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Prüfbericht / *Test Report* Nr. / *No.* TR-72654-07139-01 (Edition 2)

Applicant:	Siemens AG
Type of equipment:	RFID Reader, 13.56 MHz
Type designation:	SIMATIC RF380R
Order No.:	9702810776
Test standards:	FCC Code of Federal Regulations, CFR 47, Part 15, Sections 15.205, 15.207, 15.215 and 15.225 Industry Canada Radio Standards Specifications RSS-GEN Issue 4, Sections 8.8, 8.9 and 8.10 and RSS-210 Issue 9, Section B.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.

Bundesnetzagentur

BNetzA-CAB-16/21-15

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1 Description of the Equipment Under Test (EUT)

General data of EUT	
Type designation[1]:	SIMATIC RF380R
Parts[2]:	
Serial number(s):	VPJ4800941
Manufacturer:	Siemens AG Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany
Type of equipment:	RFID Reader, 13.56 MHz
Version (HW / SW):	As received (01 / V1.2)
FCC ID:	NXW-RF380R02
Industry Canada ID:	267X-RF380R02
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:	13.11 MHz - 14.01 MHz	
Frequency range:	13.553 MHz – 13.567 MHz	
Operating frequency:	13.56 MHz	
Type of modulation:	ASK	
Pulse train:	---	
Pulse width:	---	
Number of RF-channels:	1	
Channel spacing:	---	
Designation of emissions[3]:	260HA1D	
Type of antenna:	Integrated on printed board	
Size/length of antenna:	14 cm x 6 cm	
Connection of antenna:	☐ detachable	☒ not detachable
Type of power supply:	DC supply	
Specifications for power supply:	nominal voltage:	24 V
Type of AC power supply:	DC supply	
Specifications for power supply:	nominal voltage:	120 V
	nominal frequency:	60 Hz

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

2 Administrative Data

Application details	
Applicant (full address):	Siemens AG Gleiwitzer Str. 555 90475 Nürnberg Germany
Contact person:	Mr. Norbert Wluka
Order number:	9702810776
Receipt of EUT:	2017-05-16
Date(s) of test:	2017-05-16; 2017-06-21, 2017-06-22
Note(s):	

Report details	
Report number:	TR-72654-07139-01
Edition:	2
Issue date:	2017-08-29

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
Laboratory recognition:	Registration No. BNetzA-CAB-16/21-15
Industry Canada test site registration:	3050A-2
Contact person:	Mr. Markus Biberger 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, 15.215 and 15.225** of the Federal Communication Commission (FCC) and the **Radio Standards Specifications** **RSS-GEN Issue 4, Sections 8.8, 8.9 and 8.10 and** **RSS-210 Issue 9, Section , B.6 (Category I Equipment)** of Industry Canada (IC).

Die Prüfergebnisse beziehen sich ausschließlich auf das zur Prüfung vorgestellte Prüfmuster. Ohne schriftliche Genehmigung des Prüflabors darf der Prüfbericht auszugsweise nicht vervielfältigt werden. *The test results relate only to the individual item which has been tested. Without the written approval of the test laboratory this report may not be reproduced in extracts.*

Datum / *Date*	Geprüft von / *Tested by*	Freigabe durch / *Checked by*
2017-07-13	Steindl Martin Martin Steindl Responsible for testing	Markus Biberger Markus Biberger Reviewer

Prüfergebnis / *Test Result*
☒ **Erfüllt / *Passed***
☐ **Nicht erfüllt / *Not passed***

5 Operation Mode and Configuration of EUT

Operation Mode(s)
Reading tag continuously

Configuration(s) of EUT
The EUT was configured as stand alone device

List of ports and cables				
Port	*Description*	*Classification*[4]	*Cable type*	*Cable length*
1	DC 24 interface	dc power	Shielded	
2	Serial interface (with DC)	signal/control port	Shielded	

List of devices connected to EUT				
Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*
1	AC/DC adapter	LOGO! Power 24 V 1P6EP13332-1SH41	SF2P24666ii	Siemens

List of support devices				
Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*
1	Transponder tag			Siemens

[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 4, section 6.6 IC RSS-210 Issue 9, section A.1.3 ANSI C63.10, section 6.9.1
Guide:	ANSI C63.10 / IC RSS-Gen Issue 4, section 6.6
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).

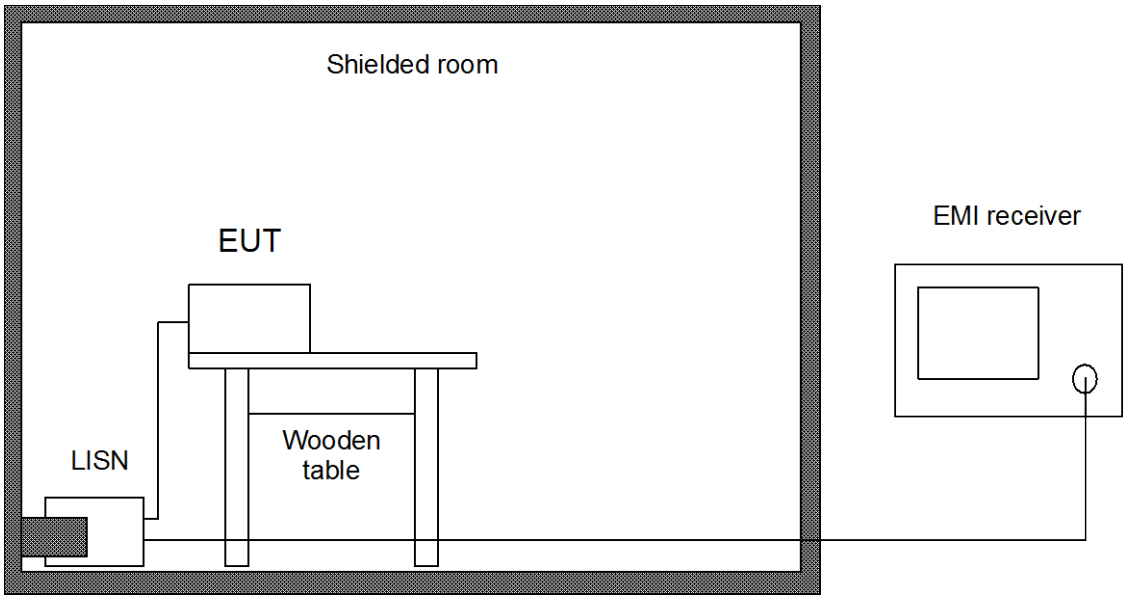
6.2 Conducted AC Powerline Emission

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.207 IC RSS-Gen Issue 4, section 8.8
Guide:	ANSI C63.10 / 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 C63.10, section 6.2.5, 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	ESCI3	1863	100008	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
☐	Microwave cable	FB293C1080005050	2157	72110-02	Rosenberger Micro-Coax
☐	Coax cable	RG214 N/N 5m	1188	---	Senton
☐	Shielded room	No. 1	1451	---	Albatross
☐	Shielded room	No. 4	1454	3FD 100 544	Euroshield
☒	Shielded room	No. 9	21083	---	Albatross
☒	Measurement Software	EMC32_K1 V9.26.01	2230	100281	Rohde & Schwarz

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 4, sections 8.9 and 8.10 and IC RSS-210 Issue 9, section B.6
Guide:	ANSI C63.10

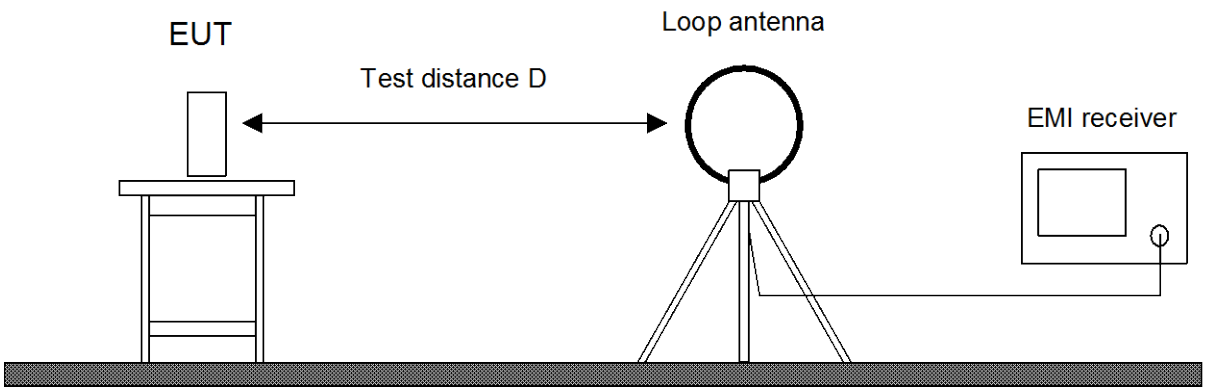
Radiated emission in the frequency range 9 kHz to 30 MHz is measured using an active loop antenna. First the whole spectrum of emission caused by the equipment is recorded at a distance of 3 meters in a fully or semi anechoic room with the detector of the spectrum analyzer or EMI receiver set to peak. 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	ESR7	22643	101713	Rohde & Schwarz
☐	EMI test receiver	ESW26	28268	101315	Rohde & Schwarz
☐	EMI test receiver	ESU8	2044	100232	Rohde & Schwarz
☒	Loop antenna	HFH2-Z2	1016	882964/1	Rohde & Schwarz
☐	Microwave cable Cabin no. 8	EF393	2053	---	Albatross Projects
☐	Microwave cable Cabin no. 8	FB293C1050005050	2054	63834-1	Rosenberger Micro-Coax
☒	Microwave cable Cabin no. 8	FB293C1080005050	2055	63833-1	Rosenberger Micro-Coax
☐	Microwave cable Cabin no. 8	LCF12-50	2057	P1.3.9	RFS
☐	Microwave cable Cabin no. 8	LCF12-50	2057	P1.4.12	RFS
☒	Microwave cable Cabin no. 8	LCF12-50	2057	P1.6.19	RFS
☐	Microwave cable Cabin no. 8	FA210AF040005050G	2127	72061-01	Rosenberger Micro-Coax
☐	Microwave cable Cabin no. 8	FA210AF04000505G	2056	64567-01	Rosenberger Micro-Coax
☒	Microwave cable Cabin no. 8	FA210AF04000505	2068	64610-1	Rosenberger Micro-Coax
☒	Semi anechoic room	No. 8	2057	---	Albatross
☒	Measurement Software	EMC32_K8 V9.25.01	1852	100016	Rohde & Schwarz
☐	Measurement Software	EMC32_K8 V10.20.01	1852	100016	Rohde & Schwarz

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 4, sections 8.9 and 8.10(b)(c) and IC RSS-210 Issue 9, section B.6
Guide:	ANSI C63.10

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 respectively ANSI C63.10 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.

