



Inter**Lab**[®]

FCC Measurement/Technical Report on NFC card reader incorporated in tablet computer INARI5-WLAN-1

Report Reference: MDE_AAVAM_1408_FCCi

FCC ID: 2ABVH-INARI51
IC: 11875A- INARI51

Test Laboratory:

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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.

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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 (October-1-2014 Edition) and 15 (October -1-2014 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:

ANSI C63.4–2014 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

OP-Mode

Setup

Port

2014

Final Result

op-mode 2

Setup_02

AC (via AC/DC
converter)

passed

FCC Part 15, Subpart C

§15.209

Radiated Emissions

The measurement was performed according to ANSI C63.4

OP-Mode

Setup

Port

2014

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

OP-Mode

Setup

Port

10-1-14 Edition

Final Result

op-mode 1

Setup_01

Enclosure

passed

FCC Part 15, Subpart C

§ 15.225

Spectrum Mask

The measurement was performed according to ANSI C63.4

OP-Mode

Setup

Port

2014

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

OP-Mode

Setup

Port

10-1-14 Edition

Final Result

op-mode 1

Setup_01

Enclosure

passed

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: Dipl.-Ing. Dobrin Dobrinov

Date of Test(s): 2015-02-15 to 2015-08-05
Date of Report: 2015-08-05

1.3 Applicant Data

Company Name: Aava Mobile Oy

Address: Nahkatehtaankatu 2
90130 Oulu
Finland

Contact Person: Mr. Antti Aho

1.4 Manufacturer Data

Company Name: please see applicant data

Address:

Contact Person:

2 Test object Data

2.1 General EUT Description

Equipment under Test	NFC card reader incorporated in tablet computer
Type Designation:	INARI5-WLAN-1
Kind of Device:	NFC card reader operating in 13.56 MHz band
Voltage Type:	DC - rechargeable Li-polymer battery AMME2675
Voltage level:	3.8 V

General product description:

The EUT is a tablet computer supporting WLAN, Bluetooth and Bluetooth Low energy technologies, and NFC card reader as well.

Specific product description for the EUT:

The object of this test report is the NFC card reader of the tablet computer. It has an integrated PCB antenna and transmits ASK modulated RF signal at 13.56 MHz.

The EUT provides the following ports:

Ports

Enclosure
DC and Data port (USB)
Headset port (3.5 mm jack)
System port
Temperature probe port
AC (via AC/DC converter)

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: DE1004006ah01)	NFC card reader	INARI5-WLAN-1	EB44900 002	Preproduction	Android 4.4	-
Remark: EUT A is equipped with an integral antenna for NFC.						
EUT B (Code: DE1004006ac01)	NFC card reader	INARI5-WLAN-1	EB44900 066	Preproduction	Android 4.4	-
Remark: EUT B is equipped with an integral antenna NFC.						
EUT C (Code: DE1004006ad01)	WLAN transceiver	INARI5-WLAN-1	EB44900 002	Preproduction	Android 4.4	-
Remark: EUT C is equipped with an integral antenna NFC.						

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

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	RFID card	-	-	-	-	-

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
AUX1	Headset	-	-	-	-	-
AUX2	USB Cable	Amphenol USB SHIELDED HIGH SPEED CABLE	-	-	-	-
AUX6	AC/DC converter with USB port	DELTA ELECTRONICS, INC. AC/DC ADAPTER ADP-10BW C	053W41T00KM	Rev. 00	-	-

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 A + AE 1	setup for EUT radiated emissions
Setup_02	EUT C + AE 1 + AUX1 to AUX2 +AUX5 to AUX6	setup for conducted emissions measurements (AC power line)

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	NFC reader active	EUT A is transmitting a periodic ASK modulated signal, reading card information continuously.
op-mode 2	NFC reader and WLAN active	EUT A is transmitting a periodic ASK modulated signal, reading card information continuously and WLAN transmits data

2.7 Special software used for testing

The applicant provided a special software which allows different operation modes to be switched for testing by using an external PC, connected via the EA 5 USB port.

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 C 63.4

3.1.1 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 setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from 50 μ H || 50 Ohm Line Impedance Stabilization Network (LISN). 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

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 (dBμV)	AV Limit (dBμV)
0.15 – 0.5	66 to 56	56 to 46
0.5 – 5	56	46
5 – 30	60	50

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

3.1.3 Test Protocol

Temperature: 25 °C
Air Pressure: 1007 hPa
Humidity: 30 %

Power line	Frequency MHz	Measured value QP dBμV	Measured value AV dBμV	QP Limit dBμV	AV Limit dBμV	Margin QP dB	Margin AV dB
N	0.185	55.4	–	64	–	8.6	–
L	–	–	–	–	–	–	–

Remark: The chosen operating mode is selected as representative mode to generate “worst-case” conditions, i.e. high power consumption.
Please refer to the plot in the annex.

3.2 Spurious radiated emissions

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.4–2014

3.2.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4–2009 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m² 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.

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 μ s
- Turntable angle range: -180° to 180°
- Turntable step size: 90°
- 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° to 180°
- Turntable step size: 45°
- 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°
- 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 ± 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° 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)	Calculate Limit(dBμV/m @10m)	Limit (dBμV/m) @10m
0.009 – 0.49	2400/F (kHz)	300	(48.5 – 13.8) + 59.1 dB	107.6 – 72.9
0.49 – 1.705	24000/F (kHz)	30	(33.8 – 23.0) + 19.1 dB	52.9 – 42.1
1.705 – 30	30	30	29.5 + 19.1 dB	39.5

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: $\text{Limit (dB}\mu\text{V/m)} = 20 \log (\text{Limit (}\mu\text{V/m)}/1\mu\text{V/m)}$

3.2.3 Test Protocol

Temperature: 23 – 24 °C
Air Pressure: 1009 – 1012 hPa
Humidity: 38 – 42 %

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
0°	–	–	–	–	–	–	–	–	–
90°	–	–	–	–	–	–	–	–	–

Remarks: The modulated signal is used.

No spurious emissions in the range 20 dB below the limit found therefore step 2 was not performed.
The radiated emissions are measured at horizontal and vertical positioning of the EUT.
Please refer to the plot in the annex.

3.2.3.2 Measurement above 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
–	40.680	38.4	–	–	40.0	–	–	1.6	–

Remarks: The modulated signal is used.

No further spurious emissions in the range 20 dB below the limit found.
Please refer to the plot in the annex.

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, 10-1-11 Edition 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: 1009 hPa
Humidity: 38 %

Op. Mode	Setup	Port
op-mode 1	Setup_01	Enclosure

20 dB bandwidth kHz	99% bandwidth kHz	Remarks
434.100	610.709 (13.26478 MHz to 13.87548 MHz)	The 20 dB bandwidth from 13.3444 MHz to 13.7785 MHz is contained within the designated frequency band 13.110 MHz to 14.010 MHz.

