Test Report acc. to FCC Title 47 CFR Part 15
relating to
ecom GmbH
MODUL-AX5243_S

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

Deutsche Akkreditierungsstelle
D-PL-12053-01-00

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RELEVANT STANDARD	
Title	**47 - Telecommunication**
Part	**15 - Radio Frequency Devices**
Subpart	**Subpart C – Intentional Radiators – Section 15.249**
Measurement procedure	**ANSI C63.10-2013**

EQUIPMENT UNDER TEST (EUT)	
Equipment category	Emission analysis equipment
Trade name	ecom
Type designation	**MODUL-AX5243_S**
Serial no.	---
Variants	---

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1. Test results

Clause	Requirements headline	FCC Rule	Test result			Page Number
8.1	Antenna requirement	§15.203	**Pass**	~~Fail~~	~~N.t.*~~	9
8.2	Restricted bands of operation	§15.205	**Pass**	~~Fail~~	~~N.t.*~~	10 – 11
8.3	Conducted limits	§15.207	~~Pass~~	~~Fail~~	**N.t.**[3]	12 – 14
8.4	Radiated emission limits, general requirements	§15.209	**Pass**	~~Fail~~	~~N.t.*~~	15 – 20
8.5	Field strength of fundamental and harmonics	§15.249	**Pass**	~~Fail~~	~~N.t.*~~	21 – 25
8.6	Bandwidth	§15.249	**Pass**	~~Fail~~	~~N.t.*~~	26 – 27

* Not tested

The equipment passed all the conducted tests	**Yes**	~~No~~

Signature	Digital unterschrieben von Tariq Maqbool DN: cn=Tariq Maqbool, o=TUV NORD Hochfrequenztechnik GmbH Co.KG, ou=RF Engineer, email=kmaqbool@tuev-nord.de, c=DE Datum: 2018.08.24 10:40:18 +02'00'	Digital unterschrieben von Ralf Trepper DN: cn=Ralf Trepper, o=TÜV NORD Hochfrequenztechnik GmbH & Co. KG, ou=Labor, email=rtrepper@tuev-nord.de, c=DE Datum: 2018.08.24 10:35:34 +02'00'
Name	**Mr. Khawaja Tariq Maqbool**	**Mr. Ralf Trepper**
Designation	**RF Test Engineer**	**Laboratory-Manager**
Date of issue	**2018-08-16**	**2018-08-16**

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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 numbers of pages in this report is **32**.

The tests were carried out in a representative assembly and in accordance with the test methods and/or requirements stated in:

FCC Title 47 CFR Part 15 Subpart C & ANSI C63.10-2013

The sample of the product was received on:

- 2018-02-23

The tests were carried out in the following period of time:

- 2018-06-11 - 2018-08-07

3. Testing laboratory

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FCC Registration Number: 763407
FCC Designation Number: DE0012

Accredited by:

DAkkS Deutsche Akkreditierungsstelle GmbH
DAkkS accreditation number: D-PL-12053-01-00

4. Applicant

Company name	: ecom GmbH
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Country	: Germany
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Fax	: +49 (0) 2371 40305
Email	: s.fischer@ecom.de
Date of order	: 2018-07-05
References	: Mr. Siegfried Fischer

5. Product and product documentation

Samples of the following apparatus were submitted for testing:

Manufacturer	: ecom GmbH
Trademark	: ecom
Type designation	: MODUL-AX5243_S
Serial number	: ---
Hardware versions	: Ax 5243 V1
Variants	: ---
Software release	: ecom J2KNpro V3
Type of equipment	: Emission Analysis equipment
Power used	: 4.5 VDC
Frequency used	: 902.1 MHz, 904.1 MHz & 906.1 MHz
Generated or used frequencies	: 48 MHz (crystal), 902.1 MHz, 904.1 MHz & 906.1 MHz (carrier)
ITU emission class	: 10K3F1D
FCC ID	: R2ZEC5X43S

For issuing this report the following product documentation was used:

Title	Description	Version
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For issuing this report the following product documentation was used:

Description	Date	Identifications
External photographs of the **E**quipment **U**nder **T**est (EUT)	2018-08-16	Annex no. 1
Internal photographs of the **E**quipment **U**nder **T**est (EUT)	2018-08-16	Annex no. 2
Channel occupancy / bandwidth	2018-08-16	Annex no. 3
Label sample	2018-08-16	Annex no. 4
Functional description / User Manual	2018-08-16	Annex no. 5
Test setup photos	2018-08-16	Annex no. 6
Block diagram	2018-08-16	Annex no. 7
Operational description	2018-08-16	Annex no. 8
Schematics	2018-08-16	Annex no. 9
Parts list	2018-08-16	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: ---

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7. Operational description

7.1 EUT details

The EUT is a narrow-band transceiver module with antenna connector, which operates in the 902 – 928 MHz band.

7.2 EUT configuration

The EUT is configured via software (AX RadioLab V2.6c) provided by the manufacturer.

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: 4.5 V DC

In order to establish the maximum radiation, firstly, there have been viewed all orthogonal adjustments of the test samples, secondly the test ample 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.

Additionally, radiated emission measurements above 1 GHz are made using calibrated linearly polarized antennas, 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.

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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 Sections 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 Section 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

The EUT is tested using the following two antennas

1. λ/2 Antenna
2. Helix Antenna

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

Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.:2

N.t.* see clause: 9

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8.2 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:

Restricted bands of operation			
Frequency Band	**Frequency Band**	**Frequency Band**	**Frequency Band**
MHz	**MHz**	**MHz**	**GHz**
0.090 - 0.110	**16.42 - 16.423**	**399.9 - 410**	**4.5 - 5.15**
[1]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**	**([2])**
13.36 - 13.41	**---**	**---**	**---**
[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz. [2] 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.

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(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 in the frequency band 75-85 GHz, or § 15.257 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 § 15.245 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 § 15.245(b).

(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	K1a, K83, K40, K56, K51, K52, K120
Test equipment used	103, 23, 171a, 166a, 406, 445a, 345

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

Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.:6

** All emissions that falls under the restricted bands of operations are included in clause 8.4 and are maked blue.

N.t.* see clause: 9

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8.3 Conducted limits

8.3.1 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 µH /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.

Conducted Limits		
Frequency of Emission	**Quasi-Peak (QP)**	**Average (AV)**
MHz	**dBµV**	**dBµV**
0.15 - 0.5	66 to 56*	56 to 46*
0.5 - 5	56	46
5 -30	60	50
*Limit Decreases with the logarithm of the frequency		

(b) The limit shown 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 system 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 µV within the frequency band 535–1705 kHz, as measured using a 50 µH /50 Ω LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in §15.205, §15.209, §15.221, §15.223, 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 provisions for, the use of battery chargers which permit operating while charging, AC adapters 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.

8.3.2 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 C63.10-2013 Section 6.
Additional equipment must also be connected to a second LISN with the same specifications described in the above section (if required).

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8.3.3 Result

Conducted emissions (Section 15.207) - Tested with external AC power supply								
Tested Line	**Frequency**	**Bandwidth**	**QP Value**	**QP Limit**	**Margin**	**AV Value**	**AV Limit**	**Margin**
L1 / N	**MHz**	**kHz**	**dBµV**	**dBµV**	**dB**	**dBµV**	**dBµV**	**dB**
		9						
		9						
		9						
		9						
		9						
		9						
		9						
		9						
		9						
		9						
		9						
		9						
		9						
		9						
		9						
Measurement uncertainty < ± 2 dB								

Test Cables used	---
Test equipment used	---

The equipment passed the conducted tests	~~Yes~~	~~No~~	**N.t.**[3]

Test setup photos / test results are attached	~~Yes~~	**No**	Annex no.:

N.t.* see clause: 9

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Conducted emissions (Section 15.207) - Tested with a Laptop over USB / LAN port								
Tested Line	**Frequency**	**Bandwidth**	**QP Value**	**QP Limit**	**Margin**	**AV Value**	**AV Limit**	**Margin**
L1 / N	**MHz**	**kHz**	**dBµV**	**dBµV**	**dB**	**dBµV**	**dBµV**	**dB**
		9						
		9						
		9						
		9						
		9						
		9						
		9						
		9						
		9						
		9						
		9						
		9						
		9						
		9						
		9						
Measurement uncertainty < ± 2 dB								

Test Cables used	---
Test equipment used	---

The equipment passed the conducted tests	~~Yes~~	~~No~~	**N.t.**[3]

Test setup photos / test results are attached	~~Yes~~	**No**	Annex no.:

N.t.* see clause: 9

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8.4 Radiated emission limits, general requirements

8.4.1 Regulation

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Intentional radiator- radiated emission limits		
Frequency	**Field Strength**	**Measurement distance**
MHz	**µV / m**	**m**
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.		

