

# Test Report

**Customer:**

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## RF test report

090369-AU02+W01



**Mühlbauer AG**

**RFID Reader**

MB1120



The test result refers exclusively  
to the model tested.

This report must not be copied without  
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Revision: 2.0



Registration number: DGA-PL-224/95-03

# EMV **TESTHAUS** GmbH

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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

## Place of Test:

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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

CFR 47 Part 2: 10-2008

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: 10-2008

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



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## 2 Summary of test results

### FCC CFR 47 Part 2 and Part 15

Section	Test	Page	Result
2.1046(a)	Conducted output power	----	Not applicable
2.202(a)	Occupied bandwidth	34	Recorded
15.215(c)	Occupied bandwidth	37	Passed
2.201, 2.202	Class of emission	44	Calculated
15.35(c)	Pulse train measurement	----	Not applicable
15.205(a) 15.205(d)(7)	Restricted bands of operation	----	Passed
15.207	Conducted emission at AC power line 0.150 MHz to 30 MHz	15	Passed
15.225(a)-(d)	Spectrum mask	11	Passed
15.205(b) 15.215(b) 15.225(a)(d)	Radiated emission 0.009 MHz to 30 MHz	22	Passed
15.205(b) 15.225(d)	Radiated emission 30 MHz to 1000 MHz	26	Passed
15.225(e)	Carrier frequency stability	41	Passed



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### 3 Equipment under Test (EUT)

Device name: RFID Reader MB1120

Manufacturer: Mühlbauer AG

Serial number: Prototype

FCC ID: XJPMBRFID1120001

Application freq. band: 13.110MHz – 14.010MHz

Frequency range: 13.5600 MHz

Operating frequency: 13.5600 MHz

Class of emission: 10K0A1D

Type of modulation: ASK

Channel spacing: ---

Number of RF-channels: 1

Pulse train: none

Pulse width: none

Antenna type: External PCB loop antenna  
☒ detachable      ☐ not detachable

Power supply: External AC power supply  
nominal: 110 V – 240 V

Temperature range: -20 °C to +55 °C

Interfaces: N/A



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### 3.1 Photo documentation



Picture 1: EUT

## 3.2 Short description of the EUT

The EUT is a USB RFID Reader with an operating frequency of 13.56 MHz

## 3.3 Operation Mode

The EUT was connected with an LAN cable to the Test PC System.

It was tested with a special test-software delivered by the customer that was simulating a continuous data transmission and was also able to activate and deactivate the modulation.

## 3.4 Configuration

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

Numbers:	Description:	Serial No.:
1	EUT: MB1120	Prototype
1	Test notebook	N/A
1	PCB loop antenna	N/A
1	RFID tag	N/A

### Used cables

Numbers:	Description: (type / lengths / remarks)	Serial No
1	DC power cable (unshielded / 1 m)	N/A
1	Cat. 5e network cable (shielded / 3 m)	N/A
1	Antenna cable (shielded / 0.3 m)	N/A



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## 4 Spectrum Mask

according to CFR 47 Part 15, section 15.225 (a)-(d)

### 4.1 Test location

- ☐ 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	200017

### 4.2 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 checked="" type="checkbox"/>	HFH2-Z2	Rohde & Schwarz	E00060
<input type="checkbox"/>	VULB 9163 (CDC)	Schwarzbeck	E00013
<input type="checkbox"/>	VULB 9160 (FF)	Schwarzbeck	E00011



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### 4.3 Limits

Frequency [MHz]	Field strength Fs [μV/m]	Field strength [dBμV/m]	Measurement distance d [m]
1.705 – 13.110	30	29.5	30
13.110 -13.410	106	40.5	30
13.410 – 13.553	334	50.5	30
13.553 – 13.567	15848	84.0	30
13.567 – 13.710	334	50.5	30
13.710 – 14.010	106	40.5	30
14.010 – 30.000	30	29.5	30

To calculate the limit for 3m measurement distance the following calculation was used.

$$L_{dm} = L_d + (-40 \frac{dB}{dec} * (\log(dm) - \log(d)) - 20$$

$L_{dm}$  = Limit at the new distance  
 $L_d$  = Limit according ANSI 63.4  
 $dm$  = Distance according to ANSI 63.4  
 $d$  = New distance for limit

$$L_{dm} = 29,5 \frac{dB\mu V}{m} + (-40 \frac{dB}{dec} * (\log(3m) - \log(30m)) - 20 = 49,5dB$$

$$L_{dm} = 40,5 \frac{dB\mu V}{m} + (-40 \frac{dB}{dec} * (\log(3m) - \log(30m)) - 20 = 60,5dB$$

$$L_{dm} = 50,5 \frac{dB\mu V}{m} + (-40 \frac{dB}{dec} * (\log(3m) - \log(30m)) - 20 = 70,5dB$$

$$L_{dm} = 84 \frac{dB\mu V}{m} + (-40 \frac{dB}{dec} * (\log(3m) - \log(30m)) - 20 = 104dB$$



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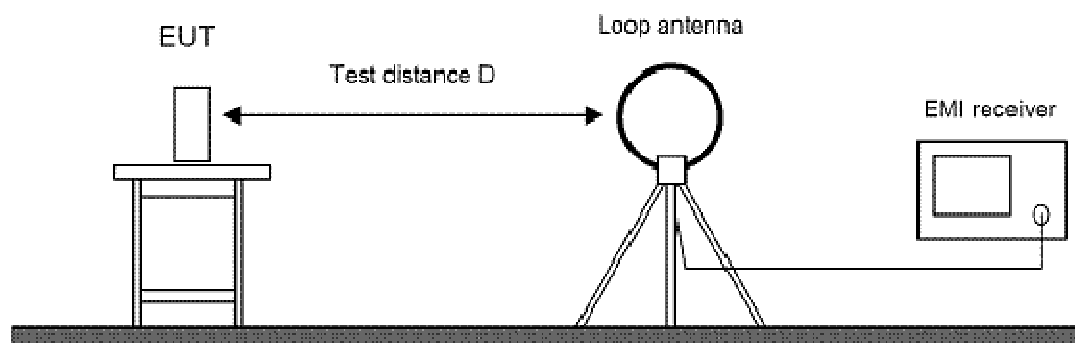
## 4.4 Test method to demonstrate compliance

A spectrum analyzer was used and set to a center frequency equal to transmitter frequency. The resolution bandwidth was adjusted to 3 kHz and the video bandwidth at least 3 times higher than the resolution bandwidth. Span was set to 1 MHz to cover the whole spectrum mask. The detector was set to maxpeak with hold function.

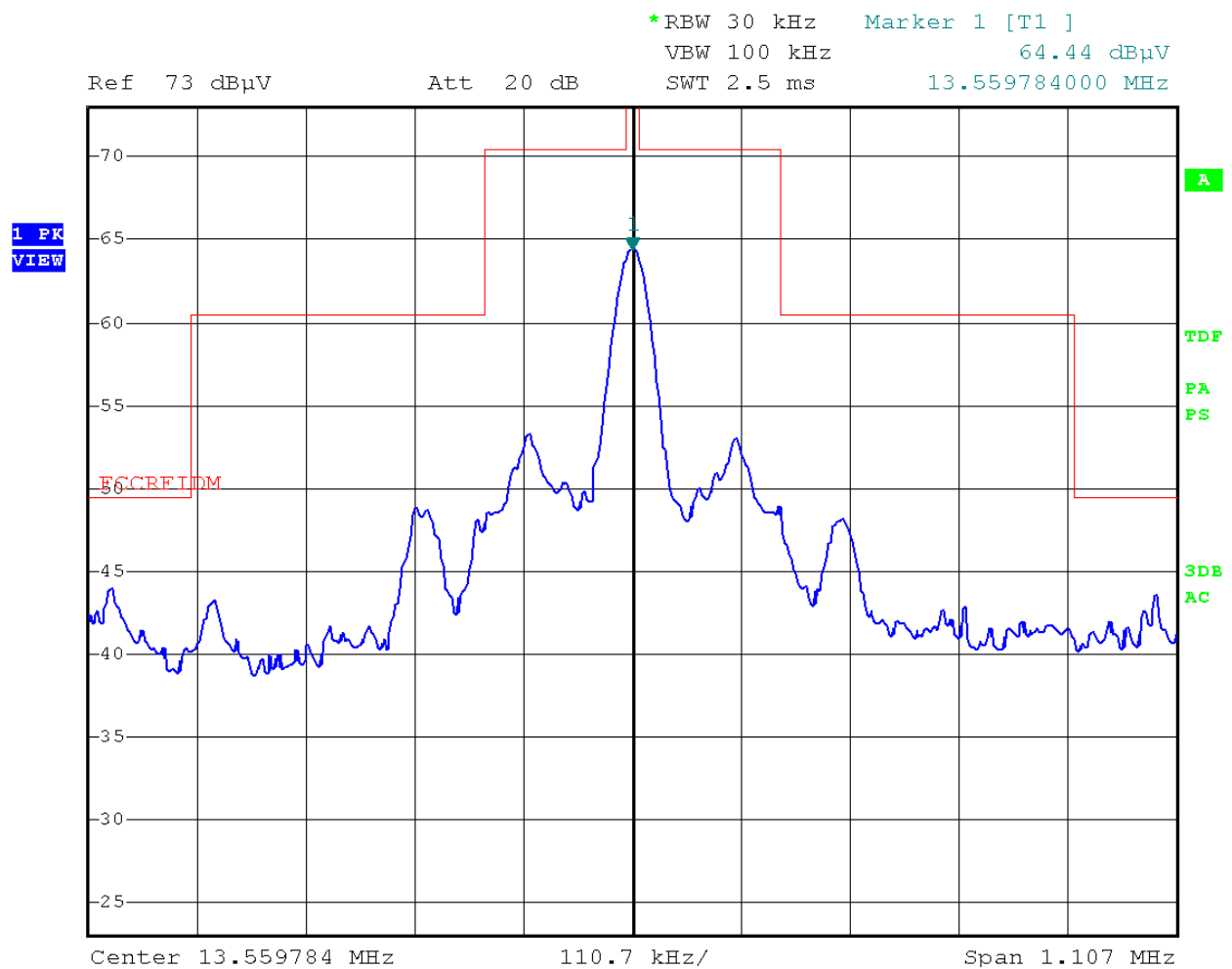
The spectrum analyzer was connected to a loop antenna in vertical polarization at a measurement distance of 3 m on an open area test site. This loop antenna has a correction factor of 20 dB. Due to better visibility in the printing the actual spectrum mask limit was reduced by this 20 dB.

