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March 20, 2017

Prüfbericht / *Test Report* Nr. / *No.* 201351-94952-4 (Edition 2)

Applicant:	Endress + Hauser GmbH & Co. KG
Type of equipment:	Level Probing Radar
Type designation:	FMR 6x
Order No.:	5002110
Test standards:	FCC Code of Federal Regulations, CFR 47, Part 15, Sections 15.205, 15.207, 15.209, 15.215 and 15.256 KDB 890966 D01 Meas level Probing Radars v01r01 Industry Canada Radio Standards Specifications RSS-GEN Issue 4, Sections 8.8, 8.9 and 8.10 (Category I Equipment) RSS-211 Issue 1

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1 Description of the Equipment Under Test (EUT)

General data of EUT	
Type designation[1]:	FMR 6x
Parts[2]:	
Serial number(s):	Prototype
Manufacturer:	Endress + Hauser GmbH & Co. KG
Type of equipment:	Level Probing Radar
Version:	As received
Additional parts/accessories:	

Technical data of EUT		
Application frequency range:	75.00 - 85.00 GHz	
Frequency range:	79.00 – 83.00 GHz	
Operating frequency:	79 - 83 GHz	
Type of modulation:	FMCW	
Pulse train:		
Pulse width:		
Number of RF-channels:	1	
Channel spacing:	---	
Designation of emissions[3]:	1G50P0NAN	
Type of antenna:	Integrated	
Size/length of antenna:	N/A	
Connection of antenna:	☐ detachable	☒ not detachable
Type of power supply:	DC supply	
Specifications for power supply:	nominal voltage:	24.0 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".

Test Sample	**FMR6x_26**	**FMR6x_27**	**FMR6x_29**	**FMR6x_25**	**FMR6x_28**	**FMR6x_30**
Model	**FMR62**	**FMR62**	**FMR 62**	**FMR60**	**FMR62F**	**FMR 67**
Antenna	¾“ Thread PEEK	PTFE plated, DN50	PTFE plated, DN80	PTFE Thread 1.5“	1.5” Thread, PEEK	Flange
Enclosure	Plastic	Plastic	Plastic	Plastic	Alu	Alu
Test Overview						
Bandwidth of Emission					**X**	
Fundamental Emission Limits (boresight)			**X**	**X**	**X**	**X**
Frequency Stability					**X**	
Antenna beamwidth			**X**	**X**	**X**	**X**
Antenna side lobe gain			**X**	**X**	**X**	**X**
Radiated emissions					**X**	
Conducted AC powerline emissions					**X**	
FCC ID	LCGFMR6XE	LCGFMR6XE	LCGFMR6XE	LCGFMR6XEF	LCGFMR6XEF	LCGFMR6XEF
IC ID	2519A-6E	2519A-6E	2519A-6E	2519A-6EF	2519A-6EF	2519A-6EF

2 Administrative Data

Application details	
Applicant (full address):	Endress + Hauser GmbH & Co. KG Hauptstr. 1 79689 Maulburg Germany
Contact person:	Mr. Ralf Reimelt
Order number:	5002110
Receipt of EUT:	2017-03-16
Date(s) of test:	2017-03-16 to 2017-03-20
Note(s):	--

Report details	
Report number:	201351-94952-4
Edition:	2
Issue date:	March 20, 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
FCC test site registration number	90926
Industry Canada test site registration:	3050A-2
Contact person:	Mr. Johann Roidt Phone: +49 9421 5522-0 Fax: +49 9421 5522-99

4 Summary

Summary of test results
The tested sample complies with the requirements set forth in the **Code of Federal Regulations CFR 47, Part 15, Sections 15.205, 15.207, 15.209, 15.215 and 15.256** of the Federal Communication Commission (FCC)

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

5 Operation Mode and Configuration of EUT

Operation Mode(s)
Normal operation mode: Measurement with sweep on.

Configuration(s) of EUT
FCC test setup, DC 24 V power supply, EUT in vertical position. TheFMR 6x with antennas according to the product specification matrix.

List of ports and cables

Port	*Description*	*Classification*[4]	*Cable type*	*Cable length*
1	DC supply with HART communication interface	signal/control port	Unshielded	2 m

List of devices connected to EUT

Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*

List of support devices

Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*
	---			

[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, sections 15.215(c) and 15.256 ANSI C63.10, section 6.9.1
Guide:	ANSI C63.10
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).

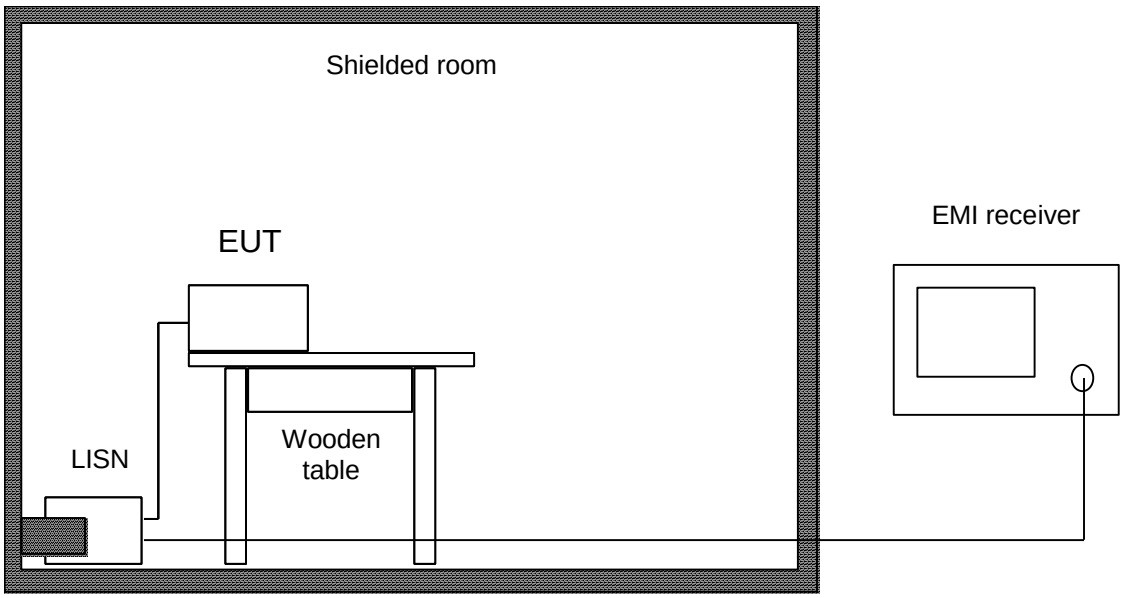
6.2 Conducted AC Powerline Emission

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.207
Guide:	ANSI C63.10 / CISPR 22

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

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

According to ANSI C63.10, section 6.2.5, testing of intentional radiators with detachable antenna shall be performed using a suitable dummy load connected to the antenna output terminals. Otherwise, the tests shall be made with the antenna connected and, if adjustable, fully extended.
Testing with dummy load may be necessary to distinguish (unintentional) conducted emissions on the supply lines from (intentional) emissions radiated by the antenna and coupling directly to supply lines and/or LISN. Usage of dummy load has to be stated in the appropriate test record(s) and notes should be added to clarify the test setup.



Test instruments used:

	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☒	Test receiver	ESHS 10	1028	860043/016	Rohde & Schwarz
☒	V-network	ESH 3-Z5	1059	894785/005	Rohde & Schwarz
☐	V-network	ESH 3-Z5	1218	830952/025	Rohde & Schwarz
☐	Artificial mains network	ESH 2-Z5	1536	842966/004	Rohde & Schwarz
☐	Microwave cable	FB293C1080005050	2157	72110-02	Rosenberger Micro-Coax
☐	Coax cable	RG214 N/N 5m	1188	---	Senton
☐	Shielded room	No. 1	1451	---	Albatross
☐	Shielded room	No. 4	1454	3FD 100 544	Euroshield
☒	Shielded room	No. 9		---	Albatross

6.3 Radiated Emission Measurement 9 kHz to 30 MHz

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, sections 15.209, 15.215 and 15.256
Guide:	ANSI C63.4

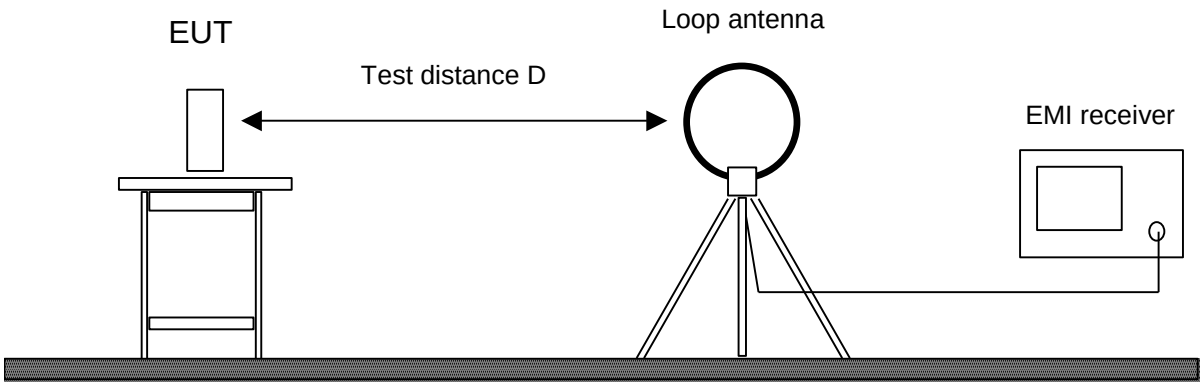
Radiated emission in the frequency range 9 kHz to 30 MHz is measured using an active loop antenna. First the whole spectrum of emission caused by the equipment is recorded at a distance of 3 meters in a fully or semi anechoic room with the detector of the spectrum analyzer or EMI receiver set to peak.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

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

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

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

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



Test instruments used:

	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☐	Spectrum analyzer	FSP30	1666	100036	Rohde & Schwarz
☐	EMI test receiver	ESMI	1569	839379/013 839587/006	Rohde & Schwarz
☐	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

6.4 Radiated Emission in Fully or Semi Anechoic Room

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, sections 15.209, 15.215 and 15.256
Guide:	ANSI C63.4

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.

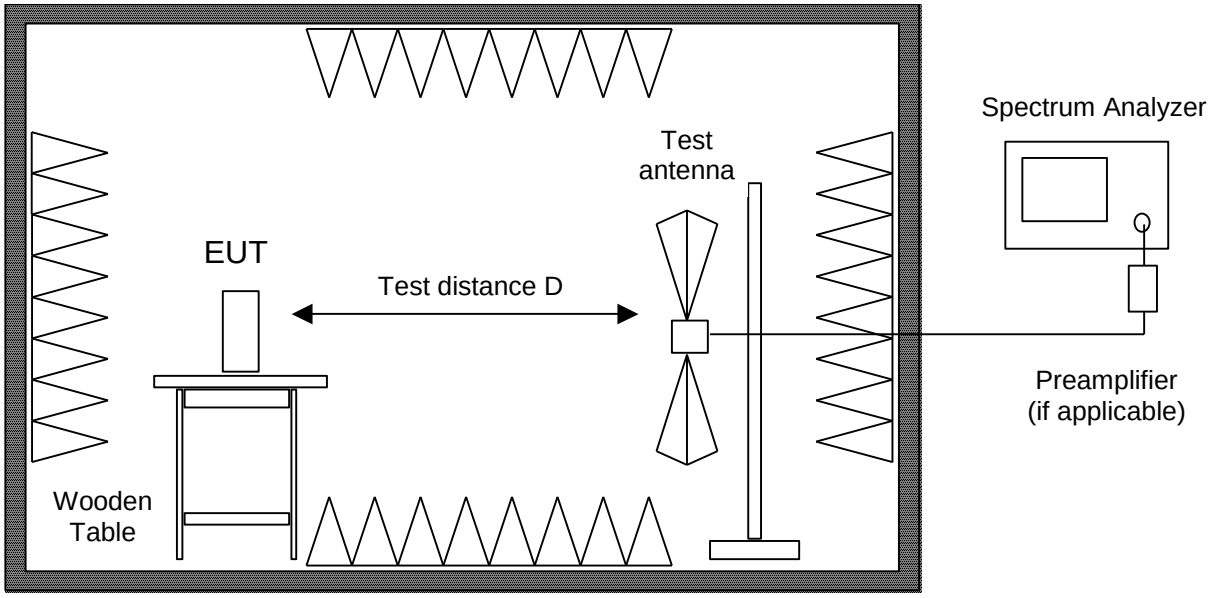
All tests below 8.2 GHz are performed at a test distance D of 3 meters. For higher frequencies the test distance may be reduced (e.g. to 1 meter) due to the sensitivity of the measuring instrument(s) and the test results are calculated according to CFR 47 Part 15 section 15.31(f)(1) using an extrapolation 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 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.



Fully or semi anechoic room

Test instruments used:

	Type		*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☒	Spectrum analyzer		FSP30	1666	100036	Rohde & Schwarz
☒	Spectrum analyzer		FSV40			Rohde & Schwarz
☐	EMI test receiver	Cabin no. 3	ESPI7	2010	101018	Rohde & Schwarz
☐	EMI test receiver		ESU8	2044	100232	Rohde & Schwarz
☐	EMI test receiver		ESMI	1569	839379/013 839587/006	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
☒	Preamplifier (8 - 18 GHz)		ACO/180-3530	1484	32641	CTT

	Type		*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☒	External Mixer		WM780U	2085	B030121	Tektronix
☒	External Mixer		WM782V	2140	B030132	Tektronix
☒	External Mixer		WM782W	2181	B010193	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		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
☒	Horn antenna		24240-20	2086	157845	FLANN
☒	Horn antenna		25240-25	2180	205900	FLANN
☒	Horn antenna		27240-25	2182	204260	FLANN
☐	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

6.5 Radiated Emission at Alternative Test Site

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, sections 15.209, 15.215 and 15.256
Guide:	ANSI C63.10

Radiated emission in the frequency range 30 MHz to 1 GHz is measured within a semi-anechoic room with groundplane complying with the NSA requirements of ANSI C63.4 respectively ANSI C63.10 for alternative test sites. A linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna") is used. The measurement bandwidth of the test receiver is set to 120 kHz with quasi-peak detector selected.

