Test Report acc. to FCC Title 47 CFR Part 15
relating to
Hirschmann Car Communication GmbH
920702A

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

ilac-MRA

DAkkS Deutsche Akkreditierungsstelle D-PL-12053-01-03

TÜV NORD Hochfrequenztechnik GmbH & Co. KG
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MANUFACTURER	
Manufacturer name	**Hirschmann Car Communication GmbH**
Manufacturer's grantee code	**XTJ**
Manufacturer's address	Stuttgarter Str.45-51 72654 Neckartenzlingen Germany
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TESTING LABORATORY	
Test engineer	Mr. Ralf Trepper
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RELEVANT STANDARD	
Title	**47 - Telecommunication**
Part	**15 - Radio Frequency Devices**
Subpart	**Subpart C – Intentional Radiators - Section 15.231**
Measurement procedure	**ANSI C63.4-2014 & ANSI C63.10-2013**

Equipment **U**nder **T**est **(EUT)**	
Equipment category	Keyless Entry Transceiver
Trade name	Hirschmann Car Communication
Type designation	920702A
Serial no.	716000000024
Variants	---

Test result summary

Clause	Requirements headline	Test result		
8.1	Antenna requirement – Section 15.203	**Pass**	~~**Fail**~~	~~**N.t.***~~
8.2	Restricted bands of operation – Section 15.205	**Pass**	~~**Fail**~~	~~**N.t.***~~
8.3	Conducted limits – Section 15.207	~~**Pass**~~	~~**Fail**~~	**N.t.***
8.4	Radiated emission limits, general requirements – Section 15.209	**Pass**	~~**Fail**~~	~~**N.t.***~~
8.5	Periodic Operation Characteristic – Section 15.231 (a) & (e)	**Pass**	~~**Fail**~~	~~**N.t.***~~
8.6	Field Strength of emission – Section 15.231 (b)	**Pass**	~~**Fail**~~	~~**N.t.***~~
8.7	Bandwidth – Section 15.231 (c)	**Pass**	~~**Fail**~~	~~**N.t.***~~
8.8	Frequency tolerance – Section 15.231 (d)	~~**Pass**~~	~~**Fail**~~	**N.t.**[3]

* 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**	~~**No**~~

Signature	TÜV NORD Digital unterschrieben von Shrestha Anup Datum: 2022.02.18 15:47:49 +01'00'	
Name	**Mr. Anup Shreshta**	**Mr. Ralf Trepper**
Designation	**RF Test engineer**	**Laboratory Manager**
Date of issue	**2022-02-10**	**2022-02-10**

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1. Table of contents

Revision	Date of issue	Creator	Content of change
00	10.02.2022	AS	Initial release
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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.

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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 number of pages in this report is **50**.

The tests were carried out at:

- TÜV NORD Hochfrequenztechnik GmbH & Co. KG, D-51069 Köln

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 15.231, ANSI C63.4-2014 & ANSI C63.10-2013

The sample of the product was received on:

- 2022-01-22

The tests were carried out in the following period:

- 2022-02-07 - 2022-02-10

3. Testing laboratory

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Germany

Phone: +49 221 88889500

- FCC Registration Number: **763407**

Accredited by:

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

4. Applicant

Company name : Hirschmann Car Communication GmbH

Address : Stuttgarter Str.45-51
72654 Neckartenzlingen

Country : Germany

Telephone : +49 7127 141027

Telefax : ---

Email : Joachim.Nebel@te.com

Date of order : 2021-10-13

References : Mr. Joachim Nebel

5. Product and product documentation

Samples of the following apparatus were submitted for testing:

Manufacturer : Hirschmann Car Communication GmbH

Trademark : Hirschmann Car Communication

Type designation : **920702A (new Antenna variant)**

Hardware version : 1.0

Variants : ---

Serial number : 716000000024

Software release : 1.0

Type of equipment : Keyless Entry Transceiver

Power used : 12.0 V DC

Frequency used : 3 channels (433.47 MHz, 433.92 MHz, 434.37 MHz)

Generated frequencies : 24.305 MHz (crystal),
(433.47 MHz, 433.92 MHz, 434.37 MHz (carrier))

ITU emission class : 76K9F1D

FCC ID : XTJ920702A

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)	2022-02-10	Annex no. 1
Internal photographs of the **E**quipment **U**nder **T**est (EUT)	2022-02-10	Annex no. 2
Channel occupancy / bandwidth	2022-02-10	Annex no. 3
Label sample	2022-02-10	Annex no. 4
Functional description / User manual	2022-02-10	Annex no. 5
Test setup photos	2022-02-10	Annex no. 6
Block diagram	2022-02-10	Annex no. 7
Operational description	2022-02-10	Annex no. 8
Schematics	2022-02-10	Annex no. 9
Parts list	2022-02-10	Annex no. 10
Periodic operation characteristics	2022-02-10	Annex no. 11

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:

The EUT was tested with a new Antenna variant.

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7. Operational description

7.1 EUT details

The product is mounted in a vehicle. It contains a keyless entry transceiver. The product is neither visible nor operable by the user of the car. It is used and controlled by the telematics system of the vehicle.

7.2 EUT configuration

DUT can be controlled with 3 buttons on the a box. All required test modes are set via the test box.

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: 12 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 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.

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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	Dedicated antennas with unique connector	**433.470**	**-12.2 dBi**	2
		434.370	**-12.3 dBi**	
		433.920	**-12.3 dBi**	

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

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

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:

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.

(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	K12a, K60, K102
Test equipment used	660, 665, 445a, 406, 667, 668, 669

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

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

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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.

Frequency of emission(MHz)	Conducted limit (dBµV)	
	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 µV within the frequency band 535-1705 kHz, as measured using a 50 µH/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.

8.3.2 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 C63.4-2014 Section 7.
Additional equipment must also be connected to a second LISN with the same specifications described in the above section (if required).

