

Appendix B: Tissue Stimulating Liquids, System Checks and System Validation

B.1. SAR System Check

Prior to SAR assessment, the system is verified to $\pm 10\%$ of the SAR measurement on the reference dipole at the time of calibration by the calibration facility. SAR System Validation was performed and complies with requirements per IEC/IEEE 62209-1528.

Table 1 System Check Results (SAR)

System	Frequency (MHz)	Tissue Type	Date	Amb. Temp. (°C)	Tissue Temp (°C)	Input Power (dBm)	Verification Source SN	Probe SN	DAE SN	Measured 1g SAR (W/Kg)	1W Target 1g SAR (W/Kg)	1W Normalized 1g SAR (W/Kg)	1g SAR Deviation	Measured 10g SAR (W/Kg)	1W Target 10g SAR (W/Kg)	1W Normalized 10g SAR (W/Kg)	10g SAR Deviation
Delta	750	Head	01/22/2025	22.2	19.7	17	1235	7853	1844	0.422	8.690	8.420	-3.11%	0.280	5.690	5.587	-1.81%
Delta	750	Head	01/27/2025	23.3	22.4	17	1235	7853	1844	0.409	8.690	8.161	-6.09%	0.269	5.690	5.367	-5.67%
Delta	835	Head	01/22/2025	22.2	19.7	17	4d311	7853	1844	0.493	9.820	9.837	0.17%	0.324	6.370	6.465	1.49%
Delta	835	Head	01/30/2025	23.3	22.9	17	4d311	7853	1844	0.496	9.820	9.897	0.78%	0.325	6.370	6.485	1.80%
Gamma	1750	Head	01/22/2025	21.6	20.6	17	1205	7836	1839	1.840	36.500	36.713	0.58%	0.988	19.200	19.713	2.67%
Gamma	1900	Head	01/22/2025	21.6	20.6	17	5d252	7836	1839	2.100	39.800	41.901	5.28%	1.090	21.000	21.748	3.56%
Beta	2450	Head	01/27/2025	23.3	22.4	17	1112	7872	1843	2.470	50.600	49.283	-2.60%	1.150	23.700	22.946	-3.18%
Gamma	2450	Head	01/27/2025	23.6	20.6	17	1112	7836	1839	2.440	50.600	48.684	-3.79%	1.140	23.700	22.746	-4.03%
Gamma	5250	Head	01/27/2025	23.3	20.6	17	1396	7836	1839	3.760	77.900	75.022	-3.69%	1.080	22.400	21.549	-3.80%
Gamma	5250	Head	01/30/2025	23.7	22	17	1396	7836	1839	3.860	77.900	77.017	-1.13%	1.110	22.400	22.147	-1.13%
Gamma	5600	Head	01/27/2025	23.3	20.6	17	1396	7836	1839	3.990	81.100	79.611	-1.84%	1.130	23.300	22.546	-3.23%
Gamma	5600	Head	01/30/2025	23.7	22	17	1396	7836	1839	4.120	81.100	82.205	1.36%	1.180	23.300	23.544	1.05%
Gamma	5750	Head	01/27/2025	23.3	20.6	17	1396	7836	1839	3.710	80.100	74.024	-7.59%	1.060	22.800	21.150	-7.24%
Gamma	5750	Head	01/30/2025	23.7	22	17	1396	7836	1839	3.810	80.100	76.019	-5.09%	1.100	22.800	21.948	-3.74%

