

**Test Report acc. to FCC Title 47 CFR Part 15  
relating to  
EBS Ink Jet Systeme GmbH  
PH1600**

**Title 47 - Telecommunication  
Part 15 - Radio Frequency Devices  
Subpart C – Intentional Radiators  
Measurement Procedure:  
ANSI C63.4-2014  
ANSI C63.10-2013**



Deutsche  
Akkreditierungsstelle  
D-PL-12053-01-03

#### MANUFACTURER

|                             |                                               |
|-----------------------------|-----------------------------------------------|
| Manufacturer name           | <b>EBS Ink-Jet Systems Poland Sp. z o.o.</b>  |
| Manufacturer's grantee code | <b>2AKBZ</b>                                  |
| Manufacturer's address      | <b>Tarnogajska 13, 50-512 Wroclaw, Poland</b> |
| Phone                       | +48 71 7384 134                               |
| Fax                         | +48 71 373 32 69                              |
| Email                       | k.solinski@ebs-inkjet.pl                      |

#### TESTING LABORATORY

|                            |                                                                  |
|----------------------------|------------------------------------------------------------------|
| Test engineer              | Mr. Ralf Trepper                                                 |
| Testing laboratory name    | <b>TÜV NORD Hochfrequenztechnik GmbH &amp; Co. KG</b>            |
| Testing laboratory address | LESKANPARK, Gebäude 10<br>Waltherstr. 49-51, 51069 Köln, Germany |
| Phone                      | +49 221 8888950                                                  |
| Email                      | rtrepper@tuev-nord.de                                            |

#### RELEVANT STANDARD

|                       |                                                           |
|-----------------------|-----------------------------------------------------------|
| Title                 | <b>47 - Telecommunication</b>                             |
| Part                  | <b>15 - Radio Frequency Devices</b>                       |
| Subpart               | <b>Subpart C – Intentional Radiators - Section 15.225</b> |
| Measurement procedure | <b>ANSI C63.4-2014 &amp; ANSI C63.10-2013</b>             |

#### Equipment Under Test (EUT)

|                    |                   |
|--------------------|-------------------|
| Equipment category | RFID              |
| Trade name         | PicAS®II EBS-1600 |
| Type designation   | <b>PH1600</b>     |
| Serial no.         | 200006            |
| Variants           | ---               |

## Test results

| Clause | Requirements headline         | Test result |                 |                  |
|--------|-------------------------------|-------------|-----------------|------------------|
| 8.1    | Antenna Requirement           | Pass        | <del>Fail</del> | <del>N.t.*</del> |
| 8.2    | Conducted limits              | Pass        | <del>Fail</del> | <del>N.t.*</del> |
| 8.3    | Restricted bands of operation | Pass        | <del>Fail</del> | <del>N.t.*</del> |
| 8.4    | Radiated emission limits      | Pass        | <del>Fail</del> | <del>N.t.*</del> |
| 8.5    | Frequency tolerance           | Pass        | <del>Fail</del> | <del>N.t.*</del> |
| 8.6    | 20 dB Bandwidth               | Pass        | <del>Fail</del> | <del>N.t.*</del> |

\* Not tested

As far as in this report statements on conformity are made, decision rules according to DIN EN ISO/IEC 17025:2018, 7.8.6 have been applied. If the report does not state otherwise, procedure 1 according to IEC Guide 115 ed.1.0 2007 (uncertainty of measurement calculated) has been applied on measurement and test procedures which are the base of this report.

|                                              |     |               |
|----------------------------------------------|-----|---------------|
| The equipment passed all the conducted tests | Yes | <del>No</del> |
|----------------------------------------------|-----|---------------|

|               |                                                                                                                                                                             |                                                                                                                                                                             |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature     | <br>Digital unterschrieben<br>von Shrestha Anup<br>Datum: 2022.02.25<br>11:34:21 +01'00' | <br>Digital unterschrieben<br>von Trepper Ralf<br>Datum: 2022.02.25<br>11:45:41 +01'00' |
| Name          | Mr. Anup Shrestha                                                                                                                                                           | Mr. Ralf Trepper                                                                                                                                                            |
| Designation   | RF Test engineer                                                                                                                                                            | Laboratory-Manager                                                                                                                                                          |
| Date of issue | 2022-02-22                                                                                                                                                                  | 2022-02-22                                                                                                                                                                  |

## Table of contents

|                                                     |    |
|-----------------------------------------------------|----|
| 1. Table of contents.....                           | 5  |
| 2. Introduction.....                                | 6  |
| 3. Testing laboratory .....                         | 6  |
| 4. Applicant.....                                   | 7  |
| 5. Product and product documentation.....           | 7  |
| 6. Conclusions, observations and comments.....      | 8  |
| 7. Operational description .....                    | 9  |
| 8. Compliance assessment.....                       | 10 |
| 8.1 Antenna requirement.....                        | 10 |
| 8.1.1 Regulation.....                               | 10 |
| 8.1.2 Result .....                                  | 10 |
| 8.2 Conducted limits .....                          | 11 |
| 8.2.1 Regulation.....                               | 11 |
| 8.2.2 Test procedures .....                         | 11 |
| 8.2.3 Result .....                                  | 12 |
| 8.3 Restricted bands of operation.....              | 15 |
| 8.2.1 Regulation.....                               | 15 |
| 8.2.2 Result .....                                  | 16 |
| 8.4 Radiated emission limits .....                  | 17 |
| 8.4.1 Regulation.....                               | 17 |
| 8.4.2 Test procedure.....                           | 19 |
| 8.4.3 Calculation of the field strength.....        | 20 |
| 8.4.4 Result .....                                  | 21 |
| 8.5 Frequency tolerance .....                       | 24 |
| 8.5.1 Regulation.....                               | 24 |
| 8.5.2 Test procedures .....                         | 24 |
| 8.5.3 Result .....                                  | 26 |
| 8.6 Bandwidth (20 dB).....                          | 27 |
| 8.6.1 Regulation.....                               | 27 |
| 8.6.2 Calculation of the 20 dB bandwidth limit..... | 27 |
| 8.6.3 Test procedure.....                           | 27 |
| 8.6.4 Result .....                                  | 28 |
| 9. Additional information to the test report.....   | 29 |
| 10. List of test equipment.....                     | 30 |
| 11. Cable list .....                                | 34 |

**1. Table of contents**

| Revision | Date of issue | Creator | Content of change |
|----------|---------------|---------|-------------------|
| 00       | 22.02.22      | AS      | Initial release   |
| ---      | ---           | ---     | ---               |
| ---      | ---           | ---     | ---               |

Table 0-1: Table of contents

Note: If the document has been changed by revision number, all previous documents are no longer valid and must be destroyed.

## 2. Introduction

This test report is **not an expert opinion** and consists of:

- Test result summary
- List of contents
- Introduction and further information
- Performance assessment
- Detailed test information

All pages have been numbered consecutively and bear the TÜV NORD Hochfrequenztechnik GmbH & Co. KG logo, the test report number, the date, the test specification in its current version as well as the type designation of the EUT. The total number of pages in this report is **37**.

The tests were carried out at:

- **TÜV NORD Hochfrequenztechnik GmbH & Co. KG**  
**LESKANPARK, Gebäude 10, Waltherstr. 49-51, 51069 Köln, Germany**

in a representative assembly and in accordance with the test methods and/or requirements stated in:

**FCC Title 47 CFR Part 15 Subpart C Section 15.225, ANSI C63.4-2014 & ANSI C63.10-2013**

The sample of the product was received on:

- **2021-01-13**

The tests were carried out in the following period:

- **2021-01-19 - 2021-07-29**

## 3. Testing laboratory

TÜV NORD Hochfrequenztechnik GmbH & Co. KG  
LESKANPARK, Gebäude 10  
Waltherstr. 49-51  
51069 Köln  
Germany

Phone: +49 221 8888 950

- **FCC Registration Number: 763407**

Accredited by:

**DAkkS Deutsche Akkreditierungsstelle GmbH**  
**DAkkS accreditation number: D-PL-12053-01**

#### 4. Applicant

Company name : EBS Ink Jet Systeme GmbH  
Address : Alte Ziegelei 19-25  
51588 Nümbrecht  
Country : Germany  
Telephone : +49 2293 939 168  
Fax : +49 2293 939 3  
Email : g.schmidt@ebs-inkjet.de  
Date of order : 2020-10-09  
References : Mr. Guido Schmidt

#### 5. Product and product documentation

Samples of the following apparatus were submitted for testing:

Manufacturer : EBS Ink-Jet Systems Poland Sp. z o.o  
Tarnogajska 13, 50-512 Wrocław, Poland  
Trademark : PicASII  
Type designation : PH1600  
Variants : ---  
Antennas : Loop  
Serial number : 200006  
Hardware version : whole printer P120478100 (includes: P340925000 + P371328000 + P380998000  
P320415000 + P390076000 + P320416000)  
Software version : 1.00.30.0.A  
Type of equipment : PH1600 EBS-module  
Power supply used : AC 100-240V~  
Frequency used : 13.56 MHz  
Generated frequencies : 27.12 MHz (crystal) // 13.56 MHz (carrier)  
ITU emission class : 396HA1D  
FCC-ID : 2AKBZPH1600

For issuing this report, the following product documentation was used:

| Title | Description | Version |
|-------|-------------|---------|
| ---   | ---         | ---     |

For issuing this report the following product documentation was used:

| Description                                            | Date       | Identifications |
|--------------------------------------------------------|------------|-----------------|
| External photographs of the Equipment Under Test (EUT) | 2022-02-22 | Annex no. 1     |
| Internal photographs of the Equipment Under Test (EUT) | 2022-02-22 | Annex no. 2     |
| Channel occupancy / bandwidth                          | 2022-02-22 | Annex no. 3     |
| Label sample                                           | 2022-02-22 | Annex no. 4     |
| Functional description / User manual                   | 2022-02-22 | Annex no. 5     |
| Test setup photos                                      | 2022-02-22 | Annex no. 6     |
| Block diagram                                          | 2022-02-22 | Annex no. 7     |
| Operational description                                | 2022-02-22 | Annex no. 8     |
| Schematics                                             | 2022-02-22 | Annex no. 9     |
| Parts list                                             | 2022-02-22 | Annex no. 10    |

## 6. Conclusions, observations and comments

The test report will be filed at TÜV NORD Hochfrequenztechnik GmbH & Co. KG for a period of 10 years following the issue of this report. It may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of TÜV NORD Hochfrequenztechnik GmbH & Co. KG.

The results of the tests as stated in this report are exclusively applicable to the EUT as identified in this report. TÜV NORD Hochfrequenztechnik GmbH & Co. KG cannot be held liable for properties of the EUT that have not been observed during these tests.

TÜV NORD Hochfrequenztechnik GmbH & Co. KG assumes the sample to comply with the requirements of FCC Title 47 CFR Part 15 for the respective test sector, if the test results turn out positive.

Comments: ---

## 7. Operational description

### 7.1 EUT details

The PH1600 module is an 13.56 MHz RFID Reader and part of the EBS-1600 inkjet family.

The industrial ink-jet printer model EBS-1600 is used to print on the objects (products, goods) moving on a belt Conveyor.

### 7.2 EUT configuration

The EUT starts to function after connecting to the power supply of 230 V AC.

### 7.3 EUT measurement description

#### Radiated measurements

The EUT was tested in a typical fashion. During preliminary emission tests, the EUT was operated in the continuous measuring mode for worst case emission mode investigation. Therefore, the final qualification testing was completed with the EUT operated in continuous measuring mode. All tests were performed with the EUT's typical voltage: 230 V AC

In order to establish the maximum radiation, firstly, there have been viewed all orthogonal adjustments of the test samples, secondly the test sample have been rotated at all adjustments around the own axis between 0° and 360°, and thirdly, the antenna polarization between horizontal and vertical had been varied.

