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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **Eurofins**

Certificate No: **DAE3-522_Oct21**

CALIBRATION CERTIFICATE

Object **DAE3 - SD 000 D03 AA - SN: 522**

Calibration procedure(s) **QA CAL-06.v30**
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: **October 14, 2021**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	31-Aug-21 (No:31368)	Aug-22
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-21 (in house check)	In house check: Jan-22
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-21 (in house check)	In house check: Jan-22

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Laboratory Technician	
Approved by:	Sven Kühn	Deputy Manager	

Issued: October 14, 2021

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



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Glossary

DAE data acquisition electronics
Connector angle information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
 - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
 - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
 - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
 - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
 - *Input Offset Measurement:* Output voltage and statistical results over a large number of zero voltage measurements.
 - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
 - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
 - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
 - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 μ V, full range = -100...+300 mV

Low Range: 1LSB = 61nV, full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.450 \pm 0.02% (k=2)	404.119 \pm 0.02% (k=2)	404.974 \pm 0.02% (k=2)
Low Range	3.95978 \pm 1.50% (k=2)	3.93908 \pm 1.50% (k=2)	3.99682 \pm 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	321.0 ° \pm 1 °
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Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	199997.12	1.77	0.00
Channel X + Input	20003.90	1.59	0.01
Channel X - Input	-19999.09	2.44	-0.01
Channel Y + Input	199996.50	0.99	0.00
Channel Y + Input	20002.01	-0.33	-0.00
Channel Y - Input	-20002.04	-0.52	0.00
Channel Z + Input	199996.43	1.02	0.00
Channel Z + Input	20001.90	-0.24	-0.00
Channel Z - Input	-20002.32	-0.57	0.00

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	2001.52	0.10	0.00
Channel X + Input	201.97	0.25	0.12
Channel X - Input	-198.73	-0.61	0.31
Channel Y + Input	2001.64	0.36	0.02
Channel Y + Input	200.56	-1.03	-0.51
Channel Y - Input	-198.98	-0.69	0.35
Channel Z + Input	2001.98	0.79	0.04
Channel Z + Input	199.57	-1.94	-0.96
Channel Z - Input	-199.10	-0.78	0.39

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-3.22	-5.14
	- 200	6.21	4.64
Channel Y	200	0.03	-0.21
	- 200	-0.30	-0.90
Channel Z	200	16.50	16.12
	- 200	-18.22	-18.31

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	-0.26	-4.59
Channel Y	200	7.28	-	0.77
Channel Z	200	9.54	5.88	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15765	16471
Channel Y	15715	14849
Channel Z	16039	14357

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10M Ω

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	0.41	-1.08	1.80	0.55
Channel Y	-0.08	-1.29	1.87	0.57
Channel Z	1.04	-0.36	2.86	0.63

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9



IMPORTANT NOTICE

USAGE OF THE DAE3

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE3 unit is connected to a fragile 3-pin battery connector. Customer is responsible to apply utmost caution not to bend or damage the connector when changing batteries.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:

Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:

Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:

To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.



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Client **Eurofins**

Certificate No: **EX3-3893_Oct21**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3893**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-14.v6, QA CAL-23.v5, QA CAL-25.v7**
Calibration procedure for dosimetric E-field probes

Calibration date: **October 20, 2021**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: CC2552 (20x)	09-Apr-21 (No. 217-03343)	Apr-22
DAE4	SN: 660	23-Dec-20 (No. DAE4-660_Dec20)	Dec-21
Reference Probe ES3DV2	SN: 3013	30-Dec-20 (No. ES3-3013_Dec20)	Dec-21
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-20)	In house check: Jun-22
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

	Name	Function	Signature
Calibrated by:	Jeffrey Katzman	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: October 20, 2021			
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Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3893

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.52	0.40	0.32	$\pm 10.1 \%$
DCP (mV) ^B	103.5	103.5	99.6	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Max dev.	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	168.3	$\pm 3.5 \%$	$\pm 4.7 \%$
		Y	0.0	0.0	1.0		147.6		
		Z	0.0	0.0	1.0		165.3		

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A The uncertainties of Norm X,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Page 5).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3893

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	158.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Note: Measurement distance from surface can be increased to 3-4 mm for an *Area Scan* job.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3893

