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Test report no.:
230193-AU01+W02
for:
HERMOS AG
RFID Reader
LFM 4x Reader E84

according to:
47 CFR Part 2

Accreditation:



Deutsche
Akkreditierungsstelle
D-PL-12155-01-04

FCC test firm accreditation expiration date: 2024-05-17
MRA US-EU, FCC designation number: DE0010
Test firm registration number: 997268
FCC Registration Number (FRN): 0032245045
BnetzA-CAB-02/21-02/6 Valid until 2023-11-26

Location of Testing:

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The technical accuracy is guaranteed through the quality management of
Element Materials Technology Straubing GmbH.

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1 Summary of test results

1.1 FCC standard

<i>FCC standard</i>	<i>Requirement</i>	<i>Result</i>	<i>Page</i>
47 CFR Part 2, § 2.1091	Maximum permissible exposure, except WPT, measurement	Passed	8

Straubing, October 12, 2023



Tested by
Konrad Graßl
Department Manager Radio



Approved by
Christian Kiermeier
Reviewer

2 Test regulations

2.1 FCC standards

<i>Standard</i>	<i>Title</i>
Part 1, Subpart I, Section 1.1307 October 2022	Actions that may have a significant environmental effect, for which Environmental Assessment (EAs) must be prepared.
Part 1, Subpart I, Section 1.1310 October 2022	Radiofrequency radiation exposure limits
Part 2, Subpart J, Section 2.1091 October 2022	Radiofrequency radiation exposure evaluation: mobile devices.
KDB 447498 D01 v06 October 23, 2015	RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices
ANSI C63.10 June, 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

3 Equipment under Test

3.1 General information

Product type:	RFID Reader		
Model name:	LFM 4x Reader E84		
Serial number(s):	2306HAG27279		
Applicant:	HERMOS AG		
Manufacturer:	HERMOS AG		
Hardware version:	LFM_E84_RevC		
Software version:	V1.4FV02		
Short description:	The EUT is a RFID Reader operating at the frequency 134.5 kHz. EUT has only one RF chip. The output of the chip is switched by means of a relay to 4 antenna outputs. Representatively, all tests were performed on output 1.		
Additional modifications:	None		
FCC ID:	2AP5OLFME84		
Power supply:	DC supply		
	Nominal voltage:	24 V	
Device type:	<input type="checkbox"/> Portable	<input checked="" type="checkbox"/> Mobile	<input type="checkbox"/> Fixed

3.2 Radio specifications

RF technology:

System type:	RFID Reader
Operating frequency:	134.5 kHz
Number of RF channels	1
Highest internal frequency:	100 MHz
Modulation	ASK
Antenna:	Type: Ferrit-antenna (rod antenna)
	Inductivity: L = 110 μ H, R = 0.4 Ω
	Model: HRF.A.LFX.SM.SS.20
	Manufacturer: HERMOS AG
	Connector: <input checked="" type="checkbox"/> external <input type="checkbox"/> internal
	<input type="checkbox"/> temporary <input type="checkbox"/> none (integral antenna)

3.3 Human exposure specifications

Exposure tier:	Body
Separation distance:	> 20 cm
Evaluated against exposure limits:	General public use
Simultaneous transmissions:	no

3.4 Photographs of EUT

See Annex B of test report 230193-AU01+W01 of test laboratory Element Materials Technology Straubing GmbH.

4 Test results

This clause gives details about the test results as collected in the summary of test results on page 4.

For information about measurement uncertainties see page 13.

The climatic conditions are recorded during the tests. It is ensured that the climatic conditions are within the following ranges:

Ambient temperature	Ambient humidity	Ambient pressure
15°C to 35°C	30 % to 75 %	86 kPa to 106 kPa

4.1 FCC

4.1.1 Maximum permissible exposure, except WPT, measurement

Requirement: Part 2, §2.1091

Performed by:	Konrad Graßl	Date of test:	October 12, 2023
Result:	<input checked="" type="checkbox"/> Limits kept	<input type="checkbox"/> Limits not kept	

4.1.1.1 Test configuration

<i>Device</i>	<i>Type designation</i>	<i>Serial or inventory no.</i>	<i>Manufacturer</i>
RFID Reader	LFM 4x Reader E84	2306HAG27279	HERMOS AG

Table 1: EUT used for testing

<i>Device</i>	<i>Type designation</i>	<i>Serial or inventory no.</i>	<i>Manufacturer</i>
RFID-tag	134 kHz	---	HERMOS AG
AC adapter	VEL18US240-EU-JA	---	XP Power

