

## TEST REPORT

Test report no.: 1-5677/17-01-02-A



### Testing laboratory

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**Accredited Testing Laboratory:**

The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)

The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-03

### Applicant

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### Manufacturer

**Pilz GmbH & Co. KG**

Felix-Wankel-Straße 2

73760 Ostfildern / GERMANY

### Test standard/s

47 CFR Part 15

Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

RSS - 210 Issue 9

Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment

RSS - Gen Issue 4

Spectrum Management and Telecommunications Radio Standards Specifications - General Requirements and Information for the Certification of Radio Apparatus

For further applied test standards please refer to section 3 of this test report.

### Test Item

**Kind of test item:** Proximity switch with defined behavior under fault conditions

**Model name:** PSEN mlock

**FCC ID:** VT8-PSENML

**IC:** 7482A-PSENML

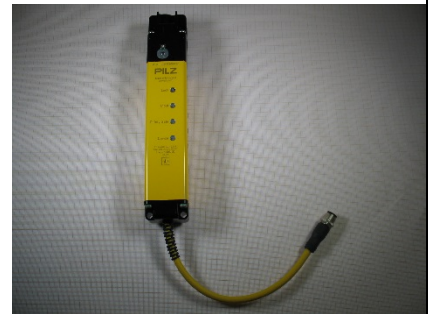
**Frequency:** 100 kHz -150 kHz (128 kHz TX)

**Technology tested:** RFID

**Antenna:** Integrated ferrite coil antenna

**Power supply:** 24 V DC by external power supply

**Temperature range:** 0°C to +60°C



This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

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## 2 General information

### 2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH 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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This test report replaces the test report with the number 1-5677/17-01-02 and dated 2018-02-19

### 2.2 Application details

|                                    |            |
|------------------------------------|------------|
| Date of receipt of order:          | 2017-12-20 |
| Date of receipt of test item:      | 2018-02-06 |
| Start of test:                     | 2018-02-07 |
| End of test:                       | 2018-02-08 |
| Person(s) present during the test: | -/-        |

### 2.3 Test laboratories sub-contracted

None

### 3 Test standard/s and references

| Test standard     | Date          | Description                                                                                                                                               |
|-------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 47 CFR Part 15    |               | Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices                                                                 |
| RSS - 210 Issue 9 | August 2016   | Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment                           |
| RSS - Gen Issue 4 | November 2014 | Spectrum Management and Telecommunications Radio Standards Specifications - General Requirements and Information for the Certification of Radio Apparatus |

| Guidance         | Version | Description                                                                                                                                                         |
|------------------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ANSI C63.4-2014  | -/-     | American national standard for methods of measurement of radio-noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz |
| ANSI C63.10-2013 | -/-     | American national standard of procedures for compliance testing of unlicensed wireless devices                                                                      |

## 4 Test environment

|                           |   |                                     |                                                                                                                                  |
|---------------------------|---|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Temperature               | : | $T_{nom}$<br>$T_{max}$<br>$T_{min}$ | +22 °C during room temperature tests<br>No tests under extreme conditions required<br>No tests under extreme conditions required |
| Relative humidity content | : |                                     | 55 %                                                                                                                             |
| Barometric pressure       | : |                                     | 1021 hpa                                                                                                                         |
| Power supply              | : | $V_{nom}$<br>$V_{max}$<br>$V_{min}$ | 24.0 V DC by external power supply<br>No tests under extreme conditions required<br>No tests under extreme conditions required   |

## 5 Test item

### 5.1 General description

|                            |   |                                  |               |
|----------------------------|---|----------------------------------|---------------|
| Kind of test item          | : | Proximity switch                 |               |
| Type identification        | : | PSEN mlock                       |               |
| HMN                        | : | -/-                              |               |
| Models:                    |   | HVIN:                            | PMN:          |
|                            |   | 570401 V2.0                      | PSEN ml b 1.1 |
|                            |   | 570403 V2.0                      | PSEN ml b 2.1 |
|                            |   | 570405 V2.0                      | PSEN ml b 2.2 |
|                            |   | 570407 V2.0                      | PSEN ml s 1.1 |
|                            |   | 570409 V2.0                      | PSEN ml s 2.1 |
|                            |   | 570411 V2.0                      | PSEN ml s 2.2 |
| FVIN                       | : | -/-                              |               |
| Serial number              | : | Muster 00280                     |               |
| HW hardware status         | : | V2.0                             |               |
| SW software status         | : | -/-                              |               |
| Frequency range            | : | 100 kHz -150 kHz (128 kHz TX)    |               |
| Type of radio transmission | : | Clean carrier                    |               |
| Use of frequency spectrum  | : |                                  |               |
| Type of modulation         | : | Load modulation                  |               |
| Number of channels         | : | 1                                |               |
| Antenna                    | : | Integrated ferrite coil antenna  |               |
| Power supply               | : | 24 V DC by external power supply |               |
| Temperature range          | : | 0°C to +60°C                     |               |

### 5.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup- and EUT-photos are included in test report:

1-5677/17-01-01\_AnnexA  
 1-5677/17-01-01\_AnnexB  
 1-5677/17-01-01\_AnnexD

## 6 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

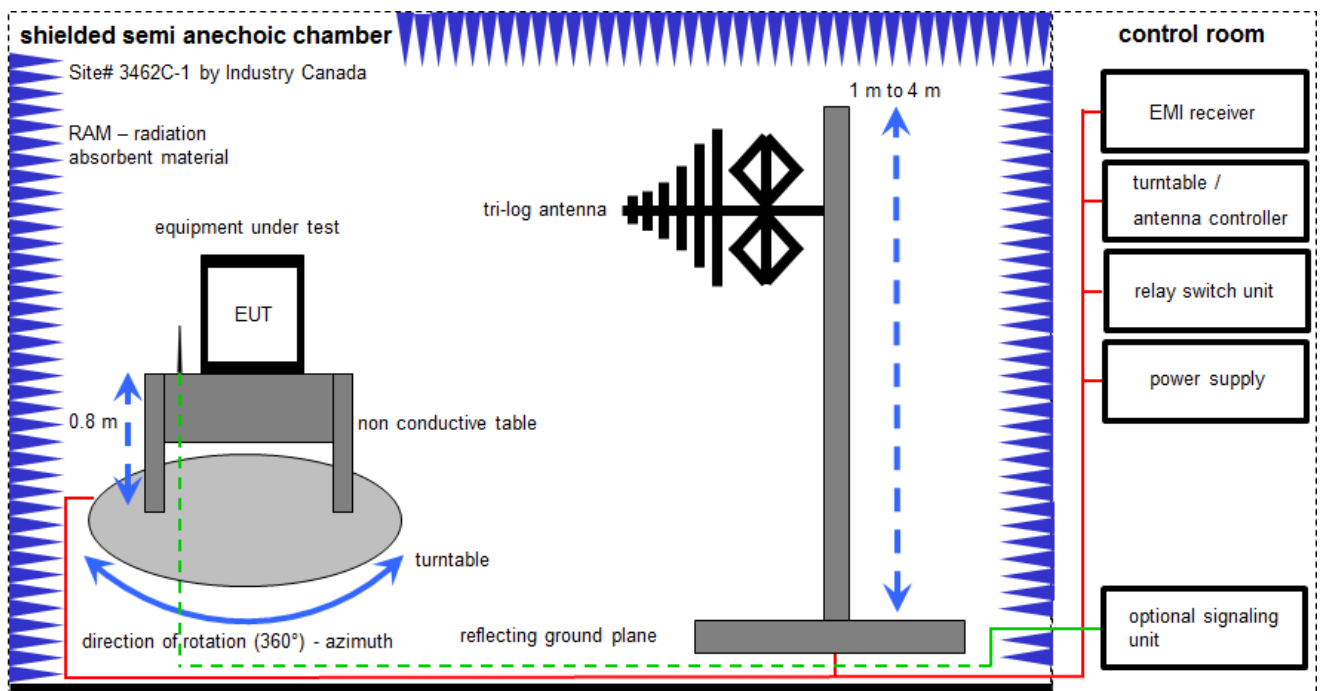
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

**Agenda:** Kind of Calibration

|      |                                            |     |                                                      |
|------|--------------------------------------------|-----|------------------------------------------------------|
| k    | calibration / calibrated                   | EK  | limited calibration                                  |
| ne   | not required (k, ev, izw, zw not required) | zw  | cyclical maintenance (external cyclical maintenance) |
| ev   | periodic self verification                 | izw | internal cyclical maintenance                        |
| Ve   | long-term stability recognized             | g   | blocked for accredited testing                       |
| vlk! | Attention: extended calibration interval   |     |                                                      |
| NK!  | Attention: not calibrated                  | *)  | next calibration ordered / currently in progress     |