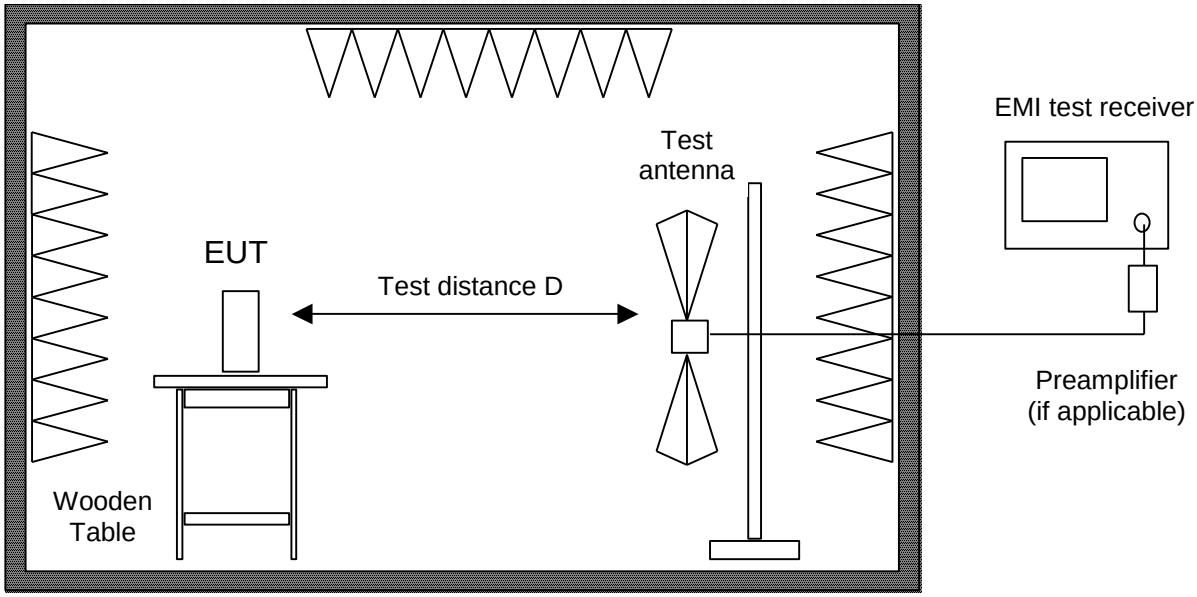
If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete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

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

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

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

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



Alternate test site (semi anechoic room)

Test instruments used:

	Type		*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☒	EMI test receiver		ESU8	2044	100232	Rohde & Schwarz
☒	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

7 Test Results

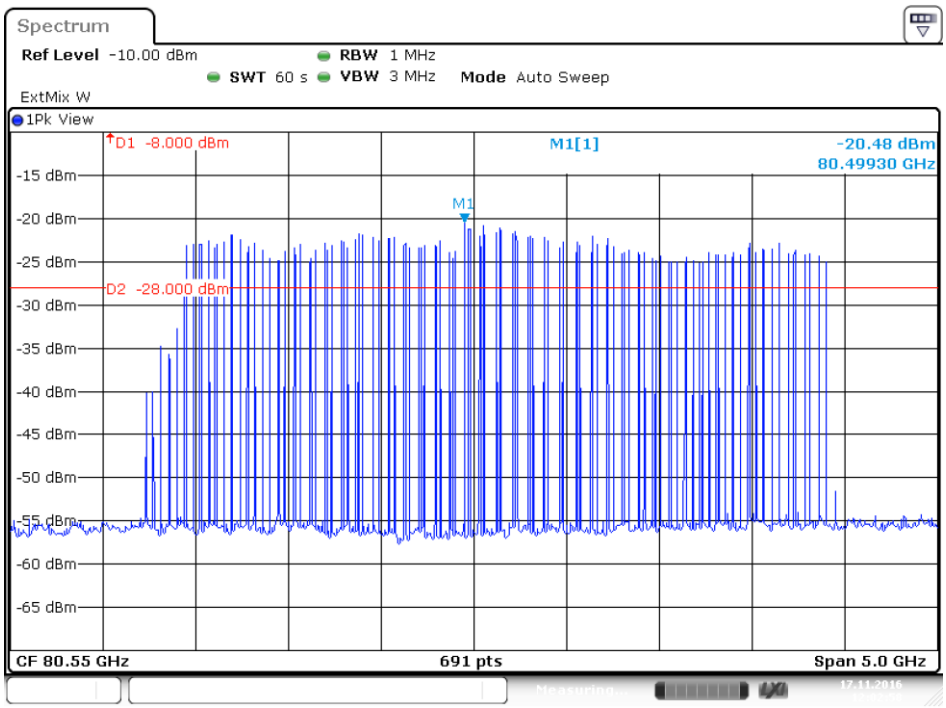
FCC CFR 47 Parts 2 and 15			
Section(s)	*Test*	*Page*	*Result*
15.256 (f)	Fundamental bandwidth.	26	Test passed
15.256 (g)	Fundamental emission limits	28	Test passed
15.256 (h)	Unwanted emission limits		Test passed
15.256(i)	Antenna beamwidth		Test passed
15.256(j)	Antenna side lobe gain		Test passed
15.215 (c)	Frequency Stability		Test passed
15.207	Conducted AC powerline emission 150 kHz to 30 MHz		Test passed

7.1 Bandwidth of Emission – Fundamental Bandwidth

Rules and specifications:	CFR 47 Part 15, sections 15.215(c) and 15.256(f)
Guide:	ANSI C63.10
Description and Limit:	Intentional radiators operating under the alternative provisions to the general emission limit must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained is contained within the frequency banddesignated in the rule section under which the equipment is operated The fundamental bandwidth of an LPR emission is defined as the width of the signal between two points, on below (f_L) and one above (f_H) the center frequency, outside of which all emissions are attenuated by at least 10 dB relative to the maximum transmitter output power when measured in an equivalent resolution bandwidth. The minimum fundamental emission bandwidth shall be 50 MHz for LPR operation under the provisions of this section. LPR devices operating under this section must convine their fundamental emission bandwidth within the 5925 MHz – 7250 MHz, 24.05 GHz – 29.00 GHz, and 75 GHz – 85 GHz bands under all conditions of operation.
	The video bandwidth shall be at least three times greater than the resolution bandwidth.
Measurement procedure:	Bandwidth Measurements (6.1)

Comment:	Test sample: FMR 6x_28
Date of test:	2017-03-17
Test site:	Fully anechoic room, cabin no. 2

Test Result:	Test passed



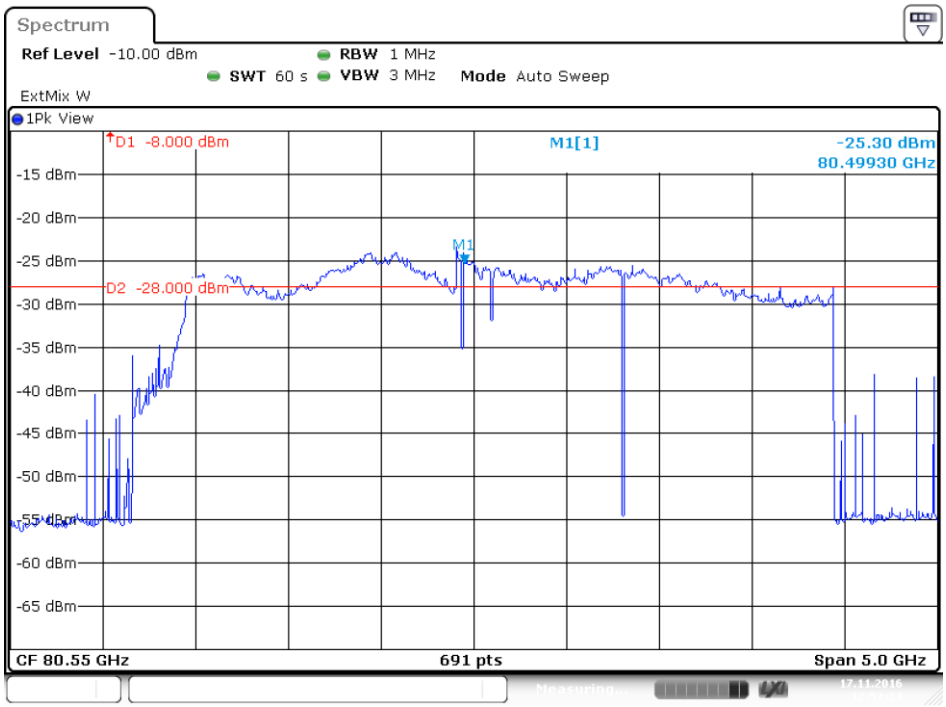
Date: 17.NOV.2016 12:02:59

Minimum frequency f_L:	**79.0 GHz**	
Maximum frequency f_H:	**83.0 GHz**	
Bandwidth of the emission:	**4.0 GHz**	
Minimum bandwidth requirement:	≥ 50 MHz	Test passed
Emission within the designated band:		Test passed

7.2 Fundamential Emission Limits

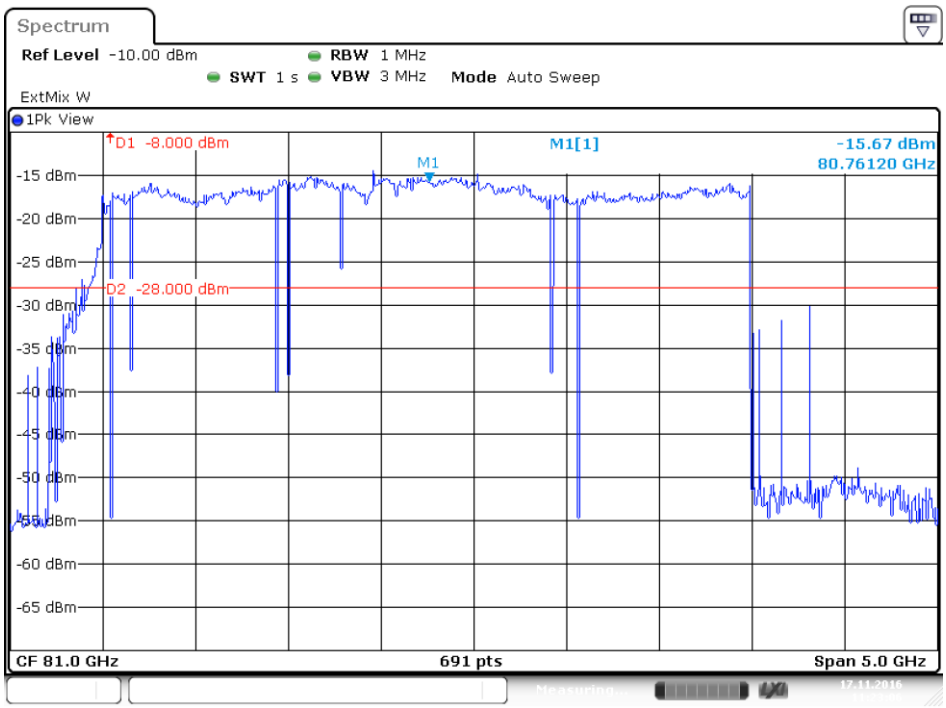
Rules and specifications:	CFR 47 Part 15, section 15.256(f)		
Guide:	ANSI C63.10		
Limit	*Frequency band of operation (GHz)*	*Average emission limit (EIRP in dBm measured in 1 MHz)*	*Peak emission limit (EIRP in dBm measured in 50 MHz)*
	75.00 – 85.00	-3	34
	Note: The EIRP in 1 MHz is computed from the maximum power level measured within any 1 MHz bandwidth using a power averaging detector. The EIRP in 50 MHz is computed from the maximum power level measured with a peak detector in a 50 MHz bandwidth centered on the frequency at which the maximum average power elvel is realized and this 50 MHz bandwidth must be contained within the authorized operating bandwidth. For a RBW less than 50 MHz, the peak EIRP limit (in dBm) is reduced by 20 log(RBW/50) dB where RBW is the resolution bandwidth in MHz. The RBW shall not be lower than 1 MHz or greater than 50 MHz. The video bandwidth shall not be less than the RBW. Note: Per FCC 15.256(g)(2)(ii): The Rhode & Schwarz FSW spectrum analyzer used a maximum video bandwidth resolution of 20 MHz, which is less than the required 50 MHz RBW; however, no bandwidth correction factor should be used for peak measurements, when the resolution is above 1 MHz, since the amplitude is a carrier wave and no amplitude change occurs after the resolution bandwidth is higher than 1 MHz.		
Measurement procedure:	Radiated Emission in Fully or Semi Anechoic Room (6.4)		
Date of test:	2017-03-17		
Test site:	Fully anechoic room, cabin no. 2		

Test Sample	*RBW (MHz)*	*Average emission (dBm e.i.r.p.)*	*Peak emission (dBm e.i.r.p.)*	*Limit (dBm e.i.r.p.)*
FMR6_25	1	-28.4		-3.0
	10		26.43	34.0
FMR6_28	1	-21.7		-3.0
	10		26.82	34.0
FMR6_29	1	-21.7		-3.0
	10		31.25	34.0
FMR6_30	1	-21.7		-3.0
	10		31,25	34.0



