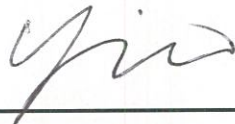


SAR TEST REPORT

HCT CO., LTD

EUT Type:	Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC		
FCC ID:	ZNFLGL24		
Model:	LGL24		
Date of Issue:	Jun. 09, 2014		
Test report No.:	HCT-A-1405-F010-1		
Test Laboratory:	HCT CO., LTD. 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea TEL: +82 31 645 6300 FAX: +82 31 645 6401		
Applicant :	LG Electronics, MobileComm U.S.A., Inc. 1000 Sylvan Avenue, Englewood Cliffs NJ 07632		
Testing has been carried out in accordance with:	RSS-102 Issue 4; Health Canada Safety Code 6 47CFR §2.1093 ANSI/ IEEE C95.1 – 1992 IEEE 1528-2003		
Test result:	The tested device complies with the requirements in respect of all parameters subject to the test. The test results and statements relate only to the items tested. The test report shall not be reproduced except in full, without written approval of the laboratory.		
Signature	 Report prepared by : Yun-Jeang Hur Test Engineer of SAR Part  Approved by : Dong-Seob Kim Manager of SAR Part		

Revision History

Rev.	Issue DATE	DESCRIPTION
HCT-A-1405-F010	May. 30, 2014	Initial Issue
HCT-A-1405-F010-1	Jun. 09, 2014	Sec. 3 was revised (typo) Sec. 12.2 was revised (revised antenna and device information) Attachment 3 was revised (add 3863 Probe calibration data) Attachmnet 4 was revised (add the 5 GHz dipole calibration data)

Table of Contents

1. INTRODUCTION	4
2. TEST METHODOLOGY	5
3. DESCRIPTION OF DEVICE.....	6
4. DESCRIPTION OF TEST EQUIPMENT	8
6. DESCRIPTION OF TEST POSITION.....	1 8
7. MEASUREMENT UNCERTAINTY	2 0
8. ANSI/ IEEE C95.1 - 1992 RF EXPOSURE LIMITS	2 2
9. SAR SYSTEM VALIDATION	2 3
10. SYSTEM VERIFICATION.....	2 4
11. RF CONDUCTED POWER MEASUREMENT	2 7
11.5 Test Exclusions Applied.....	3 6
12. SAR Test configuration & Antenna Information	4 2
13. SAR TEST DATA SUMMARY	4 3
13.1-1 Measurement Results (GSM850 Head SAR)	4 3
13.1-2 Measurement Results (GSM1900 Head SAR)	4 3
13.1-3 Measurement Results (WCDMA850 Head SAR).....	4 4
13.1-4 Measurement Results (LTE Band 17 10MHz Head SAR)	4 4
13.1-5 Measurement Results (DTS Head SAR)	4 5
13.1-6 Measurement Results (NII Head SAR)	4 6
13.2-1 Measurement Results (GSM850 Hotspot SAR).....	4 7
13. 2-2 Measurement Results (GSM1900 Hotspot SAR).....	4 7
13. 2-3 Measurement Results (WCDMA850 Hotspot SAR).....	4 7
13.2-4 Measurement Results (LTE Band 17 10MHz Hotspot SAR)	4 8
13. 2-5 Measurement Results (WLAN Hotspot SAR)	4 8
13.3-1 Measurement Results (WLAN Body-worn SAR).....	4 9
13.3-2 Measurement Results (NII Body-worn SAR).....	4 9
13.3-3 Measurement Results (Body-worn SAR)	5 0
13.4 SAR Test Notes	5 1
14. SAR Measurement Variability and Uncertainty	5 3
15. SAR Summation Scenario	5 4
16. CONCLUSION.....	6 0
17. REFERENCES	6 1
Attachment 1. – SAR Test Plots	6 2
Attachment 2. – Dipole Verification Plots.....	8 1
Attachment 3. – Probe Calibration Data.....	1 0 0
Attachment 4. – Dipole Calibration Data	1 1 2

1. INTRODUCTION

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices.

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. The measurement procedure described in IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring SAR due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86 NCRP, 1986, Bethesda, MD 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative of the incremental electromagnetic energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body.

$$SAR = \frac{d}{dt} \left(\frac{dU}{dm} \right) = \frac{d}{dt} \left(\frac{dU}{\rho dV} \right)$$

Figure 1. SAR Mathematical Equation

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

$$SAR = \sigma E^2 / \rho$$

Where:

σ = conductivity of the tissue-simulant material (S/m)

ρ = mass density of the tissue-simulant material (kg/m³)

E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC KDB Procedure, IEEE Standard 1528-2003 & IEEE 1528a-2005 and the following published KDB procedures.

- FCC KDB Publication 941225 D01 SAR test for 3G devices v02
- FCC KDB Publication 941225 D02 HSPA and 1x Advanced v02r02
- FCC KDB Publication 941225 D03 SAR Test Reduction GSM GPRS EDGE v01
- FCC KDB Publication 941225 D05 SAR for LTE Devices v02r03
- FCC KDB Publication 941225 D06 Hot Spot SAR v01r01
- FCC KDB Publication 248227 D01v01r02(SAR Considerationa for 802.11 Devices)
- FCC KDB Publication 447498 D01v05r02 (General SAR Guidance)
- FCC KDB Publication 648474 D04 Handset SAR v01r02
- FCC KDB Publication 865664 D01 SAR measurement 100 MHz to 6 GHz v01r03
- FCC KDB Publication 865664 D02 SAR Reporting v01r01
- April 2013 TCB Workshop Notes (IEEE 802.11ac)
- October 2013 TCB Workshop Notes (GPRS testing criteria)

3. DESCRIPTION OF DEVICE

Environmental evaluation measurements of specific absorption rate (SAR) distributions in emulated human head and body tissues exposed to radio frequency (RF) radiation from wireless portable devices for compliance with the rules and regulations of the U.S. Federal Communications Commission (FCC).

EUT Type	Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC					
FCC ID:	ZNFLGL24					
Model:	LGL24					
Trade Name	LG Electronics, MobileComm U.S.A., Inc.					
Application Type	Certification					
Mode(s) of Operation	GSM850 / GSM1900 / WCDMA850 / LTE17 / 802.11b/g/n/a					
Production Unit or Identical Prototype	Prototype					
Max. SAR	Band	Tx Frequency (MHz)	Equipment Class	Reported 1g SAR (W/Kg)		
				Head	Body-worn	Hotspot
	GSM/GPRS/EDGE 850	824.2 - 848.8	PCE	0.29	0.52	0.52
	GSM/GPRS/EDGE1900	1 850.2 - 1 909.8	PCE	0.17	0.41	0.41
	WCDMA 850	826.4 - 846.6	PCE	0.24	0.40	0.40
	LTE 17	706.5 ~ 713.5	PCE	0.11	0.28	0.28
	802.11b	2 412.0 - 2 462.0	DTS	0.10	0.17	0.17
	802.11a	5 745 - 5 825	DTS	0.09	0.18	0.18
	802.11a	5 180 - 5 240	UNII	0.05	0.18	-
	802.11a	5 260 - 5 320	UNII	0.05	0.09	-
	802.11a	5 500 - 5 700	UNII	0.05	0.10	-
	Bluetooth	2 402 - 2 480	DSS/DTS	-	0.12*	-
Simultaneous SAR per KDB 690783 D01v01r03				0.39	0.69	0.69
Date(s) of Tests	May. 19, 2014 ~ May. 25, 2014					
Antenna Type	Integral Antenna					
GPRS / EDGE	Multislot Class: 12, Mode Class B					
Key Feature(s)	This device supports Mobile Hotspot.					

* BT Body-worn SAR value is estimate SAR value that should not be reported standalone SAR on grants of equipment approval.

* All test performed with the battery cover already incorporate the NFC antenna and Wireless charging capability.

3.1 KDB 941225 LTE information

Item.	Description				
Frequency Range:	Band 17: 706.5 MHz ~ 713.5 MHz				
	Band 17: 5 MHz, 10 MHz				
Channel Number & Frequency:					
	Band 17				
	5 MHz		10 MHz		
	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	
	23755	706.5	23780	709	
	23790	710	23790	710	
	23825	713.5	23800	711	
UE Category & Uplink Modulation	UE Category 3 QPSK, 16QAM				
Description of the LTE Transmitter & antenna	This model have 3 Tx antennas. -, One is for GSM and WCDMA and LTE. It can not transmit simultaneously. - The other is for BT & WLAN. It can not transmit simultaneously. Please find the section 12				
LTE voice/data requirements	Data Only, LTE voice is available via VoIP. Considering the users may install 3rd party software to enable VoIP, LTE Head SAR is also evaluated.				
Identify if MPR is optional or mandatory optional or mandatory	The EUT incorporates MPR as per 3GPP TS36.101. The MPR is permanently built-in by design as a mandatory. A-MPR is not implemented in the EUT.				
Maximum average conducted output power(dBm) Identify all other U.S. wireless operating modes, device exposure configurations and frequency bands	See section 11.4 RF output power measurements in the SAR report. GSM850/1900, WCDMA850 LTE Band 17 : Head & Body SAR are required.				
Maximum average conducted output power for other wireless mode and frequency	See section 11 RF output power measurements in the SAR report.				
Simultaneous Transmission condition	This device supports simultaneous transmission. Please find the section 15.				
Power reduction explanation	This device doesn't implements power reduction.				
Description of the test equipment, software, etc.	LTE SAR Testing was performed using a CMW500. UE transmits with maximum output power during SAR testing.				

4. DESCRIPTION OF TEST EQUIPMENT

4.1 SAR MEASUREMENT SETUP

These measurements are performed using the DASY4 automated dosimetric assessment system. It is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland. It consists of high precision robotics system (Staubli), robot controller, Pentium III computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Figure.2).

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The PC consists of the HP Pentium IV 3.0 GHz computer with Windows XP system and SAR Measurement Software DASY4, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

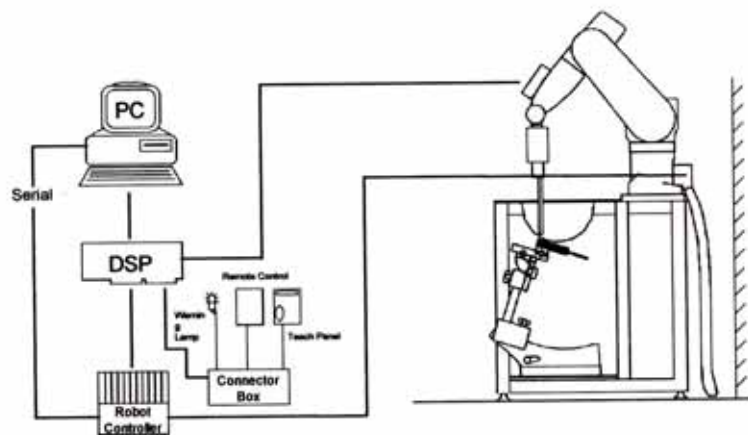


Figure 2. HCT SAR Lab. Test Measurement Set-up

The DAE4 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 PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in.

4.2 DASY E-FIELD PROBE SYSTEM

4.1 ET3DV6 Probe Specification

Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection System Built-in shielding against static charges
Calibration	In air from 10 MHz to 2.5 GHz In brain and muscle simulating tissue at Frequencies of 450 MHz, 900 MHz and 1.8 GHz (accuracy: 8 %)
Frequency	10 MHz to > 3 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)
Directivity	± 0.2 dB in brain tissue (rotation around probe axis) ± 0.4 dB in brain tissue (rotation normal probe axis)
Dynamic	5 μ W/g to > 100 mW/g;
Range Linearity:	± 0.2 dB
Surface Detection	± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces.
Dimensions	Overall length: 330 mm Tip length: 16 mm Body diameter: 12 mm Tip diameter: 6.8 mm Distance from probe tip to dipole centers: 2.7 mm
Application	General dissymmetry up to 3 GHz Compliance tests of WCDMA/LTE Phones Fast automatic scanning in arbitrary phantoms



Figure 3. Photograph of the probe and the Phantom

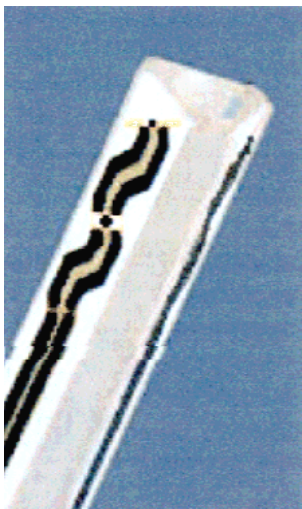


Figure 4. ET3DV6 E-field Probe

The SAR measurements were conducted with the dosimetric probe ET3DV6, designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multifiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches a maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped at reaching the maximum.

4.2.1 EX3DV4 Probe Specification

Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	Basic Broad Band Calibration in air Conversion Factors (CF) for HSL 900 and HSL 1810 Additional CF for other liquids and frequencies upon request
Frequency	10 MHz to 4 GHz; Linearity: ± 0.2 dB (30 MHz to 4 GHz)
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)
Dynamic Range	5 μ W/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm
Application	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones



Figure 5. Photograph of the probe and the Phantom



Figure 6. EX3DV4 E-field Probe

The SAR measurements were conducted with the dosimetric probe EX3DV4, designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multifiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches a maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped at reaching the maximum.

4.3 PROBE CALIBRATION PROCESS

4.3.1 E-Probe Calibration

Each probe is calibrated according to a dosimetric assessment procedure with an accuracy better than $\pm 10\%$. The spherical isotropy was evaluated with the proper procedure and found to be better than ± 0.25 dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe is tested.

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz, and in a waveguide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$SAR = C \frac{\Delta T}{\Delta t}$$

where:

Δt = exposure time (30 seconds),

C = heat capacity of tissue (brain or muscle),

ΔT = temperature increase due to RF exposure.

SAR is proportional to $\Delta T/\Delta t$, the initial rate of tissue heating, before thermal diffusion takes place.

Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E-field;

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

where:

σ = simulated tissue conductivity,

ρ = Tissue density (1.25 g/cm^3 for brain tissue)

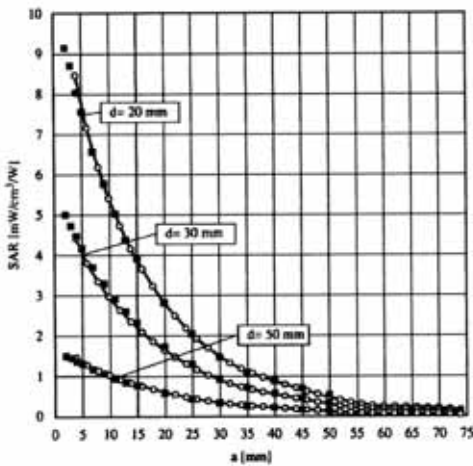


Figure 7. E-Field and Temperature measurements at 900 MHz

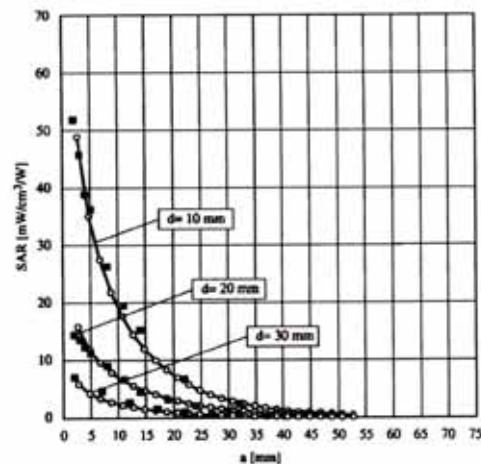


Figure 8. E-Field and temperature measurements at 1.8 GHz

4.3.2 Data Extrapolation

The DASY4 software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. 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 like below;

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i} \quad \text{with} \quad \begin{array}{ll} V_i & = \text{compensated signal of channel } i \quad (i=x,y,z) \\ U_i & = \text{input signal of channel } i \quad (i=x,y,z) \\ cf & = \text{crest factor of exciting field} \quad (\text{DASY parameter}) \\ dcp_i & = \text{diode compression poing} \quad (\text{DASY parameter}) \end{array}$$

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

E-field probes: with

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$\begin{array}{ll} V_i & = \text{compensated signal of channel } i \quad (i=x,y,z) \\ Norm_i & = \text{sensor sensitivity of channel } i \quad (i=x,y,z) \\ & \quad \mu V/(V/m)^2 \text{ for E-field probes} \\ ConvF & = \text{sensitivity of enhancement in solution} \\ E_i & = \text{electric field strength of channel } i \text{ in V/m} \end{array}$$

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

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

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

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000} \quad \text{with} \quad \begin{array}{ll} SAR & = \text{local specific absorption rate in W/g} \\ E_{tot} & = \text{total field strength in V/m} \\ \sigma & = \text{conductivity in [mho/m] or [Siemens/m]} \\ \rho & = \text{equivalent tissue density in g/cm}^3 \end{array}$$

The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770} \quad \text{with} \quad \begin{array}{ll} P_{pwe} & = \text{equivalent power density of a plane wave in w/cm}^2 \\ E_{tot} & = \text{total electric field strength in V/m} \end{array}$$

4.4 SAM Phantom

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.



Figure 9. SAM Phantom

Shell Thickness	2.0 mm $\pm$ 0.2 mm (6 $\pm$ 0.2 mm at ear point)
Filling Volume	about 25 L
Dimensions	810 mm x 1 000 mm x 500 mm (H x L x W)

Triple Modular Phantom consists of three identical modules which can be installed and removed separately without emptying the liquid. It includes three reference points for phantom installation. Covers prevent evaporation of the liquid. Phantom material is resistant to DGBE based tissue simulating liquids. The MFP V5.1 will be delivered including wooden support only (**non**-standard SPEAG support).

Applicable for system performance check from 700 MHz to 6 GHz (MFP V5.1C) or 800 MHz - 6 GHz (MFP V5.1A) as well as dosimetric evaluations for body-worn operation.

Shell Thickness	2.0 mm $\pm$ 0.2 mm
Filling Volume	approx. 9.2 L
Dimensions	830 mm x 500 mm (L x W)



Figure 10. MFP V5.1 Triple Modular Phantom

4.5 Device Holder for Transmitters

In combination with the SAM Phantom V 4.0, the Mounting Device (POM) enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatably positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produced infinite number of configurations. To produce the Worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.



Figure 11. Device Holder

4.6 Tissue Simulating Mixture Characterization

The mixture is characterized to obtain proper dielectric constant (permittivity) and conductivity of the tissue of interest. The tissue dielectric parameters recommended in IEEE 1528 and IEC 62209 have been used as targets for the compositions, and are to match within 5%, per the FCC recommendations

Ingredients (% by weight)	Frequency (MHz)							
	835		1 900		2 450 ~ 2 700		5 200 - 5 800	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body
Water	40.45	53.06	54.9	70.17	71.88	73.2	65.52	78.66
Salt (NaCl)	1.45	0.94	0.18	0.39	0.16	0.1	0.0	0.0
Sugar	57.0	44.9	0.0	0	0.0	0.0	0.0	0.0
HEC	1.0	1.0	0.0	0	0.0	0.0	0.0	0.0
Bactericide	0.1	0.1	0.0	0	0.0	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	19.97	0.0	17.24	10.67
DGBE	0.0	0.0	44.92	29.44	7.99	26.7	0.0	0.0
Diethylene glycol hexyl ether	-	-	-	-	-	-	17.24	10.67

Salt:	99 % Pure Sodium Chloride	Sugar:	98 % Pure Sucrose
Water:	De-ionized, 16M resistivity	HEC:	Hydroxyethyl Cellulose
DGBE:	99 % Di(ethylene glycol) butyl ether,[2-(2-butoxyethoxy) ethanol]		
Triton X-100(ultra pure):	Polyethylene glycol mono[4-(1,1,3,3-tetramethylbutyl)phenyl] ether		

Table 4.1 Composition of the Tissue Equivalent Matter

4.7 SAR TEST EQUIPMENT

Manufacturer	Type / Model	S/N	Calib. Date	Calib.Interval	Calib.Due
SPEAG	SAM Phantom	-	N/A	N/A	N/A
SPEAG	Triple Modular Phantom	-	N/A	N/A	N/A
Staubli	Robot RX90B L	F01/5K09A1/A/01	N/A	N/A	N/A
Staubli	Robot ControllerCS7MB	3403-91935	N/A	N/A	N/A
HP	Pavilion t000_puffer	KRJ51201TV	N/A	N/A	N/A
SPEAG	Light Alignment Sensor	265	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	D221340.01	N/A	N/A	N/A
SPEAG	DAE4	652	Mar.26, 2014	Annual	Mar.26, 2015
SPEAG	DAE4	1417	Jan.03, 2014	Annual	Jan.03, 2015
SPEAG	E-Field Probe EX3DV4	3797	Nov.29, 2013	Annual	Nov.29, 2014
SPEAG	E-Field Probe EX3DV4	3863	Jul.31, 2013	Annual	Jul.31, 2014
SPEAG	Dipole D750V3	1014	Jul. 30, 2013	Annual	Jul. 30, 2014
SPEAG	Dipole D835V2	4d165	Jan.07, 2014	Annual	Jan.07, 2015
SPEAG	Dipole D1900V2	5d032	Jul. 29, 2013	Annual	Jul. 29, 2014
SPEAG	Dipole D2450V2	743	Aug.23, 2013	Annual	Aug.23, 2014
SPEAG	Dipole D5000V2	1107	Jan.27, 2014	Annual	Jan.27, 2015
Agilent	Power Meter(F) E4419B	MY41291386	Nov. 01, 2013	Annual	Nov. 01, 2014
Agilent	Power Sensor(G) 8481	MY41090680	Oct. 30, 2013	Annual	Oct. 30, 2014
Agilent	Dielectric Probe Kit 85070C	00721521	CBT		
HP	Dual Directional Coupler 778D	16072	Oct. 31, 2013	Annual	Oct. 31, 2014
Agilent	Base Station E5515C	GB44400269	Feb. 10, 2014	Annual	Feb. 10, 2015
HP	Signal Generator 8664A	3744A02069	Nov. 04, 2013	Annual	Nov. 04, 2014
Hewlett Packard	11636B/Power Divider	11377	Nov. 10, 2013	Annual	Nov. 11, 2014
Agilent	N9020A/ SIGNAL ANALYZER	MY51110085	Jul. 18, 2013	Annual	Jul. 18, 2014
TESCOM	TC-3000C / BLUETOOTH TESTER	3000C000276	Apr. 11, 2014	Annual	Apr. 11, 2015
HP	Network Analyzer 8753ES	JP39240221	Mar. 21, 2014	Annual	Mar. 21, 2015
R&S	Base Station CMW500	1201.0002K50_116858	Jan. 17, 2014	Annual	Jan. 17, 2015

NOTE:

- The E-field probe was calibrated by SPEAG, by the waveguide technique procedure. Dipole Verification measurement is performed by HCT Lab. before each test. The brain/body simulating material is calibrated by HCT using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain/body-equivalent material.
- CBT(Calibrating Before Testing). Prior to testing, the dielectric probe kit was calibrated via the network analyzer, with the specified procedure(calibrated in pure water) and calibration kit(standard) short circuit, before the dielectric measurement. The specific procedure and calibration kit are provided by Agilent

5. SAR MEASUREMENT PROCEDURE

The evaluation was performed with the following procedure:

1. The SAR value at a fixed location above the ear point was measured and was used as a reference value for assessing the power drop.
2. The SAR distribution at the exposed side of the head was measured at a distance of 3.9 mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 15 mm x 15 mm. Based on this data, the area of the maximum absorption was determined by spline interpolation.
3. Around this point, a volume of 32 mm x 32 mm x 30 mm was assessed by measuring 5 x 5 x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure:
 - a. The data at the surface were extrapolated, since the center of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2 mm. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.
 - b. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g or 10 g) were computed using the 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions. The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.
 - c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR value, at the same location as procedure #1, was re-measured. If the value changed by more than 5 %, the evaluation is repeated.

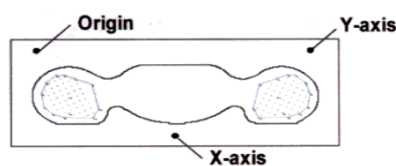


Figure 12. SAR Measurement Point in Area Scan

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 extend, 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 is performed around the highest E-field value to determine the averaged SASR-distribution over 10g. Area scan and zoom scan resolution setting follow KDB 865664 D01v01r03 quoted below.

			≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5 ± 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location			$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
Maximum area scan spatial resolution: Δx_{Area} , Δy_{Area}			≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
			When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	
Maximum zoom scan spatial resolution: Δx_{Zoom} , Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.				
* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

6. DESCRIPTION OF TEST POSITION

6.1 HEAD POSITION

The device was placed in a normal operating position with the Point A on the device, as illustrated in following drawing, aligned with the location of the RE(ERP) on the phantom. With the ear-piece pressed against the head, the vertical center line of the body of the handset was aligned with an imaginary plane consisting of the RE, LE and M. While maintaining these alignments, the body of the handset was gradually moved towards the cheek until any point on the mouth-piece or keypad contacted the cheek. This is a cheek/touch position. For ear/tilt position, while maintain the device aligned with the BM and FN lines, the device was pivot against ERP back for 15° or until the device antenna touch the phantom. Please refer to IEEE 1528-2003 illustration below.

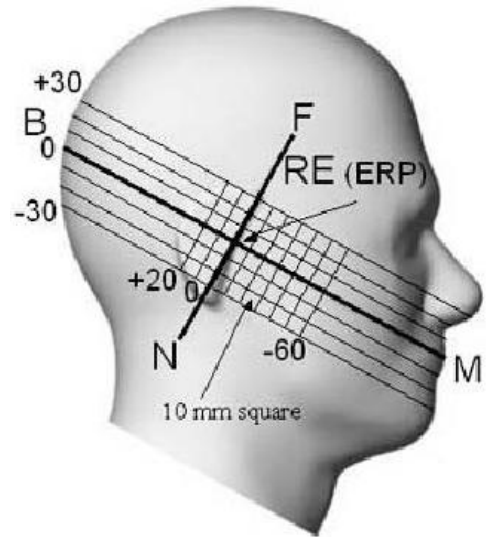


Figure 13. Side view of the phantom

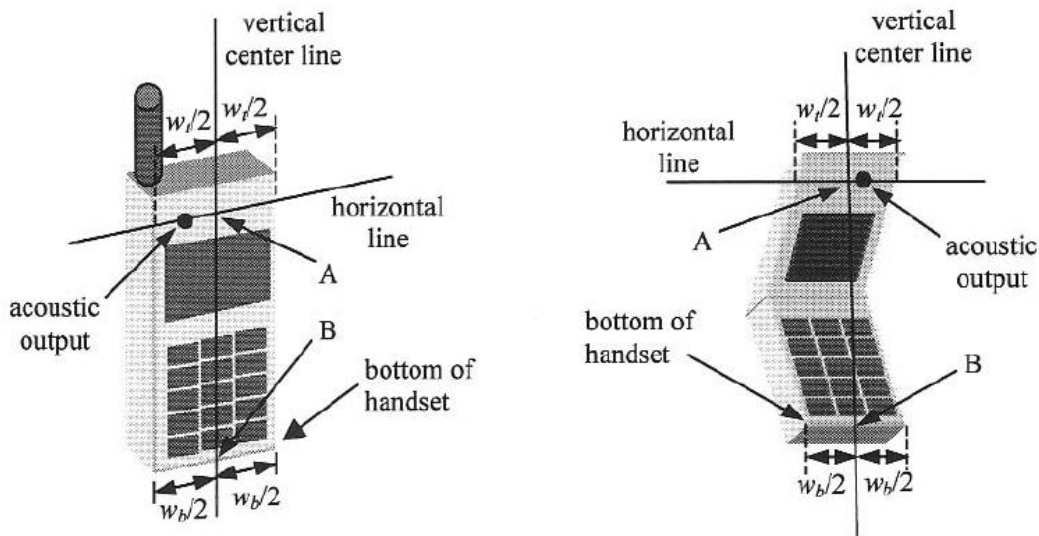


Figure 14. Handset vertical and horizontal reference lines

6.2 Body Holster/Belt Clip Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration. A device with a headset output is tested with a headset connected to the device. Body dielectric parameters are used.

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

Body-worn accessories may not always be supplied or available as options for some Devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used.

Since this EUT does not supply any body worn accessory to the end user a distance of 1.0 cm from the EUT back surface to the liquid interface is configured for the generic test.

"See the Test SET-UP Photo"

Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessory(ies), Including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

In all cases SAR measurements are performed to investigate the worst-case positioning. Worstcase positioning is then documented and used to perform Body SAR testing.

7. MEASUREMENT UNCERTAINTY

Error Description	Tol (± %)	Prob. dist.	Div.	C _i	Standard Uncertainty (± %)	V _{eff}
1. Measurement System						
Probe Calibration	6.00	N	1	1	6.00	∞
Axial Isotropy	4.70	R	1.73	0.7	1.90	∞
Hemispherical Isotropy	9.60	R	1.73	0.7	3.88	∞
Boundary Effects	1.00	R	1.73	1	0.58	∞
Linearity	4.70	R	1.73	1	2.71	∞
System Detection Limits	1.00	R	1.73	1	0.58	∞
Readout Electronics	0.30	N	1.00	1	0.30	∞
Response Time	0.8	R	1.73	1	0.46	∞
Integration Time	2.6	R	1.73	1	1.50	∞
RF Ambient Conditions	3.00	R	1.73	1	1.73	∞
Probe Positioner	0.40	R	1.73	1	0.23	∞
Probe Positioning	2.90	R	1.73	1	1.67	∞
Max SAR Eval	1.00	R	1.73	1	0.58	∞
2. Test Sample Related						
Device Positioning	2.90	N	1.00	1	2.90	145
Device Holder	3.60	N	1.00	1	3.60	5
Power Drift	5.00	R	1.73	1	2.89	∞
3. Phantom and Setup						
Phantom Uncertainty	4.00	R	1.73	1	2.31	∞
Liquid Conductivity(target)	5.00	R	1.73	0.64	1.85	∞
Liquid Conductivity(meas.)	2.07	N	1	0.64	1.32	9
Liquid Permittivity(target)	5.00	R	1.73	0.6	1.73	∞
Liquid Permittivity(meas.)	5.02	N	1	0.6	3.01	9
Combine Standard Uncertainty					11.13	
Coverage Factor for 95 %					k=2	
Expanded STD Uncertainty					22.25	

Table 7.1 Uncertainty (800 MHz- 2 600 MHz)

Error Description	Tol (± %)	Prob. dist.	Div.	C _i	Standard Uncertainty (± %)	V _{eff}
1. Measurement System						
Probe Calibration	6.55	N	1	1	6.55	∞
Axial Isotropy	4.70	R	1.73	0.7	1.90	∞
Hemispherical Isotropy	9.60	R	1.73	0.7	3.88	∞
Boundary Effects	1.00	R	1.73	1	0.58	∞
Linearity	4.70	R	1.73	1	2.71	∞
System Detection Limits	1.00	R	1.73	1	0.58	∞
Readout Electronics	0.30	N	1.00	1	0.30	∞
Response Time	0.8	R	1.73	1	0.46	∞
Integration Time	2.6	R	1.73	1	1.50	∞
RF Ambient Conditions	3.00	R	1.73	1	1.73	∞
Probe Positioner	0.40	R	1.73	1	0.23	∞
Probe Positioning	2.90	R	1.73	1	1.67	∞
Max SAR Eval	1.00	R	1.73	1	0.58	∞
2. Test Sample Related						
Device Positioning	2.90	N	1.00	1	2.90	145
Device Holder	3.60	N	1.00	1	3.60	5
Power Drift	5.00	R	1.73	1	2.89	∞
3. Phantom and Setup						
Phantom Uncertainty	4.00	R	1.73	1	2.31	∞
Liquid Conductivity(target)	5.00	R	1.73	0.64	1.85	∞
Liquid Conductivity(meas.)	2.07	N	1	0.64	1.32	9
Liquid Permittivity(target)	5.00	R	1.73	0.6	1.73	∞
Liquid Permittivity(meas.)	5.02	N	1	0.6	3.01	9
Combine Standard Uncertainty					11.43	
Coverage Factor for 95 %					k=2	
Expanded STD Uncertainty					22.86	

Table 7.2 Uncertainty (5 000 – 5 900 MHz)

8. ANSI/ IEEE C95.1 - 1992 RF EXPOSURE LIMITS

HUMAN EXPOSURE	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT Occupational (W/kg) or (mW/g)
SPATIAL PEAK SAR * (Brain)	1.60	8.00
SPATIAL AVERAGE SAR ** (Whole Body)	0.08	0.40
SPATIAL PEAK SAR *** (Hands / Feet / Ankle / Wrist)	4.00	20.00

Table 8.1 Safety Limits for Partial Body Exposure

NOTES:

* The Spatial Peak value of the SAR averaged over any 1 g of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

** The Spatial Average value of the SAR averaged over the whole-body.

*** The Spatial Peak value of the SAR averaged over any 10 g of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e.as a result of employment or occupation).

