

DELTA Test Report

TEST REPORT issued by an Accredited Testing Laboratory



Emission tests of AXIS A4011-E READER

Performed for ASSA AB

REC-E704117-FCC

Project no.: E704117

Page 1 of 36

2015-03-01

**DELTA Development
Technology AB**

Finnslätten
Elektronikgatan 47
721 36 Västerås
Sweden

Tel. 021-31 44 80
Fax 021-31 44 81
info@delta-dt.se
www.delta-dt.se

Bankgiro 5534-7728
VAT SE 556556207001

DELTA Development
Technology AB
is a subsidiary company of
DELTA

Title Emission tests of AXIS A4011-E READER

Test object AXIS A4011-E READER

Report no. REC-E704117-FCC

Project no. E704117

Test period 07 January 2015 to 09 January 2015

Client ASSA AB
Box 371
631 05 Eskilstuna
Sweden
Tel.: 087751600

Contact person Gunnar Frank
E-mail: gunnar.frank@assa.se

Manufacturer ASSA AB

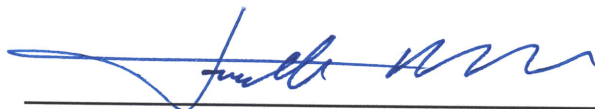
Specifications USA: FCC:47 CFR Part 15, subpart C
Canada: IC RSS-GEN, issue 4 and IC RSS-210, issue 8

Results The test object was found to be in compliance with the specifications,
as listed in Section 1

Client participant Mats Nordstrand

Date 2015-03-01

Test engineer



Fredrik Isaksson
DELTA

Responsible



Ulf Bjerke Technical manager
DELTA



	Table of contents	Page
1.	Summary of tests	4
2.	Test object(s) and auxiliary equipment	5
2.1	Test object(s)	5
2.2	Auxiliary equipment	9
3.	General test conditions	10
3.1	Test setup during test	10
3.1.1	Description and intended use of test object	10
3.1.2	Test modes during emission tests	10
3.1.3	Nominal power consumption	10
3.2	Test sequence	10
4.	Test results	11
4.1	Measurement of radio frequency voltage on DC	11
4.2	Measurement of radio frequency electromagnetic field 30 – 1000 MHz	14
4.3	Measurement of radio frequency electromagnetic field (above 1 GHz)	18
4.4	Measurement of Spurious radiated emission below 30MHz (H-field)	21
4.5	Measurement of Radiated H-field at 10m (wanted carrier)	27
4.5.1	Measurement of carrier power at normal and extreme conditions	27
4.5.2	Measurement of occupied bandwidth	32
5.	National registrations and accreditations	35
5.1	SWEDAC Accreditation	35
5.2	FCC Registrations	35
5.3	IC Registrations	35
6.	List of instruments	36



1. Summary of tests

Tests	Test methods*	Results
Measurement of radio frequency voltage on AC (15.207)	ANSI C63.4:2009	Passed ¹
Measurement of radio frequency electromagnetic field 30-1000 MHz at 10m (15.225 and 15.209)	ANSI C63.4:2009	Passed
Measurement of radio frequency electromagnetic field 1000-2000 MHz at 3m (15.225 and 15.209)	ANSI C63.4:2009	Passed
Measurement of radio frequency electromagnetic H-field 9kHz-30 MHz at 10m (15.225 and 15.209)	ANSI C63.4:2009	Passed
Measurement of Radiated H-field at 10m RFID band 13.110-14.010 MHz (15.225)	ANSI C63.4:2009	Passed
Permitted frequency range of modulation BW (15.215)	ANSI C63.4:2009	Passed
Carrier Frequency stability (15.225)	ANSI C63.4:2009	Passed

*ANSI C63.4:2009 - Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

Conclusion

The test object(s) mentioned in this report meet(s) the requirements of the standard(s) stated below.

- FCC CFR 47 Part 15C (Intentional radiator at 13.56 MHz)
- Industry Canada IC Radio Standards Specification, RSS-Gen, issue 4:2014, *General Requirements and Information for the Certification of Radio Apparatus*
- Industry Canada IC Radio Standards Specification, RSS-210, issue 8:2010, *Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment*

The test results relate only to the object(s) tested.

¹ Measured on DC with the AC limit and with exclusion band as interpreted in ETSI 301 489-3, chapter 4.3.

2. Test object(s) and auxiliary equipment

2.1 Test object(s)



Photo 2.1.1 Test object –RFID reader with (passive) tag



Photo 2.1.2 Test object –RFID reader



Photo 2.1.3 Test object –RFID reader, circuit board.





Photo 2.1.4 Test object –RFID reader, circuit board.

Test object 2.1.1

Name of test object	AXIS A4011-E READER
Model / type	-
Part no.	S559696086
PCB version	LD40062410 “2014-11-26”
FCC ID	2AEBU S559696986
Manufacturer	ASSA AB
Supply voltage	12-24VDC
Software version	1.03.00
Hardware version	A
Cycle time	1s with Tag applied
Highest frequency generated or used	120MHz
Received	Date: 07 Jan. 2015 Status: Prototype
Firmware	PR300301/PR300301_01_03.hex



Radio parameters.

Operating frequency	13.56 MHz
Type of modulation	AM
Specified output power	25.1 dBm
Specified Band Width	-
Swept frequency	No
Number of channels	1
Radio Equipment Category (RSS-General chapter 2.2)	Category I
Duty cycle	-
Ambient temperature low	-25° C
Ambient temperature high	+55° C
Power supply	12 - 24 VDC
Antenna type	Integral antenna on PCB
Antenna Gain	- 58 dBi
Data rate	106 kbit/s

Above information regarding the receiver and the transmitter is declared by the manufacturer.



2.2 Auxiliary equipment

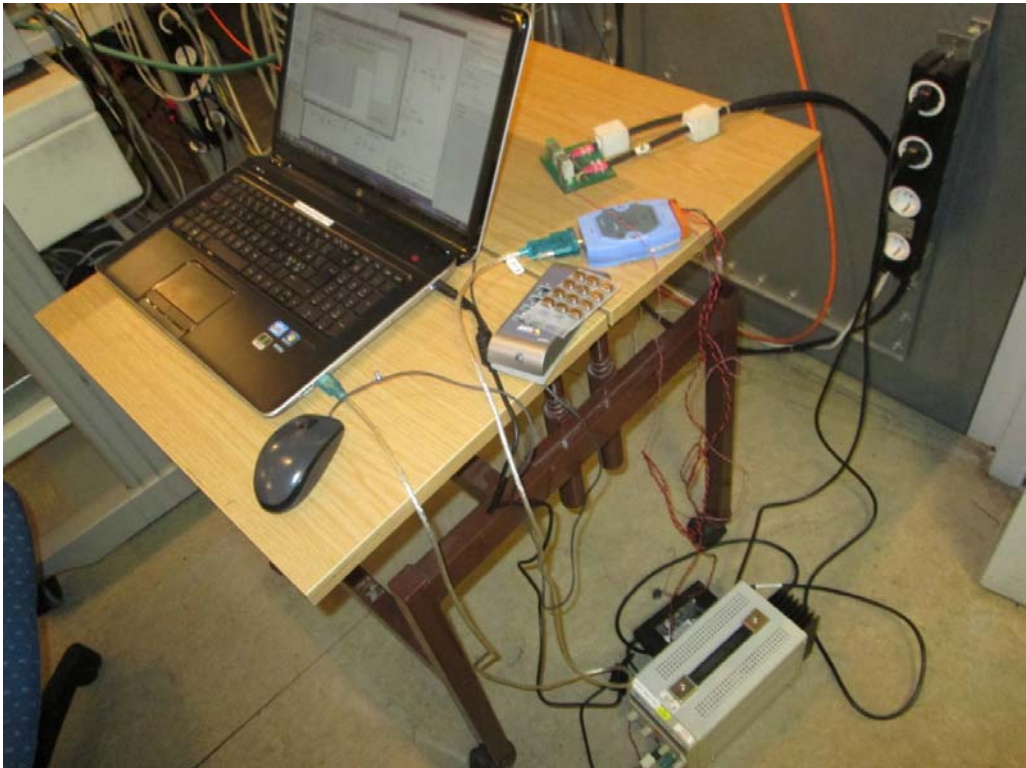


Photo 2.2.1 Auxiliary equipment outside the test chamber (RE tests).

Auxiliary equipment 2.2.1

Name of auxiliary equipment	PC (laptop)
Supply voltage	230VAC or Battery
Comment	Auxiliary equipment supplied by the client, who also has the responsibility for its correct function and set up.

Auxiliary equipment 2.2.2

Name of auxiliary equipment	Interface RS485-USB
Supply voltage	12VDC
Comment	Auxiliary equipment supplied by the client, who also has the responsibility for its correct function and set up.



