

**InterLab<sup>®</sup>**

FCC Measurement/Technical Report on

NFC transceiver

INARI10-LTBN-1

**Report Reference:** MDE\_AAVAM\_1402\_FCCa

FCC ID: 2ABVH-INARI101

IC: 11875A-INARI101

**Test Laboratory:**

7Layers AG  
Borsigstr. 11  
40880 Ratingen  
Germany



**Note:**

The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the test laboratory.

7Layers AG  
Borsigstrasse 11  
40880 Ratingen, Germany  
Phone: +49 (0) 2102 749 0  
Fax: +49 (0) 2102 749 350  
www.7Layers.com

Aufsichtsratsvorsitzender •  
Chairman of the Supervisory Board:  
Peter Mertel  
Vorstand • Board:  
Dr. H.-J. Meckelburg  
Dr. H. Ansorge

Registergericht • registered in:  
Düsseldorf, HRB 44096  
USt-IdNr • VAT No.:  
DE 203159652  
TAX No. 147/5869/0385

## Table of Contents

<b>0</b>	<b>Summary</b>	<b>3</b>
0.1	Technical Report Summary	3
0.2	Measurement Summary	4
<b>1</b>	<b>Administrative Data</b>	<b>5</b>
1.1	Testing Laboratory	5
1.2	Project Data	5
1.3	Applicant Data	5
1.4	Manufacturer Data	5
<b>2</b>	<b>Test object Data</b>	<b>6</b>
2.1	General EUT Description	6
2.2	EUT Main components	7
2.3	Ancillary Equipment	7
2.4	Auxiliary Equipment	7
2.5	EUT Setups	8
2.6	Operating Modes	8
2.7	Special software used for testing	8
2.8	Product labelling	8
<b>3</b>	<b>Test Results</b>	<b>9</b>
3.1	Conducted emissions (AC power line)	9
3.2	Spurious radiated emissions	11
3.3	Occupied bandwidth	15
3.4	Spectrum mask	16
3.5	Frequency tolerance	17
<b>4</b>	<b>Test Equipment</b>	<b>19</b>
<b>5</b>	<b>Photo Report</b>	<b>25</b>
<b>6</b>	<b>Setup Drawings</b>	<b>25</b>
<b>7</b>	<b>FCC and IC Correlation of measurement requirements</b>	<b>26</b>
<b>8</b>	<b>Annex measurement plots</b>	<b>27</b>
8.1	Radiated emissions	27
8.2	AC Mains conducted	30
8.3	Occupied bandwidth	31
8.4	Spectrum mask	33

## 0 Summary

### 0.1 Technical Report Summary

#### Type of Authorization

Certification for an intentional radiator operating at 13.56 MHz

#### Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 (10-1-13 Edition) and 15 (10-1-13 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 15, Subpart C – Intentional Radiators

§ 15.205 Restricted bands of operation

§ 15.207 Conducted limits

§ 15.209 Radiated emission limits; general requirements

§ 15.215 Additional provisions to the general radiated emission limitations

§ 15.225 Operation within the band 13.110-14.010 MHz

#### Note:

Instead of applying ANSI C63.4–1992, which is referenced in the FCC Public Note, the newer ANSI C63.4–2009 is applied.

#### Summary Test Results:

**The EUT complied with all performed tests as listed in chapter 0.2 Measurement Summary.**

## 0.2 Measurement Summary

### FCC Part 15, Subpart C § 15.207

Conducted Emissions AC Power line

The measurement was performed according to ANSI C63.4

2009

OP-Mode	Setup	Port	Final Result
op-mode 1	Setup_01	AC port (power line)	passed

### FCC Part 15, Subpart C §15.209

Radiated Emissions

The measurement was performed according to ANSI C63.4

2009

OP-Mode	Setup	Port	Final Result
op-mode 1	Setup_01	Enclosure	passed

### FCC Part 15, Subpart C § 15.215

Occupied Bandwidth

The measurement was performed according to FCC § 2.1049

10-1-13 Edition

OP-Mode	Setup	Port	Final Result
op-mode 1	Setup_02	Enclosure	passed

### FCC Part 15, Subpart C § 15.225

Spectrum Mask

The measurement was performed according to ANSI C63.4

2009

OP-Mode	Setup	Port	Final Result
op-mode 1	Setup_01	Enclosure	passed

### FCC Part 15, Subpart C § 15.225

Frequency Tolerance

The measurement was performed according to FCC § 2.1055

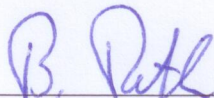
10-1-13 Edition

OP-Mode	Setup	Port	Final Result
op-mode 2	Setup_01	Enclosure	passed

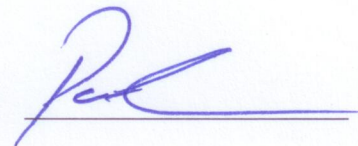
## 0.3 Report revision

Report version control			
Version	Release date	Changes	Version validity
001	29.09.2014	Section 4 of the initial version	valid

Responsible for  
Accreditation Scope:



Responsible  
for Test Report:



## 1 Administrative Data

### 1.1 Testing Laboratory

Company Name: 7Layers AG  
Address Borsigstr. 11  
40880 Ratingen  
Germany

This facility has been fully described in a report submitted to the FCC and accepted under the registration number 96716.

The test facility is also accredited by the following accreditation organisation:  
Laboratory accreditation no.: DAkKS D-PL-12140-01-01

Responsible for Accreditation Scope: Dipl.-Ing. Bernhard Retka  
Dipl.-Ing. Robert Machulec  
Dipl.-Ing. Andreas Petz  
Dipl.-Ing. Marco Kullik

Report Template Version: 2012-03-14

### 1.2 Project Data

Responsible for testing and report: Patrick Lomax  
Date of Test(s): 2014-03-21 to 2014-03-24  
Date of Report: 2014-09-29

### 1.3 Applicant Data

Company Name: Aava Mobile Oy  
Address: Nahkatehtaankatu 2  
90130 Oulu  
Finland  
Contact Person: Mr. Kari Räisänen  
Phone: +3588373800  
Fax: +49 (0) 2102 749 380  
E-Mail: kari.raisanen@aavamobile.com

### 1.4 Manufacturer Data

Company Name: please see applicant data

Address:

Contact Person:

## 2 Test object Data

### 2.1 General EUT Description

<b>Equipment under Test</b>	Tablet computer with embedded cellular modem and WLAN/BT
<b>Type Designation:</b>	INARI10-LTBN-1
<b>Kind of Device:</b>	13.56 MHz NFC transceiver
<b>(optional)</b>	
<b>Voltage Type:</b>	DC of AC/DC converter or DC (internal battery)
<b>Voltage level:</b>	120 – 240 V, 50 – 60 Hz AC / 3.8 V DC

#### General product description:

The INARI10-LTBN-1 is a tablet computer with embedded cellular modem and WLAN/BT. It supports the following technologies: WCDMA, HSDPA, HSUPA, HSPA+, GPRS, EDGE and LTE for cellular communication, IEEE 802.11 a/b/g/n for WiFi, Bluetooth 4.0 + HS and NFC transceiver. The EUT has a built in GPS receiver as well.

This tablets (INARI10-LTBN-1) implements the identical NFC radio system from the previously tested Inari8-3GAN-1 (FCC ID: 2ABVH-INAR81) and inherits the results from its testing.

#### Specific product description for the EUT:

The object of this test report is the NFC transceiver, operating in 13.56 MHz frequency range.

