

Test Report

Customer:

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RF Test Report

150637-AU01+W01



DewertOkin GmbH

RF Transmitter 2.4 GHz

RF-TOUCH



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:

EMV **TESTHAUS** GmbH
Gustav-Hertz-Straße 35
94315 Straubing
Germany

The technical accuracy is guaranteed through the quality management of the
EMV **TESTHAUS** GmbH



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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)
KDB Publication no. 558074 June 5, 2014	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
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-247 Issue 1, May 2015	Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices



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1.1 Cross reference of FCC and Industry Canada standards

47 CFR Part and Section	Test	Equivalent to IC
15.207	AC power line conducted emissions 150 kHz to 30 MHz ¹⁾	RSS-Gen Issue 4 section 8.8
15.247(a)(2) KDB 558074, section 8	6 dB bandwidth	RSS-247 Issue 1, section 5.2
15.247(b) KDB 558074, section 9	Maximum peak conducted output power	RSS-Gen Issue 4, section 6.12 RSS-247 Issue 1, section 5.4
15.247(d)	Band-edge compliance	RSS-247 Issue 1, section 5.5
15.247(e) KDB 558074, section 10	Power spectral density	RSS-Gen Issue 4, section 6.12 RSS-247 Issue 1, section 5.2
15.247(d)	Radiated emission 9 kHz to 10 th harmonic	RSS-Gen Issue 4, section 6.13 RSS-247 Issue 1, section 5.5
2.1093	Radiofrequency radiation exposure evaluation: portable devices.	RSS-Gen Issue 4, section 3.2 Exempted from SAR and RF evaluation

Note1: Test not applicable because EUT is battery powered and has no charging mode.



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1.2 Summary of test results

Standard	Test result
FCC 47 CFR Part 15, section 15.247	Passed
RSS-247 Issue 1 and RSS-Gen Issue 4	Passed



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2 Equipment under Test (EUT)

Product type:	RF Transmitter 2.4 GHz
Model Name:	RF-TOUCH
Manufacturer:	DewertOkin GmbH
Serial number(s):	R123456 0001 for radiated measurements R123456 0002 with temporary antenna connector for conducted measurements
FCC ID:	O3YRFTOUCH
IC:	10744A-RFTOUCH
Application freq. band:	2400 MHz to 2483.5 MHz
Frequency range:	2403MHz to 2478 MHz
Operating frequency:	2403MHz to 2478 MHz
Channel spacing ¹⁾ :	1 MHz
Number of RF-channels ¹⁾ :	78
Type of modulation ¹⁾ :	DSSS (GFSK)
Antenna type ¹⁾ :	PCB antenna, not detachable, antenna gain g = 0 dBi
Antenna connectors:	None Note: Temporary antenna connector for test purposes only.
Antenna diversity:	<input type="checkbox"/> yes <input checked="" type="checkbox"/> no
Power supply ¹⁾ :	Battery supplied Nominal voltage: 4.5 V DC
Temperature range ¹⁾ :	0°C to +40°C

Note1: As declared by manufacturer.



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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 remote control for hospital beds that transmits within the 2.4-GHz-band.

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

2.3 Note on variants

Manufacturer's declaration on existing variants:

- The product is provided with different colours depending on customer requirements
- The product is provided with up to 18 keys (3x6) depending on customer requirements
- The product is provided with different key symbols depending on customer requirements

Note: As stated by manufacturer different variants do not influence electronic parts of the EUT.

2.4 Operation mode

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

Tx-mode: Channel low -> 2403 MHz
Channel mid -> 2440 MHz
Channel high -> 2478 MHz
continuous carrier, modulated or unmodulated

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 (see Table 1). Artificial antenna connector is placed directly on PCB. Therefore antenna cable attenuation is assumed to be 0 dB.



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2.5 Configuration

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

Device	Model:	S/N
RF Transmitter 2.4 GHz	RF-TOUCH	R123456 0001
RF Transmitter 2.4 GHz	RF-TOUCH	R123456 0002

Used cables

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

Channel	Frequency [GHz]	test cable attenuation [dB]	antenna cable attenuation [dB]	cable correction [dB]
Low	2.403	0.76	0.00	0.76
Mid	2.440	0.75	0.00	0.75
High	2.478	0.76	0.00	0.76

Table 1: Cable corrections



3 6 dB bandwidth

according to 47 CFR Part 15, section 15.247(a), and KDB Publication no. 558074, section 8

3.1 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.
Test laboratory	EMV TESTHAUS GmbH	

3.2 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

3.3 Limits

The minimum 6 dB bandwidth shall be at least 500kHz

3.4 Test procedure

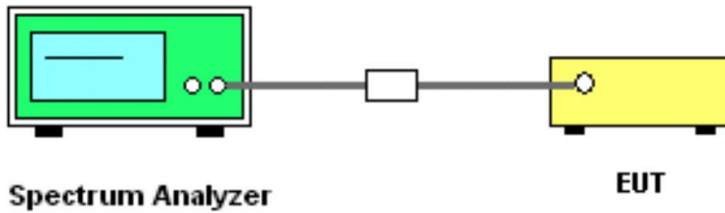
1. The test is performed in accordance with FCC KDB publication no. 558074
2. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
3. The unit was operated in continuous transmit mode with modulation.
4. The resolution bandwidth was set to 100 kHz with video bandwidth at least equal to three times the resolution bandwidth.
5. 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.



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3.5 Test setup



Picture 1: Test setup for 6 dB bandwidth measurement

3.6 Test deviation

There is no deviation with the original standard.

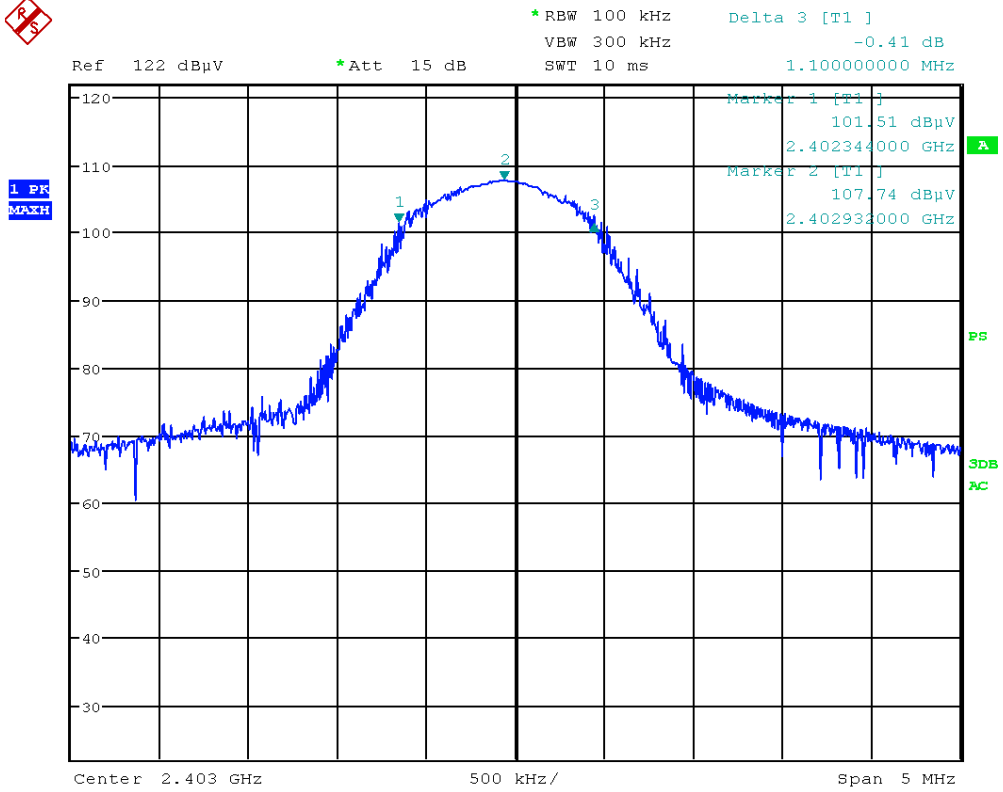
3.7 EUT operation during test

The EUT was programmed to be in continuously transmitting mode.

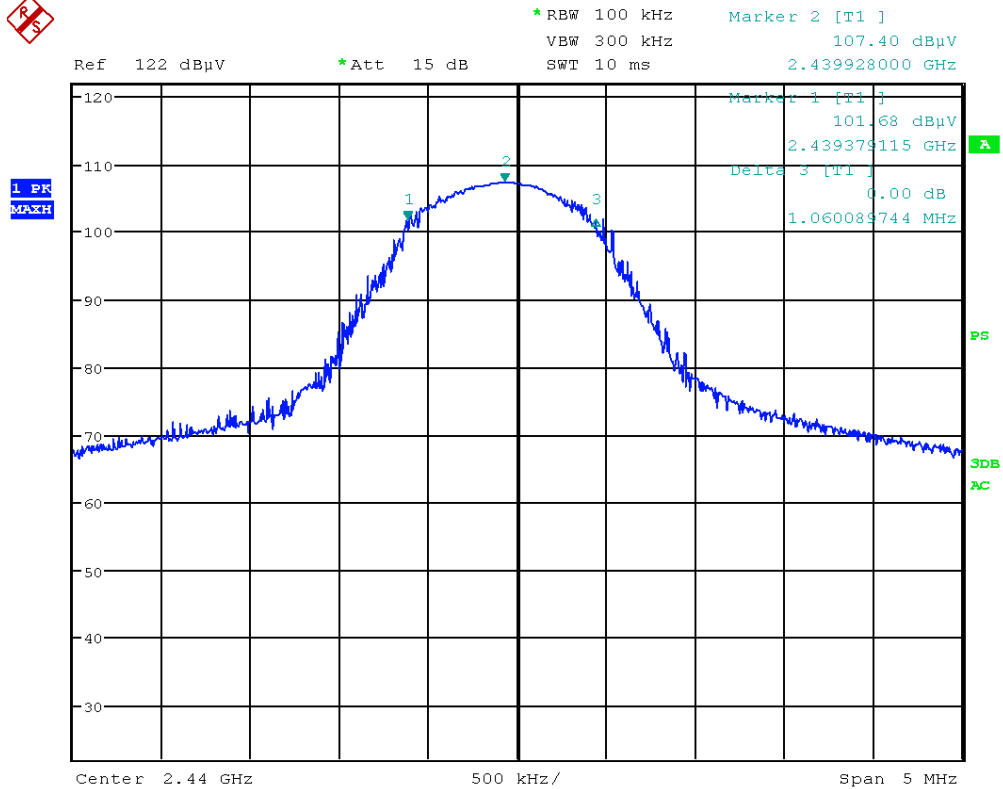
3.8 Test results

Temperature:	19°C	Humidity:	44%
Tested by:	M. Müller	Test date:	2015-11-06

Channel	Frequency (GHz)	6 dB bandwidth (MHz)
Low	2.40293	1.10000
Mid	2.43993	1.06009
High	2.47793	1.11378



Picture 2: 6dB bandwidth, channel low



Picture 3: 6dB bandwidth, channel mid

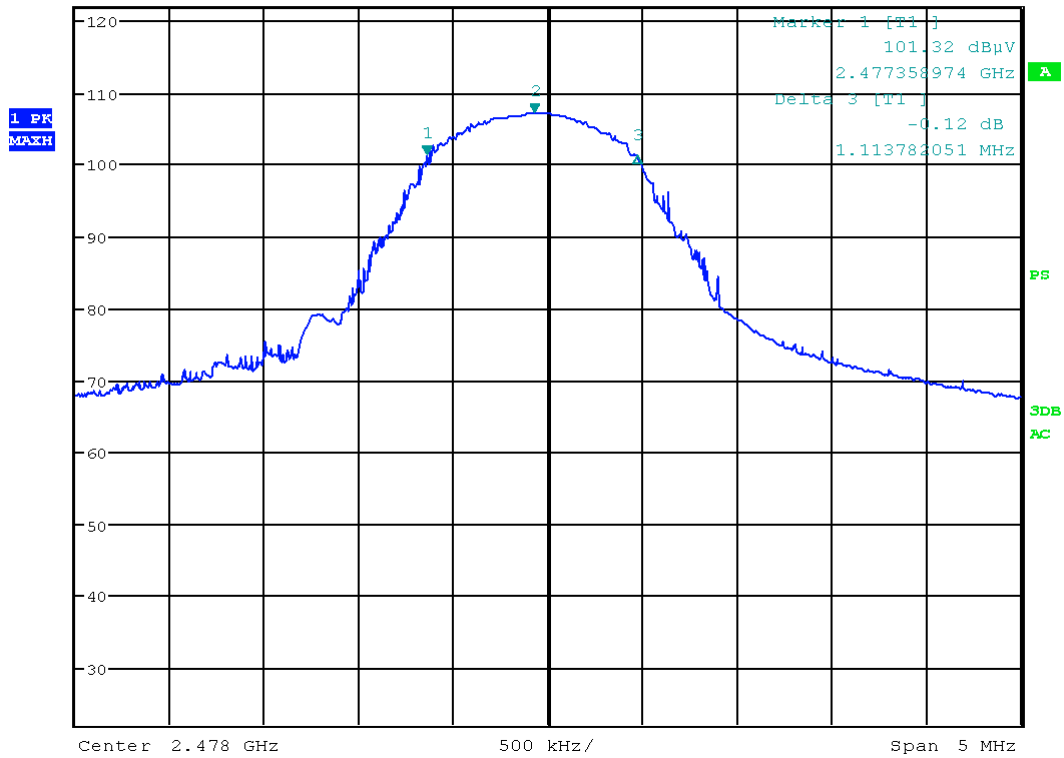


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Ref 122 dBµV *Att 15 dB *RBW 100 kHz Marker 2 [T1] 107.20 dBµV
*RBW 100 kHz Marker 2 [T1] 107.20 dBµV
VBW 300 kHz 2.477927885 GHz
*SWT 10 ms



Picture 4: 6dB bandwidth, channel high



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5 Maximum peak conducted output power

according to 47 CFR Part 15, section 15.247(b), and KDB 558074, section 9

5.1 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.
Test laboratory	EMV TESTHAUS GmbH	

5.2 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

5.3 Limits

For systems using digital modulation: 1 Watt (30 dBm).

