

SAR TEST REPORT

SAMSUNG Electronics Co., Ltd.

129, Samsung-ro, Yeongtong-gu, Suwon-City,
Gyeonggi-do, 443-742 Republic of Korea

Date of Issue: January 29, 2015

Test Report No.: HCT-A-1501-F006-1

Test Site: HCT CO., LTD.

FCC ID:

A3LSMA700F

Equipment Type:

Mobile Phone

Model Name:

SM-A700F

Testing has been carried out in accordance with:

47CFR §2.1093

ANSI/ IEEE C95.1 – 1992

IEEE 1528-2003

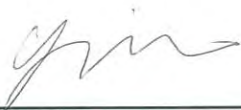
Date of Test:

January 08, 2015 ~January 21, 2015

This device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in FCC KDB procedures and had been tested in accordance with the measurement procedures specified in FCC KDB procedures.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Tested By



Yun-Jeang Heo
Test Engineer / SAR Team
Certification Division

Reviewed By



Dong-Seob Kim
Technical Manager / SAR Team
Certification Division

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Version

Rev.	DATE	DESCRIPTION
HCT-A-1501-F006	Jan. 26, 2015	First Approval Report
HCT-A-1501-F006-1	Jan. 29, 2015	Sec. 15 was revised. (Removed 5 GHz Bluetooth condition. – Typo Add the description about 5 GHz Simultaneous transmission condition.)

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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 IEEE Standard 1528-2003 & IEEE 1528-2005 and the following published KDB procedures.

- FCC KDB Publication 941225 D01 3G SAR Procedures v03
- FCC KDB Publication 941225 D06 Hot Spot SAR v02
- FCC KDB Publication 941225 D05 SAR for LTE Devices v02r03
- FCC KDB Publication 941225 D05A LTE Rel.10 KDB Inquiry sheet v01r01
- FCC KDB Publication 248227 D01 SAR Consideration for 802.11 Devices v01r02
- FCC KDB Publication 447498 D01 General SAR Guidance v05r02
- 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
- 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	Mobile Phone					
FCC ID:	A3LSMA700F					
Model:	SM-A700F					
Trade Name	SAMSUNG Electronics Co., Ltd.					
Application Type	Certification					
Production Unit or Identical Prototype	Prototype					
Max. SAR	Band	Tx. Frequency (MHz)	Equipment Class	Reported 1 g SAR (W/kg)		
				Head	Body-worn	Hotspot
	GSM/GPRS/EDGE 850	824.2 - 848.8	PCE	0.07	0.38	0.41
	GSM/GPRS/EDGE 1900	1 850.2 - 1 909.8	PCE	0.15	0.46	0.42
	WCDMA 850	826.4 - 846.6	PCE	0.11	0.56	0.56
	WCDMA1900	1 852.4 - 1 907.6	PCE	0.21	0.69	0.69
	LTE 5	824.7 - 843	PCE	0.11	0.61	0.61
	802.11b	2 412 - 2 462	DTS	0.85	0.18	0.26
	802.11a	5 745 - 5 825	DTS	0.08	0.02	0.02
	802.11a	5 180 - 5 240	UNII	0.39	0.03	
	802.11a	5 260 - 5 320	UNII	0.36	0.04	
	802.11a	5 500 - 5 700	UNII	0.27	0.01	
	Bluetooth	2 402 - 2 480	DSS/DTS	-	0.02	-
	Simultaneous SAR per KDB 690783 D01v01r03			1.05	0.80	
	Hand SAR for Phablet					
	Band	Tx Frequency (MHz)	Equipment Class	Reported 10g SAR (W/Kg)		
	Bluetooth	2 402 - 2 480	DSS/DTS	0.12		
	802.11a	5 180 - 5 240	UNII	0.20		
	802.11a	5 260 - 5 320	UNII	0.17		
802.11a	5 500 - 5 700	UNII	0.19			
Date(s) of Tests	January 08, 2015 ~January 21, 2015					
Antenna Type	Integral Antenna					
Hardware Version :	REV1.1					
Software Version :	A700F.002					
GPRS/EDGE:	Multi-slot Class 33					
EUT Description:	GSM 850/1900, WCDMA 850/1900, LTE B5, BT 3.0/4.0, WLAN a/b/g/n, NFC					
Key Feature(s)	Hotspot Support					

3.1 KDB 941225 LTE information

Item.	Description							
Frequency Range:	Band 5: 824.7 MHz ~ 848.3 MHz							
Channel Bandwidth:	Band 5: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz							
Channel Number & Frequency:								
	Band 5							
	1.4 MHz		3 MHz		5 MHz		10 MHz	
	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.
	824.7	20407	825.5	20415	826.5	20425	829.0	20450
	836.5	20525	836.5	20525	836.5	20525	836.5	20525
	848.3	20643	847.5	20635	846.5	20625	844.0	20600
UE Category & Uplink Modulation	UE Category 3 QPSK, 16QAM							
Description of the LTE Transmitter & antenna	This model has two 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 mendatory optional or mendatory	The EUT incorporates MPR as per 3GPP TS 36.101 sec. 6.2.3 ~ 6.2.5 The MPR is permanently built-in by design as a mandatory. A-MPR is not implemented in the EUT. See section 11.4 RF output power measurements in the SAR report.							
Maximum average conducted output power(dBm) Identify all other U.S. wireless operating modes, device exposure configurations and frequency bands	GSM850/ GSM1900, WCDMA850/1900, LTE Band 5 : 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.

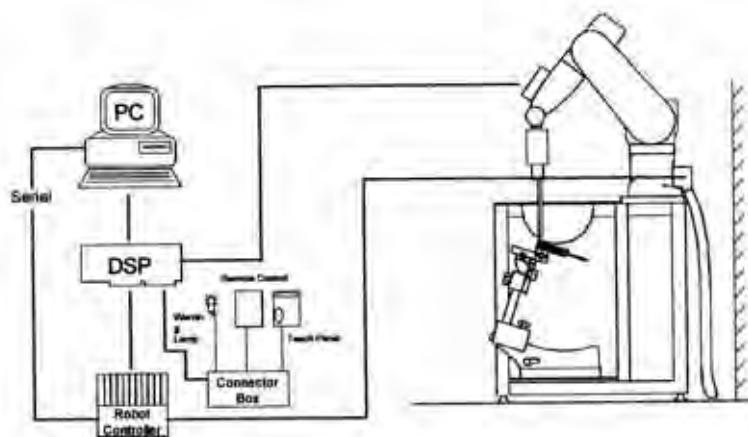


Figure 2. HCT SAR Lab. Test Measurement Set-up

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

4.2.1 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

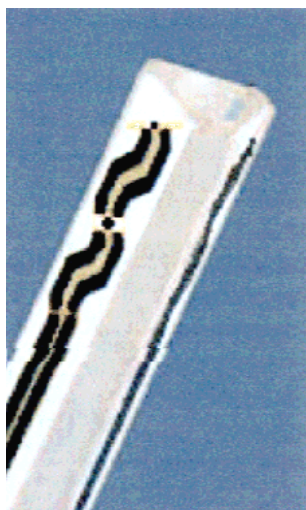


Figure 4. ET3DV6 E-field Probe

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.

4.2.2 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 multiter 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)

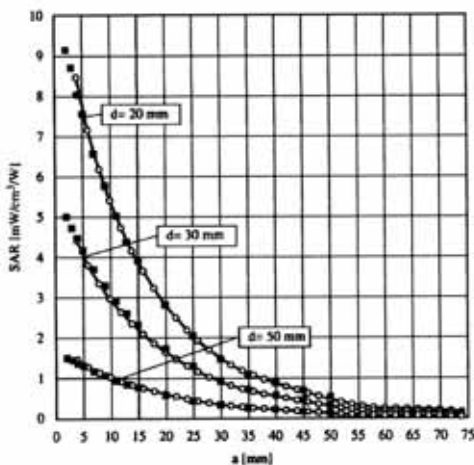


Figure 7. E-Field and Temperature measurements at 900 MHz

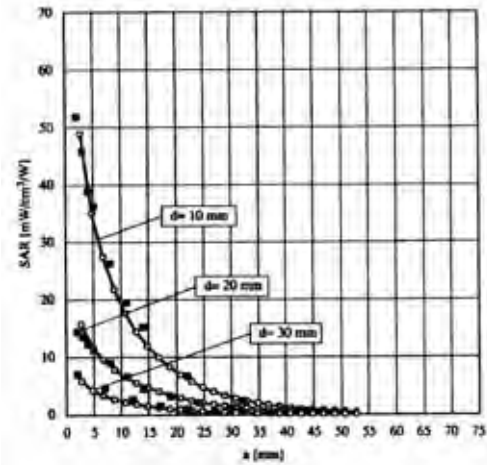


Figure 8. E-Field and temperature measurements at 1.8 GHz

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 Brain & Muscle Simulating Mixture Characterization

The brain and muscle mixtures consist of a viscous gel using hydrox-ethyl cellulose (HEC) gelling agent and saline solution (see Table 3.1). Preservation with a bactericide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Hartsgrve.

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 3.1 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	F01/5K08A1/A/01	N/A	N/A	N/A
Staubli	Robot TX90 XLspeag	F13/5R4XF1/A/01	N/A	N/A	N/A
Staubli	Robot Controller	3403-91988	N/A	N/A	N/A
Staubli	CS8Cspeag-TX90	F13/5R4XF1/C/01	N/A	N/A	N/A
HP	Pavilion t000_puffer	KRJ51201TV	N/A	N/A	N/A
SPEAG	Light Alignment Sensor	SE UKS 030 AA	N/A	N/A	N/A
SPEAG	Light Alignment Sensor	273	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	D21142605	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	D22134001 1	N/A	N/A	N/A
SPEAG	DAE4	652	Mar. 26, 2014	Annual	Mar. 26, 2015
SPEAG	DAE4	911	Feb. 25, 2014	Annual	Feb. 25, 2015
SPEAG	DAE3	479	Oct. 15, 2014	Annual	Oct. 15, 2015
SPEAG	DAE4	1225	Mar. 24, 2014	Annual	Mar. 24, 2015
SPEAG	DAE4	648	Apr. 23, 2014	Annual	Apr. 23, 2015
SPEAG	E-Field Probe ET3DV6	1630	Apr. 21, 2014	Annual	Apr. 21, 2015
SPEAG	E-Field Probe EX3DV4	3903	Aug. 28, 2014	Annual	Aug. 28, 2015
SPEAG	E-Field Probe EX3DV4	3967	Dec. 22, 2014	Annual	Dec. 22, 2015
SPEAG	E-Field Probe EX3DV4	3863	Jul. 24, 2014	Annual	Jul. 24, 2015
SPEAG	Dipole D835V2	490	May 16, 2014	Annual	May 16, 2015
SPEAG	Dipole D1900V2	5d061	Jul. 23, 2014	Annual	Jul. 23, 2015
SPEAG	Dipole D2450V2	743	Jul. 24, 2014	Annual	Jul. 24, 2015
SPEAG	Dipole D5GHzV2	1107	Jan. 27, 2014	Annual	Jan. 27, 2015
Agilent	Power Meter(F) E4419B	MY41291386	Oct. 27, 2014	Annual	Oct. 27, 2015
Agilent	Power Sensor(G) 8481	MY41090680	Oct. 27, 2014	Annual	Oct. 27, 2015
HP	Dielectric Probe Kit 85070C	00721521	CBT		
HP	Dual Directional Coupler 778D	16072	Oct. 27, 2014	Annual	Oct. 27, 2015
Agilent	Base Station E5515C	GB44400269	Feb. 10, 2014	Annual	Feb. 10, 2015
HP	Signal Generator 8664A	3744A02069	Oct. 27, 2014	Annual	Oct. 27, 2015
Agilent	11636B/Power Divider	58698	Mar. 03, 2014	Annual	Mar. 03, 2015
Agilent	N9020A/ SIGNAL ANALYZER	MY50510407	Mar. 25, 2014	Annual	Mar. 25, 2015
TESCOM	TC-3000C / BLUETOOTH	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	100990	Dec. 05, 2014	Annual	Dec. 05, 2015

NOTE:

1. 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.

2. 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.

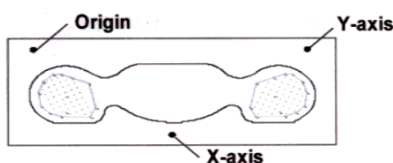


Figure 12. SAR Measurement Point in Area Scan

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 <i>1-g SAR estimation</i> 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.