Radiated measurement above 1 GHz is made by placing loose-laid RF absorber material on the ground plane as mentioned in ANSI C63.4-2014.

Additionally, radiated emission measurements above 1 GHz are made using calibrated linearly polarized antennas as specified in ANSI C63.4-2014, which may have a smaller beamwidth (main lobe) than do the antennas used for frequencies below 1 GHz. The measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal.

#### Conducted measurements

The EUT was connected to a test laptop, which is directly connected to the artificial mains network. It has been tested in three steps: test laptop with inactive EUT via LAN port, test laptop with active EUT via LAN port, directly powered by the external AC source at the AC inport port of the EUT.

## 8. Compliance assessment

### 8.1 Antenna requirement

#### 8.1.1 Regulation

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

#### 8.1.2 Result

| Antenna Type | Antenna description              | Frequency | Gain      | Number of Antennas |
|--------------|----------------------------------|-----------|-----------|--------------------|
| Loop antenna | Integrated internal loop antenna | 13.56 MHz | -66.5 dBi | 1                  |

|                                          |     |               |                  |
|------------------------------------------|-----|---------------|------------------|
| The equipment passed the conducted tests | Yes | <del>No</del> | <del>N.t.*</del> |
|------------------------------------------|-----|---------------|------------------|

|                                               |     |               |             |
|-----------------------------------------------|-----|---------------|-------------|
| Test setup photos / test results are attached | Yes | <del>No</del> | Annex no.:2 |
|-----------------------------------------------|-----|---------------|-------------|

## 8.2 Conducted limits

### 8.2.1 Regulation

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency of emission(MHz) | Conducted limit (dB $\mu$ V) |           |
|----------------------------|------------------------------|-----------|
|                            | Quasi-peak                   | Average   |
| 0.15 - 0.5                 | 66 to 56*                    | 56 to 46* |
| 0.5 - 5                    | 56                           | 46        |
| 5 -30                      | 60                           | 50        |

\*Decreases with the logarithm of the frequency

(b) The shown limit in paragraph (a) of this Section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

(1) For carrier current systems containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000  $\mu$ V within the frequency band 535-1705 kHz, as measured using a 50  $\mu$ H/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in Section 15.205 and Section 15.209, 15.221, 15.223, 15.225 or 15.227, as appropriate.

(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provision for, the use of battery chargers which permit operating while charging, AC adaptors or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

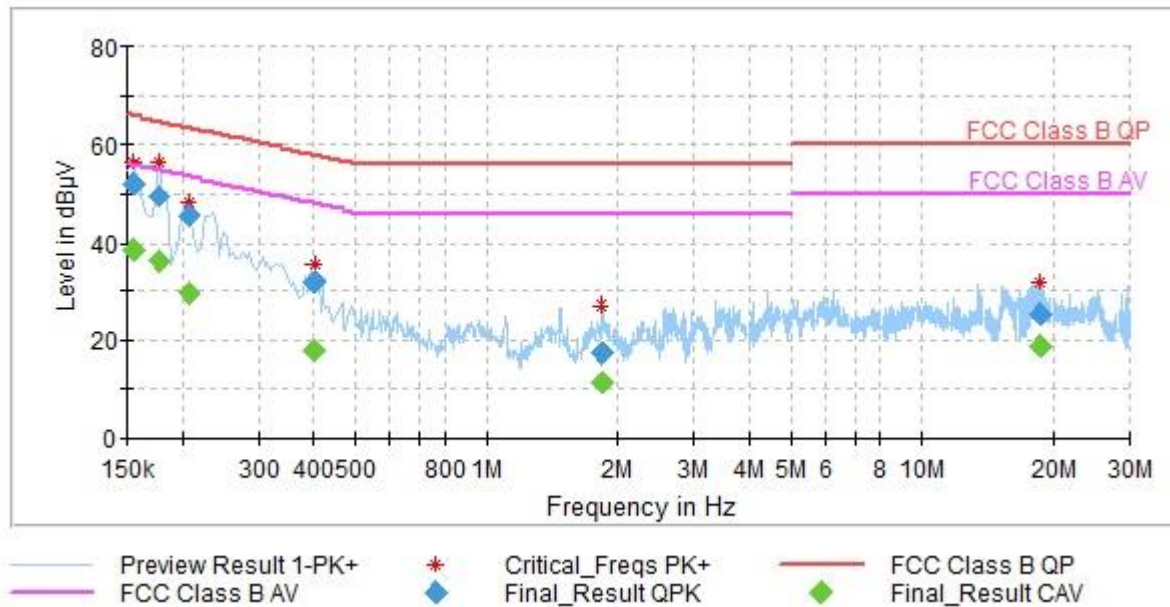
### 8.2.2 Test procedures

The EUT and the additional equipment (if required) are connected to the main power through a line impedance stabilization network (LISN). The LISN must be appropriate to ANSI C63.4-2014 Section 7.

Additional equipment must also be connected to a second LISN with the same specifications described in the above section (if required).

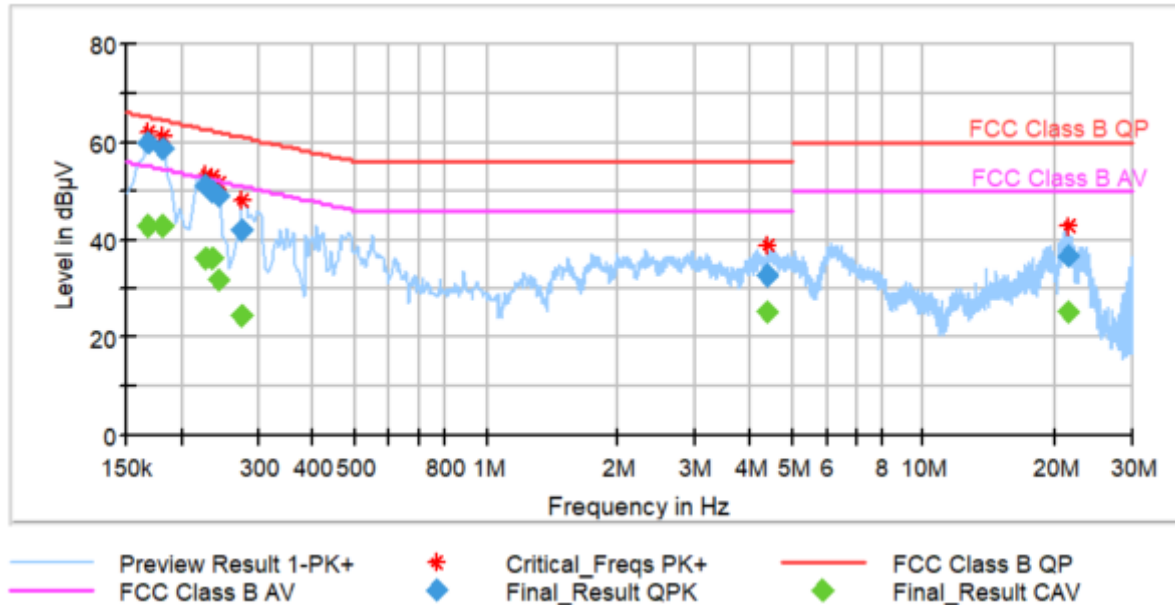
### 8.2.3 Result

- External AC power supply at the AC port of the EUT:



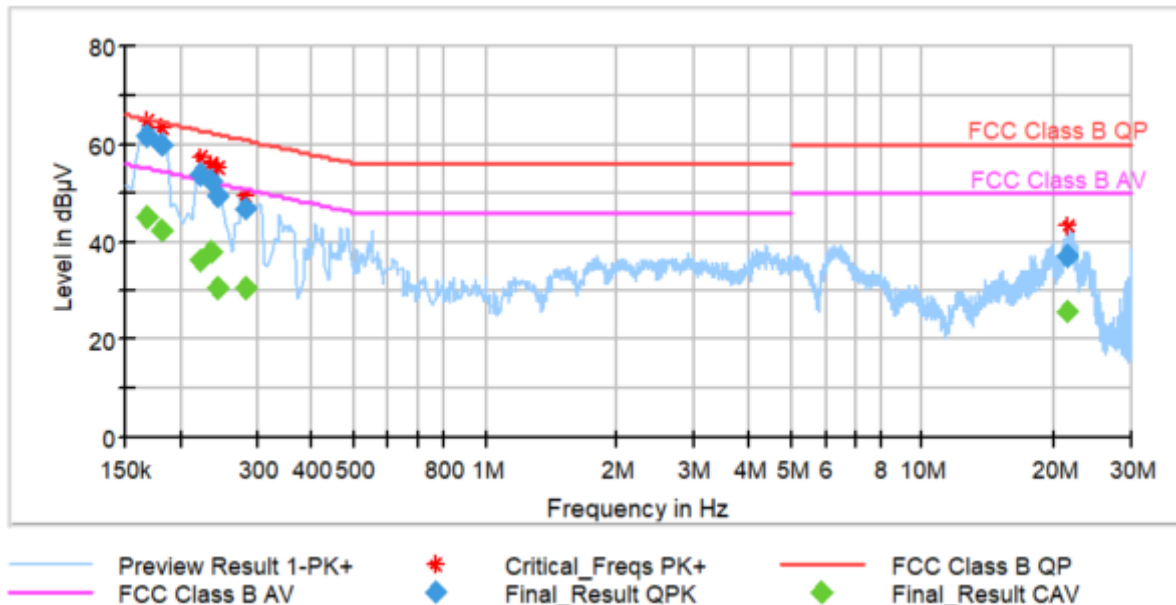
| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | PE  | Corr. (dB) |
|-----------------|------------------|-----------------|--------------|-------------|-----------------|-----------------|------|-----|------------|
| 0.154500        | 52.21            | ---             | 65.75        | 13.54       | 1000.0          | 9.000           | N    | GND | 20.1       |
| 0.154500        | ---              | 38.49           | 55.75        | 17.26       | 1000.0          | 9.000           | N    | GND | 20.1       |
| 0.177000        | 49.25            | ---             | 64.63        | 15.38       | 1000.0          | 9.000           | N    | GND | 20.1       |
| 0.177000        | ---              | 36.10           | 54.63        | 18.53       | 1000.0          | 9.000           | N    | GND | 20.1       |
| 0.208500        | ---              | 29.67           | 53.27        | 23.59       | 1000.0          | 9.000           | N    | GND | 20.1       |
| 0.208500        | 45.52            | ---             | 63.27        | 17.74       | 1000.0          | 9.000           | N    | GND | 20.1       |
| 0.402000        | 31.92            | ---             | 57.81        | 25.89       | 1000.0          | 9.000           | N    | GND | 20.1       |
| 0.402000        | ---              | 18.10           | 47.81        | 29.71       | 1000.0          | 9.000           | N    | GND | 20.1       |
| 1.851000        | 17.56            | ---             | 56.00        | 38.44       | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 1.851000        | ---              | 11.57           | 46.00        | 34.43       | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 18.627000       | ---              | 18.96           | 50.00        | 31.04       | 1000.0          | 9.000           | L1   | GND | 21.1       |
| 18.627000       | 25.38            | ---             | 60.00        | 34.62       | 1000.0          | 9.000           | L1   | GND | 21.1       |

