

Measurement Certificate / Material Test

Item Name	Head Tissue Simulating Liquid (HBBL4-250V3)
Product No.	SL AAH 005 AD (Batch: 210921-1)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated DAK probe.

Setup Validation

Validation results were within $\pm 2.5\%$ towards the target values of Methanol.

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

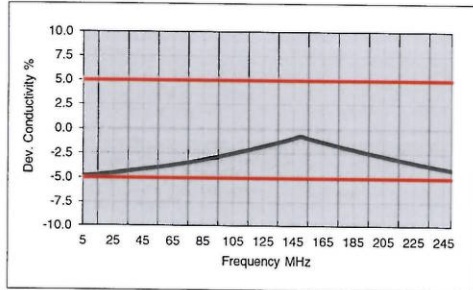
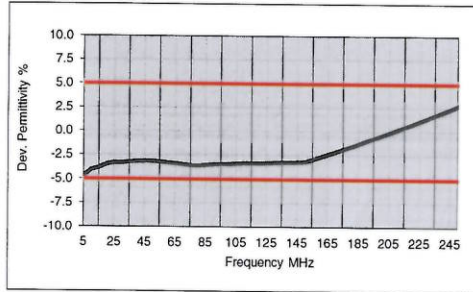
Test Condition

Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	24-Sep-21
Operator	WM

Additional Information

TSL Density	1.042 g/cm ³
TSL Heat-capacity	3.574 kJ/(kg*K)

f [MHz]	Measured			Target		Diff.to Target [%]	
	e'	e''	sigma	eps	sigma	Δ-eps	Δ-sigma
5	52.8	2566.54	0.71	55.5	0.75	-4.7	-4.8
10	53.2	1283.56	0.71	55.5	0.75	-4.0	-4.8
15	53.2	856.45	0.71	55.3	0.75	-3.9	-4.7
20	53.2	642.92	0.72	55.1	0.75	-3.5	-4.6
25	53.2	514.83	0.72	55.0	0.75	-3.3	-4.5
30	53.2	429.47	0.72	55.0	0.75	-3.3	-4.4
35	53.1	368.53	0.72	54.9	0.75	-3.2	-4.3
40	53.0	322.85	0.72	54.8	0.75	-3.2	-4.2
45	53.0	287.36	0.72	54.7	0.75	-3.1	-4.1
50	52.8	258.99	0.72	54.6	0.75	-3.1	-4.0
55	52.7	235.82	0.72	54.4	0.75	-3.2	-3.9
60	52.5	216.53	0.72	54.3	0.75	-3.3	-3.8
65	52.4	200.23	0.72	54.2	0.75	-3.4	-3.7
70	52.2	186.28	0.73	54.1	0.75	-3.5	-3.6
75	52.1	174.20	0.73	54.0	0.75	-3.6	-3.4
80	51.9	163.65	0.73	53.9	0.75	-3.6	-3.3
85	51.9	154.34	0.73	53.8	0.75	-3.5	-3.1
90	51.8	146.08	0.73	53.7	0.75	-3.5	-3.0
95	51.7	138.70	0.73	53.5	0.75	-3.4	-2.8
100	51.6	132.07	0.73	53.4	0.75	-3.4	-2.7
105	51.5	126.07	0.74	53.3	0.76	-3.4	-2.5
110	51.4	120.63	0.74	53.2	0.76	-3.3	-2.3
115	51.3	115.67	0.74	53.1	0.76	-3.3	-2.1
120	51.2	111.12	0.74	53.0	0.76	-3.3	-1.9
125	51.1	106.94	0.74	52.9	0.76	-3.3	-1.7
130	51.0	103.09	0.75	52.8	0.76	-3.3	-1.5
135	50.9	99.53	0.75	52.6	0.76	-3.3	-1.3
140	50.8	96.23	0.75	52.5	0.76	-3.2	-1.1
145	50.7	93.16	0.75	52.4	0.76	-3.2	-0.9
150	50.6	90.30	0.75	52.3	0.76	-3.2	-0.7
155	50.5	87.63	0.76	52.1	0.76	-2.9	-0.9
160	50.5	85.12	0.76	51.8	0.77	-2.7	-1.1
165	50.4	82.77	0.76	51.6	0.77	-2.4	-1.3
170	50.3	80.56	0.76	51.4	0.77	-2.1	-1.5
175	50.2	78.48	0.76	51.1	0.78	-1.9	-1.7
180	50.1	76.51	0.77	50.9	0.78	-1.6	-1.9
185	50.0	74.66	0.77	50.7	0.78	-1.3	-2.1
190	49.9	72.90	0.77	50.4	0.79	-1.0	-2.2
195	49.8	71.23	0.77	50.2	0.79	-0.7	-2.4
200	49.7	69.65	0.77	50.0	0.80	-0.5	-2.6
205	49.7	68.15	0.78	49.7	0.80	-0.2	-2.8
210	49.6	66.72	0.78	49.5	0.80	0.1	-2.9
215	49.5	65.35	0.78	49.3	0.81	0.4	-3.1
220	49.4	64.05	0.78	49.0	0.81	0.8	-3.2
225	49.3	62.81	0.79	48.8	0.81	1.1	-3.4
230	49.2	61.62	0.79	48.6	0.82	1.4	-3.6
235	49.2	60.49	0.79	48.3	0.82	1.7	-3.7
240	49.1	59.40	0.79	48.1	0.82	2.0	-3.9
245	49.0	58.36	0.80	47.9	0.83	2.4	-4.0
250	48.9	57.36	0.80	47.6	0.83	2.7	-4.1



