PHOENIX TESTLAB

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Test Report

Report Number:

F181948E1, 2nd version

Equipment under Test (EUT):

CloudBoxx 4G Worldwide

Applicant:

INVERS GmbH

Manufacturer:

INVERS GmbH

ilac-MRA

DAkkS
Deutsche
Akkreditierungsstelle
D-PL-17186-01-01
D-PL-17186-01-02
D-PL-17186-01-03

References

[1] **ANSI C63.4:2014** American National Standard for Methods of Measuring of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

[2] **FCC 47 CFR Part 2:** General Rules and Regulations

[3] **FCC 47 CFR Part 15:** Radio Frequency Devices (Subpart B)

[4] **ICES-003 Issue 6: (January 2016)** Spectrum Management and Telecommunications. Interference-Causing Equipment Standard. Information Technology Equipment (Including Digital Apparatus) —Limits and Methods of Measurement

Test Result

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test. The complete test results are presented in the following.

Tested by and written by:	Michael DINTER		09.11.2020
	Name	Signature	Date
Reviewed and approved by:	Bernd STEINER		09.11.2020
	Name	Signature	Date

This test report is only valid in its original form.

The test results herein refer only to the tested sample. PHOENIX TESTLAB GmbH is not responsible for any generalisations or conclusions drawn from these test results concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page necessarily contains the PHOENIX TESTLAB Logo and the TEST REPORT NUMBER.

Contents: Page

1 Identification

1.1 Applicant

Name:	INVERS GmbH
Address:	Untere Industriestr. 20, 57250 Netphen
Country:	Germany
Name for contact purposes:	Mr. Stefan WAGENER
Phone:	0271-23888-0
Fax:	0271-23888-29
eMail address:	Stefan.Wagener@invers.com
Applicant represented during the test by the following person:	None

1.2 Manufacturer

Name:	INVERS GmbH
Address:	Untere Industriestr. 20, 57250 Netphen
Country:	Germany
Name for contact purposes:	Mr. Stefan WAGENER
Phone:	0271-23888-0
Fax:	0271-23888-29
eMail address:	Stefan.Wagener@invers.com
Manufacturer represented during the test by the following person:	None

1.3 Test Laboratory

The tests were carried out by:

PHOENIX TESTLAB GmbH
Königswinkel 10
32825 Blomberg
Germany

Accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-06 and D-PL-17186-01-05, FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.4 EUT (Equipment under Test)

Type of equipment	RFID card reader integrated in CloudBoxx 4G Worldwide
Product model name (PMN):*	CloudBoxx 4G Worldwide
Model name (HVIN):*	CloudBoxx 4G Worldwide
Order No.:*	50529
Serial No.:*	100200000062
FCC ID:*	2ASRACB4GWW01
IC certification number:*	24868-CB4GWW01
PCB identifier:*	0702001725 and 0722000547 redboxx II
Hardware version:*	V1.2.1
Software version (FVIN):*	CloudBoxx 2.0.5-99
Lowest internal frequency:*	32.768kHz
Highest internal frequency:*	2.7 GHz LTE
Antenna type:*	loop antenna

*: declared by the applicant.

Note: Phoenix Testlab GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

1.5 Technical Data of Equipment

EUT						
Power Supply	12 V DC car battery					
Supply voltage EUT: *	U_{nom} =	12 V DC	U_{min} =	30 V DC	U_{max} =	9 V DC

* declared by the applicant.

Ports / Connectors				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
Antenna GPS	FAKRA	Fixed GPS antenna	Appr. 3 m	Yes
Antenna GSM/LTE	FAKRA	Fixed GSM antenna	Appr. 3 m	Yes
Keyholder (RFID antenna)	RJ 12	Fixed RFID antenna	Appr. 2.2 m	Yes
Terminal	RJ 45	Left open *1	-	-
MCR	customized	Left open *1	-	-
Main	Customized 24 pin	Customized	Appr. 2 m	No
MIC (microphone)	3.5 mm audio plug	Fixed at microphone	Appr. 3 m	No
Service	Mini USB	Left open *2	-	-
Log	USB A	Left open *2	-	-
Ext.	Customized 4 pin	Left open *3	-	-