Table 2: Support equipment used for testing

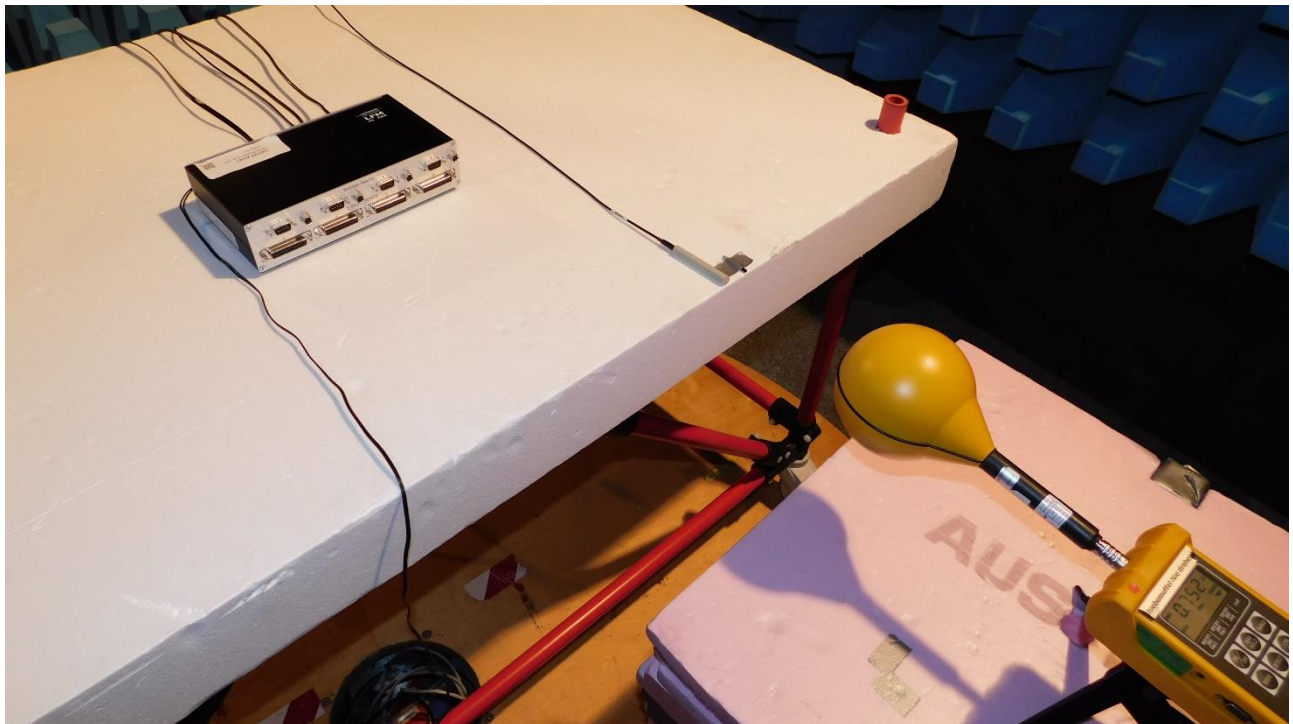
4.1.1.2 Mode of operation

EUT was working in continuous interrogation mode.

