



# FCC SAR Test Report

**APPLICANT** : SAMSUNG Electronics Co., LTD.  
**EQUIPMENT** : Mobile Phone  
**BRAND NAME** : Samsung  
**MODEL NAME** : SC-03E  
**MARKETING NAME** : GQ DCM  
**FCC ID** : A3LSWDSC03E  
**STANDARD** : FCC 47 CFR Part 2 (2.1093)  
ANSI/IEEE C95.1-1992  
IEEE 1528-2003  
FCC OET Bulletin 65 Supplement C (Edition 01-01)

The product was completely tested on Nov. 06, 2012. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the 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 INC., the test report shall not be reproduced except in full.

Reviewed by:

Jones Tsai / Manager



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### Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA2O1541	Rev. 01	Initial issue of report	Oct. 31, 2012
FA2O1541	Rev. 02	<ol style="list-style-type: none"> <li>1. Revise typo on page 29.</li> <li>2. Revise note 5 on page 27</li> <li>3. Revise power drift of plots #38, #39, and #42 in section 11.1</li> <li>4. Remove the duplicate plots in Appendix B of the SAR test report</li> <li>5. Update Appendix B #116, #117.</li> <li>6. Roundup SAR plots to 3 decimal places which scaled SAR value is less than 0.0005 before rounded in section 11.</li> </ol>	Nov. 06, 2012
FA2O1541	Rev. 03	<ol style="list-style-type: none"> <li>1. Remove Scaled SAR data; add section 11.5 to show the compliance considering the tune-up tolerance.</li> <li>2. Update 5GHz z-axis plots of Appendix B to clarify the measurement resolution.</li> </ol>	Nov. 07, 2012
FA2O1541	Rev. 04	Remove WLAN 5G Hotspot mode	Nov. 23, 2012
FA2O1541	Rev. 05	<ol style="list-style-type: none"> <li>1. Insert the 3.5mm distance between the WWAN and BT/WLAN antenna in page 26</li> <li>2. Add the information of output power fed into dipole during system verification test, in page 20</li> </ol>	Dec. 06, 2012

**1. Statement of Compliance**

The maximum results of Specific Absorption Rate (SAR) found during testing for **SAMSUNG Electronics Co., LTD. Mobile Phone, Samsung, SC-03E, GQ DCM**, are as follows.

**<Standalone SAR>**

Band	Position	SAR <sub>1g</sub> (W/kg)
GSM850	Head	0.067
GSM1900	Head	0.479
WCDMA Band V	Head	0.209
WLAN 2.4G	Head	0.113
WLAN 5G	Head	0.011
GSM850	Hotspot (1 cm Gap)	0.253
GSM1900	Hotspot (1 cm Gap)	0.495
WCDMA Band V	Hotspot (1 cm Gap)	0.00856
WLAN 2.4G	Hotspot (1 cm Gap)	0.184
GSM850	Body-worn (1 cm Gap)	0.253
GSM1900	Body-worn (1 cm Gap)	0.5
WCDMA Band V	Body-worn (1 cm Gap)	0.00856
WLAN 2.4G	Body-worn (1 cm Gap)	0.184
WLAN 5G	Body-worn (1 cm Gap)	0.456

**<Highest Simultaneous transmission SAR>**

	Band	Position	Multi-Band SAR <sub>1g</sub> (W/kg)
Head	GSM 1900	Left Cheek	0.57
	WLAN 2.4G		
	Band	Position	Multi-Band SAR <sub>1g</sub> (W/kg)
Hotspot	GSM 1900	Back (1 cm Gap)	0.68
	WLAN 2.4G		
	Band	Position	Multi-Band SAR <sub>1g</sub> (W/kg)
Body-worn	GSM 1900	Back with headset(1 cm Gap)	0.95
	WLAN 5G		

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 1528-2003 and FCC OET Bulletin 65 Supplement C (Edition 01-01).



## 2. Administration Data

### 2.1 Testing Laboratory

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No. 52, Hwa Ya 1 <sup>st</sup> Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978

### 2.2 Applicant

Company Name	SAMSUNG Electronics Co., LTD.
Address	IT center, 416, Maetan-3dong, Yeongtong-gu, Suwon-city, Gyeonggi-do, Korea

### 2.3 Manufacturer

Company Name	SAMSUNG Electronics Co., LTD.
Address	IT center, 416, Maetan-3dong, Yeongtong-gu, Suwon-city, Gyeonggi-do, Korea

### 2.4 Application Details

Date of Start during the Test	Oct. 19, 2012
Date of End during the Test	Nov. 06, 2012

### **3. General Information**

#### **3.1 Description of Equipment Under Test (EUT)**

<b>Product Feature &amp; Specification</b>	
<b>EUT</b>	Mobile Phone
<b>Brand Name</b>	Samsung
<b>Model Name</b>	SC-03E
<b>Marketing Name</b>	GQ DCM
<b>FCC ID</b>	A3LSWDSC03E
<b>Tx Frequency</b>	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz WLAN2.4G: 2412 MHz ~ 2462 MHz WLAN5G: 5180 MHz ~ 5240 MHz; 5260 MHz ~ 5320 MHz; 5500 MHz ~ 5700 MHz; 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz
<b>Maximum Average Output Power to Antenna</b>	GSM850: 32.48 dBm GSM1900: 30.98 dBm WCDMA Band V: 23.34 dBm 802.11b: 17.45 dBm 802.11g: 14.20 dBm 802.11n-HT20 (2.4GHz) : 13.15 dBm 802.11a : 14.16 dBm 802.11n-HT20 (5GHz) : 13.10 dBm 802.11n-HT40 (5GHz) : 13.18 dBm Bluetooth: 10.28 dBm
<b>Antenna Type</b>	WWAN: PIFA Antenna WLAN: PIFA Antenna Bluetooth: PIFA Antenna
<b>HW Version</b>	REV0.1
<b>SW Version</b>	SC03E.001
<b>Uplink Modulations</b>	GSM: GMSK GPRS: GMSK EDGE: GMSK / 8PSK WCDMA (Rel 99): QPSK HSDPA (Rel 6): QPSK HSUPA (Rel 6): QPSK 802.11b: DSSS (BPSK / QPSK / CCK) 802.11a/g/n: OFDM (BPSK / QPSK / 16QAM / 64QAM) Bluetooth 4.0 LE: GFSK
<b>Dual Transfer Mode (DTM) Category</b>	Class A – EUT can support Packet Switched and Circuit Switched Network simultaneously.
<b>EUT Stage</b>	Identical Prototype
<b>Remark:</b>	<ol style="list-style-type: none"> <li>The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.</li> <li>5600 MHz ~ 5650 MHz is notched.</li> </ol>

Per KDB 941225 D04 requirement, the required test configuration for this device is as below:

- This EUT is class A device
- This EUT supports (E)GPRS multi-slot class 12 (max. uplink : 4, max. downlink : 4, total timeslots : 5)
- This EUT supports DTM multi-slot class 11 (max. uplink : 3 for 1 CS & 2 PS, max. downlink : 4, total timeslots : 5)
- The measured maximum conducted power can be referred to section 12.1 of this report
- For DTM multi-slot class 11 link mode, the device was linked with system emulator (Agilent E5515C) and transmit maximum power on maximum number of Tx slots (one CS timeslot and two PS timeslots per frame).



### 3.2 Applied 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 1528-2003
- FCC OET Bulletin 65 Supplement C (Edition 01-01)
- FCC KDB 447498 D01 v04
- FCC KDB 648474 D01 v01r05
- FCC KDB 941225 D01 v02
- FCC KDB 941225 D03 v01
- FCC KDB 941225 D04 v01
- FCC KDB 941225 D06 v01
- FCC KDB 248227 D01 v01r02

### 3.3 Device Category and SAR Limits

This device belongs to portable device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user. Limit for General Population/Uncontrolled exposure should be applied for this device, it is 1.6 W/kg as averaged over any 1 gram of tissue.

### 3.4 Test Conditions

#### 3.4.1 Ambient Condition

Ambient Temperature	20 to 24 °C
Humidity	< 60 %

#### 3.4.2 Test Configuration

The device was controlled by using a base station emulator. Communication between the device and the emulator was established by air link. The distance between the EUT and the antenna of the emulator is larger than 50 cm and the output power radiated from the emulator antenna is at least 30 dB smaller than the output power of EUT. The EUT was set from the emulator to radiate maximum output power during all tests.

For WLAN SAR testing, WLAN engineering testing software installed on the EUT can provide continuous transmitting RF signal.

The maximum rated power of WWAN and WLAN is listed in "Tune-Up Procedure" exhibit, the scaling factor is calculated according to the difference between measured output power and maximum tolerance power on this device.

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

### **4.1 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.

### **4.2 SAR Definition**

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

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

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

SAR measurement can be either related to the temperature elevation in tissue by

$$\text{SAR} = C \left( \frac{\delta T}{\delta t} \right)$$

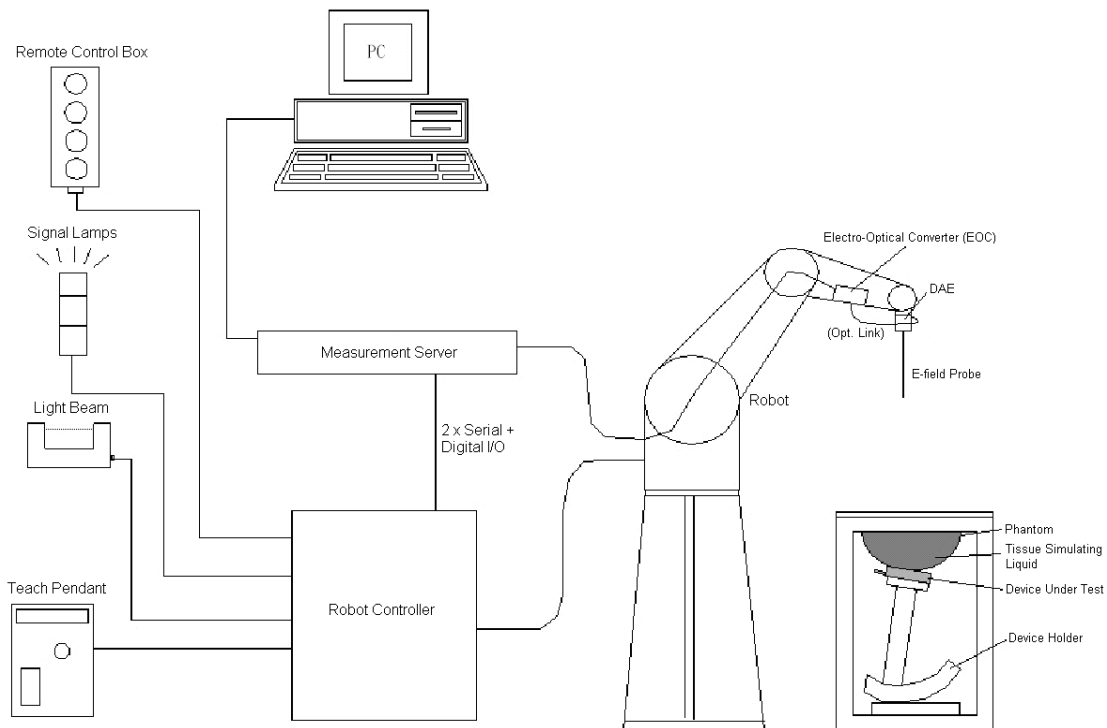
Where: C is the specific heat capacity,  $\delta T$  is the temperature rise and  $\delta t$  is the exposure duration, or related to the electrical field in the tissue by

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

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

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

## 5. SAR Measurement System



**Fig 5.1 SPEAG DASY System Configurations**

The DASY system for performance compliance tests is illustrated above graphically. This system consists of the following items:

- A standard high precision 6-axis robot with controller, a teach pendant and software
- A data acquisition electronic (DAE) attached to the robot arm extension
- A dosimetric probe equipped with an optical surface detector system
- The electro-optical converter (EOC) performs the conversion between optical and electrical signals
- A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the accuracy of the probe positioning
- A computer operating Windows XP
- DASY software
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom
- A device holder
- Tissue simulating liquid
- Dipole for evaluating the proper functioning of the system


Component details are described in in the following sub-sections.

### 5.1 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.

#### 5.1.1 E-Field Probe Specification

##### <ET3DV6 / ET3DV6R Probe >

<b>Construction</b>	Symmetrical design with triangular core Built-in optical fiber for surface detection system. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	 <p><b>Fig 5.2 Photo of ET3DV6/ET3DV6</b></p>
<b>Frequency</b>	10 MHz to 3 GHz; Linearity: $\pm 0.2$ dB	
<b>Directivity</b>	$\pm 0.2$ dB in HSL (rotation around probe axis) $\pm 0.4$ dB in HSL (rotation normal to probe axis)	
<b>Dynamic Range</b>	5 $\mu$ W/g to 100 mW/g; Linearity: $\pm 0.2$ dB	
<b>Dimensions</b>	Overall length: 330 mm (Tip: 16 mm) Tip diameter: 6.8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.7 mm	

##### <EX3DV4 / ES3DV4 Probe >

<b>Construction</b>	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	 <p><b>Fig 5.3 Photo of EX3DV4/ES3DV4</b></p>
<b>Frequency</b>	10 MHz to 6 GHz; Linearity: $\pm 0.2$ dB	
<b>Directivity</b>	$\pm 0.3$ dB in HSL (rotation around probe axis) $\pm 0.5$ dB in tissue material (rotation normal to probe axis)	
<b>Dynamic Range</b>	10 $\mu$ W/g to 100 mW/g; Linearity: $\pm 0.2$ dB (noise: typically $< 1$ $\mu$ W/g)	
<b>Dimensions</b>	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

#### 5.1.2 E-Field Probe Calibration

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than  $\pm 10\%$ . The spherical isotropy shall be evaluated and within  $\pm 0.25$ dB. The sensitivity parameters (NormX, NormY, and NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested. The calibration data can be referred to appendix C of this report.

### 5.2 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 5.4 Photo of DAE

### 5.3 Robot

The SPEAG DASY system uses the high precision robots (DASY4: RX90BL; DASY5: TX90XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY4: CS7MB; DASY5: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability  $\pm 0.035$  mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)



Fig 5.5 Photo of DASY4



Fig 5.6 Photo of DASY5

### 5.4 Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY4: 166 MHz, Intel Pentium; DASY5: 400 MHz, Intel Celeron), chipdisk (DASY4: 32 MB; DASY5: 128 MB), RAM (DASY4: 64 MB, DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.




Fig 5.7 Photo of Server for DASY4



Fig 5.8 Photo of Server for DASY5


**5.5 Phantom**

**<SAM Twin Phantom>**

<b>Shell Thickness</b>	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm	 <p><b>Fig 5.9 Photo of SAM Phantom</b></p>
<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.

**<ELI4 Phantom>**

<b>Shell Thickness</b>	2 ± 0.2 mm (sagging: <1%)	 <p><b>Fig 5.10 Photo of ELI4 Phantom</b></p>
<b>Filling Volume</b>	Approx. 30 liters	
<b>Dimensions</b>	Major ellipse axis: 600 mm Minor axis: 400 mm	

The ELI4 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.

## 5.6 Device Holder

### <Device Holder for SAM Twin Phantom>

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5 mm distance, a positioning uncertainty of  $\pm 0.5$  mm would produce a SAR uncertainty of  $\pm 20$  %. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

The DASY device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity  $\epsilon = 3$  and loss tangent  $\delta = 0.02$ . The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.



Fig 5.11 Device Holder

### <Laptop Extension Kit>

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.