9. SAR SYSTEM VALIDATION

Per FCC KCB 865664 D02v01r01, SAR system validation status should be document to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in IEEE 1528-2003 and FCC KDB 865664 D01v01r03. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

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

SAR System #	Probe	probe Type	Probe Calibration Point		Dipole	Date	Dielectric Parameters		CW Validation			Modulation Validation		
							Measured Permittivity	Measured Conductivity	Sensitivity	Probe Linearity	Probe Isortopy	MOD. Type	Duty Factor	PAR
3	3797	EX3DV4	Head	750	1014	Dec.09,2013	42	0.97	PASS	PASS	PASS	N/A	N/A	N/A
3	3797	EX3DV4	Body	750	1014	Dec.09,2013	55.8	0.95	PASS	PASS	PASS	N/A	N/A	N/A
3	3797	EX3DV4	Head	835	4d165	Jan. 16,2014	41.2	0.91	PASS	PASS	PASS	GMSK	PASS	N/A
3	3797	EX3DV4	Body	835	4d165	Jan. 17,2014	55.31	0.98	PASS	PASS	PASS	GMSK	PASS	N/A
3	3797	EX3DV4	Head	1900	5d032	Dec.10,2013	40.5	1.41	PASS	PASS	PASS	GMSK	PASS	N/A
3	3797	EX3DV4	Body	1900	5d032	Dec.10,2013	53.2	1.5	PASS	PASS	PASS	GMSK	PASS	N/A
3	3797	EX3DV4	Head	2450	743	Dec.11,2013	39.5	1.78	PASS	PASS	PASS	OFDM	N/A	PASS
3	3797	EX3DV4	Body	2450	743	Dec.11,2013	53.1	1.97	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Head	5200	1107	Feb.13,2014	35.8	4.57	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Head	5300	1107	Feb.13,2014	35.7	4.75	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Head	5500	1107	Feb.13,2014	35.4	4.92	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Head	5600	1107	Feb.13,2014	35.2	4.99	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Head	5800	1107	Feb.13,2014	35.1	5.29	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Body	5200	1107	Feb.14,2014	48.9	5.27	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Body	5300	1107	Feb.14,2014	48.5	5.38	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Body	5500	1107	Feb.14,2014	48.1	5.63	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Body	5600	1107	Feb.14,2014	47.8	5.72	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Body	5800	1107	Feb.14,2014	47.3	5.94	PASS	PASS	PASS	OFDM	N/A	PASS

SAR System Validation Summary

Note;

All measurement were performed using probes calibrated for CW signal only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01r03. SAR system were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664 D01v01r03.

10. SYSTEM VERIFICATION

10.1 Tissue Verification

Freq. [MHz]	Date	Probe	Dipole	Liquid	Liquid Temp. [°C]	Parameters	Target Value	Measured Value	Deviation [%]	Limit [%]
750	May. 21, 2014	3797	1014	Head	20.8	ϵ_r	41.9	42.7	+ 1.91	± 5
						σ	0.89	0.904	+ 1.57	± 5
750	May. 21, 2014			Body	20.8	ϵ_r	55.5	54.7	- 1.44	± 5
						σ	0.96	0.983	+ 2.40	± 5
835	May. 19, 2014	3797	4d165	Head	20.2	ϵ_r	41.5	42.1	+ 1.45	± 5
						σ	0.9	0.873	- 3.00	± 5
835	May. 20, 2014			Body	20.6	ϵ_r	55.2	54.2	- 1.81	± 5
						σ	0.97	0.984	+ 1.44	± 5
1 900	May. 23, 2014	3797	5d032	Head	20.8	ϵ_r	40.0	38.9	- 2.75	± 5
						σ	1.40	1.39	- 0.71	± 5
1 900	May. 23, 2014			Body	20.8	ϵ_r	53.3	52.3	- 1.88	± 5
						σ	1.52	1.5	- 1.32	± 5
2 450	May. 22, 2014	3797	743	Head	21.1	ϵ_r	39.2	39.8	+ 1.53	± 5
						σ	1.80	1.8	+ 0.00	± 5
2 450	May. 22, 2014			Body	21.1	ϵ_r	52.7	52.2	- 0.95	± 5
						σ	1.95	1.96	+ 0.51	± 5
5 200	May. 24, 2014	3863	1107	Head	20.4	ϵ_r	36	35.363	- 1.77	± 5
						σ	4.66	4.678	+ 0.39	± 5
5 200	May. 25, 2014			Body	21.0	ϵ_r	49.01	48.538	- 0.96	± 5
						σ	5.3	5.19	- 2.08	± 5
5 300	May. 24, 2014			Head	20.4	ϵ_r	35.9	35.074	- 2.30	± 5
						σ	4.76	4.804	+ 0.92	± 5
5 300	May. 25, 2014			Body	21.0	ϵ_r	48.9	48.284	- 1.26	± 5
						σ	5.42	5.357	- 1.16	± 5
5 500	May. 24, 2014			Head	20.4	ϵ_r	35.6	34.576	- 2.88	± 5
						σ	4.96	5.048	+ 1.77	± 5
5 500	May. 25, 2014			Body	21.0	ϵ_r	48.6	47.676	- 1.90	± 5
						σ	5.65	5.692	+ 0.74	± 5
5 600	May. 24, 2014			Head	20.4	ϵ_r	35.5	34.334	- 3.28	± 5
						σ	5.07	5.179	+ 2.15	± 5
5 600	May. 25, 2014			Body	21.0	ϵ_r	48.5	47.429	- 2.21	± 5
						σ	5.77	5.847	+ 1.33	± 5
5 800	May. 24, 2014			Head	20.4	ϵ_r	35.3	33.731	- 4.44	± 5
						σ	5.27	5.438	+ 3.19	± 5
5 800	May. 25, 2014			Body	21.0	ϵ_r	48.2	46.874	- 2.75	± 5
						σ	6.00	6.174	+ 2.90	± 5

10.2 System Verification

Prior to assessment, the system is verified to the $\pm 10\%$ of the specifications at 750 MHz / 835 MHz / 1 900 MHz / 2 450 MHz / 5 200 MHz / 5 300 MHz / 5 500 MHz / 5 600 MHz / 5 800 MHz by using the system Verification kit. (Graphic Plots Attached)

[System Verification Results]

Freq. [MHz]	Date	Probe (SN)	Dipole (SN)	Liquid	Amb. Temp. [°C]	Liquid Temp. [°C]	1 W Target SAR _{1g} (SPEAG) (mW/g)	Measured SAR _{1g} (mW/g)	1 W Normalized SAR _{1g} (mW/g)	Deviation [%]	Limit [%]
750	May. 21, 2014	3797	1014	Head	21.0	20.8	8.41	0.824	8.24	- 2.02	± 10
750	May. 21, 2014			Body	21.0	20.8	8.77	0.908	9.08	+ 3.53	± 10
835	May. 19, 2014	3797	4d165	Head	20.4	20.2	9.24	1	10	+ 8.23	± 10
835	May. 20, 2014			Body	20.8	20.6	9.58	0.987	9.87	+ 3.03	± 10
1 900	May. 23, 2014	3797	5d032	Head	21.0	20.8	40.1	3.79	37.9	- 5.49	± 10
1 900	May. 23, 2014			Body	21.0	20.8	40.5	3.93	39.3	- 2.96	± 10
2 450	May. 22, 2014	3797	743	Head	21.3	21.1	52.8	5.19	51.9	- 1.70	± 10
2 450	May. 22, 2014			Body	21.3	21.1	50.5	5.22	52.2	+ 3.37	± 10
5 200	May. 24, 2014	3863	1107	Head	20.6	20.4	77.8	7.91	79.1	+ 1.67	± 10
5 200	May. 25, 2014			Body	21.2	21.0	74.7	7.27	72.7	- 2.68	± 10
5 300	May. 24, 2014			Head	20.6	20.4	82.9	8.35	83.5	+ 0.72	± 10
5 300	May. 25, 2014			Body	21.2	21.0	75.8	7.49	74.9	- 1.19	± 10
5 500	May. 24, 2014			Head	20.6	20.4	84.0	8.05	80.5	- 4.17	± 10
5 500	May. 25, 2014			Body	21.2	21.0	79.1	7.69	76.9	- 2.78	± 10
5 600	May. 24, 2014			Head	20.6	20.4	83.0	8.42	84.2	+ 1.45	± 10
5 600	May. 25, 2014			Body	21.2	21.0	80.2	7.76	77.6	- 3.24	± 10
5 800	May. 24, 2014			Head	20.6	20.4	79.4	7.8	78	- 1.76	± 10
5 800	May. 25, 2014			Body	21.2	21.0	74.4	7.19	71.9	- 3.36	± 10

10.3 System Verification Procedure

SAR measurement was prior to assessment, the system is verified to the $\pm 10\%$ of the specifications at each frequency band by using the system Verification kit. (Graphic Plots Attached)

- Cabling the system, using the Verification kit equipments.
- Generate about 100 mW Input Level from the Signal generator to the Dipole Antenna.
- Dipole Antenna was placed below the Flat phantom.
- The measured one-gram SAR at the surface of the phantom above the dipole feed-point should be within 10 % of the target reference value.
- The results are normalized to 1 W input power.

Note;

SAR Verification was performed according to the FCC KDB 865664 D01v01r03.

11. RF CONDUCTED POWER MEASUREMENT

Power measurements were performed using a base station simulator under digital average power. The handset was placed into a simulated call using a base station simulator in a shielded chamber. Such test signals offer a consistent means for testing SAR and are recommended for evaluation SAR. SAR measurements were taken with a fully charged battery. In order to verify that the device was tested and maintained at full power, this was configured with the base station simulator. The SAR measurement Software calculates a reference point at the start and end of the test to check for power drifts. If conducted Power deviations of more than 5 % occurred, the tests were repeated.

11.1 Output Power Specifications.

This device operates using the following maximum output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB publication 447498 D01v05r02.

GSM

GSM850		GSM1900	
Target Power : 33.0 dBm		Target Power : 30.0 dBm	
GPRS850		PCS1900	
GPRS 1tx : 33.0 dBm	EGPRS 1tx : 26.5 dBm	GPRS 1tx : 30.0 dBm	EGPRS 1tx : 25.5 dBm
GPRS 2tx : 31.0 dBm	EGPRS 2tx : 26.0 dBm	GPRS 2tx : 28.0 dBm	EGPRS 2tx : 25.0 dBm
GPRS 3tx : 29.7 dBm	EGPRS 3tx : 25.5 dBm	GPRS 3tx : 26.5 dBm	EGPRS 3tx : 24.5 dBm
GPRS 4tx : 28.7 dBm	EGPRS 4tx : 24.5 dBm	GPRS 4tx : 25.0 dBm	EGPRS 4tx : 23.5 dBm
Tune-up Tolerance : -1.5 dB/ +0.5 dB			

WCDMA

WCDMA850
Target Power : 23.7 dBm
HSDPA Sub-test1 : 23.7 dBm
HSDPA Sub-test2 : 23.7 dBm
HSDPA Sub-test3 : 23.2 dBm
HSDPA Sub-test4 : 23.2 dBm
Tune-up Tolerance : -1.5 dB/ +0.5 dB

* MPD Tolerance : +0.5dB/-0.5dB

* The HSUPA transmitter power will not exceed the R99 maximum transmit power in devices based on Qualcomm's HSPA chipset solutions

LTE

Mode/Band		LTE Band 17						
Target Power		23.7 dBm						
Tune-up Tolerance : -1.5 dB/ +0.5 dB								
RB Size	1	1	50%	100%	1	1	50%	100%
Mode	QPSK	QPSK	QPSK	QPSK	16-QAM	16-QAM	16-QAM	16-QAM
MPR	0	0	1	1	1	1	2	2
* MPR Tolerance : +0.5dB/-0.5dB								

Wifi

Wifi (Average Power)	Mode / Band								
	2.4 GHz			5 GHz					
	802.11b	802.11g	802.11n	802.11a	802.11n (20MHz)	802.11n (40MHz)	802.11ac (20MHz)	802.11ac (40MHz)	802.11ac (80MHz)
Maximum	17.5 dBm	13.5 dBm	12.5 dBm	12 dBm	11.5 dBm	10 dBm	11.5 dBm	10 dBm	10 dBm
Nominal	16.5 dBm	12.5 dBm	11.5 dBm	11 dBm	10.5 dBm	9 dBm	10.5 dBm	9 dBm	9 dBm

BT.

Mode / Band	1Mbps(GFSK)	2Mbps(DPSK)	3Mbps(8DPSK)	LE
Maximum	7.6 dBm	5.1 dBm	5.1 dBm	3.3 dBm
Nominal	6.6 dBm	4.1 dBm	4.1 dBm	2.3 dBm

11.2 GSM

Conducted output power measurements were performed using a base station simulator under digital average power.



SAR Test for WWAN were performed with a base station simulator Agilent E5515C. Communication between the device and the emulator was established by air link. Set base station emulator to allow DUT to radiate maximum output power during all tests. Please refer to the below worst case SAR operation setup.

- GSM voice: Head SAR
- GPRS Multi-slots : Body SAR with GPRS/EDGE Multi-slot Class12 with CS 1 (GMSK)

Note;

CS1/MCS7 coding scheme was used in GPRS/EDGE output power measurements and SAR Testing, as a condition where GMSK/8PSK modulation was ensured. Investigation has shown that CS1 - CS4/ MCS5 - MCS9 settings do not have any impact on the output levels in the GPRS/EDGE modes.

GSM Conducted output powers (Burst-Average)

Band	Ch.	Voice	GPRS(GMSK) Data – CS1				EDGE Data			
		GSM (dBm)	GPRS 1 TX Slot (dBm)	GPRS 2 TX Slot (dBm)	GPRS 3 TX Slot (dBm)	GPRS 4 TX Slot (dBm)	EDGE 1 TX Slot (dBm)	EDGE 2 TX Slot (dBm)	EDGE 3 TX Slot (dBm)	EDGE 4 TX Slot (dBm)
GSM 850	128	32.64	32.70	30.60	29.72	28.67	26.43	26.28	25.33	24.56
	190	32.56	32.61	30.68	29.72	28.67	26.45	26.38	25.37	24.58
	251	32.90	32.99	30.82	29.63	28.56	26.48	26.38	25.33	24.42
GSM 1900	512	29.70	29.70	27.65	26.20	24.69	25.31	25.25	24.52	23.36
	661	29.87	29.87	27.78	26.44	25.00	25.46	25.37	24.62	23.53
	810	29.92	29.92	27.93	26.55	25.09	25.53	25.45	24.69	23.63

GSM Conducted output powers (Frame-Average)

Band	Ch.	Voice	GPRS(GMSK) Data – CS1				EDGE Data			
		GSM (dBm)	GPRS 1 TX Slot (dBm)	GPRS 2 TX Slot (dBm)	GPRS 3 TX Slot (dBm)	GPRS 4 TX Slot (dBm)	EDGE 1 TX Slot (dBm)	EDGE 2 TX Slot (dBm)	EDGE 3 TX Slot (dBm)	EDGE 4 TX Slot (dBm)
GSM 850	128	23.61	23.67	24.58	25.46	25.66	17.40	20.26	21.07	21.55
	190	23.53	23.58	24.66	25.46	25.66	17.42	20.36	21.11	21.57
	251	23.87	23.96	24.80	25.37	25.55	17.45	20.36	21.07	21.41
GSM 1900	512	20.67	20.67	21.63	21.94	21.68	16.28	19.23	20.26	20.35
	661	20.84	20.84	21.76	22.18	21.99	16.43	19.35	20.36	20.52
	810	20.89	20.89	21.91	22.29	22.08	16.50	19.43	20.43	20.62

Note:

Time slot average factor is as follows:

- 1 Tx slot = 9.03 dB, Frame-Average output power = Burst-Average output power – 9.03 dB
- 2 Tx slot = 6.02 dB, Frame-Average output power = Burst-Average output power – 6.02 dB
- 3 Tx slot = 4.26 dB, Frame-Average output power = Burst-Average output power – 4.26 dB
- 4 Tx slot = 3.01 dB, Frame-Average output power = Burst-Average output power – 3.01 dB

11.3 WCDMA

Body SAR is not required for handsets with HSDPA capabilities when the maximum average output of each RF channel with HSDPA active is less than ¼ dB higher than that measured without HSDPA using 12.2 kbps RMC and the maximum SAR for 12.2 kbps RMC is $\leq 75\%$ of the SAR limit. Otherwise, SAR is Measured for HSDPA, using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1, using the highest body SAR configuration in 12.2 kbps RMC without HSDPA, on the maximum output channel with the body exposure configuration that results in the highest SAR in 12.2 kbps RMC for that RF channel.

11.3.1 Output Power Verification

Maximum output power is verified on the High, Middle and Low channels according to the general descriptions in section 5.2 of 3 GPP TS 34.121, using the appropriate RMC or AMR with TPC(transmit power control) set to all “1s”.

11.3.2 Head SAR Measurements

SAR for head exposure configurations is measured using the 12.2 kbps RMC with TPC bits configured to all “1s”. SAR in AMR configurations is not required when the maximum average output of each RF channel for 12.2 kbps AMR is less than ¼ dB higher than that measured in 12.2 kbps RMC. Otherwise, SAR is measured on the maximum output channel in 12.2 AMR with a 3.4 kbps SRB (signaling radio bearer) using the exposure configuration that results in the highest SAR for that RF channel in 12.2 RMC.

11.3.3 Body SAR Measurement

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits all “1s”.

11.3.4 Handsets with Release 5 HSDPA

Body SAR is not required for handsets with HSDPA capabilities when the maximum average output of each RF channel with HSDPA active is less than ¼ dB higher than that measured without HSDPA using 12.2 kbps RMC and the maximum SAR for 12.2 kbps RMC is $\leq 75\%$ of the SAR limit. Otherwise, SAR is Measured for HSDPA, using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1, using the highest body SAR configuration in 12.2 kbps RMC without HSDPA, on the maximum output channel with the body exposure configuration that results in the highest SAR in 12.2 kbps RMC for that RF channel.

Sub-Test 1 Setup for Release 5 HSDPA

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	$\beta_{hs}^{(2)}$	CM (dB) ⁽²⁾
1	2/15	15/15	64	2/15	4/15	0.0
2	12/15 ⁽³⁾	15/15 ⁽³⁾	64	12/15 ⁽³⁾	24/15	1.0
3	15/15	8/15	64	15/8	30/15	1.5
4	15/15	4/15	64	15/4	30/15	1.5
Note 1: $\Delta_{ACK}, \Delta_{NACK}$ and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$ Note 2: CM = 1 for $\beta_c/\beta_d = 12/15, \beta_{hs}/\beta_c = 24/15$. Note 3: For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 11/15$ and $\beta_d = 15/15$.						

11.3.5 Handsets with Release 6 HSPA (HSDPA/HSUPA)

Body SAR is not required for handsets with HSPA capabilities when the maximum average output of each RF channel with HSUPA/HSDPA active is less than ¼ dB higher than that measured without HSUPA/HSDPA using 12.2 kbps RMC and the maximum SAR for 12.2 kbps RMC is ≤ 75 % of the SAR limit. Body SAR for HSPA is measured with E-DCH Sub-test 5, using H-Set 1 and QPSK for FRC and a 12.2 kbps RMC configured in Test Loop Mode 1 with power control algorithm 2, according to the highest body SAR configuration in 12.1 kbps RMC without HSPA. When VOIP is applicable for head exposure, SAR is not required when the maximum output of each RF channel with HSPA is less than ¼ dB higher than that measured using 12.2 kbps RMC; otherwise, the same HSPA configuration used for body measurement should be used to test for head exposure.

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	$\beta_{hs}^{(1)}$	β_{ec}	β_{ed}	β_{ed} (SF)	β_{ed} (codes)	CM ⁽²⁾ (dB)	MPR (dB)	AG ⁽⁴⁾ Index	E-TFCI
1	11/15 ⁽³⁾	15/15 ⁽³⁾	64	11/15 ⁽³⁾	22/15	209/225	1039/225	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 ⁽⁴⁾	15/15 ⁽⁴⁾	64	15/15 ⁽⁴⁾	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK} , Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$.

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 β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ and $\beta_d = 15/15$.

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

Note 5: Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Table 5.1g.

Note 6: β_{ed} can not be set directly; it is set by Absolute Grant Value.

WCDMA 850

3GPP	Mode	3GPP 34.121	Cellular Band [dBm]		
Release		Subtest			
Version			UL 4132 DL 4357	UL 4183 DL 4408	UL 4233 DL 4458
99	WCDMA	12.2 kbps RMC	23.62	23.44	23.47
99	WCDMA	12.2 kbps AMR	23.60	23.44	23.53
5	HSDPA	Subtest 1	23.55	23.47	23.51
5		Subtest 2	23.64	23.53	23.56
5		Subtest 3	23.61	23.53	23.60
5		Subtest 4	23.60	23.55	23.60
6	HSUPA	Subtest 1	22.94	23.11	22.70
6		Subtest 2	22.05	22.04	22.12
6		Subtest 3	22.75	22.76	22.91
6		Subtest 4	22.45	22.32	22.48
6		Subtest 5	23.10	23.19	22.78

WCDMA Average Conducted output powers

11.4 LTE

SAR testing was performed according to the FCC KDB 941225 D05v02r03 publication.

This DUT is developed base on MPR. The MPR is mandatory.

The device will not operate with any other MPR setting than that stated in the table as indicated.

SAR Testing was performed using a CMW500. UE transmits with Maximum output power during SAR testing.

A-MPR has been disabled for all SAR tests by setting NS=01 on the R&S CMW500.

- LTE Band 17

Bandwidth	UL Channel	UL Freq.(MHz)	Modulation	RB Size	RB Offset	Max.Average Power (dBm)
5 MHz	23790	710	QPSK	1	0	23.67
				1	12	23.65
				1	24	23.69
				12	0	22.50
				12	6	22.52
				12	11	22.45
				25	0	22.53
			16QAM	1	0	22.90
				1	12	22.96
				1	24	22.94
				12	0	21.60
				12	6	21.62
				12	11	21.60
				25	0	21.63
10MHz	23790	710	QPSK	1	0	23.58
				1	24	23.51
				1	49	23.44
				25	0	22.52
				25	12	22.48
				25	24	22.45
				50	0	22.52
			16QAM	1	0	22.75
				1	24	22.84
				1	49	22.73
				25	0	21.75
				25	12	21.69
				25	24	21.77
				50	0	21.65

Note: LTE Band 17 at 5 MHz & 10 MHz Bandwidth does not support three non-overlapping channels. Per KDB 941225 D05V02, when a device supports overripping channel assignment in a channel bandwidth configuration, the mid channel of the group of overripping channels should be selected for testing.

Note;

The EUT enables maximum power reduction in accordance with 3GPP 36.101. The MPR settings are configured during the manufacture process and are not configurable by the network, carrier, or end user.

11.5 WiFi

11.5.1 SAR Testing for 802.11b/g/n modes

General Device Setup

Normal Network operating configurations are not suitable for measuring the SAR of 802.11 a/b/g transmitters. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable.

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

Frequency Channel Configurations

802.11 a/b/g and 4.9 GHz operating modes are tested independently according to the service requirements in each frequency band. 802.11 b/g modes are tested on channels 1, 6 and 11. 802.11a is tested for UNII operations on channels 36 and 48 in the 5.15-5.25 GHz band; channels 52 and 64 in the 5.25-5.35 GHz band; Channels 104, 116, 124 and 136 in the 5.470-5.725 GHz band; and channels 149 and 161 in the 5.8 GHz band. When 5.8 GHz § 15.247 is also available, channels 149, 157 and 165 should be tested instead of the UNII channels. 4.9 GHz is tested on channels 1, 10 and 5 or 6, whichever has the higher output power, for 5 MHz channels; channels 11, 15 and 19 for 10 MHz channels; and channels 21 and 25 for 20 MHz channels. These are referred to as the “default test channels”. 802.11g mode was evaluated only if the output power was 0.25 dB higher than the 802.11b mode.

Mode	GHz	Channel	Turbo Channel	“Default Test Channels”			
				§15.247		UNII	
				802.11b	802.11g		
802.11b/g	2.412	1#		√			
	2.437	6	6	√			
	2.462	11#		√			
802.11a	5.18	36				√	
	5.20	40	42 (5.21 GHz)				*
	5.22	44					*
	5.24	48	50 (5.25 GHz)			√	
	5.26	52				√	
	5.28	56	58 (5.29 GHz)				*
	5.30	60					*
	5.32	64				√	
	5.500	100	Unknown				*
	5.520	104				√	
	5.540	108					*
	5.560	112					*
	5.580	116				√	
	5.600	120					*
	5.620	124				√	
	5.640	128					*
	5.660	132					*
	5.680	136				√	
	5.700	140					*
	5.745	149		√		√	
	5.765	153	152 (5.76 GHz)		*		*
	5.785	157		√			*
	5.805	161	160 (5.80 GHz)		*	√	
	5.825	165		√			

802.11 Test Channels per FCC Requirements

IEEE 802.11b Average RF Power

Mode	Freq. [MHz]	Channel	802.11b (2.4 GHz) Conducted Power [dBm]			
			Data Rate (Mbps)			
			1	2	5.5	11
802.11b	2412	1	15.97	15.98	16.20	16.03
	2437	6	16.07	16.07	16.25	16.16
	2462	11	16.06	16.10	16.20	16.11

IEEE 802.11g Average RF Power

Mode	Freq. [MHz]	Channel	802.11g (2.4 GHz) Conducted Power [dBm]							
			Data Rate (Mbps)							
			6	9	12	18	24	36	48	54
802.11g	2412	1	12.05	12.09	12.25	12.20	12.08	12.14	12.12	12.24
	2437	6	12.14	12.17	12.14	12.11	12.03	12.18	12.17	12.10
	2462	11	12.19	12.18	12.24	12.15	12.07	12.14	12.08	12.11

IEEE 802.11n Average RF Power

Mode	Freq. [MHz]	Channel	802.11n (2.4 GHz) Conducted Power [dBm]							
			Data Rate (Mbps)							
			6.5	13	19.5	26	39	52	58.5	65
802.11n (20MHz)	2412	1	11.24	11.22	11.19	11.19	11.20	11.20	11.15	11.08
	2437	6	11.19	11.15	11.18	11.05	11.12	11.15	11.17	11.18
	2462	11	11.14	11.12	11.00	11.00	11.14	11.11	11.09	11.22

IEEE 802.11a Average RF Power- 20 MHz Bandwidth

Mode	Freq. [MHz]	Channel	802.11a (5 GHz) Conducted Power [dBm]							
			Data Rate (Mbps)							
			6	9	12	18	24	36	48	54
802.11a	5180	36	11.84	11.84	11.75	11.77	11.77	11.80	11.65	11.58
	5200	40	11.53	11.53	11.44	11.43	11.50	11.39	11.47	11.46
	5220	44	11.45	11.44	11.41	11.45	11.47	11.43	11.45	11.40
	5240	48	11.38	11.36	11.39	11.46	11.41	11.51	11.42	11.39
	5260	52	11.44	11.55	11.51	11.52	11.53	11.47	11.52	11.45
	5280	56	11.32	11.31	11.28	11.29	11.30	11.32	11.31	11.38
	5300	60	11.10	10.97	11.12	11.04	11.00	11.07	10.95	11.05
	5320	64	10.82	10.66	10.82	10.90	10.83	10.85	10.77	10.80
	5500	100	10.32	10.42	10.40	10.43	10.30	10.31	10.37	10.38
	5520	104	10.61	10.65	10.61	10.59	10.63	10.61	10.58	10.57
	5540	108	11.01	11.00	11.02	10.99	10.98	10.97	11.02	10.95
	5560	112	10.89	10.90	10.87	10.90	10.91	10.90	10.93	10.90
	5580	116	11.16	11.25	11.15	11.18	11.09	11.10	11.10	11.12
	5660	132	10.77	10.80	10.81	10.77	10.76	10.81	10.80	10.79
	5680	136	10.59	10.61	10.60	10.63	10.61	10.57	10.55	10.59
	5700	140	10.83	10.71	10.86	10.85	10.84	10.77	10.76	10.80
	5720	144	10.81	10.82	10.82	10.83	10.79	10.77	10.73	10.85
	5745	149	11.05	10.99	11.04	11.14	11.07	10.84	10.89	10.98
	5765	153	10.70	10.81	10.80	10.75	10.65	10.69	10.70	10.71
	5785	157	10.49	10.55	10.46	10.51	10.46	10.52	10.51	10.35
	5805	161	10.41	10.45	10.43	10.47	10.39	10.35	10.45	10.43
	5825	165	10.32	10.09	10.15	10.18	10.12	10.20	10.41	10.25

IEEE 802.11n Average RF Power – 20 MHz Bandwidth

Mode	Freq. [MHz]	Channel	20 MHz BW 802.11n (5 GHz) Conducted Power [dBm]							
			Data Rate (Mbps)							
			6.5	13	19.5	26	39	52	58.5	65
802.11n	5180	36	11.10	11.13	11.01	10.95	11.02	11.08	11.07	11.08
	5200	40	10.87	10.93	10.98	10.94	11.00	10.86	10.95	10.86
	5220	44	10.53	10.59	10.61	10.63	10.59	10.51	10.49	10.56
	5240	48	10.90	10.81	10.86	10.83	10.78	10.79	10.81	10.86
	5260	52	10.87	10.91	10.90	10.65	10.78	10.80	10.83	10.81
	5280	56	10.77	10.80	10.81	10.79	10.73	10.85	10.90	10.75
	5300	60	10.45	10.45	10.38	10.27	10.34	10.39	10.47	10.32
	5320	64	10.27	10.28	10.30	10.33	10.36	10.37	10.28	10.41
	5500	100	9.80	9.83	9.86	9.84	9.80	9.72	9.76	9.82
	5520	104	9.50	9.61	9.63	9.48	9.61	9.45	9.56	9.51
	5540	108	10.01	10.02	9.98	9.93	9.99	9.91	9.95	9.93
	5560	112	9.80	9.89	9.87	9.89	9.83	9.80	9.75	9.85
	5580	116	10.08	10.12	10.16	10.05	10.06	9.97	10.00	10.11
	5660	132	9.60	9.55	9.61	9.63	9.59	9.63	9.65	9.66
	5680	136	9.75	9.71	9.73	9.81	9.83	9.71	9.73	9.75
	5700	140	9.90	9.91	9.96	9.94	9.91	9.90	10.02	9.85
	5720	144	9.96	9.97	9.93	9.91	9.94	9.98	9.93	9.95
	5745	149	10.27	10.30	10.32	10.23	10.26	10.18	10.18	10.19
	5765	153	9.99	10.09	10.05	10.06	9.98	9.97	10.01	10.04
	5785	157	9.74	9.76	9.84	9.84	9.86	9.89	9.71	9.65
	5805	161	9.61	9.67	9.65	9.60	9.55	9.63	9.61	9.56
	5825	165	9.57	9.49	9.57	9.53	9.66	9.62	9.60	9.51

