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February 4, 2015

Prüfbericht / *Test Report* — Nr. / *No.* 69583-49775-1e (Edition 3)

Applicant:	BALTECH AG
Type of equipment:	RFID Module
Type designation:	IDE-X-LA
Variants covered by this test report:	10094-1X-Y: 10094-100, 10094-101, 10094-102 10094-2X-Y: 10094-200 10094-3X-Y: 10094-300 10099-1X-Y: 10099-100, 10099-102 Where “X” and “Y” may replace any alphanumerical numbers
Order No.:	E-Mail 2014-09-18
Test standards:	FCC Code of Federal Regulations, CFR 47, Part 15, Sections 15.205, 15.207, 15.209, 15.215 and 15.225 Industry Canada Radio Standards Specifications RSS-GEN Issue 3, Sections 7.2.2, 7.2.4 and 7.2.5 and RSS-210 Issue 8, Section A2.6 (Category I Equipment)

Note:

The test data of this report is related only to the individual item which has been tested. This report shall not be reproduced except in full extent without the written approval of the testing laboratory.

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Germany

Table of Contents

1 Description of the Equipment Under Test (EUT)

General data of EUT	
Type designation[1]:	IDE-X-LA
Variants covered by this report:	10094-1X-Y: 10094-100, 10094-101, 10094-102 10094-2X-Y: 10094-200 10094-3X-Y: 10094-300 10099-1X-Y: 10099-100, 10099-102 Where “X” and “Y” may replace any alphanumerical numbers
Parts[2]:	
Serial number(s):	S# 16004471
Manufacturer:	Baltech AG
Type of equipment:	RFID Module
Version:	As received
FCC ID:	OKY10094100A03B
Industry Canada ID:	7657A-10094100
Additional parts/accessories:	

[1] Type designation of the system if EUT consists of more than one part.
[2] Type designations of the parts of the system, if applicable.

Technical data of EUT	
Application frequency range:	125 kHz and 13.110 - 14.010 MHz
Frequency range:	125 kHz and 13.553 – 13.567 MHz
Operating frequencies:	125 kHz and 13.56 MHz
Type of modulation:	ASK
Pulse train:	---
Pulse width:	---
Number of RF-channels:	2
Channel spacing:	N/A
Designation of emissions[3]:	1K00A1D / 43K2A1D
Type of antenna:	Integrated loop antenna
Size/length of antenna:	125 kHz: 26 mm x 37 mm 13.56 MHz: 34 mm x 47 mm
Connection of antenna:	☐ detachable ☒ not detachable
Type of power supply of EUT:	DC supply over USB interface
Specifications for power supply:	nominal voltage: 5.0 V minimum voltage: 4.5 V maximum voltage: 5.5 V
Type of AC-power supply:	AC supply
Specifications for power supply:	nominal voltage: 110 V nominal frequency: 60 Hz

[3] Also known as "Class of Emission".

2 Administrative Data

Application details	
Applicant (full address):	BALTECH AG Lilienthalstraße 27 D-85399 Halbergmoos
Contact person:	Mr. Iftekhar Alam
Order number:	E-Mail 2014-09-18
Receipt of EUT:	2014-10-06
Date(s) of test:	2014-10-06 to 2014-10-07
Note(s):	The applicant declares the compatibility to the variants covert by this test report. The test results are valid for the tested sample, only.

Report details	
Report number:	69583-49775-1e
Edition:	3
Issue date:	2015-02-04

3 Identification of the Test Laboratory

Details of the Test Laboratory	
Company name:	TÜV SÜD Product Service GmbH
Address:	Aeussere Fruehlingstrasse 45 D-94315 Straubing Germany
Laboratory accreditation:	DAkkS Registration No. D-PL-11321-11-01
FCC test site registration number	90926
Industry Canada test site registration:	3050A-2
Contact person:	Mr. Johann Roidt Phone: +49 9421 5522-0 Fax: +49 9421 5522-99

4 Summary

Summary of test results
The tested sample complies with the requirements set forth in the **Code of Federal Regulations CFR 47, Part 15, Sections 15.205, 15.207, 15.209, 15.215 and 15.225** of the Federal Communication Commission (FCC) and the **Radio Standards Specifications** **RSS-GEN Issue 3, Sections 7.2.2, 7.2.4 and 7.2.5 and** **RSS-210 Issue 8, Section , A2.6 (Category I Equipment)** of Industry Canada (IC).

Personnel involved in this report	
Laboratory Manager:	.... Mr. Johann Roidt
Responsible for testing:	.... Mr. Martin Steindl
Responsible for test report:	Mr. Martin Steindl

5 Operation Mode and Configuration of EUT

Operation Mode(s)
Reading tag continuously

Configuration(s) of EUT
The EUT was configured as input device of a laptop PC.

List of ports and cables

Port	*Description*	*Classification*[4]	*Cable type*	*Cable length*
1	AC supply AC/DC adapter	ac power	Unshielded	1 m
2	DC supply of laptop PC	dc power	Shielded	2 m
3	USB interface of EUT	signal/control port	Shielded	2 m

List of devices connected to EUT

Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*
1	AC/DC adapter of laptop PC			DELL
2	Laptop PC	DELL dimension		DELL

List of support devices

Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*
1	Transponder card			LEGIC

[4] Ports shall be classified as ac power, dc power or signal/control port

6 Measurement Procedures

6.1 Bandwidth Measurements

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 2, section 2.202(a) CFR 47 Part 15, section 15.215(c) IC RSS-Gen Issue 3, sections 4.6.1 and 4.6.2 IC RSS-210 Issue 8, section A1.1.3 ANSI C63.4, annex H.6
Guide:	ANSI C63.4 / IC RSS-Gen Issue 3, sections 4.6.1 and 4.6.2
Measurement setup:	☐ Conducted: See below ☒ Radiated: Radiated Emission Measurement 9 kHz to 30 MHz (6.3)

If antenna is detachable bandwidth measurements shall be performed at the antenna connector (conducted measurement) when the transmitter is adjusted in accordance with the tune-up procedure, if applicable. The RF output terminals are connected to a spectrum analyzer. If required, a resistive matching network equal to the impedance specified or employed for the antenna is used as well as dc block and appropriate attenuators (50 Ohms). The electrical characteristics of the radio frequency load attached to the output terminals shall be stated, if applicable.

If radiated measurements are performed the same test setups and instruments are used as with radiated emission measurements for the appropriate frequency range.

The analyzer settings are specified by the test description of the appropriate test record(s).

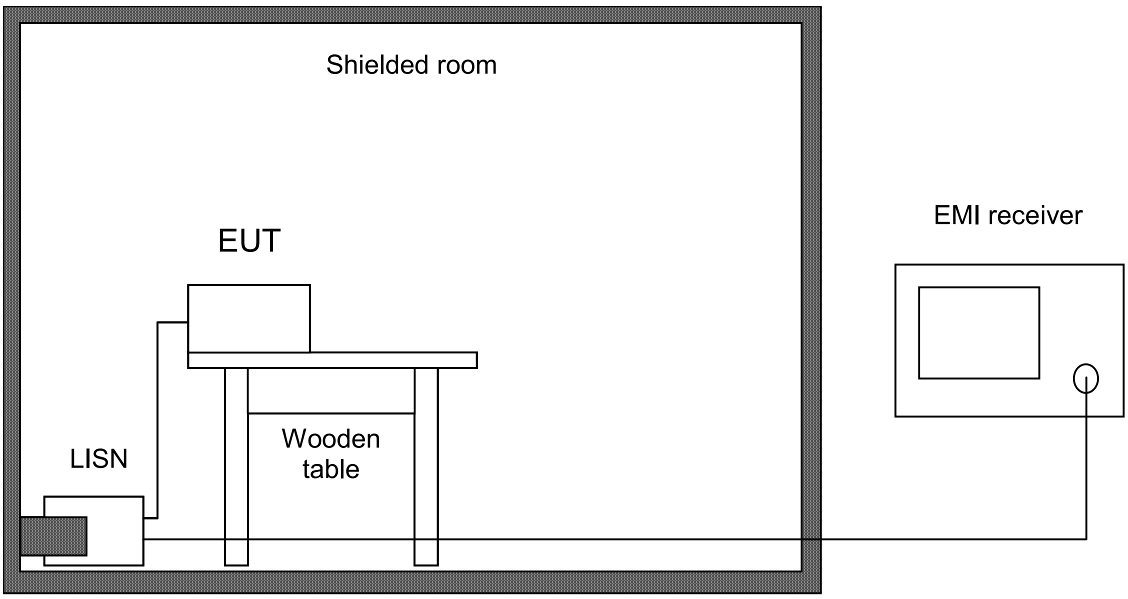
6.2 Conducted AC Powerline Emission

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.207 IC RSS-Gen Issue 3, section 7.2.4
Guide:	ANSI C63.4 / CISPR 22

Conducted emission tests in the frequency range 150 kHz to 30 MHz are performed using Line Impedance Stabilization Networks (LISNs). To simplify testing with quasi-peak and average detector the following procedure is used:

First the whole spectrum of emission caused by the equipment under test (EUT) is recorded with detector set to peak using CISPR bandwidth of 10 kHz. After that all emission levels having less margin than 10 dB to or exceeding the average limit are retested with detector set to quasi-peak.
If average limit is kept with quasi-peak levels no additional scan with average detector is necessary. In cases of emission levels between quasi-peak and average limit an additional scan with detector set to average is performed.

According to ANSI C63.4, section 13.1.3.1, testing of intentional radiators with detachable antenna shall be performed using a suitable dummy load connected to the antenna output terminals. Otherwise, the tests shall be made with the antenna connected and, if adjustable, fully extended.
Testing with dummy load may be necessary to distinguish (unintentional) conducted emissions on the supply lines from (intentional) emissions radiated by the antenna and coupling directly to supply lines and/or LISN.
Usage of dummy load has to be stated in the appropriate test record(s) and notes should be added to clarify the test setup.



Test instruments used:

	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☐	Test receiver	ESHS 10	1028	860043/016	Rohde & Schwarz
☒	Test receiver	ESHS 10	R&S	86297/001	Rohde & Schwarz
☒	V-network	ESH 3-Z5	1059	894785/005	Rohde & Schwarz
☐	V-network	ESH 3-Z5	1218	830952/025	Rohde & Schwarz
☐	Artificial mains network	ESH 2-Z5	1536	842966/004	Rohde & Schwarz
☐	Shielded room	No. 1	1451	---	Albatross
☒	Shielded room	No. 4	1454	3FD 100 544	Euroshield

6.3 Radiated Emission Measurement 9 kHz to 30 MHz

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, sections 15.205, 15.215(b) and 15.225(a)-(d) IC RSS-GEN Issue 3, sections 7.2.2 and 7.2.5 and IC RSS-210 Issue 8, section A2.6
Guide:	ANSI C63.4

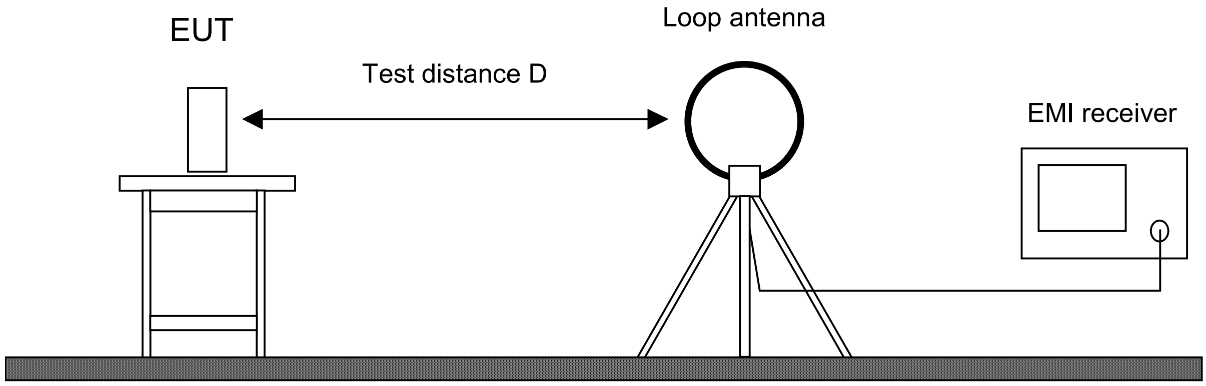
Radiated emission in the frequency range 9 kHz to 30 MHz is measured using an active loop antenna. First the whole spectrum of emission caused by the equipment is recorded at a distance of 3 meters in a fully or semi anechoic room with the detector of the spectrum analyzer or EMI receiver set to peak. This configuration is also used for recording the spectrum of intentional radiators.

Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration produces the highest emission relative to the limit and therefore shall be used for final testing.

EUT is rotated all around to find the maximum levels of emissions. Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.
If worst case emission of the EUT cannot be recorded with EUT in standard position and loop antenna in vertical polarization the EUT (or the radiating part of the EUT) is rotated by 90 degrees instead of changing the loop antenna to horizontal polarization. This procedure is selected to minimize the influence of the environment (e.g. effects caused by the floor especially with longer distances).

Final measurement is performed at a test distance D of 30 meters using an open field test site. In case the regulation requires testing at other distances, the result is extrapolated by either making measurements at an additional distance D of 10 meters to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). In cases of very low emissions measurements are performed at shorter distances and results are extrapolated to the required distance. The provisions of CFR 47 Part 15 sections 15.31(d) and (f)(2) apply. According to CFR 47 Part 15 section 15.209(d) final measurement is performed with detector function set to quasi-peak except for the frequency bands 9 to 90 kHz and 110 to 490 kHz where, for non-pulsed operation, average detector is employed.

If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete pulse train, including blanking intervals, as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.



Test instruments used:

	Type		Designation	Inv.-no.	Serial No. or ID	Manufacturer
☒	Spectrum analyzer		FSP30	1666	100036	Rohde & Schwarz
☐	EMI test receiver		ESMI	1569	839379/013 839587/006	Rohde & Schwarz
☒	EMI test receiver		ESU26	R&S	100504	Rohde & Schwarz
☐	Test receiver		ESHS 10	1028	860043/016	Rohde & Schwarz
☐	Preamplifier	Cabin no. 2	CPA9231A	1716	3557	Schaffner
☒	Loop antenna		HFH2-Z2	1016	882964/1	Rohde & Schwarz
☒	Fully anechoic room		No. 2	1452	---	Albatross
☐	Semi anechoic room		No. 3	1453	---	Siemens
☒	Semi anechoic room		No. 8	2057	---	Albatross

6.4 Radiated Emission at Alternative Test Site

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, sections 15.205(b) and 15.225(d) IC RSS-GEN Issue 3, sections 7.2.2(b)(c) and 7.2.5 and IC RSS-210 Issue 8, section A2.6
Guide:	ANSI C63.4

Radiated emission in the frequency range 30 MHz to 1 GHz is measured within a semi-anechoic room with groundplane complying with the NSA requirements of ANSI C63.4 for alternative test sites. A linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna") is used. The measurement bandwidth of the test receiver is set to 120 kHz with quasi-peak detector selected.