– **Test laptop with active EUT (LAN Port):**



| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Limit (dBµV) | Margin (dB)  | Meas. Time (ms) | Bandwidth (kHz) | Line | PE  | Corr. (dB) |
|-----------------|------------------|-----------------|--------------|--------------|-----------------|-----------------|------|-----|------------|
| 0.168000        | ---              | 42.98           | 55.06        | <b>12.08</b> | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 0.168000        | 59.74            | ---             | 65.06        | <b>5.31</b>  | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 0.181500        | ---              | 42.77           | 54.42        | <b>11.65</b> | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 0.181500        | 58.60            | ---             | 64.42        | <b>5.82</b>  | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 0.226500        | ---              | 36.20           | 52.58        | <b>16.38</b> | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 0.226500        | 51.34            | ---             | 62.58        | <b>11.23</b> | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 0.235500        | ---              | 36.47           | 52.25        | <b>15.78</b> | 1000.0          | 9.000           | N    | GND | 20.1       |
| 0.235500        | 49.96            | ---             | 62.25        | <b>12.29</b> | 1000.0          | 9.000           | N    | GND | 20.1       |
| 0.244500        | ---              | 32.04           | 51.94        | <b>19.91</b> | 1000.0          | 9.000           | N    | GND | 20.1       |
| 0.244500        | 48.96            | ---             | 61.94        | <b>12.98</b> | 1000.0          | 9.000           | N    | GND | 20.1       |
| 0.276000        | ---              | 24.47           | 50.94        | <b>26.46</b> | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 0.276000        | 42.01            | ---             | 60.94        | <b>18.93</b> | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 4.375500        | 32.95            | ---             | 56.00        | <b>23.05</b> | 1000.0          | 9.000           | L1   | GND | 20.3       |
| 4.375500        | ---              | 25.30           | 46.00        | <b>20.70</b> | 1000.0          | 9.000           | L1   | GND | 20.3       |
| 21.435000       | 36.70            | ---             | 60.00        | <b>23.30</b> | 1000.0          | 9.000           | L1   | GND | 21.2       |
| 21.435000       | ---              | 25.48           | 50.00        | <b>24.52</b> | 1000.0          | 9.000           | L1   | GND | 21.2       |

– **Test laptop with inactive EUT (LAN Port):**



| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Limit (dBµV) | Margin (dB)  | Meas. Time (ms) | Bandwidth (kHz) | Line | PE  | Corr. (dB) |
|-----------------|------------------|-----------------|--------------|--------------|-----------------|-----------------|------|-----|------------|
| 0.168000        | ---              | 45.03           | 55.06        | <b>10.03</b> | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 0.168000        | 61.85            | ---             | 65.06        | <b>3.21</b>  | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 0.181500        | ---              | 42.38           | 54.42        | <b>12.03</b> | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 0.181500        | 60.03            | ---             | 64.42        | <b>4.39</b>  | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 0.222000        | ---              | 36.46           | 52.74        | <b>16.28</b> | 1000.0          | 9.000           | N    | GND | 20.1       |
| 0.222000        | 53.74            | ---             | 62.74        | <b>9.01</b>  | 1000.0          | 9.000           | N    | GND | 20.1       |
| 0.235500        | ---              | 38.11           | 52.25        | <b>14.14</b> | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 0.235500        | 52.37            | ---             | 62.25        | <b>9.89</b>  | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 0.244500        | ---              | 30.51           | 51.94        | <b>21.43</b> | 1000.0          | 9.000           | N    | GND | 20.1       |
| 0.244500        | 49.40            | ---             | 61.94        | <b>12.54</b> | 1000.0          | 9.000           | N    | GND | 20.1       |
| 0.280500        | ---              | 30.79           | 50.80        | <b>20.01</b> | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 0.280500        | 46.89            | ---             | 60.80        | <b>13.91</b> | 1000.0          | 9.000           | L1   | GND | 20.1       |
| 21.502500       | ---              | 25.63           | 50.00        | <b>24.37</b> | 1000.0          | 9.000           | L1   | GND | 21.2       |
| 21.502500       | 37.02            | ---             | 60.00        | <b>22.98</b> | 1000.0          | 9.000           | L1   | GND | 21.2       |

|                     |               |
|---------------------|---------------|
| Test Cables used    | KISN2         |
| Test equipment used | 272, 551, 665 |

|                                          |     |    |                  |
|------------------------------------------|-----|----|------------------|
| The equipment passed the conducted tests | Yes | No | <del>Not</del> * |
|------------------------------------------|-----|----|------------------|

|                                               |     |    |            |
|-----------------------------------------------|-----|----|------------|
| Test setup photos / test results are attached | Yes | No | Annex no.: |
|-----------------------------------------------|-----|----|------------|

### 8.3 Restricted bands of operation

#### 8.2.1 Regulation

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz                        | MHz                   | MHz             | GHz              |
|----------------------------|-----------------------|-----------------|------------------|
| 0.090 - 0.110              | 16.42 - 16.423        | 399.9 - 410     | 4.5 - 5.15       |
| <sup>1</sup> 0.495 - 0.505 | 16.69475 - 16.69525   | 608 - 614       | 5.35 - 5.46      |
| 2.1735 - 2.1905            | 16.80425 - 16.80475   | 960 - 1240      | 7.25 - 7.75      |
| 4.125 - 4.128              | 25.5 - 25.67          | 1300 - 1427     | 8.025 - 8.5      |
| 4.17725 - 4.17775          | 37.5 - 38.25          | 1435 - 1626.5   | 9.0 - 9.2        |
| 4.20725 - 4.20775          | 73 - 74.6             | 1645.5 - 1646.5 | 9.3 - 9.5        |
| 6.215 - 6.218              | 74.8 - 75.2           | 1660 - 1710     | 10.6 - 12.7      |
| 6.26775 - 6.26825          | 108 - 121.94          | 1718.8 - 1722.2 | 13.25 - 13.4     |
| 6.31175 - 6.31225          | 123 - 138             | 2200 - 2300     | 14.47 - 14.5     |
| 8.291 - 8.294              | 149.9 - 150.05        | 2310 - 2390     | 15.35 - 16.2     |
| 8.362 - 8.366              | 156.52475 - 156.52525 | 2483.5 - 2500   | 17.7 - 21.4      |
| 8.37625 - 8.38675          | 156.7 - 156.9         | 2690 - 2900     | 22.01 - 23.12    |
| 8.41425 - 8.41475          | 162.0125 - 167.17     | 3260 - 3267     | 23.6 - 24.0      |
| 12.29 - 12.293             | 167.72 - 173.2        | 3332 - 3339     | 31.2 - 31.8      |
| 12.51975 - 12.52025        | 240 - 285             | 3345.8 - 3358   | 36.43 - 36.5     |
| 12.57675 - 12.57725        | 322 - 335.4           | 3600 - 4400     | ( <sup>2</sup> ) |
| 13.36 - 13.41              |                       |                 |                  |

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup> Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e), regardless of the field strength limits specified elsewhere in this Subpart, the provisions of this Section apply to emissions from any intentional radiator.

(d) The following devices are exempt from the requirements of this Section:

(1) Swept frequency field disturbance sensors operating between 1.705 and 37 MHz provided their emissions only sweep through the bands listed in paragraph (a), the sweep is never stopped with the fundamental emission within the bands listed in paragraph (a), and the fundamental emission is outside of the bands listed in paragraph (a) more than 99% of the time the device is actively transmitting, without compensation for duty cycle.

EUT: PH1600

FCC ID: 2AKBZ-PH1600

FCC Title 47 CFR Part 15

Date of issue: 2022-02-22

(2) Transmitters used to detect buried electronic markers at 101.4 kHz which are employed by telephone companies.

(3) Cable locating equipment operated pursuant to Section 15.213.

(4) Any equipment operated under the provisions of § 15.253, § 15.255 or § 15.256 of this part.

(5) Biomedical telemetry devices operating under the provisions of Section 15.242 of this part are not subject to the restricted band 608-614 MHz but are subject to compliance within the other restricted bands.

(6) Transmitters operating under the provisions of Subpart D or F of this part.

(7) Devices operated pursuant to § 15.225 are exempt from complying with this section for the 13.36-13.41 MHz band only.

(8) Devices operated in the 24.075-24.175 GHz band under § 15.245 are exempt from complying with the requirements of this section for the 48.15-48.35 GHz and 72.225-72.525 GHz bands only, and shall not exceed the limits specified in § 15.245(b).

(9) Devices operated in the 24.0-24.25 GHz band under § 15.249 are exempt from complying with the requirements of this section for the 48.0-48.5 GHz and 72.0-72.75 GHz bands only, and shall not exceed the limits specified in § 15.249(a).

(10) White space devices operating under subpart H of this part are exempt from complying with the requirements of this section for the 608-614 MHz band.

(e) Harmonic emissions appearing in the restricted bands above 17.7 GHz from field disturbance sensors operating under the provisions of Section 15.245 shall not exceed the limits specified in Section 15.245(b).

## 8.2.2 Result

|                     |                                  |
|---------------------|----------------------------------|
| Test Cables used    | K60, K101, K119                  |
| Test equipment used | 23, 502, 660, 665, 667, 668, 669 |

|                                          |       |    |                  |
|------------------------------------------|-------|----|------------------|
| The equipment passed the conducted tests | Yes** | No | <del>Not</del> * |
|------------------------------------------|-------|----|------------------|

|                                               |     |    |             |
|-----------------------------------------------|-----|----|-------------|
| Test setup photos / test results are attached | Yes | No | Annex no.:6 |
|-----------------------------------------------|-----|----|-------------|

**\*\*All emissions fall under restricted band are included in the clause 8.4 and are marked blue!**

## 8.4 Radiated emission limits

### 8.4.1 Regulation

The device operating in the frequency band 13.110-14.010, the field strength of any emission shall not exceed the following limits.

| Frequency                           | Field Strength | Measurements Distance |
|-------------------------------------|----------------|-----------------------|
| MHz                                 | dBμV/m         | m                     |
| 13.553 - 13.567                     | 84             | 30                    |
| 13.410 - 13.553 and 13.567 - 13.710 | 50.5           | 30                    |
| 13.110 - 13.410 and 13.710 - 14.010 | 40.5           | 30                    |

- (a) Outside the band 13.110-14.010, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field Strength (microvolts/meter) | Measurement distance (meters) |
|-----------------|-----------------------------------|-------------------------------|
| 0.009-0.490     | 2400/F(kHz)                       | 300                           |
| 0.490-1.705     | 24000/F(kHz)                      | 30                            |
| 1.705-30.0      | 30                                | 30                            |
| 30-88           | 100**                             | 3                             |
| 88-216          | 150**                             | 3                             |
| 216-960         | 200**                             | 3                             |
| Above 960       | 500                               | 3                             |

\*\*Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 MHz, 76–88 MHz, 174–216 MHz or 470–806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

- (c) In the emission table above, the tighter limit applies at the band edges.

(d) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators, which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(e) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

(f) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

(g) In accordance with §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator

**EUT: PH1600****FCC ID: 2AKBZ-PH1600****FCC Title 47 CFR Part 15****Date of issue: 2022-02-22**

because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in §15.109 that are applicable to the incorporated digital device.

(h) Perimeter protection systems may operate in the 54–72 MHz and 76–88 MHz bands under the provisions of this section. The use of such perimeter protection systems is limited to industrial, business and commercial applications.

## 8.4.2 Test procedure

The EUT and this peripheral (when additional equipment exists) are placed on a turn table which is 0.8 m above the ground. The turn table would be allowed to rotate 360° to determine the position of the maximum emission level. The test distance between the EUT and the receiving antenna are 3m. To find the maximum emission, the polarization of the receiving antenna is changed in horizontal and vertical polarization; the position of the EUT was changed in different orthogonal determinations.