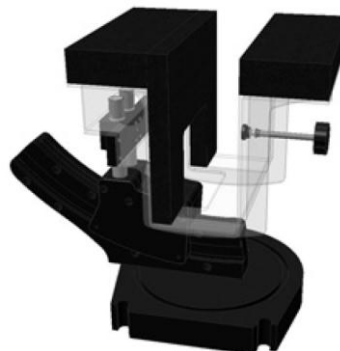


Fig 5.12 Laptop Extension Kit



## 5.7 Data Storage and Evaluation

### 5.7.1 Data Storage

The DASY software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files. The post-processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type (e.g., [V/m], [A/m], [mW/g]). Some of these units are not available in certain situations or give meaningless results, e.g., a SAR-output in a non-lose media, will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

### 5.7.2 Data Evaluation

The DASY post-processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software :

<b>Probe parameters :</b>	- Sensitivity	Norm <sub>i</sub> , a <sub>i0</sub> , a <sub>i1</sub> , a <sub>i2</sub>
	- Conversion factor	ConvF <sub>i</sub>
	- Diode compression point	dcp <sub>i</sub>
<b>Device parameters :</b>	- Frequency	f
	- Crest factor	cf
<b>Media parameters :</b>	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multi-meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power.

The formula for each channel can be given as :

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with  $V_i$  = compensated signal of channel i, (i = x, y, z)  
 $U_i$  = input signal of channel i, (i = x, y, z)  
 cf = crest factor of exciting field (DASY parameter)  
 dcp<sub>i</sub> = diode compression point (DASY parameter)

From the compensated input signals, the primary field data for each channel can be evaluated :

$$\text{E-field Probes : } E_i = \sqrt{\frac{V_i}{\text{Norm}_i \cdot \text{ConvF}}}$$

$$\text{H-field Probes : } H_i = \sqrt{V_i \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}}$$

with  $V_i$  = compensated signal of channel i, (i = x, y, z)  
 $\text{Norm}_i$  = sensor sensitivity of channel i, (i = x, y, z),  $\mu\text{V}/(\text{V/m})^2$  for E-field Probes  
 ConvF = sensitivity enhancement in solution  
 $a_{ij}$  = sensor sensitivity factors for H-field probes  
 f = carrier frequency [GHz]  
 $E_i$  = electric field strength of channel i in V/m  
 $H_i$  = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude) :

$$E_{\text{tot}} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$\text{SAR} = E_{\text{tot}}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with SAR = local specific absorption rate in mW/g  
 $E_{\text{tot}}$  = total field strength in V/m  
 $\sigma$  = conductivity in [mho/m] or [Siemens/m]  
 $\rho$  = equivalent tissue density in  $\text{g}/\text{cm}^3$

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.



**5.8 Test Equipment List**

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	835MHz System Validation Kit	D835V2	499	Mar. 22, 2010	Mar. 21, 2013
SPEAG	1900MHz System Validation Kit	D1900V2	5d041	Mar. 23, 2010	Mar. 22, 2013
SPEAG	2450MHz System Validation Kit	D2450V2	736	Jul. 25, 2011	Jul. 24, 2013
SPEAG	5GHz System Validation Kit	D5GHzV2	1006	Jan. 18, 2012	Jan. 17, 2013
SPEAG	Data Acquisition Electronics	DAE3	577	Jun. 06, 2012	Jun. 05, 2013
SPEAG	Data Acquisition Electronics	DAE3	495	Apr. 23, 2012	Apr. 22, 2013
SPEAG	Data Acquisition Electronics	DAE4	1338	Jun. 12, 2012	Jun. 11, 2013
SPEAG	Data Acquisition Electronics	DAE4	1279	May. 03, 2012	May. 02, 2013
SPEAG	Data Acquisition Electronics	DAE4	778	Aug. 27, 2012	Aug. 26, 2013
SPEAG	Dosimetric E-Field Probe	ET3DV6	1787	May. 29, 2012	May. 28, 2013
SPEAG	Dosimetric E-Field Probe	ES3DV3	3270	Sep. 28, 2012	Sep. 27, 2013
SPEAG	Dosimetric E-Field Probe	EX3DV4	3801	Jun. 22, 2012	Jun. 21, 2013
SPEAG	Dosimetric E-Field Probe	EX3DV4	3697	Sep. 28, 2012	Sep. 27, 2013
SPEAG	Dosimetric E-Field Probe	EX3DV4	3792	Jun. 21, 2012	Jun. 20, 2013
Wisewind	Thermometer	ETP-101	TM560	Nov. 16, 2011	Nov. 15, 2012
Wisewind	Thermometer	HTC-1	TM685	Nov. 16, 2011	Nov. 15, 2012
SPEAG	Device Holder	N/A	N/A	NCR	NCR
SPEAG	SAM Phantom	QD 000 P40 C	TP-1303	NCR	NCR
SPEAG	SAM Phantom	QD 000 P40 C	TP-1383	NCR	NCR
SPEAG	SAM Phantom	QD 000 P40 C	TP-1477	NCR	NCR
SPEAG	SAM Phantom	QD 000 P41 C	TP-1150	NCR	NCR
SPEAG	SAM Phantom	QD 000 P40 CD	TP-1719	NCR	NCR
SPEAG	SAM Phantom	QD 000 P40 CD	TP-1718	NCR	NCR
Agilent	Network Analyzer	E5071C	MY46101588	May 11, 2012	May 10, 2013
Agilent	ESG Vector Series Signal Generator	E4438C	MY49070755	Oct. 02, 2012	Oct. 01, 2013
Anritsu	Power Meter	ML2495A	1132003	Aug. 14, 2012	Aug. 13, 2013
Agilent	Wireless Communication Test Set	E5515C	MY48360820	Jan. 05, 2012	Jan. 04, 2014
R&S	Universal Digital Radio communication Tester	CMU200	114256	Jun. 29, 2012	Jun. 28, 2013
Agilent	Dual Directional Coupler	778D	50422	NCR	NCR
Woken	Attenuator	WK0602-XX	N/A	NCR	NCR
AR	Power Amplifier	5S1G4M2	0328767	NCR	NCR
R&S	Spectrum Analyzer	FSP	101131	Jul. 23, 2012	Jul. 22, 2013

**Table 5.1 Test Equipment List**

**Note:**

1. The calibration certificate of DASY can be referred to appendix C of this report.
2. Referring to KDB 450824 D02, the dipole calibration interval can be extended to 3 years with justification. The dipoles are also not physically damaged, or repaired during the interval.
3. The justification data of dipole D835V2, SN: 499, D1900V2, SN: 5d041, and D2450V2, SN: 736 can be found in appendix C. The return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration.

## 6. Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 6.1. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 6.2.

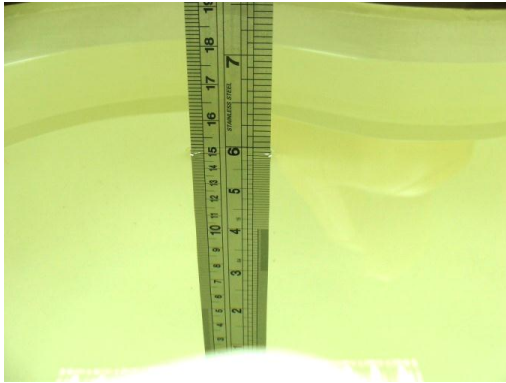


Fig 6.1 Photo of Liquid Height for Head SAR



Fig 6.2 Photo of Liquid Height for Body SAR

The following table gives the recipes for tissue simulating liquid.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity ( $\sigma$ )	Permittivity ( $\epsilon_r$ )
<b>For Head</b>								
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>								
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

Table 6.1 Recipes of Tissue Simulating Liquid

### Simulating Liquid for 5G, Manufactured by SPEAG

Ingredients	(% by weight)
Water	64~78%
Mineral oil	11~18%
Emulsifiers	9~15%
Additives and Salt	2~3%



The dielectric parameters of the liquids were verified prior to the SAR evaluation using an Agilent 85070D Dielectric Probe Kit and an Agilent Network Analyzer.

The following table shows the measuring results for simulating liquid.

Freq. (MHz)	Liquid Type	Temp. (°C)	Conductivity ( $\sigma$ )	Permittivity ( $\epsilon_r$ )	Conductivity Target ( $\sigma$ )	Permittivity Target ( $\epsilon_r$ )	Delta ( $\sigma$ ) (%)	Delta ( $\epsilon_r$ ) (%)	Limit (%)	Date
835	Head	21.6	0.906	43	0.9	41.5	0.67	3.61	$\pm 5$	2012/10/19
835	Body	21.5	0.996	55.38	0.97	55.2	2.68	0.33	$\pm 5$	2012/10/22
835	Body	21.5	0.994	55.34	0.97	55.2	2.47	0.25	$\pm 5$	2012/10/22
1900	Head	21.6	1.45	38.5	1.4	40	3.57	-3.75	$\pm 5$	2012/10/21
1900	Body	21.4	1.56	52.4	1.52	53.3	2.63	-1.69	$\pm 5$	2012/10/21
2450	Head	21.3	1.8	37.4	1.8	39.2	0.00	-4.59	$\pm 5$	2012/10/27
2450	Body	21.3	1.98	51.69	1.95	52.7	1.54	-1.92	$\pm 5$	2012/10/27
5200	Head	21.7	4.777	35.313	4.66	36	2.51	-1.91	$\pm 5$	2012/10/21
5200	Head	21.7	4.813	35.431	4.66	36.0	3.28	-1.58	$\pm 5$	2012/11/6
5200	Body	21.5	5.257	47.536	5.3	49	-0.81	-2.99	$\pm 5$	2012/10/20
5500	Head	21.7	5.087	34.853	4.96	35.6	2.56	-2.10	$\pm 5$	2012/10/21
5500	Body	21.5	5.645	47.008	5.65	48.6	-0.09	-3.28	$\pm 5$	2012/10/20
5800	Head	21.7	5.368	34.272	5.27	35.3	1.86	-2.91	$\pm 5$	2012/10/21
5800	Body	21.5	6.144	46.492	6	48.2	2.40	-3.54	$\pm 5$	2012/10/20

Table 6.2 Measuring Results for Simulating Liquid

## 7. SAR Measurement Evaluation

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder.

### 7.1 Purpose of System Performance check

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

### 7.2 System Setup

In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:

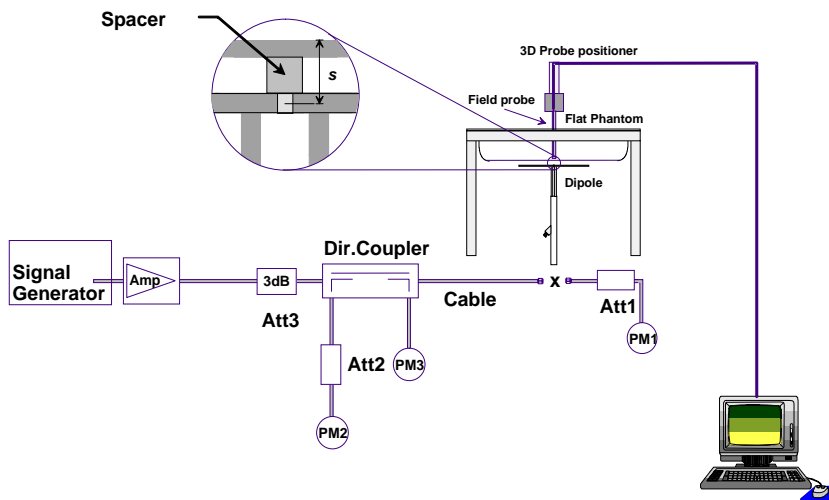


Fig 7.1 System Setup for System Evaluation



Fig 7.2 Photo of Dipole Setup

1. Signal Generator
2. Amplifier
3. Directional Coupler
4. Power Meter
5. Calibrated Dipole

The output power on dipole port must be calibrated to 24 dBm (250 mW) before dipole is connected.



### 7.3 SAR System Verification Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Table 7.1 shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the verification criterion and the plots can be referred to Appendix A of this report.

Measurement Date	Frequency (MHz)	Liquid Type	Targeted SAR <sub>1g</sub> (W/kg)	Measured SAR <sub>1g</sub> (W/kg)	Normalized SAR <sub>1g</sub> (W/kg)	Deviation (%)
2012/10/19	835	Head	9.71	2.48	9.92	2.16
2012/10/22	835	Body	9.82	2.48	9.92	1.02
2012/10/22	835	Body	9.82	2.47	9.88	0.61
2012/10/21	1900	Head	39.8	9.22	36.88	-7.34
2012/10/21	1900	Body	40.00	9.62	38.48	-3.80
2012/10/27	2450	Head	54.8	13.5	54.00	-1.46
2012/10/27	2450	Body	52.3	12.8	51.20	-2.10
2012/10/21	5200	Head	79.2	19.5	78.00	-1.52
2012/11/6	5200	Head	79.2	20.7	82.80	4.55
2012/10/20	5200	Body	72.6	16.7	66.80	-7.99
2012/10/21	5500	Head	85.2	20.6	82.40	-3.29
2012/10/20	5500	Body	78.8	18.5	74.00	-6.09
2012/10/21	5800	Head	79	19.7	78.80	-0.25
2012/10/20	5800	Body	73.1	17	68.00	-6.98

**Note :**

The output power fed into dipole port is calibrated to 24 dBm (250 mW), and a multiplication factor of 4 is applied onto the measured SAR to 1W normalized 1g-SAR.

**Note Table 7.1 Target and Measurement SAR after Normalized**

## 8. EUT Testing Position

### 8.1 Define two imaginary lines on the handset

- 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, and the midpoint of the width  $w_b$  of the bottom of the handset.
- The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output. The horizontal line is also tangential to the face of the handset at point A.
- 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, especially for clamshell handsets, handsets with flip covers, and other irregularly shaped handsets.

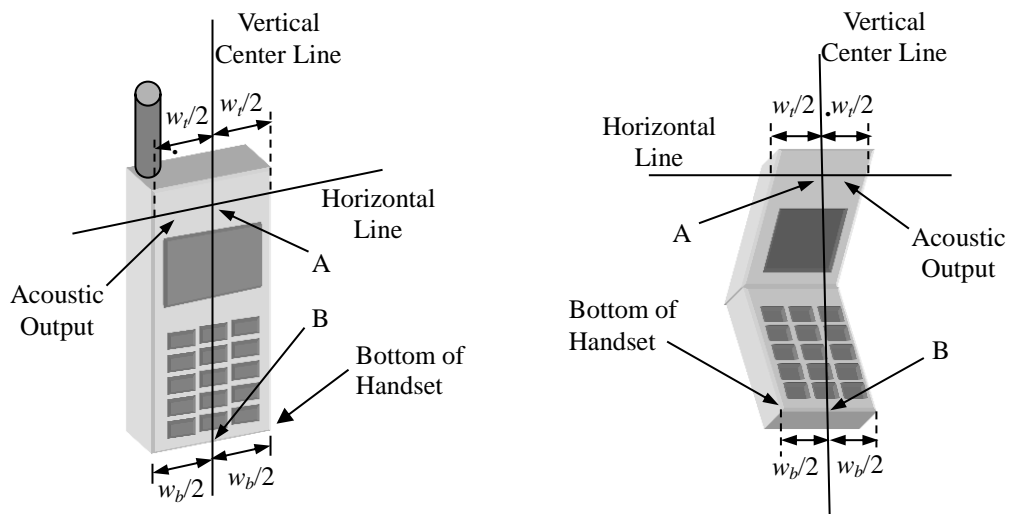


Fig 8.1 Illustration for Handset Vertical and Horizontal Reference Lines

**8.2 Cheek Position**

- (a) To position the device with the vertical center line of the body of the device and the horizontal line crossing the center piece in a plane parallel to the sagittal plane of the phantom. While maintaining the device in this plane, align the vertical center line with the reference plane containing the three ear and mouth reference point (M: Mouth, RE: Right Ear, and LE: Left Ear) and align the center of the ear piece with the line RE-LE.
- (b) To move the device towards the phantom with the ear piece aligned with the line LE-RE until the phone touched the ear. While maintaining the device in the reference plane and maintaining the phone contact with the ear, move the bottom of the phone until any point on the front side is in contact with the cheek of the phantom or until contact with the ear is lost (see Fig. 8.2).