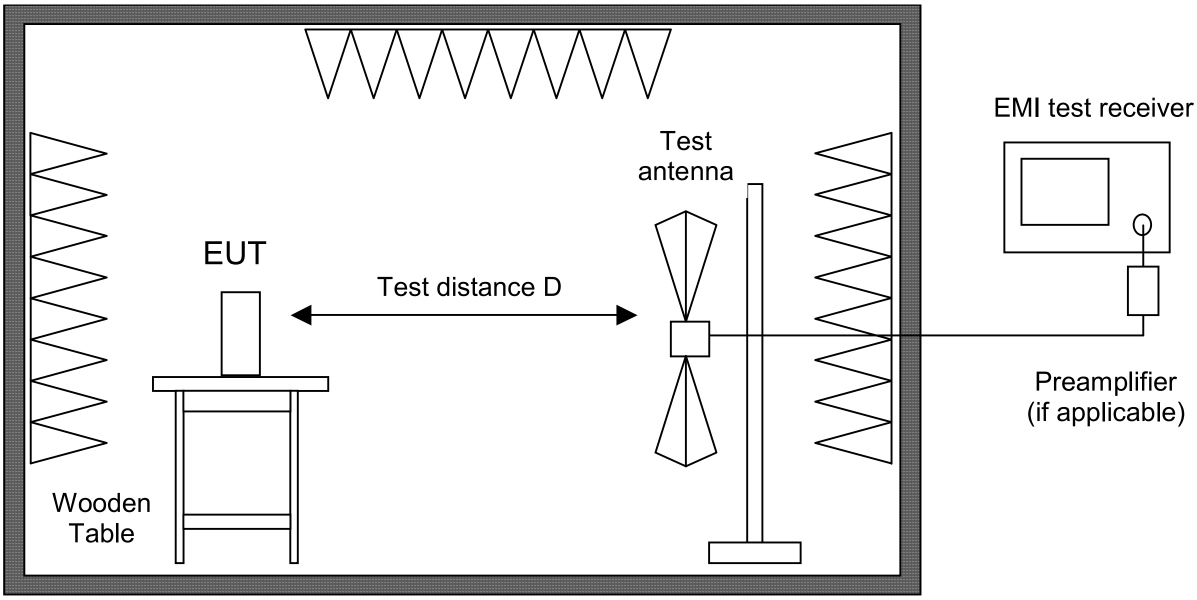
If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete pulse train, including blanking intervals, as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.

Hand-held or body-worn devices are tested in the position producing the highest emission relative to the limit as verified by prescans in fully anechoic room.

If no prescan in a fully anechoic room is used first a peak scan is performed in four positions to get the whole spectrum of emission caused by EUT with the measuring antenna raised and lowered from 1 to 4 m to find table position, antenna height and antenna polarization for the maximum emission levels.
Data reduction is applied to these results to select those levels having less margin than 10 dB to or exceeding the limit using subranges and limited number of maximums. Further maximization is following.
With detector of the test receiver set to quasi-peak final measurements are performed immediately after frequency zoom (for drifting disturbances) and maximum adjustment.
Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

In cases where prescans in a fully anechoic room are taken (e. g. if EUT is operating for a short time only or battery is dircharged quickly) final measurements with quasi-peak detector are performed manually at frequencies indicated by prescan with EUT rotating all around and receiving antenna raising and lowering within 1 meter to 4 meters to find the maximum levels of emission.
Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

For measuring emissions of intentional radiators and receivers a test distance D of 3 meters is selected. Testing of unintentional radiators is performed at a distance of 10 meters. If limits specified for 3 meters shall be used for measurements performed at 10 meters distance the limits are calculated according to CFR 47 Part 15 section 15.31(d) and (f)(1) using an inverse linear-distance extrapolation factor of 20 dB/decade.



Alternate test site (semi anechoic room)

Test instruments used:

	Type		*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☐	EMI test receiver		ESU8	2044	100232	Rohde & Schwarz
☒	EMI test receiver		ESU26	R&S	100504	Rohde & Schwarz
☒	Trilog antenna	Cabin no. 8	VULB 9163	2058	9163-408	Schwarzbeck
☒	Semi anechoic room		No. 8	2057	---	Albatross

6.5 Carrier Frequency Stability

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.225(e) IC RSS-Gen Issue 3, section 4.7 and IC RSS-210 Issue 8, section A2.6
Guide:	ANSI C63.4

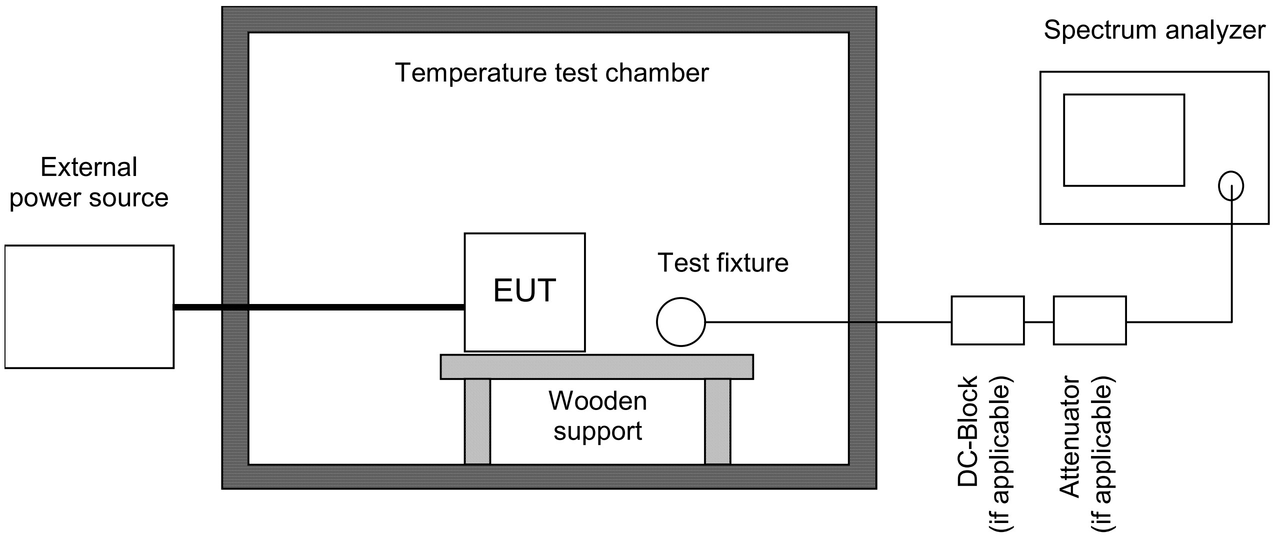
The frequency tolerance of the carrier signal is measured over a temperature variation of -20 °C to +50 °C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 °C.

If the EUT provides an antenna connector the spectrum analyzer is connected to this port. If required, a resistive matching network equal to the impedance specified or employed for the antenna is used as well as dc block and appropriate attenuators (50 Ohms). In cases where the EUT does not provide an antenna connector a test fixture is used.

For battery operated equipment, the test is performed using a new battery. Alternatively, an external supply voltage can be used and is at least set to:

- the maximum battery voltage as delivered by a new battery or 115% of the battery nominal voltage
- the battery nominal voltage
- 85% of the battery nominal voltage
- the battery operating end point voltage which shall be specified by the equipment manufacturer

The EUT is operating providing an unmodulated carrier. The peak detector of the spectrum analyzer is selected and resolution as well as video bandwidth are set to values appropriate to the shape of the spectrum of the EUT. The frequency counter mode of the spectrum analyzer is used to maximize the accuracy of the measured frequency tolerance.
If an unmodulated carrier is not available a significant and stable point on the spectrum is selected and the span is reduced to a value that delivers an accuracy which shall be better than 1% of the maximum frequency tolerance allowed for the carrier signal. This method may be performed as long as the margin to the frequency tolerance allowed is larger than the uncertainty of the measured frequency tolerance.



Test instruments used:

	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☐	Spectrum analyzer	FSP30	1666	100036	Rohde & Schwarz
☒	EMI test receiver	ESPI7	2010	101018	Rohde & Schwarz
☐	EMI test receiver	ESMI	1569	839379/013 839587/006	Rohde & Schwarz
☐	DC-block	7006	1636	A2798	Weinschel
☐	Attenuator	4776-10	1638	9412	Narda
☐	Attenuator	4776-20	1639	9503	Narda
☒	Test probe	TP 01	1628	001	TÜV SÜD PS
☒	Multimeter	21 III	1653	76530546	Fluke
☐	Multimeter	21 III	1654	76381229	Fluke
☐	Multimeter	Fluke 77 III	1975	92370108	Fluke
☐	Multimeter	Fluke 77 IV	1976	93090238	Fluke
☐	Multimeter	Fluke 177	2025	96720024	Fluke
☐	Multimeter	Fluke 177	2026	96720025	Fluke
☒	DC power supply	NGSM 32/10	1267	203	Rohde & Schwarz
☐	Isolating transformer	RT 5A	1127	10387	Grundig
☐	Isolating transformer	RT 5A	1128	10416	Grundig
☒	Temperature test chamber	HT 4010	1271	07065550	Heraeus

7 Photographs Taken During Testing

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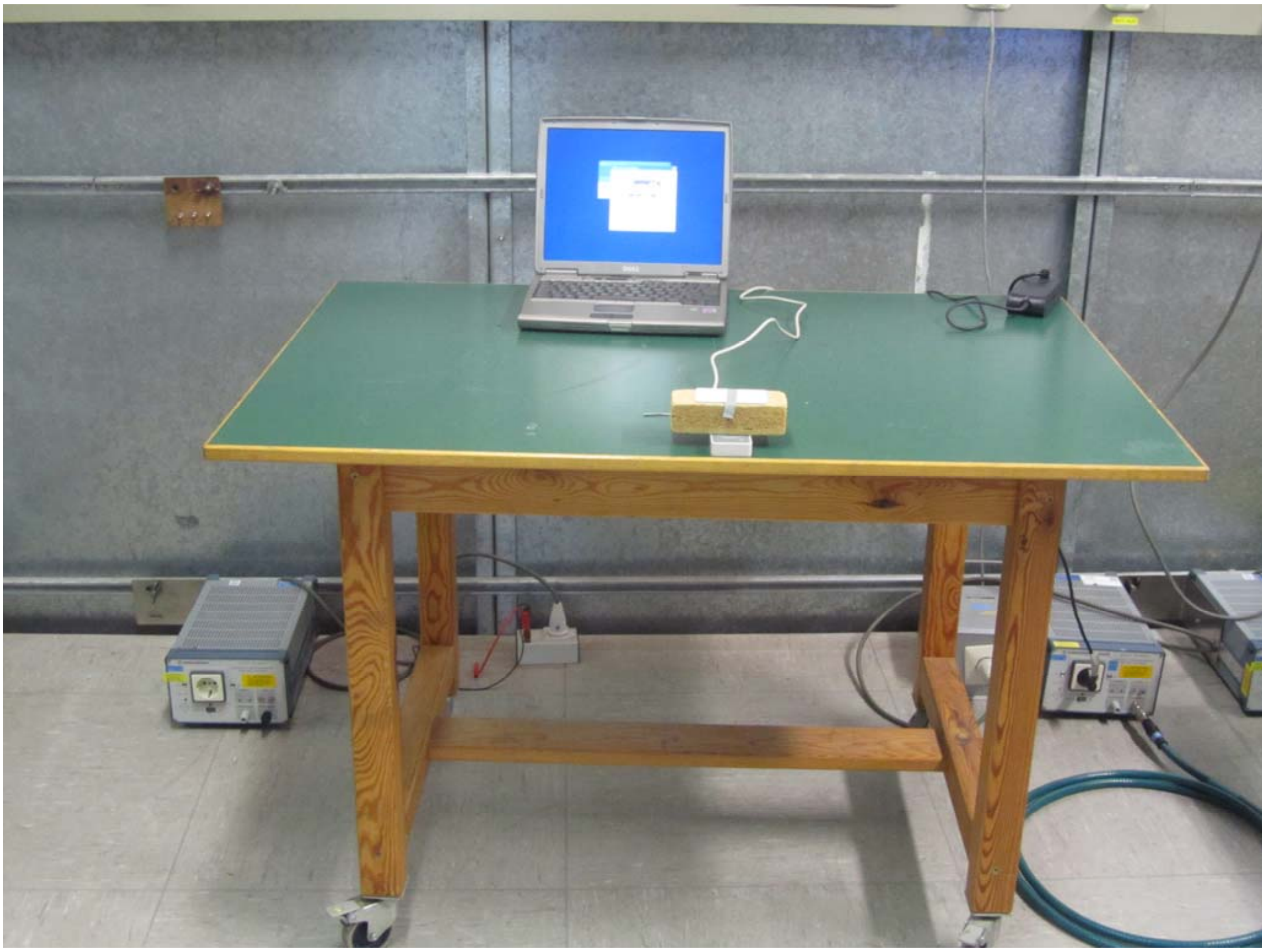
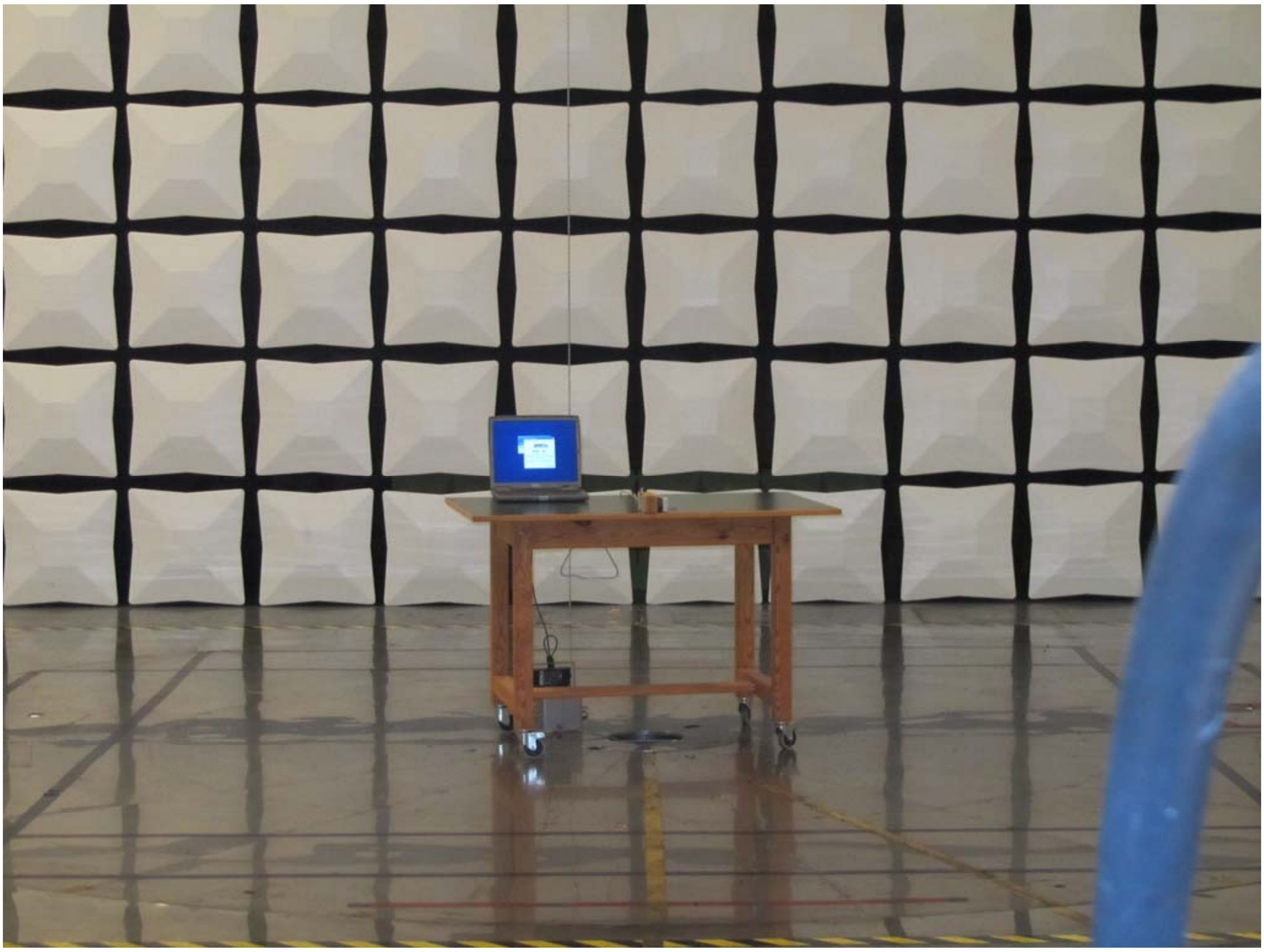
Test setup for conducted AC powerline emission measurement



