

# FCC SAR Test Report

**APPLICANT** : Lenovo (Shanghai) Electronics Technology Co., Ltd.  
**EQUIPMENT** : Portable Tablet Computer  
**BRAND NAME** : lenovo  
**MODEL NAME** : 501LV, 502LV  
**MARKETING NAME** : Lenovo TAB2  
**FCC ID** : O57TAB2A8  
**STANDARD** : FCC 47 CFR Part 2 (2.1093)  
ANSI/IEEE C95.1-1992  
IEEE 1528-2013

We, SPORTON INTERNATIONAL (KUNSHAN) INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and had been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL (KUNSHAN) INC., the test report shall not be reproduced except in full.



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Prepared by: Mark Qu / Manager



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**SPORTON INTERNATIONAL (KUNSHAN) INC.**  
**No. 3-2, PingXiang Road, Kunshan, Jiangsu Province, P. R. China**



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1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Lenovo (Shanghai) Electronics Technology Co., Ltd., Portable Tablet Computer, 501LV, 502LV**, are as follows.

Equipment Class	Frequency Band	Highest SAR Summary	
		Body 1g SAR (W/kg)	Highest Simultaneous Transmission Body 1g SAR (W/kg)
PCB	GSM850	<b>1.32</b>	1.45
	GSM1900	1.09	
	LTE Band 41	1.16	
DTS	WLAN 2.4GHz Band	1.08	1.20
DSS	Bluetooth		1.45
Date of Testing:		06/11/2015 ~ 07/14/2015	

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

## **2. Administration Data**

<b>Testing Laboratory</b>	
<b>Test Site</b>	SPORTON INTERNATIONAL (KUNSHAN) INC.
<b>Test Site Location</b>	No. 3-2, PingXiang Road, Kunshan, Jiangsu Province, P. R. China TEL: +86-0512-5790-0158 FAX: +86-0512-5790-0958

<b>Applicant</b>	
<b>Company Name</b>	Lenovo (Shanghai) Electronics Technology Co., Ltd.
<b>Address</b>	No. 68 Building, 199 Fenju Road, Wai Gao Qiao FTZ, Shanghai, China

<b>Manufacturer</b>	
<b>Company Name</b>	Lenovo PC HK Limited
<b>Address</b>	23/F, Lincoln House, Taikoo Place 979 King's Road, Quarry Bay, Hong Kong

## **3. Guidance Standard**

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 616217 D04 SAR for laptop and tablets v01r02
- FCC KDB 941225 D01 3G SAR Procedures v03r01
- FCC KDB 941225 D05 SAR for LTE Devices v02r05

## 4. Equipment Under Test (EUT)

### 4.1 General Information

Product Feature & Specification	
Equipment Name	Portable Tablet Computer
Brand Name	lenovo
Model Name	501LV, 502LV
Marketing Name	Lenovo TAB2
FCC ID	O57TAB2A8
IMEI	867651020001444
Wireless Technology and Frequency Range	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz LTE Band 41: 2547.5 MHz ~ 2652.5 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	· GPRS/EGPRS · RMC 12.2Kbps · LTE: QPSK, 16QAM · 802.11b/g/n HT20/HT40 · Bluetooth v3.0+EDR · Bluetooth v4.0 LE
HW Version	LenovoPad A8-50F
SW Version	A8-50F_150520
EUT Stage	Identical Prototype
<b>Remark:</b>	
1. The EUT has no voice function.	
2. This device supports GRPS/EGPRS mode up to multi-slot class12.	

### 4.2 Component List

**Note:** There are two types of EUT, sample 1 and sample 2, the difference between them are for LCM and back camera. The details refer the following table. According to the difference, we evaluate it is not affect SAR test, so only choose sample 1 to perform SAR test.

Component	Sample 1	Sample 2
LCM	(BOE) TFT_8"_1280X800_TTV080WXM-NL0	(Dongshan) TFT_8"_1280X800_D0800CS00
Back_camera	(O-Film) Camera_500W_AF_L545A00	(Q-tech) Camera_500W-AF_BTBTB_30PIN_FH545AB

### 4.3 Maximum Tune-up Limit

Mode	Burst average power (dBm)			
	GSM 850		GSM 1900	
	Full power mode	Reduced power mode	Full power mode	Reduced power mode
GPRS (GMSK, 1 Tx slot)	32.5	29.5	29.0	18.0
GPRS (GMSK, 2 Tx slots)	32.0	26.5	28.5	18.0
GPRS (GMSK, 3 Tx slots)	30.5	24.5	27.0	18.0
GPRS (GMSK, 4 Tx slots)	29.5	23.5	26.0	18.0
EDGE (8PSK, 1 Tx slot)	27.5	24.0	26.0	14.5
EDGE (8PSK, 2 Tx slots)	26.5	21.0	25.0	14.5
EDGE (8PSK, 3 Tx slots)	24.5	19.5	23.0	14.5
EDGE (8PSK, 4 Tx slots)	23.5	18.0	22.0	14.0

LTE Band 41					
Average Power (dBm)					
Modulation	BW (MHz)	RB size	MPR	Full power mode	Reduced power mode
QPSK	20	≤ 18	0	22.5	14.5
QPSK	20	> 18	0-1	21.5	14.5
16QAM	20	≤ 18	0-1	21.5	14.5
16QAM	20	> 18	0-2	20.5	14.5
QPSK	15	≤ 16	0	22.5	14.5
QPSK	15	> 16	0-1	21.5	14.5
16QAM	15	≤ 16	0-1	21.5	14.5
16QAM	15	> 16	0-2	20.5	14.5
QPSK	10	≤ 12	0	22.5	14.5
QPSK	10	> 12	0-1	21.5	14.5
16QAM	10	≤ 12	0-1	21.5	14.5
16QAM	10	> 12	0-2	20.5	14.5
QPSK	5	≤ 8	0	22.5	14.5
QPSK	5	> 8	0-1	21.5	14.5
16QAM	5	≤ 8	0-1	21.5	14.5
16QAM	5	> 8	0-2	20.5	14.5

Mode		Average Power (dBm)
2.4GHz	802.11b	14.0
	802.11g	13.0
	802.11n-HT20	11.0
	802.11n-HT40	11.0
Bluetooth v3.0 + EDR		5.0
Bluetooth v4.0 LE		-2.5

**4.4 General LTE SAR Test and Reporting Considerations**

Summarized necessary items addressed in KDB 941225 D05 v02r05																																							
FCC ID	O57TAB2A8																																						
Equipment Name	Portable Tablet Computer																																						
Operating Frequency Range of each LTE transmission band	LTE Band 41: 2547.5 MHz ~ 2652.5 MHz																																						
Channel Bandwidth	5MHz, 10MHz, 15MHz, 20MHz																																						
uplink modulations used	QPSK, and 16QAM																																						
LTE Voice / Data requirements	Data only																																						
LTE MPR permanently built-in by design	<p style="text-align: center;"><b>Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3</b></p> <table border="1"> <thead> <tr> <th rowspan="2">Modulation</th> <th colspan="6">Channel bandwidth / Transmission bandwidth (RB)</th> <th rowspan="2">MPR (dB)</th> </tr> <tr> <th>1.4 MHz</th> <th>3.0 MHz</th> <th>5 MHz</th> <th>10 MHz</th> <th>15 MHz</th> <th>20 MHz</th> </tr> </thead> <tbody> <tr> <td>QPSK</td> <td>&gt; 5</td> <td>&gt; 4</td> <td>&gt; 8</td> <td>&gt; 12</td> <td>&gt; 16</td> <td>&gt; 18</td> <td>≤ 1</td> </tr> <tr> <td>16 QAM</td> <td>≤ 5</td> <td>≤ 4</td> <td>≤ 8</td> <td>≤ 12</td> <td>≤ 16</td> <td>≤ 18</td> <td>≤ 1</td> </tr> <tr> <td>16 QAM</td> <td>&gt; 5</td> <td>&gt; 4</td> <td>&gt; 8</td> <td>&gt; 12</td> <td>&gt; 16</td> <td>&gt; 18</td> <td>≤ 2</td> </tr> </tbody> </table>	Modulation	Channel bandwidth / Transmission bandwidth (RB)						MPR (dB)	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1	16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1	16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2
Modulation	Channel bandwidth / Transmission bandwidth (RB)						MPR (dB)																																
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz																																	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1																																
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1																																
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2																																
LTE A-MPR	In the base station simulator configuration, Network Setting value is set to NS_01 to disable A-MPR during SAR testing and the LTE SAR tests was transmitting on all TTI frames (Maximum TTI)																																						
Spectrum plots for RB configuration	A properly configured base station simulator was used for the SAR and power measurement; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report.																																						
LTE Release	R9																																						
Power reduction applied to satisfy SAR compliance	Yes, proximity sensor.																																						

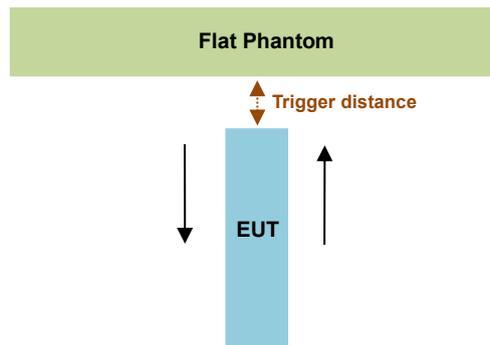
LTE Band 41								
	Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	40165	2547.5	40190	2550	40215	2552.5	40240	2555
M	40690	2600	40690	2600	40690	2600	40690	2600
H	41215	2652.5	41190	2650	41165	2647.5	41140	2645

## 5. Proximity Sensor Triggering Test

### <Proximity Sensor Triggering Distance (KDB 616217 D04 section 6.2)>:

Proximity sensor triggering distance testing was performed according to the procedures outlined in KDB 616217 D04 section 6.2, and EUT moving further away from the flat phantom and EUT moving toward the flat phantom were both assessed. The details are illustrated in the exhibit “P-Sensor operational description”, and the shortest triggering distances were reported and used for SAR assessment.

In the preliminary triggering distance testing, the tissue-equivalent medium for different frequency bands were used for verification; no other frequency bands tissue-equivalent medium was found to result in shortest triggering distance than that for 1900MHz, and the tissue-equivalent medium for 1900MHz was used for formal proximity sensor triggering testing.



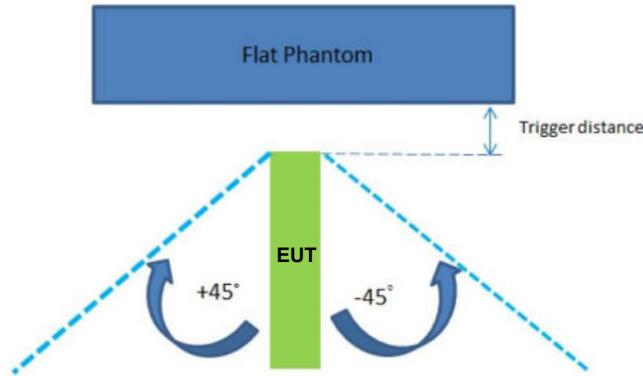
Proximity Sensor Trigger Distance (mm)		
Position	Bottom Face	Edge 3
Minimum	17	10

### <Proximity Sensor Triggering Coverage (KDB 616217 D04 section 6.3)>:

If a sensor is spatially offset from the antenna(s), it is necessary to verify sensor triggering for conditions where the antenna is next to the user but the sensor is laterally further away to ensure sensor coverage is sufficient for reducing the power to maintain compliance. For p-sensor coverage testing, the device is moved and “along the direction of maximum antenna and sensor offset”.

**<Tablet Tilt angle influences to proximity sensor triggering (KDB 616217 D04 section 6.4)>:**

The influence of table tilt angles to proximity sensor triggering was determined by positioning each tablet edge that contains a transmitting antenna, perpendicular to the flat phantom, at 10 mm separation. Rotating the tablet around the edge next to the phantom in  $\leq 10^\circ$  increments until the tablet is  $\pm 45^\circ$  from the vertical position at  $0^\circ$ , and the maximum output power remains in the reduced mode.



The Sensor Trigger Distance (mm)	
Position	Edge 3
Minimum	10

**Proximity sensor power reduction**

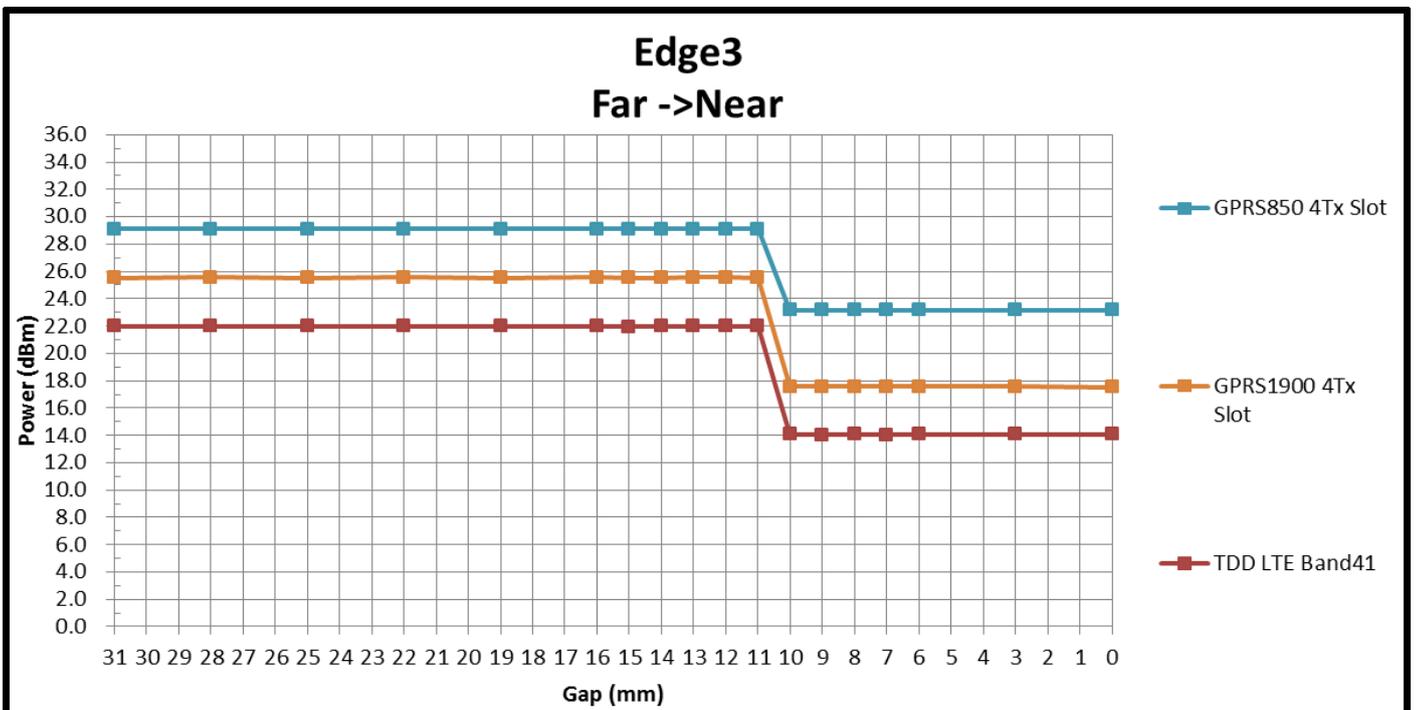
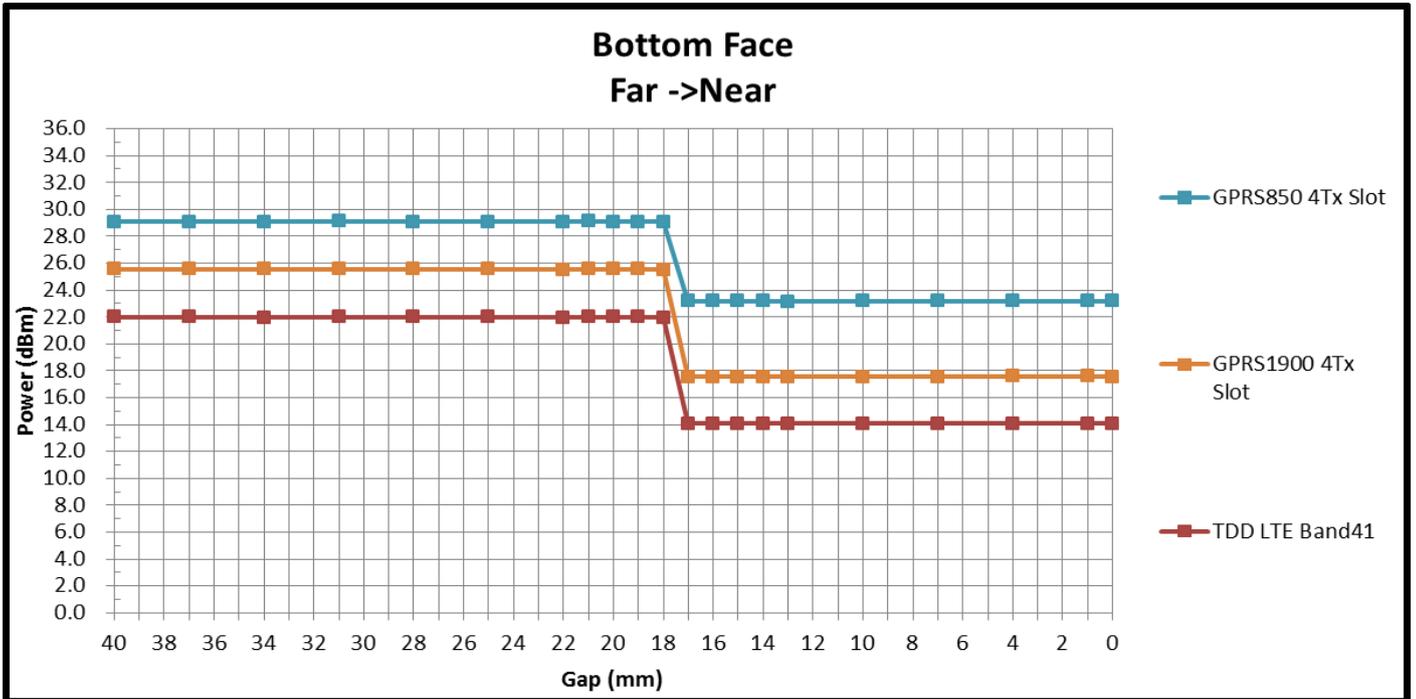
Exposure Position / wireless mode	Bottom Face <sup>(1)</sup>	Edge 1	Edge 2	Edge 3 <sup>(1)</sup>	Edge 4
GSM850 GPRS (GMSK 1 Tx slot) - CS1	3.0 dB	0 dB	0 dB	3.0 dB	0 dB
GSM850 GPRS (GMSK 2 Tx slot) - CS1	5.5 dB	0 dB	0 dB	5.5 dB	0 dB
GSM850 GPRS (GMSK 3 Tx slots) - CS1	6.0 dB	0 dB	0 dB	6.0 dB	0 dB
GSM850 GPRS (GMSK 4 Tx slots) - CS1	6.0 dB	0 dB	0 dB	6.0 dB	0 dB
GSM850 EDGE (8PSK 1 Tx slot) - MCS5	3.5 dB	0 dB	0 dB	3.5 dB	0 dB
GSM850 EDGE (8PSK 2 Tx slot) - MCS5	5.5 dB	0 dB	0 dB	5.5 dB	0 dB
GSM850 EDGE (8PSK 3 Tx slot) - MCS5	5.0 dB	0 dB	0 dB	5.0 dB	0 dB
GSM850 EDGE (8PSK 4 Tx slot) - MCS5	5.5 dB	0 dB	0 dB	5.5 dB	0 dB
GSM1900 GPRS (GMSK 1 Tx slot) - CS1	11.0 dB	0 dB	0 dB	11.0 dB	0 dB
GSM1900 GPRS (GMSK 2 Tx slot) - CS1	10.5 dB	0 dB	0 dB	10.5 dB	0 dB
GSM1900 GPRS (GMSK 3 Tx slots) - CS1	9.0 dB	0 dB	0 dB	9.0 dB	0 dB
GSM1900 GPRS (GMSK 4 Tx slots) - CS1	8.0 dB	0 dB	0 dB	8.0 dB	0 dB
GSM1900 EDGE (8PSK 1 Tx slot) - MCS5	11.5 dB	0 dB	0 dB	11.5 dB	0 dB
GSM1900 EDGE (8PSK 2 Tx slot) - MCS5	10.5 dB	0 dB	0 dB	10.5 dB	0 dB
GSM1900 EDGE (8PSK 3 Tx slot) - MCS5	8.5 dB	0 dB	0 dB	8.5 dB	0 dB
GSM1900 EDGE (8PSK 4 Tx slot) - MCS5	8.0 dB	0 dB	0 dB	8.0 dB	0 dB
LTE Band 41	8.0 dB	0 dB	0 dB	8.0 dB	0 dB

**Remark:**

1. <sup>(1)</sup>: Reduced maximum limit applied by activation of proximity sensor.
2. Power reduction is not applicable for WLAN and Bluetooth.
3. Tests were performed in accordance with KDB 616217 D04 section 6.1, 6.2, 6.3, 6.4 and 6.5 and compliant results are shown and described in exhibit "P-Sensor operational description"
4. For verification of compliance of power reduction scheme, additional SAR testing with EUT transmitting at full RF power at a conservative trigger distance was performed:
  - Bottom Face: 10 mm
  - Edge3: 8 mm

**Power Measurement during Sensor Trigger distance testing**

Band/Mode	Ch #	Measured power reduction (dBm)		Reduction Levels
		w/o power back-off	w/ power back-off	(dB)
GSM850 GPRS (GMSK 4 Tx slots)	189	29.08	23.15	5.93
GSM1900 GPRS (GMSK 4 Tx slots)	512	25.53	17.54	7.99
LTE Band 41 (BW20,RB Size 1,RB Offset 99)	40690	21.96	14.05	7.91



**6. RF Exposure Limits**

**6.1 Uncontrolled Environment**

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

**6.2 Controlled Environment**

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

**Limits for Occupational/Controlled Exposure (W/kg)**

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

**Limits for General Population/Uncontrolled Exposure (W/kg)**

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

1. Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

## **7. Specific Absorption Rate (SAR)**

### **7.1 Introduction**

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

### **7.2 SAR Definition**

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density ( $\rho$ ). The equation description is as below:

$$\text{SAR} = \frac{d}{dt} \left( \frac{dW}{dm} \right) = \frac{d}{dt} \left( \frac{dW}{\rho dv} \right)$$

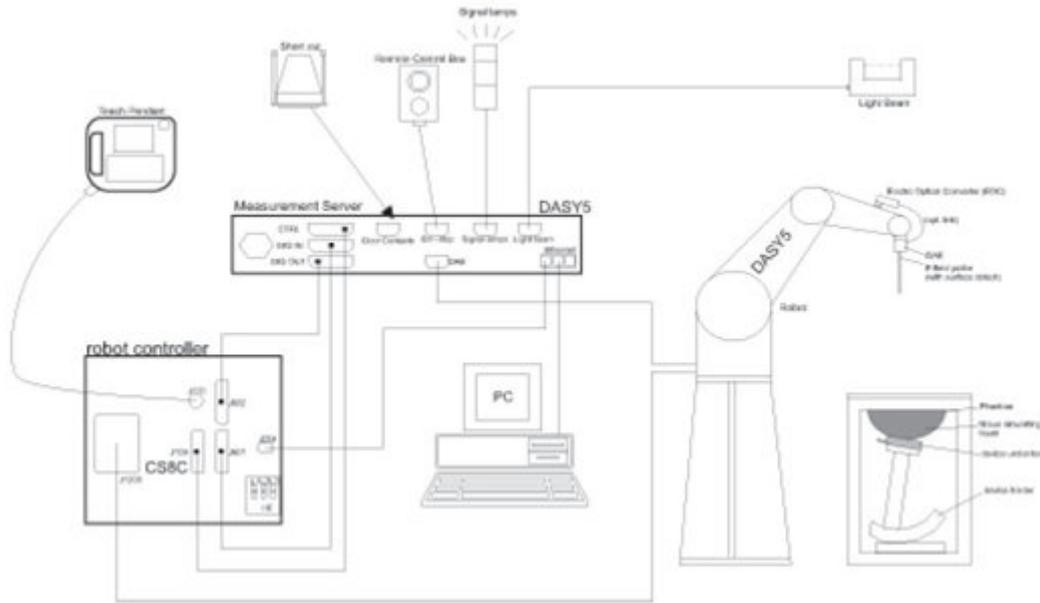
SAR is expressed in units of Watts per kilogram (W/kg)

$$\text{SAR} = \frac{\sigma |E|^2}{\rho}$$

Where:  $\sigma$  is the conductivity of the tissue,  $\rho$  is the mass density of the tissue and E is the RMS electrical field strength.

