Test report

23-0148RP15-005-A

Product / EUT:	*RFID Reader*
Type designation:	*ARE i2.0x HF*
Tested type:	*ARE i2.0x HF*
EUT authorization:	☒ Certification ☐ Suppliers Declaration of Conformity
Production level:	*n/a*
S/N:	*000593*
FCC ID:	*V7IAREI20XHF*
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

Remark: The test results effects only to the related items tested at the time of the test. The test report shall not be reproduced except in full without the written approval of the testing laboratory. Information provided by the customer are identified in italic letters and may have an influence on the validity of test results.

Applicant:	AEG Identifikationssysteme GmbH Hörvelsinger Weg 47 89081 Ulm / Germany
EUT-	
Date of arrival:	02/15/2024
Test ID:	23-0148PR07-004
Date(s) of test:	03/05/2024 – 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

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

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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
23-0148PR15-005	23-0148PR15-005-A	05/23/2024 Steffen Vogelmann	The measurement performed in the OATS to evaluate the fundamental has been moved from chapter 6.5 to chapter 6.8. Adjustment of the test setup to ANSI C63.10-2013.

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 - 130 x 70 x 35*

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	*LIF120-10B12R2S-EX*	*RS Components GmbH*	*220B22-727220855585000J*

Configuration:

☒ As-delivered condition

☐ Modified

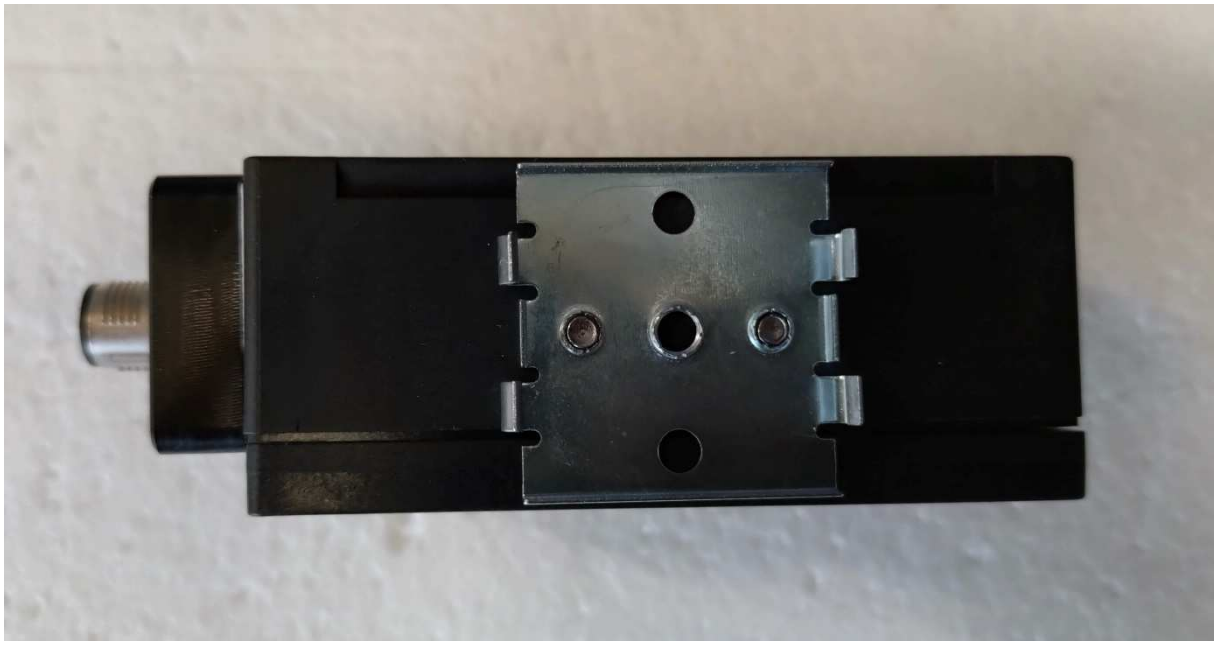
*_____

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*	*1.9 m*	*n/a*
Data cable	*Sub-D 9-core*	*1.5 m*	*n/a*
USB to SUB-D converter	*151801*	*0.5 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

AEG ID
ARE i2.0

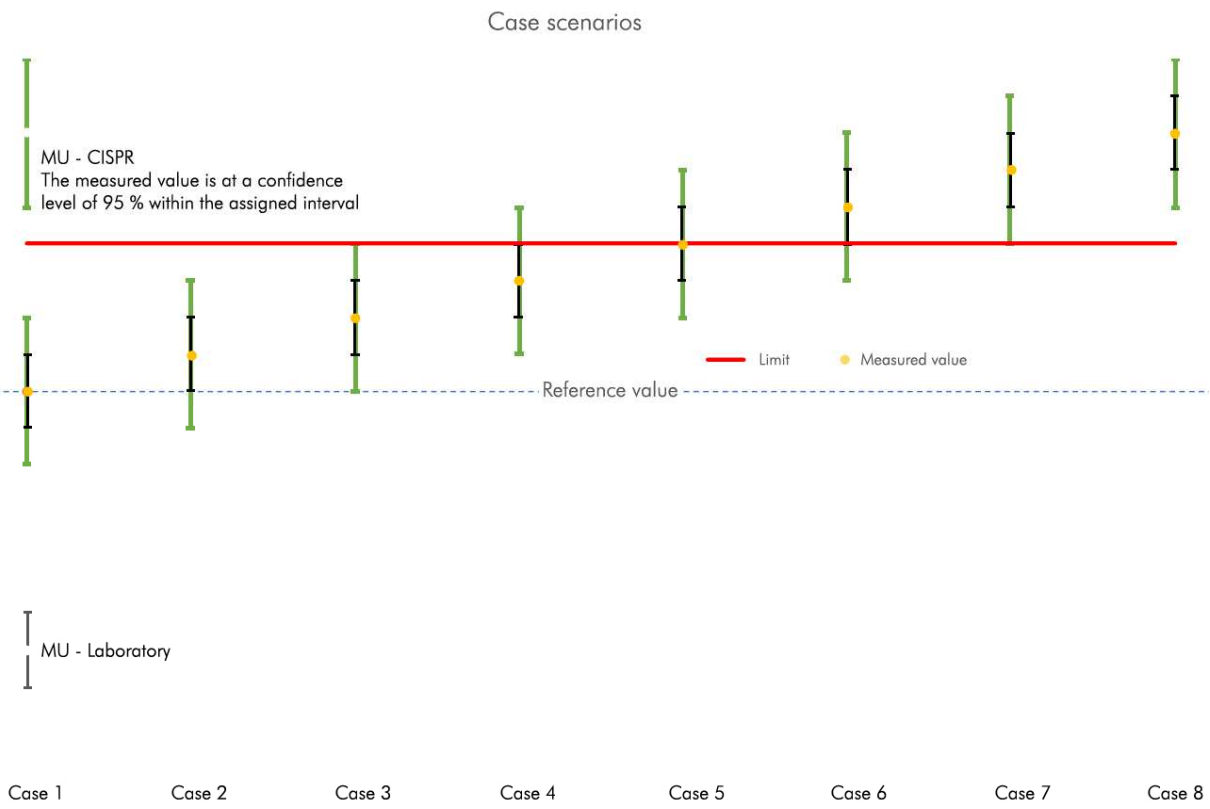


3 Decision rules for conformity assessment

"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	∅ 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 C - 03/08/2024

6.1 Requirements and conformance test specifications

Standard

47 CFR Part 15 Subpart C
ANSI C63.10-2013
KDB n/a
-

Requirement		Regulation section 47 CFR Part 15 Subpart C
☒	Antenna requirement	§ 15.203
☒	Restricted bands of operation	§ 15.205 (a) (b) (c) (d(7))
☒	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)
☒	Emission bandwidth inside the operating frequency band	§ 15.215 (c)
☒	Field strength mask within the operation band 13.110-14.010 MHz	§ 15.225 (a) (b) (c) (d)
☒	Frequency stability	§ 15.225 (e) (f)

6.2 Antenna requirements

☒ 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 15.203
Guide	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 ☐ Antenna array ☐ MIMO ☐ __-
Antenna connector:	☐ Permanent attached ☒ Unique coupling to the intentional radiator ☐ SMA ☐ UFL ☐ __

Test result

Requirement:	☒ kept ☐ not kept

Remarks: n/a

6.3 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)(d(7))
Guide n/a

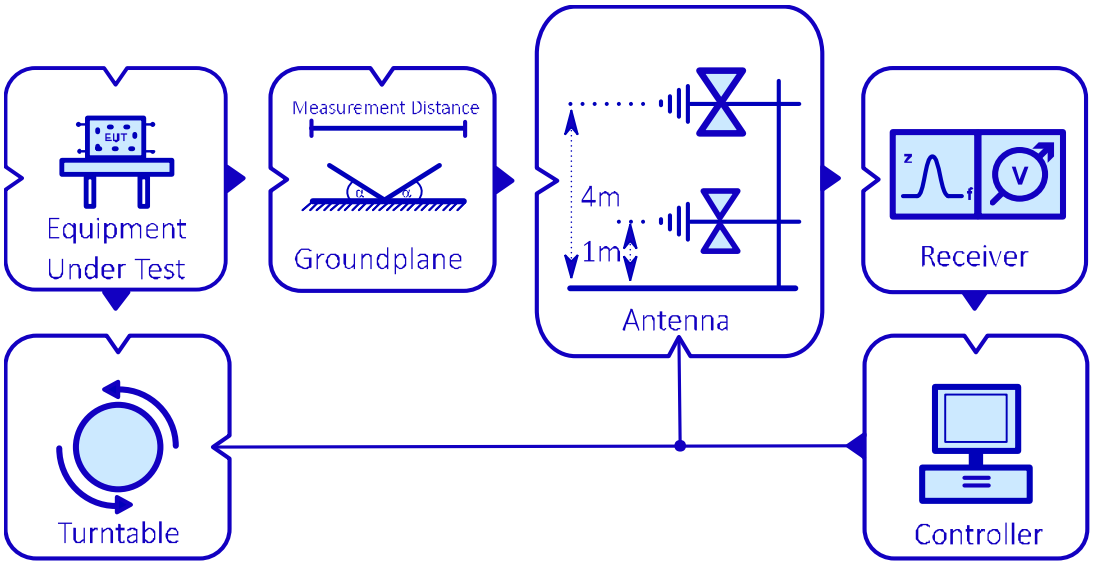
Restricted bands

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



6.3.1 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.

6.3.2 Test

Used frequency band: ☒ 13.110-14.010 MHz

Nearest restricted band: ☒ 13.360-13.410 MHz

Limits for radiated emissions in the restricted bands

Technical requirements			
Detector	Frequency / MHz	Limit / µV/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 / 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. Devices operated pursuant to §15.225 [13.110-14.010 MHz] are exempt from complying with this section for the 13.36-13.41 MHz band only.			

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

See test for spectrum mask within the operation band.

*Devices operated pursuant to §15.225 [13.110-14.010 MHz]
are exempt from complying with this section for the 13.36-13.41 MHz band only.

