



In Collaboration with

s p e a g
CALIBRATION LABORATORY

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:3923

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)	Uct. (k=2)
750	41.9	0.89	10.54	10.54	10.54	0.14	1.23	±13%
835	41.5	0.90	10.09	10.09	10.09	0.14	1.28	±13%
1640	40.3	1.29	8.89	8.89	8.89	0.21	1.04	±13%
1750	40.1	1.37	8.78	8.78	8.78	0.26	0.96	±13%
1900	40.0	1.40	8.43	8.43	8.43	0.19	1.13	±13%
2100	39.8	1.49	8.41	8.41	8.41	0.17	1.21	±13%
2300	39.5	1.67	8.21	8.21	8.21	0.53	0.67	±13%
2450	39.2	1.80	7.95	7.95	7.95	0.52	0.70	±13%
2600	39.0	1.96	7.75	7.75	7.75	0.57	0.67	±13%
3300	38.2	2.71	7.31	7.31	7.31	0.45	0.87	±14%
3500	37.9	2.91	7.15	7.15	7.15	0.38	1.05	±14%
3700	37.7	3.12	6.95	6.95	6.95	0.38	1.09	±14%
3900	37.5	3.32	6.90	6.90	6.90	0.30	1.50	±14%
5250	35.9	4.71	5.57	5.57	5.57	0.50	1.30	±14%
5600	35.5	5.07	4.97	4.97	4.97	0.45	1.40	±14%
5750	35.4	5.22	5.10	5.10	5.10	0.50	1.30	±14%

^C Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of 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. Above 5 GHz frequency validity can be extended to ± 110 MHz.

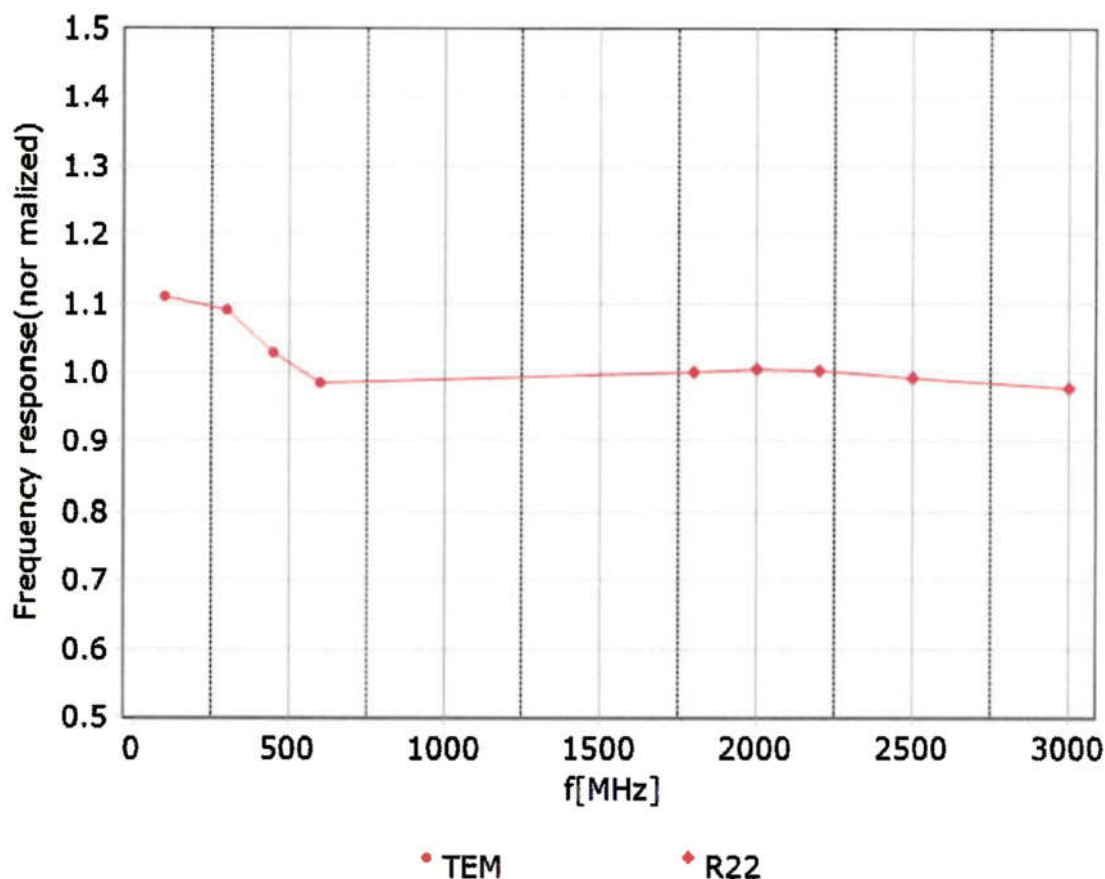
^F At frequency up to 6 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.