## 6.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 30 MHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are conform to specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: tri-log antenna 10 meter

$$FS = UR + CL + AF$$

(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

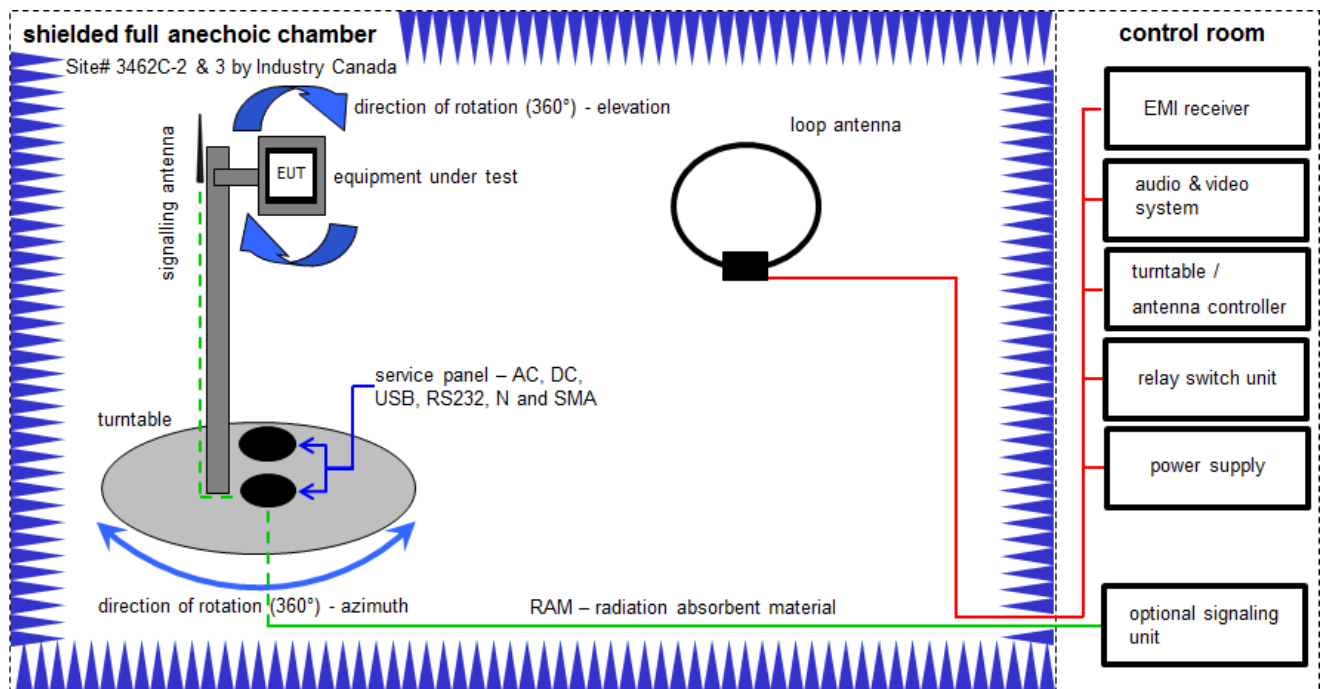
Example calculation:

$$FS [dB\mu V/m] = 12.35 [dB\mu V/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dB\mu V/m] (35.69 \mu V/m)$$

### Equipment table:

| No. | Lab / Item | Equipment                                         | Type             | Manufacturer  | Serial No.      | INV. No.  | Kind of Calibration | Last Calibration | Next Calibration |
|-----|------------|---------------------------------------------------|------------------|---------------|-----------------|-----------|---------------------|------------------|------------------|
| 1   | A          | Switch-Unit                                       | 3488A            | HP            | 2719A14505      | 300000368 | ev                  | -/-              | -/-              |
| 2   | A          | DC power supply, 60Vdc, 50A, 1200 W               | 6032A            | HP            | 2920A04466      | 300000580 | ne                  | -/-              | -/-              |
| 3   | A          | Meßkabine 1                                       | HF-Absorberhalle | MWB AG 300023 |                 | 300000551 | ne                  | -/-              | -/-              |
| 4   | A          | EMI Test Receiver                                 | ESCI 3           | R&S           | 100083          | 300003312 | k                   | 15.12.2017       | 14.12.2018       |
| 5   | A          | Analyzer-Reference-System (Harmonics and Flicker) | ARS 16/1         | SPS           | A3509 07/0 0205 | 300003314 | vKII                | 15.01.2018       | 14.01.2020       |
| 6   | A          | Antenna Tower                                     | Model 2175       | ETS-Lindgren  | 64762           | 300003745 | izw                 | -/-              | -/-              |
| 7   | A          | Positioning Controller                            | Model 2090       | ETS-Lindgren  | 64672           | 300003746 | izw                 | -/-              | -/-              |
| 8   | A          | Turntable Interface-Box                           | Model 105637     | ETS-Lindgren  | 44583           | 300003747 | izw                 | -/-              | -/-              |
| 9   | A          | TRILOG Broadband Test-Antenna 30 MHz - 3 GHz      | VULB9163         | Schwarzbeck   | 295             | 300003787 | k                   | 25.04.2016       | 25.04.2018       |

## 6.2 Shielded fully anechoic chamber



Measurement distance: loop antenna 3 meter / 1 meter

$$FS = UR + CA + AF$$

(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

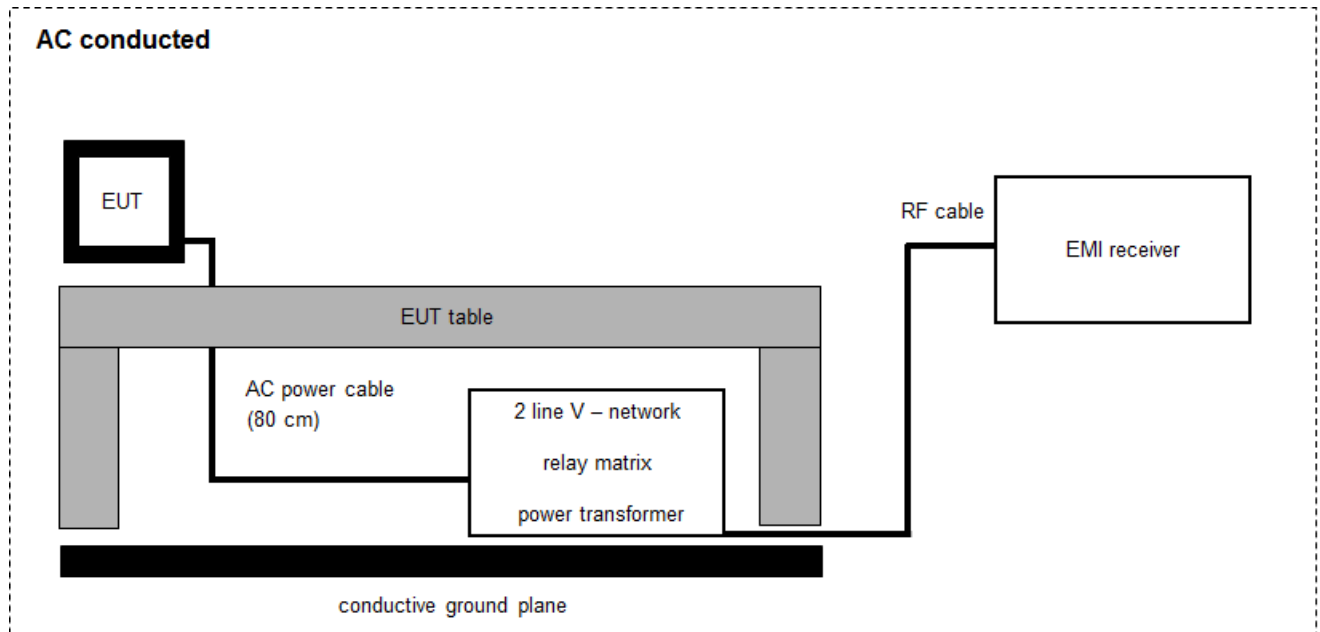
### Example calculation:

$$FS \text{ [dB}\mu\text{V/m]} = 40.0 \text{ [dB}\mu\text{V/m]} + (-35.8) \text{ [dB]} + 32.9 \text{ [dB/m]} = 37.1 \text{ [dB}\mu\text{V/m]} (71.61 \mu\text{V/m})$$

