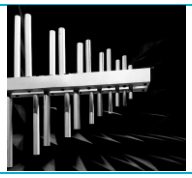
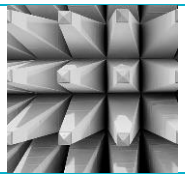

CTC advanced
member of RWTÜV group

TEST REPORT

Test Report No.: 1-3692/21-03-06

DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-01

Testing Laboratory

CTC advanced GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken/Germany
Phone: + 49 681 5 98 - 0
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e-mail: mail@ctcadvanced.com

Accredited Test Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-01.

Applicant

indurad GmbH
Belvedereallee 5
52070 Aachen/GERMANY

Phone: + 49 241 538070-0

Contact: Matthias Rabel
e-mail: matthias.rabel@indurad.com
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Manufacturer

indurad GmbH
Belvedereallee 5
52070 Aachen/GERMANY

Test Standard/s

FCC - Title 47 CFR Chapter I - Subchapter I §1.1310	Radiofrequency radiation exposure limits.
FCC KDB 680106 D01 Exposure Wireless Charging Apps v03	RF Exposure Considerations for Low Power Consumer Wireless Power Transfer Applications

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item:	iRTT RechargeUnit
Device type:	fixed device
Model name:	**iRTT-RU**
S/N serial number:	fbdf3a
FCC-ID:	2AJRSIRTTRU
Hardware status:	V3
Software status:	V0.9
Frequency:	WPT charger, 123 kHz
Antenna:	Integrated loop coil
Supply voltage:	DC Powered 24V
Accessories:	Aux-device (SN: 4a7286)
Test sample status:	identical prototype
Exposure category:	general population / uncontrolled environment

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test Report authorised:

cn=Alexander Hnatovskiy, o=CTC advaced GmbH, ou=HNA-211126, email=alexander.hnatovskiy@ctcadvaced.com, c=DE
2022.05.04 11:05:20 +02'00'

Alexander Hnatovskiy
Lab Manager
Radio Communications

Test performed:

Marco Scigliano

cn=Marco Scigliano, o=CTC advanced GmbH, ou=SCI-211118, email=marco.scigliano@ctcadvanced.com, c=DE
2022.05.04 11:19:00 +02'00'

Marco Scigliano
Testing Manager
Radio Communications

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2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CTC advanced GmbH.
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In no case this test report can be considered as a Letter of Approval.

2.2 Application details

Date of receipt of order:	2021-12-21
Date of receipt of test item:	2022-04-29
Start of test:	2022-05-02
End of test:	2022-05-02

2.3 Statement of compliance

The EMF values found for the iRTT-RU iRTT RechargeUnit are below the maximum allowed levels according to the standards listed in section 3.

3 Test standard/s:

Test Standard	Version	Test Standard Description
FCC - Title 47 CFR Chapter I - Subchapter I §1.1310	04.06.2013	Radiofrequency radiation exposure limits.
FCC KDB 680106 D01 Exposure Wireless Charging Apps v03	04.09.2018	RF Exposure Considerations for Low Power Consumer Wireless Power Transfer Applications

3.1 RF exposure limits

Reference levels for general public (uncontrolled environment) exposure to time-varying electric and magnetic fields

According to: CFR47, Subpart I - §1.1310 Radiofrequency radiation exposure limits				
Frequency Range (MHz)	**Electric Field** (V/m)	**Magnetic Field** (A/m)	**Power density** (mW/cm^2)	**Averaging time** (minutes)
Occupational / Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/ f	*900/f^2	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100000	--	--	5	6
General Population / Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	*180/f^2	30
30-300	27.5	0.073	0.2	30
300-1500	**--**	**--**	**f/1500**	**30**
1500-100000	--	--	1.0	30

<u>Limitations and test distances according FCC KDB 680106 D01:</u>

According to **FCC KDB 680106 D01 Paragraph 3 RF Exposure Requirements clause 3** the Emission-Limits in the frequency range from 100 to 300 kHz should be assessed versus the limits at 300 kHz in Table 1 of **CFR 47 – Section 1.310** as following (measurement distance shall be 20cm from the center of the probe to the top side and 15cm from the center of the probe to the edge of the device):

	E-field	H-field	B-field
Frequency	V / m	A/m	µT
0.3 – 3.0 MHz	**614**	**1.63**	2.0

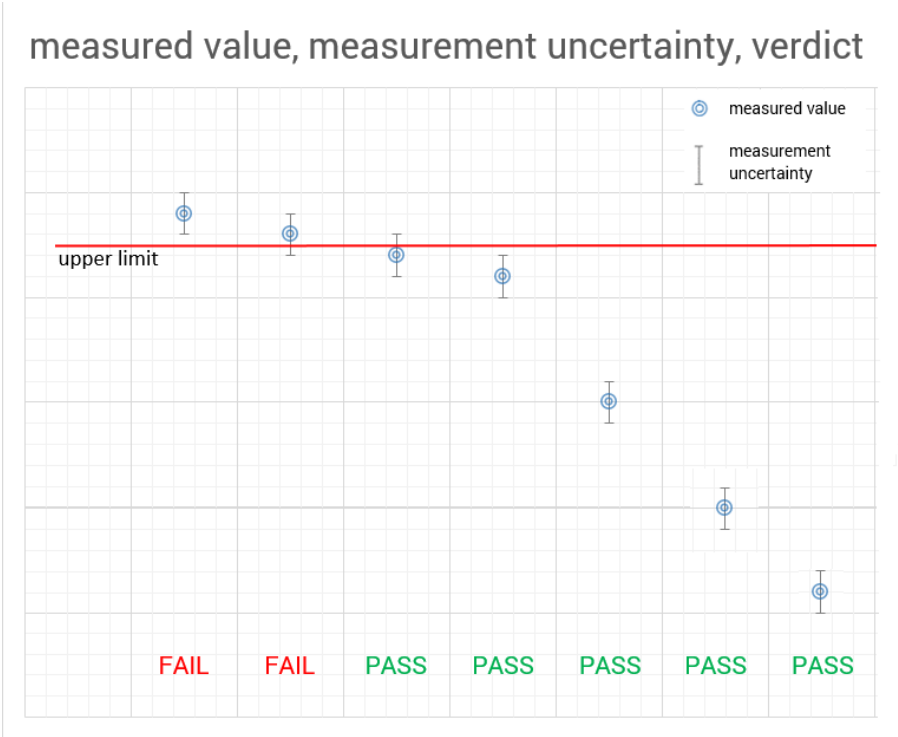
The 50% criteria according to FCC KDB 680106 D01:

	E-field	H-field	B-field
Frequency	V / m	A/m	µT
0.3 – 3.0 MHz	**614**	**1.63**	2.0
0.3 – 3.0 MHz***** (50% criteria)	**307**	**0.815**	1.0

*) **FCC KDB 680106 D01 Paragraph 5b(5)** demands, that the aggregate H-field strengths at 15 cm surrounding the device and 20 cm above the top surface from all simultaneous transmitting coils are demonstrated to be less than 50% of the MPE limit (1.6A/m) which results in an H-Field limit of 0.815 A/m. A device that complies with the 50% criteria is deemed to comply, without any further investigation through the FCC.

4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.
The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."



5 Summary of Measurement Results

☒	**No deviations from the technical specifications ascertained**
☐	Deviations from the technical specifications ascertained

The EUT full fills all safety requirements of FCC KDB 670106 D01. As the test results are below the 50% criteria, it complies without any further investigation of the FCC.

6 Test Environment

Ambient temperature:	20 – 24 °C
Relative humidity content:	40 – 50 %
Air pressure:	not relevant for this kind of testing
Power supply:	230 V / 50 Hz

7 Test Set-up

7.1 Measurement system

7.1.1 Broadband Electromagnetic Field Test system

A state of the art Broadband Electromagnetic Field Test system was used. The probes of the system are fitted with three sensors which measure the field strength of the X, Y and Z plane directions separately. The field strength is calculated by the instrument's processor by summing the squares of the three measured values.

The frequency range 5 Hz to 60 GHz is covered.
Depending on the used probe type Electric and Magnetic Field or Electric Field only is detectable.

