

EX3DV4 - SN:7896

November 07, 2024

Parameters of Probe: EX3DV4 - SN:7896

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle	28.7°
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.

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**Parameters of Probe: EX3DV4 - SN:7896****Calibration Parameter Determined in Head Tissue Simulating Media**

f (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity <sup>F</sup> (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>G</sup> (mm)	Unc <sup>H</sup> (k = 2)
750	41.9	0.89	8.72	9.14	9.15	0.35	1.27	±11.0%
900	41.5	0.97	8.08	8.47	8.48	0.35	1.27	±11.0%
1750	40.1	1.37	7.20	7.55	7.56	0.35	1.27	±11.0%
1900	40.0	1.40	6.96	7.29	7.30	0.35	1.27	±11.0%
2300	39.5	1.67	6.79	7.12	7.13	0.35	1.27	±11.0%
2450	39.2	1.80	6.54	6.85	6.86	0.35	1.27	±11.0%
2600	39.0	1.96	6.60	6.92	6.93	0.35	1.27	±11.0%
3300	38.2	2.71	5.83	6.12	6.12	0.36	1.27	±13.1%
3500	37.9	2.91	5.91	6.19	6.20	0.36	1.27	±13.1%
3700	37.7	3.12	5.92	6.20	6.21	0.36	1.27	±13.1%
3900	37.5	3.32	5.79	6.07	6.07	0.36	1.27	±13.1%
5250	35.9	4.71	4.86	5.09	5.09	0.32	1.27	±13.1%
5600	35.5	5.07	4.52	4.74	4.74	0.28	1.27	±13.1%
5800	35.3	5.27	4.56	4.78	4.78	0.27	1.27	±13.1%

<sup>C</sup> 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.

<sup>F</sup> The probes are calibrated using tissue simulating liquids (TSL) that deviate for  $\epsilon$  and  $\sigma$  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.

<sup>G</sup> 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.

<sup>H</sup> 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.

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**Parameters of Probe: EX3DV4 - SN:7896****Calibration Parameter Determined in Head Tissue Simulating Media**

f (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity <sup>F</sup> (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>G</sup> (mm)	Unc <sup>H</sup> (k = 2)
6500	34.5	6.07	4.74	4.96	4.97	0.20	1.27	±18.6%

<sup>C</sup> Frequency validity at 6.5 GHz is -600/+700 MHz, and ±700 MHz at or above 7 GHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

<sup>F</sup> The probes are calibrated using tissue simulating liquids (TSL) that deviate for  $\epsilon$  and  $\sigma$  by less than ±10% from the target values (typically better than ±6%) and are valid for TSL with deviations of up to ±10%.

<sup>G</sup> 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; below ±2% for frequencies between 3–6 GHz; and below ±4% for frequencies between 6–10 GHz at any distance larger than half the probe tip diameter from the boundary.

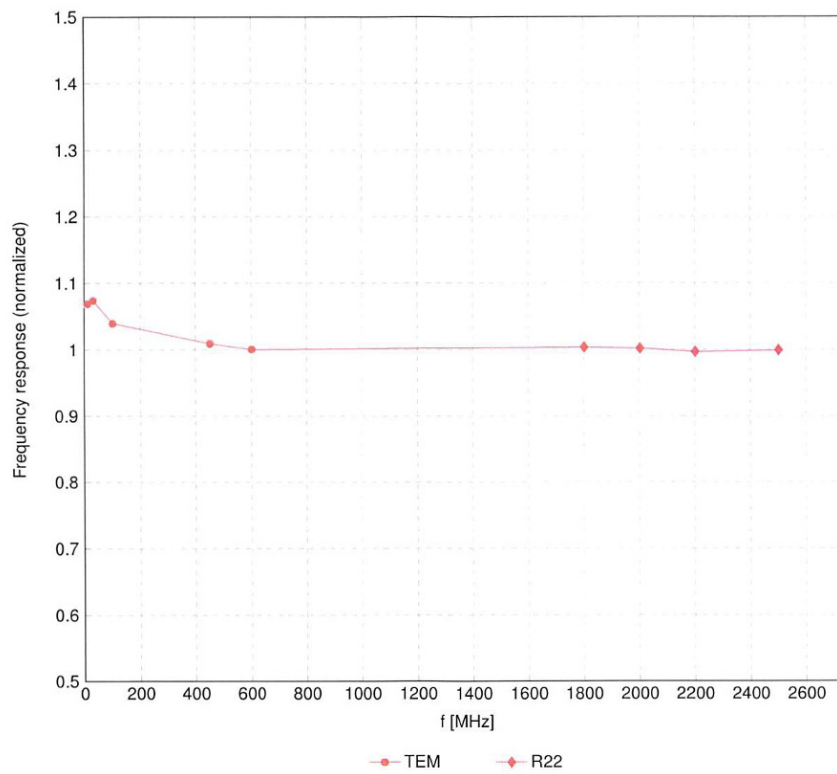
<sup>H</sup> The stated uncertainty is the total calibration uncertainty (k = 2) of Norm-ConvF. This is equivalent to the uncertainty component with the symbol CF in Table 9 of IEC/IEEE 62209-1528:2020.

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### Frequency Response of E-Field