Zeughausstrasse 43, 8004 Zurich, Switzerland
 Phone +41 44 245 9700, Fax +41 44 245 9779
 info@speag.com, http://www.speag.com

Measurement Certificate / Material Test

Item Name	Head Tissue Simulating Liquid (HBBL600-1000V6)
Product No.	SL AAH U16 BC (Batch: 181106-1)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated DAK probe.

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

Test Condition

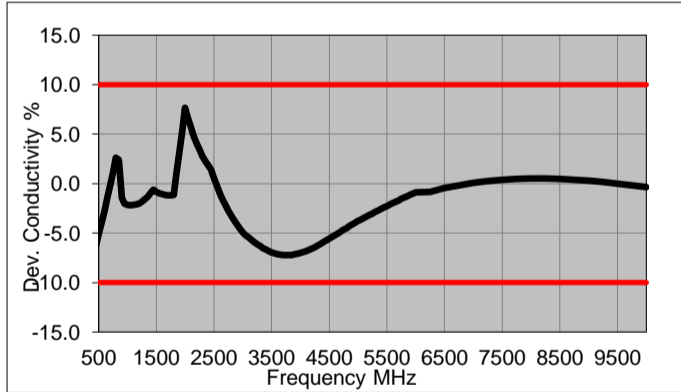
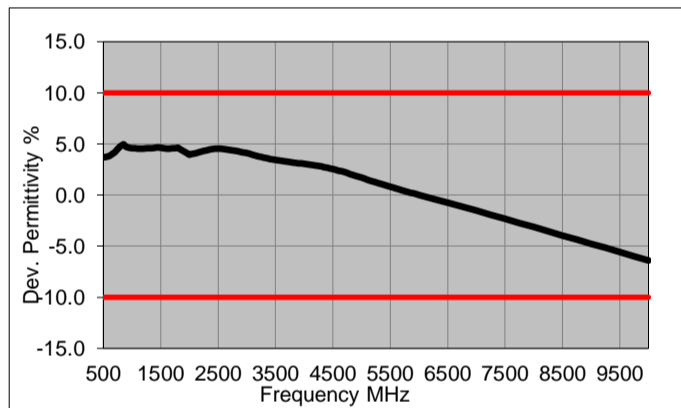
Ambient Condition 22°C ; 30% humidity
 TSL Temperature 22°C
 Test Date 7-Nov-18
 Operator CL

