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Test Report

Report Number:

F144890E3

Equipment under Test (EUT):

Hearing Aid

“faro R”

Applicant:

Audifon GmbH & Co. KG

Manufacturer:

Audifon GmbH & Co. KG



Laboratory (CAB) accredited by
Deutsche Akkreditierungsstelle GmbH (DAkkS)
in compliance with DIN EN ISO/IEC 17025
under the Reg. No. D-PL-17186-01-02,
FCC Test site registration number 90877 and
Industry Canada Test site registration IC3469A-1

REFERENCES

- [1] **ANSI C63.4:2009** American National Standard for Methods of Measuring of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- [2] **FCC 47 CFR Part 15** Radio Frequency Devices
- [3] **RSS-210 Issue 8 (December 2010)** Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
- [4] **RSS-Gen Issue 4 (November 2014)** General Requirements and Information for the Certification of Radiocommunication Equipment

TEST RESULT

The requirements of the tests performed as shown in the overview (chapter 4 of this test report) were fulfilled by the equipment under test.

The complete test results are presented in the following.

Test engineer:	<u>Michael DINTER</u> <small>Name</small>	 <small>Signature</small>	<u>27 November 2014</u> <small>Date</small>
Authorized reviewer:	<u>Bernd STEINER</u> <small>Name</small>	 <small>Signature</small>	<u>27 November 2014</u> <small>Date</small>

RESERVATION

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

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1 Identification

1.1 Applicant

Name:	audifon GmbH & Co. KG
Address:	Werner-von-Siemens-Straße 2 99625 Kölleda
Country:	Germany
Name for contact purposes:	Mr. Stephan Teders
Phone:	+49-(0)-2202-92638-14
Fax:	+49-(0)-2202-92638-29
eMail Address:	stephan.teders@audifon.com
Manufacturer represented during the test by the following person:	--

1.2 Manufacturer

Name:	audifon GmbH & Co. KG
Address:	Werner-von-Siemens-Straße 2 99625 Kölleda
Country:	Germany
Name for contact purposes:	Mr. Stephan Teders
Phone:	+49-(0)-2202-92638-14
Fax:	+49-(0)-2202-92638-29
eMail Address:	stephan.teders@audifon.com
Manufacturer represented during the test by the following person:	--

1.3 Test laboratory

The tests were carried out at: **PHOENIX TESTLAB GmbH**
Königswinkel 10
32825 Blomberg
Germany

Test Laboratory (CAB) accredited by Deutsche Akkreditierungsstelle GmbH (DAkS) in compliance with DIN EN ISO/IEC 17025 under the Reg. No. D-PL-17186-01-02, recognized by Bundesnetzagentur under the Reg.-No. BNetzA-CAB-02/21-104. CAB Designation Number DE0004, listed by FCC 31040/SIT1300F2, IC OATS Listing 3469A-1.

1.4 EUT (Equipment Under Test)

Type of equipment: *	Hearing System
Type designation / model name: *	"faro R" (Sample 1 in TX mode and Sample 2 in RX mode)
Serial No.: *	P052538 (RX) / P052499 (TX)
FCC ID: *	YU2-FAROR
IC: *	9284A-FAROR
Lowest internal frequency: *	149 kHz
Highest internal frequency: *	10.579MHz
Antenna type: *	Integral H-Field-Antenna (6mm x 2mm coil with 22 turns)
PCB identifier: *	10580-4105000 Rev.01
Hardware version: *	10580-0000400 Rev.1.0
Software version: *	Library ID 97, Version 1.0.0.7

*: declared by the applicant.

1.5 Technical data of equipment

Duty cycle class: *	Up to 100%
Rated transmitter field strength: *	≤ -9 dB μ A/m @ 1 m distance
Channel spacing: *	-
ITU classification: *	593KF1D
Alignment range: *	10.579 MHz
Switching range: *	10.579 MHz
Modulation: *	FSK
Bit rate of transmitter: *	298 kBit/s
Supply Voltage: * (TX)	U _{Nom} = 1.4 V U _{Min} = 0.9 V U _{Max} = 1.7 V
Power Supply: * (TX)	1.4 V ZincAir-Battery
Temperature range: *	-20°C to 55°C (tested range), 0°C to 35°C (manufacturers declaration)

* declared by the applicant.