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

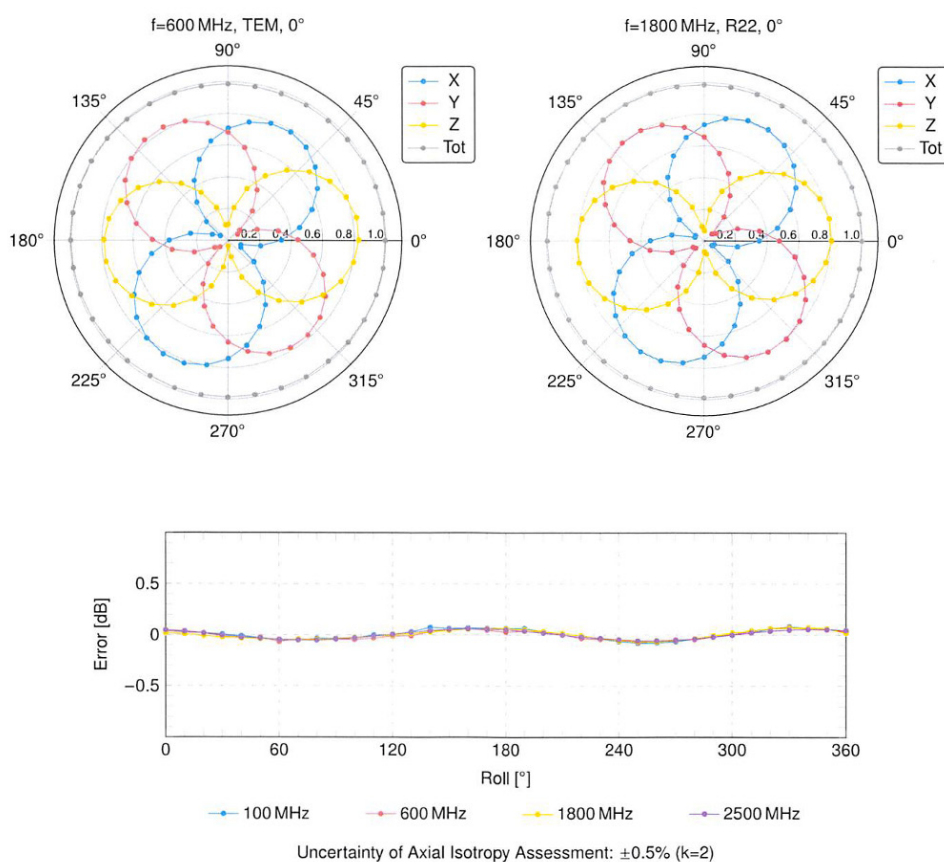


Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

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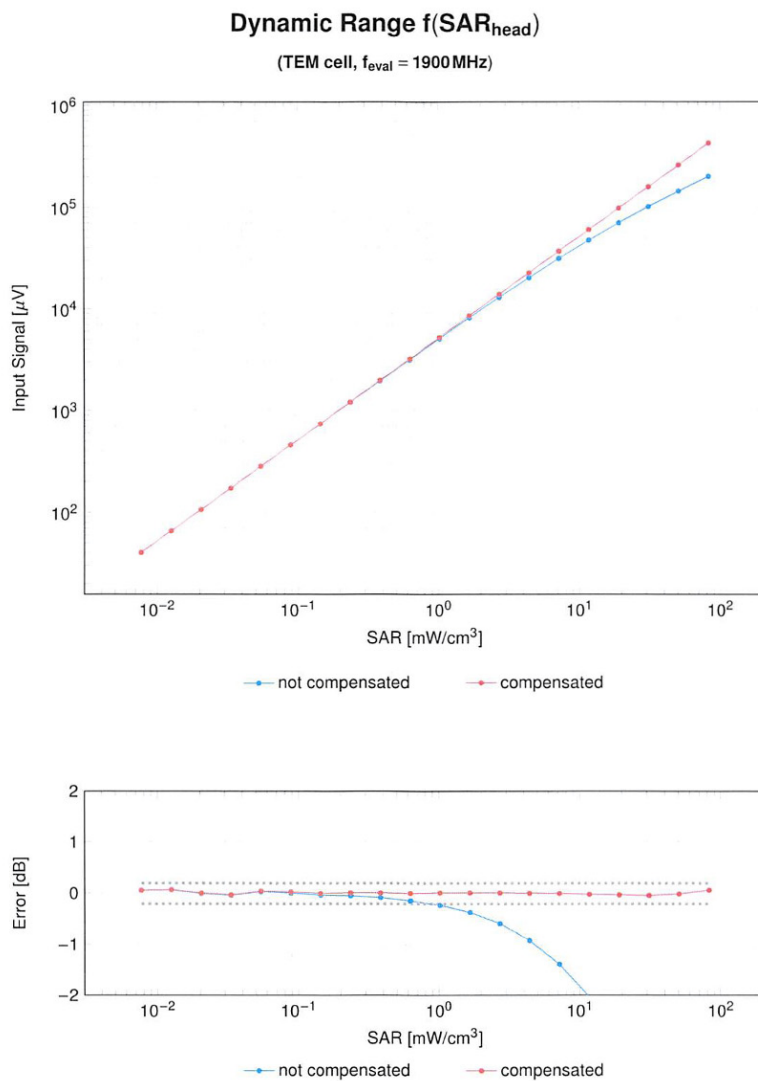
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### Receiving Pattern ( $\phi$ ), $\vartheta = 0^\circ$



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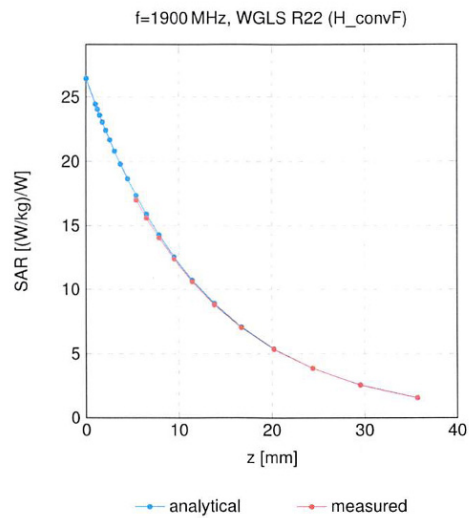


Uncertainty of Linearity Assessment: ±0.6% (k=2)

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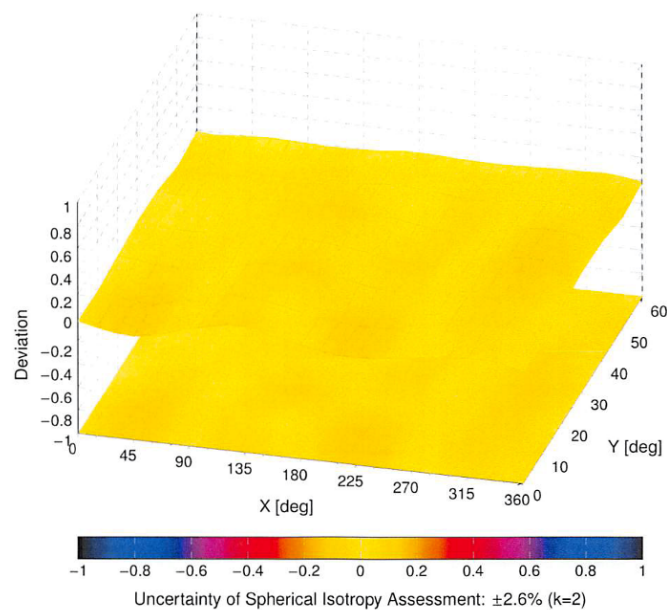
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### Conversion Factor Assessment



### Deviation from Isotropy in Liquid

Error ( $\phi, \theta$ ), f = 900 MHz



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Accreditation No.: **SCS 0108**

Client **BACL**  
Sunnyvale, USA

Certificate No. **D2450V2-1103\_Mar23**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN:1103**

Calibration procedure(s) **QA CAL-05.v12**  
**Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **March 27, 2023**

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 ( $22 \pm 3$ )°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	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: BH9394 (20k)	04-Apr-22 (No. 217-03527)	Apr-23
Type-N mismatch combination	SN: 310982 / 06327	04-Apr-22 (No. 217-03528)	Apr-23
Reference Probe EX3DV4	SN: 7349	10-Jan-23 (No. EX3-7349_Jan23)	Jan-24
DAE4	SN: 601	19-Dec-22 (No. DAE4-601_Dec22)	Dec-23

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

Calibrated by:	Name	Function	Signature
	Jeton Kastrati	Laboratory Technician	

Approved by:	Sven Kühn	Technical Manager
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Issued: March 27, 2023

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Accreditation No.: **SCS 0108**

**Glossary:**

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

**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"

**Additional Documentation:**

- DASY System Handbook

**Methods Applied and Interpretation of Parameters:**

- Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- SAR measured:* SAR measured at the stated antenna input power.
- SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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%.

