

# Test Report

Report Number:

**F181948E2, 2nd version**

Equipment under Test (EUT):

**CloudBoxx 4G Worldwide**

Applicant:

**INVERS GmbH**

Manufacturer:

**INVERS GmbH**



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

## References

- [1] **ANSI C63.10: 2013** American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- [2] **FCC CFR 47 Part 15** Radio Frequency Devices
- [3] **RSS-210 Issue 10 (December 2019)**  
Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
- [4] **RSS-Gen Issue 5 (March 2019) Amendment 1**  
General Requirements for Compliance of Radio Apparatus

## 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 and  
written by:

Michael DINTER

Name



Signature

09.11.2020

Date

Reviewed  
and approved  
by:

Bernd STEINER

Name



Signature

09.11.2020

Date

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# 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

RFID module 125 kHz						
Power Supply	12 V DC car battery					
Supply voltage EUT: *	U <sub>nom</sub> =	12 V DC	U <sub>min</sub> =	30 V DC	U <sub>max</sub> =	9 V DC
Supply voltage RFID module: *	5V DC internal stabilised					
Type of modulation: *	amplitude modulation					
Frequency deviation: *	+/- 5kHz					
Operating frequency range: *	125kHz					
Number of channels: *	1					
Antenna type: *	Internal loop antenna average loop area 4500 mm <sup>2</sup>					
Duty cycle: *	30% (max 150ms each 500ms)					
Rated RF power: *	Max 0,5W					
Data rate: *	2-4kbit					
Temperature range: *	-40°C to +85°C					

\* 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:	20.02.2019

## 2 Operational States

Description of function of the EUT:

- The EUT is a RFID reader which is part of a vehicular telematic device for carsharing applications with GSM/UMTS/LTE , GNSS and Bluetooth/NFC function.

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.

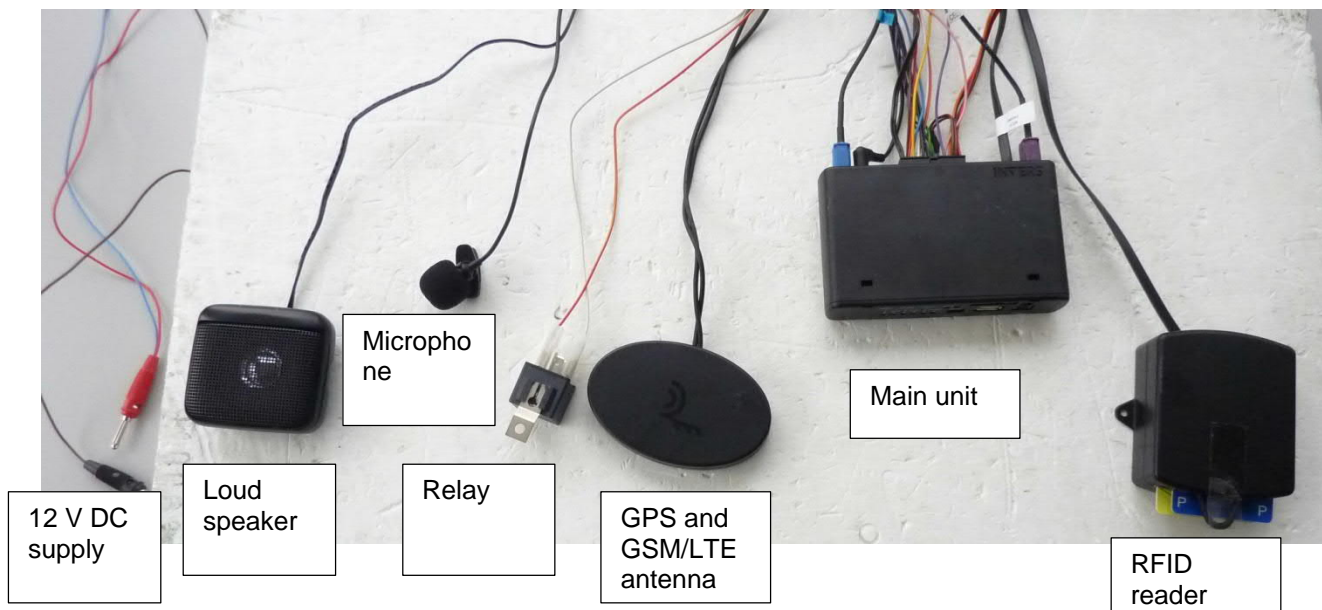
The microphone and loudspeaker were not in use during the test.

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 just covers the emissions of 125 kHz RFID part of the equipment under test.

