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July 6, 2015

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Prüfbericht / Test Report

Nr. / No. 13089-55841-01 (Edition 4)

Applicant: ALLIGATOR Ventilfabrik GmbH
Type of equipment: Tire Pressure Sensor
Type designation: 030860 (sens.it HD)
Order No.: 210613
Test standards: FCC Code of Federal Regulations,
CFR 47, Part 15,
Sections 15.205, 15.207, 15.215 and 15.231

Note:

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



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1 Description of the Equipment Under Test (EUT)

General data of EUT	
Type designation ¹ :	030860 (sens.it HD)
Parts ² :	
Serial number(s):	Test Sample No. 10
Manufacturer:	ALLIGATOR Ventilfabrik GmbH
Type of equipment:	Tire Pressure Sensor
Version:	As receiveds
FCC ID:	YMY-030860
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:	---
Pulse width:	---
Number of RF-channels:	1
Channel spacing:	---
Designation of emissions ³ :	180KF1D
Type of antenna:	Integrated
Size/length of antenna:	N/A
Connection of antenna:	<input type="checkbox"/> detachable <input checked="" type="checkbox"/> 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):	ALLIGATOR Ventilfabrik GmbH Richard-Steiff-Straße 4 D-89537 Giengen/Brenz
Contact person:	Mr. Dennis Eickenhorst
Order number:	210613
Receipt of EUT:	2015-01-30
Date(s) of test:	2015-01-30 to 2015-02-11
Note(s):	

Report details

Report number:	13089-55841-01
Edition:	4
Issue date:	2015-07-06



3 Identification of the Test Laboratory

Details of the Test Laboratory

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



4 Summary

Summary of test results

The tested sample complies with the requirements set forth in the

Code of Federal Regulations CFR 47, Part 15, Sections 15.205, 15.207, 15.215 and 15.231(a)-(e)
of the Federal Communication Commission (FCC).

Personnel involved in this report

Laboratory Manager:

A handwritten signature in blue ink, appearing to read 'J. Roidt'.

Mr. Johann Roidt

Responsible for testing:

A handwritten signature in blue ink, appearing to read 'Steindl Martin'.

Mr. Martin Steindl

Responsible for test report:

Mr. Martin Steindl



5 Operation Mode and Configuration of EUT

Operation Mode(s)

Transmitting continuously: The transmitter was triggered externally by a LF transmitter (125 kHz) for transmitting continuously.

According to the applicant the transmitting at 434 MHz when externally triggered is equal to all other operation modes regarding to modulation, frequency and transmitting power.

Configuration(s) of EUT

The EUT was configured in test mode as externally triggered device for alarm mode.

Continuous transmitting in stand alone mode for normal mode.

List of ports and cables

<i>Port</i>	<i>Description</i>	<i>Classification⁴</i>	<i>Cable type</i>	<i>Cable length</i>

List of devices connected to EUT

<i>Item</i>	<i>Description</i>	<i>Type Designation</i>	<i>Serial no. or ID</i>	<i>Manufacturer</i>

List of support devices

<i>Item</i>	<i>Description</i>	<i>Type Designation</i>	<i>Serial no. or ID</i>	<i>Manufacturer</i>
1	RF/LF Development-Tool	AH02Z89Z	V1.03.01 20140525	N/A
2	Laptop PC	---	---	DELL

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) ANSI C63.10, section 6.9.1
Guide:	ANSI C63.10
Measurement setup:	<input type="checkbox"/> Conducted: See below <input checked="" type="checkbox"/> Radiated: Radiated Emission in Fully or Semi Anechoic Room (6.4)
<p>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.</p> <p>If radiated measurements are performed the same test setups and instruments are used as with radiated emission measurements for the appropriate frequency range.</p> <p>The analyzer settings are specified by the test description of the appropriate test record(s).</p>	

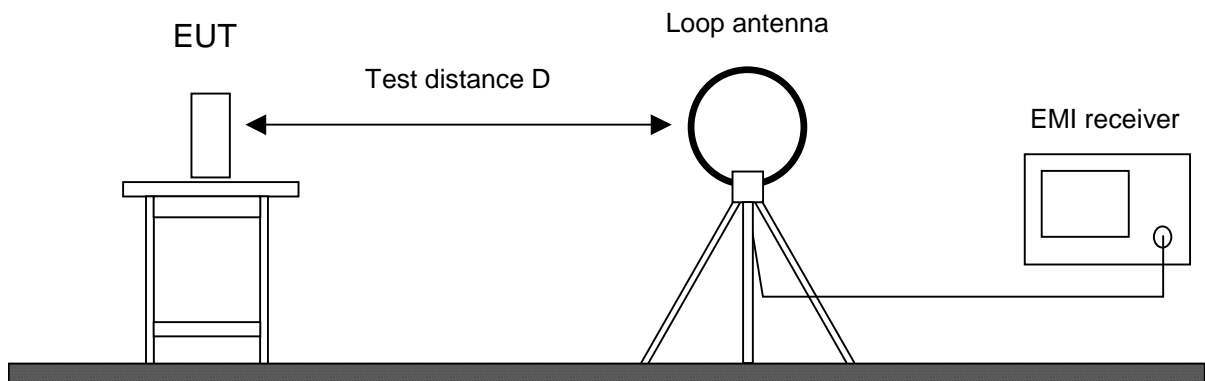


6.2 Pulse Train Measurement

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.35(c)
Guide:	ANSI C63.10
Measurement setup:	<input type="checkbox"/> Conducted: See below (direct connection or via test fixture) <input checked="" type="checkbox"/> Radiated: Radiated Emission in Fully or Semi Anechoic Room (6.4)
<p>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.</p> <p>If antenna is not detachable a test fixture may be used instead of direct connection to RF output terminals.</p> <p>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.</p>	

6.3 Radiated Emission Measurement 9 kHz to 30 MHz

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.35(c)
Guide:	ANSI C63.10
<p>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.</p> <p>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.</p> <p>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).</p> <p>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.</p> <p>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.</p>	



Test instruments used:

Type	Designation	Inv.-no.	Serial No. or ID	Manufacturer
<input type="checkbox"/> Spectrum analyzer	FSP30	1666	100036	Rohde & Schwarz
<input type="checkbox"/> EMI test receiver	ESMI	1569	839379/013 839587/006	Rohde & Schwarz
<input checked="" type="checkbox"/> Test receiver	ESHS 10	1028	860043/016	Rohde & Schwarz
<input type="checkbox"/> EMI test receiver	ESU8	2044	100232	Rohde & Schwarz
<input type="checkbox"/> Preamplifier Cabin no. 2	CPA9231A	1716	3557	Schaffner
<input checked="" type="checkbox"/> Loop antenna	HFH2-Z2	1016	882964/1	Rohde & Schwarz
<input type="checkbox"/> Microwave cable Cabin no. 2	UFA210A-FG	1681	23516	Rosenberger Micro-Coax
<input type="checkbox"/> Microwave cable Cabin no. 2	KKSF1040016	2020	289854/4	Huber + Suhner
<input type="checkbox"/> Microwave cable Cabin no. 2	FA210AF020000000	2060	64566-2	Rosenberger Micro-Coax
<input checked="" type="checkbox"/> Microwave cable Cabin no. 8	EF393	2053	---	Albatross Projects
<input type="checkbox"/> Microwave cable Cabin no. 8	FB293C1050005050	2054	63834-1	Rosenberger Micro-Coax
<input type="checkbox"/> Microwave cable Cabin no. 8	FB293C1080005050	2055	63833-1	Rosenberger Micro-Coax
<input type="checkbox"/> Microwave cable Cabin no. 8	LCF12-50	2057	P1.3.9	RFS
<input type="checkbox"/> Microwave cable Cabin no. 8	LCF12-50	2057	P1.4.12	RFS
<input checked="" type="checkbox"/> Microwave cable Cabin no. 8	LCF12-50	2057	P1.6.19	RFS
<input type="checkbox"/> Microwave cable Cabin no. 8	FA210AF040005050G	2127	72061-01	Rosenberger Micro-Coax
<input type="checkbox"/> Microwave cable Cabin no. 8	FA210AF04000505G	2056	64567-01	Rosenberger Micro-Coax
<input checked="" type="checkbox"/> Microwave cable Cabin no. 8	FA210AF04000505	2068	64610-1	Rosenberger Micro-Coax
<input type="checkbox"/> Fully anechoic room	No. 2	1452	---	Albatross
<input type="checkbox"/> Semi anechoic room	No. 3	1453	---	Siemens
<input checked="" type="checkbox"/> Semi anechoic room	No. 8	2057	---	Albatross

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

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).

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 are used.