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8.3.3 Result

Tested with external AC power supply

Conducted emissions (Section 15.207)						
Tested line	**f** **MHz**	**Bandwidth** **kHz**	**Noted receiver level** **dBµV**	**Spec. limit (average)** **dBµV**	**Margin** **dBµV**	**Remarks**
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Measurement uncertainty < ± 2 dB						

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

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

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

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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:

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.

(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 §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. 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.

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(g) 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 9kHz - 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.

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Radiated emissions test characteristics	
Frequency range	9 kHz – Above 960 MHz
Test distance	3 m*
Test instrumentation minimum resolution bandwidth	10 kHz (Below 30 MHz)
	100 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).

8.4.3 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) = 62.45

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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8.4.4 Result

Low Channel Antenna 1 @ 433.47 MHz

Transmitter Spurious Radiation below 30 MHz, (Section 15.205, 15.209)							
Frequency (MHz)	**QuasiPeak (dBµV/m)**	**Average (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Pol V / H**	**Azimuth (deg)**
0.009 - 30	**	**	---	---	---	---	---
No emissions detected							
Measurement uncertainty: Conducted ± 1 dB / ERP ± 4 dB							

Low Channel Antenna 2 @ 433.47 MHz

Transmitter Spurious Radiation below 30 MHz, (Section 15.205, 15.209)							
Frequency (MHz)	**QuasiPeak (dBµV/m)**	**Average (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Pol V / H**	**Azimuth (deg)**
0.009 - 30	**	**	---	---	---	---	---
No emissions detected							
Measurement uncertainty: Conducted ± 1 dB / ERP ± 4 dB							

High Channel Antenna 1 (434.37 MHz)

Transmitter Spurious Radiation below 30 MHz, (Section 15.205, 15.209)							
Frequency (MHz)	**QuasiPeak (dBµV/m)**	**Average (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Pol V / H**	**Azimuth (deg)**
0.009 - 30	**	**	---	---	---	---	---
No emissions detected							
Measurement uncertainty: Conducted ± 1 dB / ERP ± 4 dB							

High Channel Antenna 2 (434.37 MHz)

Transmitter Spurious Radiation below 30 MHz, (Section 15.205, 15.209)							
Frequency (MHz)	**QuasiPeak (dBµV/m)**	**Average (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Pol V / H**	**Azimuth (deg)**
0.009 - 30	**	**	---	---	---	---	---
No emissions detected							
Measurement uncertainty: Conducted ± 1 dB / ERP ± 4 dB							

Test Cables used	K12a, K60, K102
Test equipment used	23, 660, 665, 667, 668, 669

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

Test setup photos / test results are attached	**Yes**	~~No~~	page no.: 30 - 37

Low Channel Antenna 1 @ 433.47 MHz

Transmitter Spurious Radiation (30 MHz – 1 GHz), (Section 15.205, 15.209)								
Frequency (MHz)	**QuasiPeak (dBµV/m)**	**Max Peak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol V / H**	**Azimuth (deg)**
111.9	---	**34.9**	63.5	**28.6**	120.0	197.0	V	39.0
111.9	**26.5**	---	43.5	**17.0**	120.0	197.0	V	39.0
222.8	---	**40.8**	66.0	**25.2**	120.0	185.0	V	74.0
222.8	**38.7**	---	46.0	**7.3**	120.0	185.0	V	74.0
Measurement uncertainty: Conducted ± 1 dB / ERP ± 4 dB								

Blue marked: restricted bands

Low Channel Antenna 2 @ 433.47 MHz

Transmitter Spurious Radiation (30 MHz – 1 GHz), (Section 15.205, 15.209)								
Frequency (MHz)	**QuasiPeak (dBµV/m)**	**Max Peak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol V / H**	**Azimuth (deg)**
80.0	**29.7**	---	40.0	**12.3**	120.0	178.0	V	2.0
80.0	---	**31.8**	60.0	**28.2**	120.0	178.0	V	2.0
112.0	---	**37.8**	63.5	**25.7**	120.0	248.0	H	99.0
112.0	**36.4**	---	43.5	**7.1**	120.0	248.0	H	99.0
224.0	**32.7**	---	46.0	**9.6**	120.0	100.0	V	19.0
224.0	---	**34.8**	66.0	**31.2**	120.0	100.0	V	19.0
Measurement uncertainty: Conducted ± 1 dB / ERP ± 4 dB								

Blue marked: restricted bands

High Channel Antenna 1 @ 434.37 MHz

Transmitter Spurious Radiation (30 MHz – 1 GHz), (Section 15.205, 15.209)								
Frequency (MHz)	**QuasiPeak (dBµV/m)**	**Max Peak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol V / H**	**Azimuth (deg)**
112.0	**37.5**	---	43.5	**6.0**	120.0	252.0	H	114.0
112.0	---	**38.7**	63.5	**24.8**	120.0	252.0	H	114.0
224.0	---	**33.2**	**66.0**	**32.8**	**120.0**	**100.0**	**V**	**92.0**
224.0	**30.6**	---	**46.0**	**15.4**	**120.0**	**100.0**	**V**	**92.0**
Measurement uncertainty: Conducted ± 1 dB / ERP ± 4 dB								

Blue marked: restricted bands

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High Channel Antenna 2 @ 434.37 MHz

Transmitter Spurious Radiation (30 MHz – 1 GHz), (Section 15.205, 15.209)								
Frequency (MHz)	**QuasiPeak (dBµV/m)**	**Max Peak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol V / H**	**Azimuth (deg)**
112.0	**36.6**	---	43.5	**6.9**	120.0	248.0	H	112.0
112.0	---	**38.0**	63.5	**25.5**	120.0	248.0	H	112.0
224.0	**32.9**	---	**46.0**	**13.1**	**120.0**	**100.0**	**V**	**21.0**
224.0	---	**35.1**	**66.0**	**30.9**	**120.0**	**100.0**	**V**	**21.0**
Measurement uncertainty: Conducted ± 1 dB / ERP ± 4 dB								

Blue marked: restricted bands

All measurements at 3 meter distance!