#### The EUT provides the following ports:

##### Ports

- Enclosure
- AC in (@ charger)
- DC in (Micro USB interface @ tablet)
- Audio Jack (3.5 mm @ tablet)
- Data (USB 2.0 Port @ tablet)
- DC in (12 V @ docking station)
- Data (LAN @ docking station)
- Data (docking connector)
- Data (2 x USB 2.0 Port @ docking station)
- Data (1 x USB 3.0 Port @ docking station)
- Data (HDMI @ docking station)

The main components of the EUT are listed and described in Chapter 2.2.



## 2.2 EUT Main components

### Type, S/N, Short Descriptions etc. used in this Test Report

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status	Date of Receipt
EUT A (Code: DE1004000ab01)	Inari8-3GAN-C1 *	Variant: AB-W, B	IN140 60109	Pre-Prod Sample IMEI: 866274011175167	Win.8.1 Pro.	-
Remark:	EUT A is equipped with an integral antenna (gain = 2.15 dBi).					
EUT B (Code: DE1004000ad02)	Inari8-3GAN-A1*	Variant: AB-W, B	IN140 60123	Pre-Prod Sample IMEI: 866274011175209	Win.8.1 Pro.	-
Remark:	EUT B is equipped with an integral antenna (gain = 2.15 dBi).					

**NOTE:** The short description is used to simplify the identification of the EUT in this test report.

\* This tablets (INARI10-LTBN-1) implements the identical NFC radio system from the previously tested Inari8-3GAN-1 (FCC ID: 2ABVH-INAR81) and inherits the results from its testing.

## 2.3 Ancillary Equipment

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status	FCC ID
AE 1	Docking Station (DS)	AavaMobile	XHH40560983	-	-	-
AE 2	AC/DC adapter for DS (USA st.)	Toshiba, Model: PA396U-1ACA	G71C000CK110; TO113510001671A	-	-	-
AE 3	USB Cable, Type A <=> Micro USB	28AWG/1P+24A WG/2C E326508, AWM 2725, 1m	-	-	-	-
AE 4	dummy battery module	AavaMobile/ INARI	#3	-	-	-

## 2.4 Auxiliary Equipment

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Auxiliary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	Serial no.	HW Status	SW Status	FCC ID
AUX 1 (Code DE1004000 tag1)	NFC Tag	UPM RAFLATRAC Race Track		25_17	-	-

## 2.5 EUT Setups

This chapter describes the combination of EUTs and equipment used for testing. The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards.

Setup No.	Combination of EUTs	Description and Rationale
Setup_01	EUT B + AUX 1	EUT reading a tag (representative setup for radiated measurements)
Setup_02	EUT A + AUX 1 + AE 4	EUT reading a tag (representative setup for radiated measurements in normal and extreme conditions)
Setup_03	EUT A + AE 1-3 + AUX 1	EUT reading a tag (representative test for radiated emissions measurements above 30 MHz)
Setup_04	EUT A + AE 1-3 + AUX 1	setup for test "AC Mains conducted"

## 2.6 Operating Modes

This chapter describes the operating modes of the EUTs used for testing.

Op. Mode	Description of Operating Modes	Remarks
op-mode 1	modulated carrier signal	EUT is transmitting a periodic modulated signal and is continuously reading TAG information.

## 2.7 Special software used for testing

NXP Application version 1.6.

## 2.8 Product labelling

### 2.8.1 FCC ID label

Please refer to the documentation of the applicant.

### 2.8.2 Location of the label on the EUT

Please refer to the documentation of the applicant.



## 3 Test Results

### 3.1 Conducted emissions (AC power line)

**Standard** FCC Part 15, Subpart C

**The test was performed according to:** ANSI C63.4

#### 3.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4. The Equipment Under Test (EUT) was setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from 50 $\mu$ H || 50 Ohm Line Impedance Stabilization Network (LISN) which meets the requirements of ANSI C63.4, Annex B, in the frequency range of the measurements. The LISN's unused connections were terminated with 50 Ohm loads.

The measurement procedure consists of two steps. It is implemented into the EMI test software ES-K1 from R&S.

##### Step 1: Preliminary scan

Intention of this step is, to determine the conducted EMI-profile of the EUT.

EMI receiver settings:

- Detector: Peak - Maxhold
- Frequency range: 150 kHz – 30 MHz
- Frequency steps: 5 kHz
- IF-Bandwidth: 9 kHz
- Measuring time / Frequency step: 20 ms
- Measurement on phase + neutral lines of the power cords
- AC Mains supplied at 120 V / 60 Hz

On basis of this preliminary scan the highest amplitudes and the corresponding frequencies relative to the limit are identified. Emissions above the limit and emissions which are in the 10 dB range below the limit are considered.

##### Step 2: Final measurement

Intention of this step is, to determine the highest emissions with the settings defined in the test specification for the frequencies identified in step 1.

EMI receiver settings:

- Detector: Quasi-Peak
- IF - Bandwidth: 9 kHz
- Measuring time: 1 s / frequency

At each frequency determined in step 1, four measurements are performed in the following combinations:

- 1) Neutral lead - reference ground (PE grounded)
- 2) Phase lead - reference ground (PE grounded)
- 3) Neutral lead - reference ground (PE floating)
- 4) Phase lead - reference ground (PE floating)

The highest value is reported.

### 3.1.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.207

Frequency Range (MHz)	QP Limit (dB $\mu$ V)	AV Limit (dB $\mu$ V)
0.15 – 0.5	66 to 56	56 to 46
0.5 – 5	56	46
5 – 30	60	50

Used conversion factor: Limit (dB $\mu$ V) = 20 log (Limit ( $\mu$ V)/1 $\mu$ V).

### 3.1.3 Test Protocol

Temperature: 23 °C  
Air Pressure: 1009 hPa  
Humidity: 39 %

Op. Mode	Setup	Port
op-mode 1	Setup_04	AC Port (power line)

Power line	Frequency MHz	Measured value dB $\mu$ V	Delta to limit dB $\mu$ V	Remarks
L1	0.210	51.3	11.9	QP-detector
N	0.280	42.0	18.8	QP-detector
N	0.420	38.2	19.2	QP-detector
L1	13.560	45.7	4.3	QP-detector

Remark: Please see annex for the measurement plot.

The operating frequency (wanted signal / carrier) of the EUT is set to 13.56 MHz (NFC) by the manufacturer and cannot be changed.

The conducted emission found in the last row of the table above, clearly corresponds to the fixed transmitter frequency of the EUT. It was determined, that this emission on the AC mains is based on radiated coupling into the test setup. Therefore, for the assessment of the test result, the fixed transmitter frequency of the EUT is not considered.

The chosen operating mode is selected as representative mode to generate "worst-case" conditions, i.e. high power consumption.

### 3.1.4 Test result: Conducted emissions (AC power line)

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed

## 3.2 Spurious radiated emissions

**Standard** FCC Part 15, Subpart C

**The test was performed according to:** ANSI C63.4

### 3.2.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m<sup>2</sup> in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.

The measurement procedure is implemented into the EMI test software ES-K1 from R&S. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is performed at 2 axes. A pre-check is also performed while the EUT is powered from both AC and DC (battery) power in order to find the worst-case operating condition.

#### 1. Measurement up to 30 MHz

The Loop antenna HFH2-Z2 is used.

**Step 1:** pre measurement

- Anechoic chamber
- Antenna distance: 10 m
- Detector: Peak-Maxhold
- Frequency range: 0.009 – 0.15 and 0.15 – 30 MHz
- Frequency steps: 0.1 kHz and 5 kHz
- IF-Bandwidth: 0.2 kHz and 10 kHz
- Measuring time / Frequency step: 100 ms

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

**Step 2:** final measurement

For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is to find the maximum emission level.

- Open area test side
- Antenna distance: according to the Standard
- Detector: Quasi-Peak
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF-Bandwidth: 200 Hz – 10 kHz
- Measuring time / Frequency step: 100 ms

## 2. Measurement above 30 MHz and up to 1 GHz

### Step 1: Preliminary scan

Preliminary test to identify the highest amplitudes relative to the limit.