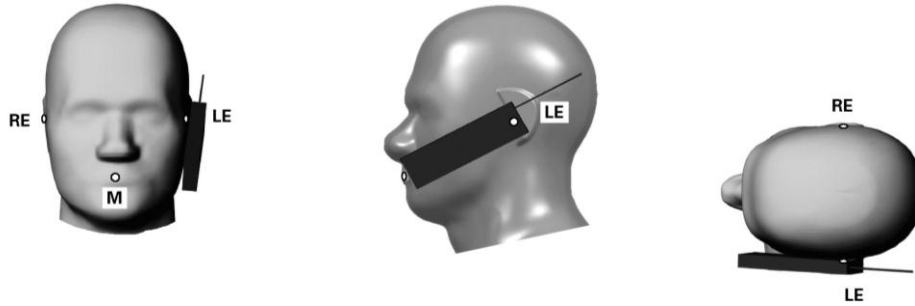


Fig 8.2 Illustration for Cheek Position

**8.3 Tilted Position**

- (a) To position the device in the “cheek” position described above.
- (b) While maintaining the device the reference plane described above and pivoting against the ear, moves it outward away from the mouth by an angle of 15 degrees or until contact with the ear is lost (see Fig. 8.3).

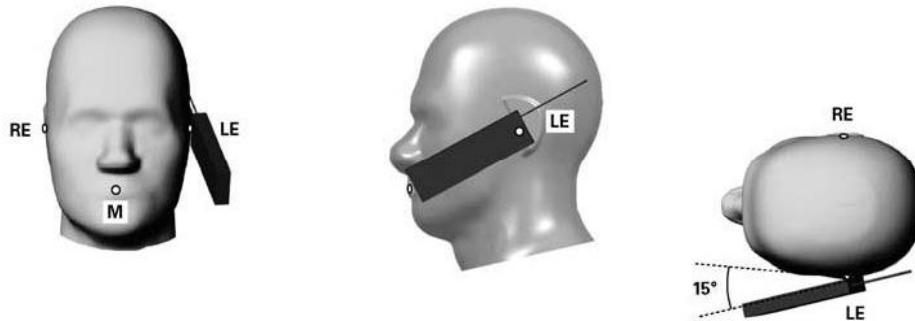
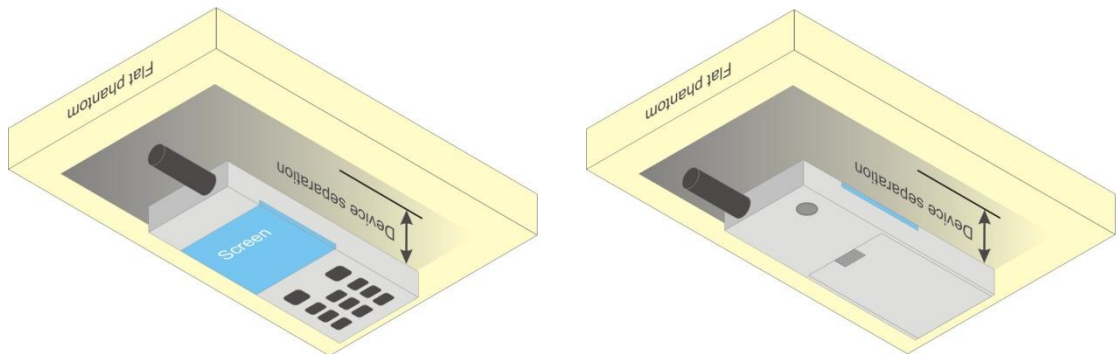


Fig 8.3 Illustration for Tilted Position

## 8.4 Body Position

1. To position the device parallel to the phantom all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge.
2. To adjust the distance between the device surface and all sides that the flat phantom to 1 cm.



**Fig 8.4 Illustration for Body Worn Position**

## **9. Measurement Procedures**

The measurement procedures are as follows:

### <Conducted power measurement>

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

### <SAR measurement>

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

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

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

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

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

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

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

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

### **9.2 Area & Zoom Scan Procedures**

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan measures 5x5x7 points with step size 8, 8 and 5 mm for 300 MHz to 3 GHz, and 8x8x8 points with step size 4, 4 and 2.5 mm for 3 GHz to 6 GHz. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.



### **9.3 Volume Scan Procedures**

The volume scan is used to 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 remains in the same test position for all measurements and all volume scans use the same spatial resolution and grid spacing (step-size is 4, 4 and 2.5 mm). When all volume scans are completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculate the multiband SAR.

### **9.4 SAR Averaged Methods**

In DASy, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

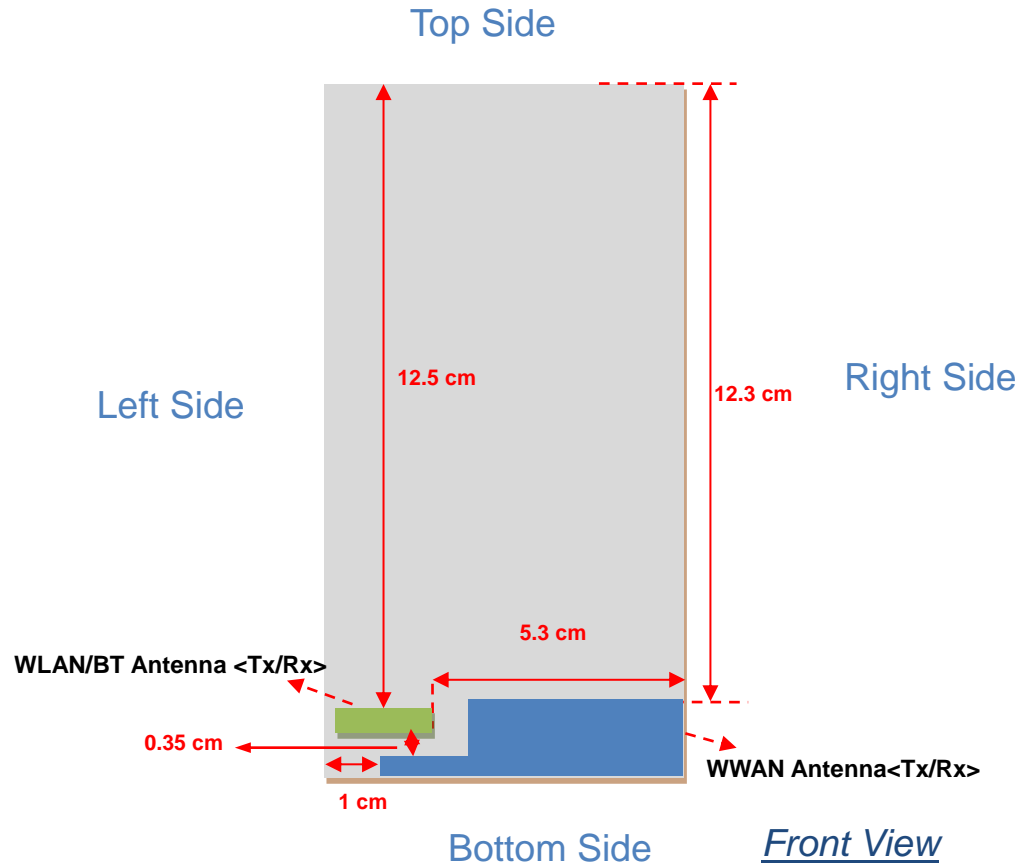
Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

### **9.5 Power Drift Monitoring**

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

## 10. SAR Test Configurations

### 10.1 Exposure Positions Consideration



Antennas	Wireless Interface
WWAN Antenna (Tx / Rx)	GSM850 GSM1900 WCDMA Band V
BT&WLAN Antenna (Tx / Rx)	WLAN 2.4GHz WLAN 5GHz Bluetooth



Sides for SAR tests; Hotspot mode						
Test distance: 10 mm						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN	YES	YES	NO	YES	YES	YES
BT&WLAN	YES	YES	NO	YES	NO	YES

**Note:**

1. Head/Body-worn/Hotspot mode SAR assessments are required.
2. Referring to KDB 941225 D06, when the overall device length and width are  $\geq 9\text{cm} \times 5\text{cm}$ , 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.
3. For WWAN antenna, SAR measurements at Top sides are not required since the distance between the transmitting antenna and surface of device is  $> 25\text{mm}$ .
4. For BT&WLAN antenna, SAR measurements Top/Right sides are not required since the distance between the transmitting antenna and surface of device is  $> 25\text{mm}$ .
5. Per KDB 648474 D01, the distance between Bluetooth antenna and WWAN antenna is 0.35cm and smaller than 2.5cm; Bluetooth output power is  $10.28\text{dBm} \leq P_{\text{Ref}}$ ,  $P_{\text{Ref}} = 10.8\text{dBm}$ , and WWAN antenna SAR is less than 1.2 W/kg, therefore stand-alone SAR and simultaneous transmission is not required.
6. Mobile hotspot only supports 2.4GHz WLAN operation; mobile hotspot of 5GHz WLAN operation is disabled.

**10.2 Conducted RF Output Power (Unit: dBm)**

**<GSM Conducted Power>**

Band: GSM850		Burst Average Power (dBm)			Frame-Average Power (dBm)		
Channel		128	189	251	128	189	251
Frequency (MHz)		824.2	836.4	848.8	824.2	836.4	848.8
GSM (GMSK, 1 Tx slot)		32.48	32.14	32.27	23.48	23.14	23.27
GPRS (GMSK, 1 Tx slot) – CS1		32.41	32.04	32.17	23.41	23.04	23.17
GPRS (GMSK, 2 Tx slots) – CS1		30.71	30.31	30.65	24.71	24.31	24.65
GPRS (GMSK, 3 Tx slots) – CS1		29.59	29.14	29.51	25.33	24.88	25.25
GPRS (GMSK, 4 Tx slots) – CS1		28.38	27.99	28.31	25.38	24.99	25.31
EDGE (GMSK, 1 Tx slot) – MCS1		32.40	32.01	32.14	23.40	23.01	23.14
EDGE (GMSK, 2 Tx slots) – MCS1		30.70	30.28	30.62	24.70	24.28	24.62
EDGE (GMSK, 3 Tx slots) – MCS1		29.55	29.11	29.48	25.29	24.85	25.22
EDGE (GMSK, 4 Tx slots) – MCS1		28.37	27.96	28.28	25.37	24.96	25.28
EDGE (8PSK, 1 Tx slot) – MCS5		27.13	26.82	26.97	18.13	17.82	17.97
EDGE (8PSK, 2 Tx slots) – MCS5		23.93	23.65	23.79	17.93	17.65	17.79
EDGE (8PSK, 3 Tx slots) – MCS5		22.68	22.32	22.47	18.42	18.06	18.21
EDGE (8PSK, 4 Tx slots) – MCS5		21.41	21.08	21.30	18.41	18.08	18.30
DTM 5	GSM (GMSK, 1 Tx slot)	30.93	30.31	30.74	24.87	24.25	24.68
	GPRS (GMSK, 1 Tx slot) – CS1	30.86	30.23	30.67			
DTM 9	GSM (GMSK, 1 Tx slot)	30.92	30.30	30.73	24.86	24.24	24.67
	GPRS (GMSK, 1 Tx slot) – CS1	30.85	30.22	30.66			
DTM 11	GSM (GMSK, 1 Tx slot)	29.70	29.21	29.63	25.39	24.90	25.33
	GPRS (GMSK, 2 Tx slots) – CS1	29.63	29.14	29.57			
DTM 5	GSM (GMSK, 1 Tx slot)	30.75	30.25	30.28	22.51	22.05	22.10
	EDGE (8PSK, 1 Tx slot) – MCS5	23.76	23.47	23.61			
DTM 9	GSM (GMSK, 1 Tx slot)	30.74	30.24	30.27	22.50	22.04	22.09
	EDGE (8PSK, 1 Tx slot) – MCS5	23.75	23.46	23.60			
DTM 11	GSM (GMSK, 1 Tx slot)	29.69	29.32	29.52	22.05	21.69	21.87
	EDGE (8PSK, 2 Tx slots) – MCS5	22.45	22.11	22.25			

**Remark:** The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.  
The calculated method are shown as below:  
Frame-averaged power = Maximum burst averaged power (1 Tx Slot) - 9 dB  
Frame-averaged power = Maximum burst averaged power (2 Tx Slots) - 6 dB  
Frame-averaged power = Maximum burst averaged power (3 Tx Slots) - 4.26 dB  
Frame-averaged power = Maximum burst averaged power (4 Tx Slots) - 3 dB

**Note:**

- For Head SAR testing, GSM and DTM should be evaluated, therefore the EUT was set in DTM Multi-slot class 11 for GSM850 due to its highest frame-average power.
- For Body worn SAR testing, GSM and DTM should be evaluated, therefore the EUT was set in DTM Multi-slot class 11 for GSM850 due to its highest frame-average power.
- For hotspot mode SAR testing, GPRS, EDGE and DTM should be evaluated, therefore the EUT was set in DTM Multi-slot class 11 for GSM850 due to its highest frame-average power.
- Per KDB 648474, the maximum output power channel is used for SAR testing and for further SAR test reduction.



Band: GSM1900		Burst Average Power (dBm)			Frame-Average Power (dBm)		
Channel		512	661	810	512	661	810
Frequency (MHz)		1850.2	1880.0	1909.8	1850.2	1880.0	1909.8
GSM (GMSK, 1 Tx slot)		30.79	30.98	30.41	21.79	21.98	21.41
GPRS (GMSK, 1 Tx slot) – CS1		30.76	30.96	30.40	21.76	21.96	21.40
GPRS (GMSK, 2 Tx slots) – CS1		28.60	28.69	28.24	22.60	22.69	22.24
GPRS (GMSK, 3 Tx slots) – CS1		27.48	27.56	26.98	23.22	23.30	22.72
GPRS (GMSK, 4 Tx slots) – CS1		25.88	26.24	25.68	22.88	23.24	22.68
EDGE (GMSK, 1 Tx slot) – MCS1		30.74	30.95	30.38	21.74	21.95	21.38
EDGE (GMSK, 2 Tx slots) – MCS1		28.56	28.67	28.22	22.56	22.67	22.22
EDGE (GMSK, 3 Tx slots) – MCS1		27.45	27.52	26.95	23.19	23.26	22.69
EDGE (GMSK, 4 Tx slots) – MCS1		25.85	26.22	25.64	22.85	23.22	22.64
EDGE (8PSK, 1 Tx slot) – MCS5		25.80	26.06	25.67	16.80	17.06	16.67
EDGE (8PSK, 2 Tx slots) – MCS5		23.07	23.34	22.99	17.07	17.34	16.99
EDGE (8PSK, 3 Tx slots) – MCS5		21.59	21.77	21.42	17.33	17.51	17.16
EDGE (8PSK, 4 Tx slots) – MCS5		20.65	20.80	20.44	17.65	17.80	17.44
DTM 5	GSM (GMSK, 1 Tx slot)	28.62	28.70	28.43	22.59	22.67	22.39
	GPRS (GMSK, 1 Tx slot) – CS1	28.60	28.68	28.40			
DTM 9	GSM (GMSK, 1 Tx slot)	28.61	28.67	28.44	22.58	22.66	22.40
	GPRS (GMSK, 1 Tx slot) – CS1	28.59	28.70	28.41			
DTM 11	GSM (GMSK, 1 Tx slot)	27.52	27.66	27.03	23.21	23.36	22.72
	GPRS (GMSK, 2 Tx slots) – CS1	27.45	27.60	26.95			
DTM 5	GSM (GMSK, 1 Tx slot)	28.69	28.88	28.31	20.71	20.92	20.40
	EDGE (8PSK, 1 Tx slot) – MCS5	23.08	23.36	22.99			
DTM 9	GSM (GMSK, 1 Tx slot)	28.67	28.85	28.29	20.69	20.90	20.38
	EDGE (8PSK, 1 Tx slot) – MCS5	23.06	23.34	22.97			
DTM 11	GSM (GMSK, 1 Tx slot)	27.58	27.78	27.13	20.29	20.50	19.95
	EDGE (8PSK, 2 Tx slots) – MCS5	21.51	21.74	21.37			

**Remark:** The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.  
The calculated method are shown as below:  
Frame-averaged power = Maximum burst averaged power (1 Tx Slot) - 9 dB  
Frame-averaged power = Maximum burst averaged power (2 Tx Slots) - 6 dB  
Frame-averaged power = Maximum burst averaged power (3 Tx Slots) - 4.26 dB  
Frame-averaged power = Maximum burst averaged power (4 Tx Slots) - 3 dB

**Note:**

1. For Head SAR testing, GSM and DTM should be evaluated, therefore the EUT was set in DTM Multi-slot class 11 for GSM1900 due to its highest frame-average power.
2. For Body worn SAR testing, GSM and DTM should be evaluated, therefore the EUT was set in DTM Multi-slot class 11 for GSM1900 due to its highest frame-average power.
3. For hotspot mode SAR testing, GPRS, EDGE and DTM should be evaluated, therefore the EUT was set in DTM Multi-slot class 11 for GSM1900 due to its highest frame-average power.
4. Per KDB 648474, the maximum output power channel is used for SAR testing and for further SAR test reduction.