### ANSI C63.4-2014 Section 8 “Radiated Emissions Testing”

Measurement procedures for electric field radiated emissions from 9 kHz - 1 GHz & 1 GHz - 40 GHz are covered in Clause 8 of ANSI C63.4-2014. The ANSI C63.4-2014 measurement procedure consists of both an exploratory test and a final measurement. The exploratory test is critical to determine the frequency of all significant emissions. For each mode of operation required to be tested, the frequency spectrum is monitored. Variations in antenna height, antenna orientation, antenna polarization, EUT azimuth, and cable or wire placement is explored to produce the emission that has the highest amplitude relative to the limit.

The final measurements are made based on the findings in the exploratory testing. When making exploratory and final measurements it is necessary to maximize the measured radiated emission. Sub clause 8.3.2 of ANSI C63.4-2014 states that the measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” We consider the “cone of radiation” to be the 3 dB beam width of the measurement antenna.

While the “bore-sighting” technique is not explicitly mentioned in ANSI C63.4-2014, it is a useful technique for measurements using a directional antenna, such as a double-ridged waveguide antenna. Several precautions must be observed, including: knowledge of the beam width of the antenna and the resulting illumination area relative to the size of the EUT, estimation for source of the emission and general location within larger EUTs, measuring system sensitivity, etc.

ANSI C63.4-2014 requires that the measurement antenna is kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. That means that if the directional radiation pattern of the EUT results in a maximum emission at an upwards angle from the EUT, when a directional antenna is used to make the measurement it will be necessary for it to be pointed towards the source of the emission within the EUT. This can be done by either pointing the antenna at an angle towards the source of the emission, or by rotating the EUT, in both height and polarization, to maximize the measured emission. The emission must be kept within the illumination area of the 3 dB beamwidth of the antenna so that the maximum emission from the EUT is measured.

| Radiated Emissions Test Characteristics   |                                             |
|-------------------------------------------|---------------------------------------------|
| Frequency range                           | 30 MHz - 1,000 MHz                          |
| Test distance                             | 10 m, 3 m*                                  |
| Test instrumentation resolution bandwidth | 9 kHz (20 kHz – 30 MHz)                     |
|                                           | 120 kHz (30 MHz – 1.000 MHz)                |
| Receive antenna height                    | 1 m (20 kHz – 30 MHz)                       |
| Receive antenna polarization              | 0° or 90° (20 kHz – 30 MHz)                 |
| Receive antenna scan height               | 1 m - 4 m (30 MHz – 1.000 MHz)              |
| Receive antenna polarization              | Vertical or Horizontal (30 MHz – 1.000 MHz) |

EUT: PH1600

FCC ID: 2AKBZ-PH1600

FCC Title 47 CFR Part 15

Date of issue: 2022-02-22

\* According to Section 15.31 (f) (1): At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

### 8.4.3 Calculation of the field strength

The field strength is calculated by the following calculation:

Corrected Level = Receiver Level + Correction Factor (without the use of a pre-amplifier)

Corrected Level = Receiver Level + Correction Factor – Pre-amplifier (with the use of a pre-amplifier)

Receiver Level : Receiver reading without correction factors

Correction Factor : Antenna factor + cable loss

For example:

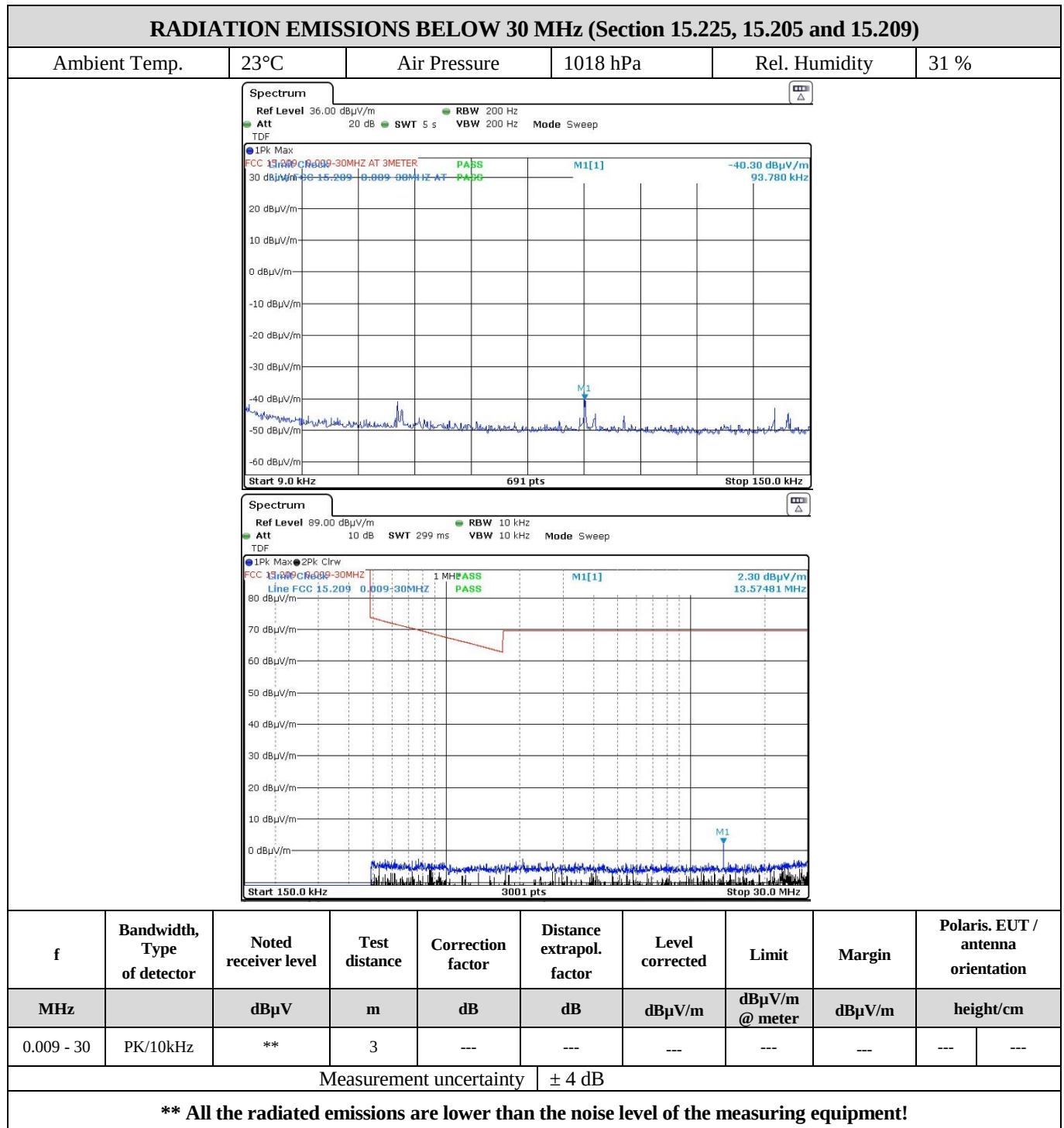
The receiver reading is 32.7 dBμV. The antenna factor for the measured frequency is +2.5 dB (1/m) and the cable factor for the measured frequency is 0.71 dB, giving a field strength of 35.91dBμV/m.

The 35.91dBμV/m value can be mathematically converted to its corresponding level in μV/m.

Level in μV/m = Common Antilogarithm (35.91/20) = 62.44

For test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f) (1) the field strength is calculated by adding additionally an extrapolation factor of 20 dB/decade (inverse linear distance for field strength measurements).

## 8.4.4 Result



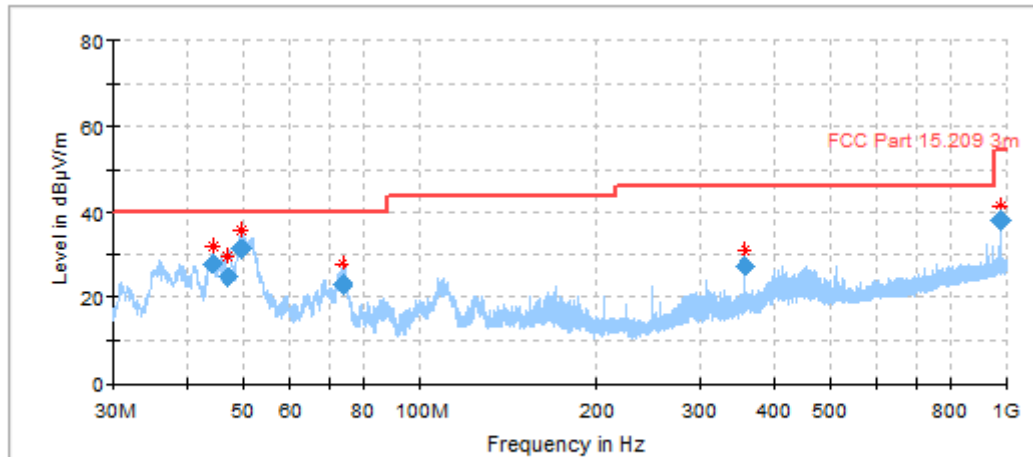
|                     |                   |
|---------------------|-------------------|
| Test Cables used    | K12a, K60, K102   |
| Test equipment used | 23, 660, 502, 665 |

|                                          |     |    |                  |
|------------------------------------------|-----|----|------------------|
| The equipment passed the conducted tests | Yes | No | <del>N.t.*</del> |
|------------------------------------------|-----|----|------------------|

|                                               |     |    |             |
|-----------------------------------------------|-----|----|-------------|
| Test setup photos / test results are attached | Yes | No | Annex no.:6 |
|-----------------------------------------------|-----|----|-------------|

**RADIATION EMISSIONS ABOVE 30 MHz (Section 15.225, 15.205 and 15.209)**

Ambient Temp. 23°C Air Pressure 1018 hPa Rel. Humidity 31 %



\* Preview Result 2-AVG Critical\_Freqs PK+ Preview Result 1-PK+ FCC Part 15.209 3m Critical\_Freqs AVG Final\_Result QPK

| f                       | Bandwidth, Type of detector | Noted receiver level | Test distance | Correction factor | Distance extrapol. factor | Level corrected | Limit          | Margin | Polaris. EUT / antenna orientation |        |
|-------------------------|-----------------------------|----------------------|---------------|-------------------|---------------------------|-----------------|----------------|--------|------------------------------------|--------|
| MHz                     |                             | dBµV                 | m             | dB                | dB                        | dBµV/m          | dBµV/m @ meter | dBµV/m | height/cm                          |        |
| 44.3                    | 120,QPK                     | 13.7                 | 3             | 14.1              | 0                         | 0               | 27.8           | 40.00  | 12.2                               | 255°/V |
| 47.0                    | 120,QPK                     | 10.7                 | 3             | 14.3              | 0                         | 0               | 25.0           | 40.00  | 15.0                               | 329°/V |
| 49.7                    | 120,QPK                     | 17.2                 | 3             | 14.3              | 0                         | 0               | 31.5           | 40.0   | 8.5                                | 329°/V |
| 73.7                    | 120,QPK                     | 11.7                 | 3             | 11.7              | 0                         | 0               | 23.4           | 40.0   | 16.6                               | 108°/H |
| 359.3                   | 120,QPK                     | 11.4                 | 3             | 16.2              | 0                         | 0               | 27.6           | 46.0   | 18.4                               | 21°/H  |
| 975.1                   | 120,QPK                     | 11.5                 | 3             | 26.7              | 0                         | 0               | 38.2           | 54.0   | 15.8                               | 20°/H  |
| Measurement uncertainty |                             |                      |               |                   | ± 4 dB                    |                 |                |        |                                    |        |

