APPENDIX D RETURN LOSS&IMPEDANCE MEASUREMENT

Equipment Details:

Description:	Dipole
Manufacturer:	Speag
Model Number:	D750V3
Serial Number:	1229
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:

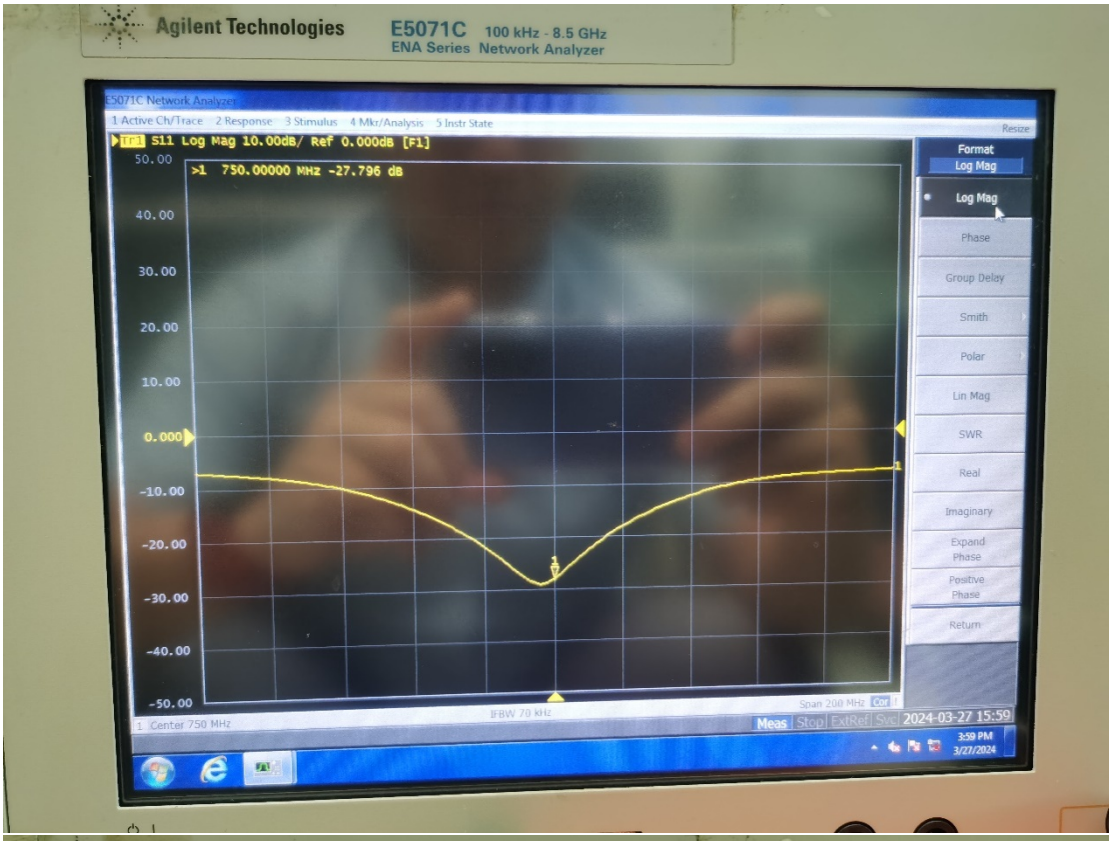
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2023/06/08	2024/06/07
Network Analyzer Calibration Kit	50Ω	51026	NCR	NCR

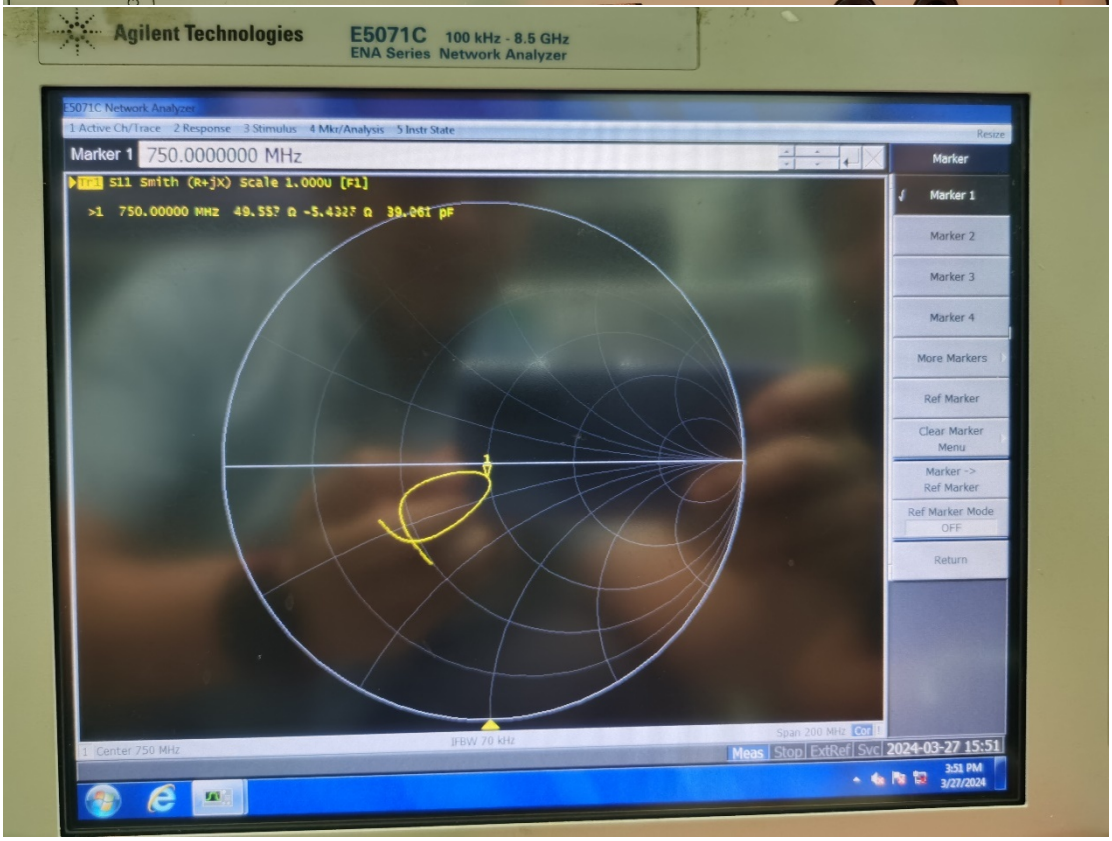
Test Data:

Frequency (MHz)	Simulated Liquid	Parameter	Measured Value	Target Value	Deviation	Reference Range	Results
750	Head	Return Loss	27.796 dB	29.503 dB	-5.786%	±20%;≥20dB	Pass
		Real Impedance	49.557 Ω	53.314 Ω	3.757 Ω	≤5Ω	Pass
		Imaginary Impedance	-5.432 Ω	-0.992 Ω	4.44 Ω	≤5Ω	Pass

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

Dipole, 750MHz, 1229





Equipment Details:

Description:	Dipole
Manufacturer:	Speag
Model Number:	D750V3
Serial Number:	1229
Calibration Date:	2025/03/24
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:

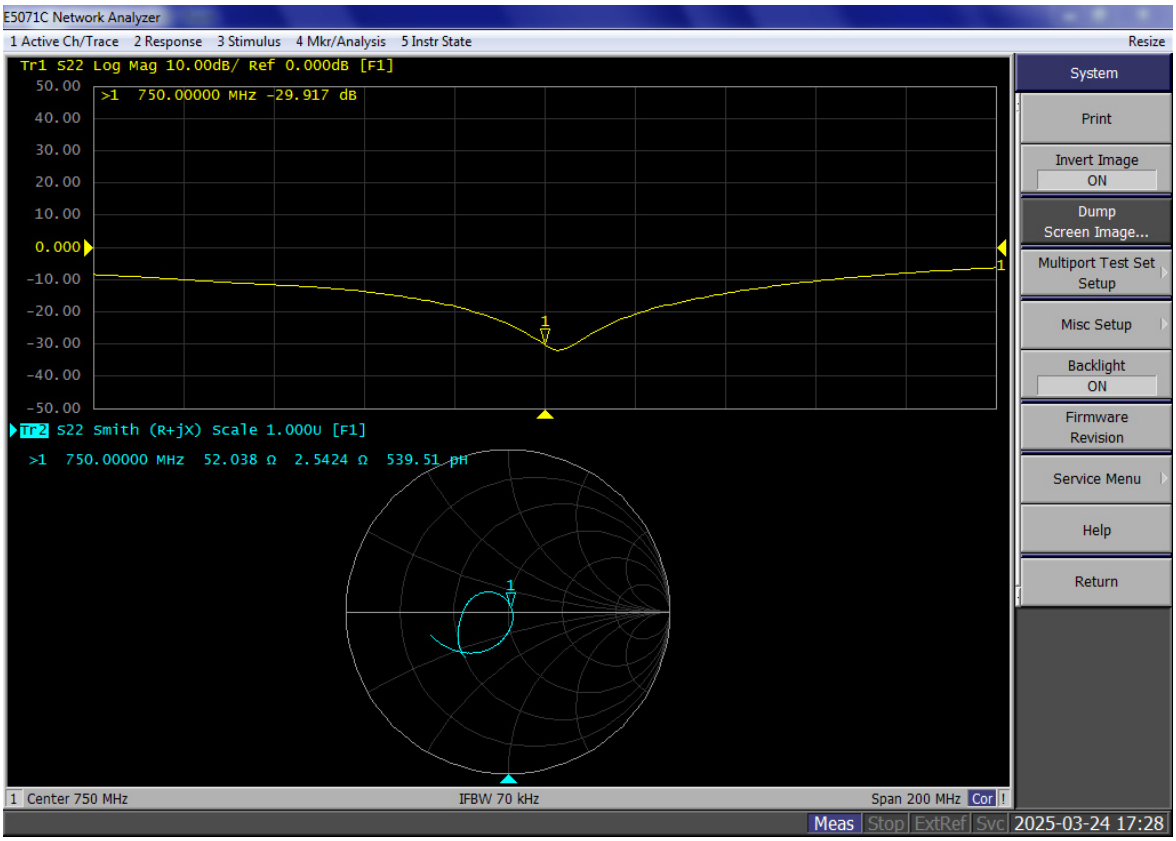
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2024/05/21	2025/05/20
Network Analyzer Calibration Kit	50Ω	51026	NCR	NCR

Test Data:

Frequency (MHz)	Simulated Liquid	Parameter	Measured Value	Target Value	Deviation	Reference Range	Results
750	Head	Return Loss	29.917 dB	29.503 dB	1.403 %	±20%;≥20dB	Pass
		Real Impedance	52.038 Ω	53.314 Ω	1.276 Ω	≤5Ω	Pass
		Imaginary Impedance	2.542 Ω	-0.992 Ω	3.534 Ω	≤5Ω	Pass

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

Dipole, 750MHz, 1229



Equipment Details:

Description:	Dipole
Manufacturer:	Speag
Model Number:	D900V2
Serial Number:	132
Calibration Date:	2024/09/26
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:

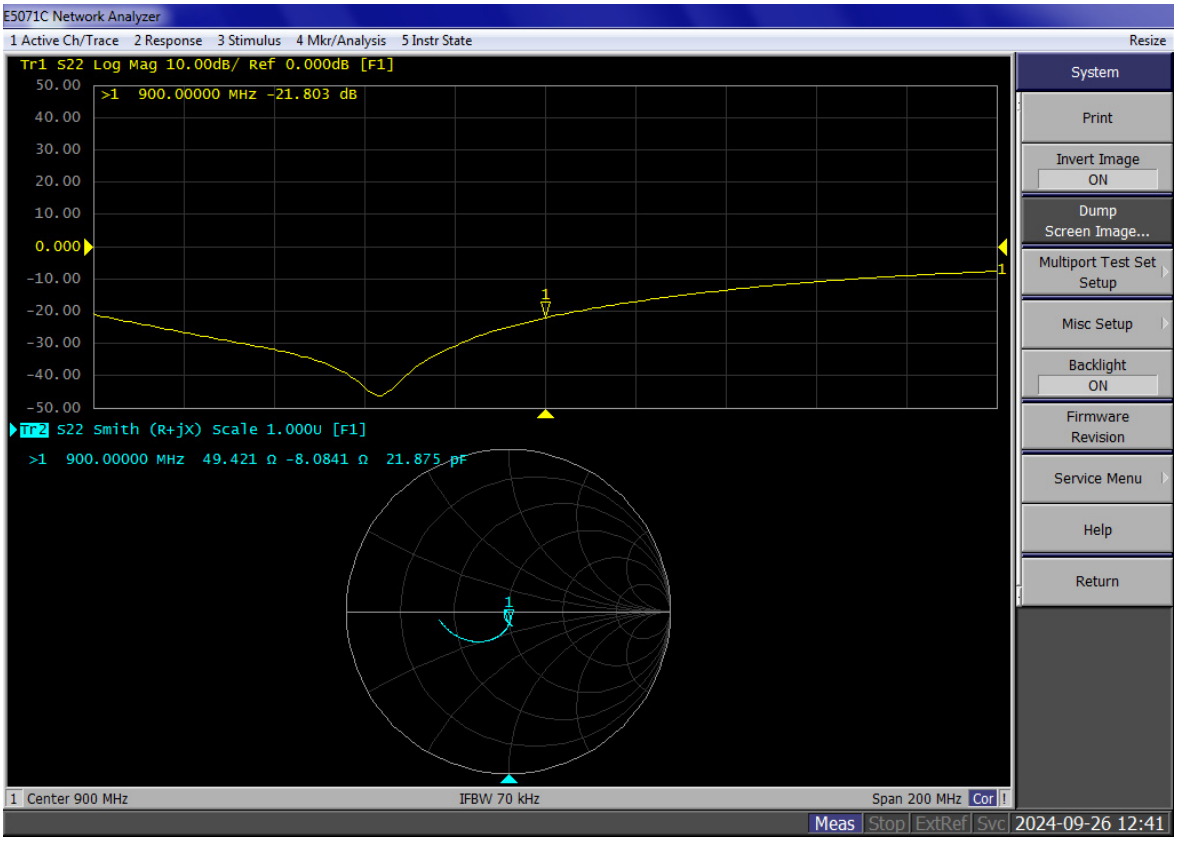
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2024/05/21	2025/05/20
Network Analyzer Calibration Kit	50Ω	51026	NCR	NCR

Test Data:

Frequency (MHz)	Simulated Liquid	Parameter	Measured Value	Target Value	Deviation	Reference Range	Results
900	Head	Return Loss	21.803 dB	22.005 dB	-0.92%	±20%;≥20dB	Pass
		Real Impedance	49.421 Ω	47.694 Ω	1.727 Ω	≤5Ω	Pass
		Imaginary Impedance	-8.084 Ω	-7.428 Ω	0.656 Ω	≤5Ω	Pass

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

Dipole, 900MHz, 132



Equipment Details:

Description:	Dipole
Manufacturer:	Speag
Model Number:	D1750V2
Serial Number:	1199
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:

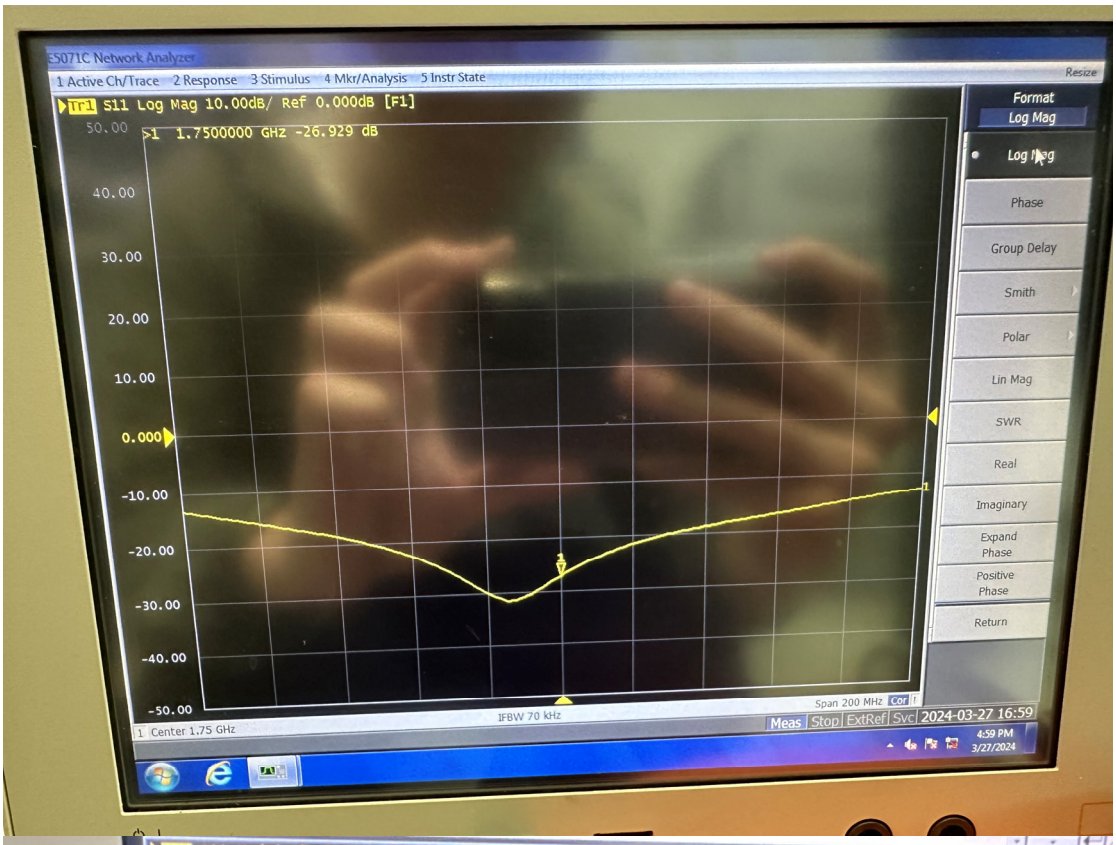
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2023/06/08	2024/06/07
Network Analyzer Calibration Kit	50 Ω	51026	NCR	NCR

Test Data:

Frequency (MHz)	Simulated Liquid	Parameter	Measured Value	Target Value	Deviation	Reference Range	Results
1750	Head	Return Loss	26.929 dB	26.017 dB	3.505%	±20%; ≥20dB	Pass
		Real Impedance	45.532 Ω	46.939 Ω	1.407 Ω	≤ 5 Ω	Pass
		Imaginary Impedance	-1.154 Ω	3.765 Ω	4.919 Ω	≤ 5 Ω	Pass

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

Dipole, 1750MHz, 1199



Equipment Details:

Description:	Dipole
Manufacturer:	Speag
Model Number:	D1750V2
Serial Number:	1199
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:

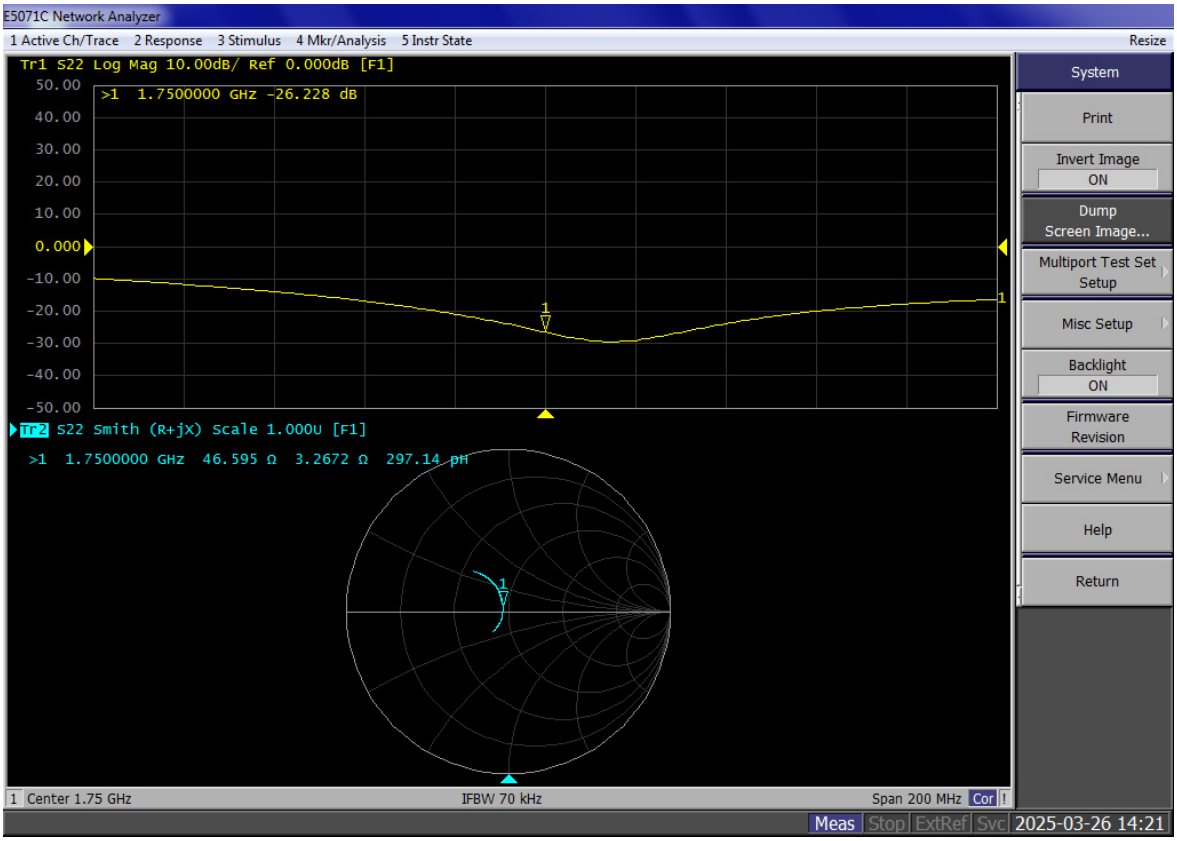
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2024/05/21	2025/05/20
Network Analyzer Calibration Kit	50Ω	51026	NCR	NCR

Test Data:

Frequency (MHz)	Simulated Liquid	Parameter	Measured Value	Target Value	Deviation	Reference Range	Results
1750	Head	Return Loss	26.228 dB	26.017 dB	0.811 %	±20%;≥20dB	Pass
		Real Impedance	46.595 Ω	46.939 Ω	0.344 Ω	≤5Ω	Pass
		Imaginary Impedance	3.267 Ω	3.765 Ω	0.498 Ω	≤5Ω	Pass

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

Dipole, 1750MHz, 1199



Equipment Details:

Description:	Dipole
Manufacturer:	Speag
Model Number:	D1900V2
Serial Number:	5d231
Calibration Date:	2024/02/01
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:

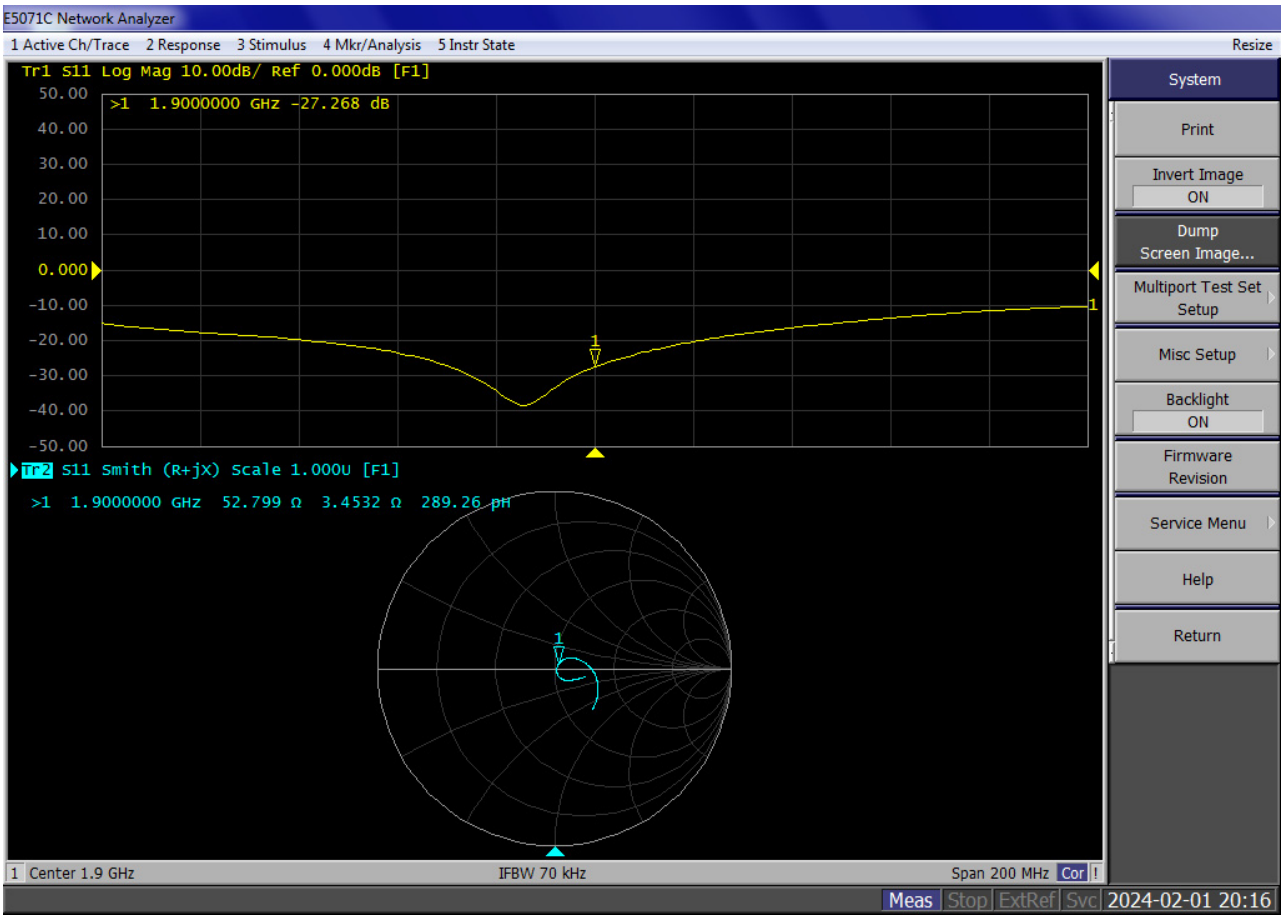
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2023/06/08	2024/06/07
Network Analyzer Calibration Kit	50Ω	51026	NCR	NCR

Test Data:

Frequency (MHz)	Simulated Liquid	Parameter	Measured Value	Target Value	Deviation	Reference Range	Results
1900	Head	Return Loss	27.268 dB	26.067dB	4.607 %	±20%;≥20dB	Pass
		Real Impedance	52.799 Ω	50.307 Ω	2.492 Ω	≤5Ω	Pass
		Imaginary Impedance	3.453 Ω	4.985 Ω	-1.532 Ω	≤5Ω	Pass

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

Dipole, 1900MHz, 5d231



Equipment Details:

Description:	Dipole
Manufacturer:	Speag
Model Number:	D1900V2
Serial Number:	5d231
Calibration Date:	2025/02/01
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:

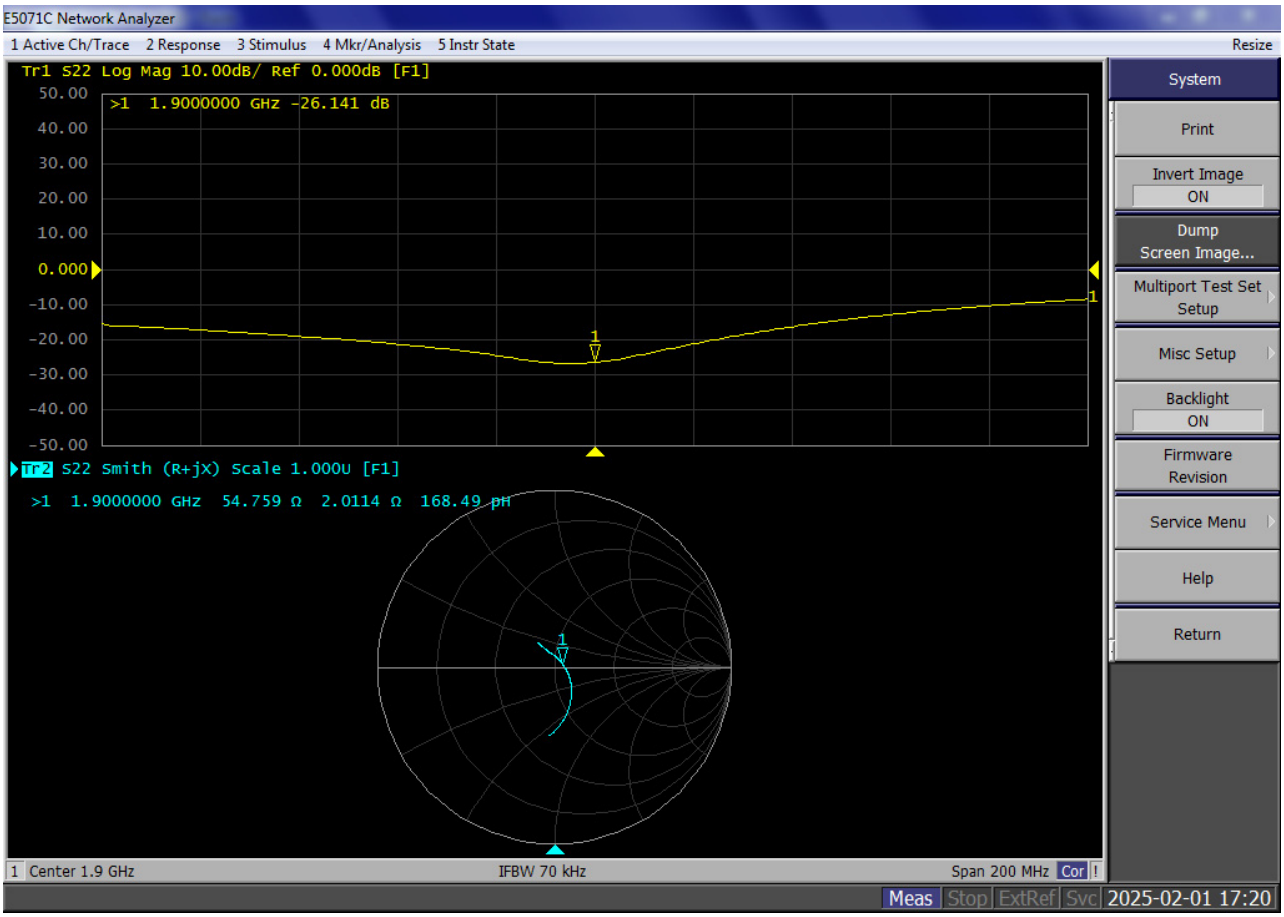
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2024/05/21	2025/05/20
Network Analyzer Calibration Kit	50Ω	51026	NCR	NCR

Test Data:

Frequency (MHz)	Simulated Liquid	Parameter	Measured Value	Target Value	Deviation	Reference Range	Results
1900	Head	Return Loss	26.141 dB	26.067dB	0.284 %	±20%;≥20dB	Pass
		Real Impedance	54.759 Ω	50.307 Ω	4.452 Ω	≤5Ω	Pass
		Imaginary Impedance	2.011 Ω	4.985 Ω	-2.974 Ω	≤5Ω	Pass

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

Dipole, 1900MHz, 5d231



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:

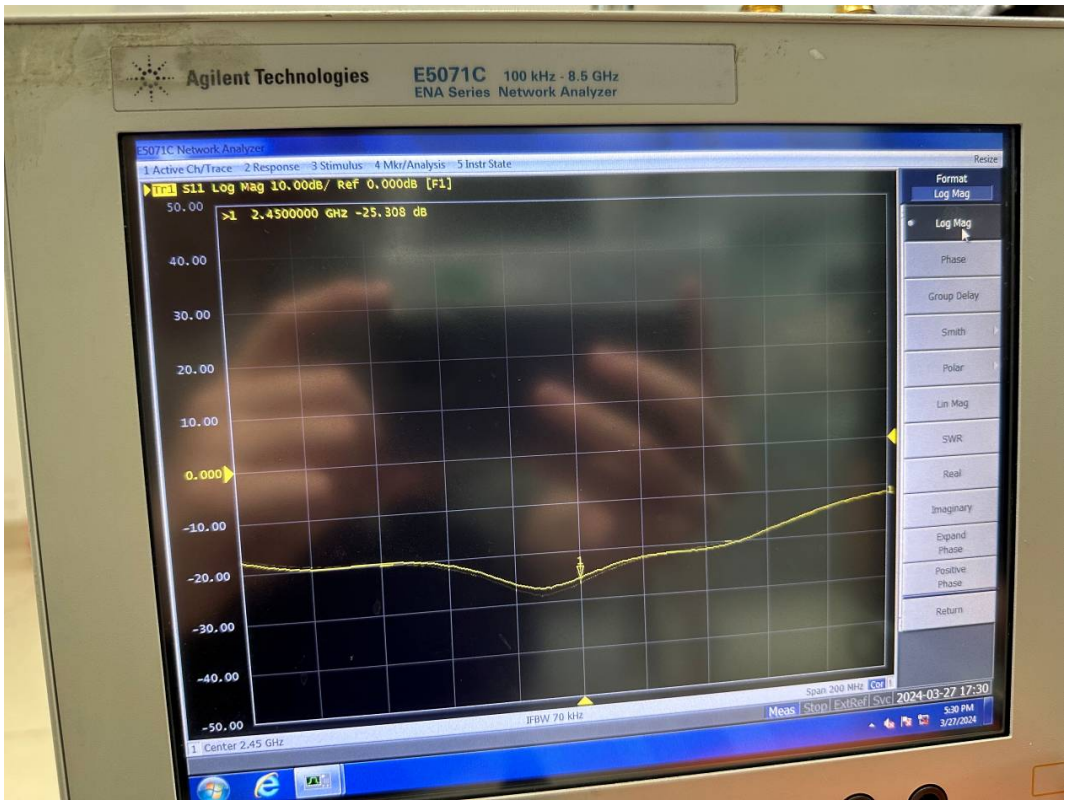
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2023/06/08	2024/06/07
Network Analyzer Calibration Kit	50Ω	51026	NCR	NCR

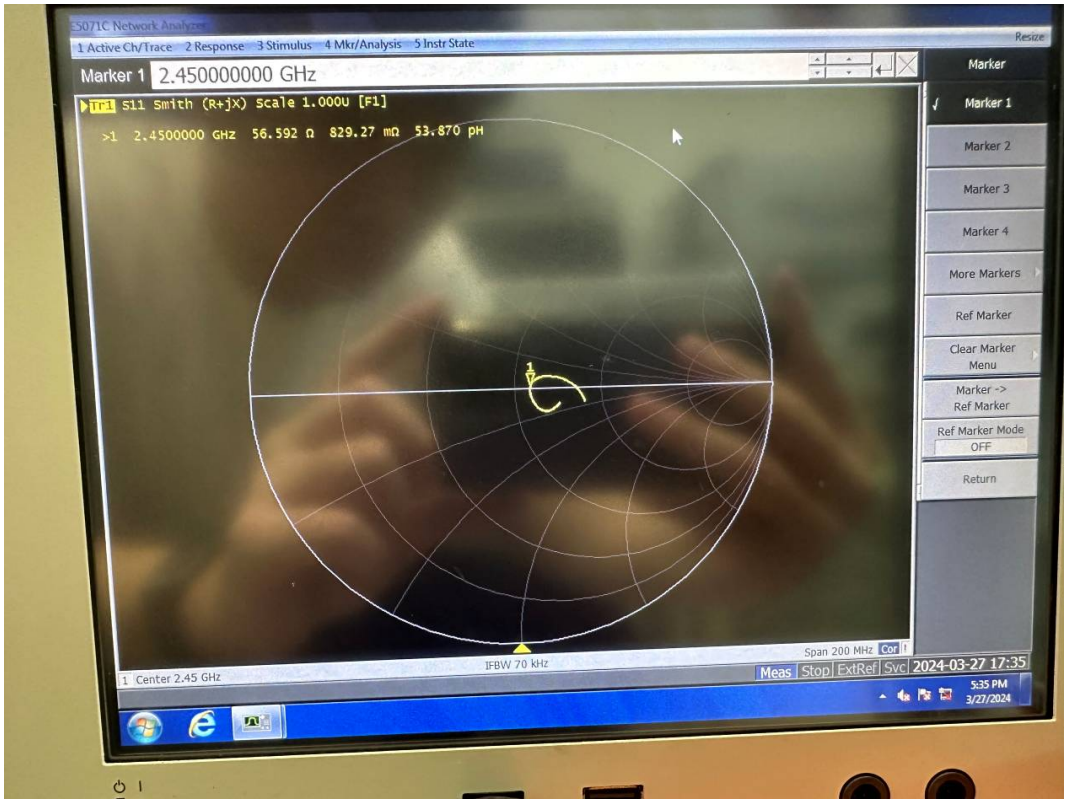
Test Data:

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:

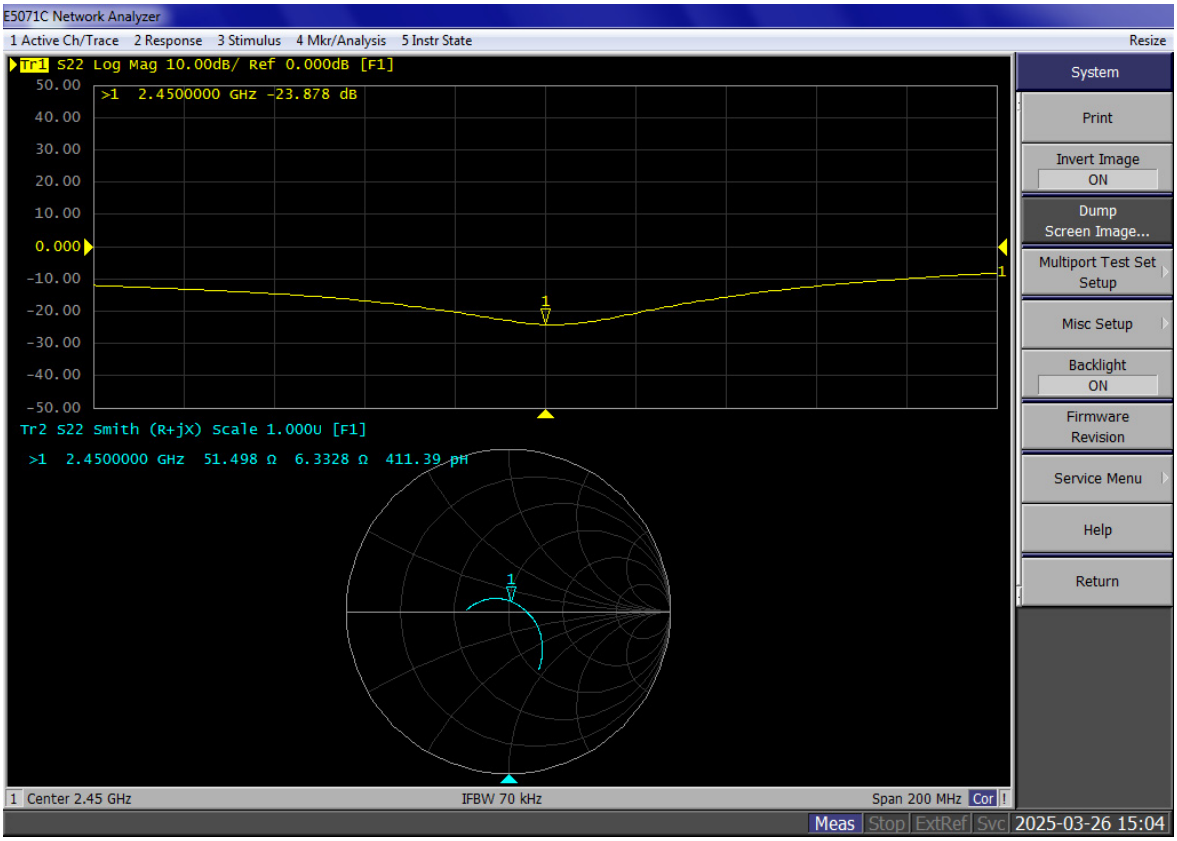
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2024/05/21	2025/05/20
Network Analyzer Calibration Kit	50Ω	51026	NCR	NCR

