

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	<b>Head Tissue Simulating Liquid (HSL2450V2)</b>
Product No.	SL AAH 245 BA (Charge: 150121-3)
Manufacturer	SPEAG

### Measurement Method

TSL dielectric parameters measured using calibrated OCP 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.

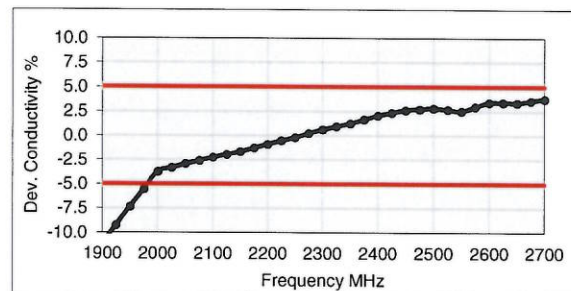
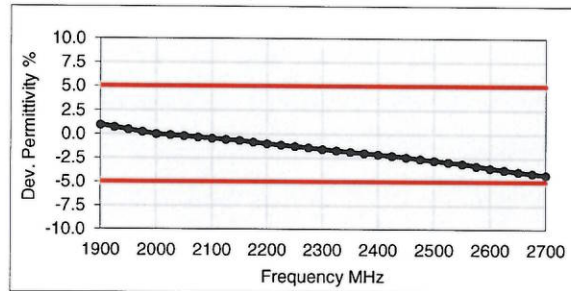
### Test Condition

Ambient	Environment temperatur ( $22 \pm 3$ )°C and humidity < 70%.
TSL Temperature	<b>23°C</b>
Test Date	21-Jan-15
Operator	IEN

### Additional Information

TSL Density	0.988 g/cm <sup>3</sup>
TSL Heat-capacity	3.680 kJ/(kg*K)

f [MHz]	Measured			Target		Diff.to Target [%]	
	HP-e'	HP-e''	sigma	eps	sigma	$\Delta$ -eps	$\Delta$ -sigma
1900	40.4	11.77	1.24	40.0	1.40	1.0	-11.1
1925	40.3	11.87	1.27	40.0	1.40	0.8	-9.2
1950	40.2	11.96	1.30	40.0	1.40	0.5	-7.3
1975	40.1	12.04	1.32	40.0	1.40	0.3	-5.5
2000	40.0	12.12	1.35	40.0	1.40	0.0	-3.7
2025	39.9	12.21	1.38	40.0	1.42	-0.1	-3.3
2050	39.8	12.30	1.40	39.9	1.44	-0.2	-2.9
2075	39.7	12.38	1.43	39.9	1.47	-0.3	-2.6
2100	39.7	12.46	1.46	39.8	1.49	-0.4	-2.2
2125	39.6	12.53	1.48	39.8	1.51	-0.5	-1.9
2150	39.5	12.61	1.51	39.7	1.53	-0.6	-1.7
2175	39.4	12.69	1.54	39.7	1.56	-0.8	-1.3
2200	39.3	12.78	1.56	39.6	1.58	-1.0	-0.9
2225	39.2	12.86	1.59	39.6	1.60	-1.1	-0.5
2250	39.1	12.94	1.62	39.6	1.62	-1.2	-0.2
2275	39.0	13.02	1.65	39.5	1.64	-1.4	0.2
2300	38.9	13.11	1.68	39.5	1.67	-1.5	0.6
2325	38.8	13.18	1.71	39.4	1.69	-1.7	1.0
2350	38.7	13.25	1.73	39.4	1.71	-1.8	1.3
2375	38.6	13.34	1.76	39.3	1.73	-2.0	1.7
2400	38.5	13.42	1.79	39.3	1.76	-2.1	2.1
2425	38.4	13.49	1.82	39.2	1.78	-2.2	2.4
2450	38.3	13.56	1.85	39.2	1.80	-2.4	2.7
2475	38.2	13.64	1.88	39.2	1.83	-2.5	2.8
2500	38.1	13.71	1.91	39.1	1.85	-2.7	2.8
2525	38.0	13.76	1.93	39.1	1.88	-2.9	2.7
2550	37.9	13.80	1.96	39.1	1.91	-3.0	2.5
2575	37.8	13.92	1.99	39.0	1.94	-3.3	3.0
2600	37.6	14.04	2.03	39.0	1.96	-3.5	3.4
2625	37.5	14.10	2.06	39.0	1.99	-3.7	3.4
2650	37.4	14.16	2.09	38.9	2.02	-3.9	3.4
2675	37.3	14.24	2.12	38.9	2.05	-4.1	3.6
2700	37.2	14.32	2.15	38.9	2.07	-4.2	3.8



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**Measurement Certificate / Material Test**

Item Name	<b>Head Tissue Simulating Liquid (HBBL3500-5800V5)</b>
Product No.	SL AAH 502 AE (Charge: 150119-1)
Manufacturer	SPEAG

**Measurement Method**

TSL dielectric parameters measured using calibrated OCP 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.