**<WCDMA Conducted Power>**

The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification. A summary of these settings are illustrated below:

**HSDPA Setup Configuration:**

- a. The EUT was connected to Base Station referred to the drawing of Setup Configuration.
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting:
  - i. Set Gain Factors ( $\beta_c$  and  $\beta_d$ ) and parameters were set according to each
  - ii. Specific sub-test in the following table, C10.1.4, quoted from the TS 34.121
  - iii. Set RMC 12.2Kbps + HSDPA mode.
  - iv. Set Cell Power = -86 dBm
  - v. Set HS-DSCH Configuration Type to FRC (H-set 1, QPSK)
  - vi. Select HSDPA Uplink Parameters
  - vii. Set Delta ACK, Delta NACK and Delta CQI = 8
  - viii. Set Ack-Nack Repetition Factor to 3
  - ix. Set CQI Feedback Cycle (k) to 4 ms
  - x. Set CQI Repetition Factor to 2
  - xi. Power Ctrl Mode = All Up bits
- d. The transmitted maximum output power was recorded.

**Table C.10.1.4:  $\beta$  values for transmitter characteristics tests with HS-DPCCH**

Sub-test	$\beta_c$	$\beta_d$	$\beta_d$ (SF)	$\beta_c/\beta_d$	$\beta_{HS}$ (Note 1, Note 2)	CM (dB) (Note 3)	MPR (dB) (Note 3)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (Note 4)	15/15 (Note 4)	64	12/15 (Note 4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1:  $\Delta_{ACK}, \Delta_{NACK}$  and  $\Delta_{CQI} = 30/15$  with  $\beta_{HS} = 30/15 * \beta_c$ .

Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA,  $\Delta_{ACK}$  and  $\Delta_{NACK} = 30/15$  with  $\beta_{HS} = 30/15 * \beta_c$ , and  $\Delta_{CQI} = 24/15$  with  $\beta_{HS} = 24/15 * \beta_c$ .

Note 3: CM = 1 for  $\beta_c/\beta_d = 12/15, \beta_{HS}/\beta_c = 24/15$ . For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 4: For subtest 2 the  $\beta_c/\beta_d$  ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to  $\beta_c = 11/15$  and  $\beta_d = 15/15$ .

**Setup Configuration**

**HSUPA Setup Configuration:**

- a. The EUT was connected to Base Station referred to the drawing of Setup Configuration.
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting \* :
  - i. Call Configs = 5.2B, 5.9B, 5.10B, and 5.13.2B with QPSK
  - ii. Set the Gain Factors ( $\beta_c$  and  $\beta_d$ ) and parameters (AG Index) were set according to each specific sub-test in the following table, C11.1.3, quoted from the TS 34.121
  - iii. Set Cell Power = -86 dBm
  - iv. Set Channel Type = 12.2k + HSPA
  - v. Set UE Target Power
  - vi. Power Ctrl Mode= Alternating bits
  - vii. Set and observe the E-TFCl
  - viii. Confirm that E-TFCl is equal to the target E-TFCl of 75 for sub-test 1, and other subtest's E-TFCl
- d. The transmitted maximum output power was recorded.

**Table C.11.1.3:  $\beta$  values for transmitter characteristics tests with HS-DPCCH and E-DCH**

Sub-test	$\beta_c$	$\beta_d$	$\beta_d$ (SF)	$\beta_c/\beta_d$	$\beta_{HS}$ (Note 1)	$\beta_{ec}$	$\beta_{ed}$ (Note 5) (Note 6)	$\beta_{ed}$ (SF)	$\beta_{ed}$ (Codes)	CM (dB) (Note 2)	MPR (dB) (Note 2)	AG Index (Note 6)	E-TFCl
1	11/15 (Note 3)	15/15 (Note 3)	64	11/15 (Note 3)	22/15	209/225	1309/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	$\beta_{ed1}: 47/15$ $\beta_{ed2}: 47/15$	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 (Note 4)	15/15 (Note 4)	64	15/15 (Note 4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1:  $\Delta_{ACK}, \Delta_{NACK}$  and  $\Delta_{CQI} = 30/15$  with  $\beta_{hs} = 30/15 * \beta_c$ .

Note 2: CM = 1 for  $\beta_c/\beta_d = 12/15, \beta_{hs}/\beta_c = 24/15$ . For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the  $\beta_c/\beta_d$  ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to  $\beta_c = 10/15$  and  $\beta_d = 15/15$ .

Note 4: For subtest 5 the  $\beta_c/\beta_d$  ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to  $\beta_c = 14/15$  and  $\beta_d = 15/15$ .

Note 5: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g.

Note 6:  $\beta_{ed}$  can not be set directly, it is set by Absolute Grant Value.

**Setup Configuration**



WCDMA Average power (dBm)			
Band	WCDMA Band V		
Channel	4132	4182	4233
Frequency (MHz)	826.4	836.4	846.6
AMR 12.2K	23.30	23.00	22.90
RMC 12.2K	23.34	23.07	22.94
HSDPA Subtest-1	22.52	22.26	22.14
HSDPA Subtest-2	22.37	22.11	22.06
HSDPA Subtest-3	21.94	21.65	21.48
HSDPA Subtest-4	21.91	21.62	21.53
HSUPA Subtest-1	22.03	21.90	21.68
HSUPA Subtest-2	21.15	21.07	20.74
HSUPA Subtest-3	21.31	20.93	20.83
HSUPA Subtest-4	21.86	21.42	21.34
HSUPA Subtest-5	22.49	22.05	21.94

MPR (dB)				
3GPP MPR	Subtest	WCDMA Band V		
0	HSDPA Subtest-1	0.00	0.00	0.00
0	HSDPA Subtest-2	0.15	0.15	0.08
≤ 0.5	HSDPA Subtest-3	0.58	0.61	0.66
≤ 0.5	HSDPA Subtest-4	0.61	0.64	0.61
0	HSUPA Subtest-1	0.46	0.15	0.26
≤ 2	HSUPA Subtest-2	1.34	0.98	1.20
≤ 1	HSUPA Subtest-3	1.18	1.12	1.11
≤ 2	HSUPA Subtest-4	0.63	0.63	0.60
0	HSUPA Subtest-5	0.00	0.00	0.00

**Note:**

1. Applying the subtest setup in Table C.11.1.3 of 3GPP TS 34.121-1 V9.1.0 to Rel. 6 HSPA.
2. For Head SAR, per KDB 941225 D01, RMC 12.2kbps setting is used to evaluate SAR. If AMR 12.2kbps power is < 0.25dB higher than RMC 12.2kbps, SAR tests with AMR 12.2kbps can be excluded.
3. For Body SAR, per KDB 941225 D01, RMC 12.2kbps setting is used to evaluate SAR. If HSDPA/HSUPA output power is < 0.25dB higher than RMC, or SAR with RMC 12.2kbps setting is ≤ 1.2W/kg, HSDPA/HSUPA SAR evaluation can be excluded.
4. By design, AMR, HSDPA/HSUPA RF power will not be larger than RMC 12.2kbps, detailed information is included in Tune-up Procure exhibit.
5. It is expected by the manufacturer that MPR for some HSDPA/HSUPA, subtests may differ from the specification of 3GPP, according to the chipset implementation in this model. The implementation and expected deviation are detailed in tune-up procedure exhibit.

<WLAN 2.4GHz Conducted Power>

WLAN 2.4G 802.11b Average Power (dBm)						
Power vs. Channel			Power vs. Data Rate			
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)		
		1M		2M	5.5M	11M
CH 01	2412	17.45	01	17.43	17.44	17.43
CH 06	2437	16.77				
CH 11	2462	16.68				

WLAN 2.4G 802.11g Average Power (dBm)										
Power vs. Channel			Power vs. Data Rate							
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)						
		6M		9M	12M	18M	24M	36M	48M	54M
CH 01	2412	14.20	01	14.18	14.17	14.18	14.18	14.19	14.19	14.18
CH 06	2437	13.65								
CH 11	2462	13.76								

WLAN 2.4G 802.11n (BW 20MHz) Average Power (dBm)										
Power vs. Channel			Power vs. Data Rate							
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index						
		MCS0		MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH 01	2412	13.15	01	13.11	13.14	13.14	13.14	13.13	13.13	13.13
CH 06	2437	12.75								
CH 11	2462	12.38								

Note:

1. Per KDB 248227, choose the highest output power channel to test SAR and determine further SAR exclusion
2. Per KDB 248227, 11g and 11n-HT20 output power is less than 0.25dB higher than 11b mode, thus the SAR can be excluded.
3. For each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 0.25dB higher than those measured at the lowest data rate.

<Bluetooth Conducted Power>

Channel	Frequency (MHz)	Average power (dBm)		
		Mode		
		GFSK	π/4-DQPSK	8-DPSK
CH 0	2402	10.28	8.31	8.29
CH 39	2441	10.15	7.62	7.58
CH 78	2480	9.75	6.71	6.70

Channel	Frequency (MHz)	Average power (dBm)
		Mode
		BT v4.0 LE, GFSK
CH 0	2402	6.41
CH 19	2440	6.11
CH 39	2480	5.44



<WLAN 5GHz Conducted Power>

WLAN 5G 802.11a Average Power (dBm)											
Power vs. Channel			Power vs. Data Rate								
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)						48M	54M
		6M		9M	12M	18M	24M	36M			
CH 36	5180	13.73	CH 36	13.71	13.72	13.70	13.71	13.71	13.70	13.72	
CH 40	5200	13.71									
CH 44	5220	13.70									
CH 48	5240	13.63									
CH 52	5260	13.65	CH 60	13.64	13.64	13.64	13.65	13.65	13.65	13.65	
CH 56	5280	13.64									
CH 60	5300	13.66									
CH 64	5320	13.63									
CH 100	5500	14.16	CH 100	14.14	14.15	14.11	14.13	14.14	14.13	14.15	
CH 104	5520	14.07									
CH 108	5540	14.05									
CH 112	5560	14.08									
CH 116	5580	13.98									
CH 132	5660	13.78									
CH 136	5680	13.53									
CH 140	5700	13.54									
CH 149	5745	13.99	CH 165	13.97	14.01	14.01	14.03	14.02	14.03	14.02	
CH 153	5765	13.71									
CH 157	5785	13.63									
CH 161	5805	13.91									
CH 165	5825	14.04									



WLAN 5G 802.11n (BW 20M) Average Power (dBm)										
Power vs. Channel			Power vs. Data Rate							
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index						
		MCS0		MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH 36	5180	12.92	CH 36	12.80	12.89	12.86	12.89	12.91	12.91	12.91
CH 40	5200	12.78								
CH 44	5220	12.68								
CH 48	5240	12.67								
CH 52	5260	12.81	CH 52	12.79	12.64	12.68	12.80	12.80	12.80	12.78
CH 56	5280	12.77								
CH 60	5300	12.68								
CH 64	5320	12.63								
CH 100	5500	13.10	CH 100	13.08	13.08	13.08	13.09	13.09	13.09	13.09
CH 104	5520	13.01								
CH 108	5540	13.03								
CH 112	5560	13.03								
CH 116	5580	12.81								
CH 132	5660	12.77								
CH 136	5680	12.62								
CH 140	5700	12.54								
CH 149	5745	12.99	CH 165	13.05	13.08	13.08	13.08	13.08	13.06	13.05
CH 153	5765	12.90								
CH 157	5785	12.61								
CH 161	5805	12.86								
CH 165	5825	13.09								

WLAN 5G 802.11n (BW 40M) Average Power (dBm)										
Power vs. Channel			Power vs. Data Rate							
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index						
		MCS0		MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH 38	5190	12.98	38	12.95	12.96	12.97	12.96	12.96	12.97	12.96
CH 46	5230	12.83								
CH 54	5270	12.82	54	12.77	12.80	12.81	12.80	12.81	12.81	12.80
CH 62	5310	12.74								
CH 102	5510	13.18	102	13.16	13.16	13.16	13.16	13.16	13.17	13.16
CH 110	5550	13.16								
CH 134	5670	12.76								
CH 151	5755	12.99	151	12.97	12.96	12.93	12.93	12.94	12.97	12.97
CH 159	5795	12.86								

Note:

1. Per KDB 248227, choose the highest output power channel to test SAR and determine further SAR exclusion
2. Per KDB 248227, 11n-HT20 and 11n-HT40 output power is less than 0.25dB higher than 11a mode, thus the SAR can be excluded.
3. For each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 0.25dB higher than those measured at the lowest data rate.



## 11. SAR Test Results

### 11.1 Test Records for Head SAR Test

#### <GSM SAR>

Plot No.	Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Power Drift (dB)	SAR <sub>1g</sub> (W/kg)
12	GSM850	DTM Multi-slot class 11	Right Cheek	128	824.2	29.7	0.125	0.063
13	GSM850	DTM Multi-slot class 11	Right Tilted	128	824.2	29.7	0.054	0.045
14	<b>GSM850</b>	<b>DTM Multi-slot class 11</b>	<b>Left Cheek</b>	<b>128</b>	<b>824.2</b>	<b>29.7</b>	<b>0.015</b>	<b>0.067</b>
15	GSM850	DTM Multi-slot class 11	Left Tilted	128	824.2	29.7	0.137	0.047
72	GSM1900	DTM Multi-slot class 11	Right Cheek	661	1880	27.66	0.022	0.39
73	GSM1900	DTM Multi-slot class 11	Right Tilted	661	1880	27.66	-0.09	0.165
74	<b>GSM1900</b>	<b>DTM Multi-slot class 11</b>	<b>Left Cheek</b>	<b>661</b>	<b>1880</b>	<b>27.66</b>	<b>-0.026</b>	<b>0.479</b>
75	GSM1900	DTM Multi-slot class 11	Left Tilted	661	1880	27.66	0.001	0.208

**Note:** Per KDB 648474 and KDB 447498, if the highest output channel SAR for each exposure position  $\leq 0.8$  W/kg other channels SAR tests are not necessary.

#### <WCDMA SAR>

Plot No.	Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Power Drift (dB)	SAR <sub>1g</sub> (W/kg)
16	WCDMA V	RMC12.2K	Right Cheek	4132	826.4	23.34	-0.139	0.00278
17	WCDMA V	RMC12.2K	Right Tilted	4132	826.4	23.34	-0.164	0.00325
18	<b>WCDMA V</b>	<b>RMC12.2K</b>	<b>Left Cheek</b>	<b>4132</b>	<b>826.4</b>	<b>23.34</b>	<b>-0.109</b>	<b>0.209</b>
19	WCDMA V	RMC12.2K	Left Tilted	4132	826.4	23.34	-0.041	0.151

**Note:** Per KDB 648474 and KDB 447498, if the highest output channel SAR for each exposure position  $\leq 0.8$  W/kg other channels SAR tests are not necessary.