**Measurement Conditions**

DASY system configuration, as far as not given on page 1.

<b>DASY Version</b>	DASY52	V52.10.4
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	2450 MHz $\pm$ 1 MHz	

**Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	39.2	1.80 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	38.0 $\pm$ 6 %	1.81 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

**SAR result with Head TSL**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	13.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>51.7 W/kg <math>\pm</math> 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	6.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>24.2 W/kg <math>\pm</math> 16.5 % (k=2)</b>

**Appendix (Additional assessments outside the scope of SCS 0108)****Antenna Parameters with Head TSL**

Impedance, transformed to feed point	53.5 $\Omega$ + 5.4 j $\Omega$
Return Loss	- 24.2 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.151 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

**Additional EUT Data**

Manufactured by	SPEAG
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**DASY5 Validation Report for Head TSL**

Date: 27.03.2023

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:1103**

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.81$  S/m;  $\epsilon_r = 38$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.88, 7.88, 7.88) @ 2450 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 114.9 V/m; Power Drift = -0.00 dB

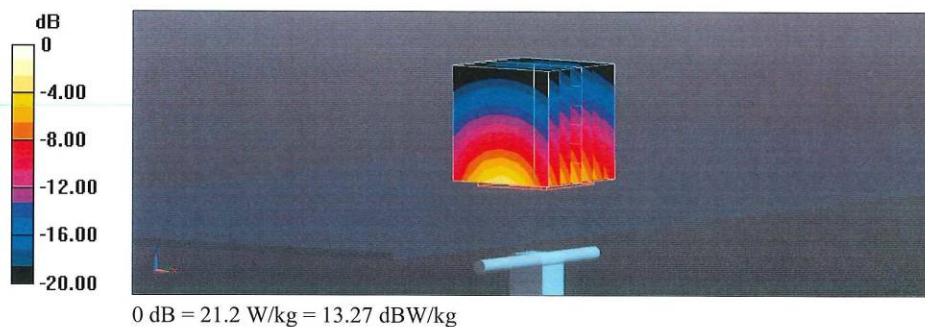
Peak SAR (extrapolated) = 25.3 W/kg

**SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.10 W/kg**

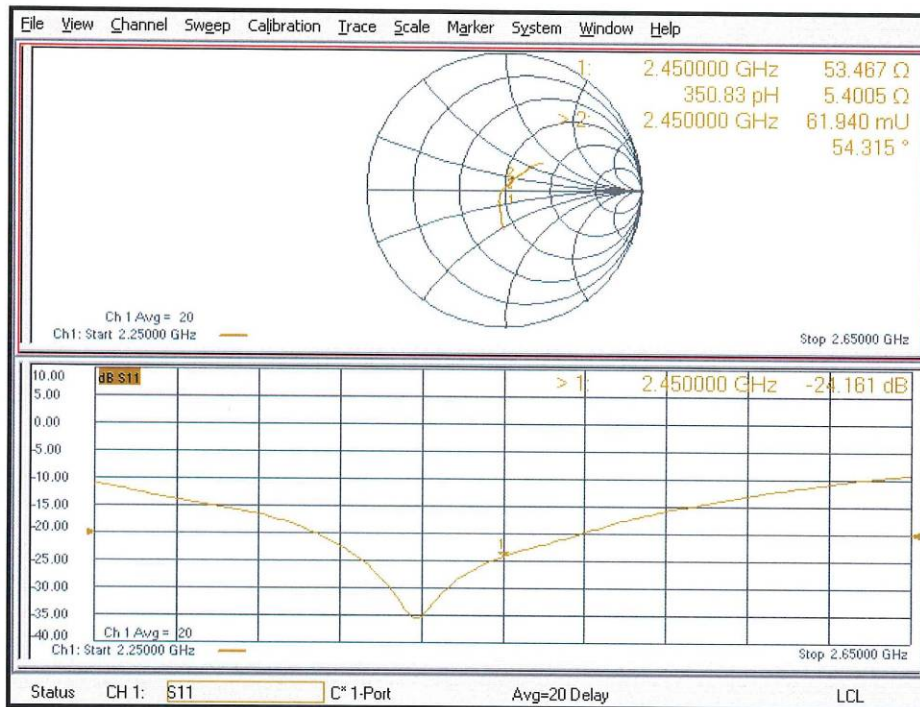
Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 51.3%

Maximum value of SAR (measured) = 21.2 W/kg



## Impedance Measurement Plot for Head TSL





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Client **BACL**  
**Sunnyvale USA**

Certificate No. **D5GHzV2-1374\_Mar23**

## CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1374**

Calibration procedure(s) **QA CAL-22.v7**  
**Calibration Procedure for SAR Validation Sources between 3-10 GHz**

Calibration date: **March 27, 2023**

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 ( $22 \pm 3$ )°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	04-Apr-22 (No. 217-03525/03524)	Apr-23
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Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: BH9394 (20k)	04-Apr-22 (No. 217-03527)	Apr-23
Type-N mismatch combination	SN: 310982 / 06327	04-Apr-22 (No. 217-03528)	Apr-23
Reference Probe EX3DV4	SN: 3503	07-Mar-23 (No. EX3-3503_Mar23)	Mar-24
DAE4	SN: 601	19-Dec-22 (No. DAE4-601_Dec22)	Dec-23

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

Calibrated by:	Name <b>Jeton Kastrati</b>	Function <b>Laboratory Technician</b>	Signature 
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Approved by:	Name <b>Sven Kühn</b>	Function <b>Technical Manager</b>	Signature 
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Issued: March 29, 2023

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Certificate No: D5GHzV2-1374\_Mar23

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Accreditation No.: **SCS 0108**

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ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

**Calibration is Performed According to the Following Standards:**

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- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- DASY System Handbook

**Methods Applied and Interpretation of Parameters:**

- Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- SAR measured:* SAR measured at the stated antenna input power.
- SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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%.

**Measurement Conditions**

DASY system configuration, as far as not given on page 1.

