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Measurement Certificate / Material Test

Head Tissue Simulating Liquid (HSL750V2) SL AAH 075 AA (Batch: 170612-4) SPEAG Item Name

Product No.

Manufacturer

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.

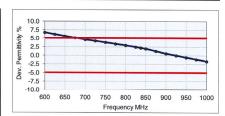
Test Condition

Ambient Environment temperatur $(22 \pm 3)^{\circ}$ C and humidity < 70%. TSL Temperature 22° C Test Date 20-Jun-17 Operator

Additional Information

TSL Density 1.284 g/cm³ TSL Heat-capacity 2.701 kJ/(kg*K)

	Measu	ured		Targe	t	Diff.to T	arget [%]
f [MHz]	e'	е"	sigma	eps	sigma	∆-eps	Δ-sigma
600	45.6	22.97	0.77	42.7	0.88	6.7	-13.1
625	45.2	22.73	0.79	42.6	0.88	6.2	-10.6
650	44.9	22.49	0.81	42.5	0.89	5.6	-8.2
675	44.5	22.27	0.84	42.3	0.89	5.1	-5.8
700	44.2	22.05	0.86	42.2	0.89	4.6	-3.5
725	43.8	21.88	0.88	42.1	0.89	4.2	-1.0
750	43.5	21.72	0.91	41.9	0.89	3.8	1.4
775	43.2	21.55	0.93	41.8	0.90	3.4	3.7
800	42.9	21.38	0.95	41.7	0.90	2.9	6.0
825	42.6	21.24	0.97	41.6	0.91	2.4	7.5
838	42.5	21.17	0.99	41.5	0.91	2.2	8.2
850	42.3	21.09	1.00	41.5	0.92	2.0	8.9
875	42.0	20.98	1.02	41.5	0.94	1.2	8.3
900	41.7	20.87	1.05	41.5	0.97	0.5	7.7
925	41.5	20.76	1.07	41.5	0.98	0.0	8.7
950	41.2	20.64	1.09	41.4	0.99	-0.6	9.7
975	40.9	20.55	1.11	41.4	1.00	-1.1	10.9
1000	40.6	20.46	1.14	41.3	1.01	-1.7	12.1



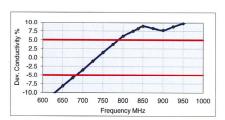


Figure D-3 750MHz Head Tissue Equivalent Matter

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3 Composition / Information on ingredients

The Item is composed of the following ingredients:

Water 50 - 73 % 25 - 50 %

Non-ionic detergents polyoxyethylenesorbitan monolaurate

NaCl Preservative 0-2% 0.05 - 0.1% Preventol-D7

Safety relevant ingredients:

CAS-No. 55965-84-9

< 0.1 % aqueous preparation, containing 5-chloro-2-methyl-3(2H)-

isothiazolone and 2-methyyl-3(2H)-isothiazolone

<50 %

CAS-No. 9005-64-5 <50 % polyoxyethylenesorbitan monolaurate
According to international guidelines, the product is not a dangerous mixture and therefore not required to be marked by symbols.

Figure D-4 Composition of 2.4 GHz Head Tissue Equivalent Matter

Note: 2.4 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.

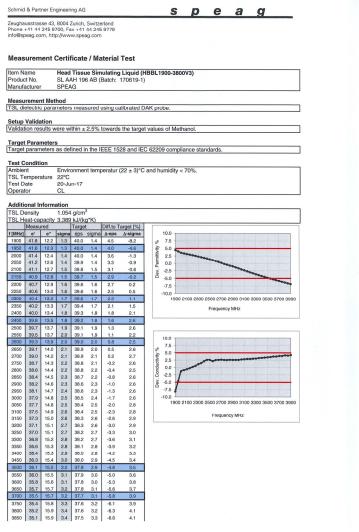


Figure D-5 2.4 GHz Head Tissue Equivalent Matter

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2 Composition / Information on ingredients

The Item is composed of the following ingredients:

 $\begin{array}{lll} \text{Water} & 50-65\% \\ \text{Mineral oil} & 10-30\% \\ \text{Emulsifiers} & 8-25\% \\ \text{Sodium salt} & 0-1.5\% \\ \end{array}$

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.