Ancillary equipment used during the tests:

1 x Stethosclip with a 30 cm long plastic tube (delivered by the applicant)

The following external I/O cables were used:

Identification	Connector		Length*
	EUT	Ancillary	
-	-	-	-

*: Length during the test.

1.6 Dates

Date of receipt of test sample:	22 September 2014
Start of test:	22 October 2014
End of test:	17 November 2014

2 Operational states and physical boundaries

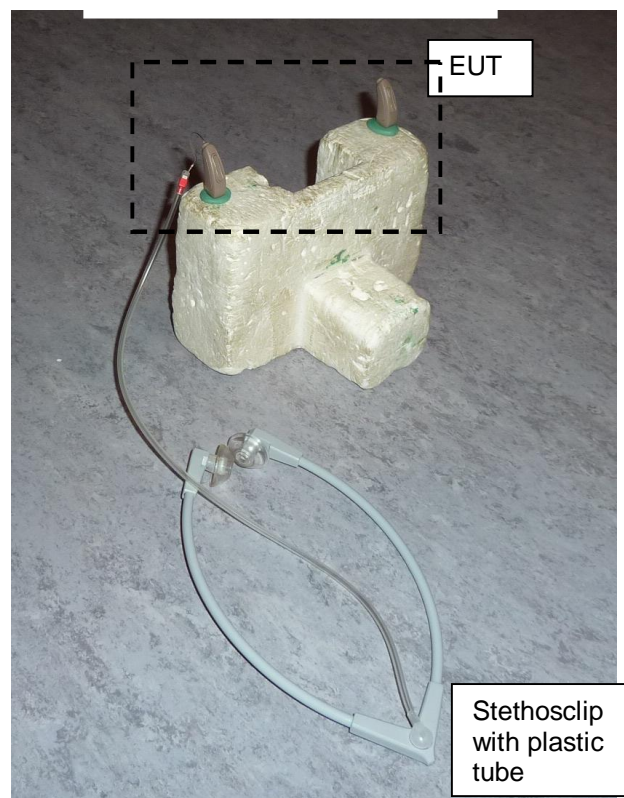
The EUT is a hearing aid system which is working with an audio link between two hearing aids. The tests were carried out with unmodified test samples. The EUT's were powered with the internal 1.4 V ZincAir-Batteries.

The Sample 1 was used as a Transmitter and the Sample 2 was used as a Receiver. The radio-link was established.

To reduce the recoupling of the audio noise during the measurements a Stethosclip with a plastic tube was plugged at the speaker of the hearing aid.

The physical boundaries are shown below:

Physical boundaries of the EUT



3 Additional information

None

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-Gen, Issue 4 [4] and RSS 210, Issue 8 [3]	Status	Refer page
Conducted emissions on supply line	0.15 - 30	15.207 (a)	8.8 [4]	Not applicable	-
Radiated emissions	0.009 - 1,000	15.205 (a) 15.209 (a)	8.9 [4] A 2.4 [3]	Passed	13 et seq.
99 % bandwidth	10.525	-	6.6 [4]	Passed	Annex D

5 Test results

5.1 Radiated emissions

5.1.1 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into five stages.

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

All measurements will be carried out with the EUT working on the middle and upper and lower edge of the assigned frequency band.

