ V) | |
|-----------------------------|------------------------------|---------|
| | Quasi-Peak | Average |
| 0.15 to 0.50 | 79 | 66 |
| 0.50 to 30 | 73 | 60 |

5.1.4 Test result

| | |
|--------------------|---|
| Verdict: | <input checked="" type="checkbox"/> P <input type="checkbox"/> F <input type="checkbox"/> N |
| Frequency range: | 0.15MHz - 30MHz |
| Kind of test site: | Shielded room |
| Remarks: | |

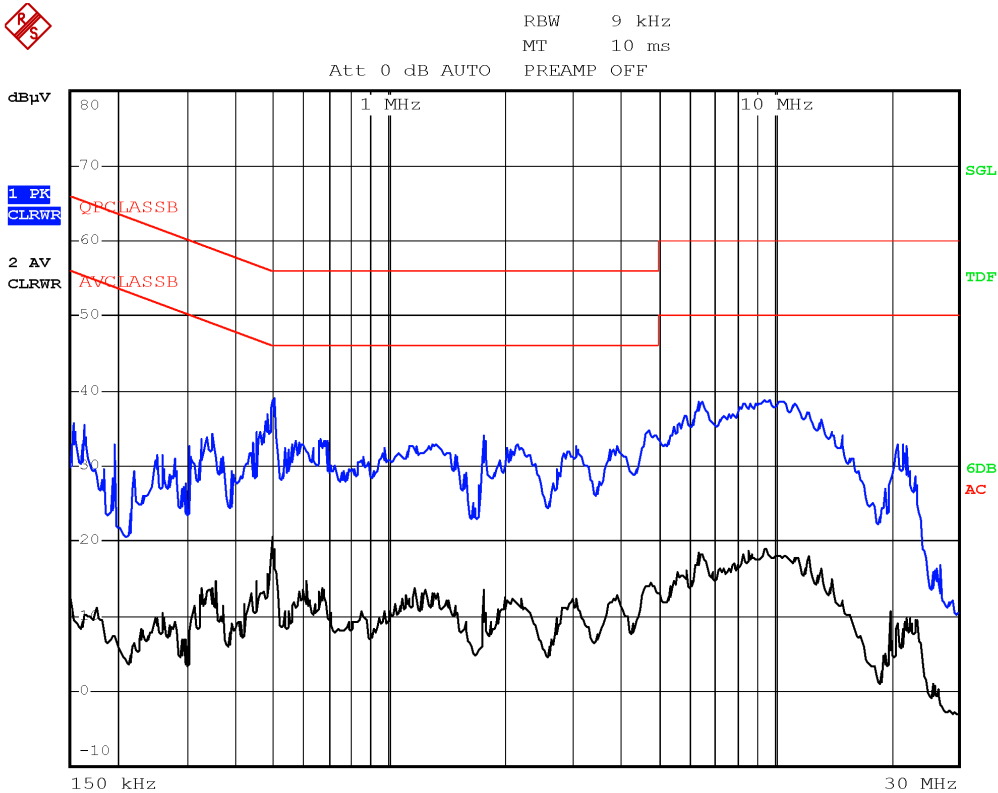
5.1.5 Test equipment used

| Equipment | Manufacturer | Model | Serial N° | Cal Date | Due Date |
|-------------------------------------|-----------------|---------------------------------|-------------|----------|----------|
| EMI receiver 20 Hz ÷ 8 GHz | Rohde & Schwarz | ESU8 | 100202 | 2019-01 | 2020-01 |
| LISN three phase 9 kHz to 30 MHz | Rohde & Schwarz | ESH2-Z5 | 872 460/041 | 2018-09 | 2019-09 |
| Shielded room | Siemens | Conducted emission test room | 1862 | NSC | - |

5.1.6 Test protocol

Test point: Phase line
Operation mode: 1
Configuration mode: 2
Remarks:

Verdict: Pass

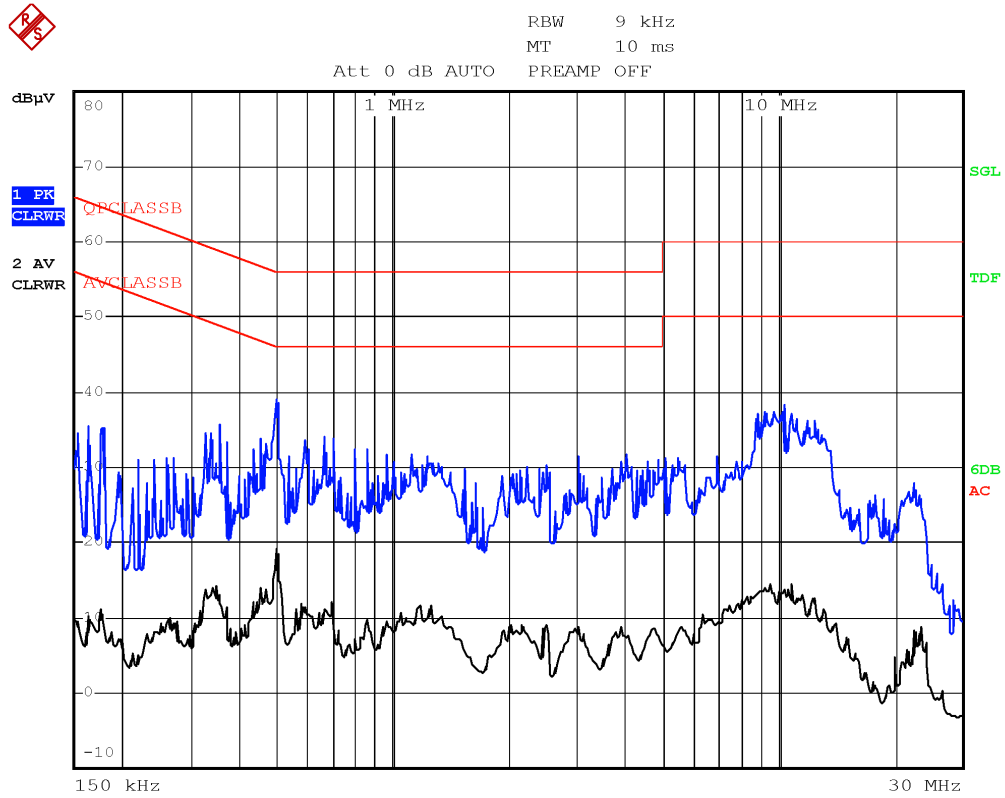


Date: 23.JUL.2019 15:35:37

| Frequency (MHz) | Level (dBμV) | Limit (dBμV) | Margin (dB) | Detector |
|-----------------|--------------|--------------|-------------|----------|
| -- | -- | -- | -- | -- |

Test point: Neutral line
 Operation mode: 1
 Configuration mode: 2
 Remarks:

Verdict: Pass



Date: 23.JUL.2019 15:33:47

| Frequency (MHz) | Level (dBμV) | Limit (dBμV) | Margin (dB) | Detector |
|-----------------|--------------|--------------|-------------|----------|
| -- | -- | -- | -- | -- |

5.2 Clause 15.109 – Radiated emissions limit

5.2.1 Photo documentation of the test set-up



5.2.2 Test method

Measurements were made on a semi anechoic chamber. Preliminary (peak) measurements were performed at an antenna to EUT separation distance of 3 or 10 meters with the receive antenna located at a fixed height (from 1 to 4 meter) in both horizontal and vertical polarities. Final measurements (quasi-peak) were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4 meters. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.

5.2.3 Limits for enclosure

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

| Frequency of emission (MHz) | Field strength ($\mu\text{V}/\text{m}$) | Field strength ($\text{dB}\mu\text{V}/\text{m}$) |
|-----------------------------|---|--|
| 30–88 | 100 | 40.0 |
| 88–216 | 150 | 43.5 |
| 216–960 | 200 | 46.0 |
| Above 960 | 500 | 54.0 |

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

| Frequency of emission (MHz) | Field strength ($\mu\text{V/m}$) | Field strength ($\text{dB}\mu\text{V/m}$) |
|-----------------------------|------------------------------------|---|
| 30–88 | 90 | 39.0 |
| 88–216 | 150 | 43.5 |
| 216–960 | 210 | 46.4 |
| Above 960 | 300 | 49.5 |