The EUT was placed on a turntable and rotate 360° to find maximum value. To find the maximum in horizontal polarization the EUT was rotated by 90°.

## 4.5 Test setup



Picture 2: Outline of setup for spectrum mask test



**Picture 3: Result of spectrum mask measurement**

The actual field strength of the carrier is:

$$FS = T1 = 64.44 \text{ dB}\mu\text{V/m}$$

Expanded uncertainty (0,009 to 30MHz):

$$E_{(y)} = (y \pm 4,25) \text{ dB}\mu\text{A/m}; k=2.00$$

y = Indicated value

Comments:



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## 5 Conducted emission test

according to CFR 47 Part 15, section 15.207

### 5.1 Test Location

Description	Manufacturer	Inventory No.
Shielded chamber	Siemens - Matsushita	E00107

### 5.2 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



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## 5.3 Limits

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

## 5.4 Test method to demonstrate compliance

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. The EMI test receiver was connected to the LISN and set to a measurement bandwidth of 9 kHz in the frequency range form 0.15 MHz to 30 MHz.

The EUT was placed on a wooden table and connected to the LISN.

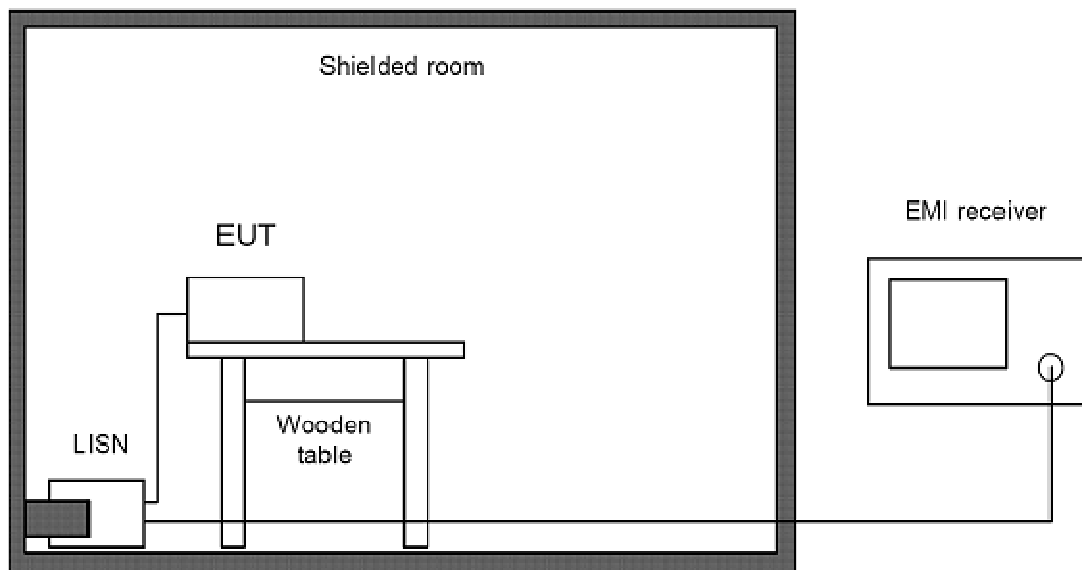
To accelerate the measurement the detector of the EMI test receiver was set to peak and the whole frequency range form 0.15 MHz to 30 MHz were scanned. After that all peaks values with fewer margins than 10 dB to quasi-peak limit or exceeding the limit were marked and re-measured with quasi-peak detector. 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.

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.



## 5.5 Test setup



**Picture 4: Outline of conducted emission test setup**

Expanded Uncertainty (9kHz to 150kHz):

$$U_{(y)} = (y \pm 4.024) \text{ dB}\mu\text{V}; k=2.00$$

y = Indicated value

Expanded Uncertainty (150kHz to 30MHz):

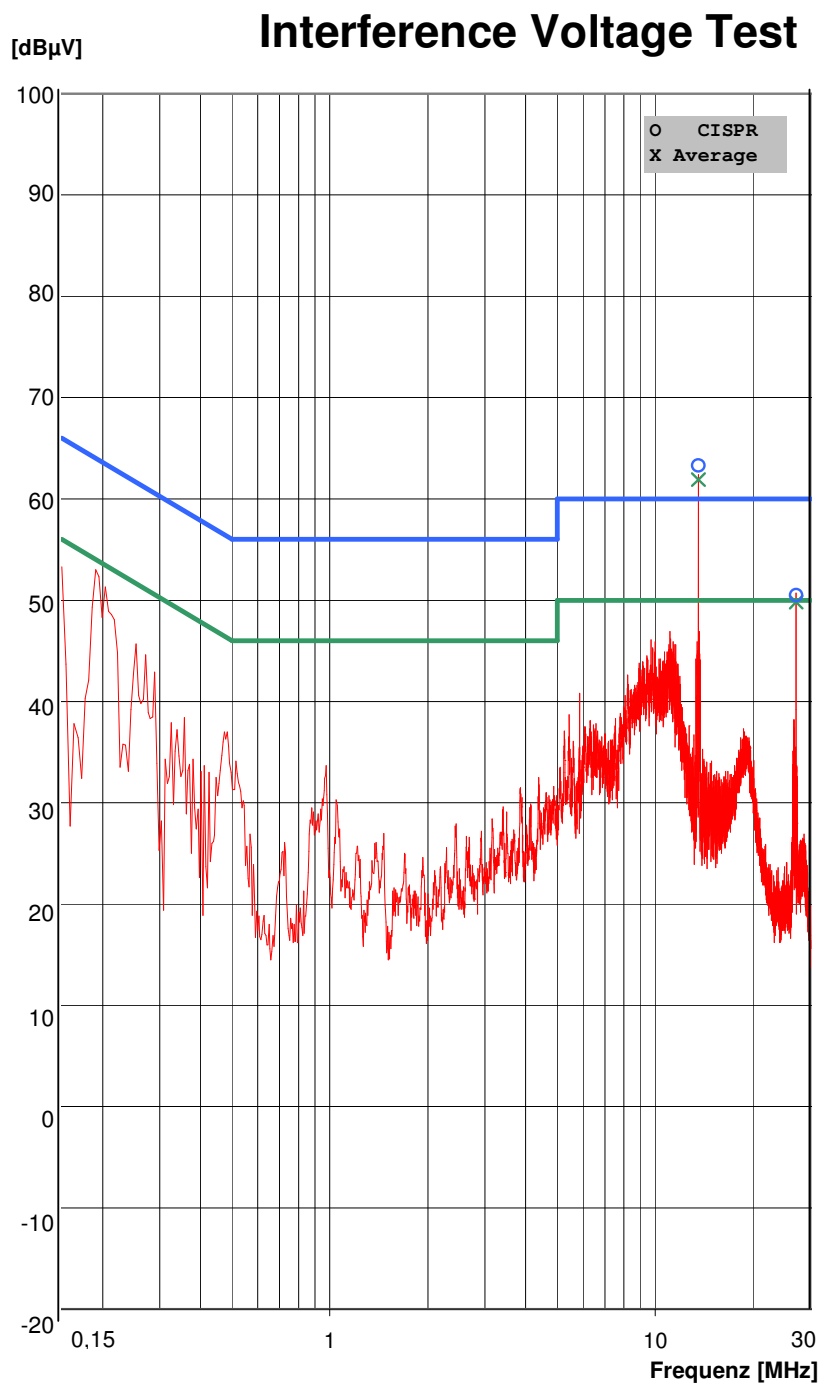
$$U_{(y)} = (y \pm 3.604) \text{ dB}\mu\text{V}; k=2.00$$

y = Indicated value

**Comments:** The 13.56 MHz disturbance belongs to the carrier frequency, which is exempted for this test. Due to a fixed internal antenna a test with 50 Ohm dummy was not possible.