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:	D2600V2
Serial Number:	1207
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:

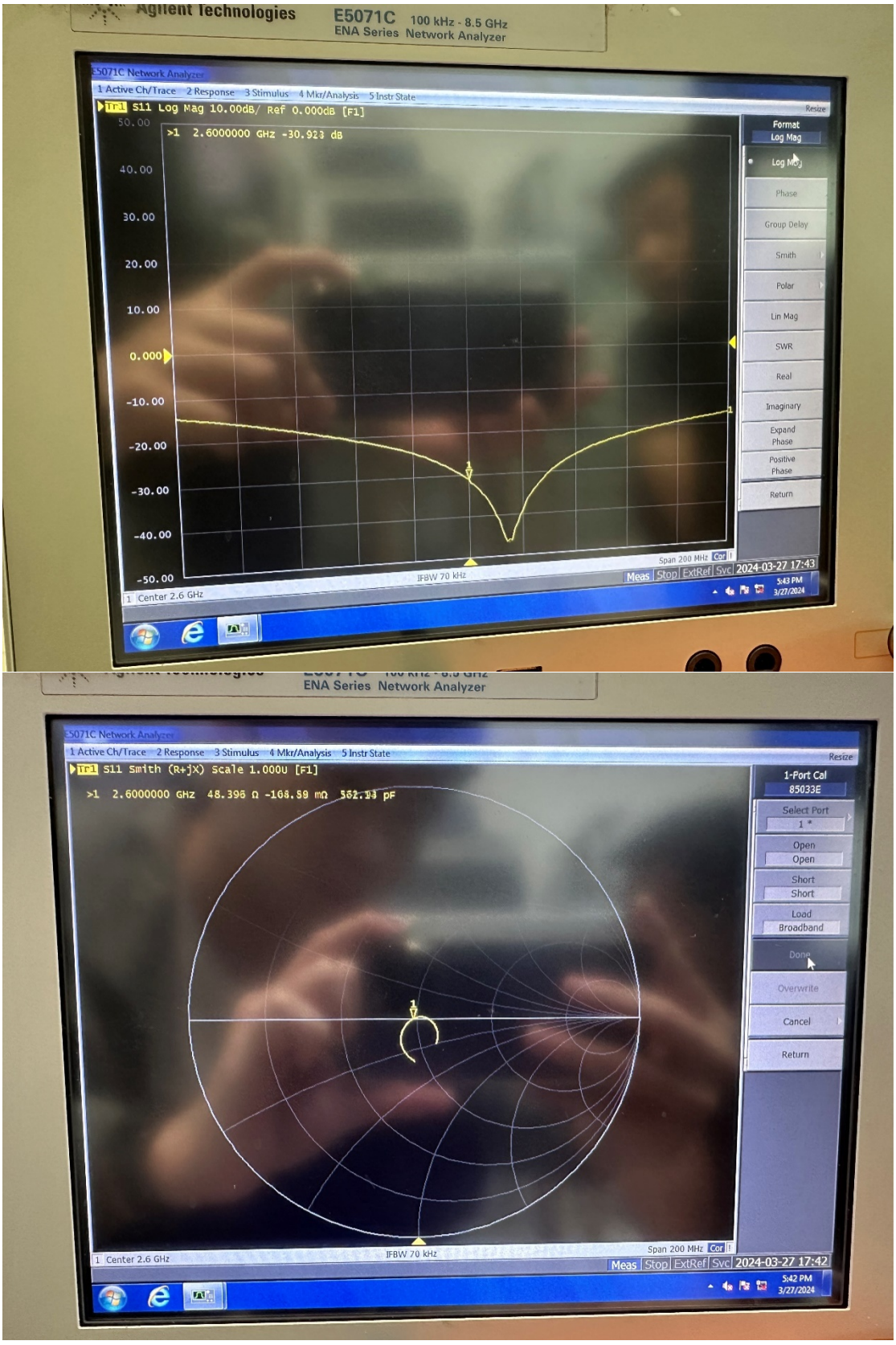
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2023/06/08	2024/06/07
Network Analyzer Calibration Kit	50Ω	51026	NCR	NCR

Test Data:

Frequency (MHz)	Simulated Liquid	Parameter	Measured Value	Target Value	Deviation	Reference Range	Results
2600	Head	Return Loss	30.923 dB	27.361 dB	13.019%	±20%;≥20dB	Pass
		Real Impedance	48.396 Ω	45.943 Ω	2.453 Ω	≤5Ω	Pass
		Imaginary Impedance	-0.109 Ω	-0.667 Ω	0.558 Ω	≤5Ω	Pass

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

Dipole, 2600MHz, 1207



Equipment Details:

Description:	Dipole
Manufacturer:	Speag
Model Number:	D2600V2
Serial Number:	1207
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:

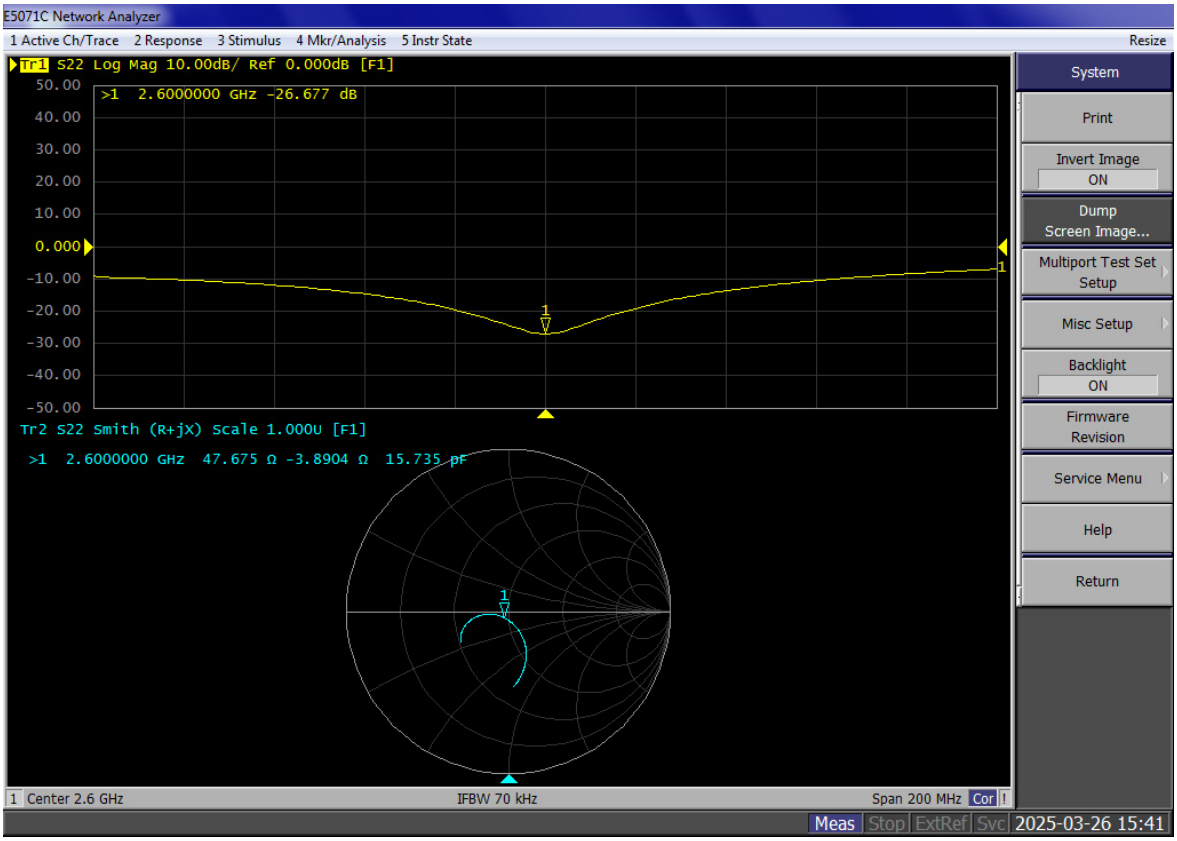
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2024/05/21	2025/05/20
Network Analyzer Calibration Kit	50Ω	51026	NCR	NCR

