
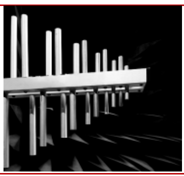
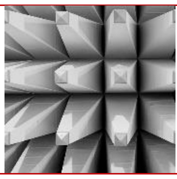

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consulting - testing - certification >>>

TEST REPORT

Test report no.: 1-0175/15-02-05-B

DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-01

Testing laboratory

CETECOM ICT Services GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: http://www.cetecom.com
e-mail: ict@cetecom.com

Accredited Testing Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-01

Applicant

Gustav Magenwirth GmbH & Co. KG
Stuttgarter Straße 48
72574 Bad Urach / GERMANY
Phone: +49 7125 153 0
Fax: +49 7125 153 244
Contact: Christoph Kern
e-mail: c.kern@magura.de
Phone: +49 7125 153 143

Manufacturer

Gustav Magenwirth GmbH & Co. KG
Stuttgarter Straße 48
72574 Bad Urach / GERMANY

Test standard/s

47 CFR Part 15	Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 247 Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item:	**eLECT controller**
Model name:	**SEATPOST, FORK, REARSHOCK**
FCC ID:	**2AF4AELECT**
IC:	**20786-ELECT**
Frequency:	DTS band 2400 MHz to 2483.5 MHz
Technology tested:	ANT+
Antenna:	Integrated antenna
Power supply:	1.8 V to 3.6 V DC by battery
Temperature range:	-15°C to +50°C

This test report is electronically signed and valid without handwriting signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test report authorized:

cn=Marco Bertolino, o=CETECOM ICT Services GmbH, ou=BTL-150828, email=marco.bertolino@cetecom.com, c=DE
2016.09.20 06:20:00 +02'00'

Marco Bertolino
Lab Manager
Radio Communications & EMC

Test performed:

cn=Christoph Schneider, o=CETECOM ICT Services GmbH, ou=SND-120402, email=christoph.schneider@cetecom.com, c=DE
2016.09.19 14:20:03 +02'00'

Christoph Schneider
Testing Manager
Radio Communications & EMC

1 Table of contents

2 General information

2.1 Notes and disclaimer

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This test report replaces the test report with the number 1-0175/15-02-05-A and dated 2016-09-16

2.2 Application details

Date of receipt of order:	2015-08-12
Date of receipt of test item:	2015-12-21
Start of test:	2016-01-08
End of test:	2016-01-12
Person(s) present during the test:	-/-

3 Test standard/s and references

Test standard	Date	Description
47 CFR Part 15		Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 247 Issue 1	May 2015	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices

Guidance	Version	Description
DTS: KDB 558074 D01	v03r03	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
ANSI C63.4-2014	-/-	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

4 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+22 °C during room temperature tests -/- °C during high temperature tests -/- °C during low temperature tests
Relative humidity content	:		55 %
Barometric pressure	:		not relevant for this kind of testing
Power supply	:	V_{nom} V_{max} V_{min}	2.4 V DC by battery -/- V -/- V

5 Test item

5.1 General description

Kind of test item	:	eLECT controller
Type identification	:	SEATPOST, FORK, REARSHOCK
HMN	:	-/-
PMN	:	SEATPOST FORK REARSHOCK
HVIN	:	SEATPOST FORK REARSHOCK
FVIN	:	-/-
S/N serial number	:	-/-
HW hardware status	:	4.0
SW software status	:	1.18
Frequency band	:	DTS band 2400 MHz to 2483.5 MHz (lowest channel 2402 MHz; highest channel 2480 MHz)
Type of radio transmission Use of frequency spectrum	: :	FHSS
Type of modulation	:	GFSK
Number of channels	:	78
Antenna	:	Integrated antenna
Power supply	:	1.8 V to 3.6 V DC by battery
Temperature range	:	-15°C to +50°C

5.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup- and EUT-photos are included in test report:	SEATPOST	1-0175/15-02-01_AnnexA 1-0175/15-02-01_AnnexB 1-0175/15-02-01_AnnexD
	FORK	1-0175/15-02-07_AnnexA 1-0175/15-02-07_AnnexB 1-0175/15-02-07_AnnexD
	REARSHOCK	1-0175/15-02-08_AnnexA 1-0175/15-02-08_AnnexB 1-0175/15-02-08_AnnexD

6 Test laboratories sub-contracted

None

7 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

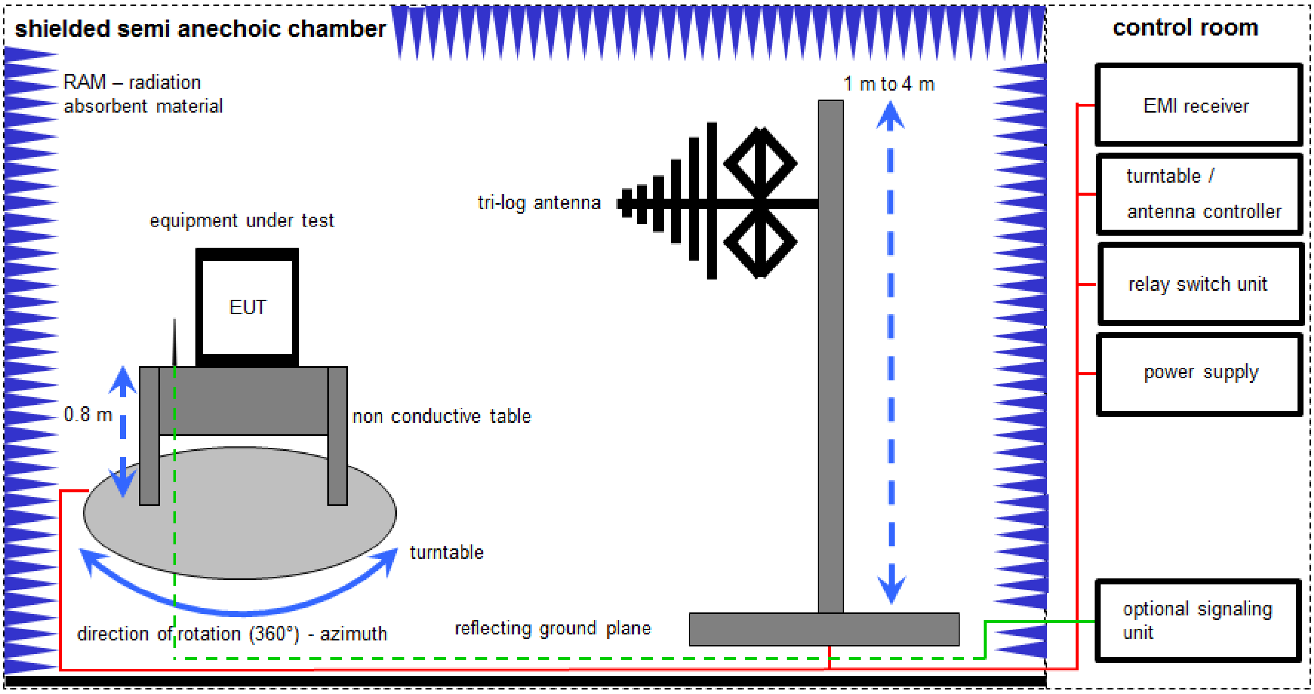
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Agenda: Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkI!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

7.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are confirmed with specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: tri-log antenna 10 meter

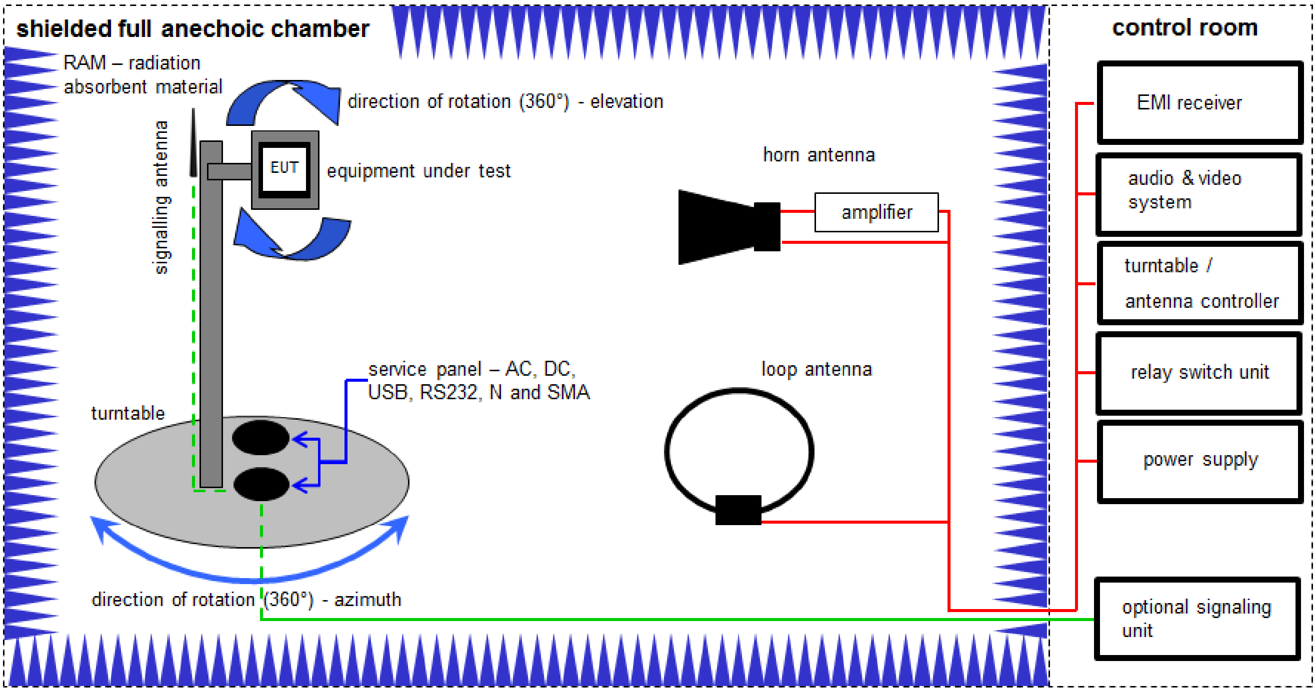
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	Switch-Unit	3488A	HP	2719A14505	300000368	ev		
2	A	RF-Filter-section	85420E	HP	3427A00162	300002214	k	27.11.2006	
3	A	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	26.01.2015	26.01.2016
4	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw		
5	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw		
6	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw		
7	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	295	300003787	k	22.04.2014	22.04.2016

7.2 Shielded fully anechoic chamber



Measurement distance: horn antenna 3 meter; loop antenna 3 meter / 1 meter

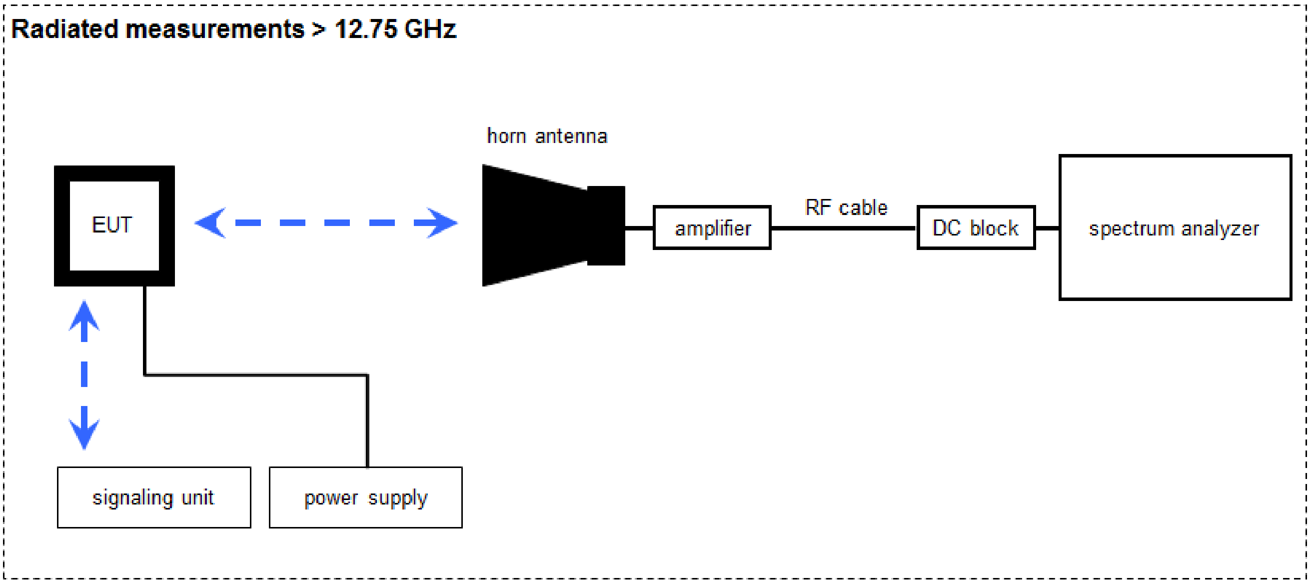
FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dBµV/m] (71.61 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9709-5290	300000212	k	13.08.2015	13.08.2017
2	A, B	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789	ne		
3	A	Band Reject Filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	26	300003792	ne		
4	B	Active Loop Antenna 10 kHz to 30 MHz	6502	EMCO/2	8905-2342	300000256	k	24.06.2015	24.06.2017
5	A	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22050	300004482	ev		
6	A, B	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000032	300004510	ne		
7	A, B	Messrechner und Monitor	Intel Core i3 3220/3,3 GHz, Prozessor	Agilent Technologies	2V2403033A54 21	300004591	ne		
8	A, B	NEXIO EMV-Software	BAT EMC	EMCO	2V2403033A54 21	300004682	ne		
9	A, B	EMI Test Receiver 9kHz-26,5GHz	ESR26	R&S	101376	300005063	k	04.09.2015	04.09.2016

7.3 Radiated measurements > 12.75 GHz



Measurement distance: horn antenna 50 cm

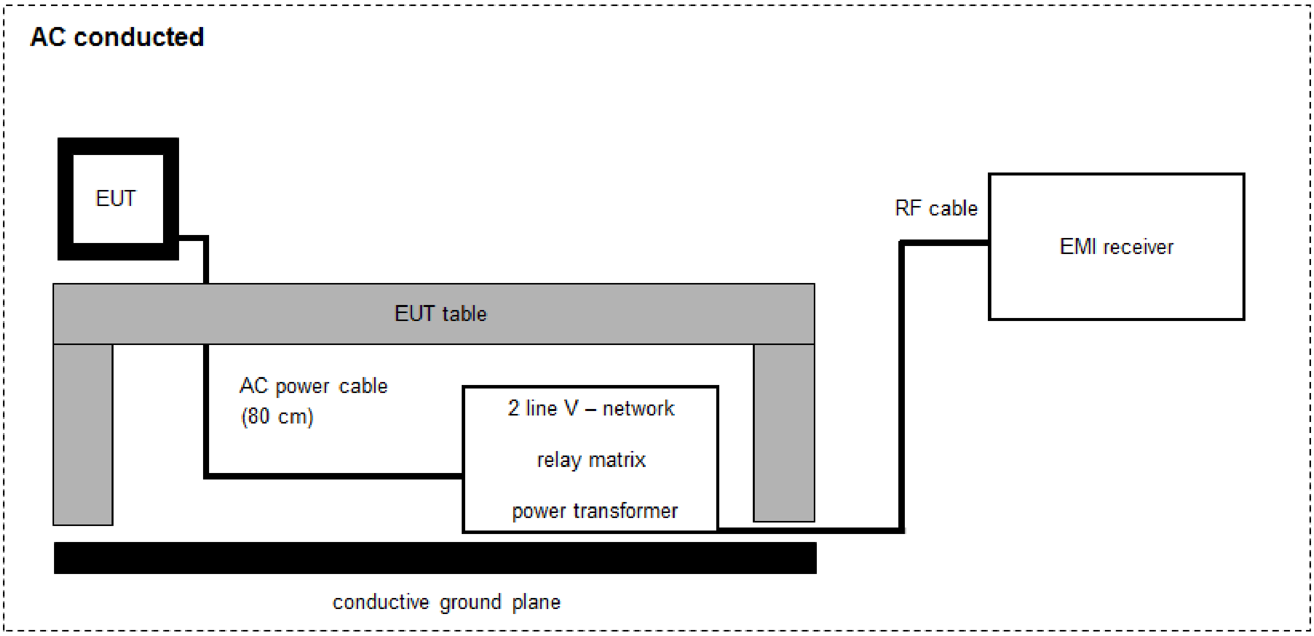
FS = U_R + CA + AF
(FS-field strength; U_R-voltage at the receiver; CA-loss signal path & distance correction; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-60.1) [dB] + 36.74 [dB/m] = 16.64 [dBµV/m] (6.79 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	Std. Gain Horn Antenna 12.4 to 18.0 GHz	639	Narda	8402	300000787	k	14.08.2015	14.08.2017
2	A	Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8205	300002442	NK!	19.07.2013	
3	A	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	22.01.2015	22.01.2016
4	A	Amplifier 2-40 GHz	JS32-02004000-57-5P	MITEQ	1777200	300004541	ev		
5	A	RF-Cable	ST18/SMAm/SMAm/48	Huber & Suhner	Batch no. 600918	400001182	ev		
6	A	RF-Cable	ST18/SMAm/SMm/48	Huber & Suhner	Batch no. 127377	400001183	ev		
7	A	DC-Blocker 0.1-40 GHz	8141A	Inmet	Batch no. 127377	400001185	ev		
8	A	Coax Attenuator 10 dB 2W 0-40 GHz	MCL BW-K10-2W44+	Mini Circuits	Batch no. 127377	400001186	ev		

7.4 AC conducted



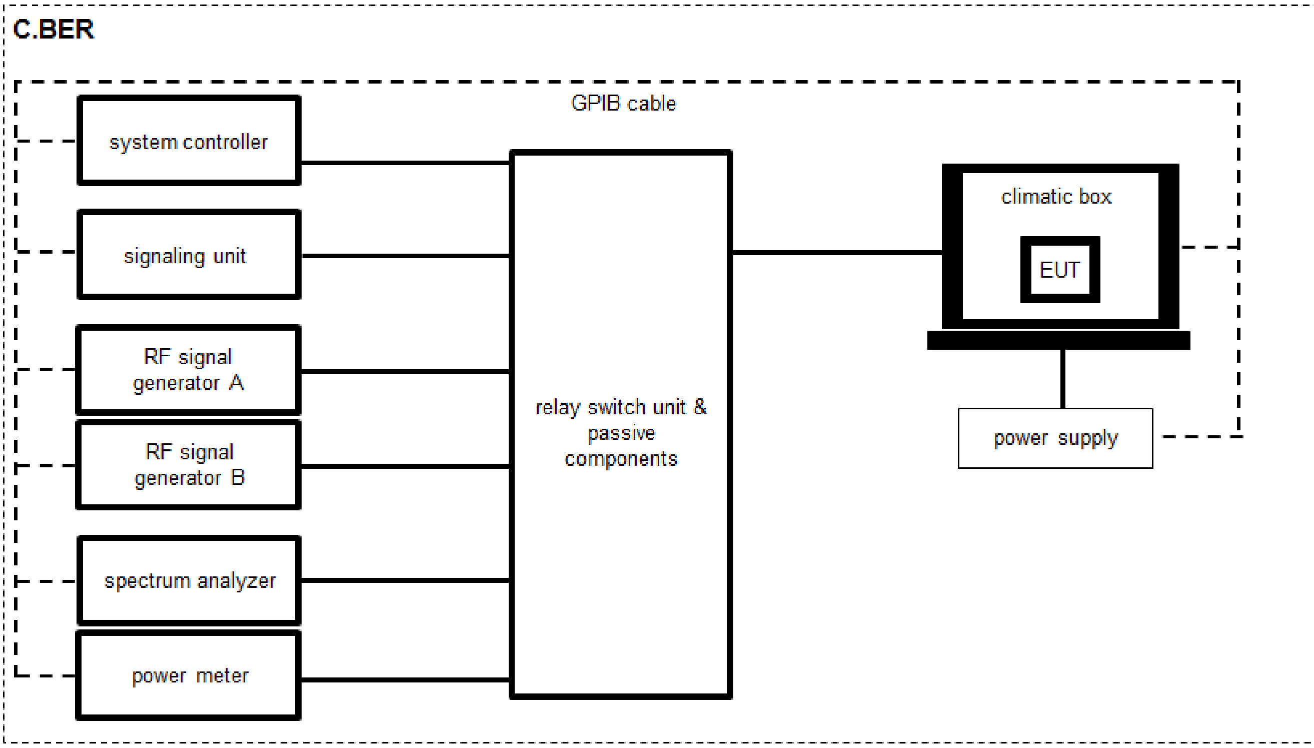
FS = UR + CF + VC
(FS-field strength; UR-voltage at the receiver; CR-loss of the cable and filter; VC-correction factor of the ISN)

Example calculation:
FS [dBµV/m] = 37.62 [dBµV/m] + 9.90 [dB] + 0.23 [dB] = 47.75 [dBµV/m] (244.06 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	Netznachbildung	ESH3-Z5	R&S	892475/017	300002209	k	17.06.2014	17.06.2016
2	A	EMI-Receiver	8542E	HP	3617A00170	300000568	k	28.01.2015	28.01.2016
3	A	Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	Ve	11.02.2014	11.02.2016

7.5 Conducted measurements C.BER system



OP = AV + CA
(OP-output power; AV-analyzer value; CA-loss signal path)

Example calculation:
OP [dBm] = 6.0 [dBm] + 11.7 [dB] = 17.7 [dBm] (58.88 mW)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	Switch / Control Unit	3488A	HP		300000929	ne		
2	A	Labormessplatzrechner 19" Servergehäuse	Intel Core i3 3225/3,3 GHz, Prozessor	Heraeus Voetsch	35230157A0370	300004646	ne		
3	A	System DC Power Supply	N5767A	Agilent Technologies	US14J1569P	300004851	vIKI!	04.09.2014	04.09.2016
4	A	USB-GPIB-Interface	82357B	Agilent Technologies	103170	300004852	ne		
5	A	DC-Blocker	8143	Inmet Corp.	none	300002842	ne		
6	A	RF-Cable	ST18/SMAm/SMAm/72	Huber & Suhner	Batch no. 605505	400001187	ev		
7	A	RF-Cable	Sucoflex 104	Huber & Suhner	147636/4	400001188	ev		
8	A	RF-Cable	ST18/SMAm/SMAm/48	Huber & Suhner	Batch no. 699866	400001189	ev		

8 Sequence of testing

8.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1.5 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

Final measurement

- Identified emissions during the premeasurement are maximized by the software by rotating the turntable from 0° to 360°. In case of the 2-axis positioner is used the elevation axis is also rotated from 0° to 360°.
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

8.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position ± 45° and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

8.3 Sequence of testing radiated spurious 1 GHz to 12.75 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

8.4 Sequence of testing radiated spurious above 12.75 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate (e.g. 0.5 m).
- The EUT is set into operation.

Premeasurement

- The test antenna is handheld and moved carefully over the EUT to cover the EUT’s whole sphere and different polarizations of the antenna.

Final measurement

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

9 Measurement uncertainty

Measurement uncertainty	
Test case	**Uncertainty**
Antenna gain	± 3 dB
Power spectral density	± 1.5 dB
DTS bandwidth	± 100 kHz (depends on the used RBW)
Occupied bandwidth	± 100 kHz (depends on the used RBW)
Maximum output power	± 1.5 dB
Detailed spurious emissions @ the band edge - conducted	± 1.5 dB
Band edge compliance radiated	± 3 dB
Spurious emissions conducted	± 3 dB
Spurious emissions radiated below 30 MHz	± 3 dB
Spurious emissions radiated 30 MHz to 1 GHz	± 3 dB
Spurious emissions radiated 1 GHz to 12.75 GHz	± 3.7 dB
Spurious emissions radiated above 12.75 GHz	± 4.5 dB
Spurious emissions conducted below 30 MHz (AC conducted)	± 2.6 dB

10 Summary of measurement results

☒	No deviations from the technical specifications were ascertained
☐	There were deviations from the technical specifications ascertained
☐	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC Identifier	Description	Verdict	Date	Remark
RF-Testing	CFR Part 15 RSS - 247, Issue 1	See table!	2016-09-19	-/-

Test specification clause	Test case	Guideline	Temperature conditions	Power source voltages	Mode	C	NC	NA	NP	Remark
§15.247(b)(4) RSS - 247 / 5.4 (4)	Antenna gain	-/-	Nominal	Nominal	TX	☒	☐	☐	☐	-/-
§15.247(e) RSS - 247 / 5.2 (2)	Power spectral density	KDB 558074 DTS clause: 10.6	Nominal	Nominal	TX	☒	☐	☐	☐	-/-
§15.247(a)(2) RSS - 247 / 5.2 (1)	DTS bandwidth	KDB 558074 DTS clause: 8.1	Nominal	Nominal	TX	☒	☐	☐	☐	-/-
RSS Gen clause 4.6.1	Occupied bandwidth	-/-	Nominal	Nominal	TX	☒	☐	☐	☐	-/-
§15.247(b)(3) RSS - 247 / 5.4 (4)	Maximum output power	KDB 558074 DTS clause: 9.2.2.5	Nominal	Nominal	TX	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5	Detailed spurious emissions @ the band edge - conducted	-/-	Nominal	Nominal	TX	☒	☐	☐	☐	-/-
§15.205 RSS - 247 / 5.5 RSS - Gen	Band edge compliance radiated	KDB 558074 DTS clause: 13.3.2	Nominal	Nominal	TX	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5	TX spurious emissions conducted	KDB 558074 DTS clause: 11.1 & 11.2 11.3	Nominal	Nominal	TX	☒	☐	☐	☐	-/-
§15.209(a) RSS-Gen	TX spurious emissions radiated below 30 MHz	-/-	Nominal	Nominal	TX	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5 RSS-Gen	TX spurious emissions radiated 30 MHz to 1 GHz	-/-	Nominal	Nominal	TX	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5 RSS-Gen	TX spurious emissions radiated above 1 GHz	-/-	Nominal	Nominal	TX	☒	☐	☐	☐	-/-
§15.109 RSS-Gen	RX spurious emissions radiated 30 MHz to 1 GHz	-/-	Nominal	Nominal	RX / idle	☒	☐	☐	☐	-/-
§15.109 RSS-Gen	RX spurious emissions radiated above 1 GHz	-/-	Nominal	Nominal	RX / idle	☒	☐	☐	☐	-/-
§15.107(a) §15.207	Conducted emissions < 30 MHz	-/-	Nominal	Nominal	TX	☒	☐	☐	☐	-/-

Note: C = Complies; NC = Not complies; NA = Not applicable; NP = Not performed

11 Additional comments

Reference documents: None

Special test descriptions: All EUTs containing the same RF board.
An additional USB to serial converter is needed to enter the different test modes. Radiated spurious emissions caused by this converter are shown in separate plots for each EUT (see 12.11).
RX plots done without this converter.

Configuration descriptions: None

Test mode:

☐ No test mode available.
Iperf was used to ping another device with the largest support packet size

☒ Special software is used.
EUT is transmitting pseudo random data by itself

Antennas and transmit operating modes:

☒ Operating mode 1 (single antenna)

- *Equipment with 1 antenna,*
- *Equipment with 2 diversity antennas operating in switched diversity mode by which at any moment in time only 1 antenna is used,*
- *Smart antenna system with 2 or more transmit/receive chains, but operating in a mode where only 1 transmit/receive chain is used)*

☐ Operating mode 2 (multiple antennas, no beamforming)

- *Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously but without beamforming.*

☐ Operating mode 3 (multiple antennas, with beamforming)

- *Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously with beamforming.*
In addition to the antenna assembly gain (G), the beamforming gain (Y) may have to be taken into account when performing the measurements.

12 Measurement results

12.1 Antenna gain

Measurement:

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module. For normal WLAN devices, the DSSS mode is used.

Measurement parameters:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	3 MHz
Video bandwidth:	3 MHz
Trace mode:	Max hold
Test setup:	See sub clause 7.2 A / 7.5 A
Measurement uncertainty	See sub clause 9

Limits:

FCC	IC
6 dBi	

Results:

SEATPOST

T_{nom}	V_{nom}	Lowest channel 2402 MHz	Middle channel 2440 MHz	Highest channel 2480 MHz
Conducted peak power [dBm]		-7.71	-7.80	-7.46
Radiated peak power [dBm]		0.78	1.10	1.65
Gain [dBi] Calculated		8.49	8.90	9.11

FORK

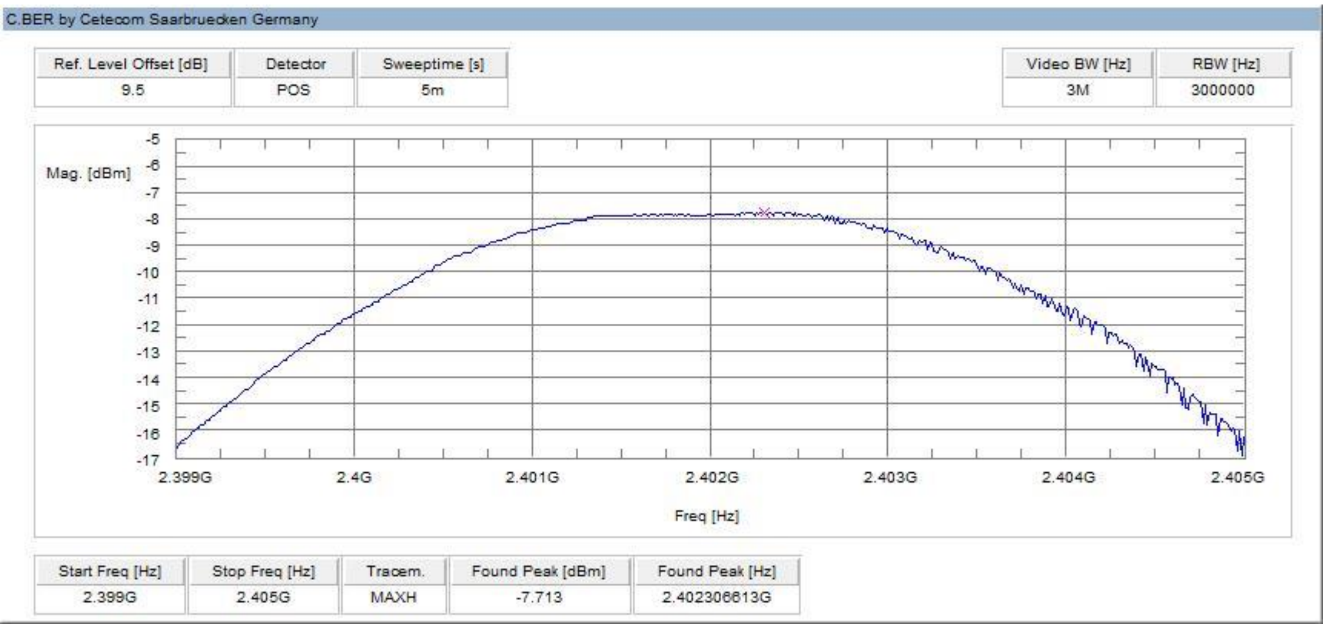
T_{nom}	V_{nom}	Lowest channel 2402 MHz	Middle channel 2440 MHz	Highest channel 2480 MHz
Conducted peak power [dBm]		-7.71	-7.80	-7.46
Radiated peak power [dBm]		-5.64	-6.21	-6.91
Gain [dBi] Calculated		2.07	1.59	0.55

REARSHOCK

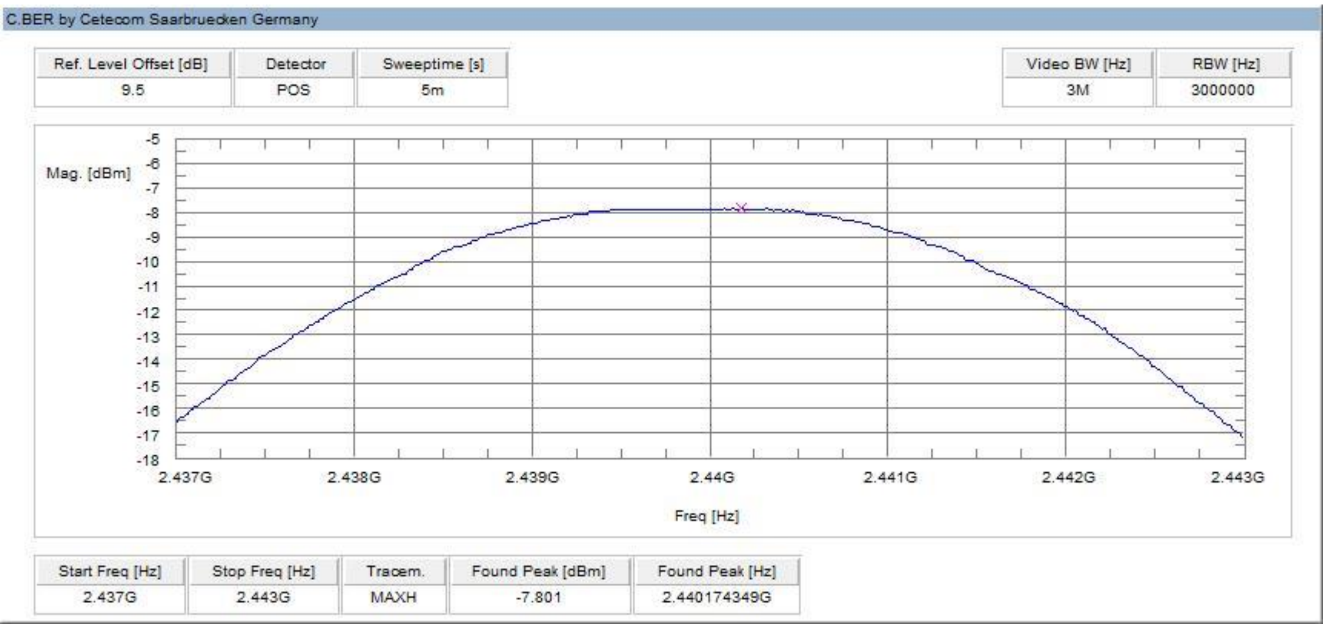
T_{nom}	V_{nom}	Lowest channel 2402 MHz	Middle channel 2440 MHz	Highest channel 2480 MHz
Conducted peak power [dBm]		-7.71	-7.80	-7.46
Radiated peak power [dBm]		2.44	2.16	1.89
Gain [dBi] Calculated		10.15	9.96	9.35

Plots:

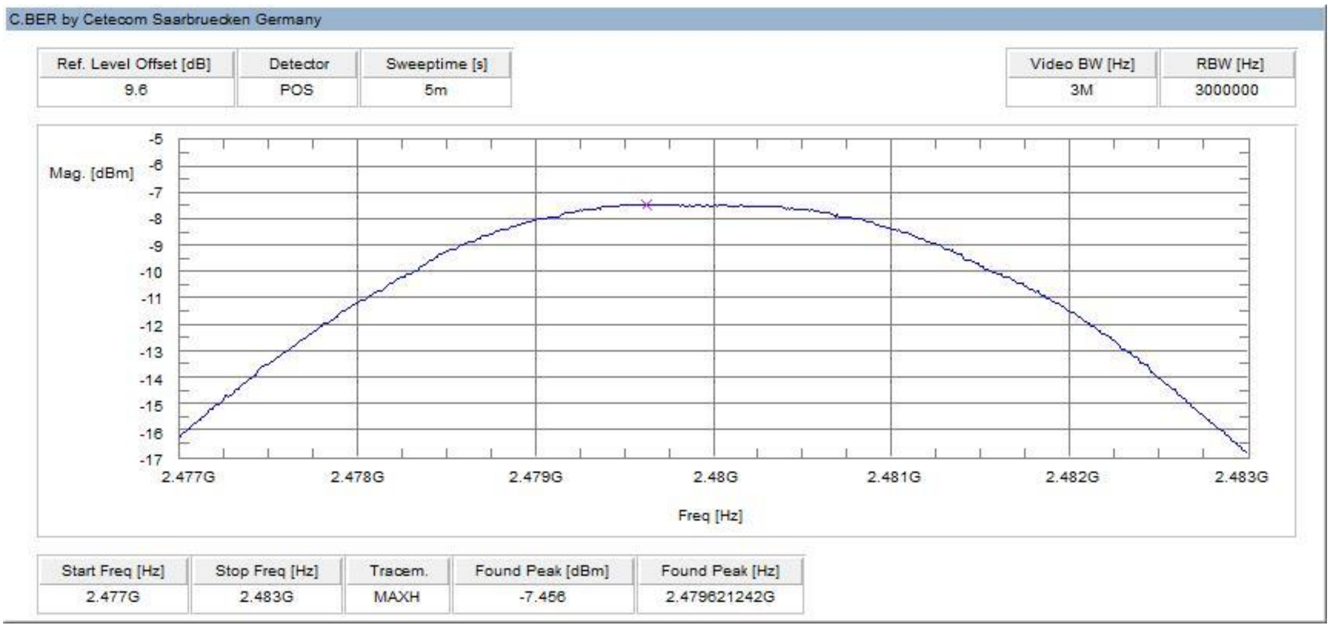
Plot 1: TX mode, lowest channel



Plot 2: TX mode, middle channel



Plot 3: TX mode, highest channel



12.2 Timing of the transmitter

Measurement:

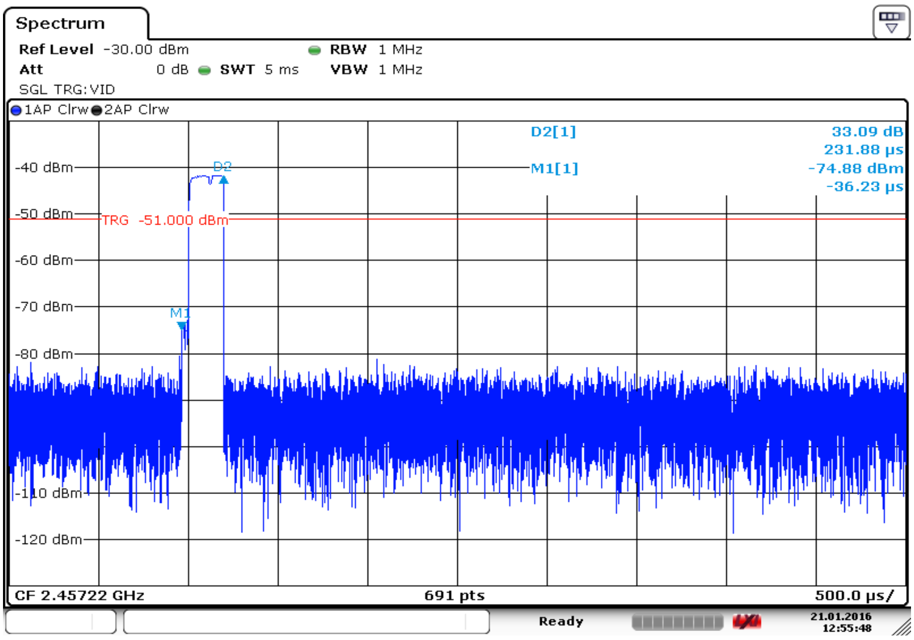
Measurement parameter	
Detector:	Peak
Sweep time:	5 ms / 500 ms
Resolution bandwidth:	1 MHz
Video bandwidth:	1 MHz
Span:	Zero
Trace-Mode:	Single sweep
Used equipment:	See chapter 7.5 A
Measurement uncertainty	See sub clause 9

Transmit time (Tx on) = 231.88 µs (Plot 1)
Tx on + Tx off = 100 ms (Plot 2, pulse train exceeds 0.1 seconds)

The peak-to-average correction factor is calculated with 20Log [Tx on/(Tx on + Tx off)].
Hereby the peak-to-average correction factor is -52.7 dB.