Calibration Parameter Determined in Head Tissue Simulating Media

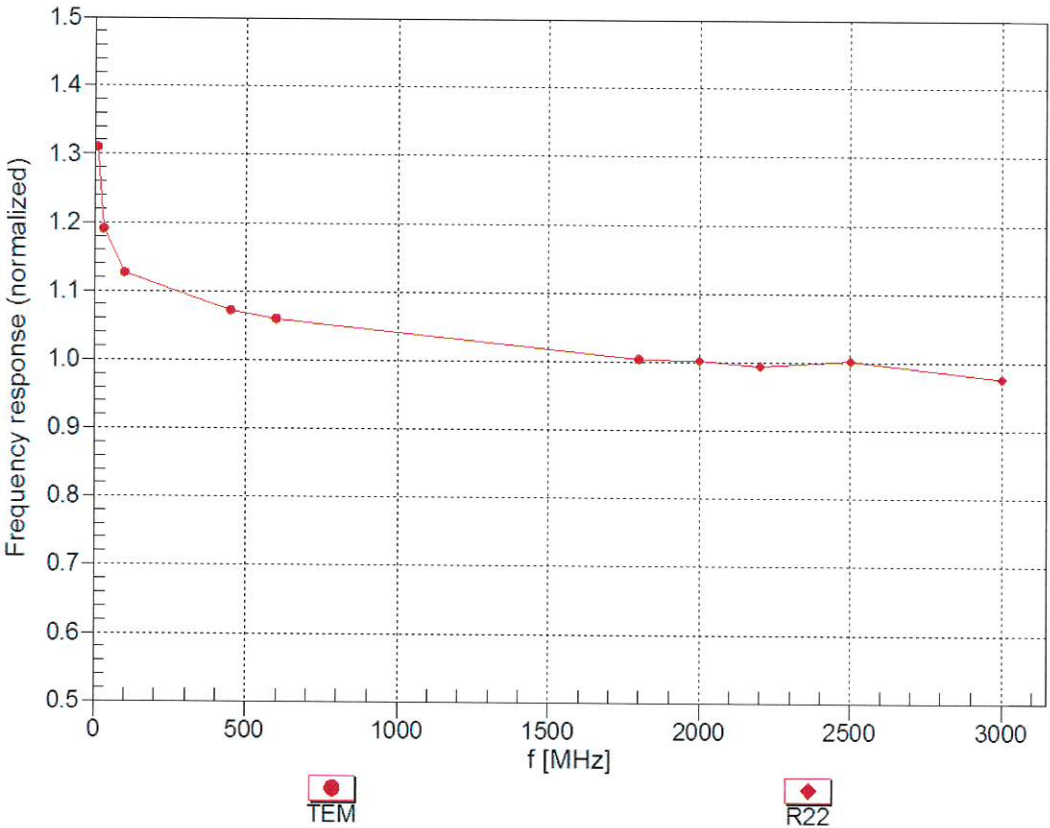
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	41.9	0.89	10.54	10.54	10.54	0.43	0.80	± 12.0 %
835	41.5	0.90	10.32	10.32	10.32	0.41	0.80	± 12.0 %
900	41.5	0.97	10.07	10.07	10.07	0.45	0.83	± 12.0 %
1750	40.1	1.37	9.08	9.08	9.08	0.32	0.86	± 12.0 %
1810	40.0	1.40	8.93	8.93	8.93	0.28	0.86	± 12.0 %
2450	39.2	1.80	7.87	7.87	7.87	0.31	0.90	± 12.0 %
2600	39.0	1.96	7.72	7.72	7.72	0.29	0.90	± 12.0 %
5250	35.9	4.71	5.19	5.19	5.19	0.40	1.80	± 13.1 %
5500	35.6	4.96	5.00	5.00	5.00	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.97	4.97	4.97	0.40	1.80	± 13.1 %

^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

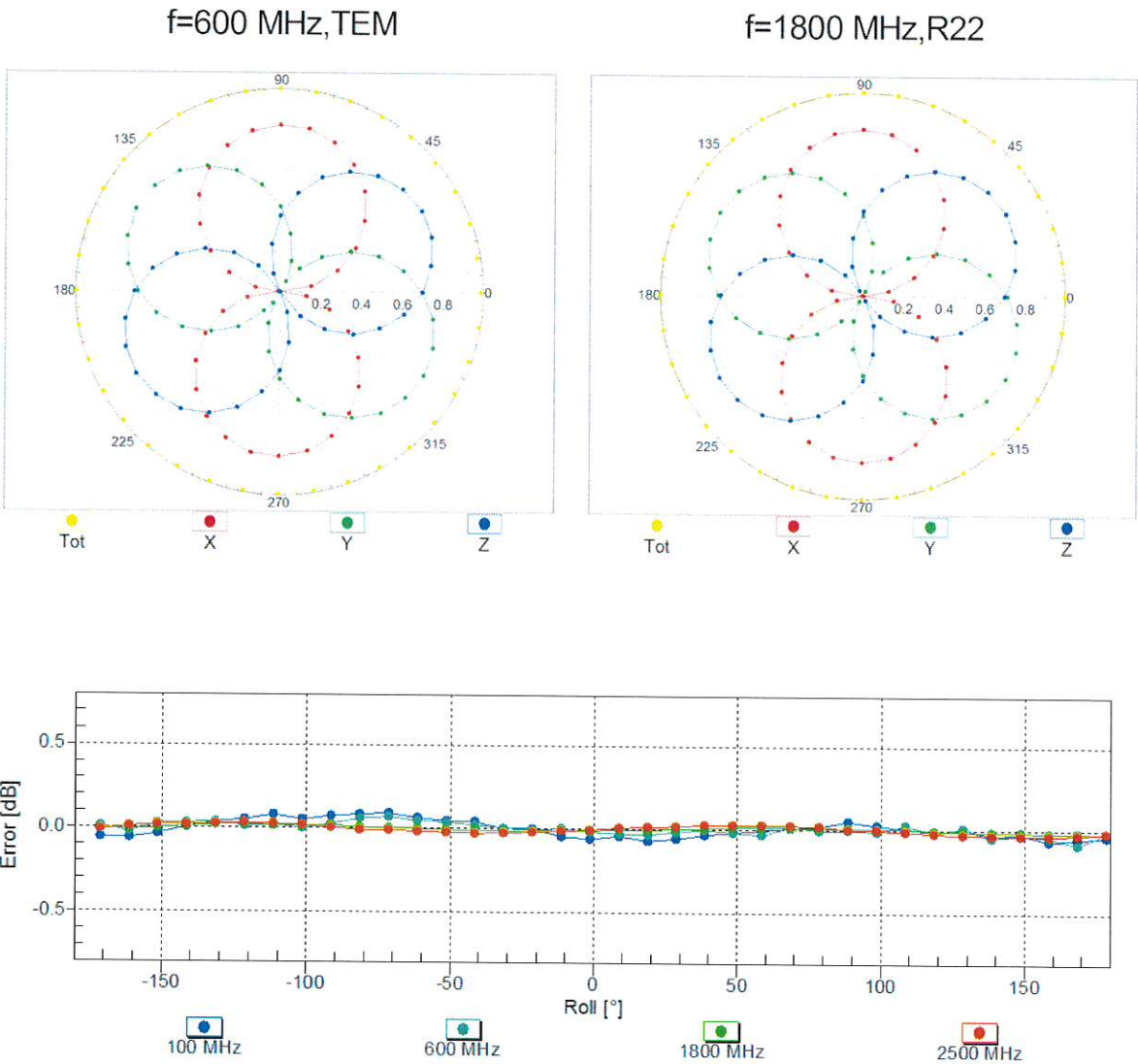
^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



