

Test report

23-0147RP49-005-A

Product / EUT: *RFID reader with an external antenna*
Type designation: *ARE i2.0x SEMI*
Tested type: *ARE i2.0x SEMI*
EUT authorization: ☒ Certification
☐ Suppliers Declaration of Conformity

Production level: *n/a*
S/N: *000577*
FCC ID: *V7IAREI20XLF-S*
Manufacturer: *AEG Identifikationssysteme GmbH*
Hörvelsinger Weg 47
89081 Ulm / Germany

Test remit: 47 CFR Part 15 – Subpart C – Intentional radiators
in accordance with the procedures given in
ANSI C63.10-2013 and ANSI C63.4a-2017

The standards were: ☒ kept
☐ kept, for the limited scope of testing
☐ not kept

Remark: ☒ Validation covered by the accredited scope
☐ Validation not covered by the accredited scope
according: _____
☐ Validation of the EMC-requirements partly proceeded

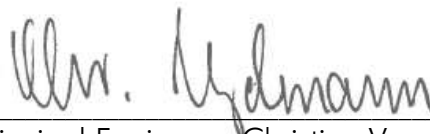


Applicant: AEG Identifikationssysteme GmbH
Hörvelsinger Weg 47
89081 Ulm / Germany

EUT-
Date of arrival: 10/23/2023
Test ID: 23-0147PR43-003
Date(s) of test: 10/26/2023 – 10/31/2023

Burgrieden, 02/06/2024

Released by:



Principal Engineer - Christian Vogelmann

Test laboratory: EMCE GmbH
Ingenieurbüro für EMV-Prüfungen und
Schaltungsentwicklung
Untere Wiesen 1 / 88483 Burgrieden / Germany

DAkS-Registration No.: D-PL-12122-01-00
CAB-Registration No.: BnetzA-CAB-02/21-01/4
FCC-Registration No.: 239304

Accredited by:

Bundesnetzagentur



Deutsche Akkreditierungsstelle GmbH





Responsible inspector: Mr. S. Vogelmann
EMCE GmbH
Ingenieurbüro für EMV-Prüfungen und Schaltungsentwicklung

Contact person: Mr. H. Leuthe / AEG Identifikationssysteme GmbH

EUT

Sampling: The device was selected and provided by the customer.

Description: *RFID Reader operating at 134.2 kHz*

Voltage supply: *120 V / 60 Hz*

Frequency list: *RFID 134.2 kHz*

Max. clock frequency: *84 MHz*

Temperature range: *n/a*

Dimension: *(LxWxH) / mm³ - 125 x 73 x 38*

**Supplied /
used equipment:**

Designation	Type	Manufacturer	S/N
<i>Antenna</i>	<i>AAN Xi9F - SEMI</i>	<i>AEG ID</i>	<i>n/a</i>
<i>DC Power Supply EUT</i>	<i>LIF120-10B12R2S-EX</i>	<i>RS Pro</i>	<i>220822- 727220855585000J</i>
<i>Laptop</i>	<i>W25CSW-W</i>	<i>Terra</i>	<i>NKW25CSWW004K00230</i>
<i>Power Supply Laptop</i>	<i>A12-065N2A</i>	<i>Chicony</i>	<i>F134091506009041</i>



Configuration: ☒ As-delivered condition
☐ Modified
* _____

Cable designation	Type	Length	Remarks
Interconnection cable	5-core + shielded	1.5 + 0.5 m	M12 connector
Antenna cable	3-core	2 m	
RS32 data cable	3-core + shielded	1.4 m	
USB to RS32	n/a	0.3 m	Ferrite WE 742 712 21 with 2 turns
EUT mains cord	3-core	1.8 m	
Laptop mains cord	3-core	1 m	



Pictures of the EUT with external antenna:







Remarks:

n/a

State of revision:

Source document	New Document	Date / Reviser	Modifications
23-0147RP49-005	23-0147RP49-005-A	2024-02-05 Chr. Vogelmann	File size reduced < 5.9 MByte. Information on radiated interference emissions by identifying environmental interference in the measured radio spectrum.

Test equipment list of EMCE GmbH:

Inv.-No.	Designation	Type	Manufacturer	S/N	Calibration: Interval /valid until
002	Passive probe	ESH2-Z3	Rohde & Schwarz		1 Year(s)/ 2023-12-23
003	LISN 1	ESH3-Z5	Rohde & Schwarz	835268/007	1 Year(s)/ 2024-01-31
004	LISN 2	ESH3-Z5	Rohde & Schwarz	835268/003	1 Year(s)/ 2024-02-28
006	LISN	NNBM 8125	Schwarzbeck	8125371	1 Year(s)/ 2024-03-31
007	Absorbing clamp	MDS 21	Schwarzbeck	942436	1 Year(s)/ 2024-02-28
008	Loop antenna 9kHz-30MHz	HFH2-Z2	Rohde & Schwarz	835776/0002	3 Year(s)/ 2026-02-28
014	OATS	Test site 3 m referred to ANSI C63.4a-2017	EMCE GmbH		3 Year(s)/ 2024-04-23
015	OATS	Test site 10 m referred to ANSI C63.4a-2017	EMCE GmbH		3 Year(s)/ 2024-04-26
042-2	AC-Source	EMV D 5000/PAS/SyCore	Spitzenberger & Spies	A274700 / 00501	3 Year(s)/ 2026-02-10
042-1	Analyser Reference System	ARS 16/3	Spitzenberger & Spies	A274707 / 00501	3 Year(s)/ 2024-12-28
043	Receiver	3DH/E Fieldmeter ESM-100	Maschek	971521	3 Year(s)/ 2026-09-11
058	Receiver	ESIB 40	Rohde & Schwarz	100200/ Firmware 4.35	1 Year(s)/ 2024-08-18
059	Log.-per. antenna	HL050	Rohde & Schwarz	100006	3 Year(s)/ 2025-10-21
062-2	Semi-Anechoic Chamber 13.5x6.1x5.5 m	30 - 1000 MHz referred to ANSI C63.4a-2017	EMC-Technik & Consulting GmbH		3 Year(s)/ 2024-01-31
062-1	Semi-Anechoic Chamber 13.5x6.1x5.5 m	1 - 18 GHz referred to CISPR16 1-4: 2010-04 Ed. 3	EMC-Technik & Consulting GmbH		3 Year(s)/ 2024-05-14
067	LISN	ESH2-Z5	Rohde & Schwarz	872460/043	1 Year(s)/ 2024-02-28
068	LISN	ESH2-Z5	Rohde & Schwarz	872460/042	1 Year(s)/ 2024-03-14

Inv.-No.	Designation	Type	Manufacturer	S/N	Calibration: Interval /valid until
070	Pulse limiter + 10 dB Attenuator	ESH3-Z2	Rohde & Schwarz	n/a	1 Year(s)/ 2024-08-31
073	Absorbing clamp	MDS21	Schwarzbeck	881757	1 Year(s)/ 2024-02-28
116	Vertical rod antenna	VAMP 9243	Schwarzbeck	9243-205	3 Year(s)/ 2026-05-19
117	LISN	ESH3-Z6	Rohde & Schwarz	100521	1 Year(s)/ 2024-03-31
174	LISN	ESH3-Z6	Rohde & Schwarz	101003	1 Year(s)/ 2024-03-31
178	V-LISN 5 μ H	NNHV 8123-400	Schwarzbeck	018	1 Year(s)/ 2024-02-28
184	V-LISN 5 μ H	NNHV8123-400	Schwarzbeck	019	1 Year(s)/ 2024-02-28
222	Broadband Preamplifier 0.5-18 GHz	BBV 9718	Schwarzbeck	9718-316	1 Year(s)/ 2024-07-31
223	Broadband Preamplifier 12-28 GHz	BBV 9719	Schwarzbeck	9719-024	1 Year(s)/ 2024-07-31
225	Electric and Magnetic Field Probe-Analyzer	EHP-200A	Narda S.T.S. / PMM	170WX70205	3 Year(s)/ 2025-07-22
226	HL050 Log.-Per. Antenna 850 MHz to 26.5 GHz	HL050 4062.4063.02	Rohde & Schwarz	100829	3 Year(s)/ 2026-07-27
229	Test receiver	ESS 5 Hz - 1000 MHz	Rohde & Schwarz	845420/0005	1 Year(s)/ 2024-01-25
230	FSV40 Signal Analyzer 40 GHz	FSV40	Rohde & Schwarz	101717	2 Year(s)/ 2024-02-23
233	OSP-B157W 8 PORT	OSP-B157W8	Rohde & Schwarz	100925	2 Year(s)/ 2024-02-25
236	Broad-Band Horn Antenna 0.5-6 GHz	BBHA 9120 E	Schwarzbeck	00831	5 Year(s)/ 2024-02-13
237	Exposure Level Tester	ELT-400	Narda Safety Test Solutions	O-0028	3 Year(s)/ 2026-03-03
239	Broadband Horn Antenna 15-40 GHz	BBHA 9170	Schwarzbeck	00932	5 Year(s)/ 2024-05-23
240	Broadband Preamplifier 18-40 GHz	BBV 9721	Schwarzbeck	54	1 Year(s)/ 2024-07-31
253	Broadband Preamplifier 20-1000 MHz	ESV-Z3	Rohde & Schwarz	881 909/030	1 Year(s)/ 2024-08-31

Inv.-No.	Designation	Type	Manufacturer	S/N	Calibration: Interval /valid until
257	Pulse limiter + 10 dB Attenuator	ESH3-Z2	Rohde & Schwarz	102769	1 Year(s)/ 2024-08-31
718	EMC-Software	BAT-EMC Vers. 3.18.0.19	Nexio	n/a	
997	EMC Software	EMC32 Vers. 10.60.20	Rohde & Schwarz	n/a	
1046	Environmental Simulation Chamber	MKF 115 (E3.1)	Binder GmbH	12-02215	3 Year(s)/ 2026-03-24
1212	EMC Software	WMS32 Vers. 10.60.20	Rohde & Schwarz	n/a	
1341	Multimeter	8845A	Fluke	5905001	3 Year(s)/ 2025-11-30
8004	Broadband Preamplifier 18-40 GHz	BLMA 1840-5G	BONN Elektronik GmbH	2113300	1 Year(s)/ 2024-07-31
8007	LPDA Broadband Antenna 180 - 1500 MHz	VULP 9118A	Schwarzbeck	899	3 Year(s)/ 2024-10-27
8008	LPDA Broadband Antenna 180 - 1500 MHz	VULP 9118A	Schwarzbeck	900	3 Year(s)/ 2024-10-27
8009	Field Monitoring Loop	FESP 5134-1	Schwarzbeck	00078	3 Year(s)/ 2024-12-20
8028	EMI Test Receiver	ESW26	Rohde & Schwarz	103119	1 Year(s)/ 2024-02-09
8033	Antenna 30-300 MHz	VHBB9124 / BBA9106	Schwarzbeck	1808	3 Year(s)/ 2026-04-21
8034	Antenna 30-300 MHz	VHBB9124 / BBA9106	Schwarzbeck	1812	3 Year(s)/ 2026-04-21
8039	Impedance Stabilisation Network	Pilot ISN	Schwarzbeck	82	1 Year(s)/ 2024-08-31



Scope:

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1 Test(s) according 47 CFR Part 15 Subpart C - 12/11/2023

1.1 Requirements and conformance test specifications

Standard

47 CFR Part 15 Subpart C

ANSI C63.10-2013

KDB n/a

-

Test mode application		
☒	Antenna requirement	§ 15.203
☒	Restricted bands of operation	§ 15.205 (a) (b) (c)
☒	Terminal voltage on powerline	§ 15.207 (a)
☒	Radiated emissions H-Field of intentional radiators	§ 15.209 (a) (b) (c) (d) (e) (f)
☒	Radiated emissions E-Field of intentional radiators	§ 15.209 (a) (b) (c) (d) (e) (f)



1.2 Antenna requirements

- ☒ No deviation from the standard
- ☐ Deviation from the standard
- ☐ Test not requested
- ☐ Test not carried out

* _____

Measurement procedure:
Rules and specification
Guide

47 CFR Part 15 Section 15.203
n/a

Requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficiently to comply with the provisions of this section.

