

# TEST REPORT

## No. AR19-0045638-04

performed in accordance with

FCC Rules: Code of Federal Regulations (CFR) no. 47  
Part 15 Subpart B Section 15.107 and 15.109

|                        |                                                                                     |
|------------------------|-------------------------------------------------------------------------------------|
| <b>PRODUCT</b>         | Electronic position indicator system                                                |
| <b>MODEL(s) TESTED</b> | DD51R-E-RF                                                                          |
| <b>FCC ID</b>          | 2AVRQ-DD51-E-RF                                                                     |
| <b>TRADE MARK(s)</b>   |  |

|                  |                                                  |
|------------------|--------------------------------------------------|
| <b>APPLICANT</b> | ELESA S.p.A. - Via Pompei, 29 – 20900 Monza (MB) |
|------------------|--------------------------------------------------|

|             |                                                 |  |
|-------------|-------------------------------------------------|--|
| Tested by   | Alessandro Macri <i>[Laboratory technician]</i> |  |
| Approved by | Roberto Colombo <i>[Laboratory manager]</i>     |  |

### Revision Sheet

| Release No. | Date       | Revision Description                                                                   |
|-------------|------------|----------------------------------------------------------------------------------------|
| Rev. 0      | 2021-09-14 | First edition<br>Digital signed - AR19-0045638-04_TR_FCC 15.107/109 _ Elesa_DD51R-E-RF |

The results of tests and checks reported in this Test Report refer exclusively to the samples tested and described in the Report itself.  
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## 1. GENERAL DATA

| SAMPLE                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                       |                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| Samples received on                                                                                                                                                                                                                                                                                                        | 2020-12-15                                                                                                                                            | (Item(s) sampled and sent by applicant) |
| IMQ reference samples                                                                                                                                                                                                                                                                                                      | BEM                                                                                                                                                   | 102171                                  |
| Samples tested No.                                                                                                                                                                                                                                                                                                         | 1                                                                                                                                                     |                                         |
| Object under analysis recognition                                                                                                                                                                                                                                                                                          | <b>Not carried out</b><br>Except where stated, characteristics of products were taken from client description and were not verified by the laboratory |                                         |
| Date of acceptance of test item                                                                                                                                                                                                                                                                                            | 2021-01-29                                                                                                                                            |                                         |
| TEST LOCATION                                                                                                                                                                                                                                                                                                              |                                                                                                                                                       |                                         |
| Testing dates                                                                                                                                                                                                                                                                                                              | 2021-01-29 ÷ 2021-02-01                                                                                                                               |                                         |
| Testing laboratory.                                                                                                                                                                                                                                                                                                        | IMQ S.p.A. - Via Quintiliano, 43 – I-20138 Milano                                                                                                     |                                         |
| Testing site                                                                                                                                                                                                                                                                                                               | Via Quintiliano, 43 – I-20138 Milano                                                                                                                  |                                         |
| ENVIRONMENTAL CONDITIONING                                                                                                                                                                                                                                                                                                 |                                                                                                                                                       |                                         |
| <b>Parameter</b>                                                                                                                                                                                                                                                                                                           | <b>Measured</b>                                                                                                                                       |                                         |
| Ambient Temperature                                                                                                                                                                                                                                                                                                        | 20.5 ÷ 22.7 °C                                                                                                                                        |                                         |
| Relative Humidity                                                                                                                                                                                                                                                                                                          | 43 ÷ 48 %                                                                                                                                             |                                         |
| Atmospheric Pressure                                                                                                                                                                                                                                                                                                       | 994 ÷ 1003 mbar                                                                                                                                       |                                         |
| The laboratory is monitored by a continuous environmental conditions measurements system.<br>Temperature, humidity and pressure data are recorded on a weekly basis and stored in local archive.                                                                                                                           |                                                                                                                                                       |                                         |
| REMARKS                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                       |                                         |
| Throughout this report a point is used as the decimal separator.<br>The ability or reliability of this product to perform its intended function in a particular application has not been investigated.<br><b>IMQ declines any responsibility derived from missing or wrong information provided aside by the applicant</b> |                                                                                                                                                       |                                         |

