Test report

23-0149RP15-002-A

Product / EUT:	*RFID Reader*
Type designation:	*ARE i9x*
Tested type:	*ARE i9x*
EUT authorization:	☒ Certification ☐ Suppliers Declaration of Conformity
Production level:	*n/a*
S/N:	*n/a*
FCC ID:	*V7IAREI9XHF*
Manufacturer:	*AEG Identifikationssysteme GmbH* *Hörvelsinger Weg 47* *89081 Ulm / Germany*
Test remit:	47 CFR Part 15 – Subpart B – Unintentional radiators in accordance with the procedures given in ANSI C63.4-2014 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:	02/21/2024
Test ID:	23-0149PR08-003
Date(s) of test:	03/07/2024 – 03/12/2024

Burgrieden, 05/26/2024

Released by:

Principal Engineer - Christian Vogelmann

Test laboratory:

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

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

Accredited by:

Bundesnetzagentur

Bundesnetzagentur
BNetzA-CAB-02/21-01

Deutsche Akkreditierungsstelle GmbH

ilac-MRA
DAkkS Deutsche Akkreditierungsstelle D-PL-12122-01-00

Scope:

1 General information

Project manager:	Mr. S. Vogelmann
Inspector:	Mr. S. Vogelmann
	EMCE GmbH Ingenieurbüro für EMV-Prüfungen und Schaltungsentwicklung
Contact person:	Mr. Waitzinger / AEG Identifikationssysteme GmbH
Remarks:	n/a

State of revision:

Source document	New Document	Date / Reviser	Modifications
23-0149RP15-002	23-0149RP15-002-A	05/23/2024 S. Vogelmann	Reduced pixel rate for the images.

2 EUT information

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

Description: *RFID Reader operating in the frequency range 13.56 MHz with an external antenna.*

Voltage supply: *120 V / 60 Hz*

Frequency list: *13.56 MHz*

Max. clock frequency: *n/a*

Temperature range: *n/a*

Dimension: *(LxWxH) / mm³ - 90 x 40 x 25*

Used antennas:

Antenna designation	Manufacturer	Connector / cable length	Gain (dBi) @ f / GHz
AAN Xi9F – HF Ser. 000580	*AEG Identifikationssysteme GmbH*	*2.0 m*	*n/a*

Supplied / used equipment:

Designation	Type	Manufacturer	S/N
Laptop	*W25CSW*	*Terra*	*n/a*
Power supply – Laptop	*A12-065N2A*	*Chicony*	*F134091506009041*
USB A Converter	*151801*	*Manhattan*	*n/a*
Power supply – EUT	*SITP PSU3600*	*Siemens*	*n/a*

Configuration:

☒ As-delivered condition
☐ Modified
* _____

Cable designation	Type	Length	Remarks
Antenna cable	*n/a*	*2.0 m*	*n/a*
Interconnection cable	*5-core*	*1.6 m*	*n/a*
Power cord (AC) Notebook	*3-core*	*1.0 m*	*n/a*
Power cord (DC) Notebook	*2-core*	*1.8 m*	*n/a*
Power Cord (AC) PSU	*3-core*	*1.8 m*	*n/a*
Data cable	*Sub-D 9-core*	*1.4 m*	*n/a*
USB to SUB-D converter	*151801*	*1.6 m*	*Ferrite with 2 turns WE 742 712 21*

Software designation	Type	Manufacturer	Version
Evaluation software	*ARE i9 Terminal*	*AEG Identifikationssysteme GmbH*	*1.084*

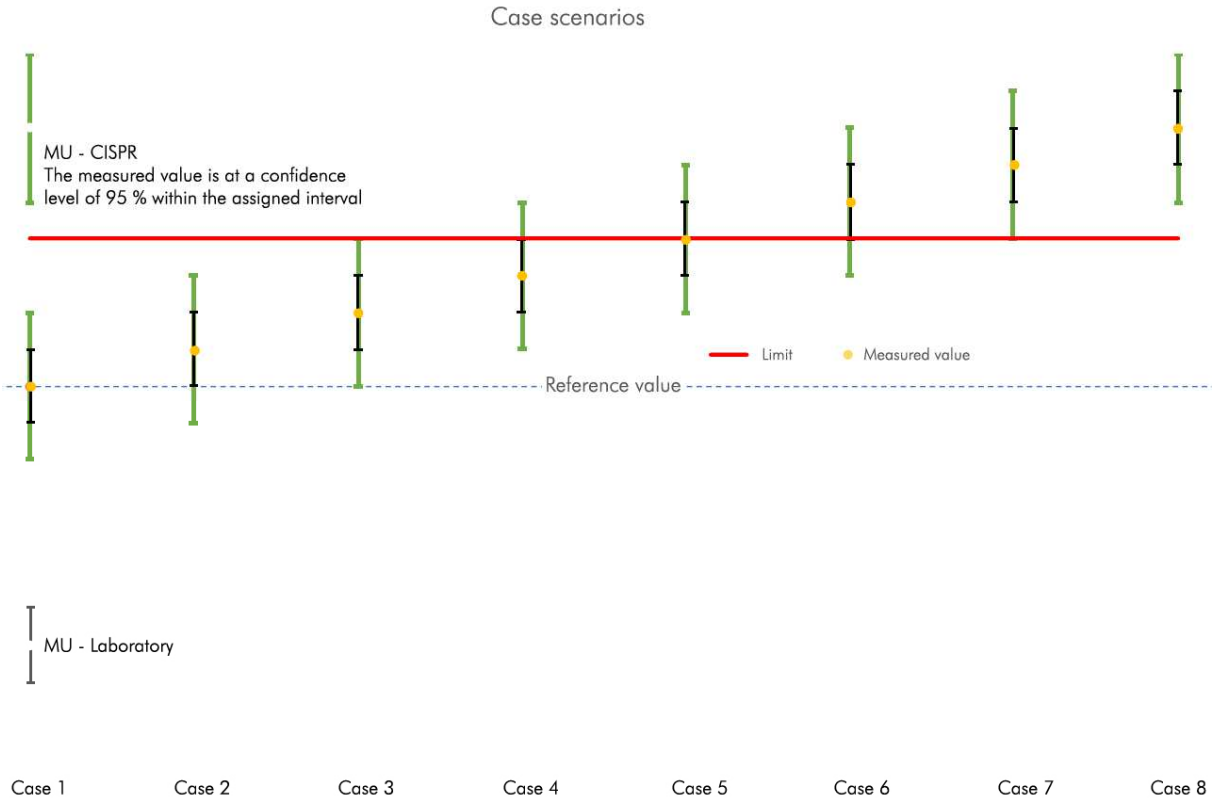
Pictures of the EUT

3 Decision rules for conformity assessment

"Binary" decision rule - pass / fail
Unless otherwise stated in the test module, the following specifications apply:

Interference emission

No measurement uncertainties are taken into account for the statement of conformity. In the case of conducted and radiated interference emission, the measurement is considered passed if the measurement result is below the permitted limit value. The accepted measurement uncertainties for a direct statement of conformity, determined for the U_{Lab} laboratory, must be less than the U_{CISPR} values determined in the CISPR16-4-2 standard. The measurement uncertainties are stated with a confidence level of 95 %. In this case the uncertainty of measurement is not taken into account for the conformity statement.



The test is passed for case 1 - 5. A rejection is made in case 6 - 8.

The test is considered as passed if the evaluation criteria for immunity to interference and the limits of emitted interference of the specified standard are met. Measurement uncertainties are not considered.