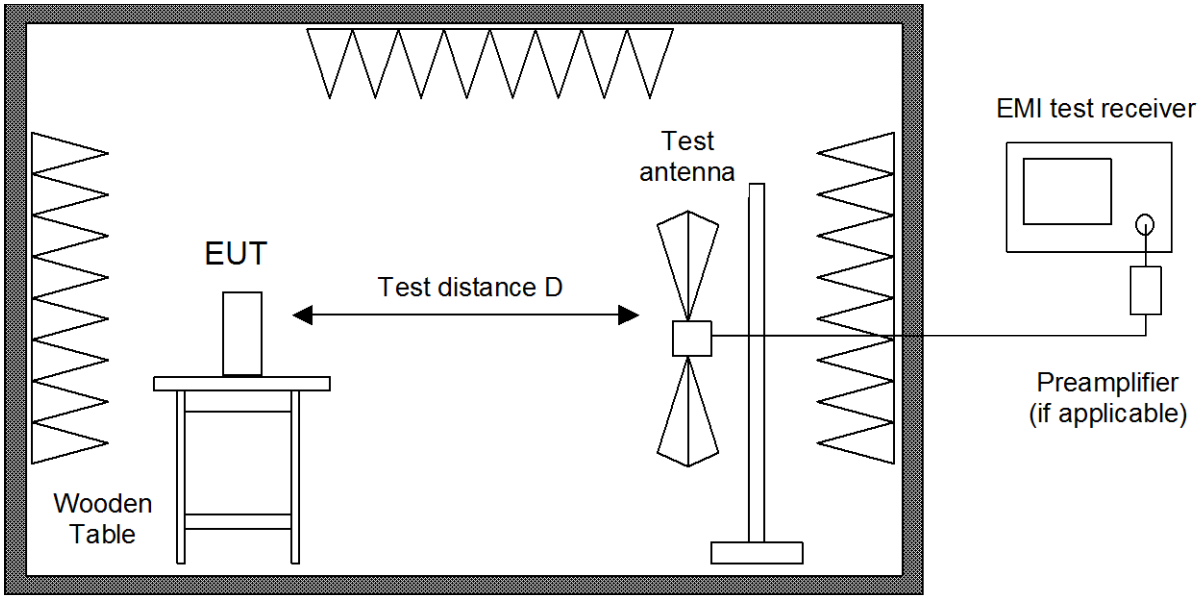
If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete 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	ESR7	22643	101713	Rohde & Schwarz
☐	EMI test receiver	ESW26	28268	101315	Rohde & Schwarz
☒	Trilog antenna Cabin no. 8	VULB 9163	2058	9163-408	Schwarzbeck
☒	Microwave cable Cabin no. 8	EF393	2053	---	Albatross Projects
☐	Microwave cable Cabin no. 8	LCF12-50	2057	P1.6.19	RFS
☒	Microwave cable Cabin no. 8	LCF12-50	2057	P1.3.9	RFS
☐	Microwave cable Cabin no. 8	FA210AF04000505	2068	64610-1	Rosenberger Micro-Coax
☒	Microwave cable Cabin no. 8	FA210AF040005050G	2127	72061-01	Rosenberger Micro-Coax
☒	Semi anechoic room	No. 8	2057	---	Albatross
☒	Measurement Software	EMC32_K8 V9.25.00	1852	100016	Rohde & Schwarz
☐	Measurement Software	EMC32_K8 V10.20.01	1852	100016	Rohde & Schwarz

6.5 Carrier Frequency Stability

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.225(e) IC RSS-Gen Issue 4, section 6.11 and IC RSS-210 Issue 9, section B.6
Guide:	ANSI C63.10

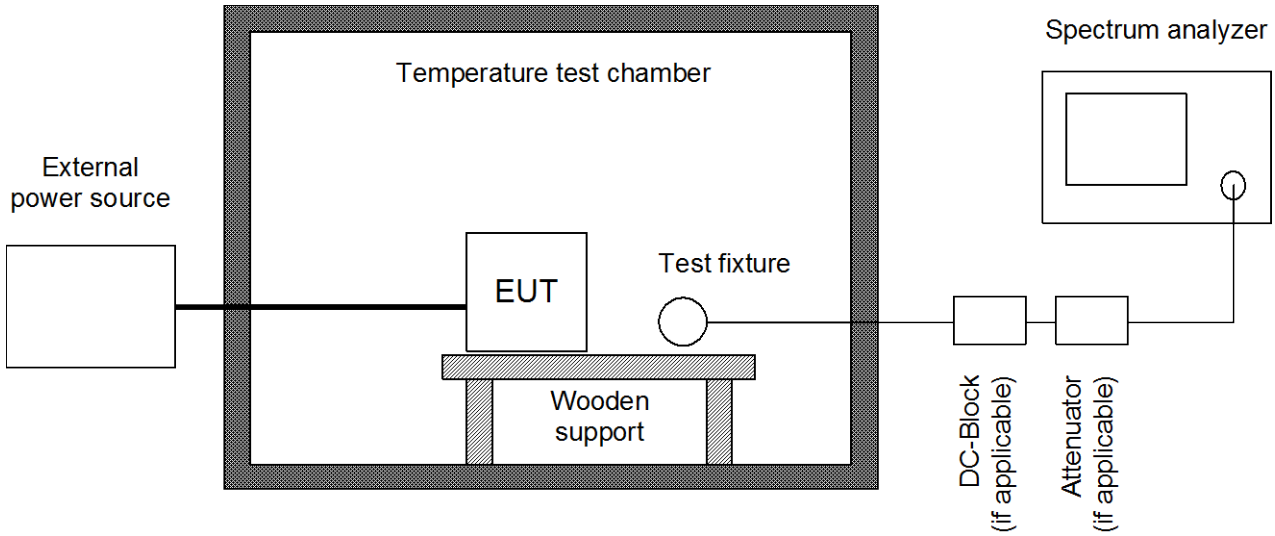
The frequency tolerance of the carrier signal is measured over a temperature variation of -20 °C to +50 °C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 °C.

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 or 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.

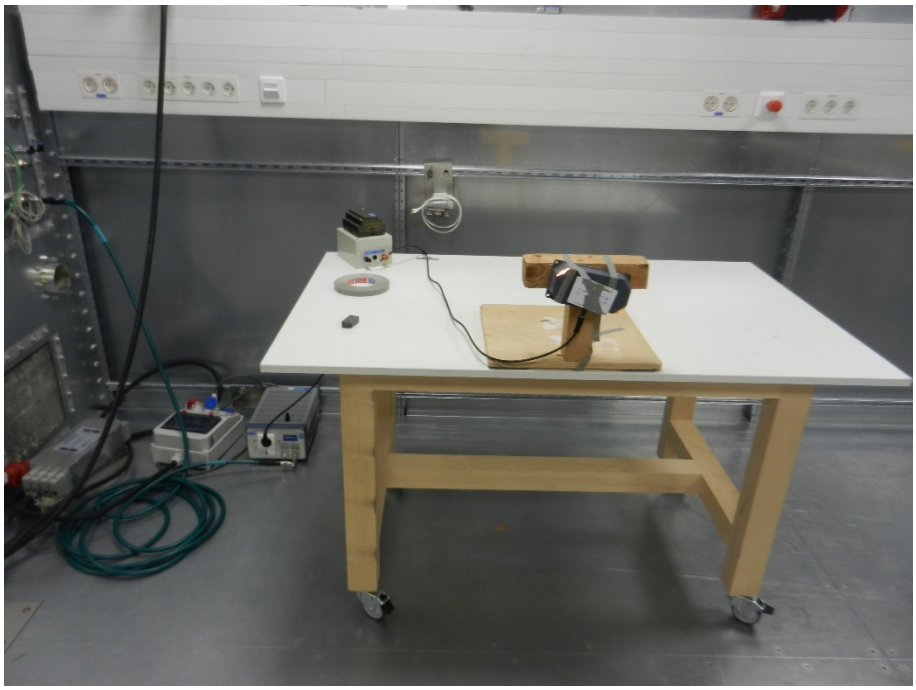


Test instruments used:

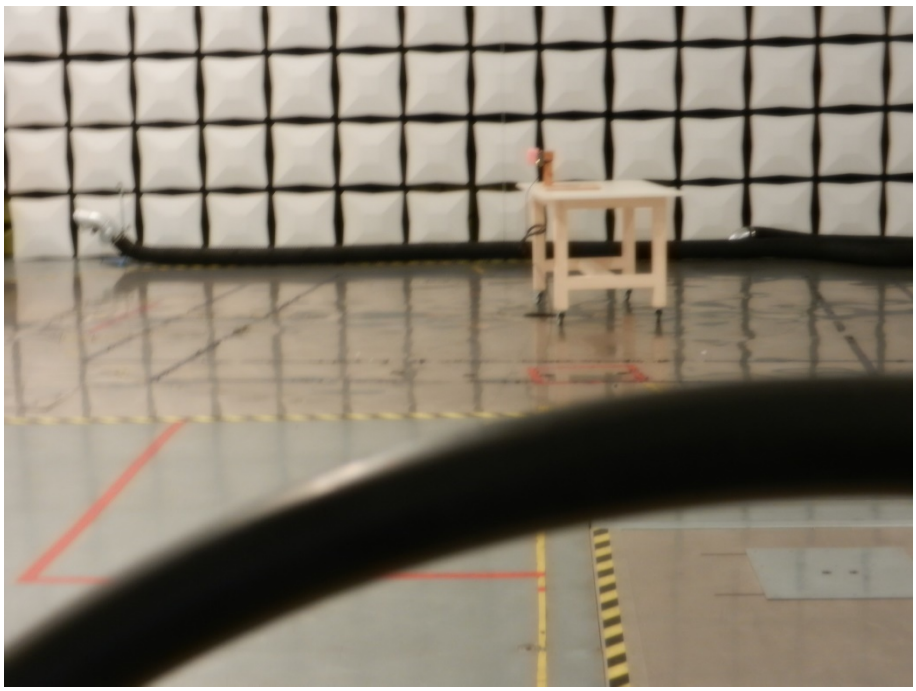
	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☐	Spectrum analyzer	FSP30	1666	100036	Rohde & Schwarz
☒	Spectrum analyzer	FSV40	2364	101448	Rohde & Schwarz
☐	EMI test receiver	ESPI7	1711	836914/0002	Rohde & Schwarz
☐	DC-block	7006	1636	A2798	Weinschel
☐	Attenuator	4776-10	1638	9412	Narda
☐	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
☒	Multimeter	U1252B	2252	MY53100196	Agilent
☒	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
☒	Climatic test chamber	PL-2J	2408	15001626	ESPEC