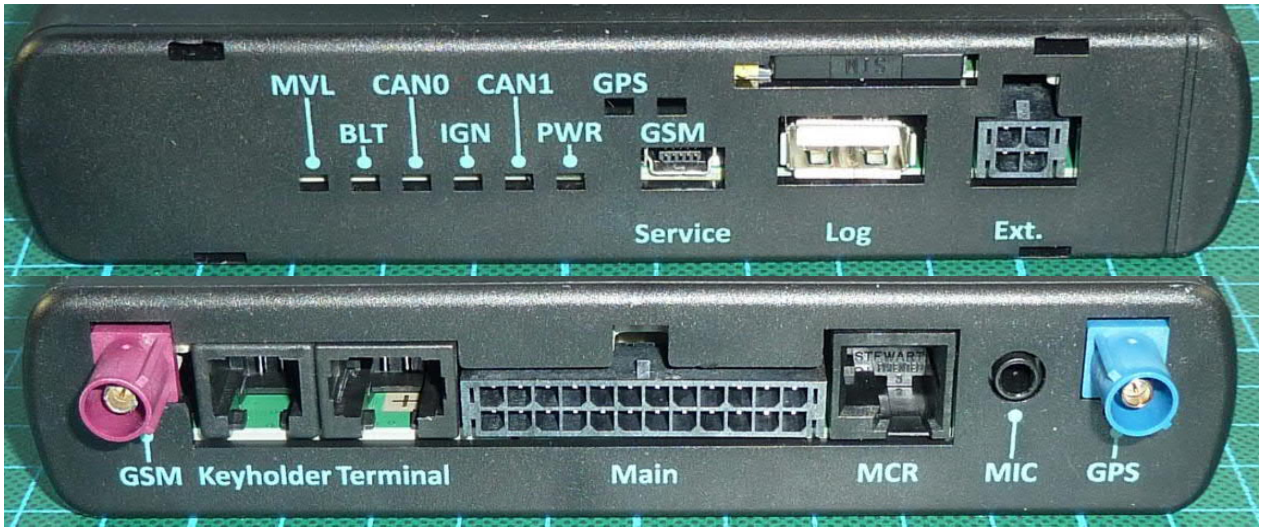
Remark *1: As declared by the applicant the connectors were not in use.
*2: As declared by the applicant the connectors were uses for services only.
*3: As declared by the applicant the connectors were not in use for the test.

Ancillary equipment used for all tests	
Microphone*2:	not labeled
GPS/GSM Antenna*2:	Hirschmann Car Communication Glonass 1890 LP/LC/P/Fakra/3.0 GPS/ GSM-Antenne
Relais*2:	Zettler AZ973-1C-12DC1
Loudspeaker*2:	not labeled

*1 Provided by the laboratory
*2 Provided by the applicant

The EUT was equipped with the following radio modules which were not subject of this test report:	
GSM/UMTS/LTE :	TOBY-R200 (FCC ID:XPY1EHM44NN / IC: 8595A-1EHM44NN)
GNSS:	ublox NEO-M8L-04B-00
Bluetooth:	NINA-B112 (FCC ID: XPYNINAB1 / IC: 8595A-NINAB1)
NFC:	HTRC 11001 Chip from NXP (125 kHz)

Photos connection Ports



1.6 Dates

Date of receipt of test sample:	31.01.2019
Start of test:	15.02.2019
End of test:	22.02.2019

2 Operational States

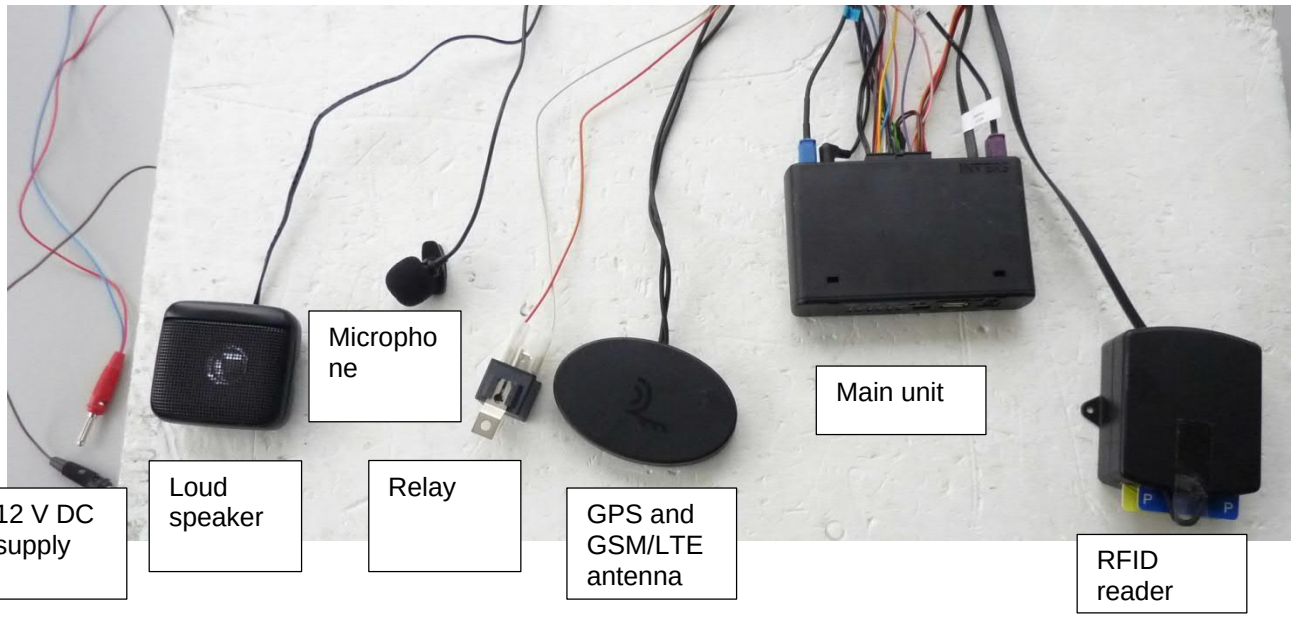
Description of function of the EUT:

- The EUT is a telematics box for car sharing which contains GSM/UMTS/LTE , GNSS and Bluetooth/NFC applications.