4 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)/ 2024-12-31
003	LISN 1	ESH3-Z5	Rohde & Schwarz	835268/007	1 Year(s)/ 2025-03-31
004	LISN 2	ESH3-Z5	Rohde & Schwarz	835268/003	1 Year(s)/ 2025-03-31
006	LISN	NNBM 8125	Schwarzbeck	8125371	1 Year(s)/ 2025-02-28
007	Absorbing clamp	MDS 21	Schwarzbeck	942436	1 Year(s)/ 2025-01-31
008	Loop antenna 9kHz-30MHz	HFH2-Z2	Rohde & Schwarz	835776/0002	3 Year(s)/ 2026-02-28
009	Antenna 30-300MHz	VHBA9123 / BBA9106	Schwarzbeck	435	3 Year(s)/ 2024-12-22
010	Antenna 250-1200MHz	UHALP 9108A	Schwarzbeck	108	3 Year(s)/ 2025-12-20
013	Antenna 9 kHz-30 MHz	Ø 1.5 m	EMCE GmbH		1 Year(s)/ 2024-12-31
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
041	Loop antenna shielded	HZ-10 0816.2511.02	Rohde & Schwarz	849788/0020	3 Year(s)/ 2026-01-10
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
067	LISN	ESH2-Z5	Rohde & Schwarz	872460/043	1 Year(s)/ 2025-03-31
068	LISN	ESH2-Z5	Rohde & Schwarz	872460/042	1 Year(s)/ 2025-03-31

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
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)/ 2025-02-28
118	Current Probe	F-52	Fischer Customs Communication, Inc.	08398	1 Year(s)/ 2025-01-31
151	DSO Infiniium 2500 MHz	DSO9254A	Agilent Technologies	MY52090137	2 Year(s)/ 2024-05-18
155	Impedance stabilisation network	ISN T400A	Teseq GmbH	26541	3 Year(s)/ 2025-01-31
174	LISN	ESH3-Z6	Rohde & Schwarz	101003	1 Year(s)/ 2025-02-28
175	EMI Test receiver	ESR7	Rohde & Schwarz	101108 Firmware: FW V3.46 SP3	1 Year(s)/ 2024-11-15
178	V-LISN 5 µH	NNHV 8123-400	Schwarzbeck	018	1 Year(s)/ 2025-02-28
184	V-LISN 5 µH	NNHV8123-400	Schwarzbeck	019	1 Year(s)/ 2025-02-28
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
224	SMB100A Signal Generator	SMB100A	Rohde & Schwarz	108055	3 Year(s)/ 2026-01-25
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)/ 2025-01-19
230	FSV40 Signal Analyzer 40 GHz	FSV40	Rohde & Schwarz	101717	2 Year(s)/ 2026-02-06
236	Broad-Band Horn Antenna 0.5-6 GHz	BBHA 9120 E	Schwarzbeck	00831	5 Year(s)/ 2024-05-13
237	Exposure Level Tester	ELT-400	Narda Safety Test Solutions	O-0028	3 Year(s)/ 2026-03-03

Inv.-No.	Designation	Type	Manufacturer	S/N	Calibration: Interval /valid until
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
257	Pulse limiter + 10 dB Attenuator	ESH3-Z2	Rohde & Schwarz	102769	1 Year(s)/ 2024-08-31
262	EM Clamp	KEMZ 801A	Teseq	78033	1 Year(s)/ 2025-01-31
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
8013	Antenna 9 - 150 kHz	Ø 120 mm, 20 Turns	EMCE GmbH	n/a	
8015	Amplifier 2.5 - 6 GHz	BBA150-E100	Rohde & Schwarz	105302	1 Year(s)/ 2024-08-31
8016	Circular Loop Antenna 0.01 - 120 MHz	HFRA 5164	Schwarzbeck	00152	
8017	Compensation network for 13.56 MHz	NFCN 1356	Schwarzbeck	00122	
8025	Monopole Antenna 144 - 148 MHz	HLC 146	Schwarzbeck	00057	3 Year(s)/ 2026-02-28

Inv.-No.	Designation	Type	Manufacturer	S/N	Calibration: Interval /valid until
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
8042	Manual Attenuator	8494B+8495B	Keysight	TH61358076+ TH61354943	1 Year(s)/ 2025-02-28
8044	EMI Test Receiver	ESW44	Rohde & Schwarz	103371	1 Year(s)/ 2025-02-28

5 Testplan provided by customer

☐ Test according to the test plan provided by the customer
☐ Deviation from the test plan authorised by the customer
☒ Test according standard

Source document	Date / Reviser	Modifications

6 Test(s) according 47 CFR Part 15 Subpart B - 03/08/2024

6.1 Requirements and conformance test specifications

Standard

47 CFR Part 15 Subpart B
ANSI C63.4-2014
ANSI-C63.04a-2017
KDB n/a
-

Requirement		Regulation section 47 CFR Part 15 Subpart B
☒	Terminal voltage on powerline	§ 15.107 (a)
☒	Radiated emissions E-Field of unintentional radiators	§ 15.109 (a)(c)(g(2))

6.2 Terminal voltage on powerline

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

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Measurement procedure:

Rules and specification	47 CFR Part 15 Section 15.107
Guide	ANSI C63.4-2014

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 remeasured. 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 C63.04 section 13.1.3.1).

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

U(f) (dBµV) = Measured Value (dBµV) + ATF (dB) + 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

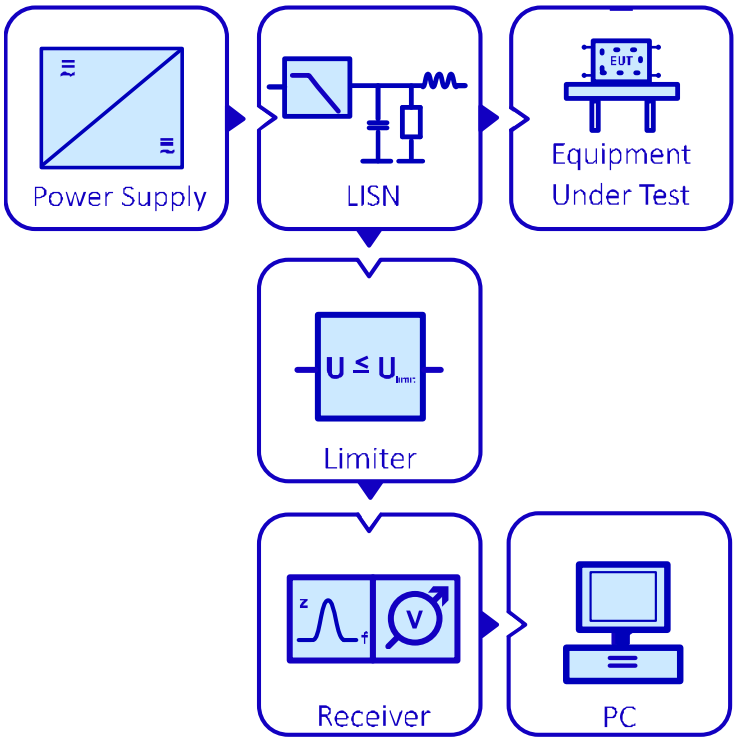
Example:

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

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

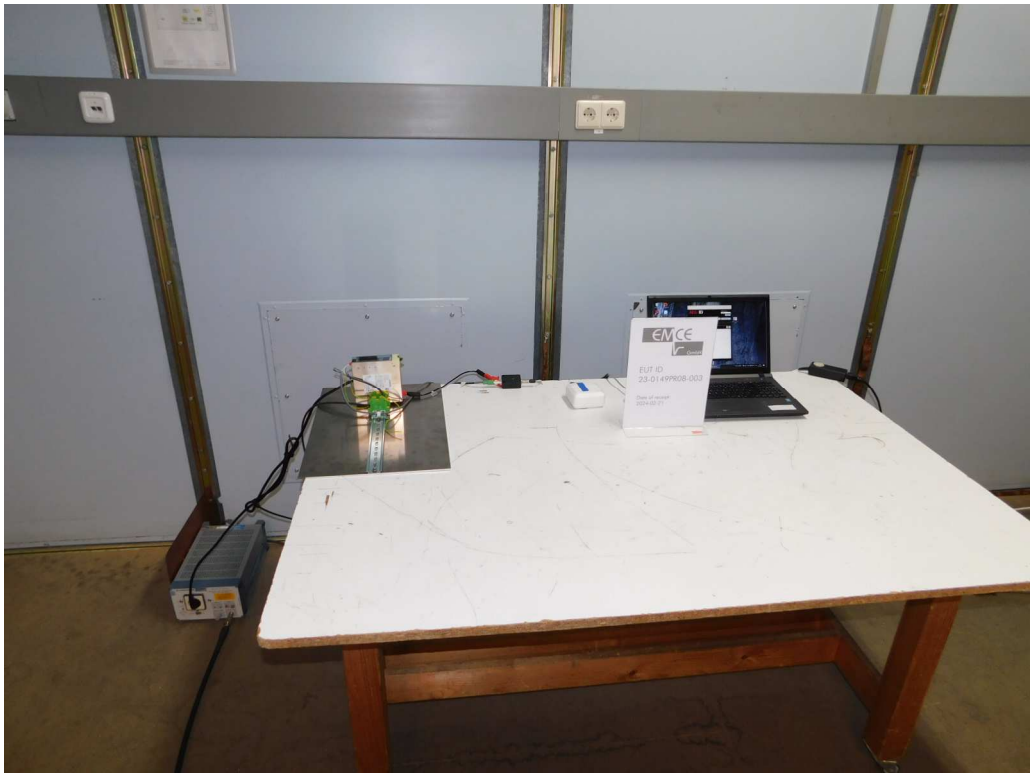
$U_{(13.56\ MHz)}$ = 31.5 dBµV + 10.2 dB + 0.4 dB = 42.1 dBµV

Basic structure - Setup



6.2.1 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
☒	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
☒	175	EMI Test receiver	ESR7	Rohde & Schwarz	101108
	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 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

6.2.2 Test

Rules and specification 47 CFR Part 15 Section 15.107 (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:

Minimal setup with EUT and external power supply unit. The DIN rail housing of the power supply unit was mounted on a metal plate. The metal plate was earthed via the power supply unit. The ground terminal and the cable shield of the reader's connection cable were connected to this metal plate. This design was chosen because it corresponds to the later intended use. The antenna was positioned away from the metal plate above a non-conductive surface. A remote laptop was provided for displaying the data from the reader.

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

The EUT was operated in read mode at maximum read speed, where the ID of a tag was read out cyclically every 80 ms. This ID was sent to a remote PC which was connected to the EUT via a USB interface. The tag was placed at a distance of 2 cm in front of the antenna.

Environmental conditions

Temperature [10 – 40 °C]:	25 °C
Relative humidity [10 – 90 %]:	31 %

Environmental conditions during the test:
☒ kept
☐ not kept

Test result

Limits for conducted powerline emissions:
☒ kept
☐ not kept
☐ not relevant

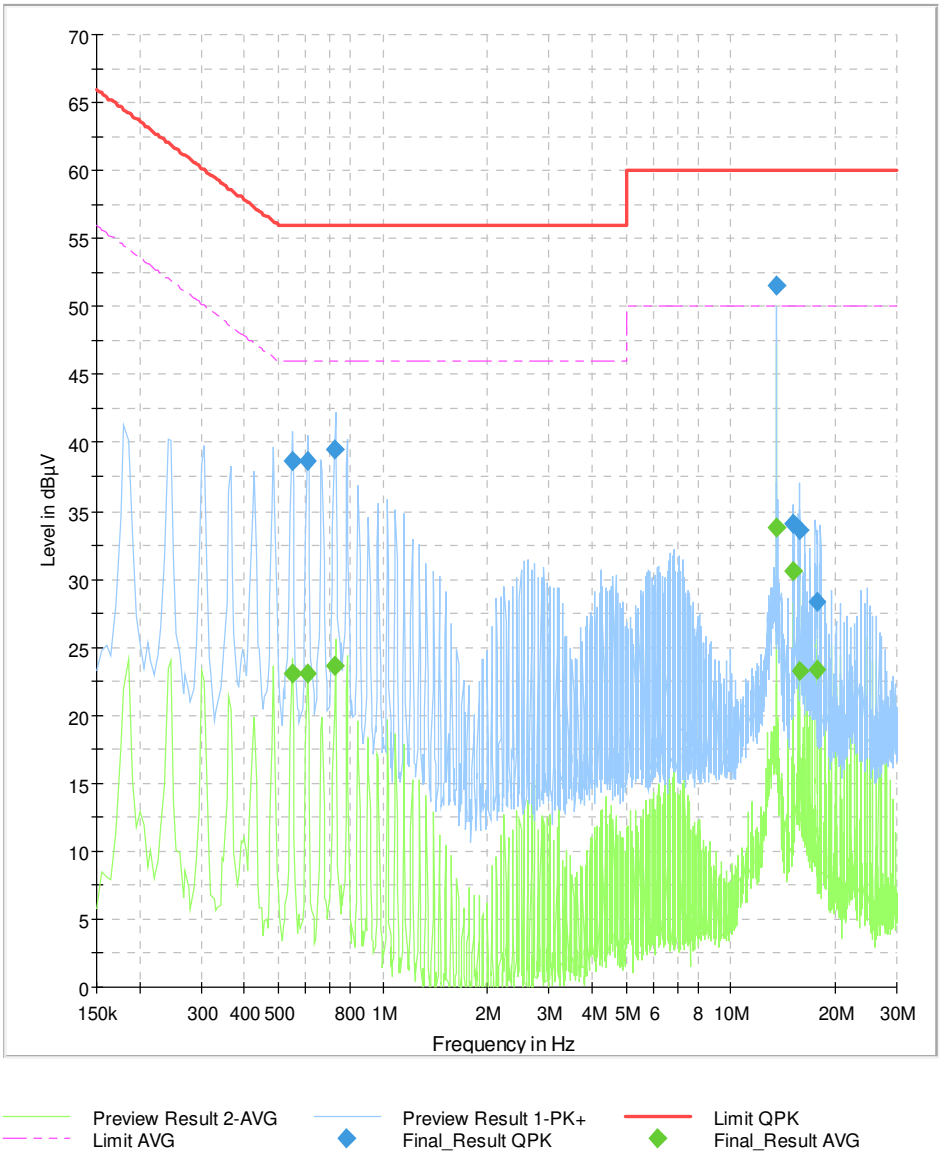
Remarks: n/a

Records

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

EUT Information

EUT Name:	ARE i9x
Test_ID: / SN:	23-0149PR08-003
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Reading mode (cyclical reading every 80 ms)
Test specification:	47 CFR Part 15 Subpart B §15.107 Class B
LISN port	N / EUT
Operator:	S. Vogelmann
File #:	23-0149RC10-003-002
Comment #1:	
Comment #2:	