Test setup for radiated emission measurement 9 kHz – 30 MHz



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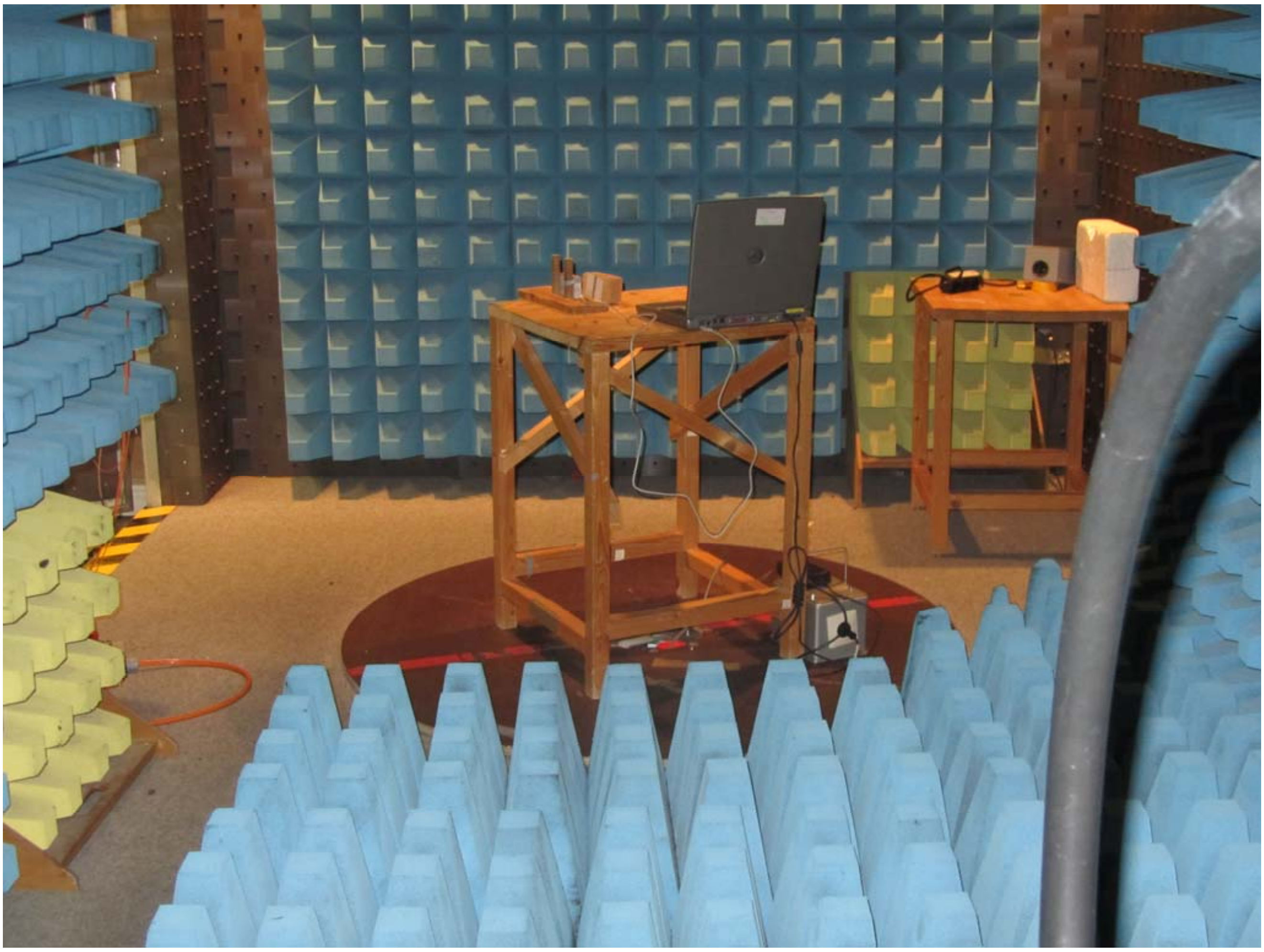
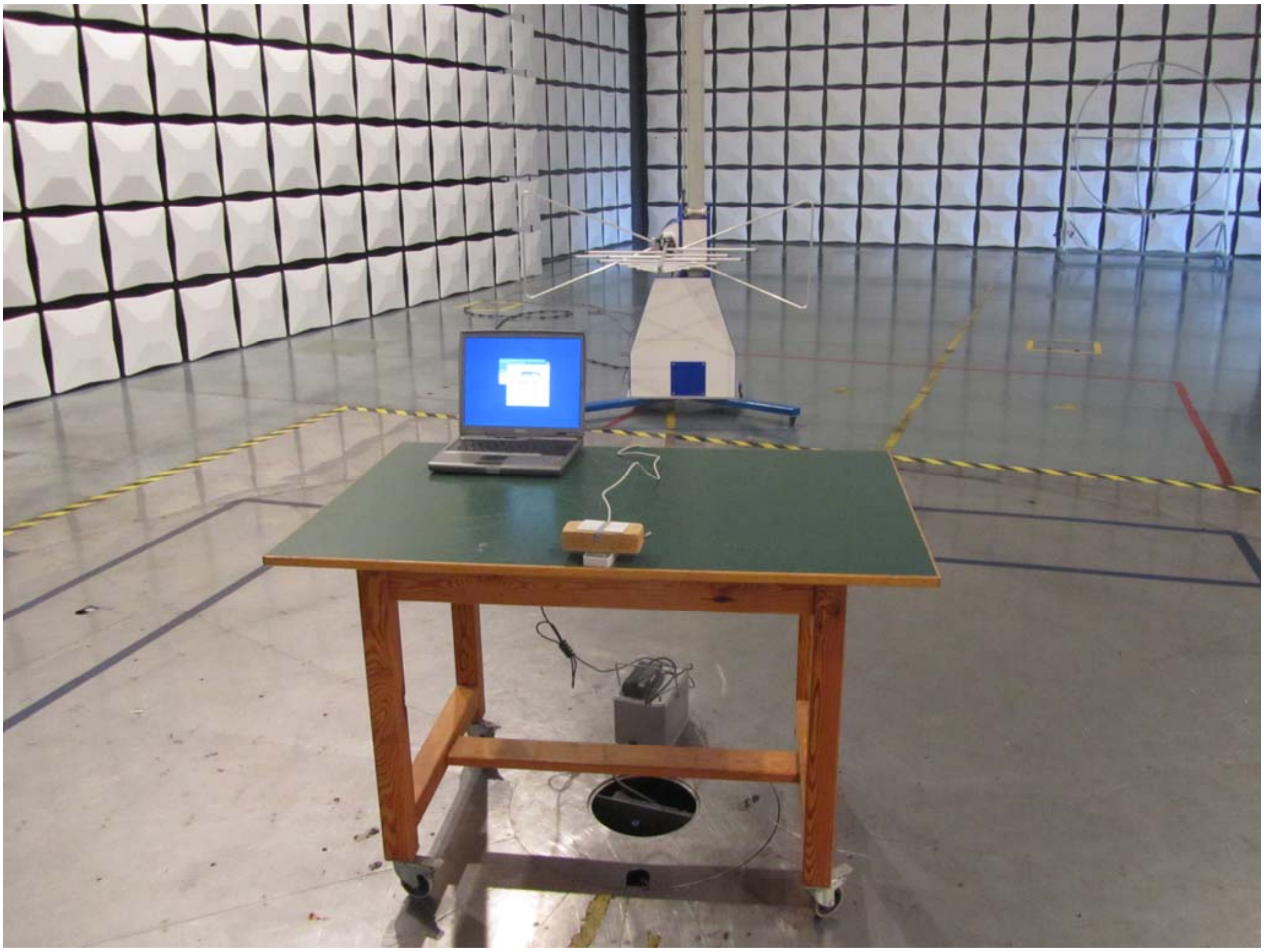
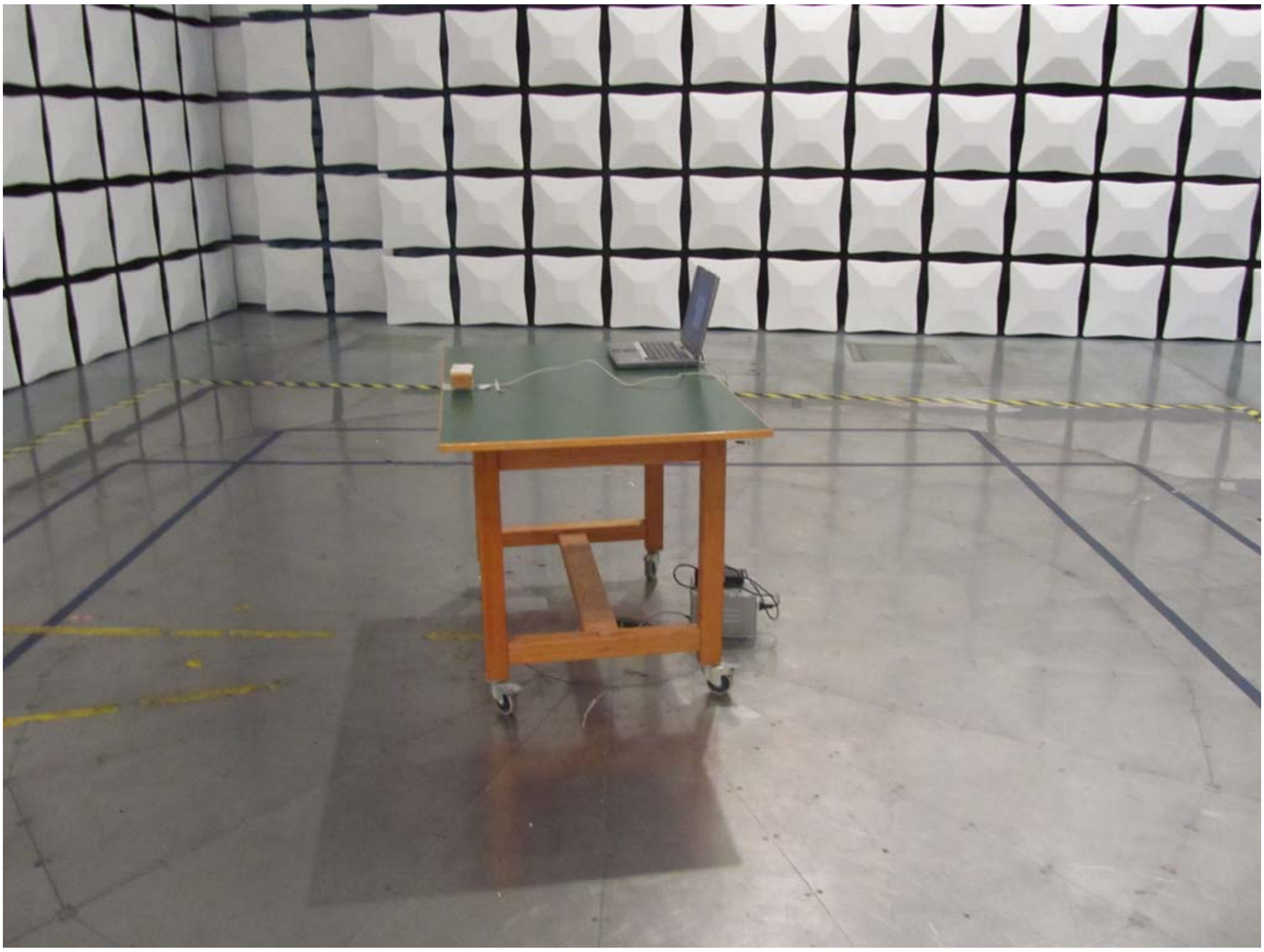
Test setup for radiated emission measurement 9 kHz – 30 MHz) - continued -

