

# FCC SAR Test Report

APPLICANT : ZTE CORPORATION  
EQUIPMENT : LTE/CDMA Multi-Mode Digital Mobile Phone  
BRAND NAME : ZTE  
MODEL NAME : Z917VL  
FCC ID : SRQ-Z917VL  
STANDARD : FCC 47 CFR Part 2 (2.1093)  
ANSI/IEEE C95.1-1992  
IEEE 1528-2013

We, SPORTON INTERNATIONAL (XI'AN) 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 (XI'AN) INC., the test report shall not be reproduced except in full.



Prepared by: Mark Qu / Manager



Approved by: Jones Tsai / Manager



**SPORTON INTERNATIONAL (XI'AN) INC.**

1F, Building A3, No. 39 Chuangye Rd., Xi'an Hi-tech Zone, Shanxi Province, P. R. China



Table of Contents

1. Statement of Compliance ..... 4
2. Administration Data ..... 5
3. Guidance Standard ..... 5
4. Equipment Under Test (EUT) Information ..... 6
4.1 General Information ..... 6
4.2 General LTE SAR Test and Reporting Considerations ..... 7
5. RF Exposure Limits ..... 8
5.1 Uncontrolled Environment ..... 8
5.2 Controlled Environment ..... 8
6. Specific Absorption Rate (SAR) ..... 9
6.1 Introduction ..... 9
6.2 SAR Definition ..... 9
7. System Description and Setup ..... 10
7.1 E-Field Probe ..... 11
7.2 Data Acquisition Electronics (DAE) ..... 11
7.3 Phantom ..... 12
7.4 Device Holder ..... 13
8. Measurement Procedures ..... 14
8.1 Spatial Peak SAR Evaluation ..... 14
8.2 Power Reference Measurement ..... 15
8.3 Area Scan ..... 15
8.4 Zoom Scan ..... 16
8.5 Volume Scan Procedures ..... 16
8.6 Power Drift Monitoring ..... 16
9. Test Equipment List ..... 17
10. System Verification ..... 18
10.1 Tissue Verification ..... 18
10.2 System Performance Check Results ..... 19
11. RF Exposure Positions ..... 20
11.1 Ear and handset reference point ..... 20
11.2 Definition of the cheek position ..... 21
11.3 Definition of the tilt position ..... 22
11.4 Body Worn Accessory ..... 23
11.5 Wireless Router ..... 23
12. Conducted RF Output Power (Unit: dBm) ..... 24
13. Bluetooth Exclusions Applied ..... 35
14. Antenna Location ..... 36
15. SAR Test Results ..... 37
15.1 Head SAR ..... 39
15.2 Hotspot SAR ..... 42
15.3 Body Worn Accessory SAR ..... 45
16. Simultaneous Transmission Analysis ..... 46
16.1 Head Exposure Conditions ..... 47
16.2 Hotspot Exposure Conditions ..... 48
16.3 Body-Worn Accessory Exposure Conditions ..... 49
17. Uncertainty Assessment ..... 50
18. References ..... 52
Appendix A. Plots of System Performance Check
Appendix B. Plots of High SAR Measurement
Appendix C. DASy Calibration Certificate
Appendix D. Test Setup Photos





1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for ZTE CORPORATION, LTE/CDMA Multi-Mode Digital Mobile Phone, Z917VL are as follows.

Equipment Class	Frequency Band		Highest 1g SAR Summary			Highest Simultaneous Transmission 1g SAR (W/kg)
			Head (Separation 0mm)	Body-worn (Separation 10mm)	Hotspot (Separation 10mm)	
			1g SAR (W/kg)			
Licensed	CDMA	CDMA2000 BC0	0.48	0.66	0.65	1.13
		CDMA2000 BC1	0.27	0.88	1.00	
	LTE	Band 13	0.23	0.49	0.49	
		Band 4	0.29	0.67	0.67	
		Band 2	0.26	0.74	0.74	
DTS	WLAN	2.4GHz WLAN	0.39	0.13	0.13	1.13
Date of Testing:			2016/04/28 ~ 2016/05/26			

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 (XI'AN) INC.
<b>Test Site Location</b>	1F, Building A3, No. 39 Chuangye Rd., Xi'an Hi-tech Zone, Shanxi Province, P. R. C. TEL: +86-029-8860-8767 FAX: +86-029-8860-8791

<b>Applicant</b>	
<b>Company Name</b>	ZTE CORPORATION
<b>Address</b>	ZTE Plaza, Keji Road South, Hi-Tech Industrial Park, Nanshan District, Shenzhen, Guangdong, 518057, P.R.China

<b>Manufacturer</b>	
<b>Company Name</b>	ZTE CORPORATION
<b>Address</b>	ZTE Plaza, Keji Road South, Hi-Tech Industrial Park, Nanshan District, Shenzhen, Guangdong, 518057, P.R.China

## **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 648474 D04 SAR Evaluation Considerations for Wireless Handsets v01r03
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 941225 D01 3G SAR Procedures v03r01
- FCC KDB 941225 D05 SAR for LTE Devices v02r05
- FCC KDB 941225 D06 Hotspot Mode SAR v02r01



4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name	LTE/CDMA Multi-Mode Digital Mobile Phone
Brand Name	ZTE
Model Name	Z917VL
FCC ID	SRQ-Z917VL
MEID Code	99000681000369
Wireless Technology and Frequency Range	CDMA2000 BC0: 824.7 MHz ~ 848.31 MHz CDMA 2000 BC1: 1851.25 MHz ~ 1908.75 MHz LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 13: 777 MHz ~ 787 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	· CDMA2000 : 1xRTT/1xEv-Do(Rev.0)/1xEv-Do(Rev.A) · LTE: QPSK, 16QAM · 802.11b/g/n HT20 · Bluetooth v2.1+EDR, Bluetooth v4.1 LE
HW Version	Z917VLHW1.0
SW Version	Z917VLV1.0.0B02
EUT Stage	Identical Prototype
<b>Remark:</b>	
<ol style="list-style-type: none"> <li>This device supported VoIP in CDMA, LTE (e.g. 3rd party VoIP).</li> <li>802.11n-HT40 is not supported in 2.4GHz WLAN.</li> <li>This device 2.4GHz WLAN supports Hotspot operation.</li> </ol>	



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

Summarized necessary items addressed in KDB 941225 D05 v02r05																																							
FCC ID	SRQ-Z917VL																																						
Equipment Name	LTE/CDMA Multi-Mode Digital Mobile Phone																																						
Operating Frequency Range of each LTE transmission band	LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 13: 777 MHz ~ 787 MHz																																						
Channel Bandwidth	LTE Band 2: 1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz LTE Band 4: 1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz LTE Band 13: 5MHz, 10MHz																																						
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	R10 ,Cat 4																																						
CA Support	NO																																						

Transmission (H, M, L) channel numbers and frequencies in each LTE band												
LTE Band 2												
	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	18607	1850.7	18615	1851.5	18625	1852.5	18650	1855	18675	1857.5	18700	1860
M	18900	1880	18900	1880	18900	1880	18900	1880	18900	1880	18900	1880
H	19193	1909.3	19185	1908.5	19175	1907.5	19150	1905	19125	1902.5	19100	1900
LTE Band 4												
	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	19957	1710.7	19965	1711.5	19975	1712.5	20000	1715	20025	1717.5	20050	1720
M	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5
H	20393	1754.3	20385	1753.5	20375	1752.5	20350	1750	20325	1747.5	20300	1745
LTE Band 13												
	Bandwidth 5 MHz						Bandwidth 10 MHz					
	Channel #			Freq.(MHz)			Channel #			Freq.(MHz)		
L	23205			779.5			23230			782		
M	23230			782								
H	23255			784.5								

**5. RF Exposure Limits**

**5.1 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.

**5.2 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.

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

### **6.1 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.

### **6.2 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:

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

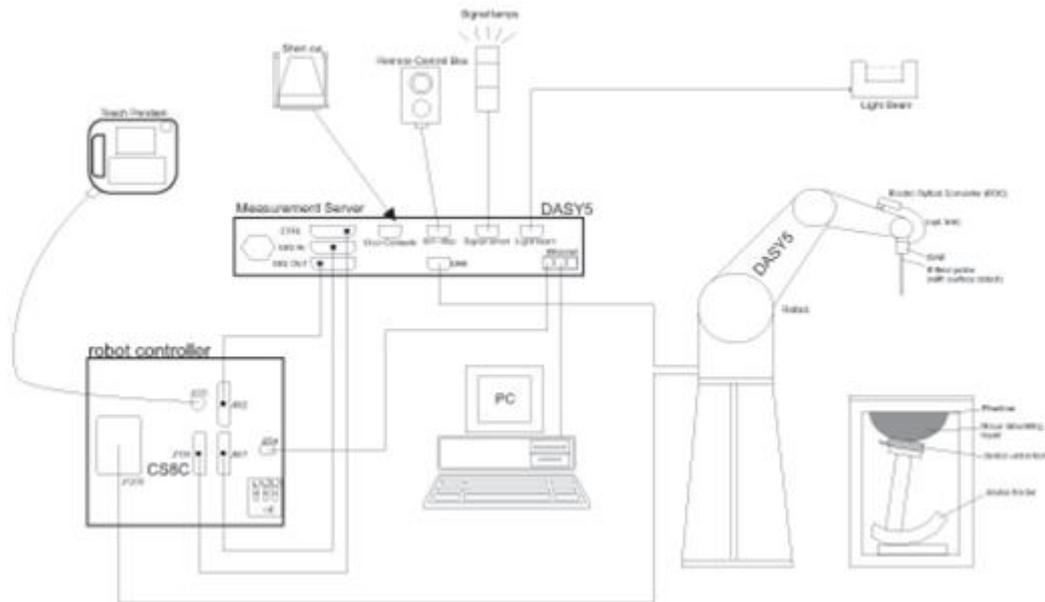
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

## 7. 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.

**7.1 E-Field Probe**

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

**<EX3DV4 Probe>**

<b>Construction</b>	Symmetric design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
<b>Frequency</b>	10 MHz – >6 GHz Linearity: ±0.2 dB (30 MHz – 6 GHz)	
<b>Directivity</b>	±0.3 dB in TSL (rotation around probe axis) ±0.5 dB in TSL (rotation normal to probe axis)	
<b>Dynamic Range</b>	10 µW/g – >100 mW/g Linearity: ±0.2 dB (noise: typically <1 µW/g)	
<b>Dimensions</b>	Overall length: 337 mm (tip: 20 mm) Tip diameter: 2.5 mm (body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

**7.2 Data Acquisition Electronics (DAE)**

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.



**Fig 5.1 Photo of DAE**

**7.3 Phantom**

**<SAM Twin Phantom>**

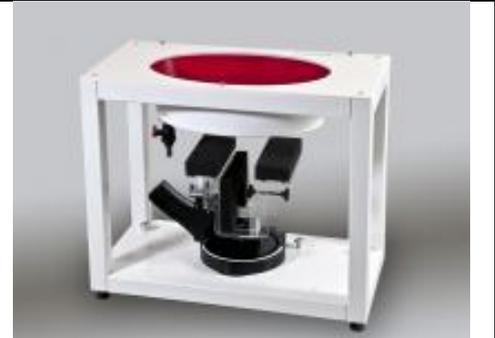
<b>Shell Thickness</b>	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm
<b>Filling Volume</b>	Approx. 25 liters
<b>Dimensions</b>	Length: 1000 mm; Width: 500 mm; Height: adjustable feet
<b>Measurement Areas</b>	Left Hand, Right Hand, Flat Phantom



The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

**<ELI Phantom>**

<b>Shell Thickness</b>	2 ± 0.2 mm (sagging: <1%)
<b>Filling Volume</b>	Approx. 30 liters
<b>Dimensions</b>	Major ellipse axis: 600 mm Minor axis: 400 mm



The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

### 7.4 Device Holder

#### <Mounting Device for Hand-Held Transmitter>

In combination with the Twin SAM V5.0/V5.0c or ELI phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). And upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140 mm.



Mounting Device for Hand-Held Transmitters



Mounting Device Adaptor for Wide-Phones

#### <Mounting Device for Laptops and other Body-Worn Transmitters>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.



Mounting Device for Laptops

## **8. 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

### **8.1 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

**8.2 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.

**8.3 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.	

### 8.4 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.				

### 8.5 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.

### 8.6 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.



**9. Test Equipment List**

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	750MHz System Validation Kit	D750V3	1087	Mar. 16, 2016	Mar. 15, 2017
SPEAG	835MHz System Validation Kit	D835V2	4d151	Mar. 16, 2016	Mar. 15, 2017
SPEAG	1750MHz System Validation Kit	D1750V2	1090	Mar. 22, 2016	Mar. 21, 2017
SPEAG	1900MHz System Validation Kit	D1900V2	5d170	Mar. 21, 2016	Mar. 20, 2017
SPEAG	2450MHz System Validation Kit	D2450V2	908	Mar. 18, 2016	Mar. 17, 2017
SPEAG	Data Acquisition Electronics	DAE4	1358	Aug. 27, 2015	Aug. 26, 2016
SPEAG	Dosimetric E-Field Probe	EX3DV4	3911	Oct. 01, 2015	Sep. 20, 2016
SPEAG	Dosimetric E-Field Probe	EX3DV4	3935	Nov. 27, 2015	Nov. 26, 2016
SPEAG	SAM Twin Phantom	QD 000 P40 CD	TP-1753	NCR	NCR
SPEAG	SAM Twin Phantom	QD 000 P40 CD	TP-1754	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Agilent	Wireless Communication Test Set	E5515C	MY52102600	Dec. 08, 2015	Dec. 07, 2016
Anritsu	Radio communication analyzer	MT8820C	6201074235	Oct. 15, 2015	Oct. 14, 2016
Agilent	ENA Series Network Analyzer	E5071C	MY46317418	Dec. 08, 2015	Dec. 07, 2016
Agilent	Dielectric Probe Kit	85070E	MY44300751	NCR	NCR
Anritsu	Power Sensor	MA2411B	0917070	Jan. 20, 2016	Jan. 19, 2017
Anritsu	Power Meter	ML2495A	1005002	Jan. 20, 2016	Jan. 19, 2017
Anritsu	Power Sensor	MA2411B	1339206	Jan. 20, 2016	Jan. 19, 2017
Anritsu	Power Meter	ML2495A	1438004	Jan. 20, 2016	Jan. 19, 2017
R&S	Spectrum Analyzer	FSV 7	101632	Dec. 08, 2015	Dec. 07, 2016
R&S	Signal Generator	N5182A	MY50145381	Jan. 12, 2016	Jan. 11, 2017
ARRA	Power Divider	A3200-2	NA	Note1	
Agilent	Dual Directional Coupler	778D	50422	Note1	
Woken	Attenuation1	WK0602-XX	N/A	Note1	
PE	Attenuation2	PE7005-10	N/A	Note1	
PE	Attenuation3	PE7005-3	N/A	Note1	
AR	Amplifier	5S1G4	342137	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.

## 10. System Verification

### 10.1 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 ( $\epsilon_r$ )
<b>For Head</b>								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
<b>For Body</b>								
750	51.7	47.2	0	0.9	0.1	0	0.96	55.5
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

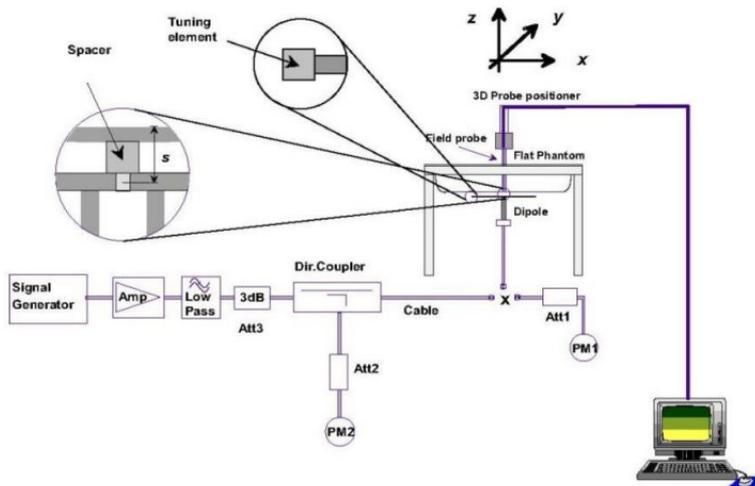
### <Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. ( $^{\circ}$ C)	Conductivity ( $\sigma$ )	Permittivity ( $\epsilon_r$ )	Conductivity Target ( $\sigma$ )	Permittivity Target ( $\epsilon_r$ )	Delta ( $\sigma$ ) (%)	Delta ( $\epsilon_r$ ) (%)	Limit (%)	Date
750	Head	22.3	0.880	40.797	0.89	41.90	-1.12	-2.63	$\pm 5$	2016/5/10
835	Head	22.2	0.906	42.204	0.90	41.50	0.67	1.70	$\pm 5$	2016/5/11
1750	Head	22.6	1.394	40.273	1.37	40.10	1.75	0.43	$\pm 5$	2016/5/11
1900	Head	22.5	1.442	38.685	1.40	40.00	3.00	-3.29	$\pm 5$	2016/5/10
2450	Head	22.5	1.833	37.683	1.80	39.20	1.83	-3.87	$\pm 5$	2016/5/24
750	Body	22.4	0.965	55.060	0.96	55.50	0.52	-0.79	$\pm 5$	2016/4/28
835	Body	22.4	0.973	54.808	0.97	55.20	0.31	-0.71	$\pm 5$	2016/4/28
1750	Body	22.3	1.495	53.474	1.49	53.40	0.34	0.14	$\pm 5$	2016/4/28
1900	Body	22.5	1.577	52.180	1.52	53.30	3.75	-2.10	$\pm 5$	2016/4/28
2450	Body	22.2	1.966	53.124	1.95	52.70	0.82	0.80	$\pm 5$	2016/5/26

**10.2 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 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2016/5/10	750	Head	250	D750V3-1087	EX3DV4 - SN3911	DAE4 Sn1358	2.18	8.30	8.72	5.06
2016/5/11	835	Head	250	D835V2-4d151	EX3DV4 - SN3911	DAE4 Sn1358	2.45	9.26	9.8	5.83
2016/5/11	1750	Head	250	D1750V2-1090	EX3DV4 - SN3911	DAE4 Sn1358	9.30	35.10	37.2	5.98
2016/5/10	1900	Head	250	D1900V2-5d170	EX3DV4 - SN3911	DAE4 Sn1358	10.30	38.10	41.2	8.14
2016/5/24	2450	Head	250	D2450V2-908	EX3DV4 - SN3935	DAE4 Sn1358	13.20	51.10	52.8	3.33
2016/4/28	750	Body	250	D750V3-1087	EX3DV4 - SN3911	DAE4 Sn1358	2.33	8.64	9.32	7.87
2016/4/28	835	Body	250	D835V2-4d151	EX3DV4 - SN3911	DAE4 Sn1358	2.39	9.52	9.56	0.42
2016/4/28	1750	Body	250	D1750V2-1090	EX3DV4 - SN3911	DAE4 Sn1358	9.78	35.90	39.12	8.97
2016/4/28	1900	Body	250	D1900V2-5d170	EX3DV4 - SN3911	DAE4 Sn1358	10.30	38.90	41.2	5.91
2016/5/26	2450	Body	250	D2450V2-908	EX3DV4 - SN3935	DAE4 Sn1358	13.10	50.40	52.4	3.97



**Fig 8.3.1 System Performance Check Setup**



**Fig 8.3.2 Setup Photo**

## 11. RF Exposure Positions

### 11.1 Ear and handset reference point

Figure 9.1.1 shows the front, back, and side views of the SAM phantom. The center-of-mouth reference point is labeled “M,” the left ear reference point (ERP) is marked “LE,” and the right ERP is marked “RE.” Each ERP is 15 mm along the B-M (back-mouth) line behind the entrance-to-ear-canal (EEC) point, as shown in Figure 9.1.2 The Reference Plane is defined as passing through the two ear reference points and point M. The line N-F (neck-front), also called the reference pivoting line, is normal to the Reference Plane and perpendicular to both a line passing through RE and LE and the B-M line (see Figure 9.1.3). Both N-F and B-M lines should be marked on the exterior of the phantom shell to facilitate handset positioning. Posterior to the N-F line the ear shape is a flat surface with 6 mm thickness at each ERP, and forward of the N-F line the ear is truncated, as illustrated in Figure 9.1.2. The ear truncation is introduced to preclude the ear lobe from interfering with handset tilt, which could lead to unstable positioning at the cheek.

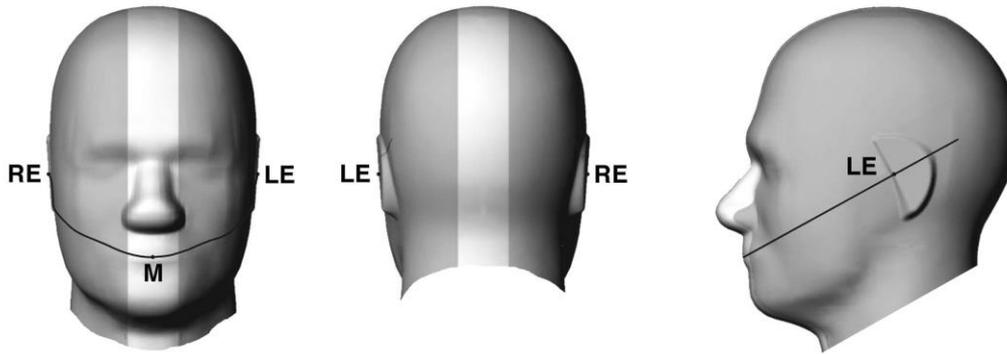


Fig 9.1.1 Front, back, and side views of SAM twin phantom

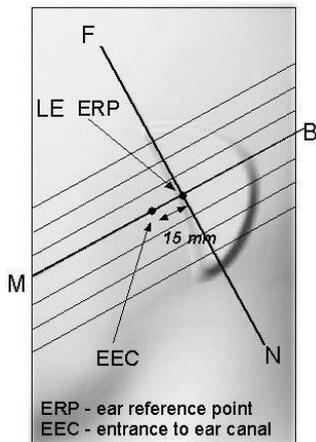


Fig 9.1.2 Close-up side view of phantom showing the ear region.