Test Cables used	K12a, K60, K102
Test equipment used	660, 665, 406

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

Test setup photos / test results are attached	**Yes**	~~**No**~~	page no.: 30 - 37

Low Channel Antenna 1 @ 433.47 MHz

Transmitter Spurious Radiation (1 GHz – 5 GHz), (Section 15.205, 15.209)								
Frequency (MHz)	**Average (dBµV/m)**	**MaxPeak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol V / H**	**Azimuth (deg)**
3988.9	**---**	**50.6**	74.0	**23.4**	1000.0	112.0	H	17.0
3988.9	**37.0**	**---**	54.0	**17.0**	1000.0	112.0	H	17.0
Measurement uncertainty: Conducted ± 1 dB / ERP ± 4 dB								

Blue marked: restricted bands

Low Channel Antenna 2 @ 433.47 MHz

Transmitter Spurious Radiation (1 GHz – 5 GHz), (Section 15.205, 15.209)								
Frequency (MHz)	**Average (dBµV/m)**	**MaxPeak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol V / H**	**Azimuth (deg)**
1000 - 5000	**	**	---	---	---	---	---	---
****No emissions detected**								
Measurement uncertainty: Conducted ± 1 dB / ERP ± 4 dB								

High Channel Antenna 1 @ 434.37 MHz

Transmitter Spurious Radiation (1 GHz – 5 GHz), (Section 15.205, 15.209)								
Frequency (MHz)	**Average (dBµV/m)**	**MaxPeak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol V / H**	**Azimuth (deg)**
1000 - 5000	**	**	---	---	---	---	---	---
****No emissions detected**								
Measurement uncertainty: Conducted ± 1 dB / ERP ± 4 dB								

High Channel Antenna 1 @ 434.37 MHz

Transmitter Spurious Radiation (1 GHz – 5 GHz), (Section 15.205, 15.209)								
Frequency (MHz)	**Average (dBµV/m)**	**MaxPeak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol V / H**	**Azimuth (deg)**
1000 - 5000	**	**	---	---	---	---	---	---
****No emissions detected**								
Measurement uncertainty: Conducted ± 1 dB / ERP ± 4 dB								

Test Cables used	K12a, K60, K102
Test equipment used	660, 665, 445a

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

Test setup photos / test results are attached	**Yes**	~~**No**~~	page no.: 30 - 37

All measurements at 3 meter distance!

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8.5 Periodic Operation Characteristics

The provisions of this Section are restricted to periodic operation within the band 40.66 40.70 MHz and above 70 MHz. Except as shown in this Section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Radio control of toys is not permitted. Continuous transmissions, such as voice or video, and data transmissions are not permitted. The prohibition against data transmissions does not preclude the use of recognition codes. Those codes are used to identify the sensor that is activated or to identify the particular component as being part of the system.

Test Cables used	---
Test equipment used	666

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

Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.: 11

8.5.1 Manually operated transmitter deactivation

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

Test Cables used	---
Test equipment used	666

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

Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.: 11

8.5.2 Automatically operated transmitter deactivation

A transmitter activated automatically shall cease transmission within 5 seconds after activation.

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.:

8.5.3 Prohibition of periodic transmission

Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

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.:

8.5.4 Continuous transmission during an alarm condition

Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

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.:

8.5.5 Transmission set-up for security system

Transmission of set-up information for security systems may exceed the transmission duration limits in 8.5.1 and 8.5.2 of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

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.:

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8.5.6 Exemption in periodic rate Transmission

Intentional radiators may operate at a periodic rate exceeding that specified in 8.5.1-8.5.5 of this section and may be employed for any type of operation, including operation prohibited in 8.5.1-8.5.5 of this section, provided the intentional radiator complies with the provisions of paragraphs 8.5 through 8.8 of this section, except the field strength table in 8.6 of this section is replaced by the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emission (microvolts/meter)
40.66-40.70	1.000	100
70-130	500	50
130-174	500 to 1.500[1]	50 to 150[1]
174-260	1.500	150
260-470	1.500 to 5.000[1]	150 to 500[1]
Above 470	5.000	500

[1]Linear interpolations.

In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

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

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

8.6 Field strength of emission

8.6.1 Regulation

In addition to the provisions of 8.2, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2.250	225
70-130	1.250	125
130-174	[1]1.250 to 3.750	[1]125 to 375
174-260	3.750	375
260-470	[1]3.750 to 12.500	[1]375 to 1.250
Above 470	12.500	1.250

[1]Linear interpolations.

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in 8.4, whichever limit permits a higher field strength.

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Exemption in periodic rate Transmission

Intentional radiators may operate at a periodic rate exceeding that specified in 8.5.1-8.5.5 of this section and may be employed for any type of operation, including operation prohibited in 8.5.1-8.5.5 of this section, provided the intentional radiator complies with the provisions of paragraphs 8.5 through 8.8 of this section, except the field strength table in 8.6 of this section is replaced by the following:

Fundamental frequency (MHz)	**Field strength of fundamental (microvolts/meter)**	**Field strength of spurious emission (microvolts/meter)**
40.66-40.70	1.000	100
70-130	500	50
130-174	500 to 1.500[1]	50 to 150[1]
174-260	1.500	150
260-470	1.500 to 5.000[1]	150 to 500[1]
Above 470	5.000	500

[1]Linear interpolations.

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8.6.2 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 9kHz - 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	9 kHz – Above 960 MHz
Test distance	3 m*
Test instrumentation minimum resolution bandwidth	10 kHz (Below 30 MHz)
	100 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

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*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).

8.6.3 Calculation of field strength limits

For example: Transmitter working on 433.920 MHz
Limit for average measurements → 16.6667*(433.920 MHz) – 2833.3333 = 4398.68µV/m = 72.8dBµV/m @3m
Limit for peak measurements → Limit for average measurements + 20dB = 92.8dBµV/m @3m

8.6.4 Calculation of the average correction factor

The average correction factor is computed by analyzing the "worst case" on time in any 100msec time period and using the formula: Corrections Factor + 20*log (worst case on time/100msec). Analysis of the remote transmitter worst case on time in any 100msec time period is an on time of 50msec, therefore the correction factor is 20*log (50/100) = - 6 dB. The maximum correction factor to be applied is 20 dB per section 15.35 of the FCC rules.

