Head Tissue Simulating Liquids

Head Tissue	Parameters according to IEEE Std 1528-2013 / IEC 62209 / FCC KDB 865664 D01		
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
	HSL1450V2	1450, 1500, 1640	Water, DGBE
	HSL1750V2	1750	Water, DGBE
	HSL1800V2	1800, 1900	Water, DGBE
	HSL1900V2	1900	Water, DGBE
	HSL1950V2	1950, 2000	Water, DGBE
	HSL2450V2	2450, 2600	Water, DGBE
Broad-Band Solutions (±5% tolerance)	**Product**	**Test Frequency (MHz)**	**Main Ingredients**
	HBBL30-250V3	30-250	Water, Tween
	HBBL1350-1850V3	1400-1800	Water, Tween
	HBBL1550-1950V3	1750-1900	Water, Tween
	HBBL1900-3800V3	1950-3000	Water, Tween
	HBBL3500-5800V5	3500-5800	Water, Oil

Body Tissue Simulating Liquids

Body Tissue (Muscle)	Parameters according to FCC KDB 865664 D01		
Narrow-Band Solutions (±5% tolerance)	**Product**	**Test Frequency (MHz)**	**Main Ingredients**
	MSL300V2	300	Water, Sugar
	MSL450V2	400, 450	Water, Sugar
	MSL750V2	750	Water, Sugar
	MSL900V2	835, 900	Water, Sugar
	MSL1450V2	1450, 1500, 1640	Water, DGBE
	MSL1750V2	1750	Water, DGBE
	MSL1800V2	1800, 1900	Water, DGBE
	MSL1900V2	1900	Water, DGBE
	MSL1950V2	1950, 2100	Water, DGBE
	MSL2450V2	2450, 2600	Water, DGBE
Broad-Band Solutions (±5% tolerance)	**Product**	**Test Frequency (MHz)**	**Main Ingredients**
	MBBL130-250V3	130-250	Water, Tween
	MBBL1350-1850V3	1350-1800	Water, Tween
	MBBL1550-1950V3	1550-1850	Water, Tween
	MBBL1900-3800V3	1950-3800	Water, Tween
	MBBL3500-5800V5	3500-5800	Water, Oil

Schmid & Partner Engineering AG

s p e a g

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 (HSL750V2)**
Product No.	SL AAH 075 AA (Charge: 140210-5)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe.

Setup Validation

Validation results were within ± 2.5% towards the target values of Methanol.

Target Parameters

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

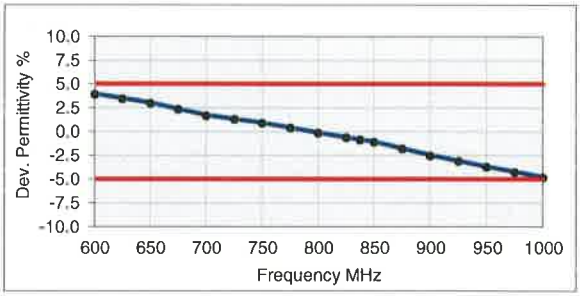
Test Condition

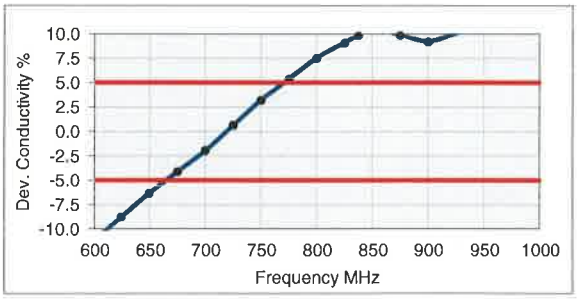
Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	12-Feb-14
Operator	IEN

Additional Information

TSL Density	1.284 g/cm^3
TSL Heat-capacity	2.701 kJ/(kg*K)

	Measured			Target		Diff.to Target [%]	
f [MHz]	**HP-e'**	**HP-e''**	**sigma**	eps	sigma	**Δ-eps**	**Δ-sigma**
600	44.4	23.49	0.78	42.7	0.88	3.9	-11.1
625	44.1	23.23	0.81	42.6	0.88	3.5	-8.6
650	43.7	22.96	0.83	42.5	0.89	3.0	-6.2
675	43.3	22.68	0.85	42.3	0.89	2.4	-4.1
700	42.9	22.40	0.87	42.2	0.89	1.7	-1.9
725	42.6	22.25	0.90	42.1	0.89	1.3	0.7
750	**42.3**	**22.10**	**0.92**	**41.9**	**0.89**	**0.9**	**3.2**
775	42.0	21.89	0.94	41.8	0.90	0.4	5.4
800	41.6	21.67	0.96	41.7	0.90	-0.1	7.5
825	41.3	21.55	0.99	41.6	0.91	-0.6	9.0
838	41.2	21.49	1.00	41.5	0.91	-0.8	9.8
850	41.1	21.42	1.01	41.5	0.92	-1.1	10.6
875	40.8	21.29	1.04	41.5	0.94	-1.8	9.9
900	40.5	21.15	1.06	41.5	0.97	-2.5	9.2
925	40.2	21.01	1.08	41.5	0.98	-3.1	10.0
950	39.9	20.87	1.10	41.4	0.99	-3.7	10.9
975	39.6	20.79	1.13	41.4	1.00	-4.3	12.2
1000	39.4	20.71	1.15	41.3	1.01	-4.8	13.5





Schmid & Partner Engineering AG

s p e a g

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 (HSL900V2)**
Product No.	SL AAH 090 BB (Charge: 140205-4)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe.