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



Uncertainty of Frequency Response of E-field: $\pm 7.4\%$ ($k=2$)

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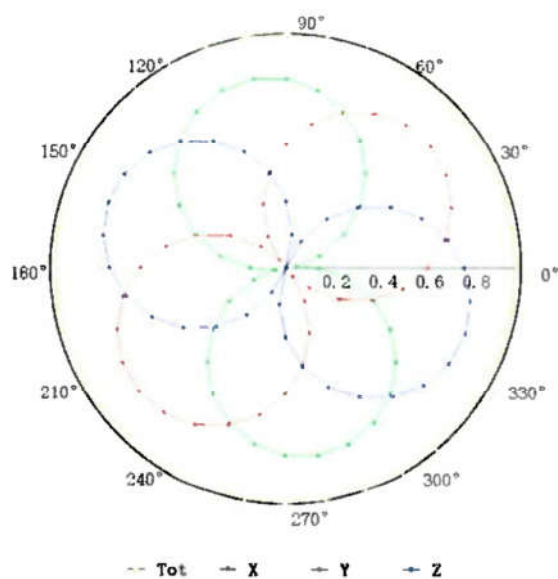
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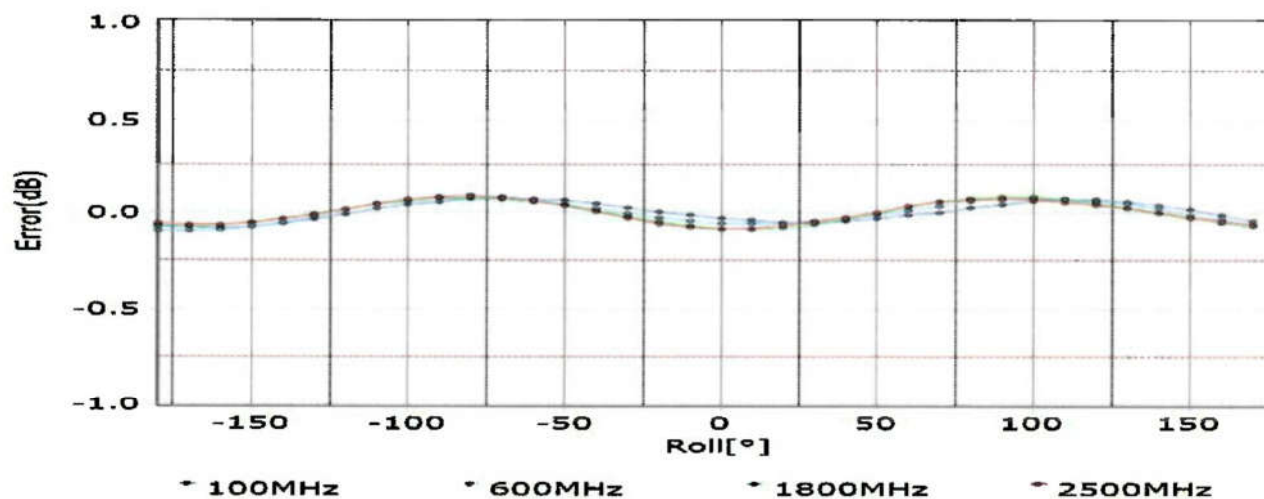
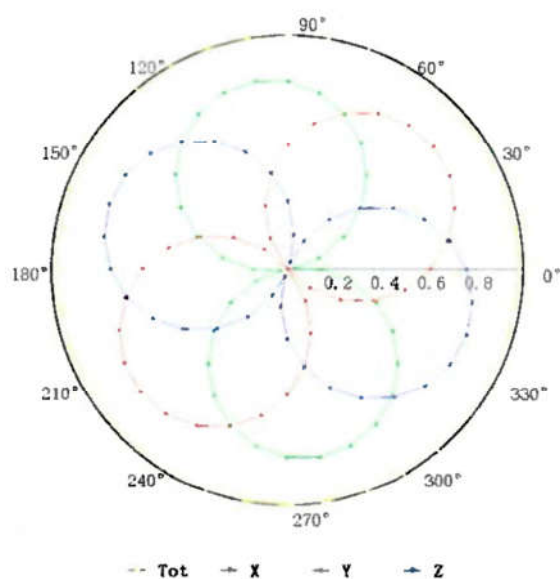
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Receiving Pattern (Φ), $\theta=0^\circ$

f=600 MHz, TEM



f=1800 MHz, R22



Uncertainty of Axial Isotropy Assessment: $\pm 1.2\%$ ($k=2$)