5.2.4 Test result

| Verdict: | <input checked="" type="checkbox"/> P <input type="checkbox"/> F <input type="checkbox"/> N | | | | | | | | | | | | |
|--|---|--|--|-------------|-----|-----------|-------|---------|-------|----------|-------|------------|--|
| Frequency range: | 30MHz – 12750 MHz | | | | | | | | | | | | |
| Kind of test site: | Semi anechoic chamber | | | | | | | | | | | | |
| Measurement distance: | 3 m | | | | | | | | | | | | |
| Remarks: for an unintentional radiator, including a digital device, the spectrum shall be investigated from the lowest radio frequency signal generated or used in the device, without going below the lowest frequency for which a radiated emission limit is specified, up to the frequency shown in the following table: | | | | | | | | | | | | | |
| <table border="1"> <thead> <tr> <th>Highest frequency generated or used in the device or on which the device operates or tunes (MHz)</th><th>Upper frequency of measurement range (MHz)</th></tr> </thead> <tbody> <tr> <td>Below 1.705</td><td>30.</td></tr> <tr> <td>1.705-108</td><td>1000.</td></tr> <tr> <td>108-500</td><td>2000.</td></tr> <tr> <td>500-1000</td><td>5000.</td></tr> <tr> <td>Above 1000</td><td>5th harmonic of the highest frequency or 40 GHz, whichever is lower.</td></tr> </tbody> </table> | | Highest frequency generated or used in the device or on which the device operates or tunes (MHz) | Upper frequency of measurement range (MHz) | Below 1.705 | 30. | 1.705-108 | 1000. | 108-500 | 2000. | 500-1000 | 5000. | Above 1000 | 5th harmonic of the highest frequency or 40 GHz, whichever is lower. |
| Highest frequency generated or used in the device or on which the device operates or tunes (MHz) | Upper frequency of measurement range (MHz) | | | | | | | | | | | | |
| Below 1.705 | 30. | | | | | | | | | | | | |
| 1.705-108 | 1000. | | | | | | | | | | | | |
| 108-500 | 2000. | | | | | | | | | | | | |
| 500-1000 | 5000. | | | | | | | | | | | | |
| Above 1000 | 5th harmonic of the highest frequency or 40 GHz, whichever is lower. | | | | | | | | | | | | |