Setup Validation

Validation results were within ± 2.5% towards the target values of Methanol.

Target Parameters

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

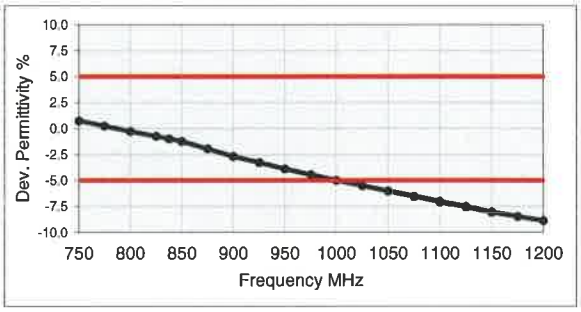
Test Condition

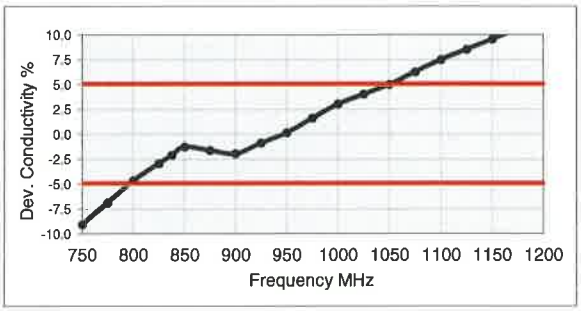
Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	12-Feb-14
Operator	IEN

Additional Information

TSL Density	1.280 g/cm^3
TSL Heat-capacity	2.942 kJ/(kg*K)

	Measured			Target		Diff.to Target [%]	
f [MHz]	HP-e'	HP-e''	sigma	eps	sigma	Δ-eps	Δ-sigma
700	42.9	19.58	0.76	42.2	0.89	1.6	-14.3
725	42.6	19.52	0.79	42.1	0.89	1.2	-11.7
750	42.3	19.47	0.81	41.9	0.89	0.8	-9.1
775	41.9	19.35	0.83	41.8	0.90	0.3	-6.8
800	41.6	19.23	0.86	41.7	0.90	-0.3	-4.6
825	41.3	19.18	0.88	41.6	0.91	-0.7	-2.9
838	41.1	19.16	0.89	41.5	0.91	-1.0	-2.1
850	41.0	19.13	0.90	41.5	0.92	-1.2	-1.2
875	40.7	19.07	0.93	41.5	0.94	-1.9	-1.6
900	40.4	19.00	0.95	41.5	0.97	-2.7	-1.9
925	40.1	18.92	0.97	41.5	0.98	-3.3	-0.9
950	39.8	18.85	1.00	41.4	0.99	-3.9	0.2
975	39.6	18.82	1.02	41.4	1.00	-4.4	1.6
1000	39.3	18.80	1.05	41.3	1.01	-5.0	3.0
1025	39.0	18.71	1.07	41.3	1.03	-5.5	4.0
1050	38.8	18.62	1.09	41.2	1.04	-6.0	5.0
1075	38.5	18.59	1.11	41.2	1.05	-6.5	6.3
1100	38.3	18.55	1.14	41.2	1.06	-7.0	7.5
1125	38.0	18.50	1.16	41.1	1.07	-7.5	8.5
1150	37.8	18.44	1.18	41.1	1.08	-8.0	9.6
1175	37.5	18.39	1.20	41.0	1.09	-8.4	10.6
1200	37.3	18.35	1.22	41.0	1.10	-8.9	11.6





Schmid & Partner Engineering AG

s p e a g

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 (HSL1750V2)**
Product No.	SL AAH 175 (Charge: 120907-2)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe.

Setup Validation

Validation results were within ± 2.5% towards the target values of Methanol.

Target Parameters

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

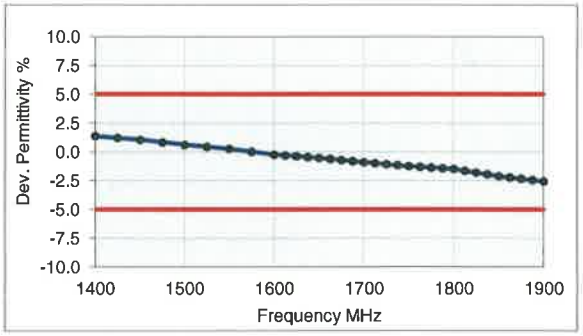
Test Condition

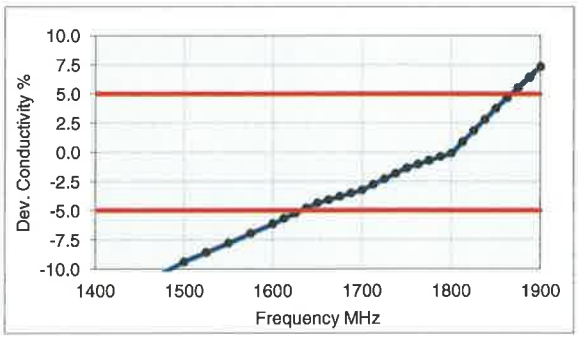
Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	13-Sep-12
Operator	CL