<b>DASY Version</b>	DASY52	V52.10.4
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom V5.0	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
<b>Frequency</b>	5250 MHz $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5800 MHz $\pm$ 1 MHz	

**Head TSL parameters at 5250 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	35.9	4.71 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	35.8 $\pm$ 6 %	4.71 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

**SAR result with Head TSL at 5250 MHz**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	100 mW input power	8.01 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>80.1 W/kg <math>\pm</math> 19.9 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	100 mW input power	2.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>23.1 W/kg <math>\pm</math> 19.5 % (k=2)</b>

**Head TSL parameters at 5600 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	35.5	5.07 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	35.6 $\pm$ 6 %	5.09 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

**SAR result with Head TSL at 5600 MHz**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	100 mW input power	8.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>83.6 W/kg <math>\pm</math> 19.9 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	100 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>23.8 W/kg <math>\pm</math> 19.5 % (k=2)</b>



**Head TSL parameters at 5800 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.3 ± 6 %	5.24 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

**SAR result with Head TSL at 5800 MHz**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	100 mW input power	8.14 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>81.4 W/kg ± 19.9 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>23.0 W/kg ± 19.5 % (k=2)</b>

**Appendix (Additional assessments outside the scope of SCS 0108)****Antenna Parameters with Head TSL at 5250 MHz**

Impedance, transformed to feed point	45.8 $\Omega$ - 4.5 j $\Omega$
Return Loss	- 23.8 dB

**Antenna Parameters with Head TSL at 5600 MHz**

Impedance, transformed to feed point	49.4 $\Omega$ + 1.5 j $\Omega$
Return Loss	- 35.9 dB

**Antenna Parameters with Head TSL at 5800 MHz**

Impedance, transformed to feed point	54.2 $\Omega$ + 1.5 j $\Omega$
Return Loss	- 27.3 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.189 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

**Additional EUT Data**

Manufactured by	SPEAG
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**DASY5 Validation Report for Head TSL**

Date: 27.03.2023

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1374**

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used:  $f = 5250$  MHz;  $\sigma = 4.71$  S/m;  $\epsilon_r = 35.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.09$  S/m;  $\epsilon_r = 35.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.24$  S/m;  $\epsilon_r = 35.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.5, 5.5, 5.5) @ 5250 MHz, ConvF(5.1, 5.1, 5.1) @ 5600 MHz, ConvF(5.01, 5.01, 5.01) @ 5800 MHz; Calibrated: 07.03.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:**

Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 76.14 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 26.9 W/kg

**SAR(1 g) = 8.01 W/kg; SAR(10 g) = 2.31 W/kg**

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 71.4%

Maximum value of SAR (measured) = 17.8 W/kg

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:**

Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 75.28 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 30.3 W/kg

**SAR(1 g) = 8.35 W/kg; SAR(10 g) = 2.38 W/kg**

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 68.8%

Maximum value of SAR (measured) = 19.2 W/kg

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan,****dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 73.43 V/m; Power Drift = 0.01 dB

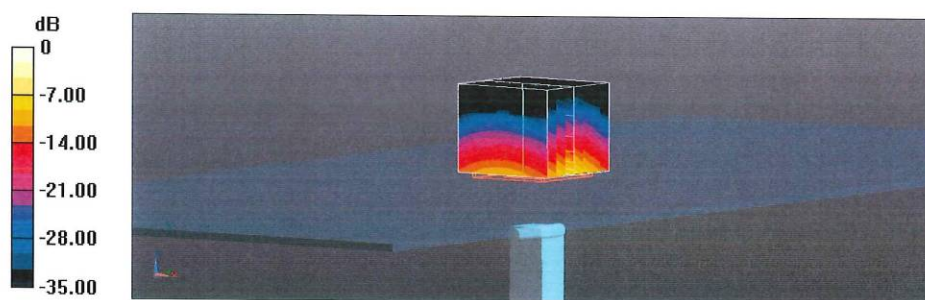
Peak SAR (extrapolated) = 31.6 W/kg

**SAR(1 g) = 8.14 W/kg; SAR(10 g) = 2.3 W/kg**

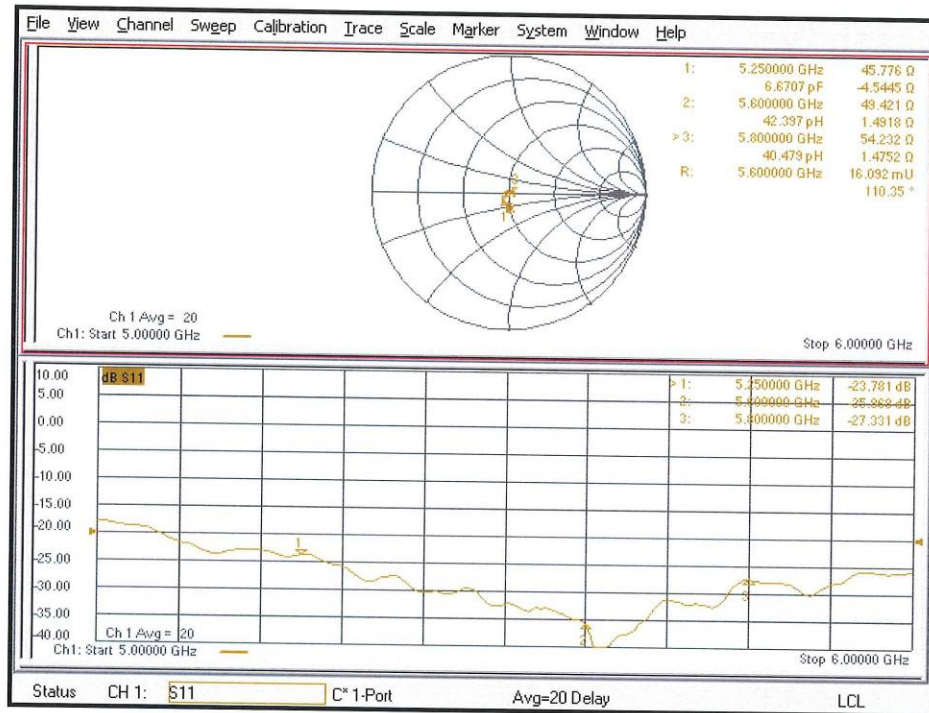
Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 66.5%

Maximum value of SAR (measured) = 19.3 W/kg



## Impedance Measurement Plot for Head TSL



**APPENDIX D RETURN LOSS&IMPEDANCE MEASUREMENT****Equipment Details:**

Description: Dipole  
Manufacturer: Speag  
Model Number: D2450V2  
Serial Number: 1103  
Calibration Date: 2024/03/26  
Calibrated By: Bob Lu  
Signature: Bob Lu

All Calibration have been conducted in the closed laboratory facility: Lab Temperature 18℃-25℃ and humidity < 70%