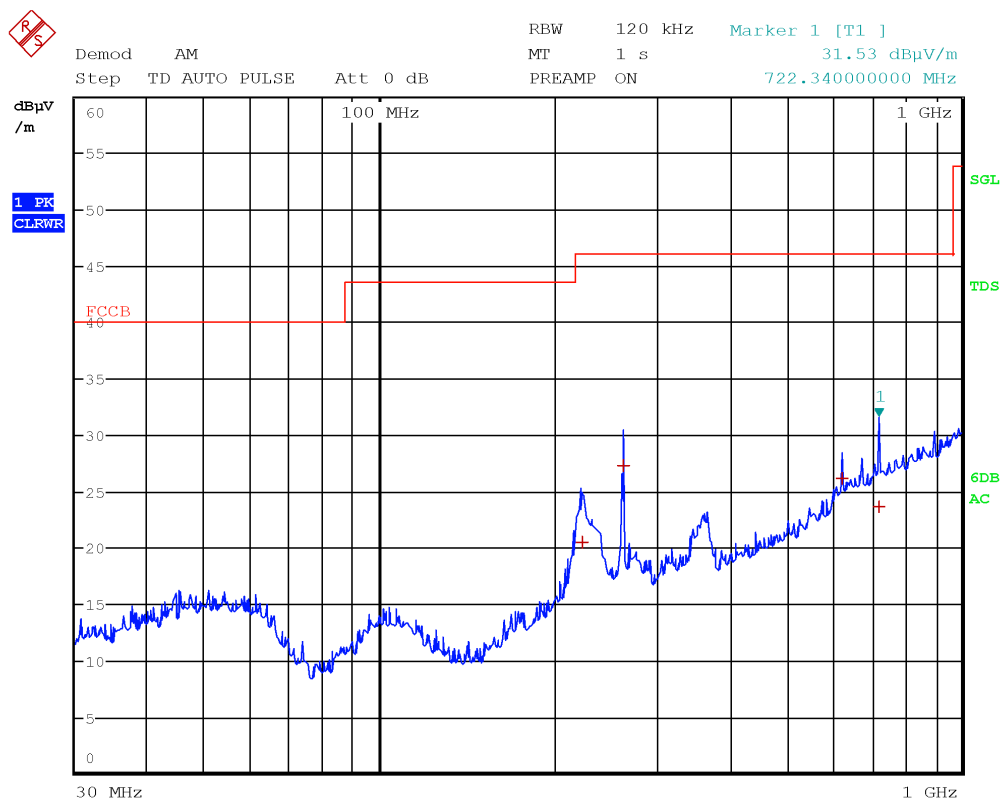
5.2.5 Test equipment used

| Equipment | Manufacturer | Model | Serial No. | Cal. Date | Cal. Due |
|------------------------------|-----------------|---------------------------|--------------|-----------|----------|
| Trilog Broadband Antenna | Schwarzbeck | VULB 9162 | 9162-025 | 2018/07 | 2021/07 |
| Antenna 1-18GHz | Schwarzbeck | STLP9148 | STLP9148-123 | 2018/07 | 2021/07 |
| Broadband preamplifier | Schwarzbeck | BBV 9718 | 9718-137 | 2018/08 | 2019/08 |
| EMI receiver 20 Hz ÷ 8 GHz | R&S | ESU8 | 100202 | 2019/01 | 2020/01 |
| Hydraulic revolving platform | Nemko | RTPL 01 | 4.233 | – | – |
| Antenna mast | R&S | HCM | 836 529/05 | – | – |
| Controller | R&S | HCC | 836 620/7 | – | – |
| Semi-anechoic chamber | Nemko | 10m semi-anechoic chamber | 530 | 2018-09 | 2021-09 |
| Shielded room | Siemens | 10m control room | 1947 | – | – |
| EMI receiver 2 Hz ÷ 44 GHz | Rohde & Schwarz | ESW44 | 101620 | 2018-05 | 2019-08 |

5.2.6 Test protocol

Antenna polarization: Horizontal
Operation mode: 1
Configuration mode: 1
Remarks: -