The following states were defined as the operating conditions:

During all tests the EUT was supplied by 12 V DC car battery.
Software delivered by the applicant was running and simulates a loop back for the CAN bus function.
GNSS , GSM/UMTS/LTE were in idle mode and a Bluetooth link to a mobile phone with an APP Cloudboxx BLE Analyser (1.0.124) was established.
The microphone and loudspeaker were not in use during the test.
The NFC/RFID reader was active and depending on the test the reader was reading a TAG or awaiting a TAG.
A relays was connected to the main connector and powered by 12 V DC.
No additional SIM card was plugged in the SIM slot. Only the SIM on board card was in use.

The system was setup as follows:



3 Additional Information

The EUT was not labeled as required by FCC / IC.

The internal photos of the RFID antenna were delivered by the applicant in order to keep the tested sample operational because the encapsulated housing could not be opened without destroying.

This test report contains the emission results of the digital part of the equipment under test.

4 Overview

Conducted emissions FCC 47 CFR Part 15 section 15.107 (b) [3] / ICES-003 Issue 6 section 6.1 [4]					
Application	Frequency range	Limits	Reference standard	Remark	Status
AC supply line	0.15 to 0.5 MHz 0.5 to 30 MHz	79 dBµV (QP) 66 dBµV (AV) 73 dBµV (QP) 60 dBµV (AV)	ANSI C63.4	Class A	-
AC supply line	0.15 to 0.5 MHz 0.5 to 5 MHz 5 to 30 MHz	66 to 56 dBµV (QP)* 56 to 46 dBµV (AV)* 56 dBµV (QP) 46 dBµV (AV) 60 dBµV (QP) 50 dBµV (AV)	ANSI C63.4	Class B	Not applicable *
*: Decreases with the logarithm of the frequency					
Radiated emissions FCC 47 CFR Part 15 section 15.109 (b) [3] / ICES-003 Issue 6 section 6.2 [4]					
Application	Frequency range	Limits	Reference standard	Remark	Status
Radiated Emission	30 to 88 MHz 88 to 216 MHz 216 to 960 MHz 960 to 1000 MHz above 1000 MHz	39.0 dBµV /m QP at 10 m 43.5 dBµV /m QP at 10 m 46.5 dBµV /m QP at 10 m 49.5 dBµV /m QP at 10 m 49.5 dBµV /m AV at 10 m and 69.5 dBµV /m PK at 10 m	ANSI C63.4	Class A	-
Radiated Emission	30 to 88 MHz 88 to 216 MHz 216 to 960 MHz 960 to 1000 MHz above 1000 MHz	40.0 dBµV/m QP at 3 m 43.5 dBµV/m QP at 3 m 46.0 dBµV/m QP at 3 m 54.0 dBµV/m QP at 3 m 54.0 dBµV/m AV at 3 m and 74.0 dBµV/m PK at 3 m	ANSI C63.4	Class B	Passed

Remark: As declared by the applicant the highest internal clock frequency is LTE 2.7 GHz. Therefore the radiated emission measurement must be carried out up to 5th of the highest internal clock frequency in this case 14 GHz.

*: Exclusively use in vehicular environment as declared by the applicant.

The EUT was classified by the applicant as CLASS B equipment.

5 Results

5.1 Radiated emissions

5.1.1 Test method

The radiated emission measurement is subdivided into four stages.

- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 30 MHz to 1 GHz.
- A final measurement carried out on an open area test side with reflecting ground plane and various antenna heights in the frequency range 30 MHz to 1 GHz.
- A preliminary measurement carried out in a fully anechoic chamber with a various antenna height of 100 to 250 cm at a distance of 1.90 m to the EUT position in the frequency range 1 GHz to 40 GHz.
- A final measurement carried out in a fully anechoic chamber and various antenna height of 100 to 250 cm at a distance of 1.90 m to the EUT position in the frequency range 1 GHz to 40 GHz.