## 8. System Description and Setup

The DASY system used for performing compliance tests consists of the following items:



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

## **9. Measurement Procedures**

The measurement procedures are as follows:

### <Conducted power measurement>

- (a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
- (b) Read the WWAN RF power level from the base station simulator.
- (c) For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
- (d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

### <SAR measurement>

- (a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
- (b) Place the EUT in the positions as Appendix D demonstrates.
- (c) Set scan area, grid size and other setting on the DASY software.
- (d) Measure SAR results for the highest power channel on each testing position.
- (e) Find out the largest SAR result on these testing positions of each band
- (f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- (a) Power reference measurement
- (b) Area scan
- (c) Zoom scan
- (d) Power drift measurement

### **9.1 Spatial Peak SAR Evaluation**

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

- (a) Extraction of the measured data (grid and values) from the Zoom Scan
- (b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
- (c) Generation of a high-resolution mesh within the measured volume
- (d) Interpolation of all measured values from the measurement grid to the high-resolution grid
- (e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- (f) Calculation of the averaged SAR within masses of 1g and 10g

**9.2 Power Reference Measurement**

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

**9.3 Area Scan**

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: $\Delta x_{Area}, \Delta y_{Area}$	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

**9.4 Zoom Scan**

Zoom scans are used assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube shoes base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

		≤ 3 GHz	> 3 GHz	
Maximum zoom scan spatial resolution: $\Delta x_{Zoom}, \Delta y_{Zoom}$		$\leq 2$ GHz: $\leq 8$ mm $2 - 3$ GHz: $\leq 5$ mm*	$3 - 4$ GHz: $\leq 5$ mm* $4 - 6$ GHz: $\leq 4$ mm*	
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$	$\leq 5$ mm	$3 - 4$ GHz: $\leq 4$ mm $4 - 5$ GHz: $\leq 3$ mm $5 - 6$ GHz: $\leq 2$ mm	
	graded grid	$\Delta z_{Zoom}(1)$ : between 1 <sup>st</sup> two points closest to phantom surface	$\leq 4$ mm	$3 - 4$ GHz: $\leq 3$ mm $4 - 5$ GHz: $\leq 2.5$ mm $5 - 6$ GHz: $\leq 2$ mm
		$\Delta z_{Zoom}(n>1)$ : between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z	$\geq 30$ mm	$3 - 4$ GHz: $\geq 28$ mm $4 - 5$ GHz: $\geq 25$ mm $5 - 6$ GHz: $\geq 22$ mm	
Note: $\delta$ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details. * When zoom scan is required and the <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB 447498 is $\leq 1.4$ W/kg, $\leq 8$ mm, $\leq 7$ mm and $\leq 5$ mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

**9.5 Volume Scan Procedures**

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

**9.6 Power Drift Monitoring**

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASy measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.



**10. Test Equipment List**

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	835MHz System Validation Kit	D835V2	4d091	Nov. 21, 2014	Nov. 20, 2015
SPEAG	1900MHz System Validation Kit	D1900V2	5d118	Nov. 21, 2014	Nov. 20, 2015
SPEAG	2450MHz System Validation Kit	D2450V2	840	Nov. 19, 2014	Nov. 18, 2015
SPEAG	2600MHz System Validation Kit	D2600V2	1061	Nov. 19, 2014	Nov. 18, 2015
SPEAG	Data Acquisition Electronics	DAE4	905	Jul. 14, 2014	Jul. 13, 2015
SPEAG	Data Acquisition Electronics	DAE4	1210	May 21, 2015	May 20, 2016
SPEAG	Dosimetric E-Field Probe	EX3DV4	7350	Jan. 08, 2015	Jan. 07, 2016
SPEAG	Dosimetric E-Field Probe	EX3DV4	3857	May 28, 2015	May 27, 2016
SPEAG	ELI4 Phantom	QD OVA 001 BB	TP-1079	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Anritsu	Radio communication analyzer	MT8820C	6201432831	Jan. 21, 2015	Jan. 20, 2016
Agilent	Wireless Communication Test Set	E5515C	MY52102706	May 04, 2015	May 03, 2016
Agilent	ENA Series Network Analyzer	E5071C	MY46111157	May 04, 2015	May 03, 2016
Agilent	Dielectric Probe Kit	85070E	MY44300475	NCR	NCR
R&S	Signal Generator	SMBV100A	258305	Jan. 23, 2015	Jan. 22, 2016
AR	Amplifier	551G4	333096	NCR	NCR
Anritsu	Power Sensor	MA2411B	0917070	Jan. 23, 2015	Jan. 22, 2016
Anritsu	Power Meter	ML2495A	1005002	Jan. 23, 2015	Jan. 22, 2016
ARRA	Power Divider	A3200-2	N/A	NA	NA
MCL	Attenuation	BW-S10W5	N/A	NA	NA
R&S	CBT BLUETOOTH TESTER	CBT	100783	Aug. 11, 2014	Aug. 10, 2015
R&S	Spectrum Analyzer	FSP40	100319	Oct. 28, 2014	Oct. 27, 2015
Agilent	Dual Directional Coupler	778D	50422	Note1	
Woken	Attenuator 1	WK0602-XX	N/A	Note1	
PE	Attenuator 2	PE7005-10	N/A	Note1	
PE	Attenuator 3	PE7005- 3	N/A	Note1	
AR	Power Amplifier	5S1G4M2	0328767	Note1	
Mini-Circuits	Power Amplifier	ZVE-3W	162601250	Note1	
Mini-Circuits	Power Amplifier	ZHL-42W+	13440021344	Note1	

**General Note:**

1. Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.



## 11. System Verification

### 11.1 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity ( $\sigma$ )	Permittivity ( $\epsilon_r$ )
For Body								
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0	0	31.4	1.95	52.7
2600	68.1	0	0	0.1	0	31.8	2.16	52.5

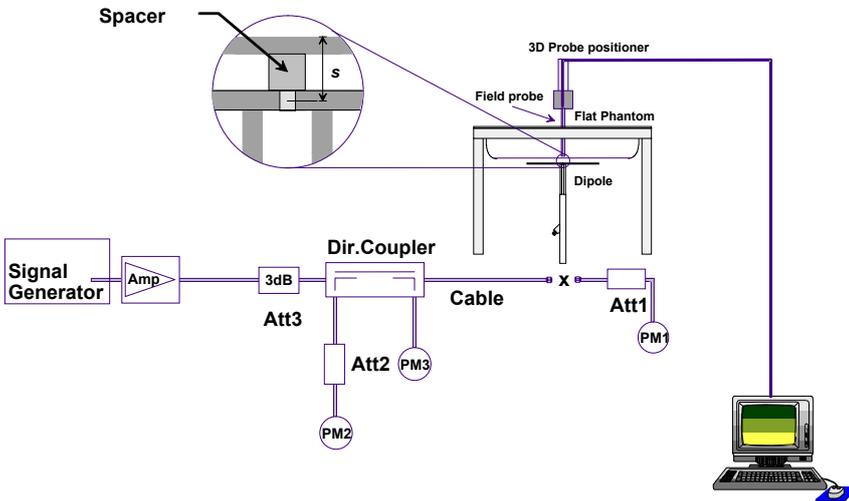
### <Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. (°C)	Conductivity ( $\sigma$ )	Permittivity ( $\epsilon_r$ )	Conductivity Target ( $\sigma$ )	Permittivity Target ( $\epsilon_r$ )	Delta ( $\sigma$ ) (%)	Delta ( $\epsilon_r$ ) (%)	Limit (%)	Date
835	Body	22.9	0.98	54.46	0.97	55.2	1.03	-1.34	±5	2015/6/11
1900	Body	22.8	1.538	52.792	1.52	53.3	1.18	-0.95	±5	2015/6/11
2450	Body	22.9	1.943	50.964	1.95	52.7	-0.36	-3.29	±5	2015/6/19
2600	Body	22.8	2.165	53.823	2.16	52.5	0.23	2.52	±5	2015/6/11
835	Body	22.7	0.978	54.089	0.97	55.2	0.82	-2.01	±5	2015/7/14
1900	Body	22.6	1.555	53.699	1.52	53.3	2.30	0.75	±5	2015/7/13
2450	Body	22.7	1.931	51.252	1.95	52.7	-0.97	-2.75	±5	2015/7/14
2600	Body	22.7	2.201	52.823	2.16	52.5	1.90	0.62	±5	2015/7/14

**11.2 System Performance Check Results**

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured SAR (W/kg)	Targeted SAR (W/kg)	Normalized SAR (W/kg)	Deviation (%)
2015/6/11	835	Body	250	4d091	7350	905	2.44	9.6	9.76	1.67
2015/6/11	1900	Body	250	5d118	7350	905	10.36	40	41.44	3.60
2015/6/19	2450	Body	250	840	7350	905	12.69	51	50.76	-0.47
2015/6/11	2600	Body	250	1061	7350	905	14.1	54.9	56.4	2.73
2015/7/14	835	Body	250	4d091	3857	1210	2.28	9.6	9.12	-5.00
2015/7/13	1900	Body	250	5d118	3857	1210	10.50	40	42	5.00
2015/7/14	2450	Body	250	840	3857	1210	11.96	51	47.84	-6.20
2015/7/14	2600	Body	250	1061	3857	1210	14.10	54.9	56.4	2.73



**Fig 8.3.1 System Performance Check Setup**



**Fig 8.3.2 Setup Photo**



## **12. RF Exposure Positions**

### **12.1 SAR Testing for Tablet**

This device can be used also in full sized tablet exposure conditions, due to its size. Per FCC KDB 616217, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. The SAR exclusion threshold in KDB 447498 D01 v06 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

This EUT was tested in five different positions. They are bottom-face of tablet PC, Edge1, Edge2, Edge3 and Edge4. EUT has proximity sensor function, it would be on bottom-face and Edge3 active, the sensor trigger distance is 17mm for bottom-face and 10mm for Edge3, EUT transmitting reduced power was performed. Additional the surface of EUT is touching with phantom 0 cm for Edge2 and Edge 4 with full power.



### 13. Conducted RF Output Power (Unit: dBm)

**<GSM Conducted Power>**

- Per KDB 447498 D01 v06, the maximum output power channel is used for SAR testing and for further SAR test reduction.
- Per KDB 941225 D01 v03r01, for Body SAR test reduction for GPRS and EDGE modes is determined by the source-based time-averaged output power including tune-up tolerance, for modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested, therefore, the GPRS 4Tx slots modes was selected when EUT operating without power back-off, the GPRS 4Tx slots modes was selected when EUT operating with power back-off, according to the highest source-based time-averaged output power.

**Maximum Average RF Power (Proximity Sensor Inactive)**

Band GSM850 TX Channel	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)	
	128	189	251		128	189	251		
Frequency (MHz)	824.2	836.4	848.8		824.2	836.4	848.8		
GPRS (GMSK, 1 Tx slot) – CS1	31.91	<b>31.95</b>	31.89	32.5	22.91	22.95	22.89	23.50	
GPRS (GMSK, 2 Tx slots) – CS1	31.46	31.51	31.45	32.0	25.46	25.51	25.45	26.00	
GPRS (GMSK, 3 Tx slots) – CS1	30.08	30.10	30.07	30.5	25.82	25.84	25.81	26.24	
GPRS (GMSK, 4 Tx slots) – CS1	29.07	29.08	29.03	29.5	26.07	<b>26.08</b>	26.03	26.50	
EDGE (8PSK, 1 Tx slot) – MCS5	27.07	27.08	27.11	27.5	18.07	18.08	18.11	18.50	
EDGE (8PSK, 2 Tx slots) – MCS5	25.92	25.96	26.05	26.5	19.92	19.96	20.05	20.50	
EDGE (8PSK, 3 Tx slots) – MCS5	24.06	24.08	24.18	24.5	19.80	19.82	19.92	20.24	
EDGE (8PSK, 4 Tx slots) – MCS5	22.93	22.92	23.01	23.5	19.93	19.92	20.01	20.50	
Band GSM1900 TX Channel		Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
Frequency (MHz)		512	661	810		512	661	810	
Frequency (MHz)		1850.2	1880	1909.8		1850.2	1880	1909.8	
GPRS (GMSK, 1 Tx slot) – CS1	<b>28.84</b>	28.78	28.84	29.0	19.84	19.78	19.84	20.00	
GPRS (GMSK, 2 Tx slots) – CS1	28.23	28.19	28.20	28.5	22.23	22.19	22.20	22.50	
GPRS (GMSK, 3 Tx slots) – CS1	26.62	26.54	26.51	27.0	22.36	22.28	22.25	22.74	
GPRS (GMSK, 4 Tx slots) – CS1	25.53	25.40	25.37	26.0	<b>22.53</b>	22.40	22.37	23.00	
EDGE (8PSK, 1 Tx slot) – MCS5	25.69	25.74	25.78	26.0	16.69	16.74	16.78	17.00	
EDGE (8PSK, 2 Tx slots) – MCS5	24.66	24.64	24.68	25.0	18.66	18.64	18.68	19.00	
EDGE (8PSK, 3 Tx slots) – MCS5	22.63	22.65	22.70	23.0	18.37	18.39	18.44	18.74	
EDGE (8PSK, 4 Tx slots) – MCS5	21.52	21.57	21.71	22.0	18.52	18.57	18.71	19.00	

Remark: The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.

The calculated method are shown as below:

Frame-averaged power = Maximum burst averaged power (1 Tx Slot) - 9 dB

Frame-averaged power = Maximum burst averaged power (2 Tx Slots) - 6 dB

Frame-averaged power = Maximum burst averaged power (3 Tx Slots) - 4.26 dB

Frame-averaged power = Maximum burst averaged power (4 Tx Slots) - 3 dB



**Reduced Average RF Power (Proximity Sensor active)**

Band GSM850	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
	TX Channel	128	189		251	128	189	
Frequency (MHz)	824.2	836.4	848.8		824.2	836.4	848.8	
GPRS (GMSK, 1 Tx slot) – CS1	29.11	<b>29.12</b>	29.06	29.5	20.11	20.12	20.06	20.50
GPRS (GMSK, 2 Tx slots) – CS1	26.17	26.18	26.13	26.5	20.17	20.18	20.13	20.50
GPRS (GMSK, 3 Tx slots) – CS1	24.36	24.38	24.30	24.5	20.10	20.12	20.04	20.24
GPRS (GMSK, 4 Tx slots) – CS1	23.11	23.15	23.03	23.5	20.11	<b>20.15</b>	20.03	20.50
EDGE (8PSK, 1 Tx slot) – MCS5	23.35	23.50	23.54	24.0	14.35	14.50	14.54	15.00
EDGE (8PSK, 2 Tx slots) – MCS5	20.50	20.55	20.57	21.0	14.50	14.55	14.57	15.00
EDGE (8PSK, 3 Tx slots) – MCS5	18.78	18.81	18.90	19.5	14.52	14.55	14.64	15.24
EDGE (8PSK, 4 Tx slots) – MCS5	17.42	17.57	17.63	18.0	14.42	14.57	14.63	15.00
Band GSM1900	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
TX Channel	512	661	810		512	661	810	
Frequency (MHz)	1850.2	1880	1909.8		1850.2	1880	1909.8	
GPRS (GMSK, 1 Tx slot) – CS1	<b>17.58</b>	17.52	17.38	18.0	8.58	8.52	8.38	9.00
GPRS (GMSK, 2 Tx slots) – CS1	17.58	17.51	17.38	18.0	11.58	11.51	11.38	12.00
GPRS (GMSK, 3 Tx slots) – CS1	17.56	17.50	17.37	18.0	13.30	13.24	13.11	13.74
GPRS (GMSK, 4 Tx slots) – CS1	17.54	17.48	17.36	18.0	14.54	14.48	14.36	15.00
EDGE (8PSK, 1 Tx slot) – MCS5	13.74	13.83	14.03	14.5	4.74	4.83	5.03	5.50
EDGE (8PSK, 2 Tx slots) – MCS5	13.69	13.83	13.92	14.5	7.69	7.83	7.92	8.50
EDGE (8PSK, 3 Tx slots) – MCS5	13.60	13.72	13.81	14.5	9.34	9.46	9.55	10.24
EDGE (8PSK, 4 Tx slots) – MCS5	13.48	13.57	13.66	14.0	10.48	10.57	10.66	11.00

Remark: The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.

The calculated method are shown as below:

Frame-averaged power = Maximum burst averaged power (1 Tx Slot) - 9 dB

Frame-averaged power = Maximum burst averaged power (2 Tx Slots) - 6 dB

Frame-averaged power = Maximum burst averaged power (3 Tx Slots) - 4.26 dB

Frame-averaged power = Maximum burst averaged power (4 Tx Slots) - 3 dB

**<LTE Conducted Power>****General Note:**

1. Anritsu MT8820C base station simulator was used to setup the connection with EUT; the frequency band, channel bandwidth, RB allocation configuration, modulation type are set in the base station simulator to configure EUT transmitting at maximum power and at different configurations which are requested to be reported to FCC, for conducted power measurement and SAR testing.
2. Per KDB 941225 D05 v02r05, when a properly configured base station simulator is used for the SAR and power measurements, spectrum plots for each RB allocation and offset configuration is not required.
3. Per KDB 941225 D05 v02r05, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
4. Per KDB 941225 D05 v02r05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
5. Per KDB 941225 D05 v02r05, For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are  $\leq 0.8$  W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is  $> 1.45$  W/kg, the remaining required test channels must also be tested.
6. Per KDB 941225 D05 v02r05, 16QAM output power for each RB allocation configuration is  $>$  not  $\frac{1}{2}$  dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is  $\leq 1.45$  W/kg; Per KDB 941225 D05 v02r05, 16QAM SAR testing is not required.
7. Per KDB 941225 D05 v02r05, Smaller bandwidth output power for each RB allocation configuration is  $>$  not  $\frac{1}{2}$  dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is  $\leq 1.45$  W/kg; Per KDB 941225 D05 v02r05, smaller bandwidth SAR testing is not required.

<TDD LTE SAR Measurement>

TDD LTE configuration setup for SAR measurement

SAR was tested with a fixed periodic duty factor according to the highest transmission duty factor implemented for the device and supported by 3GPP.

- a. 3GPP TS 36.211 section 4.2 for Type 2 Frame Structure and Table 4.2-2 for uplink-downlink configurations
- b. "special subframe S" contains both uplink and downlink transmissions, it has been taken into consideration to determine the transmission duty factor according to the worst case uplink and downlink cyclic prefix requirements for UpPTS
- c. Establishing connections with base station simulators ensure a consistent means for testing SAR and recommended for evaluating SAR. The Anritsu MT8820C (firmware: #22.52#004) was used for LTE output power measurements and SAR testing.

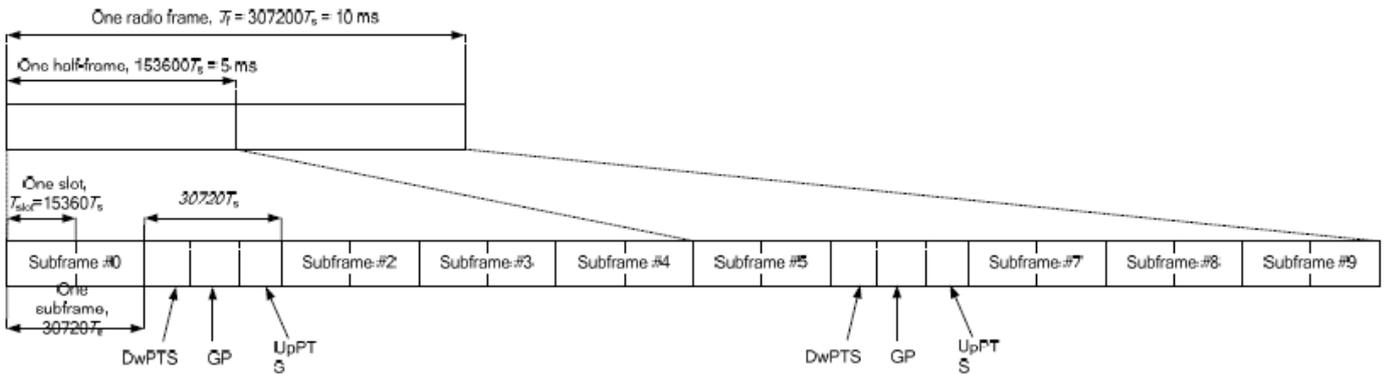


Figure 4.2-1: Frame structure type 2 (for 5 ms switch-point periodicity).

Table 4.2-2: Uplink-downlink configurations.

Uplink-downlink configuration	Downlink-to-Uplink Switch-point periodicity	Subframe number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

Table 4.2-1: Configuration of special subframe (lengths of DwPTS/GP/UpPTS).

Special subframe configuration	Normal cyclic prefix in downlink			Extended cyclic prefix in downlink		
	DwPTS	UpPTS		DwPTS	UpPTS	
		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink
0	6592 · Ts	2192 · Ts	2560 · Ts	7680 · Ts	2192 · Ts	2560 · Ts
1	19760 · Ts			20480 · Ts		
2	21952 · Ts			23040 · Ts		
3	24144 · Ts			25600 · Ts		
4	26336 · Ts	4384 · Ts	5120 · Ts	7680 · Ts	4384 · Ts	5120 · Ts
5	6592 · Ts			20480 · Ts		
6	19760 · Ts			23040 · Ts		
7	21952 · Ts			12800 · Ts		
8	24144 · Ts	-	-	-	-	-
9	13168 · Ts	-	-	-	-	-

<b>Special subframe (30720·T<sub>s</sub>): Normal cyclic prefix in downlink (UpPTS)</b>			
	<b>Special subframe configuration</b>	<b>Normal cyclic prefix in uplink</b>	<b>Extended cyclic prefix in uplink</b>
<b>Uplink duty factor in one special subframe</b>	<b>0~4</b>	7.13%	8.33%
	<b>5~9</b>	14.3%	16.7%

<b>Special subframe(30720·T<sub>s</sub>): Extended cyclic prefix in downlink (UpPTS)</b>			
	<b>Special subframe configuration</b>	<b>Normal cyclic prefix in uplink</b>	<b>Extended cyclic prefix in uplink</b>
<b>Uplink duty factor in one special subframe</b>	<b>0~3</b>	7.13%	8.33%
	<b>4~7</b>	14.3%	16.7%

The highest duty factor is resulted from:

- i. Uplink-downlink configuration: 0. In a half-frame consisted of 5 subframes, uplink operation is in 3 uplink subframes and 1 special subframe.
- ii. special subframe configuration: 5-9 for normal cyclic prefix in downlink, 4-7 for extended cyclic prefix in downlink
- iii. for special subframe with extended cyclic prefix in uplink, the total uplink duty factor in one half-frame is:  $(3+0.167)/5 = 63.3\%$
- iv. for special subframe with normal cyclic prefix in uplink, the total uplink duty factor in one half-frame is:  $(3+0.143)/5 = 62.9\%$
- v. For TDD LTE SAR measurement, the duty cycle 1:1.59 (62.9 %) was used perform testing and considering the theoretical duty cycle of 63.3% for extended cyclic prefix in the uplink, and the theoretical duty cycle of 62.9% for normal cyclic prefix in uplink, a scaling factor of extended cyclic prefix  $63.3\%/62.9\% = 1.006$  is applied to scale-up the measured SAR result. The scaled TDD LTE SAR = measured SAR (W/kg)\* Tune-up Scaling Factor\* scaling factor for extended cyclic prefix.



