DAkkS Deutsche Akkreditierungsstelle D-PL-12053-01-00

Test Report acc. to FCC Title 47 CFR Part 15
relating to
TeraTron GmbH
CAN Immobilizer Key-Plugin

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

m. dudde hochfrequenz-technik **Rottland 5a** **D-51429 Bergisch Gladbach/ Germany** **Tel: +49 2207-96890** **Fax +49 2207-968920**

MANUFACTURER	
Manufacturer name	**TeraTron GmbH**
Manufacturer's grantee code	**QLX**
Manufacturer's address	Bunsenstr. 10, 51647 Gummersbach
Country	Germany
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Email	Markus.schmidt@teratron.de

TESTING LABORATORY	
Test engineer	Mr. Ralf Trepper
Testing laboratory name	**m. dudde hochfrequenz-technik**
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RELEVANT STANDARD	
Title	**47 - Telecommunication**
Part	**15 - Radio Frequency Devices**
Subpart	**Subpart C – Intentional Radiators**
Measurement procedure	ANSI C63.4-2014 & ANSI C63.10-2013

Equipment **U**nder **T**est **(EUT)**	
Equipment category	Non specific SRD
Trade name	TeraTron
Type designation	**CAN Immobilizer Key-Plugin**
Serial no.	---
Variants	---

EUT: CAN Immobilizer Key-Plugin **FCC ID: QLXIMMOP** **FCC Title 47 CFR Part 15** **Date of issue: 2016-07-26**

1. Test results

Clause	Requirements headline	Test result			Report page number
8.1	Antenna Requirement	**Pass**	~~Fail~~	~~N.t.*~~	9
8.2	Restricted bands of operation	**Pass**	~~Fail~~	~~N.t.*~~	10 to 12
8.3	Conducted limits	~~Pass~~	~~Fail~~	**N.t.**[2]	13 to 14
8.4	Radiated emission limits	**Pass**	~~Fail~~	~~N.t.*~~	15 to 19
8.5	20 dB Bandwidth	**Pass**	~~Fail~~	~~N.t.*~~	20 to 21

* Not tested

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

Signature: ..... (Technician)

Signature: ..... (Laboratory Manager)

Digital unterschrieben von Abdelouahid Ftouhi
DN: cn=Abdelouahid Ftouhi, o=m. dudde Hochfrequenztechnik, ou, email=m.duddelaborg@dudde.com, c=DE
Datum: 2016.07.26 13:13:54 +02'00'

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m. dudde hochfrequenz-technik **Rottland 5a** **D-51429 Bergisch Gladbach/ Germany** **Tel: +49 2207-96890** **Fax +49 2207-968920**

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 m. dudde hochfrequenz-technik 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 **25**.

The tests were carried out at:

- m. dudde hochfrequenz-technik, D-51429 Bergisch Gladbach

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

The sample of the product was received on:

- 2016-07-04

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

- 2016-07-04 – 2016-07-08

3. Testing laboratory

m. dudde hochfrequenz-technik
Rottland 5a, 51429 Bergisch Gladbach, Germany

Phone: +49 - (0) 22 07 / 96 89-0
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- FCC Registration Number: **699717**

Accredited by:

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

4. Applicant

Company name	: TeraTron GmbH
Address	: Bunsenstr. 10
	51647 Gummersbach
Country	: Germany
Telephone	: +49 (0) 2261 8082 0
Telefax	: +49 (0) 2261 8082 99
Email	: markus.schmidt@teratron.de
Date of order	: 2016-06-09
References	: Mr. Markus Schmidt

5. Product and product documentation

Samples of the following apparatus were submitted for testing:

Manufacturer	: TeraTron GmbH
Trademark	: TeraTron
Type designation	: CAN Immobilizer Key-Plugin
Hardware version	: ---
Serial number	: ---
Software release	: ---
Type of equipment	: Non specific SRD
Power used	: 12.0 V DC
Frequency used	: 125 kHz
Generated frequencies	: 8 MHz (Resonator)
ITU emission class	: ---
FCC-ID	**: QLXIMMOP**

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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)	2016-07-26	Annex no. 1
Internal photographs of the **E**quipment **U**nder **T**est (EUT)	2016-07-26	Annex no. 2
Channel occupancy / bandwidth	2016-07-26	Annex no. 3
Label sample	2016-07-26	Annex no. 4
Functional description / User manual	2016-07-26	Annex no. 5
Test setup photos	2016-07-26	Annex no. 6
Block diagram	2016-07-26	Annex no. 7
Operational description	2016-07-26	Annex no. 8
Schematics	2016-07-26	Annex no. 9
Parts list	2016-07-26	Annex no. 10

6. Conclusions, observations and comments

The test report will be filed at m. dudde hochfrequenz-technik 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 m. dudde hochfrequenz-technik.

The results of the tests as stated in this report are exclusively applicable to the EUT as identified in this report. m. dudde hochfrequenz-technik cannot be held liable for properties of the EUT that have not been observed during these tests.

m. dudde hochfrequenz-technik 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:

This test report number 16010487 replaces the test report number 16010469!
The test report number 16010469 loses its validity!