Remarks: n/a

6.4 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	47 CFR Part 15 Section 15.207 (a)
Guide	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) (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

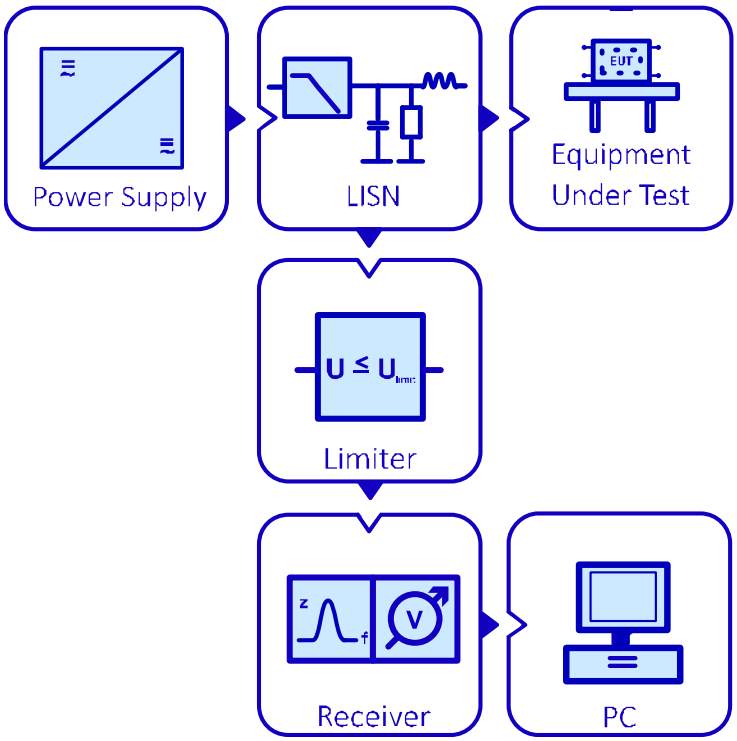
Example:

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):

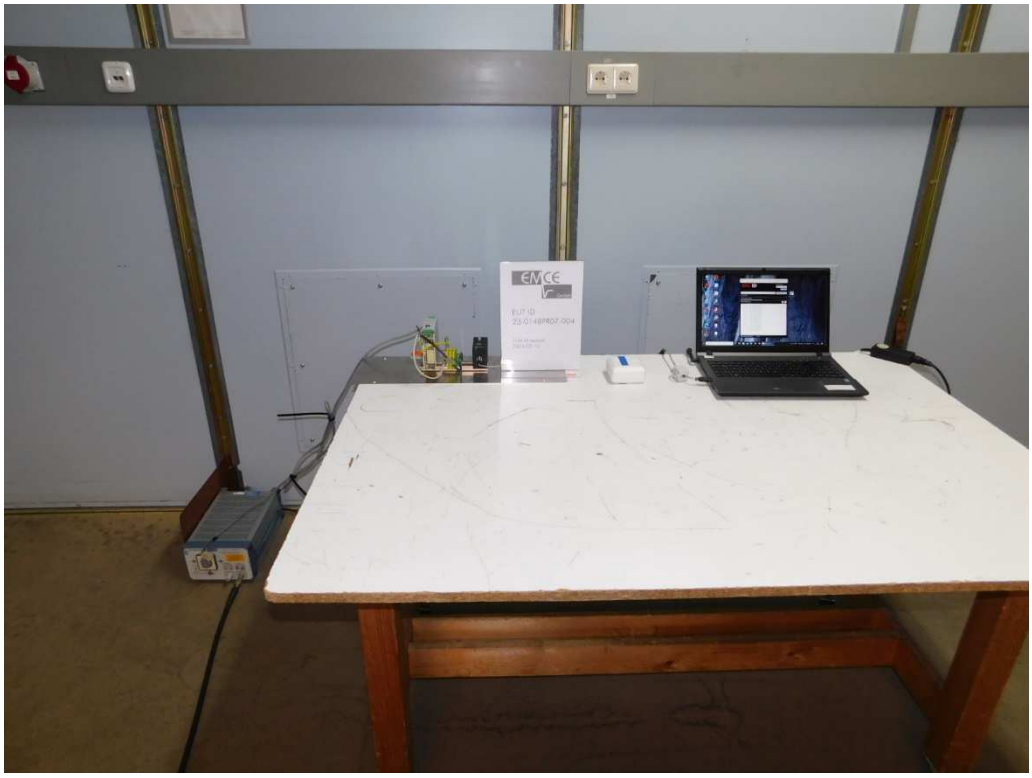
$U_{(13.56\ MHz)}$ = 31.5 dBµV + 10.2 dB + 0.4 dB = 42.1 dBµV

Basic structure – Setup



6.4.1 Test set up

According ANSI C63.10-2013


EMCE
EUT-ID
23-0148PR07-004

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

6.4.2 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:

Minimal setup with EUT and external power supply unit. The DIN rail housing of the EUT and the power supply unit were mounted together on a metal plate at a distance of >10 cm from each other. The metal plate was earthed via the power supply unit. 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]:	24 °C
Relative humidity [10 – 90 %]:	32 %
Environmental conditions during the test:	☒ kept ☐ not kept

Test result

Limits for conducted powerline emissions:	☒ kept ☐ not kept

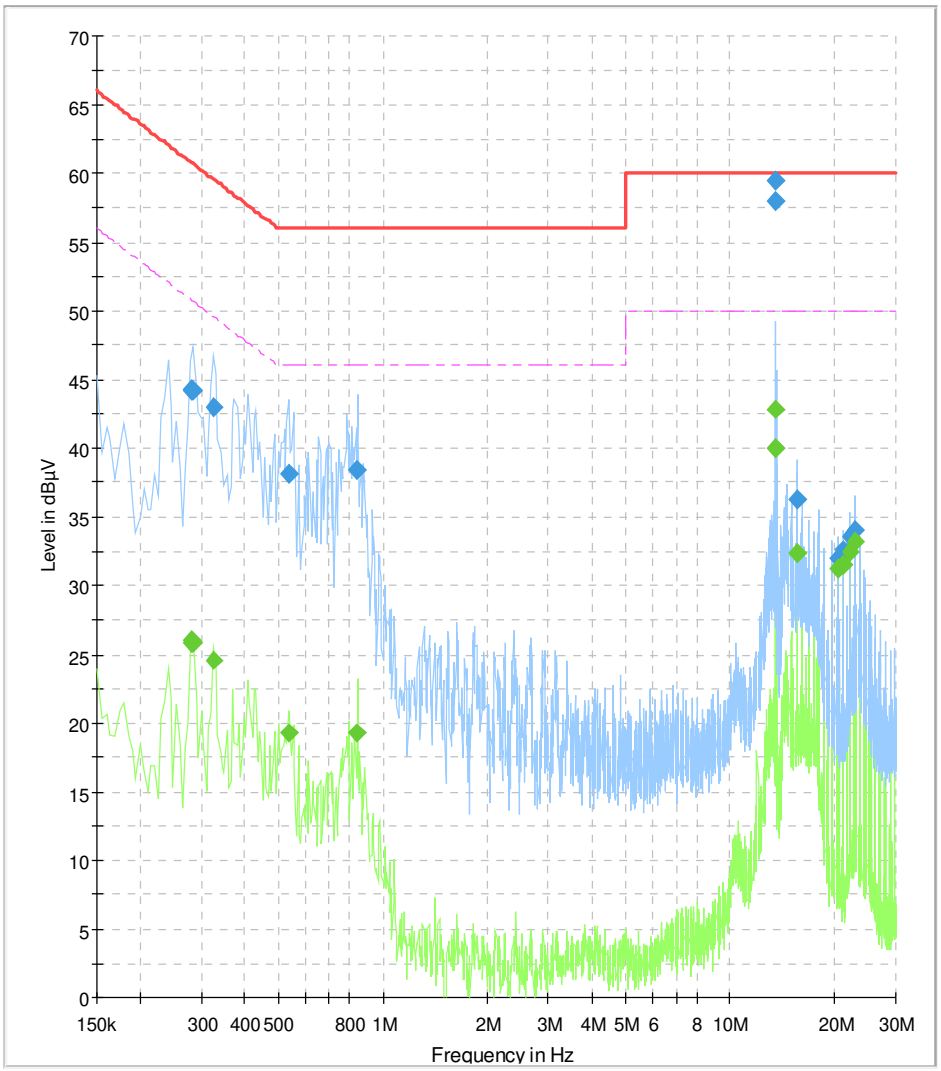
Remarks: n/a

Protocol scope

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

EUT Information

EUT Name:	ARE i2.0x HF
Test_ID: / SN:	23-0148PR07-004
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Reading mode (cyclical reading every 80 ms)
Test specification:	47 CFR Part 15 Subpart C §15.207
LISN port	N / EUT
Operator:	S. Vogelmann
File #:	23-0148RC10-004-001
Comment #1:	
Comment #2:	



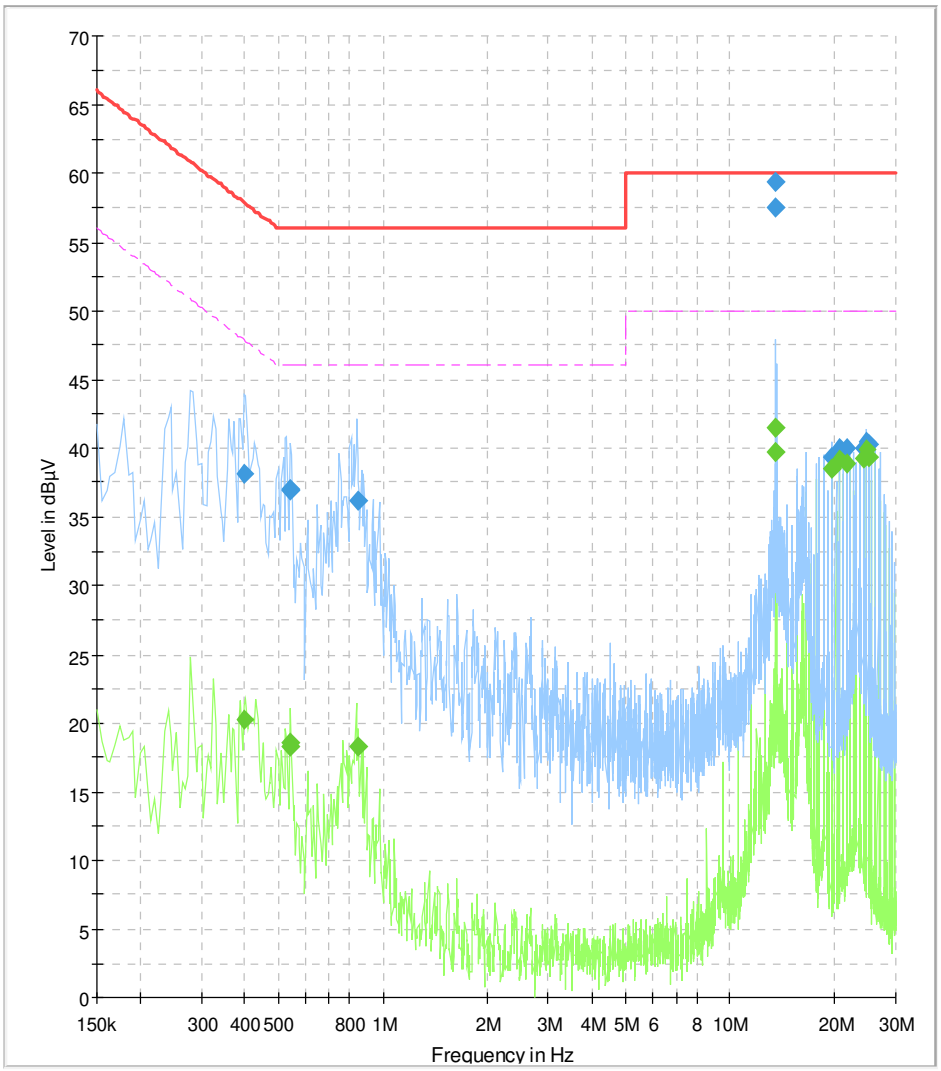
Preview Result 2-AVG
Limit AVG
Preview Result 1-PK+
Final_Result QPK
Limit QPK
Final_Result AVG

Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.281000	---	25.81	50.79	24.98	15000.0	9.000	N	10.1
0.281000	44.17	---	60.79	16.62	15000.0	9.000	N	10.1
0.283000	---	26.03	50.73	24.70	15000.0	9.000	N	10.1
0.283000	44.35	---	60.73	16.38	15000.0	9.000	N	10.1
0.284000	44.17	---	60.70	16.53	15000.0	9.000	N	10.1
0.284000	---	25.85	50.70	24.85	15000.0	9.000	N	10.1
0.326000	42.93	---	59.55	16.62	15000.0	9.000	N	10.1
0.326000	---	24.56	49.55	24.99	15000.0	9.000	N	10.1
0.537000	38.11	---	56.00	17.89	15000.0	9.000	N	10.1
0.537000	---	19.26	46.00	26.74	15000.0	9.000	N	10.1
0.843000	38.41	---	56.00	17.59	15000.0	9.000	N	10.2
0.843000	---	19.24	46.00	26.76	15000.0	9.000	N	10.2
13.562000	---	42.78	50.00	7.22	15000.0	9.000	N	10.7
13.562000	59.47	---	60.00	0.53	15000.0	9.000	N	10.7
13.564000	---	39.95	50.00	10.05	15000.0	9.000	N	10.7
13.564000	58.04	---	60.00	1.96	15000.0	9.000	N	10.7
15.646000	36.35	---	60.00	23.65	15000.0	9.000	N	10.8
15.646000	---	32.31	50.00	17.69	15000.0	9.000	N	10.8
20.379000	31.97	---	60.00	28.03	15000.0	9.000	N	10.9
20.379000	---	31.22	50.00	18.78	15000.0	9.000	N	10.9
21.226000	32.61	---	60.00	27.39	15000.0	9.000	N	11.0
21.226000	---	31.45	50.00	18.55	15000.0	9.000	N	11.0
22.075000	33.54	---	60.00	26.46	15000.0	9.000	N	11.0
22.075000	---	32.49	50.00	17.51	15000.0	9.000	N	11.0
22.926000	34.10	---	60.00	25.90	15000.0	9.000	N	10.9
22.926000	---	33.19	50.00	16.81	15000.0	9.000	N	10.9