**Maximum Average RF Power (Proximity Sensor Inactive)**

**<LTE Band 41>**

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune up Limit (dBm)	MPR (dB)
Channel				40240	40690	41140		
Frequency (MHz)				2555	2600	2645		
20	QPSK	1	0	21.56	21.84	21.72	22.5	0
20	QPSK	1	49	21.66	21.94	21.79		
20	QPSK	1	99	21.73	21.96	21.82		
20	QPSK	50	0	20.67	20.92	20.86	21.5	0-1
20	QPSK	50	24	20.61	20.95	20.88		
20	QPSK	50	49	20.72	20.97	20.90		
20	QPSK	100	0	20.64	20.93	20.86		
20	16QAM	1	0	20.77	20.96	20.86	21.5	0-1
20	16QAM	1	49	20.64	20.93	20.82		
20	16QAM	1	99	20.49	20.93	20.75		
20	16QAM	50	0	19.82	20.01	19.84	20.5	0-2
20	16QAM	50	24	19.74	20.04	19.86		
20	16QAM	50	49	19.68	20.04	19.91		
20	16QAM	100	0	19.71	20.00	19.85		
Channel				40215	40690	41165	Tune up Limit (dBm)	MPR (dB)
Frequency (MHz)				2552.5	2600	2647.5		
15	QPSK	1	0	21.90	21.72	21.84	22.5	0
15	QPSK	1	37	21.93	21.67	21.89		
15	QPSK	1	74	21.87	21.55	21.85		
15	QPSK	36	0	20.95	20.67	20.94	21.5	0-1
15	QPSK	36	18	20.98	20.66	20.93		
15	QPSK	36	37	21.02	20.62	20.95		
15	QPSK	75	0	21.00	20.67	20.92		
15	16QAM	1	0	20.87	20.74	20.80	21.5	0-1
15	16QAM	1	37	20.91	20.65	20.90		
15	16QAM	1	74	20.97	20.52	20.96		
15	16QAM	36	0	19.96	19.71	19.82	20.5	0-2
15	16QAM	36	18	19.99	19.67	19.84		
15	16QAM	36	37	20.00	19.61	19.87		
15	16QAM	75	0	20.06	19.75	19.92		



BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune up Limit (dBm)	MPR (dB)
Channel				40190	40690	41190		
Frequency (MHz)				2550	2600	2650		
10	QPSK	1	0	21.87	21.65	21.84	22.5	0
10	QPSK	1	24	21.92	21.64	21.89		
10	QPSK	1	49	21.82	21.36	21.65		
10	QPSK	25	0	20.91	20.67	20.94	21.5	0-1
10	QPSK	25	12	20.94	20.63	20.95		
10	QPSK	25	24	20.98	20.62	20.95		
10	QPSK	50	0	20.97	20.67	20.97	21.5	0-1
10	16QAM	1	0	20.87	20.71	20.87		
10	16QAM	1	24	20.93	20.63	20.93		
10	16QAM	1	49	20.97	20.53	20.87	20.5	0-2
10	16QAM	25	0	19.96	19.75	19.93		
10	16QAM	25	12	20.00	19.71	19.92		
10	16QAM	25	24	20.03	19.71	19.99	20.5	0-2
10	16QAM	50	0	20.02	19.75	19.97		
Channel				40165	40690	41215	Tune up Limit (dBm)	MPR (dB)
Frequency (MHz)				2547.5	2600	2652.5		
5	QPSK	1	0	21.85	21.64	21.86	22.5	0
5	QPSK	1	12	21.91	21.63	21.91		
5	QPSK	1	24	21.85	21.54	21.84		
5	QPSK	12	0	20.90	20.66	21.01	21.5	0-1
5	QPSK	12	6	20.90	20.65	21.11		
5	QPSK	12	11	20.94	20.64	21.00		
5	QPSK	25	0	20.89	20.62	20.99	21.5	0-1
5	16QAM	1	0	20.83	20.67	20.91		
5	16QAM	1	12	20.90	20.64	21.00		
5	16QAM	1	24	20.88	20.55	20.91	20.5	0-2
5	16QAM	12	0	19.91	19.71	19.92		
5	16QAM	12	6	19.92	19.69	19.92		
5	16QAM	12	11	19.96	19.67	19.93	20.5	0-2
5	16QAM	25	0	19.94	19.70	19.95		

**Reduced Average RF Power (Proximity Sensor active)**

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune up Limit (dBm)	MPR (dB)
Channel				40240	40690	41140		
Frequency (MHz)				2555	2600	2645		
20	QPSK	1	0	13.76	13.86	13.76	14.5	0
20	QPSK	1	49	13.68	13.93	13.79		
20	QPSK	1	99	13.91	14.05	13.98		
20	QPSK	50	0	13.60	13.95	13.84	14.5	0
20	QPSK	50	24	13.68	13.97	13.82		
20	QPSK	50	49	13.72	13.98	13.85		
20	QPSK	100	0	13.71	13.92	13.82		
20	16QAM	1	0	13.86	14.04	13.91	14.5	0
20	16QAM	1	49	13.79	14.00	13.87		
20	16QAM	1	99	13.69	14.01	13.81		
20	16QAM	50	0	13.82	14.01	13.88	14.5	0
20	16QAM	50	24	13.77	13.99	13.89		
20	16QAM	50	49	13.74	14.02	13.82		
20	16QAM	100	0	13.74	14.01	13.87		
Channel				40215	40690	41165	Tune up Limit (dBm)	MPR (dB)
Frequency (MHz)				2552.5	2600	2647.5		
15	QPSK	1	0	13.87	13.79	13.82	14.5	0
15	QPSK	1	37	13.94	13.74	13.81		
15	QPSK	1	74	13.95	13.66	13.86		
15	QPSK	36	0	13.94	13.75	13.85	14.5	0
15	QPSK	36	18	13.97	13.76	13.86		
15	QPSK	36	37	13.98	13.70	13.87		
15	QPSK	75	0	13.99	13.77	13.86		
15	16QAM	1	0	13.94	13.83	13.90	14.5	0
15	16QAM	1	37	13.98	13.78	13.85		
15	16QAM	1	74	14.01	13.71	13.92		
15	16QAM	36	0	13.92	13.74	13.82	14.5	0
15	16QAM	36	18	13.95	13.74	13.81		
15	16QAM	36	37	13.94	13.70	13.83		
15	16QAM	75	0	14.02	13.81	13.88		



BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune up Limit (dBm)	MPR (dB)
Channel				40190	40690	41190	14.5	0
Frequency (MHz)				2550	2600	2650		
10	QPSK	1	0	13.84	13.75	13.82	14.5	0
10	QPSK	1	24	13.86	13.68	13.78		
10	QPSK	1	49	13.92	13.64	13.84		
10	QPSK	25	0	13.89	13.74	13.86	14.5	0
10	QPSK	25	12	13.89	13.73	13.84		
10	QPSK	25	24	13.91	13.73	13.90		
10	QPSK	50	0	13.90	13.72	13.89		
10	16QAM	1	0	13.91	13.81	13.91	14.5	0
10	16QAM	1	24	13.94	13.76	13.83		
10	16QAM	1	49	13.98	13.71	13.92		
10	16QAM	25	0	13.91	13.77	13.90	14.5	0
10	16QAM	25	12	13.91	13.76	13.87		
10	16QAM	25	24	13.94	13.77	13.93		
10	16QAM	25	24	13.94	13.77	13.93		
10	16QAM	50	0	13.94	13.80	13.91		
Channel				40165	40690	41215	14.5	0
Frequency (MHz)				2547.5	2600	2652.5		
5	QPSK	1	0	13.82	13.70	13.83	14.5	0
5	QPSK	1	12	13.85	13.66	13.85		
5	QPSK	1	24	13.78	13.59	13.79		
5	QPSK	12	0	13.90	13.76	13.91	14.5	0
5	QPSK	12	6	13.90	13.75	13.91		
5	QPSK	12	11	13.92	13.73	13.92		
5	QPSK	25	0	13.87	13.70	13.86		
5	16QAM	1	0	13.89	13.79	13.92	14.5	0
5	16QAM	1	12	13.94	13.75	13.94		
5	16QAM	1	24	13.88	13.71	13.89		
5	16QAM	12	0	13.89	13.75	13.89	14.5	0
5	16QAM	12	6	13.89	13.73	13.89		
5	16QAM	12	11	13.92	13.72	13.91		
5	16QAM	12	11	13.92	13.72	13.91		
5	16QAM	25	0	13.91	13.73	13.89		

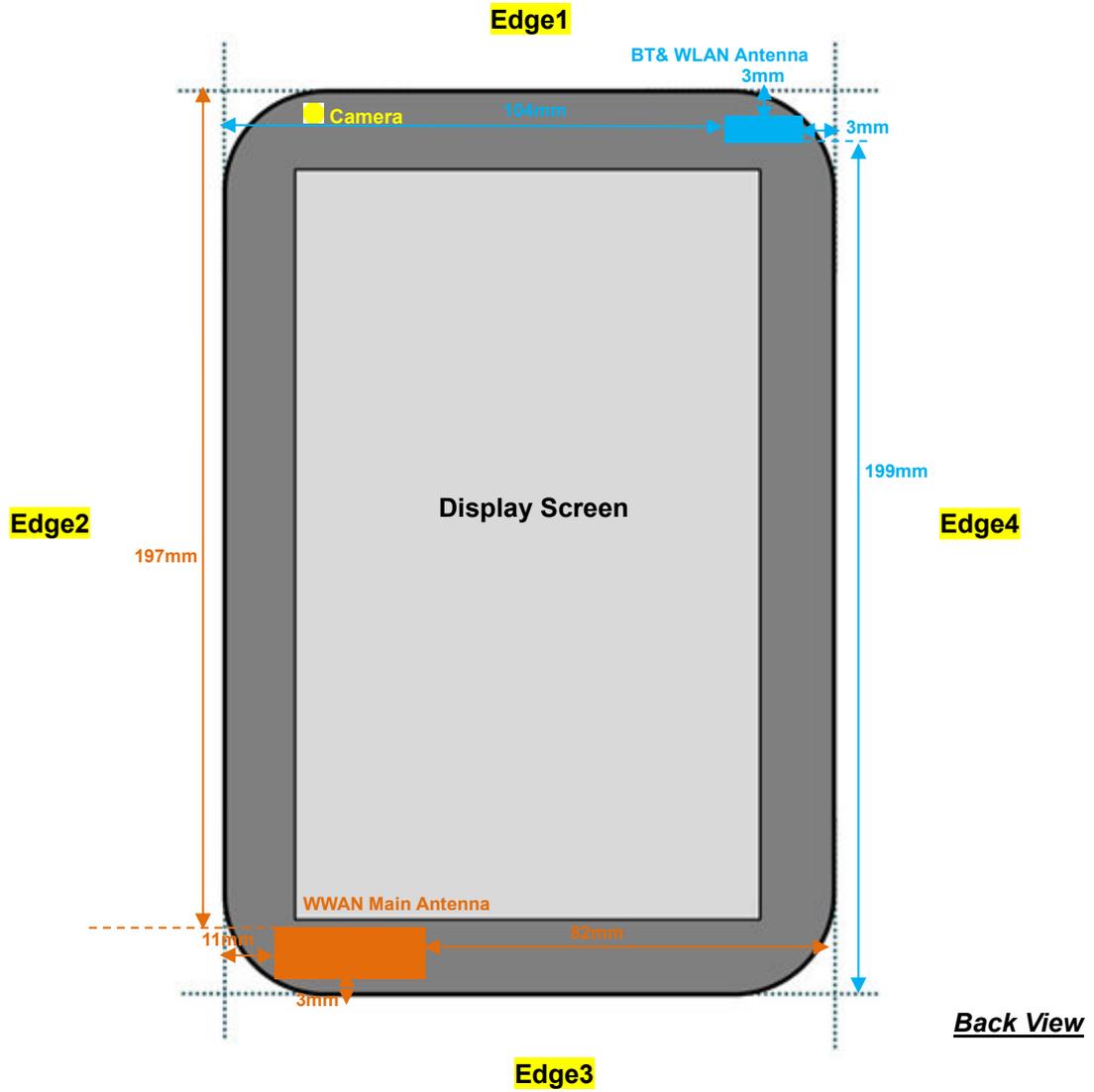
**<WLAN Conducted Power>**

**General Note:**

1. Per KDB 248227 D01 v02r02, SAR test reduction is determined according to 802.11 transmission mode configurations and certain exposure conditions with multiple test positions. In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration must be determined for each standalone and aggregated frequency band, according to the transmission mode configuration with the highest maximum output power specified for production units to perform SAR measurements. If the same highest maximum output power applies to different combinations of channel bandwidths, modulations and data rates, additional procedures are applied to determine which test configurations require SAR measurement. When applicable, an initial test position may be applied to reduce the number of SAR measurements required for next to the ear, UMPC mini-tablet or hotspot mode configurations with multiple test positions.
2. For 2.4 GHz 802.11b DSSS, either the initial test position procedure for multiple exposure test positions or the DSSS procedure for fixed exposure position is applied; these are mutually exclusive. For 2.4 GHz and 5 GHz OFDM configurations, the initial test configuration is applied to measure SAR using either the initial test position procedure for multiple exposure test position configurations or the initial test configuration procedures for fixed exposure test conditions. Based on the reported SAR of the measured configurations and maximum output power of the transmission mode configurations that are not included in the initial test configuration, the subsequent test configuration and initial test position procedures are applied to determine if SAR measurements are required for the remaining OFDM transmission configurations. In general, the number of test channels that require SAR measurement is minimized based on maximum output power measured for the test sample(s).
3. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel for each frequency band.
4. DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures.18 The initial test position procedure is described in the following:
  - a. When the reported SAR of the initial test position is  $\leq 0.4$  W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and 802.11 transmission mode combinations within the frequency band or aggregated band.
  - b. When the reported SAR of the test position is  $> 0.4$  W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is  $\leq 0.8$  W/kg or all required test position are tested.
  - c. For all positions/configurations, when the reported SAR is  $> 0.8$  W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is  $\leq 1.2$  W/kg or all required channels are tested.

	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Duty Cycle %
2.4GHz WLAN	802.11b	CH 1	2412	1Mbps	13.34	98.13
		CH 6	2437		<b>13.85</b>	
		CH 11	2462		13.47	
	802.11g	CH 1	2412	6Mbps	12.47	89.17
		CH 6	2437		12.83	
		CH 11	2462		12.56	
	802.11n-HT20	CH 1	2412	MCS0	10.45	87.77
		CH 6	2437		10.80	
		CH 11	2462		10.54	
	802.11n-HT40	CH 03	2422	MCS0	10.40	78.85
		CH 06	2437		10.79	
		CH 09	2452		10.66	

### 14. Antenna Location



Diagonal Dimension: 241mm



**General Note:**

1. The below table, when the distance is < 50 mm exclusion threshold is "Ratio", when the distance is > 50 mm exclusion threshold is "mW"
2. Maximum power is the source-based time-average power and represents the maximum RF output power among production units
3. Per KDB 447498 D01 v06, for larger devices, the test separation distance of adjacent edge configuration is determined by the closest separation between the antenna and the user.
4. Per KDB 447498 D01 v06, standalone SAR test exclusion threshold is applied; If the test separation distance is < 5mm, 5mm is used to determine SAR exclusion threshold.
5. Per KDB 447498 D01 v06, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:
  - $[(max. \text{ power of channel, including tune-up tolerance, mW}) / (min. \text{ test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$  for 1-g SAR and ≤ 7.5 for 10-g extremity SAR
  - f(GHz) is the RF channel transmit frequency in GHz
  - Power and distance are rounded to the nearest mW and mm before calculation
  - The result is rounded to one decimal place for comparison
6. Per KDB 447498 D01 v06, at 100 MHz to 6 GHz and for *test separation distances* > 50 mm, the SAR test exclusion threshold is determined according to the following
  - a) [Threshold at 50 mm in step 1) + (test separation distance - 50 mm) · ( f(MHz)/150)] mW, at 100 MHz to 1500 MHz
  - b) [Threshold at 50 mm in step 1) + (test separation distance - 50 mm) · 10] mW at > 1500 MHz and ≤ 6 GHz

**SAR test exclusion table distance is ≤ 50mm**

Exposure Position	Wireless Interface	GPRS 850 4 Tx slots	GPRS 1900 4 Tx slots	TDD LTE Band 41	BT 2.4GHz	WLAN 2.4GHz 802.11b
	Calculated Frequency (MHz)	848.8	1909.8	2652.5	2480	2462
	Tune-up Maximum power (dBm)	26.5	23.0	22.5	5.0	14.0
Bottom Face	Antenna to user (mm)	5			5	
	SAR exclusion threshold	82.3	55.3	58.4	0.9	7.9
	SAR testing required?	Yes	Yes	Yes	No	Yes
Edge 1	Antenna to user (mm)	11			3	
	SAR exclusion threshold				0.9	7.9
	SAR testing required?				No	Yes
Edge 2	Antenna to user (mm)	11				
	SAR exclusion threshold	37.4	25.1	26.5		
	SAR testing required?	Yes	Yes	Yes		
Edge 3	Antenna to user (mm)	3				
	SAR exclusion threshold	82.3	55.3	58.4		
	SAR testing required?	Yes	Yes	Yes		
Edge 4	Antenna to user (mm)	3			3	
	SAR exclusion threshold				0.9	7.9
	SAR testing required?				No	Yes



**SAR test exclusion table distance is >50mm**

Exposure Position	Wireless Interface	GPRS 850 4 Tx slots	GPRS 1900 4 Tx slots	TDD LTE Band 41	BT 2.4GHz	WLAN 2.4GHz 802.11b	
		Calculated Frequency (MHz)	848.8	1909.8	2652.5	2480	2462
	Tune-up Maximum power (dBm)	26.5	23.0	22.5	5.0	14.0	
	Tune-up Maximum rated power (mW)	447.0	200.0	178.0	3.0	25.0	
Edge 1	Antenna to user (mm)	197					
	SAR exclusion threshold	994.0	1579.0	1561.0			
	SAR testing required?	No	No	No			
Edge 2	Antenna to user (mm)					104	
	SAR exclusion threshold				635.0	636.0	
	SAR testing required?				No	No	
Edge 3	Antenna to user (mm)					199	
	SAR exclusion threshold				1585.0	1586.0	
	SAR testing required?				No	No	
Edge 4	Antenna to user (mm)	82					
	SAR exclusion threshold	344.0	429.0	411.0			
	SAR testing required?	Yes	No	No			

## 15. SAR Test Results

### General Note:

1. Per KDB 447498 D01 v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
  - a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
  - b. Duty cycle of TDD was fixed, therefore not require scaled to 100% of duty cycle. For SAR system, the crest factor 1:1.59 (62.9%) was used perform testing. Considering the theoretical duty cycle of 63.3% for extended cyclic prefix in the uplink, and the theoretical duty cycle of 62.9% for normal cyclic prefix in uplink, a scaling factor of extended cyclic prefix  $63.3\%/62.9\% = 1.006$  is applied to scale-up the measured SAR result.
  - c. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
  - d. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)\*Tune-up Scaling Factor
  - e. For WLAN: Reported SAR(W/kg)= Measured SAR(W/kg)\* Duty Cycle scaling factor \* Tune-up scaling factor
  - f. For TDD LTE Band: Reported SAR(W/kg)= Measured SAR(W/kg)\* scaling factor for extended cyclic prefix \* Tune-up scaling factor
2. Per KDB 447498 D01 v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
  - $\leq 0.8$  W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is  $\leq 100$  MHz
  - $\leq 0.6$  W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
  - $\leq 0.4$  W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is  $\geq 200$  MHz
3. For the exposure positions that proximity sensor power reduction is applied for SAR compliance, additional SAR testing with EUT transmitting full power in normal mode was performed; 1.0cm for bottom face and 0.8cm for edge 3.
4. Considering the curvature transition from bottom face to the edge, SAR testing at the curvature was performed. The SAR test setup is included in test setup photo exhibit, and the details of the curvature are included in operation description exhibit.
5. For SAR testing of the curved region of the device, the device was placed directly against the phantom at the point where the distance between the antenna and device exterior is a minimum.
6. Curved region diagram of the device according to the test setup photo (exterior radius dimension), for WWAN, X=1.40mm, Y=3.07mm, Z=1.37mm, X>Z, Y>Z, Per KDB 616217 D04 v01r02, curved SAR evaluation is required. More detail information please refer to the setup photo.
7. Per source-based time-averaged output power including tune-up tolerance, for modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested, therefore, the GPRS 4Tx slots modes was selected when EUT operating without power back-off, the GPRS 4Tx slots modes was selected when EUT operating with power back-off, according to the highest source-based time-averaged output power.
8. Per KDB 941225 D05 v02r05, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
9. Per KDB 941225 D05 v02r05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
10. Per KDB 941225 D05 v02r05, For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are  $\leq 0.8$  W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is  $> 1.45$  W/kg, the remaining required test channels must also be tested.
11. Per KDB 941225 D05 v02r05, 16QAM output power for each RB allocation configuration is  $>$  not  $\frac{1}{2}$  dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is  $\leq 1.45$  W/kg; Per KDB 941225 D05 v02r05, 16QAM SAR testing is not required.
12. Per KDB 941225 D05 v02r05, Smaller bandwidth output power for each RB allocation configuration is  $>$  not  $\frac{1}{2}$  dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is  $\leq 1.45$  W/kg; Per KDB 941225 D05 v02r05, smaller bandwidth SAR testing is not required.
13. During SAR testing the WLAN transmission was verified using a spectrum analyzer.
14. Additional WLAN SAR Test Position of bottom Face 1.0cm testing was performed for simultaneous transmission analysis.