Date	: 2016-07-26	Date	: 2016-07-26
Name	: Ralf Trepper	Name	: Manfried Dudde
Function	: Technician	Function	: Laboratory Manager
Signature	: …….	Signature	: ……

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7. Operational description

7.1 EUT details

The Immobilizer Control Device is an interface between the CAN bus and the RFID-tag.

7.2 EUT configuration

After connection with a power supply of 12 V DC the EUT begins to run.

7.3 EUT measurement description

The EUT was tested in a typical fashion. During preliminary emission tests the EUT was operated in continuous transmitting mode for worst case emission mode investigation. Therefore, the final qualification testing was completed in continuous modes.
All tests were performed with the applicant's typical voltage: 12.0 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.

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

Further test results are attached	~~Yes~~	**No**	Page no.

1. ***Dedicated Antenna without standard connector.***
2. ***Ferrite Coil Antenna***

N.t.* See page no. 25

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.

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(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 § 15.257 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 § 15.249 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).

(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).

(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 § 15.257 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 § 15.249 are exempt from 83 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).

(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

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

Further test results are attached	~~Yes~~	**No**	Page no.

***: All emissions in the restricted bands are lower than the noise level of the measuring equipment!**

N.t.* See page no. 25

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

8.3.3 Result

Tested with external AC power supply

Conducted emissions (Section 15.107)						
Tested line	f MHz	Bandwidth kHz	Noted receiver level dBµV	Spec. limit (average) dBµV	Margin dBµV	Remarks
Measurement uncertainty			< ± 2 dB			

Remark: *[1] Noise level of the measuring instrument ≤ -2dBµV (0.009 – 30MHz)
Remark: *[2] Quasi peak measurements lower than "Specified Average Limit"

The equipment passed the conducted tests	~~Yes~~	~~No~~	**N.t.**[2]

Further test results are attached	~~Yes~~	**No**	Page no.

Test equipment used: ---

N.t.* See page no. 25

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 degrees 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 above 1 GHz are covered in Clause 8 of ANSI C63.4-2014. The 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. Subclause 8.3.1.2 of 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 beamwidth of the measurement antenna.

While the “bore-sighting” technique is not explicitly mentioned in 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 beamwidth 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.

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

Radiated emissions test characteristics	
Frequency range	30 MHz - 4,000 MHz
Test distance	3 m*
Test instrumentation resolution bandwidth	120 kHz (30 MHz - 1,000 MHz)
	1 MHz (1000 MHz - 4,000 MHz)
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) = 39.8

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

8.4.4 Result

RADIATION EMISSIONS BELOW 30 MHz (Section 15.205, 15.209)									
f (MHz)	Bandwidth (kHz) Type of detector	Noted receiver level **dBµV**	Test distance **m**	Correction factor **dB**	Distance extrapol. factor **dB**	Level corrected **dBµV/m**	Limit **dBµV/m**	Margin **dBµV/m**	Polarisation EUT / antenna orientation
0.1249	***QPK/200Hz***	**41.9**	***10***	**18.0**	***-59.1***	**0.8**	***25.7 @ 300***	**24.9**	H,0°/ 100
0.2498	*QPK/9.0kHz*	*< 7.0*	*10*	18.0	*-59.1*	-34.1	*19.6 @ 300*	53.7	V, H/0-360°
0.3747	*QPK/9.0kHz*	*< 7.0*	*10*	18.0	*-59.1*	-34.1	*16.1 @ 300*	50.2	V, H/0-360°
0.4996	*QPK/9.0kHz*	*< 7.0*	*10*	18.0	*-19.1*	+5.9	*33.6 @ 30*	27.7	V, H/0-360°
0.6245	*QPK/9.0kHz*	*< 7.0*	*10*	18.0	*-19.1*	+5.9	*31.7 @ 30*	25.8	V, H/0-360°
0.8743	*QPK/9.0kHz*	*< 7.0*	*10*	18.0	*-19.1*	+5.9	*30.1 @ 30*	24.2	V, H/0-360°
0.9992	*QPK/9.0kHz*	*10.7*	*10*	18.0	*-19.1*	+9.6	*27.6 @ 30*	18.0	V, 0°/ 100
1.1241	*QPK/9.0kHz*	*< 7.0*	*10*	18.0	*-19.1*	+5.9	*26.6 @ 30*	20.7	V, 0°/ 100
1.2490	*QPK/9.0kHz*	10.9	*10*	18.0	*-19.1*	+9.8	*25.7 @ 30*	15.9	V, 0°/ 100
Measurement uncertainty		4 dB							

Remark: *[1] Noise level of the measuring instrument ≤ 4.0dBµV @ 10m distance (0.009 MHz –30 MHz)
Remark: * Peak Limit according to Section 15.35 (b).

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

Further test results are attached	~~Yes~~	**No**	Page no.