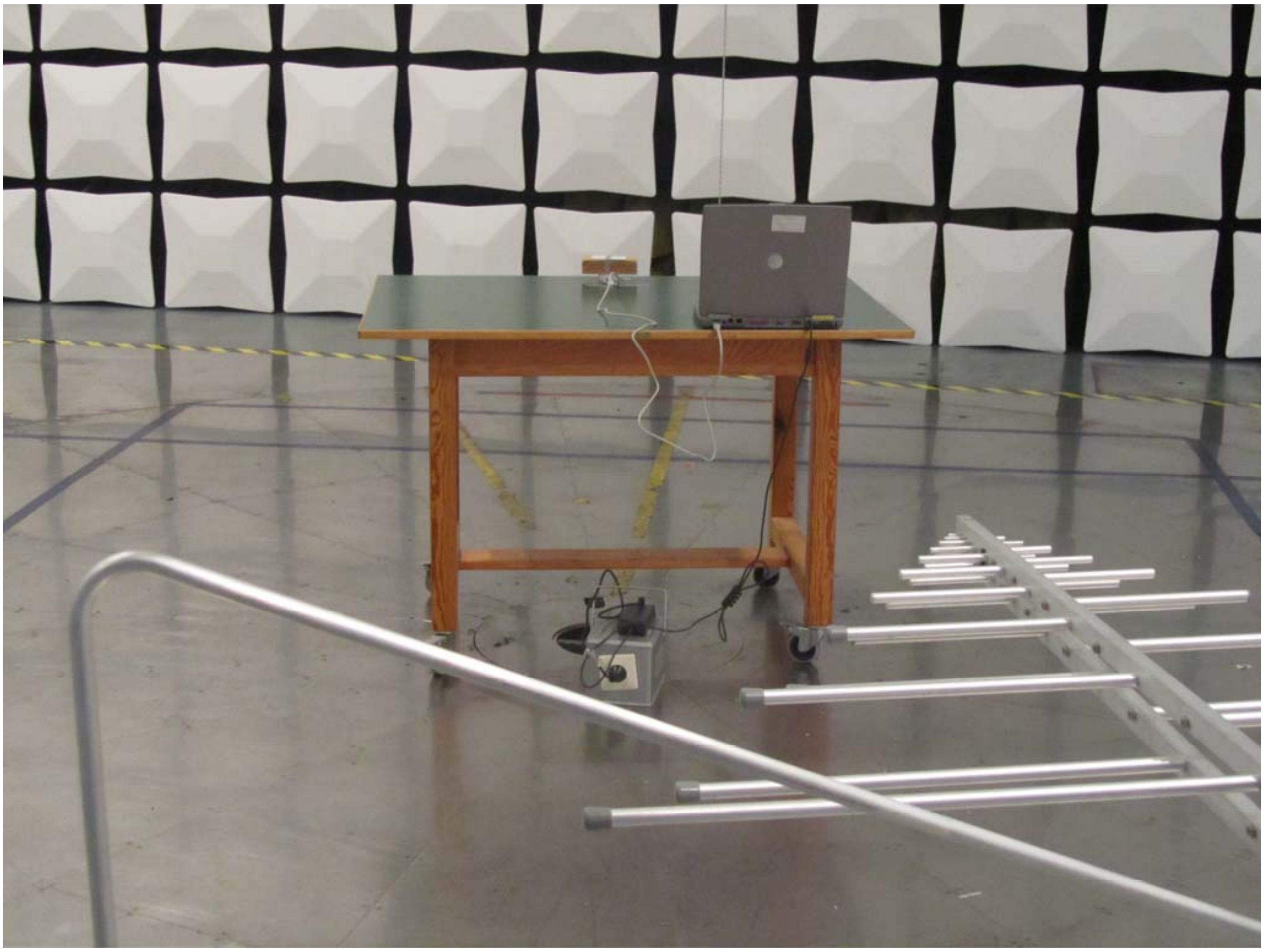


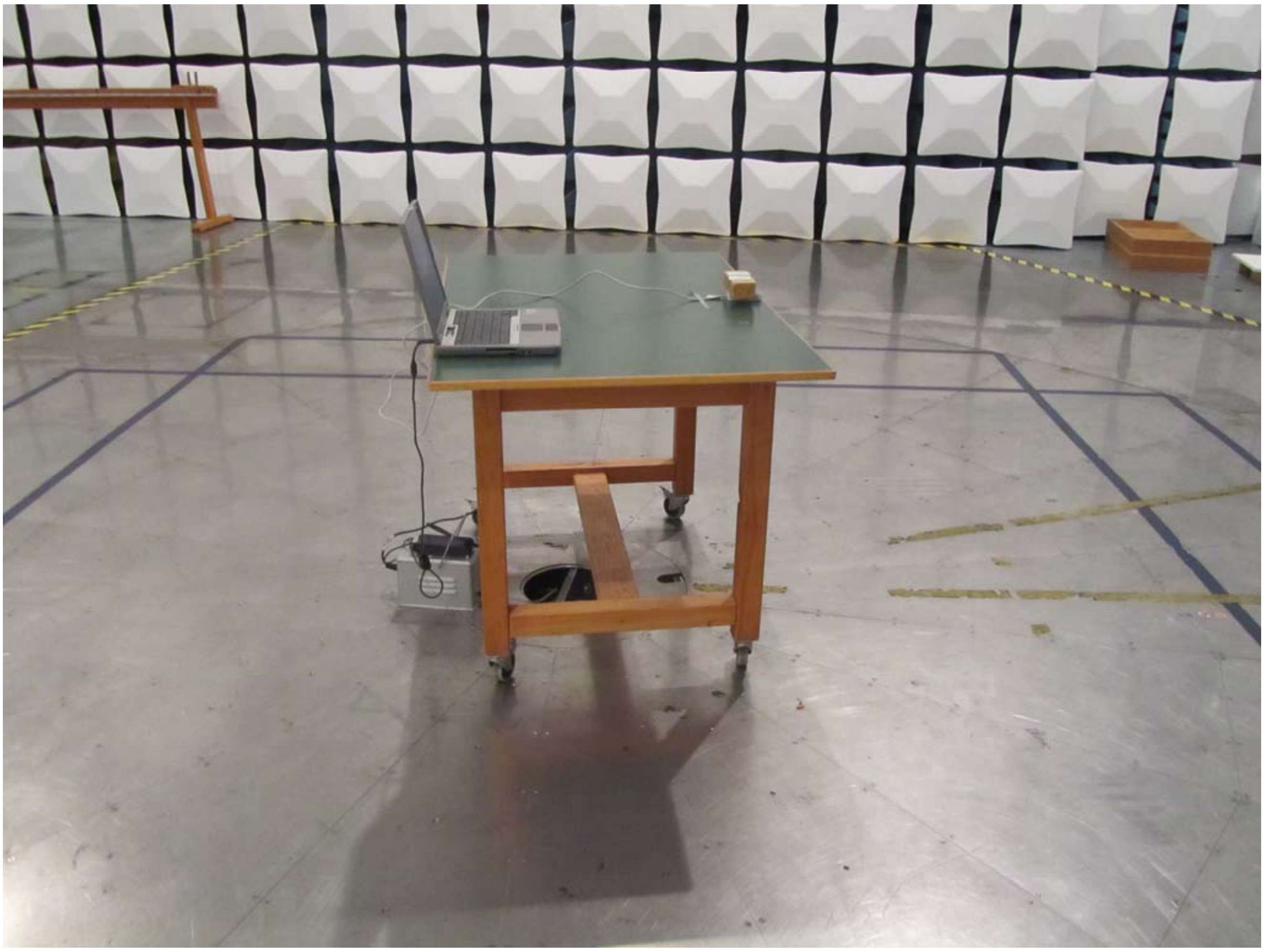
Test setup for radiated emission measurement (alternate test site)





Test setup for radiated emission measurement (alternate test site) - continued -





8 Test Results

FCC CFR 47 Parts 2 and 15			
Section(s)	*Test*	*Page*	*Result*
2.1046(a)	Conducted output power	---	Not applicable
2.202(a)	Occupied bandwidth	29	Recorded
15.215(c)	Bandwidth of the emission	35	Test passed
2.201, 2.202	Class of emission	39	Calculated
15.35(c)	Pulse train measurement for pulsed operation	---	Not applicable
15.205(a) 15.205(d)(7)	Restricted bands of operation	40[5]	Test passed
15.207	Conducted AC powerline emission 150 kHz to 30 MHz	42	Test passed
15.225(a)-(d)	Spectrum Mask	45	Test passed
15.205(b) 15.215(b) 15.225(a)(d)	Radiated emission 9 kHz to 30 MHz	48	Test passed
15.205(b) 15.225(d)	Radiated emission 30 MHz to 1 GHz	51	Test passed
15.225(e)	Carrier frequency stability	54	Test passed

[5] See "Spectrum Mask" for the 13.36 to 13.41 MHz band. For all other restricted bands see "Radiated Emission".

IC RSS-GEN Issue 3			
Section(s)	*Test*	*Page*	*Result*
4.8	Transmitter output power (conducted)	---	Not applicable
4.6.1	Occupied Bandwidth	29	Recorded
8	Designation of emissions	39	Calculated
4.5	Pulsed operation	---	Not applicable
2.2(a)	Restricted bands and unwanted emission frequencies	40[6]	Test passed
7.2.2(b)(c) 7.2.5	Unwanted emissions 9 kHz to 30 MHz	48	Test passed
2.2(b)(c) 7.2.5	Unwanted emissions 30 MHz to 1 GHz	51	Test passed
7.2.2	Transmitter AC power lines conducted emissions 150 kHz to 30 MHz	42	Test passed
5.5	Exposure of Humans to RF Fields	57	Exempted from SAR and RF evaluation

IC RSS-210 Issue 8			
Section(s)	*Test*	*Page*	*Result*
A2.6	Spectrum Mask	45	Test passed
A2.6	Unwanted emissions 9 kHz to 30 MHz	48	Test passed
A2.6	Unwanted emissions 30 MHz to 1 GHz	51	Test passed
A2.6	Carrier frequency stability	54	Test passed

[6] See "Spectrum Mask" and "Unwanted emissions".

8.1 Occupied Bandwidth

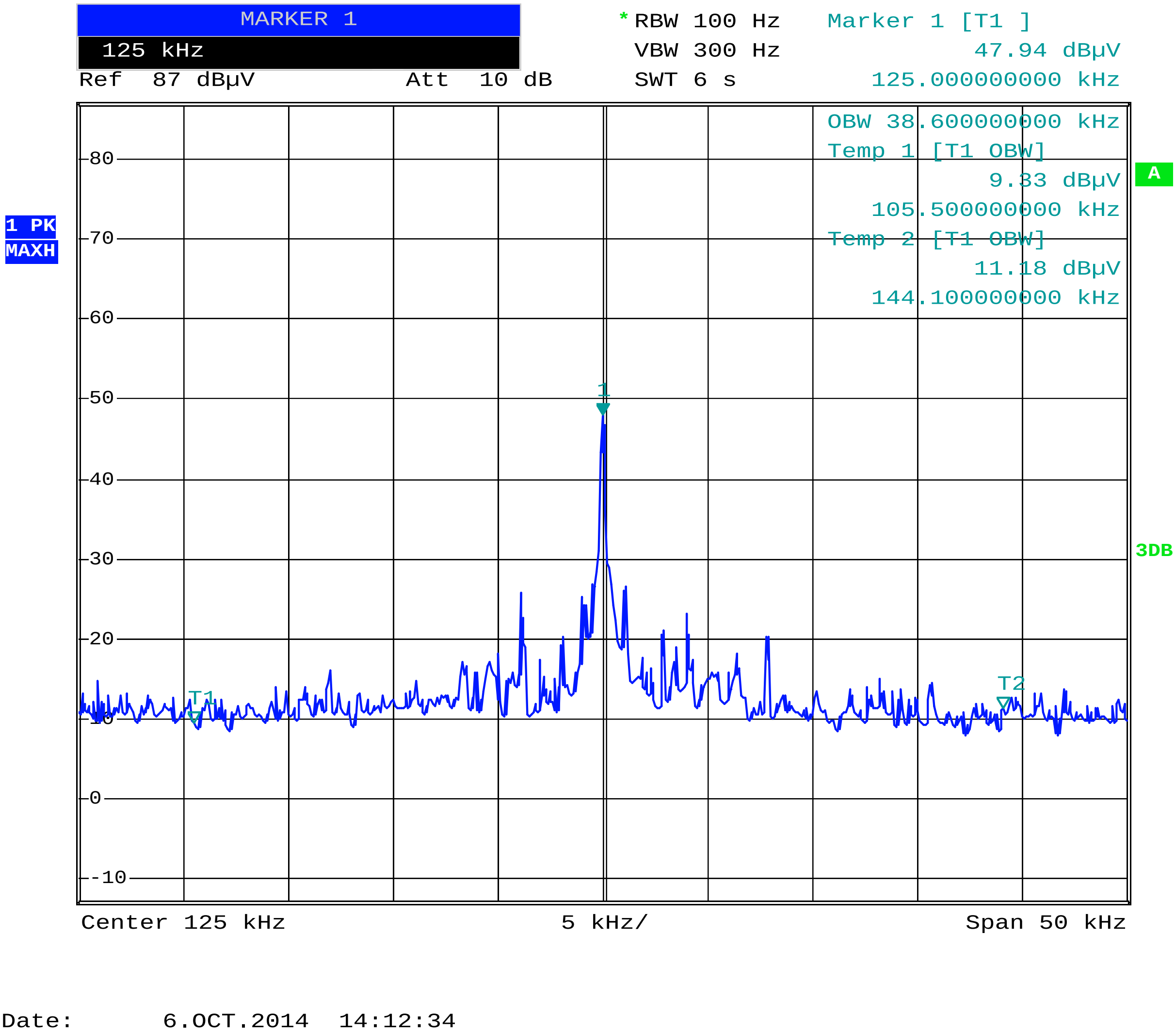
Rules and specifications:	CFR 47 Part 2, section 2.202(a) ANSI C63.4, annex H.6
Guide:	ANSI C63.4
Description:	The occupied bandwidth according to CFR 47 Part 2, section 2.202(a), is measured as the 99% emission bandwidth, i.e. below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5% of the total mean power radiated by a given emission. The occupied bandwidth according to ANSI C63.4, annex H.6; is measured as the frequency range defined by the points that are 26 dB down relative to the maximum level of the modulated carrier. The resolution bandwidth of the spectrum analyzer shall be set to a value greater than 5.0% of the allowed bandwidth. If no bandwidth specifications are given, the following guidelines are used:

Fundamental frequency	Minimum resolution bandwidth
9 kHz to 30 MHz	1 kHz
30 MHz to 1000 MHz	10 kHz
1000 MHz to 40 GHz	100 kHz

	The video bandwidth shall be at least three times greater than the resolution bandwidth.
Measurement procedure:	Bandwidth Measurements (6.1)

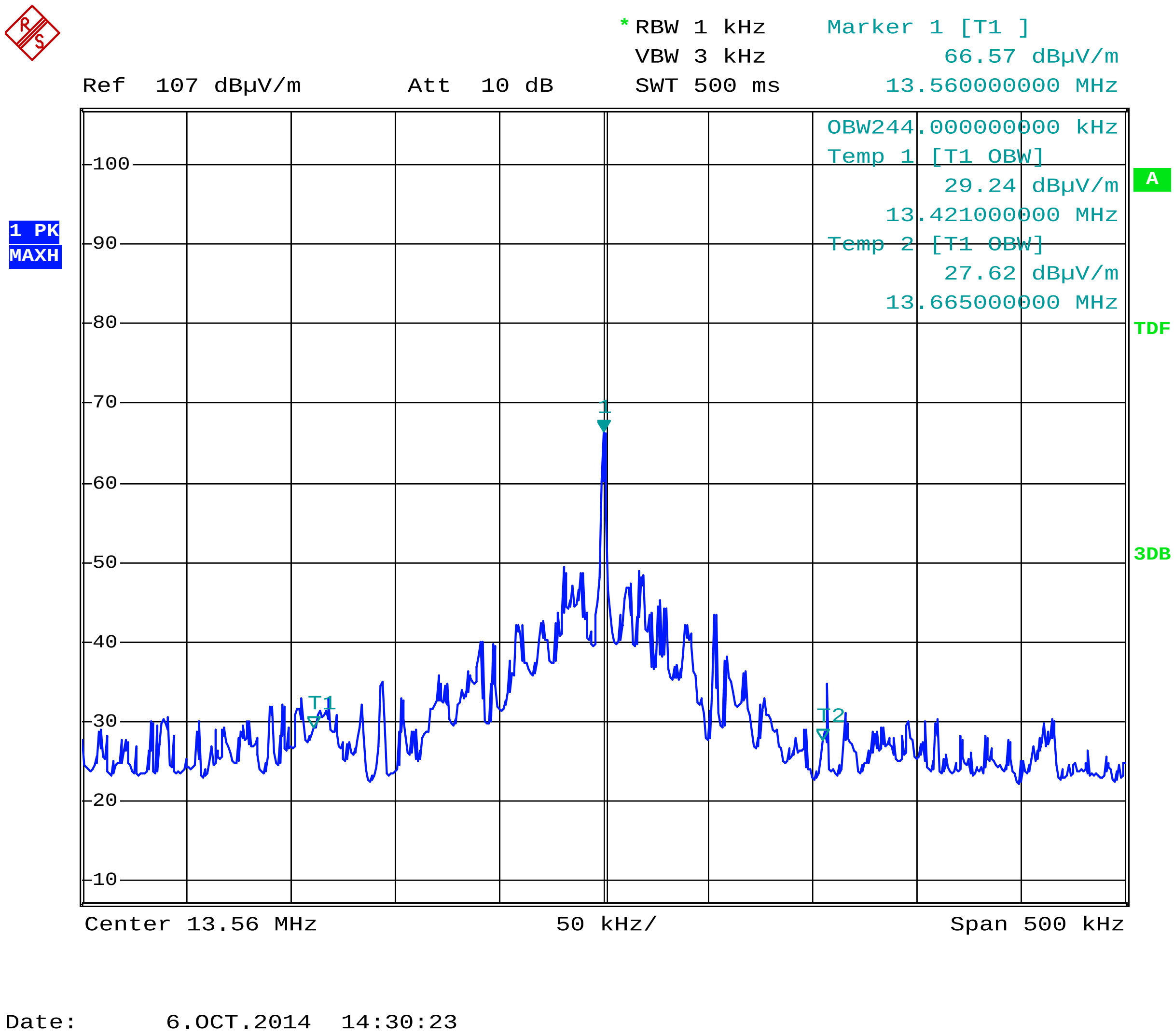
Comment:	
Date of test:	2014-10-06
Test site:	Fully anechoic room, cabin no. 2

Occupied Bandwidth 125 kHz (99 %):



Occupied Bandwidth (99 %):	**38.6 kHz**

Occupied Bandwidth 13.56 MHz (99 %):



