2 Composition / Information on ingredients

The Item is composed of the following ingredients:

Water	50 – 65%
Mineral oil	10 – 30%
Emulsifiers	8 – 25%
Sodium salt	0 – 1.5%

Figure D-6
Composition of 5 GHz Head Tissue Equivalent Matter

Note: 5 GHz head liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

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 AG (Batch: 170613-1)
Manufacturer	SPEAG

Measurement Method
TSL dielectric parameters measured using calibrated DAK 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.

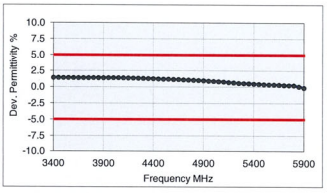
Test Condition

Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	20-Jun-17
Operator	CL

Additional Information

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

	Measured			Target		Diff.to Target [%]	
f [MHz]	e'	e''	sigma	eps	sigma	Δ-eps	Δ-sigma
3400	38.6	15.03	2.84	38.0	2.81	1.5	1.1
3500	38.5	15.00	2.92	37.9	2.91	1.5	0.3
3600	38.3	14.98	3.00	37.8	3.02	1.3	-0.5
3700	38.2	14.96	3.08	37.7	3.12	1.3	-1.2
3800	38.1	14.96	3.16	37.6	3.22	1.4	-1.9
3900	38.0	14.95	3.24	37.5	3.32	1.4	-2.5
4000	37.9	14.95	3.33	37.4	3.43	1.5	-2.8
4100	37.8	14.96	3.41	37.2	3.53	1.5	-3.3
4200	37.6	15.00	3.50	37.1	3.63	1.3	-3.6
4300	37.5	15.05	3.60	37.0	3.73	1.3	-3.5
4400	37.4	15.11	3.70	36.9	3.84	1.4	-3.5
4500	37.2	15.18	3.80	36.8	3.94	1.1	-3.5
4600	37.1	15.24	3.90	36.7	4.04	1.2	-3.5
4700	37.0	15.29	4.00	36.6	4.14	1.2	-3.4
4800	36.8	15.35	4.10	36.4	4.25	1.0	-3.4
4850	36.8	15.35	4.14	36.4	4.30	1.1	-3.6
4900	36.7	15.38	4.19	36.3	4.35	1.0	-3.6
4950	36.6	15.39	4.24	36.3	4.40	0.9	-3.6
5000	36.5	15.42	4.29	36.2	4.45	0.8	-3.6
5050	36.5	15.43	4.34	36.2	4.50	0.9	-3.6
5100	36.4	15.46	4.39	36.1	4.55	0.8	-3.6
5150	36.3	15.48	4.43	36.0	4.60	0.7	-3.8
5200	36.2	15.50	4.48	36.0	4.66	0.6	-3.8
5250	36.1	15.53	4.54	35.9	4.71	0.5	-3.5
5300	36.1	15.55	4.58	35.9	4.76	0.6	-3.7
5350	36.0	15.56	4.63	35.8	4.81	0.5	-3.7
5400	35.9	15.57	4.68	35.8	4.86	0.4	-3.7
5450	35.9	15.59	4.73	35.7	4.91	0.6	-3.7
5500	35.8	15.61	4.78	35.6	4.96	0.4	-3.7
5550	35.7	15.65	4.83	35.6	5.01	0.3	-3.7
5600	35.6	15.66	4.88	35.5	5.07	0.2	-3.7
5650	35.6	15.70	4.93	35.5	5.12	0.4	-3.6
5700	35.5	15.72	4.98	35.4	5.17	0.2	-3.6
5750	35.4	15.76	5.04	35.4	5.22	0.1	-3.4
5800	35.4	15.78	5.09	35.3	5.27	0.3	-3.4
5850	35.3	15.81	5.14	35.3	5.34	0.0	-3.7
5900	35.3	15.82	5.19	35.3	5.40	0.0	-3.9



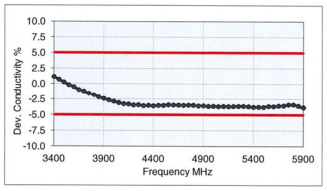


Figure D-7
5 GHz Head Tissue Equivalent Matter

© 2019 PCTEST Engineering Laboratory, Inc.

3 Composition / Information on ingredients

The Item is composed of the following ingredients:

Water	60 – 80%
Esters, Emulsifiers, Inhibitors	20 – 40%
Sodium salt	0 – 1.5%

Figure D-8
Composition of 5 GHz Body Tissue Equivalent Matter

Note: 5 GHz Body liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

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	**Body Tissue Simulating Liquid (MBBL3500-5800V5)**
Product No.	SL AAM 501 EA (Batch: 180423-2)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated DAK probe.