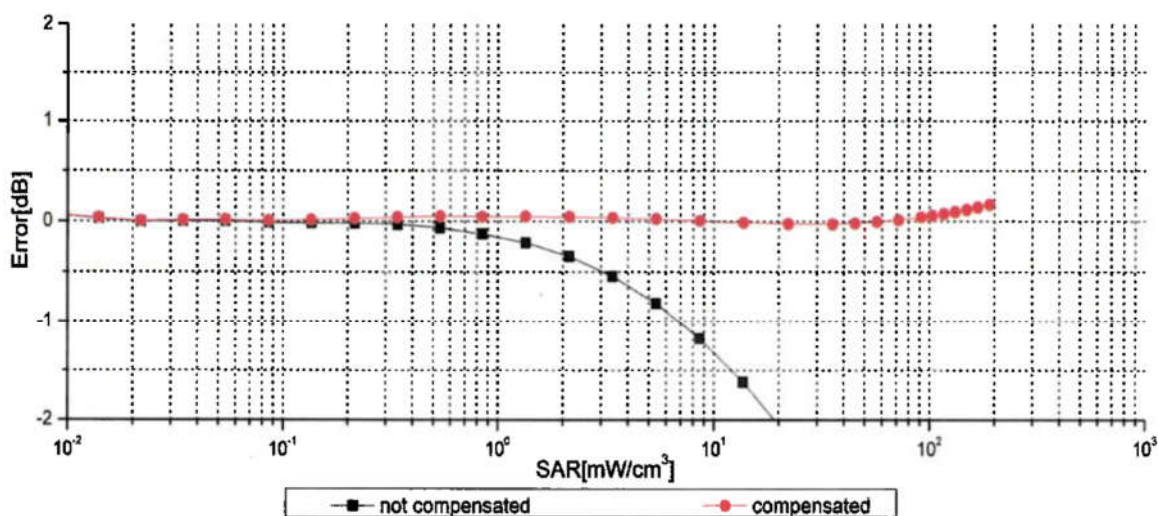
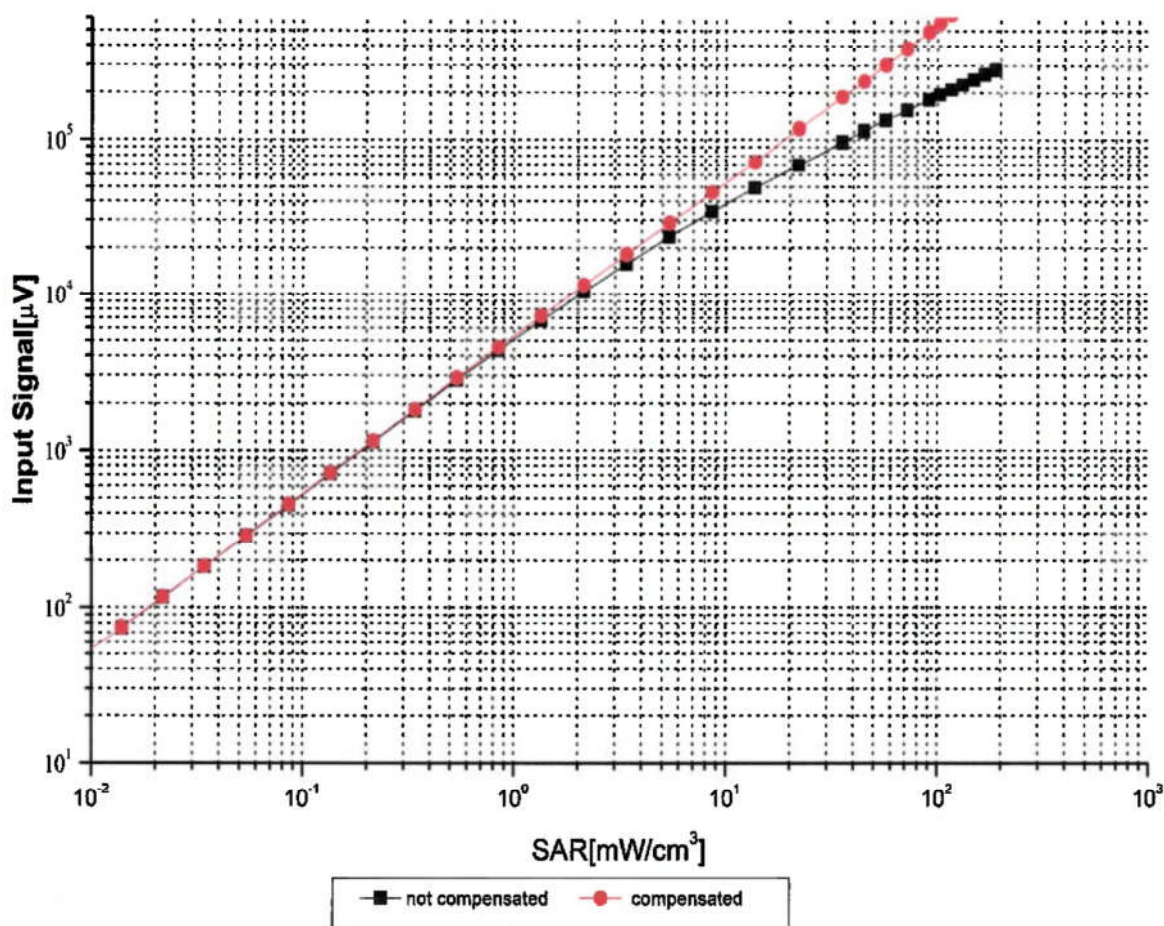
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Dynamic Range f(SAR_{head}) (TEM cell, f = 900 MHz)



Uncertainty of Linearity Assessment: $\pm 0.9\%$ ($k=2$)