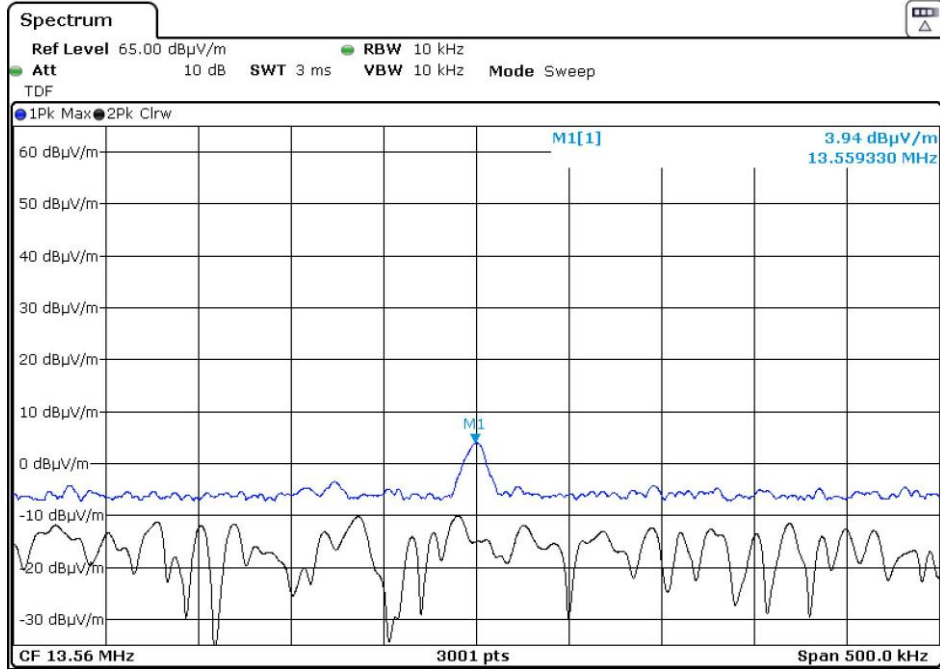
|                     |                              |
|---------------------|------------------------------|
| Test Cables used    | K12a, K60, K102              |
| Test equipment used | 406, 660, 665, 667, 668, 669 |

|                                          |     |    |     |
|------------------------------------------|-----|----|-----|
| The equipment passed the conducted tests | Yes | No | Not |
|------------------------------------------|-----|----|-----|

|                                               |     |    |             |
|-----------------------------------------------|-----|----|-------------|
| Test setup photos / test results are attached | Yes | No | Annex no.:6 |
|-----------------------------------------------|-----|----|-------------|

**FUNDAMENTAL EMISSION (Section 15.225, 15.205 and 15.209)**

|               |      |              |          |               |      |
|---------------|------|--------------|----------|---------------|------|
| Ambient Temp. | 23°C | Air Pressure | 1018 hPa | Rel. Humidity | 31 % |
|---------------|------|--------------|----------|---------------|------|



| f                              | Bandwidth, Type of detector | Noted receiver level | Test distance | Correction factor | Distance extrapol. factor | Level corrected | Limit          | Margin | Polaris. EUT / antenna orientation |     |
|--------------------------------|-----------------------------|----------------------|---------------|-------------------|---------------------------|-----------------|----------------|--------|------------------------------------|-----|
| MHz                            |                             | dBμV                 | m             | dB                | dB                        | dBμV/m          | dBμV/m @ meter | dBμV/m | height/cm                          |     |
| 13.560                         | PK/10kHz                    | 3.7                  | 3             | 18.9              | 19.1                      | 3.9             | 84.0 @ 30      | 80.1   | 0°/3°                              | 123 |
| Measurement uncertainty ± 4 dB |                             |                      |               |                   |                           |                 |                |        |                                    |     |

|                     |                   |
|---------------------|-------------------|
| Test Cables used    | K12a, K60, K102   |
| Test equipment used | 23, 660, 502, 665 |

|                                          |     |    |       |
|------------------------------------------|-----|----|-------|
| The equipment passed the conducted tests | Yes | No | N.t.* |
|------------------------------------------|-----|----|-------|

|                                               |     |    |             |
|-----------------------------------------------|-----|----|-------------|
| Test setup photos / test results are attached | Yes | No | Annex no.:6 |
|-----------------------------------------------|-----|----|-------------|

## 8.5 Frequency tolerance

### 8.5.1 Regulation

The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01$  % of the operating frequency over a temperature variation of  $-20$  °C to  $+55$  °C at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of  $20$  °C.

### 8.5.2 Test procedures

#### Stability with respect to ambient temperature:

Supply the EUT with nominal ac voltage, or install a new or fully charged battery in the EUT. If possible, a dummy load should be connected to the EUT, because an antenna near the metallic walls of an environmental test chamber could affect the output frequency of the EUT. If the EUT is equipped with a permanently attached, adjustable-length antenna, the EUT should be placed in the center of the chamber with the antenna adjusted to the shortest length possible. Turn the EUT on, and tune it to one of the number of frequencies required

Couple the intentional radiator output to the measuring instrument by connecting an antenna to the measurement instrument with a suitable length of coaxial cable and placing the measurement antenna near the EUT (e.g., 15 cm away) or by connecting a dummy load to the measuring instrument through an attenuator, if necessary.

Supply the EUT with nominal ac voltage, or install a new or fully charged battery in the EUT. Turn the EUT on, and couple its output to the measuring instrument by connecting an antenna to the measurement instrument with a suitable length of coaxial cable.

Adjust the location of the measurement antenna and the controls on the measuring instrument to obtain a suitable signal level (i.e., a level that will not overload the measuring instrument, but is strong enough to allow measurement of the operating or fundamental frequency of the EUT).

Tune the EUT to any one of the number of frequencies specified. Turn the EUT off, and place it inside an environmental chamber if appropriate. Allow the chamber to stabilize at  $+20$  °C before proceeding. Turn on the EUT, and record the operating frequency of the intentional radiator at startup and two, five, and ten minutes after startup. Turn the EUT off and allow it to cool to the ambient temperature, and then repeat this procedure for the number of the frequencies specified. Four measurements are made at each operating frequency.

Stability with respect to input voltage:

Supply the EUT with nominal ac voltage, or install a new or fully charged battery in the EUT. If possible, a dummy load should be connected to the EUT, because an antenna near the metallic walls of an environmental test chamber could affect the output frequency of the EUT. If the EUT is equipped with a permanently attached, adjustable-length antenna, the EUT should be placed in the center of the chamber with the antenna adjusted to the shortest length possible. Turn the EUT on, and tune it to one of the number of frequencies required.

Couple the intentional radiator output to the measuring instrument by connecting an antenna to the measurement instrument with a suitable length of coaxial cable and placing the measurement antenna near the EUT (e.g., 15 cm away) or by connecting a dummy load to the measuring instrument through an attenuator, if necessary.

Adjust the location of the measurement antenna and the controls on the measuring instrument to obtain a suitable signal level (i.e., a level that will not overload the measuring instrument, but is strong enough to allow measurement of the operating or fundamental frequency of the EUT). Turn the EUT off, and place it inside an environmental temperature chamber. For devices that are normally operated continuously, the EUT may be energized while inside the test chamber. For devices that have oscillator heaters, energize only the heater circuit while the EUT is inside the chamber.

Set the temperature control on the chamber to the highest specified EUT operating temperature, and allow the temperature inside the chamber to stabilize at the set temperature before starting frequency measurements.

While maintaining a constant temperature inside the environmental chamber, turn the EUT on and record the operating frequency at startup and two, five, and ten minutes after the EUT is energized. Four measurements in total are made.

Repeat the above procedure until the number of frequencies specified has been measured. After all measurements have been made at the highest specified temperature, turn the EUT off. Repeat the above measurement process for the EUT with the test chamber set at the lowest temperature specified by the regulatory or procuring agency. Measurements shall be made at the number of frequencies specified.

### 8.5.3 Result

| Frequency tolerance (Section 15.225) |                          |                      |      |
|--------------------------------------|--------------------------|----------------------|------|
| Test conditions                      | Frequency Measured (MHz) | Frequency Error      |      |
| T <sub>nom</sub> = +20° C            |                          | (kHz)                | ppm  |
| V <sub>min</sub> = 102 V AC          | 13.559416                | 0.584                | 43.1 |
| V <sub>nom</sub> = 120 V AC          | 13.559416                | 0.584                | 43.1 |
| V <sub>max</sub> = 138 V AC          | 13.559416                | 0.584                | 43.1 |
| Maximum Frequency error              |                          | 0.584                | 43.1 |
| Measurement uncertainty              |                          | ± 5*10 <sup>-8</sup> |      |

| Frequency tolerance (Section 15.225) |                          |                     |      |
|--------------------------------------|--------------------------|---------------------|------|
| Test conditions                      | Frequency Measured (MHz) | Frequency Error     |      |
| V <sub>nom</sub> = 120 V AC          |                          | (kHz)               | ppm  |
| T <sub>min</sub> -20 °C              | 13.559466                | 0.534               | 39.4 |
| T <sub>min</sub> -10 °C              | 13.559461                | 0.539               | 39.7 |
| T <sub>min</sub> 0 °C                | 13.559449                | 0.551               | 40.6 |
| T <sub>min</sub> +10 °C              | 13.559437                | 0.563               | 41.5 |
| T <sub>min</sub> +20 °C              | 13.559416                | 0.584               | 43.1 |
| T <sub>min</sub> +30 °C              | 13.559293                | 0.707               | 52.2 |
| T <sub>min</sub> +40 °C              | 13.559287                | 0.713               | 52.6 |
| T <sub>min</sub> +50 °C              | 13.559285                | 0.715               | 52.7 |
| Maximum frequency error              |                          | 0.715               | 52.7 |
| Measurement uncertainty              |                          | ±5*10 <sup>-8</sup> |      |

|                     |                              |
|---------------------|------------------------------|
| Test Cables used    | K102                         |
| Test equipment used | 102a, 502, 432, test fixture |

|                                          |     |    |                  |
|------------------------------------------|-----|----|------------------|
| The equipment passed the conducted tests | Yes | No | <del>Not</del> * |
|------------------------------------------|-----|----|------------------|

|                                               |     |    |            |
|-----------------------------------------------|-----|----|------------|
| Test setup photos / test results are attached | Yes | No | Annex no.: |
|-----------------------------------------------|-----|----|------------|

## 8.6 Bandwidth (20 dB)

### 8.6.1 Regulation

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

### 8.6.2 Calculation of the 20 dB bandwidth limit

**Within the specified band!**

### 8.6.3 Test procedure

#### ANSI C63.10-2013 Section 6.9.3 Occupied bandwidth measurements.

The occupied bandwidth is measured as the width of the spectral envelope of the modulated signal, at an amplitude level reduced from a reference value by a specified ratio (or in decibels, a specified number of dB down from the reference value). Typical ratios, expressed in dB, are -6 dB, -20 dB, and -26 dB, corresponding to 6 dB BW, 20 dB BW, and 26 dB BW, respectively. In this sub-clause, the ratio is designated by “-xx dB.” The reference value is either the level of the unmodulated carrier or the highest level of the spectral envelope of the modulated signal, as stated by the applicable requirement. Some requirements might specify a specific maximum or minimum value for the “-xx dB” bandwidth; other requirements might specify that the “-xx dB” bandwidth be entirely contained within the authorized or designated frequency band.

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.

c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than  $[10 \log (OBW/RBW)]$  below the reference level. Specific guidance is given in 4.1.5.2.

d) Steps a) through c) might require iteration to adjust within the specified tolerances.

e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target “-xx dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.

f) Set detection mode to peak and trace mode to max hold.

