

Test Report

Customer:

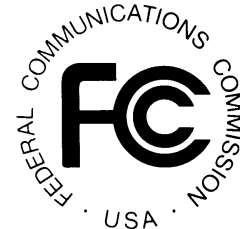
Procter & Gamble Service GmbH

Frankfurter Strasse 145
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RF Test Report

150111-AU01+W05



Industry Industrie
Canada Canada

Procter & Gamble Service GmbH

electric toothbrush with

proprietary mode

3765



The test result refers exclusively
to the tested model.
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Revision: 1.0



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Accreditation:



FCC facility registration number: 221458
Test Firm Type "2.948 listed": Valid until 2017-04-22
Test Firm Type "accredited": Valid until 2017-06-09
MRA US-EU, FCC designation number: DE0010
BnetzA-CAB-02/21-02/04 Valid until 2018-11-27

Industry Canada test site numbers with registration expiry date:
3472A-1, expiring 2018-11-09
3472A-2, expiring 2018-11-12

Test Laboratory:

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The technical accuracy is guaranteed through the quality management of the
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1 Test regulations

47 CFR Part 2 October 2014	Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC)
47 CFR Part 15 October 2014	Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)
ANSI C63.10 June 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
FCC KDB 174176 D01 June 3, 2015	AC power-line conducted emissions Frequently Asked Questions
FCC KDB 447498 D01 February 7, 2014	Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies
RSS-Gen Issue 4, November 2014	General Requirements for Compliance of Radio Apparatus
RSS-102 Issue 5, March 2015	Radio Frequency Exposure Compliance of Radiocommunications Apparatus
RSS-210 Issue 8, December 2010 Amendment 1, February 2015 Updated May 2015	Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment



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1.1 Cross reference of FCC and Industry Canada standards

47 CFR Part and Section	Test	Page	Equivalent to IC
15.207	AC power line conducted emissions 150 kHz to 30 MHz	see note 1	RSS-Gen Issue 4 section 8.8
15.249(a)	Transmitter field strength of emissions	12	RSS-Gen Issue 4, section 6.12 RSS-210 Issue 8, A2.9(a)
15.249(d) 15.209	Band-edge compliance	15	RSS-Gen Issue 4, section 6.12 RSS-210 Issue 8, A2.9(d)
15.249(d) 15.209	Emissions radiated outside of the specified frequency bands 9 kHz to 10 th harmonic	20 28	RSS-Gen Issue 4, section 6.13 RSS-210 Issue 8, A2.9(d)
---	6 dB bandwidth	40	RSS-Gen Issue 4, section 6.6
15.215(c)	20 dB bandwidth	44	RSS-Gen Issue 4, section 6.6
2.202(a)	Occupied bandwidth	48	RSS-Gen Issue 4, section 6.6
2.1093	Radiofrequency radiation exposure evaluation: portable devices.	52	RSS-Gen Issue 4, section 3.2 Exempted from SAR and RF evaluation

Note 1: As described in user manual radio transmission is deactivated while handle is placed on plugged-in charger. Therefore charging mode is not subject to radio certification and AC power line conducted emissions test does not apply, although plugged-in charger and handle are put on the market together.
In addition, handle is sold with a charging travel case that also contains a charger. Using wireless power transfer, plugged-in charger and charging travel case have to be authorized separately.

1.2 Summary of test results

Standard	Test result
FCC 47 CFR Part 15, section 15.249	Passed
RSS-210 Issue 8, Annex A2.9 and RSS-Gen Issue 4	Passed



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2 Equipment under Test (EUT)

Product type:	Electric toothbrush with proprietary mode
Model Name:	3765
Manufacturer:	Procter & Gamble Service GmbH
Serial number(s):	Sample2: for radiated measurements Sample3 with temporary antenna connector for conducted measurements
FCC ID:	USQ3765
IC:	6856A-3765
Application frequency band:	2400 MHz to 2483.5 MHz
Frequency range:	2403MHz to 2452 MHz
Operating frequency:	2403MHz to 2452 MHz
Number of RF-channels ¹⁾ :	4
Type of modulation ¹⁾ :	DSSS (MSK)
Antenna type ¹⁾ :	PCB antenna, not detachable, g = -1.0 dBi
Antenna connectors:	None (temporary antenna connector for testing purposes only)
Antenna diversity:	<input type="checkbox"/> yes <input checked="" type="checkbox"/> no
Power supply ^{1) 2)} :	Battery supplied Nominal voltage: 3.7 V DC
Temperature range ¹⁾ :	0°C to +50°C

¹⁾ As declared by manufacturer.

²⁾ As described in user manual radio transmission is deactivated while handle is placed on plugged-in charger. Therefore charging mode is not subject to radio certification, although plugged-in charger and handle are put on the market together.
In addition, handle is sold with a charging travel case that also contains a charger.
Using wireless power transfer, plugged-in charger and charging travel case have to be authorized separately.



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2.1 Photo documentation

For photos taken during testing see annex A.
For photos of the EUT see annex B.
For internal photos of the EUT see annex C.

2.2 Short description of the EUT

The EUT is a electric toothbrush that transmits data to e.g. a smart phone via proprietary mode.

During pre-measurements it was investigated which EUT position is the respective worst-case.
The EUT positions are documented in annex A.

2.3 Operation mode

The EUT was set to the measured channels. Further the following adjustments were set:

Tx-mode: Channel low -> 2403 MHz
Channel mid -> 2427 MHz
Channel high -> 2452 MHz
continuous carrier, modulated

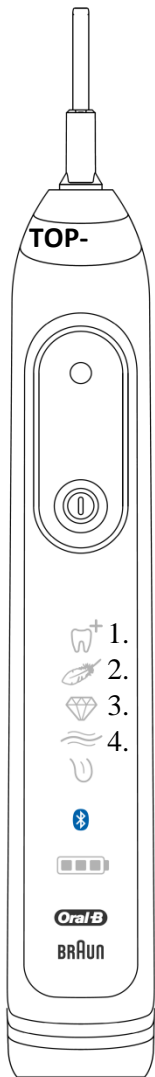


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BUTTON-PRESSED	TOP-LED	MODE-LED	MODE
1	blue	1	BT TX Continuous Wave (CW), 2402 MHz, 0 dBm
2	blue	2	BT TX Continuous Wave (CW), 2440 MHz, 0 dBm
3	blue	3	BT TX Continuous Wave (CW), 2480 MHz, 0 dBm
4	blue flashing	1	BT TX Modulated, 2402 MHz 0 dBm
5	blue flashing	2	BT TX Modulated, 2440 MHz 0 dBm
6	blue flashing	3	BT TX Modulated, 2480 MHz 0 dBm
7	off	1	BT RX On, 2402 MHz Standard gain
8	off	2	BT RX On, 2440 MHz Standard gain
9	off	3	BT RX On, 2480 MHz Standard gain
10			OFF
11	red	1	PROP TX Modulated, 2403 MHz
12	red	2	PROP TX Modulated, 2425 MHz
13	red	3	PROP TX Modulated, 2427 MHz
14	red	4	PROP TX Modulated, 2452 MHz
15			OFF

Reference point for all conducted measurements is plug of artificial antenna connector. Therefore all reading values were corrected by the attenuation of the test cable and the cable of the artificial antenna connector (see Table 1).

2.4 Configuration

The following peripheral devices and interface cables were connected during the tests:

Device	Model:	S/N
Electric toothbrush with proprietary mode	3765	Sample2 (for radiated measurements)
Electric toothbrush with proprietary mode	3765	Sample3 (for conducted measurements)
Charging device ¹⁾	Plus Voyager	97.533.685
AC power source ¹⁾ 230V/50 Hz to 120V/60 Hz	Chroma 61602	E00633

Note 1: Only used for measurement "AC power line conducted emissions 150 kHz to 30 MHz".

Used cables

Count:	Description: (type / lengths / remarks)	Serial No
1	Adapter antenna cable (MMCX / SMA-connector) / 0.1m / coax / attenuation see Table 1	N/A

Channel	Frequency [GHz]	test cable attenuation [dB]	antenna cable attenuation [dB]	cable correction [dB]
Low	2.403	0.55	0.47	1.02
Mid	2.427	0.55	0.51	1.06
High	2.452	0.56	0.46	1.02

Table 1: Cable corrections



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3 Transmitter radiated field strength

according to 47 CFR Part 15, section 15.249(a)

3.1 Test location

Description	Manufacturer	Inventory No.
Anechoic chamber	EMV TESTHAUS GmbH	E00100

3.2 Test instruments

	Description	Manufacturer	Inventory No.
<input checked="" type="checkbox"/>	ESU26	Rohde & Schwarz	W00002
<input checked="" type="checkbox"/>	AMF-5D-00501800-28-13P	Miteq	W00089
<input type="checkbox"/>	AMF-6F-16002650-25-10P	Miteq	W00090
<input checked="" type="checkbox"/>	BBHA 9170	Schwarzbeck	W00054
<input type="checkbox"/>	BBHA 9170	Schwarzbeck	W00055
<input type="checkbox"/>	COSB 4-1-26	Conformitas	W00091

3.3 Limits

For systems operating within the band 2400 – 2483.5 MHz: 94 dBµV/m (50 mV/m)

3.4 Test procedure

1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 1.5 meter above ground. The receiving antenna was placed 3 meters from the turntable. The test setup was placed inside a fully anechoic chamber.
2. Power on the EUT and all peripherals.
3. Set frequency to lowest channel
4. Maximize carrier by moving turntable and antenna height with horizontal and vertical antenna polarization. Perform test for all of the 3 orthogonal positions.
5. Record this trace(s) and set appropriate markers
6. Set frequency to middle channel
7. Repeat steps 4 and 5
8. Set frequency to highest channel
9. Repeat steps 4 and 5



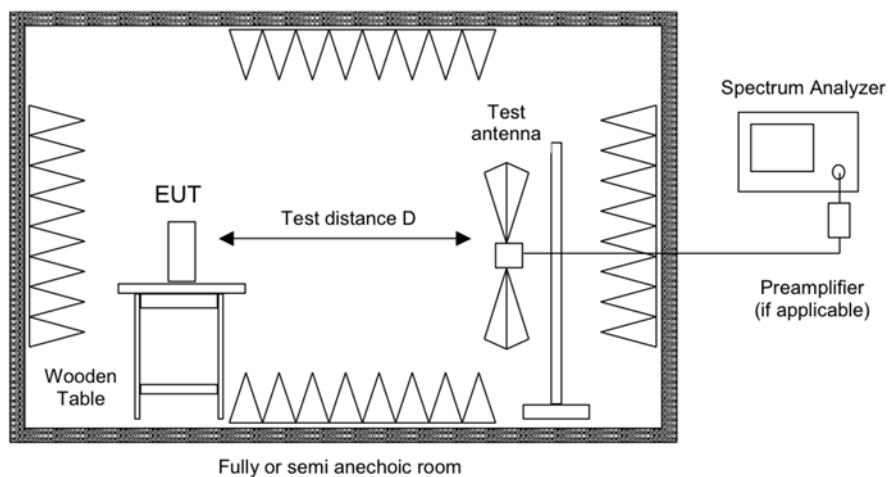
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3.5 Test setup



Picture 1: Test setup for transmitter radiated field strength measurement

3.6 Test deviation

There is no deviation with the original standard.

3.7 EUT operation during Test

The EUT was programmed to be in continuously transmitting mode.

3.8 Test results

Temperature:	20°C	Humidity:	43%
Tested by:	M. Müller	Test date:	2015-10-15

f_{meas} [GHz]	EUT-Pos	Ant.-Pol.	E_{meas} [dB μ V/m] PK	Limit [dB μ V/m]	Result
2.4030	1	H	86.23	94	Pass
2.4031	1	V	91.30	94	Pass
2.4030	2	H	90.37	94	Pass
2.4030	2	V	87.30	94	Pass
2.4029	3	H	90.94	94	Pass
2.4029	3	V	80.66	94	Pass

Picture 2: Transmitter radiated field strength, results channel low

f_{meas} [GHz]	EUT-Pos	Ant.-Pol.	E_{meas} [dB μ V/m] PK	Limit [dB μ V/m]	Result
2.4269	1	H	86.76	94	Pass
2.4269	1	V	91.52	94	Pass
2.4270	2	H	90.64	94	Pass
2.4269	2	V	87.09	94	Pass
2.4270	3	H	91.53	94	Pass
2.4271	3	V	82.19	94	Pass

Picture 3: Transmitter radiated field strength, results channel mid

f_{meas} [GHz]	EUT-Pos	Ant.-Pol.	E_{meas} [dB μ V/m] PK	Limit [dB μ V/m]	Result
2.4518	1	H	85.53	94	Pass
2.4519	1	V	90.85	94	Pass
2.4519	2	H	89.78	94	Pass
2.4518	2	V	88.08	94	Pass
2.4519	3	H	90.78	94	Pass
2.4519	3	V	83.09	94	Pass

Picture 4: Transmitter radiated field strength, results channel high



4 Band-edge compliance

according to 47 CFR Part 15, section 15.249(d)

4.1 Test location

Description	Manufacturer	Inventory No.
Anechoic chamber	EMV TESTHAUS GmbH	E00100

4.2 Test Instruments

	Description	Manufacturer	Inventory No.
<input checked="" type="checkbox"/>	ESU26	Rohde & Schwarz	W00002
<input checked="" type="checkbox"/>	AMF-5D-00501800-28-13P	Miteq	W00089
<input type="checkbox"/>	AMF-6F-16002650-25-10P	Miteq	W00090
<input checked="" type="checkbox"/>	BBHA 9170	Schwarzbeck	W00054
<input type="checkbox"/>	BBHA 9170	Schwarzbeck	W00055
<input type="checkbox"/>	COSB 4-1-26	Conformitas	W00091

4.3 Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

Limit for field strength of harmonics is 54 dB μ V/m (500 μ V/m).

In case of emission falling into restricted bands specified on 15.205(a), limit according to 15.209(a) in table below applies. For emissions above 1 GHz the limits are:

54 dB μ V/m (video average)

74 dB μ V/m (peak detector)

4.4 Test procedure

1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 1.5 meter above ground. The receiving antenna was placed 3 meters from the turntable. The test setup was placed inside a fully anechoic chamber.
2. Power on the EUT and all peripherals.
3. Set frequency to lowest channel
4. Maximize radiated emission at band edges by moving turntable and antenna height with horizontal and vertical antenna polarization.



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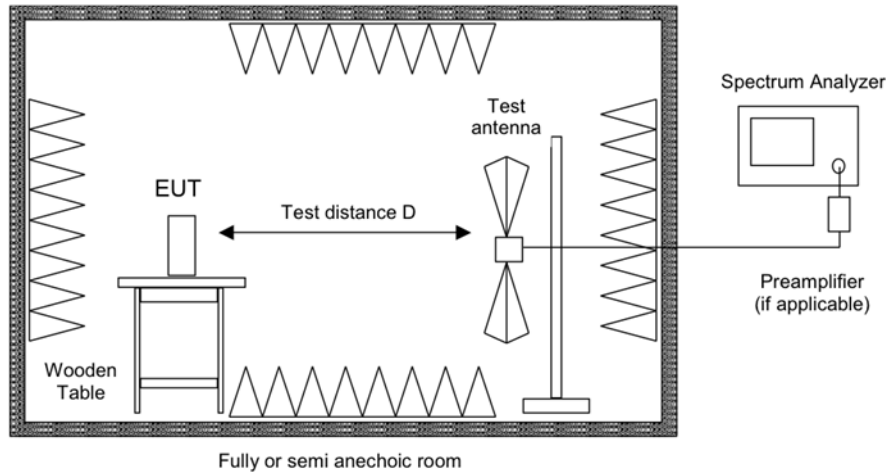
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5. Record this trace(s) and set appropriate markers
6. Set frequency to highest channel
7. Repeat steps 4 and 5

4.5 Test setup



Picture 5: Test setup for band-edge compliance measurement

4.6 Test deviation

There is no deviation with the original standard.