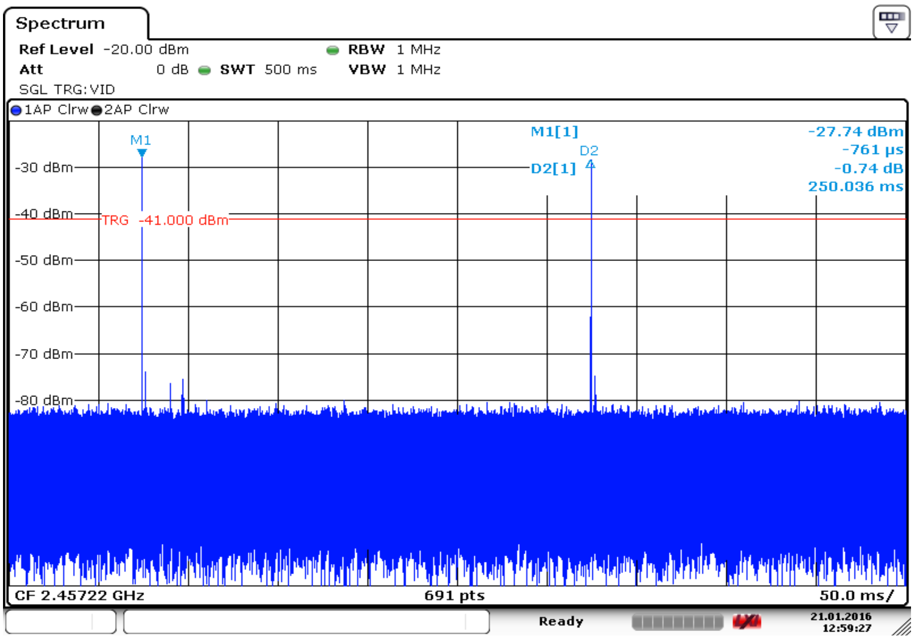
Result:

Plot 1: Transmit burst



Date: 21.JAN.2016 12:55:48

Plot 2: Timing of the transmitter



Date: 21.JAN.2016 12:59:27

12.3 Maximum output power

Description:

Measurement of the maximum output power conducted and radiated. The measurements are performed using the data rate producing the highest conducted output power.

Measurement:

Measurement parameter	
According to DTS clause: 9.2.2.5	
Detector:	RMS
Sweep time:	Auto
Resolution bandwidth:	1 – 5 % of the OBW
Video bandwidth:	≥ 3x RBW
Span:	Depends on the signal
Integration bandwidth:	99 % power - bandwidth (OBW)
Trace mode:	Max hold (allow trace to fully stabilize)
Measurement function:	Channel power with OBW
Test setup:	See sub clause 7.5 A
Measurement uncertainty	See sub clause 9

Limits:

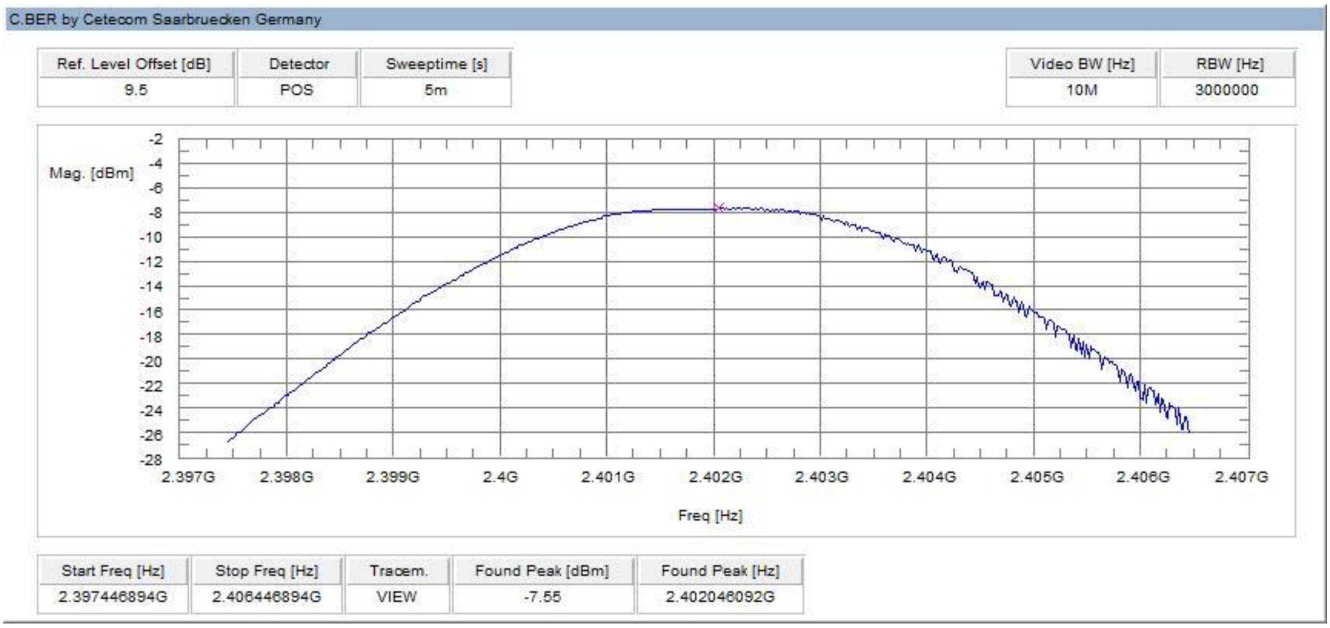
FCC	IC
Conducted: 1.0 W – Antenna gain max. 6 dBi	

Results:

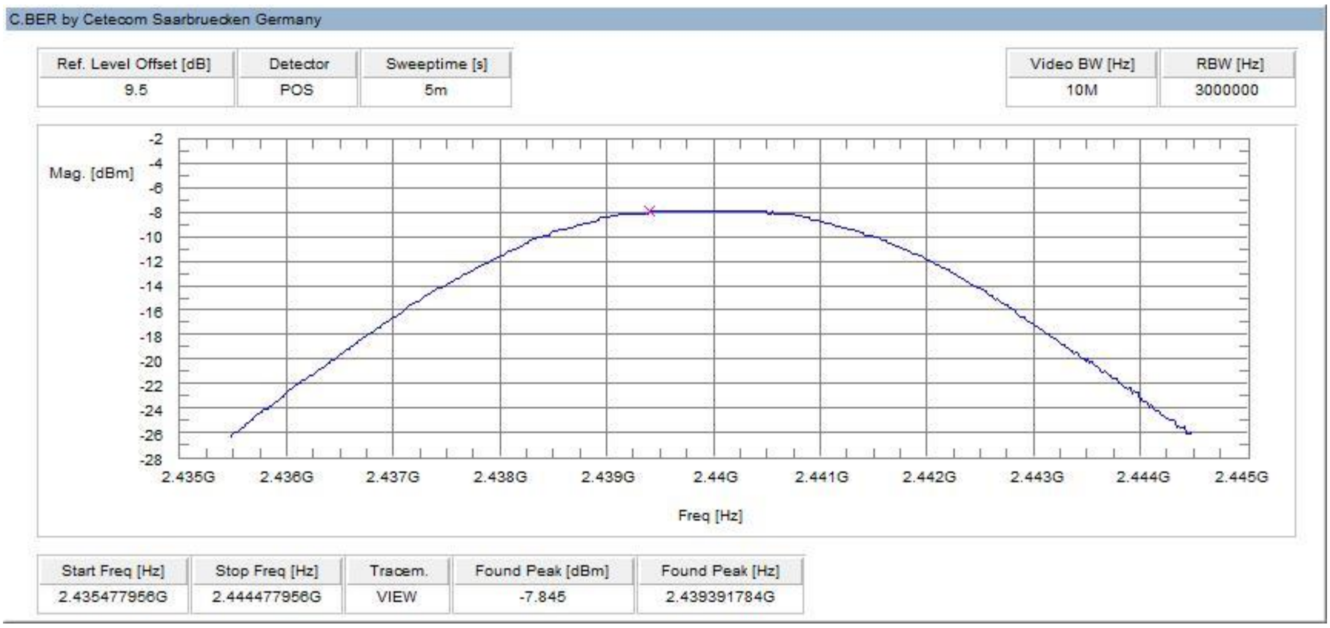
	Maximum Output Power [dBm]		
Frequency	2402 MHz	2440 MHz	2480 MHz
Output power conducted	-7.55	-7.85	-7.34

Plots:

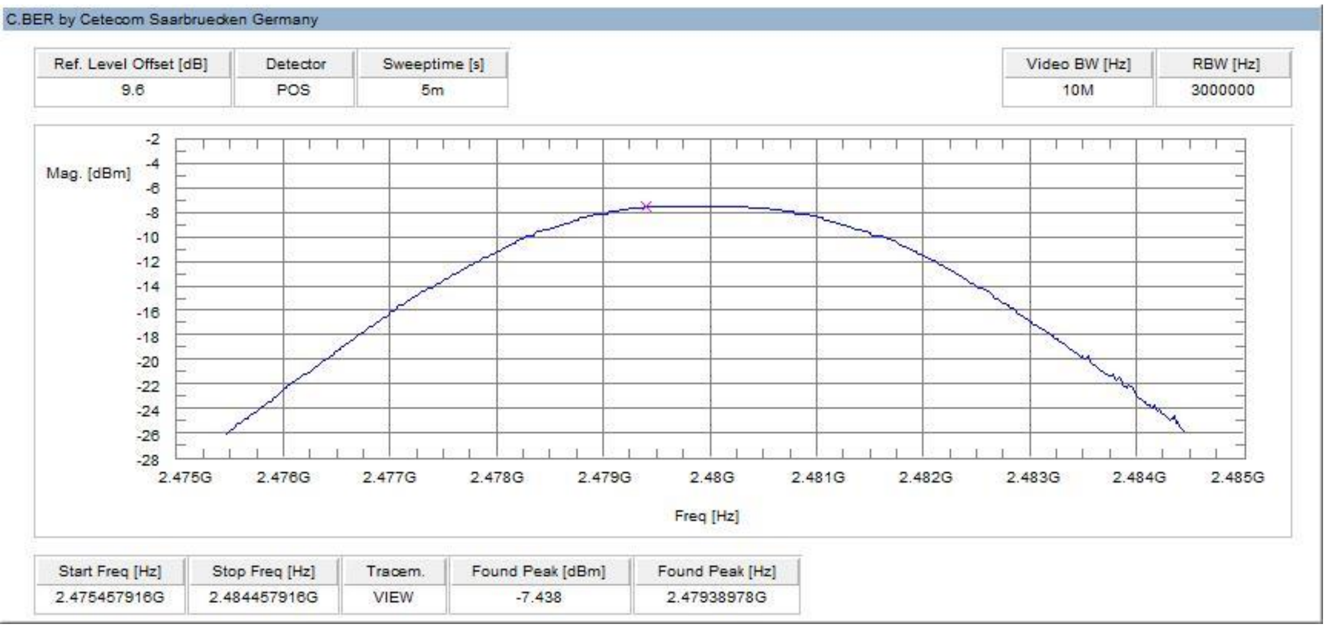
Plot 1: TX mode, lowest channel



Plot 2: TX mode, middle channel



Plot 3: TX mode, highest channel



12.4 Power spectral density

Description:

Measurement of the power spectral density of a digital modulated system. The measurement is repeated for both modulations at the lowest, middle and highest channel.

Measurement:

Measurement parameter	
According to DTS clause: 10.6	
Detector:	RMS
Sweep time:	3s
Resolution bandwidth:	3 kHz
Video bandwidth:	10 kHz
Span:	40 MHz
Trace mode:	Max hold (allow trace to fully stabilize)
Test setup:	See sub clause 7.5 A
Measurement uncertainty	See sub clause 8

Limits:

FCC	IC
8 dBm / 3kHz (conducted)	

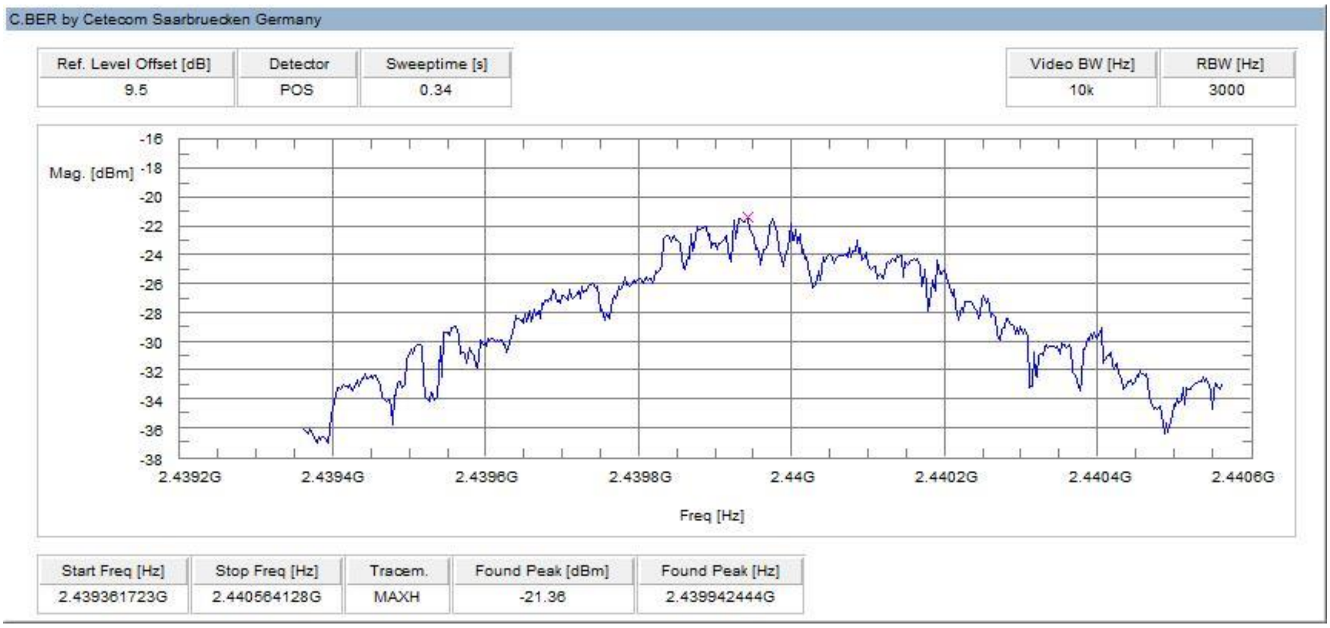
Results:

Modulation	Power Spectral density [dBm]		
Frequency	2402 MHz	2440 MHz	2480 MHz
Power Spectral density conducted	-20.01	-21.36	-20.03

Plots:

Plot 1: TX mode, lowest channel

Plot 2: TX mode, middle channel



Plot 3: TX mode, highest channel

12.5 DTS bandwidth

Description:

Measurement of the 6 dB bandwidth of the modulated signal.

Measurement:

Measurement parameter	
According to DTS clause: 8.1	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	40 MHz
Measurement procedure:	Measurement of the 75% bandwidth using the integration function of the analyzer
Trace mode:	Max hold (allow trace to stabilize)
Test setup:	See sub clause 7.5 A
Measurement uncertainty	See sub clause 9

Limits:

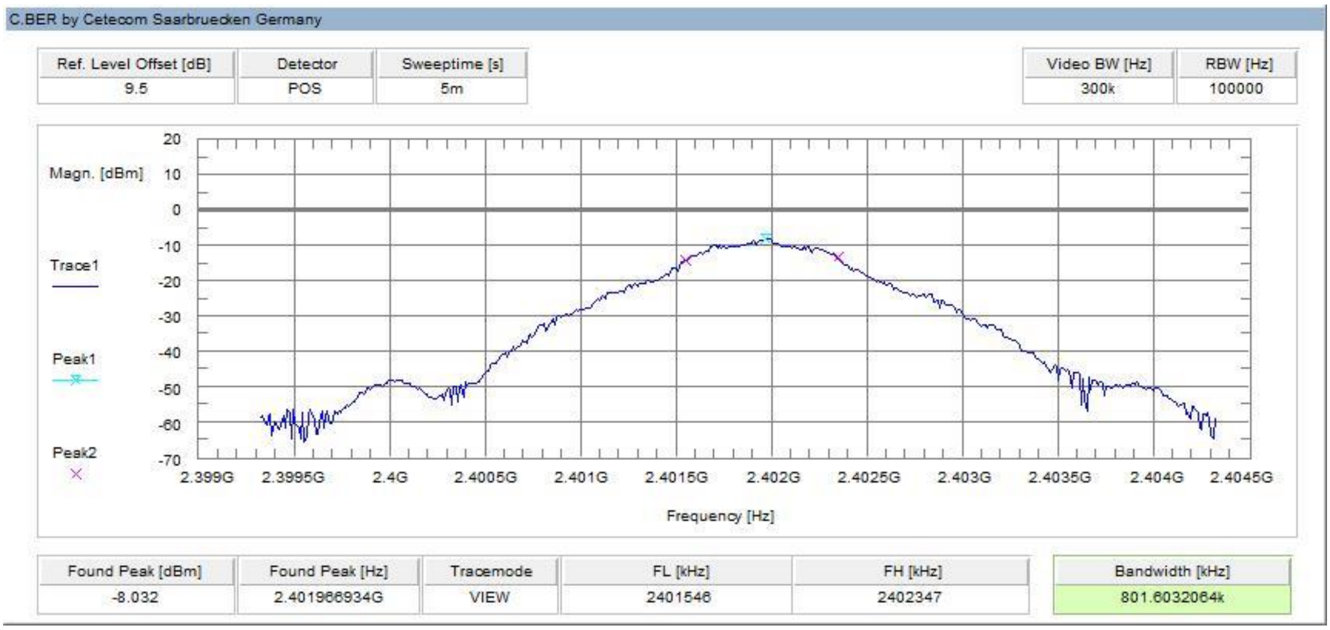
FCC	IC
Systems using digital modulation techniques may operate in the 2400–2483.5 MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz.	

Results:

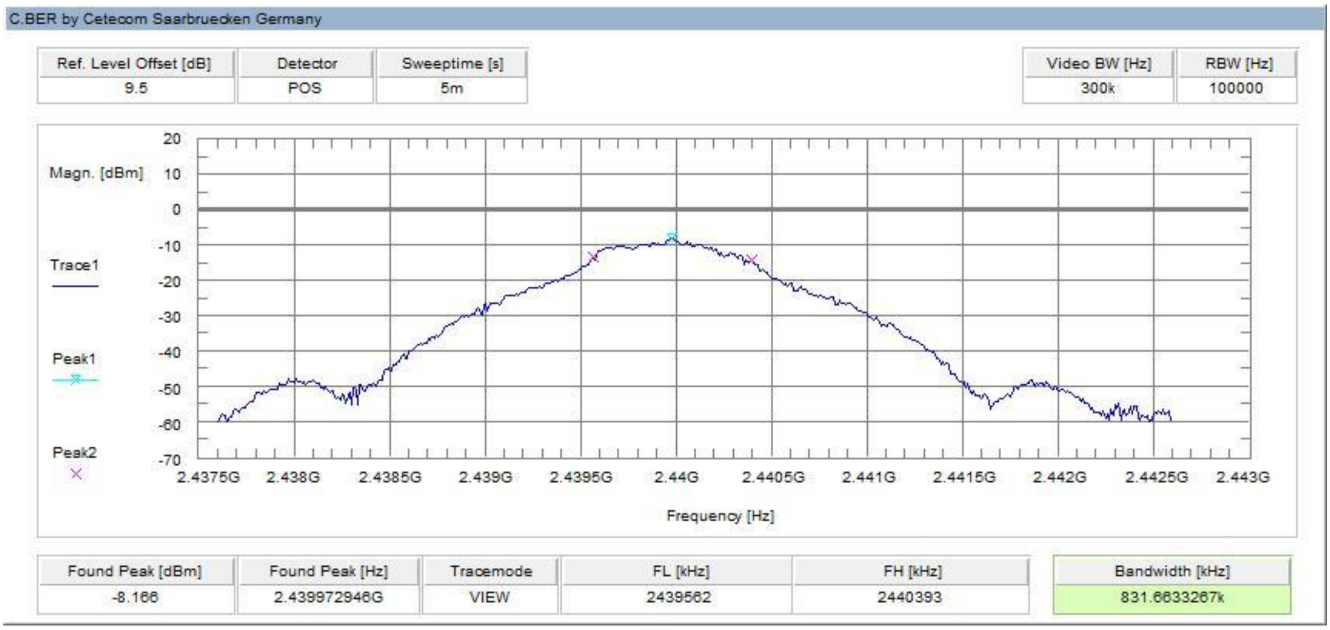
Frequency	6 dB bandwidth [kHz]		
	2402 MHz	2440 MHz	2480 MHz
	801.60	831.66	731.46

Plots:

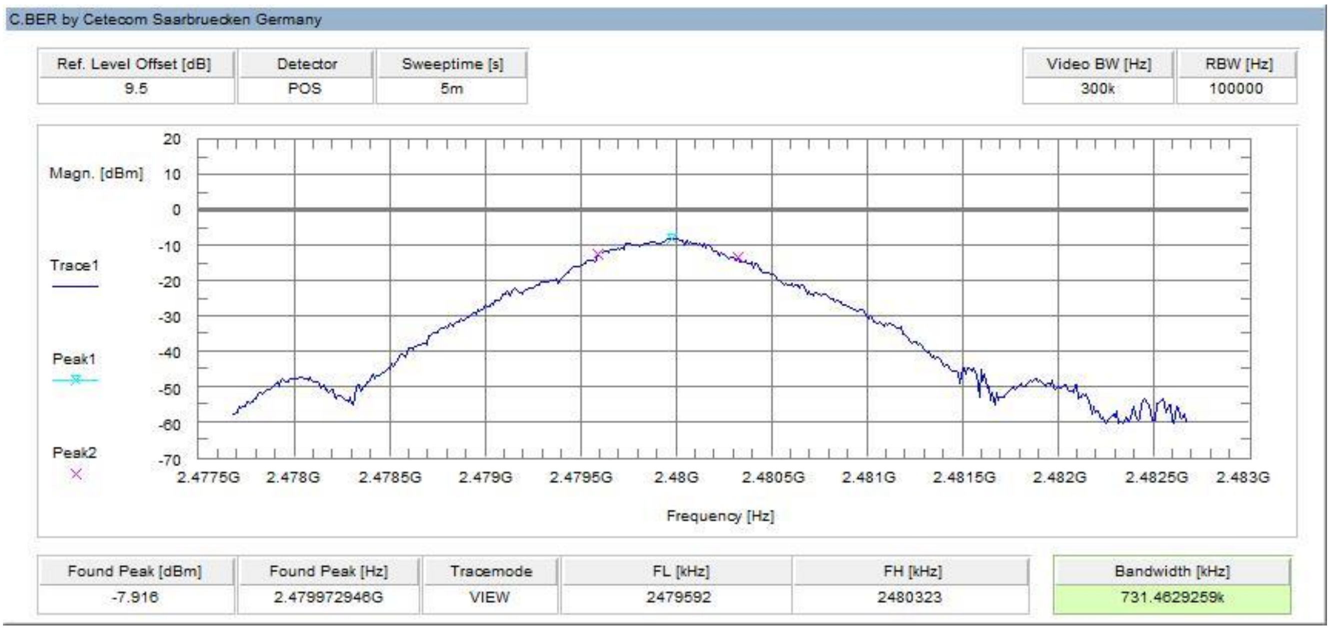
Plot 1: TX mode, lowest channel



Plot 2: TX mode, middle channel



Plot 3: TX mode, highest channel



12.6 Occupied bandwidth – 99% emission bandwidth

Description:

Measurement of the 99% bandwidth of the modulated signal acc. RSS-GEN.

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	30 kHz
Video bandwidth:	100 kHz
Span:	5 MHz
Measurement procedure:	Measurement of the 99% bandwidth using the integration function of the analyzer
Trace mode:	Max hold (allow trace to stabilize)
Test setup:	See sub clause 7.5 A
Measurement uncertainty	See sub clause 9

Usage:

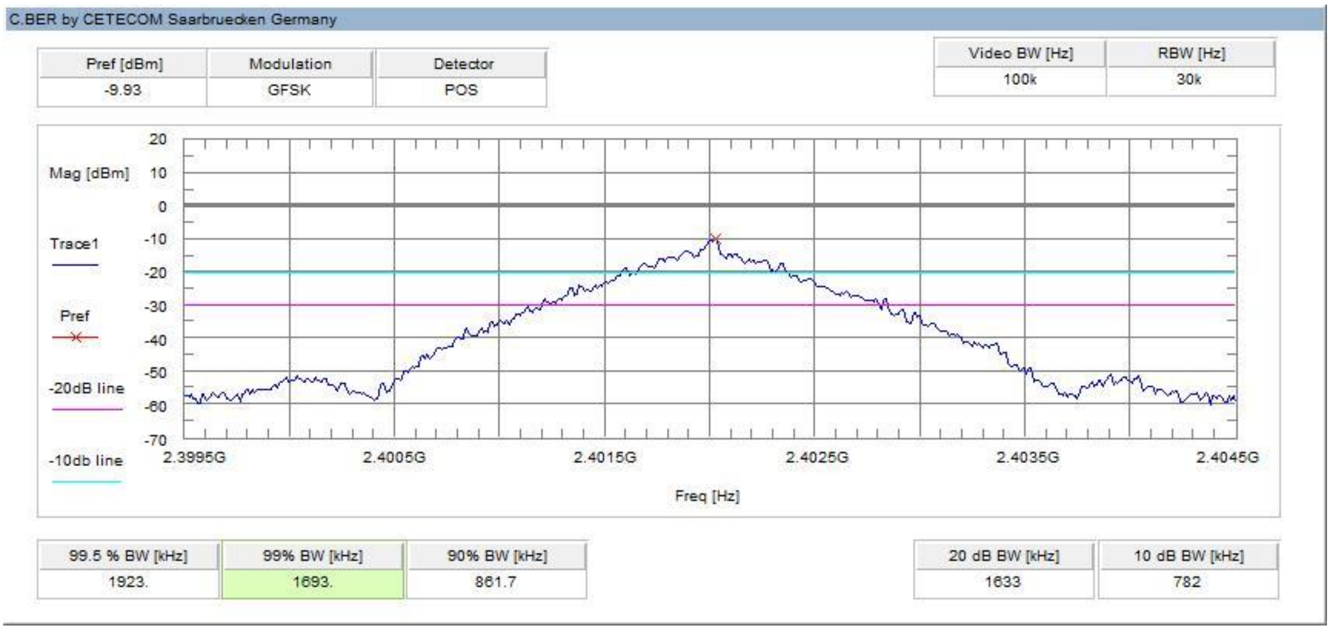
-/-	IC
OBW is necessary for Emission Designator	

Results:

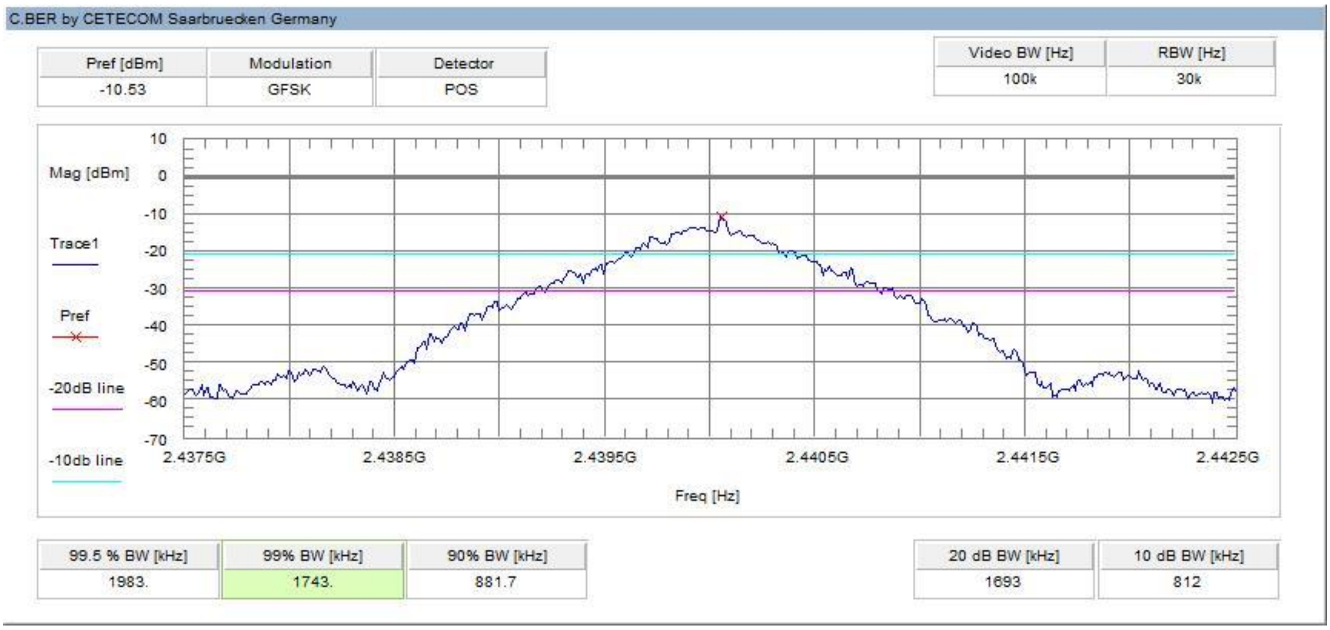
Modulation	99% bandwidth [kHz]		
Frequency	2402 MHz	2440 MHz	2480 MHz
	1693	1743	1743

Plots:

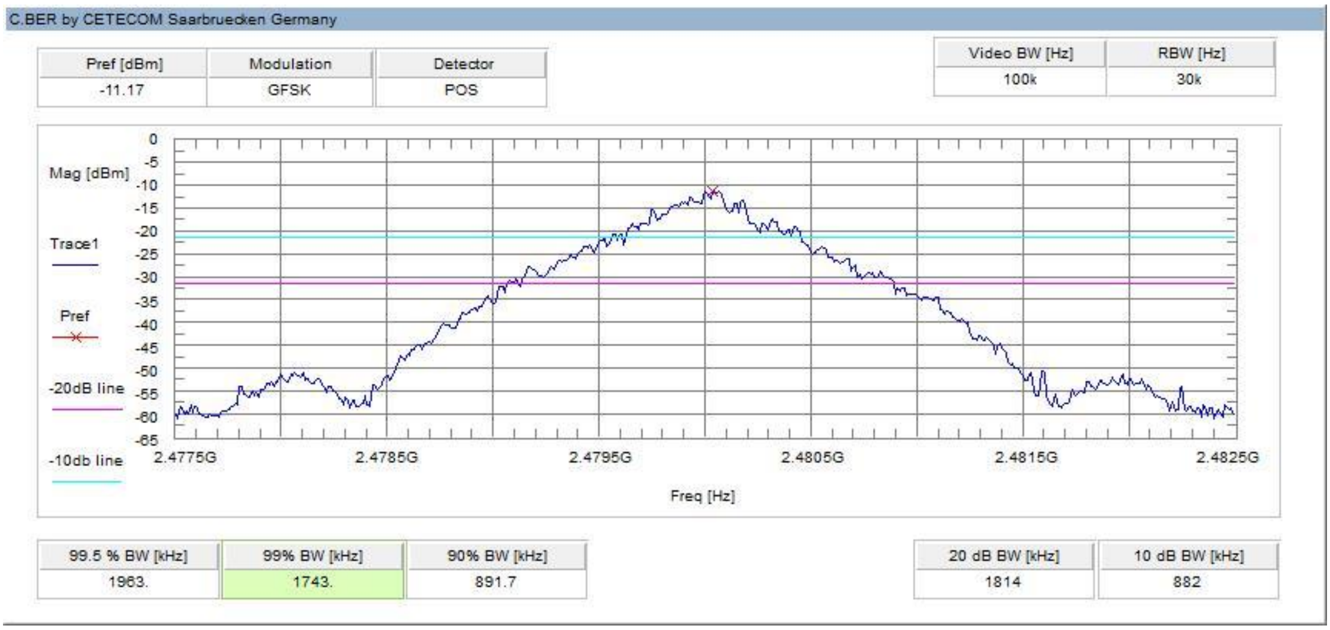
Plot 1: TX mode, lowest channel



Plot 2: TX mode, middle channel



Plot 3: TX mode, highest channel



12.7 Detailed spurious emissions @ the band edge - conducted

Description:

Measurement of the conducted band edge compliance. EUT is measured at the lower and upper band edge in both modes.