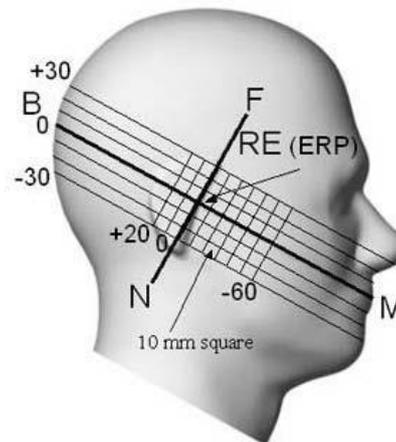
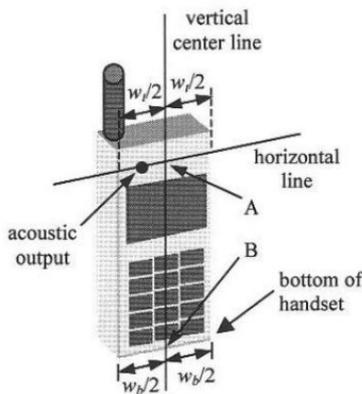


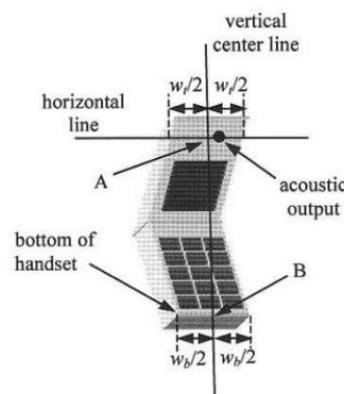
Fig 9.1.3 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

**11.2 Definition of the cheek position**

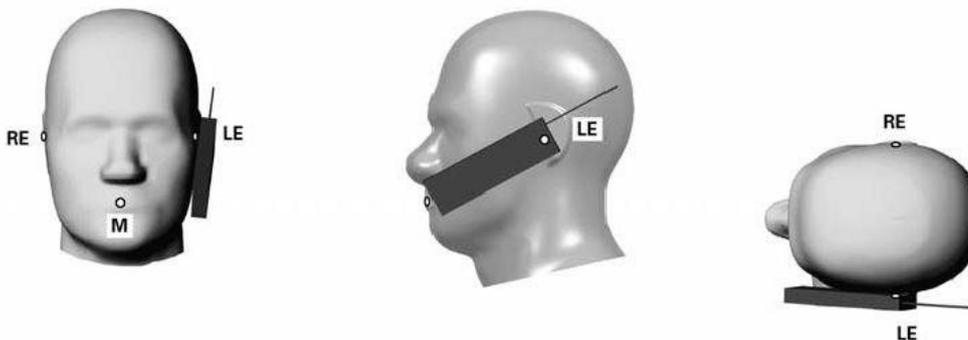
1. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece (flip cover), open the cover. If the handset can transmit with the cover closed, both configurations must be tested.
2. Define two imaginary lines on the handset—the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset—the midpoint of the width  $w_t$  of the handset at the level of the acoustic output (point A in Figure 9.2.1 and Figure 9.2.2), and the midpoint of the width  $w_b$  of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 9.2.1). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Figure 9.2.2), especially for clamshell handsets, handsets with flip covers, and other irregularly-shaped handsets.
3. Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 9.2.3), such that the plane defined by the vertical centerline and the horizontal line of the handset is approximately parallel to the sagittal plane of the phantom.
4. Translate the handset towards the phantom along the line passing through RE and LE until handset point A touches the pinna at the ERP.
5. While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to the plane containing B-M and N-F lines, i.e., the Reference Plane.
6. Rotate the handset around the vertical centerline until the handset (horizontal line) is parallel to the N-F line.
7. While maintaining the vertical centerline in the Reference Plane, keeping point A on the line passing through RE and LE, and maintaining the handset contact with the pinna, rotate the handset about the N-F line until any point on the handset is in contact with a phantom point below the pinna on the cheek. See Figure 9.2.3. The actual rotation angles should be documented in the test report.



**Fig 9.2.1 Handset vertical and horizontal reference lines—“fixed case”**



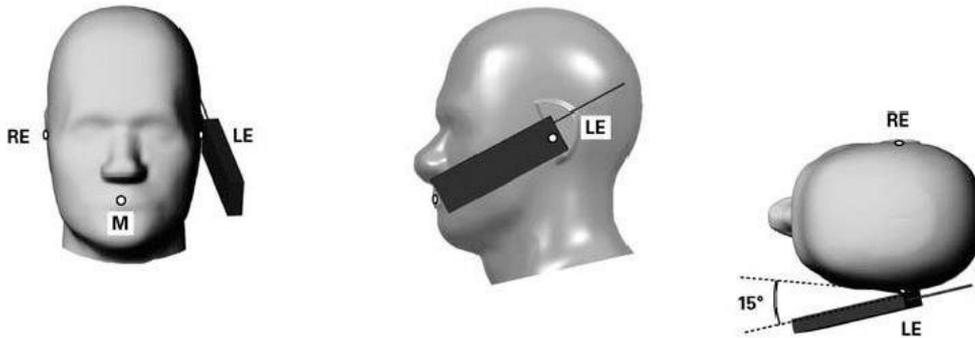
**Fig 9.2.2 Handset vertical and horizontal reference lines—“clam-shell case”**



**Fig 9.2.3 cheek or touch position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which establish the Reference Plane for handset positioning, are indicated.**

**11.3 Definition of the tilt position**

1. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece (flip cover), open the cover. If the handset can transmit with the cover closed, both configurations must be tested.
2. While maintaining the orientation of the handset, move the handset away from the pinna along the line passing through RE and LE far enough to allow a rotation of the handset away from the cheek by 15°.
3. Rotate the handset around the horizontal line by 15°.
4. While maintaining the orientation of the handset, move the handset towards the phantom on the line passing through RE and LE until any part of the handset touches the ear. The tilt position is obtained when the contact point is on the pinna. See Figure 9.3.1. If contact occurs at any location other than the pinna, e.g., the antenna at the back of the phantom head, the angle of the handset should be reduced. In this case, the tilt position is obtained if any point on the handset is in contact with the pinna and a second point

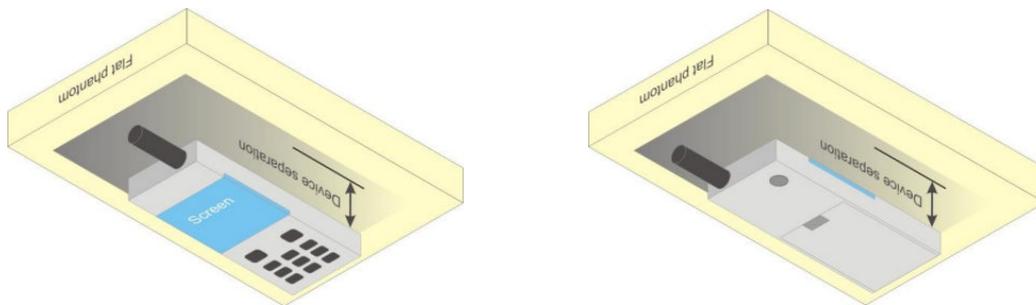


**Fig 9.3.1 Tilt position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which define the Reference Plane for handset positioning, are indicated.**

**11.4 Body Worn Accessory**

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 9.4). Per KDB648474 D04v01r03, body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB 447498 D01v06 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for body-worn accessory, measured without a headset connected to the handset is < 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a handset attached to the handset.

Accessories for body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are test with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.



**Fig 9.4 Body Worn Position**

**11.5 Wireless Router**

Some battery-operated handsets have the capability to transmit and receive user through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06 v02r01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10mm from the front, back and edges of the device containing transmitting antennas within 2.5cm of their edges, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v06 publication procedures. The “Portable Hotspot” feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

**12. Conducted RF Output Power (Unit: dBm)**

**<CDMA2000 Conducted Power>**

**General Note:**

1. Per KDB 941225 D01v03r01, SAR for head exposure is measured in RC3 with the handset configured to transmit at full rate in SO55.
2. Per KDB 941225 D01v03r01, in Hotspot mode EUT is treated as data device and SAR is tested with Ev-Do Rev 0 (RTAP 153.6kbps) as the primary mode.
3. Per KDB 941225 D01v03r01, for Body-worn accessory SAR is measured in RC3 with the handset configured in TDSO/SO32 to transmit at full rate on FCH only with all other code channels disabled. The body-worn accessory procedures in KDB Publication 447498 are applied. The 3G SAR test reduction procedure is applied to the multiple code channel configuration (FCH+SCH), with FCH only as the primary mode.

Band	CDMA2000 BC0			Tune-up Limit (dBm)	CDMA2000 BC1			Tune-up Limit (dBm)
	1013	384	777		25	600	1175	
TX Channel	824.7	836.52	848.31		1851.25	1880	1908.75	
Frequency (MHz)								
RC1 SO55	23.70	23.76	23.80	24.50	23.23	23.21	23.32	24.50
RC3 SO55	23.65	23.68	23.84	24.50	23.15	23.25	23.43	24.50
RC3 SO32(F+SCH)	23.66	23.69	23.81	24.50	23.20	23.22	23.42	24.50
RC3 SO32(+SCH)	23.64	23.67	23.80	24.50	23.17	23.21	23.41	24.50
RTAP 153.6Kbps	23.64	23.68	23.83	24.50	23.15	23.22	23.37	24.50
RETAP 4096Bits	23.70	23.71	23.82	24.50	23.07	23.14	23.35	24.50



**<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 D05v02r05, 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 D05v02r05, 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 D05v02r05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
5. Per KDB 941225 D05v02r05, 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 D05v02r05, 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 D05v02r05, 16QAM SAR testing is not required.
7. Per KDB 941225 D05v02r05, 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 D05v02r05, smaller bandwidth SAR testing is not required.
8. For LTE B4 the maximum bandwidth does not support three non-overlapping channels, per KDB 941225 D05v02r05, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.



<LTE Band 2>

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				18700	18900	19100		
Frequency (MHz)				1860	1880	1900		
20	QPSK	1	0	22.46	22.35	22.55	23.50	0
20	QPSK	1	49	22.41	22.25	22.51		
20	QPSK	1	99	22.03	22.31	22.45		
20	QPSK	50	0	21.27	21.21	21.34	22.50	0-1
20	QPSK	50	24	21.26	21.20	21.33		
20	QPSK	50	50	21.17	21.19	21.32		
20	QPSK	100	0	21.23	21.26	21.30	22.50	0-1
20	16QAM	1	0	21.22	21.60	21.55		
20	16QAM	1	49	21.70	21.27	21.56		
20	16QAM	1	99	21.21	21.41	21.63	21.50	0-2
20	16QAM	50	0	20.41	20.15	20.39		
20	16QAM	50	24	20.20	20.07	20.38		
20	16QAM	50	50	20.10	20.07	20.27	21.50	0-2
20	16QAM	100	0	20.35	20.22	20.43		
Channel				18675	18900	19125		
Frequency (MHz)				1857.5	1880	1902.5		
15	QPSK	1	0	22.20	22.22	22.41	23.50	0
15	QPSK	1	37	22.60	21.95	22.17		
15	QPSK	1	74	22.11	22.09	22.27		
15	QPSK	36	0	21.24	21.12	21.40	22.50	0-1
15	QPSK	36	20	21.06	21.17	21.34		
15	QPSK	36	39	21.01	21.13	21.31		
15	QPSK	75	0	21.17	21.13	21.31	22.50	0-1
15	16QAM	1	0	21.12	21.50	21.62		
15	16QAM	1	37	21.32	21.26	21.52		
15	16QAM	1	74	21.36	21.31	21.25	21.50	0-2
15	16QAM	36	0	20.27	20.25	20.34		
15	16QAM	36	20	20.24	20.21	20.31		
15	16QAM	36	39	20.05	20.18	20.39	21.50	0-2
15	16QAM	75	0	20.02	20.13	20.35		



Channel				18650	18900	19150	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1855	1880	1905		
10	QPSK	1	0	22.15	22.20	22.43	23.50	0
10	QPSK	1	25	22.25	22.17	22.40		
10	QPSK	1	49	22.19	22.01	22.42		
10	QPSK	25	0	21.21	21.14	21.40	22.50	0-1
10	QPSK	25	12	21.22	21.16	21.36		
10	QPSK	25	25	21.10	21.14	21.38		
10	QPSK	50	0	21.10	21.18	21.35	22.50	0-1
10	16QAM	1	0	21.50	21.51	21.77		
10	16QAM	1	25	21.39	21.44	21.92		
10	16QAM	1	49	21.31	21.35	21.68	21.50	0-2
10	16QAM	25	0	20.26	20.19	20.57		
10	16QAM	25	12	20.27	20.22	20.63		
10	16QAM	25	25	20.11	20.20	20.43	21.50	0-2
10	16QAM	50	0	20.25	20.18	20.30		
Channel				18625	18900	19175	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1852.5	1880	1907.5		
5	QPSK	1	0	21.96	22.15	22.59	23.50	0
5	QPSK	1	12	22.22	22.24	22.52		
5	QPSK	1	24	22.07	21.97	22.35		
5	QPSK	12	0	21.08	21.04	21.42	22.50	0-1
5	QPSK	12	7	21.13	21.04	21.38		
5	QPSK	12	13	21.14	21.10	21.34		
5	QPSK	25	0	21.17	21.11	21.33	22.50	0-1
5	16QAM	1	0	21.30	21.44	21.68		
5	16QAM	1	12	21.31	21.34	21.55		
5	16QAM	1	24	21.46	21.20	21.55	21.50	0-2
5	16QAM	12	0	20.13	20.10	20.38		
5	16QAM	12	7	20.18	20.02	20.35		
5	16QAM	12	13	20.15	20.08	20.32	21.50	0-2
5	16QAM	25	0	20.05	20.08	20.40		



Channel				18615	18900	19185	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1851.5	1880	1908.5		
3	QPSK	1	0	22.16	22.09	22.21	23.50	0
3	QPSK	1	8	22.21	22.09	22.10		
3	QPSK	1	14	22.22	22.14	22.27		
3	QPSK	8	0	21.18	21.21	21.51	22.50	0-1
3	QPSK	8	4	21.20	21.11	21.56		
3	QPSK	8	7	21.13	21.17	21.46		
3	QPSK	15	0	21.12	21.11	21.43	22.50	0-1
3	16QAM	1	0	21.50	21.39	21.71		
3	16QAM	1	8	21.33	21.37	21.64		
3	16QAM	1	14	21.55	21.41	21.72	21.50	0-2
3	16QAM	8	0	20.09	20.06	20.37		
3	16QAM	8	4	20.30	19.83	20.45		
3	16QAM	8	7	20.11	20.21	20.37	21.50	0-2
3	16QAM	15	0	20.10	20.00	20.44		
Channel				18607	18900	19193	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1850.7	1880	1909.3		
1.4	QPSK	1	0	22.10	22.14	22.30	23.50	0
1.4	QPSK	1	3	22.26	22.24	22.20		
1.4	QPSK	1	5	22.06	22.21	22.16		
1.4	QPSK	3	0	22.15	22.28	22.31		
1.4	QPSK	3	1	22.30	22.37	22.34		
1.4	QPSK	3	3	22.21	22.24	22.40	22.50	0-1
1.4	QPSK	6	0	21.23	21.13	21.56		
1.4	16QAM	1	0	21.30	21.37	21.88	22.50	0-1
1.4	16QAM	1	3	21.08	21.41	21.98		
1.4	16QAM	1	5	20.89	21.41	21.69		
1.4	16QAM	3	0	21.47	21.36	21.70		
1.4	16QAM	3	1	21.52	21.30	21.60		
1.4	16QAM	3	3	21.44	21.42	21.73	21.50	0-2
1.4	16QAM	6	0	20.15	19.95	20.26		



<LTE Band 4>

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				20050	20175	20300		
Frequency (MHz)				1720	1732.5	1745		
20	QPSK	1	0	22.57	22.49	22.53	23.50	0
20	QPSK	1	49	22.55	22.41	22.50		
20	QPSK	1	99	22.06	21.82	22.03		
20	QPSK	50	0	21.41	21.39	21.46	22.50	0-1
20	QPSK	50	24	21.36	21.28	21.34		
20	QPSK	50	50	21.23	21.17	21.27		
20	QPSK	100	0	21.30	21.23	21.34	22.50	0-1
20	16QAM	1	0	21.79	21.67	21.72		
20	16QAM	1	49	21.56	21.43	21.85		
20	16QAM	1	99	21.26	20.94	21.30	21.50	0-2
20	16QAM	50	0	20.26	20.43	20.35		
20	16QAM	50	24	20.08	20.33	20.32		
20	16QAM	50	50	20.25	20.12	20.28	21.50	0-2
20	16QAM	100	0	20.20	20.28	20.41		
Channel				20025	20175	20325		
Frequency (MHz)				1717.5	1732.5	1747.5		
15	QPSK	1	0	22.62	22.38	22.48	23.50	0
15	QPSK	1	37	22.17	22.12	22.29		
15	QPSK	1	74	22.05	21.82	22.07		
15	QPSK	36	0	21.27	21.28	21.37	22.50	0-1
15	QPSK	36	20	21.16	21.25	21.33		
15	QPSK	36	39	21.19	21.18	21.23		
15	QPSK	75	0	21.19	21.24	21.29	22.50	0-1
15	16QAM	1	0	22.09	21.67	21.65		
15	16QAM	1	37	21.27	21.09	21.44		
15	16QAM	1	74	21.06	21.32	21.40	21.50	0-2
15	16QAM	36	0	20.31	20.33	20.32		
15	16QAM	36	20	20.01	20.24	20.31		
15	16QAM	36	39	19.91	20.24	20.29	21.50	0-2
15	16QAM	75	0	20.13	20.29	20.20		



Channel				20000	20175	20350	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1715	1732.5	1750		
10	QPSK	1	0	22.44	22.35	22.46	23.50	0
10	QPSK	1	25	22.43	22.45	22.35		
10	QPSK	1	49	22.04	22.14	22.20		
10	QPSK	25	0	21.30	21.33	21.39	22.50	0-1
10	QPSK	25	12	21.27	21.31	21.35		
10	QPSK	25	25	21.19	21.15	21.23		
10	QPSK	50	0	21.33	21.29	21.28	22.50	0-1
10	16QAM	1	0	21.26	21.55	21.63		
10	16QAM	1	25	21.72	21.50	21.65		
10	16QAM	1	49	21.38	21.45	21.50	21.50	0-2
10	16QAM	25	0	20.20	20.29	20.55		
10	16QAM	25	12	20.25	20.28	20.55		
10	16QAM	25	25	20.14	20.22	20.54	21.50	0-2
10	16QAM	50	0	20.18	20.27	20.26		
Channel				19975	20175	20375	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1712.5	1732.5	1752.5		
5	QPSK	1	0	22.41	22.03	22.30	23.50	0
5	QPSK	1	12	22.46	22.33	22.47		
5	QPSK	1	24	22.16	22.17	22.10		
5	QPSK	12	0	21.33	21.27	21.29	22.50	0-1
5	QPSK	12	7	21.17	21.26	21.31		
5	QPSK	12	13	21.21	21.19	21.31		
5	QPSK	25	0	21.25	21.25	21.29	22.50	0-1
5	16QAM	1	0	21.65	21.50	21.51		
5	16QAM	1	12	21.50	21.52	21.52		
5	16QAM	1	24	21.52	21.33	21.42	21.50	0-2
5	16QAM	12	0	20.27	20.07	20.26		
5	16QAM	12	7	20.05	20.24	20.29		
5	16QAM	12	13	20.00	20.20	20.19	21.50	0-2
5	16QAM	25	0	20.21	20.20	20.27		



Channel				19965	20175	20385	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1711.5	1732.5	1753.5		
3	QPSK	1	0	22.38	22.25	22.35	23.50	0
3	QPSK	1	8	22.16	22.07	22.12		
3	QPSK	1	14	22.31	22.12	22.14		
3	QPSK	8	0	21.31	21.25	21.29	22.50	0-1
3	QPSK	8	4	21.23	21.24	21.30		
3	QPSK	8	7	21.25	21.23	21.27		
3	QPSK	15	0	21.23	21.25	21.31	22.50	0-1
3	16QAM	1	0	21.71	21.55	21.62		
3	16QAM	1	8	21.52	21.39	21.45		
3	16QAM	1	14	21.45	21.61	21.54	21.50	0-2
3	16QAM	8	0	20.32	20.35	20.28		
3	16QAM	8	4	20.18	20.35	20.32		
3	16QAM	8	7	20.21	20.27	20.29	21.50	0-2
3	16QAM	15	0	20.05	20.36	20.52		
Channel				19957	20175	20393	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1710.7	1732.5	1754.3		
1.4	QPSK	1	0	22.23	22.13	22.04	23.50	0
1.4	QPSK	1	3	22.26	22.07	22.02		
1.4	QPSK	1	5	22.23	22.02	22.04		
1.4	QPSK	3	0	22.21	22.09	22.08		
1.4	QPSK	3	1	22.25	22.16	22.10		
1.4	QPSK	3	3	22.23	22.12	22.05	22.50	0-1
1.4	QPSK	6	0	21.28	21.17	21.11		
1.4	16QAM	1	0	21.33	21.55	21.51	22.50	0-1
1.4	16QAM	1	3	21.27	21.50	21.53		
1.4	16QAM	1	5	21.62	21.53	21.46		
1.4	16QAM	3	0	21.40	21.52	21.45		
1.4	16QAM	3	1	21.48	21.46	21.47		
1.4	16QAM	3	3	21.41	21.49	21.41	21.50	0-2
1.4	16QAM	6	0	20.24	19.85	20.06		



<LTE Band 13>

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				23230				
Frequency (MHz)				782				
10	QPSK	1	0	22.81			23.50	0
10	QPSK	1	25	22.90				
10	QPSK	1	49	22.83				
10	QPSK	25	0	21.89			22.50	0-1
10	QPSK	25	12	21.88				
10	QPSK	25	25	21.88				
10	QPSK	50	0	21.87			22.50	0-1
10	16QAM	1	0	22.11				
10	16QAM	1	25	22.22				
10	16QAM	1	49	22.09			21.50	0-2
10	16QAM	25	0	21.06				
10	16QAM	25	12	21.06				
10	16QAM	25	25	21.05			20.90	
10	16QAM	50	0	20.90				
Channel				23205	23230	23255		
Frequency (MHz)				779.5	782	784.5		
5	QPSK	1	0	22.77	22.86	22.98	23.50	0
5	QPSK	1	12	23.06	22.96	23.11		
5	QPSK	1	24	22.83	22.70	22.65		
5	QPSK	12	0	21.86	21.89	21.79	22.50	0-1
5	QPSK	12	7	21.85	21.92	21.77		
5	QPSK	12	13	21.83	21.88	21.79		
5	QPSK	25	0	21.81	21.93	21.83	22.50	0-1
5	16QAM	1	0	21.88	22.21	22.13		
5	16QAM	1	12	22.16	22.18	22.15		
5	16QAM	1	24	22.04	22.02	21.57	21.50	0-2
5	16QAM	12	0	20.89	20.94	20.73		
5	16QAM	12	7	20.82	20.86	20.70		
5	16QAM	12	13	20.78	21.02	20.61	20.76	
5	16QAM	25	0	20.76	20.96	20.87		

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

1. Per KDB 248227 D01v02r02, 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.

**<2.4GHz WLAN>**

	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b	CH 1	2412	1Mbps	14.85	15.50	97.63
		CH 6	2437		13.96	15.50	
		CH 11	2462		<b>15.15</b>	15.50	
	802.11g	CH 1	2412	6Mbps	12.91	13.50	87.26
		CH 6	2437		12.24	13.50	
		CH 11	2462		13.14	13.50	
	802.11n-HT20	CH 1	2412	MCS0	10.24	11.00	86.50
		CH 6	2437		9.86	11.00	
		CH 11	2462		10.91	11.00	

### 13. Bluetooth Exclusions Applied

Mode Band	Average power(dBm)	
	Bluetooth v2.1+EDR	Bluetooth 4.1 LE
2.4GHz Bluetooth	9.5	9.5

**Note:**

- Per KDB 447498 D01v06, 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:  

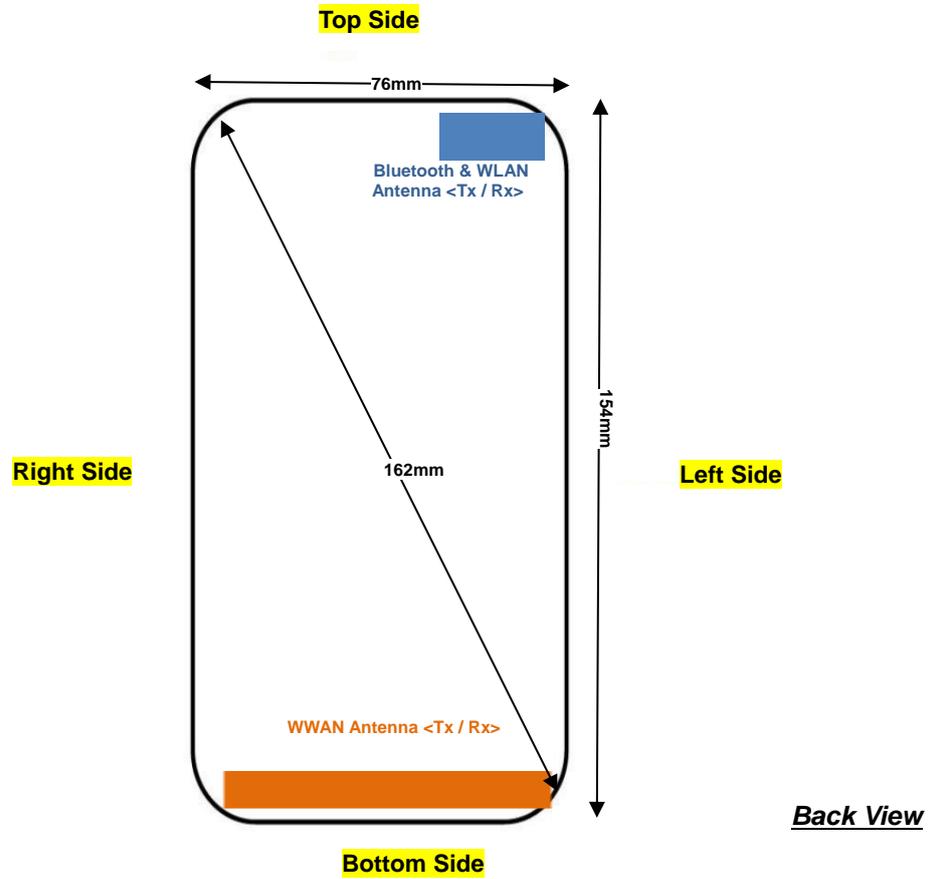
$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$$
 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR
  - f(GHz) is the RF channel transmit frequency in GHz
  - Power and distance are rounded to the nearest mW and mm before calculation
  - The result is rounded to one decimal place for comparison

Bluetooth Max Power (dBm)	Separation Distance (mm)	Frequency (GHz)	exclusion thresholds
9.5	10	2.48	1.4

**Note:**

Per KDB 447498 D01v06, the test exclusion threshold is 1.4 which is ≤ 3, SAR testing is not required.