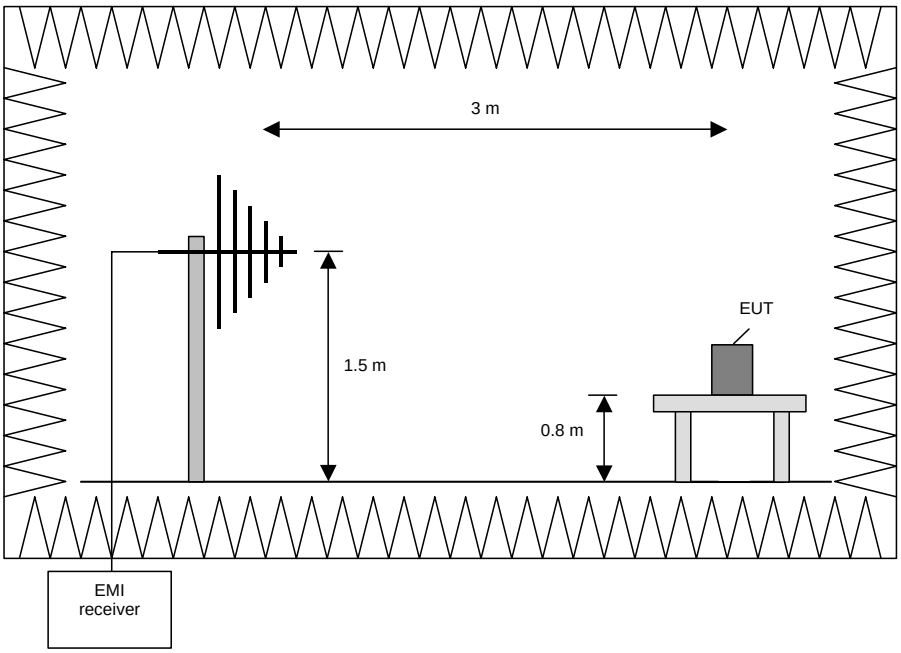
Preliminary measurement (30 MHz to 1 GHz)

In the first stage a preliminary measurement will be performed in a fully anechoic chamber with a measuring distance of 3 meter. Table top devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The setup of the Equipment under test will be in accordance to [1].

The frequency range 30 MHz to 1 GHz will be measured with an EMI Receiver set to MAX Hold mode and a resolution bandwidth of 120 kHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °.

The resolution bandwidth of the EMI Receiver / spectrum analyzer will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	100 kHz



Procedure preliminary measurement:

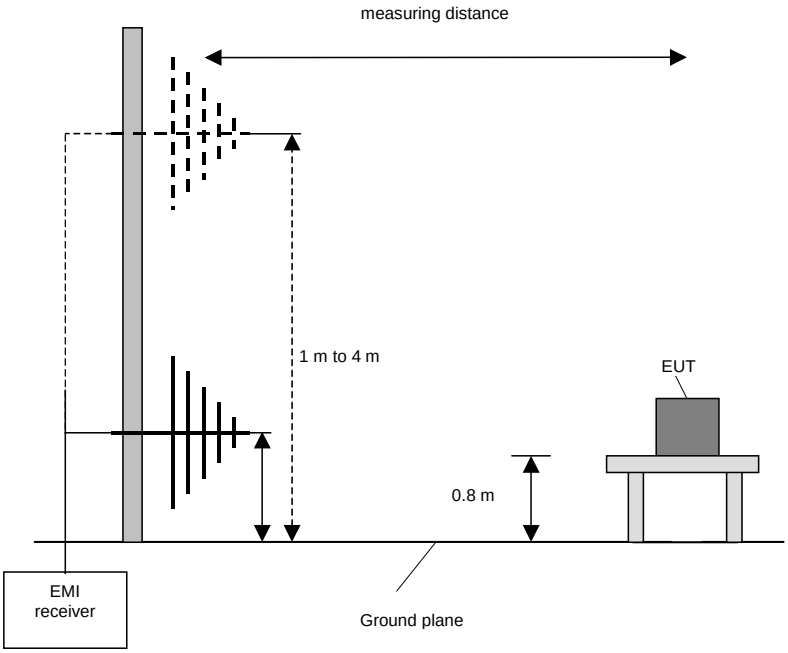
Prescans were performed in the frequency range 30 MHz to 1 GHz.
The following procedure will be used:
Monitor the frequency range at horizontal polarization and a EUT azimuth of 0 °.
Manipulate the system cables within the range to produce the maximum level of emission.
Rotate the EUT by 360 ° to maximize the detected signals.
Make a hardcopy of the spectrum.
Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
Repeat 1) to 4) with the other orthogonal axes of the EUT if handheld equipment.
Repeat 1) to 5) with the vertical polarization of the measuring antenna.

Final measurement (30 MHz to 1 GHz)

A final measurement on an open area test site will be performed on selected frequencies found in the preliminary measurement. During this test the EUT will be rotated in the range of
0 ° to 360 °, the measuring antenna will be set to horizontal and vertical polarization and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	120 kHz



Procedure final measurement:

The following procedure will be used:

Measure on the selected frequencies at an antenna height of 1 m and a EUT azimuth of 23 °.
Move the antenna from 1 m to 4 m and note the maximum value at each frequency.
Rotate the EUT by 45 ° and repeat 2) until an azimuth of 337 ° is reached.
Repeat 1) to 3) for the other orthogonal antenna polarization.
Move the antenna and the turntable to the position where the maximum value is detected.
Measure while moving the antenna slowly +/- 1 m.
Set the antenna to the position where the maximum value is found.
Measure while moving the turntable +/- 45 °.
Set the turntable to the azimuth where the maximum value is found.
Measure with Final detector (QP and AV) and note the value.
Repeat 5) to 10) for each frequency.
Repeat 1) to 11) for each orthogonal axes of the EUT if handheld equipment.