## 4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-Gen, Issue 5 [4] and RSS-210, Issue 10 [3]	Status	Refer page
Conducted emissions on supply line	0.15 – 30	15.207 (a)	8.8 [4]	Not applicable **	-
Radiated emissions	0.009 – 14000**	15.205 (a) 15.209 (a)	8.9 and 8.10 [4] 7.1 and 7.3 [3]	Passed	10 et seq.
99 % bandwidth	0.125	-	6.7 [4]	Passed	23 et seq.
Antenna requirement	-	15.203 [2]	6.8 [4]	Passed *	-

\*: As declared by the applicant the highest frequency of the in focus NFC radio module is 0.125 MHz. Therefore the radiated emission measurement must be carried out up to 10<sup>th</sup> of the highest radio clock frequency but in this case the highest internal clock frequency as declared by the applicant was LTE 2.7 GHz. Therefore the tests were carried out up to the 5<sup>th</sup> fundamental of the highest internal clock frequency up to 14 GHz.

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

## 5 Results

### 5.1 Radiated emissions

#### 5.1.1 Test method

The radiated emission measurement is subdivided into six stages.

- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 9 kHz to 1 GHz.
- A final measurement carried out on an outdoor test side without reflecting ground plane and a fixed antenna height in the frequency range 9 kHz to 30 MHz.
- 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 fixed antenna height in the frequency range 1 GHz to 40 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 1 GHz to 40 GHz.

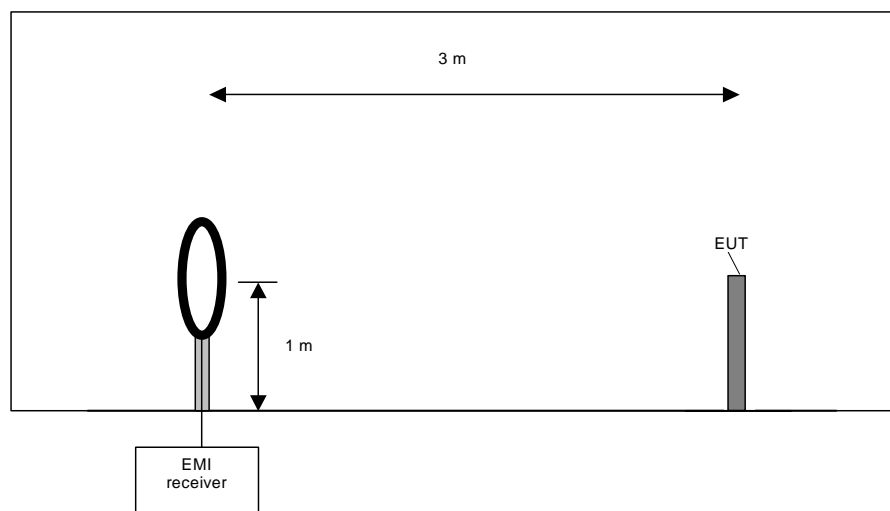
#### **Preliminary measurement (9 kHz to 30 MHz):**

In the first stage a preliminary measurement will be performed in a shielded room with a measuring distance of 3 meters. 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 set up of the Equipment under test will be in accordance to [1].

The frequency range 9 kHz to 30 MHz will be monitored with a spectrum analyser while the system and its cables will be manipulated to find out the configuration with the maximum emission levels if applicable. The EMI Receiver will be set to MAX Hold mode. The EUT and the measuring antenna will be rotated around their vertical axis to found the maximum emissions.

The resolution bandwidth of the spectrum analyser will be set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	10 kHz



### **Preliminary measurement procedure:**

Prescans were performed in the frequency range 9 kHz to 150 kHz and 150 kHz to 30 MHz.

The following procedure will be used:

- 1) Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
- 2) Manipulate the system cables within the range to produce the maximum level of emission.
- 3) Rotate the EUT by 360 ° to maximize the detected signals.
- 4) Make a hardcopy of the spectrum.
- 5) Measure the frequencies of highest detected emission with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
- 6) Repeat steps 1) to 5) with the other orthogonal axes of the EUT (because of EUT is a module and might be used in a handheld equipment application).
- 7) Rotate the measuring antenna and repeat steps 1) to 5).

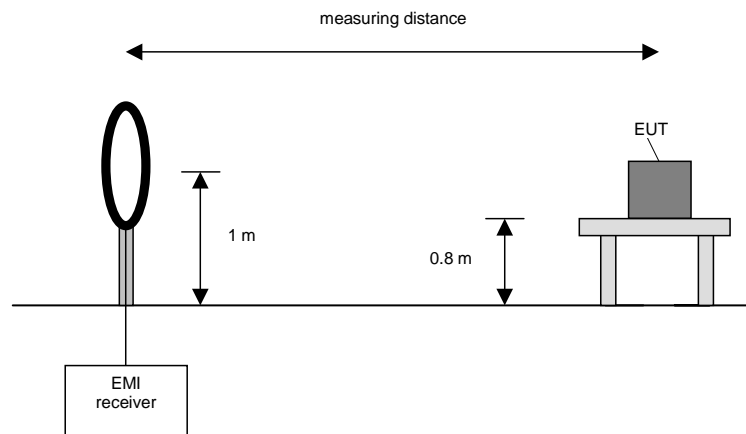
### **Final measurement (9 kHz to 30 MHz):**

In the second stage a final measurement will be performed on an open area test site with no conducting ground plane in a measuring distances of 3 m, 10 m and 30 m. In the case where larger measuring distances are required the results will be extrapolated based on the values measured on the closer distances according to Section 15.31 (f) (2) [2]. The final measurement will be performed with a EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 kHz to 490 kHz where an average detector will be used according Section 15.209 (d) [2].