<WLAN SAR>

Plot No.	Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Duty Cycle %	Duty Cycle Compensate Factor	Power Drift (dB)	SAR <sub>1g</sub> (W/kg)	Duty Cycle Compensated 1g SAR
1	WLAN2.4G	802.11b	Right Cheek	1	2412	17.45	98.63	1.014	0.07	0.111	0.113
2	WLAN2.4G	802.11b	Right Tilted	1	2412	17.45	98.63	1.014	0.17	0.053	0.054
3	WLAN2.4G	802.11b	Left Cheek	1	2412	17.45	98.63	1.014	0.17	0.085	0.086
4	WLAN2.4G	802.11b	Left Tilted	1	2412	17.45	98.63	1.014	-0.129	0.077	0.078
36	WLAN5G	802.11a	Right Cheek	36	5180	13.73	93.23	1.073	0.089	0.000654	0.001
37	WLAN5G	802.11a	Right Tilted	36	5180	13.73	93.23	1.073	0.114	0.000574	0.001
38	WLAN5G	802.11a	Left Cheek	36	5180	13.73	93.23	1.073	0.012	0.00622	0.007
116	WLAN5G	802.11a	Left Tilted	36	5180	13.73	93.23	1.073	0.023	0.00775	0.008
40	WLAN5G	802.11a	Right Cheek	60	5300	13.66	93.23	1.073	-0.11	0.00168	0.002
41	WLAN5G	802.11a	Right Tilted	60	5300	13.66	93.23	1.073	0.04	0.000282	0.001
117	WLAN5G	802.11a	Left Cheek	60	5300	13.66	93.23	1.073	-0.02	0.0039	0.004
43	WLAN5G	802.11a	Left Tilted	60	5300	13.66	93.23	1.073	-0.013	0.000486	0.001
44	WLAN5G	802.11a	Right Cheek	100	5500	14.16	93.23	1.073	-0.143	0.000251	0.001
45	WLAN5G	802.11a	Right Tilted	100	5500	14.16	93.23	1.073	0.053	0.00461	0.005
46	WLAN5G	802.11a	Left Cheek	100	5500	14.16	93.23	1.073	0.019	0.00783	0.008
47	WLAN5G	802.11a	Left Tilted	100	5500	14.16	93.23	1.073	0.012	0.000497	0.001
48	WLAN5G	802.11a	Right Cheek	165	5825	14.04	93.23	1.073	-0.026	0.00103	0.001
49	WLAN5G	802.11a	Right Tilted	165	5825	14.04	93.23	1.073	-0.001	0.00112	0.001
50	WLAN5G	802.11a	Left Cheek	165	5825	14.04	93.23	1.073	-0.011	0.01	0.011
51	WLAN5G	802.11a	Left Tilted	165	5825	14.04	93.23	1.073	-0.02	0.00884	0.009

Note: Per KDB 648474 and KDB 248227, if the highest output channel SAR for each exposure position ≤ 0.8 W/kg other channels SAR tests are not necessary.

**11.2 Test Records for Hotspot SAR Test**

**<GSM SAR>**

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Power Drift (dB)	SAR <sub>1g</sub> (W/kg)
100	GSM850	DTM Multi-slot class 11	Front	1	128	824.2	29.7	-0.02	0.085
101	<b>GSM850</b>	<b>DTM Multi-slot class 11</b>	<b>Back</b>	<b>1</b>	<b>128</b>	<b>824.2</b>	<b>29.7</b>	<b>-0.05</b>	<b>0.253</b>
102	GSM850	DTM Multi-slot class 11	Left Side	1	128	824.2	29.7	0.01	0.117
103	GSM850	DTM Multi-slot class 11	Right Side	1	128	824.2	29.7	0.07	0.135
105	GSM850	DTM Multi-slot class 11	Bottom Side	1	128	824.2	29.7	-0.033	0.013
65	GSM1900	DTM Multi-slot class 11	Front	1	661	1880	27.66	-0.059	0.435
66	<b>GSM1900</b>	<b>DTM Multi-slot class 11</b>	<b>Back</b>	<b>1</b>	<b>661</b>	<b>1880</b>	<b>27.66</b>	<b>-0.143</b>	<b>0.495</b>
67	GSM1900	DTM Multi-slot class 11	Left Side	1	661	1880	27.66	0.121	0.351
68	GSM1900	DTM Multi-slot class 11	Right Side	1	661	1880	27.66	0.159	0.135
69	GSM1900	DTM Multi-slot class 11	Bottom Side	1	661	1880	27.66	0.041	0.253

**Note:**

1. Per KDB 941225 D06, for EUT dimension ≥ 9cm\*5cm, the test distance is 1cm. SAR must be measured for all surfaces and sides with a transmitting antenna located within 2.5cm from that surface or edge.
2. As in (1), SAR for Front / Back / Bottom Side / Right Side is necessary.
3. Per KDB 648474 and KDB 447498 if the highest output channel SAR for each exposure position ≤ 0.8 W/kg other channels SAR tests are not necessary.

**<WCDMA SAR>**

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Power Drift (dB)	SAR <sub>1g</sub> (W/kg)
108	WCDMA V	RMC 12.2K	Front	1	4132	826.4	23.34	0.013	0.00325
109	<b>WCDMA V</b>	<b>RMC 12.2K</b>	<b>Back</b>	<b>1</b>	<b>4132</b>	<b>826.4</b>	<b>23.34</b>	<b>-0.16</b>	<b>0.00856</b>
110	WCDMA V	RMC 12.2K	Left Side	1	4132	826.4	23.34	-0.11	0.00565
111	WCDMA V	RMC 12.2K	Right Side	1	4132	826.4	23.34	-0.15	0.00697
113	WCDMA V	RMC 12.2K	Bottom Side	1	4132	826.4	23.34	-0.025	0.00109

**Note:**

1. Per KDB 941225 D06, for EUT dimension ≥ 9cm\*5cm, the test distance is 1cm. SAR must be measured for all surfaces and sides with a transmitting antenna located within 2.5cm from that surface or edge.
2. As in (1), SAR for Front / Back / Bottom Side / Right Side is necessary.
3. Per KDB 648474 and KDB 447498, if the highest output channel SAR for each exposure position ≤ 0.8 W/kg other channels SAR tests are not necessary.

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Duty Cycle %	Duty Cycle Compensate Factor	Power Drift (dB)	SAR <sub>1g</sub> (W/kg)	Duty Cycle Compensated 1g SAR
5	WLAN2.4G	802.11b	Front	1	1	2412	17.45	98.63	1.014	-0.124	0.085	0.086
6	WLAN2.4G	802.11b	Back	1	1	2412	17.45	98.63	1.014	-0.142	0.181	0.184
7	WLAN2.4G	802.11b	Left Side	1	1	2412	17.45	98.63	1.014	0.01	0.029	0.029
10	WLAN2.4G	802.11b	Bottom Side	1	1	2412	17.45	98.63	1.014	0.04	0.083	0.084

Note:

- Per KDB 941225 D06, for EUT dimension ≥ 9cm\*5cm, the test distance is 1cm. SAR must be measured for all surfaces and sides with a transmitting antenna located within 2.5cm from that surface or edge.
- As in (1), SAR for Front / Back / Bottom Side / Left Side is necessary.
- Per KDB 648474 and KDB 248227, if the highest output channel SAR for each exposure position ≤ 0.8 W/kg other channels SAR tests are not necessary.

11.3 Test Records for Body-worn SAR Test

<GSM SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Headset	Power Drift (dB)	SAR <sub>1g</sub> (W/kg)
100	GSM850	DTM Multi-slot class 11	Front	1	128	824.2	29.7	-	-0.02	0.085
101	GSM850	DTM Multi-slot class 11	Back	1	128	824.2	29.7	-	-0.05	0.253
107	GSM850	DTM Multi-slot class 11	Back	1	128	824.2	29.7	v	0.03	0.158
65	GSM1900	DTM Multi-slot class 11	Front	1	661	1880	27.66		-0.059	0.435
66	GSM1900	DTM Multi-slot class 11	Back	1	661	1880	27.66		-0.143	0.495
71	GSM1900	DTM Multi-slot class 11	Back	1	661	1880	27.66	v	-0.064	0.5

Note:

- Per KDB 648474 and KDB 447498, if the highest output channel SAR for each exposure position ≤ 0.8 W/kg other channels SAR tests are not necessary.
- Per KDB 941225 D06, hotspot SAR data in front/back positions can be considered as body-worn accessory SAR test data. GSM voice mode body-worn SAR was repeated at the worst position of hotspot SAR data, back position of this device
- “V” in the Headset column means the Headset is plugged during SAR testing.

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Headset	Power Drift (dB)	SAR <sub>1g</sub> (W/kg)
108	WCDMA V	RMC 12.2K	Front	1	4132	826.4	23.34	-	0.013	0.00325
109	WCDMA V	RMC 12.2K	Back	1	4132	826.4	23.34	-	-0.16	0.00856
115	WCDMA V	RMC 12.2K	Back	1	4132	826.4	23.34	v	-0.051	0.00595

Note:

- Per KDB 648474 and KDB 447498, if the highest output channel SAR for each exposure position ≤ 0.8 W/kg other channels SAR tests are not necessary.
- “V” in the Headset column means the Headset is plugged during SAR testing.

**<WLAN SAR>**

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Duty Cycle %	Duty Cycle Compensate Factor	Headset	Power Drift (dB)	SAR <sub>1g</sub> (W/kg)	Duty Cycle Compensated 1g SAR
5	WLAN2.4G	802.11b	Front	1	1	2412	17.45	98.63	1.014	-	-0.124	0.085	0.086
6	<b>WLAN2.4G</b>	<b>802.11b</b>	<b>Back</b>	<b>1</b>	<b>1</b>	<b>2412</b>	<b>17.45</b>	<b>98.63</b>	<b>1.014</b>	-	<b>-0.142</b>	<b>0.181</b>	<b>0.184</b>
11	WLAN2.4G	802.11b	Back	1	1	2412	17.45	98.63	1.014	v	-0.03	0.178	0.180
20	WLAN5G	802.11a	Front	1	36	5180	13.73	93.23	1.073	-	0.012	0.011	0.012
21	WLAN5G	802.11a	Back	1	36	5180	13.73	93.23	1.073	-	0.12	0.06	0.064
22	WLAN5G	802.11a	Back	1	36	5180	13.73	93.23	1.073	v	0.139	0.055	0.059
23	WLAN5G	802.11a	Front	1	60	5300	13.66	93.23	1.073	-	0.16	0.00934	0.010
24	WLAN5G	802.11a	Back	1	60	5300	13.66	93.23	1.073	-	-0.14	0.091	0.098
25	WLAN5G	802.11a	Back	1	60	5300	13.66	93.23	1.073	v	-0.17	0.093	0.100
26	WLAN5G	802.11a	Front	1	100	5500	14.16	93.23	1.073	-	0.11	0.012	0.013
27	WLAN5G	802.11a	Back	1	100	5500	14.16	93.23	1.073	-	0.13	0.289	0.310
28	WLAN5G	802.11a	Back	1	100	5500	14.16	93.23	1.073	v	0.17	0.295	0.316
29	WLAN5G	802.11a	Front	1	165	5825	14.04	93.23	1.073	-	0.16	0.069	0.074
30	<b>WLAN5G</b>	<b>802.11a</b>	<b>Back</b>	<b>1</b>	<b>165</b>	<b>5825</b>	<b>14.04</b>	<b>93.23</b>	<b>1.073</b>	-	<b>0.04</b>	<b>0.425</b>	<b>0.456</b>
35	WLAN5G	802.11a	Back	1	165	5825	14.04	93.23	1.073	v	0.17	0.423	0.454

**Note:**

- Per KDB 648474 and KDB 248227, if the highest output channel SAR for each exposure position ≤ 0.8 W/kg other channels SAR tests are not necessary.
- “V” in the Headset column means the Headset is plugged during SAR testing.

**11.4 Simultaneous Multi-band Transmission Analysis**

No.	Applicable Simultaneous Transmission Combination
1.	<b>WWAN + BT</b>
2.	<b>WWAN + WLAN</b>

**Note:**

- WLAN and BT share the same antenna in time-switched way and cannot transmit simultaneously.
- GSM and WCDMA share the same antenna, and cannot transmit simultaneously.
- EUT will choose either WLAN2.4G or WLAN5G according to the network signal condition; therefore, they will not transmit simultaneously.
- EUT will choose either GSM or WCDMA according to the network signal condition; therefore, they will not transmit simultaneously.
- The maximum SAR summation is calculated based on the same configuration and test position.
- If 1g-SAR scalar summation < 1.6W/kg, simultaneous SAR measurement is not necessary.
- Mobile hotspot only supports 2.4GHz WLAN operation; mobile hotspot of 5GHz WLAN operation is disabled, therefore WWAN and WLAN5G hotspot simultaneous is not supported.



<Head SAR>

Position	WWAN			WLAN2.4G		WWAN + WLAN
	WWAN Band	Plot No	Max. WWAN SAR (W/kg)	Plot No	Max. WLAN SAR (W/kg)	
Right Cheek	GSM850	12	0.063	1	0.113	0.18
	GSM1900	72	0.39	1	0.113	0.50
	WCDMA V	16	0.00278	1	0.113	0.12
Right Tilted	GSM850	13	0.045	2	0.054	0.10
	GSM1900	73	0.165	2	0.054	0.22
	WCDMA V	17	0.00325	2	0.054	0.06
Left Cheek	GSM850	14	0.067	3	0.086	0.15
	GSM1900	74	0.479	3	0.086	0.57
	WCDMA V	18	0.209	3	0.086	0.30
Left Tilted	GSM850	15	0.047	4	0.078	0.13
	GSM1900	75	0.208	4	0.078	0.29
	WCDMA V	19	0.151	4	0.078	0.23

Position	WWAN			WLAN5G		WWAN + WLAN
	WWAN Band	Plot No	Max. WWAN SAR (W/kg)	Plot No	Max. WLAN SAR (W/kg)	
Right Cheek	GSM850	12	0.063	40	0.002	0.07
	GSM1900	72	0.39	40	0.002	0.39
	WCDMA V	16	0.00278	40	0.002	0.00
Right Tilted	GSM850	13	0.045	45	0.005	0.05
	GSM1900	73	0.165	45	0.005	0.17
	WCDMA V	17	0.00325	45	0.005	0.01
Left Cheek	GSM850	14	0.067	50	0.011	0.08
	GSM1900	74	0.479	50	0.011	0.49
	WCDMA V	18	0.209	50	0.011	0.22
Left Tilted	GSM850	15	0.047	51	0.00900	0.06
	GSM1900	75	0.208	51	0.00900	0.22
	WCDMA V	19	0.151	51	0.00900	0.16

<Hotspot SAR>

Position	WWAN			WLAN2.4G		WWAN + WLAN
	WWAN Band	Plot No	Max. WWAN SAR (W/kg)	Plot No	Max. WLAN SAR (W/kg)	
Front	GSM850	100	0.085	5	0.086	0.17
	GSM1900	65	0.435	5	0.086	0.52
	WCDMA V	108	0.00325	5	0.086	0.09
Back	GSM850	101	0.253	6	0.184	0.44
	GSM1900	66	0.495	6	0.184	0.68
	WCDMA V	109	0.00856	6	0.184	0.19
Left Side	GSM850	102	0.117	7	0.029	0.15
	GSM1900	67	0.351	7	0.029	0.38
	WCDMA V	110	0.00565	7	0.029	0.03
Right Side	GSM850	103	0.135			0.14
	GSM1900	68	0.135			0.14
	WCDMA V	111	0.00697			0.01
Bottom Side	GSM850	105	0.013	10	0.084	0.10
	GSM1900	69	0.253	10	0.084	0.34
	WCDMA V	113	0.00109	10	0.084	0.09



<Body-worn SAR>

Position	WWAN			WLAN2.4G		WWAN + WLAN
	WWAN Band	Plot No	Max. WWAN SAR (W/kg)	Plot No	Max. WLAN SAR (W/kg)	
Front	GSM850	100	0.085	5	0.09	0.18
	GSM1900	65	0.435	5	0.09	0.53
	WCDMA V	108	0.00325	5	0.09	0.09
Back	GSM850	101	0.253	6	0.192	0.45
	GSM1900	66	0.495	6	0.192	0.69
	WCDMA V	109	0.00856	6	0.192	0.20
Back (w/ Headset)	GSM850	107	0.158	11	0.189	0.35
	GSM1900	71	0.5	11	0.189	0.69
	WCDMA V	115	0.00595	11	0.189	0.19

Position	WWAN			WLAN5G		WWAN + WLAN
	WWAN Band	Plot No	Max. WWAN SAR (W/kg)	Plot No	Max. WLAN SAR (W/kg)	
Front	GSM850	100	0.085	29	0.074	0.16
	GSM1900	65	0.435	29	0.074	0.51
	WCDMA V	108	0.00325	29	0.074	0.08
Back	GSM850	101	0.253	30	0.456	0.71
	GSM1900	66	0.495	30	0.456	0.95
	WCDMA V	109	0.00856	30	0.456	0.46
Back(w/ Headset)	GSM850	107	0.158	35	0.454	0.61
	GSM1900	71	0.5	35	0.454	0.95
	WCDMA V	115	0.00595	35	0.454	0.46



**11.5 Scaled SAR Value to Maximum Tune-up Tolerances**

The following measured results were scaled to the maximum tune-up tolerance, according to the output power of the channel tested for the highest measured results in each frequency band.