**15.1 Body Accessory SAR**

**<GSM SAR>**

Plot No.	Band	Mode	Test Position	Gap (cm)	Power Back-off	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Sample	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
01	GSM850	GPRS ( 4 Tx slots)	Bottom Face	0	On	189	836.4	23.15	23.50	1.084	#1	-0.03	1.220	1.322
	<b>GSM850</b>	<b>GPRS ( 4 Tx slots)</b>	<b>Bottom Face</b>	<b>0</b>	<b>On</b>	<b>128</b>	<b>824.2</b>	<b>23.11</b>	<b>23.50</b>	<b>1.094</b>	<b>#1</b>	<b>0.01</b>	<b>1.210</b>	<b>1.324</b>
	GSM850	GPRS ( 4 Tx slots)	Bottom Face	0	On	251	848.8	23.03	23.50	1.114	#1	0.1	1.120	1.248
	GSM850	GPRS ( 4 Tx slots)	Bottom Face	0	On	128	824.2	23.11	23.50	1.094	#2	0.068	0.948	1.037
	GSM850	GPRS ( 4 Tx slots)	Bottom Face	0	On	189	836.4	23.15	23.50	1.084	#2	0.035	0.915	0.992
	GSM850	GPRS ( 4 Tx slots)	Bottom Face	0	On	251	848.8	23.03	23.50	1.114	#2	-0.05	0.739	0.823
	GSM850	GPRS ( 4 Tx slots)	Edge3	0	On	189	836.4	23.15	23.50	1.084	#1	-0.04	0.717	0.777
	GSM850	GPRS ( 4 Tx slots)	Bottom Face Curved surface of Edge3	0	On	189	836.4	23.15	23.50	1.084	#1	0.12	0.76	0.824
	GSM850	GPRS ( 4 Tx slots)	Bottom Face Curved surface of Edge3	0	On	128	824.2	23.11	23.50	1.094	#1	0.08	0.894	0.978
	GSM850	GPRS ( 4 Tx slots)	Bottom Face Curved surface of Edge3	0	On	251	848.8	23.03	23.50	1.114	#1	0.08	0.517	0.576
GSM850	GPRS ( 4 Tx slots)	Bottom Face	1	Off	189	836.4	29.08	29.50	1.102	#1	-0.04	0.752	0.828	
GSM850	GPRS ( 4 Tx slots)	Bottom Face	1	Off	128	824.2	29.07	29.50	1.104	#1	0.03	0.714	0.788	
GSM850	GPRS ( 4 Tx slots)	Bottom Face	1	Off	251	848.8	29.03	29.50	1.114	#1	0.02	0.959	1.069	
GSM850	GPRS ( 4 Tx slots)	Edge2	0	Off	189	836.4	29.08	29.50	1.102	#1	-0.1	0.398	0.438	
GSM850	GPRS ( 4 Tx slots)	Edge3	0.8	Off	189	836.4	29.08	29.50	1.102	#1	-0.1	0.594	0.654	
GSM850	GPRS ( 4 Tx slots)	Edge4	0	Off	189	836.4	29.08	29.50	1.102	#1	0.1	0.077	0.085	
GSM1900	GPRS ( 4 Tx slots)	Bottom Face	0	On	512	1850.2	17.54	18.00	1.112	#1	0.15	0.669	0.744	
GSM1900	GPRS ( 4 Tx slots)	Edge3	0	On	512	1850.2	17.54	18.00	1.112	#1	-0.05	0.367	0.408	
GSM1900	GPRS ( 4 Tx slots)	Bottom Face Curved surface of Edge3	0	On	512	1850.2	17.54	18.00	1.112	#1	0.07	0.767	0.853	
GSM1900	GPRS ( 4 Tx slots)	Bottom Face Curved surface of Edge3	0	On	661	1880	17.48	18.00	1.127	#1	-0.16	0.755	0.851	
GSM1900	GPRS ( 4 Tx slots)	Bottom Face Curved surface of Edge3	0	On	810	1909.8	17.36	18.00	1.159	#1	-0.02	0.772	0.895	
GSM1900	GPRS ( 4 Tx slots)	Bottom Face	1	Off	512	1850.2	25.53	26.00	1.114	#1	0.09	0.896	0.998	
GSM1900	GPRS ( 4 Tx slots)	Bottom Face	1	Off	661	1880	25.40	26.00	1.148	#1	0.1	0.928	1.065	
GSM1900	GPRS ( 4 Tx slots)	Bottom Face	1	Off	810	1909.8	25.37	26.00	1.156	#1	0.06	0.909	1.051	
GSM1900	GPRS ( 4 Tx slots)	Bottom Face	1	Off	661	1880	25.40	26.00	1.148	#2	0.17	0.947	1.087	
02	<b>GSM1900</b>	<b>GPRS ( 4 Tx slots)</b>	<b>Bottom Face</b>	<b>1</b>	<b>Off</b>	<b>512</b>	<b>1850.2</b>	<b>25.53</b>	<b>26.00</b>	<b>1.114</b>	<b>#2</b>	<b>-0.07</b>	<b>0.980</b>	<b>1.092</b>
GSM1900	GPRS ( 4 Tx slots)	Bottom Face	1	Off	810	1909.8	25.37	26.00	1.156	#2	-0.17	0.853	0.986	
GSM1900	GPRS ( 4 Tx slots)	Edge2	0	Off	512	1850.2	25.53	26.00	1.114	#1	0.05	0.754	0.840	
GSM1900	GPRS ( 4 Tx slots)	Edge2	0	Off	661	1880	25.40	26.00	1.148	#1	-0.04	0.782	0.898	
GSM1900	GPRS ( 4 Tx slots)	Edge2	0	Off	810	1909.8	25.37	26.00	1.156	#1	0.1	0.726	0.839	
GSM1900	GPRS ( 4 Tx slots)	Edge3	0.8	Off	512	1850.2	25.53	26.00	1.114	#1	-0.05	0.589	0.656	



<TDD LTE SAR>

Plot No.	Band	Mode	BW (MHz)	RB Size	RB Offset	Test Position	Gap (cm)	Power Back-off	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Sample	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	TDD LTE Band 41	20M	1	99	QPSK	Bottom Face	0	On	40690	2600	14.05	14.50	1.109	62.9	1.006	#1	0.01	0.821	0.916
	TDD LTE Band 41	20M	1	99	QPSK	Bottom Face	0	On	40240	2550	13.91	14.50	1.146	62.9	1.006	#1	-0.16	0.792	0.913
	TDD LTE Band 41	20M	1	99	QPSK	Bottom Face	0	On	41140	2645	13.98	14.50	1.127	62.9	1.006	#1	-0.068	0.806	0.914
	TDD LTE Band 41	20M	50	49	QPSK	Bottom Face	0	On	40690	2600	13.98	14.50	1.127	62.9	1.006	#1	-0.07	0.824	0.934
	TDD LTE Band 41	20M	50	49	QPSK	Bottom Face	0	On	40240	2550	13.72	14.50	1.197	62.9	1.006	#1	-0.07	0.785	0.945
	TDD LTE Band 41	20M	50	49	QPSK	Bottom Face	0	On	41140	2645	13.85	14.50	1.161	62.9	1.006	#1	-0.086	0.815	0.952
	TDD LTE Band 41	20M	100	0	QPSK	Bottom Face	0	On	40690	2600	13.92	14.50	1.143	62.9	1.006	#1	0.1	0.824	0.947
	TDD LTE Band 41	20M	1	99	QPSK	Edge3	0	On	40690	2600	14.05	14.50	1.109	62.9	1.006	#1	0.02	0.678	0.757
	TDD LTE Band 41	20M	1	99	QPSK	Edge3	0	On	40240	2550	13.91	14.50	1.146	62.9	1.006	#1	-0.18	0.699	0.806
	TDD LTE Band 41	20M	1	99	QPSK	Edge3	0	On	41140	2645	13.98	14.50	1.127	62.9	1.006	#1	-0.05	0.829	0.940
	TDD LTE Band 41	20M	50	49	QPSK	Edge3	0	On	40690	2600	13.98	14.50	1.127	62.9	1.006	#1	-0.16	0.686	0.778
	TDD LTE Band 41	20M	50	49	QPSK	Edge3	0	On	40240	2550	13.72	14.50	1.197	62.9	1.006	#1	-0.01	0.755	0.909
	TDD LTE Band 41	20M	50	49	QPSK	Edge3	0	On	41140	2645	13.85	14.50	1.161	62.9	1.006	#1	0.09	0.829	0.969
	TDD LTE Band 41	20M	100	0	QPSK	Edge3	0	On	40690	2600	13.92	14.50	1.143	62.9	1.006	#1	-0.08	0.764	0.878
	TDD LTE Band 41	20M	1	99	QPSK	Bottom Face Curved surface of Edge3	0	On	40690	2600	14.05	14.50	1.109	62.9	1.006	#1	-0.023	0.916	1.022
	TDD LTE Band 41	20M	1	99	QPSK	Bottom Face Curved surface of Edge3	0	On	40240	2550	13.91	14.50	1.146	62.9	1.006	#1	-0.17	0.884	1.019
	TDD LTE Band 41	20M	1	99	QPSK	Bottom Face Curved surface of Edge3	0	On	41140	2645	13.98	14.50	1.127	62.9	1.006	#1	-0.14	0.912	1.034
	TDD LTE Band 41	20M	50	49	QPSK	Bottom Face Curved surface of Edge3	0	On	40690	2600	13.98	14.50	1.127	62.9	1.006	#1	-0.062	0.921	1.044
	TDD LTE Band 41	20M	50	49	QPSK	Bottom Face Curved surface of Edge3	0	On	40240	2550	13.72	14.50	1.197	62.9	1.006	#1	0.094	0.877	1.056
	TDD LTE Band 41	20M	50	49	QPSK	Bottom Face Curved surface of Edge3	0	On	41140	2645	13.85	14.50	1.161	62.9	1.006	#1	0.034	0.923	1.078
	TDD LTE Band 41	20M	100	0	QPSK	Bottom Face Curved surface of Edge3	0	On	40690	2600	13.92	14.50	1.143	62.9	1.006	#1	-0.046	0.926	1.065



Plot No.	Band	Mode	BW (MHz)	RB Size	RB Offset	Test Position	Gap (cm)	Power Back-off	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Sample	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	TDD LTE Band 41	20M	50	49	QPSK	Bottom Face Curved surface of Edge3	0	On	41140	2645	13.85	14.50	1.161	62.9	1.006	#2	-0.057	0.862	1.007
	TDD LTE Band 41	20M	50	49	QPSK	Bottom Face Curved surface of Edge3	0	On	40690	2600	13.98	14.50	1.127	62.9	1.006	#2	0.02	0.886	1.005
<b>03</b>	<b>TDD LTE Band 41</b>	<b>20M</b>	<b>50</b>	<b>49</b>	<b>QPSK</b>	<b>Bottom Face Curved surface of Edge3</b>	<b>0</b>	<b>On</b>	<b>40240</b>	<b>2550</b>	<b>13.72</b>	<b>14.50</b>	<b>1.197</b>	<b>62.9</b>	<b>1.006</b>	<b>#2</b>	<b>0.01</b>	<b>0.962</b>	<b>1.158</b>
	TDD LTE Band 41	20M	1	99	QPSK	Bottom Face	1	Off	40690	2600	21.96	22.50	1.132	62.9	1.006	#1	0.05	0.56	0.638
	TDD LTE Band 41	20M	1	99	QPSK	Bottom Face	1	Off	40240	2550	21.73	22.50	1.194	62.9	1.006	#1	0.04	0.455	0.547
	TDD LTE Band 41	20M	1	99	QPSK	Bottom Face	1	Off	41140	2645	21.82	22.50	1.169	62.9	1.006	#1	0.05	0.511	0.601
	TDD LTE Band 41	20M	50	49	QPSK	Bottom Face	1	Off	40690	2600	20.97	21.50	1.130	62.9	1.006	#1	0.02	0.467	0.531
	TDD LTE Band 41	20M	100	0	QPSK	Bottom Face	1	Off	40690	2600	20.93	21.50	1.140	62.9	1.006	#1	-0.09	0.491	0.563
	TDD LTE Band 41	20M	1	99	QPSK	Edge2	0	Off	40690	2600	21.96	22.50	1.132	62.9	1.006	#1	-0.1	0.332	0.378
	TDD LTE Band 41	20M	50	49	QPSK	Edge2	0	Off	40690	2600	20.97	21.50	1.130	62.9	1.006	#1	-0.08	0.292	0.332
	TDD LTE Band 41	20M	1	99	QPSK	Edge3	0.8	Off	40690	2600	21.96	22.50	1.132	62.9	1.006	#1	-0.12	0.674	0.768
	TDD LTE Band 41	20M	1	99	QPSK	Edge3	0.8	Off	40240	2550	21.73	22.50	1.194	62.9	1.006	#1	-0.1	0.562	0.675
	TDD LTE Band 41	20M	1	99	QPSK	Edge3	0.8	Off	41140	2645	21.82	22.50	1.169	62.9	1.006	#1	-0.19	0.711	0.837
	TDD LTE Band 41	20M	50	49	QPSK	Edge3	0.8	Off	40690	2600	20.97	21.50	1.130	62.9	1.006	#1	-0.06	0.553	0.629
	TDD LTE Band 41	20M	50	49	QPSK	Edge3	0.8	Off	40240	2550	20.72	21.50	1.197	62.9	1.006	#1	-0.18	0.572	0.689
	TDD LTE Band 41	20M	50	49	QPSK	Edge3	0.8	Off	41140	2645	20.90	21.50	1.148	62.9	1.006	#1	-0.19	0.589	0.680
	TDD LTE Band 41	20M	100	0	QPSK	Edge3	0.8	Off	40690	2600	20.93	21.50	1.140	62.9	1.006	#1	-0.13	0.580	0.665

**<DTS WLAN SAR>**

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Sample	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN 2.4GHz	802.11b 1Mbps	Bottom Face	0	6	2437	13.85	14.00	1.035	98.13	1.019	#1	0.03	0.976	1.029
<b>04</b>	<b>WLAN 2.4GHz</b>	<b>802.11b 1Mbps</b>	<b>Bottom Face</b>	<b>0</b>	<b>11</b>	<b>2462</b>	<b>13.47</b>	<b>14.00</b>	<b>1.130</b>	<b>98.13</b>	<b>1.019</b>	<b>#1</b>	<b>0.11</b>	<b>0.940</b>	<b>1.082</b>
	WLAN 2.4GHz	802.11b 1Mbps	Bottom Face	0	11	2462	13.47	14.00	1.130	98.13	1.019	#2	0.12	0.760	0.875
	WLAN 2.4GHz	802.11b 1Mbps	Bottom Face	0	6	2437	13.85	14.00	1.035	98.13	1.019	#2	-0.12	0.868	0.916
	WLAN 2.4GHz	802.11b 1Mbps	Edge1	0	6	2437	13.85	14.00	1.035	98.13	1.019	#1	-0.029	0.650	0.686
	WLAN 2.4GHz	802.11b 1Mbps	Edge4	0	6	2437	13.85	14.00	1.035	98.13	1.019	#1	0.06	0.264	0.278
	WLAN 2.4GHz	802.11b 1Mbps	Bottom Face	1	6	2437	13.85	14.00	1.035	98.13	1.019	#1	0.02	0.101	0.107



**15.2 Repeated SAR Measurement**

Plot No.	Band	Mode	BW (MHz)	RB Size	RB Offset	Test Position	Gap (cm)	Power Back-off	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Sample	Power Drift (dB)	Measured 1g SAR (W/kg)	Ratio	Reported 1g SAR (W/kg)
1st	GSM850	GPRS (4 Tx slots)	-	-	-	Bottom Face	0	On	189	836.4	23.15	23.50	1.084	-	-	#1	-0.03	1.220	1	1.322
2nd	GSM850	GPRS (4 Tx slots)	-	-	-	Bottom Face	0	On	189	836.4	23.15	23.50	1.084	-	-	#1	-0.01	1.210	1.008	1.312
1st	GSM1900	GPRS (4 Tx slots)	-	-	-	Bottom Face	1	Off	512	1850.2	25.53	26.00	1.114	-	-	#2	-0.07	0.980	1	1.092
2nd	GSM1900	GPRS (4 Tx slots)	-	-	-	Bottom Face	1	Off	512	1850.2	25.53	26.00	1.114	-	-	#2	-0.09	0.961	1.019	1.071
1st	TDD LTE Band 41	QPSK	20M	50	49	Bottom Face Curved surface of Edge3	0	On	40240	2550	13.72	14.50	1.197	62.9	1.006	#2	0.01	0.962	1	1.158
2nd	TDD LTE Band 41	QPSK	20M	50	49	Bottom Face Curved surface of Edge3	0	On	40240	2550	13.72	14.50	1.197	62.9	1.006	#2	0.056	0.959	1.003	1.155
1st	WLAN 2.4GHz	802.11b 1Mbps	-	-	-	Bottom Face	0	Off	6	2437	13.85	14.00	1.035	98.13	1.019	#1	0.03	0.976	1	1.029
2nd	WLAN 2.4GHz	802.11b 1Mbps	-	-	-	Bottom Face	0	Off	6	2437	13.85	14.00	1.035	98.13	1.019	#1	0.09	0.933	1.044	0.984

**General Note:**

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8W/kg$ .
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is  $\leq 1.2$  and the measured SAR  $< 1.45W/kg$ , only one repeated measurement is required.
3. The ratio is the difference in percentage between original and repeated *measured SAR*.
4. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

**16. Simultaneous Transmission Analysis**

NO.	Simultaneous Transmission Configurations	Tablet	Note
		Body	
1.	GPRS/EDGE(Data) + WLAN2.4GHz(data)	Yes	2.4GHz Hotspot
2.	LTE(Data) + WLAN2.4GHz(data)	Yes	2.4GHz Hotspot
3.	GPRS/EDGE(Data) + Bluetooth(data)	Yes	Bluetooth Tethering
4.	LTE(Data) + Bluetooth(data)	Yes	Bluetooth Tethering

**General Note:**

1. EUT will choose each GSM and LTE according to the network signal condition; therefore, they will not operate simultaneously at any moment.
2. WLAN and Bluetooth share the same antenna, and cannot transmit simultaneously.
3. The Scaled SAR summation is calculated based on the same configuration and test position.
4. Per KDB 447498 D01 v06, simultaneous transmission SAR is compliant if,
  - i) Scalar SAR summation < 1.6W/kg.
  - ii)  $SPLSR = (SAR1 + SAR2)^{1.5} / (\text{min. separation distance, mm})$ , and the peak separation distance is determined from the square root of  $[(x1-x2)^2 + (y1-y2)^2 + (z1-z2)^2]$ , where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
  - iii) If  $SPLSR \leq 0.04$ , simultaneously transmission SAR measurement is not necessary.
  - iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.
  - v) The SPLSR calculated results please refer to section 16.2.
5. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01 v06 based on the formula below.
  - i)  $(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm}) \cdot [\sqrt{f(\text{GHz})}]^x \text{ W/kg}$  for test separation distances  $\leq 50 \text{ mm}$ ; where  $x = 7.5$  for 1-g SAR, and  $x = 18.75$  for 10-g SAR.
  - ii) When the minimum separation distance is < 5mm, the distance is used 5mm to determine SAR test exclusion.
  - iii) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm.
  - iv) Bluetooth estimated SAR is conservatively determined by 5mm separation, for all applicable exposure positions.

Bluetooth Max Power	Exposure Position	All Positions
5.0 dBm	Estimated SAR (W/kg)	0.126 W/kg



**16.1 Body Accessory Exposure Conditions**

**<WWAN PCB + WLAN DTS>**

WWAN Band		Exposure Position	WWAN PCB	WLAN DTS	Summed SAR (W/kg)	SPLSR	Case No
			Max. WWAN SAR (W/kg)	Max. WLAN SAR (W/kg)			
GSM	GSM850	Bottom Face at 1cm	1.069	0.107	1.18		
		Bottom Face at 0cm	1.324	1.082	2.41	0.02	#1
		Edge1 at 0cm		0.686	0.69		
		Edge2 at 0cm	0.438		0.44		
		Edge3 at 0cm	0.777		0.78		
		Edge3 at 0.8cm	0.654		0.65		
		Edge4 at 0cm	0.085	0.278	0.36		
		Bottom Face Curved surface of Edge3	0.978		0.98		
	GSM1900	Bottom Face at 1cm	1.092	0.107	1.20		
		Bottom Face at 0cm	0.744	1.082	1.83	0.01	#2
		Edge1 at 0cm		0.686	0.69		
		Edge2 at 0cm	0.898		0.90		
		Edge3 at 0cm	0.408		0.41		
		Edge3 at 0.8cm	0.656		0.66		
Edge4 at 0cm			0.278	0.28			
	Bottom Face Curved surface of Edge3	0.895		0.90			
LTE	Band 41	Bottom Face at 1cm	0.638	0.107	0.75		
		Bottom Face at 0cm	0.952	1.082	2.03	0.01	#3
		Edge1 at 0cm		0.686	0.69		
		Edge2 at 0cm	0.378		0.38		
		Edge3 at 0cm	0.969		0.97		
		Edge3 at 0.8cm	0.837		0.84		
		Edge4 at 0cm		0.278	0.28		
	Bottom Face Curved surface of Edge3	1.158		1.16			



<WWAN PCB + Bluetooth DSS>

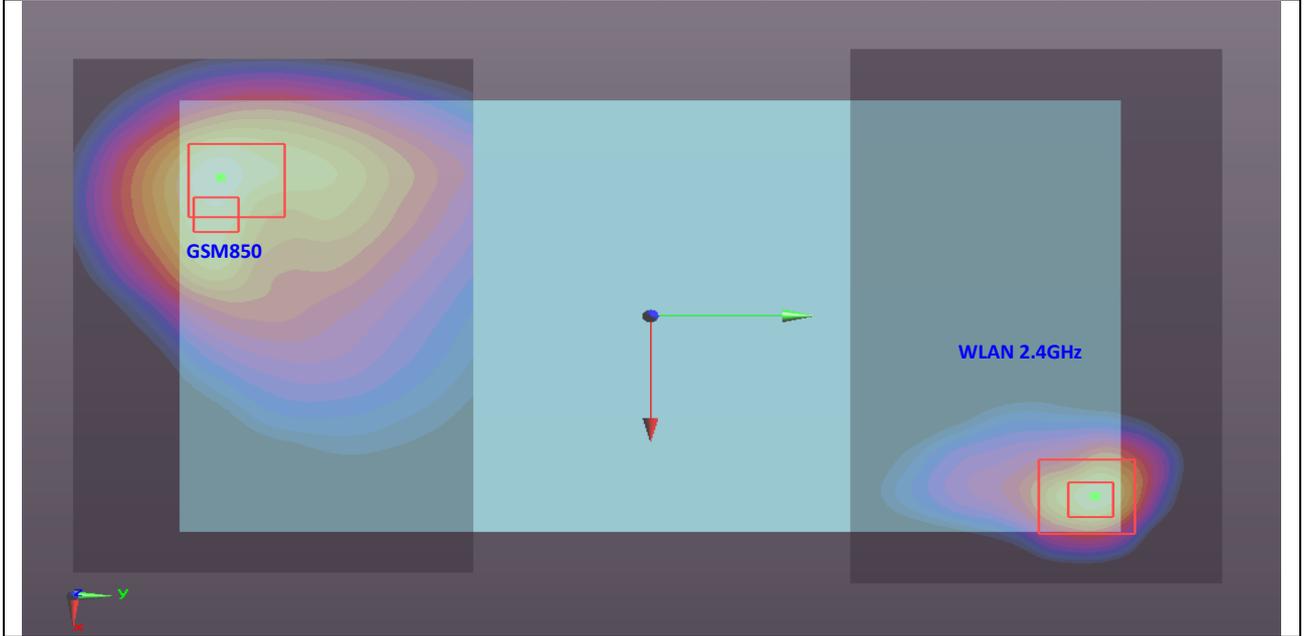
WWAN Band		Exposure Position	WWAN PCB	Bluetooth DSS	Summed SAR (W/kg)	SPLSR	Case No
			Max. WWAN SAR (W/kg)	Estimated Bluetooth SAR (W/kg)			
GSM	GSM850	Bottom Face at 1cm	1.069	0.126	1.20		
		Bottom Face at 0cm	1.324	0.126	1.45		
		Edge1 at 0cm		0.126	0.13		
		Edge2 at 0cm	0.438	0.126	0.56		
		Edge3 at 0cm	0.777	0.126	0.90		
		Edge3 at 0.8cm	0.654	0.126	0.78		
		Edge4 at 0cm	0.085	0.126	0.21		
		Bottom Face Curved surface of Edge3	0.978	0.126	1.10		
	GSM1900	Bottom Face at 1cm	1.092	0.126	1.22		
		Bottom Face at 0cm	0.744	0.126	0.87		
		Edge1 at 0cm		0.126	0.13		
		Edge2 at 0cm	0.898	0.126	1.02		
		Edge3 at 0cm	0.408	0.126	0.53		
		Edge3 at 0.8cm	0.656	0.126	0.78		
Edge4 at 0cm			0.126	0.13			
	Bottom Face Curved surface of Edge3	0.895	0.126	1.02			
LTE	Band 41	Bottom Face at 1cm	0.638	0.126	0.76		
		Bottom Face at 0cm	0.952	0.126	1.08		
		Edge1 at 0cm		0.126	0.13		
		Edge2 at 0cm	0.378	0.126	0.50		
		Edge3 at 0cm	0.969	0.126	1.10		
		Edge3 at 0.8cm	0.837	0.126	0.96		
		Edge4 at 0cm		0.126	0.13		
	Bottom Face Curved surface of Edge3	1.158	0.126	1.28			

