

# Test Report

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## RF test report

100409-AU01+E02



Industry  
Canada Industrie  
Canada

**Arnold & Richter Cine Technik GmbH & Co.  
Betriebs KG**

**RF module**

**EMIP100**



The test result refers exclusively  
to the model tested.

This report must not be copied without  
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Revision: 1.0



Deutscher  
Akkreditierungs  
Rat

DGA-PL-224/95-03 / BNetzA-CAB-02/21-02/2

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## Accreditation:



Registration number: DGA-PL-224/95-03  
CAB (EMC) registration number: BNetzA-CAB-02/21-02/3  
FCC facility registration number: 221458  
MRA US-EU, FCC designation number: DE0010

## Location of Testing:

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Germany

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

CFR 47 Part 2: 01-2010	Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC)
CFR 47 Part 15: 10-2009	Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)
ANSI C63.4: December 2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
RSS-Gen Issue 2 June 2007	General Requirements and Information for the Certification of Radiocommunication Equipment, published by Industry Canada
RSS-102: Issue 4 March 2010	Radio Frequency Exposure Compliance of Radiocommunications Apparatus
RSS-210: Issue 7 June 2007	Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, published by Industry Canada

## 1.1 Summary of test results

Standard	Test result
FCC CFR 47 Part 15	Passed
RSS-210 Issue 7 Annex 8 and RSS-Gen Issue 2	Passed



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## 2 Equipment under Test (EUT)

Product type: RF module  
Model Name: EMIP100  
Manufacturer: Arnold & Richter Cine Technik GmbH & Co. Betriebs KG  
Serial number: N/A  
FCC ID: Y7N-EMIP100  
IC: 9482A-EMIP100  
Application freq. band: 2400 MHz - 2483.5 MHz  
Frequency range: 2.405634 GHz - 2.480570 GHz  
Operating frequency: 2.405634 GHz - 2.480570 GHz  
Number of RF-channels: 16  
Modulation: DSSS  
Antenna type: Dipole antenna  
☒ detachable ☐ not detachable  
with MMCX connector  
Power supply: Host powered  
nominal: 5.0 VDC  
Temperature range: -20°C to +55°C

### 2.1 List of antennas

For detailed specification see annex C.

Manufacturer	Model	Gain
Nearson	S131AH-2450S	2dBi
PCTEL Unity Gain	MMSO2300	0dBi



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## 2.2 Photo documentation

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

## 2.3 Short description of the EUT

The EUT is a radio frequency module connected to a video camera for establishing a control link between multiple devices on a film set.

## 2.4 Operation mode

The EUT was tested in the following operation modes:

- Connect module to DC power supply and power on RF module
- Establish a serial connection with the RF module
- Adjust settings of RF module (menu structure below):
  - 1 - CHANGE CHANNEL
    - 0 - CHANNEL 11      8 - CHANNEL 19
    - 1 - CHANNEL 12      9 - CHANNEL 20
    - 2 - CHANNEL 13      A - CHANNEL 21
    - 3 - CHANNEL 14      B - CHANNEL 22
    - 4 - CHANNEL 15      C - CHANNEL 23
    - 5 - CHANNEL 16      D - CHANNEL 24
    - 6 - CHANNEL 17      E - CHANNEL 25
    - 7 - CHANNEL 18      F - CHANNEL 26
  - 2 - ADJUST OUTPUT POWER
    - Current Power: 09
    - Please enter the new Power, 0x00 for minimum and to 0x12 for maximum: 09
  - 3 - SELECT TEST MODE
    - I - IDLE
    - T - CONTINUOUS TRANSMISSION
      - S - PULSE PSEUDO RANDOM BINARY SEQUENCE TRANSMISSION
      - M - MODULATED TRANSMISSION
      - U - UNMODULATED TRANSMISSION
    - P - PACKET ERROR RATE TRANSMITTER
    - r - RANGE TEST TRANSMITTER
    - R - RECEPTION

The standard operating mode is **CONTINUOUS MODULATED TRANSMISSION** with power set to **09** on channels 11 to 26.



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## 2.5 Configuration

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

Device	Model:	S/N
RF module	EMIP100	N/A
19" LCD monitor	Belinea 1019	N/A
Test Notebook	Pro 600 IW	N/A
AC power supply	SADP-65KB AD	N/A
Test PC-System 1	Fujitsu Siemens Esprimo P9900	YL6K001108
USB Mouse	Microsoft	N/A
PS/2 Keyboard	Maxdata	N/A
DC power supply	Statron 3231.1	0702007

## Used cables

Numbers:	Description: (type / lengths / remarks)	Serial No
1	RF connection cable with MMCX adaptor, shielded, 50 cm	N/A
2	AC cable, unshielded, 1.5m	N/A
2	Measuring cables, unshielded, 1.5 m	N/A
1	DVI cable, shielded, 1.5 m	N/A



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# 3 AC power line conducted emissions

according to CFR 47 Part 15, section 15.207

## 3.1 Test location

Description	Manufacturer	Inventory No.
Shielded chamber	Siemens - Matsushita	E00107

## 3.2 Test instruments

	Description	Manufacturer	Inventory No.
<input checked="" type="checkbox"/>	ESCS 30	Rohde & Schwarz	E00003
<input type="checkbox"/>	ESCI	Rohde & Schwarz	E00001
<input checked="" type="checkbox"/>	ESH3 Z2	Rohde & Schwarz	E00028
<input checked="" type="checkbox"/>	ESH 2-Z5	Rohde & Schwarz	E00004
<input checked="" type="checkbox"/>	ESH 2-Z5	Rohde & Schwarz	E00005

## 3.3 Limits

Frequency [MHz]	Quasi-peak [dB $\mu$ V]	Average [dB $\mu$ V]
0.15 – 0.5	66 - 56	56 – 46
0.5 – 5.0	56	46
5 – 30	60	50

## 3.4 Test procedure

1. The tests of conducted emission were carried out in a shielded room using a line impedance stabilization network (LISN) 50  $\mu$ H/50 Ohms and an EMI test receiver.
2. The EMI test receiver was connected to the LISN and set to a measurement bandwidth of 9 kHz in the frequency range from 0.15 MHz to 30 MHz.
3. The EUT was placed on a wooden table and connected to the LISN.
4. To accelerate the measurement the detector of the EMI test receiver was set to peak and the whole frequency range from 0.15 MHz to 30 MHz were scanned.
5. After that all peaks values with fewer margins than 10 dB to quasi-peak limit or exceeding the limit were marked and re-measured with quasi-peak detector.
6. If after that all values are under the average limit no addition measurement is necessary. In case there are still values between quasi-peak and average limit than these values were re-measured again with an average detector.
7. These measurements were done on all current carrying conductors.

According to ANSI C63.4, section 13.1.3.1 testing of intentional radiators with detachable antennas shall be done with a dummy load otherwise the tests should be done with connected antenna and if adjustable fully extended.



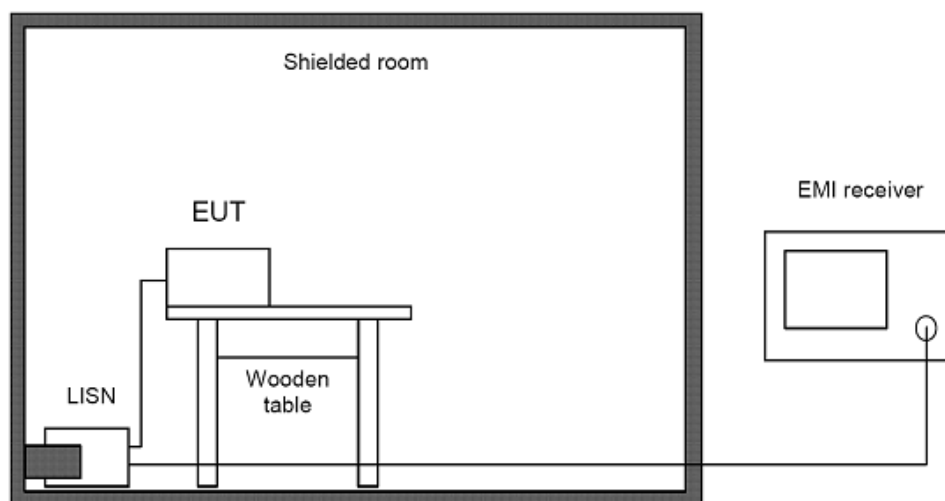
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### 3.5 Test setup



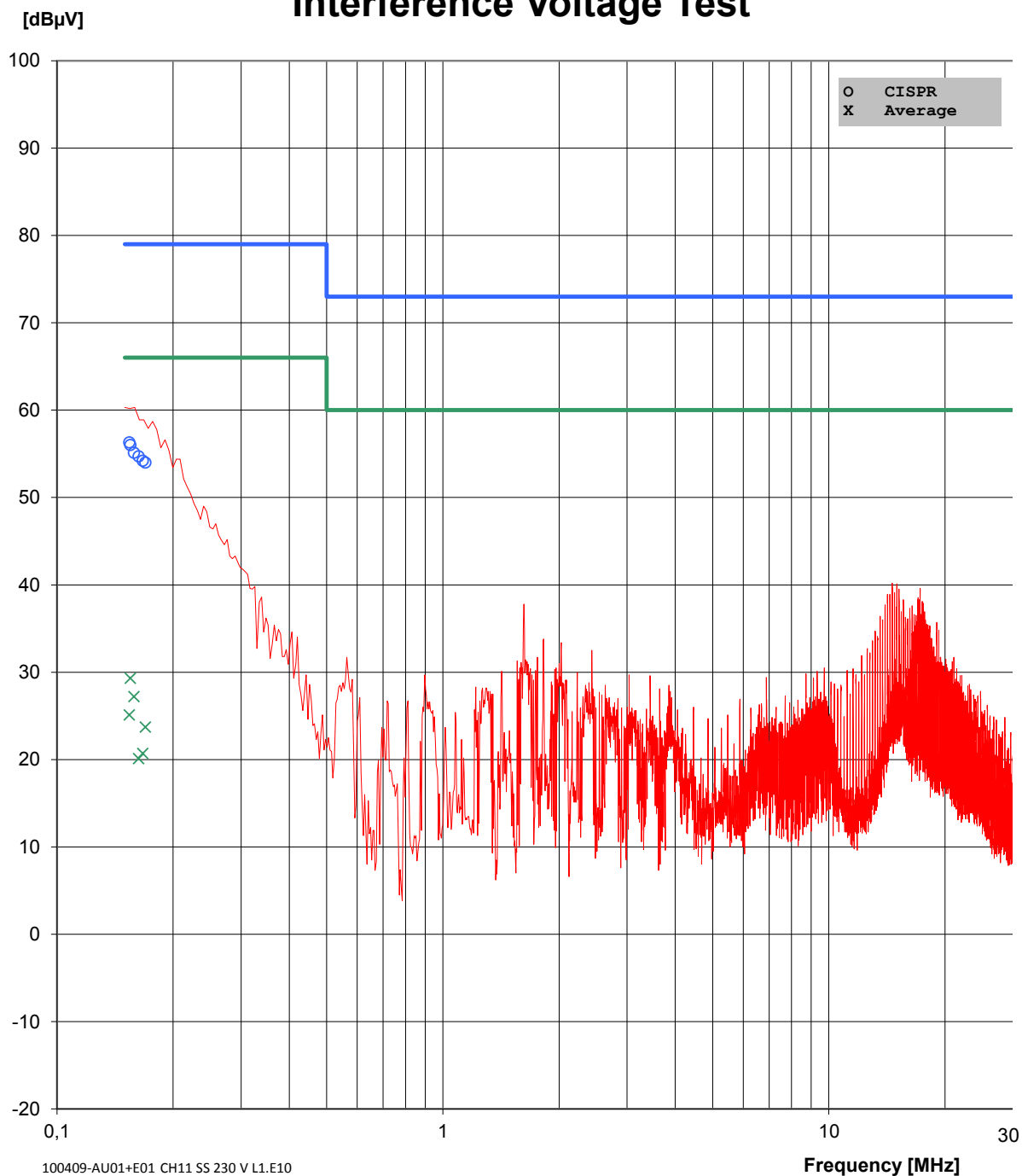
Picture 1: Outline of conducted emission test setup

Comments: All peripheral devices were additionally decoupled by means of a line stabilization network.

### 3.6 Test results

Temperature:	22°C	Humidity:	44%
Tested by:	M. Janker	Test date:	2010-11-19

# Interference Voltage Test



Picture 2: Conducted emission on mains, phase 1 (Chart)

## Interference Voltage Test

Freq. [MHz]	U_CISPR [dBμV]	Limit [dBμV]	delta_U [dB]	U_AV [dBμV]	Limit [dBμV]	delta_U [dB]	Corr. [dB]	Remark
0,16	56,0	79,0	23,0	29,3	66,0	36,7	0,0	100409-AU01+E01_CH11_SS_230_V
0,17	54,0	79,0	25,0	23,7	66,0	42,3	0,0	L1.E10
0,15	56,3	79,0	22,7	25,1	66,0	40,9	0,0	
0,16	55,1	79,0	23,9	27,2	66,0	38,8	0,0	
0,16	54,7	79,0	24,3	20,1	66,0	45,9	0,0	
0,17	54,2	79,0	24,8	20,7	66,0	45,3	0,0	

Picture 3: Conducted emission on mains, phase 1 (Table)