Preliminary and final measurement (1 GHz to 40 GHz)

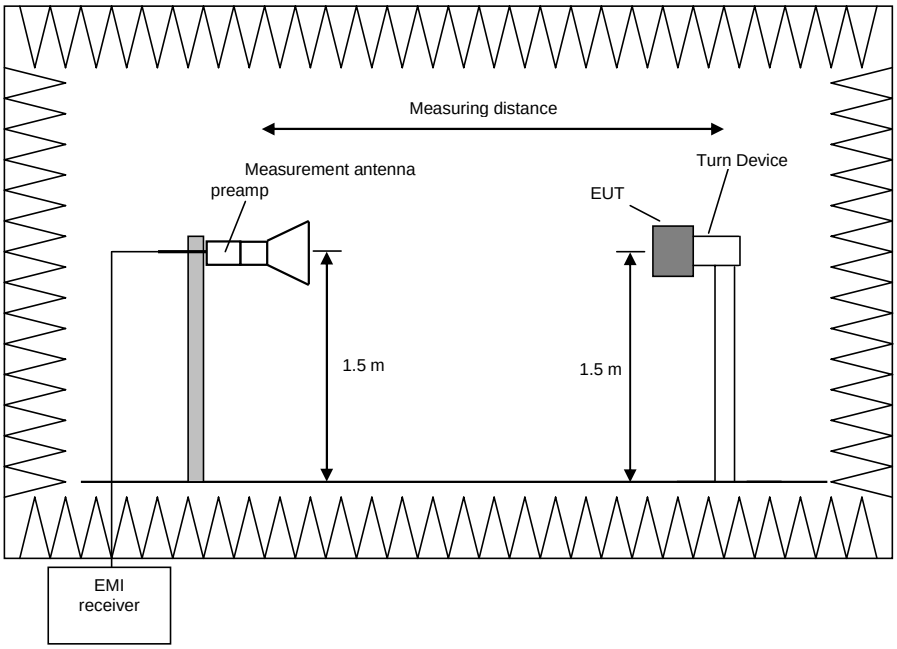
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5 m. The set-up of the Equipment under test will be in accordance to [1].

Preliminary measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The spectrum analyser set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °. This measurement is repeated after raising the EUT in 30 ° steps according to [1].

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz



Procedure preliminary measurement:

Prescans were performed in the frequency range 1 to 40 GHz.
The following procedure will be used:

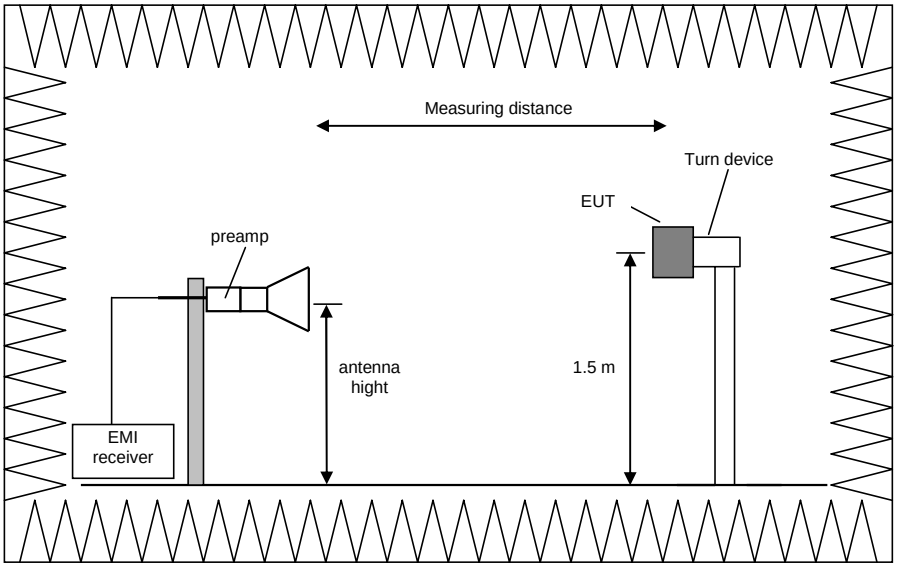
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an angle of 30° (60°, 90°, 120° and 150°).
6. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
7. The measurement antenna polarisation, with the according EUT position (Turntable and Turn device) which produces the highest emission for each frequency will be used for the final measurement. The six closest values to the applicable limit will be used for the final measurement.