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

## 5.6 Test result



### REGULATIONS:

DIN EN 55022 Class B  
PEAK / CISPR / AV

### TEST EQUIPMENT:

R&S ESH3 (10 0 002)  
R&S ESH2-Z5 (10 0 040)  
R&S Pulse Limiter (20 0 051)

### ORDER NO.:

090369-AU02+E01

### EUT:

Mühlbauer AG  
RFID Reader  
MB1120  
Prototype

### OPERATION MODE:

PHOENIX PSU  
continuous writing

Mains 120V AC /60Hz  
Phase

### TEST FACILITY:

EMV TESTHAUS GmbH  
Gustav-Hertz-Straße 35  
94315 Straubing

### DATE / TIME:

2010-03-12 10:57:10  
18 °C 28 %H 98 kPa

### TEST ENGINEER:

Christian Kiermeier

ss\_11\_02.E10

Picture 5: Conducted emission on mains, phase 1



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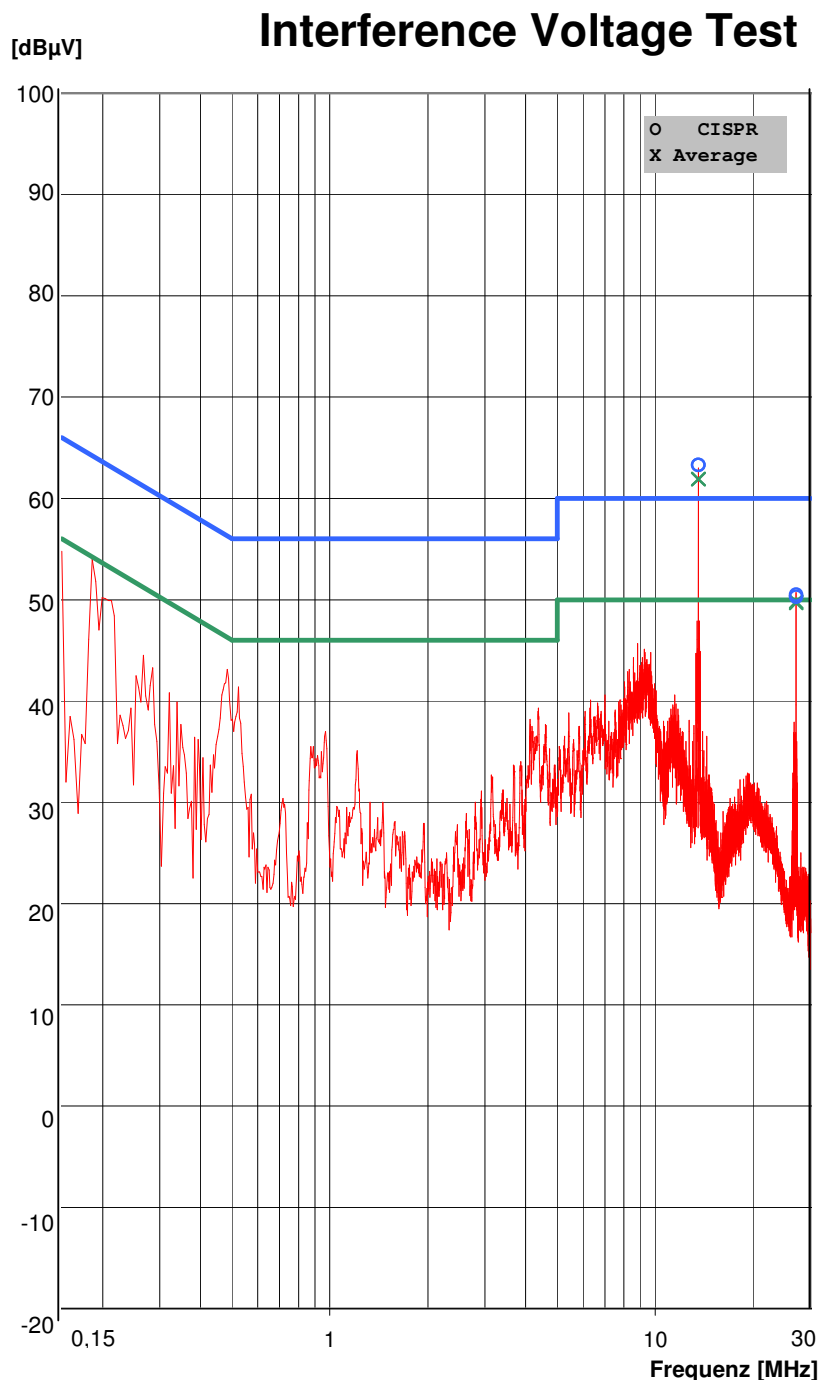
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## Interference Voltage Test

Freq. [MHz]	U_CISPR [dBμV]	Limit [dBμV]	delta_U [dB]	U_AV [dBμV]	Limit [dBμV]	delta_U [dB]	Corr. [dB]	Remark ss_i1_02.E10
13,56	63,3	60,0	-3,3	61,9	50,0	-11,9	0,0	
27,12	50,5	60,0	9,5	49,8	50,0	0,2	0,0	

**Picture 6: Conducted emission on mains, phase 1**



### REGULATIONS:

DIN EN 55022 Class B  
 PEAK / CISPR / AV

### TEST EQUIPMENT:

R&S ESH3 (E00007)  
 R&S ESH2-Z5 (E00004)  
 R&S Pulse Limiter (E00028)

### ORDER NO.:

090369-AU02+E01

### EUT:

Mühlbauer AG  
 RFID Reader  
 MB1120  
 Prototype

### OPERATION MODE:

PHOENIX PSU  
 continuous writing

Mains 120V AC /60Hz  
 Neutral

### TEST FACILITY:

EMV TESTHAUS GmbH  
 Gustav-Hertz-Straße 35  
 94315 Straubing

### DATE / TIME:

2010-03-12 10:57:38  
 18 °C 28 %H 98 kPa

### TEST ENGINEER:

Christian Kiermeier

ss\_n\_02.E10

**Picture 7: Conducted emission on mains, neutral**



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## Interference Voltage Test

Freq. [MHz]	U_CISPR [dBμV]	Limit [dBμV]	delta_U [dB]	U_AV [dBμV]	Limit [dBμV]	delta_U [dB]	Corr. [dB]	Remark ss_n_02.E10
13,56	63,3	60,0	-3,3	61,9	50,0	-11,9	0,0	
13,56	63,3	60,0	-3,3	61,9	50,0	-11,9	0,0	
27,12	50,3	60,0	9,7	49,7	50,0	0,3	0,0	
27,12	50,5	60,0	9,5	49,8	50,0	0,2	0,0	

**Picture 8: Conducted emission on mains, neutral**



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## 6 Measurement of radiated emission

according to CFR 47 Part 15, section 15.205(d7), 15.209

### 6.1 Radiated emission measurement from 9 kHz to 30 MHz:

#### 6.1.1 Location of measurement

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

Description	Manufacturer	Inventory No.
CDC	Albatross Projects	E00026
Open site area	EMV <b>TESTHAUS</b> GmbH	200017

#### 6.1.2 Measurement equipment

	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 and FF)	Rohde & Schwarz	E00001
<input type="checkbox"/>	VULB 9163 (CDC)	Schwarzbeck	E00013
<input type="checkbox"/>	VULB 9160 (FF)	Schwarzbeck	E00014
<input checked="" type="checkbox"/>	Feedline OATS	Huber & Suhner	200024
<input checked="" type="checkbox"/>	HFH2-Z2 (CDC and FF)	Rohde & Schwarz	E00060

### 6.1.3 Limits

Frequency [MHz]	Field strength Fs [μV/m]	Field strength [dBμV/m]	Measurement distance d [m]
0.009 – 0.490	266.7 – 4.9	48.5 – 13.8	300
0.490 – 1.705	49.0 – 14.1	33.8 – 23.0	30
1.705 - 30	30	29.5	30