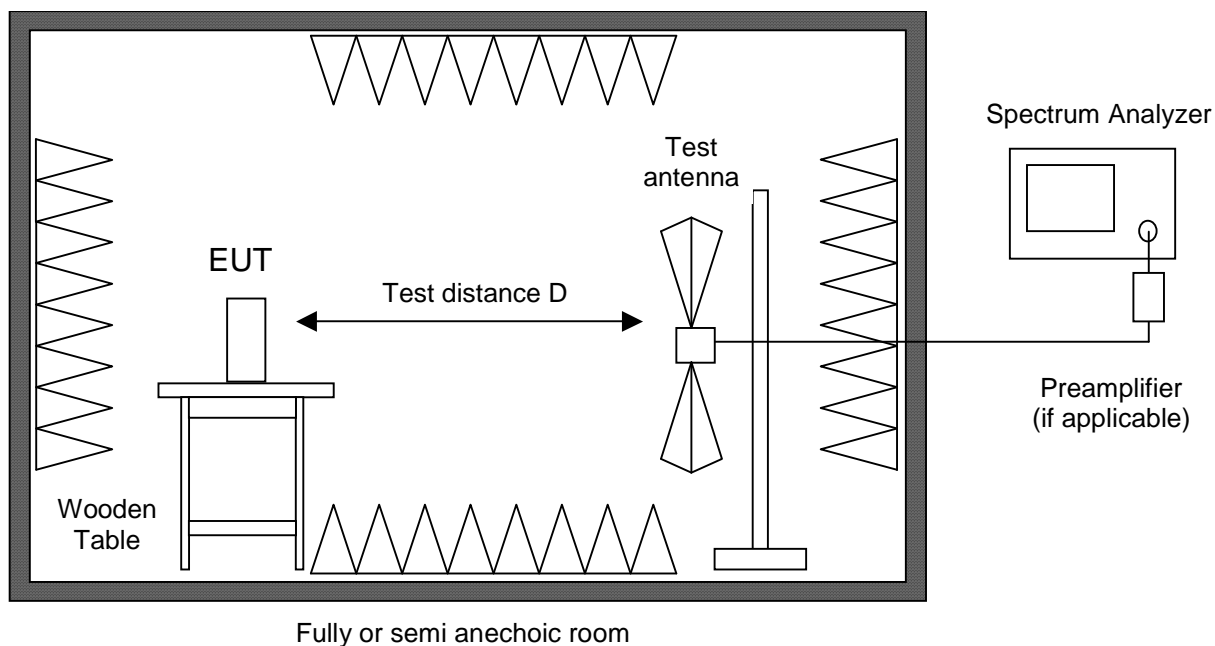
All tests below 8.2 GHz are performed at a test distance D of 3 meters. For higher frequencies the test distance may be reduced (e.g. to 1 meter) due to the sensitivity of the measuring instrument(s) and the test results are calculated according to CFR 47 Part 15 section 15.31(f)(1) using an extrapolation 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 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
<input checked="" type="checkbox"/>	Spectrum analyzer	FSP30	1666	100036	Rohde & Schwarz
<input type="checkbox"/>	EMI test receiver	Cabin no. 3 ESPI7	2010	101018	Rohde & Schwarz
<input type="checkbox"/>	EMI test receiver	ESU8	2044	100232	Rohde & Schwarz
<input type="checkbox"/>	EMI test receiver	ESMI	1569	839379/013 839587/006	Rohde & Schwarz
<input checked="" type="checkbox"/>	Preamplifier	Cabin no. 2 CPA9231A	1716	3557	Schaffner
<input type="checkbox"/>	Preamplifier	R14601	1142	13120026	Advantest
<input checked="" type="checkbox"/>	Preamplifier (1 - 8 GHz)	AFS3-00100800-32-LN	1684	847743	Miteq
<input type="checkbox"/>	Preamplifier (0.5 - 8 GHz)	AMF-4D-005080-25-13P	1685	860149	Miteq

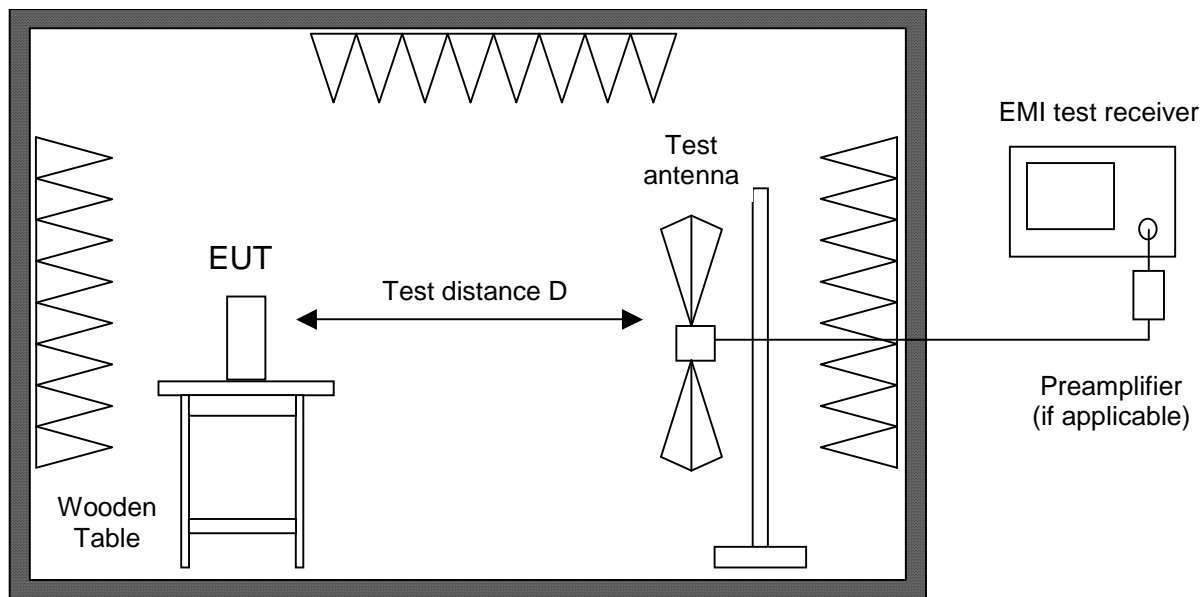


Type	Designation	Inv.-no.	Serial No. or ID	Manufacturer
<input type="checkbox"/> Preamplifier (8 - 18 GHz)	ACO/180-3530	1484	32641	CTT
<input type="checkbox"/> External Mixer	WM782A	1576	845881/005	Tektronix
<input type="checkbox"/> Harmonic Mixer Accessories	FS-Z30	1577	624413/003	Rohde & Schwarz
<input type="checkbox"/> Trilog antenna Cabin no. 2	VULB 9163	1802	9163-214	Schwarzbeck
<input type="checkbox"/> Trilog antenna Cabin no. 3	VULB 9163	1722	9163-188	Schwarzbeck
<input type="checkbox"/> Trilog antenna Cabin no. 8	VULB 9163	2058	9163-408	Schwarzbeck
<input checked="" type="checkbox"/> Trilog antenna Cabin no. 2	VULB 9162	2256	9162-048	Schwarzbeck
<input checked="" type="checkbox"/> Horn antenna	3115	1516	9508-4553	EMCO
<input type="checkbox"/> Horn antenna	3160-03	1010	9112-1003	EMCO
<input type="checkbox"/> Horn antenna	3160-04	1011	9112-1001	EMCO
<input type="checkbox"/> Horn antenna	3160-05	1012	9112-1001	EMCO
<input type="checkbox"/> Horn antenna	3160-06	1013	9112-1001	EMCO
<input type="checkbox"/> Horn antenna	3160-07	1014	9112-1008	EMCO
<input type="checkbox"/> Horn antenna	3160-08	1015	9112-1002	EMCO
<input type="checkbox"/> Horn antenna	3160-09	1265	9403-1025	EMCO
<input type="checkbox"/> Horn antenna	3160-10	1575	399185	EMCO
<input checked="" type="checkbox"/> Microwave cable Cabin no. 2	UFA210A-FG	1681	23516	Rosenberger Micro-Coax
<input checked="" type="checkbox"/> Microwave cable Cabin no. 2	KKSF1040016	2020	289854/4	Huber + Suhner
<input checked="" type="checkbox"/> Microwave cable Cabin no. 2	FA210AF020000000	2060	64566-2	Rosenberger Micro-Coax
<input type="checkbox"/> Microwave cable Cabin no. 8	EF393	2053	---	Albatross Projects
<input type="checkbox"/> Microwave cable Cabin no. 8	FB293C1050005050	2054	63834-1	Rosenberger Micro-Coax
<input type="checkbox"/> Microwave cable Cabin no. 8	FB293C1080005050	2055	63833-1	Rosenberger Micro-Coax
<input type="checkbox"/> Microwave cable Cabin no. 8	LCF12-50	2057	P1.3.9	RFS
<input type="checkbox"/> Microwave cable Cabin no. 8	LCF12-50	2057	P1.4.12	RFS
<input type="checkbox"/> Microwave cable Cabin no. 8	LCF12-50	2057	P1.6.19	RFS
<input type="checkbox"/> Microwave cable Cabin no. 8	FA210AF040005050G	2127	72061-01	Rosenberger Micro-Coax
<input type="checkbox"/> Microwave cable Cabin no. 8	FA210AF04000505G	2056	64567-01	Rosenberger Micro-Coax
<input type="checkbox"/> Microwave cable Cabin no. 8	FA210AF04000505	2068	64610-1	Rosenberger Micro-Coax
<input checked="" type="checkbox"/> Fully anechoic room	No. 2	1452	---	Albatross
<input type="checkbox"/> Semi anechoic room	No. 3	1453	---	Siemens
<input type="checkbox"/> Semi anechoic room	No. 8	2057	---	Albatross



6.5 Radiated Emission at Alternative Test Site

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, sections 15.215(b) and 15.231
Guide:	ANSI C63.10
<p>Radiated emission in the frequency range 30 MHz to 1 GHz is measured within a semi-anechoic room with groundplane complying with the NSA requirements of ANSI C63.4 for alternative test sites. A linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna") is used. The measurement bandwidth of the test receiver is set to 120 kHz with quasi-peak detector selected.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>With detector of the test receiver set to quasi-peak final measurements are performed immediately after frequency zoom (for drifting disturbances) and maximum adjustment.</p> <p>Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.</p> <p>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 discharged 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.</p> <p>Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.</p> <p>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.</p>	



Alternate test site (semi anechoic room)