**Calibrated Equipment:**

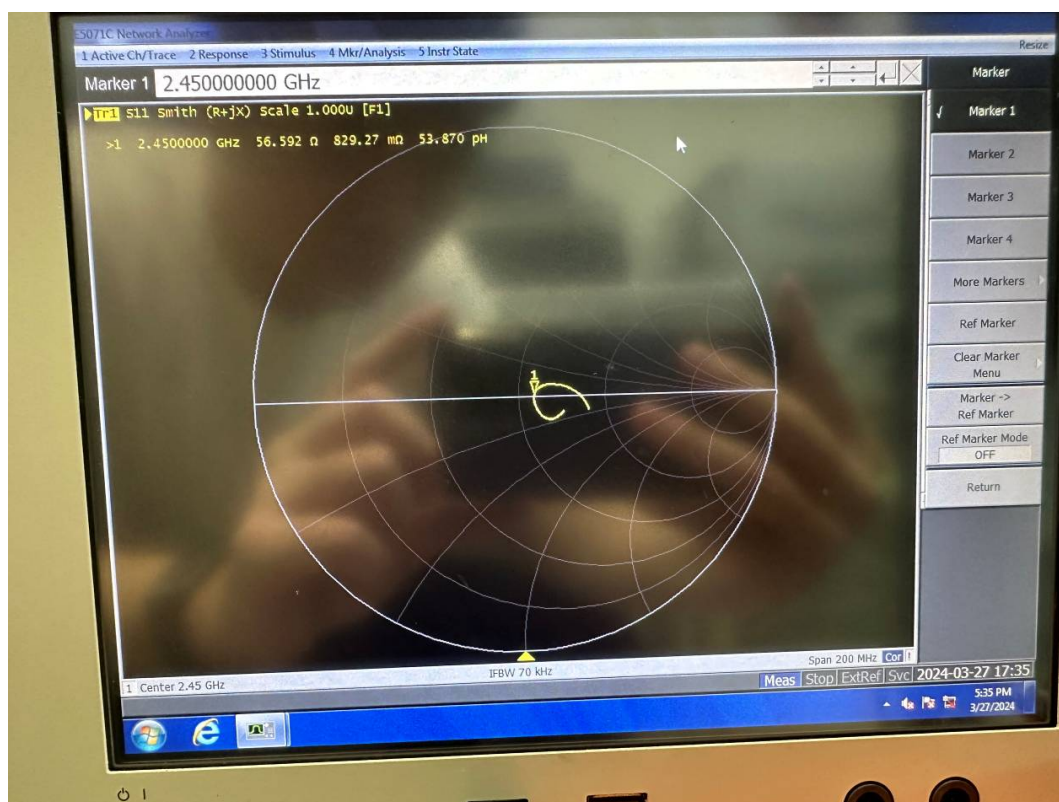
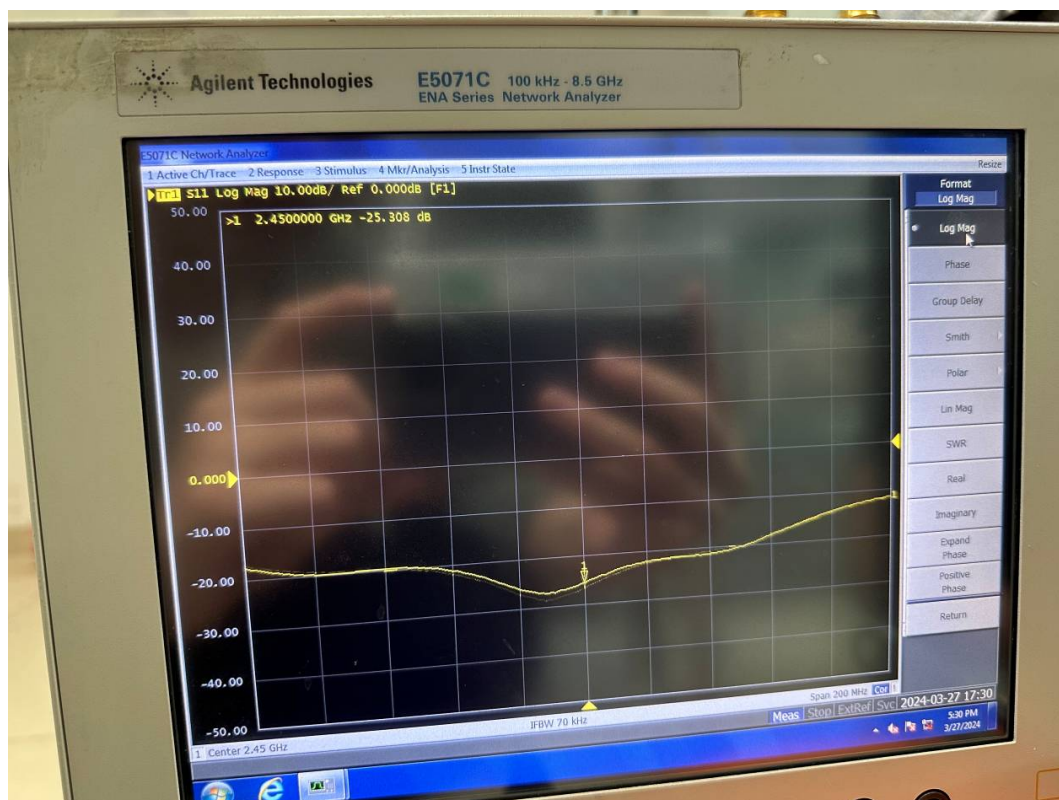
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2023/06/08	2024/06/07
Network Analyzer Calibration Kit	50Ω	51026	NCR	NCR

**Test Data:**

Frequency (MHz)	Simulated Liquid	Parameter	Measured Value	Target Value	Deviation	Reference Range	Results
2450	Head	Return Loss	25.308 dB	24.161 dB	4.747 %	±20%;≥20dB	Pass
		Real Impedance	56.592 Ω	53.467 Ω	3.125 Ω	≤5Ω	Pass
		Imaginary Impedance	0.829 Ω	5.400 Ω	-4.571 Ω	≤5Ω	Pass

Note: Return Loss Deviation = (Measured-Target)/Target×100%

## Dipole, 2450MHz, 1103



**Equipment Details:**

Description: Dipole  
Manufacturer: Speag  
Model Number: D2450V2  
Serial Number: 1103  
Calibration Date: 2025/03/26  
Calibrated By: Bob Lu  
Signature: Bob Lu

All Calibration have been conducted in the closed laboratory facility: Lab Temperature 18℃-25℃ and humidity < 70%

**Calibrated Equipment:**

Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2024/05/21	2025/05/20
Network Analyzer Calibration Kit	50Ω	51026	NCR	NCR