As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.

Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level.

The conducted output power limit is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



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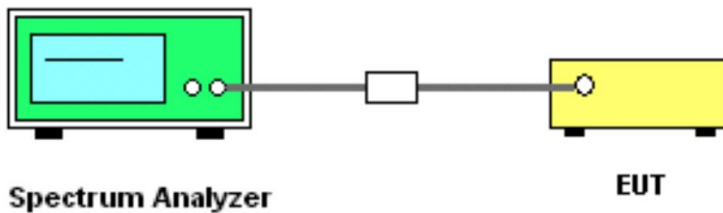
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5.4 Test procedure

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. Test was performed in accordance with measurement of Digital Transmission Systems operating under Section 15.247 and FCC KDB publication no. 558074, section 9.1.1 with detector set to peak (max hold) and the following settings:
 - a) $RBW \geq DTS$ bandwidth (6 dB bandwidth)
 - b) $VBW \geq 3 \times RBW$.
 - c) $span \geq 3 \times RBW$
 - d) Sweep time = auto couple.

5.5 Test setup



Picture 5: Test setup for conducted output power measurement

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

Temperature:	20°C	Humidity:	43%
Tested by:	M. Müller	Test date:	2015-11-06

Channel	Frequency (GHz)	Detector	Conducted power		Limit (dBm)	Result
			reading (dBm)	final (dBm)		
Low	2.40290	PK	0.92	1.68	30	Passed
Mid	2.43982	PK	0.56	1.31	30	Passed
High	2.47789	PK	0.30	1.06	30	Passed

Comments: Final conducted power value is reading value + cable correction according to Table 1.

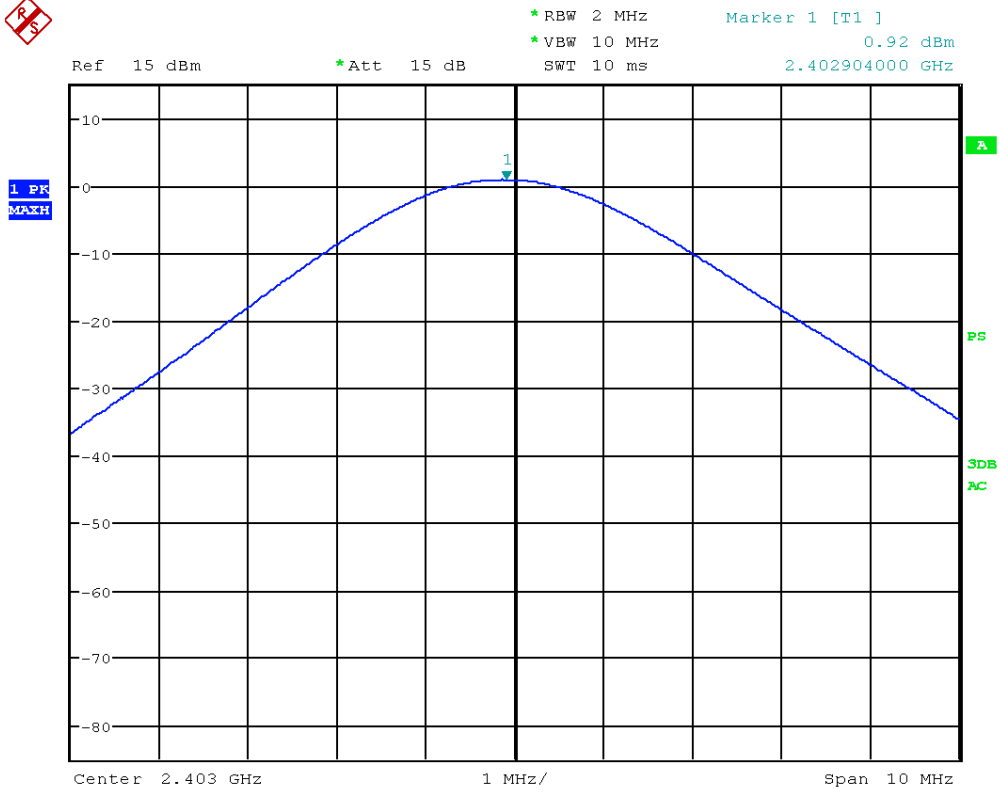


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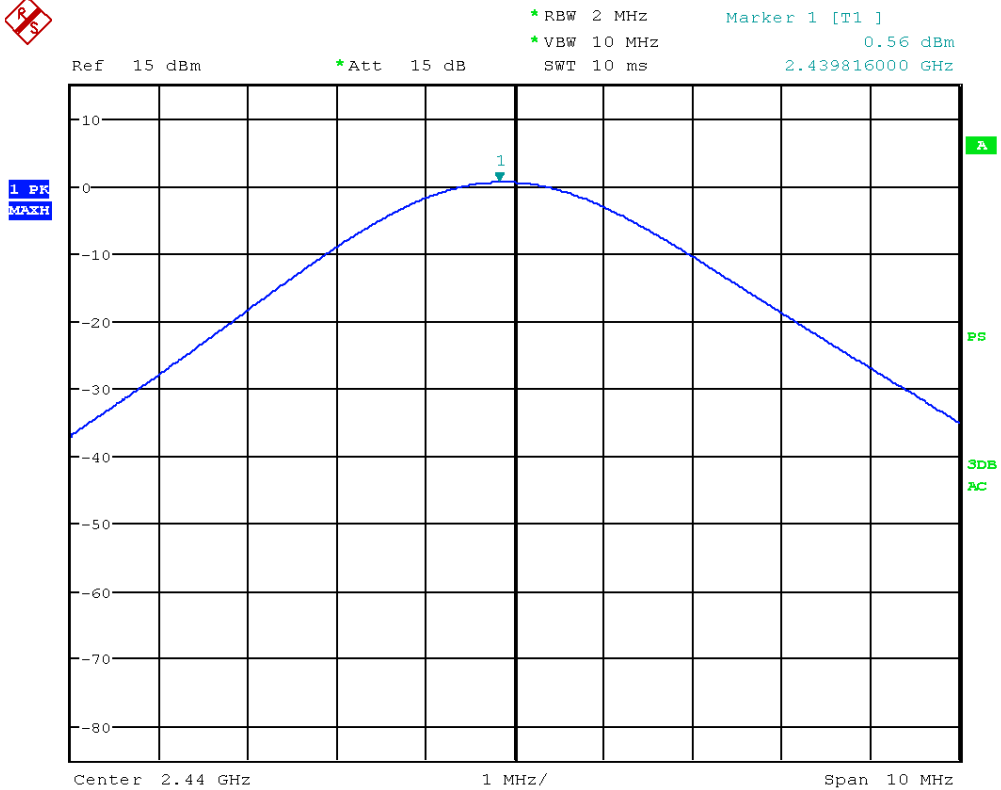
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Picture 6: Conducted output power, channel low



Picture 7: Conducted output power, channel mid

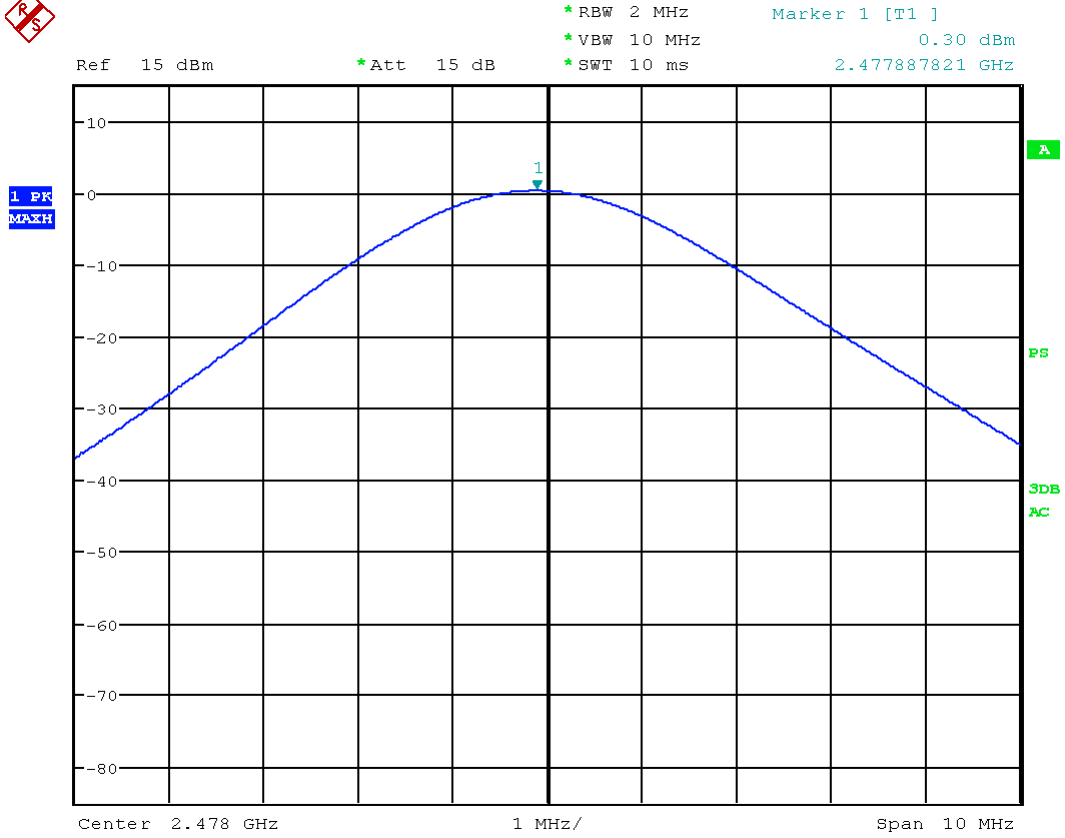


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Picture 8: Conducted output power, channel high



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6 Power spectral density

according to 47 CFR Part 15, section 15.247(e), and KDB 558074, section 10

6.1 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.
Test laboratory	EMV TESTHAUS GmbH	

6.2 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

6.3 Limits

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of section 15.247.

The same method of determining the conducted output power shall be used to determine the power spectral density.



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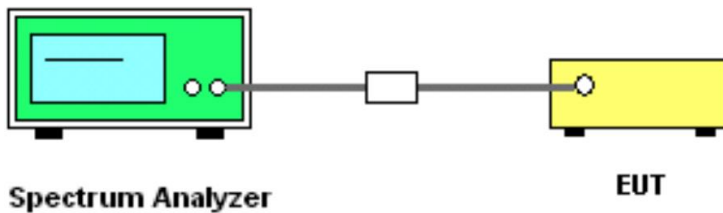
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6.4 Test procedure

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. Test was performed in accordance with measurement of Digital Transmission Systems operating under Section 15.247 and FCC KDB publication no. 558074, section 10 with detector set to peak (max hold) and the following settings:
 - a) span = 1.5 x DTS bandwidth (6 dB bandwidth)
 - b) $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
 - c) $\text{VBW} \geq 3 \times \text{RBW}$.
 - d) Sweep time = auto couple for prescans, $\geq \text{span} / \text{RBW}$ for final scan

6.5 Test setup



Picture 9: Test setup for power spectral density measurement

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.

6.8 Test results

Temperature:	21°C	Humidity:	46%
Tested by:	M. Müller	Test date:	2015-11-06

Channel	Detector	Frequency (GHz)	PSD @ 3kHz RBW		Limit (dBm)	Result
			reading (dBm)	final (dBm)		
Low	PK	2.40293	-0.18	0.58	8	Passed
Mid	PK	2.43993	-0.47	0.28	8	Passed
High	PK	2.47993	-0.85	-0.09	8	Passed

Comments: Final PSD value is reading value + cable correction according to Table 1.