Final measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1 MHz. The measurement will be performed by rotating the turntable through 0 to 360° in the worst-case EUT orientation which was obtained during the preliminary measurements.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz



Procedure of measurement:

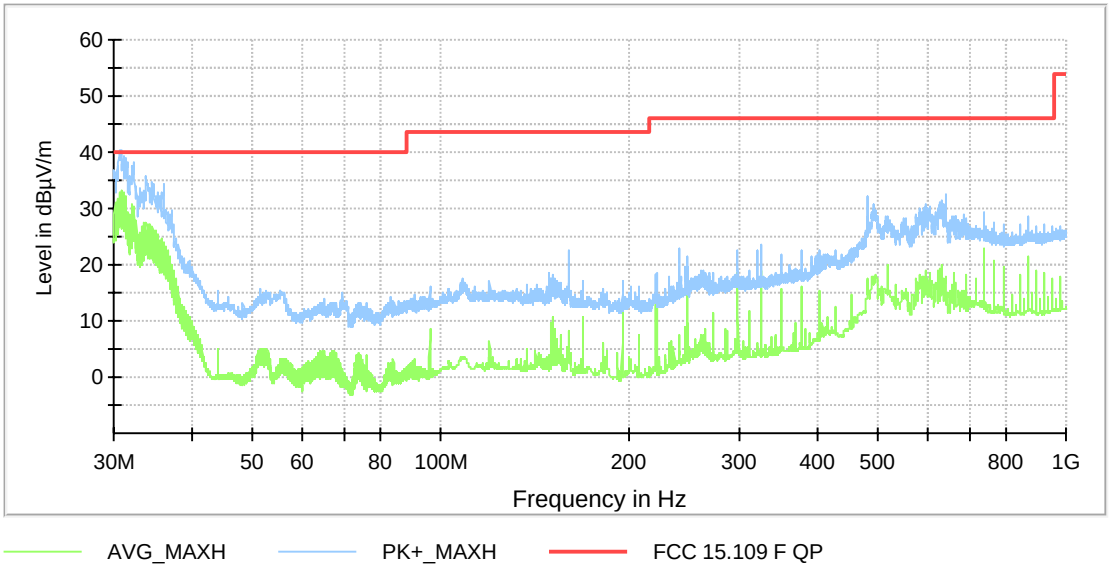
The measurements were performed in the frequency range 1 GHz to 40 GHz.
The following procedure will be used:

1) Set the turntable and the turn device to obtain the worst-case emission for the first frequency identified in the preliminary measurements.
2) Set the measurement antenna polarisation to the orientation with the highest emission for the first frequency identified in the preliminary measurements.
3) Set the spectrum analyser to EMI mode with peak and average detector activated.
4) Rotate the turntable from 0° to 360° to find the EUT angle that produces the highest emissions.
5) Note the highest displayed peak and average values
6) Repeat the steps 1) to 5) for each frequency detected during the preliminary measurements.

5.1.2 Results preliminary measurement 30 MHz to 1 GHz

Ambient temperature:	21°C	Relative humidity:	31 %

Test description:	Radiated emission measurement
EUT:	CloudBoxx 4G Worldwide
Manufacturer:	Invers GmbH
Operating conditions:	NFC TAG reading continuous CAN Loop, GPS and Bluetooth active, GSM/UMTS/LTE in idle mode
Test site:	Phoenix TESTLAB GmbH, anechoic chamber M8
Operator:	M. Dinter
Comment:	12 VDC car battery supply
Date of test	18.02.2019



The following frequencies were found during the preliminary radiated emission test:

Frequency (MHz)
30.612000
30.828000
30.882000
31.380000
36.066000
160.002000
480.012000
640.002000

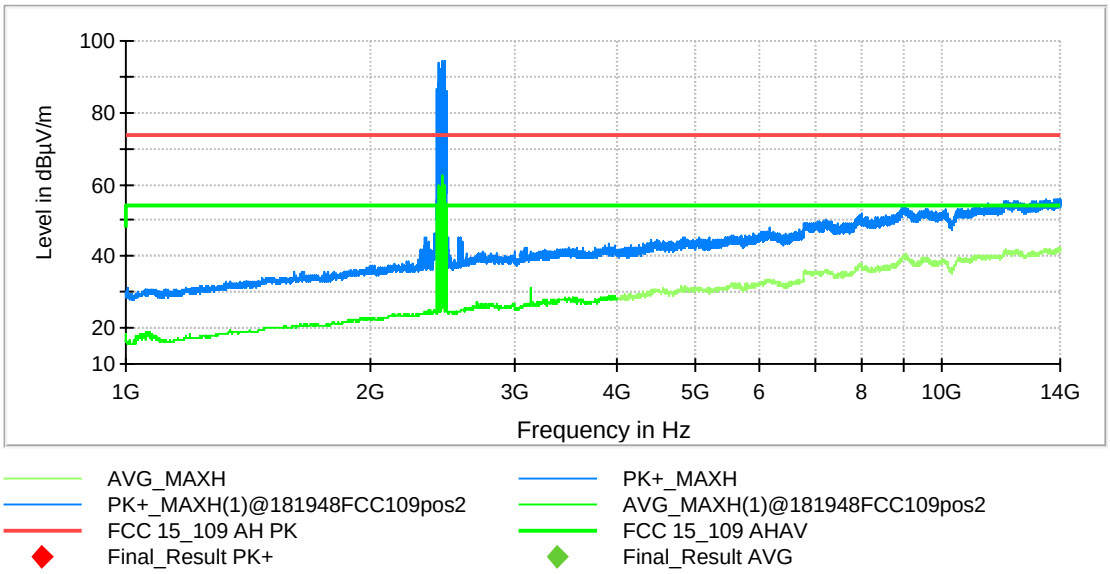
These frequencies have to be measured with in a final measurement.