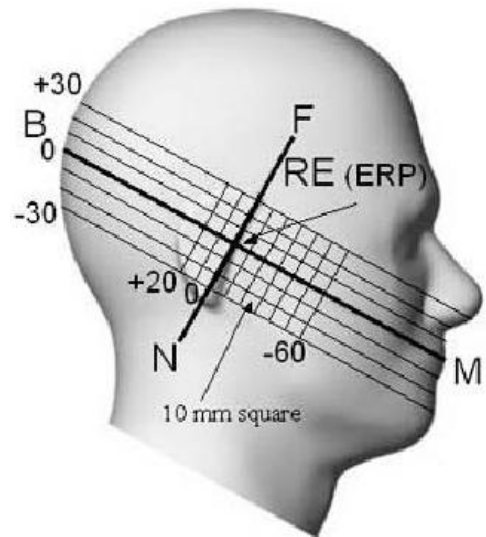


Figure 13. Side view of the phantom

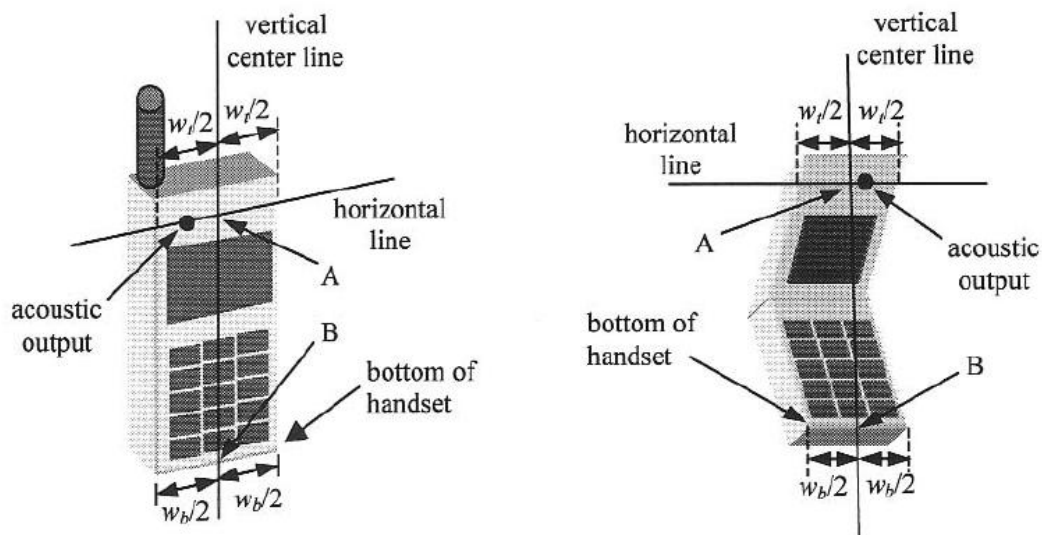


Figure 14. Handset vertical and horizontal reference lines

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.

6.3 Extremity Exposure Configurations

Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions; i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation. When the device also operates in close proximity to the user's body, SAR compliance for the body is also required. The 1-g body and 10-g extremity SAR Exclusion Thresholds found in KDB Publication 447498 D01v05 should be applied to determine SAR test requirements.

For smart phones with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm that provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets that support voice calls next to the ear, the phablets procedures outlined in KDB Publication 648474 D04 v01r02 should be applied to evaluate SAR compliance. A device marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance. In addition to the normally required head and body-worn accessory SAR test procedures required for handsets, the UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna ≥ 25 mm from that surface or edge, in direct contact with the phantom, for 10-g SAR. The UMPC mini-tablet 1-g SAR at 5 mm is not required. When hotspot mode applies, 10-g SAR is required only for the surfaces and edges with hotspot mode 1-g SAR > 1.2W/kg.

7. MEASUREMENT UNCERTAINTY

Error Description	Tol ($\pm$ %)	Prob. dist.	Div.	c_i	Standard Uncertainty ($\pm$ %)	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.)	2.50	N	1	0.64	1.60	∞
Liquid Permittivity(target)	5.00	R	1.73	0.6	1.73	∞
Liquid Permittivity(meas.)	2.50	N	1	0.6	1.50	∞
Combine Standard Uncertainty					10.85	
Coverage Factor for 95 %					$k=2$	
Expanded STD Uncertainty					21.70	

Table 7.1 Uncertainty (800 MHz- 2 450 MHz)

Error Description	Tol (± %)	Prob. dist.	Div.	C _i	Standard Uncertainty (± %)	V _{eff}
1. Measurement System						
Probe Calibration	6.55	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					11.43	
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 Isotropy	MOD. Type	Duty Factor	PAR
8	3967	EX3DV4	Head	835	490	Jan. 07,2015	41.6	0.91	PASS	PASS	PASS	GMSK	PASS	N/A
5	3903	EX3DV4	Body	835	490	Jan. 05,2015	55.3	1.01	PASS	PASS	PASS	GMSK	PASS	N/A
1	3863	EX3DV4	Head	1900	5d061	Aug.05,2014	39.8	1.4	PASS	PASS	PASS	GMSK	PASS	N/A
5	3903	EX3DV4	Body	1900	5d061	Aug.06,2014	52.1	1.52	PASS	PASS	PASS	GMSK	PASS	N/A
7	1630	ET3DV6	Head	2450	743	Aug.05,2014	38.2	1.79	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Body	2450	743	Aug.06,2014	53.2	1.95	PASS	PASS	PASS	OFDM	N/A	PASS
8	3967	EX3DV4	Head	5200	1107	Feb.13,2014	35.8	4.57	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Body	5200	1107	Aug.06,2014	49.5	5.28	PASS	PASS	PASS	OFDM	N/A	PASS
8	3967	EX3DV4	Head	5300	1107	Feb.13,2014	35.7	4.75	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Body	5300	1107	Aug.06,2014	49.1	5.31	PASS	PASS	PASS	OFDM	N/A	PASS
8	3967	EX3DV4	Head	5500	1107	Feb.13,2014	35.4	4.92	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Body	5500	1107	Aug.06,2014	48.8	5.64	PASS	PASS	PASS	OFDM	N/A	PASS
8	3967	EX3DV4	Head	5800	1107	Feb.13,2014	35.1	5.29	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Body	5800	1107	Aug.06,2014	47.6	5.96	PASS	PASS	PASS	OFDM	N/A	PASS

SAR System Validation Summary 1g

SAR System #	Probe	Probe Type	Probe Calibration Point		Dipole	Date	Dielectric Parameters		CW Validation			Modulation Validation		
							Measured Permittivity	Measured Conductivity	Sensitivity	Probe Linearity	Probe Isotropy	MOD. Type	Duty Factor	PAR
1	3863	EX3DV4	Body	2450	743	Aug.06,2014	53.2	1.95	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Body	5200	1107	Aug.06,2014	49.5	5.28	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Body	5300	1107	Aug.06,2014	49.1	5.31	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Body	5500	1107	Aug.06,2014	48.8	5.64	PASS	PASS	PASS	OFDM	N/A	PASS
1	3863	EX3DV4	Body	5800	1107	Aug.06,2014	47.6	5.96	PASS	PASS	PASS	OFDM	N/A	PASS

SAR System Validation Summary – Extremity SAR Considerations

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 [%]	
835	Jan. 08, 2015	3967	490	Head	20.5	ϵ_r	41.5	40.4	- 2.65	± 5	
						σ	0.90	0.919	+ 2.11	± 5	
835	Jan. 09, 2015	3903		Body	20.0	ϵ_r	55.2	55.9	+ 1.27	± 5	
						σ	0.97	0.95	- 2.06	± 5	
1 900	Jan. 08, 2015	3863	5d061	Head	20.5	ϵ_r	40.0	39.8	- 0.50	± 5	
						σ	1.40	1.41	+ 0.71	± 5	
1 900	Jan. 08, 2015	3903		Body	20.5	ϵ_r	53.3	54	+ 1.31	± 5	
						σ	1.52	1.55	+ 1.97	± 5	
2 450	Jan. 21, 2015	1630		743	Head	19.9	ϵ_r	39.2	38.7	- 1.28	± 5
							σ	1.80	1.76	- 2.22	± 5
2 450	Jan. 19, 2015	3863	Body		20.0	ϵ_r	52.7	54.3	+ 3.04	± 5	
						σ	1.95	1.93	- 1.03	± 5	
5 200	Jan. 20, 2015	3967	1107	Head	20.1	ϵ_r	36	35.84	- 0.44	± 5	
						σ	4.66	4.545	- 2.47	± 5	
5 200	Jan. 21, 2015	3863		Body	20.0	ϵ_r	49.0	48.2	- 1.63	± 5	
						σ	5.30	5.17	- 2.45	± 5	
5 300	Jan. 20, 2015	3967	1107	Head	20.1	ϵ_r	35.9	35.532	- 1.03	± 5	
						σ	4.76	4.714	- 0.97	± 5	
5 300	Jan. 21, 2015	3863		Body	20.0	ϵ_r	48.9	47.8	- 2.25	± 5	
						σ	5.42	5.31	- 2.03	± 5	
5 500	Jan. 20, 2015	3967	1107	Head	20.1	ϵ_r	35.6	35.034	- 1.59	± 5	
						σ	4.96	4.888	- 1.45	± 5	
5 500	Jan. 21, 2015	3863		Body	20.0	ϵ_r	48.6	47.3	- 2.67	± 5	
						σ	5.65	5.55	- 1.77	± 5	
5 800	Jan. 20, 2015	3967	1107	Head	20.1	ϵ_r	35.3	34.24	- 3.00	± 5	
						σ	5.27	5.276	+ 0.11	± 5	
5 800	Jan. 21, 2015	3863		Body	20.0	ϵ_r	48.2	46.9	- 2.70	± 5	
						σ	6.00	6.08	+ 1.33	± 5	

The Tissue dielectronic parameters were measured prior to the SAR evaluation using an Agilent 85070C Dielectronic Probe Kit and Agilent Network Analyzer.

10.2 System Verification

Prior to assessment, the system is verified to the $\pm 10\%$ of the specifications at 850 MHz / 1 900 MHz / 2 450 MHz / 5 200 MHz/ 5 300 MHz/ 5 500 MHz/ 5 800 MHz by using the system Verification kit. (Graphic Plots Attached)

System Verification Results

Freq.	Date	Probe (S/N)	Dipole (S/N)	Liquid	Amb. Temp.	Liquid Temp.	1 W Target SAR _{1g} (SPEAG)	Measured SAR _{1g}	1 W Normalized SAR _{1g}	Deviation	Limit [%]
[MHz]					[°C]	[°C]	[mW/g]	[mW/g]	[mW/g]	[%]	[%]
835	Jan. 08, 2015	3967	490	Head	20.7	20.5	9.07	0.898	8.98	- 0.99	± 10
835	Jan. 09, 2015	3903		Body	20.2	20.0	9.49	0.923	9.23	- 2.74	± 10
1 900	Jan. 08, 2015	3863	5d061	Head	20.7	20.5	40.6	4.01	40.1	- 1.23	± 10
1 900	Jan. 08, 2015	3903		Body	20.7	20.5	40.8	3.93	39.3	- 3.68	± 10
2 450	Jan. 21, 2015	1630	743	Head	20.1	19.9	53.2	5.35	53.5	+ 0.56	± 10
2 450	Jan. 19, 2015	3863		Body	20.2	20.0	51.3	5.21	52.1	+ 1.56	± 10
5 200	Jan. 20, 2015	3967	1107	Head	20.3	20.1	77.8	7.82	78.2	+ 0.51	± 10
5 200	Jan. 21, 2015	3863		Body	20.2	20.0	74.7	7.41	74.1	- 0.80	± 10
5 300	Jan. 20, 2015	3967	1107	Head	20.3	20.1	82.9	8.37	83.7	+ 0.97	± 10
5 300	Jan. 21, 2015	3863		Body	20.2	20.0	75.8	7.89	78.9	+ 4.09	± 10
5 500	Jan. 20, 2015	3967	1107	Head	20.3	20.1	84.0	8.54	85.4	+ 1.67	± 10
5 500	Jan. 21, 2015	3863		Body	20.2	20.0	79.1	7.89	78.9	- 0.25	± 10
5 800	Jan. 20, 2015	3967	1107	Head	20.3	20.1	79.4	7.9	79	- 0.50	± 10
5 800	Jan. 21, 2015	3863		Body	20.2	20.0	74.4	7.26	72.6	- 2.42	± 10