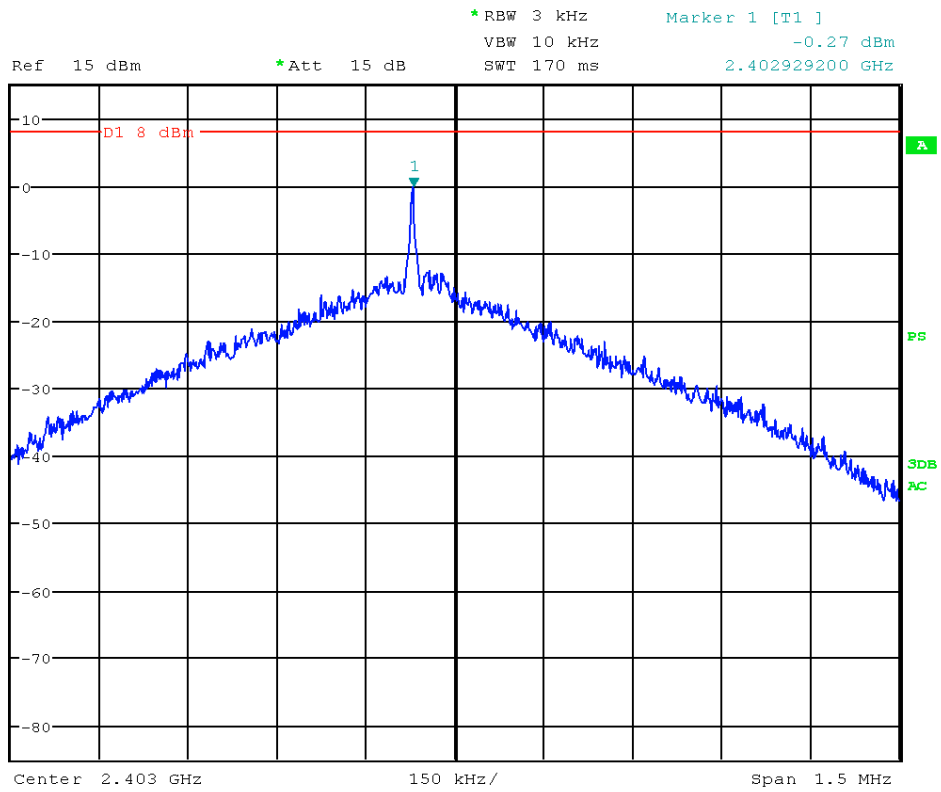


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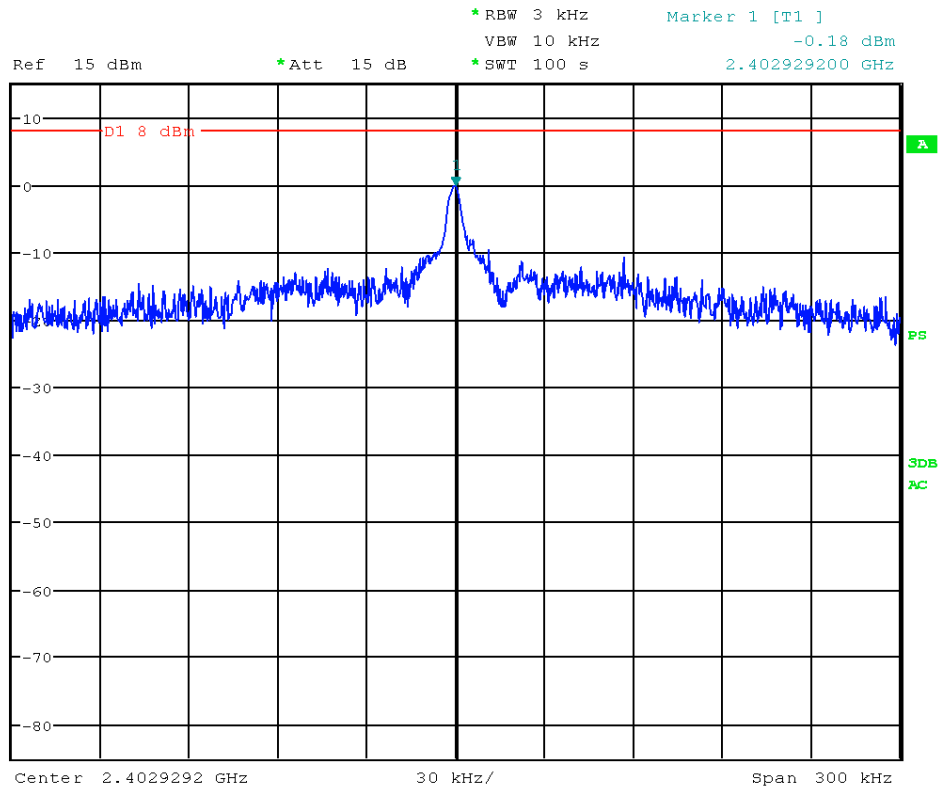
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Picture 10: Power spectral density, channel low - complete carrier



Picture 11: Power spectral density, channel low - zoom to maximum

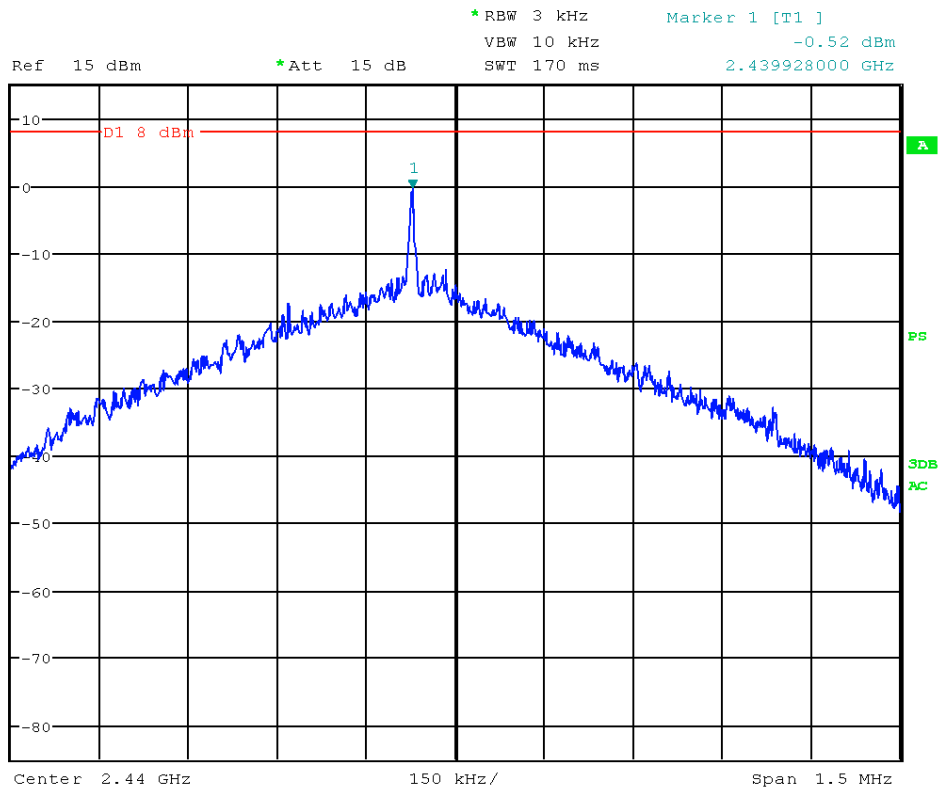


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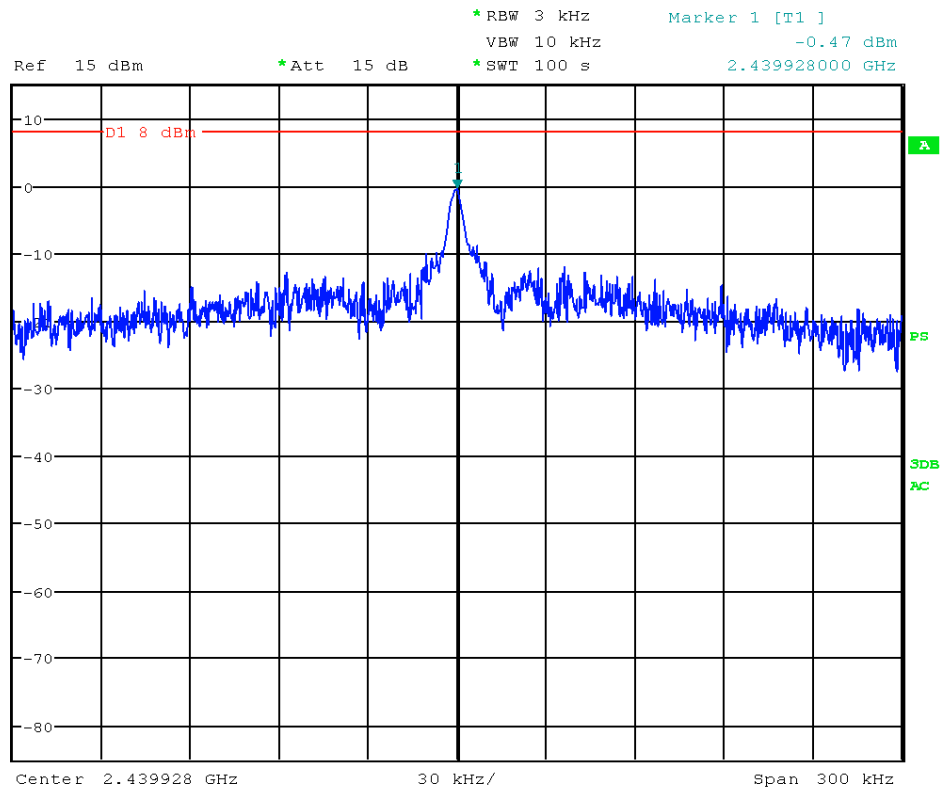
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Picture 12: Power spectral density, channel mid - complete carrier



Picture 13: Power spectral density, channel mid - zoom to maximum

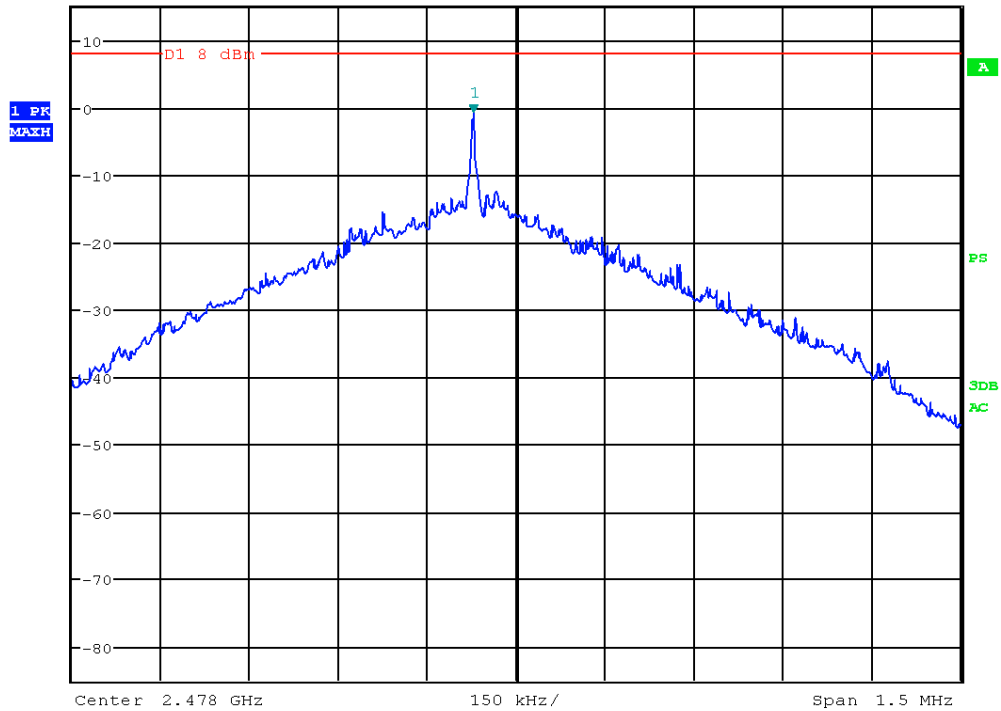


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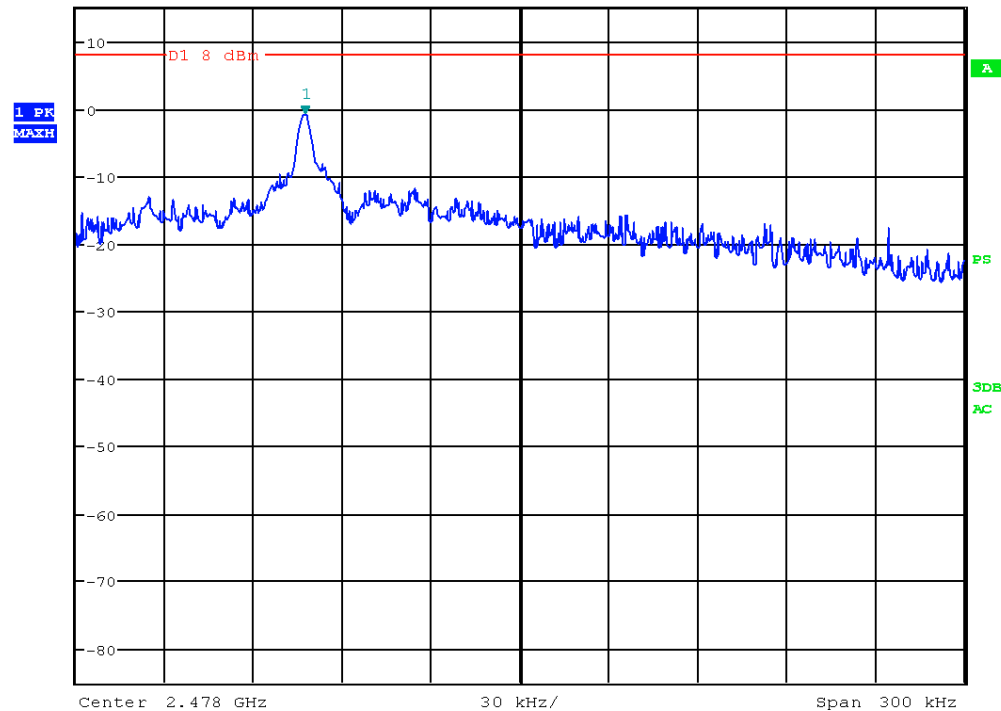
Ref 15 dBm *Att 15 dB *RBW 3 kHz VBW 10 kHz Marker 1 [T1] -0.81 dBm
SWT 170 ms 2.477927885 GHz