3. General test conditions

3.1 Test setup during test

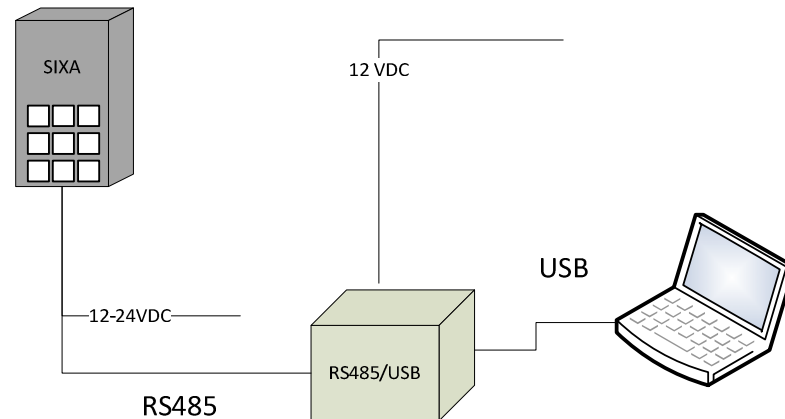


Figure 3.1.1 Block diagram of test object(s) with cables and auxiliary equipment.

3.1.1 Description and intended use of test object

The test object is a 13.56 MHz RFID reader for access control systems.

The cable includes RS485 and DC power supply and is not shielded.

The RFID tag used in the tests is passive.

3.1.2 Test modes during emission tests

Active mode (tag present).

3.1.3 Nominal power consumption

Nominal power consumption: 1.5W

3.2 Test sequence

The tests described in this test report were performed in the following sequence:

1. Measurement of radio frequency electromagnetic field 30-1000 MHz
2. Measurement of radio frequency voltage on mains
3. Measurement of radio frequency electromagnetic H-field
4. Measurement of In-band emission
5. Measurement of OBW
6. Measurement of carrier freq. stability
7. Measurement of radio frequency electromagnetic field 1-2 GHz



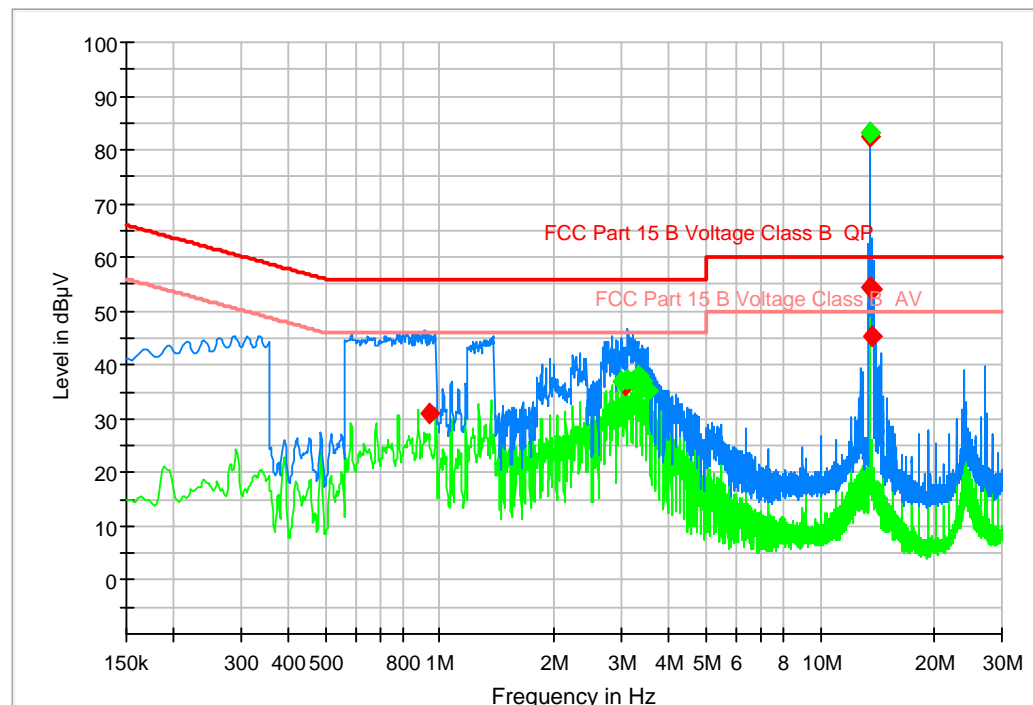
4. Test results

4.1 Measurement of radio frequency voltage on DC

Test object	AXIS A4011-E READER	Sheet	CE-1
Type	-	Project no.	E704117
Serial no.	S559696086	Date	07 Jan. 2015
Client	ASSA AB	Initials	FRI
Specification	FCC Part 15c §15.207 and RSS Gen. chapter 8.8	Frequency	0.15-30 MHz

Test method	ANSI C63.4:2009	Temperature	22 °C
Characteristics	Artificial mains network: 50 Ω , 50 μ H	Humidity	31 % RH
Detector	Quasi Peak and Average	Bandwidth	9 kHz
Test equipm.	EMC Hall A Västerås Setup VEA2	Uncertainty	1.8 dB

Full Spectrum



— Preview Result 2-AVG
— Preview Result 1-PK+
— FCC Part 15 B Voltage Class B QP
— FCC Part 15 B Voltage Class B AV
◆ Final_Result QPK
◆ Final_Result AVG



Final_Result

Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.939750	30.98	---	56.00	25.02	2000.0	9.000	N	16.2
2.820750	---	31.64	46.00	14.36	2000.0	9.000	N	16.4
3.018750	---	36.94	46.00	9.06	2000.0	9.000	N	16.4
3.075000	36.29	---	56.00	19.71	2000.0	9.000	P	16.4
3.115500	---	37.41	46.00	8.59	2000.0	9.000	N	16.4
3.212250	---	36.90	46.00	9.10	2000.0	9.000	N	16.4
3.311250	---	37.96	46.00	8.04	2000.0	9.000	N	16.4
3.408000	---	36.88	46.00	9.12	2000.0	9.000	N	16.5
3.504750	---	35.26	46.00	10.74	2000.0	9.000	N	16.4
13.508250	54.44	---	60.00	5.56	2000.0	9.000	N	17.2
13.560000	83.13	---	60.00	-23.13	2000.0	9.000	N	17.2
13.560000	---	83.16	50.00	-33.16	2000.0	9.000	N	17.2
13.562250	82.46	---	60.00	-22.46	2000.0	9.000	N	17.2
13.611750	54.03	---	60.00	5.97	2000.0	9.000	N	17.2
13.695000	45.32	---	60.00	14.68	2000.0	9.000	N	17.2

Line under test	Maximum of Positive and Negative
Test result	The measured voltages were below the limit ²
Compliant	Yes
Comments	Signal above limit is inside the exclusion band. The Test object was powered by 24 VDC. The FCC part 15c limit equals the part 15b class B limit.

² Measured on DC with the AC limit and with exclusion band as interpreted in ETSI 301 489-3, chapter 4.3.