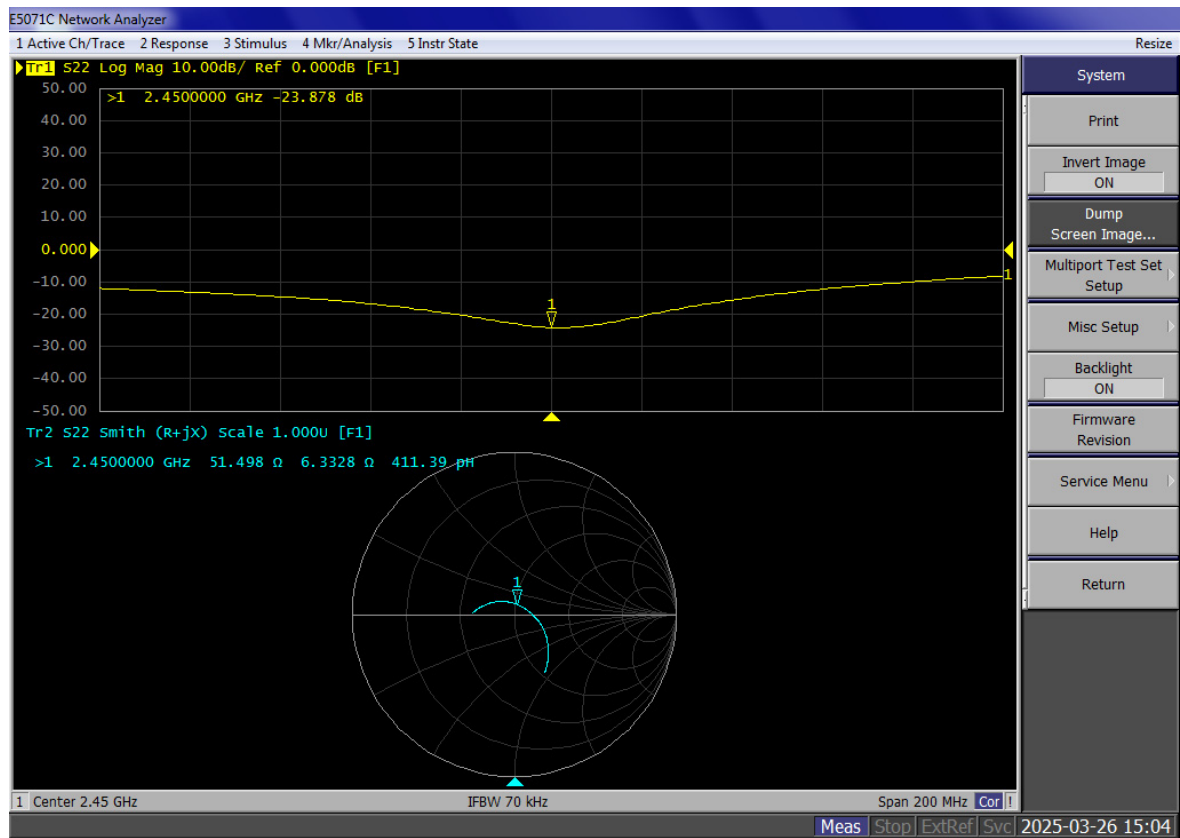
**Test Data:**

Frequency (MHz)	Simulated Liquid	Parameter	Measured Value	Target Value	Deviation	Reference Range	Results
2450	Head	Return Loss	23.878 dB	24.161 dB	-1.171 %	±20%;≥20dB	Pass
		Real Impedance	51.498 Ω	53.467 Ω	1.969 Ω	≤5Ω	Pass
		Imaginary Impedance	6.333 Ω	5.400 Ω	0.933 Ω	≤5Ω	Pass

Note: Return Loss Deviation = (Measured-Target)/Target×100%



## Dipole, 2450MHz, 1103



**Equipment Details:**

Description: Dipole  
 Manufacturer: Speag  
 Model Number: D5GHzV2  
 Serial Number: 1374  
 Calibration Date: 2024/03/26  
 Calibrated By: Bob Lu  
 Signature: Bob Lu

All Calibration have been conducted in the closed laboratory facility: Lab Temperature 18℃-25℃ and humidity < 70%

**Calibrated Equipment:**

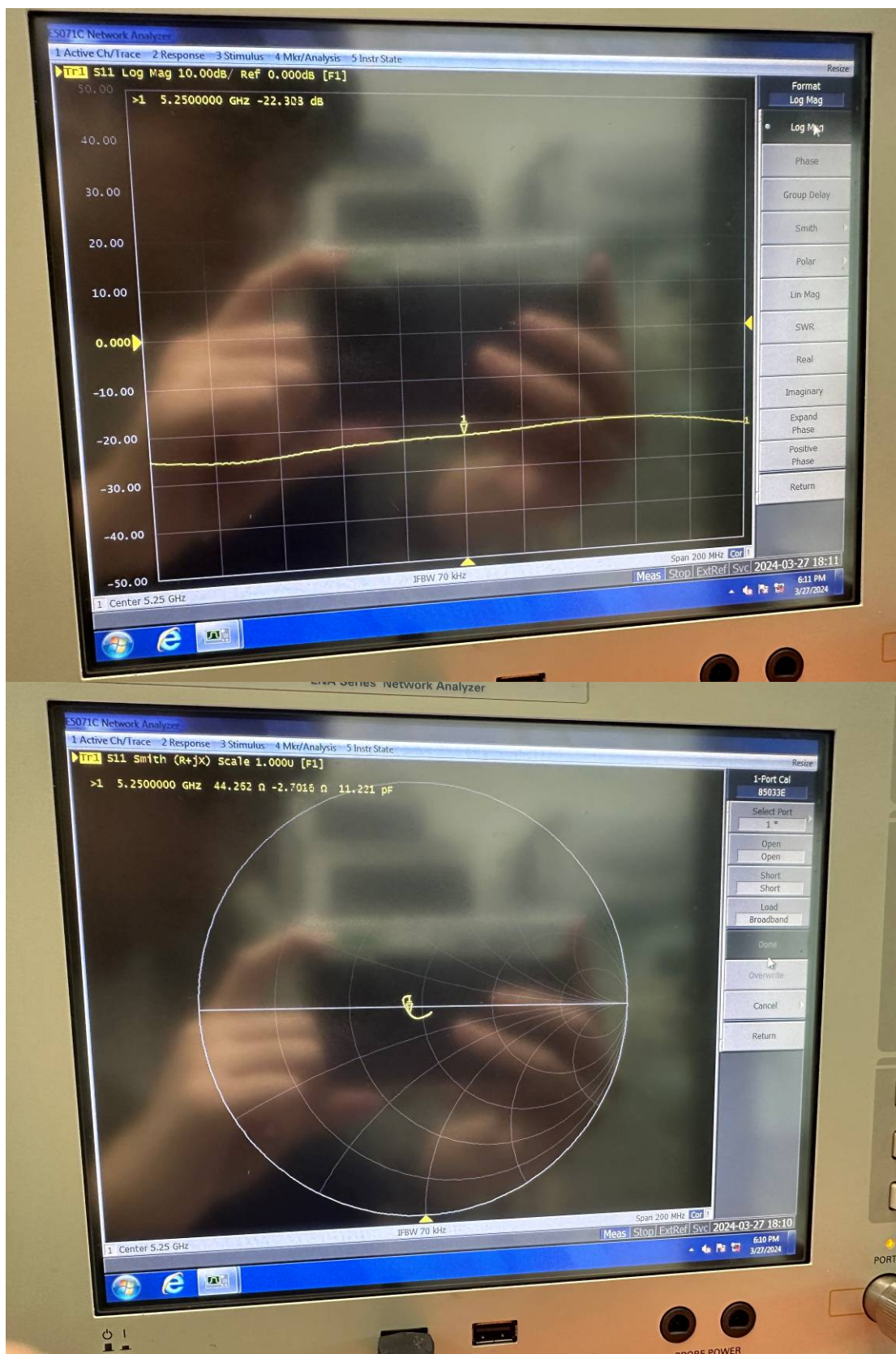
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2023/06/08	2024/06/07
Network Analyzer Calibration Kit	50 Ω	51026	NCR	NCR