### 16.2 SPLSR Evaluation and Analysis

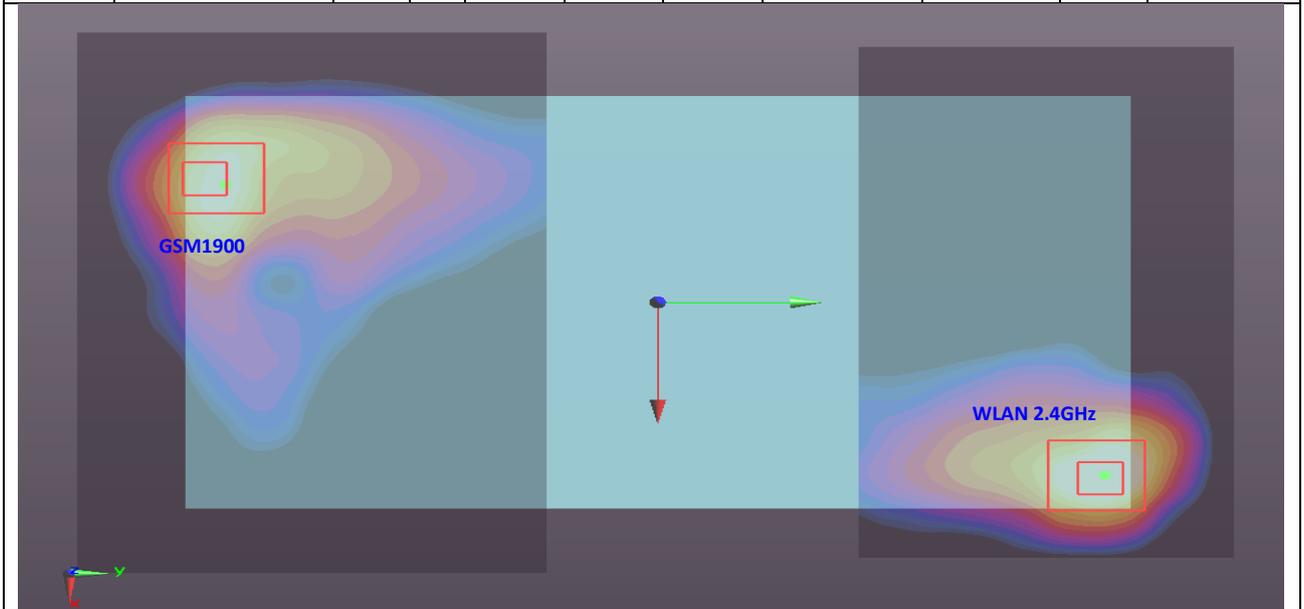
**General Note:**

$SPLSR = (SAR_1 + SAR_2)^{1.5} / (min. \text{ separation distance, mm})$ . If  $SPLSR \leq 0.04$ , simultaneously transmission SAR measurement is not necessary

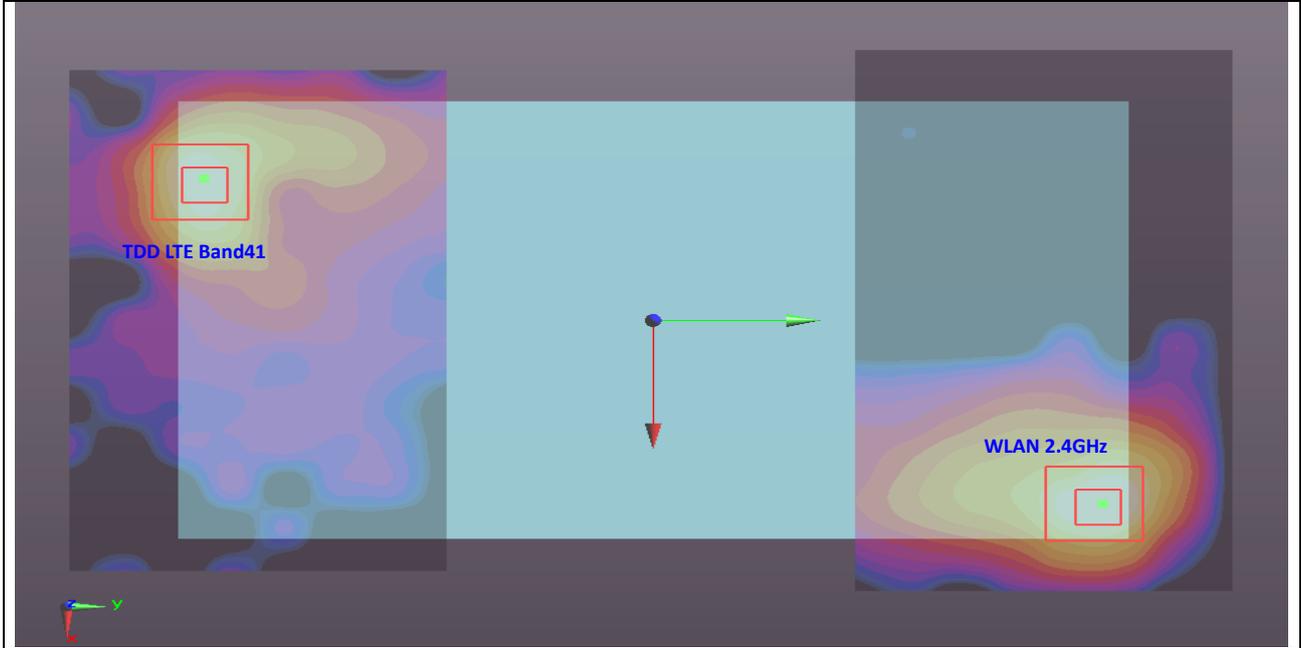
Case No #1	Band	SAR (W/kg)	Gap (cm)	SAR peak location (m)			3D distance (mm)	Pair SAR sum (W/kg)	SPLSR	Simultaneous SAR
				X	Y	Z				
Bottom Face	GSM850	1.324	0	-0.0245	-0.097	-0.179	211.6	2.41	0.02	Not required
	WLAN2.4GHz	1.082	0	0.0528	0.1	-0.178				



Case No #2	Band	SAR (W/kg)	Gap (cm)	SAR peak location (m)			3D distance (mm)	Pair SAR sum (W/kg)	SPLSR	Simultaneous SAR
				X	Y	Z				
Bottom Face	GSM1900	0.744	0	-0.036	-0.105	-0.176	223.4	1.83	0.01	Not required
	WLAN2.4GHz	1.082	0	0.0528	0.1	-0.178				



Case No #3 Position	Band	SAR (W/kg)	Gap (cm)	SAR peak location (m)			3D distance (mm)	Pair SAR sum (W/kg)	SPLSR	Simultaneous SAR
				X	Y	Z				
Bottom Face	TDD LTE Band41	0.952	0	-0.0408	-0.1	-0.179	220.8	2.03	0.01	Not required
	WLAN2.4GHz	1.082	0	0.0528	0.1	-0.178				



**Test Engineer :** Fulu Hu

## **17. Uncertainty Assessment**

The component of uncertainty may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainty by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observations is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture’s specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in table below.

<b>Uncertainty Distributions</b>	<b>Normal</b>	<b>Rectangular</b>	<b>Triangular</b>	<b>U-Shape</b>
Multi-plying Factor <sup>(a)</sup>	1/k <sup>(b)</sup>	1/√3	1/√6	1/√2

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b)  $\kappa$  is the coverage factor

**Table 17.1. Standard Uncertainty for Assumed Distribution**

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual “root-sum-squares” (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.

Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
<b>Measurement System</b>							
Probe Calibration	6.0	N	1	1	1	6.0	6.0
Axial Isotropy	4.7	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.6	R	1.732	0.7	0.7	3.9	3.9
Boundary Effects	1.0	R	1.732	1	1	0.6	0.6
Linearity	4.7	R	1.732	1	1	2.7	2.7
System Detection Limits	1.0	R	1.732	1	1	0.6	0.6
Modulation Response	3.2	R	1.732	1	1	1.8	1.8
Readout Electronics	0.3	N	1	1	1	0.3	0.3
Response Time	0.0	R	1.732	1	1	0.0	0.0
Integration Time	2.6	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.0	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.0	R	1.732	1	1	1.7	1.7
Probe Positioner	0.4	R	1.732	1	1	0.2	0.2
Probe Positioning	2.9	R	1.732	1	1	1.7	1.7
Max. SAR Eval.	2.0	R	1.732	1	1	1.2	1.2
<b>Test Sample Related</b>							
Device Positioning	3.0	N	1	1	1	3.0	3.0
Device Holder	3.6	N	1	1	1	3.6	3.6
Power Drift	5.0	R	1.732	1	1	2.9	2.9
Power Scaling	0.0	R	1.732	1	1	0.0	0.0
<b>Phantom and Setup</b>							
Phantom Uncertainty	6.1	R	1.732	1	1	3.5	3.5
SAR correction	0.0	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.2	N	1	0.78	0.71	0.1	0.1
Liquid Conductivity (target)	5.0	R	1.732	0.78	0.71	2.3	2.0
Liquid Conductivity (mea.)	2.5	R	1.732	0.78	0.71	1.1	1.0
Temp. unc. - Conductivity	3.4	R	1.732	0.78	0.71	1.5	1.4
Liquid Permittivity Repeatability	0.15	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.0	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.5	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.83	R	1.732	0.23	0.26	0.1	0.1
<b>Combined Std. Uncertainty</b>						<b>11.4%</b>	<b>11.4%</b>
<b>Coverage Factor for 95 %</b>						<b>K=2</b>	<b>K=2</b>
<b>Expanded STD Uncertainty</b>						<b>22.9%</b>	<b>22.7%</b>

**Table 17.2. Uncertainty Budget for frequency range 300 MHz to 3 GHz**

## **18. References**

- [1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”
- [2] ANSI/IEEE Std. C95.1-1992, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, September 1992
- [3] IEEE Std. 1528-2013, “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, Sep 2013
- [4] SPEAG DASY System Handbook
- [5] FCC KDB 248227 D01 v02r02, “SAR Guidance for IEEE 802.11 (WiFi) Transmitters”, Oct 2015.
- [6] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015
- [7] FCC KDB 941225 D01 v03r01, “3G SAR MEAUREMENT PROCEDURES”, Oct 2015
- [8] FCC KDB 941225 D05 v02r05, “SAR Evaluation Considerations for LTE Devices”, Dec 2015
- [9] FCC KDB 616217 D04 v01r02, “SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers”, Oct 2015
- [10] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.
- [11] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015.



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**Appendix A. Plots of System Performance Check**

The plots are shown as follows.

### System Check\_Body\_835MHz\_150611

#### DUT: D835V2 - SN:4d091

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: MSL\_835\_150611 Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.98 \text{ mho/m}$ ;  $\epsilon_r = 54.46$ ;  $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature :  $23.7 \text{ }^\circ\text{C}$  ; Liquid Temperature :  $22.9 \text{ }^\circ\text{C}$

#### DASY5 Configuration:

- Probe: EX3DV4 - SN7350; ConvF(9.42, 9.42, 9.42); Calibrated: 2015.01.08
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2014.07.14
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.4.5 (3634)

**Pin=250mW/Area Scan (61x61x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

Maximum value of SAR (interpolated) =  $3.077 \text{ mW/g}$

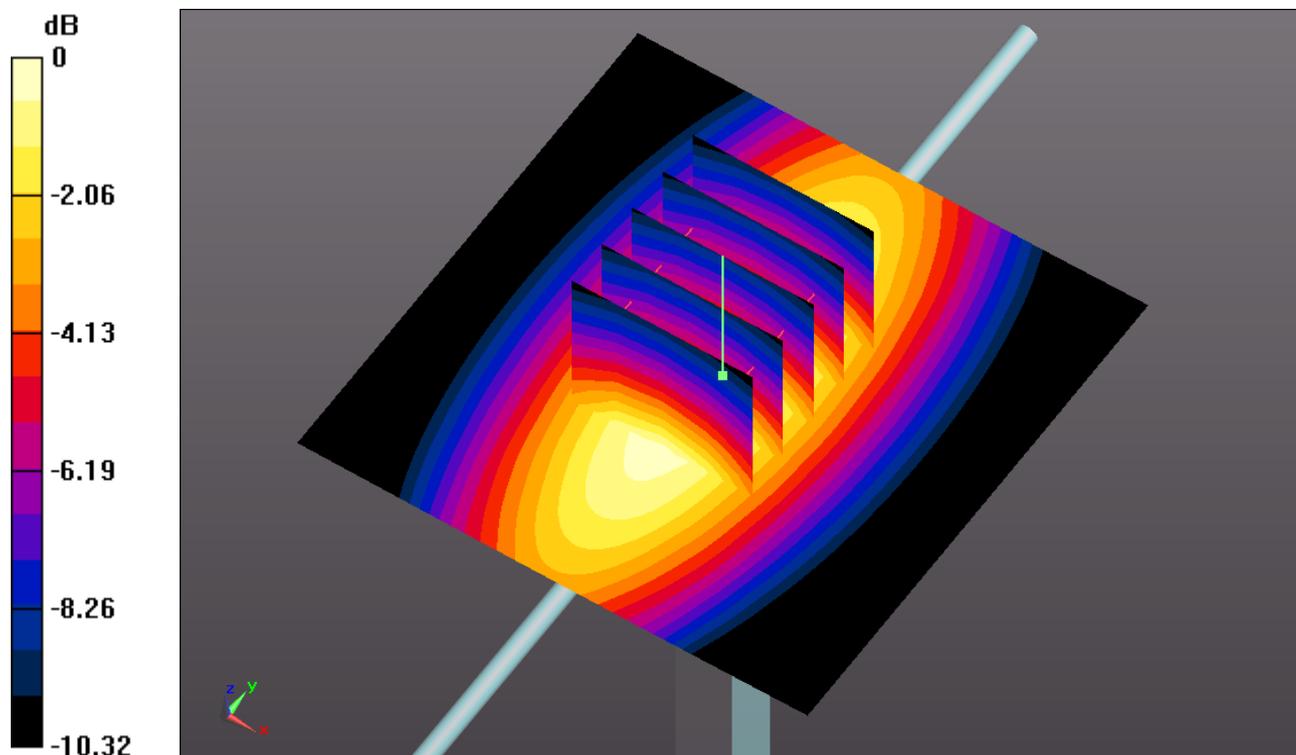
**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $51.915 \text{ V/m}$ ; Power Drift =  $-0.05 \text{ dB}$

Peak SAR (extrapolated) =  $3.395 \text{ W/kg}$

**SAR(1 g) =  $2.44 \text{ mW/g}$ ; SAR(10 g) =  $1.59 \text{ mW/g}$**

Maximum value of SAR (measured) =  $3.064 \text{ mW/g}$



0 dB =  $3.060\text{mW/g}$

### System Check\_Body\_1900MHz\_150611

#### DUT: D1900V2 - SN:5d118

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: MSL\_1900\_150611 Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.538$  mho/m;  $\epsilon_r =$

$52.792$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 23.6 °C ; Liquid Temperature : 22.8 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN7350; ConvF(7.82, 7.82, 7.82); Calibrated: 2015.01.08
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2014.07.14
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.4.5 (3634)

**Pin=250mW/Area Scan (61x61x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 14.827 mW/g

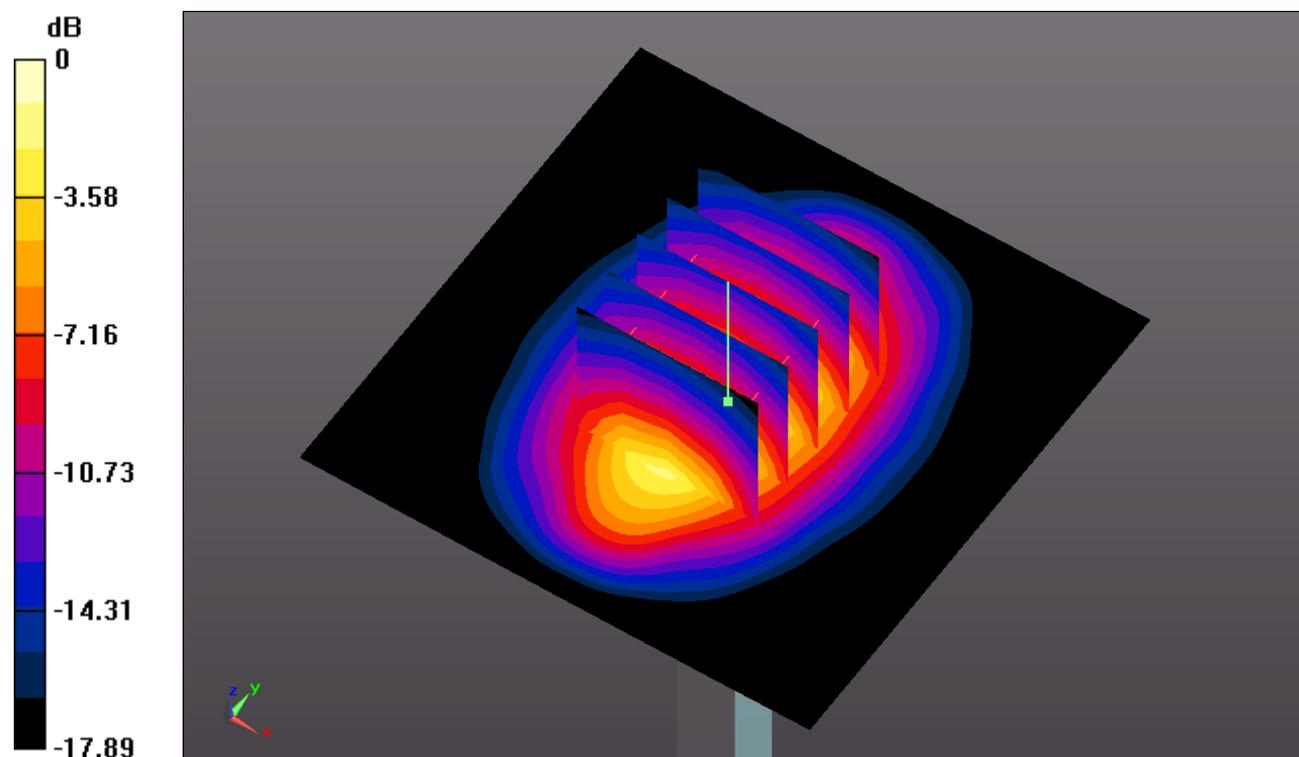
**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 87.195 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 12.239 W/kg

**SAR(1 g) = 10.36 mW/g; SAR(10 g) = 5.33 mW/g**

Maximum value of SAR (measured) = 14.873 mW/g



0 dB = 14.870mW/g

### System Check\_Body\_2450MHz\_150619

#### DUT: D2450V2 - SN:840

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL\_2450\_150619 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.943$  mho/m;  $\epsilon_r =$

$50.964$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 23.8 °C ; Liquid Temperature : 22.9 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN7350; ConvF(7.23, 7.23, 7.23); Calibrated: 2015.01.08
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2014.07.14
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.4.5 (3634)

**Pin=250mW/Area Scan (81x81x1):** Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 18.867 mW/g

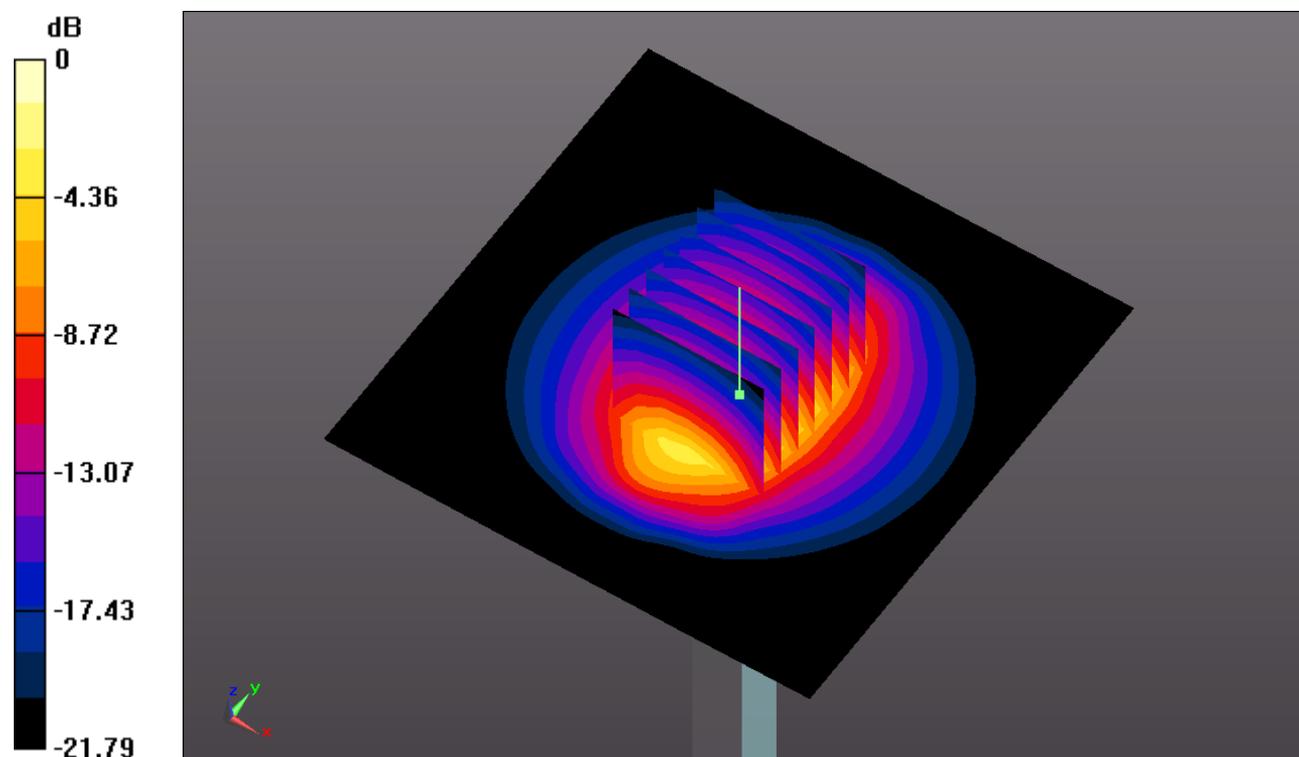
**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 86.14 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 25.070 W/kg

**SAR(1 g) = 12.69 mW/g; SAR(10 g) = 5.81 mW/g**

Maximum value of SAR (measured) = 19.571 mW/g



0 dB = 19.570mW/g

### System Check\_Body\_2600MHz\_150611

#### DUT: D2450V2 - SN:1061

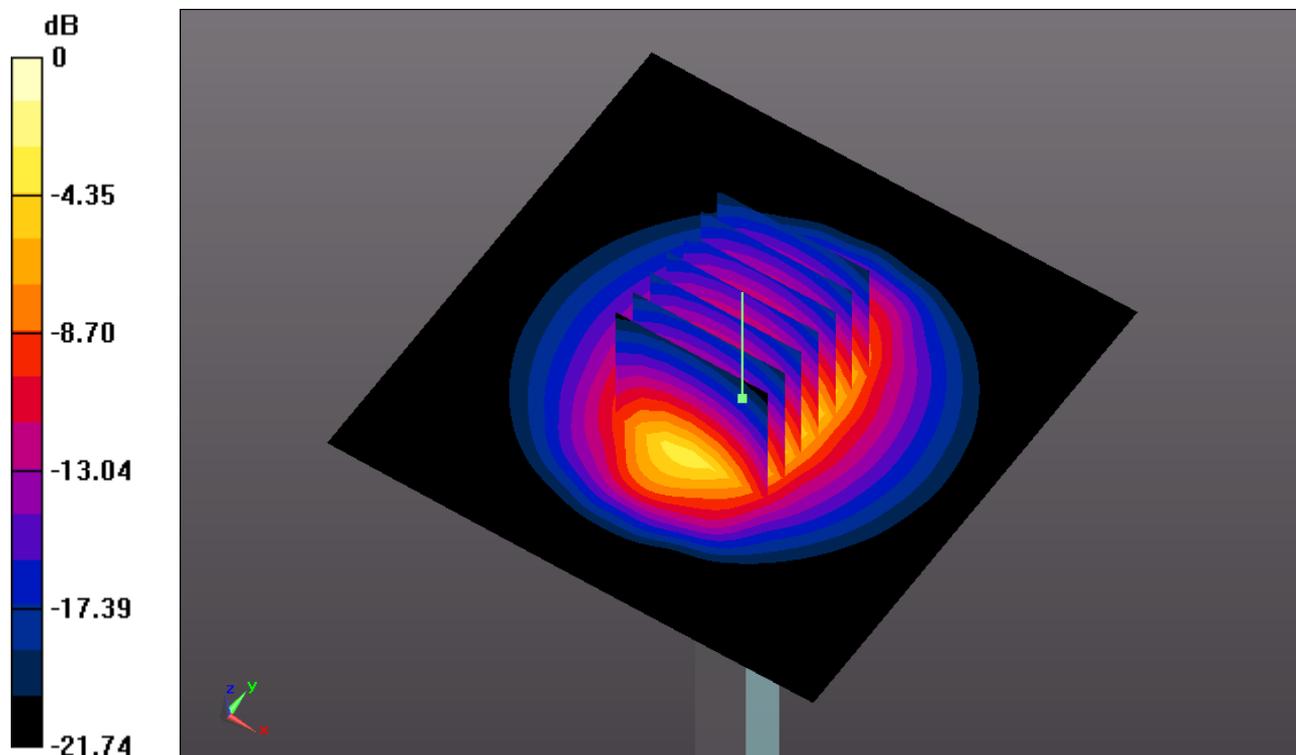
Communication System: CW (0); Frequency: 2600 MHz; Duty Cycle: 1:1  
Medium: MSL\_2600\_150611 Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.165$  mho/m;  $\epsilon_r = 53.823$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.8 °C ; Liquid Temperature : 22.8 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN7350; ConvF(7.15, 7.15, 7.15); Calibrated: 2015.01.08
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2014.07.14
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.4.5 (3634)