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	Lower Band Edge: 2300 – 2425 MHz Upper Band Edge: 2450 – 2550 MHz
Trace mode:	Max hold
Test setup:	See sub clause 7.5 A
Measurement uncertainty	See sub clause 9

Limits:

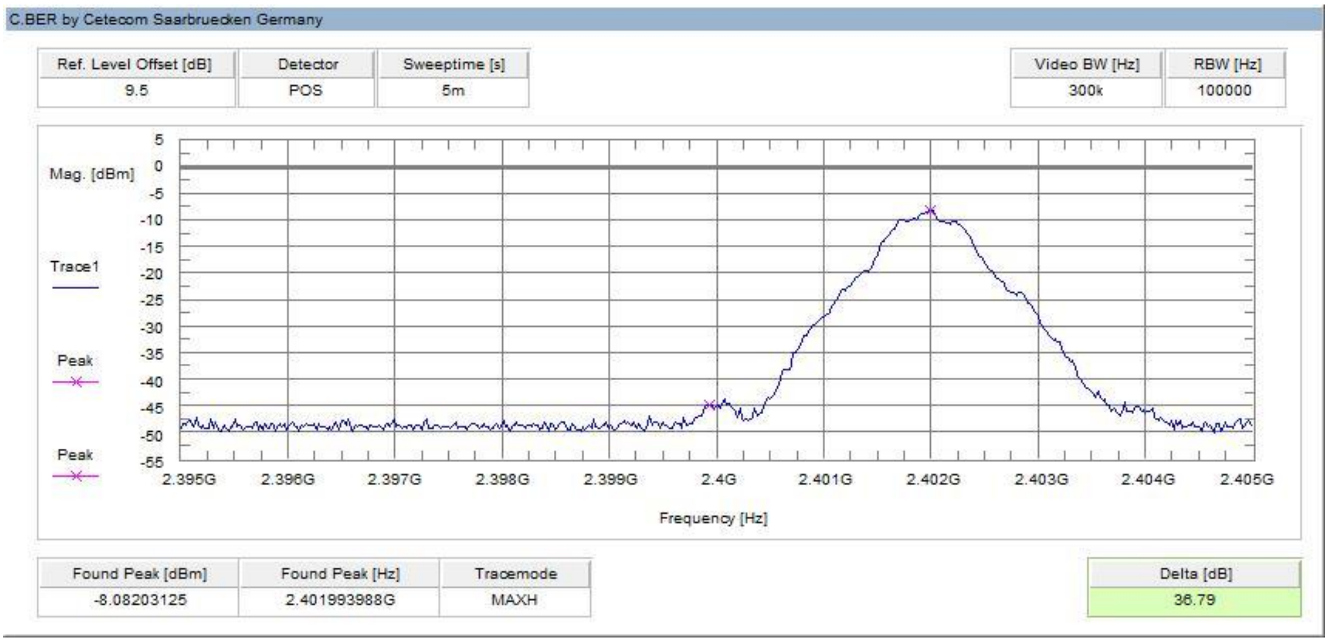
FCC	IC
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.	

Results:

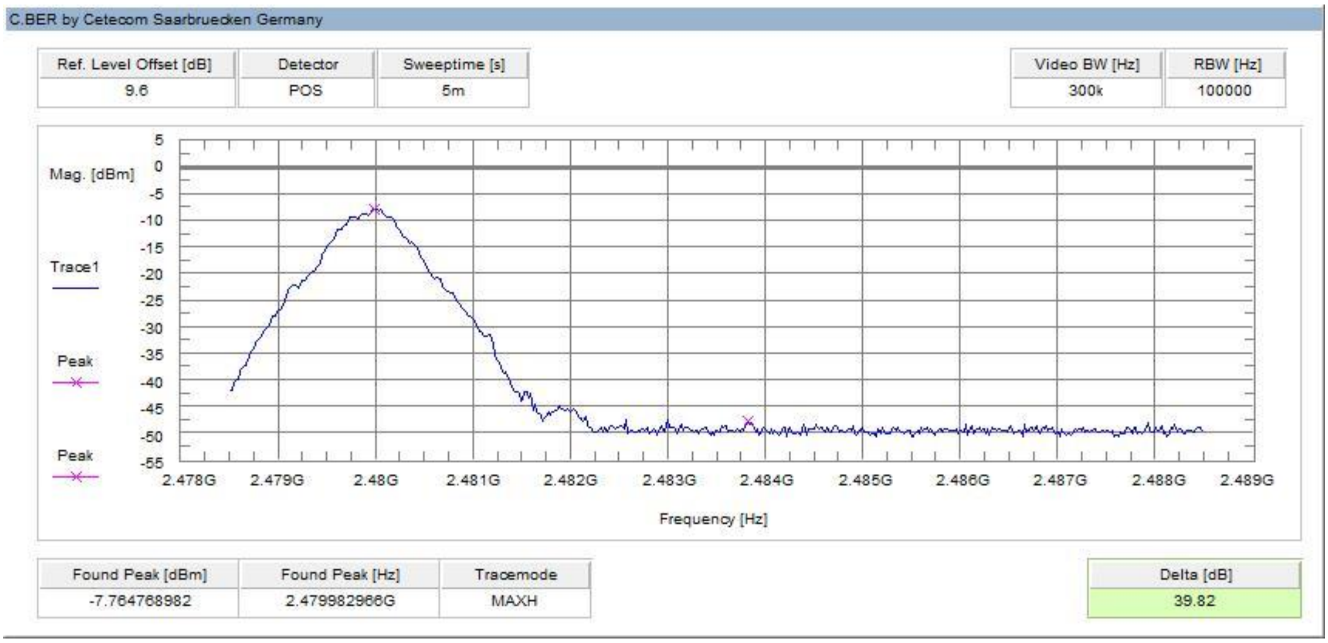
Scenario	Compliance conducted [dB]
Modulation	GFSK
Lower band edge	> 30 dB
Upper band edge	> 30 dB

Plots:

Plot 1: TX mode, lower band edge



Plot 2: TX mode, upper band edge



12.8 Band edge compliance radiated

Description:

Measurement of the radiated band edge compliance. The EUT is turned in the position that results in the maximum level at the band edge. Then a sweep over the corresponding restricted band is performed. The EUT is set to channel 1 for the lower restricted band and to channel 11 for the upper restricted band. The measurement is repeated for all modulations. Measurement distance is 3 m.

Measurement:

Measurement parameter for peak measurements	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1 MHz
Video bandwidth:	1 MHz
Span:	See plot!
Trace mode:	Max Hold
Test setup:	See sub clause 7.2 A
Measurement uncertainty	See sub clause 9

Limits:

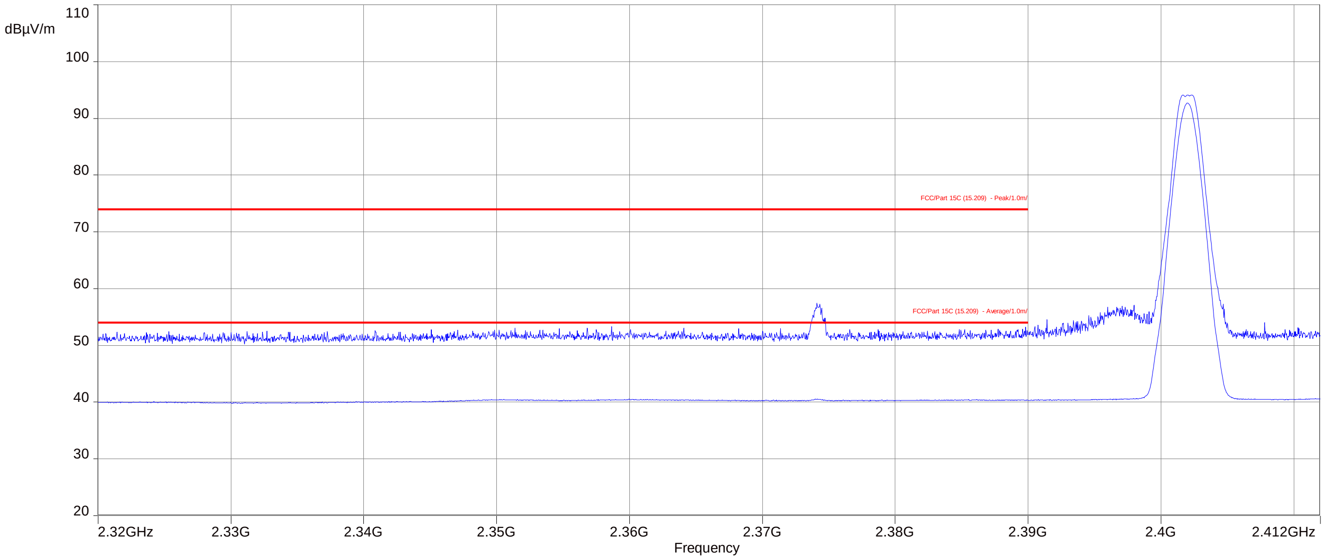
FCC	IC
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).	
74 dBµV/m Peak 54 dBµV/m AVG	

Results:

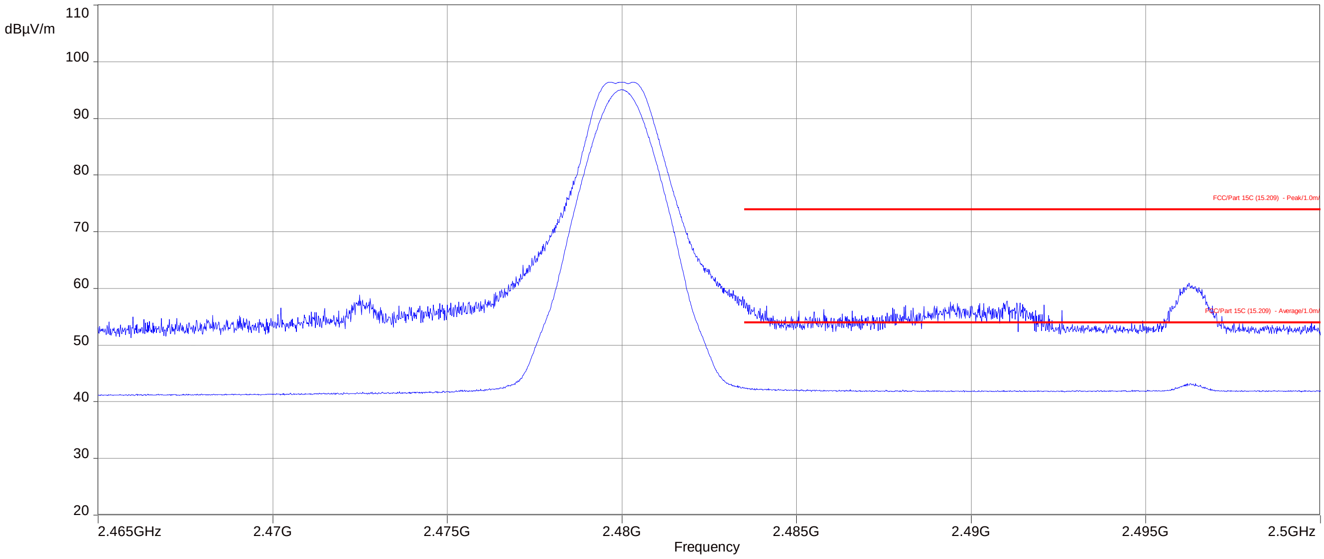
Scenario	**Band edge compliance radiated [dB]**
Modulation	GFSK
Lower band edge	> 20 dB (Peak) > 20 dB (AVG)
Upper band edge	> 20 dB (Peak) > 20 dB (AVG)

Plots: SEATPOST

Plot 1: TX mode, lower band edge, vertical & horizontal polarization

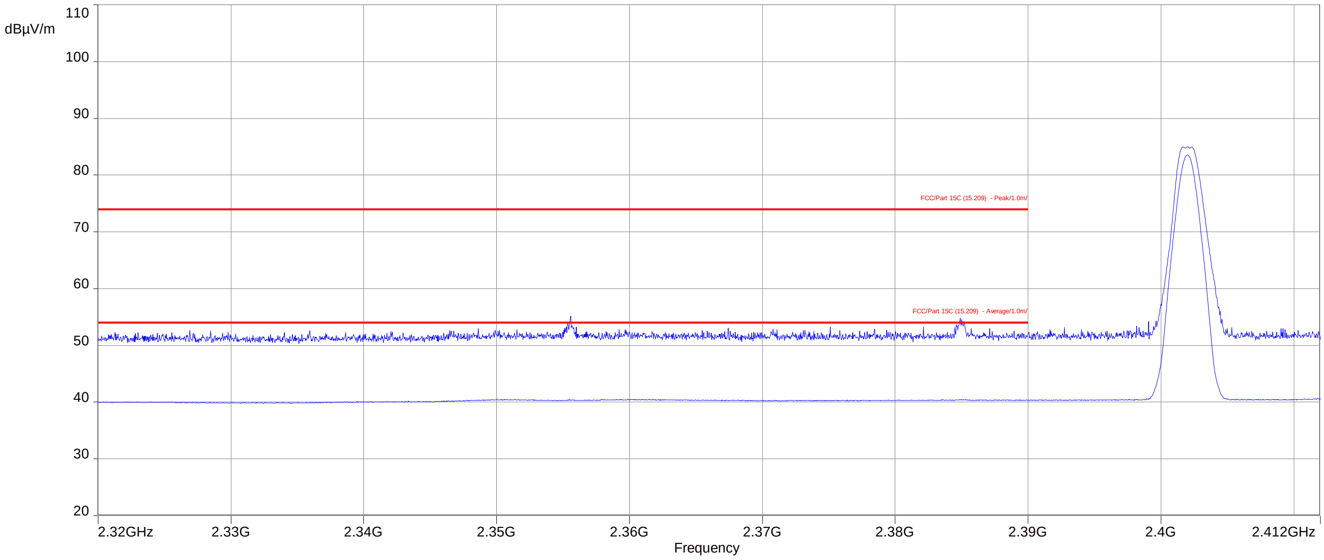


Plot 2: TX mode, upper band edge, vertical & horizontal polarization

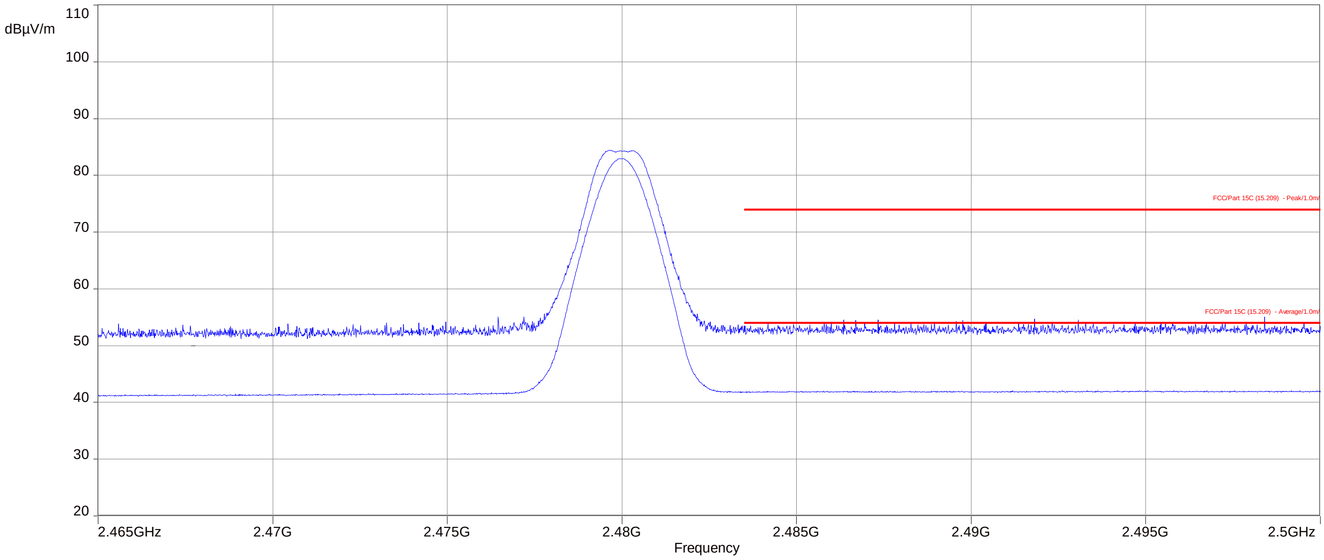


Plots: FORK

Plot 1: TX mode, lower band edge, vertical & horizontal polarization

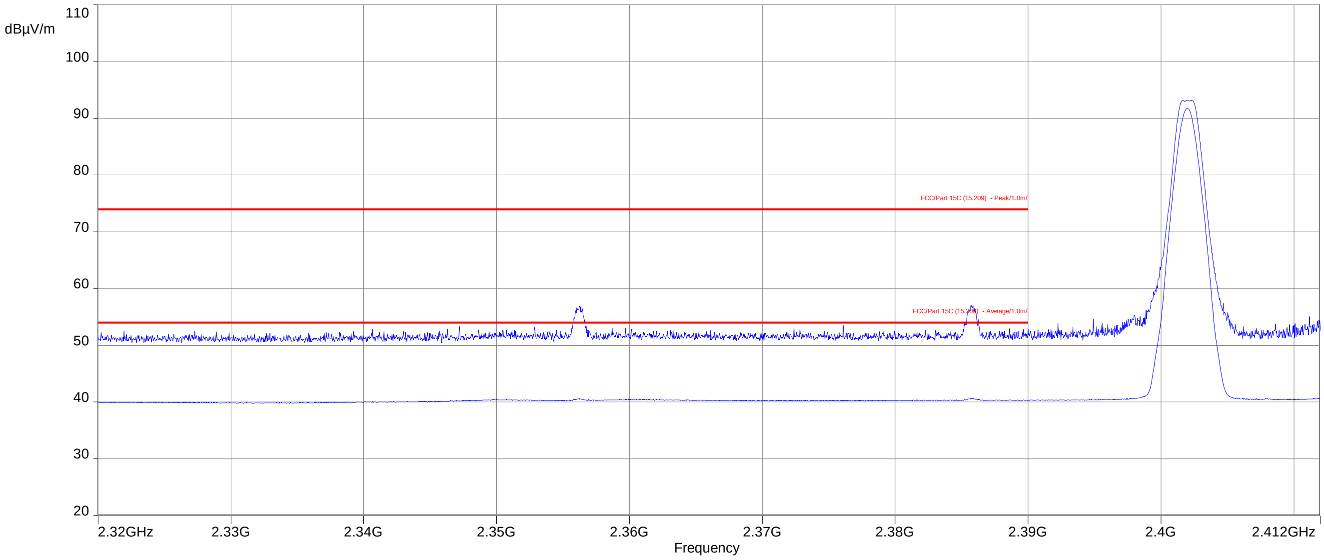


Plot 2: TX mode, upper band edge, vertical & horizontal polarization

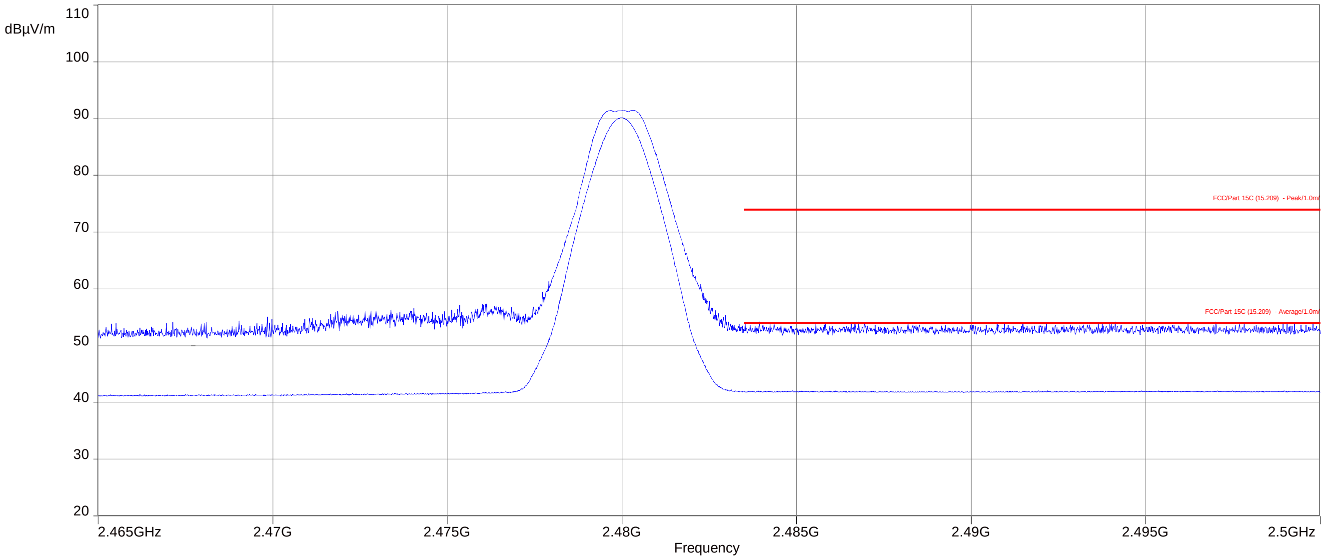


Plots: REARSHOCK

Plot 1: TX mode, lower band edge, vertical & horizontal polarization



Plot 2: TX mode, upper band edge, vertical & horizontal polarization



12.9 Spurious emissions conducted

Description:

Measurement of the conducted spurious emissions in transmit mode. The measurement is performed at channel 1, 6 and 11. The measurement is repeated for all modulations.

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	500 kHz
Span:	9 kHz to 25 GHz
Trace mode:	Max Hold
Test setup:	See sub clause 7.5 A
Measurement uncertainty	See sub clause 9

Limits:

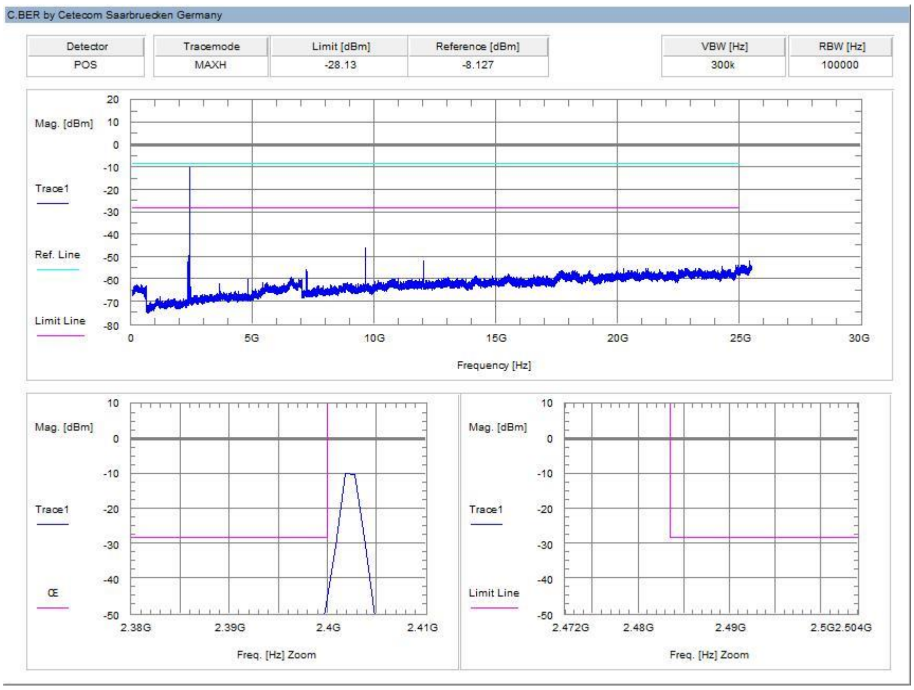
FCC	IC
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required	

Results:

TX Spurious Emissions Conducted					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
2412		-8.13	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		complies
2437		-8.17	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		complies
2462		-7.98	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		complies
Measurement uncertainty		± 3 dB			

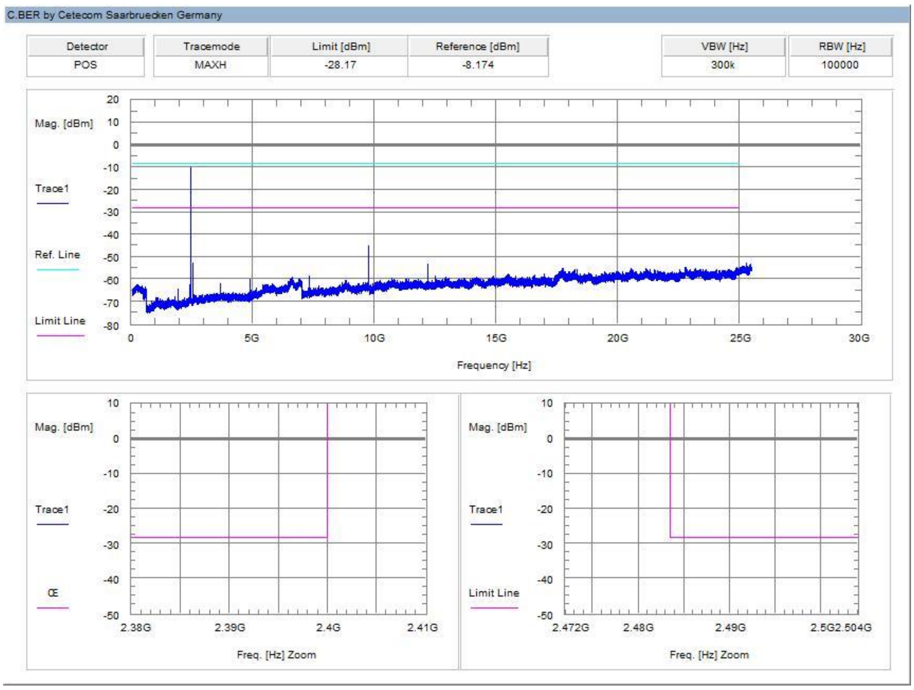
Plots:

Plot 1: TX mode, lowest channel, up to 25 GHz



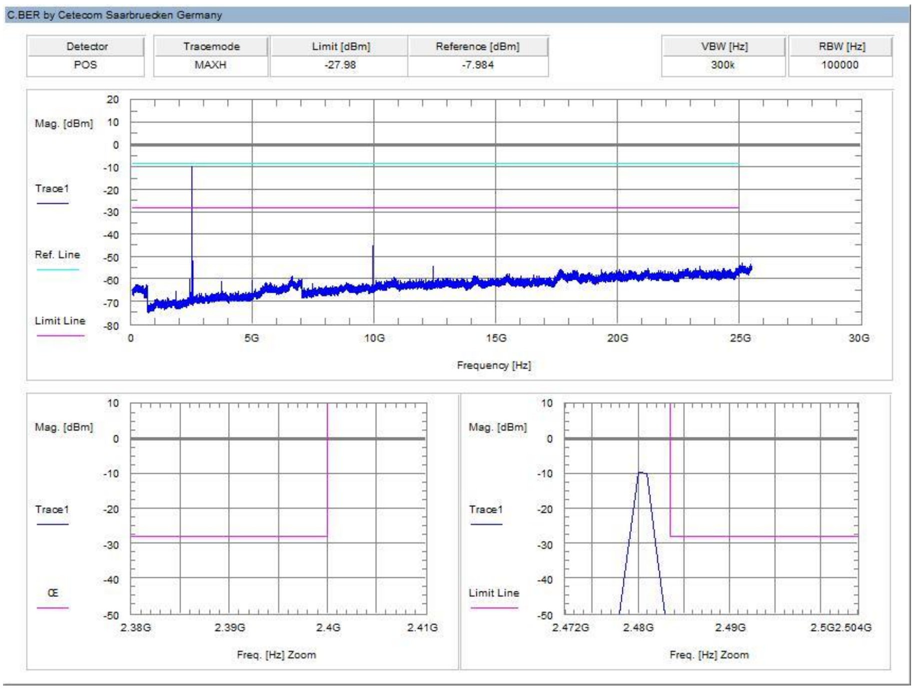
The peak at the beginning of the plot is the LO from the SA.

Plot 2: TX mode, middle channel, up to 25 GHz



The peak at the beginning of the plot is the LO from the SA.

Plot 3: TX mode, highest channel, up to 25 GHz



The peak at the beginning of the plot is the LO from the SA.

12.10 Spurious emissions radiated below 30 MHz

Description:

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The EUT is set to channel 6. This measurement is representative for all channels and modes. If peaks are found channel 1 and channel 11 will be measured too. The measurement is performed with the data rate producing the highest output power. The limits are recalculated to a measurement distance of 3 m with 40 dB/decade according CFR Part 2.

Measurement:

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Resolution bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Video bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span:	9 kHz to 30 MHz
Trace mode:	Max Hold
Test setup:	See sub clause 7.2 B
Measurement uncertainty	See sub clause 9

Limits:

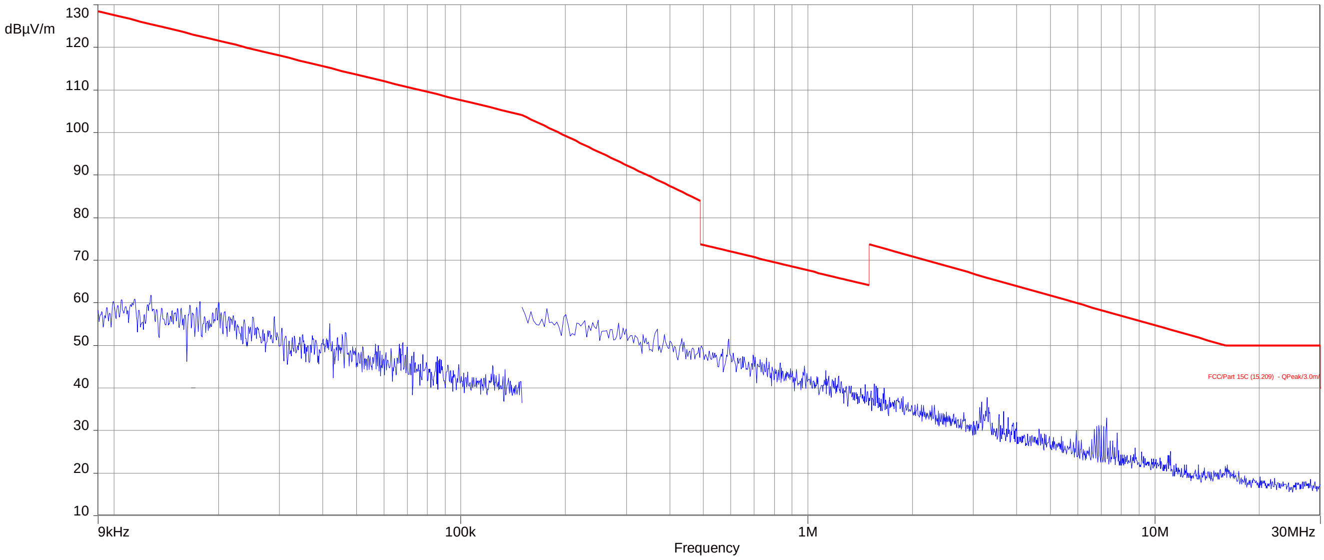
FCC		IC
Frequency (MHz)	Field Strength (dBµV/m)	Measurement distance
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30

Results:

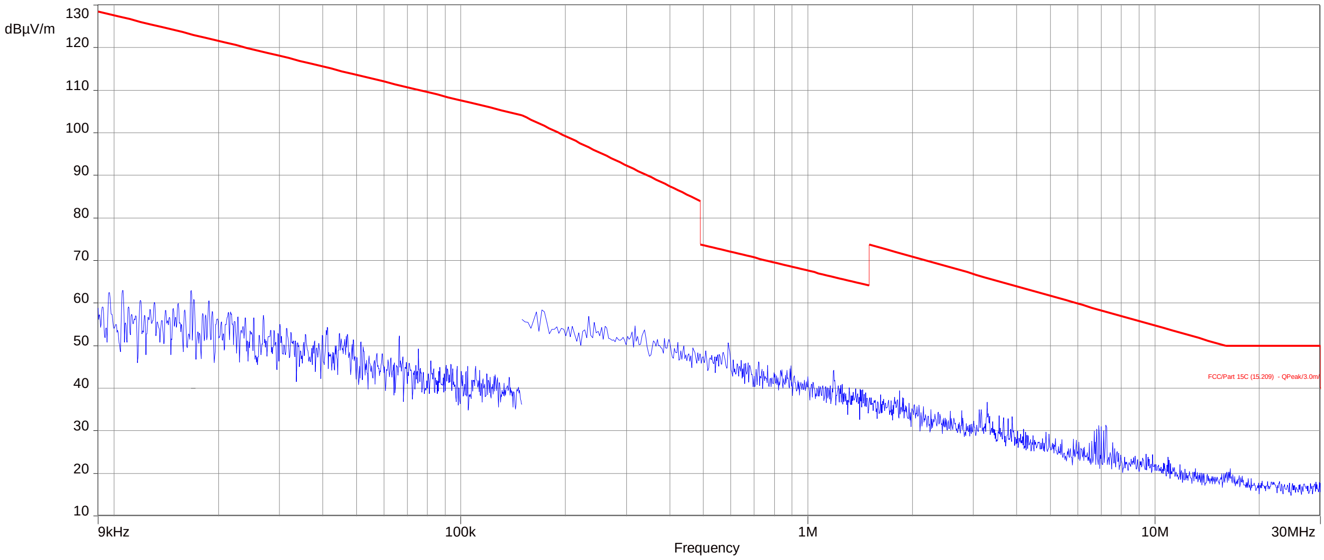
TX Spurious Emissions Radiated < 30 MHz [dBµV/m]		
F [MHz]	Detector	Level [dBµV/m]
All detected peaks are more than 20 dB below the limit.		