### 14. Antenna Location



Distance of the Antenna to the EUT surface/edge						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Main	≤ 25mm	≤ 25mm	144mm	≤ 25mm	≤ 25mm	≤ 25mm
BT&WLAN	≤ 25mm	≤ 25mm	≤ 25mm	140mm	42mm	≤ 25mm

Positions for SAR tests; Hotspot mode						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Main	Yes	Yes	No	Yes	Yes	Yes
BT&WLAN	Yes	Yes	Yes	No	No	Yes

**General Note:**

Referring to KDB 941225 D06 v02r01, when the overall device length and width are ≥ 9cm\*5cm, the test distance is 10 mm. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge



## **15. SAR Test Results**

### **General Note:**

1. Per KDB 447498 D01v06, 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. 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)"
  - c. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)\*Tune-up Scaling Factor
  - d. For WLAN: Reported SAR(W/kg)= Measured SAR(W/kg)\* Duty Cycle scaling factor \* Tune-up scaling factor
2. Per KDB 447498 D01v06, 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. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8$ W/kg.
4. Per KDB 648474 D04v01r03, when the reported SAR for a body-worn accessory measured without a headset connected to the handset is  $\leq 1.2$  W/kg, SAR testing with a headset connected to the handset is not required.
5. Per KDB648474 D04v01r03, for smart phones with a display diagonal dimension  $> 15.0$  cm or an overall diagonal dimension  $> 16.0$  cm, when hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR  $> 1.2$  W/kg, however, when power reduction applies to hotspot mode the measured SAR must be scaled to the maximum output power, including tolerance, allowed for phablet modes to compare with the 1.2 W/kg SAR test reduction threshold. All hotspot reported SAR are all less than 1.2W/Kg, so no need to evaluate the extremity SAR.

### **CMDA Note:**

1. Per KDB 941225 D01v03r01, SAR for next to the ear head exposure is measured in RC3 with the handset configured to transmit at full rate in SO55.
2. Per KDB 941225 D01v03r01, in Hotspot mode EUT is treated as data device and SAR is tested with Ev-Do Rev 0 (RTAP 153.6kbps) as the primary mode.
3. Per KDB 941225 D01v03r01, for Body-worn accessory SAR is measured in RC3 with the handset configured in TDSO/SO32 to transmit at full rate on FCH only with all other code channels disabled. The body-worn accessory procedures in KDB Publication 447498 are applied. The 3G SAR test reduction procedure is applied to the multiple code channel configuration (FCH+SCH), with FCH only as the primary mode.

### **LTE Note:**

1. Per KDB 941225 D05v02r05, 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.
2. Per KDB 941225 D05v02r05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
3. Per KDB 941225 D05v02r05, 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.
4. Per KDB 941225 D05v02r05, 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 D05v02r05, 16QAM SAR testing is not required.
5. Per KDB 941225 D05v02r05, 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 D05v02r05, smaller bandwidth SAR testing is not required.
6. For LTE B4 the maximum bandwidth does not support three non-overlapping channels, per KDB 941225 D05v02r05, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.



**WLAN Note:**

1. Per KDB 248227 D01v02r02, for 2.4GHz 802.11g/n SAR testing is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is  $\leq 1.2$  W/kg.
2. Per KDB 248227 D01v02r02, for U-NII-1 Head and Body-worn SAR testing is not required when the U-NII-2A band highest reported SAR for a test configuration is  $\leq 1.2$  W/kg, SAR is not required for U-NII-1 band.
3. 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.
4. 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.
5. During SAR testing the WLAN transmission was verified using a spectrum analyzer.



15.1 Head SAR

<CDMA SAR>

Plot No.	Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	CDMA2000 BC0	1xRTT RC3 SO55	Right Cheek	777	848.31	23.84	24.50	1.164	0.02	0.330	0.384
	CDMA2000 BC0	1xRTT RC3 SO55	Right Tilted	777	848.31	23.84	24.50	1.164	0.04	0.226	0.263
01	CDMA2000 BC0	1xRTT RC3 SO55	Left Cheek	777	848.31	23.84	24.50	1.164	0.02	0.412	0.480
	CDMA2000 BC0	1xRTT RC3 SO55	Left Tilted	777	848.31	23.84	24.50	1.164	0.03	0.253	0.295
02	CDMA2000 BC1	1xRTT RC3 SO55	Right Cheek	1175	1908.75	23.43	24.50	1.279	0.15	0.208	0.266
	CDMA2000 BC1	1xRTT RC3 SO55	Right Tilted	1175	1908.75	23.43	24.50	1.279	0.12	0.074	0.095
	CDMA2000 BC1	1xRTT RC3 SO55	Left Cheek	1175	1908.75	23.43	24.50	1.279	0.04	0.142	0.182
	CDMA2000 BC1	1xRTT RC3 SO55	Left Tilted	1175	1908.75	23.43	24.50	1.279	0.16	0.064	0.082



<LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	LTE Band 13	10M	QPSK	1RB	25offset	Right Cheek	23230	782	22.90	23.50	1.148	0.03	0.176	0.202
	LTE Band 13	10M	QPSK	1RB	25offset	Right Tilted	23230	782	22.90	23.50	1.148	0.06	0.115	0.132
03	LTE Band 13	10M	QPSK	1RB	25offset	Left Cheek	23230	782	22.90	23.50	1.148	0.02	0.204	0.234
	LTE Band 13	10M	QPSK	1RB	25offset	Left Tilted	23230	782	22.90	23.50	1.148	0.05	0.123	0.141
	LTE Band 13	10M	QPSK	25RB	0offset	Right Cheek	23230	782	21.89	22.50	1.151	0.01	0.145	0.167
	LTE Band 13	10M	QPSK	25RB	0offset	Right Tilted	23230	782	21.89	22.50	1.151	0.07	0.089	0.102
	LTE Band 13	10M	QPSK	25RB	0offset	Left Cheek	23230	782	21.89	22.50	1.151	0.03	0.160	0.184
	LTE Band 13	10M	QPSK	25RB	0offset	Left Tilted	23230	782	21.89	22.50	1.151	0.12	0.097	0.112
04	LTE Band 4	20M	QPSK	1RB	0offset	Right Cheek	20175	1732.5	22.49	23.50	1.262	0.1	0.228	0.288
	LTE Band 4	20M	QPSK	1RB	0offset	Right Tilted	20175	1732.5	22.49	23.50	1.262	0.09	0.096	0.121
	LTE Band 4	20M	QPSK	1RB	0offset	Left Cheek	20175	1732.5	22.49	23.50	1.262	-0.16	0.208	0.262
	LTE Band 4	20M	QPSK	1RB	0offset	Left Tilted	20175	1732.5	22.49	23.50	1.262	-0.01	0.140	0.177
	LTE Band 4	20M	QPSK	50RB	0offset	Right Cheek	20175	1732.5	21.39	22.50	1.291	0.02	0.181	0.234
	LTE Band 4	20M	QPSK	50RB	0offset	Right Tilted	20175	1732.5	21.39	22.50	1.291	-0.01	0.078	0.101
	LTE Band 4	20M	QPSK	50RB	0offset	Left Cheek	20175	1732.5	21.39	22.50	1.291	0.11	0.164	0.212
	LTE Band 4	20M	QPSK	50RB	0offset	Left Tilted	20175	1732.5	21.39	22.50	1.291	0.04	0.109	0.141
05	LTE Band 2	20M	QPSK	1RB	0offset	Right Cheek	19100	1900	22.55	23.50	1.245	-0.03	0.209	0.260
	LTE Band 2	20M	QPSK	1RB	0offset	Right Tilted	19100	1900	22.55	23.50	1.245	0.01	0.091	0.113
	LTE Band 2	20M	QPSK	1RB	0offset	Left Cheek	19100	1900	22.55	23.50	1.245	0.07	0.145	0.180
	LTE Band 2	20M	QPSK	1RB	0offset	Left Tilted	19100	1900	22.55	23.50	1.245	0.03	0.080	0.100
	LTE Band 2	20M	QPSK	50RB	0offset	Right Cheek	19100	1900	21.34	22.50	1.306	0.07	0.170	0.222
	LTE Band 2	20M	QPSK	50RB	0offset	Right Tilted	19100	1900	21.34	22.50	1.306	0.05	0.072	0.094
	LTE Band 2	20M	QPSK	50RB	0offset	Left Cheek	19100	1900	21.34	22.50	1.306	0.06	0.099	0.129
	LTE Band 2	20M	QPSK	50RB	0offset	Left Tilted	19100	1900	21.34	22.50	1.306	0.02	0.063	0.082



<WLAN SAR>

Plot No.	Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Max Area Scan	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
06	WLAN2.4GHz	802.11b 1Mbps	Right Cheek	11	2462	15.15	15.50	1.084	97.63	1.024	0.682	-0.04	0.354	0.393
	WLAN2.4GHz	802.11b 1Mbps	Right Tilted	11	2462	15.15	15.50	1.084	97.63	1.024	0.535	-0.12	0.352	0.391
	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	11	2462	15.15	15.50	1.084	97.63	1.024	0.401			
	WLAN2.4GHz	802.11b 1Mbps	Left Tilted	11	2462	15.15	15.50	1.084	97.63	1.024	0.376			



15.2 Hotspot SAR

<CDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	CDMA2000 BC0	1xEVDO RTAP 153.6Kbps	Front	10	777	848.31	23.83	24.50	1.167	0.02	0.388	0.453
07	CDMA2000 BC0	1xEVDO RTAP 153.6Kbps	Back	10	777	848.31	23.83	24.50	1.167	-0.03	0.557	0.650
	CDMA2000 BC0	1xEVDO RTAP 153.6Kbps	Left side	10	777	848.31	23.83	24.50	1.167	0.13	0.523	0.610
	CDMA2000 BC0	1xEVDO RTAP 153.6Kbps	Right side	10	777	848.31	23.83	24.50	1.167	0.14	0.339	0.396
	CDMA2000 BC0	1xEVDO RTAP 153.6Kbps	Bottom side	10	777	848.31	23.83	24.50	1.167	0.04	0.133	0.155
	CDMA2000 BC1	1xEVDO RTAP 153.6Kbps	Front	10	1175	1908.75	23.37	24.50	1.297	-0.08	0.386	0.501
08	CDMA2000 BC1	1xEVDO RTAP 153.6Kbps	Back	10	1175	1908.75	23.37	24.50	1.297	0.06	0.773	1.003
	CDMA2000 BC1	1xEVDO RTAP 153.6Kbps	Left side	10	1175	1908.75	23.37	24.50	1.297	-0.08	0.144	0.187
	CDMA2000 BC1	1xEVDO RTAP 153.6Kbps	Right side	10	1175	1908.75	23.37	24.50	1.297	0.07	0.201	0.261
	CDMA2000 BC1	1xEVDO RTAP 153.6Kbps	Bottom side	10	1175	1908.75	23.37	24.50	1.297	-0.03	0.556	0.721
	CDMA2000 BC1	1xEVDO RTAP 153.6Kbps	Back	10	25	1851.25	23.15	24.50	1.365	0.09	0.592	0.808
	CDMA2000 BC1	1xEVDO RTAP 153.6Kbps	Back	10	600	1880	23.22	24.50	1.343	0.05	0.654	0.878



<LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
09	LTE Band 13	10M	QPSK	1RB	25offset	Front	10	23230	782	22.90	23.50	1.148	-0.01	0.257	0.295
	LTE Band 13	10M	QPSK	1RB	25offset	Back	10	23230	782	22.90	23.50	1.148	0.04	0.427	0.490
	LTE Band 13	10M	QPSK	1RB	25offset	Left side	10	23230	782	22.90	23.50	1.148	0.14	0.395	0.454
	LTE Band 13	10M	QPSK	1RB	25offset	Right side	10	23230	782	22.90	23.50	1.148	0.02	0.336	0.386
	LTE Band 13	10M	QPSK	1RB	25offset	Bottom side	10	23230	782	22.90	23.50	1.148	0.08	0.055	0.063
	LTE Band 13	10M	QPSK	25RB	0offset	Front	10	23230	782	21.89	22.50	1.151	-0.04	0.202	0.232
	LTE Band 13	10M	QPSK	25RB	0offset	Back	10	23230	782	21.89	22.50	1.151	0.05	0.350	0.403
	LTE Band 13	10M	QPSK	25RB	0offset	Left side	10	23230	782	21.89	22.50	1.151	0.02	0.312	0.359
	LTE Band 13	10M	QPSK	25RB	0offset	Right side	10	23230	782	21.89	22.50	1.151	0.03	0.273	0.314
10	LTE Band 4	20M	QPSK	1RB	0offset	Front	10	20175	1732.5	22.49	23.50	1.262	0.02	0.392	0.495
	LTE Band 4	20M	QPSK	1RB	0offset	Back	10	20175	1732.5	22.49	23.50	1.262	0.04	0.534	0.674
	LTE Band 4	20M	QPSK	1RB	0offset	Left side	10	20175	1732.5	22.49	23.50	1.262	0.01	0.158	0.199
	LTE Band 4	20M	QPSK	1RB	0offset	Right side	10	20175	1732.5	22.49	23.50	1.262	0.14	0.191	0.241
	LTE Band 4	20M	QPSK	1RB	0offset	Bottom side	10	20175	1732.5	22.49	23.50	1.262	0.09	0.266	0.336
	LTE Band 4	20M	QPSK	50RB	0offset	Front	10	20175	1732.5	21.39	22.50	1.291	-0.07	0.316	0.408
	LTE Band 4	20M	QPSK	50RB	0offset	Back	10	20175	1732.5	21.39	22.50	1.291	0.01	0.405	0.523
	LTE Band 4	20M	QPSK	50RB	0offset	Left side	10	20175	1732.5	21.39	22.50	1.291	0.18	0.127	0.164
	LTE Band 4	20M	QPSK	50RB	0offset	Right side	10	20175	1732.5	21.39	22.50	1.291	0.18	0.149	0.192
11	LTE Band 2	20M	QPSK	1RB	0offset	Front	10	19100	1900	22.55	23.50	1.245	-0.02	0.329	0.409
	LTE Band 2	20M	QPSK	1RB	0offset	Back	10	19100	1900	22.55	23.50	1.245	-0.09	0.595	0.740
	LTE Band 2	20M	QPSK	1RB	0offset	Left side	10	19100	1900	22.55	23.50	1.245	-0.14	0.134	0.167
	LTE Band 2	20M	QPSK	1RB	0offset	Right side	10	19100	1900	22.55	23.50	1.245	-0.13	0.180	0.224
	LTE Band 2	20M	QPSK	1RB	0offset	Bottom side	10	19100	1900	22.55	23.50	1.245	0.17	0.392	0.488
	LTE Band 2	20M	QPSK	50RB	0offset	Front	10	19100	1900	21.34	22.50	1.306	-0.04	0.258	0.337
	LTE Band 2	20M	QPSK	50RB	0offset	Back	10	19100	1900	21.34	22.50	1.306	0.18	0.506	0.661
	LTE Band 2	20M	QPSK	50RB	0offset	Left side	10	19100	1900	21.34	22.50	1.306	0.06	0.109	0.142
	LTE Band 2	20M	QPSK	50RB	0offset	Right side	10	19100	1900	21.34	22.50	1.306	0.1	0.151	0.197
LTE Band 2	20M	QPSK	50RB	0offset	Bottom side	10	19100	1900	21.34	22.50	1.306	0.16	0.358	0.468	



<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Max Area Scan	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN 2.4GHz	802.11b 1Mbps	Front	10	11	2462	15.15	15.50	1.084	97.63	1.024	0.0876			
12	WLAN 2.4GHz	802.11b 1Mbps	Back	10	11	2462	15.15	15.50	1.084	97.63	1.024	0.17	-0.08	0.113	0.125
	WLAN 2.4GHz	802.11b 1Mbps	Left side	10	11	2462	15.15	15.50	1.084	97.63	1.024	0.0442			
	WLAN 2.4GHz	802.11b 1Mbps	Top side	10	11	2462	15.15	15.50	1.084	97.63	1.024	0.104			



**15.3 Body Worn Accessory SAR**

**<CDMA SAR>**

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	CDMA2000 BC0	1xRTT RC3 SO32	Front	10	777	848.31	23.81	24.50	1.172	0.02	0.397	0.465
13	CDMA2000 BC0	1xRTT RC3 SO32	Back	10	777	848.31	23.81	24.50	1.172	-0.02	0.566	<b>0.663</b>
	CDMA2000 BC1	1xRTT RC3 SO32	Front	10	1175	1908.75	23.42	24.50	1.143	-0.11	0.379	0.433
14	CDMA2000 BC1	1xRTT RC3 SO32	Back	10	1175	1908.75	23.42	24.50	1.143	0.06	0.771	<b>0.881</b>
	CDMA2000 BC1	1xRTT RC3 SO32	Back	10	25	1851.25	23.20	24.50	1.202	0.02	0.611	0.735
	CDMA2000 BC1	1xRTT RC3 SO32	Back	10	600	1880	23.22	24.50	1.197	0.19	0.667	0.798

**<LTE SAR>**

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	LTE Band 13	10M	QPSK	1RB	25offset	Front	10	23230	782	22.90	23.50	1.148	-0.01	0.257	0.295
09	LTE Band 13	10M	QPSK	1RB	25offset	Back	10	23230	782	22.90	23.50	1.148	0.04	0.427	<b>0.490</b>
	LTE Band 13	10M	QPSK	25RB	0offset	Front	10	23230	782	21.89	22.50	1.151	-0.04	0.202	0.232
	LTE Band 13	10M	QPSK	25RB	0offset	Back	10	23230	782	21.89	22.50	1.151	0.05	0.350	0.403
	LTE Band 4	20M	QPSK	1RB	0offset	Front	10	20175	1732.5	22.49	23.50	1.262	0.02	0.392	0.495
10	LTE Band 4	20M	QPSK	1RB	0offset	Back	10	20175	1732.5	22.49	23.50	1.262	0.04	0.534	<b>0.674</b>
	LTE Band 4	20M	QPSK	50RB	0offset	Front	10	20175	1732.5	21.39	22.50	1.291	-0.07	0.316	0.408
	LTE Band 4	20M	QPSK	50RB	0offset	Back	10	20175	1732.5	21.39	22.50	1.291	0.01	0.405	0.523
	LTE Band 2	20M	QPSK	1RB	0offset	Front	10	19100	1900	22.55	23.50	1.245	-0.02	0.329	0.409
11	LTE Band 2	20M	QPSK	1RB	0offset	Back	10	19100	1900	22.55	23.50	1.245	-0.09	0.595	<b>0.740</b>
	LTE Band 2	20M	QPSK	50RB	0offset	Front	10	19100	1900	21.34	22.50	1.306	-0.04	0.258	0.337
	LTE Band 2	20M	QPSK	50RB	0offset	Back	10	19100	1900	21.34	22.50	1.306	0.18	0.506	0.661

**<WLAN SAR>**

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Max Area Scan	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN 2.4GHz	802.11b 1Mbps	Front	10	11	2462	15.15	15.50	1.084	97.63	1.024	0.0876			
12	WLAN 2.4GHz	802.11b 1Mbps	Back	10	11	2462	15.15	15.50	1.084	97.63	1.024	0.17	-0.08	0.113	<b>0.125</b>

**16. Simultaneous Transmission Analysis**

NO.	Simultaneous Transmission Configurations	Portable Handset			Note
		Head	Body-worn	Hotspot	
1.	CDMA(Voice) + WLAN2.4GHz(data)	Yes	Yes		
2.	CDMA((Voice) + Bluetooth(data)	Yes	Yes		
3.	CDMA(Data) + WLAN2.4GHz(data)	Yes	Yes	Yes	2.4GHz Hotspot
4.	LTE(Data) + WLAN2.4GHz(data)	Yes	Yes	Yes	2.4GHz Hotspot
5.	CDMA(Data) + Bluetooth(data)		Yes		WWAN VoIP
6.	LTE(Data) + Bluetooth(data)		Yes		WWAN VoIP

**General Note:**

1. This device supported VoIP in CDMA, LTE (e.g. 3rd party VoIP).
2. This device 2.4GHz WLAN supports Hotspot operation.
3. WLAN 2.4GHz and Bluetooth share the same antenna, and cannot transmit simultaneously.
4. EUT will choose either CDMA or LTE according to the network signal condition; therefore, CDMA or LTE will not operate simultaneously at any moment.
5. Chose the worse zoom scan SAR of WLAN2.4GHz SAR for co-located with WWAN analysis.
6. The Scaled SAR summation is calculated based on the same configuration and test position.
7. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
  - i) Scalar SAR summation < 1.6W/kg.
  - ii)  $SPLSR = (SAR_1 + SAR_2)^{1.5} / (min. separation distance, mm)$ , and the peak separation distance is determined from the square root of  $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$ , where  $(x_1, y_1, z_1)$  and  $(x_2, y_2, z_2)$  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.
8. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v06 based on the formula below.
  - i)  $(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm) \cdot [\sqrt{f(GHz)} / x] W/kg$  for test separation distances  $\leq 50$  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.