Settings for step 1:

- Antenna distance: 3 m
- Detector: Peak-Maxhold
- Frequency range: 30 – 1000 MHz
- Frequency steps: 60 kHz
- IF-Bandwidth: 120 kHz
- Measuring time / Frequency step: 100  $\mu$ s
- Turntable angle range:  $-180^\circ$  to  $180^\circ$
- Turntable step size:  $90^\circ$
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

### Step 2: second measurement

For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is, to find out the approximate turntable angle and antenna height for each frequency.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range:  $-180^\circ$  to  $180^\circ$
- Turntable step size:  $45^\circ$
- Height variation range: 1 – 4 m
- Height variation step size: 0.5 m
- Polarisation: horizontal + vertical

After this step, the EMI test system has determined the following values for each frequency (of step 1):

- Frequency
- Azimuth value (of turntable)
- Antenna height

The last two values have now the following accuracy:

- Azimuth value (of turntable):  $45^\circ$
- Antenna height: 0.5 m

### Step 3: final measurement

In this step, the accuracy of the turntable azimuth and antenna height will be improved.

This is necessary to find out the maximum value of every frequency.

For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will be slowly varied by  $\pm 22.5^\circ$  around this value.

During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position the antenna height is also slowly varied by  $\pm 25$  cm around the antenna height determined.

During this action, the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range:  $-22.5^\circ$  to  $+22.5^\circ$  around the determined value
- Height variation range:  $-0.25$  m to  $+0.25$  m around the determined value

**Step 4:** final measurement with QP detector

With the settings determined in step 3, the final measurement will be performed:

EMI receiver settings for step 4:

- Detector: Quasi-Peak (< 1 GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

After the measurement a plot will be generated, which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

**3.2.2 Test Requirements / Limits**

FCC Part 15, Subpart C, §15.247 (d)

... In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit(dBµV/m @10m)
0.009 – 0.49	2400/F(kHz)	300	Limit (dBµV/m) +59.1dB
0.49 – 1.705	24000/F(kHz)	30	Limit (dBµV/m) +19.1dB
1.705 – 30	30	30	Limit (dBµV/m) +19.1dB

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit (dBµV/m)
30 – 88	100	3	40.0
88 – 216	150	3	43.5
216 – 960	200	3	46.0
above 960	500	3	54.0

§15.35(b)

..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

### 3.2.3 Test Protocol

Temperature: 23 – 24 °C  
 Air Pressure: 1009 – 1011 hPa  
 Humidity: 38 – 41 %

#### 3.2.3.1 Measurement up to 30 MHz

Op. Mode	Setup	Port
op-mode 1	Setup_01	Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
-	-	-	-	-	-	-	-	-	-

Remark: No spurious emissions in the range 20 dB below the limit found therefore step 2 was not performed. Please refer to the plot in the annex.

#### 3.2.3.2 Measurement above 30 MHz

Op. Mode	Setup	Port
op-mode 1	Setup_03	Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
vertical	30.120	27.6	-	-	40.0	-	-	12.4	-
vertical	30.780	29.5	-	-	40.0	-	-	10.5	-
vertical	31.320	27.7	-	-	40.0	-	-	12.3	-
vertical	48.000	27.4	-	-	40.0	-	-	12.6	-
vertical	49.080	24.4	-	-	40.0	-	-	15.6	-
vertical	72.000	27.2	-	-	40.0	-	-	12.8	-
vertical	87.960	33.1	-	-	40.0	-	-	6.9	-
vertical	103.980	40.1	-	-	43.5	-	-	3.4	-
vertical	180.000	36.0	-	-	43.5	-	-	7.5	-
horizontal	939.960	33.6	-	-	46.0	-	-	12.4	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found. Please see annex for the measurement plot.

### 3.2.4 Test result: Spurious radiated emissions

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed



### 3.3 Occupied bandwidth

**Standard** FCC Part 15, Subpart C

**The test was performed according to:** FCC §15.31

#### 3.3.1 Test Description

The Equipment Under Test (EUT) was setup in a shielded room to perform the occupied bandwidth measurements.

The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

The results recorded were measured with the modulation which produces the worst-case (widest) occupied bandwidth.

#### 3.3.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.215 (c)

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. ...

#### 3.3.3 Test Protocol

Temperature: 23 °C  
 Air Pressure: 1010 hPa  
 Humidity: 39 %

Op. Mode	Setup	Port
op-mode 1	Setup_02	Enclosure

20 dB bandwidth kHz	99% bandwidth kHz	Remarks
40.080 kHz	430.862 kHz	The 99% bandwidth from 13.346072 MHz to 13.776934 MHz is contained within the designated frequency band 13.110 MHz to 14.010 MHz.

Remark: Please see annex for the measurement plot.

#### 3.3.4 Test result: Occupied bandwidth

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed

### 3.4 Spectrum mask

**Standard** FCC Part 15, Subpart C

**The test was performed according to:** FCC §15.225

#### 3.4.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4.

The Equipment Under Test (EUT) was set up on a non-conductive table in the anechoic chamber.

The radiated emissions measurements were made in a typical installation configuration. The measurement procedure is implemented into the EMI test software ES-K1 from R&S. The Loop antenna HFH2-Z2 is used.

- Anechoic chamber
- Antenna distance: 10 m
- Detector: Peak-Maxhold
- Frequency range: 13.06 – 14.06 MHz
- Frequency steps: 5 kHz
- IF-Bandwidth: 10 kHz
- Measuring time / Frequency step: 100 ms

#### 3.4.2 Test Limits

FCC Part 15, Subpart C, §15.225 (a-d), and §15.209, corrected by the means of the extrapolation of §15.31 due to the reduced measuring distance from 30 m to 10 m.

#### 3.4.3 Test Protocol

Temperature: 23 °C  
Air Pressure: 1009 hPa  
Humidity: 39 %

Op. Mode	Setup	Port
op-mode 1	Setup_01	Enclosure

Maximum value dBµV/m	Limit dBµV/m	Remarks
-32.16	103	measuring distance 10 m

Remark: Please see annex for the measurement plot.

#### 3.4.4 Test result: Spectrum mask

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed

### **3.5 Frequency tolerance**

**Standard** FCC Part 15, Subpart C

**The test was performed according to:** FCC §15.225

#### **3.5.1 Test Description**

The Equipment Under Test (EUT) is placed in a temperature chamber.

The frequency drift during temperature and voltage variation is measured by the means of a spectrum analyzer with frequency counter function.

The temperature was varied from  $-20\text{ }^{\circ}\text{C}$  to  $+50\text{ }^{\circ}\text{C}$ . At  $+20\text{ }^{\circ}\text{C}$  the extreme power supply voltages of 85% to 115% DC are applied. After reaching each target temperature and waiting sufficient time allowing the temperature to stabilize, one measurement is performed immediately after powering on the EUT, and two further measurements are performed after 5 and 10 minutes continuous operation of EUT.

#### **3.5.2 Test Limits**

FCC Part 15, Subpart C, §15.225 (e): The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency over a temperature variation of  $-20$  degrees to  $+50$  degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C.