Antenna:

- ☐ Print antenna
- ☐ Internal antenna
- ☒ External antenna
- ☒ Single Antenna
- ☐ MIMO
- ☐ Antenna array
- ☐ __-

Antenna connector:

- ☐ Permanent attached
- ☒ Unique coupling to the intentional radiator
- ☐ SMA
- ☒ M12
- ☐ UFL

Test result

Requirement: ☒ kept
☐ not kept

Remarks: n/a

1.3 Restricted bands of operation

- ☒ No deviation from the standard
☐ Deviation from the standard
☐ Test not requested
☐ Test not carried out

*

Requirement: 47 CFR Part 15 Section 15.205 (a)(b)(c)
 Guide n/a

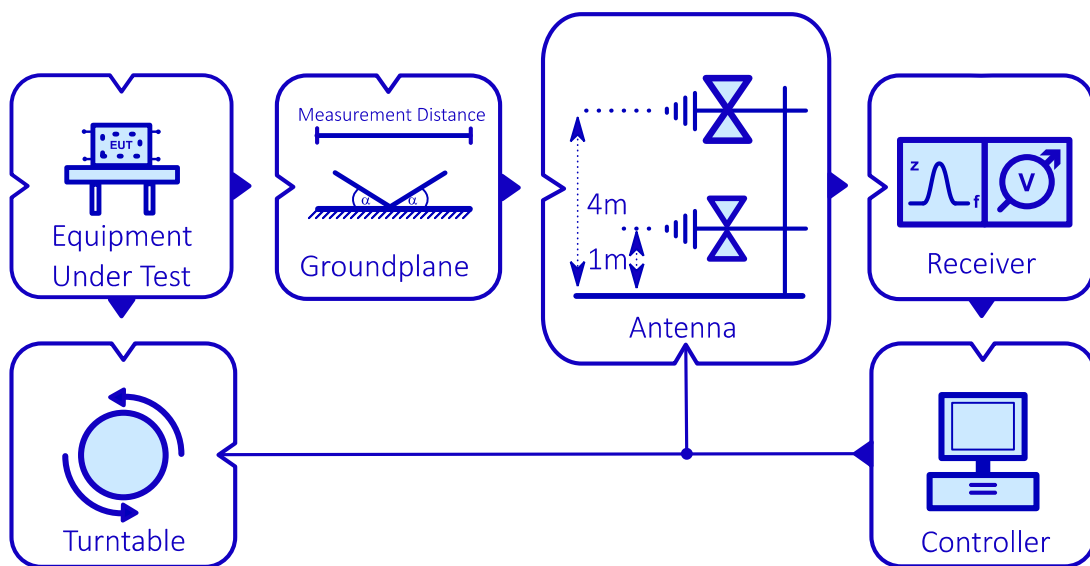
Restricted bands

f / MHz	f / MHz	f / MHz	f / GHz
0.090-0.110	12.57675-12.57725	322-335.4	4.500-5.150
0.495 – 0.505	13.36-13.41	399.9-410	5.350-5.460
2.1735-2.1905	16.42-16.423	608-614	7.250-7.750
4.125-4.128	16.69475-16.69525	960-1427	8.025-8.500
4.17725-4.17775	16.80425-16.80475	1435-1626.5	9.0-9.2
4.20725-4.20775	25.5-25.67	1645.5-1646.5	9.3-9.5
5.677-5.683	37.5-38.25	1660-1710	10.6-12.7
6.215-6.218	73-74.6	1718.8-1722.2	13.25-13.4
6.26775-6.26825	74.8-75.2	2200-2300	14.47-14.5
6.31175-6.31225	108-138	2310-2390	15.35-16.2
8.291-8.294	149.9-150.05	2483.5-2500	17.7-21.4
8.362-8.366	156.52475-156.52525	2655-2900	22.01-23.12
8.37625-8.38675	156.7-156.9	3260-3267	23.6-24.0
8.41425-8.41475	162.0125-167.17	3332-3339	31.2-31.8
12.29-12.293	167.72-173.2	3345.8-3358	36.43-36.5
12.51975-12.52025	240-285	3500-4400	above 38.6

Only spurious emissions are permitted in any of the frequency bands listed before. The field strength of emissions appearing within these frequency bands shall not exceed the radiated emission limits; general requirements. At frequencies equal to or less than 1000 MHz, compliance with the radiated emission limits; general requirements shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions.

Basic structure - Setup

OATS / SAC





1.3.1 Test set up

See test for radiated emissions of intentional radiators.

Test location

See test for radiated emissions of intentional radiators.

Used test equipment

See test for radiated emissions of intentional radiators.

1.3.2 Test

Used frequency band: ☒ 0.119 – 0.140 MHz
☐ _____ MHz

Nearest restricted band: ☒ 0.090 - 0.110 MHz

Limits for radiated emissions accepted in the restricted bands

Technical requirements			
Detector	Frequency / MHz	Limit / $\mu\text{V/m}$	Measurement distance / m
AV	0.009 – 0.09	2400/F(kHz)	300
QP	0.09 – 0.110	2400/F(kHz)	300
AV	0.110 – 0.49	2400/F(kHz)	300
QP	0.49 – 1.705	24000/F(kHz)	30
QP	1.705 – 30.0	30	30
Detector	Frequency / MHz	Limit / $\text{dB}\mu\text{V/m}$	Measurement distance / m
QP	30.0 – 88.0	40.0	3
QP	88.0 – 216.0	43.5	3
QP	216.0 – 960.0	46.0	3
QP	960.0 – 1000.0	54.0	3
AV	> 1000	54.0	3
PK	> 1000	74.0	3
The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.			



Test procedure

See test for radiated emissions of intentional radiators.

Test result

Used frequency range outside of restricted bands

☒ kept
☐ not kept

General emission limits for restricted frequency bands:

☒ kept
☐ not kept

See test for radiated emissions of intentional radiators.

Limits for next restricted frequency band:

☒ kept
☐ not kept

Remarks: n/a

1.4 Terminal voltage on powerline

- ☒ No deviation from the standard
- ☐ Deviation from the standard
- ☐ Test not requested
- ☐ Test not carried out

*

Measurement procedure:

Rules and specification
Guide

47 CFR Part 15 Section 15.207 (a)
ANSI C63.10-2013

The conducted disturbances are recorded in the frequency range from 150 kHz to 30 MHz. For this purpose line impedance stabilization networks (LISNs) are used which are inserted between the DUT and the mains supply. The output of one LISN is connected directly to a receiver according to CISPR 16 guidelines via a pulse limiter and 10 dB fixed attenuator. Not used ports of the LISN are terminated by 50 Ω . The Average- and Quasi-Peak-Detectors are provided to evaluate the spectrum. To speed up the measurement process, a pre-measurement is performed with the Peak- and Average-Detectors. The 10 frequencies with the smallest distance to the limit and priority with the highest exceeding are selected and re-measured. The Average and Quasi-Peak-Detectors are used for the final measurement. This measurement procedure is performed for each individual current conductor.

Depending on the limit lines, 6 final measurements are documented. The highest limit exceeding or, in case of compliance with the limit, the emissions found with the smallest distance to the limit are documented.

If less than six emission frequencies with a distance of 20 dB are below the limit value, the noise level of the measuring device at representative frequencies is indicated.

For the measurement, it may be necessary to terminate the antenna output to distinguish the interference level caused by the unintentional part from the intentional part (see ANSI C63.4 section 13.1.3.1).

The documented final test results are calculated using the following formula:

$$U(f) \text{ (dB}\mu\text{V)} = \text{Measured Value (dB}\mu\text{V)} + \text{ATF (dB)} + \text{CF (dB)}$$

$U(f) =$	Final result of the terminal voltage at the test frequency
Measured Value =	Reading of the uncorrected measured value
ATF =	Correction factor for the pulse limiter + 10 dB attenuator
CF =	Correction factor for the cable attenuation

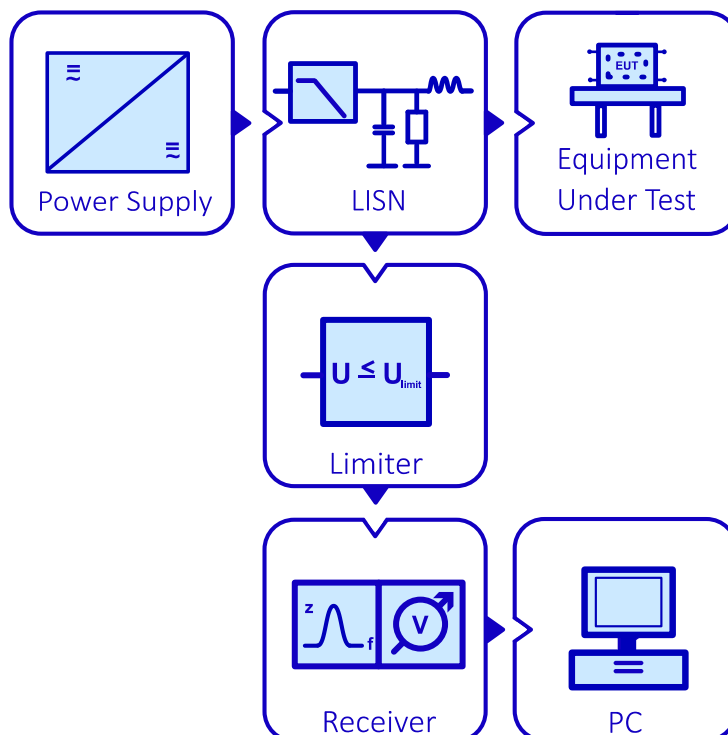
Example:

Test frequency	13.56 MHz
Reading	31.5 dB μ V
$AFT_{(13.56 \text{ MHz})}$	10.2 dB
$CF_{(13.56 \text{ MHz})}$	0.4 dB

Calculated final result for the terminal voltage $u(f)$:

$$U_{(13.56 \text{ MHz})} = 31.5 \text{ dB}\mu\text{V} + 10.2 \text{ dB} + 0.4 \text{ dB} = 42.1 \text{ dB}\mu\text{V}$$