4.7 EUT operation during test

The EUT was programmed to be in continuously transmitting mode. It was investigated that for this test EUT-position1 in combination with measurement-antenna polarized to vertical is the respective worst-case.

4.8 Test results

Temperature:	22°C	Humidity:	44%
Tested by:	M. Müller	Test date:	2015-10-29

f[GHz]	E _{meas} [dB μ V/m]	Detector	Restr. Band	Limit [dB μ V/m]	Result
2.40313	90.99	PK	No	----	Carrier
2.40295	88.20	AV (1 kHz)		----	Carrier
2.40000	60.00	PK	No	74	Pass
2.40000	52.48	AV (1 kHz)		54	Pass
2.39000	39.76	PK	Yes	74	Pass
2.39000	28.79	AV (1 kHz)		54	Pass
2.31000	39.11	PK	Yes	74	Pass
2.31000	27.90	AV (1 kHz)		54	Pass

Picture 6: Band edge compliance – lower edge

Note: Frequency lines in charts are set to the edges of the restricted band closest to the carrier:

F1 = 2.3100 GHz

F2 = 2.3900 GHz

f[GHz]	E _{meas} [dB μ V/m]	Detector	Restr. Band	Limit [dB μ V/m]	Result
2.45188	90.68	PK	No	----	Carrier
2.45177	87.81	AV (1 kHz)		----	Carrier
2.48350	39.13	PK	Yes	74	Pass
2.48350	28.95	AV (1 kHz)		54	Pass
2.50000	39.67	PK	Yes	74	Pass
2.50000	28.50	AV (1 kHz)		54	Pass

Picture 7: Band edge compliance – upper edge

Note: Frequency lines in charts are set to the edges of the restricted band closest to the carrier:

F1 = 2.4835 GHz

F2 = 2.5000 GHz

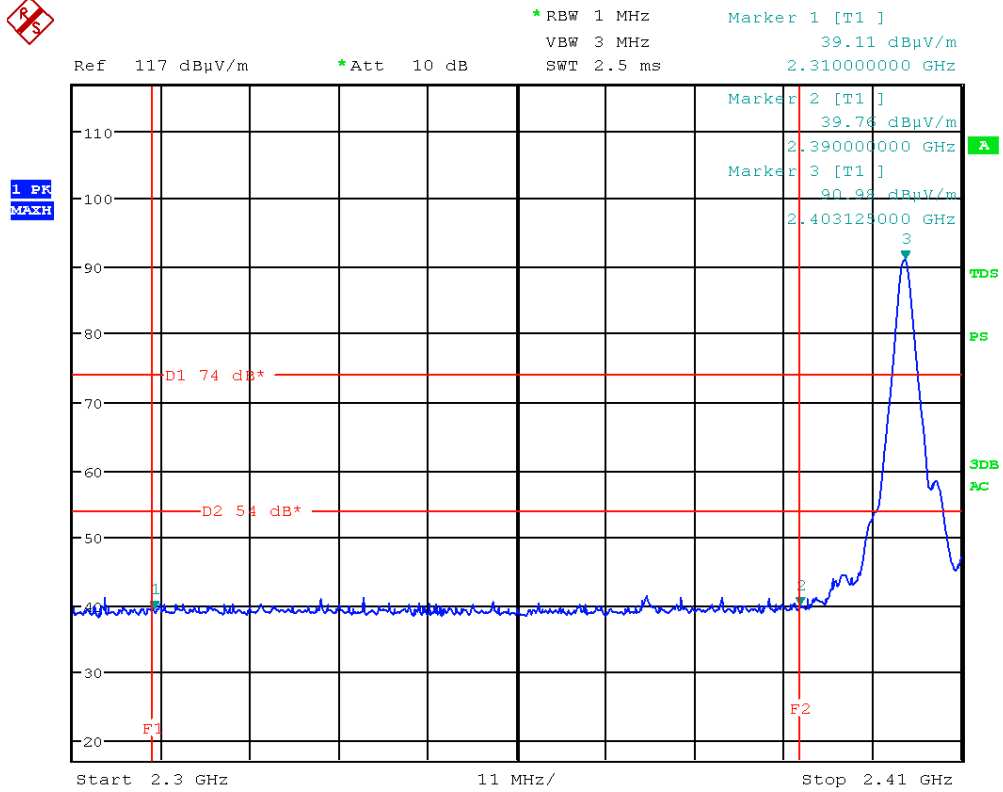


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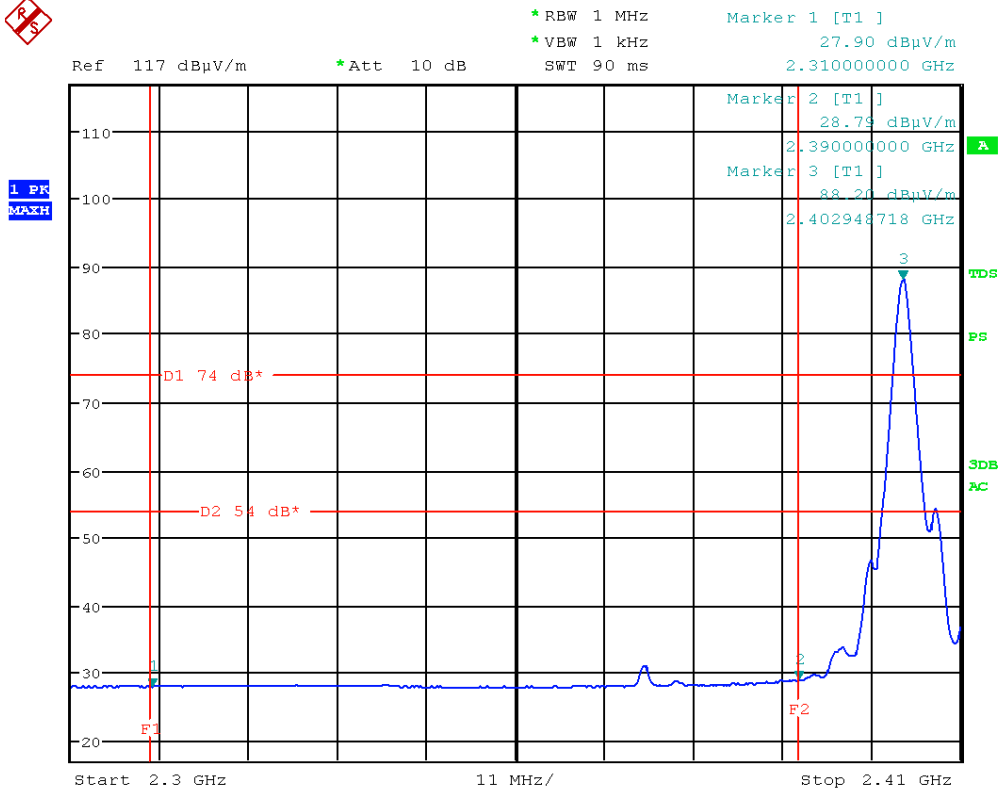
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Picture 8: lower edge (PK)

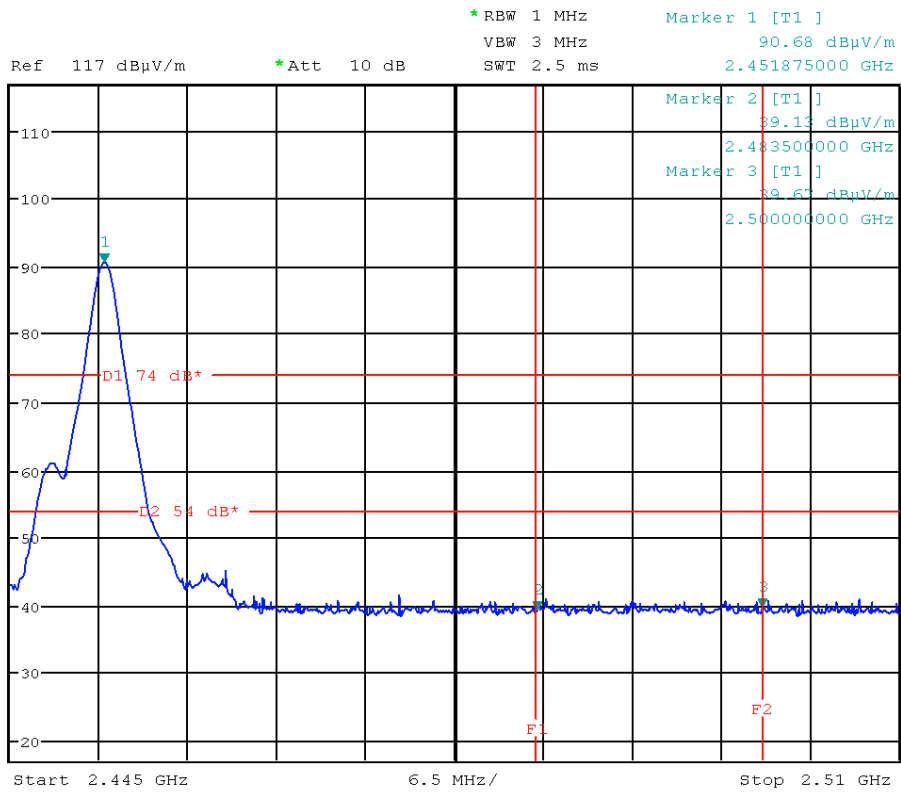


Picture 9: lower edge (AV)

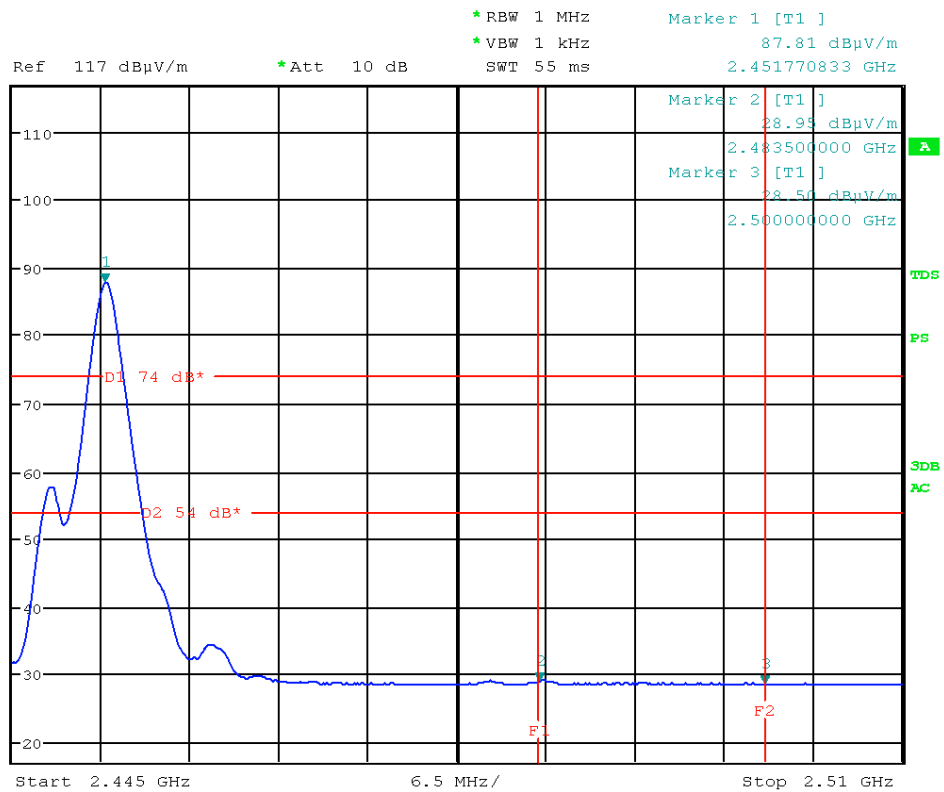


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Picture 10: upper edge (PK)



Picture 11: upper edge (AV)



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5 Radiated emission measurement (<1 GHz)

according to 47 CFR Part 15, sections 15.205(a), 15.209(a) and 15.249(d)

5.1 Test Location

- Scan with peak detector in 3 m CDC.
- Final CISPR measurement with quasi peak detector on 3 m open area test site.

Description	Manufacturer	Inventory No.
CDC	Albatross Projects	E00026
Open site area	EMV TESTHAUS GmbH	E00354

5.2 Test instruments

	Description	Manufacturer	Inventory No.
<input checked="" type="checkbox"/>	ESCS 30 (OATS)	Rohde & Schwarz	E00003
<input type="checkbox"/>	ESU 26	Rohde & Schwarz	W00002
<input checked="" type="checkbox"/>	ESCI (CDC)	Rohde & Schwarz	E00001
<input checked="" type="checkbox"/>	VULB 9163 (OATS)	Schwarzbeck	E00013
<input checked="" type="checkbox"/>	VULB 9160 (CDC)	Schwarzbeck	E00011
<input checked="" type="checkbox"/>	HFH2-Z2	Rohde & Schwarz	E00060
<input checked="" type="checkbox"/>	Feedline OATS	Huber & Suhner	200024



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5.3 Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

Limit for field strength of harmonics is 54 dB μ V/m (500 μ V/m).

In case of emission falling into restricted bands specified on 15.205(a), limit according to 15.209(a) in table below applies.