Plots: SEATPOST

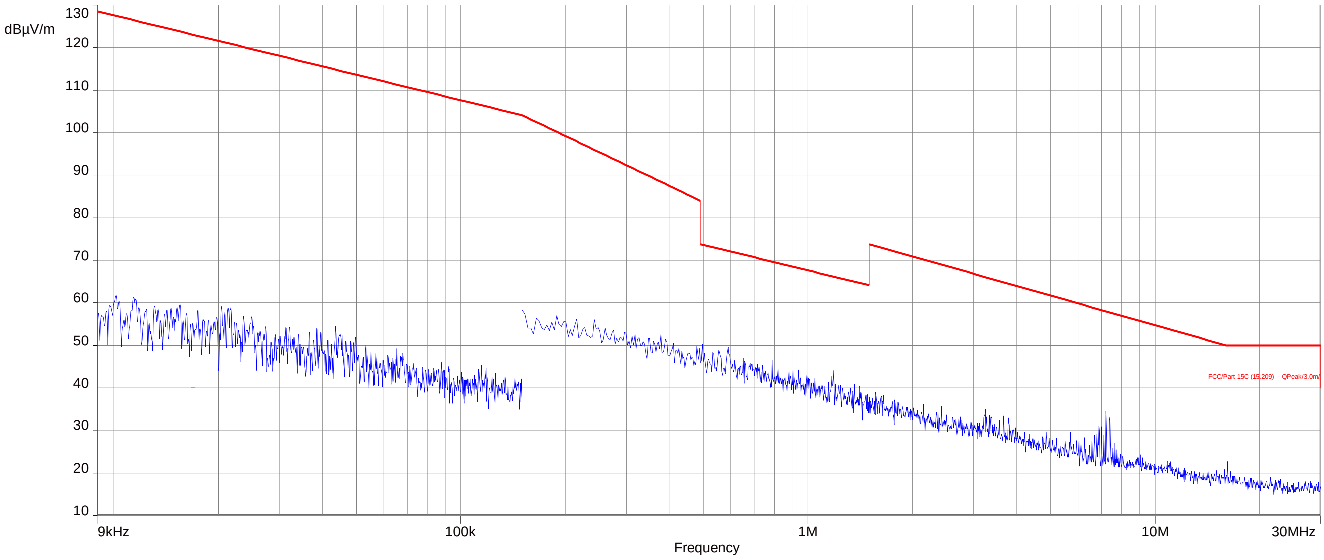
Plot 1: 9 kHz to 30 MHz, low channel



Plot 2: 9 kHz to 30 MHz, mid channel

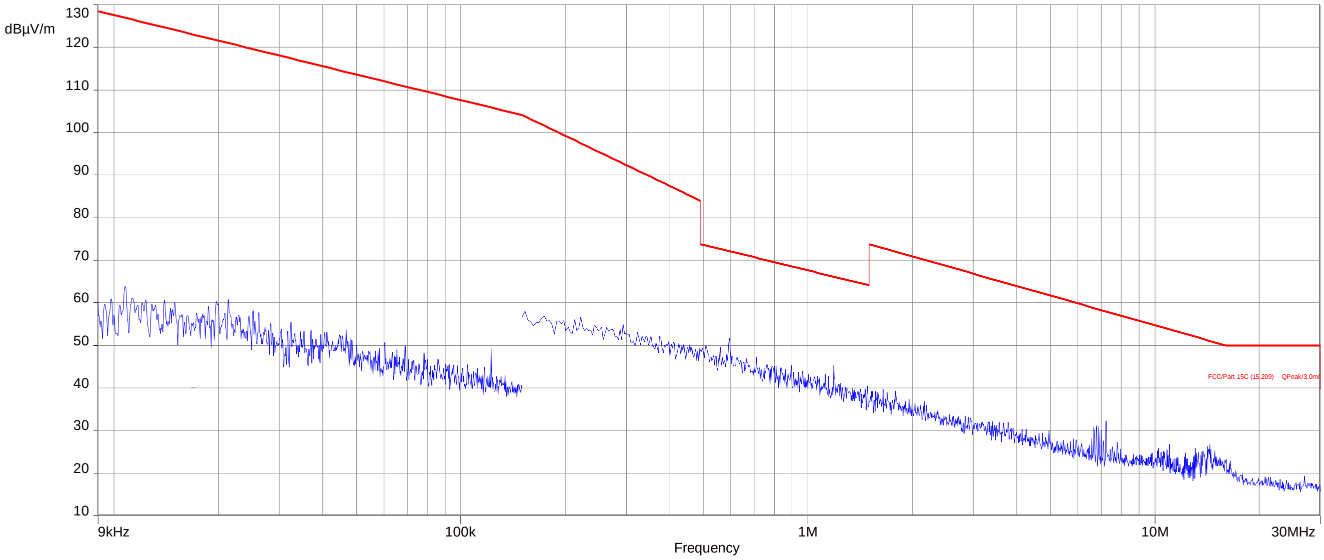


Plot 3: 9 kHz to 30 MHz, high channel

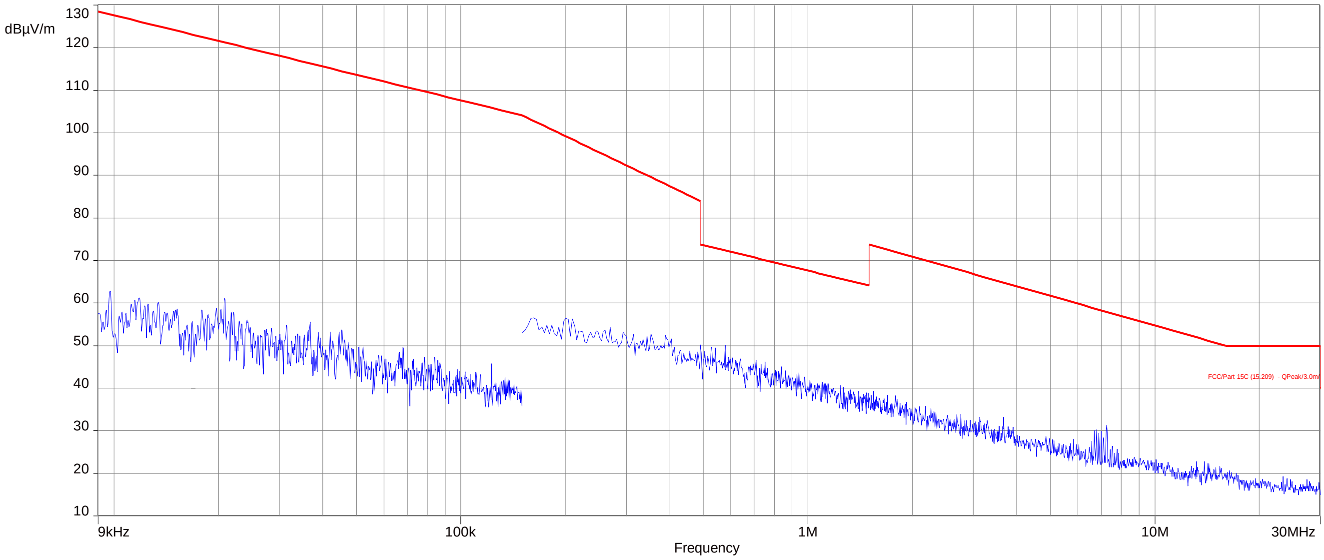


Plots: FORK

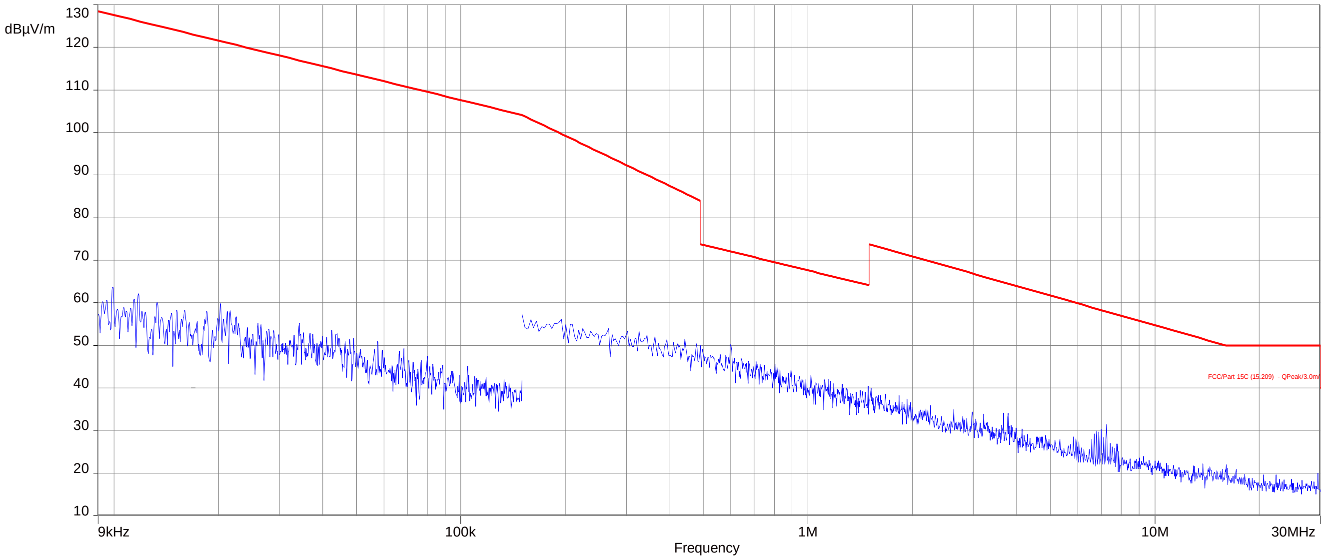
Plot 1: 9 kHz to 30 MHz, low channel



Plot 2: 9 kHz to 30 MHz, mid channel

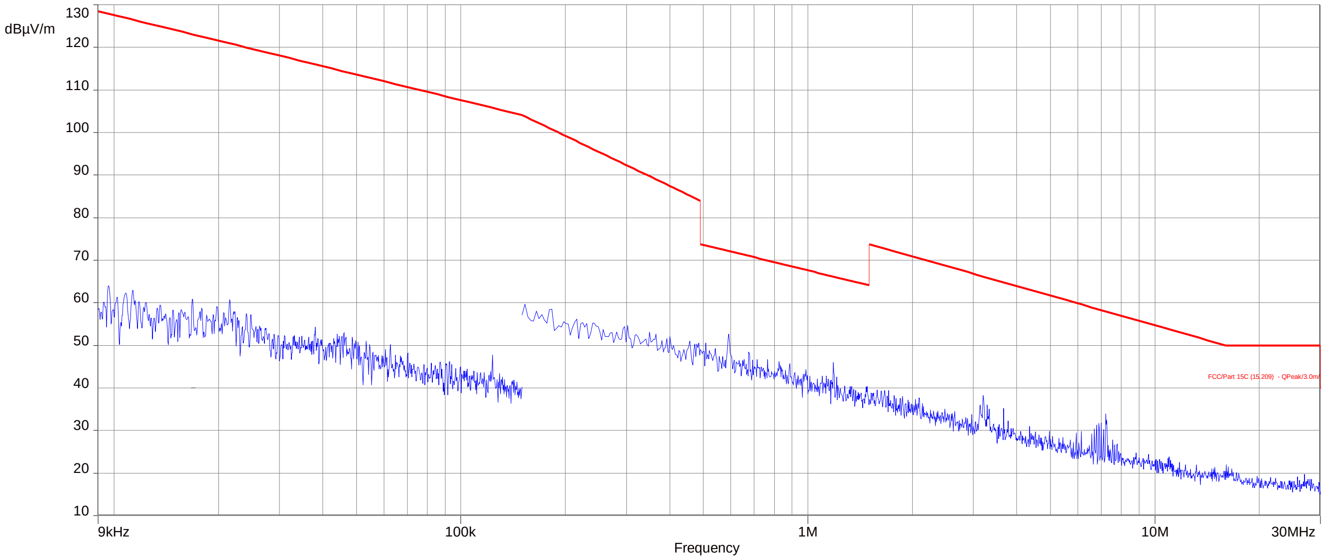


Plot 3: 9 kHz to 30 MHz, high channel

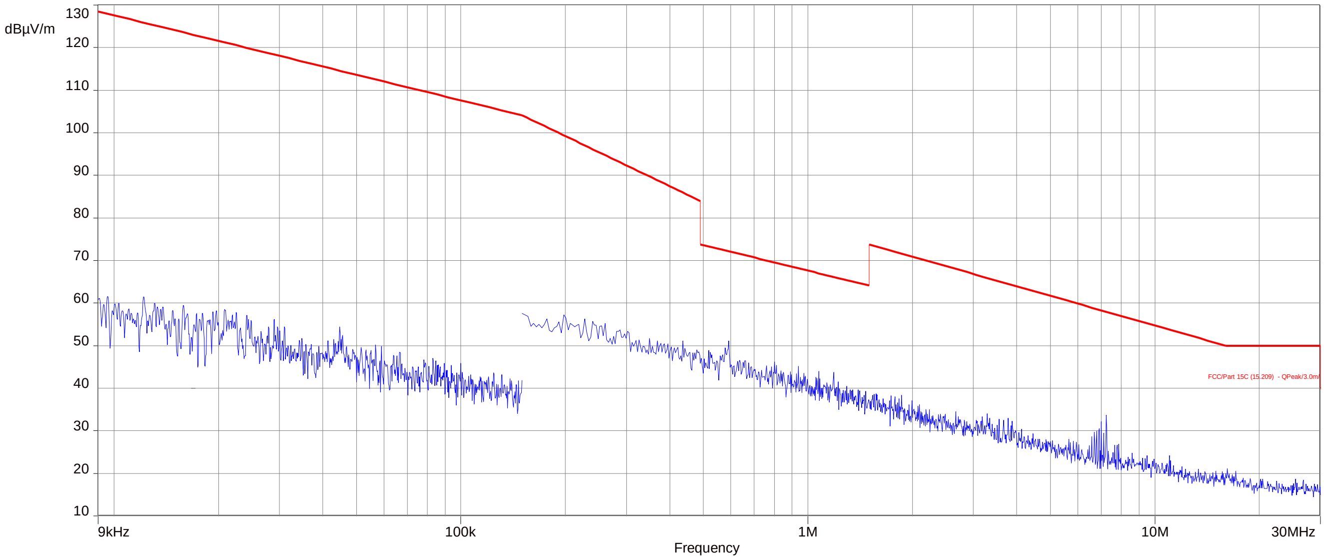


<u>Plots:</u> REARSHOCK

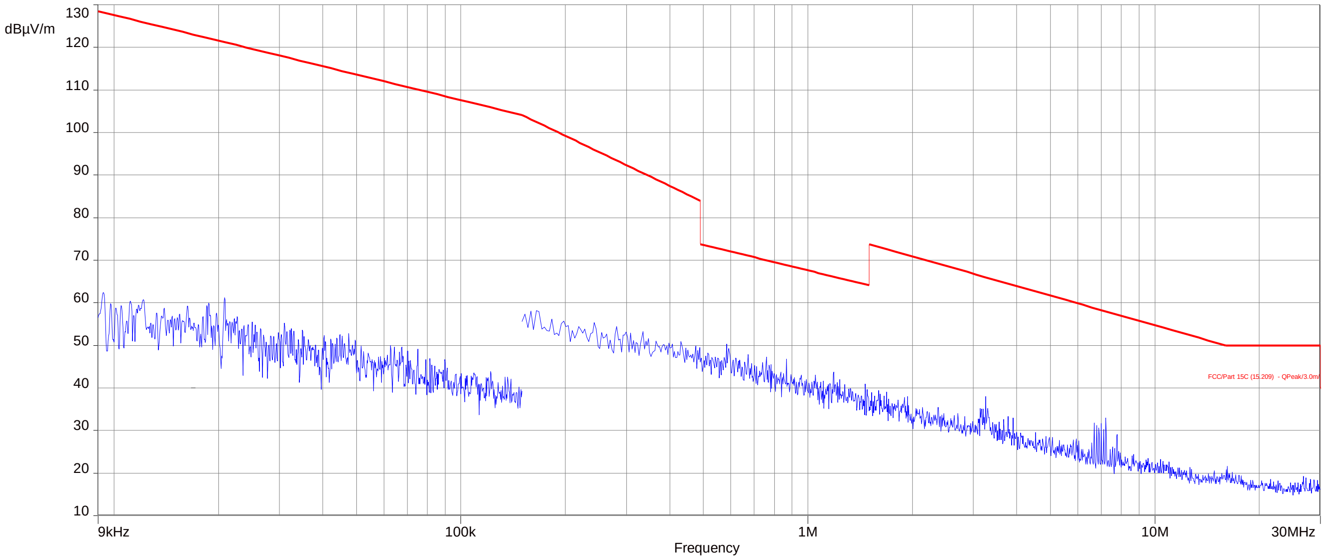
Plot 1: 9 kHz to 30 MHz, low channel



Plot 2: 9 kHz to 30 MHz, mid channel



Plot 3: 9 kHz to 30 MHz, high channel



12.11 Spurious emissions radiated 30 MHz to 1 GHz

Description:

Measurement of the radiated spurious emissions and cabinet radiations below 1 GHz.

Measurement:

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Resolution bandwidth:	F < 1 GHz: 120 kHz
Video bandwidth:	3 x RBW
Span:	30 MHz to 1 GHz
Trace mode:	Max Hold
Test setup:	See sub clause 7.1 A
Measurement uncertainty	See sub clause 9

The modulation with the highest output power was used to perform the transmitter spurious emissions. If spurious were detected a re-measurement was performed on the detected frequency with each modulation.

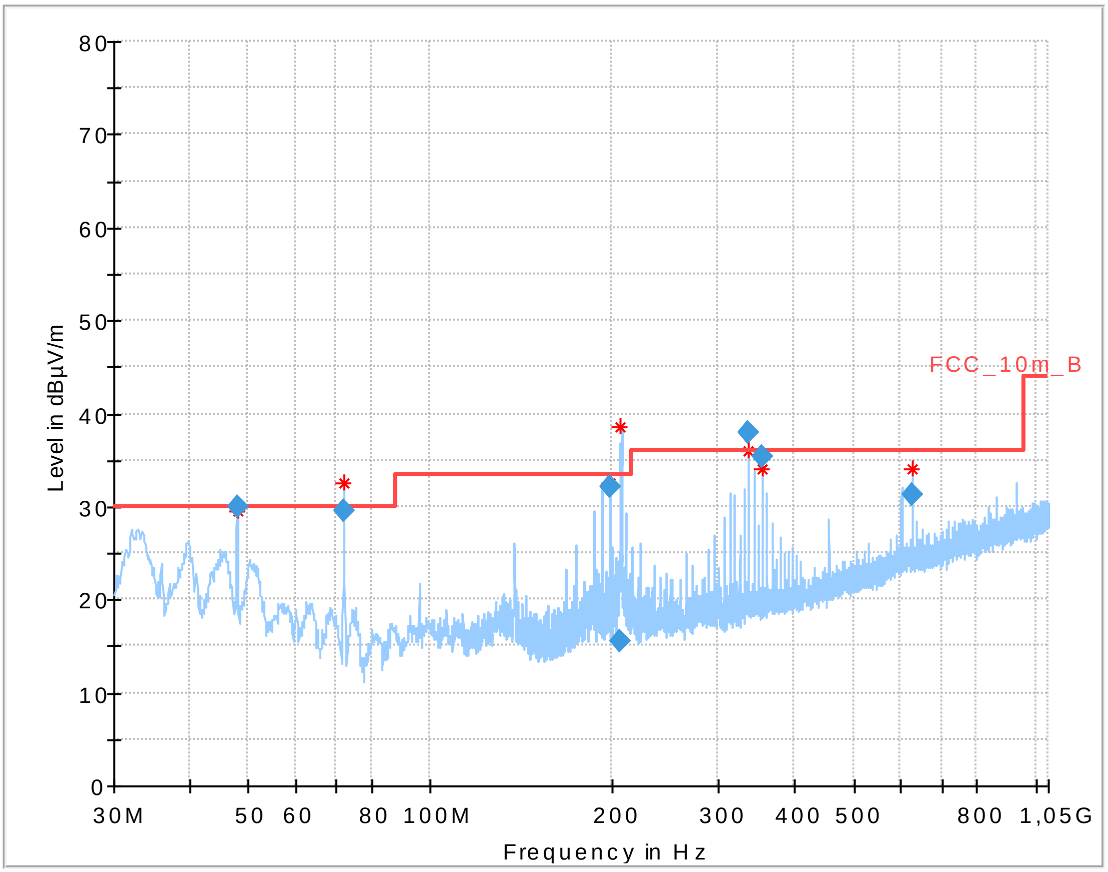
Limits:

<table>
<tr><th colspan="2">FCC</th><th>IC</th></tr>
<tr><td colspan="3">In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).</td></tr>
<tr><td>Frequency (MHz)</td><td>Field Strength (dBµV/m)</td><td>Measurement distance</td></tr>
<tr><td>30 - 88</td><td>30.0</td><td>10</td></tr>
<tr><td>88 – 216</td><td>33.5</td><td>10</td></tr>
<tr><td>216 – 960</td><td>36.0</td><td>10</td></tr>
</table>

Note: For spurious caused by USB to serial converter see separate plots!

Plot: SEATPOST

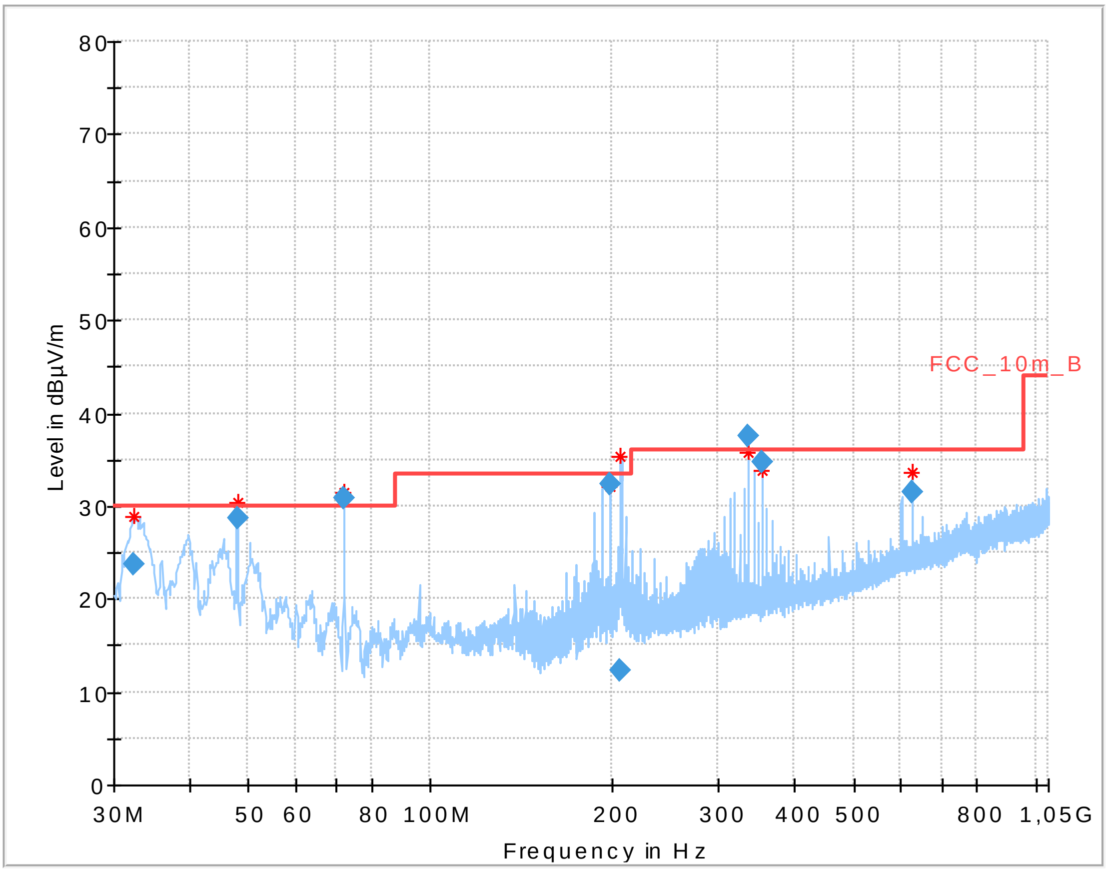
Plot 1: 30 MHz to 1 GHz, vertical & horizontal polarization, low channel



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
48.000000	29.87	30.00	0.13	1000.0	120.000	98.0	V	329.0	13.1
72.001950	29.55	30.00	0.45	1000.0	120.000	101.0	V	279.0	8.4
197.993250	32.21	33.50	1.29	1000.0	120.000	98.0	V	212.0	11.6
206.562600	15.53	33.50	17.97	1000.0	120.000	101.0	V	99.0	11.9
335.996250	37.90	36.00	-1.90	1000.0	120.000	170.0	H	35.0	15.6
353.992950	35.26	36.00	0.74	1000.0	120.000	170.0	H	169.0	16.1
624.009900	31.23	36.00	4.77	1000.0	120.000	101.0	H	55.0	20.9

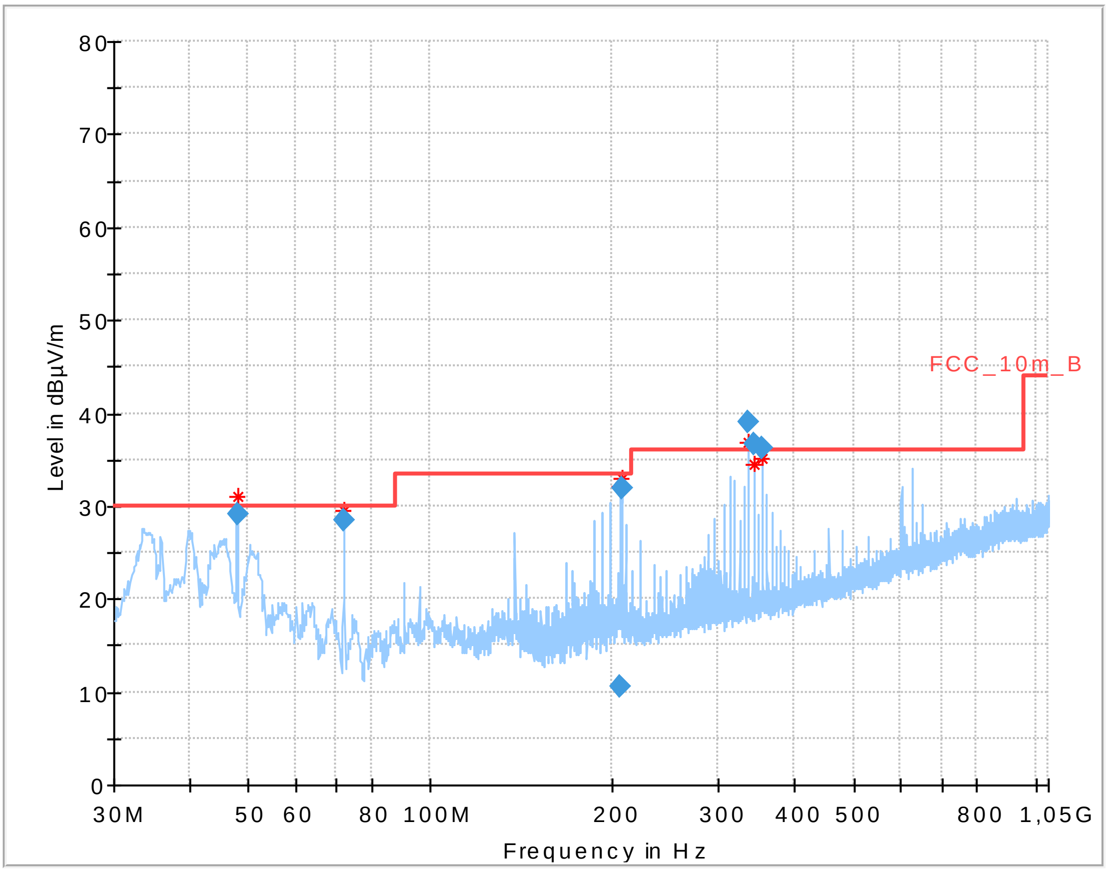
Plot 2: 30 MHz to 1 GHz, vertical & horizontal polarization, mid channel



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
32.466600	23.81	30.00	6.19	1000.0	120.000	101.0	V	59.0	13.6
47.989650	28.72	30.00	1.28	1000.0	120.000	98.0	V	341.0	13.1
71.988750	30.89	30.00	-0.89	1000.0	120.000	101.0	V	290.0	8.4
198.004050	32.26	33.50	1.24	1000.0	120.000	98.0	V	209.0	11.6
206.449950	12.25	33.50	21.25	1000.0	120.000	98.0	V	75.0	11.9
336.003000	37.55	36.00	-1.55	1000.0	120.000	170.0	H	39.0	15.6
354.009000	34.68	36.00	1.32	1000.0	120.000	170.0	H	180.0	16.1
623.995050	31.42	36.00	4.58	1000.0	120.000	101.0	H	59.0	20.9

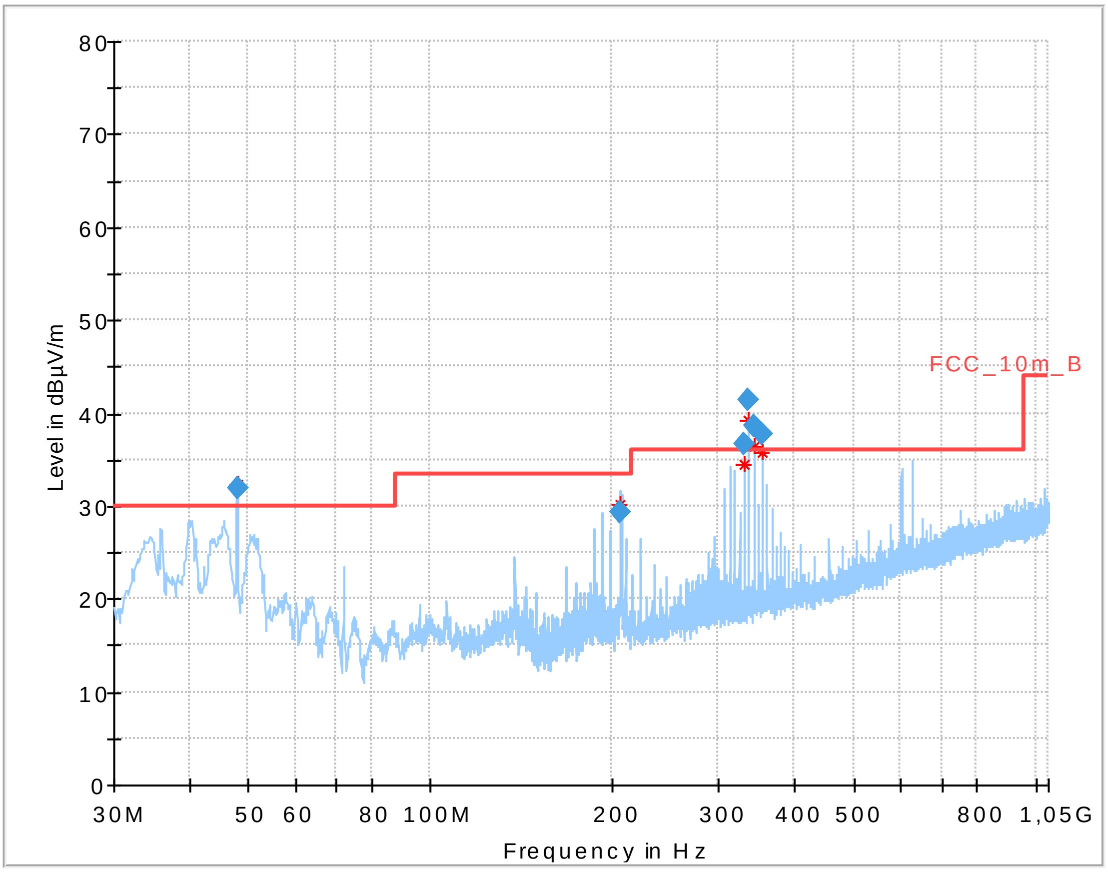
Plot 3: 30 MHz to 1 GHz, vertical & horizontal polarization, high channel



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
47.977500	29.11	30.00	0.89	1000.0	120.000	98.0	V	4.0	13.1
72.001200	28.44	30.00	1.56	1000.0	120.000	101.0	V	289.0	8.4
206.309400	10.50	33.50	23.00	1000.0	120.000	98.0	V	87.0	11.9
206.970000	31.81	33.50	1.69	1000.0	120.000	98.0	V	166.0	11.9
335.997750	39.12	36.00	-3.12	1000.0	120.000	170.0	H	166.0	15.6
342.000900	36.70	36.00	-0.70	1000.0	120.000	170.0	H	166.0	15.8
353.995200	36.18	36.00	-0.18	1000.0	120.000	170.0	H	178.0	16.1

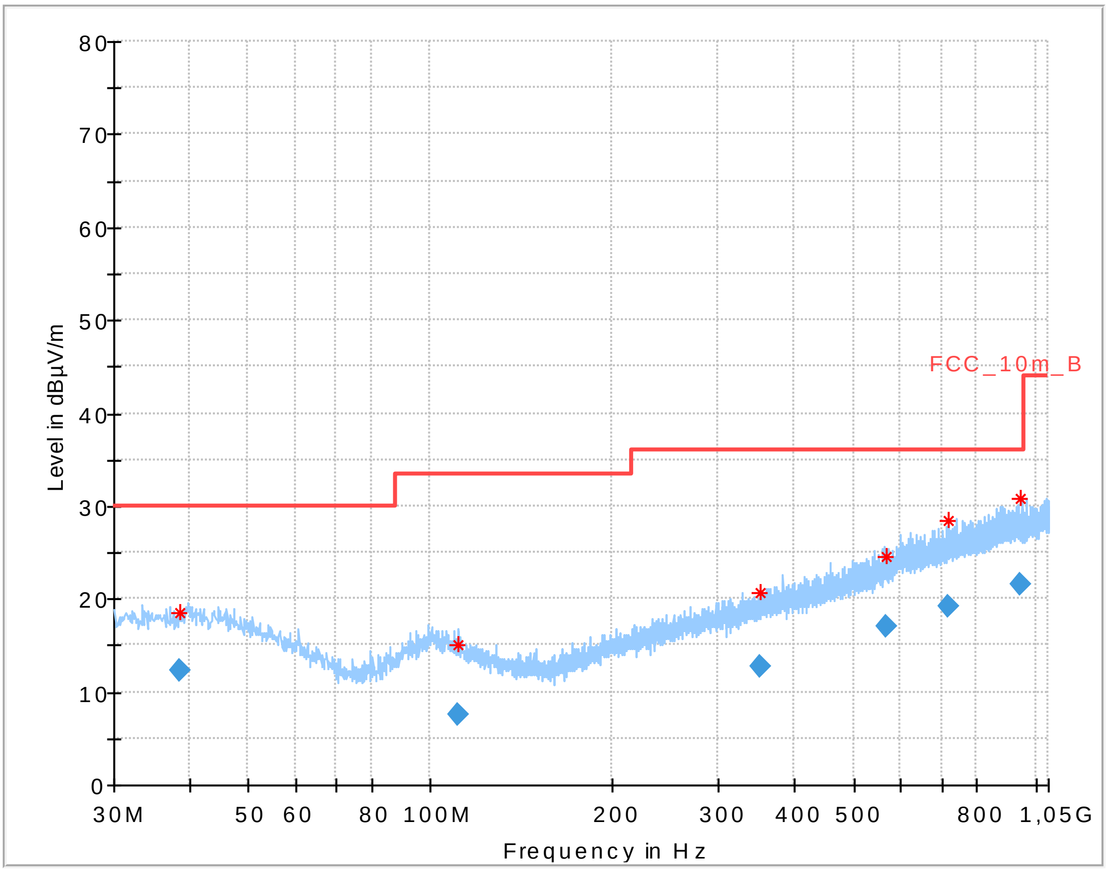
Plot 4: 30 MHz to 1 GHz, vertical & horizontal polarization, only USB converter active



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
48.001200	32.02	30.00	-2.02	1000.0	120.000	98.0	V	234.0	13.1
206.290200	29.32	33.50	4.18	1000.0	120.000	101.0	V	174.0	11.9
330.001500	36.72	36.00	-0.72	1000.0	120.000	170.0	H	167.0	15.4
335.999700	41.30	36.00	-5.30	1000.0	120.000	170.0	H	167.0	15.6
342.002400	38.56	36.00	-2.56	1000.0	120.000	170.0	H	167.0	15.8
353.988900	37.67	36.00	-1.67	1000.0	120.000	170.0	H	174.0	16.1

Plot 5: RX mode, 30 MHz to 1 GHz, vertical & horizontal polarization

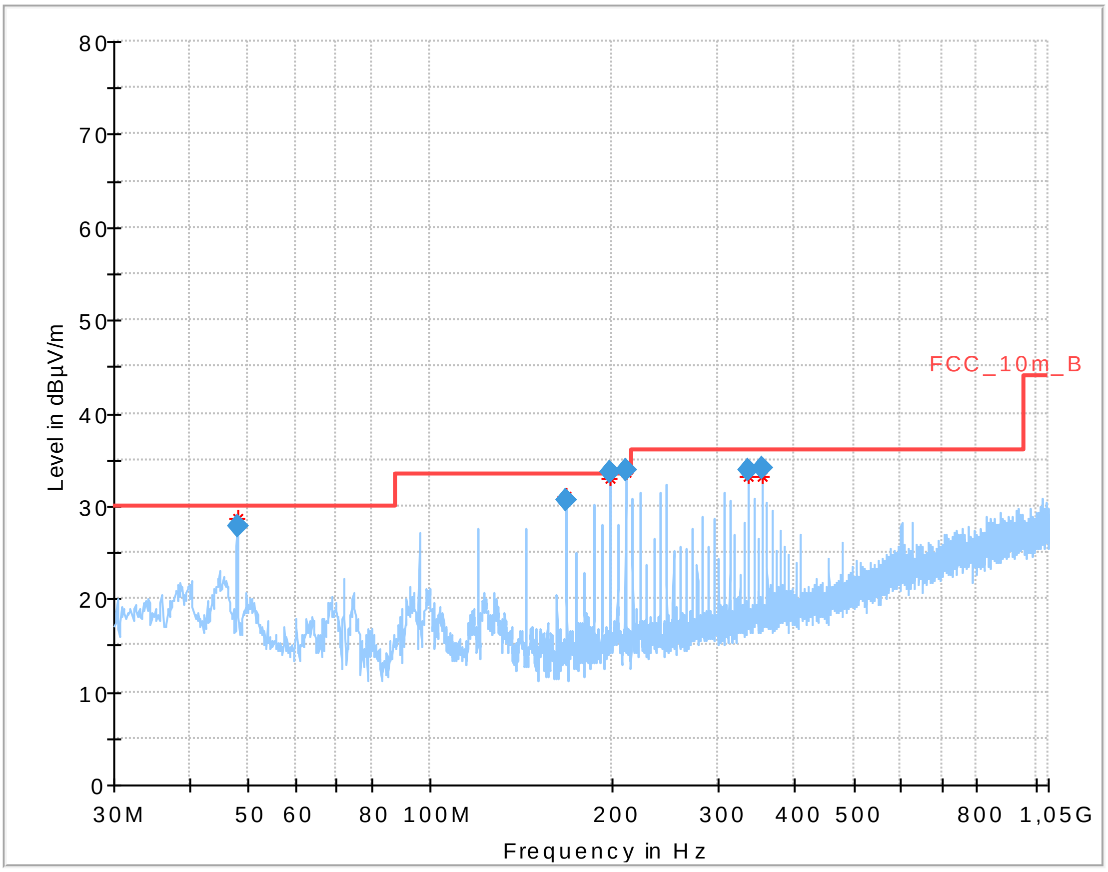


Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
38.713500	12.36	30.00	17.64	1000.0	120.000	101.0	V	353.0	14.0
111.100500	7.57	33.50	25.93	1000.0	120.000	101.0	H	124.0	11.0
350.936700	12.71	36.00	23.29	1000.0	120.000	170.0	V	52.0	16.0
566.859750	17.13	36.00	18.87	1000.0	120.000	170.0	V	102.0	19.8
715.176300	19.26	36.00	16.74	1000.0	120.000	170.0	V	353.0	21.9
947.239800	21.61	36.00	14.39	1000.0	120.000	170.0	V	133.0	24.3