Additional Information

TSL Density	0.998 g/cm^3
TSL Heat-capacity	3.572 kJ/(kg*K)

	Measured			Target		Diff.to Target [%]	
f [MHz]	HP-e'	HP-e''	sigma	eps	sigma	Δ-eps	Δ-sigma
1400	41.2	13.09	1.02	40.6	1.18	1.4	-13.6
1425	41.0	13.14	1.04	40.5	1.19	1.2	-12.4
1450	40.9	13.19	1.06	40.5	1.20	1.1	-11.3
1475	40.8	13.26	1.09	40.5	1.21	0.8	-10.3
1500	40.7	13.34	1.11	40.4	1.23	0.6	-9.4
1525	40.6	13.39	1.14	40.4	1.24	0.4	-8.6
1550	40.5	13.44	1.16	40.4	1.26	0.3	-7.8
1575	40.3	13.49	1.18	40.3	1.27	0.0	-6.9
1600	40.2	13.55	1.21	40.3	1.28	-0.2	-6.1
1613	40.2	13.58	1.22	40.3	1.29	-0.3	-5.7
1625	40.1	13.62	1.23	40.3	1.30	-0.4	-5.2
1638	40.1	13.65	1.24	40.3	1.31	-0.5	-4.8
1650	40.0	13.68	1.26	40.2	1.31	-0.5	-4.3
1663	40.0	13.70	1.27	40.2	1.32	-0.6	-4.1
1675	39.9	13.71	1.28	40.2	1.33	-0.7	-3.8
1688	39.8	13.72	1.29	40.2	1.33	-0.8	-3.5
1700	39.8	13.73	1.30	40.2	1.34	-0.9	-3.2
1713	39.7	13.77	1.31	40.1	1.35	-1.0	-2.7
1725	39.7	13.81	1.33	40.1	1.36	-1.1	-2.3
1738	39.6	13.85	1.34	40.1	1.36	-1.2	-1.8
1750	39.6	13.89	1.35	40.1	1.37	-1.3	-1.4
1763	39.5	13.91	1.36	40.1	1.38	-1.3	-1.0
1775	39.5	13.93	1.38	40.0	1.39	-1.4	-0.7
1788	39.4	13.95	1.39	40.0	1.39	-1.4	-0.4
1800	39.4	13.97	1.40	40.0	1.40	-1.5	-0.1
1813	39.3	14.01	1.41	40.0	1.40	-1.7	0.9
1825	39.3	14.04	1.43	40.0	1.40	-1.8	1.8
1838	39.2	14.08	1.44	40.0	1.40	-2.0	2.8
1850	39.2	14.11	1.45	40.0	1.40	-2.1	3.8
1863	39.1	14.14	1.47	40.0	1.40	-2.2	4.7
1875	39.1	14.17	1.48	40.0	1.40	-2.3	5.6
1888	39.0	14.19	1.49	40.0	1.40	-2.5	6.5
1900	39.0	14.22	1.50	40.0	1.40	-2.6	7.4





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 (HSL 1900)**
Product No.	SL AAH 190 AA (Charge: 120112-1)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe (type DAK).

Target Parameters

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

Test Condition

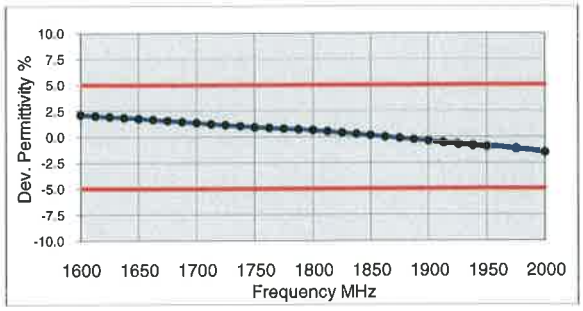
Ambient Condition	22°C ; 30% humidity
TSL Temperature	22°C
Test Date	18-Jan-12

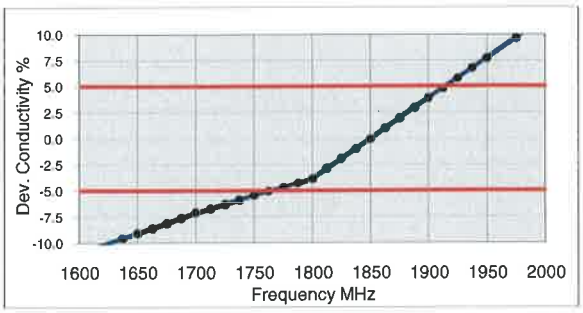
Additional Information

TSL Density	0.985 g/cm^3
TSL Heat-capacity	3.710 kJ/(kg*K)