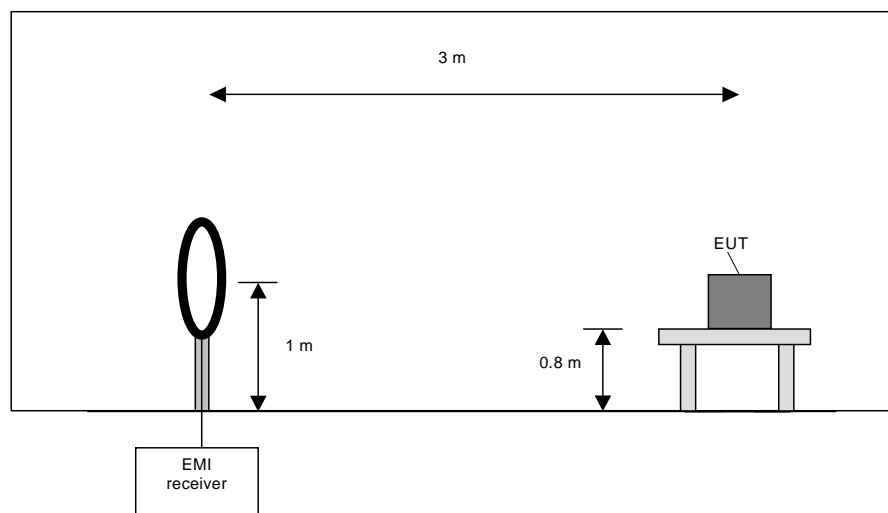
Preliminary measurement (9 kHz to 30 MHz):

In the first stage a preliminary measurement will be performed in a shielded room with a measuring distance of 3 meters. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2009 [1].

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

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

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



Preliminary measurement procedure:

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

The following procedure will be used:

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

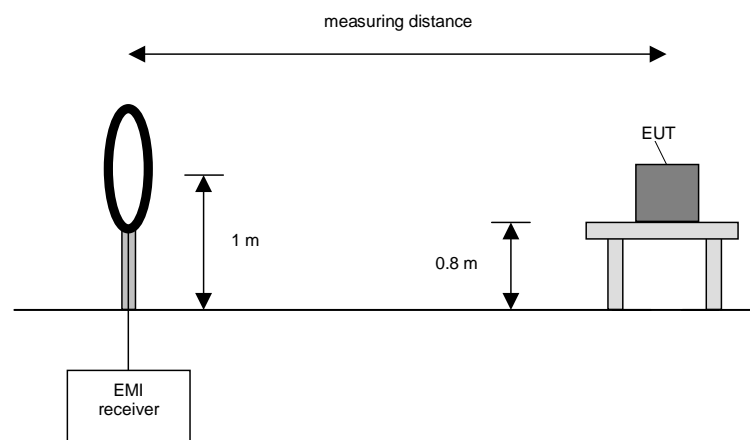
Final measurement (9 kHz to 30 MHz):

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

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

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

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



Final measurement procedure:

The following procedure will be used:

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

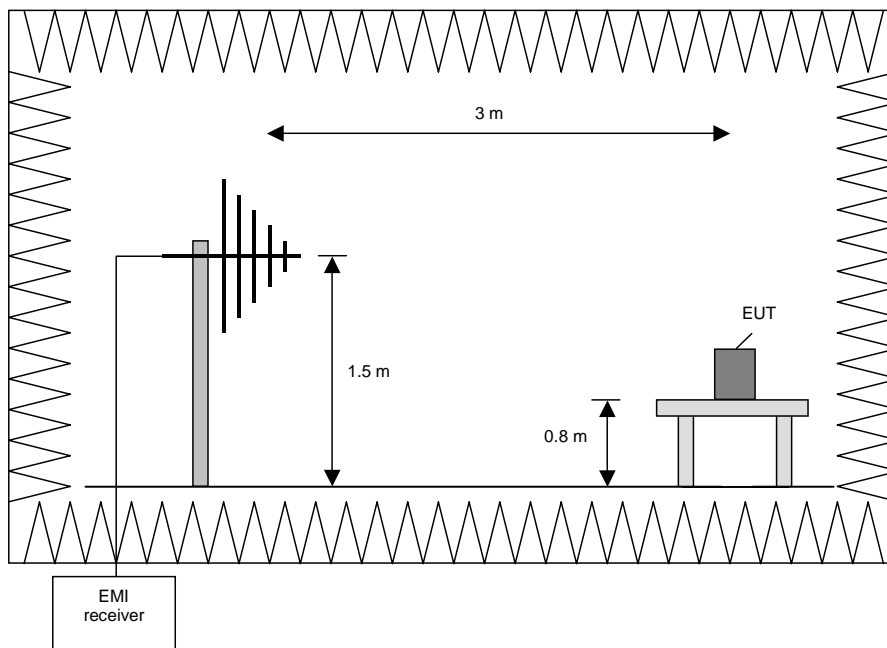
Preliminary measurement (30 MHz to 1 GHz)

In the first stage a preliminary measurement will be performed in a fully anechoic chamber with a measuring distance of 3 meter. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2009 [1].