Remark: Please see annex for the measurement plots.

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 63.4–2014. 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: 24 °C
Air Pressure: 1010 hPa
Humidity: 42 %

Op. Mode	Setup	Port
op-mode 1	Setup_01	Enclosure

Maximum value dBµV/m	Limit dBµV/m	Remarks
41.82	103.1	Calculated from measured value 52.28 dBµV/m at 3 m distance. The formula used is: $H_{f10m} = H_{f3m} - 20(1 - \log 3)$

Remark:
Please see annex for the measurement plots.

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, 10-1-11 Edition 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 °C to +55 °C. At +20 °C the extreme power supply voltages of 85% and 115% 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.

3.5.3 Test Protocol

Temperature: -20 °C to +55 °C
 Air Pressure: 10010 hPa
 Humidity: 41 %

Op. Mode	Setup	Port
op-mode 2	Setup_02	Enclosure

Temperature / °C	Voltage / V	Time / min.	Frequency / MHz	Delta / Hz
55	3.8	0	13.560251	251
55	3.8	5	13.560245	245
55	3.8	10	13.560244	244
40	3.8	0	13.560292	292
40	3.8	5	13.560275	275
40	3.8	10	13.560268	268
30	3.8	0	13.560327	327
30	3.8	5	13.560308	308
30	3.8	10	13.560300	300
20	3.23	0	13.560315	315
20	3.23	5	13.560317	317
20	3.23	10	13.560319	319
20	3.8	0	13.560315	315
20	3.8	5	13.560316	316
20	3.8	10	13.560317	317
20	4.37	0	13.560316	316
20	4.37	5	13.560315	315
20	4.37	10	13.560317	317
10	3.8	0	13.560377	377
10	3.8	5	13.560367	367
10	3.8	10	13.560364	364
0	3.8	0	13.560398	398
0	3.8	5	13.560392	392
0	3.8	10	13.560390	390
-10	3.8	0	13.560402	402
-10	3.8	5	13.560404	404
-10	3.8	10	13.560404	404
-20	3.8	0	13.560402	402
-20	3.8	5	13.560403	403
-20	3.8	10	13.560402	402

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

3.5.4 Test result: Frequency tolerance

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 2	passed

4 Test Equipment

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

Test Equipment Anechoic Chamber

Lab ID:	Lab 2		
Manufacturer:	Frankonia		
Description:	Anechoic Chamber for radiated testing		
Type:	10.58x6.38x6.00 m ³		
	<i>Calibration Details</i>	<i>Last Execution</i>	<i>Next Exec.</i>
	NSA (FCC)	2014/01/09	2017/01/09

Single Devices for Anechoic Chamber

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
Air compressor	none	-	Atlas Copco
Anechoic Chamber	10.58 x 6.38 x 6.00 m ³	none	Frankonia
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	FCC listing 96716 3m Part15/18		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

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

Single Devices for Auxiliary Equipment for Conducted emissions

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
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

Single Devices for Auxiliary Equipment for Conducted emissions (continued)

Single Device Name	Type	Serial Number	Manufacturer	
One-Line V-Network	Calibration Details		Last Execution	Next Exec.
	Standard Calibration		2014/01/08	2016/01/31
	ESH 3-Z6	100489	Rohde & Schwarz GmbH & Co. KG	
One-Line V-Network	Calibration Details		Last Execution	Next Exec.
	standard calibration		2014/06/18	2017/11/30
	ESH 3-Z6	100570	Rohde & Schwarz GmbH & Co. KG	
Two-Line V-Network	Calibration Details		Last Execution	Next Exec.
	Standard Calibration		2013/11/25	2016/11/24
	ESH 3-Z5	828304/029	Rohde & Schwarz GmbH & Co. KG	
Two-Line V-Network	Calibration Details		Last Execution	Next Exec.
	Standard Calibration		2013/03/01	2015/03/31
	DAkKS Calibration		2015/03/30	2017/03/31
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		Last Execution	Next Exec.
	Standard Calibration		2013/03/01	2015/02/28
	DAkks Calibration		2015/03/30	2017/03/31

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 13	Maturo GmbH
Biconical Broadband Antenna	SBA 9119	9119-005	Schwarzbeck Mess-Elektronik OHG
Biconical dipole	VUBA 9117	9117-108	Schwarzbeck Mess-Elektronik OHG
Broadband Amplifier 1 GHz - 4 GHz	AFS4-01000400-1Q-10P-4	-	Miteq
Broadband Amplifier 18 GHz - 26 GHz	JS4-18002600-32-5P	849785	Miteq
Broadband Amplifier 30 MHz - 18 GHz	JS4-00101800-35-5P	896037	Miteq
Cable "ESI to EMI Antenna"	EcoFlex10	W18.01-2+W38.01-2	Kabel Kusch
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02-2+W38.02-2	Rosenberger Micro-Coax
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
Double-ridged horn-duplicated 2015-07-15 10:47:55	HF 906	357357/001	Rohde & Schwarz GmbH & Co. KG
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic
High Pass Filter	5HC3500/18000-1.2-KK	200035008	Trilithic
High Pass Filter	WHKX 7.0/18G-8SS	09	Wainwright
Horn Antenna Schwarzbeck 15-26.5 GHz BBHA 9170	BBHA 9170	BBHA9170262	Schwarzbeck Mess-Elektronik OHG
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 (upgraded)	HL 562 Ultralog new refelector	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>
DKD Calibration			2014/11/27 2017/11/27
Standard Gain / Pyramidal Horn Antenna 26.5 GHz	3160-09	00083069	EMCO Elektronik GmbH
Standard Gain / Pyramidal Horn Antenna 40 GHz	3160-10	00086675	EMCO Elektronik GmbH

Single Devices for Auxiliary Equipment for Radiated emissions (continued)

Single Device Name	Type	Serial Number	Manufacturer
Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	TD1.5-10kg/024/3790709	Maturo GmbH

Test Equipment Auxiliary Test Equipment

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

Single Devices for Auxiliary Test Equipment

Single Device Name	Type	Serial Number	Manufacturer
Broadband Power Divider1506A / 93459 N (Aux)		LM390	Weinschel Associates
Broadband Power DividerWA1515 SMA		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 Transformatorenwerke 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		2014/07/29 2015/07/28
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG

Test Equipment Digital Signalling Devices

Lab ID:

Lab 1, Lab 2, Lab 3

Description:

Signalling equipment for various wireless technologies.