Plot: FORK

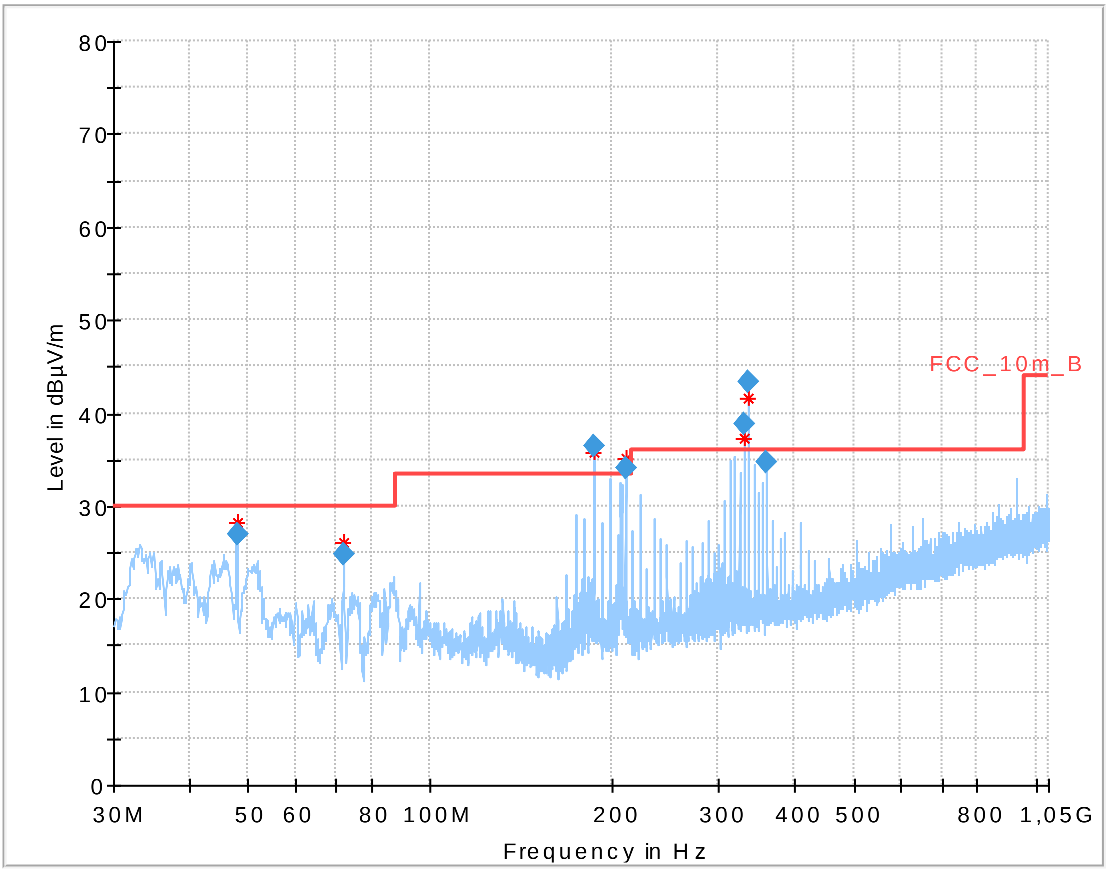
Plot 1: 30 MHz to 1 GHz, vertical & horizontal polarization, low channel



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
48.006000	27.75	30.00	2.25	1000.0	120.000	98.0	V	190.0	13.1
167.992950	30.71	33.50	2.79	1000.0	120.000	98.0	V	171.0	9.6
198.000900	33.67	33.50	-0.17	1000.0	120.000	98.0	V	190.0	11.6
210.001800	33.90	33.50	-0.40	1000.0	120.000	98.0	V	171.0	12.1
336.000300	33.82	36.00	2.18	1000.0	120.000	98.0	V	10.0	15.6
353.998350	33.98	36.00	2.02	1000.0	120.000	98.0	V	80.0	16.1

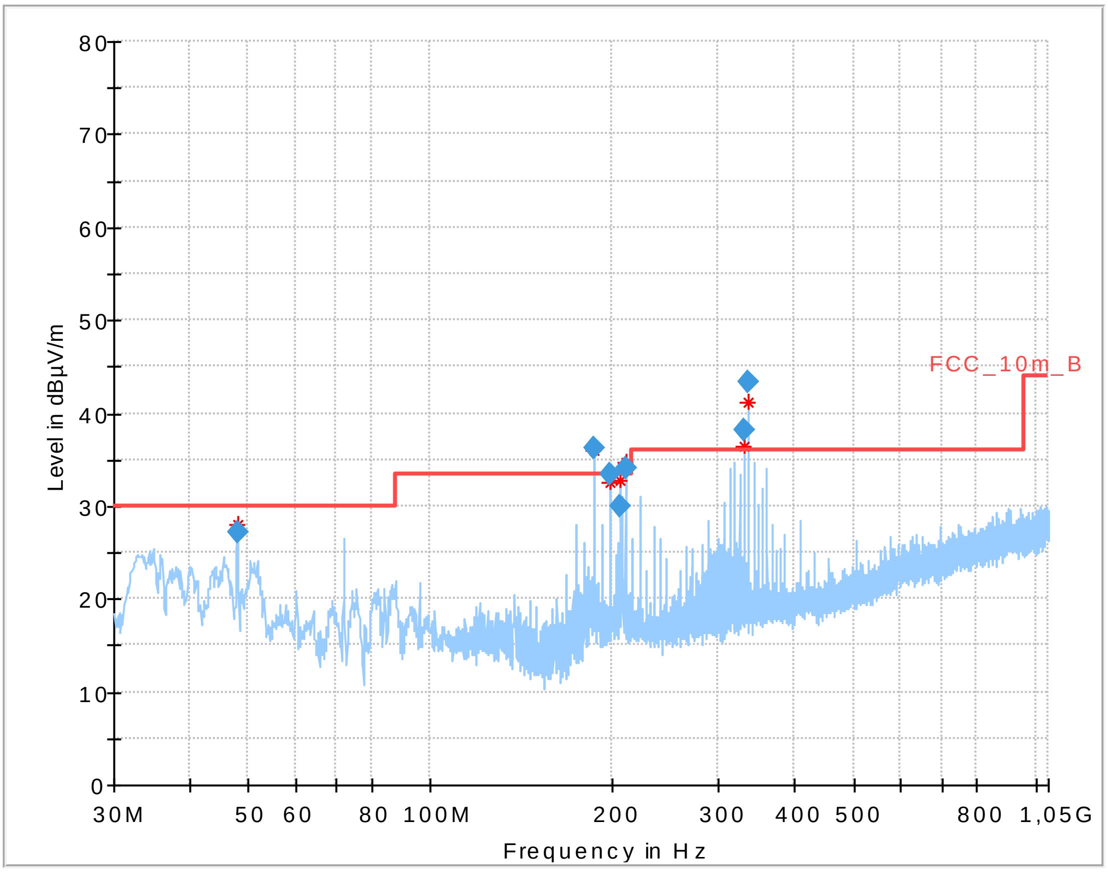
Plot 2: 30 MHz to 1 GHz, vertical & horizontal polarization, mid channel



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
47.992950	26.97	30.00	3.03	1000.0	120.000	98.0	V	190.0	13.1
72.008400	24.88	30.00	5.12	1000.0	120.000	101.0	V	261.0	8.4
186.004050	36.34	33.50	-2.84	1000.0	120.000	98.0	V	-10.0	10.8
209.987700	34.02	33.50	-0.52	1000.0	120.000	98.0	V	-10.0	12.1
329.999700	38.90	36.00	-2.90	1000.0	120.000	170.0	H	280.0	15.4
335.995500	43.39	36.00	-7.39	1000.0	120.000	170.0	H	280.0	15.6
359.984100	34.82	36.00	1.18	1000.0	120.000	170.0	H	280.0	16.2

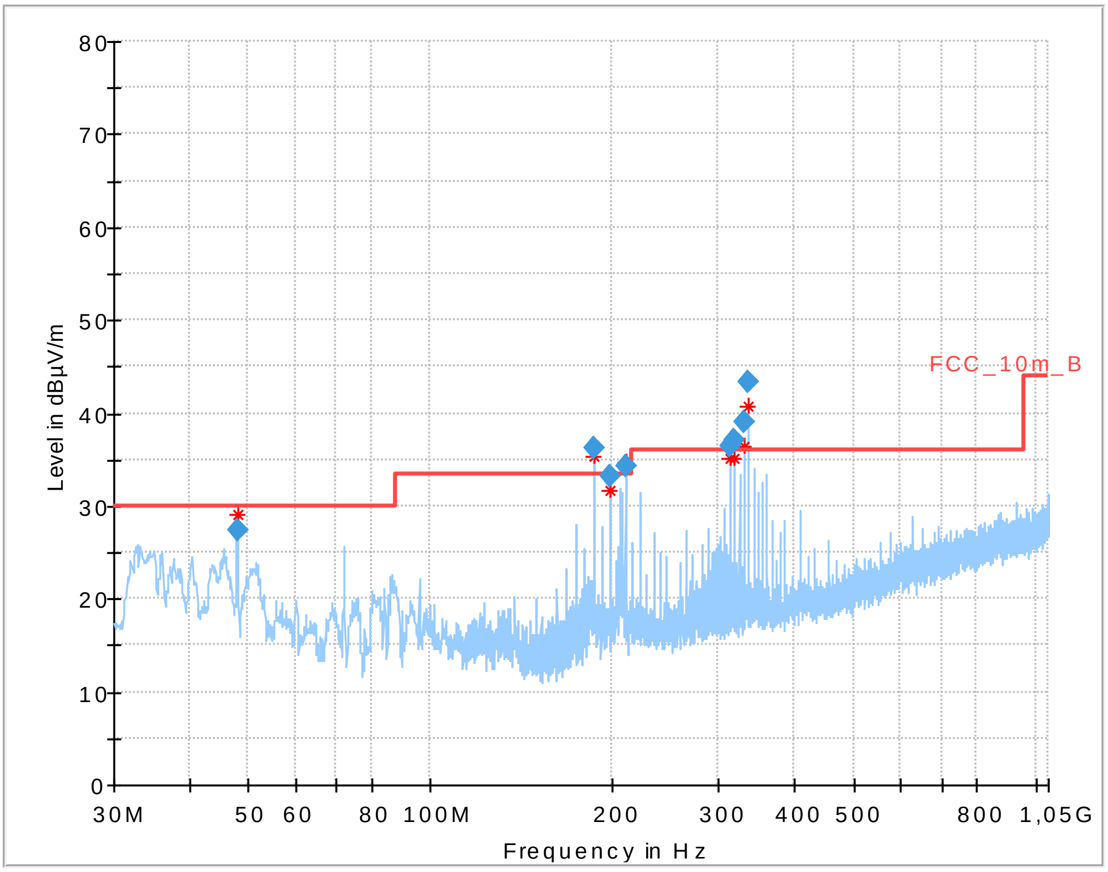
Plot 3: 30 MHz to 1 GHz, vertical & horizontal polarization, high channel



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
48.000450	27.27	30.00	2.73	1000.0	120.000	98.0	V	190.0	13.1
185.994600	36.32	33.50	-2.82	1000.0	120.000	98.0	V	-10.0	10.8
197.995800	33.39	33.50	0.11	1000.0	120.000	98.0	V	-10.0	11.6
206.271750	29.93	33.50	3.57	1000.0	120.000	98.0	V	190.0	11.9
209.996250	33.99	33.50	-0.49	1000.0	120.000	98.0	V	-9.0	12.1
329.997750	38.20	36.00	-2.20	1000.0	120.000	170.0	H	261.0	15.4
335.993250	43.34	36.00	-7.34	1000.0	120.000	170.0	H	280.0	15.6

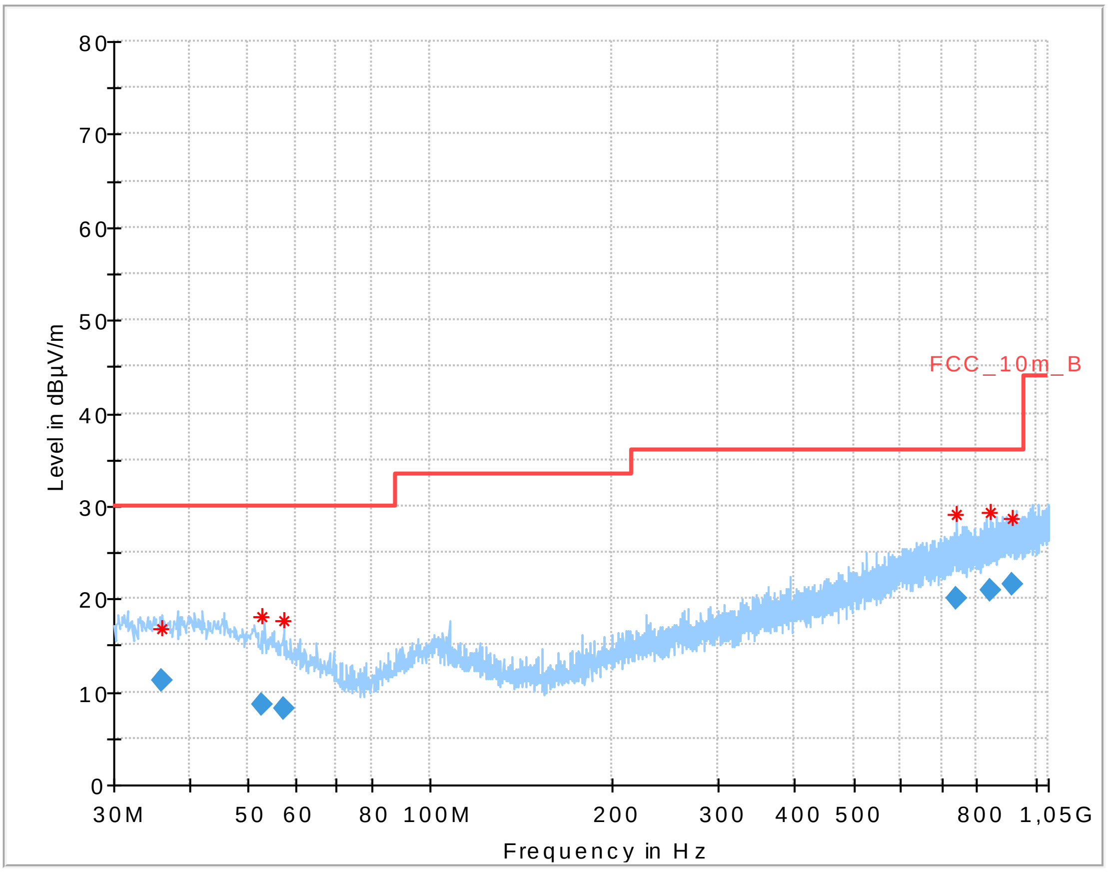
Plot 4: 30 MHz to 1 GHz, vertical & horizontal polarization, only USB converter active



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
47.994750	27.49	30.00	2.51	1000.0	120.000	98.0	V	280.0	13.1
185.994900	36.15	33.50	-2.65	1000.0	120.000	98.0	V	-10.0	10.8
197.989350	33.25	33.50	0.25	1000.0	120.000	98.0	V	-10.0	11.6
209.990400	34.19	33.50	-0.69	1000.0	120.000	98.0	V	-9.0	12.1
311.999250	36.52	36.00	-0.52	1000.0	120.000	170.0	H	280.0	14.8
318.004200	37.18	36.00	-1.18	1000.0	120.000	170.0	H	280.0	15.0
329.998050	38.96	36.00	-2.96	1000.0	120.000	170.0	H	280.0	15.4
336.004800	43.29	36.00	-7.29	1000.0	120.000	170.0	H	280.0	15.6

Plot 5: RX mode, 30 MHz to 1 GHz, vertical & horizontal polarization

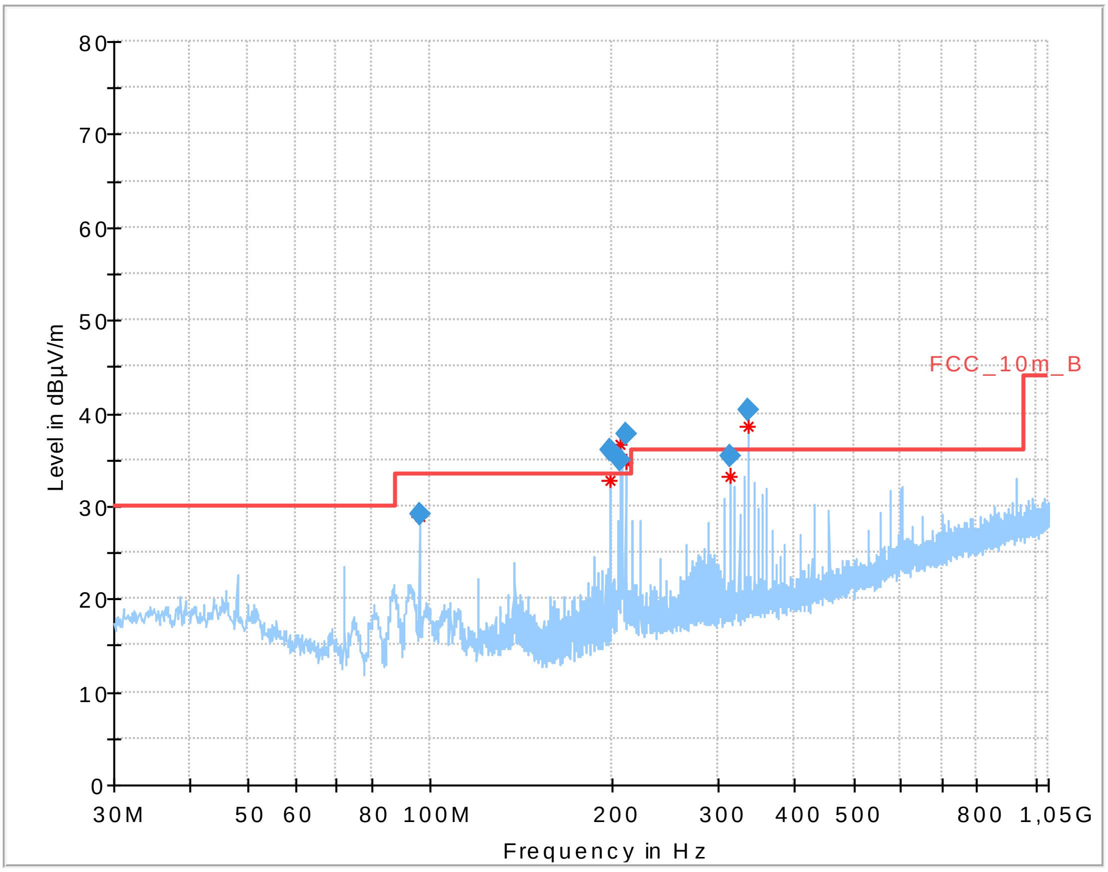


Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
36.035550	11.29	30.00	18.71	1000.0	120.000	101.0	H	280.0	13.8
52.666800	8.72	30.00	21.28	1000.0	120.000	101.0	V	-9.0	12.2
57.154800	8.28	30.00	21.72	1000.0	120.000	101.0	V	100.0	11.3
742.540950	20.06	36.00	15.94	1000.0	120.000	101.0	H	190.0	22.5
844.068450	20.87	36.00	15.13	1000.0	120.000	101.0	V	190.0	23.4
914.021100	21.57	36.00	14.43	1000.0	120.000	170.0	V	190.0	24.2

Plot: REARSHOCK

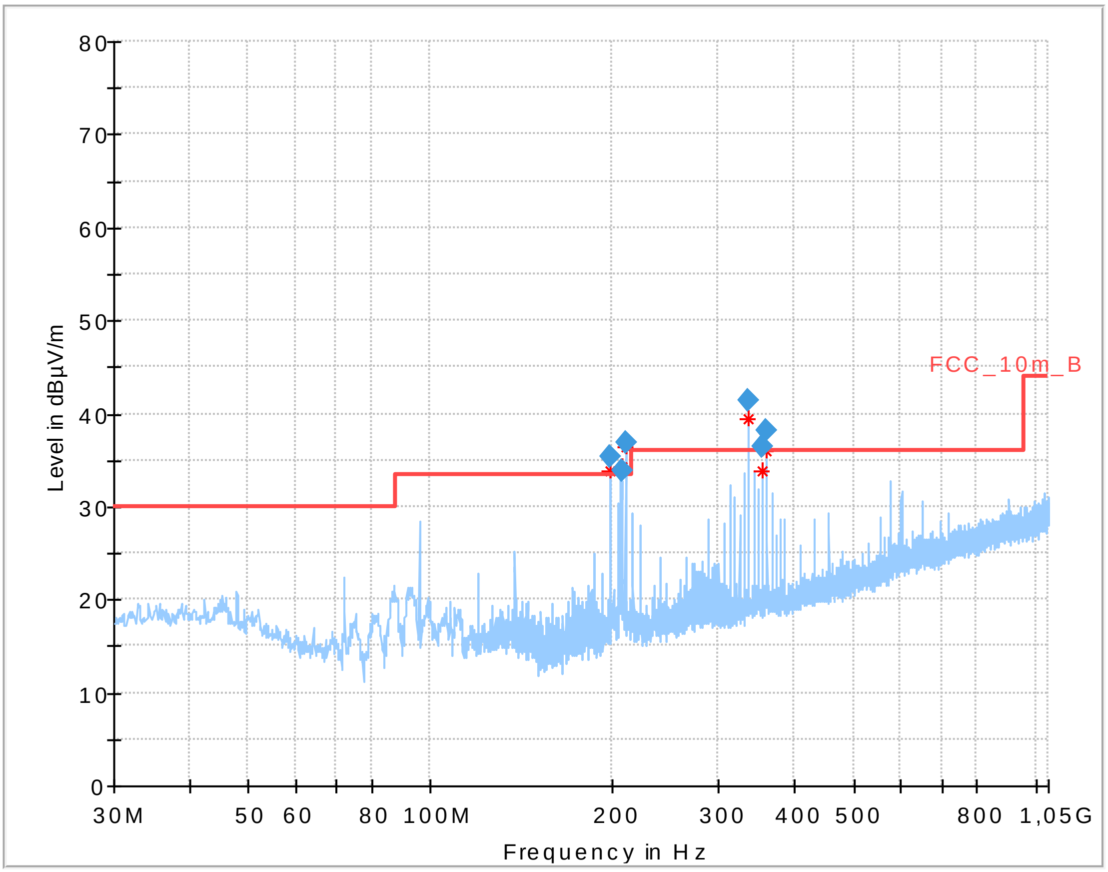
Plot 1: 30 MHz to 1 GHz, vertical & horizontal polarization, low channel



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
96.013950	29.16	33.50	4.34	1000.0	120.000	170.0	H	0.0	11.5
198.006150	36.04	33.50	-2.54	1000.0	120.000	170.0	H	131.0	11.6
206.254050	34.89	33.50	-1.39	1000.0	120.000	101.0	V	25.0	11.9
209.997600	37.67	33.50	-4.17	1000.0	120.000	170.0	H	131.0	12.1
311.991600	35.33	36.00	0.67	1000.0	120.000	170.0	H	89.0	14.8
335.995650	40.28	36.00	-4.28	1000.0	120.000	170.0	H	89.0	15.6

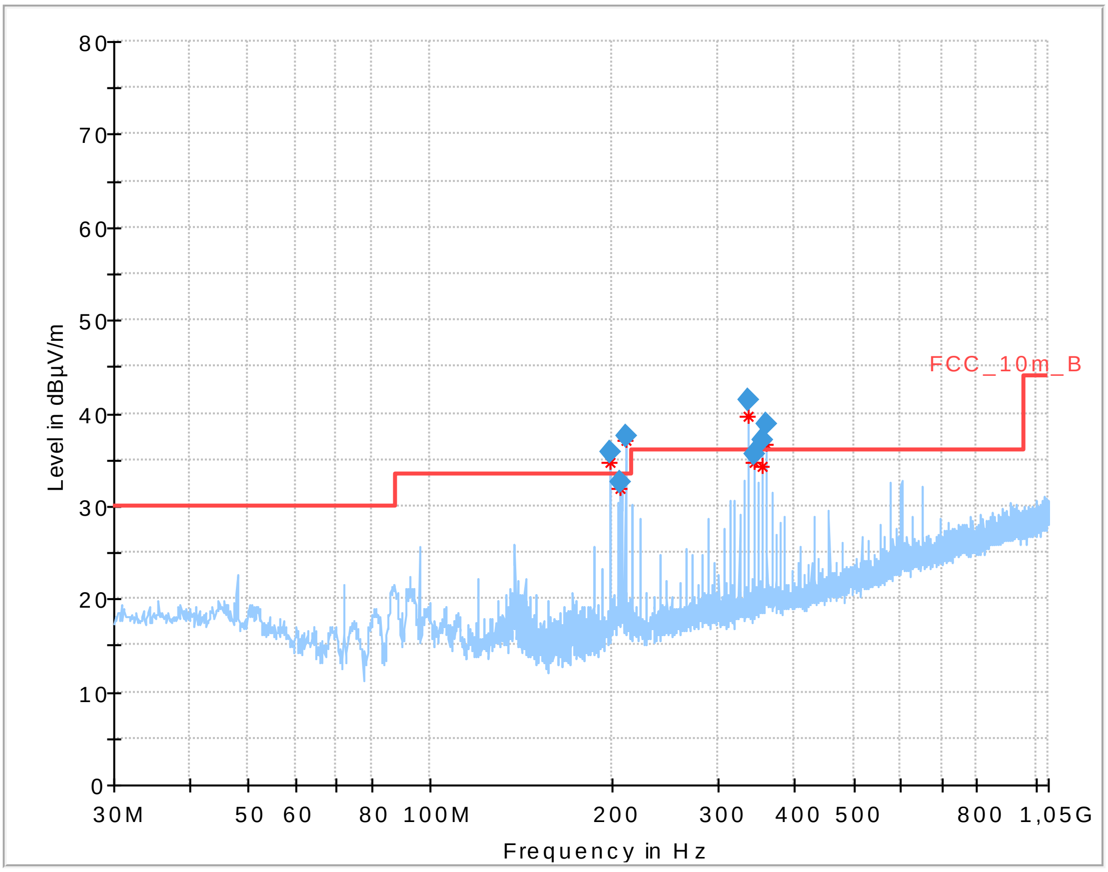
Plot 2: 30 MHz to 1 GHz, vertical & horizontal polarization, mid channel



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
197.999850	35.33	33.50	-1.83	1000.0	120.000	98.0	V	274.0	11.6
206.958450	33.83	33.50	-0.33	1000.0	120.000	98.0	V	353.0	11.9
210.001950	36.93	33.50	-3.43	1000.0	120.000	98.0	V	267.0	12.1
336.002250	41.42	36.00	-5.42	1000.0	120.000	170.0	H	92.0	15.6
353.987550	36.47	36.00	-0.47	1000.0	120.000	170.0	H	321.0	16.1
360.005400	38.11	36.00	-2.11	1000.0	120.000	170.0	H	321.0	16.2

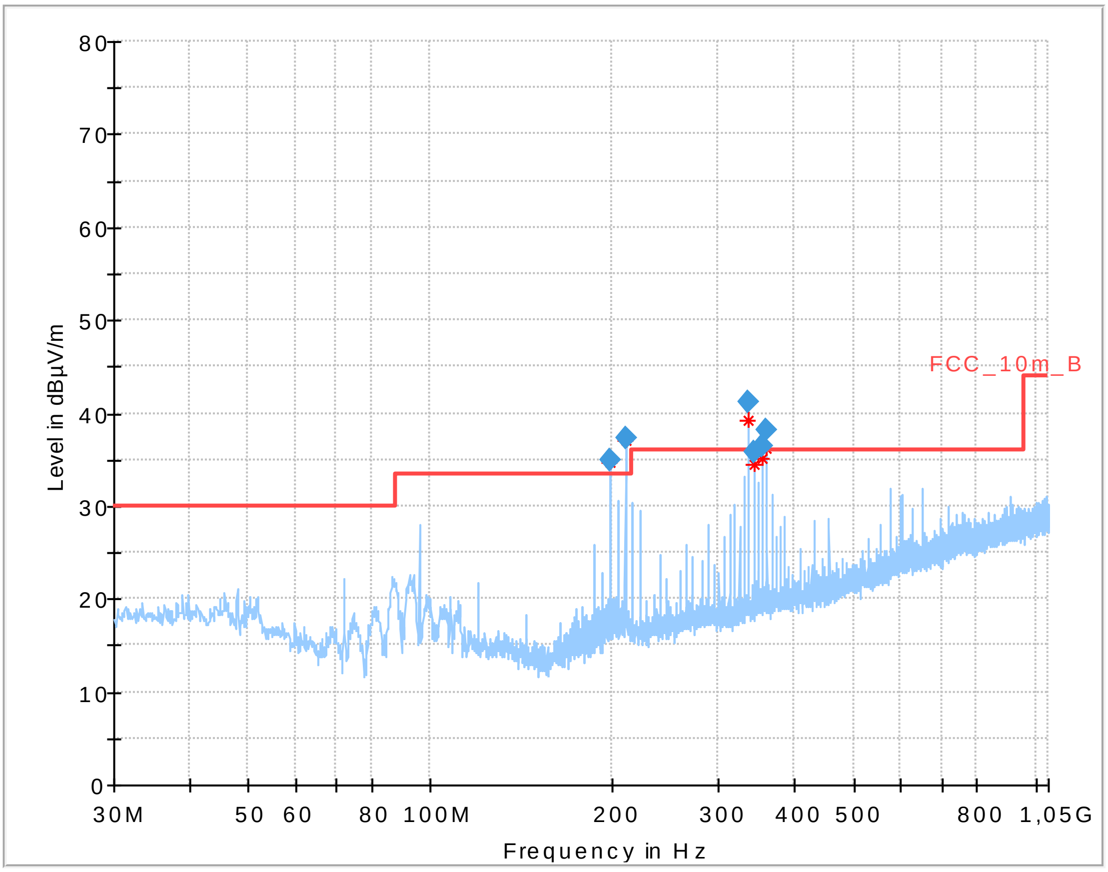
Plot 3: 30 MHz to 1 GHz, vertical & horizontal polarization, high channel



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
197.995200	35.78	33.50	-2.28	1000.0	120.000	98.0	V	274.0	11.6
206.317800	32.61	33.50	0.89	1000.0	120.000	98.0	V	310.0	11.9
209.999850	37.49	33.50	-3.99	1000.0	120.000	98.0	V	274.0	12.1
336.004800	41.38	36.00	-5.38	1000.0	120.000	170.0	H	95.0	15.6
342.007950	35.65	36.00	0.35	1000.0	120.000	170.0	H	95.0	15.8
353.996400	37.08	36.00	-1.08	1000.0	120.000	170.0	H	326.0	16.1
359.997000	38.85	36.00	-2.85	1000.0	120.000	170.0	H	326.0	16.2

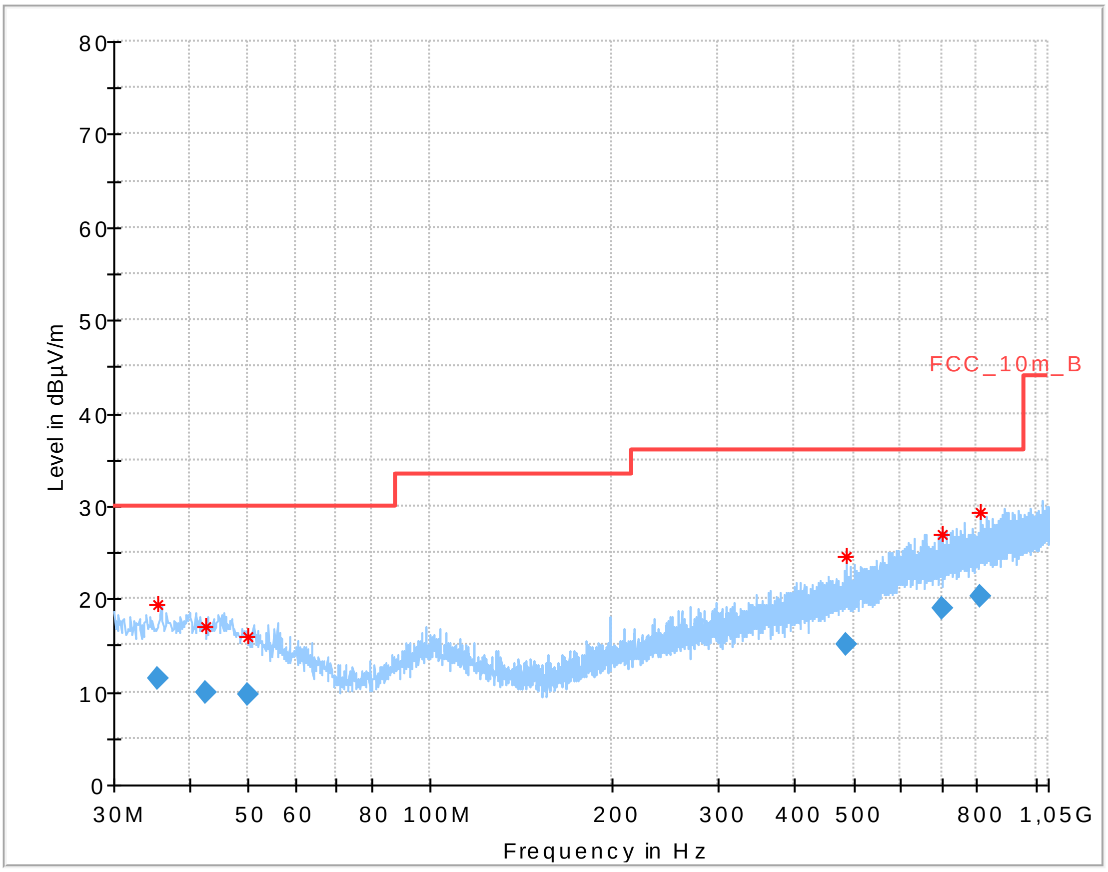
Plot 4: 30 MHz to 1 GHz, vertical & horizontal polarization, only USB converter active



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
198.001650	34.87	33.50	-1.37	1000.0	120.000	98.0	V	289.0	11.6
209.996400	37.20	33.50	-3.70	1000.0	120.000	98.0	V	289.0	12.1
335.995800	41.13	36.00	-5.13	1000.0	120.000	170.0	H	102.0	15.6
341.986650	35.70	36.00	0.30	1000.0	120.000	170.0	H	94.0	15.8
353.991750	36.37	36.00	-0.37	1000.0	120.000	170.0	H	332.0	16.1
359.995500	38.22	36.00	-2.22	1000.0	120.000	170.0	H	332.0	16.2

Plot 5: RX mode, 30 MHz to 1 GHz, vertical & horizontal polarization



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
35.570700	11.37	30.00	18.63	1000.0	120.000	101.0	H	-10.0	13.8
42.706500	10.00	30.00	20.00	1000.0	120.000	101.0	V	280.0	13.9
49.983450	9.74	30.00	20.26	1000.0	120.000	170.0	V	80.0	12.6
486.550950	15.14	36.00	20.86	1000.0	120.000	101.0	V	280.0	18.4
703.302900	19.01	36.00	16.99	1000.0	120.000	170.0	V	190.0	21.6
811.677000	20.18	36.00	15.82	1000.0	120.000	98.0	H	80.0	22.9

12.12 Spurious emissions radiated above 1 GHz

Description:

Measurement of the radiated spurious emissions above 1 GHz in transmit mode and receiver / idle mode.