- EHP-50D 5 Hz to 100 kHz Electric and Magnetic Field
- EHP-50F 5 Hz to 400 kHz Electric and Magnetic Field
- HF 3061 300 kHz to 30 MHz Magnetic Field
- EF 0691 100 kHz to 6 GHz Electric Field
- EF 6092 100 MHz to 60 GHz Electric Field

7.1.2 Test equipment list

	Manufacturer	Device	Type	Serial number	Last Calibration
☐	Narda	Electric and Magnetic Field Meter	NBM-550	F-0319	2021-03-10
☐	Narda	Electric and Magnetic Field Meter	NBM-520	D-1234	2019-05-15
☐	Narda	Electric Field Probe (100 kHz - 6 GHz)	EF 0691	G-0027	2021-03-10
☐	Narda	Electric Field Probe (100 MHz - 60 GHz)	EF 6092	A-0071	2019-05-15
☐	Narda	Magnetic Field Probe (300 kHz to 30 MHz)	HF 3061	D-0404	2021-02-23
☐	Narda	Electric and Magnetic Field Analyser (5 Hz – 100 kHz)	EHP-50D	230WX50108	2021-03-03
☒	Narda	Electric and Magnetic Field Analyser (5 Hz – 400 kHz)	EHP-50F	000WX60907	2020-10-14

☒ Devices used during the test ☐ Devices not used during the test

7.1.3 Averaging

For time efficient testing an average of 8 seconds was used. With some spot checks was verified, that caused by the time structure of the measured responses, the results did not change with a 6-minute-averaging.

7.1.4 Uncertainties

The probe uncertainties stated by the manufacturer are considered to be the main relevant and dominant issues.

7.1.4.1 Typical uncertainty of EHP-50F

The uncertainties stated in this document have been determined according to EA-4/2 [4].
They were estimated as expanded uncertainty obtained multiplying the standard by the coverage factor k=2, corresponding to a confidence level of about 95%.
The total uncertainty of the probe derived from typical contributions of linearity, anisotropy, frequency response, temperature, relative humidity and with/without contribution of uncertainty of calibration.

Magnetic probe (1)	Magnetic flux density	Total expanded uncertainty (k=2)	
		Without contribution of uncertainty of calibration U_{EHP50F} (%)	With contribution of uncertainty of calibration U_T (%)
Frequency at 50Hz	0.05µT to < 100µT	2.3	3.0 (2)
	100µT to < 3000µT	2.6	3.8 (3)
Frequency from 5 to 40 Hz	0.05µT to < 10µT	5.3	5.7 (2)
Frequency from 40 to 100kHz	0.05µT to < 10µT	4.9	5.3 (2)

(1) This uncertainty budget is for an ambient temperature of (23 +/- 4) °C, and relative humidity of (50 +/- 5) %
The expanded uncertainty for magnetic flux density for values close to 50 nT is calculated with negligible contribution of noise level.
(2) The uncertainty of calibration used is 2.0%
(3) The uncertainty of calibration used is 2.8%

Electric probe (4)	Electric field range	Total expanded uncertainty (k=2)	
		Without contribution of uncertainty of calibration U_{EHP50F} (%)	With contribution of uncertainty of calibration U_T (%)
Frequency at 50Hz	1 V/m to 1000 V/m	7.1	7.4 (5)
	1 V/m to < 100 kV/m	7.8	8.2 (6)
Frequency from 5 Hz to 100 kHz	1 V/m to <1000 V/m	8.8	9.2 (6)

(4) This uncertainty budget is for an ambient temperature of (23 +/- 4) °C, and relative humidity of (50 +/- 5) %
(5) The uncertainty of calibration used is 2.0%
(6) The uncertainty of calibration used is 2.5%

7.1.5 Validation procedure

Before performing the tests the empty test chamber was checked for system immanent frequency responses. The following background signal level was detected. All levels are small enough to allow accurate proof of the limits to be considered.

Probe	Frequency Range	Magnetic Flux Density (B) in µT	Electrical Field Strength in V/m	Remark
EHP-50F	5 – 1000 Hz	0.006	0.50	
EHP-50F	4 – 400 kHz	0.004	0.235	

7.1.6 Definition of test position and distances

In absence of an equipment specific regulation with given test distances, all not further noted test positions were measured in “touched” mode, the probe radome touching the DUT at the defined test position.
Due to the mechanical concept of the used probe a distance between DUT surface and electrical centre of the probe antennas remains.

Probe type	Maximum distance (cm)	
	Magnetic Field	Electrical Field
EHP-50F	4	4

7.1.7 Anisotrophical probe behaviour management

As EMF measurements for safety and health aspects are often performed in the nearfield of a radiation source it is important to be aware of the not ideal isotropic performance of a typical probe and how to reproduce reliable results.

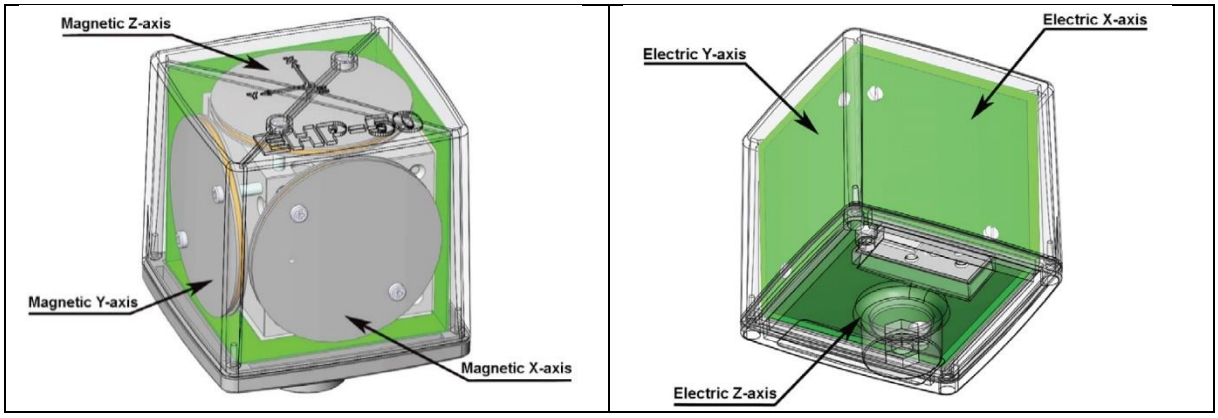
During measurements the following steps are performed to get always the highest possible field strength result and validate that the measured results are always the worst case scenario with the highest energy emitted by the source.

Step 1: Finding the position of the highest radiated field source with a basic probe orientation.
Step 2: Turning the probe to all possible orientations to find the orientation that delivers the maximum field strength.

7.1.8 Measurement distances with EHP probes

In lack of better possibilities to measure in the nearfield at very low frequencies, the touch position of the probe towards the source in the orientation that delivers the largest field is considered as 0cm between source and probe.

The following pictures show the position of the axis



Probe dimensions: 8 x 8 x 8 cm
Electrical center: 4 cm
Distance of probes to the outer housing: according to manufacturer (0.9cm)

7.2 Test results

For considering worst-case conditions all measurements were performed at smallest possible distance from the device under test. Limits shown in the tables below are the lowest ones within the wideband frequency ranges of the field probe applied.

Test positions see photo documentation (Annex A).

During the measurements the DUT was charging a slave device via WPT.

WPT 123 kHz								
test position	distance (cm)	H (A/m)	Limit (A/m)	Probe	distance (cm)	E (V/m)	Limit (V/m)	Probe
front	0	0.909	**1.63** (100%) **0.815** (50%)	EHP 50F	0	9.4	**614** (100%) **307** (50%)	EHP 50F
	15	**0.061**			15	--		
	20	**0.031**			20	--		
left	0	1.456			0	9.3		
	15	**0.068**			15	--		
right	0	0.788			0	3.7		
	15	**0.032**			15	--		
top	0	0.488			0	3.4		
	15	**0.041**			15	--		
	20	**0.029**			20	--		