IEEE 802.11n Average RF Power – 40 MHz Bandwidth

Mode	Freq. [MHz]	Channel	40 MHz BW 802.11n (5 GHz) Conducted Power [dBm]							
			Data Rate (Mbps)							
			13.5	27	40.5	54	81	108	121.5	135
802.11n	5190	38	9.71	9.82	9.83	9.78	9.52	9.76	9.69	9.73
	5230	46	9.82	9.78	9.77	9.75	9.81	9.81	9.79	9.81
	5270	54	9.94	9.95	9.89	9.95	9.90	9.98	9.99	9.95
	5310	62	9.70	9.78	9.77	9.60	9.69	9.72	9.61	9.62
	5510	102	8.97	8.85	9.01	8.87	8.96	9.03	8.99	8.92
	5550	110	9.10	9.16	9.22	9.20	9.26	9.16	9.08	9.14
	5670	134	8.98	9.06	9.00	9.07	8.96	8.99	9.02	9.06
	5710	142	8.92	9.01	9.00	8.99	8.95	8.99	8.97	8.99
	5755	151	9.11	9.23	9.25	9.24	9.18	9.26	9.28	9.27
	5795	159	8.85	8.89	8.99	8.86	8.96	8.89	8.93	8.89

IEEE 802.11ac Average RF Power – 20 MHz Bandwidth

Mode	Freq. [MHz]	Channel	802.11ac (5 GHz) Conducted Power [dBm]								
			Data Rate (Mbps)								
			6.5	13	19.5	26	39	52	58.5	65	78
802.11ac	5180	36	11.13	11.11	11.21	11.15	11.16	11.10	11.06	11.06	11.07
	5200	40	11.03	11.04	11.11	10.89	10.95	11.09	11.13	11.05	11.02
	5220	44	10.99	11.00	11.01	10.99	10.90	11.01	10.89	10.97	11.01
	5240	48	10.96	10.86	10.90	10.99	11.04	10.98	10.94	10.98	10.96
	5260	52	10.95	10.97	11.05	10.95	11.03	10.98	11.03	10.97	10.93
	5280	56	10.61	10.63	10.62	10.59	10.67	10.62	10.65	10.57	10.59
	5300	60	10.50	10.62	10.60	10.51	10.50	10.59	10.60	10.46	10.43
	5320	64	10.31	10.31	10.39	10.39	10.05	10.45	10.32	10.31	10.28
	5500	100	9.97	9.92	10.01	9.75	9.77	9.94	9.88	9.93	9.90
	5520	104	10.01	10.03	10.02	10.01	9.98	9.97	10.00	9.93	9.96
	5540	108	9.89	9.93	9.91	9.87	9.85	9.83	10.01	10.00	9.99
	5560	112	9.96	9.96	9.97	9.93	9.98	9.91	9.95	9.89	9.86
	5580	116	10.19	10.24	10.25	10.13	10.12	10.31	10.20	10.17	10.16
	5660	132	9.75	9.77	9.76	9.77	9.81	9.80	9.71	9.70	9.75
	5680	136	9.69	9.71	9.70	9.68	9.66	9.72	9.73	9.71	9.70
	5700	140	10.06	10.14	10.07	9.96	9.95	10.12	10.08	10.05	10.04
	5720	144	9.93	9.92	9.92	9.91	9.90	9.89	9.87	9.85	9.86
	5745	149	10.28	10.24	10.29	10.31	10.13	10.33	10.21	10.19	10.22
	5765	153	10.10	10.11	10.11	10.09	10.08	10.05	10.01	10.12	10.10
	5785	157	9.88	9.78	9.81	9.79	9.83	9.96	9.92	9.79	9.73
	5805	161	9.79	9.80	9.76	9.75	9.73	9.80	9.85	9.81	9.83
	5825	165	9.75	9.65	9.66	9.52	9.78	9.86	9.81	9.66	9.60

IEEE 802.11ac Average RF Power – 40 MHz Bandwidth

Mode	Freq. [MHz]	Channel	40 MHz BW 802.11ac (5 GHz) Conducted Power [dBm]									
			Data Rate (Mbps)									
			13.5	27	40.5	54	81	108	121.5	135	162	180
802.11ac	5190	38	9.93	9.90	9.92	9.82	9.91	9.92	9.86	9.61	9.61	9.62
	5230	46	9.95	9.86	9.97	9.88	9.96	9.93	9.93	9.90	9.99	9.90
	5270	54	9.86	9.74	9.93	9.81	9.93	9.95	9.94	9.99	9.99	9.88
	5310	62	9.56	9.63	9.64	9.43	9.64	9.65	9.70	9.67	9.71	9.76
	5510	102	8.79	8.90	8.79	8.75	8.80	8.85	8.90	8.80	8.89	8.98
	5550	110	9.02	9.11	9.09	8.90	9.00	9.03	9.10	9.02	9.08	9.17
	5670	134	8.91	8.91	8.79	8.86	8.96	8.95	9.08	8.94	9.04	8.95
	5710	142	8.71	8.72	8.72	8.61	8.69	8.75	8.68	8.76	8.72	8.73
	5755	151	8.89	9.04	9.09	8.94	9.07	9.06	9.14	9.10	9.12	9.19
	5795	159	8.61	8.67	8.54	8.43	8.51	8.61	8.66	8.48	8.65	8.62

IEEE 802.11ac Average RF Power – 80 MHz Bandwidth

Mode	Freq. [MHz]	Channel	80 MHz BW 802.11ac (5 GHz) Conducted Power [dBm]									
			Data Rate (Mbps)									
			29.3	58.5	87.8	117	175.5	234	263.3	292.5	351	390
802.11ac	5210	42	9.70	9.54	9.66	9.68	9.57	9.84	9.51	9.81	9.74	9.66
	5290	58	9.45	9.36	9.54	9.48	9.45	9.66	9.38	9.49	9.43	9.58
	5530	106	8.41	8.51	8.39	8.39	8.33	8.63	8.43	8.61	8.49	8.55
	5690	138	8.60	8.60	8.71	8.50	8.43	8.62	8.74	8.70	8.76	8.69
	5775	155	8.90	8.65	8.78	8.70	8.82	9.01	8.68	8.80	9.05	8.86

11.6 Test Exclusions Applied

11.6.1 BT

Per FCC KDB 447498 D01v05r02, The SAR exclusion threshold for distance < 50 mm is defined by the following equation:

$$\frac{\text{Max Power of Channel(mW)}}{\text{Test Separation Distance (mm)}} * \sqrt{\text{Frequency(GHz)}} \leq 3.0$$

Mode	Frequency	Maximum Allowed Power	Separatuin Distance	≤ 3.0
	[MHz]	[mW]	[mm]	
Bluetooth	2441	6	10	0.94

Based on the maximum conducted power of Bluetooth and antenna to use separation distance, Bluetooth SAR was not required $[(6/10)*\sqrt{2.441}] = 0.94 < 3.0$.

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05r02 IV.C.1iii, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤ 1.6W/kg. When standalone SAR is not required to be measured per FCC KDB 447498 D01v05r02 4.3.22, the following equation must be used to estimate the standalone 1-g SAR for simultaneous transmission assessment involving that transmitter.

$$\text{Estimated SAR} = \frac{\sqrt{f(\text{GHZ})}}{7.5} * \frac{(\text{Max Power of channel mW})}{\text{Min Seperation Distance}}$$

Mode	Frequency	Maximum Allowed Power	Separatuin Distance (Body)	Estimated SAR (Body)
	[MHz]	[mW]	[mm]	[W/kg]
Bluetooth	2441	6	10	0.12

Note :

1) Held-to ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission. The Estimated SAR results were determined according to FCC KDB447498 D01v05r02.

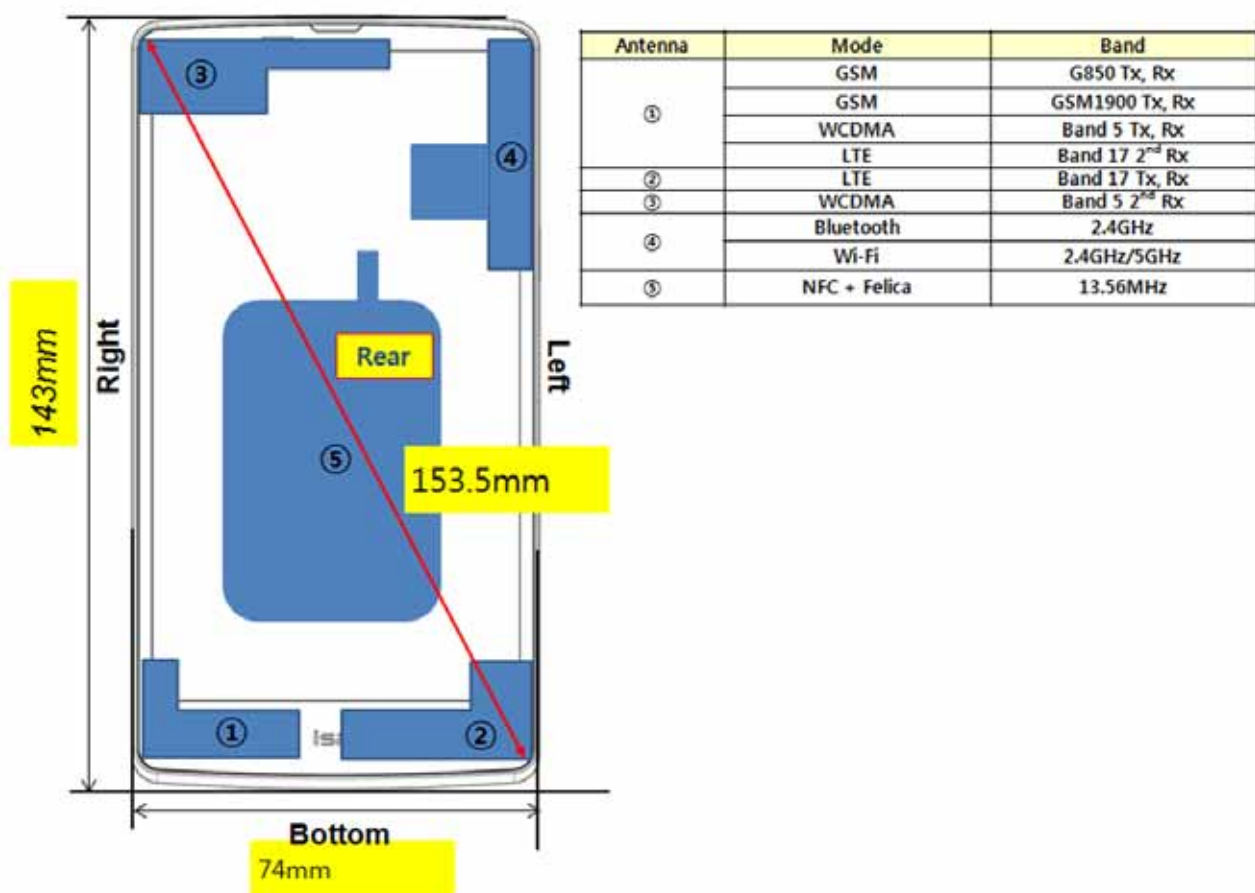
2) Bluetooth LE conducted Power is not calculated on the SAR test exclusions table. Because Bluetooth LE conducted power is lower than Bluetooth conducted Power.

12. SAR Test configuration & Antenna Information

12.1 Mobile Hotspot sides for SAR Testing configurations

Mode	Rear	Front	Left	Right	Bottom	Top
GSM/GPRS 850	Yes	Yes	No	Yes	Yes	No
GSM/GPRS 1900	Yes	Yes	No	Yes	Yes	No
WCDMA 850	Yes	Yes	No	Yes	Yes	No
LTE Band 17	Yes	Yes	Yes	No	Yes	No
2.4 GHz WLAN	Yes	Yes	Yes	No	No	Yes
5.8 GHz WLAN	Yes	Yes	Yes	No	No	Yes

12.2 Antenna and Device Information



Note;

1. Per FCC KDB Publication 941225 D06v01r01, we performed the SAR testing at 1.0 cm from the top & bottom surfaces and also from side edges with a transmitting antenna ≤ 2.5 cm from an edge.

*Please see the LGL24_ZNFLGL24_Antenna distance for further information

* All test performed with the battery cover already incorporate the NFC antenna and Wireless charging capability.

13. SAR TEST DATA SUMMARY

13.1-1 Measurement Results (GSM850 Head SAR)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Battery	Phantom Position	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No.
MHz	Ch.		Tune-Up Limit	Conducted Power							
836.6	190	GSM 850	33.5	32.56	-0.051	Standard	Left Ear	0.152	1.242	0.189	-
836.6	190		33.5	32.56	-0.066	Standard	Left Tilt	0.087	1.242	0.108	-
836.6	190		33.5	32.56	-0.074	Standard	Right Ear	0.180	1.242	0.223	-
836.6	190		33.5	32.56	-0.046	Standard	Right Tilt	0.097	1.242	0.120	-
836.6	190	GPRS 4Tx	29.2	28.67	-0.142	Standard	Left Ear	0.237	1.130	0.268	-
836.6	190		29.2	28.67	-0.179	Standard	Left Tilt	0.153	1.130	0.173	-
836.6	190		29.2	28.67	-0.194	Standard	Right Ear	0.255	1.130	0.288	1
836.6	190		29.2	28.67	-0.191	Standard	Right Tilt	0.156	1.130	0.176	-
ANSI/ IEEE C95.1 - 1992- Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Head 1.6 W/kg (mW/g) Averaged over 1 gram				

13.1-2 Measurement Results (GSM1900 Head SAR)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Battery	Phantom Position	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No.
MHz	Ch.		Tune-Up Limit	Conducted Power							
1 880.0	661	GSM 1900	30.5	29.87	-0.127	Standard	Left Ear	0.095	1.156	0.110	-
1 880.0	661		30.5	29.87	-0.050	Standard	Left Tilt	0.035	1.156	0.040	-
1 880.0	661		30.5	29.87	0.029	Standard	Right Ear	0.065	1.156	0.075	-
1 880.0	661		30.5	29.87	-0.017	Standard	Right Tilt	0.041	1.156	0.047	-
1 880.0	661	GPRS 4Tx	25.5	25.00	0.148	Standard	Left Ear	0.151	1.122	0.169	2
1 880.0	661		25.5	25.00	-0.045	Standard	Left Tilt	0.056	1.122	0.063	-
1 880.0	661		25.5	25.00	0.026	Standard	Right Ear	0.106	1.122	0.119	-
1 880.0	661		25.5	25.00	-0.100	Standard	Right Tilt	0.066	1.122	0.074	-
ANSI/ IEEE C95.1 - 1992- Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Head 1.6 W/kg (mW/g) Averaged over 1 gram				

13.1-3 Measurement Results (WCDMA850 Head SAR)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Battery	Phantom Position	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No.
MHz	Ch.		Tune-Up Limit	Conducted Power							
836.6	4183	WCDMA 850	24.2	23.44	-0.076	Standard	Left Ear	0.179	1.191	0.213	-
836.6	4183		24.2	23.44	-0.118	Standard	Left Tilt	0.097	1.191	0.116	-
836.6	4183		24.2	23.44	-0.082	Standard	Right Ear	0.201	1.191	0.239	3
836.6	4183		24.2	23.44	-0.155	Standard	Right Tilt	0.127	1.191	0.151	-
ANSI/ IEEE C95.1 - 1992- Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Head 1.6 W/kg (mW/g) Averaged over 1 gram				

13.1-4 Measurement Results (LTE Band 17 10MHz Head SAR)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Battery	Phantom Position	RB Size	RB Offset	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No
MHz	ch.		Tune-Up Limit	Conducted Power									
710	23790	QPSK	24.2	23.58	-0.062	Standard	Left Ear	1	0	0.092	1.153	0.106	4
710	23790		23.2	22.52	-0.095	Standard	Left Ear	25	0	0.079	1.169	0.092	-
710	23790		24.2	23.58	-0.035	Standard	Left Tilt 15°	1	0	0.061	1.153	0.070	-
710	23790		23.2	22.52	-0.045	Standard	Left Tilt 15°	25	0	0.051	1.169	0.060	-
710	23790		24.2	23.58	-0.075	Standard	Right Ear	1	0	0.079	1.153	0.091	-
710	23790		23.2	22.52	-0.020	Standard	Right Ear	25	0	0.067	1.169	0.078	-
710	23790		24.2	23.58	-0.075	Standard	Right Tilt 15°	1	0	0.044	1.153	0.051	-
710	23790		23.2	22.52	-0.152	Standard	Right Tilt 15°	25	0	0.037	1.169	0.043	-
ANSI/ IEEE C95.1 1992 – Safety Limit													
Spatial Peak								Head					
Uncontrolled Exposure/ General Population								1.6 W/kg (mW/g)					
								Averaged over 1 gram					

13.1-5 Measurement Results (DTS Head SAR)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Battery	Phantom Position	Data Rate	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No.
MHz	Ch.		Tune-Up Limit	Conducted Power								
2 437	6	802.11b	17.5	16.07	0.027	Standard	Left Ear	1Mbps	0.028	1.390	0.039	-
			17.5	16.07	-0.045	Standard	Left Tilt	1Mbps	0.00986	1.390	0.014	-
			17.5	16.07	0.117	Standard	Right Ear	1Mbps	0.073	1.390	0.101	5
			17.5	16.07	-0.064	Standard	Right Tilt	1Mbps	0.023	1.390	0.032	-
5 745	149	802.11a	12.0	11.05	-0.06	Standard	Left Ear	6Mbps	0.020	1.245	0.025	-
			12.0	11.05	-0.07	Standard	Left Tilt	6Mbps	0.021	1.245	0.026	-
			12.0	11.05	-0.14	Standard	Right Ear	6Mbps	0.070	1.245	0.087	6
			12.0	11.05	-0.17	Standard	Right Tilt	6Mbps	0.062	1.245	0.077	-
5 775	155	802.11ac	10	8.90	0.07	Standard	Right Ear	29.3Mbps	0.046	1.288	0.059	-
ANSI/ IEEE C95.1 - 1992- Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Head 1.6 W/kg (mW/g) Averaged over 1 gram					

13.1-6 Measurement Results (NII Head SAR)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Battery	Phantom Position	Data Rate	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No.
MHz	Ch.		Tune-Up Limit	Conducted Power								
5 180	36	802.11a	12	11.84	-0.01	Standard	Left Ear	6Mbps	0.00935	1.038	0.010	-
			12	11.84	-0.05	Standard	Left Tilt	6Mbps	0.00829	1.038	0.009	-
			12	11.84	-0.09	Standard	Right Ear	6Mbps	0.043	1.038	0.045	7
			12	11.84	0.00	Standard	Right Tilt	6Mbps	0.00849	1.038	0.009	-
5 210	42	802.11ac	10	9.70	-0.17	Standard	Right Ear	29.3Mbps	0.030	1.072	0.032	-
5 260	52	802.11a	12	11.44	0.00	Standard	Left Ear	6Mbps	0	1.138	0	-
			12	11.44	0.00	Standard	Left Tilt	6Mbps	0.0000448	1.138	0.000	-
			12	11.44	0.00	Standard	Right Ear	6Mbps	0.041	1.138	0.047	-
			12	11.44	0.00	Standard	Right Tilt	6Mbps	0.011	1.138	0.013	-
5 290	58	802.11ac	10	9.45	0.00	Standard	Right Ear	29.3Mbps	0.00462	1.135	0.005	-
5 580	116	802.11a	12	11.16	-0.01	Standard	Left Ear	6Mbps	0.00786	1.213	0.010	-
			12	11.16	-0.18	Standard	Left Tilt	6Mbps	0.00887	1.213	0.011	-
			12	11.16	0.00	Standard	Right Ear	6Mbps	0.038	1.213	0.046	-
			12	11.16	0.00	Standard	Right Tilt	6Mbps	0.025	1.213	0.030	-
5 530	106	802.11ac	10	8.41	0.00	Standard	Right Ear	29.3Mbps	0.022	1.442	0.032	-
5 690	138	802.11ac	10	8.60	0.00	Standard	Right Ear	29.3Mbps	0.033	1.380	0.046	-
ANSI/ IEEE C95.1 - 1992- Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Head 1.6 W/kg (mW/g) Averaged over 1 gram					

13.2-1 Measurement Results (GSM850 Hotspot SAR)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Configuration	Separation Distance	Measured SAR(mW/g)	Scaling Factor	Scaled SAR(mW/g)	Plot No.
MHz	Ch.		Tune-Up Limit	Conducted Power							
836.6	190	GPRS 4Tx	29.2	28.67	0.057	Rear	1.0 cm	0.456	1.130	0.515	8
836.6	190		29.2	28.67	-0.140	Front	1.0 cm	0.333	1.130	0.376	-
836.6	190		29.2	28.67	0.102	Right	1.0 cm	0.294	1.130	0.332	-
836.6	190		29.2	28.67	-0.011	Bottom	1.0 cm	0.180	1.130	0.203	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 1.6 W/kg (mW/g) Averaged over 1 gram				

13. 2-2 Measurement Results (GSM1900 Hotspot SAR)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Configuration	Separation Distance	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No.
MHz	Ch.		Tune-Up Limit	Conducted Power							
1 880.0	661	GPRS 4Tx	25.5	25.00	-0.080	Rear	1.0 cm	0.361	1.122	0.405	9
1 880.0	661		25.5	25.00	0.002	Front	1.0 cm	0.267	1.122	0.300	-
1 880.0	661		25.5	25.00	-0.068	Right	1.0 cm	0.096	1.122	0.108	-
1 880.0	661		25.5	25.00	0.010	Bottom	1.0 cm	0.353	1.122	0.396	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 1.6 W/kg (mW/g) Averaged over 1 gram				

13. 2-3 Measurement Results (WCDMA850 Hotspot SAR)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Configuration	Separation Distance	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No.
MHz	Ch.		Tune-Up Limit	Conducted Power							
836.6	4183	WCDMA 850	24.2	23.44	-0.024	Rear	1.0 cm	0.338	1.191	0.403	10
836.6	4183		24.2	23.44	-0.020	Front	1.0 cm	0.271	1.191	0.323	-
836.6	4183		24.2	23.44	-0.080	Right	1.0 cm	0.222	1.191	0.264	-
836.6	4183		24.2	23.44	0.073	Bottom	1.0 cm	0.163	1.191	0.194	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 1.6 W/kg (mW/g) Averaged over 1 gram				

13.2-4 Measurement Results (LTE Band 17 10MHz Hotspot SAR)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Configuration	RB Size	RB Offset	Separation Distance	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No.
MHz	Ch.		Tune-Up Limit	Conducted Power									
710	23790	QPSK	24.2	23.58	0.003	Rear	1	0	1.0 cm	0.242	1.153	0.279	11
710	23790		23.2	22.52	0.086	Rear	25	0	1.0 cm	0.201	1.169	0.235	-
710	23790		24.2	23.58	-0.071	Front	1	0	1.0 cm	0.129	1.153	0.149	-
710	23790		23.2	22.52	-0.086	Front	25	0	1.0 cm	0.114	1.169	0.133	-
710	23790		24.2	23.58	0.016	Left	1	0	1.0 cm	0.113	1.153	0.130	-
710	23790		23.2	22.52	0.100	Left	25	0	1.0 cm	0.098	1.169	0.115	-
710	23790		24.2	23.58	-0.013	Bottom	1	0	1.0 cm	0.060	1.153	0.069	-
710	23790		23.2	22.52	0.038	Bottom	25	0	1.0 cm	0.050	1.169	0.058	-
ANSI/ IEEE C95.1 1992 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population								Body 1.6 W/kg (mW/g) Averaged over 1 gram					

13. 2-5 Measurement Results (WLAN Hotspot SAR)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Configuration	Data Rate	Separation Distance	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No.
MHz	Ch.		Tune-Up Limit	Conducted Power								
2 437	6	802.11b	17.5	16.07	0.067	Rear	1Mbps	1.0 cm	0.125	1.390	0.174	12
			17.5	16.07	0.143	Front	1Mbps	1.0 cm	0.012	1.390	0.017	-
			17.5	16.07	-0.052	Left	1Mbps	1.0 cm	0.072	1.390	0.100	-
			17.5	16.07	-0.020	Top	1Mbps	1.0 cm	0.00563	1.390	0.008	-
5 745	149	802.11a	12.0	11.05	-0.07	Rear	6Mbps	1.0 cm	0.143	1.245	0.178	13
			12.0	11.05	-0.09	Front	6Mbps	1.0 cm	0.00549	1.245	0.007	-
			12.0	11.05	-0.10	Left	6Mbps	1.0 cm	0.069	1.245	0.086	-
			12.0	11.05	-0.05	Top	6Mbps	1.0 cm	0.028	1.245	0.035	-
5 775	155	802.11ac	10.0	8.90	0.02	Rear	29.3Mbps	1.0 cm	0.090	1.288	0.116	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population								Body 1.6 W/kg (mW/g) Averaged over 1 gram				

13.3-1 Measurement Results (WLAN Body-worn SAR)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Configuration	Data Rate	Separation Distance	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No.
MHz	Ch.		Tune-Up Limit	Conducted Power								
2 437	6	802.11b	17.5	16.07	0.067	Rear	1Mbps	1.0 cm	0.125	1.390	0.174	12
5 745	149	802.11a	12.0	11.05	-0.07	Rear	6Mbps	1.0 cm	0.143	1.245	0.178	13
5 775	155	802.11ac	10.0	8.90	0.02	Rear	29.3Mbps	1.0 cm	0.090	1.288	0.116	-
ANSI/ IEEE C95.1 - 1992- Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 1.6 W/kg (mW/g) Averaged over 1 gram					

13.3-2 Measurement Results (NII Body-worn SAR)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Configuration	Data Rate	Separation Distance	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No.
MHz	Ch.		Tune-Up Limit	Conducted Power								
5 180	36	802.11a	12.0	11.84	-0.07	Rear	6Mbps	1.0 cm	0.097	1.038	0.101	-
5 210	42	802.11ac	10.0	9.70	-0.08	Rear	29.3Mbps	1.0 cm	0.172	1.072	0.184	14
5 260	52	802.11a	12.0	11.44	-0.01	Rear	6Mbps	1.0 cm	0.078	1.138	0.089	15
5 290	58	802.11ac	10.0	9.45	-0.17	Rear	29.3Mbps	1.0 cm	0.052	1.135	0.059	-
5 580	116	802.11a	12.0	11.16	0.06	Rear	6Mbps	1.0 cm	0.052	1.213	0.063	-
5 530	106	802.11ac	10.0	8.41	-0.07	Rear	29.3Mbps	1.0 cm	0.034	1.442	0.049	-
5 690	138	802.11ac	10.0	8.60	0.01	Rear	29.3Mbps	1.0 cm	0.075	1.380	0.104	16
ANSI/ IEEE C95.1 - 1992- Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 1.6 W/kg (mW/g) Averaged over 1 gram					

13.3-3 Measurement Results (Body-worn SAR)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Configuration	Separation Distance	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No.
MHz	Ch.		Tune-Up Limit	Conducted Power							
836.6	190	GSM850	33.5	32.56	-0.048	Rear	1.0 cm	0.293	1.242	0.364	17
836.6	190	GPRS 4Tx	29.2	28.67	0.057	Rear	1.0 cm	0.456	1.130	0.515	8
1 880.0	661	GSM1900	30.5	29.87	-0.015	Rear	1.0 cm	0.224	1.156	0.259	18
1 880.0	661	GPRS 4Tx	25.5	25.00	-0.080	Rear	1.0 cm	0.361	1.122	0.405	9
836.6	4183	WCDMA850	24.2	23.44	-0.024	Rear	1.0 cm	0.338	1.191	0.403	10
710	23790	LTE Band 17	24.2	23.58	0.003	Rear	1.0 cm	0.242	1.153	0.279	11
ANSI/ IEEE C95.1 - 1992- Safety Limit Spatial Peak Uncontrolled Exposure/ General Population								Body 1.6 W/kg (mW/g) Averaged over 1 gram			

13.4 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, FCC KDB Procedure.
2. Batteries are fully charged at the beginning of the SAR measurements. A standard battery was used for all SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB 447498 D01v05r02.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 10 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
7. Per FCC KDB 648474 D04v01r02, SAR was evaluated without a headset connected to the device. Since the standalone reported SAR was ≤ 1.2 W/kg, no additional SAR evaluation using a headset cable were required.
8. Per FCC KDB 865664 D01v01r03, variability SAR tests were not performed since the measured SAR results for all frequency bands were less than 0.8 W/kg. Please see Section 14 for variability analysis information.

GSM/GPRS Test Notes:

1. This device supports GSM VOIP in the head and the body-worn configurations therefore GPRS was additionally evaluated for head and body-worn compliance.
2. Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.
3. Justification for reduced test configurations per KDB 941225 D03v01: The source-based time-averaged output power was evaluated for all multi-slot operations. The multi-slot configuration with the highest frame averaged output power was evaluated for SAR.
4. Per FCC KDB 447498 D01v05r02, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is 1/2 dB, instead of the middle channel, the highest output power channel must be used.
5. Justification for reduced test configurations per KDB Publication 941225 D03v01 and October 2013 TCB Workshop Notes: The source-based frame-averaged output power was evaluated for all GPRS/EDGE slot configurations. The configuration with the highest target frame averaged output power was evaluated for hotspot SAR. When the maximum frame-averaged powers are equivalent across two or more slots (within 0.25 dB), the configuration with the most number of time slots was tested.

UMTS Notes:

1. UMTS mode in Body SAR was tested under RMC 12.2 kbps with HSPA inactive per KDB 941225 D01v02. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.
2. Per FCC KDB 447498 D01v05r02, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the channel highest output power channel was used.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Consideration for LTE Devices in FCC KDB 941225 D05v02r03.
2. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 to 6.2.5 2.5 under Table 6.2.3-1.
3. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator.
4. *Pre-installed VOIP applications are considered.

WLAN Notes:

1. Justification for reduced test configurations for WIFI channels per KDB 248227 D01v01r02 and Oct. 2012 FCC/TCB Meeting Notes for 2.4 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11b. Other IEEE 802.11 modes (including 802.11 g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
2. Justification for reduced test configurations for WIFI channels per KDB 248227 D01v01r02 and Oct. 2012 FCC/TCB Meeting Notes for 5 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11a. Other IEEE 802.11 modes (including 802.11 n 20MHz and 40 MHz bandwidths) were not investigated since the average output power over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data of IEEE 802.11a mode.
3. Per Apr. 2013 TCB Workshop notes, full SAR test for all IEEE 802.11 ac configurations were not required because the average output power was not more than 0.25 dB higher than IEEE 802.11 a mode. IEEE 802.11 ac was evaluated for the highest IEEE 802.11 a configuration in each 5 GHz band and exposure condition.
4. When wireless router is enabled, 5.2, 5.3 and 5.5 GHz bands are disabled.
5. 5G WiFi Direct GO is supported in the 5.8 GHz band only. The manufacturer expects 5.8 GHz WiFi Direct GO may be used similar to wireless router usage. Therefore, 5.8 GHz WiFi Direct GO was evaluated For SAR similar to wireless router SAR procedures in FCC KDB Publication 941225 D06v01r01.
6. Since the maximum extrapolated peak SAR of the zoom scan for the maximum output channel was ≤ 1.6 W/kg and the reported 1g averaged SAR was < 0.8 W/kg, SAR testing on other default channels was not required.

14. SAR Measurement Variability and Uncertainty

In accordance with published RF Exposure KDB procedure 865664 D01v01r03 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

- 1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.
- 2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
- 3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg ($\sim 10\%$ from the 1-g SAR limit).
- 4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20 .

Note(s):

- 1) Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is not > 1.20 .
- 2) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg.