Results

	Measured			Target		Diff.to Target [%]	
f [MHz]	**HP-e'**	**HP-e"**	**sigma**	eps	sigma	**Δ-eps**	**Δ-sigma**
1600	41.2	12.84	1.14	40.3	1.28	2.1	-11.0
1613	41.1	12.88	1.16	40.3	1.29	2.0	-10.5
1625	41.1	12.93	1.17	40.3	1.30	1.9	-10.0
1638	41.0	12.97	1.18	40.3	1.31	1.8	-9.5
1650	40.9	13.01	1.19	40.2	1.31	1.8	-9.1
1663	40.9	13.05	1.21	40.2	1.32	1.7	-8.6
1675	40.8	13.10	1.22	40.2	1.33	1.6	-8.1
1688	40.8	13.14	1.23	40.2	1.33	1.4	-7.6
1700	40.7	13.18	1.25	40.2	1.34	1.3	-7.1
1713	40.6	13.22	1.26	40.1	1.35	1.2	-6.7
1725	40.6	13.25	1.27	40.1	1.36	1.1	-6.3
1738	40.5	13.28	1.28	40.1	1.36	1.0	-5.9
1750	40.5	13.31	1.30	40.1	1.37	0.9	-5.5
1763	40.4	13.35	1.31	40.1	1.38	0.9	-5.1
1775	40.4	13.38	1.32	40.0	1.39	0.8	-4.7
1788	40.3	13.41	1.33	40.0	1.39	0.7	-4.3
1800	**40.3**	**13.44**	**1.35**	**40.0**	**1.40**	**0.6**	**-3.9**
1813	40.2	13.48	1.36	40.0	1.40	0.5	-2.9
1825	40.2	13.52	1.37	40.0	1.40	0.4	-2.0
1838	40.1	13.55	1.39	40.0	1.40	0.3	-1.0
1850	40.1	13.59	1.40	40.0	1.40	0.1	-0.1
1863	40.0	13.63	1.41	40.0	1.40	0.0	0.9
1875	39.9	13.67	1.43	40.0	1.40	-0.1	1.9
1888	39.9	13.71	1.44	40.0	1.40	-0.3	2.9
1900	**39.8**	**13.75**	**1.45**	**40.0**	**1.40**	**-0.4**	**3.8**
1913	39.8	13.79	1.47	40.0	1.40	-0.5	4.8
1925	39.7	13.83	1.48	40.0	1.40	-0.7	5.8
1938	39.7	13.86	1.49	40.0	1.40	-0.8	6.7
1950	39.6	13.90	1.51	40.0	1.40	-0.9	7.7
1975	39.5	13.97	1.53	40.0	1.40	-1.2	9.6
2000	39.4	14.04	1.56	40.0	1.40	-1.5	11.6





Schmid & Partner Engineering AG

s p e a g

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 (HSL1950V2)**
Product No.	SL AAH 195 CA (Charge: 120717-3)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe.

Setup Validation

Validation results were within ± 2.5% towards the target values of Methanol.

Target Parameters

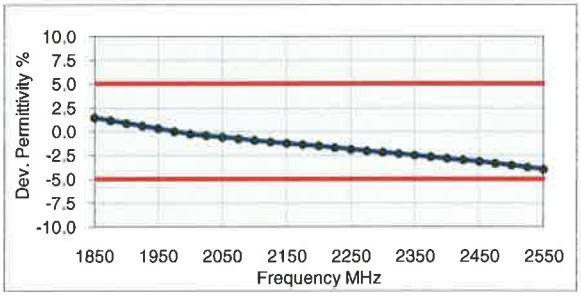
Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

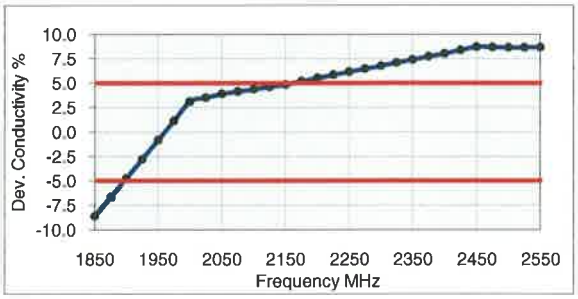
Test Condition

Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	18-Jul-12
Operator	DI

TSL Density	0.995 g/cm^3
TSL Heat-capacity	3.720 kJ/(kg*K)