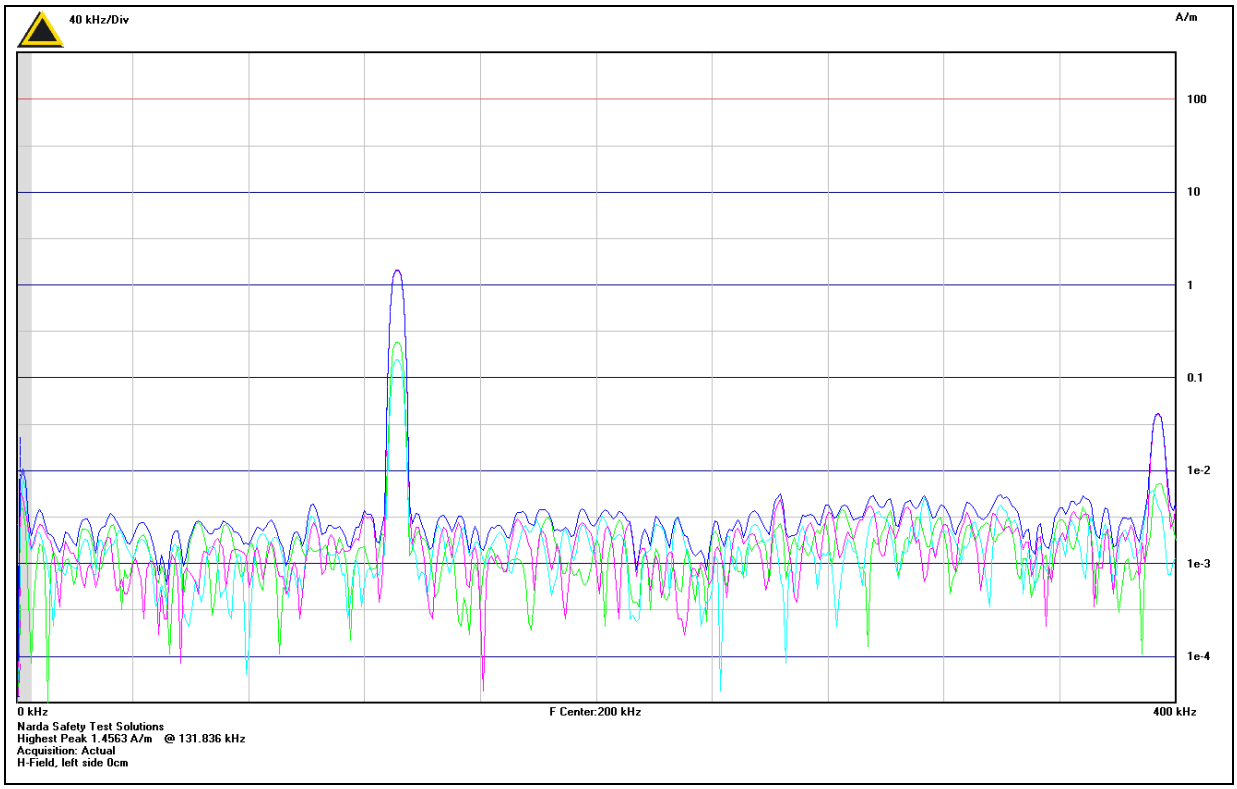
Table 1: Test results E-/ H-f@123kHz

7.3 Final verdict

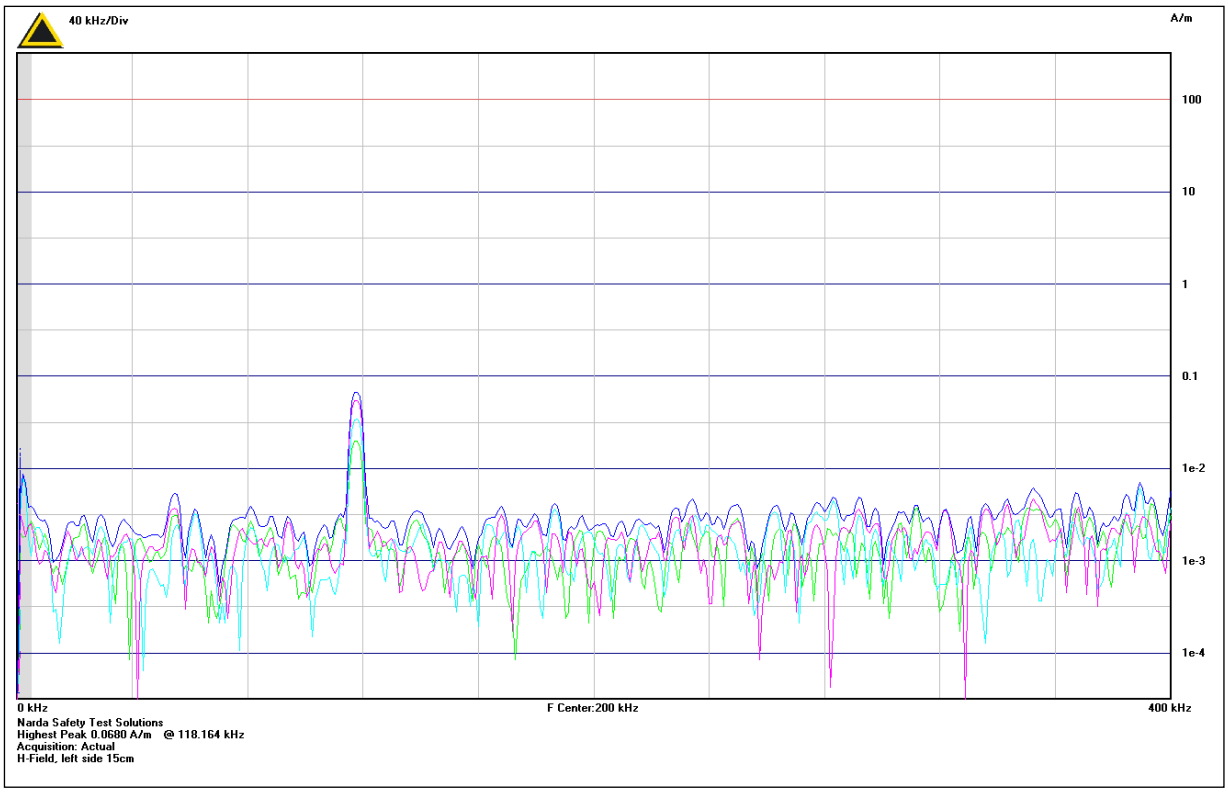
The EUT full fills all safety requirements of FCC KDB 670106 D01. As the test results are below the 50% criteria, it complies without any further investigation of the FCC.

7.4 Plots for E and H field measurements

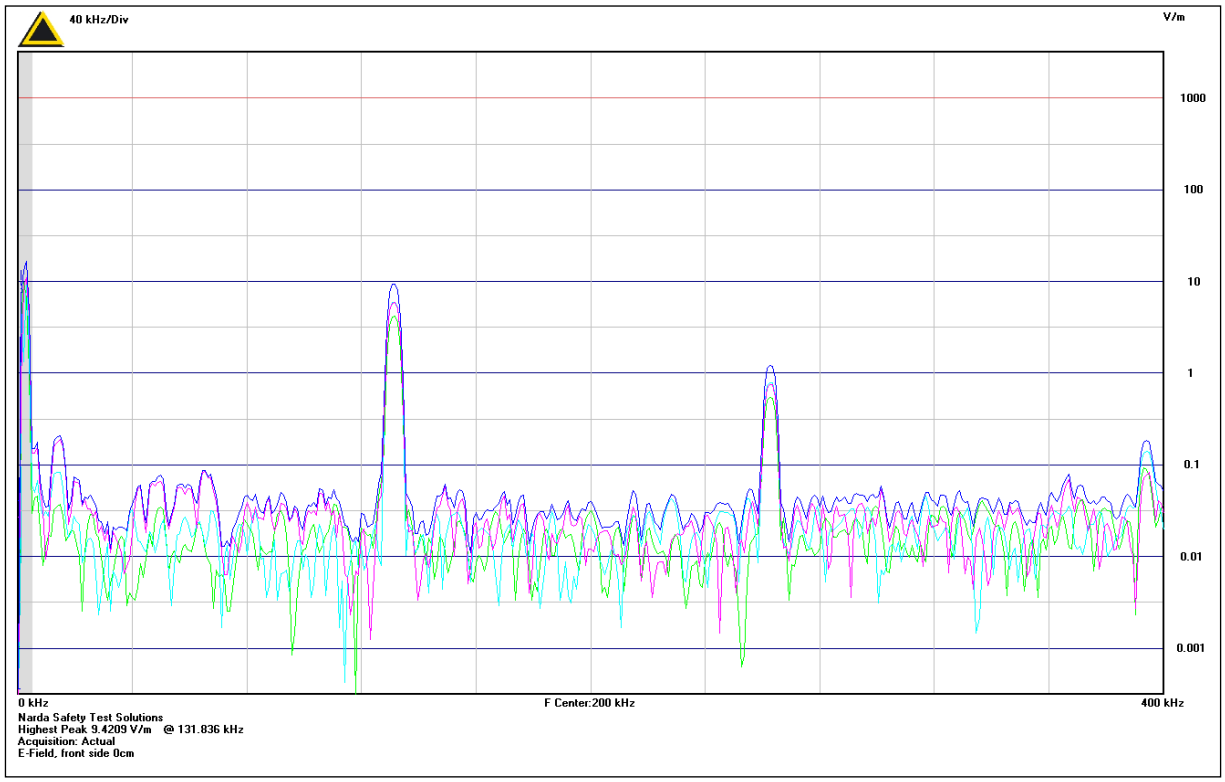
H-Field, Left side 0cm:



H-Field, Left side 15cm:



E-Field, Front side 0cm:



Annex A: Photo documentation

Photo 1: EUT - Front side view

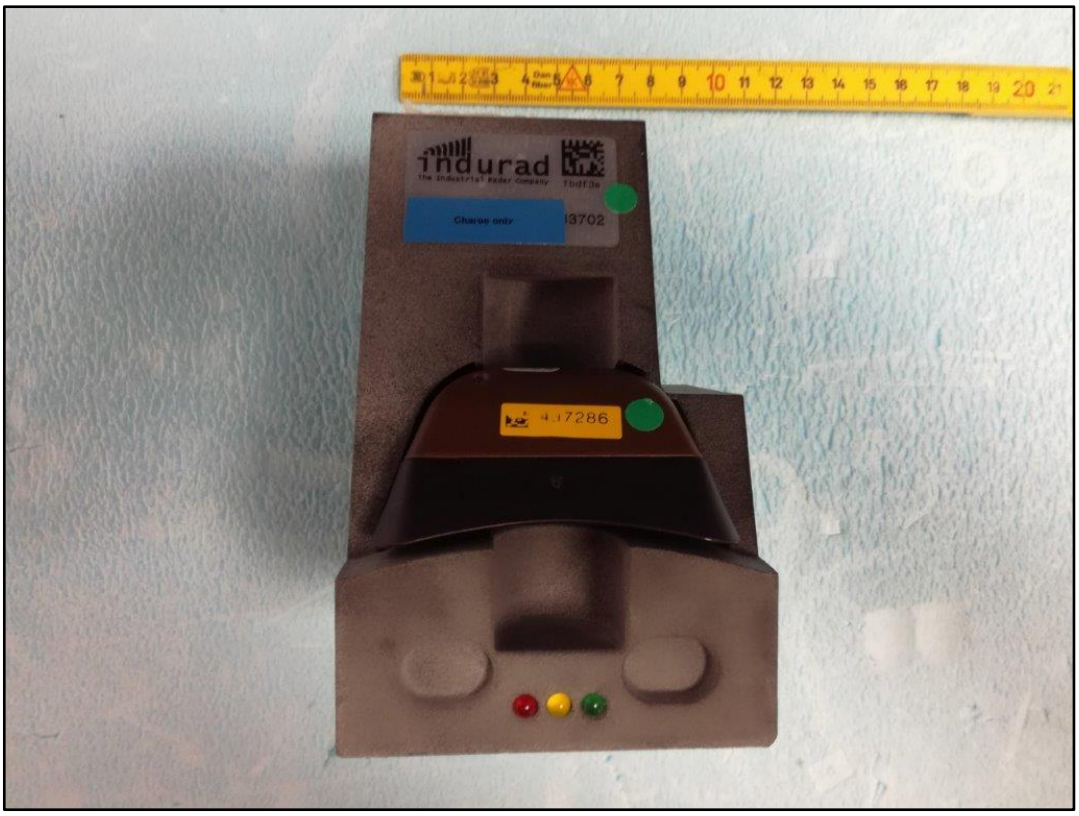


Photo 2: EUT - Top side view (+AUX-device that is charged)