Picture 14: Power spectral density, channel high - complete carrier



Ref 15 dBm *Att 15 dB *RBW 3 kHz VBW 10 kHz Marker 1 [T1] -0.85 dBm
*SWT 100 s 2.477927404 GHz



Picture 15: Power spectral density, channel high - zoom to maximum



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7 Band-edge compliance

according to 47 CFR Part 15, section 15.247(d)

7.1 Test location

Description	Manufacturer	Inventory No.
Anechoic chamber	EMV TESTHAUS GmbH	E00100

7.2 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

7.3 Limits

≤ -20dBc outside restricted bands
≤ 54dBμV (video average) inside restricted bands
≤ 74dBμV (peak detector) inside restricted bands

7.4 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.
5. Record this trace(s) and set appropriate markers
6. Set frequency to highest channel
7. Repeat steps 4 and 5



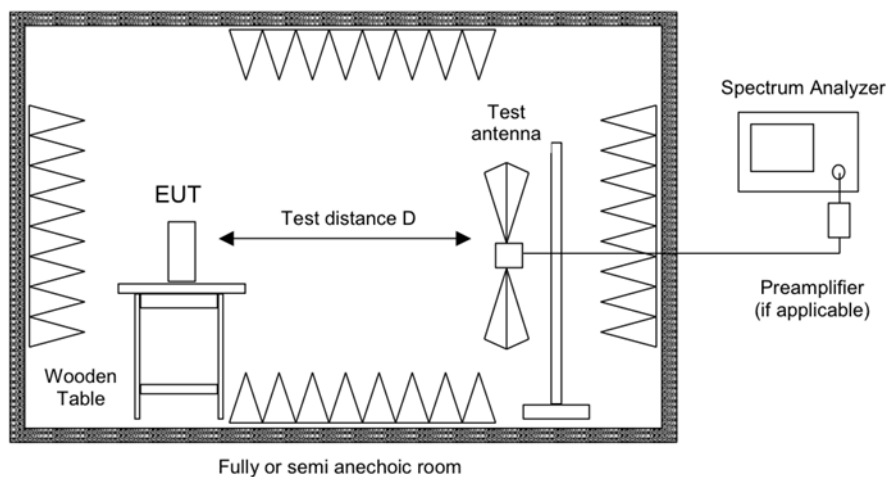
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7.5 Test setup



Picture 16: Test setup for band-edge compliance 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. It was investigated that for this test EUT-position3 in combination with measurement-antenna polarized to horizontal is the respective worst-case.

7.8 Test results

Temperature:	22°C	Humidity:	44%
Tested by:	M. Müller	Test date:	2015-12-01

f[GHz]	E _{meas} [dBμV/m]	Detector	Restricted Band	Limit [dBμV/m]	Result
2.40297	100.67	PK	No	----	Carrier
2.40297	100.39	AV (VBW 1 kHz)		----	Carrier
2.39000	66.72	PK	Yes	74	Pass
2.39000	30.30	AV (VBW 1 kHz)		54	Pass
2.38694	32.00	AV (VBW 1 kHz)		54	Pass
2.35377	53.84	PK		74	Pass
2.31000	47.39	PK		74	Pass
2.31000	28.00	AV (VBW 1 kHz)		54	Pass

Picture 17: 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} [dBμV/m]	Detector	Restricted Band	Limit [dBμV/m]	Result
2.47796	99.82	PK	No	----	Carrier
2.47785	99.64	AV (VBW 1 kHz)		----	Carrier
2.48317	74.09	PK		-20dBc	Pass
2.48350	73.47	PK	Yes	74	Pass
2.48350	34.56	AV (VBW 1 kHz)		54	Pass
2.48579	32.53	AV (VBW 1 kHz)		54	Pass
2.50000	60.32	PK		74	Pass
2.50000	28.49	AV (VBW 1 kHz)		54	Pass

Picture 18: 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

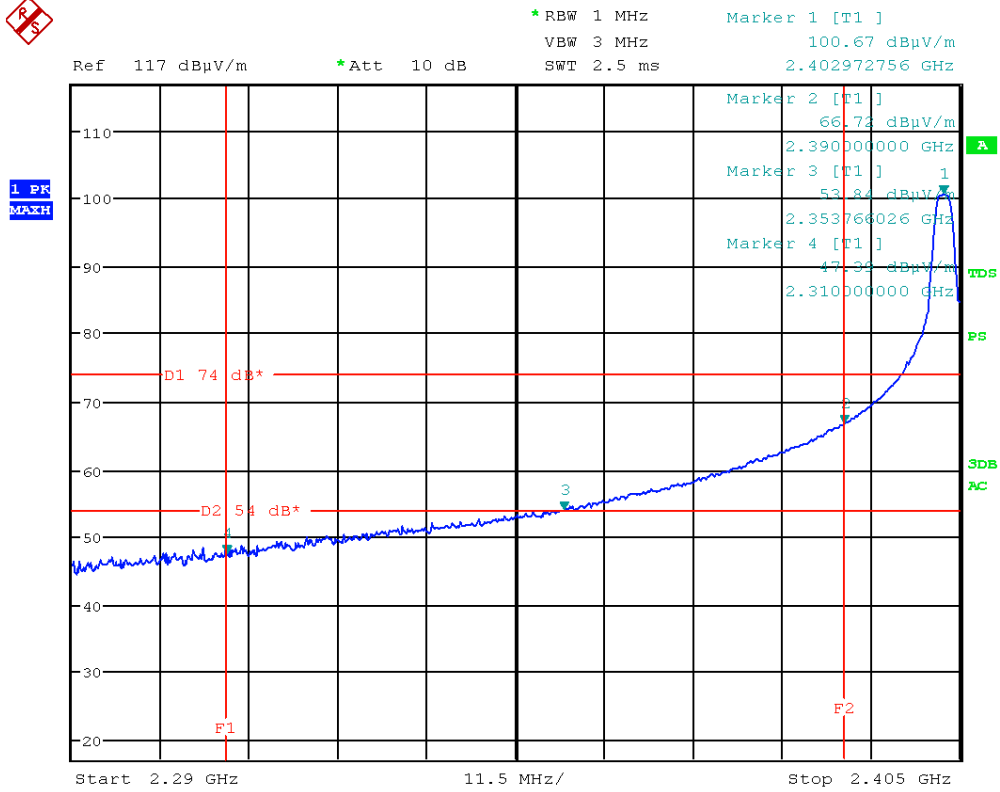


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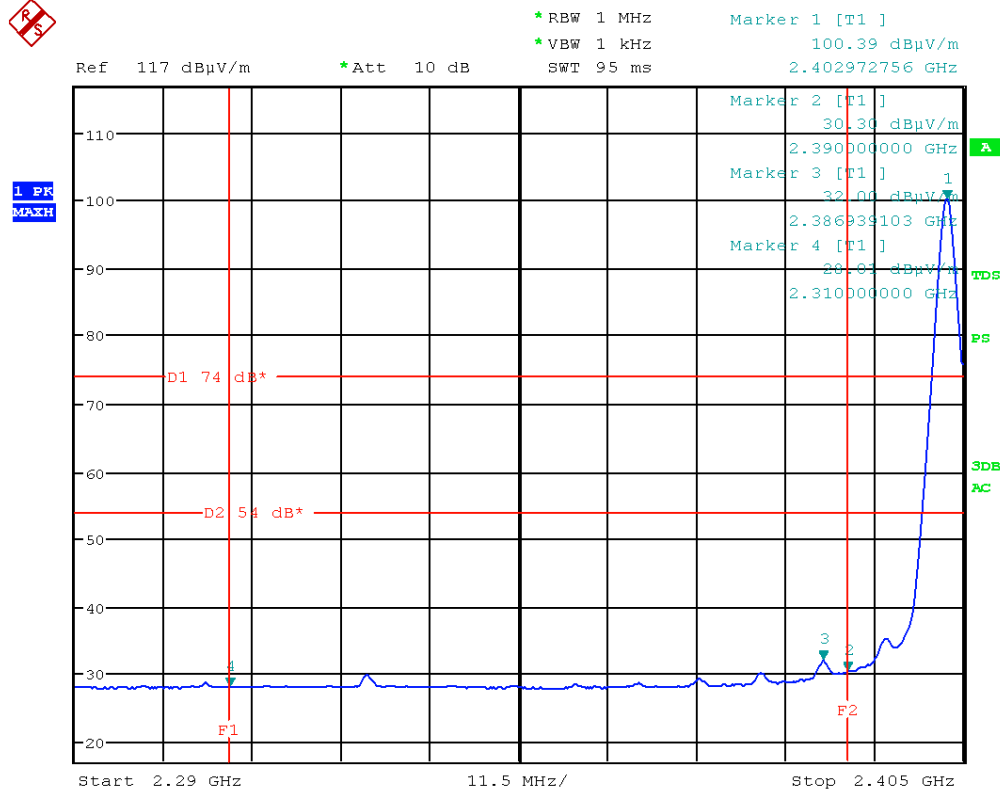
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Picture 19: lower edge (PK)

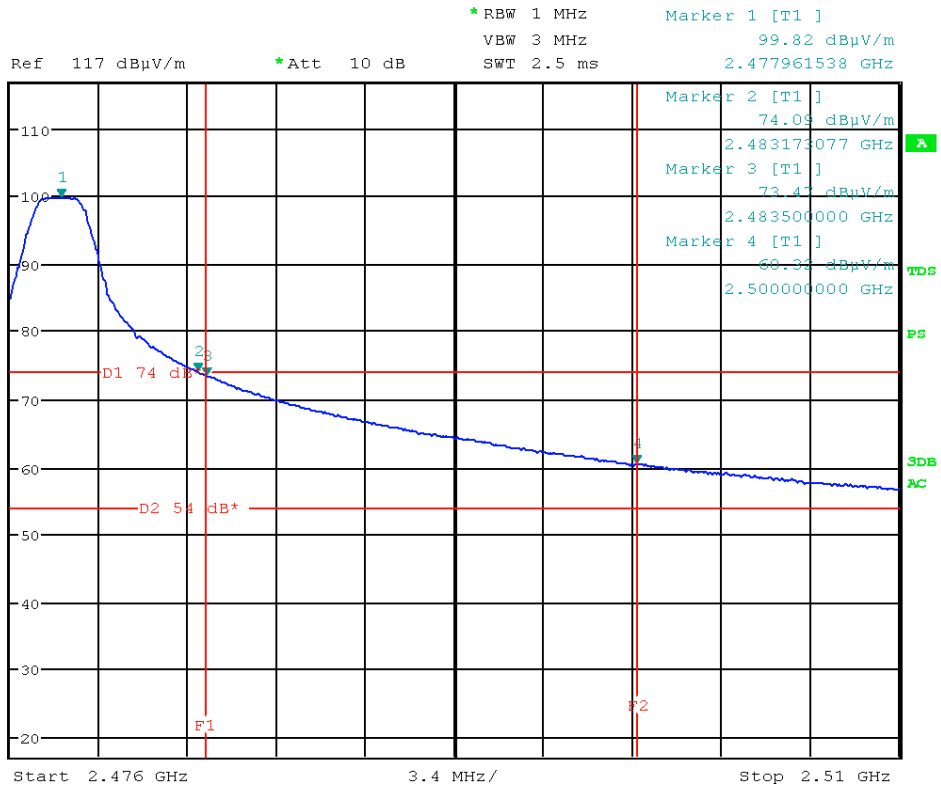


Picture 20: lower edge (AV)