Additional Information

TSL Density
 TSL Heat-capacity

Results

f [MHz]	Measured			Target		Diff.to Target [%]	
	e'	e"	sigma	eps	sigma	D-eps	D-sigma
800	43.7	20.7	0.92	41.7	0.90	4.8	2.5
825	43.7	20.3	0.93	41.6	0.91	5.1	2.6
835	43.7	20.1	0.94	41.5	0.91	5.2	3.1
850	43.6	19.8	0.94	41.5	0.92	5.1	2.6
900	43.5	19.1	0.96	41.5	0.97	4.8	-1.0
1400	42.5	15.0	1.17	40.6	1.18	4.7	-0.8
1450	42.4	14.8	1.19	40.5	1.20	4.7	-0.8
1600	42.1	14.3	1.27	40.3	1.28	4.4	-1.1
1625	42.1	14.2	1.29	40.3	1.30	4.5	-0.7
1640	42.1	14.2	1.30	40.3	1.31	4.6	-0.5
1650	42.1	14.1	1.30	40.2	1.31	4.6	-1.0
1700	42.0	14.0	1.33	40.2	1.34	4.6	-0.9
1750	41.9	13.9	1.35	40.1	1.37	4.5	-1.5
1800	41.8	13.8	1.38	40.0	1.40	4.5	-1.4
1810	41.8	13.8	1.39	40.0	1.40	4.5	-0.7
1825	41.8	13.8	1.40	40.0	1.40	4.5	0.0
1850	41.8	13.7	1.41	40.0	1.40	4.5	0.7
1900	41.7	13.7	1.44	40.0	1.40	4.3	2.9
1950	41.6	13.6	1.48	40.0	1.40	4.0	5.7
2000	41.6	13.6	1.51	40.0	1.40	4.0	7.9
2050	41.5	13.5	1.54	39.9	1.44	4.0	6.6
2100	41.5	13.5	1.57	39.8	1.49	4.2	5.4
2150	41.4	13.4	1.61	39.7	1.53	4.2	5.0
2200	41.3	13.4	1.64	39.6	1.58	4.2	3.9
2250	41.3	13.4	1.68	39.6	1.62	4.4	3.6
2300	41.2	13.4	1.71	39.5	1.67	4.4	2.6
2350	41.1	13.4	1.75	39.4	1.71	4.4	2.3
2400	41.1	13.4	1.79	39.3	1.76	4.6	2.0
2450	41.0	13.4	1.83	39.2	1.80	4.6	1.7
2500	40.9	13.4	1.86	39.1	1.85	4.5	0.3
2550	40.8	13.4	1.90	39.1	1.91	4.4	-0.5
2600	40.8	13.5	1.95	39.0	1.96	4.6	-0.7
3500	39.2	13.9	2.71	37.9	2.91	3.4	-6.9
3700	38.9	14.1	2.89	37.7	3.12	3.3	-7.2



5200	36.5	15.6	4.51	36.0	4.66	1.3	-3.2
5250	36.4	15.6	4.56	35.9	4.71	1.2	-3.0
5300	36.3	15.7	4.62	35.9	4.76	1.1	-2.9
5500	35.9	15.9	4.85	35.6	4.96	0.8	-2.3
5600	35.8	15.9	4.96	35.5	5.07	0.6	-2.0
5700	35.6	16.0	5.08	35.4	5.17	0.5	-1.7
5800	35.4	16.1	5.20	35.3	5.27	0.3	-1.4
6000	35.1	16.3	5.43	35.1	5.48	0.0	-0.9
6500	34.2	16.7	6.04	34.5	6.07	-0.7	-0.5
7000	33.4	17.1	6.66	33.9	6.65	-1.5	0.1
7500	32.5	17.4	7.27	33.3	7.24	-2.3	0.4
8000	31.7	17.7	7.88	32.7	7.84	-3.1	0.5
8500	30.9	18.0	8.49	32.1	8.45	-4.0	0.5
9000	30.0	18.2	9.10	31.5	9.08	-4.8	0.3
9500	29.2	18.4	9.71	31.0	9.71	-5.6	0.0
10000	28.4	18.5	10.32	30.4	10.36	-6.4	-0.4