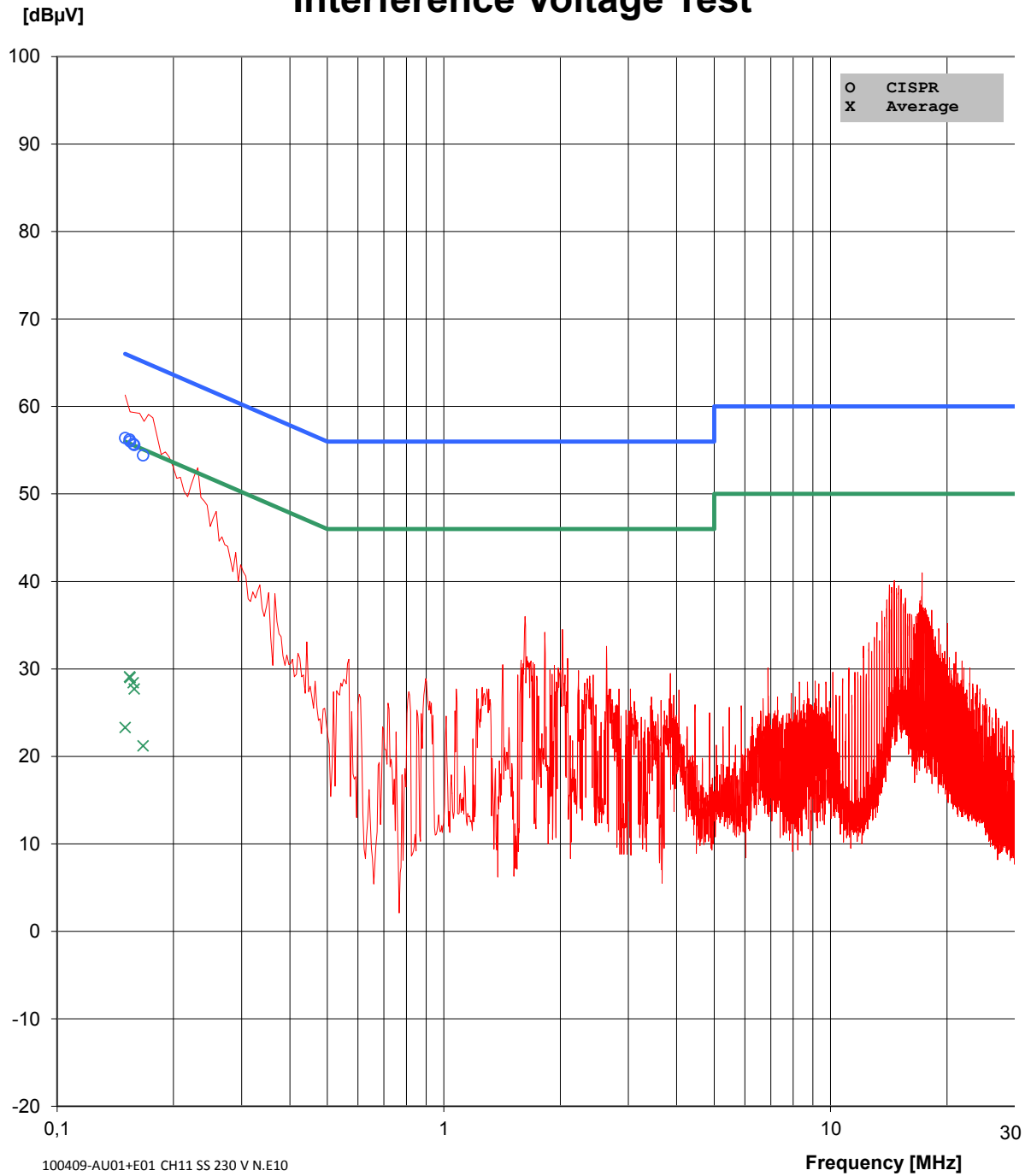
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# Interference Voltage Test



Picture 4: Conducted emission on mains, neutral (Chart)

## Interference Voltage Test

Freq. [MHz]	U_CISPR [dBμV]	Limit [dBμV]	delta_U [dB]	U_AV [dBμV]	Limit [dBμV]	delta_U [dB]	Corr. [dB]	Remark
0,15	56,4	66,0	9,6	23,3	56,0	32,7	0,0	100409-AU01+E01_CH11_SS_230_V
0,15	56,0	65,8	9,8	29,0	55,8	26,8	0,0	N.E10
0,15	56,2	65,5	9,3	29,1	55,5	26,4	0,0	
0,16	55,6	65,3	9,7	27,7	55,3	27,6	0,0	
0,16	55,7	64,8	9,1	28,4	54,8	26,4	0,0	
0,17	54,4	64,6	10,2	21,2	54,6	33,4	0,0	

Picture 5: Conducted emission on mains, neutral (Table)



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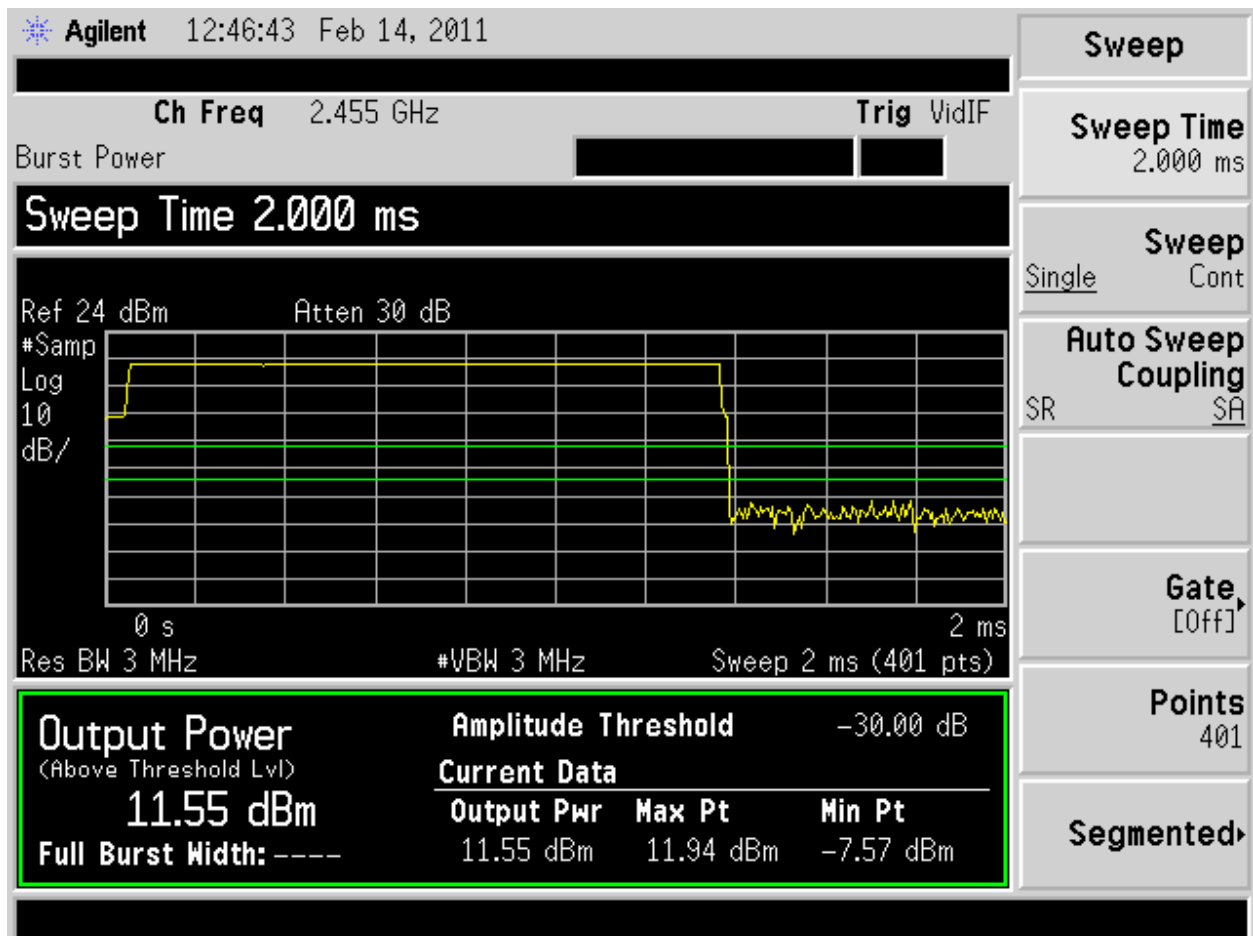
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## 4 Duty cycle / Averaging factor

The duty cycle was declared by the applicant.

$$T_{on} = 13 \cdot 1,405ms = 18,26ms$$



Picture 6: Duty cycle ( $T_{on}$ )

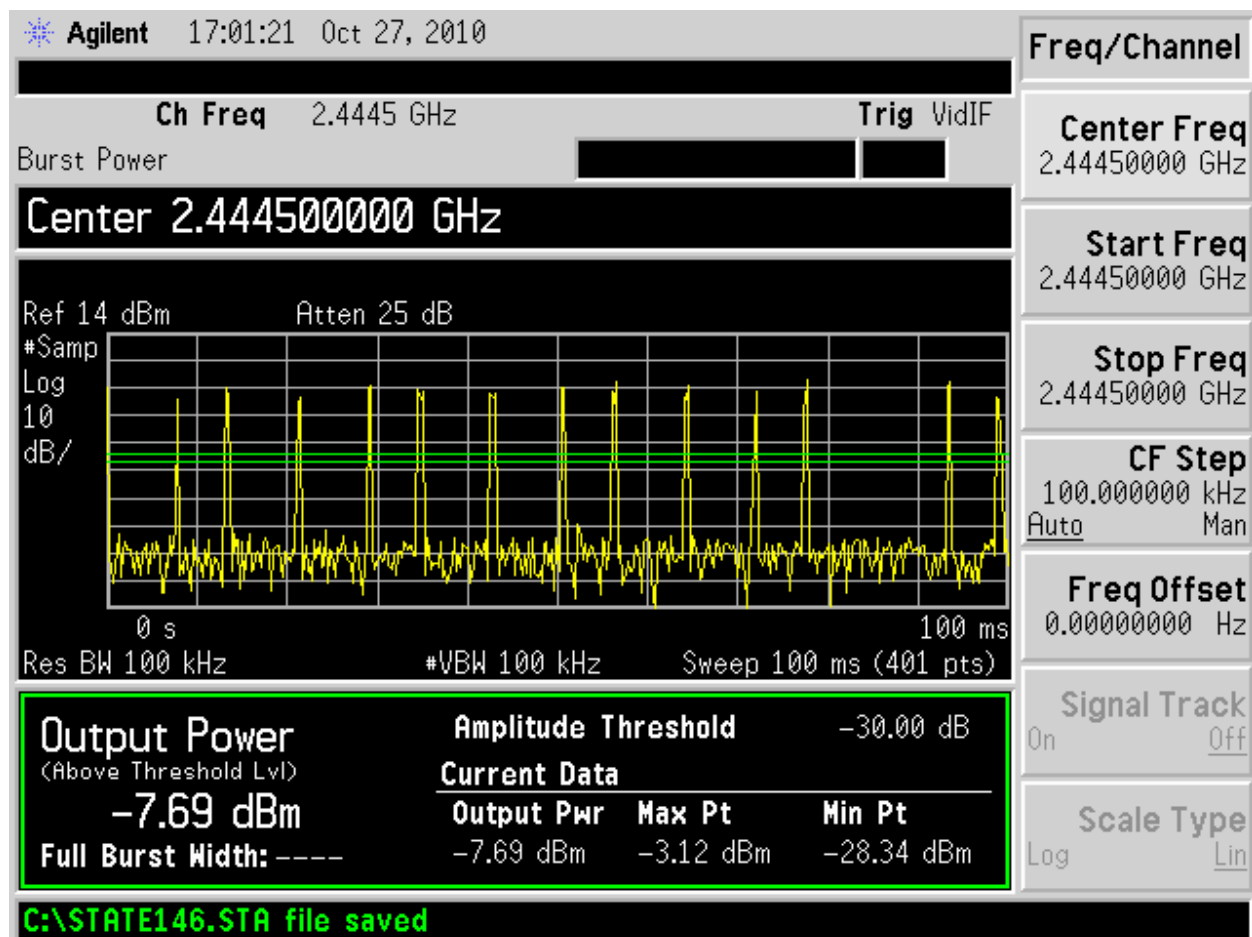
Duty cycle calculation for field strength measurements:

$$CF(dB) = 20 \log \left( \frac{T_{on}}{T_{on+off}} \right) = 20 \log \left( \frac{18,26}{100} \right) = -14,7dB$$

Duty cycle calculation for power measurements:

$$CF(dB) = 10 \log \left( \frac{T_{on}}{T_{on+off}} \right) = 10 \log \left( \frac{18,26}{100} \right) = -7,4dB$$





Picture 7: Duty cycle

# 5 Maximum conducted output power

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

## 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.
CDC	Albatross Projects	E00026
Open area test site	EMV <b>TESTHAUS</b> GmbH	E00354

## 5.2 Test instruments

	Description	Manufacturer	Inventory No.
<input type="checkbox"/>	ESCS 30 (FF)	Rohde & Schwarz	E00003
<input checked="" type="checkbox"/>	ESU	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 in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands is 1 Watt (30dBm).

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.

## 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.



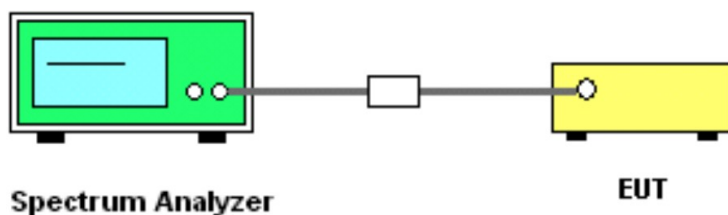
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## 5.5 Test setup



Picture 8: Test setup for conducted output power measurement

## 5.6 Test deviation

There is no deviation with the original standard.

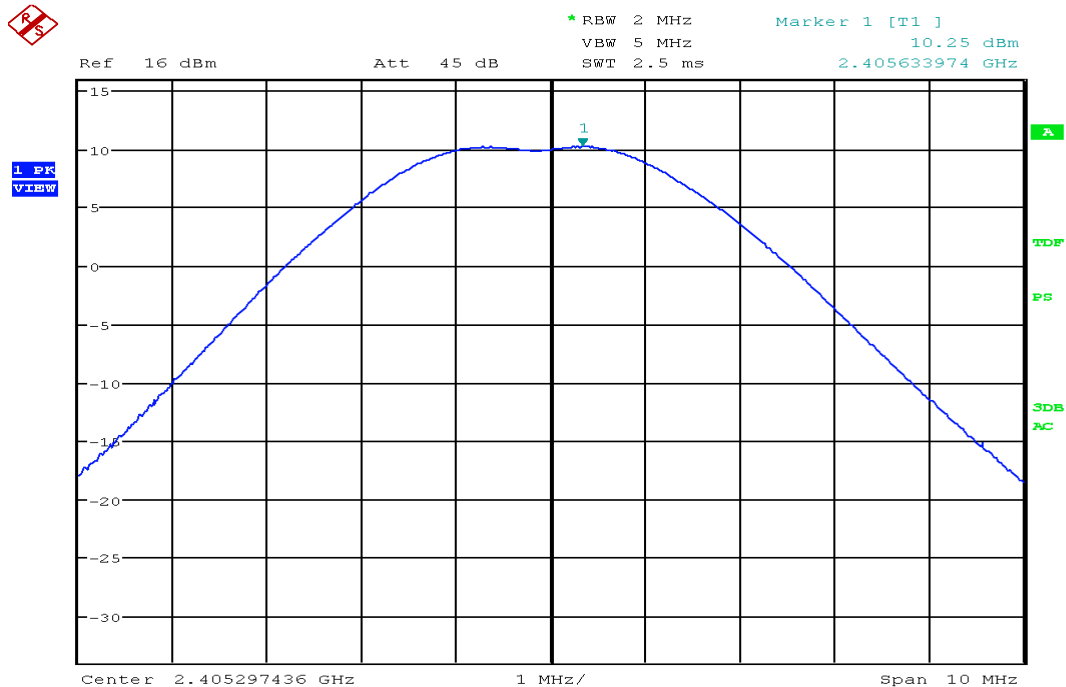
## 5.7 EUT operation during Test

The EUT was programmed to be in continuously transmitting mode.

