

# Test Report

**Customer:**

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## RF test report

140202-AU01+W01



**SIGMATEK GmbH & Co KG**

HF-RFID Reader  
HF-RFID01



The test result refers exclusively  
to the tested model.  
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of the accreditation agency and/or  
EMV **TESTHAUS** GmbH  
Revision: 1.0



# 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

## Test Laboratory:

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

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



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# 1 Test regulations

47 CFR Part 2: 10-2013	Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC)
47 CFR Part 15: 10-2013	Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)
ANSI C63.4: September 2009	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

## Summary of test results

Standard	Test result
47 CFR Part 15, sections 15.207 and 15.225	Passed



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## 2 Equipment under Test (EUT)

Product type: HF-RFID Reader  
Model Name: HF-RFID01  
Manufacturer: SIGMATEK GmbH & Co KG  
Serial number: 96999000010  
FCC ID: 2ACQNPFR001  
Application freq. band: N/A  
Frequency range: 13,56MHz  
Operating frequency: 13,56MHz  
Number of RF-channels: 1  
Modulation: ASK  
Antenna types: PCB antenna  
☒ detachable ☐ not detachable  
  
Power supply: External power source  
nominal: 5.0 VDC  
Temperature range: -20°C to +70°C <sup>1)</sup>

Remark:  
The tests were performed with 120V AC / 60Hz.

<sup>1)</sup> In accordance with ANSI C63.4 and 47 CFR Part 15, section 15.225 (e) the temperature range from -20°C to +50°C has to be used. The manufactor specified a wider temperature range.



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## Photo documentation

For photos of the EUT, see annex B.

For photos taken during testing and the EUT-positions, see annex A.

## Short description of the EUT

RFID reader 13,56MHz with detachable PCB antenna.

## Operation mode

During the pre-measurements it was observed that the “searching-for-tag-mode” is the respective worst- case.

## EUT positions

The EUT was tested in the 3 orthogonal positions. This is documented in annex A.



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## Configuration

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

Device	Model:	S/N
HF-RFID Reader	HF-RFID01	96999000010
RFID tag	TI-TagIt "HF-I2048"	FF783508000007E0
Notebook	DELL "Latitude EG410"	COKNRM1
Notebook	ASUS "ASUS N56VZ"	CANOBC029611406
Transceiver optoUSB-2.0	GS18E12	121680
Transceiver optoUSB-2.0	GS18E12	121679
Power Supply	Statron 3231.1	E00017
Multimeter	Gossen "METRAHit 29S"	SEB00194
AC power source	Chroma ATE INC. 61602	ABP000000731

## Used cables

Numbers:	Description: (type / lengths / remarks)	Serial No
1	USB-2.0-cable, 50 cm	n/a
1	LWL, 10m	n/a
2	LWL, 5m	n/a

Applied Software:            SIGMATEK test application



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# 3 AC power line conducted emissions

according to 47 CFR Part 15, section 15.207

## Test location

Description	Manufacturer	Inventory No.
Shielded chamber	Siemens - Matsushita	E00107

## Test instruments

	Description	Manufacturer	Inventory No.
<input checked="" type="checkbox"/>	ESCS 30	Rohde & Schwarz	E00003
<input type="checkbox"/>	ESU 26	Rohde & Schwarz	W00002
<input type="checkbox"/>	ESCI	Rohde & Schwarz	E00001
<input 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

## Limits

Frequency [MHz]	Quasi-peak [dBµV]	Average [dBµV]
0.15 – 0.5	66 – 56	56 – 46
0.5 – 5.0	56	46
5 – 30	60	50



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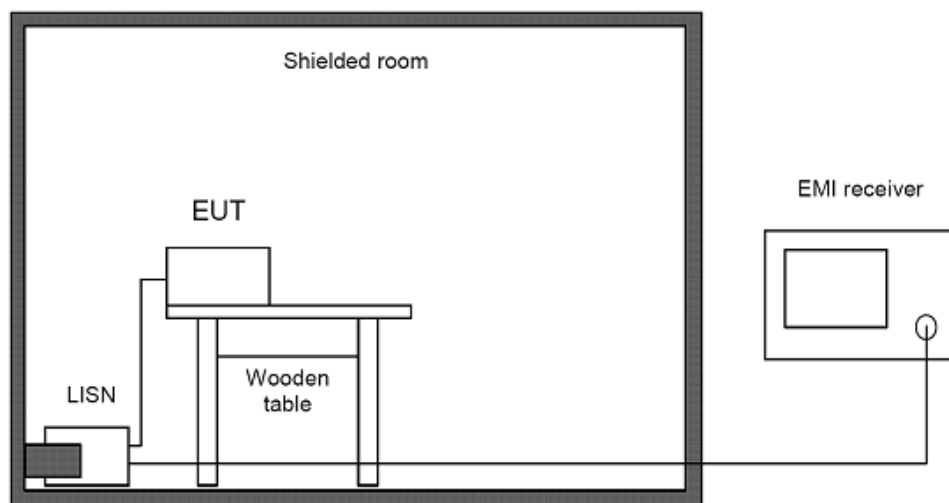
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## Test procedure

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

According to ANSI C63.4, section 13.3.1 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.

## Test setup



Picture 1: Outline of conducted emission test setup

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

## Test results

Temperature:	24°C	Humidity:	44%
Tested by:	Martin Müller	Test date:	2014-08-08



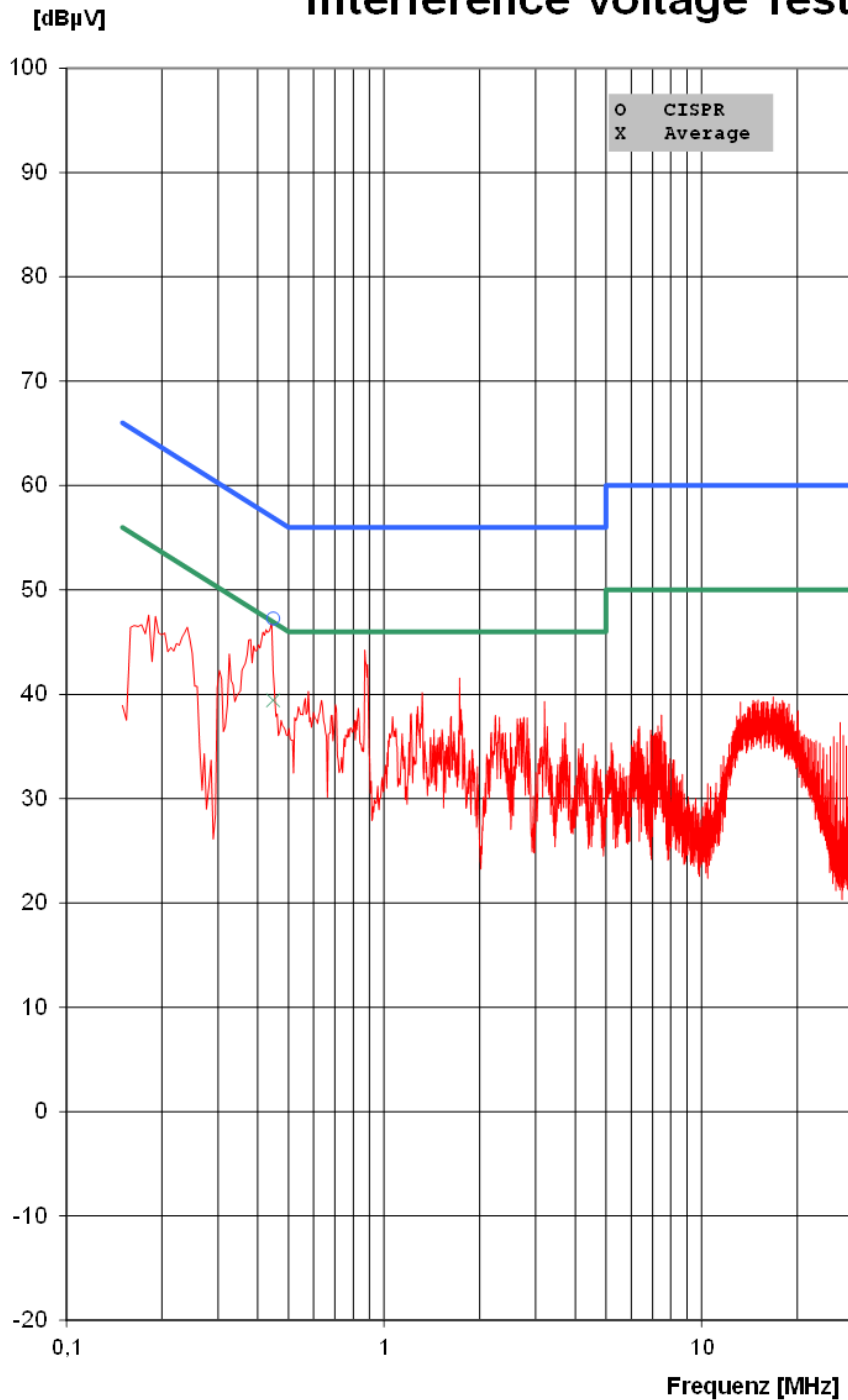
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# Interference Voltage Test



REGULATIONS:  
EN 55022 Class B  
PEAK / CISPR / AV

TEST EQUIPMENT:  
R&S ESCS30 (E00003)  
R&S ESH2-Z5 (E00004)

ORDER NO.:  
140202-AU01+W01

EUT:  
SIGMATEK GmbH & Co KG  
HF-RFID Reader  
HF-RFID01  
96999090010

OPERATION MODE:  
Antenna deactivated

Mains 120V AC /60Hz  
Phase

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

DATE / TIME:  
2014-08-08 15:15:09  
24°C 44% 99kPa

TEST ENGINEER:  
Martin Müller

StöSp LI AntDeactivated.E10

...	Freq. [MHz]	U_CISPR ...	Limit CISPR	delta CISPR	U_AV ...	Limit AV	delta AV	Date	P.	Remarks	U_Scan ...	Cor.
✓	0,4475	47,2	56,9	9,7	39,4	46,9	7,5	2014-08-08 15:46...	L		47,1	0,0

Picture 2: Graphic Conducted emission on mains, phase (antenna deactivated)

Note: "Antenna deactivated" means replaced by 50 ohms termination (dummy load).



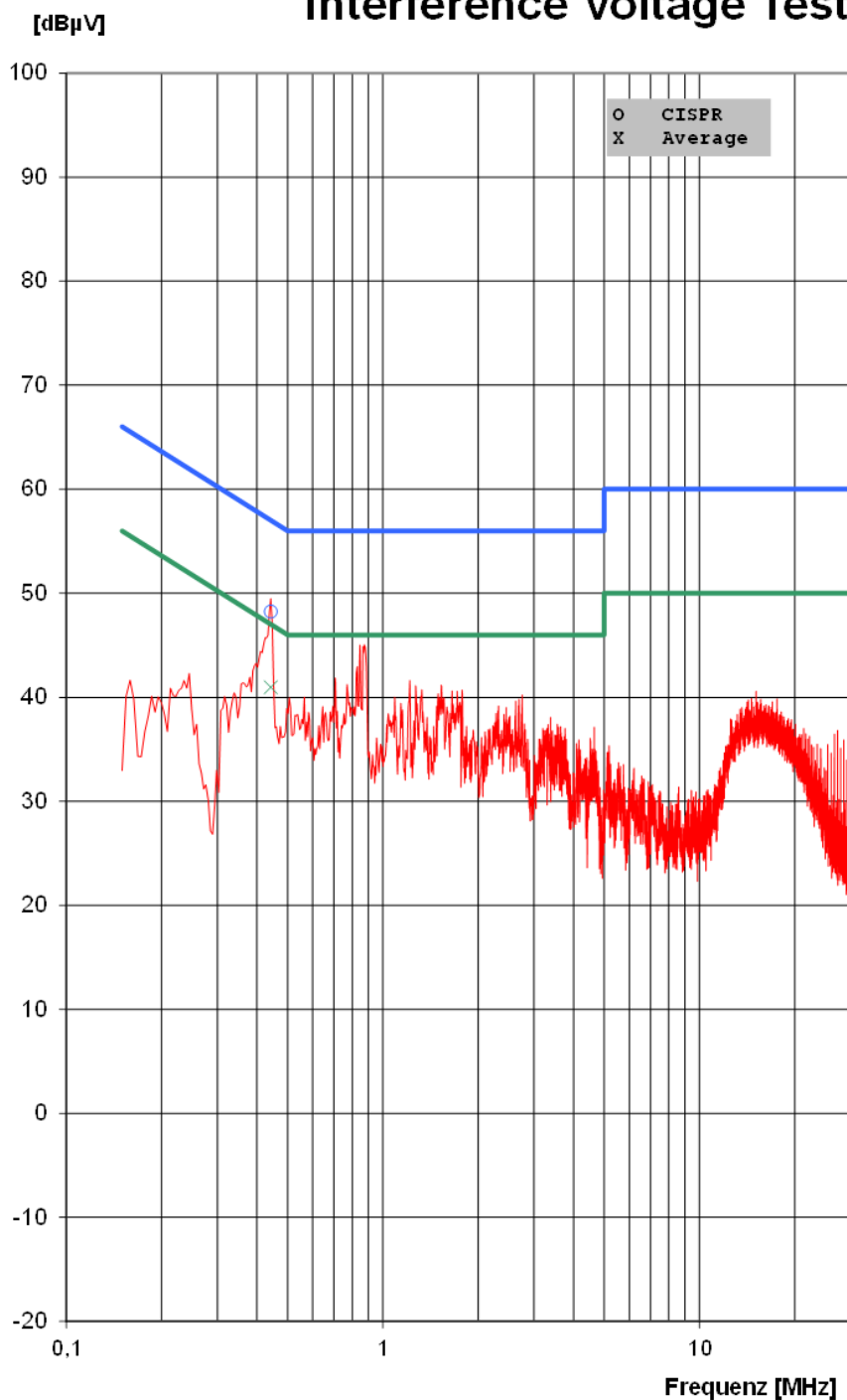
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# Interference Voltage Test



REGULATIONS:  
EN 55022 Class B  
PEAK / CISPR / AV

TEST EQUIPMENT:  
R&S ESCS30 (E00003)  
R&S ESH2-Z5 (E00004)

ORDER NO.:  
140202-AU01+W01

EUT:  
SIGMATEK GmbH & Co KG  
HF-RFID Reader  
HF-RFID01  
96999090010

OPERATION MODE:  
Antenna deactivated

Mains 120V AC /60Hz  
Neutral

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

DATE / TIME:  
2014-08-08 15:17:10  
24°C 44% 99kPa

TEST ENGINEER:  
Martin Müller

StöSp N AntDeactivated.E10

Freq. [MHz]	U_CISPR ...	Limit CISPR	delta CISPR	U_AV ...	Limit AV	delta AV	Date	P..	Remarks	U_Scan ...	Cor.
0,4425	48,2	57,0	8,8	41,0	47,0	6,1	2014-08-08 15:46...	N		49,5	0,0

Picture 3: Conducted emission on mains, neutral (antenna deactivated)

Note: "Antenna deactivated" means replaced by 50 ohms termination (dummy load).



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## 4 Radiated emission measurement (<1 GHz)

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

### Test Location

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

Description	Manufacturer	Inventory No.
CDC	Albatross Projects	E00026
Open site area	EMV <b>TESTHAUS</b> GmbH	E00354

### Test instruments

	Description	Manufacturer	Inventory No.
<input checked="" type="checkbox"/>	ESCS 30 (FF)	Rohde & Schwarz	E00003
<input type="checkbox"/>	ESU 26	Rohde & Schwarz	W00002
<input checked="" type="checkbox"/>	ESCI (CDC)	Rohde & Schwarz	E00001
<input checked="" type="checkbox"/>	VULB 9163 (FF)	Schwarzbeck	E00013
<input checked="" type="checkbox"/>	VULB 9160 (CDC)	Schwarzbeck	E00011
<input checked="" type="checkbox"/>	HFH2-Z2	Rohde & Schwarz	E00060
<input checked="" type="checkbox"/>	Feedline OATS	Huber & Suhner	200024



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## Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

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

Frequency [MHz]	Field strength Fs [µV/m]	Field strength [dBµV/m]	Measurement distance d [m]
0.009 – 0.490	266.6 – 4.9	48.5 – 13.8	300
0.490 – 1.705	48.98 – 14.08	33.8 – 22.97	30
1.705 – 30.0	30	29.54	30
30 – 88	100	40	3
88 – 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

In case the emission fall within the restricted band specified on 15.225 limit in the table below has to be followed.

Frequency [MHz]	Field strength Fs [µV/m]	Field strength [dBµV/m]	Measurement distance d [m]
13.553 - 13.567	15,848	84	30
13.410 - 13.553	334	50.47	30
13.567 - 13.710	334	50.47	30
13.110 - 13.410	106	40.51	30
13.710 - 14.010	106	40.51	30
f < 13.110	according to limits in §15.209		
f > 14.010			



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## Test procedure

1. Configure the EUT according to ANSI C63.4. The EUT was placed on the top of the turntable 0.8 meter above ground. The receiving antenna was placed 3 meters from the turntable. The test setup was placed inside a compact diagnostic chamber.
2. Power on the EUT and all peripherals.
3. The broadband antenna was set to vertical polarization.
4. The EMI receiver performed a scan from 30MHz to 1000MHz with the detector set to peak and the measurement bandwidth to 120 kHz.
5. The turn table was rotated to 6 different positions ( $360^\circ / 6$ ) and the antenna polarization was changed to horizontal.
6. Repeat the test procedure at step 4 and 5.
7. The test setup was then placed in an OATS at 3 m distance and all peak values over or with less distance to limit then 6dB were marked and re-measured with a quasi-peak detector.
8. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
9. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization. The highest value was recorded.
10. For emissions below 30MHz, measurements were done with a loop antenna. The recorded data were measured in QP mode of the receiver. Antenna height was not changed during this test. Appropriate CISPR bandwidths of 200 Hz up to 150 kHz and 9 or 10 kHz above were used.



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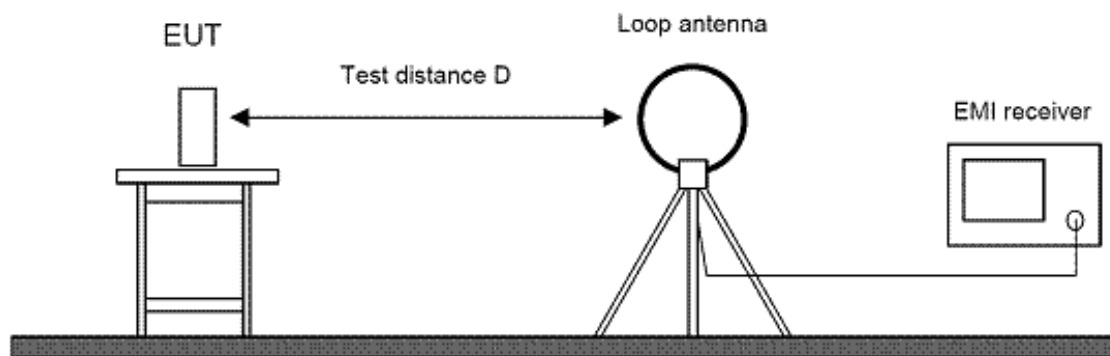
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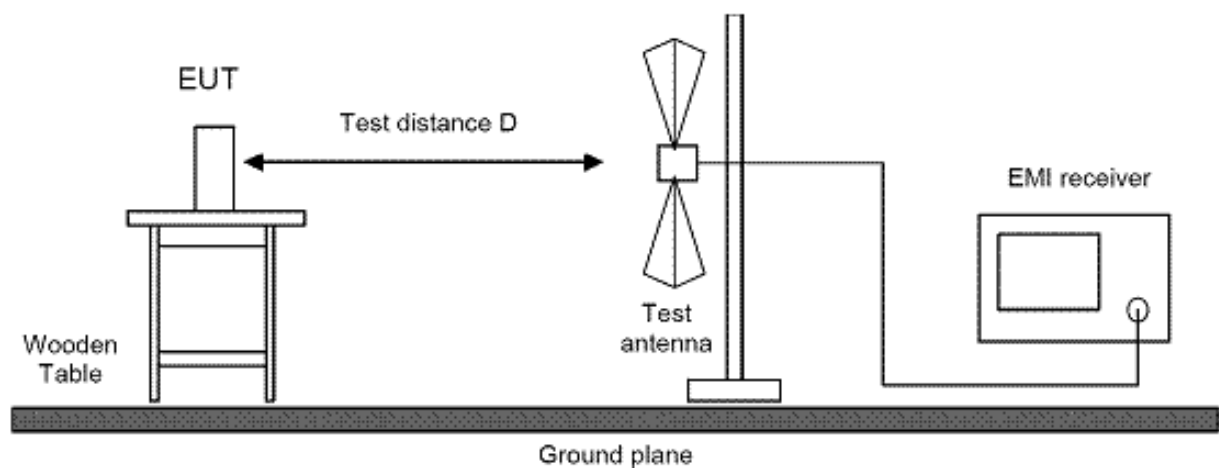
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## Test setup



Picture 4: Test setup for radiated emission measurement (< 30 MHz)



Picture 5: Test setup for radiated emission measurement (< 1 GHz)

## Test deviation

There is no deviation with the original standard.

## Test results

Temperature:	24°C	Humidity:	44%
Tested by:	Martin Müller	Test date:	2014-08-08

## Radiated Emission Measurement 9 kHz – 30 MHz

### Test procedure

The EUT was placed in a full anechoic chamber and the spurious emissions testing was performed in accordance with ANSI C63.4, FCC Part 15, Subpart C. The measurement distance was 3 m.

The following picture shows the worst-case-emissions at EUT-position 1 and the loop-antenna polarised to "I".

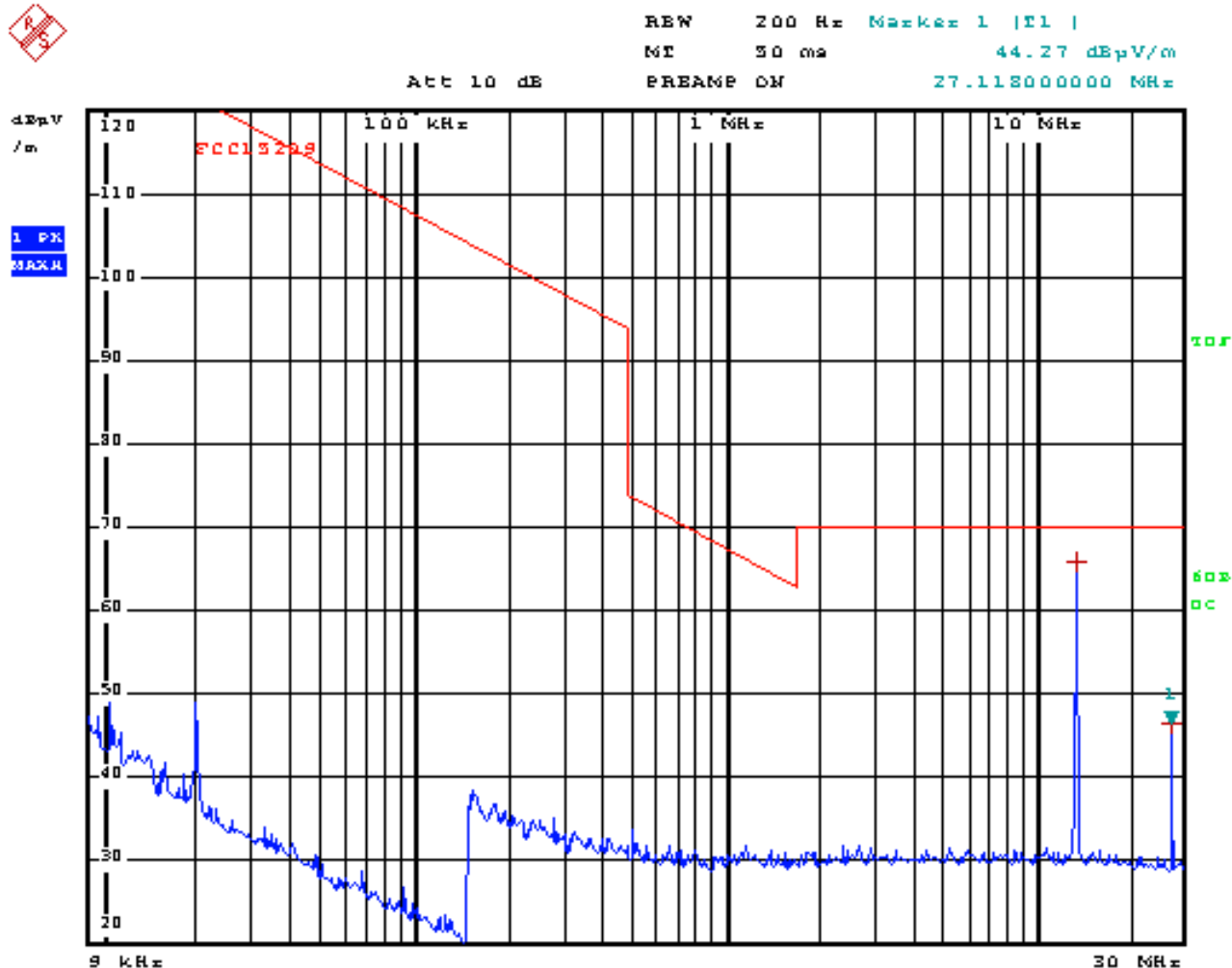


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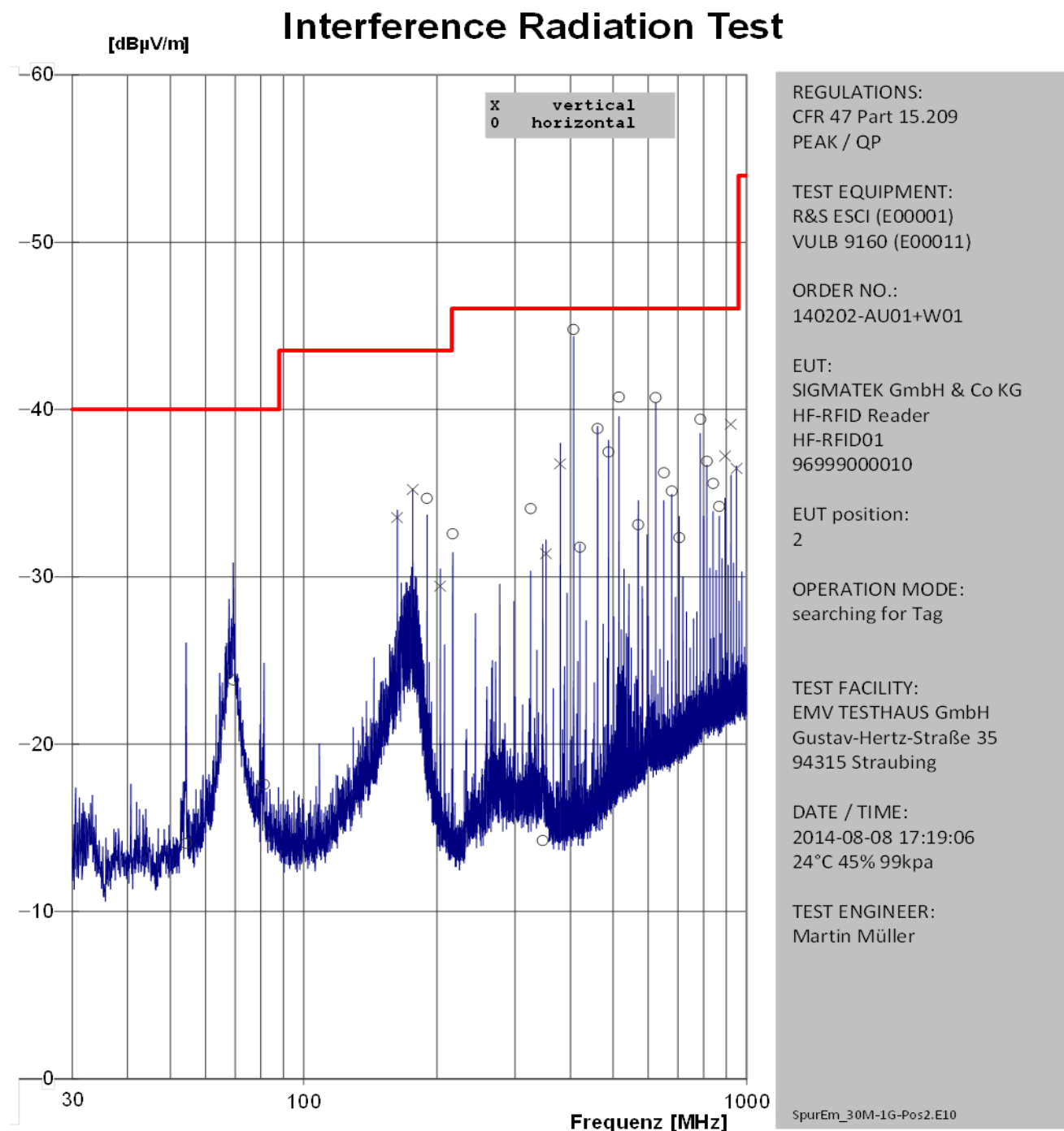


EDIT PEAK LIST (Final Measurement Results)			
Trace1:	FCC15209		
Trace2:	---		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dB $\mu$ V/m	DELTA LIMIT dB
1 Quasi Peak	13.558 MHz	66.84	-3.15
1 Quasi Peak	27.118 MHz	46.06	-23.93

Picture 6: Radiated emission 9 kHz – 30 MHz @ 3m distance (13.56 MHz)

# Radiated Emission Measurement 30 MHz – 1000 MHz

The following pictures show the worst-case-emissions at EUT-position 2.



Picture 7: Radiated emission trace 30 MHz – 1000MHz @ 3m distance



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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
									SpurEm_30M-1G-Pos2.F10
54,24	14,1	40,0	12,6	1,5	25,9	32°	100 cm	H	
69,30	23,8	40,0	10,5	13,4	16,2	29°	100 cm	H	
81,36	17,6	40,0	8,8	8,8	22,4	45°	100 cm	H	
162,72	33,5	43,5	14,0	19,6	10,0	19°	100 cm	V	
176,28	35,2	43,5	12,3	22,9	8,3	34°	100 cm	V	
189,84	34,7	43,5	10,7	24,0	8,8	74°	100 cm	H	
203,40	29,4	43,5	10,1	19,4	14,1	57°	100 cm	V	
216,96	32,6	46,0	10,1	22,4	13,5	84°	100 cm	H	
325,44	34,1	46,0	13,3	20,8	11,9	87°	100 cm	H	
346,38	14,2	46,0	13,6	0,6	31,8	84°	100 cm	H	
352,56	31,4	46,0	13,7	17,6	14,6	33°	100 cm	V	
379,68	36,7	46,0	14,3	22,4	9,3	57°	100 cm	V	
406,80	44,8	46,0	14,8	30,0	1,2	86°	100 cm	H	
420,36	31,8	46,0	15,1	16,6	14,2	2°	100 cm	H	
461,04	38,9	46,0	16,0	22,9	7,2	6°	100 cm	H	
488,16	37,5	46,0	16,3	21,1	8,6	21°	100 cm	H	
515,28	40,7	46,0	16,7	24,0	5,3	20°	100 cm	H	
569,52	33,1	46,0	17,8	15,3	12,9	30°	100 cm	H	
623,76	40,7	46,0	18,8	22,0	5,3	32°	100 cm	H	
650,88	36,2	46,0	19,1	17,1	9,8	206°	100 cm	H	
678,00	35,1	46,0	19,4	15,7	10,9	194°	100 cm	H	
705,12	32,3	46,0	19,7	12,6	13,7	206°	100 cm	H	
786,48	39,4	46,0	20,9	18,6	6,6	315°	100 cm	H	
813,60	36,9	46,0	21,1	15,8	9,1	328°	100 cm	H	
840,72	35,6	46,0	21,3	14,3	10,4	330°	100 cm	H	
867,84	34,2	46,0	21,5	12,7	11,8	340°	100 cm	H	
894,90	37,2	46,0	21,8	15,4	8,8	45°	100 cm	V	
922,02	39,1	46,0	22,2	16,9	6,9	57°	100 cm	V	
949,20	36,5	46,0	22,6	13,9	9,6	47°	100 cm	V	

Picture 8: Radiated emission table 30 MHz – 1000MHz @ 10m distance



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## Spectrum Mask

### Test procedure

The EUT was placed in a full anechoic chamber and the emission bandwidth testing was performed in accordance with ANSI C63.4 and 47 CFR Part 15, section 15.225 (a) - (d). The measurement distance was 3 m. To find the closest margin of the spectrum to the limit mask adapted to the test distance the EUT was rotated by 360 degrees with detector of the test receiver set to peak. The loop antenna placed in a fixed height of 1 meter was rotated by 360 degrees to get the maximum of emission. In case of exceeding the limits the detector is switched to quasi peak for final testing in position of maximum emission.



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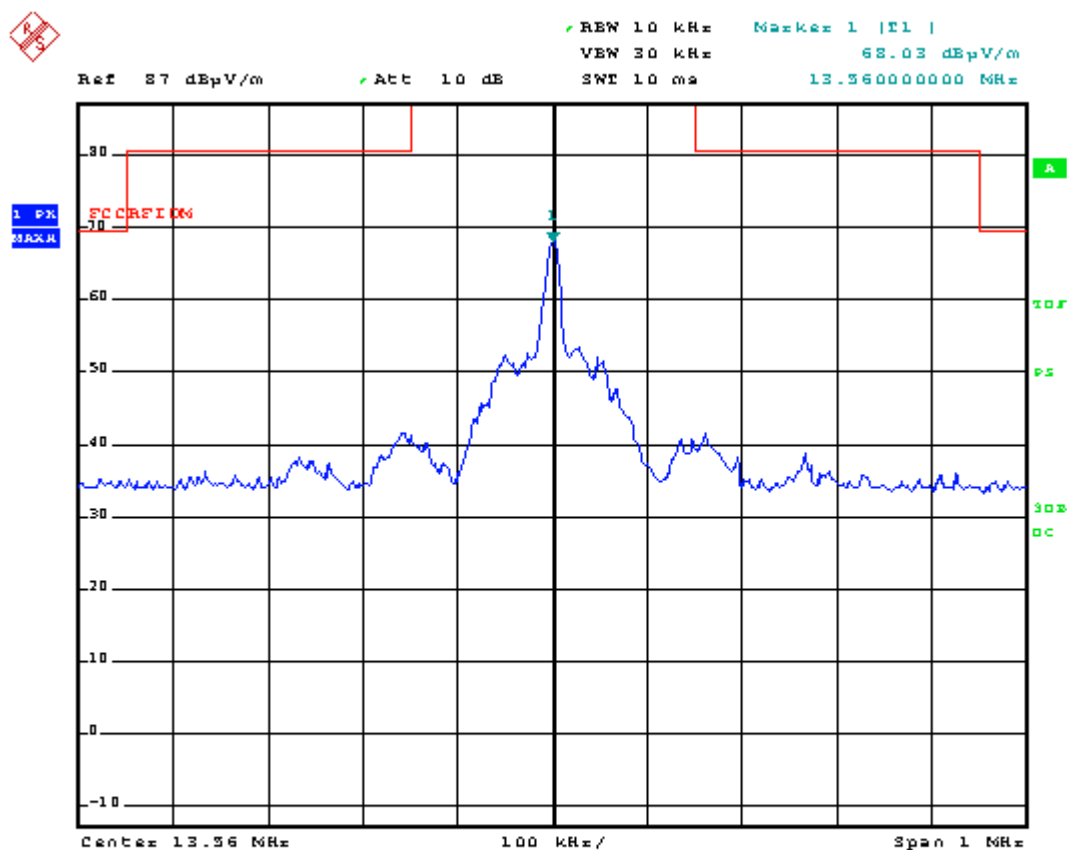
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## Test result

Temperature:	24°C	Humidity:	44%
Tested by:	Martin Müller	Test date:	2014-08-08



Date: 8.AUG.2014 11:30:24

Picture 9: Spectrum mask at 13.56 MHz @ 3m distance

$f_{\text{meas}}$ [MHz]	$E_{\text{meas}}$ @ 3m [dBμV/m]	Correction 3m -> 30m	Calc. Value [dBμV/m]	Limit @ 30m	Result
13.560	68.03	-40 dB	28.03	84 dBμV/m	Pass



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# Frequency Stability

## Test procedure

The EUT was placed in a climatic chamber and the emission bandwidth testing was performed in accordance with ANSI C63.4 and 47 CFR Part 15, section 15.225 (e). The Frequency Stability was measured using the radiated signals from the EUT so that the measurement equipment would not load the radio frequency circuits. A frequency counter was used for the frequency stability measurements. A close field probe was attached to the counter and placed near the antenna of the reader for measurement. The Reader was put into a continuous output mode through instructions from the host computer. The frequency was measured while the input DC Power to the intentional radiator was varied over the required input range.



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## Test result

Temperature:	24°C	Humidity:	44%
Tested by:	Martin Müller	Test date:	2014-08-11

Temperature: 20° C		
Carrier Frequency	Voltage range	Frequency change
13,56 MHz	Nominal: 5.0 V DC	--
13,56 MHz	4.25 V DC (85%)	< 0.01 %
13,56 MHz	5.75 V DC (115%)	< 0.01 %

Voltage 24 V DC:		
Carrier Frequency	Temperature range	Frequency change
13,56 MHz	-20 °C	< 0.01 %
13,56 MHz	-10 °C	< 0.01 %
13,56 MHz	0 °C	< 0.01 %
13,56 MHz	10 °C	< 0.01 %
13,56 MHz	20 °C	---
13,56 MHz	30 °C	< 0.01 %
13,56 MHz	40 °C	< 0.01 %
13,56 MHz	50°C	< 0.01 %
13,56 MHz	60°C	< 0.01 %
13,56 MHz	70°C	< 0.01 %



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## 5 Radiated emission measurement (>1 GHz)

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

Remark:

This measurement does not need to be applied because there are no internal frequencies higher than 108 MHz (see 47 CFR Part 15, section 15.209 (f)).



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## 6 Equipment calibration status

Description	Modell Number	Serial number	Inventory number	Next calibration
Spectrum analyzer	ESCI 1166.5950.03	100013	E00001	2015-01
Broadband antenna	VULB9163	9163-114	E00012	2015-09
Loop antenna	HFH2-Z2	871398/0050	E00060	2016-07
OATS			E00354	
Compact Diagnostic Chamber (CDC)	VK041.0174	D62128-A502-A69-2-0006	E00026	
Climatic chamber 990 Liter	VC 4100	59566102680010	C00014	2015-01

Table 1: Equipment Calibration status



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## 7 Measurement uncertainty

Description	Max. deviation	k=
Conducted emission AMN (9kHz to 30 MHz)	$\pm 3,8$ dB	2
Radiated emission open field (3 m) (30 MHz to 300 MHz) (300MHz to 1 GHz)	$\pm 5,4$ dB $\pm 5,9$ dB	2
Radiated emission absorber chamber (> 1000 MHz)	$\pm 4.5$ dB	2

Table 2: Measurement uncertainty

The uncertainty stated is the expanded uncertainty obtained by multiplying the standard uncertainty by the coverage factor k. For a confidence level of 95 % the coverage factor k is 2.



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## 8 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.

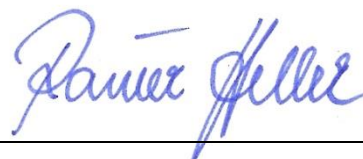
Place, Date:      Straubing, August 12<sup>th</sup>, 2014



Martin Müller

Test engineer

EMV **TESTHAUS** GmbH



Rainer Heller

Head of EMC / radio department

EMV **TESTHAUS** GmbH



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## 9 Revision History

Date	Description	Person	Revision
2014-08-12	First edition	M. Müller	----



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