Bluetooth Max Power	Exposure Position	Body worn
	Test separation	10 mm
9.5 dBm	Estimated SAR (W/kg)	0.189 W/kg

**16.1 Head Exposure Conditions**

WWAN Band		Exposure Position	1	2	1+2 Summed 1g SAR (W/kg)
			WWAN	2.4GHz WLAN	
			1g SAR (W/kg)	1g SAR (W/kg)	
CDMA	CDMA2000 BC0	Right Cheek	0.384	0.393	0.78
		Right Tilted	0.263	0.393	0.66
		Left Cheek	0.480	0.393	0.87
		Left Tilted	0.295	0.393	0.69
	CDMA2000 BC1	Right Cheek	0.266	0.393	0.66
		Right Tilted	0.095	0.393	0.49
		Left Cheek	0.182	0.393	0.58
		Left Tilted	0.082	0.393	0.48
LTE	Band 13	Right Cheek	0.202	0.393	0.60
		Right Tilted	0.132	0.393	0.53
		Left Cheek	0.234	0.393	0.63
		Left Tilted	0.141	0.393	0.53
	Band 4	Right Cheek	0.288	0.393	0.68
		Right Tilted	0.121	0.393	0.51
		Left Cheek	0.262	0.393	0.66
		Left Tilted	0.177	0.393	0.57
	Band 2	Right Cheek	0.260	0.393	0.65
		Right Tilted	0.113	0.393	0.51
		Left Cheek	0.180	0.393	0.57
		Left Tilted	0.100	0.393	0.49



16.2 Hotspot Exposure Conditions

WWAN Band		Exposure Position	1	2	1+2 Summed 1g SAR (W/kg)
			WWAN	2.4GHz WLAN	
			1g SAR (W/kg)	1g SAR (W/kg)	
CDMA	CDMA2000 BC0	Front	0.453	0.125	0.58
		Back	0.650	0.125	0.78
		Left side	0.610	0.125	0.74
		Right side	0.396		0.40
		Top side		0.125	0.13
		Bottom side	0.155		0.16
	CDMA2000 BC1	Front	0.501	0.125	0.63
		Back	1.003	0.125	1.13
		Left side	0.187	0.125	0.31
		Right side	0.261		0.26
		Top side		0.125	0.13
		Bottom side	0.721		0.72
LTE	Band 13	Front	0.295	0.125	0.42
		Back	0.490	0.125	0.62
		Left side	0.454	0.125	0.58
		Right side	0.386		0.39
		Top side		0.125	0.13
		Bottom side	0.063		0.06
	Band 4	Front	0.495	0.125	0.62
		Back	0.674	0.125	0.80
		Left side	0.199	0.125	0.32
		Right side	0.241		0.24
		Top side		0.125	0.13
		Bottom side	0.336		0.34
	Band 2	Front	0.409	0.125	0.53
		Back	0.740	0.125	0.87
		Left side	0.167	0.125	0.29
		Right side	0.224		0.22
		Top side		0.125	0.13
		Bottom side	0.488		0.49

**16.3 Body-Worn Accessory Exposure Conditions**

WWAN Band		Exposure Position	1	2	3	1+2 Summed 1g SAR (W/kg)	1+3 Summed 1g SAR (W/kg)
			WWAN	2.4GHz WLAN	Bluetooth		
			1g SAR (W/kg)	1g SAR (W/kg)	Estimated 1g SAR (W/kg)		
CDMA	CDMA2000 BC0	Front	0.465	0.125	0.189	0.59	0.65
		Back	0.663	0.125	0.189	0.79	0.85
	CDMA2000 BC1	Front	0.433	0.125	0.189	0.56	0.62
		Back	0.881	0.125	0.189	1.01	1.07
LTE	Band 13	Front	0.295	0.125	0.189	0.42	0.48
		Back	0.490	0.125	0.189	0.62	0.68
	Band 4	Front	0.495	0.125	0.189	0.62	0.68
		Back	0.674	0.125	0.189	0.80	0.86
	Band 2	Front	0.409	0.125	0.189	0.53	0.60
		Back	0.740	0.125	0.189	0.87	0.93

**Test Engineer :** Kat Yin

## 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 observation 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.

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
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 648474 D04 v01r03, "SAR Evaluation Considerations for Wireless Handsets", Oct 2015.
- [8] FCC KDB 941225 D01 v03r01, "3G SAR MEAUREMENT PROCEDURES", Oct 2015
- [9] FCC KDB 941225 D05 v02r05, "SAR Evaluation Considerations for LTE Devices", Dec 2015
- [10] FCC KDB 941225 D06 v02r01, "SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities", Oct 2015.
- [11] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.
- [12] FCC KDB 865664 D02 v01r02, "RF Exposure Compliance Reporting and Documentation Considerations" Oct 2015.



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

The plots are shown as follows.

### System Check\_Head\_750MHz\_20160510

**DUT: D750V3-SN:1087**

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: HSL\_750\_2016/05/10 Medium parameters used:  $f = 750$  MHz;  $\sigma = 0.88$  S/m;  $\epsilon_r = 40.797$ ;  $\rho = 1000$  kg/m<sup>3</sup>

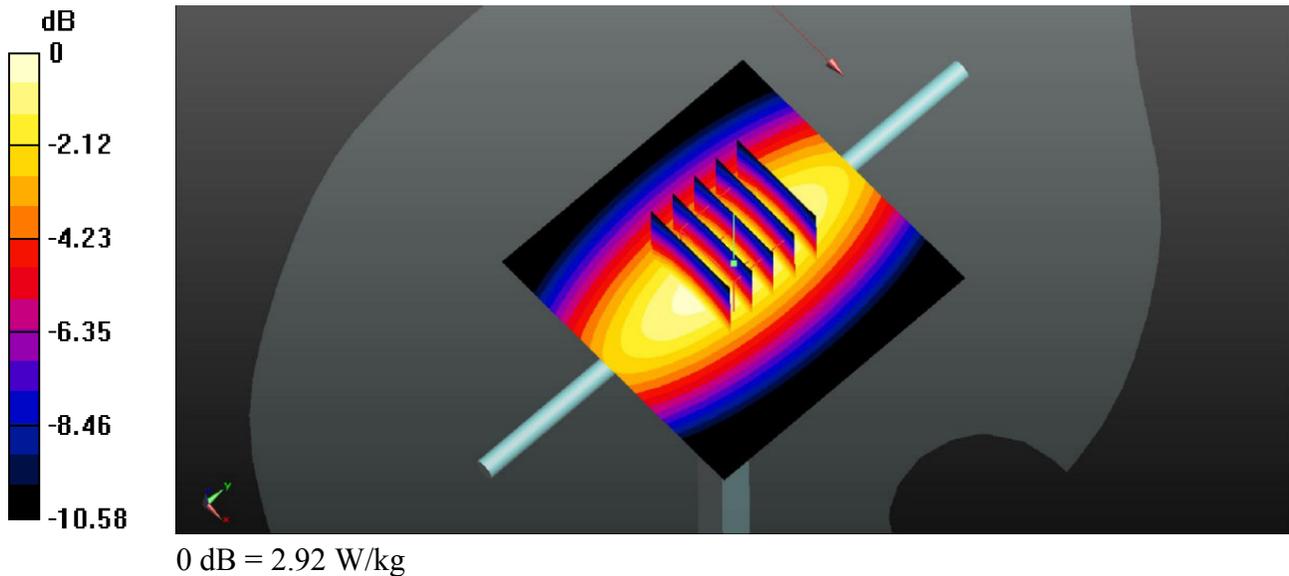
Ambient Temperature : 23.6 °C; Liquid Temperature : 22.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(10.06, 10.06, 10.06); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1754
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Pin=250mW/Area Scan (61x61x1):** Interpolated grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 2.93 W/kg

**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 58.96 V/m; Power Drift = 0.01 dB  
Peak SAR (extrapolated) = 3.43 W/kg  
**SAR(1 g) = 2.18 W/kg; SAR(10 g) = 1.41 W/kg**  
Maximum value of SAR (measured) = 2.92 W/kg



### System Check\_Head\_835MHz\_20160511

**DUT: D835V2-SN:4d151**

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: HSL\_835\_2016/05/11 Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.906 \text{ S/m}$ ;  $\epsilon_r = 42.204$ ;

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

Ambient Temperature :  $23.5 \text{ }^\circ\text{C}$ ; Liquid Temperature :  $22.2 \text{ }^\circ\text{C}$

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(9.75, 9.75, 9.75); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1754
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Maximum value of SAR (interpolated) =  $3.09 \text{ W/kg}$

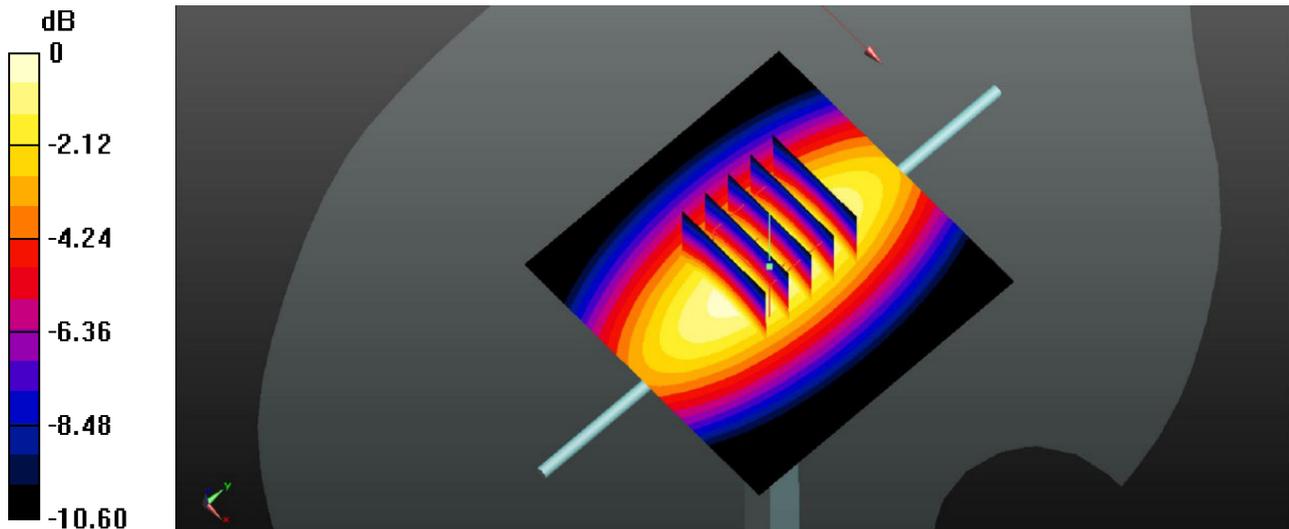
**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $56.59 \text{ V/m}$ ; Power Drift =  $0.03 \text{ dB}$

Peak SAR (extrapolated) =  $3.59 \text{ W/kg}$

**SAR(1 g) =  $2.45 \text{ W/kg}$ ; SAR(10 g) =  $1.61 \text{ W/kg}$**

Maximum value of SAR (measured) =  $3.08 \text{ W/kg}$



0 dB =  $3.08 \text{ W/kg}$

### System Check\_Head\_1750MHz\_20160511

**DUT: D1750V2-SN:1090**

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: HSL\_1750\_2016/05/11 Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.394$  S/m;  $\epsilon_r = 40.273$ ;  $\rho = 1000$  kg/m<sup>3</sup>

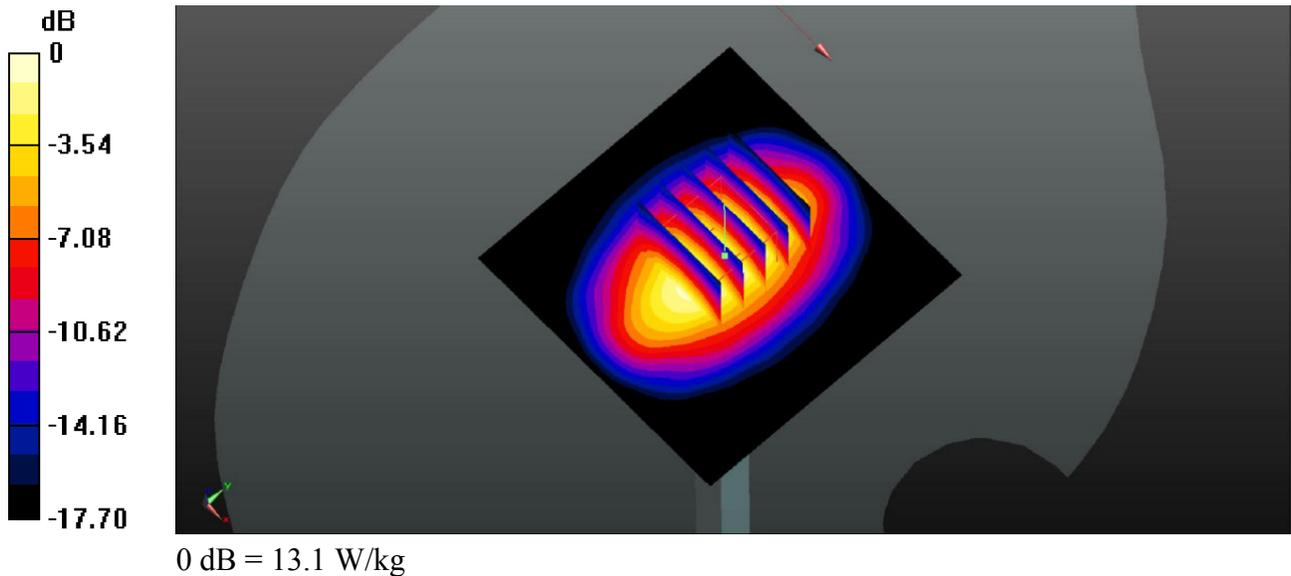
Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(8.41, 8.41, 8.41); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1754
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Pin=250mW/Area Scan (61x61x1):** Interpolated grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 13.4 W/kg

**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 98.93 V/m; Power Drift = 0.03 dB  
Peak SAR (extrapolated) = 16.8 W/kg  
**SAR(1 g) = 9.3 W/kg; SAR(10 g) = 4.92 W/kg**  
Maximum value of SAR (measured) = 13.1 W/kg



### System Check\_Head\_1900MHz\_20160510

#### DUT: D1900V2-SN:5d170

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: HSL\_1900\_2016/05/10 Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.442$  S/m;  $\epsilon_r = 38.685$ ;  $\rho = 1000$  kg/m<sup>3</sup>

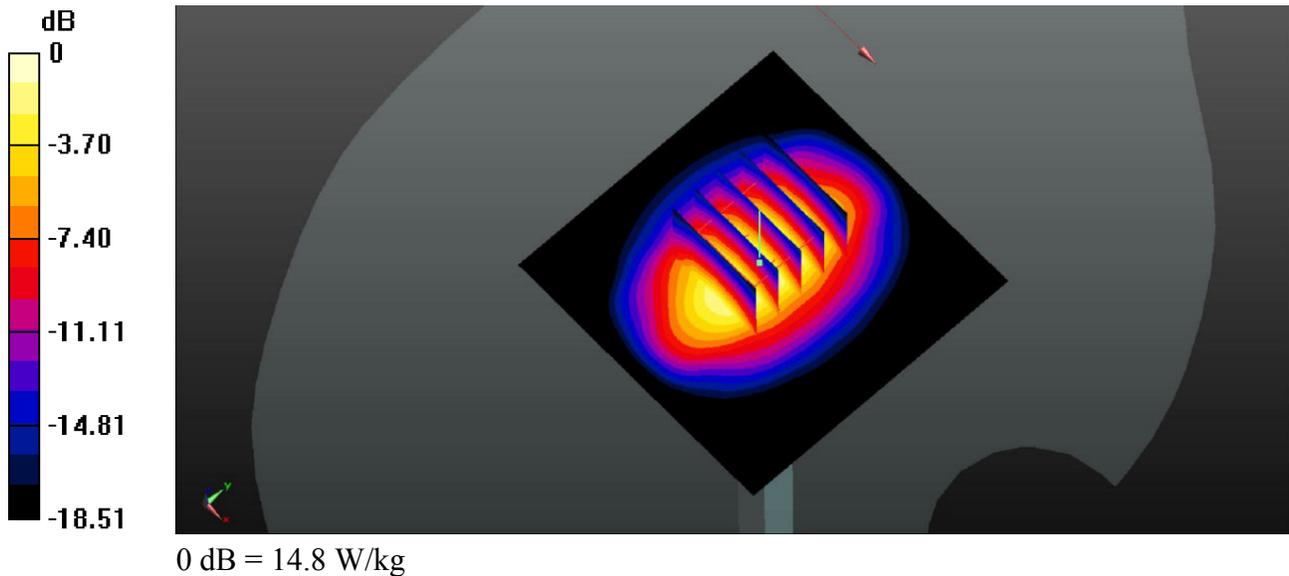
Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.5 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(8.12, 8.12, 8.12); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Pin=250mW/Area Scan (61x61x1):** Interpolated grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 14.7 W/kg

**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 99.51 V/m; Power Drift = 0.13 dB  
Peak SAR (extrapolated) = 19.1 W/kg  
**SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.28 W/kg**  
Maximum value of SAR (measured) = 14.8 W/kg



### System Check\_Head\_2450MHz\_20160524

#### DUT: D2450V2-SN:908

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL\_2450\_2016/05/24 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.833$  S/m;  $\epsilon_r = 37.683$ ;  $\rho = 1000$  kg/m<sup>3</sup>

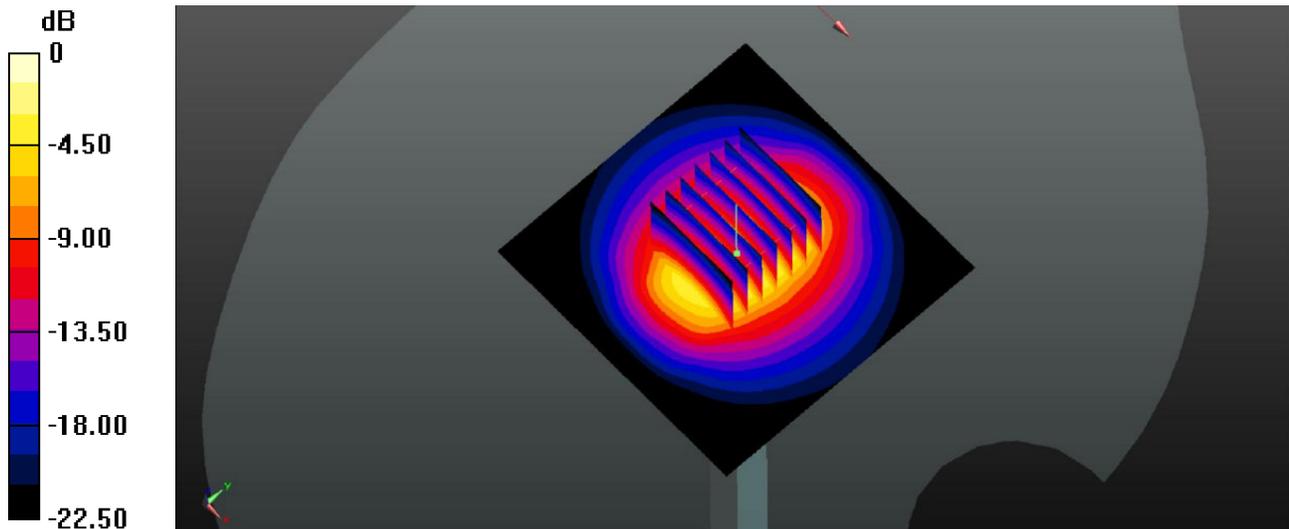
Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.5 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3935; ConvF(7.49, 7.49, 7.49); Calibrated: 2015/11/27;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Pin=250mW/Area Scan (71x71x1):** Interpolated grid: dx=12mm, dy=12mm  
Maximum value of SAR (interpolated) = 20.8 W/kg

**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 90.16 V/m; Power Drift = 0.07 dB  
Peak SAR (extrapolated) = 27.7 W/kg  
**SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.07 W/kg**  
Maximum value of SAR (measured) = 20.3 W/kg



0 dB = 20.3 W/kg

**System Check\_Body\_750MHz\_20160428**

**DUT: D750V3-SN:1087**

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: MSL\_750\_2016/04/28 Medium parameters used:  $f = 750$  MHz;  $\sigma = 0.965$  S/m;  $\epsilon_r = 55.06$ ;  $\rho = 1000$  kg/m<sup>3</sup>

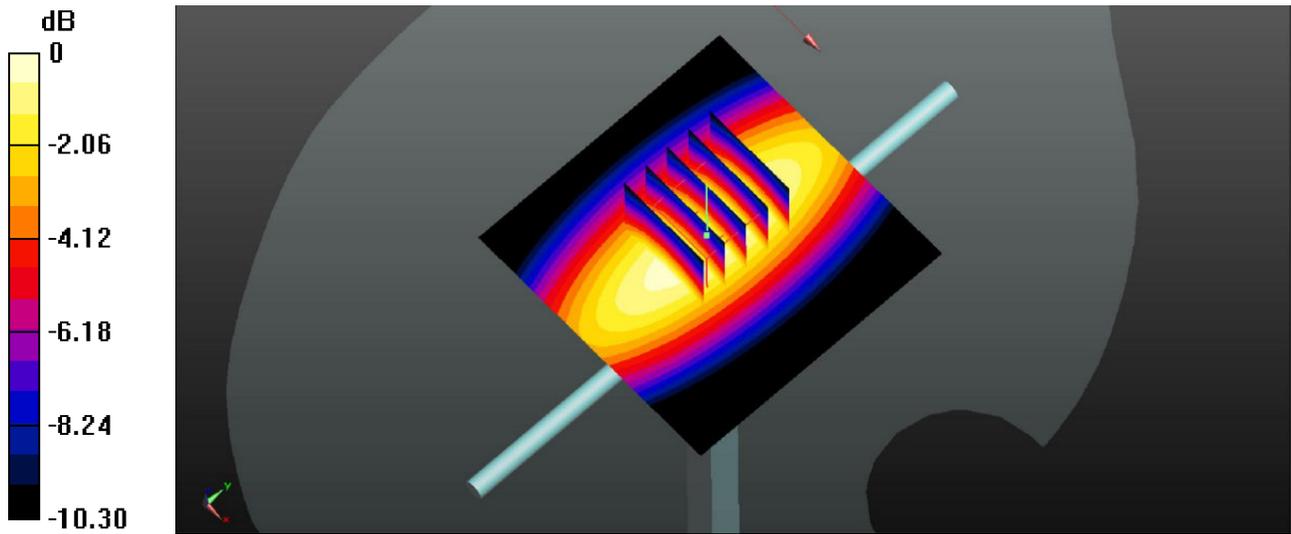
Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.4 °C