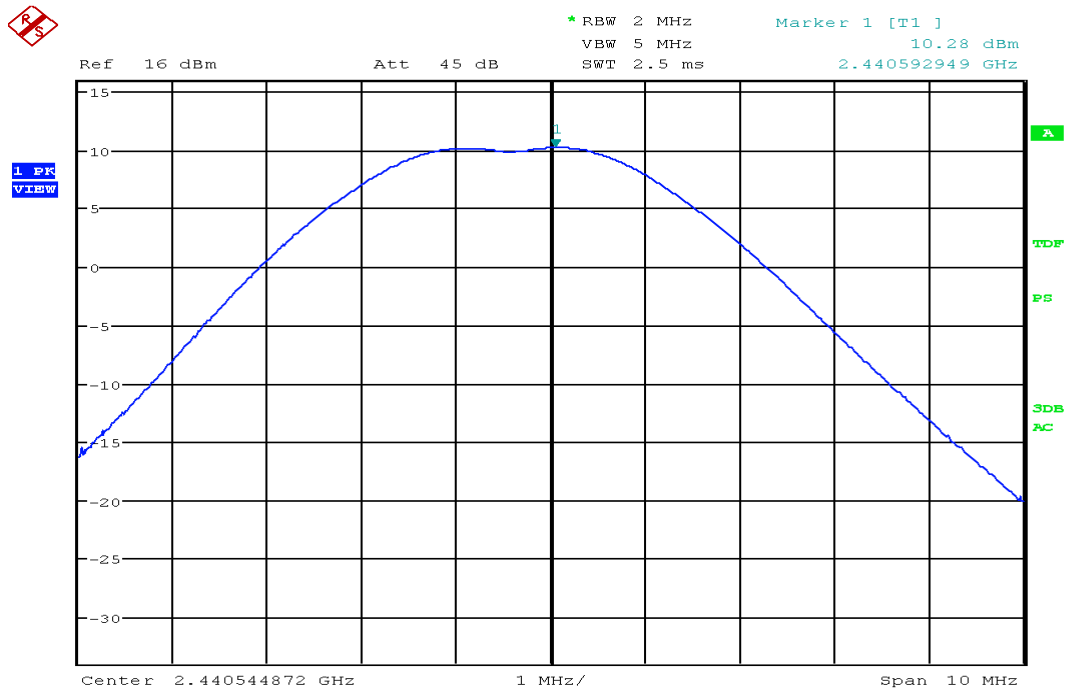
## 5.8 Test results

Temperature:	22°C	Humidity:	44%
Tested by:	M. Janker	Test date:	2010-11-19

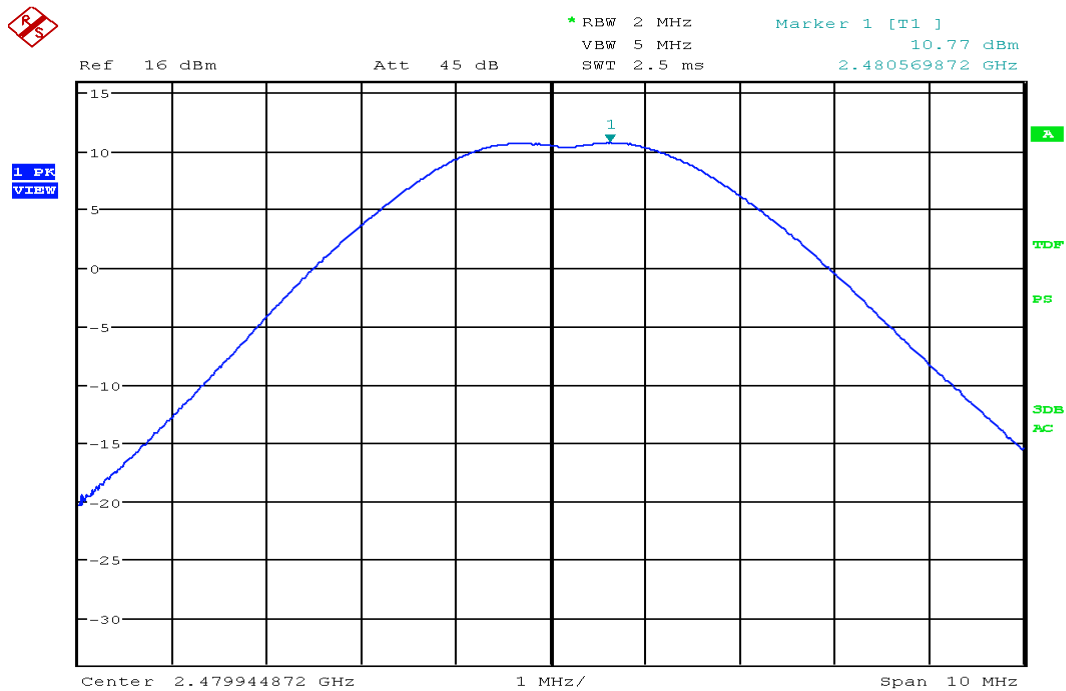
Channel	Frequency (GHz)	Reading (dBm)	Detector	Correction factor (dB)	Conducted power (dBm)	Limit (dBm)	Result
11	2.405634	10.25	Peak		2.85		PASS
18	2.440593	10.28	Peak	-7.4	2.88	30	PASS
26	2.480570	10.77	Peak		3.37		PASS



Picture 9: Conducted output power channel 11



Picture 10: Conducted output power channel 18



Picture 11: Conducted output power channel 26

# 6 Power spectral density measurement

according to CFR 47 Part 15 section 2.247(e)

## 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.
CDC	Albatross Projects	E00026
Open area test site	EMV <b>TESTHAUS</b> GmbH	E00354

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

## 6.4 Test procedure

1. The test is performed in accordance with FCC Public Notice KBD 558074
2. The transmitter output (antenna port) was connected to the spectrum analyser.
3. The unit was operated in continuous transmit mode with modulation.
4. Set RBW of spectrum analyzer to 3kHz and VBW to 10kHz. Set Detector to Peak, Trace to Max Hold.
5. Set the span to 1.5MHz and the sweep time to 500s and record the maximum peak value.
6. Mark the frequency with maximum peak power as the center of the display of the spectrum.



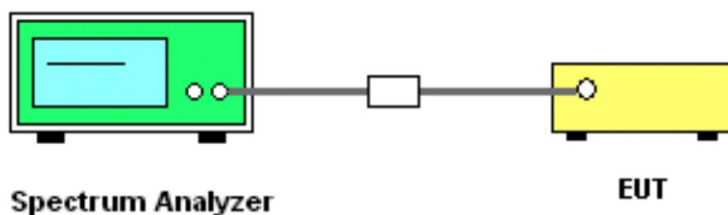
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## 6.5 Test setup



Picture 12: Test setup for power spectral density measurement

## 6.6 Test Deviation

There is no deviation with the original standard.

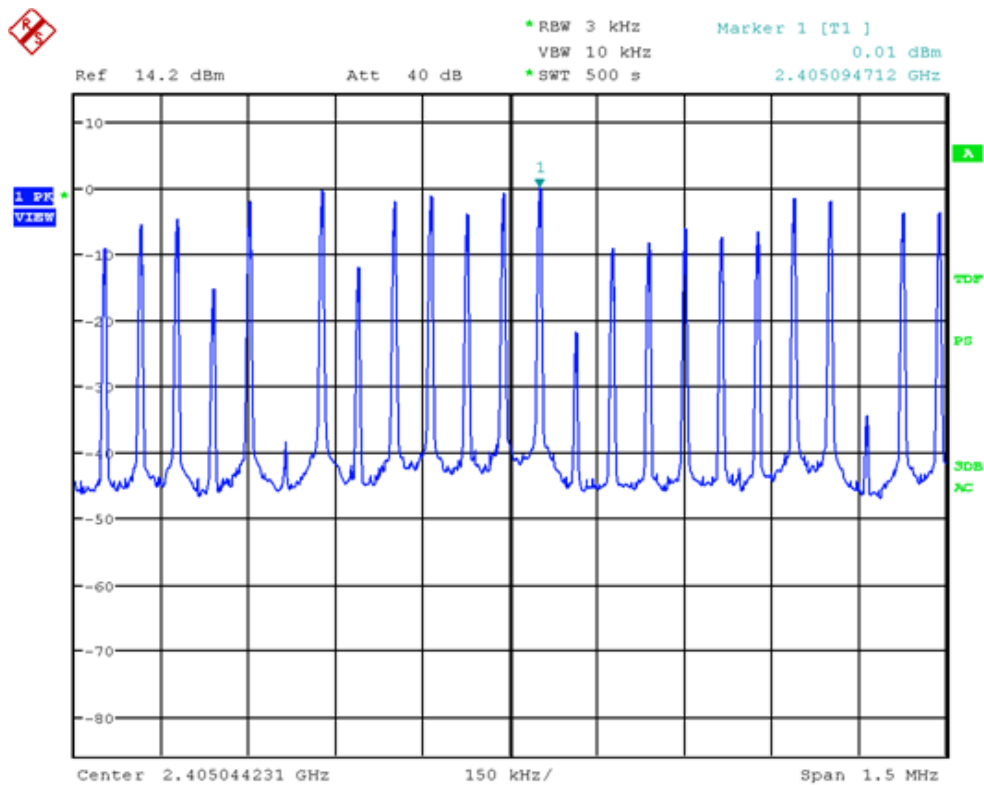
## 6.7 EUT operation during test

The EUT was programmed to be in continuously transmitting mode.

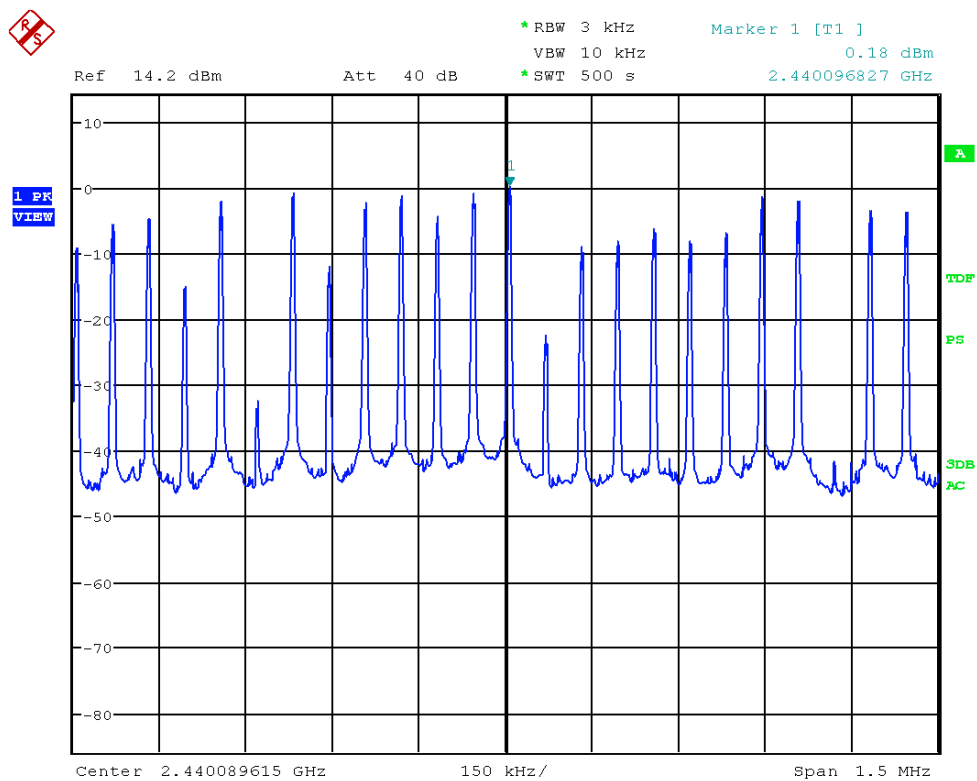
## 6.8 Test results

Temperature:	23°C	Humidity:	41%
Tested by:	M. Janker	Test date:	2010-10-26

Channel	Frequency (GHz)	Reading (dBm)	Detector	Correction factor (dB)	Spectral density (dBm)	Limit (dBm)	Result
11	2.40509	0.01	Peak		-7.39		PASS
18	2.44010	0.18	Peak	-7.4	-7.22	8.0	PASS
26	2.48010	0.28	Peak		-7.12		PASS

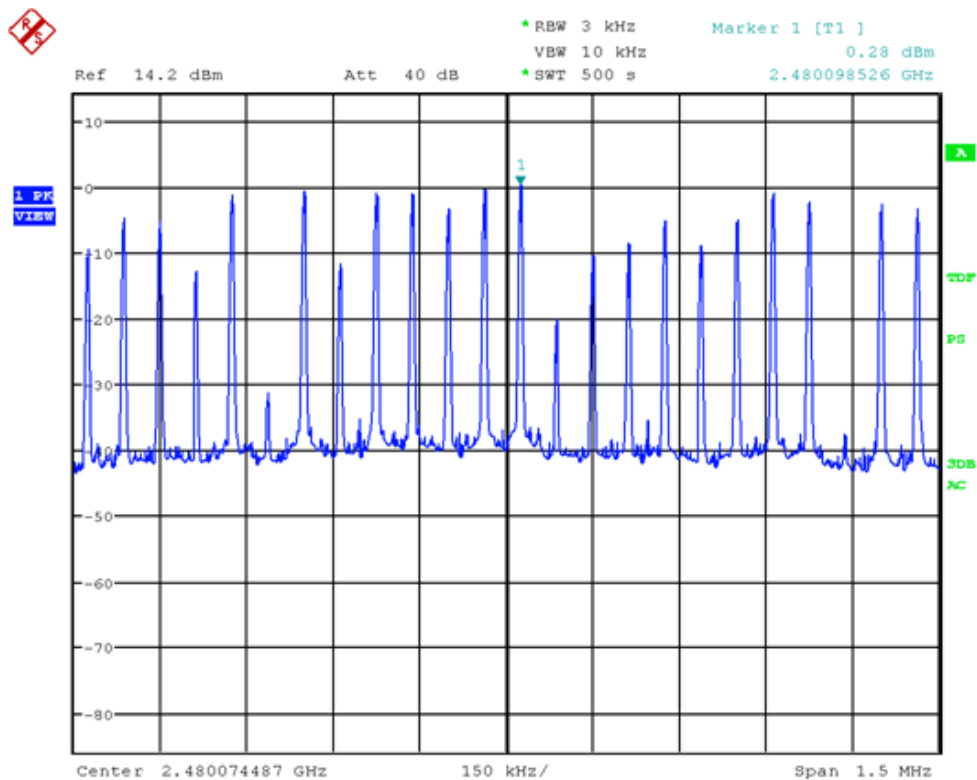


Picture 13: Power spectral density channel 11



Picture 14: Power spectral density channel 18





Picture 15: Power spectral density channel 26

# 7 6dB spectrum bandwidth measurement

according to CFR 47 Part 15 section 2.247(a)(2)

## 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 <b>TESTHAUS</b> 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

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

## 7.4 Test procedure

1. The test is performed in accordance with FCC Public Notice KBD 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 of 100 kHz and the video bandwidth of 100 kHz were used.
5. Measured the spectrum width with power higher than 6dB below carrier. The transmitter output (antenna port) was connected to the spectrum analyzer.