EUT Information

EUT Name:	ARE i2.0x HF
Test_ID: / SN:	23-0148PR07-004
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Reading mode (cyclical reading every 80 ms)
Test specification:	47 CFR Part 15 Subpart C §15.207
LISN port	L1 / EUT
Operator:	S. Vogelmann
File #:	23-0148RC10-004-002
Comment #1:	
Comment #2:	



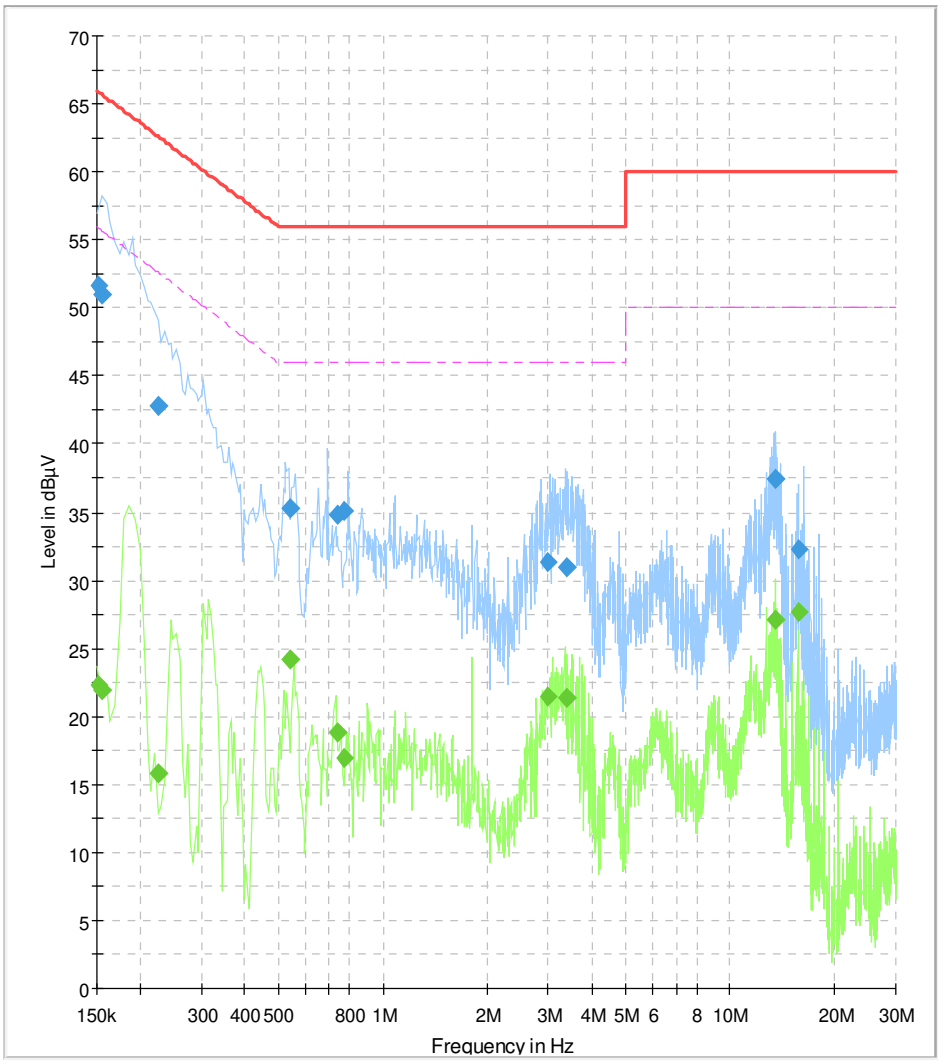
Preview Result 2-AVG
Limit AVG
Preview Result 1-PK+
Final_Result QPK
Limit QPK
Final_Result AVG

Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.400000	---	20.25	47.85	27.61	15000.0	9.000	L1	10.1
0.400000	38.15	---	57.85	19.71	15000.0	9.000	L1	10.1
0.538000	---	18.55	46.00	27.45	15000.0	9.000	L1	10.1
0.538000	37.00	---	56.00	19.00	15000.0	9.000	L1	10.1
0.540000	---	18.26	46.00	27.74	15000.0	9.000	L1	10.1
0.540000	36.88	---	56.00	19.12	15000.0	9.000	L1	10.1
0.844000	---	18.27	46.00	27.73	15000.0	9.000	L1	10.1
0.844000	36.21	---	56.00	19.79	15000.0	9.000	L1	10.1
13.563000	---	41.50	50.00	8.50	15000.0	9.000	L1	10.7
13.563000	59.40	---	60.00	0.60	15000.0	9.000	L1	10.7
13.564000	---	39.79	50.00	10.21	15000.0	9.000	L1	10.7
13.564000	57.54	---	60.00	2.46	15000.0	9.000	L1	10.7
19.625000	---	38.58	50.00	11.42	15000.0	9.000	L1	10.8
19.625000	39.44	---	60.00	20.56	15000.0	9.000	L1	10.8
20.628000	---	39.13	50.00	10.87	15000.0	9.000	L1	10.9
20.628000	39.99	---	60.00	20.01	15000.0	9.000	L1	10.9
21.633000	---	38.87	50.00	11.13	15000.0	9.000	L1	11.0
21.633000	40.01	---	60.00	19.99	15000.0	9.000	L1	11.0
24.152000	---	39.29	50.00	10.71	15000.0	9.000	L1	10.9
24.152000	40.05	---	60.00	19.95	15000.0	9.000	L1	10.9
24.653000	---	39.87	50.00	10.13	15000.0	9.000	L1	10.9
24.653000	40.51	---	60.00	19.49	15000.0	9.000	L1	10.9
25.158000	---	39.37	50.00	10.63	15000.0	9.000	L1	10.9
25.158000	40.27	---	60.00	19.73	15000.0	9.000	L1	10.9

EUT Information

EUT Name:	ARE i2.0x HF
Test_ID: / SN:	23-0148PR07-004
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Reading mode (cyclical reading every 80 ms)
Test specification:	47 CFR Part 15 Subpart C §15.207
LISN port	N / AE
Operator:	S. Vogelmann
File #:	23-0148RC10-004-003
Comment #1:	
Comment #2:	



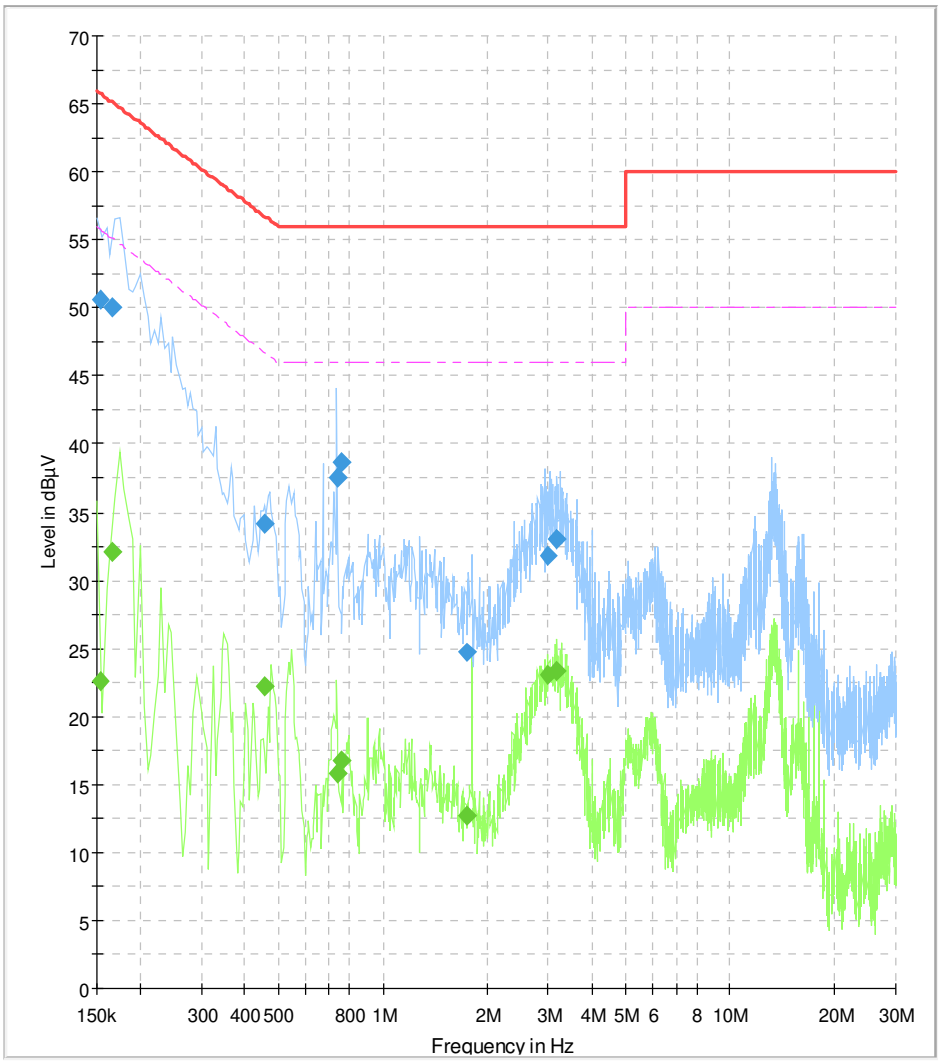
Preview Result 2-AVG
Limit AVG
Preview Result 1-PK+
Final_Result QPK
Limit QPK
Final_Result AVG

Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.152000	51.72	---	65.89	14.17	15000.0	9.000	N	10.0
0.152000	---	22.33	55.89	33.56	15000.0	9.000	N	10.0
0.156000	51.08	---	65.67	14.60	15000.0	9.000	N	10.0
0.156000	---	21.97	55.67	33.70	15000.0	9.000	N	10.0
0.225000	42.77	---	62.63	19.87	15000.0	9.000	N	10.1
0.225000	---	15.79	52.63	36.84	15000.0	9.000	N	10.1
0.543000	35.37	---	56.00	20.63	15000.0	9.000	N	10.1
0.543000	---	24.19	46.00	21.81	15000.0	9.000	N	10.1
0.741000	34.84	---	56.00	21.16	15000.0	9.000	N	10.2
0.741000	---	18.84	46.00	27.16	15000.0	9.000	N	10.2
0.773000	35.02	---	56.00	20.98	15000.0	9.000	N	10.2
0.773000	---	16.96	46.00	29.04	15000.0	9.000	N	10.2
3.004000	31.28	---	56.00	24.72	15000.0	9.000	N	10.3
3.004000	---	21.44	46.00	24.56	15000.0	9.000	N	10.3
3.402000	30.93	---	56.00	25.07	15000.0	9.000	N	10.3
3.402000	---	21.29	46.00	24.71	15000.0	9.000	N	10.3
13.561000	37.41	---	60.00	22.59	15000.0	9.000	N	10.7
13.561000	---	27.10	50.00	22.90	15000.0	9.000	N	10.7
15.726000	32.31	---	60.00	27.69	15000.0	9.000	N	10.8
15.726000	---	27.67	50.00	22.33	15000.0	9.000	N	10.8

EUT Information

EUT Name:	ARE i2.0x HF
Test_ID: / SN:	23-0148PR07-004
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Reading mode (cyclical reading every 80 ms)
Test specification:	47 CFR Part 15 Subpart C §15.207
LISN port	L1 / AE
Operator:	S. Vogelmann
File #:	23-0148RC10-004-004
Comment #1:	
Comment #2:	



Preview Result 2-AVG
Limit AVG
Preview Result 1-PK+
Final_Result QPK
Limit QPK
Final_Result AVG

Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.154000	---	22.63	55.78	33.16	15000.0	9.000	L1	10.0
0.154000	50.71	---	65.78	15.07	15000.0	9.000	L1	10.0
0.166000	---	32.02	55.16	23.14	15000.0	9.000	L1	10.0
0.166000	50.06	---	65.16	15.10	15000.0	9.000	L1	10.0
0.455000	34.22	---	56.78	22.56	15000.0	9.000	L1	10.1
0.455000	---	22.19	46.78	24.60	15000.0	9.000	L1	10.1
0.745000	37.56	---	56.00	18.44	15000.0	9.000	L1	10.1
0.745000	---	15.88	46.00	30.12	15000.0	9.000	L1	10.1
0.761000	38.66	---	56.00	17.34	15000.0	9.000	L1	10.1
0.761000	---	16.69	46.00	29.31	15000.0	9.000	L1	10.1
1.735000	24.68	---	56.00	31.32	15000.0	9.000	L1	10.2
1.735000	---	12.77	46.00	33.23	15000.0	9.000	L1	10.2
3.003000	31.76	---	56.00	24.24	15000.0	9.000	L1	10.3
3.003000	---	23.07	46.00	22.93	15000.0	9.000	L1	10.3
3.180000	33.11	---	56.00	22.89	15000.0	9.000	L1	10.3
3.180000	---	23.33	46.00	22.67	15000.0	9.000	L1	10.3

6.5 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 30MHz. 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.

