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July 21, 2017

Prüfbericht / *Test Report* Nr. / *No.* TR-00163-05659-03 (Edition 2)

Applicant:	Huf Hülsbeck & Fürst GmbH & Co. KG
Type of equipment:	TPMS Sensor G5M
Type designation:	TSSRE4A
Order No.:	24155929
Test standards:	FCC Code of Federal Regulations, CFR 47, Part 15, Sections 15.205, 15.207, 15.215 and 15.231 and KDB 447498 D01 Industry Canada Radio Standards Specifications RSS-GEN Issue 4, Sections 8.8 and 8.10 and RSS-210 Issue 9, Section A.1 (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

Table of Contents

1 Description of the Equipment Under Test (EUT)

General data of EUT	
Type designation[1]:	TSSRE4A
Parts[2]:	
Serial number(s):	20042B7E, 200421DE (Temperature test)
Manufacturer:	Huf Electronics Bretten GmbH Gewerbestr. 40 75015 Bretten Germany
Type of equipment:	TPMS Sensor G5M
Version:	
FCC ID:	YGOTSSRE4A
Industry Canada ID:	4008C-TSSRE4A
Additional parts/accessories:	

Technical data of EUT		
Application frequency range:	433.05 MHz - 434.79 MHz	
Frequency range:	433.92 MHz	
Operating frequency:	433.92 MHz	
Type of modulation:	FSK	
Pulse train:	30 s to 1 s	
Pulse width:	6.5 ms	
Number of RF-channels:	1	
Channel spacing:	N/A	
Designation of emissions[3]:	100KF1D	
Type of antenna:	Integrated	
Size/length of antenna:	N/A	
Connection of antenna:	☐ detachable	☒ not detachable
Type of power supply:	Battery supply	
Specifications for power supply:	nominal voltage:	3.0 V

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

2 Administrative Data

Application details	
Applicant (full address):	Huf Hülsbeck & Fürst GmbH & Co. KG Steeger Str. 17 42551 Velbert Germany
Contact person:	Mr. Alexander Härter
Order number:	24155929
Receipt of EUT:	2017-05-23
Date(s) of test:	2017-06-02 and 2017-06-07
Note(s):	

Report details	
Report number:	TR-00163-05659-03
Edition:	2
Issue date:	July 21, 2017

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 15.231(a)-(d)** of the Federal Communication Commission (FCC) and the **Radio Standards Specifications** **RSS-Gen Issue 3, Sections 8.8 and 8.10 and** **RSS-210 Issue 9, Sections A1.1 to A1.1.3 (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*
July 21, 2017	Steindl Martin Martin Steindl Responsible for testing	Markus Biberger Reviewer

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

5 Operation Mode and Configuration of EUT

Operation Mode(s)
Transmitting continuously

Configuration(s) of EUT
The EUT was configured as stand alone device. Radiated tests were performed in three orthogonal axis.

List of ports and cables					
No.	*Description*	*Classification*[4]	*Cable type*	*Cable length used*	*maximum*[5]

List of devices connected to EUT				
No.	*Description*	*Type designation*	*Serial no. or ID*	*Manufacturer*

List of support devices				
No.	*Description*	*Type designation*	*Serial no. or ID*	*Manufacturer*
1	TPMS TestTool	MB3000		

[4] Ports shall be classified as ac power, dc power or signal/control port.
[5] As specified by applicant

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 in Fully or Semi Anechoic Room (6.4)

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 Pulse Train Measurement

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.35(c) IC RSS-Gen Issue 4, section 6.10
Guide:	ANSI C63.10
Measurement setup:	☐ Conducted: See below (direct connection or via test fixture) ☒ Radiated: Radiated Emission in Fully or Semi Anechoic Room (6.4)

If antenna is detachable pulse train measurements shall be performed at the antenna connector (conducted measurement). The RF output terminals are connected to a spectrum analyzer or to a diode detector in combination with an oscilloscope. 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 antenna is not detachable a test fixture may be used instead of direct connection to RF output terminals.

If radiated measurements are performed similar test setups and instruments are used as with radiated emission measurements for the appropriate frequency range. However, the spectrum analyzer may be replaced by a diode detector connected to an oscilloscope.

6.3 Radiated Emission Measurement 9 kHz to 30 MHz

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, sections 15.215(b) and 15.231(b)(3) IC RSS-210 Issue 9, section A1.2(a)
Guide:	ANSI C63.10

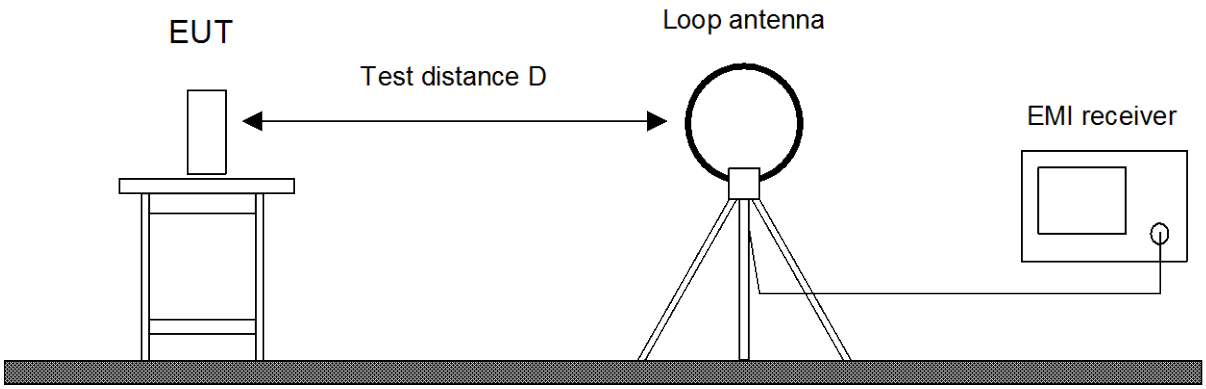
Radiated emission in the frequency range 9 kHz to 30 MHz is measured using an active loop antenna. First the whole spectrum of emission caused by the equipment is recorded at a distance of 3 meters in a fully or semi anechoic room with the detector of the spectrum analyzer or EMI receiver set to peak.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



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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
☐	Test receiver	ESHS 10	1028	860043/016	Rohde & Schwarz
☐	EMI test receiver	ESU8	2044	100232	Rohde & Schwarz
☐	Preamplifier Cabin no. 2	CPA9231A	1716	3557	Schaffner
☒	Loop antenna	HFH2-Z2	1016	882964/1	Rohde & Schwarz
☐	Microwave cable Cabin no. 2	UFA210A-FG	1681	23516	Rosenberger Micro-Coax
☐	Microwave cable Cabin no. 2	KKSF1040016	2020	289854/4	Huber + Suhner
☐	Microwave cable Cabin no. 2	FA210AF020000000	2060	64566-2	Rosenberger Micro-Coax
☐	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
☐	Fully anechoic room	No. 2	1452	---	Albatross
☐	Semi anechoic room	No. 3	1453	---	Siemens
☒	Semi anechoic room	No. 8	2057	---	Albatross
☒	Measurement Software	EMC32_K8 V9.25.00	1852	100016	Rohde & Schwarz

6.4 Radiated Emission in Fully or Semi Anechoic Room

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, sections 15.215(b) and 15.231 IC RSS-210 Issue 9, section A.1.2
Guide:	ANSI C63.10

Radiated emission in fully or semi anechoic room is measured in the frequency range from 30 MHz to the maximum frequency as specified in CFR 47 Part 15 section 15.33.

Measurements are made in both the horizontal and vertical planes of polarization using a spectrum analyzer with the detector function set to peak and resolution as well as video bandwidth set to 100 kHz (below 1 GHz) or 1 MHz (above 1 GHz). Table height is 80 cm for tested frequencies below 1 GHz and 1.5 m for frequencies above 1 GHz.

A peak scan is performed in six 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.

Testing up to 1 GHz is performed with a linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna"). For testing above 1 GHz horn antennas and a tilt-mast are used.

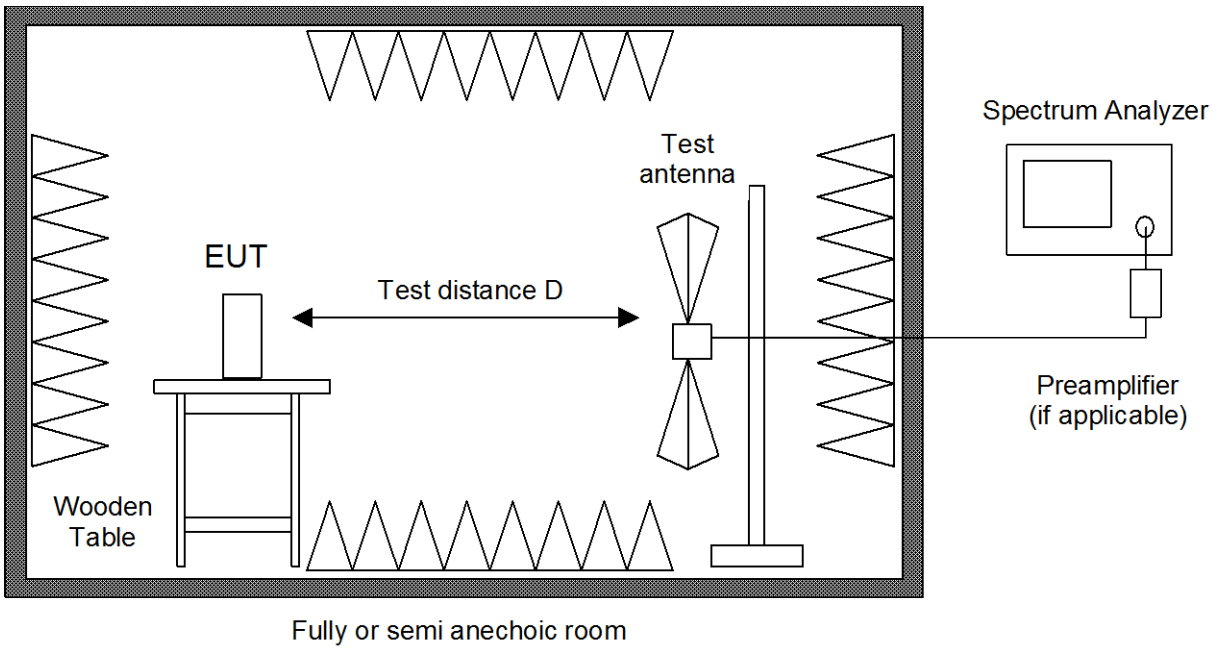
All tests below 8.2 GHz are performed at a test distance D of 3 meters. For higher frequencies the test distance may be reduced (e.g. to 1 meter) due to the sensitivity of the measuring instrument(s) and the test results are calculated according to CFR 47 Part 15 section 15.31(f)(1) using an extrapolation factor of 20 dB/decade. If required, preamplifiers are used for the whole frequency range. Special care is taken to avoid overload, using appropriate attenuators and filters, if necessary.