Test Protocol

Temperature: 23 °C  
Air Pressure: 1009 hPa  
Humidity: 38 %

Op. Mode	Setup	Port
op-mode 1	Setup_02	Enclosure

Temperature / °C	Voltage / V	Time / min.	Frequency / MHz	Delta / Hz
50	3.8	0	13.559905	-102
50	3.8	5	13.559899	-101
50	3.8	10	13.559898	-95
40	3.8	0	13.559912	-88
40	3.8	5	13.559906	-94
40	3.8	10	13.559903	-97
30	3.8	0	13.559925	-75
30	3.8	5	13.559922	-78
30	3.8	10	13.559918	-82
20	4.35	0	13.559936	-64
20	4.35	5	13.559933	-67
20	4.35	10	13.559932	-68
20	3.8	0	13.559935	-65
20	3.8	5	13.559933	-67
20	3.8	10	13.559932	-68
20	3.5	0	13.559934	-66
20	3.5	5	13.559933	-67
20	3.5	10	13.559932	-68
10	3.8	0	13.559948	-51
10	3.8	5	13.559948	-52
10	3.8	10	13.559949	-50
0	3.8	0	13.559965	-35
0	3.8	5	13.559964	-36
0	3.8	10	13.559965	-35
-10	3.8	0	13.559985	-25
-10	3.8	5	13.559984	-26
-10	3.8	10	13.559984	-26
-20	3.8	0	13.560022	22
-20	3.8	5	13.560021	21
-20	3.8	10	13.560021	21

Remark: The limit is a delta of max.  $\pm 1356$  Hz (0.01 %).

### 3.5.3 Test result: Frequency tolerance

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed

## 4 Test Equipment

The calibration, hardware and software states are shown for the testing period.

### Test Equipment Anechoic Chamber

<b>Lab ID:</b>	<b>Lab 2</b>		
<b>Manufacturer:</b>	Frankonia		
<b>Description:</b>	Anechoic Chamber for radiated testing		
<b>Type:</b>	10.58x6.38x6.00 m <sup>3</sup>		
	NSA (FCC)	2014/01/09	2017/01/09

### Single Devices for Anechoic Chamber

Single Device Name	Type	Serial Number	Manufacturer
Air compressor	none	-	Atlas Copco
Anechoic Chamber	10.58 x 6.38 x 6.00 m <sup>3</sup> FCC listing 96716 3m Part15/18	none	Frankonia 2014/01/09 2017/01/08
Controller Maturo	MCU	961208	Maturo GmbH
EMC camera	CE-CAM/1	-	CE-SYS
EMC camera Nr.2	CCD-400E	0005033	Mitsubishi
Filter ISDN	B84312-C110-E1		Siemens&Matsushita
Filter Universal 1A	BB4312-C30-H3	-	Siemens&Matsushita

### Test Equipment Auxiliary Equipment for Conducted emissions

<b>Lab ID:</b>	<b>Lab 1</b>
<b>Manufacturer:</b>	Rohde & Schwarz GmbH & Co.KG
<b>Description:</b>	EMI Conducted Auxiliary Equipment

### Single Devices for Auxiliary Equipment for Conducted emissions

Single Device Name	Type	Serial Number	Manufacturer
Cable "LISN to ESI"	RG214	W18.03+W48.03	Huber&Suhner
Impedance Stabilization Network	ISN T800	36159	Teseq GmbH
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard Calibration		2014/02/06 2016/02/28
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN ENY41	100002	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration		2013/03/01 2015/03/31
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN ST08	36292	Teseq GmbH
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration		2014/01/10 2016/01/31
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN T8-Cat6	32187	Teseq GmbH
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard Calibration		2014/01/08 2016/01/31

**Single Devices for Auxiliary Equipment for Conducted emissions (continued)**

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>	
One-Line V-Network	ESH 3-Z6	100489	Rohde & Schwarz GmbH & Co. KG	
One-Line V-Network	ESH 3-Z6	100570	Rohde & Schwarz GmbH & Co. KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Standard Calibration		2013/11/25	2016/11/24
Two-Line V-Network	ESH 3-Z5	828304/029	Rohde & Schwarz GmbH & Co. KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Standard Calibration		2013/03/01	2015/02/28
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz GmbH & Co. KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Standard Calibration		2013/03/01	2015/02/28



## Test Equipment Auxiliary Equipment for Radiated emissions

**Lab ID:** Lab 2  
**Description:** Equipment for emission measurements  
**Serial Number:** see single devices

### Single Devices for Auxiliary Equipment for Radiated emissions

Single Device Name	Type	Serial Number	Manufacturer		
Antenna mast	AM 4.0	AM4.0/180/119205	Maturo GmbH		
		13			
Antenna mast	AS 620 P	620/37	HD GmbH		
Biconical Broadband Antenna	SBA 9119	9119-005	Schwarzbeck		
	<i>Calibration Details</i>			<i>Last Execution</i>	<i>Next Exec.</i>
	Standard Calibration			2009/06/04	2014/06/03
Biconical dipole	VUBA 9117	9117-108	Schwarzbeck		
	<i>Calibration Details</i>			<i>Last Execution</i>	<i>Next Exec.</i>
	Standard Calibration			2012/01/18	2015/01/17
Broadband Amplifier 18MHz-26GHz	JS4-18002600-32-5P	849785	Miteq		
Broadband Amplifier 1GHz-4GHz	AFS4-01000400-1Q-10P-4	-	Miteq		
Broadband Amplifier 30MHz-18GHz	JS4-00101800-35-5P	896037	Miteq		
Cable "ESI to EMI Antenna"	EcoFlex10	W18.01-2+W38.01-	Kabel Kusch		
		2			
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02-2+W38.02-	Rosenberger Micro-Coax		
		2			
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz GmbH & Co. KG		
	<i>Calibration Details</i>			<i>Last Execution</i>	<i>Next Exec.</i>
	Standard Calibration			2012/05/18	2015/05/17
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG		
	<i>Calibration Details</i>			<i>Last Execution</i>	<i>Next Exec.</i>
	Standard Calibration			2012/06/26	2015/06/25
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic		
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic		
High Pass Filter	5HC3500/12750-1.2-KK	200035008	Trilithic		
High Pass Filter	WHKX 7.0/18G-8SS	09	Wainwright		
Horn Antenna Schwarzbeck 15-26 GHz BBHA 9170	BBHA 9170				
Log.-per. Antenna	HL 562 Ultralog	100609	Rohde & Schwarz GmbH & Co. KG		
	<i>Calibration Details</i>			<i>Last Execution</i>	<i>Next Exec.</i>
	Standard Calibration			2012/12/18	2015/12/17
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz GmbH & Co. KG		
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG		
	<i>Calibration Details</i>			<i>Last Execution</i>	<i>Next Exec.</i>
	Standard calibration			2011/10/27	2014/10/26

**Single Devices for Auxiliary Equipment for Radiated emissions (continued)**

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
Pyramidal Horn Antenna 26,5 GHz	3160-09	00083069	EMCO Elektronik GmbH
Pyramidal Horn Antenna 40 GHz	3160-10	00086675	EMCO Elektronik GmbH
Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	TD1.5- 10kg/024/3790709	Maturo GmbH

**Test Equipment Auxiliary Test Equipment**

<b>Lab ID:</b>	<b>Lab 2, Lab 3</b>
<b>Manufacturer:</b>	see single devices
<b>Description:</b>	Single Devices for various Test Equipment
<b>Type:</b>	various
<b>Serial Number:</b>	none

**Single Devices for Auxiliary Test Equipment**

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
Broadband Power Divider N (Aux)	1506A / 93459	LM390	Weinschel Associates
Broadband Power Divider SMA	WA1515	A855	Weinschel Associates
Digital Multimeter 03 (Multimeter)	Fluke 177	86670383	Fluke Europe B.V.
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Customized calibration		2013/12/04   2015/12/03
Fibre optic link Satellite (Aux)	FO RS232 Link	181-018	Pontis
Fibre optic link Transceiver (Aux)	FO RS232 Link	182-018	Pontis
Isolating Transformer	LTS 604	1888	Thalheimer Transformatorwerke GmbH
Notch Filter Ultra Stable (Aux)	WRCA800/960-6EEK	24	Wainwright
Signal Analyzer	FSV30	103005	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard		2014/02/10   2016/02/09
Spectrum Analyser	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard		2012/06/13   2015/06/12
Spectrum Analyser	FSU26	200418	Rohde & Schwarz GmbH & Co.KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration		2013/07/29   2014/07/28
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG

### Test Equipment Radio Lab Test Equipment

**Lab ID:** Lab 3  
**Description:** Radio Lab Test Equipment

#### Single Devices for Radio Lab Test Equipment

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
Broadband Power Divider SMA	WA1515	A856	Weinschel Associates
Coax Attenuator 10dB SMA 2W	4T-10	F9401	Weinschel Associates
Coax Attenuator 10dB SMA 2W	56-10	W3702	Weinschel Associates
Coax Attenuator 10dB SMA 2W	56-10	W3711	Weinschel Associates
Coax Cable Huber&Suhner	Sucotest 2,0m		Huber&Suhner
Coax Cable Rosenberger Micro Coax FA210A0010003030 SMA/SMA 1,0m	FA210A0010003030	54491-2	Rosenberger Micro-Coax
Power Meter	NRVD Standard calibration	828110/016	Rohde & Schwarz GmbH & Co.KG 2013/05/03 2014/05/02
RF Step Attenuator	RSP RSP	833695/001	Rohde & Schwarz GmbH & Co.KG
Rubidium Frequency Standard	Datum, Model: MFS Standard calibration	5489/001	Datum-Beverly 2013/06/24 2014/06/23
Sensor Head A	NRV-Z1 Standard calibration	827753/005	Rohde & Schwarz GmbH & Co.KG 2013/04/30 2014/04/29
Signal Generator SME	SME03 <i>Calibration Details</i> Standard calibration	827460/016	Rohde & Schwarz GmbH & Co.KG <i>Last Execution</i> <i>Next Exec.</i> 2011/11/25 2014/11/24
Signal Generator SMP	SMP02 <i>Calibration Details</i> Standard calibration	836402/008	Rohde & Schwarz GmbH & Co. KG <i>Last Execution</i> <i>Next Exec.</i> 2013/05/06 2016/05/05
Spectrum Analyser	FSIQ26 <i>Calibration Details</i> Standard Calibration	840061/005	Rohde & Schwarz GmbH & Co. KG <i>Last Execution</i> <i>Next Exec.</i> 2013/02/12 2015/02/11
Temperature Chamber Vötsch 03	VT 4002 <i>Calibration Details</i> Customized calibration	58566002150010	Vötsch <i>Last Execution</i> <i>Next Exec.</i> 2014/03/11 2016/03/10

**Test Equipment Temperature Chamber 01**

**Lab ID:** Lab 4  
**Manufacturer:** see single devices  
**Description:** Temperature Chamber KWP 120/70  
**Type:** Weiss  
**Serial Number:** see single devices

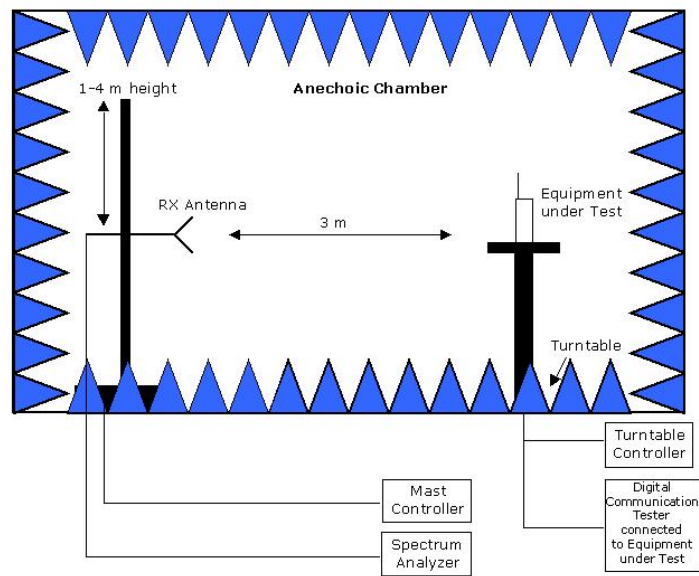
**Single Devices for Temperature Chamber 01**

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>	
Temperature Chamber Weiss 01	KWP 120/70	59226012190010	Weiss Umwelttechnik GmbH	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Customized calibration		2012/03/12	2014/03/11
	Customized calibration		2014/03/12	2016/03/11

## 5 Photo Report

Photos are included in an external report.

## 6 Setup Drawings



Remark: Depending on the frequency range suitable antenna types, attenuators or preamplifiers are used.

**Drawing 1:** Setup in the Anechoic chamber:  
Measurements below 1 GHz: Semi-anechoic, conducting ground plane.

## 7 FCC and IC Correlation of measurement requirements

The following table shows the correlation of measurement requirements for Radio equipment operating in the Band 13.110-14.010 MHz from FCC and IC..

### Radio equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 3: 7.2.4
Out-of-band emissions	§ 15.225 (d)	RSS-Gen Issue 3: 7.2.5; RSS-210 Issue 8: A2.6
In-band emissions	§ 15.225 (a) / (b) / (c)	RSS-210 Issue 8: A2.6
Frequency stability	§ 15.225 (e)	RSS-210 Issue 8: A2.6
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 3: 7.1.2
Receiver spurious emissions	-	RSS-210 Issue 8: 2.3 RSS-Gen Issue 3: 6 *)
Handling of active and passive tag devices of RFID application	§ 15.225 (f)	RSS-Gen Issue 3: 7.1.8

\*) Receivers operating below 30 MHz are exempted with respect to Notice 2012-DRS0126.