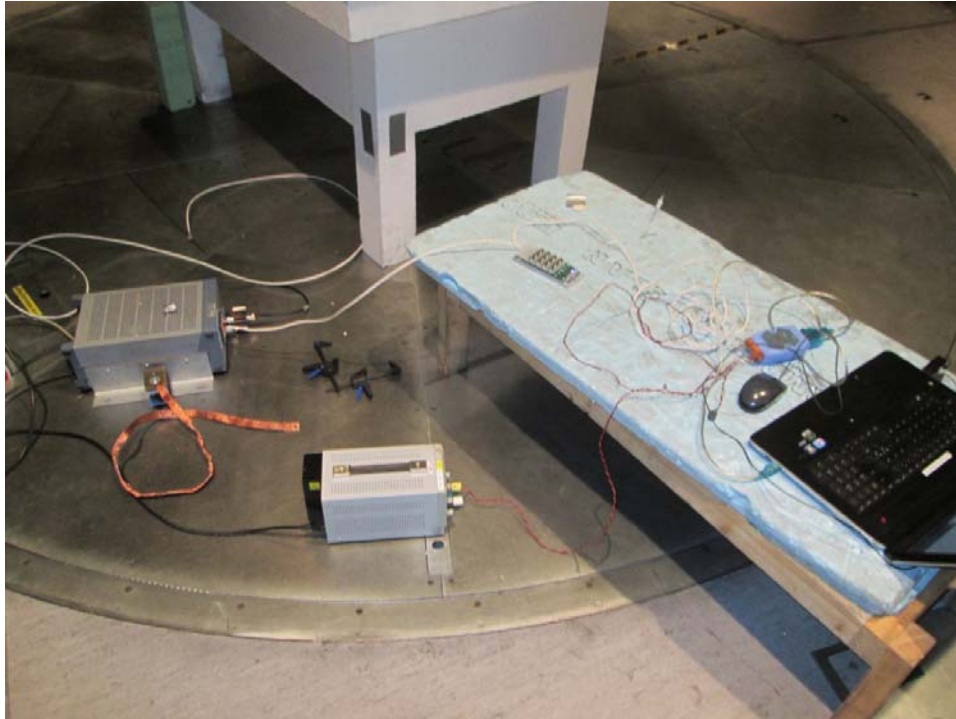
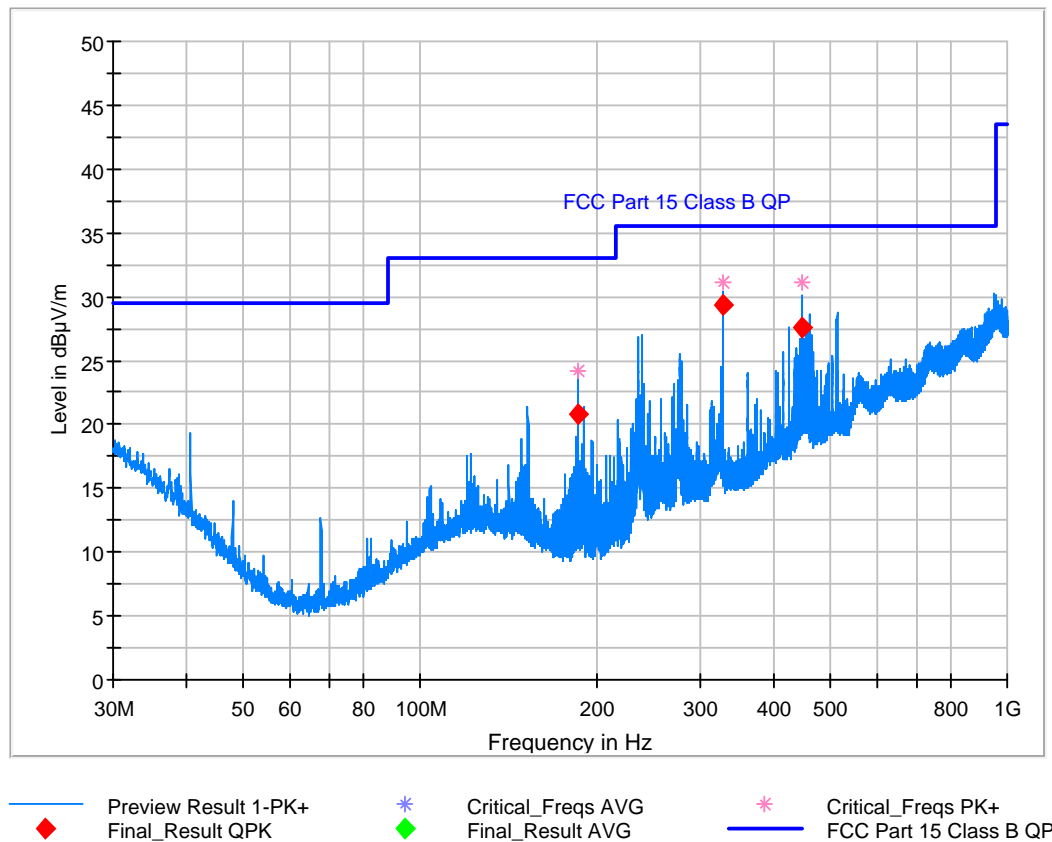


Photo 4.1.1 Test setup regarding measurement of radio frequency voltage on DC.

4.2 Measurement of radio frequency electromagnetic field 30 – 1000 MHz

Test object	AXIS A4011-E READER	Sheet	RE-1
Type	-	Project no.	E704117
Serial no.	S559696086	Date	07 Jan. 2015
Client	ASSA AB	Initials	FRI
Specification	FCC Part 15c §15.209, §15.225 and RSS-Gen. chapter 6.13	Frequency	30 -1000 MHz

Test method	ANSI C63.4:2009	Temperature	22 °C
Characteristics	Complete search, antenna distance 10 m	Humidity	31 % RH
Detector	Peak and QP	Bandwidth	120 kHz
Test equipm.	EMC Hall A Västerås Setup VEC1	Uncertainty	5.1 dB



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
185.490000	20.84	33.00	12.16	1000.0	120.000	305.0	H	153.0	-16.4
327.270000	29.40	35.50	6.10	1000.0	120.000	243.0	H	236.0	-10.8
447.270000	27.61	35.50	7.89	1000.0	120.000	199.0	H	125.0	-8.0

Test result

The measured field strengths are below the limits.

Compliant

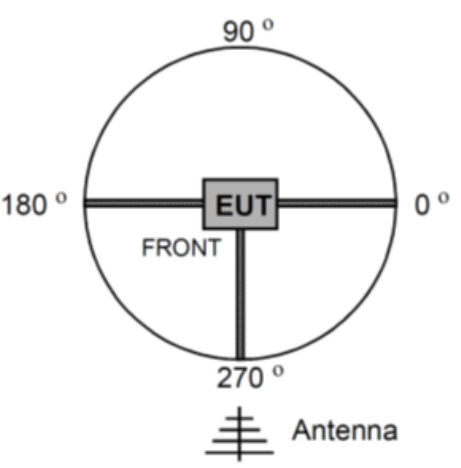
Yes

Comments

Final maximal measurements by variation of turntable azimuth, antenna height, and antenna polarisation.

The test object was powered with 24VDC from outside the chamber.

The FCC part 15c limit equals the part 15b class B limit.



Picture 4.2.1 Turntable azimuth variations.





Photo 4.2.2 Test setup regarding measurement of radio frequency electromagnetic field.



Photo 4.2.3 Test setup regarding measurement of radio frequency electromagnetic field.



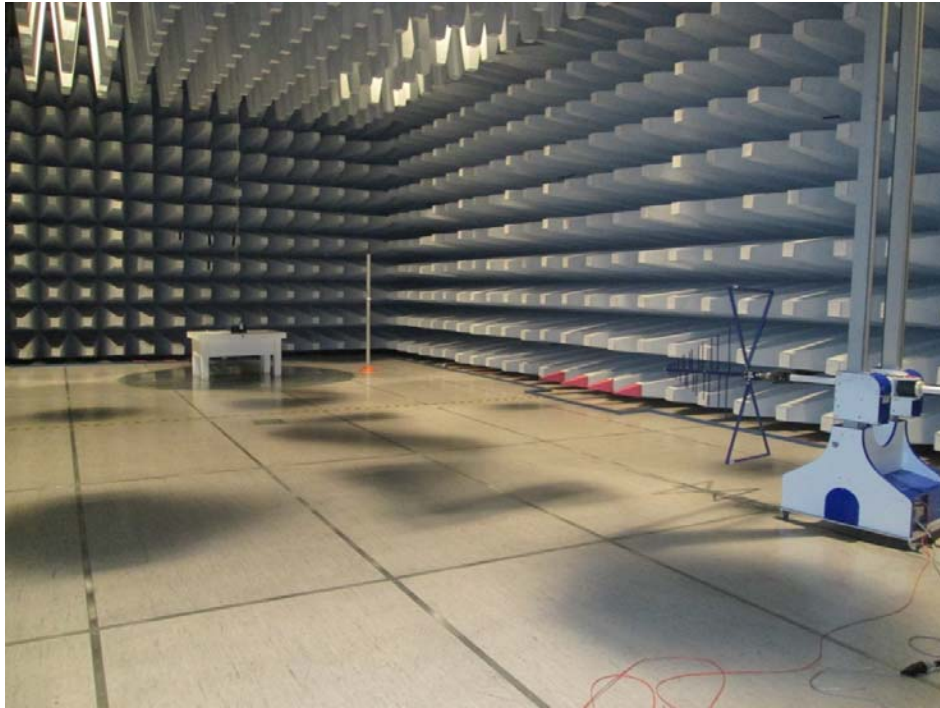


Photo 4.2.3 Test setup regarding measurement of radio frequency electromagnetic field.

4.3 Measurement of radio frequency electromagnetic field (above 1 GHz)

Test object	AXIS A4011-E READER	Sheet	RE-2
Type	-	Project no.	E704117
Serial no.	S559696086	Date	07 Jan. 2015
Client	ASSA AB	Initials	FRI
Specification	FCC Part 15c §15.209, §15.225 and RSS-Gen. chapter 6.13	Frequency	1-2 GHz

Test method	ANSI C63.4:2009	Temperature	22 °C
Characteristics	3m antenna distance	Humidity	34 % RH
Detector	Peak and average	Bandwidth	120 kHz
Test equipm.	EMC Hall A Västerås Setup VEC1 (3m)	Uncertainty	4.5 dB

Test Description: Radiated emission. Complete measurement 1 GHz – 2 GHz
(Measured upper frequency limited by $10xf_0$, where $f_0 = 120$ MHz)

Comments Only two final measurements were made due to large margin to limit.
FCC part 15c limit equals the part 15b class B limit.



