Test Report

Customer:

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RF test report

090308-AU01+W01

Elatec Vertriebs GmbH
RFID Reader
TWN3 MultiISO

EMV TESTHAUS

The test result refers exclusively to the model tested.

This report must not be copied without the written authorization by the lab.
Revision: 2.0

Deutscher Akkreditierungs Rat DAR

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

EMV **TESTHAUS** GmbH

Gustav-Hertz-Straße 35
94315 Straubing
Tel.: +49 9421 56868-0
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Email: company@emv-testhaus.com

Accreditation:

Registration number: DAT-P-224/95-02
CAB (EMC) registration number: BNetzA-CAB-02/21-02/1
FCC facility registration number: 221458
Industry Canada registration number: 3472A-1

Place of Inspection:

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

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

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1 Test regulations

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

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	16	Passed
15.225(a)-(d)	Spectrum mask	12	Passed
15.205(b) 15.215(b) 15.225(a)(d)	Radiated emission 0.009 MHz to 30 MHz	23	Passed
15.205(b) 15.225(d)	Radiated emission 30 MHz to 1000 MHz	28	Passed
15.225(e)	Carrier frequency stability	41	Passed

3 Equipment under Test (EUT)

Device name:	TWN3 MultiISO Reader
Manufacturer:	Elatec Vertriebs GmbH
Serial number:	Prototype
FCC ID:	WP5TWN3U1
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*
Temperature range:	-20°C to +55°C
Interfaces:	N/A

*The device is USB-powered. It was not possible to operate the EUT with an external power supply.

3.1 Photo documentation

Picture 1: EUT (top side)

Picture 2: EUT (bottom side)

Picture 3: EUT complete with USB cable*

* The ferrite core visible on the pictures is a Würth model 7427114.

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. The EUT was preconfigured for this operation mode.
- The EUT employs a combined receiver and transmitter that cannot be operated separately.

3.4 Configuration

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

Device	Model:	S/N
RFID Reader (EUT)	TWN3 MultiISO	Prototype
USB Cable	Standard cable attached to EUT (2 m)	N/A
Test Notebook	Pro 600 IW	N/A

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	100089
Open area test site	EMV **TESTHAUS** GmbH	200017

4.2 Test Instruments

	Description	Manufacturer	Inventory No.
¤	ESCS 30 (FF)	Rohde & Schwarz	100072
	ESU	Rohde & Schwarz	100146
¤	ESCI (CDC)	Rohde & Schwarz	100132
	HFH2-Z2	Rohde & Schwarz	100005
¤	VULB 9163 (CDC)	Schwarzbeck	100077
¤	VULB 9160 (FF)	Schwarzbeck	100064

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

$$L_{dm} = 29{,}5\frac{dB\mu V}{m} + (-40\frac{dB}{dec} * (\log(3m) - \log(30m)) - 20 = 49.5dB$$

$$L_{dm} = 40.5\frac{dB\mu V}{m} + (-40\frac{dB}{dec} * (\log(3m) - \log(30m)) - 20 = 60{,}5dB$$

$$L_{dm} = 50.5\frac{dB\mu V}{m} + (-40\frac{dB}{dec} * (\log(3m) - \log(30m)) - 20 = 70{,}5dB$$

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

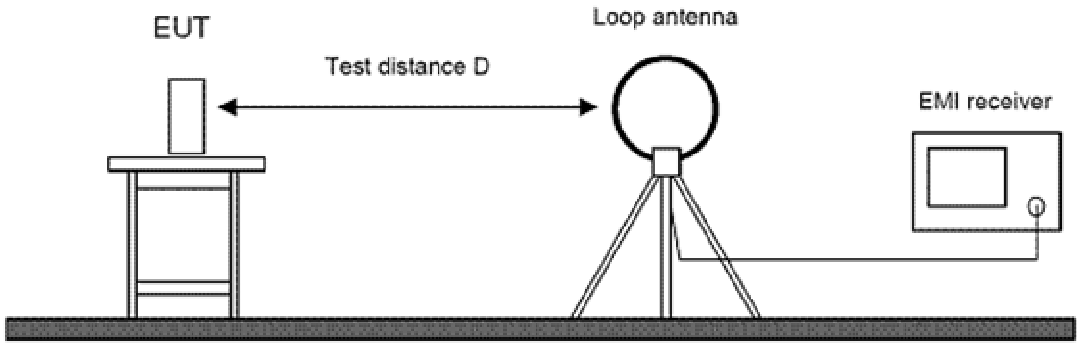
4.4 Test method to demonstrate compliance

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.

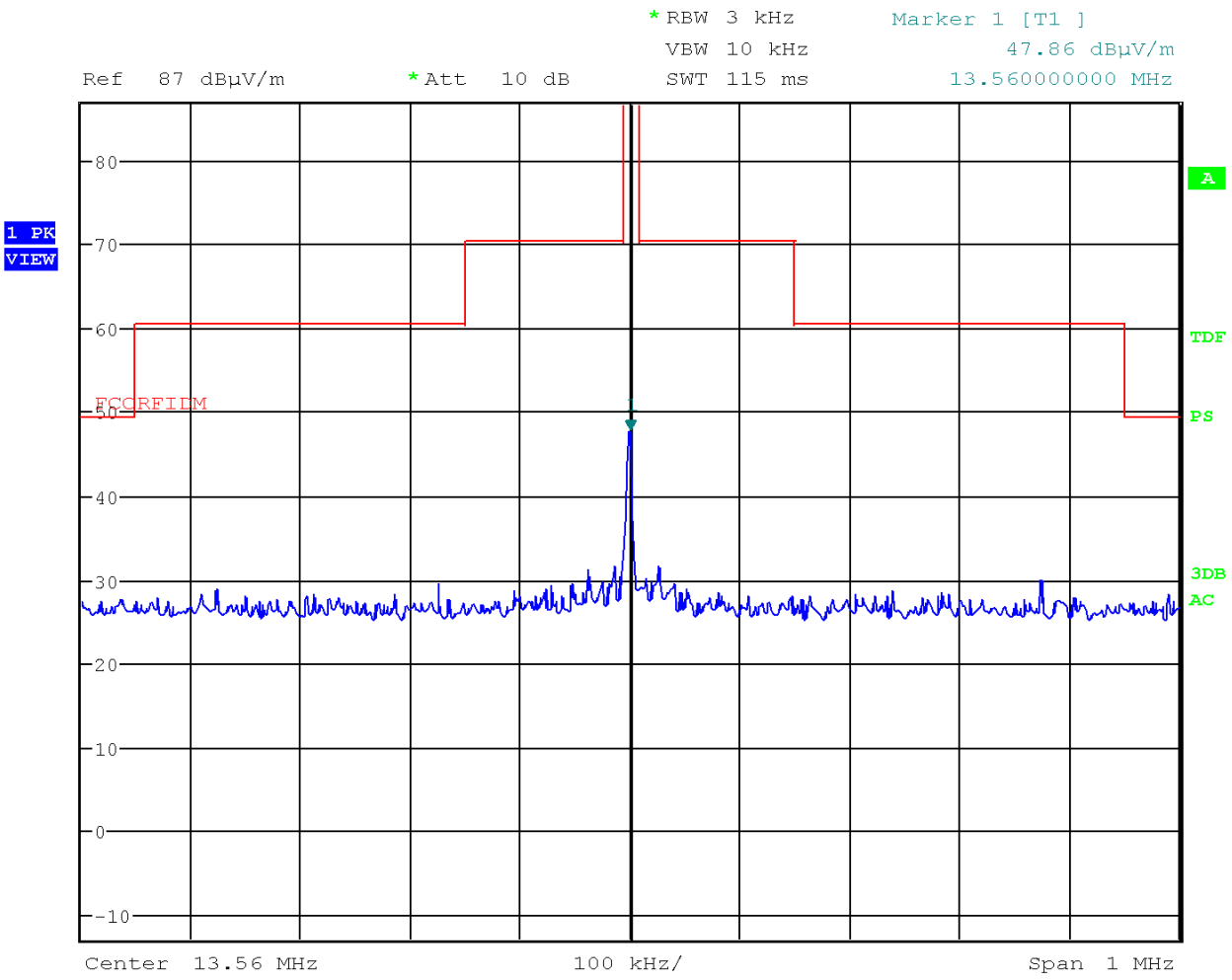
The spectrum analyzer was connected to a loop antenna with vertical polarization at a measurement distance of 3 m on an open area test site. This loop antenna has a correction factor of 20 dB. Due to better visibility in the printing the actual spectrum mask limit was reduced by this 20 dB. Therefore the Picture 5 shows the correct distance to the limit. To get the correct field strength 20 dB 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°.

4.5 Test setup



Picture 4: Outline of setup for spectrum mask test



Picture 5: Result of spectrum mask measurement

The actual field strength of the carrier is:

FS = T1 + 20 dB = 47.86 dBµV/m + 20 dB = 67.86 dBµV/m

Expanded uncertainty (0,009 to 30MHz):
$E_{(y)}$ = (y ± 4,25) dBµA/m; k=2.00
y = Indicated value

Comments:

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	200016

5.2 Test Instruments

	Description	Manufacturer	Inventory No.
	ESH 3	Rohde & Schwarz	100002
¤	ESCS 30	Rohde & Schwarz	100072
¤	ESCI	Rohde & Schwarz	100132
	ESH3 Z2	Rohde & Schwarz	200051
	ESH 2-Z5	Rohde & Schwarz	100040

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

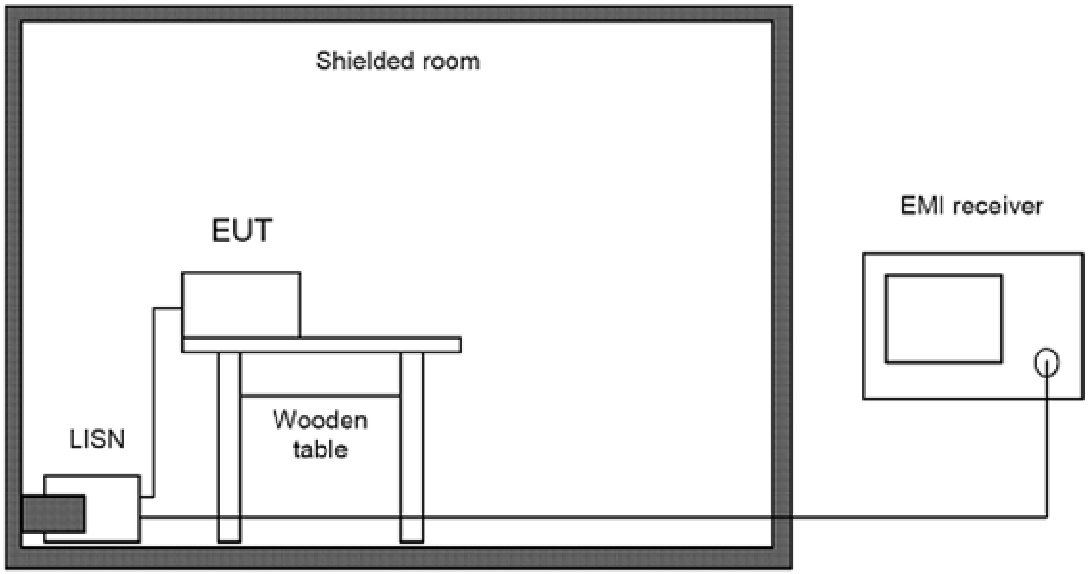
5.4 Test method to demonstrate compliance

The tests of conducted emission were carried out in a shielded room using a line impedance stabilization network (LISN) 50 µH/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 6: Outline of conducted emission test setup

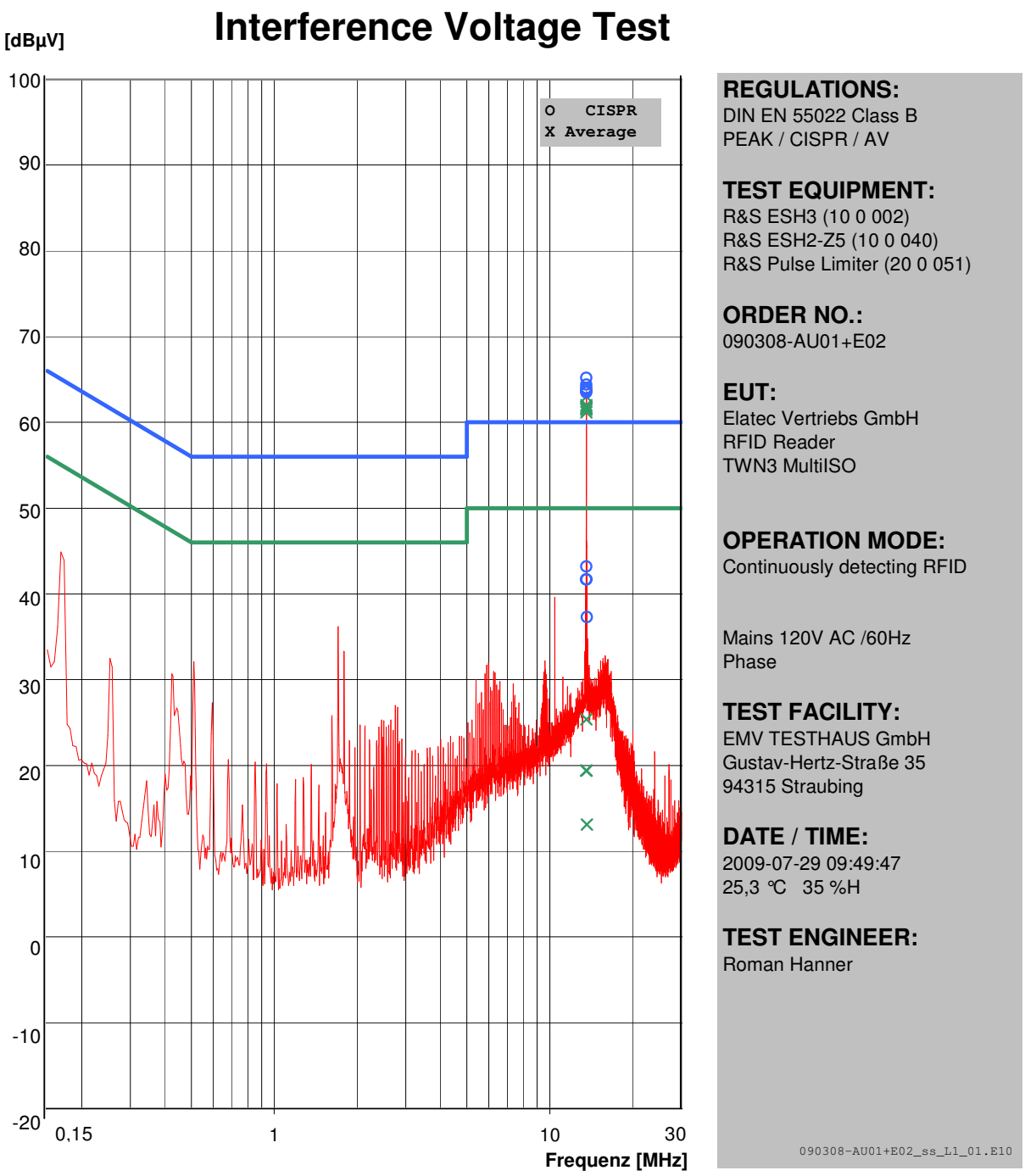
Expanded Uncertainty (9kHz to 150kHz): $U_{(y)}$ = (y ± 4.024) dBµV; k=2.00 y = Indicated value

Expanded Uncertainty (150kHz to 30MHz): $U_{(y)}$ = (y ± 3.604) dBµV; 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



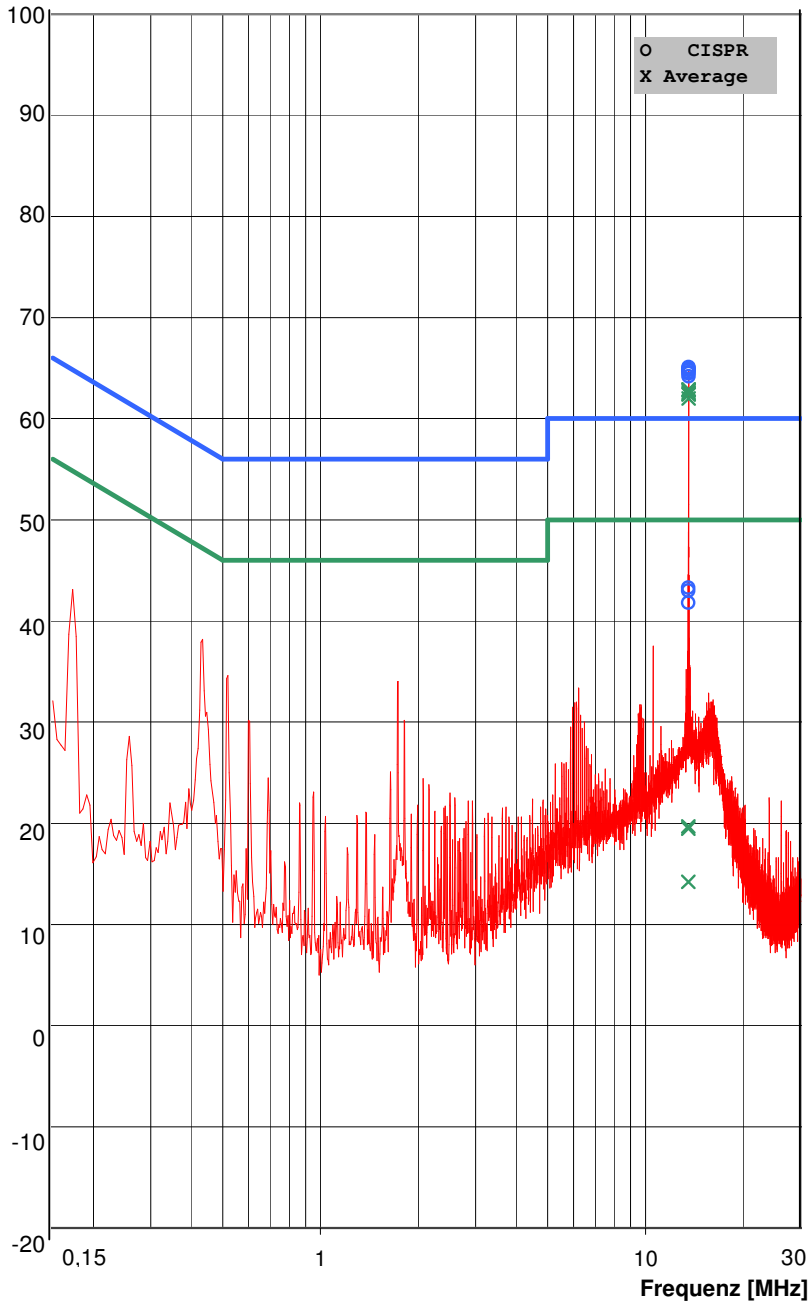
Picture 7: Conducted emission on mains, phase 1

Interference Voltage Test

Freq. [MHz]	U_CISPR [dBµV]	Limit [dBµV]	delta_U [dB]	U_AV [dBµV]	Limit [dBµV]	delta_U [dB]	Corr. [dB]	Remark 090308-AU01+E02_ss_L1_01.E10
13,55	41,7	60,0	18,3	19,4	50,0	30,6	0,0	
13,56	63,5	60,0	**-3,5**	61,2	50,0	**-11,2**	0,0	
13,56	63,6	60,0	**-3,6**	61,5	50,0	**-11,5**	0,0	
13,56	63,8	60,0	**-3,8**	61,6	50,0	**-11,6**	0,0	
13,56	64,0	60,0	**-4,0**	61,8	50,0	**-11,8**	0,0	
13,56	64,4	60,0	**-4,4**	62,0	50,0	**-12,0**	0,0	
13,56	65,2	60,0	**-5,2**	63,0	50,0	**-13,0**	0,0	
13,57	43,2	60,0	16,8	25,4	50,0	24,6	0,0	
13,60	41,7	60,0	18,3	19,4	50,0	30,6	0,0	
13,62	37,3	60,0	22,7	13,1	50,0	36,9	0,0	

Picture 8: Conducted emission on mains, phase 1

Interference Voltage Test



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.:
090308-AU01+E02

EUT:
Elatec Vertriebs GmbH
RFID Reader
TWN3 MultiISO

OPERATION MODE:
Continuously detecting RFID

Mains 120V AC /60Hz
Neutral

TEST FACILITY:
EMV TESTHAUS GmbH
Gustav-Hertz-Straße 35
94315 Straubing

DATE / TIME:
2009-07-29 09:49:43
25,3 °C 35 %H

TEST ENGINEER:
Roman Hanner

090308-AU01+E02_ss_N_01.E10

Picture 9: Conducted emission on mains, neutral

Interference Voltage Test

Freq. [MHz]	U_CISPR [dBµV]	Limit [dBµV]	delta_U [dB]	U_AV [dBµV]	Limit [dBµV]	delta_U [dB]	Corr. [dB]	Remark 090308-AU01+E02_ss_N_01.E10
13,53	41,8	60,0	18,2	19,5	50,0	30,5	0,0	
13,53	43,0	60,0	17,0	19,7	50,0	30,3	0,0	
13,53	43,3	60,0	16,7	14,2	50,0	35,8	0,0	
13,56	64,5	60,0	**-4,5**	62,4	50,0	**-12,4**	0,0	
13,56	64,2	60,0	**-4,2**	62,0	50,0	**-12,0**	0,0	
13,56	64,6	60,0	**-4,6**	62,4	50,0	**-12,4**	0,0	
13,56	64,8	60,0	**-4,8**	62,6	50,0	**-12,6**	0,0	
13,56	64,9	60,0	**-4,9**	62,8	50,0	**-12,8**	0,0	
13,56	65,0	60,0	**-5,0**	62,9	50,0	**-12,9**	0,0	
13,56	65,1	60,0	**-5,1**	62,9	50,0	**-12,9**	0,0	

Picture 10: Conducted emission on mains, neutral

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	100089
Open site area	EMV **TESTHAUS** GmbH	200017

6.1.2 Measurement equipment

	Description	Manufacturer	Inventory No.
¤	ESCS 30 (FF)	Rohde & Schwarz	100072
	ESU	Rohde & Schwarz	100146
¤	ESCI (CDC and FF)	Rohde & Schwarz	100132
¤	VULB 9163 (CDC)	Schwarzbeck	100077
¤	VULB 9160 (FF)	Schwarzbeck	100064
	Feedline OATS	Huber & Suhner	200024
	HFH2-Z2 (CDC and FF)	Rohde & Schwarz	100005

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

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

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

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

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

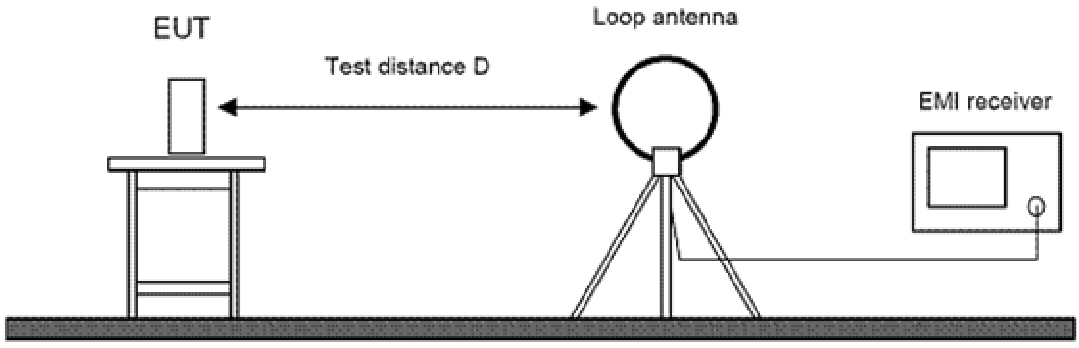
$$L_{dm} = 29.5\frac{dB\mu V}{m} + (-40\frac{dB}{dec} * (\log(3m) - \log(30m)) = 69.5dB$$ for 1.705MHz (low)

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 form 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° 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.

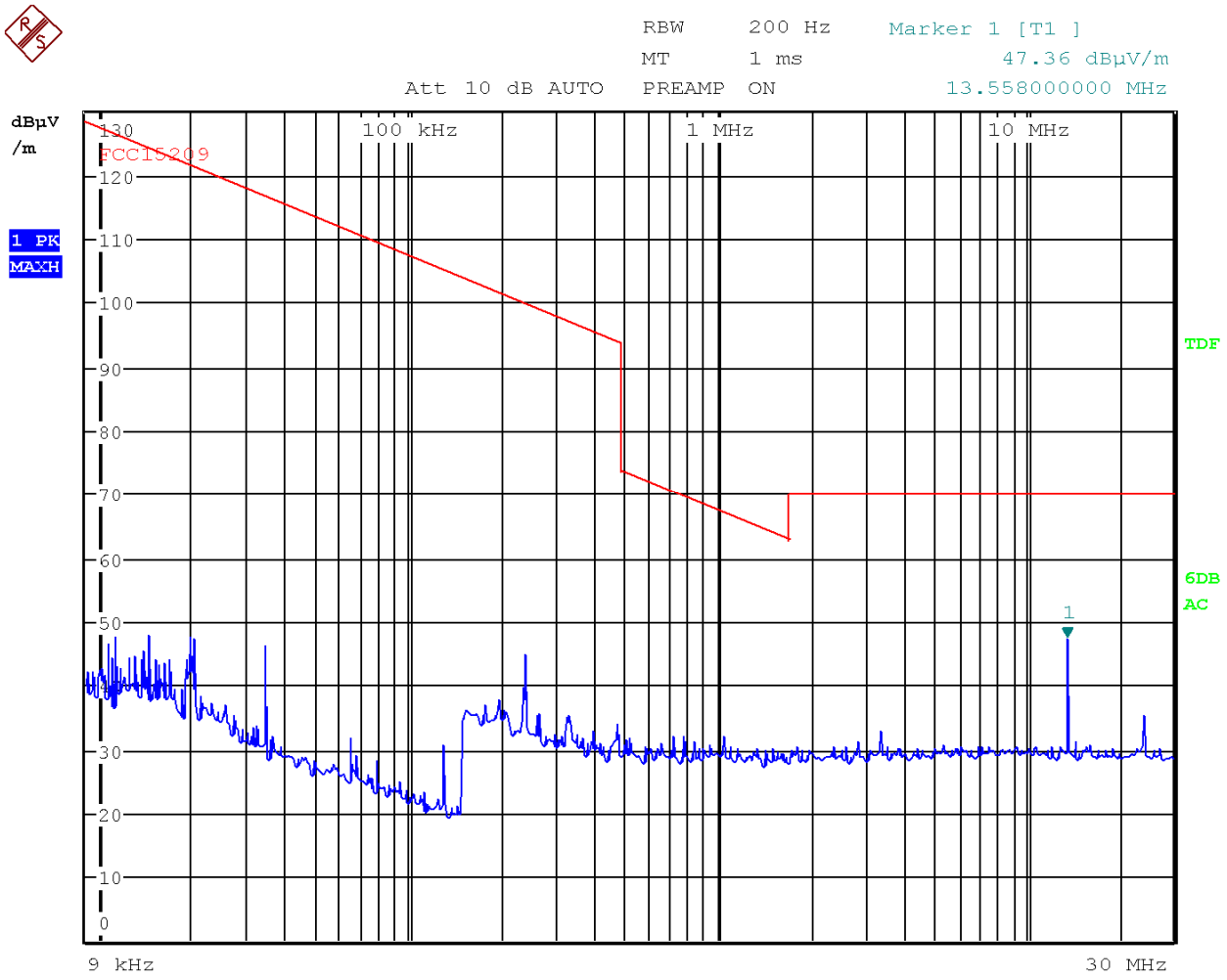
To check the horizontal polarization the EUT was rotated by 90° instead of the loop antenna and the procedure was repeated. Both results are combined inside on graphic.

6.1.5 Test setup



Picture 11: Outline of radiated emission test setup

6.1.6 Test result



Picture 12: Radiated field strength from 9 kHz to 30 MHz

Frequency	Field strength	Margin
13.558000 MHz	47.36 dBµV/m	-22.14 dB

Table 1: Result table of radiated field strength from 9 kHz to 30 MHz

Expanded Uncertainty (9kHz to 150kHz): $U_{(y)}$ = (y ± 4.024) dBµV; k=2.00 y = Indicated value

Expanded Uncertainty (150kHz to 30MHz): $U_{(y)}$ = (y ± 3.604) dBµV; 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 10m open site area.

Description	Manufacturer	Inventory No.
CDC	Albatross Projects	100089
Open site area	EMV **TESTHAUS** GmbH	200017

6.2.2 Measurement equipment

	Description	Manufacturer	Inventory No.
	ESCS 30 (FF)	Rohde & Schwarz	100072
¤	ESU	Rohde & Schwarz	100146
	ESCI (CDC)	Rohde & Schwarz	100132
	VULB 9163 (FF)	Schwarzbeck	100077
	VULB 9160 (CDC)	Schwarzbeck	100064
¤	HFH2-Z2	Rohde & Schwarz	100005
	Feedline OATS	Huber & Suhner	200024

6.2.3 Limits

Frequency [MHz]	Field strength Fs [µV/m]	Field strength [dBµV/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

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

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

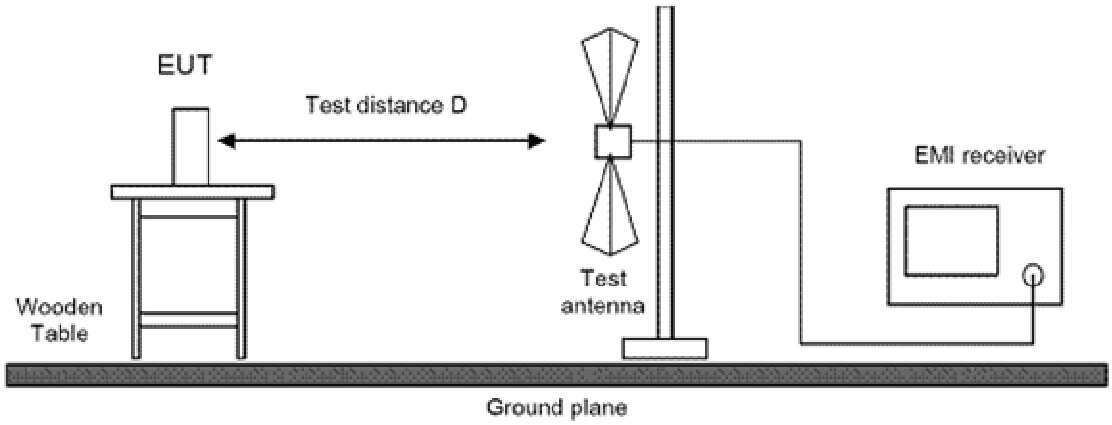
$$L_{dm} = 46\frac{dB\mu V}{m} + (-20\frac{dB}{dec} * (\log(10m) - \log(3m)) = 36dB$$ for 216 MHz to 960 MHz

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

6.2.4 Test method to demonstrate compliance

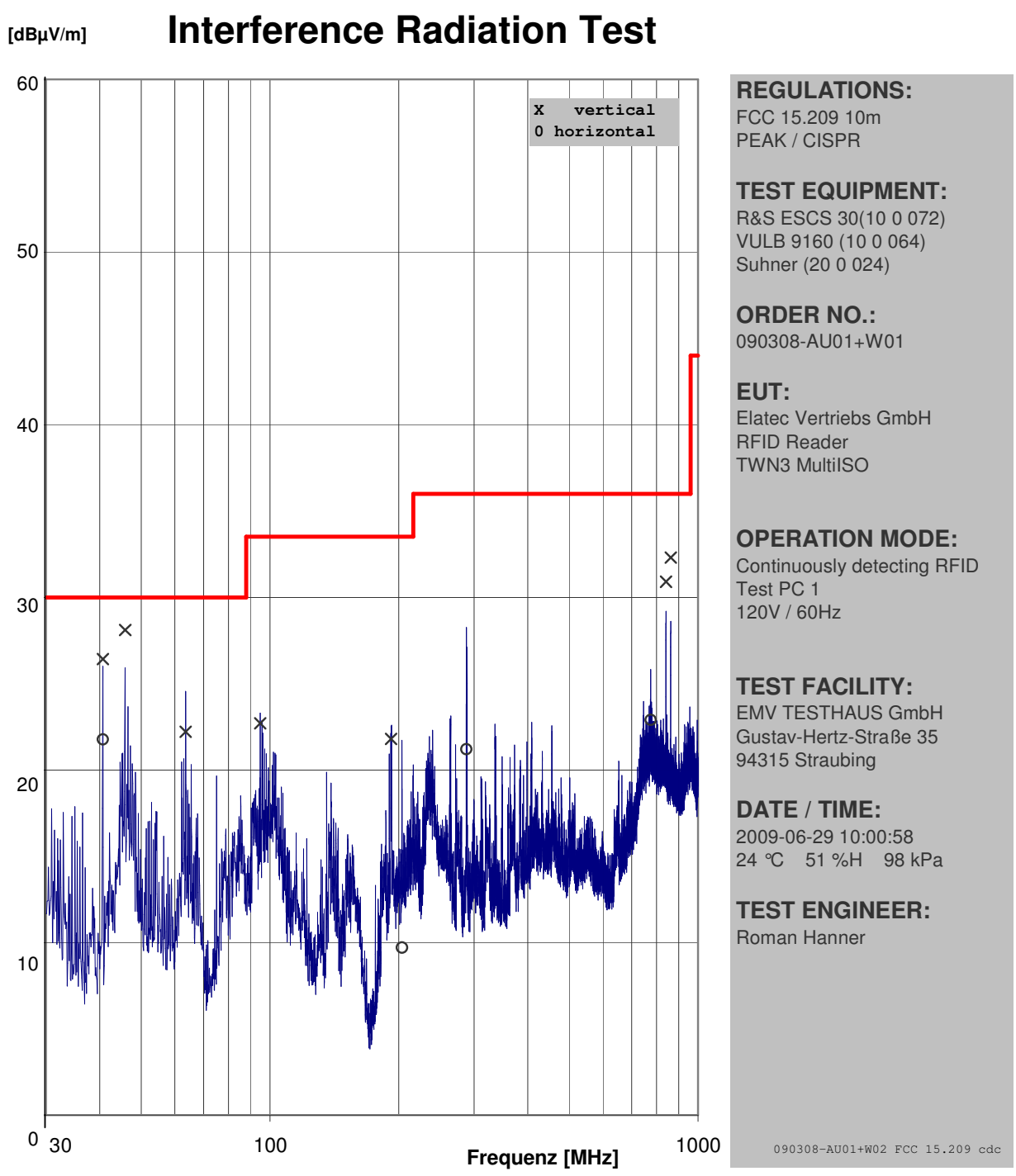
An EMI test receiver was used and connected to a broadband antenna. The EUT was placed on a wooden table in a distance of 3m inside a compact diagnostic chamber. This chamber is a fully anechoic chamber and correlated to our 10m open site. Therefore the 10 m limit was applicable for the pre-scan inside this chamber.
The broadband antenna was placed in vertical polarization and the EMI receiver performed a scan from 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 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 6 dB were marked and re-measured with a quasi-peak detector with the following method on a 10 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 form 1 m to 4 m height to find the maximum value. This value was recorded.

6.2.5 Test setup



Picture 14: Outline of radiated emission test setup

6.2.6 Test result



Picture 15: 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 090308-AU01+W02 FCC 15.209 cdc
40,70	21,8	30,0	2,1	19,7	8,2	160°	100 cm	H	
40,70	26,4	30,0	8,3	18,1	3,6	207°	100 cm	V	
45,90	28,1	30,0	12,9	15,2	1,9	77°	100 cm	V	
63,60	22,2	30,0	12,1	10,1	7,8	242°	100 cm	V	
94,90	22,7	33,5	10,7	12,0	10,8	0°	100 cm	V	
192,00	21,8	33,5	12,1	9,7	11,7	345°	110 cm	V	
203,60	9,7	33,5	11,7	-2,0	23,8	349°	250 cm	H	
287,60	21,2	36,0	15,0	6,2	14,8	133°	250 cm	H	
775,20	22,9	36,0	25,9	-3,0	13,1	33°	250 cm	H	
840,70	30,9	36,0	26,8	4,1	5,1	353°	100 cm	V	
863,00	32,3	36,0	27,1	5,2	3,7	17°	110 cm	V	

Picture 17: Radiated emission 30 MHz – 1000MHz (Table)

Expanded uncertainty (30MHz to 300MHz): $E_{(y)}$ = (y ± 4.994) dBµV/m; k=2.00 y = Indicated value

Expanded uncertainty (300MHz to 1000MHz): $E_{(y)}$ = (y ± 5.276) dBµV/m; k=2.00 y = Indicated value

Comments:

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.
¤	ESCS 30 (FF)	Rohde & Schwarz	100072
	ESU	Rohde & Schwarz	100146
¤	ESCI (CDC)	Rohde & Schwarz	100132
	HFH2-Z2	Rohde & Schwarz	100005
¤	VULB 9163 (CDC)	Schwarzbeck	100077
¤	VULB 9160 (FF)	Schwarzbeck	100064

7.3 Test method to demonstrate compliance

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

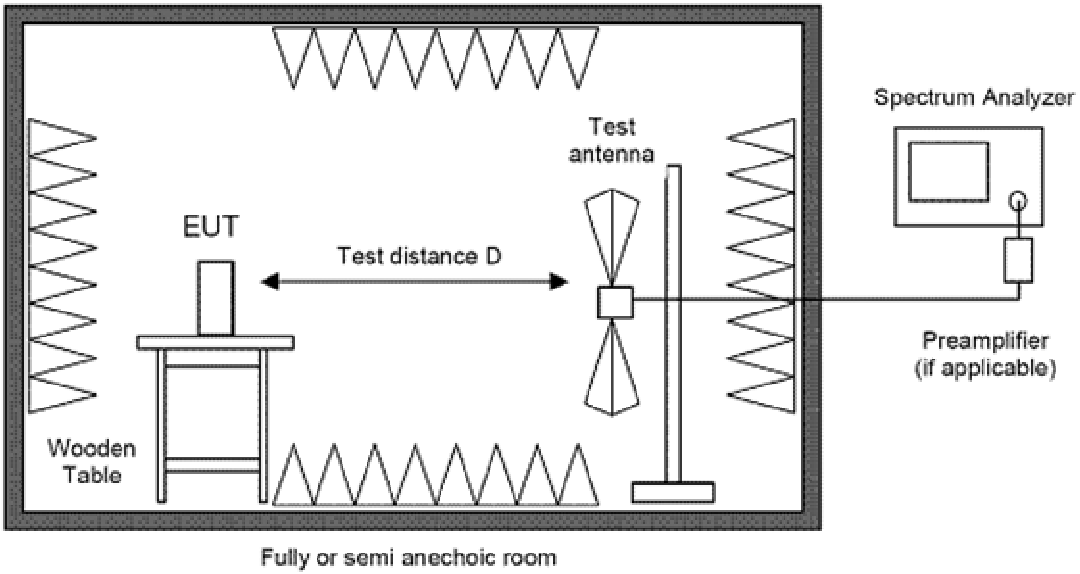
The occupied bandwidth is measured as the 99% bandwidth. For this measurement the occupied bandwidth function of the spectrum analyzer was used.

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.

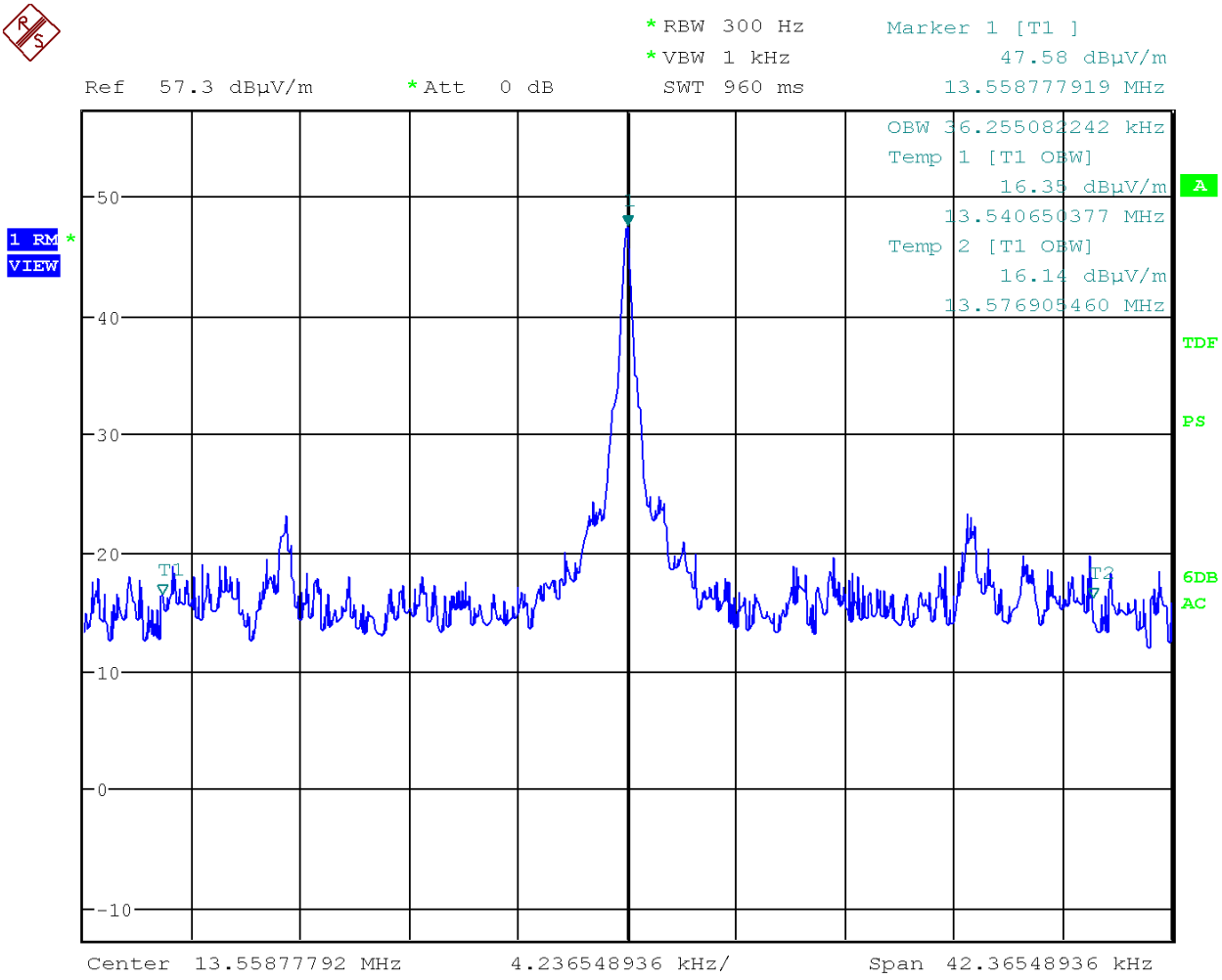
Fundamental frequency	Minimum resolution bandwidth
0.009MHz to 30MHz	1kHz
30MHz to 1000MHz	10kHz
1000MHz to 40000MHz	100kHz

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

7.4 Test setup



Picture 18: Outline of test setup for occupied bandwidth measurement



Picture 19: Occupied bandwidth 99%

Frequency lower value:	13.5406503 MHz	Limit: 13.110 MHz
Frequency upper value:	13.5769054 MHz	Limit: 14.010 MHz
Occupied Bandwidth:	36.255 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	100089

8.2 Test Instruments

	Description	Manufacturer	Inventory No.
¤	ESCS 30 (FF)	Rohde & Schwarz	100072
	ESU	Rohde & Schwarz	100146
¤	ESCI (CDC)	Rohde & Schwarz	100132
	HFH2-Z2	Rohde & Schwarz	100005
¤	VULB 9163 (CDC)	Schwarzbeck	100077
¤	VULB 9160 (FF)	Schwarzbeck	100064

8.3 Test method to demonstrate compliance

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

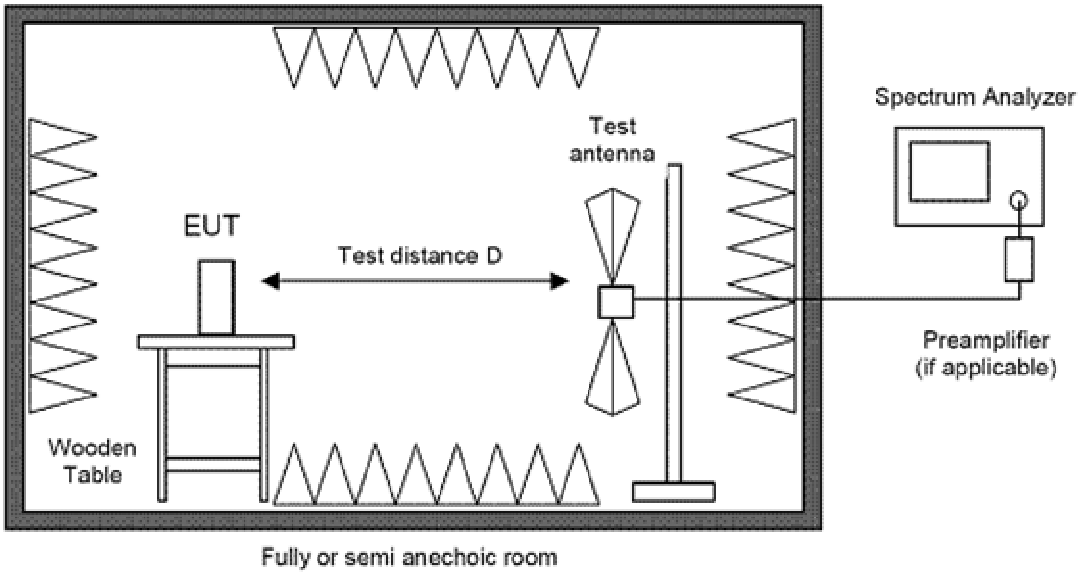
The 20 dB bandwidth of the emission is measured as the frequency range defined by the points that are 20 dB down relative to the maximum level of the modulated carrier. For intentional radiators operating under the alternative provisions to the general emission limits the requirement to contain the 20 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 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.

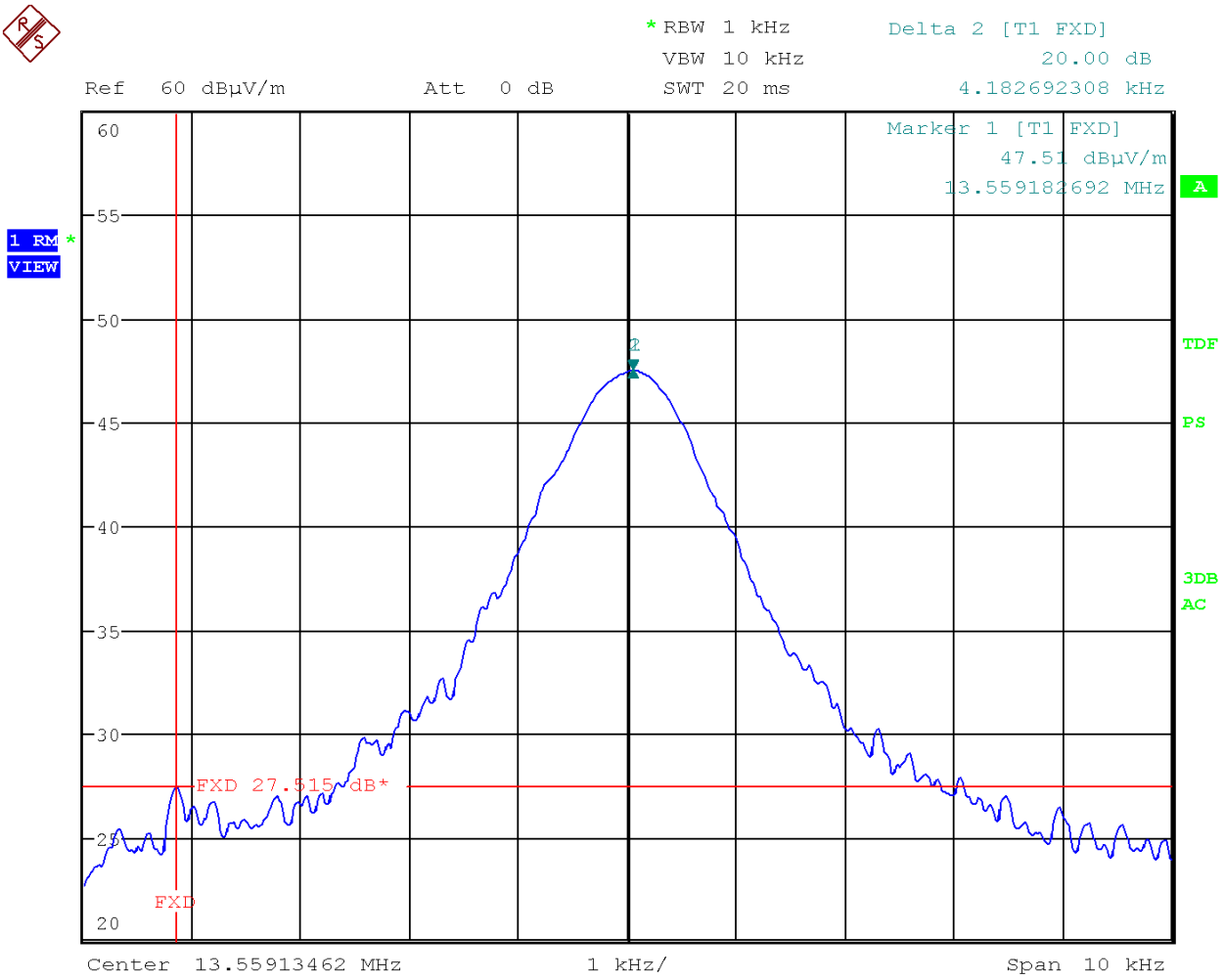
Fundamental frequency	Minimum resolution bandwidth
0.009MHz to 30MHz	1kHz
30MHz to 1000MHz	10kHz
1000MHz to 40000MHz	100kHz

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

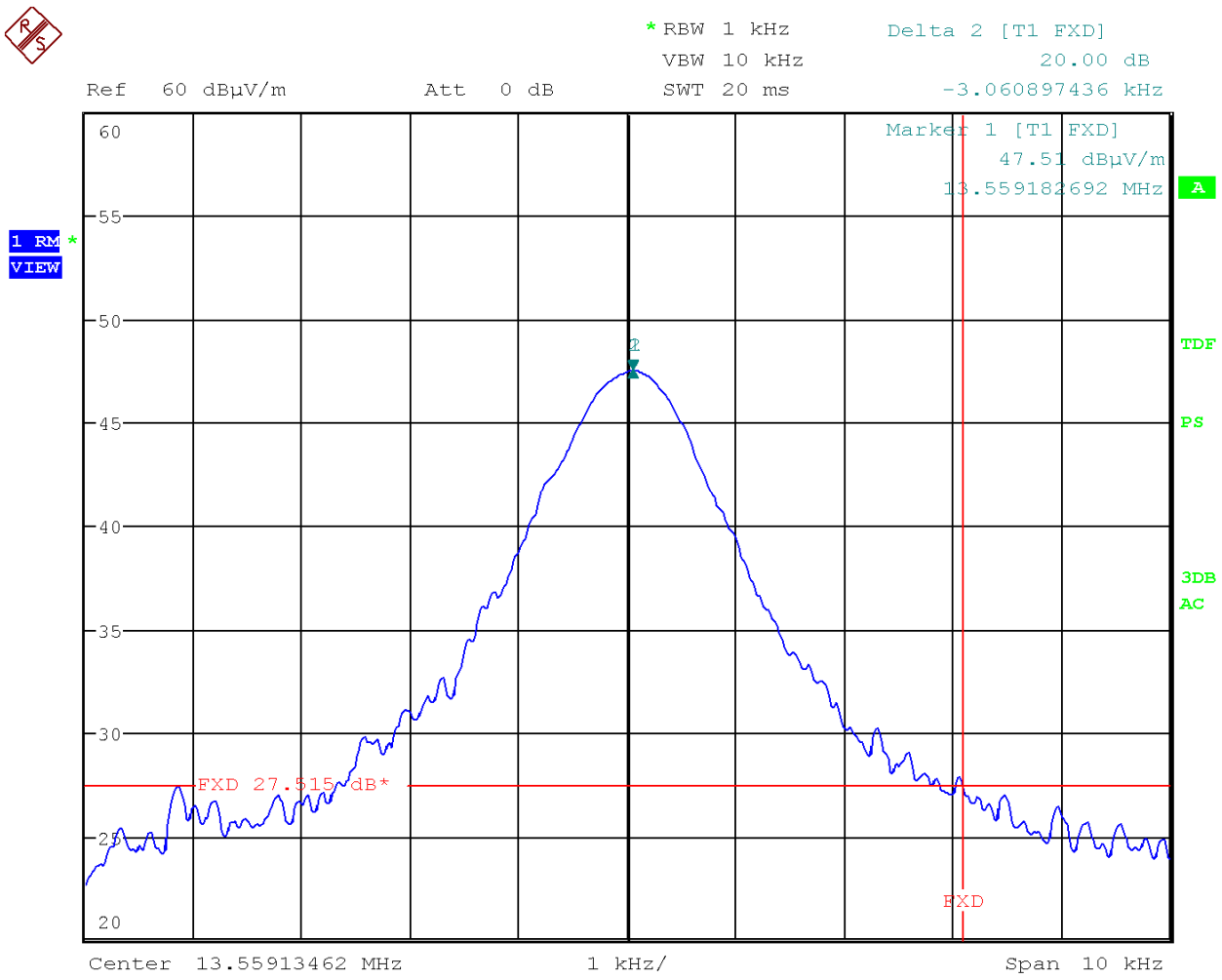
8.4 Test setup



Picture 20: Outline of occupied bandwidth test setup



Picture 21: Occupied bandwidth lower value



Picture 22: Occupied bandwidth upper value

Frequency lower value:	13.5550 MHz	Limit: 13.110 MHz
Frequency upper value:	13.5622 MHz	Limit: 14.010 MHz
Occupied Bandwidth:	7.244 kHz	

9 Carrier frequency stability

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

9.1 Test location

	Description	Manufacturer	Inventory No.
	Climatic Chamber VC4100	Vötsch	110023
¤	Climatic Chamber VC^{3}4043	Vötsch	110040

9.2 Test Instruments

	Description	Manufacturer	Inventory No.
¤	ESCI	Rohde & Schwarz	100132
	ESU	Rohde & Schwarz	100146
	Test Probe RFR400-1	Langer	200086
	Power Supply	Statron	300193
	Multimeter	Metra Hit 29S	100080
¤	USLP 9142	USLP 9142	100044

9.3 Test method to demonstrate compliance

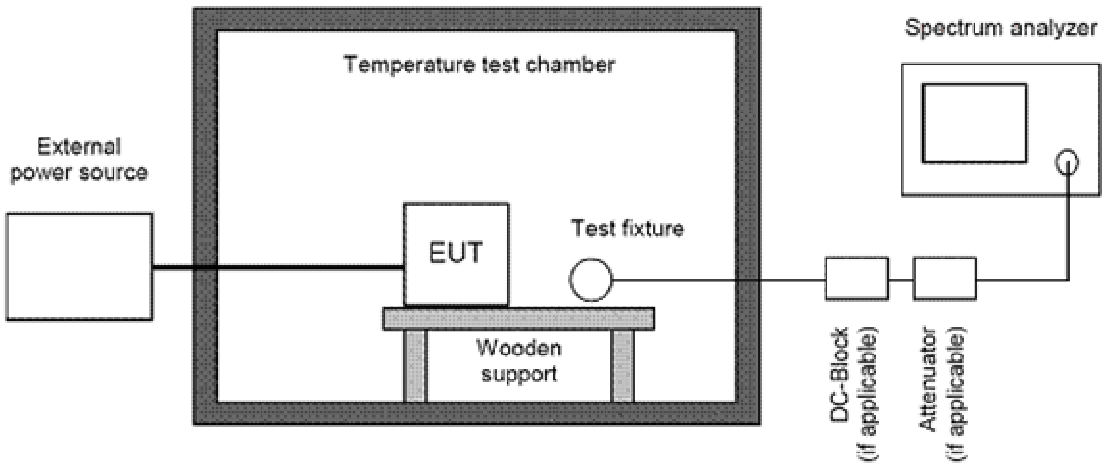
The frequency tolerance of the carrier signal is measured over a temperature variation of -20°C to +50°C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20°C.
If the EUT provides an antenna connector the spectrum 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

- 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 23: Outline of carrier frequency stability test setup

9.5 Carrier vs. temperature

Supply Voltage 5V		Nominal frequency: 13.559199 MHz	
Temperature	Carrier frequency	Δ Frequency	Deviation
℃	MHz	Hz	ppm
-20	13.559327	-128	-9.44
-10	13.559311	-112	-8.26
0	13.559279	-80	-5.90
+10	13.559247	-48	-3.54
+20	*13.559199*	*0*	*0*
+30	13.559183	+16	+1.18
+40	13.559151	+48	+3.54
+50	13.559151	+48	+3.54
Limit ± 100ppm			

Table 2: Carrier vs. temperature

9.6 Carrier vs. input voltage

The device is USB-powered. It was not possible to operate it with an external power supply to test the influence of the input voltage to the carrier frequency.

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:	

11 Equipment Calibration Status

Inventory Number	Model Number	Manufacturer	Last calibration	Next calibration	Cycle of calibration
100146	ESU26	Rohde & Schwarz	Oct. 07	Oct. 09	2 Years
100132	ESCI	Rohde & Schwarz	June 09	June 11	2 Years
100072	ESCS 30	Rohde & Schwarz	May 09	May 11	2 Year
200051	ESH3 Z2	Rohde & Schwarz	Feb. 09	Feb. 10	1 Year
100040	ESH 2-Z5	Rohde & Schwarz	Oct. 07	Oct. 09	2 Years
100041	ESH 2-Z5	Rohde & Schwarz	Oct. 08	Oct. 10	2 Years
100005	HFH2-Z2	Rohde & Schwarz	Oct. 08	Oct 10	2 Years
100134	VULB 9163	Schwarzbeck	Apr. 09	Apr. 10	2 Years
100077	VULB 9163	Schwarzbeck	Apr. 08	Apr. 10	2 Years
100064	VULB 9160	Schwarzbeck	Sep. 07	Sep. 09	2 Years
110040	VC^{3}4034	Vötsch	June 08	Jan 12	2 Years
110023	VC4100	Vötsch	Jan 07	Jan 11	2 Years
100080	Multimeter	Metra Hit 29S	May 09	May 10	1 Year

Table 3: Equipment Calibration status

12 Summary

The EMC Regulations according to the marked specifications are

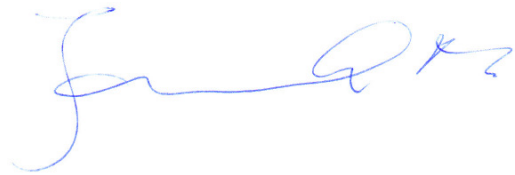
KEPT

The EUT does fulfill the general approval requirements mentioned.

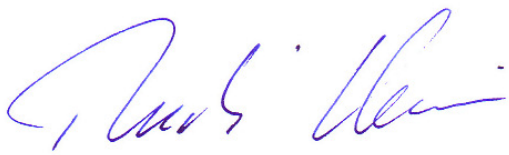
- **NOT KEPT**

The EUT does not fulfill the general approval requirements mentioned.

Place, Date: Straubing, September 30, 2009



Marco Janker
EMI / EMC Test Engineer



Rudolf Klein
GM / EMV **TESTHAUS** GmbH