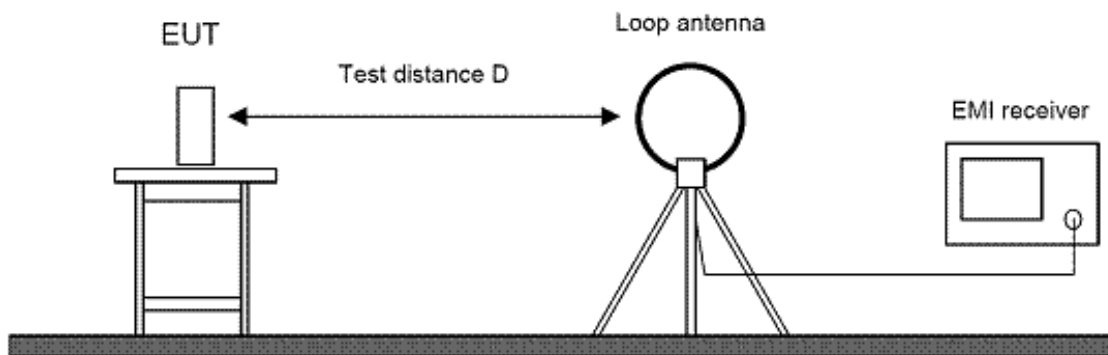
Frequency [MHz]	Field strength Fs [μ V/m]	Field strength [dB μ V/m]	Measurement distance d [m]
0.009 – 0.490	266.6 – 4.9	48.5 – 13.8	300
0.490 – 1.705	48.98 – 14.08	33.8 – 22.97	30
1.705 – 30.0	30	29.54	30
30 – 88	100	40	3
88 – 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

5.4 Test procedure

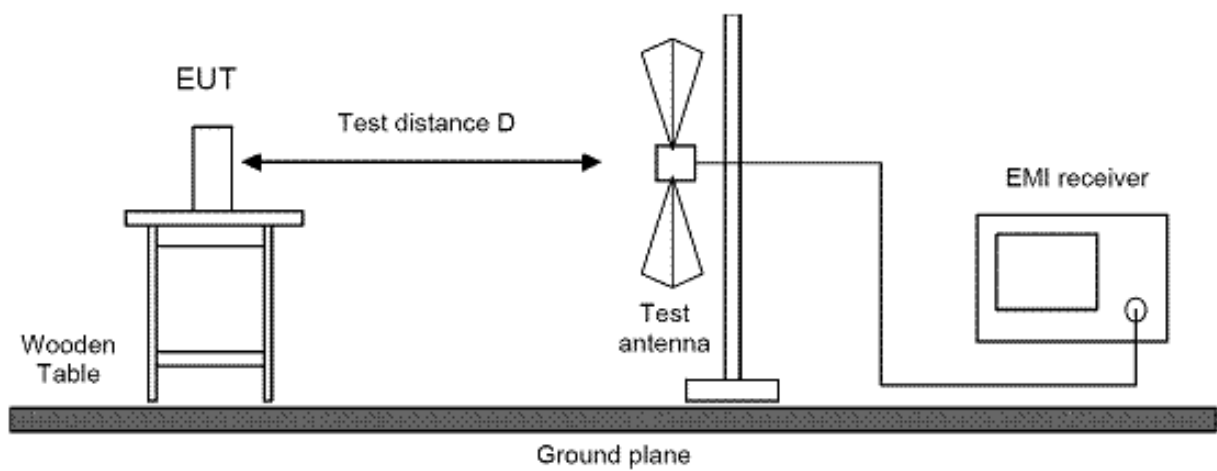
1. Configure the EUT according to ANSI C63.10. The EUT is placed on the top of the turntable 0.8 meter above ground. The receiving antenna is placed 3 meters from the turntable. For prescan measurements the test setup is placed inside a compact diagnostic chamber.
2. Power on the EUT and all peripherals.
3. The broadband antenna is set to vertical polarization.
4. The EMI receiver performs a scan from 9 kHz to 30 MHz or 30MHz to 1000MHz with the detector set to peak. Appropriate CISPR measurement bandwidths are used, i. e. 200 Hz for the frequency range 9 kHz to 150 kHz, 10 kHz for 150 kHz to 30 MHz and 120 kHz for 30MHz to 1000MHz.
5. The turn table is rotated to 6 different positions (360° / 6) and the antenna polarization is changed to horizontal.
6. Repeat the test procedure at step 4 and 5.
7. Then the test setup is placed in an OATS at 3 m distance and all peak values over or with less than 6dB margin to the limit are re-measured with quasi-peak detector (except for the frequency bands 9–90 kHz and 110–490 kHz where average detector is used). If the margin of all emissions recorded prescan in the compact diagnostic chamber is more than 6 dB no final test in OATS is performed.
8. The turntable is rotated by 360 degrees to determine the position of the highest radiation.
9. The height of the broadband receiving antenna is varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization. The highest value is recorded.
10. For emissions below 30MHz, measurements are performed with a loop antenna. The antenna height is not changed during this test.



5.5 Test setup



Picture 12: Test setup for radiated emission measurement (< 30 MHz)



Picture 13: Test setup for radiated emission measurement (< 1 GHz)

5.6 Test deviation

There is no deviation with the original standard.

5.7 EUT operation during test

The EUT was programmed to be in continuously transmitting mode.

5.8 Test results

Transmit mode

Temperature:	22°C	Humidity:	46%
Tested by:	M. Müller	Test date:	2015-10-22

Radiated Emission Measurement 9 kHz – 30 MHz

Note:

Measured value = dB μ V/m @ 3 m

Recalculation factor = 40 dB / decade

Recalculated value1 = dB μ V/m @ 3 m - 40 dB = **dB μ V/m @ 30 m**

Recalculated value2 = dB μ V/m @ 30 m - 40 dB = **dB μ V/m @ 300 m**

During pre-measurements it was investigated that for the radiated emission measurement from 9kHz to 30MHz the worst-case-position is EUT-position 1 in combination with the loop-antenna polarised to "I".

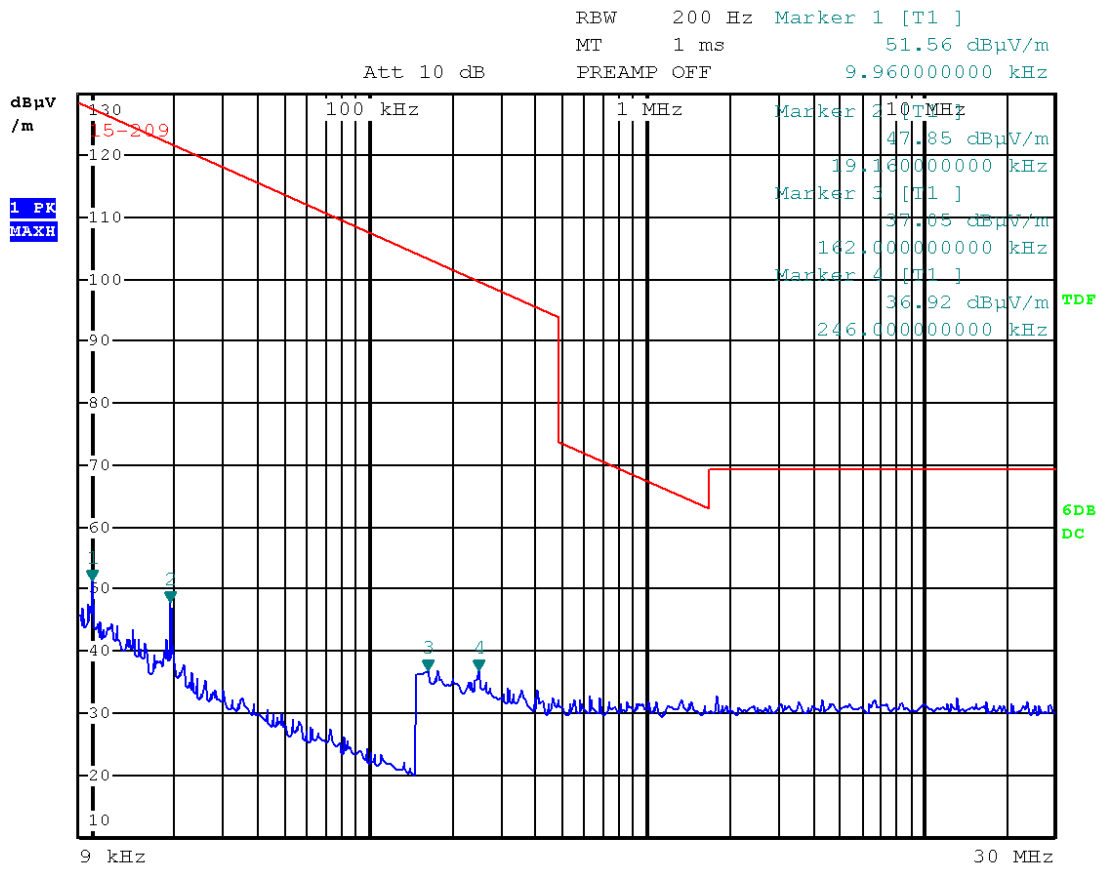


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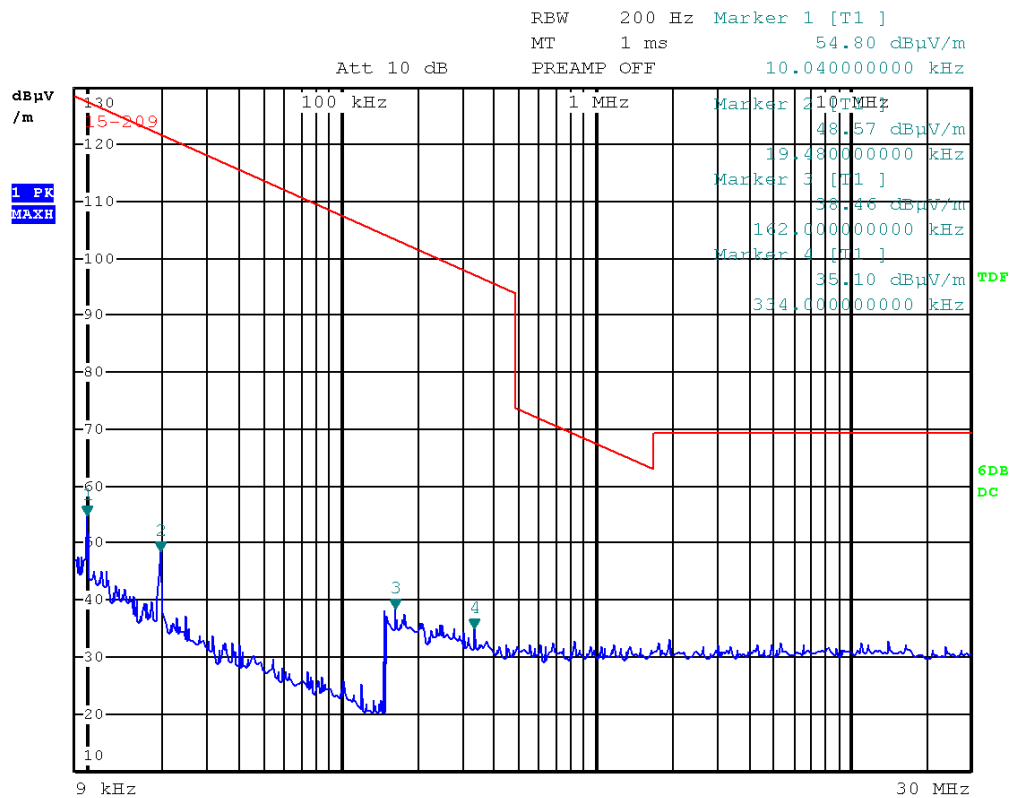


Picture 14: Radiated emission 9 kHz – 30MHz (Channel low)

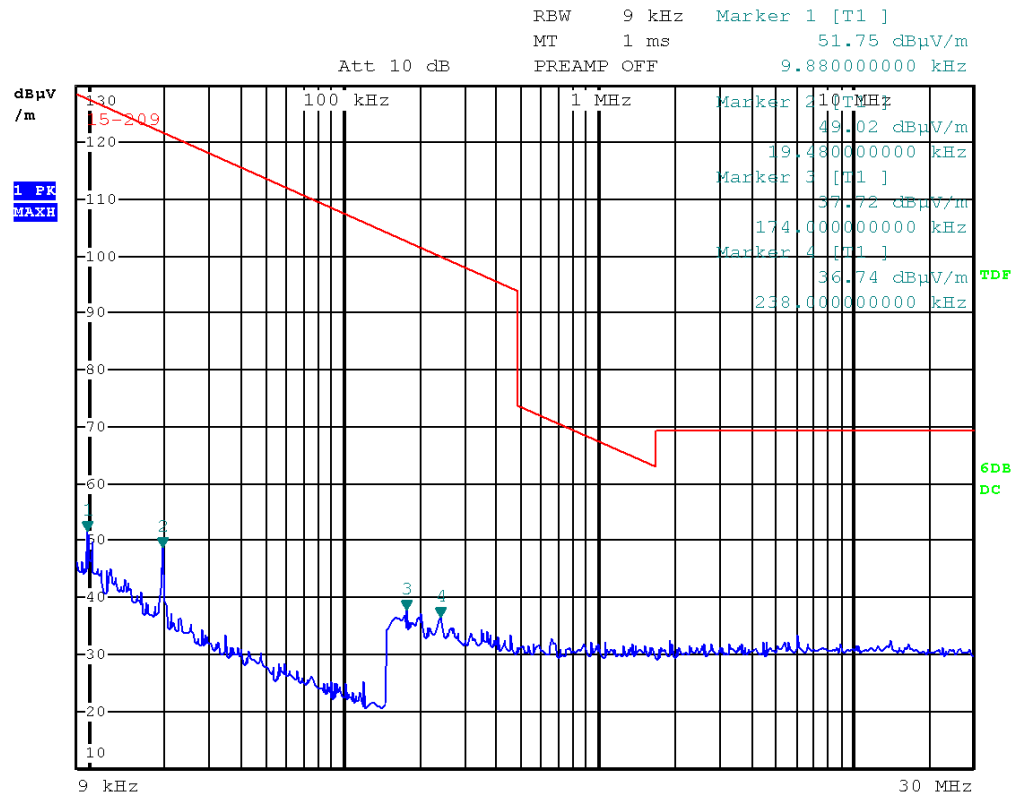


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Picture 15: Radiated emission 9 kHz – 30MHz (Channel mid)



Picture 16: Radiated emission 9 kHz – 30MHz (Channel high)



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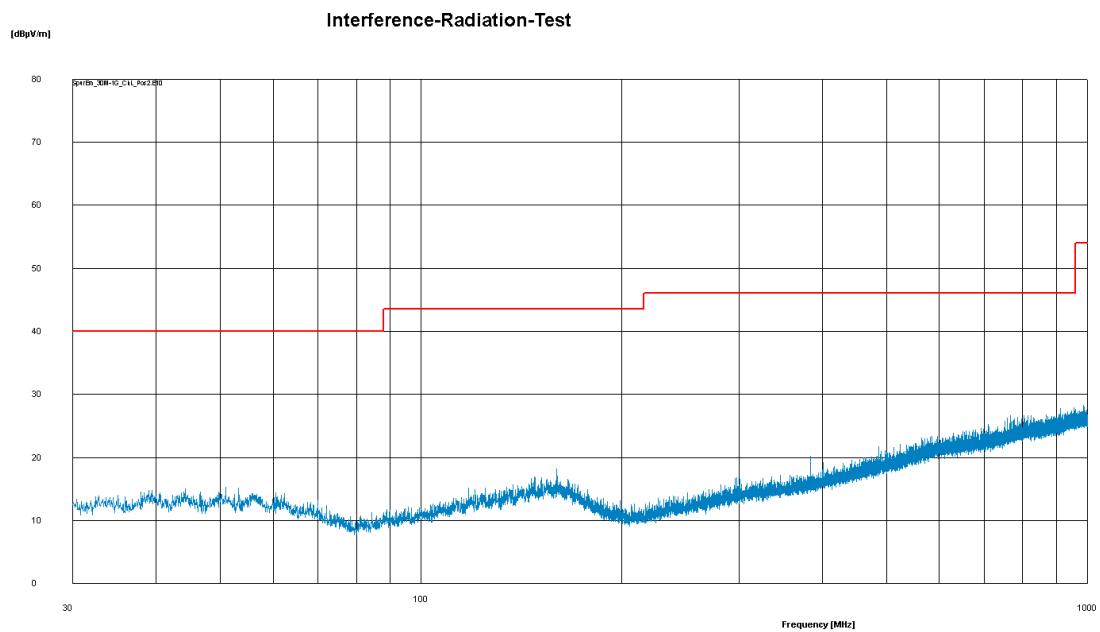
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Transmit mode