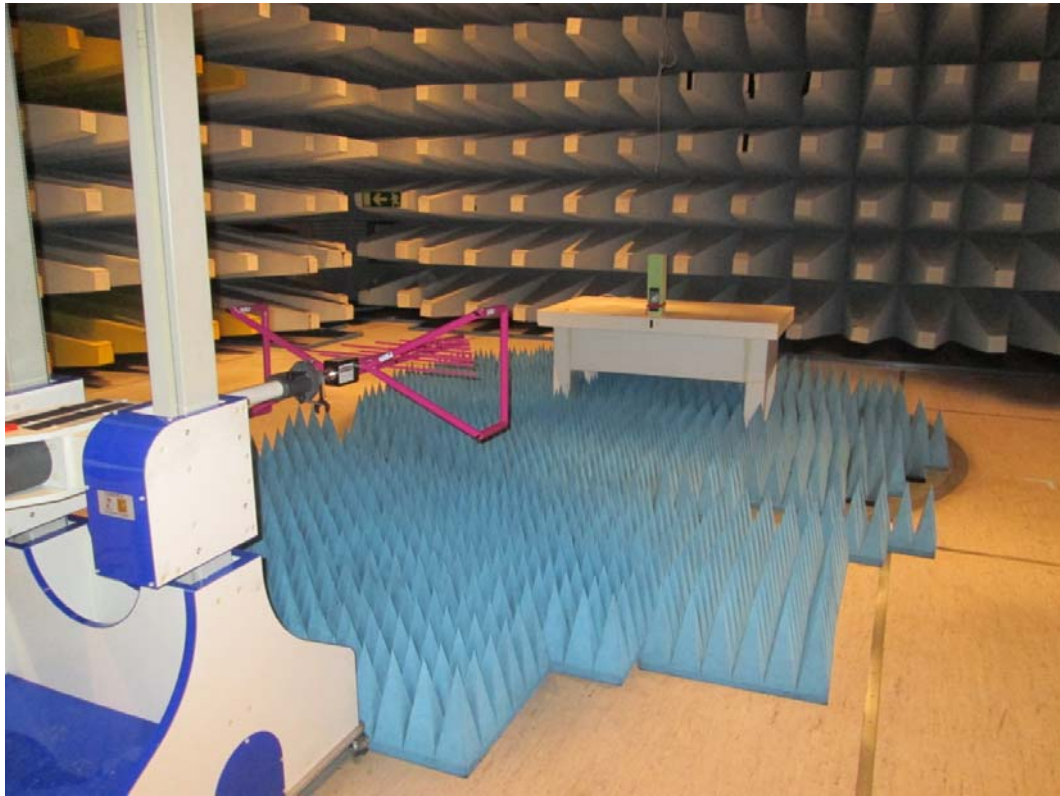
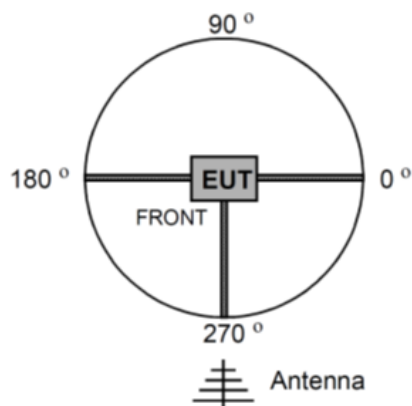
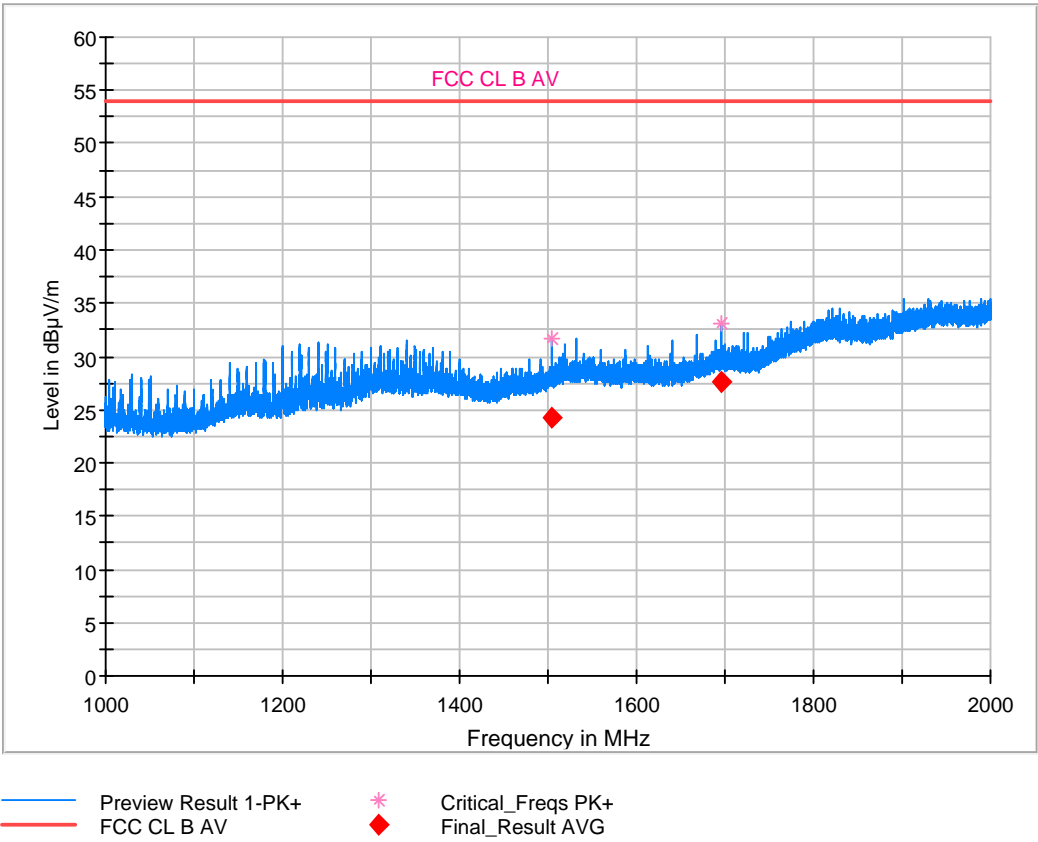


Photo 4.3.3 Test setup regarding measurement of radio frequency electromagnetic field.



Picture 4.3.1 Turntable azimuth variations.



Final Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1505.230000	24.22	54.00	29.78	1500.0	120.000	294.0	H	278.0	-0.4
1695.070000	27.65	54.00	26.35	1500.0	120.000	111.0	H	188.0	1.5

Test result	The measured field strengths are below the limits.
Compliant	Yes
Comments	<p>Final maximal measurements by variation of turntable azimuth, antenna height, and antenna polarisation.</p> <p>The test object was powered with 24VDC from outside the chamber.</p> <p>The FCC part 15c limit equals the part 15b class B limit.</p>



4.4 Measurement of Spurious radiated emission below 30MHz (H-field)

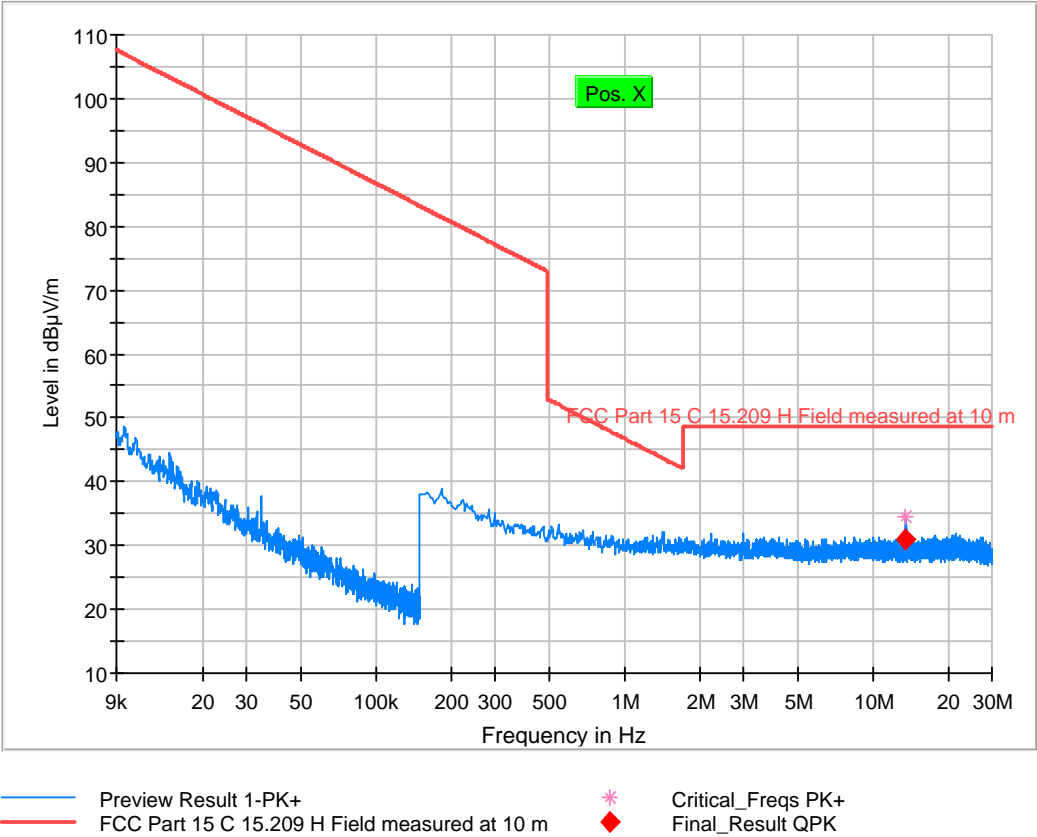
Test object	AXIS A4011-E READER	Sheet	RE Loop-3
Type	-	Project no.	E704117
Serial no.	S559696086	Date	07 Jan. 2015
Client	ASSA AB	Initials	FRI
Specification	FCC Part 15c §15.209, §15.225 and RSS-Gen. chapter 6.13	Frequency	0.009-30 MHz