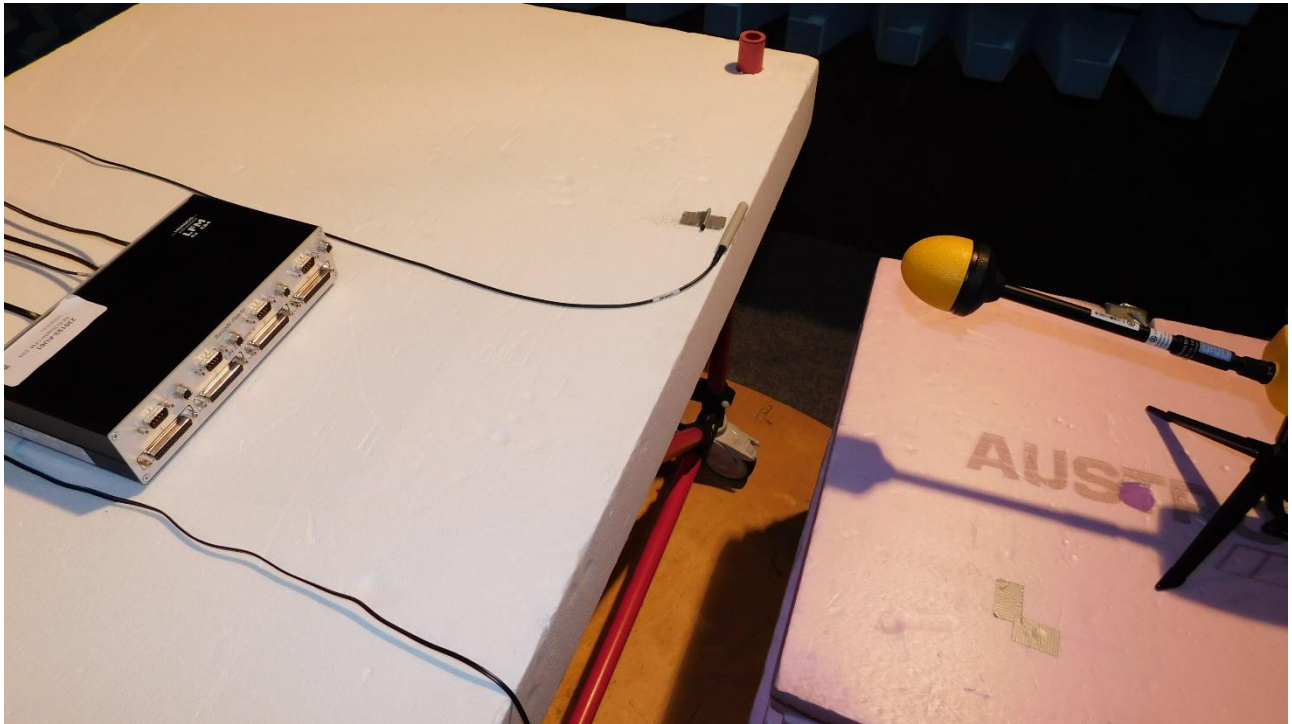
4.1.1.3 Test equipment

Type	Designation	Manufacturer	Inventory no.
Exposure level tester with magnetic field probe 100 cm ²	ELT-400 with BN 2300/90.10	Narda Safety Test Solutions GmbH	E00276
Broadband field meter	NBM-550	Narda Safety Test Solutions GmbH	E00900
Electric field probe	EF0691	Narda Safety Test Solutions GmbH	E00902

4.1.1.4 Test setup



Picture 1: Setup of magnetic field test at a measurement distance of 20 cm, with RFID tag



Picture 2: Setup of electric field test at a measurement distance of 20 cm, with RFID tag

4.1.1.5 Requirements and limits maximum permissible exposure

According to §2.1091(b):

A mobile device is defined as “a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter’s radiating structure(s) and the body of the user or nearby persons.”

According to §2.1091(c)(1):

Evaluation of compliance with the exposure limits in §1.1310 of this chapter, and preparation of an EA if the limits are exceeded, is necessary for mobile devices with single RF sources having either more than an available maximum time-averaged power of 1 mW or more than the ERP listed in Table 1 to §1.1307(b)(3)(i)(C), whichever is greater. For mobile devices not exempt by §1.1307(b)(3)(i)(C) at distances from 20 centimeters to 40 centimeters and frequencies from 0.3 GHz to 6 GHz, evaluation of compliance with the exposure limits in §1.1310 of this chapter is necessary if the ERP of the device is greater than ERP_{20cm} in the formula below. If the ERP of a single RF source at distances from 20 centimeters to 40 centimeters and frequencies from 0.3 GHz to 6 GHz is not easily obtained, then the available maximum time-averaged power may be used (i.e., without consideration of ERP) in comparison with the following formula only if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

$$P_{th}(\text{mW}) = ERP_{20\text{ cm}}(\text{mW}) = \begin{cases} 2040f & 0.3\text{ GHz} \leq f < 1.5\text{ GHz} \\ 3060 & 1.5\text{ GHz} \leq f \leq 6\text{ GHz} \end{cases}$$

According to §1.1307(b)(3)(i)(C):

Or using Table 3 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	$1,920 R^2$.
1.34-30	$3,450 R^2/f^2$.
30-300	$3.83 R^2$.
300-1,500	$0.0128 R^2f$.
1,500-100,000	$19.2R^2$.