System Verification Results – Extremity SAR

Freq.	Date	Probe (S/N)	Dipole (S/N)	Liquid	Amb. Temp.	Liquid Temp.	1 W Target SAR _{10g} (SPEAG)	Measured SAR _{10g}	1 W Normalized SAR _{10g}	Deviation	Limit [%]
[MHz]					[°C]	[°C]	[mW/g]	[mW/g]	[mW/g]	[%]	[%]
2 450	Jan. 19, 2015	3863	743	Body	20.2	20.0	23.9	2.32	23.2	- 2.93	± 10
5 200	Jan. 21, 2015	3863	1107	Body	20.2	20.0	20.8	2.11	21.1	+ 1.44	± 10
5 300	Jan. 21, 2015	3863	1107	Body	20.2	20.0	21.2	2.25	22.5	+ 6.13	± 10
5 500	Jan. 21, 2015	3863	1107	Body	20.2	20.0	21.9	2.25	22.5	+ 2.74	± 10
5 800	Jan. 21, 2015	3863	1107	Body	20.2	20.0	20.5	2.05	20.5	+ 0.00	± 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 : 32.5 dBm	Target Power : 29.5 dBm
GPRS850	GSM1900
GPRS 1tx : 32.0 dBm / EGPRS 1tx : 27.0 dBm	GPRS 1tx : 29.5 dBm / EGPRS 1tx : 26.0 dBm
GPRS 2tx : 29.5 dBm / EGPRS 2tx : 26.0 dBm	GPRS 2tx : 26.5 dBm / EGPRS 2tx : 26.0 dBm
GPRS 3tx : 27.7 dBm / EGPRS 3tx : 24.5 dBm	GPRS 3tx : 24.7 dBm / EGPRS 3tx : 24.2 dBm
GPRS 4tx : 26.5 dBm / EGPRS 4tx : 23.0 dBm	GPRS 4tx : 23.5 dBm / EGPRS 4tx : 23.5 dBm
Tune-up Tolerance : -1.5 dB/ +0.5 dB	

WCDMA

WCDMA850		WCDMA1900	
3GPP RMC Rel. 99	Target Power : 22.5 dBm	3GPP RMC Rel. 99	Target Power : 22.0 dBm
HSDPA 3GPP Rel.5	Target Power : 22.0 dBm	HSDPA 3GPP Rel.5	Target Power : 21.0 dBm
HSUPA 3GPP Rel.6	Target Power : 22.0 dBm	HSUPA 3GPP Rel.6	Target Power : 21.0 dBm
DC-HSDPA 3GPP Rel.8	Target Power : 22.0 dBm	DC-HSDPA 3GPP Rel.8	Target Power : 21.0 dBm
Tune-up Tolerance : -1.5 dB/ +0.5 dB			

LTE

Mode/Band	LTE Band 5
Target Power	23.0 dBm
Tune-up Tolerance : -1.5 dB/ +0.5 dB	

Wifi

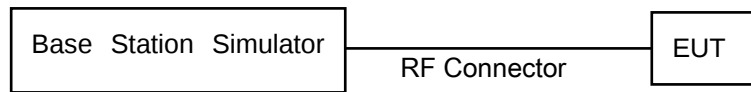
Mode / Band	IEEE 802.11 (in dBm)				
	802.11 a	802.11 b	802.11 g	802.11 n	802.11 ac
2.4 GHz WIFI	N/A	17	16	12.5	N/A
Mode / Band	802.11 a (20MHz BW)	802.11 n (20MHz BW)	802.11 n (40MHz BW)	802.11 n (80MHz BW)	802.11 ac (20MHz BW)
5 GHz WIFI	11.5	11.5	11.5	N/A	N/A
Upper Tune-up Tolerance : +0.5 dB					

BT.

Bluetooth (in dBm)	Target power (dBm)	
	Bluetooth DH5	10.5
	Bluetooth 2-DH5	7
	Bluetooth 3-DH5	7
	Bluetooth LE	7.5
Upper Tune-up Tolerance : +0.5 dB		

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, Body SAR
- GPRS Multi-slots : Body SAR with GPRS/EDGE Multi-slot Class 33 with CS 1 (GMSK)

Note;

This EUT'S GSM, GPRS and EDGE device class is B. Per KDB 941225 D01v03, GMSK GPRS and EDGE mode is the primary mode. 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	Channel	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	32.02	30.56	28.66	26.27	25.32	26.57	26.23	23.98	23.00
	190	32.08	30.51	28.68	26.30	25.35	26.65	26.18	23.91	22.22
	251	32.29	30.70	28.88	26.51	25.56	27.03	26.49	24.28	22.40
GSM 1900	512	29.33	29.33	25.69	24.20	23.35	25.74	25.66	23.94	23.92
	661	29.31	29.29	25.73	24.25	23.36	25.73	25.51	24.27	23.52
	810	29.34	29.33	25.84	24.35	23.45	25.74	25.66	24.29	23.19

GSM Conducted output powers (Frame-Average)

Band	Channel	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	22.99	21.53	22.64	22.01	22.31	17.54	20.21	19.72	19.99
	190	23.05	21.48	22.66	22.04	22.34	17.62	20.16	19.65	19.21
	251	23.26	21.67	22.86	22.25	22.55	18.00	20.47	20.02	19.39
GSM 1900	512	20.30	20.30	19.67	19.94	20.34	16.71	19.64	19.68	20.91
	661	20.28	20.26	19.71	19.99	20.35	16.70	19.49	20.01	20.51
	810	20.31	20.30	19.82	20.09	20.44	16.71	19.64	20.03	20.18

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/HSUPA 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 ≤ 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 ≤ 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: 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 $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$.
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	$\beta_{ed}: 47/15$ $\beta_{ed}: 47/15$	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: $\Delta_{ACK}, \Delta_{NACK}$ 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 $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. 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.

Note : Per KDB 941225 D01v03, the 12.2kbps RMC is the primary mode.

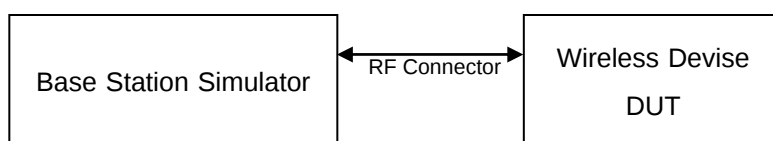
11.3.6 DC-HSDPA

UMTS SAR was tested under RMC 12.2 kbps with HSPA inactive per KDB publication 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.

DC-HSDPA Considerations:

- 3GPP Specification 34.121-1 Release 8 Ver 8.10.0 was used for DC-HSDPA guidance
- H-Set 12(QPSK) was confirmed to be used during DC-HSDPA measurements
- Measured maximum output powers for DC-HSDPA were not greater than 1/4 dB higher than the WCDMA 12.2 kbps RMC maximum output and as a result, SAR is not required for DC-HSDPA
- The DUT supports UE category 24 for HSDPA

It is expected by the manufacturer that MPR for some HSUPA subtests may be up to 1 dB more than specified by 3GPP, but also as low as 0 dB according to the chipset implementation in this model.



WCDMA850

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	22.35	22.35	22.38
99	WCDMA	12.2 kbps AMR	22.36	22.35	22.37
5	HSDPA	Subtest 1	21.80	21.82	21.85
5		Subtest 2	21.79	21.82	21.84
5		Subtest 3	21.27	21.28	21.30
5		Subtest 4	21.26	21.28	21.31
6	HSUPA	Subtest 1	21.79	21.81	21.83
6		Subtest 2	18.73	18.74	18.77
6		Subtest 3	19.70	19.71	19.72
6		Subtest 4	18.74	18.75	18.76
6		Subtest 5	21.24	21.26	21.30
8	DC-HSDPA	Subtest 1	21.66	21.54	21.45
8		Subtest 2	21.68	21.56	21.46
8		Subtest 3	21.12	21.02	20.88
8		Subtest 4	21.12	21.02	20.88

WCDMA Average Conducted output powers

WCDMA1900

3GPP	Mode	3GPP 34.121	PCS Band [dBm]		
Release		Subtest			
Version			UL 9262 DL 9662	UL 9400 DL 9800	UL 9538 DL 9938
99	WCDMA	12.2 kbps RMC	21.64	21.72	21.84
99	WCDMA	12.2 kbps AMR	21.65	21.72	21.84
5	HSDPA	Subtest 1	21.16	21.27	21.38
5		Subtest 2	21.16	21.26	21.37
5		Subtest 3	20.58	20.69	20.81
5		Subtest 4	20.60	20.69	20.82
6	HSUPA	Subtest 1	21.14	21.24	21.36
6		Subtest 2	18.05	18.15	18.27
6		Subtest 3	19.06	19.16	19.30
6		Subtest 4	18.06	18.16	18.30
6		Subtest 5	20.61	20.70	20.84
8	DC-HSDPA	Subtest 1	21.04	21.21	21.45
8		Subtest 2	21.06	21.21	21.46
8		Subtest 3	20.49	20.67	20.88
8		Subtest 4	20.50	20.67	20.88

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 5

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)		
				20407 824.7 MHz	20525 836.5 MHz	20643 848.3 MHz
1.4 MHz	QPSK	1	0	23.20	23.35	23.16
		1	3	23.16	23.29	23.07
		1	5	23.23	23.31	23.13
		3	0	23.29	23.41	23.21
		3	1	23.28	23.42	23.20
		3	3	23.29	23.41	23.22
		6	0	22.29	22.30	22.18
	16QAM	1	0	22.30	22.30	22.26
		1	3	22.28	22.19	22.16
		1	5	22.36	22.28	22.22
		3	0	22.25	22.37	22.17
		3	1	22.20	22.37	22.13
		3	3	22.26	22.47	22.15
		6	0	21.36	21.46	21.32

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)		
				20415 825.5 MHz	20525 836.5 MHz	20635 847.5 MHz
3 MHz	QPSK	1	0	23.18	23.14	23.08
		1	7	23.33	23.39	23.34
		1	14	23.17	23.04	22.98
		8	0	22.15	22.23	22.07
		8	3	22.20	22.21	22.09
		8	7	22.19	22.16	22.05
		15	0	22.18	22.20	22.10
	16QAM	1	0	22.05	22.25	22.08
		1	7	22.41	22.22	22.35
		1	14	22.06	22.37	21.99
		8	0	21.25	21.28	21.15
		8	3	21.30	21.30	21.18
		8	7	21.26	21.24	21.14
		15	0	21.19	21.26	21.05

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)		
				20425 826.5 MHz	20525 836.5 MHz	20625 846.5 MHz
5 MHz	QPSK	1	0	23.28	23.38	23.27
		1	12	23.35	23.35	23.19
		1	24	23.37	23.30	23.19
		12	0	22.28	22.39	22.25
		12	6	22.36	22.44	22.31
		12	11	22.27	22.35	22.22
		25	0	22.31	22.37	22.25
	16QAM	1	0	22.27	22.48	22.49
		1	12	22.26	22.41	22.47
		1	24	22.34	22.47	22.49
		12	0	21.29	21.48	21.25
		12	6	21.39	21.50	21.34
		12	11	21.30	21.40	21.24
		25	0	21.36	21.35	21.17

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)		
				20450 829 MHz	20525 836.5 MHz	20600 844 MHz
10 MHz	QPSK	1	0	23.34	23.49	23.40
		1	24	23.40	23.48	23.41
		1	49	23.31	23.33	23.26
		25	0	22.48	22.47	22.40
		25	12	22.43	22.49	22.41
		25	24	22.40	22.43	22.31
		50	0	22.38	22.46	22.34
	16QAM	1	0	22.36	22.47	22.34
		1	24	22.44	22.44	22.38
		1	49	22.29	22.46	22.15
		25	0	21.40	21.47	21.47
		25	12	21.45	21.49	21.43
		25	24	21.34	21.41	21.35
		50	0	21.39	21.41	21.38

Note: LTE Band 5 at 10 MHz Bandwidth does not support three non-overlapping channels. Per KDB 941225 D05v02r03, when a device supports overlapping channel assignment in a channel bandwidth configuration, the mid channel of the group of overlapping channels should be selected for testing.