EUT: PH1600      FCC ID: 2AKBZ-PH1600      FCC Title 47 CFR Part 15      Date of issue: 2022-02-22

g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyser marker to the highest level of the displayed trace (this is the reference value).

h) Determine the “-xx dB down amplitude” using [(reference value) – xx]. Alternatively, this calculation may be made by using the marker-delta function of the instrument.

i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum Analyser and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).

j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the “- xx dB down amplitude” determined in step h). If a marker is below this “-xx dB down amplitude” value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the “-xx dB down amplitude” determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.

k) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labelled. Tabular data may be reported in addition to the plot(s).

#### 8.6.4 Result

**The measured 20 dB bandwidth: 0.39561 kHz**

**The measured 99% bandwidth: 0.37624 kHz**

|                     |                              |
|---------------------|------------------------------|
| Test Cables used    | K102                         |
| Test equipment used | 102a, 502, 432, test fixture |

|                                          |     |    |       |
|------------------------------------------|-----|----|-------|
| The equipment passed the conducted tests | Yes | No | N.t.* |
|------------------------------------------|-----|----|-------|

|                                               |     |    |             |
|-----------------------------------------------|-----|----|-------------|
| Test setup photos / test results are attached | Yes | No | Annex no.:3 |
|-----------------------------------------------|-----|----|-------------|

## 9. Additional information to the test report

| Remark            | Description                                             |
|-------------------|---------------------------------------------------------|
| N.t. <sup>1</sup> | Not tested, because the antenna is part of the PCB      |
| N.t. <sup>2</sup> | Not tested, because the EUT is directly battery powered |
| N.t. <sup>3</sup> | Not tested, because not applicable to the EUT           |
| N.t. <sup>4</sup> | Not tested, because not ordered                         |

## 10. List of test equipment

| State<br>Jun. 23, 2021                        |                 |                    |                |                |         |
|-----------------------------------------------|-----------------|--------------------|----------------|----------------|---------|
| Marking                                       | Manufacturer    | SW/Type/Serial-No. | Last Cal./Val. | Next Cal./Val. | No.     |
| <b>1 Measuring Instruments</b>                |                 |                    |                |                |         |
| Attenuator                                    | Radiall         | ---                | Nov 19         | Nov 22         | 62      |
| Attenuator 3dB                                | Suhner          | 6803/17            | Nov 19         | Nov 22         | 137     |
| Attenuator 3dB / 18 GHz                       | Suhner          | 3dB/18GHz          | Nov 19         | Nov 22         | 299     |
| Terminator                                    | Texcan          | ---                | Nov 19         | Nov 22         | 304     |
| Attenuator 6dB / 18 GHz                       | Suhner          | 6dB/18GHz          | Nov 19         | Nov 22         | 344     |
| Attenuator 20dB / 20GHz                       | Parzich         | 40AH-20            | Nov 19         | Nov 22         | 354     |
| Terminator                                    | KDI             | T173CS             | Nov 19         | Nov 22         | 490     |
| Variable transformer                          | RFT             | LS 002             | ---            | ---            | 154a    |
| Variable transformer                          | Schunt+Ben      | ---                | ---            | ---            | 155     |
| Power sensor                                  | Marconi         | 6914               | Sep 20         | Sep 22         | 258     |
| Power sensor                                  | Marconi         | 6913               | Aug 19         | Aug 21         | 286     |
| Power sensor                                  | Rohde & Schwarz | NRP18SN            | Nov 19         | Nov 21         | 651     |
| 3-Path Diode Power Sensor<br>10 MHz to 8 GHz  | Rohde & Schwarz | NRP8S              | Oct 20         | Oct 22         | 663     |
| 3-Path Diode Power Sensor<br>10 MHz to 18 GHz | Rohde & Schwarz | NRP18S-20          | Oct 20         | Oct 22         | 664     |
| Coaxial Directional Coupler                   | Narda           | 3003-20            | Jan 21         | Jan 24         | 370/342 |
| Coaxial directional coupler                   | Mini Circuits   | ZFDC-20-5          | Mar 20         | Mar 22         | 434     |
| Coaxial directional coupler                   | Narda+Suhner    | ---                | Mar 20         | Mar 23         | 472/492 |
| Coaxial High Pass Filter                      | Mini circuits   | NHP-700            | Apr 21         | Apr 24         | 435     |
| Coaxial High Pass Filter                      | Mini circuits   | NHP-200            | Apr 21         | Apr 24         | 405     |
| Coaxial High Pass Filter                      | Mini circuits   | NHP-25+            | Apr 21         | Apr 24         | 455     |
| High Pass Filter                              | Mini circuits   | VHF-3500+          | Apr 21         | Apr 24         | 451     |
| High Pass Filter                              | Mini circuits   | VHF-1200+          | Apr 21         | Apr 24         | 452     |
| Bandpass Filter                               | Schomandl       | BN86871            | Nov 18         | Nov 21         | 66      |
| Bandpass Filter                               | Schomandl       | BN68673            | Nov 18         | Nov 21         | 67      |
| Low Pass Filter                               | Mini circuits   | SLP550             | Apr 21         | Apr 24         | 273     |
| Low Pass Filter                               | Mini circuits   | SLP550             | Apr 21         | Apr 24         | 274     |
| RF Current Probe 9 kHz – 30 MHz               | Rohde & Schwarz | ESH2-Z1            | Jun 18         | Jun 21         | 42      |
| Passive Test Probe – 9 kHz – 30 MHz           | TÜV NORD        | VDE 0876           | Apr 21         | Apr 24         | 45      |
| Coaxial Fixed Attenuator DC – 1 GHz           | Texscan         | HFP50/10           | Jul 20         | Jul 23         | 60      |
| 8 Wire Impedance Stabilisation Network        | Schwarzbeck     | CAT5 8158          | Nov 19         | Nov 21         | 71a     |
| T-Section - 50 W                              | Rohde & Schwarz | BN 42441/50        | Aug 18         | Aug 21         | 93      |
| RF Current Injection Clamp 0.15 – 1GHz        | Lüthi GmbH      | EM 101             | Nov 19         | Nov 22         | 156     |
| Absorbing Clamp MDS 30MHz – 1GHz              | Lüthi GmbH      | MDS-21             | Nov 19         | Nov 22         | 160     |
| Insertion Unit                                | Rohde & Schwarz | URV5-Z4            | Mai 19         | Mai 22         | 162     |
| Coaxial RF Termination - 0 – 1000 MHz         | Telewave Inc.   | TWL 35             | Nov 18         | Nov 21         | 164     |
| Coaxial RF Termination - 0 – 1000 MHz         | Telewave Inc.   | TWL 60             | Nov 18         | Nov 21         | 165     |
| Fixed Attenuator - DC – 1.5GHz                | Bird            | Mod/ 8343-060      | Apr. 20        | Apr. 23        | 177     |
| Rotary Step Attenuator DC – 2 GHz             | Texscan         | TA – 50            | Mar20          | Mar 22         | 184     |
| CDN up to 230 MHz                             | MEB             | KEN-M 2 /M 3       | Nov 19         | Nov 21         | 264     |
| Impulse limiter 10 dB                         | Rohde & Schwarz | ESH3 Z2            | Mai 19         | Mai 22         | 272     |
| Fixed Attenuator - DC – 18 GHz   30 dB        | MTS             | ---                | Nov 20         | Nov 23         | 275     |
| Fixed Attenuator - DC – 18 GHz   30 dB        | MTS             | ---                | Mar 20         | Mar 22         | 276     |
| Passive Probe - 9 kHz – 30 MHz   2.5 kΩ       | RFT             | TK 121             | Jun 20         | Jun 23         | 302     |
| Passive probe 1.5kΩ                           | Schwarzbeck     | TK 9416            | Oct 20         | Oct 23         | 621     |
| Termination Resistor 50 W                     | Radiall         | 404011             | Nov 18         | Nov 21         | 309     |
| Branching device (4x) 50W                     | Rohde & Schwarz | 892228/20          | Sep 19         | Sep 22         | 320     |
| Dummy-Load - 2 – 18 GHz                       | Narda           | MODEL 367NF        | Nov 19         | Nov 22         | 343     |
| DC Block Adapter - 0.045 – 26.5 GHz           | Hewlett-Packard | 11742A             | Apr 21         | Apr 24         | 356     |

|                                          |                       |                                                 |        |        |          |
|------------------------------------------|-----------------------|-------------------------------------------------|--------|--------|----------|
| Insertion Unit 10V   9 kHz 1000 MHz      | Rohde & Schwarz       | URV 5-Z2                                        | Mai 19 | Mai 22 | 367      |
| RF Probe 0.02 – 1000 MHz                 | Rohde & Schwarz       | 395.2680.02                                     | Mai 19 | Mai 22 | 368      |
| 150W attenuator                          | Weinschel             | 49-20-33                                        | Oct 19 | Oct 22 | 374      |
| Fixed Coaxial Attenuator - DC – 18 GHz   | Weinschel             | 23-6-34                                         | Feb 20 | Feb 23 | 375      |
| Insertion Unit 9 kHz – 2000 MHz          | Rohde & Schwarz       | URY-Z2                                          | Oct 19 | Oct 22 | 416      |
| Panoramic Adapter (Monitoring)           | Schwarzbeck           | PAN1550                                         | ---    | ---    | 429      |
| DC-BLOCK - DC – 6.0 GHz  50 W            | Mini Circuits         | BLK-6-N+                                        | Aug 18 | Aug 21 | 462      |
| Terminating resistor 50Ω SMA             | ---                   | ---                                             | Nov 19 | Nov 22 | 493      |
| Terminating resistor 50Ω SMA             | ---                   | SC 60-601-0000-31                               | Nov 19 | Nov 22 | 497      |
| Fixed Attenuator –0 – 40 GHz             | Anritsu               | 41KC-10                                         | Nov 19 | Nov 22 | 504      |
| Fixed Attenuator – 0 – 40 GHz            | Anritsu               | 41KC-10                                         | Nov 19 | Nov 22 | 505      |
| Fixed Attenuator – 0 – 40 GHz            | Anritsu               | 41KC-6                                          | Nov 19 | Nov 22 | 506      |
| Fixed Attenuator – 0 – 40 GHz            | Anritsu               | 41KC-3                                          | Nov 19 | Nov 22 | 507      |
| Electric Dummy Load                      | RA-NAV Lab.           | DA-75U                                          | ---    | ---    | 526      |
| Power Splitter / Combiner                | Mini Circuits         | ZESC-2-11                                       | Nov 19 | Nov 22 | 527      |
| 3 Way Power Splitter / Combiner          | Mini Circuits         | ZFSC-3-1                                        | Mar 20 | Mar 23 | 529      |
| 3 Way Power Splitter / Combiner          | Mini Circuits         | ZFSC-3-1                                        | Mar 20 | Mar 23 | 530      |
| RF-Attenuator - 6 dB                     | Haefely               | ---                                             | Mar 20 | Mar 23 | 540      |
| RF-Attenuator - 1– 120 MHz   12 dB       | Haefely               | ---                                             | Mar 20 | Mar 23 | 541      |
| RF-Attenuator - 1– 120 MHz   39 dB       | Haefely               | ---                                             | Mar 20 | Mar 23 | 542      |
| LISN 9kHz – 30 MHz                       | Schwarzbeck           | NNLA 8120                                       | Aug 20 | Aug 22 | 551      |
| HV Probe P6013A                          | Tektronix             | P6013A                                          | Mai 19 | Mai 22 | 559      |
| VLISN 5μH                                | Schwarzbeck           | 8125-1944                                       | Nov 19 | Nov 21 | 585      |
| VLISN 5μH                                | Schwarzbeck           | 8125-1945                                       | Nov 19 | Nov 21 | 586      |
| 20dB Attenuator, up to 18 GHz            | Mini Circuit          | BW-N20W5+                                       | Nov 19 | Nov 22 | 594      |
| Step Attenuator - DC-18 GHz   0 to 11 dB | Hewlett-Packard       | 8494B                                           | Nov 19 | Nov 22 | 604      |
| Analyser Reference System                | Spitzenberger & Spies | ARS 16/1                                        | Jan 20 | Jan 22 | 606a/b/c |
| Capacitive Coupling Clamp 5 kV           | Schlöder              | SFT 415                                         | Mai 20 | Mai 23 | 608      |
| RF Probes for 50 Ω Receivers             | Schwarzbeck           | TK 9416                                         | ---    | ---    | 612      |
| Current probe TRMS                       | BEHA APROB            | CHB35                                           | Oct 19 | Oct 22 | 652      |
| Semi Anechoic Chamber                    | COMTEST               | SAC-3m                                          | Apr 21 | Apr 23 | 660      |
| Maturo Turntable                         | Maturo                | TT2.0SI<br>(SN: TT2.05SI/817<br>SW: 1.0.0.4473) | ---    | ---    | 667      |
| Maturo Antenna Mast                      | Maturo                | TAM4.5-E-10kg<br>(SN: 10011/216/2588.01)        | ---    | ---    | 668      |
| Maturo Controller                        | Maturo                | FCU3.0/009/2588.01<br>(SN: 10014/2019)          | ---    | ---    | 669      |
| Current probe 20 Hz – 100 MHz            | Rohde & Schwarz       | EZ-17 (0816.2063.03)                            | Mar 20 | Mar 23 | 670      |
| Coupling Decoupling Network              | AMETEK                | CDN ST08A                                       | Aug 20 | Aug 23 | 762      |
| BONN HF Switch Matrix DC – 8 GHz         | BONN Elektronik       | BAS 0080-3                                      | ---    | ---    | 682      |
| External Directional Coupler             | BONN Elektronik       | BDC 1060-40/500                                 | Dec 20 | Dec 22 | 683      |
| BI-Directional Coax. Coup. 50-1000 MHz   | Narda                 | 3020A                                           | Jan 18 | Jan 22 | 141      |
| Vertical coupling plate                  | TÜV NORD HFT          | ---                                             | ---    | ---    | 265      |
| Measuring table                          | TÜV NORD HFT          | ---                                             | ---    | ---    | 106      |
| Data line coupling network               | EM Test AG            | CNV 504/ 508                                    | ---    | ---    | 285      |
| <b>2 Generators</b>                      |                       |                                                 |        |        |          |
| EFT/Burst Generator                      | Schlöder              | SFT 1400                                        | Mai 20 | Mai 22 | 46a      |
| Hybrid Generator                         | Schlöder              | CWG1500                                         | Nov 19 | Nov 21 | 522      |
| ESD Generator                            | Schlöder              | SESD 216                                        | Oct 19 | Oct 21 | 653      |
| Signal Generator                         | Rohde & Schwarz       | SMB100A                                         | Jul 20 | Jul 22 | 571      |
| RF Generator                             | Rohde & Schwarz       | SGT100A                                         | Apr 20 | Apr 22 | 636      |
| Signal Generator                         | Rohde & Schwarz       | SMG                                             | Jun 21 | Jun 23 | 136      |