On the frequencies, which were detected during the preliminary measurements, the final measurement will be performed while rotating the EUT and the measuring antenna in the range of 0 ° to 360 ° around their vertical axis until the maximum value is found.

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

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz



### **Final measurement procedure:**

The following procedure will be used:

- 1) Monitor the frequency range with the measuring antenna at vertical orientation parallel to the EUT at an azimuth of 0 °.
- 2) Rotate the EUT by 360 ° to maximize the detected signals and note the azimuth and orientation.
- 3) Rotate the measuring antenna to find the maximum and note the value.
- 4) Rotate the measuring antenna and repeat steps 1) to 3) until the maximum value is found.
- 5) Repeat steps 1) to 4) with the other orthogonal axes of the EUT (if the EUT is a module and might be used in a handheld equipment application).

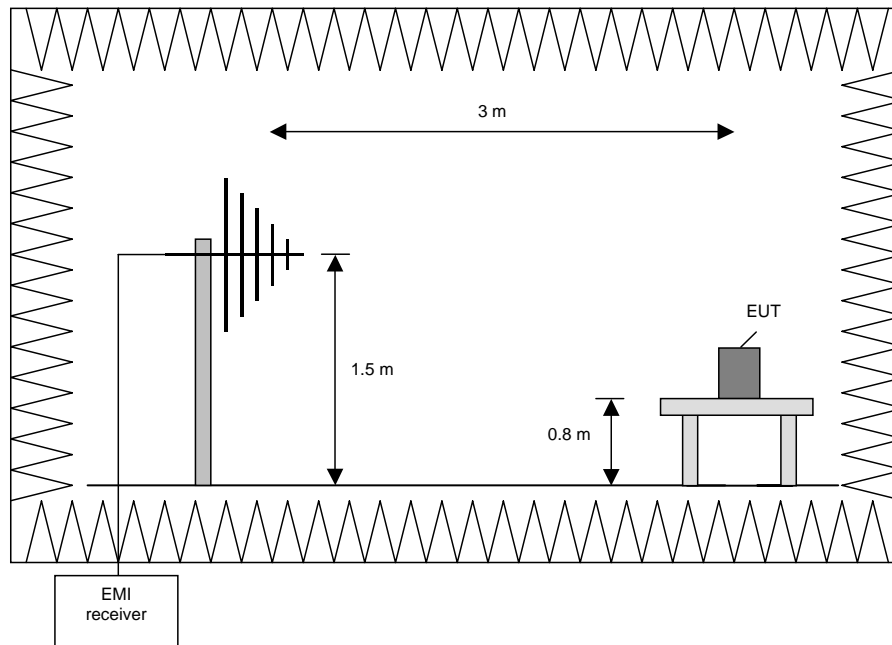
### **Preliminary measurement (30 MHz to 1 GHz)**

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 set-up 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 polarisation 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 will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	120 kHz



### **Procedure preliminary measurement:**

Prescans were performed in the frequency range 30 MHz to 1 GHz.

The following procedure will be used:

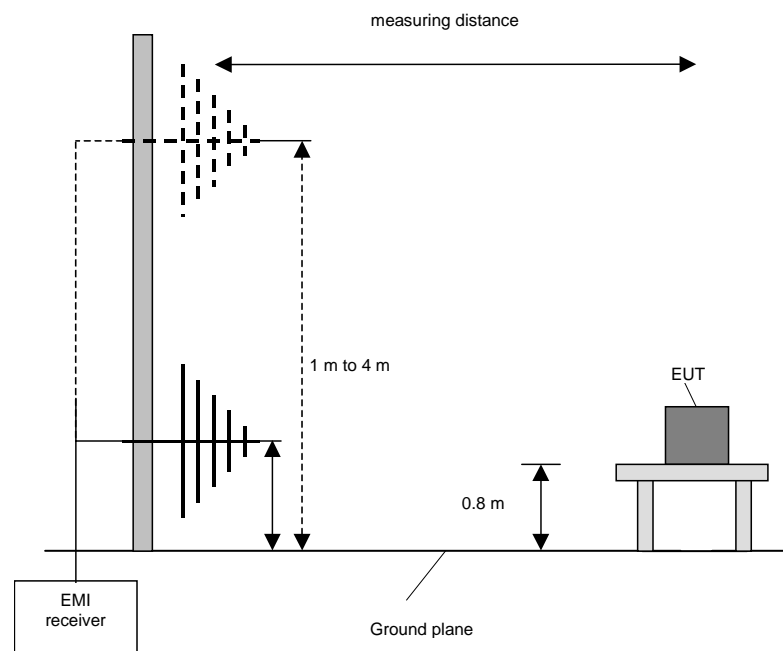
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
6. Repeat 1) to 4) with the other orthogonal axes of the EUT if handheld equipment.
7. Repeat 1) to 5) with the vertical polarisation 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 polarisation 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:

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

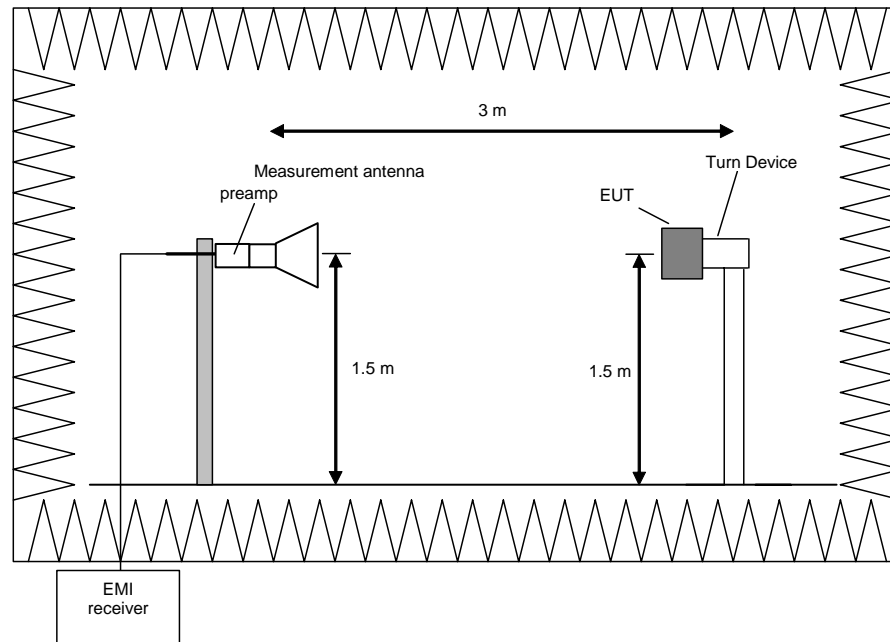
**Preliminary and final measurement (1 GHz to 110 GHz)**

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].

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 6.6.5.4 in [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
40 GHz to 60 GHz	1 MHz
50 GHz to 75 GHz	1 MHz
75 GHz to 110 GHz	1 MHz



### **Procedure preliminary measurement:**

Prescans were performed in the frequency range 1 to 110 GHz.

The following procedure will be used:

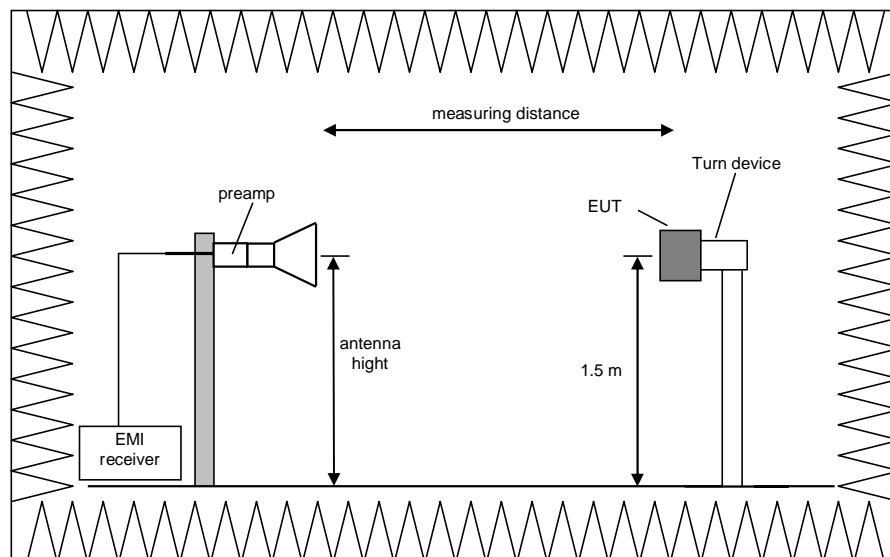
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0°.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an angle of 30° (60°, 90°, 120° and 150°) according to 6.6.5.4 in [1].
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 110 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
40 GHz to 60 GHz	1 MHz
50 GHz to 75 GHz	1 MHz
75 GHz to 110 GHz	1 MHz



### **Procedure of measurement:**

The measurements were performed in the frequency range 1 GHz to 110 GHz.