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

(c) 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.

(d) 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.

(e) 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.

(f) In accordance with Section 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 because of the incorporation of a digital device. lf 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 Section 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 Section 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 Section 15.109 that are applicable to the incorporated digital device.

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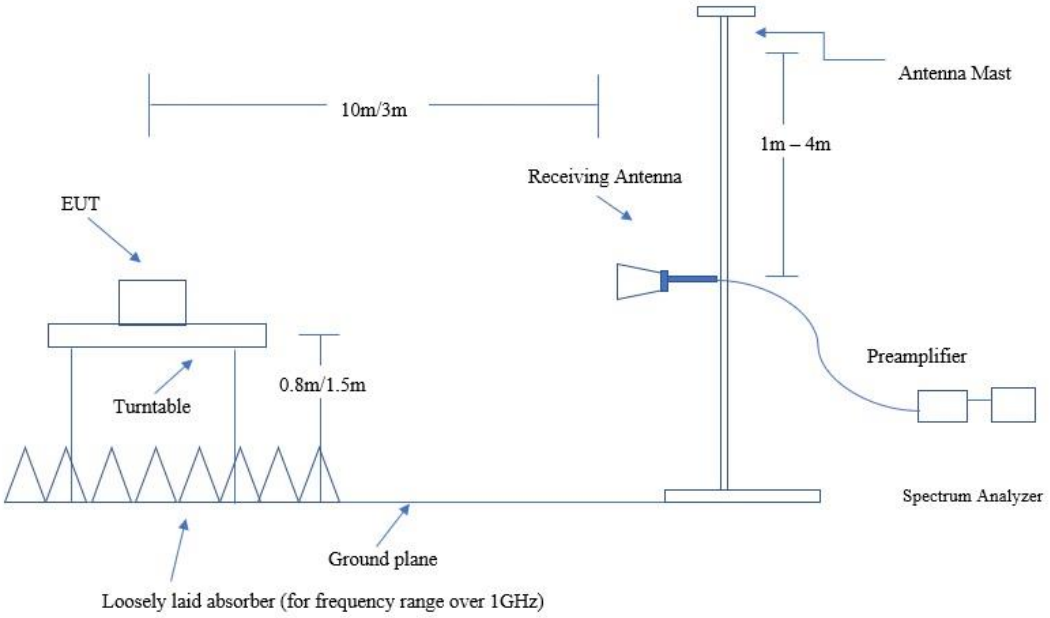
8.4.2 Test setup photo



8.4.3 Test procedure

The EUT and this peripheral (when additional equipment exists) are placed on a nonconducting platform with nominal top surface dimensions 1 m by 1.5 m turn table. For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. 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 is 3m above 30 MHz and is 10m within frequency range 9kHz to 30 MHz. 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.

Measurement procedures for electric field radiated emissions from frequency range within 9 kHz to 1 GHz & above 1 GHz are consisting 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. 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.

Bore-sighting technique is used 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.

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

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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 measurement above 1 GHz is made by placing loose-laid RF absorber material on the ground plane

Radiated emissions test characteristics	
Frequency range	9 kHz – 231 GHz
Test distance	10 m (below 30 MHz) 3 m* (above 30 MHz)
Test instrumentation minimum resolution bandwidth	9 kHz (Below 30 MHz)
	120 kHz (30 MHz - 1,000 MHz)
	1 MHz (Above 1000 MHz)
Detector Type	Quasi peak and Average based on frequency range
Receive antenna scan height	1 m - 4 m
Receive antenna polarization	Vertical/horizontal

* 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).