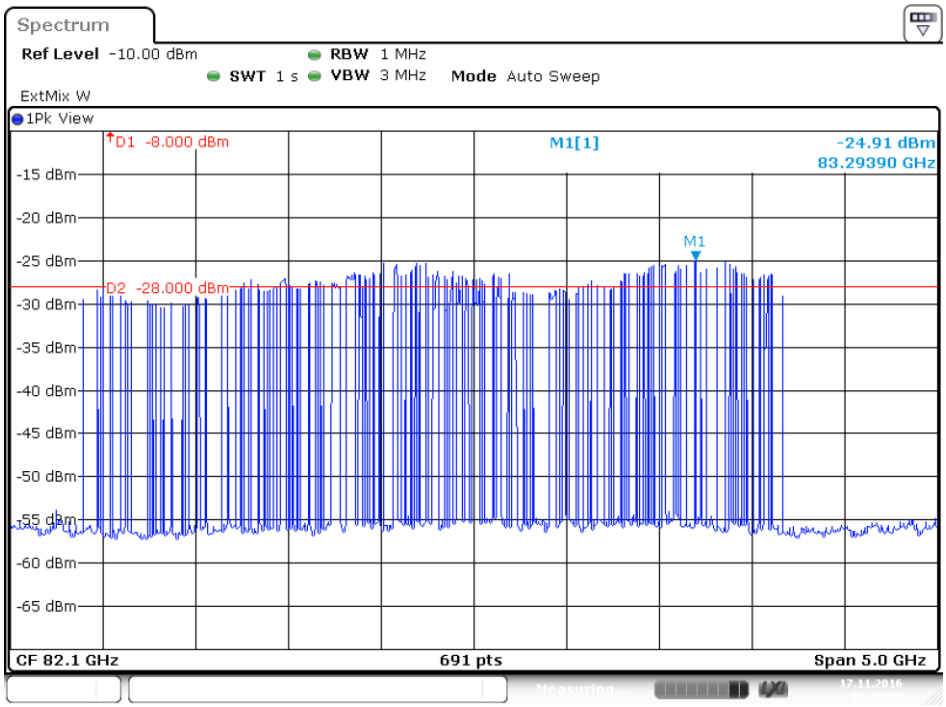
Date: 17.NOV.2016 12:51:24

FMR 6_25, Fundamental emission, d = 2 m



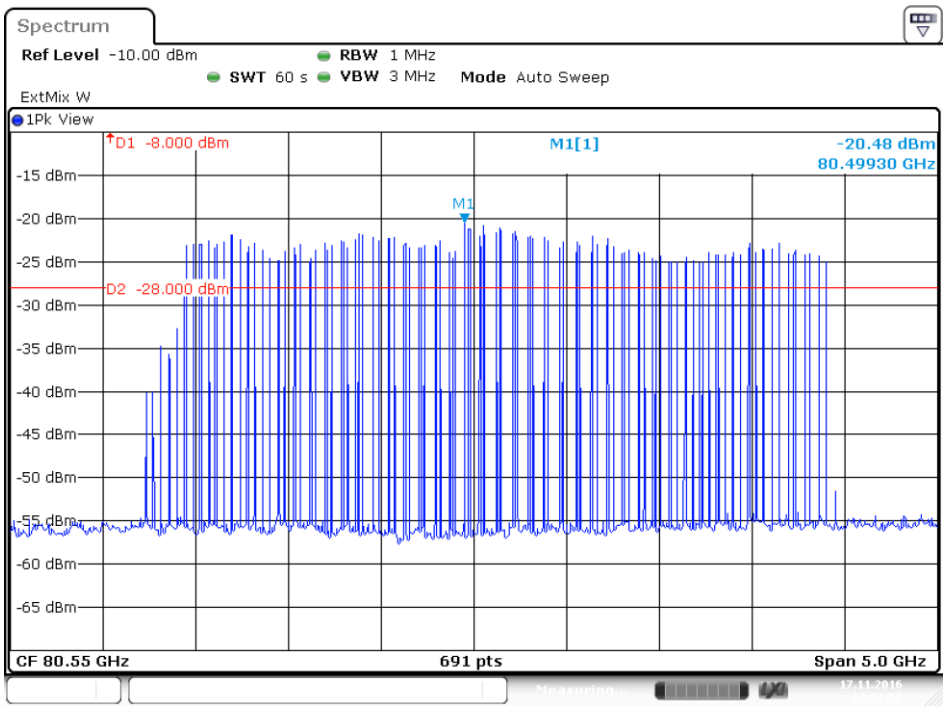
Date: 17.NOV.2016 11:23:06

FMR 6_29, Fundamental emission, d = 2 m



Date: 17.NOV.2016 11:40:00

FMR 6_28, Fundamental emission, d = 2 m



Date: 17.NOV.2016 12:02:59

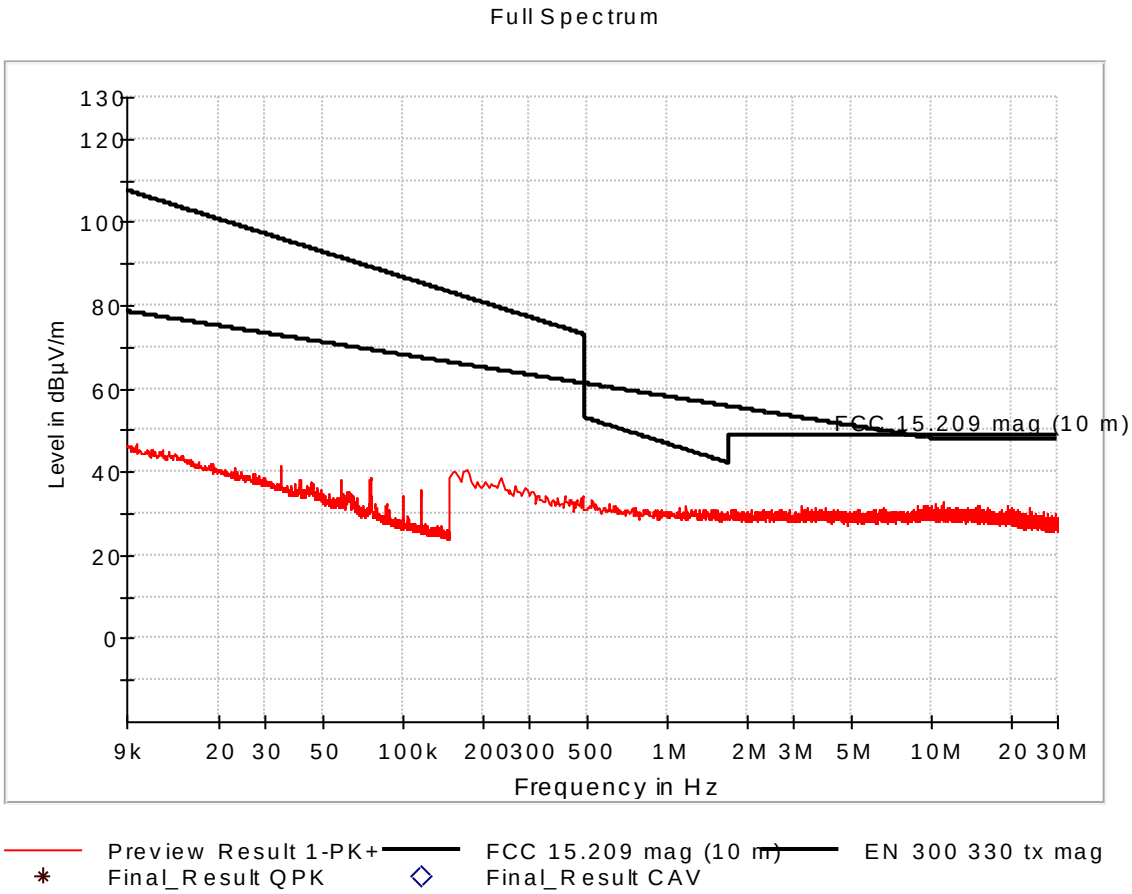
FMR 6_30, Fundamental emission, d = 2 m

7.3 Unwanted emission limits 9 kHz to 30 MHz

Rules and specifications:	CFR 47 Part 15, sections 15.205 and 15.209			
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)			

Test Result:	Test passed

Comment:	
Date of test:	2017-03-17
Test site:	Open field test site



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.

7.4 Unwanted emission limits 30 MHz to 325 GHz

Rules and specifications:	CFR 47 Part 15, section 15.209, section 15.256 (h)
Guide:	ANSI C63.10
Limit:	(h) Unwanted emissions limits. Unwanted emissions from LPR devices shall not exceed the general emission limit in § 15.209 of this chapter. Additionally, the level of any unwanted emissions shall not exceed the level of the fundamental emission.

Frequency of Emission (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

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

Comment:	
Date of test:	2017-03-17
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 to ≤ 26 GHz: 1 meter Frequencies > 26 GHz to ≤ 40 GHz: 0.25 meters Frequencies > 40 GHz: 0.1 meters

Test Result:	Test passed

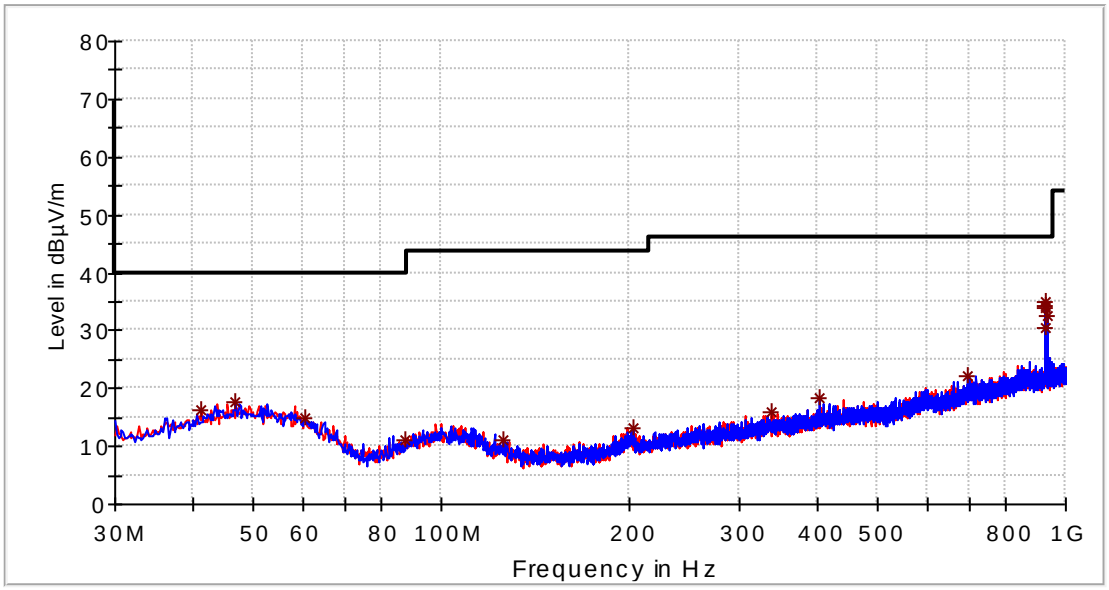
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB)
41.252000	16.14	40.00	23.86	2.5	100.000	H	318.0	-15.2
46.878000	17.57	40.00	22.43	2.5	100.000	V	169.0	-14.1
60.652000	14.77	40.00	25.23	2.5	100.000	H	200.0	-15.3
87.424000	11.03	40.00	28.97	2.5	100.000	H	205.0	-18.3
125.448000	11.02	43.50	32.48	2.5	100.000	V	163.0	-18.6
203.048000	13.07	43.50	30.43	2.5	100.000	V	114.0	-16.7
338.072000	15.89	46.00	30.11	2.5	100.000	H	246.0	-13.9
402.092000	18.20	46.00	27.80	2.5	100.000	V	129.0	-12.9
695.614000	22.25	46.00	23.75	2.5	100.000	V	243.0	-8.4
926.086000	30.31	46.00	15.69	2.5	100.000	V	317.0	-5.5
927.250000	34.05	46.00	11.95	2.5	100.000	H	99.0	-5.5
931.130000	34.19	46.00	11.81	2.5	100.000	V	202.0	-5.4
931.906000	35.02	46.00	10.98	2.5	100.000	H	106.0	-5.4
933.652000	32.58	46.00	13.42	2.5	100.000	V	77.0	-5.4

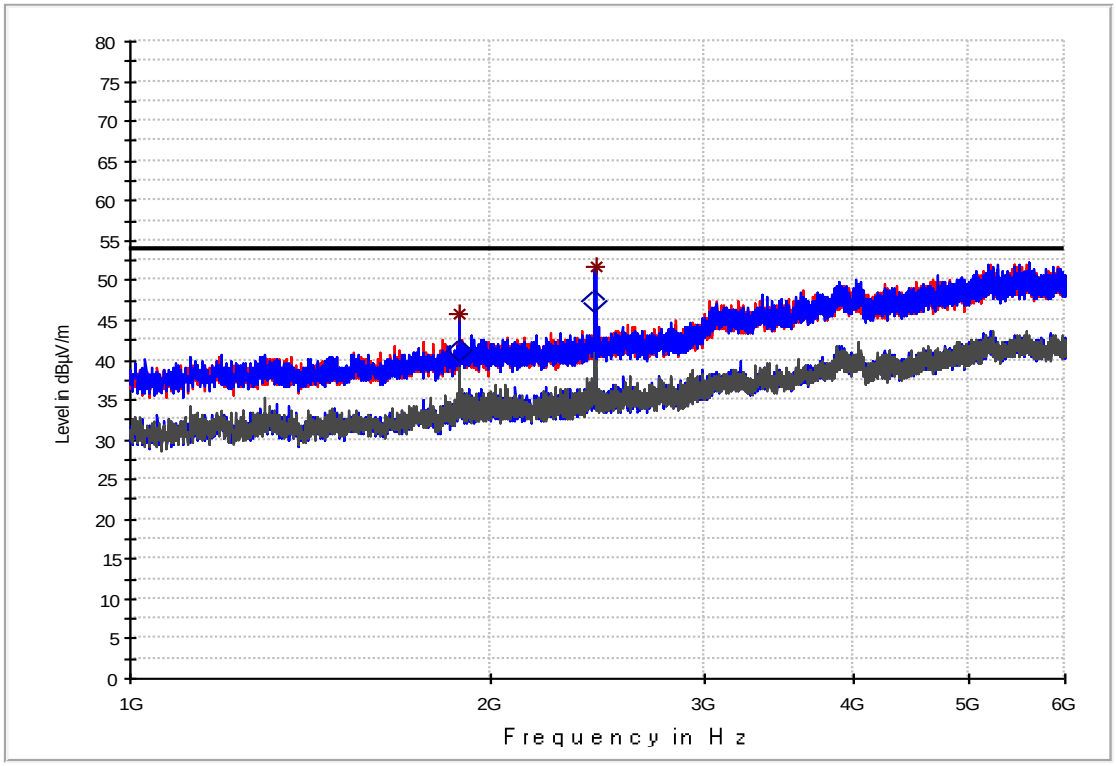
Sample calculation of final values:

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

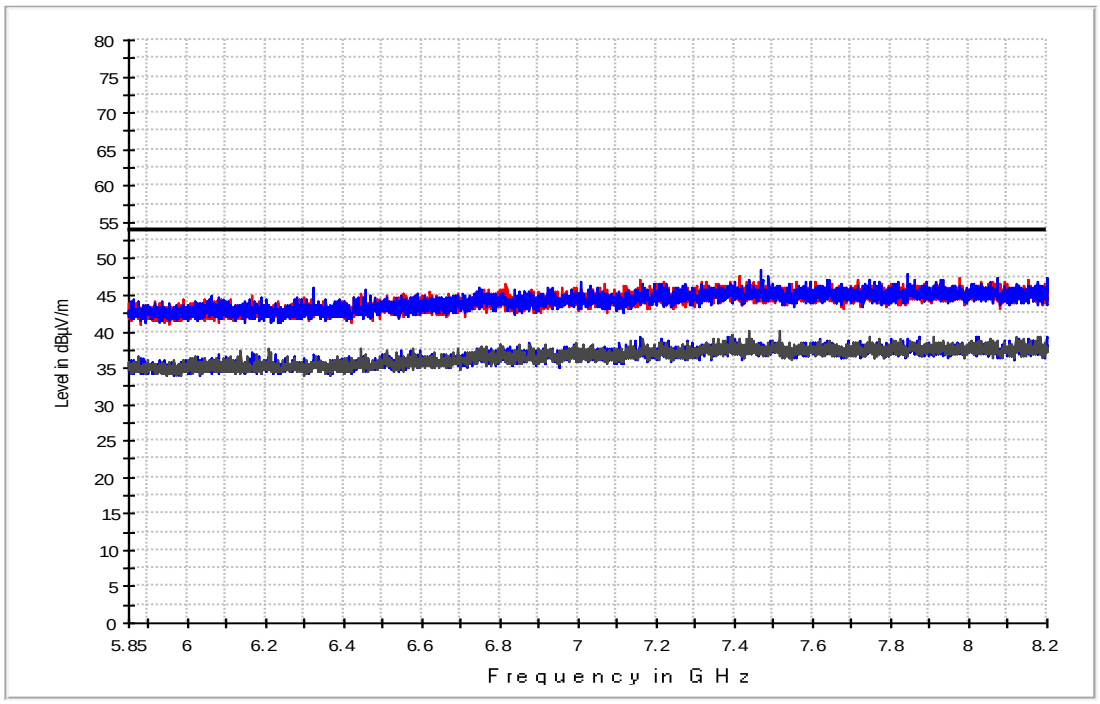
Full Spectrum



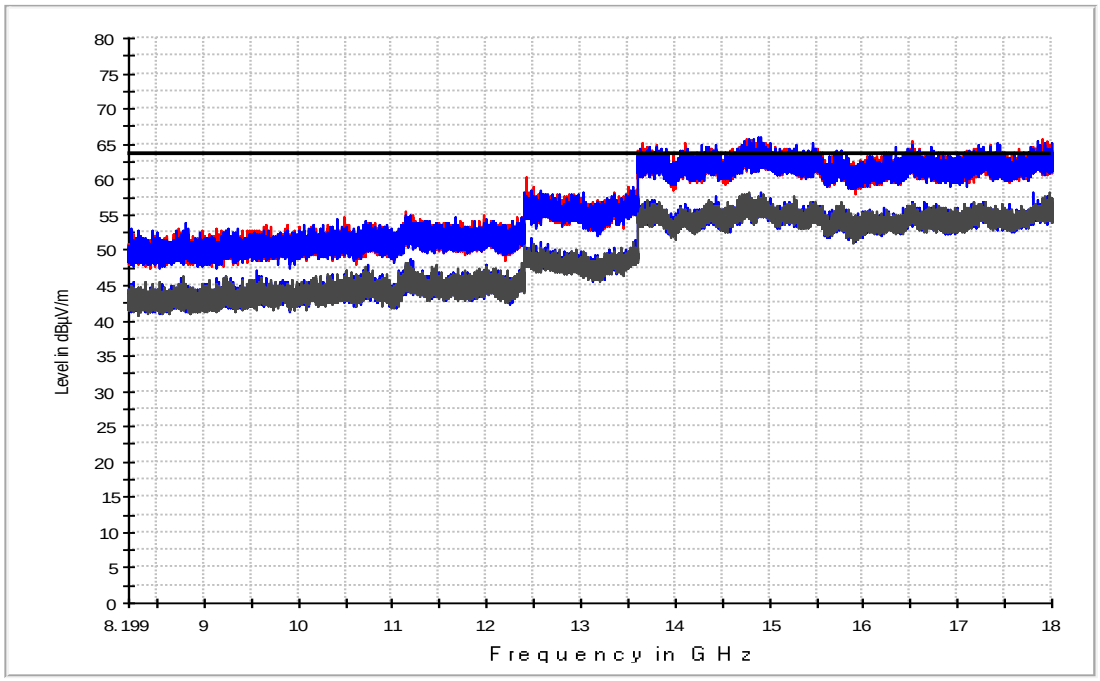
Preview Result 1H-PK+
Preview Result 1V-PK+
FCC 15.209
Final_Result PK+