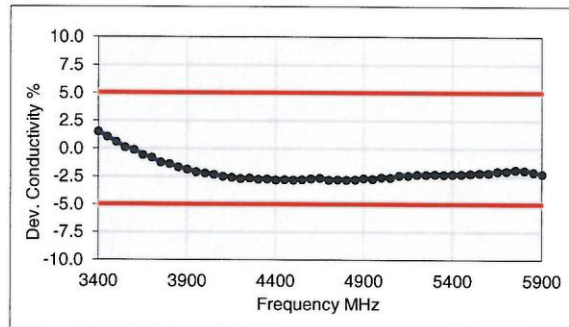
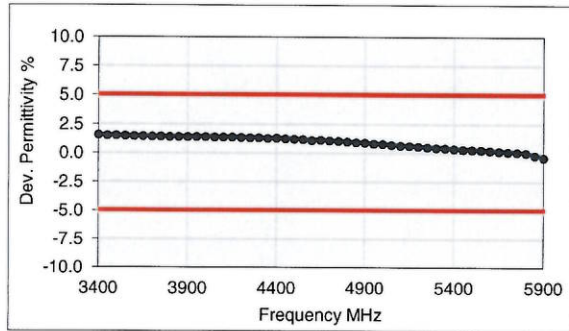
**Test Condition**

Ambient	Environment temperatur ( $22 \pm 3$ )°C and humidity < 70%.
TSL Temperature	22°C
Test Date	21-Jan-15
Operator	IEN

**Additional Information**

TSL Density	0.985 g/cm <sup>3</sup>
TSL Heat-capacity	3.383 kJ/(kg*K)

f [MHz]	Measured			Target		Diff.to Target [%]	
	HP-e'	HP-e''	sigma	eps	sigma	$\Delta$ -eps	$\Delta$ -sigma
3400	38.6	15.08	2.85	38.0	2.81	1.5	1.4
3500	38.5	15.05	2.93	37.9	2.91	1.5	0.6
3600	38.4	15.04	3.01	37.8	3.02	1.5	-0.2
3700	38.3	15.03	3.09	37.7	3.12	1.6	-0.9
3800	38.1	15.02	3.18	37.6	3.22	1.4	-1.2
3900	38.0	15.03	3.26	37.5	3.32	1.4	-1.9
4000	37.9	15.05	3.35	37.4	3.43	1.5	-2.2
4100	37.8	15.08	3.44	37.2	3.53	1.5	-2.5
4200	37.6	15.12	3.53	37.1	3.63	1.3	-2.8
4300	37.5	15.18	3.63	37.0	3.73	1.3	-2.7
4400	37.4	15.23	3.73	36.9	3.84	1.4	-2.7
4500	37.2	15.29	3.83	36.8	3.94	1.1	-2.7
4600	37.1	15.36	3.93	36.7	4.04	1.2	-2.7
4700	37.0	15.40	4.03	36.6	4.14	1.2	-2.7
4800	36.8	15.46	4.13	36.4	4.25	1.0	-2.7
4850	36.7	15.48	4.18	36.4	4.30	0.9	-2.7
4900	36.7	15.53	4.23	36.3	4.35	1.0	-2.7
4950	36.6	15.54	4.28	36.3	4.40	0.9	-2.7
5000	36.5	15.59	4.34	36.2	4.45	0.8	-2.5
5050	36.4	15.61	4.39	36.2	4.50	0.7	-2.5
5100	36.3	15.66	4.44	36.1	4.55	0.6	-2.5
5150	36.3	15.69	4.49	36.0	4.60	0.7	-2.5
5200	36.2	15.72	4.55	36.0	4.66	0.6	-2.3
5250	36.1	15.74	4.60	35.9	4.71	0.5	-2.3
5300	36.1	15.77	4.65	35.9	4.76	0.6	-2.3
5350	36.0	15.78	4.70	35.8	4.81	0.5	-2.3
5400	35.9	15.81	4.75	35.8	4.86	0.4	-2.3
5450	35.8	15.83	4.80	35.7	4.91	0.3	-2.3
5500	35.8	15.86	4.85	35.6	4.96	0.4	-2.3
5550	35.7	15.89	4.91	35.6	5.01	0.3	-2.1
5600	35.6	15.91	4.96	35.5	5.07	0.2	-2.1
5650	35.5	15.95	5.01	35.5	5.12	0.1	-2.1
5700	35.5	15.97	5.06	35.4	5.17	0.2	-2.1
5750	35.4	16.01	5.12	35.4	5.22	0.1	-1.9
5800	35.3	16.02	5.17	35.3	5.27	0.0	-1.9
5850	35.2	16.05	5.22	35.3	5.34	-0.3	-2.2
5900	35.2	16.08	5.28	35.3	5.40	-0.3	-2.2