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		√			
UNII or §15.247							

802.11 Test Channels per FCC Requirements

TEST RESULTS-Average

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	17.40	17.42	17.39	17.48
	2437	6	16.45	16.54	16.49	16.53
	2462	11	16.84	16.95	17.03	16.96

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	16.48	16.45	16.48	16.49	16.45	16.46	16.47	16.46
	2437	6	15.80	15.82	15.76	15.85	15.80	15.83	15.80	15.83
	2462	11	15.94	16.01	15.96	16.06	15.99	16.04	15.99	16.05

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	2412	1	12.98	12.92	12.92	12.90	12.89	12.91	12.91	12.91
	2437	6	12.26	12.23	12.23	12.24	12.18	12.21	12.22	12.17
	2462	11	12.40	12.44	12.48	12.45	12.38	12.36	12.46	12.31

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	11.15	11.22	11.19	11.24	11.22	11.27	11.33	11.39
	5200	40	11.23	11.31	11.37	11.35	11.34	11.35	11.42	11.44
	5220	44	11.20	11.23	11.26	11.39	11.30	11.36	11.34	11.37
	5240	48	11.22	11.27	11.27	11.40	11.30	11.36	11.40	11.43
	5260	52	11.30	11.37	11.23	11.30	11.26	11.27	11.42	11.48
	5280	56	11.24	11.24	11.36	11.34	11.32	11.26	11.41	11.42
	5300	60	11.24	11.24	11.36	11.34	11.30	11.23	11.34	11.40
	5320	64	11.24	11.27	11.32	11.30	11.28	11.36	11.44	11.45
	5500	100	11.69	11.72	11.75	11.81	11.80	11.83	11.86	11.93
	5520	104	11.65	11.71	11.73	11.77	11.77	11.78	11.86	11.88
	5540	108	11.59	11.54	11.70	11.67	11.63	11.76	11.77	11.80
	5560	112	11.54	11.50	11.68	11.64	11.62	11.75	11.74	11.75
	5580	116	11.44	11.54	11.54	11.57	11.56	11.65	11.65	11.68
	5660	132	11.38	11.52	11.46	11.51	11.51	11.61	11.60	11.58
	5680	136	11.34	11.52	11.48	11.49	11.53	11.58	11.58	11.57
	5700	140	11.24	11.19	11.28	11.26	11.30	11.31	11.34	11.41
	5745	149	11.26	11.32	11.34	11.39	11.33	11.34	11.50	11.47
	5765	153	11.20	11.27	11.20	11.34	11.21	11.37	11.37	11.32
	5785	157	11.21	11.33	11.21	11.39	11.22	11.37	11.40	11.36
	5805	161	11.15	11.25	11.16	11.33	11.16	11.35	11.34	11.31
	5825	165	11.10	11.12	11.12	11.17	11.13	11.26	11.26	11.30

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	11.13	11.25	11.28	11.30	11.33	11.40	11.40	11.34
	5200	40	11.16	11.25	11.31	11.31	11.33	11.32	11.39	11.39
	5220	44	11.12	11.22	11.28	11.28	11.32	11.38	11.35	11.29
	5240	48	11.08	11.18	11.23	11.27	11.26	11.27	11.32	11.33
	5260	52	11.02	11.13	11.14	11.22	11.20	11.22	11.28	11.28
	5280	56	11.01	11.13	11.13	11.22	11.16	11.21	11.28	11.27
	5300	60	11.09	11.10	11.11	11.18	11.19	11.12	11.26	11.19
	5320	64	11.02	11.11	11.13	11.18	11.23	11.23	11.34	11.35
	5500	100	11.62	11.74	11.71	11.75	11.73	11.81	11.79	11.81
	5520	104	11.57	11.70	11.68	11.71	11.69	11.76	11.77	11.79
	5540	108	11.55	11.69	11.64	11.70	11.65	11.76	11.77	11.74
	5560	112	11.54	11.69	11.65	11.70	11.69	11.72	11.73	11.73
	5580	116	11.52	11.65	11.59	11.59	11.67	11.66	11.77	11.67
	5660	132	11.50	11.58	11.55	11.59	11.63	11.60	11.71	11.62
	5680	136	11.38	11.54	11.44	11.44	11.57	11.47	11.53	11.49
	5700	140	11.26	11.25	11.28	11.32	11.38	11.38	11.35	11.41
	5745	149	11.22	11.35	11.36	11.34	11.41	11.35	11.40	11.39
	5765	153	11.20	11.27	11.25	11.38	11.29	11.28	11.25	11.28
	5785	157	11.22	11.31	11.32	11.38	11.31	11.33	11.27	11.32
	5805	161	11.20	11.24	11.32	11.36	11.29	11.26	11.20	11.27
	5825	165	10.99	11.14	11.10	11.17	11.10	11.13	11.23	11.20

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	10.62	10.74	10.78	10.84	10.77	10.79	10.84	10.80
	5230	46	10.69	10.75	10.76	10.73	10.81	10.74	10.75	10.77
	5270	54	10.50	10.57	10.59	10.68	10.71	10.64	10.73	10.66
	5310	62	10.61	10.69	10.68	10.67	10.70	10.66	10.74	10.73
	5510	102	11.05	11.13	11.14	11.15	11.16	11.17	11.18	11.20
	5550	110	11.05	11.05	11.08	11.09	11.15	11.11	11.13	11.13
	5670	134	10.69	10.81	10.81	10.88	10.85	10.82	10.87	10.86
	5710	142	10.69	10.77	10.75	10.84	10.82	10.75	10.86	10.83
	5755	151	10.49	10.56	10.64	10.63	10.73	10.58	10.65	10.65
	5795	159	10.42	10.53	10.51	10.55	10.56	10.67	10.64	10.73

11.6 BT

Averaged-conducted Power

Mode	Channel	Power (dBm)
DH5	0	8.46
	39	10.6
	78	8.14
2-DH5	0	5.26
	39	7.3
	78	4.73
3-DH5	0	5.29
	39	7.3
	78	4.74

11.7 SAR Test Exclusions Applied

11.7.1 WCDMA

Per FCC KDB 941225 D01V03, 12.2 kbps RMC is the primary mode and HSPA (HSUPA/HSDPA with RMC) is the secondary mode.

Per KDB 941225 D01V03, The SAR test exclusion is applied to the secondary mode by the following equation.

$$\text{Adjusted SAR} = \text{Highest Reported SAR} * \frac{\text{Secondary Max tune - up (mW)}}{\text{Primary Max tune tune - up(mW)}} \leq 1.2 \text{ W/kg.}$$

Based on the highest Reported SAR, the secondary mode is not required.

$$[0.691 * (178/178)] = 0.691 \text{ W/kg} \leq 1.2 \text{ W/kg}$$

And the the maximum output power and tune-up tolerance in secondary mode is ≤ 0.25 dB higher than the primary mode.

11.7.2 BT LE

Per FCC KDB 447498 D01v05r02, The SAR exclusion threshold for distance < 50mm 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 LE	2 480	6	10	0.94

Based on the maximum conducted power of Bluetooth and antenna to use separation distance, Bluetooth LE SAR was not required $[(6/10)*\sqrt{2.480}] = 0.94 < 3.0$.

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 LE	2 480	6	10	0.13

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) The frequency of Bluetooth using for estimated SAR was selected highest channel of Bluetooth for highest estimated SAR.

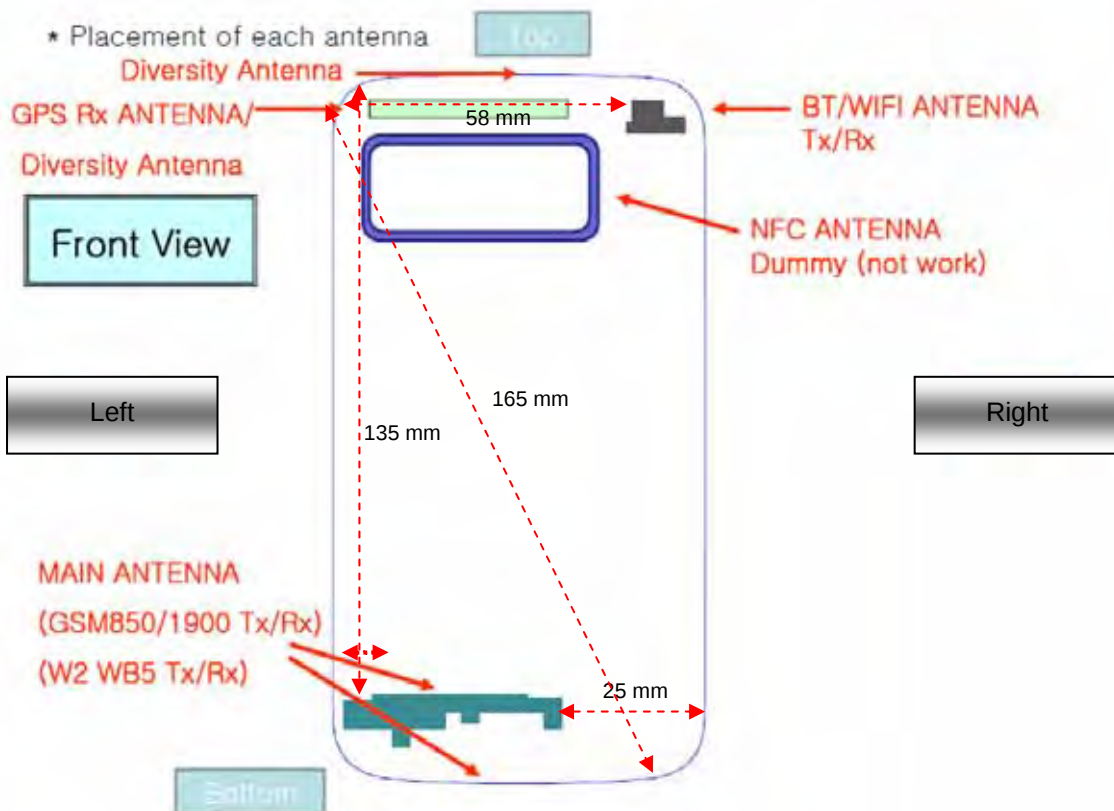
12. SAR Test configuration & Antenna Information

Mode	Rear	Front	Left	Right	Bottom	Top
GSM/GPRS/EDGE 850	Yes	Yes	Yes	Yes	Yes	No
GSM/GPRS/EDGE 1900	Yes	Yes	Yes	Yes	Yes	No
WCDMA 850	Yes	Yes	Yes	Yes	Yes	No
WCDMA 1900	Yes	Yes	Yes	Yes	Yes	No
LTE Band 5	Yes	Yes	Yes	Yes	Yes	No
2.4 GHz WLAN	Yes	Yes	No	Yes	No	Yes
5 GHz WLAN	Yes	Yes	No	Yes	No	Yes
BT	Yes	Yes	No	Yes	No	Yes

Note; All test configurations are based on front view.

Particular DUT edges were not required to be evaluated for Wireless Router or Extremity SAR if the edges were greater than 2.5cm from the transmitting antenna according to KDB Publication 941225 D06v01 guidance, and FCC KDB 648474 D04v01r02. Handset SAR.

12.1 Antenna and Device Information



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.

2. Since the diagonal dimension of this device is > 160 mm and < 200 mm , it is considered a "phablet"

Please see [A3LSMA700F] Ant distance file for further information.

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	GSM850	33.0	32.08	-0.10	Standard	Left Ear	0.057	1.236	0.070	1
836.6	190		33.0	32.08	0.166	Standard	Left Tilt	0.026	1.236	0.032	-
836.6	190		33.0	32.08	0.129	Standard	Right Ear	0.054	1.236	0.067	-
836.6	190		33.0	32.08	0.188	Standard	Right Tilt	0.019	1.236	0.023	-
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	GSM1900	30.0	29.31	0.147	Standard	Left Ear	0.131	1.172	0.154	2
1 880.0	661		30.0	29.31	0.149	Standard	Left Tilt	0.049	1.172	0.057	-
1 880.0	661		30.0	29.31	0.182	Standard	Right Ear	0.090	1.172	0.105	-
1 880.0	661		30.0	29.31	0.160	Standard	Right Tilt	0.061	1.172	0.072	-
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	23.0	22.35	-0.003	Standard	Left Ear	0.093	1.161	0.108	-
836.6	4183		23.0	22.35	0.108	Standard	Left Tilt	0.043	1.161	0.050	-
836.6	4183		23.0	22.35	0.062	Standard	Right Ear	0.097	1.161	0.113	3
836.6	4183		23.0	22.35	0.172	Standard	Right Tilt	0.033	1.161	0.038	-
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 (WCDMA1900 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	9400	WCDMA 1900	22.5	21.72	0.056	Standard	Left Ear	0.173	1.197	0.207	4
1 880.0	9400		22.5	21.72	-0.008	Standard	Left Tilt	0.059	1.197	0.071	-
1 880.0	9400		22.5	21.72	-0.152	Standard	Right Ear	0.086	1.197	0.103	-
1 880.0	9400		22.5	21.72	0.158	Standard	Right Tilt	0.081	1.197	0.097	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Head 1.6 W/kg (mW/g) Averaged over 1 gram				