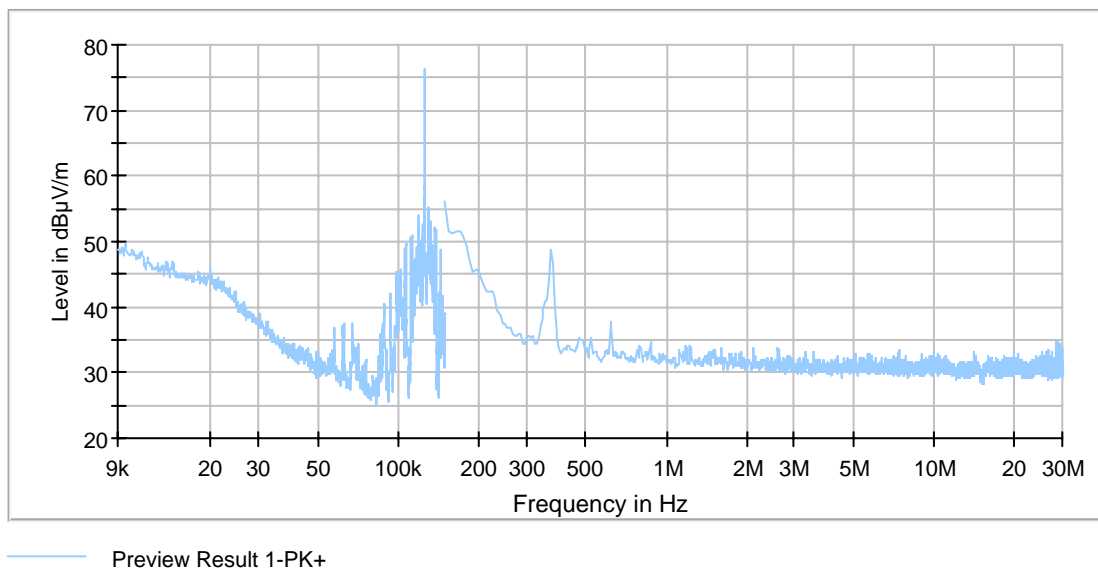
The following procedure will be used:

- 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 9 kHz to 30 MHz

Ambient temperature:	21 C°	Relative humidity:	31%
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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



The following emission was found according to [2] and [3].

The following frequencies were found outside and inside the restricted bands according to FCC 47 CFR Part 15 section 15.209.

Frequency (MHz)
0.125
0.377

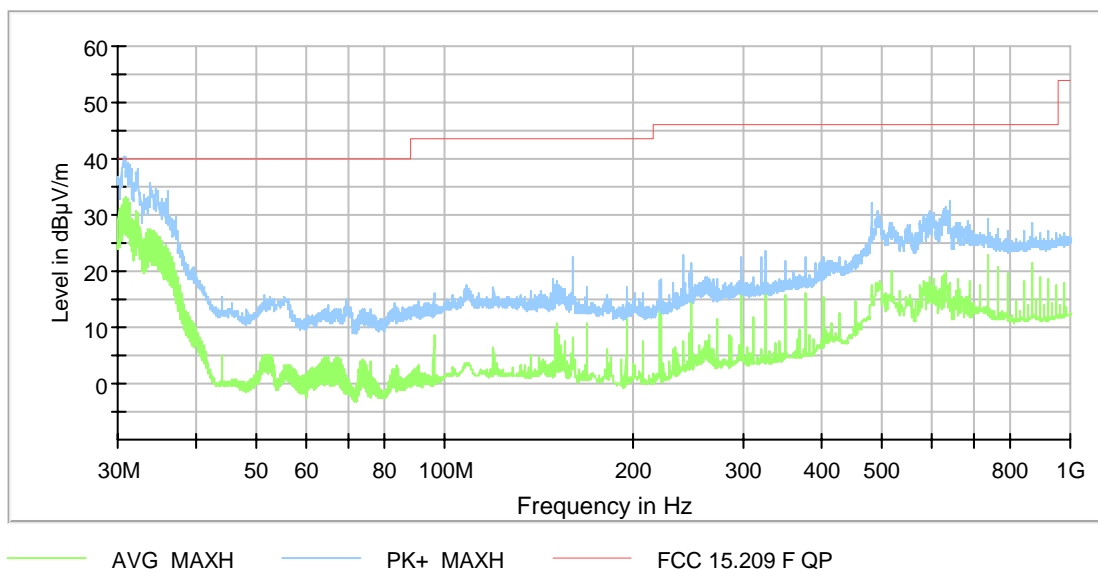
These frequencies have to be measured with in a final measurement.

Test equipment (please refer to chapter 6 for details)
1 – 7, 33

### 5.1.3 Result final measurement from 30 MHz to 1 GHz

Ambient temperature:	21 °C	Relative humidity:	31 %
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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