Test Data:

Frequency (MHz)	Simulated Liquid	Parameter	Measured Value	Target Value	Deviation	Reference Range	Results
2600	Head	Return Loss	26.677 dB	27.316 dB	-2.339 %	±20%;≥20dB	Pass
		Real Impedance	47.675 Ω	45.943 Ω	1.732 Ω	≤5Ω	Pass
		Imaginary Impedance	-3.890 Ω	-0.667 Ω	3.223 Ω	≤5Ω	Pass

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

Dipole, 2600MHz, 1207



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:

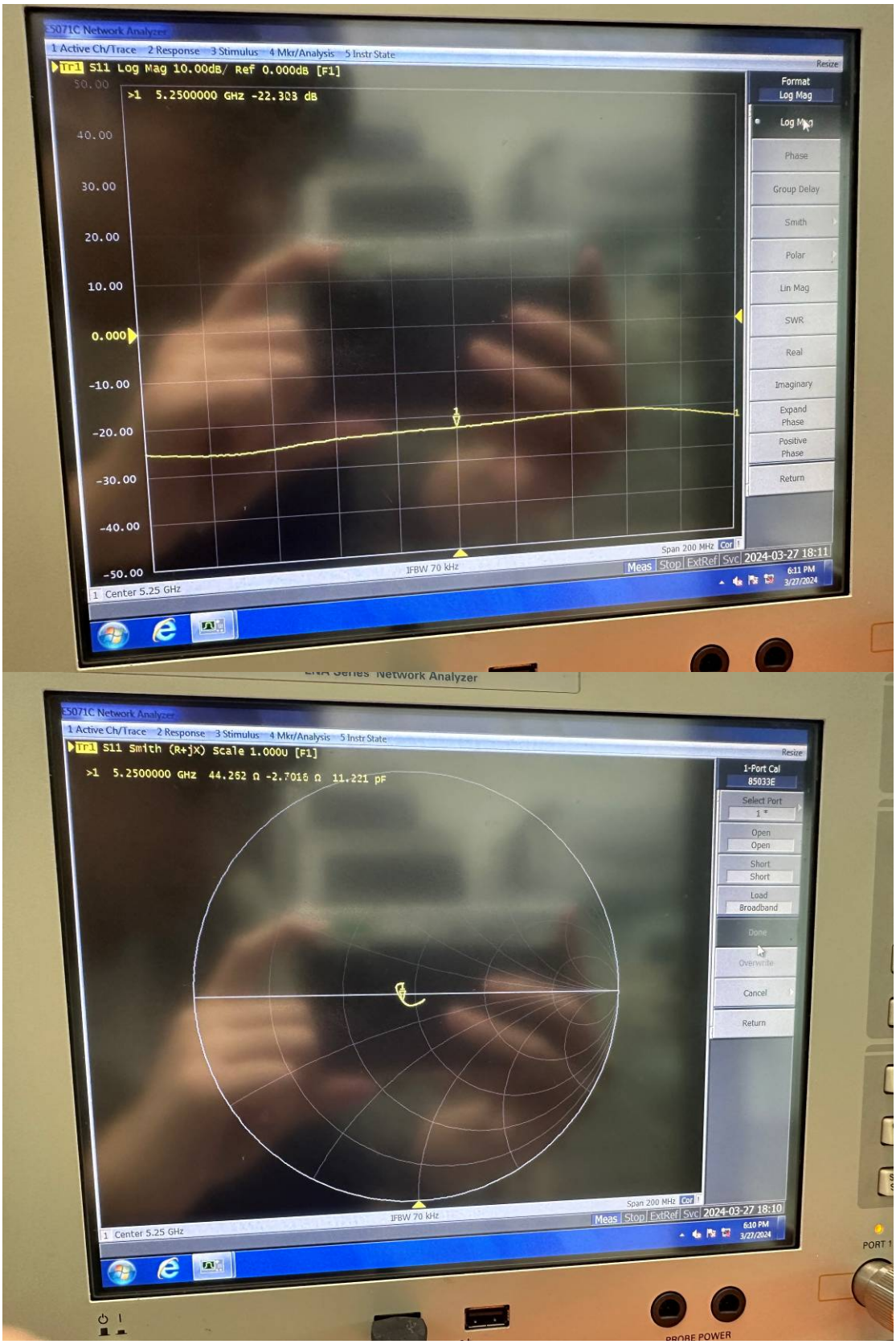
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2023/06/08	2024/06/07
Network Analyzer Calibration Kit	50 Ω	51026	NCR	NCR

Test Data:

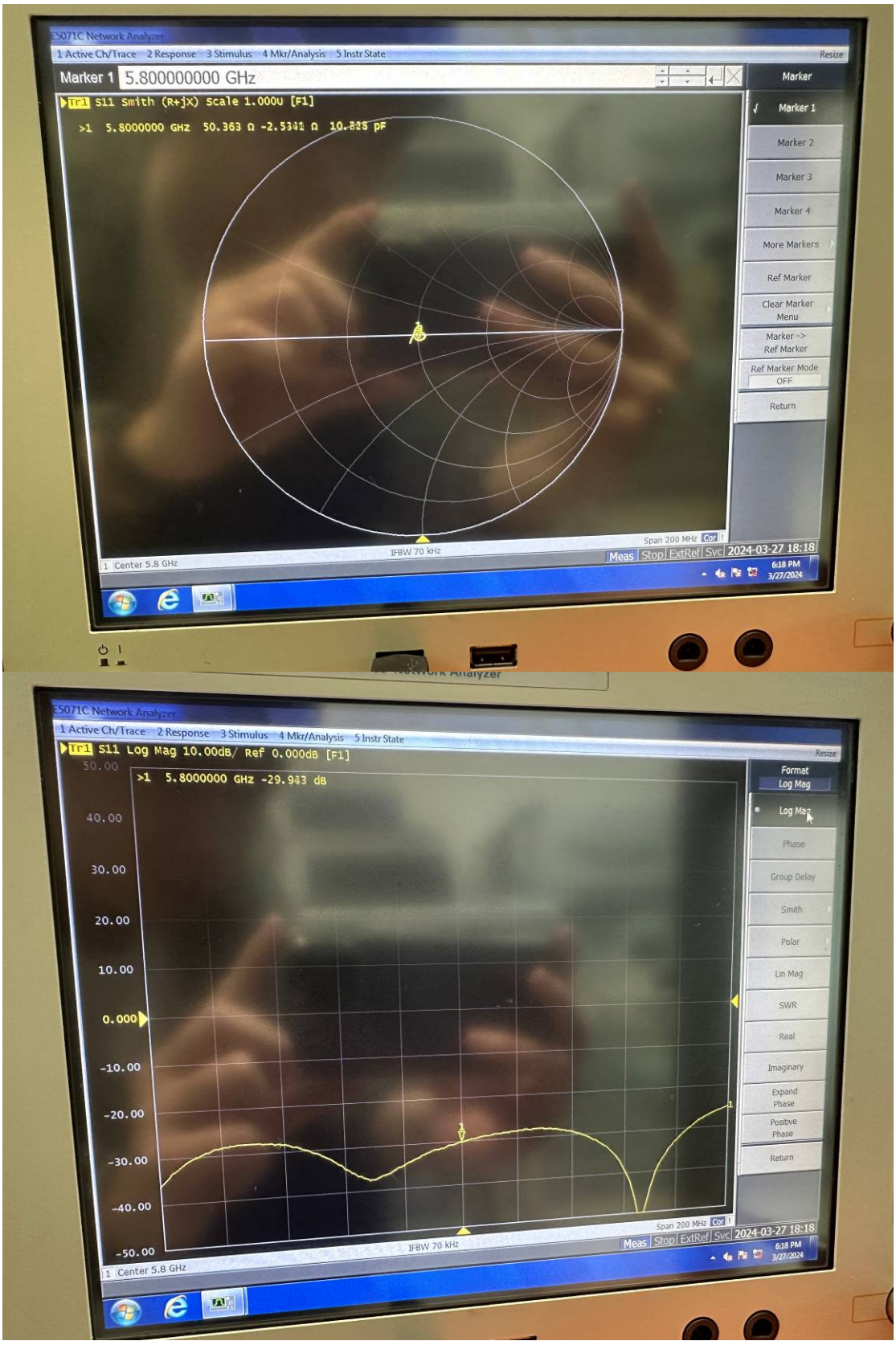
Frequency (MHz)	Simulated Liquid	Parameter	Measured Value	Target Value	Deviation	Reference Range	Results
5250	Head	Return Loss	22.303 dB	23.781 dB	-6.215 %	±20%; ≥20dB	Pass
		Real Impedance	44.252 Ω	45.776 Ω	1.524 Ω	≤ 5 Ω	Pass
		Imaginary Impedance	-2.702 Ω	-4.545 Ω	1.843 Ω	≤ 5 Ω	Pass
5800	Head	Return 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℃-25℃ and humidity < 70%