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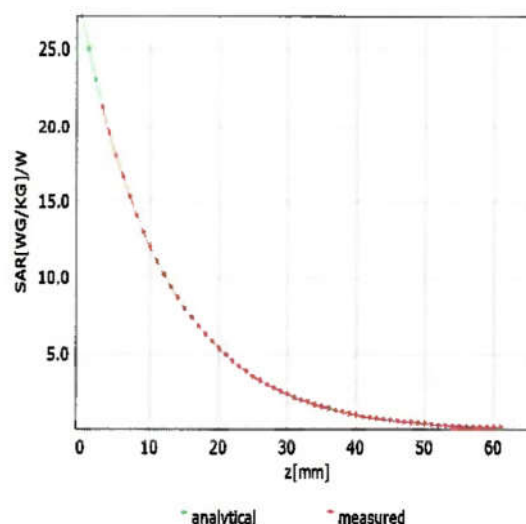
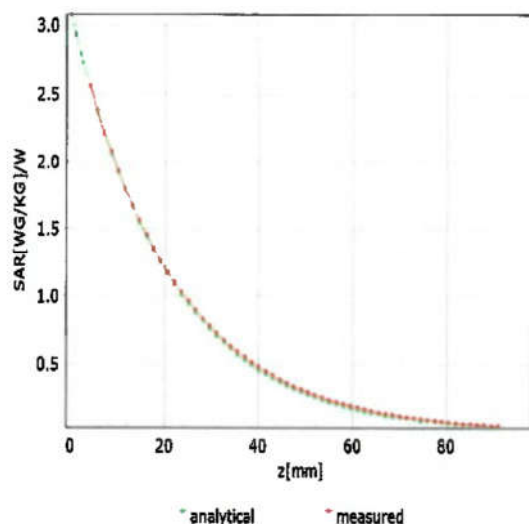
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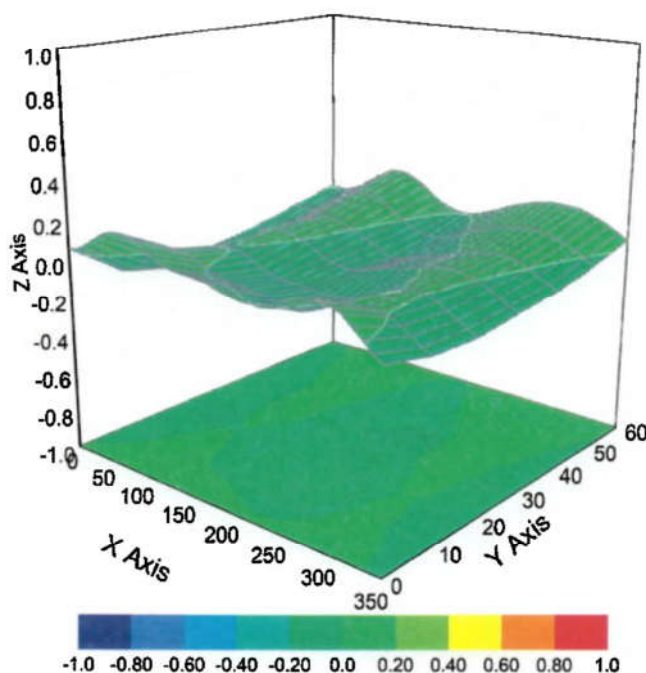
Conversion Factor Assessment

f=750 MHz,WGLS R9(H_convF)

f=1750 MHz,WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: $\pm 3.2\%$ ($k=2$)



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DASY/EASY – Parameters of Probe: EX3DV4 – SN:3923

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	178.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

Calibration Laboratory of**Schmid & Partner
Engineering AG**

Zeughausstrasse 43, 8004 Zurich, Switzerland

**S** Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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Multilateral Agreement for the recognition of calibration certificates**Accreditation No.: **SCS 0108**

Client

SGS

Suzhou

Certificate No.

EX-3982_Nov25**CALIBRATION CERTIFICATE**

Object

EX3DV4 - SN:3982

Calibration procedure(s)

**QA CAL-01.v10, QA CAL-12.v10, QA CAL-14.v7, QA CAL-23.v6,
QA CAL-25.v8, QA CAL-48.v2
Calibration procedure for dosimetric E-field probes**

Calibration date

November 07, 2025

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	Calibration Date (Certificate No.)	Sched. Cal.
Power Sensor R&S NRP-33T	SN: 100967	29-Oct-25 (No. Part of L1407)	Oct-26
N-type mismatch combination	SN: L1119	26-Mar-25 (No. 217-04292)	Mar-26
OCP DAK-12	SN: 1016	16-Sept-25 (No. OCP-DAK12-1016_Sep25)	Sep-26
OCP DAK-3.5	SN: 1249	16-Sept-25 (No. OCP-DAK3.5-1249_Sep25)	Sep-26
Reference Probe EX3DV4	SN: 7349	10-Jan-25 (No. EX3-7349_Jan25)	Jan-26
DAE4	SN: 1301	30-Oct-25 (No. DAE4-1301_Oct25)	Oct-26

Secondary Standards	ID	Check Date (in house)	Sched. Check
ACAP 2020 Setup 1	SN: L1404	01-Oct-25 (No. IHCK_ACAP2020-1_Oct25)	Oct-26
OCP DAK-12	SN: 1029	27-Feb-25 (No. OCP-DAK12-1029_Feb25)	Feb-26
OCP DAK-3.5	SN: 1336	09-Dec-24 (No. OCP-DAK3.5-1336_Dec24)	Dec-25

	Name	Function	Signature
Calibrated by	Krešimir Franjić	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	

Issued: November 07, 2025

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



Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

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., $\theta = 0$ 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 $\theta = 0$ ($f \leq 900$ 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. 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).

Parameters of Probe: EX3DV4 - SN:3982

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc ($k = 2$)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.63	0.58	0.58	$\pm 10.1\%$
DCP (mV) ^B	109.9	108.5	109.1	$\pm 4.7\%$

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B $\text{dB}\sqrt{\mu\text{V}}$	C	D dB	VR mV	Max dev.	Max Unc ^E $k = 2$
0	CW	X	0.00	0.00	1.00	0.00	131.6	$\pm 1.9\%$	$\pm 4.7\%$
		Y	0.00	0.00	1.00		122.2		
		Z	0.00	0.00	1.00		128.7		

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 Linearization parameter uncertainty for maximum specified field strength.

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

Parameters of Probe: EX3DV4 - SN:3982**Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle	-52.5°
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	12 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.