### Equipment table:

| No. | Lab / Item | Equipment                           | Type                                  | Manufacturer         | Serial No.      | INV. No.  | Kind of Calibration | Last Calibration | Next Calibration |
|-----|------------|-------------------------------------|---------------------------------------|----------------------|-----------------|-----------|---------------------|------------------|------------------|
| 1   | A.         | Active Loop Antenna 9 kHz to 30 MHz | 6502                                  | EMCO                 | 2210            | 300001015 | k                   | 07.07.2017       | 06.07.2019       |
| 2   | A          | DC power supply, 60Vdc, 50A, 1200 W | 6032A                                 | HP                   | 2920A04590      | 300001041 | v/KII               | 14.12.2017       | 13.12.2020       |
| 3   | A          | 4U RF Switch Platform               | L4491A                                | Agilent Technologies | MY50000032      | 300004510 | ne                  | -/-              | -/-              |
| 4   | A          | Computer                            | Intel Core i3 3220/3,3 GHz, Prozessor |                      | 2V2403033A54 21 | 300004591 | ne                  | -/-              | -/-              |
| 5   | A          | NEXIO EMV-Software                  | BAT EMC V3.16.0.49                    | EMCO                 |                 | 300004682 | ne                  | -/-              | -/-              |
| 6   | A          | Anechoic chamber                    |                                       | TDK                  |                 | 300003726 | ne                  | -/-              | -/-              |
| 7   | A          | EMI Test Receiver 9kHz-26,5GHz      | ESR26                                 | R&S                  | 101376          | 300005063 | k                   | 14.12.2017       | 13.12.2018       |

### 6.3 AC conducted



$$FS = UR + CF + VC$$

(FS-field strength; UR-voltage at the receiver; CR-loss of the cable and filter; VC-correction factor of the ISN)

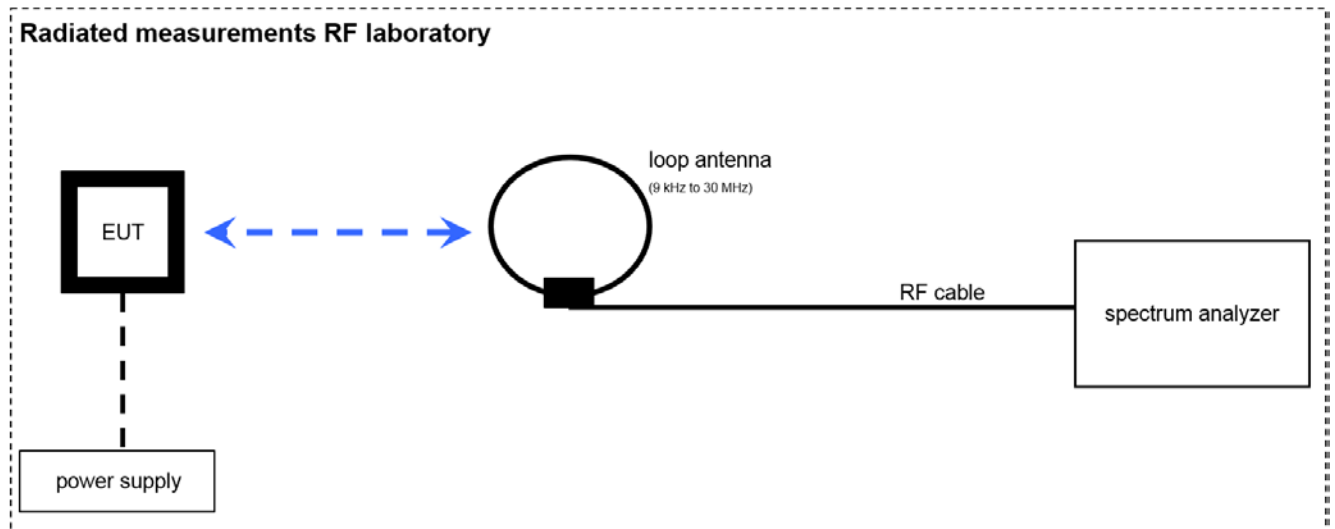
Example calculation:

$$FS [dB\mu V/m] = 37.62 [dB\mu V/m] + 9.90 [dB] + 0.23 [dB] = 47.75 [dB\mu V/m] \quad (244.06 \mu V/m)$$

Equipment table:

| No. | Lab / Item | Equipment                                         | Type       | Manufacturer         | Serial No.      | INV. No.  | Kind of Calibration | Last Calibration | Next Calibration |
|-----|------------|---------------------------------------------------|------------|----------------------|-----------------|-----------|---------------------|------------------|------------------|
| 1   | A          | Two-line V-Network (LISN) 9 kHz to 30 MHz         | ESH3-Z5    | R&S                  | 893045/004      | 300000584 | k                   | 13.12.2017       | 12.12.2018       |
| 2   | A          | RF-Filter-section                                 | 85420E     | HP                   | 3427A00162      | 300002214 | k                   | 27.11.2006       | -/-              |
| 3   | A          | AC-Spannungsquelle variabel                       | MV2616-V   | EM-Test              | 0397-12         | 300003259 | k                   | 11.12.2017       | 11.12.2019       |
| 4   | A          | Analyzer-Reference-System (Harmonics and Flicker) | ARS 16/1   | SPS                  | A3509 07/0 0205 | 300003314 | vKI!                | 15.01.2018       | 14.01.2020       |
| 5   | A          | Hochpass 150 kHz                                  | EZ-25      | R&S                  | 100010          | 300003798 | ev                  | 08.04.2008       | -/-              |
| 6   | A          | Power Supply                                      | NGSM 32/10 | R&S                  | 3939            | 400000192 | vKI!                | 31.01.2017       | 30.01.2020       |
| 7   | A          | MXE EMI Receiver 20 Hz to 26,5 GHz                | N9038A     | Agilent Technologies | MY51210197      | 300004405 | k                   | 18.12.2017       | 17.12.2018       |

## 6.4 Radiated measurements RF laboratory



### Equipment table:

| No. | Lab / Item | Equipment                                         | Type             | Manufacturer   | Serial No. | INV. No.  | Kind of Calibration | Last Calibration | Next Calibration |
|-----|------------|---------------------------------------------------|------------------|----------------|------------|-----------|---------------------|------------------|------------------|
| 1   | A          | Inductive Probe for ESH2/ESH3 100 kHz - 30 MHz    | HFH2-Z4          | R&S            | 881468/026 | 300001464 | k                   | 28.02.2017       | 27.02.2019       |
| 2   | A          | HF-Cable 1 m                                      | BPS-1551-394-BPS | Insulated Wire | 080492     | 300001713 | g                   | -/-              | -/-              |
| 3   | A          | DC Power Supply, 60V, 10A                         | 6038A            | HP             | 3122A11097 | 300001204 | vKI!                | 12.12.2017       | 11.12.2020       |
| 4   | A          | EMI Test Receiver 9 kHz - 3 GHz incl. Preselector | ESPI3            | R&S            | 101713     | 300004059 | k                   | 13.12.2017       | 12.12.2018       |

## 7 Sequence of testing

### 7.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

#### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, it is placed on a table with 0.8 m height.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

#### Premeasurement\*

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

#### Final measurement

- Identified emissions during the pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

\*)Note: The sequence will be repeated three times with different EUT orientations.