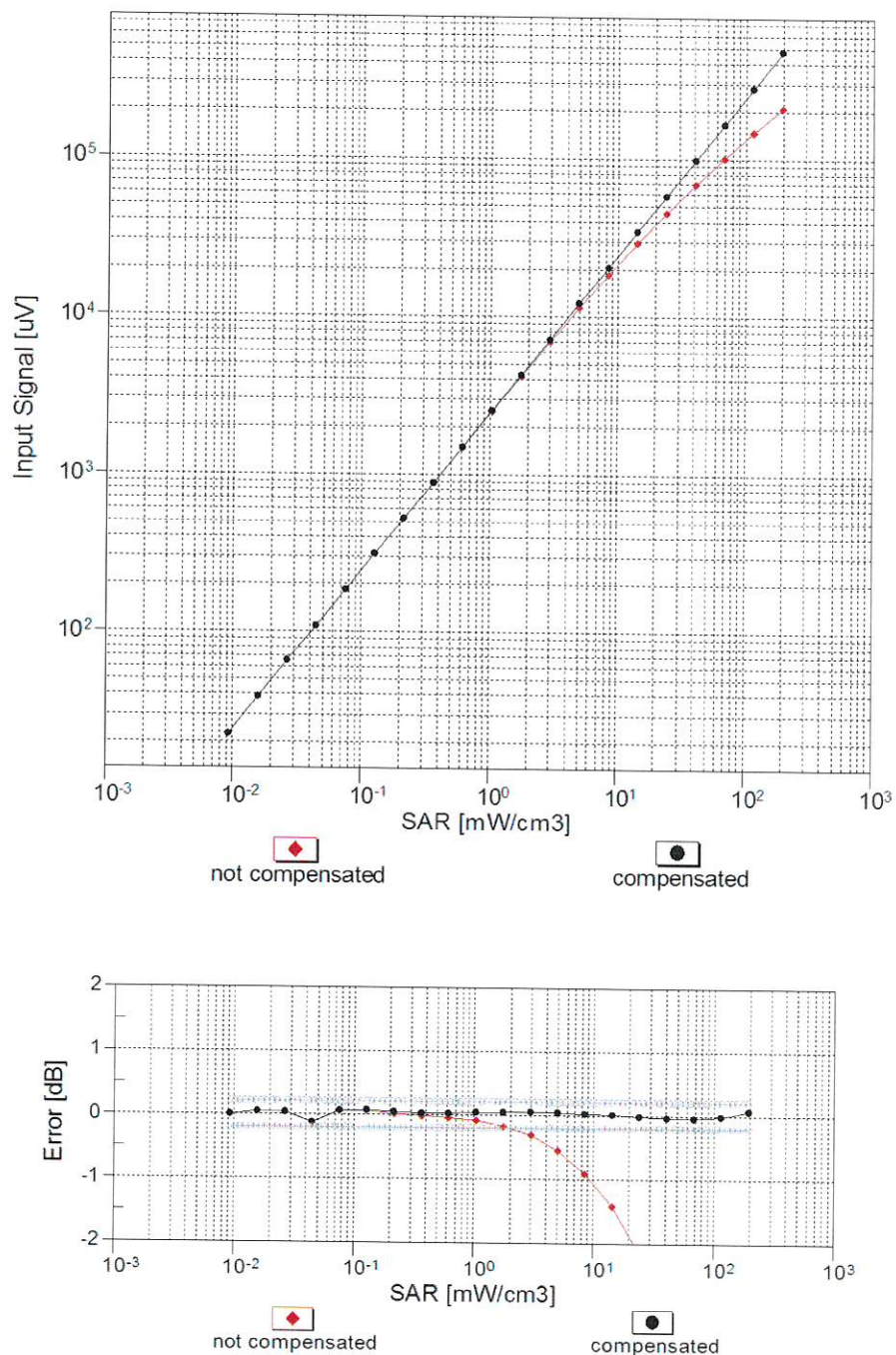
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\vartheta = 0^\circ$



Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f_{\text{eval}} = 1900 \text{ MHz}$)



Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Validation Report

No. VAL_0946_EF 2021-12

Kind of doc.:
QM Template

EUROFINS PRODUCT SERVICE GmbH

Storkower Str. 38c, 15526 Reichenwalde, Germany

1 Customer

Eurofins Product Service GmbH

2 Object

Equipment Number: EF00946
 Equipment Name: System validation dipole
 Equipment Type: D750V3
 Serial Number: 1125
 Manufacturer: Schmid & Partner Engineering AG

3 State of Measurement

Validation: ☒
 Performance Control: ☒
 Other: ☐

4 Performance of Measurement

4.1 Generals

(e.g. object of validation such as specific setup, non-standard method or SW, specification of the requirements, test set-up configuration, risk analysis etc.)

Dipol verification

4.2 Validation procedure / measurement

(e.g. comparison of results achieved with other methods, interlaboratory comparison, systematic assessment of factors influencing the result, assessment of the uncertainty of the results based on scientific understanding of the theoretical principles of the method and practical experience; criteria/requirements for approval/rejection etc.)

According KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04 3.2.2 Dipole calibration

Limits for the verification: return loss <20% to the original measurement or >20 dB minimum return-loss
 Impedance <5 Ω to the original measurement.

4.3 Used reference equipment

Equipment name	Equipment type	Manufacturer	Equipment number	Cal. Date	Cal. Due Date
RF Network analyzer	ZNB 40	R&S	EF01065	2021-07-27	2022-07-26

- new acquired (incl. calibration) ☐
- new calibrated ☐
- check reference standard ☒

4.4 Environmental conditions

Temperature: _23_ °C ± 2°C
 Relative Air Humidity: _50_ rH ± 5%
 Air Pressure: _1020_ hPa ± 5%

Validation Report

No. VAL_0946_EF 2021-12

Kind of doc.:
QM Template

EUROFINS PRODUCT SERVICE GmbH
Storkower Str. 38c, 15526 Reichenwalde, Germany

5 Results

5.1 General:

(e.g. measurement results, user instructions such as handling, transport, storage, preparation; checks to be made before the work started; information about how to install (operations)-, to maintain-, to train and to use; safety measures etc.)

	Original measurement	Verification measurement	Margin
Impedance, transformend to feed point	54.2 Ω - 1.8 j Ω	52.91 Ω + 5.48 j Ω	1.29 Ω + 7.28 j Ω
Return Loss	-27.1 dB	-29.22 dB	-7.82 %
Tissue Validation ϵ_r	41.900	41.746	-0.37 %
Tissue Validation σ [S/m]	0.890	0.873	-1.91 %
System validation	8.52 W/kg (1g)	8.76 W/kg (1g)	-2.7 %
Date:	28.08.2014	28.12.2021	

5.2 Measurement uncertainty

The reported expanded uncertainty of measurement is stated as the standard uncertainty multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.
+/- 2.5 %

5.3 Results of Validation

Validated ☒
Not validated ☐

6 Operator

C.Graf
Name


Signature

Place and Date of Verification: Reichenwalde, 28.12.2021

Attachment:

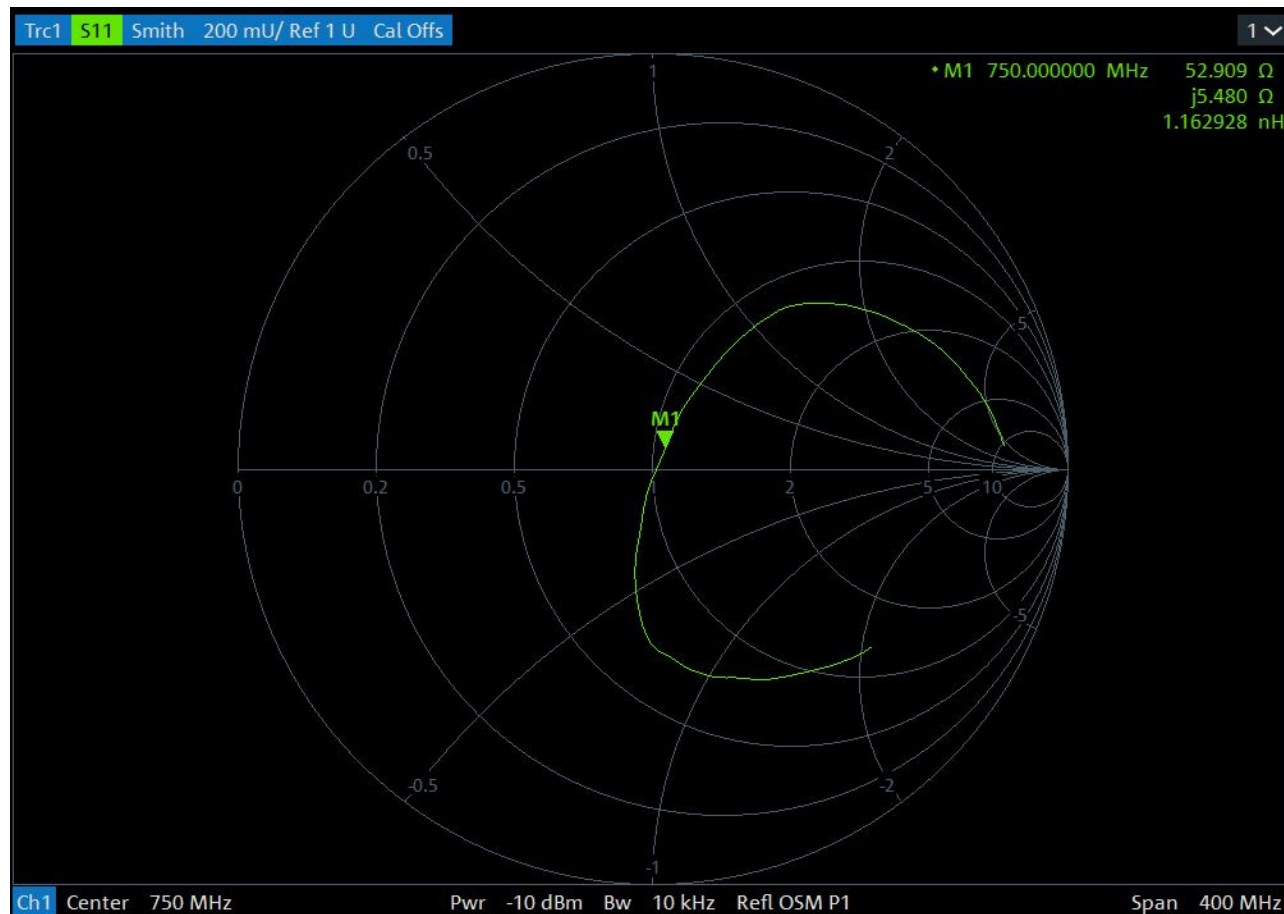
Impedance, Return Loss, System validierung