**DASY5 Configuration:**

- Probe: EX3DV4 - SN3911; ConvF(10.08, 10.08, 10.08); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Pin=250mW/Area Scan (61x61x1):** Interpolated grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 2.93 W/kg

**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 50.58 V/m; Power Drift = 0.08 dB  
Peak SAR (extrapolated) = 3.46 W/kg  
**SAR(1 g) = 2.33 W/kg; SAR(10 g) = 1.55 W/kg**  
Maximum value of SAR (measured) = 2.93 W/kg



0 dB = 2.93 W/kg

**System Check\_Body\_835MHz\_20160428**

**DUT: D835V2-SN:4d151**

Communication System: UID 0, CW; Frequency: 835 MHz;Duty Cycle: 1:1

Medium: MSL\_835\_2016/04/28 Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.973 \text{ S/m}$ ;  $\epsilon_r = 54.808$ ;

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

Ambient Temperature :  $23.7 \text{ }^\circ\text{C}$ ; Liquid Temperature :  $22.4 \text{ }^\circ\text{C}$

**DASY5 Configuration:**

- Probe: EX3DV4 - SN3911; ConvF(9.8, 9.8, 9.8); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Maximum value of SAR (interpolated) =  $3.02 \text{ W/kg}$

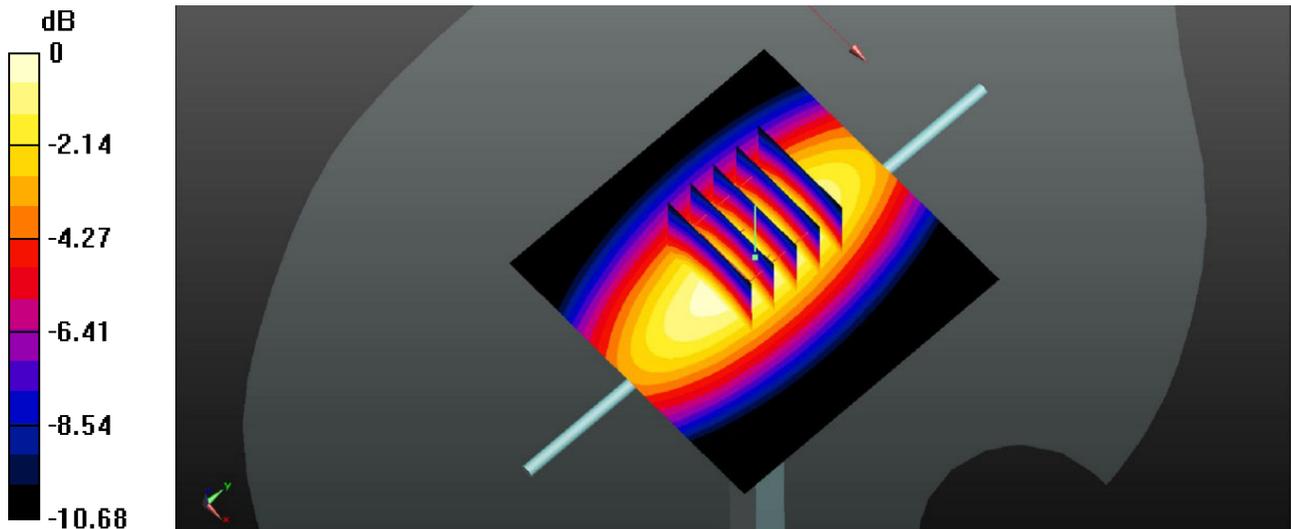
**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $51.02 \text{ V/m}$ ; Power Drift =  $0.05 \text{ dB}$

Peak SAR (extrapolated) =  $3.55 \text{ W/kg}$

**SAR(1 g) =  $2.39 \text{ W/kg}$ ; SAR(10 g) =  $1.57 \text{ W/kg}$**

Maximum value of SAR (measured) =  $3.02 \text{ W/kg}$



0 dB =  $3.02 \text{ W/kg}$

**System Check\_Body\_1750MHz\_20160428**

**DUT: D1750V2-SN:1090**

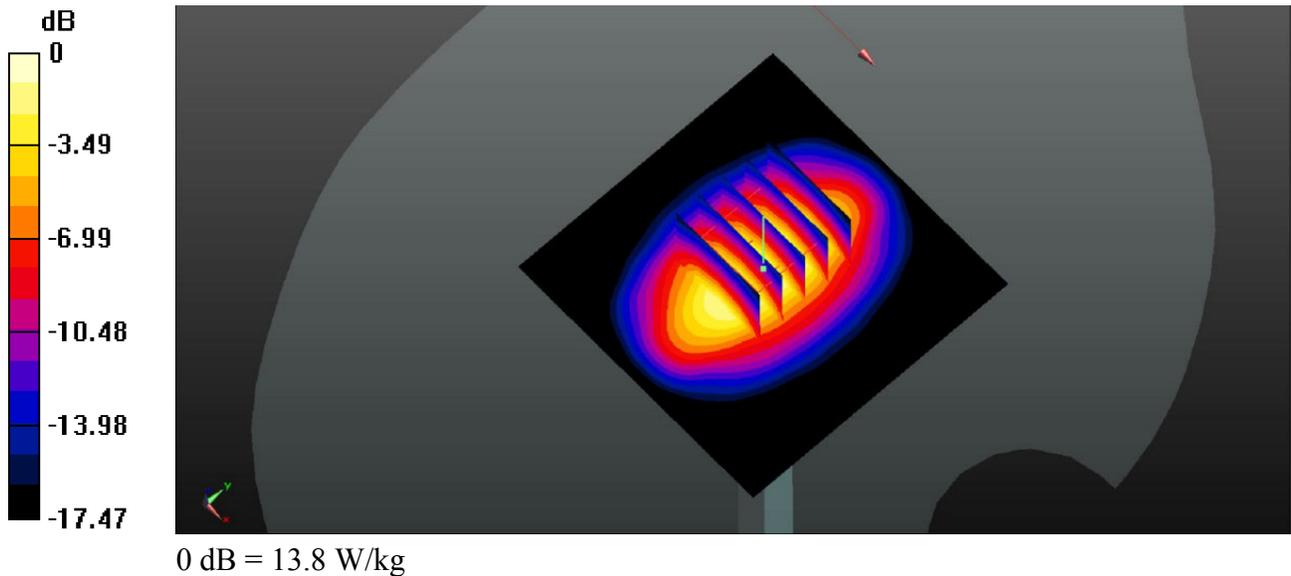
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1  
Medium: MSL\_1750\_2016/04/28 Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.495$  S/m;  $\epsilon_r = 53.474$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.6 °C ; Liquid Temperature : 22.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(8.01, 8.01, 8.01); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Pin=250mW/Area Scan (61x61x1):** Interpolated grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 13.9 W/kg

**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 97.71 V/m; Power Drift = 0.05 dB  
Peak SAR (extrapolated) = 17.5 W/kg  
**SAR(1 g) = 9.78 W/kg; SAR(10 g) = 5.14 W/kg**  
Maximum value of SAR (measured) = 13.8 W/kg



**System Check\_Body\_1900MHz\_20160428**

**DUT: D1900V2-SN:5d170**

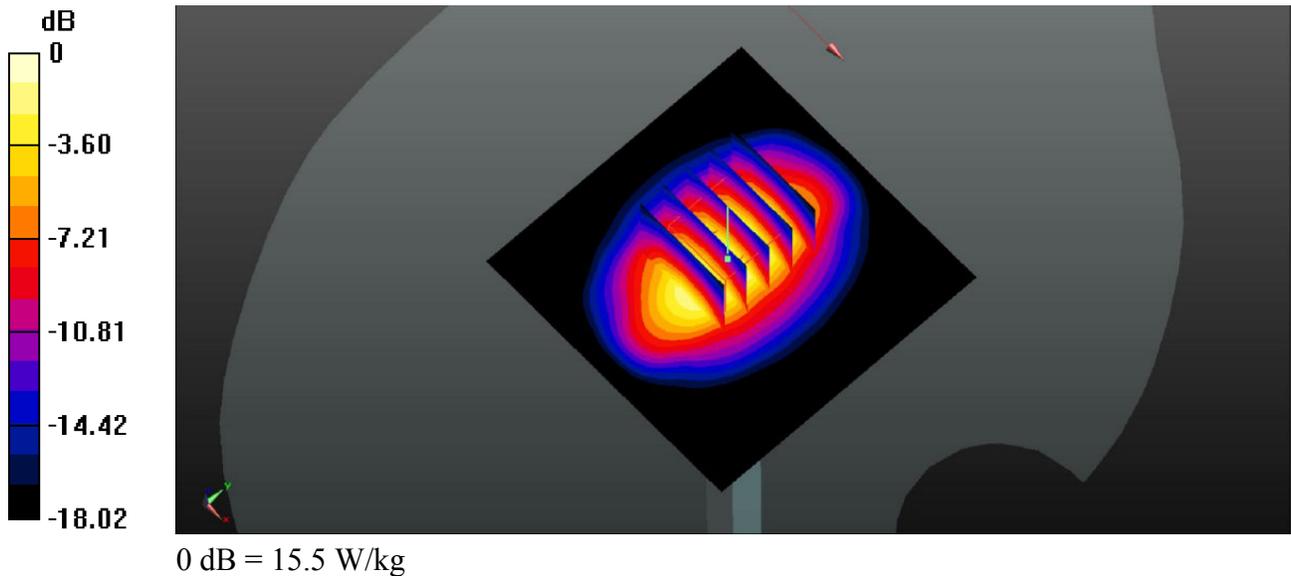
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1  
Medium: MSL\_1900\_2016/04/28 Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.577$  S/m;  $\epsilon_r = 52.18$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(7.75, 7.75, 7.75); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1754
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Pin=250mW/Area Scan (61x61x1):** Interpolated grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 15.3 W/kg

**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 85.03 V/m; Power Drift = 0.14 dB  
Peak SAR (extrapolated) = 19.6 W/kg  
**SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.6 W/kg**  
Maximum value of SAR (measured) = 15.5 W/kg



### System Check\_Body\_2450MHz\_20160526

#### DUT: D2450V2-SN:908

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL\_2450\_2016/05/26 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.966$  S/m;  $\epsilon_r = 53.124$ ;  $\rho = 1000$  kg/m<sup>3</sup>

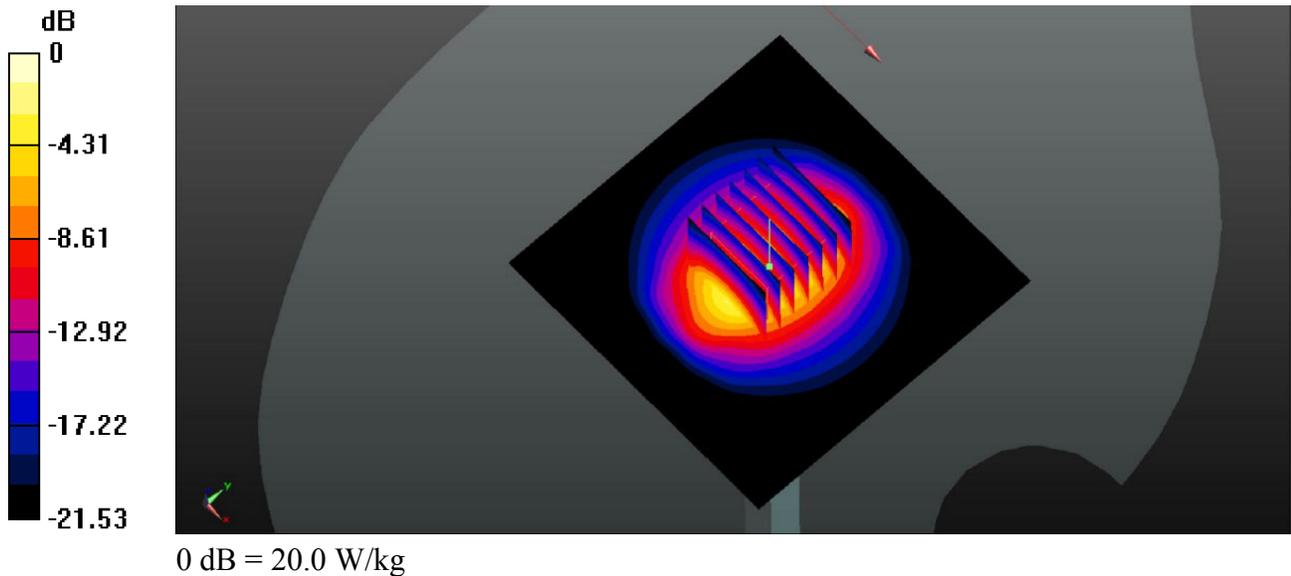
Ambient Temperature : 23.6 °C ; Liquid Temperature : 22.2 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3935; ConvF(7.55, 7.55, 7.55); Calibrated: 2015/11/27;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Pin=250mW/Area Scan (81x81x1):** Interpolated grid: dx=12mm, dy=12mm  
Maximum value of SAR (interpolated) = 19.8 W/kg

**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 87.05 V/m; Power Drift = 0.05 dB  
Peak SAR (extrapolated) = 26.6 W/kg  
**SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.07 W/kg**  
Maximum value of SAR (measured) = 20.0 W/kg





## **Appendix B. Plots of High SAR Measurement**

The plots are shown as follows.

**01\_CDMA2000 BC0\_1xRTT RC3 SO55\_Left Cheek\_0mm\_Ch777**

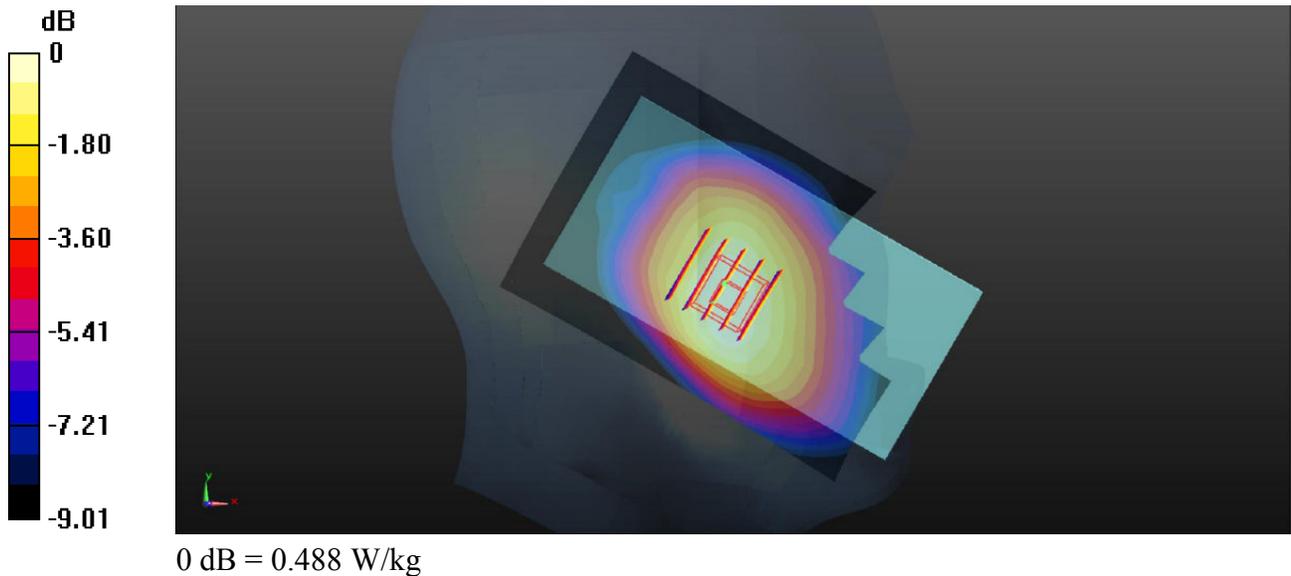
Communication System: UID 0, CDMA2000 (0); Frequency: 848.31 MHz; Duty Cycle: 1:1  
Medium: HSL\_835\_2016/05/11 Medium parameters used:  $f = 848.31$  MHz;  $\sigma = 0.918$  S/m;  $\epsilon_r = 42.055$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.2 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(9.75, 9.75, 9.75); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1754
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch777/Area Scan (71x121x1):** Interpolated grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 0.495 W/kg

**Ch777/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 7.796 V/m; Power Drift = 0.02 dB  
Peak SAR (extrapolated) = 0.536 W/kg  
**SAR(1 g) = 0.412 W/kg; SAR(10 g) = 0.316 W/kg**  
Maximum value of SAR (measured) = 0.488 W/kg



## 02\_CDMA2000 BC1\_1xRTT RC3 SO55\_Right Cheek\_0mm\_Ch1175

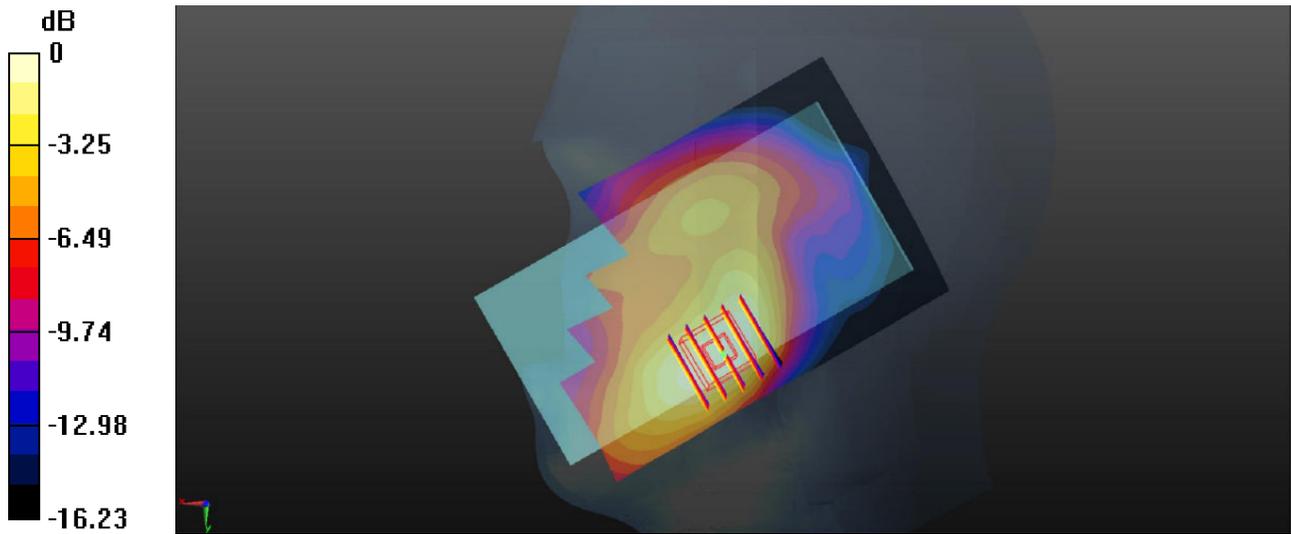
Communication System: UID 0, CDMA2000 (0); Frequency: 1908.75 MHz; Duty Cycle: 1:1  
Medium: HSL\_1900\_2016/05/10 Medium parameters used:  $f = 1908.75$  MHz;  $\sigma = 1.451$  S/m;  
 $\epsilon_r = 38.642$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.5 °C

### DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(8.12, 8.12, 8.12); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch1175/Area Scan (71x121x1):** Interpolated grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 0.269 W/kg

**Ch1175/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 4.297 V/m; Power Drift = 0.15 dB  
Peak SAR (extrapolated) = 0.318 W/kg  
**SAR(1 g) = 0.208 W/kg; SAR(10 g) = 0.130 W/kg**  
Maximum value of SAR (measured) = 0.267 W/kg



0 dB = 0.267 W/kg

### 03\_LTE Band 13\_10M\_QPSK\_1RB\_25offset\_Left Cheek\_10mm\_Ch23230

Communication System: UID 0, FDD-LTE (0); Frequency: 782 MHz; Duty Cycle: 1:1

Medium: HSL\_750\_2016/05/10 Medium parameters used:  $f = 782 \text{ MHz}$ ;  $\sigma = 0.899 \text{ S/m}$ ;  $\epsilon_r = 40.06$ ;  $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature :  $23.6 \text{ }^\circ\text{C}$ ; Liquid Temperature :  $22.3 \text{ }^\circ\text{C}$

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(10.06, 10.06, 10.06); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1754
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch23230/Area Scan (71x121x1):** Interpolated grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

Maximum value of SAR (interpolated) =  $0.224 \text{ W/kg}$

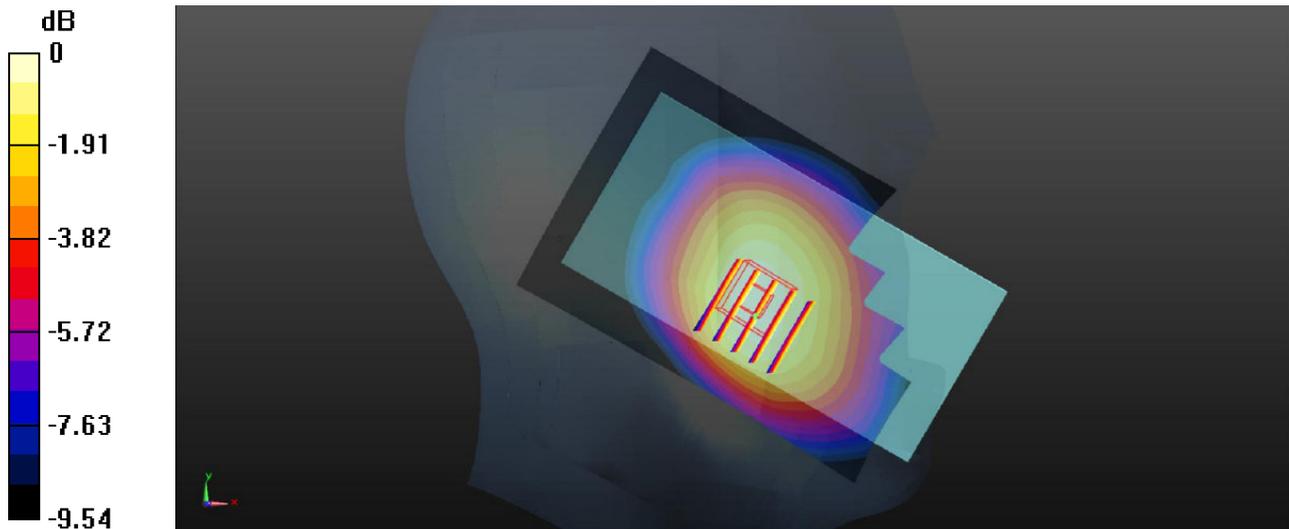
**Ch23230/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $5.126 \text{ V/m}$ ; Power Drift =  $0.02 \text{ dB}$

Peak SAR (extrapolated) =  $0.248 \text{ W/kg}$

**SAR(1 g) =  $0.204 \text{ W/kg}$ ; SAR(10 g) =  $0.158 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.229 \text{ W/kg}$