## 7.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

### Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

### Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position  $\pm 45^\circ$  and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

## 8 Measurement uncertainty

| Measurement uncertainty                            |             |
|----------------------------------------------------|-------------|
| Test case                                          | Uncertainty |
| Occupied bandwidth                                 | ± used RBW  |
| Field strength of the fundamental                  | ± 3 dB      |
| Field strength of the harmonics and spurious       | ± 3 dB      |
| Receiver spurious emissions and cabinet radiations | ± 3 dB      |
| Conducted limits                                   | ± 2.6 dB    |

## 9 Summary of measurement results

|                                     |                                                                                                                       |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | No deviations from the technical specifications were ascertained                                                      |
| <input type="checkbox"/>            | There were deviations from the technical specifications ascertained                                                   |
| <input type="checkbox"/>            | This test report is only a partial test report. The content and verdict of the performed test cases are listed below. |

| TC Identifier | Description                                       | Verdict    | Date       | Remark |
|---------------|---------------------------------------------------|------------|------------|--------|
| RF-Testing    | CFR Part 15<br>RSS 210 Issue 9<br>RSS Gen Issue 4 | See table! | 2018-04-24 | -/-    |

| Test specification clause          | Test case                                          | Temperature conditions | Power source conditions | C                                   | NC                       | NA                       | NP                       | Remark |
|------------------------------------|----------------------------------------------------|------------------------|-------------------------|-------------------------------------|--------------------------|--------------------------|--------------------------|--------|
| RSS Gen Issue 4 (6.6)              | Occupied bandwidth                                 | Nominal                | Nominal                 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -/-    |
| § 15.209                           | Field strength of the fundamental                  | Nominal                | Nominal                 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -/-    |
| § 15.209<br>RSS Gen Issue 4 (6.13) | Field strength of the harmonics and spurious       | Nominal                | Nominal                 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -/-    |
| § 15.109                           | Receiver spurious emissions and cabinet radiations | Nominal                | Nominal                 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -/-    |
| §15.107<br>§15.207                 | Conducted limits                                   | Nominal                | Nominal                 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -/-    |

**Note:** NA = Not applicable; NP = Not performed; C = Compliant; NC = Not compliant

## 10 Additional comments

Reference documents: None

Special test descriptions: We tested 2 EUTs (570401 V2.0 and 570407 V2.0) containing equal RF hardware setup but different data interface. Therefore only spurious emissions and radiated field strength was tested on both models.

Configuration descriptions: None

## 11 Measurement results

### 11.1 Occupied bandwidth

#### Measurement:

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal.

| Measurement parameters   |                     |
|--------------------------|---------------------|
| Detector:                | Peak                |
| Resolution bandwidth:    | 30 Hz               |
| Video bandwidth:         | ≥ 3x RBW            |
| Trace mode:              | Max hold            |
| Analyser function:       | 99 % power function |
| Used test setup:         | See sub clause 6.4A |
| Measurement uncertainty: | See sub clause 8    |

#### Limit:

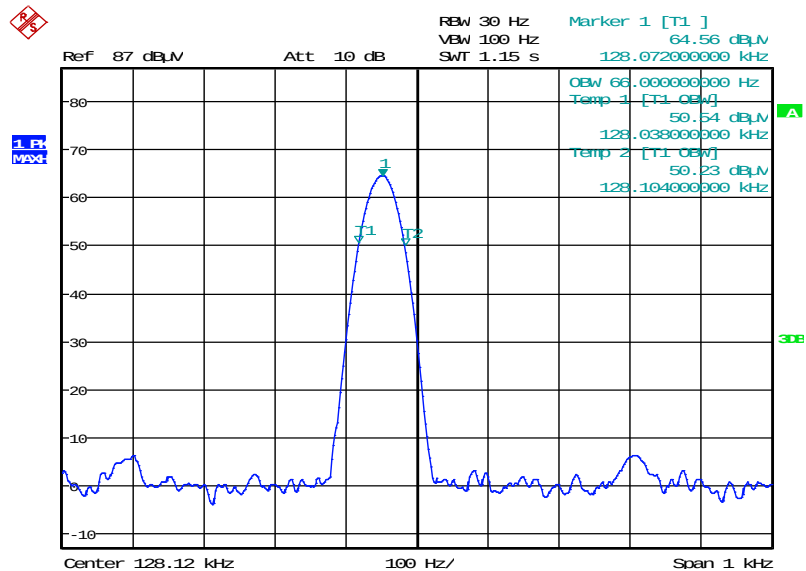
| IC                                      |
|-----------------------------------------|
| for RSP-100 test report coversheet only |

#### Result:

| 99% emission bandwidth |
|------------------------|
| 0.066 kHz              |

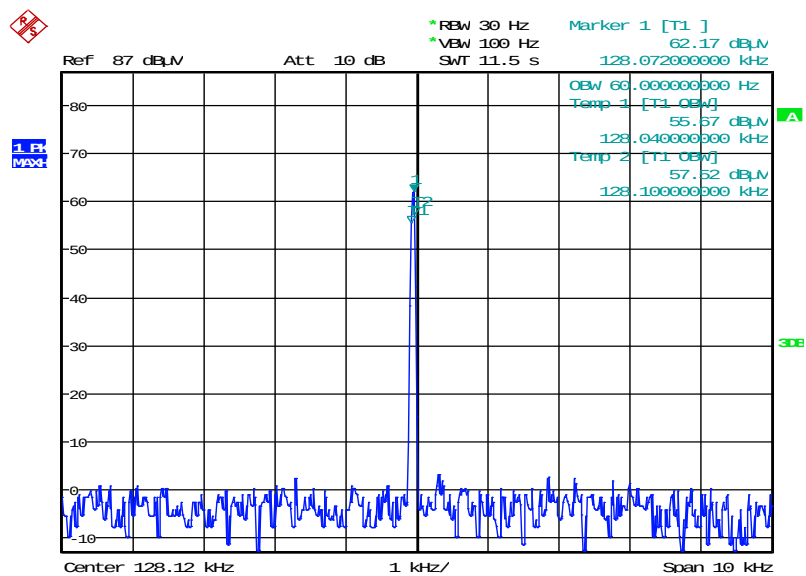
**Plot:**

**Plot 1:** 99 % emission bandwidth zoomed



Date: 7.FEB.2018 13:33:19

**Plot 1:** 99 % emission bandwidth no sidebands



Date: 7.FEB.2018 13:33:53

## 11.2 Field strength of the fundamental

### Measurement:

The maximum detected field strength for the carrier signal.

| Measurement parameters   |                                |
|--------------------------|--------------------------------|
| Detector:                | Quasi peak / peak (worst case) |
| Resolution bandwidth:    | 9 kHz                          |
| Video bandwidth:         | ≥ 3x RBW                       |
| Trace mode:              | Max hold                       |
| Used test setup          | See sub clause 6.2A            |
| Measurement uncertainty: | See sub clause 8               |

### Limit:

| FCC & IC        |                       |                          |
|-----------------|-----------------------|--------------------------|
| Frequency (MHz) | Field strength (μV/m) | Measurement distance (m) |
| 0.009 – 0.490   | 2400/F(kHz) *         | 300                      |

\*25.46 dBμV/m for 128 kHz TX frequency

### Recalculation:

| According to ANSI C63.10 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                        |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Frequency                | Formula                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Correction value       |
| 125 kHz                  | $FS_{limit} = FS_{max} - 40 \log\left(\frac{d_{nearfield}}{d_{measure}}\right) - 20 \log\left(\frac{d_{limit}}{d_{nearfield}}\right)$ <p> <math>FS_{limit}</math> is the calculation of field strength at the limit distance, expressed in dBμV/m<br/> <math>FS_{max}</math> is the measured field strength, expressed in dBμV/m<br/> <math>d_{nearfield}</math> is the <math>\lambda/2\pi</math> distance<br/> <math>d_{measure}</math> is the distance of the measurement point from EUT<br/> <math>d_{limit}</math> is the reference limit distance         </p> | -101.19 dB (1m to 300) |

### Result:

EUT1 (570401 V2.0)

| Field strength of the fundamental              |             |                    |
|------------------------------------------------|-------------|--------------------|
| Frequency                                      | 128 kHz     |                    |
| Distance                                       | @ 1 m       | @ 300 m calculated |
| Measured / calculated value (peak measurement) | 68.5 dBμV/m | -32.69 dBμV/m      |
| Measured / calculated value (QP measurement)   | 68.3 dBμV/m | -32.89 dBμV/m      |

EUT2 (570407 V2.0)

| Field strength of the fundamental              |             |                    |
|------------------------------------------------|-------------|--------------------|
| Frequency                                      | 128 kHz     |                    |
| Distance                                       | @ 1 m       | @ 300 m calculated |
| Measured / calculated value (peak measurement) | 65.8 dBμV/m | -35.39 dBμV/m      |
| Measured / calculated value (QP measurement)   | 65.7 dBμV/m | -35.19 dBμV/m      |

### 11.3 Field strength of the harmonics and spurious

#### Measurement:

The maximum detected field strength for the harmonics and spurious.

