

Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz \pm 1 MHz 5300 MHz \pm 1 MHz 5500 MHz \pm 1 MHz 5600 MHz \pm 1 MHz 5800 MHz \pm 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	34.8 \pm 6 %	4.47 mho/m \pm 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.1 W/kg \pm 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.1 W/kg \pm 19.5 % (k=2)

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	35.6 \pm 6 %	4.60 mho/m \pm 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.2 W/kg \pm 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.5 W/kg \pm 19.5 % (k=2)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	4.76 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.75 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	86.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.46 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.3 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	4.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.47 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 W/kg ± 19.5 % (k=2)

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	34.0 ± 6 %	5.06 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.9 W/kg ± 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	50.5 Ω - 3.9 j Ω
Return Loss	- 28.1 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	50.0 Ω - 3.4 j Ω
Return Loss	- 29.3 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	52.6 Ω + 2.1 j Ω
Return Loss	- 29.7 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	54.2 Ω + 4.2 j Ω
Return Loss	- 24.9 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	56.9 Ω + 1.0 j Ω
Return Loss	- 23.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.207 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: 27.09.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1124

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.47$ S/m; $\epsilon_r = 34.8$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5300$ MHz; $\sigma = 4.6$ S/m; $\epsilon_r = 35.6$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5500$ MHz; $\sigma = 4.76$ S/m; $\epsilon_r = 34.4$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5600$ MHz; $\sigma = 4.86$ S/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5800$ MHz; $\sigma = 5.06$ S/m; $\epsilon_r = 34$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.8, 5.8, 5.8) @ 5200 MHz, ConvF(5.49, 5.49, 5.49) @ 5300 MHz, ConvF(5.25, 5.25, 5.25) @ 5500 MHz, ConvF(5.1, 5.1, 5.1) @ 5600 MHz, ConvF(5.01, 5.01, 5.01) @ 5800 MHz; Calibrated: 30.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- 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=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 79.26 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 28.5 W/kg

SAR(1 g) = 8.18 W/kg; SAR(10 g) = 2.34 W/kg

Smallest distance from peaks to all points 3 dB below = 7.4 mm

Ratio of SAR at M2 to SAR at M1 = 69.5%

Maximum value of SAR (measured) = 18.6 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 79.18 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 29.5 W/kg

SAR(1 g) = 8.34 W/kg; SAR(10 g) = 2.36 W/kg

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

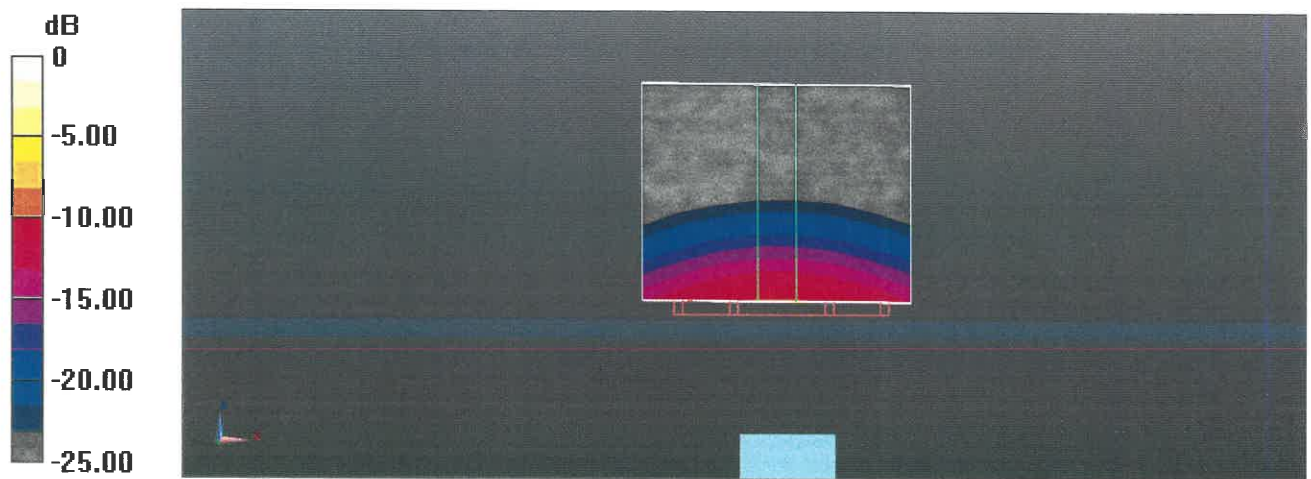
Ratio of SAR at M2 to SAR at M1 = 69.2%

Maximum value of SAR (measured) = 19.6 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 78.92 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 33.3 W/kg
SAR(1 g) = 8.75 W/kg; SAR(10 g) = 2.46 W/kg
Smallest distance from peaks to all points 3 dB below = 7.4 mm
Ratio of SAR at M2 to SAR at M1 = 66.8%
Maximum value of SAR (measured) = 20.6 W/kg

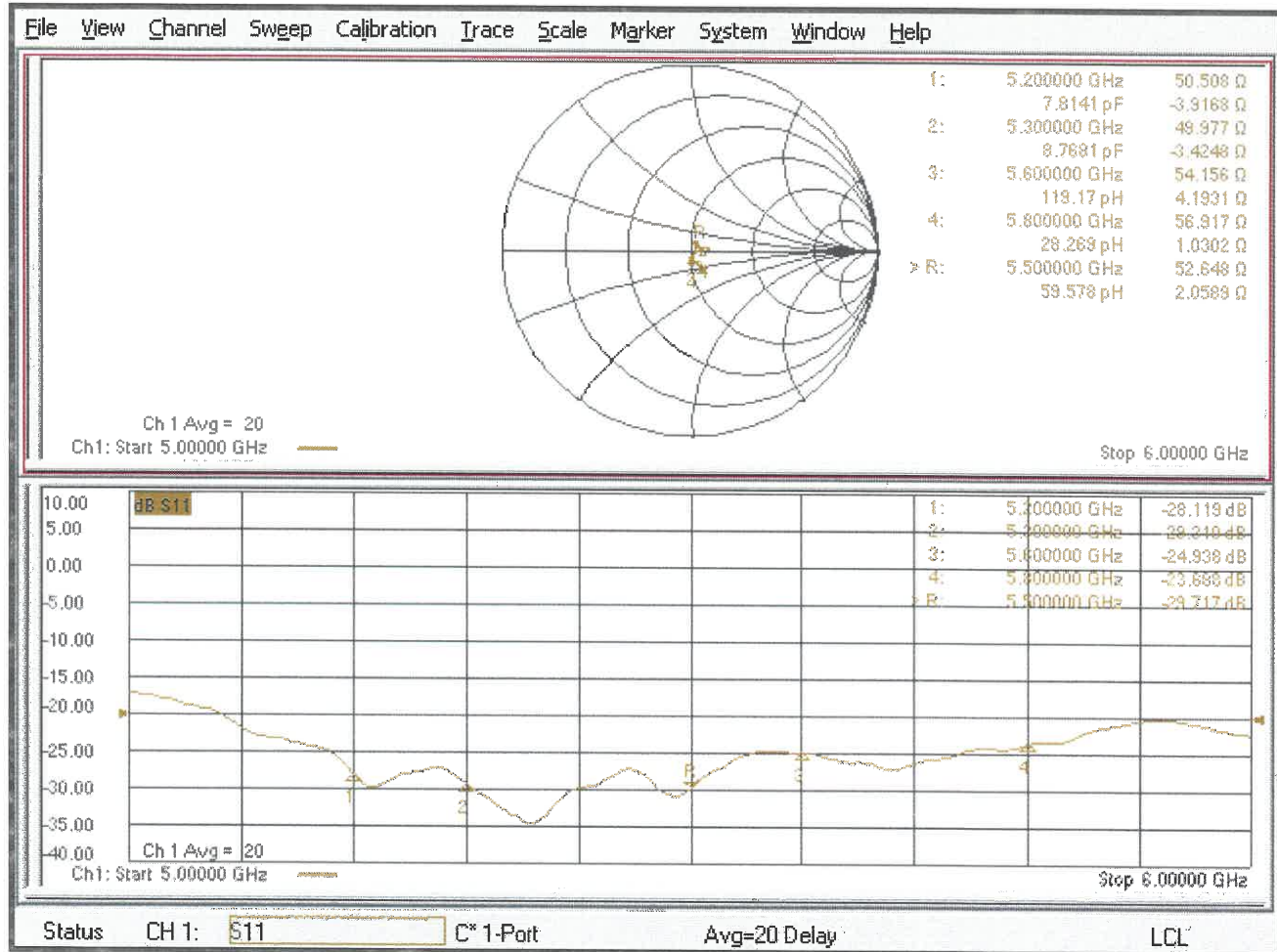
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 79.93 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 31.1 W/kg
SAR(1 g) = 8.47 W/kg; SAR(10 g) = 2.41 W/kg
Smallest distance from peaks to all points 3 dB below = 7.4 mm
Ratio of SAR at M2 to SAR at M1 = 67.9%
Maximum value of SAR (measured) = 19.8 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 = 77.54 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 32.1 W/kg
SAR(1 g) = 8.26 W/kg; SAR(10 g) = 2.31 W/kg
Smallest distance from peaks to all points 3 dB below = 7.4 mm
Ratio of SAR at M2 to SAR at M1 = 66.1%
Maximum value of SAR (measured) = 19.8 W/kg