|                  |         |               |                 |                 |     |
|------------------|---------|---------------|-----------------|-----------------|-----|
| Signal Generator | Marconi | 2042          | Mai 20          | Mai 22          | 6   |
| Signal Generator | Marconi | 2024          | Mai 20          | Mai 22          | 213 |
| Puls Generator   | EM Test | MPG 200       | Cal. before use | Cal. before use | 181 |
| Surge Generator  | H+H     | MIG063 IN S-T | Apr 21          | Apr 23          | 561 |

### 3. Antennas

|                                                    |                               |                 |                 |                 |         |
|----------------------------------------------------|-------------------------------|-----------------|-----------------|-----------------|---------|
| Loop Ant. 9kHz-30MHz                               | Schwarzbeck                   | FMZB1516        | Sep 19          | Sep 21          | 23      |
| Biconical Ant. 30-300 MHz                          | Schwarzbeck                   | VHA9103/BBA9106 | Apr 20          | Apr 22          | 80/616  |
| Double Ridged Horn                                 | Schwarzbeck                   | BBHA9120C       | Oct 19          | Oct 21          | 169     |
| Double Ridged Horn                                 | Schwarzbeck                   | BBHA 9120A      | Apr 20          | Apr 22          | 284     |
| Tri-Log Broadband                                  | Schwarzbeck                   | VULB9168        | Mai 21          | Mai 23          | 406     |
| Broadband Horn 14-40 GHz                           | Schwarzbeck                   | BBHA9170        | Nov 19          | Nov 21          | 442     |
| Log Per Antenna 0.7-20 GHz                         | Schwarzbeck                   | STLP9148        | Mai 21          | Mai 23          | 445a    |
| Bilog Ant.                                         | Schwarzbeck                   | CBL6111         | Cal. before use | Cal. before use | 167     |
| Balun with biconical BBA9106 (TX)                  | Schwarzbeck<br>[only for NSA] | VHBB9124        | Nov 19          | Nov 21          | 0796    |
| Balun with biconical BBA9106 (RX)                  | Schwarzbeck<br>[only for NSA] | VHBA9123        | Nov 19          | Nov 21          | 9758    |
| Log periodic Ant (TX)                              | Schwarzbeck<br>[only for NSA] | UHALP9108       | Nov 19          | Nov 21          | 9002    |
| Log periodic Ant (RX)                              | Schwarzbeck<br>[only for NSA] | UHALP9108       | Nov 19          | Nov 21          | 9003    |
| Spectrum analyser Mixer 220 – 325 GHz              | Radiometer Physics            | SAM325          | Aug 19          | Aug 21          | 591     |
| Dual Mode Potter Horn 220-325 GHz                  | Radiometer Physics            | 325-WR2         | ---             | ---             | 592     |
| Dual Mode Potter Horn 75-110 GHz                   | Radiometer Physics            | ---             | ---             | ---             | 649     |
| Gain Horn Antenna 50-75 GHz                        | Dorado                        | GH-15-20        | ---             | ---             | 511     |
| Standard Gain Horn 1.7 – 2.6 GHz                   | Narda                         | 645             | ---             | ---             | 514     |
| W-band active Sextupler with input drive amplifier | Spacek Labs Inc.              | AW-6XW-0        | ---             | ---             | 221a    |
| 60 to 65 GHz active frequency quadrupler           | Spacek Labs Inc.              | A625-4XW-0      | ---             | ---             | 222a    |
| Harmonic Mixer 40-60 GHz                           | Rohde & Schwarz               | FS-Z60          | Jul 19          | Jul 21          | 515     |
| Gain Horn Antenna 40-60 GHz                        | Dorado                        | GH-19-20        | ---             | ---             | 518     |
| Spectrum analyser Mixer 90-140 GHz                 | Radiometer Physics            | SAM140          | Aug 19          | Aug 21          | 545     |
| Dual Mode Potter Horn 90-140 GHz                   | Radiometer Physics            | 140-WR8         | ---             | ---             | 547     |
| Spectrum analyser Mixer 140-220GHz                 | Radiometer Physics            | SAM220          | Aug 19          | Aug 21          | 450     |
| Dual Mode Potter Horn 140-220 GHz                  | Radiometer Physics            | 220-WR5.1       | ---             | ---             | 548     |
| Harmonic Mixer 60-90 GHz                           | Rohde & Schwarz               | FS-Z90          | Jul 19          | Jul 21          | 501     |
| Dual Mode Potter Horn 60-90 GHz                    | Radiometer Physics            | 90-W12          | ---             | ---             | 549     |
| Gain Horn 33-55 GHz                                | Dorado                        | ---             | ---             | ---             | 383     |
| Gain Horn 50-75 GHz                                | Dorado                        | ---             | ---             | ---             | 384     |
| Gain Horn 75-110 GHz                               | Dorado                        | ---             | ---             | ---             | 385     |
| Standard Gain Ant. 26.5-40 GHz                     | Maury Microwave               | U211C           | ---             | ---             | 532/628 |
| Waveguide Harmonic Mixer 50 – 75 GHz               | Keysight                      | M1971V          | Oct 19          | Oct 21          | 763     |
| Waveguide Harmonic Mixer 75 – 110 GHz              | Keysight                      | M1971W          | Oct 19          | Oct 21          | 764     |
| Stacked Log.-Per. Antenna<br>70 MHz – 10 GHz       | Schwarzbeck                   | STLP 9129       | ---             | ---             | 662     |

### 4. Amplifier

|                                      |             |                                                 |        |        |      |
|--------------------------------------|-------------|-------------------------------------------------|--------|--------|------|
| RF-Power Amplifier 250 kHz – 150 MHz | ENI         | 3100LA                                          | ---    | ---    | ---  |
| RF pre-amplifier 100kHz-1.3GHz       | HP          | 8447E                                           | Aug 20 | Aug 22 | 166a |
| Mitteq amplifier 26.5-40 GHz         | Mitteq      | ---                                             | Mar 20 | Mar 22 | 223a |
| RF pre-amplifier 1-18GHz             | Narda       | ---                                             | Mar 20 | Mar 22 | 345  |
| Mitteq Amplifier 18-26GHz            | Mitteq      | ---                                             | Apr 20 | Apr 22 | 433  |
| Microwave amplifier 12-18GHz         | Schwarzbeck | BBV9719                                         | Mar 20 | Mar 22 | 443  |
| Microwave amplifier 0.5-18GHz        | Schwarzbeck | BBV9718                                         | Apr 21 | Apr 23 | 444  |
| RF-Power Amplifier 10kHz-1000 MHz    | Poetschke   | 8100 (Band 1)<br>BHED (Band 2)<br>BHED (Band 3) | ---    | ---    | 684  |