13.1-5 Measurement Results (LTE Band 5 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									
836.5	20525	QPSK	23.5	23.49	-0.130	Standard	Left Ear	1	0	0.099	1.002	0.099	-
836.5	20525		22.5	22.49	-0.189	Standard	Left Ear	25	12	0.081	1.002	0.081	-
836.5	20525		23.5	23.49	0.115	Standard	Left Tilt	1	0	0.043	1.002	0.043	-
836.5	20525		22.5	22.49	0.169	Standard	Left Tilt	25	12	0.034	1.002	0.034	-
836.5	20525		23.5	23.49	-0.184	Standard	Right Ear	1	0	0.113	1.002	0.113	5
836.5	20525		22.5	22.49	0.158	Standard	Right Ear	25	12	0.089	1.002	0.089	-
836.5	20525		23.5	23.49	0.027	Standard	Right Tilt	1	0	0.044	1.002	0.044	-
836.5	20525		22.5	22.49	0.131	Standard	Right Tilt	25	12	0.033	1.002	0.033	-
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 (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								
2 412	1	802.11b	17.5	17.40	0.151	Standard	Left Ear	1Mbps	0.708	1.023	0.724	-
2 437	6		17.5	16.45	-0.026	Standard	Left Ear	1Mbps	0.663	1.274	0.844	-
2 462	11		17.5	16.84	-0.11	Standard	Left Ear	1Mbps	0.728	1.164	0.847	6
2 412	1		17.5	17.40	0.105	Standard	Left Tilt	1Mbps	0.545	1.023	0.558	-
2 437	6		17.5	16.45	-0.090	Standard	Left Tilt	1Mbps	0.543	1.274	0.692	-
2 462	11		17.5	16.84	0.022	Standard	Left Tilt	1Mbps	0.591	1.164	0.688	-
2 412	1		17.5	17.40	-0.114	Standard	Right Ear	1Mbps	0.439	1.023	0.449	-
2 412	1		17.5	17.40	-0.001	Standard	Right Tilt	1Mbps	0.497	1.023	0.509	-
5 745	149	802.11a	12.0	11.26	-0.138	Standard	Left Ear	6Mbps	0.064	1.186	0.076	7
			12.0	11.26	-0.07	Standard	Left Tilt	6Mbps	0.020	1.186	0.024	-
			12.0	11.26	-0.07	Standard	Right Ear	6Mbps	0.012	1.186	0.014	-
			12.0	11.26	-0.12	Standard	Right Tilt	6Mbps	0.00792	1.186	0.009	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Head 1.6 W/kg (mW/g) Averaged over 1 gram					

13.1-7 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								
5 200	40	802.11a	12.0	11.23	-0.02	Standard	Left Ear	6Mbps	0.324	1.194	0.387	8
			12.0	11.23	0.13	Standard	Left Tilt	6Mbps	0.253	1.194	0.302	-
			12.0	11.23	0.17	Standard	Right Ear	6Mbps	0.116	1.194	0.139	-
			12.0	11.23	-0.17	Standard	Right Tilt	6Mbps	0.128	1.194	0.153	-
5 260	52	802.11a	12.0	11.30	0.19	Standard	Left Ear	6Mbps	0.305	1.175	0.358	-
			12.0	11.30	0.15	Standard	Left Tilt	6Mbps	0.223	1.175	0.262	-
			12.0	11.30	0.17	Standard	Right Ear	6Mbps	0.119	1.175	0.140	-
			12.0	11.30	0.14	Standard	Right Tilt	6Mbps	0.097	1.175	0.114	-
5 500	100	802.11a	12.0	11.69	0.15	Standard	Left Ear	6Mbps	0.247	1.074	0.265	-
			12.0	11.69	-0.08	Standard	Left Tilt	6Mbps	0.148	1.074	0.159	-
			12.0	11.69	-0.143	Standard	Right Ear	6Mbps	0.089	1.074	0.096	-
			12.0	11.69	-0.19	Standard	Right Tilt	6Mbps	0.070	1.074	0.075	-
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 2Tx	30.0	28.68	0.024	Rear	1.0 cm	0.301	1.355	0.408	9
836.6	190		30.0	28.68	-0.120	Front	1.0 cm	0.256	1.355	0.347	-
836.6	190		30.0	28.68	0.091	Left	1.0 cm	0.090	1.355	0.122	-
836.6	190		30.0	28.68	-0.022	Right	1.0 cm	0.090	1.355	0.122	-
836.6	190		30.0	28.68	-0.099	Bottom	1.0 cm	0.140	1.355	0.190	-
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	24.0	23.36	0.11	Rear	1.0 cm	0.364	1.159	0.422	10
1 880.0	661		24.0	23.36	0.12	Front	1.0 cm	0.319	1.159	0.370	-
1 880.0	661		24.0	23.36	0.017	Left	1.0 cm	0.092	1.159	0.107	-
1 880.0	661		24.0	23.36	0.186	Right	1.0 cm	0.050	1.159	0.058	-
1 880.0	661		24.0	23.36	-0.091	Bottom	1.0 cm	0.665	1.159	0.771	-
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	23.0	22.35	0.007	Rear	1.0 cm	0.483	1.161	0.561	11
836.6	4183		23.0	22.35	-0.013	Front	1.0 cm	0.436	1.161	0.506	-
836.6	4183		23.0	22.35	-0.073	Left	1.0 cm	0.120	1.161	0.139	-
836.6	4183		23.0	22.35	0.082	Right	1.0 cm	0.120	1.161	0.139	-
836.6	4183		23.0	22.35	-0.007	Bottom	1.0 cm	0.221	1.161	0.257	-
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 (WCDMA1900 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	9400	WCDMA 1900	22.5	21.72	-0.064	Rear	1.0 cm	0.574	1.197	0.687	12
1 880.0	9400		22.5	21.72	-0.020	Front	1.0 cm	0.483	1.197	0.578	-
1 880.0	9400		22.5	21.72	0.010	Left	1.0 cm	0.149	1.197	0.178	-
1 880.0	9400		22.5	21.72	-0.009	Right	1.0 cm	0.100	1.197	0.120	-
1 880.0	9400		22.5	21.72	-0.11	Bottom	1.0 cm	0.577	1.197	0.691	13
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 (LTE Band 5 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									
836.5	20525	QPSK	23.5	23.49	-0.057	Rear	1	0	1.0 cm	0.606	1.002	0.607	14
836.5	20525		22.5	22.49	0.009	Rear	25	12	1.0 cm	0.491	1.002	0.492	-
836.5	20525		23.5	23.49	-0.038	Front	1	0	1.0 cm	0.512	1.002	0.513	-
836.5	20525		22.5	22.49	-0.060	Front	25	12	1.0 cm	0.404	1.002	0.405	-
836.5	20525		23.5	23.49	-0.027	Left	1	0	1.0 cm	0.114	1.002	0.114	-
836.5	20525		22.5	22.49	-0.021	Left	25	12	1.0 cm	0.102	1.002	0.102	-
836.5	20525		23.5	23.49	-0.023	Right	1	0	1.0 cm	0.122	1.002	0.122	-
836.5	20525		22.5	22.49	-0.003	Right	25	12	1.0 cm	0.107	1.002	0.107	-
836.5	20525		23.5	23.49	-0.005	Bottom	1	0	1.0 cm	0.278	1.002	0.279	-
836.5	20525		22.5	22.49	-0.021	Bottom	25	12	1.0 cm	0.234	1.002	0.235	-
ANSI/ IEEE C95.1 1992 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 1.6 W/kg (mW/g) Averaged over 1 gram						

13.2-6 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								
2 412	1	802.11b	17.5	16.48	-0.164	Rear	1Mbps	1.0 cm	0.086	1.265	0.109	15
			17.5	16.48	-0.122	Front	1Mbps	1.0 cm	0.141	1.265	0.178	-
			17.5	16.48	0.167	Right	1Mbps	1.0 cm	0.049	1.265	0.062	-
			17.5	16.48	0.007	Top	1Mbps	1.0 cm	0.203	1.265	0.257	16
5 745	149	802.11a	12.0	11.26	-0.169	Rear	6Mbps	1.0 cm	0.016	1.186	0.019	17
			12.0	11.26	0.004	Front	6Mbps	1.0 cm	0.00756	1.186	0.009	-
			12.0	11.26	-0.12	Right	6Mbps	1.0 cm	0.0091	1.186	0.011	-
			12.0	11.26	0.129	Top	6Mbps	1.0 cm	0.0012	1.186	0.001	-
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								
2 412	1	802.11b	17.5	16.48	-0.164	Rear	1Mbps	1.0 cm	0.086	1.265	0.109	15
2 412	1	802.11b	17.5	16.48	-0.122	Front	1Mbps	1.0 cm	0.141	1.265	0.178	-
5 745	149	802.11a	12.0	11.26	--0.169	Rear	6Mbps	1.0 cm	0.016	1.186	0.019	17
5 745	149	802.11a	12.0	11.26	0.004	Front	6Mbps	1.0 cm	0.00756	1.186	0.009	-
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								
5 200	40	802.11a	12.0	11.23	-0.100	Rear	6Mbps	1.0 cm	0.026	1.194	0.031	-
5 200	40	802.11a	12.0	11.23	0.142	Front	6Mbps	1.0 cm	0.027	1.194	0.032	18
5 260	52	802.11a	12.0	11.30	0.135	Rear	6Mbps	1.0 cm	0.034	1.175	0.040	-
5 260	52	802.11a	12.0	11.30	-0.142	Front	6Mbps	1.0 cm	0.024	1.175	0.028	-
5 500	100	802.11a	12.0	11.69	0.010	Rear	6Mbps	1.0 cm	0.00741	1.074	0.008	-
5 500	100	802.11a	12.0	11.69	0.11	Front	6Mbps	1.0 cm	0.00793	1.074	0.009	-
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	33.0	32.08	0.138	Rear	1.0 cm	0.295	1.236	0.365	-
836.6	190	GSM850	33.0	32.08	0.023	Front	1.0 cm	0.305	1.236	0.377	19
1 880.0	661	GSM1900	30.0	29.31	-0.174	Rear	1.0 cm	0.391	1.172	0.458	20
1 880.0	661	GSM1900	30.0	29.31	-0.146	Front	1.0 cm	0.355	1.172	0.416	-
836.6	4183	WCDMA 850	23.0	22.35	0.007	Rear	1.0 cm	0.483	1.161	0.561	11
836.6	4183	WCDMA 850	23.0	22.35	-0.013	Front	1.0 cm	0.436	1.161	0.506	-
1 880.0	9400	WCDMA 1900	22.5	21.72	0.064	Rear	1.0 cm	0.574	1.197	0.687	12
1 880.0	9400	WCDMA 1900	22.5	21.72	-0.020	Front	1.0 cm	0.483	1.197	0.578	-
836.5	20525	LTE Band 5	23.5	23.49	-0.057	Rear	1.0 cm	0.606	1.002	0.607	14
836.5	20525	LTE Band 5	23.5	23.49	-0.038	Front	1.0 cm	0.512	1.002	0.492	-
2 441	39	Bluetooth DH5	11.0	10.6	0.171	Rear	1.0 cm	0.020	1.096	0.022	21
2 441	39	Bluetooth DH5	11.0	10.6	0.184	Front	1.0 cm	0.00242	1.096	0.003	-
ANSI/ IEEE C95.1 - 1992- Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 1.6 W/kg (mW/g) Averaged over 1 gram				

13.3-4 Measurement Results (Bluetooth Hand 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							
2 441	39	Bluetooth DH5	11.0	10.6	0.16	Rear	0 cm	0.082	1.096	0.090	-
2 441	39	Bluetooth DH5	11.0	10.6	0.142	Front	0 cm	0.107	1.096	0.117	22
2 441	39	Bluetooth DH5	11.0	10.6	0.079	Right	0 cm	0.019	1.096	0.021	-
2 441	39	Bluetooth DH5	11.0	10.6	-0.157	Top	0 cm	0.078	1.096	0.086	-
ANSI/ IEEE C95.1 - 1992- Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 2.0 W/kg (mW/g) Averaged over 10 gram				

13.3-5 Measurement Results (NII Hand 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								
5 200	40	802.11a	12.0	11.23	-0.039	Rear	6Mbps	0 cm	0.079	1.194	0.094	-
			12.0	11.23	0.004	Front	6Mbps	0 cm	0.167	1.194	0.199	-
			12.0	11.23	0.187	Right	6Mbps	0 cm	0.020	1.194	0.024	-
			12.0	11.23	0.154	Top	6Mbps	0 cm	0.064	1.194	0.076	-
5 260	52	802.11a	12.0	11.30	-0.10	Rear	6Mbps	0 cm	0.040	1.175	0.047	-
			12.0	11.30	0.150	Front	6Mbps	0 cm	0.147	1.175	0.173	-
			12.0	11.30	-0.18	Right	6Mbps	0 cm	0.021	1.175	0.025	-
			12.0	11.30	0.151	Top	6Mbps	0 cm	0.046	1.175	0.054	-
5 500	100	802.11a	12.0	11.69	0.01	Rear	6Mbps	0 cm	0.087	1.074	0.093	-
			12.0	11.69	0.127	Front	6Mbps	0 cm	0.180	1.074	0.193	23
			12.0	11.69	-0.148	Right	6Mbps	0 cm	0.017	1.074	0.018	-
			12.0	11.69	0.132	Top	6Mbps	0 cm	0.018	1.074	0.019	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 2.0 W/kg (mW/g) Averaged over 10 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.
9. Per FCC KDB Publication 648474 D04v01r02, this is considered a "Phablet" since the diagonal dimension is greater than 160mm and less than 200mm. therefore, extremity SAR tests are required when wireless router mode dose not apply or if wireless router 1g SAR >1.2 W/kg. Extremity SAR was not evaluated for 2.4GHz WIFI and GSM/GPRS/EDGE/UMTS since Hotspot 1g SAR for these band s was <1.2 W/kg