B.2. Dielectric Parameters of the TSL

Table 2 SAR Tissue Dielectric Parameters

Date	Tissue Type	Liquid Temp (°C)	Frequency (MHz)	Conductivity Measured (σ)	Conductivity Target (σ)	Deviation	Permittivity measured (ϵ_r)	Permittivity Target (ϵ_r)	Deviation
1/22/2025	Head	20.9	1710	1.30	1.35	-3.33%	38.6	40.1	-3.93%
1/22/2025	Head	20.9	1750	1.33	1.37	-3.11%	38.5	40.1	-3.92%
1/22/2025	Head	20.9	1790	1.35	1.39	-2.92%	38.5	40.0	-3.87%
1/22/2025	Head	20.9	1850	1.39	1.40	-0.59%	38.3	40.0	-4.17%
1/22/2025	Head	20.9	1880	1.41	1.40	0.69%	38.3	40.0	-4.24%
1/22/2025	Head	20.9	1900	1.42	1.40	1.46%	38.3	40.0	-4.33%
1/22/2025	Head	20.9	1920	1.43	1.40	2.45%	38.2	40.0	-4.45%
1/22/2025	Head	20.8	680	0.86	0.89	-3.43%	43.6	42.3	3.04%
1/22/2025	Head	20.8	695	0.86	0.89	-2.77%	43.5	42.2	3.12%
1/22/2025	Head	20.8	700	0.86	0.89	-2.86%	43.5	42.2	3.05%
1/22/2025	Head	20.8	710	0.87	0.89	-2.15%	43.5	42.1	3.18%
1/22/2025	Head	20.8	750	0.88	0.89	-1.39%	43.3	41.9	3.26%
1/22/2025	Head	20.8	770	0.89	0.89	-0.60%	43.2	41.8	3.44%
1/22/2025	Head	20.8	785	0.89	0.89	-0.17%	43.2	41.7	3.48%
1/22/2025	Head	20.8	815	0.90	0.90	0.72%	43.1	41.6	3.68%
1/22/2025	Head	20.8	835	0.91	0.90	1.15%	43.1	41.5	3.88%
1/22/2025	Head	20.8	850	0.92	0.92	-0.09%	43.1	41.5	3.82%
1/27/2025	Head	22.9	680	0.88	0.89	-0.74%	42.5	42.3	0.60%
1/27/2025	Head	22.9	695	0.88	0.89	-0.17%	42.5	42.2	0.61%
1/27/2025	Head	22.9	700	0.89	0.89	-0.29%	42.4	42.2	0.53%
1/27/2025	Head	22.9	710	0.89	0.89	0.40%	42.4	42.1	0.64%
1/27/2025	Head	22.9	750	0.90	0.89	1.23%	42.3	41.9	0.77%
1/27/2025	Head	22.9	770	0.91	0.89	1.98%	42.2	41.8	0.96%
1/27/2025	Head	22.9	785	0.92	0.89	2.38%	42.2	41.7	1.00%
1/27/2025	Head	22.9	2400	1.80	1.76	2.80%	39.1	39.3	-0.52%
1/27/2025	Head	22.9	2450	1.84	1.80	2.31%	39.0	39.2	-0.51%
1/27/2025	Head	22.9	2480	1.86	1.83	1.74%	38.9	39.2	-0.57%
1/27/2025	Head	22	2400	1.75	1.76	-0.59%	38.2	39.3	-2.70%
1/27/2025	Head	22	2450	1.78	1.80	-0.99%	38.2	39.2	-2.61%
1/27/2025	Head	22	2480	1.81	1.83	-1.44%	38.1	39.2	-2.62%
1/27/2025	Head	22	5150	4.31	4.60	-6.40%	33.7	36.0	-6.49%
1/27/2025	Head	22	5200	4.36	4.66	-6.24%	33.6	36.0	-6.57%
1/27/2025	Head	22	5250	4.42	4.71	-6.11%	33.5	35.9	-6.69%
1/27/2025	Head	22	5300	4.47	4.76	-5.99%	33.5	35.9	-6.74%
1/27/2025	Head	22	5350	4.52	4.81	-5.98%	33.3	35.8	-6.91%
1/27/2025	Head	22	5500	4.68	4.96	-5.71%	33.1	35.6	-7.10%
1/27/2025	Head	22	5550	4.73	5.01	-5.61%	33.0	35.6	-7.21%
1/27/2025	Head	22	5600	4.79	5.07	-5.41%	32.9	35.5	-7.31%
1/27/2025	Head	22	5650	4.85	5.12	-5.28%	32.8	35.5	-7.43%
1/27/2025	Head	22	5700	4.90	5.17	-5.10%	32.7	35.4	-7.55%
1/27/2025	Head	22	5750	4.96	5.22	-5.03%	32.7	35.4	-7.61%
1/27/2025	Head	22	5800	5.02	5.27	-4.81%	32.6	35.3	-7.72%
1/27/2025	Head	22	5850	5.06	5.32	-4.85%	32.5	35.3	-7.81%
1/30/2025	Head	22.3	5150	4.35	4.60	-5.51%	33.4	36.0	-7.21%
1/30/2025	Head	22.3	5200	4.40	4.66	-5.39%	33.4	36.0	-7.30%
1/30/2025	Head	22.3	5250	4.46	4.71	-5.29%	33.3	35.9	-7.42%
1/30/2025	Head	22.3	5300	4.51	4.76	-5.23%	33.2	35.9	-7.47%
1/30/2025	Head	22.3	5350	4.56	4.81	-5.16%	33.1	35.8	-7.64%
1/30/2025	Head	22.3	5500	4.71	4.96	-5.03%	32.8	35.6	-7.88%
1/30/2025	Head	22.3	5550	4.77	5.01	-4.85%	32.8	35.6	-7.95%
1/30/2025	Head	22.3	5600	4.82	5.07	-4.83%	32.7	35.5	-8.08%
1/30/2025	Head	22.3	5650	4.88	5.12	-4.57%	32.6	35.5	-8.17%
1/30/2025	Head	22.3	5700	4.93	5.17	-4.59%	32.5	35.4	-8.31%
1/30/2025	Head	22.3	5750	4.99	5.22	-4.37%	32.4	35.4	-8.37%
1/30/2025	Head	22.3	5800	5.04	5.27	-4.33%	32.3	35.3	-8.50%
1/30/2025	Head	22.3	5850	5.10	5.32	-4.23%	32.2	35.3	-8.59%
1/30/2025	Head	21.9	815	0.92	0.90	2.66%	40.2	41.6	-3.29%
1/30/2025	Head	21.9	835	0.93	0.90	3.10%	40.2	41.5	-3.17%
1/30/2025	Head	21.9	850	0.93	0.92	1.70%	40.1	41.5	-3.26%