15. SAR Summation Scenario

	Position	Applicable Combination	Note
Simultaneous Transmission	Head	GSM 850 + 2.4 GHz WiFi	
		GPRS 850 + 2.4 GHz WiFi	
		GSM 1900 + 2.4 GHz WiFi	
		GPRS 1900 + 2.4 GHz WiFi	
		WCDMA850 + 2.4 GHz WiFi	
		LTE Band 17 + 2.4 GHz WiFi	*Pre-installed VOIP applications are considered.
		GSM 850 + 5 GHz WiFi	
		GPRS 850 + 5 GHz WiFi	
		GSM 1900 + 5 GHz WiFi	
		GPRS 1900 + 5 GHz WiFi	
		WCDMA850 + 5 GHz WiFi	
		LTE Band 17 + 5 GHz WiFi	*Pre-installed VOIP applications are considered.
	Hotspot	GPRS 850 + 2.4 GHz WiFi	
		GPRS 1900 + 2.4 GHz WiFi	
		WCDMA850 + 2.4 GHz WiFi	
		LTE Band 17 + 2.4 GHz WiFi	
		GPRS 850 + 5 GHz WiFi	WIFI Direct* 5.8 GHz
		GPRS 1900 + 5 GHz WiFi	
		WCDMA850 + 5 GHz WiFi	
		LTE Band 17 + 5 GHz WiFi	
	Body-worn	GSM 850 + 2.4 GHz WiFi	
		GPRS 850 + 2.4 GHz WiFi	
		GSM 1900 + 2.4 GHz WiFi	
		GPRS 1900 + 2.4 GHz WiFi	
		WCDMA850 + 2.4 GHz WiFi	
		LTE Band 17 + 2.4 GHz WiFi	*Pre-installed VOIP applications are considered.
		GSM 850 + 5 GHz WiFi	
		GPRS 850 + 5 GHz WiFi	
		GSM 1900 + 5 GHz WiFi	
		GPRS 1900 + 5 GHz WiFi	
		WCDMA850 + 5 GHz WiFi	
		LTE Band 17 + 5 GHz WiFi	*Pre-installed VOIP applications are considered.
		GSM 850 Voice + 2.4 GHz Bluetooth	
		GPRS VoIP 850 + 2.4 GHz Bluetooth	
		GSM 1900 Voice + 2.4 GHz Bluetooth	
		GPRS VoIP 1900 + 2.4 GHz Bluetooth	
		WCDMA850 + 2.4 GHz Bluetooth	
		LTE Band 17 2.4 GHz Bluetooth	*Pre-installed VOIP applications are considered.

* BT and WLAN are not simultaneous transmission.
 * When the WIFI Direct mode is enabled, all 5 GHz NII Band are disabled. Therefore 5GHz NII WIFI is not considered in this section.

15.1 Simultaneous Transmission Summation for Head

Simultaneous Transmission Summation with 2.4 GHz WIFI

Band	configuration	Scaled SAR (W/kg)	2.4 GHz WIFI Scaled SAR (W/kg)	Σ 1-g SAR (W/kg)
GSM 850	Left Cheek	0.189	0.039	0.228
	Left Tilt	0.108	0.014	0.122
	Right Cheek	0.223	0.101	0.324
	Right Tilt	0.120	0.032	0.152
GPRS 850	Left Cheek	0.268	0.039	0.307
	Left Tilt	0.173	0.014	0.187
	Right Cheek	0.288	0.101	0.389
	Right Tilt	0.176	0.032	0.208
GSM 1900	Left Cheek	0.110	0.039	0.149
	Left Tilt	0.040	0.014	0.054
	Right Cheek	0.075	0.101	0.176
	Right Tilt	0.047	0.032	0.079
GPRS 1900	Left Cheek	0.169	0.039	0.208
	Left Tilt	0.063	0.014	0.077
	Right Cheek	0.119	0.101	0.220
	Right Tilt	0.074	0.032	0.106
WCDMA 850	Left Cheek	0.213	0.039	0.252
	Left Tilt	0.116	0.014	0.130
	Right Cheek	0.239	0.101	0.340
	Right Tilt	0.151	0.032	0.183
LTE Band 17	Left Cheek	0.106	0.039	0.145
	Left Tilt	0.070	0.014	0.084
	Right Cheek	0.091	0.101	0.192
	Right Tilt	0.051	0.032	0.083

Simultaneous Transmission Summation with 5 GHz WIFI

Band	configuration	Scaled SAR (W/kg)	5 GHz WIFI Scaled SAR (W/kg)	Σ 1-g SAR (W/kg)
GSM 850	Left Cheek	0.189	0.025	0.214
	Left Tilt	0.108	0.026	0.134
	Right Cheek	0.223	0.087	0.310
	Right Tilt	0.120	0.077	0.197
GPRS 850	Left Cheek	0.268	0.025	0.293
	Left Tilt	0.173	0.026	0.199
	Right Cheek	0.288	0.087	0.375
	Right Tilt	0.176	0.077	0.253
GSM 1900	Left Cheek	0.110	0.025	0.135
	Left Tilt	0.040	0.026	0.066
	Right Cheek	0.075	0.087	0.162
	Right Tilt	0.047	0.077	0.124
GPRS 1900	Left Cheek	0.169	0.025	0.194
	Left Tilt	0.063	0.026	0.089
	Right Cheek	0.119	0.087	0.206
	Right Tilt	0.074	0.077	0.151
WCDMA 850	Left Cheek	0.213	0.025	0.238
	Left Tilt	0.116	0.026	0.142
	Right Cheek	0.239	0.087	0.326
	Right Tilt	0.151	0.077	0.228
LTE Band 17	Left Cheek	0.106	0.025	0.131
	Left Tilt	0.070	0.026	0.096
	Right Cheek	0.091	0.087	0.178
	Right Tilt	0.051	0.077	0.128

Note: The worst case 5 GHz WLAN reported SAR for each configuration was used for SAR summation, regardless of whether the WLAN channel has WIFI Direct capability. Therefore, the summations above represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN.

15.2 Simultaneous Transmission Summation for Body-Worn

Simultaneous Transmission Summation with Wifi (1 cm)

Band	configuration	Scaled SAR(W/kg)	2.4 GHz WIFI Scaled SAR (W/kg)	Σ 1-g SAR (W/kg)
GSM 850	Rear	0.364	0.174	0.538
GPRS 850	Rear	0.515	0.174	0.689
GSM 1900	Rear	0.259	0.174	0.433
GPRS 1900	Rear	0.405	0.174	0.579
WCDMA850	Rear	0.403	0.174	0.577
LTE Band 17	Rear	0.279	0.174	0.453

Simultaneous Transmission Summation with Wifi (1 cm)

Band	configuration	Scaled SAR(W/kg)	5 GHz WIFI Scaled SAR (W/kg)	Σ 1-g SAR (W/kg)
GSM 850	Rear	0.364	0.178	0.542
GPRS 850	Rear	0.515	0.178	0.693
GSM 1900	Rear	0.259	0.178	0.437
GPRS 1900	Rear	0.405	0.178	0.583
WCDMA850	Rear	0.403	0.178	0.581
LTE Band 17	Rear	0.279	0.178	0.457

Note: The worst case 5 GHz WLAN reported SAR for each configuration was used for SAR summation, regardless of whether the WLAN channel has WIFI Direct capability. Therefore, the summations above represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN.

Simultaneous Transmission Summation with Bluetooth (1 cm)

Band	configuration	Scaled SAR(W/kg)	BT SAR (W/kg)	Σ 1-g SAR (W/kg)
GSM 850	Rear	0.364	0.12	0.484
GPRS 850	Rear	0.515	0.12	0.635
GSM 1900	Rear	0.259	0.12	0.379
GPRS 1900	Rear	0.405	0.12	0.525
WCDMA1900	Rear	0.403	0.12	0.523
LTE Band 17	Rear	0.279	0.12	0.399

15.3 Simultaneous Transmission Summation for Hotspot

Simultaneous Transmission Summation with 2.4 GHz WIFI (1 cm)

Band	configuration	Scaled SAR (W/kg)	2.4 GHz WIFI Scaled SAR (W/kg)	Σ 1-g SAR (W/kg)
GSM 850	Rear	0.515	0.174	0.689
	Front	0.376	0.017	0.393
	Left		0.100	0.100
	Right	0.332		0.332
	Bottom	0.203		0.203
	Top		0.008	0.008
GSM 1900	Rear	0.405	0.174	0.579
	Front	0.300	0.017	0.317
	Left		0.100	0.100
	Right	0.108		0.108
	Bottom	0.396		0.396
	Top		0.008	0.008
WCDMA 850	Rear	0.403	0.174	0.577
	Front	0.323	0.017	0.340
	Left		0.100	0.100
	Right	0.264		0.264
	Bottom	0.194		0.194
	Top		0.008	0.008
LTE Band 17	Rear	0.279	0.174	0.453
	Front	0.149	0.017	0.166
	Left	0.130	0.100	0.230
	Right			
	Bottom	0.069		0.069
	Top		0.008	0.008

Simultaneous Transmission Summation with 5.8 GHz DTS Wifi (1 cm)

Band	configuration	Scaled SAR (W/kg)	5.8 GHz WIFI Scaled SAR (W/kg)	Σ 1-g SAR (W/kg)
GSM 850	Rear	0.515	0.178	0.693
	Front	0.376	0.007	0.383
	Left		0.086	0.086
	Right	0.332		0.332
	Bottom	0.203		0.203
	Top		0.035	0.035
GSM 1900	Rear	0.405	0.178	0.583
	Front	0.300	0.007	0.307
	Left		0.086	0.086
	Right	0.108		0.108
	Bottom	0.396		0.396
	Top		0.035	0.035
WCDMA 850	Rear	0.403	0.178	0.581
	Front	0.323	0.007	0.330
	Left		0.086	0.086
	Right	0.264		0.264
	Bottom	0.194		0.194
	Top		0.035	0.035
LTE Band 17	Rear	0.279	0.178	0.457
	Front	0.149	0.007	0.156
	Left	0.130	0.086	0.216
	Right			
	Bottom	0.069		0.069
	Top		0.035	0.035

Note: The worst case 5 GHz WLAN reported SAR for each configuration was used for SAR summation, regardless of whether the WLAN channel has WIFI Direct capability. Therefore, the summations above represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN.

15.4 Simultaneous Transmission Conclusion

The above numerical summed SAR results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit. And therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v05r02.

16. CONCLUSION

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the ANSI/IEEE C95.1 1992.

These measurements are taken to simulate the RF effects exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests.

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Attachment 1. – SAR Test Plots

Test Laboratory: HCT CO., LTD
EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
Liquid Temperature: 20.2
Ambient Temperature: 20.4
Test Date: May.19, 2014
Plot No. 1

DUT: LGL24; Type: Bar; Serial: #1

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:2.075
Medium parameters used (interpolated): $f = 836.6 \text{ MHz}$; $\sigma = 0.875 \text{ mho/m}$; $\epsilon_r = 42.1$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Right Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(9.04, 9.04, 9.04); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: 1800/1900 Phantom; Type: SAM

GSM850 right touch 190ch GPRS 4Tx/Area Scan (61x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.285 mW/g

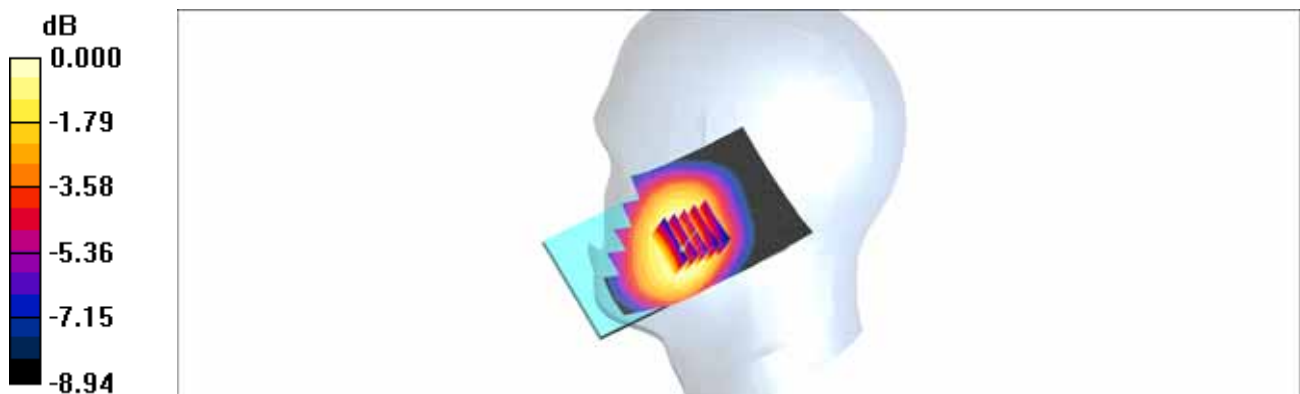
GSM850 right touch 190ch GPRS 4Tx/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 4.78 V/m; Power Drift = -0.194 dB

Peak SAR (extrapolated) = 0.316 W/kg

SAR(1 g) = 0.255 mW/g; SAR(10 g) = 0.198 mW/g

Maximum value of SAR (measured) = 0.267 mW/g



0 dB = 0.267mW/g

Test Laboratory: HCT CO., LTD
 EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
 Liquid Temperature: 20.8
 Ambient Temperature: 21.0
 Test Date: May.23, 2014
 Plot No. 2

DUT: LGL24; Type: Bar

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:2.075
 Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.37 \text{ mho/m}$; $\epsilon_r = 39$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Left Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(7.73, 7.73, 7.73); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: SAM 835/900 MHz; Type: SAM

GSM1900 left touch 661 GPRS 4Tx/Area Scan (61x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
 Maximum value of SAR (interpolated) = 0.162 mW/g

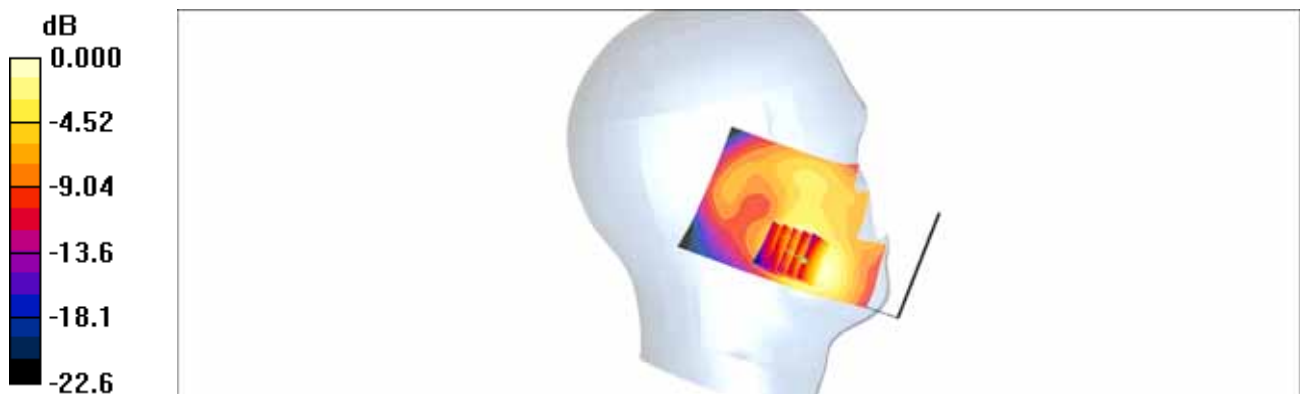
GSM1900 left touch 661 GPRS 4Tx/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 4.71 V/m; Power Drift = 0.148 dB

Peak SAR (extrapolated) = 0.416 W/kg

SAR(1 g) = 0.151 mW/g; SAR(10 g) = 0.092 mW/g

Maximum value of SAR (measured) = 0.157 mW/g



0 dB = 0.157mW/g

Test Laboratory: HCT CO., LTD
 EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
 Liquid Temperature: 20.2
 Ambient Temperature: 20.4
 Test Date: May.19, 2014
 Plot No. 3

DUT: LGL24; Type: Bar

Communication System: WCDMA850; Frequency: 836.6 MHz; Duty Cycle: 1:1
 Medium parameters used (interpolated): $f = 836.6 \text{ MHz}$; $\sigma = 0.875 \text{ mho/m}$; $\epsilon_r = 42.1$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Right Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(9.04, 9.04, 9.04); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: 1800/1900 Phantom; Type: SAM

WCDMA850 right touch 4183/Area Scan (61x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
 Maximum value of SAR (interpolated) = 0.212 mW/g

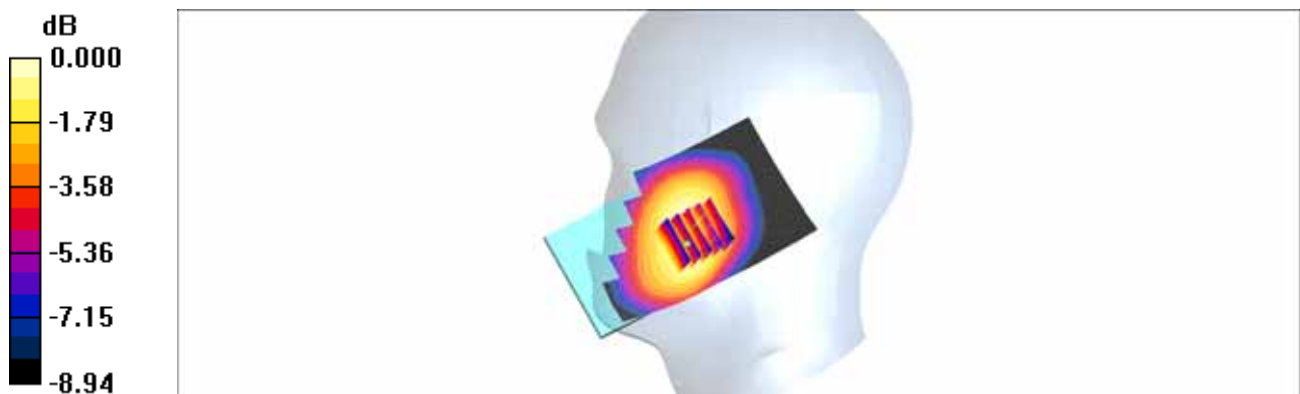
WCDMA850 right touch 4183/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 5.24 V/m; Power Drift = -0.082 dB

Peak SAR (extrapolated) = 0.245 W/kg

SAR(1 g) = 0.201 mW/g; SAR(10 g) = 0.156 mW/g

Maximum value of SAR (measured) = 0.210 mW/g



0 dB = 0.210mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
Liquid Temperature: 20.8
Ambient Temperature: 21.0
Test Date: May.21, 2014
Plot No. 4

DUT: LGL24; Type: Bar

Communication System: LTE 17; Frequency: 710 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 710 \text{ MHz}$; $\sigma = 0.869 \text{ mho/m}$; $\epsilon_r = 43.3$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Left Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(9.33, 9.33, 9.33); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: 1800/1900 Phantom; Type: SAM

LTE17 left touch QPSK 10MHz 1RB 0offset 23790/Area Scan (61x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.097 mW/g

LTE17 left touch QPSK 10MHz 1RB 0offset 23790/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

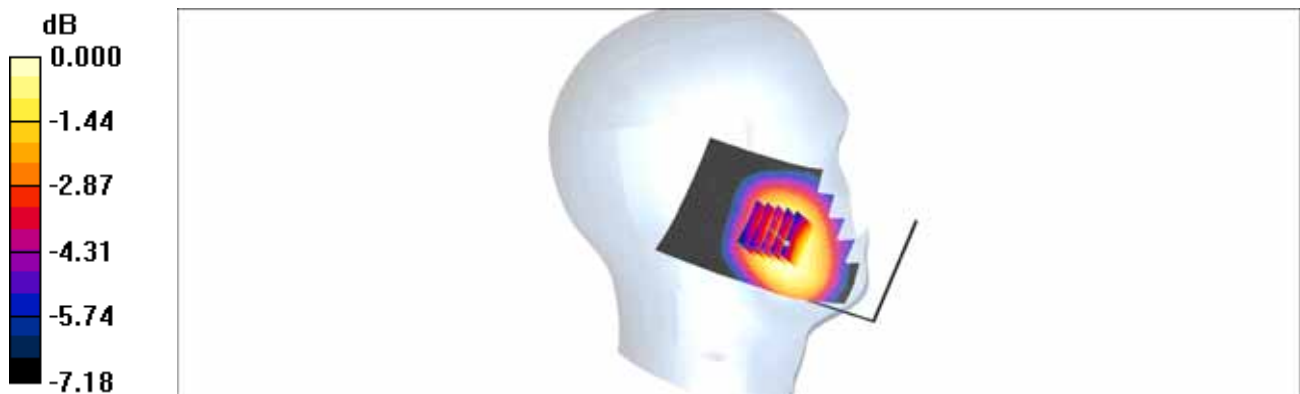
$dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 2.72 V/m; Power Drift = -0.062 dB

Peak SAR (extrapolated) = 0.109 W/kg

SAR(1 g) = 0.092 mW/g; SAR(10 g) = 0.074 mW/g

Maximum value of SAR (measured) = 0.096 mW/g



0 dB = 0.096mW/g

Test Laboratory: HCT CO., LTD
 EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
 Liquid Temperature: 21.1
 Ambient Temperature: 21.3
 Test Date: May.22, 2014
 Plot No. 5

DUT: LGL24; Type: Bar

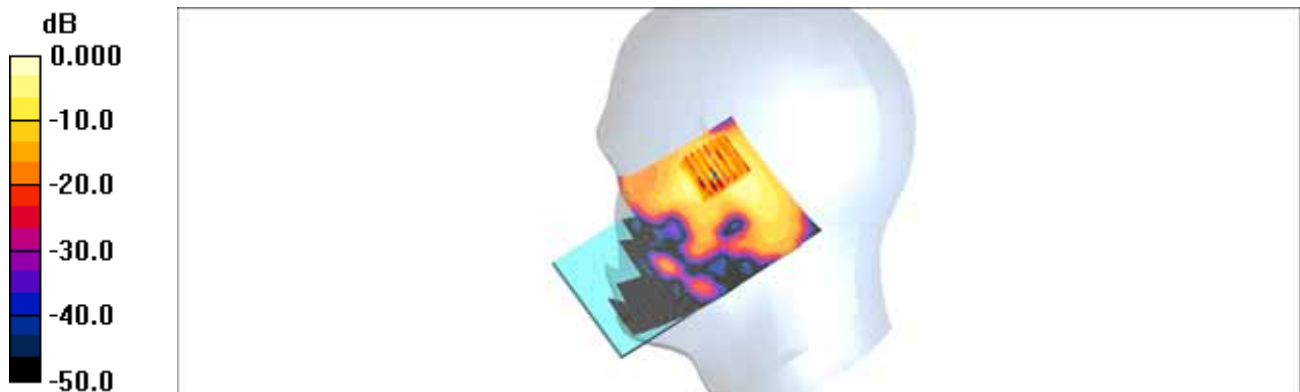
Communication System: 2450MHz FCC; Frequency: 2437 MHz; Duty Cycle: 1:1
 Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.78$ mho/m; $\epsilon_r = 39.8$; $\rho = 1000$ kg/m³
 Phantom section: Right Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(6.94, 6.94, 6.94); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: SAM 1800/1900 MHz; Type: SAM

WIFI2450 right touch 6ch/Area Scan (81x131x1): Measurement grid: dx=12mm, dy=12mm
 Maximum value of SAR (interpolated) = 0.119 mW/g

WIFI2450 right touch 6ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
 Reference Value = 3.52 V/m; Power Drift = 0.117 dB
 Peak SAR (extrapolated) = 0.191 W/kg
SAR(1 g) = 0.073 mW/g; SAR(10 g) = 0.029 mW/g
 Maximum value of SAR (measured) = 0.112 mW/g



0 dB = 0.112mW/g

Test Laboratory: HCT CO., LTD
 EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
 Liquid Temperature: 20.4
 Ambient Temperature: 20.6
 Test Date: May.24, 2014
 Plot No. 6

DUT: LGL24; Type: Bar

Communication System: UID 0, WIFI 5GHz (0); Frequency: 5745 MHz; Duty Cycle: 1:1
 Medium parameters used (interpolated): $f = 5745 \text{ MHz}$; $\sigma = 5.342 \text{ S/m}$; $\epsilon_r = 33.904$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(4.7, 4.7, 4.7); Calibrated: 2013-07-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: TP:xxxx
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7331)

LGL24/802.11a Right Touch 6Mbps 149ch/Area Scan (101x161x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Maximum value of SAR (interpolated) = 0.222 W/kg

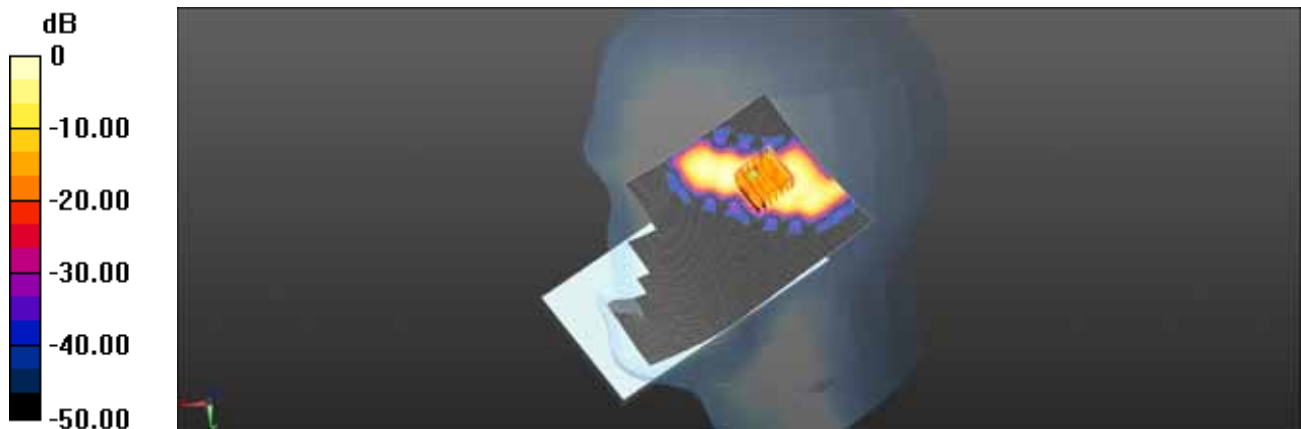
LGL24/802.11a Right Touch 6Mbps 149ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$

Reference Value = 3.494 V/m; Power Drift = -0.14 dB

Peak SAR (extrapolated) = 0.367 W/kg

SAR(1 g) = 0.070 W/kg; SAR(10 g) = 0.018 W/kg

Maximum value of SAR (measured) = 0.232 W/kg



0 dB = 0.222 W/kg = -6.53 dBW/kg

Test Laboratory: HCT CO., LTD
 EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
 Liquid Temperature: 20.4
 Ambient Temperature: 20.6
 Test Date: May.24, 2014
 Plot No. 7

DUT: LGL24; Type: Bar

Communication System: UID 0, WIFI 5GHz (0); Frequency: 5180 MHz; Duty Cycle: 1:1
 Medium parameters used (interpolated): $f = 5180$ MHz; $\sigma = 4.648$ S/m; $\epsilon_r = 35.423$; $\rho = 1000$ kg/m³
 Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(5.11, 5.11, 5.11); Calibrated: 2013-07-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: TP:xxxx
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7331)

LGL24/802.11a Right Touch 6Mbps 36ch/Area Scan (101x161x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm

Maximum value of SAR (interpolated) = 0.276 W/kg

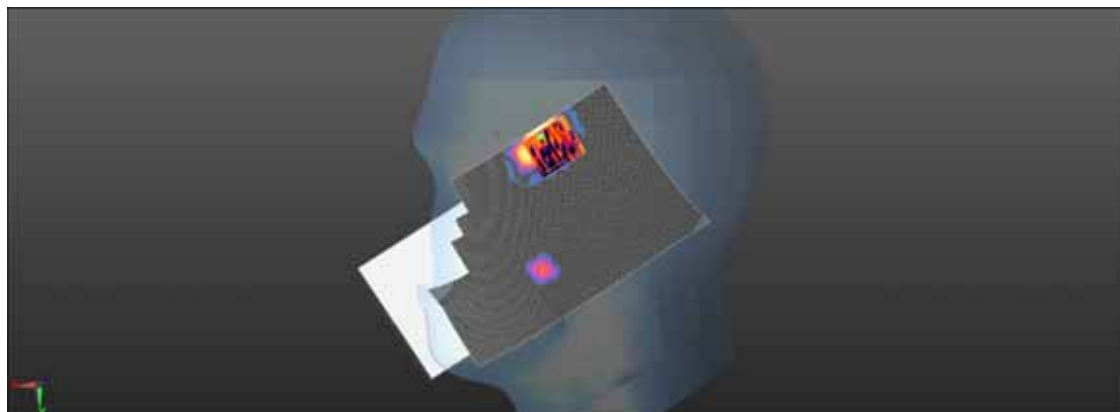
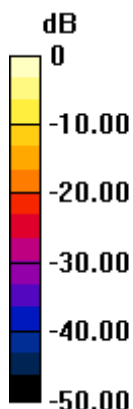
LGL24/802.11a Right Touch 6Mbps 36ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=1.4$ mm

Reference Value = 2.027 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 0.612 W/kg

SAR(1 g) = 0.043 W/kg; SAR(10 g) = 0.00677 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 0.162 W/kg



0 dB = 0.276 W/kg = -5.59 dBW/kg

Test Laboratory: HCT CO., LTD
EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
Liquid Temperature: 20.6
Ambient Temperature: 20.8
Test Date: May.20, 2014
Plot No. 8

DUT: LGL24; Type: Bar

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:2.075
Medium parameters used (interpolated): $f = 836.6$ MHz; $\sigma = 0.985$ mho/m; $\epsilon_r = 54.2$; $\rho = 1000$ kg/m³
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(9.03, 9.03, 9.03); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

GSM850 body rear 190 GPRS 4Tx/Area Scan (61x111x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.455 mW/g

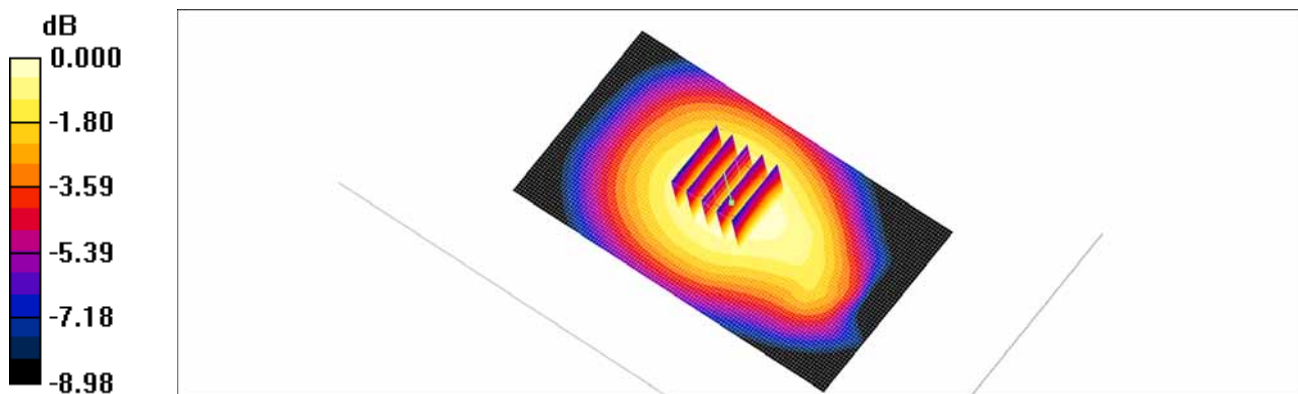
GSM850 body rear 190 GPRS 4Tx/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 21.8 V/m; Power Drift = 0.057 dB

Peak SAR (extrapolated) = 0.567 W/kg

SAR(1 g) = 0.456 mW/g; SAR(10 g) = 0.353 mW/g

Maximum value of SAR (measured) = 0.476 mW/g



0 dB = 0.476mW/g

Test Laboratory: HCT CO., LTD
 EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
 Liquid Temperature: 20.8
 Ambient Temperature: 21.0
 Test Date: May.23, 2014
 Plot No. 9

DUT: LGL24; Type: Bar

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:2.075
 Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.48 \text{ mho/m}$; $\epsilon_r = 52.4$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(7.14, 7.14, 7.14); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

GSM1900 body rear 661 GPRS 4Tx/Area Scan (61x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
 Maximum value of SAR (interpolated) = 0.381 mW/g