	Measured			Target		Diff.to Target [%]	
f [MHz]	HP-e'	HP-e''	sigma	eps	sigma	Δ-eps	Δ-sigma
1850	40.6	12.43	1.28	40.0	1.40	1.5	-8.6
1875	40.5	12.53	1.31	40.0	1.40	1.2	-6.7
1900	40.3	12.62	1.33	40.0	1.40	0.9	-4.7
1925	40.2	12.71	1.36	40.0	1.40	0.6	-2.8
1950	40.1	12.80	1.39	40.0	1.40	0.3	-0.8
1975	40.0	12.89	1.42	40.0	1.40	0.0	1.1
2000	39.9	12.98	1.44	40.0	1.40	-0.3	3.1
2025	39.8	13.07	1.47	40.0	1.42	-0.4	3.5
2050	39.7	13.16	1.50	39.9	1.44	-0.6	3.9
2075	39.6	13.23	1.53	39.9	1.47	-0.8	4.2
2100	39.5	13.30	1.55	39.8	1.49	-0.9	4.4
2125	39.3	13.37	1.58	39.8	1.51	-1.1	4.6
2150	39.2	13.44	1.61	39.7	1.53	-1.2	4.9
2175	39.1	13.52	1.64	39.7	1.56	-1.4	5.2
2200	39.1	13.61	1.67	39.6	1.58	-1.5	5.5
2225	38.9	13.68	1.69	39.6	1.60	-1.7	5.9
2250	38.8	13.76	1.72	39.6	1.62	-1.9	6.2
2275	38.7	13.83	1.75	39.5	1.64	-2.0	6.5
2300	38.6	13.91	1.78	39.5	1.67	-2.2	6.8
2325	38.5	13.98	1.81	39.4	1.69	-2.3	7.1
2350	38.4	14.06	1.84	39.4	1.71	-2.5	7.4
2375	38.3	14.13	1.87	39.3	1.73	-2.7	7.7
2400	38.2	14.21	1.90	39.3	1.76	-2.8	8.0
2425	38.1	14.28	1.93	39.2	1.78	-3.0	8.4
2450	38.0	14.36	1.96	39.2	1.80	-3.1	8.7
2475	37.9	14.42	1.99	39.2	1.83	-3.3	8.7
2500	37.8	14.49	2.02	39.1	1.85	-3.5	8.7
2525	37.6	14.56	2.04	39.1	1.88	-3.7	8.7
2550	37.5	14.62	2.07	39.1	1.91	-3.9	8.7
2575	37.4	14.69	2.10	39.0	1.94	-4.1	8.7
2600	37.3	14.76	2.13	39.0	1.96	-4.3	8.7





Schmid & Partner Engineering AG

s p e a g

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 (HSL2450V2)**
Product No.	SL AAH 245 BA (Charge: 130430-3)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe.

Setup Validation

Validation results were within ± 2.5% towards the target values of Methanol.

Target Parameters

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

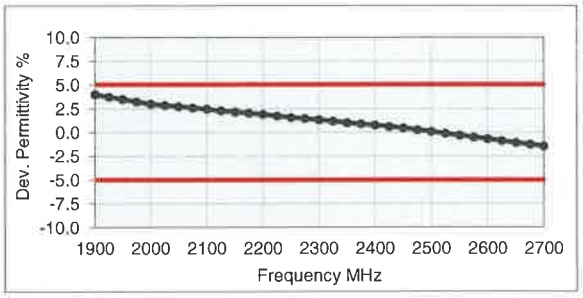
Test Condition

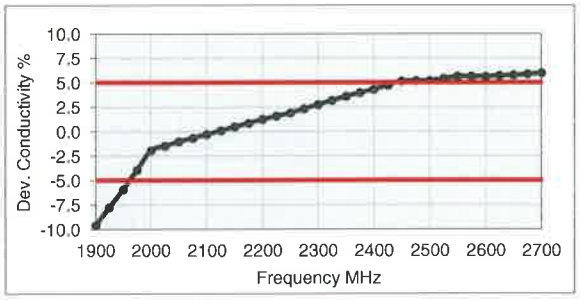
Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	23°C
Test Date	2-May-13
Operator	CL

Additional Information

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

	Measured			Target		Diff.to Target [%]	
f [MHz]	HP-e'	HP-e''	sigma	eps	sigma	Δ-eps	Δ-sigma
1900	41.6	11.98	1.27	40.0	1.40	4.0	-9.6
1925	41.5	12.06	1.29	40.0	1.40	3.8	-7.7
1950	41.4	12.15	1.32	40.0	1.40	3.5	-5.9
1975	41.3	12.24	1.35	40.0	1.40	3.3	-3.9
2000	41.2	12.34	1.37	40.0	1.40	3.0	-1.9
2025	41.1	12.44	1.40	40.0	1.42	2.9	-1.5
2050	41.0	12.54	1.43	39.9	1.44	2.8	-1.0
2075	40.9	12.62	1.46	39.9	1.47	2.6	-0.6
2100	40.8	12.71	1.48	39.8	1.49	2.5	-0.3
2125	40.7	12.80	1.51	39.8	1.51	2.3	0.1
2150	40.6	12.88	1.54	39.7	1.53	2.2	0.5
2175	40.5	12.97	1.57	39.7	1.56	2.0	0.9
2200	40.4	13.05	1.60	39.6	1.58	1.9	1.3
2225	40.3	13.13	1.63	39.6	1.60	1.7	1.6
2250	40.2	13.21	1.65	39.6	1.62	1.6	1.9
2275	40.1	13.30	1.68	39.5	1.64	1.5	2.4
2300	**40.0**	**13.39**	**1.71**	**39.5**	**1.67**	**1.3**	**2.8**
2325	39.9	13.48	1.74	39.4	1.69	1.2	3.2
2350	39.8	13.56	1.77	39.4	1.71	1.0	3.6
2375	39.7	13.64	1.80	39.3	1.73	0.9	4.0
2400	39.6	13.72	1.83	39.3	1.76	0.8	4.3
2425	39.5	13.80	1.86	39.2	1.78	0.6	4.8
2450	**39.4**	**13.89**	**1.89**	**39.2**	**1.80**	**0.5**	**5.2**
2475	39.3	13.96	1.92	39.2	1.83	0.3	5.2
2500	39.2	14.03	1.95	39.1	1.85	0.1	5.2
2525	39.1	14.12	1.98	39.1	1.88	-0.1	5.4
2550	39.0	14.22	2.02	39.1	1.91	-0.3	5.6
2575	38.9	14.28	2.05	39.0	1.94	-0.5	5.6
2600	**38.7**	**14.34**	**2.07**	**39.0**	**1.96**	**-0.7**	**5.6**
2625	38.6	14.41	2.10	39.0	1.99	-0.9	5.7
2650	38.5	14.48	2.13	38.9	2.02	-1.1	5.8
2675	38.4	14.55	2.17	38.9	2.05	-1.3	5.9
2700	38.3	14.62	2.20	38.9	2.07	-1.4	6.0