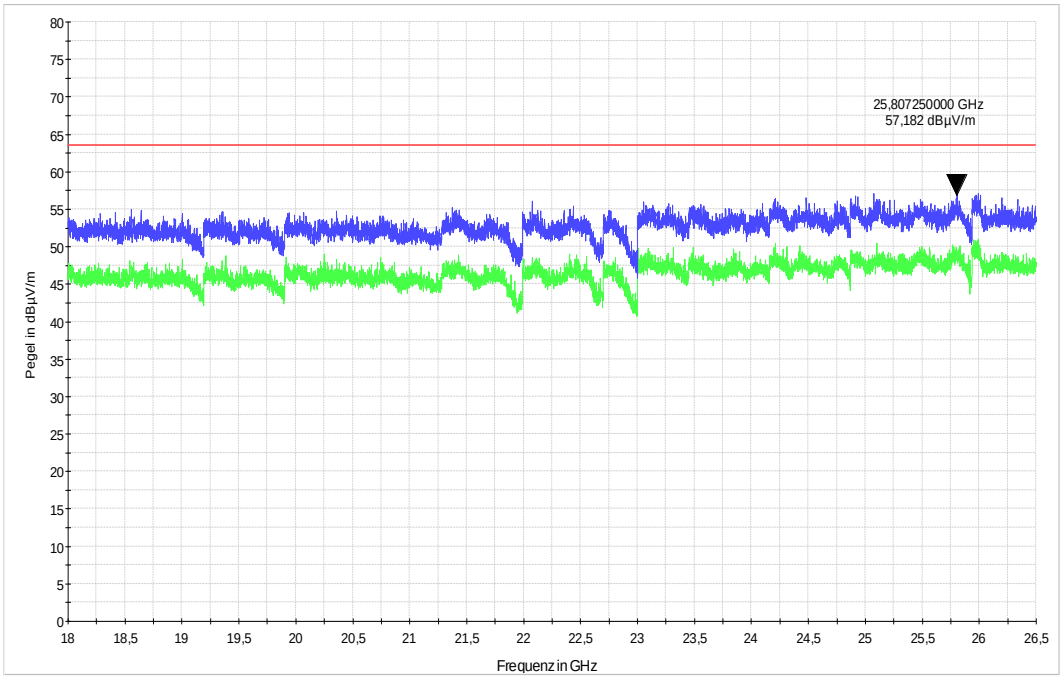
Preview Result 2H-AVG
Preview Result 1V-PK+
Final_Result AVG
Preview Result 1H-PK+
FCC 15.209
Preview Result 2V-AVG
Final_Result PK+



Preview Result 2H-AVG
Preview Result 1V-PK+
Final_Result AVG
Preview Result 1H-PK+
FCC 15.209
Preview Result 2V-AVG
Final_Result PK+

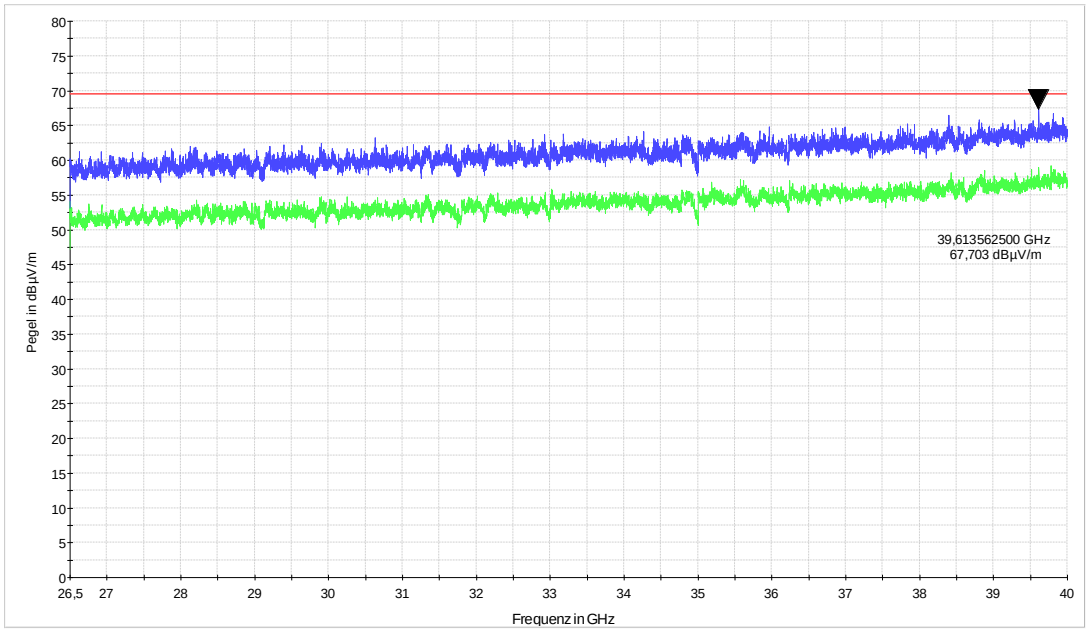


Preview Result 2H-AVG
Preview Result 1V-PK+
Final_Result AVG
Preview Result 1H-PK+
FCC 15.209 (1m)
Preview Result 2V-AVG
Final_Result PK+

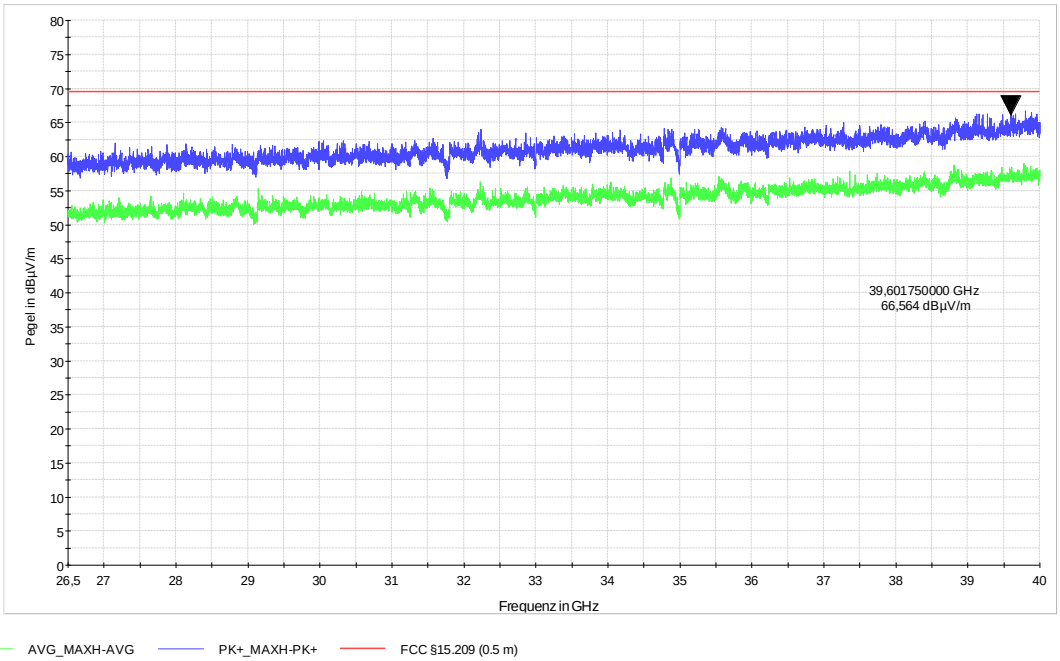


Horizontal polarization, DuT vertical, no tank

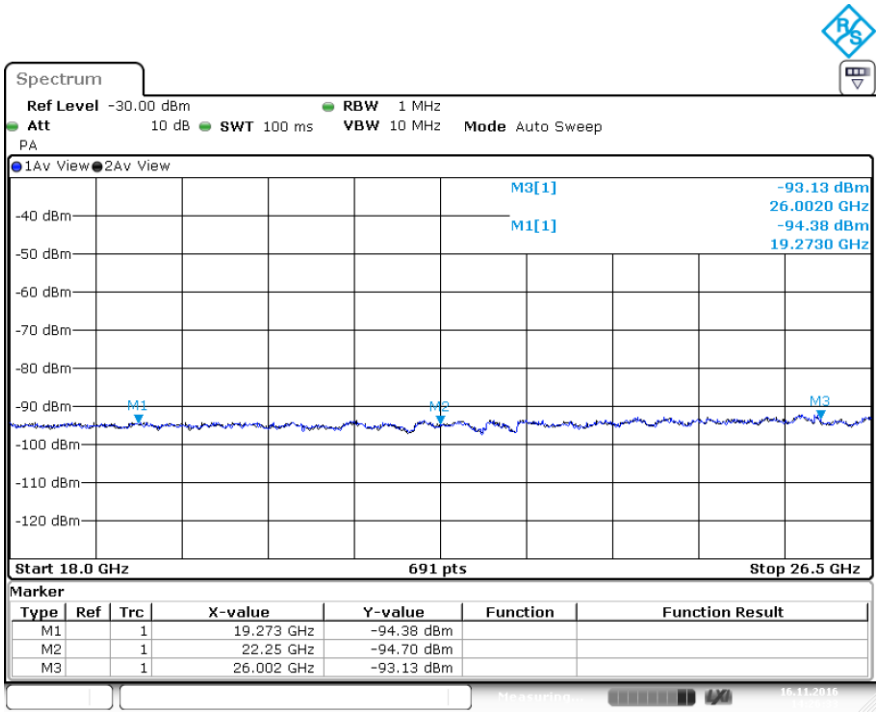
Vertical polarization, DuT vertical, no tank