Parameters of Probe: EX3DV4 - SN:3982

Calibration Parameter Determined in HSL

f (MHz) ^C	Relative Permittivity ^F	Conductivity ^F (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc ^H (k = 2)
13	55.0	0.75	15.44	17.46	16.16	0.00	1.25	±13.3%
150	52.3	0.76	12.51	13.79	13.16	0.00	1.25	±13.3%
450	43.5	0.87	11.49	11.49	11.49	0.16	1.30	±13.3%
750	41.9	0.89	9.52	10.18	9.86	0.35	1.27	±11.0%
850	41.5	0.92	9.34	9.98	9.67	0.35	1.27	±11.0%
1750	40.1	1.37	7.99	8.53	8.27	0.35	1.27	±11.0%
1900	40.0	1.40	7.79	8.32	8.06	0.35	1.27	±11.0%
2100	39.8	1.49	7.55	8.06	7.81	0.35	1.27	±11.0%
2300	39.5	1.67	7.30	7.80	7.56	0.35	1.27	±11.0%
2450	39.2	1.80	7.18	7.67	7.44	0.35	1.27	±11.0%
2600	39.0	1.96	7.03	7.51	7.28	0.35	1.27	±11.0%
3300	38.2	2.71	6.69	7.14	6.92	0.34	1.27	±13.1%
3500	37.9	2.91	6.61	7.06	6.84	0.34	1.27	±13.1%
3700	37.7	3.12	6.56	7.01	6.79	0.34	1.27	±13.1%
3900	37.5	3.32	6.52	6.97	6.75	0.34	1.27	±13.1%
4100	37.2	3.53	6.41	6.85	6.64	0.34	1.27	±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.

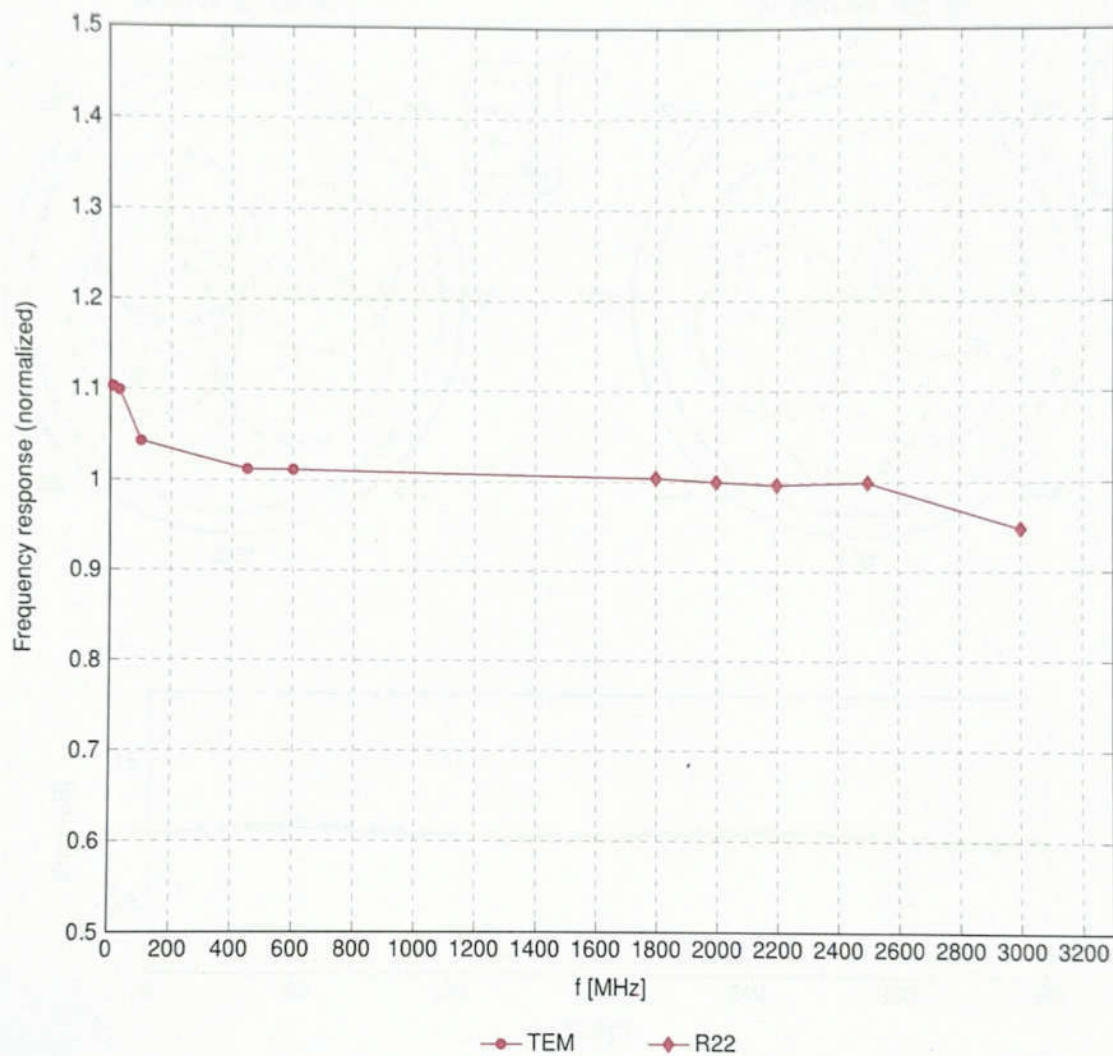
^F The probes are calibrated using tissue simulating liquids (TSL) that deviate for ϵ and σ by less than ±5% from the target values (typically better than ±3%) and are valid for TSL with deviations of up to ±10% if SAR correction is applied.

^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.