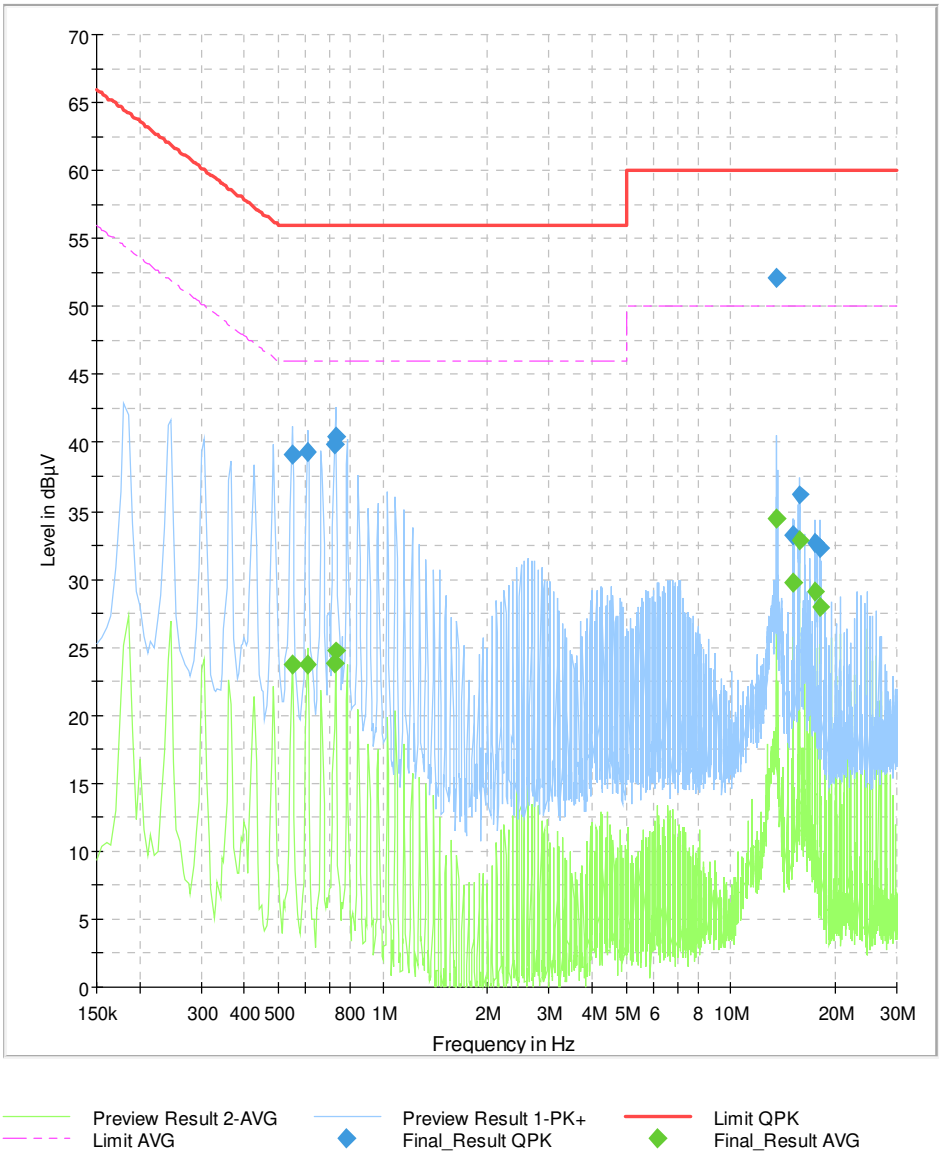


Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.545000	---	23.14	46.00	22.86	15000.0	9.000	N	10.1
0.545000	38.71	---	56.00	17.29	15000.0	9.000	N	10.1
0.605000	---	23.08	46.00	22.92	15000.0	9.000	N	10.1
0.605000	38.64	---	56.00	17.36	15000.0	9.000	N	10.1
0.728000	39.56	---	56.00	16.44	15000.0	9.000	N	10.2
0.728000	---	23.63	46.00	22.37	15000.0	9.000	N	10.2
13.563000	51.50	---	60.00	8.50	15000.0	9.000	N	10.7
13.563000	---	33.87	50.00	16.13	15000.0	9.000	N	10.7
15.155000	34.01	---	60.00	25.99	15000.0	9.000	N	10.8
15.155000	---	30.62	50.00	19.38	15000.0	9.000	N	10.8
15.750000	33.54	---	60.00	26.46	15000.0	9.000	N	10.8
15.750000	---	23.20	50.00	26.80	15000.0	9.000	N	10.8
17.604000	28.38	---	60.00	31.62	15000.0	9.000	N	10.8
17.604000	---	23.33	50.00	26.67	15000.0	9.000	N	10.8

EUT Information

EUT Name:	ARE i9x
Test_ID: / SN:	23-0149PR08-003
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Reading mode (cyclical reading every 80 ms)
Test specification:	47 CFR Part 15 Subpart B §15.107 Class B
LISN port	L1 / EUT
Operator:	S. Vogelmann
File #:	23-0149RC10-003-003
Comment #1:	
Comment #2:	

