

# Test Report

## RF Test Report



Industry  
Canada

Industrie  
Canada

**268.097**

**Elatec Vertriebs GmbH**

RFID Reader

TWN3 Reader Legic advant

13,56 MHz / (TWN3LA)

### Customer:

Elatec Vertriebs GmbH

Max-Plank-Strasse 16

82223 Eichenau

Germany

Tel.: +49.8141.53498-0

Fax: +49.8414.53498-29



The test result refers exclusively  
to the model tested.

This report must not be copied without  
the written authorization by the lab.  
Revision: 2.1



Registration number: DAT-P-224/95-02

# EMV **TESTHAUS** GmbH

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Tel.: +49 9421 56868-0  
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## Accreditation:



Registration number: DAT-P-224/95-02  
Valid until 08.06.2011

CAB (EMC) registration number: BNetzA-CAB-02/21-02/1  
Valid until 27.11.2008

FCC facility registration number: 221458  
Valid until 04.09.2011

Industry Canada registration number: 3472A-1  
Valid until 17.07.2010

## Place of Inspection:

EMV **TESTHAUS** GmbH  
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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: 10-2007	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: 09-2007	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	Radio Standards Specification RSS-Gen Issue 2 containing General Requirements and Information for the Certification of Radiocommunication Equipment, published by Industry Canada
RSS-102: Issue 2 November 2005	Radio Standards Specification RSS-102 Issue 2 Radio Frequency Exposure Compliance of Radiocommunications Apparatus
RSS-210: Issue 7 June 2007	Radio Standards Specification RSS-210 Issue 7 for Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, published by Industry Canada



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## 2 Summary of test results separated by FCC and Industry Canada

### 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	37	Recorded
15.215(c)	Occupied bandwidth	40	Passed
2.201, 2.202	Class of emission	50	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 0,150MHz to 30MHz	15	Passed
15.225(a)-(d)	Spectrum mask	10	Passed
15.205(b) 15.215(b) 15.225(a)(d)	Radiated emission 0,009MHz to 30MHz	23	Passed
15.205(b) 15.225(d)	Radiated emission 30MHz to 1000MHz	30	Passed
15.225(e)	Carrier frequency stability	47	Passed



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### Industry Canada RSS Gen Issue 2

Section	Test	Page	Result
4.8	Transmitter output power	----	Not applicable
4.6.1	Occupied bandwidth	44	Recorded
3.2(h)	Emission designator	50	Calculated
4.5	Pulsed operation	----	Not applicable
7.2.2	Transmitter AC conducted emission	15	Passed
5.5	Exposure of humans to RF fields	51	Exempted form SAR and RF evaluation

### Industry Canada RSS 210 Issue 7

Section	Test	Page	Result
2.2(a)	Restricted bands and unwanted emission frequencies	----	Passed
A2.6	Spectrum mask	10	Passed
2.2(b)(c), 2.6, A2.6	Unwanted emission 0,009MHz to 30MHz	23	Passed
2.2(b)(c), 2.6, A2.6	Unwanted emission 30MHz to 1000MHz	30	Passed
A2.6	Carrier frequency stability	47	Passed



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### 3 Equipment under Test (EUT)

Device name: TWN3 Reader Legic advant (TWN3LA)

Manufacturer: Elatec Vertriebs GmbH

Serial number: Engineering Sample

FCC ID: WP5TWN3A1

Canada IC: 7948A-TWN3A1

Application freq. band: 13.110MHz – 14.010MHz

Frequency range: 13,1466 MHz – 13,8906 MHz

Operating frequency: 13,56023 MHz

Class of emission: 10K0A1D

Type of modulation: ASK

Channel spacing: N/A

Number of RF-channels: 1

Pulse train: none

Pulse width: none

Antenna type: Integrated PCB antenna  
 detachable       not detachable

Power supply: USB powered  
nominal: 5.0 V  
minimum: 4.25 V  
maximum: 5.75 V

Temperature range: -20 °C to +55 °C

Interfaces: N/A



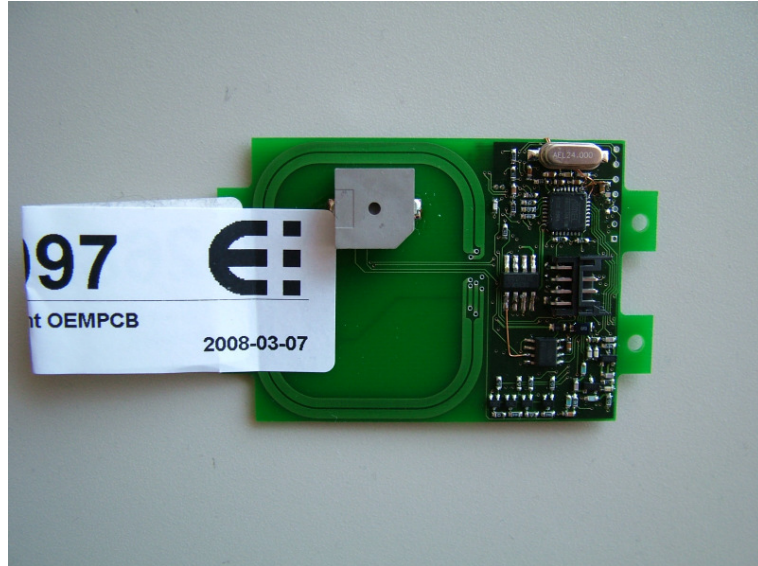
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### 3.1 Photo documentation



Picture 1: EUT TWN3 Reader Legic advant (TWN3LA)



Picture 2: USB cable for EUT TWN3 Reader Legic advant (TWN3LA)



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### 3.2 Short description of the EUT

The EUT is a RFID Reader with the operating frequency of 13,56 MHz

### 3.3 Operation Mode

The EUT was tested in the following operation modes:

- Reading tags continuously. For this mode a software form Elatec was used.

### 3.4 Configuration

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

Device	Model:	S/N
RFID Reader (EUT)	TWN3 Reader Legic advant (TWN3LA)	Engineering Sample
USB Cable	Standard cable form Elatec 1,5m	Engineering Sample
Test Monitor	Belinea 10 17 05 with 1,8m cable attached. Ferrite 10cm away from VGA connector. Power cord 1.8m from Longwell	AA1117230420AC10400802
Test PC	Monitor Test PC 3 with 1,8m power cord form Longwell	302822800136
Mouse	Microsoft Basic Optical 1.0A 950010 with cable 1.5m, ferrite on USB plug side	X8008998



## 4 Spectrum Mask

according to CFR 47 Part 15, section 15.225 (a)-(d),  
RSS-210 Issue 7, section 2.6 and section A2.6

### 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	100089
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	100072
<input checked="" type="checkbox"/>	ESCI (CDC)	Rohde & Schwarz	100132
<input checked="" type="checkbox"/>	HFH2-Z2	Rohde & Schwarz	100005
<input type="checkbox"/>	VULB 9163 (CDC)	Schwarzbeck	100077
<input type="checkbox"/>	VULB 9160 (FF)	Schwarzbeck	100064



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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.

$$L_{dm} = L_d + (-40 \frac{dB}{dec} * (\log(dm) - \log(d)) - 20) L_{dm} = \text{Limit at the new distance}$$

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

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

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

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

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



## 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 1 kHz and the video bandwidth at least 3 times higher than the resolution bandwidth. Span was set to 1MHz to cover the whole spectrum mask. The detector was set to maxpeak with hold function.

The spectrum analyzer was connected to a loop antenna with vertical polarization at a measurement distance of 3m on an open area test site. This loop antenna has a correction factor of 20dB. Due to better visibility in the printing the actual spectrum mask limit was reduced by this 20dB. Therefore the picture 3-1: shows the correct distance to the limit, to get the correct field strength 20dB has to be added to the marker value T1.

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°.



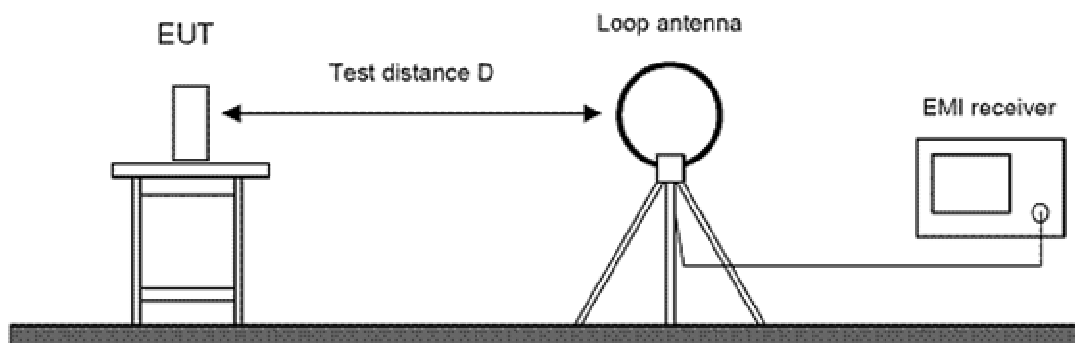
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## 4.5 Test setup



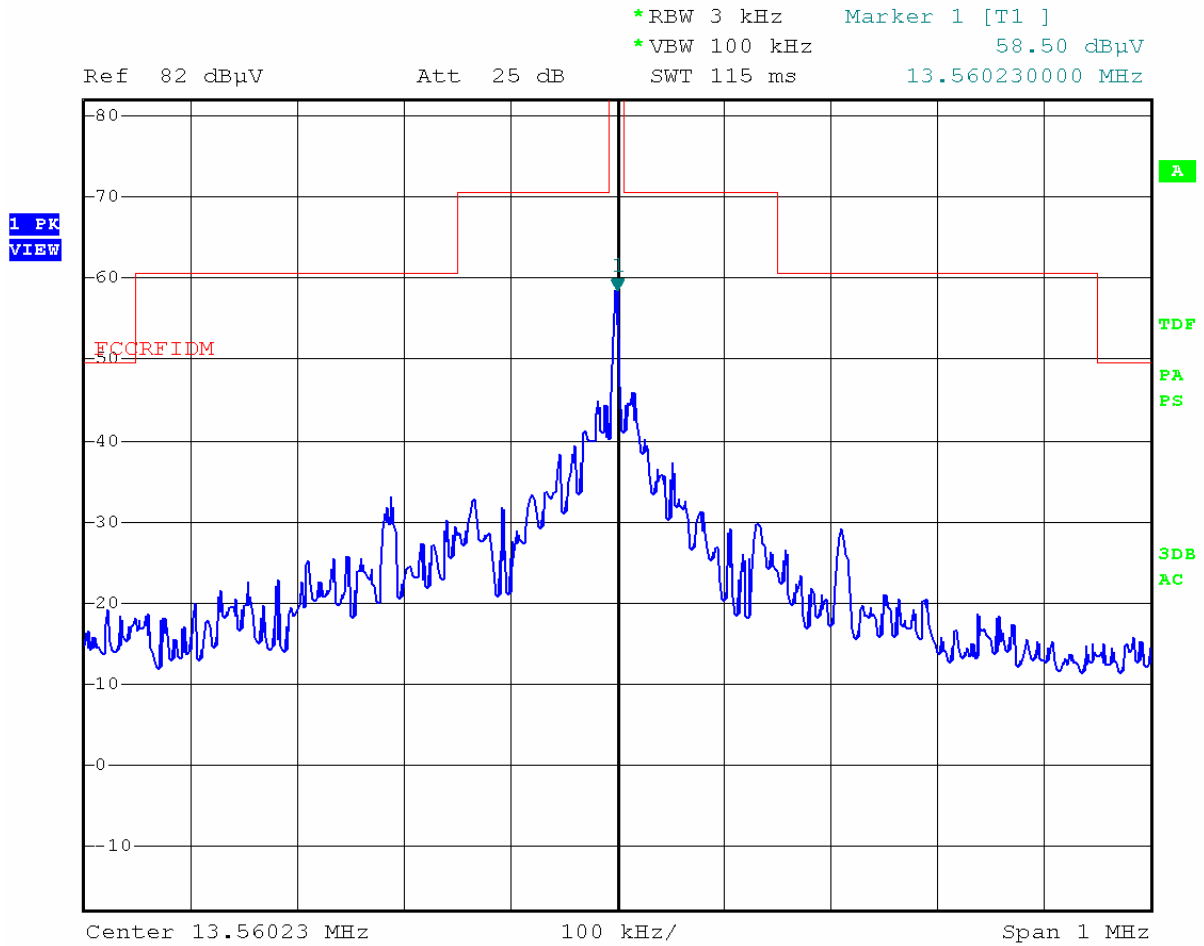
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## 4.6 Test result



**Picture 4-1:Result of spectrum mask measurement**

The actual field strength of the carrier is:

$$F_S = T1 + 20dB = 58,50dB\mu V/m + 20dB = 78,50dB\mu V/m$$

Expanded uncertainty (0,009 to 30MHz):

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

y = Indicated value

Comments:



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## 5 Conducted emission test

according to CFR 47 Part 15, section 15.207  
RSS-Gen Issue 2, section 7.2.2

### 5.1 Test Location

Description	Manufacturer	Inventory No.
Shielded chamber	Siemens - Matsushita	200016

### 5.2 Test Instruments

	Description	Manufacturer	Inventory No.
<input checked="" type="checkbox"/>	ESH 3	Rohde & Schwarz	100002
<input type="checkbox"/>	ESCS 30	Rohde & Schwarz	100072
<input type="checkbox"/>	ESCI	Rohde & Schwarz	100132
<input checked="" type="checkbox"/>	ESH3 Z2	Rohde & Schwarz	200051
<input checked="" type="checkbox"/>	ESH 2-Z5	Rohde & Schwarz	100040



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### 5.3 Limits

Frequency [MHz]	Quasi-peak [dBµV]	Avarage [dBµV]
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) 50µH/50ohms and a EMI test receiver. The EMI test receiver was connected to the LISN and set to a measurement bandwidth of 9kHz in the frequency range form 0.15MHz to 30MHz. 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 0.15MHz to 30MHz were scanned. After that all peaks values with fewer margins than 10dB 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.



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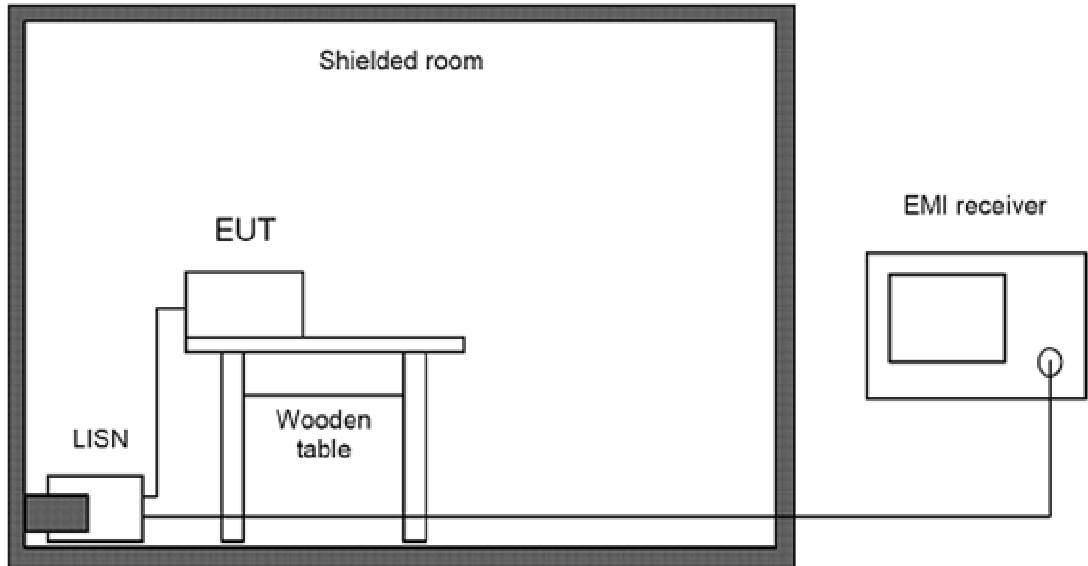
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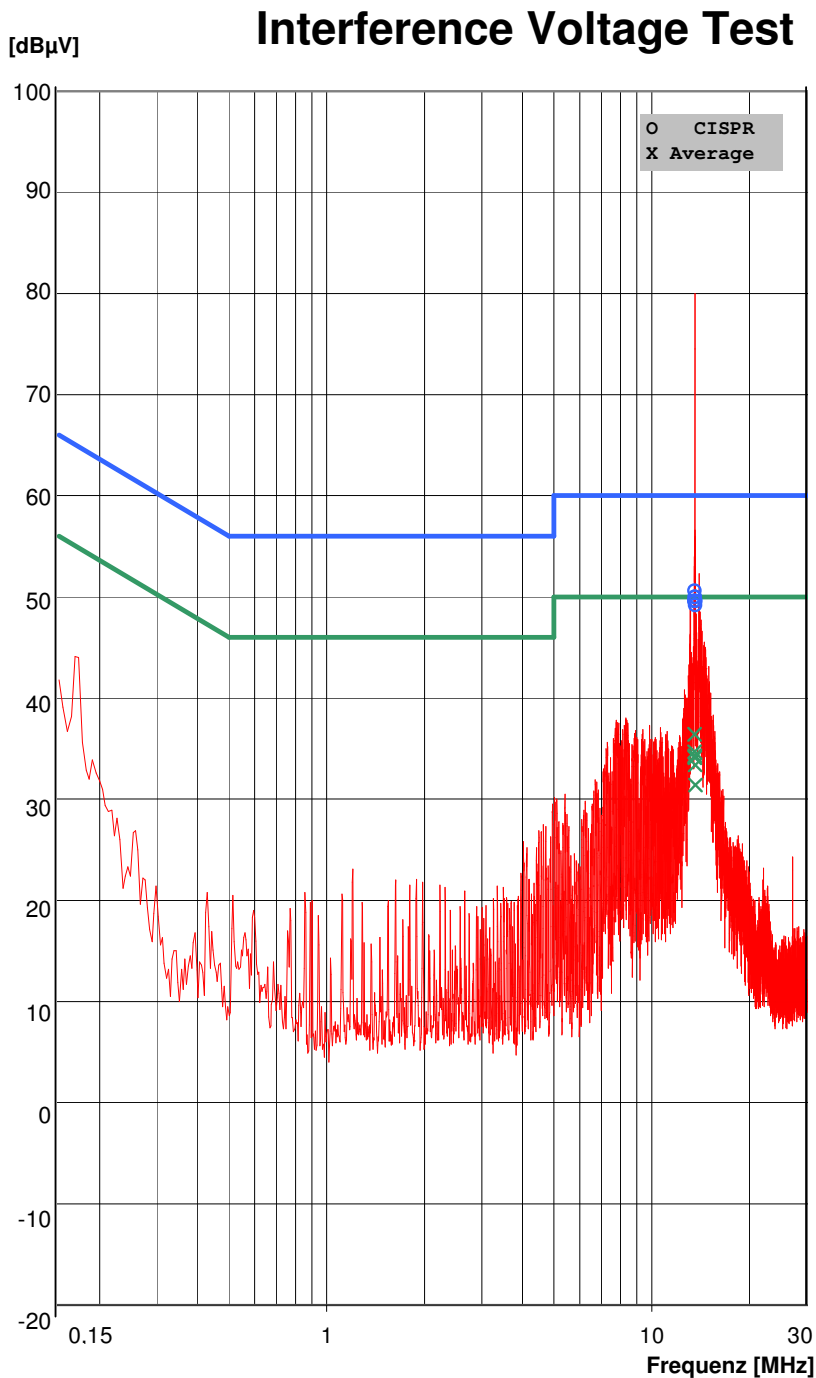
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## 5.5 Test setup





**REGULATIONS:**

FCC 15.207  
 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.:**

268.097

**EUT:**

Elatec Vertriebs GmbH  
 RFID Reader  
 TWN3-Legic Advant OEMPCB  
 Prototyp

**OPERATION MODE:**

continuously transmission  
 EUT connected with USB port

Mains 115V AC /60Hz  
 Phase

**TEST FACILITY:**

EMV TESTHAUS GmbH  
 Gustav-Hertz-Straße 35  
 94315 Straubing

**DATE / TIME:**

06.05.2008

**TEST ENGINEER:**

Penning Axel

097 ss Legic Advant

**Picture: 5-1 Conducted emission on mains, phase 1**



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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
13,54	50,6	60,0	9,4	36,4	50,0	13,6	0,0	
13,54	49,6	60,0	10,4	34,7	50,0	15,3	0,0	
13,54	49,6	60,0	10,4	34,2	50,0	15,8	0,0	
13,58	50,0	60,0	10,0	34,3	50,0	15,7	0,0	
13,58	50,0	60,0	10,0	34,1	50,0	15,9	0,0	
13,60	49,2	60,0	10,8	33,4	50,0	16,6	0,0	
13,61	49,6	60,0	10,4	31,4	50,0	18,6	0,0	

**Table: 5-1 Conducted emission on mains, phase 1**



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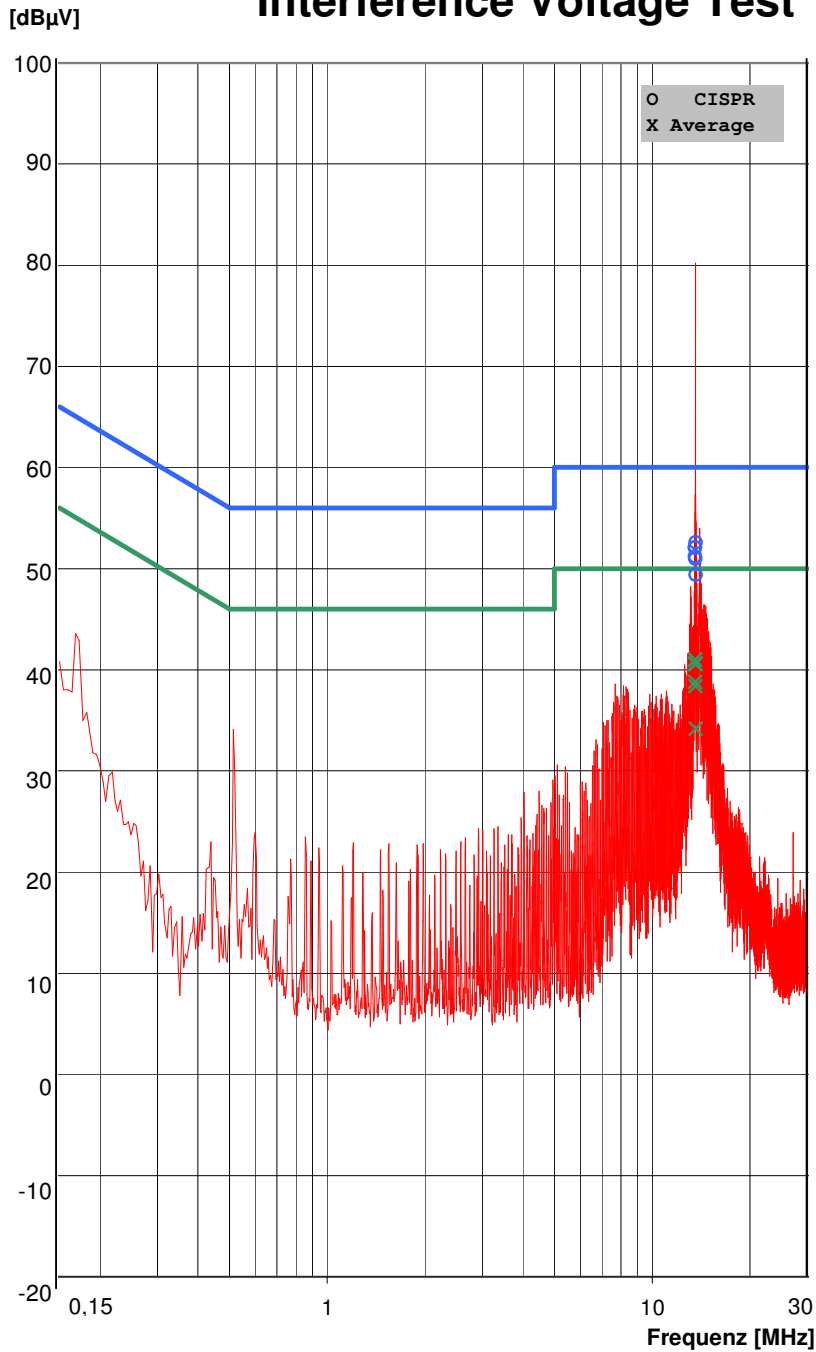
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## 5.6 Test result

### Interference Voltage Test



#### REGULATIONS:

FCC 15.207  
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.:

268.097

#### EUT:

Elatec Vertriebs GmbH  
RFID Reader  
TWN3-Legic Advant OEMPCB  
Prototyp

#### OPERATION MODE:

continuously transmission  
EUT connected with USB port

Mains 115V AC /60Hz  
Neutral

#### TEST FACILITY:

EMV TESTHAUS GmbH  
Gustav-Hertz-Straße 35  
94315 Straubing

#### DATE / TIME:

06.05.2008

#### TEST ENGINEER:

Penning Axel

097 ss Legic Advant

Picture: 5-2 Conducted emission on mains, neutral



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## Interference Voltage Test

Freq. [MHz]	U_CISPR [dB $\mu$ V]	Limit [dB $\mu$ V]	delta_U [dB]	U_AV [dB $\mu$ V]	Limit [dB $\mu$ V]	delta_U [dB]	Corr. [dB]	Remark
13,54	52,1	60,0	7,9	41,0	50,0	9,0	0,0	
13,53	52,1	60,0	7,9	40,6	50,0	9,4	0,0	
13,55	51,2	60,0	8,8	38,8	50,0	11,2	0,0	
13,57	51,0	60,0	9,0	38,4	50,0	11,6	0,0	
13,59	52,6	60,0	7,4	40,6	50,0	9,4	0,0	
13,60	49,4	60,0	10,6	34,2	50,0	15,8	0,0	

**Table: 5-2 Conducted emission on mains, neutral**



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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 13,56MHz disturbance belongs to the carrier frequency, which is exempted for this test. Due to fixed internal antenna a test with 50ohm dummy was not possible.

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



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## 6 Measurement of radiated emission

according to CFR 47 Part 15, section 15.205(d7), 15.209  
RSS-210 Issue 7, section 2.6

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

#### 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	100089
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	100072
<input checked="" type="checkbox"/>	ESCI (CDC and FF)	Rohde & Schwarz	100132
<input type="checkbox"/>	ESVP (FF)	Rohde & Schwarz	100001
<input type="checkbox"/>	VULB 9163 (CDC)	Schwarzbeck	100077
<input type="checkbox"/>	VULB 9160 (FF)	Schwarzbeck	100064
<input checked="" type="checkbox"/>	Feedline OATS	Huber & Suhner	200024
<input checked="" type="checkbox"/>	HFH2-Z2 (CDC and FF)	Rohde & Schwarz	100005



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### 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.

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

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

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

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

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

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

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





## 6.1.4 Test method to demonstrate compliance

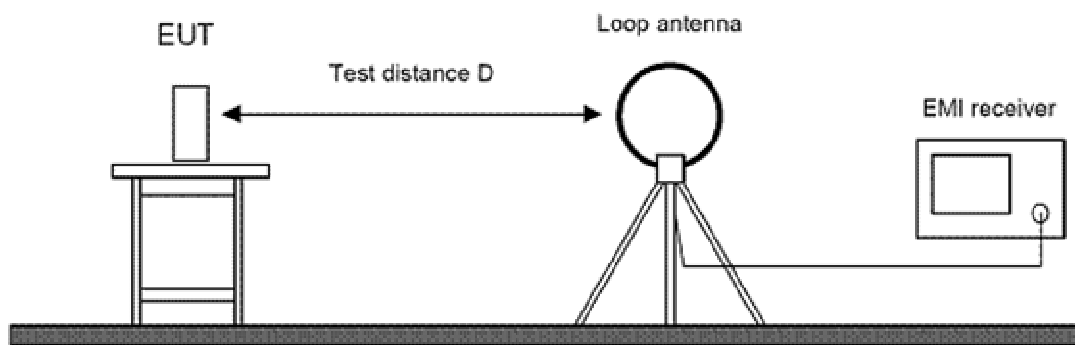
An EMI test receiver was used and connected to the loop antenna. The EUT was placed on a wooden table in a distance of 3m inside a compact diagnostic chamber.. The loop antenna was placed in vertical polarization at an angle of 0° and the EMI receiver performed a scan from 0.009MHz to 30MHz with the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

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° to find the position of maximum field strength. After reaching this position the loop antenna was rotated 360° 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° instead of the loop antenna and the procedure was repeated. Both results are combined inside on graphic.

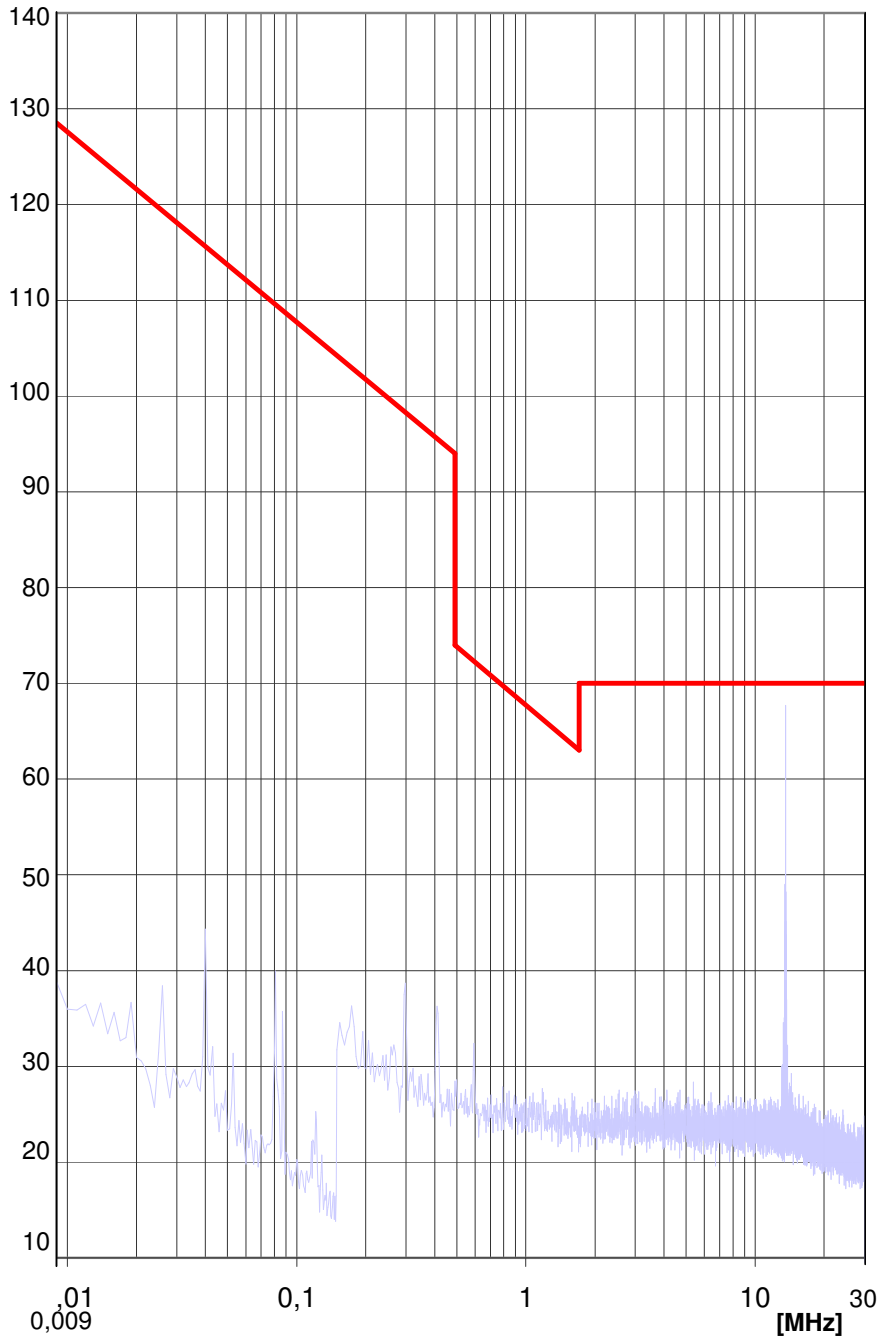
## 6.1.5 Test setup



## 6.1.6 Test result

[dB $\mu$ V/m]

### Radiated Field Strength



#### REGULATIONS:

FCC 15.209 3m  
PEAK / CISPR

#### TEST EQUIPMENT:

R&S ESCI (10 0 132)  
R&S HFH2-Z2(10 0 005)  
Suhner (20 0 024)

#### ORDER NO.:

268.097

#### EUT:

Elatec Vertriebs GmbH  
RFID Reader  
TWN3 Reader Legic advant  
Prototyp

#### OPERATION MODE:

Continuous transmission  
with modulation  
13,56MHz

#### TEST FACILITY:

EMV TESTHAUS GmbH  
Gustav-Hertz-Straße 35  
94315 Straubing

#### DATE / TIME:

03.04.2008  
21 °C

#### TEST ENGINEER:

Penning Axel

097 Legic Advant FCC-15.209.E10

Picture: 6-1 Radiated field strength 0,009 MHz – 30 MHz (pre scan)



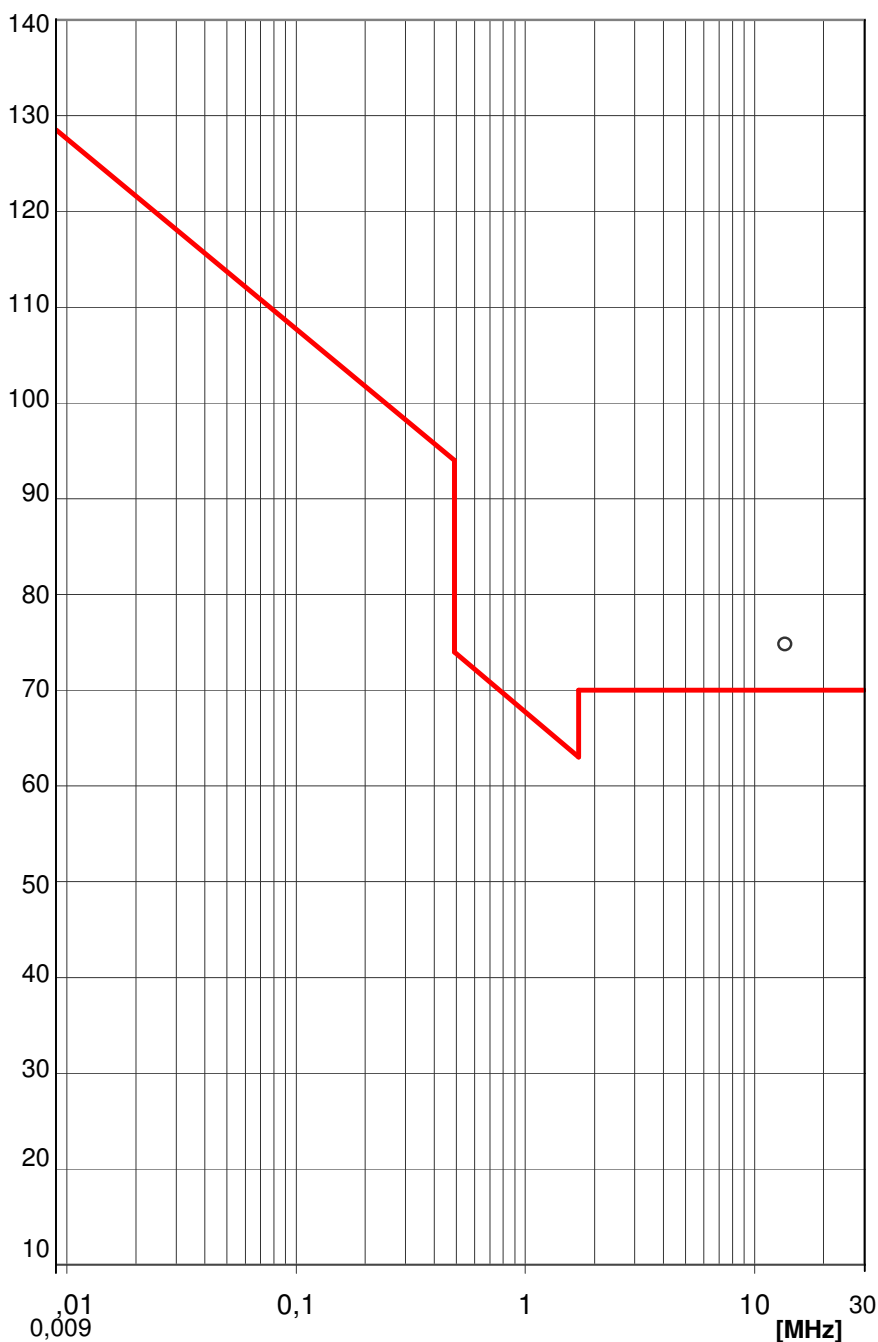
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## Radiated Field Strength



**REGULATIONS:**

FCC 15.209 3m  
PEAK / CISPR

**TEST EQUIPMENT:**

R&S ESCI (10 0 132)  
R&S HFH2-Z2(10 0 005)  
Suhner (20 0 024)

**ORDER NO.:**

268.097

**EUT:**

Elatec Vertriebs GmbH  
RFID Reader  
TWN3 Reader Legic advant  
Prototyp

**OPERATION MODE:**

Continuous transmission  
with modulation  
13,56MHz

**TEST FACILITY:**

EMV TESTHAUS GmbH  
Gustav-Hertz-Straße 35  
94315 Straubing

**DATE / TIME:**

03.04.2008  
21 °C

**TEST ENGINEER:**

Penning Axel

097 Legic Advant FCC-15.209.E10

**Picture: 6-2 Radiated field strength 0,009 MHz – 30 MHz (final)**



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## Radiated Field Strength

Freq. [MHz]	I_Rec [dBm]	Limit [dBm]	Corr. [dB]	I_Ant. [dBm]	delta_I [dB]	Turn- table	Antenna	Pol.	Remark
13,57	74,8	70,0	51,5	23,3	-4,8	252°	100 cm	H	097 Legic Advant FCC-15.209.E10

**Table: 6-1 Radiated field strength 0,009 MHz – 30 MHz (final)**

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

Remark: 13,57MHz is the carrier frequency. For this frequency the limit in section 15.225 applies ( $L_{dm} = 84 \frac{\text{dB}\mu\text{V}}{m} + (-40 \frac{\text{dB}}{\text{dec}} * (\log(3m) - \log(30m))) = 124\text{dB}$ ), therefore the result is positive.



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

### 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 10m open site area.

Description	Manufacturer	Inventory No.
CDC	Albatross Projects	100089
Open site area	EMV <b>TESTHAUS</b> GmbH	200017

### 6.2.2 Measurement equipment

	Description	Manufacturer	Inventory No.
<input type="checkbox"/>	ESCS 30 (FF)	Rohde & Schwarz	100072
<input checked="" type="checkbox"/>	ESCI (CDC)	Rohde & Schwarz	100132
<input checked="" type="checkbox"/>	ESVP (FF)	Rohde & Schwarz	100001
<input checked="" type="checkbox"/>	VULB 9163 (CDC)	Schwarzbeck	100077
<input checked="" type="checkbox"/>	VULB 9160 (FF)	Schwarzbeck	100064
<input type="checkbox"/>	HFH2-Z2	Rohde & Schwarz	100005
<input checked="" type="checkbox"/>	Feedline OATS	Huber & Suhner	200024



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## 6.2.3 Limits

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

To calculate the limit for 10m measurement distance the following calculation was used.

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

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

$$L_{dm} = 40 \frac{dB\mu V}{m} + (-20 \frac{dB}{dec} * (\log(10m) - \log(3m))) = 30dB \quad \text{for 30MHz to 88MHz}$$

$$L_{dm} = 43,5 \frac{dB\mu V}{m} + (-20 \frac{dB}{dec} * (\log(10m) - \log(3m))) = 33.5dB \quad \text{for 88MHz to 216MHz}$$

$$L_{dm} = 46 \frac{dB\mu V}{m} + (-20 \frac{dB}{dec} * (\log(10m) - \log(3m))) = 36dB \quad \text{for 216MHz to 960MHz}$$

$$L_{dm} = 54 \frac{dB\mu V}{m} + (-20 \frac{dB}{dec} * (\log(10m) - \log(3m))) = 44dB \quad \text{above 960MHz}$$



## 6.2.4 Test method to demonstrate compliance

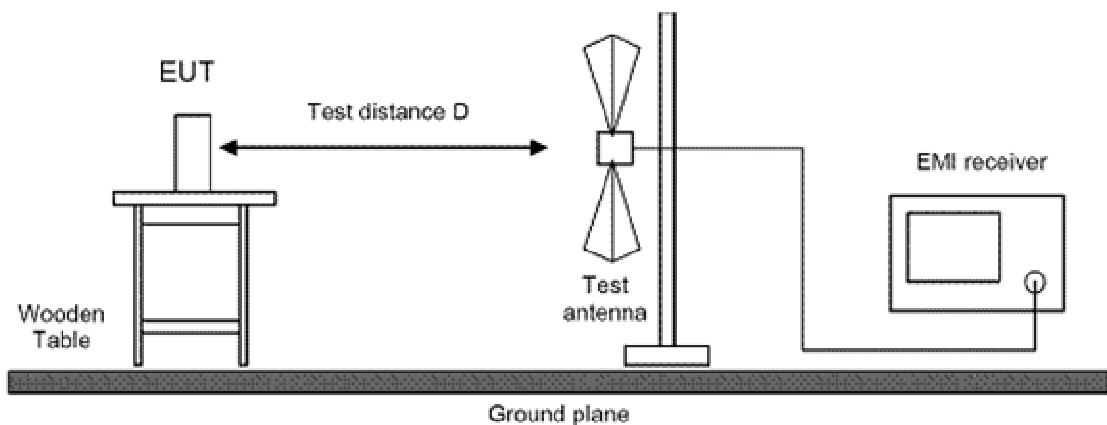
An EMI test receiver was used and connected to a broadband antenna. The EUT was placed on a wooden table in a distance of 3m inside a compact diagnostic chamber. This chamber is a fully anechoic chamber and correlated to our 10m open site. Therefore the 10m limit was applicable for the pre-scan inside this chamber. The broadband antenna was placed in vertical polarization and the EMI receiver performed a scan from 30MHz to 1000MHz with the detector set to peak and the measurement bandwidth to 120kHz.

This procedure was repeated at 6 different positions of the EUT by rotating turn table. After that die 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 6dB were marked and re-measured with a quasi-peak detector with the following method on a 10m 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 form 1m to 4m height to find the maximum value. This value was recorded.

## 6.2.5 Test setup

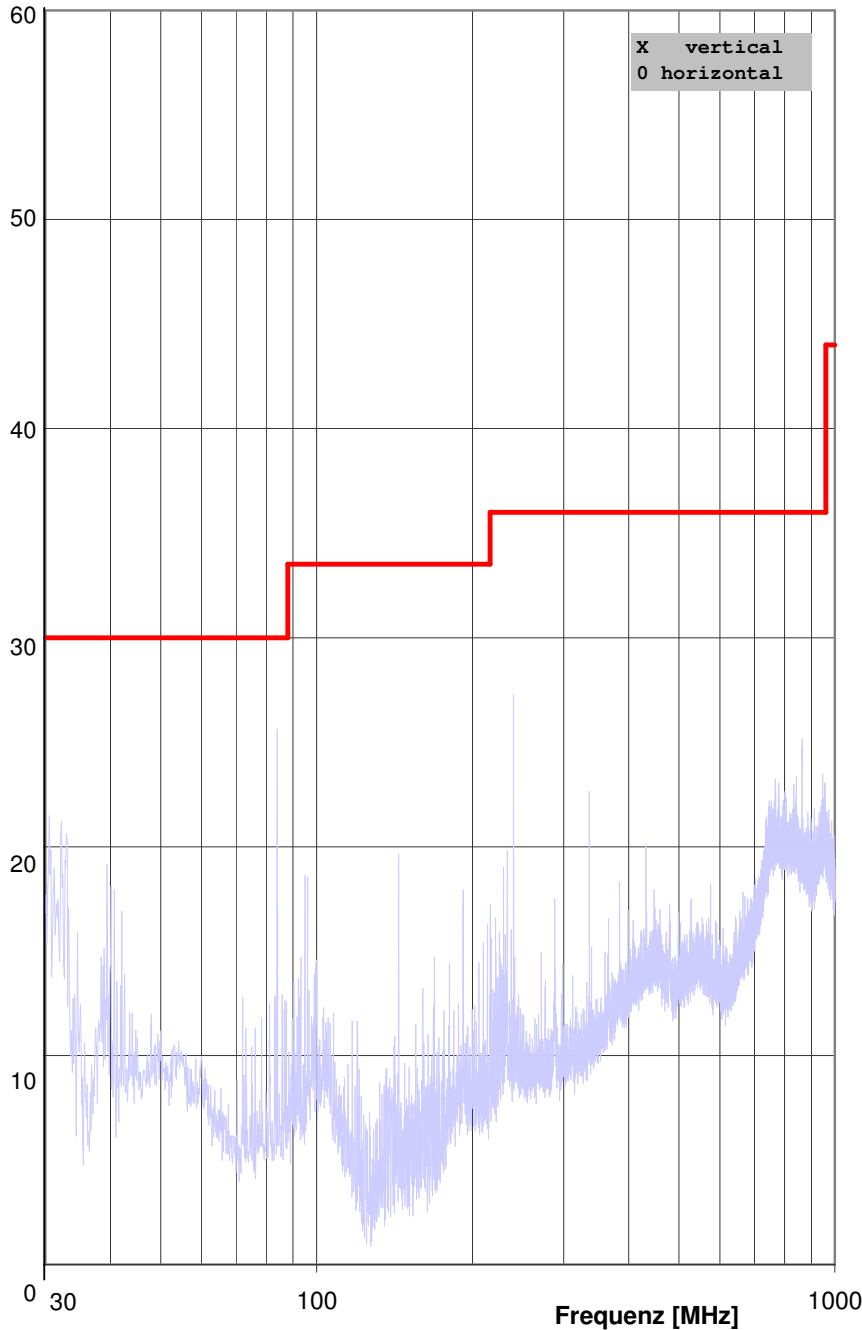




## 6.2.6 Test result

[dB $\mu$ V/m]

## Interference Radiation Test



### REGULATIONS:

FCC 15.209 10m  
PEAK / CISPR

### TEST EQUIPMENT:

R&S ESVP (10 0 001)  
VULB 9160 (10 0 064)  
Suhner (20 0 024)

### ORDER NO.:

268.097

### EUT:

Elatec Vertriebs GmbH  
RFID Reader  
TWN3 Reader Legic advant  
Prototyp

### OPERATION MODE:

Normal operation

### TEST FACILITY:

EMV TESTHAUS GmbH  
Gustav-Hertz-Straße 35  
94315 Straubing

### DATE / TIME:

21.04.2008

### TEST ENGINEER:

Christian Kiermeier

097 cdc Legic

Picture: 6-3 Radiated emission 30 MHz – 1000MHz (pre scan)



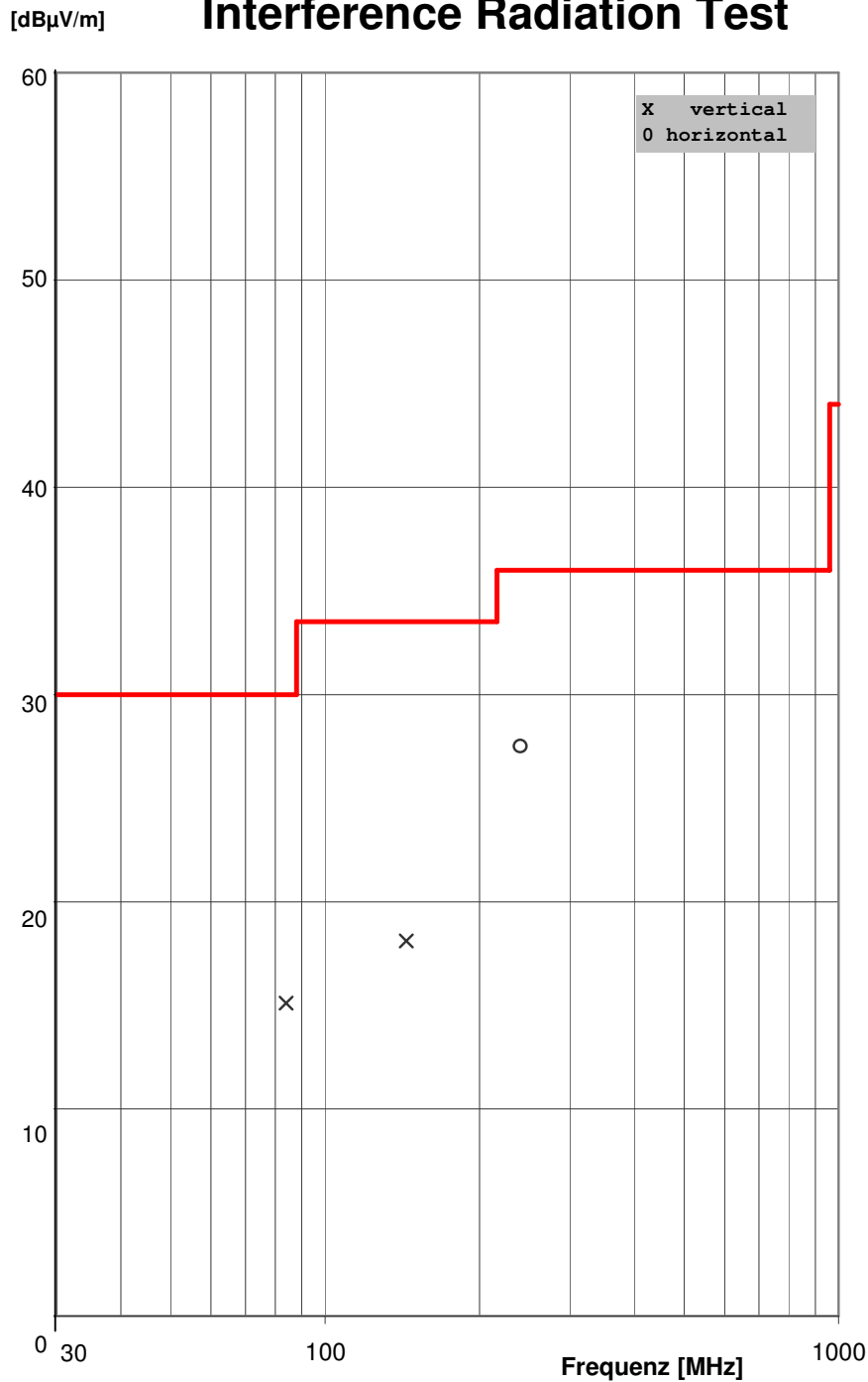
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# Interference Radiation Test



## REGULATIONS:

FCC 15.209 10m  
PEAK / CISPR

## TEST EQUIPMENT:

R&S ESVP (10 0 001)  
VULB 9160 (10 0 064)  
Suhner (20 0 024)

## ORDER NO.:

268.097

## EUT:

Elatec Vertriebs GmbH  
RFID Reader  
TWN3 Reader Legic advant  
Prototyp

## OPERATION MODE:

Normal operation

## TEST FACILITY:

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Gustav-Hertz-Straße 35  
94315 Straubing

## DATE / TIME:

21.04.2008

## TEST ENGINEER:

Christian Kiermeier

097 cdc Legic

Picture: 6-4 Radiated emission 30 MHz – 1000MHz (final)



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## 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
83,90	15,1	30,0	9,7	5,4	14,9	234°	100 cm	V	
144,00	18,1	33,5	14,6	3,5	15,4	272°	100 cm	V	
240,00	27,5	36,0	13,3	14,2	8,5	315°	250 cm	H	

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**Table: 6-2 Radiated emission 30 MHz – 1000MHz (final)**



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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	100089

## 7.2 Test Instruments

	Description	Manufacturer	Inventory No.
<input checked="" type="checkbox"/>	ESCS 30 (FF)	Rohde & Schwarz	100072
<input checked="" type="checkbox"/>	ESCI (CDC)	Rohde & Schwarz	100132
<input checked="" type="checkbox"/>	HFH2-Z2	Rohde & Schwarz	100005
<input type="checkbox"/>	VULB 9163 (CDC)	Schwarzbeck	100077
<input type="checkbox"/>	VULB 9160 (FF)	Schwarzbeck	100064

## 7.3 Test method to demonstrate compliance

The EUT has no detachable antenna therefore the radiated 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.



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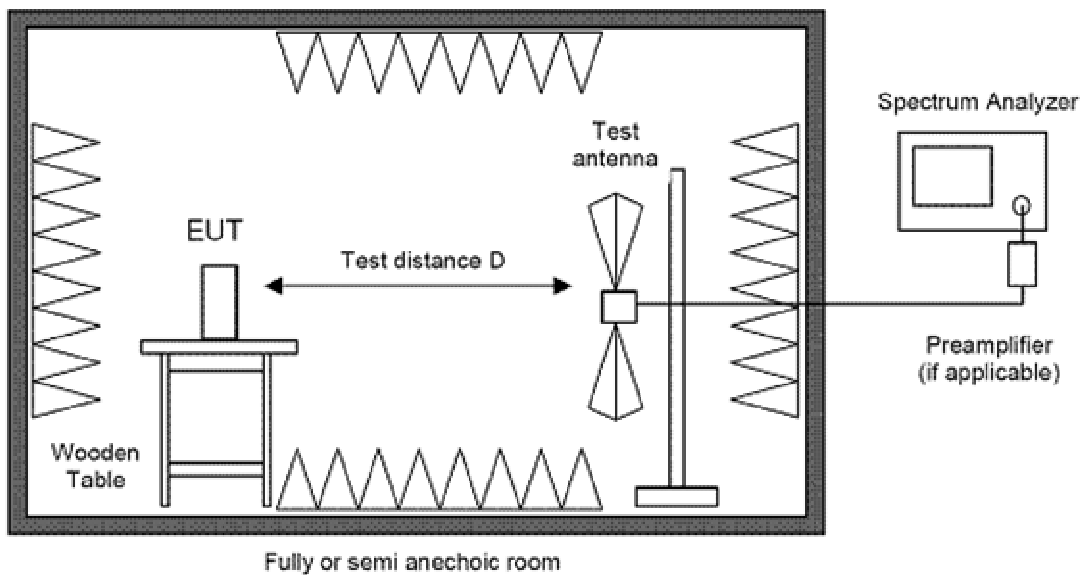
The resolution bandwidth of the spectrum analyzer shall be set to a greater value than 5% of the allowed bandwidth.

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

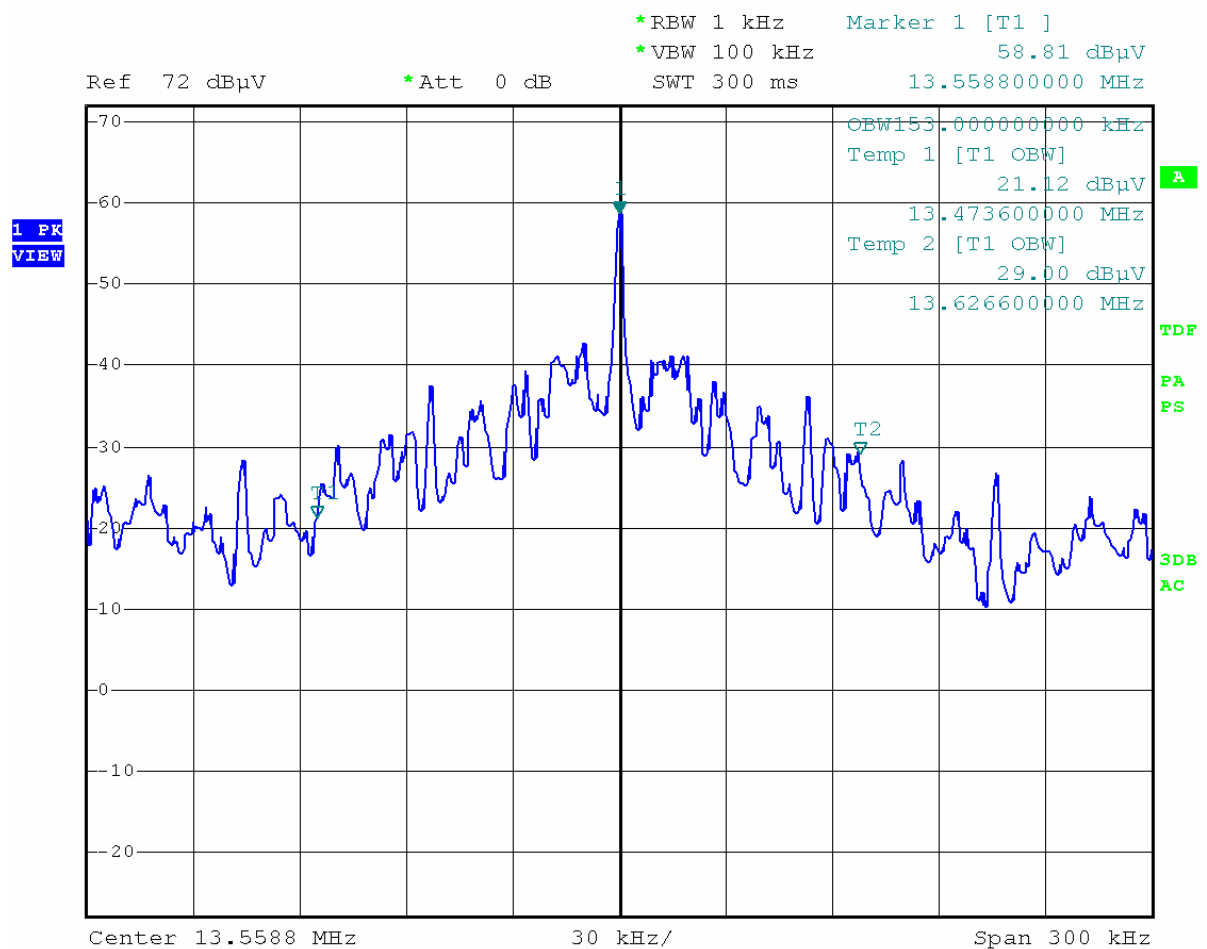
Fundamental frequency	Minimum resolution bandwidth
0.009MHz to 30MHz	1kHz
30MHz to 1000MHz	10kHz
1000MHz to 40000MHz	100kHz

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

## 7.4 Test setup



## 7.5 Test results



**Picture 7-1: Occupied bandwidth 99%**

Frequency lower value:      13,473MHz      Limit: 13,110MHz  
 Frequency upper value:      13,626MHz      Limit: 14,010MHz

Occupied Bandwidth:      153kHz



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## 8 Occupied Bandwidth (20dB)

according to FCC Part 15, section 15.215(c)

### 8.1 Test location

Description	Manufacturer	Inventory No.
CDC	Albatross Projects	100089

### 8.2 Test Instruments

	Description	Manufacturer	Inventory No.
<input checked="" type="checkbox"/>	ESCS 30 (FF)	Rohde & Schwarz	100072
<input checked="" type="checkbox"/>	ESCI (CDC)	Rohde & Schwarz	100132
<input checked="" type="checkbox"/>	HFH2-Z2	Rohde & Schwarz	100005
<input type="checkbox"/>	VULB 9163 (CDC)	Schwarzbeck	100077
<input type="checkbox"/>	VULB 9160 (FF)	Schwarzbeck	100064

### 8.3 Test method to demonstrate compliance

The EUT has no detachable antenna therefore the radiated method was used

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



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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

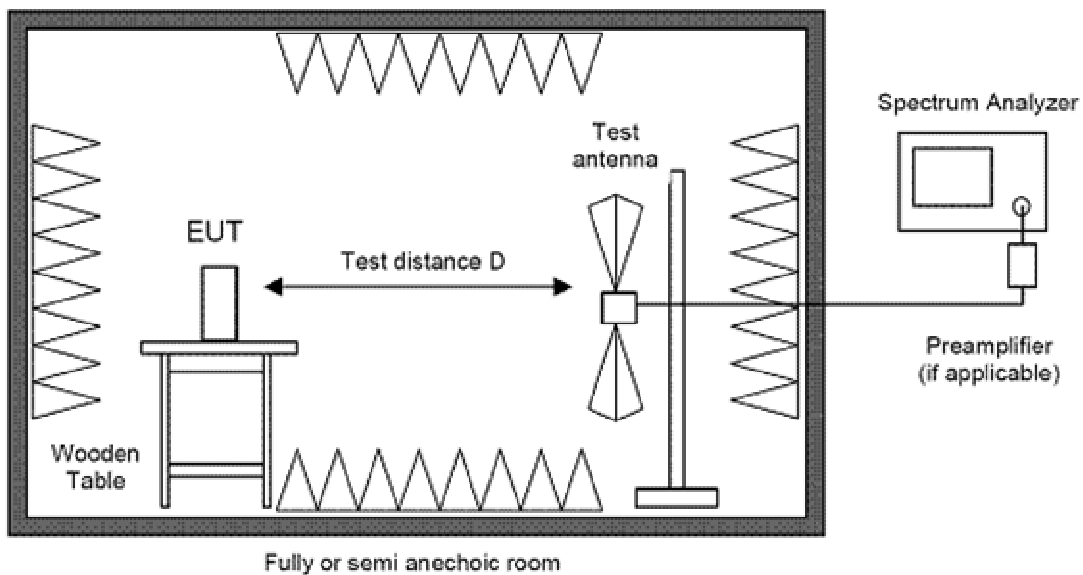
The resolution bandwidth of the spectrum analyzer shall be set to a greater value than 5% of the allowed bandwidth.

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

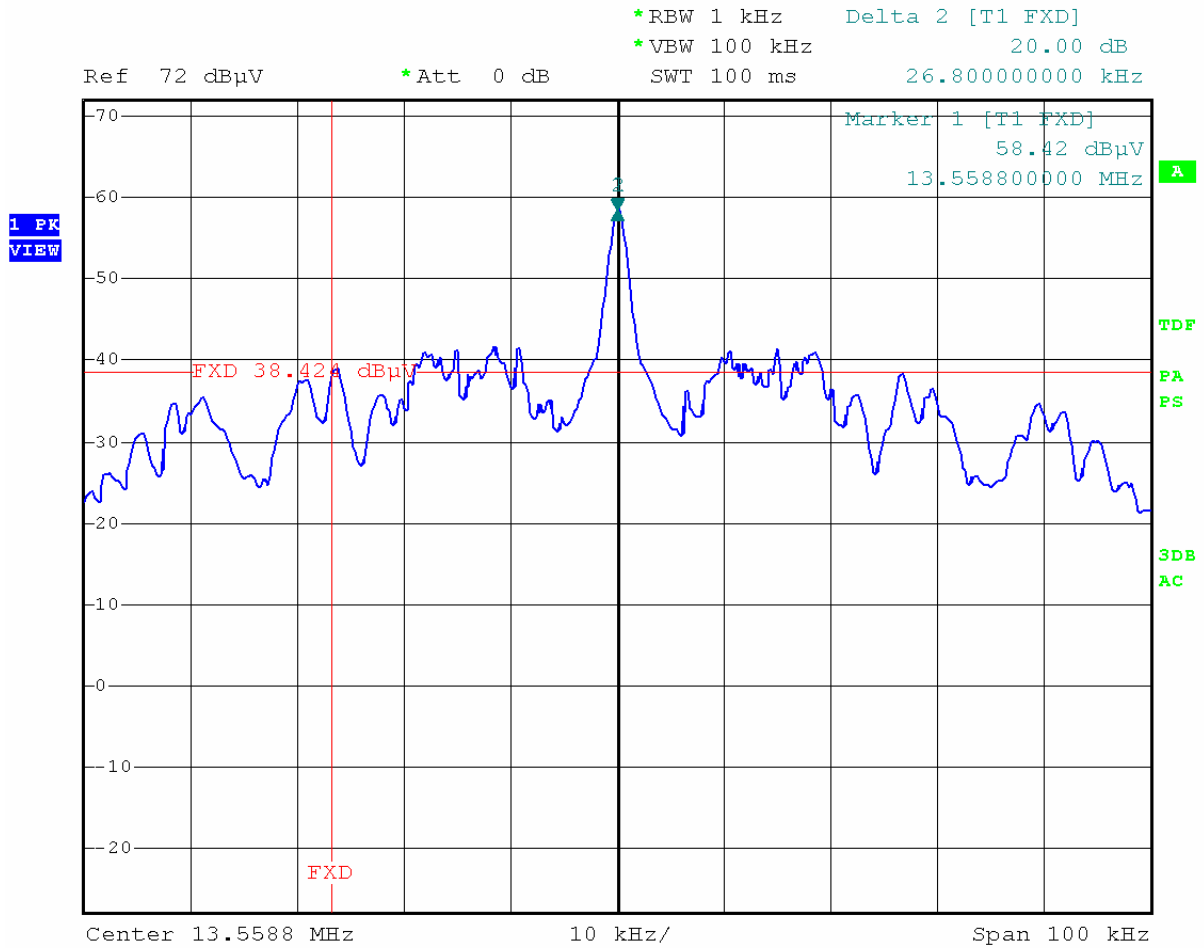
Fundamental frequency	Minimum resolution bandwidth
0.009MHz to 30MHz	1kHz
30MHz to 1000MHz	10kHz
1000MHz to 40000MHz	100kHz

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

## 8.4 Test setup



## 8.5 Test results



Picture 8-1: Occupied bandwidth lower value

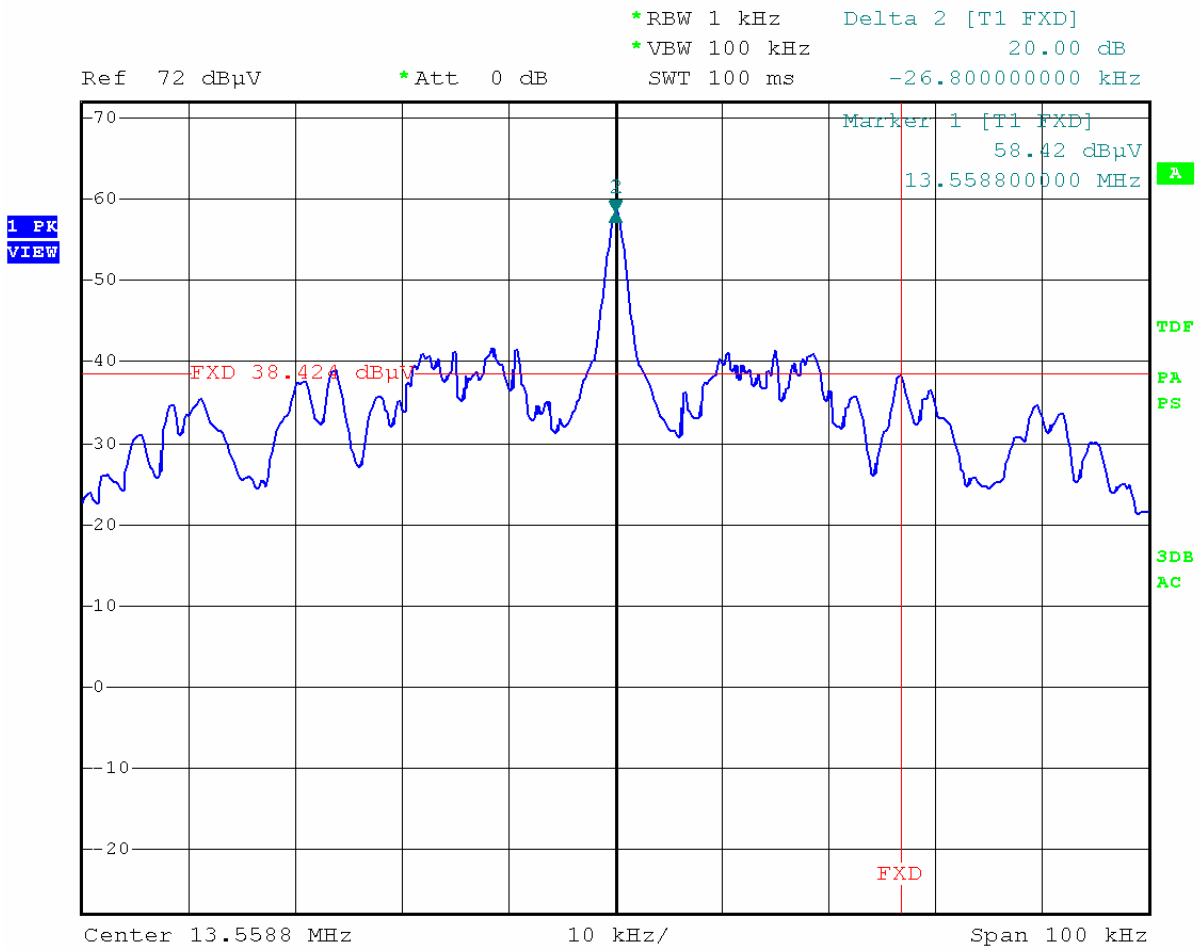


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**Picture 8-2: Occupied bandwidth upper value**

Frequency lower value:	13,532MHz	Limit: 13,110MHz
Frequency upper value:	13,586MHz	Limit: 14,010MHz
Occupied Bandwidth:	54kHz	



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## 9 Occupied Bandwidth (99%)

according to RSS Gen Issue 2, section 4.6.1

### 9.1 Test location

Description	Manufacturer	Inventory No.
CDC	Albatross Projects	100089

### 9.2 Test Instruments

	Description	Manufacturer	Inventory No.
<input type="checkbox"/>	ESCS 30 (FF)	Rohde & Schwarz	100072
<input checked="" type="checkbox"/>	ESCI (CDC)	Rohde & Schwarz	100132
<input checked="" type="checkbox"/>	HFH2-Z2	Rohde & Schwarz	100005
<input type="checkbox"/>	VULB 9163 (CDC)	Schwarzbeck	100077
<input type="checkbox"/>	VULB 9160 (FF)	Schwarzbeck	100064

### 9.3 Test method to demonstrate compliance

The EUT has no detachable antenna therefore the radiated method was used

If not specified in the applicable RSS the occupied bandwidth is measured as the 99% emission bandwidth.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth.

The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is also recorded. The span between the two recorded frequencies is the occupied bandwidth.



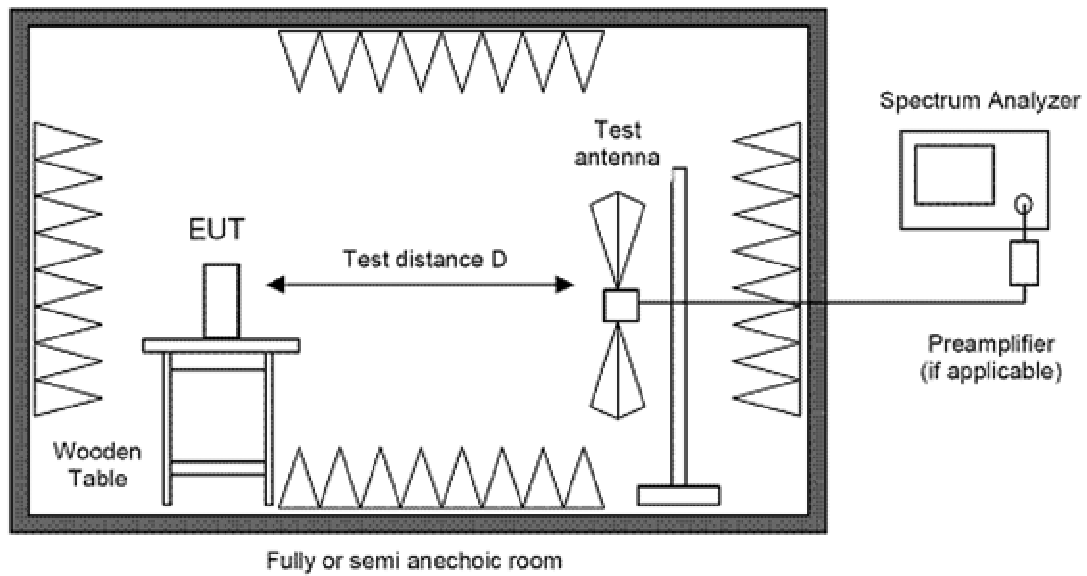
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## 9.4 Test setup



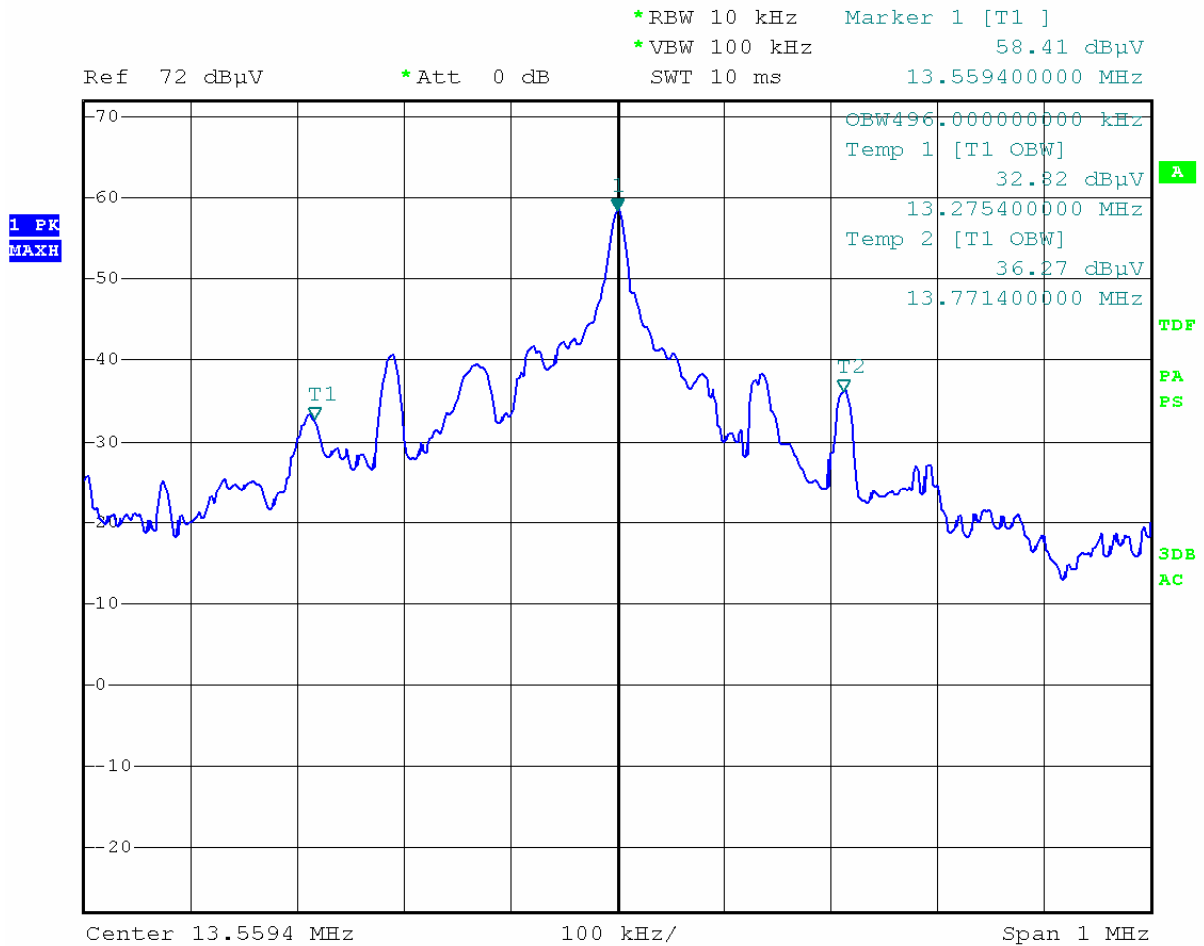
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## 9.5 Test results



**Picture 9-1: Occupied bandwidth 99%**

Frequency lower value:	13,275MHz	Limit: 13,110MHz
Frequency upper value:	13,771MHz	Limit: 14,010MHz
Occupied Bandwidth:	496kHz	



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## 10 Carrier frequency stability

according to CFR 47 Part 15, section 15.225(e)  
RSS-Gen Issue 2, section 7.2.4 and 4.7(b)

### 10.1 Test location

	Description	Manufacturer	Inventory No.
<input checked="" type="checkbox"/>	Climatic Chamber VC4100	Vötsch	110023
<input type="checkbox"/>	Climatic Chamber VC <sup>3</sup> 4043	Vötsch	110040

### 10.2 Test Instruments

	Description	Manufacturer	Inventory No.
<input checked="" type="checkbox"/>	ESCI	Rohde & Schwarz	100132
<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

### 10.3 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.



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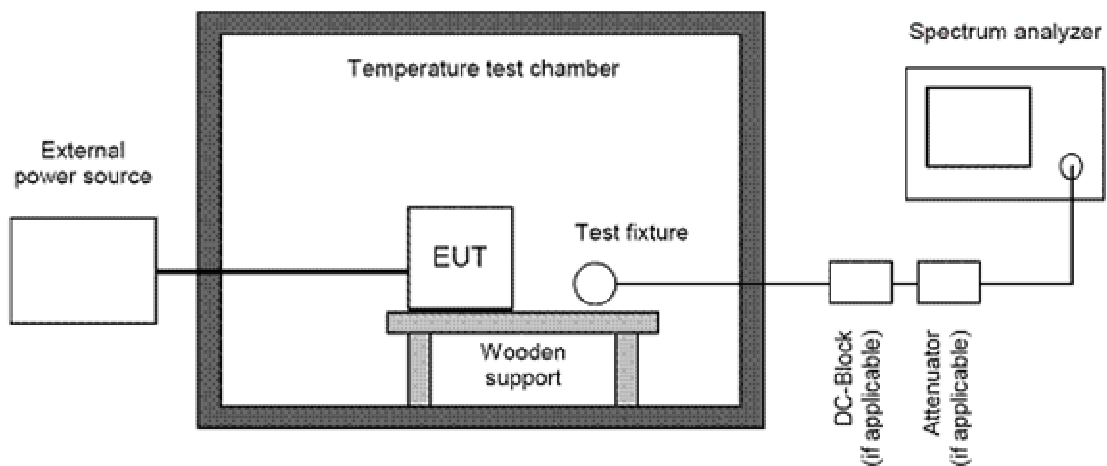
For battery operated equipment, the test is performed using a new battery. Alternatively, an external supply voltage can be used and is at least set to:

- 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
- 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 resolution as well as video bandwidth are 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

## 10.4 Test setup



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## 10.5 Carrier vs. temperature

Supply Voltage 5V		Nominal frequency 13.55894 MHz	
Temperature	Carrier frequency	$\Delta$ Frequency	Deviation
°C	MHz	Hz	Ppm
-20	13,55885	-90	-6,6
-10	13,55886	-80	-5,9
0	13,55888	-60	-4,5
+10	13,55890	-40	-3,0
+20	13,55894	0	0
+30	13,55889	-50	-3,7
+40	13,55886	-80	-5,9
+50	13,55883	-110	-8,1
Limit $\pm$ 100ppm			

## 10.6 Carrier vs. input voltage

Temperature 20°C		Nominal frequency 13.55894 MHz	
Voltage	Carrier frequency	$\Delta$ Frequency	Deviation
V	MHz	Hz	ppm
4,25	13,55892	-20	-1,5
5V	13,55894	0	0
5,75	13,55893	-10	-0,7
Limit $\pm$ 100ppm			



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# 11 Designation of emissions

according to CFR 47 Part 2, Sections 2.201 and 2.202  
RSS-Gen Issue 2, Sections 3.2(h) and 8

## 11.1 Designation

Type of Modulation:	Amplitude Modulation
Necessary Bandwidth: Modulation Rate: Overall numerical Factor:	$B_n = 2 \cdot B \cdot K$ $B = 5kHz$ $K = 1$ $B_n = 2 \cdot 5kHz \cdot 1 = 10kHz$
Designation of Emissions according ITU-R:	<b>10K0A1D</b>

Remarks:



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## 12 Exposure of humans to RF fields

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

### 12.1 Antenna type and power calculation

- Antenna detachable

$$EIRP = G \cdot CP$$

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

- Antenna not detachable

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

Fs: field strength [V/m]  
D: distance between antennas [m]

$$EIRP = \frac{(1.30 \cdot 3)^2}{30} = 507 nW$$

### 12.2 Distance between user and transmitting device\*

- Distance >20cm  
 Distance <20cm

\*declared by applicant



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## 12.3 Exemption from SAR evaluation

SAR evaluation is required if separation distance between user and devices is less than, or equal to 20cm, except the device operates:

- from 3 kHz up to 1 GHz inclusively and its source based time-averaged output power is  $\leq 200$  mW for general public use and  $\leq 1000$  mW for controlled use.
- above 1 GHz up to 2.2 GHz inclusively and its source-based time-averaged output power is  $\leq 100$  mW for general public use and  $\leq 500$  mW for controlled use.
- above 2.2 GHz up to 3 GHz inclusively and its source-based time-averaged output power is  $\leq 20$  mW for general public use and  $\leq 100$  mW for controlled use.
- above 3 GHz up to 6 GHz inclusively and its source-based time-averaged Output power is  $\leq 10$  mW for general public use and  $\leq 50$  mW for controlled use.

See output power calculation 12.1

## 12.4 Exemption from RF exposure evaluation

RF exposure evaluation is required if separation distance between user and devices is greater than 20cm, except the device operates:

- below 1,5GHz and its e.i.r.p is equal to, or less than 2.5W.
- above 1,5GHz and the e.i.r.p of the device is equal to or less than 5W.

See output power calculation 12.1



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## 13 Equipment calibration status

Inventory Number	Model Number	Manufacturer	Last calibration	Next calibration	Cycle of calibration
100132	ESCI	Rohde & Schwarz	June 07	June 09	2 Years
100005	HFH2-Z2	Rohde & Schwarz	July 07	July 09	2 Years
100002	ESH 3	Rohde & Schwarz	Oct. 07	Oct. 08	1 Year
200051	ESH3 Z2	Rohde & Schwarz	Oct. 07	Oct. 08	1 Year
100040	ESH 2-Z5	Rohde & Schwarz	Oct. 07	Oct. 09	2 Years
100041	ESH 2-Z5	Rohde & Schwarz	Aug. 08	Aug. 10	2 Years
100072	ESCS 30	Rohde & Schwarz	July 08	July 09	1 Year
100001	ESVP	Rohde & Schwarz	Sep. 07	Sep. 08	1 Year
100077	VULB 9163	Schwarzbeck	April 08	April 10	2 Years
100064	VULB 9160	Schwarzbeck	March 07	March 09	2 Years
110040	VC <sup>3</sup> 4034	Vötsch	June 08	June 10	2 Years
110023	VC4100	Vötsch	January 07	January 09	2 Years
100080	Multimeter	Metra Hit 29S	Mai 08	Mai 09	1 Year



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## 14 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, September 16, 2008



Christian Kiermeier  
EMI / EMC Test Engineer



Dipl. Ing. (FH) Axel Penning  
TM / EMV **TESTHAUS** GmbH



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