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 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.

During testing the 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.

For final testing below 1 GHz a semi anechoic room complying with the NSA requirements of ANSI C63.4 respectively ANSI C63.10 for alternative test sites is used (see 6.5). If prescans are recorded in fully anechoic room they are indicated appropriately.



Test instruments used:

	Type		*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☐	Spectrum analyzer		FSP30	1666	100036	Rohde & Schwarz
☐	EMI test receiver	Cabin no. 3	ESPI7	2010	101018	Rohde & Schwarz
☐	EMI test receiver		ESU8	2044	100232	Rohde & Schwarz
☒	EMI test receiver		ESR7	22643	101713	Rohde & Schwarz
☐	Preamplifier	Cabin no. 2	CPA9231A	1716	3557	Schaffner
☐	Preamplifier		R14601	1142	13120026	Advantest
☐	Preamplifier (1 - 8 GHz)		AFS3-00100800-32-LN	1684	847743	Miteq
☐	Preamplifier (0.5 - 8 GHz)		AMF-4D-005080-25-13P	1685	860149	Miteq

	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☐	Preamplifier (8 - 18 GHz)	ACO/180-3530	1484	32641	CTT
☐	External Mixer	WM782A	1576	845881/005	Tektronix
☐	Harmonic Mixer Accessories	FS-Z30	1577	624413/003	Rohde & Schwarz
☐	Trilog antenna Cabin no. 2	VULB 9163	1802	9163-214	Schwarzbeck
☐	Trilog antenna Cabin no. 3	VULB 9163	1722	9163-188	Schwarzbeck
☐	Trilog antenna Cabin no. 8	VULB 9163	2058	9163-408	Schwarzbeck
☐	Trilog antenna Cabin no. 2	VULB 9162	2256	9162-048	Schwarzbeck
☒	Horn antenna	HF907	2073	100154	Rohde & Schwarz
☐	Horn antenna	3115	1516	9508-4553	EMCO
☐	Horn antenna	3160-03	1010	9112-1003	EMCO
☐	Horn antenna	3160-04	1011	9112-1001	EMCO
☐	Horn antenna	3160-05	1012	9112-1001	EMCO
☐	Horn antenna	3160-06	1013	9112-1001	EMCO
☐	Horn antenna	3160-07	1014	9112-1008	EMCO
☐	Horn antenna	3160-08	1015	9112-1002	EMCO
☐	Horn antenna	3160-09	1265	9403-1025	EMCO
☐	Horn antenna	3160-10	1575	399185	EMCO
☐	Microwave cable Cabin no. 2	UFA210A-FG	1681	23516	Rosenberger Micro-Coax
☐	Microwave cable Cabin no. 2	KKSF1040016	2020	289854/4	Huber + Suhner
☐	Microwave cable Cabin no. 2	FA210AF020000000	2060	64566-2	Rosenberger Micro-Coax
☐	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
☐	Fully anechoic room	No. 2	1452	---	Albatross
☒	Semi anechoic room	No. 8	2057	---	Albatross
☐	Measurement Software	EMC32_K2 V9.25.00	2033	100003	Rohde & Schwarz
☒	Measurement Software	EMC32_K8 V9.25.00	1852	100016	Rohde & Schwarz

6.5 Radiated Emission at Alternative Test Site

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, sections 15.215(b) and 15.231 IC RSS-210 Issue 9, section A.1.2
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.

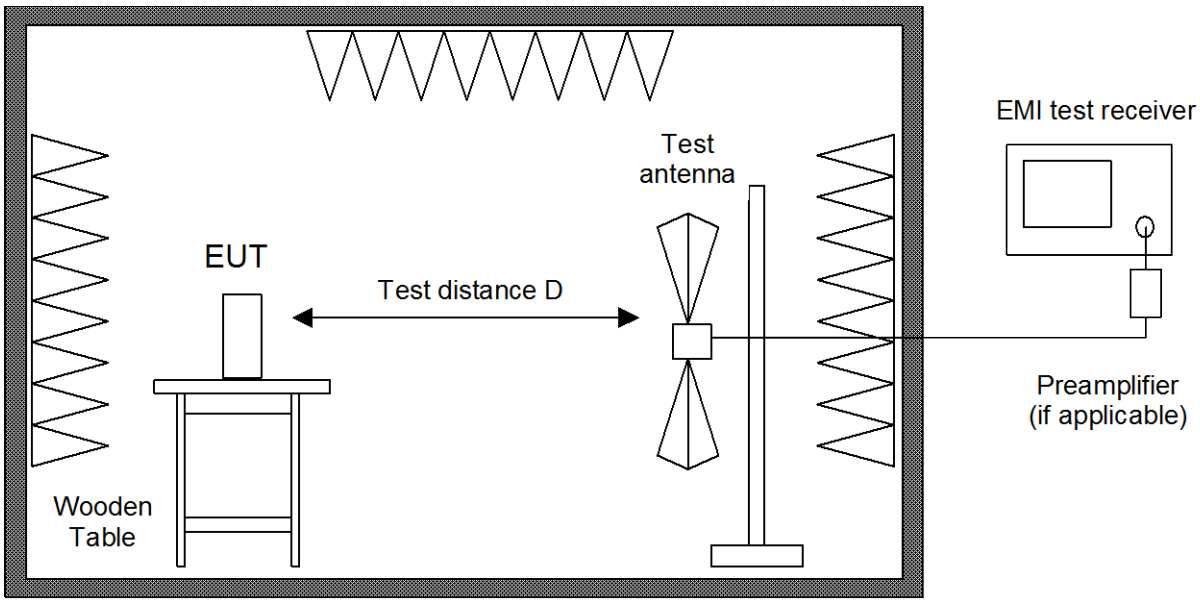
If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete 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.

A peak scan is performed in six 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.



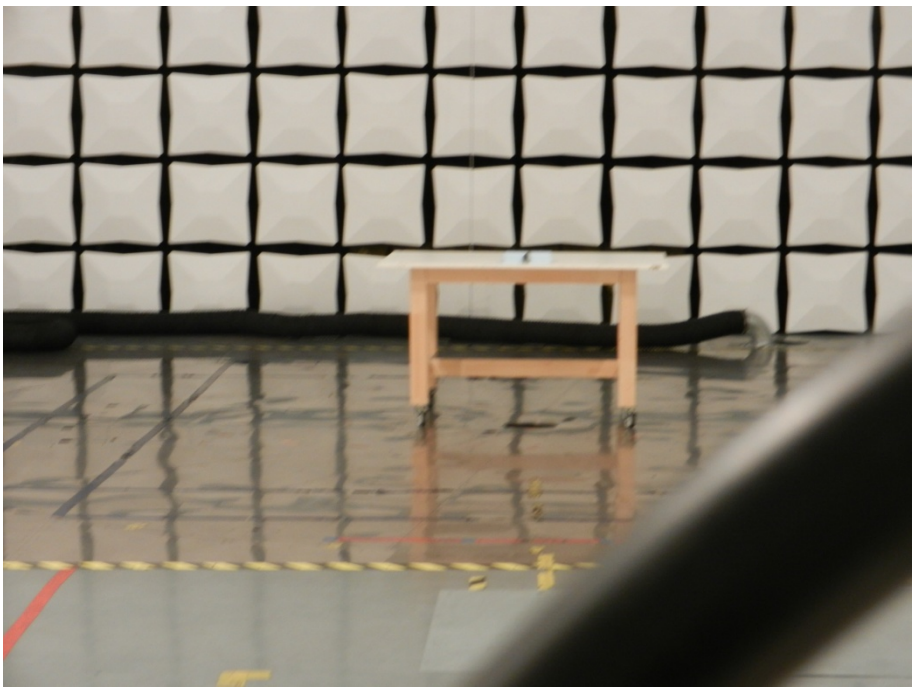
Alternate test site (semi anechoic room)

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
☒	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