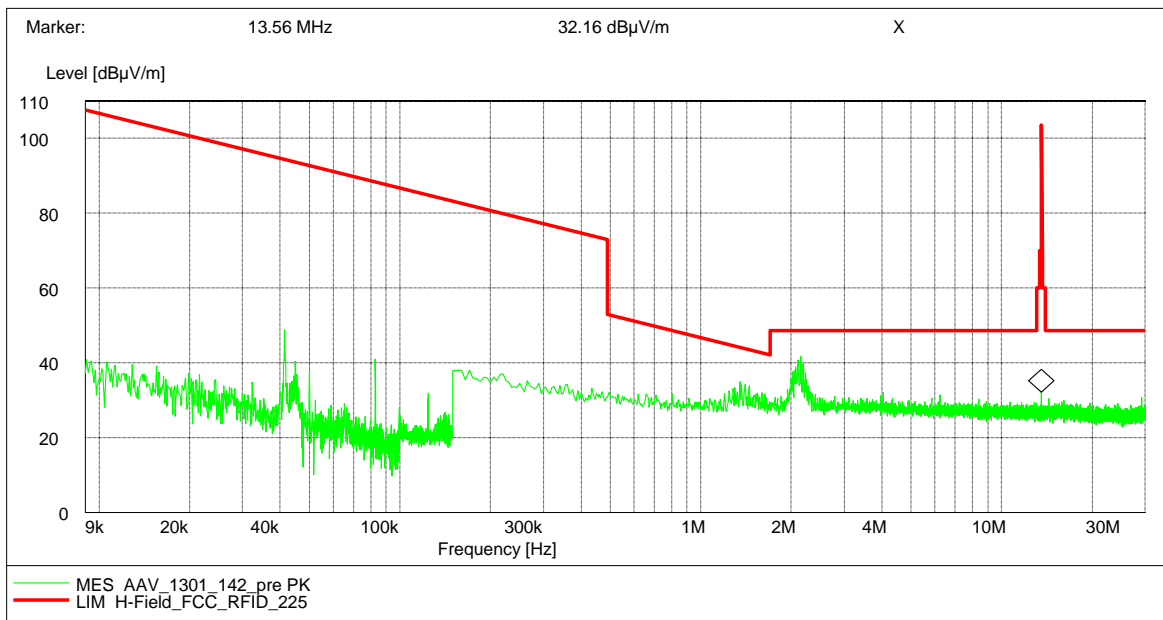


## 8 Annex measurement plots

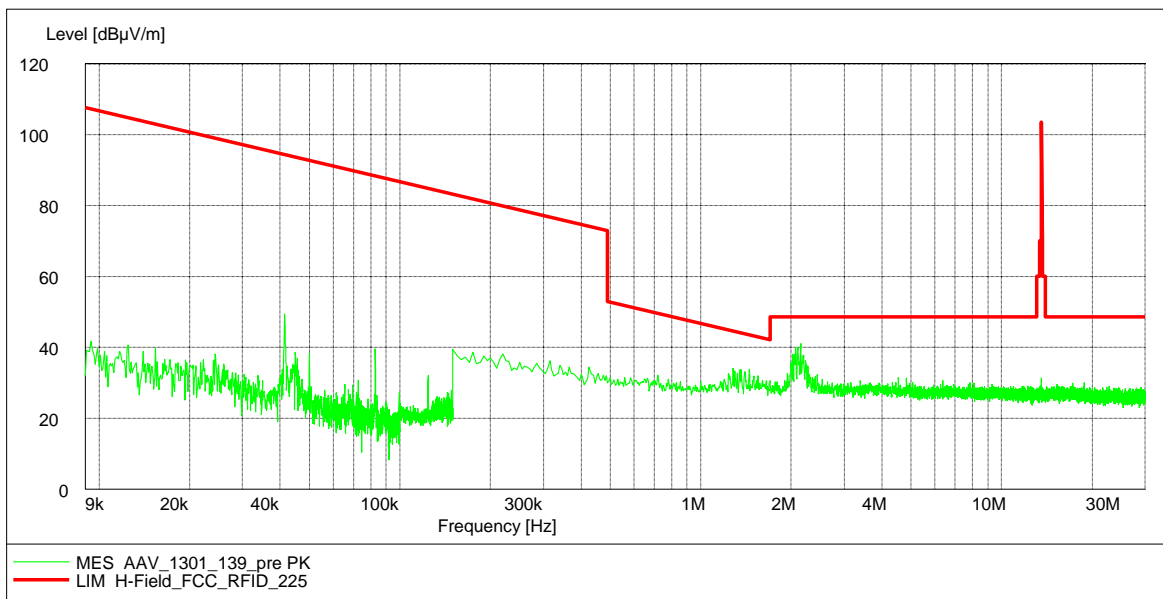
### 8.1 Radiated emissions

#### 8.1.1 Radiated emissions (f < 30 MHz)

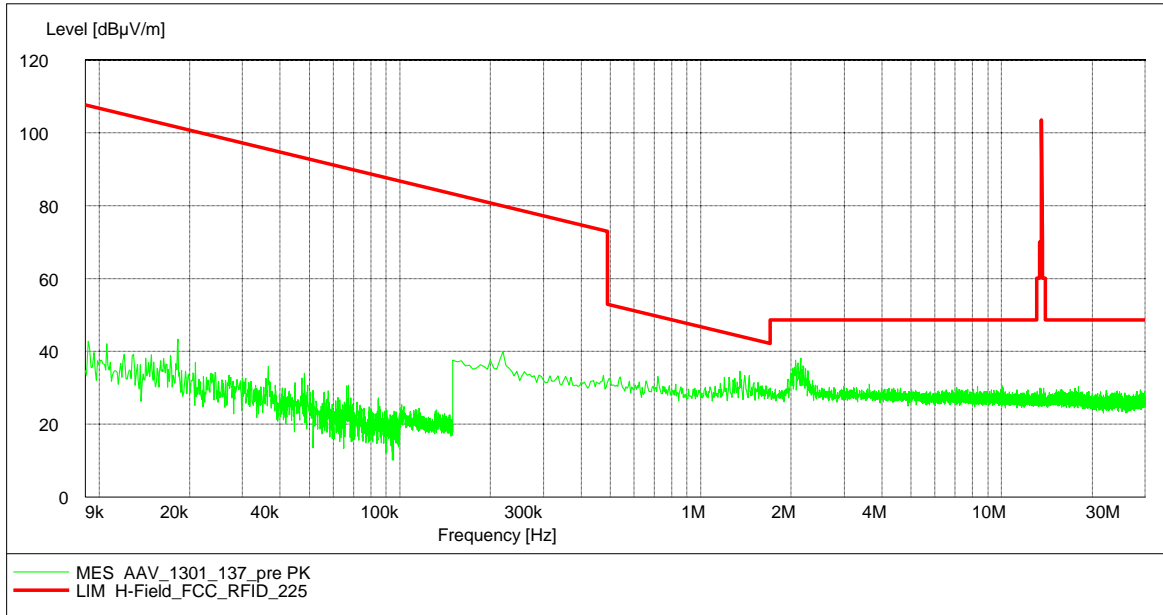
Antenna position 90°  
EUT position horizontal



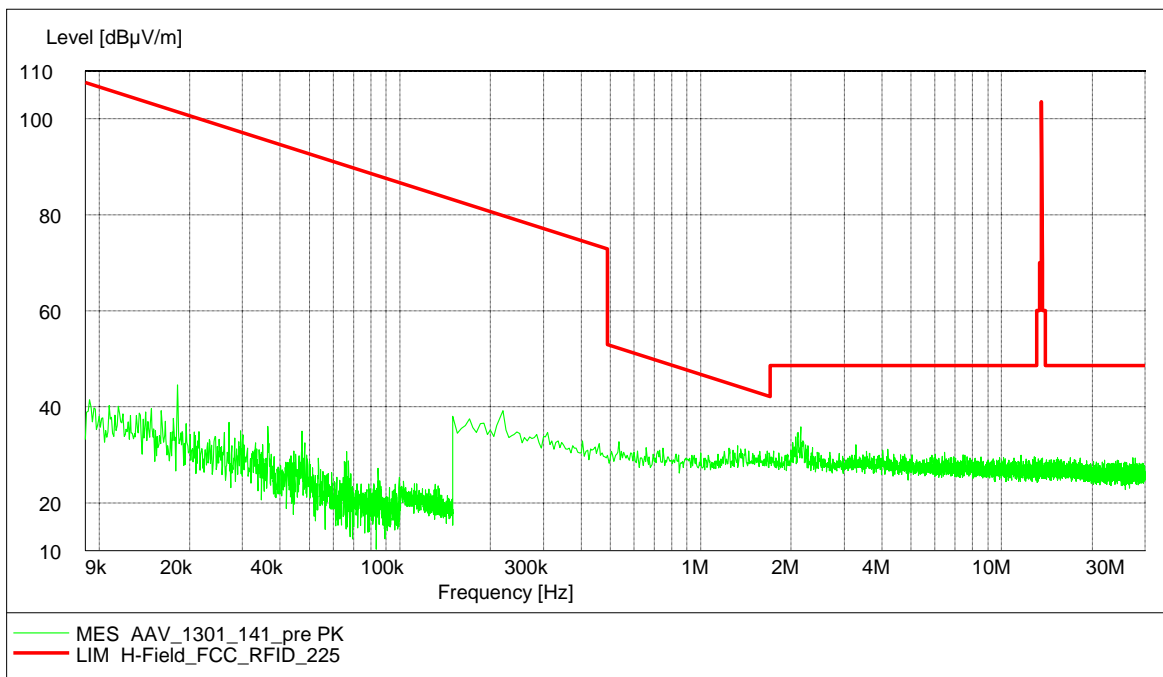
Antenna position 90°  
EUT position vertical