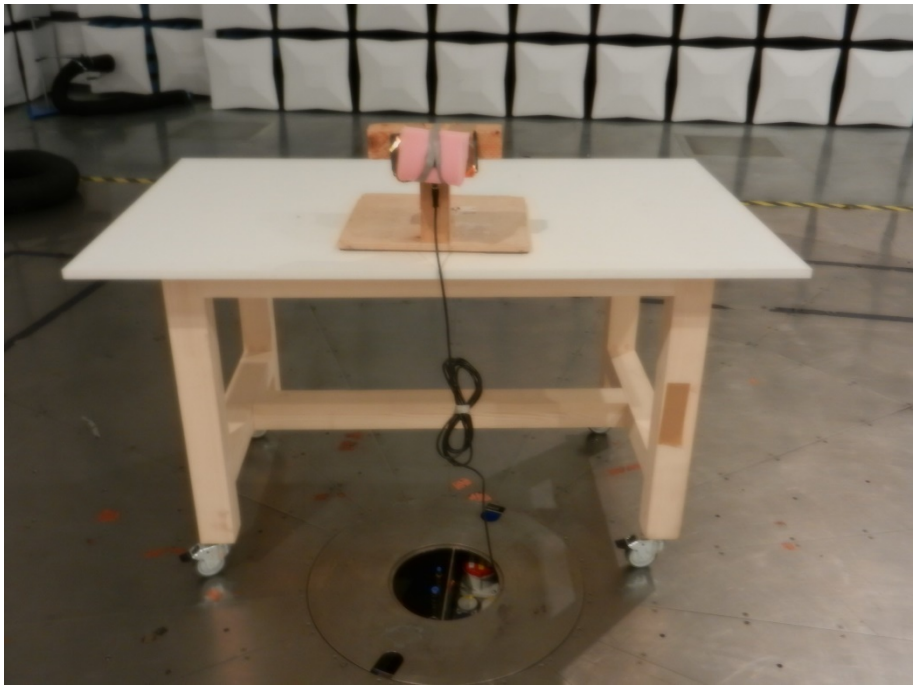
7 Photographs Taken During Testing

Test setup for conducted AC powerline emission measurement

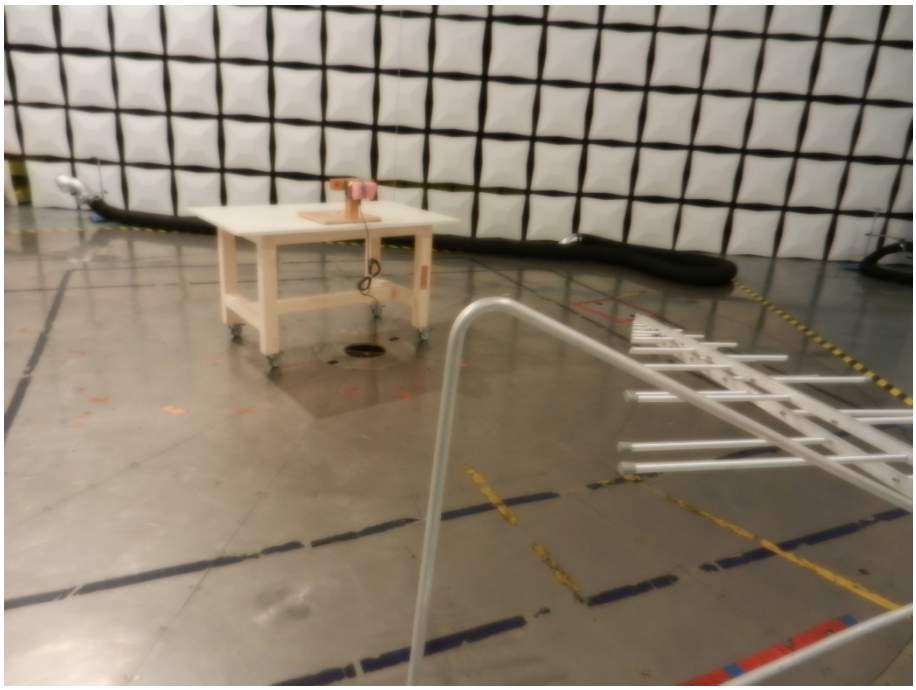


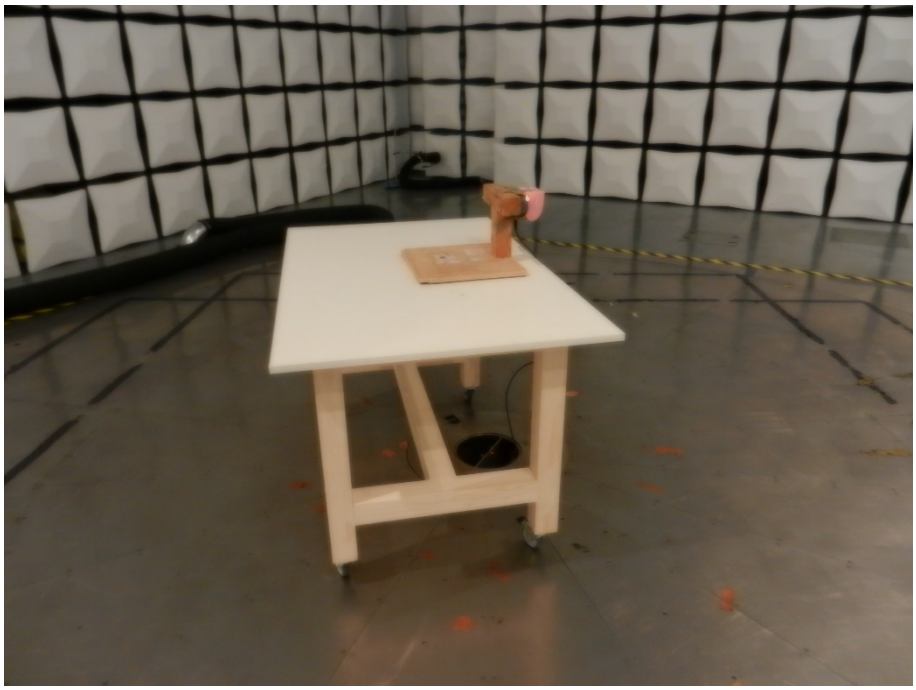
Test setup for radiated emission measurement 9 kHz – 30 MHz



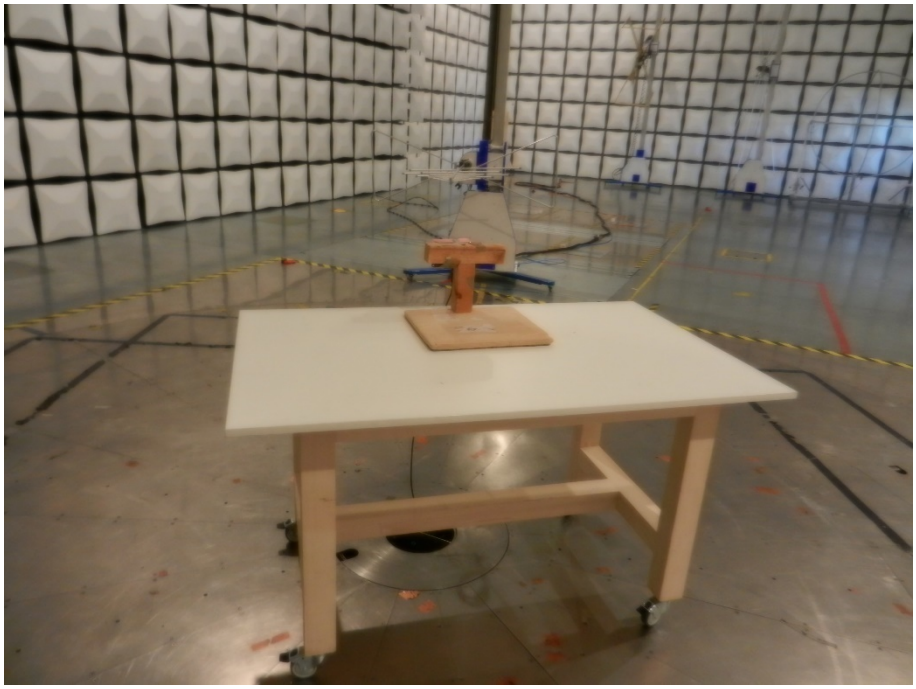


Test setup for radiated emission measurement (alternate test site)





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	25	Recorded
15.215(c)	Bandwidth of the emission	29	Test passed
2.201, 2.202	Class of emission	31	Calculated
15.35(c)	Pulse train measurement for pulsed operation	---	Not applicable
15.205(a) 15.205(d)(7)	Restricted bands of operation	---[5]	Test passed
15.207	Conducted AC powerline emission 150 kHz to 30 MHz	32	Test passed
15.225(a)-(d)	Spectrum Mask	40	Test passed
15.205(b) 15.215(b) 15.225(a)(d)	Radiated emission 9 kHz to 30 MHz	42	Test passed
15.205(b) 15.225(d)	Radiated emission 30 MHz to 1 GHz	44	Test passed
15.225(e)	Carrier frequency stability	46	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 4			
Section(s)	*Test*	*Page*	*Result*
6.12	Transmitter output power (conducted)	---	Not applicable
6.6	Occupied Bandwidth	25	Recorded
9	Designation of emissions	31	Calculated
6.10	Pulsed operation	---	Not applicable
8.10	Restricted bands and unwanted emission frequencies	---[6]	Test passed
6.4, 6.13, 8.9	Unwanted emissions 9 kHz to 30 MHz	42	Test passed
6.4, 6.13, 8.9	Unwanted emissions 30 MHz to 1 GHz	44	Test passed
8.8	Transmitter AC power lines conducted emissions 150 kHz to 30 MHz	32	Test passed
3.2	Exposure of Humans to RF Fields	49	Exempted from SAR and RF eval-uation

IC RSS-210 Issue 9			
Section(s)	*Test*	*Page*	*Result*
B.6	Spectrum Mask	40	Test passed
B.6	Unwanted emissions 9 kHz to 30 MHz	42	Test passed
B.6	Unwanted emissions 30 MHz to 1 GHz	44	Test passed
B.6	Carrier frequency stability	46	Test passed

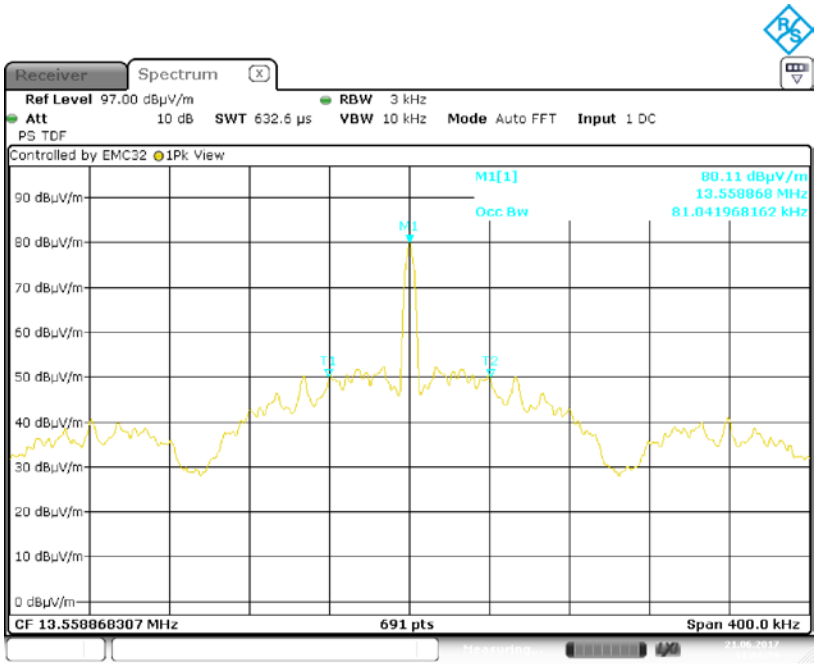
[6] See "Spectrum Mask" and "Unwanted emissions".