To calculate the limit for 3m measurement distance the following calculation was used.

$$L_{dm} = L_d + (-40 \frac{dB}{dec} * (\log(dm) - \log(d))) \quad L_{dm} = \text{Limit at the new distance}$$

$L_d$  = Limit according ANSI 63.4  
 $dm$  = Distance according to ANSI 63.4  
 $d$  = New distance for limit

$$L_{dm} = 48.5 \frac{dB\mu V}{m} + (-40 \frac{dB}{dec} * (\log(3m) - \log(300m))) = 128,5dB \quad \text{for 0.009MHz}$$

$$L_{dm} = 13.8 \frac{dB\mu V}{m} + (-40 \frac{dB}{dec} * (\log(3m) - \log(300m))) = 93.8dB \quad \text{for 0.490MHz (high)}$$

$$L_{dm} = 33.8 \frac{dB\mu V}{m} + (-40 \frac{dB}{dec} * (\log(3m) - \log(30m))) = 73.8dB \quad \text{for 0.490MHz (low)}$$

$$L_{dm} = 23 \frac{dB\mu V}{m} + (-40 \frac{dB}{dec} * (\log(3m) - \log(30m))) = 63dB \quad \text{for 1.705MHz (high)}$$

$$L_{dm} = 29.5 \frac{dB\mu V}{m} + (-40 \frac{dB}{dec} * (\log(3m) - \log(30m))) = 69.5dB \quad \text{for 1.705MHz (low)}$$



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## 6.1.4 Test method to demonstrate compliance

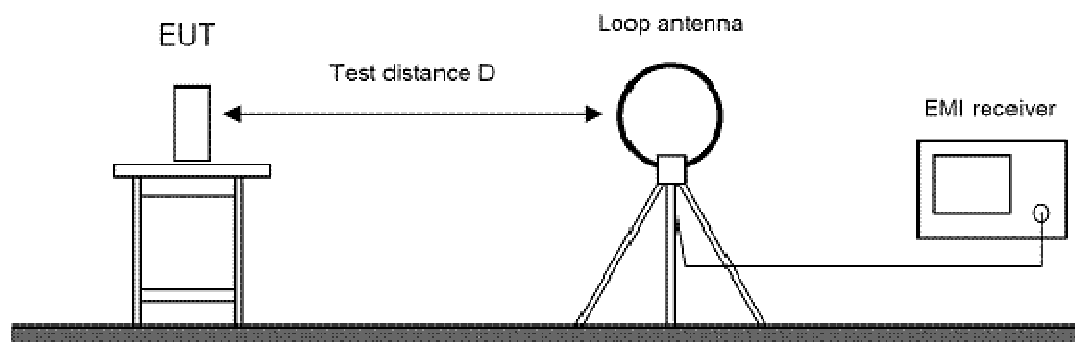
An EMI test receiver was used and connected to the loop antenna. The EUT was placed on a wooden table in a distance of 3m inside a compact diagnostic chamber.. The loop antenna was placed in vertical polarization at an angle of  $0^\circ$  and the EMI receiver performed a scan from 0.009 MHz to 30 MHz with the detector set to peak and the measurement bandwidth to 200 Hz. At .150 kHz the measurement bandwidth was changed to 9 kHz.

This procedure was repeated at 6 different positions of the EUT by rotating turn table. All peak values over the limit or with less distance to limit then 6dB were marked and re-measured with a quasi-peak detector with the following method on a 3m open area test site.

The turn table was turned  $360^\circ$  to find the position of maximum field strength. After reaching this position the loop antenna was rotated  $360^\circ$  to find the maxima. The measured value was recorded. This measurement was done for all marked frequencies with respect to the appropriate bandwidth for the frequency ranges.

To check the horizontal polarization the EUT was rotated by  $90^\circ$  instead of the loop antenna and the procedure was repeated. Both results are combined inside on graphic.

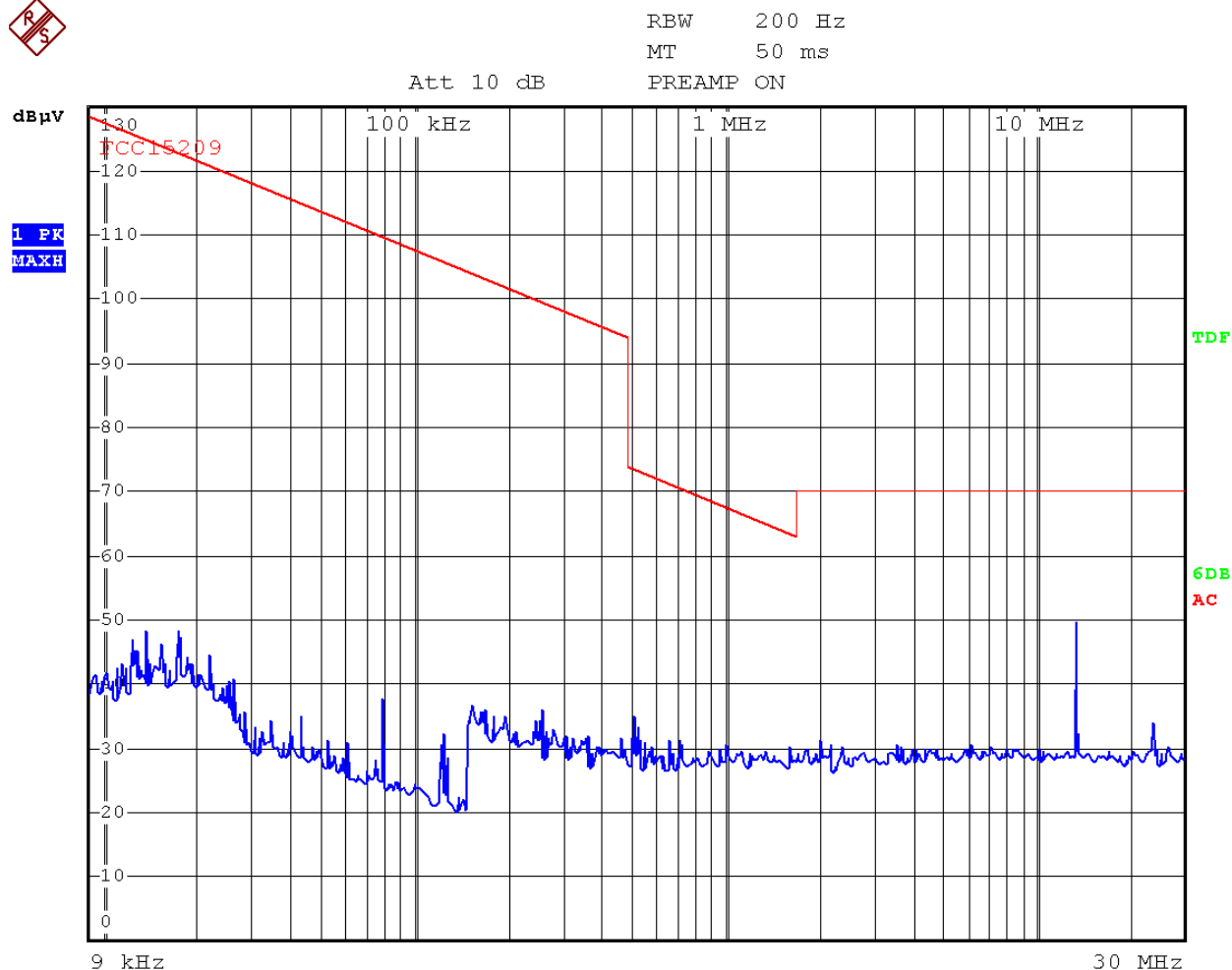
## 6.1.5 Test setup



Picture 9: Outline of radiated emission test setup



## 6.1.6 Test result



Picture 10: Radiated field strength from 9 kHz to 30 MHz

Expanded Uncertainty (9kHz to 150kHz):

$$U_{(y)} = (y \pm 4.024) \text{ dB}\mu\text{V}; k=2.00$$

y = Indicated value

Expanded Uncertainty (150kHz to 30MHz):

$$U_{(y)} = (y \pm 3.604) \text{ dB}\mu\text{V}; k=2.00$$

y = Indicated value

## 6.2 Radiated emission measurement from 30 MHz to 1000 MHz

### 6.2.1 Location of measurement

- ☒ Scan with peak detector in 3 m CDC witch is correlated to the 10m open site area.
- ☒ Final CISPR measurement with quasi peak detector on 3m open site area.