## 2. REFERENCE DOCUMENT

| DOCUMENT                            |                | DATE | TITLE                                                                                                                                |
|-------------------------------------|----------------|------|--------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | 47 CFR Part 15 | 2015 | Radio Frequency Device                                                                                                               |
| <input checked="" type="checkbox"/> | 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 |
| <input checked="" type="checkbox"/> | ANSI C63.10    | 2013 | American National Standard for Testing Unlicensed Wireless Devices                                                                   |

### 3. UNIT UNDER TEST (EUT) DETAILS

#### GENERAL DATA

| MODEL (basic)      | Description                          |
|--------------------|--------------------------------------|
| DD51R-E-RF         | Electronic position indicator system |
| VARIANTS (derived) | Description                          |
| /                  | /                                    |

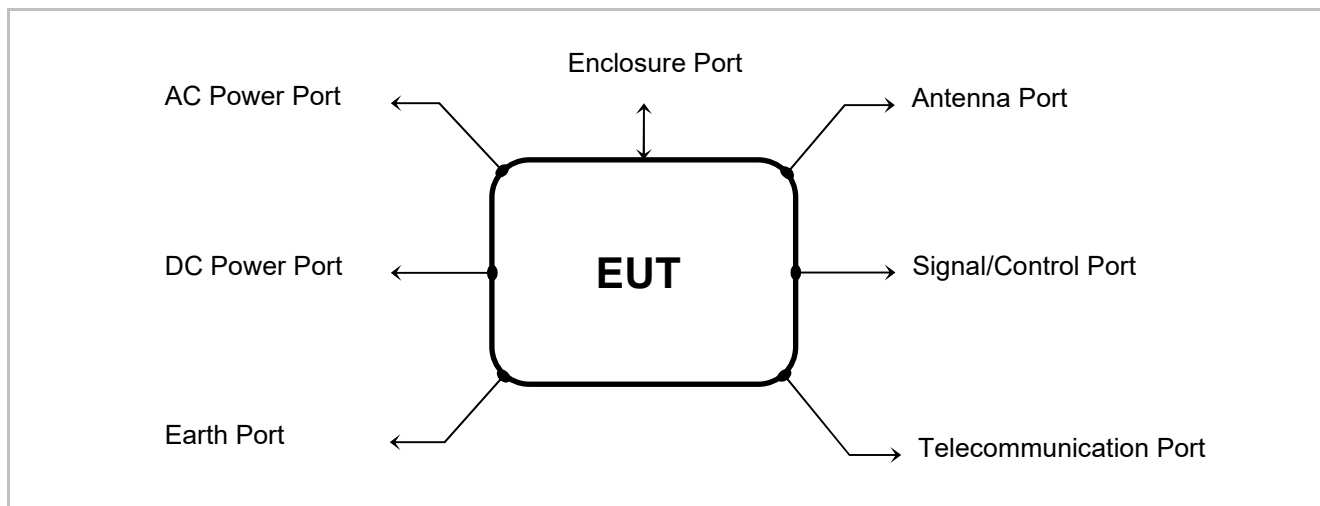
|        |                 |
|--------|-----------------|
| FCC ID | 2AVRQ-DD51-E-RF |
|--------|-----------------|

|              |                                                  |
|--------------|--------------------------------------------------|
| Manufacturer | ELESA S.p.A. - Via Pompei, 29 – 20900 Monza (MB) |
|--------------|--------------------------------------------------|

|                            |                                                                     |
|----------------------------|---------------------------------------------------------------------|
| Type of equipment          | Electronic position indicator system with 2.4 GHz module integrated |
| Operating frequency:       | 2400 ÷ 2483.5 MHz                                                   |
| Maximum RF radiated power: | 82.92 dBuV/m                                                        |
| Modulation:                | MSK modulation                                                      |
| Channel Spacing:           | 200 kHz                                                             |
| Antenna:                   | Integral on PCB                                                     |