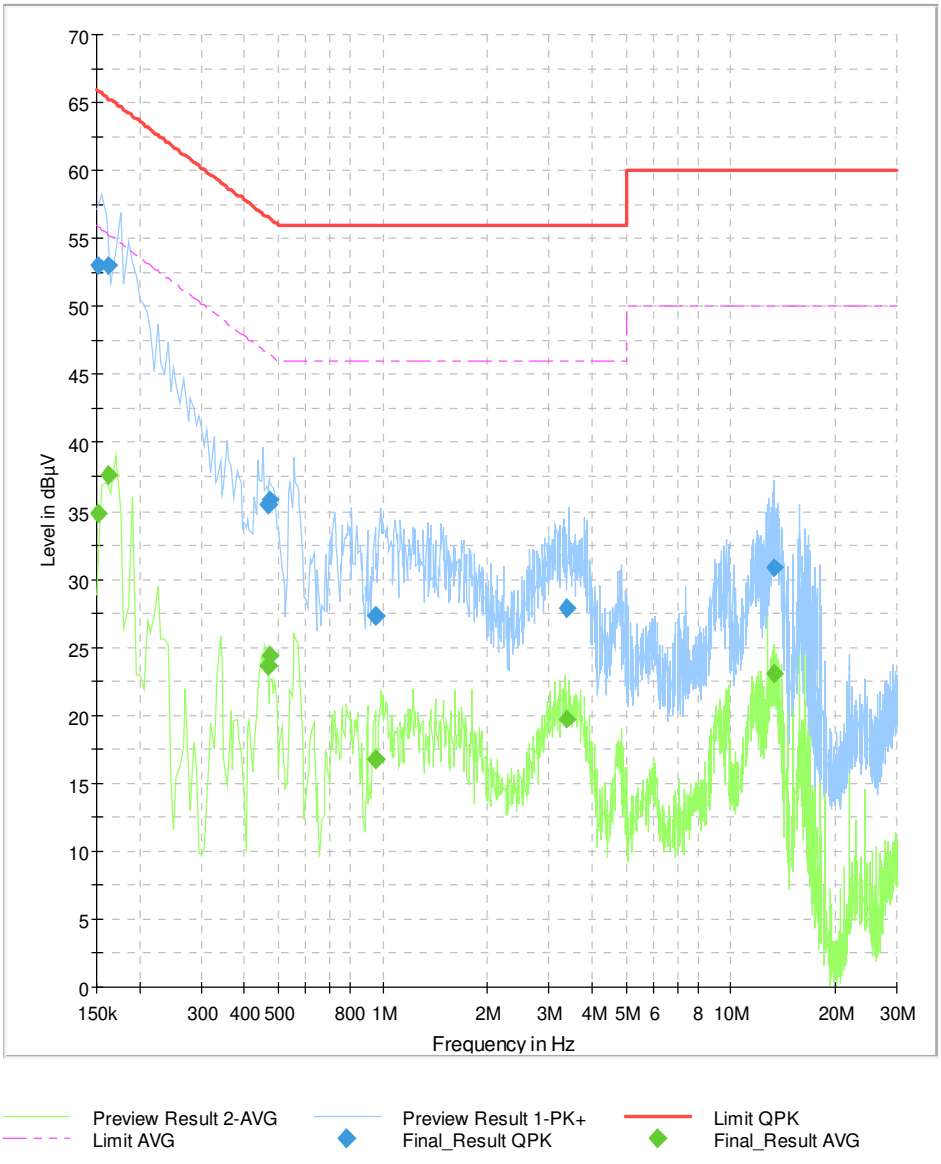


Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.545000	39.22	---	56.00	16.78	15000.0	9.000	L1	10.1
0.545000	---	23.74	46.00	22.26	15000.0	9.000	L1	10.1
0.607000	39.32	---	56.00	16.68	15000.0	9.000	L1	10.1
0.607000	---	23.76	46.00	22.24	15000.0	9.000	L1	10.1
0.728000	39.92	---	56.00	16.08	15000.0	9.000	L1	10.1
0.728000	---	23.86	46.00	22.14	15000.0	9.000	L1	10.1
0.730000	40.44	---	56.00	15.56	15000.0	9.000	L1	10.1
0.730000	---	24.72	46.00	21.28	15000.0	9.000	L1	10.1
13.558000	---	34.43	50.00	15.57	15000.0	9.000	L1	10.7
13.558000	52.16	---	60.00	7.84	15000.0	9.000	L1	10.7
15.139000	---	29.67	50.00	20.33	15000.0	9.000	L1	10.8
15.139000	33.23	---	60.00	26.77	15000.0	9.000	L1	10.8
15.743000	---	32.82	50.00	17.18	15000.0	9.000	L1	10.8
15.743000	36.21	---	60.00	23.79	15000.0	9.000	L1	10.8
17.560000	---	29.11	50.00	20.89	15000.0	9.000	L1	10.8
17.560000	32.65	---	60.00	27.35	15000.0	9.000	L1	10.8
18.169000	---	27.98	50.00	22.02	15000.0	9.000	L1	10.8
18.169000	32.28	---	60.00	27.72	15000.0	9.000	L1	10.8

EUT Information

EUT Name:	ARE i9x
Test_ID: / SN:	23-0149PR08-003
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Reading mode (cyclical reading every 80 ms)
Test specification:	47 CFR Part 15 Subpart B §15.107 Class B
LISN port	N / AE
Operator:	S. Vogelmann
File #:	23-0149RC10-003-004
Comment #1:	
Comment #2:	

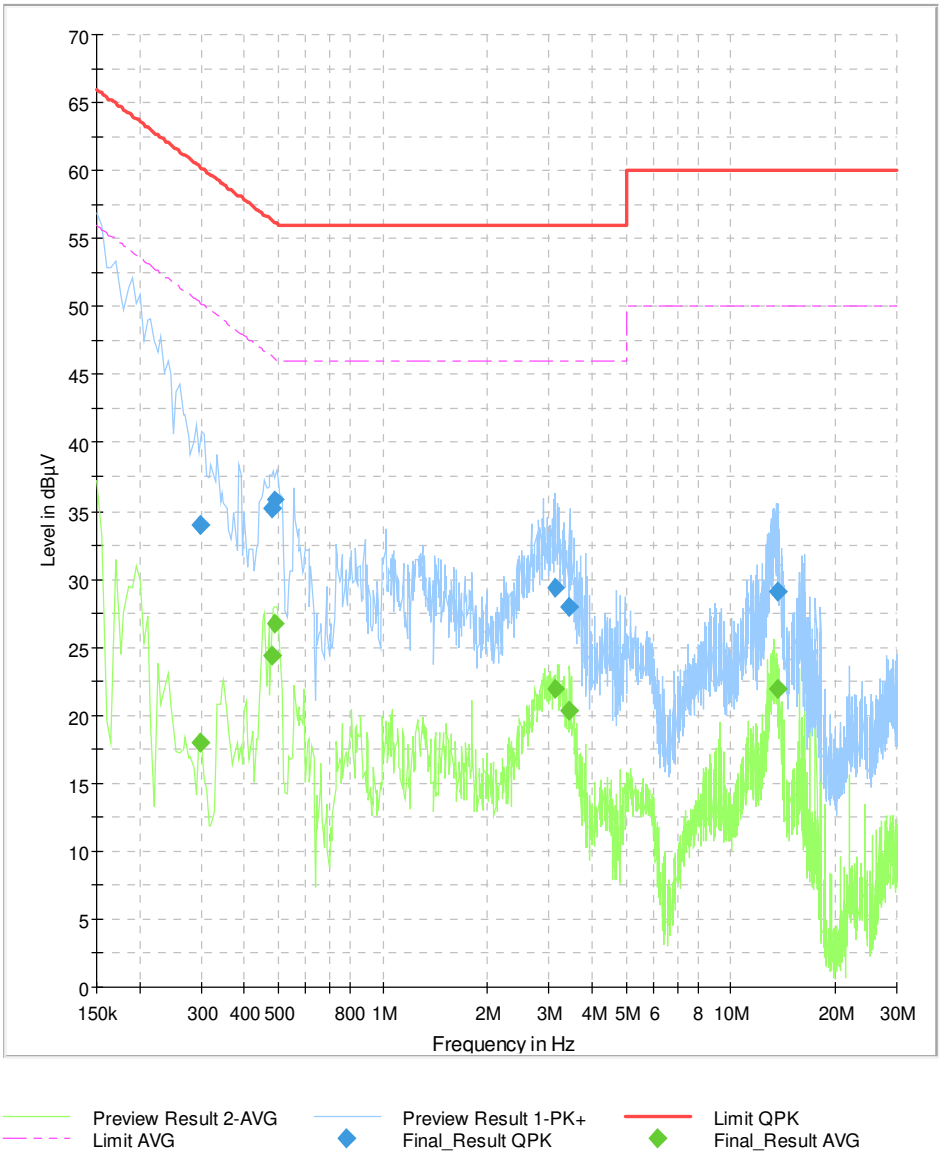


Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.152000	---	34.82	55.89	21.07	15000.0	9.000	N	10.0
0.152000	53.06	---	65.89	12.83	15000.0	9.000	N	10.0
0.162000	---	37.74	55.36	17.62	15000.0	9.000	N	10.0
0.162000	53.00	---	65.36	12.36	15000.0	9.000	N	10.0
0.468000	35.41	---	56.55	21.13	15000.0	9.000	N	10.1
0.468000	---	23.63	46.55	22.92	15000.0	9.000	N	10.1
0.471000	35.86	---	56.50	20.64	15000.0	9.000	N	10.1
0.471000	---	24.37	46.50	22.12	15000.0	9.000	N	10.1
0.944000	27.29	---	56.00	28.71	15000.0	9.000	N	10.2
0.944000	---	16.74	46.00	29.26	15000.0	9.000	N	10.2
3.391000	27.86	---	56.00	28.14	15000.0	9.000	N	10.3
3.391000	---	19.71	46.00	26.29	15000.0	9.000	N	10.3
13.386000	30.81	---	60.00	29.19	15000.0	9.000	N	10.7
13.386000	---	23.09	50.00	26.91	15000.0	9.000	N	10.7