0 dB =  $0.229 \text{ W/kg}$

### 04\_LTE Band 4\_20M\_QPSK\_1RB\_0offset\_Right Cheek\_0mm\_Ch20175

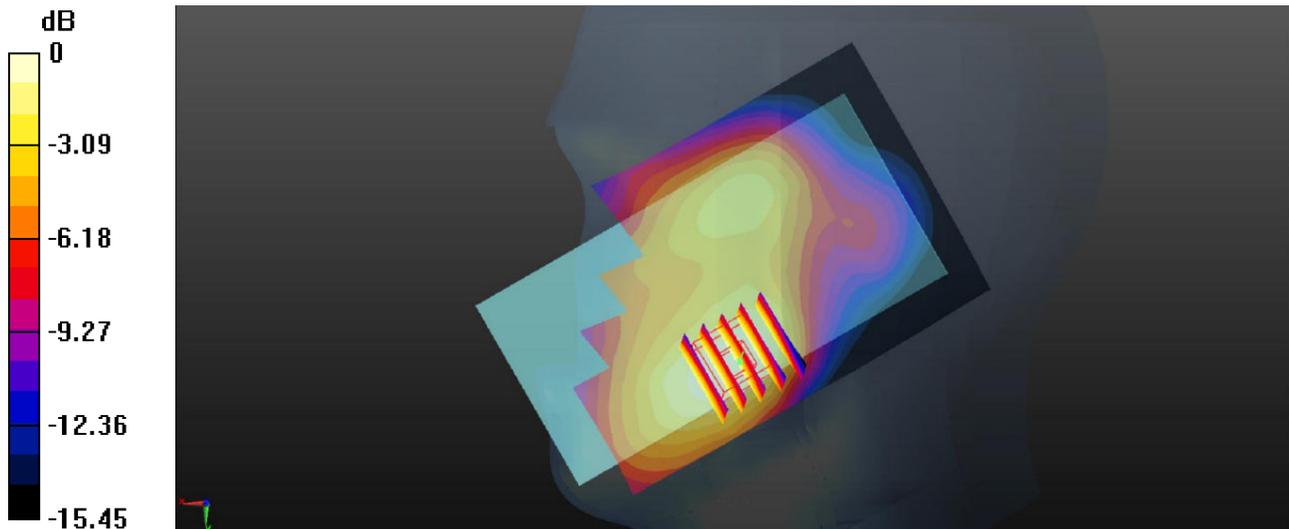
Communication System: UID 0, FDD-LTE (0); Frequency: 1732.5 MHz; Duty Cycle: 1:1  
Medium: HSL\_1750\_2016/05/11 Medium parameters used:  $f = 1732.5$  MHz;  $\sigma = 1.377$  S/m;  $\epsilon_r = 40.366$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.6 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(8.41, 8.41, 8.41); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1754
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch20175/Area Scan (71x121x1):** Interpolated grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 0.281 W/kg

**Ch20175/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 4.725 V/m; Power Drift = 0.10 dB  
Peak SAR (extrapolated) = 0.331 W/kg  
**SAR(1 g) = 0.228 W/kg; SAR(10 g) = 0.151 W/kg**  
Maximum value of SAR (measured) = 0.284 W/kg



### 05\_LTE Band 2\_20M\_QPSK\_1RB\_0offset\_Right Cheek\_0mm\_Ch19100

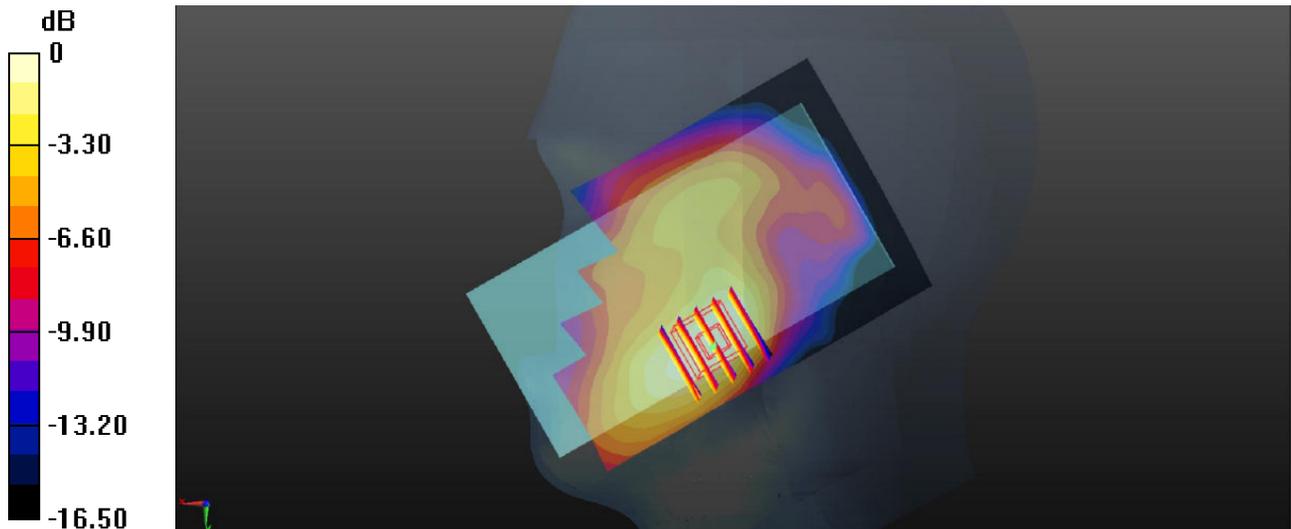
Communication System: UID 0, FDD-LTE (0); Frequency: 1900 MHz; Duty Cycle: 1:1  
Medium: HSL\_1900\_2016/05/10 Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.442$  S/m;  $\epsilon_r = 38.685$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.5 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(9.8, 9.8, 9.8); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch19100/Area Scan (71x121x1):** Interpolated grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 0.258 W/kg

**Ch19100/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 5.123 V/m; Power Drift = -0.03 dB  
Peak SAR (extrapolated) = 0.318 W/kg  
**SAR(1 g) = 0.209 W/kg; SAR(10 g) = 0.133 W/kg**  
Maximum value of SAR (measured) = 0.266 W/kg



0 dB = 0.266 W/kg

### 06\_WLAN2.4GHz\_802.11b 1Mbps\_Right Cheek\_0mm\_Ch11

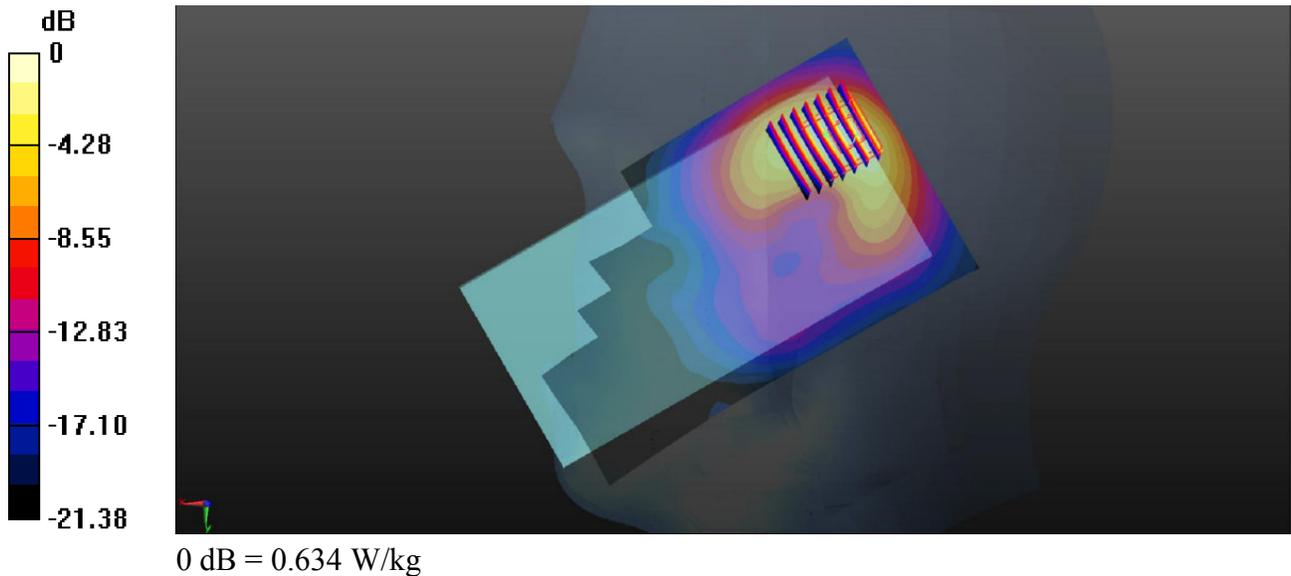
Communication System: UID 0, 802.11b (0); Frequency: 2462 MHz; Duty Cycle: 1:1.024  
Medium: HSL\_2450\_2016/05/24 Medium parameters used:  $f = 2462$  MHz;  $\sigma = 1.849$  S/m;  $\epsilon_r = 37.633$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.5 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3935; ConvF(7.49, 7.49, 7.49); Calibrated: 2015/11/27;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch11/Area Scan (81x151x1):** Interpolated grid: dx=12mm, dy=12mm  
Maximum value of SAR (interpolated) = 0.682 W/kg

**Ch11/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 10.19 V/m; Power Drift = -0.04 dB  
Peak SAR (extrapolated) = 0.833 W/kg  
**SAR(1 g) = 0.354 W/kg; SAR(10 g) = 0.150 W/kg**  
Maximum value of SAR (measured) = 0.634 W/kg



**07\_CDMA2000 BC0\_1xEVDO RTAP 153.6Kbps\_Back\_10mm\_Ch777**

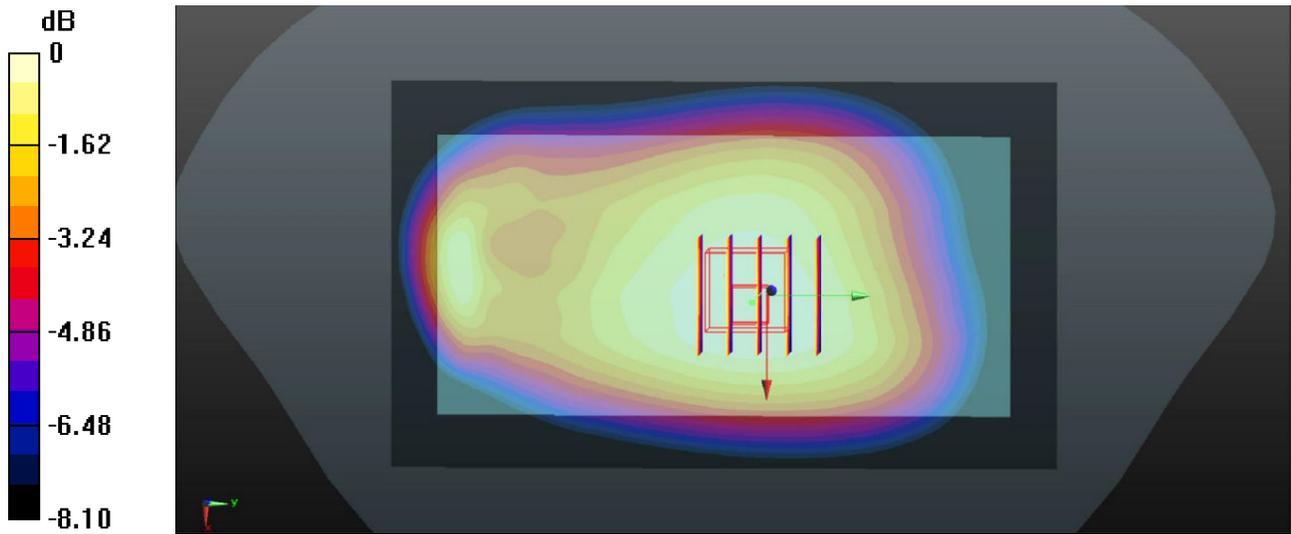
Communication System: UID 0, CDMA2000 (0); Frequency: 848.31 MHz; Duty Cycle: 1:1  
 Medium: MSL\_835\_2016/04/28 Medium parameters used:  $f = 848.31 \text{ MHz}$ ;  $\sigma = 0.984 \text{ S/m}$ ;  $\epsilon_r = 54.698$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Ambient Temperature :  $23.7 \text{ }^\circ\text{C}$ ; Liquid Temperature :  $22.4 \text{ }^\circ\text{C}$

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(9.8, 9.8, 9.8); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch777/Area Scan (71x121x1):** Interpolated grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$   
 Maximum value of SAR (interpolated) =  $0.637 \text{ W/kg}$

**Ch777/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value =  $23.86 \text{ V/m}$ ; Power Drift =  $-0.03 \text{ dB}$   
 Peak SAR (extrapolated) =  $0.718 \text{ W/kg}$   
**SAR(1 g) =  $0.557 \text{ W/kg}$ ; SAR(10 g) =  $0.425 \text{ W/kg}$**   
 Maximum value of SAR (measured) =  $0.640 \text{ W/kg}$



0 dB =  $0.640 \text{ W/kg}$

**08\_CDMA2000 BC1\_1xEVDO RTAP 153.6Kbps\_Back\_10mm\_Ch1175**

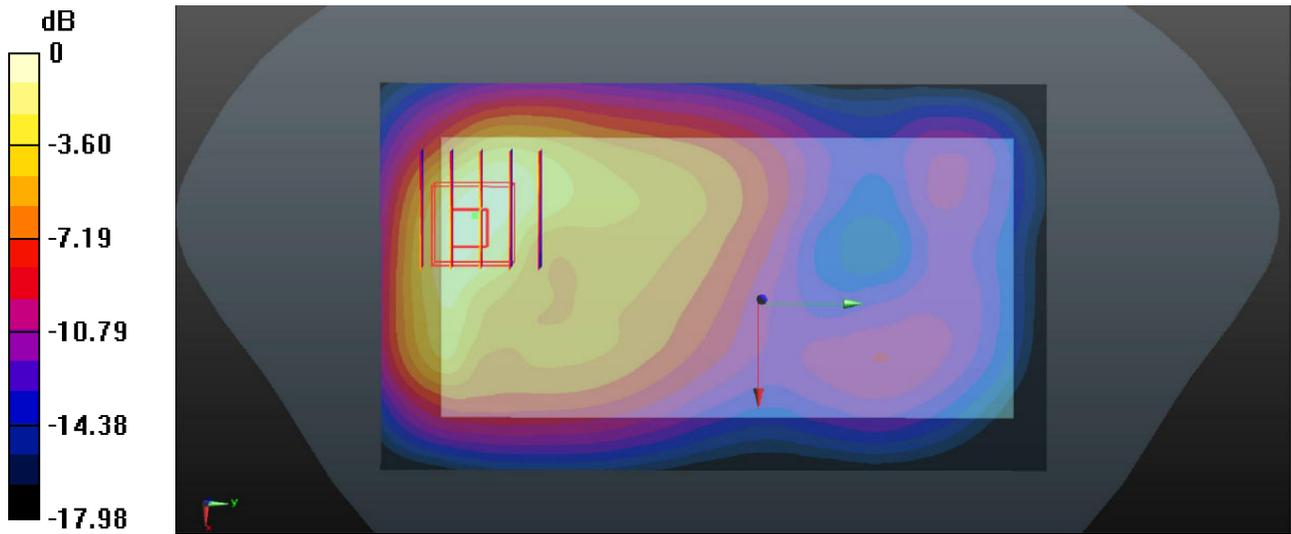
Communication System: UID 0, CDMA2000 (0); Frequency: 1908.75 MHz; Duty Cycle: 1:1  
 Medium: MSL\_1900\_2016/04/28 Medium parameters used:  $f = 1908.75 \text{ MHz}$ ;  $\sigma = 1.588 \text{ S/m}$ ;  
 $\epsilon_r = 52.148$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Ambient Temperature :  $23.5 \text{ }^\circ\text{C}$ ; Liquid Temperature :  $22.5 \text{ }^\circ\text{C}$

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(7.75, 7.75, 7.75); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1754
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch1175/Area Scan (71x121x1):** Interpolated grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$   
 Maximum value of SAR (interpolated) =  $0.955 \text{ W/kg}$

**Ch1175/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value =  $9.317 \text{ V/m}$ ; Power Drift =  $0.06 \text{ dB}$   
 Peak SAR (extrapolated) =  $1.34 \text{ W/kg}$   
**SAR(1 g) =  $0.773 \text{ W/kg}$ ; SAR(10 g) =  $0.416 \text{ W/kg}$**   
 Maximum value of SAR (measured) =  $1.03 \text{ W/kg}$



0 dB =  $1.03 \text{ W/kg}$

### 09\_LTE Band 13\_10M\_QPSK\_1RB\_25offset\_Back\_10mm\_Ch23230

Communication System: UID 0, FDD-LTE (0); Frequency: 782 MHz; Duty Cycle: 1:1

Medium: MSL\_750\_2016/04/28 Medium parameters used:  $f = 782 \text{ MHz}$ ;  $\sigma = 0.995 \text{ S/m}$ ;  $\epsilon_r = 54.724$ ;

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

Ambient Temperature :  $23.5 \text{ }^\circ\text{C}$ ; Liquid Temperature :  $22.4 \text{ }^\circ\text{C}$

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(10.08, 10.08, 10.08); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch23230/Area Scan (71x121x1):** Interpolated grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

Maximum value of SAR (interpolated) =  $0.499 \text{ W/kg}$

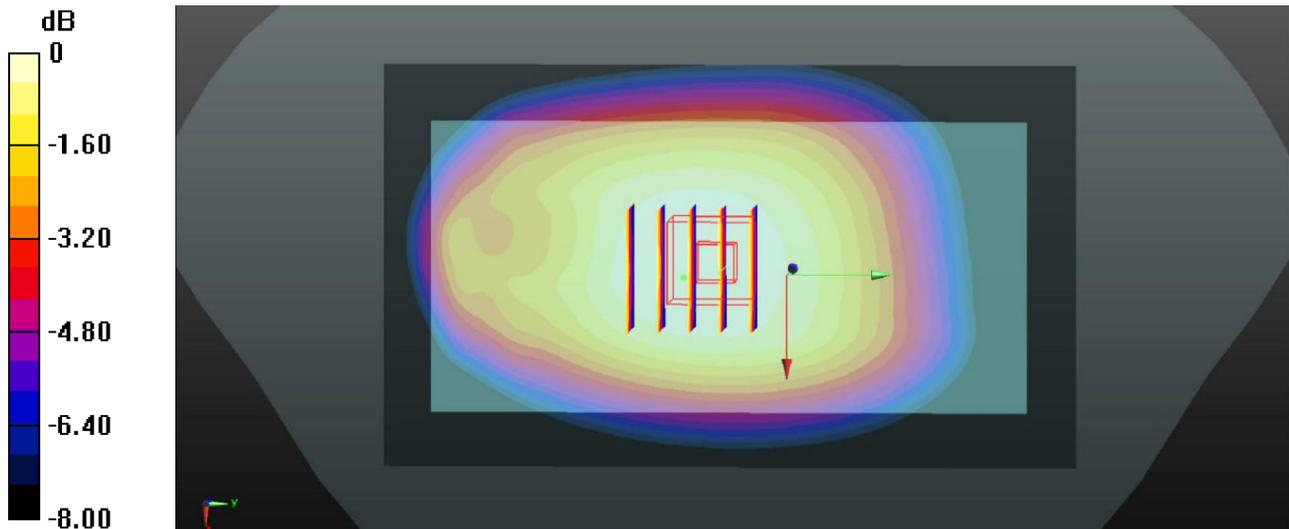
**Ch23230/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $20.91 \text{ V/m}$ ; Power Drift =  $0.04 \text{ dB}$

Peak SAR (extrapolated) =  $0.544 \text{ W/kg}$

**SAR(1 g) =  $0.427 \text{ W/kg}$ ; SAR(10 g) =  $0.327 \text{ W/kg}$**

Maximum value of SAR (measured) =  $0.496 \text{ W/kg}$



0 dB =  $0.496 \text{ W/kg}$

**10\_LTE Band 4\_20M\_QPSK\_1RB\_0offset\_Back\_10mm\_Ch20175**

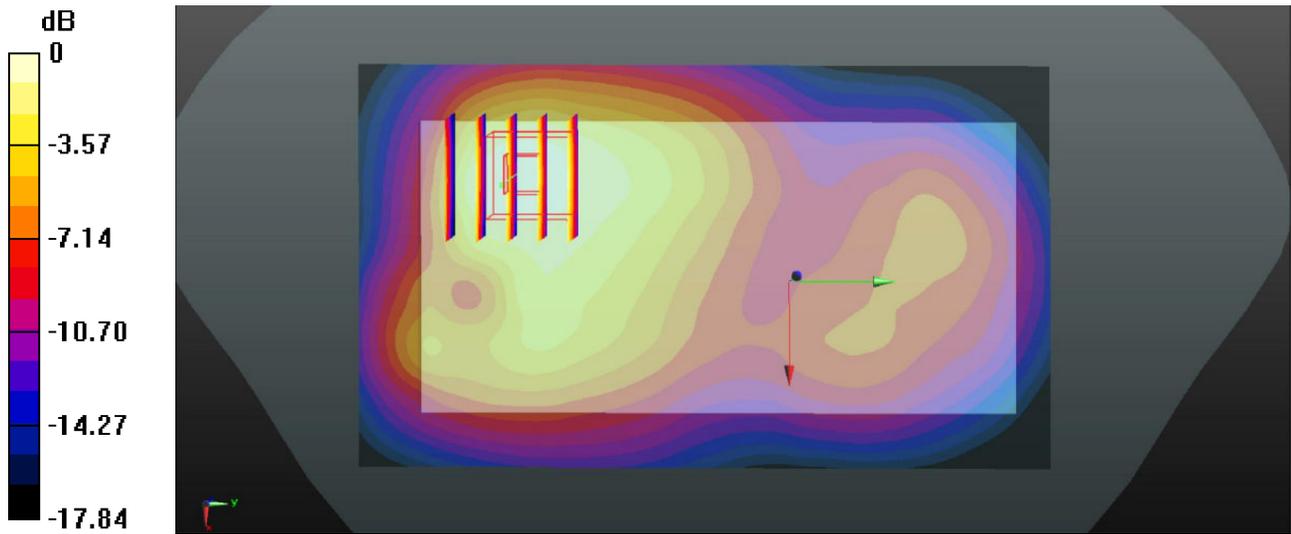
Communication System: UID 0, FDD-LTE (0); Frequency: 1732.5 MHz;Duty Cycle: 1:1  
 Medium: MSL\_1750\_2016/04/28 Medium parameters used:  $f = 1732.5 \text{ MHz}$ ;  $\sigma = 1.476 \text{ S/m}$ ;  $\epsilon_r = 53.535$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Ambient Temperature :  $23.6 \text{ }^\circ\text{C}$ ; Liquid Temperature :  $22.3 \text{ }^\circ\text{C}$

**DASY5 Configuration:**

- Probe: EX3DV4 - SN3911; ConvF(8.01, 8.01, 8.01); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch20175/Area Scan (71x121x1):** Interpolated grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$   
 Maximum value of SAR (interpolated) =  $0.696 \text{ W/kg}$

**Ch20175/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value =  $8.752 \text{ V/m}$ ; Power Drift =  $0.04 \text{ dB}$   
 Peak SAR (extrapolated) =  $0.881 \text{ W/kg}$   
**SAR(1 g) =  $0.534 \text{ W/kg}$ ; SAR(10 g) =  $0.317 \text{ W/kg}$**   
 Maximum value of SAR (measured) =  $0.697 \text{ W/kg}$