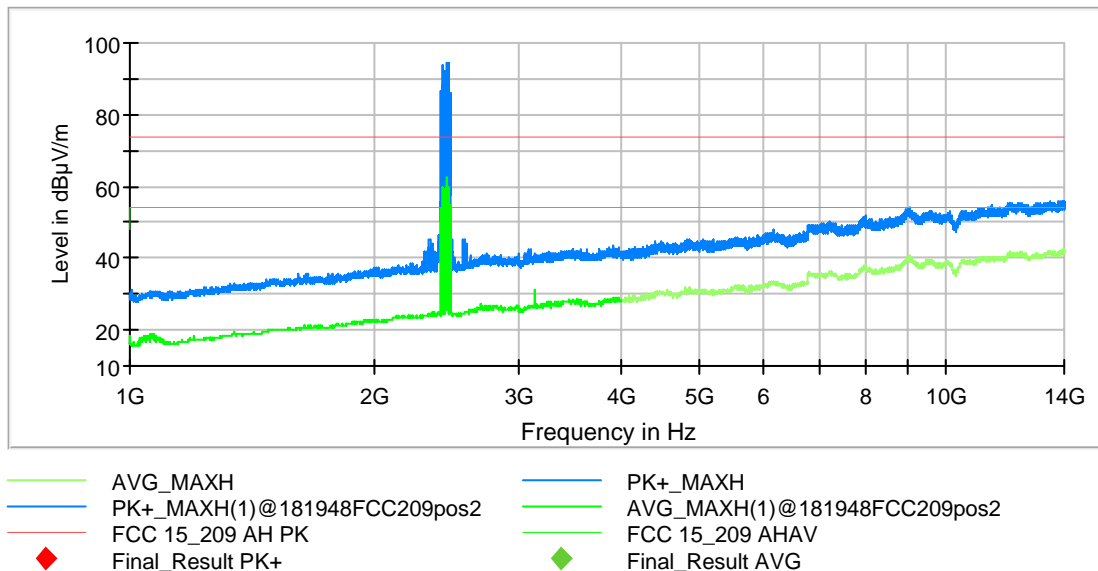
These frequencies have to be measured with in a final measurement.

Test equipment (please refer to chapter 6 for details)
8 – 14, 33

#### 5.1.4 Results preliminary measurement above 1 GHz

Ambient temperature:	21 °C	Relative humidity:	32 %
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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)
1 - 4, 6, 15 – 21, 33

### 5.1.5 Result final measurement from 9 kHz to 30 MHz

Ambient temperature	10 °C	Relative humidity	45 %
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Test description: Radiated emission measurement  
 EUT: CloudBoxx 4G Worldwide  
 Manufacturer: Invers GmbH  
 Operating conditions: NFC TAG reading continuous\*<sup>1</sup> (without TAG\*<sup>2</sup>) CAN Loop, GPS and GSM/UMTS/LTE in idle mode  
 Test site: Phoenix TESTLAB GmbH, Outdoor Test Site  
 Operator: M. DINTER  
 Comment: 12 V DC car battery  
 Date of test: 20.02.2019

The results of the standard subsequent measurement on the outdoor 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 300 m measuring distance.

Results 9kHz - 30 MHz										
Frequency [MHz]	Reading [dBμV]	Result* [dBμV/m]	Result* [dBμA/m]	Limit acc. 15.209 [dBμV/m]	Limit acc. RSS-Gen Table 6 [dBμA/m]	Margin** [dB]	Detector (acc. to §15.209 (d))	Antenna factor [dB/m]	Measuring Distance [m]	Distance correction factor*** [dB]
0.125000* <sup>1</sup>	56.4	-3.3 @ 300m	-54.8 @ 300m	25.7	-25.9	29.0	AV	20.3	3	80.0
0.125000* <sup>1</sup>	20.6	-18.2 @ 300m	-69.7 @ 300m	25.7	-25.9	43.9	AV	20.3	10	59.1
0.125000* <sup>2</sup>	59.7	0 @ 300m	-51.5 @ 300m	25.7	-25.9	25.7	AV	20.3	3	80.0
0.125000* <sup>2</sup>	32.5	-6.3 @ 300m	-57.8 @ 300m	25.7	-25.9	32.0	AV	20.3	10	59.1
0.377000* <sup>2</sup>	29.3	-30.4 @ 300m	-81.9 @ 300m	16.1	-35.4	46.5	AV	20.3	3	80.0
Measurement uncertainty			+/- 4.69 dB							

Remark\*<sup>1</sup>: reading TAGs

Remark\*<sup>2</sup>: without reading TAGs

\* Result @ norm dist = Reading + Antenna factor - Distance correction factor;

Result [dBμA/m] = Result [dBμV/m] - 20\*log(377 Ω)

\*\* Margin = Limit [dBμ{V|A}/m] - Result @ norm dist

\*\*\* 40dB/decade according Part §15.31 (f) (2)

Test: Passed

The test results were calculated with the following formula:

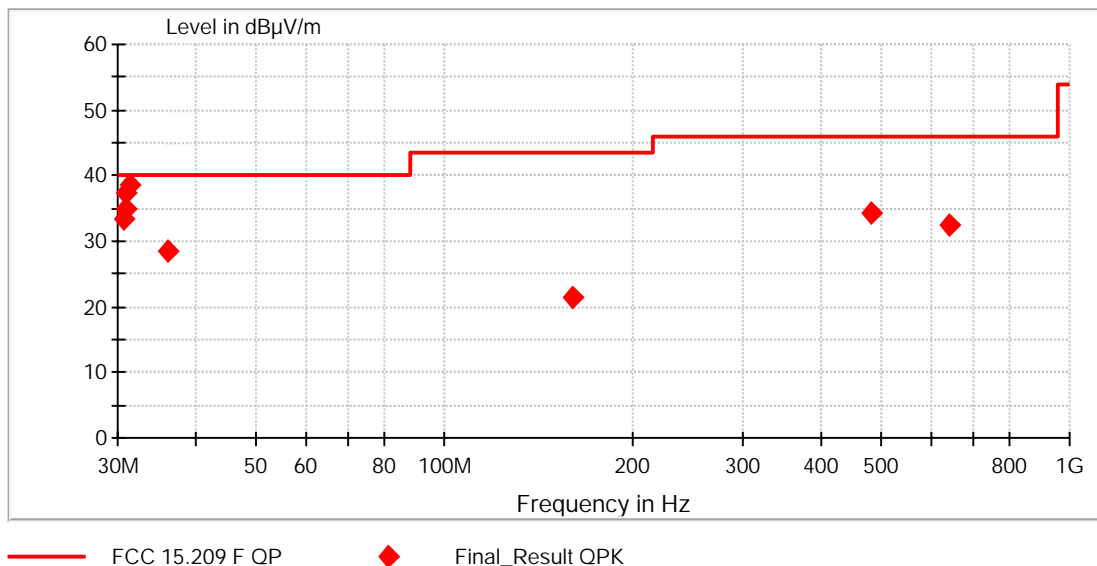
Test equipment (please refer to chapter 6 for details)
7, 22 - 23