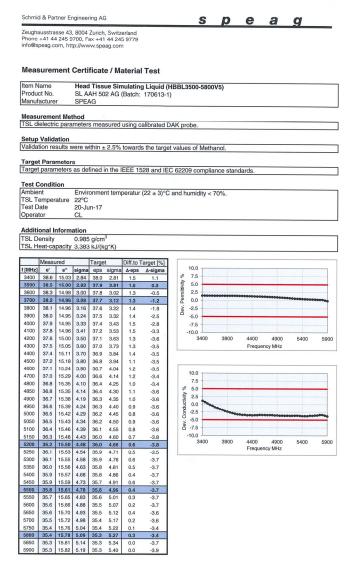


Figure D-7
5 GHz Head Tissue Equivalent Matter

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3 Composition / Information on ingredients

The Item is composed of the following ingredients:

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.

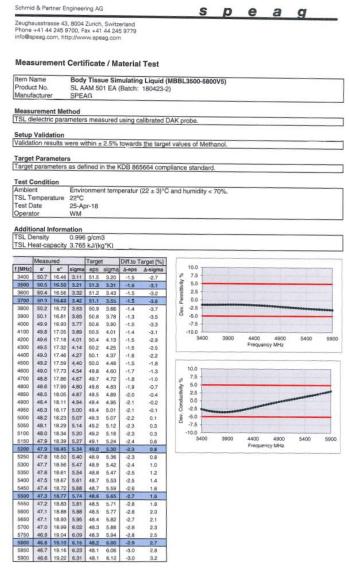


Figure D-9
5 GHz Body Tissue Equivalent Matter

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APPENDIX D: 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 D-1
SAR System Validation Summary – 1g

245	_				AIT Oy			cv	W VALIDATIO	N	MOD.	VALIDATIO	ON
SAR System	Freq. (MHz)	Date	Probe SN	Probe C	Cal Point	Cond. (σ)	Perm. (ɛr)	SENSITIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
Н	750	9/5/2018	7409	750	Head	0.887	41.85	PASS	PASS	PASS	N/A	N/A	N/A
D	750	4/12/2019	3914	750	Head	0.903	42.79	PASS	PASS	PASS	N/A	N/A	N/A
D	835	4/12/2019	3914	835	Head	0.935	42.55	PASS	PASS	PASS	GMSK	PASS	N/A
Н	1750	7/16/2018	7409	1750	Head	1.331	41.19	PASS	PASS	PASS	N/A	N/A	N/A
G	1900	8/9/2018	7410	1900	Head	1.429	38.61	PASS	PASS	PASS	GMSK	PASS	N/A
Е	1900	3/11/2019	3589	1900	Head	1.436	39.62	PASS	PASS	PASS	GMSK	PASS	N/A
L	2450	4/29/2019	7308	2450	Head	1.82	37.75	PASS	PASS	PASS	OFDM/TDD	PASS	PASS
Е	2450	2/5/2019	3589	2450	Head	1.825	39.84	PASS	PASS	PASS	OFDM/TDD	PASS	PASS
Е	2600	2/7/2019	3589	2600	Head	1.964	40.46	PASS	PASS	PASS	TDD	PASS	N/A
Н	5250	7/5/2018	7409	5250	Head	4.492	34.99	PASS	PASS	PASS	OFDM	N/A	PASS
Н	5600	7/5/2018	7409	5600	Head	4.839	34.5	PASS	PASS	PASS	OFDM	N/A	PASS
Н	5750	7/5/2018	7409	5750	Head	4.995	34.29	PASS	PASS	PASS	OFDM	N/A	PASS
L	750	11/6/2018	7308	750	Body	0.962	53.92	PASS	PASS	PASS	N/A	N/A	N/A
J	835	3/10/2019	7488	835	Body	0.988	53.87	PASS	PASS	PASS	GMSK	PASS	N/A
D	1750	4/29/2019	3914	1750	Body	1.529	51.89	PASS	PASS	PASS	N/A	N/A	N/A
I	1900	4/29/2019	7357	1900	Body	1.584	51.77	PASS	PASS	PASS	GMSK	PASS	N/A
G	1900	8/10/2018	7410	1900	Body	1.567	52.24	PASS	PASS	PASS	GMSK	PASS	N/A
K	2450	3/6/2019	7417	2450	Body	2.039	50.67	PASS	PASS	PASS	OFDM/TDD	PASS	PASS
К	2600	3/6/2019	7417	2600	Body	2.224	50.17	PASS	PASS	PASS	TDD	PASS	N/A
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

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Table D-2 SAR System Validation Summary – 10g

							u	on Gamma	iy iog					
SAR	Freq. (MHz)		Probe SN			Cond. Perm.	Perm.	CV	CW VALIDATION			MOD. VALIDATION		
System		Date		Probe C	Cal Point (σ)		(0.4)	SENSITIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR	
G	1900	8/10/2018	7410	1900	Body	1.567	52.239	PASS	PASS	PASS	GMSK	PASS	N/A	
I	1900	4/29/2019	7357	1900	Body	1.584	51.771	PASS	PASS	PASS	GMSK	PASS	N/A	
K	2450	3/6/2019	7417	2450	Body	2.039	50.67	PASS	PASS	PASS	OFDM/TDD	PASS	PASS	
K	2600	3/6/2019	7417	2600	Body	2.224	50.17	PASS	PASS	PASS	TDD	PASS	N/A	
L	5250	10/29/2018	7308	5250	Body	5.511	48.77	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

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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 Table G-2 for more details).
- 4. Steps 1 through 3 were repeated for all distance-based power reduction mechanisms.