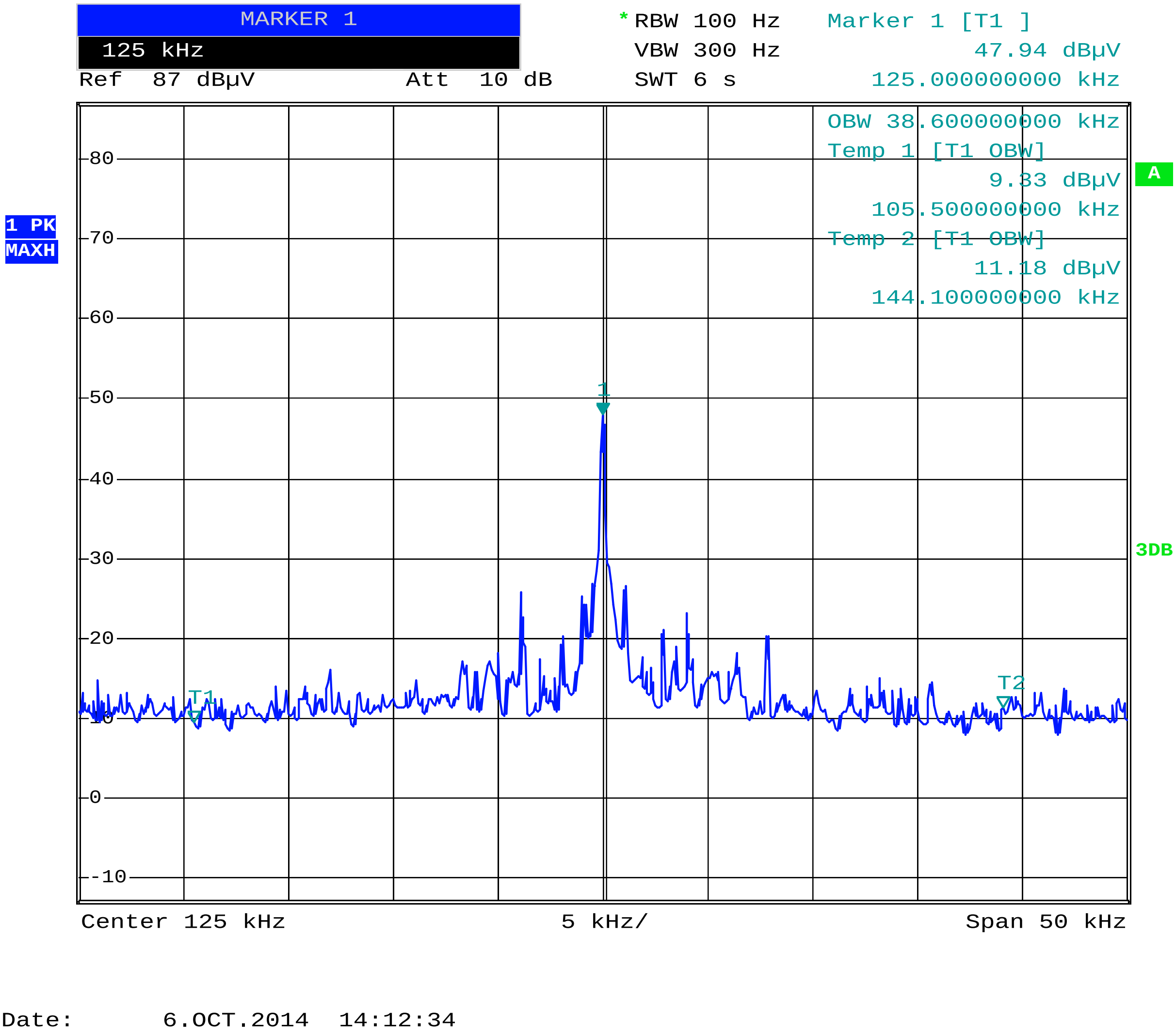
Occupied Bandwidth (99 %):	**244 kHz**

Occupied Bandwidth (continued)

Rules and specifications:	IC RSS-Gen Issue 3, section 4.6.1
Guide:	IC RSS-Gen Issue 3, section 4.6.1
Description:	If not specified in the applicable RSS the occupied bandwidth is measuredas the 99% emission bandwidth. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is also recorded. The span between the two recorded frequencies is the occupied bandwidth.
Measurement procedure:	Bandwidth Measurements (6.1)

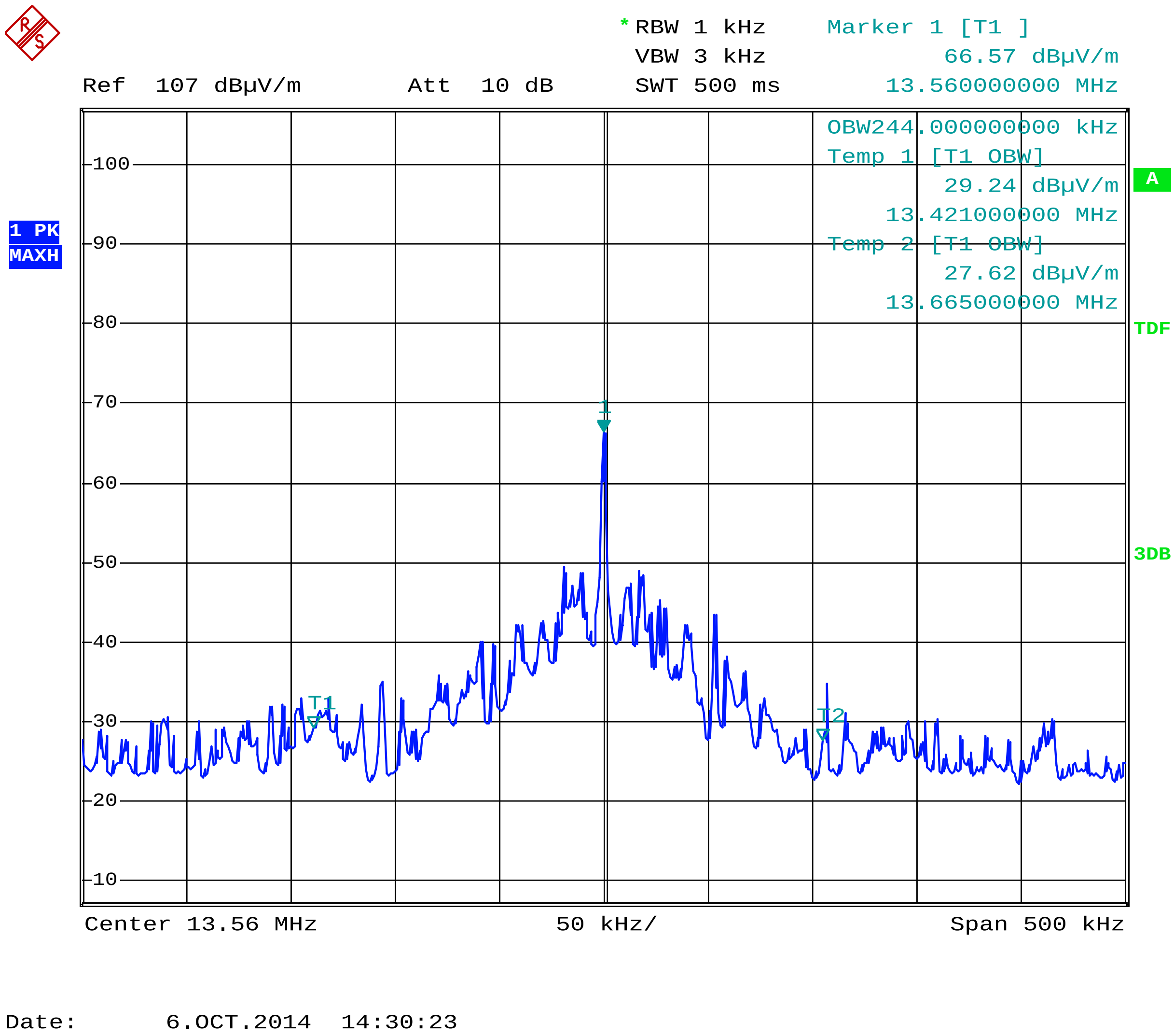
Comment:	
Date of test:	2014-10-06
Test site:	Fully anechoic room, cabin no. 2

Occupied Bandwidth 125 kHz (99 %):



Occupied Bandwidth (99 %):	**38.6 kHz**

Occupied Bandwidth 13.56 MHz (99 %):



Occupied Bandwidth (99 %):	**244 kHz**

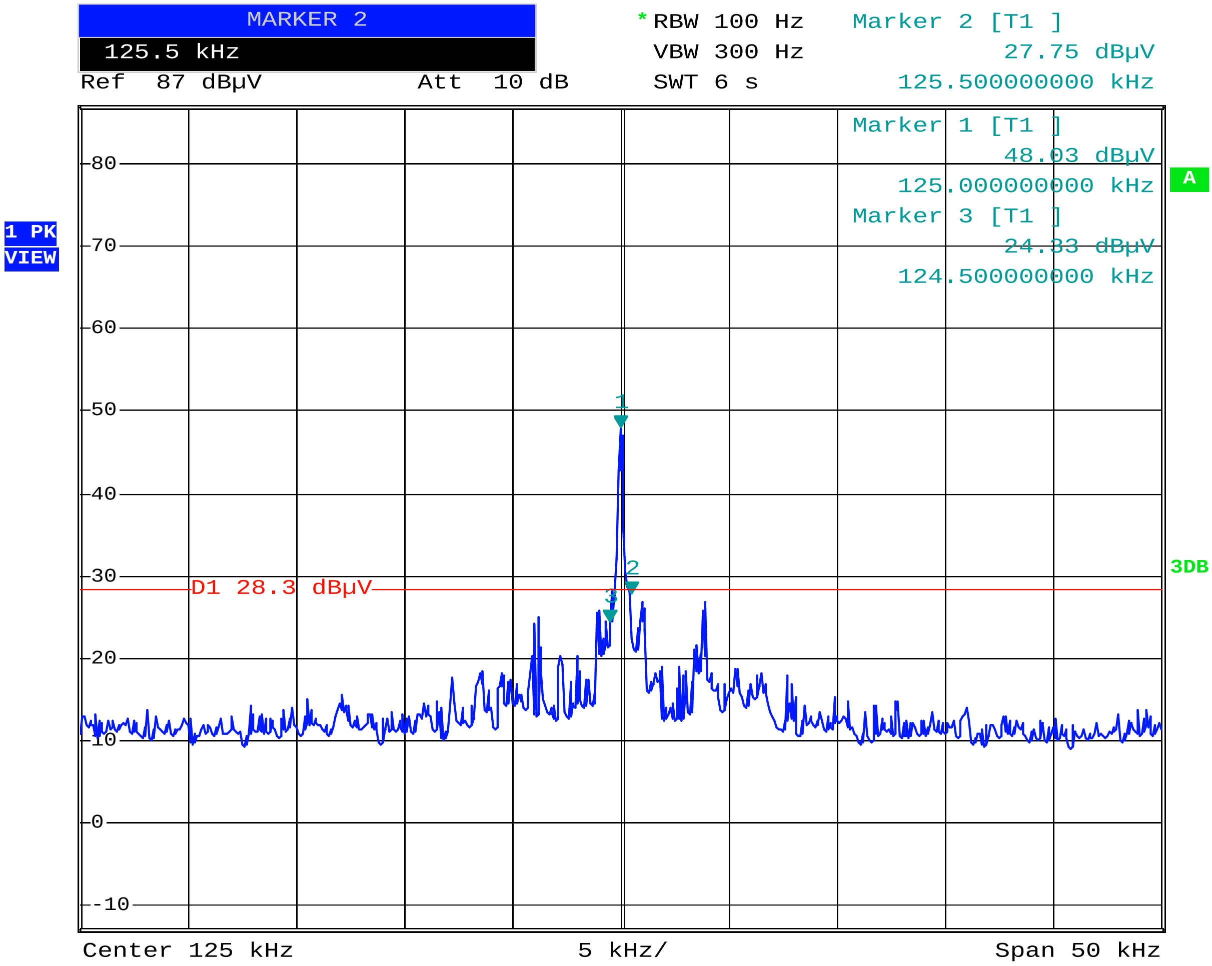
8.2 Bandwidth of the Emission

Rules and specifications:	CFR 47 Part 15, section 15.215(c)
Guide:	ANSI C63.4
Description:	The 20 dB bandwidth of the emission is measured as the frequency range defined by the points that are 20 dB down relative to the maximum level of the modulated carrier. For intentional radiators operating under the alternative provisions to the general emission limits the requirement to contain the 20 dB bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation. The resolution bandwidth of the spectrum analyzer shall be set to a value greater than 5.0% of the allowed bandwidth. If no bandwidth specifications are given, the following guidelines are used:

Fundamental frequency	Minimum resolution bandwidth
9 kHz to 30 MHz	1 kHz
30 MHz to 1000 MHz	10 kHz
1000 MHz to 40 GHz	100 kHz

	The video bandwidth shall be at least three times greater than the resolution bandwidth.
Measurement procedure:	Bandwidth Measurements (6.1)

Comment:	
Date of test:	2014-10-06
Test site:	Fully anechoic room, cabin no. 2



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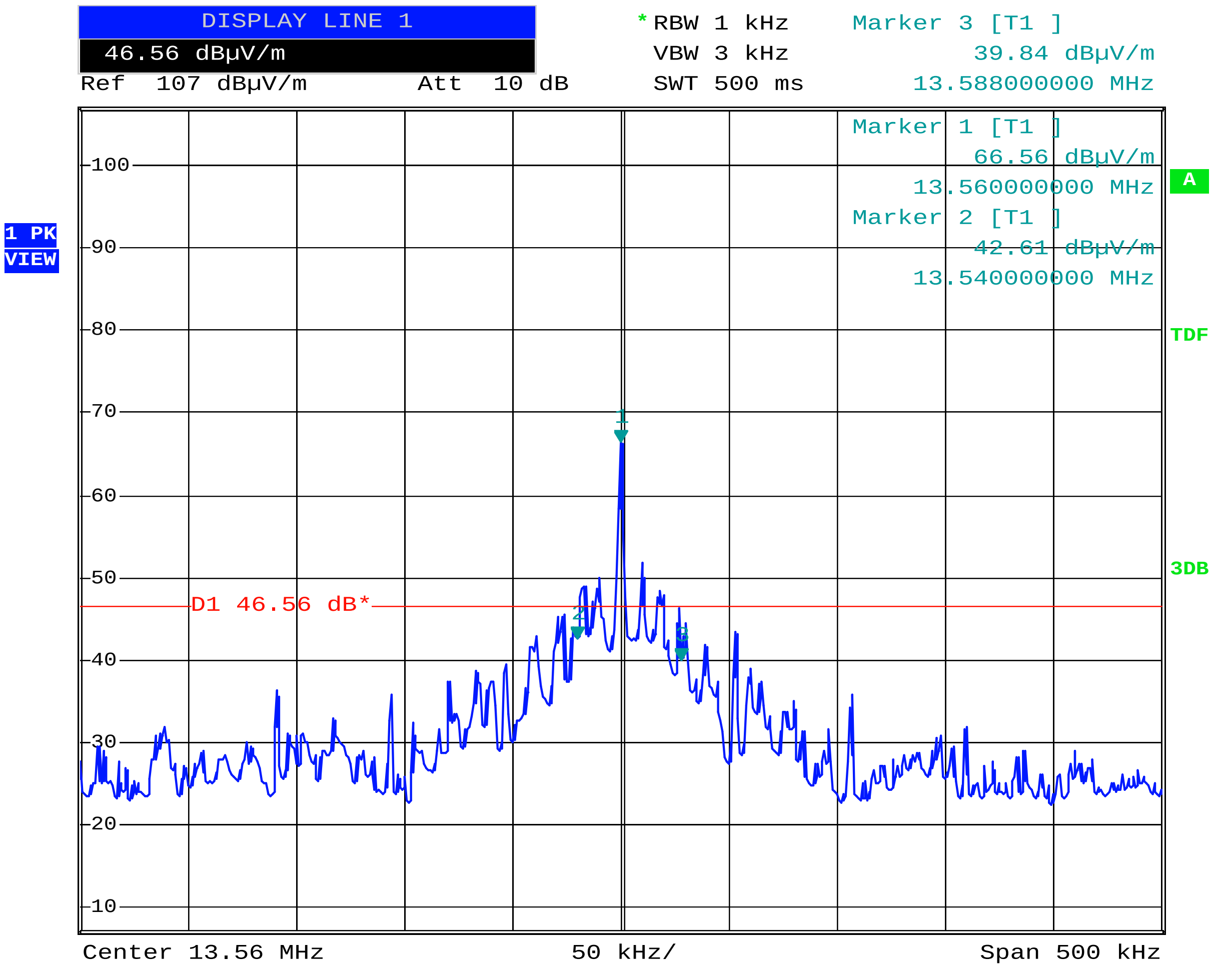
Bandwidth of the emission:	**1.0 kHz**

Comment:	
Date of test:	2014-10-06
Test site:	Fully anechoic room, cabin no. 2



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Permitted frequency band:	**125 kHz and 13.110** - 14.010 MHz	
20 dB bandwidth:	**48.0 kHz**	
Carrier frequency stability: Maximum frequency tolerances:	☒ **specified** **+0.130 kHz** **-0.110 kHz**	☐ **not specified**
Bandwidth of the emission:	**43.3 kHz**	**within permitted frequency band[7]:** ☒ **yes** ☐ **no**