The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB Publication 865664 D01v01r04 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

The SAR values were compensated for deviations between the measured and required tissue dielectric properties, as described in IEC/IEEE 62209-1528. The SAR values were applied to only scale up the measured SAR values, and not downward, per KDB Publication 865664 D01v04r04.

B.3. FCC System Validation Summary

Per FCC KDB Publication 865664 D02 Section 2.3 a) states “SAR system validation status and system verification results should be documented in a separate section of the SAR report, or as an attachment, to confirm measurement accuracy.”

The SAR systems used for evaluating this device were validated against its performance specifications prior to the SAR measurements.

Reference dipoles were used with the required tissue-equivalent media for system validation, according to the procedures outlined in FCC KDB Publication 865664 D01 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point.

Per FCC KDB 865664 D02, “the validation status should be documented according to the validation date(s), measurement frequencies, SAR probes, calibrated signal type(s) and tissue dielectric parameters.” A tabulated summary of the system validation status is provided accordingly:

Table 3 System Validation

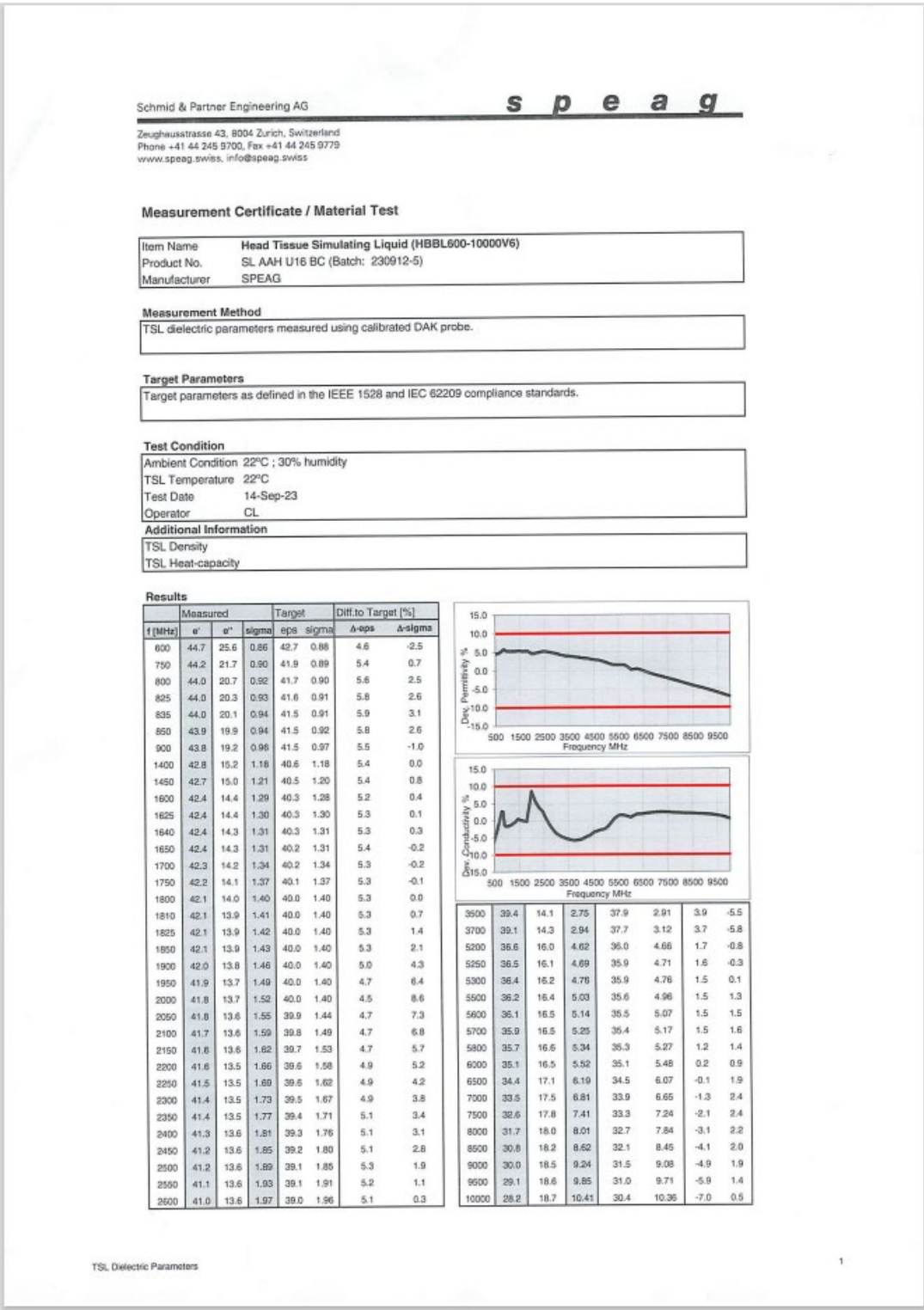
System	Frequency (MHz)	Date	Probe	DAE	Probe CalF		Cond. (σ)	Perm (ϵ_r)	CW Validation			Mod Validation		