Verdict: Pass

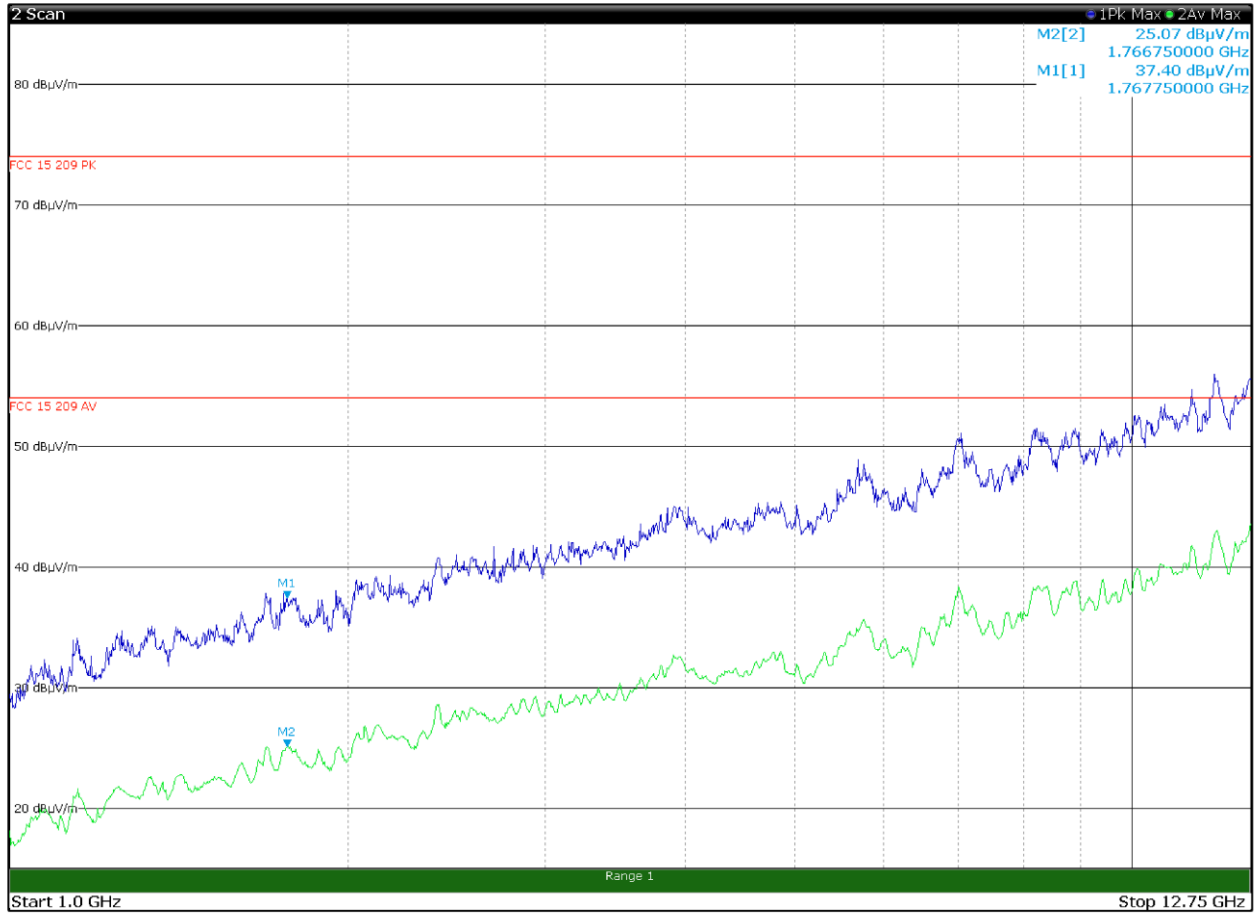


Date: 17.JUL.2019 19:10:22

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector |
|-----------------|----------------|----------------|-------------|----------|
| 222.5100 | 20.5 | 46.0 | -25.5 | QP |
| 262.7100 | 27.4 | 46.0 | -18.6 | QP |
| 625.0200 | 26.3 | 46.0 | -19.7 | QP |
| 722.3400 | 23.6 | 46.0 | -22.4 | QP |

Antenna polarization: Horizontal
Operation mode: 1
Configuration mode: 1
Remarks: -

Verdict: Pass



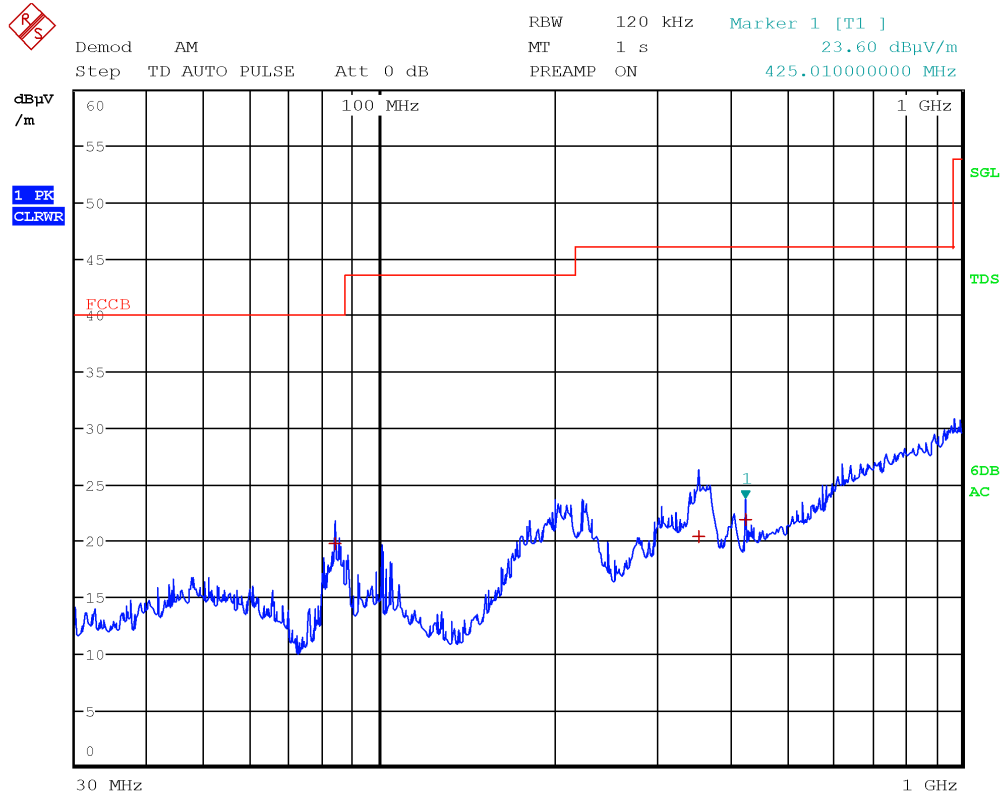
18:57:13 17.07.2019

Page 1/1

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector |
|-----------------|----------------|----------------|-------------|----------|
| -- | -- | -- | -- | -- |

Antenna polarization: Vertical
Operation mode: 1
Configuration mode: 1
Remarks: -

Verdict: Pass



Date: 17.JUL.2019 19:08:02

| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector |
|-----------------|----------------|----------------|-------------|----------|
| 84.0000 | 19.8 | 40.0 | -20.2 | QP |
| 223.8300 | 0.0 | 0.0 | 0.0 | QP |
| 352.9500 | 20.4 | 46.0 | -25.6 | QP |
| 425.0100 | 21.9 | 46.0 | -24.1 | QP |

Antenna polarization: Vertical
Operation mode: 1
Configuration mode: 1
Remarks: -

Verdict: Pass



| Frequency (MHz) | Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector |
|-----------------|----------------|----------------|-------------|----------|
| -- | -- | -- | -- | -- |

6 EUT PHOTOS



End of report