Single Devices for Digital Signalling Devices

Single Device Name	Type	Serial Number	Manufacturer	
CMW500	CMW500	107500	Rohde & Schwarz GmbH & Co.KG	
	Calibration Details		Last Execution	Next Exec.
	Standard calibration		2014/01/27	2016/01/26
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		Last Execution	Next Exec.
	DKD calibration		2014/12/02	2017/12/01
Universal Radio Communication Tester	CMU 200	102366	Rohde & Schwarz GmbH & Co. KG	
	HW/SW Status		Date of Start	Date of End
	Hardware: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B56V14, B68 3v04, PCMCIA, U65V04 Software: K21 4v21, K22 4v21, K23 4v21, K24 4v21, K42 4v21, K43 4v21, K53 4v21, K56 4v22, K57 4v22, K58 4v22, K59 4v22, K61 4v22, K62 4v22, K63 4v22, K64 4v22, K65 4v22, K66 4v22, K67 4v22, K68 4v22, K69 4v22 Firmware: µP1 8v50 02.05.06 ---		2007/07/16	
Universal Radio Communication Tester	CMU 200	837983/052	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		Last Execution	Next Exec.
	DKD calibration		2014/12/03	2017/12/02
	HW/SW Status		Date of Start	Date of End
	HW options: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B54V14, B56V14, B68 3v04, B95, PCMCIA, U65V02 SW options: K21 4v11, K22 4v11, K23 4v11, K24 4v11, K27 4v10, K28 4v10, K42 4v11, K43 4v11, K53 4v10, K65 4v10, K66 4v10, K68 4v10, Firmware: µP1 8v40 01.12.05 ---		2007/01/02	
	SW: K62, K69		2008/11/03	
Vector Signal Generator	SMU200A	100912	Rohde & Schwarz GmbH & Co. KG	

Test Equipment Emission measurement devices

Lab ID: Lab 1, Lab 2
Description: Equipment for emission measurements
Serial Number: see single devices

Single Devices for Emission measurement devices

Single Device Name	Type	Serial Number	Manufacturer
EMI Receiver / Spectrum ESR 7 Analyser		101424	Rohde & Schwarz
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Initial Factory Calibration		2014/11/13 2016/11/12
Personal Computer	Dell	30304832059	Dell
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration		2014/05/13 2015/05/10
	Standard calibration		2015/05/11 2016/05/10
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration		2014/05/13 2015/05/10
	Standard calibration		2015/05/11 2016/05/10
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard Calibration		2014/06/24 2017/06/23
Spectrum Analyser	FSW 43	103779	Rohde & Schwarz
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Initial Factory Calibration		2014/11/17 2016/11/16
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard Calibration		2014/01/07 2016/01/31
	<i>HW/SW Status</i>		<i>Date of Start</i> <i>Date of End</i>
	Firmware-Update 4.34.4 from 3.45 during calibration		2009/12/03

Test Equipment Multimeter 03

Lab ID: Lab 2, Lab 3
Description: Fluke 177
Serial Number: 86670383

Single Devices for Multimeter 03

Single Device Name	Type	Serial Number	Manufacturer
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

Test Equipment Radio Lab Test Equipment

Lab ID: Lab 3
Description: Radio Lab Test Equipment

Single Devices for Radio Lab Test Equipment

Single Device Name	Type	Serial Number	Manufacturer
Broadband Power DividerWA1515 SMA		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	828110/016	Rohde & Schwarz GmbH & Co.KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration		2014/05/13 2015/05/10
	Standard calibration		2015/05/11 2016/05/10
RF Step Attenuator RSP	RSP	833695/001	Rohde & Schwarz GmbH & Co.KG
Rubidium Frequency Standard	Datum, Model: MFS	5489/001	Datum-Beverly
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration		2014/07/03 2015/07/02
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration		2014/05/13 2015/05/10
	Standard calibration		2015/05/11 2016/05/10
Signal Generator SME	SME03	827460/016	Rohde & Schwarz GmbH & Co.KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration		2014/12/02 2017/12/01
Signal Generator SMP	SMP02	836402/008	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration		2013/05/06 2016/05/05
Spectrum Analyser	FSIQ26	840061/005	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Calibration after reparation		2015/04/02 2017/04/01

Test Equipment Shielded Room 02

Lab ID: Lab 1
Manufacturer: Frankonia
Description: Shielded Room for conducted testing
Type: 12 qm
Serial Number: none

Test Equipment T/A Logger 13

Lab ID: Lab 1, Lab 2, Lab 3
Description: Lufft Opus10 TPR
Type: Opus10 TPR
Serial Number: 13936

Single Devices for T/A Logger 13

Single Device Name	Type	Serial Number	Manufacturer
ThermoAirpressure Datalogger 13 (Environ)	Opus10 TPR (8253.00)	13936	Lufft Mess- und Regeltechnik GmbH
<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
Customized calibration		2013/02/07	2015/02/26
Customized calibration		2015/02/27	2017/02/26

Test Equipment T/H Logger 02

Lab ID: Lab 1
Description: Lufft Opus10
Serial Number: 7489

Single Devices for T/H Logger 02

Single Device Name	Type	Serial Number	Manufacturer
ThermoHygro DataloggerOpus10 THI (8152.00) 02 (Environ)	Opus10 THI (8152.00)	7489	Lufft Mess- und Regeltechnik GmbH
<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
Customized calibration		2013/02/07	2015/02/26
Customized calibration		2015/02/27	2017/02/26

Test Equipment T/H Logger 03

Lab ID: Lab 3
Description: Lufft Opus10
Serial Number: 7482

Single Devices for T/H Logger 03

Single Device Name	Type	Serial Number	Manufacturer
ThermoHygro DataloggerOpus10 THI (8152.00) 03 (Environ)	Opus10 THI (8152.00)	7482	Lufft Mess- und Regeltechnik GmbH
<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
Customized calibration		2013/02/07	2015/02/26
Customized calibration		2015/02/27	2017/02/26



Test Equipment T/H Logger 12

Lab ID: Lab 2
Description: Lufft Opus10
Serial Number: 12482

Single Devices for T/H Logger 12

Single Device Name	Type	Serial Number	Manufacturer
ThermoHygro DataloggerOpus10 THI (8152.00) 12 (Environ)		12482	Lufft Mess- und Regeltechnik GmbH
Calibration Details			Last Execution Next Exec.
Customized calibration			2013/01/07 2015/03/09
Customized calibration			2015/03/10 2017/03/09

Test Equipment Temperature Chamber 05

Lab ID: Lab 3
Manufacturer: see single devices
Description: Temperature Chamber VT4002
Type: Vötsch
Serial Number: see single devices