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G.3 Main Antenna Verification Summary

Table G-1
Power Measurement Verification for Main Antenna

Mechanism(s)		Conducted Power (dBm)			
1st	Mode/Band	Un-triggered (Max)	. ,		
Grip	UMTS 1900	23.76	23.21		
Grip	PCS CDMA	24.03	22.74		
Grip	LTE FDD Band 2	23.66	23.15		
Grip	LTE FDD Band 25	23.78	23.31		
Grip	LTE TDD Band 41 (PC3)	24.87	22.99		
Grip	LTE TDD Band 41 (PC2)	27.7	25.69		

Table G-2
Distance Measurement Verification for Main Antenna

Machaniam/a)	Test Condition	Band	Distance Meas	Minimum Distance per	
Mechanism(s)	rest Condition	Band	Moving Toward	Moving Away	Manufacturer (mm)
Grip	Phablet - Back Side	Mid	2	4	2
Grip	Phablet - Back Side	High	2	4	2
Grip	Phablet - Front Side	Mid	2	4	2
Grip	Phablet - Front Side	High	2	4	2
Grip	Phablet - Bottom Edge	Mid	5	7	4
Grip	Phablet - Bottom Edge	High	5	7	4

^{*}Note: Mid band refers to: PCS CDMA, UMTS B2, LTE B2/25; High band refers to: LTE 41 PC3/PC2

G.4 WIFI Verification Summary

Table G-3
Power Measurement Verification WIFI

Mechanism(s)		Conducted Power (dBm)					
1st	Mode/Band	Un-triggered (Max)	Mechanism #1 (Reduced)				
Held-to-Ear	802.11b	20.48	18.34				
Held-to-Ear	802.11a	17.64	16.83				
Held-to-Ear	802.11n (5GHz, 20MHz BW)	17.72	16.75				

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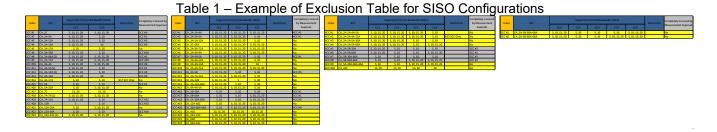
APPENDIX H: DOWNLINK LTE CA RF CONDUCTED POWERS

1.1 LTE Downlink Only Carrier Aggregation Test Reduction Methodology

SAR test exclusion for LTE downlink Carrier Aggregation is determined by power measurements according to the number of component carriers (CCs) supported by the product implementation. Per April 2018 TCBC Workshop Notes, the following test reduction methodology was applied to determine the combinations required for conducted power measurements.

LTE DLCA Test Reduction Methodology:

- The supported combinations were arranged by the number of component carriers in columns.
- Any limitations on the PCC or SCC for each combination were identified alongside the combination (e.g. CA_2A-4A-12A, but B12 can only be configured as a SCC).
- Power measurements were performed for "supersets" (LTE CA combinations with multiple components carriers) and any "subsets" (LTE CA combinations with fewer component carriers) that were not completely covered by the supersets.
- Only subsets that have the exact same components as a superset were excluded for measurement.
- When there were certain restrictions on component carriers that existed in the superset that were not applied for the subset, the subset configuration was additionally evaluated.
- Both inter-band and intra-band downlink carrier aggregation scenarios were considered.



1.2 LTE Downlink Only Carrier Aggregation Test Selection and Setup

SAR test exclusion for LTE downlink Carrier Aggregation is determined by power measurements according to the number component carriers (CCs) supported by the product implementation. For those configurations required by April 2018 TCBC Workshop Notes, conducted power measurements with LTE Carrier Aggregation (CA) (downlink only) active are made in accordance to KDB Publication 941225 D05Av01r02. The RRC connection is only handled by one cell, the primary component carrier (PCC) for downlink and uplink communications. After making a data connection to the PCC, the UE device adds secondary component carrier(s) (SCC) on the downlink only. All uplink communications and acknowledgements remain identical to specifications when downlink carrier aggregation is inactive on the PCC. Additional conducted output powers are measured with the downlink carrier aggregation active for the configuration with highest measured maximum conducted power with downlink carrier aggregation inactive measured among the channel bandwidth, modulation, and RB combinations in each frequency band.