Test method	ANSI C63.4:2009	Temperature	22 °C
Characteristics	10m antenna distance	Humidity	34 % RH
Detector	Peak and QP	Bandwidth	200 Hz and 9 kHz
Test equipm.	EMC Hall A Västerås Setup VED1	Uncertainty	3.2 dB

Test Description: Radiated emission. Complete measurement 9 kHz – 30 MHz

Comments Measurement was performed in a shielded room





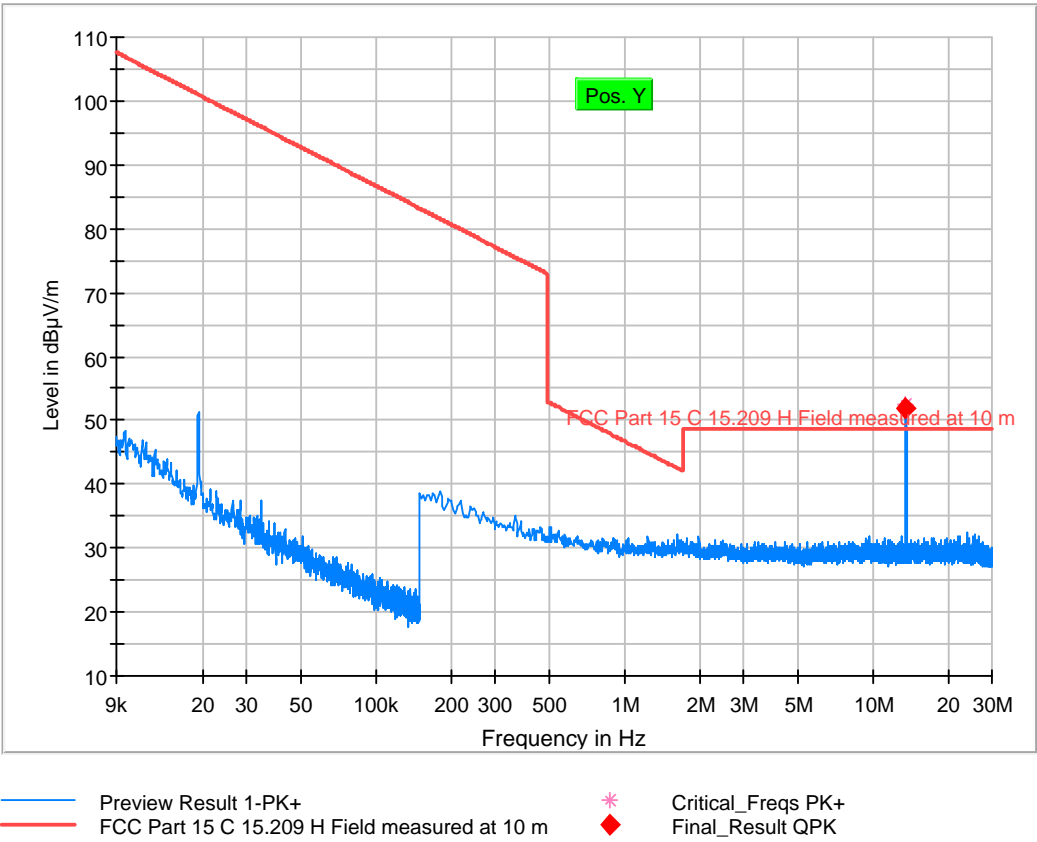
Comments

X position

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB)
13.562500	31.03	48.60	17.57	1500.0	10.000	H	175.0	18.8





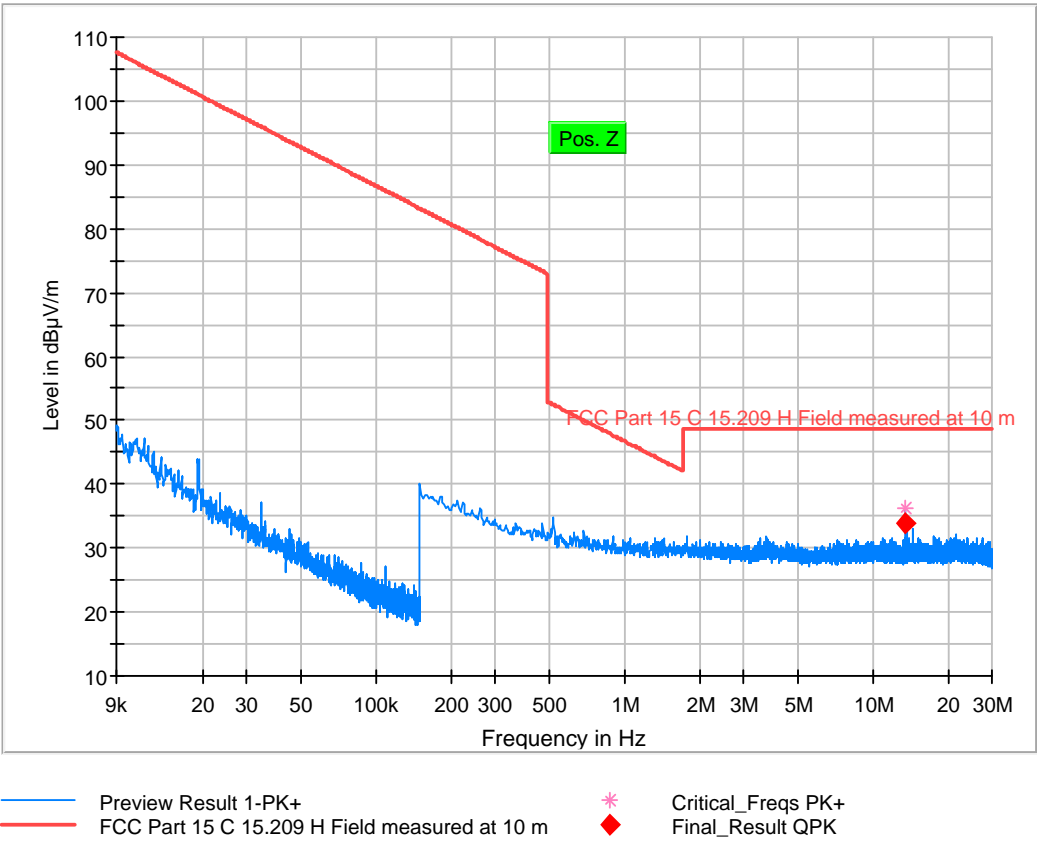
Comments

Y position

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB)
13.560000	51.96	48.60	-3.36	1500.0	10.000	H	44.0	18.8

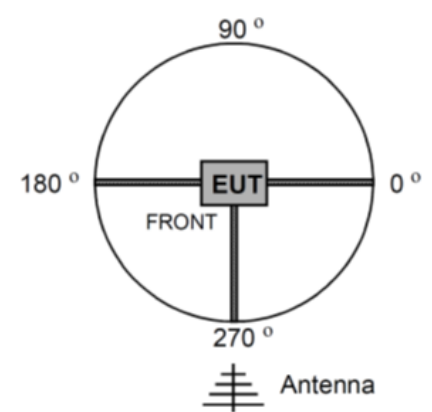




Comments Z position

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB)
13.560000	33.86	48.60	14.74	1500.0	10.000	H	137.0	18.8



Picture 4.4.1 Turntable azimuth variations.



Test result The measured field strengths are below the limit outside the 13.56 MHz frequency band.

Compliant Yes

Comments Final maximal measurements by variation of turntable azimuth.
All measurements were performed in a shielded room.