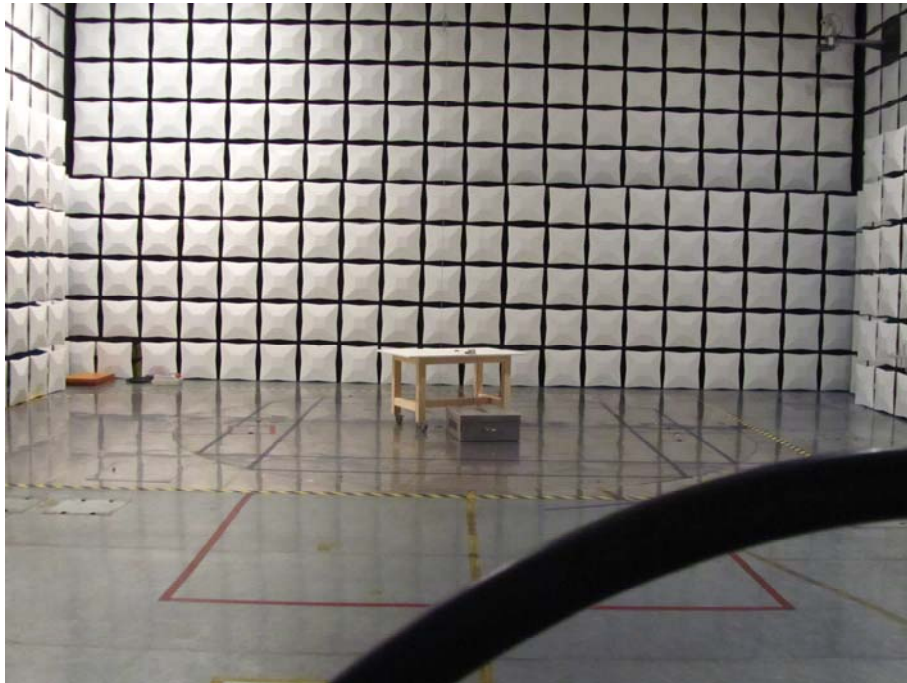
Test instruments used:

Type	Designation	Inv.-no.	Serial No. or ID	Manufacturer
<input checked="" type="checkbox"/> EMI test receiver	ESU8	2044	100232	Rohde & Schwarz
<input checked="" type="checkbox"/> Trilog antenna Cabin no. 8	VULB 9163	2058	9163-408	Schwarzbeck
<input checked="" type="checkbox"/> Microwave cable Cabin no. 8	EF393	2053	---	Albatross Projects
<input type="checkbox"/> Microwave cable Cabin no. 8	LCF12-50	2057	P1.6.19	RFS
<input checked="" type="checkbox"/> Microwave cable Cabin no. 8	LCF12-50	2057	P1.3.9	RFS
<input type="checkbox"/> Microwave cable Cabin no. 8	FA210AF04000505	2068	64610-1	Rosenberger Micro-Coax
<input checked="" type="checkbox"/> Microwave cable Cabin no. 8	FA210AF040005050G	2127	72061-01	Rosenberger Micro-Coax
<input checked="" type="checkbox"/> Semi anechoic room	No. 8	2057	---	Albatross



7 Photographs Taken During Testing

Test setup for radiated emission measurement 9 kHz – 30 MHz



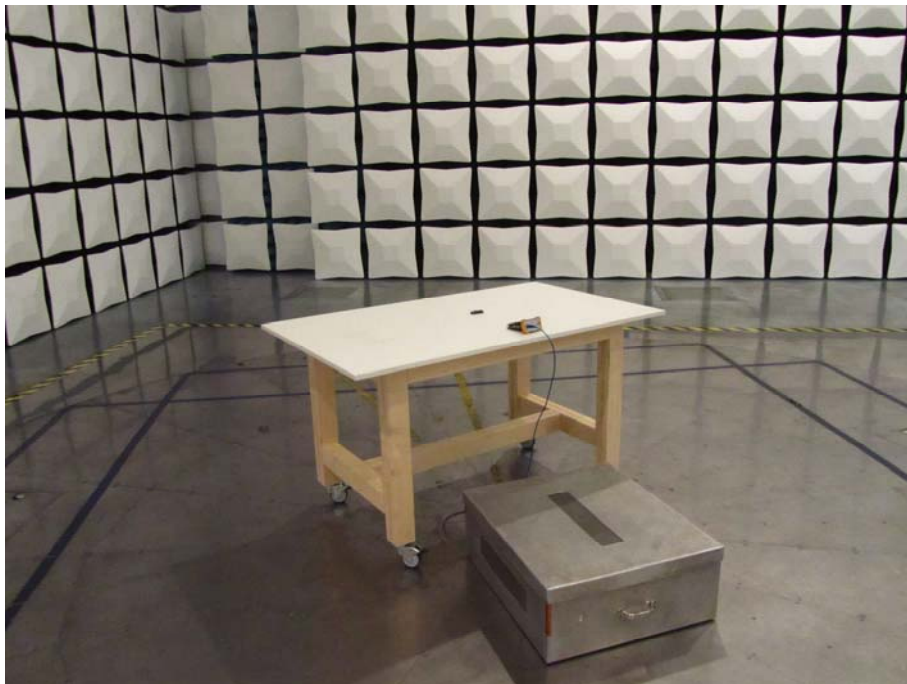
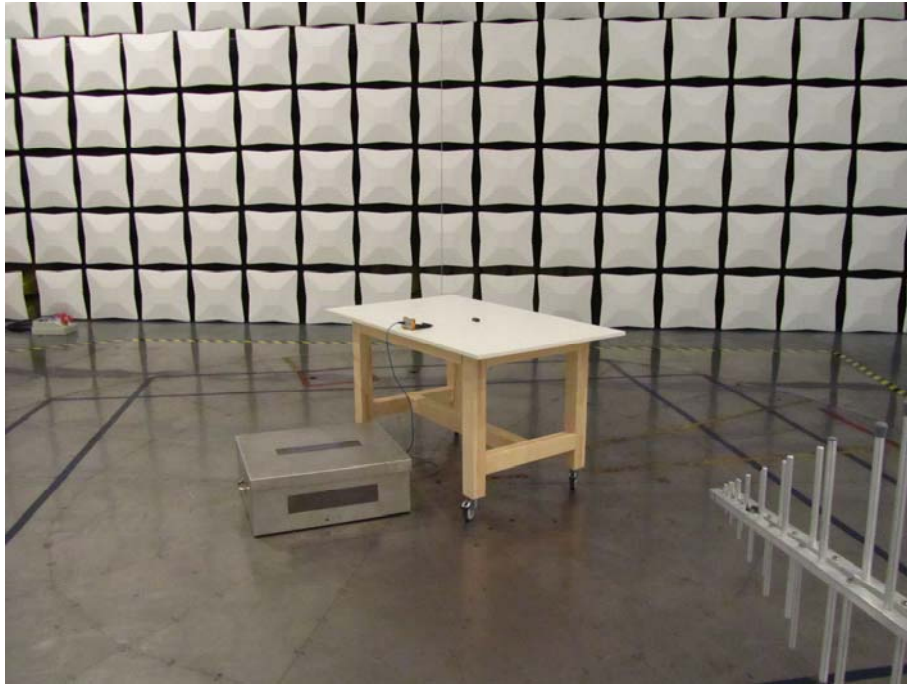
Test setup for radiated emission measurement (fully anechoic room)



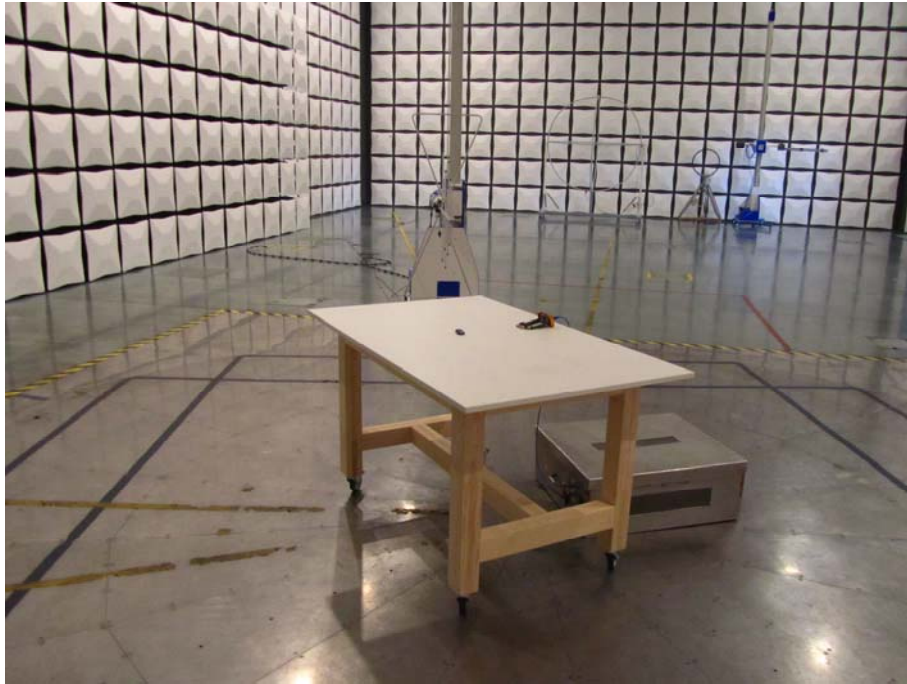
Test setup for radiated emission measurement (fully anechoic room) – continued -



Test setup for radiated emission measurement (alternate test site)