8.6.5 Calculation of the field strengths

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) = 62.45

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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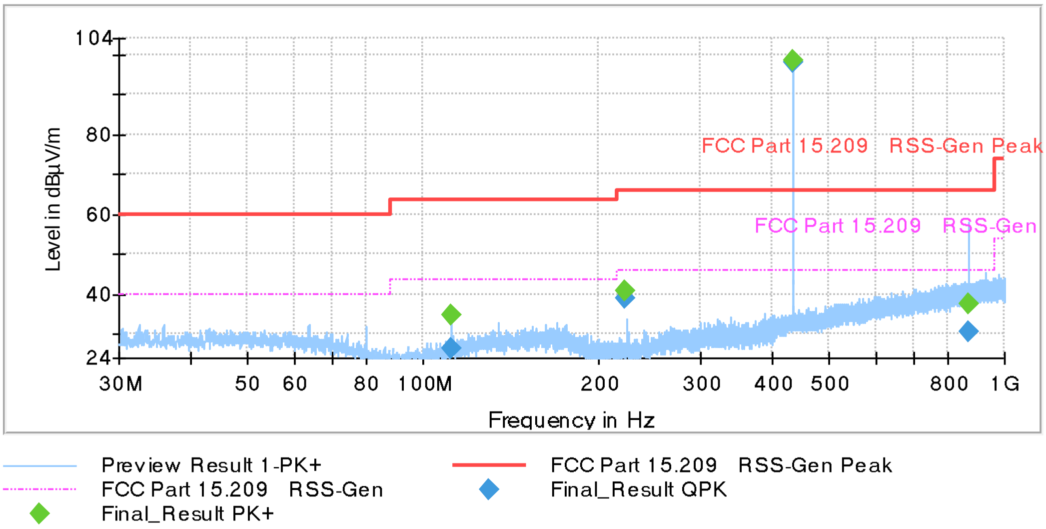
8.6.6 Result

Low Channel Antenna 1 @ 433.47 MHz

Transmitter Field Strengths - Fundamental Emissions & Spurious (Section 15.231) below 1 GHz										
Frequency (MHz)	Peak (dBµV/m)	*1Aver. Corr. (dB)	Level corrected (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
433.48	98.2	20.0	78.2	80.8	2.6	120.0	103.0	V	22.0	18.6
866.95	37.6	20.0	17.6	60.8	43.2	120.0	100.0	V	97.0	25.8
Measurement uncertainty: ± 4 dB										



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

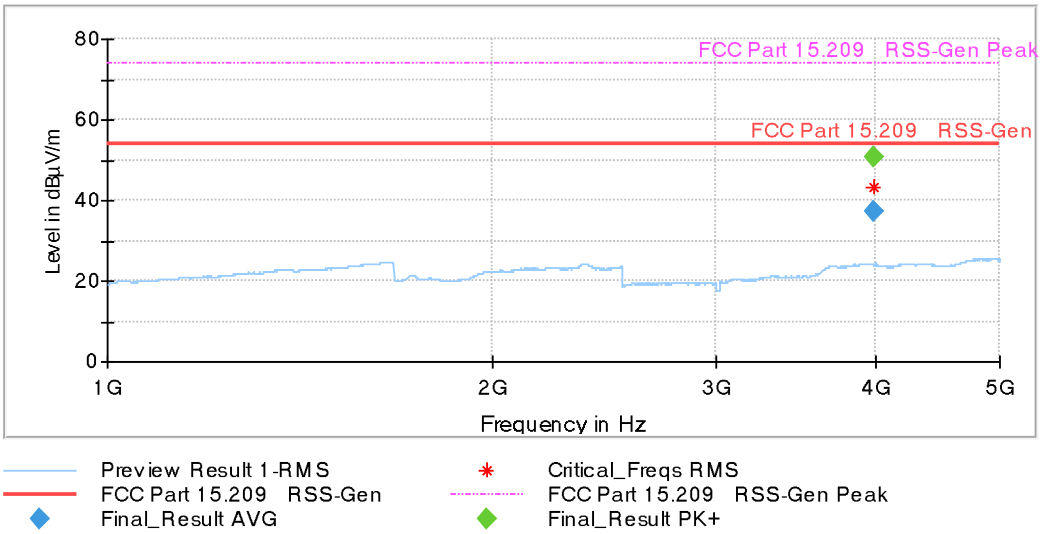
The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~*

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

Remark: *1 AVERAGE FACTOR CALCULATION (Standard 47 CFR Part 15C (periodic intentional transmitter)
Maximum transmitting duration in every 100 ms period: 6.59 ms.
Averaging factor = 20 x log (6.59 ms/100 ms) = **-23.62 dB,**
therefore the maximum averaging factor of 20 dB is used.(see Annex no. 11)

Low Channel Antenna 1 @ 433.47 MHz

Transmitter Field Strengths - Fundamental Emissions & Spurious (Section 15.231) above 1 GHz									
Frequency (MHz)	**Average (dBµV/m)**	**MaxPeak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol**	**Azimuth (deg)**	**Corr. (dB/m)**
3988.9	---	50.6	74.0	23.4	1000.0	112.0	H	17.0	25.9
3988.9	37.0	---	54.0	17.0	1000.0	112.0	H	17.0	25.9
Measurement uncertainty: ± 4 dB									