Per FCC KDB Publication 941225 D05Av01r02, no SAR measurements are required for carrier aggregation configurations when the maximum average output power with downlink only carrier aggregation active is not more than 0.25 dB higher than the average output power with downlink only carrier aggregation inactive. All bands required for SAR testing per FCC KDB procedures were considered. Based on the measured maximum powers below, no additional SAR tests were required for DLCA SAR configurations.

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General PCC and SCC configuration selection procedure

- PCC uplink channel, channel bandwidth, modulation and RB configurations were selected based on section C)3)b)ii) of KBD 941225 D05 V01r02. The downlink PCC channel was paired with the selected PCC uplink channel according to normal configurations without carrier aggregation.
- To maximize aggregated bandwidth, highest channel bandwidth available for that CA combination was selected for SCC. For inter-band CA, the SCC downlink channels were selected near the middle of their transmission bands. For contiguous intra-band CA, the downlink channel spacing between the component carriers was set to multiple of 300 kHz less than the nominal channel spacing defined in section 5.4.1A of 3GPP TS 36.521. For non-contiguous intra-band CA, the downlink channel spacing between the component carriers was set to be larger than the nominal channel spacing and provided maximum separation between the component carriers.
- All selected PCC and SCC(s) remained fully within the uplink/downlink transmission band of the respective component carrier.



Figure 1
DL CA Power Measurement Setup

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1.3 Downlink Carrier Aggregation RF Conducted Powers

1.3.1 LTE Band 26 as PCC

Table 1 Maximum Output Powers

		PCC									SC	Power				
	Combination	PCC Band	PCC BW [MHz]	PCC (UL) Ch.	PCC (UL) Freq. [MHz]	Mod.	PCC UL# RB	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Freq. [MHz]	SCC Band	SCC BW [MHz]	SCC (DL) Channel	SCC (DL) Freq. [MHz]	LTE Tx.Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
[CA_25A-26A	LTE B26	15	26865	831.5	QPSK	1	74	8865	876.5	LTE B25	20	8365	1962.5	25.49	25.42

1.3.2 **LTE Band 25 as PCC**

Table 2 Maximum Output Powers

	PCC									SCC 1				Power	
Combination	PCC Band	PCC BW [MHz]	PCC (UL) Ch.	PCC (UL) Freq. [MHz]	Mod.	PCC UL#	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Freq. [MHz]	SCC Band	SCC BW [MHz]	SCC (DL) Channel	SCC (DL) Freq. [MHz]	LTE Tx.Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_25A-25A (1)	LTE B25	10	26090	1855	QPSK	1	49	8090	1935	LTE B25	20	8590	1985	24.28	24.30
CA_25A-26A	LTE B25	10	26090	1855	QPSK	1	49	8090	1935	LTE B26	15	8865	876.5	24.08	24.30

1.3.3 **LTE Band 41 PC3 as PCC**

Table 3 Maximum Output Powers

	PCC								SC	Power					
Combination	PCC Band	PCC BW [MHz]	PCC (UL) Ch.	PCC (UL) Freq. [MHz]	Mod.	PCC UL#	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Freq. [MHz]	SCC Band	SCC BW [MHz]	SCC (DL) Channel	SCC (DL) Freq. [MHz]	LTE Tx.Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_41A-41A (1)	LTE B41	20	40185	2549.5	QPSK	1	0	40185	2549.5	LTE B41	20	41490	2680	24.99	25.00
CA 41C (1)	LTE B41	20	40185	2549.5	QPSK	1	0	40185	2549.5	LTE B41	20	40383	2569.3	24.99	25.00

1.3.1 LTE Band 41 PC2 as PCC

Table 4 Maximum Output Powers

The state of the s															
		PCC									SC	Power			
Combination	PCC Band	PCC BW [MHz]	PCC (UL) Ch.	PCC (UL) Freq. [MHz]	Mod.	PCC UL#	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Freq. [MHz]	SCC Band	SCC BW [MHz]	SCC (DL) Channel	SCC (DL) Freq. [MHz]	LTE Tx.Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
CA_41A-41A (1)	LTE B41 PC2	15	41055	2636.5	QPSK	1	74	41055	2636.5	LTE B41 PC2	20	39750	2506	27.68	27.68
CA 41C (1)	LTE B41 PC2	15	41055	2636.5	QPSK	1	74	41055	2636.5	LTE B41 PC2	20	40884	2619.4	27.69	27.68

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