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 (HBBL1550-1950V3)**
Product No.	SL AAH 181 AA (Charge: 140206-3)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe.

Setup Validation

Validation results were within ± 2.5% towards the target values of Methanol.

Target Parameters

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

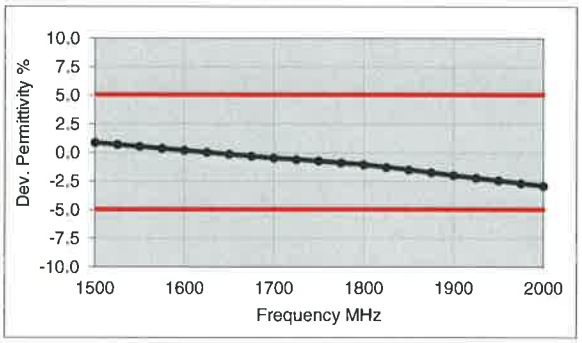
Test Condition

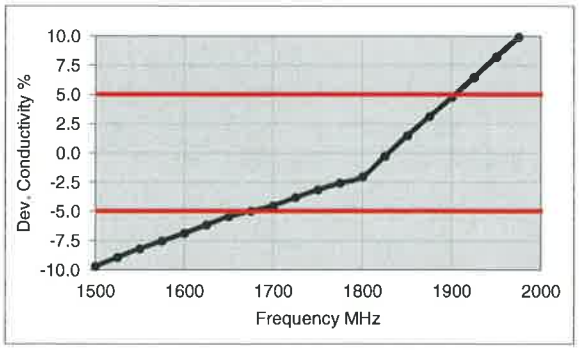
Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	12-Feb-14
Operator	IEN

Additional Information

TSL Density	1.052 g/cm^3
TSL Heat-capacity	3.322 kJ/(kg*K)

	Measured			Target		Diff.to Target [%]	
f [MHz]	HP-e'	HP-e''	sigma	eps	sigma	Δ-eps	Δ-sigma
1500	40.8	13.29	1.11	40.4	1.23	0.9	-9.7
1525	40.7	13.34	1.13	40.4	1.24	0.7	-8.9
1550	40.6	13.38	1.15	40.4	1.26	0.6	-8.2
1575	40.5	13.41	1.17	40.3	1.27	0.4	-7.5
1600	40.4	13.44	1.20	40.3	1.28	0.2	-6.9
1625	40.3	13.48	1.22	40.3	1.30	0.1	-6.2
1650	40.2	13.53	1.24	40.2	1.31	-0.1	-5.4
1675	40.1	13.54	1.26	40.2	1.33	-0.3	-5.0
1700	40.0	13.55	1.28	40.2	1.34	-0.4	-4.5
1725	39.9	13.60	1.30	40.1	1.36	-0.6	-3.8
1750	39.8	13.64	1.33	40.1	1.37	-0.7	-3.1
1775	39.7	13.67	1.35	40.0	1.39	-0.9	-2.6
1800	39.6	13.70	1.37	40.0	1.40	-1.0	-2.0
1825	39.5	13.75	1.40	40.0	1.40	-1.2	-0.3
1850	39.4	13.81	1.42	40.0	1.40	-1.5	1.5
1875	39.3	13.84	1.44	40.0	1.40	-1.7	3.1
1900	39.2	13.88	1.47	40.0	1.40	-2.0	4.8
1925	39.1	13.92	1.49	40.0	1.40	-2.2	6.5
1950	39.0	13.97	1.52	40.0	1.40	-2.4	8.3
1975	38.9	14.01	1.54	40.0	1.40	-2.6	10.0
2000	38.8	14.05	1.56	40.0	1.40	-2.9	11.6





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 (HBBL1900-3800V3)**
Product No.	SL AAH 196 AB (Charge: 131212-1)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe.