					Freq (MHz)	Tissue Type			Sensitivity	Probe Linearity	Probe Isotropy	Mod Type	Duty Factor	PAR
Delta	750	11/18/2024	7853	1844	750	Head	0.906	43.8	PASS	PASS	PASS	N/A	N/A	N/A
Delta	835	11/18/2024	7853	1844	835	Head	0.936	43.6	PASS	PASS	PASS	GMSK	PASS	N/A
Gamma	1750	11/19/2024	7836	1839	1750	Head	1.365	39.532	PASS	PASS	PASS	N/A	N/A	N/A
Gamma	1900	11/19/2024	7836	1839	1900	Head	1.448	39.323	PASS	PASS	PASS	GMSK	PASS	N/A
Beta	2450	10/14/2024	7872	1843	2450	Head	1.8	41.7	PASS	PASS	PASS	OFDM	N/A	PASS
Gamma	2450	11/21/2024	7836	1839	2450	Head	1.824	38.955	PASS	PASS	PASS	OFDM	N/A	PASS
Gamma	5250	11/21/2024	7836	1839	5250	Head	4.494	34.126	PASS	PASS	PASS	OFDM	N/A	PASS
Gamma	5600	11/22/2024	7836	1839	5600	Head	4.866	33.528	PASS	PASS	PASS	OFDM	N/A	PASS
Gamma	5750	11/22/2024	7836	1839	5750	Head	5.038	33.263	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: The probes have been calibrated for both CW and modulated signals. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01 for scenarios when CW probe calibrations are used with other signal types.

SAR systems were additionally validated for modulated signals with a periodic duty cycle or with a high PAR (peak to average ratio) >5 dB, such as OFDM according to FCC KDB Publication 865664 D01 v01r04.

B.4. Sample TSL Compositions

TSL recipes are proprietary to SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer data sheets are provided below.