8.1 Occupied Bandwidth

Rules and specifications:	CFR 47 Part 2, section 2.202(a) ANSI C63.10, section 6.9.1
Guide:	ANSI C63.10
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 C63.10, section 6.9.1; is measured as the frequency range defined by the points that are 20 dB down relative to the maximum level of the modulated carrier. The span range of the spectrum analysator display shall be between two times and five times of the occupied bandwidth. The resolution bandwidth of the spectrum analyzer should be approximately 1 % to 5 % of the occupied bandwidth, unless otherwise specified, depending on the applicable requirement. The video bandwidth shall be at least three times greater than the resolution bandwidth. The dynamic range of the spectrum analyzator at the selected resolution bandwidth shall be more than 10 dB below the target “dB down” (attenuation) requirement.
Measurement procedure:	Bandwidth Measurements (6.1)

Comment:	
Date of test:	2017-06-21
Test site:	Fully anechoic room, cabin no. 8

Occupied Bandwidth (99 %):



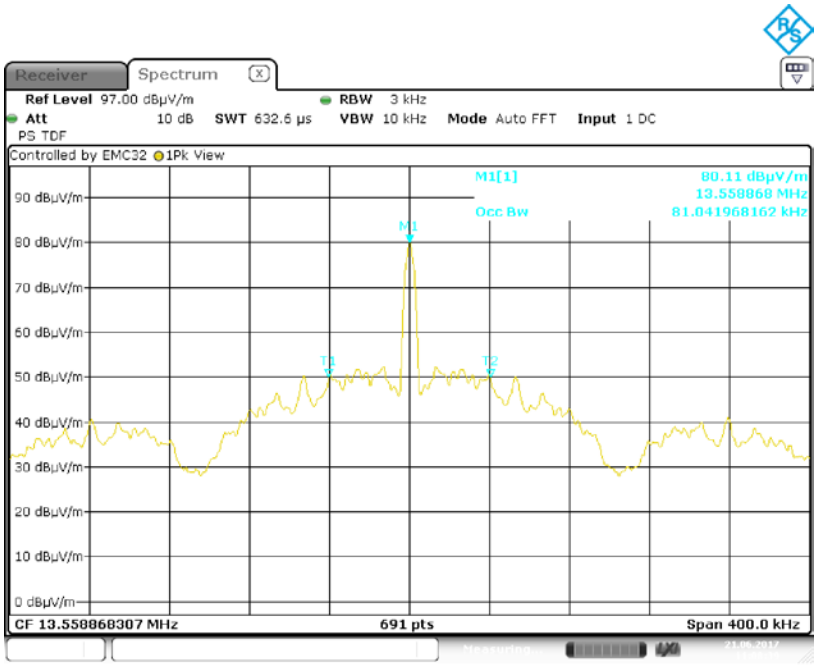
Occupied Bandwidth (99 %):	**81.041 kHz**

Occupied Bandwidth (continued)

Rules and specifications:	IC RSS-Gen Issue 4, section 6.6
Guide:	IC RSS-Gen Issue 4, section 6.6
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:	2017-06-21
Test site:	Fully anechoic room, cabin no. 8

Occupied Bandwidth (99 %):

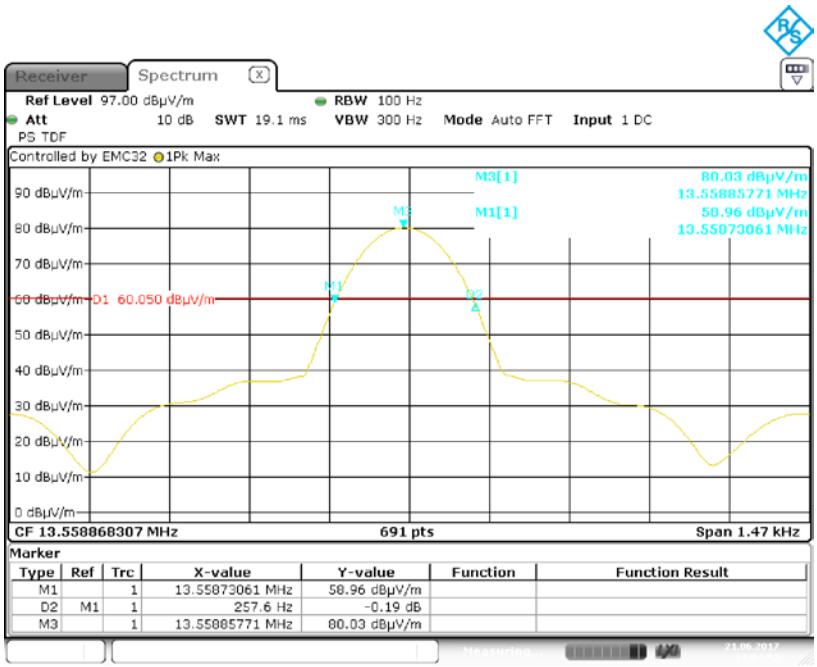


Occupied Bandwidth (99 %):	**81.041 kHz**

8.2 Bandwidth of the Emission

Rules and specifications:	CFR 47 Part 15, section 15.215(c)
Guide:	ANSI C63.10
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 span range of the spectrum analysator display shall be between two times and five times of the occupied bandwidth. The resolution bandwidth of the spectrum analyzer should be approximately 1 % to 5 % of the occupied bandwidth, unless otherwise specified, depending on the applicable requirement. The video bandwidth shall be at least three times greater than the resolution bandwidth. The dynamic range of the spectrum analyzator at the selected resolution bandwidth shall be more than 10 dB below the target “dB down” (attenuation) requirement.
	The video bandwidth shall be at least three times greater than the resolution bandwidth.
Measurement procedure:	Bandwidth Measurements (6.1)

Comment:	
Date of test:	2017-06-21
Test site:	Fully anechoic room, cabin no. 8



Permitted frequency band:	**13.11 MHz - 14.01** MHz	
20 dB bandwidth:	**257.6 Hz**	
Carrier frequency stability: Maximum frequency tolerances:	☒ **specified** **+37 Hz** **- 64 Hz**	☐ **not specified**
Bandwidth of the emission:	**358.6 Hz**	**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 4, section 9
Guide:	ANSI C63.10 / TRC-43

Type of modulation:	Amplitude Modulation

B_n = Necessary Bandwidth B = Modulation rate K = Overall numerical factor	$B_n = 2BK$ B = 130 Hz K = 1
Calculation:	$B_n = 2 \cdot (130\ Hz) \cdot 1 = 260\ Hz$

Designation of Emissions:	**260HA1D**

8.4 Conducted Powerline Emission Measurement 150 kHz to 30 MHz

Rules and specifications:	CFR 47 Part 15, section 15.207 IC RSS-GEN Issue 4, section 8.8		
Guide:	ANSI C63.10 / CISPR 22		
Limit:	Frequency of Emission (MHz)	Conducted Limit (dBµV)	
		Quasi-peak	Average
	0.15 - 0.5	66 to 56	56 to 46
	0.5 - 5	56	46
	5 - 30	60	50
Measurement procedure:	Conducted AC Powerline Emission (6.2)		

Test Result:	Test passed

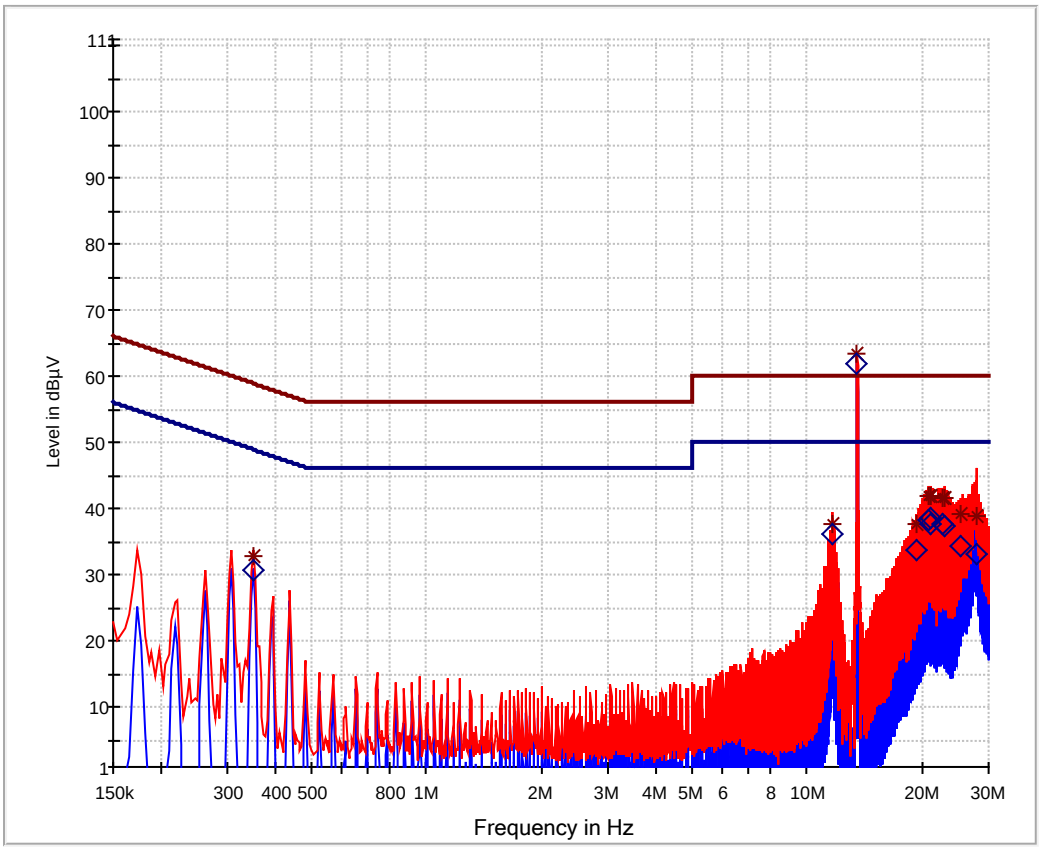
Sample calculation of final values:

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

Comment:	EUT Reading tag continuosuly
Date of test:	2017-06-22
Test site:	Shielded room, cabin no. 9

Test Result:	Test passed - Carrier excluded

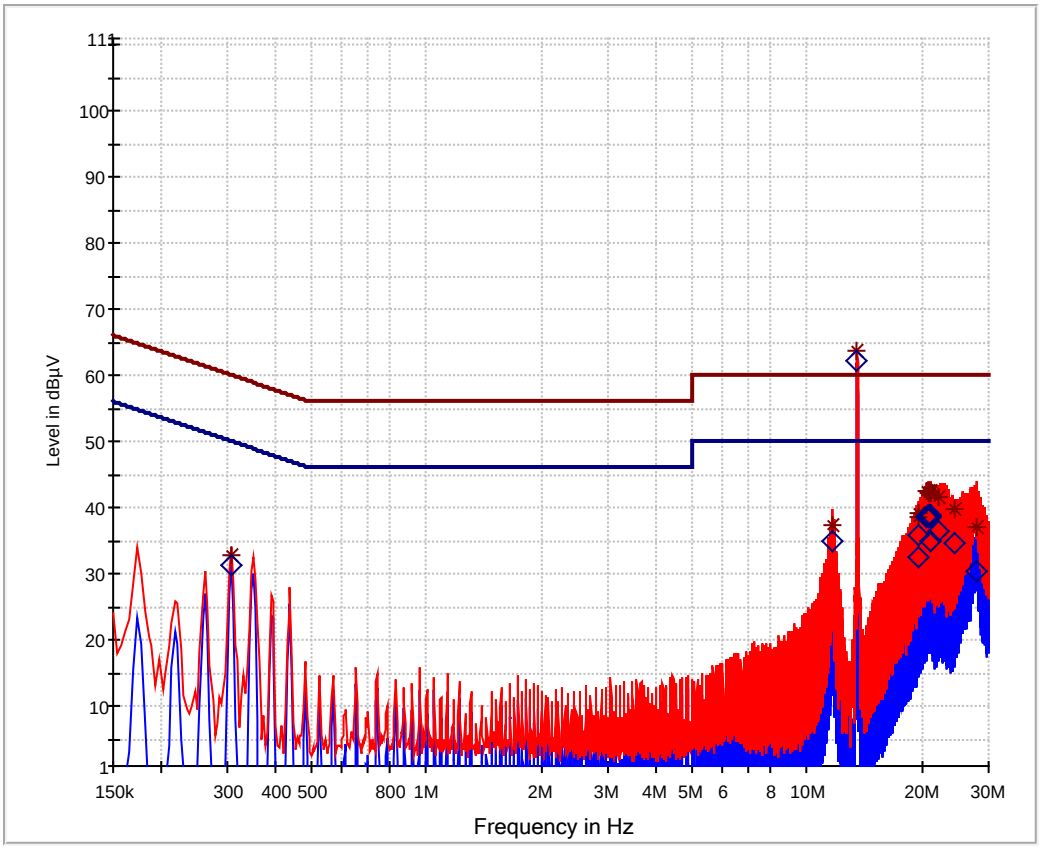
Tested on:	L1



Frequency MHz	QuasiPeak dBµV	CAverage dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Corr. dB
0.350		30.6	49.0	18.3	1000	9	0.0
0.350	32.7		59.0	26.3	1000	9	0.0
11.678		36.2	50.0	13.8	1000	9	0.1
11.678	37.8		60.0	22.2	1000	9	0.1
13.558		61.9	50.0	-11.9	1000	9	0.2
13.558	63.4		60.0	-3.4	1000	9	0.2
19.482		33.7	50.0	16.3	1000	9	0.3
19.482	37.8		60.0	22.2	1000	9	0.3
20.870		38.2	50.0	11.8	1000	9	0.2

Frequency MHz	*QuasiPeak dBµV*	*CAverage dBµV*	*Limit dBµV*	*Margin dB*	*Meas. Time ms*	*Bandwidth kHz*	*Corr. dB*
20.870	41.9		60.0	18.1	1000	9	0.2
21.046		38.6	50.0	11.4	1000	9	0.2
21.046	41.9		60.0	18.2	1000	9	0.2
21.218		37.8	50.0	12.2	1000	9	0.2
21.218	41.8		60.0	18.2	1000	9	0.2
22.614		37.8	50.0	12.2	1000	9	0.2
22.614	41.6		60.0	18.4	1000	9	0.2
22.874		37.4	50.0	12.6	1000	9	0.2
22.874	41.6		60.0	18.4	1000	9	0.2
25.226		34.4	50.0	15.6	1000	9	0.3
25.226	39.2		60.0	20.8	1000	9	0.3
27.762		33.0	50.0	17.0	1000	9	0.4
27.762	39.0		60.0	21.0	1000	9	0.4

Tested on:	N



Preview Result 2-AVG
FCC 15.207 AV
Preview Result 1-PK+
Final_Result QPK
FCC 15.207 QP
Final_Result CAV

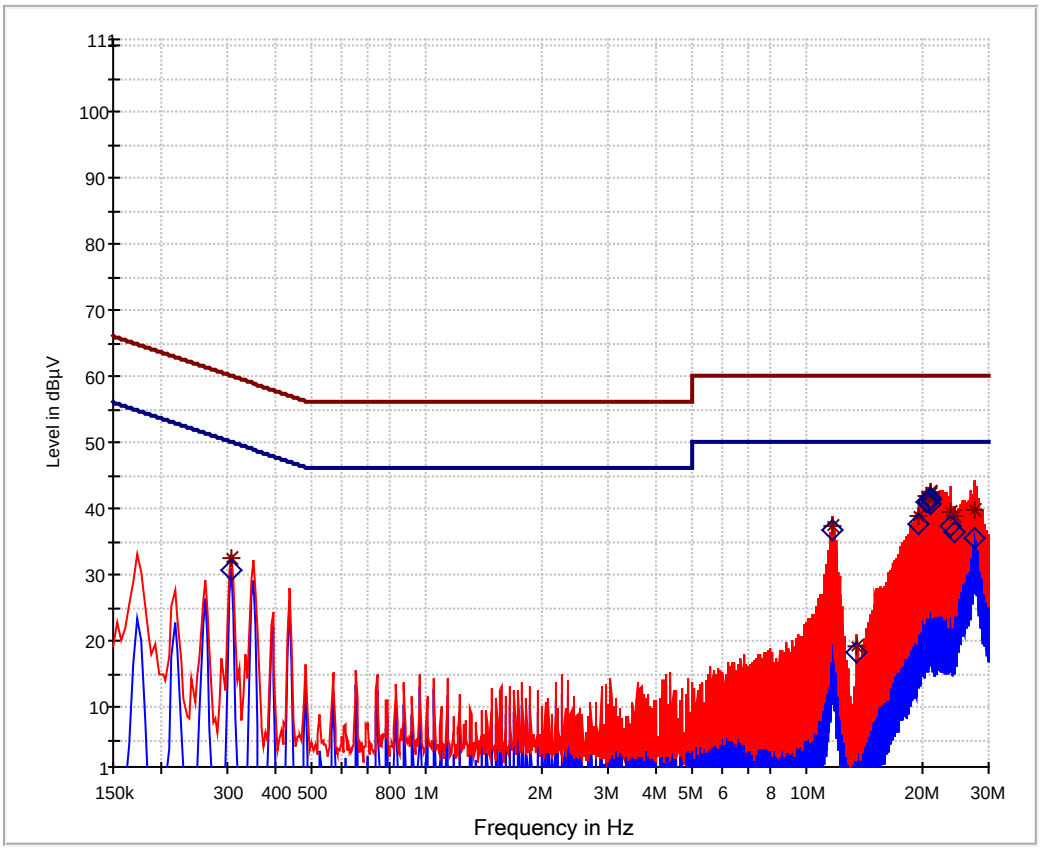
Frequency MHz	*QuasiPeak dBµV*	*CAverage dBµV*	*Limit dBµV*	*Margin dB*	*Meas. Time ms*	*Bandwidth kHz*	*Corr. dB*
0.306		31.3	50.1	18.8	1000	9	0.0
0.306	32.8		60.1	27.3	1000	9	0.0
11.678		34.9	50.0	15.1	1000	9	0.1
11.678	37.4		60.0	22.7	1000	9	0.1
13.558		62.1	50.0	-12.1	1000	9	0.2
13.558	63.6		60.0	-3.6	1000	9	0.2
19.554		32.5	50.0	17.6	1000	9	0.3
19.554	38.7		60.0	21.3	1000	9	0.3
19.558		35.8	50.0	14.2	1000	9	0.3
19.558	39.1		60.0	21.0	1000	9	0.3
20.690		38.5	50.0	11.5	1000	9	0.2
20.690	42.4		60.0	17.6	1000	9	0.2
20.778		38.9	50.0	11.1	1000	9	0.2
20.778	42.5		60.0	17.5	1000	9	0.2
20.782		38.7	50.0	11.3	1000	9	0.2
20.782	42.4		60.0	17.6	1000	9	0.2
21.034		35.0	50.0	15.0	1000	9	0.2
21.034	42.1		60.0	17.9	1000	9	0.2
21.126		38.9	50.0	11.1	1000	9	0.2

Frequency MHz	*QuasiPeak dBµV*	*CAverage dBµV*	*Limit dBµV*	*Margin dB*	*Meas. Time ms*	*Bandwidth kHz*	*Corr. dB*
21.126	42.7		60.0	17.4	1000	9	0.2
21.218		38.5	50.0	11.6	1000	9	0.2
21.218	42.3		60.0	17.7	1000	9	0.2
22.082		36.4	50.0	13.6	1000	9	0.2
22.082	41.6		60.0	18.4	1000	9	0.2
24.522		34.7	50.0	15.3	1000	9	0.3
24.522	39.7		60.0	20.3	1000	9	0.3
27.762		30.3	50.0	19.7	1000	9	0.4
27.762	36.9		60.0	23.1	1000	9	0.4

Comment:	EUT Reading tag continuosuly; Antenna port terminated with 50 Ω
Date of test:	2017-06-22
Test site:	Shielded room, cabin no. 9