8.4.4 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

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. Measurements shall not be performed at a distance greater than 30 meters unless it can be further demonstrated that measurements at a

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distance of 30 meters or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

For example: Distance limit (d_{limit}) = 3, Distance measured ($d_{measured}$) = 1
Distance Extrapolation Factor (DEF) = 20 * log ($d_{limit}/d_{measured}$) = 20 * log (3/1) = 9.5

At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). This paragraph (f) shall not apply to Access BPL devices operating below 30 MHz.

For example: Distance limit (d_{limit}) = 300, Distance measured ($d_{measured}$) = 10
Distance Extrapolation Factor (DEF) = 40 * log ($d_{limit}/d_{measured}$) = 40 * log (300/10) = 59.1

Radiated emissions test characteristics	
Frequency range	9 kHz – Above 960 MHz
Test distance	3 m*
Test instrumentation minimum resolution bandwidth	9 kHz (Below 30 MHz)
	120 kHz (30 MHz - 1,000 MHz)
	1 MHz (Above 1000 MHz)
Detector Type	Quasi peak and Average based on frequency range
Receive antenna scan height	1 m - 4 m
Receive antenna polarization	Vertical/horizontal

* 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).

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8.4.5 Result

Transmitter spurious radiation below 30 MHz (Section 15.205 and 15.209) – λ/2 Antenna & Helix Antenna										
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/m**	
0.250	QPK/9.0kHz	< 4.0	10	20.2	-59.1	-34.9	19.6 @ 300	54.5	V, H/0-360°	1-4
0.375	QPK/9.0kHz	< 4.0	10	20.2	-59.1	-34.9	16.1 @ 300	51.0	V, H/0-360°	1-4
0.500	QPK/9.0kHz	< 4.0	10	20.2	-19.1	5.1	33.6 @ 30	28.5	V, H/0-360°	1-4
0.625	QPK/9.0kHz	< 4.0	10	20.2	-19.1	5.1	31.7 @ 30	26.6	V, H/0-360°	1-4
0.750	QPK/9.0kHz	< 4.0	10	20.2	-19.1	5.1	30.1 @ 30	25.0	V, H/0-360°	1-4
0.875	QPK/9.0kHz	< 4.0	10	20.2	-19.1	5.1	28.6 @ 30	23.5	V, H/0-360°	1-4
1.000	QPK/9.0kHz	< 4.0	10	20.2	-19.1	5.1	27.6 @ 30	22.5	V, H/0-360°	1-4
1.250	QPK/9.0kHz	< 4.0	10	20.2	-19.1	5.1	25.6 @ 30	28.5	V, H/0-360°	1-4
1.500	QPK/9.0kHz	< 4.0	10	20.2	-19.1	5.1	24.1 @ 30	19.0	V, H/0-360°	1-4
3.000	QPK/9.0kHz	< 4.0	10	20.2	-19.1	5.1	29.5 @ 30	24.4	V, H/0-360°	1-4
5.000	QPK/9.0kHz	< 4.0	10	20.2	-19.1	5.1	29.5 @ 30	24.4	V, H/0-360°	1-4
30.000	QPK/9.0kHz	< 4.0	10	20.2	-19.1	5.1	29.5 @ 30	24.4	V, H/0-360°	1-4
Measurement uncertainty						± 4 dB				

Blue marked: restricted bands

Test Cables used	K1a, K83, K40
Test equipment used	103, 23, 171a

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

Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.:6

N.t.* see clause: 9

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Transmitter spurious radiation above 30 MHz (Section 15.205, 15.209) – λ/2 Antenna & Helix Antenna