0 dB = 20.6 W/kg = 13.13 dBW/kg

Impedance Measurement Plot for Head TSL



Dipole Verified Data

Model Name: D5GHzV2

SN:1124

Pursuant to KDB 865664 D01 V01r04 section 3.2.2 that the reference dipole calibration can be extended to 3 years if Lab. does a confirmation on return loss and impedance annually, and compliance with following conditions,

1. Return loss deviates by less than 20% from the previous measurement and have 20 dB minimum return-loss requirement
2. The real or imaginary parts of the impedance, measured at least annually, deviates by less than 5 Ω from the previous measurement.

Antenna Parameters with Head Tissue 5200 MHz

Item	Verified on 9/27, 2022	Original Cal. Result	Deviation
Impedance, transformed to feed point	50.882 Ω -6.9745 Ω	50.5 Ω -3.9j Ω	< 5 Ω
Return Loss	-26.744 dB	-28.1 dB	-4.825%

Antenna Parameters with Head Tissue 5300 MHz

Item	Verified on 9/27, 2022	Original Cal. Result	Deviation
Impedance, transformed to feed point	48.257 Ω -4.4523 Ω	50.0 Ω -3.4j Ω	< 5 Ω
Return Loss	-23.753 dB	-29.3 dB	-18.93%

Antenna Parameters with Head Tissue 5500 MHz

Item	Verified on 9/27, 2022	Original Cal. Result	Deviation
Impedance, transformed to feed point	50.821 Ω +13.783 Ω	52.6 Ω +2.1j Ω	< 5 Ω
Return Loss	-24.002 dB	-29.7 dB	-19.18%

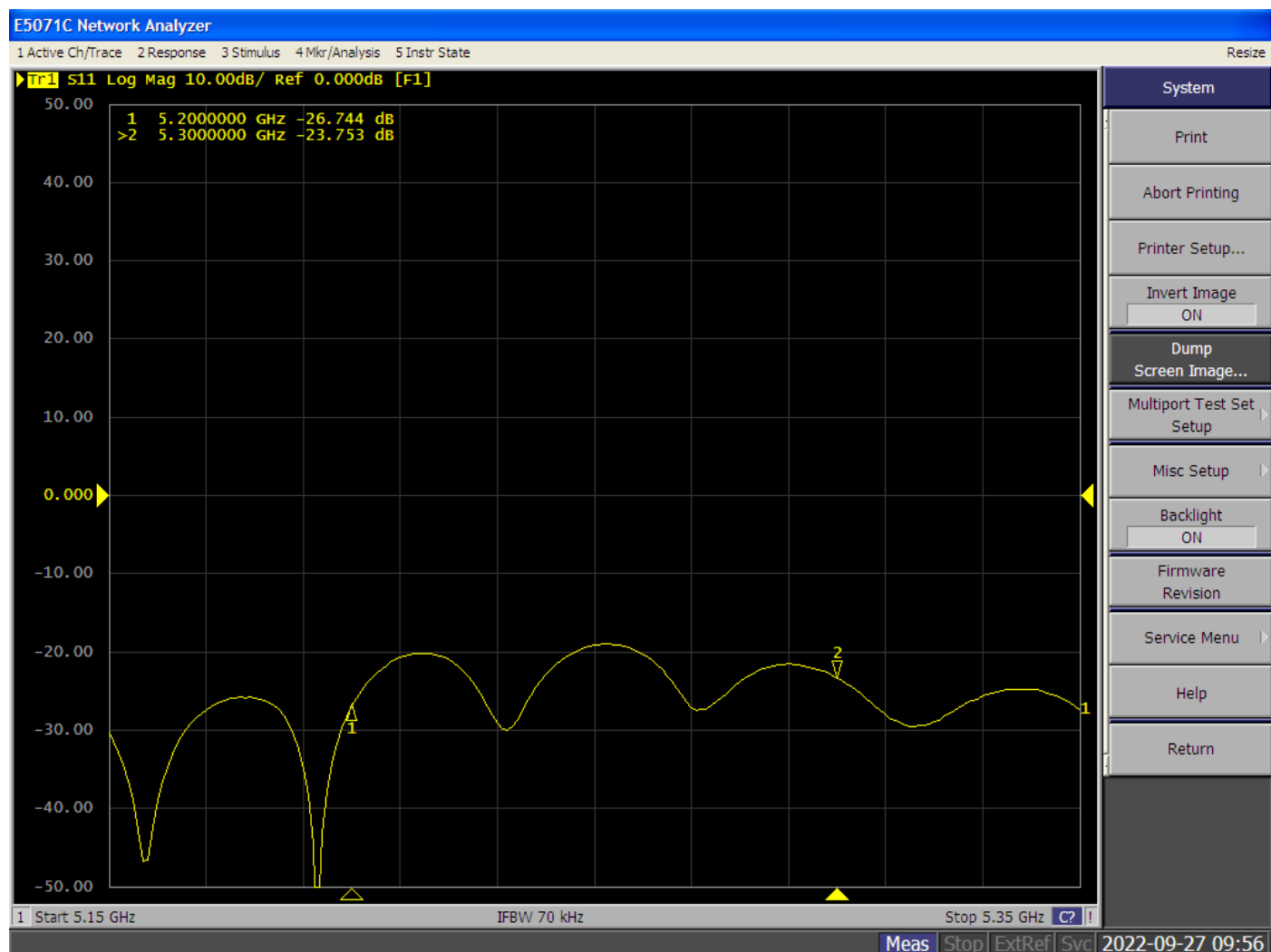
Antenna Parameters with Head Tissue 5600 MHz