Test equipment used: K1a, K40, K56, K83, K84, 103, 166a, 171a, 23, 406

N.t.* See page no. 25

EUT: CAN Immobilizer Key-Plugin **FCC ID: QLXIMMOP** **FCC Title 47 CFR Part 15** **Date of issue: 2016-07-26**

RADIATION EMISSIONS ABOVE 30 MHz (Section 15.205, 15.209)											
f (MHz)	Bandwidth (kHz) Type of detector	Noted receiver level **dBµV**	Test distance **m**	Correction factor **dB**	Distance extrapol. factor **dB**	AV Correction factor **dB**	Level corrected **dBµV/m**	Limit **dBµV/m**	Margin **dBµV/m**	Polaris. EUT / antenna	Antenna height **cm**
88.0	100, AV	**	3	---	0	0	---	---	---	H,V/H,V	100-400
200.0	100, AV	**	3	---	0	0	---	---	---	H,V/H,V	100-400
400.0	100, AV	**	3	---	0	0	---	---	---	H,V/H,V	100-400
600.0	100, AV	**	3	---	0	0	---	---	---	H,V/H,V	100-400
800.0	100, AV	**	3	---	0	0	---	---	---	H,V/H,V	100-400
900.0	100, AV	**	3	---	0	0	---	---	---	H,V/H,V	100-400
1000.0	1000, AV	**	3	---	0	0	---	---	---	H,V/H,V	100-400
Measurement uncertainty		4 dB									

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

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

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

Further test results are attached	~~Yes~~	**No**	Page no.

Test equipment used: K1a, K40, K56, K83, K84, 103, 166a, 171a, 23, 406

N.t.* See page no. 25

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8.5 Bandwidth (20 dB)

8.5.1 Regulation

The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual.

8.5.2 Calculation of the 20 dB bandwidth limit

Within the specified band!

8.5.3 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 subclause, 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.

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 downamplitude" 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 labeled. Tabular data may be reported in addition to the plot(s).

8.5.4 Result

The measured 20 dB bandwidth is: **0.275 kHz**

The measured 99% bandwidth is: **0.861 kHz**

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

Further test results are attached	**Yes**	~~No~~	Annex No. 3

N.t.* See page no. 25

9. Additional information to the test report

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
OATS	Dudde (104)	---	06/2014	10/2016	Dudde
Pre-amplifier (100kHz - 1.3GHz)	Hewlett Packard 8447 E (166a)	1726A00705	07/2014	07/2016	Dudde
Receiver (9 kHz –18.0 GHz)	Rohde & Schwarz Spectrum Analyzer FSL 18 (171a)	100.117	06/2014	09/2017	Rohde & Schwarz
Bilog-antenna (30- 1000 MHz)	Schwarzbeck VULP 9168 (406)	---	05/2015	05/2018	Schwarzbeck
Log. Per, Antenne (1- 18 GHz)	Schwarzbeck STLP 9148 (445a)	---	10/2015	10/2018	Schwarzbeck
Horn antenna (15.0-40.0 GHz)	Schwarzbeck BBHA 9170 (280)	BBHA9170378	08/2014	08/2017	Schwarzbeck
Signal Analyzer (9 kHz –30.0 GHz)	Rohde & Schwarz FSV 30 (502)	100932	06/2016	06/2019	Rohde & Schwarz

Type	Manufacturer/ Model no.	Serial no.	Last calibration	Next calibration	Calibration executed by
Test fixture	Dudde	---	---	---	Dudde
signal generator (10 kHz –5.4 GHz)	Marconi Instruments Low noise signal generator 2042 (6)	119347/003	03/2015	03/2018	Rohde & Schwarz
Frequency counter (10MHz -40.0GHz)	Hewlett & Packard 5351B Microwave frequency counter (432)	3049A01217	11/2015	11/2017	DKD
Receiver (9 kHz –18.0 GHz)	Rohde & Schwarz Spectrum Analyzer FSL 18 (171a)	100.117	06/2014	09/2017	Rohde & Schwarz
RF- cable	Sucoflex 104 P Suhner 2,13m [APC 3.5]	K17a	10/2015	10/2016	Dudde
RF- cable	Sucoflex 104 P Suhner 2,13m [APC 3.5]	K18a	10/2015	10/2016	Dudde

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11. Cable list

Type	Manufacturer/ Model no.	Cable no.	Last calibration	Next calibration	Calibration executed by
RF- cable	Kabelmetal 18m [N]	K1a	10/2015	10/2016	Dudde
RF- cable	Aircell 0.5m [BNC]	K40	10/2015	10/2016	Dudde
RF- cable	Sucoflex 104 Suhner [N] 1 m	K50	10/2015	10/2016	Dudde
RF- cable	Aircell 1m [BNC/N]	K56	10/2015	10/2016	Dudde
RF- cable	Sucoflex 100 Suhner [N] 1 m	K51	10/2015	10/2016	Dudde
RF- cable	Sucoflex 106 Suhner 6,4m [N]	K83	10/2015	10/2016	Dudde
RF- cable	Sucoflex 106 Suhner 6,4m [N]	K84	10/2015	10/2016	Dudde
RF- cable	Sucoflex Suhner 13 m [N]	K144	10/2015	10/2016	Dudde
RF- cable	Sucoflex Suhner 8m [SMA]	K145	10/2015	10/2016	Dudde
RF- cable	Sucoflex Suhner 8m [SMA]	K146	10/2015	10/2016	Dudde

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End of test report

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