Description	Manufacturer	Inventory No.
CDC	Albatross Projects	E00026
Open site area	EMV <b>TESTHAUS</b> GmbH	200017

### 6.2.2 Measurement equipment

	Description	Manufacturer	Inventory No.
<input checked="" type="checkbox"/>	ESCS 30 (FF)	Rohde & Schwarz	E00003
<input type="checkbox"/>	ESU	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



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### 6.2.3 Limits

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



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## 6.2.4 Test method to demonstrate compliance

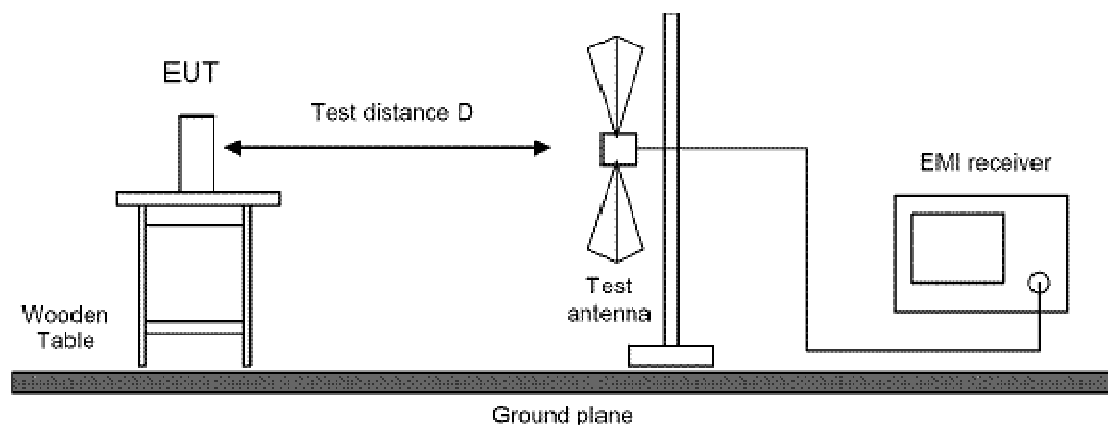
An EMI test receiver was used and connected to a broadband antenna. The EUT was placed on a wooden table in a distance of 3m inside a compact diagnostic chamber. The broadband antenna was placed in vertical polarization and the EMI receiver performed a scan from 30 MHz to 1000 MHz with the detector set to peak and the measurement bandwidth to 120 kHz.

This procedure was repeated at 6 different positions of the EUT by rotating turn table. After that the polarization switched to horizontal and repeated this procedure. After all 12 scans the results of the two polarizations were combined.

All peak values over or with less distance to limit then 6 dB were marked and re-measured with a quasi-peak detector with the following method on a 3 m open area test site.

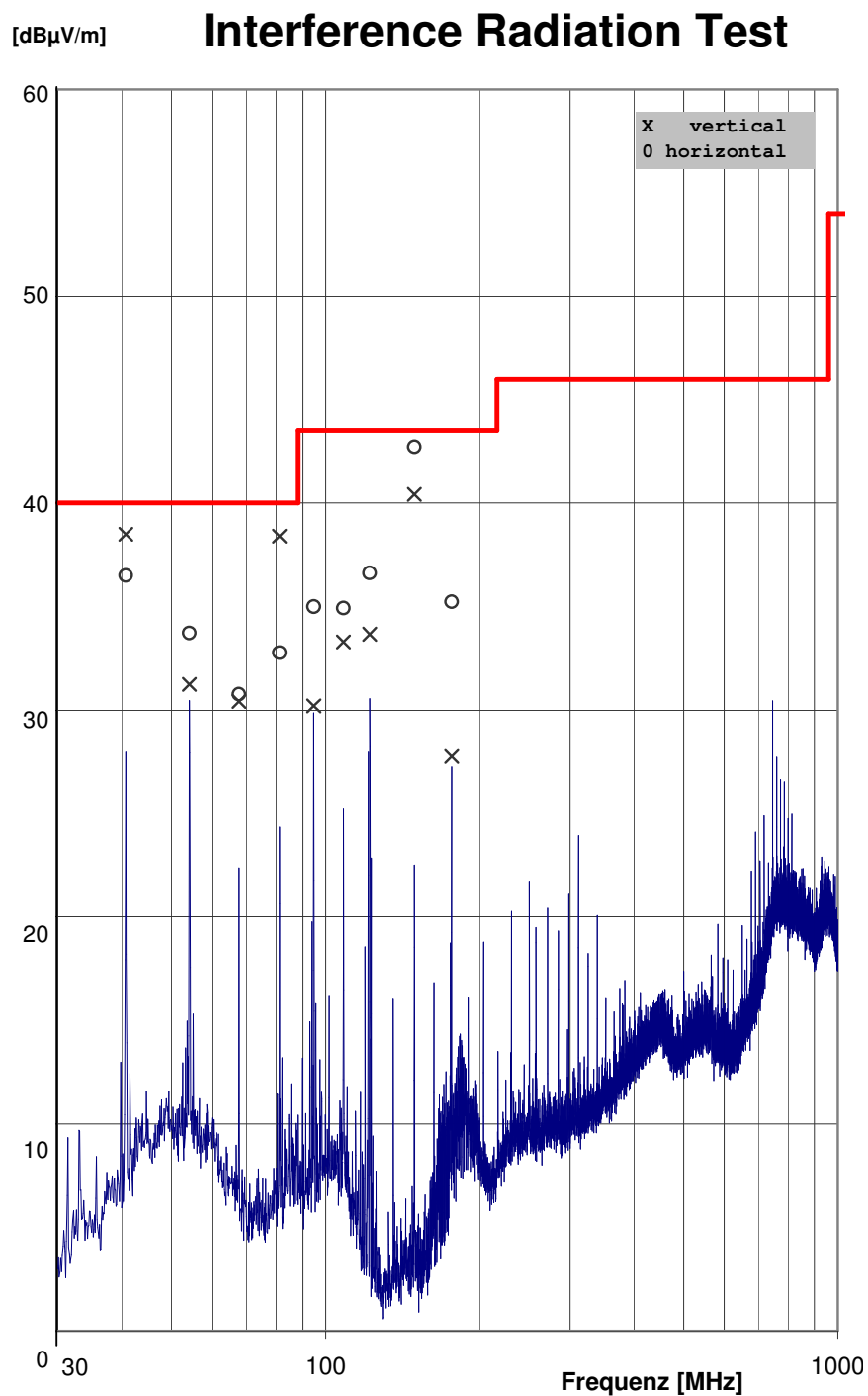
The turn table was turned 360° to find the position of maximum field strength. After reaching this position the antenna was moved from 1 m to 4 m height to find the maximum value. This value was recorded.

## 6.2.5 Test setup



Picture 12: Outline of radiated emission test setup

## 6.2.6 Test result



Picture 13: Radiated emission 30 MHz – 1000MHz

## 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
40,70	38,5	40,0	13,2	25,3	1,5	280°	110 cm	V	
40,70	36,5	40,0	13,2	23,3	3,5	210°	355 cm	H	
54,20	33,7	40,0	12,9	20,8	6,3	187°	360 cm	H	
54,20	31,2	40,0	12,9	18,3	8,8	134°	108 cm	V	
67,80	30,8	40,0	11,2	19,5	9,2	324°	250 cm	H	
67,80	30,4	40,0	11,2	19,2	9,6	226°	100 cm	V	
81,40	32,8	40,0	9,5	23,3	7,2	97°	250 cm	H	
81,40	38,4	40,0	9,5	28,9	1,6	222°	139 cm	V	
94,90	35,0	43,5	10,7	24,3	8,5	251°	250 cm	H	
94,90	30,2	43,5	7,3	22,9	13,3	196°	100 cm	V	
108,50	33,3	43,5	12,2	21,1	10,2	214°	110 cm	V	
108,50	34,9	43,5	12,2	22,8	8,6	174°	250 cm	H	
122,00	33,7	43,5	13,5	20,2	9,8	262°	110 cm	V	
122,00	36,6	43,5	13,5	23,1	6,9	1°	261 cm	H	
149,20	42,7	43,5	14,8	27,9	0,8	266°	234 cm	H	
149,20	40,4	43,5	14,8	25,7	3,1	302°	111 cm	V	
176,30	27,8	43,5	13,4	14,3	15,8	267°	110 cm	V	
176,30	35,2	43,5	13,4	21,8	8,3	33°	250 cm	H	

Picture 14: Radiated emission 30 MHz – 1000MHz ( table)



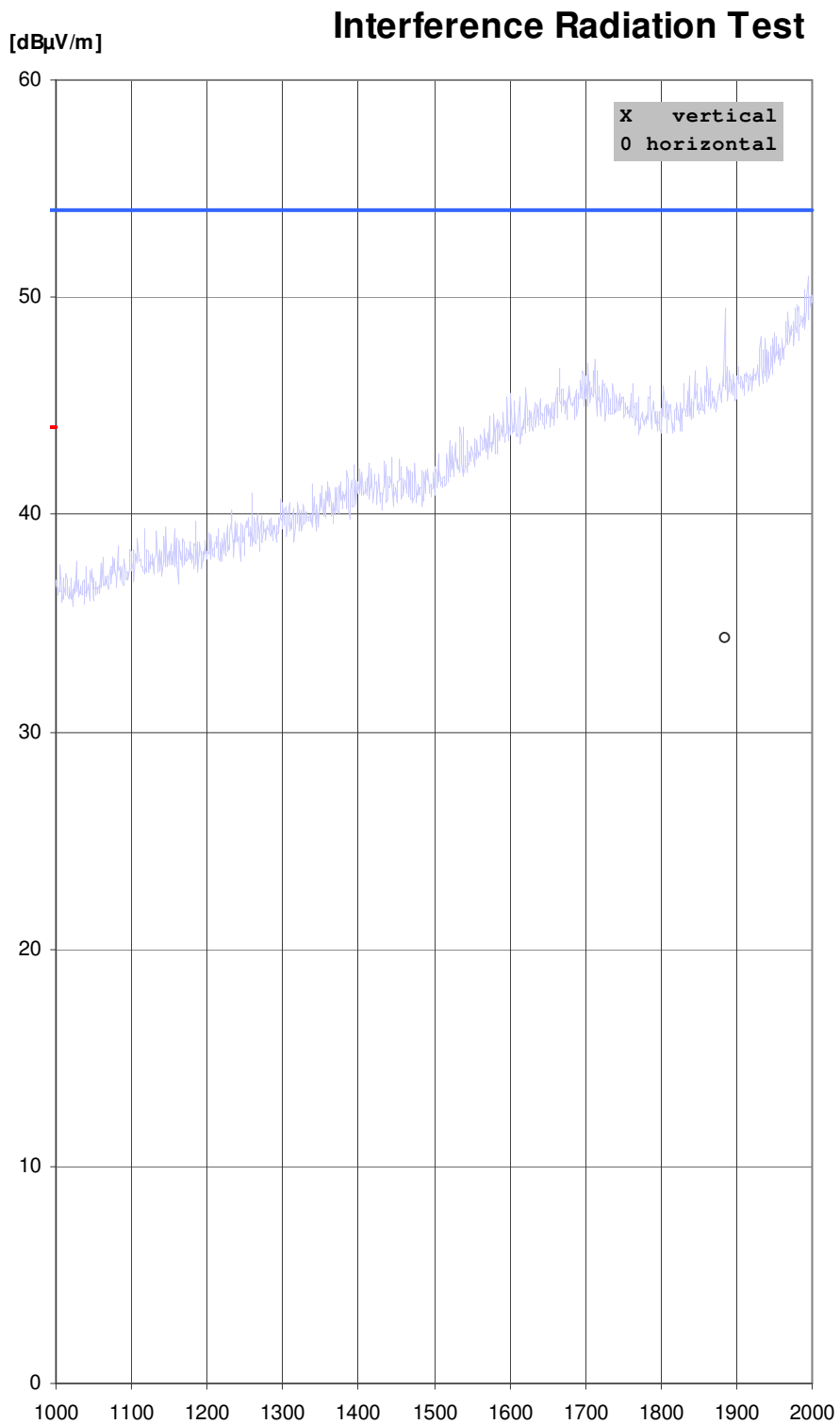
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**Picture 15: Radiated emission 1000 MHz – 2000MHz**

# 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
1884,80	34,3	0,0	36,9	-2,6	-34,3	55°	100 cm	H	

**Picture 16: Radiated emission 1000 MHz – 2000MHz (table)**



Expanded uncertainty (30MHz to 300MHz):

$$E_{(y)} = (y \pm 4.994) \text{ dB}\mu\text{V/m}; k=2.00$$

y = Indicated value

Expanded uncertainty (300MHz to 1000MHz):

$$E_{(y)} = (y \pm 5.276) \text{ dB}\mu\text{V/m}; k=2.00$$

y = Indicated value

Comments:



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## 7 Occupied Bandwidth (99%)

according to CFR 47 Part 2 section 2.202

### 7.1 Test location

Description	Manufacturer	Inventory No.
CDC	Albatross Projects	E00026

### 7.2 Test Instruments

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

### 7.3 Test method to demonstrate compliance

The EUT has detachable antenna therefore the conducted method was used

The occupied bandwidth is measured as the 99% bandwidth. For this measurement the occupied bandwidth function of the spectrum analyzer was used.

The resolution bandwidth of the spectrum analyzer shall be set to a greater value than 5% of the allowed bandwidth.

Because no resolution bandwidth was given the following guideline from ANSI C63.4 annex H6 was consulted.



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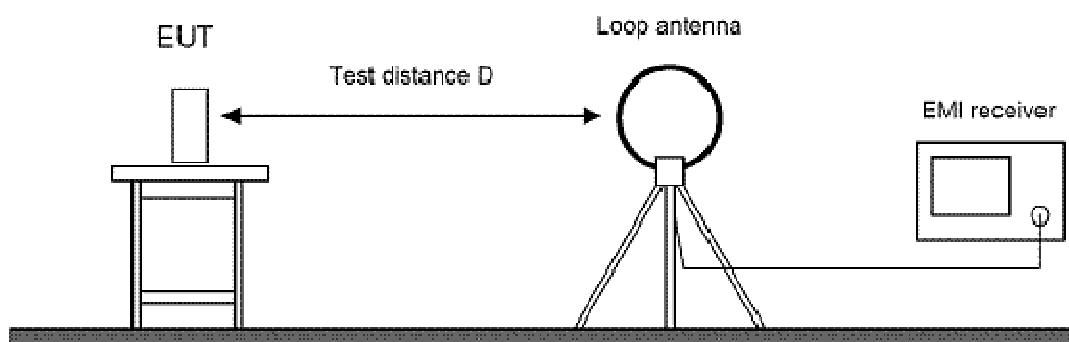
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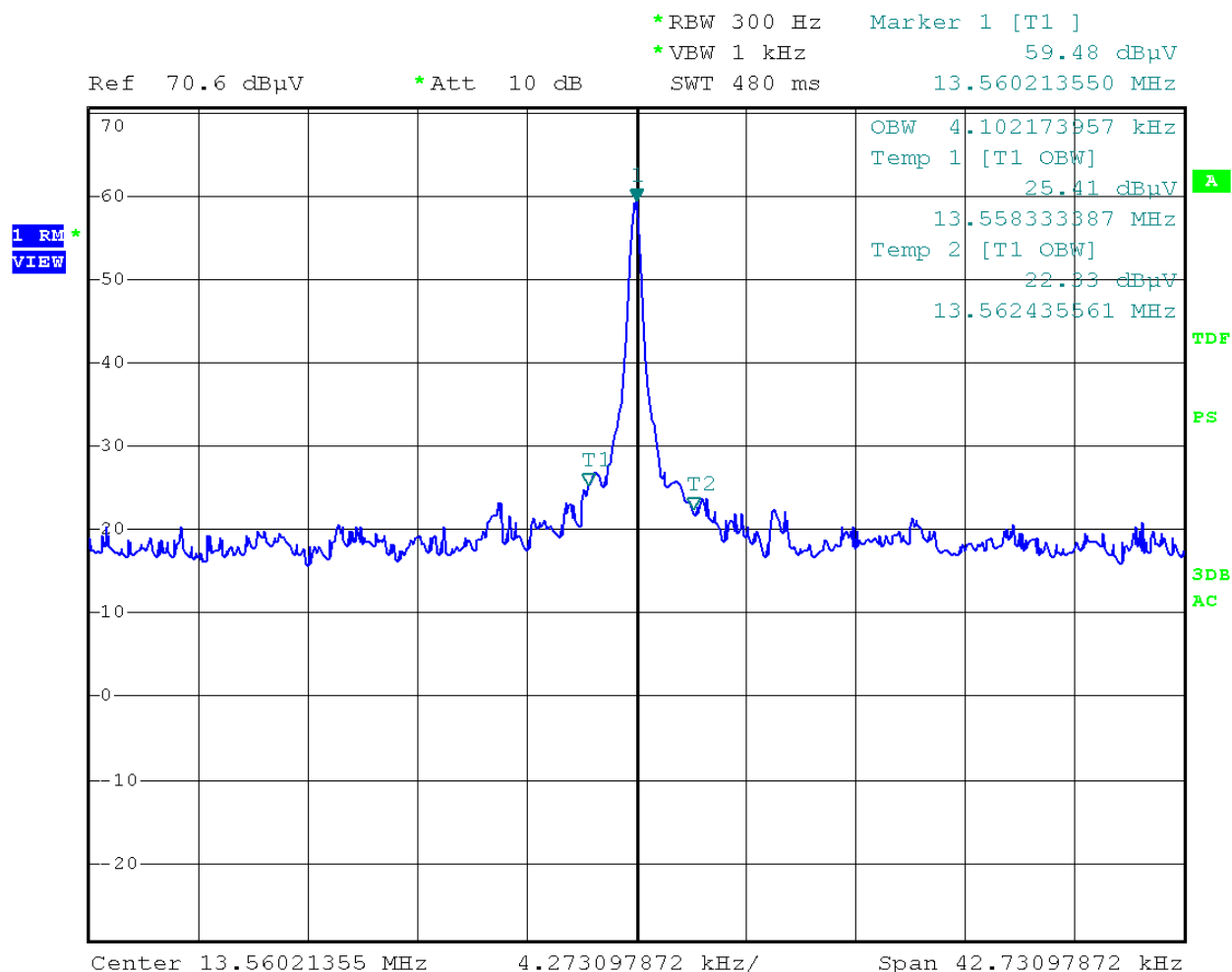
Fundamental frequency	Minimum resolution bandwidth
0.009MHz to 30MHz	1kHz
30MHz to 1000MHz	10kHz
1000MHz to 40000MHz	100kHz

The video bandwidth was adjusted at least 3 times wider than the resolution bandwidth

## 7.4 Test setup



Picture 17: Outline of test setup for occupied bandwidth measurement



**Picture 18: Occupied bandwidth 99%**

Frequency lower value:	13.5583333 MHz	Limit: 13.110 MHz
Frequency upper value:	13.5624355 MHz	Limit: 14.010 MHz
Occupied Bandwidth:	4.102 kHz	

## 8 Occupied Bandwidth (20dB)

according to FCC Part 15, section 15.215(c)

### 8.1 Test location

Description	Manufacturer	Inventory No.
CDC	Albatross Projects	E00026

### 8.2 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 checked="" type="checkbox"/>	HFH2-Z2	Rohde & Schwarz	E00060
<input type="checkbox"/>	VULB 9163 (CDC)	Schwarzbeck	E00013
<input type="checkbox"/>	VULB 9160 (FF)	Schwarzbeck	E00011

### 8.3 Test method to demonstrate compliance

The 20 dB bandwidth of the emission is measured as the frequency range defined by the points that are 20 dB down relative to the maximum level of the modulated carrier. For intentional radiators operating under the alternative provisions to the general emission limits the requirement to contain the 20 dB bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation

The resolution bandwidth of the spectrum analyzer shall be set to a greater value than 5% of the allowed bandwidth.



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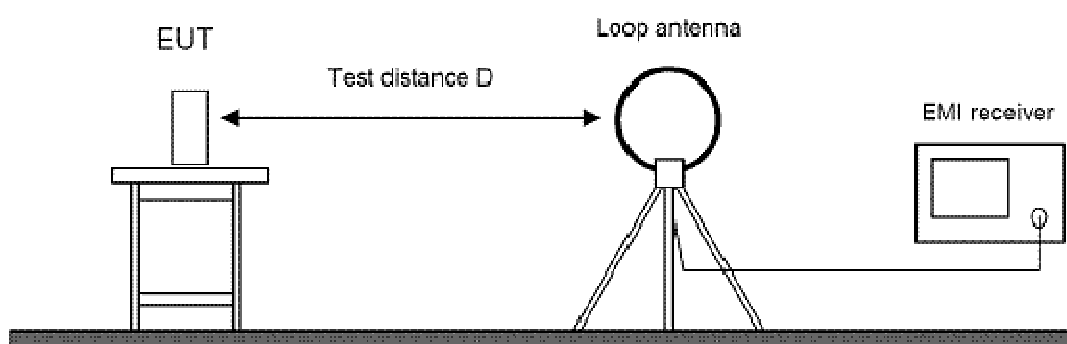
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Because no resolution bandwidth was given the following guideline from ANSI C63.4 annex H6 was consulted.

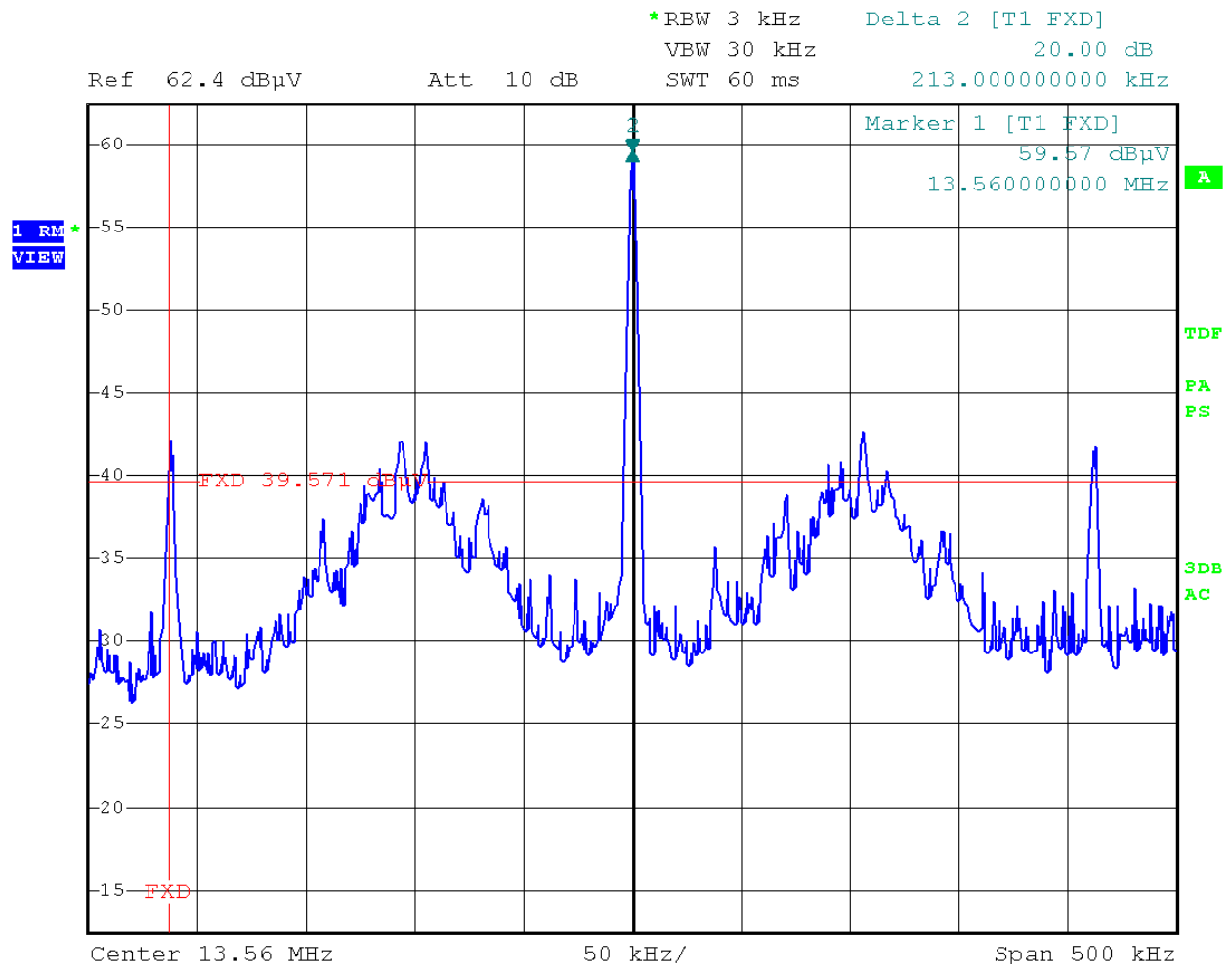
Fundamental frequency	Minimum resolution bandwidth
0.009MHz to 30MHz	1kHz
30MHz to 1000MHz	10kHz
1000MHz to 40000MHz	100kHz

The video bandwidth was adjusted at least 3 times wider than the resolution bandwidth

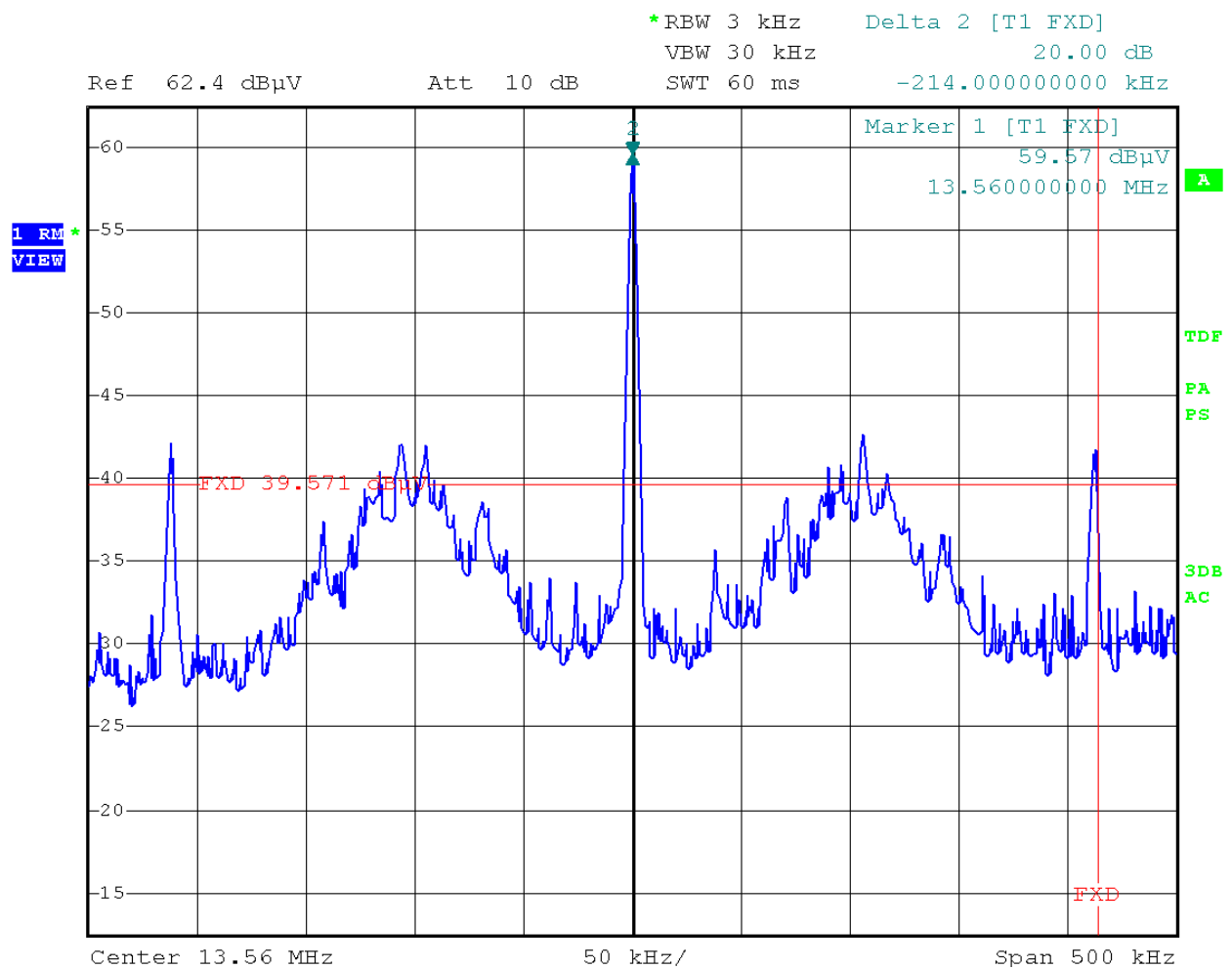
## 8.4 Test setup



Picture 19: Outline of occupied bandwidth test setup



**Picture 20: Occupied bandwidth lower value**



**Picture 21: Occupied bandwidth upper value**

Frequency lower value:	13.3470 MHz	Limit: 13.110 MHz
Frequency upper value:	13.774 MHz	Limit: 14.010 MHz

Occupied Bandwidth: 426.0 kHz



## 9 Carrier frequency stability

according to CFR 47 Part 15, section 15.225(e)

### 9.1 Test location

	Description	Manufacturer	Inventory No.
<input checked="" type="checkbox"/>	Climatic Chamber VC4100	Vötsch	C00014
<input type="checkbox"/>	Climatic Chamber VC <sup>3</sup> 4043	Vötsch	C00015

### 9.2 Test Instruments

	Description	Manufacturer	Inventory No.
<input type="checkbox"/>	ESCI	Rohde & Schwarz	E00001
<input checked="" type="checkbox"/>	ESU	Rohde & Schwarz	W00002
<input checked="" type="checkbox"/>	Test Probe RFR400-1	Langer	200086
<input checked="" type="checkbox"/>	Power Supply	Statron	300193
<input checked="" type="checkbox"/>	Multimeter	Metra Hit 29S	100080
<input type="checkbox"/>	USLP 9142	USLP 9142	100044

### 9.3 Test method to demonstrate compliance

The frequency tolerance of the carrier signal is measured over a temperature variation of -20 °C to +50 °C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 °C. If the EUT provides an antenna connector the spectrum analyzer is connected to this port. If required, a resistive matching network equal to the impedance specified or employed for the antenna is used as well as dc block and appropriate attenuators (50 Ohms). In cases where the EUT does not provide an antenna connector a test fixture is used.

For battery operated equipment, the test is performed using a new battery. Alternatively, an external supply voltage can be used and is at least set to:

- the maximum battery voltage as delivered by a new battery or 115% of the battery nominal voltage
- the battery nominal voltage
- 85% of the battery nominal voltage



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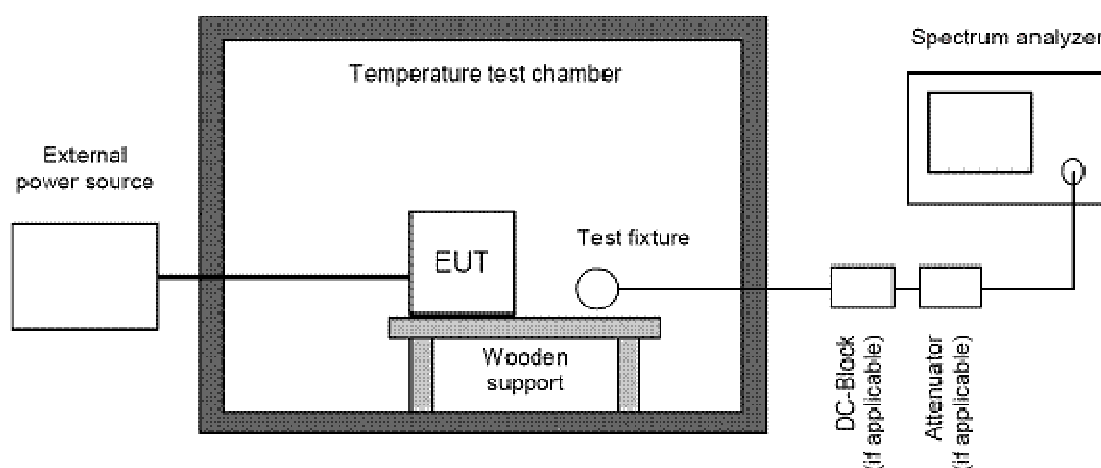
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- the battery operating end point voltage which shall be specified by the equipment manufacturer

The EUT is operating providing an unmodulated carrier. The peak detector of the spectrum analyzer is selected and the resolution bandwidth as well as the video bandwidth is set to values appropriate to the shape of the spectrum of the EUT. The frequency counter mode of the spectrum analyzer is used to maximize the accuracy of the measured frequency tolerance.

If an unmodulated carrier is not available a significant and stable point on the spectrum is selected and the span is reduced to a value that delivers an accuracy which shall be better than 1% of the maximum frequency tolerance allowed for the carrier signal. This method may be performed as long as the margin to the frequency tolerance allowed is larger than the uncertainty of the measured frequency tolerance

## 9.4 Test setup



**Picture 22: Outline of carrier frequency stability test setup**

## 9.5 Carrier vs. temperature

Supply Voltage 5V		Nominal frequency: 13.560000 MHz	
Temperature	Carrier frequency	$\Delta$ Frequency	Deviation
°C	MHz	Hz	ppm
-20	13.560224	0	0
-10	13.560224	0	0
0	13.560224	0	0
+10	13.560224	0	0
+20	13.560224	0	0
+30	13.560224	0	0
+40	13.560224	0	0
+50	13.560304	80	5.9
Limit $\pm 100$ ppm			

Table 1: Carrier vs. temperature

## 9.6 Carrier vs. input voltage

No deviation of  $f_c$  was recorded due to input voltage variation!

# 10 Designation of Emissions

according to CFR 47 Part 2, Sections 2.201 and 2.202

## 10.1 Designation

Type of Modulation: Amplitude Modulation

Necessary Bandwidth:  $B_n = 2 \cdot B \cdot K$

Modulation Rate:  $B = 5kHz$

Overall numerical Factor:  $K = 1$

$$B_n = 2 \cdot 5kHz \cdot 1 = 10kHz$$

Designation of Emissions according ITU-R: **10K0A1D**

Comments:



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# 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 08	Aug 10	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

**Table 2: Equipment Calibration status**



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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 8, 2010



Marco Janker  
EMI / EMC Test Engineer



Markus Biberger  
Technical executive  
EMV **TESTHAUS** GmbH



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