Test Configuration		Mode	CH	Freq. (MHz)	Power (dBm)		SAR (W/kg)	
					MAX tune up limit	Measured	Measured	Scaled
Body-Worn & Hotspot	Back	GSM 850 (GPRS class 11)	128	824.2	30	29.7	0.253	0.271
Body-Worn	Back	GSM 1900 with headset (GPRS class 11)	661	1880	28	27.66	0.5	0.541
Head	Left Cheek	WCDMA V	4132	826.4	23.5	23.34	0.209	0.217
Body-Worn & Hotspot	Back	WLAN2.4G	1	2412	17.5	17.45	0.184	0.186
Body-Worn	Back	WLAN5G	36	5180	14.5	13.73	0.064	0.076
Body-Worn	Back	WLAN5G	60	5300	14.5	13.66	0.100	0.121
Body-Worn	Back	WLAN5G	100	5500	14.5	14.16	0.316	0.341
Body-Worn	Back	WLAN5G	165	5825	14.5	14.04	0.456	0.506

**Test Engineer :** Michael Yang, Angelo Chang, Nick Yu, Cona Huang, Bevis Chang, Ted Sun, San Lin, and Aaron Chen

## 12. 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 12.1

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 12.1 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 Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (1g)	Standard Uncertainty (10g)
<b>Measurement System</b>							
Probe Calibration	6.0	Normal	1	1	1	± 6.0 %	± 6.0 %
Axial Isotropy	4.7	Rectangular	√3	0.7	0.7	± 1.9 %	± 1.9 %
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	0.7	± 3.9 %	± 3.9 %
Boundary Effects	1.0	Rectangular	√3	1	1	± 0.6 %	± 0.6 %
Linearity	4.7	Rectangular	√3	1	1	± 2.7 %	± 2.7 %
System Detection Limits	1.0	Rectangular	√3	1	1	± 0.6 %	± 0.6 %
Readout Electronics	0.3	Normal	1	1	1	± 0.3 %	± 0.3 %
Response Time	0.8	Rectangular	√3	1	1	± 0.5 %	± 0.5 %
Integration Time	2.6	Rectangular	√3	1	1	± 1.5 %	± 1.5 %
RF Ambient Noise	3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
RF Ambient Reflections	3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
Probe Positioner	0.4	Rectangular	√3	1	1	± 0.2 %	± 0.2 %
Probe Positioning	2.9	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
Max. SAR Eval.	1.0	Rectangular	√3	1	1	± 0.6 %	± 0.6 %
<b>Test Sample Related</b>							
Device Positioning	2.9	Normal	1	1	1	± 2.9 %	± 2.9 %
Device Holder	3.6	Normal	1	1	1	± 3.6 %	± 3.6 %
Power Drift	5.0	Rectangular	√3	1	1	± 2.9 %	± 2.9 %
<b>Phantom and Setup</b>							
Phantom Uncertainty	4.0	Rectangular	√3	1	1	± 2.3 %	± 2.3 %
Liquid Conductivity (Target)	5.0	Rectangular	√3	0.64	0.43	± 1.8 %	± 1.2 %
Liquid Conductivity (Meas.)	2.5	Normal	1	0.64	0.43	± 1.6 %	± 1.1 %
Liquid Permittivity (Target)	5.0	Rectangular	√3	0.6	0.49	± 1.7 %	± 1.4 %
Liquid Permittivity (Meas.)	2.5	Normal	1	0.6	0.49	± 1.5 %	± 1.2 %
<b>Combined Standard Uncertainty</b>						± 11.0 %	± 10.8 %
<b>Coverage Factor for 95 %</b>						K=2	
<b>Expanded Uncertainty</b>						± 22.0 %	± 21.5 %

Table 12.2 Uncertainty Budget of DASY for frequency range 300 MHz to 3 GHz



Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (1g)	Standard Uncertainty (10g)
<b>Measurement System</b>							
Probe Calibration	6.55	Normal	1	1	1	± 6.55 %	± 6.55 %
Axial Isotropy	4.7	Rectangular	√3	0.7	0.7	± 1.9 %	± 1.9 %
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	0.7	± 3.9 %	± 3.9 %
Boundary Effects	2.0	Rectangular	√3	1	1	± 1.2 %	± 1.2 %
Linearity	4.7	Rectangular	√3	1	1	± 2.7 %	± 2.7 %
System Detection Limits	1.0	Rectangular	√3	1	1	± 0.6 %	± 0.6 %
Readout Electronics	0.3	Normal	1	1	1	± 0.3 %	± 0.3 %
Response Time	0.8	Rectangular	√3	1	1	± 0.5 %	± 0.5 %
Integration Time	2.6	Rectangular	√3	1	1	± 1.5 %	± 1.5 %
RF Ambient Noise	3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
RF Ambient Reflections	3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
Probe Positioner	0.8	Rectangular	√3	1	1	± 0.5 %	± 0.5 %
Probe Positioning	9.9	Rectangular	√3	1	1	± 5.7 %	± 5.7 %
Max. SAR Eval.	4.0	Rectangular	√3	1	1	± 2.3 %	± 2.3 %
<b>Test Sample Related</b>							
Device Positioning	2.9	Normal	1	1	1	± 2.9 %	± 2.9 %
Device Holder	3.6	Normal	1	1	1	± 3.6 %	± 3.6 %
Power Drift	5.0	Rectangular	√3	1	1	± 2.9 %	± 2.9 %
<b>Phantom and Setup</b>							
Phantom Uncertainty	4.0	Rectangular	√3	1	1	± 2.3 %	± 2.3 %
Liquid Conductivity (Target)	5.0	Rectangular	√3	0.64	0.43	± 1.8 %	± 1.2 %
Liquid Conductivity (Meas.)	2.5	Normal	1	0.64	0.43	± 1.6 %	± 1.1 %
Liquid Permittivity (Target)	5.0	Rectangular	√3	0.6	0.49	± 1.7 %	± 1.4 %
Liquid Permittivity (Meas.)	2.5	Normal	1	0.6	0.49	± 1.5 %	± 1.2 %
<b>Combined Standard Uncertainty</b>						± 12.8 %	± 12.6 %
<b>Coverage Factor for 95 %</b>						K=2	
<b>Expanded Uncertainty</b>						± 25.6 %	± 25.2 %

Table 12.3 Uncertainty Budget of DASYS for frequency range 3 GHz to 6 GHz



### **13. 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. 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- [4] FCC OET Bulletin 65 (Edition 97-01) Supplement C (Edition 01-01), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", June 2001
- [5] SPEAG DASY System Handbook
- [6] FCC KDB 248227 D01 v01r02, "SAR Measurement Procedures for 802.11 a/b/g Transmitters", May 2007
- [7] FCC KDB 447498 D01 v04, "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies", November 2009
- [8] FCC KDB 648474 D01 v01r05, "SAR Evaluation Considerations for Handsets with Multiple Transmitters and Antennas", September 2008
- [9] FCC KDB 941225 D01 v02, "SAR Measurement Procedures for 3G Devices – CDMA 2000 / Ev-Do / WCDMA / HSDPA / HSPA", October 2007
- [10] FCC KDB 941225 D02 v02 "3GPP R6 HSPA and R7 HSPA+ SAR Guidance", December 2009.
- [11] FCC KDB 941225 D03 v01, "Recommended SAR Test Reduction Procedures for GSM / GPRS / EDGE", December 2008
- [12] FCC KDB 941225 D06 v01, "SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities", April 2011



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

The plots are shown as follows.

**System Check\_Head\_835MHz\_121019****DUT: D835V2-SN:499**

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

Medium: HSL\_850\_121019 Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.906$  mho/m;  $\epsilon_r = 43$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.6 °C ; Liquid Temperature : 21.6 °C

DASY4 Configuration:

- Probe: ET3DV6 - SN1787; ConvF(6.12, 6.12, 6.12); Calibrated: 2012/5/29

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn577; Calibrated: 2012/6/6

- Phantom: SAM\_Left; Type: SAM; Serial: TP-1150

- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

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

Maximum value of SAR (interpolated) = 2.70 mW/g

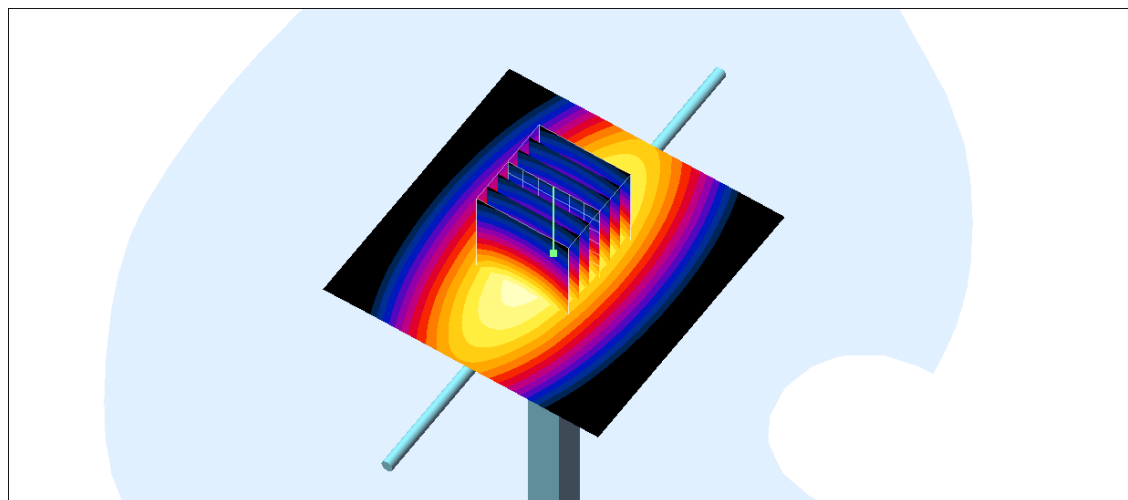
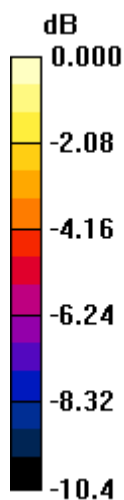
**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.2 V/m; Power Drift = 0.010 dB

Peak SAR (extrapolated) = 3.51 W/kg

**SAR(1 g) = 2.48 mW/g; SAR(10 g) = 1.64 mW/g**

Maximum value of SAR (measured) = 2.69 mW/g



0 dB = 2.69mW/g

## System Check\_Body\_835MHz\_121022

**DUT: D835V2-SN:499**

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

Medium: MSL\_850\_121022 Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.996 \text{ mho/m}$ ;  $\epsilon_r = 55.38$ ;  $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature : 22.5 °C ; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: ES3DV3 - SN3270; ConvF(6.16, 6.16, 6.16); Calibrated: 2012/9/28;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn495; Calibrated: 2012/4/23
- Phantom: SAM Right; Type: QD000P40CC; Serial: TP:1383
- Measurement SW: DASY52, Version 52.8 (3); SEMCAD X Version 14.6.7 (6848)

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

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

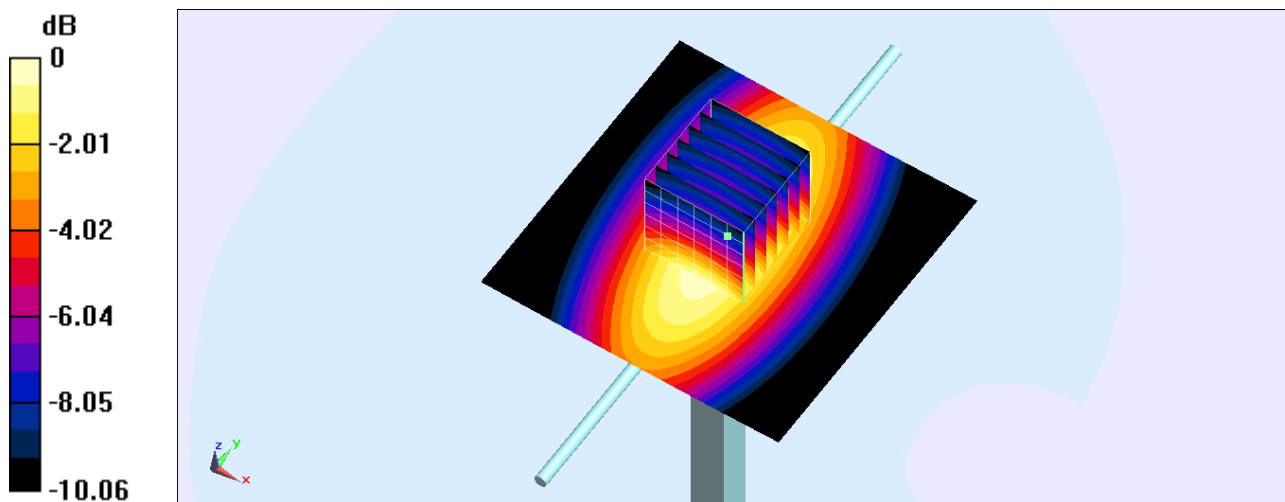
**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 52.937 V/m; Power Drift = -0.009 dB

Peak SAR (extrapolated) = 3.57 W/kg

**SAR(1 g) = 2.48 W/kg; SAR(10 g) = 1.64 W/kg**

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



0 dB = 2.69 W/kg

## System Check\_Body\_835MHz\_121022

**DUT: D835V2-SN:499**

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

Medium: MSL\_850\_121022 Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.994 \text{ mho/m}$ ;  $\epsilon_r = 55.34$ ;  $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature : 22.5 °C ; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: ES3DV3 - SN3270; ConvF(6.16, 6.16, 6.16); Calibrated: 2012/9/28;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2012/6/12
- Phantom: SAM Right; Type: QD000P40CC; Serial: TP:1383
- Measurement SW: DASY52, Version 52.8 (3); SEMCAD X Version 14.6.7 (6848)

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

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

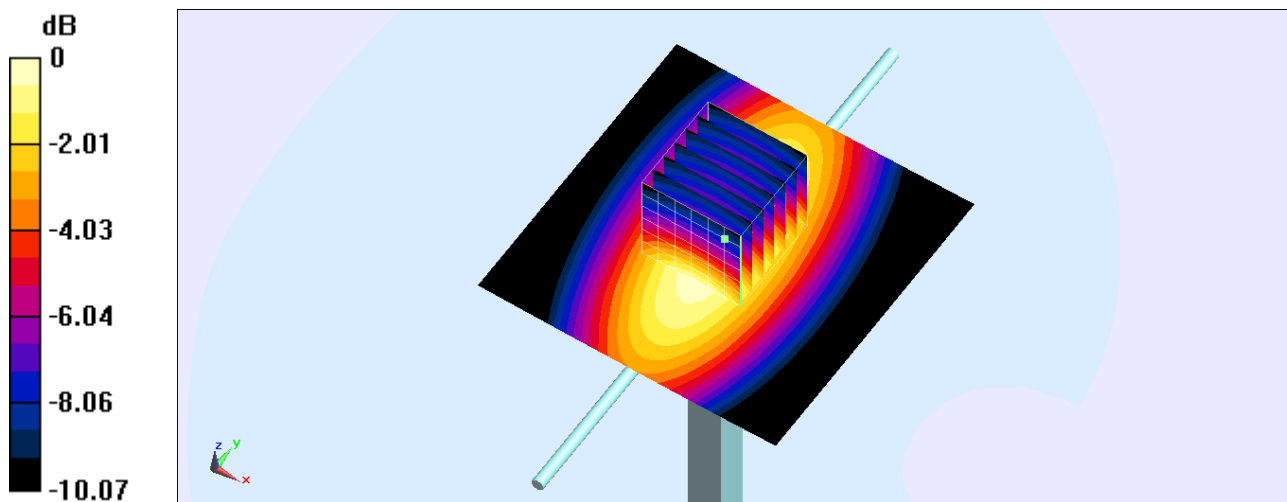
**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 52.883 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 3.57 W/kg