## 4. TEST CONFIGURATION OF UNIT UNDER TEST

### EUT PORTS



| Port              | Description | Max length |
|-------------------|-------------|------------|
| Enclosure         | Plastic     | /          |
| AC power          | /           | /          |
| DC power          | 3 V DC      | /          |
| Earth             | /           | /          |
| Telecommunication | /           | /          |
| Signal            | /           | /          |
| Control           | /           | /          |
| Antenna           | Internal    | /          |

### STATE OF THE EUT DURING TESTS

| Ref. | Mode      | Description  |
|------|-----------|--------------|
| #1   | Operating | Standby mode |

## SUPPORT EQUIPMENT

Defined as equipment needed for correct operation or loading of the EUT, but not considered as tested:

| Equipment | Manufacturer | Model |
|-----------|--------------|-------|
| /         | /            | /     |

## ELECTROMAGNETICALLY RELEVANT COMPONENTS

| Component     | No. | Manufacturer      | Model     |
|---------------|-----|-------------------|-----------|
| Main board    | 1   | ELESA             | T689 V1.0 |
| Battery board | 1   | ELESA             | T867 V1.0 |
| Control board | 1   | ELESA             | T690 V1.0 |
| Radio module  | 1   | TEXAS INSTRUMENTS | CC2500    |

## RFI SUPPRESSION DEVICES

| Component | No. | Manufacturer | Model |
|-----------|-----|--------------|-------|
| /         | /   | /            | /     |

## EMI PROTECTION DEVICES

| Component | No. | Manufacturer | Model |
|-----------|-----|--------------|-------|
| /         | /   | /            | /     |

## EUT TECHNICAL DOCUMENTATION

| Document | Reference |
|----------|-----------|
| /        | /         |

## 5. METHODS OF MEASUREMENT

All compliance measurements have been carried out using the procedures described in the standard ANSI C63.4:2014, ANSI C63.10:2013 and Section 15.31 of CFR47 Part 15 – Subpart A (General).

Additional test requirements have been adopted according to the reference Section indicated in the § 6 of this test report.

### FREQUENCY RANGE INVESTIGATED

Conducted emission tests: from 150 kHz to 30 MHz.

Radiated emission tests: from 9 kHz to 13 GHz (fifth harmonic of highest frequency)

## 6. SUMMARY OF TEST RESULTS

| POSSIBLE TEST CASE VERDICTS:                |      |
|---------------------------------------------|------|
| Test object meets the requirement           | PASS |
| Test object does not meet the requirement   | FAIL |
| Test case does not apply to the test object | N.A. |
| Test not performed                          | N.P. |

| CFR47 Part 15 | TITLE                 | RESULT              |
|---------------|-----------------------|---------------------|
| § 15.107      | Conducted emission    | N.A. <sup>(1)</sup> |
| § 15.109      | Radiated disturbances | PASS                |

|               |                                            |
|---------------|--------------------------------------------|
| <b>Note 1</b> | Port not present, battery operating device |
|---------------|--------------------------------------------|

## 7. TEST RESULTS

### 7.1 RADIATED DISTURBANCES

| TEST REQUIREMENT               |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test setup                     | ANSI C63.4                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Test facility                  | Semi-anechoic chamber                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Test distance                  | 3 meters                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Frequency range                | 9 kHz to 13 GHz                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| IF bandwidth (below 30 MHz)    | 9 kHz                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| IF bandwidth (below 1,000 MHz) | 120 kHz                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| IF bandwidth (above 1,000 MHz) | 1 MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Deviation to test procedure    | None                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Limits                         | sections 15.109                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| EUT operating condition        | #1                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Remark                         | (*) In accordance with part 15.31 (f) (2), where the measurement distance was specified to be 30 or 300 meters, a correction factor was applied in order to permit measurement to be performed at a separation distance.<br>The applied formula for limits at 3 meter is:<br>Extrapolation (dB) = $40 \log (300 \text{ meter} / 3 \text{ meter}) = +80 \text{ dB}$<br>Extrapolation (dB) = $40 \log (30 \text{ meter} / 3 \text{ meter}) = +40 \text{ dB}$ |
| Testing dates                  | 2021-01-29 ÷ 2021-02-01                                                                                                                                                                                                                                                                                                                                                                                                                                    |