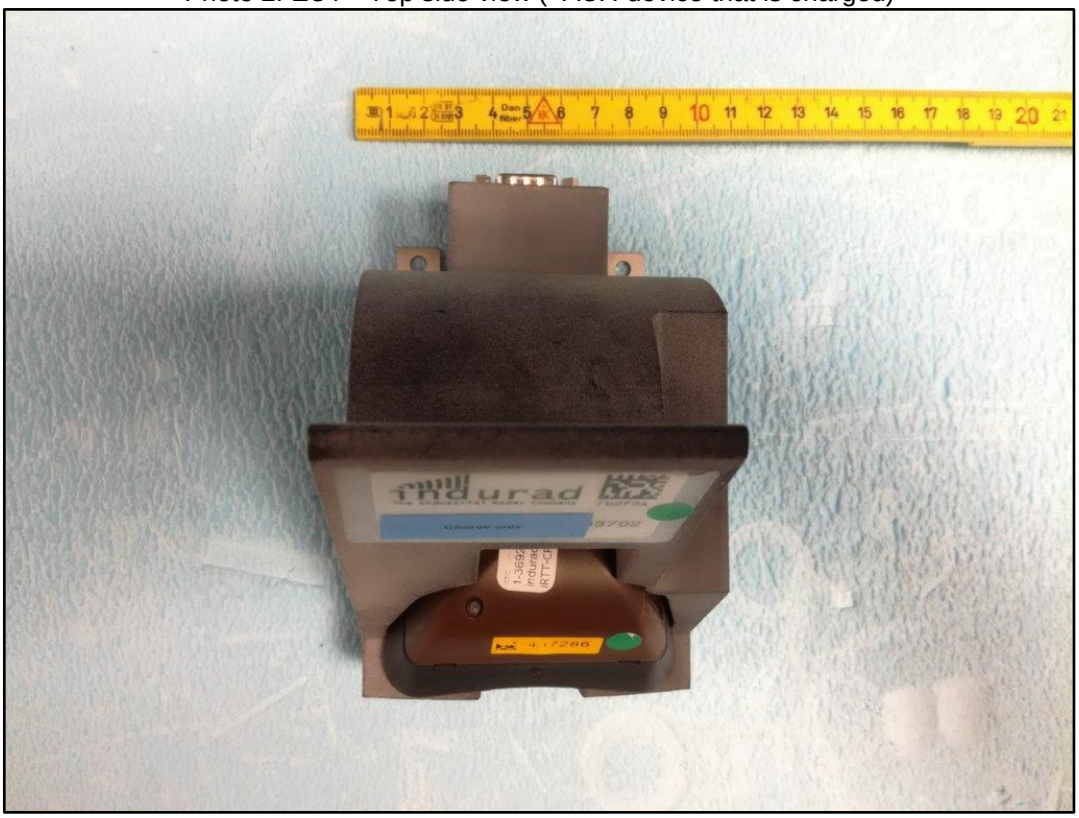


Photo 3: EUT + AUX-device - top side view

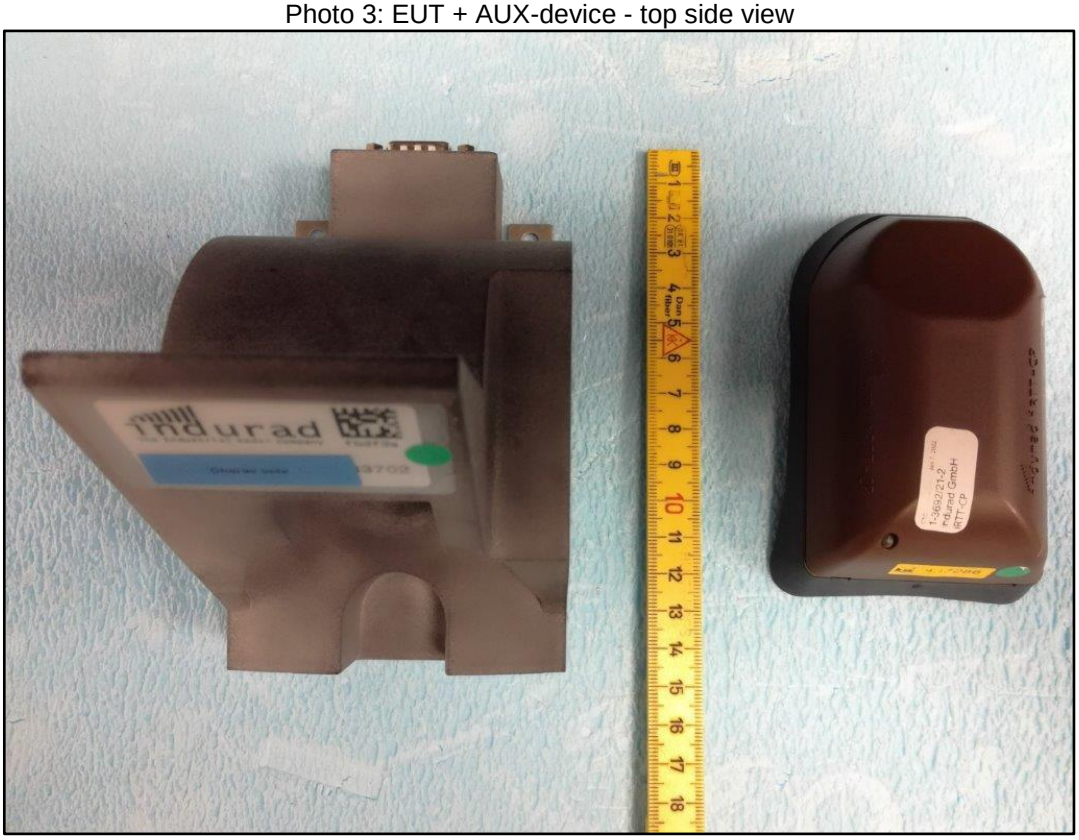


Photo 4: EUT - Right side view

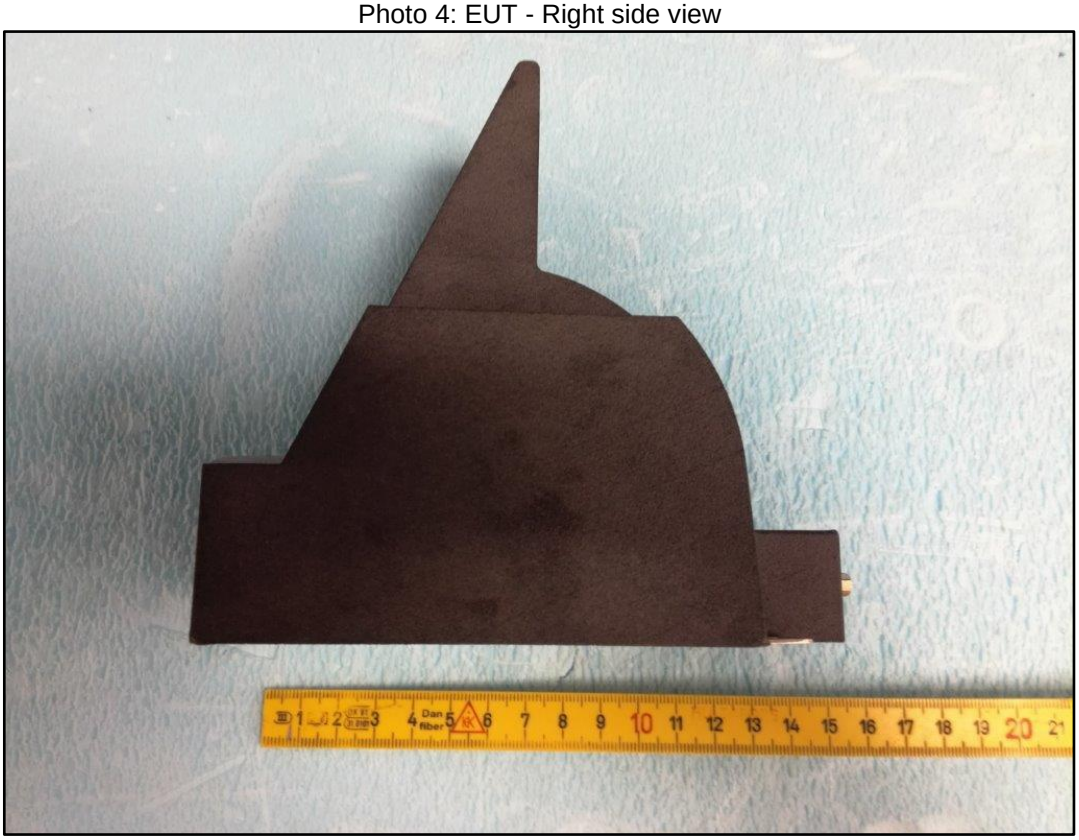


Photo 5: EUT - Rear side view (connector)

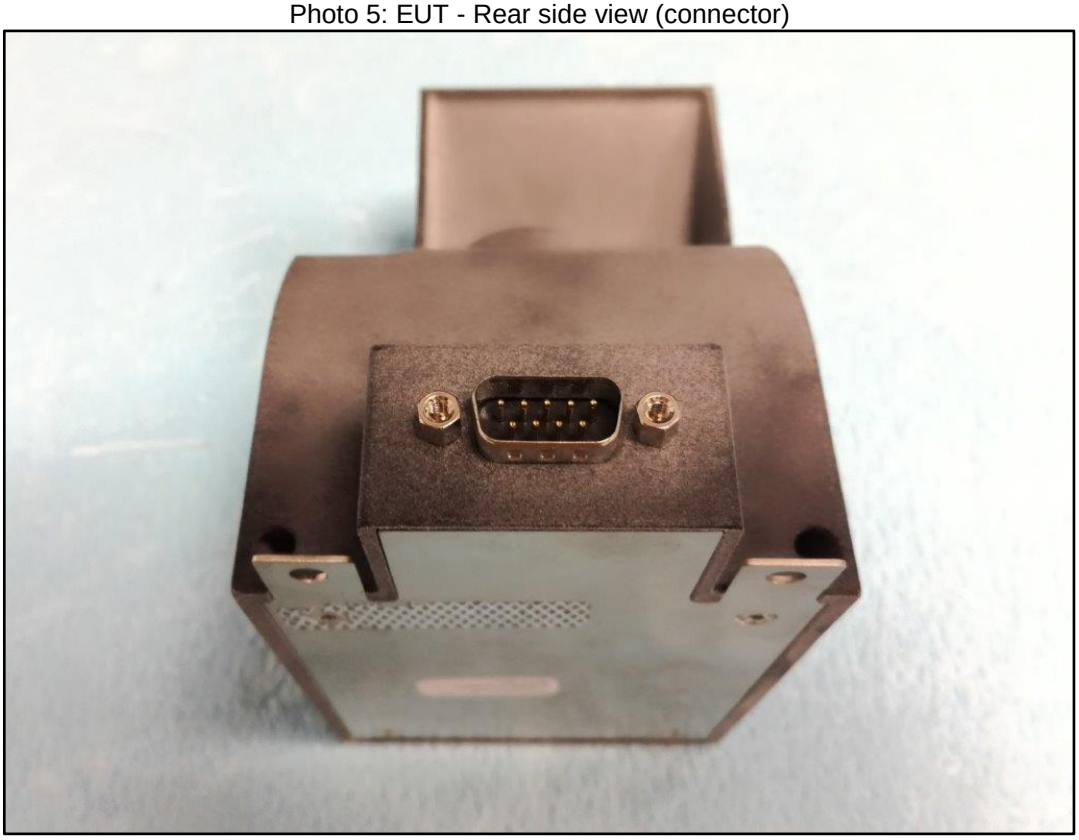


Photo 6: EUT - LABEL

Photo 7: AUX-device - side view

Photo 8: AUX-device - top side view

Photo 9: AUX-device - LABEL

Photo 10: AUX-device - bottom side - LABEL

Photo 11: Test position - Front with 0cm distance (EHP 50F probe)