The frequency range 30 MHz to 1 GHz will be measured with an EMI Receiver set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °.

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

Frequency range	Resolution bandwidth
30 MHz to 230 MHz	100 kHz
230 MHz to 1 GHz	100 kHz



Procedure preliminary measurement:

Prescans were performed in the frequency range 30 MHz to 230 MHz and 230 MHz to 1 GHz.

The following procedure will be used:

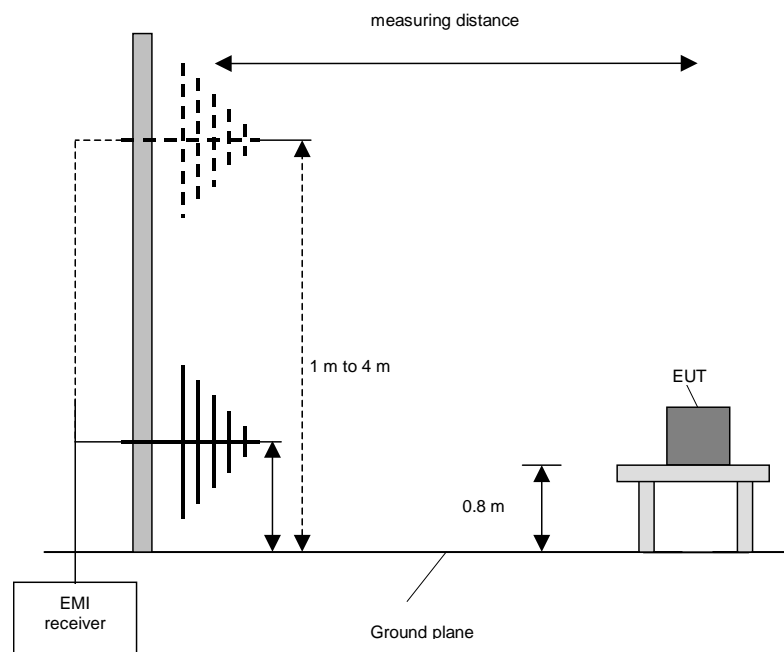
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the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

Final measurement (30 MHz to 1 GHz)

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

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

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	120 kHz



Procedure final measurement:

The following procedure will be used:

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

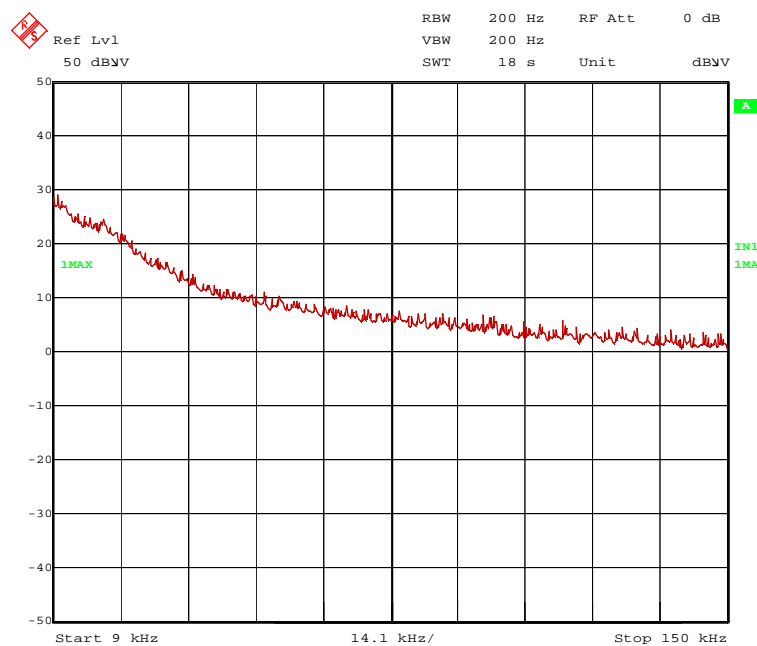
5.1.2 Preliminary radiated emission tests (9 kHz to 30 MHz)