### TEST RESULT

The EUT meets the requirements of sections 15.109

| LIMITS FOR SPURIOUS |                                     |                                        |
|---------------------|-------------------------------------|----------------------------------------|
| Band of operations  | Limit $\mu\text{V/m}$               | Limit $\text{dB}\mu\text{V/m}$         |
| 30÷88 MHz           | 100                                 | 40                                     |
| 88÷216 MHz          | 150                                 | 43,5                                   |
| 216÷960 MHz         | 200                                 | 46                                     |
| Above 960MHz        | 500                                 | 54                                     |
| Band of operations  | Limit $\text{dB}\mu\text{V/m}$ Peak | Limit $\text{dB}\mu\text{V/m}$ Average |
| Above 1000 MHz      | 74                                  | 54                                     |

## TEST PROCEDURE

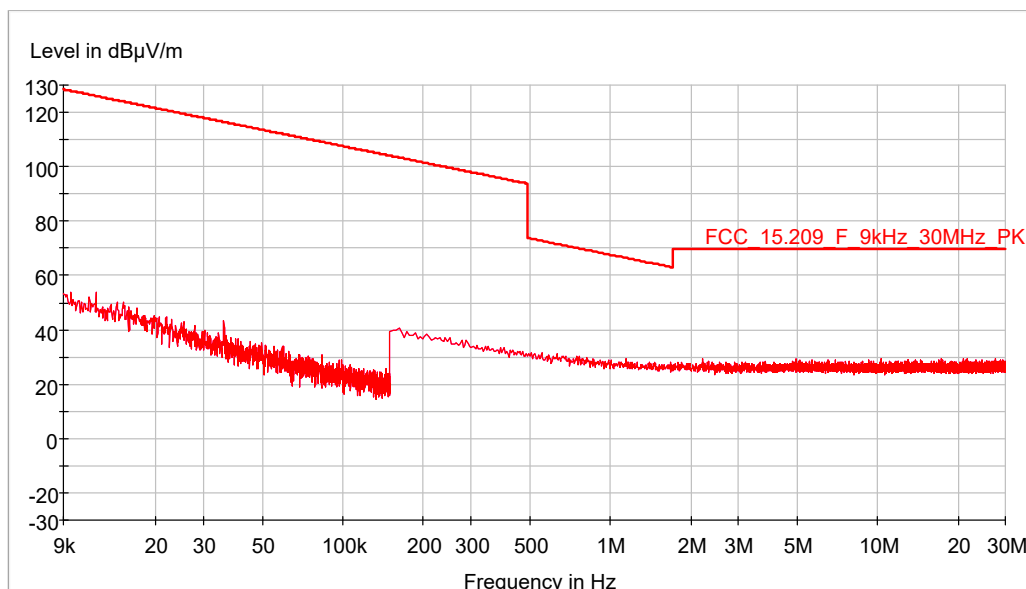
- 1) The EUT was placed on turntable which is 0.8 m above the ground plane
- 2) The turntable shall rotate from 0° to 360° degrees to determine the position of maximum emission level.
- 3) The EUT is positioned 3 m away from the receiving antenna which varied from 1 to 4 m to find the highest emission.
- 4) The measurements were made with the detector set to **PEAK** amplitude within a bandwidth of 120 kHz below 1000 MHz and 1 MHz above 1000 MHz.
- 5) The receiving antenna was positioned in both horizontal and vertical polarization.
- 6) The measurements with Quasi-Peak detector, below 1000 MHz are performed only for frequencies for which the Peak values are  $\geq$  Q.P. limit – 6 dB (♦ mark symbol).