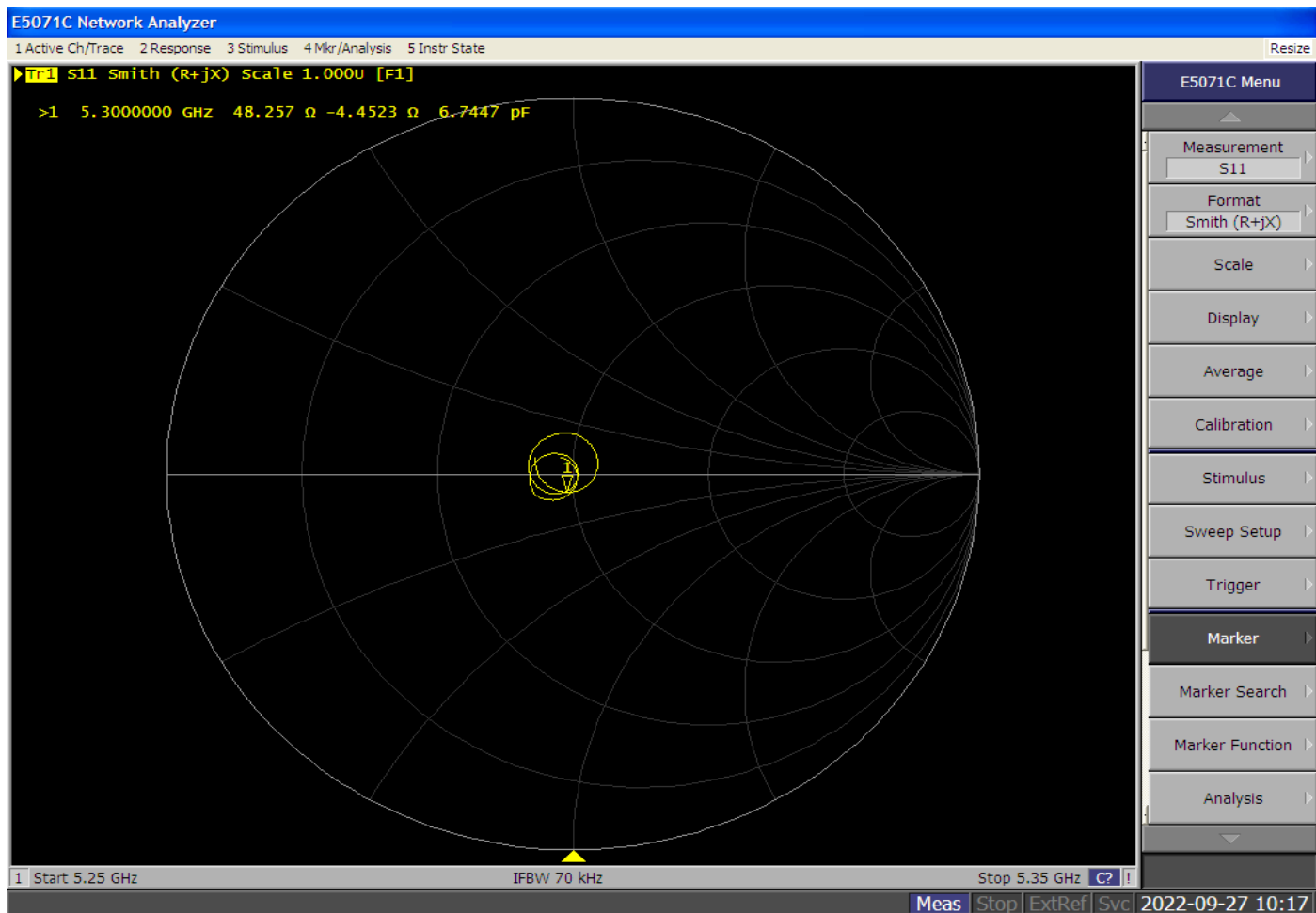
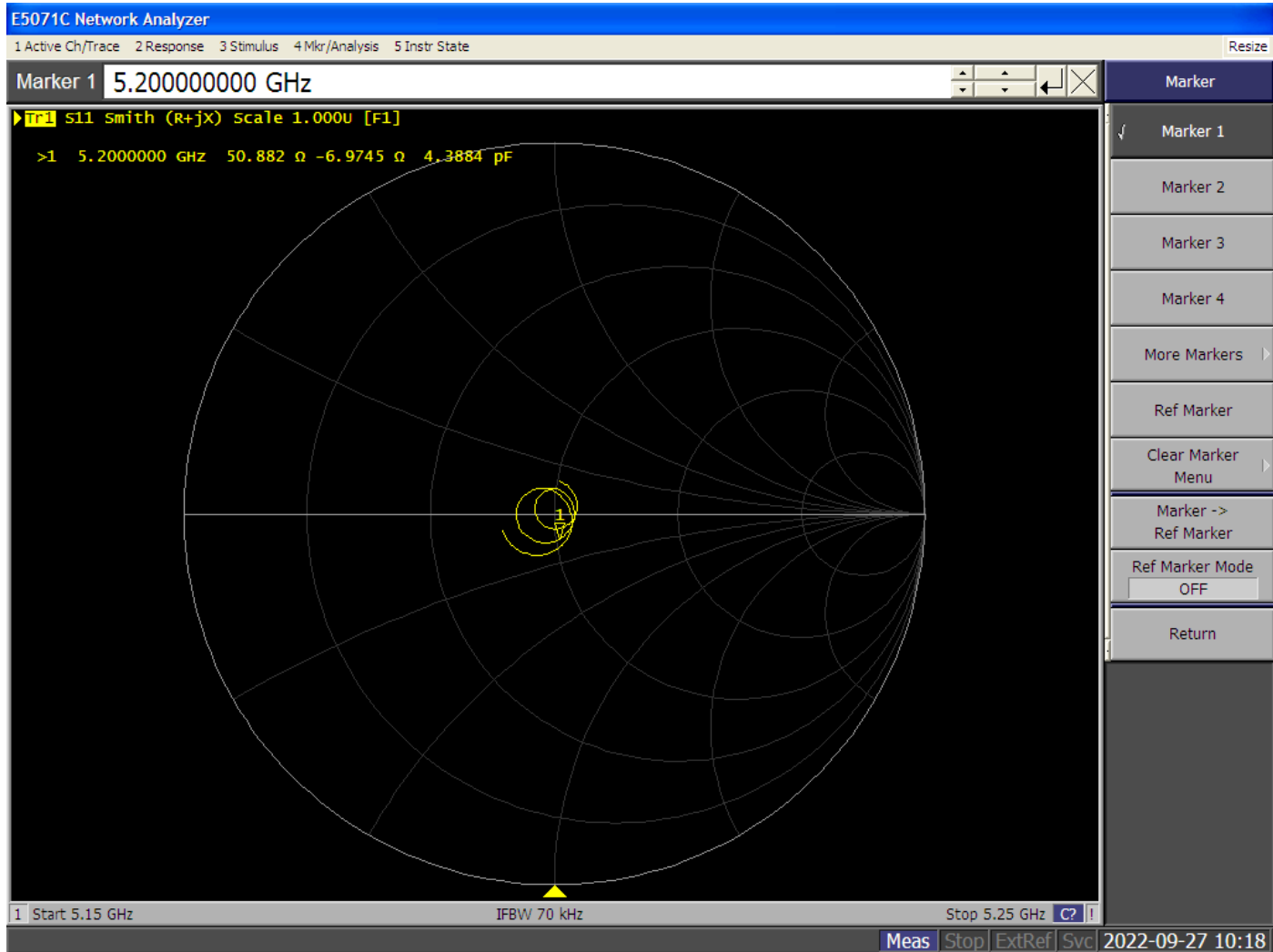
Item	Verified on 9/27, 2022	Original Cal. Result	Deviation
Impedance, transformed to feed point	$52.386\ \Omega + 11.596m\ \Omega$	$54.2\ \Omega + 4.2j\ \Omega$	$< 5\ \Omega$
Return Loss	-29.233 dB	-24.9 dB	17.4%