Antenna height: 1 m

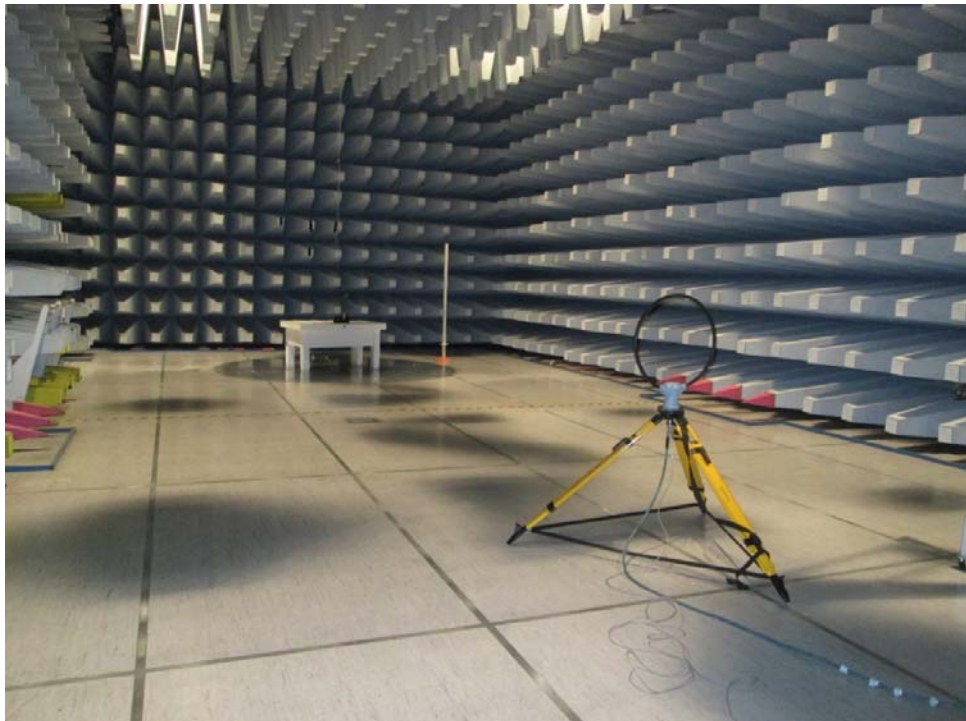


Photo 4.4.2 Test setup regarding measurement of radio frequency electromagnetic field – X position.

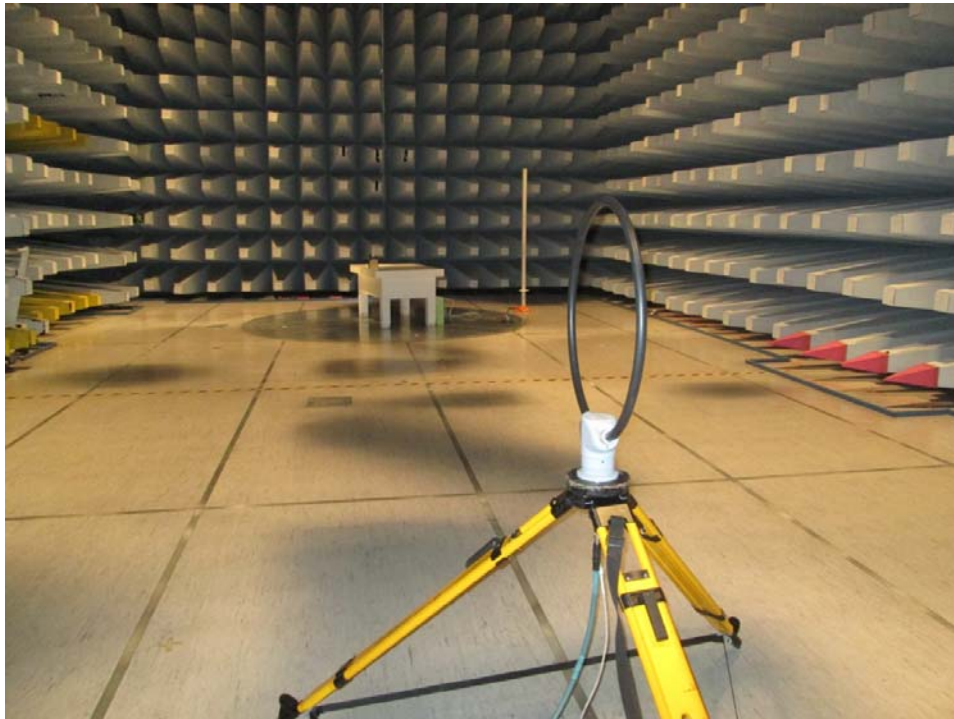


Photo 4.4.3 Test setup regarding measurement of radio frequency electromagnetic field
– Y position.

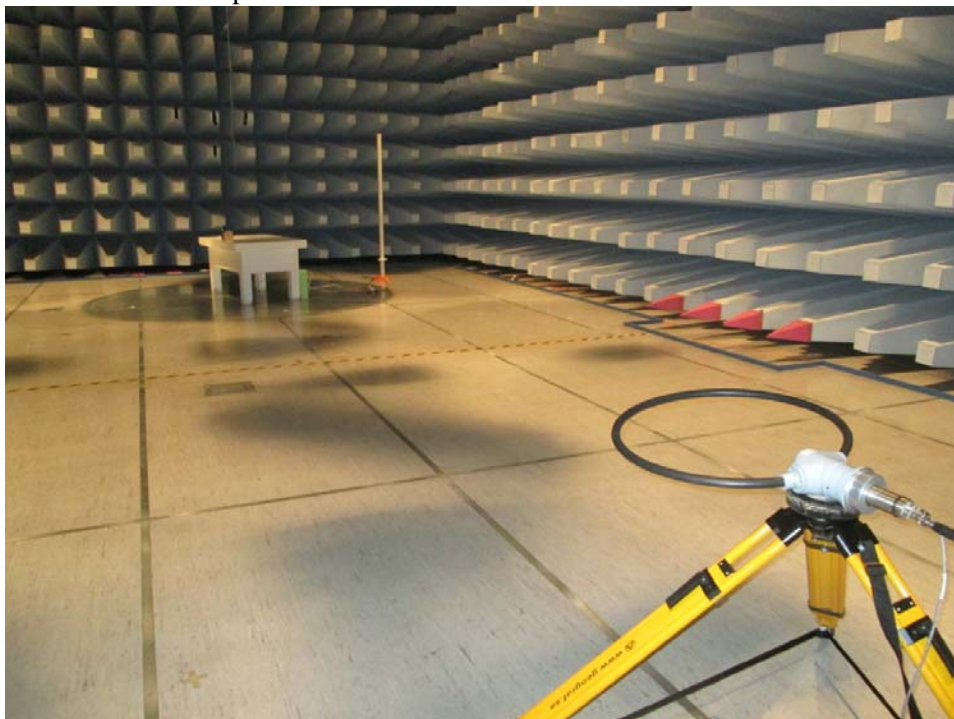


Photo 4.4.4 Test setup regarding measurement of radio frequency electromagnetic field
– Z position.



4.5 Measurement of Radiated H-field at 10m (wanted carrier)

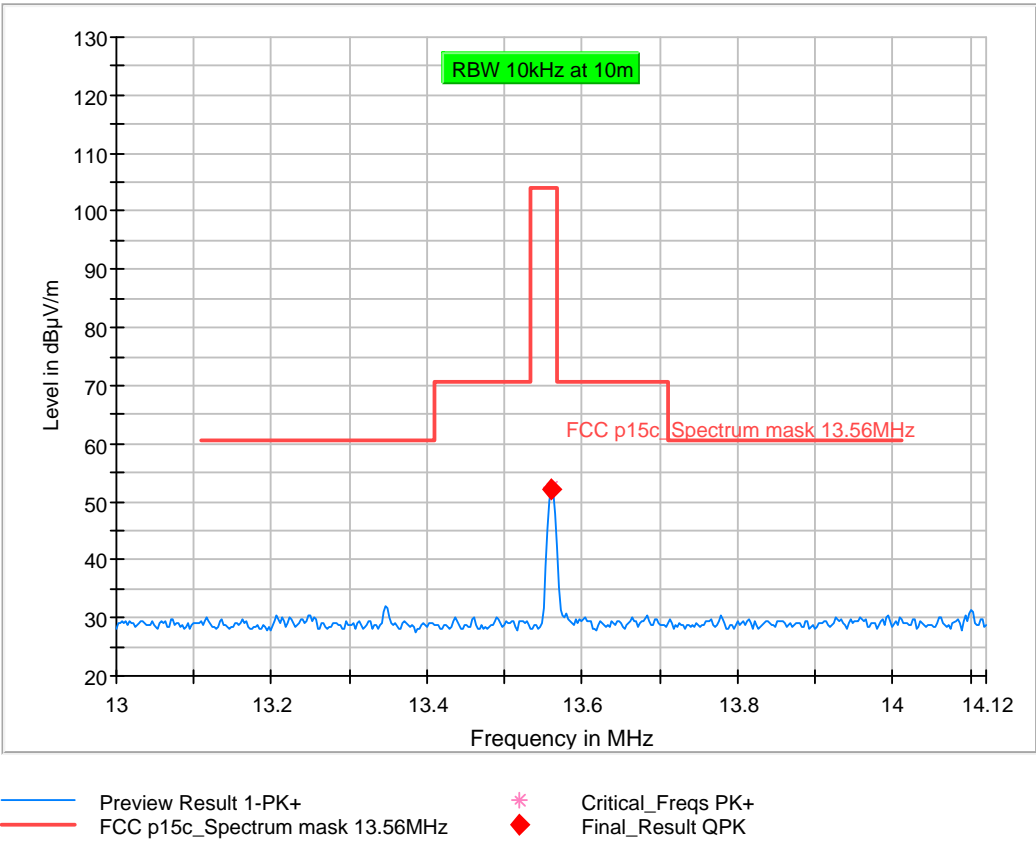
4.5.1 Measurement of carrier power at normal and extreme conditions