GSM/GPRS Test Notes:

1. This EUT'S GSM, GPRS and EDGE device class is B.
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 D01v03: 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 D01v03 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. The 12.2 kbps RMC mode is the primary mode.
2. UMTS mode in Body SAR was tested under RMC 12.2 kbps with HSPA inactive per KDB 941225 D01v03. 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 Adjusted SAR value was less than 1.2 W/kg.
3. 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.
4. UMTS SAR was tested under RMC 12.2 kbps with HSPA inactive per KDB publication 941225 D01v03. 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.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Consideration for LTE Devices in FCC KDB 941225 D05v02r03.
2. According to FCC KDB 941225 D05v02r01:
 - i. When the reported SAR is ≤ 0.8 W/kg, testing of the 100%RB allocation and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the 1RB, 50%RB and 100%RB allocation with highest output power for that channel.
 - ii. Only one channel, and as reported SAR values for 1RB allocation and 50%RB allocation were less than 1.45W/Kg only the highest power RB offset for each allocation was required.
3. 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 target MPR is indicated alongside the SAR results.
4. A-MPR was dialed for all SAR tests by setting NS=01 on the base station simulator.
5. Pre-installed VOIP applications are considered.
6. SAR test reduction is applied using the following criteria:
 - Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB, and 50% RB allocation, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel.
 - When the reported SAR is >0.8 W/kg, testing for other Channels is performed at the highest output power level for 1RB, and 50% RB configuration for that channel.
 - Testing for 100% RB configuration is performed at the highest output power level for 100% RB configuration across the Low, Mid and High Channel when the highest reported SAR for 1 RB and 50% RB are >0.8 W/kg, Testing for the remaining required channels is not needed because the reported SAR for 100% RB Allocation <1.45 W/kg.
 - Testing for 16-QAM modulation is not required because the reported SAR for QPSK is <1.45 W/kg and its output power is not more than 0.5 dB higher than that a QPSK.
 - Testing for the other channel bandwidths is not required because the reported SAR for the highest channel bandwidth is <1.45 W/kg and its output power is not more than 0.5 dB higher than that of the highest channel bandwidth.

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. 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.
3. 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.
4. 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.
5. When wireless router is enabled, 5.2, 5.3 and 5.5 GHz bands are disabled.
6. This device can operate in the 2.4 GHz and 5.8 GHz bands using WIFI Direct Go capability. Per FCC KDB 941225 D06v02, 5.8 GHz WIFI Direct Go is evaluated for SAR using wireless router SAR evaluation procedures.
7. 5GHz 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 D06v02.
8. Per FCC KDB Publication 648474 D04v01r02, this device is considered a "phablet" since its diagonal distance, 160.1 mm, is greater than 160 mm. Therefore hand SAR tests are required. Because wireless router operations are not supported for 5 GHz NII WIFI and Bluetooth, hand SAR was evaluated for 5 GHz NII WIFI and Bluetooth. However, hand SAR was not evaluated for 2.4 GHz WIFI and 5 GHz DTS WIFI since Hotspot SAR for 2.4 GHz WIFI and 5 GHz DTS WIFI were < 1.2 W/kg."

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 for 1g SAR or < 2.0 W/kg for 10g SAR ; steps 2) through 4) do not apply.
- 2) When the original highest measured 1g SAR is ≥ 0.80 W/kg or 10g SAR ≥ 2.0 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 for 1g SAR or ≥ 3.625 W/kg for 10g SAR (~ 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 for 1g SAR or ≥ 3.75 W/kg for 10g SAR 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 Voice + 2.4 GHz WiFi	
		GSM 1900 Voice + 2.4 GHz WiFi	
		WCDMA850 Voice + 2.4 GHz WiFi	
		WCDMA1900 Voice + 2.4 GHz WiFi	
		LTE Band 5 Data + 2.4 GHz WiFi	*3 rd Party applications are considered
		GSM 850 Voice + 5 GHz WiFi	
		GSM 1900 Voice + 5 GHz WiFi	
		WCDMA850 Voice + 5 GHz WiFi	
		WCDMA1900 Voice + 5 GHz WiFi	
		LTE Band 5 Data + 5 GHz WiFi	*3 rd Party applications are considered
	Hotspot	GPRS 850 Data + 2.4 GHz WiFi	
		GPRS 1900 Data + 2.4 GHz WiFi	
		WCDMA850 Data + 2.4 GHz WiFi	
		WCDMA1900 Data + 2.4 GHz WiFi	
		LTE Band 5 Data + 2.4 GHz WiFi	
		GPRS 850 Data + 5 GHz WiFi	
		GPRS 1900 Data + 5 GHz WiFi	
		WCDMA850 Data + 5 GHz WiFi	
		WCDMA1900 Data + 5 GHz WiFi	
		LTE Band 5 Data + 5 GHz WiFi	
	Body-worn	GSM 850 Voice + 2.4 GHz WiFi	
		GSM 1900 Voice + 2.4 GHz WiFi	
		WCDMA850 Voice + 2.4 GHz WiFi	
		WCDMA1900 Voice + 2.4 GHz WiFi	
		LTE Band 5 Voice + 2.4 GHz WiFi	
		GSM 850 Voice + 5 GHz WiFi	
		GSM 1900 Voice + 5 GHz WiFi	
		WCDMA850 Voice + 5 GHz WiFi	
		WCDMA1900 Voice + 5 GHz WiFi	
		LTE Band 5 Voice + 5 GHz WiFi	
		GSM 850 Voice + 2.4 GHz Bluetooth	
		GSM 1900 Voice + 2.4 GHz Bluetooth	
		WCDMA850 Voice + 2.4 GHz Bluetooth	
		WCDMA1900 Voice + 2.4 GHz Bluetooth	
		LTE Band 5 Voice + 2.4 GHz Bluetooth	

* BT and WLAN are not simultaneous transmission.

All licensed modes share the same antenna path and cannot transmit simultaneously.

3rd party VOIP applications can be used by end-user

5 GHz WiFi SAR value for simultaneous condition used highest SAR value in a same position.

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	0.070	0.847	0.917
	Left Tilt	0.032	0.688	0.720
	Right Cheek	0.067	0.449	0.516
	Right Tilt	0.023	0.509	0.532
GSM 1900	Left Cheek	0.154	0.847	1.001
	Left Tilt	0.057	0.688	0.745
	Right Cheek	0.105	0.449	0.554
	Right Tilt	0.072	0.509	0.581
WCDMA 850	Left Cheek	0.108	0.847	0.955
	Left Tilt	0.050	0.688	0.738
	Right Cheek	0.113	0.449	0.562
	Right Tilt	0.038	0.509	0.547
WCDMA 1900	Left Cheek	0.207	0.847	1.054
	Left Tilt	0.071	0.688	0.759
	Right Cheek	0.103	0.449	0.552
	Right Tilt	0.097	0.509	0.606
LTE 5	Left Cheek	0.099	0.847	0.946
	Left Tilt	0.043	0.688	0.731
	Right Cheek	0.113	0.449	0.562
	Right Tilt	0.044	0.509	0.553

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	0.070	0.387	0.457
	Left Tilt	0.032	0.302	0.334
	Right Cheek	0.067	0.140	0.207
	Right Tilt	0.023	0.153	0.176
GSM 1900	Left Cheek	0.154	0.387	0.541
	Left Tilt	0.057	0.302	0.359
	Right Cheek	0.105	0.140	0.245
	Right Tilt	0.072	0.153	0.225
WCDMA 850	Left Cheek	0.108	0.387	0.495
	Left Tilt	0.050	0.302	0.352
	Right Cheek	0.113	0.140	0.253
	Right Tilt	0.038	0.153	0.191
WCDMA 1900	Left Cheek	0.207	0.387	0.594
	Left Tilt	0.071	0.302	0.373
	Right Cheek	0.103	0.140	0.243
	Right Tilt	0.097	0.153	0.250
LTE 5	Left Cheek	0.099	0.387	0.486
	Left Tilt	0.043	0.302	0.345
	Right Cheek	0.113	0.140	0.253
	Right Tilt	0.044	0.153	0.197

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)	$\sum$ 1-g SAR (W/kg)
GSM 850	Rear	0.365	0.109	0.474
GSM 850	Front	0.377	0.178	0.555
GSM 1900	Rear	0.458	0.109	0.567
GSM 1900	Front	0.416	0.178	0.594
WCDMA 850	Rear	0.561	0.109	0.670
WCDMA 850	Front	0.506	0.178	0.684
WCDMA 1900	Rear	0.687	0.109	0.796
WCDMA 1900	Front	0.578	0.178	0.756
LTE 5	Rear	0.607	0.109	0.716
LTE 5	Front	0.492	0.178	0.670

Simultaneous Transmission Summation with Wifi (1 cm)

Band	configuration	Scaled SAR (W/kg)	5 GHz WIFI Scaled SAR (W/kg)	$\sum$ 1-g SAR (W/kg)
GSM 850	Rear	0.365	0.031	0.396
GSM 850	Front	0.377	0.032	0.409
GSM 1900	Rear	0.458	0.031	0.489
GSM 1900	Front	0.416	0.032	0.448
WCDMA 850	Rear	0.561	0.031	0.592
WCDMA 850	Front	0.506	0.032	0.538
WCDMA 1900	Rear	0.687	0.031	0.718
WCDMA 1900	Front	0.578	0.032	0.610
LTE 5	Rear	0.607	0.031	0.638
LTE 5	Front	0.492	0.032	0.524

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	0.365	0.022	0.387
GSM 850	Front	0.377	0.003	0.380
GSM 1900	Rear	0.458	0.022	0.480
GSM 1900	Front	0.416	0.003	0.419
WCDMA 850	Rear	0.561	0.022	0.583
WCDMA 850	Front	0.506	0.003	0.509
WCDMA 1900	Rear	0.687	0.022	0.709
WCDMA 1900	Front	0.578	0.003	0.581
LTE 5	Rear	0.607	0.022	0.629
LTE 5	Front	0.492	0.003	0.495

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	0.408	0.109	0.517
	Front	0.347	0.178	0.525
	Left	0.122		0.122
	Right	0.122	0.062	0.184
	Bottom	0.190		0.190
	Top		0.257	0.257
GSM 1900	Rear	0.422	0.109	0.531
	Front	0.370	0.178	0.548
	Left	0.107		0.107
	Right	0.058	0.062	0.120
	Bottom	0.771		0.771
	Top		0.257	0.257
WCDMA 850	Rear	0.561	0.109	0.670
	Front	0.506	0.178	0.684
	Left	0.139		0.139
	Right	0.139	0.062	0.201
	Bottom	0.257		0.257
	Top		0.257	0.257
WCDMA 1900	Rear	0.687	0.109	0.796
	Front	0.578	0.178	0.756
	Left	0.178		0.178
	Right	0.120	0.062	0.182
	Bottom	0.691		0.691
	Top		0.257	0.257
LTE 5	Rear	0.607	0.109	0.716
	Front	0.513	0.178	0.691
	Left	0.114		0.114
	Right	0.122	0.062	0.184
	Bottom	0.279		0.279
	Top		0.257	0.257

Simultaneous Transmission Summation with 5.8 GHz DTS 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	0.408	0.019	0.427
	Front	0.347	0.009	0.356
	Left	0.122		0.122
	Right	0.122	0.011	0.133
	Bottom	0.190		0.190
	Top		0.001	0.001
GSM 1900	Rear	0.422	0.019	0.441
	Front	0.370	0.009	0.379
	Left	0.107		0.107
	Right	0.058	0.011	0.069
	Bottom	0.771		0.771
	Top		0.001	0.001
WCDMA 850	Rear	0.561	0.019	0.580
	Front	0.506	0.009	0.515
	Left	0.139		0.139
	Right	0.139	0.011	0.150
	Bottom	0.257		0.257
	Top		0.001	0.001
WCDMA 1900	Rear	0.687	0.019	0.706
	Front	0.578	0.009	0.587
	Left	0.178		0.178
	Right	0.120	0.011	0.131
	Bottom	0.691		0.691
	Top		0.001	0.001
LTE 5	Rear	0.607	0.019	0.626
	Front	0.513	0.009	0.522
	Left	0.114		0.114
	Right	0.122	0.011	0.133
	Bottom	0.279		0.279
	Top		0.001	0.001

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.