**Test Data:**

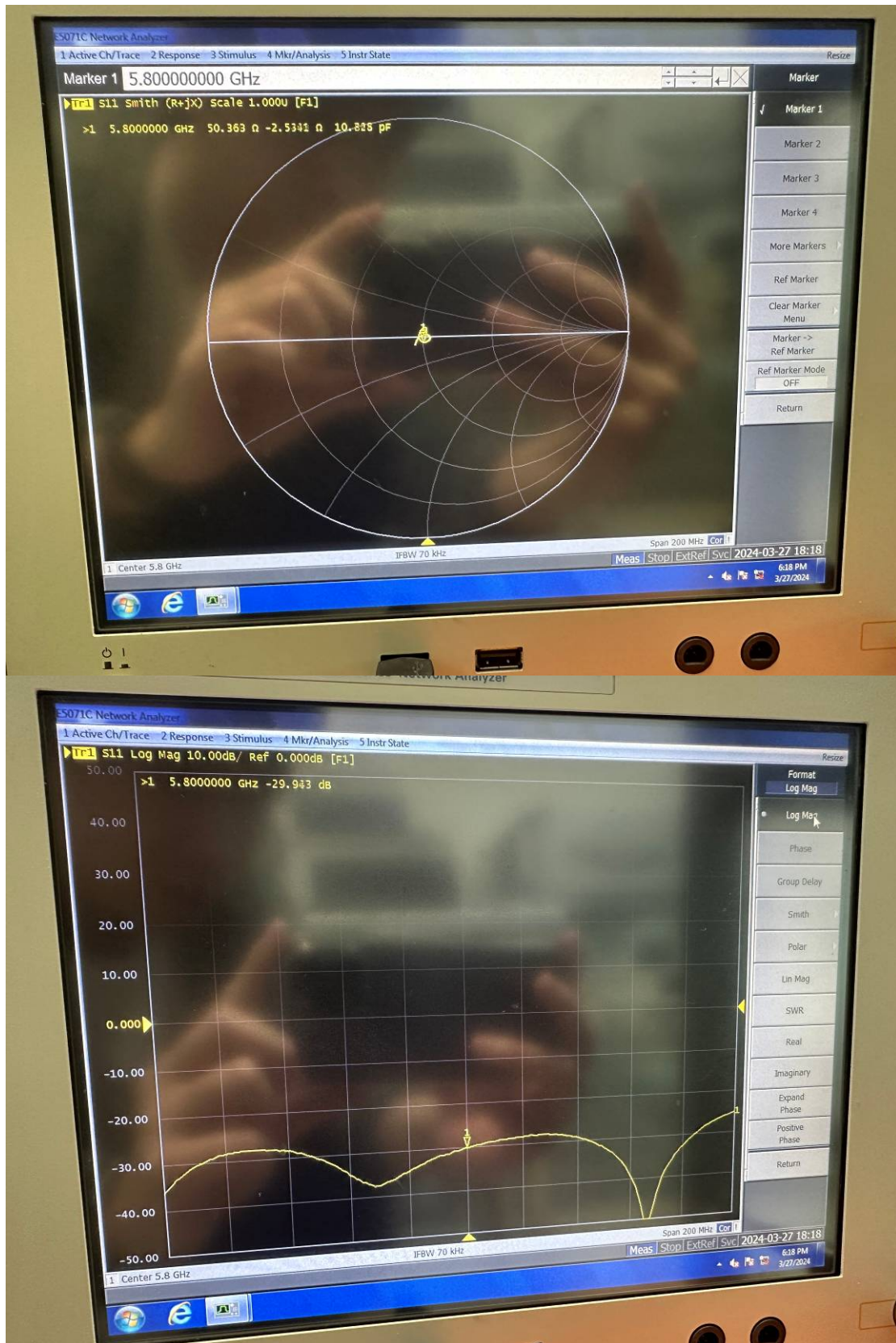
Frequency (MHz)	Simulated Liquid	Parameter	Measured Value	Target Value	Deviation	Reference Range	Results
5250	Head	Return Loss	22.303 dB	23.781 dB	-6.215 %	±20%; ≥20dB	Pass
		Real Impedance	44.252 Ω	45.776 Ω	1.524 Ω	≤ 5 Ω	Pass
		Imaginary Impedance	-2.702 Ω	-4.545 Ω	1.843 Ω	≤ 5 Ω	Pass
5800	Head	Return Loss	29.943 dB	27.331 dB	9.557 %	±20%; ≥20dB	Pass
		Real Impedance	50.363 Ω	54.232 Ω	-3.869 Ω	≤ 5 Ω	Pass
		Imaginary Impedance	-2.534 Ω	1.475 Ω	-4.009 Ω	≤ 5 Ω	Pass

Note: Return Loss Deviation = (Measured-Target)/Target×100%

Dipole, 5250MHz, 1374



## Dipole, 5800MHz, 1374



**Equipment Details:**

Description: Dipole  
Manufacturer: Speag  
Model Number: D5GHzV2  
Serial Number: 1374  
Calibration Date: 2025/03/26  
Calibrated By: Bob Lu  
Signature: Bob Lu

All Calibration have been conducted in the closed laboratory facility: Lab Temperature 18°C-25°C and humidity < 70%

**Calibrated Equipment:**

Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2024/05/21	2025/05/20
Network Analyzer Calibration Kit	50 Ω	51026	NCR	NCR