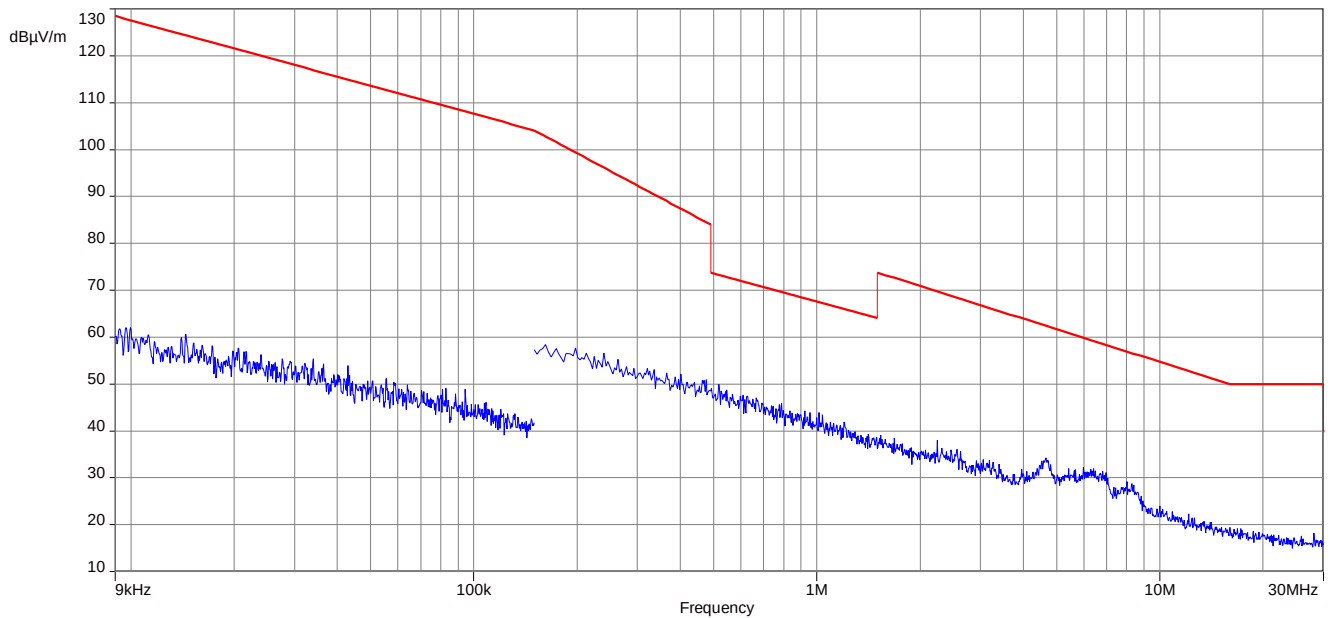
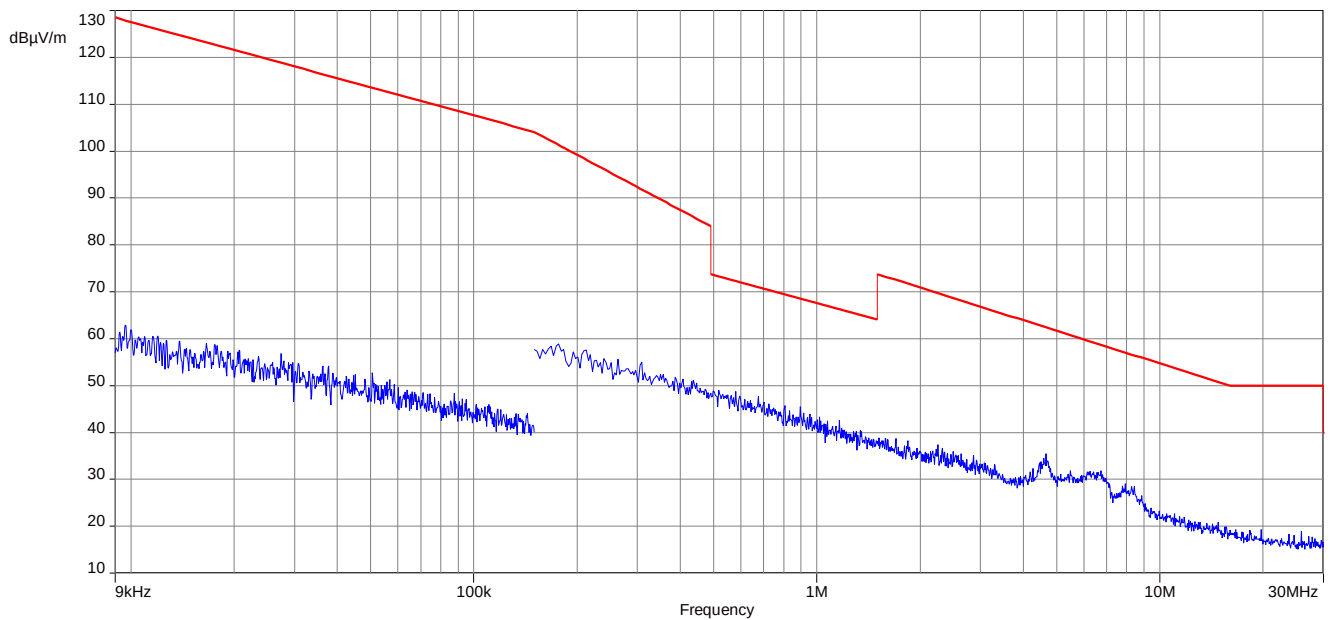
| Measurement parameters   |                                                                                    |
|--------------------------|------------------------------------------------------------------------------------|
| Detector:                | Quasi peak / average or peak (worst case – pre-scan)                               |
| Resolution bandwidth:    | F < 150 kHz: 200 Hz<br>150 kHz < F < 30 MHz: 9 kHz<br>30 MHz < F < 1 GHz: 120 kHz  |
| Video bandwidth:         | F < 150 kHz: 1 kHz<br>150 kHz < F < 30 MHz: 100 kHz<br>30 MHz < F < 1 GHz: 300 kHz |
| Trace mode:              | Max hold                                                                           |
| Used test setup:         | 9 kHz to 30 MHz: see sub clause 6.2A<br>30 MHz to 1 GHz: see sub clause 6.1A       |
| Measurement uncertainty: | See sub clause 8                                                                   |

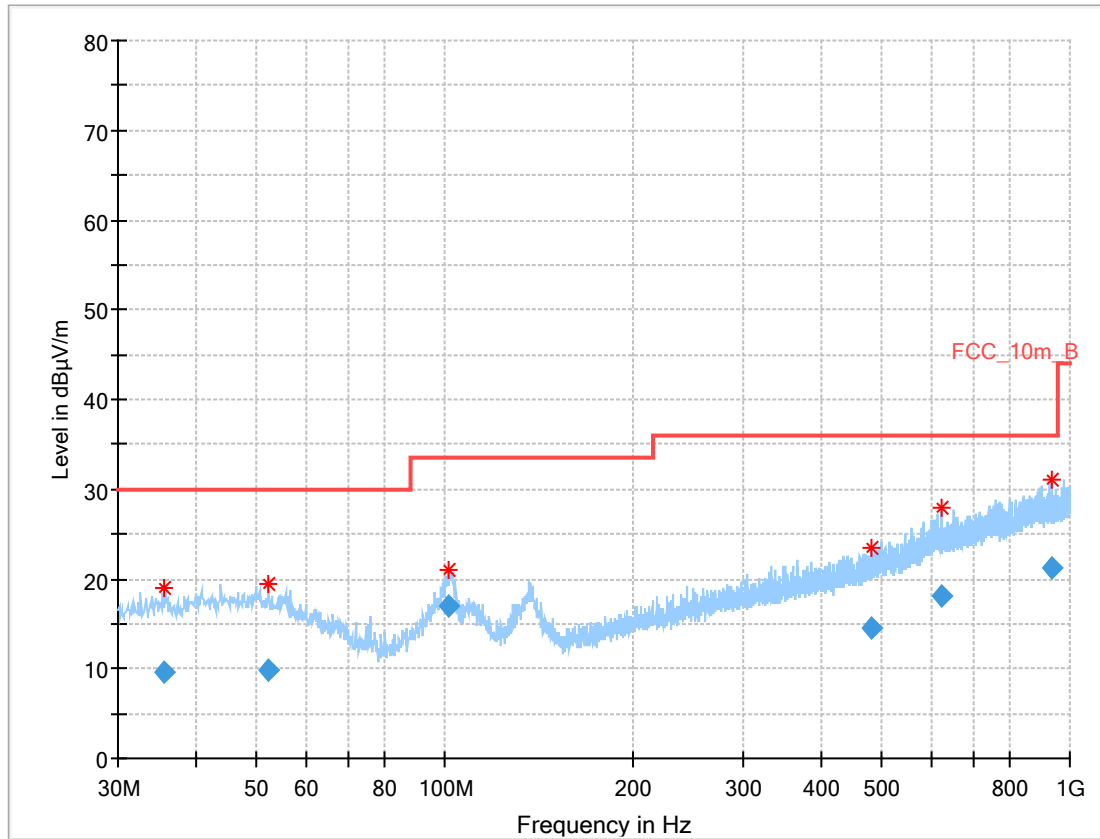
#### Limit:

| FCC & IC        |                               |                          |
|-----------------|-------------------------------|--------------------------|
| Frequency (MHz) | Field strength (dB $\mu$ V/m) | Measurement distance (m) |
| 0.009 – 0.490   | 2400/F(kHz)                   | 300                      |
| 0.490 – 1.705   | 24000/F(kHz)                  | 30                       |
| 1.705 – 30      | 30 (29.5 dB $\mu$ V/m)        | 30                       |
| 30 – 88         | 100 (40 dB $\mu$ V/m)         | 3                        |
| 88 – 216        | 150 (43.5 dB $\mu$ V/m)       | 3                        |
| 216 – 960       | 200 (46 dB $\mu$ V/m)         | 3                        |