17. REFERENCES

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Attachment 1. – SAR Test Plots

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.5
Ambient Temperature: 20.7
Test Date: Jan.08, 2015
Plot No.: 1

DUT: SM-A700F; Type: Bar;

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:8.3
Medium parameters used (interpolated): $f = 836.6 \text{ MHz}$; $\sigma = 0.92 \text{ mho/m}$; $\epsilon_r = 40.4$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Left Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3967; ConvF(9.75, 9.75, 9.75); Calibrated: 2014-12-22
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn479; Calibrated: 2014-10-15
- Phantom: 1800/1900; Type: SAM

GSM850 Left Touch 190ch/Area Scan (71x111x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.069 mW/g

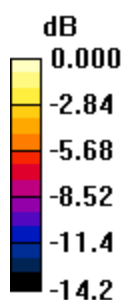
GSM850 Left Touch 190ch/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.11 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 0.079 W/kg

SAR(1 g) = 0.057 mW/g; SAR(10 g) = 0.039 mW/g

Maximum value of SAR (measured) = 0.069 mW/g



0 dB = 0.069mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.5
Ambient Temperature: 20.7
Test Date: Jan.08, 2015
Plot No.: 2

DUT: SM-A700F; Type: Bar;

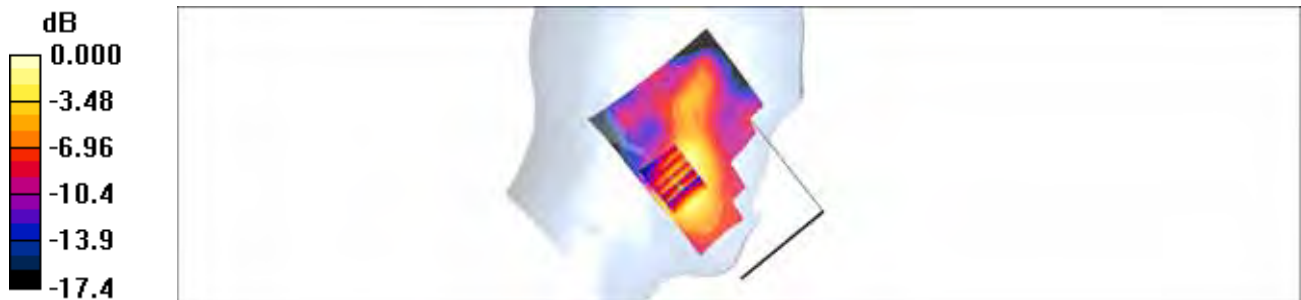
Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.39 \text{ mho/m}$; $\epsilon_r = 39.9$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Left Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(8.02, 8.02, 8.02); Calibrated: 2014-07-24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2014-03-24
- Phantom: 1800/1900 Phantom; Type: SAM

GSM1900 Left touch 661ch/Area Scan (71x101x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.178 mW/g

GSM1900 Left touch 661ch/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
Reference Value = 4.16 V/m; Power Drift = 0.147 dB
Peak SAR (extrapolated) = 0.200 W/kg
SAR(1 g) = 0.131 mW/g; SAR(10 g) = 0.083 mW/g
Maximum value of SAR (measured) = 0.166 mW/g



0 dB = 0.166mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.5
Ambient Temperature: 20.7
Test Date: Jan.08, 2015
Plot No.: 3

DUT: SM-A700F; Type: Bar;

Communication System: WCDMA850; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): $f = 836.6 \text{ MHz}$; $\sigma = 0.92 \text{ mho/m}$; $\epsilon_r = 40.4$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Right Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3967; ConvF(9.75, 9.75, 9.75); Calibrated: 2014-12-22
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn479; Calibrated: 2014-10-15
- Phantom: 1800/1900; Type: SAM

WCDMA850 Right Touch 4183/Area Scan (71x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.113 mW/g

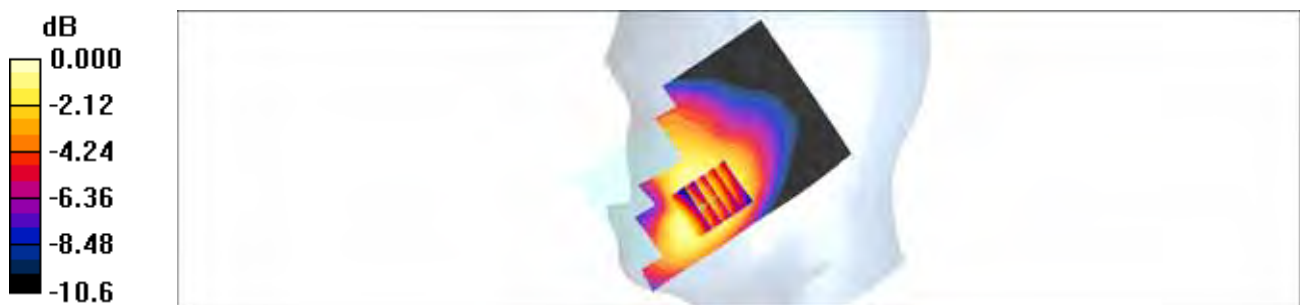
WCDMA850 Right Touch 4183/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 2.79 V/m; Power Drift = 0.062 dB

Peak SAR (extrapolated) = 0.120 W/kg

SAR(1 g) = 0.097 mW/g; SAR(10 g) = 0.075 mW/g

Maximum value of SAR (measured) = 0.110 mW/g



0 dB = 0.110mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.5
Ambient Temperature: 20.7
Test Date: Jan.08, 2015
Plot No.: 4

DUT: SM-A700F; Type: Bar;

Communication System: WCDMA1900; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.39 \text{ mho/m}$; $\epsilon_r = 39.9$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Left Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(8.02, 8.02, 8.02); Calibrated: 2014-07-24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2014-03-24
- Phantom: 1800/1900 Phantom; Type: SAM

WCDMA1900 Left Touch 9400ch/Area Scan (71x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.233 mW/g

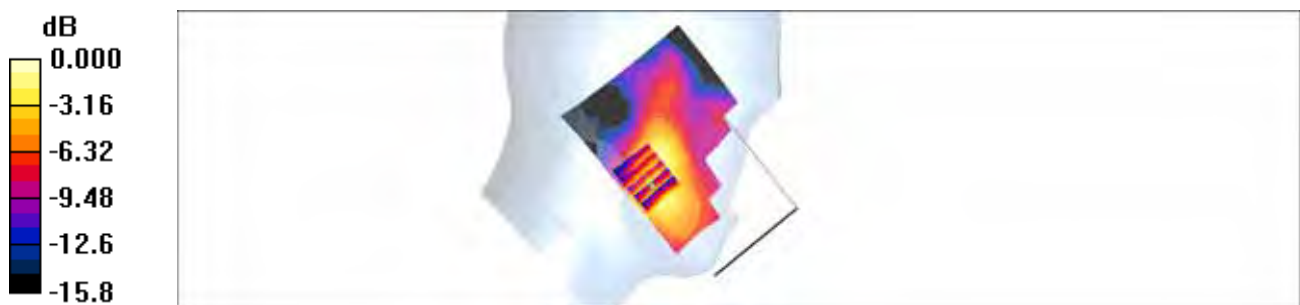
WCDMA1900 Left Touch 9400ch/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 3.72 V/m; Power Drift = 0.056 dB

Peak SAR (extrapolated) = 0.266 W/kg

SAR(1 g) = 0.173 mW/g; SAR(10 g) = 0.109 mW/g

Maximum value of SAR (measured) = 0.216 mW/g



0 dB = 0.216mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.5
Ambient Temperature: 20.7
Test Date: Jan.08, 2015
Plot No.: 5

DUT: SM-A700F; Type: Bar;

Communication System: LTE Band 5; Frequency: 836.5 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): $f = 836.5 \text{ MHz}$; $\sigma = 0.92 \text{ mho/m}$; $\epsilon_r = 40.4$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Right Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3967; ConvF(9.75, 9.75, 9.75); Calibrated: 2014-12-22
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn479; Calibrated: 2014-10-15
- Phantom: 1800/1900; Type: SAM

LTE Band 5 Right touch 10Mhz 1RB 0 offset 20525/Area Scan (71x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.132 mW/g

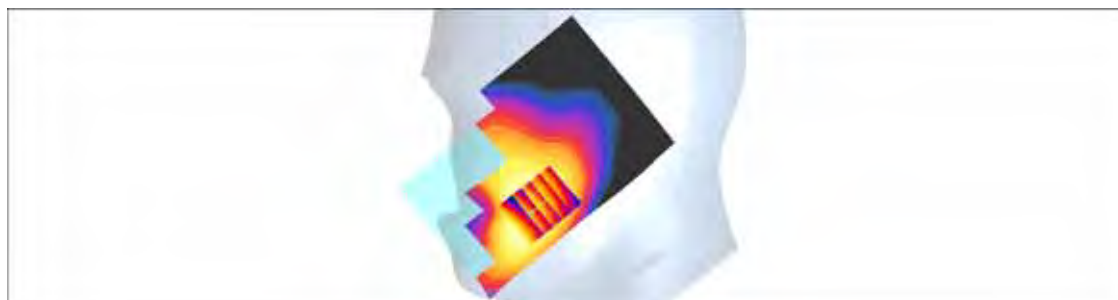
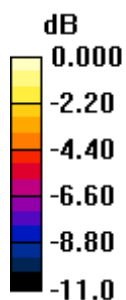
LTE Band 5 Right touch 10Mhz 1RB 0 offset 20525/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 2.99 V/m; Power Drift = -0.184 dB

Peak SAR (extrapolated) = 0.140 W/kg

SAR(1 g) = 0.113 mW/g; SAR(10 g) = 0.087 mW/g

Maximum value of SAR (measured) = 0.129 mW/g



0 dB = 0.129mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 19.9
Ambient Temperature: 20.1
Test Date: Jan.21, 2015
Plot No.: 6

DUT: SM-A700F; Type: Bar;

Communication System: 2450MHz FCC; Frequency: 2462 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): $f = 2462 \text{ MHz}$; $\sigma = 1.78 \text{ mho/m}$; $\epsilon_r = 38.7$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Left Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: ET3DV6 - SN1630; ConvF(4.57, 4.57, 4.57); Calibrated: 2014-04-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn911; Calibrated: 2014-02-25
- Phantom: 800/900 Phantom; Type: SAM

802.11b Left Touch 11ch 1Mbps/Area Scan (81x131x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$
Maximum value of SAR (interpolated) = 0.946 mW/g

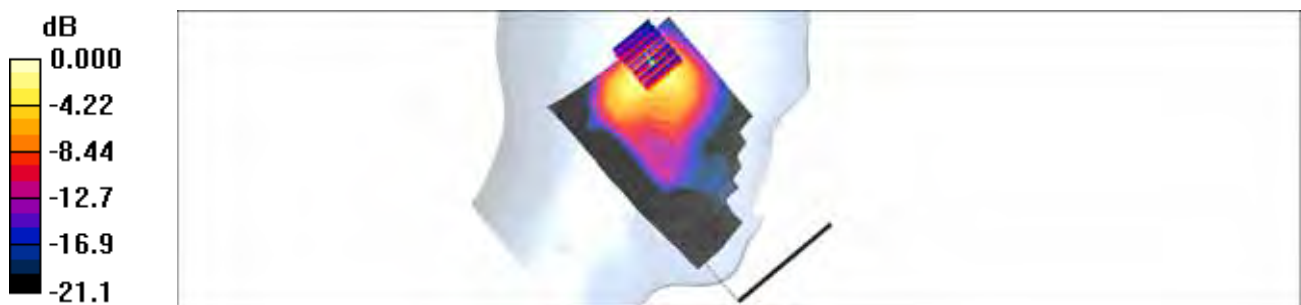
802.11b Left Touch 11ch 1Mbps/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 16.6 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 2.15 W/kg

SAR(1 g) = 0.728 mW/g; SAR(10 g) = 0.323 mW/g

Maximum value of SAR (measured) = 0.821 mW/g



0 dB = 0.821mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.1
Ambient Temperature: 20.3
Test Date: Jan.20, 2015
Plot No.: 7

DUT: SM-A700F; Type: Bar

Communication System: UID 0, WIFI 5GHz; Frequency: 5745 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): $f = 5745 \text{ MHz}$; $\sigma = 5.213 \text{ S/m}$; $\epsilon_r = 34.376$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Left Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3967; ConvF(4.64, 4.64, 4.64); Calibrated: 2014-12-22;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2014-04-23
- Phantom: SAM (20deg probe tilt) with CRP v5.0_Left_2014_02_25; Type: QD000P40CD; Serial: TP:1804
- Measurement SW: DASY52, Version 52.8 (0); SEMCAD X Version 14.6.10 (7331)

SM-A700F/802.11a Head Left touch 6Mbps 149ch/Area Scan (91x171x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$
Maximum value of SAR (interpolated) = 0.195 W/kg