Results

f (MHz)	Measured			Target			Diff. to Target (%)	
	ϵ'	ϵ''	σ	ϵ'	ϵ''	σ	$\Delta\epsilon'$	$\Delta\sigma$
600	44.7	25.6	0.86	42.7	0.88	4.6	-2.5	
750	44.2	21.7	0.90	41.9	0.89	5.4	0.7	
800	44.0	20.7	0.92	41.7	0.90	5.6	2.5	
825	44.0	20.3	0.93	41.6	0.91	5.8	2.6	
835	44.0	20.1	0.94	41.5	0.91	5.9	3.1	
850	43.9	19.9	0.94	41.5	0.92	5.8	2.6	
900	43.8	19.2	0.96	41.5	0.97	5.5	-1.0	
1400	42.8	15.2	1.18	40.6	1.18	5.4	0.0	
1450	42.7	15.0	1.21	40.5	1.20	5.4	0.8	
1600	42.4	14.4	1.29	40.3	1.28	5.2	0.4	
1625	42.4	14.4	1.30	40.3	1.30	5.3	0.1	
1640	42.4	14.3	1.31	40.3	1.31	5.3	0.3	
1650	42.4	14.3	1.31	40.2	1.31	5.4	-0.2	
1700	42.3	14.2	1.34	40.2	1.34	5.3	-0.2	
1750	42.2	14.1	1.37	40.1	1.37	5.3	-0.1	
1800	42.1	14.0	1.40	40.0	1.40	5.3	0.0	
1810	42.1	13.9	1.41	40.0	1.40	5.3	0.7	
1825	42.1	13.9	1.42	40.0	1.40	5.3	1.4	
1850	42.1	13.9	1.43	40.0	1.40	5.3	2.1	
1900	42.0	13.8	1.46	40.0	1.40	5.0	4.3	
1950	41.9	13.7	1.49	40.0	1.40	4.7	6.4	
2000	41.8	13.7	1.52	40.0	1.40	4.5	8.6	
2050	41.8	13.6	1.55	39.9	1.44	4.7	7.3	
2100	41.7	13.6	1.59	39.8	1.49	4.7	6.8	
2150	41.6	13.6	1.62	39.7	1.53	4.7	5.7	
2200	41.6	13.5	1.66	39.6	1.58	4.9	5.2	
2250	41.5	13.5	1.69	39.6	1.62	4.9	4.2	
2300	41.4	13.5	1.73	39.5	1.67	4.9	3.8	
2350	41.4	13.5	1.77	39.4	1.71	5.1	3.4	
2400	41.3	13.6	1.81	39.3	1.76	5.1	3.1	
2450	41.2	13.6	1.85	39.2	1.80	5.1	2.8	
2500	41.2	13.6	1.89	39.1	1.85	5.3	1.9	
2550	41.1	13.6	1.93	39.1	1.91	5.2	1.1	
2600	41.0	13.6	1.97	39.0	1.96	5.1	0.3	

Dielectric Permittivity %

Frequency MHz

Conductivity %

Frequency MHz

3500	39.4	14.1	2.75	37.9	2.91	3.9	-5.5
3700	39.1	14.3	2.94	37.7	3.12	3.7	-5.8
5200	36.6	16.0	4.62	36.0	4.66	1.7	-0.8
5250	36.5	16.1	4.69	35.9	4.71	1.6	-0.3
5300	36.4	16.2	4.76	35.9	4.78	1.5	0.1
5500	36.2	16.4	5.03	35.6	4.96	1.5	1.3
5600	36.1	16.5	5.14	35.5	5.07	1.5	1.5
5700	35.9	16.5	5.25	35.4	5.17	1.5	1.6
5800	35.7	16.6	5.34	35.3	5.27	1.2	1.4
6000	35.1	16.5	5.52	35.1	5.48	0.2	0.9
6500	34.4	17.1	6.19	34.5	6.07	-0.1	1.9
7000	33.6	17.5	6.81	33.9	6.65	-1.3	2.4
7500	32.6	17.8	7.41	33.3	7.24	-2.1	2.4
8000	31.7	18.0	8.01	32.7	7.84	-3.1	2.2
8500	30.8	18.2	8.62	32.1	8.45	-4.1	2.0
9000	30.0	18.5	9.24	31.5	9.08	-4.9	1.9
9500	29.1	18.6	9.85	31.0	9.71	-5.9	1.4
10000	28.2	18.7	10.41	30.4	10.36	-7.0	0.6

TSL Dielectric Parameters

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Figure 1 - Head TSL Calibration Certificate Example