**Pin=250mW/Area Scan (81x81x1):** Measurement grid: dx=12mm, dy=12mm  
Maximum value of SAR (interpolated) = 21.833 mW/g

**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 85.249 V/m; Power Drift = -0.05 dB  
Peak SAR (extrapolated) = 30.176 W/kg  
**SAR(1 g) = 14.1 mW/g; SAR(10 g) = 6.34 mW/g**  
Maximum value of SAR (measured) = 21.196 mW/g



0 dB = 21.200mW/g

### System Check\_Body\_835MHz\_150714

**DUT: D835V2 - SN:4d091**

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: MSL\_835\_150714 Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.978 \text{ mho/m}$ ;  $\epsilon_r = 54.089$ ;

$\rho = 1000 \text{ kg/m}^3$

Ambient Temperature :  $23.7 \text{ }^\circ\text{C}$ ; Liquid Temperature :  $22.7 \text{ }^\circ\text{C}$

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(9.52, 9.52, 9.52); Calibrated: 2015.05.28
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2015.05.21
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.4.5 (3634)

**Pin=250mW/Area Scan (61x61x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

Maximum value of SAR (interpolated) =  $2.888 \text{ mW/g}$

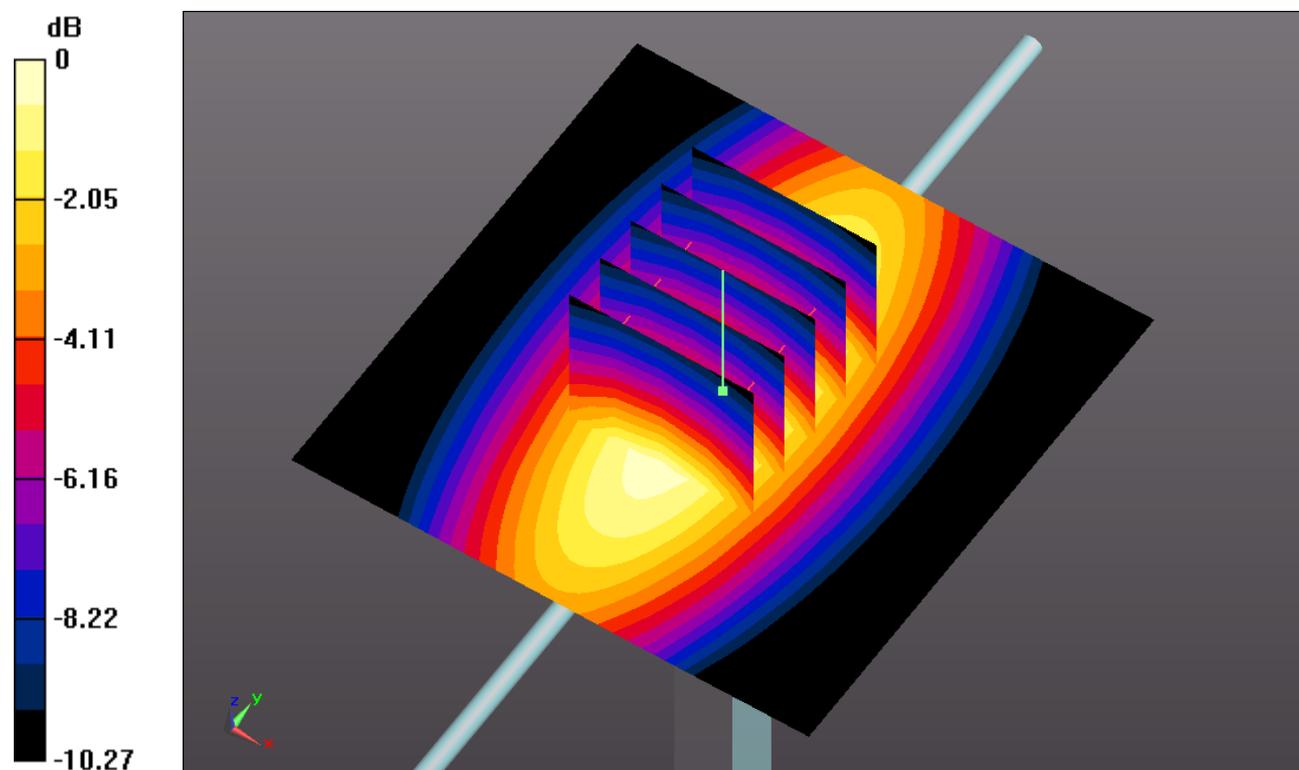
**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $50.692 \text{ V/m}$ ; Power Drift =  $-0.05 \text{ dB}$

Peak SAR (extrapolated) =  $3.315 \text{ W/kg}$

**SAR(1 g) =  $2.28 \text{ mW/g}$ ; SAR(10 g) =  $1.52 \text{ mW/g}$**

Maximum value of SAR (measured) =  $2.867 \text{ mW/g}$



0 dB =  $2.870\text{mW/g}$

**System Check\_Body\_1900MHz\_150713**

**DUT: D1900V2 - SN:5d118**

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: MSL\_1900\_150713 Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.555$  mho/m;  $\epsilon_r =$

$53.699$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 23.8 °C ; Liquid Temperature : 22.6 °C

**DASY5 Configuration:**

- Probe: EX3DV4 - SN3857; ConvF(7.54, 7.54, 7.54); Calibrated: 2015.05.28
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2015.05.21
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.4.5 (3634)

**Pin=250mW/Area Scan (61x61x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 14.917 mW/g

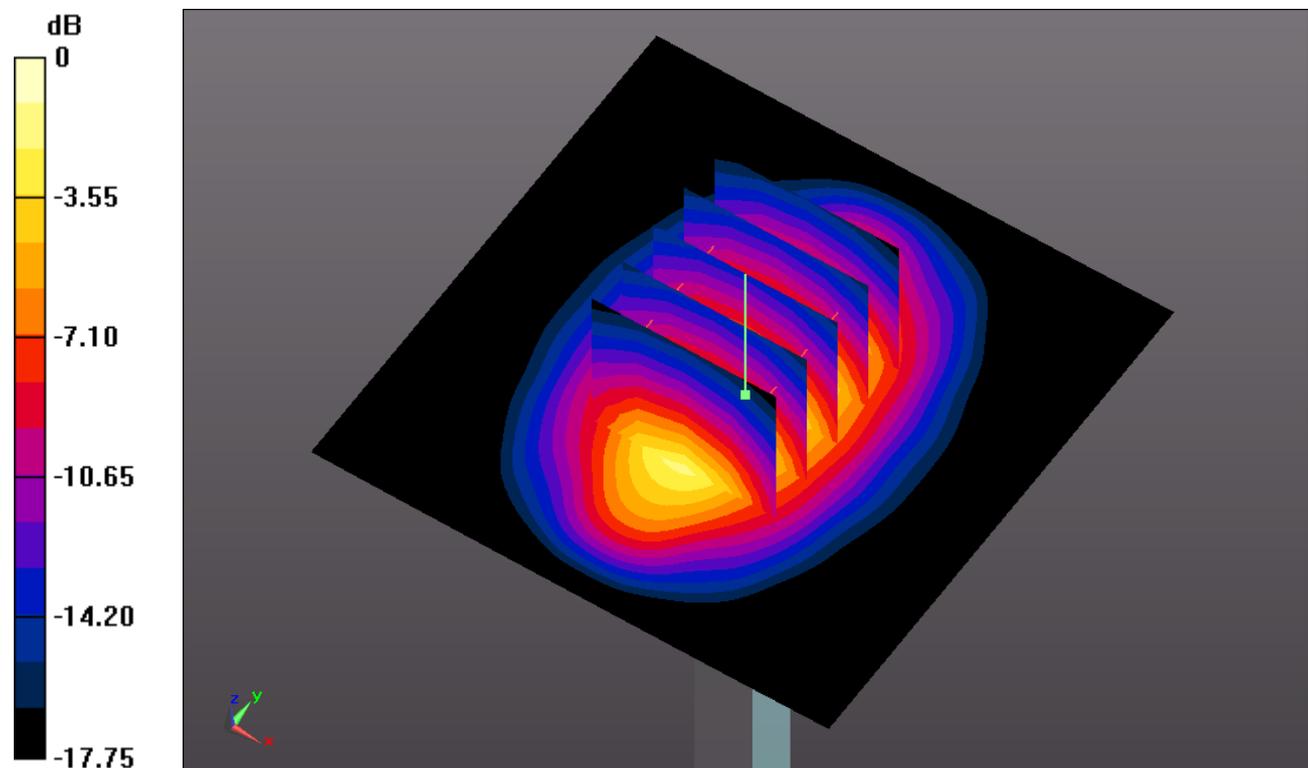
**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 87.145 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 18.707 W/kg

**SAR(1 g) = 10.5 mW/g; SAR(10 g) = 5.45 mW/g**

Maximum value of SAR (measured) = 14.985 mW/g



0 dB = 14.980mW/g

### System Check\_Body\_2450MHz\_150714

#### DUT: D2450V2 - SN:840

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL\_2450\_150714 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.931$  mho/m;  $\epsilon_r =$

$51.252$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 23.7 °C ; Liquid Temperature : 22.7 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(7.29, 7.29, 7.29); Calibrated: 2015.05.28
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2015.05.21
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.4.5 (3634)

**Pin=250mW/Area Scan (71x71x1):** Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 17.458 mW/g

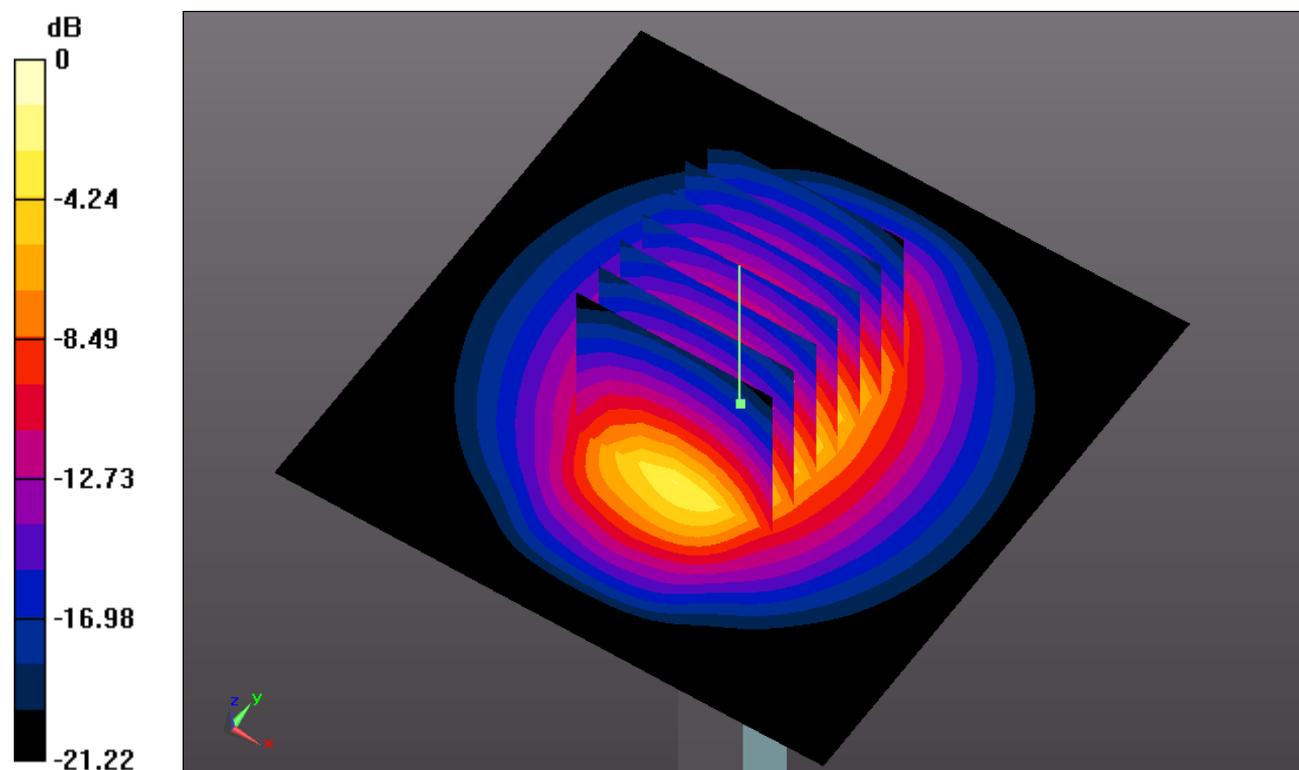
**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 83.742 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 22.053 W/kg

**SAR(1 g) = 11.96 mW/g; SAR(10 g) = 5.17 mW/g**

Maximum value of SAR (measured) = 16.688 mW/g



0 dB = 16.690mW/g

### System Check\_Body\_2600MHz\_150714

**DUT: D2600V2 - SN:1061**

Communication System: CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium: MSL\_2600\_150714 Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.201$  mho/m;  $\epsilon_r =$

$52.823$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 23.7 °C ; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(7.17, 7.17, 7.17); Calibrated: 2015.05.28
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2015.05.21
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.4.5 (3634)

**Pin=250mW/Area Scan (81x81x1):** Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 21.309 mW/g

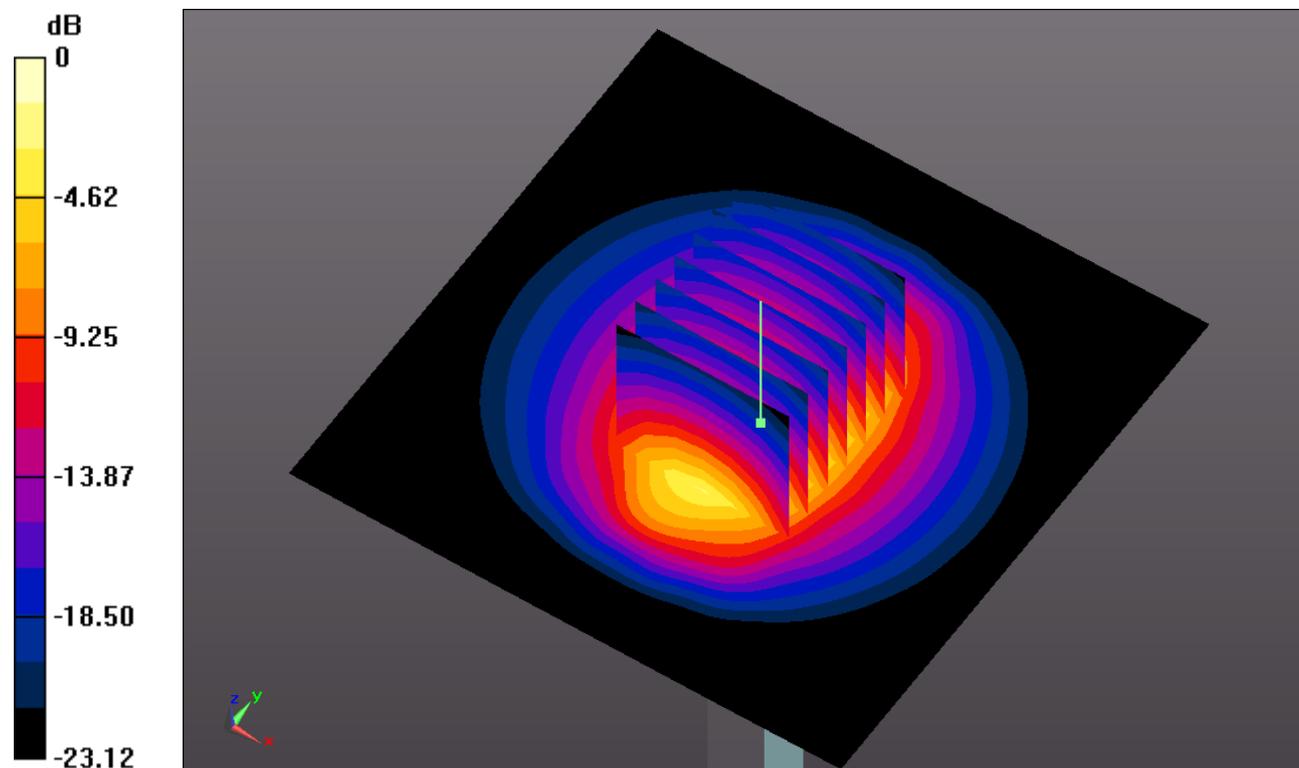
**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 85.266 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 29.981 W/kg

**SAR(1 g) = 14.1 mW/g; SAR(10 g) = 6.45 mW/g**

Maximum value of SAR (measured) = 21.805 mW/g



0 dB = 21.800mW/g



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**Appendix B. Plots of SAR Measurement**

The plots are shown as follows.

**01\_GSM850\_GPRS(4Tx Slots)\_Bottom Face 0cm\_Ch128\_Sensor On\_Sample 1**

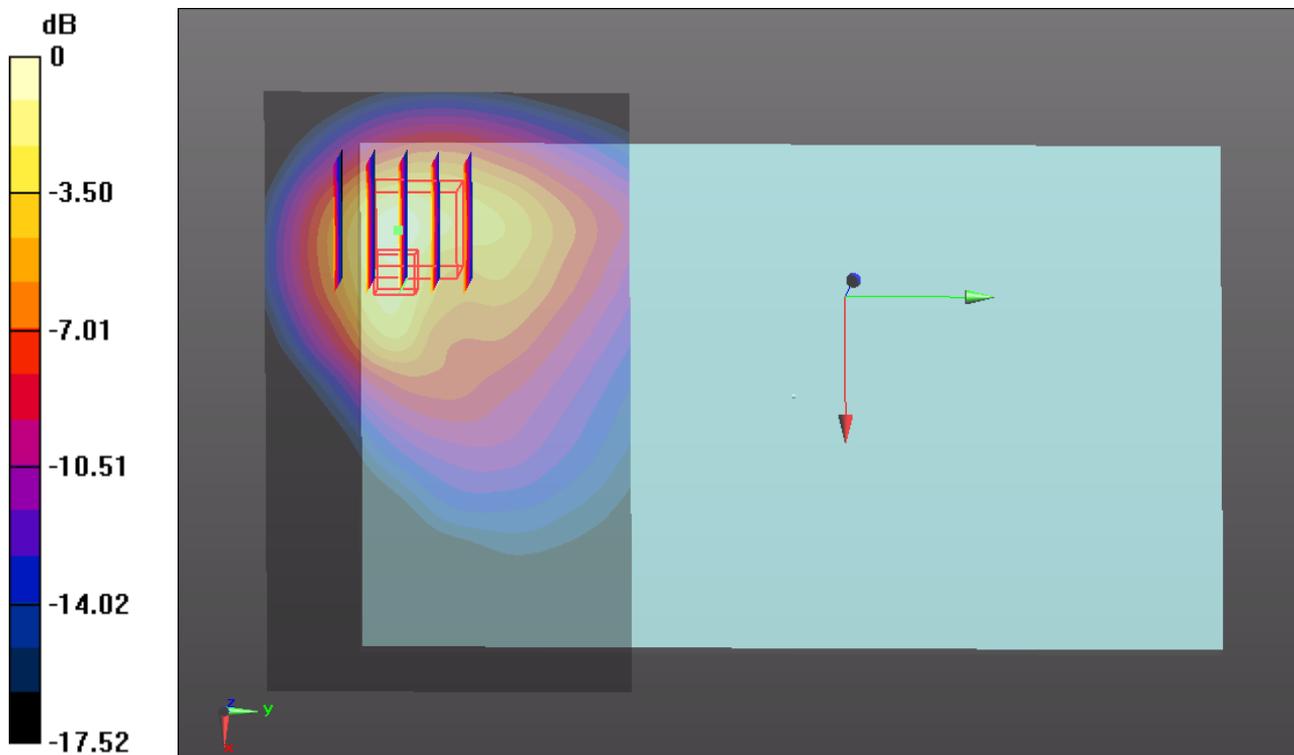
Communication System: GPRS/EDGE (4 Tx slots) (0); Frequency: 824.2 MHz; Duty Cycle: 1:2.08  
 Medium: MSL\_835\_150611 Medium parameters used:  $f = 824.2 \text{ MHz}$ ;  $\sigma = 0.969 \text{ mho/m}$ ;  $\epsilon_r = 54.56$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Ambient Temperature :  $23.7 \text{ }^\circ\text{C}$ ; Liquid Temperature :  $22.9 \text{ }^\circ\text{C}$

**DASY5 Configuration:**

- Probe: EX3DV4 - SN7350; ConvF(9.42, 9.42, 9.42); Calibrated: 2015.01.08
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2014.07.14
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.4.5 (3634)

**Ch128/Area Scan (101x61x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$   
 Maximum value of SAR (interpolated) =  $2.218 \text{ mW/g}$

**Ch128/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value =  $4.704 \text{ V/m}$ ; Power Drift =  $0.01 \text{ dB}$   
 Peak SAR (extrapolated) =  $3.626 \text{ W/kg}$   
**SAR(1 g) =  $1.210 \text{ mW/g}$ ; SAR(10 g) =  $0.665 \text{ mW/g}$**   
 Maximum value of SAR (measured) =  $2.367 \text{ mW/g}$