Test Result:	Test passed

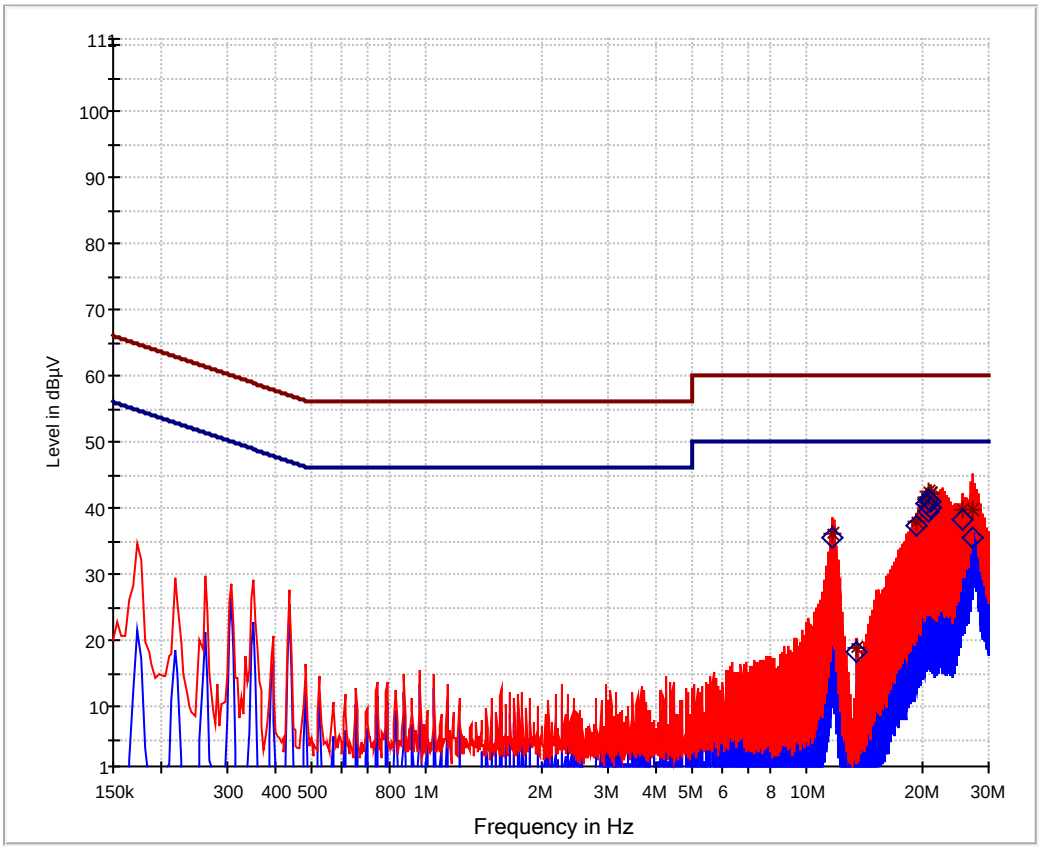
Tested on:	L1



Frequency MHz	*QuasiPeak dBµV*	*CAverage dBµV*	*Limit dBµV*	*Margin dB*	*Meas. Time ms*	*Bandwidth kHz*	*Corr. dB*
0.300		30.8	50.1	19.3	1000	9	0.0
0.306	32.4		60.1	27.7	1000	9	0.0
11.722		36.6	50.0	13.4	1000	9	0.1
11.722	37.4		60.0	22.7	1000	9	0.1
13.558		18.3	50.0	31.8	1000	9	0.2
13.558	19.2		60.0	40.8	1000	9	0.2
19.566		37.8	50.0	12.2	1000	9	0.3
19.566	38.7		60.0	21.3	1000	9	0.3
20.610		40.9	50.0	9.1	1000	9	0.2

Frequency MHz	QuasiPeak dBµV	CAverage dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Corr. dB
20.610	41.8		60.0	18.2	1000	9	0.2
20.786		40.9	50.0	9.1	1000	9	0.2
20.786	42.1		60.0	18.0	1000	9	0.2
21.046		41.5	50.0	8.5	1000	9	0.2
21.046	42.5		60.0	17.6	1000	9	0.2
21.134		41.3	50.0	8.7	1000	9	0.2
21.134	42.4		60.0	17.6	1000	9	0.2
21.222		40.6	50.0	9.4	1000	9	0.2
21.222	42.1		60.0	17.9	1000	9	0.2
23.750		37.4	50.0	12.7	1000	9	0.2
23.750	39.6		60.0	20.4	1000	9	0.2
24.534		36.6	50.0	13.4	1000	9	0.3
24.534	38.8		60.0	21.2	1000	9	0.3
27.494		35.4	50.0	14.6	1000	9	0.4
27.494	39.8		60.0	20.2	1000	9	0.4

Tested on:	N



Preview Result 2-AVG
FCC 15.207 AV
Preview Result 1-PK+
Final_Result QPK
FCC 15.207 QP
Final_Result CAV

Frequency MHz	QuasiPeak dBµV	CAverage dBµV	Limit dBµV	Margin dB	Meas. Time ms	Bandwidth kHz	Corr. dB

Frequency MHz	*QuasiPeak dBµV*	*CAverage dBµV*	*Limit dBµV*	*Margin dB*	*Meas. Time ms*	*Bandwidth kHz*	*Corr. dB*
11.678		35.6	50.0	14.4	1000	9	0.1
11.678	36.2		60.0	23.8	1000	9	0.1
13.558		18.3	50.0	31.8	1000	9	0.2
13.558	19.0		60.0	41.0	1000	9	0.2
19.390		37.3	50.0	12.7	1000	9	0.3
19.390	38.1		60.0	21.9	1000	9	0.3
20.522		40.8	50.0	9.2	1000	9	0.2
20.522	41.6		60.0	18.4	1000	9	0.2
20.610		40.7	50.0	9.3	1000	9	0.2
20.610	41.7		60.0	18.3	1000	9	0.2
20.786		39.4	50.0	10.6	1000	9	0.2
20.786	41.7		60.0	18.3	1000	9	0.2
20.958		41.4	50.0	8.6	1000	9	0.2
20.958	42.4		60.0	17.6	1000	9	0.2
21.042		40.0	50.0	10.0	1000	9	0.2
21.042	42.1		60.0	17.9	1000	9	0.2
21.046		40.9	50.0	9.1	1000	9	0.2
21.046	42.3		60.0	17.7	1000	9	0.2
21.134		40.2	50.0	9.8	1000	9	0.2
21.134	42.1		60.0	17.9	1000	9	0.2
25.750		38.2	50.0	11.8	1000	9	0.3
25.750	39.9		60.0	20.1	1000	9	0.3
27.146		35.6	50.0	14.4	1000	9	0.4
27.146	39.7		60.0	20.3	1000	9	0.4

8.5 Spectrum Mask

Rules and specifications:	CFR 47 Part 15, section 15.225(a)-(d) IC RSS-210 Issue 9, section B.6
Guide:	ANSI C63.10
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. General fieldstrength limit according to RSS-GEN is applicable outside the band 13.110 MHz – 14.010 MHz. See Radiated Emission Measurement 9 kHz to 30 MHz (8.6) for details.

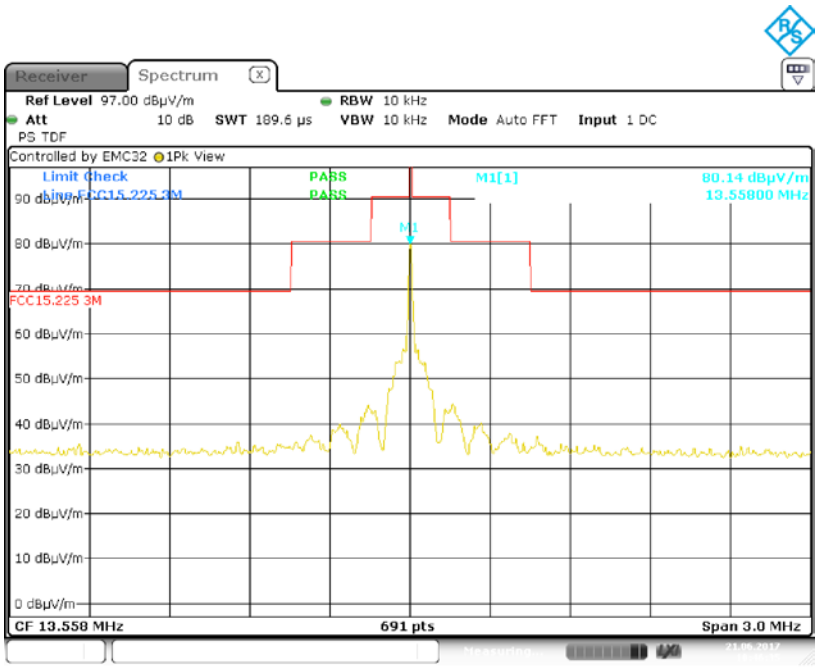
Limit:

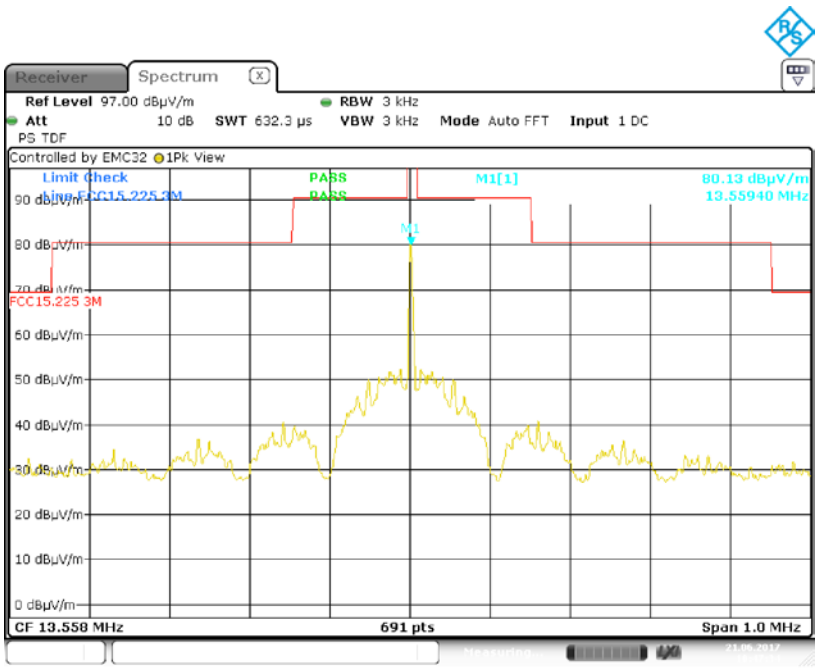
Frequency of Emission (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)	Measurement Distance d (meters)
1.705 - 13.110	30	29.5	30
13.110 - 13.410	106	40.5	30
13.410 - 13.553	334	50.5	30
13.553 - 13.567	15848	84.0	30
13.567 - 13.710	334	50.5	30
13.710 - 14.010	106	40.5	30
14.010 - 30.000	30	29.5	30

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

Comment: Date of test: Test site:	 2017-06-21 Fully anechoic room, cabin no.8
Test distance:	3 meters
Extrapolation Factor:	40 dB/decade