Ambient temperature:	20 °C	Relative humidity:	45 %
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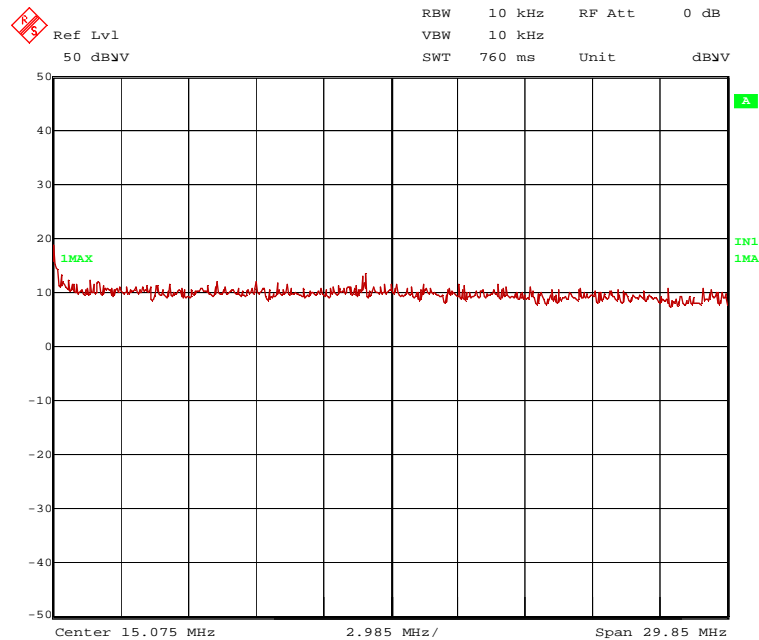
Position of EUT: The EUT was set-up on a wooden table of a height of 0.8 m.

Test record: The test was carried out in normal operation mode of the EUT.
All results are shown in the following.

Supply voltage: During all measurements the EUT's were supplied with 1.4 V.



14489.wmf: Spurious emissions from 9 kHz to 150 kHz



144890_13.wmf: Spurious emissions from 150 kHz to 30 MHz

No emission was found according to FCC 47 CFR Part 15 section 15.209 (a).
The wanted signal 10.525 MHz (wanted signal is according to FCC 47 CFR Part 15) was to low at the 3 m distance.

Test equipment used the test:

1 – 4, 8

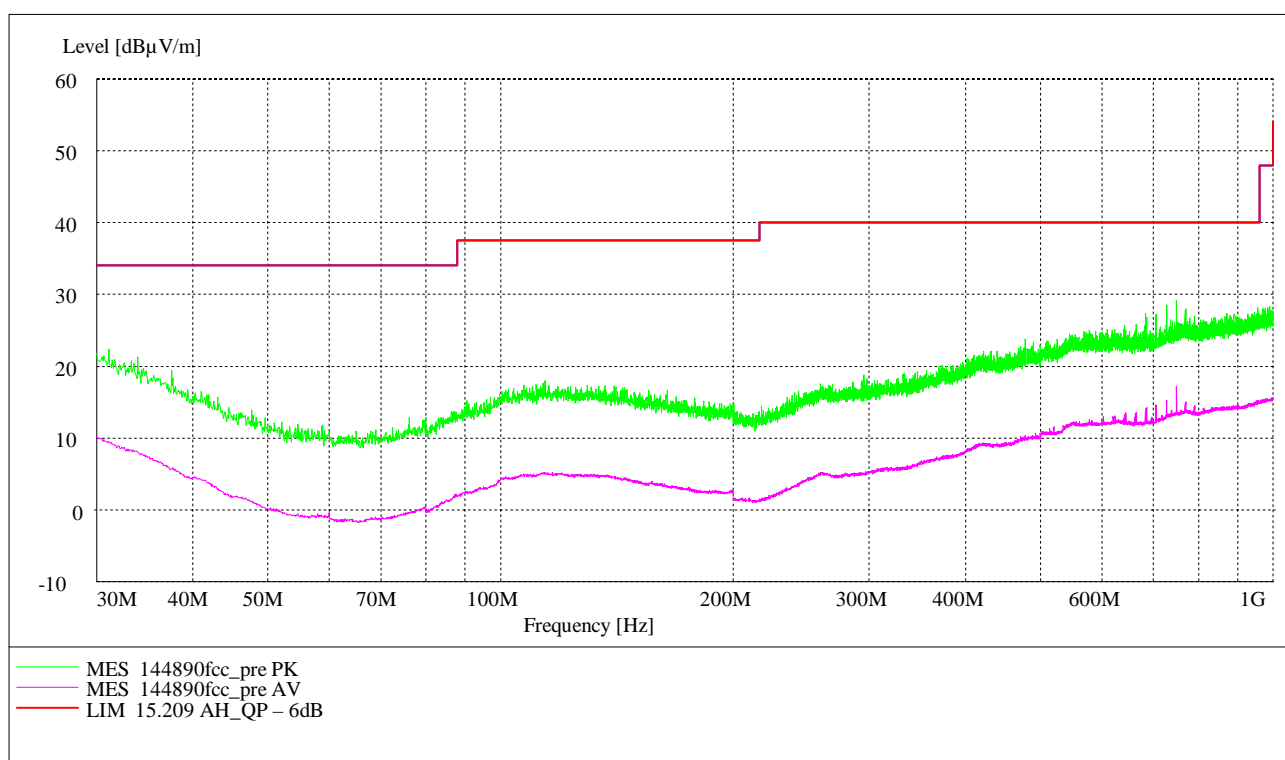
5.1.3 Preliminary radiated emission tests (30 MHz to 1 GHz)

Ambient temperature:	20 °C	Relative humidity:	45 %
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Position of EUT: The EUT was set-up on a wooden table of a height of 0.8 m.

Test record: The test was carried out in normal operation mode of the EUT.
All results are shown in the following.

Supply voltage: During all measurements the EUT's were supplied with 1.4 V.



Data record name: 144890fcc

Results with measuring distance of 3 m						
Frequency	Result dBμV/m	QP Limit dBμV/m	Margin dB	Detector	Readings dBμV	Antenna factor* ² dB/m
748.64 MHz	29.5	46.0	16.5	PK	18.0	21.5
Measurement uncertainty			+2.2 dB / -3.6 dB			

*2: Cable loss included

Limits

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490	2400/F (kHz)	300
0.490–1.705	24000/F (kHz)	30
1.705–30.0	30	30
30–88	100**	3
88–216	150**	3
216–960	200**	3
Above 960	500	3

No frequencies were found inside and outside the restricted bands during the preliminary radiated emission test:

Therefore no frequencies were measured in a final measurement on an open area test-site.

Test equipment used the test:

1 – 7

5.1.4 Final radiated emission test (9 kHz to 30 MHz)

Ambient temperature:	20 °C	Relative humidity:	45 %
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Position of EUT: The EUT was set-up on a wooden table of a height of 0.8 m.

Test record: The test was carried out in normal operation mode of the EUT.
All results are shown in the following.

Supply voltage: During all measurements the EUT's were supplied with 1.4 V.

Test results: The test results were calculated with the following formula:

Result [dBµV/m] = reading [dBµV] + antenna factor [dB/m]

Limits

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490	2400/F (kHz)	300
0.490–1.705	24000/F (kHz)	30
1.705–30.0	30	30
30–88	100**	3
88–216	150**	3
216–960	200**	3
Above 960	500	3

Only the wanted frequency at 10.525 MHz was detected above the noise floor of the system during the preliminary radiated emission test.