Calibrated Equipment:

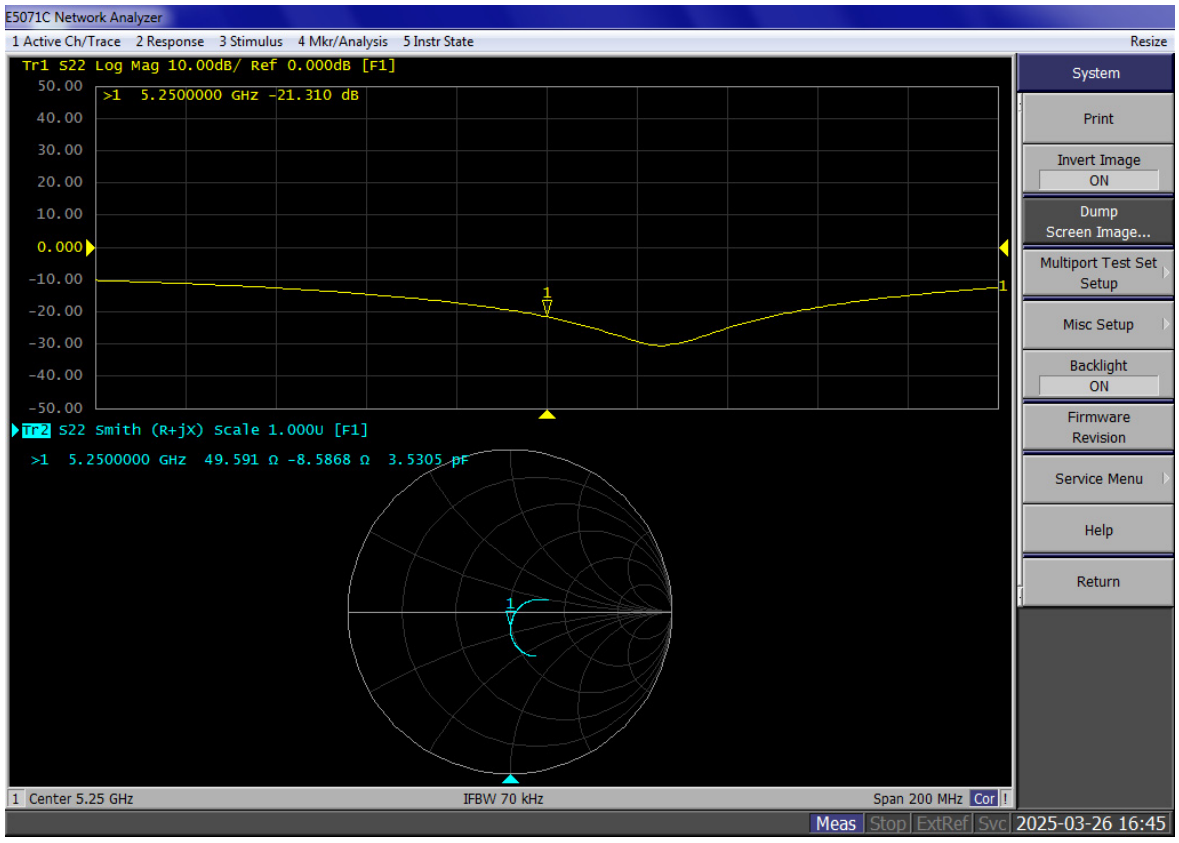
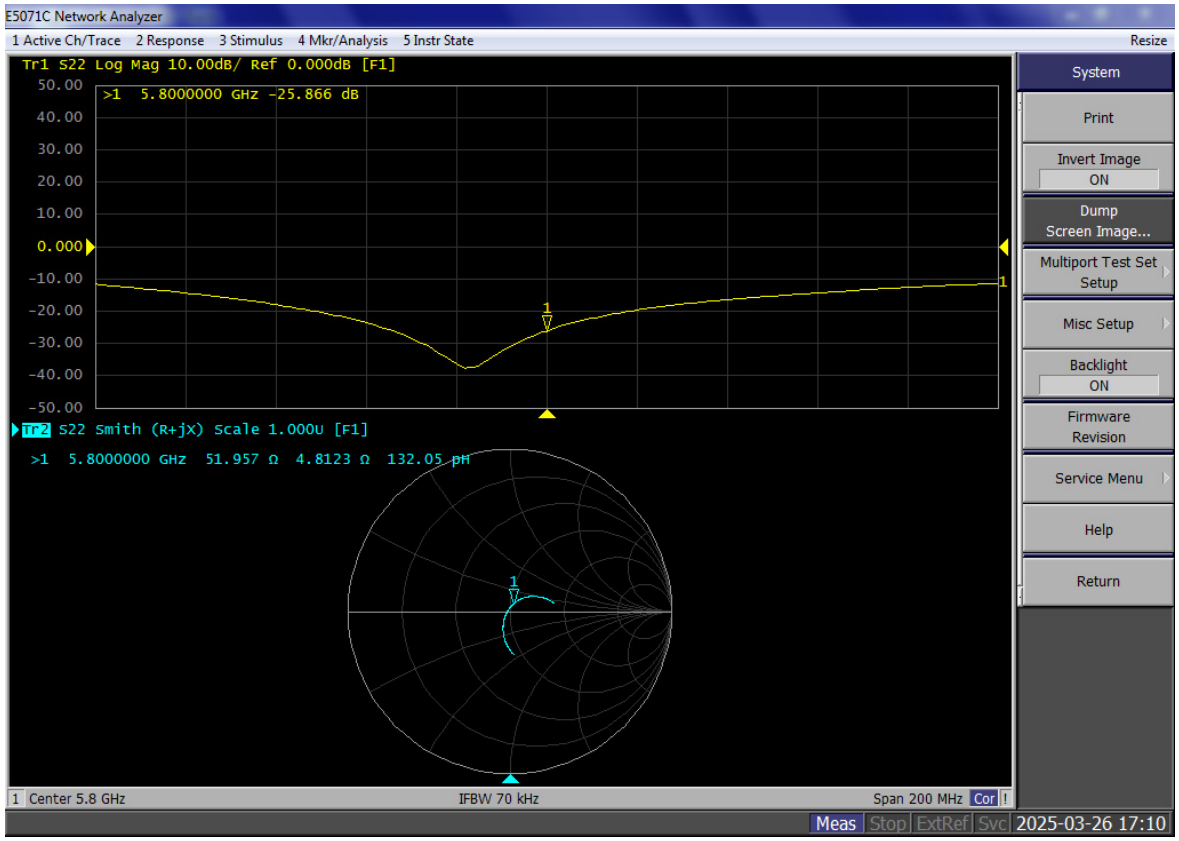
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue Liquid Head	HBBL600-10000V6	2200808-2	Each Time	
SAM Twin Phantom	SAM-Twin V8.0	1962	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2024/05/21	2025/05/20
Network Analyzer Calibration Kit	50 Ω	51026	NCR	NCR

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