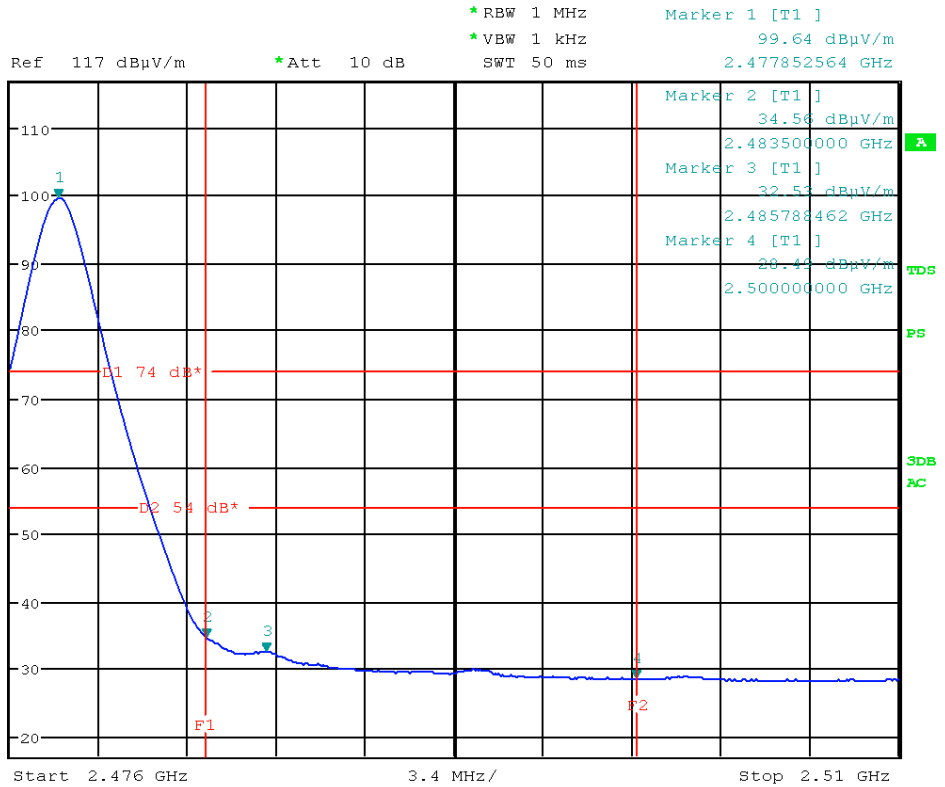


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Picture 21: upper edge (PK)



Picture 22: upper edge (AV)



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8 Radiated emission measurement (<1 GHz)

according to 47 CFR Part 15, sections 15.205(a), 15.209(a), 15.247(d), and Public Notice DA 00-705

8.1 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 area test site	EMV TESTHAUS GmbH	E00354

8.2 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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8.3 Limits

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.

In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequency [MHz]	Field strength Fs [$\mu\text{V}/\text{m}$]	Field strength [dB $\mu\text{V}/\text{m}$]	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

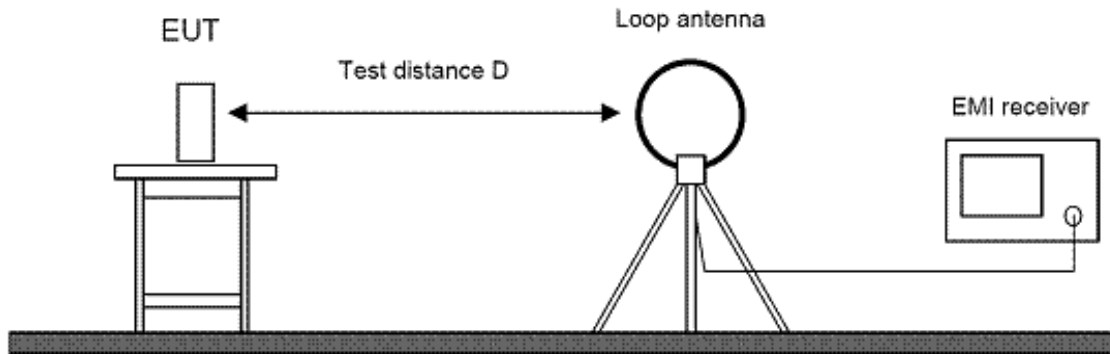
8.4 Test procedure

1. Configure the EUT according to ANSI C63.4. 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 ($360^\circ / 6$) 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.

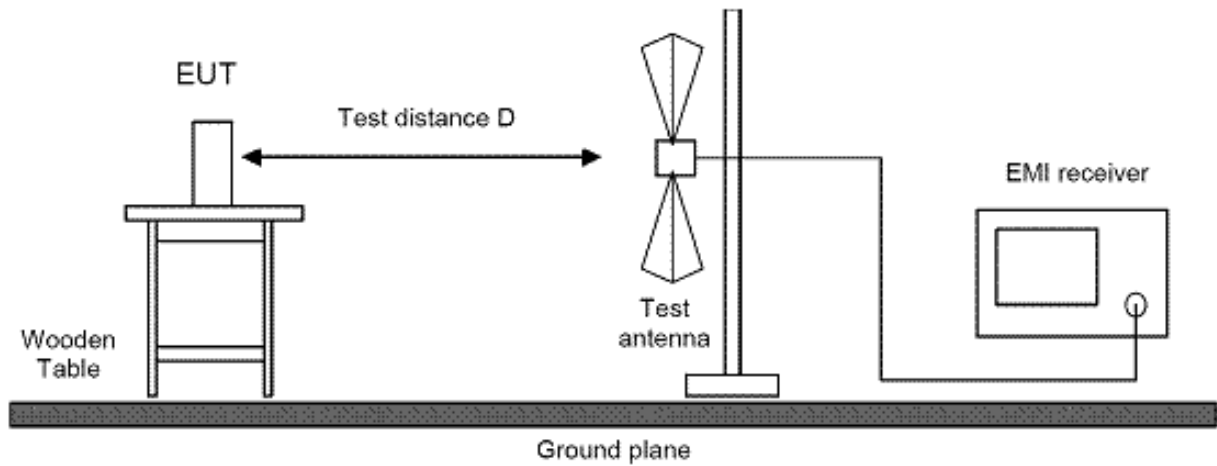


10. For emissions below 30MHz, measurements are performed with a loop antenna. The antenna height is not changed during this test.

8.5 Test setup



Picture 23: Test setup for radiated emission measurement (< 30 MHz)



Picture 24: Test setup for radiated emission measurement (< 1 GHz)

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

Transmit mode

Temperature:	18°C	Humidity:	46%
Tested by:	M. Müller	Test date:	2015-11-09

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 2 in combination with the loop-antenna orientated in parallel to EUT.

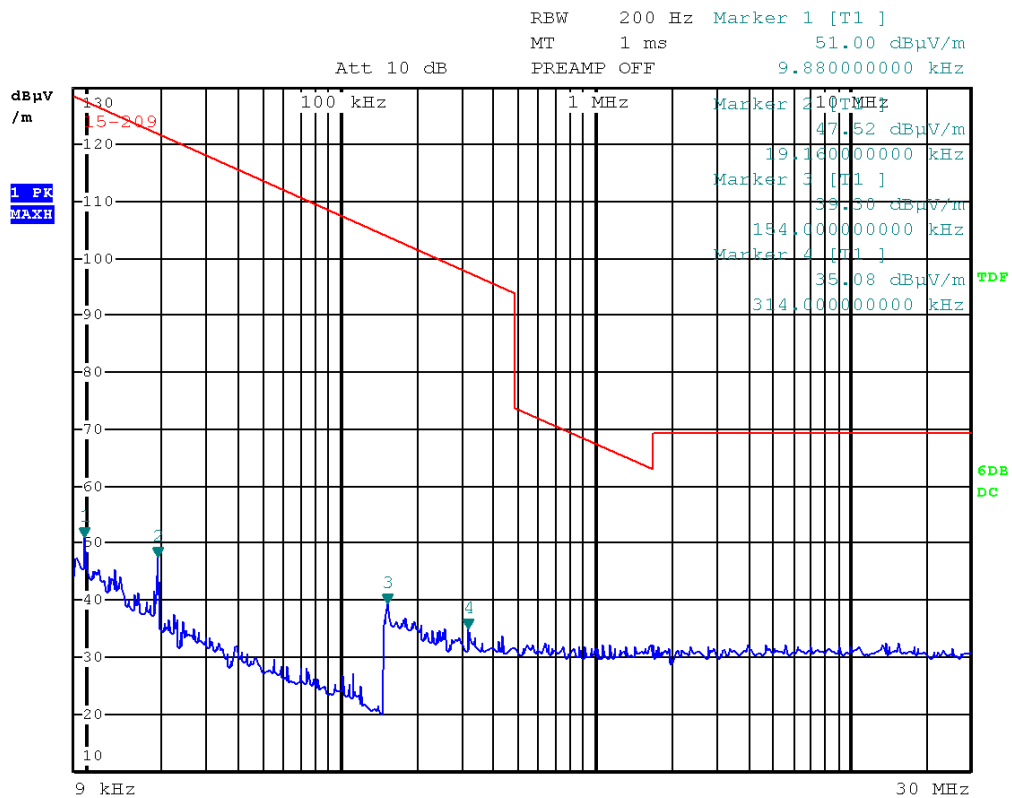


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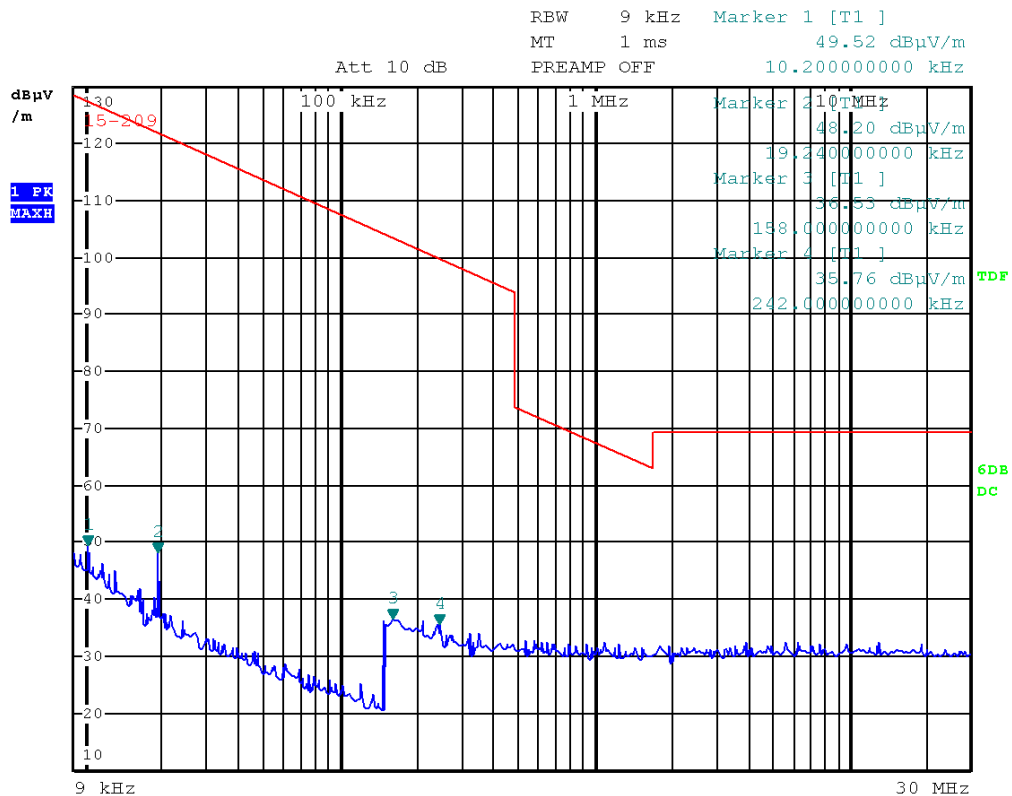
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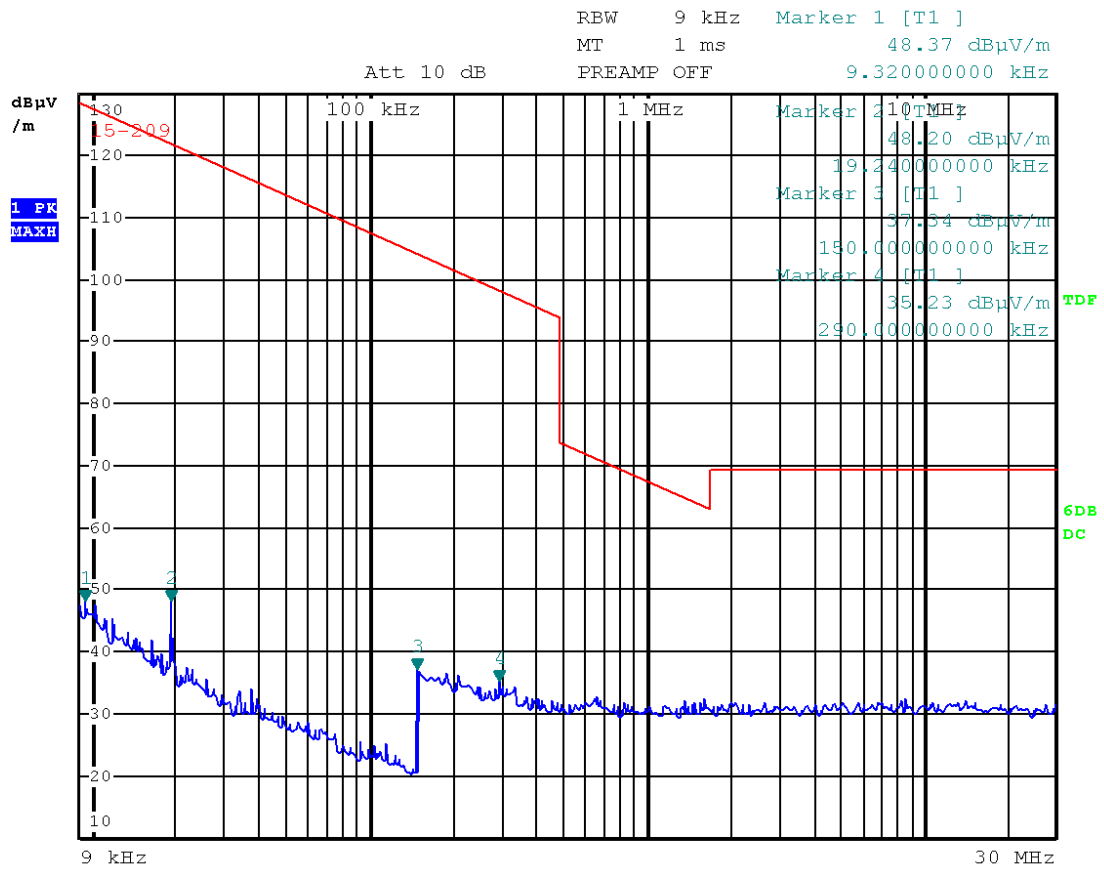
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Picture 25: Radiated emission 9 kHz – 30MHz (Channel low)