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**Measurement Certificate / Material Test**

Item Name	<b>Head Tissue Simulating Liquid (HBBL600-10000V6)</b>
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**

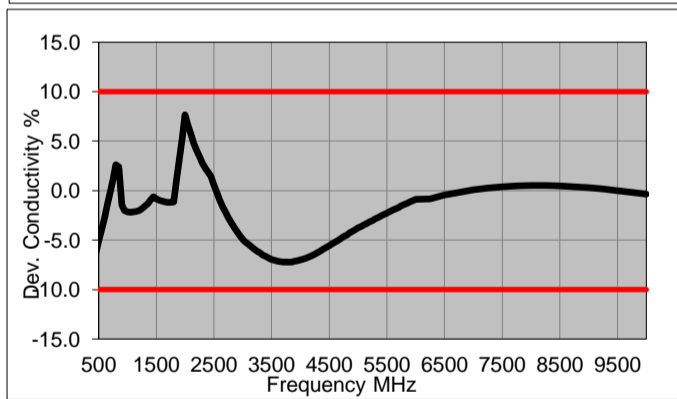
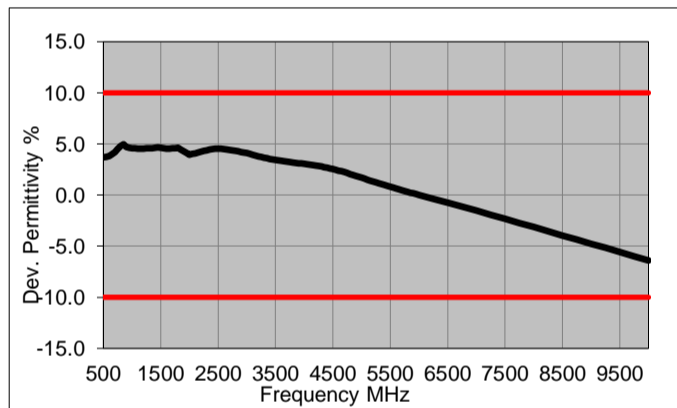
Ambient Condition 22°C ; 30% humidity  
 TSL Temperature 22°C  
 Test Date 7-Nov-18  
 Operator CL

**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

# LIQUIDS

## Head Tissue Simulating Liquids

Application	Specific absorption rate according to standards (e.g., IEC 62209-x, IEEE 1528)		
Packaging	Plastic container of 10 liters with nozzle		
Life Time	Life time and stability of the liquid depend on usage, storage, and handling of tissue simulating liquid		
Options	Tissue simulating liquids for frequencies outside the below listed ranges are available upon request (please contact <a href="mailto:info@speag.swiss">info@speag.swiss</a> )		
Head Tissue	Parameters according to IEEE 1528 / IEC 62209-1/ IEC 62209-2 / FCC KDB 865664		
Narrow-Band Solutions (±5% Tolerance)	Product	Test Frequency (MHz)	Main Ingredients
	HSL300V2	300	Water, Sugar
	HSL450V2	450	Water, Sugar
	HSL750V2	750	Water, Sugar
	HSL900V2	835, 900	Water, Sugar
Broad-Band Solutions (±5% Tolerance)	Product	Test Frequency (MHz)	Main Ingredients
	HBBL1350-1850V3	1450 – 1800	Water, Tween
	HBBL1550-1950V3	1750 – 1850	Water, Tween
	HBBL1900-3800V3	1950 – 3000	Water, Tween
	HBBL3500-5800V5	3500 – 5800	Water, Oil
Broad-Band Solutions (±10% Tolerance)	Product	Test Frequency (MHz)	Main Ingredients
	HBBL4-250V3	4 – 250	Water, Tween
	HBBL1350-1850V3	1300 – 1850	Water, Tween
	HBBL1550-1950V3	1550 – 1950	Water, Tween
	HBBL1900-3800V3	1900 – 3800	Water, Tween
	HBBL600-10000V6	600 – 10000	Water, Oil

**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 ( $22 \pm 3$ )°C and humidity < 70%.
TSL Temperature	22°C
Test Date	24-Sep-21
Operator	WM

**Additional Information**

TSL Density	1.042 g/cm <sup>3</sup>
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