f	Detct	BW	Rx Level	MD	CF	DEF	AVC	LC	Limit	Margin	EP	Antenna	
												Pol	H
MHz	Type	kHz	dBµV	m	dB	dB	dB	dBµV/m	dBµV/m	dB	°	H / V	m
88.0	PK	100	≤ 3.5**	3	-10.8*[5]	0	0	**-7.3**	40.0	**47.3**	0-360°	H / V	1-4
216.0	PK	100	≤ 3.5**	3	-10.3*[5]	0	0	**-6.8**	43.5	**50.3**	0-360°	H / V	1-4
960.0	PK	100	≤ 3.5**	3	8.5*[5]	0	0	**12.0**	43.5	**31.5**	0-360°	H / V	1-4
1700.0	PK	1000	≤ 4.5**	3	3.8*[6]	0	0	**8.3**	54.0	**45.7**	0-360°	H / V	1-4
1805.5	PK	1000	≤ 10**	3	9.5*[6]	0	0	**19.5**	54.0	**34.5**	0-360°	H / V	1-4
2250.0	PK	1000	≤ 10**	3	8.0*[6]	0	0	**18.0**	54.0	**36.0**	0-360°	H / V	1-4
4000.0	PK	1000	≤ 10**	3	8.4*[6]	0	0	**18.4**	54.0	**35.6**	0-360°	H / V	1-4
5000.0	PK	1000	≤ 10**	3	9.1*[6]	0	0	**19.4**	54.0	**34.6**	0-360°	H / V	1-4
7500.0	PK	1000	≤ 14**	3	12.9*[6]	0	0	**26.9**	54.0	**27.1**	0-360°	H / V	1-4
8300.0	PK	1000	≤ 14**	3	14.8*[6]	0	0	**28.8**	54.0	**25.2**	0-360°	H / V	1-4

Measurement uncertainty: ± 4 dB

**** All other emissions are lower than the noise level of the measuring equipment!**

f: Frequency | Detct : Detector type | BW: Bandwidth | Rx Level : Receiver level | MD: Measurement distance | CF : Correction factor | DEF :Distance extrapolation factor | AVC : Averaging Correction factor | LC : Level corrected | EP: EUT Position | Pol:Antenna polarization | H: Antenna height |

Blue marked: restricted bands

Remark: *[1] noise floor noise level of the measuring instrument ≤ 3.5dBµV @ 3m distance (30 – 1,000 MHz)
Remark: *[2] noise floor noise level of the measuring instrument ≤ 4.5dBµV @ 3m distance (1,000 – 2,000 MHz)
Remark: *[3] noise floor noise level of the measuring instrument ≤ 10dBµV @ 3m distance (2,000 – 5,500 MHz)
Remark: *[4] noise floor noise level of the measuring instrument ≤ 14dBµV @ 3m distance (5,500 – 14,500 MHz)
Remark: *[5] for using a pre-amplifier in the range between 100 kHz and 1,000 MHz
Remark: *[6] for using a pre-amplifier in the range between 1.0 GHz and 18.0 GHz

Test Cables used	K1a, K1b, K83, K40, K56, K51, K52, K120
Test equipment used	103, 23, 171a, 406, 445a, 345, 166a

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

Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.:6

N.t.* see clause: 9

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8.5 Field strength limits of fundamental frequencies and harmonics

8.5.1 Regulation

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Intentional radiator- Fundamental frequencies / Field strength limits		
Frequency	**Field strength of fundamental**	**Field strength of harmonics**
MHz	**mV / m**	**µV / m**
902-928	50	500
2400-2483.5	50	500
5725-5875	50	500
24.0-24.25	250	2500

(b) Fixed, point-to-point operation as referred to in this paragraph shall be limited to systems employing a fixed transmitter transmitting to a fixed remote location. Point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information are not allowed. Fixed, point-to-point operation is permitted in the 24.05-24.25 GHz band subject to the following conditions:

(1) The field strength of emissions in this band shall not exceed 2500 millivolts/meter.

(2) The frequency tolerance of the carrier signal shall be maintained within ±0.001% of the operating frequency over a temperature variation of -20 °C to +50 °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. For battery operated equipment, the equipment tests shall be performed using a new battery.

(3) Antenna gain must be at least 33 dBi. Alternatively, the main lobe beamwidth must not exceed 3.5°. The beamwidth limit shall apply to both the azimuth and elevation planes. At antenna gains over 33 dBi or beamwidths narrower than 3.5°, power must be reduced to ensure that the field strength does not exceed 2500 millivolts/meter.

(c) Field strength limits are specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.