Table 3: Table 1 to §1.1307(b)(3)(i)(C)—Single RF Sources Subject to Routine Environmental Evaluation

Note:

1. According to the TCB Workshop on April 27, 2022 regarding the frequency range from 100 kHz to 300 kHz the limit for the frequency 300 kHz in table 1 to § 1.1310(e)(1) is applicable: E = 614 V/m and H = 1.63 A/m

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
0.3-3.0	614	1.63	(100)(see note 1)	<30

Table 4: Table 1 to § 1.1310(e)(1), limits for general population/ uncontrolled exposure

Note:

1. Plane-wave equivalent power density

4.1.1.6 Test procedure

The RF exposure test is performed by the direct measurement method using a Broadband probe.

To find the worst case emissions, the field probe is moved over all sides of the EUT at the separation distance of 20 cm, while observing the display of the field meter. At the worst case position, the final value is measured and recorded.

The test distance is measured from the center of the probe(s) to the edge of the device.

4.1.1.7 Results

Application: RFID
 Operation frequency: 134.5 kHz

Information related to Exposure:

Separation distance: 200 mm
 Exposure: general public

Note(s):

- 1 Averaging time over 6 minutes was applied.
- 2 Worst case: with RFID tag
- 3 Separation distance to the edge of the EUT: 20 cm

<i>Type of measurement</i>	<i>Operating frequency of EUT</i>	<i>Measured average value</i>	<i>Limit</i>	<i>Ratio of limit</i>	<i>Result</i>
E-Field	134.5 kHz	2.22 V/m	614 V/m	0.004	Passed
H-Field	134.5 kHz	0.48 A/m	1.63 A/m	0.296	Passed

Table 5: Test results for electric, magnetic and electromagnetic fields

5 Equipment calibration status

Description	Modell number(s)	Serial number(s)	Inventory number(s)	Last calibration	Next calibration
Exposure level tester with magnetic field probe 100 cm ²	ELT-400 with BN 2300/90.10	B-0087 B-0102	E00276	2022-11	2023-11
Broadband field meter with electric field probe	NBM-550 with EF0691	H-0015 H-0318	E00900 E00902	2023-09	2025-09

6 Measurement uncertainty

Test	Frequency range	Equipment used	Expanded uncertainty	U_{Limit}	k=
Magnetic field	1 Hz – 10 kHz	ELT 400 + probe	± 28.147 %	+58.% / -37 %	2
Magnetic field	10 kHz – 400 kHz	ELT 400 + probe	± 28.147 %	+41.% / -30 %	2
H-field	300 kHz – 800 kHz	NBM 550 + HF3061	± 25.602 %	+41.% / -30 %	2
H-field	800 kHz – 1 MHz	NBM 550 + HF3061	± 25.245 %	+41.% / -30 %	2
H-field	1 MHz – 30 MHz	NBM 550 + HF3061	± 25.245 %	+41.% / -30 %	2
E-field	100 kHz – 1 MHz	NBM 550 + EF0691	± 28.467 %	+41.% / -30 %	2
E-field	1 MHz – 30 MHz	NBM 550 + EF0691	± 27.324 %	+41.% / -30 %	2
E-field	30 MHz – 1 GHz	NBM 550 + EF0691	± 27.324 %	+100.% / -50 %	2
E-field	1 GHz – 4 GHz	NBM 550 + EF0691	± 30.244 %	+100.% / -50 %	2
E-field	4 GHz – 6 GHz	NBM 550 + EF0691	± 32.150 %	+100.% / -50 %	2
Contact current	0 Hz – 110 MHz	EZ 17	+41.25 % / -29.21.%	+100.% / -50 %	2

Note(s):

1. The uncertainty stated is the expanded uncertainty obtained by multiplying the standard uncertainty by the coverage factor k. For a confidence level of 95 % the coverage factor k is 2.
2. The values of the measurement uncertainty as listed above are equal to or lower than the required ones stated in table 3 of EN 62369-1 2009 and listed as (U_{Limit}) in the table above.
3. Simple acceptance is applied as the decision rule while keeping the specified limits (U_{ETSI}) for the expanded measurement uncertainty (i.e. Test Uncertainty Ratio TUR ≥ 1:1). That means, compliance is based on the recorded level by the lab irrespective of the expanded measurement uncertainty value but with a limitation to it.
4. All used test instrument as well as the test accessories are calibrated at regular intervals.

7 Revision history

<i>Revision</i>	<i>Date</i>	<i>Issued by</i>	<i>Description of modifications</i>
0	2023-10-12	Konrad Graßl	First edition

Template: RF_FCC_IC_Human Exposure_V1.8