Antenna Parameters with Head Tissue 5800 MHz

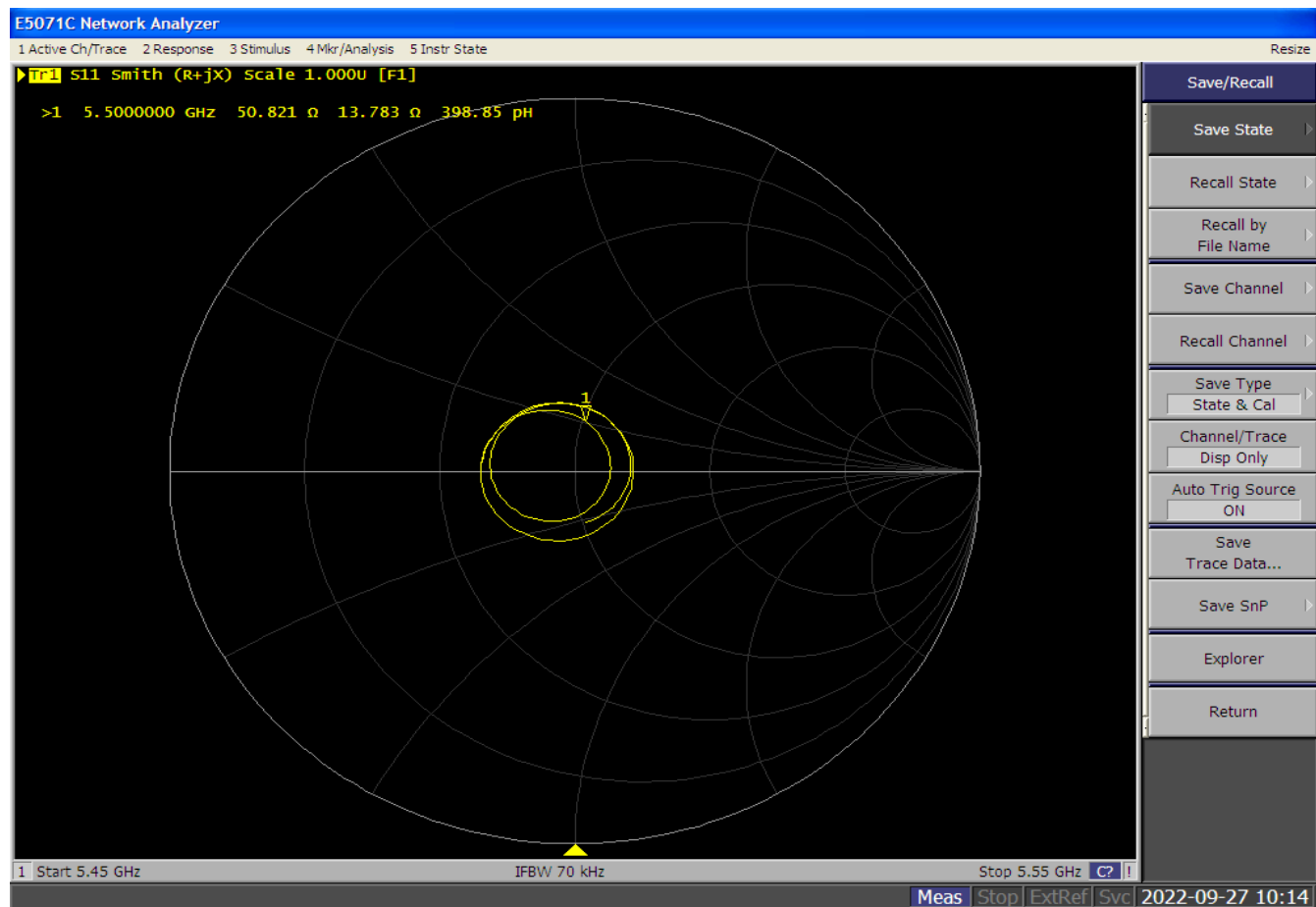
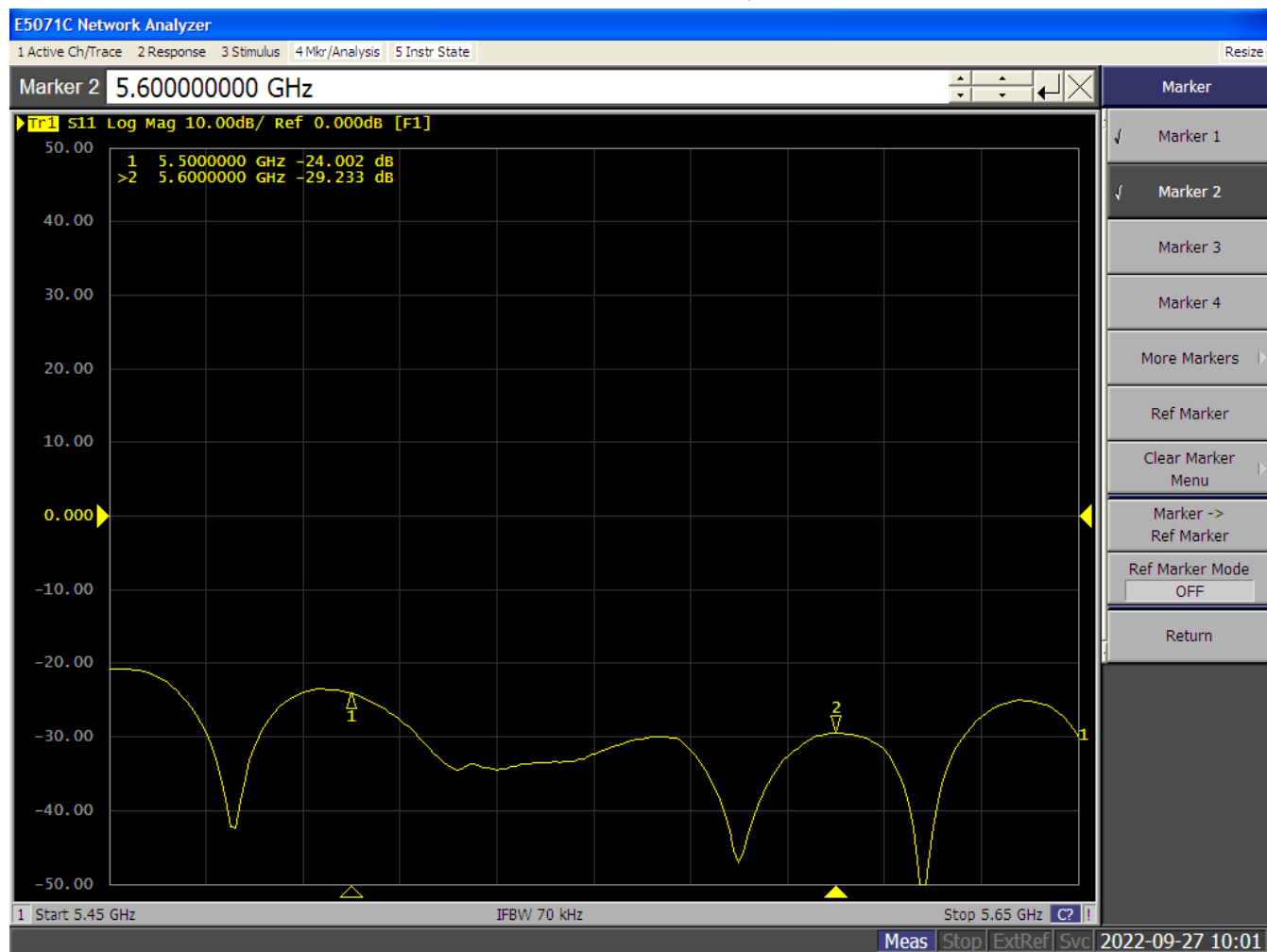
Item	Verified on 9/27, 2022	Original Cal. Result	Deviation
Impedance, transformed to feed point	$57.088\ \Omega + 16.446\ \Omega$	$56.9\ \Omega + 1.0j\ \Omega$	$< 5\ \Omega$
Return Loss	-20.380 dB	-23.7 dB	-14.00%

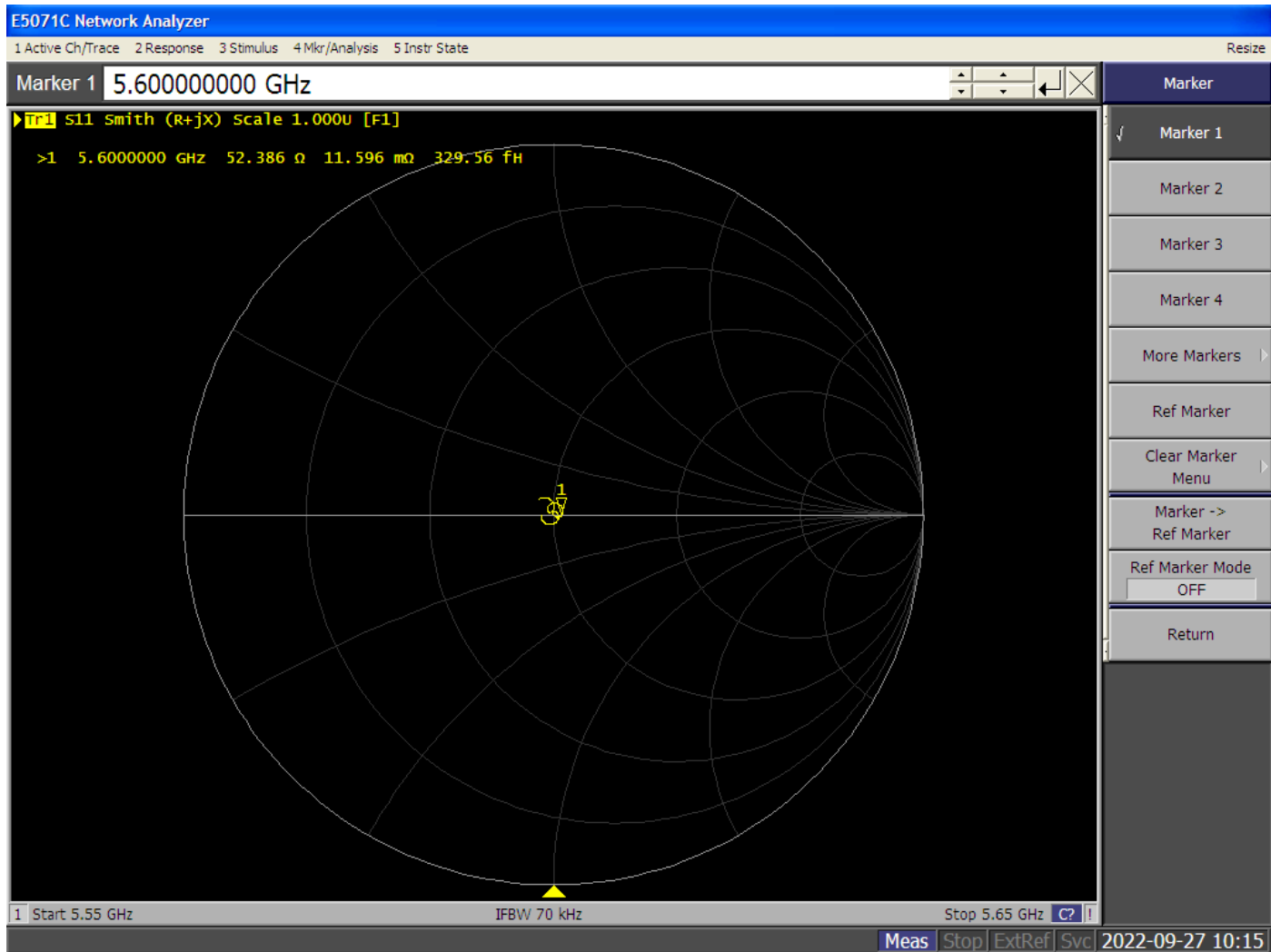
Plot for Antenna Parameters with Head Tissue 5200 MHz & 5300 MHz