Basic structure – Setup





1.4.1 Test set up

According ANSI C63.4-2014



Test location

☒	Inv.-No.	Designation	Type (L x W x H)	Manufacturer	Location
☒	588	Shielded room # 2	8.3/5.8 x 5.5/2.9 x 3.4 m	EMC-Technik & Consulting GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	1319	Shielded room #5	5.6 x 5.0 x 3.8 m	Albatross Projects GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden

Used test equipment

☒	Inv.-No.	Designation	Type	Manufacturer	S/N
	001	Test receiver	ESS 5 Hz – 1000 MHz	Rohde & Schwarz	833776/008
	003	LISN 1	ESH3-Z5	Rohde & Schwarz	835268/007
	004	LISN 2	ESH3-Z5	Rohde & Schwarz	835268/003
	005	LISN 3	NNB 4/32T	Rolf Heine HF-Technik	4/32T-96015
☒	042	AC-Source / Analyzer / Norm impedance	EMV D5000/PAS	Spitzenberger + Spies	A274700/ 0 0501
	058	Test receiver	ESIB 40	Rohde & Schwarz	100200
	067	LISN 5	ESH2-Z5	Rohde & Schwarz	0872460/043
☒	068	LISN 4	ESH2-Z5	Rohde & Schwarz	0872460/042
☒	070	Pulse limiter / 10 dB attenuator	ESH3-Z2	Rohde & Schwarz	357.8810.52
	229	Test receiver	ESS 5 Hz – 1000 MHz	Rohde & Schwarz	845420/0005
☒	230	FSV40 Signal Analyzer 40 GHz	FSV40	Rohde & Schwarz	101717
☒	997	Software	EMC32	Rohde & Schwarz	n/a

All used test equipment are checked resp. calibrated periodically.

☒ Test equipment was checked and complied to the requirements



Test-/Measurement uncertainty

The measurement uncertainty in the test met the guideline of CISPR16-4-2 or better.

Measurement uncertainty of the terminal voltage with an extended coverage factor of $k = 2$:

Frequency	Measurement uncertainty
9 kHz – 150 kHz	4.0 dB
150 kHz – 30 MHz	3.6 dB



1.4.2 Test

Requirement 47 CFR Part 15 Section 15.207 (a)

Frequency range: 150 kHz – 30 MHz

Limits for conducted emissions

Technical requirements			
Detector	Frequency / MHz	Limit QP-Detector / dBμV	Limit AV-Detector / dBμV
QP AV	0.15 – 0.5	66.0 – 56.0	56.0 – 46.0
QP AV	0.5 – 5.0	56.0	46.0
QP AV	5.0 – 30.0	60	50.0

Rationale for selecting the EUT test set up

Equipment units:

RFID reader with external antenna, an external power supply and a remote laptop to display the tag information.

Cabling:

- ☒ Standard cables
☐ Special cables provided by the manufacturer

Port #	Designation	Remarks
# 1	AC power line (EUT)	L1/N/PE
# 2	AC power line (AE)	L1/N/PE
# 3		



Operation mode

EUT arrangement: ☒ Tabletop ☐ Floor standing
Power supply: ☒ 120 V/60 Hz ☐ 240 V/60 Hz

Continuous reading of a transponder with the highest repetition rate for the reading process. The transponder was placed in the field at the maximum reading distance.

Environmental conditions

Temperature [10 – 40 °C]: 24.7 °C
Relative humidity [10 – 90 %]: 36 %
Environmental conditions during the test: ☒ kept ☐ not kept

Test result

Limits for conducted powerline emissions: ☒ kept ☐ not kept

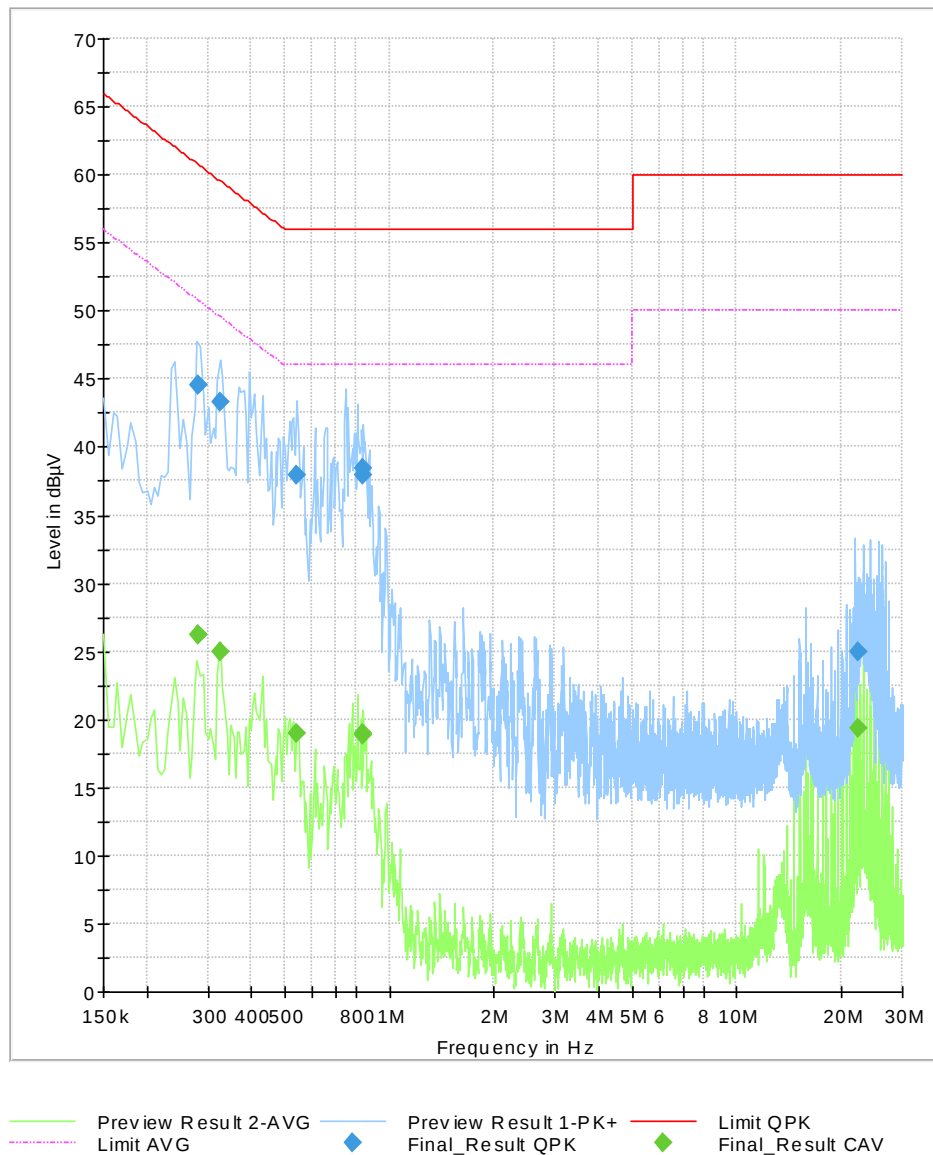
Remarks: n/a

Protocol scope

- ☒ Readings – emissions for EUT
- ☒ Diagrams - emissions for EUT
- ☒ Readings - emissions for AE
- ☒ Diagrams - emissions for AE

EUT Information

EUT Name:	RFID Reader ARE i2.0x SEMI
Test_ID: / SN:	23-0147PR43-003 / 000577
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Test mode, max. perm. customer reading speed
Test specification:	47 CFR Part 15 Subpart C Terminal voltage
LISN port	N (EUT)
Operator:	S. Vogelmann
File #:	23-0147RC44-003-015
Comment #1:	
Comment #2:	



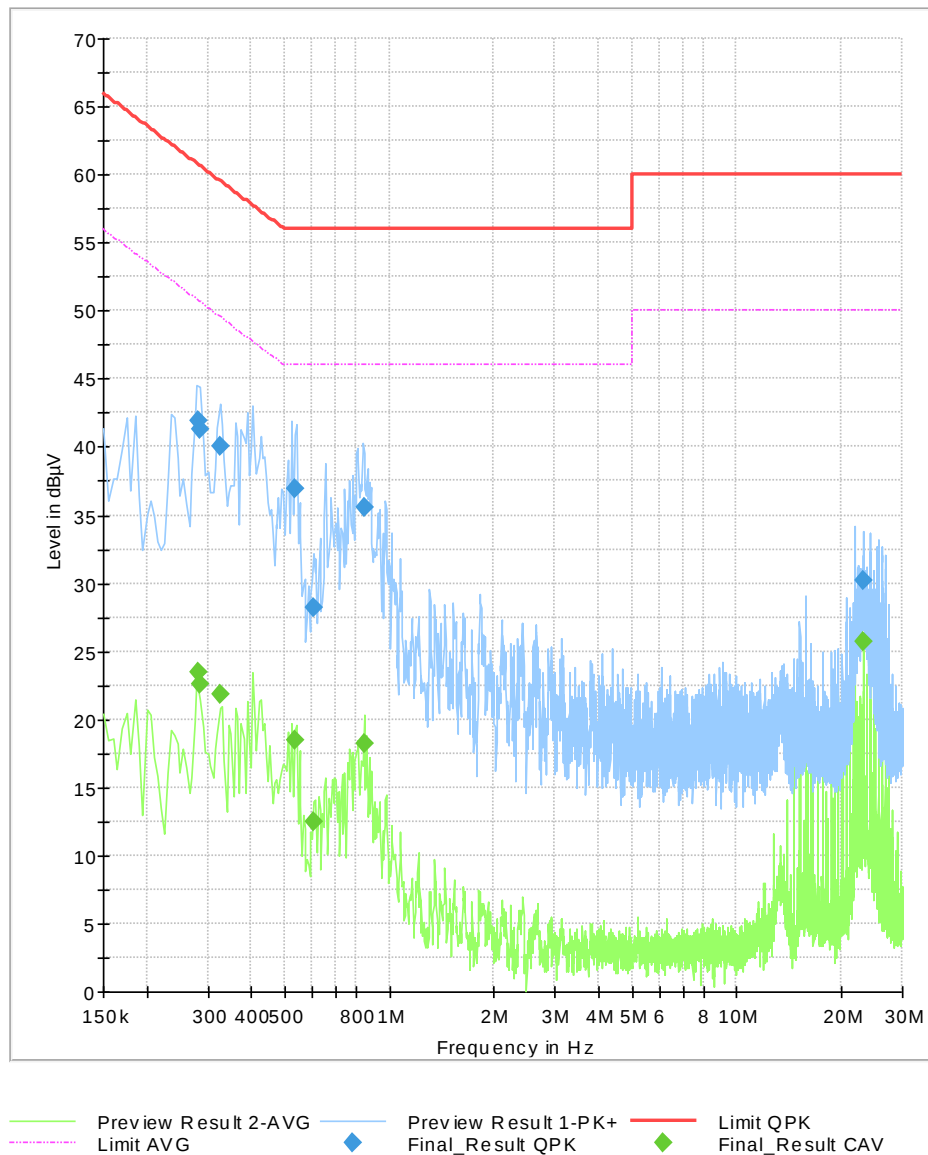


Final Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.281000	---	26.16	50.79	24.63	15000.0	9.000	N	10.1
0.281000	44.50	---	60.79	16.29	15000.0	9.000	N	10.1
0.282000	---	26.17	50.76	24.59	15000.0	9.000	N	10.1
0.282000	44.57	---	60.76	16.19	15000.0	9.000	N	10.1
0.327000	43.29	---	59.53	16.23	15000.0	9.000	N	10.1
0.327000	---	24.92	49.53	24.60	15000.0	9.000	N	10.1
0.538000	37.93	---	56.00	18.07	15000.0	9.000	N	10.1
0.538000	---	18.91	46.00	27.09	15000.0	9.000	N	10.1
0.838000	37.94	---	56.00	18.06	15000.0	9.000	N	10.1
0.838000	---	18.83	46.00	27.17	15000.0	9.000	N	10.1
0.842000	38.45	---	56.00	17.55	15000.0	9.000	N	10.1
0.842000	---	18.95	46.00	27.05	15000.0	9.000	N	10.1
22.472000	24.90	---	60.00	35.10	15000.0	9.000	N	11.0
22.472000	---	19.39	50.00	30.61	15000.0	9.000	N	11.0