|                                                            |                       |                                                         |                 |                 |         |
|------------------------------------------------------------|-----------------------|---------------------------------------------------------|-----------------|-----------------|---------|
| RF-Power Amplifier 800 MHz – 4,2 GHz                       | Amplifier Research    | 10S1G4                                                  | ---             | ---             | 685     |
| RF-Power Amplifier 4 GHz – 8 GHz                           | Amplifier Research    | 35S4G8A                                                 | ---             | ---             | 686     |
| <b>5. Power supplies</b>                                   |                       |                                                         |                 |                 |         |
| Programmable Power Supply                                  | Fluke                 | PM 2813                                                 | ---             | ---             | 28a     |
| Power Supply                                               | HP                    | ---                                                     | ---             | ---             | 125     |
| Power Supply                                               | Sorensen              | LM 30-6                                                 | ---             | ---             | 134a    |
| Power Supply                                               | HP                    | 6034L                                                   | ---             | ---             | 226     |
| Regulated Power Supply                                     | Farnell               | AP60-50                                                 | ---             | ---             | 408     |
| Power Supply                                               | EA                    | PSI 8080-40-DT                                          | ---             | ---             | 560     |
| Power Supply                                               | HP                    | 6032A                                                   | ---             | ---             | 644     |
| <b>6. Meters</b>                                           |                       |                                                         |                 |                 |         |
| Microwave Frequency Counter                                | Hewlett-Packard       | 5351B                                                   | Nov 20          | Nov 22          | 432     |
| Temperature test cabinet                                   | Heraeus Vötsch        | VMT04/35                                                | ---             | ---             | 102a    |
| Temperature test cabinet                                   | Brabender             | TTE 32/40 H                                             | ---             | ---             | 87      |
| Digital-Hygro-Thermometer                                  | Greisinger            | GFTH95                                                  | Nov 19          | Nov 21          | 57a     |
| Volt & RF Power Meter                                      | Rohde & Schwarz       | URV35                                                   | Cal. before use | Cal. before use | 161     |
| Spectrum Analyzer - 9 kHz – 18 GHz                         | Rohde & Schwarz       | FSL18                                                   | Jul 20          | Jul 22          | 171a    |
| Multimeter                                                 | Gossen Metrawatt      | Metrahit pro                                            | Nov 19          | Nov 21          | 215a    |
| Humidity/Temperature Measuring device                      | TESTO                 | Testo 625                                               | Oct 19          | Oct 21          | 259a    |
| Volt & RF Power Meter                                      | Rohde & Schwarz       | URV35                                                   | Nov 19          | Nov 21          | 271     |
| Multimeter                                                 | Gossen Metrawatt      | Metrahit 26S                                            | Sep 20          | Sep 22          | 313     |
| Level and Power Meter - 9 kHz – 3 GHz                      | Rohde & Schwarz       | URY                                                     | Mar 20          | Mar 22          | 307     |
| Temperature test device                                    | Ahlhorn               | Almemo 2390-5 PT100                                     | Mar 20          | Mar 23          | 401/402 |
| Signal & Spectrum Analyser 10 Hz-30 GHz                    | Rohde & Schwarz       | FSV-30                                                  | Jul 19          | Jul 21          | 502     |
| Digital-Vacuum-/Barometer                                  | Greisinger            | GDH12AN                                                 | Oct 19          | Oct 21          | 558     |
| Temperature test cabinet                                   | Weiß Umwelttechnik    | WKL 34/40                                               | Aug 18          | Aug 21          | 562     |
| Digital Storage Oscilloscope                               | Tektronix             | TDS 2012C                                               | Oct 19          | Oct 21          | 568     |
| Miniature Flat, Zero-Biased Schottky Detector –0.1– 18 GHz | Narda                 | 4503A-03                                                | Val. bevor use  | Val. bevor use  | 613     |
| Digital-Vacuum-/Barometer                                  | Greisinger            | GDH-200-14                                              | Oct 19          | Oct 21          | 632     |
| EMI Test receiver ESW26                                    | Rohde & Schwarz       | R&S ESW26<br>(SN: 101383/26<br>SW: R&S ESW1.61))        | Nov 19          | Nov 21          | 665     |
| Signal analyser Keysight 50GHz                             | Keysight              | UXA N9040B<br>(SN: MY57213006<br>SW: A.24.58/2019.0702) | Nov 19          | Nov 21          | 666     |
| <b>7. test/control software</b>                            |                       |                                                         |                 |                 |         |
| EMC32                                                      | Rohde & Schwarz       | V10.60.20                                               | ---             | ---             | ---     |
| Maturo mcApp                                               | Maturo                | SW: V3.4.9.4537<br>(19.04.04)                           | ---             | ---             | ---     |
| SPS EMC                                                    | Spitzenberger & Spies | SW: V4.1.3                                              | ---             | ---             | ---     |
| EMV-Soft                                                   | Schlöder GmbH         | SW: V11.95                                              | ---             | ---             | ---     |
| ISMISO                                                     | EM Test AG            | SW:V3.63                                                | ---             | ---             | ---     |

## 11. Cable list

| Internal Cable Number | Connector Type | Frequency Range (MHz) | Cable Length (m) | Manufacturer           |
|-----------------------|----------------|-----------------------|------------------|------------------------|
| 4a                    | BNC            | 10 – 1500             | 0.50             | Telemeter              |
| 14a                   | BNC            | 10 – 1000             | 1.00             | Telemeter              |
| 17a                   | APC3.5         | 10 – 26500            | 2.13             | Huber + Suhner         |
| 18a                   | APC3.5         | 10 – 26500            | 2.13             | Huber + Suhner         |
| 22                    | BNC            | 10 – 1000             | 1.50             | ---                    |
| 27                    | BNC            | 10 – 1000             | 1.00             | Fabrica Milanese Cond. |
| 40                    | BNC            | ---                   | 0.50             | Aircell                |
| 43                    | SMA            | 10 – 18000            | 0.50             | Rosenberger            |
| 44                    | SMA            | ---                   | 0.50             | Huber + Suhner         |
| 45                    | SMA            | 10 – 18000            | 0.50             | Huber + Suhner         |
| 48                    | SMA            |                       | 0.50             | Huber + Suhner         |
| 49                    | N              | 10 – 18000            | 1.00             | Huber + Suhner         |
| 50                    | N              | 10 – 18000            | 1.00             | Huber + Suhner         |
| 51                    | N              | 10 – 18000            | 1.00             | Huber + Suhner         |
| 52                    | N              | 10 – 18000            | 1.00             | Huber + Suhner         |
| 54                    | BNC            | 10 – 3500             | 1.00             | Aircell                |
| 58                    | N              | 10 – 18000            | 2.00             | Huber + Suhner         |
| 59                    | N              | 10 – 18000            | 1.00             | Huber + Suhner         |
| 60                    | N              | 10 – 18000            | 2.00             | Huber + Suhner         |
| 61                    | N              | 10 – 18000            | 1.00             | Huber + Suhner         |
| 62                    | SMA            | ---                   | 0.50             | Huber + Suhner         |
| 63                    | SMA            | 10 – 18000            | 0.50             | Huber + Suhner         |
| 64                    | SMA            | 10 – 18000            | 0.50             | Huber + Suhner         |
| 65                    | APC3.5         | 10 – 26500            | 0.60             | ---                    |
| 66                    | APC3.5         | 10 – 26500            | 0.60             | ---                    |
| 67                    | APC3.5         | 10 – 26500            | 0.60             | ---                    |
| 68                    | APC3.5         | 10 – 26500            | 0.60             | ---                    |
| 72                    | BNC            | ---                   | 0.40             | ---                    |
| 73                    | BNC            | ---                   | 0.40             | ---                    |
| 76                    | SMA            | 10 – 30000            | 3.00             | Gore                   |
| 79                    | BNC/N          | 10 – 1000             | 5.00             | ---                    |
| 80                    | SMA            | ---                   | 0.25             | Huber + Suhner         |
| 87                    | SMA            | 10 – 18000            | 0.15             | Huber + Suhner         |
| 88                    | SMA            | 10 – 18000            | 0.15             | Huber + Suhner         |
| 89                    | SMA            | 10 – 18000            | 0.15             | Huber + Suhner         |
| 90                    | SMA            | 10 – 18000            | 0.15             | Huber + Suhner         |
| 91                    | SMA            | ---                   | 1.50             | Huber + Suhner         |
| 94                    | BNC            | ---                   | 1.10             | ---                    |
| 95                    | BNC            | ---                   | 0.80             | ---                    |
| 96                    | BNC            | ---                   | 0.80             | ---                    |
| 100                   | N              | 10 – 26500            | 6.00             | Rosenberg              |
| 101                   | N              | 10 – 18000            | 2.90             | Huber + Suhner         |
| 102                   | SMA            | 10 – 18000            | 2.00             | Huber + Suhner         |
| 111                   | BNC            | 10 – 1000             | 0.50             | ---                    |
| 112                   | BNC            | 10 – 1000             | 0.50             | ---                    |
| 114                   | SMA            | 10 – 18000            | 0.25             | Huber + Suhner         |
| 116                   | SMA            | 10 – 18000            | 0.25             | Huber + Suhner         |
| 119                   | N              | 10 – 20000            | 8.00             | Jyebao                 |
| 121                   | SMA            | 10 – 18000            | 1.50             | Huber + Suhner         |
| 122                   | SMA            | 10 – 18000            | 2.00             | Huber + Suhner         |
| 123                   | SMA            | 10 – 18000            | 2.00             | Huber + Suhner         |
| 145                   | SMA            | 10 – 26500            | 8.00             | Huber + Suhner         |
| 147                   | APC3.5         | 10 – 40000            | 1.50             | Jyebao                 |
| 148                   | APC3.5         | 10 – 40000            | 3.00             | Jyebao                 |

| Internal Cable Number | Connector Type | Frequency Range (MHz) | Cable Length (m) | Manufacturer    |
|-----------------------|----------------|-----------------------|------------------|-----------------|
| 151                   | SMA            | 10 – 18000            | 0.50             | Rosenberger     |
| 152                   | SMA            | 10 – 18000            | 0.50             | Rosenberger     |
| 154                   | BNC            | 10 – 1000             | 1.00             | ---             |
| 155                   | N/BNC          | ---                   | 0.85             | ---             |
| 157                   | BNC            | ---                   | 0.50             | ---             |
| 158                   | SMA            | 10 – 26500            | 2.00             | Huber + Suhner  |
| 160                   | SMA            | 10 – 18000            | 0.40             | Nortel Networks |
| 161                   | SMA            | 10 – 18000            | 1.00             | Huber + Suhner  |
| 162                   | APC35          | 10 – 26500            | 2.00             | Huber + Suhner  |
| 163                   | APC3.5         | 10 - 26500            | 2.00             | Huber + Suhner  |
| 164                   | APC3.5         | 10 – 26500            | 2.00             | Huber + Suhner  |
| 165                   | APC2.9         | 10 – 26500            | 2.00             | Huber + Suhner  |
| 166                   | APC3.5         | 10 – 40000            | ---              | ---             |
| 167                   | APC3.5         | 10 – 40000            | 1.00             | Jyebao          |
| 168                   | APC3.5         | 10 – 40000            | 1.00             | Jyebao          |
| 169                   | APC3.5         | 10 – 40000            | 1.00             | Jyebao          |
| 170                   | APC3.5         | 10 – 40000            | 1.00             | Jyebao          |
| 171                   | APC3.5         | 10 – 40000            | 1.00             | Jyebao          |
| 172                   | SAM            | ---                   | 0.90             | Huber + Suhner  |
| 173                   | APC            | 10 – 26500            | 2.00             | Huber + Suhner  |
| 174                   | APC            | 10 – 26500            | ---              | Huber + Suhner  |
| 175                   | SMA            | 10 – 18000            | 0.40             | Huber + Suhner  |
| 176                   | N-SMA          | 10 – 18000            | 0.50             | Huber + Suhner  |
| 188                   | N              | 10 – 18000            | 5.00             | Huber + Suhner  |
| EMV 1                 | BNC            | ---                   | 2.00             | Henn            |
| EMV 2                 | BNC            | 10 – 1000             | 2.00             | Henn            |
| EMV 4                 | BNC            | ---                   | 9.70             | Henn            |
| EMV 5                 | BNC            | ---                   | 3.80             | Henn            |
| EMV 6                 | BNC/N          | 10 – 1000             | 5.00             | Lüthi           |
| EMV 7                 | BNC            | 10 – 1000             | 1.50             | Henn            |
| EMV 8                 | BNC            | 10 – 1500             | 1.70             | Henn            |
| EMV 9                 | BNC            | 10 – 1000             | 1.70             | Henn            |
| EMV 11                | BNC            | ---                   | 5.20             | Hasselt         |
| EMV 12                | BNC            | 10 – 1000             | 2.40             | Hasselt         |
| EMV 13                | BNC            | 10 – 1000             | 4.10             | Hasselt         |
| EMV 14                | BNC            | 10 – 1000             | 2.50             | Hasselt         |
| EMV 15                | BNC            | ---                   | 0.90             | Henn            |
| EMV 16                | Fischer        | ---                   | 2.00             | ---             |
| EMV 18a               | Fischer        | ---                   | 1.00             | ---             |
| EMV 19a               | Fischer        | ---                   | 1.50             | ---             |
| KISN2                 | BNC            | 10 – 2000             | 4.80             | ---             |

**End of test report**