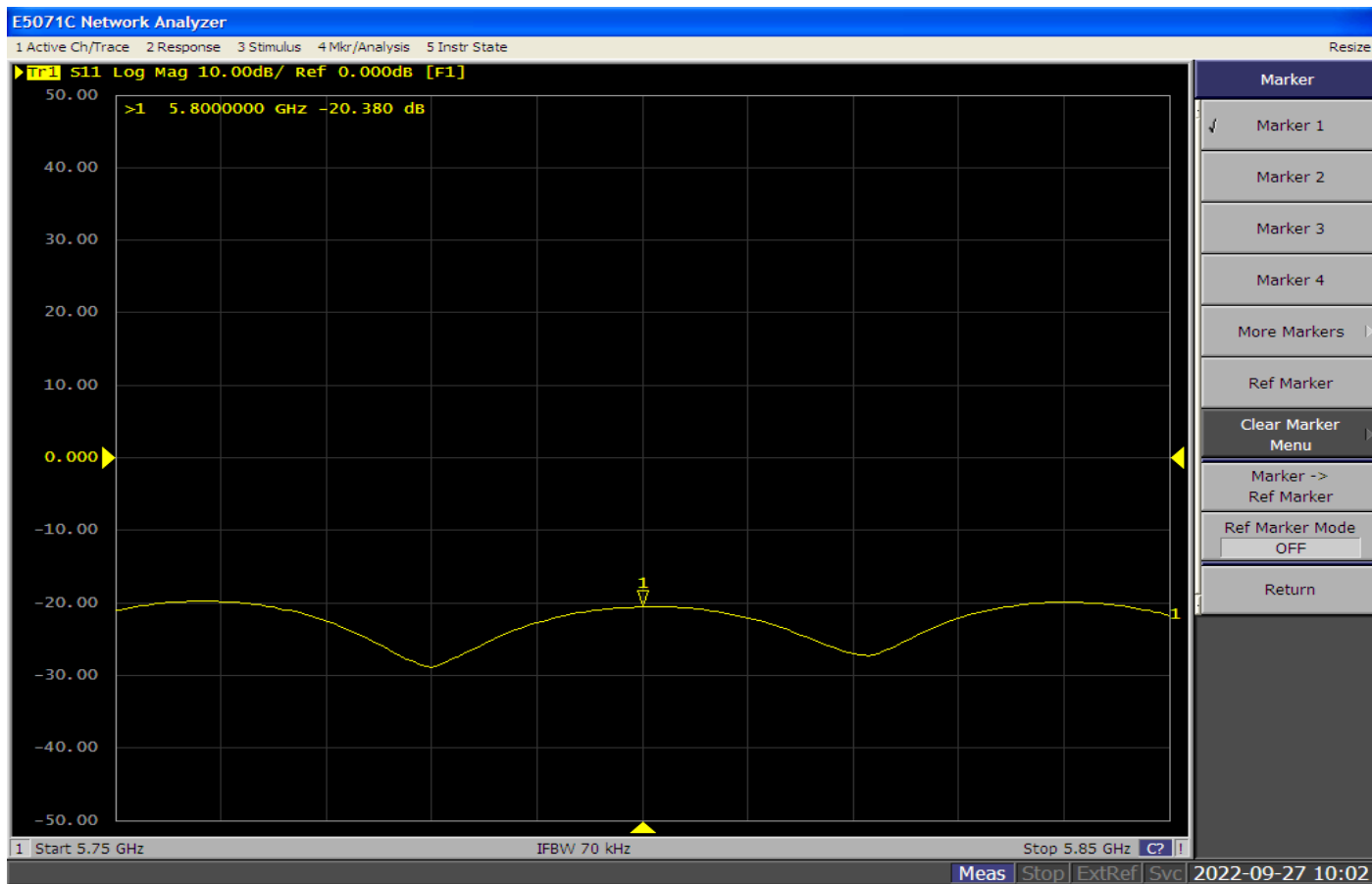


Plot for Antenna Parameters with Head Tissue 5500,5600MHz





Plot for Antenna Parameters with Head Tissue 5800 MHz



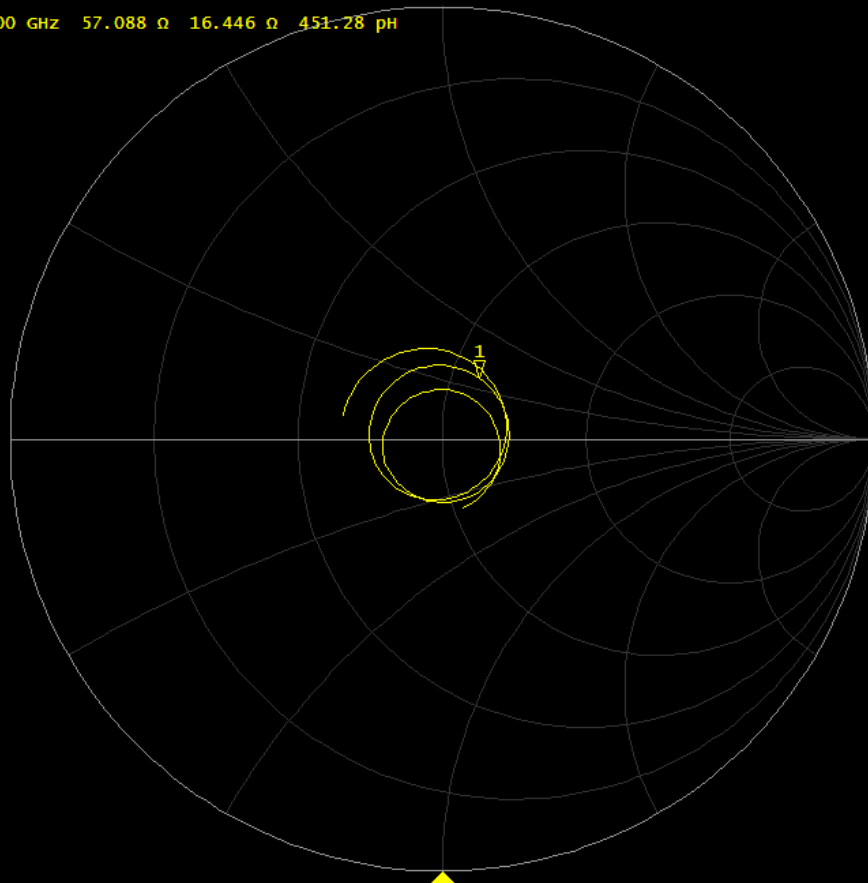
E5071C Network Analyzer

1 Active Ch/Trace 2 Response 3 Stimulus 4 Mkr/Analysis 5 Instr State

Resize

▶ Tr1 S11 Smith (R+jX) Scale 1.000u [F1]

>1 5.800000 GHz 57.088 Ω 16.446 Ω 451.28 pF



Format

Smith (R+jX)

Log Mag

Phase

Group Delay

Smith

R + jX

Polar

Lin Mag

SWR

Real

Imaginary

Expand
Phase

Positive
Phase

Return

1 Start 5.75 GHz

IFBW 70 kHz

Stop 5.85 GHz

Meas

Stop

ExtRef

Svc

2022-09-27 10:06

Dipole Verified Data

Model Name: D5GHzV2

SN:1124

Pursuant to KDB 865664 D01 V01r04 section 3.2.2 that the reference dipole calibration can be extended to 3 years if Lab. does a confirmation on return loss and impedance annually, and compliance with following conditions,

1. Return loss deviates by less than 20% from the previous measurement and have 20 dB minimum return-loss requirement
2. The real or imaginary parts of the impedance, measured at least annually, deviates by less than 5 Ω from the previous measurement.