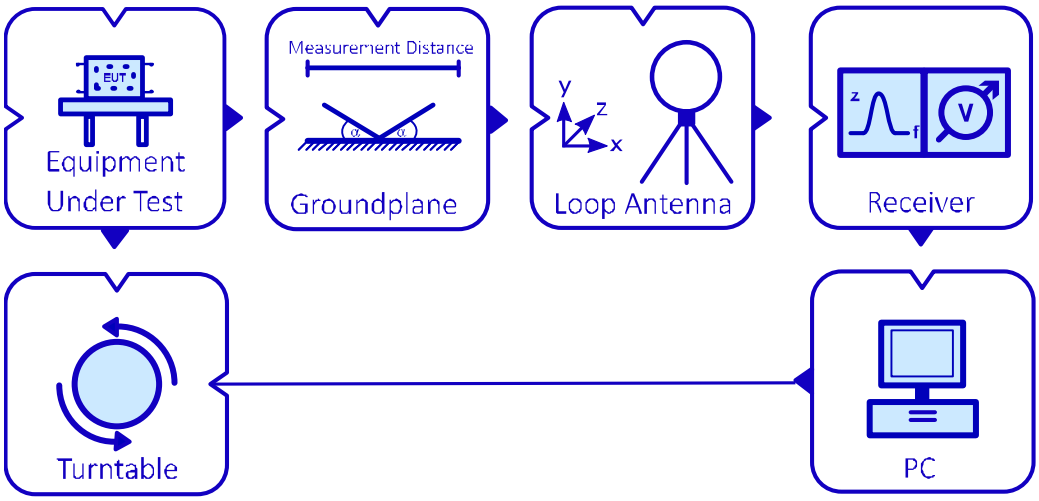
The reported test results are calculated using the following formula to normalize the results for the requested test distance:

Field strength (dBμV/m) = Reading (dBμV) + AF (dB/m) + CF (dB) + 40 *(D_T/D_R) (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

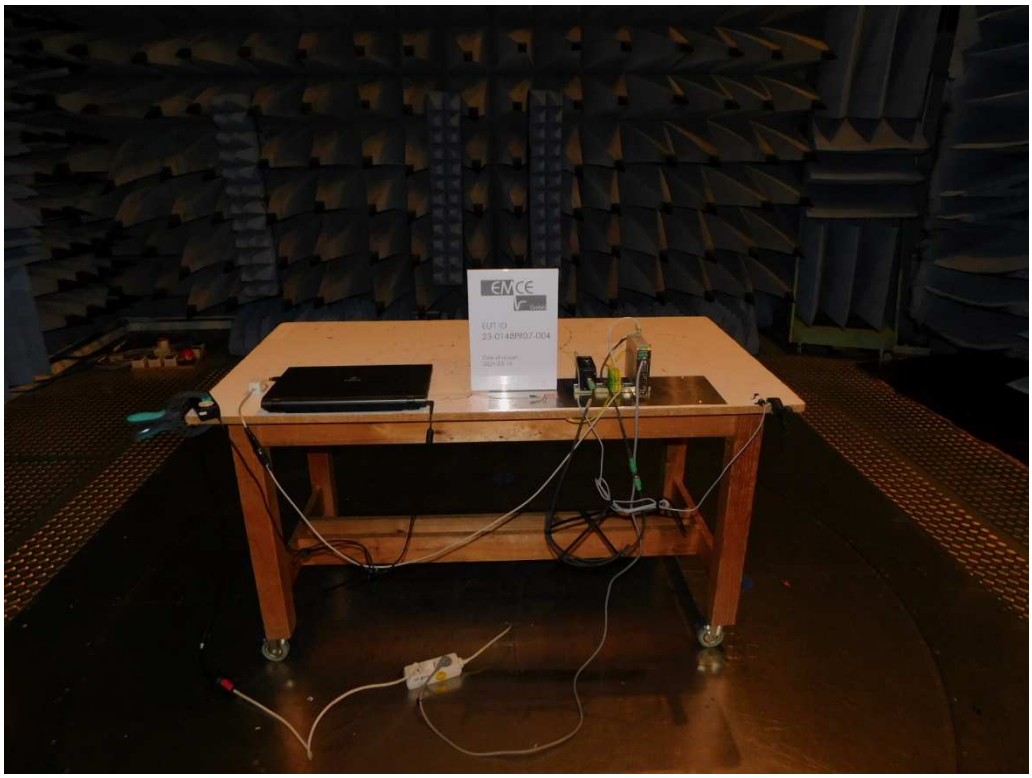
Basic structure - Setup

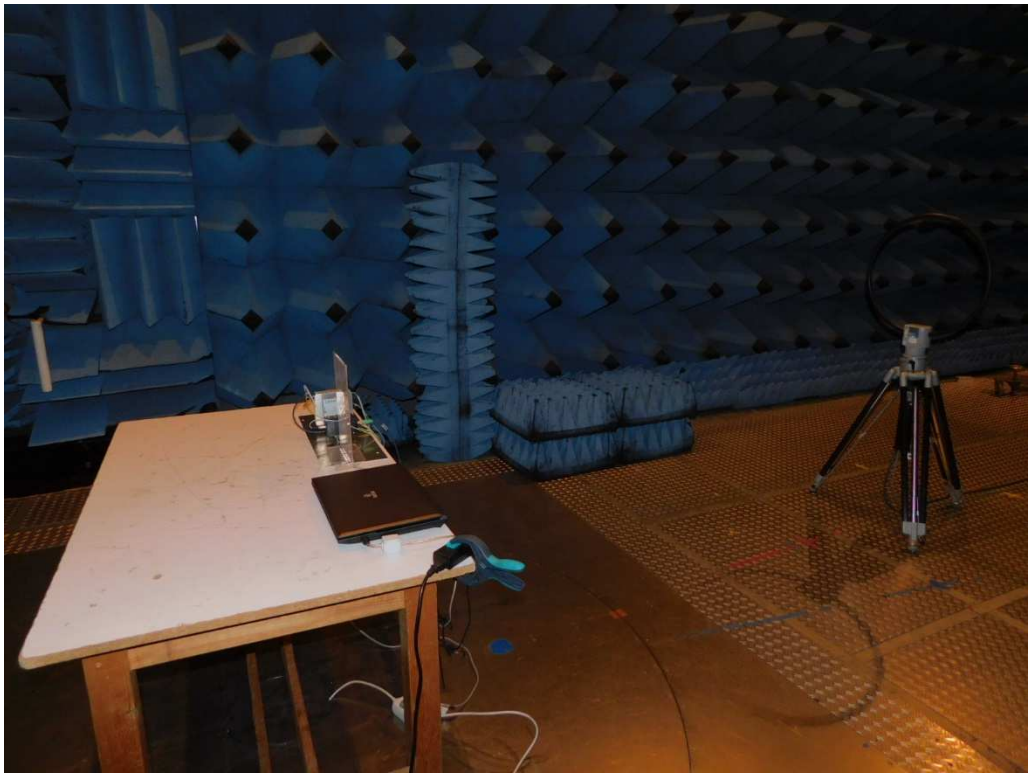
OATS / SAC



6.5.1 Test set up

According ANSI C63.10-2013





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
	1345	Open area test site	3 - 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	Measurement uncertainty
9 kHz – 30 MHz	on request

6.5.2 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 / µV/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			

☒ The level of any unwanted emissions shall not exceed the level of the fundamental frequency.

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:

Minimal setup with EUT and external power supply unit. The DIN rail housing of the EUT and the power supply unit were mounted together on a metal plate at a distance of >10 cm from each other. The metal plate was earthed via the power supply unit. 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	☐ Internal battery

The EUT was operated in read mode at maximum read speed, with a read cycle being started every 80 ms. The data read was sent to a PC connected to the EUT via a USB interface. No tag was used during the measurement.

Environmental conditions

Temperature [10 – 40 °C]:	26 °C
Relative humidity [10 – 90 %]:	32 %
Environmental conditions during the test:	☒ kept ☐ not kept

Test result

Limits for unwanted radiated emissions:	☒ kept ☐ not kept
No unwanted radiated emissions exceed the level of the fundamental frequency:	☒ kept ☐ not kept

Remarks: n/a

Records

Pre-compliance measurement

☒ Readings

☒ Diagram

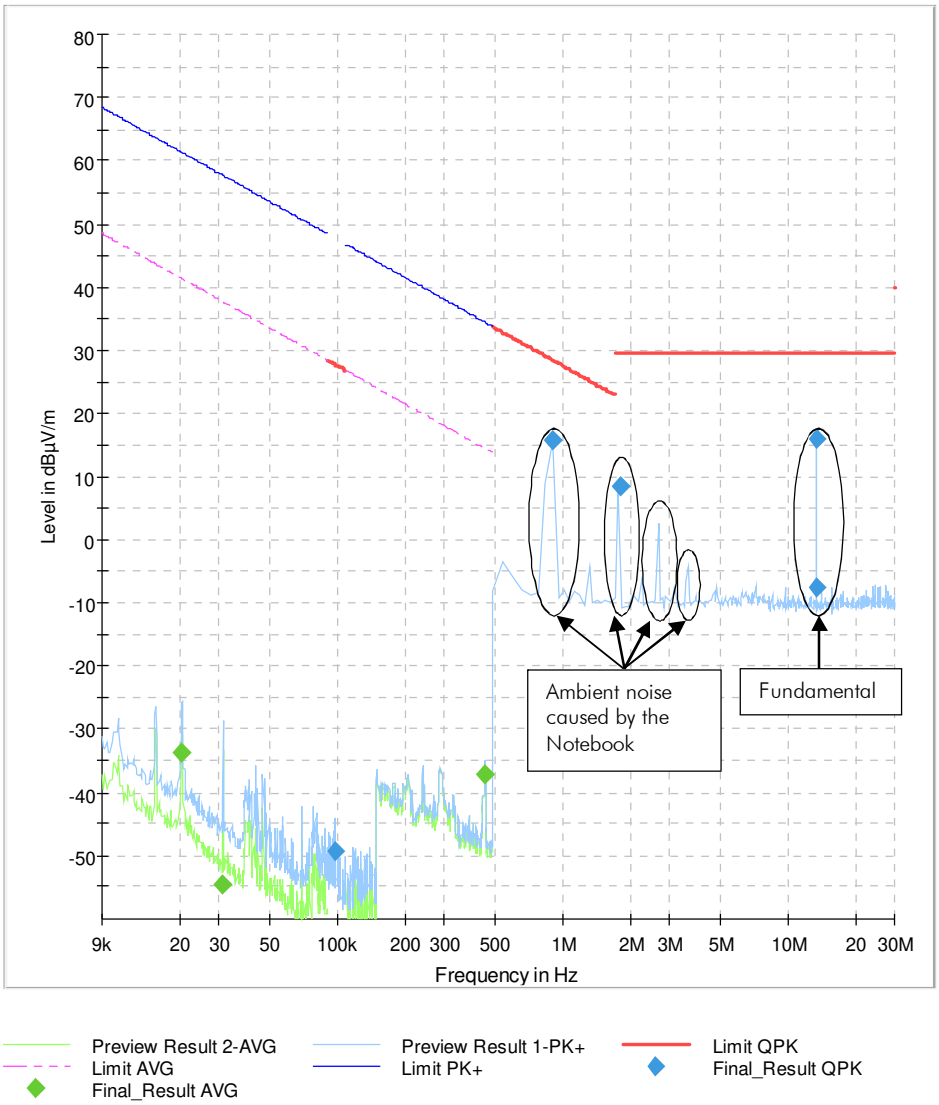
Final measurement

☒ Readings

☒ Diagram

EUT Information

EUT Name:	ARE i2.0x HF
Test_ID: / SN:	23-0148PR07-004
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Reading mode (cyclical reading every 80 ms)
Test specification:	47 CFR Part 15 Subpart C §15.209
Antenna information:	Distance EUT-Ant.: 3.0 m / Polarisation: Para./Orth./ Ant.Height: 1.0 m.
Operator:	S. Vogelmann
File #:	23-0148RC10-004-007
Comment #1:	Test results normalized to antenna distances according to §15.209.
Comment #2:	



Pre-Test Result – SAC @3.0 m antenna distance

Frequency (MHz)	QuasiPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
0.020385	---	-33.69	41.42 @300m	75.11	5000.0	0.200	Parallel	17.0	-59.8
0.030587	---	-54.63	37.89 @300m	92.53	5000.0	0.200	Parallel	25.0	-59.9
0.097930	-49.20	---	27.79 @300m	76.99	5000.0	0.200	Parallel	268.0	-60.0
0.452380	---	-37.13	14.49 @300m	51.62	5000.0	9.000	Parallel	289.0	-60.1
0.902265*	15.85	---	28.50 @30m	12.65	5000.0	9.000	Parallel	286.0	-20.0
1.804569*	8.55	---	29.54 @30m	20.99	5000.0	9.000	Parallel	292.0	-20.1
13.522585**	-7.62	---	---	---	5000.0	9.000	Parallel	34.0	-19.7
13.559559**	16.08	---	---	---	5000.0	9.000	Parallel	26.0	-19.7
Test results normalized to reference distance for limit value with 40 dB/Dec.									