7 Photographs Taken During Testing

Test setup for radiated emission measurement 9 kHz – 30 MHz



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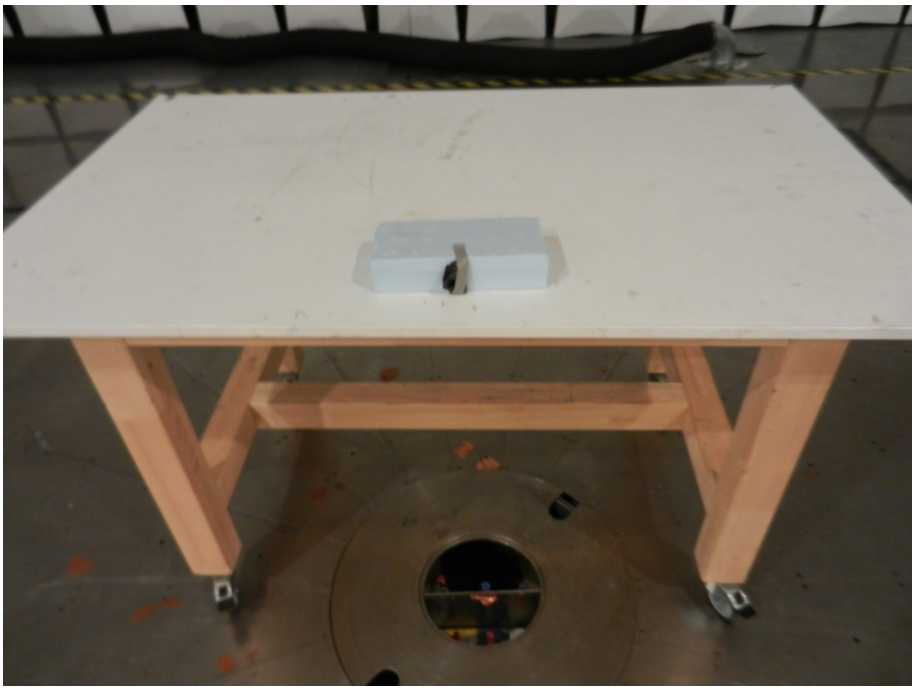
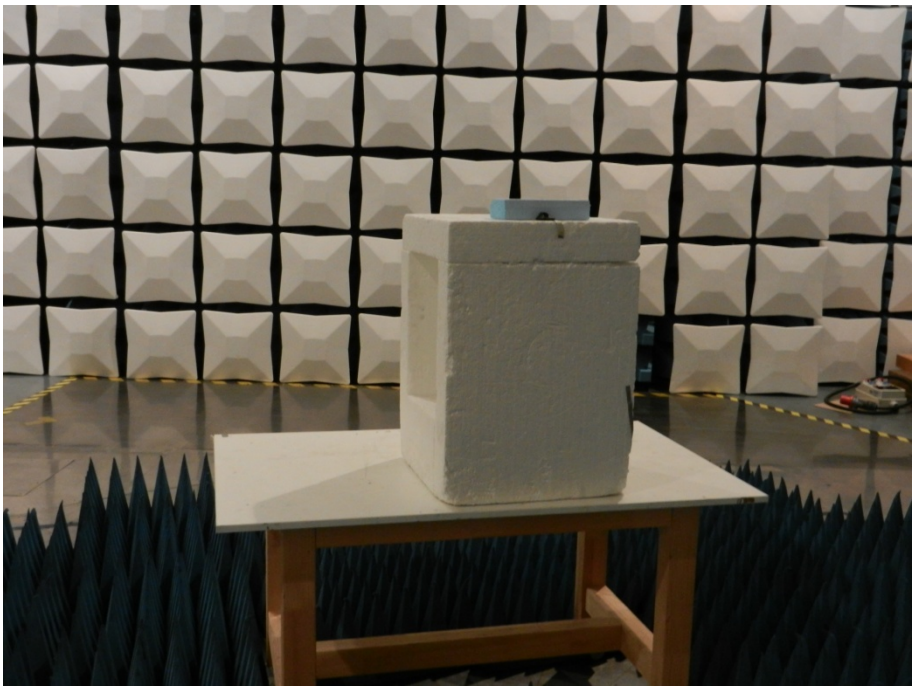
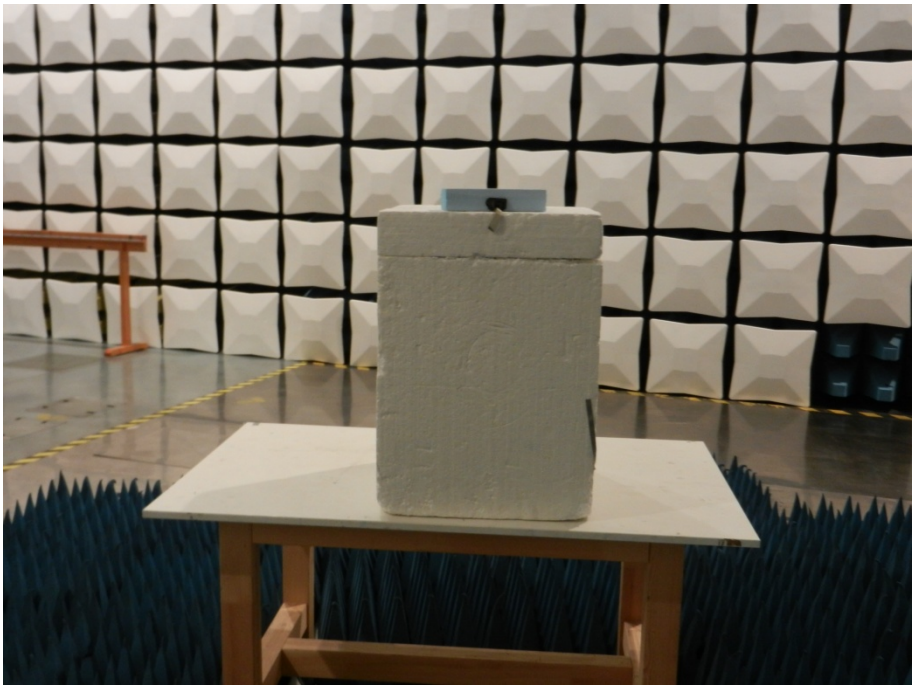
Test setup for radiated emission measurement 9 kHz – 30 MHz - continued -

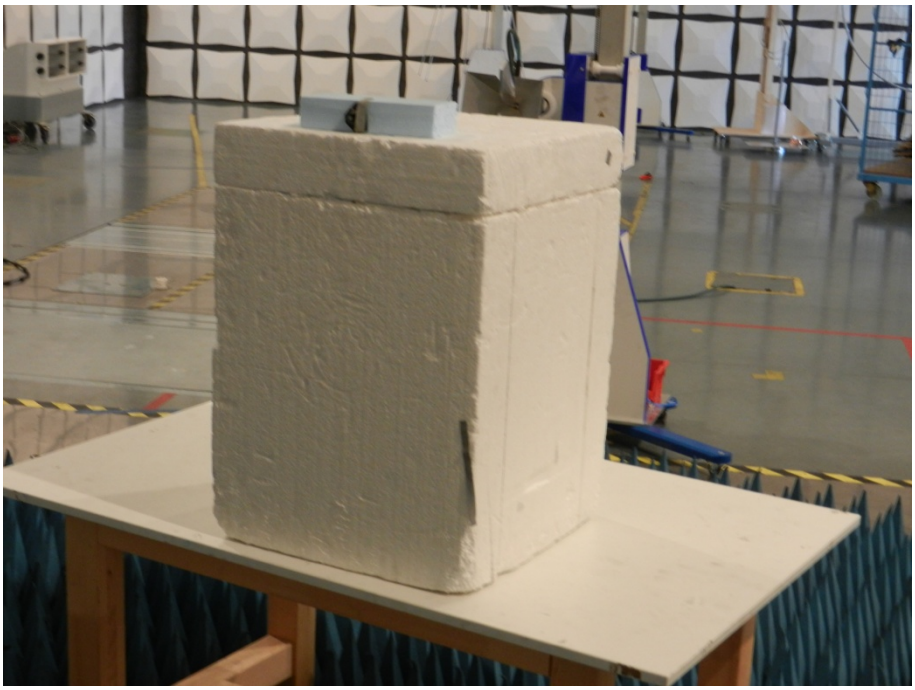


Test setup for radiated emission measurement (fully anechoic room)

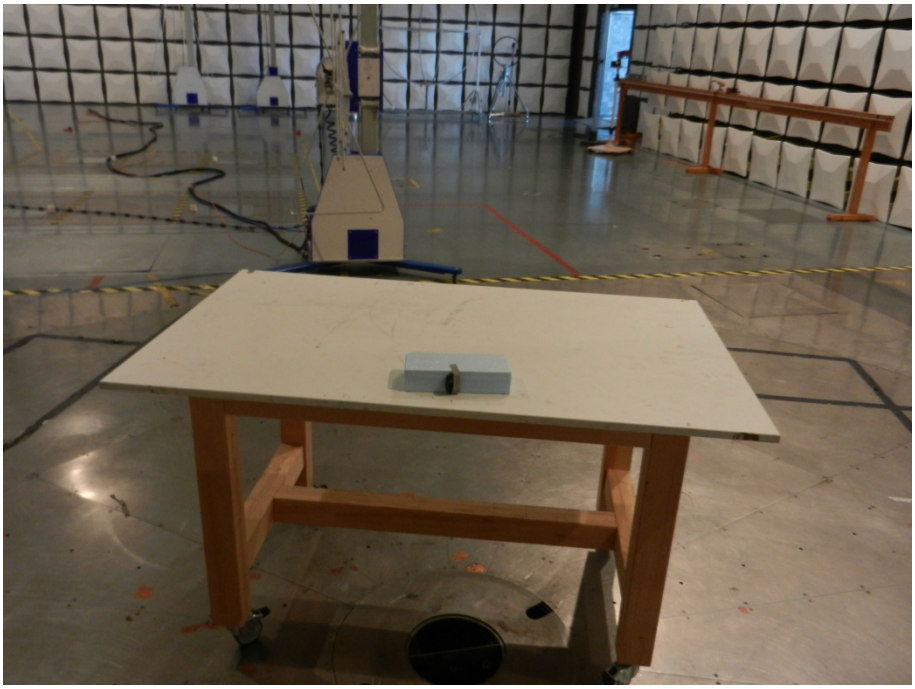


Test setup for radiated emission measurement (fully anechoic room) - continued -





Test setup for radiated emission measurement (alternate test site)



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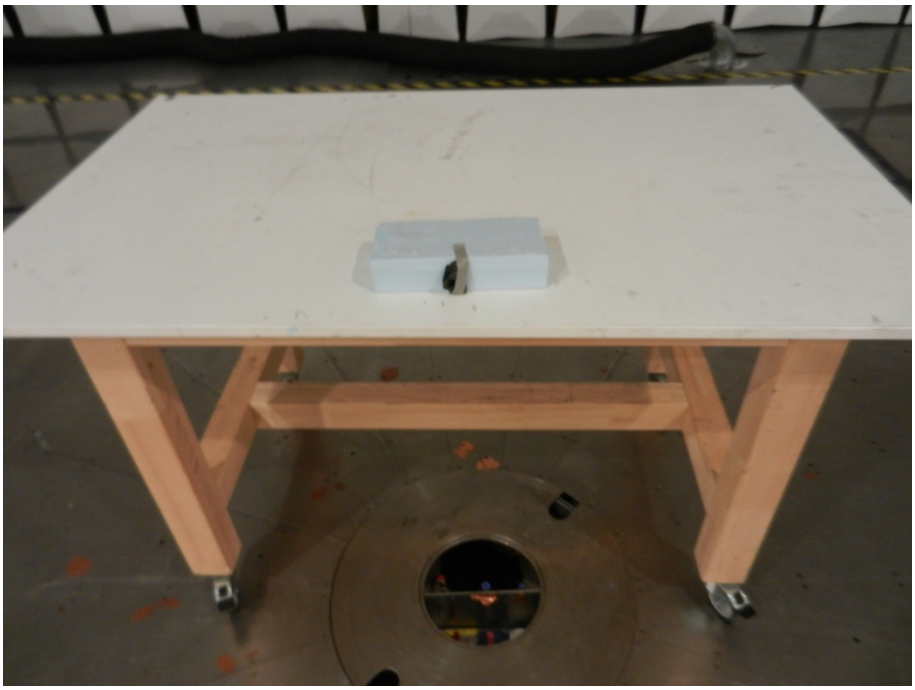
Test setup for radiated emission measurement (alternate test site) - continued -