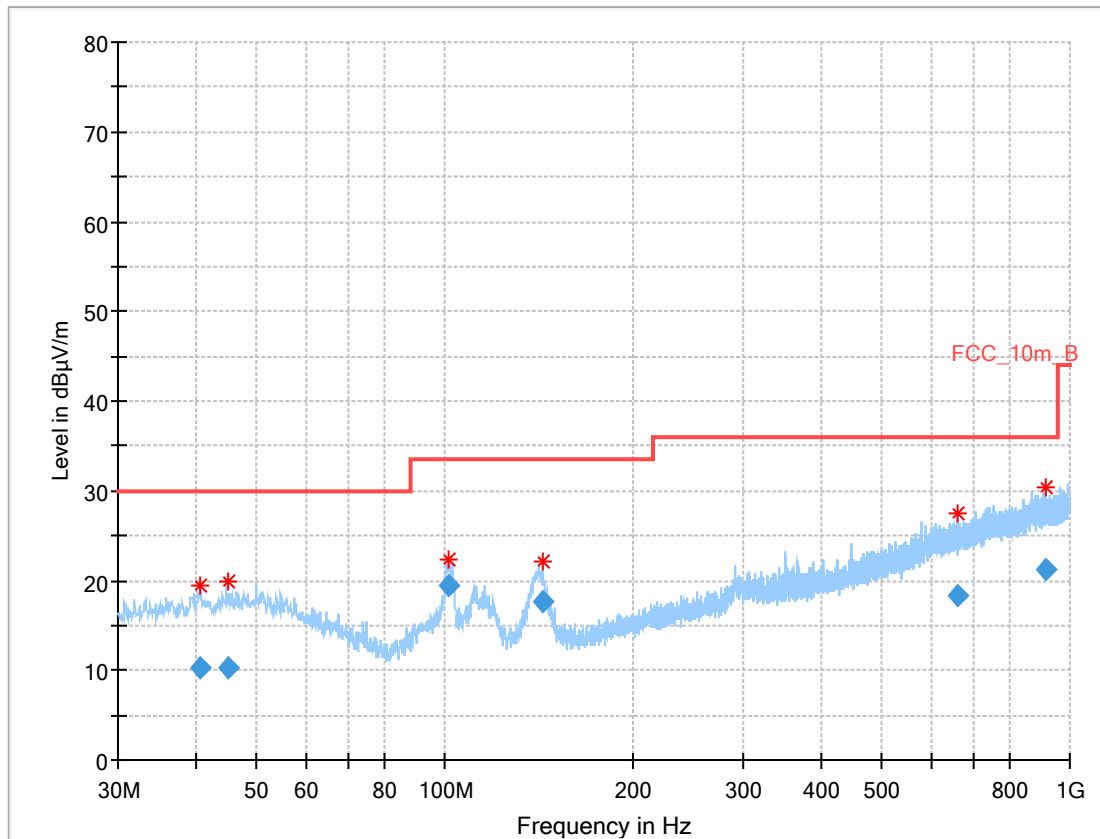
#### Result:

| Detected emissions                                                                                                           |          |                            |                |
|------------------------------------------------------------------------------------------------------------------------------|----------|----------------------------|----------------|
| Frequency (MHz)                                                                                                              | Detector | Resolution bandwidth (kHz) | Detected value |
| All emissions were more than 10 dB below the limit. For frequencies between 30 MHz – 1 GHz see result table below the plots. |          |                            |                |
|                                                                                                                              |          |                            |                |
|                                                                                                                              |          |                            |                |

**Plots:****Plot 1:** 9 kHz – 30 MHz, magnetic emissions EUT1 (570401 V2.0)**Plot 1:** 9 kHz – 30 MHz, magnetic emissions EUT2 (570407 V2.0)

**Plot 3:** 30 MHz – 1 GHz, vertical and horizontal polarisation EUT1 (570401 V2.0)**Final\_Result**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|------------|
| 35.504          | 9.69               | 30.0           | 20.31       | 1000            | 120             | 101.0       | H   | 233.0         | 12.7       |
| 52.061          | 9.73               | 30.0           | 20.27       | 1000            | 120             | 101.0       | H   | 263.0         | 13.5       |
| 101.407         | 17.04              | 33.5           | 16.46       | 1000            | 120             | 101.0       | V   | 183.0         | 12.0       |
| 481.564         | 14.42              | 36.0           | 21.58       | 1000            | 120             | 170.0       | H   | 188.0         | 18.3       |
| 622.318         | 18.13              | 36.0           | 17.87       | 1000            | 120             | 170.0       | V   | 152.0         | 20.9       |
| 936.278         | 21.34              | 36.0           | 14.66       | 1000            | 120             | 170.0       | V   | 163.0         | 24.3       |

**Plot 4:** 30 MHz – 1 GHz, vertical and horizontal polarisation EUT2 (570407 V2.0)**Final\_Result**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|------------|
| 40.714          | 10.39              | 30.0           | 19.61       | 1000            | 120             | 170.0       | V   | 17.0          | 13.3       |
| 45.004          | 10.31              | 30.0           | 19.69       | 1000            | 120             | 101.0       | V   | 228.0         | 13.6       |
| 101.418         | 19.34              | 33.5           | 14.16       | 1000            | 120             | 100.0       | V   | 232.0         | 12.0       |
| 143.790         | 17.75              | 33.5           | 15.75       | 1000            | 120             | 98.0        | V   | 333.0         | 9.0        |
| 660.229         | 18.43              | 36.0           | 17.57       | 1000            | 120             | 170.0       | V   | 46.0          | 21.2       |
| 913.720         | 21.31              | 36.0           | 14.69       | 1000            | 120             | 170.0       | H   | 101.0         | 24.2       |

## 11.4 Conducted limits

### Measurement:

Measurement of the conducted spurious emissions for an intentional radiator that is designed to be connected to the public utility (AC) power line.

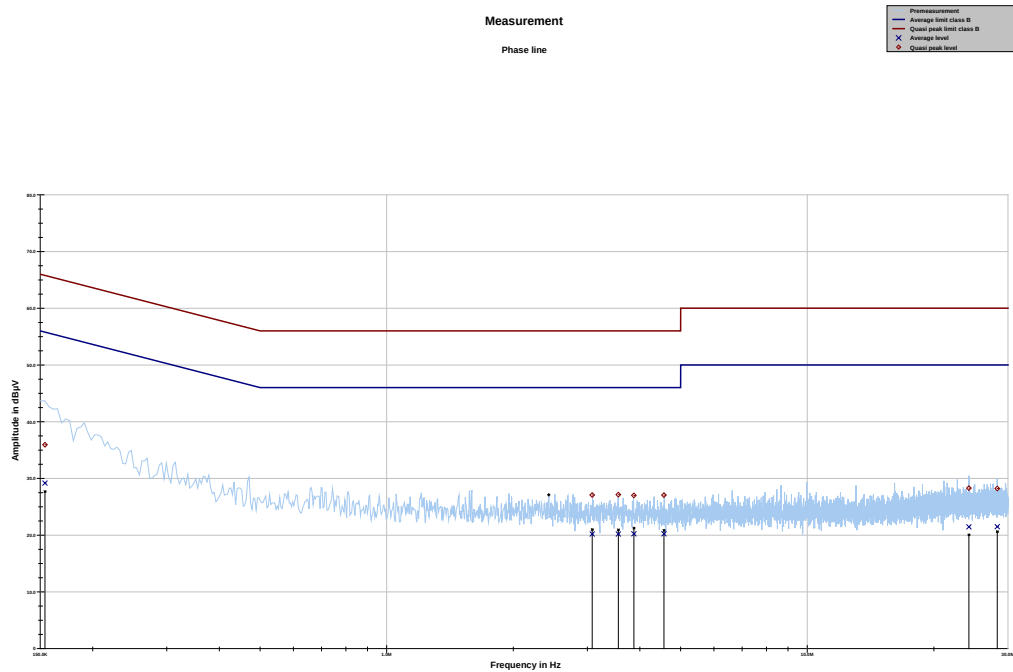
| Measurement parameters   |                                                      |
|--------------------------|------------------------------------------------------|
| Detector:                | Quasi peak / average or peak (worst case – pre-scan) |
| Resolution bandwidth:    | F < 150 kHz: 200 Hz<br>F > 150 kHz: 9 kHz            |
| Video bandwidth:         | F < 150 kHz: 1 kHz<br>F > 150 kHz: 100 kHz           |
| Trace mode:              | Max hold                                             |
| Used test setup          | See sub clause 6.3A                                  |
| Measurement uncertainty: | See sub clause 8                                     |