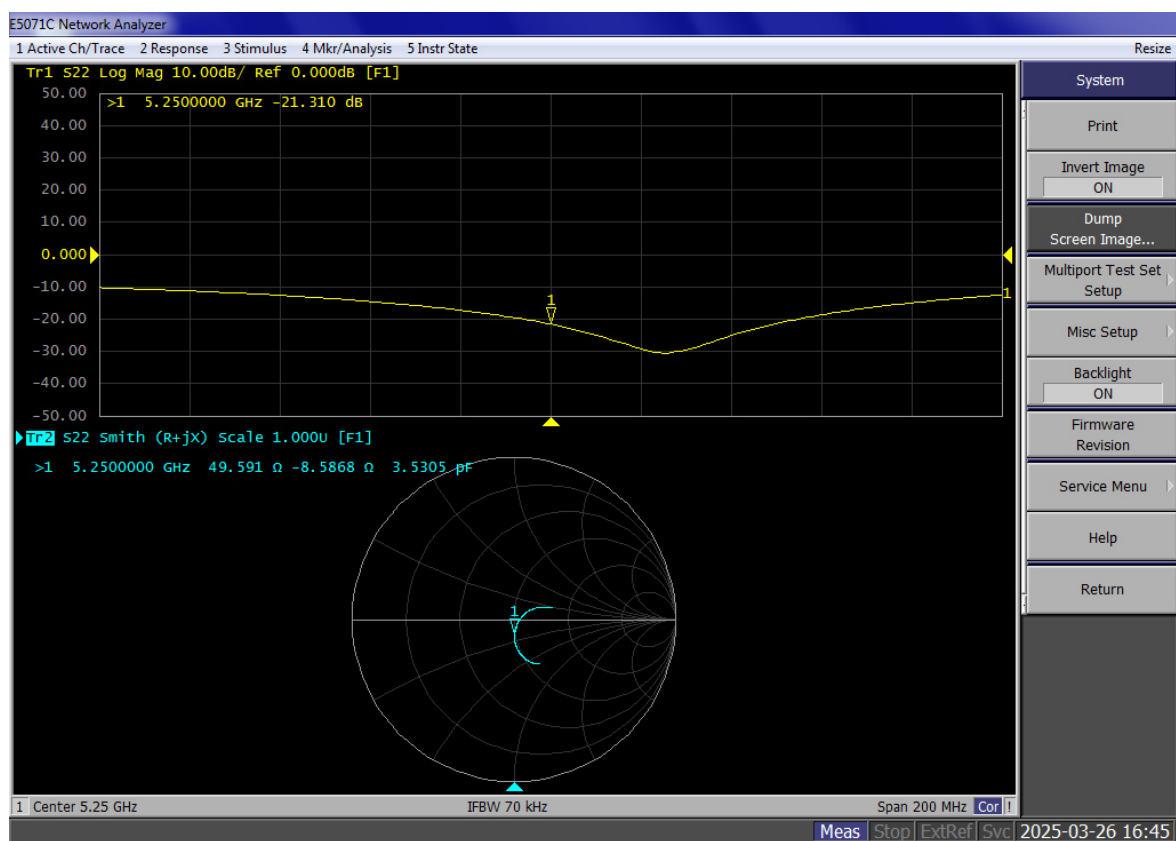
**Test Data:**

Frequency (MHz)	Simulated Liquid	Parameter	Measured Value	Target Value	Deviation	Reference Range	Results
5250	Head	Return Loss	21.310 dB	23.781 dB	-10.391 %	±20%; ≥20dB	Pass
		Real Impedance	49.591 Ω	45.776 Ω	3.815 Ω	≤ 5 Ω	Pass
		Imaginary Impedance	-8.589 Ω	-4.545 Ω	4.044 Ω	≤ 5 Ω	Pass
5800	Head	Return Loss	25.866 dB	27.331 dB	-5.360 %	±20%; ≥20dB	Pass
		Real Impedance	51.957 Ω	54.232 Ω	2.275 Ω	≤ 5 Ω	Pass
		Imaginary Impedance	4.812 Ω	1.475 Ω	3.337 Ω	≤ 5 Ω	Pass

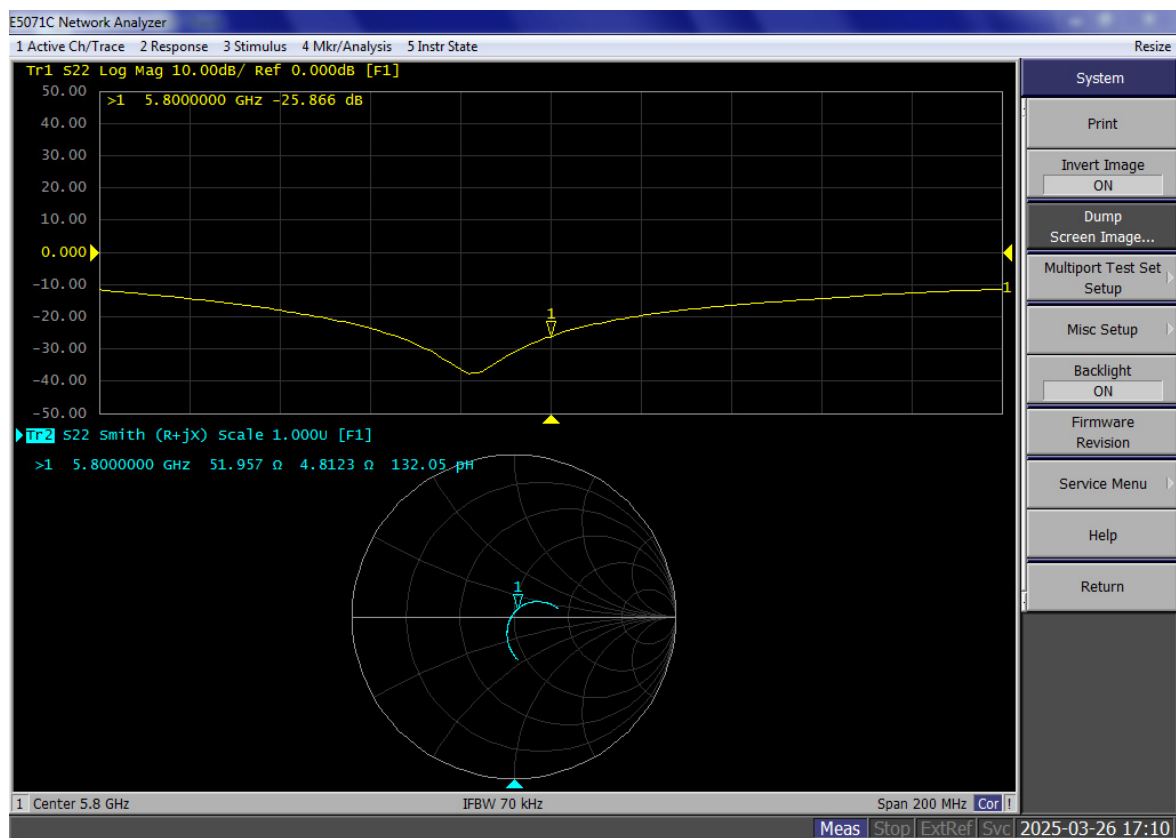
Note: Return Loss Deviation = (Measured-Target)/Target×100%



## Dipole, 5250MHz, 1374



## Dipole, 5800MHz, 1374



\*\*\*\* END OF REPORT \*\*\*\*