### 5.1.6 Result final measurement from 30 MHz to 1 GHz

Ambient temperature	12 °C	Relative humidity	46 %
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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)

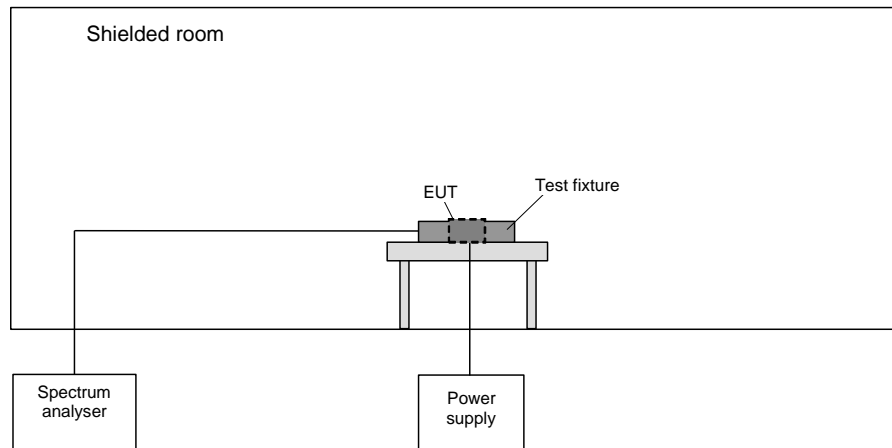
Test equipment (please refer to chapter 6 for details)
13, 24 – 30, 33

### 5.1.7 Result final measurement above 1 GHz

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

## 5.2 99 % bandwidth

### 5.2.1 Test method



The following procedure will be used for the occupied bandwidth measurement according to [1]:

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:

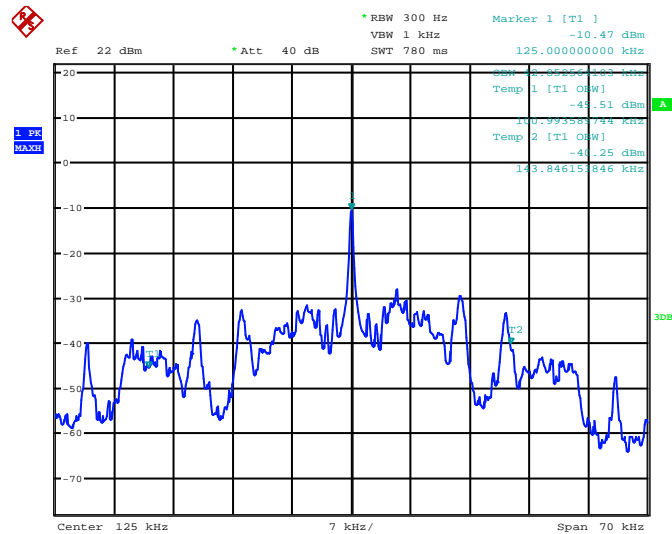
- The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
- 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.
- Step a) through step c) might require iteration to adjust within the specified range.

### 5.2.2 Test results

Ambient temperature: 23 °C

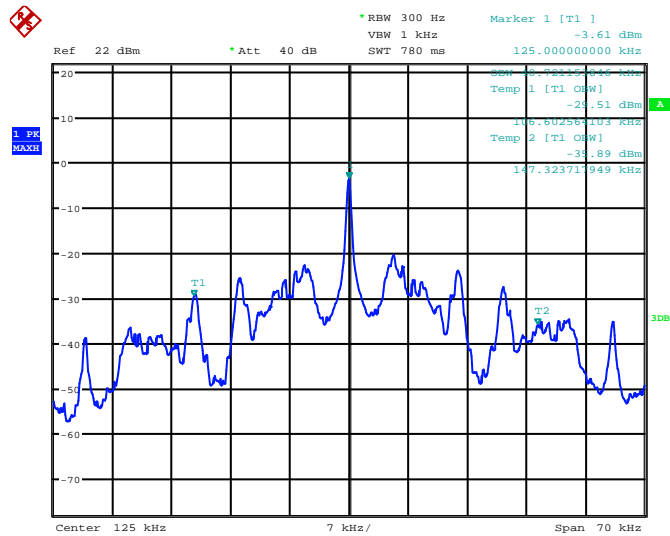
Relative humidity: 41 %

99 % bandwidth with reading a TAG:



$F_L$	$F_U$	BW ( $F_U - F_L$ )
100.994 kHz	143.846 kHz	42.852 kHz
Measurement uncertainty		$< 1 \cdot 10^{-7}$

99 % bandwidth without a TAG:



$F_L$	$F_U$	BW ( $F_U - F_L$ )
106.603 kHz	147.324 kHz	40.721 kHz
Measurement uncertainty		$< 1 \cdot 10^{-7}$

Test: Passed

Test equipment (please refer to chapter 6 for details)

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## 6 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Positioners	TDF 1.5- 10Kg	Maturo	15920215	482034	Calibration not necessary	
2	EMI Receiver / Spectrum Analyser	ESW44	Rohde & Schwarz	101635	482467	29.03.2018	03.2019
3	Fully anechoic chamber M20	B83117-E2439-T232	Albatross Projects	103	480303	Calibration not necessary	
4	Turntable	DS420 HE	Deisel	420/620/00	480315	Calibration not necessary	
5	Antenna support	AS620P	Deisel	620/375	480325	Calibration not necessary	
6	Multiple Control Unit	MCU	Maturo GmbH	MCU/043/971107	480832	Calibration not necessary	
7	loop antenna	HFH2-Z2	Rohde & Schwarz	100417	481912	10.01.2019	01.2020
8	Antenna (BiLog)	CBL6112	Schaffner EMV GmbH (-Chase)	2034	480185	26.03.2017	03.2019
9	EMI Receiver / Spectrum Analyser	ESR7	Rohde & Schwarz	101733	482330	13.03.2018	03.2020
10	Turntable	DS420	Deisel	420/435/97	480186	Calibration not necessary	
11	Fully anechoic chamber M8	B83117-E7019-T231	Siemens	190075	480190	Calibration not necessary	
12	Antenna mast	AS200P	Inn-Co GmbH	AS200P/030/8921004	480455	Calibration not necessary	
13	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
14	Multiple Control Unit	MCU	Maturo GmbH	MCU/039/971107	481353	Calibration not necessary	
15	Antenna mast	AS615P	Deisel	615/310	480187	Calibration not necessary	
16	Antenna (Log.Per.)	HL050	Rohde & Schwarz	100438	481170	09.10.2017	10.2020
17	Software	WMS32	Rohde & Schwarz		481800	Calibration not necessary	
18	Preamplifier 100 MHz - 16 GHz	AFS6-00101600-23-10P-6-R	Narda MITEQ	2011215	482333	10.07.2018	07.2020
19	RF-cable No.3	Sucoflex 106B	Suhner	0563/6B / Kabel 3	480670	Calibration not necessary	
20	HF-Cable	Sucoflex 104	Huber+Suhner	517402	482392	Calibration not necessary	
21	RF-Cable No. 40	Sucoflex 106B	Suhner	0708/6B / Kabel 40	481330	Calibration not necessary	
22	Outdoor test site	-	PHOENIX TESTLAB GmbH	-	480293	Calibration not necessary	
23	EMI Receiver / Spectrum Analyser	ESI 40	Rohde & Schwarz	100064/040	480355	27.02.2018	02.2019
24	Open area test site M6	Freifeld M6	Phoenix Contact	-	480085	Calibration not necessary	
25	Antenna mast	MA240-0	Inn-Co GmbH	MA240-0/030/6600603	480086	Calibration not necessary	
26	Turntable	DS412	Deisel	412/316	480087	Calibration not necessary	
27	Controller	HD100	Deisel	100/349	480139	Calibration not necessary	
28	Antenna (Bilog)	CBL6111D	Schaffner Elektrottest GmbH / Teseq GmbH	25761	480894	19.10.2017	10.2020

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
29	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	28.02.2018	02.2020
30	Attenuator 6 dB	WA2-6	Weinschel	8254	410119	Calibration not necessary	
31	Spectrum Analyser	FSU46	Rohde & Schwarz	200125	480956	31.10.2018	10.2019
32	Lopp antenna	Loop antenna 22.5cm	PHOENIX TESTLAB GmbH	-	410085	Calibration not necessary	
33	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
OATS Outdoor	480293	9 kHz – 30 MHz	-	ANSI C63.4-2014	-	-

## 8 Report History

Report Number	Date	Comment
F181948E2	25.03.2019	Initial Test Report
F181948E2, 2nd version	09.11.2020	Editorial changes and change of Issues from RSS-210 Issue 10 (December 2019), RSS-Gen Issue 5 (March 2019) Amendment 1
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## 9 List of Annexes

Annex A	Test Setup Photos	4 pages
Annex B	EUT External Photos	5 pages
Annex C	EUT Internal Photos	8 pages