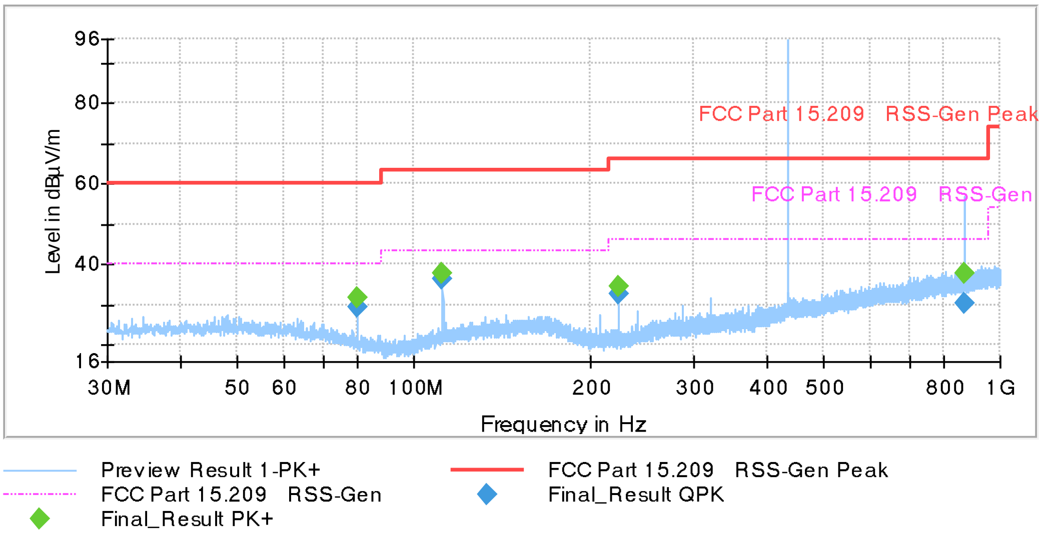
Test Cables used	K12a, K60, K102
Test equipment used	445a, 660, 665, 667, 668, 669

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

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

Low Channel Antenna 2 @ 433.47 MHz

Transmitter Field Strengths - Fundamental Emissions & Spurious (Section 15.231) below 1 GHz										
Frequency (MHz)	**Peak (dBµV/m)**	***[1]Aver. Corr. (dB)**	**Level corrected (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol**	**Azimuth (deg)**	**Corr. (dB/m)**
433.48	**96.7**	**20.0**	**76.7**	**80.8**	**4.1**	**120.0**	**104.0**	**V**	**1.0**	**18.6**
866.91	**38.0**	**20.0**	**18.0**	**60.8**	**42.8**	**120.0**	**100.0**	**V**	**45.0**	**25.8**
Measurement uncertainty: ± 4 dB										



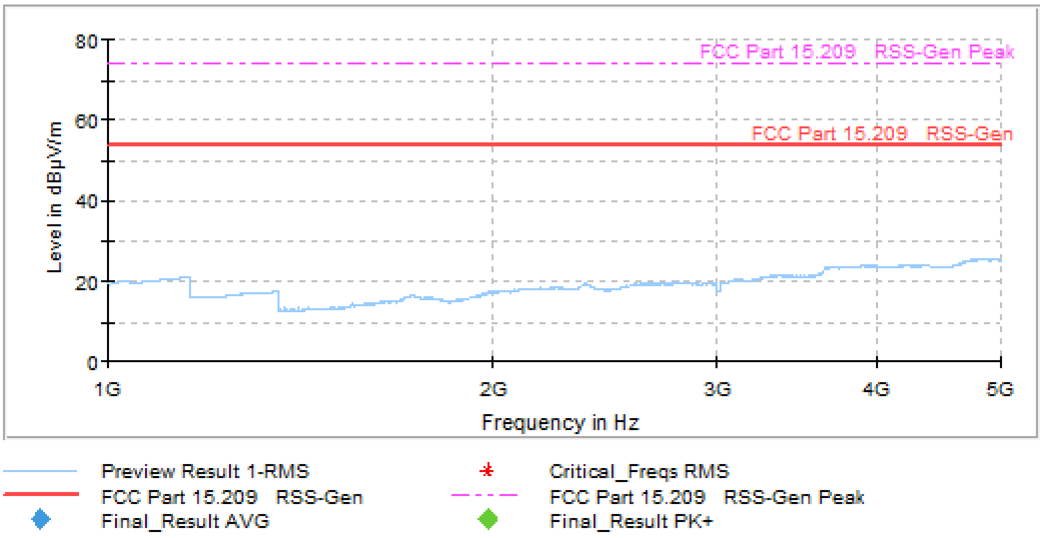
Test Cables used	K12a, K60, K102
Test equipment used	406, 660, 665, 667, 668, 669

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~*
Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.: 6

Remark: *[1] AVERAGE FACTOR CALCULATION (Standard 47 CFR Part 15C (periodic intentional transmitter)
Maximum transmitting duration in every 100 ms period: 6.59 ms.
Averaging factor = 20 x log (6.59 ms/100 ms) = **-23.62 dB,**
therefore the maximum averaging factor of 20 dB is used.(see Annex no. 11)

Low Channel Antenna 2 @ 433.47 MHz

Transmitter Field Strengths - Fundamental Emissions & Spurious (Section 15.231) above 1 GHz									
Frequency (MHz)	**Average (dBµV/m)**	**MaxPeak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol**	**Azimuth (deg)**	**Corr. (dB/m)**
---	**	**	---	---	---	---	---	---	---
---	**	**	---	---	---	---	---	---	---
**** No Emissions detected**									
Measurement uncertainty: ± 4 dB									