Test object	AXIS A4011-E READER	Sheet	RE-4
Type	-	Project no.	E704117
Serial no.	S559696086	Date	07, 08 Jan. 2015
Client	ASSA AB	Initials	FRI
Specification	FCC Part 15, Subpart C, Section 15.31 and 15.225 RSS Gen. chapter 6.11 and 6.12, RSS-210 Annex A.2.6	Frequency	13.56 MHz

Test method	ANSI C63.4:2009 10m antenna distance at semi anechoic chamber		Temperature	23 °C
Characteristics	Reference measurement: 10m antenna distance at semi anechoic chamber, test during extreme temperature in climate chamber		Humidity	34 % RH
Detector	Peak	Bandwidth	10 kHz	
Test equipm.	EMC Hall A Västerås Setup VEC1, Climate chamber Weiss WK1 1000, 36065 Measuring receiver Rohde & Schwarz ESL6, Fluke 87 E-P754			Uncertainty 3.2 dB

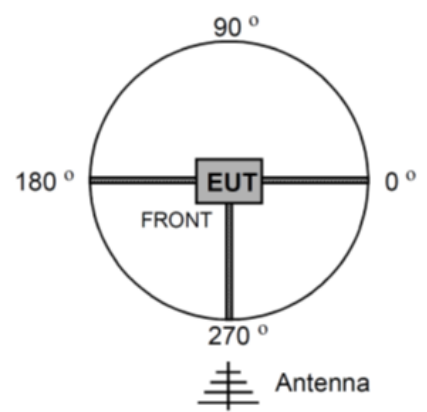
Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
150 kHz - 30 MHz	2.5 kHz	QPK	10 kHz	1.5 s	0 dB
Receiver:	[ESU 26]				





Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB)
13.560000	51.97	104.00	52.03	1500.0	10.000	H	25.0	18.8



Picture 4.5.1.1 Turntable azimuth variations.



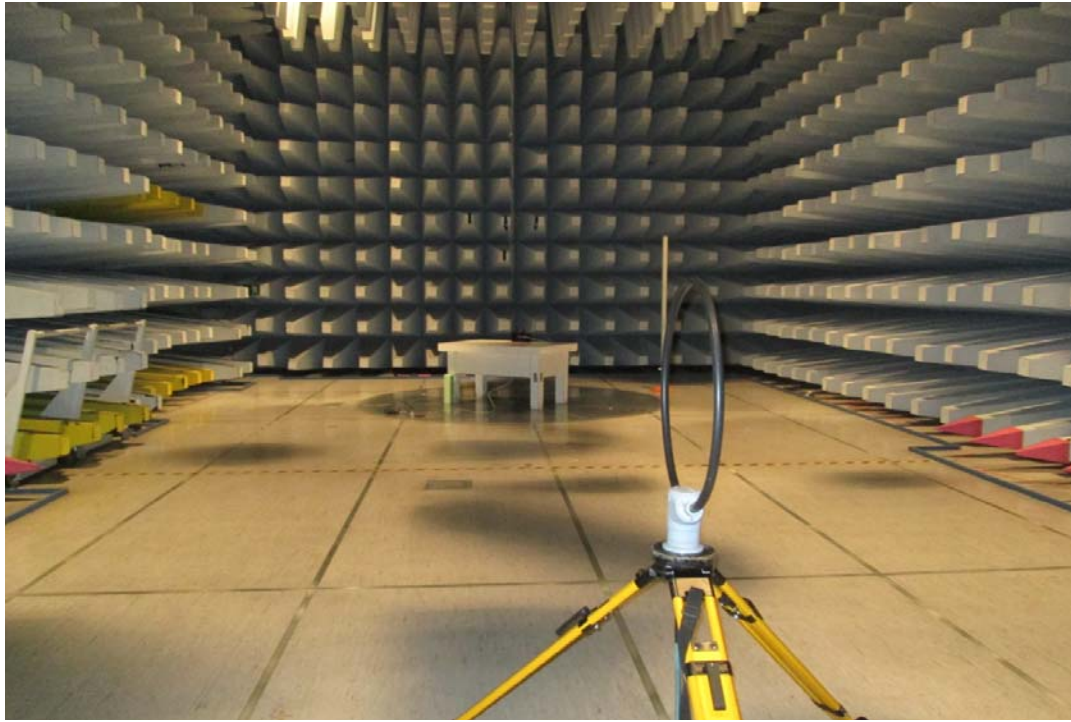


Photo 4.5.1.1 Test setup regarding measurement of radio frequency electromagnetic field



Photo 4.5.1.2 Test setup regarding test with extreme conditions with antenna and test object fixed mounted on a piece of polystyrene inside the climate chamber.



Photo 4.5.1.3 Test setup regarding test with extreme conditions outside the climate chamber.



The H-field was measured with modulation:

Measured Field strength at 10 m: 52 dBuV/m
Limit: 104dBuV/m (84 dBuV/m @ 30m)

Normal conditions: 24VDC and 22 °C

Measured carrier at extreme conditions:

Power supply level	24V	27.6V (+15 %)	10.2V (-11.5 %)
Temperature 22 °C	81.09 dBuV/m	81.09 dBuV/m	81.09 dBuV/m
	13.560604 MHz	13.560604 MHz	13.560604 MHz
Temperature -20 °C	81.84 dBuV/m	81.84 dBuV/m	81.84 dBuV/m
	13.560679 MHz	13.560679 MHz	13.560679 MHz
Temperature 50 °C	80.76 dBuV/m	80.76 dBuV/m	80.76 dBuV/m
	13.560570 MHz	13.560570 MHz	13.560570 MHz

Results:

Maximum amplitude deviation from normal conditions: +0.75dB

Maximum frequency deviation from normal conditions: +35Hz

Limits:

Maximum amplitude deviation from normal conditions: Margin to limit in previous test is 52 dB.

Maximum frequency deviation from normal conditions: 0.01 % of 13.56 MHz i.e. 1356 Hz

Antenna position Y (see photo 4.5.1.1)

Antenna height: 100 cm

Compliant Yes



4.5.2 Measurement of occupied bandwidth

Test object	AXIS A4011-E READER		Sheet	ADJ_PWR-1
Type	-		Project no.	E704117
Serial no.	S559696086		Date	08 Jan. 2015
Client	ASSA AB		Initials	FRI
Specification	FCC Part 15, Subpart C, Section 15.225 RSS Gen. chapter 6.6			

Test method	ANSI C63.4:2009	Temperature	23 °C
Characteristics	-20 dBc and 99% power	Humidity	30 % RH

Test equipm.	36065 Measuring receiver Rohde & Schwarz ESL6		
SA Settings	RBW: 1 kHz		

Frequency [MHz]	Occupied bandwidth	Passed ³	Remarks
13.560599	2.64 kHz	Yes	-20dB BW
13.560559	2.20 kHz	Yes	99% BW

³ The field strength outside the band 13.553-13.567 MHz (i.e. below the 13.553 MHz and above 13.567 MHz is not exceeding 334uV/m at 30m (70.5dBuV/m at 10m), see previous test.