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



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





8 Test Results

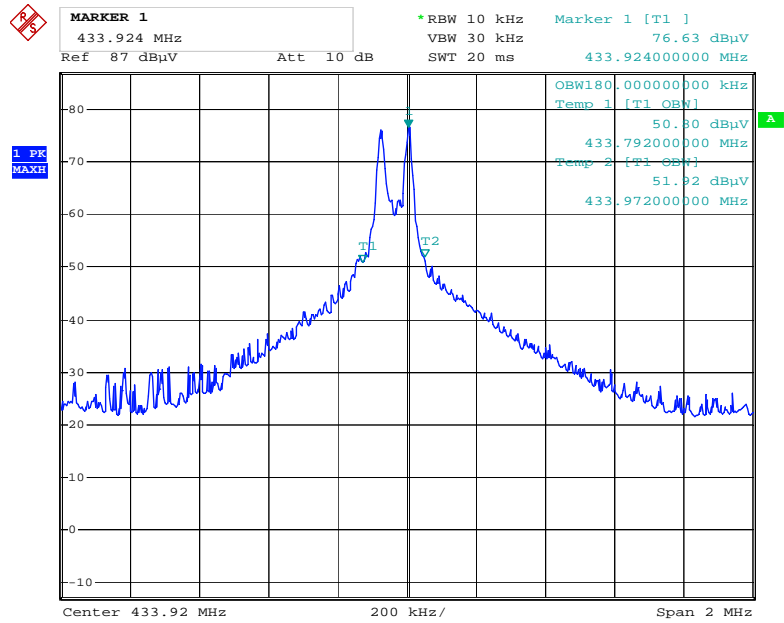
FCC CFR 47 Parts 2 and 15			
Section(s)	Test	Page	Result
2.1046(a)	Conducted output power	---	Not applicable
2.202(a)	Occupied bandwidth	25	Recorded
15.215(c) 15.231(c)	Bandwidth of the emission	27	Test passed
2.201, 2.202	Class of emission	29	Calculated
15.35(c)	Pulse train measurement for pulsed operation	30	Recorded
15.205(a)	Restricted bands of operation	34	Test passed
15.207	Conducted AC powerline emission 150 kHz to 30 MHz	---	Not applicable
15.231(a) 15.231(e)	Periodic operation requirements	35	Test passed
15.205(b) 15.231(b) 15.231(e)	Radiated emission 9 kHz to 30 MHz	39	Test passed
15.205(b) 15.215(b) 15.231(b) 15.231(e)	Radiated emission 30 MHz to 4.5 GHz	42	Test passed
15.231(d)	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:	<p>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.</p> <p>The occupied bandwidth according to ANSI C63.4, annex H.6; is measured as the frequency range defined by the points that are 26 dB down relative to the maximum level of the modulated carrier.</p> <p>The resolution bandwidth of the spectrum analyzer shall be set to a value greater than 5.0% of the allowed bandwidth. If no bandwidth specifications are given, the following guidelines are used:</p>	
	Fundamental frequency	Minimum resolution bandwidth
	9 kHz to 30 MHz	1 kHz
	30 MHz to 1000 MHz	10 kHz
	1000 MHz to 40 GHz	100 kHz
	The video bandwidth shall be at least three times greater than the resolution bandwidth.	
Measurement procedure:	Bandwidth Measurements (6.1)	

Comment:	
Date of test:	2015-02-11
Test site:	Fully anechoic room, cabin no. 2

Occupied Bandwidth (99 %):



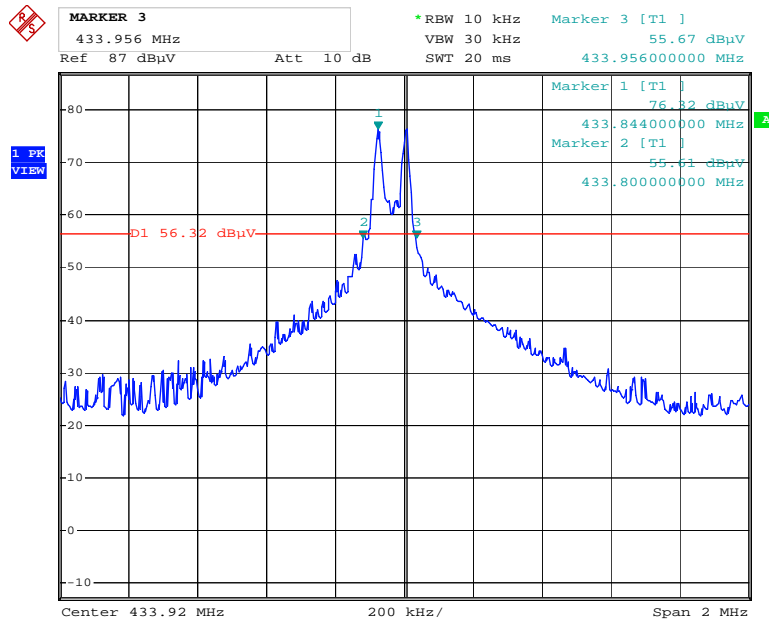
Date: 11.FEB.2015 17:12:28



8.2 Bandwidth of the Emission

Rules and specifications:	CFR 47 Part 15, section 15.215(c)	
Guide:	ANSI C63.10	
Description:	<p>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.</p> <p>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.</p> <p>The resolution bandwidth of the spectrum analyzer shall be set to a value greater than 5.0% of the allowed bandwidth. If no bandwidth specifications are given, the following guidelines are used:</p>	
	Fundamental frequency	Minimum resolution bandwidth
	9 kHz to 30 MHz	1 kHz
	30 MHz to 1000 MHz	10 kHz
	1000 MHz to 40 GHz	100 kHz
	The video bandwidth shall be at least three times greater than the resolution bandwidth.	
Measurement procedure:	Bandwidth Measurements (6.1)	

Comment:	
Date of test:	2015-02-11
Test site:	Fully anechoic room, cabin no. 2



Date: 11.FEB.2015 17:14:45

Permitted frequency band:	433.05 MHz - 434.79 MHz	
20 dB bandwidth:	156 kHz	
Carrier frequency stability:	<input type="checkbox"/> specified	<input checked="" type="checkbox"/> not specified
Maximum frequency tolerances:	---	
Bandwidth of the emission:	156 kHz	within permitted frequency band⁵: <input checked="" type="checkbox"/> yes <input type="checkbox"/> no

Test Result:	Test passed
--------------	-------------

⁵ 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
Guide:	ANSI C63.10 / TRC-43

Type of modulation:	Frequency Shift Keying (FSK)
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B_n = Necessary Bandwidth	$B_n = 2DK + B$
D = Peak deviation	D = 38 kHz
K = Overall numerical factor	K = 1
B = Modulation rate	B = 104 kHz
Calculation:	$B_n = 2 \cdot (38 \text{ kHz}) \cdot 1 + (104 \text{ kHz}) = 180 \text{ kHz}$

Designation of Emissions:	180KF1D
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8.4 Pulse Train Measurement

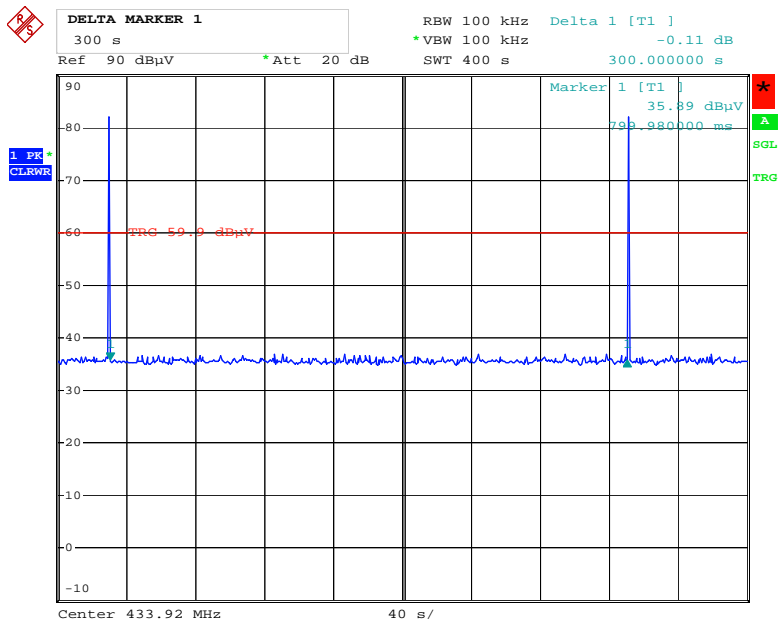
Rules and specifications:	CFR 47 Part 15, section 15.35(c)
Guide:	ANSI C63.10
Measurement procedure:	Pulse Train Measurement (6.2)

Comment:	Normal mode
Date of test:	2015-06-25
Test site:	Fully anechoic room, cabin no. 2

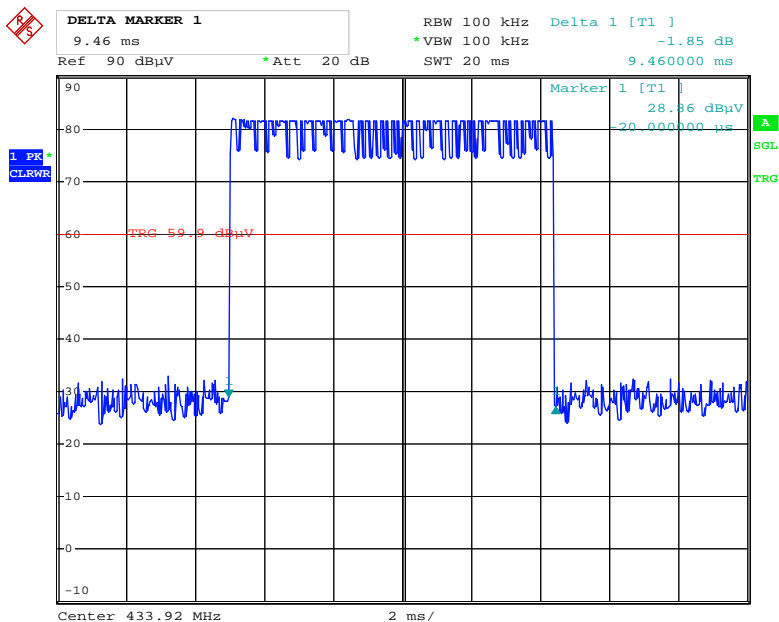
Calculation of pulse train correction:

TX-On-Time (worst case):	T_{on}	=	9.46 ms
Pulse Train Time:	T_{pt}	=	300 s
Period Time:	T_{period}	=	100 ms
Pulse Train Correction:	C_{pt}	=	$20 \cdot \text{Log}(T_{on} / T_{period})$ dB -20.48 dB
	$C_{pt,used}$	=	-20 dB

Total Pulse Train:



Date: 25.JUN.2015 14:50:21



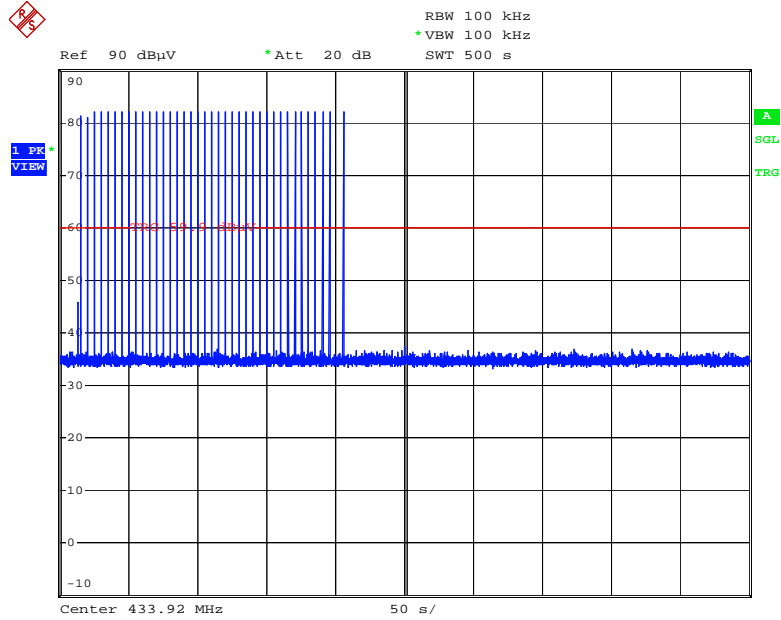
Date: 25.JUN.2015 14:26:41

Comment:	Alarm mode
Date of test:	2015-06-25
Test site:	Fully anechoic room, cabin no. 2

Calculation of pulse train correction:

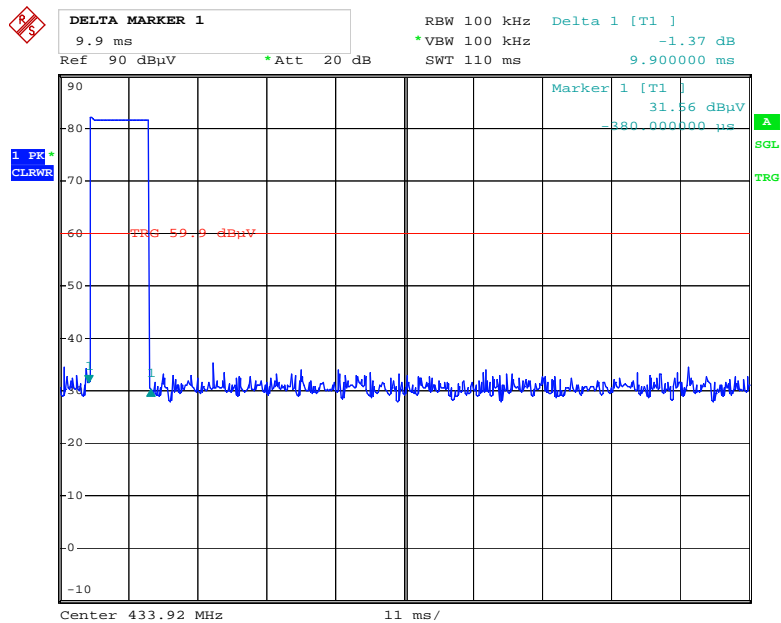
TX-On-Time (worst case):	T_{on}	=	9.9 ms
Pulse Train Time:	T_{pt}	=	5 s
Period Time:	T_{period}	=	100 ms
Pulse Train Correction:	C_{pt}	=	$20 \cdot \text{Log}(T_{on} / T_{period})$ dB
		=	-20.09 dB
	$C_{pt,used}$	=	-20 dB

Total Pulse Train:



Date: 25.JUN.2015 13:56:32

Worst case 0.1 second interval:

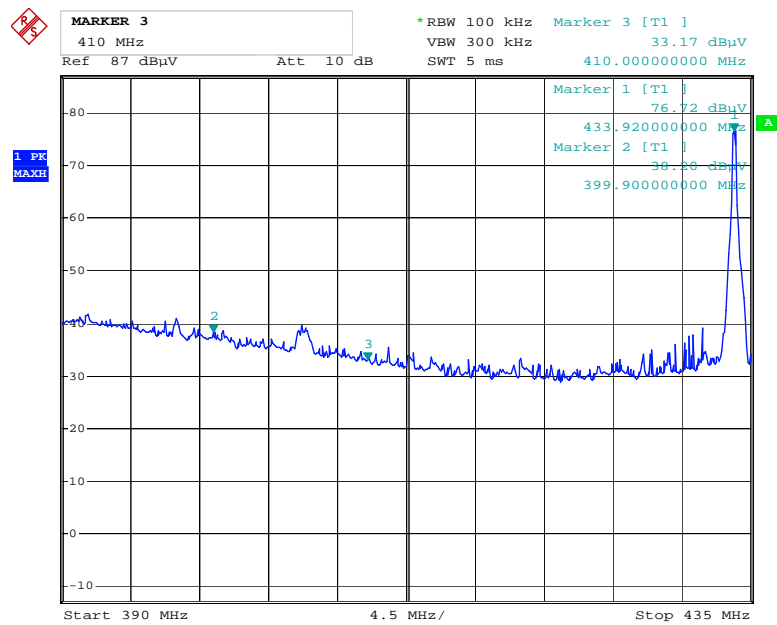


Date: 25.JUN.2015 14:01:38

8.5 Restricted Bands of Operation

Rules and specifications:	CFR 47 Part 15, section 15.205(a)
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).
Measurement procedure:	Radiated Emission in Fully or Semi Anechoic Room (6.4)

Comment:	
Date of test:	2015-02-11
Test site:	Fully anechoic room, cabin no. 2
Test distance:	3 meters



Date: 11.FEB.2015 17:16:33

Test Result:

Test passed

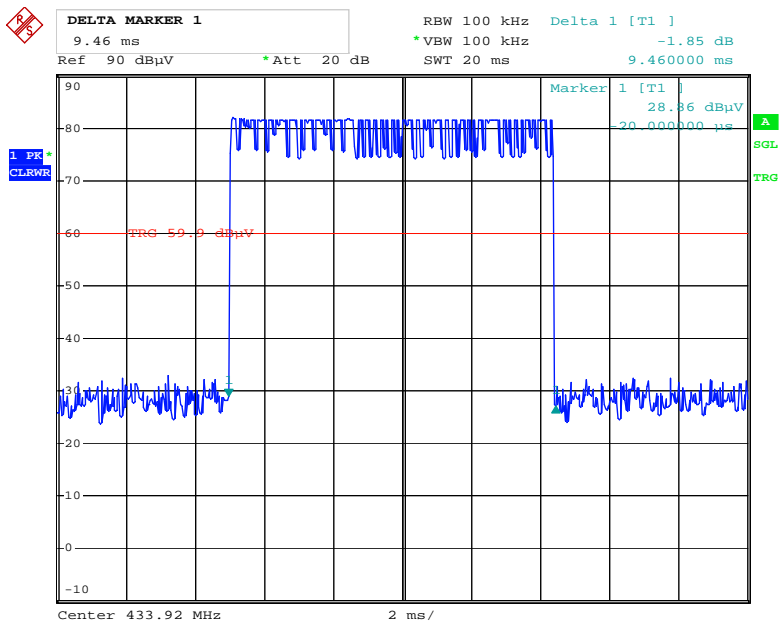
8.6 Periodic Operation Requirements

Rules and specifications:	CFR 47 Part 15, section 15.231(a) and (e)
Guide:	---

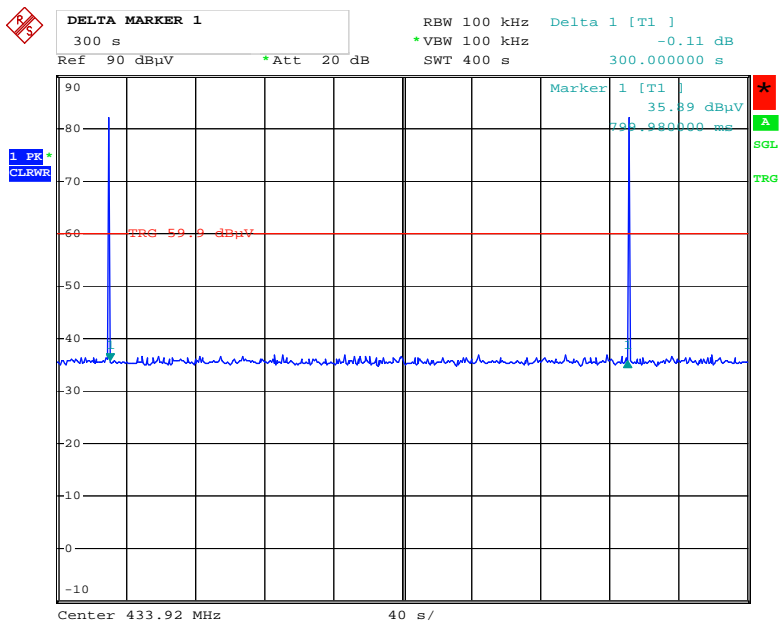
Normal mode:

Periodic operation requirements	Applicable	Declared by applicant	Test performed	Passed
The transmitter is used for				
<input checked="" type="checkbox"/> security or safety applications <input type="checkbox"/> other applications		<input checked="" type="checkbox"/>		
The transmitter is operated				
<input type="checkbox"/> manually <input checked="" type="checkbox"/> automatically		<input checked="" type="checkbox"/>		
Periodic operation according to				
<input type="checkbox"/> CFR 47 Part 15, section 15.231(a)				
Only control signals are sent and there is no continuous transmission	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A manually operated transmitter employs a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A transmitter activated automatically ceases transmission within 5 seconds after activation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Periodic transmissions at regular predetermined intervals are <input type="checkbox"/> not performed <input type="checkbox"/> 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)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> CFR 47 Part 15, section 15.231(e)				
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.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

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.