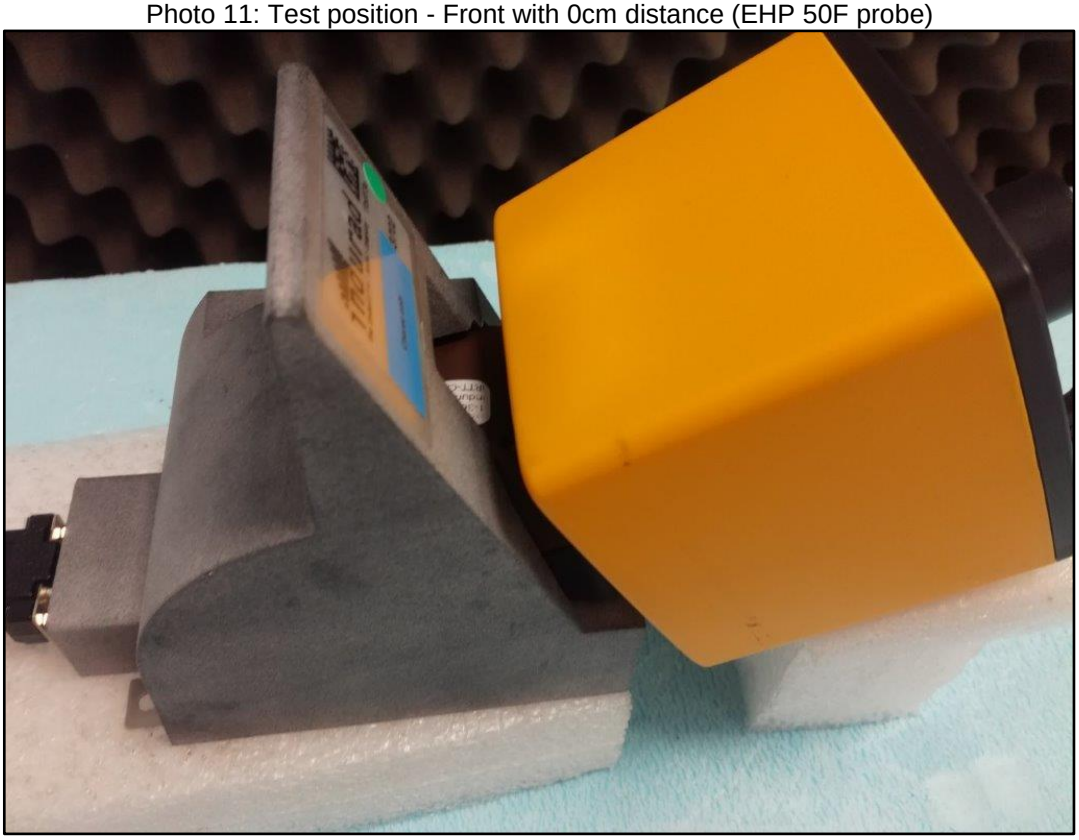


Photo 12: Test position - Front with 15cm distance (EHP 50F probe)

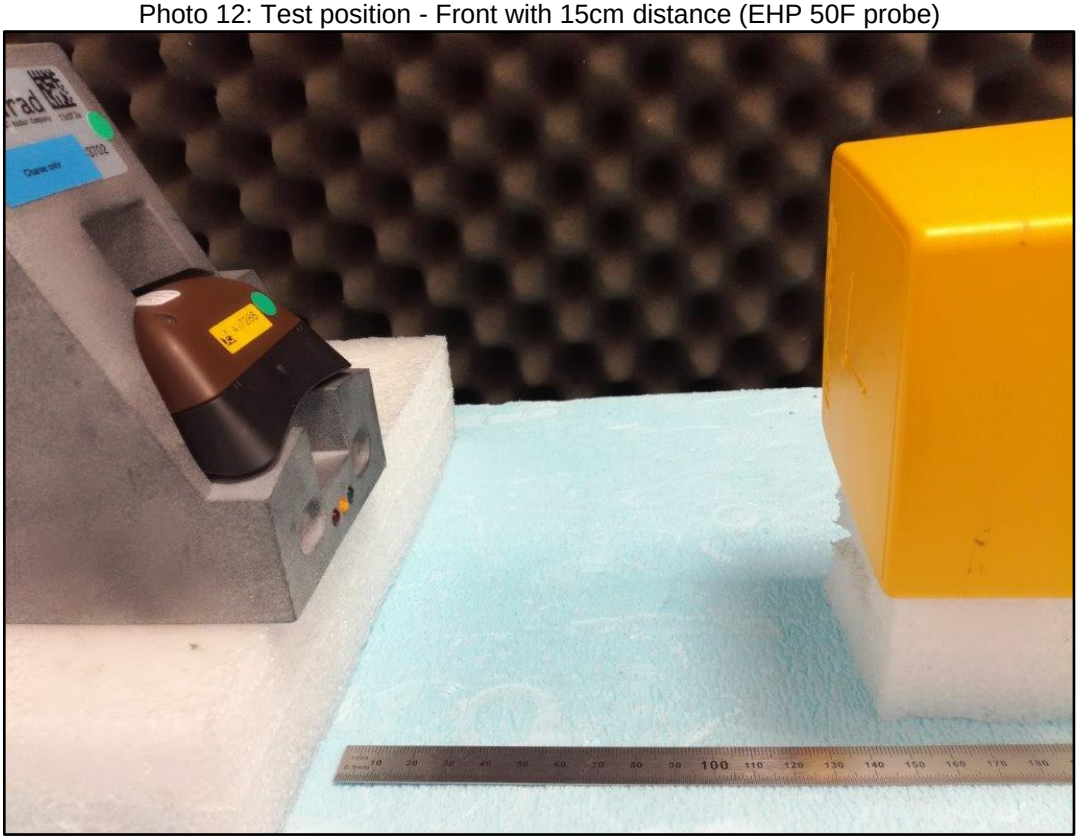


Photo 13: Test position - Front with 20cm distance (EHP 50F probe)

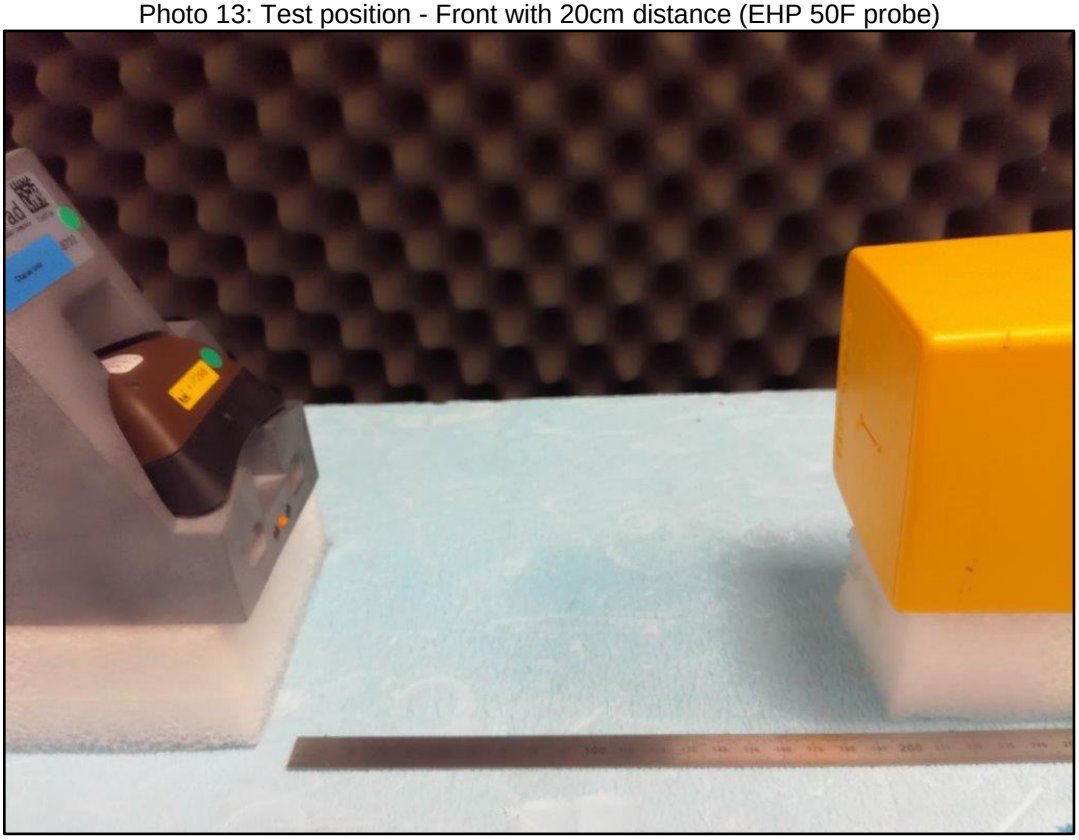


Photo 14: Test position - Left side with 15cm (EHP 50F probe)