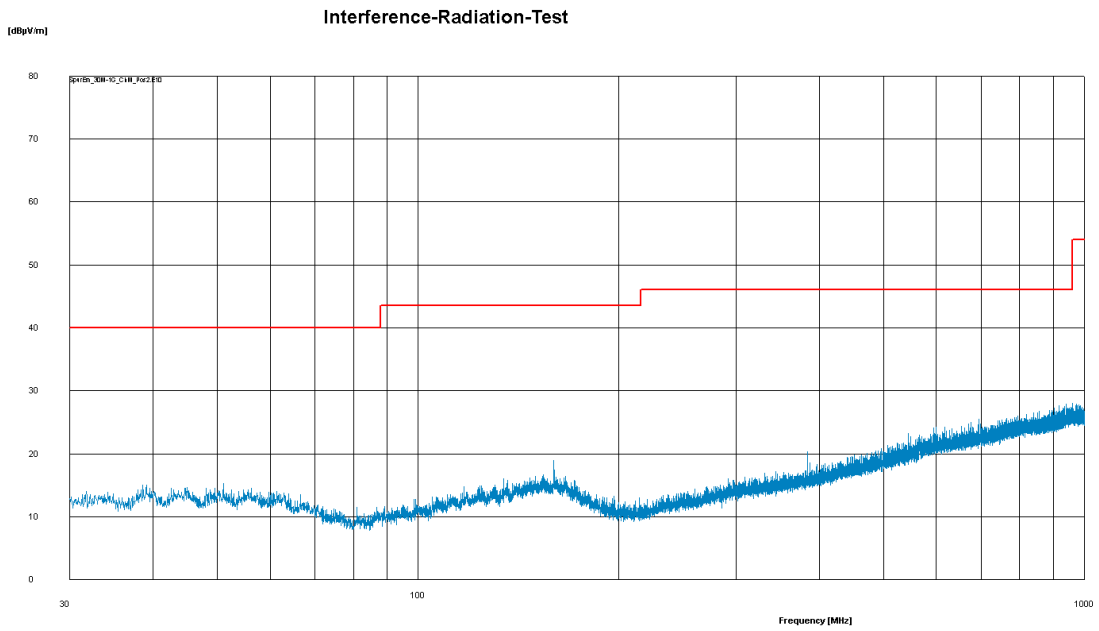
Temperature:	21°C	Humidity:	48%
Tested by:	M. Müller	Test date:	2015-10-22

Radiated Emission Measurement 30 MHz - 1 GHz

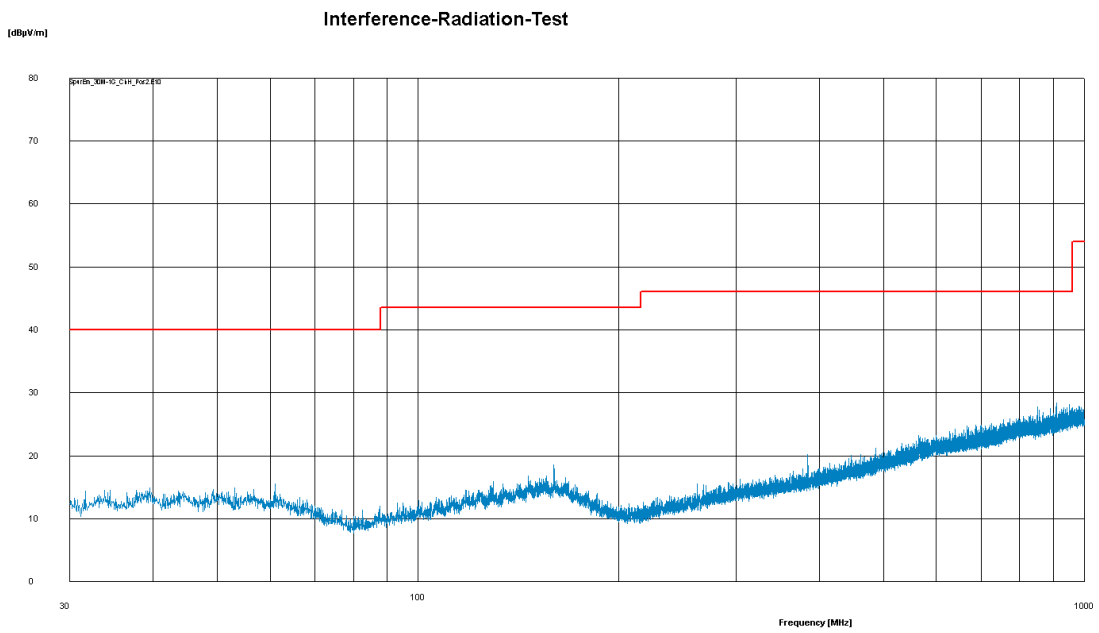
It was investigated that EUT position 2 is the respective worst-case.



Picture 17: Radiated emission 30 MHz – 1000MHz (Channel low)



Picture 18: Radiated emission 30 MHz – 1000MHz (Channel mid)



Picture 19: Radiated emission 30 MHz – 1000MHz (Channel high)

6 Radiated emission measurement (>1 GHz)

according to 47 CFR Part 15, sections 15.205(a), 15.209(a) and 15.249(d)

6.1 Test location

- Scan with peak detector in 3 m anechoic chamber
- Final measurement with average and max peak detector.

Description	Manufacturer	Inventory No.
Anechoic chamber	EMV TESTHAUS GmbH	E00100

6.2 Test instruments

	Description	Manufacturer	Inventory No.
<input checked="" type="checkbox"/>	ESU26	Rohde & Schwarz	W00002
<input checked="" type="checkbox"/>	AMF-5D-00501800-28-13P	Miteq	W00089
<input checked="" type="checkbox"/>	AMF-6F-16002650-25-10P	Miteq	W00090
<input checked="" type="checkbox"/>	BBHA 9120D	Schwarzbeck	W00053
<input checked="" type="checkbox"/>	BBHA 9170	Schwarzbeck	W00055
<input type="checkbox"/>	COSB 4-1-26	Conformitas	W00091

6.3 Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

Limit for field strength of harmonics is 54 dB μ V/m (500 μ V/m).

In case of emission falling into restricted bands specified on 15.205(a), limit according to 15.209(a) in table below applies.

Frequency [MHz]	Field strength Fs [μ V/m]	Field strength [dB μ V/m]	Measurement distance d [m]
30 – 88	100	40	3
88 – 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3



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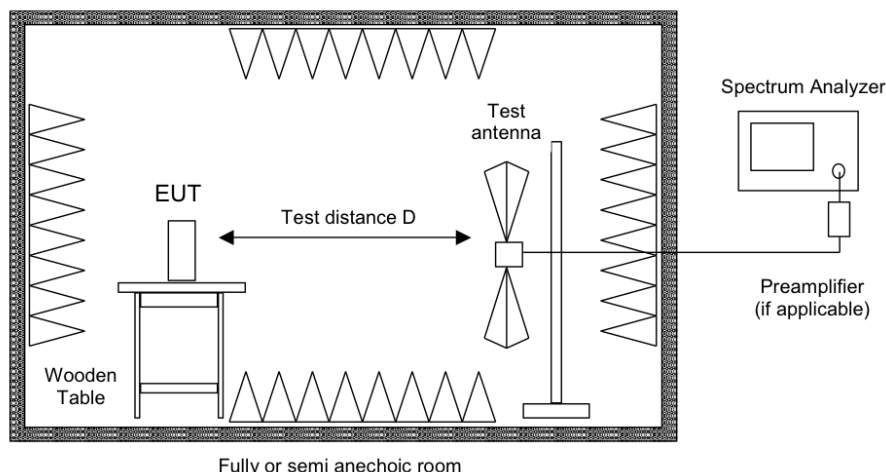
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6.4 Test procedure

1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 1.5 meter above ground. The receiving antenna was placed 3 meters from the turntable. The test setup was placed inside a fully anechoic chamber.
2. Power on the EUT and all peripherals.
3. The broadband antenna was set to vertical polarization.
4. The EMI receiver performed a scan from 1000 MHz to 10th harmonic of the fundamental frequency with the detector set to peak and the measurement bandwidth set to 1 MHz (VBW \geq 3 MHz). The trace data was recorded with the receiver Max Hold function.
5. The turn table was rotated in intervals of 15°.
6. After a full 360°-turn the antenna polarization was changed to horizontal and the test was repeated at step 4 and 5.
7. After the scan suspicious frequencies were selected and maximized by moving turntable and variation of antenna height until maximum of emission was found.
8. Then the RBW was set to 1 MHz and the VBW was reduced to a minimum of 10 Hz (1 kHz by default) to get average values determined by video averaging.
9. The receiving antenna was set to vertical polarization.
10. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
11. The receiving antenna was then set to horizontal polarization and the measurement was repeated at step 9.
12. The highest recorded level was noted.

6.5 Test setup



Picture 20: Test setup for radiated emission measurement (> 1 GHz)

6.6 Test deviation

There is no deviation with the original standard.

6.7 EUT operation during test

The EUT was programmed to be in continuously transmitting mode.
For these measurements it was investigated that EUT-position3 is the respective worst-case.



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6.8 Test results

Temperature:	19°C	Humidity:	47%
Tested by:	M. Müller	Test date:	2015-10-29

Final Results:

Channel low								
f[GHz]	E _{meas} [dB μ V/m]	Ant	Turntable [°]	Height [cm]	Detector	Restr. Band	Limit [dB μ V/m]	Result
2.40294	92.56	H	6.9	194	PK	No	----	Carrier
2.40297	88.84				AV		----	Carrier
4.80606	49.48	H	10.5	138	PK	Yes	74	Pass
4.80589	45.17				AV		54	Pass

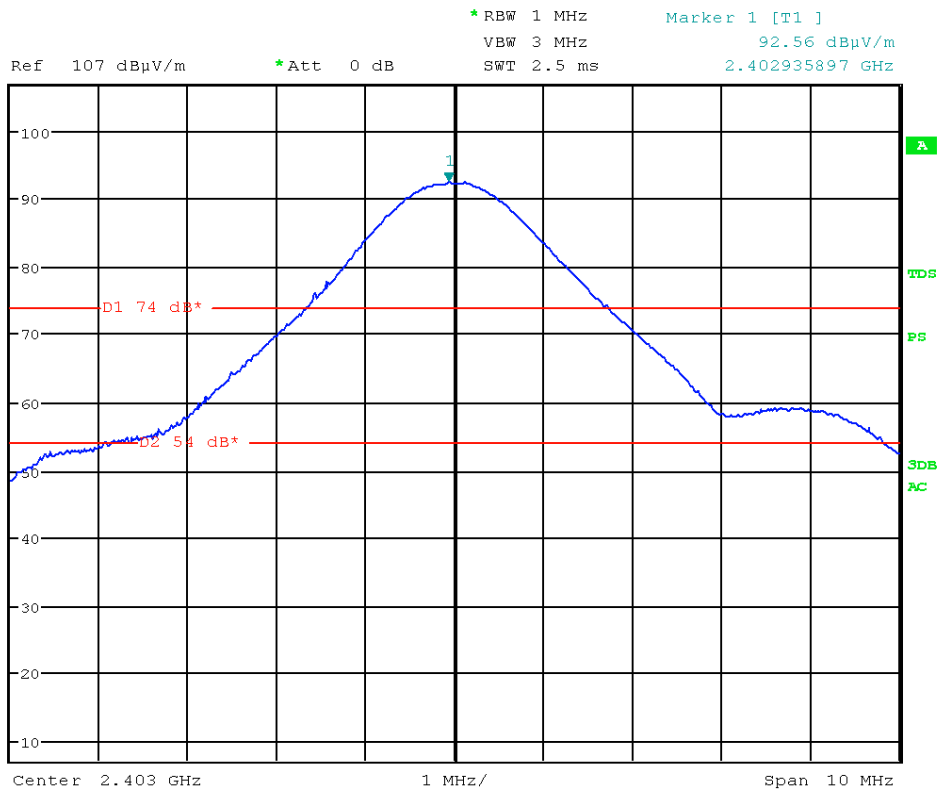


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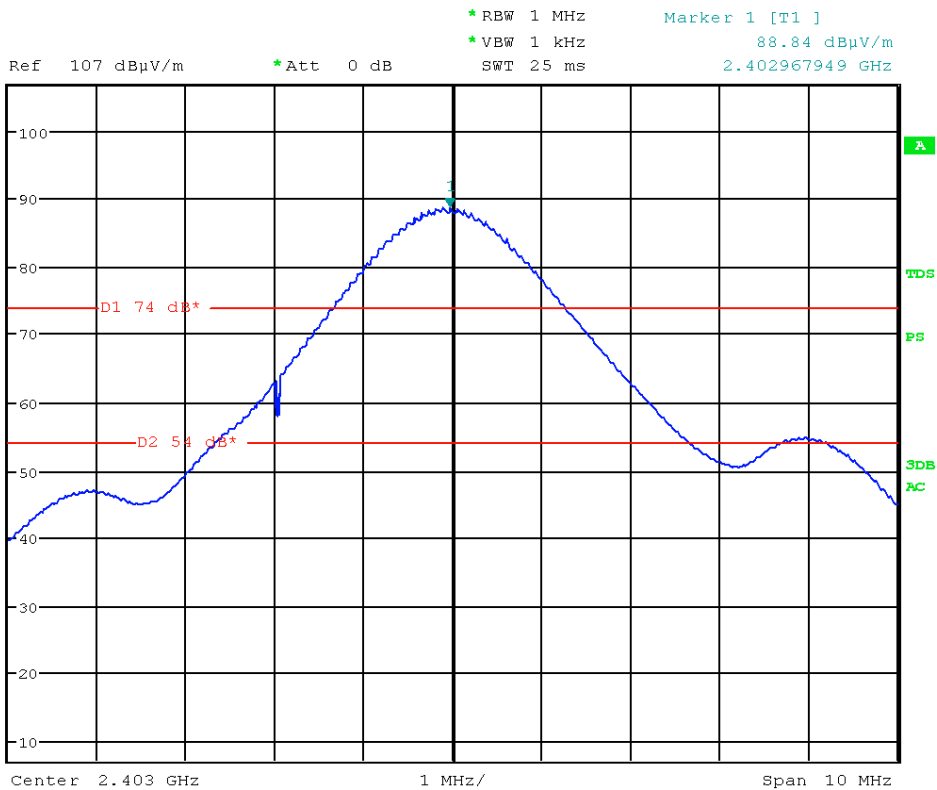
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Picture 21: carrier emission, Channel low - PK