Date: 25.JUN.2015 14:26:41



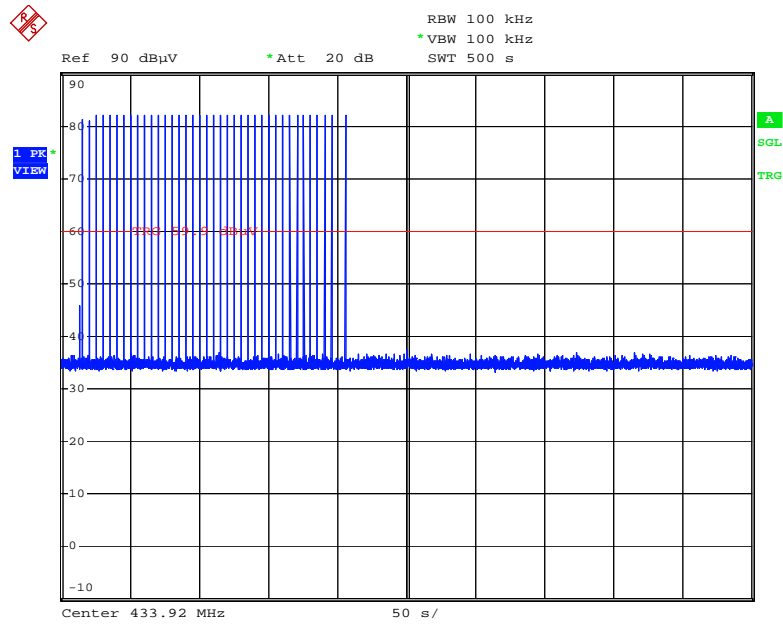
Date: 25.JUN.2015 14:50:21

Alarm mode:

Periodic operation requirements	Applicable	Declared by applicant	Test performed	Passed
The transmitter is used for				
<input checked="" type="checkbox"/> security or safety applications <input type="checkbox"/> other applications		<input checked="" type="checkbox"/>		
The transmitter is operated				
<input type="checkbox"/> manually <input checked="" type="checkbox"/> automatically		<input checked="" type="checkbox"/>		
Periodic operation according to				
<input checked="" type="checkbox"/> CFR 47 Part 15, section 15.231(a)				
Only control signals are sent and there is no continuous transmission	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A manually operated transmitter employs a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A transmitter activated automatically ceases transmission within 5 seconds after activation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Periodic transmissions at regular predetermined intervals are <input type="checkbox"/> not performed <input type="checkbox"/> 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)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/> CFR 47 Part 15, section 15.231(e)				
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.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

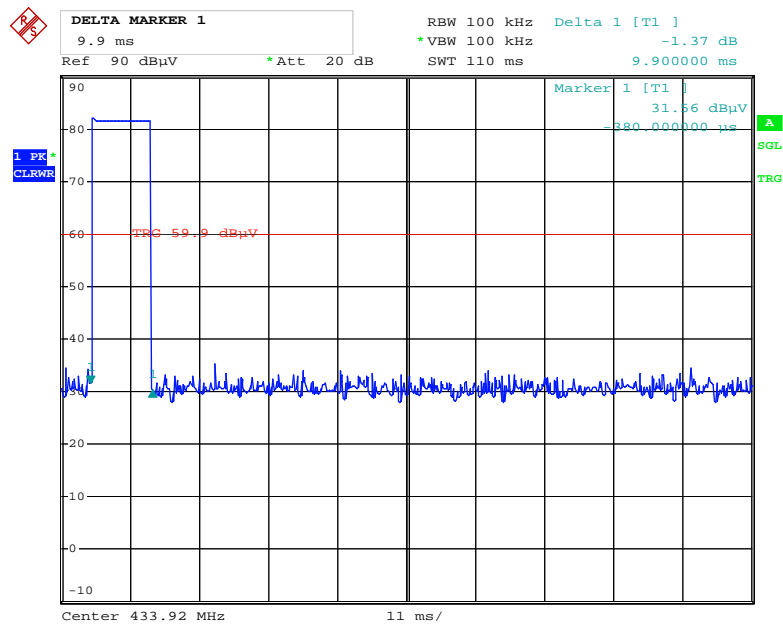
After 37 transmissions within approximately 200 seconds the EUT performs a fall-back into normal mode.

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.



Date: 25.JUN.2015 13:56:32

Note: After 37 transmissions within approximately 200 seconds the EUT performs a fall-back into normal mode.



Date: 25.JUN.2015 14:01:38



8.7 Radiated Emission Measurement 9 kHz to 30 MHz

Rules and specifications:	CFR 47 Part 15, sections 15.215(b) and 15.231(b)(3) and (e)			
Guide:	ANSI C63.10			
Limit:	Frequency of Emission (MHz)	Field Strength ($\mu\text{V}/\text{m}$)	Field Strength ($\text{dB}\mu\text{V}/\text{m}$)	Measurement Distance d (meters)
	0.009 - 0.490	$2400/F(\text{kHz})$	$67.6 - 20 \cdot \log(F(\text{kHz}))$	300
	0.490 - 1.705	$24000/F(\text{kHz})$	$87.6 - 20 \cdot \log(F(\text{kHz}))$	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)			

Test Result:	Test passed
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Comment:	Emission at 124.5 kHz is caused by external trigger system. This emission is not evaluated. Alarm mode; Limits according § 15.231(b)
Date of test:	2015-01-30
Test site:	Open field test site

Test Result:	Test passed
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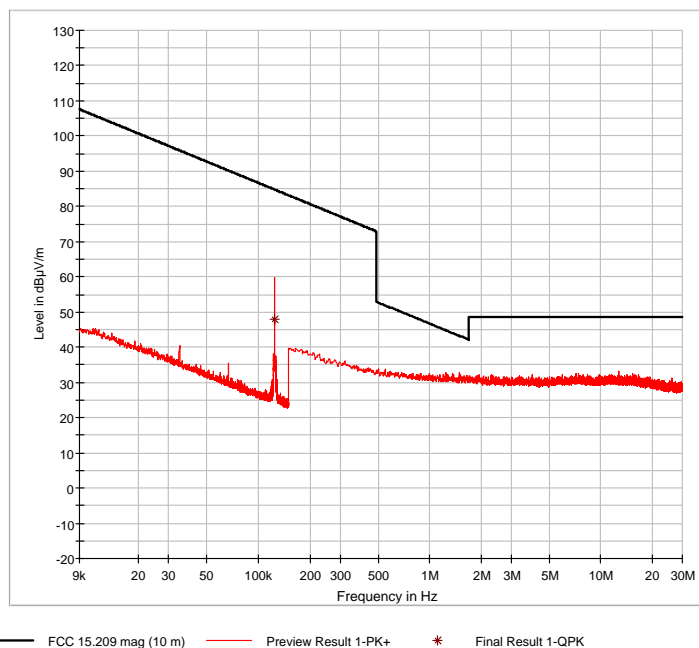
Extrapolation factor:		-40 dB/decade									
Frequency (MHz)	Detector	Distance		Reading Value (dBµV)	Correction Factor (dB/m)	Extrapolation Factor (dB)	Pulse Train Correction (dB)	Final Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)	
		d1 (m)	d (m)								
0.12450	Quasi-Peak	10	300	27.9	20.0	-59.1		-11.1	25.7	36.8	

Sample calculation of final values:

Extrapolation Factor (dB) = (Log(d) - Log(d₁)) · Extrapolation Factor (dB/decade)

Final Value (dBµV/m) = Reading Value d₁ (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.



Comment:	Normal mode; Limits according § 15.231(e)
Date of test:	2015-06-25
Test site:	Open field test site

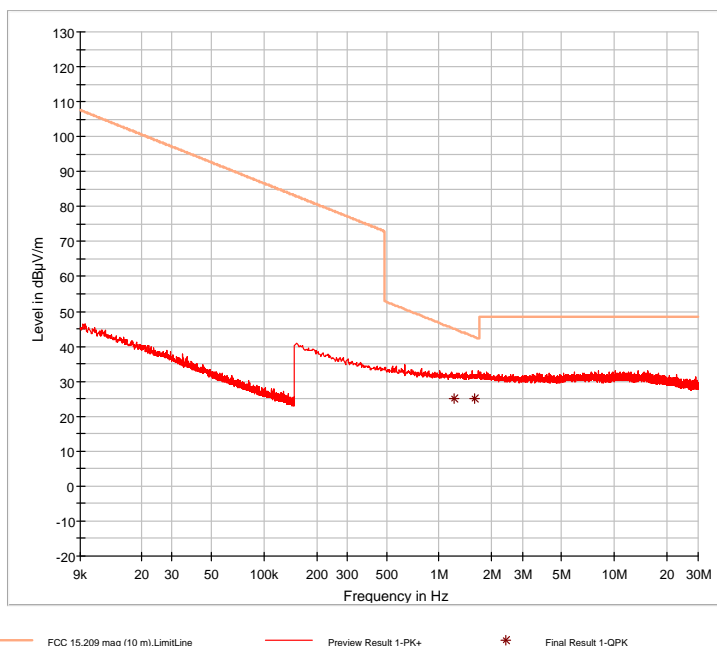
Test Result:	Test passed
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No emissions above noise level detected

Sample calculation of final values:

$$\begin{aligned} \text{Extrapolation Factor (dB)} &= (\text{Log}(d) - \text{Log}(d_1)) \cdot \text{Extrapolation Factor (dB/decade)} \\ \text{Final Value (dB}\mu\text{V/m)} &= \text{Reading Value } d_1 \text{ (dB}\mu\text{V)} + \text{Correction Factor (dB/m)} \\ &\quad + \text{Extrapolation Factor (dB)} + \text{Pulse Train Correction (dB)} \end{aligned}$$