Test Result:	Test passed


Receiver
Spectrum
Ref Level 97.00 dBµV/m
RBW 10 kHz
Att 10 dB
SWT 189.6 µs
VBW 10 kHz
Mode Auto FFT
Input 1 DC
PS TDF
Controlled by EMC32
1Pk View
Limit Check
PASS
M1[1]
80.14 dBµV/m
13.55800 MHz
Line FCC15.225 3M
90 dBµV/m
80 dBµV/m
FCC15.225 3M
60 dBµV/m
50 dBµV/m
40 dBµV/m
30 dBµV/m
20 dBµV/m
10 dBµV/m
0 dBµV/m
CF 13.558 MHz
691 pts
Span 3.0 MHz


Receiver
Spectrum
Ref Level 97.00 dBµV/m
RBW 3 kHz
Att 10 dB
SWT 632.3 µs
VBW 3 kHz
Mode Auto FFT
Input 1 DC
PS TDF
Controlled by EMC32
1Pk View
Limit Check
PASS
M1[1]
80.13 dBµV/m
13.55940 MHz
Line FCC15.225 3M
90 dBµV/m
80 dBµV/m
FCC15.225 3M
60 dBµV/m
50 dBµV/m
40 dBµV/m
30 dBµV/m
20 dBµV/m
10 dBµV/m
0 dBµV/m
CF 13.558 MHz
691 pts
Span 1.0 MHz

8.6 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 4, sections 8.9 and 8.10(b)(c) and IC RSS-210 Issue 9, section B.6			
Guide:	ANSI C63.10			
Limit:	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:	
Date of test:	2017-05-16
Test site:	Semi-anechoic room, cabin no. 8

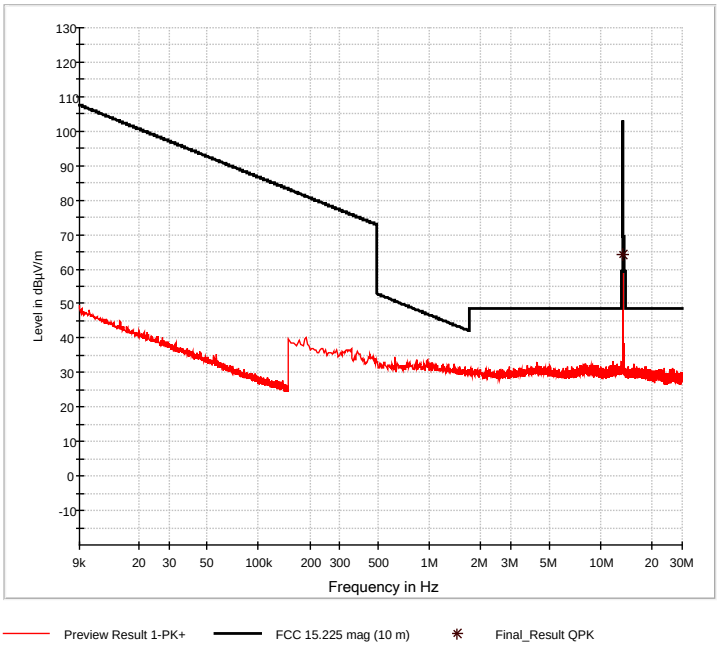
Test Result:	Test passed

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.



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)
13.56000	Quasi-Peak	10	30	44.1	20.0	-19.1		45.0	84.0	**39.0**

8.7 Radiated Emission Measurement 30 MHz to 1 GHz

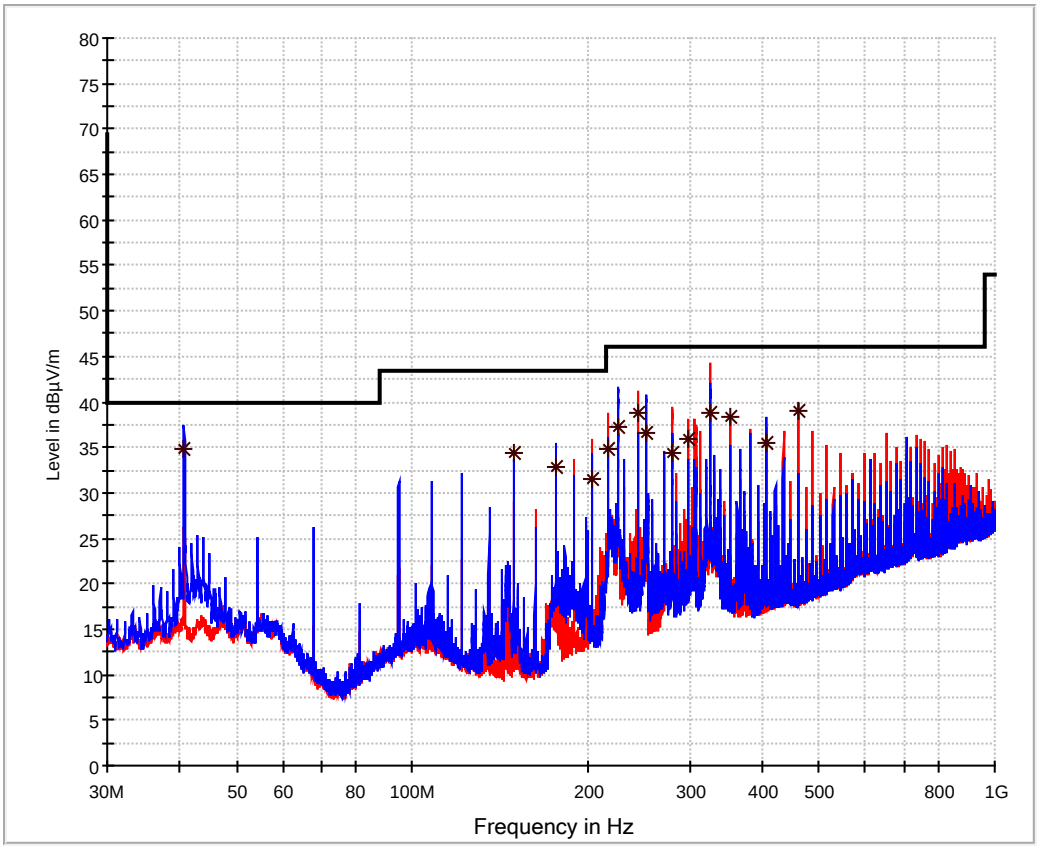
Rules and specifications:	CFR 47 Part 15, sections 15.205(b) and 15.225(d) IC RSS-GEN Issue 4, sections 8.9 and 8.10(b)(c) and IC RSS-210 Issue 9, section B.6		
Guide:	ANSI C63.10		
Limit:	Frequency of Emission (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)
	30 - 88	100	40.0
	88 - 216	150	43.5
	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:	
Date of test:	2017-05-16
Test site:	Frequencies ≤ 1 GHz: Semi-anechoic room, cabin no. 8 Frequencies > 1 GHz: Fully anechoic room, cabin no. 2
Test distance:	Frequencies ≤ 8.2 GHz: 3 meters Frequencies > 8.2 GHz: 1 meter

Test Result:	Test passed

Sample calculation of final values:

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



Preview Result 1H-PK+ Final_Result QPK
Preview Result 1V-PK+ Final_Result AVG
FCC 15.209_3m

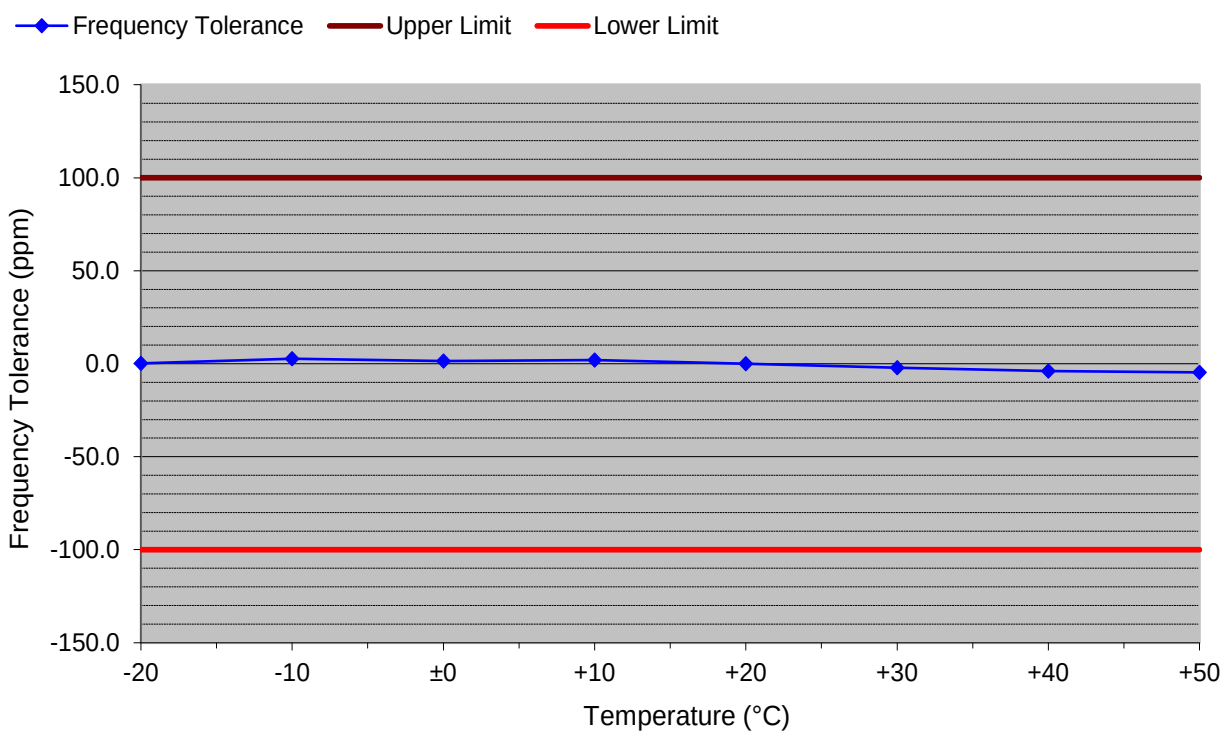
Frequency MHz	QuasiPeak dBµV/m	Limit dBµV/m	Margin dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg	Corr. dB
40.680	34.8	40.0	5.2	1000	120	100	V	-138	15.5
149.135	34.5	43.5	9.1	1000	120	105	V	158	10.0
176.275	32.8	43.5	10.7	1000	120	103	V	-171	10.9
203.375	31.5	43.5	12.0	1000	120	147	H	54	12.1
216.935	34.8	46.0	11.2	1000	120	150	H	62	12.6
225.655	37.3	46.0	8.8	1000	120	103	V	-65	13.1
244.050	38.7	46.0	7.3	1000	120	111	H	-84	13.9
252.685	36.6	46.0	9.4	1000	120	226	V	-63	14.1
279.505	34.5	46.0	11.6	1000	120	103	H	-98	14.6
298.290	36.0	46.0	10.1	1000	120	103	H	87	14.9
325.410	38.8	46.0	7.2	1000	120	106	H	-112	15.6
352.530	38.5	46.0	7.6	1000	120	103	H	109	16.6
406.770	35.4	46.0	10.6	1000	120	207	V	183	17.5
461.010	39.0	46.0	7.0	1000	120	146	H	-8	18.1