EUT Information

EUT Name:	RFID Reader ARE i2.0x SEMI
Test_ID: / SN:	23-0147PR43-003 / 000577
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Test mode, max. perm. customer reading speed
Test specification:	47 CFR Part 15 Subpart C Terminal voltage
LISN port	L1 (EUT)
Operator:	S. Vogelmann
File #:	23-0147RC44-003-016
Comment #1:	
Comment #2:	

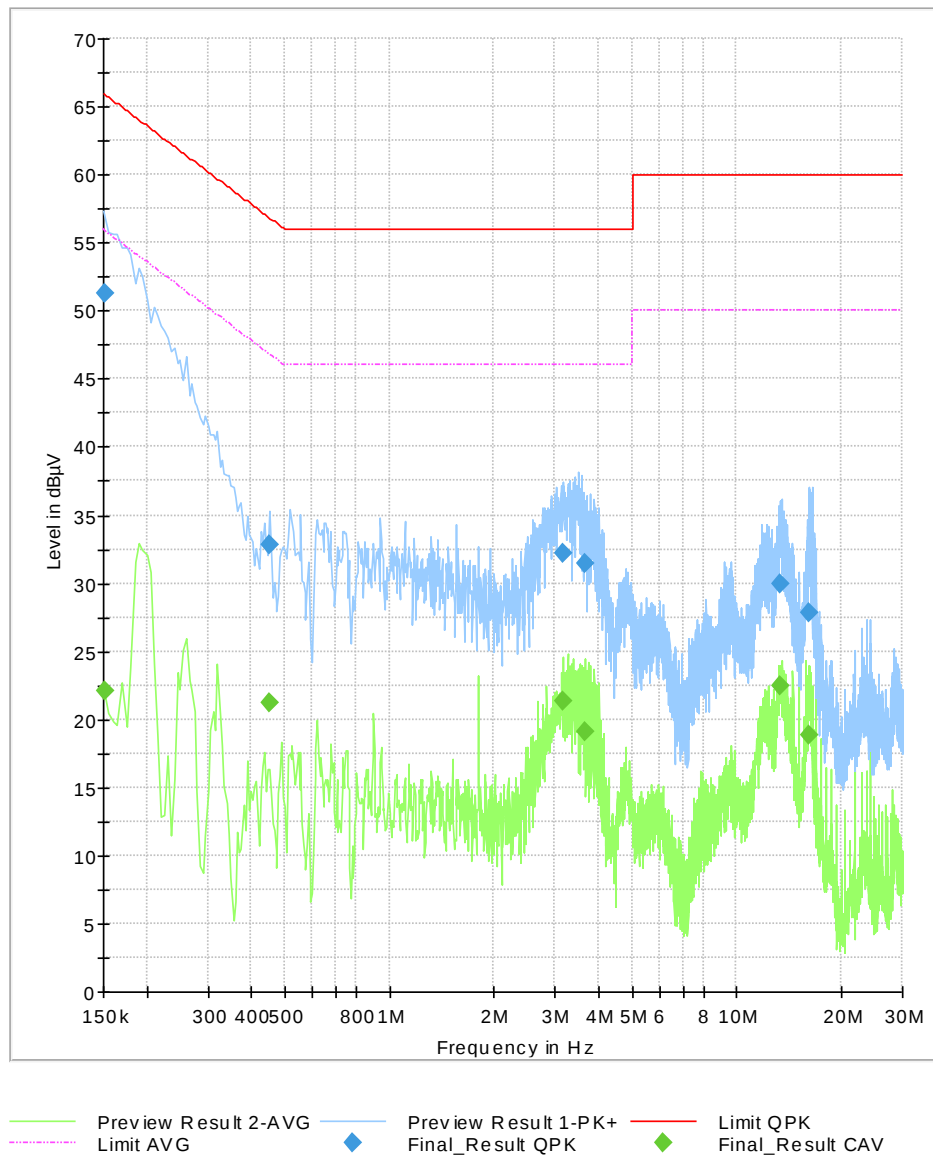


Final Result

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.281000	41.88	---	60.79	18.91	15000.0	9.000	L1	10.1
0.281000	---	23.51	50.79	27.28	15000.0	9.000	L1	10.1
0.285000	41.25	---	60.67	19.41	15000.0	9.000	L1	10.1
0.285000	---	22.60	50.67	28.07	15000.0	9.000	L1	10.1
0.325000	40.11	---	59.58	19.47	15000.0	9.000	L1	10.1
0.325000	---	21.82	49.58	27.76	15000.0	9.000	L1	10.1
0.537000	36.90	---	56.00	19.10	15000.0	9.000	L1	10.1
0.537000	---	18.41	46.00	27.59	15000.0	9.000	L1	10.1
0.605000	28.26	---	56.00	27.74	15000.0	9.000	L1	10.1
0.605000	---	12.54	46.00	33.46	15000.0	9.000	L1	10.1
0.847000	35.61	---	56.00	20.39	15000.0	9.000	L1	10.1
0.847000	---	18.20	46.00	27.80	15000.0	9.000	L1	10.1
23.087000	30.23	---	60.00	29.77	15000.0	9.000	L1	11.1
23.087000	---	25.70	50.00	24.30	15000.0	9.000	L1	11.1

EUT Information

EUT Name:	RFID Reader ARE i2.0x SEMI
Test_ID: / SN:	23-0147PR43-003 / 000577
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Test mode, max. perm. customer reading speed
Test specification:	47 CFR Part 15 Subpart C Terminal voltage
LISN port	N (AE)
Operator:	S. Vogelmann
File #:	23-0147RC44-003-011
Comment #1:	
Comment #2:	



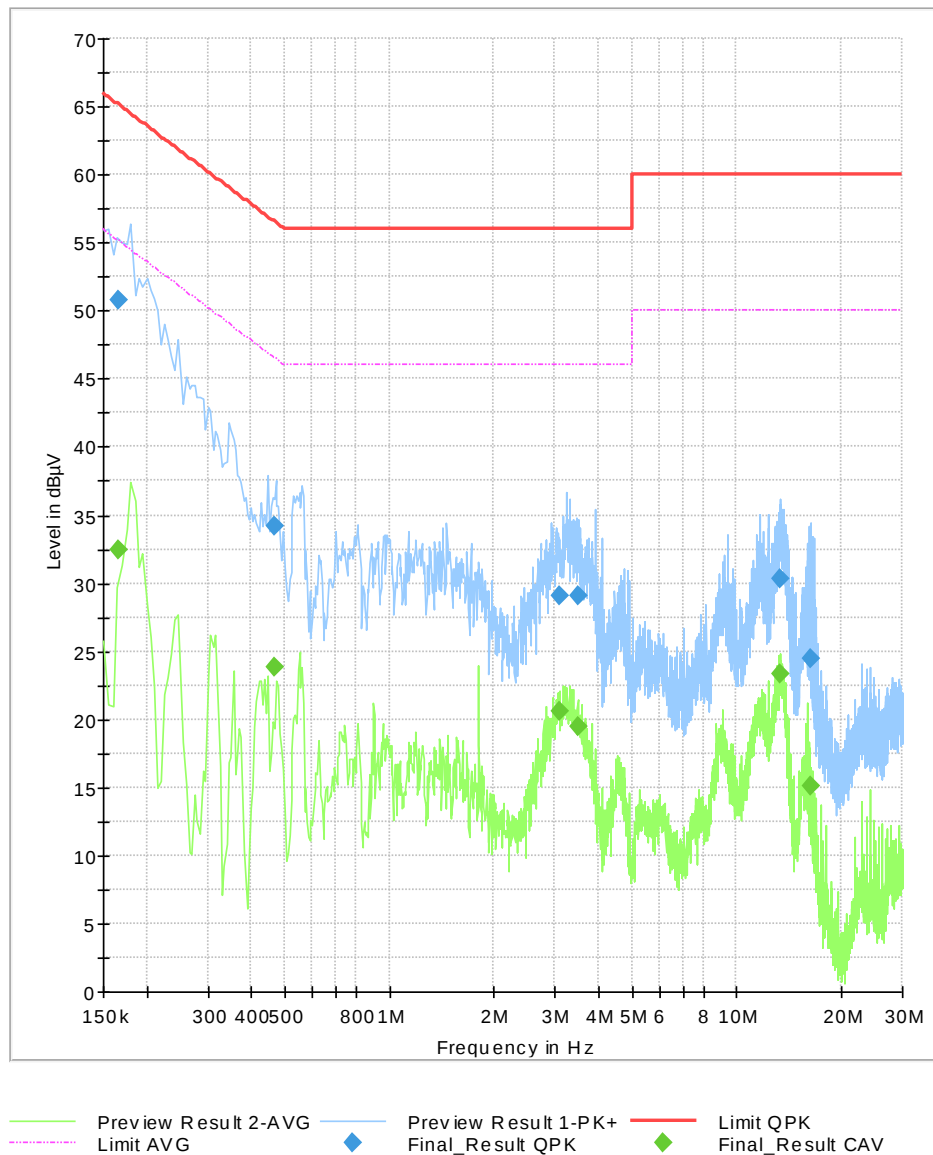


Final Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.152000	51.29	---	65.89	14.60	15000.0	9.000	N	10.0
0.152000	---	22.05	55.89	33.84	15000.0	9.000	N	10.0
0.453000	32.87	---	56.82	23.95	15000.0	9.000	N	10.1
0.453000	---	21.15	46.82	25.67	15000.0	9.000	N	10.1
3.178000	32.24	---	56.00	23.76	15000.0	9.000	N	10.2
3.178000	---	21.37	46.00	24.63	15000.0	9.000	N	10.2
3.669000	31.45	---	56.00	24.55	15000.0	9.000	N	10.2
3.669000	---	19.14	46.00	26.86	15000.0	9.000	N	10.2
13.383000	29.91	---	60.00	30.09	15000.0	9.000	N	10.7
13.383000	---	22.43	50.00	27.57	15000.0	9.000	N	10.7
16.205000	27.86	---	60.00	32.14	15000.0	9.000	N	10.7
16.205000	---	18.90	50.00	31.10	15000.0	9.000	N	10.7