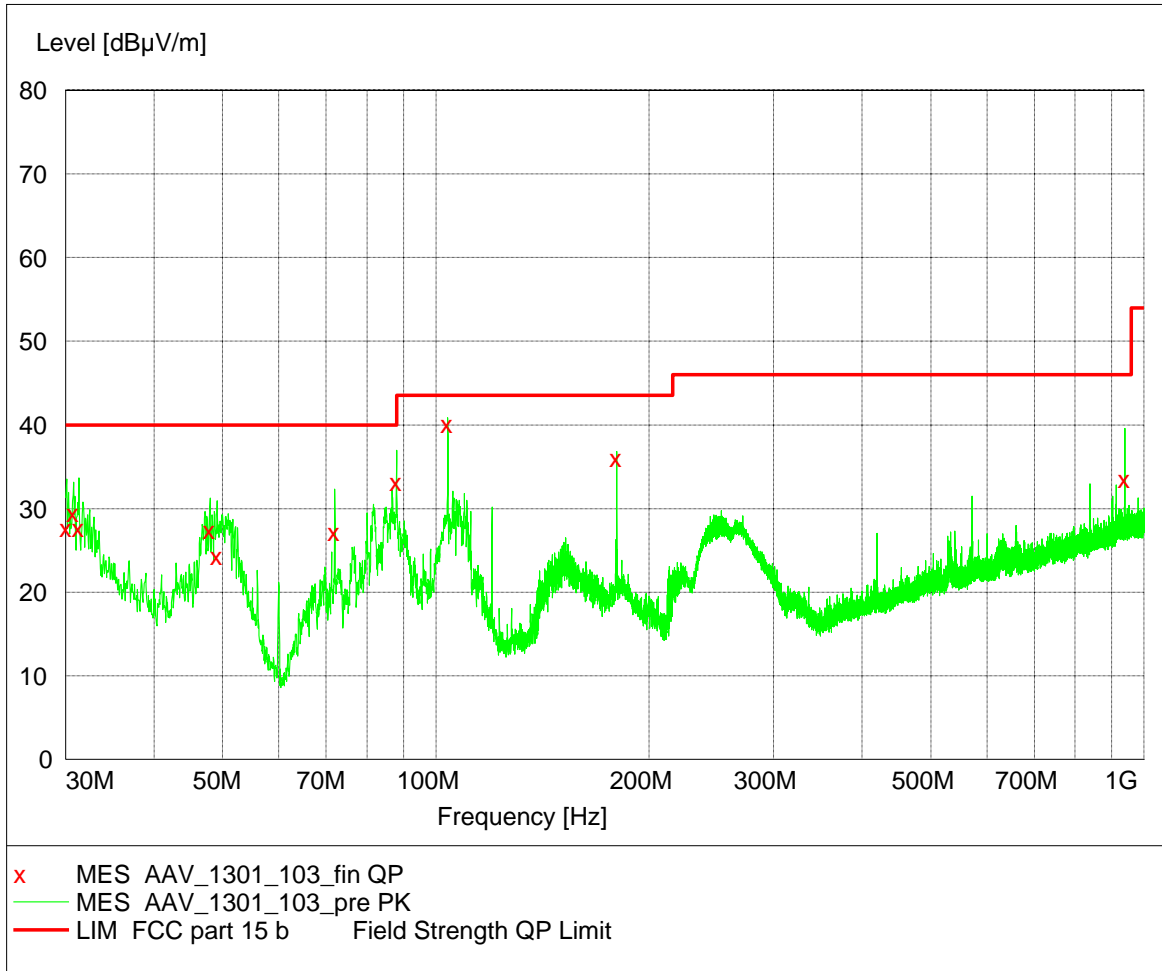
Antenna position 0°  
EUT position vertical