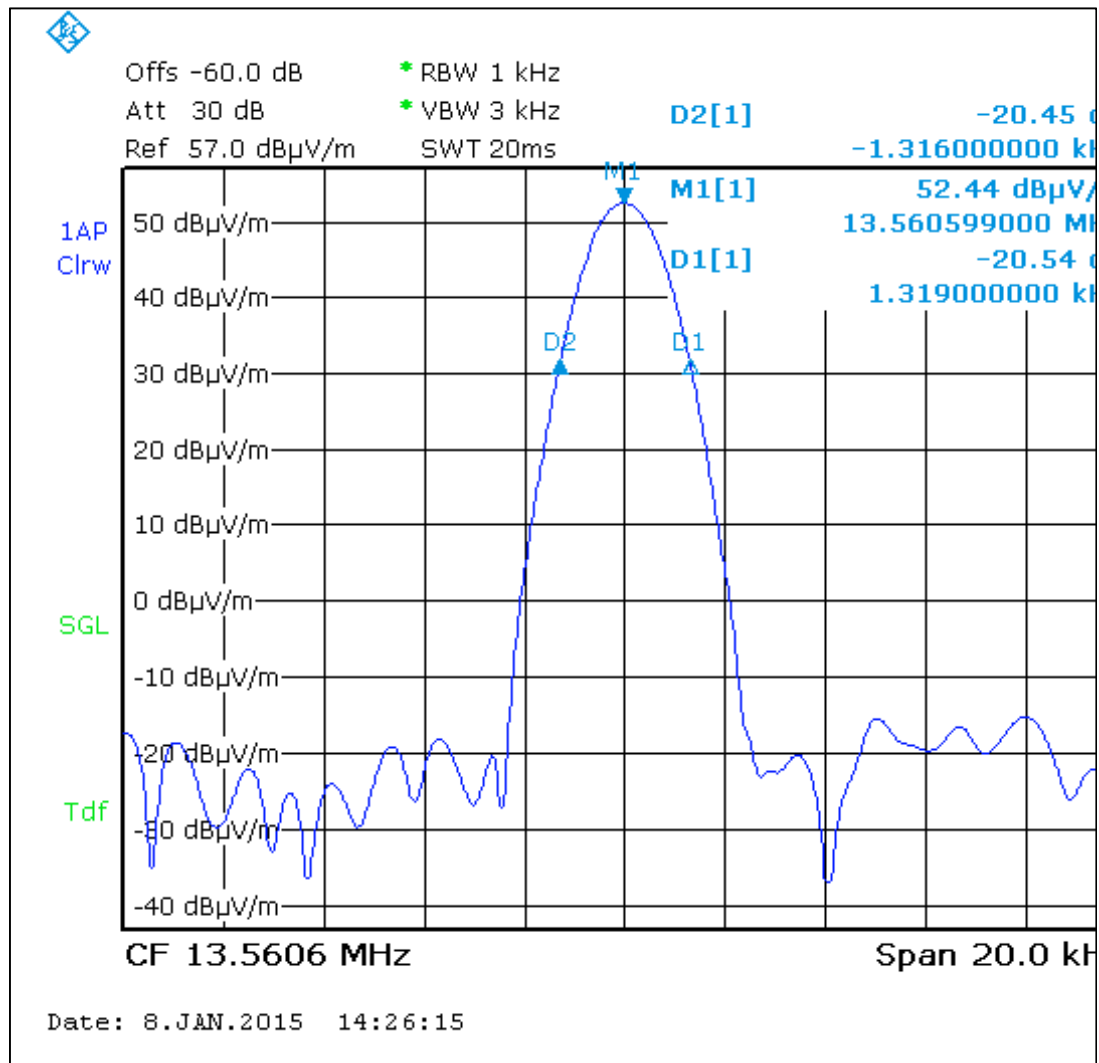


Figure 4.5.2.1 20 dB Bandwidth of the modulated carrier.



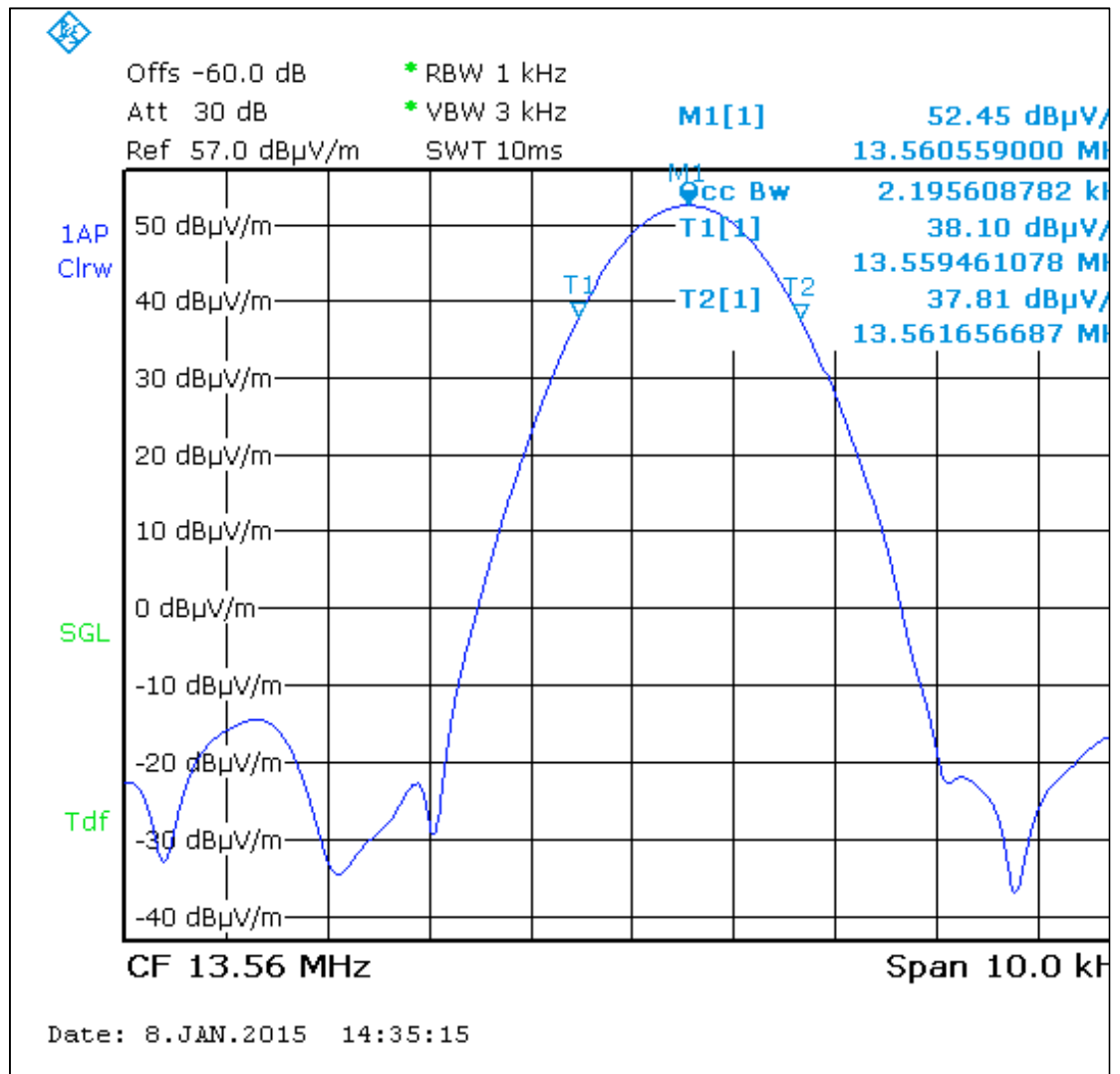


Figure 4.5.2.2 99% Bandwidth of the modulated carrier.



5. National registrations and accreditations

5.1 SWEDAC Accreditation

Organization: Swedish Board for Accreditation and Conformity Assessment - SWEDAC, see www.swedac.se and www.ilac.org

Registration Number: 1688

SWEDAC is part of ILAC (International Laboratory Accreditation Cooperation) including its MRA (Mutual Recognition Arrangement).

5.2 FCC Registrations

Organization: Federal Communications Commission, USA

Registration Number: 516880

Facilities: EMC chamber A 3 and 10 m

5.3 IC Registrations

Organization: Industry Canada, Certification and Engineering Bureau

Registration Number: 9347A

Facilities: EMC chamber A (9347A-1)



6. List of instruments

Setup VEA1						
Measurement of radio frequency voltage on mains						
<i>Last Cal.</i>	<i>Next Cal.</i>	<i>ID no.</i>	<i>Description</i>	<i>Manufacturer</i>	<i>Type no.</i>	<i>Setup uncertainty</i>
-	-	36070	Software	Rohde & Schwarz	EMC32 ver. 9.15.01	1.8 dB
2014-08	2015-09	36020	Measuring receiver	Rohde & Schwarz	ESU26	
2014-08	2015-09	IE-B919	LISN 2 x 10 A 250 V	Rohde & Schwarz	ESH3-Z5	
2014-06	2015-06	36062	Impulse Voltage Limiter	Rohde & Schwarz	ESH3-Z2	

Setup VEC1						
Measurement of radio frequency electromagnetic field						
<i>Last Cal.</i>	<i>Next Cal.</i>	<i>ID no.</i>	<i>Description</i>	<i>Manufacturer</i>	<i>Type no.</i>	<i>Setup uncertainty</i>
-	-	36070	Software	Rohde & Schwarz	EMC32 ver. 9.15.01	5.1 dB 30-1000 MHz (10 m) 6.2 dB 30-1000 MHz (3 m) 4.5 dB 1-6 GHz (3 m)
2014-08	2015-08	IE-B758	Preamplifier	HP	8447F	
2014-08	2015-08	36020	Measuring receiver	Rohde & Schwarz	ESU26	
2013-07	2015-07	IE-B928	Antenna Bilog	Chase	CBL6111A	
-	-	36071	Controller	Maturo	NCD	
-	-	36072	Tilt antenna mast	Maturo	TAM 4.0-E	
-	-	-	Turntable	Heinrich Deisel	DT 440	

Setup VED1						
Measurement of radio frequency electromagnetic field (Loop antenna)						
<i>Last Cal.</i>	<i>Next Cal.</i>	<i>ID no.</i>	<i>Description</i>	<i>Manufacturer</i>	<i>Type no.</i>	<i>Setup uncertainty</i>
-	-	36070	Software	Rohde & Schwarz	EMC32 ver. 9.15.01	3.24 dB
2014-08	2015-08	36020	Measuring receiver	Rohde & Schwarz	ESU26	
2013-07	2015-07	35047	Loop antenna	Rohde & Schwarz	HFH2-Z2	