Picture 22: carrier emission, Channel low - AV

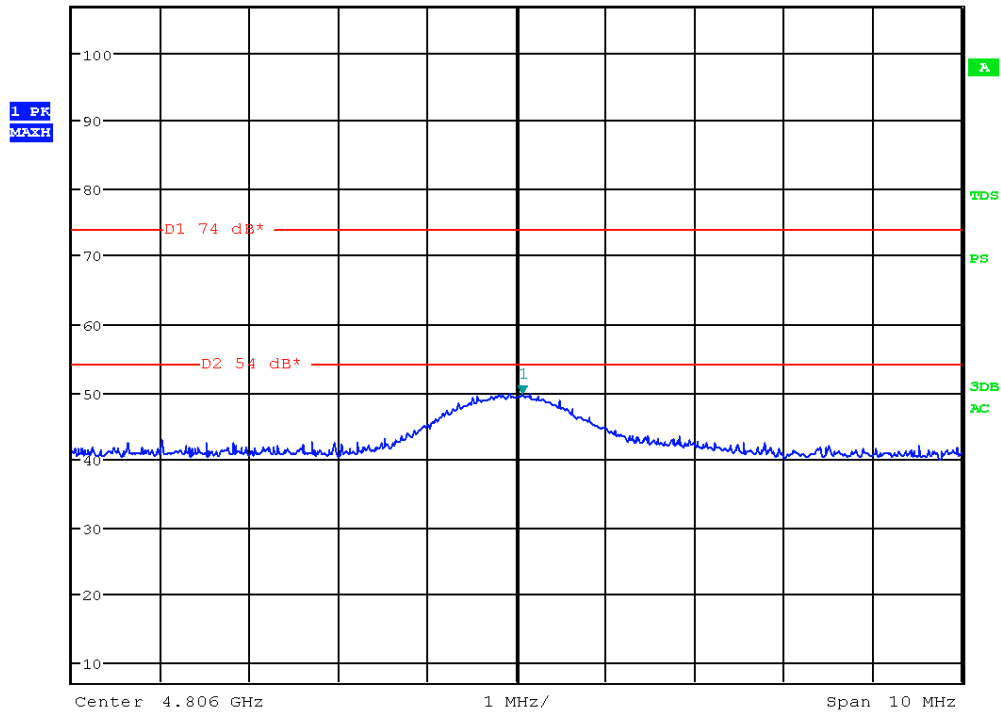


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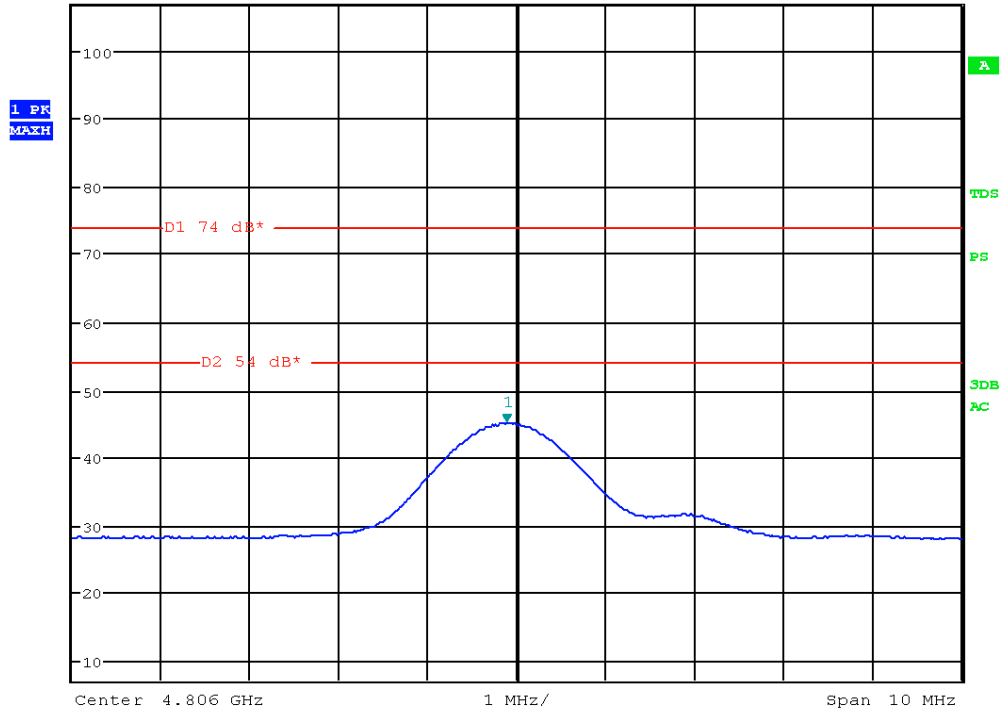
Ref 107 dBµV/m *Att 0 dB *RBW 1 MHz Marker 1 [T1] 49.48 dBµV/m
 VBW 3 MHz
 SWT 20 ms 4.806064103 GHz



Picture 23: spurious emission, Channel low - PK



Ref 107 dBµV/m *Att 0 dB *RBW 1 MHz Marker 1 [T1] 45.17 dBµV/m
 *VBW 1 kHz
 SWT 25 ms 4.805887821 GHz



Picture 24: spurious emission, Channel low - AV



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Channel mid								
f[GHz]	E _{meas} [dB μ V/m]	Ant	Turntable [°]	Height [cm]	Detector	Restr. Band	Limit [dB μ V/m]	Result
2.42687	92.17	H	5.2	187	PK	No	----	Carrier
2.42689	88.87				AV		----	Carrier
4.85394	48.60	H	351.0	163	PK	Yes	74	Pass
4.85389	43.98				AV		54	Pass



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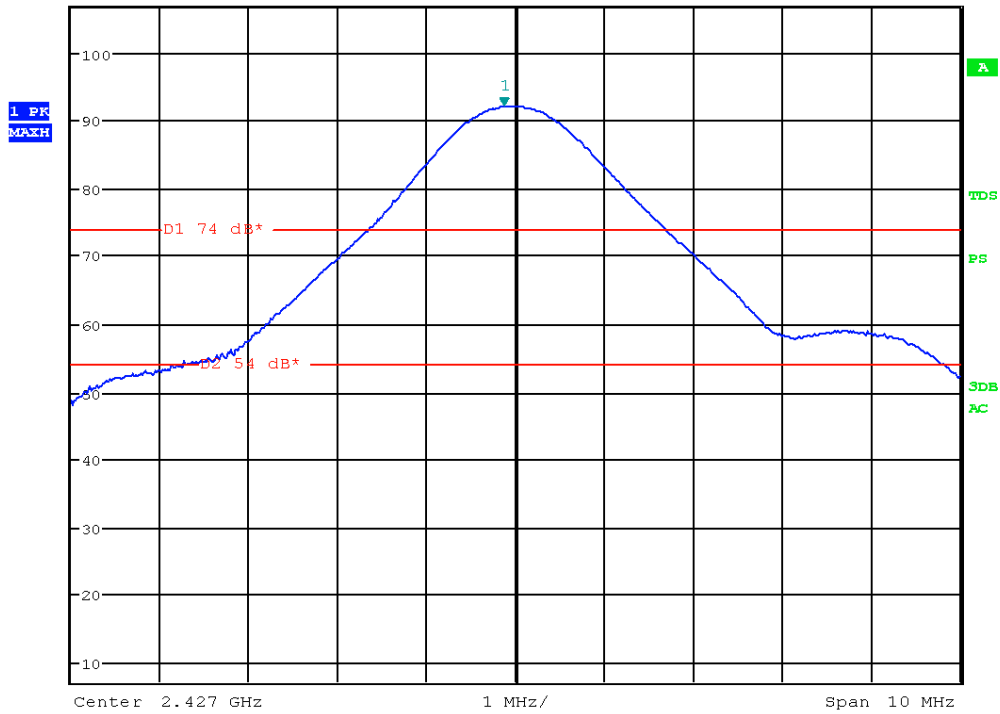
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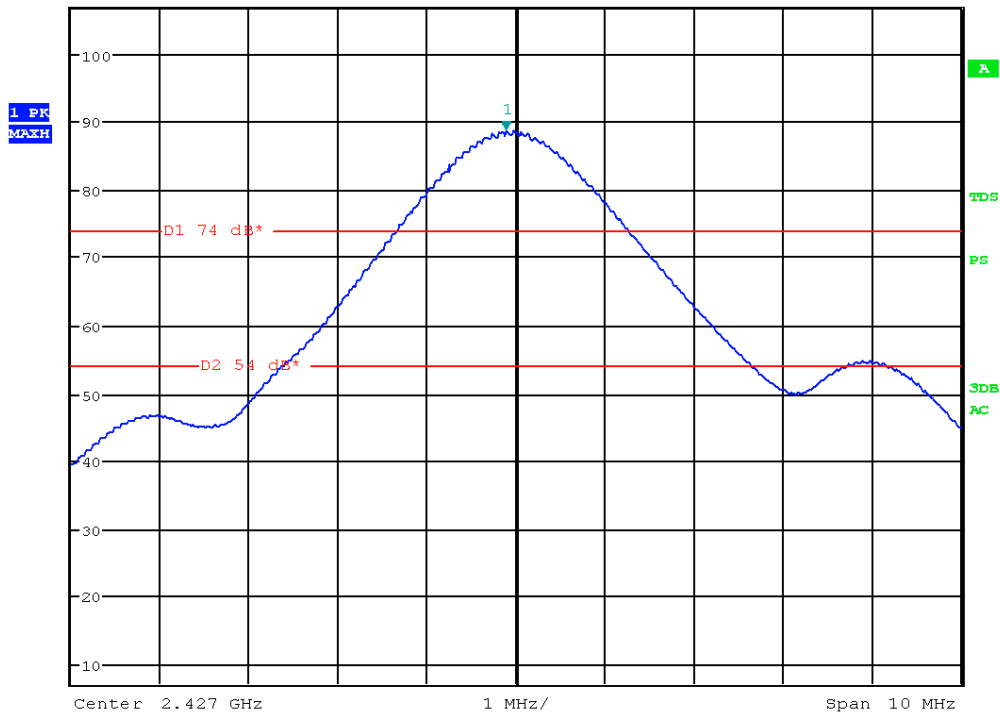
Ref 107 dBµV/m *Att 0 dB *RBW 1 MHz Marker 1 [T1]
 VBW 3 MHz 92.17 dBµV/m
 SWT 2.5 ms 2.426871795 GHz



Picture 25: carrier emission, Channel mid - PK



Ref 107 dBµV/m *Att 0 dB *RBW 1 MHz Marker 1 [T1]
 *VBW 1 kHz 88.87 dBµV/m
 SWT 25 ms 2.426887821 GHz



Picture 26: carrier emission, Channel mid - AV

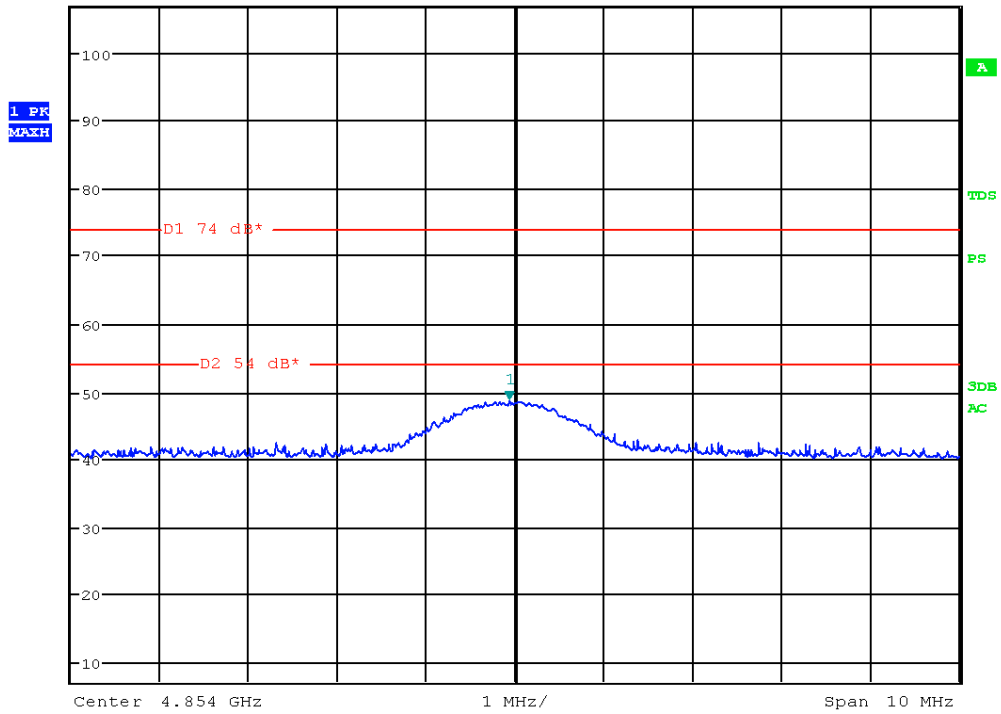


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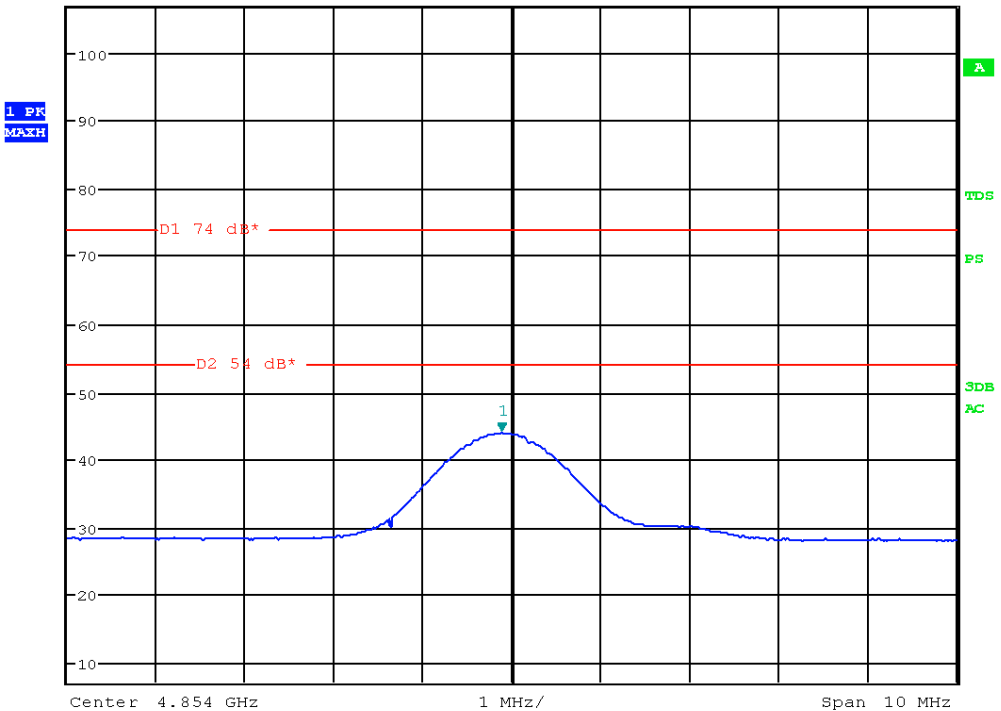
Ref 107 dBµV/m *Att 0 dB *RBW 1 MHz Marker 1 [T1]
 VBW 3 MHz 48.60 dBµV/m
 SWT 20 ms 4.853935897 GHz



Picture 27: spurious emission, Channel mid - PK



Ref 107 dBµV/m *Att 0 dB *RBW 1 MHz Marker 1 [T1]
 *VBW 1 kHz 43.98 dBµV/m
 SWT 25 ms 4.853887821 GHz



Picture 28: spurious emission, Channel mid - AV



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Channel high								
f[GHz]	E _{meas} [dB μ V/m]	Ant	Turntable [°]	Height [cm]	Detector	Restr. Band	Limit [dB μ V/m]	Result
2.45192	91.49	H	15.2	159	PK	No	----	Carrier
2.45198	88.09				AV		----	Carrier
4.90379	47.67	H	19.2	166	PK	Yes	74	Pass
4.90389	41.71				AV		54	Pass