EUT Information

EUT Name:	ARE i9x
Test_ID: / SN:	23-0149PR08-003
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Reading mode (cyclical reading every 80 ms)
Test specification:	47 CFR Part 15 Subpart B §15.107 Class B
LISN port	L1 / AE
Operator:	S. Vogelmann
File #:	23-0149RC10-003-005
Comment #1:	
Comment #2:	



Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.297000	33.98	---	60.33	26.34	15000.0	9.000	L1	10.1
0.297000	---	17.96	50.33	32.37	15000.0	9.000	L1	10.1
0.477000	35.19	---	56.39	21.20	15000.0	9.000	L1	10.1
0.477000	---	24.37	46.39	22.02	15000.0	9.000	L1	10.1
0.489000	35.87	---	56.19	20.32	15000.0	9.000	L1	10.1
0.489000	---	26.67	46.19	19.52	15000.0	9.000	L1	10.1
3.142000	29.30	---	56.00	26.70	15000.0	9.000	L1	10.3
3.142000	---	21.91	46.00	24.09	15000.0	9.000	L1	10.3
3.407000	27.96	---	56.00	28.04	15000.0	9.000	L1	10.3
3.407000	---	20.32	46.00	25.68	15000.0	9.000	L1	10.3
13.614000	29.11	---	60.00	30.89	15000.0	9.000	L1	10.7
13.614000	---	22.02	50.00	27.98	15000.0	9.000	L1	10.7

6.3 Radiated emissions E-Field of unintentional 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 15.109
Guide	ANSI C63.4-2014

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 ±20° 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 ±45° 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:

$$E(f)\ (dB\mu V/m) = \text{Measured value}\ (dB\mu V) + AF\ (dB/m) + CF\ (dB) + 20 * (D_T/D_R)\ (dB)$$

E(f) =	Final result of the electrical field strength
Measured Value =	Reading of the uncorrected measured value
AF =	Correction factor for the receiving antenna
CF =	Correction factor for the cable loss
D_T =	Test distance
D_R =	Reference distance for the limit defined in the standard

Example:

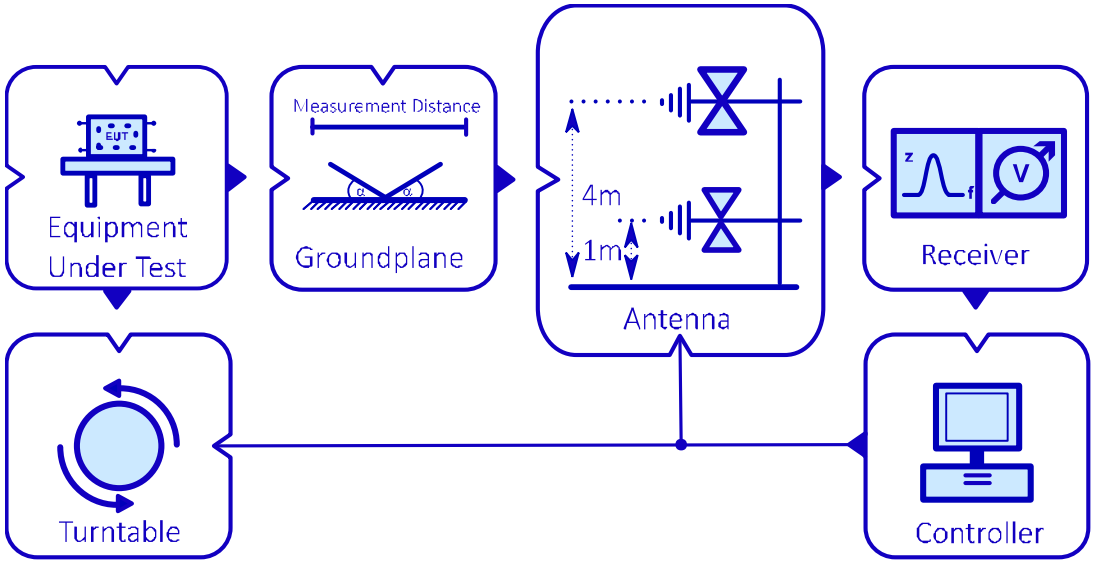
Test frequency	500.00 MHz
Reading	12.3 dBµV
$AF_{(500.00\ MHz)}$	17.1 dB/m
$CF_{(500.00\ MHz)}$	1.4 dB
D_T =	3 m
D_R =	3 m