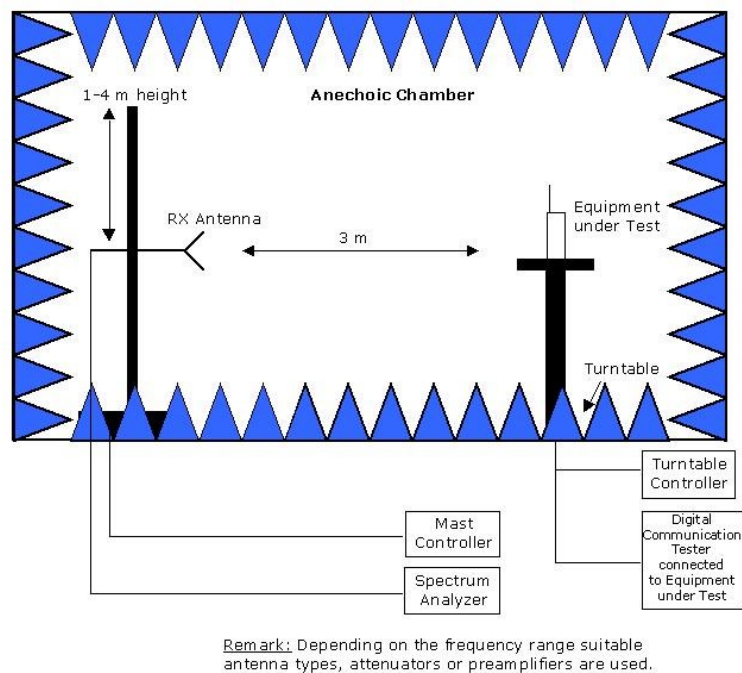
Single Devices for Temperature Chamber 05

Single Device Name	Type	Serial Number	Manufacturer
Temperature Chamber Vötsch 05	VT 4002	58566080550010	Vötsch
Calibration Details			Last Execution Next Exec.
Customized calibration			2014/03/11 2016/03/10

5 Photo Report

Photos are included in an external report.

6 Setup Drawings



Drawing 1: Setup in the Anechoic chamber:
 Measurements below 1 GHz: Semi-anechoic, conducting ground plane.
 Measurements above 1 GHz: Fully-anechoic, absorbers on all surfaces.

7 FCC and IC Correlation of measurement requirements

The following tables show the correlation of measurement requirements 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 4: 8.8
Out-of-band emissions	§ 15.225 (d)	RSS Gen Issue 4: 6.13/8.9/8.10; 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 4: 8.3
Receiver spurious emissions	–	RSS-210 Issue 8: 2.3; RSS Gen Issue 4: 5/7 *)
Handling of active and passive tag devices of RFID application	§ 15.225 (f)	RSS Gen Issue 4: 8.7

*) Receivers are exempted from certification besides if operating in stand-alone mode in the frequency range 30–960 MHz or if these are scanner receivers.

8 Annex measurement plots

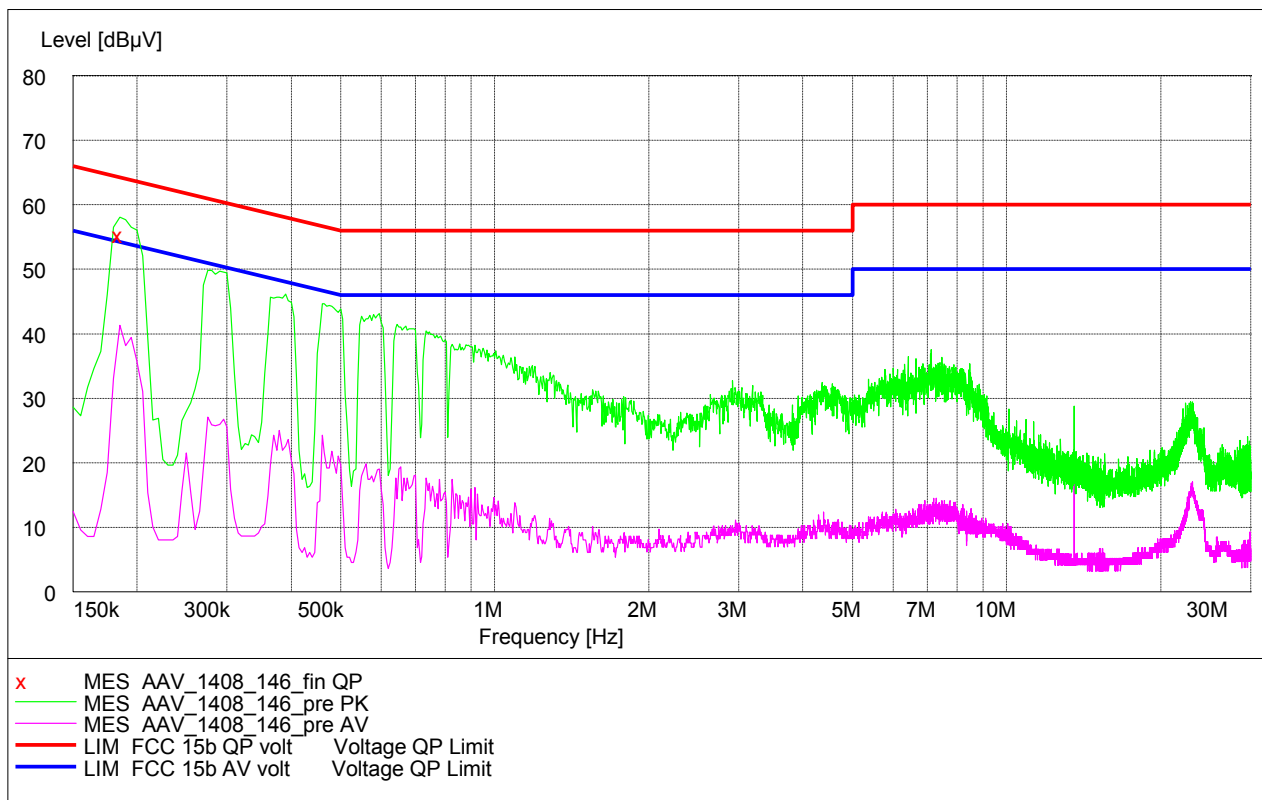
8.1 Conducted Emissions (AC Power line)

AC MAINS CONDUCTED

EUT: (DE1004006ad01)
 Manufacturer: AAVAM
 Operating Condition: WLAN normal mode, NFC on, video recording
 Test Site: 7 layers Ratingen
 Operator: URO
 Test Specification: ANSI C63.4; FCC 15.107 / 15.207
 Comment: 120 V / 60 Hz ; AC/DC adapter
 Start of Test: 15.02.2015 / 21:19:36