### Limit:

| FCC & IC        |                     |                  |
|-----------------|---------------------|------------------|
| Frequency (MHz) | Quasi-peak (dBμV/m) | Average (dBμV/m) |
| 0.15 – 0.5      | 66 to 56*           | 56 to 46*        |
| 0.5 – 5         | 56                  | 46               |
| 5 – 30.0        | 60                  | 50               |

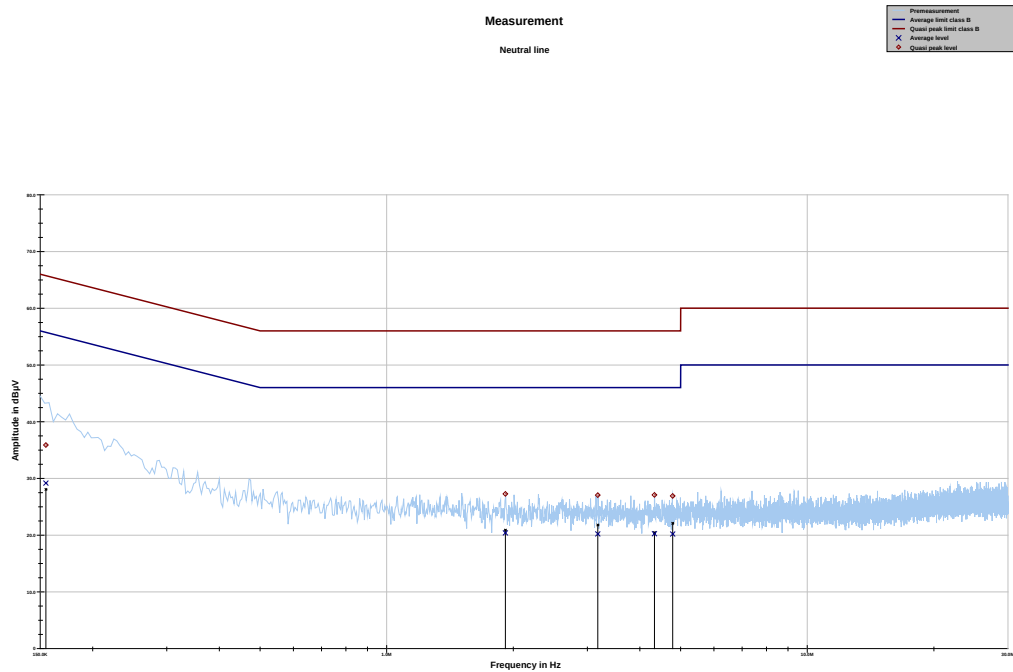
### Result:

| Detected emissions                |          |                            |                |
|-----------------------------------|----------|----------------------------|----------------|
| Frequency (MHz)                   | Detector | Resolution bandwidth (kHz) | Detected value |
| See result table below the plots. |          |                            |                |
|                                   |          |                            |                |
|                                   |          |                            |                |

**Plots:** EUT1 (570401 V2.0)**Plot 1:** 150 kHz to 30 MHz, phase line

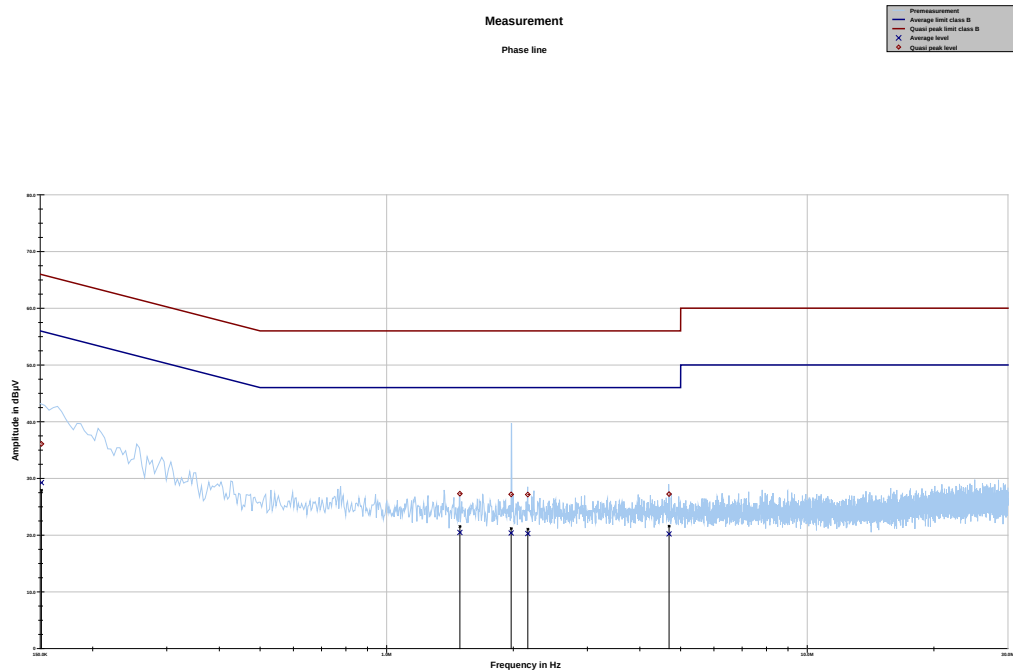
Project ID: 1-5677/17-01-02

| Frequency | Quasi peak level | Margin quasi peak | Limit QP | Average level | Margin average | Limit AV |
|-----------|------------------|-------------------|----------|---------------|----------------|----------|
| MHz       | dBµV             | dB                | dBµV     | dBµV          | dB             | dBµV     |
| 0.154021  | 35.93            | 29.85             | 65.780   | 29.17         | 26.72          | 55.885   |
| 3.081314  | 27.07            | 28.93             | 56.000   | 20.19         | 25.81          | 46.000   |
| 3.555646  | 27.14            | 28.86             | 56.000   | 20.20         | 25.80          | 46.000   |
| 3.870470  | 27.00            | 29.00             | 56.000   | 20.23         | 25.77          | 46.000   |
| 4.563295  | 27.06            | 28.94             | 56.000   | 20.22         | 25.78          | 46.000   |
| 24.232371 | 28.28            | 31.72             | 60.000   | 21.46         | 28.54          | 50.000   |
| 28.295924 | 28.23            | 31.77             | 60.000   | 21.49         | 28.51          | 50.000   |