Setup Validation

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

Target Parameters

Target parameters as defined in the KDB 865664 compliance standard.

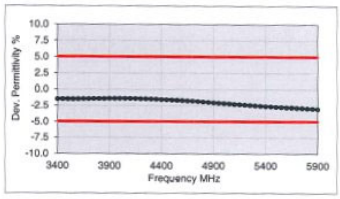
Test Condition

Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	25-Apr-18
Operator	WM

Additional Information

TSL Density	0.996 g/cm3
TSL Heat-capacity	3.765 kJ/(kg*K)

	Measured			Target		Diff.to Target [%]	
f [MHz]	e'	e''	sigma	eps	sigma	Δ-eps	Δ-sigma
3400	50.7	16.46	3.11	51.5	3.20	-1.5	-2.7
3500	50.5	16.50	3.21	51.3	3.31	-1.6	-3.1
3600	50.4	16.56	3.32	51.2	3.43	-1.5	-3.2
3700	50.3	16.63	3.42	51.1	3.55	-1.5	-3.6
3800	50.2	16.72	3.53	50.9	3.66	-1.4	-3.7
3900	50.1	16.81	3.65	50.8	3.78	-1.3	-3.5
4000	49.9	16.93	3.77	50.6	3.90	-1.5	-3.3
4100	49.8	17.05	3.89	50.5	4.01	-1.4	-3.1
4200	49.6	17.18	4.01	50.4	4.13	-1.5	-2.9
4300	49.5	17.32	4.14	50.2	4.25	-1.5	-2.5
4400	49.3	17.46	4.27	50.1	4.37	-1.6	-2.2
4500	49.2	17.59	4.40	50.0	4.48	-1.5	-1.8
4600	49.0	17.73	4.54	49.8	4.60	-1.7	-1.3
4700	48.8	17.86	4.67	49.7	4.72	-1.8	-1.0
4800	48.6	17.99	4.80	49.6	4.83	-1.9	-0.7
4850	48.5	18.05	4.87	49.5	4.89	-2.0	-0.4
4900	48.4	18.11	4.94	49.4	4.95	-2.1	-0.2
4950	48.3	18.17	5.00	49.4	5.01	-2.1	-0.1
5000	48.2	18.23	5.07	49.3	5.07	-2.2	0.1
5050	48.1	18.29	5.14	49.2	5.12	-2.3	0.3
5100	48.0	18.34	5.20	49.2	5.18	-2.3	0.3
5150	47.9	18.39	5.27	49.1	5.24	-2.4	0.6
5200	47.9	18.45	5.34	49.0	5.30	-2.3	0.8
5250	47.8	18.50	5.40	48.9	5.36	-2.3	0.8
5300	47.7	18.56	5.47	48.9	5.42	-2.4	1.0
5350	47.6	18.61	5.54	48.8	5.47	-2.5	1.2
5400	47.5	18.67	5.61	48.7	5.53	-2.5	1.4
5450	47.4	18.72	5.68	48.7	5.59	-2.6	1.6
5500	47.3	18.77	5.74	48.6	5.65	-2.7	1.6
5550	47.2	18.83	5.81	48.5	5.71	-2.8	1.8
5600	47.1	18.88	5.88	48.5	5.77	-2.8	2.0
5650	47.1	18.93	5.95	48.4	5.82	-2.7	2.1
5700	47.0	18.99	6.02	48.3	5.88	-2.8	2.3
5750	46.9	19.04	6.09	48.3	5.94	-2.8	2.5
5800	46.8	19.10	6.16	48.2	6.00	-2.9	2.7
5850	46.7	19.16	6.23	48.1	6.06	-3.0	2.8
5900	46.6	19.22	6.31	48.1	6.12	-3.0	3.2



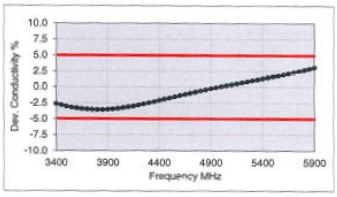


Figure D-9
5 GHz Body Tissue Equivalent Matter

© 2019 PCTEST Engineering Laboratory, Inc.