*** Ambient noise caused by notebook inside the field.**
**** Evaluation of the fundamental in chapter 6.8**

Final Result

No result - Margin ≥ 20 dB.

6.6 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	47 CFR Part 15 Section 15.209 (a)(b)(c)(d)(e)(f)
Guide	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 ±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:

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

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:

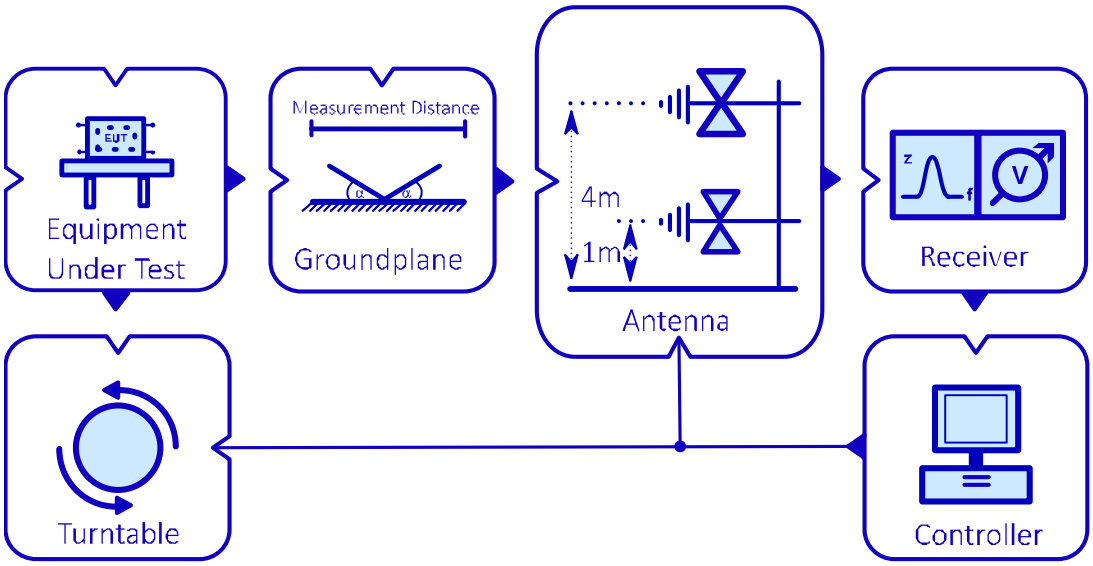
Test frequency	500.00 MHz
Reading	12.3 dBµV
$AF_{(500.00\ MHz)}$	17.1 dB/m
$CF_{(500.00\ MHz)}$	1.4 dB
DT =	3 m
DR =	3 m

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

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

Basic structure - Setup

OATS / SAC

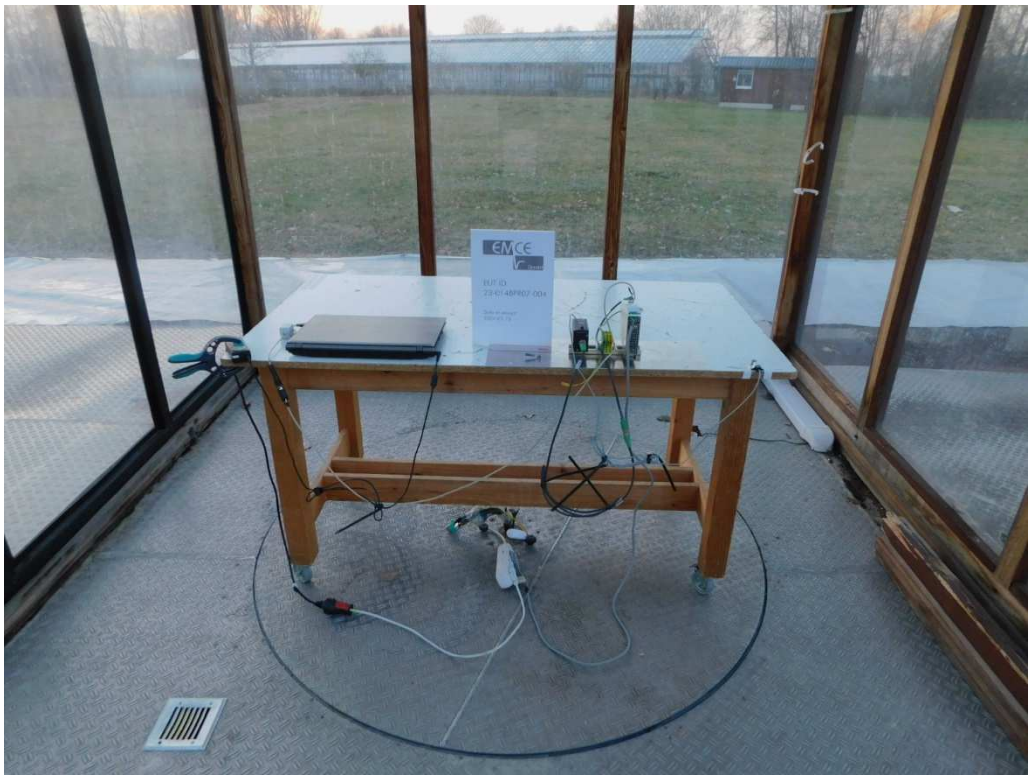


6.6.1 Test set up

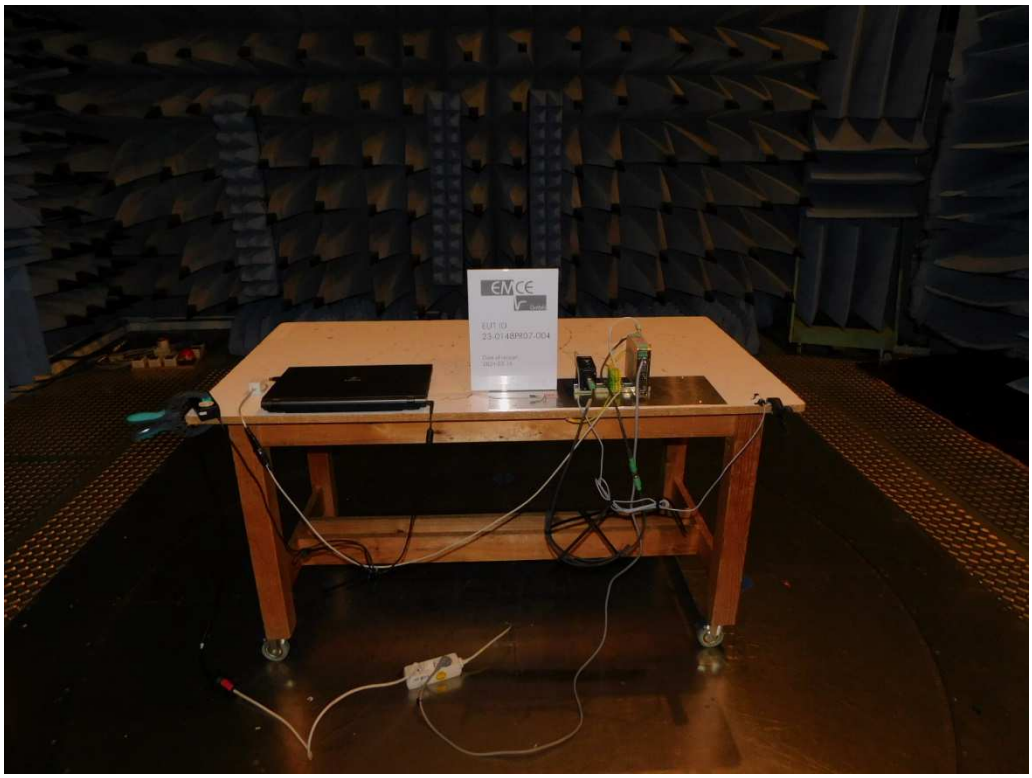
According ANSI C63.10-2013

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 – 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)

6.6.2 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:	Upper frequency of measurement:
☒ <10 GHz	☒ 10th harmonic of the highest frequency or 40 GHz, whichever is lower
☐ 10 GHz – 30 GHz	☐ 5th harmonic of the highest frequency or 100 GHz, whichever is lower
☐ 30 GHz – 95 GHz	☐ 5th harmonic of the highest frequency or 200 GHz, whichever is lower
☐ ≥95 GHz	☐ 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:

Minimal setup with EUT and external power supply unit. The DIN rail housing of the EUT and the power supply unit were mounted together on a metal plate at a distance of >10 cm from each other. The metal plate was earthed via the power supply unit. 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.

EUT Orientation

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

Operation mode

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

The EUT was operated in read mode at maximum read speed, with a read cycle being started every 80 ms. The data read was sent to a PC connected to the EUT via a USB interface. No tag was used during the measurement.

Environmental conditions - SAC

Temperature [10 – 40 °C]:	22 °C
Relative humidity [10 – 90 %]:	31 %
Environmental conditions during the test:	☒ kept ☐ not kept

Environmental conditions - OATS

Temperature [10 – 40 °C]:	16 °C
Relative humidity [10 – 90 %]:	43 %
Environmental conditions during the test:	☒ kept ☐ not kept