0 dB =  $2.370 \text{ mW/g}$

### 02\_GSM1900\_GPRS(4Tx Slots)\_Bottom Face 1cm\_Ch512\_Sensor Off aUco r ig'4

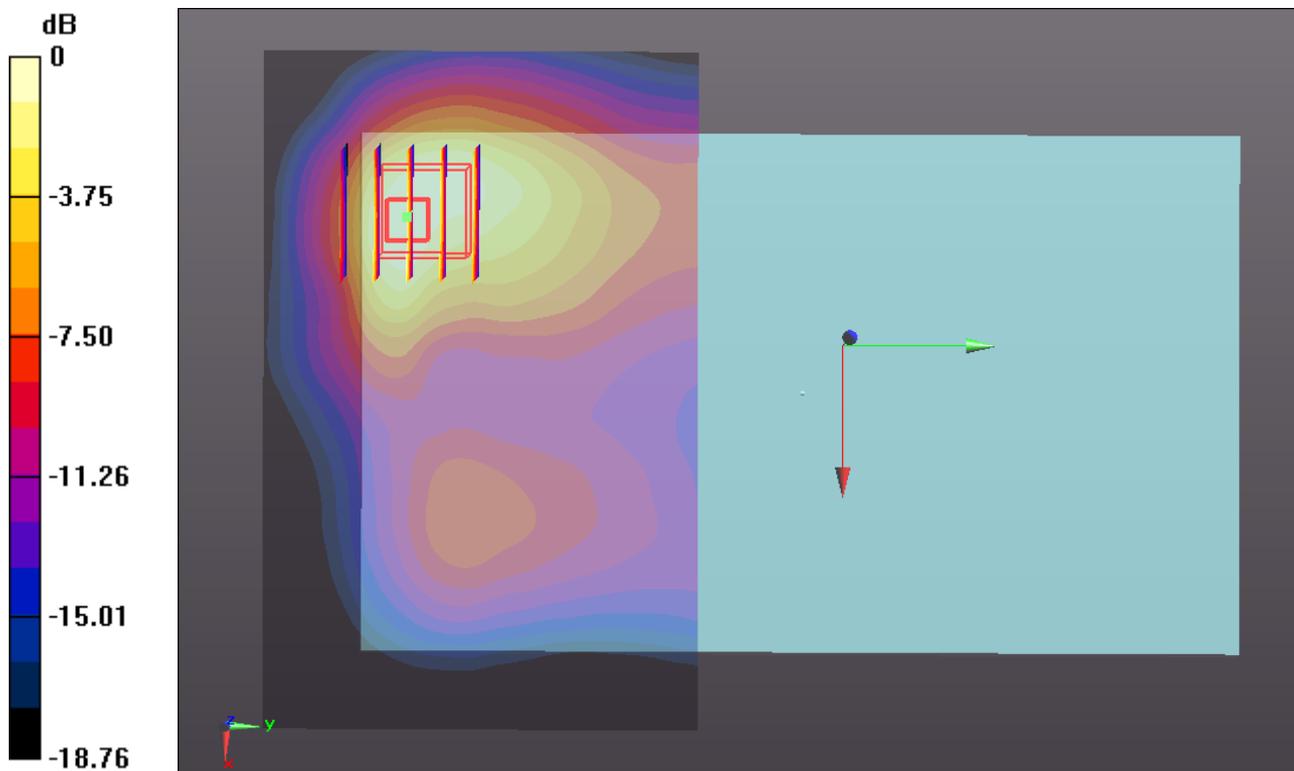
Communication System: GPRS/EDGE (4 Tx slots) (0); Frequency: 1850.2 MHz; Duty Cycle: 1:2.08  
Medium: MSL\_1900\_150713 Medium parameters used:  $f = 1850.2$  MHz;  $\sigma = 1.492$  mho/m;  $\epsilon_r = 53.419$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.8 °C ; Liquid Temperature : 22.6 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(7.54, 7.54, 7.54); Calibrated: 2015.05.28
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2015.05.21
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.4.5 (3634)

**Ch512/Area Scan (11x71x1):** Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 1.498 mW/g

**Ch512/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 5.203 V/m; Power Drift = -0.07 dB  
Peak SAR (extrapolated) = 1.647 W/kg  
**SAR(1 g) = 0.980 mW/g; SAR(10 g) = 0.562 mW/g**  
Maximum value of SAR (measured) = 1.320 mW/g



0 dB = 1.320mW/g

### 03\_TDD LTE Band41\_20M\_QPSK(50,49)\_Bottom Face Curved surface of Edge3 Tilt14 0cm\_Ch40240\_Sensor On\_Sample 2

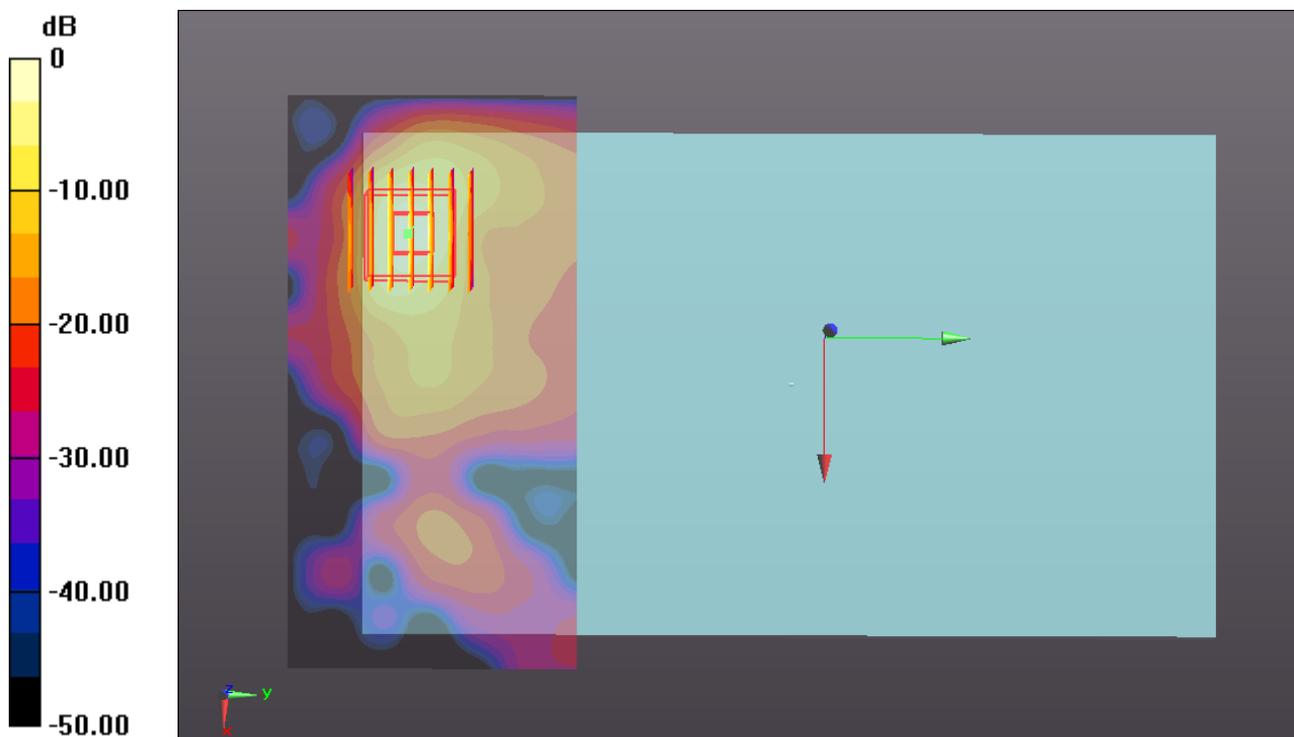
Communication System: TDD\_LTE (0); Frequency: 2555 MHz; Duty Cycle: 1:1.59  
Medium: MSL\_2600\_150714 Medium parameters used:  $f = 2555$  MHz;  $\sigma = 2.142$  mho/m;  $\epsilon_r = 52.796$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.7 °C ; Liquid Temperature : 22.7 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(7.17, 7.17, 7.17); Calibrated: 2015.05.28
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2015.05.21
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.4.5 (3634)

**Ch40240/Area Scan (121x61x1):** Measurement grid: dx=12mm, dy=12mm  
Maximum value of SAR (interpolated) = 1.372 mW/g

**Ch40240/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 0.706 V/m; Power Drift = 0.01 dB  
Peak SAR (extrapolated) = 2.708 W/kg  
**SAR(1 g) = 0.962 mW/g; SAR(10 g) = 0.315 mW/g**  
Maximum value of SAR (measured) = 1.760 mW/g



0 dB = 1.760mW/g

### 04\_WLAN2.4GHz\_802.11b\_1M\_Bottom Face 0cm\_Ch11\_Sample 1

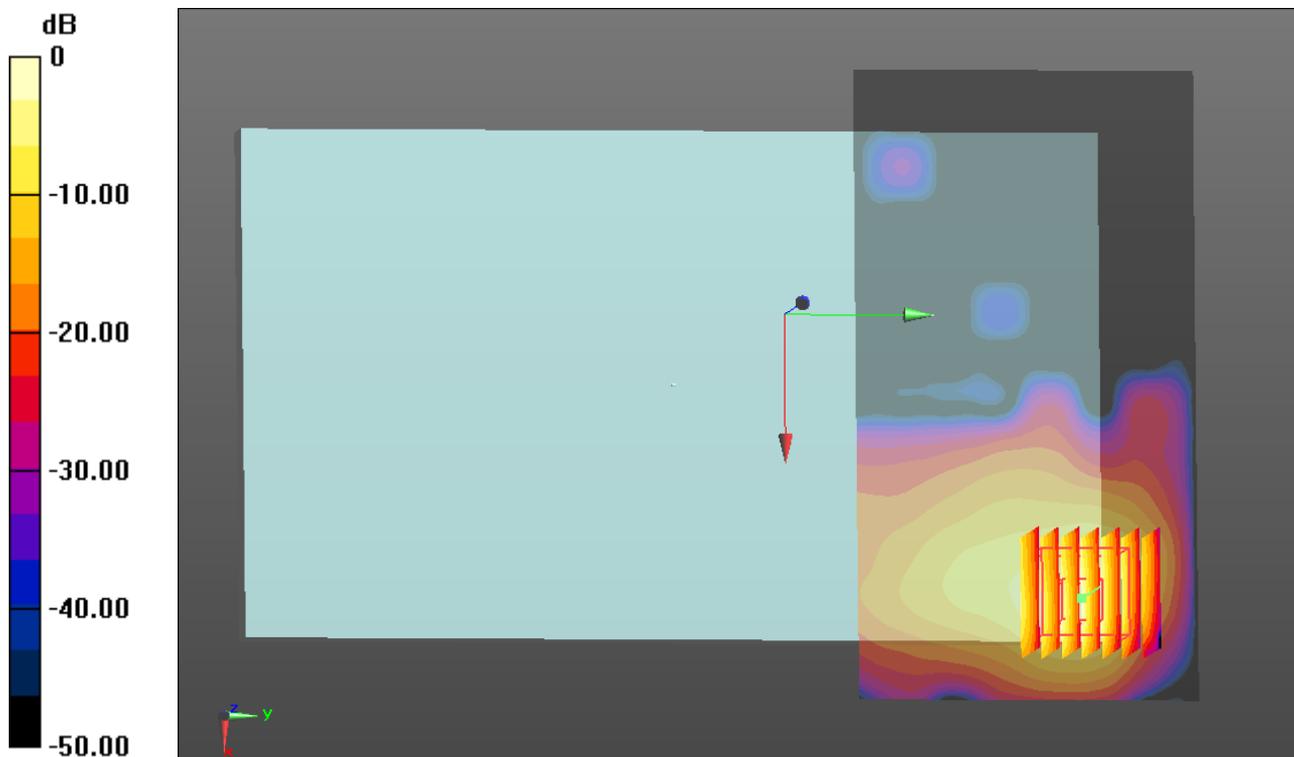
Communication System: WIFI (0); Frequency: 2462 MHz; Duty Cycle: 1:1.019  
Medium: MSL\_2450\_150619 Medium parameters used:  $f = 2462$  MHz;  $\sigma = 1.959$  mho/m;  $\epsilon_r = 50.915$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.8 °C ; Liquid Temperature : 22.9 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN7350; ConvF(7.23, 7.23, 7.23); Calibrated: 2015.01.08
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn905; Calibrated: 2014.07.14
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.4.5 (3634)

**Ch11/Area Scan (131x71x1):** Measurement grid: dx=12mm, dy=12mm  
Maximum value of SAR (interpolated) = 1.799 mW/g

**Ch11/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 0 V/m; Power Drift = 0.11 dB  
Peak SAR (extrapolated) = 2.362 W/kg  
**SAR(1 g) = 0.940 mW/g; SAR(10 g) = 0.344 mW/g**  
Maximum value of SAR (measured) = 1.582 mW/g



0 dB = 1.580mW/g



---

**Appendix C. DASYS Calibration Certificate**

The DASYS calibration certificates are shown as follows.



Accredited by the Swiss Accreditation Service (SAS)  
The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Sporton-CN (Auden)**

Certificate No: **D835V2-4d091\_Nov14**

## CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d091**

Calibration procedure(s) **QA CAL-05.v9  
Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **November 21, 2014**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: **Name** Michael Weber **Function** Laboratory Technician

**Signature**

Approved by: **Name** Katja Pokovic **Function** Technical Manager

Issued: November 21, 2014

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



Accredited by the Swiss Accreditation Service (SAS)  
The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

**Glossary:**

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

**Calibration is Performed According to the Following Standards:**

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

- Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:* SAR measured at the stated antenna input power.
- SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

<b>DASY Version</b>	DASY5	V52.8.8
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	15 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	835 MHz $\pm$ 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	41.5	0.90 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	41.2 $\pm$ 6 %	0.91 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>9.11 W/kg <math>\pm</math> 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	1.50 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>5.95 W/kg <math>\pm</math> 16.5 % (k=2)</b>

## Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Body TSL parameters</b>	22.0 °C	55.2	0.97 mho/m
<b>Measured Body TSL parameters</b>	(22.0 $\pm$ 0.2) °C	54.5 $\pm$ 6 %	1.01 mho/m $\pm$ 6 %
<b>Body TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Body TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	2.48 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>9.60 W/kg <math>\pm</math> 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b>	condition	
SAR measured	250 mW input power	1.62 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>6.31 W/kg <math>\pm</math> 16.5 % (k=2)</b>

## Appendix (Additional assessments outside the scope of SCS108)

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7 $\Omega$ - 1.8 j $\Omega$
Return Loss	- 32.2 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.7 $\Omega$ - 4.2 j $\Omega$
Return Loss	- 25.2 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.394 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 15, 2009

## DASY5 Validation Report for Head TSL

Date: 19.11.2014

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d091**

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.91$  S/m;  $\epsilon_r = 41.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.22, 6.22, 6.22); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

### Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

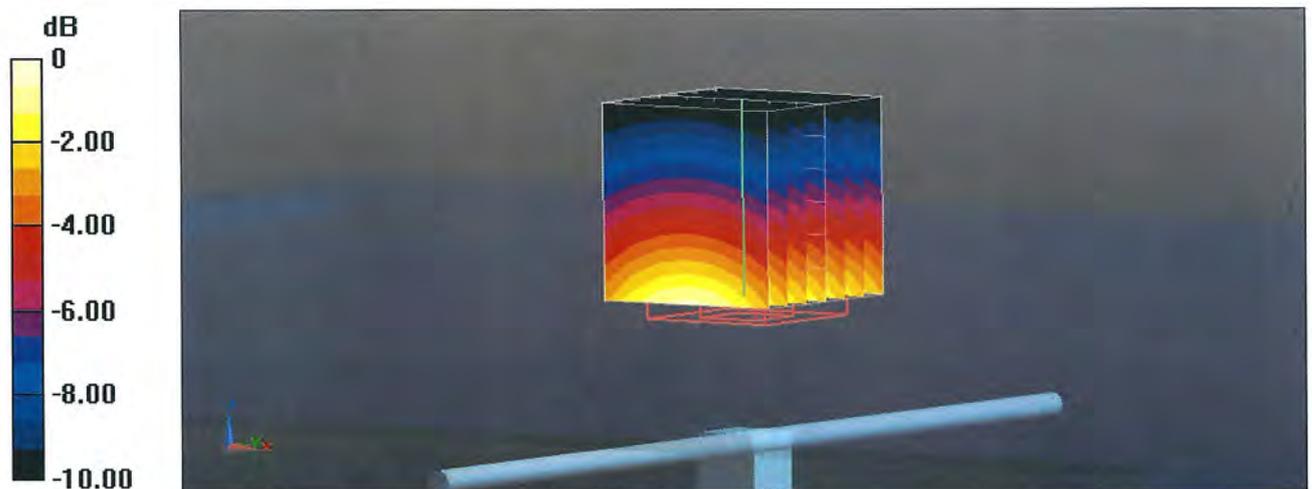
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.46 V/m; Power Drift = -0.04 dB

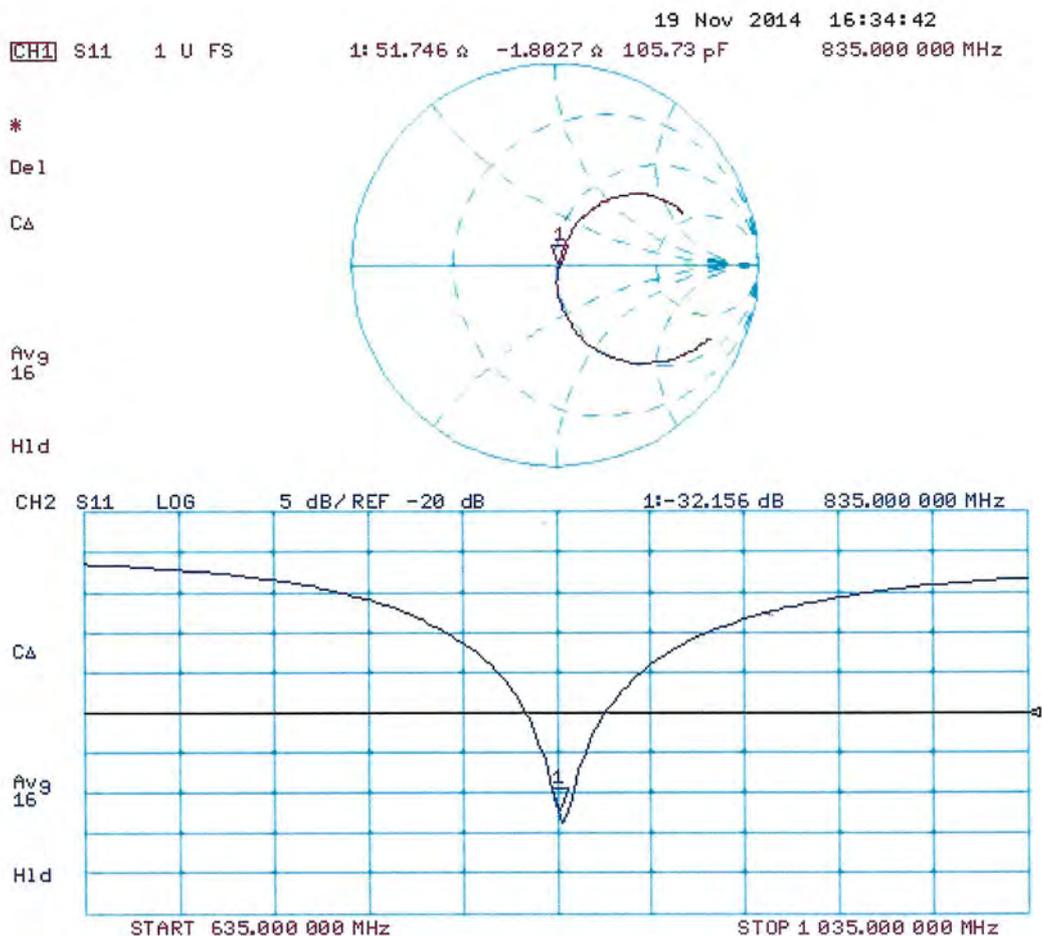
Peak SAR (extrapolated) = 3.43 W/kg

**SAR(1 g) = 2.3 W/kg; SAR(10 g) = 1.5 W/kg**

Maximum value of SAR (measured) = 2.69 W/kg



# Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 21.11.2014

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d091**

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used:  $f = 835$  MHz;  $\sigma = 1.01$  S/m;  $\epsilon_r = 54.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.09, 6.09, 6.09); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

### Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

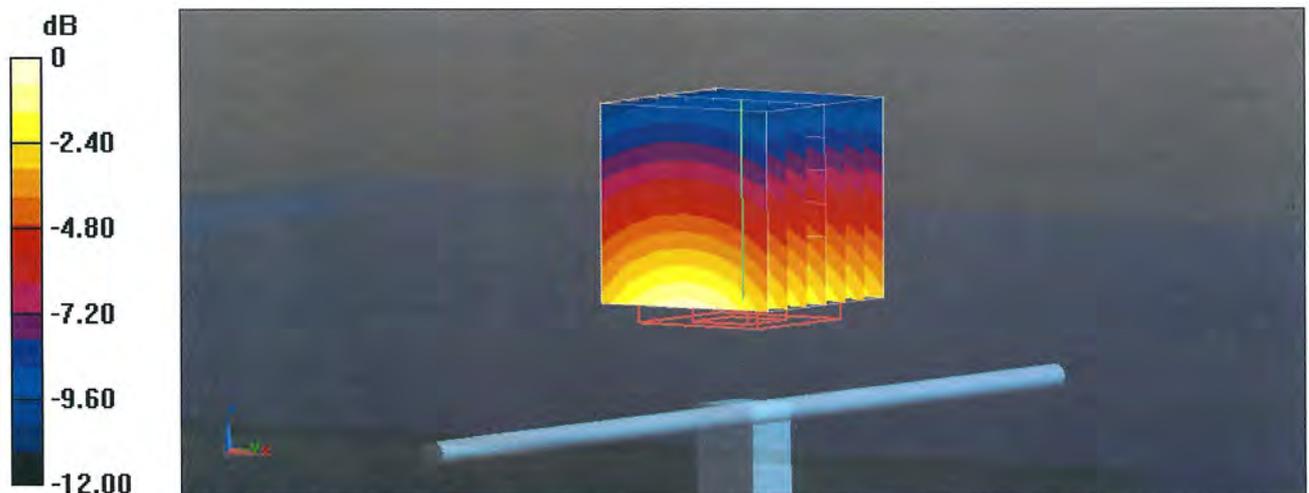
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.36 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.64 W/kg

**SAR(1 g) = 2.48 W/kg; SAR(10 g) = 1.62 W/kg**

Maximum value of SAR (measured) = 2.89 W/kg



# Impedance Measurement Plot for Body TSL

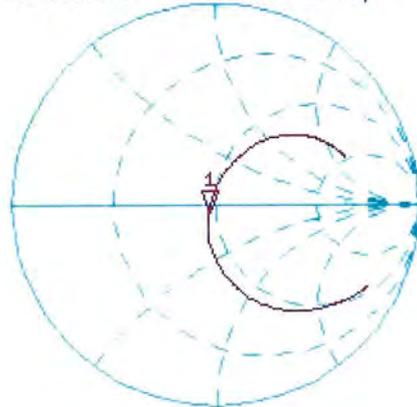
21 Nov 2014 13:55:09

CH1 S11 1 U FS

1: 46.666  $\Omega$  -4.1563  $\Omega$  45.860 pF

835.000 000 MHz

\*  
De1  
Cor



Avg  
16

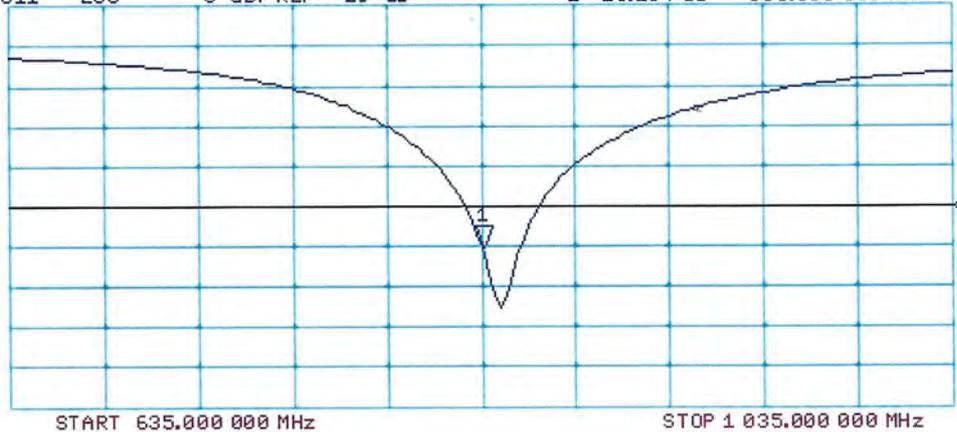
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-25.184 dB 835.000 000 MHz

Cor

Avg  
16

H1d





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Sporton-CN (Auden)**

Certificate No: **D1900V2-5d118\_Nov14**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d118**

Calibration procedure(s) **QA CAL-05.v9  
Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **November 21, 2014**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: **Michael Weber**      Name: Michael Weber      Function: Laboratory Technician

Approved by: **Katja Pokovic**      Name: Katja Pokovic      Function: Technical Manager

Signature

Issued: November 21, 2014

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

### Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:* SAR measured at the stated antenna input power.
- SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