(e) As shown in § 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

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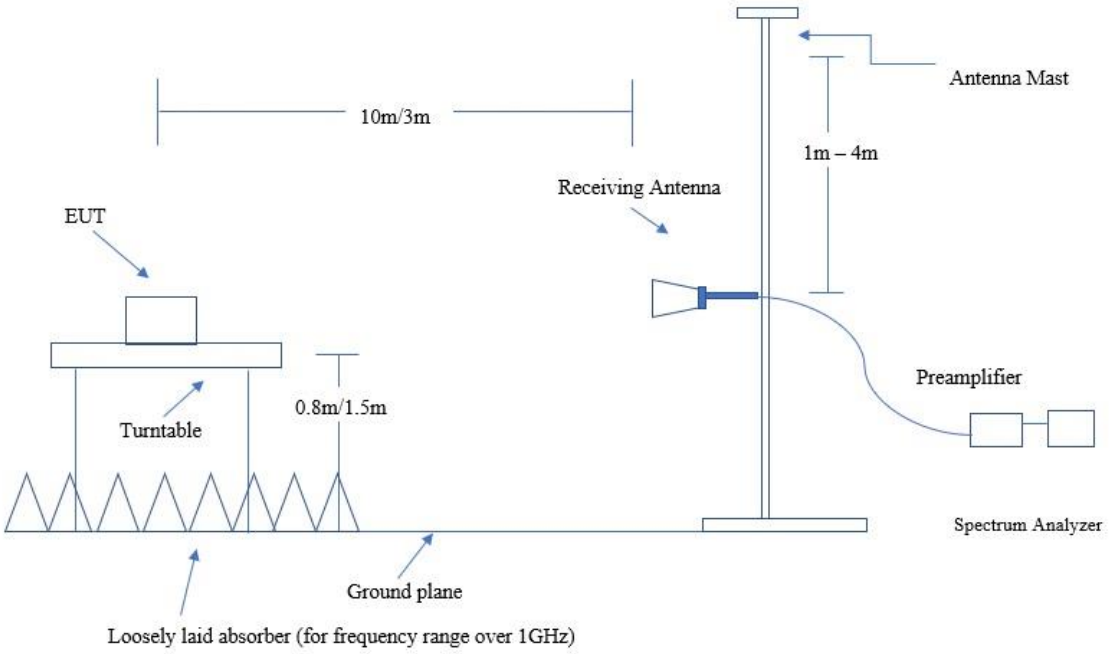
8.5.2 Test setup photo



8.5.3 Test procedure

The EUT and this peripheral (when additional equipment exists) are placed on a nonconducting platform with nominal top surface dimensions 1 m by 1.5 m turn table. For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. 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 is 3m above 30 MHz and is 10m within frequency range 9kHz to 30 MHz. 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.

Measurement procedures for electric field radiated emissions from frequency range within 9 kHz to 1 GHz & above 1 GHz are consisting 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. 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.

Bore-sighting technique is used 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.

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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 measurement above 1 GHz is made by placing loose-laid RF absorber material on the ground plane

Radiated emissions test characteristics	
Frequency range	9 kHz – 231 GHz
Test distance	10 m (below 30 MHz) 3 m* (above 30 MHz)
Test instrumentation minimum resolution bandwidth	9 kHz (Below 30 MHz)
	120 kHz (30 MHz - 1,000 MHz)
	1 MHz (Above 1000 MHz)
Detector Type	Quasi peak and Average based on frequency range
Receive antenna scan height	1 m - 4 m
Receive antenna polarization	Vertical/horizontal

* 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).

8.5.4 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).

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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. Measurements shall not be performed at a distance greater than 30 meters unless it can be further demonstrated that measurements at a distance of 30 meters or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

For example: Distance limit (d_{limit}) = 3, Distance measured ($d_{measured}$) = 1
Distance Extrapolation Factor (DEF) = 20 * log ($d_{limit}/d_{measured}$) = 20 * log (3/1) = 9.5

If the test distance is taken less than the recommended one, then the minimum distance of the receiving antenna should be calculated according to the $2D^2/\lambda$, where D is the antenna length.

At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). This paragraph (f) shall not apply to Access BPL devices operating below 30 MHz.