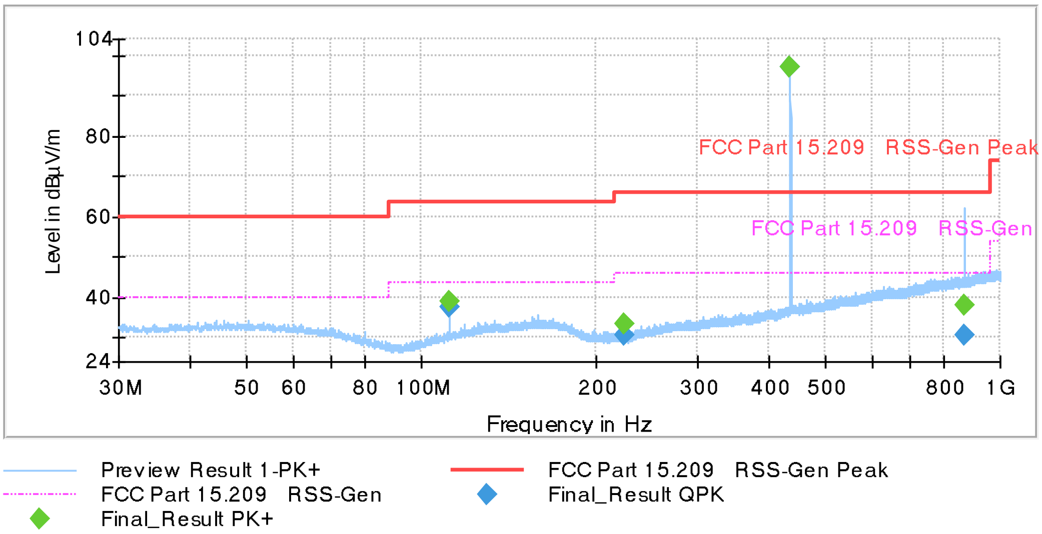
Test Cables used	K60, K101, K119
Test equipment used	445a, 660, 665, 667, 668, 669

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

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

High Channel Antenna 1 @ 434.37 MHz

Transmitter Field Strengths - Fundamental Emissions & Spurious (Section 15.231) below 1 GHz										
Frequency (MHz)	**Peak (dBµV/m)**	***[1]Aver. Corr. (dB)**	**Level corrected (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol**	**Azimuth (deg)**	**Corr. (dB/m)**
434.37	97.0	20.00	77.0	80.8	3.8	120.0	105.0	V	107.0	18.6
868.7	38.0	20.00	18.0	60.8	42.8	120.0	100.0	V	347.0	25.8
Measurement uncertainty: ± 4 dB										



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

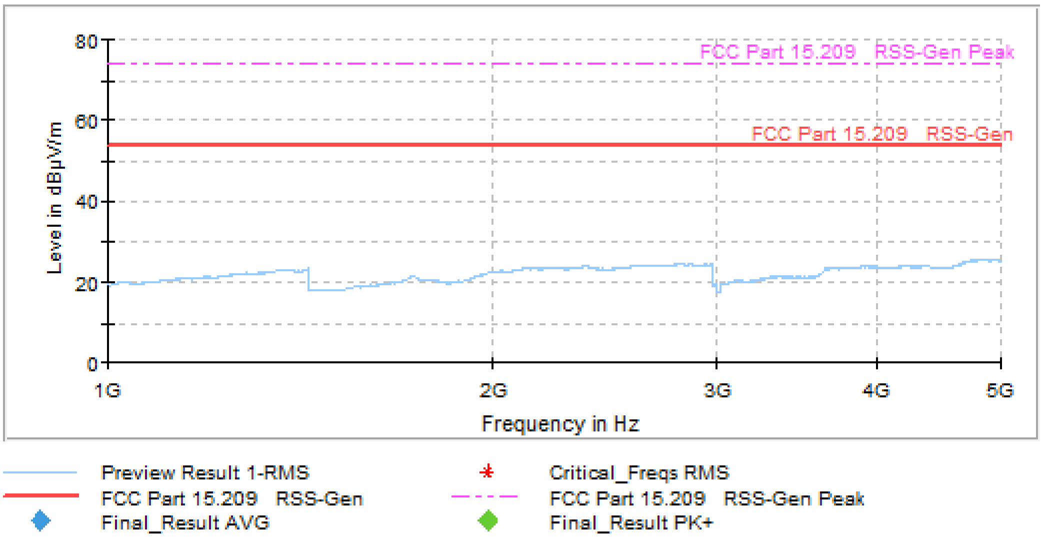
The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~*

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

Remark: *[1] AVERAGE FACTOR CALCULATION (Standard 47 CFR Part 15C (periodic intentional transmitter)
Maximum transmitting duration in every 100 ms period: 6.59 ms.
Averaging factor = 20 x log (6.59 ms/100 ms) = **-23.62 dB,**
therefore the maximum averaging factor of 20 dB is used.(see Annex no. 11)

High Channel Antenna 1 @ 434.37 MHz

Transmitter Field Strengths - Fundamental Emissions & Spurious (Section 15.231) above 1 GHz									
Frequency (MHz)	Average (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
---	**	**	---	---	---	---	---	---	---
---	**	**	---	---	---	---	---	---	---
** No Emissions detected									
Measurement uncertainty: ± 4 dB									



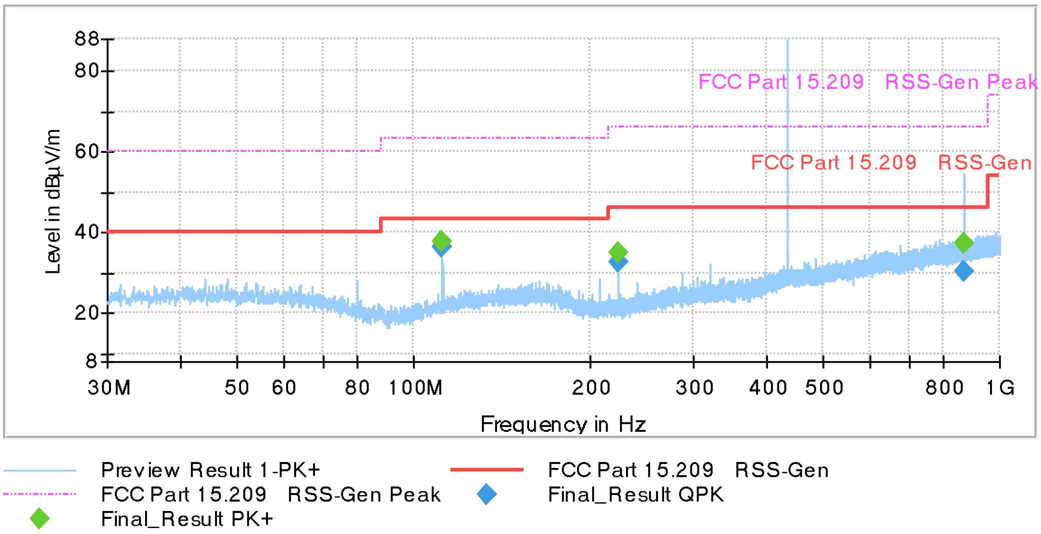
Test Cables used	K60, K101, K119
Test equipment used	445a, 660, 665, 667, 668, 669