<b>DASY Version</b>	DASY5	V52.8.8
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	1900 MHz $\pm$ 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	40.0	1.40 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	40.1 $\pm$ 6 %	1.39 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	9.97 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>40.1 W/kg <math>\pm</math> 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	5.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>21.0 W/kg <math>\pm</math> 16.5 % (k=2)</b>

## Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Body TSL parameters</b>	22.0 °C	53.3	1.52 mho/m
<b>Measured Body TSL parameters</b>	(22.0 $\pm$ 0.2) °C	53.3 $\pm$ 6 %	1.52 mho/m $\pm$ 6 %
<b>Body TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Body TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	10.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>40.0 W/kg <math>\pm</math> 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b>	condition	
SAR measured	250 mW input power	5.34 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>21.4 W/kg <math>\pm</math> 16.5 % (k=2)</b>

## Appendix (Additional assessments outside the scope of SCS108)

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.3 $\Omega$ + 6.8 j $\Omega$
Return Loss	- 23.1 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.5 $\Omega$ + 7.1 j $\Omega$
Return Loss	- 22.3 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 21, 2009

## DASY5 Validation Report for Head TSL

Date: 21.11.2014

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d118**

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.39$  S/m;  $\epsilon_r = 40.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.06, 5.06, 5.06); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

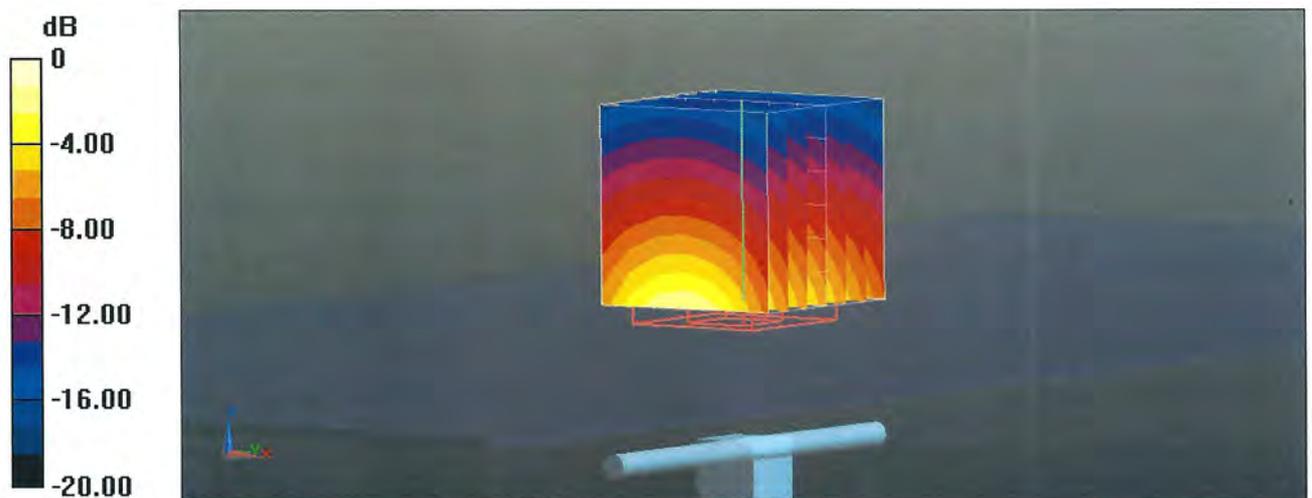
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.04 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 18.2 W/kg

**SAR(1 g) = 9.97 W/kg; SAR(10 g) = 5.24 W/kg**

Maximum value of SAR (measured) = 12.6 W/kg



0 dB = 12.6 W/kg = 11.00 dBW/kg

# Impedance Measurement Plot for Head TSL

21 Nov 2014 12:34:52

CH1 S11 1 U FS

1: 52.277  $\Omega$  6.8418  $\Omega$  573.11 pF

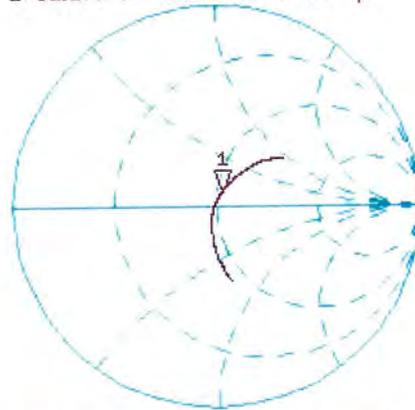
1 900.000 000 MHz

\*  
De1

CA

Avg  
16

H1d



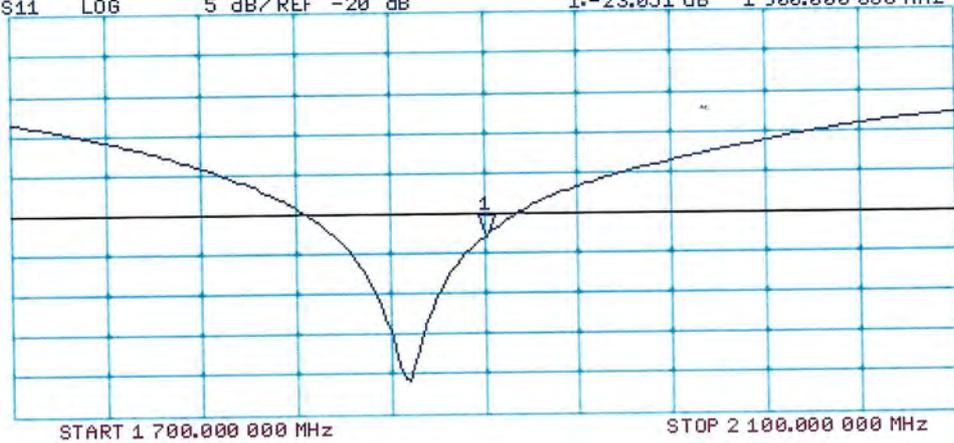
CH2 S11 LOG 5 dB/REF -20 dB

1: -23.051 dB 1 900.000 000 MHz

CA

Avg  
16

H1d



## DASY5 Validation Report for Body TSL

Date: 21.11.2014

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d118**

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.52$  S/m;  $\epsilon_r = 53.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

### Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

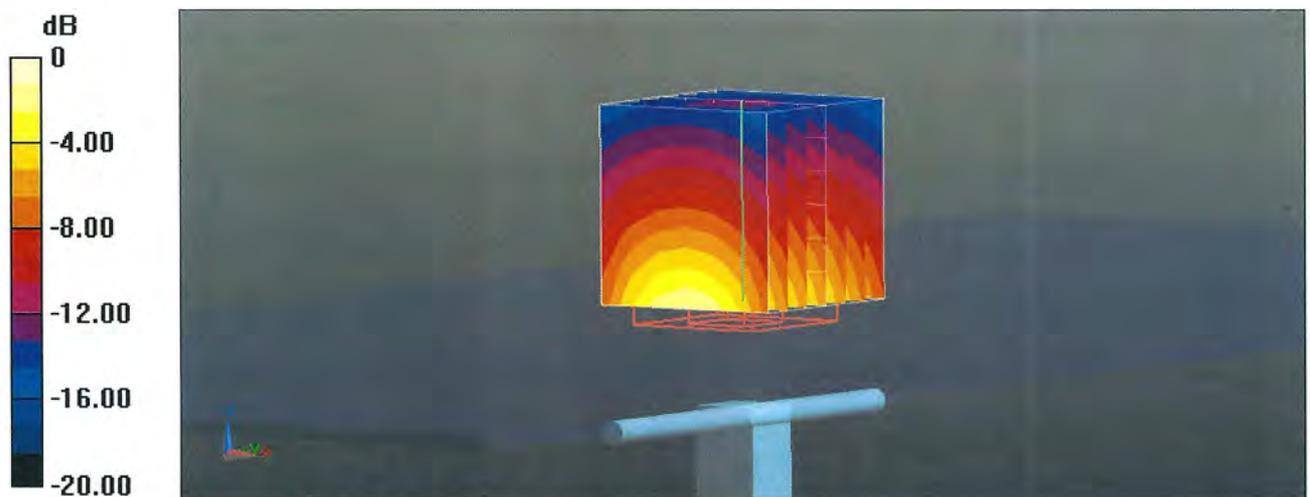
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.09 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 17.5 W/kg

**SAR(1 g) = 10 W/kg; SAR(10 g) = 5.34 W/kg**

Maximum value of SAR (measured) = 12.7 W/kg



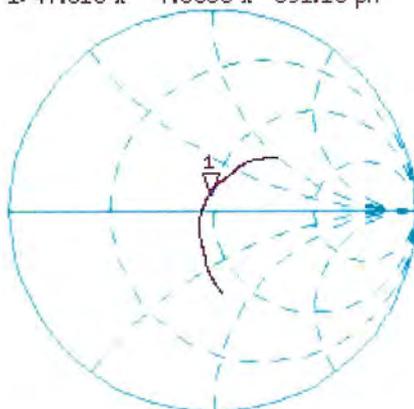
0 dB = 12.7 W/kg = 11.04 dBW/kg

# Impedance Measurement Plot for Body TSL

21 Nov 2014 12:34:24

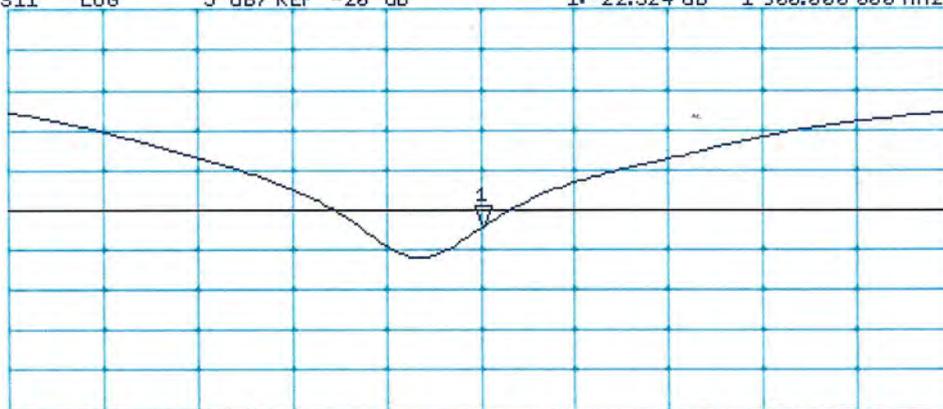
CH1 S11 1 U FS 1: 47.516  $\Omega$  7.0566  $\Omega$  591.10 pF 1 900.000 000 MHz

\*  
De1  
CA  
Avg  
16  
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1: -22.324 dB 1 900.000 000 MHz

CA  
Avg  
16  
H1d



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Sporton-CN (Auden)**

Certificate No: **D2450V2-840\_Nov14**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 840**

Calibration procedure(s) **QA CAL-05.v9  
Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **November 19, 2014**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: **Name** Jeton Kastrati **Function** Laboratory Technician **Signature**

Approved by: **Name** Katja Pokovic **Function** Technical Manager

Issued: November 20, 2014

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

### Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

<b>DASY Version</b>	DASY5	V52.8.8
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	2450 MHz ± 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	39.2	1.80 mho/m
<b>Measured Head TSL parameters</b>	(22.0 ± 0.2) °C	39.0 ± 6 %	1.86 mho/m ± 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	13.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>52.3 W/kg ± 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	6.21 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>24.6 W/kg ± 16.5 % (k=2)</b>

## Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Body TSL parameters</b>	22.0 °C	52.7	1.95 mho/m
<b>Measured Body TSL parameters</b>	(22.0 ± 0.2) °C	50.9 ± 6 %	2.03 mho/m ± 6 %
<b>Body TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Body TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	13.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>51.0 W/kg ± 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b>	condition	
SAR measured	250 mW input power	6.00 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>23.6 W/kg ± 16.5 % (k=2)</b>

## Appendix (Additional assessments outside the scope of SCS108)

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.7 $\Omega$ + 2.8 j $\Omega$
Return Loss	- 25.6 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.9 $\Omega$ + 4.4 j $\Omega$
Return Loss	- 27.0 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.162 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 20, 2009

## DASY5 Validation Report for Head TSL

Date: 19.11.2014

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 840**

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.86$  S/m;  $\epsilon_r = 39$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

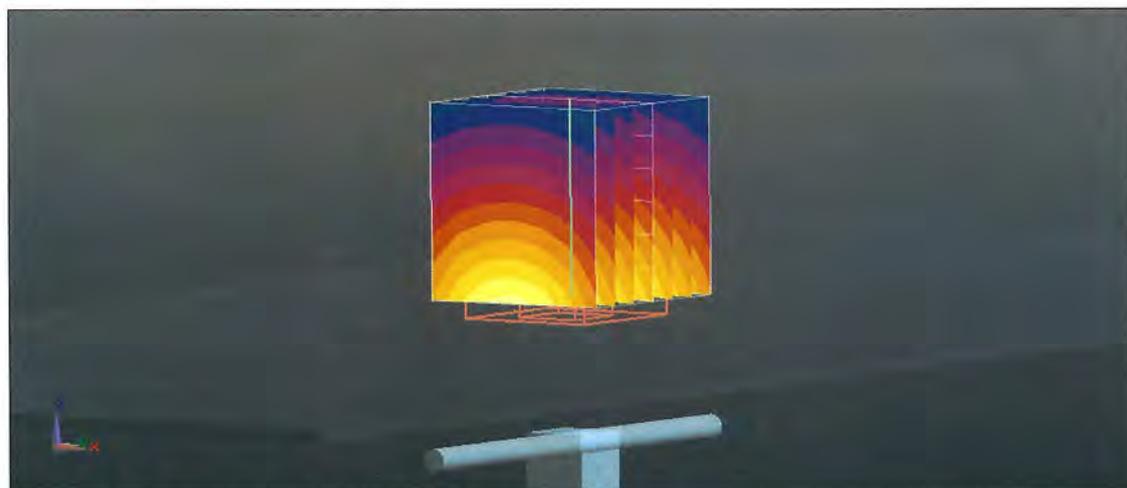
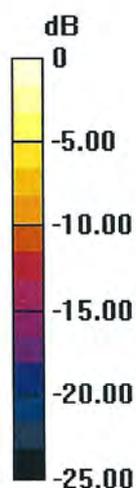
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.9 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 27.3 W/kg

**SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.21 W/kg**

Maximum value of SAR (measured) = 17.5 W/kg



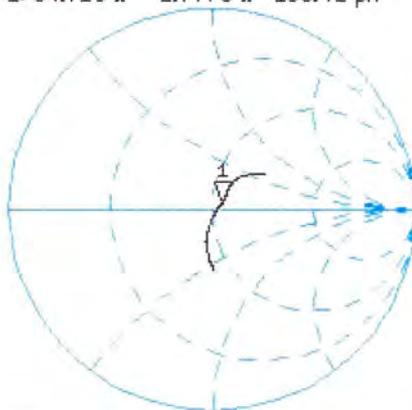
0 dB = 17.5 W/kg = 12.43 dBW/kg

# Impedance Measurement Plot for Head TSL

19 Nov 2014 17:06:19

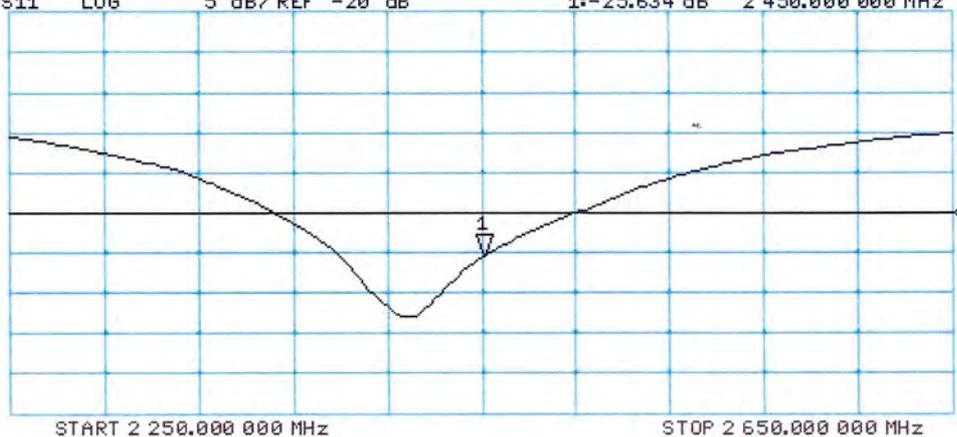
CH1 S11 1 U FS 1: 54.719  $\Delta$  2.7773  $\Delta$  180.42  $\mu$ H 2 450.000 000 MHz

\*  
De1  
CA  
Avg  
16  
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-25.634 dB 2 450.000 000 MHz

CA  
Avg  
16  
H1d



## DASY5 Validation Report for Body TSL

Date: 19.11.2014

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 840**

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.03$  S/m;  $\epsilon_r = 50.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.35, 4.35, 4.35); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

### Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

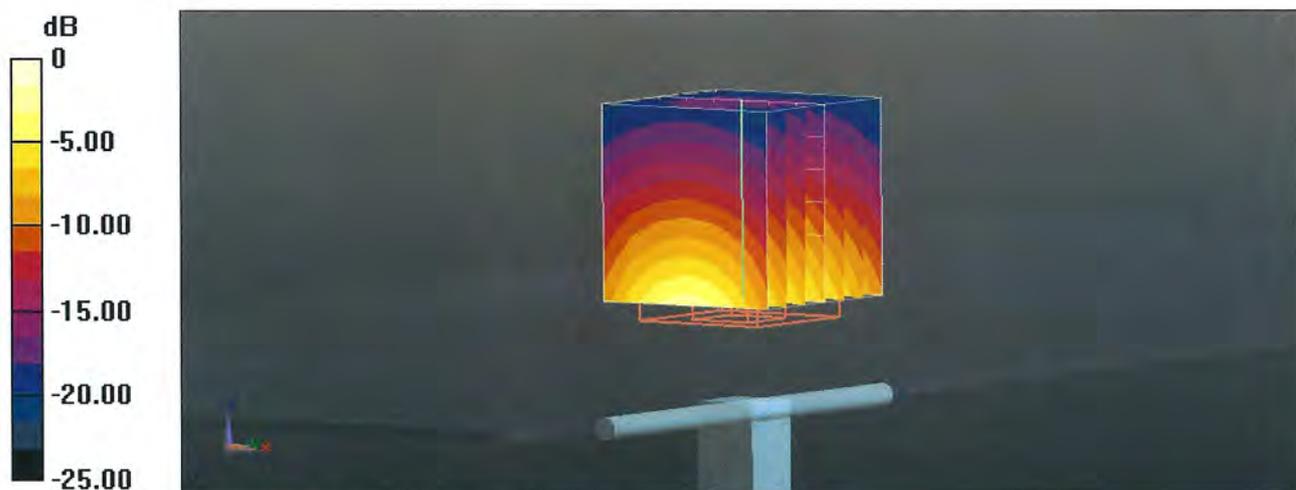
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.80 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 27.6 W/kg

**SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6 W/kg**

Maximum value of SAR (measured) = 17.3 W/kg



# Impedance Measurement Plot for Body TSL

19 Nov 2014 17:05:53

CH1 S11 1 U FS

1: 50.891  $\Omega$  4.4375  $\Omega$  288.27  $\mu\text{H}$

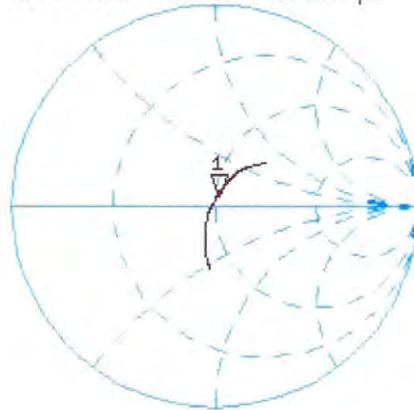
2 450.000 000 MHz

\*  
De1

CΔ

Avg  
16

H1d



CH2 S11

LOG

5 dB/REF -20 dB

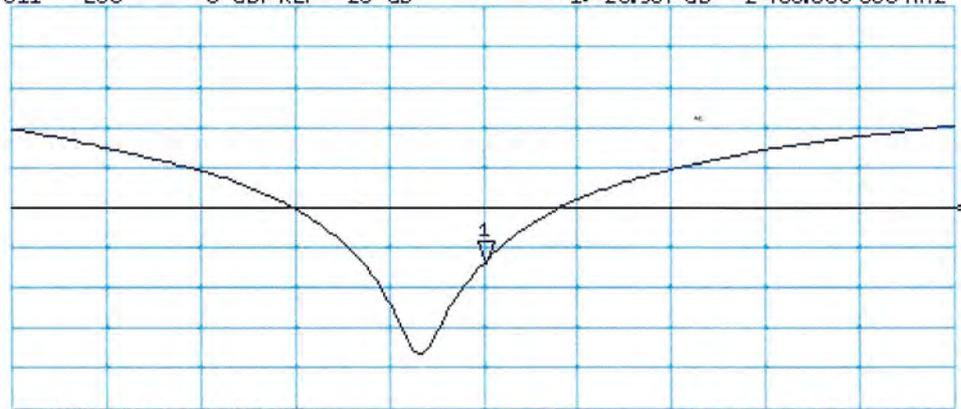
1: -26.967 dB

2 450.000 000 MHz

CΔ

Avg  
16

H1d



START 2 250.000 000 MHz

STOP 2 650.000 000 MHz



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Sporton-CN (Auden)**

Certificate No: **D2600V2-1061\_Nov14**

## CALIBRATION CERTIFICATE

Object: **D2600V2 - SN: 1061**

Calibration procedure(s): **QA CAL-05.v9  
Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **November 19, 2014**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature 

Issued: November 19, 2014

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Accreditation No.: **SCS 108**

### Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

### Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

<b>DASY Version</b>	DASY5	V52.8.8
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	2600 MHz $\pm$ 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	39.0	1.96 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	38.4 $\pm$ 6 %	2.03 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	14.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>56.9 W/kg <math>\pm</math> 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	6.49 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>25.7 W/kg <math>\pm</math> 16.5 % (k=2)</b>

## Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Body TSL parameters</b>	22.0 °C	52.5	2.16 mho/m
<b>Measured Body TSL parameters</b>	(22.0 $\pm$ 0.2) °C	50.5 $\pm$ 6 %	2.21 mho/m $\pm$ 6 %
<b>Body TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Body TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	14.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>54.9 W/kg <math>\pm</math> 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b>	condition	
SAR measured	250 mW input power	6.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>24.4 W/kg <math>\pm</math> 16.5 % (k=2)</b>

## Appendix (Additional assessments outside the scope of SCS108)

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.9 $\Omega$ - 5.7 j $\Omega$
Return Loss	- 25.0 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.9 $\Omega$ - 5.2 j $\Omega$
Return Loss	- 24.1 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.162 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 14, 2012

## DASY5 Validation Report for Head TSL

Date: 19.11.2014

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1061**

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.03$  S/m;  $\epsilon_r = 38.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.46, 4.46, 4.46); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

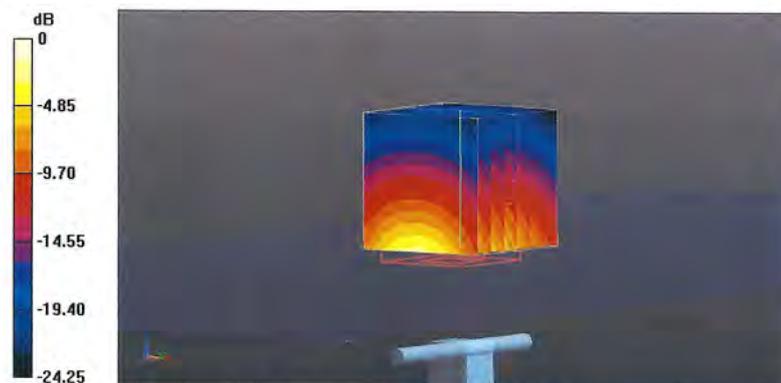
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 101.3 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 30.5 W/kg

**SAR(1 g) = 14.5 W/kg; SAR(10 g) = 6.49 W/kg**

Maximum value of SAR (measured) = 19.0 W/kg



0 dB = 19.0 W/kg = 12.79 dBW/kg