Validation Report

No. VAL_0946_EF 2021-12

Kind of doc.:
QM Template

EUROFINS PRODUCT SERVICE GmbH
Storkower Str. 38c, 15526 Reichenwalde, Germany

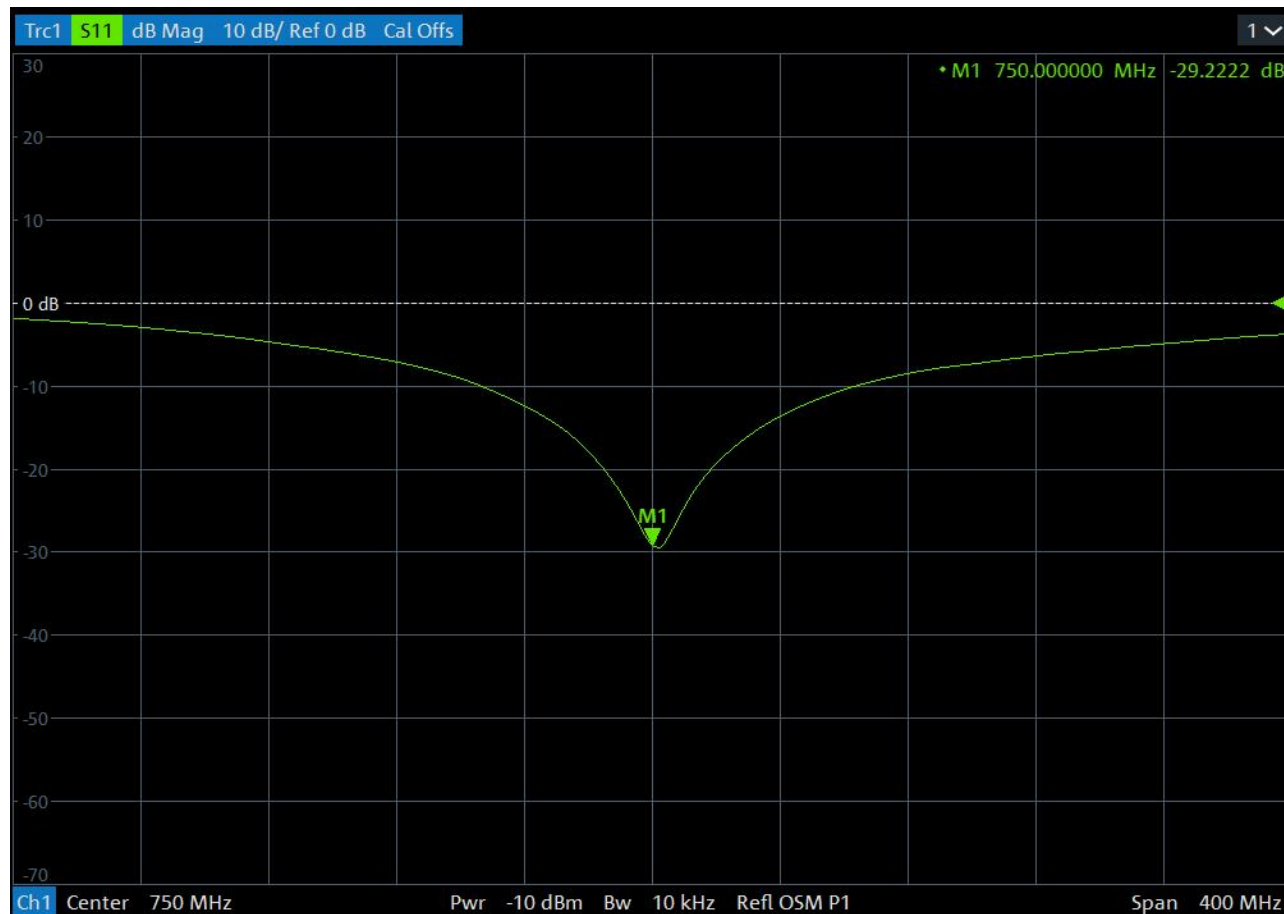


Validation Report

No. VAL_0946_EF 2021-12

Kind of doc.:
QM Template

EUROFINS PRODUCT SERVICE GmbH
Storkower Str. 38c, 15526 Reichenwalde, Germany



Validation Report

No. VAL_0946_EF 2021-12

Kind of doc.:
QM Template

EUROFINS PRODUCT SERVICE GmbH
Storkower Str. 38c, 15526 Reichenwalde, Germany

Date/Time: 28.12.2021 11:03:43

Test Laboratory: Eurofins Product Service GmbH

Dipol Valid.750 (m)_250mW ELI4 - 2021-12-28

DUT: Dipole 750 MHz D750V3; Type: D750V3; Serial: D750V3 - SN:1125

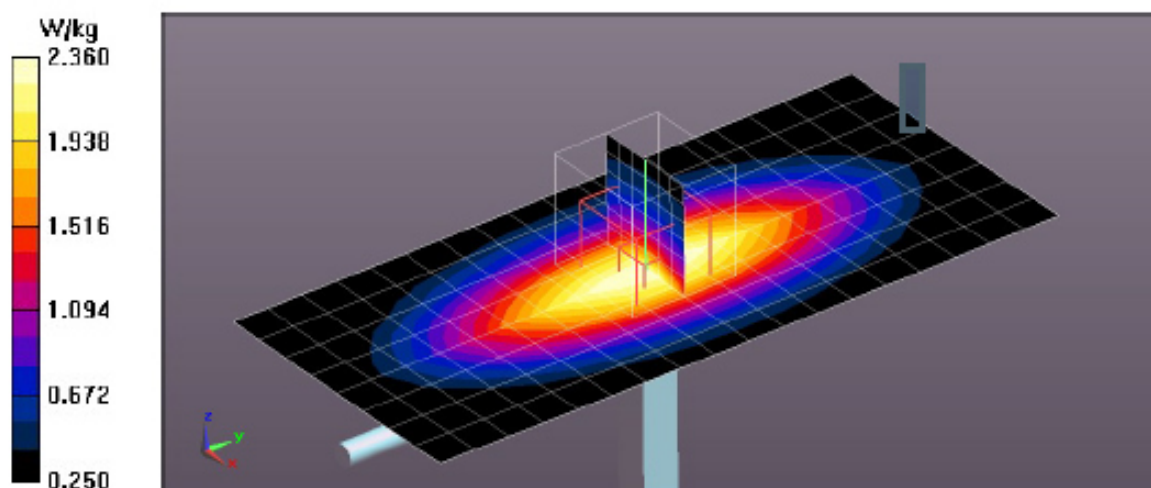
Communication System: UID 0, CW (0); Frequency: 750 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.906 \text{ S/m}$; $\epsilon_r = 41.707$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3893; ConvF(10.54, 10.54, 10.54) @ 750 MHz; Calibrated: 20.10.2021
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn522; Calibrated: 14.10.2021
- Phantom: ELI v4.0; Type: QDOVA001BB;
- Measurement SW: DASY52, Version 52.10 (2);

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=4.0mm (EX-Probe)/Area Scan (9x19x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 2.45 W/kg

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=4.0mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.14 V/m; Power Drift = -0.16 dB
Peak SAR (extrapolated) = 3.25 W/kg
SAR(1 g) = 2.19 W/kg; SAR(10 g) = 1.46 W/kg
Maximum value of SAR (measured) = 2.36 W/kg



Validation Report

No. VAL_0947_EF 2021-12

Kind of doc.:
QM Template

EUROFINS PRODUCT SERVICE GmbH

Storkower Str. 38c, 15526 Reichenwalde, Germany

1 Customer

Eurofins Product Service GmbH

2 Object

Equipment Number: EF00947
Equipment Name: System validation dipole
Equipment Type: D1750V2
Serial Number: 1126
Manufacturer: Schmid & Partner Engineering AG

3 State of Measurement

Validation: ☒
Performance Control: ☒
Other: ☐

4 Performance of Measurement

4.1 Generals

(e.g. object of validation such as specific setup, non-standard method or SW, specification of the requirements, test set-up configuration, risk analysis etc.)