Horizontal Polarisation, DuT vertical, no tank

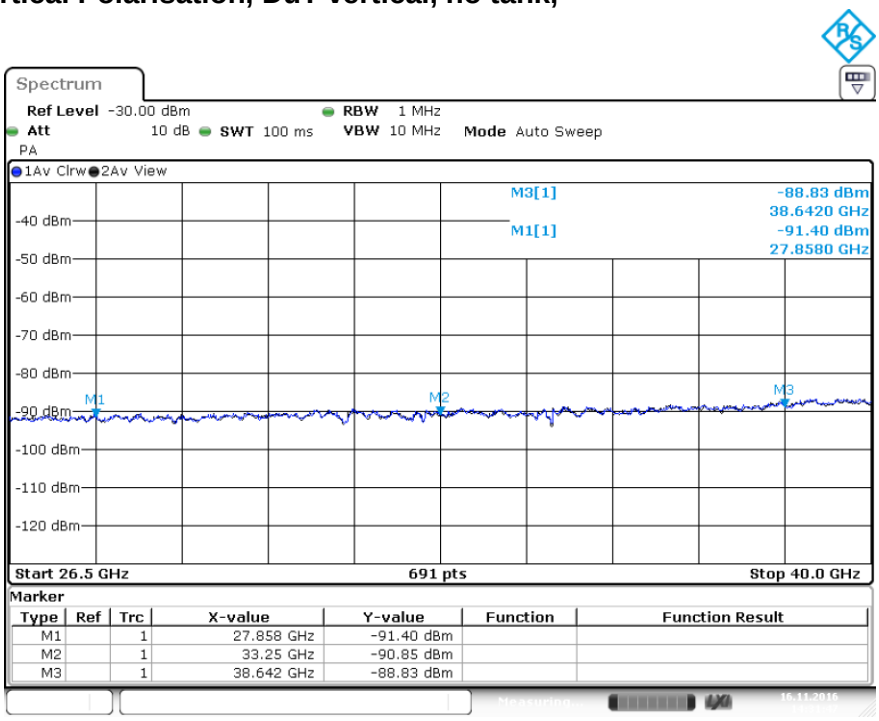


Vertical Polarisation, DuT vertical, no tank



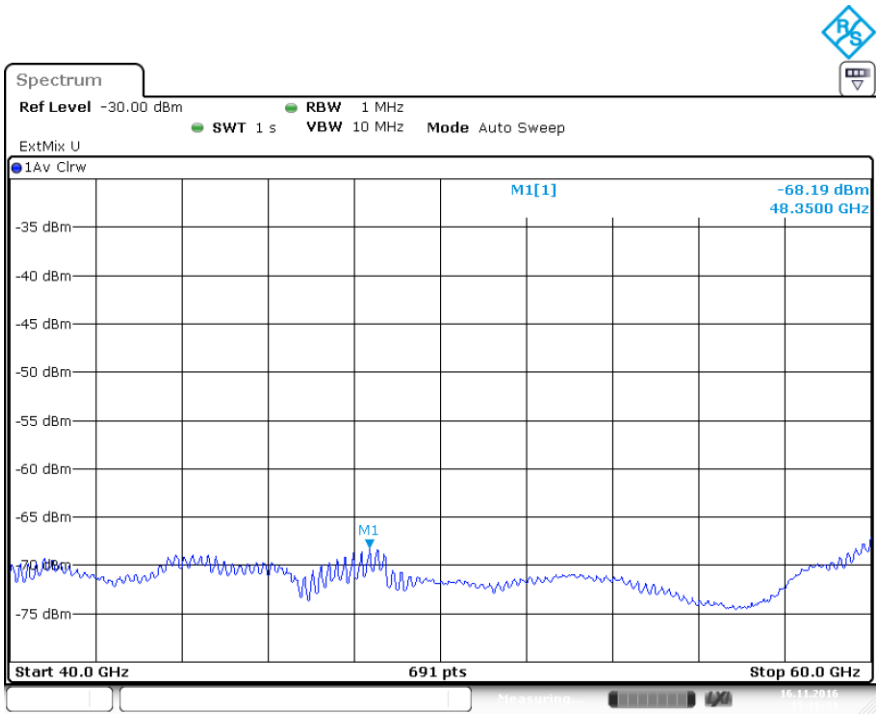
Date: 16.NOV.2016 14:26:34

Horizontal & Vertical Polarisation, DuT vertical, no tank,



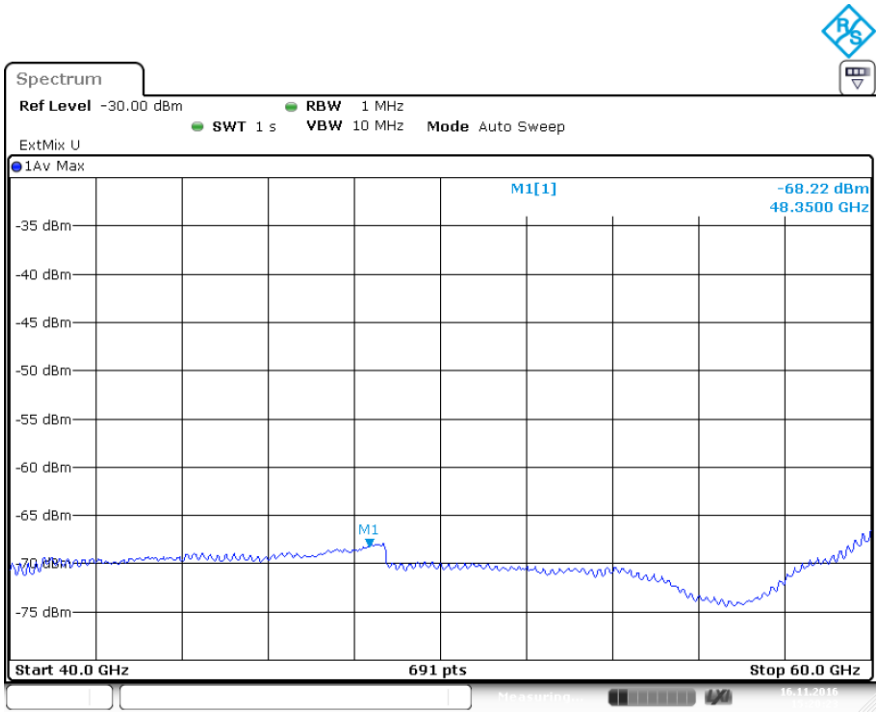
Date: 16.NOV.2016 14:31:47

Horizontal & Vertical Polarisation, DuT vertical, no tank



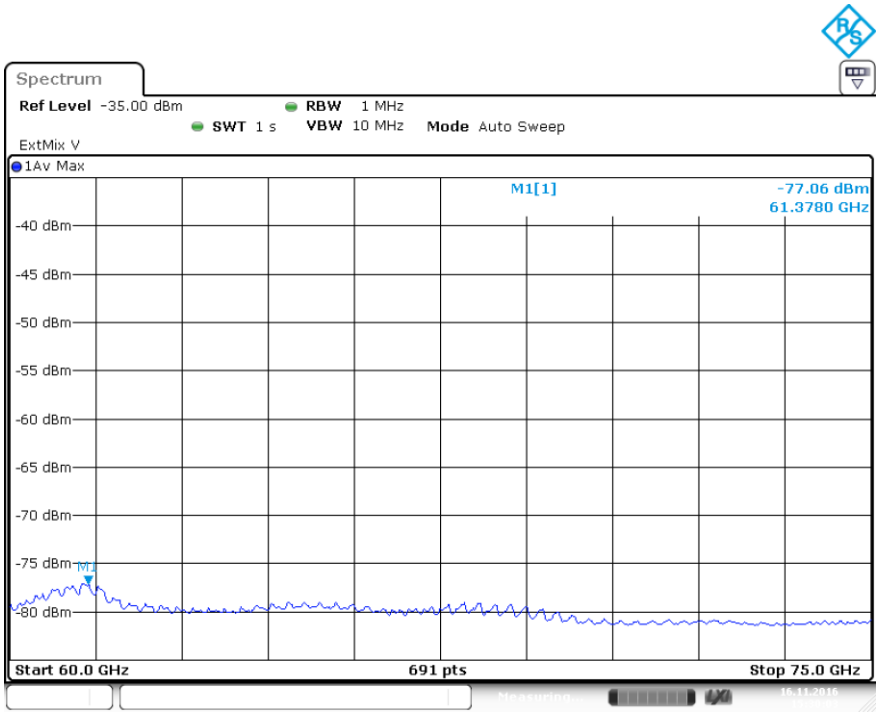
Date: 16.NOV.2016 15:16:31

Horizontal Polarisation, DuT vertical, no tank



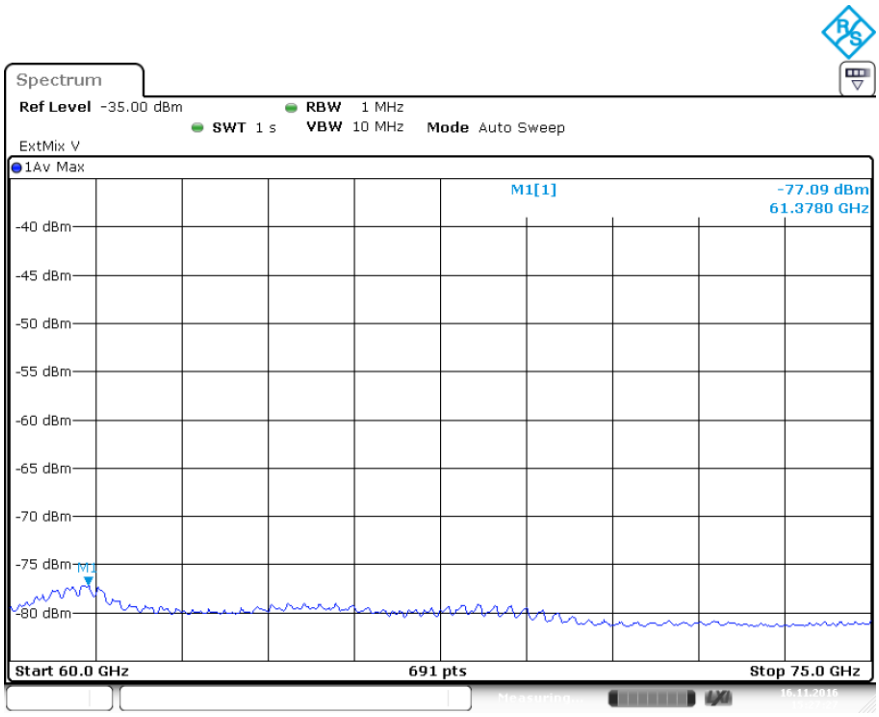
Date: 16.NOV.2016 15:20:23

Vertical Polarisation, DuT vertical, no tank



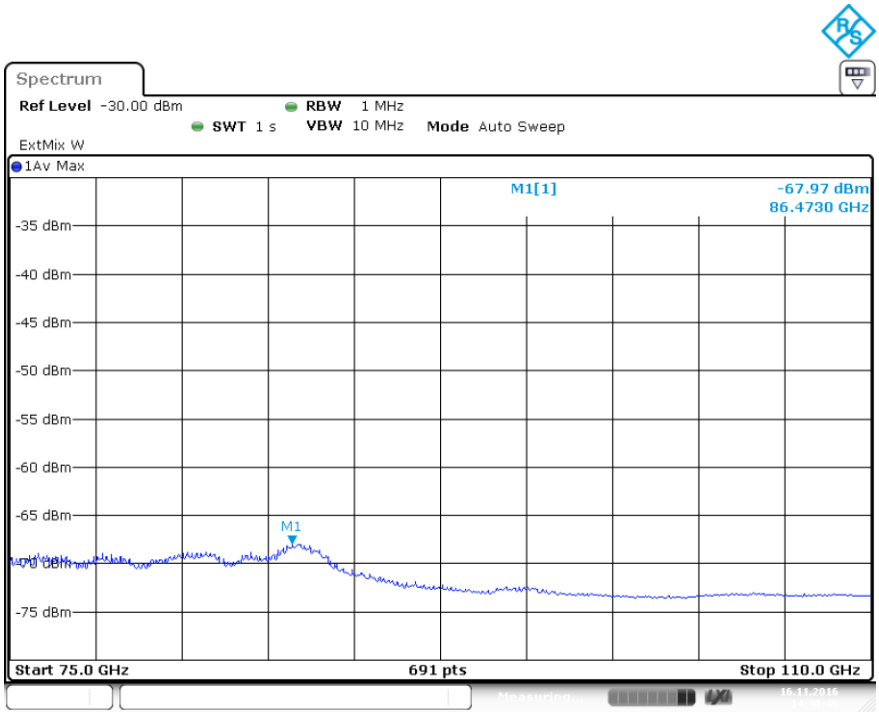
Date: 16.NOV.2016 15:30:04

Horizontal Polarisation, DuT vertical, no tank



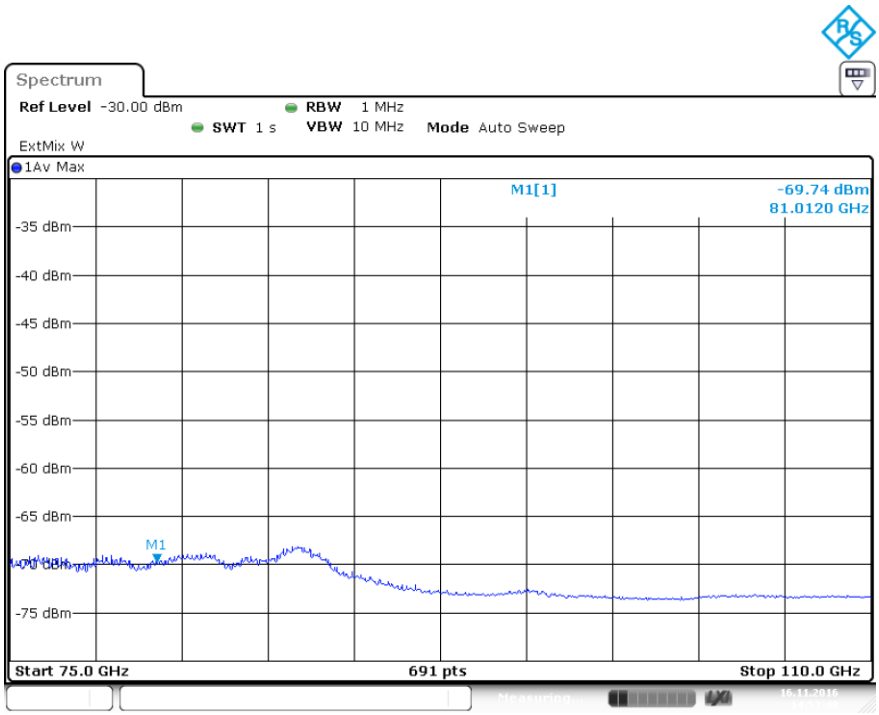
Date: 16.NOV.2016 15:27:28

Vertical Polarisation, DuT vertical, no tank



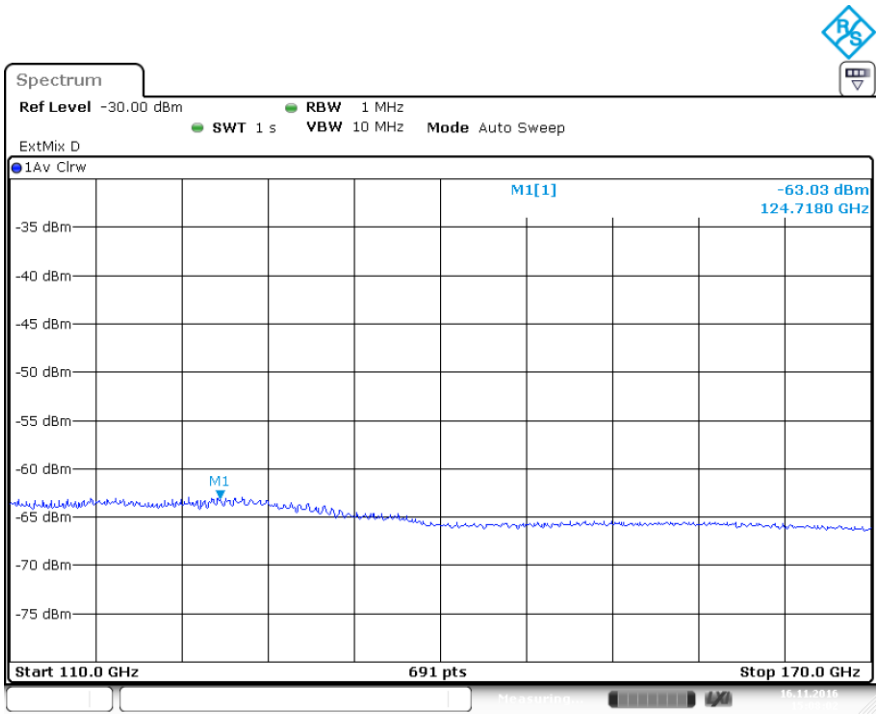
Date: 16.NOV.2016 14:40:49

Horizontal Polarisation, DuT vertical, no tank



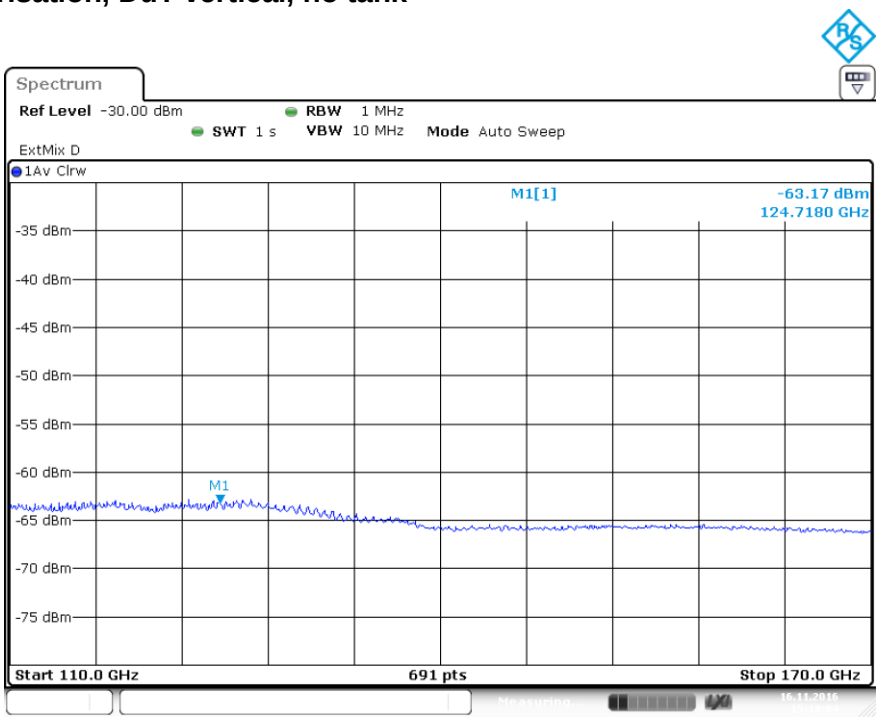
Date: 16.NOV.2016 14:53:48

Vertical Polarisation, DuT vertical, no tank



Date: 16.NOV.2016 15:08:02

Horizontal Polarisation, DuT vertical, no tank



Date: 16.NOV.2016 15:10:05

Vertical Polarisation, DuT vertical, no tank

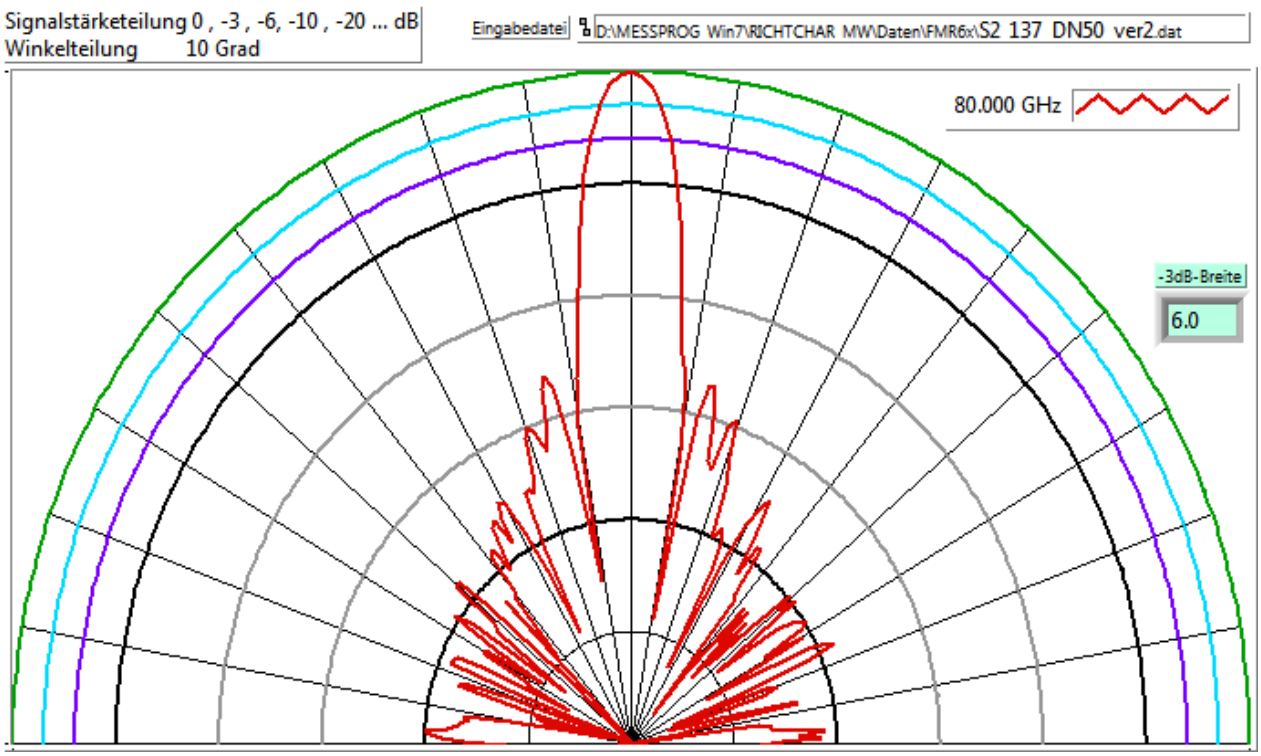
7.5 Antenna beamwidth – Antenna side lobe gain

Rules and specifications:	CFR 47 Part 15, sections 15.256(i) and 15.256(j)
Guide:	ANSI C63.10