Test result

Limits for unwanted radiated emissions: ☒ kept
☐ not kept

Remarks: n/a

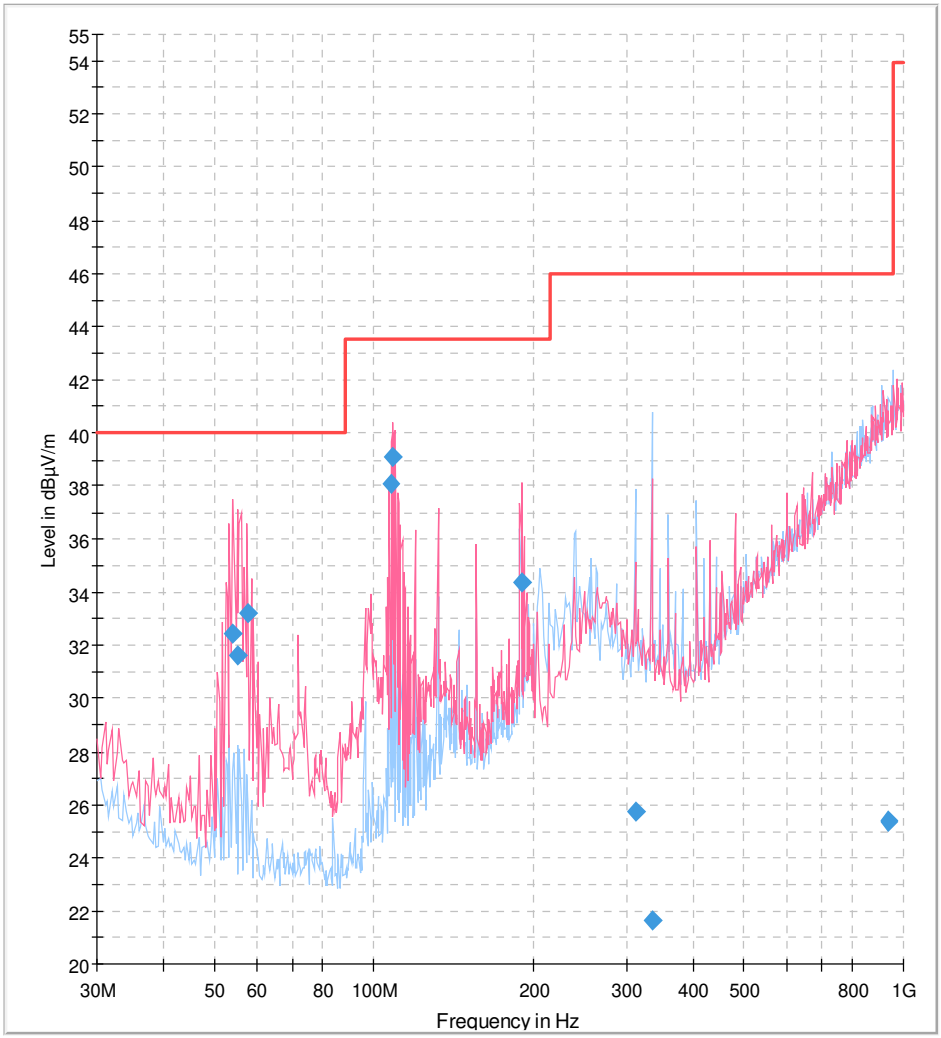
Records

Pre-compliance measurement
☒ Readings
☒ Diagram

Final measurement
☒ Readings
☒ Diagram

EUT Information

EUT Name:	ARE i2.0x HF
Test_ID: / SN:	23-0148PR07-004
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Reading mode (cyclical reading every 80 ms)
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 #:	23-0148RC10-007-009
Comment #1:	No tag inside the field.



Preview Result 1H-PK+
Limit QPK
Preview Result 1V-PK+
Final_Result QPK

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
54.341082	32.47	40.00	7.53	5000.0	120.000	112.0	V	10.0	10.3
55.192385	31.62	40.00	8.38	5000.0	120.000	120.0	V	4.0	10.3
57.776753	33.25	40.00	6.75	5000.0	120.000	179.0	V	-3.0	10.1
107.896994	38.05	43.50	5.45	5000.0	120.000	103.0	V	49.0	10.9
108.710622	39.11	43.50	4.39	5000.0	120.000	113.0	V	73.0	10.9
189.866533	34.38	43.50	9.12	5000.0	120.000	105.0	V	184.0	15.1
310.935071	25.77	46.00	20.23	5000.0	120.000	105.0	H	311.0	14.7
334.194389	21.63	46.00	24.37	5000.0	120.000	135.0	H	344.0	15.4
406.283367	18.41	46.00	27.59	5000.0	120.000	330.0	H	1.0	17.2
932.926253	25.38	46.00	20.62	5000.0	120.000	208.0	H	131.0	25.1
935.822445	25.43	46.00	20.57	5000.0	120.000	172.0	H	0.0	25.1

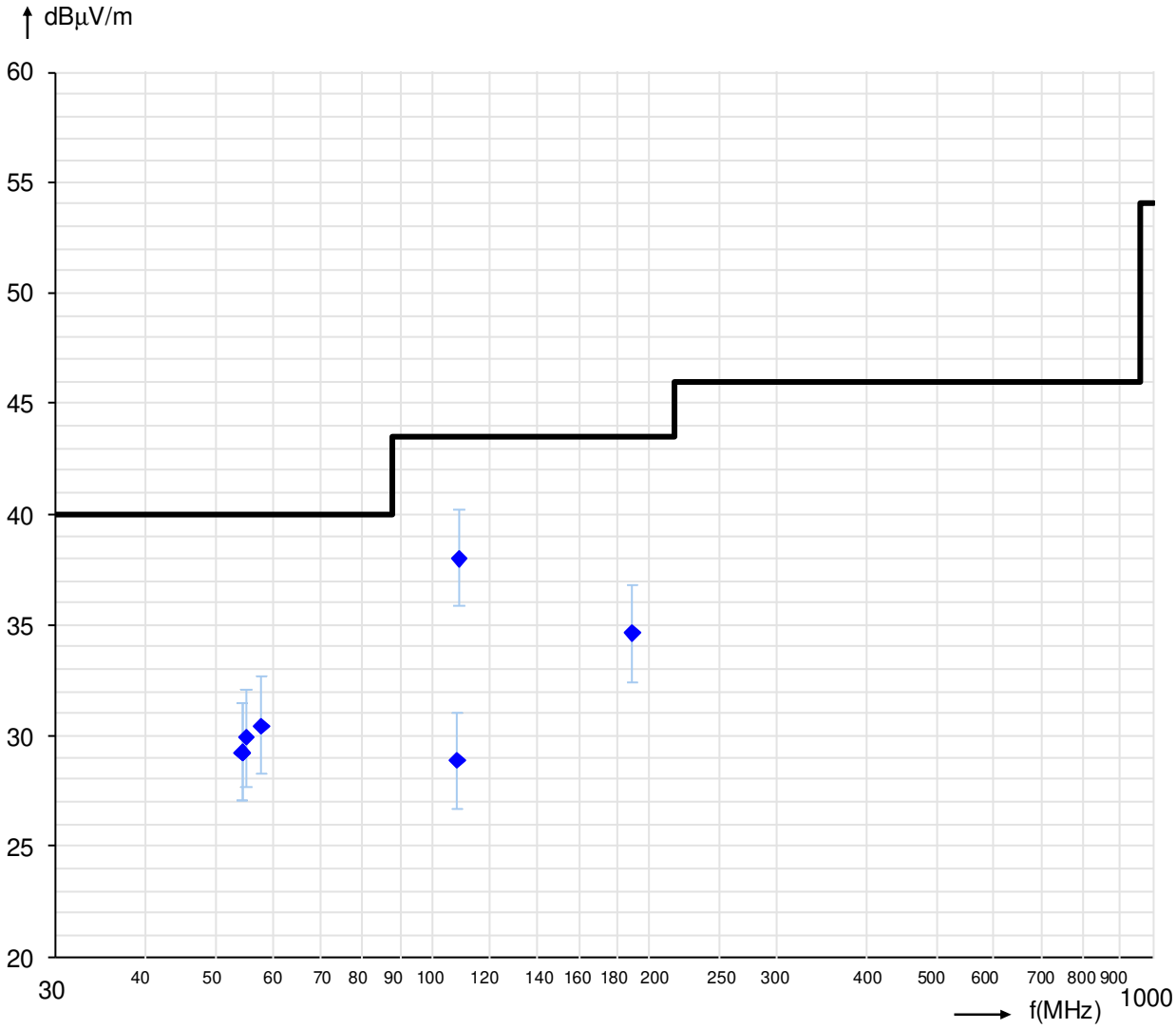
Final measurement

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
54.341	18.8	9.6	0.9	29.3	40.0	10.7	V	1.00	170
55.192	19.5	9.5	0.9	29.9	40.0	10.1	V	1.00	175
57.729	20.2	9.4	0.9	30.5	40.0	9.5	V	1.00	90
107.960	17.6	10.0	1.2	28.9	43.5	14.6	V	1.00	90
108.650	26.7	10.1	1.2	38.0	43.5	5.5	V	1.00	90
189.847	19.1	13.9	1.7	34.6	43.5	8.9	V	1.00	0

Diagram radio disturbances – Antenna horizontal / vertical polarized

Limit: 47 CFR Part 15 Subpart C §15.209



6.7 Emission bandwidth inside the operating frequency band

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

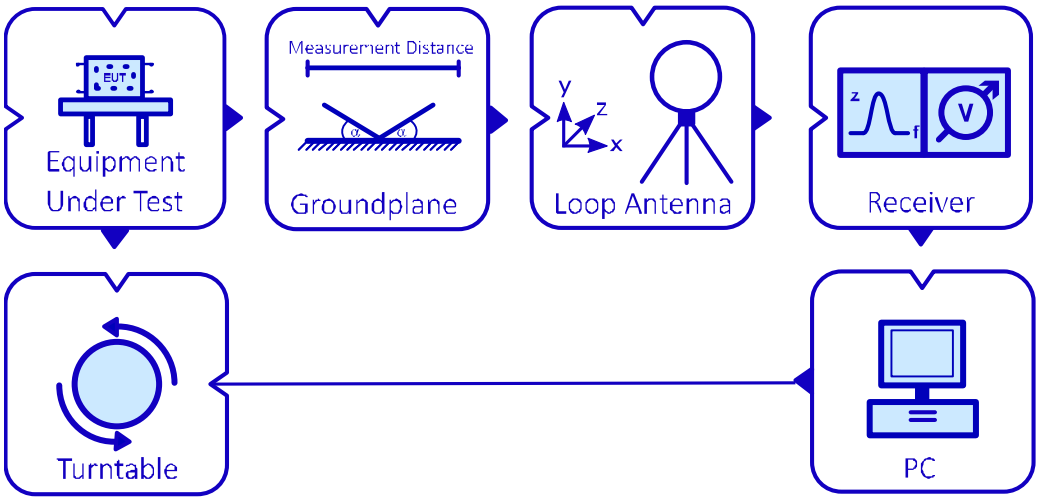
Measurement procedure:

Rules and specification	47 CFR Part 15 Section 15.215 (c)
Guide	ANSI C63.10-2013

The occupied bandwidth is measured as the width of the spectral envelope of the modulated signal, at an amplitude level reduced from a reference value by 20 dB. The reference value is either the level of the unmodulated carrier or the highest level of the spectral envelope of the modulated signal, as stated by the applicable requirement. The test is performed in a semi anechoic chamber while the EUT is positioned to a receiving antenna for maximum output power. The modulated signal is recorded with an analyzer.
The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. After the trace of the spectrum analyzer is stabilized the envelope of the signal the amplitude -20 dB below the reference value is determined. The occupied bandwidth is the calculated value between both specific - 20 dB frequency positions.