Test equipment (please refer to chapter 6 for details)
1 – 7, 28

5.1.3 Results preliminary measurement above 1 GHz

Ambient temperature:	21 °C	Relative humidity:	32 %

Test description:	Radiated emission measurement
EUT:	CloudBoxx 4G Worldwide
Manufacturer:	Invers GmbH
Operating conditions:	NFC TAG reading continuous CAN Loop, GPS and Bluetooth active, GSM/UMTS/LTE in idle mode
Test site:	Phoenix TESTLAB GmbH, anechoic chamber M20
Operator:	M. Dinter
Comment:	12 VDC car battery supply
Date of test	19.02.2019



Remark: The emissions around 2.45 GHz were caused by the wanted Bluetooth radio signal and have to be taken not in account for this measurement.

There was more the 15 dB margin to the limit lines.
Therefore no frequencies were found during the preliminary radiated emission test for the final test:

Frequency (MHz)
-

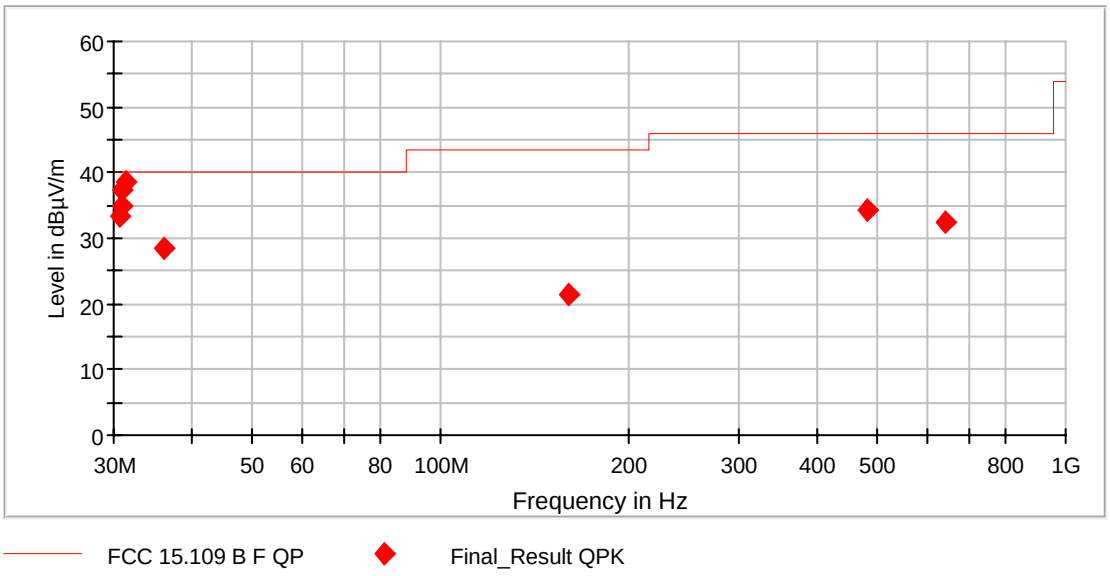
Test equipment (please refer to chapter 6 for details)
8 – 20, 28

5.1.4 Result final measurement from 30 MHz to 1 GHz

Ambient temperature	12 °C	Relative humidity	46 %

Test description:	Radiated emission measurement according to FCC PART 15
EUT:	CloudBoxx 4G Worldwide
Manufacturer:	Invers GmbH
Operating conditions:	NFC TAG reading continuous CAN Loop, GPS and Bluetooth active, GSM/UMTS/LTE in idle mode
Test site:	Phoenix TESTLAB GmbH, OATS M6
Operator:	M.DINTER
Comment:	EMC 32 Version 10.30.00 12V DC car battery supply
Date of test	20.02.2019

The measured points and the limit line in the following diagram refer to the standard measurement of the emitted interference in compliance with the above mentioned standard. The measured points marked with "◆" are the measured results of the standard subsequent measurement on the open area test site.



The results of the standard subsequent measurement on the open area test site are indicated in the table below. The limits as well as the measured results (levels) refer to the above mentioned standard while taking account of the specified requirements for a 3 m measuring distance.