For example: Distance limit (d_{limit}) = 300, Distance measured ($d_{measured}$) = 10
Distance Extrapolation Factor (DEF) = 40 * log ($d_{limit}/d_{measured}$) = 40 * log (300/10) = 59.1

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8.5.5 Result

Field strength of fundamental and harmonic (Section 15.249) – λ/2 Antenna										
Frequency MHz	Bandwidth Type of detector kHz	Noted receiver level dBµV	Test distance m	Correction factor dB	Distance extrapol. factor dB	Level corrected dBµV/m	Limit dBµV/m	Margin dB	Polaris. EUT / antenna H xx° / H	Antenna height cm
902.1	**100 / Av**	**85.7**	**3**	**7.2**	**0**	**92.9**	**94.0**	**1.1**	**235° / H**	**120**
904.1	**100 / Av**	**86.0**	**3**	**7.3**	**0**	**93.3**	**94.0**	**0.7**	**235° / H**	**119**
906.1	**100 / Av**	**86.1**	**3**	**7.4**	**0**	**93.5**	**94.0**	**0.5**	**210° / H**	**122**
1804.2	**1000 / Av**	**36.2**	**3**	**8.1**	**0**	**44.3**	**54.0**	**9.7**	**0° / V**	**179**
1808.2	**1000 / Av**	**36.6**	**3**	**8.1**	**0**	**44.7**	**54.0**	**9.3**	**0° / V**	**189**
1812.2	**1000 / Av**	**37.7**	**3**	**8.1**	**0**	**45.8**	**54.0**	**8.2**	**0° / V**	**181**
The blue marked frequencies fall into the restricted bands										
Measurement uncertainty: 4 dB										

The above measurement is made with an input power of -7 dBm.
Bandwidth = the measuring receiver bandwidth

Remark: *[1] noise floor noise level of the measuring instrument ≤ 3.5dBµV @ 3m distance (30 – 1,000 MHz)
Remark: *[2] noise floor noise level of the measuring instrument ≤ 4.5dBµV @ 3m distance (1,000 – 2,000 MHz)
Remark: *[3] noise floor noise level of the measuring instrument ≤ 10dBµV @ 3m distance (2,000 – 5,500 MHz)
Remark: *[4] noise floor noise level of the measuring instrument ≤ 14dBµV @ 3m distance (5,500 – 14,500 MHz)
Remark: *[5] for using a pre-amplifier in the range between 100 kHz and 1,000 MHz
Remark: *[6] for using a pre-amplifier in the range between 1.0 GHz and 18.0 GHz
Remark: *[7] for periodic operated transmitter

Test Cables used	K1a, K83, K40, K56, K1b, K120, K51, K52
Test equipment used	103, 23, 171a, 406, 445a, 345, 166a

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

Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.:6

N.t.* see clause: 9

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Field strength of fundamental and harmonic (Section 15.249) – Helix Antenna										
Frequency MHz	Bandwidth Type of detector kHz	Noted receiver level dBµV	Test distance m	Correction factor dB	Distance extrapol. factor dB	Level corrected dBµV/m	Limit dBµV/m	Margin dB	Polaris. EUT / antenna H xx° / H	Antenna height cm
902.1	**100 / Av**	**83.8**	**3**	**7.2**	**0**	**91.0**	**94.0**	**3.0**	**235° / H**	**120**
904.1	**100 / Av**	**82.8**	**3**	**7.3**	**0**	**90.1**	**94.0**	**3.9**	**235° / H**	**119**
906.1	**100 / Av**	**83.5**	**3**	**7.4**	**0**	**90.9**	**94.0**	**3.1**	**210° / H**	**122**
The blue marked frequencies fall into the restricted bands										
Measurement uncertainty: 4 dB										

The above measurement is made with an input power of 0 dBm.
Bandwidth = the measuring receiver bandwidth

Remark: *[1] noise floor noise level of the measuring instrument ≤ 3.5dBµV @ 3m distance (30 – 1,000 MHz)
Remark: *[2] noise floor noise level of the measuring instrument ≤ 4.5dBµV @ 3m distance (1,000 – 2,000 MHz)
Remark: *[3] noise floor noise level of the measuring instrument ≤ 10dBµV @ 3m distance (2,000 – 5,500 MHz)
Remark: *[4] noise floor noise level of the measuring instrument ≤ 14dBµV @ 3m distance (5,500 – 14,500 MHz)
Remark: *[5] for using a pre-amplifier in the range between 100 kHz and 1,000 MHz
Remark: *[6] for using a pre-amplifier in the range between 1.0 GHz and 18.0 GHz
Remark: *[7] for periodic operated transmitter

Test Cables used	K1a, K83, K40, K56, K1b, K120, K51, K52
Test equipment used	103, 23, 171a, 406, 445a, 345, 166a

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

Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.:6

N.t.* see clause: 9

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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 Test procedure

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.