Basic structure - Setup

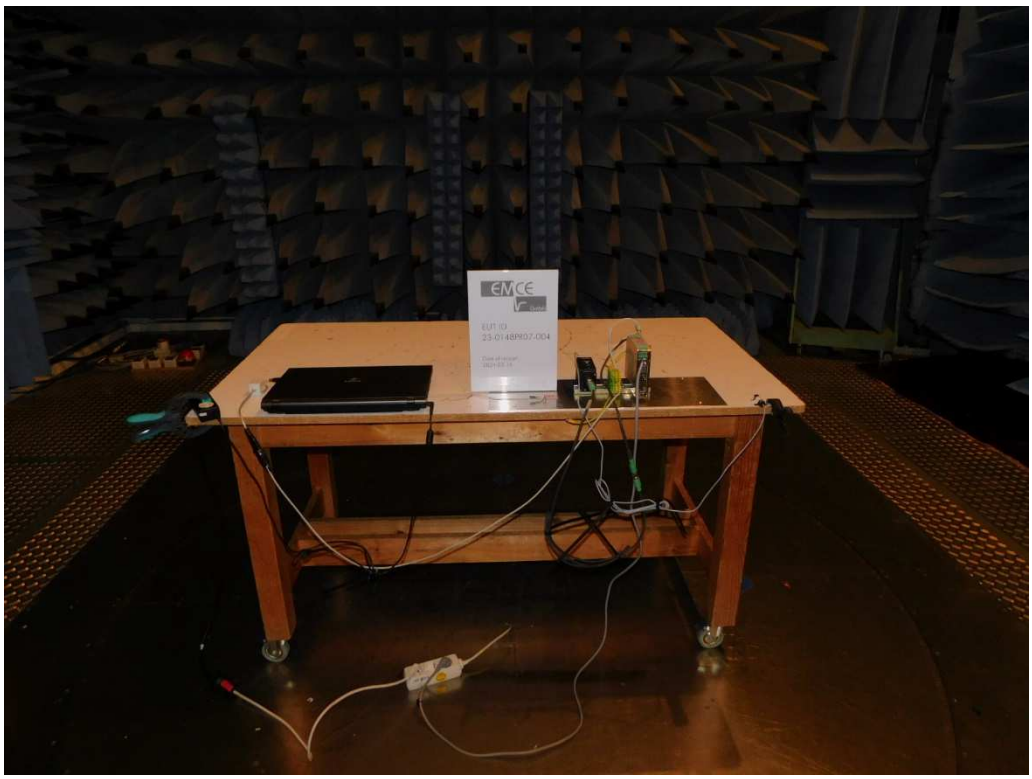
OATS / SAC

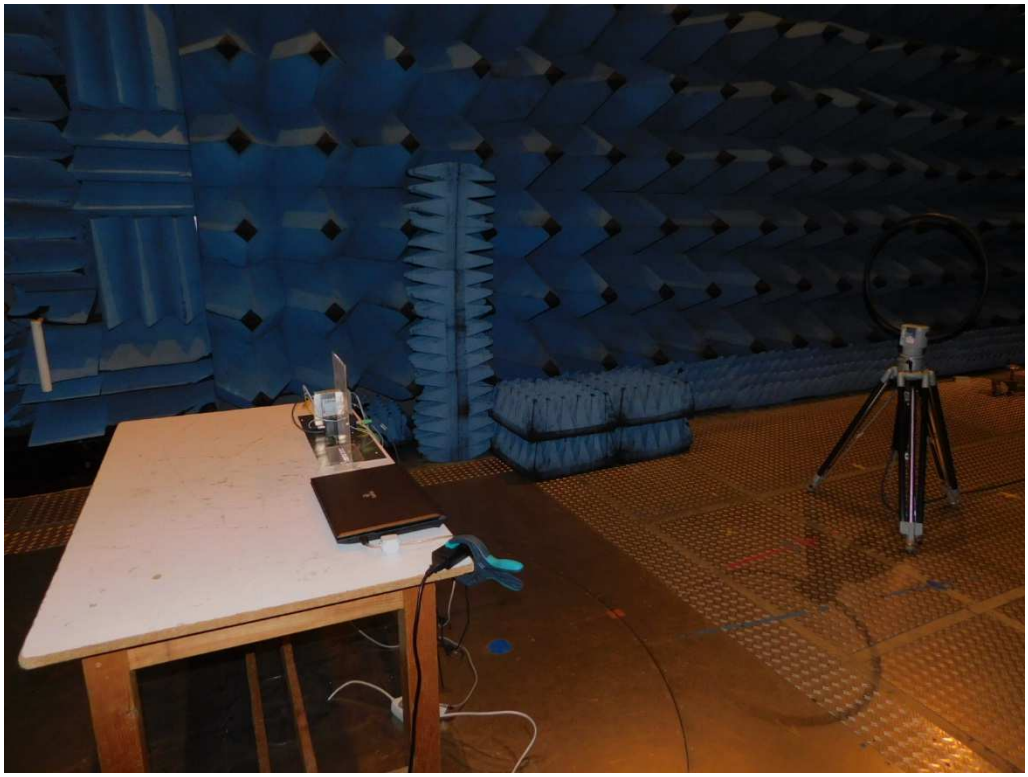


6.7.1 Test set up

According ANSI C63.10-2013

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





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
	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
	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 radiated emission with an extended coverage factor of k = 2:

Frequency	Measurement uncertainty
9 kHz – 30 MHz	on request

6.7.2 Test

Rules and specification	47 CFR Part 15 Section 15.215 (c)
Frequency range:	9 kHz – 30 MHz
20 dB Emission BW	Inside operating frequency band

Operation mode

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

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]:	16 °C
Relative humidity [10 – 90 %]:	43 %

Environmental conditions during the test: ☒ kept ☐ not kept

Test result

Nominal frequency / MHz	-20 dBc @ lower frequency / MHz	-20 dBc @ upper frequency / MHz	20 dB BW / kHz
13.560000	13.557940	13.563017	5.077

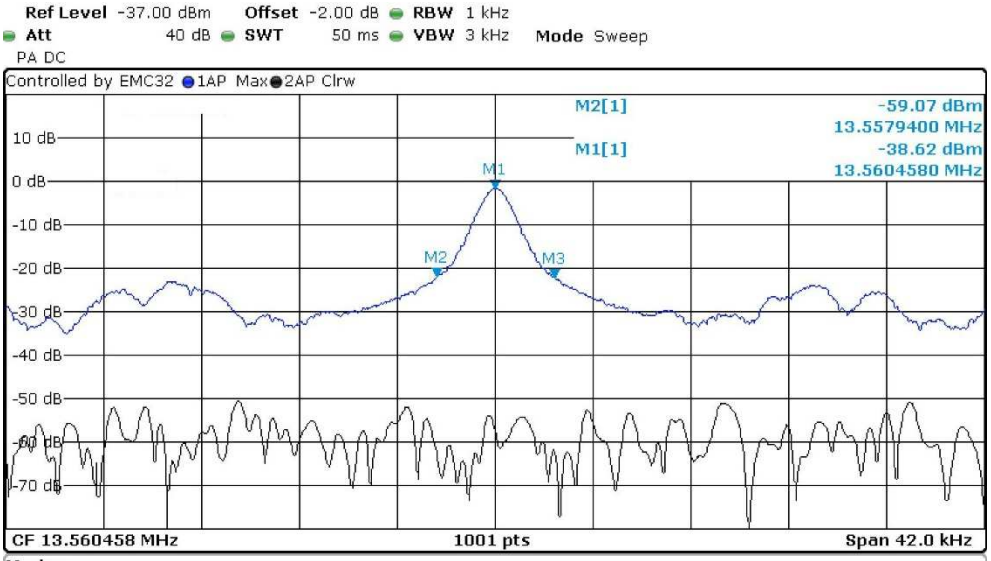
20 dB BW within the used frequency band 13.110 – 14.010 MHz: ☒ kept ☐ not kept.

Remarks: n/a

Records

☒ Readings
☒ Diagram

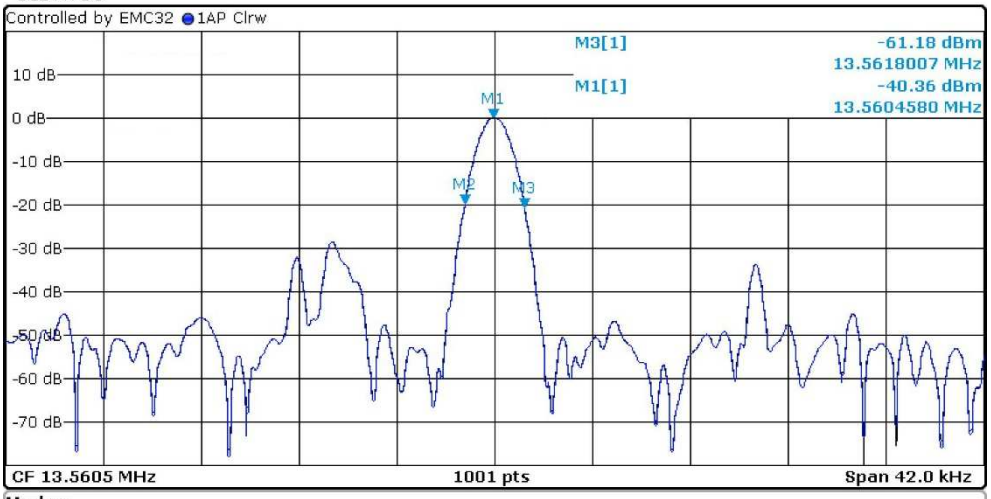
20 dB Bandwidth - Relative measurement	
Nominal frequency:	13.56 MHz



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	13.560458 MHz	-38.62 dBm		
M2		1	13.55794 MHz	-59.07 dBm		
M3		1	13.563017 MHz	-59.16 dBm		

20 dB Bandwidth - Relative measurement (single measurement)	
Nominal frequency:	13.56 MHz



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	13.560458 MHz	-40.36 dBm		
M2		1	13.5591993 MHz	-60.24 dBm		
M3		1	13.5618007 MHz	-61.18 dBm		

6.8 Field strength mask within the operation band 13.110-14.010 MHz

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

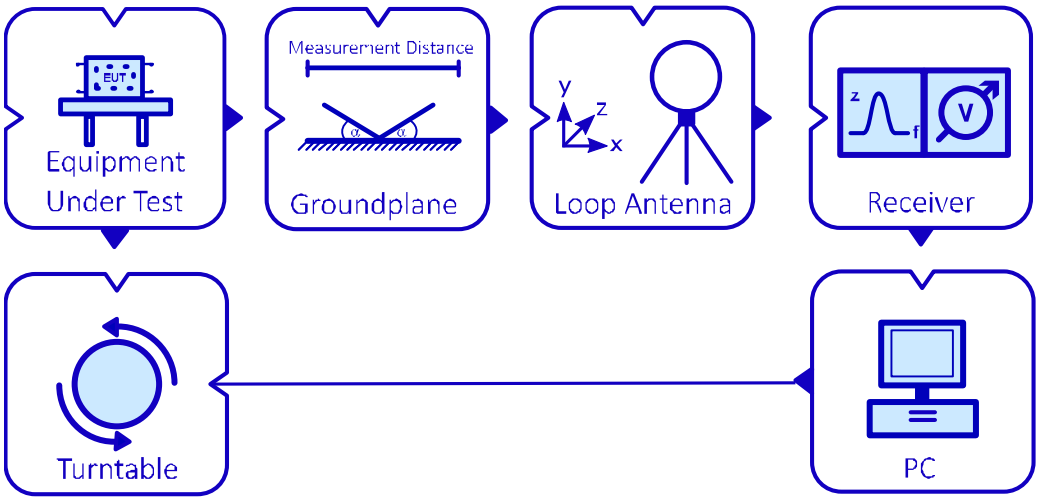
Measurement procedure:

Rules and specification	47 CFR Part 15 Section 15.225 (a)(b)(c)(d)
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 field strength mask. Measurements shall be made around the EUT and the orientation of the measurement antenna shall be investigated to determine the maximum radiated emission level. Cables or wires shall be manipulated within the range of likely arrangements to maximize the measured emission levels. External antenna(s) shall be positioned for maximum radiated emissions. If the EUT is equipped with or uses an adjustable antenna, then the EUT antenna shall be manipulated through typical positions and lengths during exploratory testing to maximize emission levels. Where EUTs are designed to be installed in one of two orientations (be located horizontally on a table or mounted vertically to the wall), these devices shall be tested in both orientations. EUTs that can be operated in multiple orientations (such as handheld, portable, or modular devices) shall be tested in three
orientations. However, in all cases, the antenna shall be adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. When rotating the EUT, the maximum antenna coupling between the EUT and the measurement antenna
must be achieved at some point during the rotation.

Basic structure - Setup

OATS / SAC



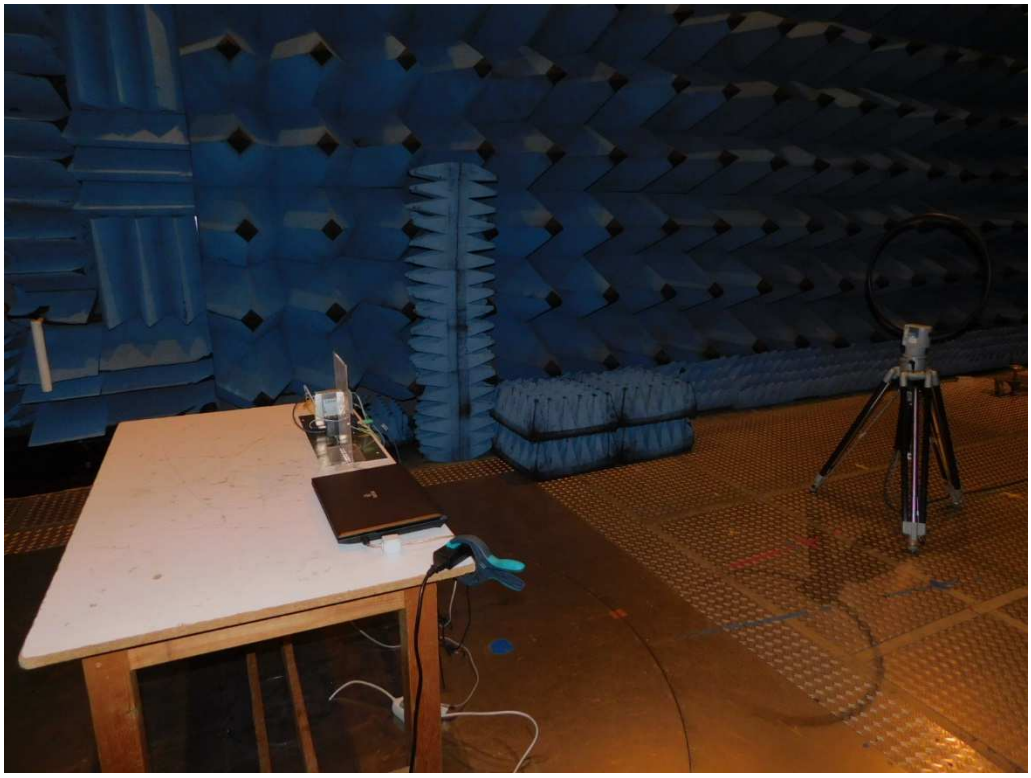
6.8.1 Test set up

According ANSI C63.10-2013

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

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
☒	1345	Open area test site	3 - 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
☒	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	Measurement uncertainty
9 kHz – 30 MHz	on request

6.8.2 Test

Rules and specification 47 CFR Part 15 Section 15.225 (a)(b)(c)(d)

Limits for radiated emissions

Technical requirements				
Detector	Frequency / MHz	QP-Limit / dBµV/m	RBW / kHz	Measurement distance / m
QP	13.110 – 13.410	40.5	10	30
QP	13.410 – 13.553	50.5	10	30
QP	13.553 – 13.567	84.0	10	30
QP	13.567 – 13.710	50.5	10	30
QP	13.710 – 14.010	40.5	10	30
The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.				