Setup Validation

Validation results were within ± 2.5% towards the target values of Methanol.

Target Parameters

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

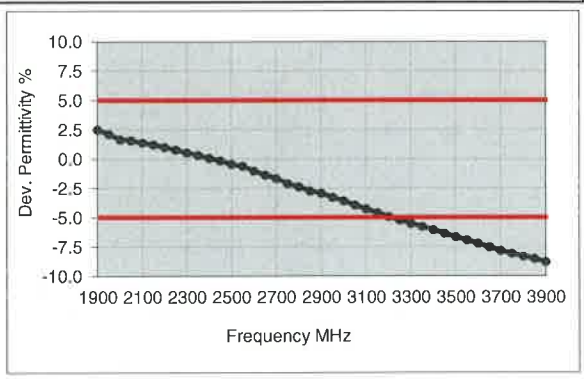
Test Condition

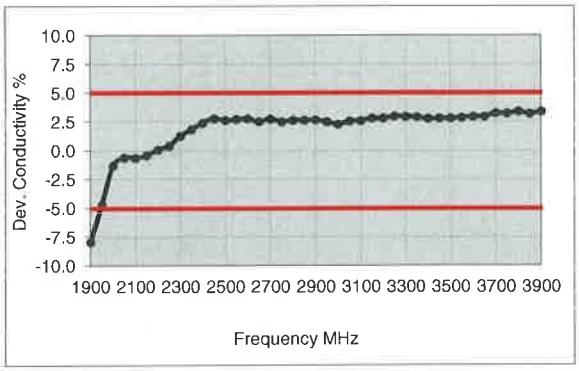
Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	18-Dec-13
Operator	IEN

Additional Information

TSL Density	1.054 g/cm^3
TSL Heat-capacity	3.389 kJ/(kg*K)

	Measured			Target		Diff.to Target [%]	
f [MHz]	HP-e'	HP-e''	sigma	eps	sigma	Δ-eps	Δ-sigma
1900	41.0	12.2	1.3	40.0	1.4	2.5	-7.9
1950	40.8	12.3	1.3	40.0	1.4	2.1	-4.7
2000	40.7	12.4	1.4	40.0	1.4	1.7	-1.3
2050	40.5	12.6	1.4	39.9	1.4	1.6	-0.6
2100	40.4	12.7	1.5	39.8	1.5	1.4	-0.6
2150	40.2	12.8	1.5	39.7	1.5	1.2	-0.4
2200	40.0	12.9	1.6	39.6	1.6	1.0	0.1
2250	39.9	13.0	1.6	39.6	1.6	0.8	0.4
2300	39.7	13.2	1.7	39.5	1.7	0.5	1.3
2350	39.5	13.3	1.7	39.4	1.7	0.3	1.8
2400	39.3	13.5	1.8	39.3	1.8	0.1	2.4
2450	39.1	13.6	1.9	39.2	1.8	-0.1	2.8
2500	39.0	13.7	1.9	39.1	1.9	-0.4	2.6
2550	38.8	13.8	2.0	39.1	1.9	-0.6	2.7
2600	38.6	14.0	2.0	39.0	2.0	-1.0	2.8
2650	38.4	14.0	2.1	38.9	2.0	-1.4	2.5
2700	38.2	14.2	2.1	38.9	2.1	-1.7	2.7
2750	38.0	14.3	2.2	38.8	2.1	-2.1	2.5
2800	37.8	14.4	2.2	38.8	2.2	-2.4	2.6
2850	37.6	14.5	2.3	38.7	2.2	-2.7	2.6
2900	37.5	14.6	2.4	38.6	2.3	-2.9	2.6
2950	37.3	14.6	2.4	38.6	2.3	-3.3	2.5
3000	37.1	14.7	2.5	38.5	2.4	-3.6	2.3
3050	36.9	14.8	2.5	38.4	2.5	-3.9	2.6
3100	36.7	14.9	2.6	38.4	2.5	-4.3	2.6
3150	36.6	15.0	2.6	38.3	2.6	-4.6	2.8
3200	36.4	15.0	2.7	38.3	2.6	-4.9	2.8
3250	36.2	15.1	2.7	38.2	2.7	-5.2	3.0
3300	36.1	15.2	2.8	38.2	2.7	-5.5	3.0
3350	35.9	15.2	2.8	38.1	2.8	-5.8	2.9
3400	35.7	15.3	2.9	38.0	2.8	-6.0	2.8
3450	35.6	15.3	2.9	38.0	2.9	-6.3	2.8
3500	35.4	15.4	3.0	37.9	2.9	-6.6	2.8
3550	35.3	15.4	3.0	37.9	3.0	-6.9	2.9
3600	35.1	15.5	3.1	37.8	3.0	-7.2	2.9
3650	34.9	15.5	3.2	37.8	3.1	-7.5	2.9
3700	34.7	15.6	3.2	37.7	3.1	-7.8	3.2
3750	34.6	15.7	3.3	37.6	3.2	-8.1	3.2
3800	34.5	15.7	3.3	37.6	3.2	-8.3	3.4
3850	34.3	15.8	3.4	37.5	3.3	-8.5	3.2





Schmid & Partner Engineering AG

s p e a g

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 (HBBL3500-5800V5)**
Product No.	SL AAH 502 AB (Charge: 130123-1)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe.