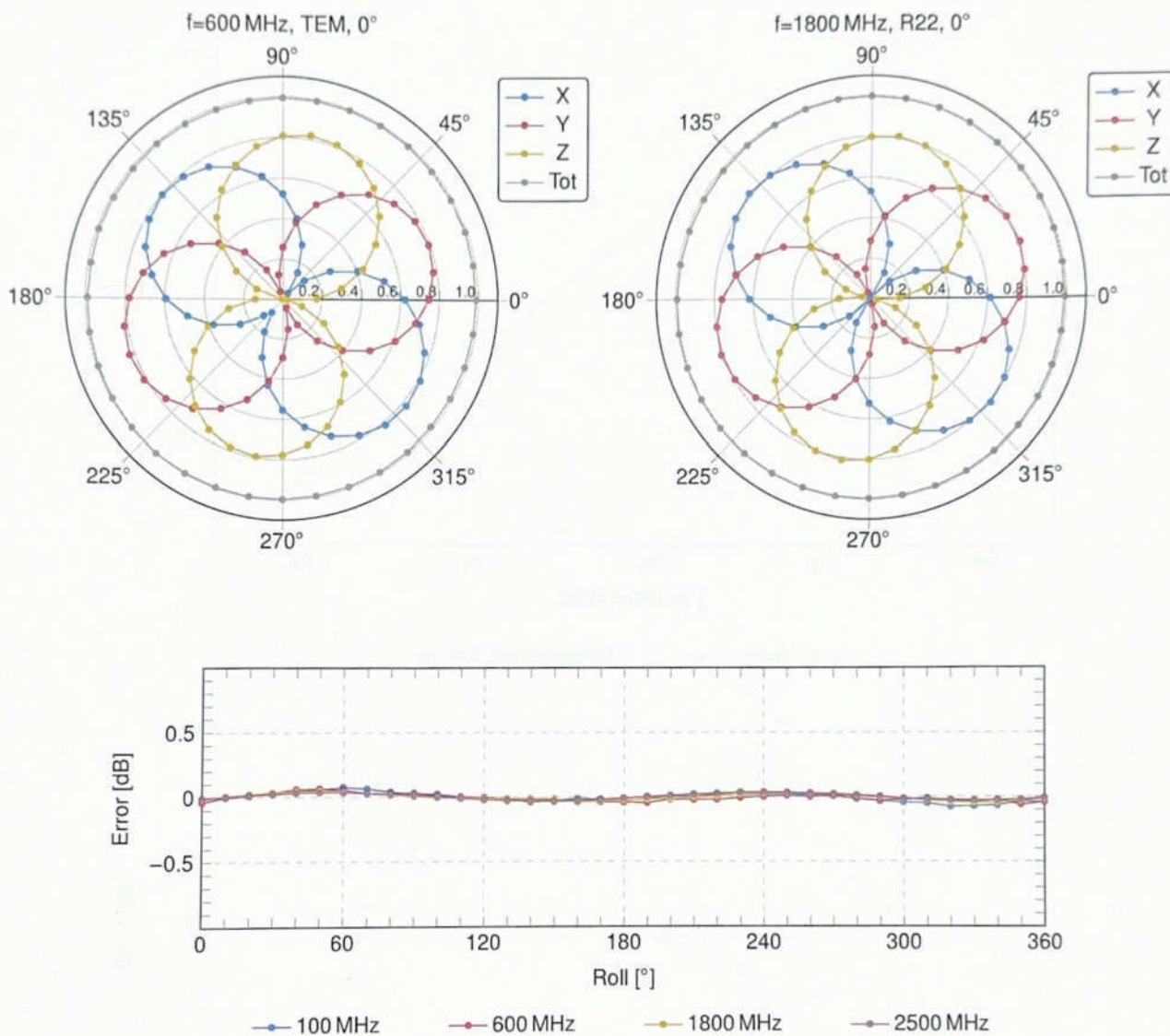
^H The stated uncertainty is the total calibration uncertainty (k = 2) of Norm-ConvF. This is equivalent to the uncertainty component with the symbol CF in Table 9 of IEC/IEEE 62209-1528:2020.