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	26	Recorded
15.215(c) 15.231(c)	Bandwidth of the emission	31	Test passed
2.201, 2.202	Class of emission	35	Calculated
15.35(c)	Pulse train measurement for pulsed operation	36	Recorded
15.205(a)	Restricted bands of operation	38	Test passed
15.207	Conducted AC powerline emission 150 kHz to 30 MHz	---	Not applicable
15.231(a)	Periodic operation requirements	39	Test passed
15.205(b) 15.231(b)	Radiated emission 9 kHz to 30 MHz	43	Test passed
15.205(b) 15.215(b) 15.231(b)	Radiated emission 30 MHz to 5 GHz	46	Test passed
15.231(d)	Carrier frequency stability	---	Not applicable

KDB 447498 D01			
Section(s)	*Test*	*Page*	*Result*
		55	Test passed

IC RSS-Gen Issue 4			
Section(s)	*Test*	*Page*	*Result*
6.12	Transmitter output power (conducted)	---	Not applicable
6.6	Occupied Bandwidth	26	Recorded
9	Designation of emissions	35	Calculated
6.10	Pulsed operation	36	Recorded
8.8	Conducted AC powerline emission 150 kHz to 30 MHz	---	Not applicable
8.10	Restricted bands and unwanted emission frequencies	38	Test passed
6.4, 6.13, 8.9	Unwanted emissions 9 kHz to 30 MHz	43	Test passed
6.4, 6.13, 8.9	Unwanted emissions 30 MHz to 5 GHz	46	Test passed
3.2	Exposure of Humans to RF Fields	51	Exempted from SAR and RF evaluation

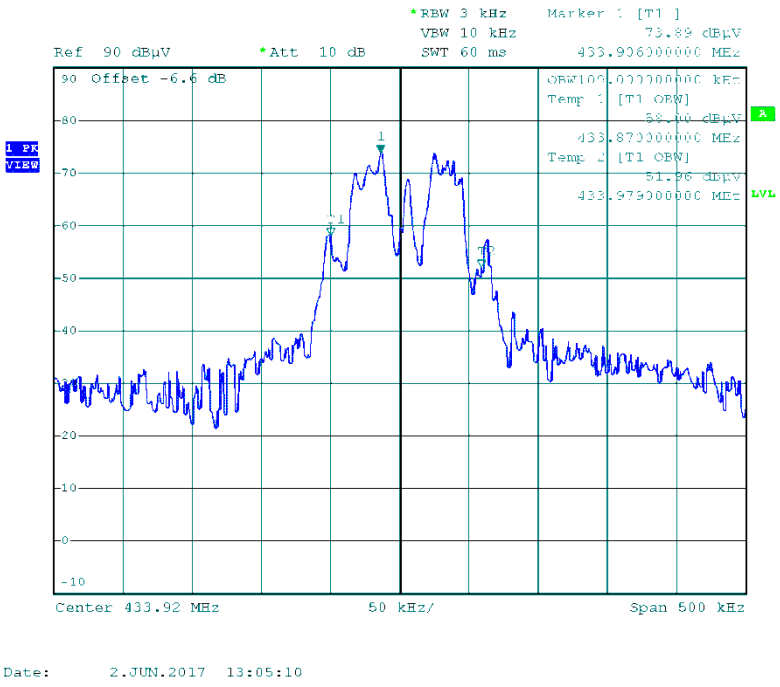
IC RSS-210 Issue 9			
Section(s)	*Test*	*Page*	*Result*
A.1.1	Requirements for momentarily operated devices	39	Test passed
A.1.2	Unwanted emissions 9 kHz to 30 MHz	43	Test passed
A.1.2	Unwanted emissions 30 MHz to 5 GHz	46	Test passed
A.1.3	Bandwidth of momentary signals	33	Test passed
A.1.4	Carrier frequency stability	---	Not applicable

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)

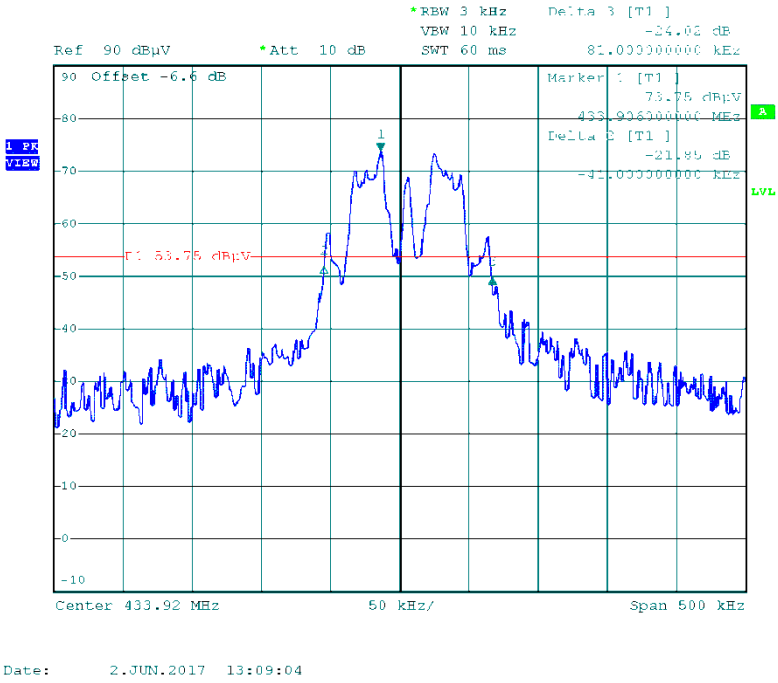
Comment:	
Date of test:	2017-06-02
Test site:	Fully anechoic room, cabin no. 8

Occupied Bandwidth (99 %):



Occupied Bandwidth (99 %):	**109 kHz**

Occupied Bandwidth (-20 dB):



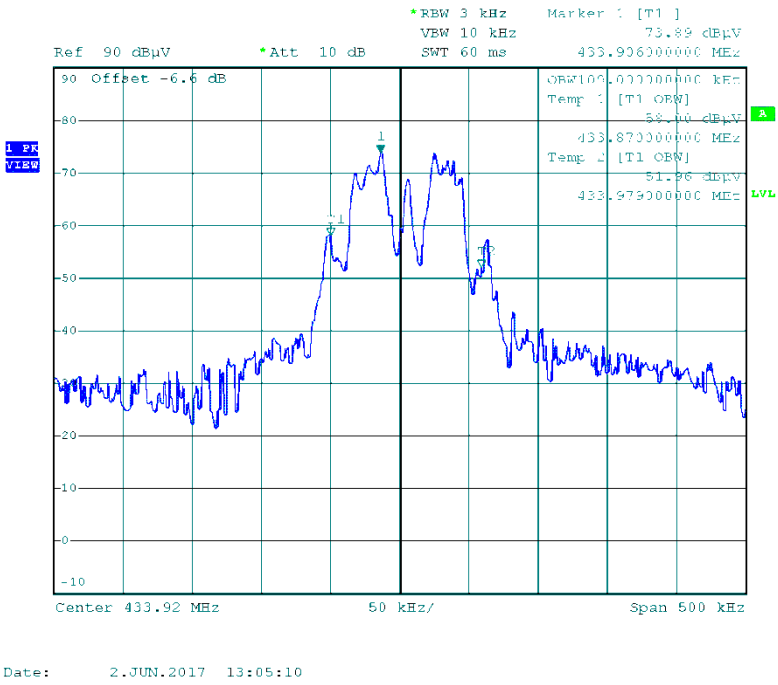
Occupied Bandwidth (-20 dB):	**122 kHz**

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:	2017-06-02
Test site:	Fully anechoic room, cabin no. 8

Occupied Bandwidth (99 %):

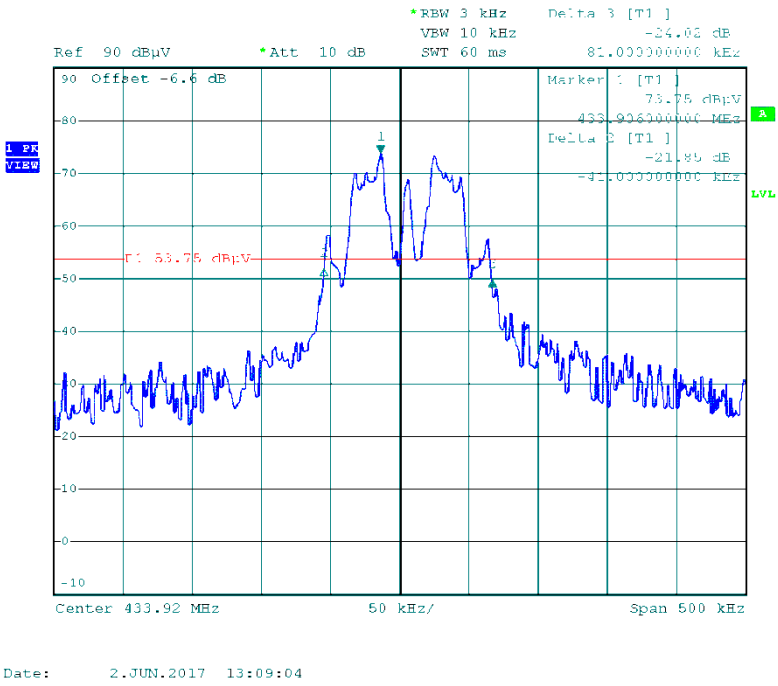


Occupied Bandwidth (99 %):	**109 kHz**

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:	2017-06-02
Test site:	Fully anechoic room, cabin no. 8



Permitted frequency band:	**433.05 MHz - 434.79 MHz**	
20 dB bandwidth:	**122 kHz**	
Carrier frequency stability: Maximum frequency tolerances:	☐ **specified** **---**	☒ **not specified**
Bandwidth of the emission:	**122 kHz**	**within permitted frequency band[6]:** ☒ **yes** ☐ **no**

Test Result:	Test passed

[6] 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 Bandwidth of Momentary Signals

Rules and specifications:	CFR 47 Part 15, section 15.231(c)
Guide:	ANSI C63.10
Limit:	The bandwidth shall be no wider than 0.25% of the centre frequency for devices operating between 70 MHz and 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the centre frequency. Bandwidth is determined as the points 20 dB down from the modulated carrier.