Operation mode

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

The EUT was operated in read mode at maximum read speed, with a read cycle being started every 80 ms. The data read was sent to a PC connected to the EUT via a USB interface. No tag was used during the measurement.

Environmental conditions

Temperature [10 – 40 °C]: 16 °C
Relative humidity [10 – 90 %]: 43 %

Environmental conditions during the test: ☒ kept
☐ not kept

Test result

Limits for the field strength mask:
13.110 – 14.010 MHz:

☒ kept
☐ not kept.

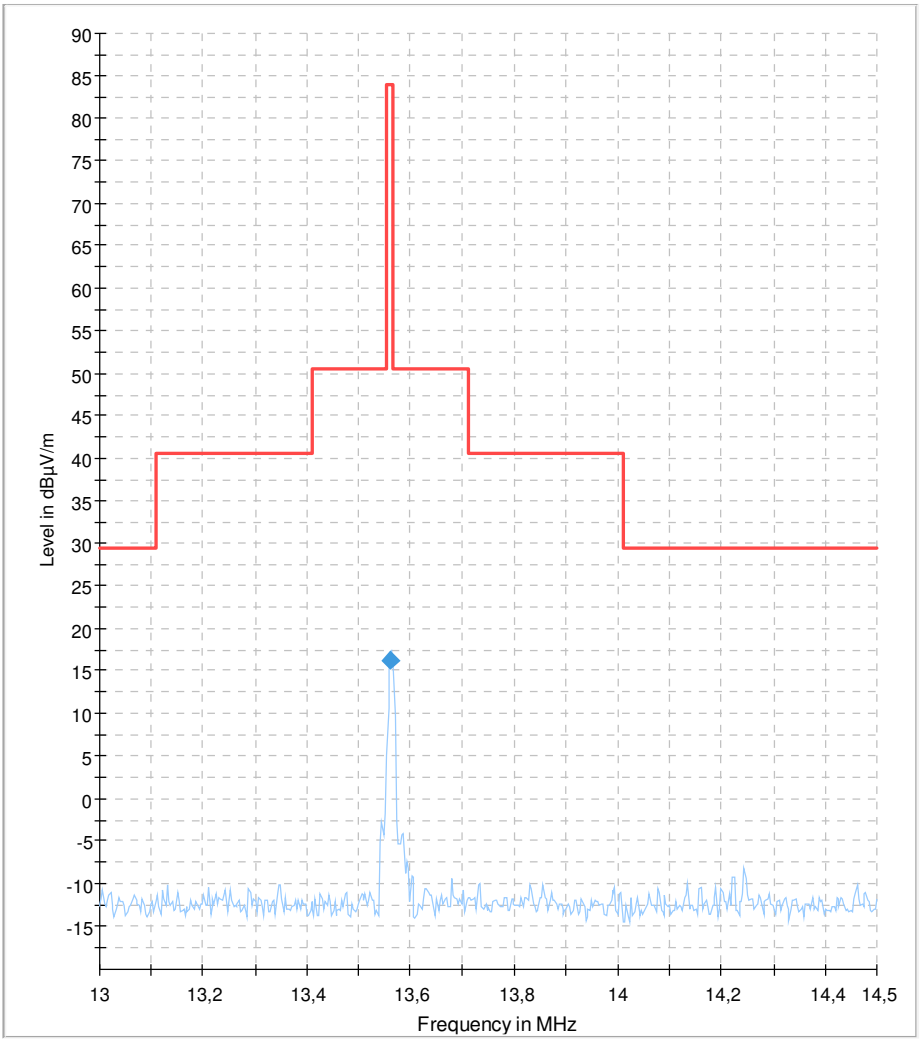
Remarks: n/a

Records

☒ Readings
☒ Diagram

EUT Information

EUT Name:	ARE i2.0x HF
Test_ID: / SN:	23-0148PR07-004
Customer:	AEG Identifikationssysteme GmbH
Operational condition:	Reading mode (cyclical reading every 80 ms)
Test specification:	47 CFR Part 15 Subpart C §15.225 SAC @30 m
Antenna information:	Distance EUT-Ant.: 3.0 m / Polarisation: Para./Orth./ Ant.Height: 1.0 m.
Operator:	S. Vogelmann
File #:	23-0148RC10-007-009
Comment #1:	Test results normalized to 30 m test distance.
Comment #2:	



Preview Result 2-AVG
Final_Result QPK
Preview Result 1-PK+
Final_Result AVG
Limit QPK

Pre-Test Result – SAC @3.0 m antenna distance

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
13.560124	16.32	84.00	67.68	5000.0	9.000	Parallel	25.0	-19.7

Final Result - OATS @10.0 m antenna distance

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Receiver 6dB BW (kHz)	Ant.-Orientation	Azimuth (deg)	Corr. (dB/m)
13.5600	22.42	84.00 @30m	61.58	5000.0	9.000	Parallel	75	0.92
13.5600	22.62	84.00 @30m	61.38	5000.0	9.000	Orthogonal	75	0.92
Test results normalized to reference distance for limit value with 40 dB/Dec.								

6.9 Frequency stability

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

Measurement procedure:

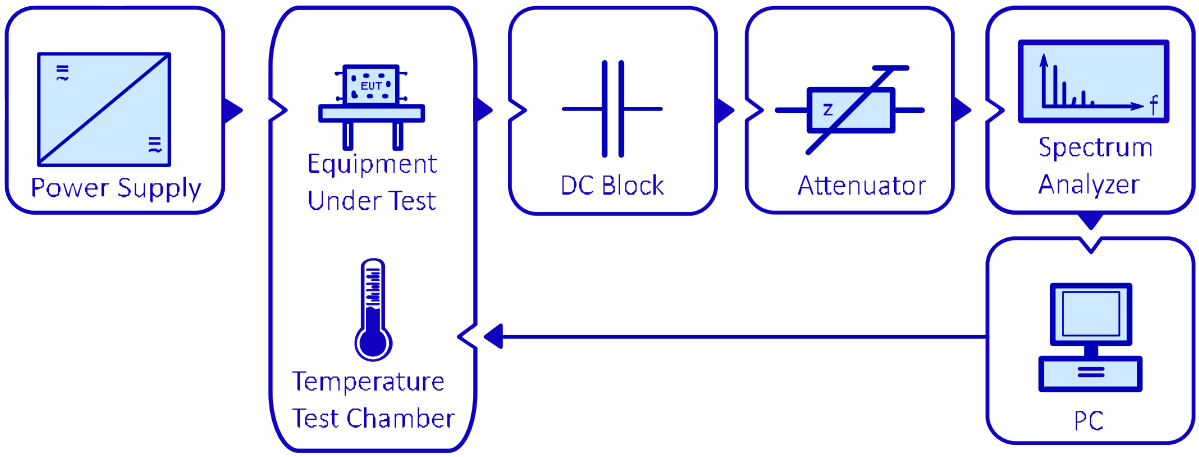
Rules and specification	47 CFR Part 15 Section 15.225 (e)(f)
Guide	ANSI C63.10-2013

The frequency stability of the carrier frequency of an intentional radiator is determined over a temperature range of -20° C to + 50° C and at supply voltages of 85 % to 115 % of the nominal voltage at 20 °C ambient temperature. For battery-powered devices, a new battery is used or, if possible, an external power supply is used to set 115 %, 100% and 85 % of the battery normal voltage. If an antenna connection is available, the transmitter is connected directly to the input of a spectrum analyzer. If necessary, an impedance matching network and a DC blocking filter are also connected in between. Alternatively, a test fixture is used. The transmitter is operated unmodulated. The peak detector of the spectrum analyzer is used, whereby the resolution bandwidth and video bandwidth are selected accordingly to achieve the highest possible accuracy. Starting from the highest temperature, the temperature range is lowered in 10° steps to the lowest temperature. At each temperature, the DUT is switched on after reaching a stable value and the carrier frequency is determined at switch-on, after 2, 5 and 10 minutes.

Frequency stability test with respect to supply voltage variation is performed when, the EUT is supplied by nominal voltage at ambient temperature of +20 °C. The EUT is turned on and its output coupled to a spectrum analyzer by a test antenna placed near (approx.. 15 cm) the EUT. The spectrum analyzer is adjusted to obtain a suitable signal. The frequency is recorded at 85 %; 100 % and 115 % nominal voltage.

Basic structure - Setup

OATS / SAC



6.9.1 Test set up

According ANSI C63.10-2013

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

Test location

Final test					
☒	Inv.-No.	Designation	Type (L x W x H)	Manufacturer	Location
☒	1046	Environmental Simulation Chamber -40 - +180 °C 10 % - 98 % r.H.	Indoor 0.6 x 0.4 x 0.48 m	Binder GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden

Used test equipment

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
☒	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

6.9.2 Test

Rules and specification	47 CFR Part 15 Section 15.225 (e)(f)
Frequency range:	13.110 - 14.010 MHz
Temperature range:	+50 °C down to –20 °C
Voltage range:	85 % to 115 % of the rated supply voltage
Frequency tolerance:	±0.01% of the operating frequency

Operation mode

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

The EUT was operated in read mode at maximum read speed, with a read cycle being started every 80 ms. The data read was sent to a PC connected to the EUT via a USB interface. No tag was used during the measurement.

Test result

Limits for frequency tolerance over

Temperature variations: ☒ kept
☐ not kept

Supply voltage variations: ☒ kept
☐ not kept

Remarks: n/a

Records

☒ Readings

Carrier Frequency Stability vs. Temperature						
Fundamental frequency at						
Temp. / °C	Frequency of fundamental / kHz				Max. frequency tolerance / ppm	Limit / ppm
	at start	after 2 min	after 5 min	after 10 min		
50	13,560.471	13,560.470	13,560.467	13,560.465	2	±100
40	13,560.475	13,560.467	13,560.472	13,560.473	2	±100
30	13,560.487	13,560.487	13,560.487	13,560.480	1	±100
20	13,560.518	13,560.509	13,560.502	13,560.498	1	±100
10	13,560.544	13,560.535	13,560.529	13,560.524	3	±100
0	13,560.550	13,560.549	13,560.547	13,560.545	4	±100
-10	13,560.532	13,560.543	13,560.548	13,560.550	4	±100
-20	13,560.474	13,560.502	13,560.519	13,560.528	2	±100
Operating frequency - Reference						

Carrier Frequency Stability vs. Supply Voltage Variation					
Fundamental frequency at 20 °C, 35 % rH					
Nominal Voltage U_N	Frequency of fundamental / kHz			Max. frequency tolerance / ppm	Limit / ppm
	85 % U_N	100 % U_N	115 % U_N		
120 V / 60 Hz	13,560.497	13,560.497	13,560.497	0	±100
Operating frequency - Reference					

7 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) (d(7))	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
Emission bandwidth inside the operating frequency band	§ 15.215 (c)	Pass	n/a
Field strength mask within the operation band 13.110-14.010 MHz	§ 15.225 (a) (b) (c) (d) (f)	Pass	n/a
Frequency stability	§ 15.225 (e) (f)	Pass	n/a

Burgrieden, 05/26/2024

Responsible inspector:

Project manager – Steffen Vogelmann

- End of Test Report -