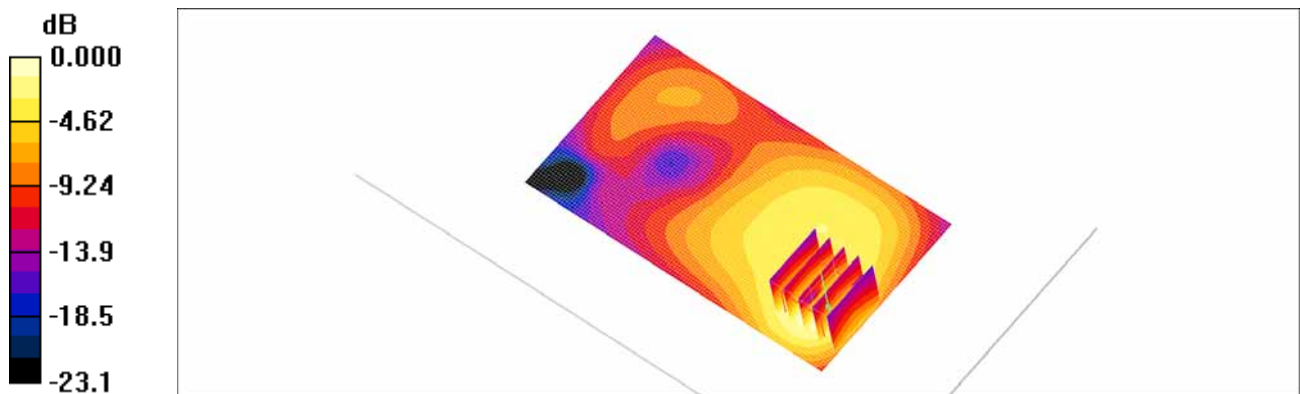
GSM1900 body rear 661 GPRS 4Tx/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 6.97 V/m; Power Drift = -0.080 dB

Peak SAR (extrapolated) = 0.594 W/kg

SAR(1 g) = 0.361 mW/g; SAR(10 g) = 0.201 mW/g

Maximum value of SAR (measured) = 0.403 mW/g



0 dB = 0.403mW/g

Test Laboratory: HCT CO., LTD
 EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
 Liquid Temperature: 20.6
 Ambient Temperature: 20.8
 Test Date: May.20, 2014
 Plot No. 10

DUT: LGL24; Type: Bar

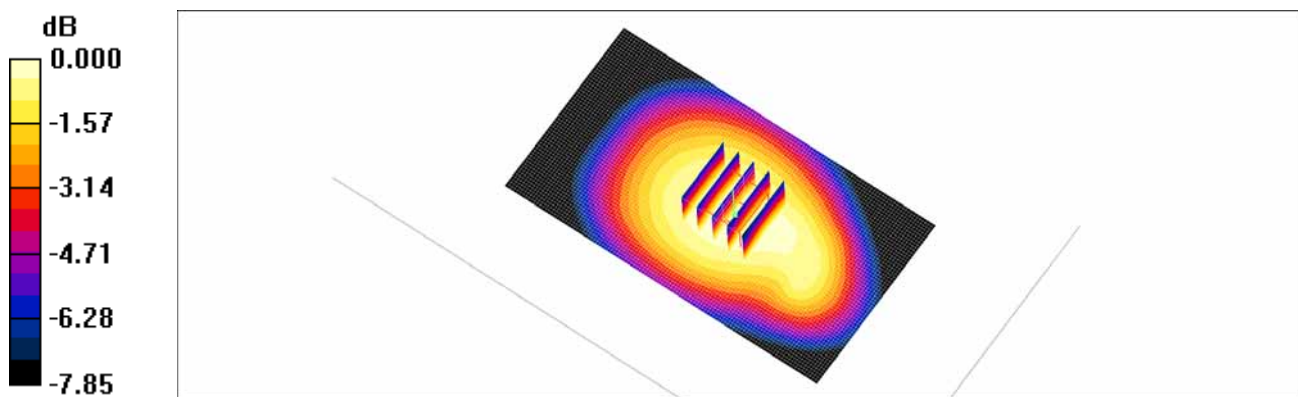
Communication System: WCDMA850; Frequency: 836.6 MHz; Duty Cycle: 1:1
 Medium parameters used (interpolated): $f = 836.6 \text{ MHz}$; $\sigma = 0.985 \text{ mho/m}$; $\epsilon_r = 54.2$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(9.03, 9.03, 9.03); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

WCDMA850 body rear 4183/Area Scan (61x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
 Maximum value of SAR (interpolated) = 0.349 mW/g

WCDMA850 body rear 4183/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
 Reference Value = 18.6 V/m; Power Drift = -0.024 dB
 Peak SAR (extrapolated) = 0.419 W/kg
SAR(1 g) = 0.338 mW/g; SAR(10 g) = 0.261 mW/g
 Maximum value of SAR (measured) = 0.354 mW/g



0 dB = 0.354mW/g

Test Laboratory: HCT CO., LTD
 EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
 Liquid Temperature: 20.8
 Ambient Temperature: 21.0
 Test Date: May.21, 2014
 Plot No. 11

DUT: LGL24; Type: Bar

Communication System: LTE 17; Frequency: 710 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 710 \text{ MHz}$; $\sigma = 0.946 \text{ mho/m}$; $\epsilon_r = 55.1$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(9.03, 9.03, 9.03); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA

LTE17 Body Rear QPSK 10MHz 1RB 0offset 23790/Area Scan (61x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.256 mW/g

LTE17 Body Rear QPSK 10MHz 1RB 0offset 23790/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

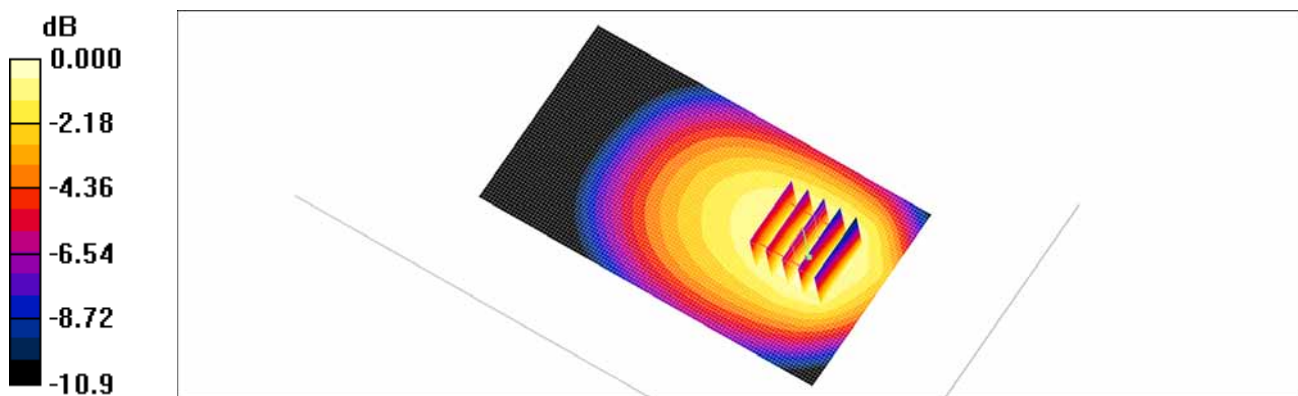
$dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 11.9 V/m; Power Drift = 0.003 dB

Peak SAR (extrapolated) = 0.316 W/kg

SAR(1 g) = 0.242 mW/g; SAR(10 g) = 0.181 mW/g

Maximum value of SAR (measured) = 0.254 mW/g



0 dB = 0.254mW/g

Test Laboratory: HCT CO., LTD
 EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
 Liquid Temperature: 21.1
 Ambient Temperature: 21.3
 Test Date: May.22, 2014
 Plot No. 12

DUT: LGL24; Type: Bar

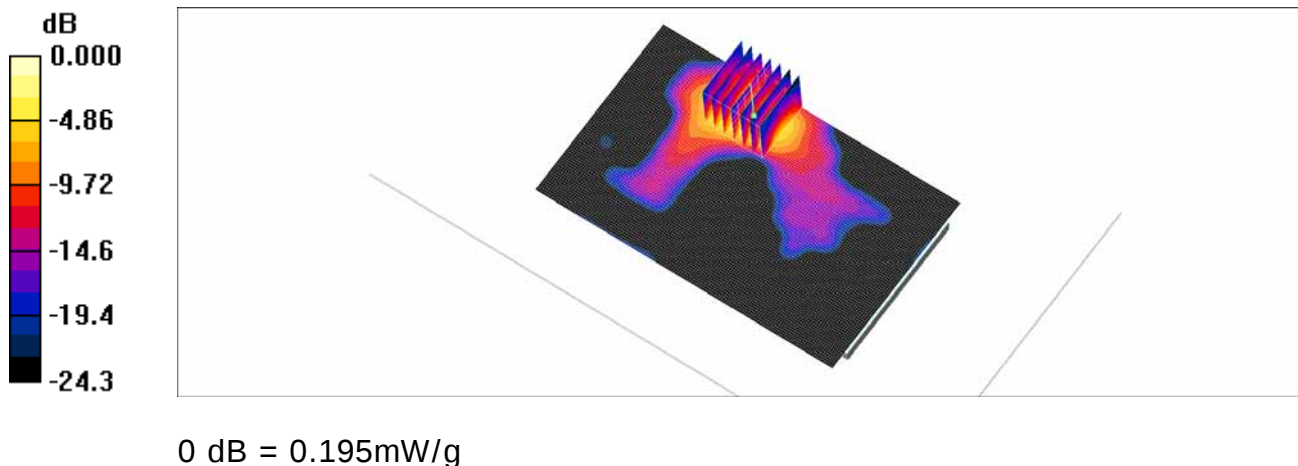
Communication System: 2450MHz FCC; Frequency: 2437 MHz; Duty Cycle: 1:1
 Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.94$ mho/m; $\epsilon_r = 52.2$; $\rho = 1000$ kg/m³
 Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(6.75, 6.75, 6.75); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

WIFI2450 body rear 6ch/Area Scan (81x131x1): Measurement grid: dx=12mm, dy=12mm
 Maximum value of SAR (interpolated) = 0.192 mW/g

WIFI2450 body rear 6ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
 Reference Value = 0.925 V/m; Power Drift = 0.067 dB
 Peak SAR (extrapolated) = 0.260 W/kg
SAR(1 g) = 0.125 mW/g; SAR(10 g) = 0.053 mW/g
 Maximum value of SAR (measured) = 0.195 mW/g



Test Laboratory: HCT CO., LTD
 EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
 Liquid Temperature: 21.0
 Ambient Temperature: 21.2
 Test Date: May.25, 2014
 Plot No. 13

DUT: LGL24; Type: Bar

Communication System: UID 0, WIFI 5GHz (0); Frequency: 5745 MHz; Duty Cycle: 1:1
 Medium parameters used (interpolated): $f = 5745 \text{ MHz}$; $\sigma = 6.091 \text{ S/m}$; $\epsilon_r = 47.022$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(3.95, 3.95, 3.95); Calibrated: 2013-07-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: xxxx
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7331)

LGL24/802.11a Body Rear 6Mbps 149ch/Area Scan (101x161x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Maximum value of SAR (interpolated) = 1.06 W/kg

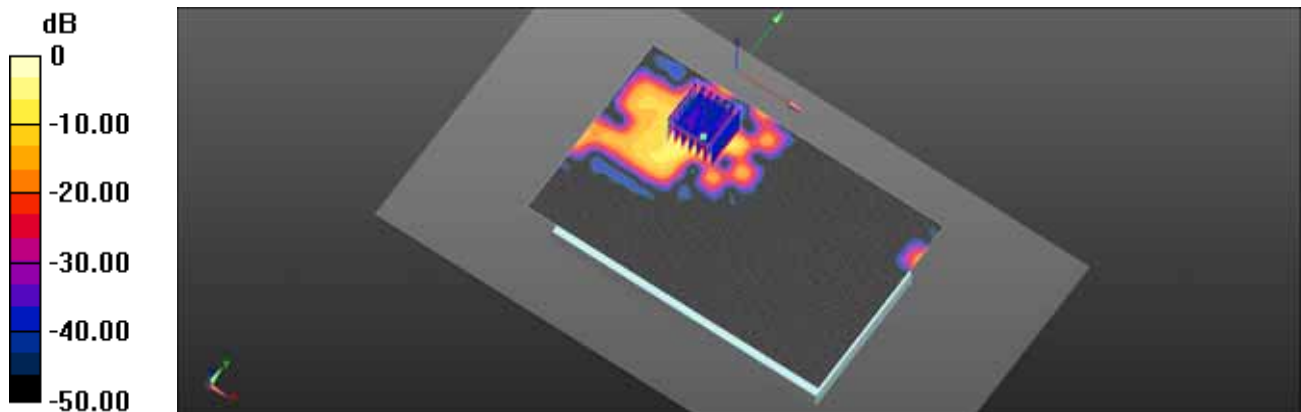
LGL24/802.11a Body Rear 6Mbps 149ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$

Reference Value = 1.711 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 0.601 W/kg

SAR(1 g) = 0.143 W/kg; SAR(10 g) = 0.047 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 0.385 W/kg



0 dB = 1.06 W/kg = 0.27 dBW/kg

Test Laboratory: HCT CO., LTD
 EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
 Liquid Temperature: 21.0
 Ambient Temperature: 21.2
 Test Date: May.25, 2014
 Plot No. 14

DUT: LGL24; Type: Bar

Communication System: UID 0, 5GHz(80ac) (0); Frequency: 5210 MHz; Duty Cycle: 1:1
 Medium parameters used (interpolated): $f = 5210 \text{ MHz}$; $\sigma = 5.208 \text{ S/m}$; $\epsilon_r = 48.512$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(4.49, 4.49, 4.49); Calibrated: 2013-07-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: xxxx
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7331)

LGL24/802.11ac80 Body Rear MCS0 42ch/Area Scan (101x161x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Maximum value of SAR (interpolated) = 0.511 W/kg

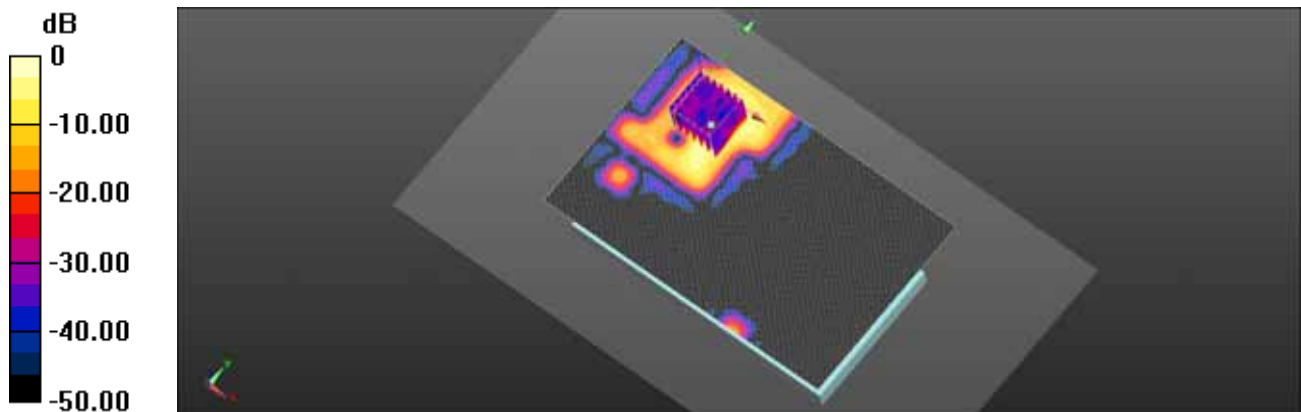
LGL24/802.11ac80 Body Rear MCS0 42ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$

Reference Value = 1.703 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 0.668 W/kg

SAR(1 g) = 0.172 W/kg; SAR(10 g) = 0.051 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 0.433 W/kg



0 dB = 0.511 W/kg = -2.92 dBW/kg

Test Laboratory: HCT CO., LTD
 EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
 Liquid Temperature: 21.0
 Ambient Temperature: 21.2
 Test Date: May.25, 2014
 Plot No. 15

DUT: LGL24; Type: Bar

Communication System: UID 0, WIFI 5GHz (0); Frequency: 5260 MHz; Duty Cycle: 1:1
 Medium parameters used (interpolated): $f = 5260$ MHz; $\sigma = 5.295$ S/m; $\epsilon_r = 48.384$; $\rho = 1000$ kg/m³
 Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(4.14, 4.14, 4.14); Calibrated: 2013-07-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: xxxx
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7331)

LGL24/802.11a Body Rear 6Mbps 52ch/Area Scan (101x161x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm

Maximum value of SAR (interpolated) = 0.226 W/kg

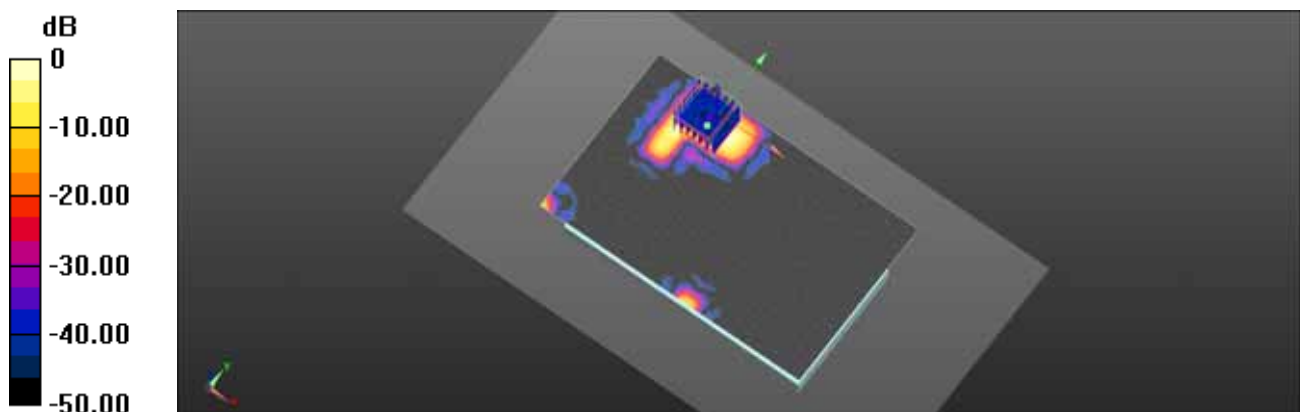
LGL24/802.11a Body Rear 6Mbps 52ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=1.4$ mm

Reference Value = 0.9720 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.320 W/kg

SAR(1 g) = 0.078 W/kg; SAR(10 g) = 0.019 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 0.201 W/kg



0 dB = 0.226 W/kg = -6.46 dBW/kg

Test Laboratory: HCT CO., LTD
 EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
 Liquid Temperature: 21.0
 Ambient Temperature: 21.2
 Test Date: May.25, 2014
 Plot No. 16

DUT: LGL24; Type: Bar

Communication System: UID 0, 5GHz(80ac) (0); Frequency: 5690 MHz; Duty Cycle: 1:1
 Medium parameters used (interpolated): $f = 5690 \text{ MHz}$; $\sigma = 5.999 \text{ S/m}$; $\epsilon_r = 47.16$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(3.6, 3.6, 3.6); Calibrated: 2013-07-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: xxxx
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7331)

LGL24/802.11ac80 Body Rear MCS0 138ch/Area Scan (101x161x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Maximum value of SAR (interpolated) = 0.355 W/kg

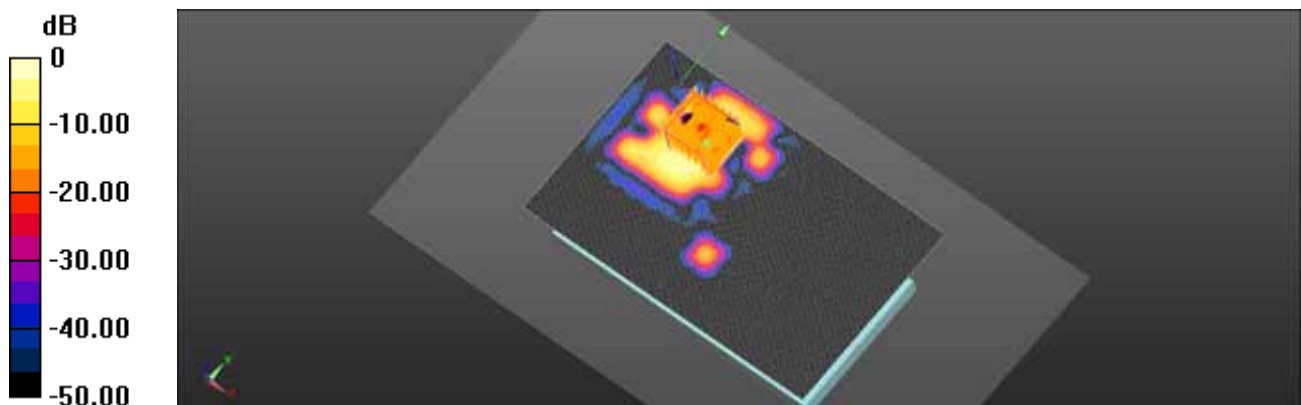
LGL24/802.11ac80 Body Rear MCS0 138ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$

Reference Value = 1.100 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 1.32 W/kg

SAR(1 g) = 0.075 W/kg; SAR(10 g) = 0.011 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 0.512 W/kg



0 dB = 0.355 W/kg = -4.50 dBW/kg

Test Laboratory: HCT CO., LTD
EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
Liquid Temperature: 20.6
Ambient Temperature: 20.8
Test Date: May.20, 2014
Plot No. 17

DUT: LGL24; Type: Bar

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:8.3
Medium parameters used (interpolated): $f = 836.6$ MHz; $\sigma = 0.985$ mho/m; $\epsilon_r = 54.2$; $\rho = 1000$ kg/m³
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(9.03, 9.03, 9.03); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

GSM850 body rear 190 body worn/Area Scan (61x111x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.308 mW/g

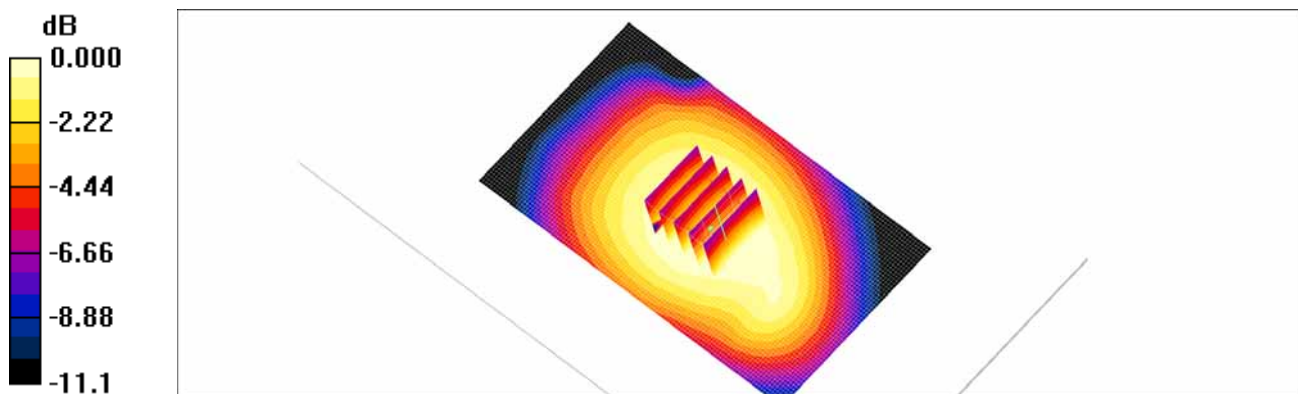
GSM850 body rear 190 body worn/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 17.5 V/m; Power Drift = -0.048 dB

Peak SAR (extrapolated) = 0.417 W/kg

SAR(1 g) = 0.293 mW/g; SAR(10 g) = 0.222 mW/g

Maximum value of SAR (measured) = 0.300 mW/g



0 dB = 0.300mW/g

Test Laboratory: HCT CO., LTD

EUT Type: Cellular/PCS GSM, Cellular WCDMA, LTE Phone with Bluetooth/WLAN/NFC
 Liquid Temperature: 20.8
 Ambient Temperature: 21.0
 Test Date: May.23, 2014
 Plot No. 18

DUT: LGL24; Type: Bar

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3
 Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.48 \text{ mho/m}$; $\epsilon_r = 52.4$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(7.14, 7.14, 7.14); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

GSM1900 body rear 661 body worn/Area Scan (61x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
 Maximum value of SAR (interpolated) = 0.236 mW/g

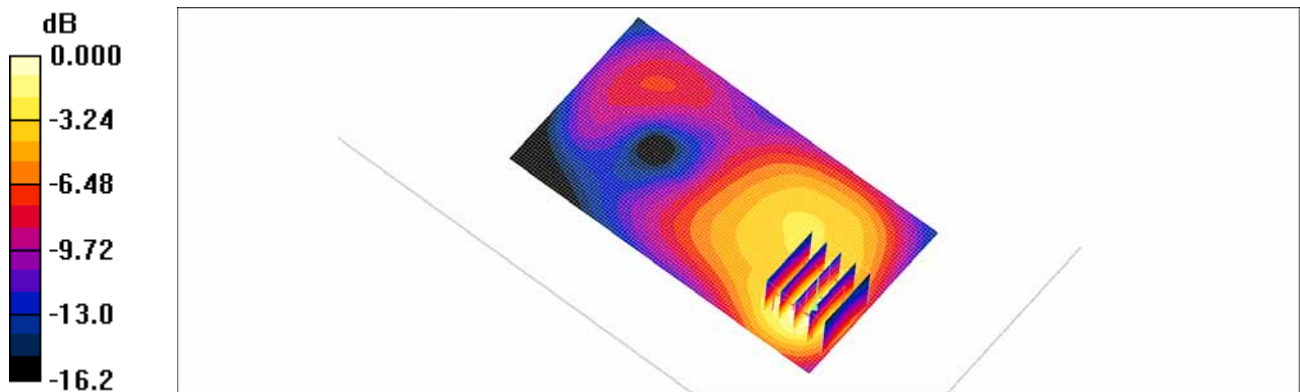
GSM1900 body rear 661 body worn/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 5.45 V/m; Power Drift = -0.015 dB

Peak SAR (extrapolated) = 0.373 W/kg

SAR(1 g) = 0.224 mW/g; SAR(10 g) = 0.125 mW/g

Maximum value of SAR (measured) = 0.248 mW/g



0 dB = 0.248mW/g

Attachment 2. – Dipole Verification Plots

■ Verification Data (750 MHz Head)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 20.8
Test Date: May. 21, 2014

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1014

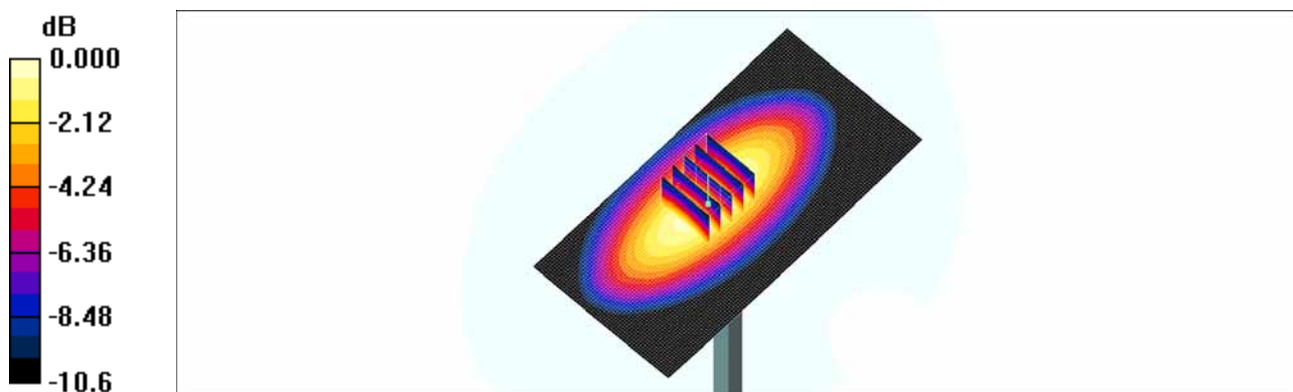
Communication System: CW; Frequency: 750 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.904 \text{ mho/m}$; $\epsilon_r = 42.7$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(9.33, 9.33, 9.33); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: SAM 1800/1900 MHz; Type: SAM

Verification 750 MHz/Area Scan (61x121x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.874 mW/g

Verification 750 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
Reference Value = 28.9 V/m; Power Drift = 0.042 dB
Peak SAR (extrapolated) = 1.23 W/kg
SAR(1 g) = 0.824 mW/g; SAR(10 g) = 0.540 mW/g
Maximum value of SAR (measured) = 0.890 mW/g



0 dB = 0.890mW/g

■ Verification Data (750 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 20.8
Test Date: May. 21, 2014

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1014

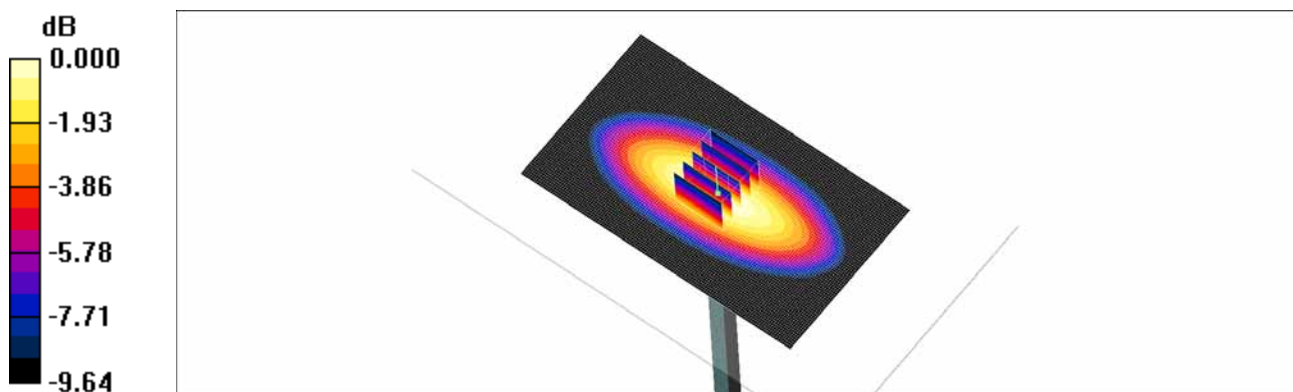
Communication System: CW; Frequency: 750 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.983 \text{ mho/m}$; $\epsilon_r = 54.7$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(9.03, 9.03, 9.03); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

Verification 750 MHz/Area Scan (121x71x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.962 mW/g

Verification 750 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
Reference Value = 31.4 V/m; Power Drift = 0.013 dB
Peak SAR (extrapolated) = 1.32 W/kg
SAR(1 g) = 0.908 mW/g; SAR(10 g) = 0.611 mW/g
Maximum value of SAR (measured) = 0.974 mW/g



0 dB = 0.974mW/g

■ Verification Data (835 MHz Head)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 20.2
Test Date: May. 19, 2014

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d165

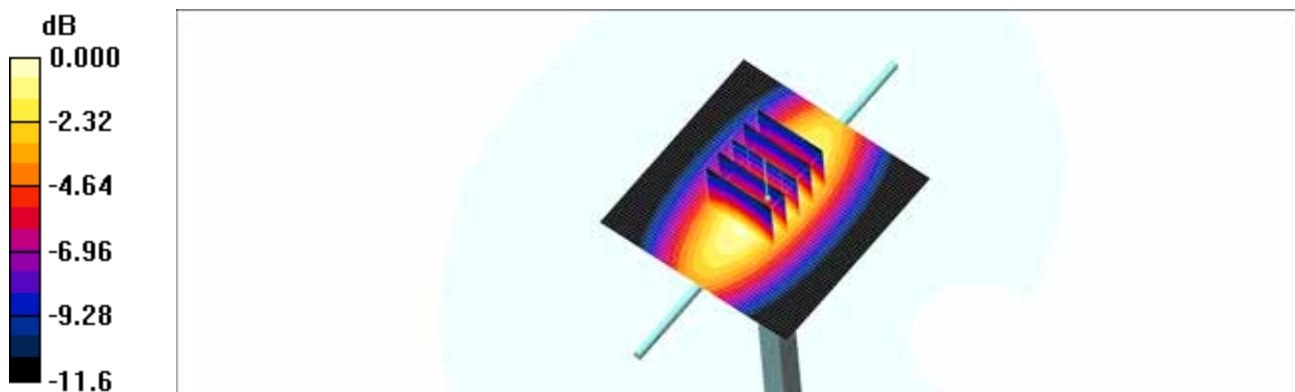
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.873 \text{ mho/m}$; $\epsilon_r = 42.1$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(9.04, 9.04, 9.04); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: 1800/1900 Phantom; Type: SAM