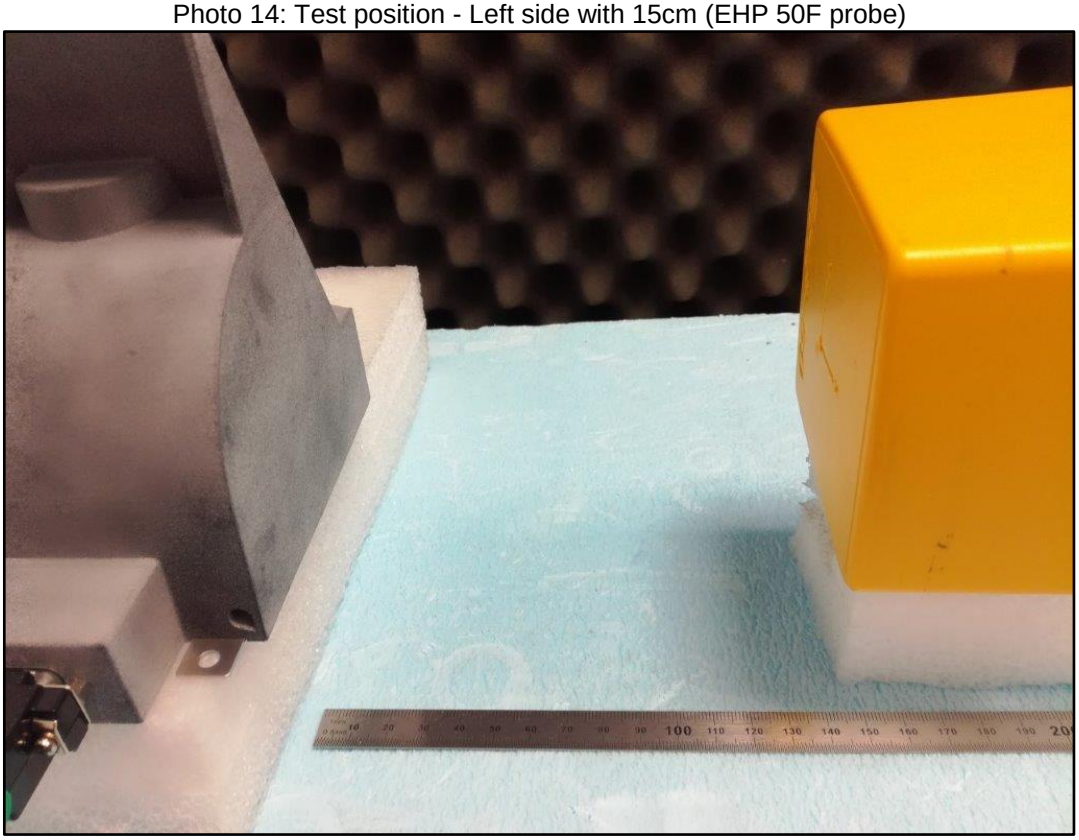


Photo 15: Test position - Left side with 0cm (EHP 50F probe)

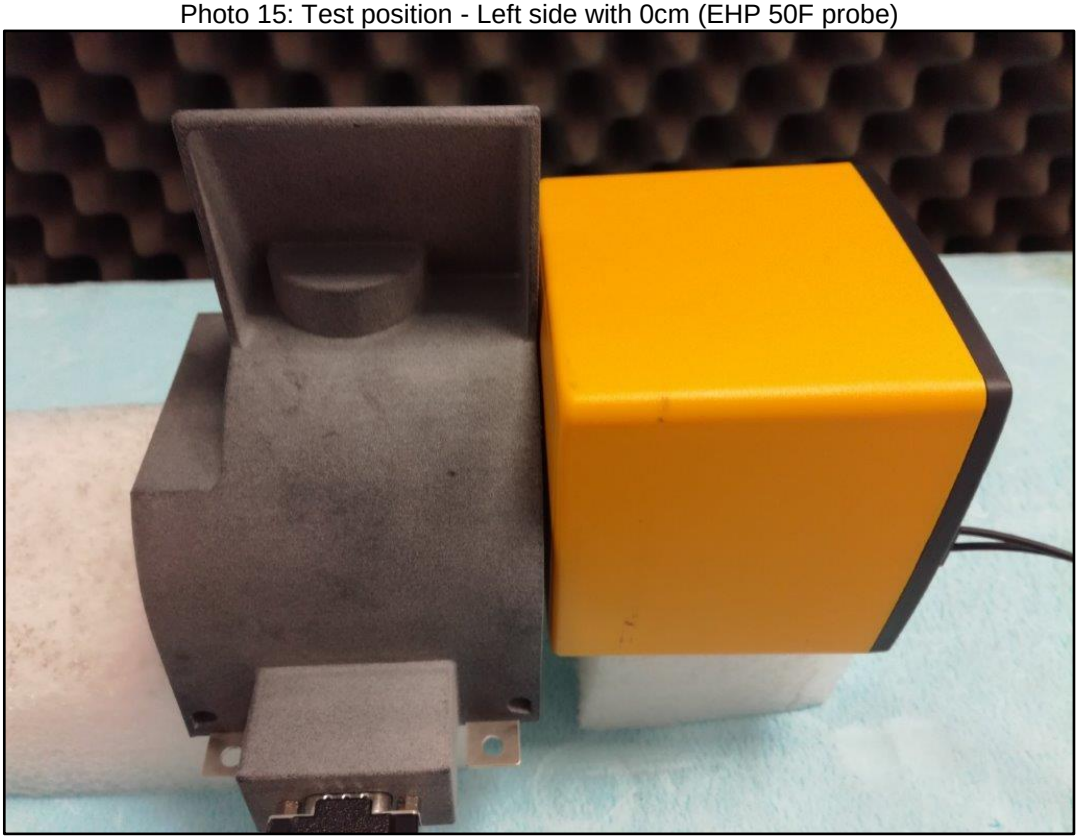


Photo 16: Test position - Right side with 0cm (EHP 50F probe)

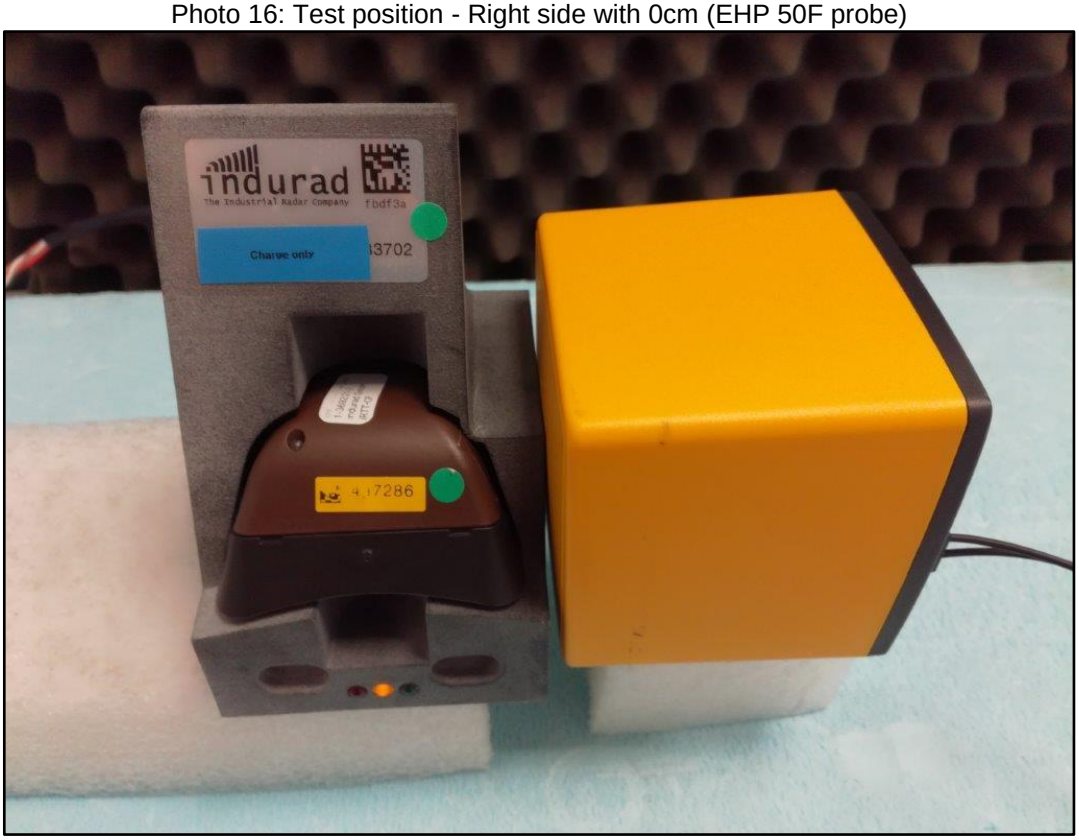


Photo 17: Test position - Right side with 15cm (EHP 50F probe)