Operating frequency: Bandwidth limit:	**433.92 MHz** **1084.8 kHz**
Occupied bandwidth:	**122 kHz**
Emission bandwidth within band-width limit:	☒ **yes** ☐ **no**

Test Result:	Test passed

Bandwidth of Momentary Signals (continued)

Rules and specifications:	IC RSS-210 Issue 9, section A.1.3
Guide:	IC RSS-Gen Issue 4, section 6.6
Limit:	For the purpose of Section A.1, the 99% bandwidth shall be no wider than 0.25% of the centre frequency for devices operating between 70 MHz and 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the centre frequency.

Operating frequency: Bandwidth limit:	**433.92 MHz** **1084.8 kHz**
Occupied bandwidth:	**109 kHz**
Emission bandwidth within band-width limit:	☒ **yes** ☐ **no**

Test Result:	Test passed

8.4 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:	Frequency Shift Keying (FSK)

B_n = Necessary Bandwidth	$B_n = 2DK + B$
D = Peak deviation	D = 25 kHz
K = Overall numerical factor	K = 1
B = Modulation rate	B = 50 kHz
Calculation:	$B_n = 2 \cdot (25\ kHz) \cdot 1 + (50\ kHz) = 100\ kHz$

Designation of Emissions:	**100K F1D**

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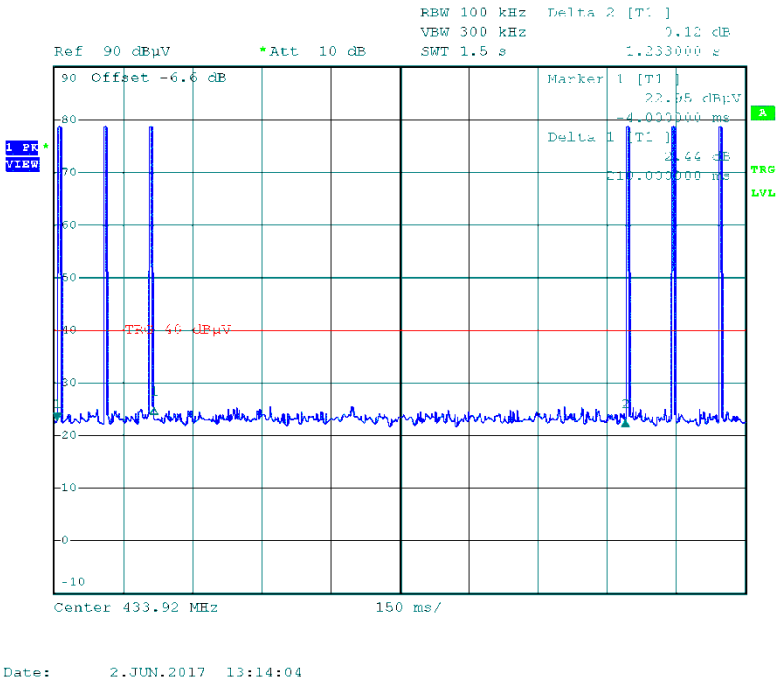
8.5 Pulse Train Measurement

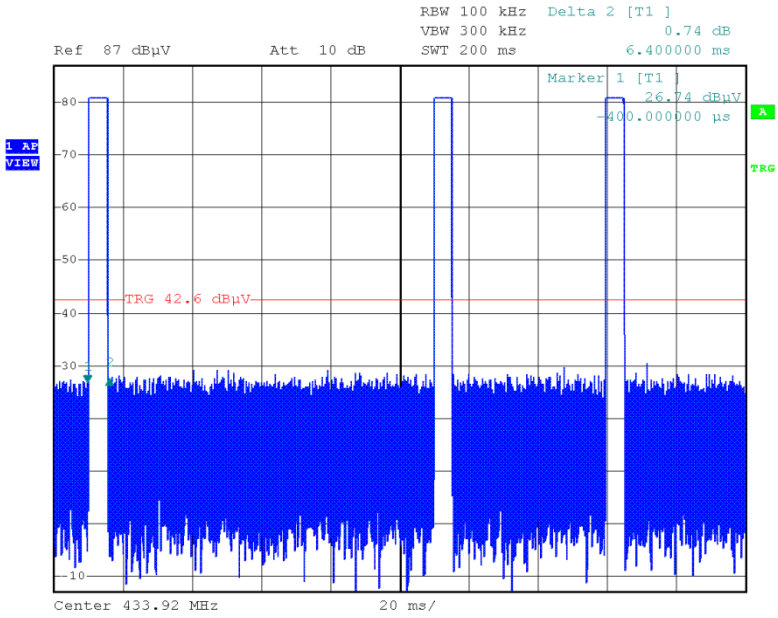
Rules and specifications:	CFR 47 Part 15, section 15.35(c) IC RSS-Gen Issue 4, section 6.10
Guide:	ANSI C63.10
Measurement procedure:	Pulse Train Measurement (6.2)

Comment:	
Date of test:	2017-06-02
Test site:	Fully anechoic room, cabin no. 8

Total Pulse Train:



Worst case 0.1 second interval:



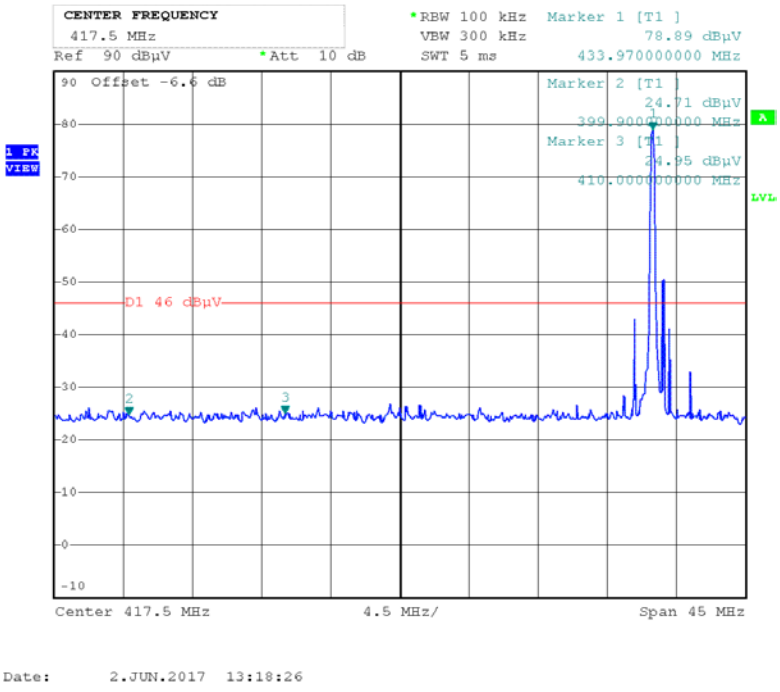
Calculation of pulse train correction:

TX-On-Time (worst case):	T_{on}	=	2 · 6.5 ms = 13 ms
Pulse Train Time:	T_{pt}	=	100 ms
Period Time:	T_{period}	=	100 ms
Pulse Train Correction:	C_{pt}	=	$20 \cdot \text{Log}(T_{on} / T_{period})$ dB
		=	**-17.72 dB**

8.6 Restricted Bands of Operation

Rules and specifications:	CFR 47 Part 15, section 15.205(a) IC RSS-GEN Issue 4, section 8.10
Guide:	ANSI C63.10
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-GEN Issue 4, section 8.10.
Measurement procedure:	Radiated Emission in Fully or Semi Anechoic Room (6.4)

Comment: Date of test: Test site:	 Fully anechoic room, cabin no. 8
Test distance:	3 meters



Test Result:	Test passed

8.7 Periodic Operation Requirements

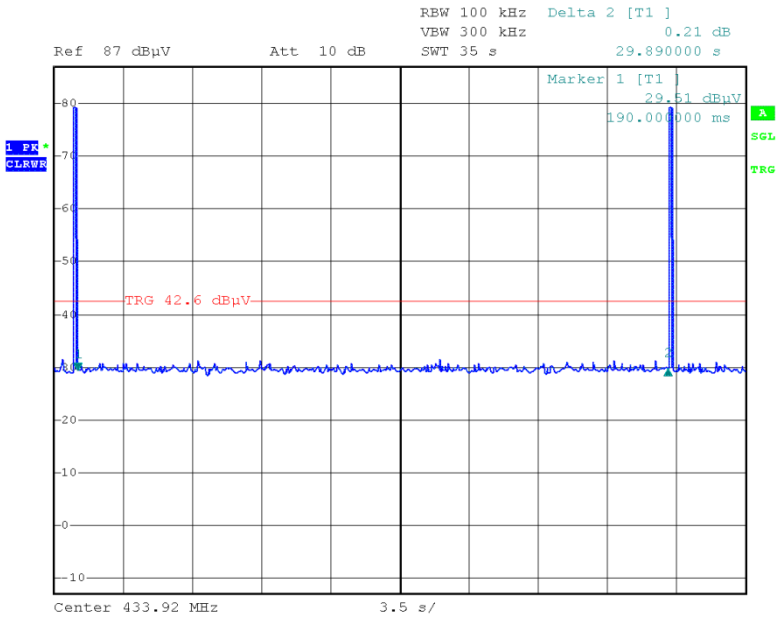
Rules and specifications:	CFR 47 Part 15, section 15.231(a) IC RSS-210 Issue 9, section A.1.1
Guide:	---