Verification 835MHz/Area Scan (61x61x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 1.11 mW/g

Verification 835MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
Reference Value = 35.6 V/m; Power Drift = -0.003 dB
Peak SAR (extrapolated) = 1.65 W/kg
SAR(1 g) = 1 mW/g; SAR(10 g) = 0.613 mW/g
Maximum value of SAR (measured) = 1.10 mW/g



0 dB = 1.10mW/g

■ Verification Data (835 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 20.6
Test Date: May. 20, 2014

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d165

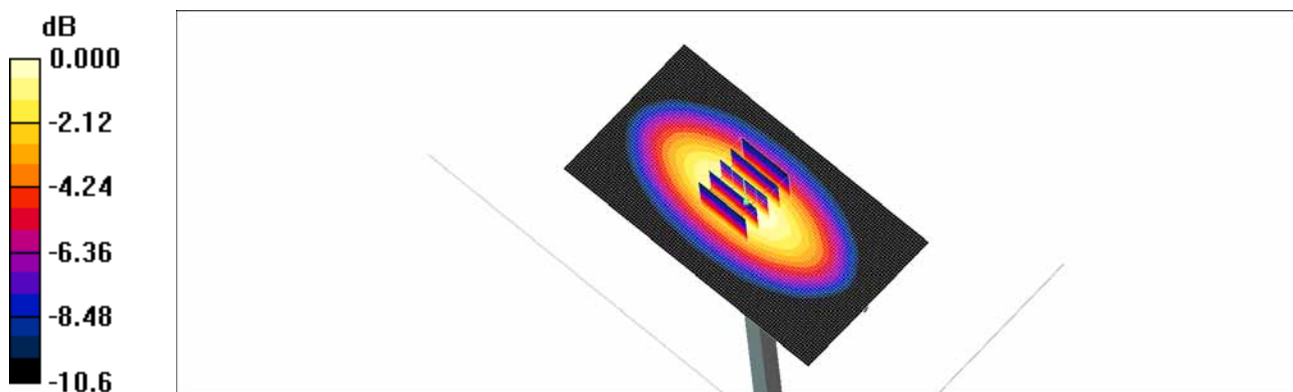
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.984 \text{ mho/m}$; $\epsilon_r = 54.2$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(9.03, 9.03, 9.03); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA

Verification 835 MHz/Area Scan (111x61x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 1.07 mW/g

Verification 835 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
Reference Value = 33.0 V/m; Power Drift = -0.006 dB
Peak SAR (extrapolated) = 1.48 W/kg
SAR(1 g) = 0.987 mW/g; SAR(10 g) = 0.641 mW/g
Maximum value of SAR (measured) = 1.06 mW/g



0 dB = 1.06mW/g

■ Verification Data (1 900 MHz Head)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 20.8
Test Date: May. 23, 2014

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d032

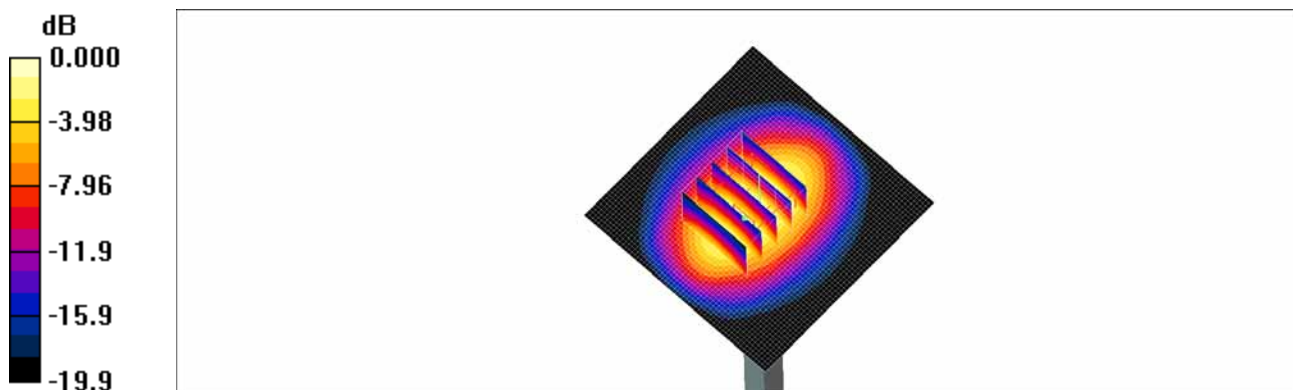
Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 1900$ MHz; $\sigma = 1.39$ mho/m; $\epsilon_r = 38.9$; $\rho = 1000$ kg/m³
Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(7.73, 7.73, 7.73); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: 1800/1900 Phantom; Type: SAM

Verification 1900MHz/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 4.46 mW/g

Verification 1900MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 54.8 V/m; Power Drift = 0.002 dB
Peak SAR (extrapolated) = 7.33 W/kg
SAR(1 g) = 3.79 mW/g; SAR(10 g) = 1.93 mW/g
Maximum value of SAR (measured) = 4.16 mW/g



0 dB = 4.16mW/g

■ Verification Data (1 900 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 20.8
Test Date: May. 23, 2014

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d032

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 1900$ MHz; $\sigma = 1.5$ mho/m; $\epsilon_r = 52.3$; $\rho = 1000$ kg/m³
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(7.14, 7.14, 7.14); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA

Verificaton1900 MHz/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 4.75 mW/g

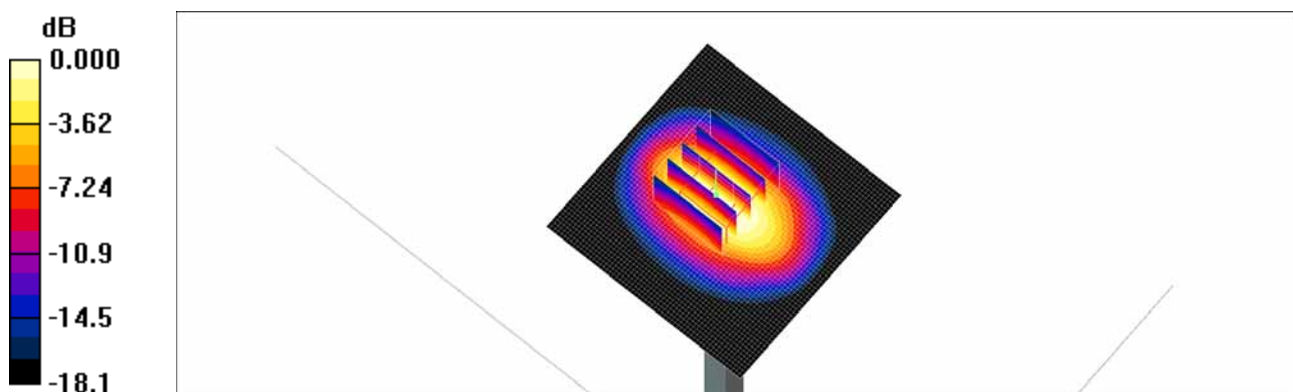
Verificaton1900 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 53.4 V/m; Power Drift = 0.001 dB

Peak SAR (extrapolated) = 7.01 W/kg

SAR(1 g) = 3.93 mW/g; SAR(10 g) = 2.07 mW/g

Maximum value of SAR (measured) = 4.31 mW/g



0 dB = 4.31mW/g

■ Verification Data (2 450 MHz Head)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 21.1
Test Date: May. 22, 2014

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:743

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 2450$ MHz; $\sigma = 1.8$ mho/m; $\epsilon_r = 39.8$; $\rho = 1000$ kg/m³
Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(6.94, 6.94, 6.94); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: 835/900 Phantom ; Type: SAM

Verification 2450MHz/Area Scan (81x81x1): Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 8.20 mW/g

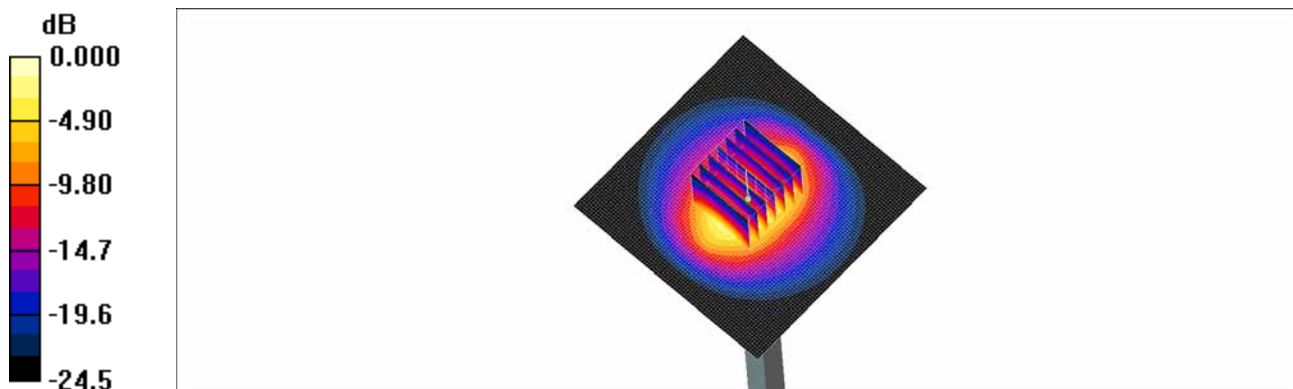
Verification 2450MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.1 V/m; Power Drift = -0.013 dB

Peak SAR (extrapolated) = 11.6 W/kg

SAR(1 g) = 5.19 mW/g; SAR(10 g) = 2.3 mW/g

Maximum value of SAR (measured) = 8.19 mW/g



0 dB = 8.19mW/g

■ Verification Data (2 450 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 21.1
Test Date: May. 22, 2014

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:743

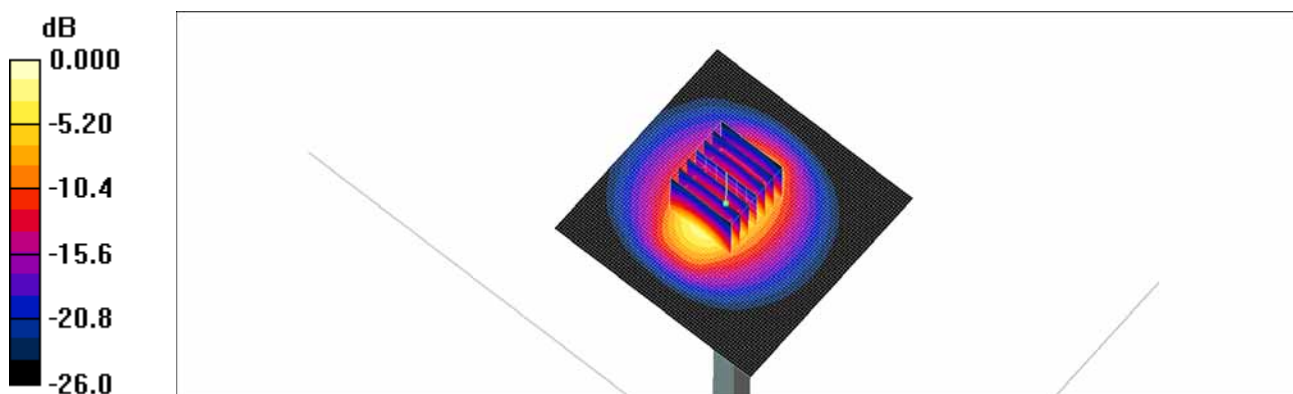
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 2450$ MHz; $\sigma = 1.96$ mho/m; $\epsilon_r = 52.2$; $\rho = 1000$ kg/m³
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(6.75, 6.75, 6.75); Calibrated: 2013-11-29
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2014-03-26
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA

Verification 2450MHz/Area Scan (81x81x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 8.35 mW/g

Verification 2450MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 49.9 V/m; Power Drift = -0.076 dB
Peak SAR (extrapolated) = 12.2 W/kg
SAR(1 g) = 5.22 mW/g; SAR(10 g) = 2.24 mW/g
Maximum value of SAR (measured) = 8.42 mW/g



0 dB = 8.42mW/g

■ Verification Data (5 200 MHz Head)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 20.4
Test Date: May. 24, 2014

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1107

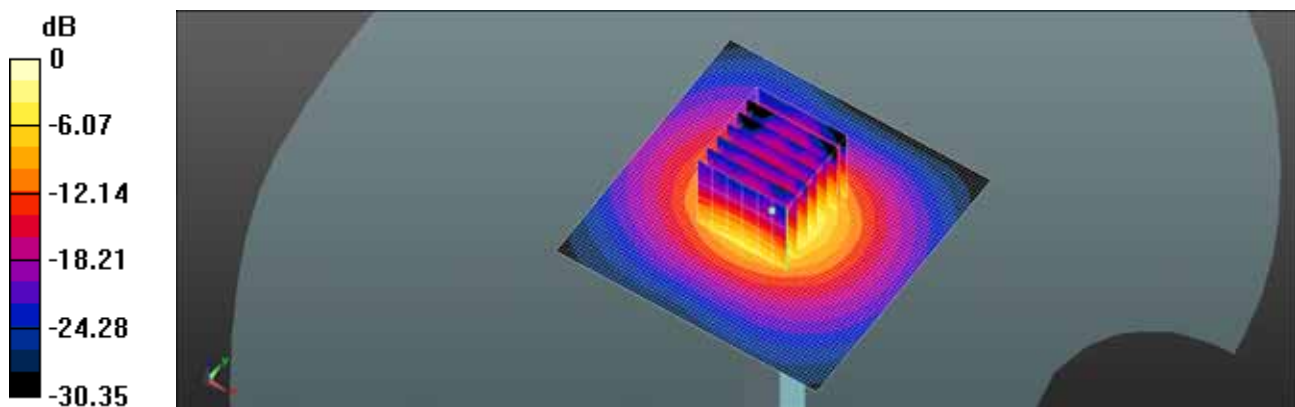
Communication System: UID 0, CW (0); Frequency: 5200 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5200$ MHz; $\sigma = 4.678$ S/m; $\epsilon_r = 35.363$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(5.11, 5.11, 5.11); Calibrated: 2013-07-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: TP:xxxx
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7331)

5200MHz Verification/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 18.5 W/kg

5200MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 70.28 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 31.6 W/kg
SAR(1 g) = 7.91 W/kg; SAR(10 g) = 2.28 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 20.0 W/kg



0 dB = 18.5 W/kg = 12.68 dBW/kg

■ Verification Data (5 200 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 21.0
Test Date: May. 25, 2014

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1107

Communication System: UID 0, CW (0); Frequency: 5200 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5200$ MHz; $\sigma = 5.19$ S/m; $\epsilon_r = 48.538$; $\rho = 1000$ kg/m³
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(4.49, 4.49, 4.49); Calibrated: 2013-07-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: xxxx
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7331)

5200MHz Verification/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 17.4 W/kg

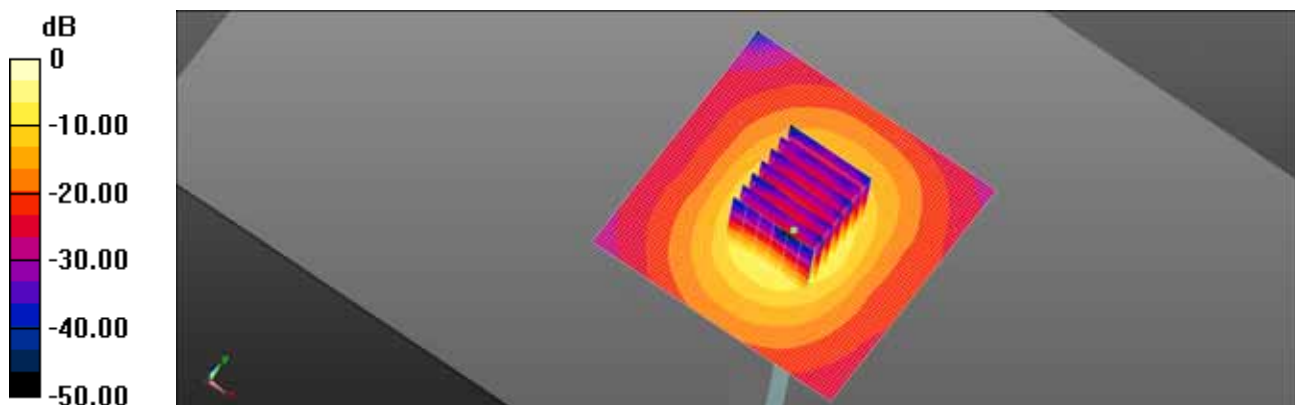
5200MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 61.61 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 31.2 W/kg

SAR(1 g) = 7.27 W/kg; SAR(10 g) = 2.05 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 18.7 W/kg



0 dB = 17.4 W/kg = 12.40 dBW/kg

■ Verification Data (5 300 MHz Head)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 20.4
Test Date: May. 24, 2014

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1107

Communication System: UID 0, CW (0); Frequency: 5300 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5300$ MHz; $\sigma = 4.804$ S/m; $\epsilon_r = 35.074$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(4.83, 4.83, 4.83); Calibrated: 2013-07-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: TP:xxxx
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7331)

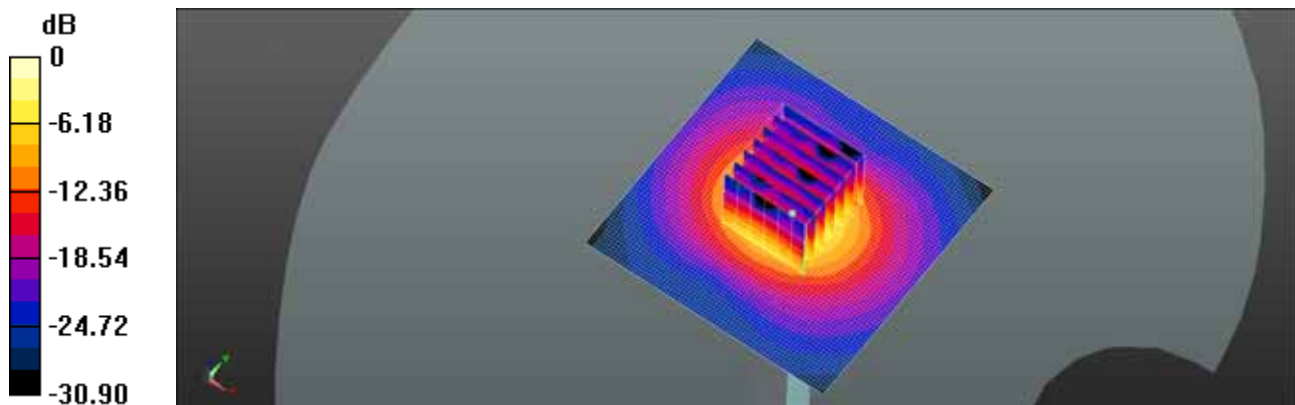
5300MHz Verification/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 20.4 W/kg

5300MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 72.61 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 33.5 W/kg

SAR(1 g) = 8.35 W/kg; SAR(10 g) = 2.36 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 21.3 W/kg



0 dB = 20.4 W/kg = 13.10 dBW/kg

■ Verification Data (5 300 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 21.0
Test Date: May. 25, 2014

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1107

Communication System: UID 0, CW (0); Frequency: 5300 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5300$ MHz; $\sigma = 5.357$ S/m; $\epsilon_r = 48.284$; $\rho = 1000$ kg/m³
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(4.14, 4.14, 4.14); Calibrated: 2013-07-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: xxxx
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7331)

5300MHz Verification/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 17.8 W/kg

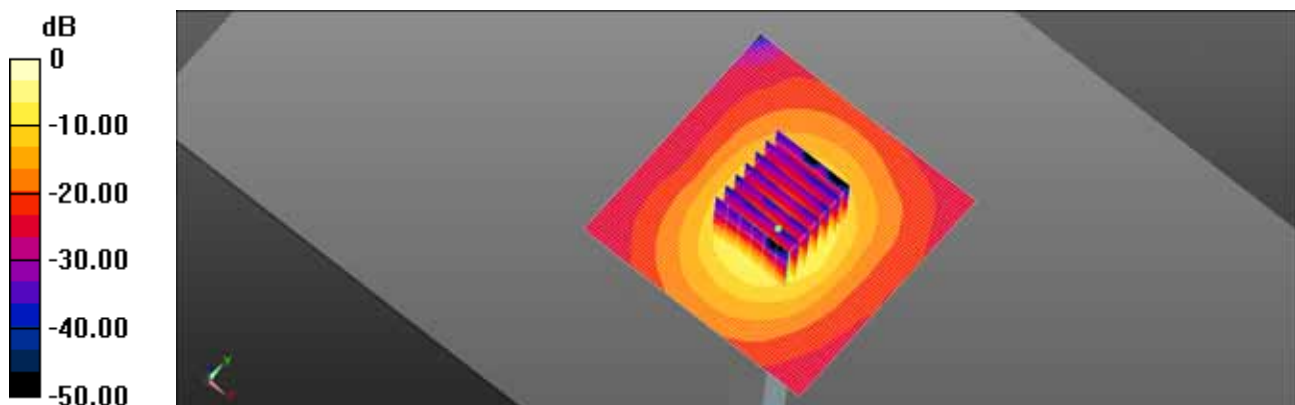
5300MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.51 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 31.0 W/kg

SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.1 W/kg (SAR corrected for target medium)

Maximum value of SAR (measured) = 19.3 W/kg



0 dB = 17.8 W/kg = 12.50 dBW/kg

■ Verification Data (5 500 MHz Head)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 20.4
Test Date: May. 24, 2014

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1107

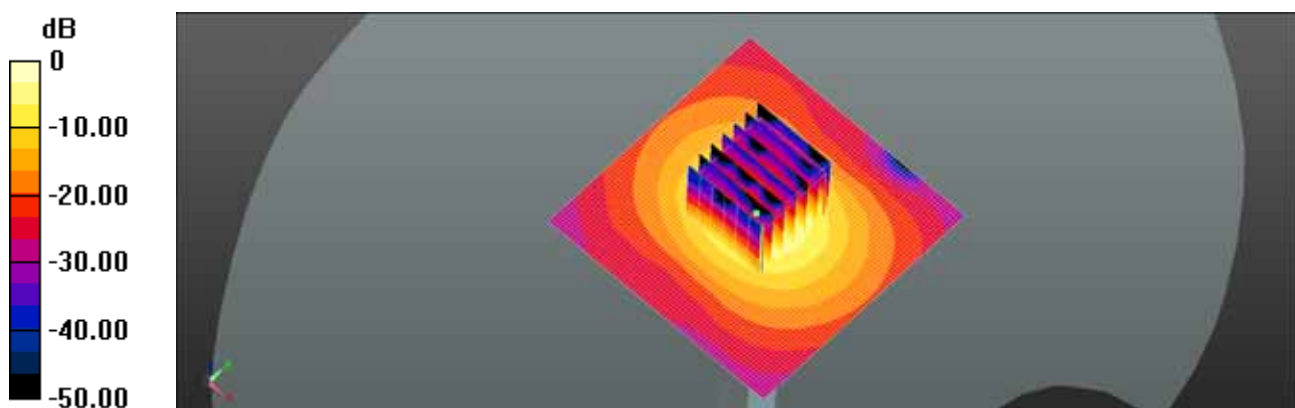
Communication System: UID 0, CW (0); Frequency: 5500 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5500$ MHz; $\sigma = 5.048$ S/m; $\epsilon_r = 34.576$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(4.81, 4.81, 4.81); Calibrated: 2013-07-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: TP:xxxx
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7331)

5500MHz Verification/Area Scan (71x71x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm
Maximum value of SAR (interpolated) = 18.6 W/kg

5500MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=1.4$ mm
Reference Value = 70.43 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 33.6 W/kg
SAR(1 g) = 8.05 W/kg; SAR(10 g) = 2.26 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 20.6 W/kg



0 dB = 18.6 W/kg = 12.70 dBW/kg

■ Verification Data (5 500 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 21.0
Test Date: May. 25, 2014

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1107

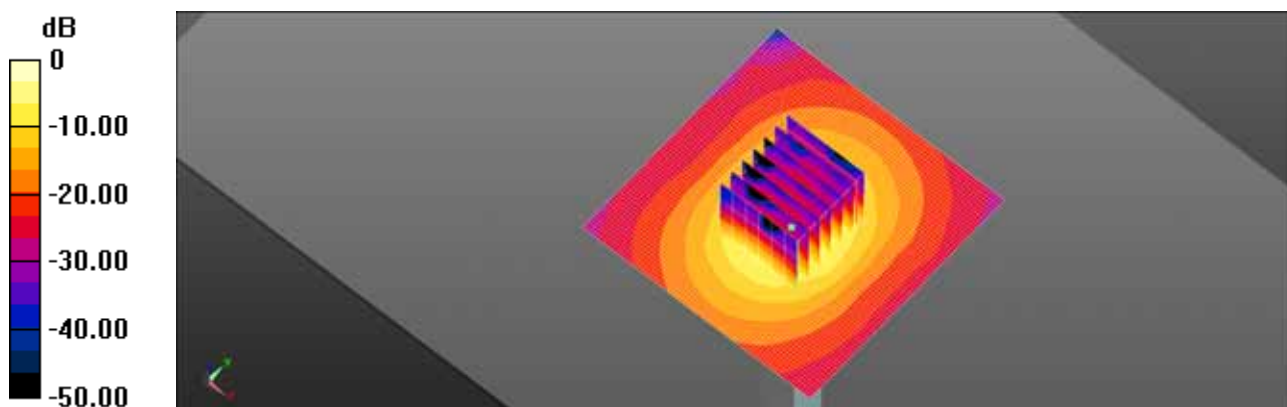
Communication System: UID 0, CW (0); Frequency: 5500 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5500$ MHz; $\sigma = 5.692$ S/m; $\epsilon_r = 47.676$; $\rho = 1000$ kg/m³
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(3.91, 3.91, 3.91); Calibrated: 2013-07-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: xxxx
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7331)

5500MHz Verification/Area Scan (71x71x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm
Maximum value of SAR (interpolated) = 18.7 W/kg

5500MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=1.4$ mm
Reference Value = 63.63 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 32.9 W/kg
SAR(1 g) = 7.69 W/kg; SAR(10 g) = 2.14 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 20.0 W/kg



0 dB = 18.7 W/kg = 12.72 dBW/kg

■ Verification Data (5 600 MHz Head)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 20.4
Test Date: May. 24, 2014

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1107

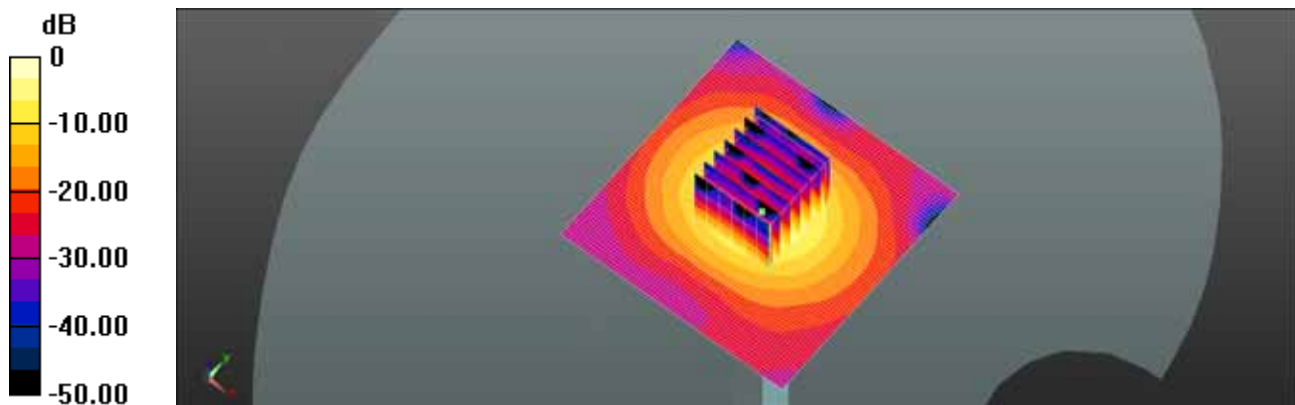
Communication System: UID 0, CW (0); Frequency: 5600 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5600$ MHz; $\sigma = 5.179$ S/m; $\epsilon_r = 34.334$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(4.44, 4.44, 4.44); Calibrated: 2013-07-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: TP:xxxx
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7331)

5600MHz Verification/Area Scan (71x71x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm
Maximum value of SAR (interpolated) = 20.0 W/kg

5600MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=1.4$ mm
Reference Value = 71.24 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 34.1 W/kg
SAR(1 g) = 8.42 W/kg; SAR(10 g) = 2.37 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 21.7 W/kg



0 dB = 20.0 W/kg = 13.02 dBW/kg

■ Verification Data (5 600 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 21.0
Test Date: May. 25, 2014

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1107

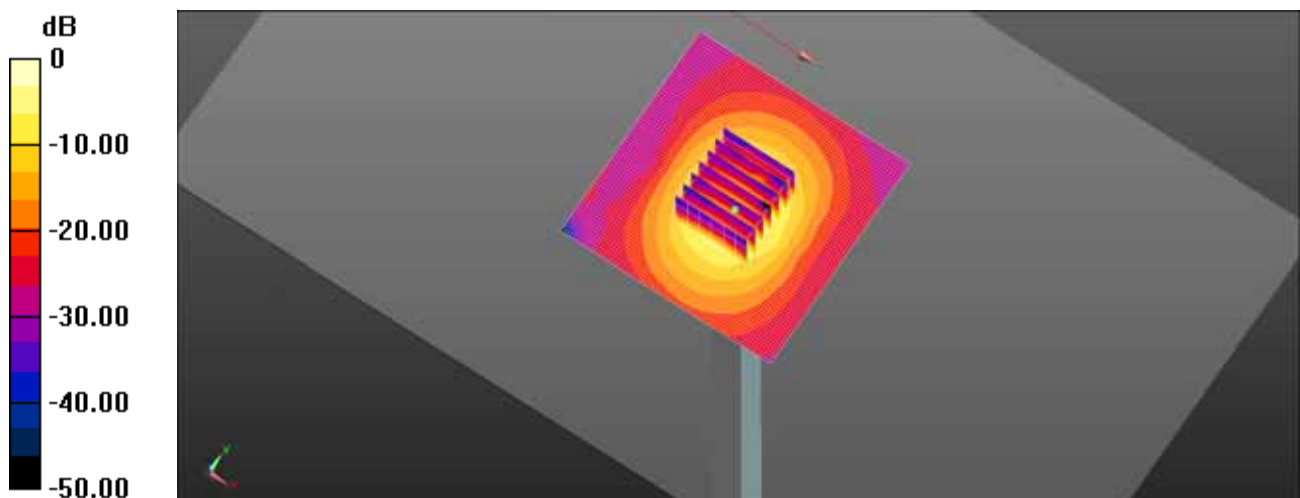
Communication System: UID 0, CW (0); Frequency: 5600 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5600$ MHz; $\sigma = 5.847$ S/m; $\epsilon_r = 47.429$; $\rho = 1000$ kg/m³
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(3.6, 3.6, 3.6); Calibrated: 2013-07-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: xxxx
- ; SEMCAD X Version 14.6.10 (7331)

5600MHz Verification/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 19.6 W/kg

5600MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.63 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 31.9 W/kg
SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.16 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 20.4 W/kg



0 dB = 19.6 W/kg = 12.93 dBW/kg

■ Verification Data (5 800 MHz Head)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 20.4
Test Date: May. 24, 2014