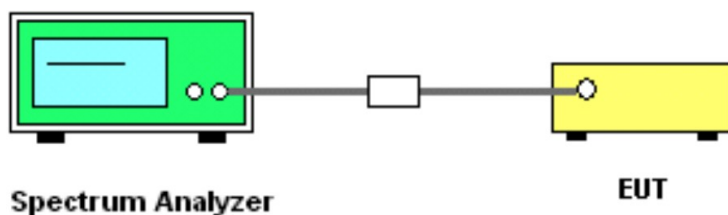
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## 7.5 Test setup



Picture 16: Test setup for 6dB spectrum bandwidth measurement

## 7.6 Test deviation

There is no deviation with the original standard.

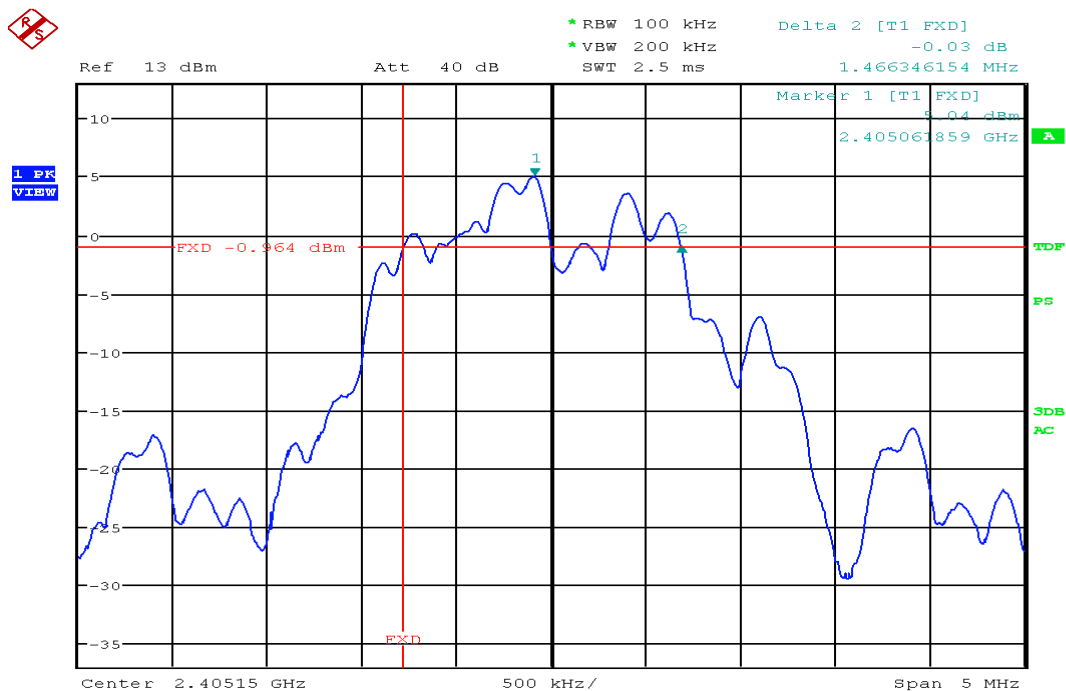
## 7.7 EUT operation during test

The EUT was programmed to be in continuously transmitting mode.

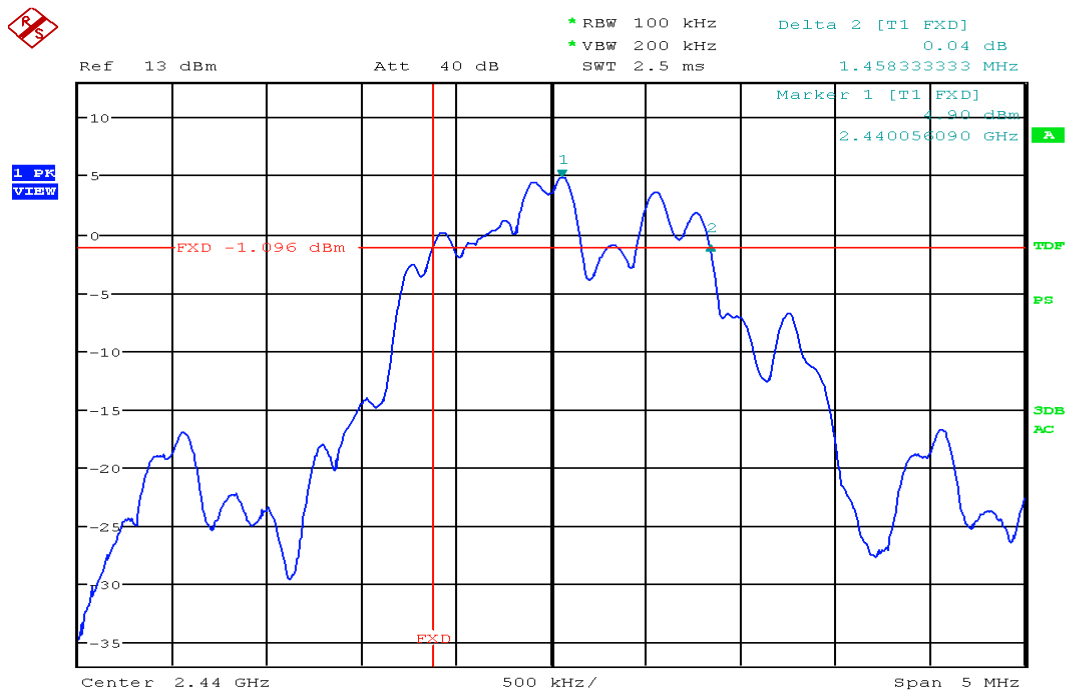
## 7.8 Test results

Temperature:	22°C	Humidity:	44%
Tested by:	M. Janker	Test date:	2010-11-19

Channel	Frequency (GHz)	6 dB bandwidth (MHz)	Min. limit (kHz)	Result
11	2.405062	1.46635		PASS
18	2.440056	1.45833	500	PASS
26	2.480063	1.45833		PASS



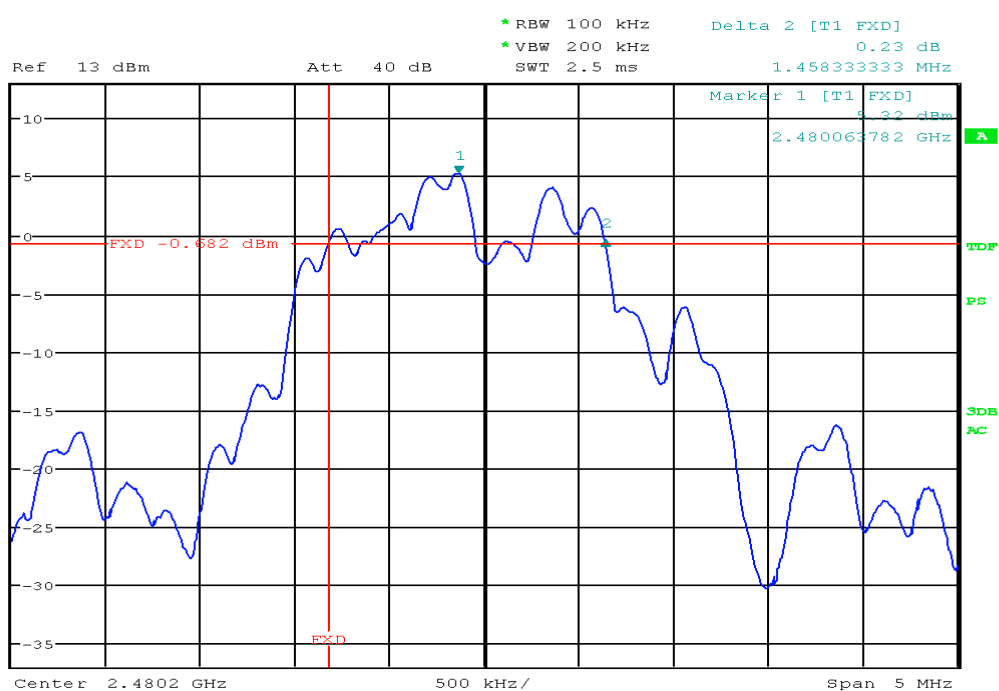
Picture 17: 6dB spectrum bandwidth channel 11



Picture 18: 6dB spectrum bandwidth channel 18



1 PF  
VIEW



Picture 19: 6dB spectrum bandwidth channel 26



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## 8 Radiated emission measurement (<1 GHz)

according to CFR 47 Part 15, section 15.205(a), 15.209(a), 15.247(d)

### 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 site area	EMV <b>TESTHAUS</b> GmbH	E00354

### 8.2 Test instruments

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

### 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 [μV/m]	Field strength [dBμV/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



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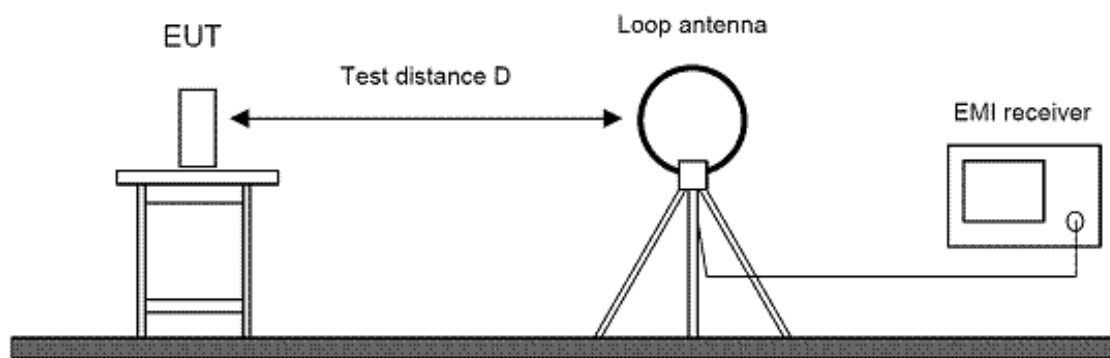
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216 - 960	200	46	3
Above 960	500	54	3

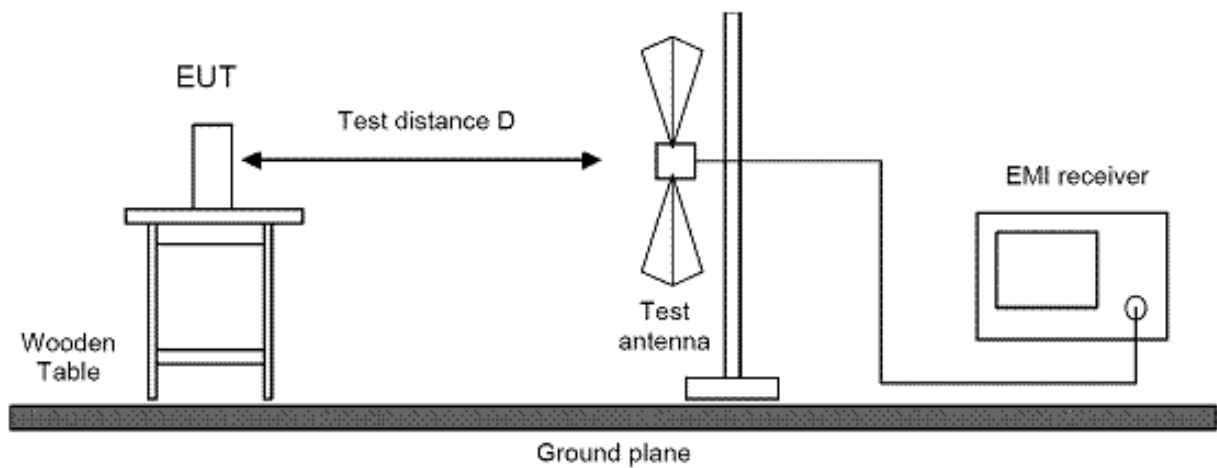
## 8.4 Test procedure

1. Configure the EUT according to ANSI C63.4. The EUT was placed on the top of the turntable 0.8 meter above ground. The receiving antenna was placed 3 meters from the turntable. The test setup was placed inside a compact diagnostic 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 30MHz to 1000MHz with the detector set to peak and the measurement bandwidth to 120 kHz.
5. The turn table was rotated to 6 different positions ( $360^\circ / 6$ ) and the antenna polarization was changed to horizontal.
6. Repeat the test procedure at step 4 and 5.
7. The test setup was then placed in an OATS at 3 m distance and all peak values over or with less distance to limit then 6dB were marked and re-measured with a quasi-peak detector.
8. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
9. The height of the broadband receiving antenna was 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 was recorded.
10. For emissions below 30MHz, measurement were done with a loop antenna. The recorded data were measured in QP mode off he receiver. Antenna height was not changed during this test.