Picture 26: Radiated emission 9 kHz – 30MHz (Channel mid)



Picture 27: Radiated emission 9 kHz – 30MHz (Channel high)



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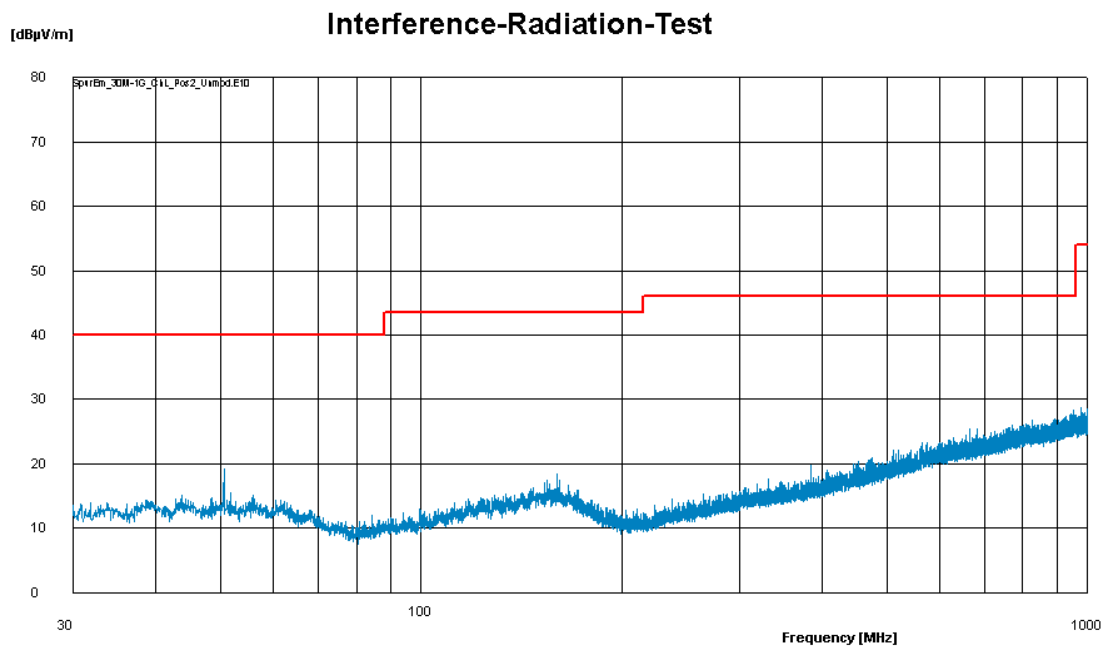
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Transmit mode

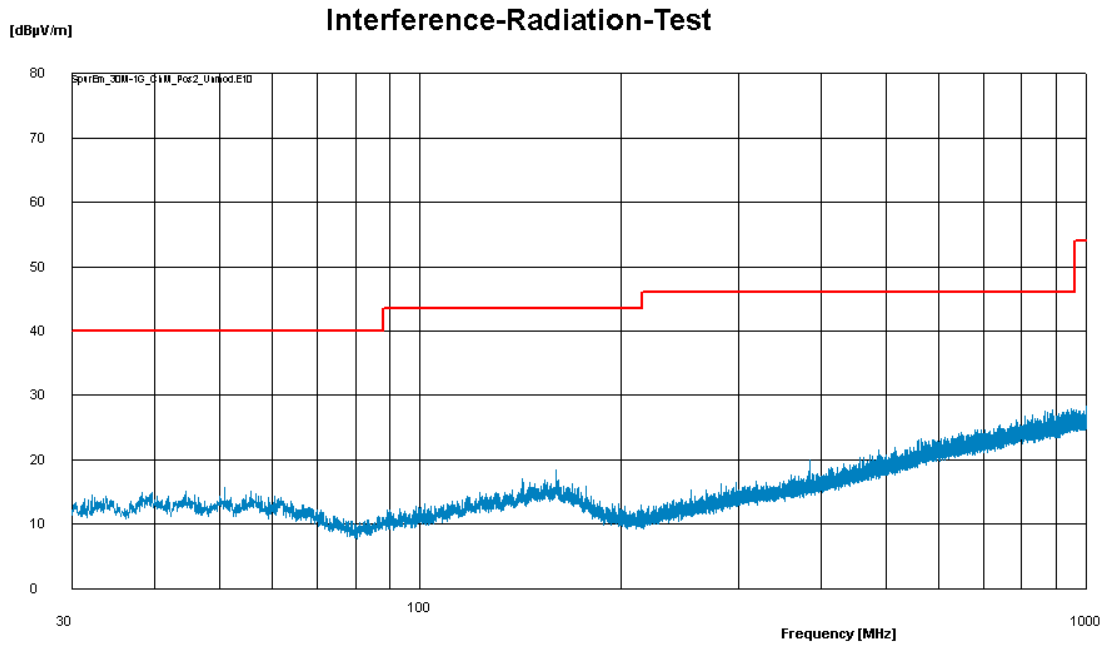
Temperature:	17°C	Humidity:	48%
Tested by:	M. Müller	Test date:	2015-11-06

Radiated Emission Measurement 30 MHz - 1 GHz

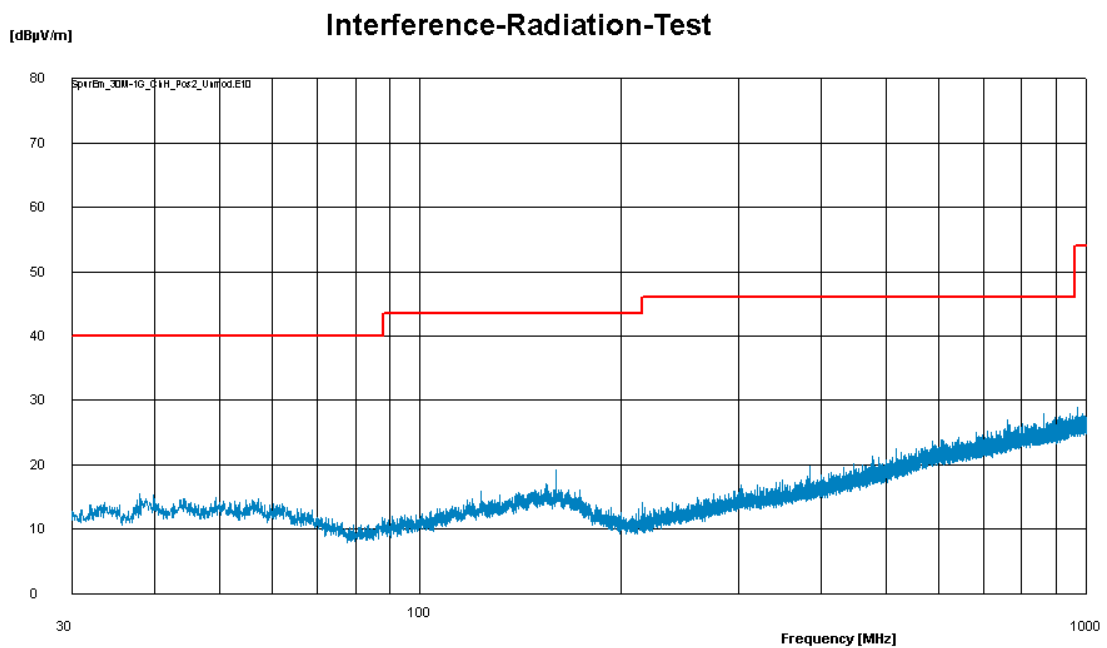
It was investigated that EUT position 2 is the respective worst-case.



Picture 28: Radiated emission 30 MHz – 1000MHz (Channel low)



Picture 29: Radiated emission 30 MHz – 1000MHz (Channel mid)



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

9 Radiated emission measurement (>1 GHz)

according to 47 CFR Part 15, sections 15.205(a), 15.209(a), 15.247(d), and Public Notice DA 00-705

9.1 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

9.2 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
<input checked="" type="checkbox"/>	FSM-2450-85	Miteq	W00092

9.3 Limits

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. 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.

In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.



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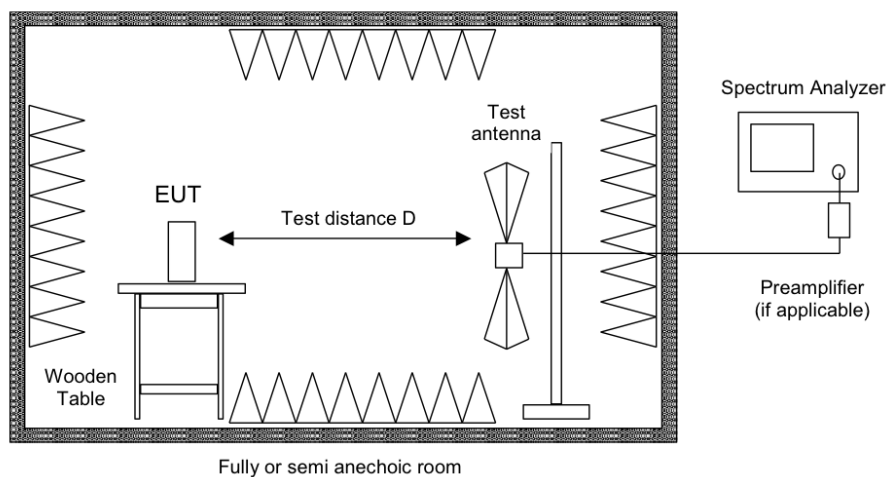
Frequency [MHz]	Field strength Fs [$\mu\text{V/m}$]	Field strength [$\text{dB}\mu\text{V/m}$]	Measurement distance d [m]
30 – 88	100	40	3
88 – 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

9.4 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.



9.5 Test setup



Picture 31: Test setup for radiated emission measurement (> 1 GHz)

9.6 Test deviation

There is no deviation with the original standard.

9.7 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.

9.8 Test results

Temperature:	19°C	Humidity:	47%
Tested by:	M. Müller	Test date:	2015-12-01

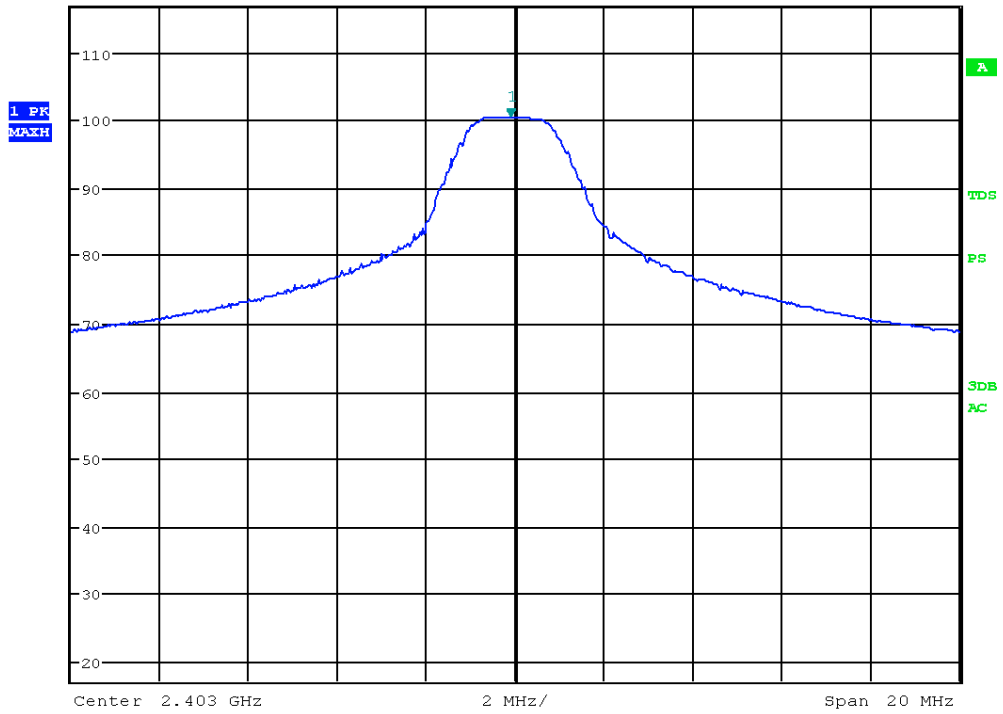
Final Results:

Channel low								
f[GHz]	E _{meas} [dB μ V/m]	Pol	Turntable [°]	Height [cm]	Detector	Restr. Band	Limit [dB μ V/m]	Result
2.40290	100.56	H	77.8	173	PK	No	----	Carrier
2.40287	99.22				AV		----	Carrier
7.20871	58.67	H	147.8	167	PK	No	-20dBc	Pass
7.20874	54.36				AV		-20dBc	Pass





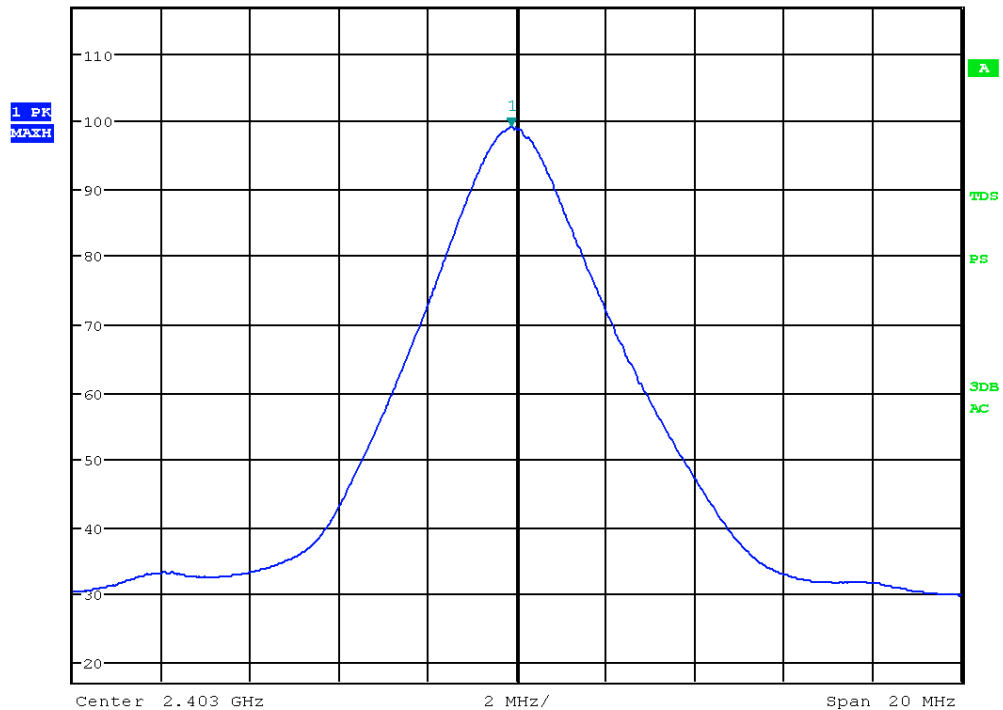
Ref 117 dB μ V/m *Att 10 dB *RBW 1 MHz Marker 1 [T1]
VBW 3 MHz 100.56 dB μ V/m
SWT 2.5 ms 2.402903846 GHz



Picture 32: spurious emission, Channel low - PK



Ref 117 dB μ V/m *Att 10 dB *RBW 1 MHz Marker 1 [T1]
*VBW 10 Hz 99.22 dB μ V/m
SWT 5 s 2.402871795 GHz



Picture 33: spurious emission, Channel low - AV



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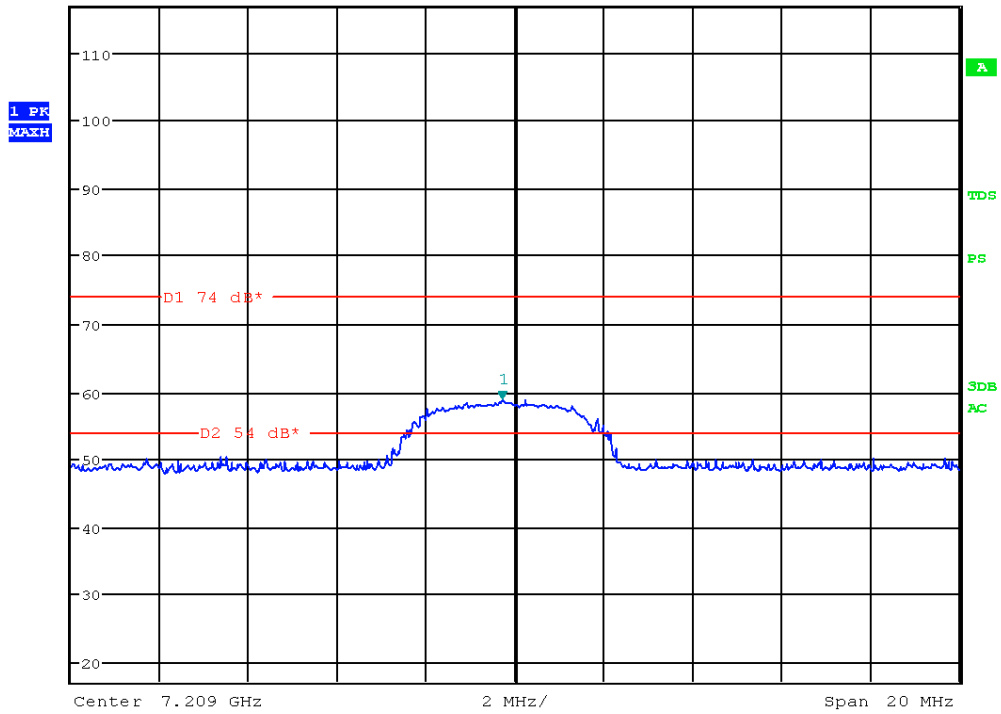
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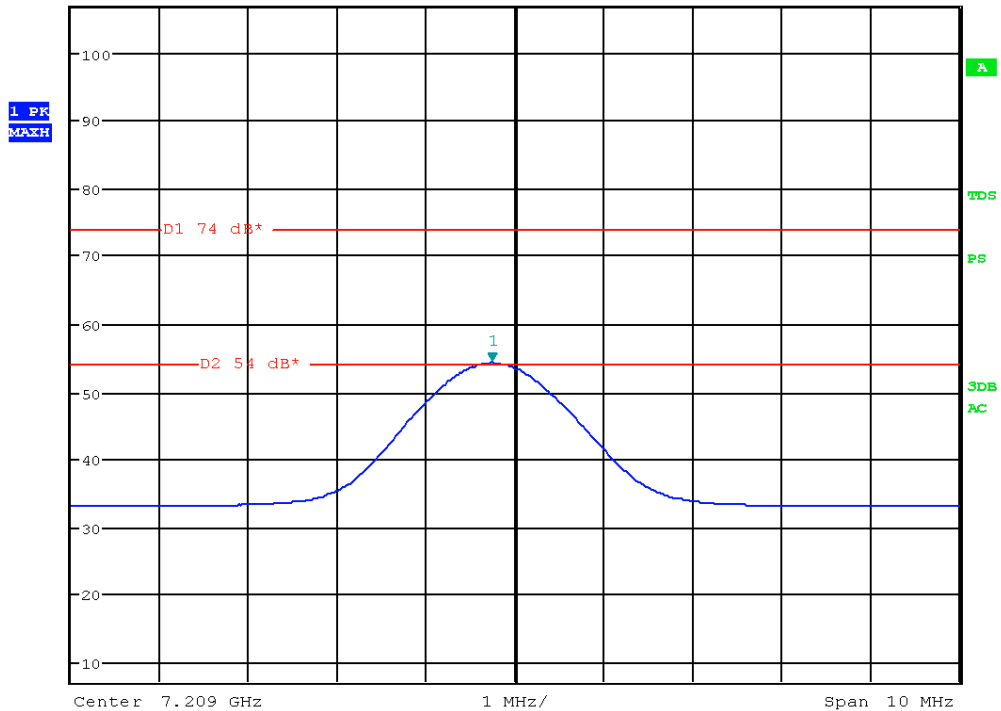
Ref 117 dB μ V/m *Att 10 dB *RBW 1 MHz Marker 1 [T1]
 VBW 3 MHz 58.67 dB μ V/m
 SWT 20 ms 7.208711538 GHz



Picture 34: spurious emission, Channel low - PK



Ref 107 dB μ V/m *Att 10 dB *RBW 1 MHz Marker 1 [T1]
 *VBW 10 Hz 54.36 dB μ V/m
 SWT 2.5 s 7.208743590 GHz



Picture 35: spurious emission, Channel low - AV



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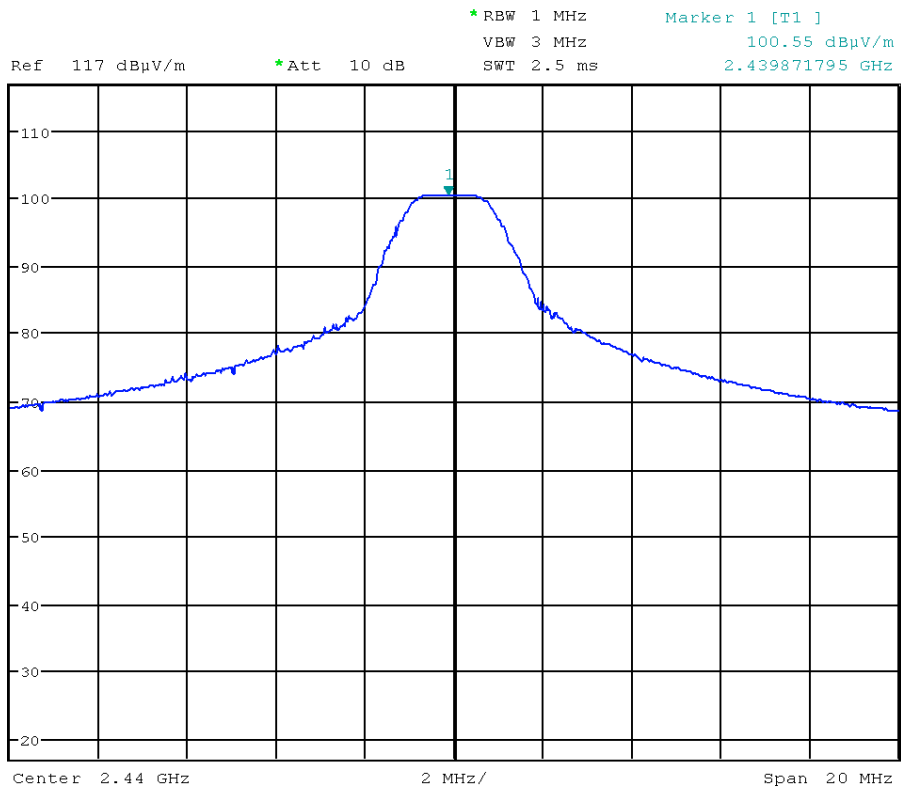
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Channel mid								
f[GHz]	E _{meas} [dB μ V/m]	Ant	Turntable [°]	Hight [cm]	Detector	Restr. Band	Limit [dB μ V/m]	Result
2.43987	100.55	H	77.8	173	PK	No	----	Carrier
2.43997	99.24				AV		----	Carrier
7.31968	55.80	H	152.0	169	PK	Yes	74	Pass
7.31974	49.89				AV		54	Pass

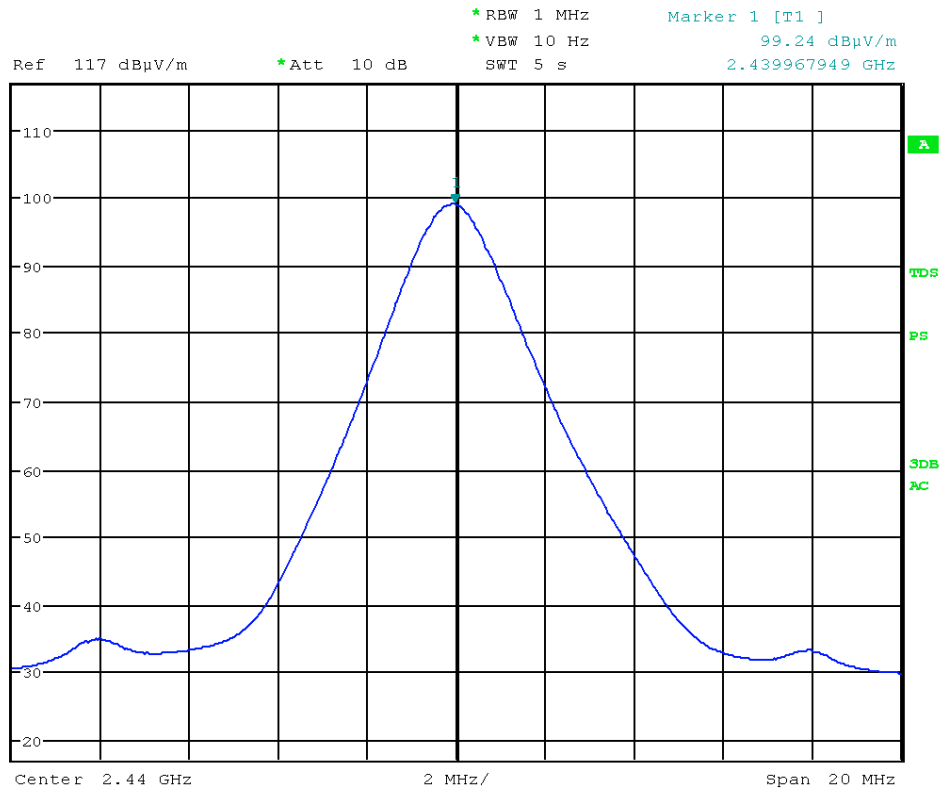


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Picture 36: spurious emission, Channel mid - PK