SCAN TABLE: "FCC Voltage"

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



MEASUREMENT RESULT: "AAV_1408_146_fin QP"

Frequency	Level	Transd	Limit	Margin	Line	PE
MHz	dBµV	dB	dBµV	dB		
0.185000	55.40	10.1	64	8.8	N	GND

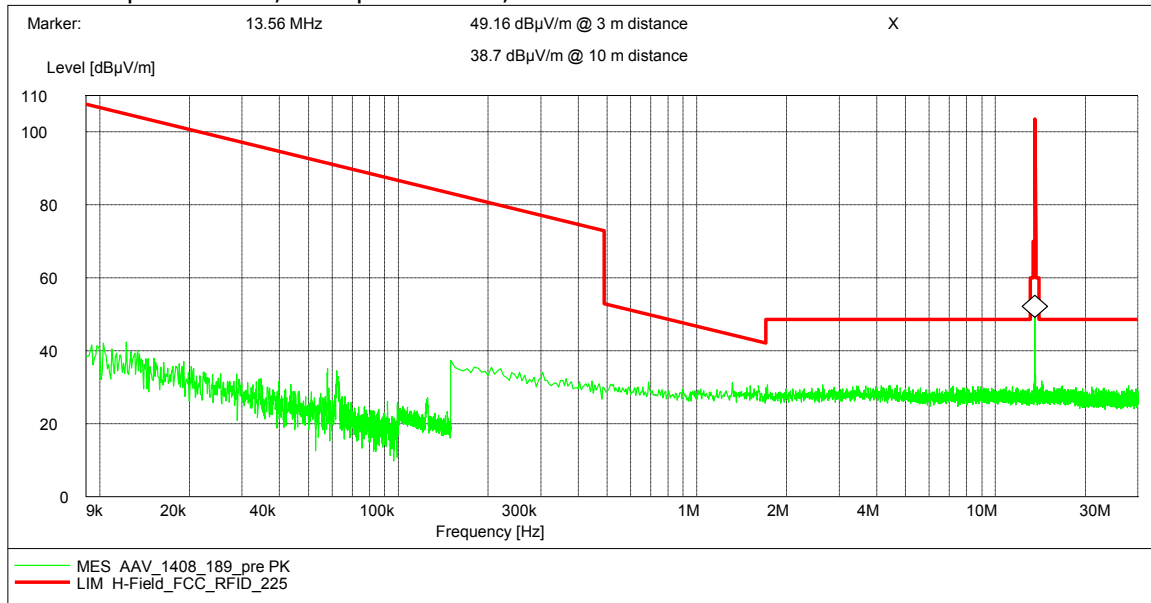
8.2 Radiated emissions

8.2.1 Radiated emissions ($f < 30$ MHz)

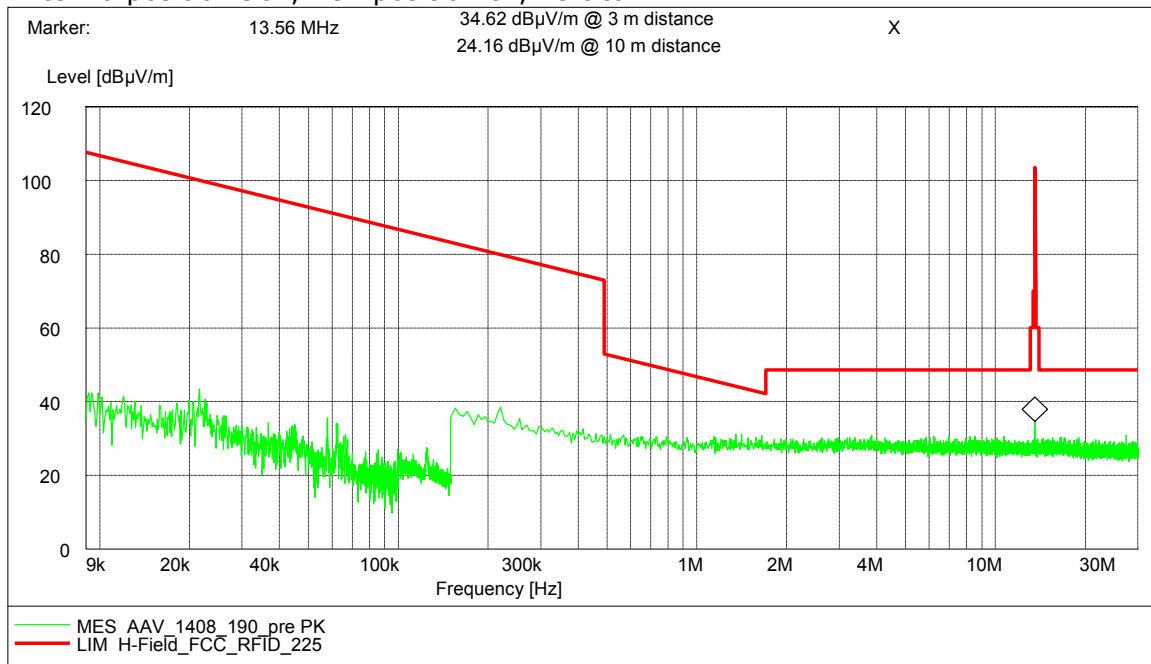
Remark: The H-Field emissions measurements shown are performed at 3 m distance between the EUT and measuring antenna, because of very low transmitter level.

The maximal measured value of 52.28 dB μ V/m @ 3 m distance, calculated for 10 m distance is **41.82 dB μ V/m**. The calculation formula used is: $H_{f10m} = H_{f3m} - 20(1 - \log 3)$