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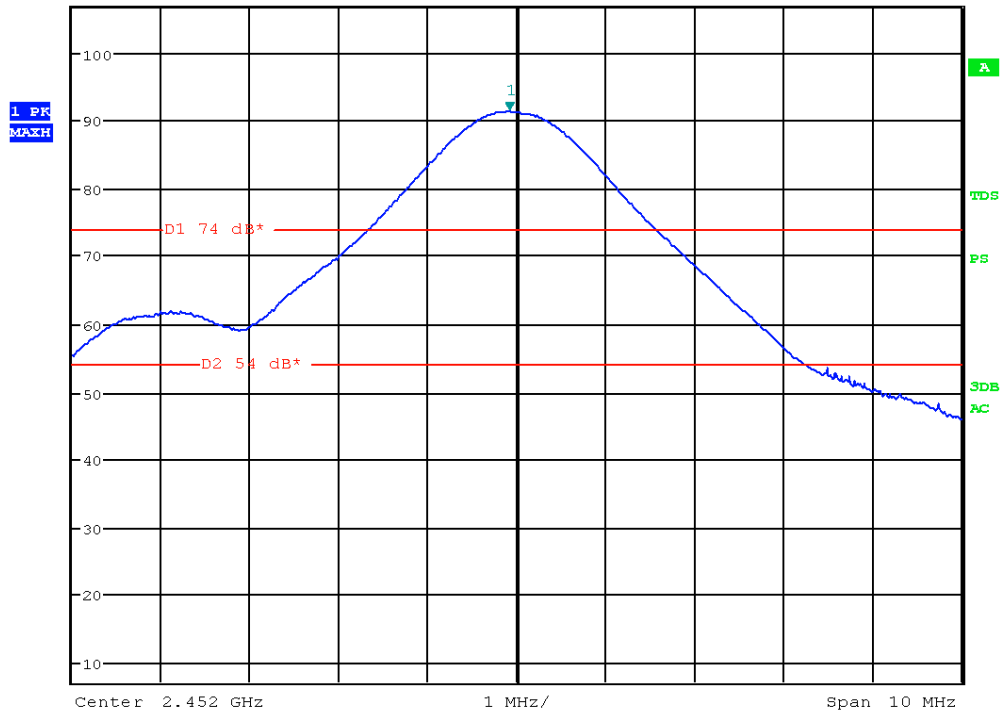
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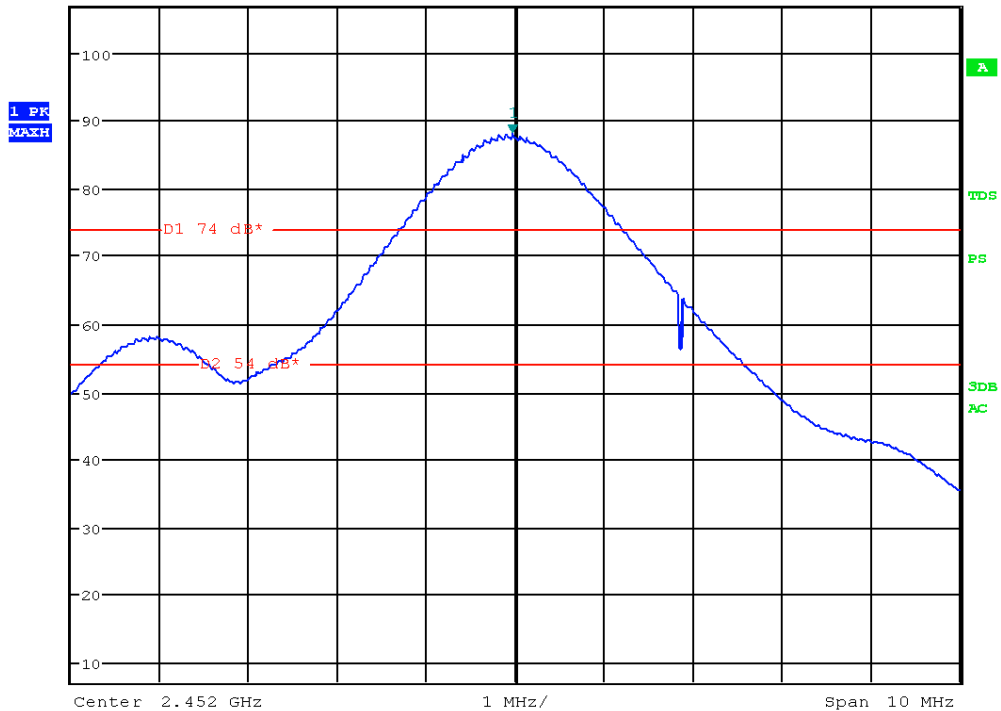
Ref 107 dBµV/m *Att 0 dB *RBW 1 MHz Marker 1 [T1] 91.49 dBµV/m
 VBW 3 MHz
 SWT 2.5 ms 2.451919872 GHz



Picture 29: carrier emission, Channel high - PK



Ref 107 dBµV/m *Att 0 dB *RBW 1 MHz Marker 1 [T1] 88.09 dBµV/m
 *VBW 1 kHz
 SWT 25 ms 2.451967949 GHz



Picture 30: carrier emission, Channel high - AV



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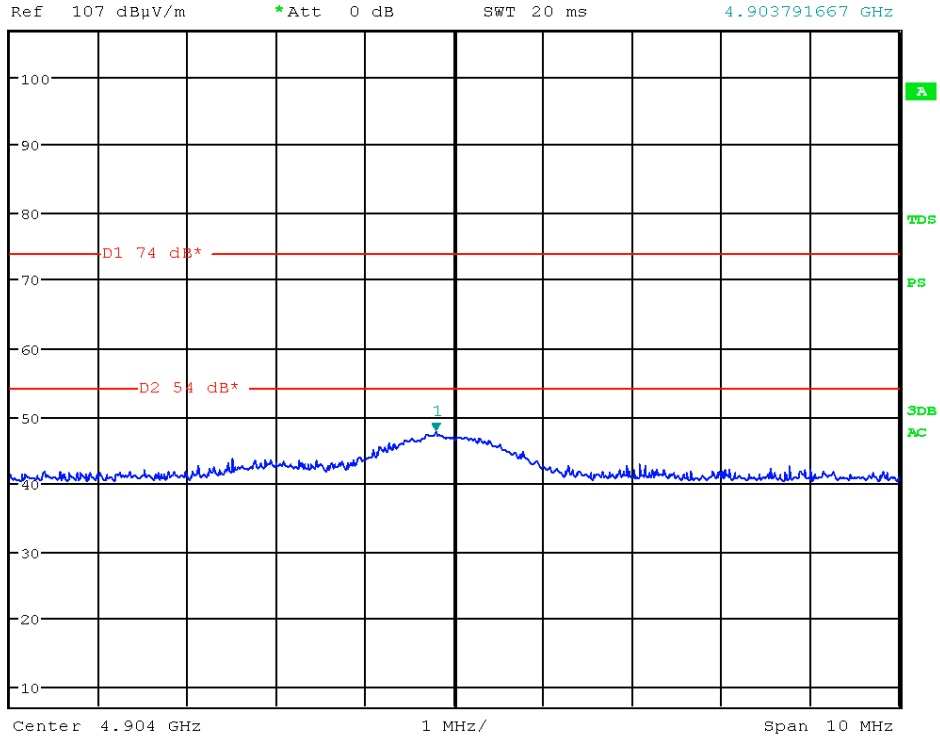
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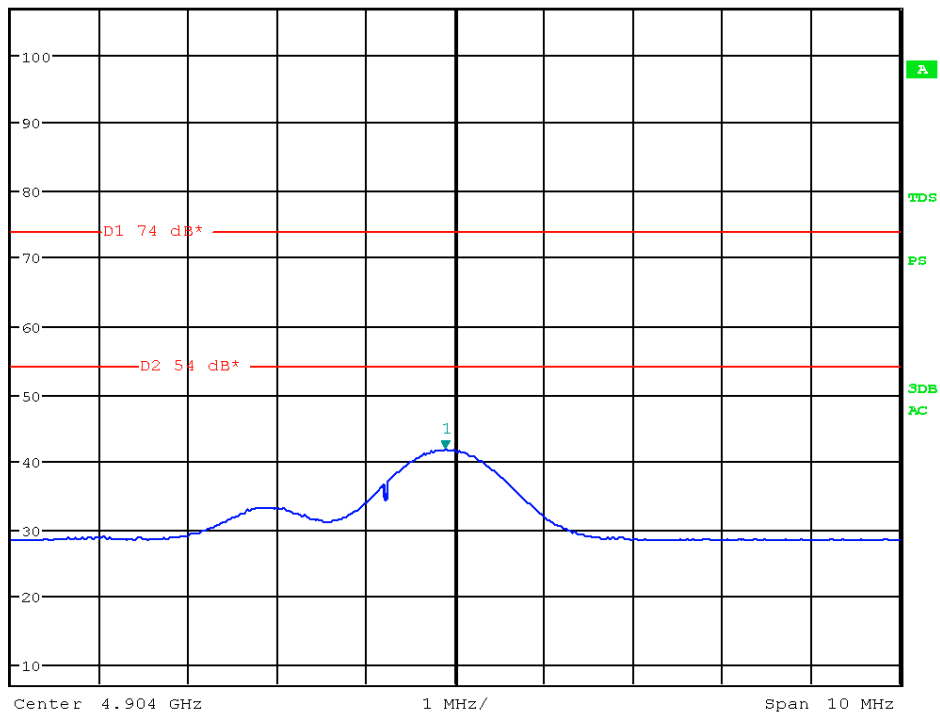
*RBW 1 MHz Marker 1 [T1]
 VBW 3 MHz 47.67 dBµV/m
 SWT 20 ms 4.903791667 GHz



Picture 31: spurious emission, Channel high - PK



*RBW 1 MHz Marker 1 [T1]
 *VBW 1 kHz 41.71 dBµV/m
 SWT 25 ms 4.903887821 GHz



Picture 32: spurious emission, Channel high – AV



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7 6 dB bandwidth

according to 47 CFR Part 15, section 15.215(c)

7.1 Test location

- Conducted measurement
- Scan with peak detector in 3 m CDC
- CISPR measurement with quasi peak detector on 10m open area test site.
- Measurement with peak detector on 3m open area test site

Description	Manufacturer	Inventory No.
CDC	Albatross Projects	E00026
Open area test site	EMV TESTHAUS GmbH	E00354

7.2 Test Instruments

	Description	Manufacturer	Inventory No.
<input type="checkbox"/>	ESCS 30 (FF)	Rohde & Schwarz	E00003
<input checked="" type="checkbox"/>	ESU 26	Rohde & Schwarz	W00002
<input type="checkbox"/>	ESCI (CDC)	Rohde & Schwarz	E00001
<input type="checkbox"/>	HFH2-Z2	Rohde & Schwarz	E00060
<input type="checkbox"/>	VULB 9163 (FF)	Schwarzbeck	E00013
<input type="checkbox"/>	VULB 9160 (CDC)	Schwarzbeck	E00011

7.3 Limits

As not specified in the specific rule section the 6 dB bandwidth is measured and reported for information only.

7.4 Test procedure

1. The test is performed in accordance with FCC KDB publication no. 558074 for testing digital transmission system (DTS)
2. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
3. The unit was operated in continuous transmit mode with modulation.
4. The resolution bandwidth was set to 100 kHz with video bandwidth at least equal to three times the resolution bandwidth.



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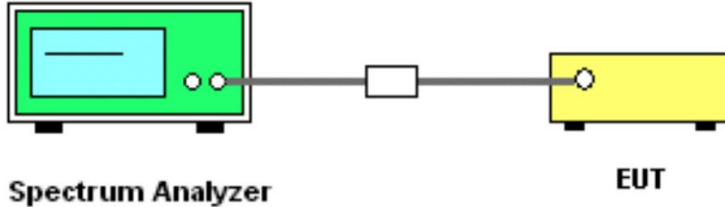
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- The maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission were recorded.

7.5 Test setup



Picture 33: Test setup for 6 dB bandwidth measurement

7.6 Test deviation

There is no deviation with the original standard.

7.7 EUT operation during test

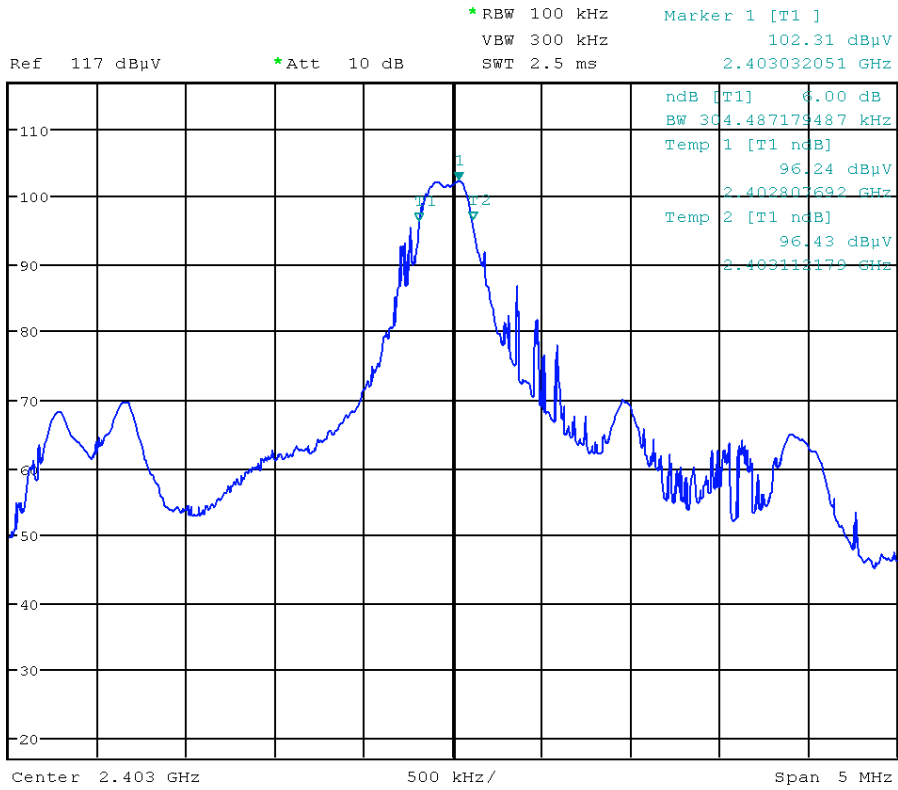
The EUT was programmed to be in continuously transmitting mode.