8.8 Carrier Frequency Stability

Rules and specifications:	CFR 47 Part 15, section 15.225(e) IC RSS-Gen Issue 4, section 8.11 and IC RSS-210 Issue 9, section B.6
Guide:	ANSI C63.10
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: Date of test:	 2017-06-22

8.8.1 Carrier Frequency Stability vs. Temperature

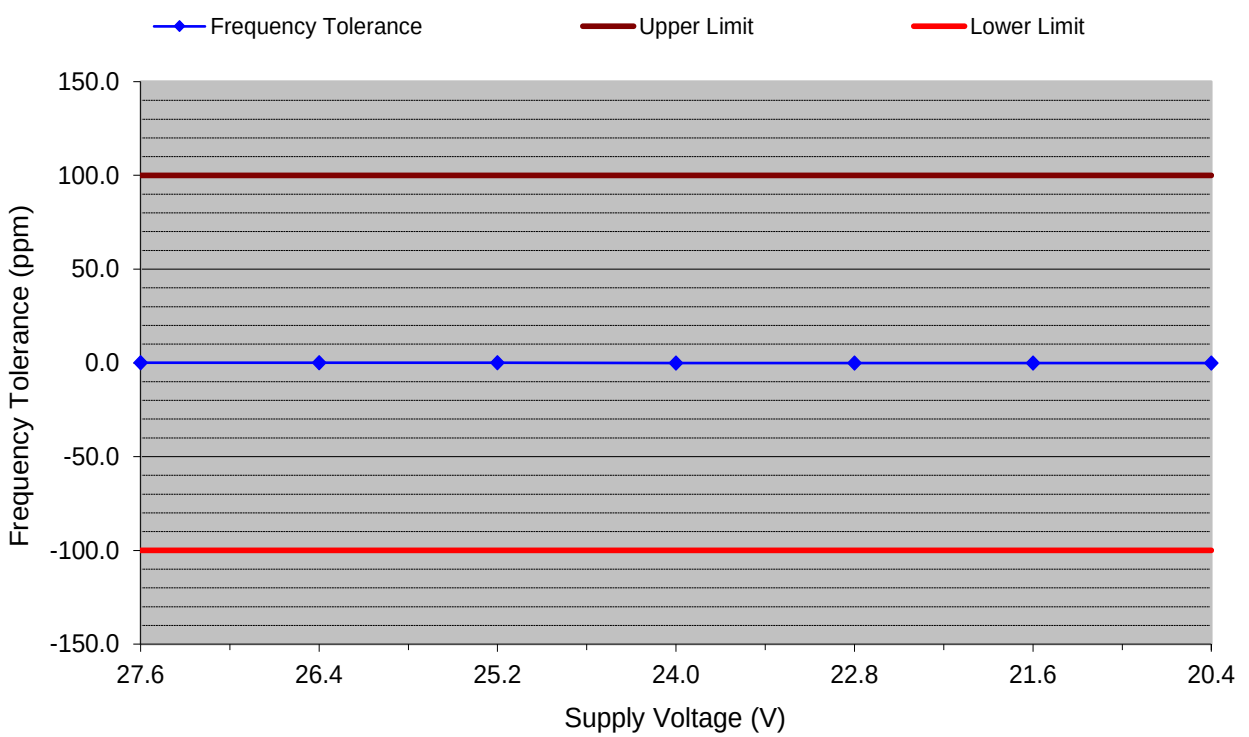


Supply voltage: 24 V Nominal frequency: 13.558846 MHz

Temperature (°C)	Frequency (MHz)	Frequency Tolerance (Hz)	(ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
-20	13.558847	2	0.1	+100.0	-100.0	99.9
-10	13.558883	37	2.8	+100.0	-100.0	97.2
±0	13.558866	20	1.5	+100.0	-100.0	98.5
+10	13.558873	28	2.0	+100.0	-100.0	98.0
+20	13.558846	0	0.0	+100.0	-100.0	100.0
+30	13.558817	-29	-2.2	+100.0	-100.0	97.8
+40	13.558792	-54	-4.0	+100.0	-100.0	96.0
+50	13.558782	-64	-4.7	+100.0	-100.0	**95.3**

Test Result:	Test passed

8.8.2 Carrier Frequency Stability vs. Supply Voltage



Temperature: +20 °C
Nominal frequency: 13.558822 MHz
Battery End Point: Not applicable

Supply Voltage (V)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
27.6	13.558825	2	0.2	+100.0	-100.0	**99.8**
26.4	13.558824	2	0.1	+100.0	-100.0	99.9
25.2	13.558823	1	0.1	+100.0	-100.0	99.9
24.0	13.558822	0	0.0	+100.0	-100.0	100.0
22.8	13.558822	-1	0.0	+100.0	-100.0	100.0
21.6	13.558821	-1	-0.1	+100.0	-100.0	99.9
20.4	13.558821	-1	-0.1	+100.0	-100.0	99.9

Test Result:	Test passed

8.9 Exposure of Humans to RF Fields

Rules and specifications:	IC RSS-Gen Issue 4, section 3.2
Guide:	IC RSS-102 Issue 5, 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**				
with:				
Distance between the antennas in m: D = **..... m**			☐	
☒ not detachable				
A field strength measurement is used to determine the effective isotropic radiated power (EIRP in watts) given by8:				
$EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP$ = **8.54 µW**				
with:				
Field strength in V/m: FS = **1.60 mV/m**			☒	
Distance between the two antennas in m: D = **10 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 = **8.54 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/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in the table. For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in the table are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in the table are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in the table, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required. For medical implants devices, the exemption limit for routine evaluation is set at 1 mW. The output power of a medical implants device is defined as the higher of the conducted or e.i.r.p to determine whether the device is exempt from the SAR evaluation.				

Frequency (MHz)	Exemption limits (mW)[9] at separation distance of									
	≤5 mm	10 mm	15 mm	20 mm	25 mm	30 mm	35 mm	40 mm	45 mm	≥50 mm
≤300 [10]	71	101	132	162	193	223	254	284	315	345
450	52	70	88	106	123	141	159	177	195	213
835	17	30	42	55	67	80	92	105	117	130
1900	7	10	18	34	60	99	153	225	316	431
2450	4	7	15	30	52	83	123	173	235	309
3500	2	6	16	32	55	86	124	170	225	290
5800	1	6	15	27	41	56	71	85	97	106

Carrier frequency:	f	=	**..... MHz**
Distance:	d	=	**..... mm**
Transmitter output power:	TP	=	**..... mW**
Limit:	TP_{limit}	=	**..... mW**

☐ SAR evaluation is documented in test report no. .....

[9] The exemption limit in the table are based on measurements and simulations on half-wave dipole antennas at separaton distances of 5 mm to 25 mm from a flat phantom, providing a SAR value of approximately 0.4 W/kg for 1 g of tissue. For low frequencies (300 MHz to 835 MHz), the exemption limits are derived from alinear fit. For high frequencies (1900 MHz and above), the exemption limits are derived from athird order polynomial fit.

[10] Transmitters operating between 3 kHz and 10 MHz, meeting the exemption from routine SAR evaluation, shall demonstrate compliance to the instantaneous limits in IC RSS-102, issue 5, section 4.

Exposure of Humans to RF Fields (continued)	Applicable	Declared by applicant	Measured	Exemption
RF exposure evaluation				
RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows: ☒ below 20 MHz[11] and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance). ☐ between 3 kHz and 10 MHz exposure limits apply as following: ☐ In a uncontrolled environment the basic restriction for the instantaneous internal electric field strength is equal to or less than 2.7 · 10-4 *f* V/m_{rms} at any part of the body where *f* is in Hz. The instantaneous RF field strength is equal or less than 83 V/m_{rms} and equal or less than 90 A/m_{rms}. ☐ In a controlled environment the basic restriction for the instantaneous internal electric field strength is equal to or less than 1.35 · 10-4 *f* V/m_{rms} at any part of the body where *f* is in Hz. The instantaneous RF field strength is equal or less than 170 V/m_{rms} and equal or less than 180 A/m_{rms}. ☐ at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 4,49/$f^{0.5}$ W (adjusted for tune-up tolerance, where *f* is in MHz. ☐ at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance). ☐ at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1.31 · $10^{-2}f^{0.6834}$ W (adjusted for tune-up tolerance), where *f* is in MHz. ☐ at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance). In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.				
Carrier frequency: f = **13.56 MHz** Transmitter output power: TP = **8.54 µW** Limit: TP_{limit} = **1000 mW**				☒
☐ RF exposure evaluation is documented in test report no.				

[11] Transmitters operating between 3 kHz and 10 MHz, meeting the exemption from routine RF Exposure evaluation, shall demostrate compilance tot he instanteneous limits in IC RSS-102, issue 5, section 4.

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, 2016
☒	CFR 47 Part 15	Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)	October 1, 2016
☐	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 13, 2014 (published on June 20, 2014)
☒	ANSI C63.10	American national Standard of Procedures for Compilance Testing of Unlicensed Wireless Devices	June 27, 2013 (published on September 13, 2013)
☒	RSS-Gen	Radio Standards Specification RSS-Gen Issue 4 containing General Requirements for Compilance of Radio Apparatus, published by Industry Canada	November 2014
☒	RSS-210	Radio Standards Specification RSS-210 Issue 9 for Licence-Exempt Radio Apparatus: Category I Equipment, published by Industry Canada	August 2016
☐	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 5: Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), published by Industry Canada	March 2015
☐	ICES-003	Interference-Causing Equipment Standard ICES-003 Issue 6: Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement, published by Industry Canada	January 2016
☒	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	1863	ESCI3	100008	Rohde & Schwarz	Rohde & Schwarz	2016/10	2017/10
EMI test receiver	22643	ESR7	101713	Rohde & Schwarz	Rohde & Schwarz	2016/11	2017/11
Spectrum analyzer	2364	FSV40	101448	Rohde & Schwarz	Rohde & Schwarz	2016/11	2017/11
V-network	1059	ESH3-Z5	894785/005	Rohde & Schwarz	Rohde & Schwarz	2016/10	2019/10
Loop antenna	1016	HFH2-Z2	882964/0001	Rohde & Schwarz	Rohde & Schwarz	2016/07	2018/07
TRILOG Broadband Antenna	2058	VULB 9163	9163-408	Schwarzbeck	Rohde & Schwarz	2016/07	2018/07
Multimeter	2252	U1252B	MY53100196	Agilent	Agilent	2016/02	2018/02
Climatic test chamber	2408	PL-2J	15001626	ESPEC	THERMOTEC	2017/03	2019/03

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	2017-07-13	M. Steindl (lc)	First Edition
2	2017-08-29	M. Steindl (lc)	Correcton of IC-ID.