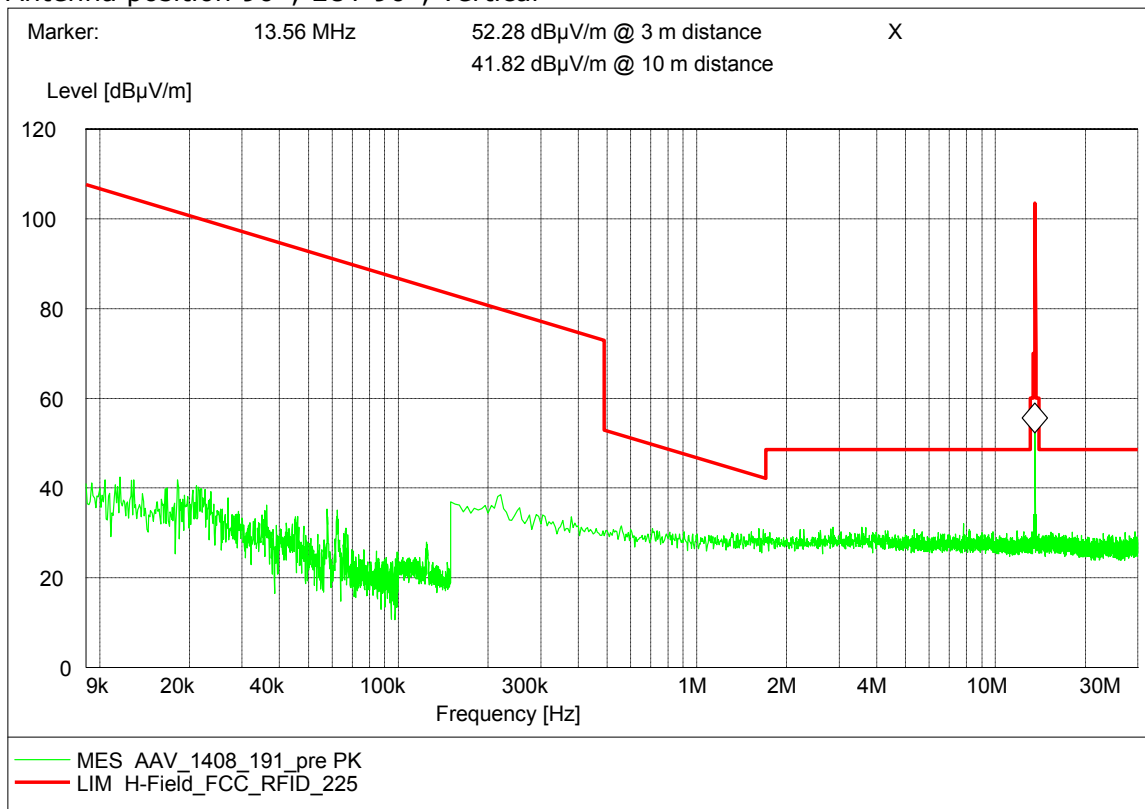
Antenna position 0°; EUT position 0°, vertical



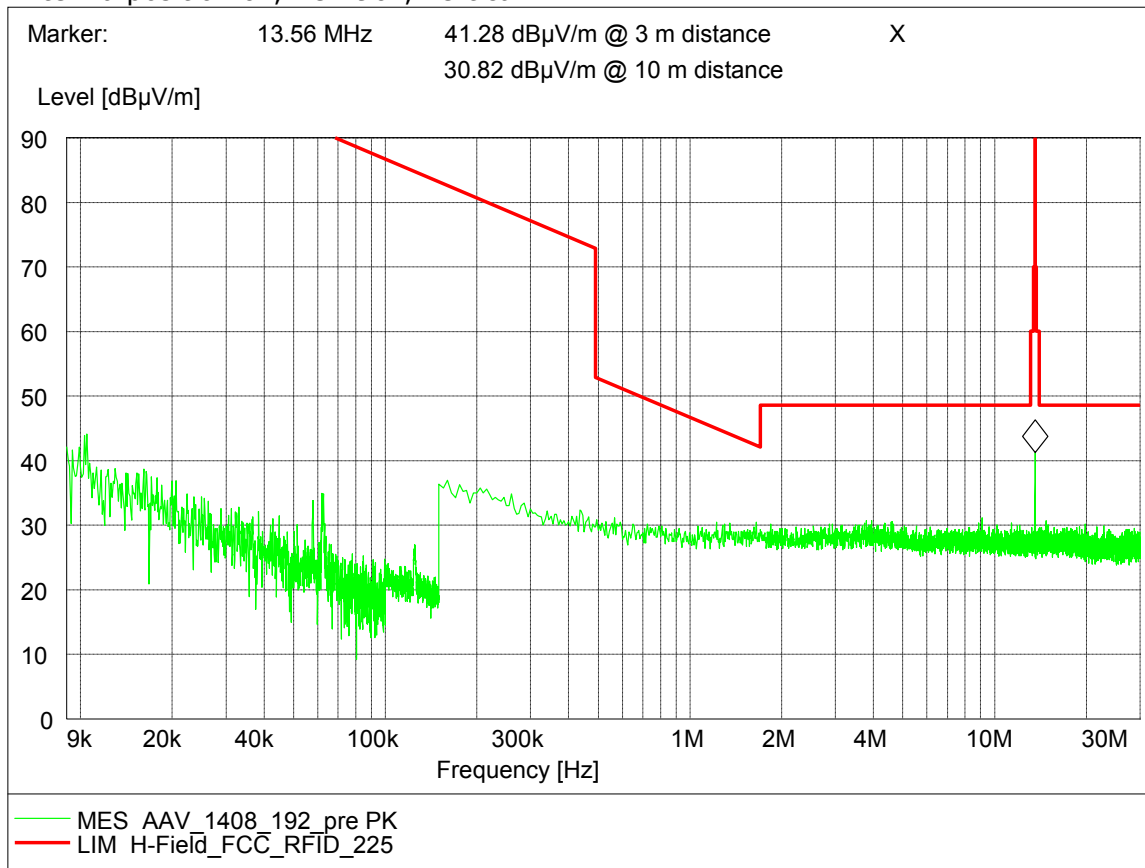
Antenna position 90°; EUT position 0°, vertical