**SAR(1 g) = 2.47 W/kg; SAR(10 g) = 1.63 W/kg**

Maximum value of SAR (measured) = 2.68 W/kg



0 dB = 2.68 W/kg

## System Check\_Head\_1900MHz\_121021

**DUT: D1900V2-SN:5d041**

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

Medium: HSL\_1900\_121021 Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.45$  mho/m;  $\epsilon_r = 38.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.6°C; Liquid Temperature : 21.6 °C

DASY4 Configuration:

- Probe: ET3DV6 - SN1787; ConvF(5.06, 5.06, 5.06); Calibrated: 2012/5/29
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2012/6/6
- Phantom: SAM\_Left; Type: SAM; Serial: TP-1150
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

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

Maximum value of SAR (interpolated) = 10.9 mW/g

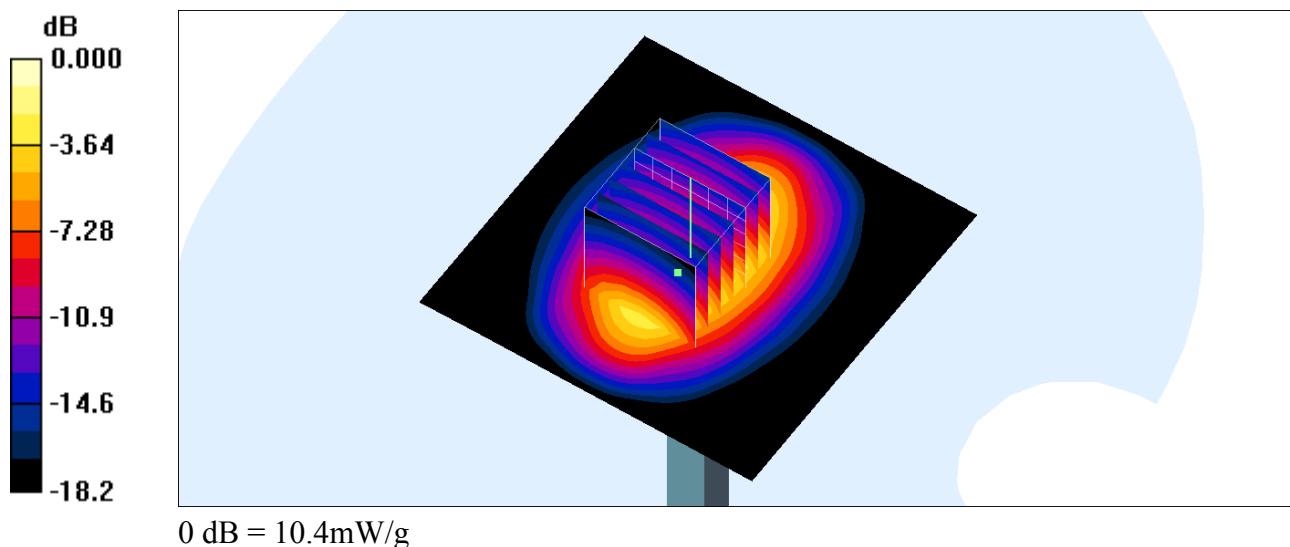
**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 90.5 V/m; Power Drift = -0.018 dB

Peak SAR (extrapolated) = 15.4 W/kg

**SAR(1 g) = 9.22 mW/g; SAR(10 g) = 4.92 mW/g**

Maximum value of SAR (measured) = 10.4 mW/g



**System Check\_Body\_1900MHz\_121021****DUT: D1900V2-SN:5d041**

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

Medium: MSL\_1900\_121021 Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.56$  mho/m;  $\epsilon_r = 52.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.4°C; Liquid Temperature : 21.4 °C

**DASY4 Configuration:**

- Probe: ET3DV6 - SN1787; ConvF(4.58, 4.58, 4.58); Calibrated: 2012/5/29
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2012/6/6
- Phantom: SAM\_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

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

Maximum value of SAR (interpolated) = 11.6 mW/g

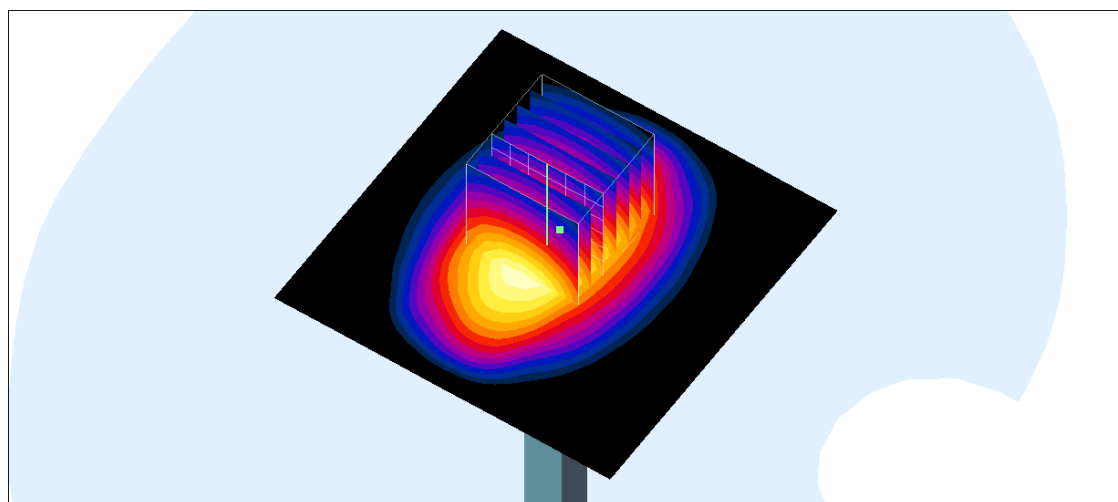
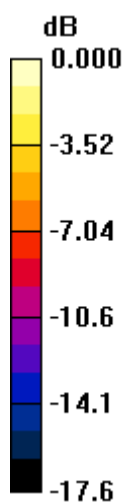
**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 88.9 V/m; Power Drift = 0.003 dB

Peak SAR (extrapolated) = 15.3 W/kg

**SAR(1 g) = 9.62 mW/g; SAR(10 g) = 5.18 mW/g**

Maximum value of SAR (measured) = 11.0 mW/g



0 dB = 11.0mW/g

## System Check\_Head\_2450MHz\_121018

**DUT: D2450V2-SN:736**

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

Medium: HSL\_2450\_121027 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.8$  mho/m;  $\epsilon_r = 37.4$ ;  $\rho$

$= 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.3 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: ES3DV3 - SN3270; ConvF(4.45, 4.45, 4.45); Calibrated: 2012/9/28;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2012/6/6
- Phantom: SAM-Right; Type: QD 000 P40 C; Serial: TP-1383
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6477)

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

Maximum value of SAR (interpolated) = 15.4 mW/g

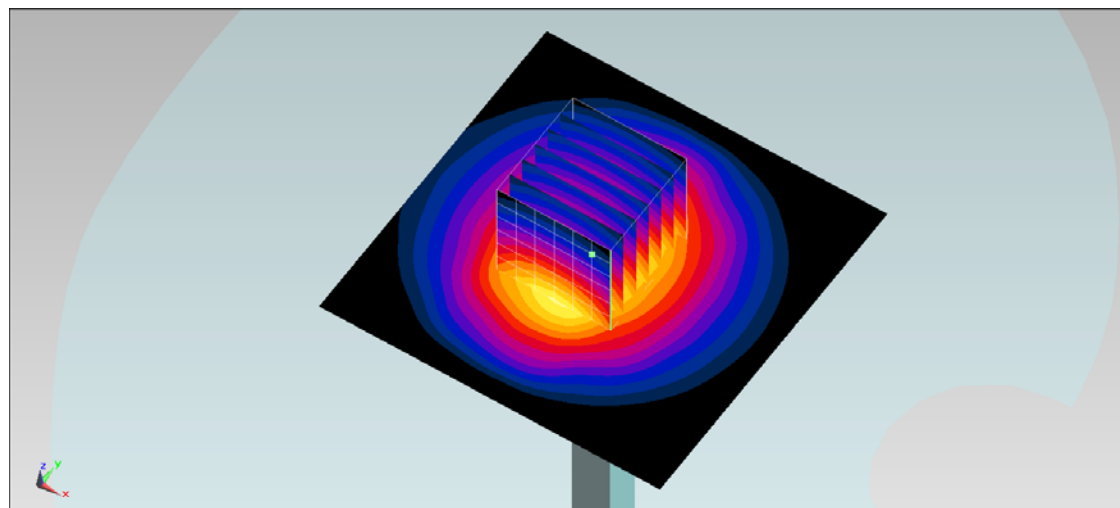
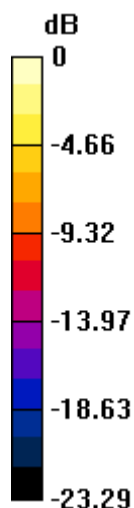
**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 90.649 V/m; Power Drift = 0.15 dB

Peak SAR (extrapolated) = 29.455 mW/g

**SAR(1 g) = 13.7 mW/g; SAR(10 g) = 70 ; mW/g**

Maximum value of SAR (measured) = 15.3 mW/g



0 dB = 15.3 mW/g = 23.69 dB mW/g

## System Check\_Body\_2450MHz\_121018

**DUT: D2450V2-SN:736**

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

Medium: MSL\_2450\_121027 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 51.69$ ;  $\rho =$

$1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.3 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3801; ConvF(6.59, 6.59, 6.59); Calibrated: 2012/6/22;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn495; Calibrated: 2012/4/23
- Phantom: SAM-Left; Type: QD 000 P40 C; Serial: TP-1477
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6477)

**Pin=250mW/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 15.0 mW/g

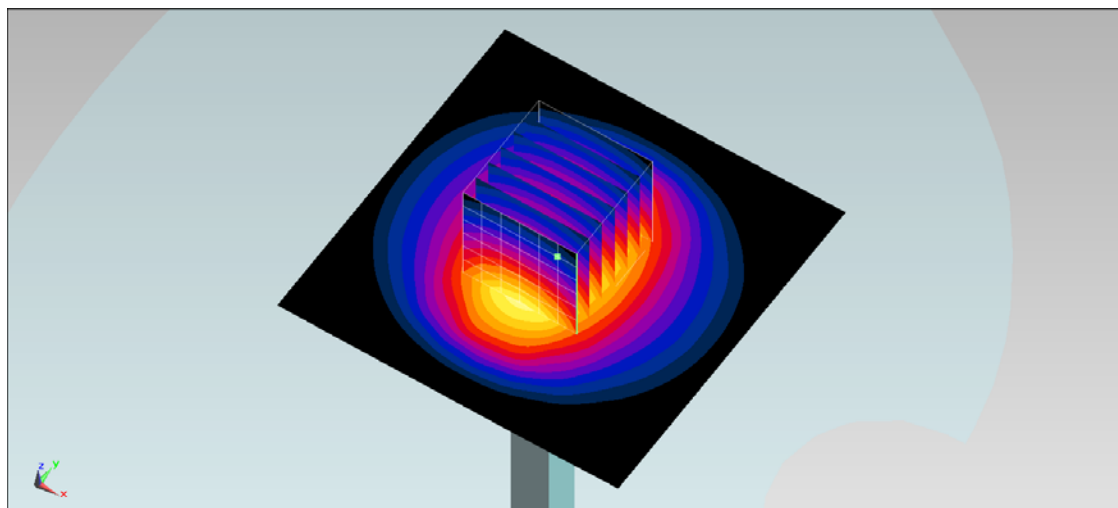
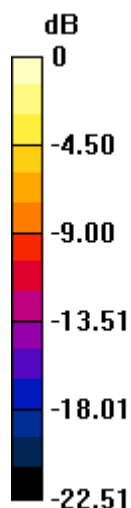
**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 84.786 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 27.197 mW/g

**SAR(1 g) = 12.8 mW/g; SAR(10 g) = 5.82 mW/g**

Maximum value of SAR (measured) = 14.6 mW/g



0 dB = 14.6 mW/g = 23.29 dB mW/g

## System Check\_Head\_5200MHz\_121021

### DUT: D5GHzV2-SN:1006

Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: HSL\_5G\_121021 Medium parameters used:  $f = 5200$  MHz;  $\sigma = 4.777$  mho/m;  $\epsilon_r = 35.313$ ;  $\rho =$

$1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.7 °C ; Liquid Temperature : 21.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(4.86, 4.86, 4.86); Calibrated: 2012/9/28;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2012/8/27
- Phantom: SAM RIGHT; Type: SAM; Serial: 1719
- Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

**Pin=250mW/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 33.5 mW/g

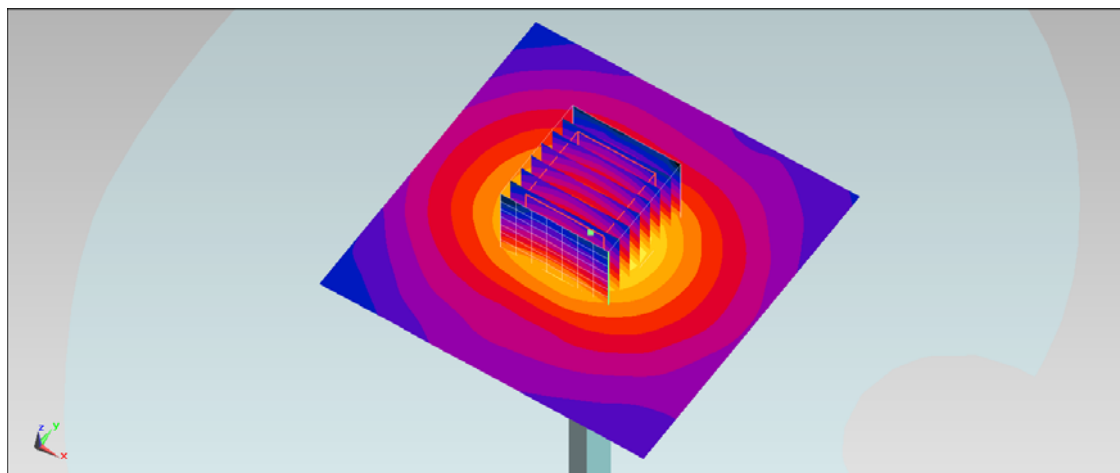
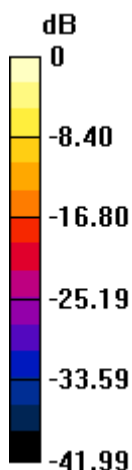
**Pin=250mW/Zoom Scan (8x8x8)/Cube 0:** Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm

Reference Value = 85.798 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 78.470 mW/g

**SAR(1 g) = 19.5 mW/g; SAR(10 g) = 5.46 mW/g**

Maximum value of SAR (measured) = 32.9 mW/g



0 dB = 32.9 mW/g = 30.34 dB mW/g

## System Check\_Head\_5200MHz\_121106

### DUT: D5GHzV2-SN:1006

Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: HSL\_5G\_121106 Medium parameters used:  $f = 5200$  MHz;  $\sigma = 4.813$  mho/m;  $\epsilon_r = 35.431$ ;  $\rho =$

$1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.9 °C ; Liquid Temperature : 21.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3792; ConvF(5.07, 5.07, 5.07); Calibrated: 2012/6/21;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn495; Calibrated: 2012/4/23
- Phantom: SAM-Right; Type: QD 000 P40 C; Serial: TP-1383
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6477)