EUT Information

EUT Name:	RFID Reader ARE i2.0x SEMI
Test_ID: / SN:	23-0147PR43-003 / 000577
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Test mode, max. perm. customer reading speed
Test specification:	47 CFR Part 15 Subpart C Terminal voltage
LISN port	L1 (AE)
Operator:	S. Vogelmann
File #:	23-0147RC44-003-012
Comment #1:	
Comment #2:	





Final Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.166000	---	32.44	55.16	22.72	15000.0	9.000	L1	10.0
0.166000	50.77	---	65.16	14.39	15000.0	9.000	L1	10.0
0.468000	---	23.82	46.55	22.73	15000.0	9.000	L1	10.1
0.468000	34.23	---	56.55	22.32	15000.0	9.000	L1	10.1
3.093000	---	20.59	46.00	25.41	15000.0	9.000	L1	10.2
3.093000	29.10	---	56.00	26.90	15000.0	9.000	L1	10.2
3.485000	---	19.46	46.00	26.54	15000.0	9.000	L1	10.2
3.485000	29.06	---	56.00	26.94	15000.0	9.000	L1	10.2
13.300000	---	23.30	50.00	26.70	15000.0	9.000	L1	10.7
13.300000	30.34	---	60.00	29.66	15000.0	9.000	L1	10.7
16.251000	---	15.08	50.00	34.92	15000.0	9.000	L1	10.8
16.251000	24.46	---	60.00	35.54	15000.0	9.000	L1	10.8

1.5 Radiated emissions of intentional radiators

1.5.1 Radiated emissions H-Field of intentional radiators

- ☒ No deviation from the standard
☐ Deviation from the standard
☐ Test not requested
☐ Test not carried out

*

Measurement procedure:

Rules and specification

47 CFR Part 15 Section 15.209 (a)(b)(c)(d)(e)(f)

Guide

ANSI C63.10-2013

The radiated magnetic fields are measured in a frequency range from 9 kHz to 30 MHz. For this purpose, a shielded active loop antenna is used, which is directly connected to a receiver according to CISPR 16 specifications. For the measurement, the loop antenna is successively aligned once parallel to the DUT and once perpendicular to the DUT. The center of the loop antenna is 1 m above the ground. This setup is also used to determine the spectrum of intentional radiators.

The test is performed at a distance of 3 m between the antenna and the EUT in the frequency range up to 30 MHz. A Quasi-Peak or Average-Detector is used, depending on the frequency range. The Average-Detector is used in the frequency bands 9-90 kHz and 110-490 kHz, otherwise the quasi-peak is determined. For pulse modulated devices with a pulse repetition frequency of 20 Hz or less, the Peak-Detector is used (§15.35a Note).

To speed up the measurement process, a pre-measurement is performed with the Peak- and Average-Detectors. The spectrum is determined by rotating the EUT by 360° and the antenna orientation changed accordingly. The maxhold function is used. Hand-held or body-worn devices are rotated through three orthogonal axes to determine maximum emanation. Also the placement and layout of the equipment and the cables are arranged to maximize the disturbance level.

For the re-measurement, the 10 frequencies with the highest exceedance or the smallest distance to the limit are selected. The Average and Quasi-Peak-Detectors are used for the final measurement. Depending on the limit lines, 6 final measurements are documented. The highest limit exceeding or, in case of compliance with the limit, the emissions found with the smallest distance to the limit are documented.

If less than six emission frequencies with a distance of 20 dB are below the limit value, the noise level of the measuring device at representative frequencies is indicated.



The final measurement is performed at a test distance of 3 m. In case the regulation requires testing at different distances, the result is extrapolated by an extrapolation factor 40 dB / decade to the required distance. Frequency, the measured value, antenna information and the limit will be printed out.

The reported test results are calculated using the following formula to normalize the results for the requested test distance:

$$\text{Field strength (dB}\mu\text{V/m)} = \text{Reading (dB}\mu\text{V)} + \text{AF (dB/m)} + \text{CF (dB)} + 40 \cdot (\text{D}_\text{T}/\text{D}_\text{R}) \text{ (dB)}$$

- AF = Correction factor for the antenna
- CF = Correction factor for the cable loss
- DT = Test distance
- DR = Reference distance for the limit defined in the standard

Relation E- / H-Field in the far field

$$E_{\text{dB}\mu\text{V/m}} = H_{\text{dB}\mu\text{A/m}} + 51.5 \text{ dB}\Omega$$

Example:

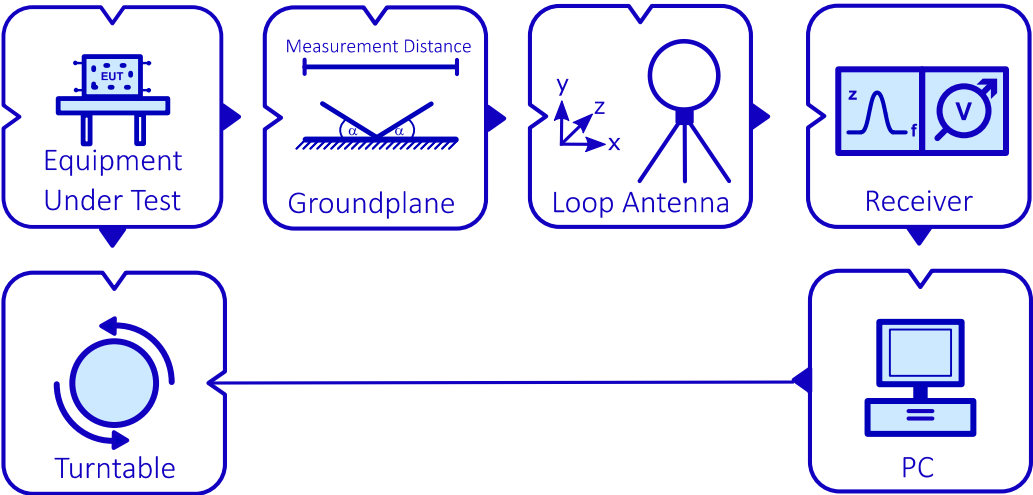
Test frequency	135 kHz
Reading	70.5 dB μ V
AF _(135 kHz)	19.3 dB/m
CF _(135 kHz)	0.5 dB
DT =	3 m
DR =	300 m

Calculated final result for the electrical field strength E(f):

$$E_{(135 \text{ kHz})} = 70.5 \text{ dB}\mu\text{V} + 19.3 \text{ dB/m} + 0.5 \text{ dB} - 80.0 \text{ dB} = 10.3 \text{ dB}\mu\text{V/m}$$

Basic structure - Setup

OATS / SAC





1.5.1.1 Test set up

According ANSI C63.10-2013

Test setup 10 m – Antenna orientation – vertical / parallel





Test setup – EUT X-Direction



Pre-compliance test setup
Test setup 3 m – Antenna orientation vertical / parallel





Test location

Pre-compliance test					
☒	Inv.-No.	Designation	Type (L x W x H)	Manufacturer	Location
☒	062	Semi anechoic chamber # 2	13.5 x 6.1 x 5.5 m	EMC-Technik & Consulting GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden

Final test					
☒	Inv.-No.	Designation	Type (L x W x H)	Manufacturer	Location
	062	Semi anechoic chamber # 2	13.5 x 6.1 x 5.5 m	EMC-Technik & Consulting GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	014	Open area test site	10 m	EMCE GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	015	Open area test site	3 m	EMCE GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
☒	1345	Open area test site	3 / 10 / 30 m	EMCE GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden

Used test equipment

Pre-compliance test					
☒	Inv.-No.	Designation	Type	Manufacturer	S/N
☒	008	Antenna 9 kHz – 30 MHz	HFH2-Z2	Rohde & Schwarz	835776/0002
☒	042	AC-Source / Analyzer / Norm impedance	EMV D5000/PAS	Spitzenberger + Spies	A274700/ 0 0501
☒	058	Test receiver	ESIB 40	Rohde & Schwarz	100200
☒	997	Software	EMC32	Rohde & Schwarz	n/a

Final test					
☒	Inv.-No.	Designation	Type	Manufacturer	S/N
☒	008	Antenna 9 kHz – 30 MHz	HFH2-Z2	Rohde & Schwarz	835776/0002
☒	042	AC-Source / Analyzer / Norm impedance	EMV D5000/PAS	Spitzenberger + Spies	A274700/ 0 0501
	058	Test receiver	ESIB 40	Rohde & Schwarz	100200
☒	229	Test receiver	ESS 5 Hz – 1000 MHz	Rohde & Schwarz	845420/0005
	997	Software	EMC32	Rohde & Schwarz	n/a

All used test equipment are checked resp. calibrated periodically.

☒ Test equipment was checked and complied to the requirements

Test-/Measurement uncertainty

The measurement uncertainty in the test met the guideline of CISPR16-4-2 or better.

Measurement uncertainty of the radiated emission with an extended coverage factor of $k = 2$:

Frequency
9 kHz – 30 MHz

Measurement uncertainty
on request



1.5.1.2 Test

Rules and specification 47 CFR Part 15 Section 15.209 (a)(b)(c)(d)(e)(f)

Frequency range: 9 kHz – 30 MHz

Limits for radiated emissions

Technical requirements			
Detector	Frequency / MHz	Limit / $\mu\text{V/m}$	Measurement distance / m
AV	0.009 – 0.09	2400/F(kHz)	300
QP	0.09 – 0.110	2400/F(kHz)	300
AV	0.110 – 0.49	2400/F(kHz)	300
QP	0.49 – 1.705	24000/F(kHz)	30
QP	1.705 – 30.0	30	30
For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz			

Antenna Orientation

☒ Parallel to EUT ☒ Orthogonal to EUT

Antenna Height

☒ 1 m - Loop center above ground

Antenna Distance - EUT

☐ 3 m ☒ 10 m ☐ 30 m

EUT Orientation to Antenna

☒ X-Axis ☒ Y-Axis ☒ Z-Axis



Rationale for selecting the EUT test set up

Equipment units:

RFID reader with external antenna, an external power supply and a remote laptop to display the tag information.

Operation mode

EUT arrangement: ☒ Tabletop ☐ Floor standing
Power supply: ☒ 120 V/60 Hz ☐ Internal battery

Continuous reading of a transponder with the highest repetition rate for the reading process. The transponder was placed in the field at the maximum reading distance.