Antenna position 90°; EUT 90°, vertical



Antenna position 0°; EUT 90°, vertical



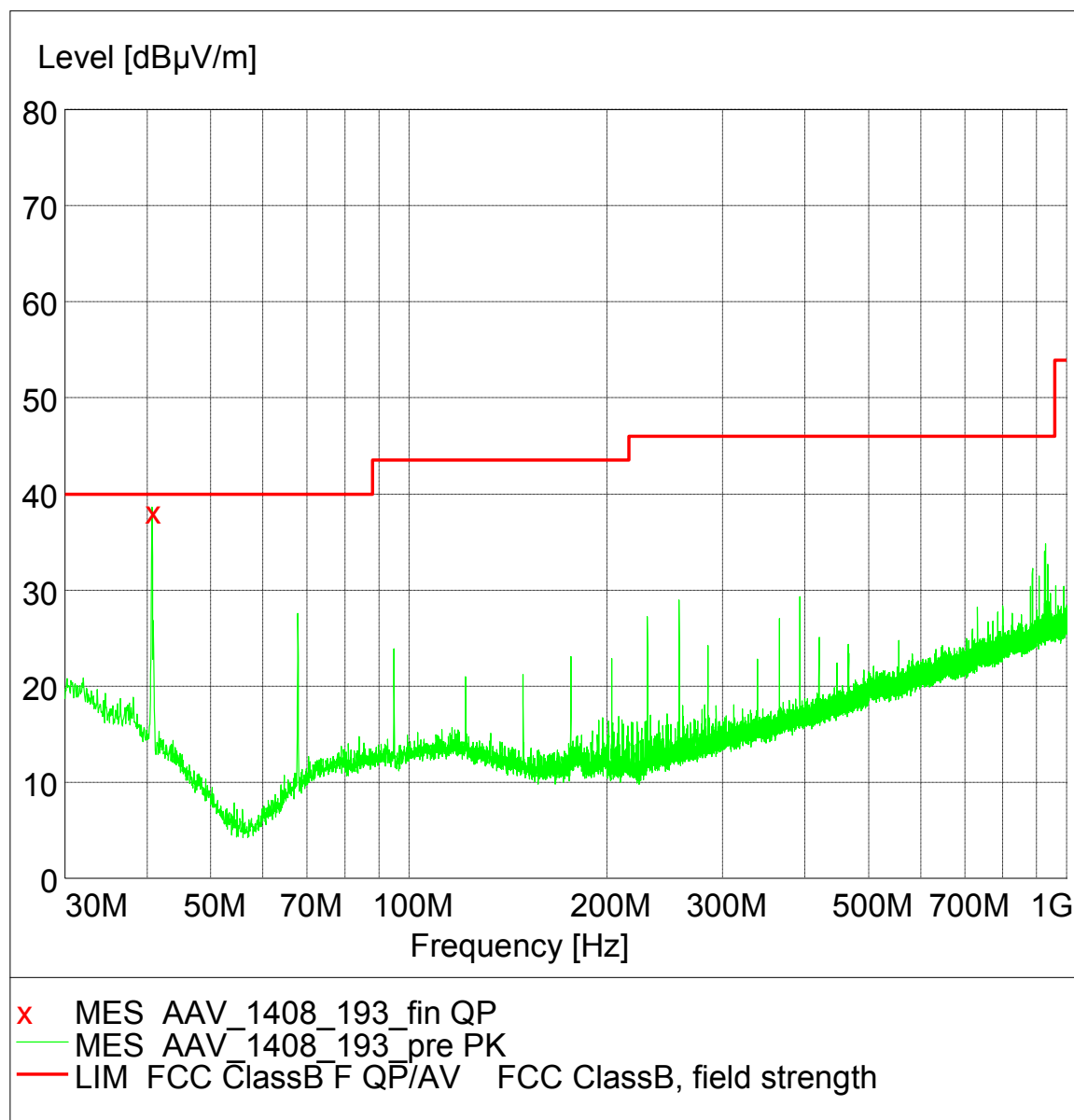
8.2.2 Radiated emissions (f > 30 MHz)

EUT: (DE10004006ah01)
 Manufacturer: AAVAMOBILE
 Operating Condition: TX on 13,56MHz
 Test Site: 7 layers, Ratingen
 Operator: Rab
 Test Specification: FCC Part 15 B Class B
 Comment: Vertical EUT position, Horiz.+Vert. antenna polarization

Start of Test: 05.08.2015 / 11:57:00

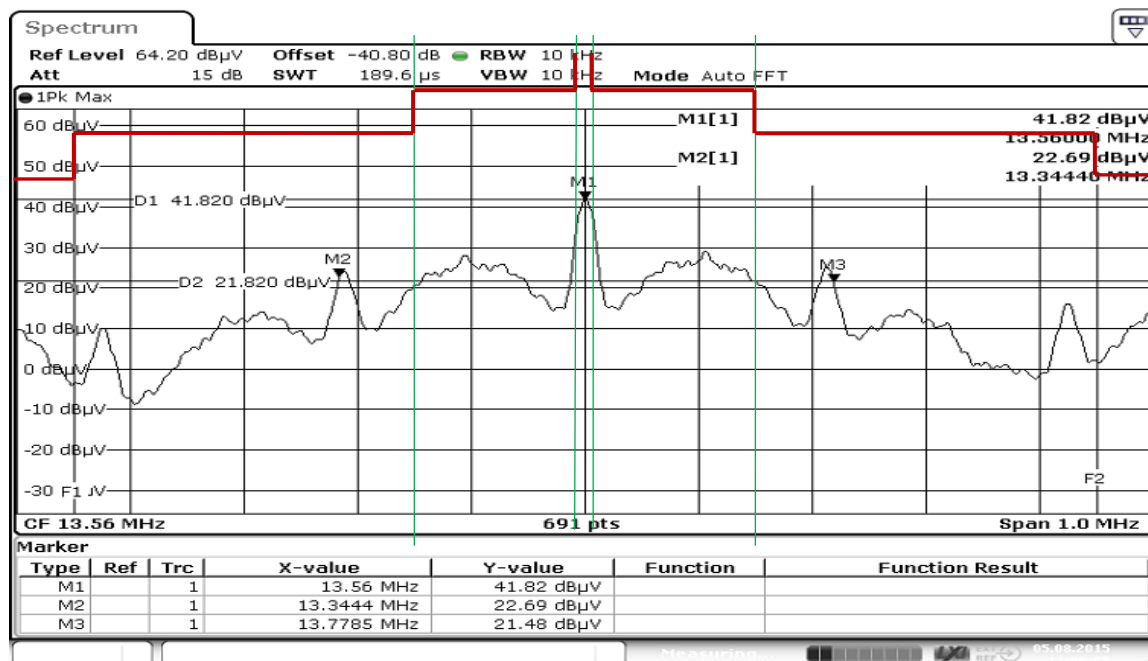
SCAN TABLE: "FCC 15.225"

Short Description:			FCC 15.225			
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	60.0 kHz	MaxPeak	1.0 ms	120 kHz	HL562