**Pin=250mW/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 34.0 mW/g

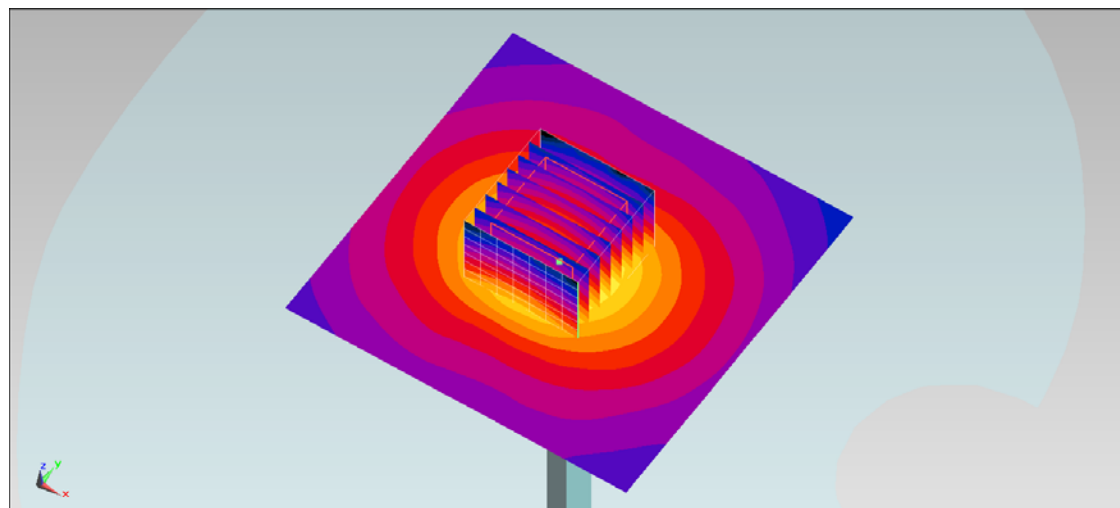
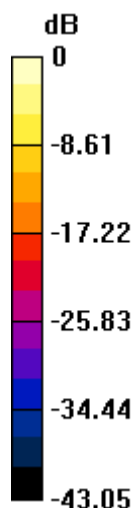
**Pin=250mW/Zoom Scan (8x8x8)/Cube 0:** Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm

Reference Value = 81.998 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 77.542 mW/g

**SAR(1 g) = 20.7 mW/g; SAR(10 g) = 5.79 mW/g**

Maximum value of SAR (measured) = 30.1 mW/g



0 dB = 30.1 mW/g = 29.57 dB mW/g

## System Check\_Body\_5200MHz\_121020

### DUT: D5GHzV2-SN:1006

Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: MSL\_5G\_121020 Medium parameters used:  $f = 5200$  MHz;  $\sigma = 5.257$  mho/m;  $\epsilon_r = 47.536$ ;  $\rho =$

$1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.5 °C ; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(4.29, 4.29, 4.29); Calibrated: 2012/9/28;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2012/8/27
- Phantom: SAM RIGHT; Type: SAM; Serial: 1719
- Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

**Pin=250mW/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 28.3 mW/g

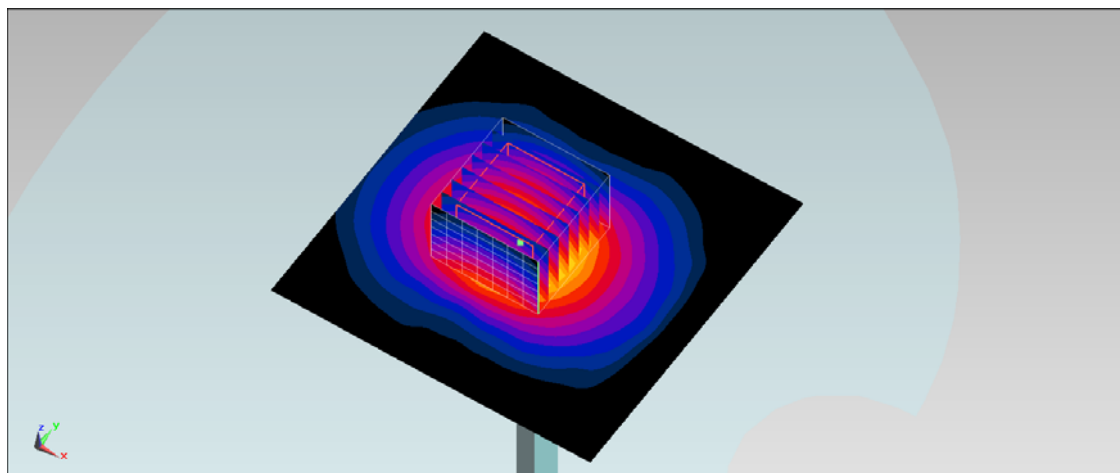
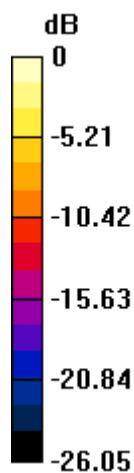
**Pin=250mW/Zoom Scan (8x8x8)/Cube 0:** Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm

Reference Value = 65.012 V/m; Power Drift = 0.132 dB

Peak SAR (extrapolated) = 43.235 mW/g

**SAR(1 g) = 16.7 mW/g; SAR(10 g) = 5.57 mW/g**

Maximum value of SAR (measured) = 25.0 mW/g



0 dB = 25.0 mW/g = 27.96 dB mW/g

## System Check\_Head\_5500MHz\_121021

### DUT: D5GHzV2-SN:1006

Communication System: CW; Frequency: 5500 MHz; Duty Cycle: 1:1

Medium: HSL\_5G\_121021 Medium parameters used:  $f = 5500$  MHz;  $\sigma = 5.087$  mho/m;  $\epsilon_r = 34.853$ ;  $\rho =$

$1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.7 °C ; Liquid Temperature : 21.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(4.6, 4.6, 4.6); Calibrated: 2012/9/28;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2012/8/27
- Phantom: SAM RIGHT; Type: SAM; Serial: 1719
- Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

**Pin=250mW/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 36.8 mW/g

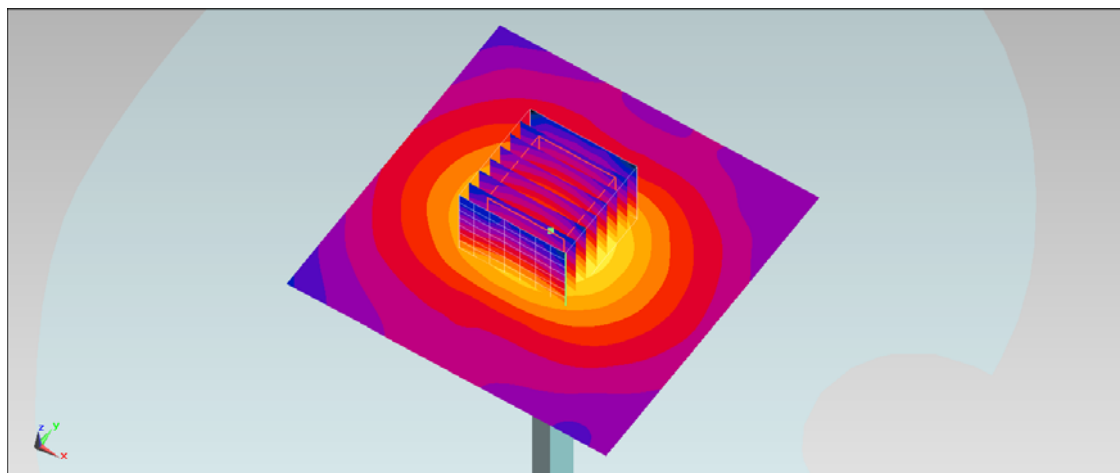
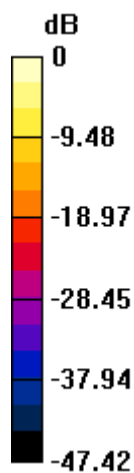
**Pin=250mW/Zoom Scan (8x8x8)/Cube 0:** Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm

Reference Value = 85.676 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 89.927 mW/g

**SAR(1 g) = 20.6 mW/g; SAR(10 g) = 5.68 mW/g**

Maximum value of SAR (measured) = 35.6 mW/g



0 dB = 35.6 mW/g = 31.03 dB mW/g

## System Check\_Body\_5500MHz\_121020

### DUT: D5GHzV2-SN:1006

Communication System: CW; Frequency: 5500 MHz; Duty Cycle: 1:1

Medium: MSL\_5G\_121020 Medium parameters used:  $f = 5500$  MHz;  $\sigma = 5.645$  mho/m;  $\epsilon_r = 47.008$ ;  $\rho =$

$1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.5 °C ; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(3.91, 3.91, 3.91); Calibrated: 2012/9/28;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2012/8/27
- Phantom: SAM RIGHT; Type: SAM; Serial: 1719
- Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

**Pin=250mW/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 30.0 mW/g

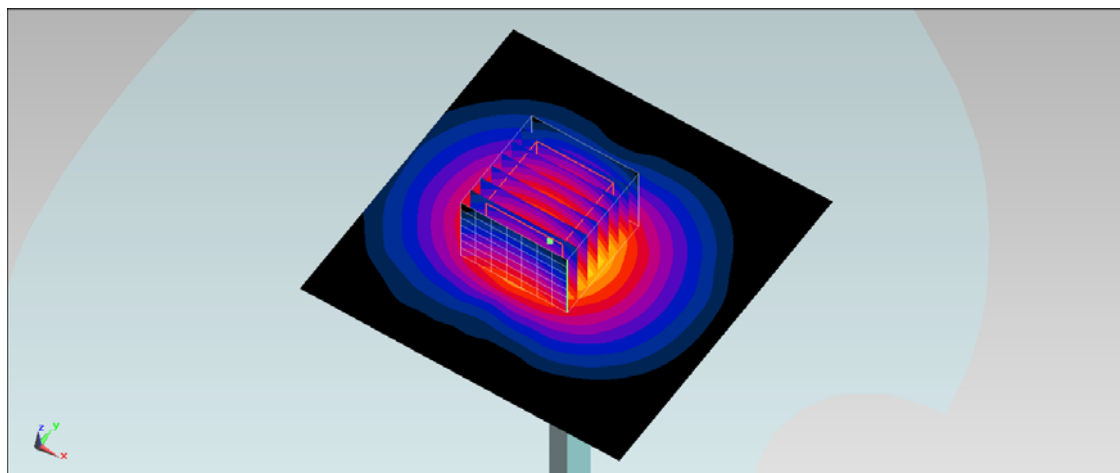
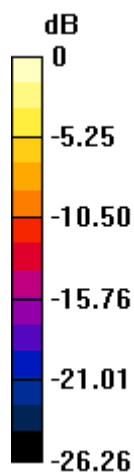
**Pin=250mW/Zoom Scan (8x8x8)/Cube 0:** Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm

Reference Value = 70.785 V/m; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 49.482 mW/g

**SAR(1 g) = 18.5 mW/g; SAR(10 g) = 6.17 mW/g**

Maximum value of SAR (measured) = 27.9 mW/g



0 dB = 27.9 mW/g = 28.91 dB mW/g

## System Check\_Head\_5800MHz\_121021

### DUT: D5GHzV2-SN:1006

Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: HSL\_5G\_121021 Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.368$  mho/m;  $\epsilon_r = 34.272$ ;  $\rho =$

$1000$  kg/m<sup>3</sup>

Ambient Temperature :  $22.7$  °C ; Liquid Temperature :  $21.7$  °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(4.28, 4.28, 4.28); Calibrated: 2012/9/28;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2012/8/27
- Phantom: SAM RIGHT; Type: SAM; Serial: 1719
- Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

**Pin=250mW/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 35.4 mW/g

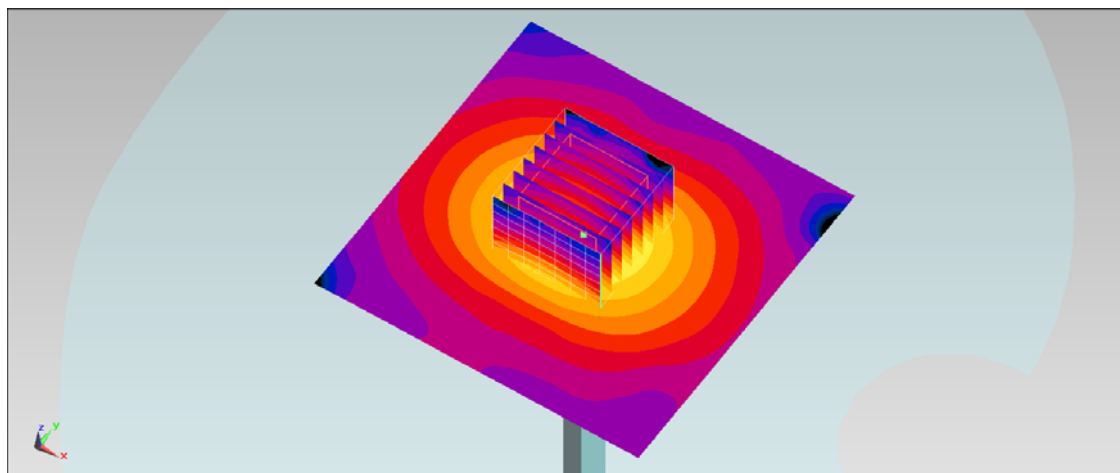
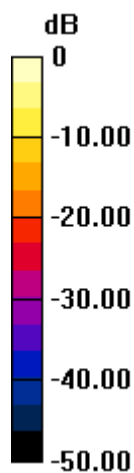
**Pin=250mW/Zoom Scan (8x8x8)/Cube 0:** Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm

Reference Value = 86.467 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 83.297 mW/g

**SAR(1 g) = 19.7 mW/g; SAR(10 g) = 5.47 mW/g**

Maximum value of SAR (measured) = 34.7 mW/g



0 dB = 34.7 mW/g = 30.81 dB mW/g

## System Check\_Body\_5800MHz\_121020

### DUT: D5GHzV2-SN:1006

Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: MSL\_5G\_121020 Medium parameters used:  $f = 5800$  MHz;  $\sigma = 6.144$  mho/m;  $\epsilon_r = 46.492$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.5 °C ; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(4.06, 4.06, 4.06); Calibrated: 2012/9/28;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2012/8/27
- Phantom: SAM RIGHT; Type: SAM; Serial: 1719
- Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

**Pin=250mW/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 28.3 mW/g

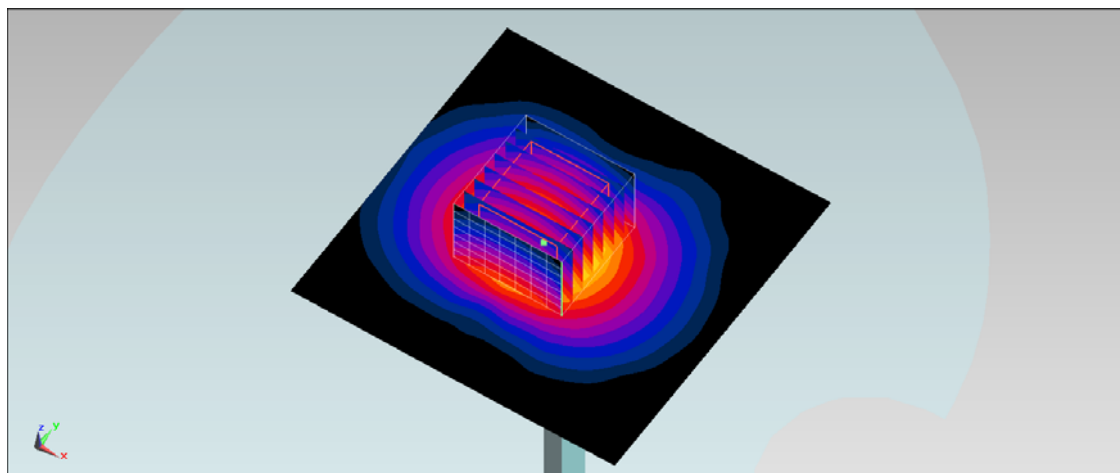
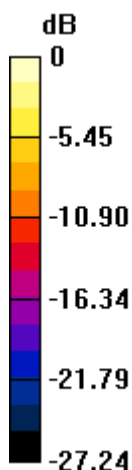
**Pin=250mW/Zoom Scan (8x8x8)/Cube 0:** Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm

Reference Value = 66.219 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 42.374 mW/g

**SAR(1 g) = 17 mW/g; SAR(10 g) = 5.59 mW/g**

Maximum value of SAR (measured) = 25.9 mW/g



0 dB = 25.9 mW/g = 28.27 dB mW/g



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

The plots are shown as follows.



## **Appendix C. DASYS Calibration Certificate**

The DASYS calibration certificates are shown as follows.