Antenna position 0°  
EUT position horizontal

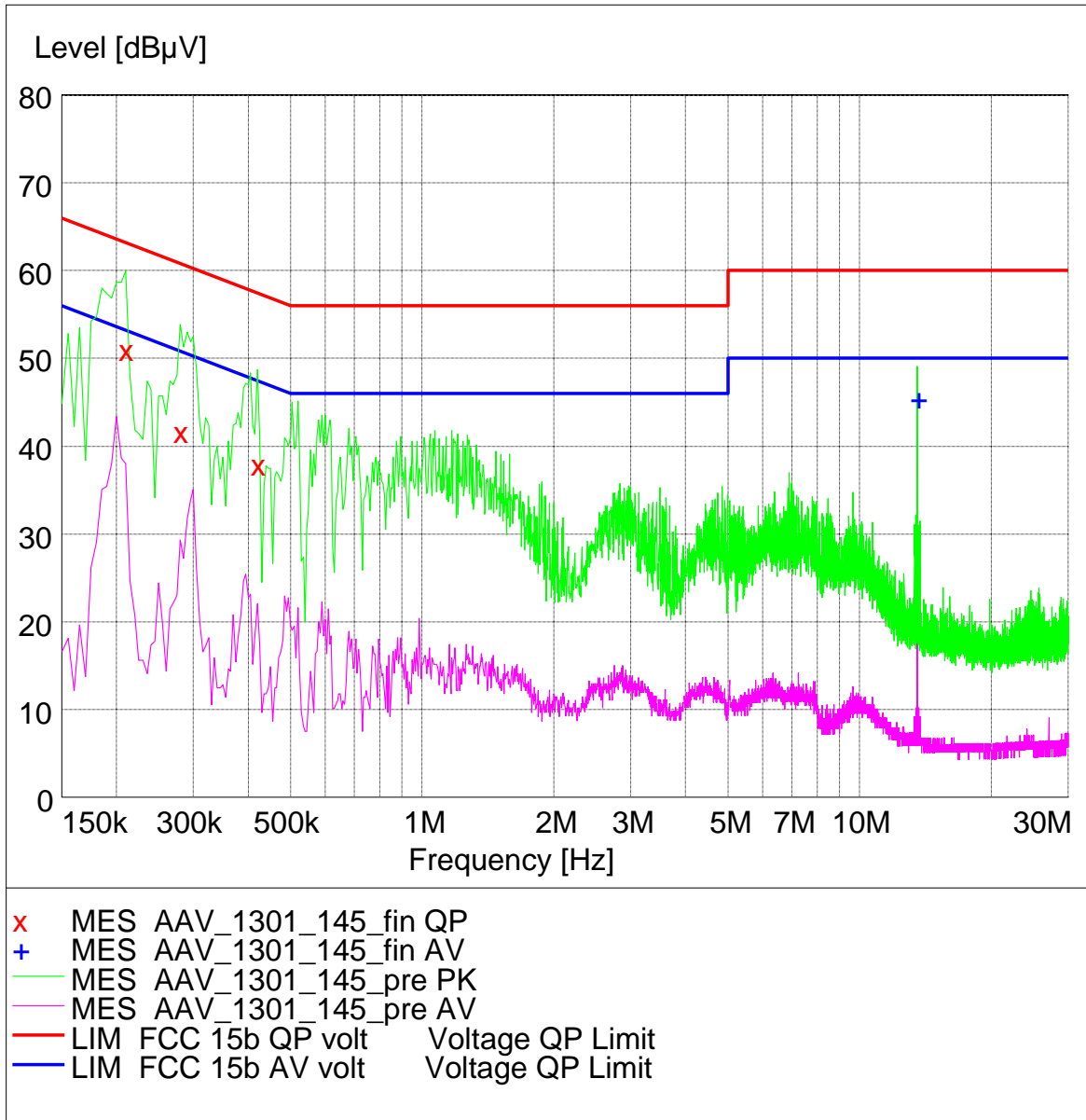


### 8.1.2 Radiated emissions (f > 30 MHz)

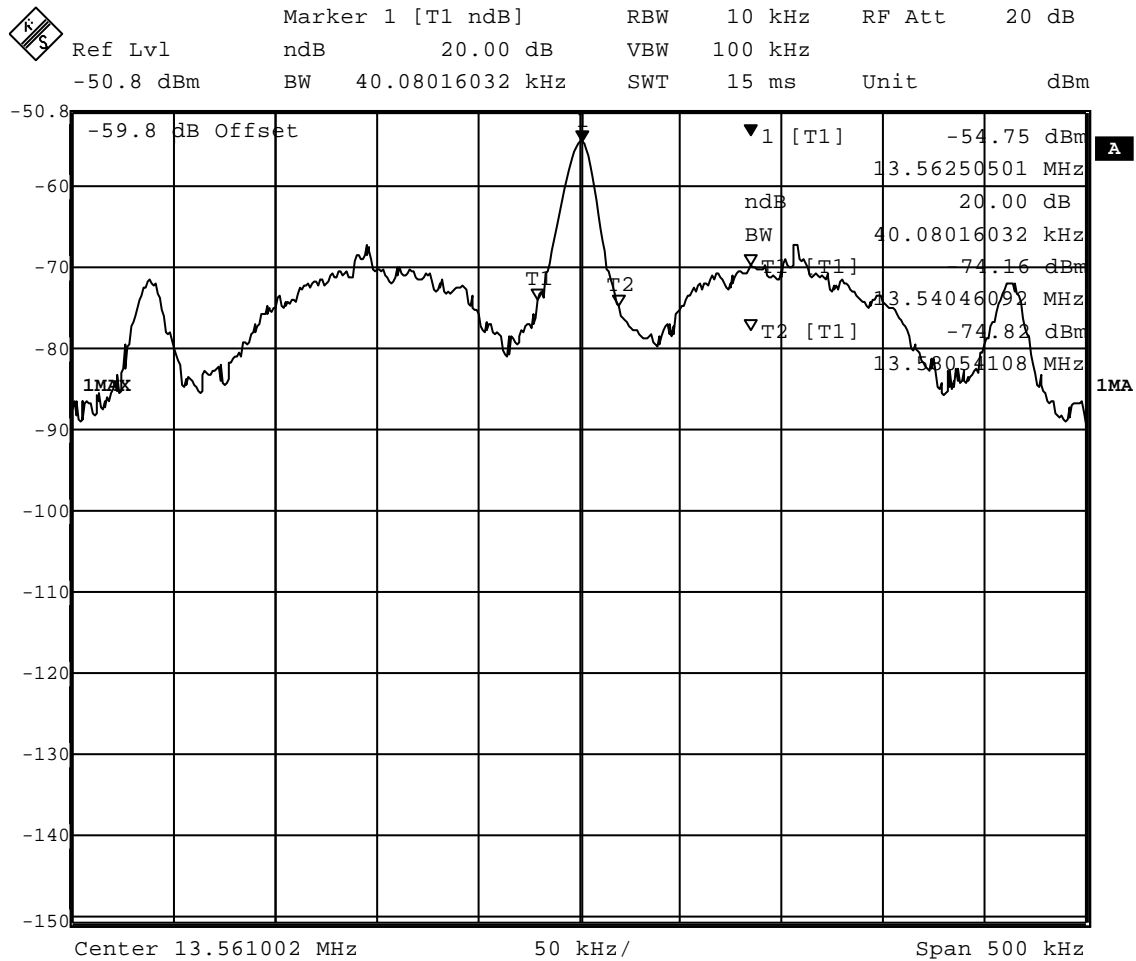


## 8.2 AC Mains conducted

Short Description:		FCC Voltage				
Start	Stop	Step	Detector	Meas.	IF	Transducer
Frequency	Frequency	Width		Time	Bandw.	
150.0 kHz	30.0 MHz	5.0 kHz	MaxPeak	20.0 ms	9 kHz	ESH3-Z5
			Average			




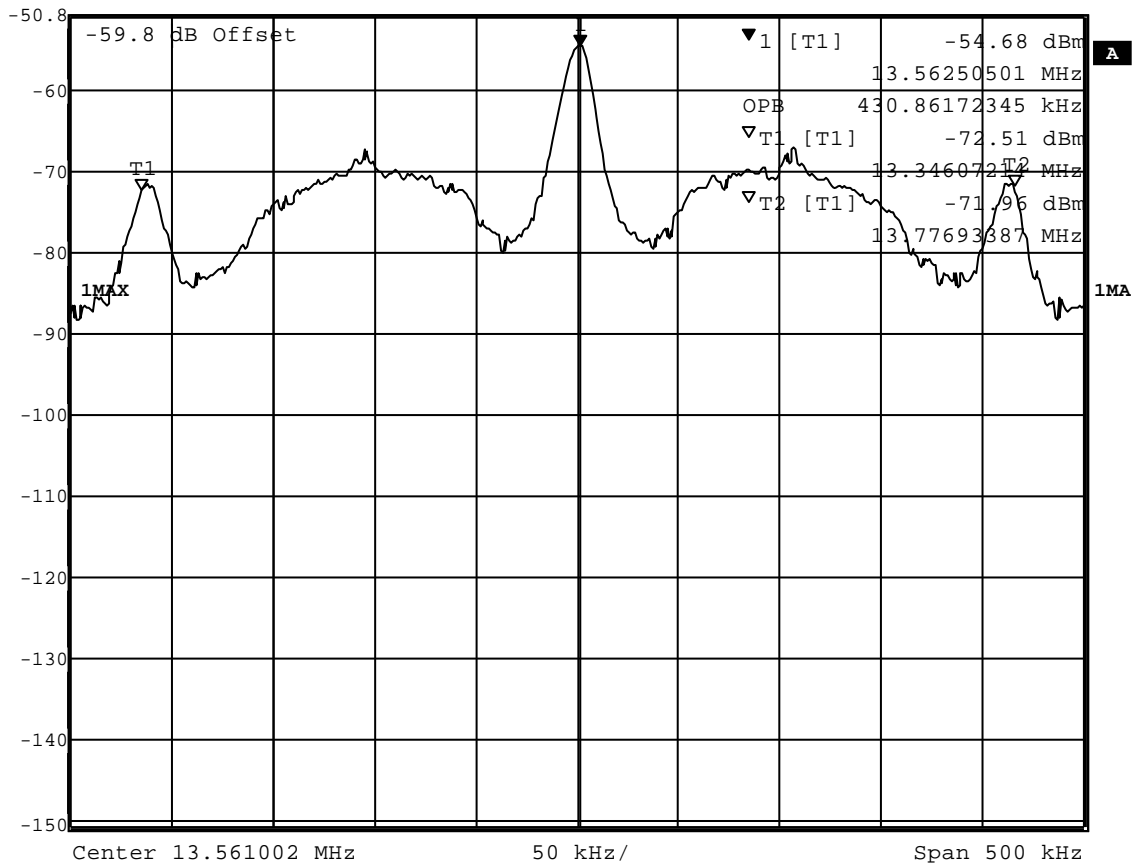
### 8.3 Occupied bandwidth



Date: 24.MAR.2014 09:38:42

20 dB occupied bandwidth


 Marker 1 [T1]      RBW    10 kHz    RF Att    20 dB  
 Ref Lvl                    -54.68 dBm    VBW    100 kHz  
 -50.8 dBm                13.56250501 MHz    SWT    15 ms    Unit            dBm



Date:      24.MAR.2014    09:40:36

99% occupied bandwidth.

### 8.4 Spectrum mask