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

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

High Channel Antenna 2 @ 434.37 MHz

Transmitter Field Strengths - Fundamental Emissions & Spurious (Section 15.231) below 1 GHz										
Frequency (MHz)	**Peak (dBµV/m)**	***1Aver. Corr. (dB)**	**Level corrected (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol**	**Azimuth (deg)**	**Corr. (dB/m)**
434.37	95.7	20.00	75.7	80.8	5.1	120.0	103.0	V	11.0	18.6
868.7	37.4	20.00	17.4	60.8	43.4	120.0	215.0	V	45.0	25.8
Measurement uncertainty: ± 4 dB										



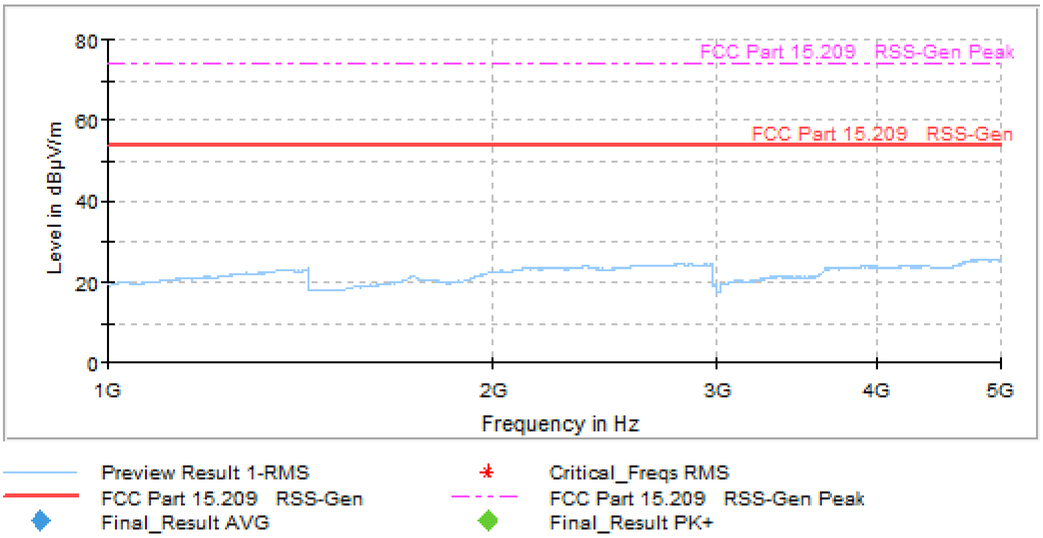
Test Cables used	K12a, K60, K102
Test equipment used	406, 660, 665, 667, 668, 669

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~*
Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.: 6

Remark: *1 AVERAGE FACTOR CALCULATION (Standard 47 CFR Part 15C (periodic intentional transmitter)
Maximum transmitting duration in every 100 ms period: 6.59 ms.
Averaging factor = 20 x log (6.59 ms/100 ms) = **-23.62 dB,**
therefore the maximum averaging factor of 20 dB is used.(see Annex no. 11)

High Channel Antenna 2 @ 434.37 MHz

Transmitter Field Strengths - Fundamental Emissions & Spurious (Section 15.231) above 1 GHz									
Frequency (MHz)	**Average (dBµV/m)**	**MaxPeak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol**	**Azimuth (deg)**	**Corr. (dB/m)**
---	**	**	---	---	---	---	---	---	---
---	**	**	---	---	---	---	---	---	---
**** No Emissions detected**									
Measurement uncertainty: ± 4 dB									



Test Cables used	K60, K101, K119
Test equipment used	445a, 660, 665, 667, 668, 669

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

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

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8.7 Bandwidth (20 dB)

8.7.1 Regulation

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

8.7.2 Calculation of the 20 dB bandwidth limit

The 20 dB bandwidth limit = 0.0025 * 433.470 (MHz) * 1000 = 1083.7 (kHz)

8.7.3 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.

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).

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.

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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).

8.7.4 Result

The measured 20 dB bandwidth at 433.470 MHz is: 81.54 kHz
The measured 20 dB bandwidth at 434.370 MHz is: 81.76 kHz

Test Cables used	---
Test equipment used	660

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

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

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8.8 Frequency Tolerance

8.5.1 Regulation

For devices operating within the frequency band 40.66-40.70 MHz, the bandwidth of the emission shall be confined within the band edges and the frequency tolerance of the carrier shall be ±0.01%. This frequency tolerance shall be maintained for a temperature variation of −20 degrees to + 50 degrees 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 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

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 15.231(d))			
Test conditions	**Frequency Measured (MHz)**	**Frequency Error**	
		(kHz)	**ppm**
V_{min} = x.xx V DC			
V_{nom} = x.xx V DC			
V_{max} = x.xx V DC			
Maximum Frequency error (MHz)			
	Measurement uncertainty	± 5*10^{-8}	

Frequency tolerance (Section 15.231(d))			
Test conditions	**Frequency Measured (MHz)**	**Frequency Error**	
		(kHz)	**(kHz)**
T_{min} -20 °C			
T_{min} -10 °C			
T_{min} 0 °C			
T_{min} +10 °C			
T_{min} +20 °C			
T_{min} +30 °C			
T_{min} +40 °C			
T_{min} +50 °C			
Maximum frequency error (kHz)			
	Measurement uncertainty	±5*10^{-8}	

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.:

9. Additional information to the test report

Remark	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

State Jan. 27, 2022					
Marking	**Manufacturer**	**SW/Type/Serial-No.**	**Last Cal./Val.**	**Next Cal./Val.**	**No.**
1 Measuring Instruments					
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*
3-Path Diode Power Sensor 10 MHz to 8 GHz	Rohde & Schwarz	NRP8S	*Oct 20*	*Oct 22*	*663*
3-Path Diode Power Sensor 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 21*	*Nov 24*	*66*
Bandpass Filter	Schomandl	BN68673	*Nov 21*	*Nov 24*	*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	*Aug 21*	*Aug 24*	*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 21*	*Nov 23*	*71a*
T-Section - 50 W	Rohde & Schwarz	BN 42441/50	*Nov 21*	*Nov 24*	*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 21*	*Nov 24*	*164*
Coaxial RF Termination - 0 – 1000 MHz	Telewave Inc.	TWL 60	*Nov 21*	*Nov 24*	*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	*Dec 21*	*Dec 23*	*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 21*	*Nov 23*	*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*

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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+	*Nov 21*	*Nov 24*	*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 21*	*Nov 23*	*585*
VLISN 5µH	Schwarzbeck	8125-1945	*Nov 21*	*Nov 23*	*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 (SN: TT2.05SI/817 SW: 1.0.0.4473)	---	---	*667*
Maturo Antenna Mast	Maturo	TAM4.5-E-10kg (SN: 10011/216/2588.01)	---	---	*668*
Maturo Controller	Maturo	FCU3.0/009/2588.01 (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	*Nov 21*	*Jan 23*	*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
2 Generators					
EFT/Burst Generator	Schlöder	SFT 1400	*Mai 20*	*Mai 22*	*46a*
ESD Generator	Schlöder	SESD 216	*Dec 21*	*Dec 23*	*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*

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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	*Oct 21*	*Oct 23*	*23*
Biconical Ant. 30-300 MHz	Schwarzbeck	VHA9103/BBA9106	*Apr 20*	*Apr 22*	*80/616*
Double Ridged Horn	Schwarzbeck	BBHA 9120A	*Apr 20*	*Apr 22*	*284*
Tri-Log Broadband	Schwarzbeck	VULB9168	*Mai 21*	*Mai 23*	*406*
Log Per Antenna 0.7-20 GHz	Schwarzbeck	STLP9148	*Mai 21*	*Mai 23*	*445a*
Bilog Ant.	CHASE	CBL6111	*Cal. before use*	*Cal. before use*	*167*
Spectrum analyser Mixer 220 – 325 GHz	Radiometer Physics	SAM325	*Aug 21*	*Aug 23*	*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	*Aug 21*	*Aug 23*	*515*
Gain Horn Antenna 40-60 GHz	Dorado	GH-19-20	---	---	*518*
Spectrum analyser Mixer 90-140 GHz	Radiometer Physics	SAM140	*Aug 21*	*Aug 23*	*545*
Dual Mode Potter Horn 90-140 GHz	Radiometer Physics	140-WR8	---	---	*547*
Spectrum analyser Mixer 140-220GHz	Radiometer Physics	SAM220	*Aug 21*	*Aug 23*	*450*
Dual Mode Potter Horn 140-220 GHz	Radiometer Physics	220-WR5.1	---	---	*548*
Harmonic Mixer 60-90 GHz	Rohde & Schwarz	FS-Z90	*Aug 21*	*Aug 23*	*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	*Cal. before use*	*Cal. before use*	*763*
Waveguide Harmonic Mixer 75 – 110 GHz	Keysight	M1971W	*Cal. before use*	*Cal. before use*	*764*
Stacked Log.-Per. Antenna 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) BHED (Band 2) 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*
RF-Power Amplifier 0.69 GHz – 6 GHz	Rohde & Schwarz	BBA150-D110/E60	---	---	*690*
5. Power supplies					
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*

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Power Supply	EA	PSI 8080-40-DT	---	---	*560*
Power Supply	HP	6032A	---	---	*644*
6. Meters					
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 22*	*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 21*	*Nov 23*	*215a*
Humidity/Temperature Measuring device	TESTO	Testo 625	*Nov 21*	*Nov 23*	*259a*
Volt & RF Power Meter	Rohde & Schwarz	URV35	*Cal. before use*	*Cal. before use*	*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*
Digital-Vacuum-/Barometer	Greisinger	GDH12AN	*Oct 19*	*Oct 22*	*558*
Digital Storage Oscilloscope	Tektronix	TDS 2012C	*Cal. before use*	*Cal. before use*	*568*
Miniature Flat, Zero-Biased Schottky Detector –0.1– 18 GHz	Narda	4503A-03	*Val. before use*	*Val. before use*	*613*
Digital-Vacuum-/Barometer	Greisinger	GDH-200-14	*Nov 21*	*Nov 23*	*632*
Signal & Spectrum Analyser 10 Hz-30 GHz	Rohde & Schwarz	FSV-30	*Aug 21*	*Aug 23*	*502*
EMI Test receiver ESW26	Rohde & Schwarz	R&S ESW26 (SN: 101383/26 SW: R&S ESW1.61))	*Nov 21*	*Nov 23*	*665*
Signal analyser Keysight 50GHz	Keysight	UXA N9040B (SN: MY57213006 SW: A.24.58/2019.0702)	*Jan 22*	*Jan 24*	*666*
7. test/control software					
EMC32	Rohde & Schwarz	V10.60.20	---	---	---
Maturo mcApp	Maturo	SW: V3.4.9.4537 (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	---	---	---

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11. List of test cables

Internal Cable Number	Connector Type	Frequency Range (MHz)	Cable Length (m)	Manufacturer
3	N	0,5 - 8000	3	Cellflex
4	N	0,5 - 8000	3	Cellflex
4a	BNC	10 – 1500	0.50	Telemeter
12a	N	10 – 265000	6	Huber + Suhner
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

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Internal Cable Number	Connector Type	Frequency Range (MHz)	Cable Length (m)	Manufacturer
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
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	---

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End of test report

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