## NOTE

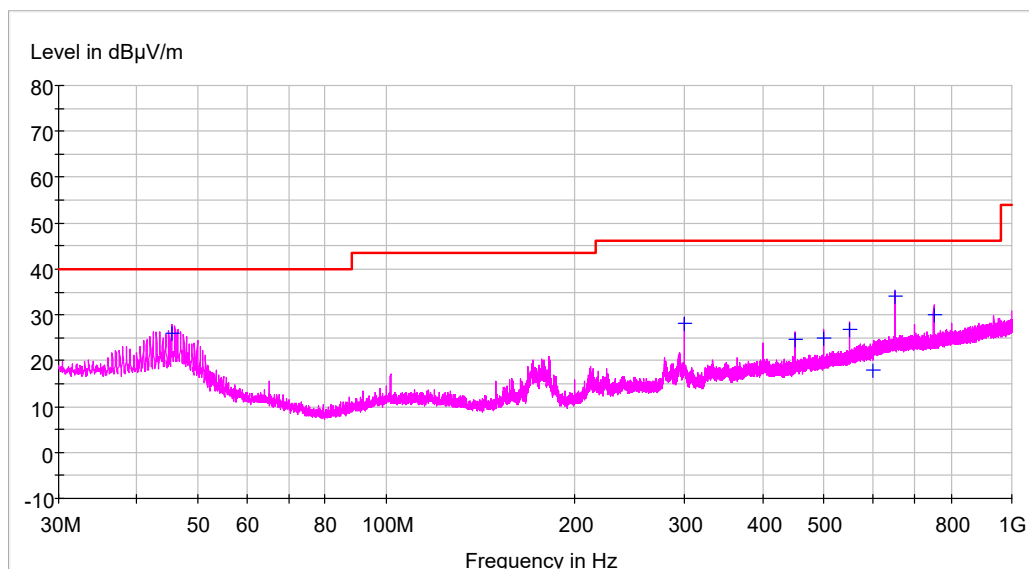
The product falls into class A. In any case, class B limits are included in the report, which are more restrictive than class A.