Periodic operation requirements	Applicable	Declared by applicant	Test performed	Passed
The transmitter is used for				
☒ security or safety applications ☐ other applications		☒		
The transmitter is operated				
☐ manually ☒ automatically		☒		
Periodic operation according to				
☐ CFR 47 Part 15, section 15.231(a) / IC RSS-210 Issue 7, section A1.1.1				
Only control signals are sent and there is no continuous transmission	☐	☐	☐	☐
A manually operated transmitter employs a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released	☐	☐	☐	☐
A transmitter activated automatically ceases transmission within 5 seconds after activation	☐	☐	☐	☐
Periodic transmissions at regular predetermined intervals are ☐ not performed ☐ performed with total transmission time of two seconds per hour or less (for polling or supervision transmissions to determine system integrity of transmitters used in security or safety applications)	☐	☐	☐	☐
☒ CFR 47 Part 15, section 15.231(e) / IC RSS-210 Issue 7, section A1.1.5				
The device is provided with a means for automatically limiting operation so that the duration of each transmission is not greater than one second and the silent period between transmissions is at least 30 times the duration of the transmission but in no case less than 10 seconds.	☒	☐	☐	☐

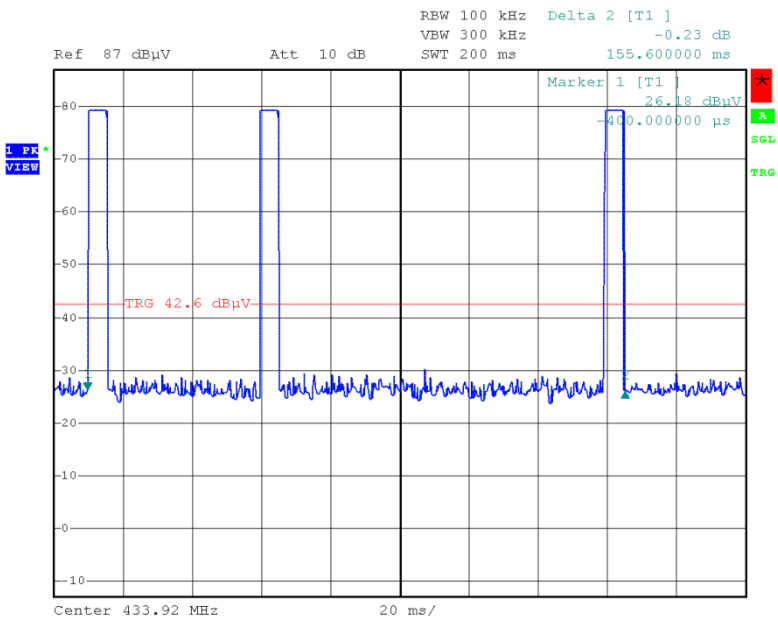
Note: Result may be based on the appropriate declaration of the applicant (i.e. no test is performed). However, in this case there is no verification by the test laboratory.

Plots taken during testing

Normal operation mode

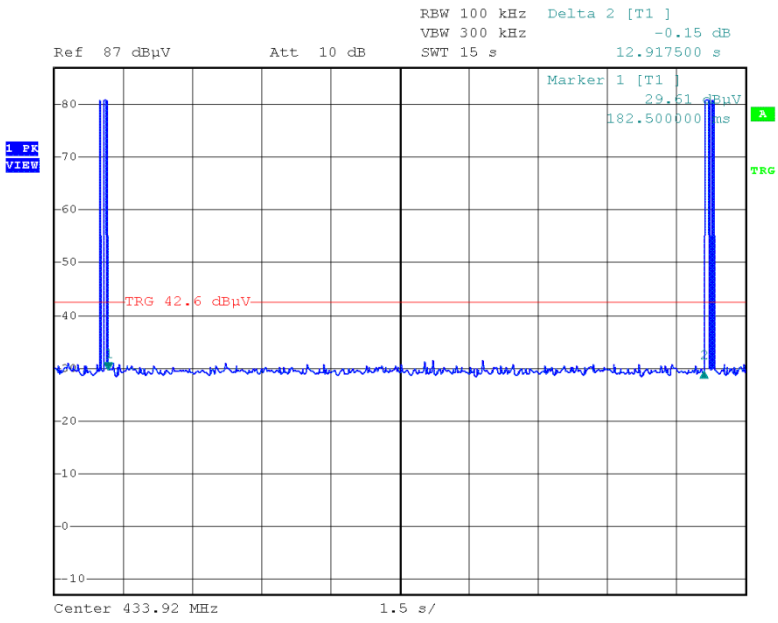


Date: 7.JUN.2017 20:23:56



Date: 7.JUN.2017 20:27:37

Learning mode



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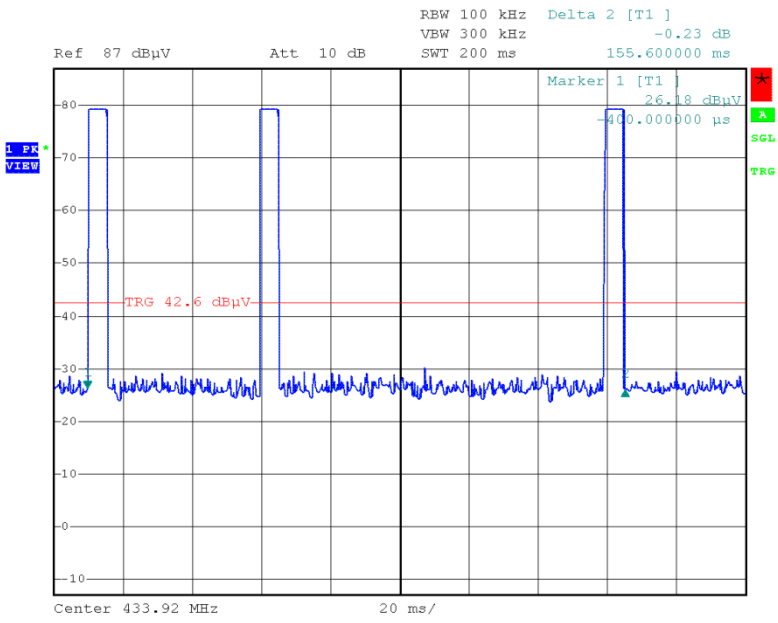
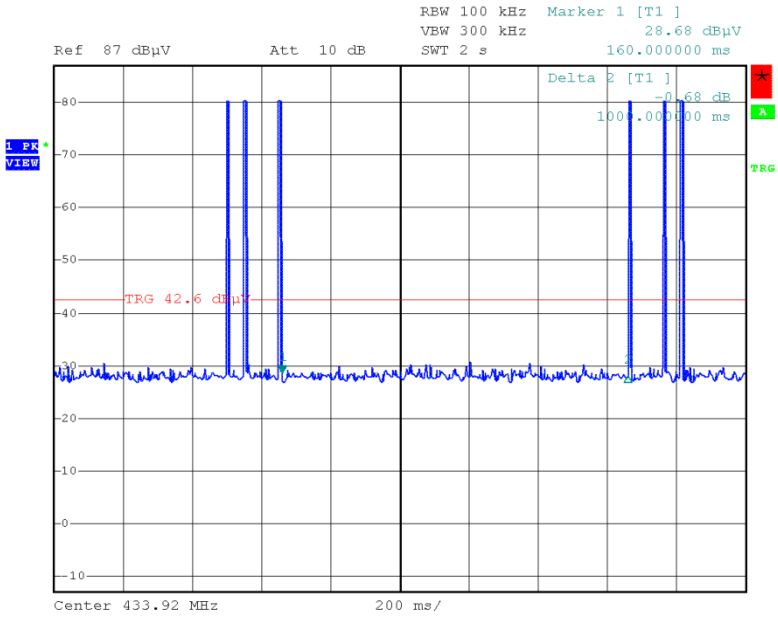
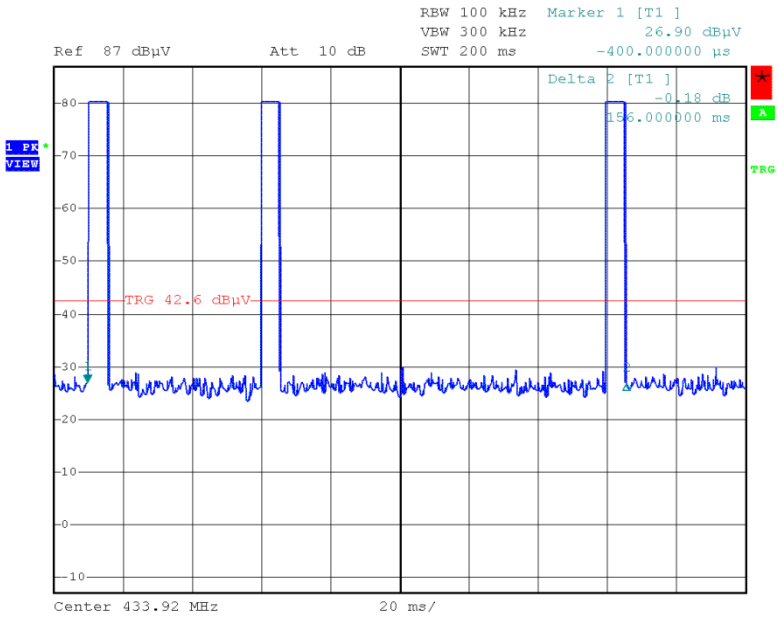


Date: 7.JUN.2017 20:27:37

Alarm mode

According to CFR 47, Part 15, section 15.231(a)(4) the alarm mode is excempted from evaluation.