## 8.5 Test setup



Picture 20: Test setup for radiated emission measurement (< 30 MHz)



Picture 21: 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

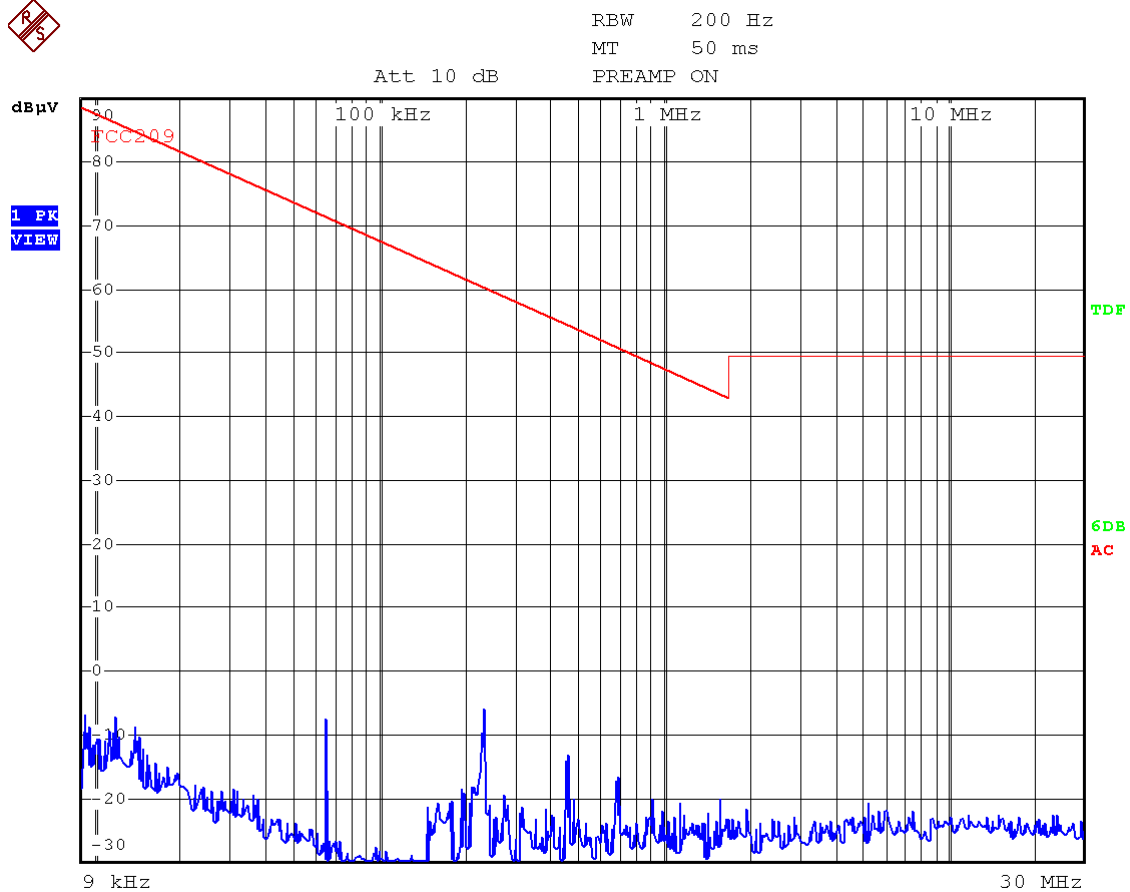
### Transmit mode

Temperature:	22°C	Humidity:	44%
Tested by:	M. Janker	Test date:	2010-11-19

## Radiated Emission Measurement 9 kHz – 30 MHz

Frequency (GHz)	Reading (dBμV/m)	Detector	Correction factor (dB)	Average field strength (dBμV/m)	Limit (dBμV/m)	Margin	Result
–	–	–	–	–	–	–	See note

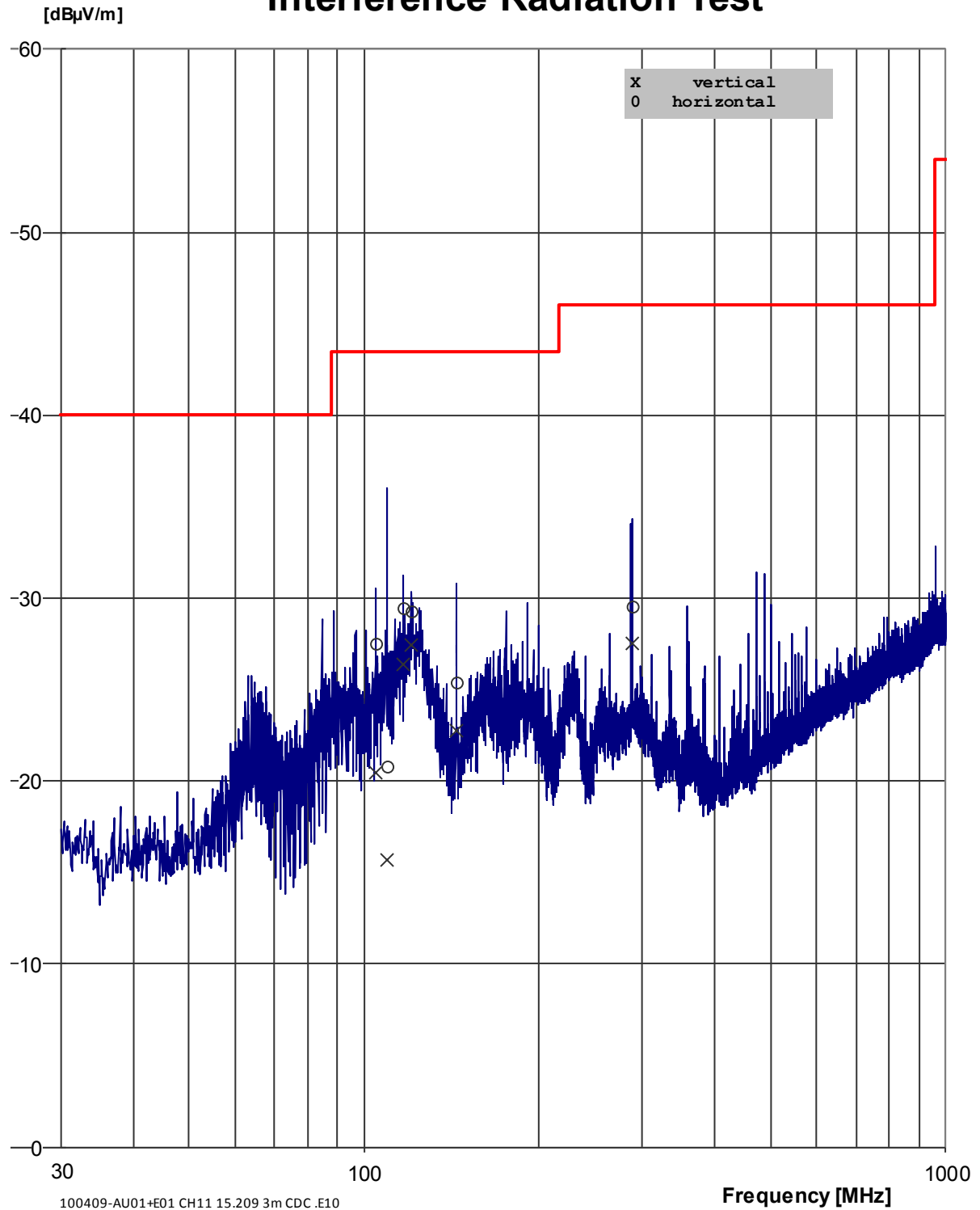




Picture 22: Radiated emission 9 kHz – 30 MHz

Note: Amplitudes of spurious emissions that are attenuated more than 20 dB below the permissible limit are not reported.

# Interference Radiation Test



Picture 23: Radiated emission 30 MHz – 1000MHz (Channel 11)

## Interference Radiation Test

Freq. [MHz]	U_Rec [dBµV/m]	Limit [dBµV/m]	Corr. [dB]	U_Ant. [dBµV]	delta_U [dB]	Turn- table	Antenna	Pol.	Remark
104,60	20,5	43,5	12,9	7,6	23,0	60°	100 cm	V	100409-AU01+E01_CH11_15.209 3m CDC .E10
104,60	27,5	43,5	12,9	14,6	16,0	302°	100 cm	H	
109,20	20,8	43,5	13,3	7,5	22,7	300°	100 cm	H	
109,20	15,7	43,5	13,3	2,3	27,8	272°	100 cm	V	
116,70	26,3	43,5	14,2	12,2	17,2	256°	100 cm	V	
116,70	29,5	43,5	14,2	15,3	14,0	285°	100 cm	H	
120,70	29,3	43,5	14,5	14,8	14,2	272°	100 cm	H	
120,70	27,5	43,5	14,5	12,9	16,0	225°	100 cm	V	
144,00	25,4	43,5	15,6	9,8	18,1	317°	100 cm	H	
144,00	22,7	43,5	15,6	7,1	20,8	88°	100 cm	V	
288,40	27,6	46,0	15,2	12,3	18,4	4°	100 cm	V	
288,40	29,6	46,0	15,2	14,4	16,4	136°	100 cm	H	

Picture 24: Radiated emission 30 MHz – 1000MHz (Table, channel 11)



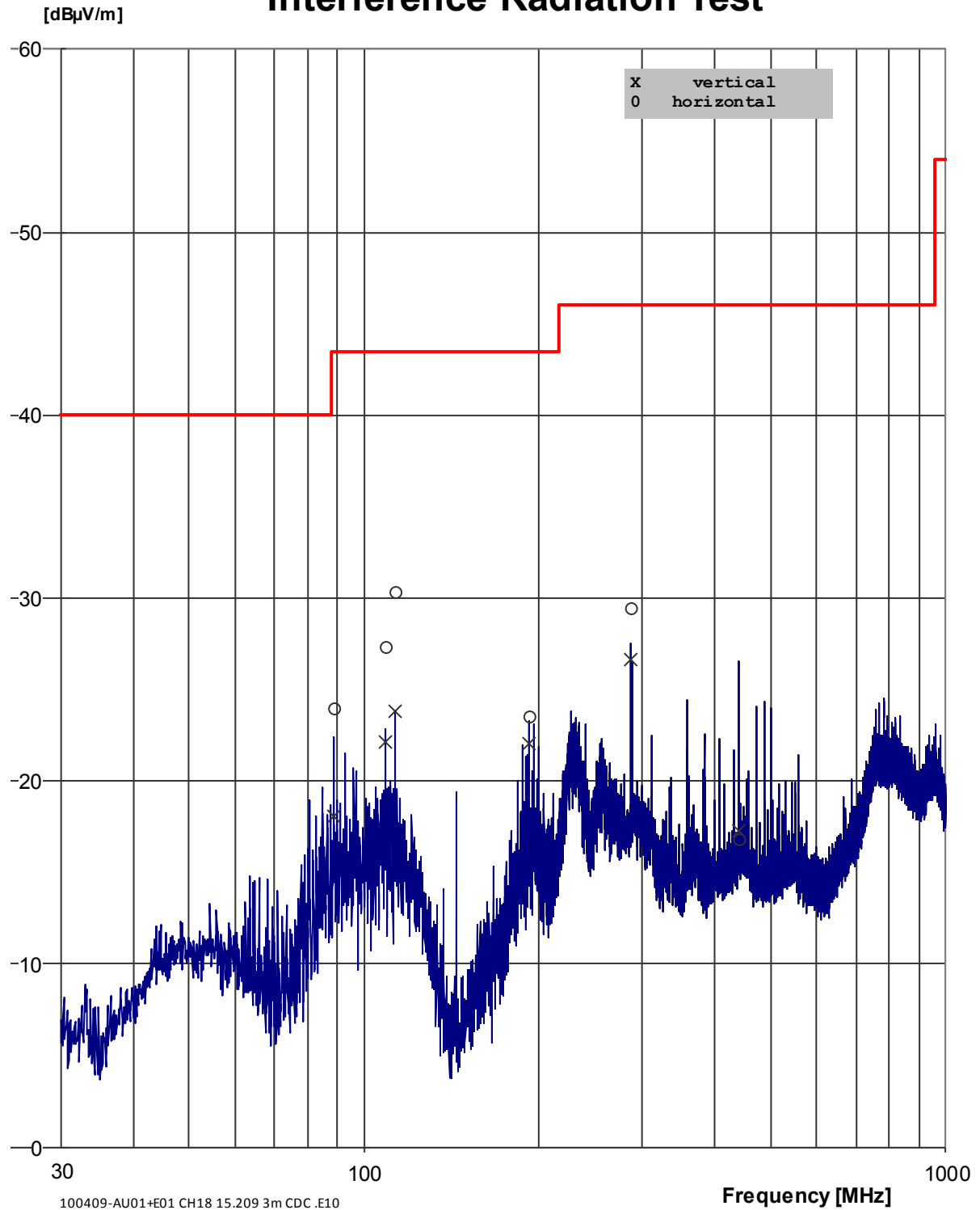
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# Interference Radiation Test



Picture 25: Radiated emission 30 MHz – 1000MHz (Channel 18)

## Interference Radiation Test

Freq. [MHz]	U_Rec [dBµV/m]	Limit [dBµV/m]	Corr. [dB]	U_Ant. [dBµV]	delta_U [dB]	Turn- table	Antenna	Pol.	Remark
88,50	18,1	43,5	11,5	6,6	25,4	44°	100 cm	V	100409-AU01+E01_CH18_15.209 3m CDC .E10
88,50	24,0	43,5	11,5	12,5	19,5	302°	100 cm	H	
108,70	22,1	43,5	13,3	8,8	21,4	75°	100 cm	V	
108,70	27,3	43,5	13,3	14,0	16,2	286°	100 cm	H	
112,70	23,9	43,5	13,7	10,1	19,6	74°	100 cm	V	
112,70	30,4	43,5	13,7	16,6	13,1	285°	100 cm	H	
192,30	23,6	43,5	12,8	10,7	19,9	257°	100 cm	H	
192,30	22,1	43,5	12,8	9,2	21,4	90°	100 cm	V	
287,60	26,7	46,0	15,2	11,5	19,3	14°	100 cm	V	
287,60	29,5	46,0	15,2	14,3	16,5	256°	100 cm	H	
439,80	17,3	46,0	18,8	-1,5	28,7	136°	100 cm	V	
439,80	16,8	46,0	18,8	-2,0	29,2	197°	100 cm	H	

Picture 26: Radiated emission 30 MHz – 1000MHz (Table, channel 18)