0 dB =  $0.697 \text{ W/kg}$

**11\_LTE Band 2\_20M\_QPSK\_1RB\_0offset\_Back\_10mm\_Ch19100**

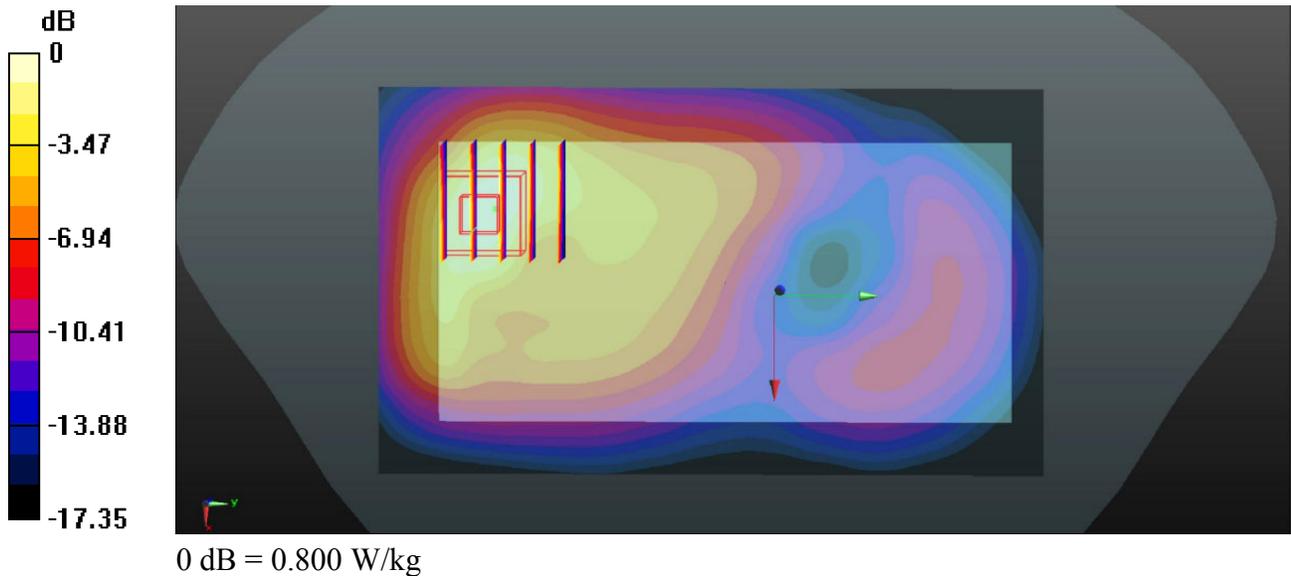
Communication System: UID 0, FDD-LTE (0); Frequency: 1900 MHz;Duty Cycle: 1:1  
 Medium: MSL\_1900\_2016/04/28 Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.577$  S/m;  $\epsilon_r = 52.18$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.5 °C

**DASY5 Configuration:**

- Probe: EX3DV4 - SN3911; ConvF(7.75, 7.75, 7.75); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1754
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch19100/Area Scan (71x121x1):** Interpolated grid: dx=15mm, dy=15mm  
 Maximum value of SAR (interpolated) = 0.775 W/kg

**Ch19100/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 8.481 V/m; Power Drift = -0.09 dB  
 Peak SAR (extrapolated) = 1.03 W/kg  
**SAR(1 g) = 0.595 W/kg; SAR(10 g) = 0.329 W/kg**  
 Maximum value of SAR (measured) = 0.800 W/kg



## 12\_WLAN2.4GHz\_802.11b 1Mbps\_Back\_10mm\_Ch11

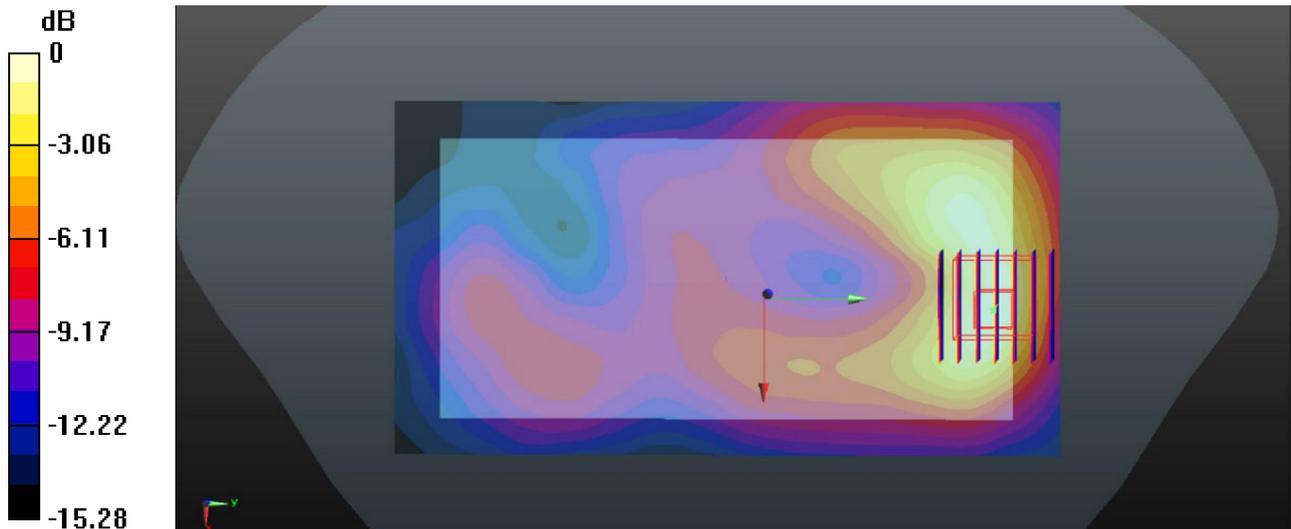
Communication System: UID 0, 802.11b (0); Frequency: 2462 MHz; Duty Cycle: 1:1.024  
Medium: MSL\_2450\_2016/05/26 Medium parameters used:  $f = 2462$  MHz;  $\sigma = 1.989$  S/m;  $\epsilon_r = 53.077$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.6 °C ; Liquid Temperature : 22.2 °C

### DASY5 Configuration:

- Probe: EX3DV4 - SN3935; ConvF(7.55, 7.55, 7.55); Calibrated: 2015/11/27;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch11/Area Scan (81x151x1):** Interpolated grid: dx=12mm, dy=12mm  
Maximum value of SAR (interpolated) = 0.170 W/kg

**Ch11/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 3.279 V/m; Power Drift = -0.08 dB  
Peak SAR (extrapolated) = 0.214 W/kg  
**SAR(1 g) = 0.113 W/kg; SAR(10 g) = 0.059 W/kg**  
Maximum value of SAR (measured) = 0.177 W/kg



0 dB = 0.177 W/kg

**13\_CDMA2000 BC0\_1xRTT RC3 SO32\_Back\_10mm\_Ch777**

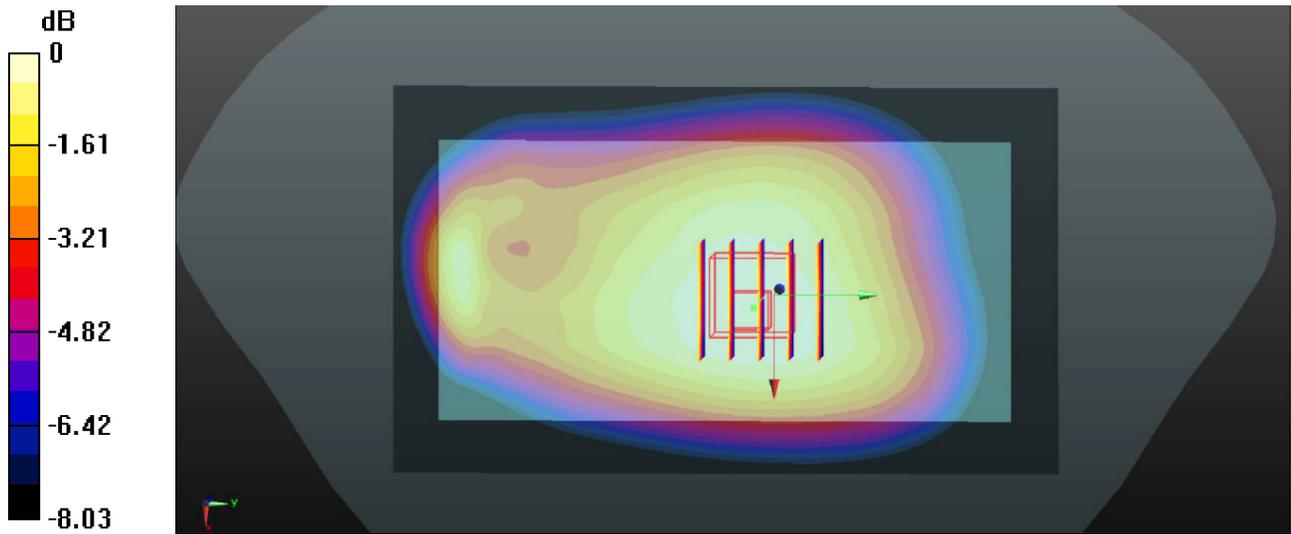
Communication System: UID 0, CDMA2000 (0); Frequency: 848.31 MHz; Duty Cycle: 1:1  
 Medium: MSL\_835\_2016/04/28 Medium parameters used:  $f = 848.31 \text{ MHz}$ ;  $\sigma = 0.984 \text{ S/m}$ ;  $\epsilon_r = 54.698$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Ambient Temperature :  $23.7 \text{ }^\circ\text{C}$ ; Liquid Temperature :  $22.4 \text{ }^\circ\text{C}$

**DASY5 Configuration:**

- Probe: EX3DV4 - SN3911; ConvF(9.8, 9.8, 9.8); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM1; Type: QD000P40CD; Serial: TP:1753
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch777/Area Scan (71x121x1):** Interpolated grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$   
 Maximum value of SAR (interpolated) =  $0.651 \text{ W/kg}$

**Ch777/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value =  $24.02 \text{ V/m}$ ; Power Drift =  $-0.02 \text{ dB}$   
 Peak SAR (extrapolated) =  $0.727 \text{ W/kg}$   
**SAR(1 g) =  $0.566 \text{ W/kg}$ ; SAR(10 g) =  $0.433 \text{ W/kg}$**   
 Maximum value of SAR (measured) =  $0.650 \text{ W/kg}$



0 dB =  $0.650 \text{ W/kg}$

**14\_CDMA2000 BC1\_1xRTT RC3 SO32\_Back\_10mm\_Ch1175**

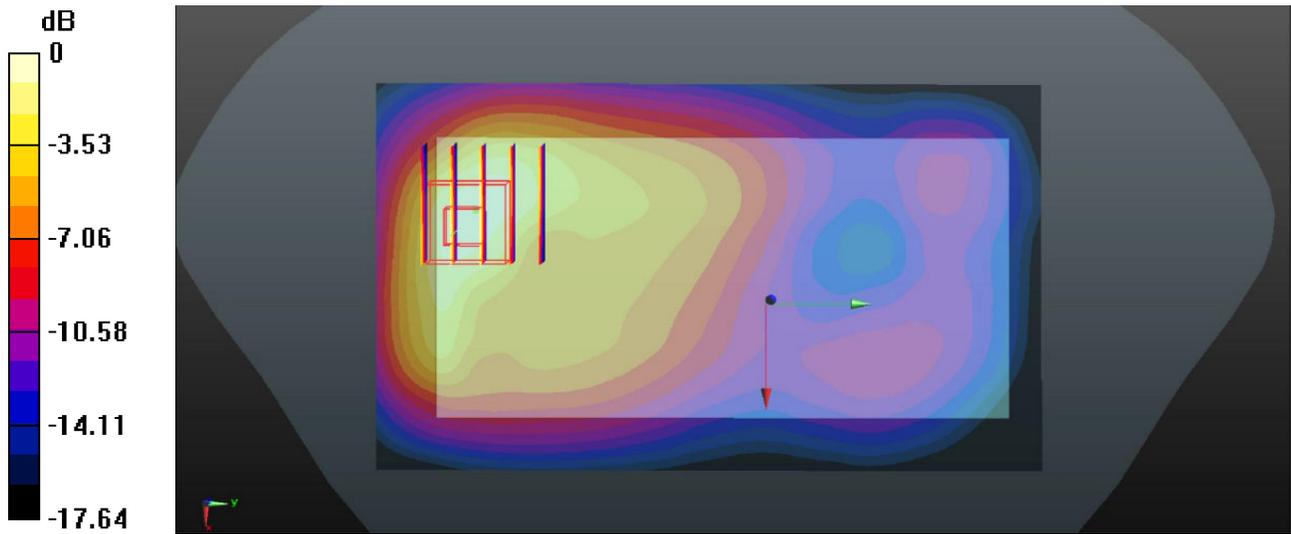
Communication System: UID 0, CDMA2000 (0); Frequency: 1908.75 MHz; Duty Cycle: 1:1  
 Medium: MSL\_1900\_2016/04/28 Medium parameters used:  $f = 1908.75 \text{ MHz}$ ;  $\sigma = 1.588 \text{ S/m}$ ;  
 $\epsilon_r = 52.148$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Ambient Temperature :  $23.5 \text{ }^\circ\text{C}$ ; Liquid Temperature :  $22.5 \text{ }^\circ\text{C}$

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(7.75, 7.75, 7.75); Calibrated: 2015/10/1;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2015/8/27
- Phantom: SAM2; Type: QD000P40CD; Serial: TP:1754
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch1175/Area Scan (71x121x1):** Interpolated grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$   
 Maximum value of SAR (interpolated) =  $0.960 \text{ W/kg}$

**Ch1175/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value =  $9.235 \text{ V/m}$ ; Power Drift =  $0.06 \text{ dB}$   
 Peak SAR (extrapolated) =  $1.34 \text{ W/kg}$   
**SAR(1 g) =  $0.771 \text{ W/kg}$ ; SAR(10 g) =  $0.416 \text{ W/kg}$**   
 Maximum value of SAR (measured) =  $0.987 \text{ W/kg}$



0 dB =  $0.987 \text{ W/kg}$



**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 0108**

Client **Sporton-CN (Auden)**

Certificate No: **D750V3-1087\_Mar16**

## CALIBRATION CERTIFICATE

Object: **D750V3 - SN:1087**

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

Calibration date: **March 16, 2016**

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-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	US37292783	07-Oct-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	MY41092317	07-Oct-15 (No. 217-02223)	Oct-16
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe EX3DV4	SN: 7349	31-Dec-15 (No. EX3-7349_Dec15)	Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100972	15-Jun-15 (in house check Jun-15)	In house check: Jun-18
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

Calibrated by: **Jeton Kastrati** (Name), **Laboratory Technician** (Function),  (Signature)

Approved by: **Katja Pokovic** (Name), **Technical Manager** (Function),  (Signature)

Issued: March 16, 2016

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 0108**

**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
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- 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>	750 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	41.9	0.89 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	41.9 $\pm$ 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	2.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>8.30 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	1.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>5.45 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	55.5	0.96 mho/m
<b>Measured Body TSL parameters</b>	(22.0 $\pm$ 0.2) °C	54.7 $\pm$ 6 %	0.98 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	2.20 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>8.64 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	1.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>5.75 W/kg <math>\pm</math> 16.5 % (k=2)</b>

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.0 $\Omega$ - 1.8 j $\Omega$
Return Loss	- 29.3 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.8 $\Omega$ - 3.5 j $\Omega$
Return Loss	- 28.5 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.031 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	April 04, 2013

# DASY5 Validation Report for Head TSL

Date: 16.03.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1087**

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used:  $f = 750$  MHz;  $\sigma = 0.91$  S/m;  $\epsilon_r = 41.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.28, 10.28, 10.28); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom Type: QD000P49AA
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

## Dipole Calibration for Head Tissue EX-Probe/Pin=250 mW, d=15mm/Zoom Scan

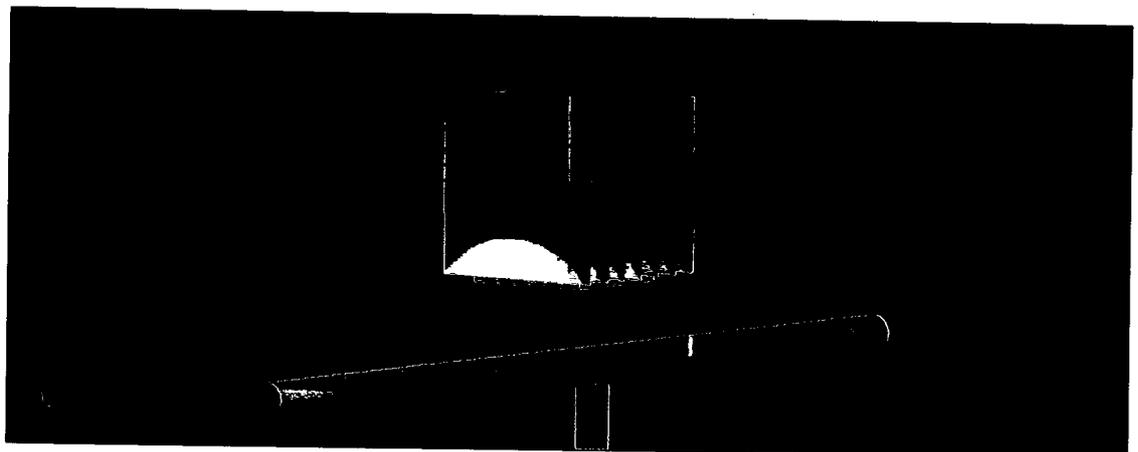
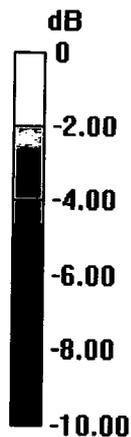
(7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 58.15 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.14 W/kg

**SAR(1 g) = 2.11 W/kg; SAR(10 g) = 1.38 W/kg**

Maximum value of SAR (measured) = 2.79 W/kg



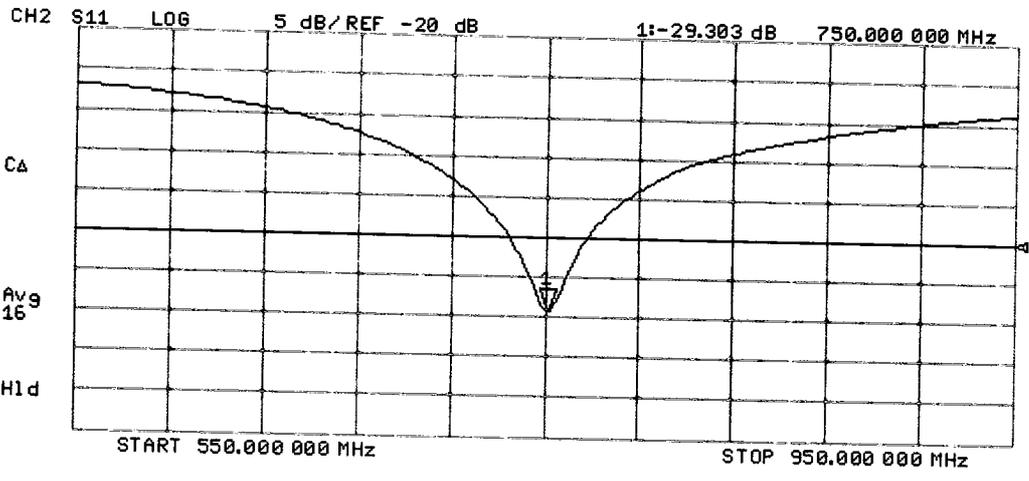
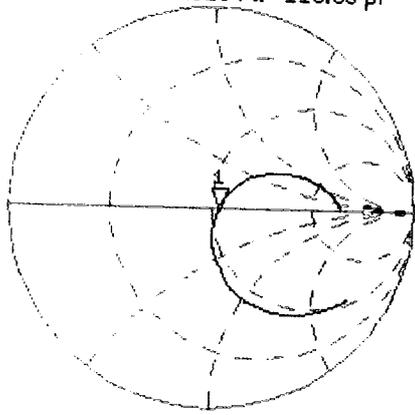
0 dB = 2.79 W/kg = 4.46 dBW/kg

# Impedance Measurement Plot for Head TSL

CH1 S11 1 U FS

16 Mar 2016 13:57:40  
 1: 53.027  $\Omega$  -1.8164  $\Omega$  116.83 pF  
 750.000 000 MHz

\*  
 De1  
 CA  
 Avg  
 16  
 H1d



# DASY5 Validation Report for Body TSL

Date: 16.03.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1087**

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used:  $f = 750$  MHz;  $\sigma = 0.98$  S/m;  $\epsilon_r = 54.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.99, 9.99, 9.99); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom Type: QD000P49AA
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

## Dipole Calibration for Body Tissue EX-Probe/Pin=250 mW, d=15mm/Zoom Scan

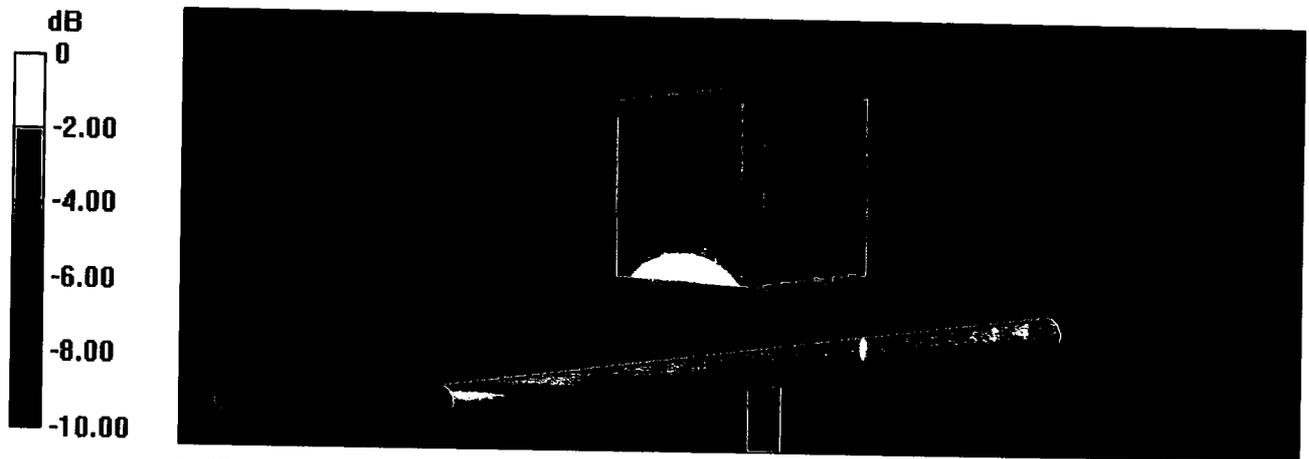
(7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 58.44 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 3.26 W/kg

**SAR(1 g) = 2.2 W/kg; SAR(10 g) = 1.46 W/kg**

Maximum value of SAR (measured) = 2.91 W/kg

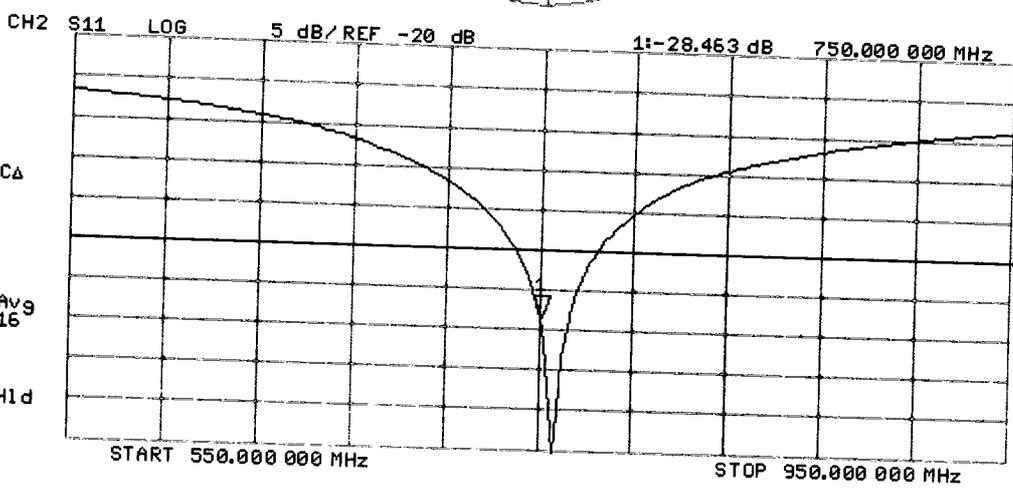
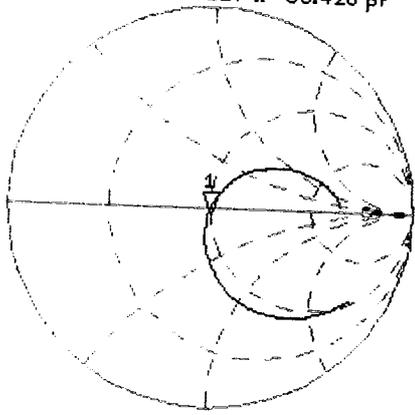


0 dB = 2.91 W/kg = 4.64 dBW/kg

# Impedance Measurement Plot for Body TSL

CH1 S11 1 U FS 16 Mar 2016 11:39:47  
 1: 48.750  $\Omega$  -3.5117  $\Omega$  60.428 pF 750.000 000 MHz

\*  
 De1  
 CA  
 Avg  
 16  
 H1d





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 0108**

Client **Sporton-CN (Auden)**

Certificate No: **D835V2-4d151\_Mar16**

## CALIBRATION CERTIFICATE

Object **D835V2 - SN:4d151**

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

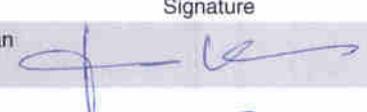
Calibration date: **March 16, 2016**

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-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	US37292783	07-Oct-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	MY41092317	07-Oct-15 (No. 217-02223)	Oct-16
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe EX3DV4	SN: 7349	31-Dec-15 (No. EX3-7349_Dec15)	Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100972	15-Jun-15 (in house check Jun-15)	In house check: Jun-18
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

Calibrated by: **Jeton Kastrati** (Name) / **Laboratory Technician** (Function) /  (Signature)

Approved by: **Katja Pokovic** (Name) / **Technical Manager** (Function) /  (Signature)

Issued: March 16, 2016

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 0108**

**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:**

- a) 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
- b) 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
- c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- e) 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.