Setup Validation

Validation results were within ± 2.5% towards the target values of Methanol.

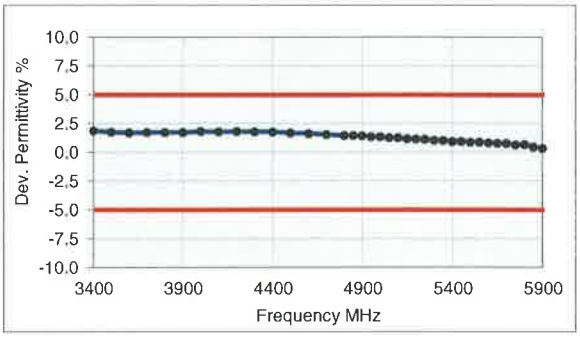
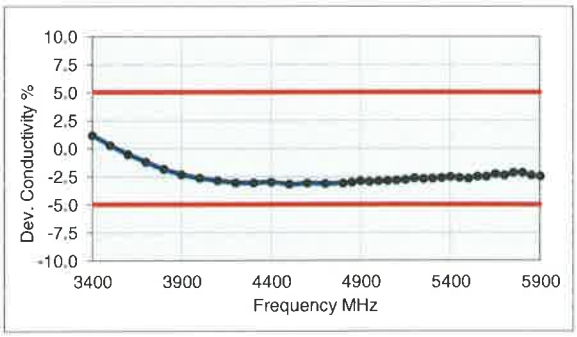
Target Parameters

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	23-Jan-13
Operator	DI

Additional Information

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

	Measured			Target		Diff.to Target [%]	
f [MHz]	HP-e'	HP-e''	sigma	eps	sigma	Δ-eps	Δ-sigma
3400	38.8	15.03	2.84	38.0	2.81	1.9	1.2
3500	**38.6**	**15.00**	**2.92**	**37.9**	**2.91**	**1.8**	**0.3**
3600	38.5	14.98	3.00	37.8	3.02	1.7	-0.5
3700	**38.4**	**14.97**	**3.08**	**37.7**	**3.12**	**1.7**	**-1.2**
3800	38.2	14.95	3.16	37.6	3.22	1.7	-1.8
3900	38.1	14.96	3.25	37.5	3.32	1.7	-2.3
4000	38.0	14.99	3.34	37.4	3.43	1.8	-2.6
4100	37.9	15.03	3.43	37.2	3.53	1.8	-2.8
4200	37.8	15.06	3.52	37.1	3.63	1.8	-3.0
4300	37.7	15.13	3.62	37.0	3.73	1.8	-3.1
4400	37.6	15.20	3.72	36.9	3.84	1.8	-3.0
4500	37.4	15.23	3.81	36.8	3.94	1.7	-3.2
4600	37.3	15.30	3.92	36.7	4.04	1.6	-3.1
4700	37.1	15.35	4.01	36.6	4.14	1.5	-3.1
4800	37.0	15.41	4.11	36.4	4.25	1.5	-3.1
4850	36.9	15.45	4.17	36.4	4.30	1.5	-3.0
4900	36.8	15.49	4.22	36.3	4.35	1.4	-2.9
4950	36.8	15.51	4.27	36.3	4.40	1.4	-2.9
5000	36.7	15.54	4.32	36.2	4.45	1.4	-2.9
5050	36.6	15.57	4.37	36.2	4.50	1.3	-2.8
5100	36.6	15.60	4.42	36.1	4.55	1.3	-2.8
5150	36.5	15.63	4.48	36.0	4.60	1.2	-2.7
5200	**36.4**	**15.67**	**4.53**	**36.0**	**4.66**	**1.2**	**-2.6**
5250	36.3	15.68	4.58	35.9	4.71	1.1	-2.7
5300	36.2	15.71	4.63	35.9	4.76	1.0	-2.6
5350	36.2	15.74	4.68	35.8	4.81	1.0	-2.6
5400	36.1	15.78	4.74	35.8	4.86	0.9	-2.5
5450	36.0	15.78	4.78	35.7	4.91	0.9	-2.6
5500	**36.0**	**15.79**	**4.83**	**35.6**	**4.96**	**0.9**	**-2.6**
5550	35.9	15.84	4.89	35.6	5.01	0.9	-2.5
5600	35.8	15.86	4.94	35.5	5.07	0.8	-2.5
5650	35.8	15.91	5.00	35.5	5.12	0.8	-2.2
5700	35.7	15.91	5.05	35.4	5.17	0.8	-2.4
5750	35.6	15.97	5.11	35.4	5.22	0.7	-2.1
5800	**35.5**	**15.98**	**5.16**	**35.3**	**5.27**	**0.7**	**-2.1**
5850	35.5	16.01	5.21	35.3	5.34	0.5	-2.4
5900	35.4	16.05	5.27	35.3	5.40	0.3	-2.4