Measurement:

Measurement parameter	
Detector:	Peak / RMS
Sweep time:	Auto
Resolution bandwidth:	F > 1 GHz: 1 MHz
Video bandwidth:	3 x RBW
Span:	1 GHz to 26 GHz
Trace mode:	Max Hold
Test setup:	See sub clause 7.2 A / 7.3 A
Measurement uncertainty	See sub clause 9

Limits:

FCC	IC	
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).		
Frequency (MHz)	Field Strength (dBµV/m)	Measurement distance
Above 960	54.0	3

Results: SEATPOST

TX Spurious Emissions Radiated [dBµV/m]								
2412 MHz			2437 MHz			2462 MHz		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
All detected emissions are more than 20 dB below the limit.			All detected emissions are more than 20 dB below the limit.			All detected emissions are more than 20 dB below the limit.		
	Peak			Peak			Peak	
	AVG			AVG			AVG	
	Peak			Peak			Peak	
	AVG			AVG			AVG	

Results: FORK

TX Spurious Emissions Radiated [dBµV/m]								
2412 MHz			2437 MHz			2462 MHz		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
4804	Peak	60.27	4880	Peak	61.52	4960	Peak	62.47
	AVG	7.57		AVG	8.82		AVG	9.77
	Peak			Peak			Peak	
	AVG			AVG			AVG	

Results: REARSHOCK

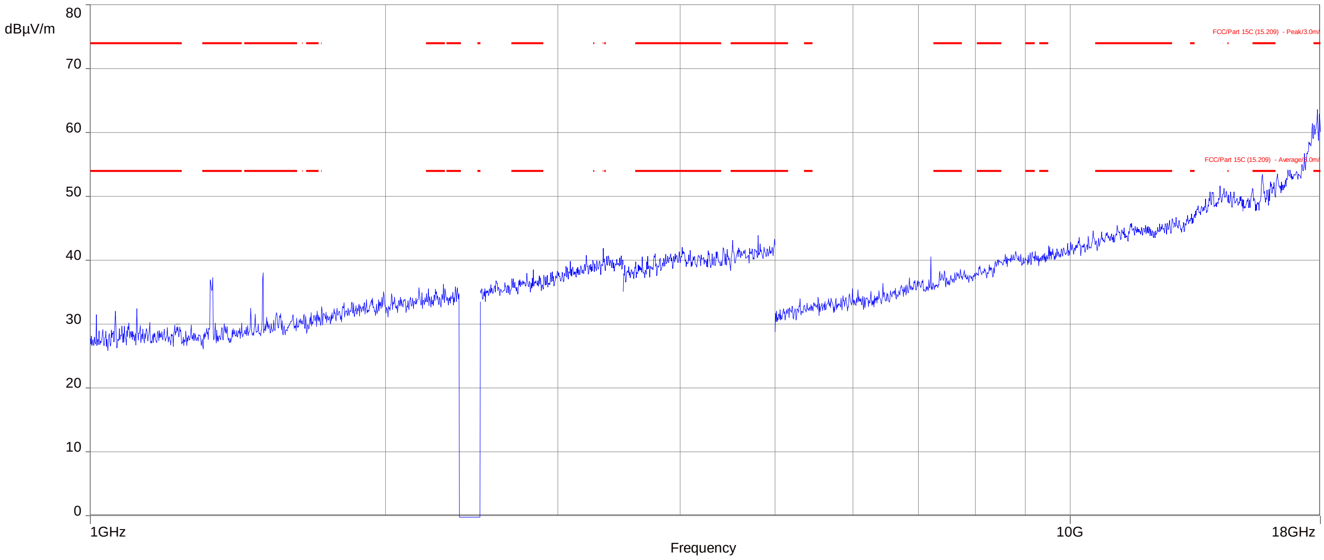
TX Spurious Emissions Radiated [dBµV/m]								
2412 MHz			2437 MHz			2462 MHz		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
All detected emissions are more than 20 dB below the limit.			All detected emissions are more than 20 dB below the limit.			All detected emissions are more than 20 dB below the limit.		
	Peak			Peak			Peak	
	AVG			AVG			AVG	
	Peak			Peak			Peak	
	AVG			AVG			AVG	

Results: RX / idle – mode

TX Spurious Emissions Radiated [dBµV/m]		
F [MHz]	Detector	Level [dBµV/m]
All detected emissions are more than 20 dB below the limit.		
	Peak	
	AVG	
	Peak	
	AVG	

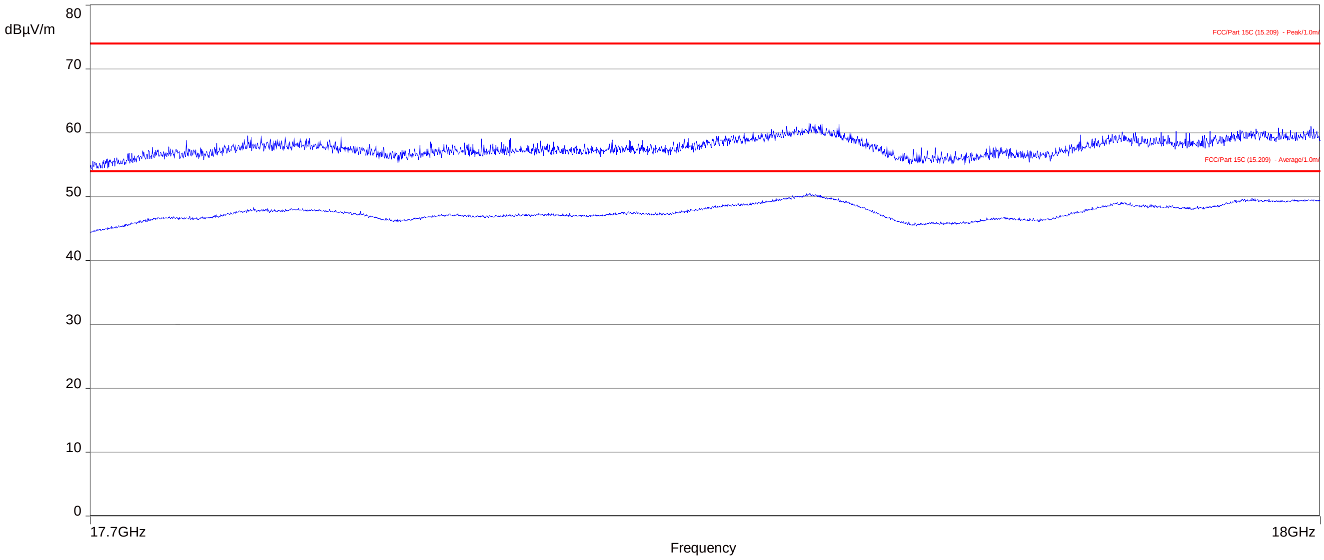
Plots: SEATPOST

Plot 1: Lowest channel, 1 GHz to 18 GHz, vertical & horizontal polarization

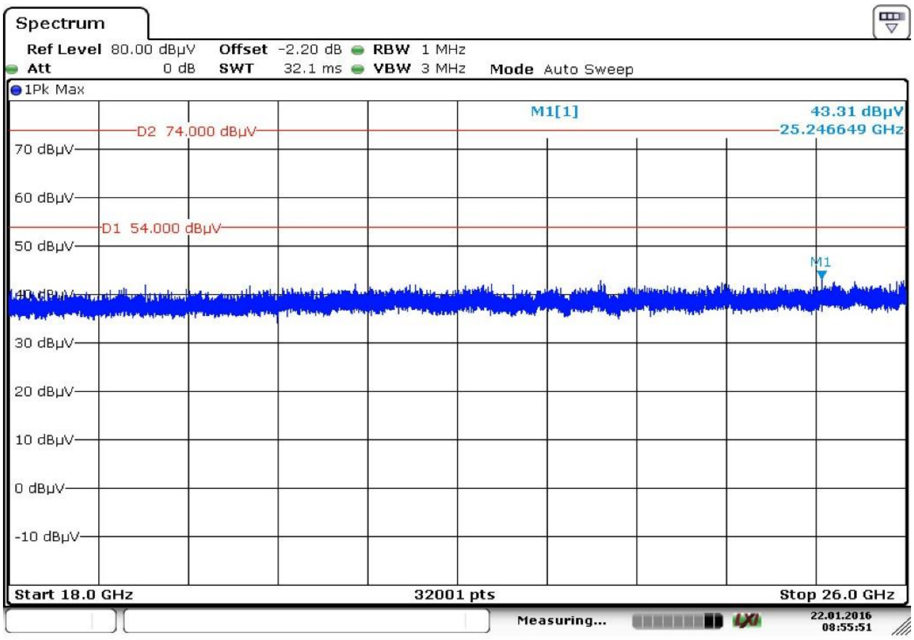


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 2: Lowest channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization, peak & average

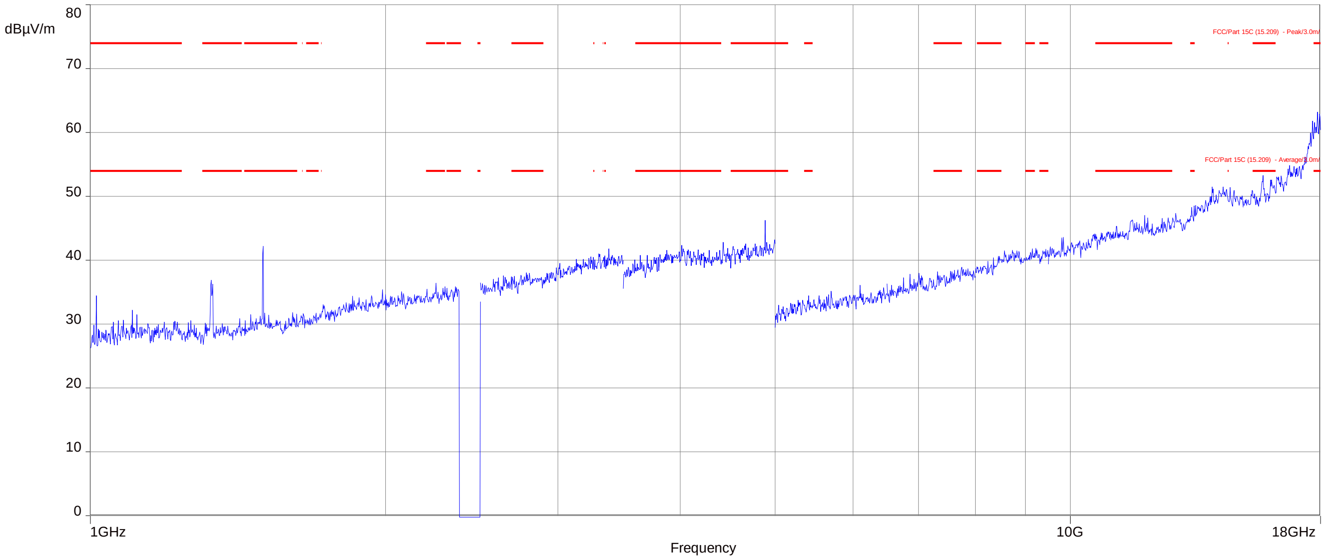


Plot 3: Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



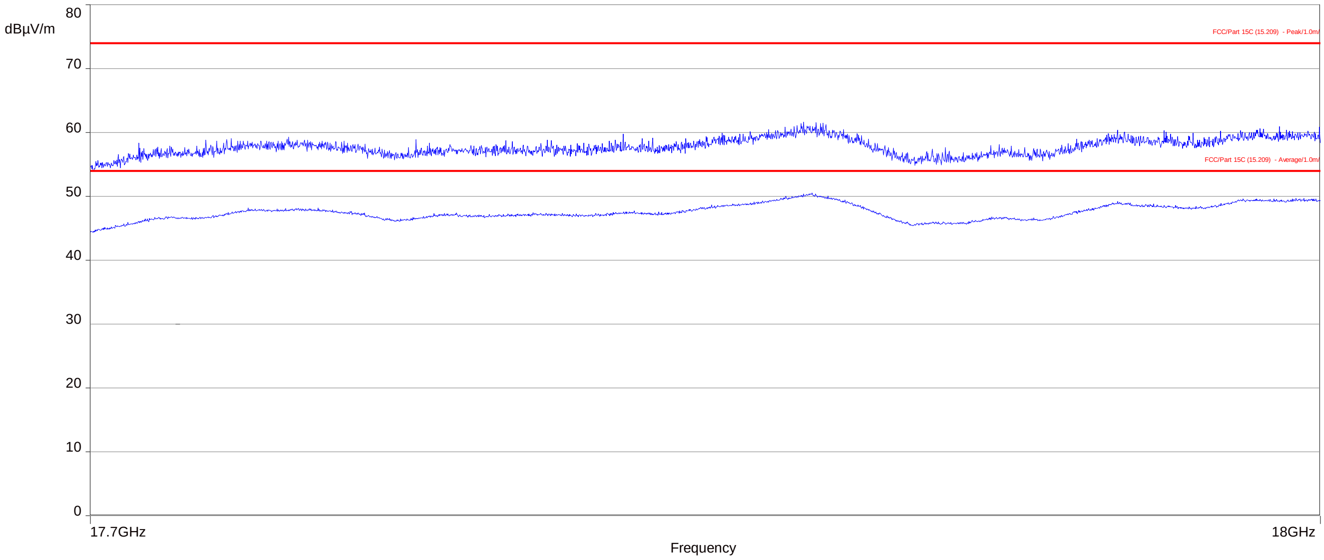
Date: 22.JAN.2016 08:55:51

Plot 4: Middle channel, 1 GHz to 18 GHz, vertical & horizontal polarization

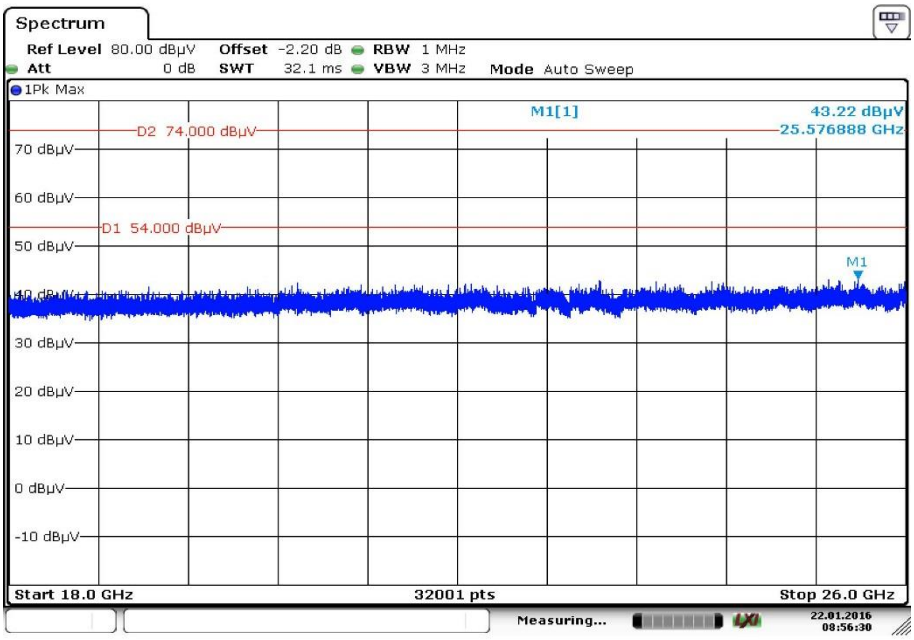


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 5: Middle channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization

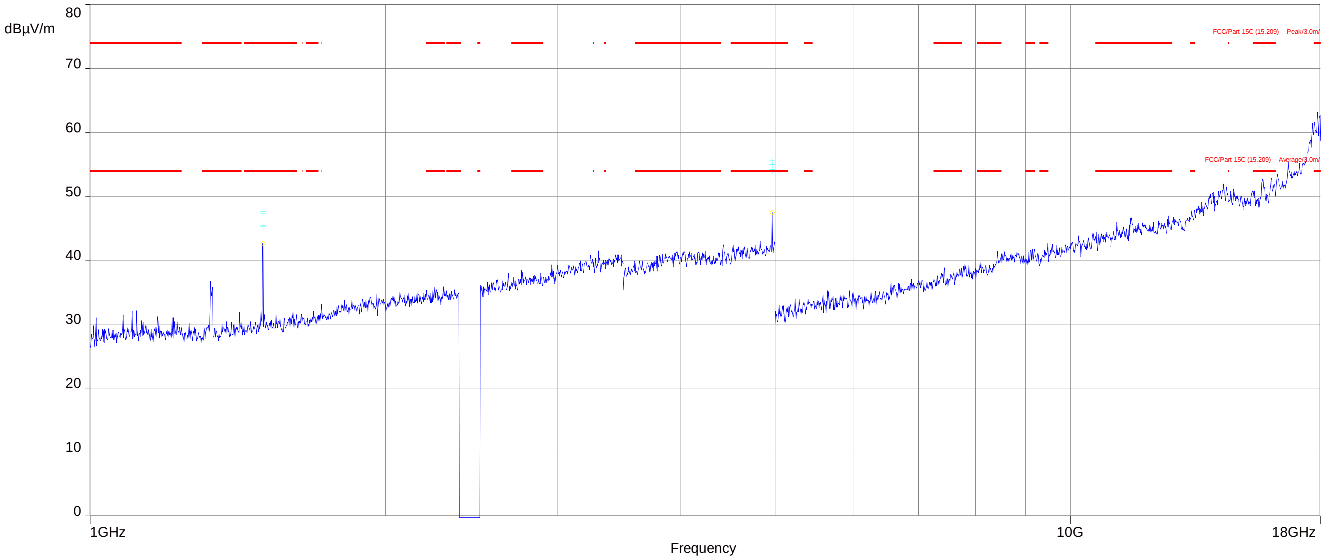


Plot 6: Middle channel, 18 GHz to 26 GHz, vertical & horizontal polarization



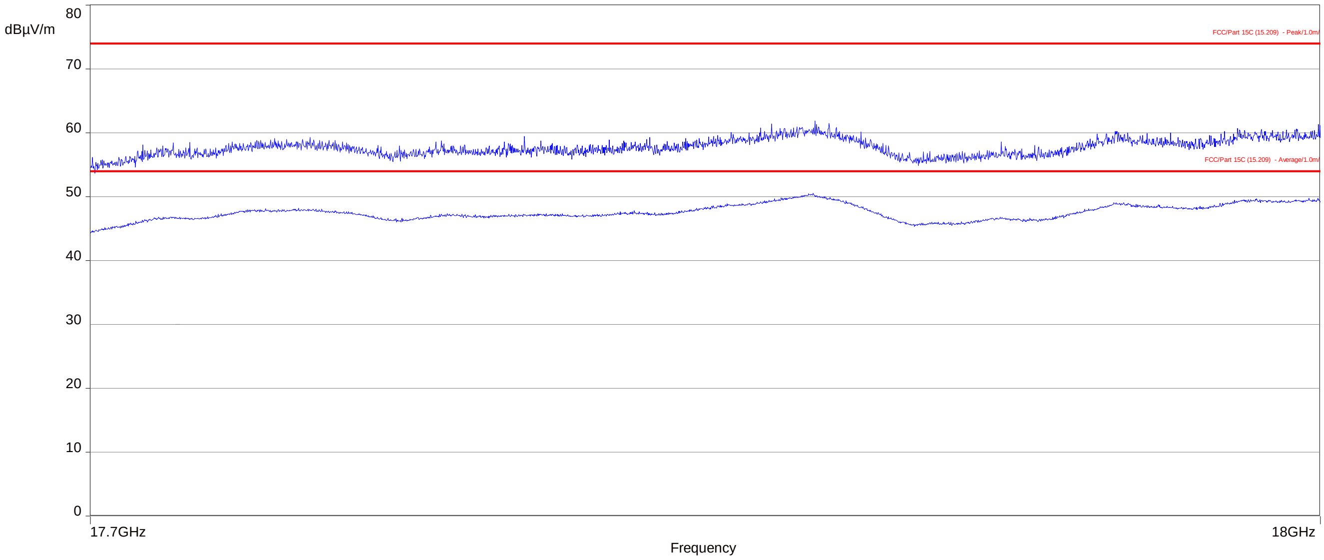
Date: 22.JAN.2016 08:56:31

Plot 7: Highest channel, 1 GHz to 18 GHz, vertical & horizontal polarization

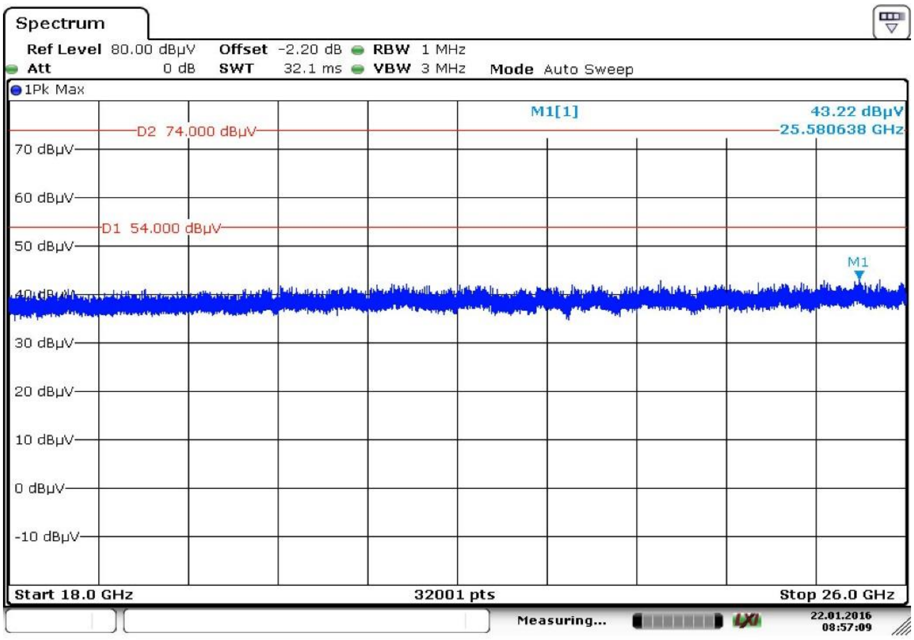


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 8: Highest channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization

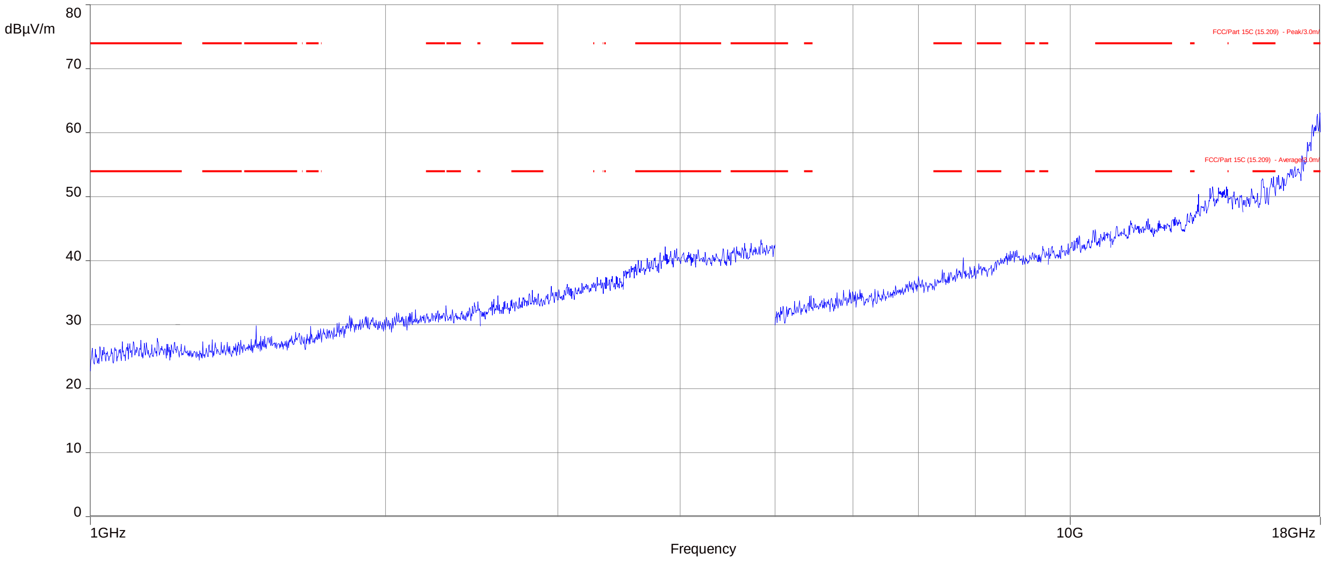


Plot 9: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization

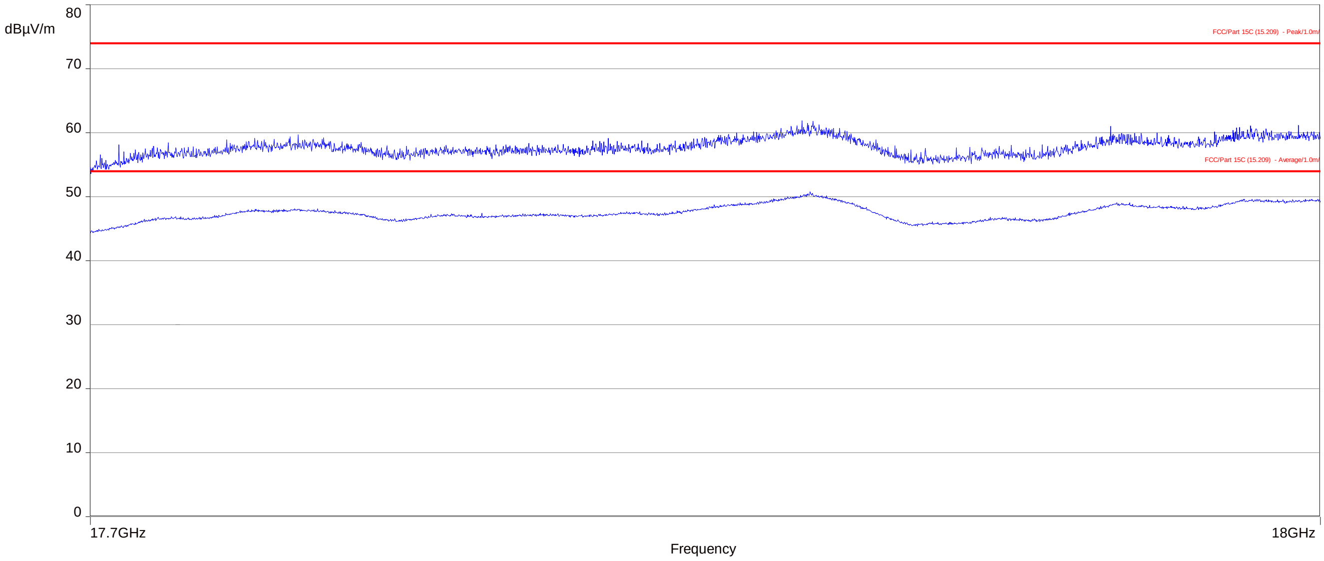


Date: 22.JAN.2016 08:57:09

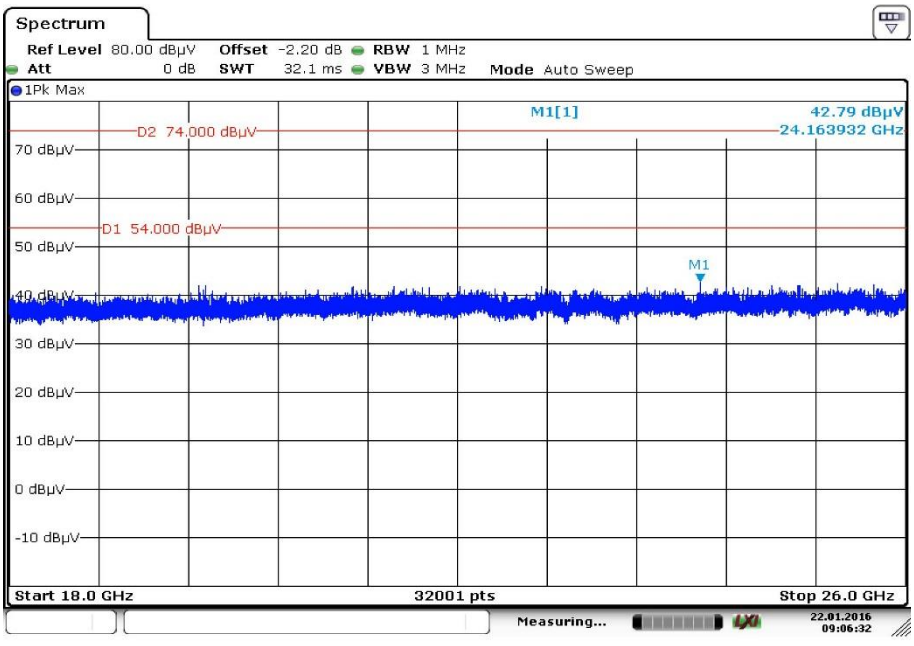
Plot 10: 1 GHz to 12.75 GHz, vertical & horizontal polarization



Plot 11: RX mode, 17.7 GHz to 18 GHz, vertical & horizontal polarization



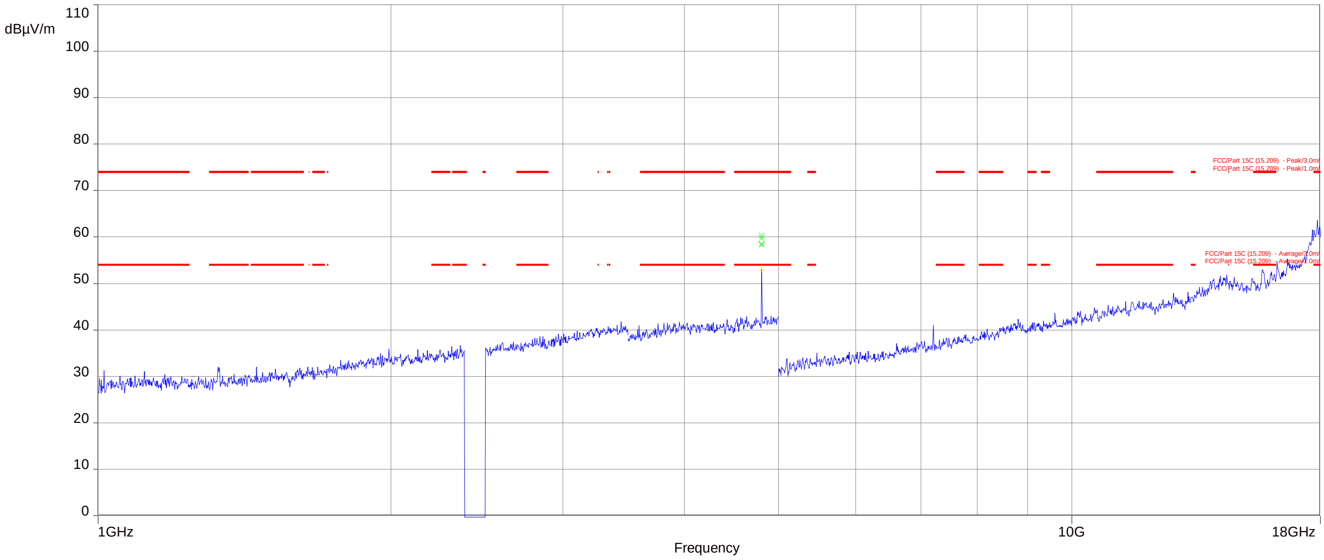
Plot 12: 18 GHz to 26 GHz, vertical & horizontal polarization



Date: 22.JAN.2016 09:06:31

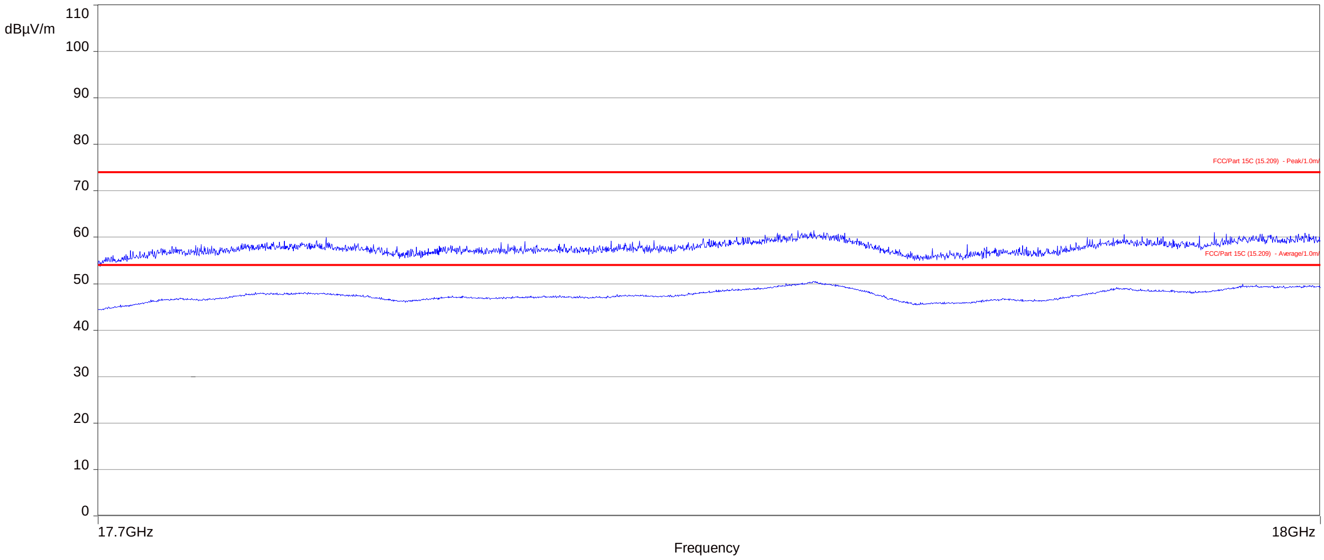
Plots: FORK

Plot 1: Lowest channel, 1 GHz to 18 GHz, vertical & horizontal polarization

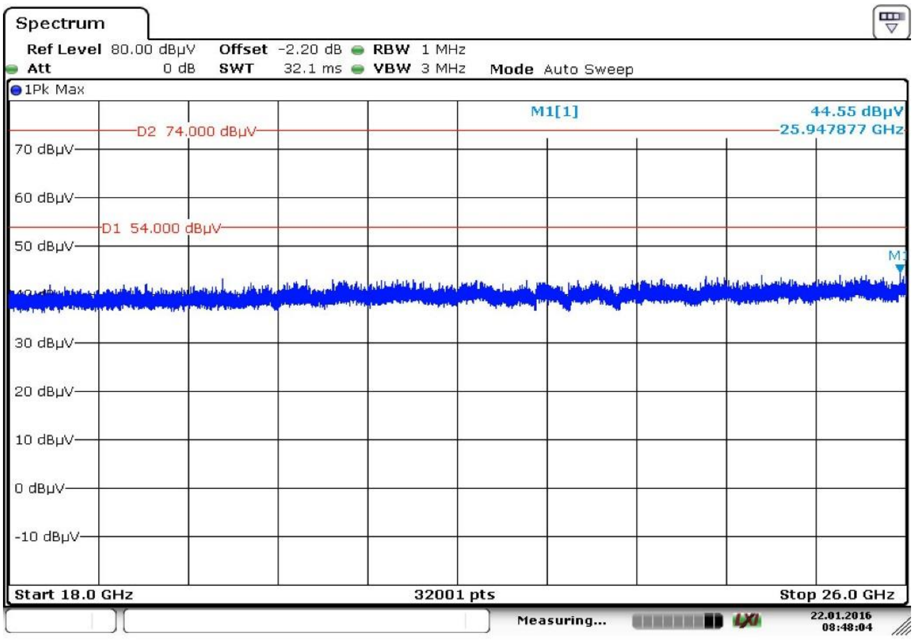


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 2: Lowest channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization, peak & average