7.8 Test results

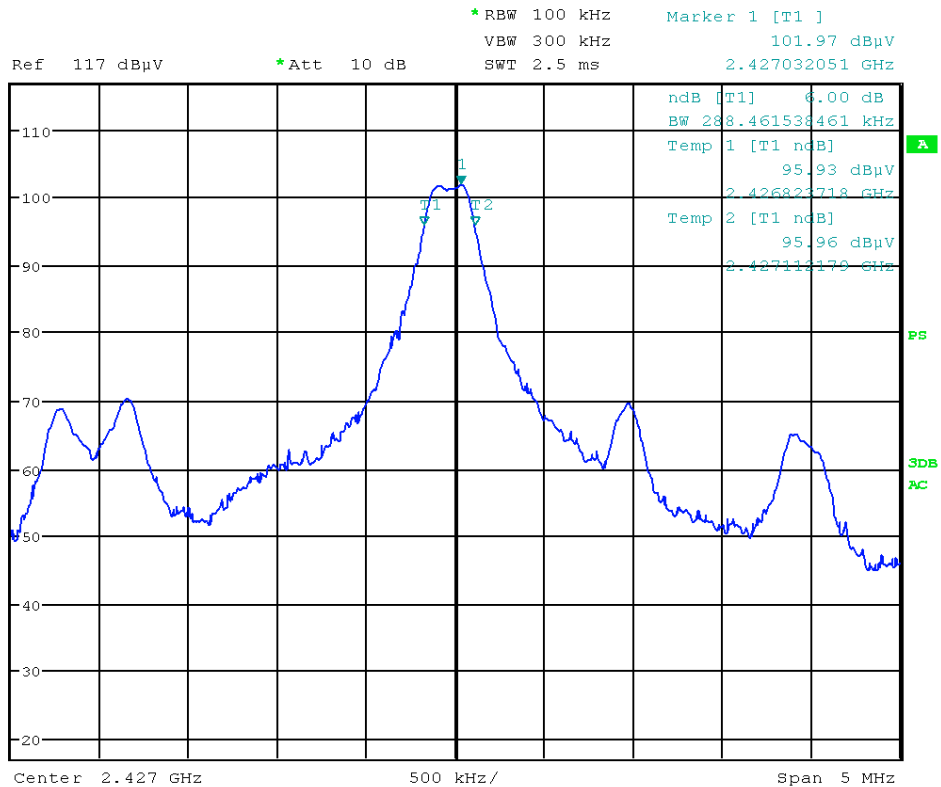
Temperature:	19°C	Humidity:	44%
Tested by:	M. Müller	Test date:	2015-10-19

Designated frequency band: 2400 MHz to 2483.5 MHz

Channel	Frequency (GHz)			6 dB bandwidth (MHz)	Result
	peak	low	high		
Low	2.40303	2.40281	2.40311	0.30449	within band
Mid	2.42703	2.42682	2.42711	0.28846	within band
High	2.45190	2.45182	2.45211	0.28846	within band



Picture 34: 6dB bandwidth, channel low



Picture 35: 6dB bandwidth, channel mid



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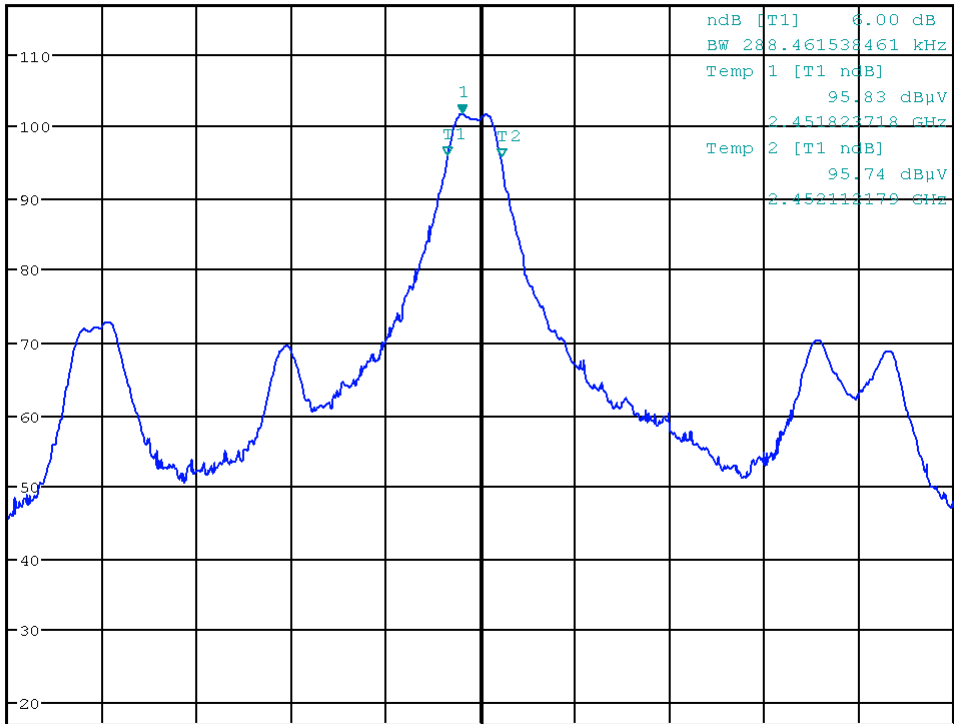


*RBW 100 kHz Marker 1 [T1]
VBW 300 kHz 101.78 dBµV
SWT 2.5 ms 2.451903846 GHz

Ref 117 dBµV

*Att 10 dB

1 PR
MAXH



Center 2.452 GHz

500 kHz/

Span 5 MHz

Picture 36: 6dB bandwidth, channel high



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20 dB bandwidth

according to 47 CFR Part 15, section 15.215(c)

7.9 Test location

- Conducted measurement
- Scan with peak detector in 3 m CDC
- CISPR measurement with quasi peak detector on 10m open area test site.
- Measurement with peak detector on 3m open area test site

Description	Manufacturer	Inventory No.
CDC	Albatross Projects	E00026
Open area test site	EMV TESTHAUS GmbH	E00354

7.10 Test Instruments

	Description	Manufacturer	Inventory No.
<input type="checkbox"/>	ESCS 30 (FF)	Rohde & Schwarz	E00003
<input checked="" type="checkbox"/>	ESU 26	Rohde & Schwarz	W00002
<input type="checkbox"/>	ESCI (CDC)	Rohde & Schwarz	E00001
<input type="checkbox"/>	HFH2-Z2	Rohde & Schwarz	E00060
<input type="checkbox"/>	VULB 9163 (FF)	Schwarzbeck	E00013
<input type="checkbox"/>	VULB 9160 (CDC)	Schwarzbeck	E00011

7.11 Limits

20 dB bandwidth must be contained within the designated frequency band.

7.12 Test procedure

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
2. The unit was operated in continuous transmit mode with modulation.
3. The resolution bandwidth was set to equal or greater than 1.0% of the emission bandwidth with video bandwidth at least equal to resolution bandwidth.
4. The maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission were recorded.



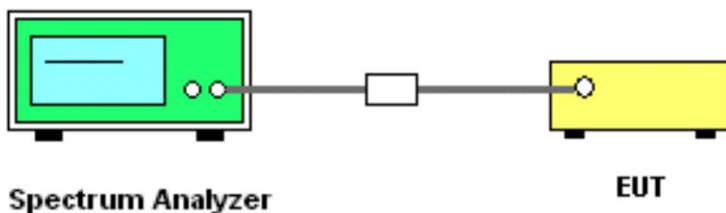
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7.13 Test setup



Picture 37: Test setup for 20 dB bandwidth measurement

7.14 Test deviation

There is no deviation with the original standard.

7.15 EUT operation during test

The EUT was programmed to be in continuously transmitting mode.

7.16 Test results

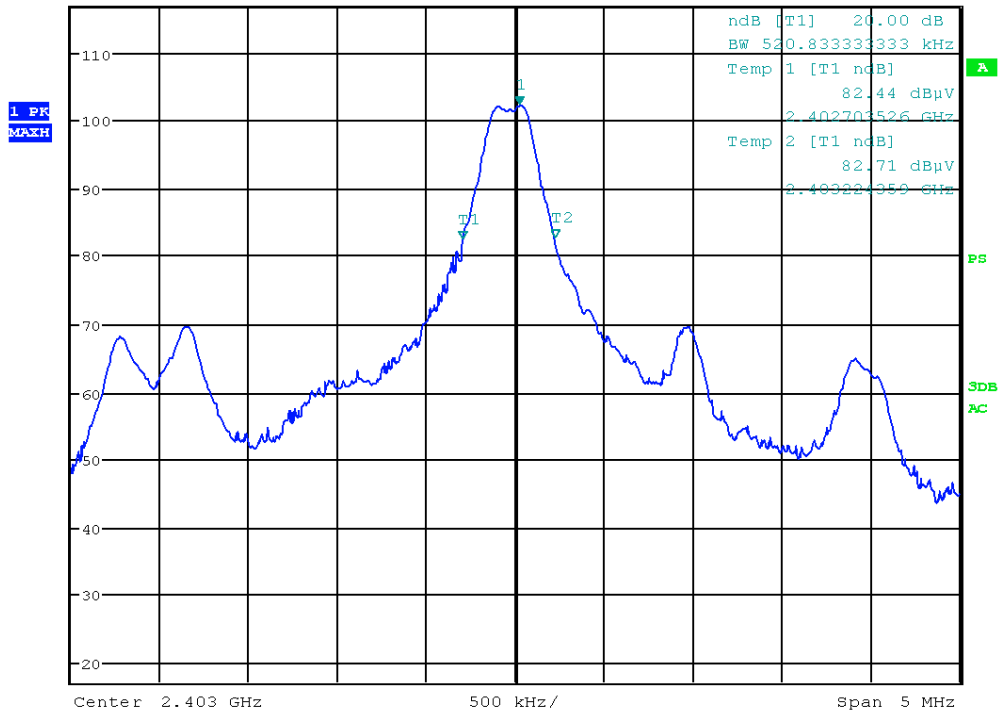
Temperature:	19°C	Humidity:	44%
Tested by:	M. Müller	Test date:	2015-10-19

Designated frequency band: 2400 MHz to 2483.5 MHz

Channel	Frequency (GHz)			20 dB bandwidth (MHz)	Result
	peak	low	high		
Low	2.40302	2.40270	2.40322	0.52083	Pass
Mid	2.42703	2.42670	2.42723	0.53686	Pass
High	2.45190	2.45170	2.45222	0.52083	Pass



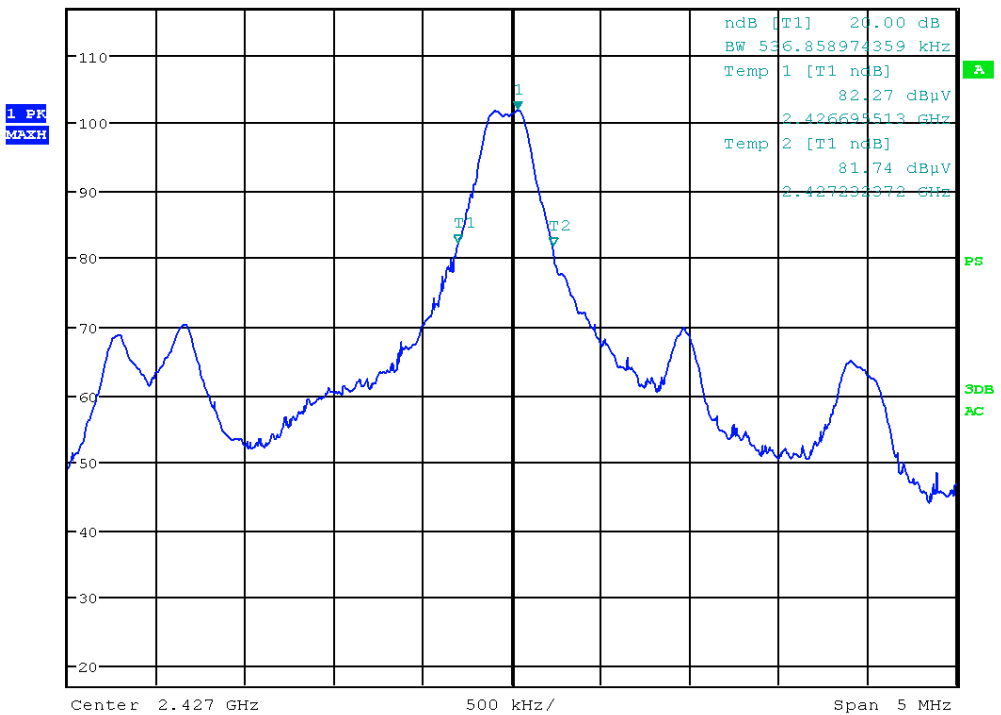
Ref 117 dBµV *Att 10 dB *RBW 100 kHz Marker 1 [T1]
 VBW 300 kHz 102.32 dBµV
 SWT 2.5 ms 2.403024038 GHz



Picture 38: 20dB bandwidth, channel low



Ref 117 dBµV *Att 10 dB *RBW 100 kHz Marker 1 [T1]
 VBW 300 kHz 101.98 dBµV
 SWT 2.5 ms 2.427032051 GHz



Picture 39: 20dB bandwidth, channel mid



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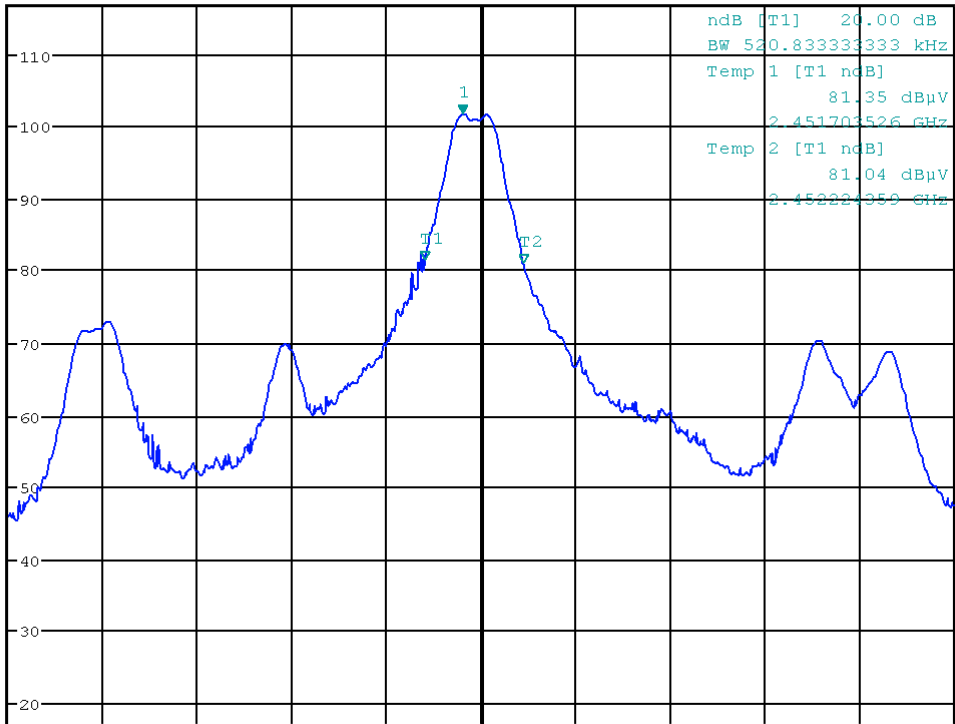


*RBW 100 kHz Marker 1 [T1]
VBW 300 kHz 101.78 dBµV
SWT 2.5 ms 2.451903846 GHz

Ref 117 dBµV

*Att 10 dB

1 PR
MAXH



Center 2.452 GHz

500 kHz/

Span 5 MHz

ndB [T1] 20.00 dB
BW 520.833333333 kHz
Temp 1 [T1 ndB] 81.35 dBµV
2.451703526 GHz
Temp 2 [T1 ndB] 81.04 dBµV
2.452224359 GHz

Picture 40: 20dB bandwidth, channel high



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8 Occupied bandwidth

according to 47 CFR Part 2, section 2.202(a)

8.1 Test location

- Conducted measurement
- Scan with peak detector in 3 m CDC
- CISPR measurement with quasi peak detector on 10m open area test site.
- Measurement with peak detector on 3m open area test site

Description	Manufacturer	Inventory No.
CDC	Albatross Projects	E00026
Open area test site	EMV TESTHAUS GmbH	E00354

8.2 Test Instruments

	Description	Manufacturer	Inventory No.
<input type="checkbox"/>	ESCS 30 (FF)	Rohde & Schwarz	E00003
<input checked="" type="checkbox"/>	ESU 26	Rohde & Schwarz	W00002
<input type="checkbox"/>	ESCI (CDC)	Rohde & Schwarz	E00001
<input type="checkbox"/>	HFH2-Z2	Rohde & Schwarz	E00060
<input type="checkbox"/>	VULB 9163 (FF)	Schwarzbeck	E00013
<input type="checkbox"/>	VULB 9160 (CDC)	Schwarzbeck	E00011

8.3 Limits

As not specified in the specific rule section the occupied bandwidth is measured and reported for information only.