## MEASUREMENTS RESULTS

Range: 9 kHz ÷ 30 MHz

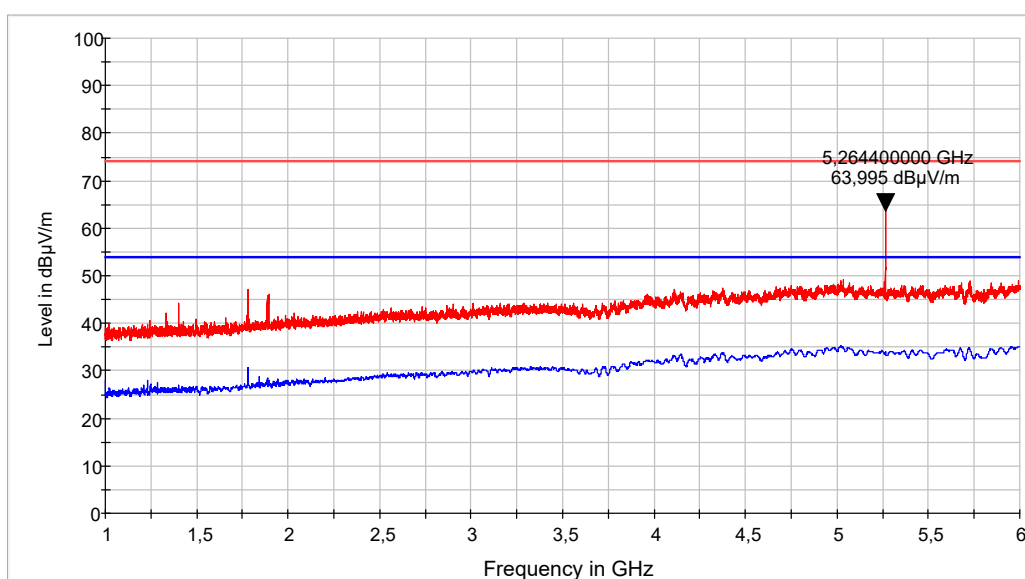


Range: 30 ÷ 1000 MHz



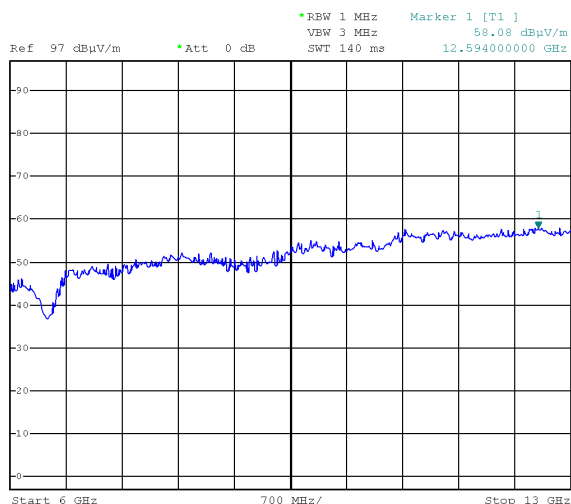
| Frequency (MHz) | Peak (dBμV/m) | Polarization | Margin (dB) |
|-----------------|---------------|--------------|-------------|
| 45.480000       | 26.0          | H            | 14.0        |
| 300.000000      | 28.3          | H            | 17.7        |
| 450.000000      | 24.7          | V            | 21.3        |
| 500.000000      | 24.8          | H            | 21.2        |
| 550.000000      | 26.8          | H            | 19.2        |
| 600.000000      | 18.0          | H            | 28.0        |
| 650.000000      | 33.9          | V            | 12.1        |
| 750.000000      | 30.1          | V            | 15.9        |

Range: 1 ÷ 6 GHz

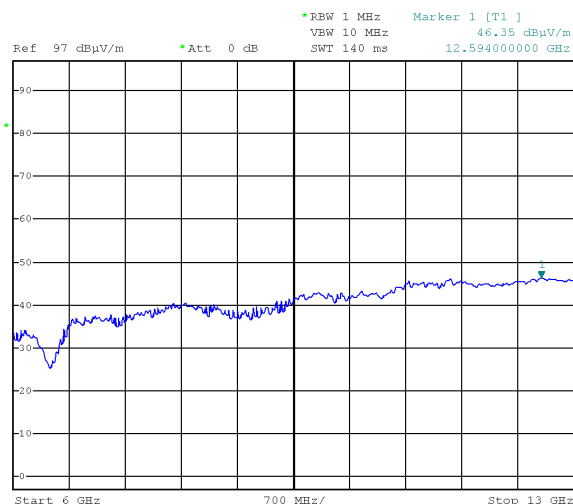


### Worst case measurement result >6,000 MHz

#### Worst case – H antenna Peak



#### Worst case – H antenna Average



### Tabular worst case measurement result >6,000 MHz (PK & AV)

#### PEAK RESULT (RBW=1MHz; VBW=3MHz)

| Frequency | Reading value                    | Antenna Factor | Cable Loss | Pre-Amp. Gain | Correct reading | PK Limit (AV + 20dB) |                | Margin |
|-----------|----------------------------------|----------------|------------|---------------|-----------------|----------------------|----------------|--------|
| (MHz)     | (dB $\mu$ V)                     | (dB@3m)        | (dB)       | (dB)          | (dB $\mu$ V/m)  | ( $\mu$ V/m)         | (dB $\mu$ V/m) | (dB)   |
| f>6000    | No significant values were found |                |            |               |                 | 5000                 | 74             | /      |