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1107

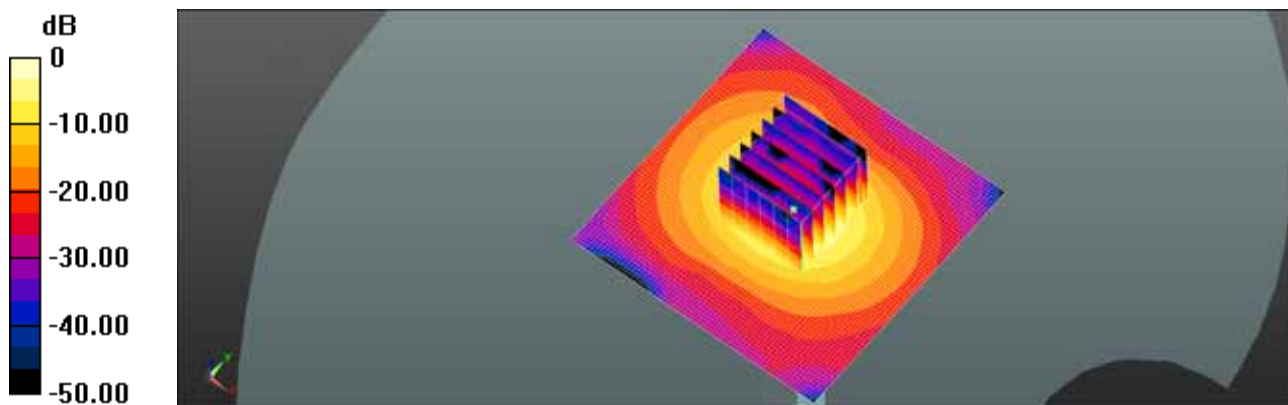
Communication System: UID 0, CW (0); Frequency: 5800 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5800$ MHz; $\sigma = 5.438$ S/m; $\epsilon_r = 33.731$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(4.7, 4.7, 4.7); Calibrated: 2013-07-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: TP:xxxx
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7331)

5800MHz Verification/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 19.1 W/kg

5800MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.94 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 34.1 W/kg
SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.17 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 20.7 W/kg



0 dB = 19.1 W/kg = 12.81 dBW/kg

■ Verification Data (5 800 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 21.0
Test Date: May. 25, 2014

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1107

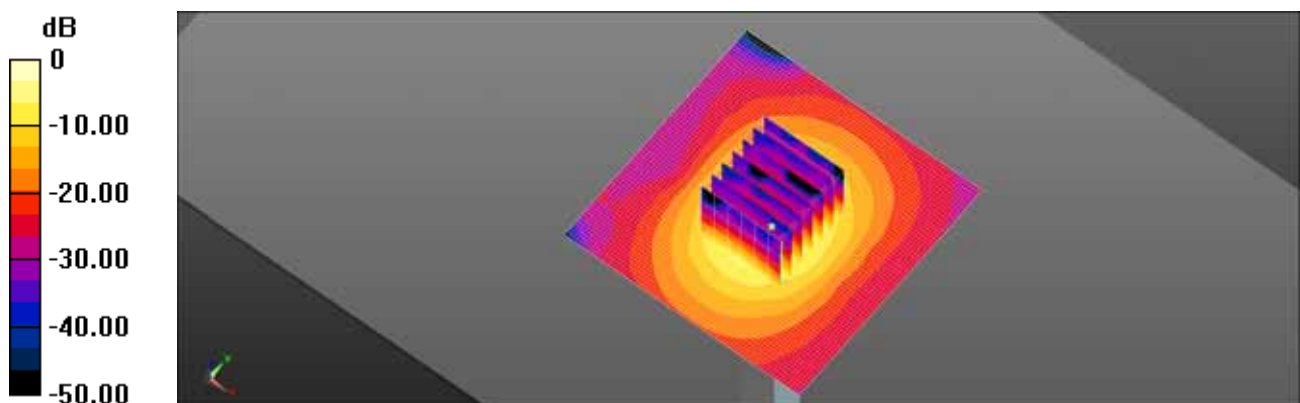
Communication System: UID 0, CW (0); Frequency: 5800 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5800$ MHz; $\sigma = 6.174$ S/m; $\epsilon_r = 46.874$; $\rho = 1000$ kg/m³
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(3.95, 3.95, 3.95); Calibrated: 2013-07-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: xxxx
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7331)

5800MHz Verification/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 18.1 W/kg

5800MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.14 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 32.5 W/kg
SAR(1 g) = 7.19 W/kg; SAR(10 g) = 2 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 19.3 W/kg



0 dB = 18.1 W/kg = 12.58 dBW/kg

Attachment 3. – Probe Calibration Data

**Calibration Laboratory of
Schmid & Partner
Engineering AG**
Zeughausstrasse 43, 8004 Zurich, Switzerland



S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

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

Accreditation No.: **SCS 108**

Client **HCT (Dymstec)**

Certificate No: **EX3-3797_Nov13**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3797**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes**

Calibration date: **November 29, 2013**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	4-Sep-13 (No. DAE4-660_Sep13)	Sep-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: November 30, 2013			

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

Certificate No: EX3-3797_Nov13

Page 1 of 11

**Calibration Laboratory of
Schmid & Partner
Engineering AG**
Zeughausstrasse 43, 8004 Zurich, Switzerland



S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\theta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z} = NORM_{x,y,z} * frequency_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Certificate No: EX3-3797_Nov13

Page 2 of 11

EX3DV4 – SN:3797

November 29, 2013

Probe EX3DV4

SN:3797

Manufactured: April 5, 2011
Calibrated: November 29, 2013

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

EX3DV4- SN:3797

November 29, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3797

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.63	0.58	0.57	± 10.1 %
DCP (mV) ^B	98.7	97.9	96.5	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^C (k=2)
0	CW	X	0.0	0.0	1.0	0.00	135.5	±2.7 %
		Y	0.0	0.0	1.0		175.4	
		Z	0.0	0.0	1.0		176.6	

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

^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^C Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

EX3DV4- SN:3797

November 29, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3797

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^f	Conductivity (S/m) ^f	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^g (mm)	Unct. (k=2)
750	41.9	0.89	9.33	9.33	9.33	0.59	0.73	± 12.0 %
835	41.5	0.90	9.04	9.04	9.04	0.71	0.66	± 12.0 %
900	41.5	0.97	8.89	8.89	8.89	0.35	0.98	± 12.0 %
1450	40.5	1.20	8.27	8.27	8.27	0.80	0.68	± 12.0 %
1750	40.1	1.37	8.02	8.02	8.02	0.69	0.62	± 12.0 %
1900	40.0	1.40	7.73	7.73	7.73	0.64	0.65	± 12.0 %
1950	40.0	1.40	7.48	7.48	7.48	0.60	0.66	± 12.0 %
2300	39.5	1.67	7.27	7.27	7.27	0.31	0.92	± 12.0 %
2450	39.2	1.80	6.94	6.94	6.94	0.51	0.71	± 12.0 %
2600	39.0	1.96	6.76	6.76	6.76	0.34	0.89	± 12.0 %
5200	36.0	4.66	5.00	5.00	5.00	0.33	1.80	± 13.1 %
5300	35.9	4.76	4.77	4.77	4.77	0.35	1.80	± 13.1 %
5500	35.6	4.96	4.70	4.70	4.70	0.37	1.80	± 13.1 %
5600	35.5	5.07	4.43	4.43	4.43	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.64	4.64	4.64	0.35	1.80	± 13.1 %

^c Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^f At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^g Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

EX3DV4- SN:3797

November 29, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3797

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^f	Conductivity (S/m) ^f	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^g (mm)	Unct. (k=2)
750	55.5	0.96	9.03	9.03	9.03	0.53	0.76	± 12.0 %
835	55.2	0.97	9.03	9.03	9.03	0.43	0.87	± 12.0 %
900	55.0	1.05	8.73	8.73	8.73	0.33	1.01	± 12.0 %
1750	53.4	1.49	7.61	7.61	7.61	0.31	1.20	± 12.0 %
1900	53.3	1.52	7.14	7.14	7.14	0.28	1.17	± 12.0 %
1950	53.3	1.52	7.33	7.33	7.33	0.27	1.11	± 12.0 %
2450	52.7	1.95	6.75	6.75	6.75	0.80	0.59	± 12.0 %
2600	52.5	2.16	6.45	6.45	6.45	0.80	0.60	± 12.0 %
5200	49.0	5.30	4.42	4.42	4.42	0.42	1.90	± 13.1 %
5300	48.9	5.42	4.17	4.17	4.17	0.45	1.90	± 13.1 %
5500	48.6	5.65	4.01	4.01	4.01	0.45	1.90	± 13.1 %
5600	48.5	5.77	3.67	3.67	3.67	0.55	1.90	± 13.1 %
5800	48.2	6.00	4.23	4.23	4.23	0.45	1.90	± 13.1 %

^c Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

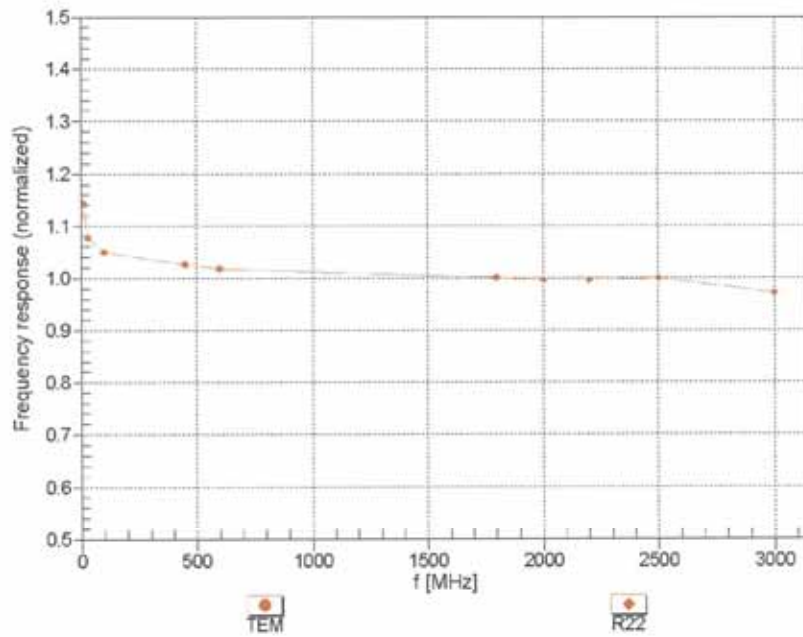
^f At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^g Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

EX3DV4- SN:3797

November 29, 2013

Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)

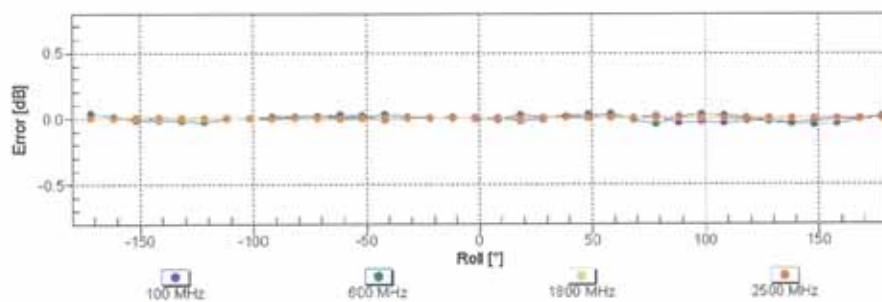
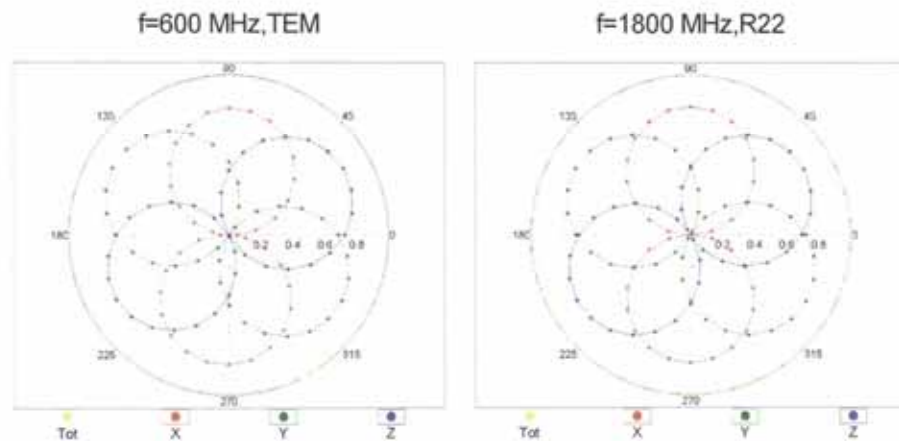


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

EX3DV4- SN:3797

November 29, 2013

Receiving Pattern (ϕ), $\theta = 0^\circ$

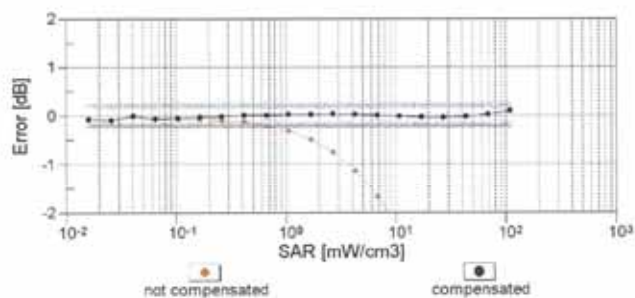
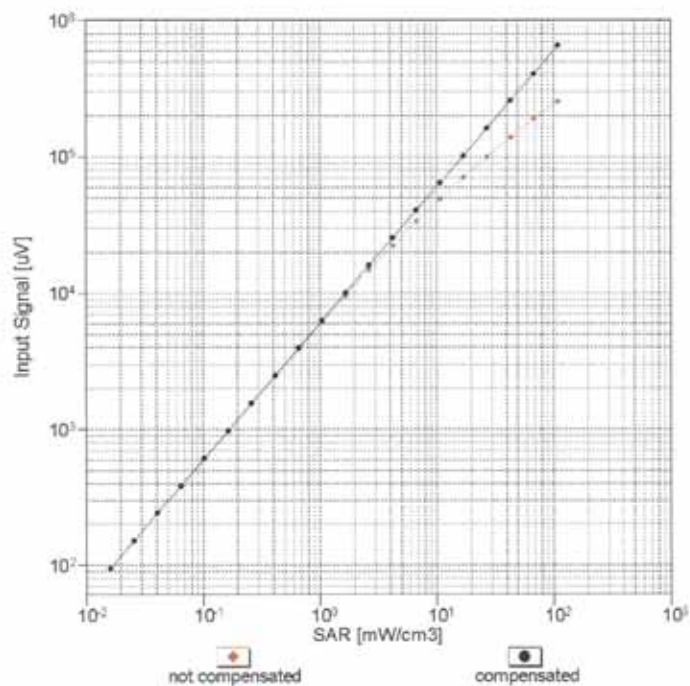


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

EX3DV4- SN:3797

November 29, 2013

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)

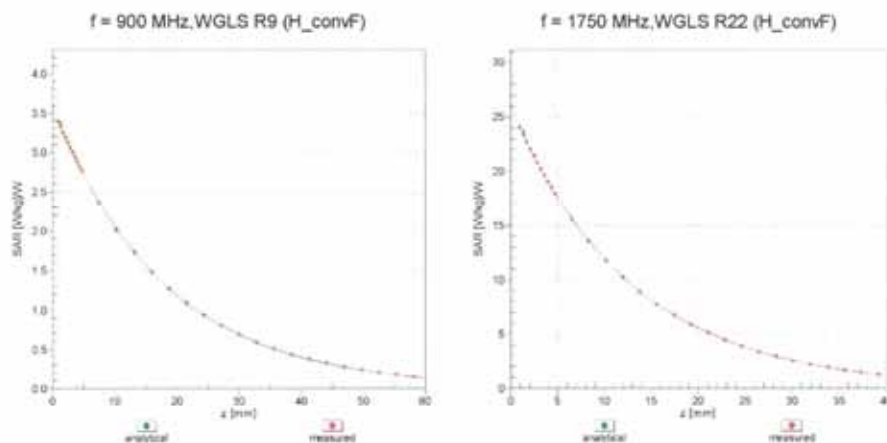


Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

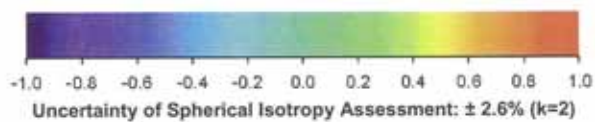
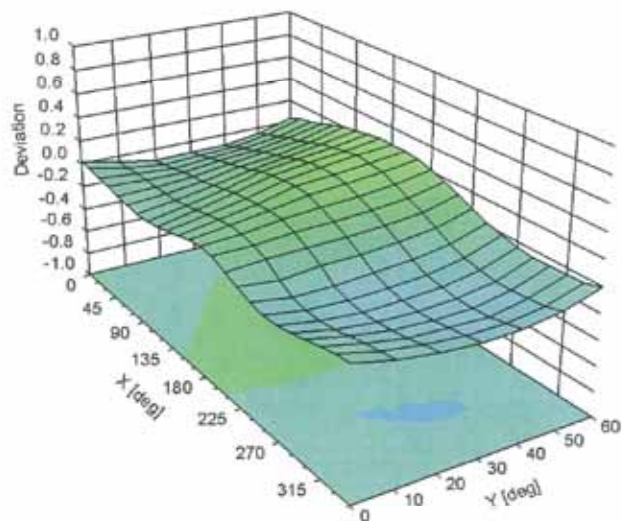
EX3DV4--SN:3797

November 29, 2013

Conversion Factor Assessment



Deviation from Isotropy in Liquid Error (ϕ , θ), f = 900 MHz



Certificate No: EX3-3797_Nov13

Page 10 of 11

EX3DV4- SN:3797

November 29, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3797

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-111.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

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Accreditation No.: **SCS 108**

Client **HCT (Dymstec)**

Certificate No: **EX3-3863_Jul13**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3863**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes**

Calibration date: **July 31, 2013**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: July 31, 2013			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

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Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\theta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

EX3DV4 – SN:3863

July 31, 2013

Probe EX3DV4

SN:3863

Manufactured: February 2, 2012
Calibrated: July 31, 2013

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

EX3DV4- SN:3863

July 31, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3863

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.36	0.35	0.45	± 10.1 %
DCP (mV) ^B	105.0	102.2	97.9	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	134.8	±2.7 %
		Y	0.0	0.0	1.0		134.1	
		Z	0.0	0.0	1.0		152.6	

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

^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

EX3DV4- SN:3863

July 31, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3863

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^f	Conductivity (S/m) ^f	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	9.77	9.77	9.77	0.30	0.98	± 12.0 %
835	41.5	0.90	9.46	9.46	9.46	0.48	0.74	± 12.0 %
900	41.5	0.97	9.29	9.29	9.29	0.18	1.31	± 12.0 %
1450	40.5	1.20	8.40	8.40	8.40	0.19	1.21	± 12.0 %
1750	40.1	1.37	8.10	8.10	8.10	0.43	0.73	± 12.0 %
1900	40.0	1.40	7.86	7.86	7.86	0.45	0.75	± 12.0 %
1950	40.0	1.40	7.70	7.70	7.70	0.39	0.80	± 12.0 %
2450	39.2	1.80	7.08	7.08	7.08	0.38	0.80	± 12.0 %
2600	39.0	1.96	6.82	6.82	6.82	0.25	1.13	± 12.0 %
5200	36.0	4.66	5.11	5.11	5.11	0.33	1.80	± 13.1 %
5300	35.9	4.76	4.83	4.83	4.83	0.37	1.80	± 13.1 %
5500	35.6	4.96	4.81	4.81	4.81	0.37	1.80	± 13.1 %
5600	35.5	5.07	4.44	4.44	4.44	0.44	1.80	± 13.1 %
5800	35.3	5.27	4.70	4.70	4.70	0.40	1.80	± 13.1 %

^c Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^f At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

EX3DV4- SN:3863

July 31, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3863

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^f	Conductivity (S/m) ^f	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	9.57	9.57	9.57	0.19	1.54	± 12.0 %
835	55.2	0.97	9.59	9.59	9.59	0.34	0.99	± 12.0 %
1750	53.4	1.49	7.84	7.84	7.84	0.27	0.99	± 12.0 %
1900	53.3	1.52	7.49	7.49	7.49	0.27	1.02	± 12.0 %
2450	52.7	1.95	7.04	7.04	7.04	0.77	0.56	± 12.0 %
2600	52.5	2.16	6.79	6.79	6.79	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.49	4.49	4.49	0.38	1.90	± 13.1 %
5300	48.9	5.42	4.14	4.14	4.14	0.48	1.90	± 13.1 %
5500	48.6	5.65	3.91	3.91	3.91	0.51	1.90	± 13.1 %
5600	48.5	5.77	3.60	3.60	3.60	0.58	1.90	± 13.1 %
5800	48.2	6.00	3.95	3.95	3.95	0.53	1.90	± 13.1 %

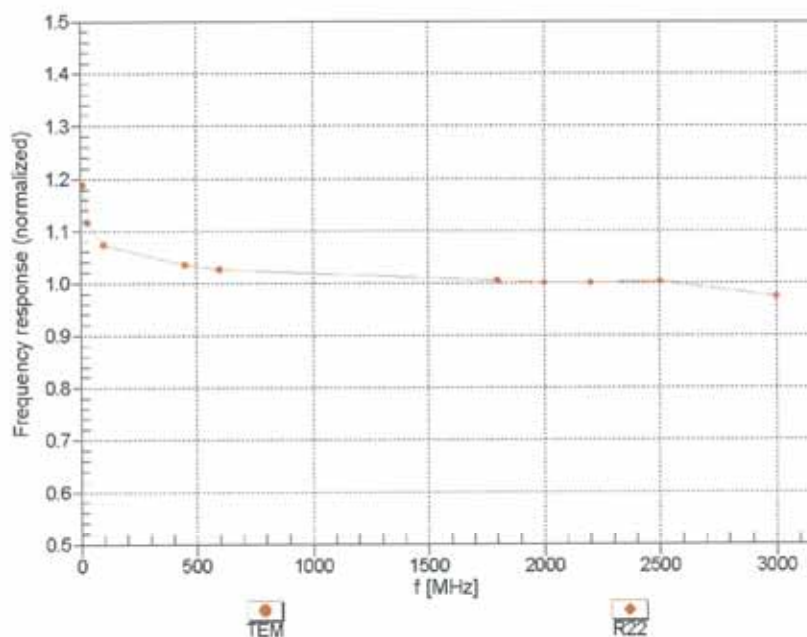
^c Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^f At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

EX3DV4- SN:3863

July 31, 2013

Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

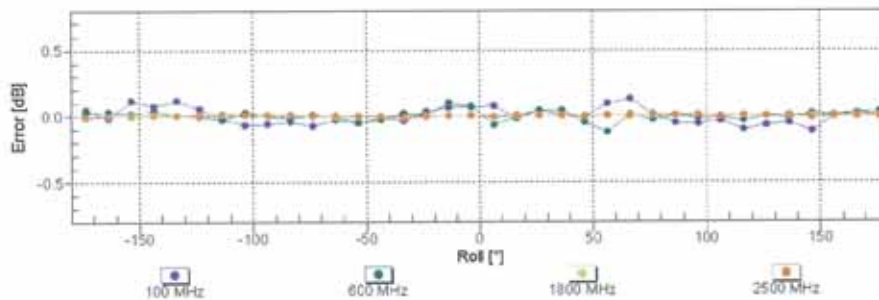
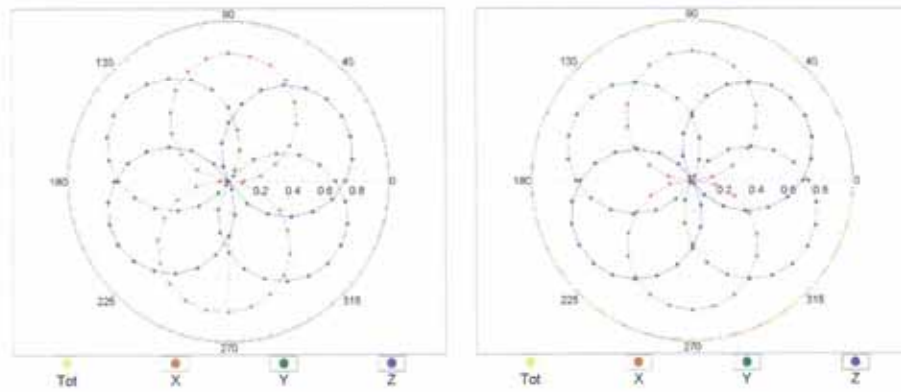
EX3DV4- SN:3863

July 31, 2013

Receiving Pattern (ϕ), $\theta = 0^\circ$

f=600 MHz, TEM

f=1800 MHz, R22

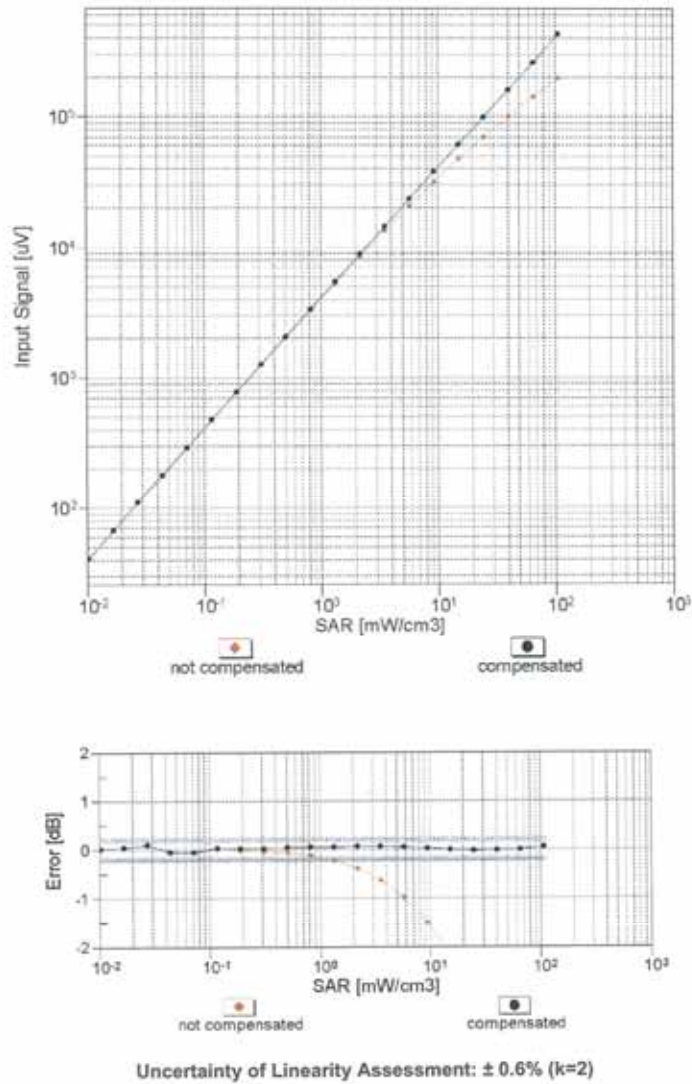


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

EX3DV4- SN:3863

July 31, 2013

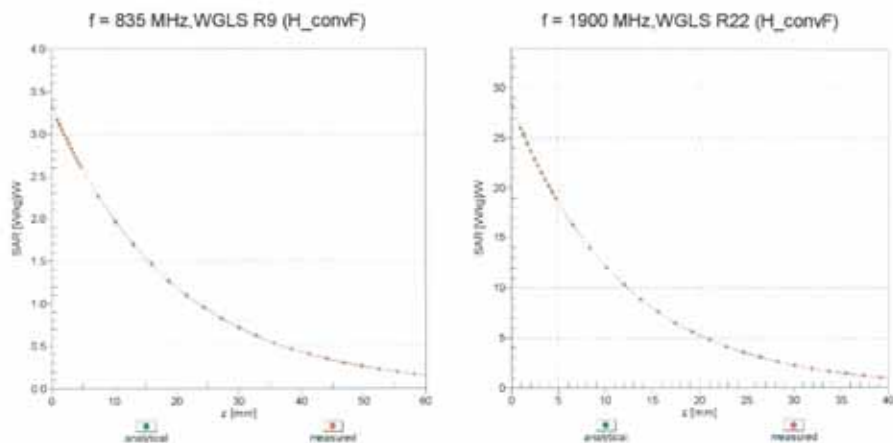
Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f = 900 \text{ MHz}$)



EX3DV4- SN:3863

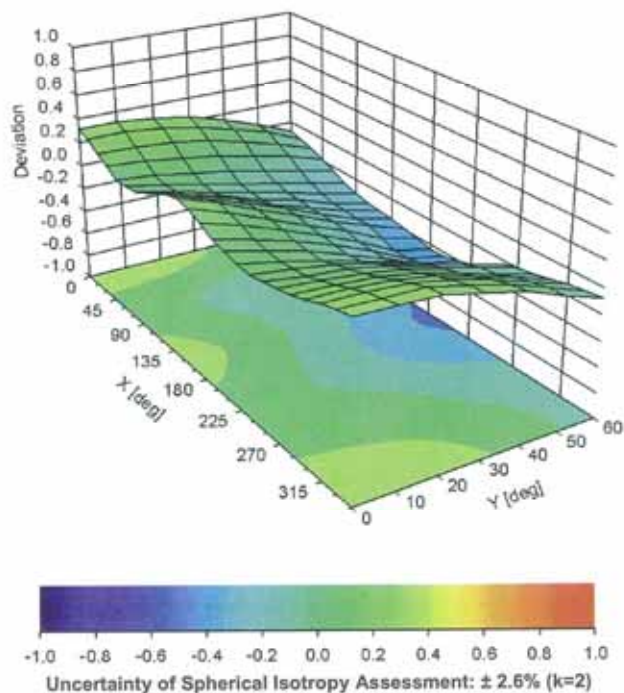
July 31, 2013

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900 \text{ MHz}$



Certificate No: EX3-3863_Jul13

Page 10 of 11

EX3DV4- SN:3863

July 31, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3863

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-73.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

Attachment 4. – Dipole Calibration Data

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Client **HCT (Dymstec)**

Certificate No: **D750V3-1014_Jul13**

CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1014**

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

Calibration date: **July 30, 2013**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature

Issued: July 30, 2013

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Certificate No: D750V3-1014_Jul13

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	42.0 $\pm$ 6 %	0.90 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.41 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.56 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	55.1 $\pm$ 6 %	0.98 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.77 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.48 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.84 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.1 Ω + 1.5 j Ω
Return Loss	- 29.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.2 Ω - 0.4 j Ω
Return Loss	- 41.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.046 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 22, 2010

DASY5 Validation Report for Head TSL

Date: 30.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1014

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

Communication System Frame Length in ms: 100

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.9 \text{ S/m}$; $\epsilon_r = 42$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.28, 6.28, 6.28); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

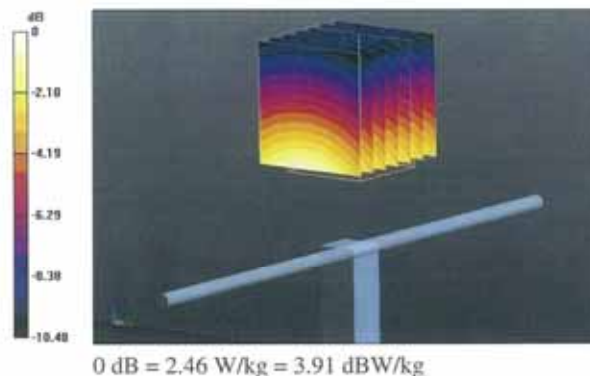
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 52.976 V/m; Power Drift = 0.01 dB