8.3 Occupied bandwidth

8.3.1 20 dB bandwidth



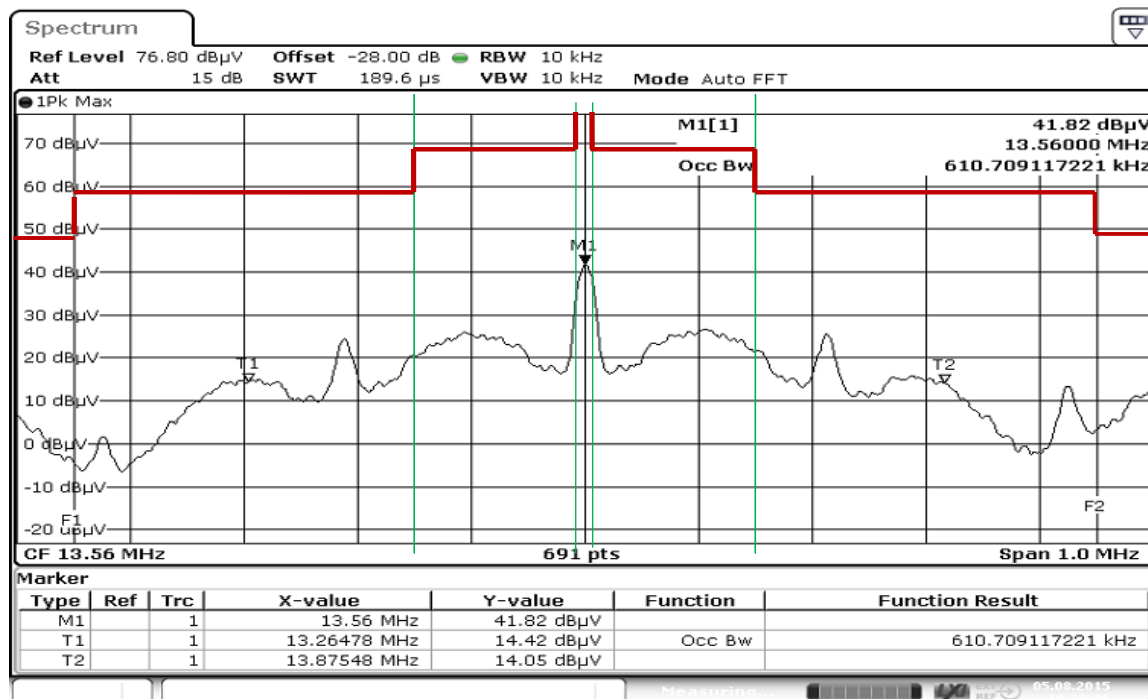
Date: 5 AUG. 2015 13:00:05

Notes: F1=13.11 MHz and F2=14.01 MHz are the boundaries of the designated BW.

Markers 2 and 3 are defining the 20 dB BW

The red line is the FCC 15.225 Standard spectrum mask.

8.3.2 99% bandwidth



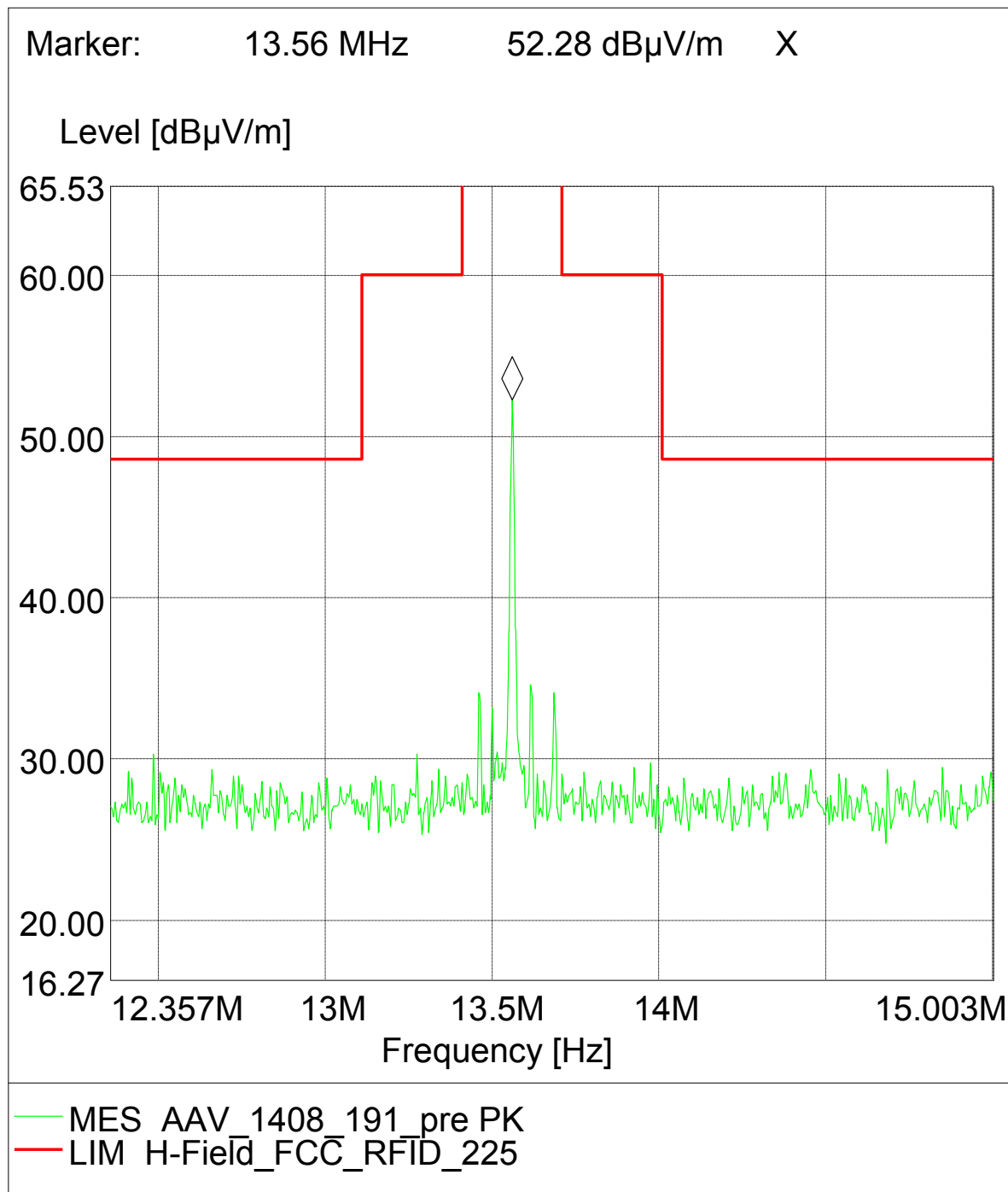
Date: 5 AUG. 2015 13:23:06

Notes: F1=13.11 MHz and F2=14.01 MHz are the boundaries of the designated BW.

The red line is the FCC 15.225 Standard spectrum mask.

8.4 Spectrum mask

EUT: (DE1004006ah01)
 Manufacturer: AAVAM
 Operating Condition: Tx on 13.56 MHz
 Test Site: 7 layers, Ratingen
 Operator: Dob
 Test Specification: FCC 15.225
 Comment: Antenna position 90°, EUT 90° vertical position



Remark: The maximal value of 52.28 dBμV/m is measured @ 3 m distance. For the report purposes @ 10 m distance it is calculated to **41.82 dBμV/m**, using the following calculation formula: $H_{f10m} = H_{f3m} - 20(1 - \log 3)$