Antenna Parameters with Head Tissue 5200 MHz

Item	Verified on 9/26, 2023	Original Cal. Result	Deviation
Impedance, transformed to feed point	50.425 Ω +3.0872 Ω	50.5 Ω -3.9j Ω	< 5 Ω
Return Loss	-31.542 dB	-28.1 dB	10.912%

Antenna Parameters with Head Tissue 5300 MHz

Item	Verified on 9/26, 2023	Original Cal. Result	Deviation
Impedance, transformed to feed point	54.665 Ω +6.8722 Ω	50.0 Ω -3.4j Ω	< 5 Ω
Return Loss	-24.366 dB	-29.3 dB	-16.84%

Antenna Parameters with Head Tissue 5500 MHz

Item	Verified on 9/26, 2023	Original Cal. Result	Deviation
Impedance, transformed to feed point	50.610 Ω -855.62m Ω	52.6 Ω +2.1j Ω	< 5 Ω
Return Loss	-28.657 dB	-29.7 dB	-3.52%

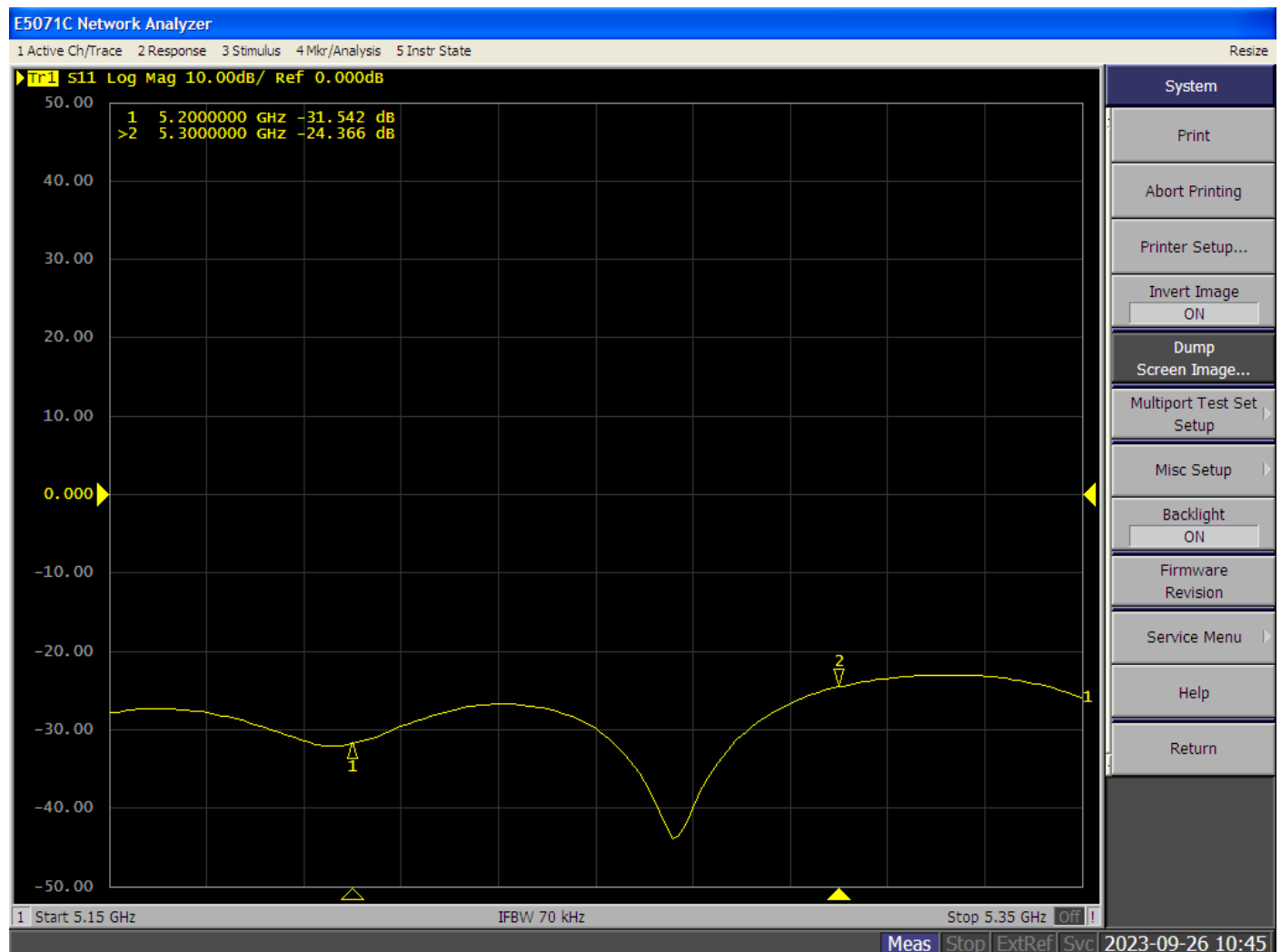
Antenna Parameters with Head Tissue 5600 MHz

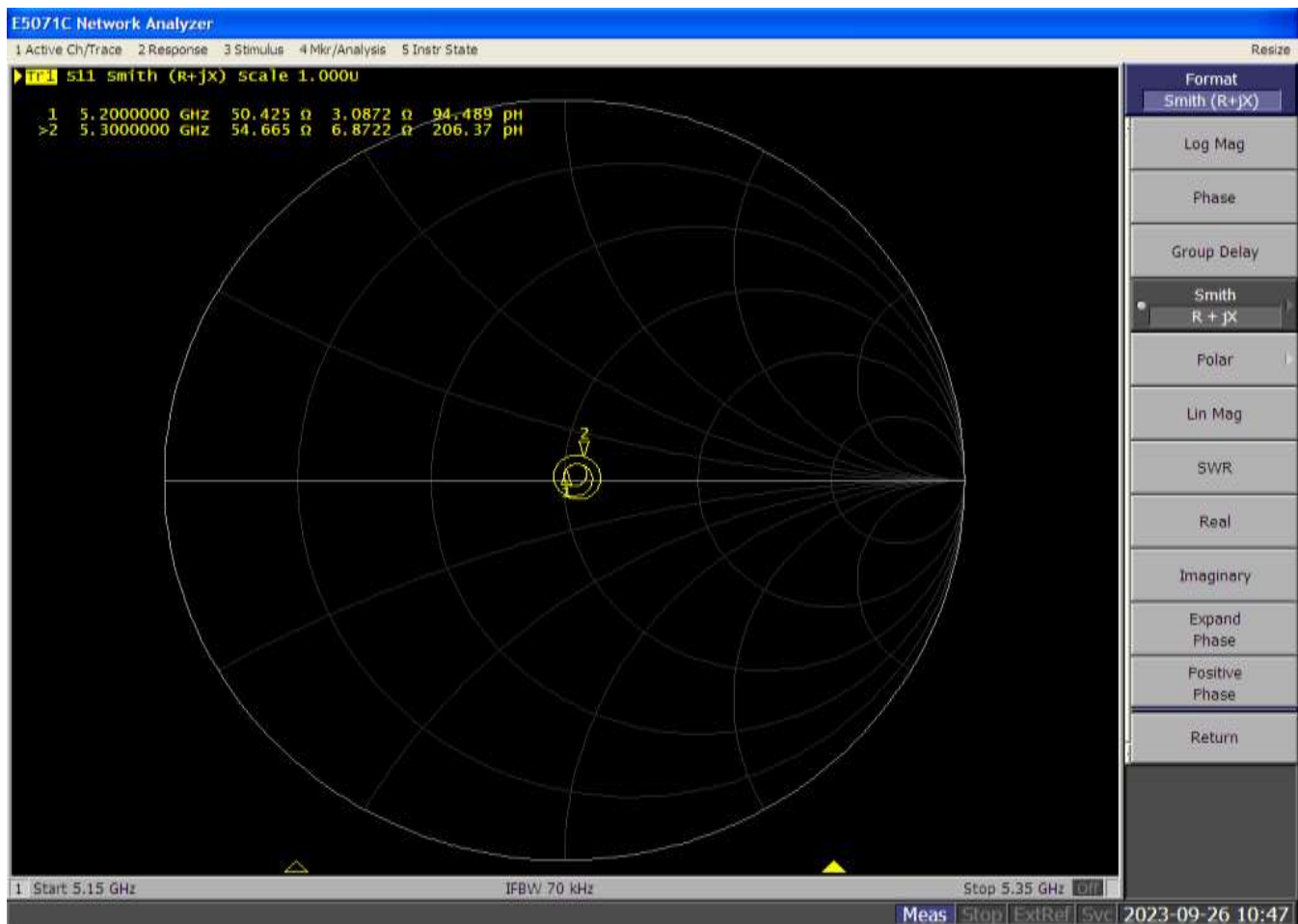
Item	Verified on 9/26, 2023	Original Cal. Result	Deviation
Impedance, transformed to feed point	$52.023 \Omega + 7.781 \Omega$	$54.2 \Omega + 4.2j \Omega$	$< 5 \Omega$
Return Loss	-23.344 dB	-24.9 dB	6.25%