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



8.8 Radiated Emission Measurement 30 MHz to 4.5 GHz

Rules and specifications:	CFR 47 Part 15, sections 15.205, 15.215(b) and 15.231(b) and (e)				
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 ($\mu\text{V/m}$) (dB $\mu\text{V/m}$)		Field Strength of Spurious Emissions ($\mu\text{V/m}$) (dB $\mu\text{V/m}$)	
	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)				

Test Result:	Test passed
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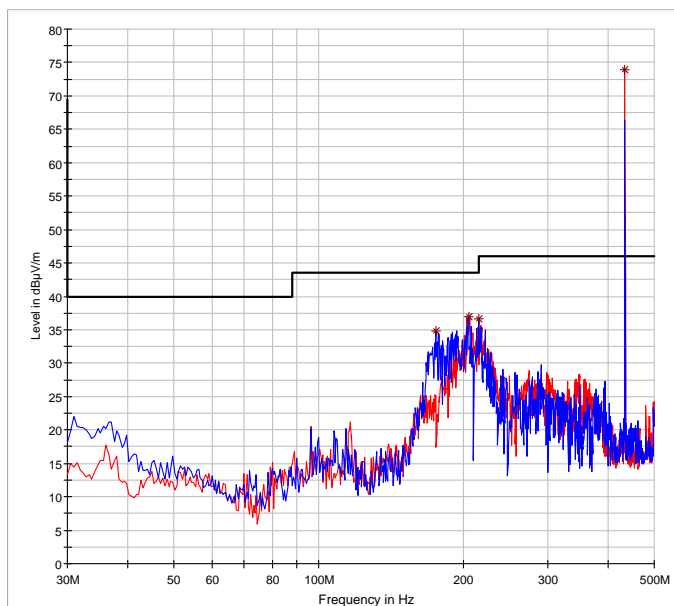
Comment:	Alarm mode; Limits according § 15.231(b)		
Date of test:	2015-01-30		
Test site:	Frequencies ≤ 1 GHz: Semi-anechoic room, cabin no. 8 Frequencies > 1 GHz: Fully anechoic room, cabin no. 2		
Test distance:	Frequencies ≤ 8.2 GHz:	3 meters	
	Frequencies > 8.2 GHz:	1 meter	

Test Result:	Test passed
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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)
39.790	vertical	Quasi-Peak	13.7	15.5		29.2	60.8	31.6
76.630	vertical	Quasi-Peak	20.8	8.7		29.5	60.8	31.3
433.920	horizontal	Peak	60.1	17.9	-20.0	58.0	80.8	22.8
797.190	horizontal	Quasi-Peak	-1.0	23.3		22.3	60.8	38.5
867.760	vertical	Quasi-Peak	20.5	24.4		44.9	60.8	15.9
1063.000	vertical	Peak	9.9	27.2	-20.0	17.1	54.0	36.9
1301.000	horizontal	Peak	12.2	27.9	-20.0	20.1	54.0	33.9
2169.000	horizontal	Peak	23.6	32.2	-20.0	35.9	60.8	25.0
2606.500	horizontal	Peak	20.3	34.3	-20.0	34.6	60.8	26.3
3037.000	vertical	Peak	12.1	35.6	-20.0	27.8	60.8	33.0

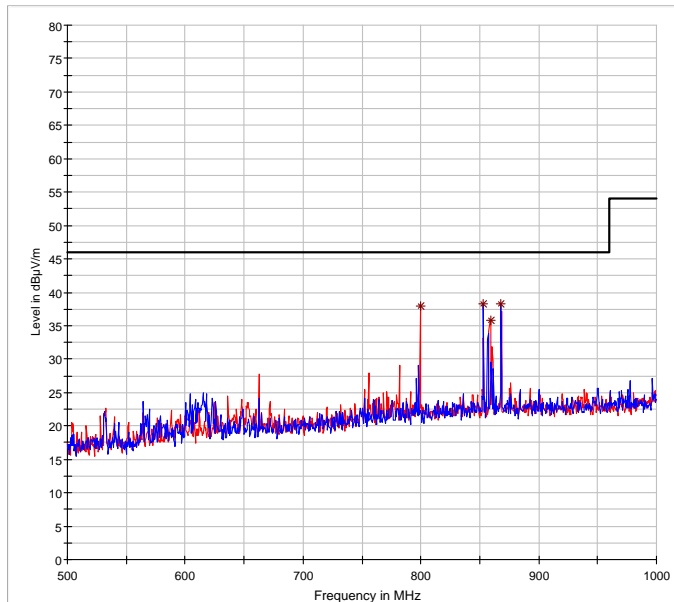
Sample calculation of final values:

$$\text{Final Value (dB}\mu\text{V/m)} = \text{Reading Value (dB}\mu\text{V)} + \text{Correction Factor (dB/m)} + \text{Pulse Train Correction (dB)}$$



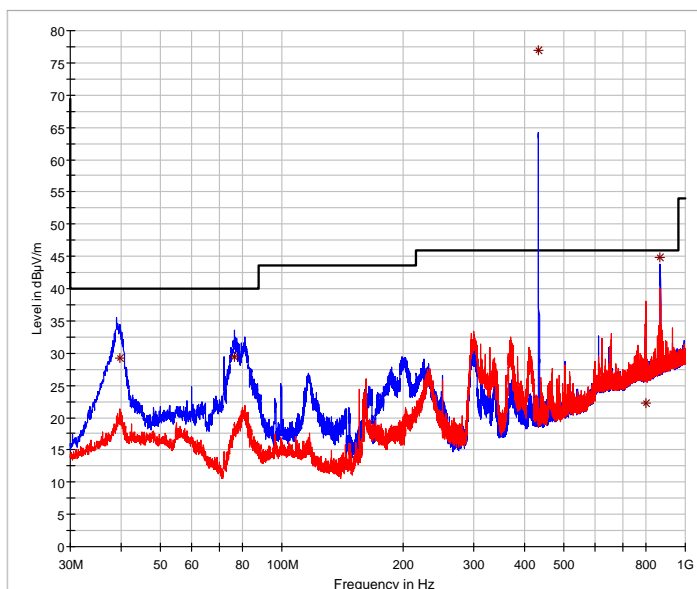
— Preview Result 1H-PK+ — Preview Result 1V-PK+ — FCC 15.209 * Final_Result PK+

Prescan 30 MHz – 500 MHz



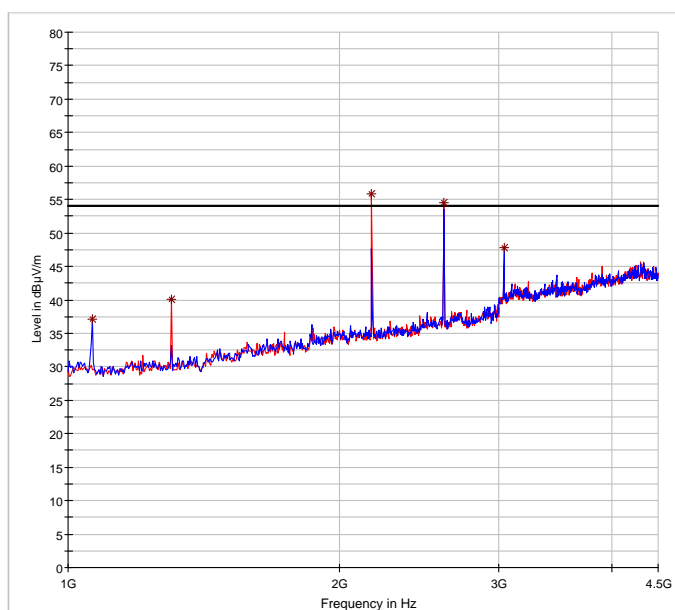
— Preview Result 1H-PK+ — Preview Result 1V-PK+ — FCC 15.209 * Final_Result PK+