Environmental conditions

Temperature [10 – 40 °C]: 17 °C
Relative humidity [10 – 90 %]: 45 %

Environmental conditions during the test: ☒ kept ☐ not kept

Test result

Radiated emission limits; general requirements: ☒ kept ☐ not kept

| Remarks: n/a

Records

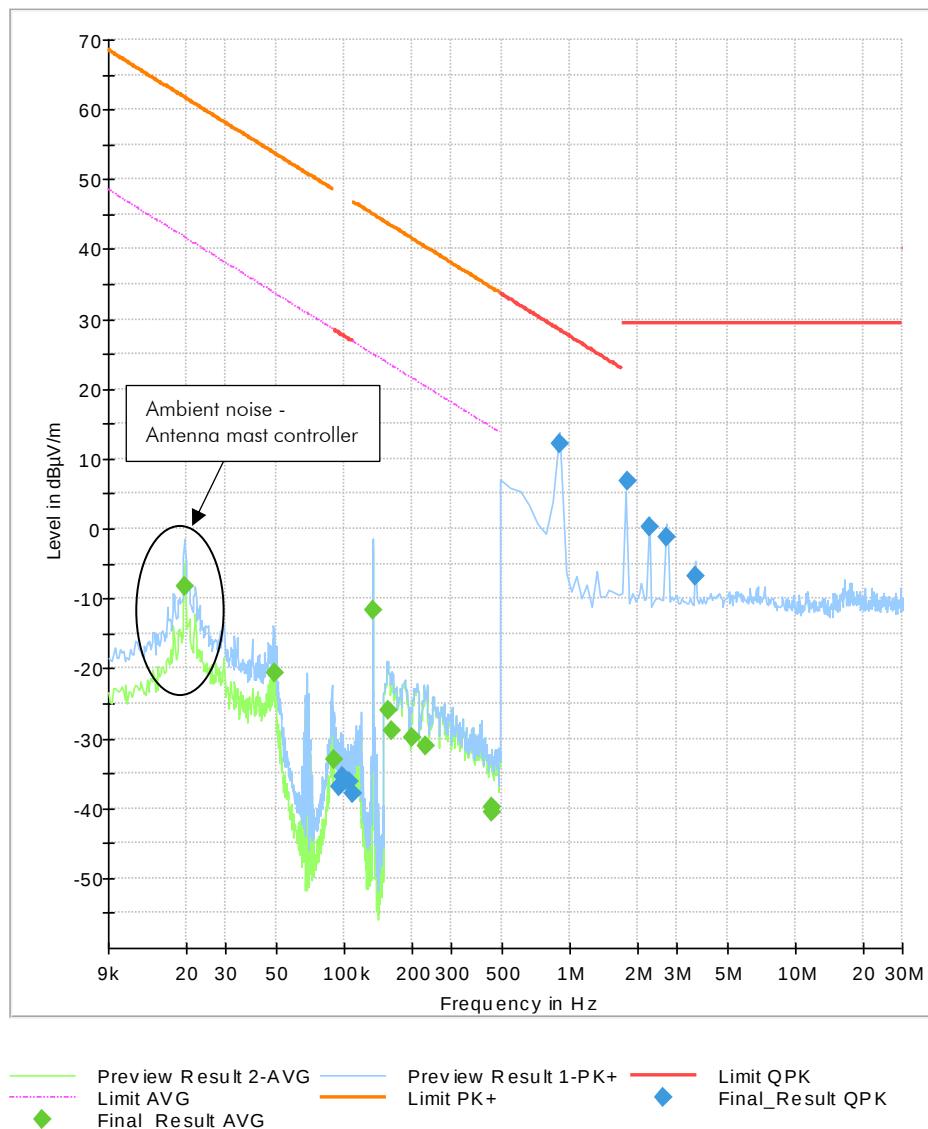
Pre-compliance measurement
☒ Readings
☒ Diagram

Final measurement
☒ Readings
☒ Diagram

Pre-compliance measurement

EUT Information

EUT Name:	RFID Reader ARE i2.0x SEMI
Test_ID: / SN:	23-0147PR43-003
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Reading mode
Test specification:	47 CFR Part 15 Subpart C §15.209 SAC@3 m
Antenna information:	Distance EUT-Ant.: 3.0 m / Orientation: Orthogonal/Parallel / Ant.Height: 1.0 m.
Operator:	S. Vogelmann
File #:	23-0147RC45-003-043
Comment #1:	
Comment #2:	



Pre-Test_Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	RBW (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
0.019681	---	-8.20	41.72	49.93	5000.0	0.200	Orthogonal	-5.0	-59.8
0.048862	---	-20.72	33.83	54.55	5000.0	0.200	Orthogonal	160.0	-59.9
0.090000	---	-32.92	28.52	61.44	5000.0	0.200	Orthogonal	85.0	-60.0
0.095469	-36.93	---	28.01	64.94	5000.0	0.200	Orthogonal	4.0	-60.0
0.098439	-35.42	---	27.74	63.17	5000.0	0.200	Orthogonal	296.0	-60.0
0.106335	-36.17	---	27.07	63.24	5000.0	0.200	Orthogonal	143.0	-60.0
0.109896	-37.86	---	26.79	64.65	5000.0	0.200	Orthogonal	5.0	-60.0
0.134227	---	-11.63	25.05	36.68	5000.0	0.200	Parallel	35.0	-60.0
0.157112	---	-26.09	23.68	49.77	5000.0	9.000	Orthogonal	265.0	-60.0
0.163928	---	-28.91	23.31	52.23	5000.0	9.000	Orthogonal	165.0	-60.0
0.200922	---	-29.99	21.55	51.54	5000.0	9.000	Orthogonal	126.0	-60.0
0.229660	---	-31.11	20.38	51.49	5000.0	9.000	Orthogonal	352.0	-60.0
0.452104	---	-39.82	14.50	54.32	5000.0	9.000	Orthogonal	9.0	-60.1
0.452739	---	-40.60	14.49	55.08	5000.0	9.000	Orthogonal	178.0	-60.1
0.906673	12.15	---	28.46	16.30	5000.0	9.000	Orthogonal	284.0	-20.1
1.808176	6.79	---	29.54	22.75	5000.0	9.000	Orthogonal	286.0	-20.1
2.266453	0.20	---	29.54	29.34	5000.0	9.000	Parallel	6.0	-20.1
2.715090	-1.27	---	29.54	30.81	5000.0	9.000	Orthogonal	290.0	-20.1
3.619018	-6.77	---	29.54	36.31	5000.0	9.000	Orthogonal	291.0	-20.1

∞ Ambient noise caused by antenna mast controller.

Final result

Frequency	Field strength	Limit _{10m}	Margin	Antenna		Detector	Receiver	Supply voltage	Remarks
				Distance	Orientation				
MHz	dBμV/m	dBμV/m	dB	m	H/V	Peak / QP / AV	6dB BW		
0.13423	48.4	84.1	55.7	10.0	Parallel	AV	0.2	7.2VDC	
	57.8	104.1	66.3			PK			
0.909	48.9	87.5	38.6	10.0	Orthogonal	QP	9.0	7.2VDC	
	-	-	-			-			
1.808	31.7	90.8	59.1	10.0	Orthogonal	QP	9.0	7.2VDC	
	-	-	-			-			
2.267	<30	90.8	≥60.8	10.0	Parallel	QP	9.0	7.2VDC	
	-	-	-			-			
2.716	<30	90.8	≥60.8	10.0	Orthogonal	QP	9.0	7.2VDC	
	-	-	-			-			
3.621	<30	90.8	≥60.8	10.0	Orthogonal	QP	9.0	7.2VDC	
	-	-	-			-			

Limit_{10m} Limit calculated for 10m test distance

1.5.2 Radiated emissions E-Field of intentional radiators

- ☒ No deviation from the standard
☐ Deviation from the standard
☐ Test not requested
☐ Test not carried out

*

Measurement procedure:

Rules and specification
Guide

47 CFR Part 15 Section 15.209 (a)(b)(c)(d)(e)(f)
ANSI C63.10-2013

The radiated interference emission is measured on an alternative open area test site OATS in the frequency range 30 - 1000 MHz. The measurement distance is 3 m or 10 m, depending on the standard. Above 1 GHz, the measurement is performed in a 3 m semi-anechoic chamber with floor absorber to reduce ground reflections. For the measurement of the field strength a biconical antenna up to 200 MHz, a logperiodic antenna from 200 MHz to 1 GHz and horn antennas or double stacked logperiodic antenna above 1 GHz are used. All antennas are linearly polarized. External low-noise preamplifiers are used in the range above 1 GHz to improve measurement sensitivity. Special measures, such as filters or attenuators, are taken to avoid overloading the amplifiers. The antenna height is varied between 1 m and 4 m as required. The elevation angle of the antenna can be corrected via the antenna mast to ensure that the main lobe of the antenna is always directed at the EUT. A turntable allows the alignment of the EUT towards the antenna to maximize the radiated emission. The test sites are located above a metallic ground plane. Table-top devices are placed on a non-conductive wooden table. Hand-held, body-worn, or ceiling-mounted devices are examined in 3 orthogonal axis orientations to determine the maximum emission level. Floor-standing devices are placed directly on the grounded metal turntable/reference insulated from ground plane by an insulating material <12 mm.

During an initial automated pre-test run in a semi-anechoic chamber, the desired frequency range is measured. The receiver is operated as an analyzer and the frequency ranges are run sequentially depending on the antenna. For the measurement, the turntable is continuously rotated from 0° - 360° and back, and the antenna height is changed in 0.5 m increments after each complete turntable cycle. The antenna position is then changed from 1.0 m to 4.0 m in 0.5 m steps for vertical polarization and back for horizontal polarization. During a cycle, the frequency range is continuously swept with peak detector and max hold function. Depending on the test specification, an average detector is also used if required. For each discrete antenna polarization over all positions, the maximum peak values are recorded with frequency, level, turntable position, antenna height and antenna



polarization. Significant peaks or clock frequencies are marked and re-measured with increased frequency accuracy. The recordings are used to determine the exact frequency and to optimize the interference level. At the predefined position, the turntable position is fine-adjusted in the range of $\pm 20^\circ$ and then the antenna height is varied by ± 0.3 m. At the maximized position, the emission is measured with quasi-peak or average detector and listed. The six highest emissions are selected for final measurement in the OATS.

In a final test run, an open area test site measurement is made at selected frequencies determined by the previous test procedure. For each selected frequency, the frequency setting is optimized again in the OATS and the field strength value is maximized, rotating the EUT 360° at an antenna height of 1.0 m for vertical antenna polarization and 2.0 m for horizontal antenna polarization. At the azimuth position of the EUT for the highest radiation, the antenna height is varied within 1.0 m and 4.0 m until the highest interference level is reached. To maximize the interference level at the determined position, the turntable azimuth is fine-adjusted by $\pm 45^\circ$ and the antenna height is fine-adjusted by ± 0.3 m. The setup of the instrument and the cables are manipulated within the range to produce the highest emission.

Final measurement is made using a receiver conforming to CISPR 16 guidelines with a quasi-peak and average detector.

The identified frequency and amplitude of the six highest radiated emissions relative to the limit lines are listed. If fewer than six emission frequencies are within 20 dB of the limit, the noise level of the instrument at representative frequencies is reported. For documentation of final testing below 1 GHz on the OATS the plots recorded in den SAC are indicated as pre-compliance.

In case the regulation requires testing at different distances, the result is extrapolated by an extrapolation factor 20 dB / decade to the required distance.