#### AVERAGE RESULT (RBW=1MHz; VBW=10Hz)

| Frequency | Reading value                                           | Antenna Factor | Cable Loss | Pre-Amp. Gain | Correct reading | AV Limit     |                | Margin |
|-----------|---------------------------------------------------------|----------------|------------|---------------|-----------------|--------------|----------------|--------|
| (MHz)     | (dB $\mu$ V)                                            | (dB@3m)        | (dB)       | (dB)          | (dB $\mu$ V/m)  | ( $\mu$ V/m) | (dB $\mu$ V/m) | (dB)   |
| f>6000    | No significant values were found (see also above plots) |                |            |               |                 | 500          | 54             | /      |

See above the measurements plots.

## 8. MEASUREMENTS AND TESTS UNCERTAINTY

Unless otherwise stated the uncertainties for the tests and measurements are evaluated in according to IMQ Operational Instruction IO-LAB-001 and IO-LAB-004. and requirement of NIST Technical Note 1297 and NIS 81:1994 “The Treatment of Uncertainty in EMC Measurements”

The expanded uncertainty was calculated for all measurements and tests listed in this test report according to CISPR 16-4-2 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainty in EMC Measurements”, with UKAS document LAB 34 and is documented in the quality system accordance to ISO/IEC 17025.

Internal Procedure PG-037 ensures that the requirements for traceability of calibrations, of all test equipment requiring calibration, and calibration intervals are met.

| Methods/Standard     | Parameter                                            | Expanded Uncertainty | Unit | Confidence level |
|----------------------|------------------------------------------------------|----------------------|------|------------------|
| Radiated disturbance | QP detector<br>(30 MHz - 100 MHz)<br>H polarization  | 4.3                  | dB   | 95%              |
|                      | QP detector<br>(30 MHz - 100 MHz)<br>V polarization  | 4.2                  | dB   | 95%              |
|                      | QP detector<br>(100 MHz - 200 MHz)<br>H polarization | 3.4                  | dB   | 95%              |
|                      | QP detector<br>(100 MHz - 200 MHz)<br>V polarization | 4.8                  | dB   | 95%              |
|                      | QP detector<br>(200 MHz - 1000 MHz) H polarization   | 3.9                  | dB   | 95%              |
|                      | QP detector<br>(200 MHz - 1000 MHz) V polarization   | 3.8                  | dB   | 95%              |
|                      | P detector<br>1 - 6 GHz                              | 4.8                  | dB   | 95%              |
|                      | P detector<br>6 - 18 GHz                             | 5.1                  | dB   | 95%              |

## 9. LIST OF MEASURING EQUIPMENT AND CALIBRATION INFORMATION

| Instrument                     | Manufacturer    | Model           | IMQ Ref.  | Cal. Date  | Cal. Due   |
|--------------------------------|-----------------|-----------------|-----------|------------|------------|
| Shielded semi-anechoic chamber | SIDT            | /               | P01709    | 2019-10-21 | 2021-10-31 |
| Turntable controller unit      | FRANKONIA       | FCTAM01         | P02486    | /          | /          |
| Mast antenna                   | FRANKONIA       | FAM4            | P02488    | /          | /          |
| Log antenna                    | ARA             | LPB-2513        | S02385    | 2020-07-20 | 2021-07-31 |
| Horn Antenna                   | SCHWARZBECK     | BBHA 9120D      | S03463    | 2020-07-06 | 2021-07-31 |
| Loop Antenna                   | ROHDE & SCHWARZ | HFH2-Z2         | S02508    | 2020-08-18 | 2021-08-31 |
| Spectrum Analyzer              | Rohde & Schwarz | FSP40           | S03629    | 2020-12-10 | 2021-12-31 |
| Preamplifier                   | Hewlett Packard | HP 8449B        | S03542    | 2020-04-05 | 2021-04-30 |
| Software                       | ROHDE & SCHWARZ | EMC32 Ver. 6.30 | W-00199/E | /          | /          |
| PC                             | /               | /               | H-00165   | /          | /          |

**END OF REPORT**