Prescan 500 MHz – 1 GHz



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

Final measurement for alarm mode



— Preview Result 1H-PK+ — Preview Result 1V-PK+ — FCC 15.209 * Final_Result PK+



Comment:	Normal mode; Limits according § 15.231(e)	
Date of test:	2015-01-30, 2015-06-25	
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
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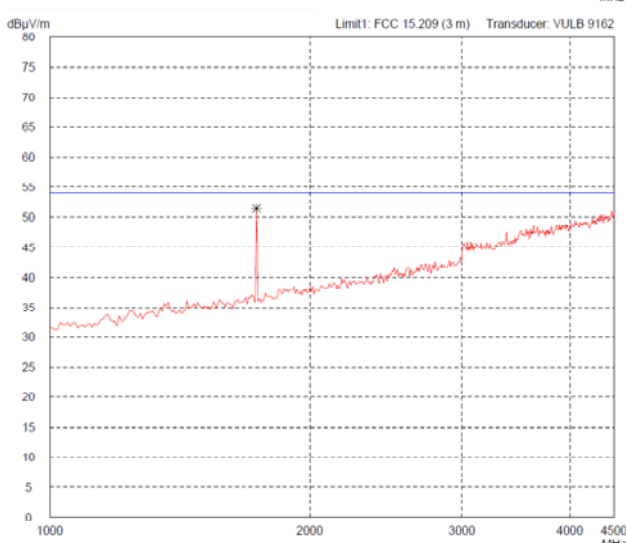
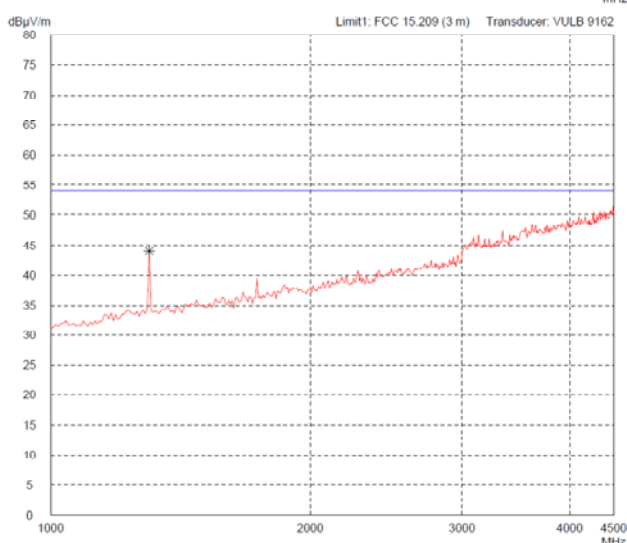
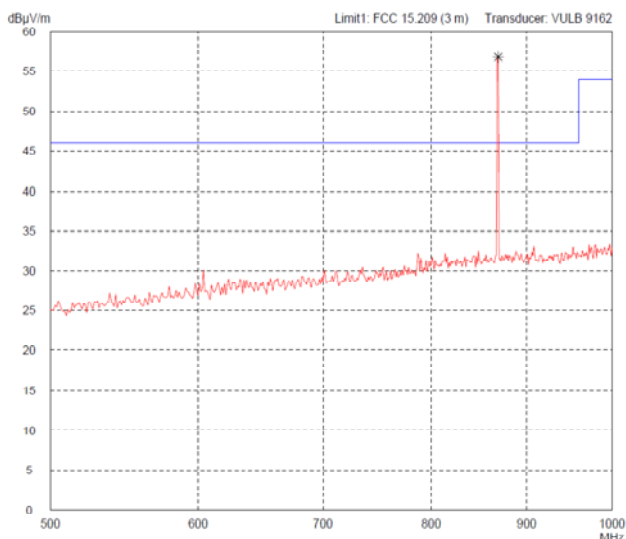
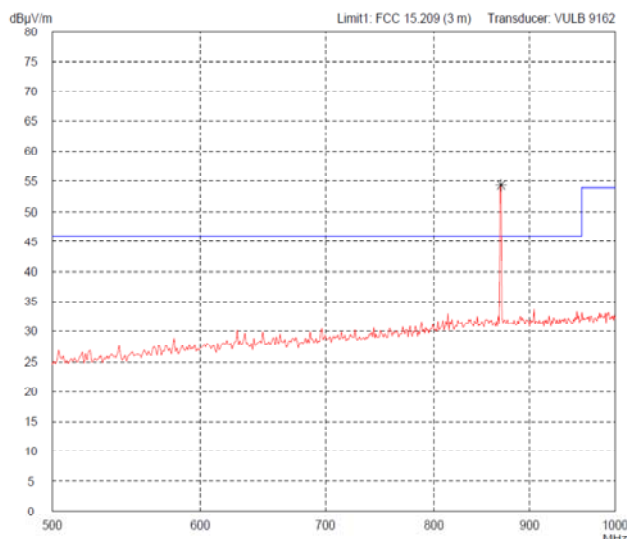
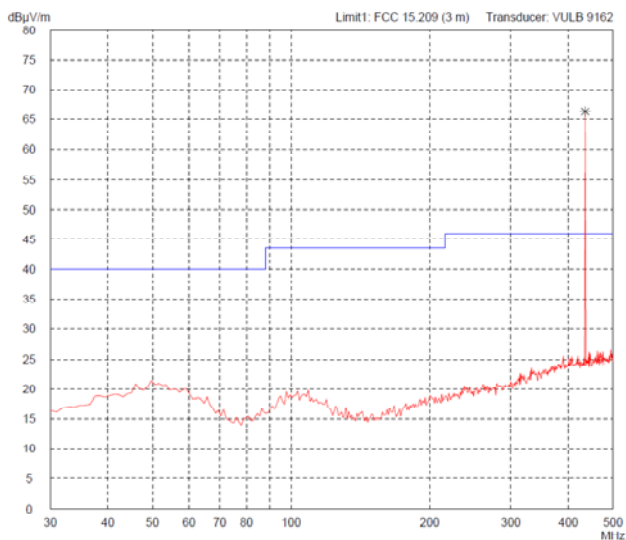
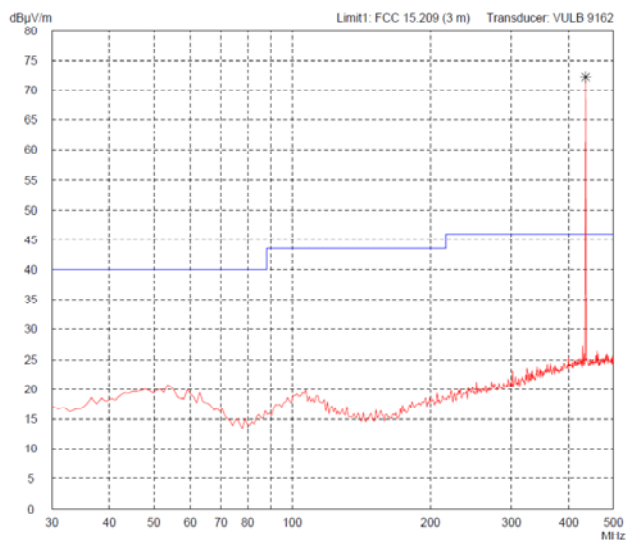
Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dBµV)	Correction Factor (dB/m)	Pulse Train Correction (dB)	Final Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
39.790	vertical	Quasi-Peak	13.7	15.5		29.2	52.9	23.7
76.630	vertical	Quasi-Peak	20.8	8.7		29.5	52.9	23.4
433.920	vertical	Peak	47.0	19.4	-20.0	46.3	72.9	26.5
797.190	horizontal	Quasi-Peak	-1.0	23.3		22.3	52.9	30.6
867.760	vertical	Quasi-Peak	20.5	24.4		44.9	52.9	8.0
1063.000	vertical	Peak	9.9	27.2	-20.0	17.1	54.0	36.9
1301.000	horizontal	Peak	12.2	27.9	-20.0	20.1	54.0	33.9
1735.000	vertical	Peak	17.8	33.5	-20.0	31.4	54.0	22.6
2169.000	horizontal	Peak	23.6	32.2	-20.0	35.9	54.0	18.1
2606.500	horizontal	Peak	20.3	34.3	-20.0	34.6	54.0	19.4
3037.000	vertical	Peak	12.1	35.6	-20.0	27.8	54.0	26.2

Sample calculation of final values:

$$\text{Final Value (dB}\mu\text{V/m)} = \text{Reading Value (dB}\mu\text{V)} + \text{Correction Factor (dB/m)} + \text{Pulse Train Correction (dB)}$$

Horiozontal

Vertical



9 Referenced Regulations

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

<input checked="" type="checkbox"/>	CFR 47 Part 2	Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC)	October 1, 2014
<input checked="" type="checkbox"/>	CFR 47 Part 15	Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)	October 1, 2014
<input type="checkbox"/>	ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz	December 11, 2003 (published on January 30, 2004)
<input type="checkbox"/>	ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz	June 7, 2009 (published on September 15, 2009)
<input checked="" type="checkbox"/>	ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz	June 7, 2009 (published on September 15, 2009)
<input type="checkbox"/>	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)
<input checked="" type="checkbox"/>	ANSI C63.10	American National Standard for Testing Unlicensed Wireless Devices	July 3, 2009 (published on September 10, 2009)
<input type="checkbox"/>	ANSI C63.10	American national Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices	June 27, 2013 (published on September 13, 2013)
<input type="checkbox"/>	RSS-Gen	Radio Standards Specification RSS-Gen Issue 4 containing General Requirements for Compliance of Radio Apparatus, published by Industry Canada	November 2014
<input type="checkbox"/>	RSS-210	Radio Standards Specification RSS-210 Issue 8 for Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, published by Industry Canada	December 2010

<input type="checkbox"/>	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
<input type="checkbox"/>	RSS-102	Radio Standards Specification RSS-102 Issue 4: Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), published by Industry Canada	March 2010, footnote 13 updated December 2010
<input type="checkbox"/>	ICES-003	Interference-Causing Equipment Standard ICES-003 Issue 5 (Information Technology Equipment (ITE) - Limits and methods of measurement), published by Industry Canada	August 2012
<input checked="" type="checkbox"/>	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
<input type="checkbox"/>	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
<input checked="" type="checkbox"/>	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	2044	ESU8	100232	Rohde & Schwarz	Rohde & Schwarz	10/2014	10/2015
Spectrum analyser	1666	FSP30	100063	Rohde & Schwarz	Rohde & Schwarz	05/2014	05/2015
Preamplifier	1684	AFS3-00100800-32-LN	847743	MITEQ	TÜV SÜD PS-EMC-STR	10/2013	04/2015
Preamplifier	1716	CPA9231A	3557	Schaffner EMC Systems	TÜV SÜD PS-EMC-STR	05/2014	11/2015
Double ridged waveguide horn antenna	1516	3115	9508-4553	EMCO Elektronik	Seibersdorf Laboratories	01/2015	01/2017
Loop antenna	1016	HFH2-Z2	882964/0001	Rohde & Schwarz	Rohde & Schwarz	05/2014	05/2016
TRILOG Broadband Antenna	2256	VULB 9162	9162-048	Schwarzbeck	Schwarzbeck	09/2013	03/2015

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			
<i>Edition</i>	<i>Date</i>	<i>Issued by</i>	<i>Modifications</i>
1	13.02.2015	M. Steindl (as)	First Edition
2	17.04.2015	M. Steindl	Type designation corrected. Correction of typos on carrier frequency to 433.92 MHz. Added not regarding to emission at 125 kHz. Added photos for positions of EUT.
3	30.06.2015	M. Steindl	Added test protocols for „normal mode“. Test mode description altered accordingly. Normative references updated; References to IC-regulations removed.
4	6.07.2015	M. Steindl	Added protocol line for § 15.231(a)(4). Changed protocol for “periodic operation” for “alarm mode” to § 15.231(a)(4)