Dipol verification

4.2 Validation procedure / measurement

(e.g. comparison of results achieved with other methods, interlaboratory comparison, systematic assessment of factors influencing the result, assessment of the uncertainty of the results based on scientific understanding of the theoretical principles of the method and practical experience; criteria/requirements for approval/rejection etc.)

According KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04 3.2.2 Dipole calibration

Limits for the verification: return loss <20% to the original measurement or >20 dB minimum return-loss
Impedance <5 Ω to the original measurement.

4.3 Used reference equipment

Equipment name	Equipment type	Manufacturer	Equipment number	Cal. Date	Cal. Due Date
RF Network analyzer	ZNB 40	R&S	EF01065	2021-07-27	2022-07-26

- new acquired (incl. calibration) ☐
- new calibrated ☐
- check reference standard ☒

4.4 Environmental conditions

Temperature: _23_ °C \pm 2°C
Relative Air Humidity: _50_ rH \pm 5%
Air Pressure: _1020_ hPa \pm 5%

Validation Report

No. VAL_0947_EF 2021-12

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Storkower Str. 38c, 15526 Reichenwalde, Germany

5 Results

5.1 General:

(e.g. measurement results, user instructions such as handling, transport, storage, preparation; checks to be made before the work started; information about how to install (operations)-, to maintain-, to train and to use; safety measures etc.)

	Original measurement	Verification measurement	Margin
Impedance, transformend to feed point	51.1 Ω + 0.9 j Ω	50.55 Ω + 1.55 j Ω	0.55 Ω + 0.65j Ω
Return Loss	-36.90 dB	-35.57 dB	3.60 %
Tissue Validation ϵ_r	40.100	40.079	0.05 %
Tissue Validation σ [S/m]	1.370	1.371	-0.08 %
System validation	36.6 W/kg (10g)	38.16 W/kg (1g)	-4.1 %
Date:	14.08.2014	22.12.2021	

5.2 Measurement uncertainty

The reported expanded uncertainty of measurement is stated as the standard uncertainty multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.
+/- 2.5 %

5.3 Results of Validation

Validated ☒
Not validated ☐

6 Operator

C.Graf

Name


Signature

Place and Date of Verification: Reichenwalde, 22.12.2021

Attachment:

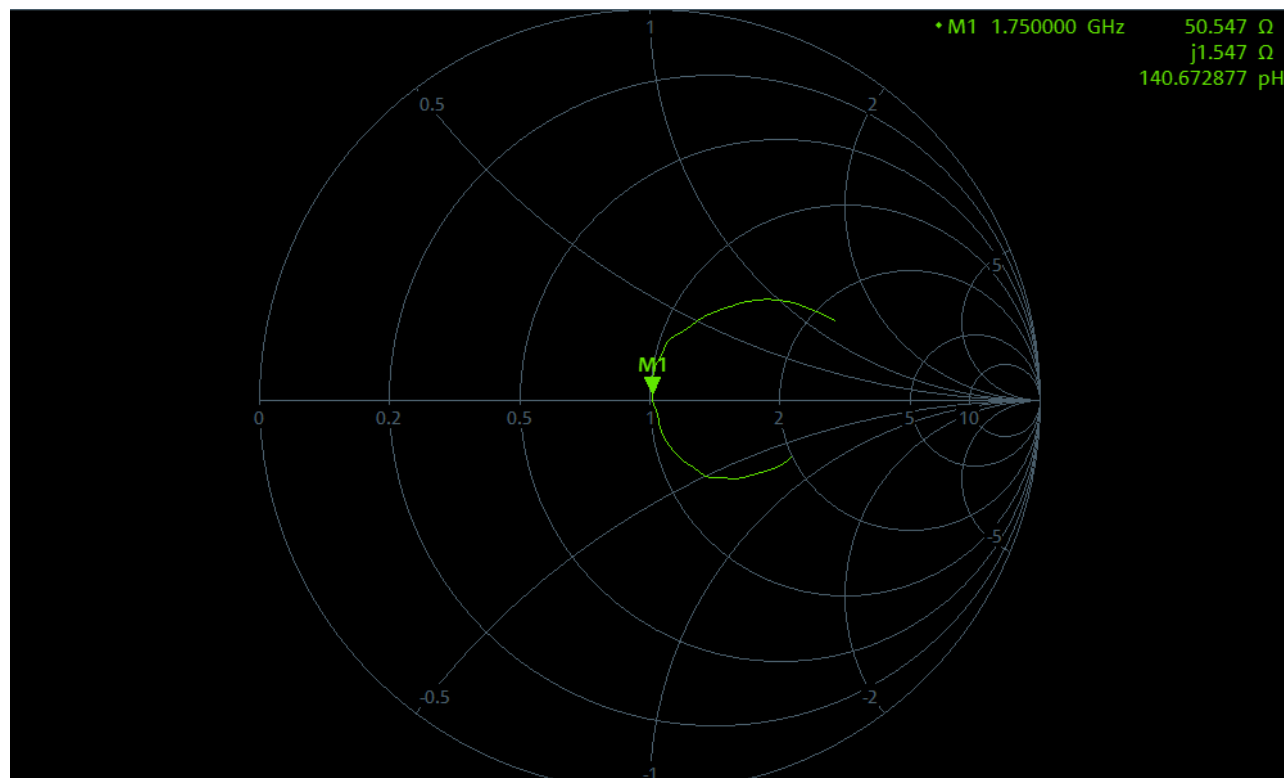
Impedance, Return Loss, System validierung