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.612000	33.31	40.00	6.69	1000.0	120.000	109.0	V	146.0	27.0
30.828000	34.89	40.00	5.11	1000.0	120.000	100.0	V	90.0	26.9
30.882000	37.43	40.00	2.57	1000.0	120.000	103.0	V	121.0	26.9
31.380000	38.54	40.00	1.46	1000.0	120.000	107.0	V	136.0	26.7
36.066000	28.61	40.00	11.39	1000.0	120.000	103.0	V	358.0	24.7
160.002000	21.55	43.50	21.95	1000.0	120.000	114.0	V	232.0	18.8
480.012000	34.29	46.00	11.71	1000.0	120.000	179.0	H	201.0	27.2
640.002000	32.59	46.00	13.41	1000.0	120.000	107.0	V	111.0	30.7
Measurement uncertainty				+/- 4.78 dB					

Test: Passed

The correction factor was calculated as follows.

Corr. (dB) = cable attenuation (dB) + 6 dB attenuator (dB) + antenna factor (dB)

Therefore the reading can be calculated as follows:

Reading (dBµV/m) = result QuasiPeak (dBµV/m) - Corr. (dB)

Test equipment (please refer to chapter 6 for details)
6, 21 - 27

5.1.5 Result final measurement above 1 GHz

There were no other emissions except the wanted Bluetooth signal found.
Therefore no final measurements were carried out.

6 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Antenna (BiLog)	CBL6112	Schaffner EMV GmbH (-Chase)	2034	480185	26.03.2017	03.2019
2	EMI Receiver / Spectrum Analyser	ESR7	Rohde & Schwarz	101733	482330	13.03.2018	03.2020
3	Turntable	DS420	Deisel	420/435/97	480186	Calibration not necessary	
4	Fully anechoic chamber M8	B83117-E7019-T231	Siemens	190075	480190	Calibration not necessary	
5	Antenna mast	AS200P	Inn-Co GmbH	AS200P/030/8921004	480455	Calibration not necessary	
6	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
7	Multiple Control Unit	MCU	Maturo GmbH	MCU/039/971107	481353	Calibration not necessary	
8	Antenna mast	AS615P	Deisel	615/310	480187	Calibration not necessary	
9	Fully anechoic chamber M20	B83117-E2439-T232	Albatross Projects	103	480303	Calibration not necessary	
10	Turntable	DS420 HE	Deisel	420/620/00	480315	Calibration not necessary	
11	Multiple Control Unit	MCU	Maturo GmbH	MCU/043/971107	480832	Calibration not necessary	
12	Antenna (Log.Per.)	HL050	Rohde & Schwarz	100438	481170	09.10.2017	10.2020
13	Software	WMS32	Rohde & Schwarz		481800	Calibration not necessary	
14	Preamplifier 100 MHz - 16 GHz	AFS6-00101600-23-10P-6-R	Narda MITEQ	2011215	482333	10.07.2018	07.2020
15	RF-cable No.3	Sucoflex 106B	Suhner	0563/6B / Kabel 3	480670	Calibration not necessary	
16	RF-cable No.38	Sucoflex 106B	Suhner	0709/6B / Kabel 38	481328	Calibration not necessary	
17	HF-Cable	Sucoflex 104	Huber+Suhner	517402	482392	Calibration not necessary	
18	RF-Cable No. 40	Sucoflex 106B	Suhner	0708/6B / Kabel 40	481330	Calibration not necessary	
19	Positioners	TDF 1.5- 10Kg	Maturo	15920215	482034	Calibration not necessary	
20	EMI Receiver / Spectrum Analyser	ESW44	Rohde & Schwarz	101635	482467	29.03.2018	03.2019
21	Open area test site M6	Freifeld M6	Phoenix Contact	-	480085	Calibration not necessary	
22	Antenna mast	MA240-0	Inn-Co GmbH	MA240-0/030/6600603	480086	Calibration not necessary	
23	Turntable	DS412	Deisel	412/316	480087	Calibration not necessary	
24	Controller	HD100	Deisel	100/349	480139	Calibration not necessary	
25	Antenna (Bilog)	CBL6111D	Schaffner Elektrotest GmbH / Teseq GmbH	25761	480894	19.10.2017	10.2020
26	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	28.02.2018	02.2020
27	Attenuator 6 dB	WA2-6	Weinschel	8254	410119	Calibration not necessary	
28	Wideband Radio Communication Tester	CMW500	Rohde&Schwarz	167339	483023	15.04.2019	04.2021

7 Test site Validation

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
OATS M6	480085	30 – 1000 MHz	NSA	ANSI C63.4-2014	25.10.2018	24.10.2020
Fully anechoic chamber M20	480303	1 -18 GHz	SVSWR	CISPR 16-1-4 Amd. 1	13.07.2018	12.07.2020

8 Report History

Report Number	Date	Comment
F181948E1	25.03.2019	Initial Test Report
F181948E1, 2nd version	09.11.2020	Editorial changes

9 List of Annexes

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