8.8 Radiated Emission Measurement 9 kHz to 30 MHz

Rules and specifications:	CFR 47 Part 15, sections 15.215(b) and 15.231(b)(3) IC RSS-210 Issue 9, section A.1.2(b)			
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 - 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:	
Test site:	Open field test site

Test Result:	Test passed

No emissions above noise level detected

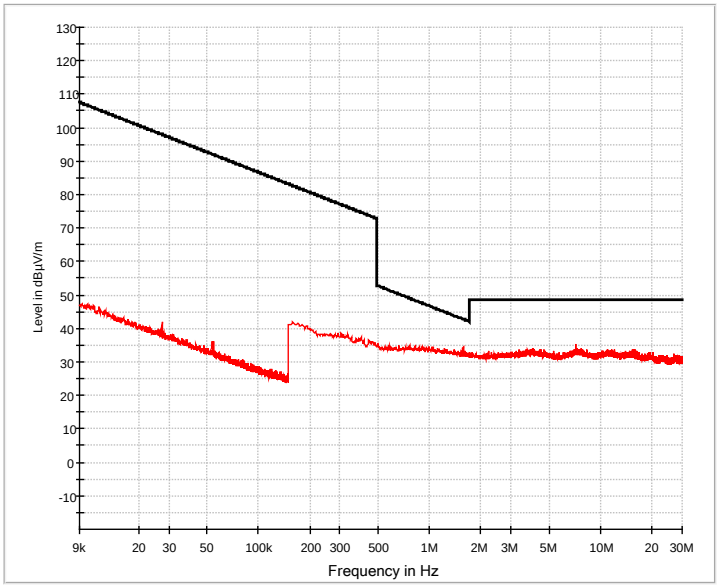
Sample calculation of final values:

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

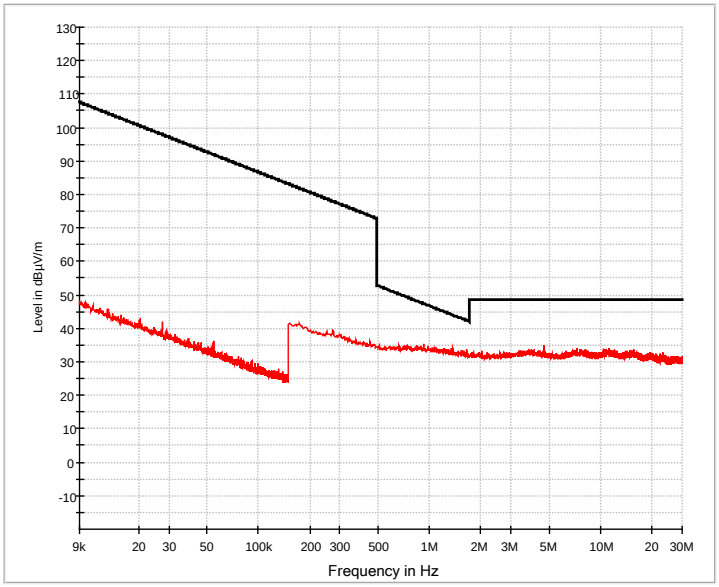
Final Value (dBµV/m) = Reading Value d_1 (dBµV) + Correction Factor (dB/m) + Extrapolation Factor (dB) + Pulse Train Correction (dB)

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

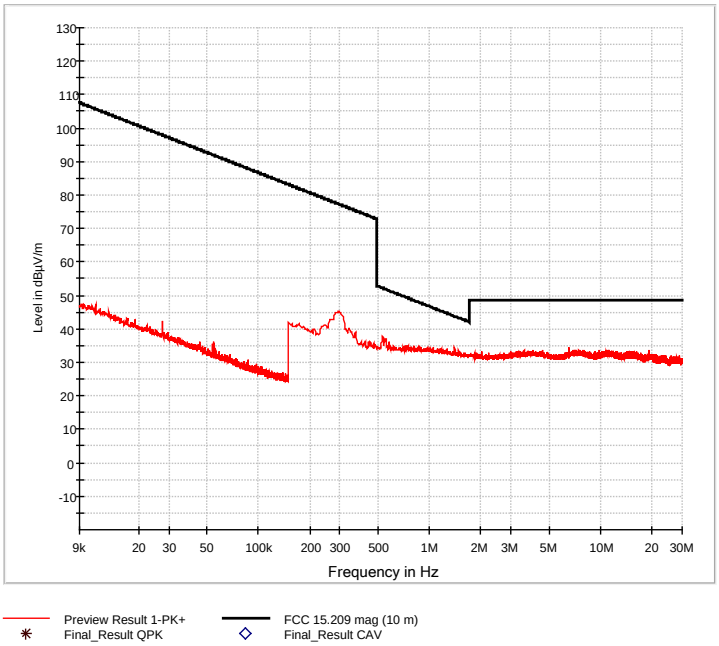
Plots taken during testing



EUT flat on table



EUT on long side



EUT in upright position

8.9 Radiated Emission Measurement 30 MHz to 5 GHz

Rules and specifications:	CFR 47 Part 15, sections 15.205, 15.215(b) and 15.231(b) IC RSS-210 Issue 9, section A.1.2
Guide:	ANSI C63.10
Limit:	In addition to the provisions of section 15.205, the field strength shall not exceed the levels as listed in the table below or the general limits shown in section 15.209, whichever limit permits a higher field strength. In no case shall the level of the unwanted emissions exceed the field strength of the fundamental emission.

Frequency of Emission (MHz)	Field Strength of Fundamental (µV/m)	(dBµV/m)	Field Strength of Spurious Emissions (µV/m)	(dBµV/m)
40.66 - 40.70	2,250	67.0	225 **	47.0
70 - 130	1,250	61.9	125	41.9
130 - 174	1,250 to 3,750 *	61.9 to 71.5	125 to 375 *	41.9 to 51.5
174 - 260	3,750	71.5	375	51.5
260 - 470	3,750 to 12,500 *	71.5 to 81.9	375 to 1,250 *	51.5 to 61.9
Above 470	12,500	81.9	1,250	61.9

* linear interpolations ** for harmonics only

Measurement procedures:	Radiated Emission in Fully or Semi Anechoic Room (6.4) Radiated Emission at Alternative Test Site (6.5)

Comment:	
Date of test:	2017-06-02
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

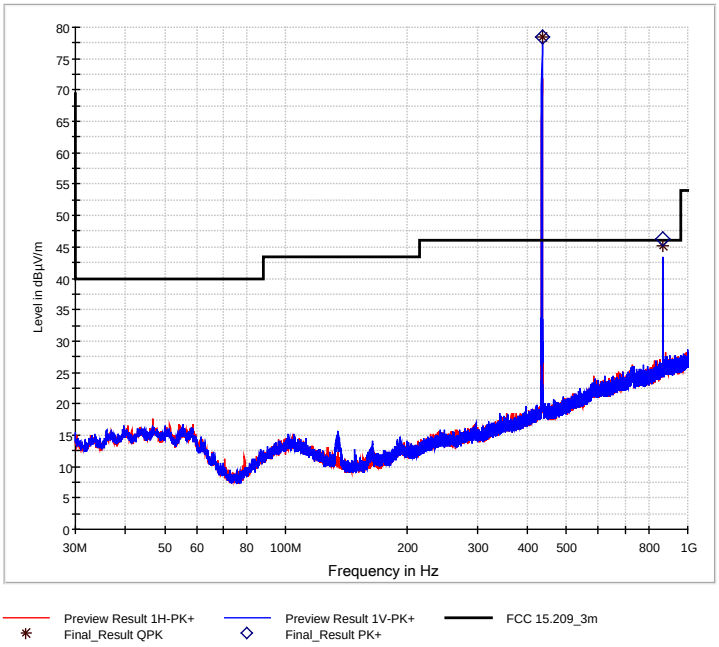
Test Result:	Test passed

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)
54.490	vertical	Quasi-Peak	-11.1	15.1		4.0	52.9	48.9
433.900	horizontal	Peak	60.5	18.0	-17.7	60.8	72.9	**12.1**
867.800	horizontal	Peak	22.8	24.5	-17.7	29.6	52.9	23.3
1301.750	vertical	Peak	17.0	27.9	-17.7	27.2	74.0	46.8
1735.500	horizontal	Peak	14.6	30.3	-17.7	27.2	74.0	46.8
2595.250	vertical	Peak	12.3	34.5	-17.7	29.1	74.0	44.8
2603.250	horizontal	Peak	15.5	34.6	-17.7	32.4	74.0	41.6
3471.000	horizontal	Peak	18.8	37.7	-17.7	38.8	74.0	35.2
4339.000	vertical	Peak	16.0	40.6	-17.7	38.9	74.0	35.0

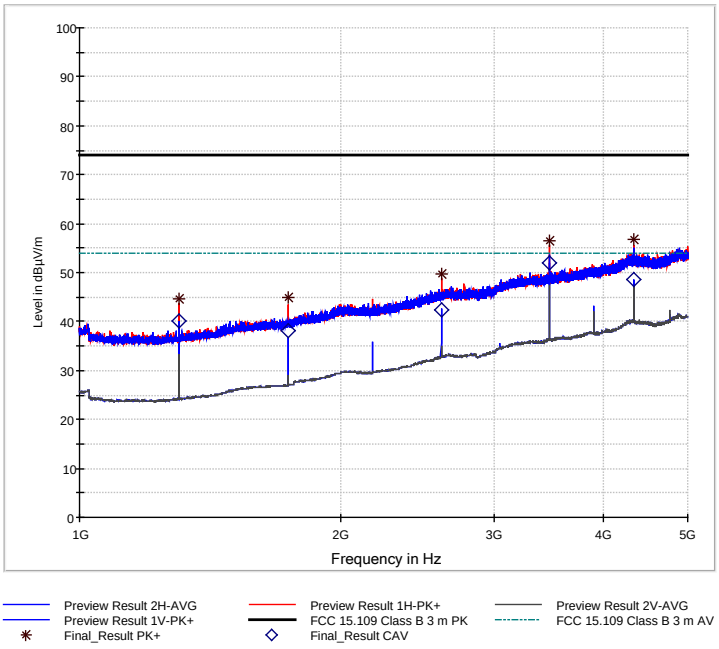
Sample calculation of final values:

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

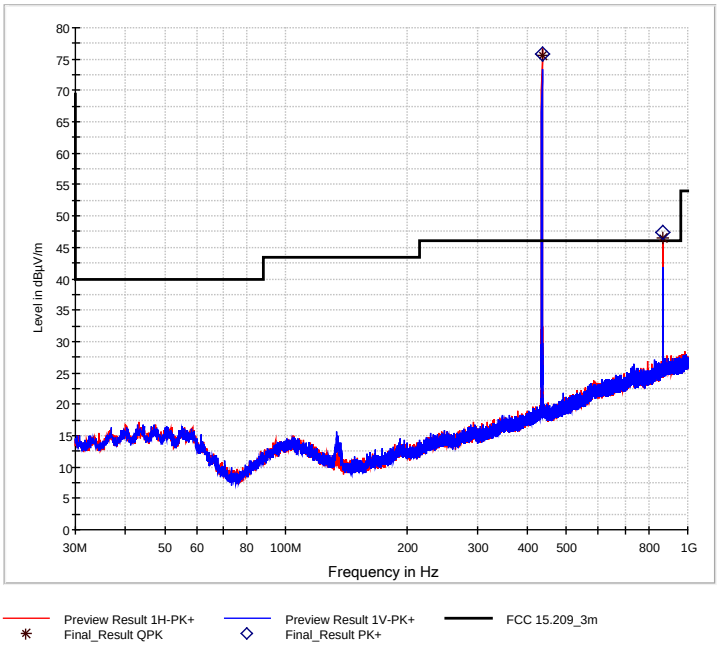
Plots taken during testing



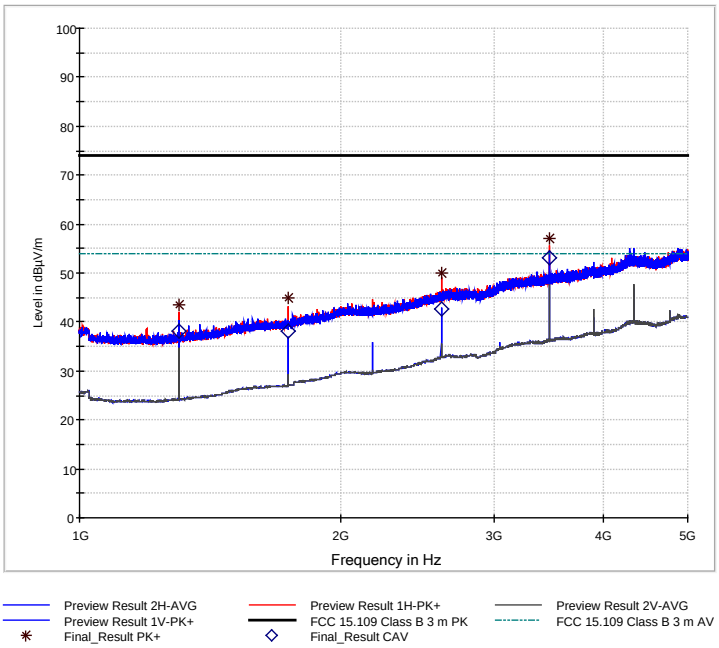
EUT on flat on table



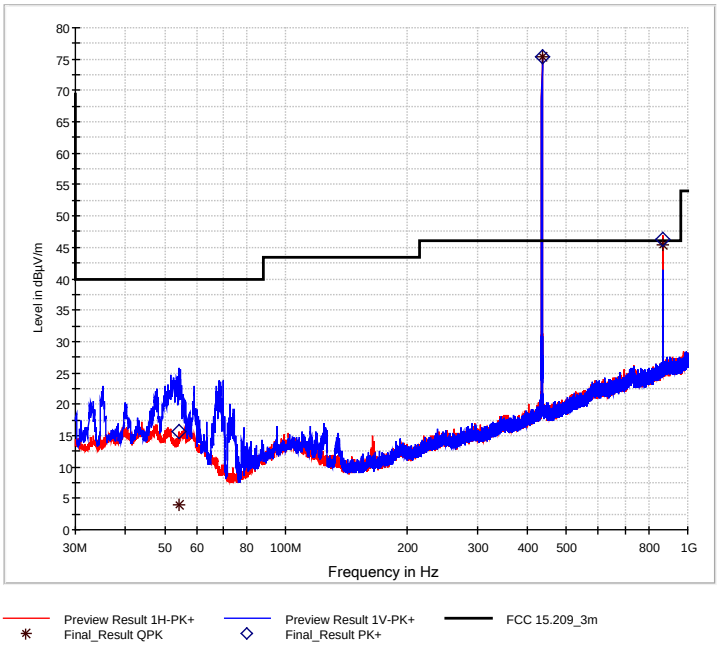
EUT on flat on table



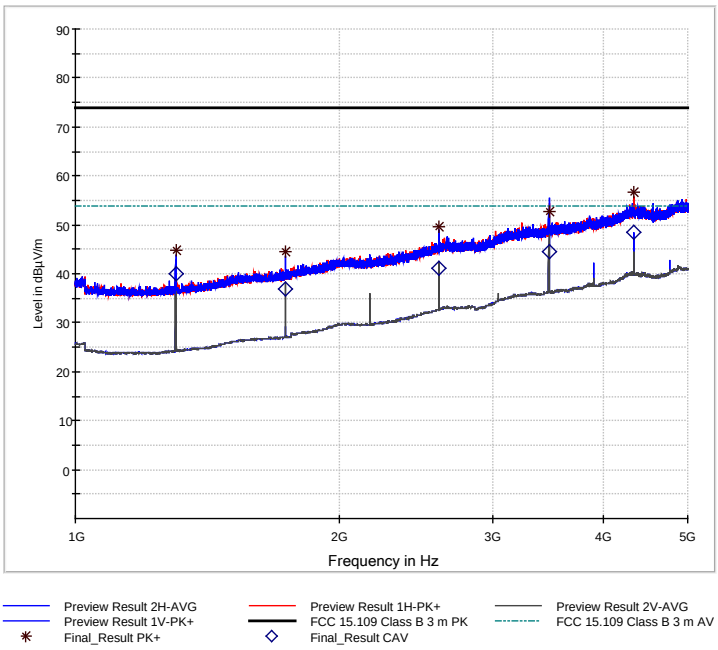
EUT on long side



EUT on long side



EUT in upright position



EUT in upright position

8.10 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[7] 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 by7: $EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP$ = **361 nW** with:				
Field strength in V/m: FS = **60.8 dBµV/m** = **1.096 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 = **361 nW**				

[7] 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.

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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)[8] 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 [9]	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	=	**433.92 MHz**	
Distance:	d	=	**5 mm**	
Transmitter output power:	TP	=	**681 nW**	
Limit:	TP_{limit}	=	**52 mW**	☒

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

[8] The excemption 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.

[9] 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[10] 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 $1.31 \cdot 10^{-2} f^{0.6834}$ 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 = **...** Transmitter output power: TP = **...** Limit: TP_{limit} = **...**				☐
☐ RF exposure evaluation is documented in test report no.				

[10] 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.

Exposure of Humans to RF Fields (continued)

Rules and specifications:	KDB 447498 D1 V06, section 4.3.1
Guide:	47 CFR Sections 2.1091 and 2.1093

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[11] 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 by7:				
$EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP$ = **361 nW**				
with:				
Field strength in V/m: FS = **60.8 dBµV/m** = **1.096 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 = **361 nW**				

[11] 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.

General standalone SAR evaluation					
Unless specified otherwise, standalone 1 g head or body and 10 g extremity SAR evaluation for general population exposure conditions is not required when the corresponding *SAR Test Exclusion Thres*hold condition(s) is (are) satisfied:					
☒ a) For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1 g and 10 g SAR test exclusion thresholds are determined by the following: $\frac{\max power\ of\ channel,incl.tune-up\ tolerance\ [mW]}{min.test\ separation\ distance\ [mm]} \times \sqrt{f\ [GHz]} \leq 3.0$ for 1 g SAR and ≤ 7.5 for 10 g SAR.	☒				
☐ b) For 100 MHz to 6 GHz and test separation distances > 50 mm, the 1 g and 10 g SAR test exclusion thresholds are determined by the following:					
☐ For 100 MHz to 1500 MHz: $\left((Powerallowed\ at\ numeric\ threshold\ for\ 50\ mm) + (test\ separation\ distance - 50\ mm) \times \left(\frac{f[MHz]}{150}\right)\right)[mW]$	☐				
☐ For 1500 MHz to 6 GHz: $\left((Powerallowed\ at\ numeric\ threshold\ for\ 50\ mm) + (test\ separation\ distance - 50\ mm) \times 10\right)[mW]$	☐				
☐ c) For frequencies below 100 MHz					
☐ 1) For test separation distances > 50 mm and < 200 mm, the power threshold at the corresponding test separation distance at 100 MHz in step b) is multiplied by $1 + \log(100/f[MHz])$	☐				
☐ 2) For test separation distances ≤ 50 mm, the power threshold determined by the equation in c)1) for 50 mm and 100 MHz is multiplied by ½.	☐				
☐ 3)	☐				
Carrier frequency: *f* = **433.92 MHz**				☒	
Distance: *d* = **5 mm**			☒		
Transmitter output power: *TP* = **0.0004 mW**				☒	
STET = **(0.0004 [mW] / 5 [mm]) √(0.43392 [GHz])**					
= **0.00005**					
Limit: *STET* $_{limit}$ = **3.0**					☒
☐ SAR 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, 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
☒	KDB 447498 D01	RF Exposure procedures and equipment authorization policies for mobile and portable devices.	October 2015

10 Test Equipment List with Calibration Data

Type	*Inv.-No.*	*Type Designation*	*Serial Number*	*Manufacturer*	*Calibration Organization*	*Last Calibration*	*Next Calibration*
EMI test receiver	22643	ESR7	101713	Rohde & Schwarz	Rohde & Schwarz	2016/11	2017/11
Spectrum analyser	1666	FSP30	100063	Rohde & Schwarz	Rohde & Schwarz	2016/07	2017/07
Double ridged horn antenna	2073	HF907	100154	Rohde & Schwarz	Rohde & Schwarz	06/2015	06/2017
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

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	2017-06-23	M. Steindl	First Edition
2	2017-07-21	M. Steindl	Altered ISED SAR calculation from > 20 cm to 5 mm. Added SAR calculation and reference acc. To KDB 447498 D01