Validation Report

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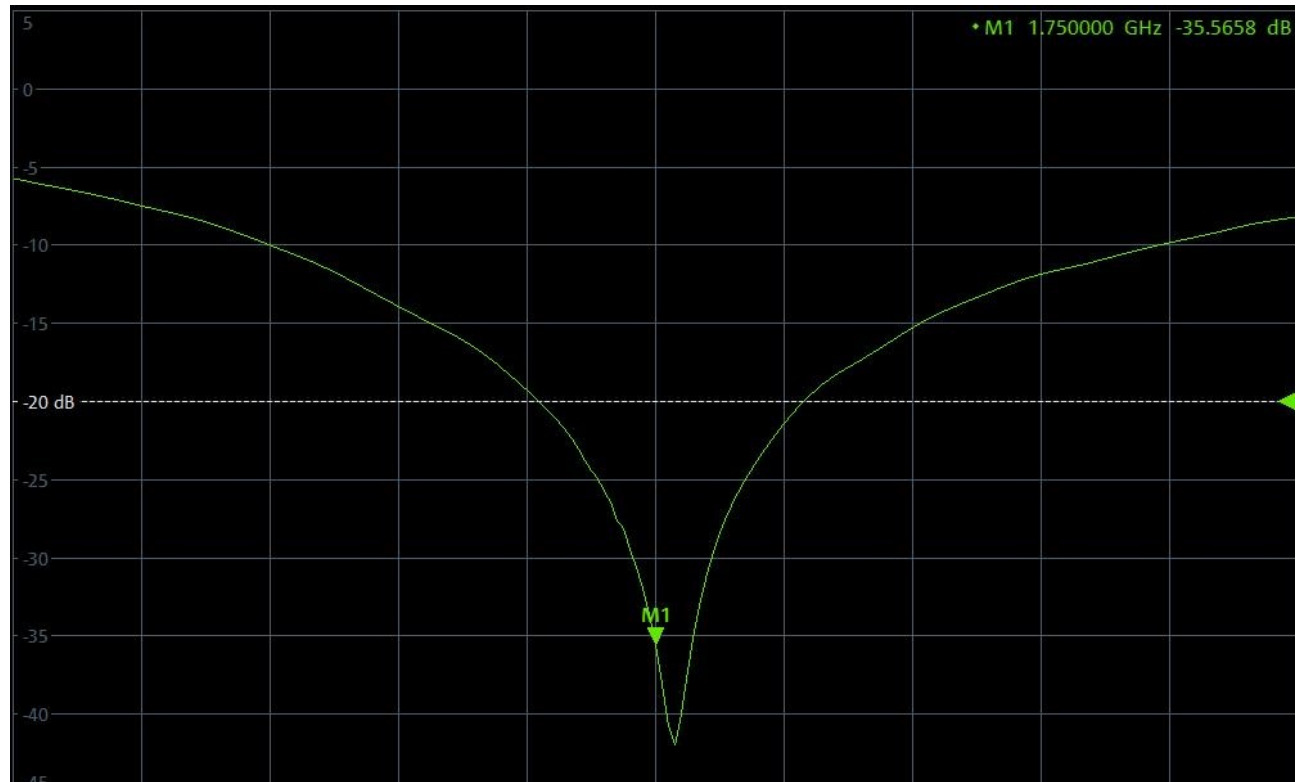


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Validation Report

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EUROFINS PRODUCT SERVICE GmbH
Storkower Str. 38c, 15526 Reichenwalde, Germany

Date/Time: 22.12.2021 09:03:38

Test Laboratory: Eurofins Product Service GmbH

Dipol Valid.1750 (m)_250mW ELI4 - 2021-12-22

DUT: Dipole 1750 MHz D1750V3; Type: D1750V3; Serial: D1750V3 - SN:1126

Communication System: UID 0, CW (0); Frequency: 1750 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 1750$ MHz; $\sigma = 1.371$ S/m; $\epsilon_r = 40.079$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3893; ConvF(10.28, 10.28, 10.28) @ 1750 MHz; Calibrated: 20.10.2021
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn522; Calibrated: 14.10.2021
- Phantom: ELI v4.0; Type: QDOVA001BB;
- Measurement SW: DASY52, Version 52.10 (2);

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=4.0mm (EX-Probe)/Area Scan (11x11x1):

Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 10.71 W/kg

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=4.0mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 49.50 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 10.67 W/kg
SAR(1 g) = 9.54 W/kg; SAR(10 g) = 7.56 W/kg
Maximum value of SAR (measured) = 9.61 W/kg