The reported test results are calculated using the following formula to normalize the results to the requested test distance:

$$\text{Result (dB}\mu\text{V/m)} = \text{Reading (dB}\mu\text{V)} + \text{AF (dB/m)} + \text{CF (dB)} + 20 \cdot (D_T/D_R) \text{ (dB)}$$

AF = Correction factor for the antenna

CF = Correction factor for the cable loss

D_T = Test distance

D_R = Reference distance for the limit defined in the standard



Example:

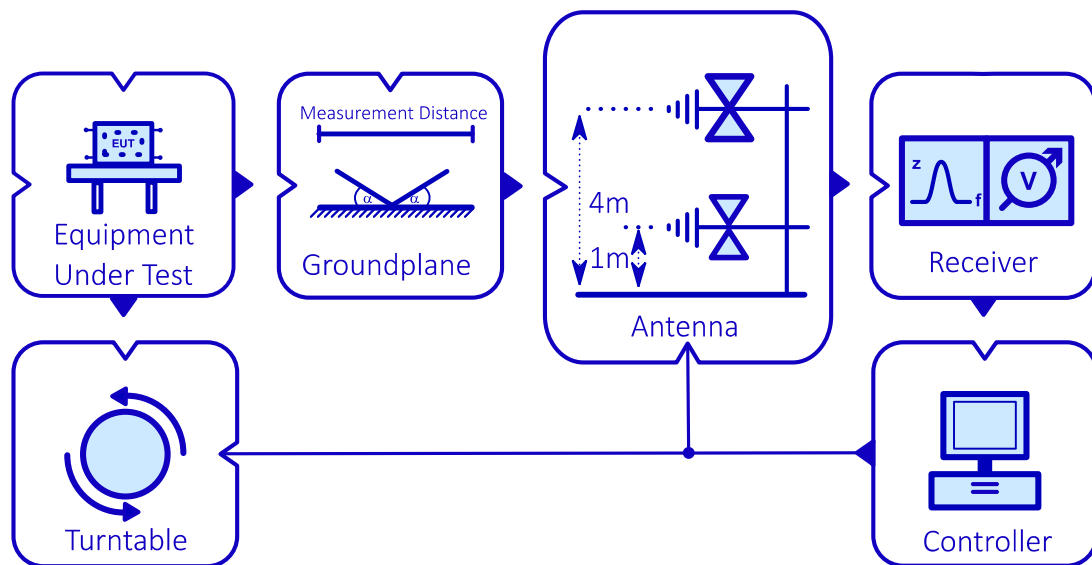
Test frequency	500.00 MHz
Reading	12.3 dB μ V
AF _(500.00 MHz)	17.1 dB/m
CF _(500.00 MHz)	1.4 dB
DT =	3 m
DR =	3 m

Calculated final result for the electrical field strength E(f):

$$E_{(500.00 \text{ MHz})} = 12.3 \text{ dB}\mu\text{V} + 17.1 \text{ dB/m} + 1.4 \text{ dB} + 0 \text{ dB} = 30.8 \text{ dB}\mu\text{V/m}$$

Basic structure - Setup

OATS / SAC





1.5.2.1 Test set up

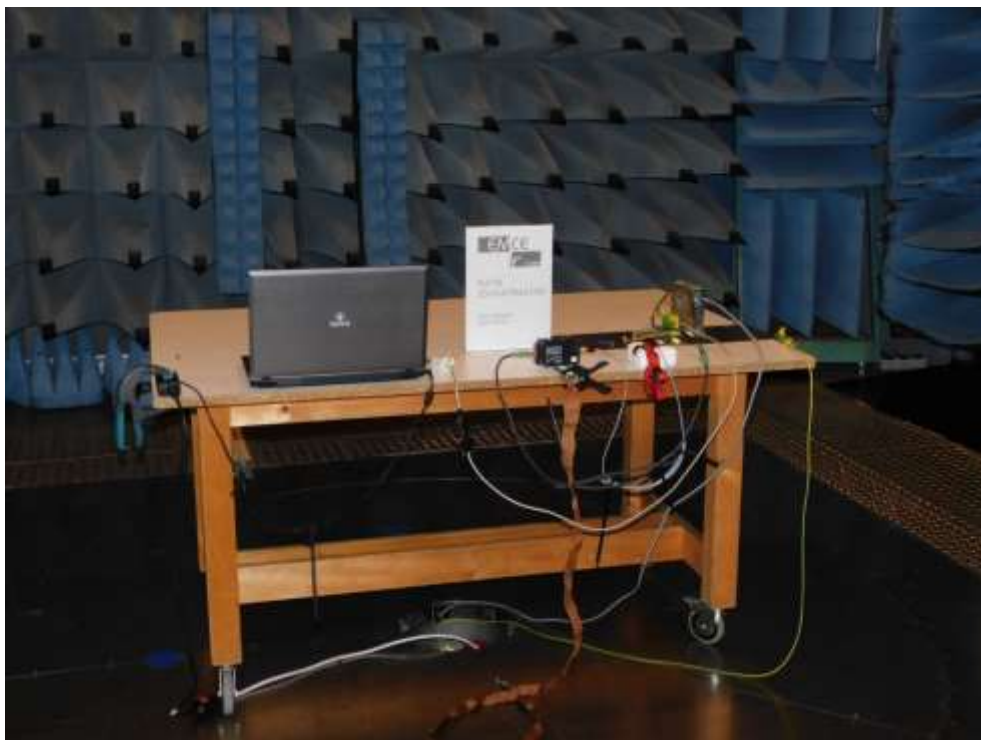
According ANSI C63.4-2014

Final test setup





Pre-test setup







Test location

Pre-compliance test					
☒	Inv.-No.	Designation	Type (L x W x H)	Manufacturer	Location
☒	062	Semi anechoic chamber # 2	13.5 x 6.1 x 5.5 m	EMC-Technik & Consulting GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden

Final test					
☒	Inv.-No.	Designation	Type (L x W x H)	Manufacturer	Location
	062	Semi anechoic chamber # 2	13.5 x 6.1 x 5.5 m	EMC-Technik & Consulting GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	014	Open area test site	10 m	EMCE GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
☒	015	Open area test site	3 m	EMCE GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden

Used test equipment

Pre-compliance test					
☒	Inv.-No.	Designation	Type	Manufacturer	S/N
☒	042	AC-Source / Analyzer / Norm impedance	EMV D5000/PAS	Spitzenberger + Spies	A274700/ 0 0501
☒	058	Test receiver	ESIB 40	Rohde & Schwarz	100200
☒	997	Software	EMC32	Rohde & Schwarz	n/a
☒	8008	Logarithmic Periodic Broadband Antenna	VULP 9118A 180 - 1500 MHz	Schwarzbeck	900
☒	8034	Antenna 30-300 MHz	VHBB9124 / BBA9106	Schwarzbeck	1812

Final test					
☒	Inv.-No.	Designation	Type	Manufacturer	S/N
☒	042	AC-Source / Analyzer / Norm impedance	EMV D5000/PAS	Spitzenberger + Spies	A274700/ 0 0501
	058	Test receiver	ESIB 40	Rohde & Schwarz	100200
	059	Logper. Antenna	HL050	Rohde & Schwarz	100006
	222	Broadband Preamplifier	BBV 9718 0.5-18GHz	Schwarzbeck	9718-316
☒	229	Test receiver	ESS 5 Hz – 1000 MHz	Rohde & Schwarz	845420/0005
	997	Software	EMC32	Rohde & Schwarz	n/a
	8004	Broadband Preamplifier	BLMA 1840-5G 18-40 GHz	BONN Elektronik GmbH	2113300
☒	8007	Logarithmic Periodic Broadband Antenna	VULP 9118A 180 - 1500 MHz	Schwarzbeck	899
☒	8033	Antenna 30-300 MHz	VHBB9124 / BBA9106	Schwarzbeck	1808

All used test equipment are checked resp. calibrated periodically.

☒ Test equipment was checked and complied to the requirements



Test-/Measurement uncertainty

The measurement uncertainty in the test met the guideline of CISPR16-4-2 or better.

Measurement uncertainty of the radiated emission with an extended coverage factor of $k = 2$:

Frequency	Measurement uncertainty
30 MHz – 225 MHz	4.8 dB (valid for 10 m-OATS)
225 MHz – 1 GHz	4.9 dB (valid for 10 m-OATS)
30 MHz – 225 MHz	4.8 dB (valid for 3 m-OATS)
225 MHz – 1 GHz	6.2 dB (valid for 3 m-OATS)

1.5.2.2 Test

Rules and specification 47 CFR Part 15 Section 15.209 (a)(b)(c)(d)(e)(f)

Highest frequency generated or used in the device or on which the device operates or tunes:

- ☒ <10 GHz
- ☐ 10 GHz – 30 GHz
- ☐ 30 GHz – 95 GHz
- ☐ ≥95 GHz

Upper frequency of measurement:

- ☒ 10th harmonic of the highest frequency or 40 GHz, whichever is lower
- ☐ 5th harmonic of the highest frequency or 100 GHz, whichever is lower
- ☐ 5th harmonic of the highest frequency or 200 GHz, whichever is lower
- ☐ 3rd harmonic of the highest frequency or 750 GHz, whichever is lower

Frequency range:

- ☐ 9 kHz – 30 MHz
- ☒ 30 MHz – 1000 MHz
- ☐ 1 – 5 GHz
- ☐ 5 – 18 GHz
- ☐ 18 – 26 GHz
- ☐ 26 – 40 GHz

Limits for radiated emissions

Technical requirements			
Detector	Frequency / MHz	Limit / dBµV/m	Measurement distance / m
QP	30.0 – 88.0	40.0	3
QP	88.0 – 216.0	43.5	3
QP	216.0 – 960.0	46.0	3
QP	960.0 – 1000.0	54.0	3
AV	> 1000	54.0	3
PK	> 1000	74.0	3
The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.			



Rationale for selecting the EUT test set up

Equipment units:

RFID reader with external antenna, an external power supply and a remote laptop to display the tag information.

EUT Orientation

☒ X-Direction ☒ Y-Direction ☒ Z-Direction

Operation mode

EUT arrangement: ☒ Tabletop ☐ Floor standing
Power supply: ☒ 120 V/60 Hz ☐ Internal battery

Continuous reading of a transponder with the highest repetition rate for the reading process. The transponder was placed in the field at the maximum reading distance.