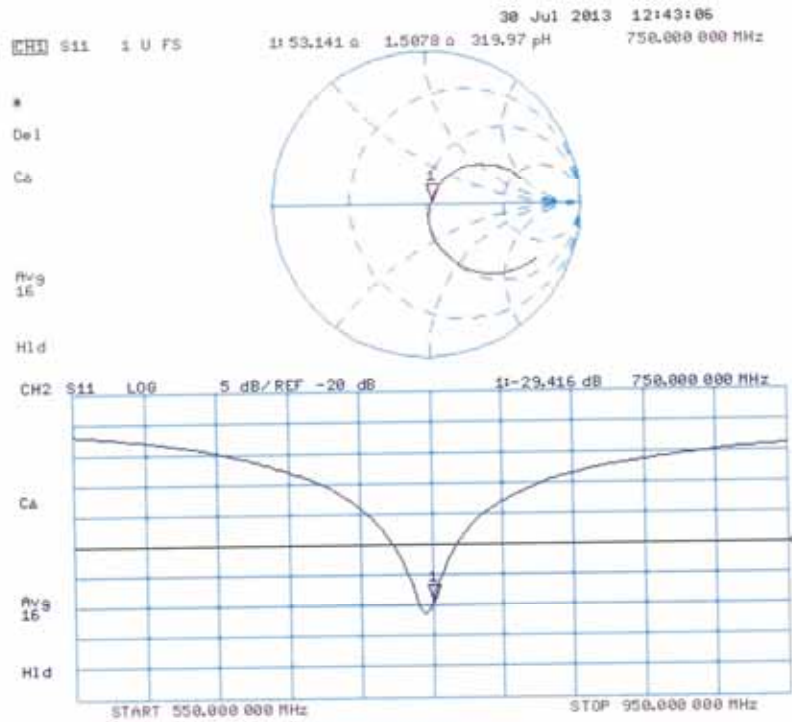
Peak SAR (extrapolated) = 3.19 W/kg

SAR(1 g) = 2.12 W/kg; SAR(10 g) = 1.4 W/kg

Maximum value of SAR (measured) = 2.46 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 30.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1014

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

Communication System Frame Length in ms: 100

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.98 \text{ S/m}$; $\epsilon_r = 55.1$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.11, 6.11, 6.11); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

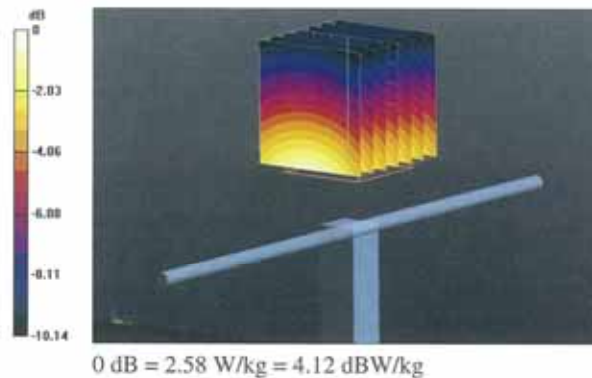
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 52.976 V/m; Power Drift = 0.01 dB

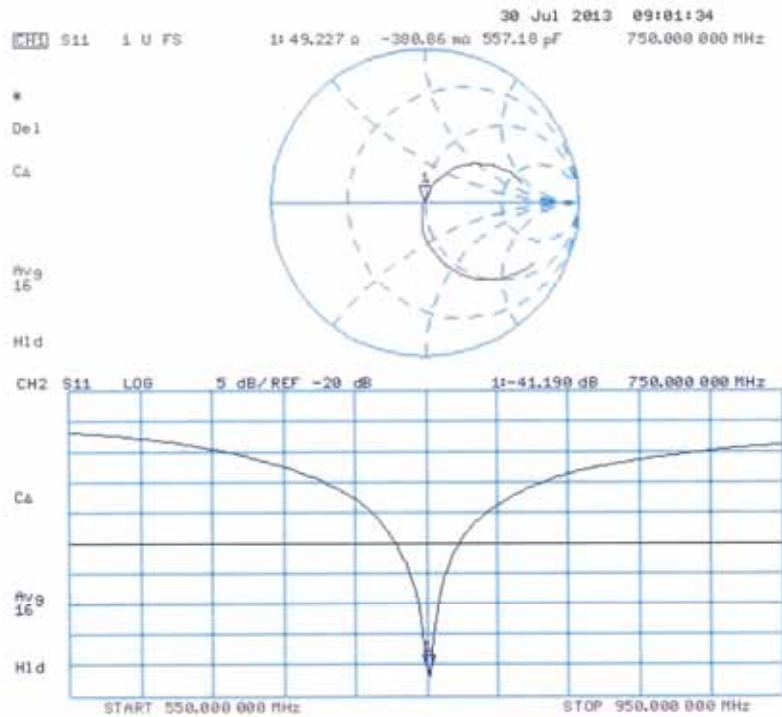
Peak SAR (extrapolated) = 3.24 W/kg

SAR(1 g) = 2.23 W/kg; SAR(10 g) = 1.48 W/kg

Maximum value of SAR (measured) = 2.58 W/kg



Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 108**

Client **HCT (Dymstec)**

Certificate No: **D835V2-4d165_Jan14**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d165**

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

Calibration date: **January 07, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8461A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20K)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: January 9, 2014

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Certificate No: D835V2-4d165_Jan14

Page 1 of 8

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.7 $\pm$ 6 %	0.91 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.24 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.52 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.02 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	56.8 $\pm$ 6 %	1.01 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.58 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.60 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.26 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.6 Ω - 3.8 $j\Omega$
Return Loss	- 28.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.2 Ω - 5.7 $j\Omega$
Return Loss	- 23.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.440 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 28, 2012

DASY5 Validation Report for Head TSL

Date: 07.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d165

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

Medium parameters used: $f = 835$ MHz; $\sigma = 0.91$ S/m; $\epsilon_r = 40.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.22, 6.22, 6.22); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

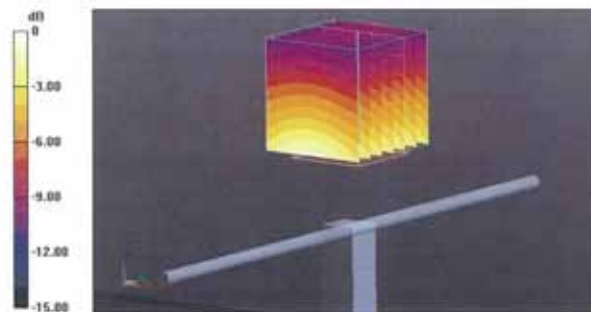
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 60.874 V/m; Power Drift = -0.00 dB

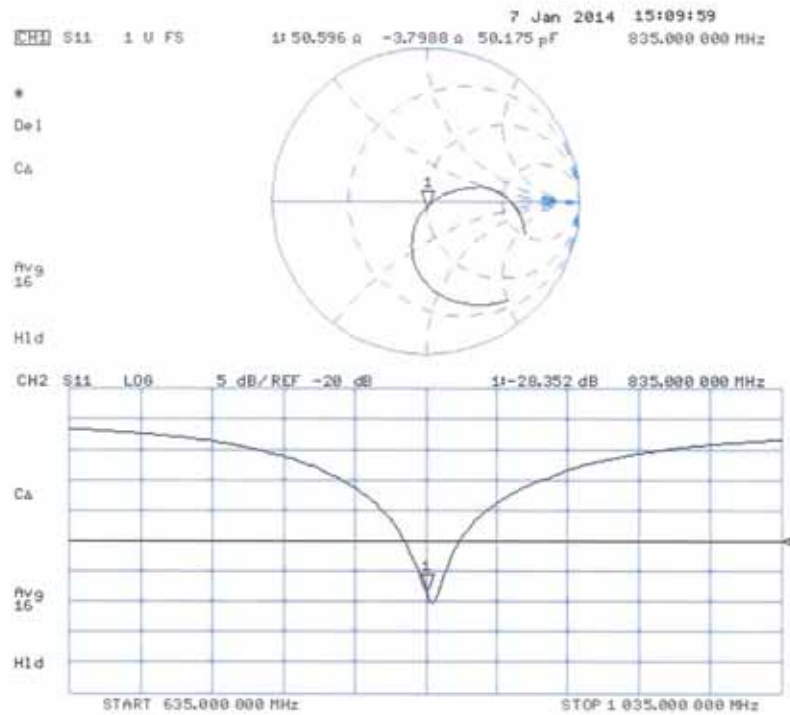
Peak SAR (extrapolated) = 3.54 W/kg

SAR(1 g) = 2.34 W/kg; SAR(10 g) = 1.52 W/kg

Maximum value of SAR (measured) = 2.73 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d165

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

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 1.013 \text{ S/m}$; $\epsilon_r = 56.8$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.09, 6.09, 6.09); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

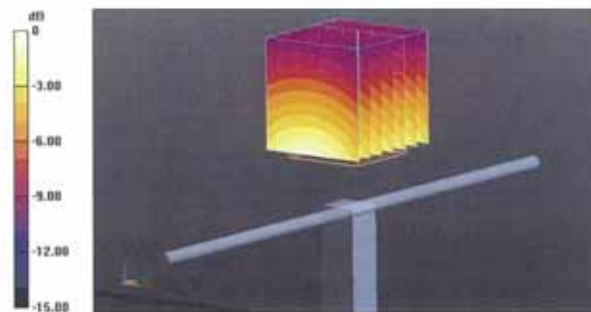
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 60.874 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.66 W/kg

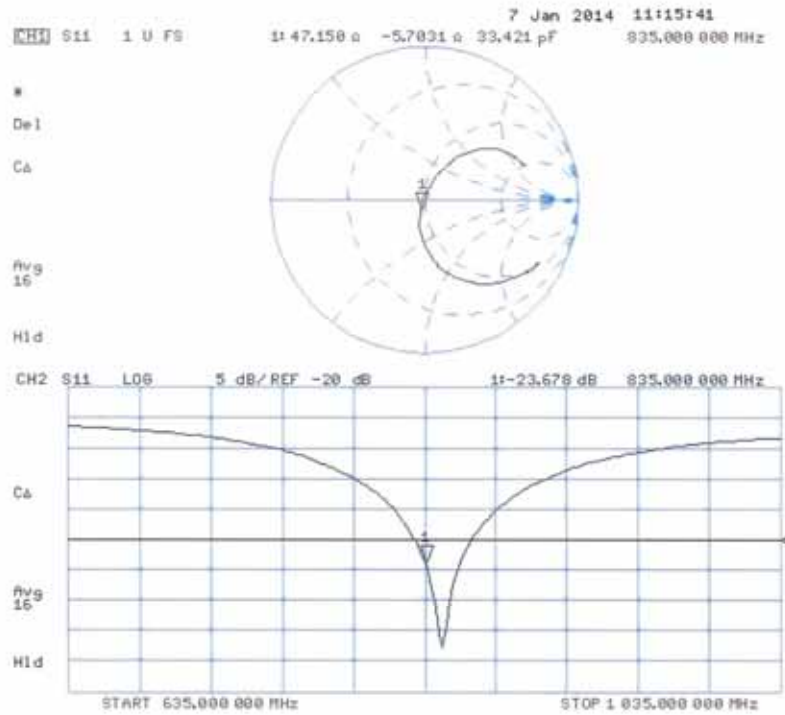
SAR(1 g) = 2.46 W/kg; SAR(10 g) = 1.6 W/kg

Maximum value of SAR (measured) = 2.86 W/kg



0 dB = 2.86 W/kg = 4.56 dBW/kg

Impedance Measurement Plot for Body TSL



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Client HCT (Dymstec)

Certificate No: D1900V2-5d032_Jul13

CALIBRATION CERTIFICATE

Object D1900V2 - SN: 5d032

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

Calibration date: July 29, 2013

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES30V3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by:	Name Israe El-Naouq	Function Laboratory Technician	Signature
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Approved by:	Katja Pokovic	Technical Manager	
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Issued: July 30, 2013

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Certificate No: D1900V2-5d032_Jul13

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	38.9 $\pm$ 6 %	1.36 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.91 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.1 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.21 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.0 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.4 $\pm$ 6 %	1.49 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.5 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.34 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.5 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.1 Ω + 5.3 j Ω
Return Loss	- 25.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.8 Ω + 5.4 j Ω
Return Loss	- 23.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.193 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 17, 2003

DASY5 Validation Report for Head TSL

Date: 29.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d032

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.36$ S/m; $\epsilon_r = 38.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

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

Reference Value = 96.191 V/m; Power Drift = 0.04 dB

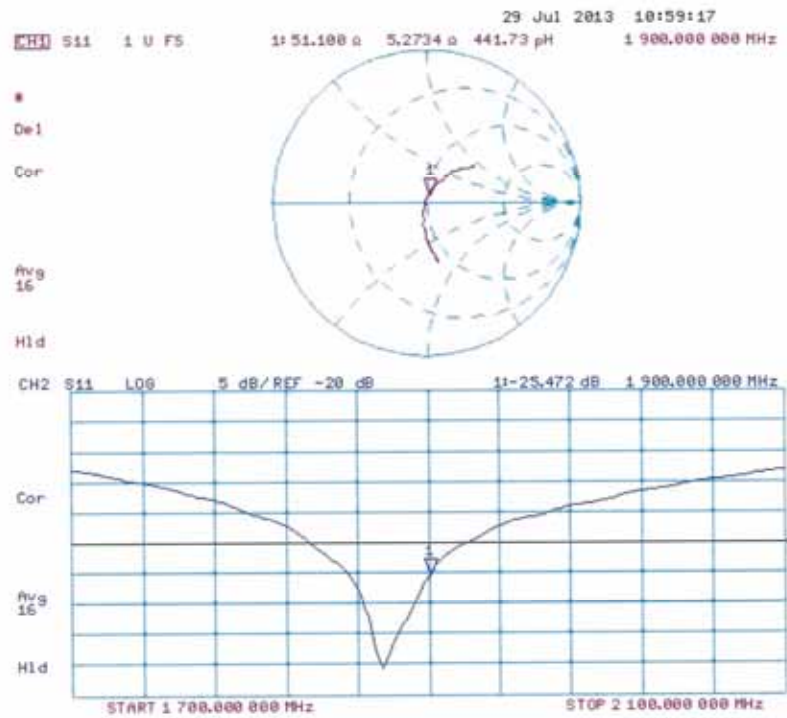
Peak SAR (extrapolated) = 17.9 W/kg

SAR(1 g) = 9.91 W/kg; SAR(10 g) = 5.21 W/kg

Maximum value of SAR (measured) = 12.3 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 29.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d032

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.49$ S/m; $\epsilon_r = 53.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

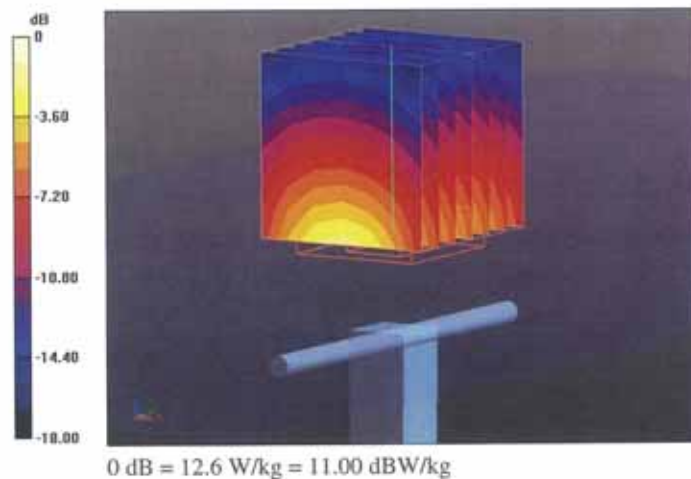
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.191 V/m; Power Drift = 0.01 dB

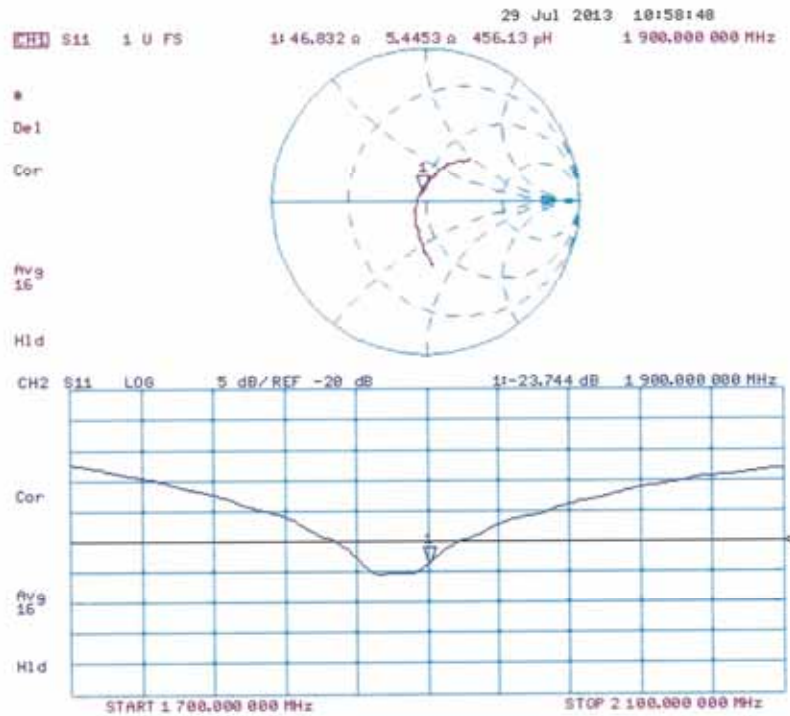
Peak SAR (extrapolated) = 17.1 W/kg

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

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



Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client **HCT (Dymstec)**

Certificate No: D2450V2-743_Aug13

CALIBRATION CERTIFICATE

Object: D2450V2 - SN: 743

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

Calibration date: August 23, 2013

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Issued: August 23, 2013

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

Certificate No: D2450V2-743_Aug13

Page 1 of 8

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Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	37.8 $\pm$ 6 %	1.80 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.8 W/kg $\pm$ 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.6 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	50.6 $\pm$ 6 %	2.03 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.5 W/kg $\pm$ 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.01 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.6 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.9 Ω + 4.2 j Ω
Return Loss	- 25.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.0 Ω + 5.5 j Ω
Return Loss	- 25.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.159 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 01, 2003

DASY5 Validation Report for Head TSL

Date: 22.08.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 743

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.8$ S/m; $v_p = 37.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

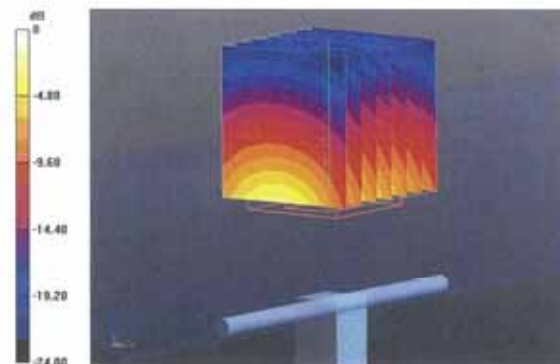
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.4 V/m; Power Drift = 0.06 dB

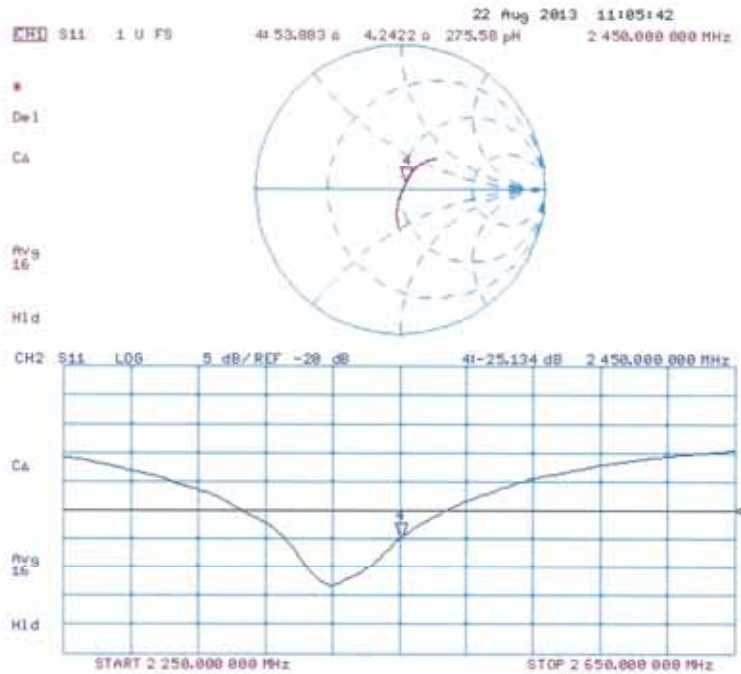
Peak SAR (extrapolated) = 27.8 W/kg

SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.18 W/kg

Maximum value of SAR (measured) = 16.9 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 23.08.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 743

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.03$ S/m; $\epsilon_r = 50.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

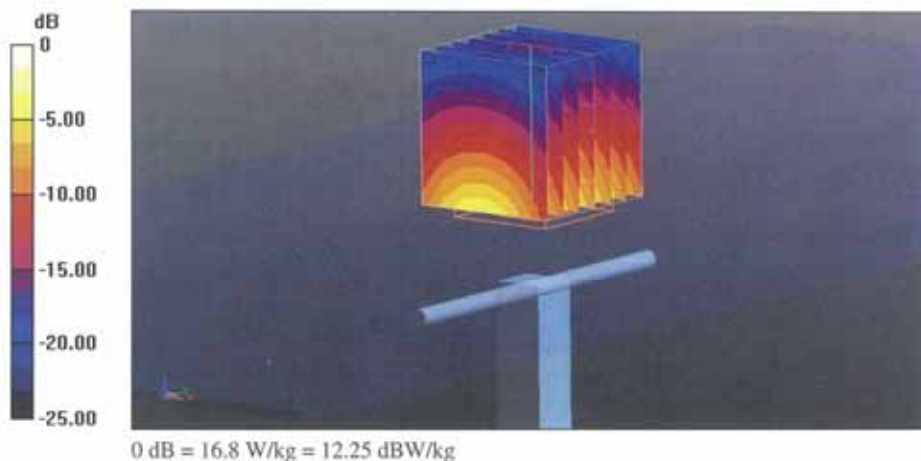
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.835 V/m; Power Drift = 0.06 dB

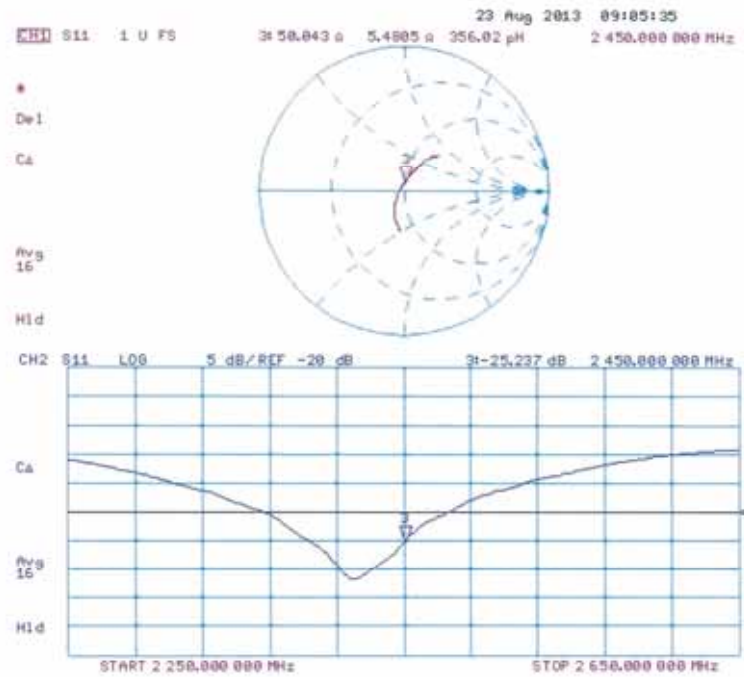
Peak SAR (extrapolated) = 27.3 W/kg

SAR(1 g) = 13 W/kg; SAR(10 g) = 6.01 W/kg

Maximum value of SAR (measured) = 16.8 W/kg



Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 108**

Client **HCT (Dymstec)**

Certificate No: **D5GHzV2-1107_Jan14**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1107**

Calibration procedure(s) **QA CAL-22.v2**
Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date: **January 27, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe EX3DV4	SN: 3503	30-Dec-13 (No. EX3-3503_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by:	Name Israe El-Naouq	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 27, 2014

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Certificate No: D5GHzV2-1107_Jan14

Page 1 of 16

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"
- c) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz $\pm$ 1 MHz 5300 MHz $\pm$ 1 MHz 5500 MHz $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5800 MHz $\pm$ 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	35.0 $\pm$ 6 %	4.45 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.83 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.8 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.3 W/kg $\pm$ 19.5 % (k=2)

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.9 ± 6 %	4.54 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.9 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.9 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.6 ± 6 %	4.74 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.47 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	84.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.0 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.5 ± 6 %	4.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.7 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	5.07 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.01 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.6 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.3 ± 6 %	5.44 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.52 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.7 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.8 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.2 ± 6 %	5.57 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.63 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.8 ± 6 %	5.84 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.96 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	79.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.9 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.6 ± 6 %	5.98 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	80.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.3 ± 6 %	6.23 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.49 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.5 W/kg ± 19.5 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	48.9 Ω - 10.5 j Ω
Return Loss	- 19.5 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	49.2 Ω - 7.4 j Ω
Return Loss	- 22.6 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	51.0 Ω - 5.4 j Ω
Return Loss	- 25.3 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	53.7 Ω - 5.7 j Ω
Return Loss	- 23.7 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	55.0 Ω - 5.8 j Ω
Return Loss	- 22.8 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	49.2 Ω - 9.7 j Ω
Return Loss	- 20.2 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	49.6 Ω - 6.7 j Ω
Return Loss	- 23.5 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	51.0 Ω - 4.7 j Ω
Return Loss	- 26.5 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	54.6 Ω - 4.6 j Ω
Return Loss	- 24.1 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	56.1 Ω - 4.2 j Ω
Return Loss	- 23.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.196 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 27.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1107

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.45$ S/m; $\epsilon_r = 35$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 4.54$ S/m; $\epsilon_r = 34.9$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 4.74$ S/m; $\epsilon_r = 34.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 4.86$ S/m; $\epsilon_r = 34.5$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.07$ S/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.52, 5.52, 5.52); Calibrated: 30.12.2013, ConvF(5.2, 5.2, 5.2); Calibrated: 30.12.2013, ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2013, ConvF(4.86, 4.86, 4.86); Calibrated: 30.12.2013, ConvF(4.91, 4.91, 4.91); Calibrated: 30.12.2013;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.171 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 28.2 W/kg

SAR(1 g) = 7.83 W/kg; SAR(10 g) = 2.25 W/kg

Maximum value of SAR (measured) = 17.8 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.166 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 31.1 W/kg

SAR(1 g) = 8.35 W/kg; SAR(10 g) = 2.41 W/kg

Maximum value of SAR (measured) = 19.3 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.499 V/m; Power Drift = 0.08 dB

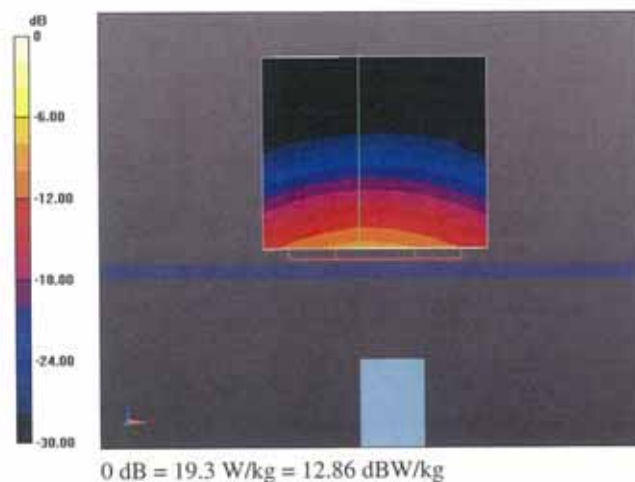
Peak SAR (extrapolated) = 32.9 W/kg

SAR(1 g) = 8.47 W/kg; SAR(10 g) = 2.42 W/kg

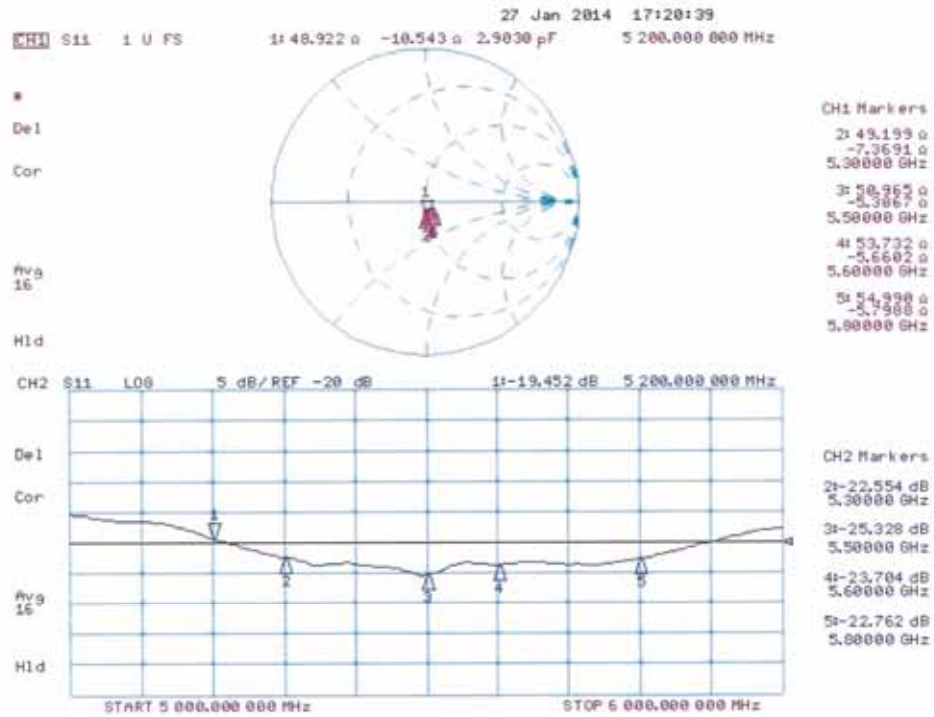
Maximum value of SAR (measured) = 19.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 62.691 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 32.8 W/kg
SAR(1 g) = 8.37 W/kg; SAR(10 g) = 2.39 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.600 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 33.0 W/kg
SAR(1 g) = 8.01 W/kg; SAR(10 g) = 2.28 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 24.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1107

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.44$ S/m; $\epsilon_r = 47.3$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 5.57$ S/m; $\epsilon_r = 47.2$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 5.84$ S/m; $\epsilon_r = 46.8$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 5.98$ S/m; $\epsilon_r = 46.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 6.23$ S/m; $\epsilon_r = 46.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2013, ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013, ConvF(4.52, 4.52, 4.52); Calibrated: 30.12.2013, ConvF(4.3, 4.3, 4.3); Calibrated: 30.12.2013, ConvF(4.47, 4.47, 4.47); Calibrated: 30.12.2013;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.992 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 29.6 W/kg

SAR(1 g) = 7.52 W/kg; SAR(10 g) = 2.1 W/kg

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

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.567 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 31.0 W/kg

SAR(1 g) = 7.63 W/kg; SAR(10 g) = 2.14 W/kg

Maximum value of SAR (measured) = 17.8 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.552 V/m; Power Drift = -0.01 dB

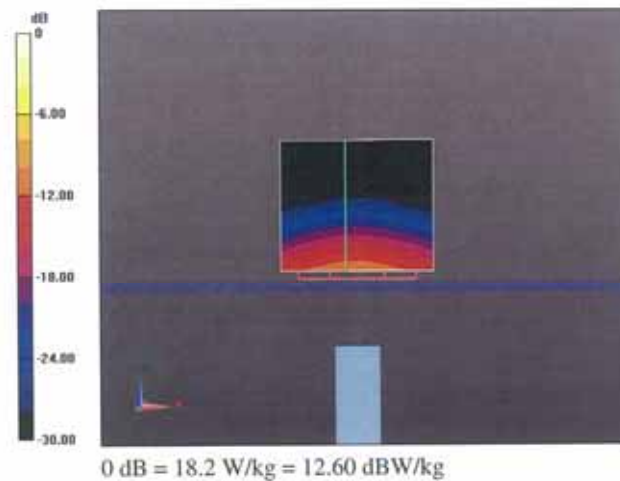
Peak SAR (extrapolated) = 34.3 W/kg

SAR(1 g) = 7.96 W/kg; SAR(10 g) = 2.21 W/kg

Maximum value of SAR (measured) = 18.9 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.338 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 35.7 W/kg
SAR(1 g) = 8.07 W/kg; SAR(10 g) = 2.24 W/kg
Maximum value of SAR (measured) = 19.4 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 55.156 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 34.8 W/kg
SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.07 W/kg
Maximum value of SAR (measured) = 18.2 W/kg



Impedance Measurement Plot for Body TSL