Picture 37: spurious emission, Channel mid - AV

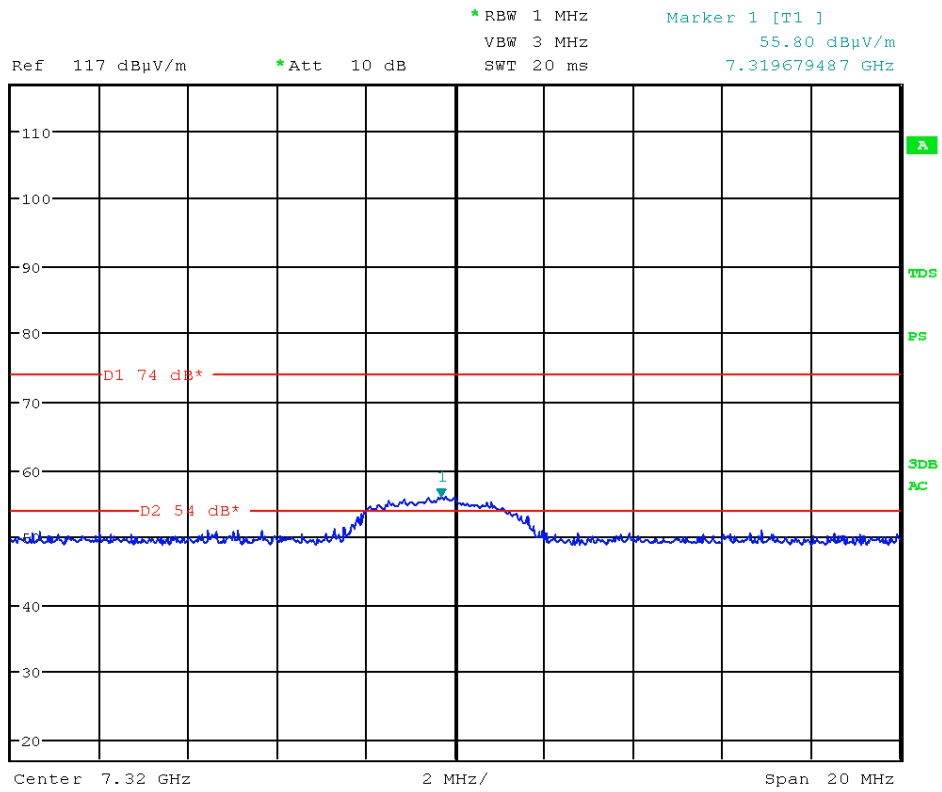


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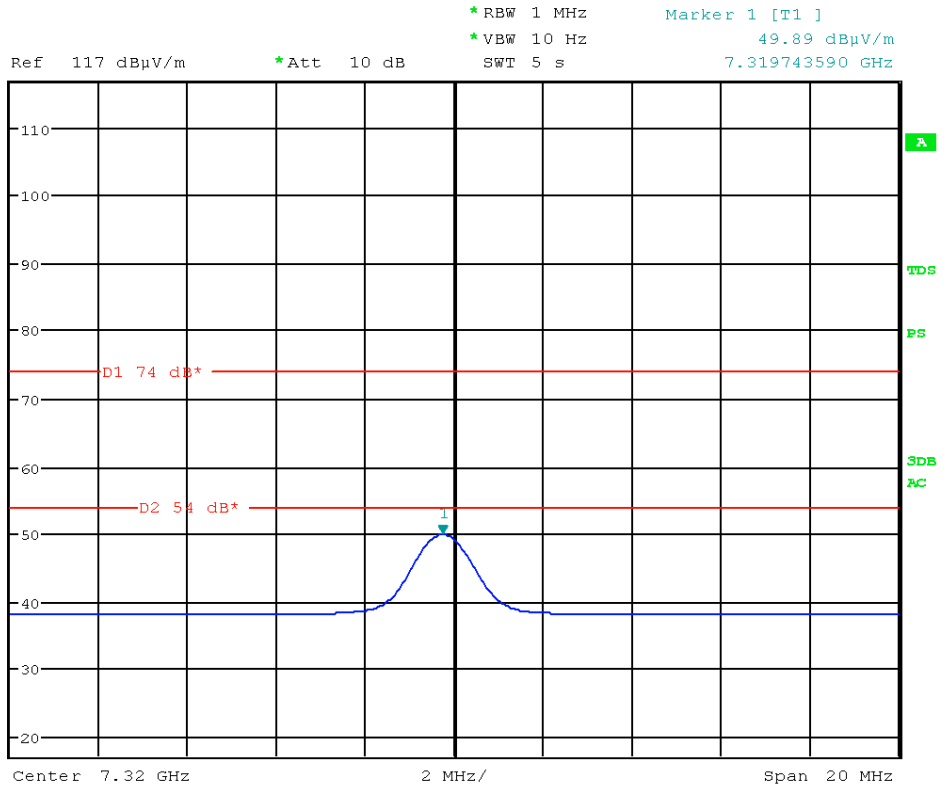
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Picture 38: spurious emission, Channel mid - PK



Picture 39: spurious emission, Channel mid – AV



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Channel high								
f[GHz]	E _{meas} [dB μ V/m]	Ant	Turntable [°]	Hight [cm]	Detector	Restr. Band	Limit [dB μ V/m]	Result
2.47784	99.85	H	77.8	173	PK	No	----	Carrier
2.47787	98.57				AV		----	Carrier

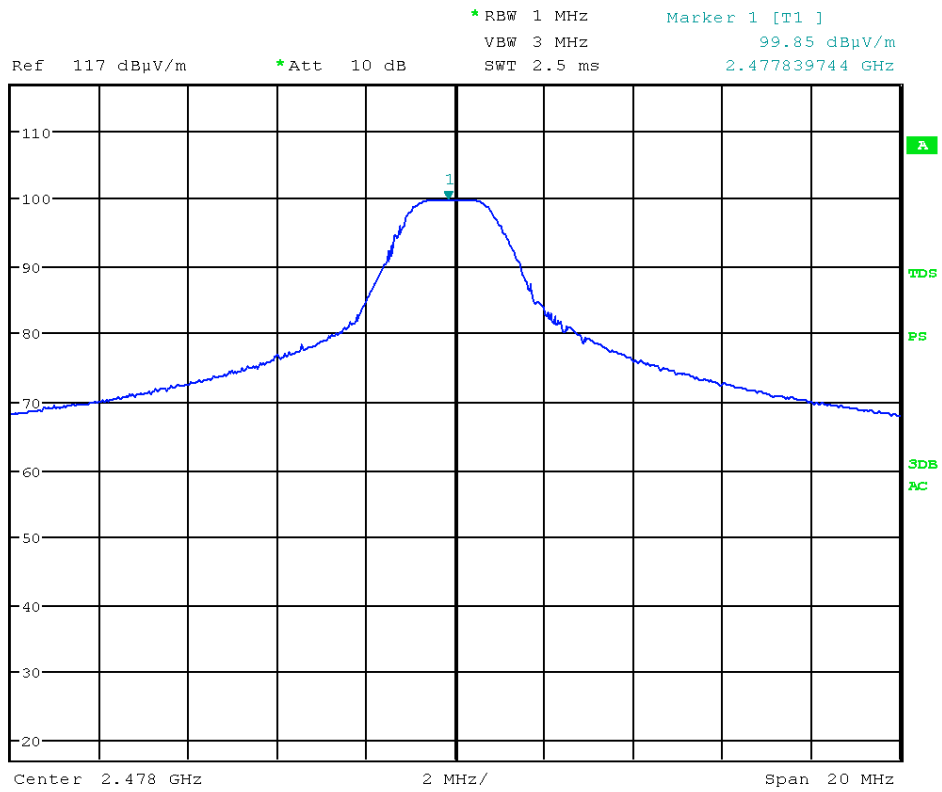


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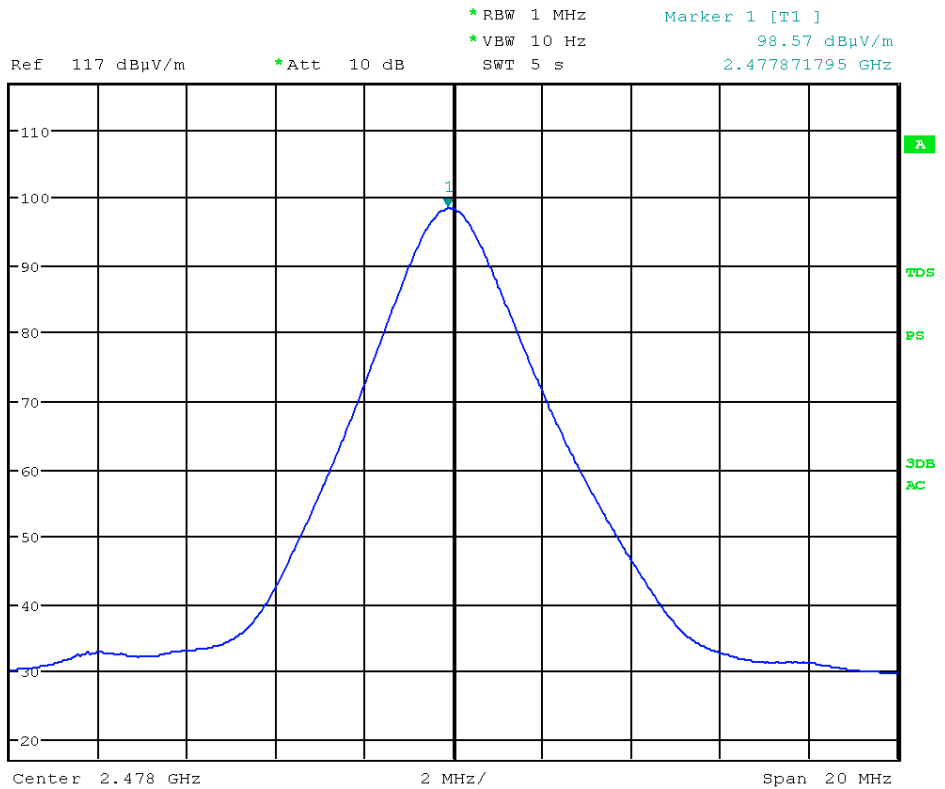
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Picture 40: spurious emission, Channel high - PK



Picture 41: spurious emission, Channel high - AV



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10 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

10.1 Equipment data

Antenna detachable (see antenna specifications):	<input type="checkbox"/> yes	<input checked="" type="checkbox"/> no
Temporary antenna connector:	<input checked="" type="checkbox"/> yes	<input type="checkbox"/> no
Tune-up function:	<input type="checkbox"/> yes	<input checked="" type="checkbox"/> no
Antenna gain G referring to isotropic radiator:	0.0 dBi	Numeric gain: 1.000
Conducted output power CP (maximum):	1.68 dBm	Numeric power: 1.472 mW
Separation distance between user and transmitting device:	<input checked="" type="checkbox"/> R ≤ 20 cm	<input type="checkbox"/> R > 20 cm
Test separation distance Δ_{min} between user and:	<input checked="" type="checkbox"/> antenna	<input type="checkbox"/> outer surface

10.2 SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm and < 5 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: $\frac{1mW \times \sqrt{2.478}}{5mm} = 0.315 < 3.0$

Note: According to section 4.3.1.1 for a minimum test separation distance < 5 mm, worst case distance of 5 mm is applied to determine SAR test exclusion.



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

Limit according to table1:

Frequency (MHz)	Exemption Limit (mW) at separation distance of ≤ 5 mm
2450	4



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11 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



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: Expiry date of measurement facility registration by
- FCC (registration number 221458): 2017-04
 - Industry Canada (test site numbers 3472A-1 and 3472A-2): 2018-11



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12 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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13 Summary

The EMC Regulations according to the marked specifications are

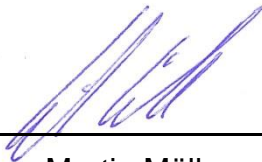
KEPT

The EUT does fulfill the general approval requirements mentioned.

NOT KEPT

The EUT does not fulfill the general approval requirements mentioned.

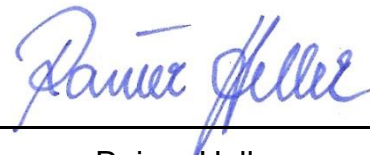
Place, Date: Straubing, December 3rd, 2015



Martin Müller

Test engineer

EMV **TESTHAUS** GmbH



Rainer Heller

Head of EMC / radio department

EMV **TESTHAUS** GmbH



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14 Revision History

Date	Description	Person	Revision
2015-12-03	First edition	M. Müller	----



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