Antenna Parameters with Head Tissue 5800 MHz

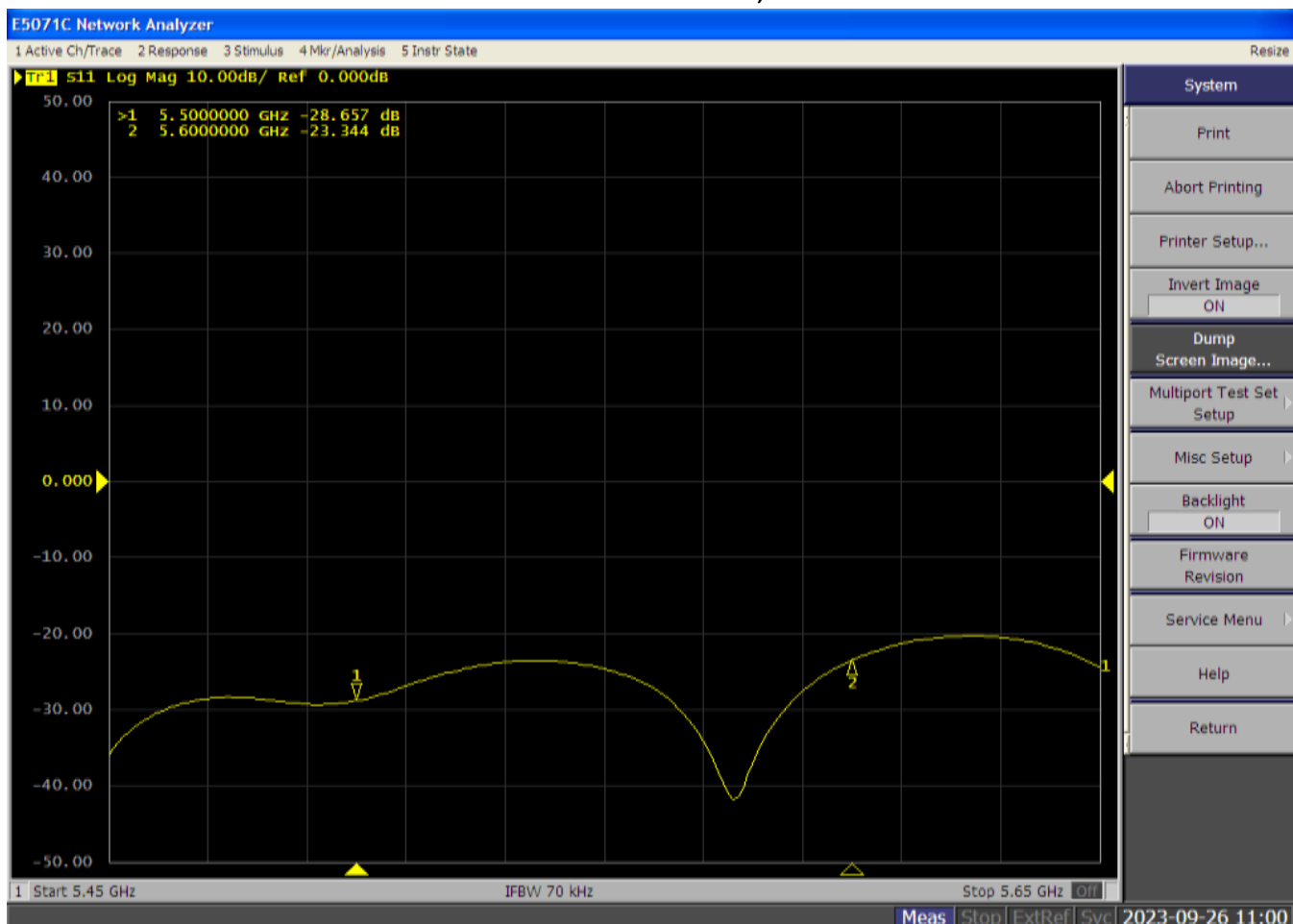
Item	Verified on 9/26, 2023	Original Cal. Result	Deviation
Impedance, transformed to feed point	$54.955 \Omega - 2.3507 \Omega$	$56.9 \Omega + 1.0j \Omega$	$< 5 \Omega$
Return Loss	-27.245 dB	-23.7 dB	-13.02%

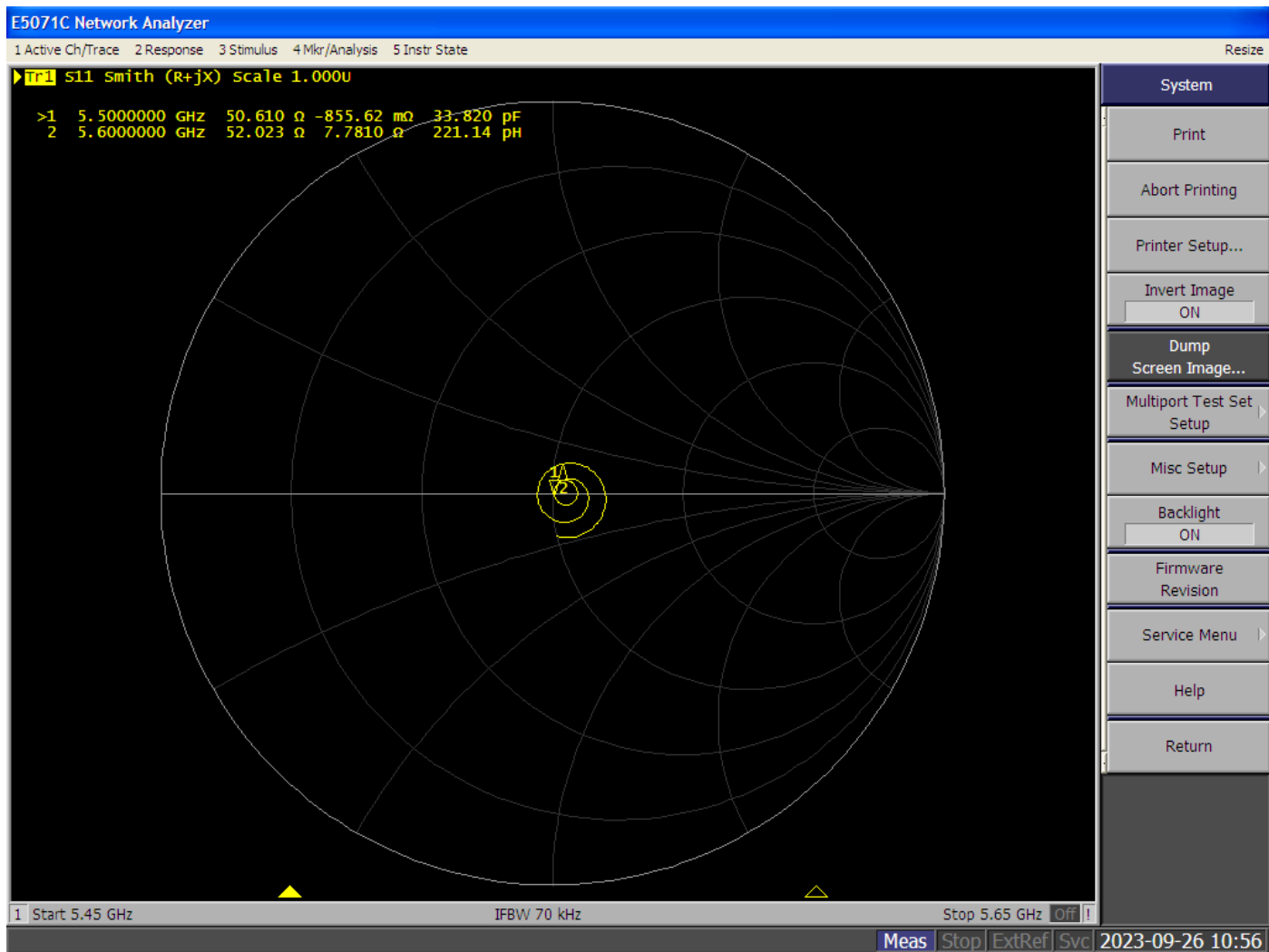
Plot for Antenna Parameters with Head Tissue 5200 MHz & 5300 MHz