Test Result:	Test passed

[7] If a frequency stability is not specified, it is recommended that the fundamental emission is kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

8.3 Designation of Emissions

Rules and specifications:	CFR 47 Part 2, sections 2.201 and 2.202 IC RSS-Gen Issue 3, sections 8
Guide:	ANSI C63.4 / TRC-43

Type of modulation:	Amplitude Modulation

125 kHz:

B_n = Necessary Bandwidth B = Modulation rate K = Overall numerical factor	B_n = 2BK B = 0.5 kHz K = 1
Calculation:	B_n = 2 · (0.5 kHz) · 1 = 1 kHz

Designation of Emissions:	**1K00A1D**

13.56 MHz

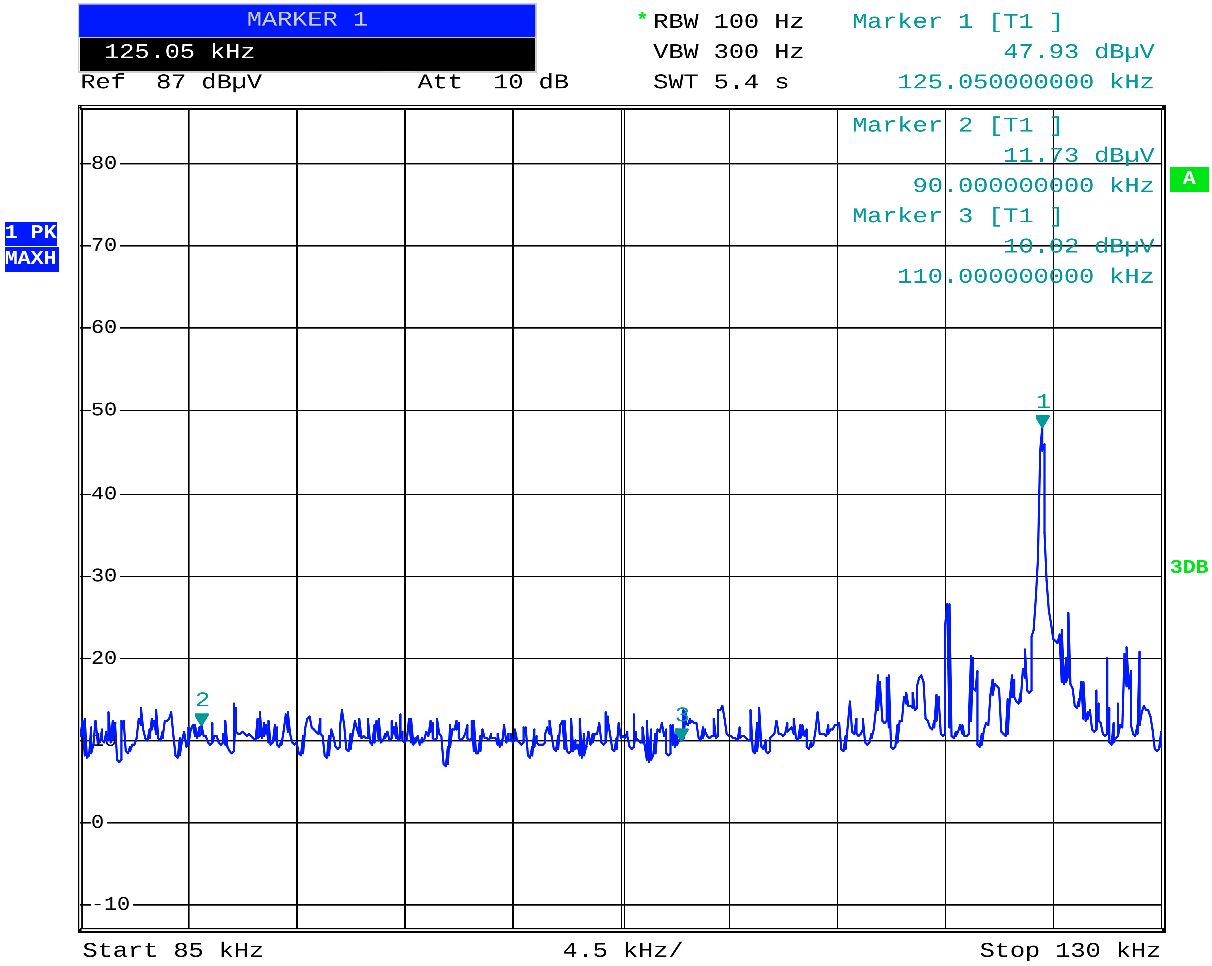
B_n = Necessary Bandwidth B = Modulation rate K = Overall numerical factor	B_n = 2BK B = 21.6 kHz K = 1
Calculation:	B_n = 2 · (21.6 kHz) · 1 = 43.2 kHz

Designation of Emissions:	**43K2A1D**

8.4 Restricted Bands of Operation

Rules and specifications:	CFR 47 Part 15, section 15.205(a) IC RSS-210 Issue 8, section 7.2.2(a)
Guide:	ANSI C63.4
Limit:	Only spurious emissions are permitted in any of the frequency bands listed in CFR 47 Part 15, section 15.205(a) or IC RSS-210 Issue 7, section 2.2(a).
Measurement procedure:	Radiated Emission Measurement 9 kHz to 30 MHz (6.3)

Comment: Date of test: Test site:	 2014-10-06 Fully anechoic room, cabin no. 2
Test distance:	3 meters



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Test Result:	Test passed

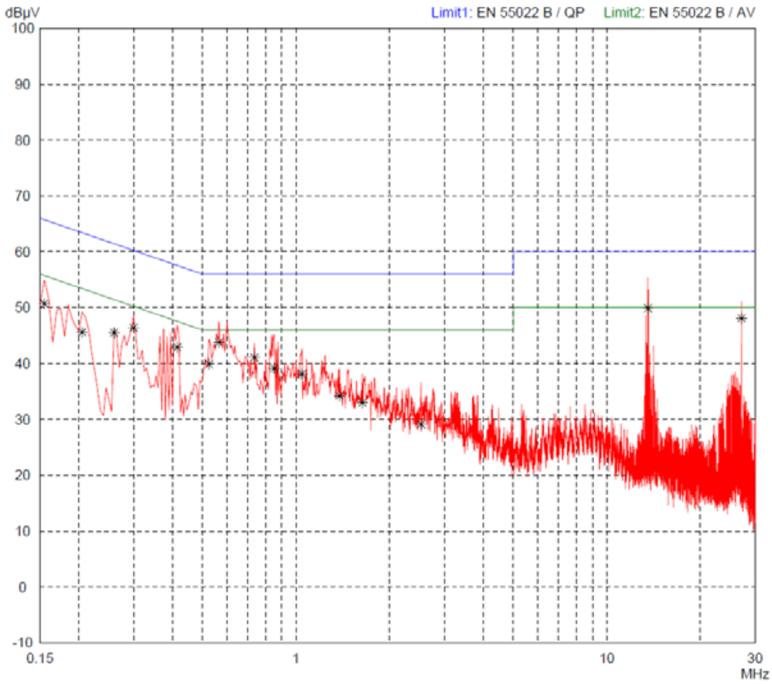
8.5 Conducted Powerline Emission Measurement 150 kHz to 30 MHz

Rules and specifications:	CFR 47 Part 15, section 15.207 IC RSS-GEN Issue 3, section 7.2.4		
Guide:	ANSI C63.4 / CISPR 22		
Limit:	Frequency of Emission (MHz)	Conducted Limit (dBµV)	
		Quasi-peak	Average
	0.15 - 0.5 0.5 - 5 5 - 30	66 to 56 56 60	56 to 46 46 50
Measurement procedure:	Conducted AC Powerline Emission (6.2)		

Comment:	Reading tag continuously
Date of test:	2014-10-07
Test site:	Shielded room, cabin no. 1

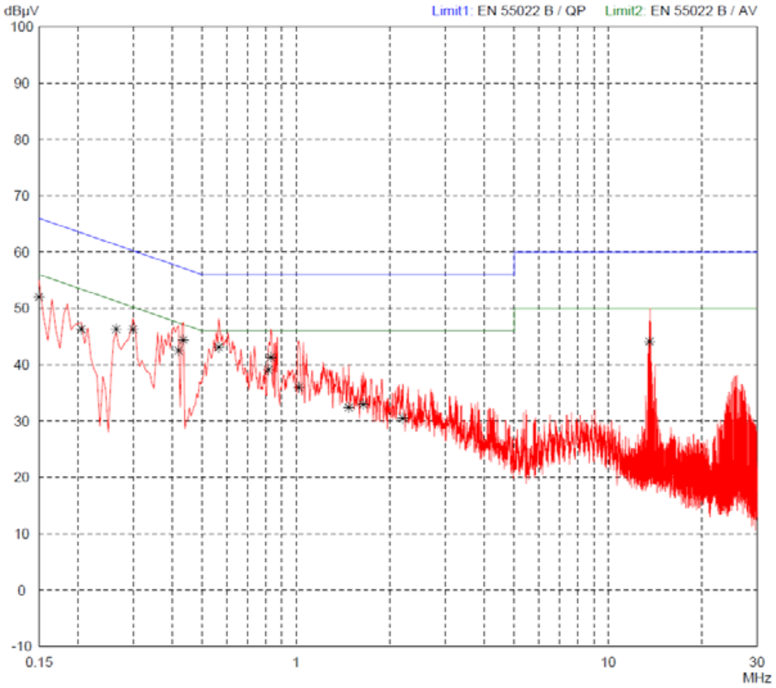
Test Result:	Test passed

Tested on:	L1



Frequency (MHz)	Detector	Reading Value (dBµV)	Correction Factor (dB)	Final Value (dBµV)	Limit (dBµV)	Margin (dB)
0.155	Quasi-Peak	50.7	0.0	50.7	65.7	15.0
0.205	Quasi-Peak	45.6	0.0	45.6	63.4	17.8
0.260	Quasi-Peak	45.5	0.0	45.5	61.4	15.9
0.300	Quasi-Peak	46.4	0.0	46.4	60.2	13.8
0.415	Quasi-Peak	42.9	0.0	42.9	57.5	14.6
0.525	Quasi-Peak	39.9	0.0	39.9	56.0	16.1
0.565	Quasi-Peak	43.8	0.0	43.8	56.0	12.2
0.735	Quasi-Peak	41.1	0.0	41.1	56.0	14.9
0.850	Quasi-Peak	39.1	0.0	39.1	56.0	16.9
1.045	Quasi-Peak	38.1	0.0	38.1	56.0	17.9
1.380	Quasi-Peak	34.2	0.0	34.2	56.0	21.8
1.635	Quasi-Peak	33.0	0.0	33.0	56.0	23.0
2.525	Quasi-Peak	29.1	0.0	29.1	56.0	26.9
13.560	Quasi-Peak	49.9	0.0	49.9	60.0	**10.1**
27.120	Quasi-Peak	48.1	0.0	48.1	60.0	11.9

Tested on:	N



Frequency (MHz)	Detector	Reading Value (dBµV)	Correction Factor (dB)	Final Value (dBµV)	Limit (dBµV)	Margin (dB)
0.150	Quasi-Peak	52.0	0.0	52.0	66.0	14.0
0.205	Quasi-Peak	46.3	0.0	46.3	63.4	17.1
0.265	Quasi-Peak	46.3	0.0	46.3	61.3	15.0
0.300	Quasi-Peak	46.3	0.0	46.3	60.2	13.9
0.420	Quasi-Peak	42.5	0.0	42.5	57.4	14.9
0.435	Quasi-Peak	44.4	0.0	44.4	57.2	**12.8**
0.565	Quasi-Peak	43.1	0.0	43.1	56.0	12.9
0.815	Quasi-Peak	39.1	0.0	39.1	56.0	16.9
0.830	Quasi-Peak	41.3	0.0	41.3	56.0	14.7
1.020	Quasi-Peak	36.0	0.0	36.0	56.0	20.0
1.475	Quasi-Peak	32.4	0.0	32.4	56.0	23.6
1.640	Quasi-Peak	33.0	0.0	33.0	56.0	23.0
2.195	Quasi-Peak	30.5	0.0	30.5	56.0	25.5
13.560	Quasi-Peak	44.1	0.0	44.1	60.0	15.9

Sample calculation of final values:

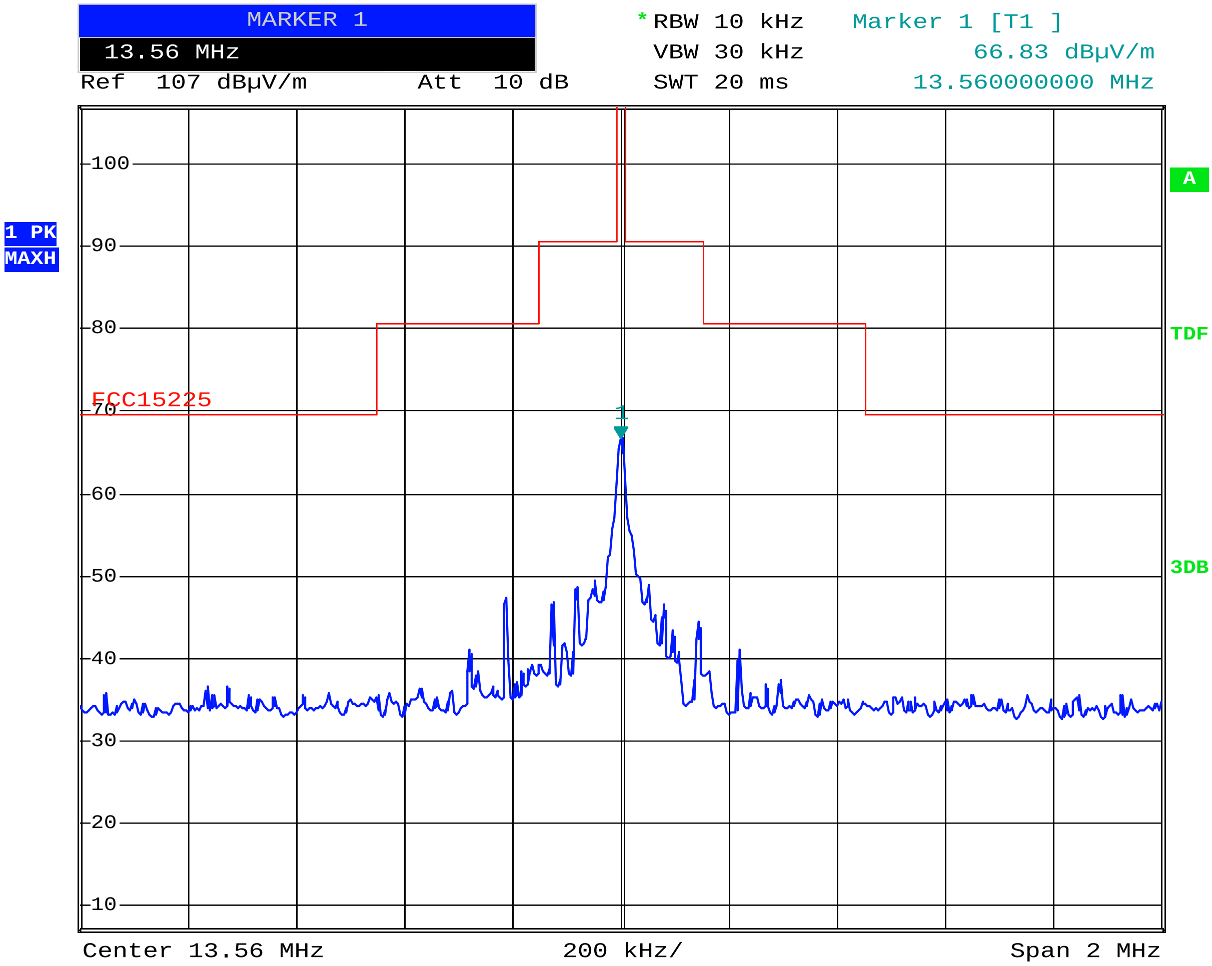
Final Value (dBµV) = Reading Value (dBµV) + Correction Factor (dB)