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

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

Basic structure - Setup

OATS / SAC

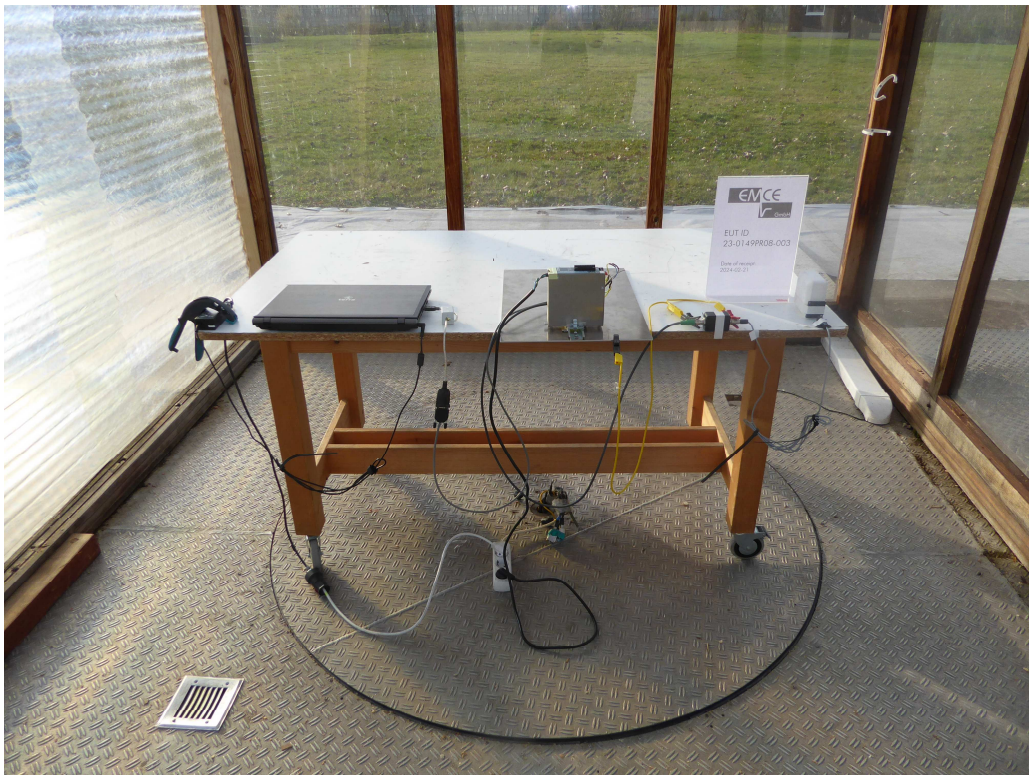


6.3.1 Test set up

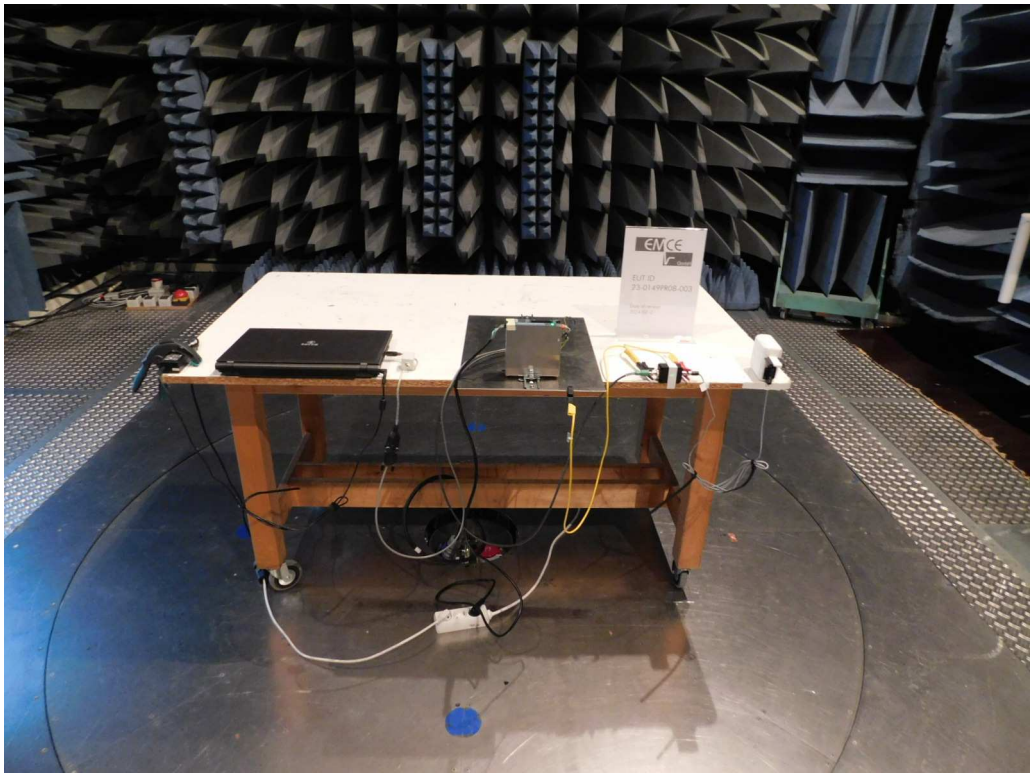
According ANSI C63.4-2014

Photo(s) showing the interconnection of the major function units

Final test setup



Precompliance 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
	059	Logper. Antenna	HL050	Rohde & Schwarz	100006
☒	997	Software	EMC32	Rohde & Schwarz	n/a
☒	8008	Logarithmic Periodic Broadband Antenna 180 - 1500 MHz	VULP 9118A	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
☒	229	Test receiver	ESS 5 Hz – 1000 MHz	Rohde & Schwarz	845420/0005
	236	Broad-Band Horn Antenna 0.5-6 GHz	BBHA 9120 E	Schwarzbeck	00831
	997	Software	EMC32	Rohde & Schwarz	n/a
☒	8007	Logarithmic Periodic Broadband Antenna 180 - 1500 MHz	VULP 9118A	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 – 200 MHz	4.8 dB (valid for 10 m-OATS)
200 MHz – 1 GHz	4.9 dB (valid for 10 m-OATS)
30 MHz – 200 MHz	4.8 dB (valid for 3 m-OATS)
200 MHz – 1 GHz	6.2 dB (valid for 3 m-OATS)

6.3.2 Test

Rules and specification 47 CFR Part 15 Section 15.109 (a)(c)(g(2))

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

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

- ☐ < 1.705 MHz
- ☒ 1.705 – 108 MHz
- ☐ 108 – 500 MHz
- ☐ 500 – 1000 MHz
- ☐ > 1000 MHz

Upper frequency of measurement:

- ☐ 30 MHz
- ☒ 1000 MHz
- ☐ 2000 MHz
- ☐ 5000 MHz
- ☐ 5th harmonic of the highest frequency or 40 GHz, whichever is lower

Frequency range:

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

Rationale for selecting the EUT test set up

Equipment units:

Minimal setup with EUT and external power supply unit. The DIN rail housing of the power supply unit was mounted on a metal plate. The metal plate was earthed via the power supply unit. The ground terminal and the cable shield of the reader's connection cable were connected to this metal plate. This design was chosen because it corresponds to the later intended use. The antenna was positioned away from the metal plate above a non-conductive surface. A remote laptop was provided for displaying the data from the reader.

Operation mode

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

The EUT was operated in read mode at maximum read speed, where the ID of a tag was read out cyclically every 80 ms. This ID was sent to a remote PC which was connected to the EUT via a USB interface. The tag was placed at a distance of 2 cm in front of the antenna.

Environmental conditions - SAC

Temperature [10 – 40 °C]:	24 °C
Relative humidity [10 – 90 %]:	35 %
Environmental conditions during the test:	☒ kept ☐ not kept

Environmental conditions - OATS

Temperature [10 – 40 °C]:	14 °C
Relative humidity [10 – 90 %]:	48 %
Environmental conditions during the test:	☒ kept ☐ not kept

Test result

Limits for unwanted radiated emissions:

- ☒ kept
- ☐ not kept
- ☐ not relevant

Remarks: n/a

Records

Pre-compliance measurement

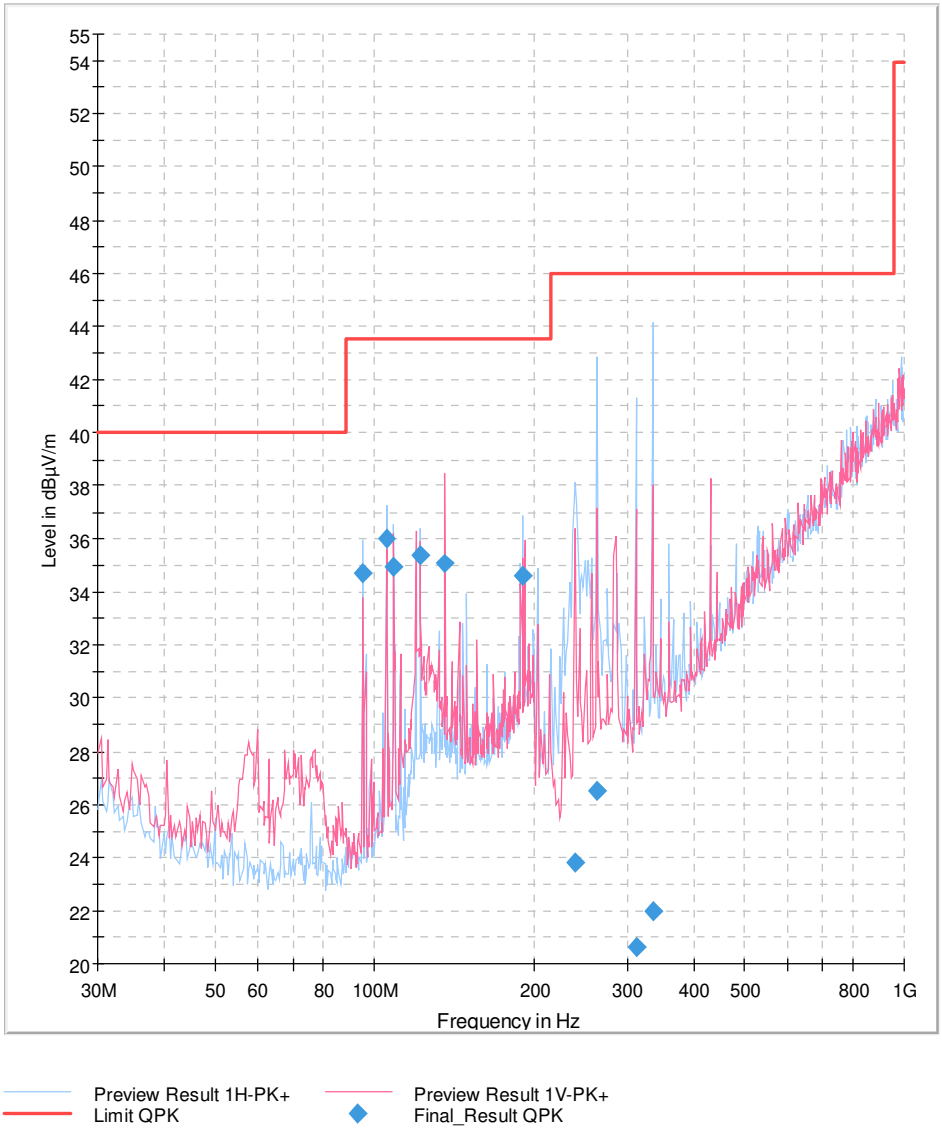
- ☒ Readings
- ☒ Diagram

Final measurement

- ☒ Readings
- ☒ Diagram

EUT Information

EUT Name:	ARE i9x
Test_ID: / SN:	23-0149PR08-003
Customer:	AEG ID GmbH
Operational condition:	Reading mode (cyclical reading every 80 ms)
Test specification:	47 CFR Part 15 Subpart B §15.109 Class B SAC @3m
Antenna information:	Distance EUT-Ant.: 3.0 m / Polarisation: H/V / Ant.Height: 1.0-4.0 m.
Operator:	S. Vogelmann
File #:	23-0149RC12-003-006
Comment #1:	
Comment #2:	



Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
94.931863	34.72	43.50	8.78	5000.0	120.000	185.0	H	28.0	10.2
105.030461	36.05	43.50	7.45	5000.0	120.000	212.0	H	14.0	10.7
108.513427	34.95	43.50	8.55	5000.0	120.000	176.0	H	37.0	10.9
122.052505	35.38	43.50	8.12	5000.0	120.000	235.0	H	92.0	11.8
135.607615	35.09	43.50	8.41	5000.0	120.000	120.0	V	110.0	12.6
189.856913	34.62	43.50	8.88	5000.0	120.000	180.0	H	240.0	15.1
238.713828	23.83	46.00	22.17	5000.0	120.000	157.0	H	348.0	12.4
262.639279	26.51	46.00	19.49	5000.0	120.000	103.0	H	0.0	13.4
311.216433	20.67	46.00	25.33	5000.0	120.000	156.0	H	22.0	14.7
334.393988	21.96	46.00	24.04	5000.0	120.000	105.0	H	274.0	15.4

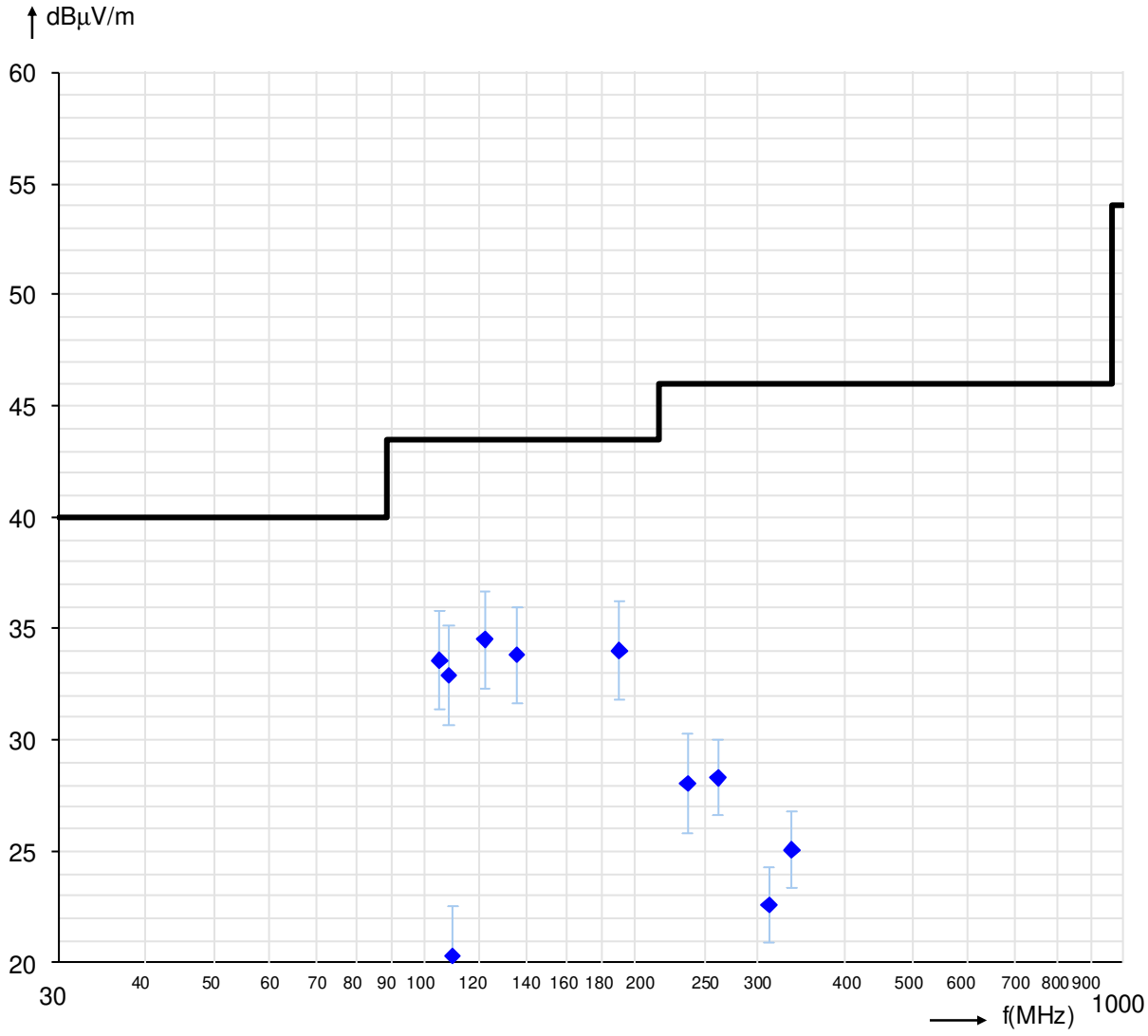
Final measurement

Readings – Antenna horizontal / vertical polarized

Frequency	Readings	+ AF Antenna correction factor	+ KF Cable correction factor	Field strength	Limit	Margin	Antenna-Polarization	Antenna-Height	Turn Table-Position
MHz	dBµV	dB/m	dB	dBµV/m	dBµV/m	dB	hor./ver.	m	Degree
104.924	22.6	9.8	1.2	33.7	43.5	9.8	H	2.00	0
108.481	21.7	10.1	1.2	33.0	43.5	10.5	H	3.00	0
122.042	22.5	10.7	1.3	34.6	43.5	8.9	H	1.60	90
135.602	21.0	11.5	1.4	33.9	43.5	9.6	V	1.00	90
189.860	18.6	13.9	1.7	34.1	43.5	9.4	H	1.80	250
262.439	14.6	11.9	2.0	28.4	46.5	18.1	H	1.24	180

Diagram radio disturbances – Antenna horizontal / vertical polarized

Limit: 47 CFR Part 15 Subpart B §15.109 (a)(c)



7 Summary

Reference

47 CFR Part 15 Subpart B

Requirement	Regulation section	Result	Remarks
	47 CFR Part 15 Subpart B		
Terminal voltage on powerline	§ 15.107 (a)	Pass	n/a
Radiated emissions E-Field of unintentional radiators	§ 15.109 (a)(c)(g(2))	Pass	n/a

Burgrieden, 05/26/2024

Responsible inspector:

Project manager – Steffen Vogelmann

- End of Test Report -