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

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.7 $\pm$ 6 %	0.93 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

## SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>9.26 W/kg <math>\pm</math> 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>6.05 W/kg <math>\pm</math> 16.5 % (k=2)</b>

## Body TSL parameters

The following parameters and calculations were applied.

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

## SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>9.52 W/kg <math>\pm</math> 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>6.28 W/kg <math>\pm</math> 16.5 % (k=2)</b>

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.2 $\Omega$ - 3.3 j $\Omega$
Return Loss	- 28.3 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.9 $\Omega$ - 4.5 j $\Omega$
Return Loss	- 25.9 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.390 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	March 27, 2012

## DASY5 Validation Report for Head TSL

Date: 16.03.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d151**

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

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.93$  S/m;  $\epsilon_r = 41.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.83, 9.83, 9.83); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom Type: QD000P49AA
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

### Dipole Calibration for Head Tissue EX-Probe/Pin=250 mW, d=15mm/Zoom Scan

(7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 61.40 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.57 W/kg

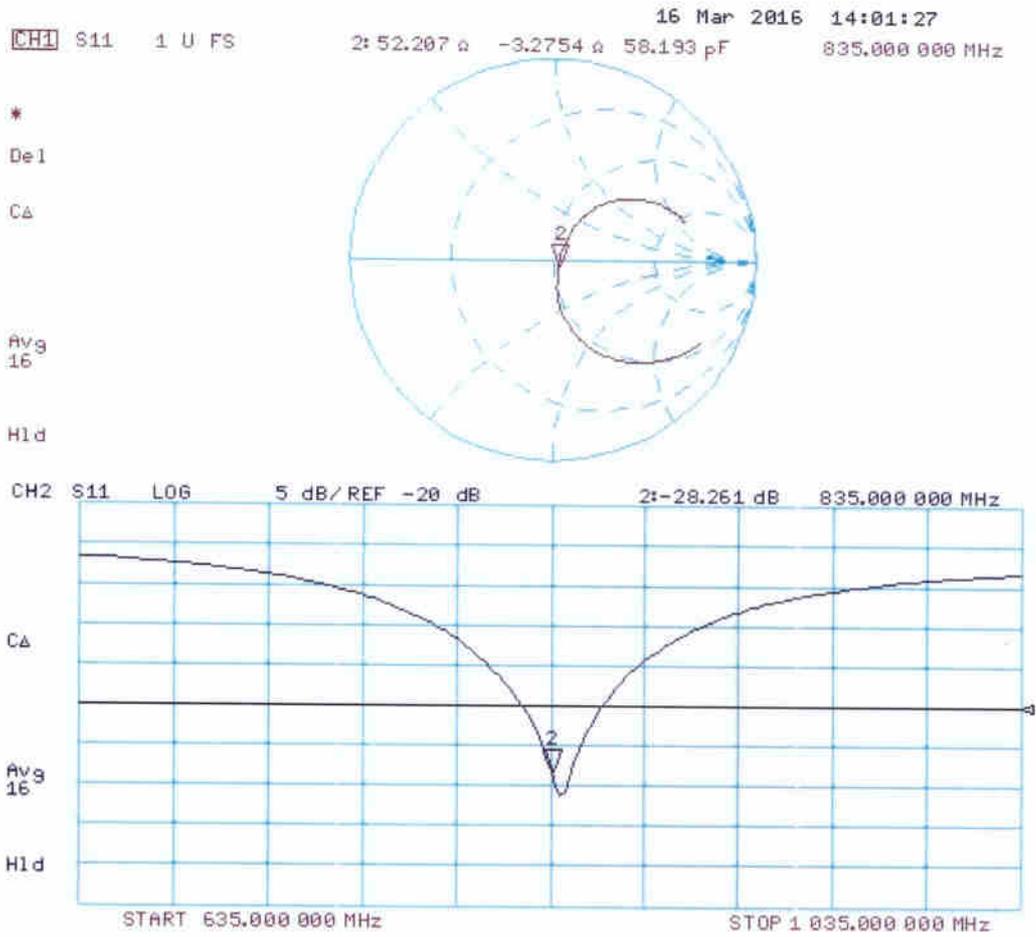
**SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.54 W/kg**

Maximum value of SAR (measured) = 3.18 W/kg



0 dB = 3.18 W/kg = 5.02 dBW/kg

# Impedance Measurement Plot for Head TSL



# DASY5 Validation Report for Body TSL

Date: 16.03.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d151**

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: EX3DV4 - SN7349; ConvF(9.73, 9.73, 9.73); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

## Dipole Calibration for Body Tissue EX-Probe/Pin=250 mW, d=15mm/Zoom Scan

(7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 60.04 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.65 W/kg

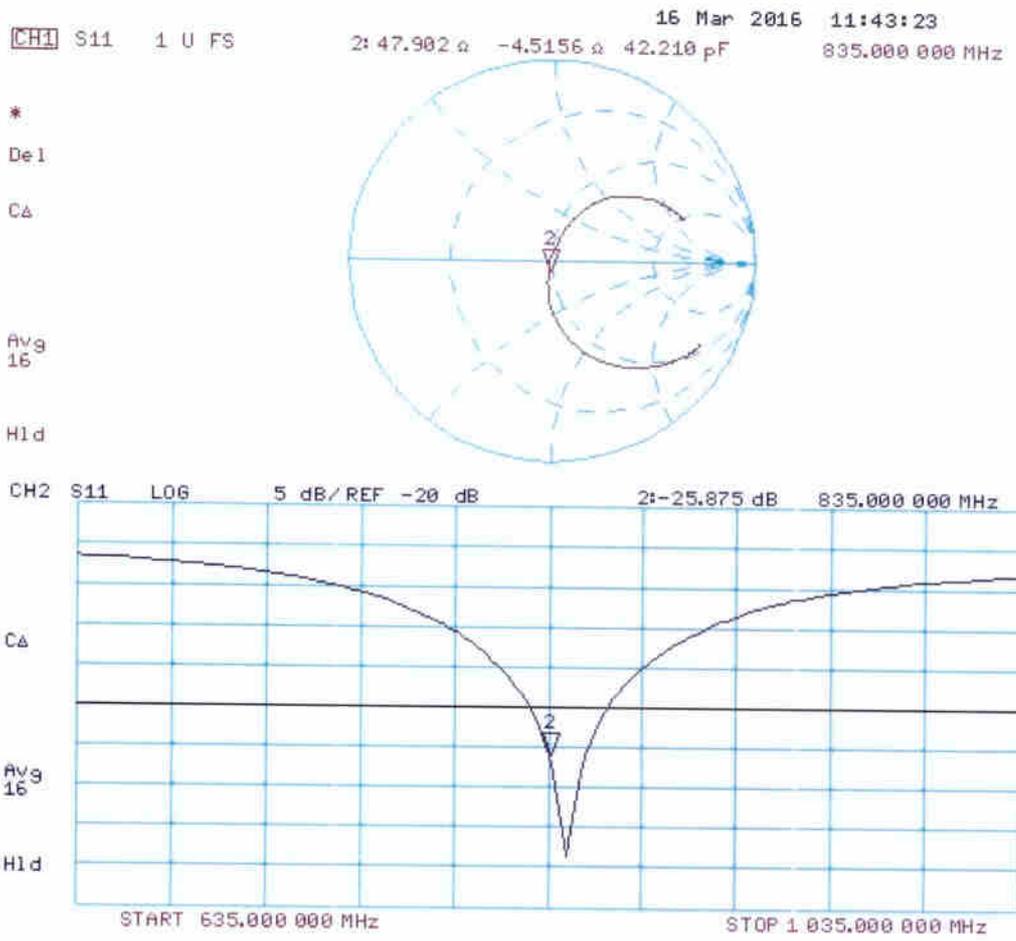
**SAR(1 g) = 2.46 W/kg; SAR(10 g) = 1.61 W/kg**

Maximum value of SAR (measured) = 3.26 W/kg



0 dB = 3.26 W/kg = 5.13 dBW/kg

# Impedance Measurement Plot for Body TSL





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 0108**

Client **Sporton-CN (Auden)**

Certificate No: **D1750V2-1090\_Mar16**

## CALIBRATION CERTIFICATE

Object **D1750V2 - SN: 1090**

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

Calibration date: **March 22, 2016**

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-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	US37292783	07-Oct-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	MY41092317	07-Oct-15 (No. 217-02223)	Oct-16
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe EX3DV4	SN: 7349	31-Dec-15 (No. EX3-7349_Dec15)	Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100972	15-Jun-15 (in house check Jun-15)	In house check: Jun-18
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

Calibrated by: **Claudio Leubler**      Name: Claudio Leubler      Function: Laboratory Technician

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

Signature

Issued: March 22, 2016

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 0108**

### 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
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- 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>	1750 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	40.1	1.37 mho/m
<b>Measured Head TSL parameters</b>	(22.0 ± 0.2) °C	39.9 ± 6 %	1.35 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	8.71 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>35.1 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	4.63 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>18.6 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	53.4	1.49 mho/m
<b>Measured Body TSL parameters</b>	(22.0 ± 0.2) °C	53.0 ± 6 %	1.46 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	8.88 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>35.9 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	4.73 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>19.1 W/kg ± 16.5 % (k=2)</b>

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.3 $\Omega$ - 3.5 j $\Omega$
Return Loss	- 27.9 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.4 $\Omega$ - 3.0 j $\Omega$
Return Loss	- 24.8 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.221 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	November 07, 2012

# DASY5 Validation Report for Head TSL

Date: 22.03.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1090**

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.35$  S/m;  $\epsilon_r = 39.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.54, 8.54, 8.54); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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

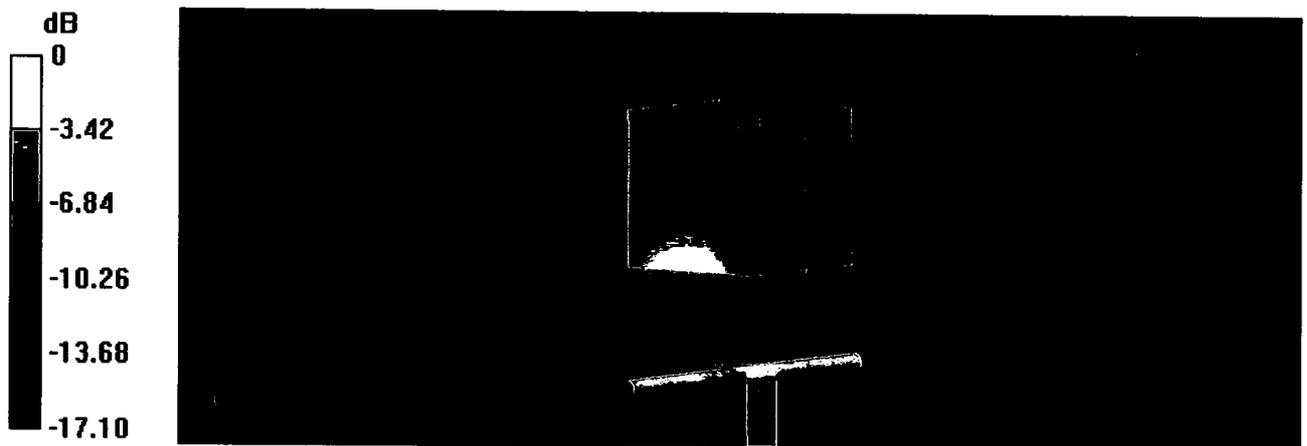
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.4 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 15.8 W/kg

**SAR(1 g) = 8.71 W/kg; SAR(10 g) = 4.63 W/kg**

Maximum value of SAR (measured) = 13.0 W/kg

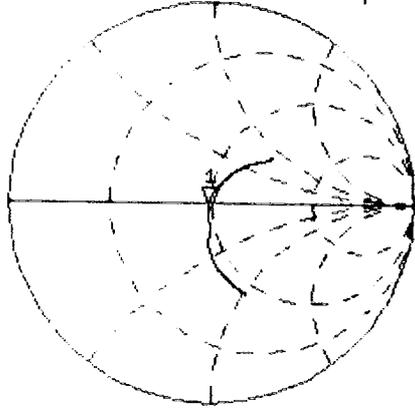


0 dB = 13.0 W/kg = 11.14 dBW/kg

# Impedance Measurement Plot for Head TSL

22 Mar 2016 12:35:16  
[CH1] S11 1 U FS 1: 48.250  $\Omega$  -3.5254  $\Omega$  25.797 pF 1 750.000 000 MHz

\*  
De1  
CA



Avg  
16

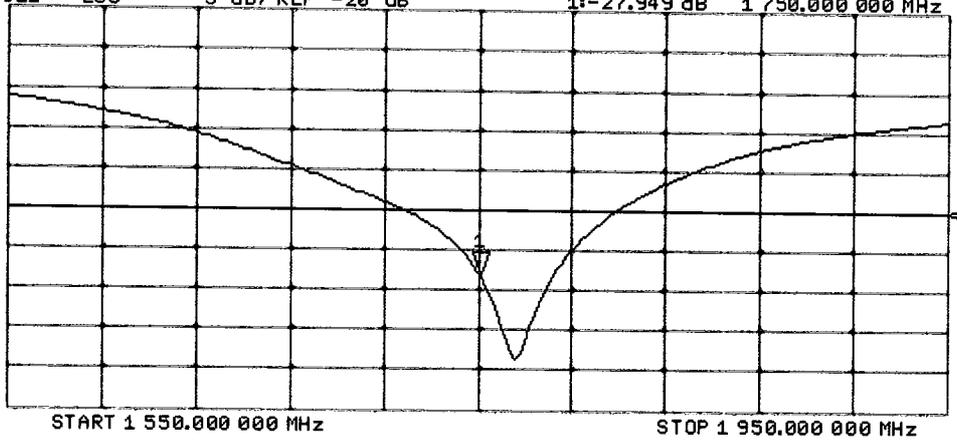
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -27.949 dB 1 750.000 000 MHz

CA

Avg  
16

H1d



# DASY5 Validation Report for Body TSL

Date: 22.03.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1090**

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.46$  S/m;  $\epsilon_r = 53$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.25, 8.25, 8.25); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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

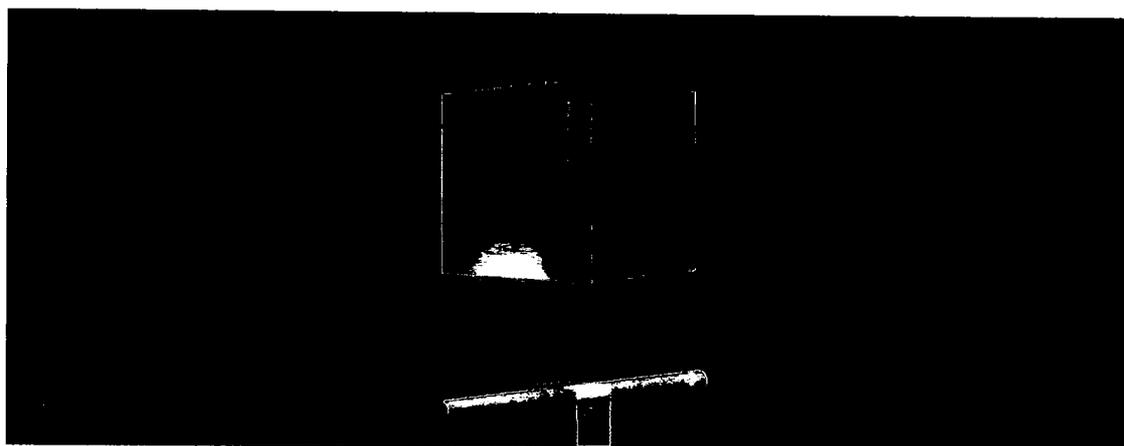
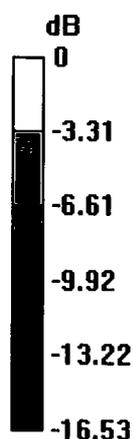
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.20 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 15.6 W/kg

**SAR(1 g) = 8.88 W/kg; SAR(10 g) = 4.73 W/kg**

Maximum value of SAR (measured) = 13.2 W/kg

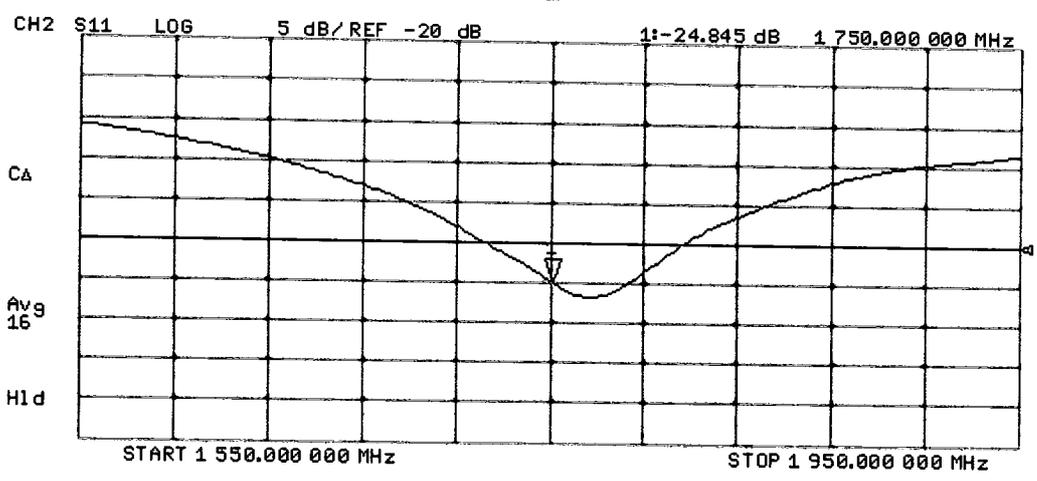
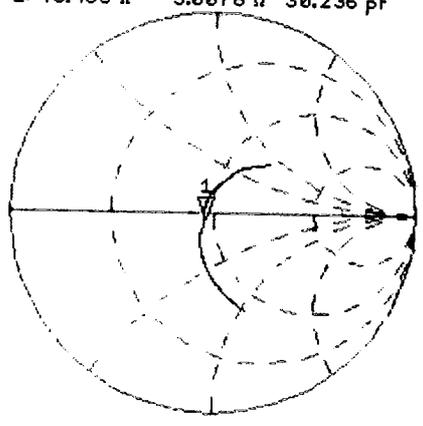


0 dB = 13.2 W/kg = 11.21 dBW/kg

# Impedance Measurement Plot for Body TSL

CH1 S11 1 U FS 22 Mar 2016 12:34:29  
 1: 45.436  $\Omega$  -3.0078  $\Omega$  30.236 pF 1 750.000 000 MHz

\*  
 De1  
 CA  
 Avg  
 16  
 H1 d





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 0108**

Client **Sporton-CN (Auden)**

Certificate No: **D1900V2-5d170\_Mar16**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d170**

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

Calibration date: **March 21, 2016**

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-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	US37292783	07-Oct-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	MY41092317	07-Oct-15 (No. 217-02223)	Oct-16
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe EX3DV4	SN: 7349	31-Dec-15 (No. EX3-7349_Dec15)	Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100972	15-Jun-15 (in house check Jun-15)	In house check: Jun-18
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

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

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

**Signature**  
*M. Weber*  
*K. Pokovic*

Issued: March 21, 2016

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 0108**

**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
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- 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 ± 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 ± 0.2) °C	39.8 ± 6 %	1.39 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	9.50 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>38.1 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	4.99 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>20.0 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	53.3	1.52 mho/m
<b>Measured Body TSL parameters</b>	(22.0 ± 0.2) °C	52.9 ± 6 %	1.51 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	9.71 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>38.9 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	5.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>20.6 W/kg ± 16.5 % (k=2)</b>

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.2 $\Omega$ + 5.3 j $\Omega$
Return Loss	- 23.8 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.0 $\Omega$ + 7.8 j $\Omega$
Return Loss	- 22.2 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	June 08, 2012