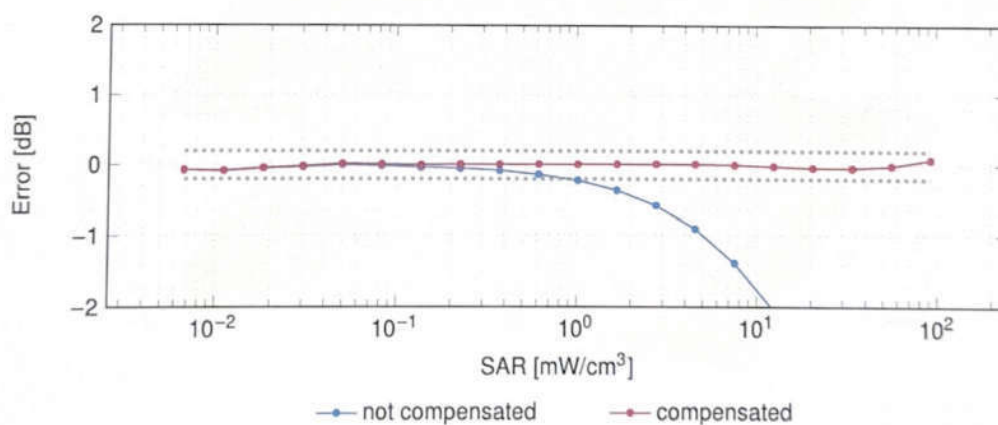
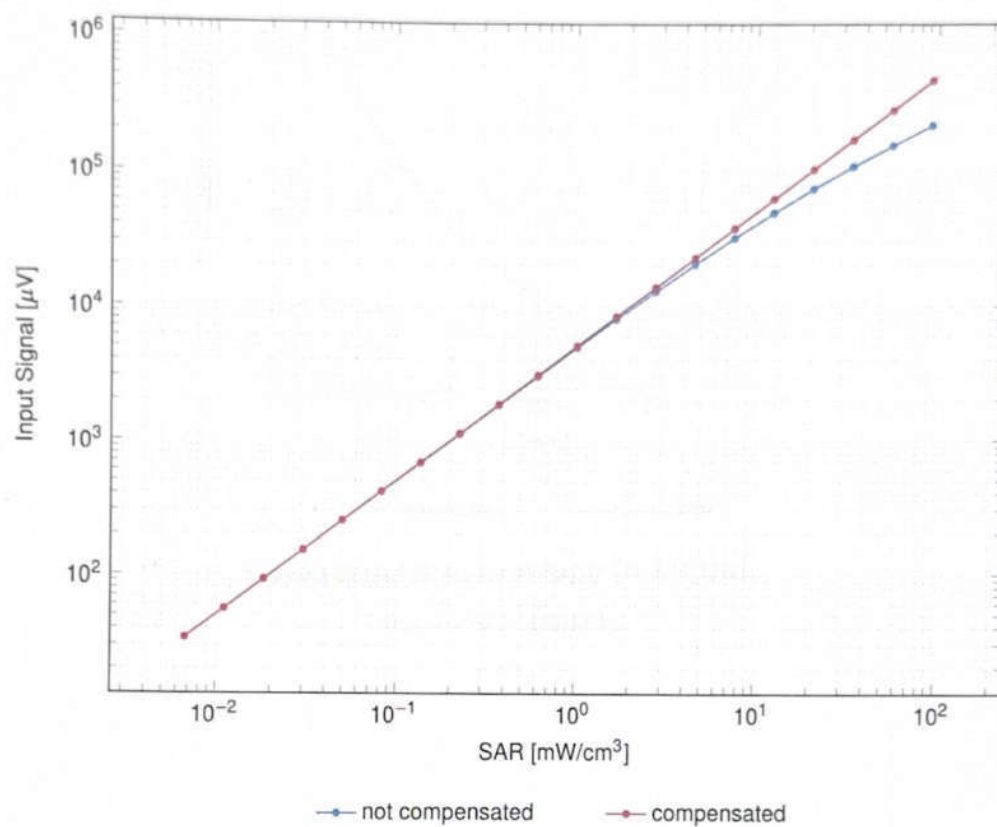
Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide:R22)

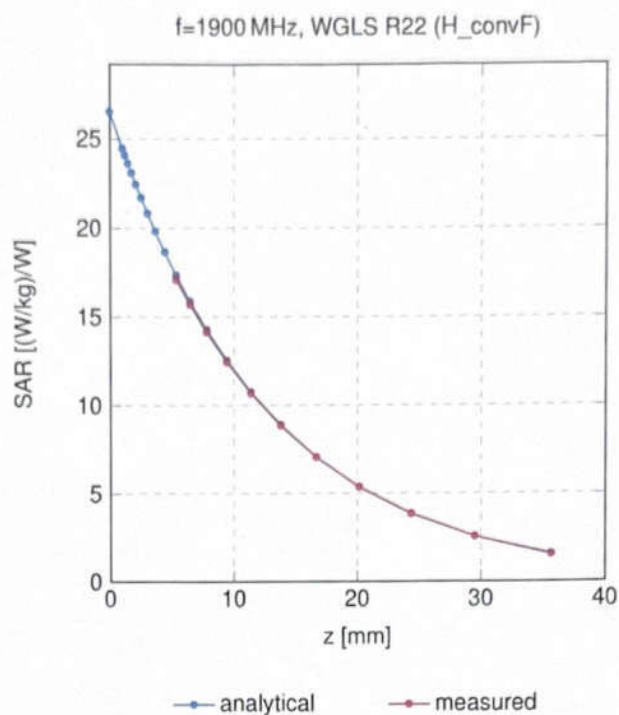


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

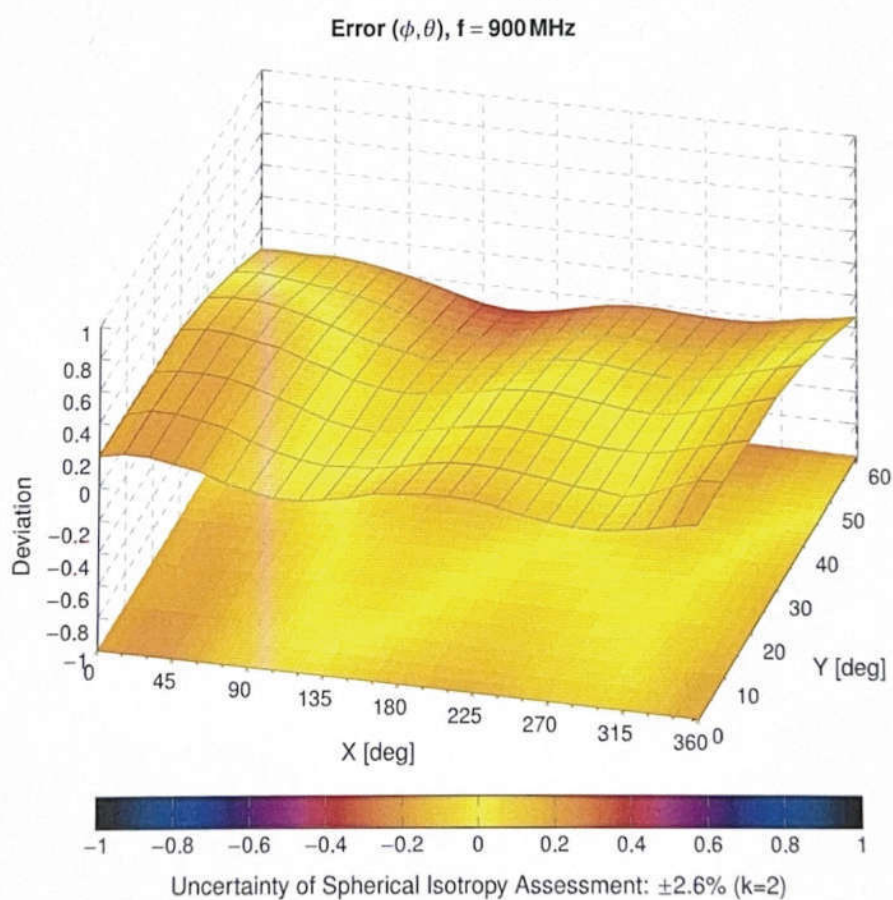
Receiving Pattern (ϕ), $\theta = 0^\circ$ Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{HSL}})$ (TEM cell, $f_{\text{eval}} = 1900 \text{ MHz}$)Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid



Dipole D750V3 SN 1214						
Head Liquid						
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$	Impedance imaginary ($j\Omega$)	$\Delta j\Omega$
2025-04-01	-30.1	/	50.7	/	-3.08	/
2026-03-31	-29.8	1.00%	50.5	0.2	-3.28	0.2

Dipole D835V2 SN 4d161						
Head Liquid						
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$	Impedance imaginary ($j\Omega$)	$\Delta j\Omega$
2023-08-25	-29.3	/	50.3	/	-3.44	/
2024-08-24	-29.1	0.68%	50.1	0.2	-3.59	0.15
2025-08-23	-29.2	0.34%	50.2	0.1	-3.52	0.08

Dipole D1750V2 SN 1105						
Head Liquid						
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$	Impedance imaginary ($j\Omega$)	$\Delta j\Omega$
2023-11-03	-29.1	/	47.8	/	-2.61	/
2024-11-02	-28.9	0.69%	47.7	0.1	-2.71	0.1
2025-11-01	-28.5	2.06%	47.6	0.2	-2.88	0.27

Dipole D2300V2 SN1096						
Head Liquid						
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$	Impedance imaginary ($j\Omega$)	$\Delta j\Omega$
2025-04-01	-26.1	/	46.6	/	-3.40	/
2026-03-31	-25.8	1.15%	47.5	0.9	-2.71	0.69

Dipole D2450V2 SN 922						
Head Liquid						
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$	Impedance imaginary ($j\Omega$)	$\Delta j\Omega$
2023-08-28	-24.3	/	53.2	/	5.45	/
2024-08-27	-24.1	0.82%	52.9	0.3	5.23	0.22
2025-08-26	-24.2	0.41%	53	0.2	5.29	0.16

Dipole D2600V2 SN 1158						
Head Liquid						
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$	Impedance imaginary ($j\Omega$)	$\Delta j\Omega$
2025-03-31	-23.8	/	46.9	/	5.43	/
2026-03-30	-23.5	1.26%	46.7	0.2	5.58	0.15

Dipole D3500V2 SN1133						
Head Liquid						
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$	Impedance imaginary ($j\Omega$)	$\Delta j\Omega$
2025-04-02	-37.4	/	50.9	/	1.00	/
2026-03-31	-35.7	4.55%	49.8	1.1	-0.15	1.15

Dipole D3700V2 SN1108						
Head Liquid						
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$	Impedance imaginary ($j\Omega$)	$\Delta j\Omega$
2025-04-01	-22.8	/	44.3	/	3.82	/
2026-03-31	-23.7	3.95%	41.5	2.8	3.85	0.03

Dipole D3900V2 SN1083						
Head Liquid						
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$	Impedance imaginary ($j\Omega$)	$\Delta j\Omega$
2025-03-31	-21.9	/	44.0	/	-4.62	/
2026-03-31	-22.8	4.11%	42.8	1.2	-3.82	0.8

Dipole D4100V2 SN1083						
Head Liquid						
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$	Impedance imaginary ($j\Omega$)	$\Delta j\Omega$
2025-03-31	-24.9	/	55.9	/	1.21	/
2026-03-31	-23.8	4.4%	55.7	0.2	2.38	1.17

Dipole D5GHzV2 SN 1174						
5250MHz Head Liquid						
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$	Impedance imaginary ($j\Omega$)	$\Delta j\Omega$
2023-08-23	-22.1	/	47.3	/	-7.19	/
2024-08-22	-21.9	0.90%	47.1	0.2	-7.35	0.16
2025-08-21	-22	0.45%	47.2	0.1	-7.28	0.09
5600MHz Head Liquid						
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$	Impedance imaginary ($j\Omega$)	$\Delta j\Omega$
2023-08-23	-27.4	/	53.9	/	-2.14	/
2024-08-22	-27.1	1.09%	53.7	0.2	-2.35	0.21
2025-08-21	-27.2	1.09%	53.8	0.1	-2.23	0.09
5750MHz Head Liquid						
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$	Impedance imaginary ($j\Omega$)	$\Delta j\Omega$
2023-08-23	-24.6	/	53.2	/	-5.17	/
2024-08-22	-24.2	1.63%	52.9	0.3	-5.39	0.22
2025-08-21	-24.4	1.63%	53.1	0.1	-5.27	0.1

- End of the Appendix -