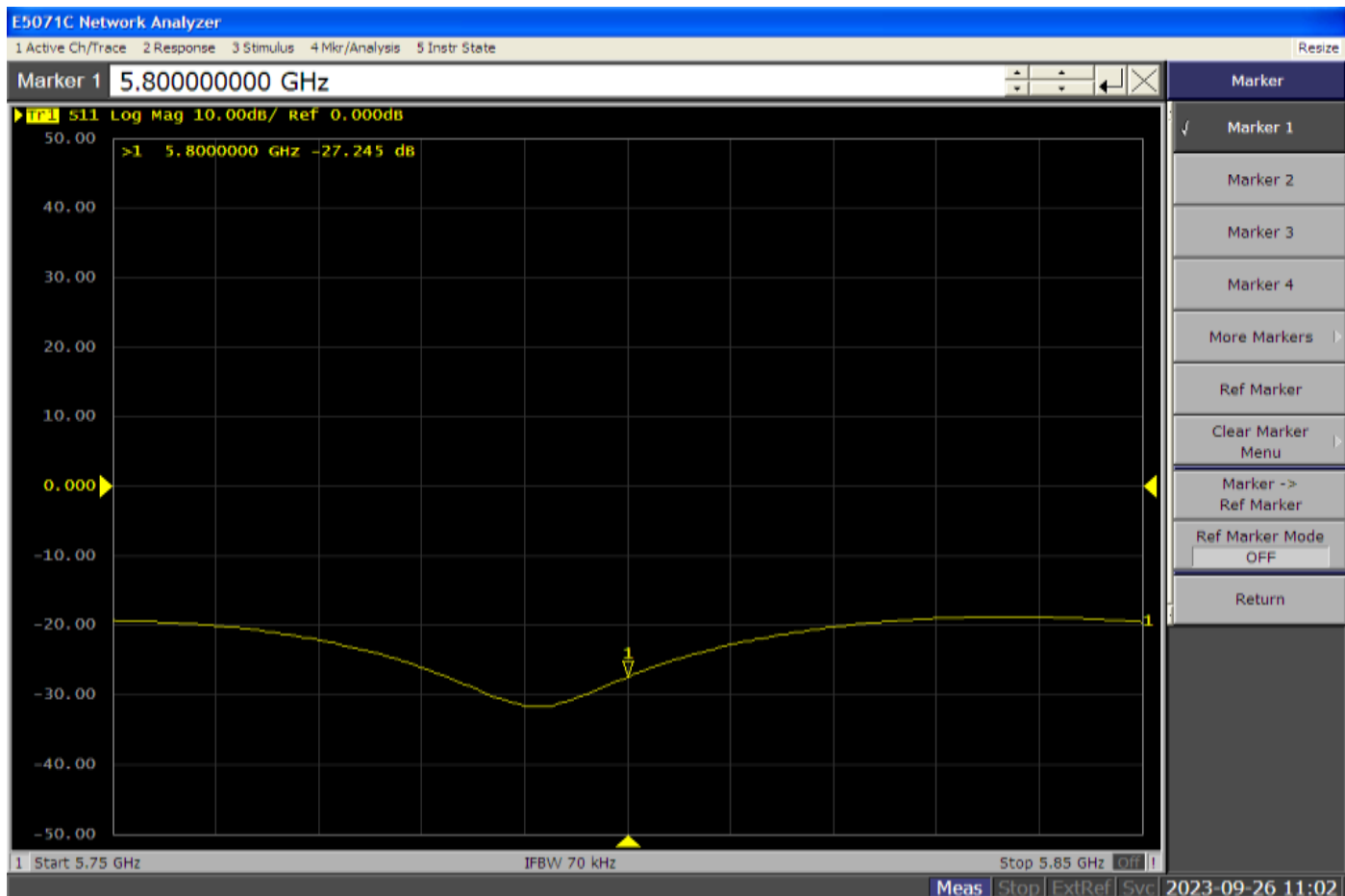


Plot for Antenna Parameters with Head Tissue 5500,5600MHz





Plot for Antenna Parameters with Head Tissue 5800 MHz



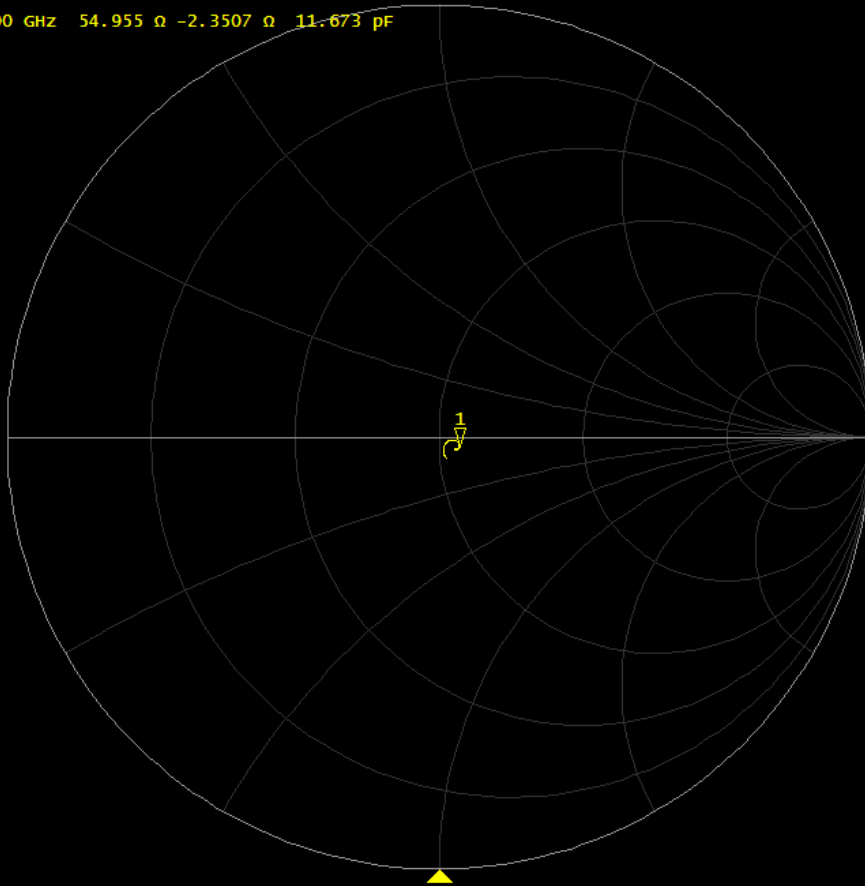
E5071C Network Analyzer

1 Active Ch/Trace 2 Response 3 Stimulus 4 Mkr/Analysis 5 Instr State

Resize

▶ Tr1 S11 Smith (R+jX) Scale 1.000u

>1 5.800000 GHz 54.955 Ω -2.3507 Ω 11.673 pF



1 Start 5.75 GHz

IFBW 70 kHz

Stop 5.85 GHz Off

Meas Stop ExtRef Svc 2023-09-26 11:03

System

Print

Abort Printing

Printer Setup...

Invert Image

ON

Dump
Screen Image...

Multiport Test Set
Setup

Misc Setup

Backlight

ON

Firmware
Revision

Service Menu

Help

Return