Description:	**(i) Antenna beamwidth.** (A) LPR devices operating under the provisions of this section within the 5.925-7.250 GHz and 24.05-29.00 GHz bands must use an antenna with a -3 dB beamwidth no greater than 12 degrees. (B) LPR devices operating under the provisions of this section within the 75-85 GHz band must use an antenna with a -3 dB beamwidth no greater than 8 degrees.§15.256(j): **(j) Antenna side lobe gain.** LPR devices operating under the provisions of this section must limit the side lobe antenna gain relative to the main beam gain for off-axis angles from the main beam of greater than 60 degrees to the levels provided in Table 2. Table 2—Antenna Side Lobe Gain Limits Frequency range(GHz) Antenna sidelobe gain limit relative to main beam gain (dB) 5.925-7.250 GHz −22 dB 24.05-29.00 GHz −27 dB 75-85 GHz −38 dB
Note:	
Date of test:	2017-03-17
Test site:	Fully anechoic room, cabin no. 2
Measurement description:	Radiated Emission in Fully or Semi Anechoic Room (6.4)

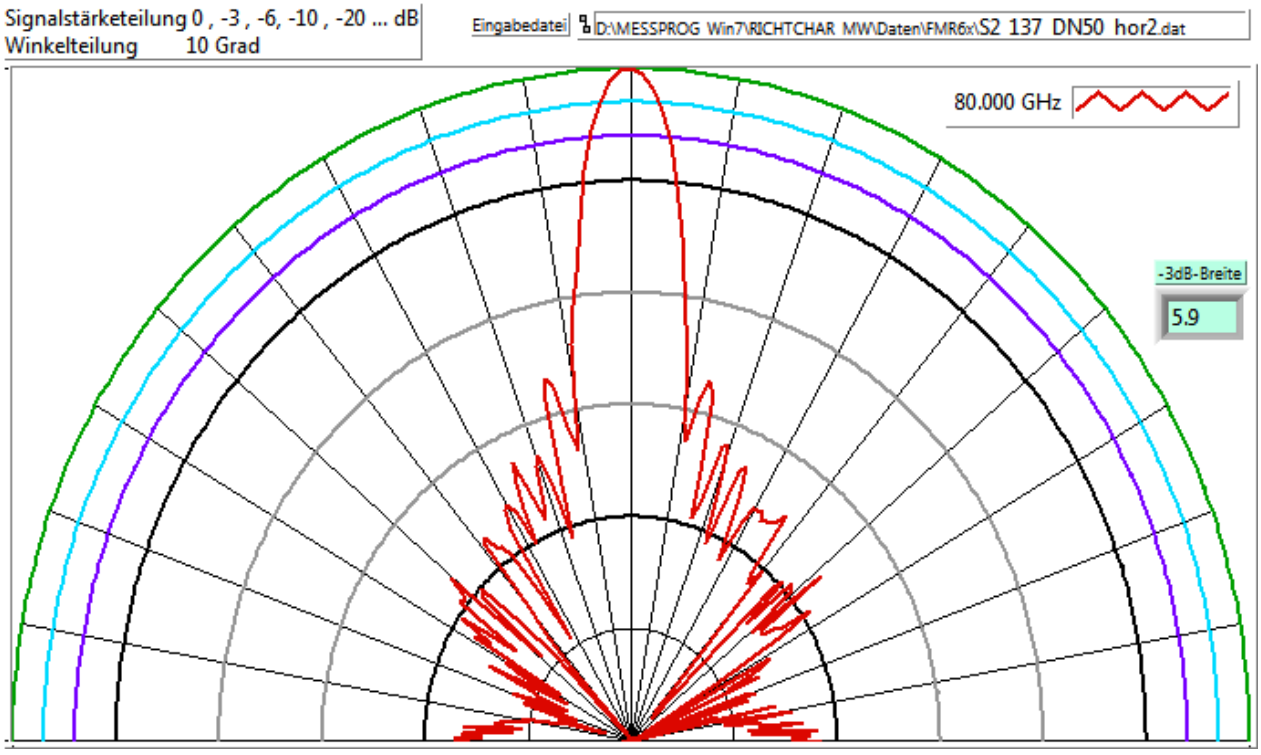
3 dB Antenna Beamwidth			
Antenna	**Required (degrees)**	**Measured (degrees)**	**Result**
PTFE Thread – Antenna S2-137	< 8	6.0	Pass
1.5“ Thread PEEK– Antenna S1-139	< 8	7.8	Pass
Antenna S3-136 Flange	< 8	4.6	Pass

Antenna side lobe gain			
Antenna	**Required (dB)**	**Measured (dB)**	**Result**
PTFE Thread – Antenna S2-137	-38	> -38	Pass
1.5“ Thread PEEK– Antenna S1-139	-38	> -38	Pass
Antenna S3-136 Flange	-38	> -38	Pass

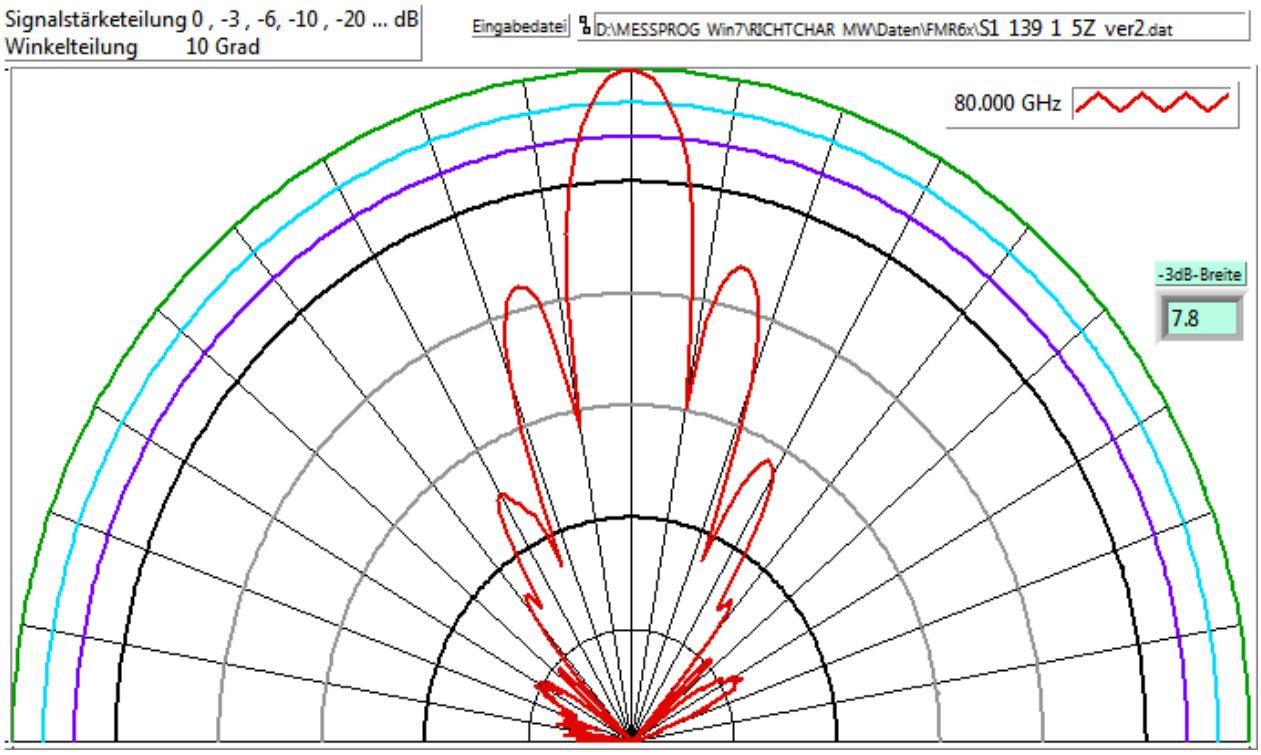
PTFE Thread – Antenna S2-137, Vertical Polarisation



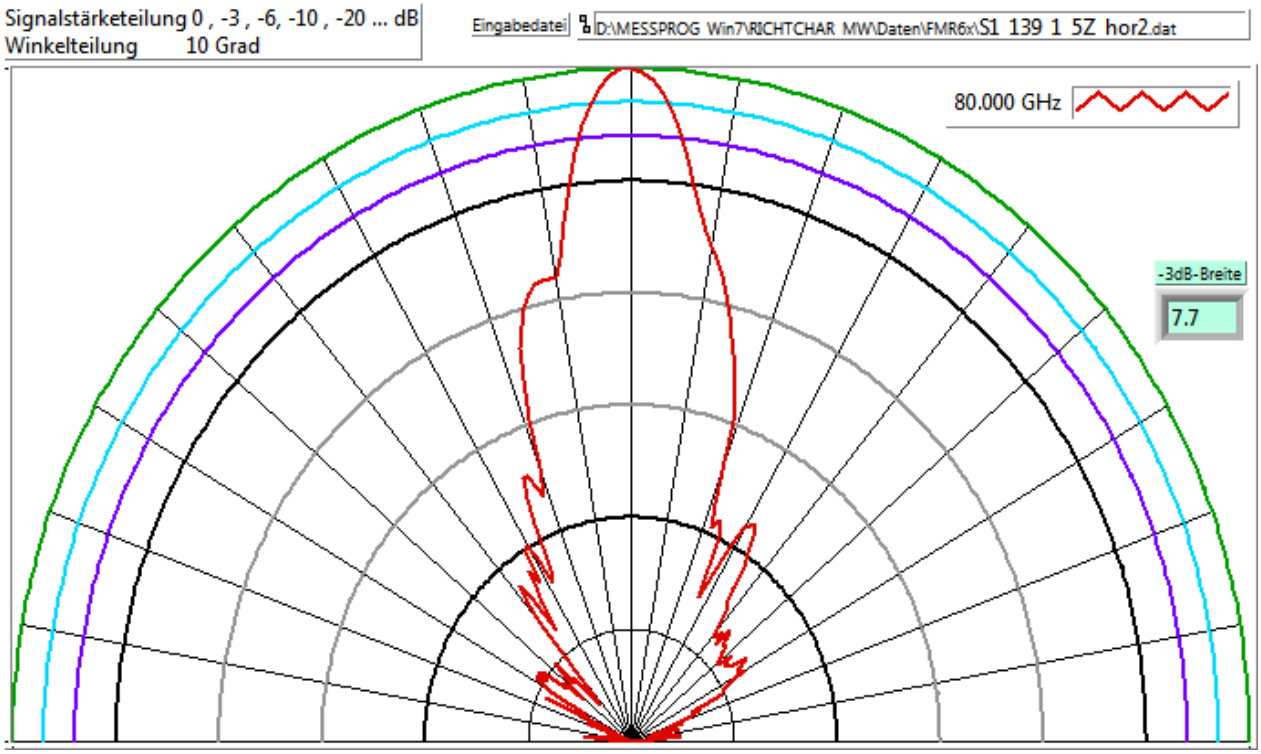
PTFE Thread – Antenna S2-137, Horizontal Polarisation



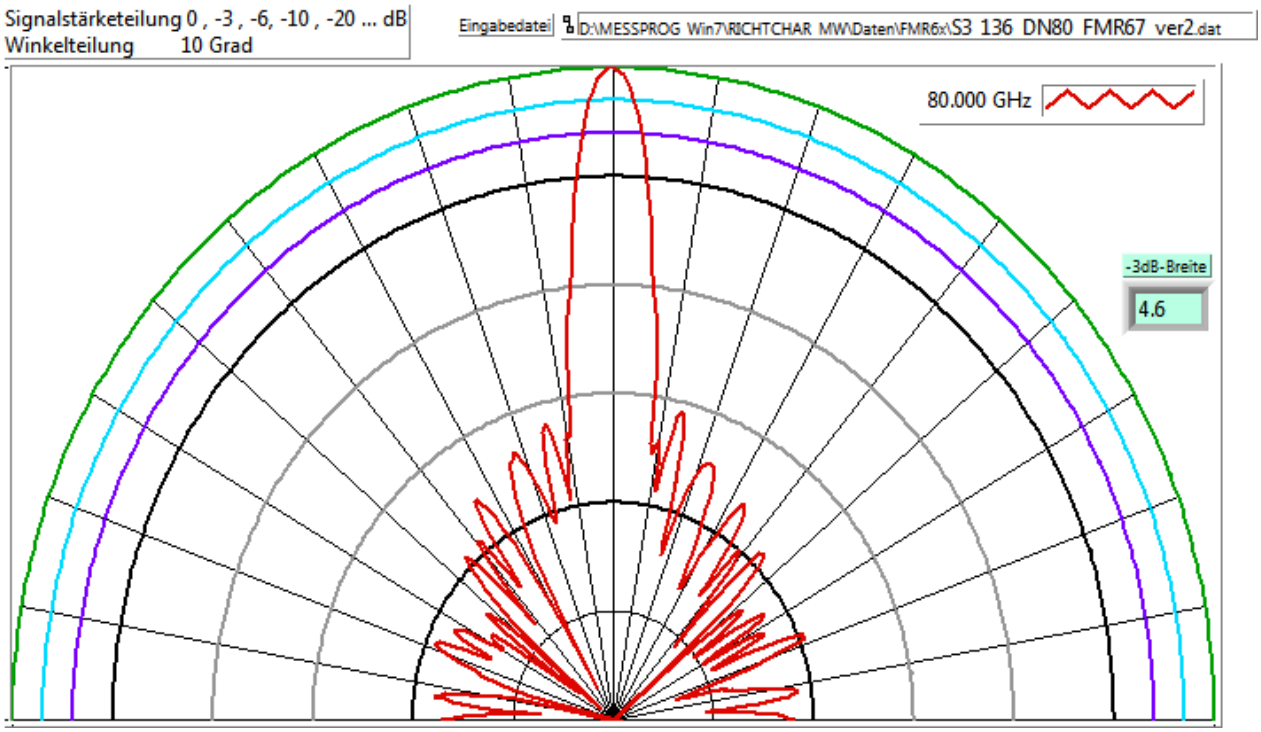
1.5“ Thread PEEK– Antenna S1-139, Vertical Polarisation