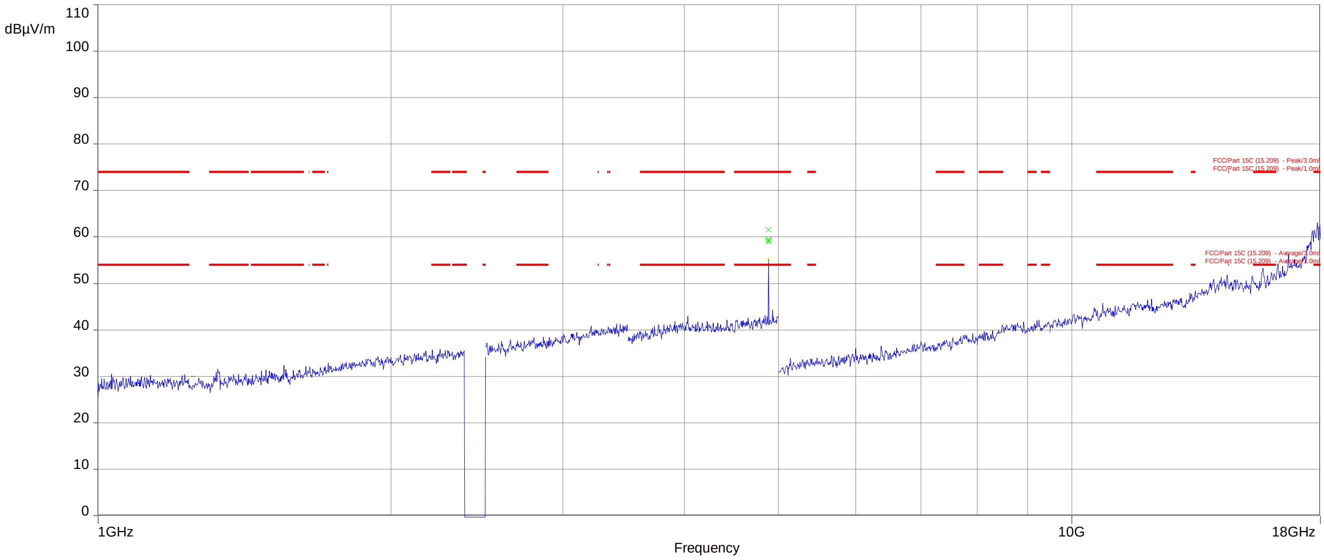


Plot 3: Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



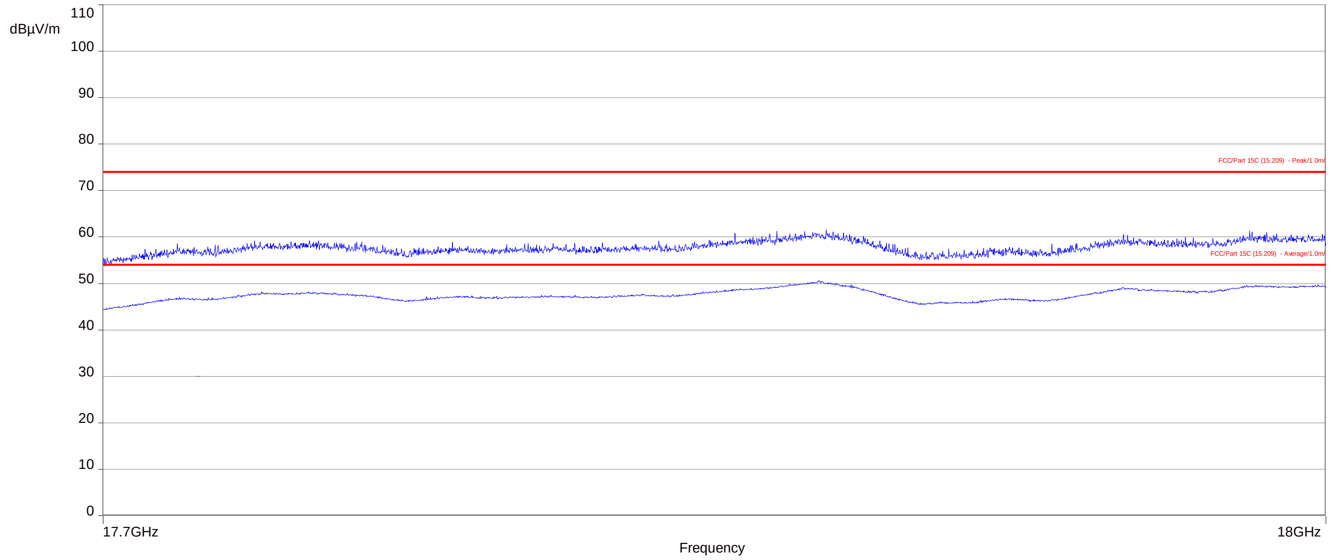
Date: 22.JAN.2016 08:48:05

Plot 4: Middle channel, 1 GHz to 18 GHz, vertical & horizontal polarization

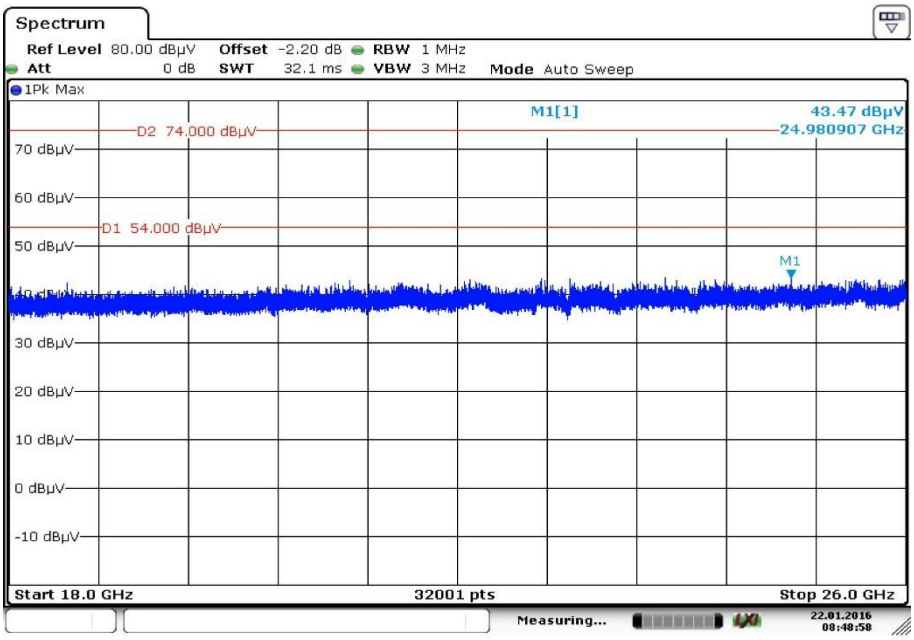


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 5: Middle channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization

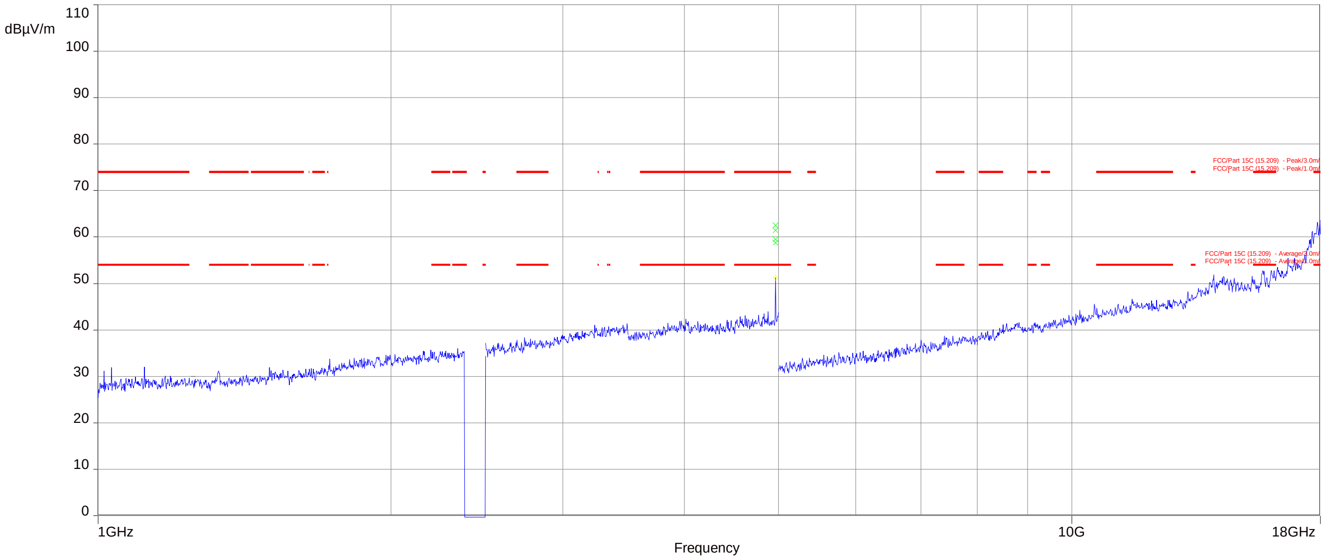


Plot 6: Middle channel, 18 GHz to 26 GHz, vertical & horizontal polarization



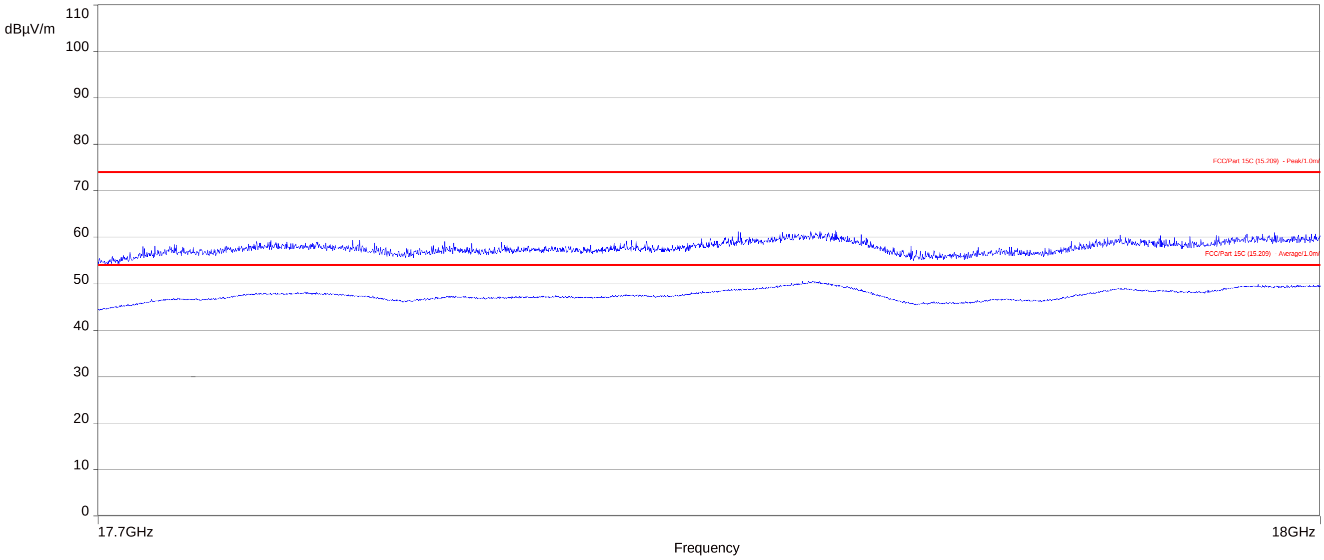
Date: 22.JAN.2016 08:48:58

Plot 7: Highest channel, 1 GHz to 18 GHz, vertical & horizontal polarization

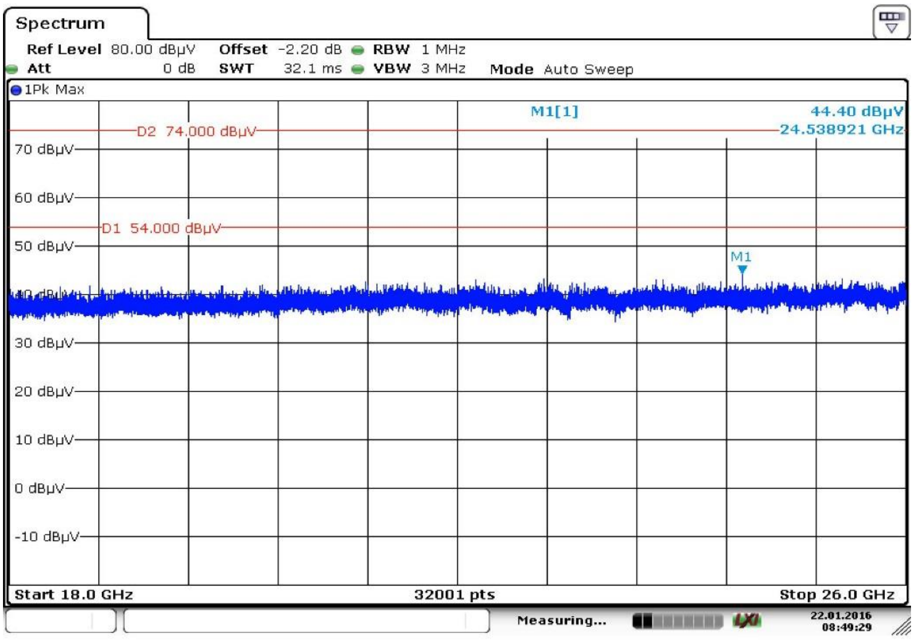


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 8: Highest channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization

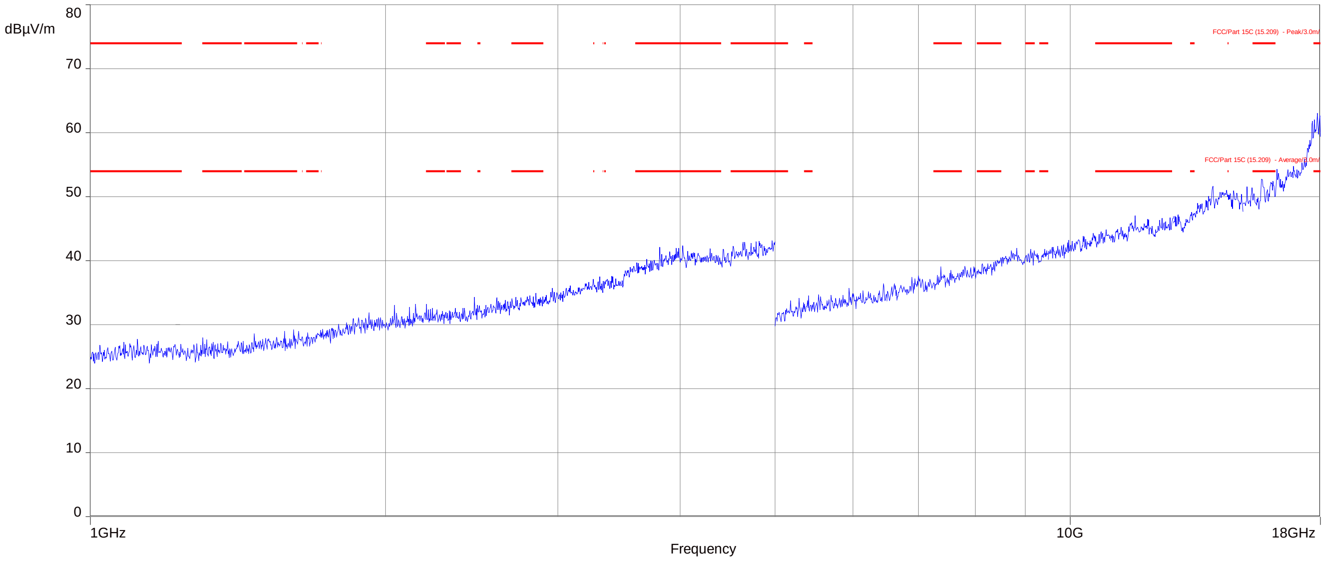


Plot 9: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization

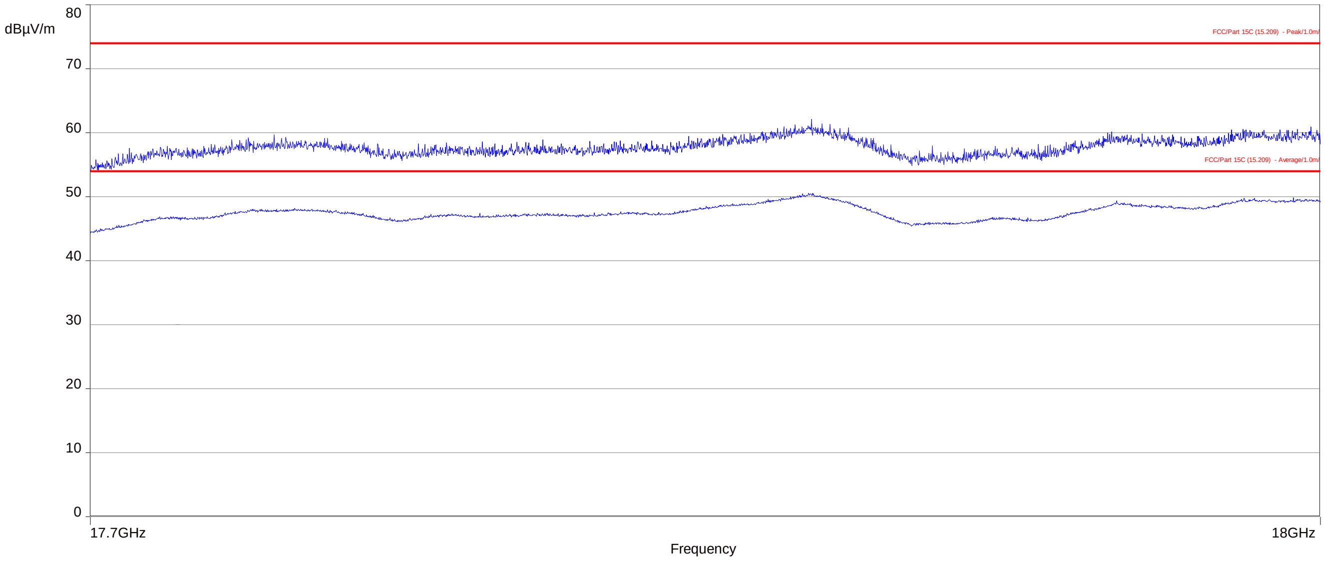


Date: 22.JAN.2016 08:49:29

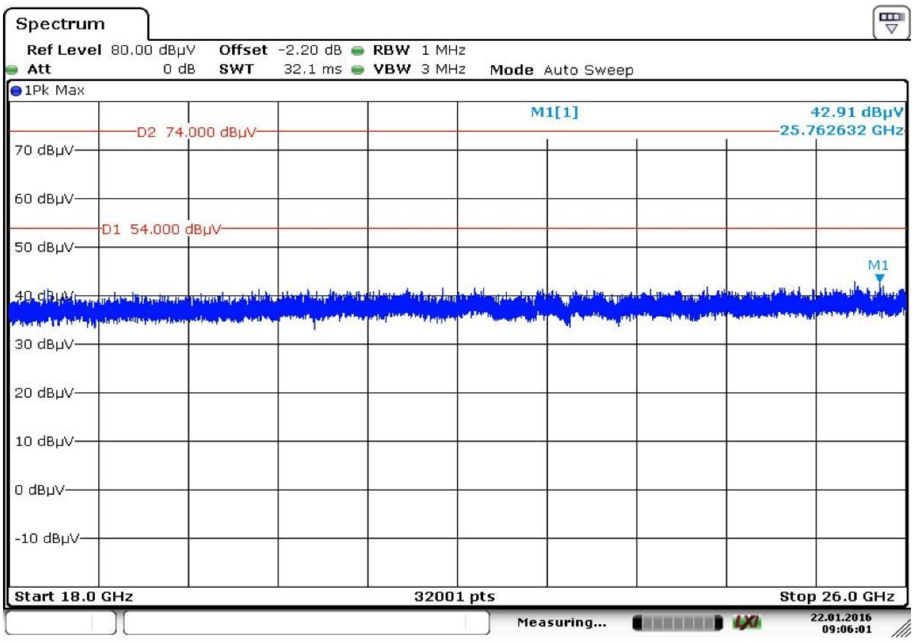
Plot 10: RX mode, 1 GHz to 18 GHz, vertical & horizontal polarization



Plot 11: RX mode, 17.7 GHz to 18 GHz, vertical & horizontal polarization



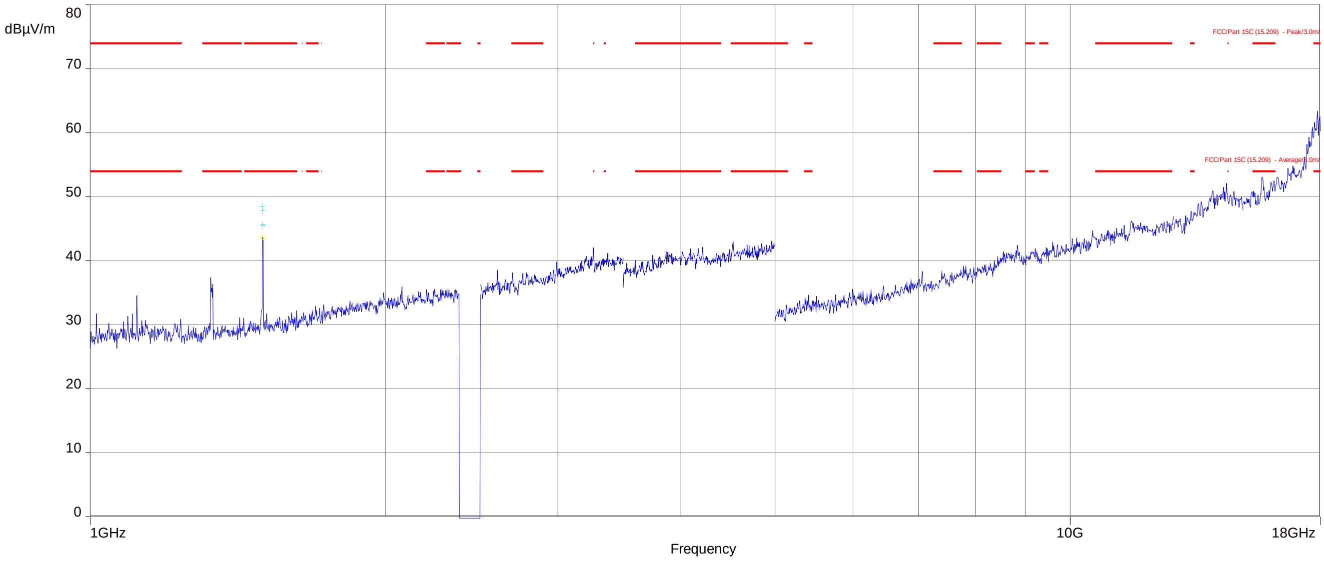
Plot 12: RX mode, 18 GHz to 26 GHz, vertical & horizontal polarization



Date: 22.JAN.2016 09:06:01

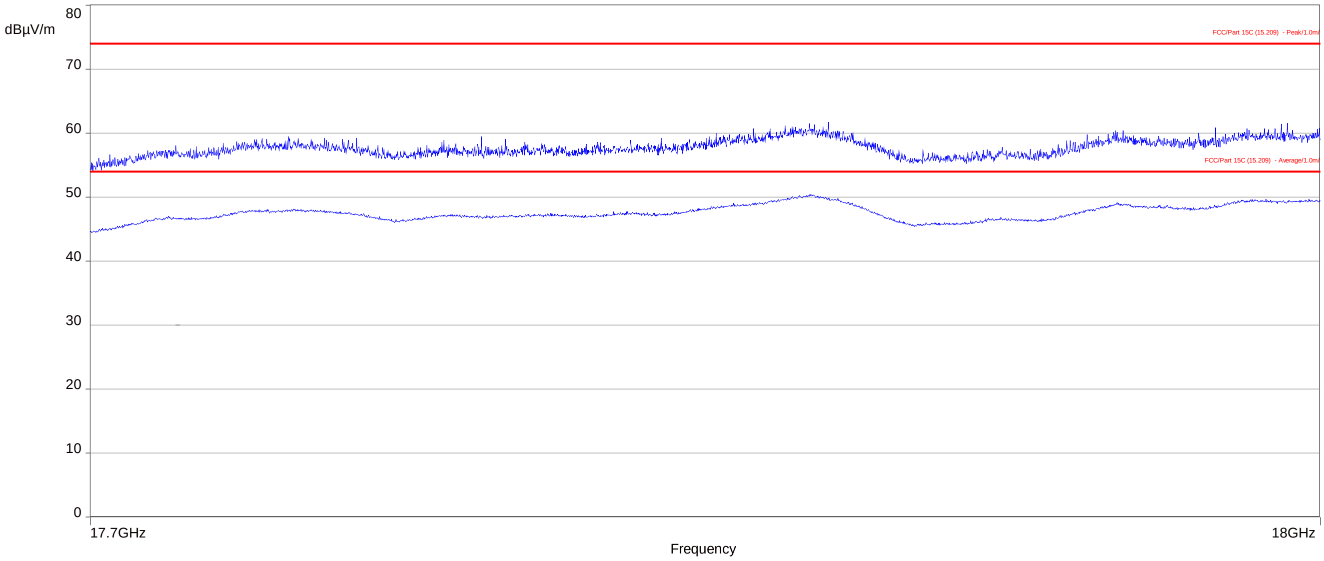
<u>Plots:</u> REARSHOCK

Plot 1: Lowest channel, 1 GHz to 18 GHz, vertical & horizontal polarization

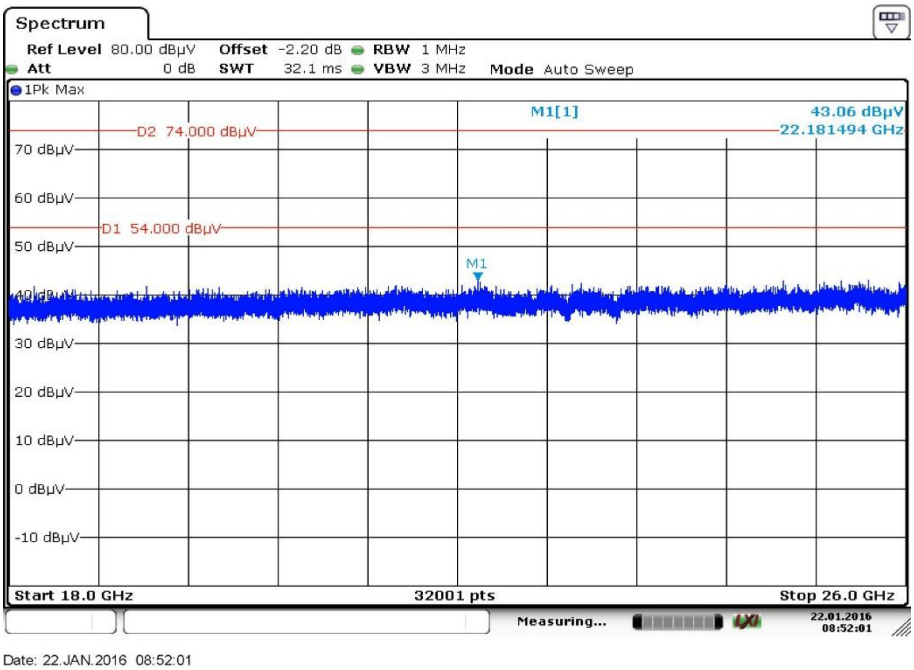


The carrier signal is notched with a 2.4 GHz band rejection filter.

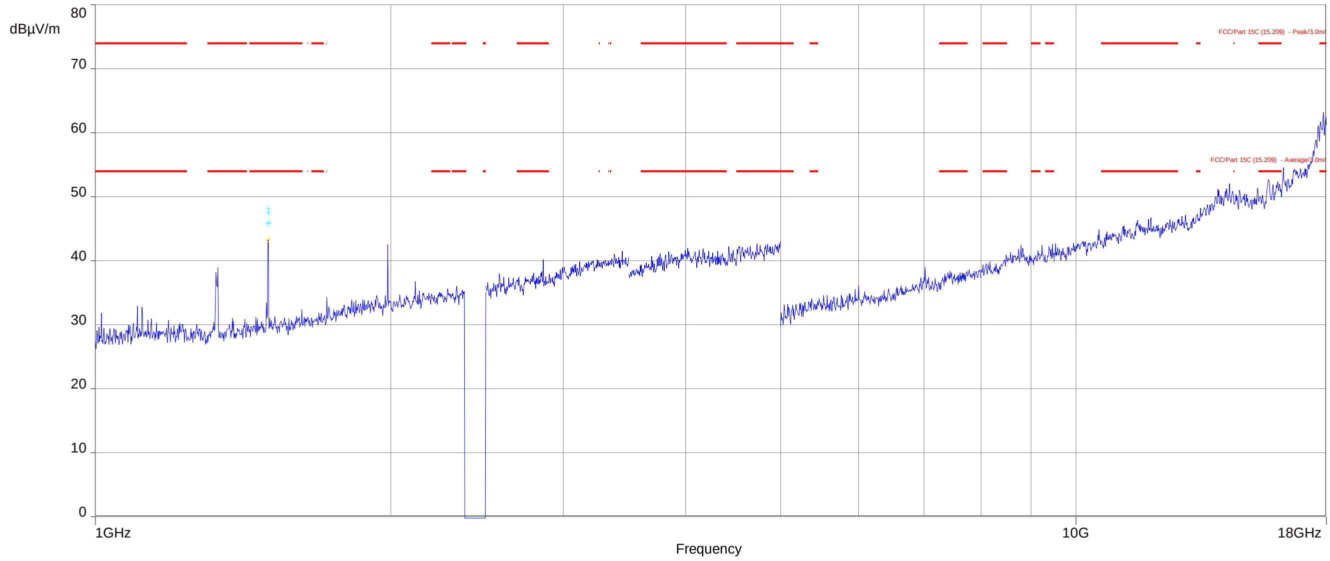
Plot 2: Lowest channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization, peak & average



Plot 3: Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization

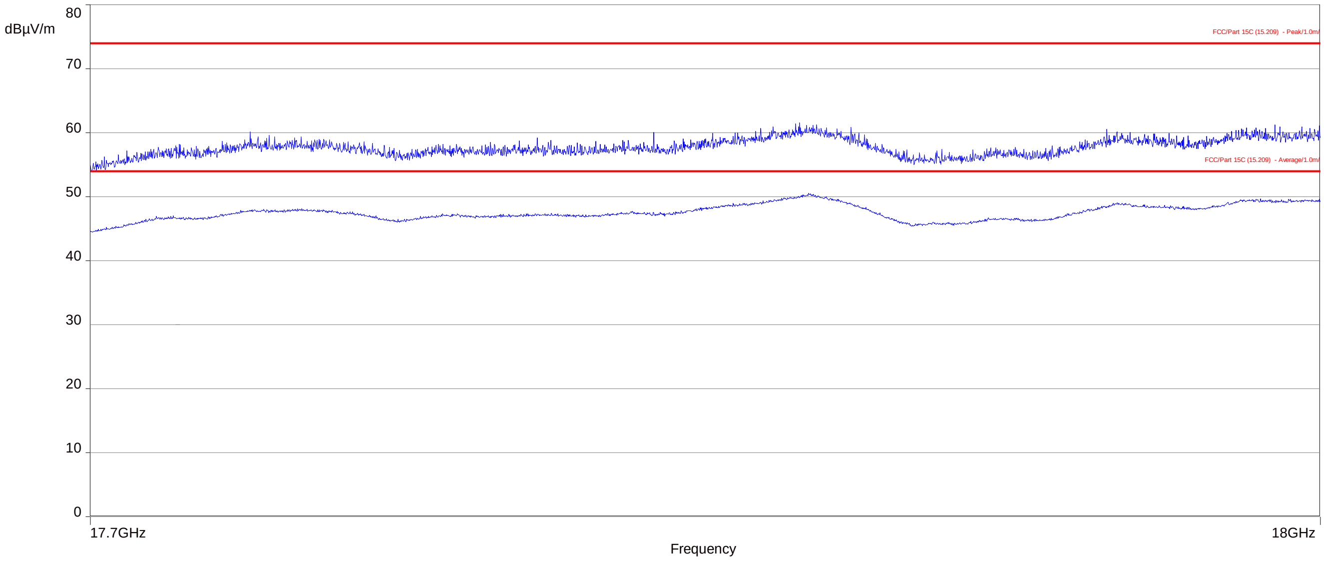


Plot 4: Middle channel, 1 GHz to 18 GHz, vertical & horizontal polarization

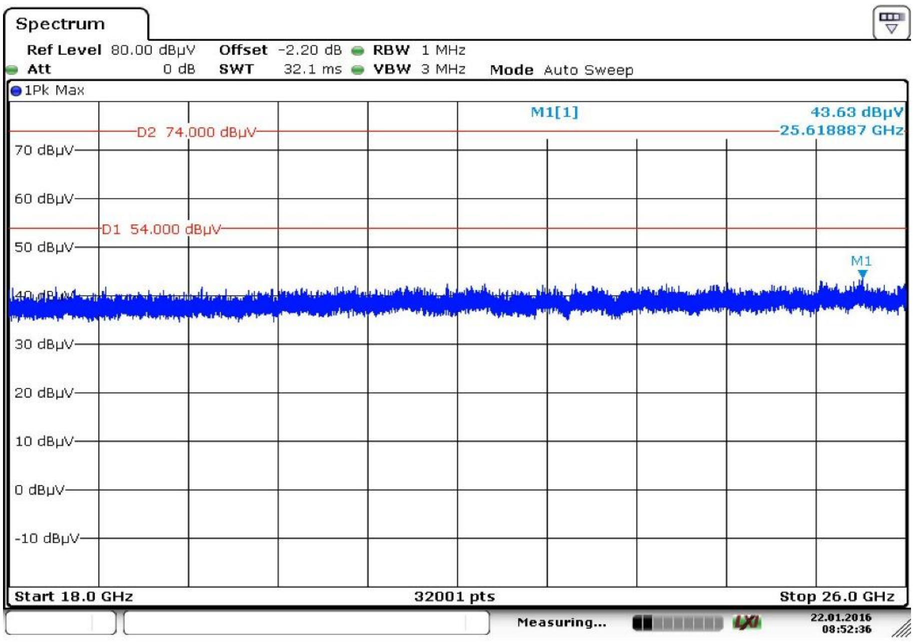


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 5: Middle channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization

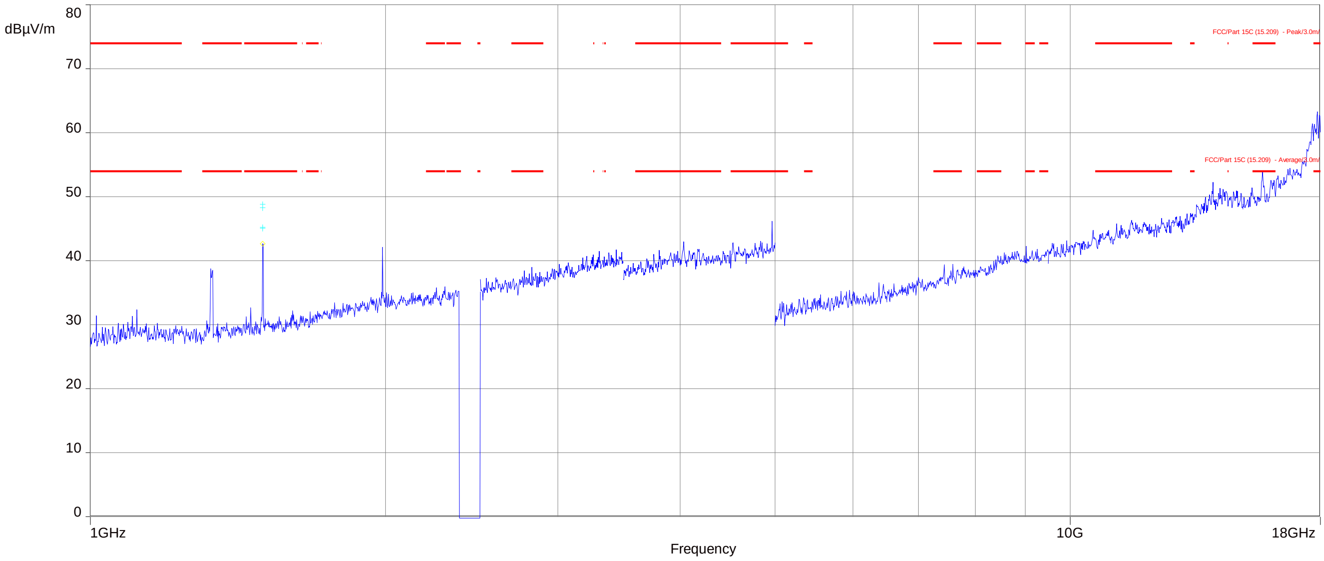


Plot 6: Middle channel, 18 GHz to 26 GHz, vertical & horizontal polarization



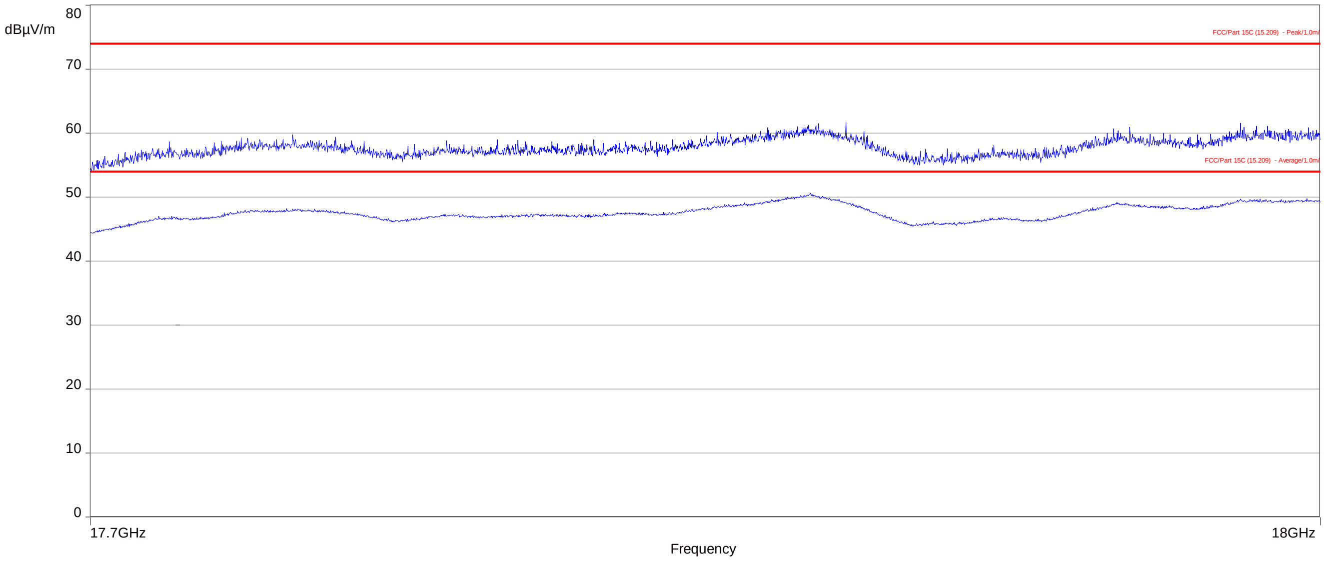
Date: 22.JAN.2016 08:52:37

Plot 7: Highest channel, 1 GHz to 18 GHz, vertical & horizontal polarization

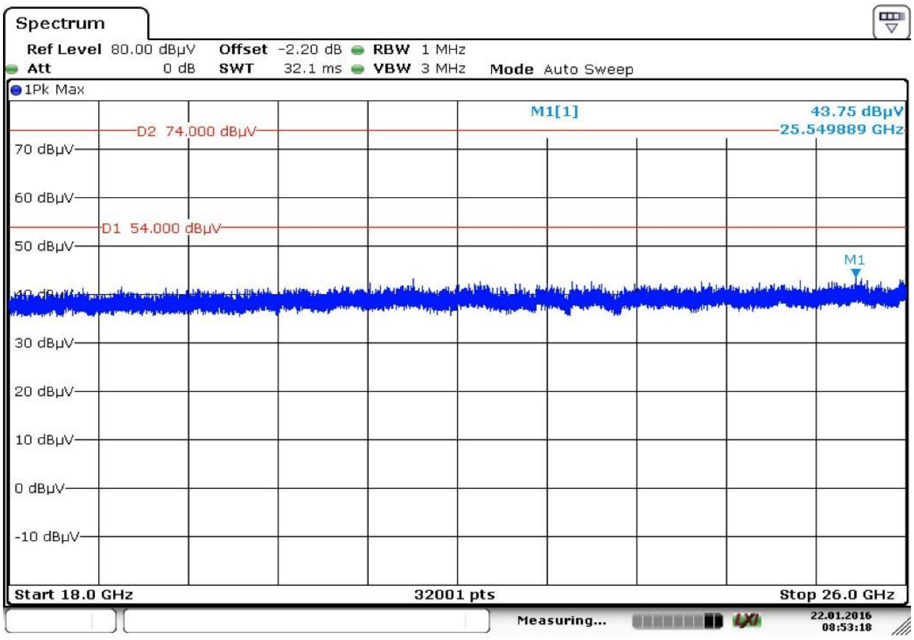


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 8: Highest channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization

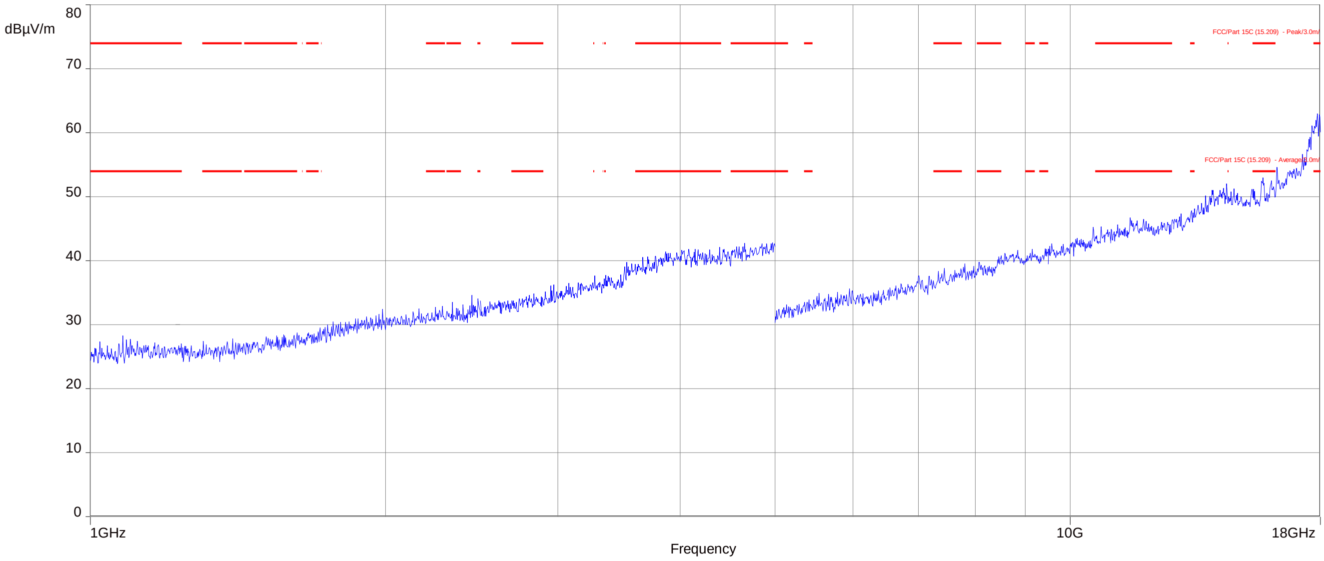


Plot 9: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization

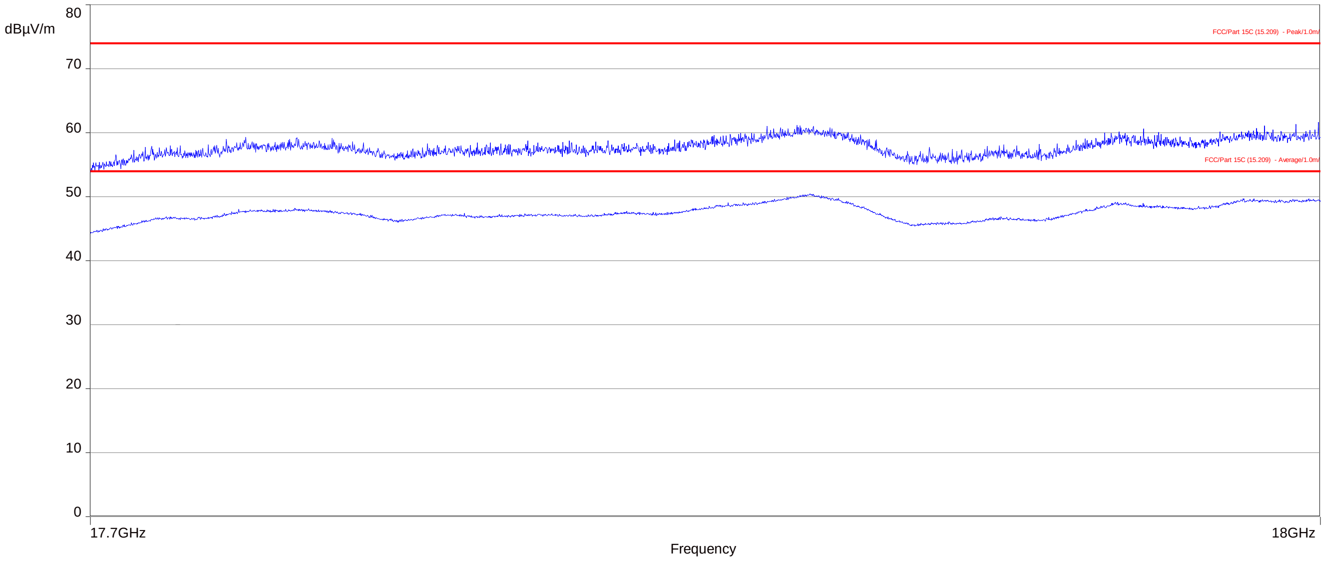


Date: 22.JAN.2016 08:53:18

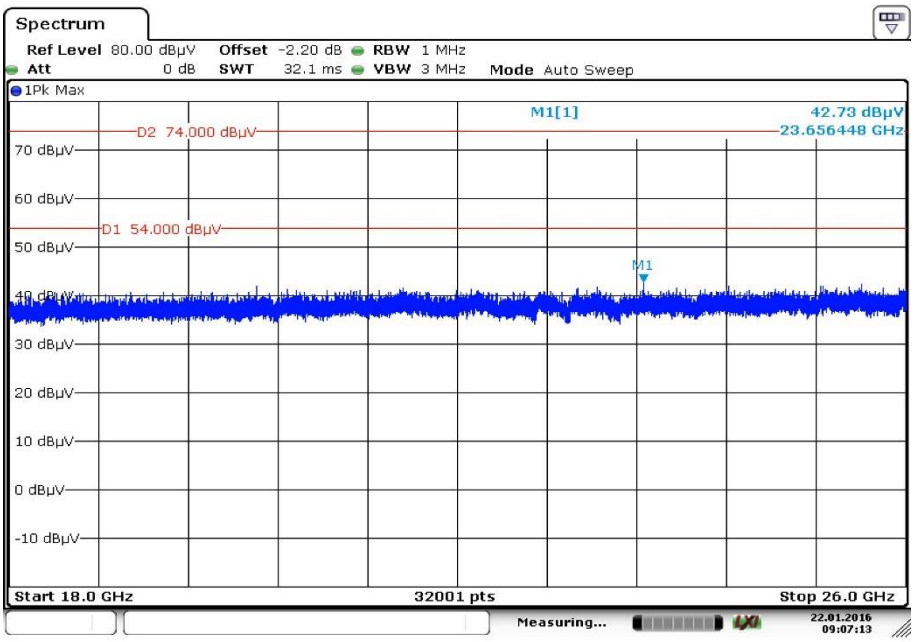
Plot 10: RX mode, 1 GHz to 18 GHz, vertical & horizontal polarization



Plot 11: RX mode, 17.7 GHz to 18 GHz, vertical & horizontal polarization



Plot 12: RX mode, 18 GHz to 26 GHz, vertical & horizontal polarization



Date: 22.JAN.2016 09:07:13

12.13 Spurious emissions conducted below 30 MHz (AC conducted)

Description:

Measurement of the conducted spurious emissions in transmit mode below 30 MHz. The EUT is set to channel 6. This measurement is repeated for DSSS and OFDM modulation. If peaks are found channel 1 and channel 11 will be measured too. The measurement is performed with the data rate producing the highest output power. Both power lines, phase and neutral line, are measured. Found peaks are remeasured with average and quasi peak detection to show compliance to the limits.

Measurement:

Measurement parameter	
Detector:	Peak - Quasi Peak / Average
Sweep time:	Auto
Resolution bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Video bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span:	9 kHz to 30 MHz
Trace mode:	Max Hold
Test setup:	See sub clause 7.4 A
Measurement uncertainty	See sub clause 9

Limits:

FCC		IC
Frequency (MHz)	Quasi-Peak (dBµV/m)	Average (dBµV/m)
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30.0	60	50

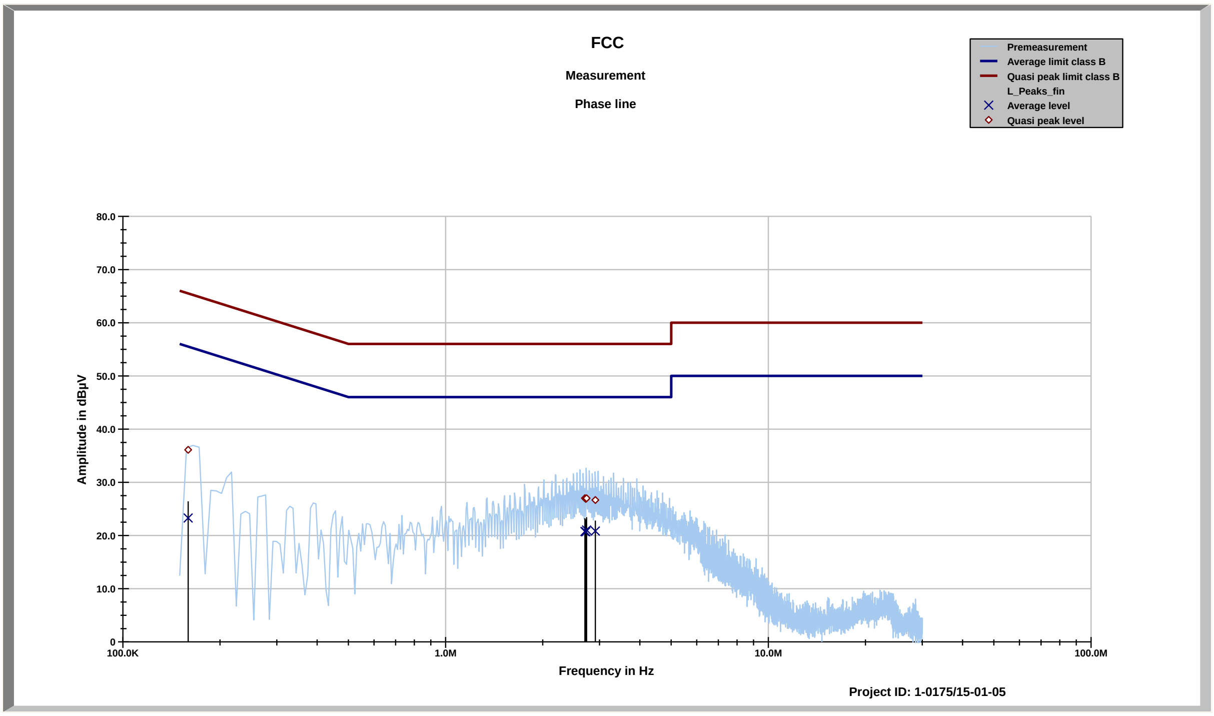
*Decreases with the logarithm of the frequency

Results:

TX Spurious Emissions Conducted < 30 MHz [dBµV/m]		
F [MHz]	Detector	Level [dBµV/m]
All detected peaks are more than 20 dB below the limit.		

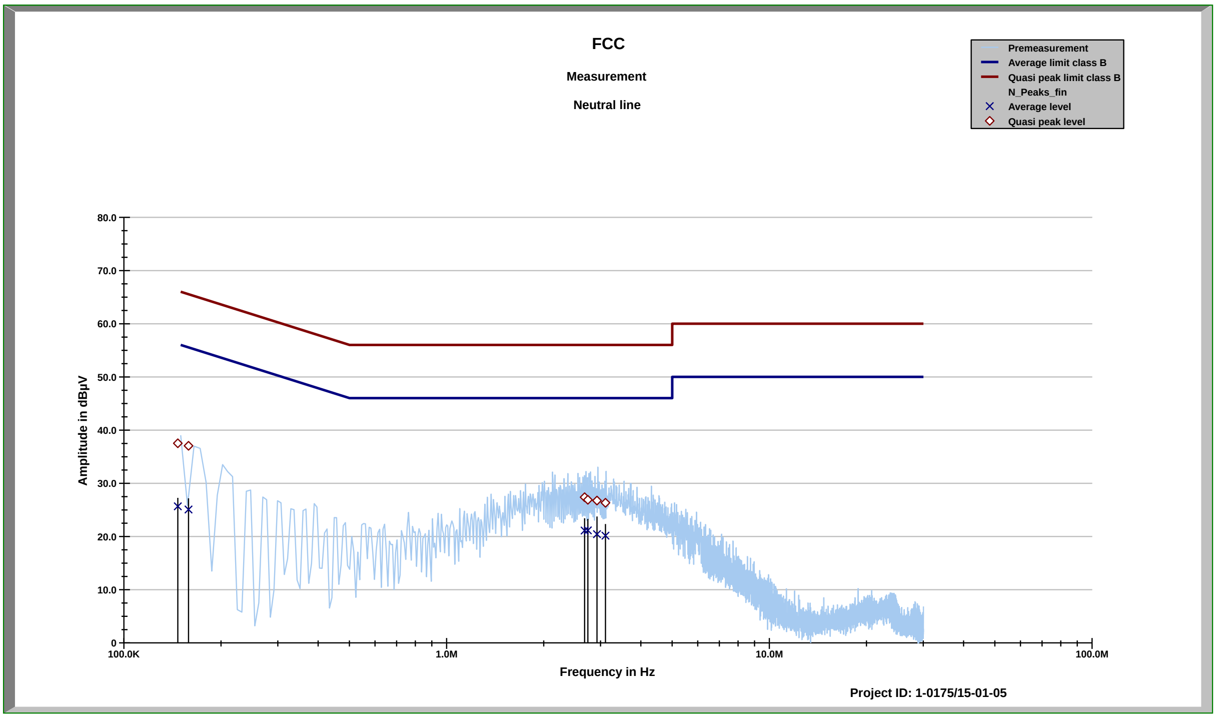
Plots: SEATPOST

Plot 1: 150 kHz to 30 MHz, phase line



Frequency	Quasi peak level	Margin quasi peak	Average level	Margin average
MHz	dBµV	dBµV	dBµV	dBµV
0.15936	36.09	29.41	23.28	32.46
2.7002	27.01	28.99	20.75	25.25
2.7185	26.87	29.13	20.69	25.31
2.7331	26.99	29.01	21.02	24.98
2.9099	26.66	29.34	20.83	25.17

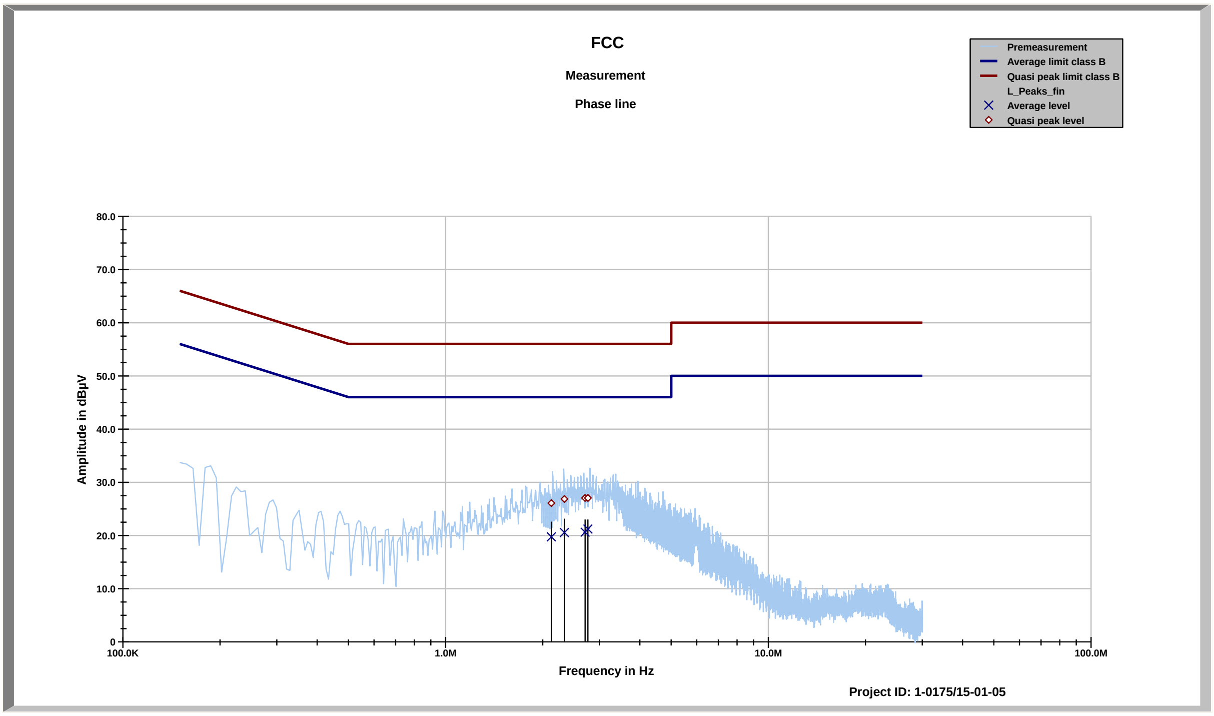
Plot 2: 150 kHz to 30 MHz, neutral line



Frequency	Quasi peak level	Margin quasi peak	Average level	Margin average
MHz	dBµV	dBµV	dBµV	dBµV
0.14694	37.51	NAN	25.66	NAN
0.15863	37.04	28.49	25.07	30.69
2.6762	27.37	28.63	21.10	24.90
2.7394	26.88	29.12	21.13	24.87
2.9231	26.75	29.25	20.42	25.58
3.1057	26.32	29.68	20.15	25.85

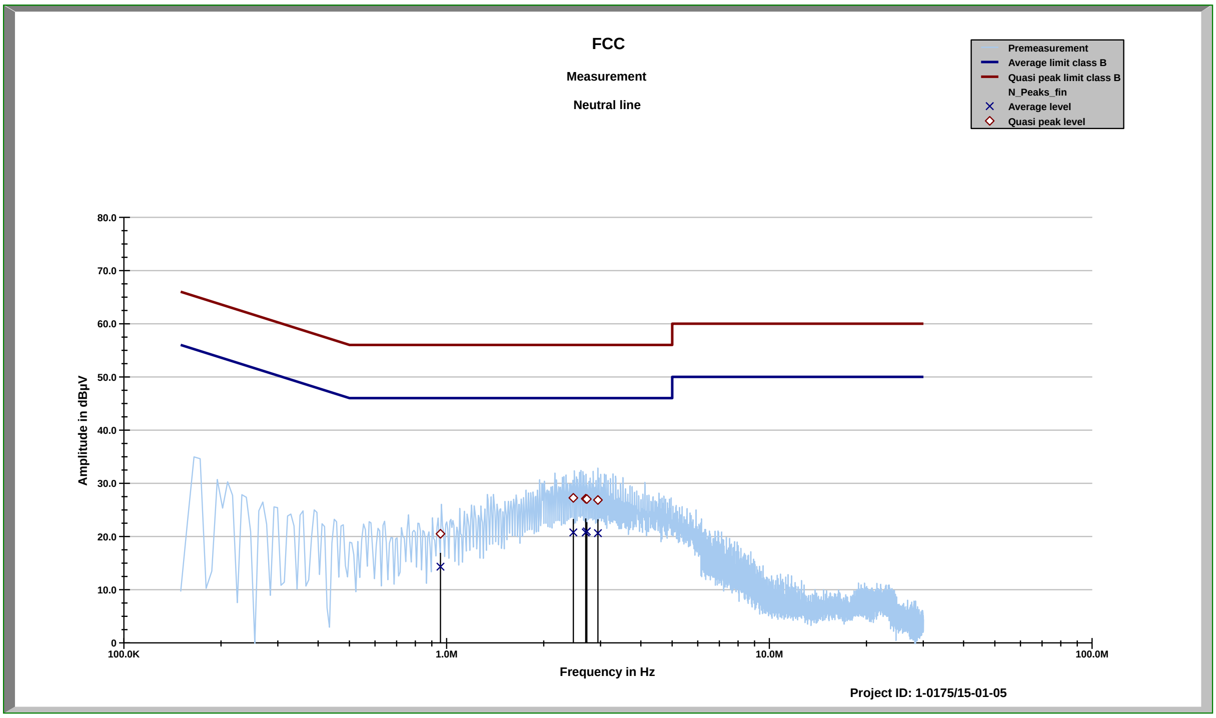
Plots: FORK

Plot 1: 150 kHz to 30 MHz, phase line



Frequency	Quasi peak level	Margin quasi peak	Average level	Margin average
MHz	dBµV	dBµV	dBµV	dBµV
2.1258	26.08	29.92	19.74	26.26
2.3329	26.85	29.15	20.55	25.45
2.7047	27.05	28.95	20.62	25.38
2.7581	27.05	28.95	21.20	24.80

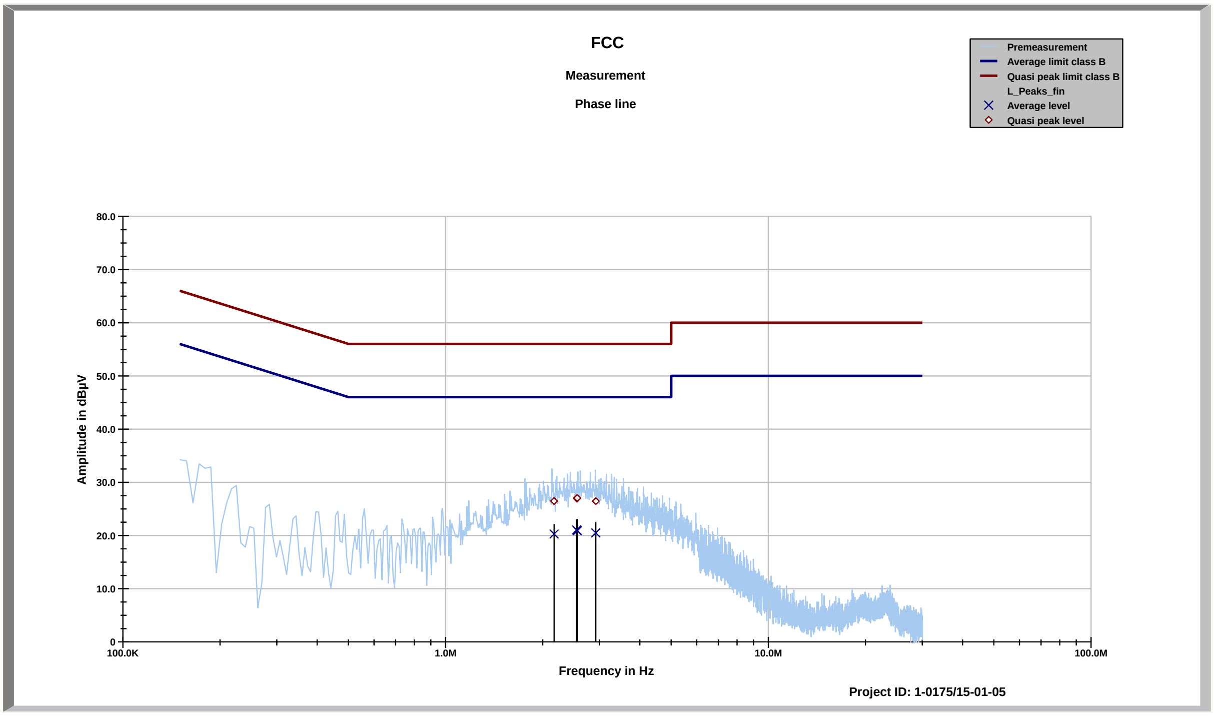
Plot 2: 150 kHz to 30 MHz, neutral line



Frequency	Quasi peak level	Margin quasi peak	Average level	Margin average
MHz	dBµV	dBµV	dBµV	dBµV
0.95728	20.49	35.51	14.31	31.69
2.4696	27.25	28.75	20.76	25.24
2.6969	27.09	28.91	20.74	25.26
2.7186	27.02	28.98	20.94	25.06
2.9433	26.85	29.15	20.62	25.38

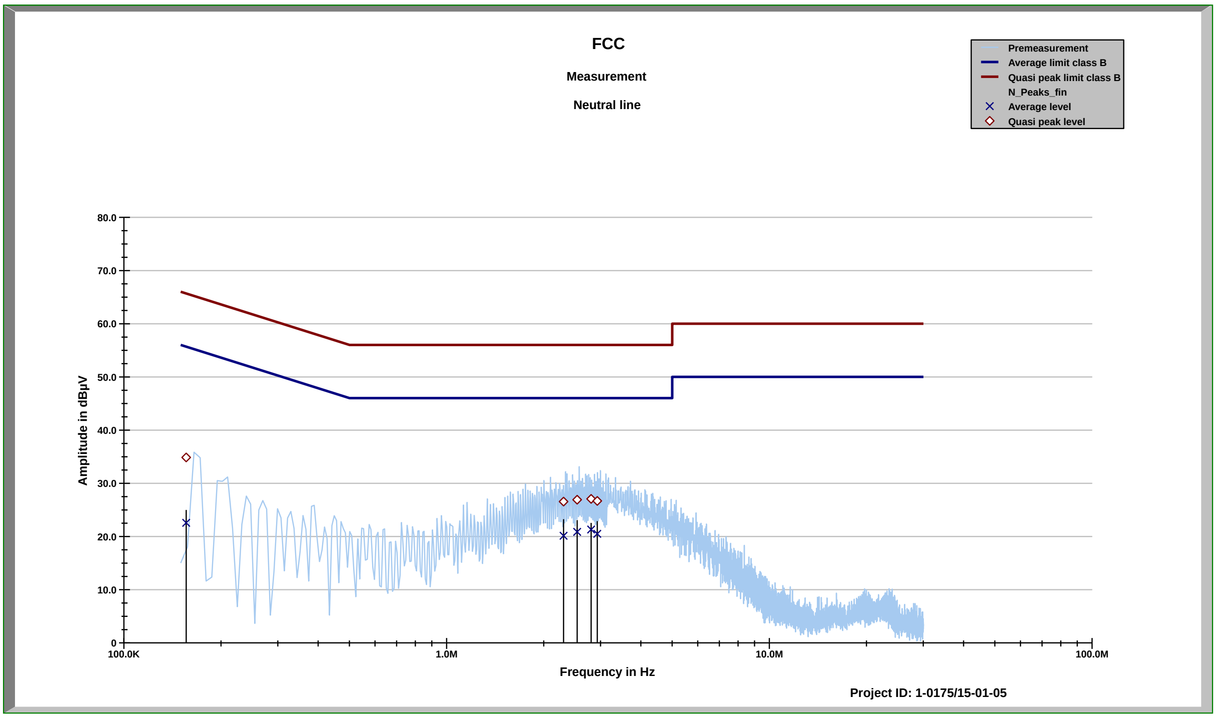
Plots: REARSHOCK

Plot 1: 150 kHz to 30 MHz, phase line



Frequency	Quasi peak level	Margin quasi peak	Average level	Margin average
MHz	dBµV	dBµV	dBµV	dBµV
2.1672	26.47	29.53	20.26	25.74
2.5476	26.98	29.02	21.04	24.96
2.5585	27.03	28.97	20.87	25.13
2.9192	26.45	29.55	20.48	25.52

Plot 2: 150 kHz to 30 MHz, neutral line



Frequency	Quasi peak level	Margin quasi peak	Average level	Margin average
MHz	dBµV	dBµV	dBµV	dBµV
0.15598	34.84	30.83	22.56	33.26
2.3027	26.55	29.45	20.12	25.88
2.5368	26.91	29.09	20.86	25.14
2.8035	27.06	28.94	21.29	24.71
2.9284	26.67	29.33	20.49	25.51

13 Observations

No observations except those reported with the single test cases have been made.

Annex A Document history

Version	Applied changes	Date of release
	Initial release	2016-04-21
A	Updated PMN and HVIN	2016-09-16
B	Updated Test Standard	2016-09-19

Annex B Further information

Glossary

AVG	-	Average
DUT	-	Device under test
EMC	-	Electromagnetic Compatibility
EN	-	European Standard
EUT	-	Equipment under test
ETSI	-	European Telecommunications Standard Institute
FCC	-	Federal Communication Commission
FCC ID	-	Company Identifier at FCC
HW	-	Hardware
IC	-	Industry Canada
Inv. No.	-	Inventory number
N/A	-	Not applicable
PP	-	Positive peak
QP	-	Quasi peak
S/N	-	Serial number
SW	-	Software
PMN		Product marketing name
HMN		Host marketing name
HVIN		Hardware version identification number
FVIN		Firmware version identification number

Annex C Accreditation Certificate

Front side of certificate

DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Beliehene gemäß § 8 Absatz 1 AkkStelleG i.V.m. § 1 Absatz 1 AkkStelleGBV
Unterzeichnerin der Multilateralen Abkommen
von EA, ILAC und IAF zur gegenseitigen Anerkennung

Akkreditierung

Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

CETECOM ICT Services GmbH
Untertürkheimer Straße 6-10, 66117 Saarbrücken

die Kompetenz nach DIN EN ISO/IEC 17025:2005 besitzt, Prüfungen in folgenden Bereichen durchzuführen:

Funk
Mobilfunk (GSM / DCS) + OTA
Elektromagnetische Verträglichkeit (EMV)
Produktsicherheit
SAR / EMF
Umwelt
Smart Card Technology
Bluetooth®
Automotive
Wi-Fi-Services
Kanadische Anforderungen
US-Anforderungen
Akustik
Near Field Communication (NFC)

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 04.05.2016 mit der Akkreditierungsnummer D-PL-12076-01 und ist gültig bis 17.01.2018. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 63 Seiten.

Registrierungsnummer der Urkunde: **D-PL-12076-01-01**

Frankfurt, 04.05.2016

Im Auftrag Dipl.-Ing. (FH) Ralf Egner
Abteilungsleiter

Siehe Hinweise auf der Rückseite

Back side of certificate

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Standort Berlin
Spittelmarkt 10
10117 Berlin

Standort Frankfurt am Main
Europa-Allee 52
60327 Frankfurt am Main

Standort Braunschweig
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Es darf nicht der Anschein erweckt werden, dass sich die Akkreditierung auch auf Bereiche erstreckt, die über den durch die DAkkS bestätigten Akkreditierungsbereich hinausgehen.

Die Akkreditierung erfolgte gemäß des Gesetzes über die Akkreditierungsstelle (AkkStelleG) vom 31. Juli 2009 (BGBl. I S. 2625) sowie der Verordnung (EG) Nr. 765/2008 des Europäischen Parlaments und des Rates vom 9. Juli 2008 über die Vorschriften für die Akkreditierung und Marktüberwachung im Zusammenhang mit der Vermarktung von Produkten (Abl. L 218 vom 9. Juli 2008, S. 30).
Die DAkkS ist Unterzeichnerin der Multilateralen Abkommen zur gegenseitigen Anerkennung der European co-operation for Accreditation (EA), des International Accreditation Forum (IAF) und der International Laboratory Accreditation Cooperation (ILAC). Die Unterzeichner dieser Abkommen erkennen ihre Akkreditierungen gegenseitig an.

Der aktuelle Stand der Mitgliedschaft kann folgenden Webseiten entnommen werden:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu