

Test Report

Customer:

Elatec GmbH

Lilienthalstraße 3
82178 Puchheim

Tel.: +49 89 5529961-13

Fax: +49 89 5529961-29

RF test report

160617-AU01+W02



Industry
Canada

Industrie
Canada

Elatec GmbH

RFID Reader

TWN4 MultiTech 2



The test result refers exclusively
to the tested model.
This test report may not be copied or
published in a part without the written
authorization
of the accreditation agency and/or
EMV **TESTHAUS** GmbH



Deutsche
Akkreditierungsstelle
D-PL-12155-01-00

EMV **TESTHAUS** GmbH

Gustav-Hertz-Straße 35
94315 Straubing
Tel.: +49 9421 56868-0
Fax: +49 9421 56868-100
Email: info@emv-testhaus.com

Accreditation:



FCC facility registration number: 221458
Test Firm Type "2.948 listed": Valid until 2017-04-22
Test Firm Type "accredited": Valid until 2017-06-09
MRA US-EU, FCC designation number: DE0010
BnetzA-CAB-02/21-02/04 Valid until 2018-11-27

Industry Canada test site numbers with registration expiry date:
3472A-1, expiring 2018-11-09
3472A-2, expiring 2018-11-12

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



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 2 of 34

Table of contents

1	Test regulations	5
2	Summary of test results	6
3	Equipment under Test (EUT)	7
4	AC power line conducted emissions	10
5	Radiated emission measurement (<1 GHz)	16
6	Radiated emission measurement (>1 GHz)	27
7	Bandwidths	28
8	Equipment calibration status	32
9	Measurement uncertainty	33
10	Revision History	34



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 3 of 34

List of pictures

Picture 1: Outline of conducted emission test setup	11
Picture 2: Graphic - Conducted emission on mains, phase 1 (without termination).....	12
Picture 3: Table - Conducted emission on mains, phase 1 (without termination)	13
Picture 4: Graphic - Conducted emission on mains, neutral (without termination).....	14
Picture 5: Table - Conducted emission on mains, neutral (without termination)	15
Picture 6: Test setup for radiated emission measurement (< 30 MHz).....	19
Picture 7: Test setup for radiated emission measurement (< 1 GHz).....	19
Picture 8: Radiated emission 9 kHz – 30 MHz @ 3m distance	21
Picture 9: Restricted band of operation, QP @ 3m distance	23
Picture 10: Restricted band of operation, AV @ 3m distance	24
Picture 11: Radiated emission 30 MHz - 1000MHz @ 3m distance	26
Picture 12: Occupied bandwidth (99 %).....	30
Picture 13: -20 dB emission bandwidth.....	31

List of tables

Table 1: Equipment calibration status.....	32
Table 2: Measurement uncertainty	33



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

1 Test regulations

47 CFR Part 2: 10-2016	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: 10-2016	Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)
ANSI C63.10:2013-06	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
FCC KDB 174176 D01 June 3, 2015	AC power-line conducted emissions Frequently Asked Questions
ICES-003 Issue 6, January 2016	Spectrum Management and Telecommunications Interference-Causing Equipment Standard Information Technology Equipment (ITE) – Limits and methods of measurement
RSS-Gen Issue 4, November 2014	Spectrum Management and Telecommunications Radio Standards Specification General Requirements and Information for the Certification of Radiocommunication Equipment
RSS-210 Issue 9, August 2016	Spectrum Management and Telecommunications Radio Standards Specification Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 5 of 34

2 Summary of test results

Standard	Test result
47 CFR Part 15, sections 15.207 and 15.209	Passed
RSS-210 Issue 9 Section 4.3 (with appropriate references to RSS-Gen Issue 4)	Passed

Straubing, January 17, 2017



Martin Müller
Test engineer
EMV **TESTHAUS** GmbH



Christian Kiermeier
Technical executive
EMV **TESTHAUS** GmbH



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 6 of 34

3 Equipment under Test (EUT)

Product type: RFID Reader
Model Name: TWN4 MultiTech 2
Applicant: Elatec GmbH
Manufacturer: Elatec GmbH
Serial number: #8
FCC ID: WP5TWN4F3
IC certification number: 7948A-TWN4F3
Application frequency band: n/a
Frequency range: 134 kHz
Operating frequency: 134 kHz
Number of RF-channels: 1
Modulation: ASK
Antenna types: PCB antenna
☐ detachable ☒ not detachable

Power supply: USB powered
nominal: 5.0 VDC \pm 15 %

Temperature range: -20°C to +50°C

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



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 7 of 34

3.1 Photo documentation

For external photos of the EUT see annex B, for internal ones see annex C.
For photos taken during testing and including EUT-positions see annex A.

3.2 Short description of the EUT

EUT is a RFID reader employing 3 frequencies. The other frequencies are documented within the following test reports:

160617-AU02+W01 -> 125 kHz
160617-AU02+W03 -> 13.56 MHz

3.3 Operation mode

During the pre-tests it was observed that the “continuous-tag-reading-mode” is the respective worst- case. Therefore this mode was selected for final testing. The device was configured by manufacturer to activate the RFID reader for continuous transmission via RFID card.

BLE module was only included to complete hardware setup. During tests it was deactivated.

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



3.4 Configuration

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

Device	Model:	Serial or inventory no.
RFID Reader	TWN4 MultiTech 2	#8
RFID tag	134 kHz	----
Test-PC	Esprimo P9900	E00351
Notebook	Lifebook A531	E00521
AC power source (120 V / 60 Hz)	Chroma 616062	E00633
DC supply	Statron 3252.1	E00541
Digital multimeter	UT61D	H150188102

3.5 Used cables

Count	Description (type / lengths / remarks)	Serial no.
1	USB cable (1.5 m, shielded)	---



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 9 of 34

4 AC power line conducted emissions

according to 47 CFR Part 15, section 15.207, and
RSS-210, section 3.1 with RSS-Gen, section 8.8

4.1 Test location

Description	Manufacturer	Inventory No.
Shielded room	Siemens - Matsushita	E00107

4.2 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"/>	ESH2-Z5	Rohde & Schwarz	E00004
<input type="checkbox"/>	ESH2-Z5	Rohde & Schwarz	E00005
<input checked="" type="checkbox"/>	Cable set shielded room	Huber + Suhner	E00424

4.3 Limits

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



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

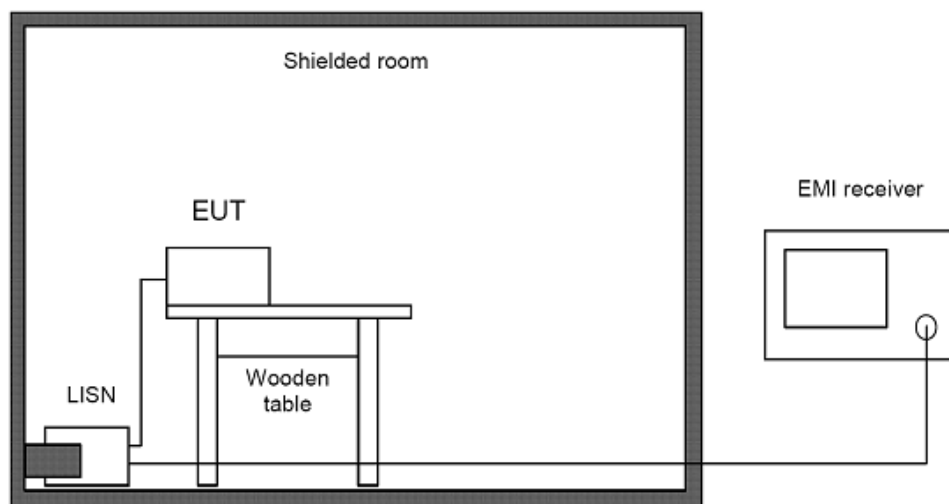
Page 10 of 34

4.4 Test procedure

1. The tests of conducted emission were carried out in a shielded room using a line impedance stabilization network (LISN) 50 μ 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 was scanned.
5. After that all peaks values with less margin 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 then these values were re-measured with average detector.
7. These measurements were done on all power lines.

According to ANSI C63.10, section 6.2.2 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.

4.5 Test setup

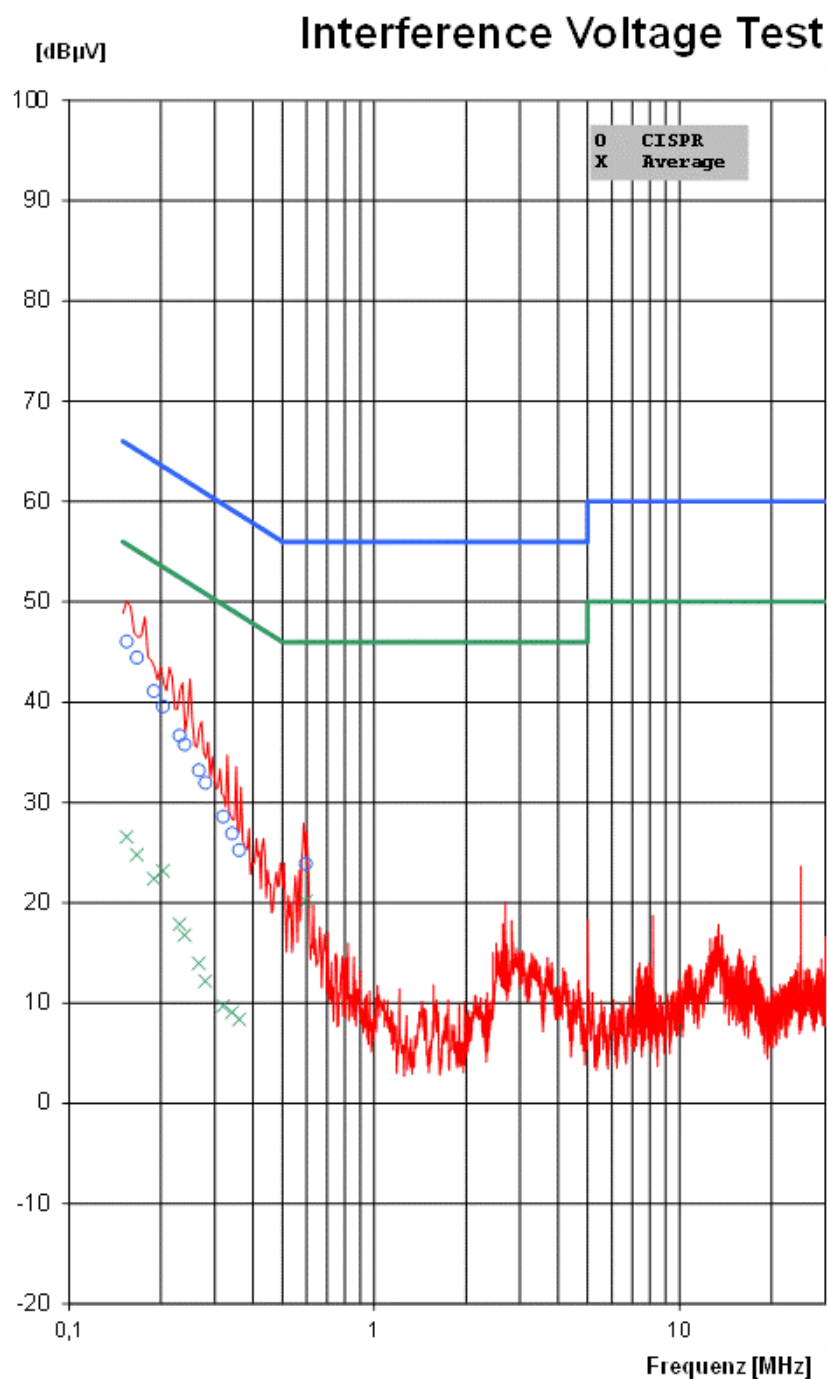


Picture 1: Outline of conducted emission test setup

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

4.6 Test results

Temperature:	20°C	Humidity:	41%
Tested by:	Martin Müller	Test date:	2016-12-02



REGULATIONS:
47CFR, 15.207
PEAK / CISPR / AV

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

ORDER NO.:
160617-AU02+W02

EUT:
Elatec GmbH
RFID Reader
TWN4 MultiTech 2
Sample #8

OPERATION MODE:
Cont. tag reading

Mains 120V AC /60Hz
Phase

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

DATE / TIME:
2016-12-02 09:34:10
23°C 41% 98kPa

TEST ENGINEER:
Martin Müller

StoSp_11.E10

Picture 2: Graphic - Conducted emission on mains, phase 1 (without termination)



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 12 of 34

Interference Voltage Test

Freq. [MHz]	U_CISPR [dBµV]	Limit [dBµV]	delta_U [dB]	U_AV [dBµV]	Limit [dBµV]	delta_U [dB]	Corr. [dB]	Remark
0,15	46,0	65,8	19,7	26,5	55,8	29,2	0,0	
0,17	44,5	65,1	20,7	24,8	55,1	30,3	0,0	
0,19	41,1	64,1	23,0	22,4	54,1	31,7	0,0	
0,20	39,6	63,5	23,9	23,2	53,5	30,3	0,0	
0,23	36,7	62,4	25,8	17,9	52,4	34,6	0,0	
0,24	35,8	62,1	26,4	16,8	52,1	35,4	0,0	
0,27	33,2	61,2	28,0	13,9	51,2	37,3	0,0	
0,28	32,0	60,8	28,9	12,2	50,8	38,6	0,0	
0,32	28,6	59,7	31,1	9,7	49,7	40,0	0,0	
0,34	26,9	59,1	32,3	9,1	49,1	40,1	0,0	
0,36	25,3	58,7	33,5	8,4	48,7	40,4	0,0	
0,60	23,9	56,0	32,1	20,1	46,0	25,9	0,0	

Picture 3: Table - Conducted emission on mains, phase 1 (without termination)

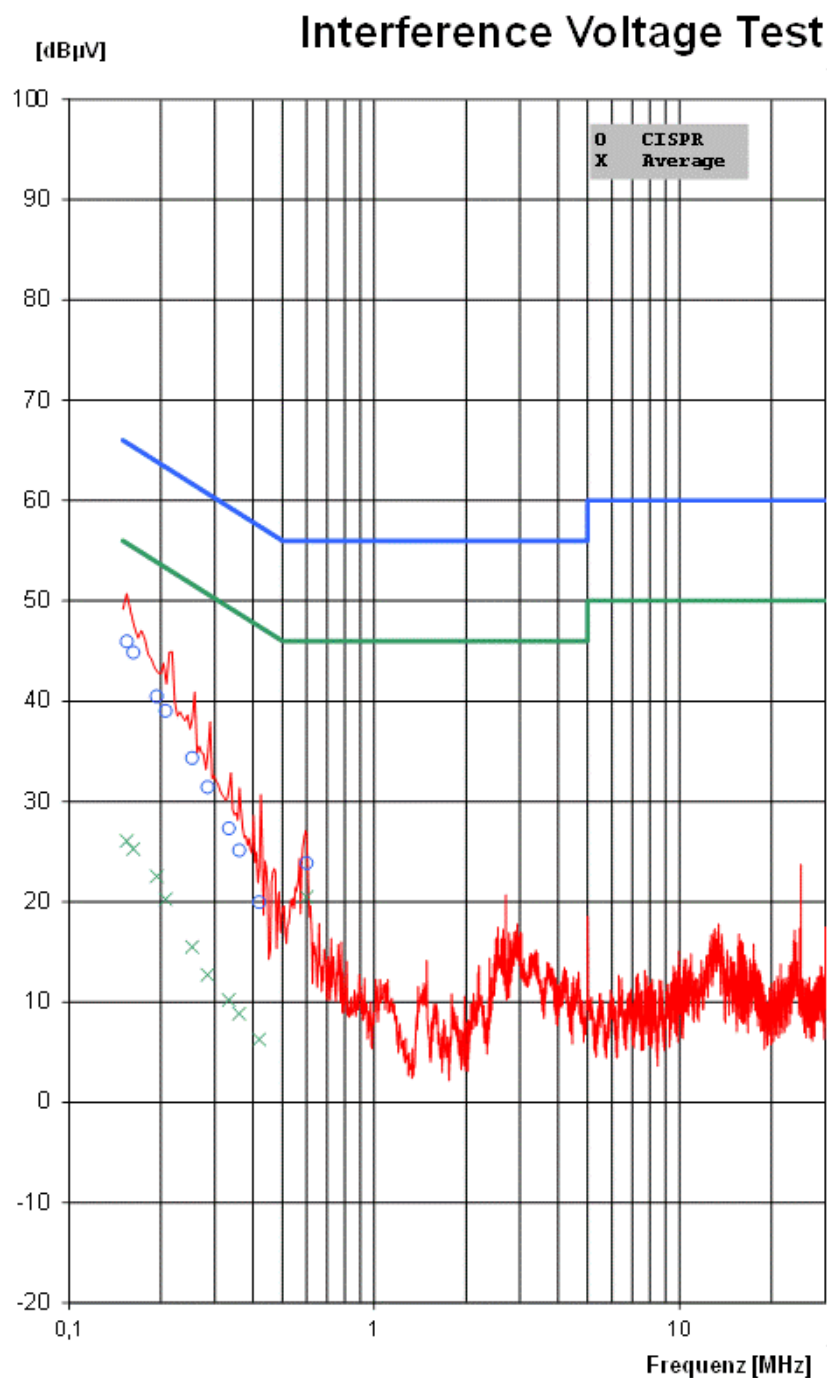


EMV **TESTHAUS** GmbH
Gustav-Hertz-Straße 35
94315 Straubing
Germany

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 13 of 34



REGULATIONS:
 47CFR, 15.207
 PEAK / CISPR / AV

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

ORDER NO.:
 160617-AU02+W02

EUT:
 Elatec GmbH
 RFID Reader
 TWN4 MultiTech 2
 Sample #8

OPERATION MODE:
 Cont. tag reading

Mains 120V AC /60Hz
 Neutral

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

DATE / TIME:
 2016-12-02 09:34:10
 23°C 41% 98kPa

TEST ENGINEER:
 Martin Müller

StoSp_N.E10

Picture 4: Graphic - Conducted emission on mains, neutral (without termination)



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

Elatec GmbH
 RFID Reader
 TWN4 MultiTech 2

160617-AU02+W02

Page 14 of 34

Interference Voltage Test

Freq.	U_CISPR	Limit	delta_U	U_AV	Limit	delta_U	Corr.	Remark
[MHz]	[dBµV]	[dBµV]	[dB]	[dBµV]	[dBµV]	[dB]	[dB]	StöSe N.F.10
0,15	46,0	65,8	19,8	26,0	55,8	29,7	0,0	
0,16	44,9	65,3	20,5	25,2	55,3	30,1	0,0	
0,19	40,5	63,9	23,4	22,5	53,9	31,3	0,0	
0,21	39,0	63,3	24,3	20,2	53,3	33,1	0,0	
0,25	34,3	61,7	27,3	15,5	51,7	36,2	0,0	
0,28	31,4	60,7	29,3	12,7	50,7	38,0	0,0	
0,33	27,3	59,4	32,0	10,2	49,4	39,2	0,0	
0,36	25,1	58,7	33,6	8,8	48,7	39,9	0,0	
0,42	20,0	57,5	37,5	6,3	47,5	41,2	0,0	
0,60	23,9	56,0	32,2	20,4	46,0	25,6	0,0	

5 Radiated emission measurement (<1 GHz)

according to 47 CFR Part 15, section 15.205(a), 15.209(a) and
RSS-210, section 4.3 with RSS-Gen, sections 8.10 and 8.9

5.1 Test Location

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

Description	Manufacturer	Inventory No.
CDC	Albatross Projects	E00026
Open area test site (OATS)	EMV TESTHAUS GmbH	E00354

5.2 Test instruments

	Description	Manufacturer	Inventory No.
<input checked="" type="checkbox"/>	ESCS 30 (OATS)	Rohde & Schwarz	E00551
<input type="checkbox"/>	ESU 26	Rohde & Schwarz	W00002
<input checked="" type="checkbox"/>	ESCI (CDC)	Rohde & Schwarz	E00001
<input checked="" type="checkbox"/>	VULB 9163 (OATS)	Schwarzbeck	E00013
<input checked="" type="checkbox"/>	VULB 9160 (CDC)	Schwarzbeck	E00011
<input checked="" type="checkbox"/>	HFH2-Z2	Rohde & Schwarz	E00060
<input checked="" type="checkbox"/>	Cable set CDC	Huber + Suhner	E00060
<input checked="" type="checkbox"/>	Cable set OATS 3 m	Huber + Suhner	E00453, E00456, E00458
<input type="checkbox"/>	Cable set OATS 10 m	Huber + Suhner	E00453, E00455, E00458



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 16 of 34

5.3 Limits

The field strength of any emissions including spurious emissions falling into restricted bands as specified in 15.205(a) shall not exceed the general radiated emission limits as specified in 15.209.

Frequency [MHz]	Field strength Fs [μ V/m]	Field strength [dB μ V/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



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 17 of 34

5.4 Test procedure

1. EUT was configured according to ANSI C63.10. It 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. EUT and all peripherals were powered on.
3. The broadband antenna was set to vertical polarization.
4. The EMI receiver performed a scan from 30 MHz to 1000 MHz with peak detector peak and measurement bandwidth set 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. Test procedure at step 4 and 5 was repeated.
7. The test setup was then placed in an OATS at 3 m distance and all peak values over or with less margin to the limit than 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 emission field strength of both horizontal and vertical polarization. The highest value was recorded.
10. For emissions below 30 MHz measurements were done using a loop antenna. Prescan was performed with peak detector and final measurements with quasi-peak except for the frequency bands 9 to 90 kHz and 110 to 490 kHz where average detector applies. Antenna height was not changed during this test. Appropriate CISPR bandwidths of 200 Hz for frequencies up to 150 kHz and 9 or 10 kHz for frequencies above were used.



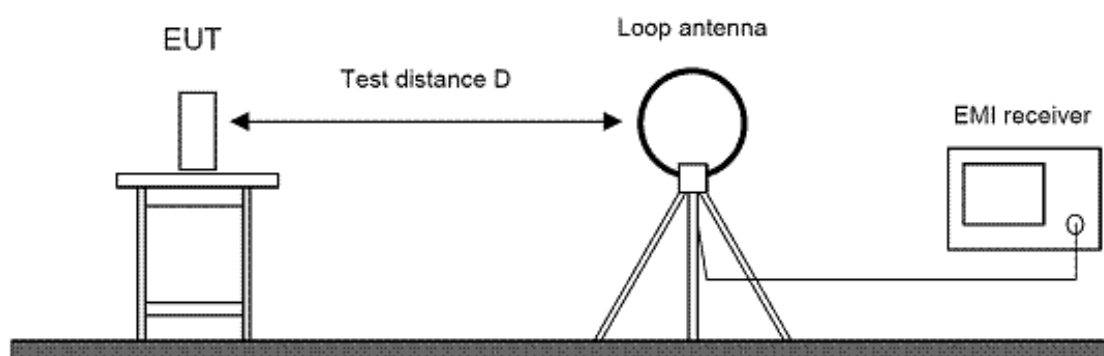
EMV **TESTHAUS** GmbH
Gustav-Hertz-Straße 35
94315 Straubing
Germany

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

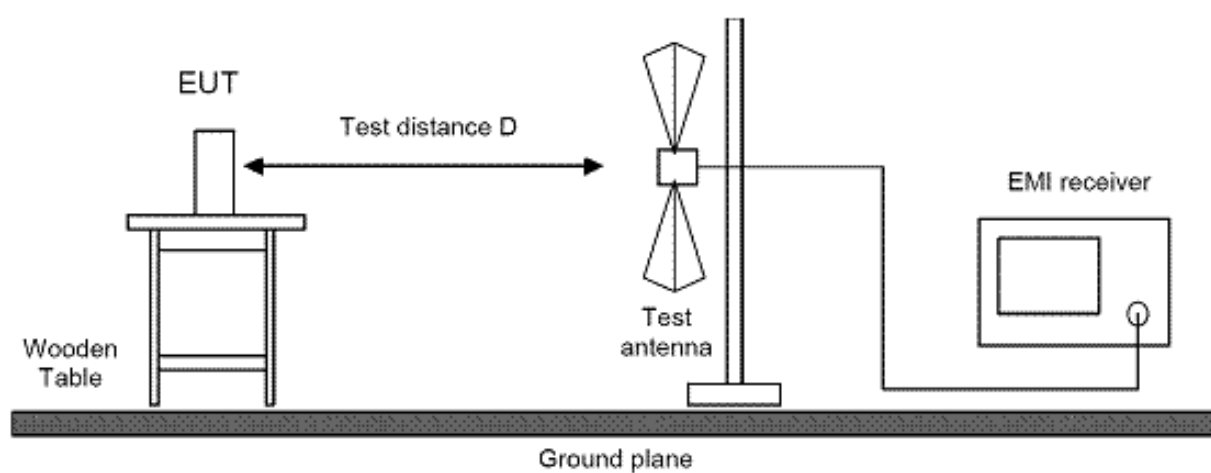
160617-AU02+W02

Page 18 of 34

5.5 Test setup



Picture 6: Test setup for radiated emission measurement (< 30 MHz)



Picture 7: Test setup for radiated emission measurement (< 1 GHz)

5.6 Test deviation

There is no deviation from the standards referred to.

5.7 Test results

Temperature:	20°C	Humidity:	41%
Tested by:	Martin Müller	Test date:	2016-12-01

Radiated Emission Measurement 9 kHz - 30 MHz

Recalculation factor is determined according to ANSI C63.10, section 6.4.4.2 "Extrapolation from the measurement of a single point":

$$d_{\text{near field}} = 47.77 / f_{\text{MHz}}, \text{ or}$$

$$f_{\text{MHz}} = 47.77 / d_{\text{near field}}$$

The frequency f_{MHz} at which the near field distance is equal to the limit and/or test distance is important for selection of the right formula for determining the recalculation factor:

$$f_{\text{MHz}}(300 \text{ m}) \approx 0.159 \text{ MHz}$$

$$f_{\text{MHz}}(30 \text{ m}) \approx 1.592 \text{ MHz}$$

$$f_{\text{MHz}}(3 \text{ m}) \approx 15.923 \text{ MHz}$$

For $9 \text{ kHz} \leq f \leq 159 \text{ kHz}$ and $490 \text{ kHz} < f \leq 1.592 \text{ MHz}$:

$$\text{Recalculation factor} = -40 \log(d_{\text{limit}} / d_{\text{measure}})$$

For $159 \text{ kHz} < f \leq 490 \text{ kHz}$ and $1.592 \text{ MHz} < f \leq 15.923 \text{ MHz}$:

$$\text{Recalculation factor} = -40 \log(d_{\text{near field}} / d_{\text{measure}}) - 20 \log(d_{\text{limit}} / d_{\text{near field}})$$

For $f > 15.923 \text{ MHz}$:

$$\text{Recalculation factor} = -20 \log(d_{\text{limit}} / d_{\text{near field}})$$

The limits in the graphics and value lists are derived from the general radiated emission limits as specified in 15.209 using the recalculation factor as described above.



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

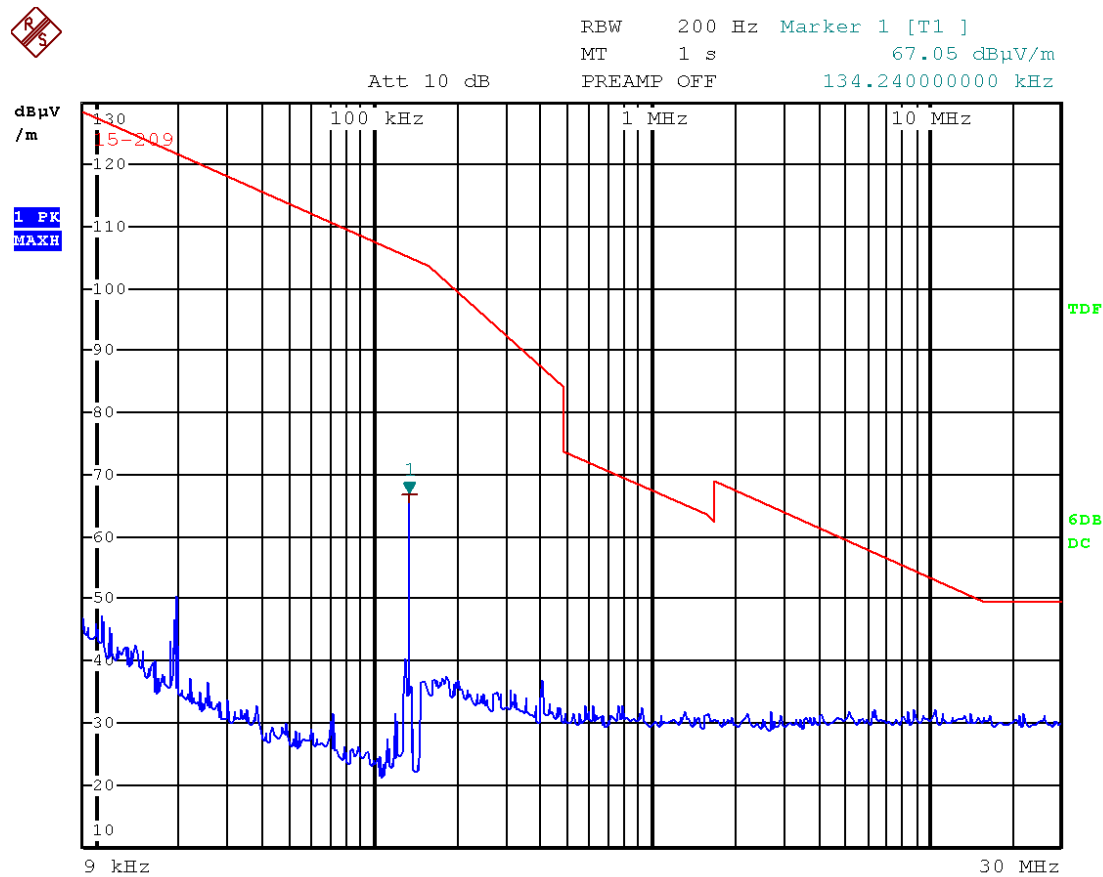
Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 20 of 34

Frequency range	Step size	IF Bandwidth	Detector		Measurement Time		Preamplifier
			Prescan	Final scan	Prescan	Final scan	
9 kHz – 90 kHz	80 Hz	200 Hz	PK	AV	1 ms	1 s	off
90 kHz – 110 kHz	80 Hz	200 Hz	PK	QPK	1 ms	1 s	off
110 kHz – 150 kHz	80 Hz	200 Hz	PK	AV	1 ms	1 s	off
150 kHz – 490 kHz	4 kHz	9 kHz	PK	AV	1 ms	1 s	off
490 kHz – 30 MHz	4 kHz	9 kHz	PK	QPK	1 ms	1 s	off

The following picture shows the worst-case-emissions for the spurious emissions at EUT-position 1, antenna parallel.



Picture 8: Radiated emission 9 kHz – 30 MHz @ 3m distance

Frequency [MHz]	Measured value [dBµV/m]	Detector	Recalculation factor [dB]	Field strength [dBµV/m]	Limit [dBµV/m]	Margin	Result
0.13424	67.05	PK	-80.0	-12.95	---	---	---
0.13424	66.98	AV	-80.0	-13.02	25.05	-38.07	Pass

Recalculation factor is determined according to ANSI C63.10, section 6.4.4.2 "Extrapolation from the measurement of a single point":

$$d_{\text{near field}} = 47.77 / f_{\text{MHz}}$$

$$\text{Recalculation factor} = -40 \log(d_{\text{limit}} / d_{\text{measure}})$$

f_{MHz} [MHz]	$d_{\text{near field}}$ [m]	d_{measure} [m]	d_{limit} [m]	Recalculation factor [dB]
0.13424	355.855	3.0	300.0	-80.0



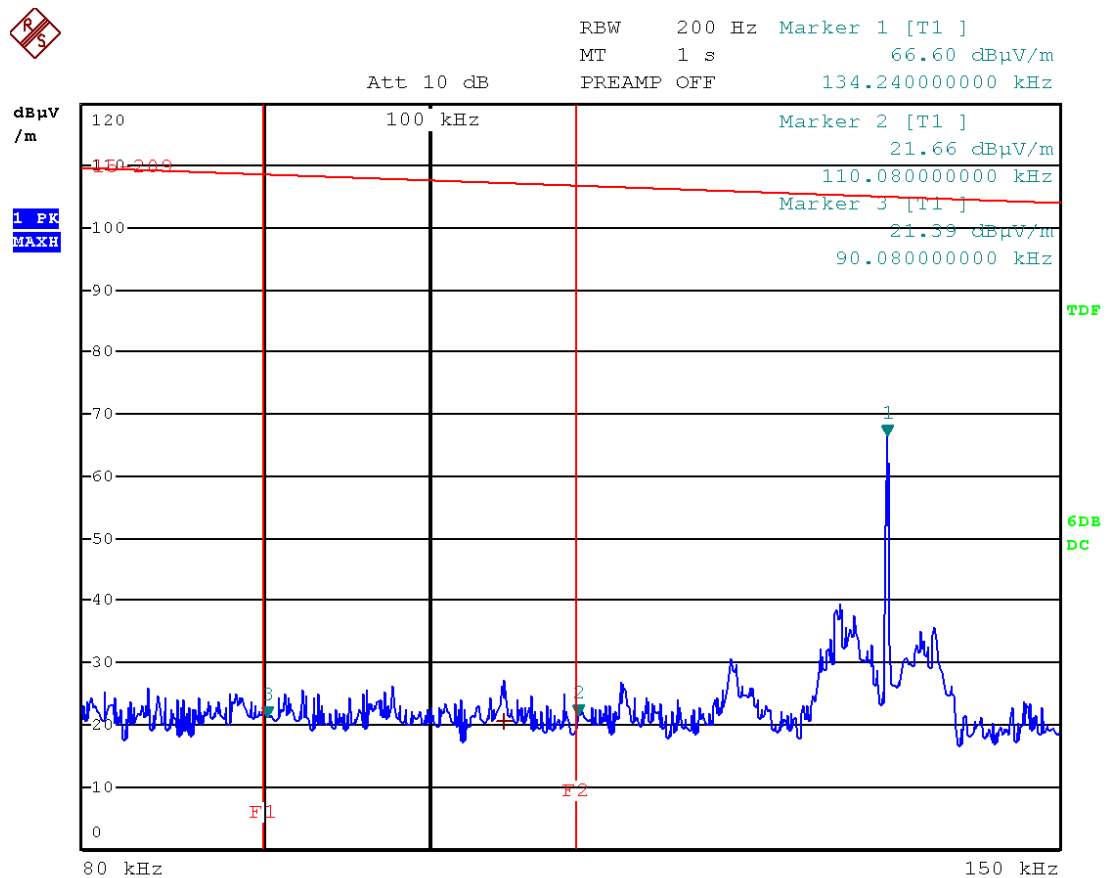
EMV **TESTHAUS** GmbH
Gustav-Hertz-Straße 35
94315 Straubing
Germany

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

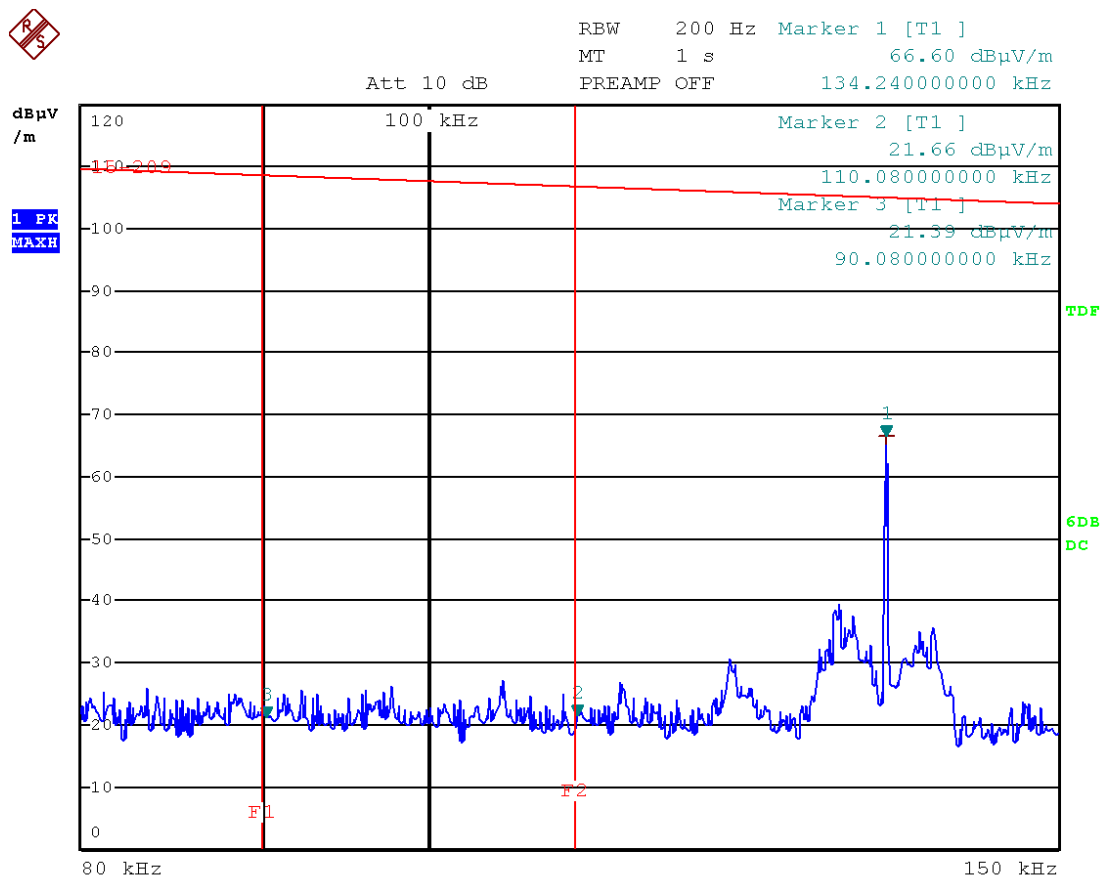
Page 22 of 34

Restricted band of operation from 0.090 MHz to 0.110 MHz



Picture 9: Restricted band of operation, QP @ 3m distance

Frequency [MHz]	Measured value [dBμV/m]	Detector	Recalculation factor [dB]	Field strength [dBμV/m]	Limit [dBμV/m]	Margin	Result
0.10488	20.72	QP	-80.0	-59.28	27.19	-86.47	Pass



Picture 10: Restricted band of operation, AV @ 3m distance

Frequency [MHz]	Measured value [dBμV/m]	Detector	Recalculation factor [dB]	Field strength [dBμV/m]	Limit [dBμV/m]	Margin	Result
0.13424	66.60	PK	-80.0	-13.40	---	---	---
0.13424	66.53	AV	-80.0	-13.47	25.05	-38.52	Pass



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 24 of 34

Note 1:

Recalculation factor is determined according to ANSI C63.10, section 6.4.4.2 "Extrapolation from the measurement of a single point":

$$d_{\text{near field}} = 47.77 / f_{\text{MHz}}$$

$$\text{Recalculation factor} = -40 \log(d_{\text{limit}} / d_{\text{measure}})$$

f_{MHz} [MHz]	$d_{\text{near field}}$ [m]	d_{measure} [m]	d_{limit} [m]	Recalculation factor [dB]
0.10488	455.473	3.0	300.0	-80.0
0.13424	355.855	3.0	300.0	-80.0



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

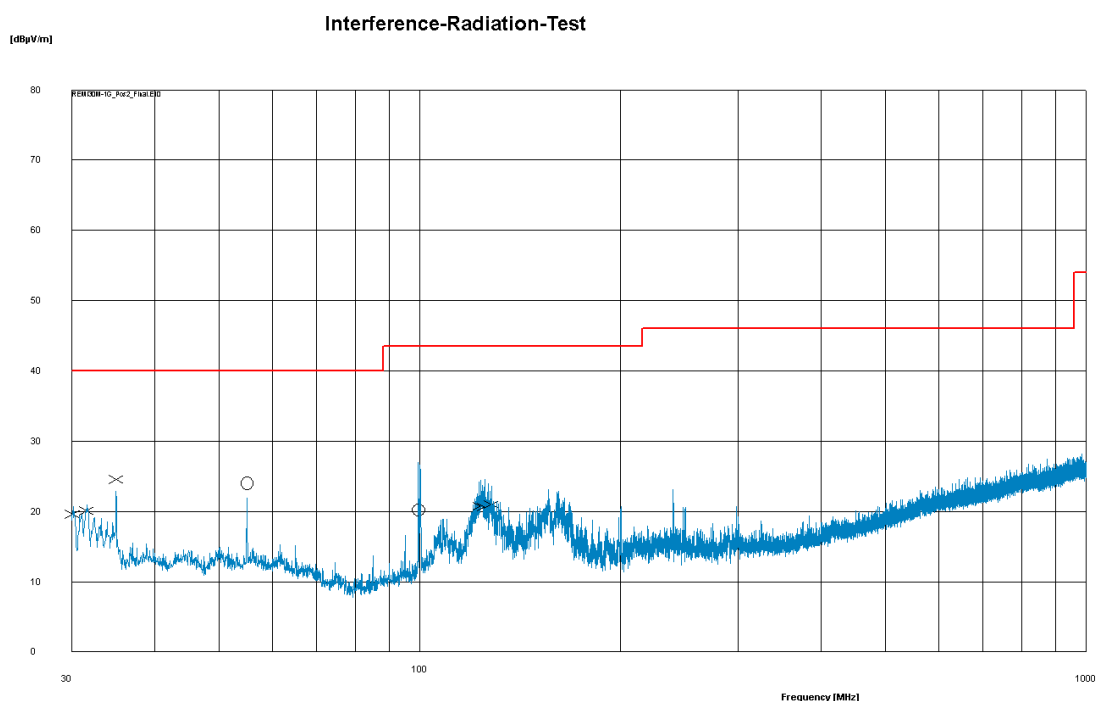
160617-AU02+W02

Page 25 of 34

Radiated Emission Measurement 30 MHz - 1000 MHz

Frequency range	Polarisation	Step size	IF Bandwidth	Detector		Measurement Time		Pre-amplifier
				Prescan	Final scan	Prescan	Final scan	
30 MHz – 1 GHz	H / V	60 kHz	120 kHz	PK	QPK	1 ms	1 s	20 dB

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



f [MHz]	E _{final} [dBV/m]	Limit [dBμV/m]	Height [cm]	TT [°]	Polarisation	Result
30.12	19.59	40.00	100	301.3	V	Pass
31.62	20.08	40.00	100	321	V	Pass
34.98	24.57	40.00	100	282	V	Pass
55.02	24.02	40.00	250	204.9	H	Pass
99.48	20.20	43.52	250	214	H	Pass
123.30	20.74	43.52	100	136.3	V	Pass
125.10	20.60	43.52	100	145.8	V	Pass
127.98	20.99	43.52	100	107	V	Pass

Picture 11: Radiated emission 30 MHz - 1000MHz @ 3m distance



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 26 of 34

6 Radiated emission measurement (>1 GHz)

according to 47 CFR Part 15, section 15.209(a),
RSS-210, section 4.3 with RSS-Gen, section 8.9

Remark:

This measurement needs not to be applied for the RFID part because

- the intentional radiator operates below 10 GHz and tenth harmonic of the highest fundamental frequency is lower than 1 GHz (see 47 CFR Part 15, section 15.33(a)(1), and RSS-Gen, section 6.13), and
- the digital part of the device does not generate or use internal frequencies higher than 108 MHz (see 47 CFR Part 15 section 15.33(b)(1), and RSS-Gen, section 2.3.3 with ICES-003, section 6.2).



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 27 of 34

7 Bandwidths

according to CFR 47 Part 2, section 2.202(a), and RSS-Gen, section 6.6

7.1 Test Location

See clause 5.1 on page 16.

7.2 Test instruments

See clause 5.2 on page 16.

7.3 Limits

The bandwidths are recorded only.

7.4 Test setup

See clause 5.5 on page 19.

7.5 Test deviation

There is no deviation from the standards referred to.



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

7.6 Test results

Temperature:	20°C	Humidity:	41%
Tested by:	Martin Müller	Test date:	2016-12-01

Occupied bandwidth (99 %)

Test procedure

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured. The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

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. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual.

The trace data points are recovered and 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 recorded. The span between the two recorded frequencies is the occupied bandwidth. For this purpose the appropriate measurement function of the spectrum analyzer is used.



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

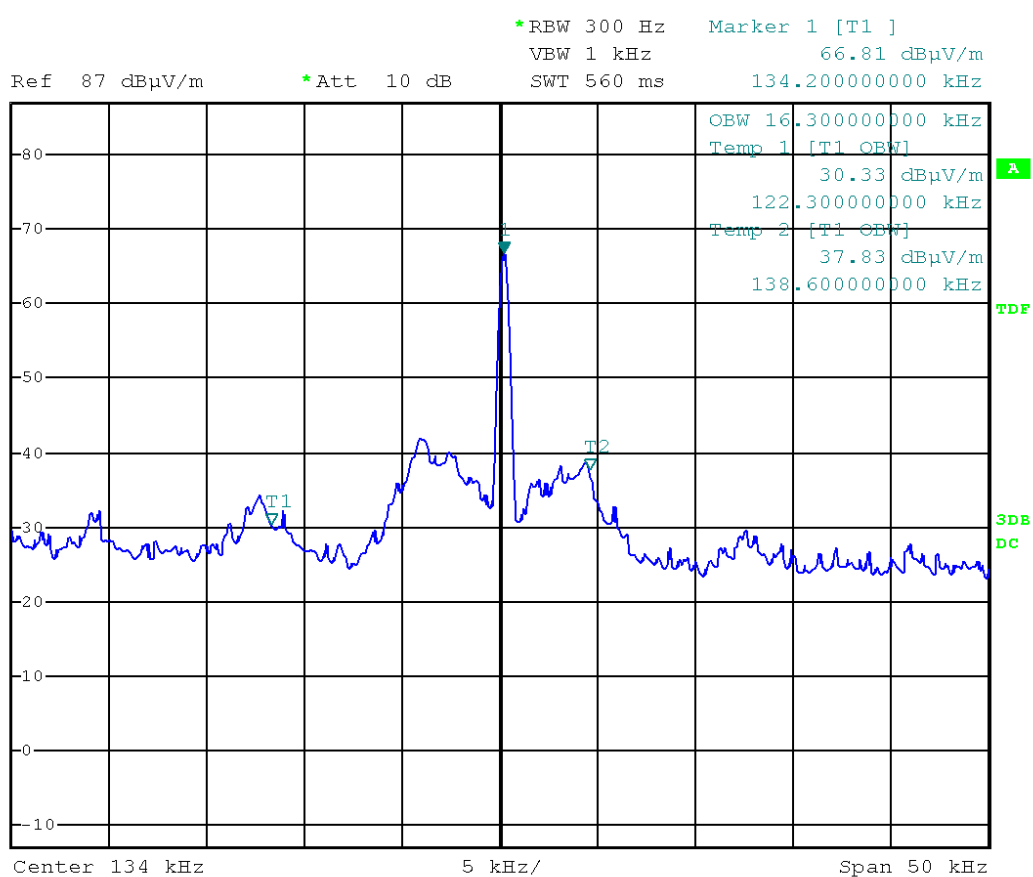
Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 29 of 34



1 PK
MAXH



Picture 12: Occupied bandwidth (99 %)

Measured occupied bandwidth (99 %): 16.300 kHz



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

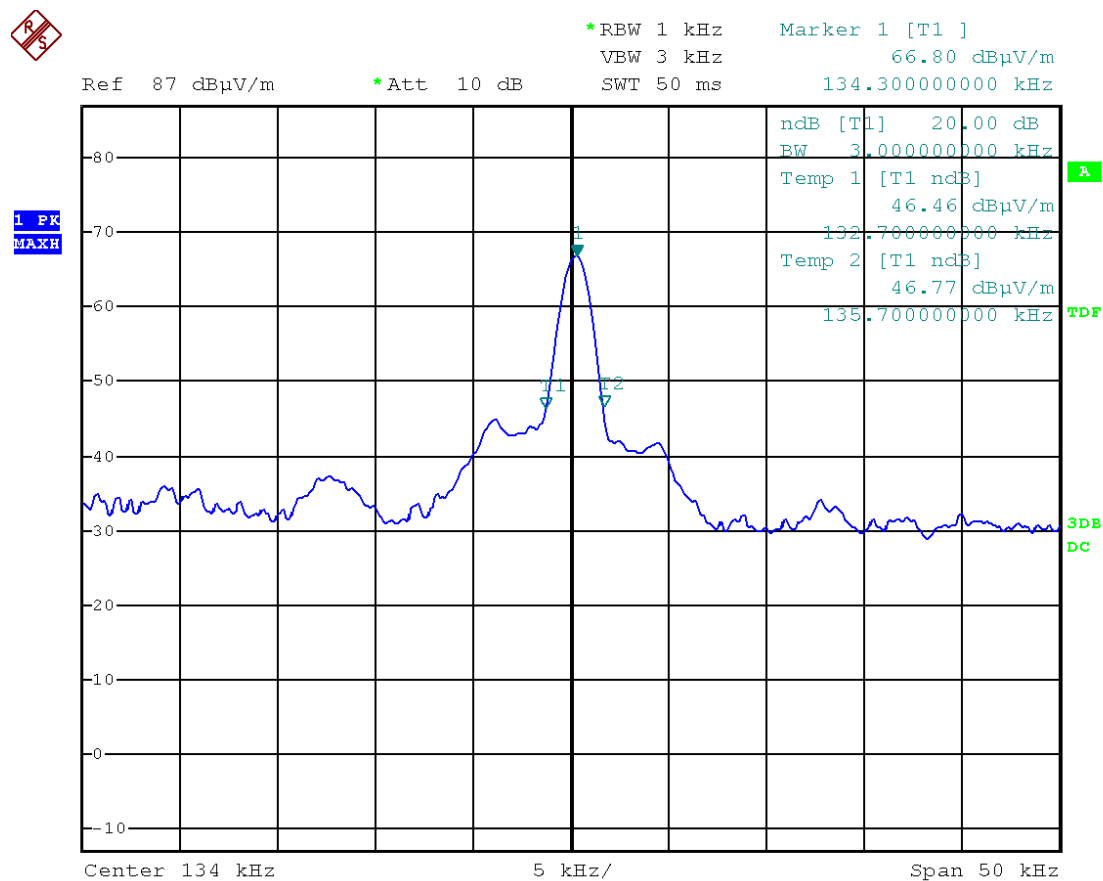
160617-AU02+W02

Page 30 of 34

-20 dB emission bandwidth

Test procedure

Where indicated, the -20 dB emission bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 20 dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth equal to approximately 1.0% of the emission bandwidth.



Picture 13: -20 dB emission bandwidth

Measured -20 dB emission bandwidth: 3.000 kHz

8 Equipment calibration status

Description	Modell number	Serial number	Inventory number(s)	Last calibration	Next calibration
Test receiver	ESCI 3	100013	E00001	2016-02	2018-02
Test receiver	ESCI 3	100328	E00552	2016-09	2018-09
Test receiver	ESCS 30	825442/0002	E00003	2016-04	2018-04
LISN	ESH2-Z5	893406/009	E00005	2016-02	2018-02
Loop antenna	HFH2-Z2	871398/0050	E00060	2016-09	2018-09
Broadband antenna	VULB 9160	9160-3050	E00011	2015-09	2017-09
Broadband antenna	VULB 9163	9163-114	E00013	2015-09	2017-09
Shielded room	P92007	B83117C1109T211	E00107	N/A	
Compact diagnostic chamber (CDC)	VK041.0174	D62128-A502-A69-2-0006	E00026	N/A	
Open area test site (OATS)	---	---	E00354	2015-10	2017-10
Climatic chamber 340 I	VC ³ 4034	58566123250010	C00015	2016-10	2018-10
Cable set shielded room	Cable no. 30	---	E00424	2016-07	2018-07
Cable set CDC	Cables no. 37 and 38	---	E00459 E00460	2015-05	2017-05
Cable set OATS 3 m	Cables no. 19, 34 and 36	---	E00453 E00456 E00458	2015-11	2017-11

Table 1: Equipment calibration status

- Note 1: Expiration date of measurement facility registration (OATS) by
 - FCC (registration number 221458): 2017-04
 - Industry Canada (test sites number 3472A-1 and 3472A-2): 2018-11
- Note 2: Expiration date of test firm accreditation for OATS and SAC:
 FCC test firm type "accredited": 2017-06



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

Elatec GmbH
 RFID Reader
 TWN4 MultiTech 2

160617-AU02+W02

Page 32 of 34

9 Measurement uncertainty

Description	Max. deviation	k=
Conducted emission AMN (9kHz to 30 MHz)	± 3.8 dB	2
Radiated emission open field (3 m) (30 MHz to 300 MHz) (300MHz to 1 GHz)	± 5.4 dB ± 5.9 dB	2
Radiated emission absorber chamber (> 1000 MHz)	± 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.



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 33 of 34

10 Revision History

Date	Description	Person	Revision
2017-01-17	First edition	M. Müller	0



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

Elatec GmbH
RFID Reader
TWN4 MultiTech 2

160617-AU02+W02

Page 34 of 34