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 analyzer marker to the highest level of the displayed trace (this is the reference value).

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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 analyzer 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).

8.6.3 Result

Intentional radiator- Maximum Measured 20 dB Bandwidth – λ/2 Antenna	
Operating Frequency	**Maximum Measured 20 dB Bandwidth**
MHz	**kHz**
902.1	10.1
904.1	10.1
906.1	10.1

Intentional radiator- Maximum Measured 20 dB Bandwidth – Helix Antenna	
Operating Frequency	**Maximum Measured 20 dB Bandwidth**
MHz	**kHz**
902.1	10.0
904.1	10.3
906.1	10.0

Test Cables used	K116
Test equipment used	171a

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

Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.:3

N.t.* see clause: 9

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9. Additional information to the test report

Remarks	Description
N.t.[1]	Not tested, because the antenna is part of the PCB
N.t.[2]	Not tested, because the EUT is directly battery powered
N.t.[3]	Not tested, because not applicable to the EUT
N.t.[4]	Not tested, because not ordered

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10. List of test equipment

Type	Manufacturer/ Model no.	Serial no.	Last calibration	Next calibration	Calibration executed by
Test fixture	Dudde	---	---	---	---
Magnetic loop antenna (9 kHz - 30 MHz)	Schwarzbeck FMZB 1516 (23)	---	05/2016	05/2019	Seibersdorf
OATS	Dudde (104)	---	06/2018	06/2020	Dudde
Digital Multimeter	GW GDM-8045G (144)	0090256	08/2016	08/2019	Testo
Pre-amplifier (100kHz - 1.3GHz)	Hewlett Packard 8447 E (166a)	1726A00705	08/2018	08/2020	Dudde
Hornantenna (2.0-14.0 GHz)	Schwarzbeck BBHA 9120 C (169)	305	09/2016	09/2020	Seibersdorf
Receiver (9 kHz –18.0 GHz)	Rohde & Schwarz Spectrum Analyzer FSL 18 (171a)	100.117	03/2018	03/2020	Rohde & Schwarz
Pre-amplifier (1GHz - 18GHz)	Narda (345)	---	03/2018	03/2020	Dudde
Bilog-antenna (30- 1000 MHz)	Schwarzbeck VULP 9168 (406)	---	04/2016	04/2019	Seibersdorf
Log. Per, Antenne (1- 18 GHz)	Schwarzbeck STLP 9148 (445a)	---	03/2016	03/2019	Seibersdorf
Signal Analyzer (9 kHz –30.0 GHz)	Rohde & Schwarz FSV 30 (502)	100932	06/2016	06/2019	Rohde & Schwarz

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11. List of test cables

Type	Manufacturer/ Model no.	Cable no.	Last calibration	Next calibration	Calibration executed by
RF- cable	Kabelmetal 18m [N]	K1a	10/2017	10/2018	Dudde
RF- cable	Aircell 0.5m [BNC]	K40	10/2017	10/2018	Dudde
RF- cable	Sucoflex 104 Suhner [N] 1 m	K51	10/2017	10/2018	Dudde
RF- cable	Aircell 1m [BNC/N]	K56	10/2017	10/2018	Dudde
RF- cable	Sucoflex 100 Suhner [N] 1 m	K52	10/2017	10/2018	Dudde
RF- cable	Sucoflex 106 Suhner 6,4m [N]	K83	10/2017	10/2018	Dudde
RF- cable	Sucoflex 106 Suhner 6,4m [N]	K84	10/2017	10/2018	Dudde
RF- cable	Sucoflex Suhner 13 m [N]	K120	10/2017	10/2018	Dudde
RF- cable	Sucoflex Suhner 8m [SMA]	K145	10/2017	10/2018	Dudde
RF- cable	Sucoflex Suhner 8m [SMA]	K146	10/2017	10/2018	Dudde
RF- cable	Sucoflex Suhner 0.25m [SMA]	K116	10/2017	10/2018	Dudde

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End of test report

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