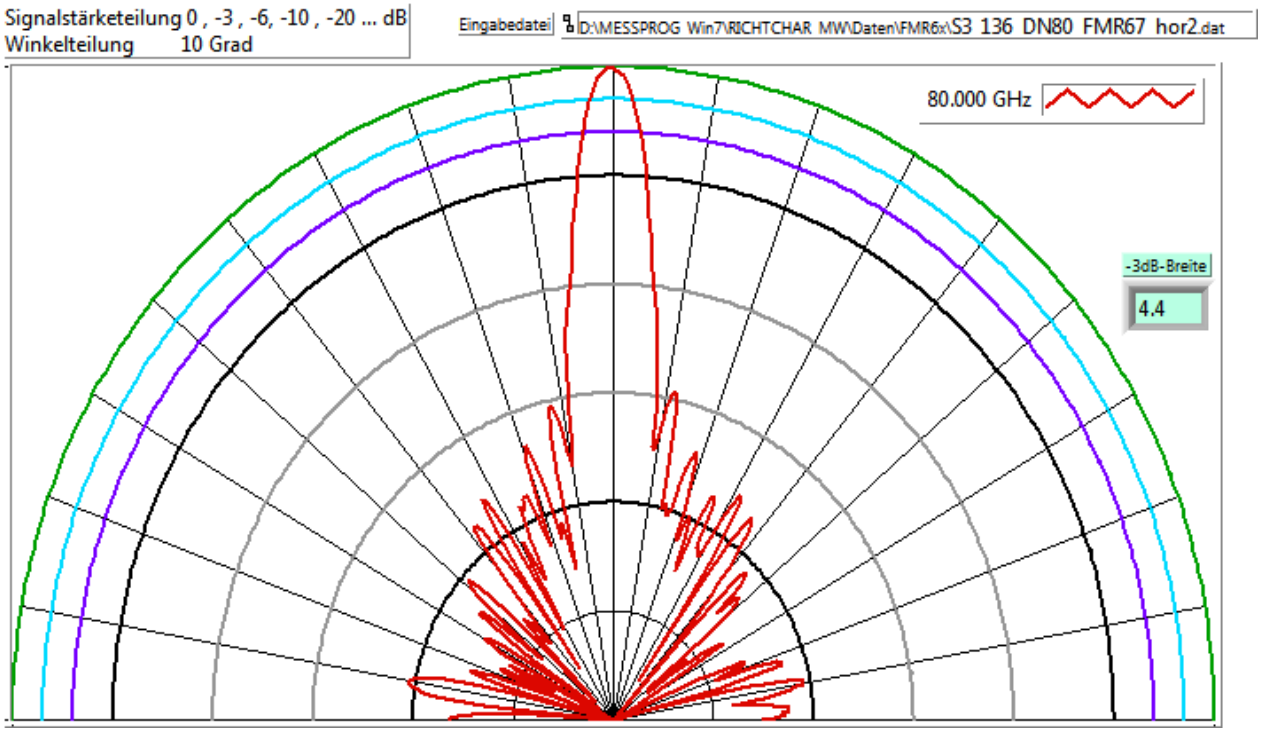
1.5“ Thread PEEK – Antenna S1-139, Horizontal Polarisation



Antenne S3-136 Flange, no plating, Vertical Polarisation



Antenne S3-136 Flange, no plating, Horizontal Polarisation



7.6 Frequency Stability

Rules and specifications:	CFR 47 Part 15, section 15.215 (c)
Guide:	ANSI C63.10, KDB 890966, section H
Description:	(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated 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.
Note:	
Date of test:	2017-03-20
Test site:	Fully anechoic room, cabin no. 2
Measurement description:	Radiated Emission in Fully or Semi Anechoic Room (6.4)

Carrier Frequency Stability vs Temperature

Temperature	Lower Band edge	Upper Band edge	Lower Band Limit	Upper Band Limit	Result
°C	GHz	GHz	GHz	GHz	Pass/Fail
50	78.917	82.427	75.00	85.00	Pass
40	78.917	82.427	75.00	85.00	Pass
30	78.917	82.427	75.00	85.00	Pass
20	78.917	82.427	75.00	85.00	Pass
10	78.917	82.427	75.00	85.00	Pass
0	78.917	82.427	75.00	85.00	Pass
-10	78.917	82.427	75.00	85.00	Pass
-20	78.917	82.427	75.00	85.00	Pass

Carrier Frequency Stability vs Suppy Voltage

Supply Voltage	Lower Band edge	Upper Band edge	Lower Band Limit	Upper Band Limit	Result
V	GHz	GHz	GHz	GHz	Pass/Fail
10.5	78.917	82.427	75.00	85.00	Pass
24	78.917	82.427	75.00	85.00	Pass
30	78.917	82.427	75.00	85.00	Pass

7.7 Conducted Powerline Emission Measurement 150 kHz to 30 MHz

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

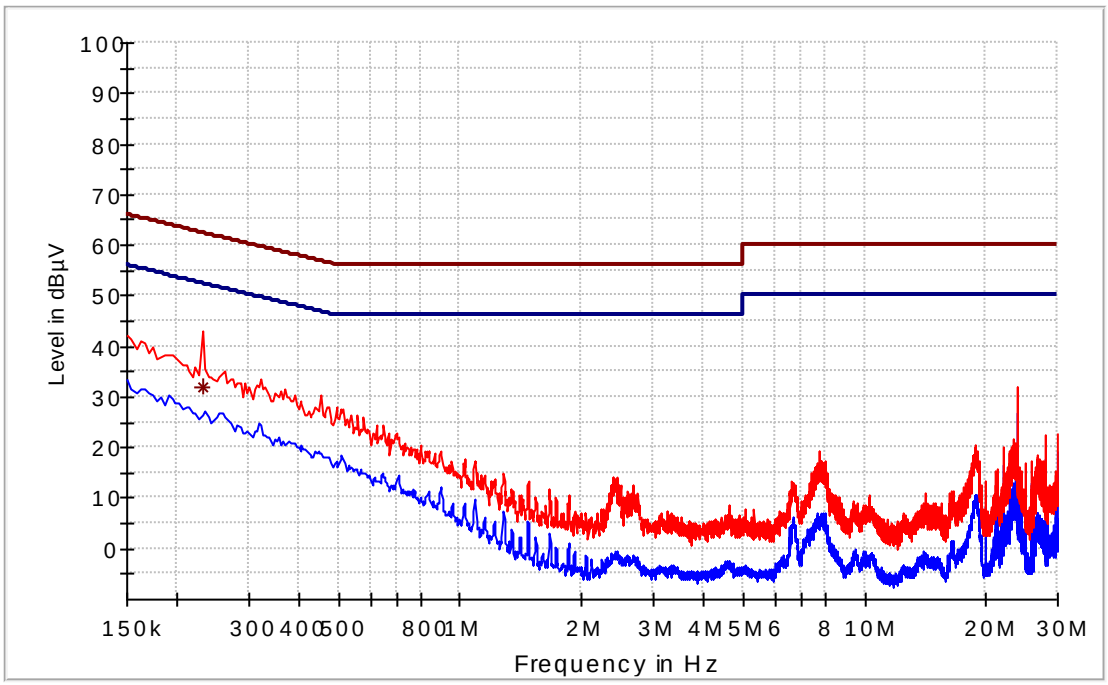
Comment:	
Date of test:	2017-03-16
Test site:	Shielded room, cabin no. 9

Test Result:	Test passed

TÜV SÜD Product Service GmbH
Äußere Frühlingstraße 45
94315 Straubing
Germany

Phone: +49 9421 5522-0
Fax: +49 9421 5522-99
Web: www.tuev-sued.de

Tested on:	Plus Terminal



Preview Result 2-AVG
Preview Result 1-PK+
EN 55022 Class B Conducted voltage at mains ports QP
EN 55022 Class B Conducted voltage at mains ports AV
Final_Result QPK
Final_Result AVG

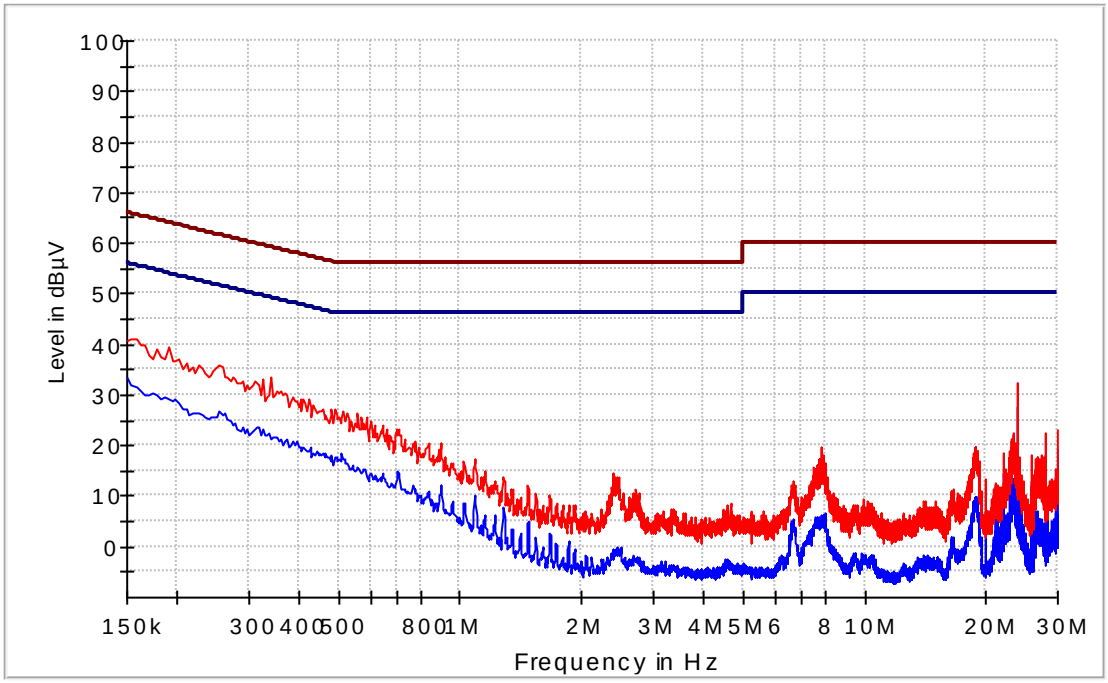
Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Line	Corr. (dB)
0.230000	31.80	---	62.45	30.65	1000.0	L1	0.0

TÜV SÜD Product Service GmbH
Äußere Frühlingstraße 45
94315 Straubing
Germany

Phone: +49 9421 5522-0
Fax: +49 9421 5522-99
Web: www.tuev-sued.de

Tested on:	Minus Terminal



Preview Result 2-AVG
Preview Result 1-PK+
EN 55022 Class B Conducted voltage at mains ports QP
EN 55022 Class B Conducted voltage at mains ports AV
Final_Result QPK
Final_Result AVG

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Line	Corr. (dB)
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Sample calculation of final values:

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

8 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, 2015
☒	CFR 47 Part 15	Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)	October 1, 2015
☐	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 8 for Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, published by Industry Canada	December 2010
☒	RSS-211	Radio Standards Specification RSS-211 Issue 1 for Level Probing Radar Equipment	March 2015
☐	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

9 Test Equipment List with Calibration Data

Type	*Inv.-No.*	*Type Designation*	*Serial Number*	*Manufacturer*	*Calibration Organization*	*Last Calibration*	*Next Calibration*
EMI test receiver	1028	ESHS10	860043/016	Rohde & Schwarz	Rohde & Schwarz	10/2016	10/2017
EMI test receiver	2044	ESU8	100232	Rohde & Schwarz	Rohde & Schwarz	10/2016	10/2017
Spectrum analyser	1666	FSP30	100063	Rohde & Schwarz	Rohde & Schwarz	06/2016	06/2017
Spectrum analyser	2364	FSV40	101448	Rohde & Schwarz	Rohde & Schwarz	08/2016	08/2017
Preamplifier	1484	ACO/180-3530	32641	CTT	TÜV SÜD PS-EMC-STR	07/2015	07/2017
Preamplifier	1684	AFS3-00100800-32-LN	847743	MITEQ	TÜV SÜD PS-EMC-STR	11/2015	11/2017
Preamplifier	1716	CPA9231A	3557	Schaffner EMC Systems	TÜV SÜD PS-EMC-STR	11/2015	11/2017
V-network	1059	ESH3-Z5	894785/005	Rohde & Schwarz	Rohde & Schwarz	08/2016	08/2019
Double ridged waveguide horn antenna	1516	3115	9508-4553	EMCO Elektronik	Seibersdorf Laboratories	01/2015	01/2017
Horn antenna	1014	3160-07	9112-1008	EMCO Elektronik		see note 1	
Horn antenna	1015	3160-08	9112-1002	EMCO Elektronik		see note 1	
Horn antenna	1265	3160-09	9403-1025 (931941-010)	EMCO Elektronik		see note 1	
Horn antenna	1575	3160-10	399185	EMCO Elektronik		see note 1	
Horn antenna	2086	24240-20	157845	Flann		see note 1	
Horn antenna	2180	25240-25	205900	Flann		see note 1	
Horn antenna	2182	27240-25	204260	Flann		see note 1	
Loop antenna	1016	HFH2-Z2	882964/0001	Rohde & Schwarz	Rohde & Schwarz	05/2016	05/2018
TRILOG Broadband Antenna	2058	VULB 9163	9163-408	Schwarzbeck	Rohde & Schwarz	06/2016	06/2018
Waveguide mixer		FS-Z60		Radiometer Physics	Rohde & Schwarz	12/2016	12/2019
Waveguide mixer		FS-Z90		Radiometer Physics	Rohde & Schwarz	12/2016	12/2019
Waveguide mixer		FS-Z110		Radiometer Physics	Rohde & Schwarz	12/2016	12/2019
Waveguide mixer		FS-Z170		Radiometer Physics	Rohde & Schwarz	12/2016	12/2019

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.