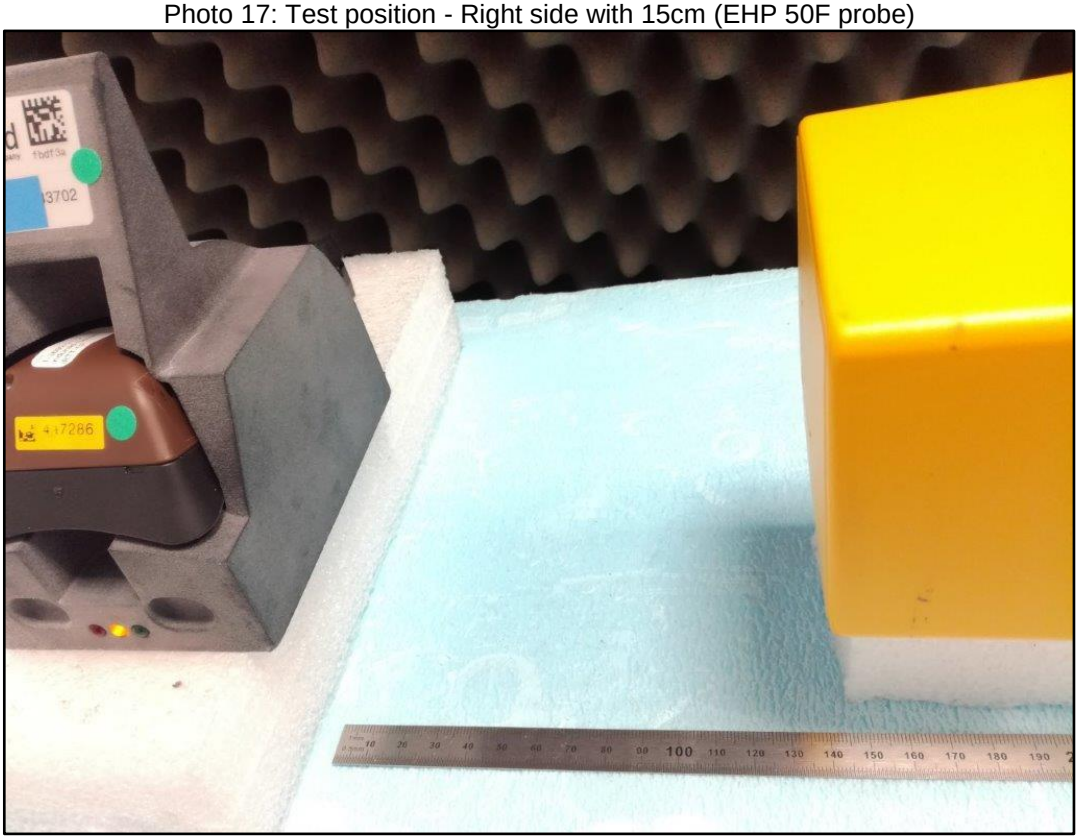


Photo 18: Test position - Top side with 0cm (EHP 50F probe)

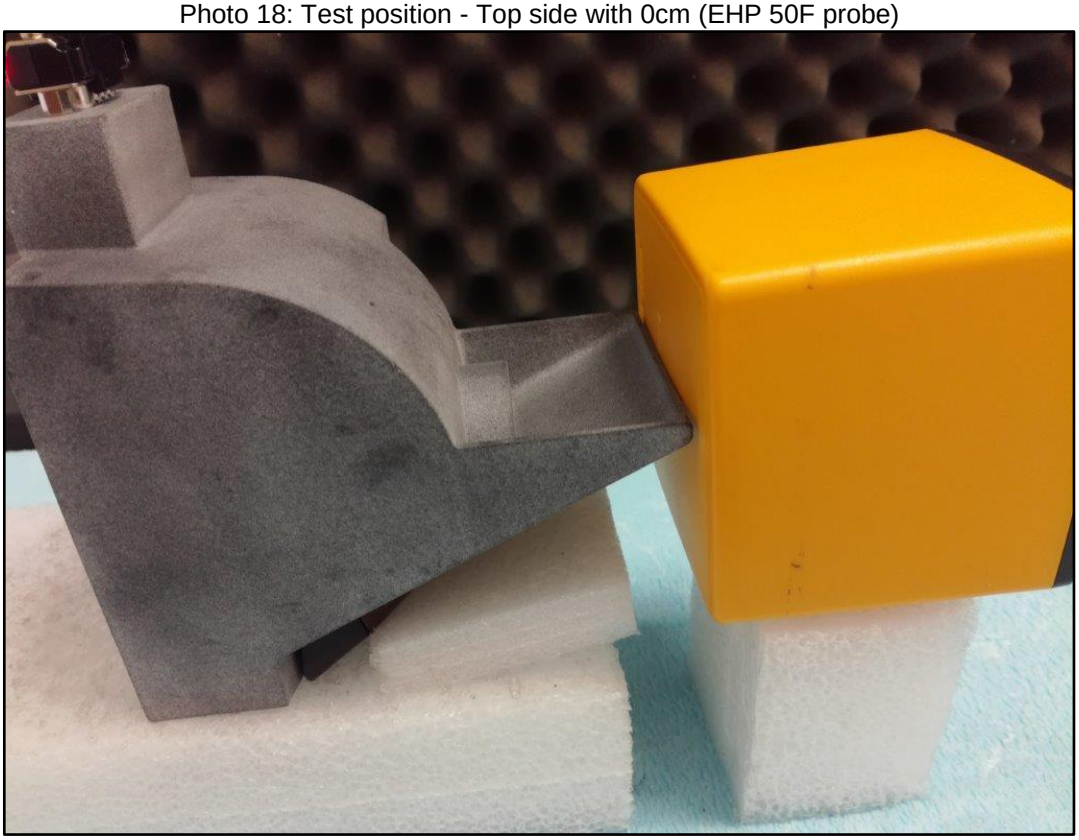
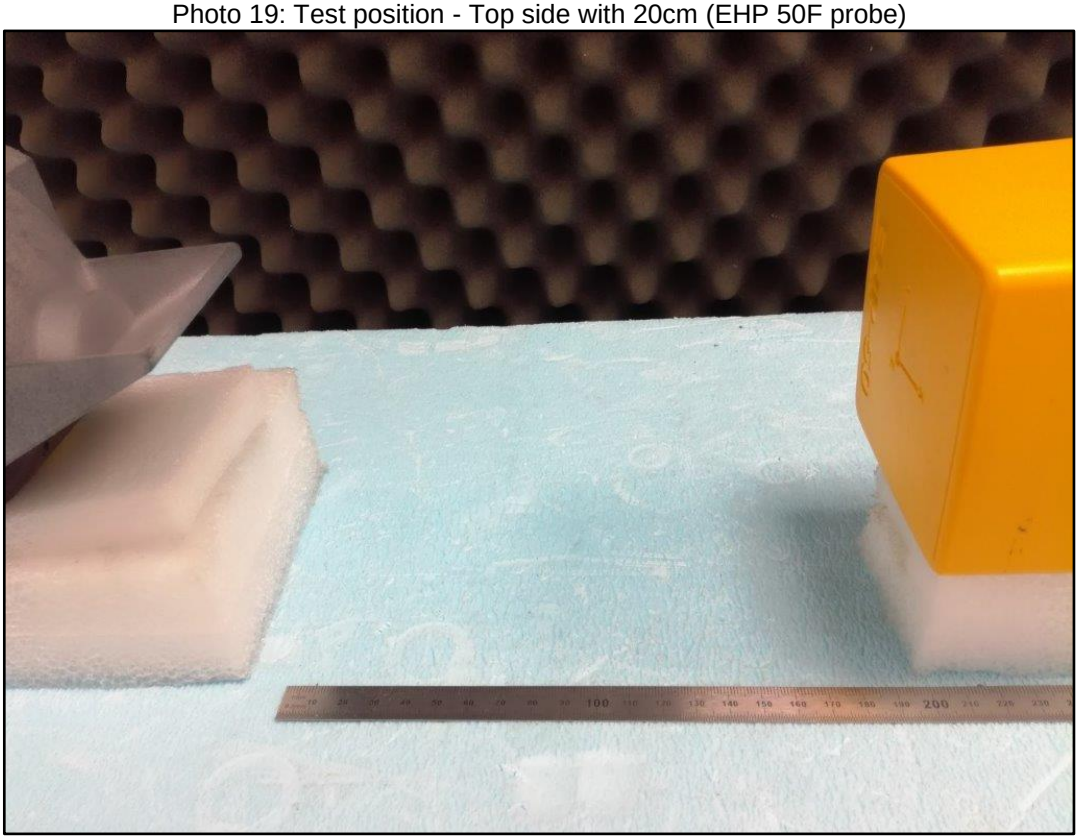


Photo 19: Test position - Top side with 20cm (EHP 50F probe)



Annex B: Document History

Version	Applied Changes	Date of Release
	Initial Release	2022-05-03

Annex C: Further Information

Glossary

DUT	-	Device under Test
EUT	-	Equipment under Test
FCC	-	Federal Communication Commission
FCC ID	-	Company Identifier at FCC
HW	-	Hardware
Inv. No.	-	Inventory number
N/A	-	not applicable
S/N	-	Serial Number
SW	-	Software