8.4 Test procedure

1. The test is performed in accordance with 47 CFR Part 2, section 2.202(a)
2. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
3. The unit was operated in continuous transmit mode with modulation.
4. The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately three times the RBW.



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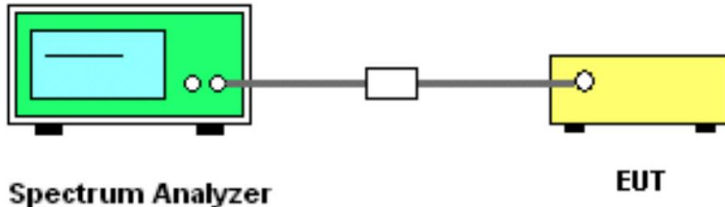
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- The 99 % frequency bandwidth was measured so that, below its lower and above its upper frequency limits, the mean powers radiated were each equal to 0.5 percent of the total mean power radiated by a given emission.

8.5 Test setup



Picture 41: Test setup for occupied bandwidth measurement

8.6 Test deviation

There is no deviation with the original standard.

8.7 EUT operation during test

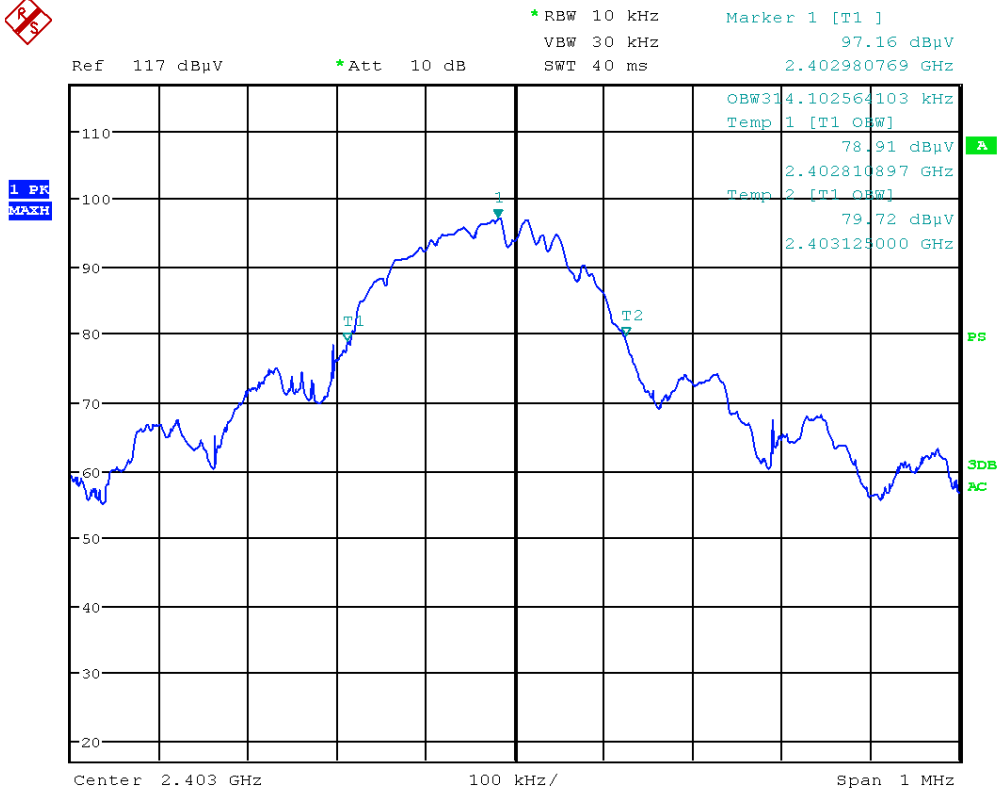
The EUT was programmed to be in continuously transmitting mode.

8.8 Test results

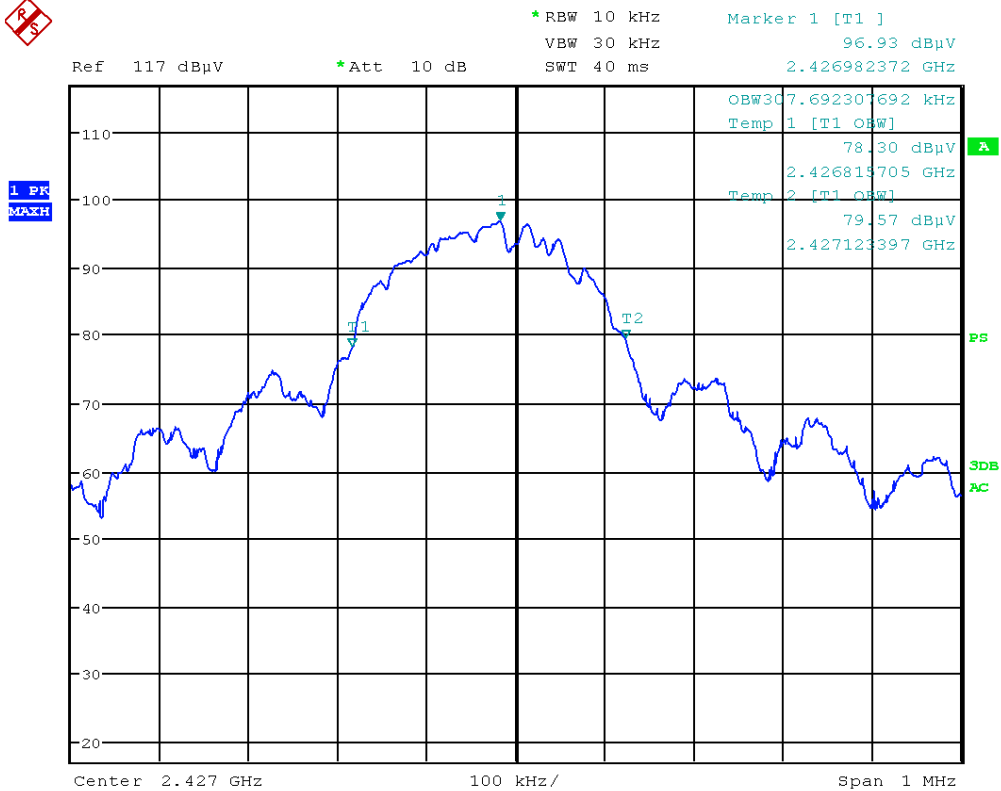
Temperature:	19°C	Humidity:	44%
Tested by:	M. Müller	Test date:	2015-10-19

Designated frequency band: 2400 MHz to 2483.5 MHz

Channel	Frequency (GHz)			99 % bandwidth (MHz)	Result
	peak	low	high		
Low	2.40298	2.40281	2.40313	0.31410	within band
Mid	2.42698	2.41682	2.42712	0.30769	within band
High	2.45198	2.45181	2.45212	0.30769	within band



Picture 42: Occupied bandwidth, channel low



Picture 43: Occupied bandwidth, channel mid



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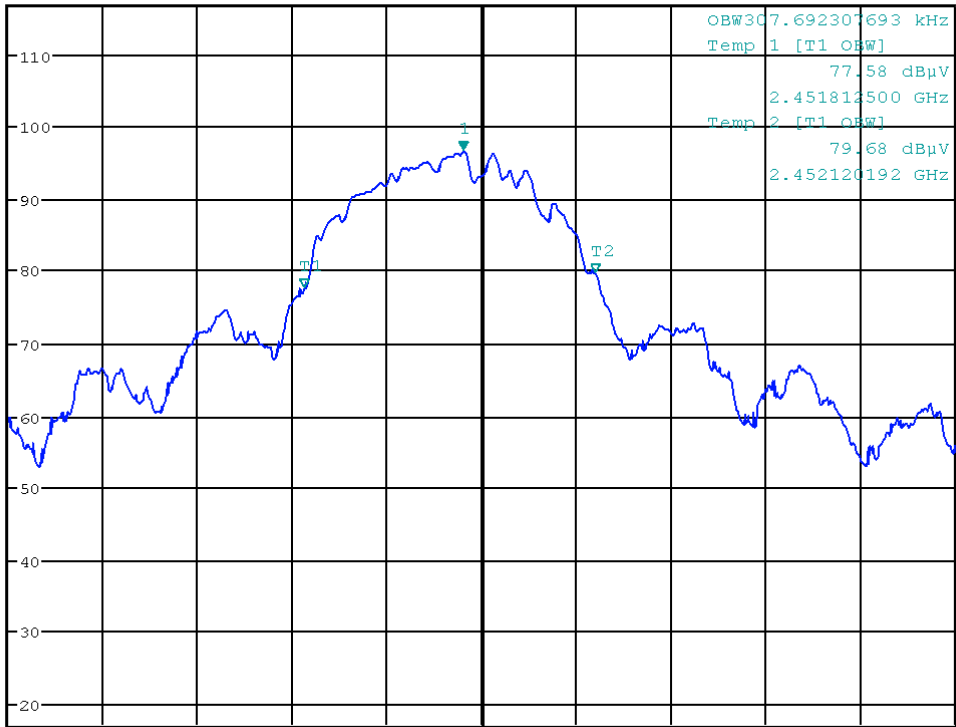


*RBW 10 kHz Marker 1 [T1]
 VBW 30 kHz 96.65 dBµV
 SWT 40 ms 2.451980769 GHz

Ref 117 dBµV

*Att 10 dB

1 PR
 MAXH



Center 2.452 GHz

100 kHz/

Span 1 MHz

Picture 44: Occupied bandwidth, channel high



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9 Radio frequency radiation exposure evaluation for mobile devices

according to 47 CFR Part 2, section 2.1093,
KDB 447498 D01, section 4.3.1,
RSS Gen Issue 4, section 3.2, and RSS-102 Issue 5, section 2.5.1

9.1 Equipment data

Antenna detachable (see antenna specifications): yes no
 Temporary antenna connector: yes no
 Tune-up function: yes no

Antenna gain G referring to isotropic radiator: -1.0 dBi
 Numeric gain: 0.794

Conducted output power CP (maximum): -4.06 dBm
 Numeric power: 0.393 mW

Separation distance between user and transmitting device: R ≤ 20 cm R > 20 cm

9.2 SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm according to KDB 447498 D01 section 4.3.1 1):

$$\frac{P_{conducted}(mW) \cdot \sqrt{f(GHz)}}{\Delta_{min}} \leq 3.0$$

Calculation: $\frac{0mW \times \sqrt{2.452}}{1mm} = 0 < 3.0$

9.3 Exemption Limits for SAR Evaluation according to RSS-102 Issue 5, section 2.5.1:

Limit according to table1:

Frequency (MHz)	Exemption Limits (mW) At separation distance of ≤5 mm
2450	4



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10 Equipment calibration status

Description	Modell number	Serial number	Inventory number(s)	Last calibration	Next calibration
Test receiver	ESU 26	100026	W00002	2014-02	2016-02
Test receiver	ESCI 3	100013	E00001	2013-12	2015-12
Test receiver	ESCI 3	100328	E00552	2014-07	2016-07
Test receiver	ESCS 30	825442/0002	E00003	2014-02	2016-02
Test receiver	ESCS 30	845552/0008	E00551	2014-01	2016-01
LISN	ESH2-Z5	881362/037	E00004	2015-06	2017-06
LISN	ESH2-Z5	893406/009	E00005	2014-01	2016-01
Loop antenna	HFH2-Z2	871398/0050	E00004	2014-07	2016-07
Broadband antenna	VULB 9163	9163-114	E00013	2015-09	2017-09
Broadband horn antenna	BBHA 9120D	9120D-593	W00053	2014-03	2016-03
Broadband horn antenna	BBHA 9170	9170-331	W00055	2014-03	2016-03
Shielded room	P92007	B83117C1109T211	E00107	N/A	
Compact Diagnostic Chamber (CDC)	VK041.0174	D62128-A502-A69-2-0006	E00026	N/A	
Open area test site (OATS)	---	---	E00354	2015-10	2016-10
Climatic chamber 340 I	VC ³ 4034	58566123250010	C00015	2014-09	2016-09
Cable set shielded room	Cable no. 30	---	E00424	2015-07	2016-07
Cable set CDC	Cables no. 37 and 38	---	E00459 E00460	2015-05	2016-05
Cable set OATS 3 m	Cables no. 19, 34 and 36	---	E00453 E00456 E00458	2015-10	2016-10
Cable set OATS 10 m	Cables no. 19, 33 and 36	---	E00453 E00455 E00458	2015-10	2016-10
Cable set anechoic chamber 01	Cables no. 01, 09, 11 and 13	---	W00095 E00307 E00319 E00436	2015-04	2016-04



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Description	Modell number	Serial number	Inventory number(s)	Last calibration	Next calibration
Cable set anechoic chamber 02	Cables no. 01, 09, 12 and 14	---	W00095 E00307 E00320 E00437	2015-04	2016-04

Table 2: Equipment calibration status

Note: Expiration date of measurement facility registration (OATS) by

- FCC (registration number 221458): 2017-04
- Industry Canada (test site numbers 3472A-1 and 3472A-2): 2018-11



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11 Measurement uncertainty

Description	Max. deviation	k=
Conducted emission AMN (9kHz to 30 MHz)	± 4.0 dB	2
Radiated emission open field (30 MHz to 1 GHz)	± 4.5 dB	2
Radiated emission absorber chamber (> 1000 MHz)	± 5.4 dB	2

Table 3: Measurement uncertainty

Comment: The uncertainty stated is the expanded uncertainty obtained by multiplying the standard uncertainty by the coverage factor k. If k=2 the value of the measurements lies within the assigned range of values with a probability of 95 %.



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12 Summary

The EMC Regulations according to the marked specifications are

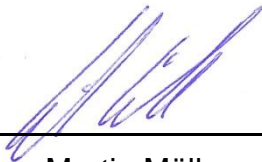
KEPT

The EUT does fulfill the general approval requirements mentioned.

NOT KEPT

The EUT does not fulfill the general approval requirements mentioned.

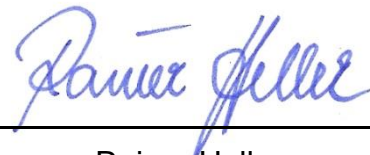
Place, Date: Straubing, April 28th, 2016



Martin Müller

Test engineer

EMV **TESTHAUS** GmbH



Rainer Heller

Head of EMC / radio department

EMV **TESTHAUS** GmbH



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13 Revision History

Date	Description	Person	Revision
2016-04-28	First edition	M. Müller	-----



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