Environmental conditions

Temperature [10 – 40 °C]: 14.3 °C
Relative humidity [10 – 90 %]: 51 %

Environmental conditions during the test: ☒ kept
 ☐ not kept



Test result

Radiated emission limits; general requirements:

☒ kept
☐ not kept

Remarks: n/a

Records

Pre-compliance measurement

☒ Readings
☒ Diagram

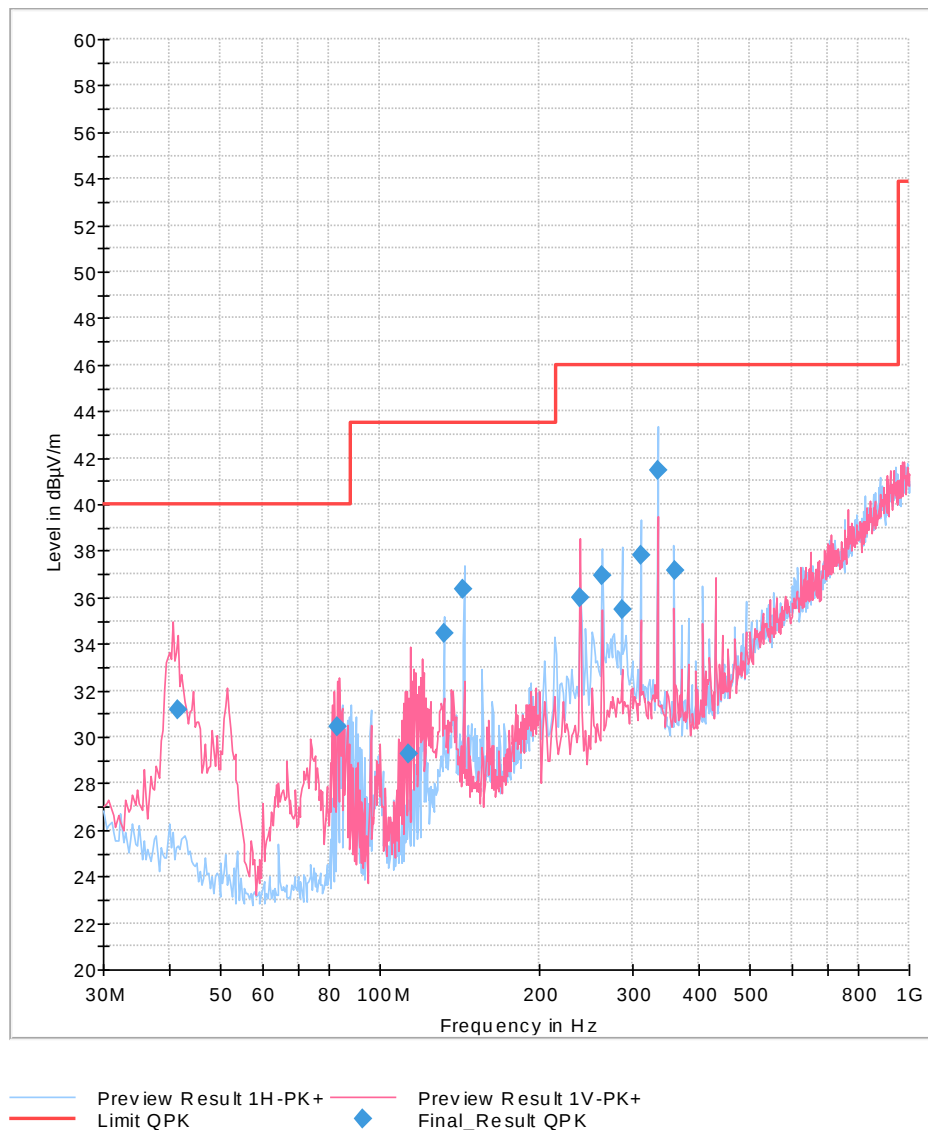
Final measurement

☒ Readings
☒ Diagram

Pre-compliance measurement

EUT Information

EUT Name:	RFID Reader ARE i2.0x SEMI
Test_ID: / SN:	23-0147PR43-003 / 000577
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Test mode, max. perm. customer reading speed
Test specification:	47 CFR Part 15 Subpart C §15.209 SAC @3 m
Antenna information:	Distance EUT-Ant.: 3.0 m / Polarisation: H/V / Ant.Height: 1.0-4.0 m.
Operator:	S. Vogelmann
File #:	23-0147RC44-003-009
Comment #1:	
Comment #2:	





Pre-Test_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
41.490340	31.20	40.00	8.80	5000.0	120.000	130.0	V	292.0	11.7
82.984529	30.46	40.00	9.54	5000.0	120.000	172.0	V	59.0	9.8
113.211383	29.25	43.50	14.25	5000.0	120.000	130.0	V	4.0	11.2
131.896433	34.47	43.50	9.03	5000.0	120.000	235.0	H	163.0	12.4
143.918557	36.34	43.50	7.16	5000.0	120.000	227.0	H	162.0	13.0
239.566333	35.97	46.00	10.03	5000.0	120.000	104.0	V	72.0	12.4
263.609619	36.96	46.00	9.04	5000.0	120.000	115.0	H	170.0	13.4
287.773146	35.46	46.00	10.54	5000.0	120.000	106.0	H	146.0	14.1
311.806814	37.78	46.00	8.22	5000.0	120.000	106.0	H	164.0	14.8
335.797195	41.47	46.00	4.53	5000.0	120.000	121.0	H	164.0	15.4
359.763527	37.13	46.00	8.87	5000.0	120.000	111.0	H	216.0	15.9



Final measurement

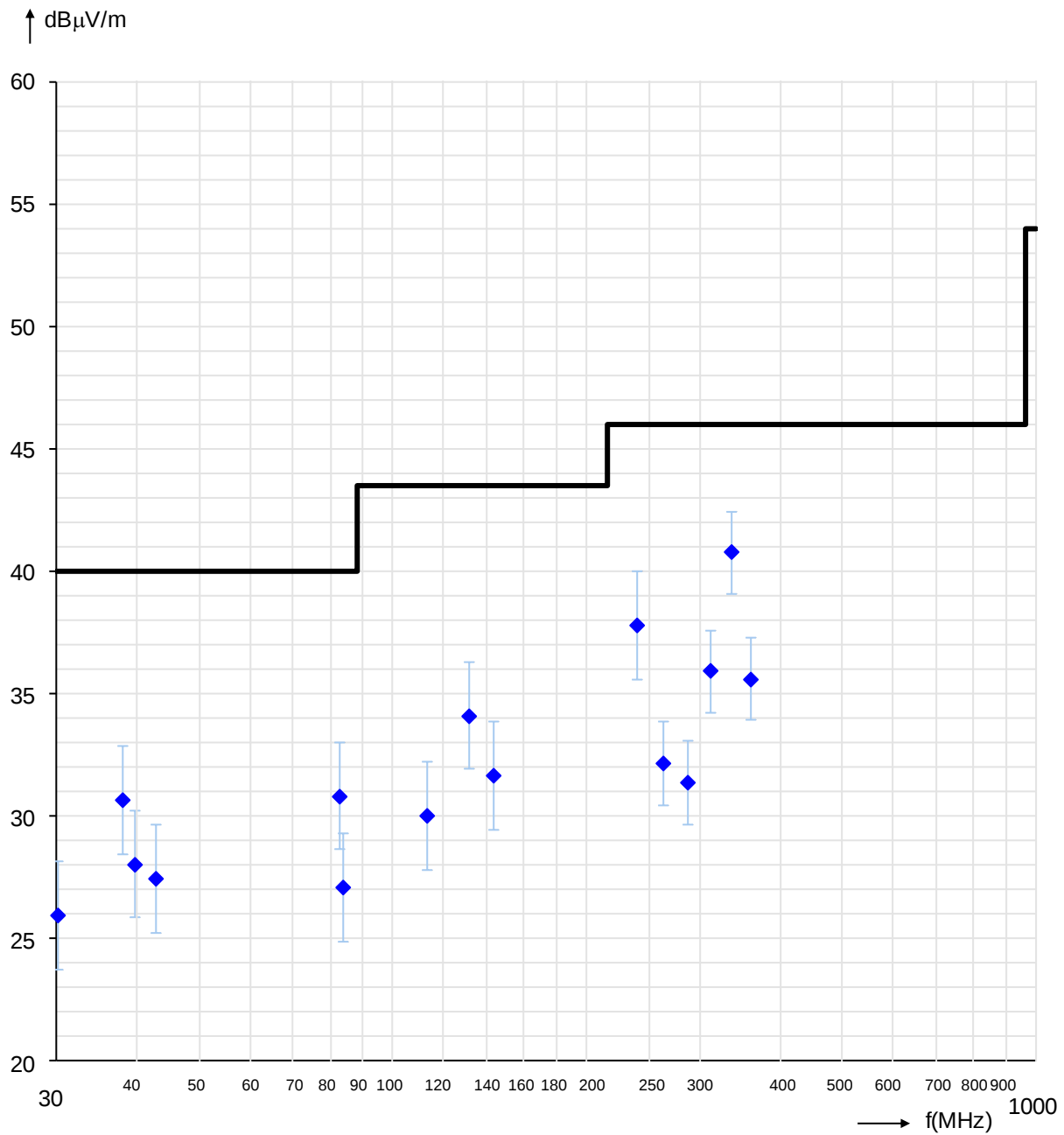
Readings – Antenna horizontal / vertical polarized

Frequency	Readings	+ AF Antenna correction factor	+ KF Cable correction factor	Field strength	Limit	Margin	Antenna- Height	Antenna- Polarization	Turn Table- Position
MHz	dBμV	dB/m	dB	dBμV/m	dBμV/m	dB	m	hor./ver.	Degree
30.258	11.8	13.5	0.6	26.0	40.0	14.0	V	1.00	0
37.980	18.2	11.8	0.7	30.7	40.0	9.3	V	1.00	315
39.860	15.9	11.4	0.7	28.0	40.0	12.0	V	1.00	0
42.810	15.8	10.9	0.7	27.5	40.0	12.5	V	1.00	0
82.884	20.8	9.0	1.0	30.8	40.0	9.2	V	1.00	215
83.880	17.0	9.1	1.0	27.1	40.0	12.9	V	1.00	90
113.088	18.5	10.3	1.2	30.0	43.5	13.5	V	1.00	205
131.822	21.5	11.3	1.3	34.1	43.5	9.4	V	1.00	0
143.790	18.5	11.8	1.4	31.7	43.5	11.8	H	1.40	180
239.668	25.0	11.0	1.8	37.8	46.5	8.7	V	1.20	45
263.640	18.4	11.9	1.9	32.2	46.5	14.3	H	1.10	180
287.606	16.8	12.6	1.9	31.4	46.5	15.1	H	1.20	150
311.568	20.7	13.2	2.0	35.9	46.5	10.6	H	1.60	160
335.544	24.8	13.9	2.1	40.8	46.5	5.7	V	1.20	30
359.500	19.2	14.2	2.2	35.6	46.5	10.9	H	1.00	170



Diagram radio disturbances – Antenna horizontal / vertical polarized

Limit: 47 CFR Part 15 Section 15.209





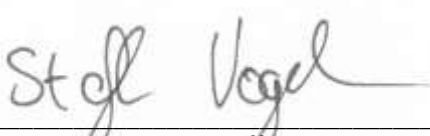
2 Summary

47 CFR Part 15 Subpart C

Requirement	Regulation section	Result	Remarks
Antenna requirement	§ 15.203	Pass	n/a
Restricted bands of operation	§ 15.205 (a) (b) (c)	Pass	n/a
Terminal voltage on powerline	§ 15.207 (a)	Pass	n/a
Radiated emissions H-Field of intentional radiators	§ 15.209 (a) (b) (c) (d) (e) (f)	Pass	n/a
Radiated emissions E-Field of intentional radiators	§ 15.209 (a) (b) (c) (d) (e) (f)	Pass	n/a

Burgrieden, 02/06/2024

Responsible inspector:


Project manager – Steffen Vogelmann

- End of Test Report -