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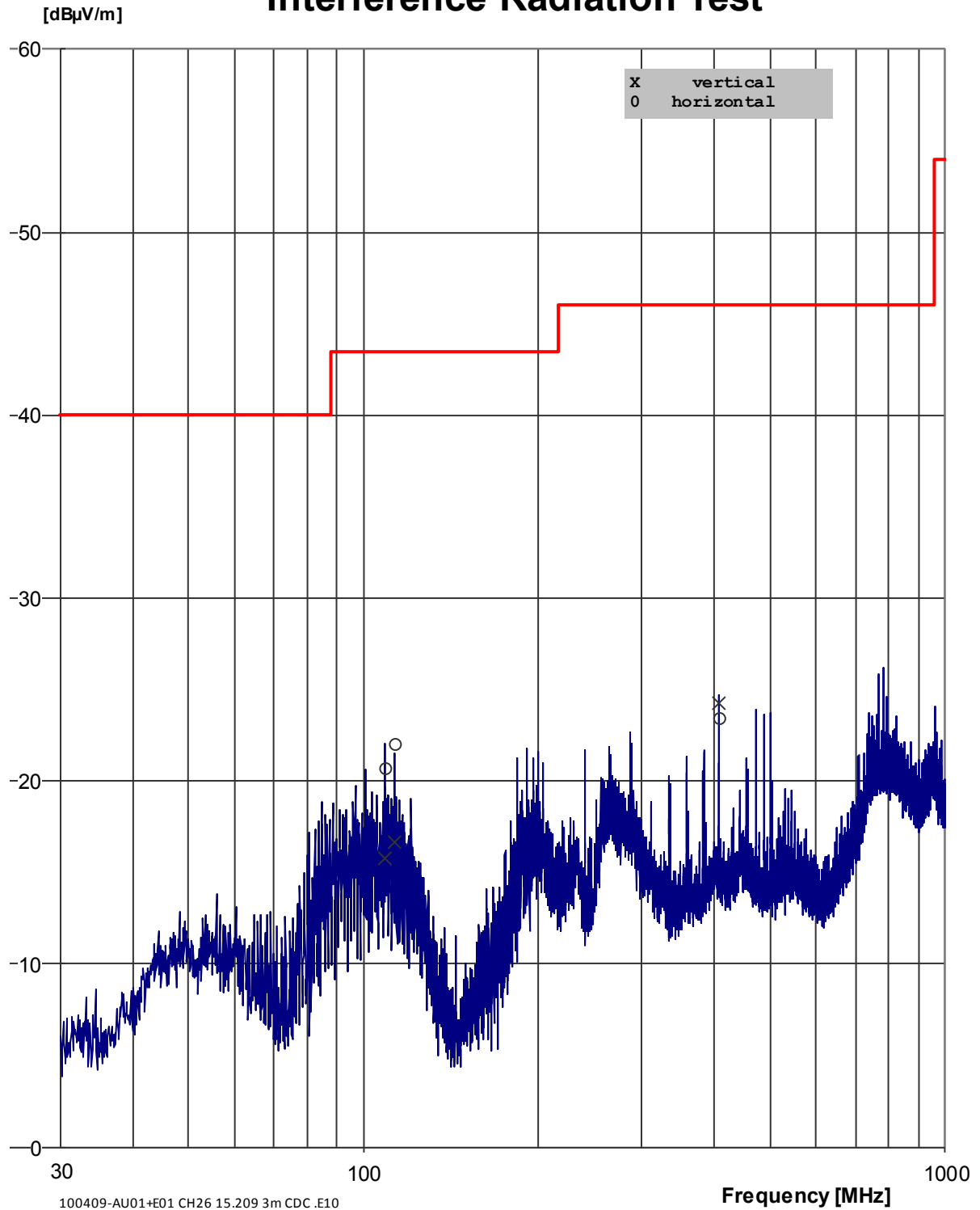
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# Interference Radiation Test



Picture 27: Radiated emission 30 MHz – 1000MHz (Channel 26)

## Interference Radiation Test

Freq. [MHz]	U_Rec [dBµV/m]	Limit [dBµV/m]	Corr. [dB]	U_Ant. [dBµV]	delta_U [dB]	Turn- table	Antenna	Pol.	Remark
108,70	15,7	43,5	7,4	8,3	27,8	92°	100 cm	V	100409-AU01+E01_CH26 15.209 3m CDC .E10
108,70	20,8	43,5	6,5	14,3	22,7	294°	100 cm	H	
112,70	16,6	43,5	6,3	10,3	26,9	75°	100 cm	V	
112,70	22,1	43,5	5,5	16,5	21,4	284°	100 cm	H	
408,00	23,5	46,0	14,1	9,4	22,5	136°	100 cm	H	
408,00	24,3	46,0	13,3	11,0	21,7	135°	100 cm	V	

Picture 28: Radiated emission 30 MHz – 1000MHz (Table, channel 26)



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## Receive Mode

Temperature:	23°C	Humidity:	40%
Tested by:	M. Janker	Test date:	2010-11-22



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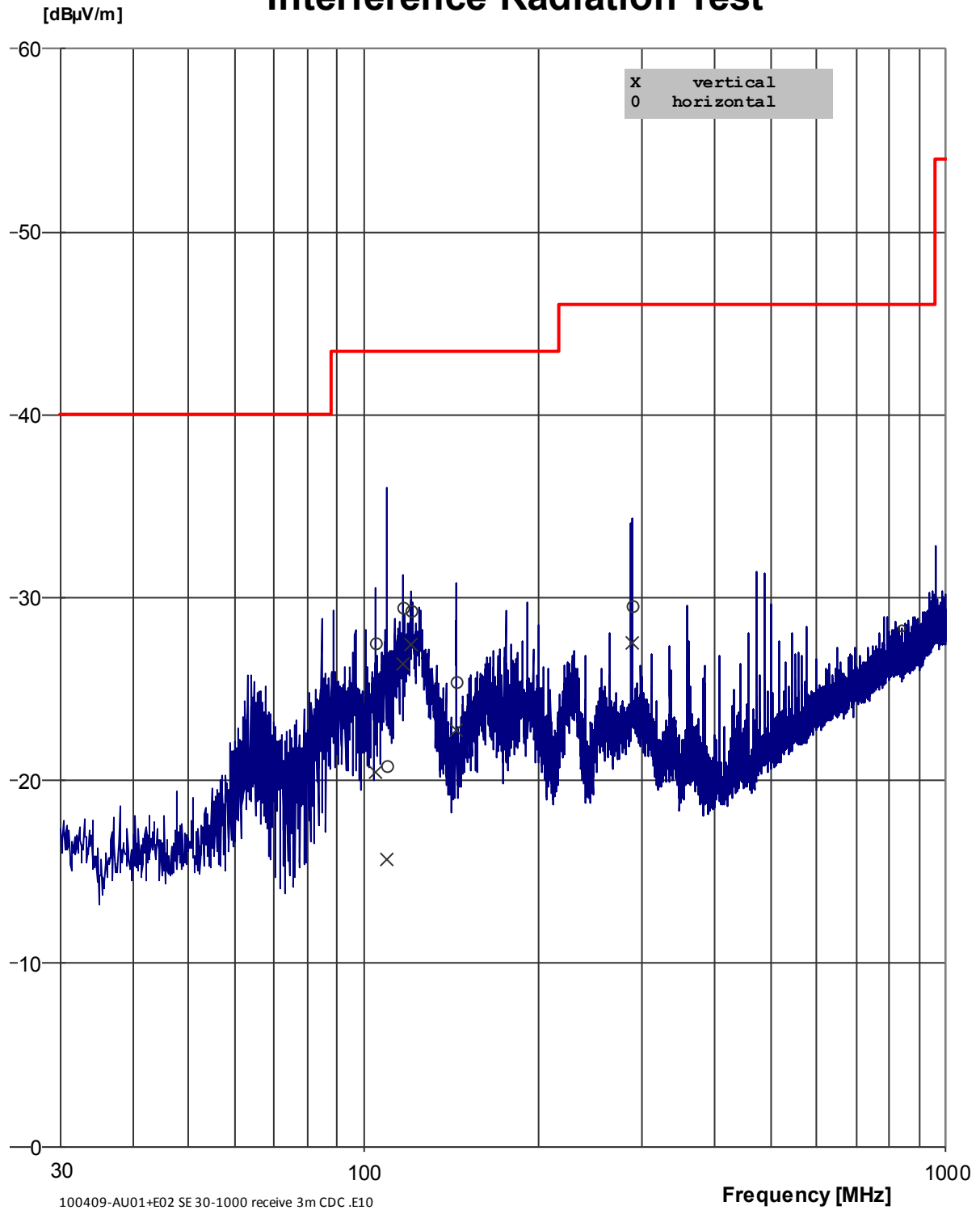
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# Interference Radiation Test



Picture 29: Radiated emission 30 MHz – 1000MHz (RX mode)

## Interference Radiation Test

Freq. [MHz]	U_Rec [dBµV/m]	Limit [dBµV/m]	Corr. [dB]	U_Ant. [dBµV]	delta_U [dB]	Turn- table	Antenna	Pol.	Remark
104,60	20,5	43,5	12,9	7,6	23,0	60°	100 cm	V	100409-AU01+E02 SE 30-1000 receive 3m CDC .E10
104,60	27,5	43,5	12,9	14,6	16,0	302°	100 cm	H	
109,20	20,8	43,5	13,3	7,5	22,7	300°	100 cm	H	
109,20	15,7	43,5	13,3	2,3	27,8	272°	100 cm	V	
116,70	26,3	43,5	14,2	12,2	17,2	256°	100 cm	V	
116,70	29,5	43,5	14,2	15,3	14,0	285°	100 cm	H	
120,70	29,3	43,5	14,5	14,8	14,2	272°	100 cm	H	
120,70	27,5	43,5	14,5	12,9	16,0	225°	100 cm	V	
144,00	25,4	43,5	15,6	9,8	18,1	317°	100 cm	H	
144,00	22,7	43,5	15,6	7,1	20,8	88°	100 cm	V	
288,40	27,6	46,0	15,2	12,3	18,4	4°	100 cm	V	
288,40	29,6	46,0	15,2	14,4	16,4	136°	100 cm	H	

Picture 30: Radiated emission 30 MHz – 1000MHz (Table, RX mode)



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## 9 Radiated emission measurement (>1 GHz)

according to CFR 47 Part 15, section 15.205(a), 15.209(a), 15.247(d)

### 9.1 Test location

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

### Location of measurement

Description	Manufacturer	Inventory No.
Anechoic chamber	EMV <b>TESTHAUS</b> GmbH	E00100

### Measurement equipment

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

### 9.2 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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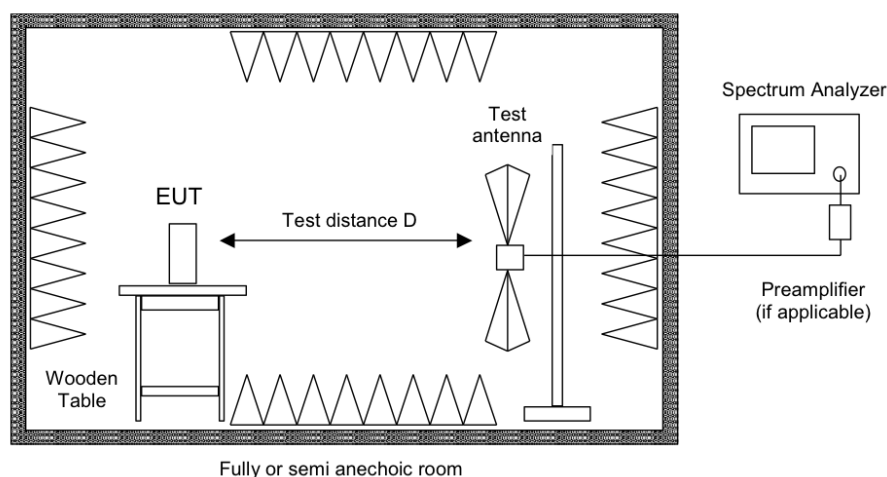
### 9.2.1 General limits according 15.209(a)

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

### 9.3 Test procedure

1. Configure the EUT according to ANSI C63.4. The EUT was placed on the top of the turntable 0.8 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 10<sup>th</sup> 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 the RBW was set to 1 MHz and the VBW was set to 10Hz and the detector was changed to average reading.
8. The receiving antenna was set to vertical polarization.
9. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
10. The receiving antenna was then set to horizontal polarization and the measurement was repeated at step 9.
11. The highest recorded level was noted.
12. For measurements above 18 GHz, first a scan was done with RBW set to 1 MHz and VBW set to 10 MHz to determine existing peaks of the spectrum. If there was any the measurement was carried out as described above.

## 9.4 Test setup



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

## 9.5 Test deviation

There is no deviation with the original standard.

## 9.6 EUT operation during test

The EUT was programmed to be in continuously transmitting mode.