8.6 Spectrum Mask

Rules and specifications:	CFR 47 Part 15, section 15.225(a)-(d) IC RSS-210 Issue 8, section A2.6			
Guide:	ANSI C63.4			
Description:	Compliance with the spectrum mask is tested using a spectrum analyzer with resolution bandwidth set to a 1 kHz for the band 13.553 to 13.567 MHz and to 10 kHz outside this band. The video bandwidth shall be at least three times greater than the resolution bandwidth.			
Limit:	Frequency of Emission (MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)	Measurement Distance d (meters)
	1.705 - 13.110	30	29.5	30
	13.110 - 13.410	106	40.5	30
	13.410 - 13.553	334	50.5	30
	13.553 - 13.567	15848	84.0	30
	13.567 - 13.710	334	50.5	30
	13.710 - 14.010	106	40.5	30
	14.010 - 30.000	30	29.5	30
Measurement procedure:	Radiated Emission Measurement 9 kHz to 30 MHz (6.3)			

Comment:	
Date of test:	2014-10-06
Test site:	Fully anechoic room, cabin no. 2
Test distance:	3 meters
Extrapolation Factor:	40 dB/decade

Test Result:	Test passed



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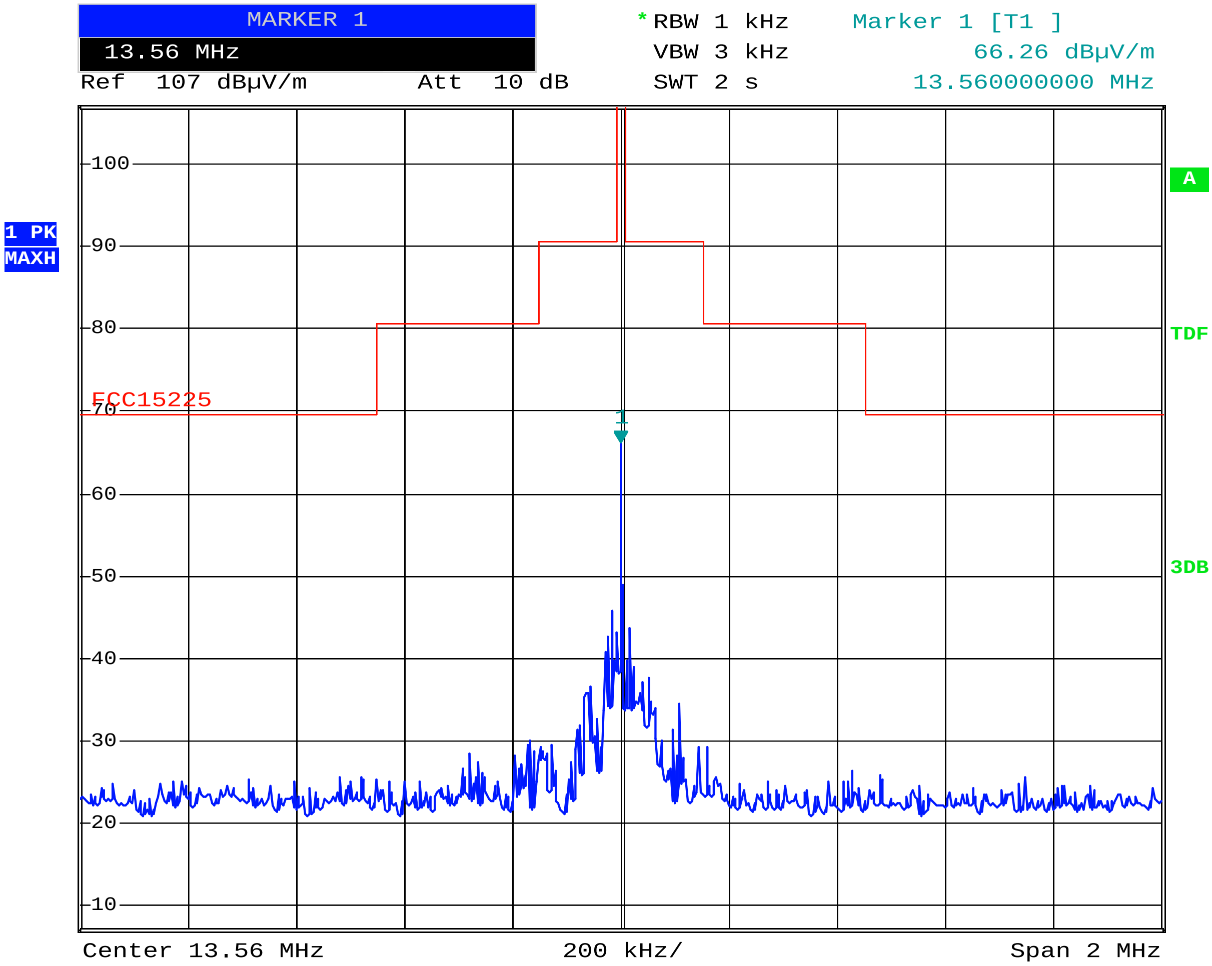

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8.7 Radiated Emission Measurement 9 kHz to 30 MHz

Rules and specifications:	CFR 47 Part 15, sections 15.205 and 15.225(a)-(d) IC RSS-GEN Issue 3, sections 7.2.2(b)(c) and 7.2.5 and IC RSS-210 Issue 8, section A2.6
Guide:	ANSI C63.4
Limit:	see table below

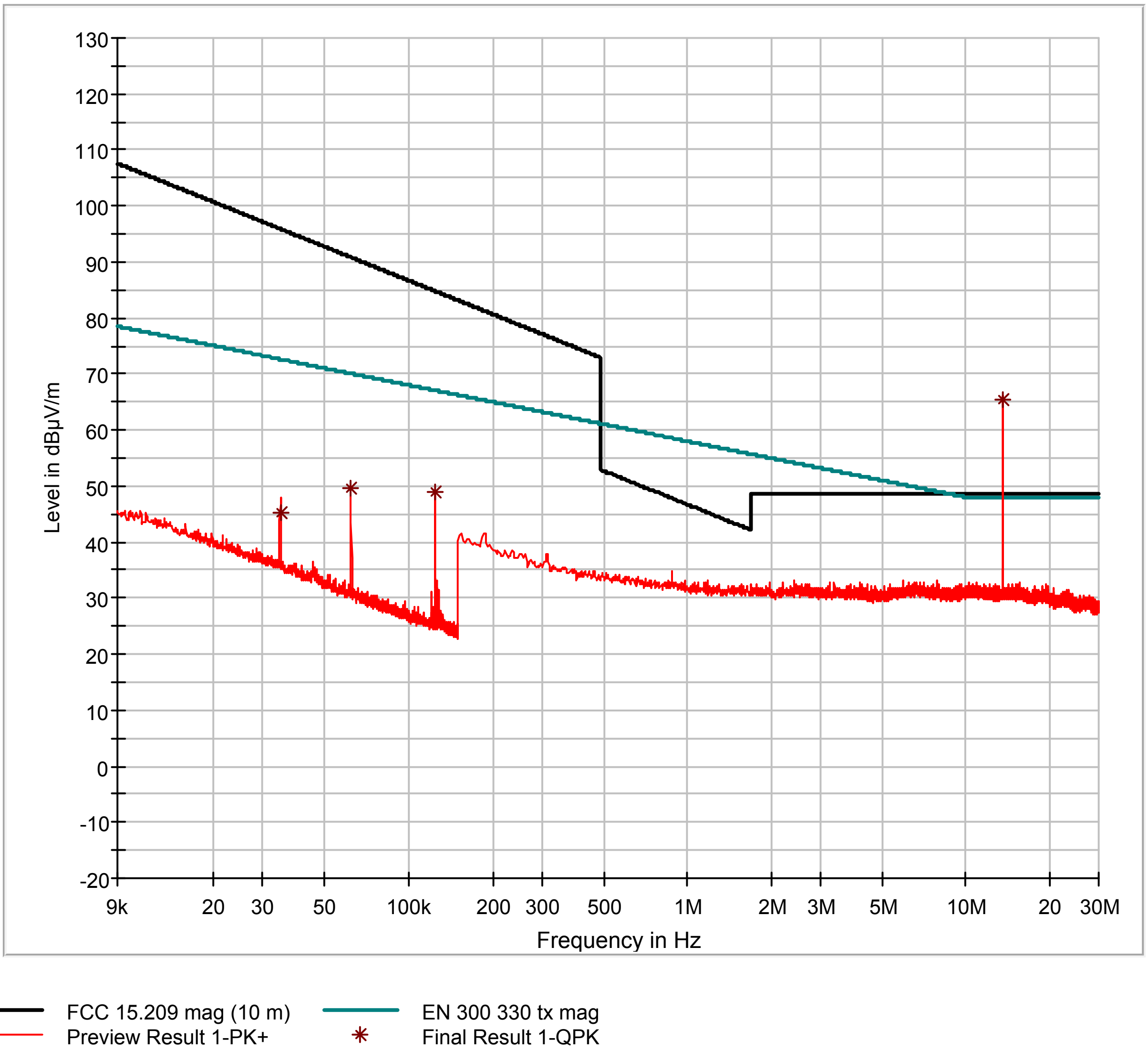
Frequency of Emission (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)	Measurement Distance d (meters)
0.009 - 0.490	2400/F(kHz)	67.6 - 20 · log(F(kHz))	300
0.490 - 1.705	24000/F(kHz)	87.6 - 20 · log(F(kHz))	30
1.705 - 13.110	30	29.5	30
13.110 - 13.410	106	40.5	30
13.410 - 13.553	334	50.5	30
13.553 - 13.567	15848	84.0	30
13.567 - 13.710	334	50.5	30
13.710 - 14.010	106	40.5	30
14.010 - 30.000	30	29.5	30

Additionally, the level of any unwanted emissions shall not exceed the level of the fundamental emission.

Measurement procedure:	Radiated Emission Measurement 9 kHz to 30 MHz (6.3)

Comment:	Reading tag continuously
Date of test:	2014-10-06
Test site:	Open field test site

Test Result:	Test passed



Extrapolation factor: -40 dB/decade

Frequency (MHz)	Detector	Distance d1 (m)	Distance d (m)	Reading Value (dBµV)	Correction Factor (dB/m)	Extrapolation Factor (dB)	Pulse Train Correction (dB)	Final Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
0.04560	Quasi-Peak	10	300	25.2	20.0	-59.1		-13.9	34.4	48.3
0.06215	Quasi-Peak	10	300	29.8	20.0	-59.1		-9.3	31.7	41.0
0.12500	Quasi-Peak	10	300	28.9	20.0	-59.1		-10.2	25.7	35.9
13.56000	Quasi-Peak	10	30	45.5	20.0	-19.1		46.4	84.0	37.6

Sample calculation of final values:

Extrapolation Factor (dB) = (Log(d) - Log(d_1)) · Extrapolation Factor (dB/decade)

Final Value (dBµV/m) = Reading Value d_1 (dBµV) + Correction Factor (dB/m) + Extrapolation Factor (dB) + Pulse Train Correction (dB)

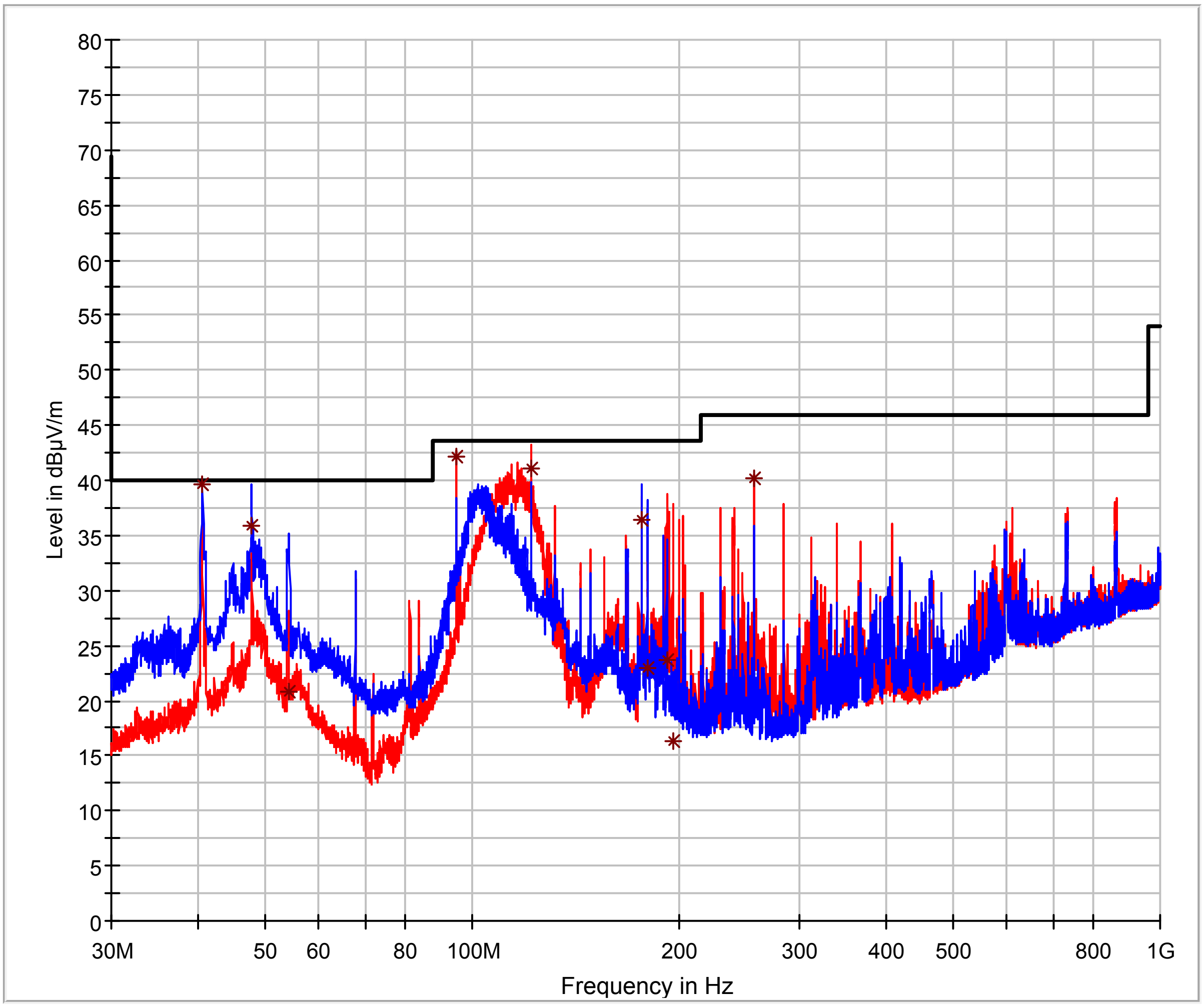
Note: Extrapolation factor (dB) and final value (dBµV/m) are relating to distance d.