Test results: The test results were calculated with the following formula:
Result [dBµV/m] = reading [dBµV] + antenna factor [dB/m]

Results with measuring distance of 1 m						
Frequency	Result dBµV/m	Limit* ¹ dBµV/m	Margin dB	Detector	Readings dBµV	Antenna factor* ² dB/m
10.525 MHz	42.5	89.5	47.0	QP	22.5	20.0
Measurement uncertainty			+2.2 dB / -3.6 dB			

*¹: Limit corrected with 40 dB / decade

*²: Cable loss included

Remark: At distances more than 1 m the wanted signal was below the noise of the measuring system.

Test: Passed

Test equipment used for the test:

8 – 9, 11

6 Report history

Report Number	Date	Comment
144890E3	27 November 2014	Document created

7 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
1	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
2	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355	26/02/2014	02/2016
3	Controller	HD100	Deisel	100/670	480326	-	-
4	Turntable	DS420HE	Deisel	420/620/80	480315	-	-
5	Antenna support	AS615P	Deisel	615/310	480187	-	-
6	Antenna	CBL6112 B	Chase	2688	480328	14/04/2014	04/2017
7	RF-cable No. 30	RTK 081	Rosenberger	-	410141	Weekly verification (system cal.)	
8	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	18/02/2012	02/2016
9	EMI test receiver	ESPC	Rohde & Schwarz	843756/006	480150	24/02/2014	02/2016
10	RF-cable No. 10	RG223	Phoenix-Test-Lab	-	410102	Weekly verification	
11	Outdoor test site	-	Phoenix-Test-Lab	-	480293	-	
12	Open area test site	-	Phoenix Test-Lab	-	480085	Weekly verification (system cal.)	
13	Measuring receiver	ESIB7	Rohde & Schwarz	100304	480521	06/02/2013	02/2015
14	Controller	HD100	Deisel	100/670	480139	-	
15	Turntable	DS420HE	Deisel	420/620/80	480087	-	
16	Antenna support	AS615P	Deisel	615/310	480086	-	-
17	Antenna	CBL6111 D	Chase	25761	480894	09/18/2014	09/2017
18	EMI Software	ES-K1	Rohde & Schwarz	-	480111	-	
19	Horn Antenna	3115 A	EMCO	9609-4918	480183	9/11/2011	11/2014
20	Shielded chamber M4	-	Siemens	B83117S1-X158	480088	Weekly verification (system cal.)	
21	EMI Software	ES-K1	Rohde & Schwarz	-	480111	not necessary	
22	LISN	NSLK8128	Schwarzbeck	8128155	480058	20/12/2012	12/2014
23	LISN	MN2050B	Chase	1133	480146	2/12/2012	12/2014
26	Spectrum analyser	FSW43	Rohde & Schwarz	100586	481720	10/09/2013	09/2015
27	Loop Antenna Ø = 225 mm	-	Phoenix Test-Lab	-	410085	Weekly verification	
28	Spectrum analyser	FSU	Rohde & Schwarz	100586	480956	24/02/2014	02/2016

8 List of annexes

ANNEX A	Test setup photos:	5 pages
	Test setup fully anechoic chamber (E-Field)	144890_emi1.jpg
	Test setup fully anechoic chamber (E-Field)	144890_emi2.jpg
	Test setup fully anechoic chamber (H-Field)	144890_emi3.jpg
	Test setup outdoor test site	144890_emi4.jpg
	Test setup outdoor test site	144890_emi5.jpg
ANNEX B	External photos:	4 pages
	EUT, 3D view 1	144890_eut1.jpg
	EUT, 3D view 2	144890_eut2.jpg
	EUT, 3D view 3	144890_eut3.jpg
	EUT, 3D view 4	144890_eut4.jpg
ANNEX C	Internal photos:	8 pages
	EUT, internal view 1	144890_eut5.jpg
	EUT, internal view 2	144890_eut6.jpg
	EUT, internal view 3	144890_eut7.jpg
	EUT, internal view 4	144890_eut8.jpg
	EUT, PCB view 1	144890_eut9.jpg
	EUT, PCB view 2	144890_eut10.jpg
	EUT, PCB view 3	144890_eut11.jpg
	EUT, PCB view 4	144890_eut12.jpg
ANNEX D	Additional measurement results for industry Canada:	2 pages