## 9.7 Test results channel 11

Temperature:	22°C	Humidity:	44%
Tested by:	M. Janker	Test date:	2010-11-19

Frequency (GHz)	Reading (dBμV/m)	Detector	Correction factor (dB)	Average field strength (dBμV/m)	Limit (dBμV/m)	Margin	Result
1.5000	39.28	Peak	-14.7	24,58	53,98	29,4	Passed
2.23702	46.62	Peak	-14.7	31,92	53,98	22,06	Passed
2.26106	43.46	Peak	-14.7	28,76	53,98	25,22	Passed
2.28510	48.48	Peak	-14.7	33,78	53,98	20,2	Passed
2.35718	45.09	Peak	-14.7	30,39	53,98	23,59	Passed
2.33308	47.46	Peak	-14.7	32,76	53,98	21,22	Passed
2.26106	45.65	Peak	-14.7	30,95	53,98	23,03	Passed
2.35718	45.09	Peak	-14.7	30,39	53,98	23,59	Passed
2.33308	47.46	Peak	-14.7	32,76	53,98	21,22	Passed



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Frequency (GHz)	Reading (dBµV/m)	Detector	Correction factor (dB)	Average field strength (dBµV/m)	Limit (dBµV/m)	Margin	Result
2.38115	45.65	Peak	-14.7	30,95	53,98	23,03	Passed
2.49611	36.02	Peak	-14.7	21,32	53,98	32,66	Passed
2.71692	50.73	Peak	-14.7	36,03	53,98	17,95	Passed
2.76505	49.45	Peak	-14.7	34,75	53,98	19,23	Passed
2.81317	48.11	Peak	-14.7	33,41	53,98	20,57	Passed
2.86129	44.02	Peak	-14.7	29,32	53,98	24,66	Passed
7.21434	61.23	Peak	-14.7	46,53	53,98	7,45	Passed

**In receive mode there were no significant emissions detected!**

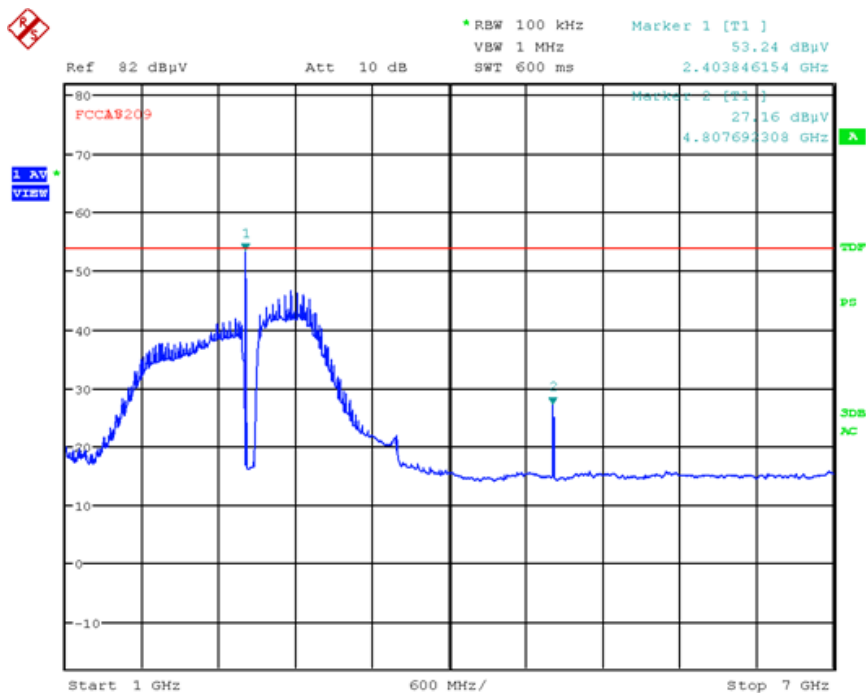


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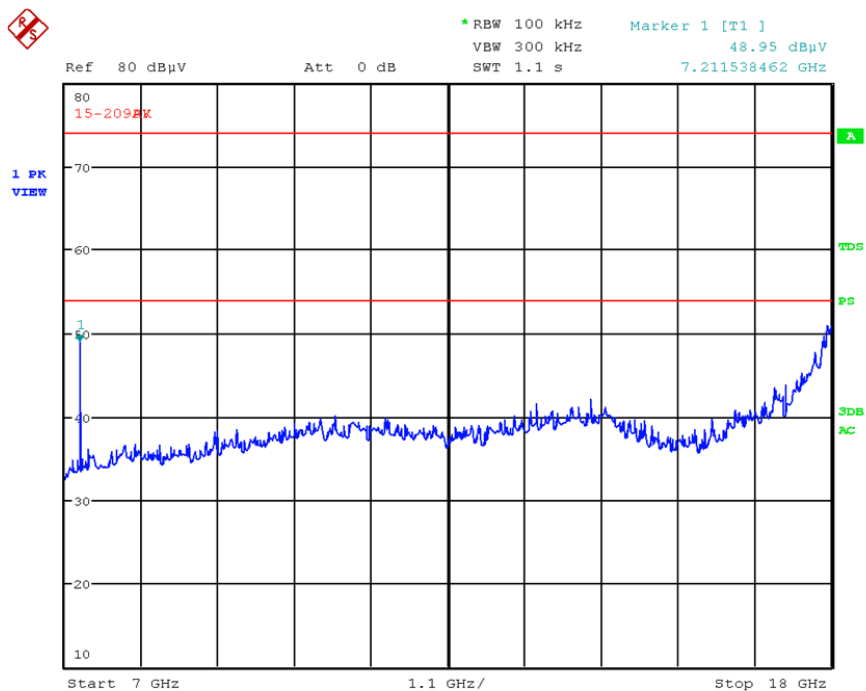
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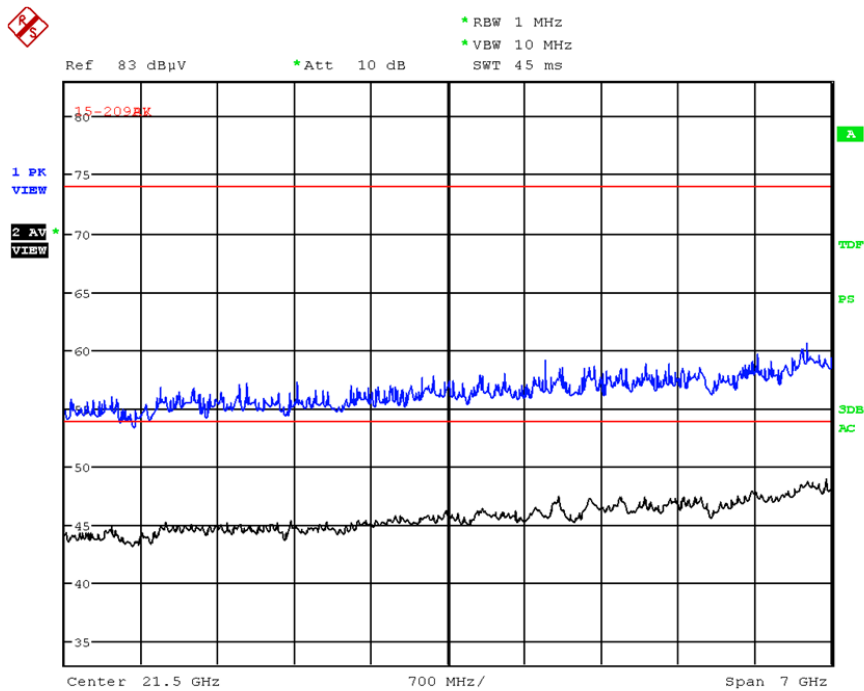
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Picture 32: Spurious emissions channel 11, 1 GHz-7 GHz (Overview scan)



Picture 39: Spurious emissions channel 11, 7 GHz-18 GHz (overview scan)



Picture 41: Spurious emissions channel 11, 18 GHz-25 GHz (overview scan)



## 9.8 Test results channel 18

Temperature:	22°C	Humidity:	44%
Tested by:	M. Janker	Test date:	2010-11-19

Frequency (GHz)	Reading (dBµV/m)	Detector	Correction factor (dB)	Average field strength (dBµV/m)	Limit (dBµV/m)	Margin	Result
1.69598	29.29	Peak	-14,7	14,59	53,98	39,39	Passed
1.67194	29.55	Peak	-14,7	14,85	53,98	39,13	Passed
2.29599	44.44	Peak	-14,7	29,74	53,98	24,24	Passed
2.27211	48.89	Peak	-14,7	34,19	53,98	19,79	Passed
2.22404	45.28	Peak	-14,7	30,58	53,98	23,4	Passed
2.36808	49.57	Peak	-14,7	34,87	53,98	19,11	Passed
2.32000	50.16	Peak	-14,7	35,46	53,98	18,52	Passed
2.49616	37.21	Peak	-14,7	22,51	53,98	31,47	Passed
2.48805	40.16	Peak	-14,7	25,46	53,98	28,52	Passed
2.84817	49.04	Peak	-14,7	34,34	53,98	19,64	Passed
2.75192	53.62	Peak	-14,7	38,92	53,98	15,06	Passed
2.70379	51.98	Peak	-14,7	37,28	53,98	16,7	Passed
2.80004	51.05	Peak	-14,7	36,35	53,98	17,63	Passed
3.01619	42.50	Peak	-14,7	27,8	53,98	26,18	Passed
2.94407	48.04	Peak	-14,7	33,34	53,98	20,64	Passed
2.99214	46.31	Peak	-14,7	31,61	53,98	22,37	Passed
2.96810	45.27	Peak	-14,7	30,57	53,98	23,41	Passed
2.89629	48.47	Peak	-14,7	33,77	53,98	20,21	Passed
2.75192	53.62	Peak	-14,7	38,92	53,98	15,06	Passed
2.70379	51.98	Peak	-14,7	37,28	53,98	16,7	Passed
2.80004	51.05	Peak	-14,7	36,35	53,98	17,63	Passed
7.31931	60.20	Peak	-14,7	45,5	53,98	8,48	Passed

**In receive mode there were no significant emissions detected!**

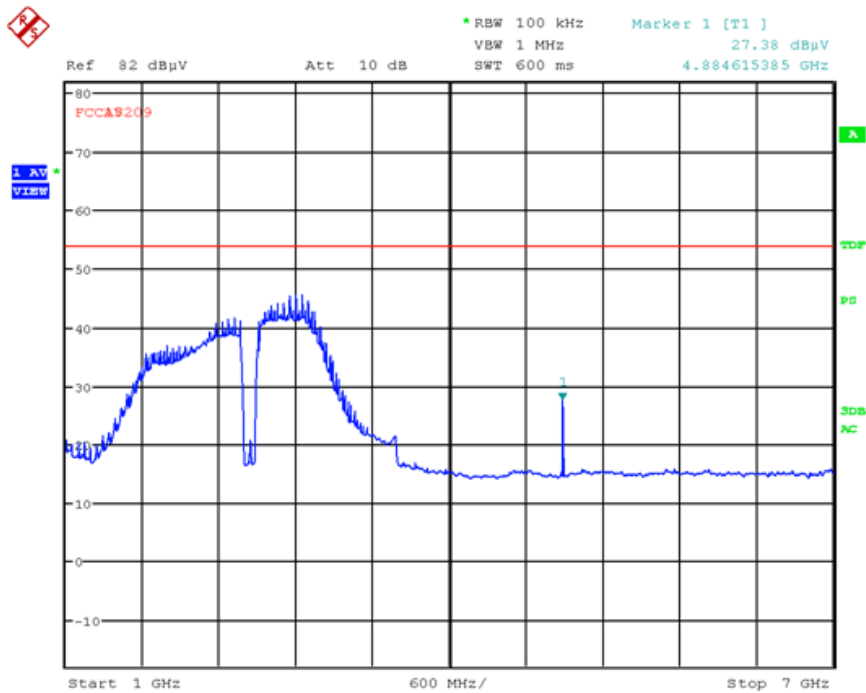


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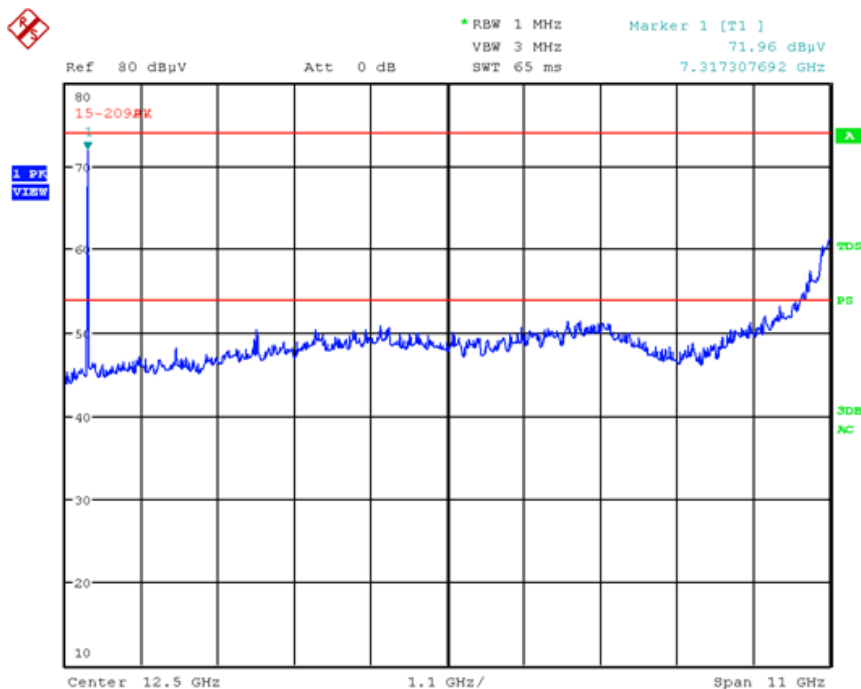
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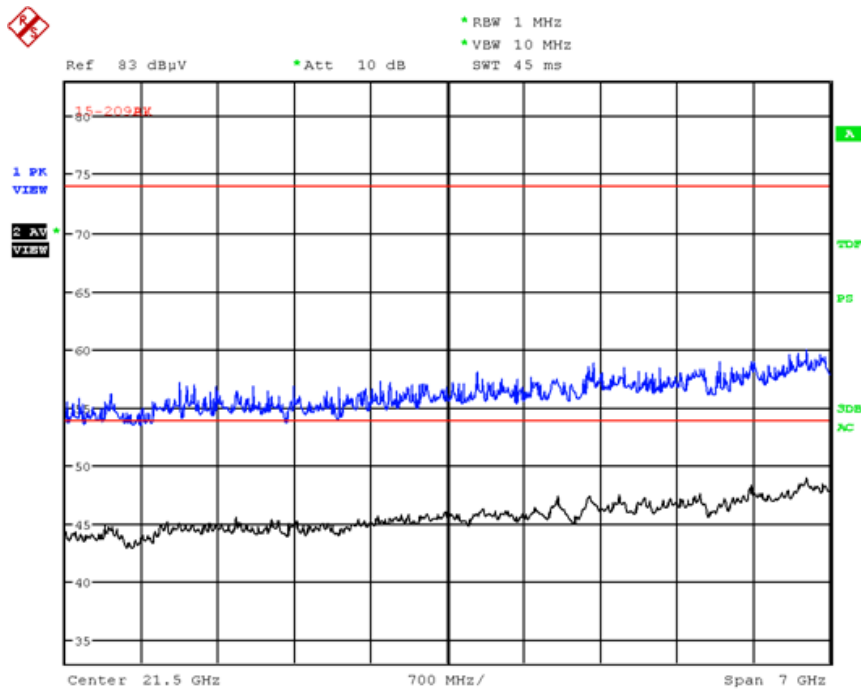
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Picture 42: Spurious emissions channel 18, 1 GHz-7 GHz (overview scan)



Picture 51: Spurious emissions channel 18, 7 GHz-18 GHz (overview scan)



Picture 53: Spurious emissions channel 18, 18 GHz-25 GHz (overview scan)