**Plot 2:** 150 kHz to 30 MHz, neutral line

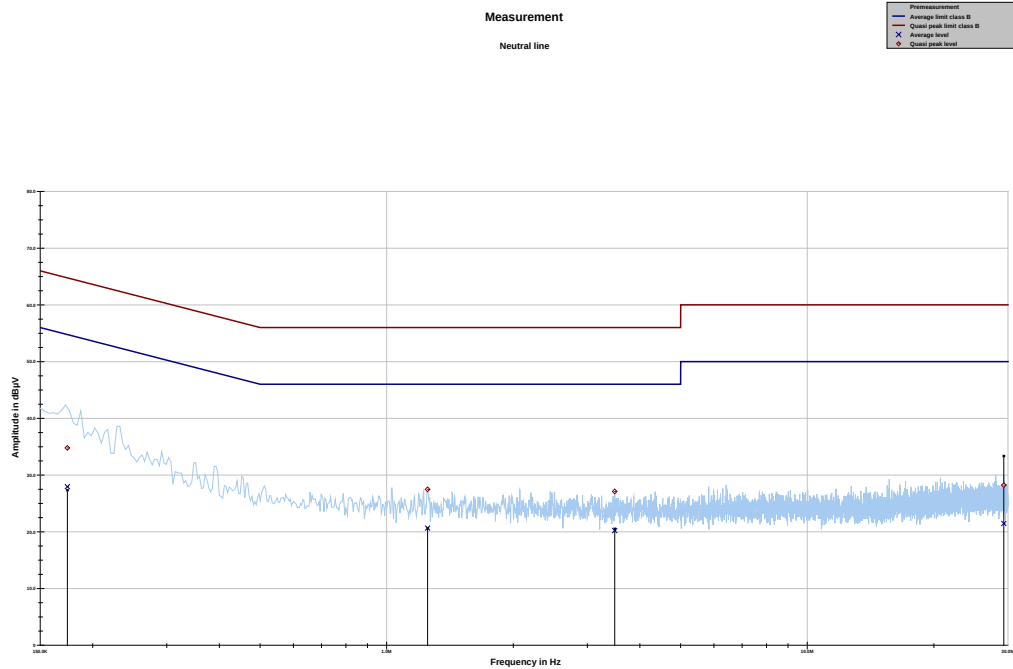
Project ID: 1-5677/17-01-02

| Frequency | Quasi peak level | Margin quasi peak | Limit QP | Average level | Margin average | Limit AV |
|-----------|------------------|-------------------|----------|---------------|----------------|----------|
| MHz       | dBµV             | dB                | dBµV     | dBµV          | dB             | dBµV     |
| 0.154790  | 35.87            | 29.87             | 65.739   | 29.16         | 26.70          | 55.863   |
| 1.915818  | 27.26            | 28.74             | 56.000   | 20.40         | 25.60          | 46.000   |
| 3.176032  | 27.05            | 28.95             | 56.000   | 20.22         | 25.78          | 46.000   |
| 4.331988  | 27.08            | 28.92             | 56.000   | 20.23         | 25.77          | 46.000   |
| 4.786612  | 26.90            | 29.10             | 56.000   | 20.19         | 25.81          | 46.000   |

**Plots:** EUT2 (570407 V2.0)**Plot 1:** 150 kHz to 30 MHz, phase line

Project ID: 1-5677/17-01-02

| Frequency | Quasi peak level | Margin quasi peak | Limit QP | Average level | Margin average | Limit AV |
|-----------|------------------|-------------------|----------|---------------|----------------|----------|
| MHz       | dBµV             | dB                | dBµV     | dBµV          | dB             | dBµV     |
| 0.151033  | 36.07            | 29.87             | 65.943   | 29.25         | 26.72          | 55.970   |
| 1.492764  | 27.29            | 28.71             | 56.000   | 20.48         | 25.52          | 46.000   |
| 1.976462  | 27.19            | 28.81             | 56.000   | 20.37         | 25.63          | 46.000   |
| 2.165763  | 27.16            | 28.84             | 56.000   | 20.28         | 25.72          | 46.000   |
| 4.691934  | 27.23            | 28.77             | 56.000   | 20.21         | 25.79          | 46.000   |

**Plot 2:** 150 kHz to 30 MHz, neutral line

| Frequency | Quasi peak level | Margin quasi peak | Limit QP | Average level | Margin average | Limit AV |
|-----------|------------------|-------------------|----------|---------------|----------------|----------|
| MHz       | dBµV             | dB                | dBµV     | dBµV          | dB             | dBµV     |
| 0.174117  | 34.78            | 29.98             | 64.762   | 27.95         | 27.36          | 55.311   |
| 1.250975  | 27.48            | 28.52             | 56.000   | 20.65         | 25.35          | 46.000   |
| 3.485860  | 27.10            | 28.90             | 56.000   | 20.21         | 25.79          | 46.000   |
| 29.321535 | 28.22            | 31.78             | 60.000   | 21.46         | 28.54          | 50.000   |

## 12 Observations

No observations except those reported with the single test cases have been made.

## Annex A Glossary

|                        |                                                    |
|------------------------|----------------------------------------------------|
| <b>EUT</b>             | Equipment under test                               |
| <b>DUT</b>             | Device under test                                  |
| <b>UUT</b>             | Unit under test                                    |
| <b>GUE</b>             | GNSS User Equipment                                |
| <b>ETSI</b>            | European Telecommunications Standards Institute    |
| <b>EN</b>              | European Standard                                  |
| <b>FCC</b>             | Federal Communications Commission                  |
| <b>FCC ID</b>          | Company Identifier at FCC                          |
| <b>IC</b>              | Industry Canada                                    |
| <b>PMN</b>             | Product marketing name                             |
| <b>HMN</b>             | Host marketing name                                |
| <b>HVIN</b>            | Hardware version identification number             |
| <b>FVIN</b>            | Firmware version identification number             |
| <b>EMC</b>             | Electromagnetic Compatibility                      |
| <b>HW</b>              | Hardware                                           |
| <b>SW</b>              | Software                                           |
| <b>Inv. No.</b>        | Inventory number                                   |
| <b>S/N or SN</b>       | Serial number                                      |
| <b>C</b>               | Compliant                                          |
| <b>NC</b>              | Not compliant                                      |
| <b>NA</b>              | Not applicable                                     |
| <b>NP</b>              | Not performed                                      |
| <b>PP</b>              | Positive peak                                      |
| <b>QP</b>              | Quasi peak                                         |
| <b>AVG</b>             | Average                                            |
| <b>OC</b>              | Operating channel                                  |
| <b>OCW</b>             | Operating channel bandwidth                        |
| <b>OBW</b>             | Occupied bandwidth                                 |
| <b>OOB</b>             | Out of band                                        |
| <b>DFS</b>             | Dynamic frequency selection                        |
| <b>CAC</b>             | Channel availability check                         |
| <b>OP</b>              | Occupancy period                                   |
| <b>NOP</b>             | Non occupancy period                               |
| <b>DC</b>              | Duty cycle                                         |
| <b>PER</b>             | Packet error rate                                  |
| <b>CW</b>              | Clean wave                                         |
| <b>MC</b>              | Modulated carrier                                  |
| <b>WLAN</b>            | Wireless local area network                        |
| <b>RLAN</b>            | Radio local area network                           |
| <b>DSSS</b>            | Dynamic sequence spread spectrum                   |
| <b>OFDM</b>            | Orthogonal frequency division multiplexing         |
| <b>FHSS</b>            | Frequency hopping spread spectrum                  |
| <b>GNSS</b>            | Global Navigation Satellite System                 |
| <b>C/N<sub>0</sub></b> | Carrier to noise-density ratio, expressed in dB-Hz |

## Annex B Document history

| Version | Applied changes                | Date of release |
|---------|--------------------------------|-----------------|
| -/-     | Initial release                | 2018-02-19      |
| -A      | HVIN / PMN information changed | 2018-04-24      |

## Annex C Accreditation Certificate

| first page                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | last page                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>Deutsche Akkreditierungsstelle GmbH</p> <p>Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV<br/>Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition</p> <p><b>Accreditation</b> </p> <p>The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory<br/><b>CTC advanced GmbH</b><br/>Untertürkheimer Straße 6-10, 66117 Saarbrücken</p> <p>is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields:<br/><b>Telecommunication</b></p> <p>The accreditation certificate shall only apply in connection with the notice of accreditation of 02.06.2017 with the accreditation number D-PL-12076-01 and is valid until 21.04.2021. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 43 pages.</p> <p>Registration number of the certificate: D-PL-12076-01-03</p> <p>Frankfurt, 02.06.2017</p> <p><br/>Ralf Reiter<br/>Head of Division</p> | <p>Deutsche Akkreditierungsstelle GmbH</p> <p>Office Berlin<br/>Spittelmarkt 10<br/>10117 Berlin</p> <p>Office Frankfurt am Main<br/>Europa-Allee 52<br/>60327 Frankfurt am Main</p> <p>Office Braunschweig<br/>Bundesallee 100<br/>38116 Braunschweig</p> <p>The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkkS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.</p> <p>No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkkS.</p> <p>The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.</p> <p>The up-to-date state of membership can be retrieved from the following websites:<br/>EA: <a href="http://www.european-accreditation.org">www.european-accreditation.org</a><br/>ILAC: <a href="http://www.ilac.org">www.ilac.org</a><br/>IAF: <a href="http://www.iaf.nu">www.iaf.nu</a></p> |

**Note: The current certificate annex is published on the website (link see below) of the Accreditation Body DAkkS or may be received by CTC advanced GmbH on request**

<http://www.dakks.de/as/ast/d/D-PL-12076-01-03.pdf>