10 Annex 1: Test Setup Photographs

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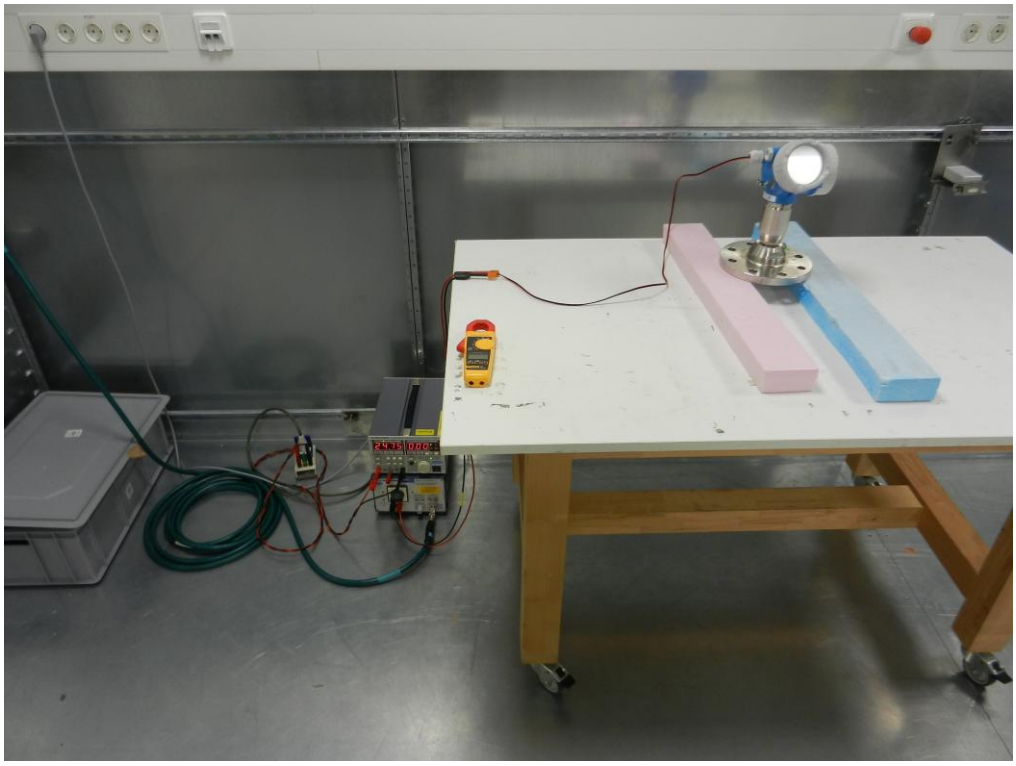
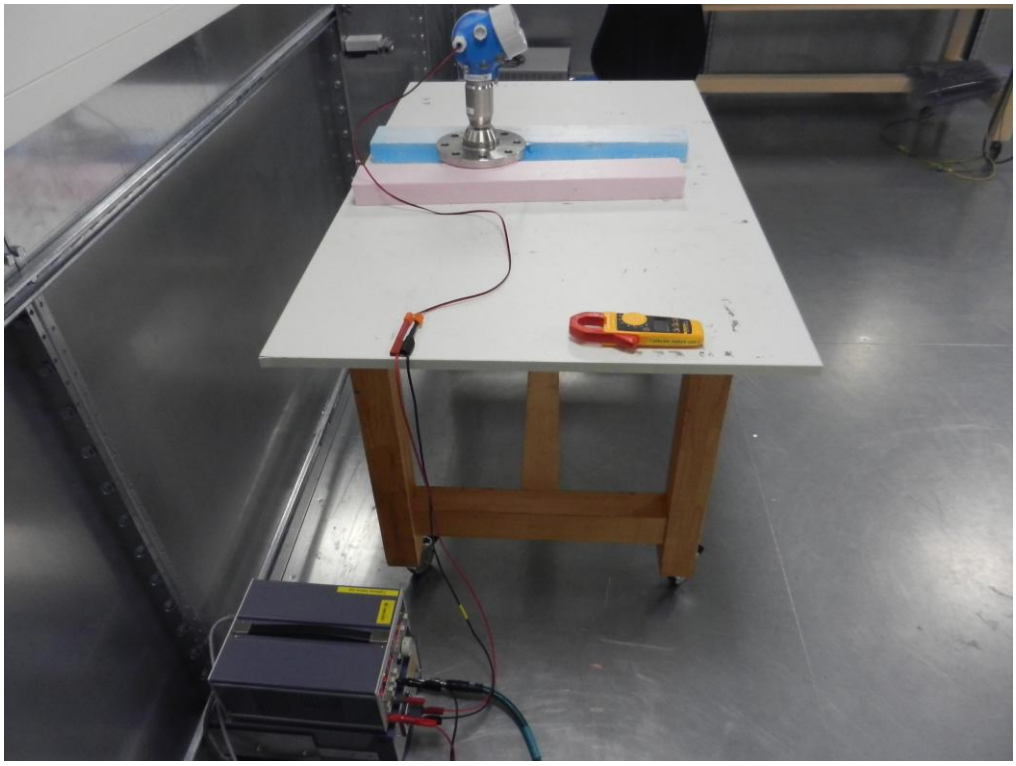
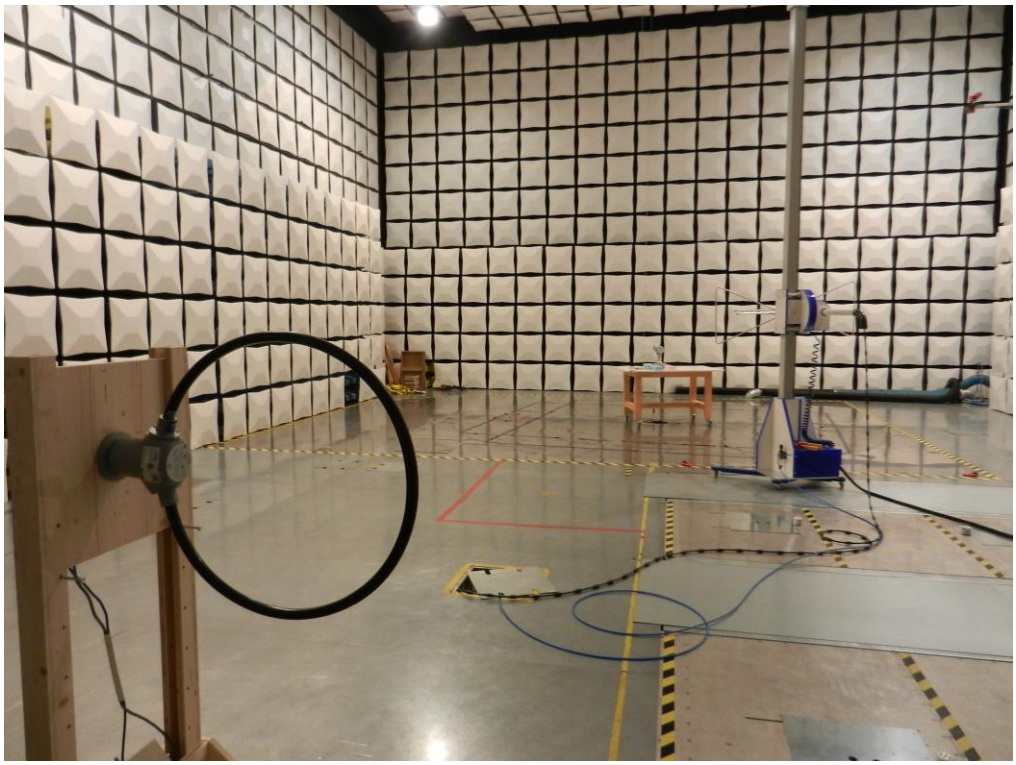
Test setup for conducted DC powerline emission measurement on model: FMR62F





Test setup for radiated emission measurement 9 kHz – 30 MHz on model FMR62F



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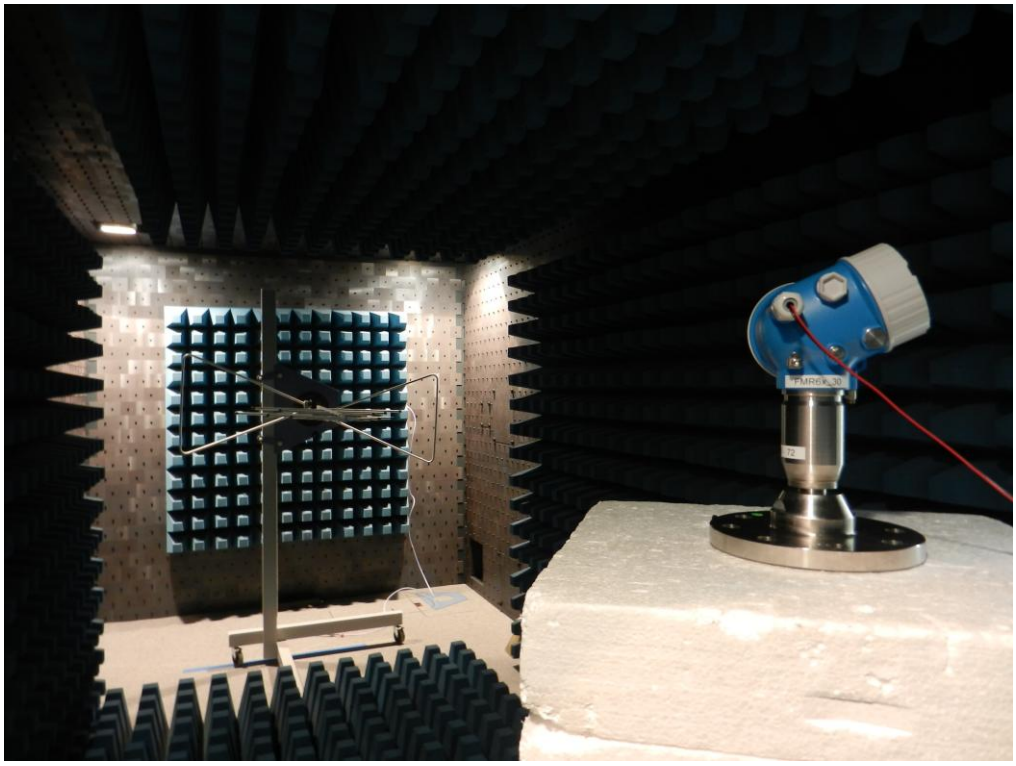
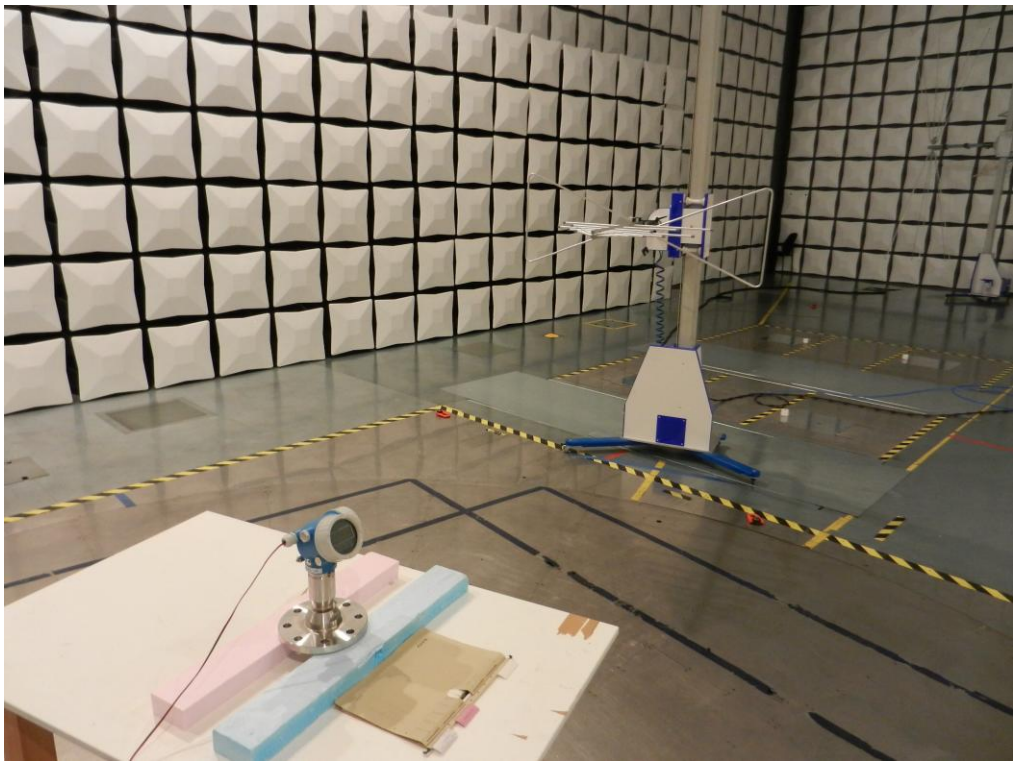
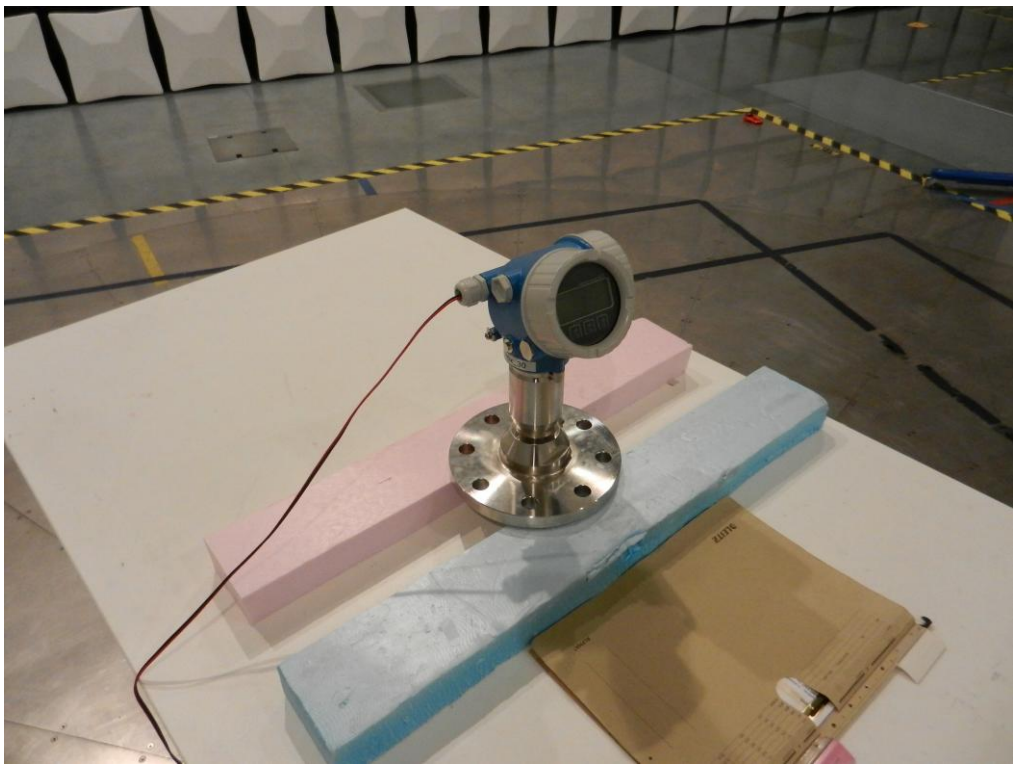
Test setup for radiated emission measurement (fully anechoic room) FMR62F



Test setup for radiated emission measurement (alternate test site)
FMR62F





11 Revision History

Revision History			
Edition	*Date*	*Issued by*	*Modifications*
1	2016-12-01	J. Roidt	First Edition
2	2017-03-20	M. Biberger	Second Edition: IC &FCC ID updated, Model names updated, models added at the photos