8.8 Radiated Emission Measurement 30 MHz to 1 GHz

Rules and specifications:	CFR 47 Part 15, sections 15.205(b) and 15.225(d) IC RSS-GEN Issue 3, sections 7.2.2(b)(c) and 7.2.5 and IC RSS-210 Issue 8, section A2.6		
Guide:	ANSI C63.4		
Limit:	Frequency of Emission (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)
	30 - 88	100	40.0
	88 - 216	150	43.5
	216 - 960	200	46.0
	Above 960	500	54.0
	Additionally, the level of any unwanted emissions shall not exceed the level of the fundamental emission.		
Measurement procedures:	Radiated Emission at Alternative Test Site (6.4)		

Comment:	Reading tag continuosuly
Date of test:	2014-10-06
Test site:	Frequencies ≤ 1 GHz: Semi-anechoic room, cabin no. 8 Frequencies > 1 GHz: Fully anechoic room, cabin no. 2
Test distance:	3 meters

Test Result:	Test passed



FCC 15.209
Preview Result 1V-PK+
Preview Result 1H-PK+
Final Result 1-QPK

Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dBµV)	Correction Factor (dB/m)	Pulse Train Correction (dB)	Final Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
40.710	vertical	Quasi-Peak	23.9	15.7		39.6	40.0	**0.4**
48.020	vertical	Quasi-Peak	19.9	16.0		35.9	40.0	4.1
54.410	vertical	Quasi-Peak	5.8	15.0		20.8	40.0	19.2
94.940	horizontal	Quasi-Peak	28.7	13.3		42.1	43.5	1.4
122.060	horizontal	Quasi-Peak	29.4	11.7		41.1	43.5	2.4
176.260	vertical	Quasi-Peak	25.7	10.7		36.5	43.5	7.0
180.110	vertical	Quasi-Peak	12.0	11.0		23.0	43.5	20.5
192.090	horizontal	Quasi-Peak	11.4	12.3		23.7	43.5	19.8
196.930	horizontal	Quasi-Peak	4.1	12.3		16.4	43.5	27.1
257.620	horizontal	Quasi-Peak	26.3	14.0		40.2	46.0	5.8

Sample calculation of final values:

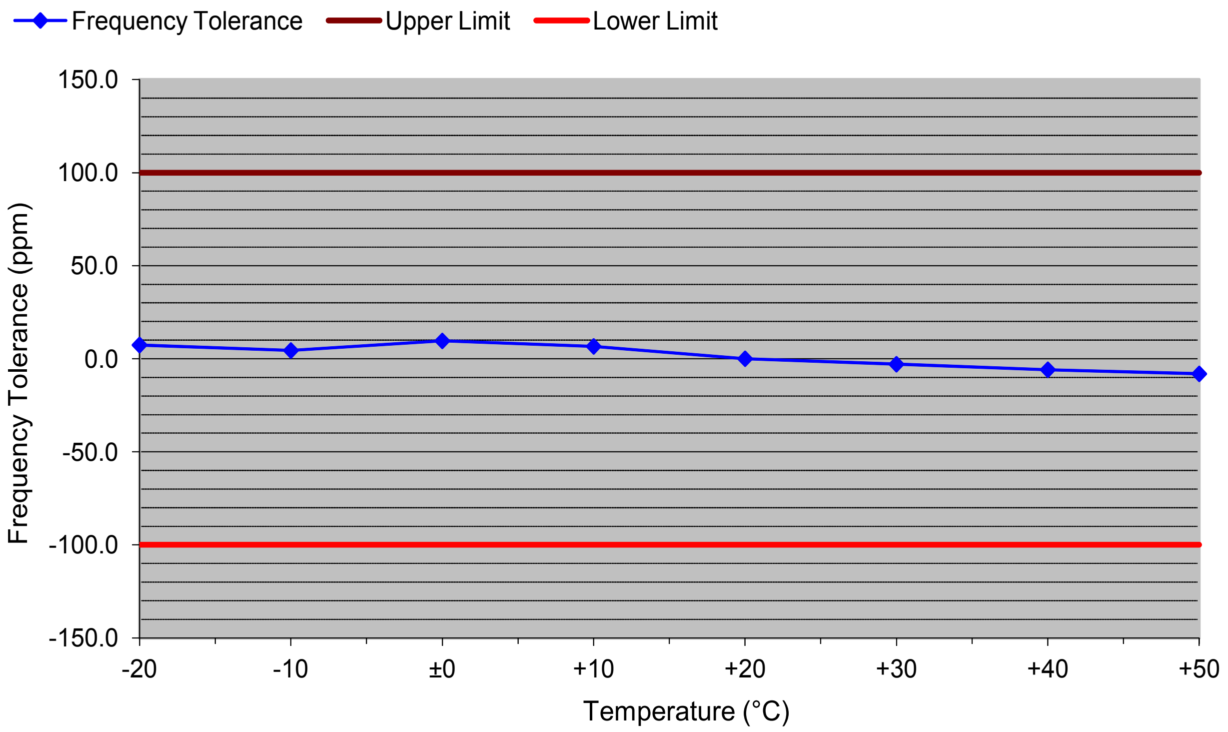
Final Value (dBµV/m) = Reading Value (dBµV) + Correction Factor (dB/m) + Pulse Train Correction (dB)

8.9 Carrier Frequency Stability

Rules and specifications:	CFR 47 Part 15, section 15.225(e) IC RSS-Gen Issue 3, section 4.7 and IC RSS-210 Issue 8, section A2.6
Guide:	ANSI C63.4
Limit:	The frequency tolerance of the carrier signal shall be maintained within ±0.01 % (±100 ppm) of the carrier frequency under nominal conditions.
Temperature range: Voltage range:	-20°C to +50°C (at normal supply voltage) 85% to 115% of the rated supply voltage (at a temperature of +20°C)
Measurement procedure:	Carrier Frequency Stability (6.5)

Comment:	The supply voltage is specified as 90 % to 110 % of the nominal DC supply voltage.
Date of test:	

8.9.1 Carrier Frequency Stability vs. Temperature

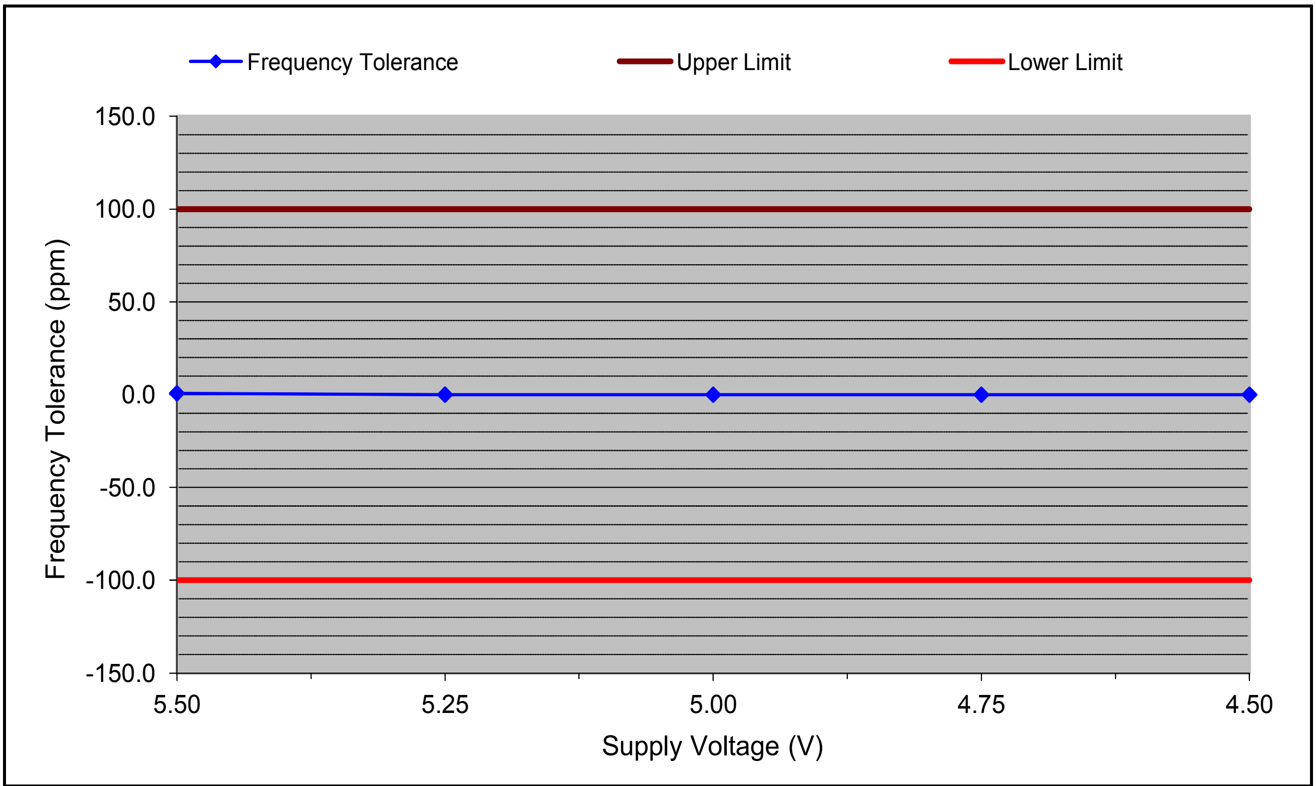


Supply voltage:	5 V	Nominal frequency:	13.560280 MHz

Temperature (°C)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
-20	13.560380	100	7.4	+100.0	-100.0	92.6
-10	13.560340	60	4.4	+100.0	-100.0	95.6
±0	13.560410	130	9.6	+100.0	-100.0	**90.4**
+10	13.560370	90	6.6	+100.0	-100.0	93.4
+20	13.560280	0	0.0	+100.0	-100.0	100.0
+30	13.560240	-40	-2.9	+100.0	-100.0	97.1
+40	13.560200	-80	-5.9	+100.0	-100.0	94.1
+50	13.560170	-110	-8.1	+100.0	-100.0	91.9

Test Result:	Test passed

8.9.2 Carrier Frequency Stability vs. Supply Voltage



Temperature:	+20 °C	Battery End Point:	Not applicable
Nominal frequency:	13.560260 MHz		

Supply Voltage (V)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
5.50	13.560270	10	0.7	+100.0	-100.0	**99.3**
5.25	13.560260	0	0.0	+100.0	-100.0	100.0
5.00	13.560260	0	0.0	+100.0	-100.0	100.0
4.75	13.560260	0	0.0	+100.0	-100.0	100.0
4.50	13.560260	0	0.0	+100.0	-100.0	100.0

Test Result:	Test passed

8.10 Exposure of Humans to RF Fields

Rules and specifications:	IC RSS-Gen Issue 3, section 5.6
Guide:	IC RSS-102 Issue 4, section 2.5

Exposure of Humans to RF Fields	Applicable	Declared by applicant	Measured	Exemption
The antenna is				
☐ detachable				
The conducted output power (CP in watts) is measured at the antenna connector:				
$CP =$ **................ W**			☐	
The effective isotropic radiated power (EIRP in watts) is calculated using				
☐ the numerical antenna gain: $G =$ **................**		☐		
$EIRP = G \cdot CP \Rightarrow EIRP =$ **................ W**				
☐ the field strength[8] in V/m: $FS =$ **................ V/m**			☐	
$EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP =$ **................ W**				
☒ not detachable				
A field strength measurement is used to determine the effective isotropic radiated power (EIRP in watts) given by[8]:				
$EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP =$ **2.6 µW**				
with:				
Field strength in V/m: $FS =$ **2.92 mV/m**			☒	
Distance between the two antennas in m: $D =$ **3 m**			☒	
Selection of output power				
The output power TP is the higher of the conducted or effective isotropic radiated power (e.i.r.p.):				
$TP =$ **2.6 µW**				

[8] The conversion formula is valid only for properly matched antennas. In other cases the transmitter output power may have to be measured by a terminated measurement when applying the exemption clauses.
If an open area test site is used for field strength measurement, the effect due to the metal ground reflecting plane should be subtracted from the maximum field strength value in order to reference it to free space, before calculating TP.

Exposure of Humans to RF Fields (continued)	Applicable	Declared by applicant	Measured	Exemption
Separation distance between the user and the transmitting device is				
☐ less than or equal to 20 cm ☒ greater than 20 cm		☒		
Transmitting device is				
☐ in the vicinity of the human head ☐ body-worn		☒		
SAR evaluation				
SAR evaluation is required if the separation distance between the user and the device is less than or equal to 20 cm.				
☐ The device operates from 3 kHz up to 1 GHz inclusively and with output power (i.e. the higher of the conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 200 mW for general public use and 1000 mW for controlled use.				☐
☐;				
☐ The device operates above 1 GHz and up to 2.2 GHz inclusively and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 100 W for general public use and 500 W for controlled use.				☐
☐ The device operates above 2.2 GHz and up to 3 GHz inclusively and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 20 mW for general public use and 100 mW for controlled use.				☐
☐ The device operates above 3 GHz and up to 6 GHz inclusively and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 10 mW for general public use and 50 mW for controlled use.				☐
☐ SAR evaluation is documented in test report no.				
RF exposure evaluation				
RF exposure evaluation is required if the separation distance between the user and the device is greater than 20 cm.				
☒ The device operates below 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 2.5 W.				☒
☐ The device operates at or above 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 5 W.				☐
☐ RF exposure evaluation is documented in test report no.				

9 Referenced Regulations

All tests were performed with reference to the following regulations and standards:

☒	CFR 47 Part 2	Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC)	October 1, 2014
☒	CFR 47 Part 15	Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)	October 1, 2014
☒	ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz	December 11, 2003 (published on January 30, 2004)
☐	ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz	June 7, 2009 (published on September 15, 2009)
☒	RSS-Gen	Radio Standards Specification RSS-Gen Issue 3 containing General Requirements and Information for the Certification of Radiocommunication Equimpment, published by Industry Canada	December 2010
☒	RSS-210	Radio Standards Specification RSS-210 Issue 8 for Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, published by Industry Canada	December 2010
☐	RSS-310	Radio Standards Specification RSS-310 Issue 3 for Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category II Equipment, published by Industry Canada	December 2010
☒	RSS-102	Radio Standards Specification RSS-102 Issue 4: Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), published by Industry Canada	March 2010, footnote 13 updated December 2010
☐	ICES-003	Interference-Causing Equipment Standard ICES-003 Issue 5 (Information Technology Equipment (ITE) - Limits and methods of measurement), published by Industry Canada	August 2012
☒	CISPR 22	Third Edition of the International Special Committee on Radio Interference (CISPR), Pub. 22, “Information Technology Equipment – Radio Disturbance Characteristics – Limits and Methods of Measurement”	1997

☐	CAN/CSA CISPR 22-10	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement (Adopted IEC CISPR 22:2008, sixth edition, 2008-09)	2010
☒	TRC-43	Designation of Emissions, Class of Station and Nature of Service, published by Industry Canada	November 2012

10 Test Equipment List with Calibration Data

Type	*Inv.-No.*	*Type Designation*	*Serial Number*	*Manufacturer*	*Calibration Organization*	*Last Calibration*	*Next Calibration*
EMI test receiver	R&S	ESHS10	862970/001	Rohde & Schwarz	Rohde & Schwarz	10/2014	10/2015
EMI test receiver	2010	ESPI7	101018	Rohde & Schwarz	Rohde & Schwarz	06/2014	06/2015
EMI test receiver	R&S	ESU26	100504	Rohde & Schwarz	Rohde & Schwarz	07/2013	01/2015
Spectrum analyser	1666	FSP30	100063	Rohde & Schwarz	Rohde & Schwarz	05/2014	11/2015
V-network	1059	ESH3-Z5	894785/005	Rohde & Schwarz	Rohde & Schwarz	08/2013	08/2015
Loop antenna	1016	HFH2-Z2	882964/0001	Rohde & Schwarz	Rohde & Schwarz	11/2012	11/2014
TRILOG Broadband Antenna	2058	VULB 9163	9163-408	Schwarzbeck	Rohde & Schwarz	05/2014	05/2016
Multimeter	1653	21 III	76530546	Fluke	ZMK	11/2012	11/2014
Temperature test chamber	1271	HT 4010	07065550	Heraeus	TÜV SÜD PS-EMC-STR	06/2013	06/2015
DC power supply	1267	NGSM 32/10	203	Rohde & Schwarz		see note 4	

Note 1: No calibration required.
Note 2: Not calibrated separately but with the whole test system when recording calibration data.
Note 3: No calibration required. Devices are checked before use.
Note 4: No calibration required. Devices are checked by calibrated equipment during test.

11 Revision History

Revision History			
Edition	*Date*	*Issued by*	*Modifications*
1	2014-10-09	M. Steindl (cb)	First Edition
2	2015-02-02	M. Steindl	Added FCC- and IC-IDs; Added variants of the tested sample.
3	2015-02-04	M. Steindl	Type designation corrected.