APPENDIX E: SAR SYSTEM VALIDATION

Per FCC KDB Publication 865664 D02v01r02, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for 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 D01v01r04 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, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

Table E-1
SAR System Validation Summary – 1g

SAR System	Freq. (MHz)	Date	Probe SN	Probe Cal Point		Cond. (σ)	Perm. (εr)	CW VALIDATION			MOD. VALIDATION		
								SENSITIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
G	750	8/9/2018	7410	750	Head	0.898	41.769	PASS	PASS	PASS	N/A	N/A	N/A
G	835	8/9/2018	7410	835	Head	0.889	40.915	PASS	PASS	PASS	GMSK	PASS	N/A
D	1750	10/26/2018	7357	1750	Head	1.345	39.703	PASS	PASS	PASS	N/A	N/A	N/A
D	1900	10/25/2018	7357	1900	Head	1.433	39.444	PASS	PASS	PASS	GMSK	PASS	N/A
H	2450	8/8/2018	7409	2450	Head	1.844	40.474	PASS	PASS	PASS	OFDM/TDD	PASS	PASS
E	2450	2/5/2019	3589	2450	Head	1.825	39.836	PASS	PASS	PASS	OFDM/TDD	PASS	PASS
H	5250	7/5/2018	7409	5250	Head	4.492	34.994	PASS	PASS	PASS	OFDM	N/A	PASS
H	5600	7/5/2018	7409	5600	Head	4.839	34.496	PASS	PASS	PASS	OFDM	N/A	PASS
H	5750	7/5/2018	7409	5750	Head	4.995	34.288	PASS	PASS	PASS	OFDM	N/A	PASS
E	750	2/6/2019	3589	750	Body	0.984	54.096	PASS	PASS	PASS	N/A	N/A	N/A
D	835	8/15/2018	7357	835	Body	1	53.368	PASS	PASS	PASS	GMSK	PASS	N/A
G	1750	8/29/2018	7410	1750	Body	1.464	52.807	PASS	PASS	PASS	N/A	N/A	N/A
J	1900	2/8/2019	7488	1900	Body	1.571	52.538	PASS	PASS	PASS	GMSK	PASS	N/A
K	2450	4/3/2018	3319	2450	Body	2.043	51.13	PASS	PASS	PASS	OFDM/TDD	PASS	PASS
L	2450	11/6/2018	7308	2450	Body	2.022	51.315	PASS	PASS	PASS	OFDM/TDD	PASS	PASS
L	5250	10/29/2018	7308	5250	Body	5.511	48.77	PASS	PASS	PASS	OFDM	N/A	PASS
L	5600	10/29/2018	7308	5600	Body	5.994	48.2	PASS	PASS	PASS	OFDM	N/A	PASS
L	5750	10/29/2018	7308	5750	Body	6.219	47.96	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: While the probes have been calibrated for both CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01r04 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to FCC KDB Publication 865664 D01v01r04.

© 2019 PCTEST Engineering Laboratory, Inc.

APPENDIX G POWER REDUCTION VERIFICATION

Per the May 2017 TCBC Workshop Notes, demonstration of proper functioning of the power reduction mechanisms is required to support the corresponding SAR configurations. The verification process was divided into two parts: (1) evaluation of output power levels for individual or multiple triggering mechanisms and (2) evaluation of the triggering distances for proximity-based sensors.

G.1 Power Verification Procedure

The power verification was performed according to the following procedure:

1. A base station simulator was used to establish a conducted RF connection and the output power was monitored. The power measurements were confirmed to be within expected tolerances for all states before and after a power reduction mechanism was triggered.

2. Step 1 was repeated for all relevant modes and frequency bands for the mechanism being investigated.

3. Steps 1 and 2 were repeated for all individual power reduction mechanisms and combinations thereof. For the combination cases, one mechanism was switched to a 'triggered' state at a time; powers were confirmed to be within tolerances after each additional mechanism was activated.

G.2 Distance Verification Procedure

The distance verification procedure was performed according to the following procedure:

1. A base station simulator was used to establish an RF connection and to monitor the power levels. The device being tested was placed below the relevant section of the phantom with the relevant side or edge of the device facing toward the phantom.

2. The device was moved toward and away from the phantom to determine the distance at which the mechanism triggers and the output power is reduced, per KDB Publication 616217 D04v01r02 and FCC Guidance. Each applicable test position was evaluated. The distances were confirmed to be the same or larger (more conservative) than the minimum distances provided by the manufacturer.

3. Steps 1 and 2 were repeated for low, mid, and high bands, as appropriate (see note below for more details).

4. Steps 1 through 3 were repeated for all distance-based power reduction mechanisms.

© 2019 PCTEST Engineering Laboratory, Inc.

G.3 WIFI Verification Summary

Table G-1
Power Measurement Verification WIFI

Mechanism(s)	Mode/Band	Conducted Power (dBm)	
		Un-triggered (Max)	Mechanism #1 (Reduced)
Held-to-Ear	802.11b	18.29	15.06
Held-to-Ear	802.11g	16.11	14.95
Held-to-Ear	802.11n (2.4GHz)	15.89	14.78
Held-to-Ear	802.11a	14.82	11.71
Held-to-Ear	802.11n (5GHz, 20MHz BW)	15.08	11.98

© 2019 PCTEST Engineering Laboratory, Inc.