## 9.9 Test results channel 26

Temperature:	22°C	Humidity:	44%
Tested by:	M. Janker	Test date:	2010-11-19

Frequency (GHz)	Reading (dBµV/m)	Detector	Correction factor (dB)	Average field strength (dBµV/m)	Limit (dBµV/m)	Margin	Result
2.21602	41.21	Peak	-14,7	26,51	53,98	27,47	Passed
2.26410	45.51	Peak	-14,7	30,81	53,98	23,17	Passed
2.28814	45.36	Peak	-14,7	30,66	53,98	23,32	Passed
2.24006	43.60	Peak	-14,7	28,9	53,98	25,08	Passed
2.33603	43.97	Peak	-14,7	29,27	53,98	24,71	Passed
2.36013	48.59	Peak	-14,7	33,89	53,98	20,09	Passed
2.31192	48.16	Peak	-14,7	33,46	53,98	20,52	Passed
2.79197	49.11	Peak	-14,7	34,41	53,98	19,57	Passed
2.69606	52.26	Peak	-14,7	37,56	53,98	16,42	Passed
2.74385	51.11	Peak	-14,7	36,41	53,98	17,57	Passed
2.71995	50.44	Peak	-14,7	35,74	53,98	18,24	Passed
2.79197	49.11	Peak	-14,7	34,41	53,98	19,57	Passed
2.84009	49.02	Peak	-14,7	34,32	53,98	19,66	Passed
2.86433	46.02	Peak	-14,7	31,32	53,98	22,66	Passed
2.88822	46.63	Peak	-14,7	31,93	53,98	22,05	Passed
7.43929	61.61	Peak	-14,7	46,91	53,98	7,07	Passed

**In receive mode there were no significant emissions detected!**

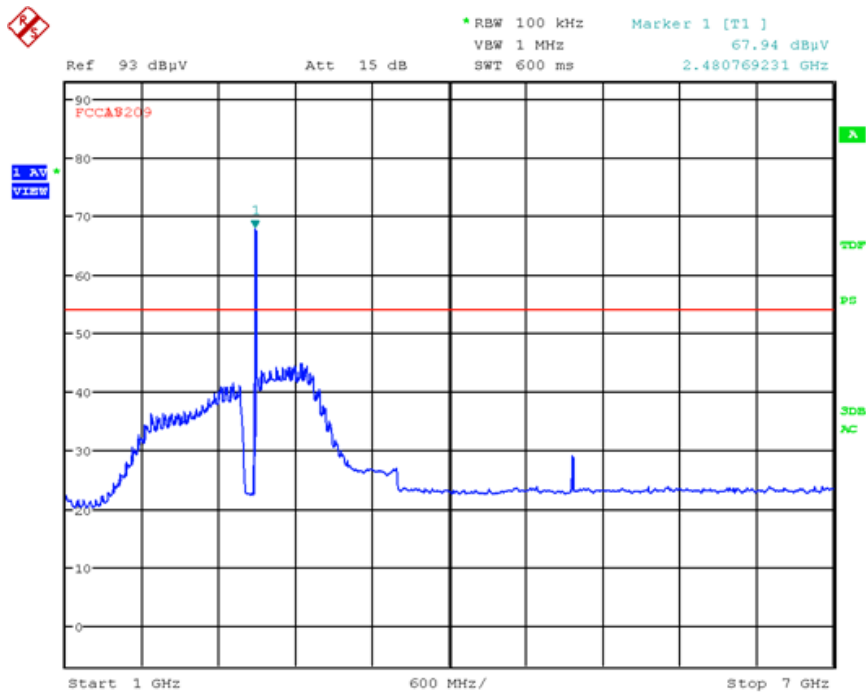


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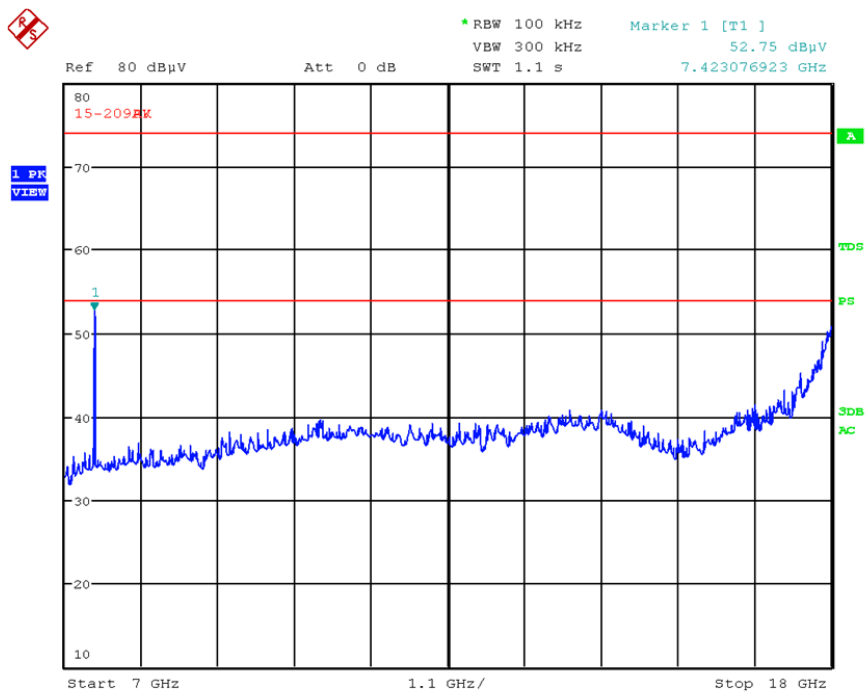
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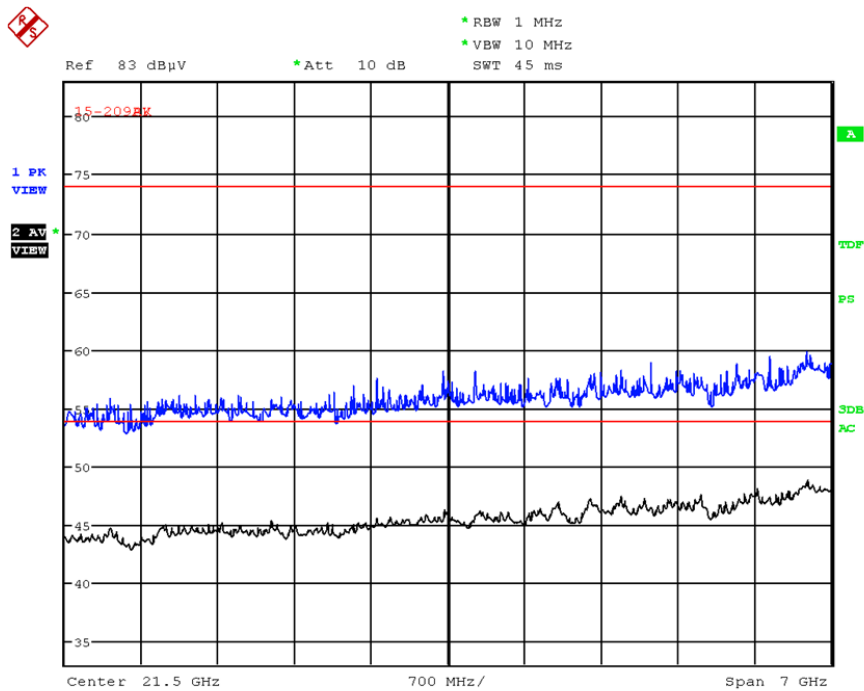
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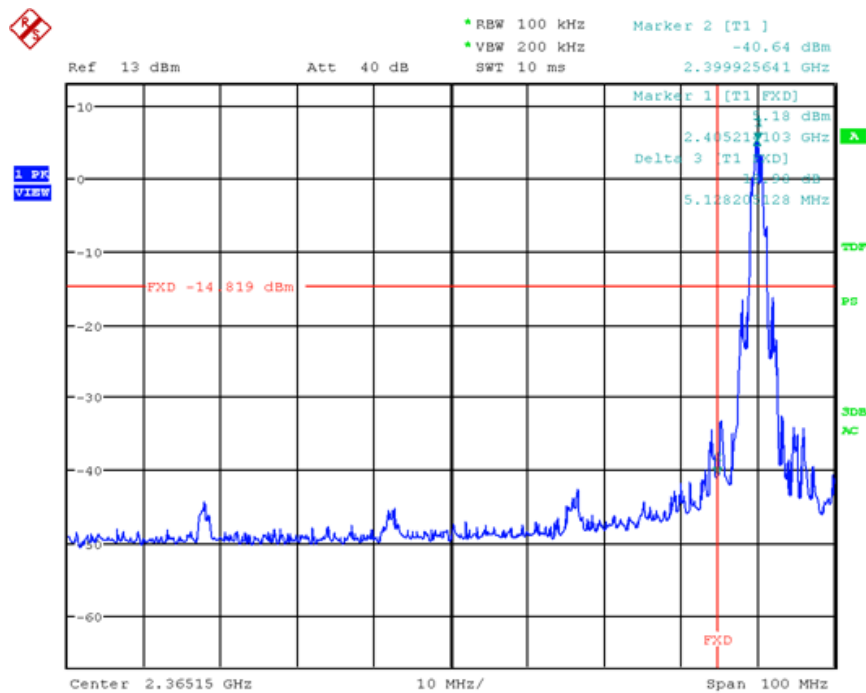
Picture 54: Spurious emissions channel 26, 1 GHz-7 GHz (overview scan)



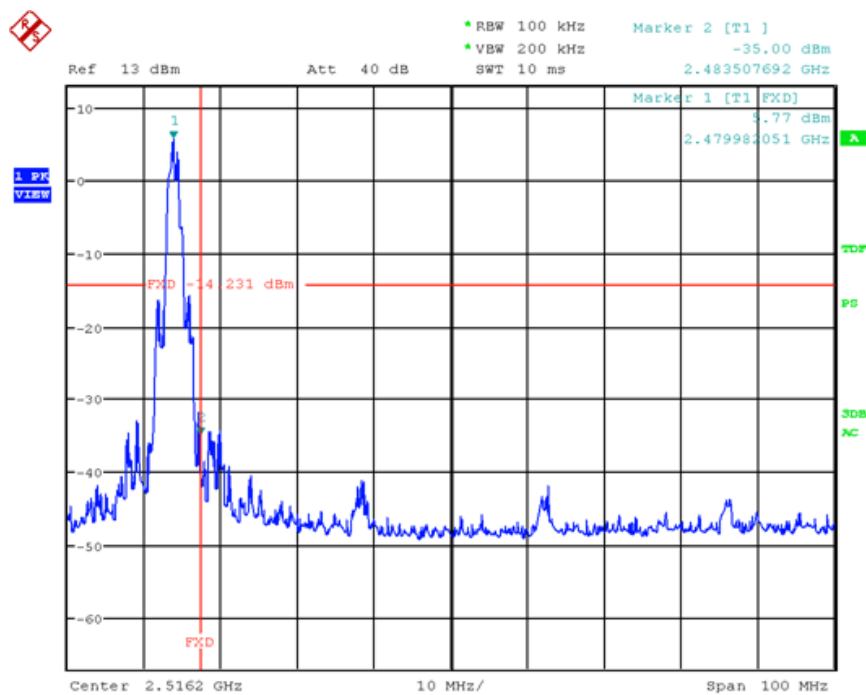
Picture 60: Spurious emissions channel 26, 7 GHz-18 GHz (overview scan)



Picture 62: Spurious emissions channel 26, 18 GHz-26 GHz (overview scan)



Picture 63: Low band edge channel 11



Picture 64: High band edge channel 26

# 10 Exposure of humans to RF fields

according to RSS-Gen Issue 2, section 5.5 and  
RSS-102 Issue 2, section 2.5

## 10.1 Antenna type and power calculation

☒ Antenna detachable

$$EIRP = G \cdot CP$$

G: numerical antenna gain  
CP: conducted output power [W]

$$EIRP = 1.6 \cdot 2.17 \text{ mW} = 3.472 \text{ mW}$$

Limit:

$$60 / f [\text{GHz}]$$
$$= 60 / 2.400$$
$$= \underline{\underline{25 \text{ mW}}}$$

☐ Antenna not detachable

$$EIRP = \frac{(F_s \cdot D)^2}{30}$$

F<sub>s</sub>: field strength [V/m]  
D: distance between antennas [m]

Output power is less than 25mW, therefore no MPE necessary.



# 11 Equipment calibration status

Inventory Number	Model Number	Manufacturer	Last calibration	Next calibration	Cycle of calibration
W00002	ESU26	Rohde & Schwarz	Sep 09	Sep 11	2 Years
E00001	ESCI	Rohde & Schwarz	Sep 09	Mar 11	2 Years
E00003	ESCS 30	Rohde & Schwarz	Aug 10	Aug 12	2 Year
E00004	ESH 2-Z5	Rohde & Schwarz	Oct. 08	Oct. 10	2 Years
E00005	ESH 2-Z5	Rohde & Schwarz	Sep 09	Sep 11	2 Years
E00060	HFH2-Z2	Rohde & Schwarz	Oct 08	Oct 11	2 Years
E00012	VULB 9163	Schwarzbeck	Apr. 09	Apr. 11	2 Years
E00013	VULB 9163	Schwarzbeck	Apr. 08	Apr. 10	2 Years
E00011	VULB 9160	Schwarzbeck	Sep. 09	Sep. 11	2 Years
C00015	VC34034	Vötsch	Jan 08	Jan 12	4 Years
C00014	VC4100	Vötsch	Jan 07	Jan 11	4 Years
E00099	Multimeter	Metra Hit 29S	---	---	---

Table 1: Equipment Calibration status



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# 12 Measurement uncertainty

Description	Max. deviation	k=
Conducted emission AMN (9kHz to 30 MHz)	$\pm 4,0$ dB	2
Radiated emission open field (30 MHz to 1 GHz)	$\pm 4,5$ dB	2
Radiated emission absorber chamber (> 1000 MHz)	$\pm 5,4$ dB	2

Table 2: 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.

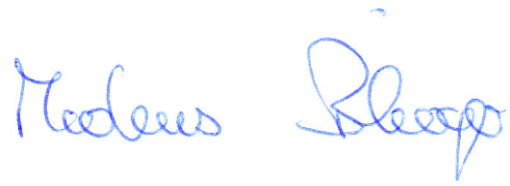
☐ **NOT KEPT**

The EUT does not fulfill the general approval requirements mentioned.

Place, Date:      Straubing, December 08, 2010



Marco Janker  
EMI / EMC Test Engineer



Markus Biberger  
Technical Executive / EMV **TESTHAUS**  
GmbH



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