SM-A700F/802.11a Head Left 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 = 1.481 V/m; Power Drift = -0.138 dB
Peak SAR (extrapolated) = 0.288 W/kg
SAR(1 g) = 0.064 W/kg; SAR(10 g) = 0.019 W/kg
Maximum value of SAR (measured) = 0.187 W/kg



0 dB = 0.195 W/kg = -7.09 dBW/kg

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.1
Ambient Temperature: 20.3
Test Date: Jan.20, 2015
Plot No.: 8

DUT: SM-A700F; Type: Bar

Communication System: UID 0, WIFI 5GHz (0); Frequency: 5200 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5200 \text{ MHz}$; $\sigma = 4.545 \text{ S/m}$; $\epsilon_r = 35.84$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Left Section
Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3967; ConvF(5.07, 5.07, 5.07); Calibrated: 2014-12-22;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2014-04-23
- Phantom: SAM (20deg probe tilt) with CRP v5.0_Left_2014_02_25; Type: QD000P40CD; Serial: TP:1804
- Measurement SW: DASYS2, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

SM-A700F/802.11a Head Left Touch 6Mbps 40ch/Area Scan (91x171x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$
Maximum value of SAR (interpolated) = 0.887 W/kg

SM-A700F/802.11a Head Left Touch 6Mbps 40ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$
Reference Value = 3.557 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 1.42 W/kg
SAR(1 g) = 0.324 W/kg; SAR(10 g) = 0.092 W/kg
Maximum value of SAR (measured) = 0.822 W/kg



$$0 \text{ dB} = 0.887 \text{ W/kg} = -0.52 \text{ dBW/kg}$$

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.0
Ambient Temperature: 20.2
Test Date: Jan.09, 2015
Plot No.: 9

DUT: SM-A700F; Type: Bar;

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:4.15
Medium parameters used (interpolated): $f = 836.6 \text{ MHz}$; $\sigma = 0.951 \text{ mho/m}$; $\epsilon_r = 55.9$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(9.78, 9.78, 9.78); Calibrated: 2014-08-28
- 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 190ch 2Tx/Area Scan (71x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.359 mW/g

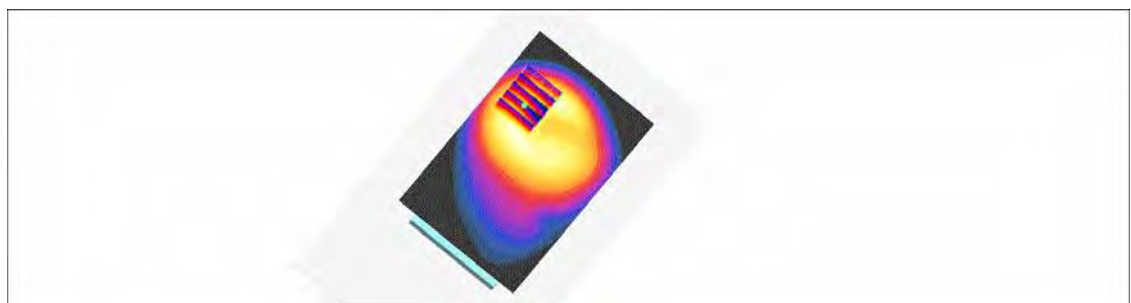
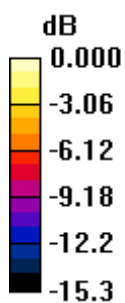
GSM850 Body rear 190ch 2Tx/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 7.96 V/m; Power Drift = 0.024 dB

Peak SAR (extrapolated) = 0.531 W/kg

SAR(1 g) = 0.301 mW/g; SAR(10 g) = 0.166 mW/g

Maximum value of SAR (measured) = 0.405 mW/g



0 dB = 0.405mW/g

Test Laboratory: HCT CO., LTD
 EUT Type: Mobile Phone
 Liquid Temperature: 20.5
 Ambient Temperature: 20.7
 Test Date: Jan.08, 2015
 Plot No.: 10

DUT: SM-A700F; Type: Bar;

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:2.075
 Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.53 \text{ mho/m}$; $\epsilon_r = 54.1$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(7.72, 7.72, 7.72); Calibrated: 2014-08-28
- 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 661ch 4Tx/Area Scan (71x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
 Maximum value of SAR (interpolated) = 0.560 mW/g

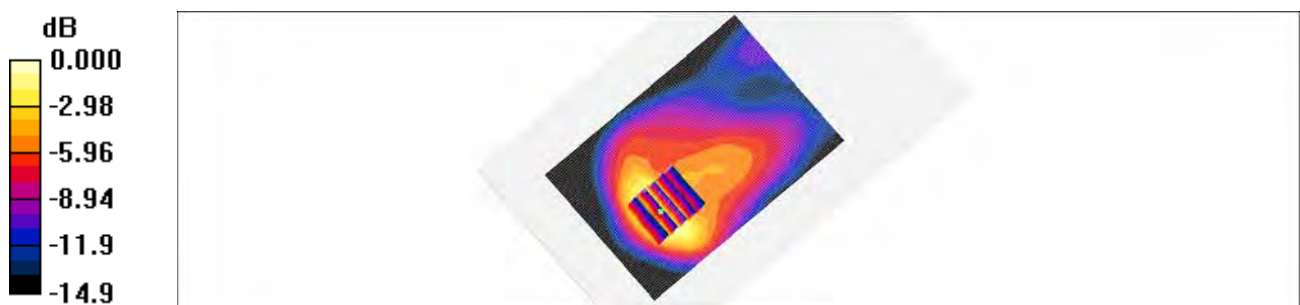
GSM1900 Body rear 661ch 4Tx/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 7.11 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 0.586 W/kg

SAR(1 g) = 0.364 mW/g; SAR(10 g) = 0.210 mW/g

Maximum value of SAR (measured) = 0.481 mW/g



0 dB = 0.481mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.0
Ambient Temperature: 20.2
Test Date: Jan.09, 2015
Plot No.: 11

DUT: SM-A700F; Type: Bar;

Communication System: WCDMA850; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): $f = 836.6 \text{ MHz}$; $\sigma = 0.951 \text{ mho/m}$; $\epsilon_r = 55.9$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

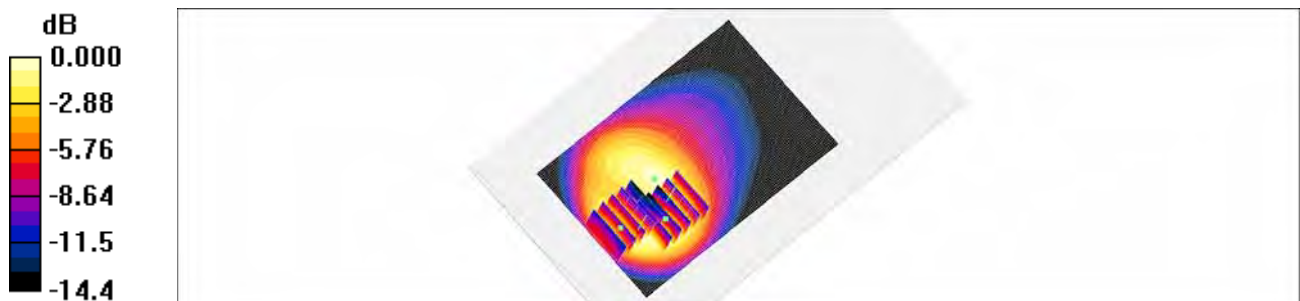
DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(9.78, 9.78, 9.78); Calibrated: 2014-08-28
- 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 (71x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.565 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 = 8.46 V/m; Power Drift = 0.007 dB
Peak SAR (extrapolated) = 0.725 W/kg
SAR(1 g) = 0.468 mW/g; SAR(10 g) = 0.285 mW/g
Maximum value of SAR (measured) = 0.579 mW/g

WCDMA850 Body rear 4183/Zoom Scan (5x5x7)/Cube 1: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
Reference Value = 8.46 V/m; Power Drift = 0.007 dB
Peak SAR (extrapolated) = 0.790 W/kg
SAR(1 g) = 0.483 mW/g; SAR(10 g) = 0.282 mW/g
Maximum value of SAR (measured) = 0.597 mW/g



0 dB = 0.597mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.5
Ambient Temperature: 20.7
Test Date: Jan.08, 2015
Plot No.: 12

DUT: SM-A700F; Type: Bar;

Communication System: WCDMA1900; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.53 \text{ mho/m}$; $\epsilon_r = 54.1$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(7.72, 7.72, 7.72); Calibrated: 2014-08-28
- 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

WCDMA1900 Body rear 9400ch/Area Scan (71x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.728 mW/g

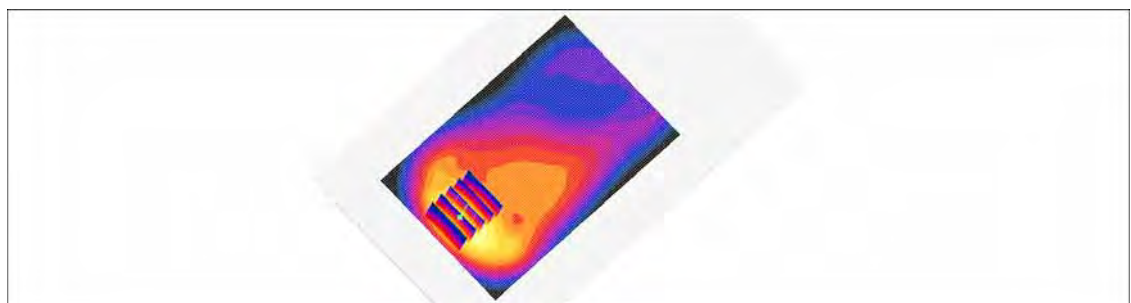
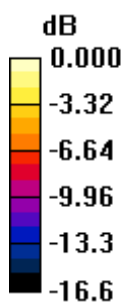
WCDMA1900 Body rear 9400ch/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 6.88 V/m; Power Drift = -0.064 dB

Peak SAR (extrapolated) = 0.947 W/kg

SAR(1 g) = 0.574 mW/g; SAR(10 g) = 0.326 mW/g

Maximum value of SAR (measured) = 0.778 mW/g



0 dB = 0.778mW/g

Test Laboratory: HCT CO., LTD
 EUT Type: Mobile Phone
 Liquid Temperature: 20.5
 Ambient Temperature: 20.7
 Test Date: Jan.08, 2015
 Plot No.: 13

DUT: SM-A700F; Type: Bar;

Communication System: WCDMA1900; Frequency: 1880 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.53 \text{ mho/m}$; $\epsilon_r = 54.1$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(7.72, 7.72, 7.72); Calibrated: 2014-08-28
- 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

WCDMA1900 Body Bottom 9400ch/Area Scan (81x41x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
 Maximum value of SAR (interpolated) = 0.792 mW/g

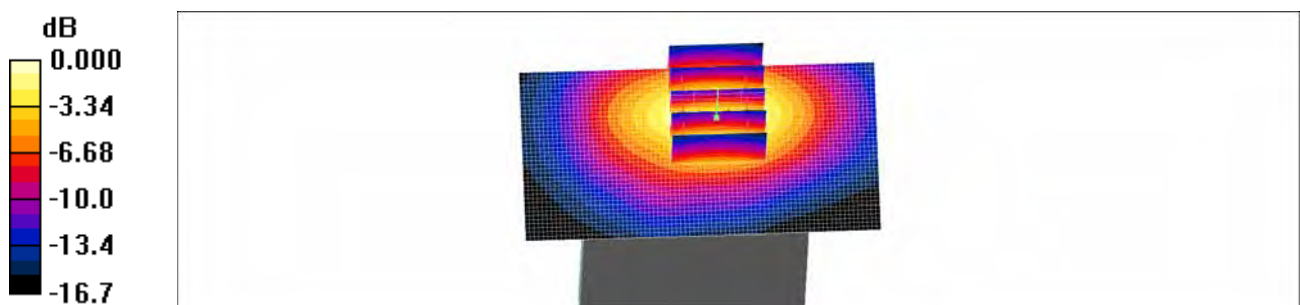
WCDMA1900 Body Bottom 9400ch/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 19.3 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 0.935 W/kg

SAR(1 g) = 0.577 mW/g; SAR(10 g) = 0.329 mW/g

Maximum value of SAR (measured) = 0.774 mW/g



0 dB = 0.774mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.0
Ambient Temperature: 20.2
Test Date: Jan.09, 2015
Plot No.: 14

DUT: SM-A700F; Type: Bar;

Communication System: LTE Band 5; Frequency: 836.5 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): $f = 836.5 \text{ MHz}$; $\sigma = 0.951 \text{ mho/m}$; $\epsilon_r = 55.9$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

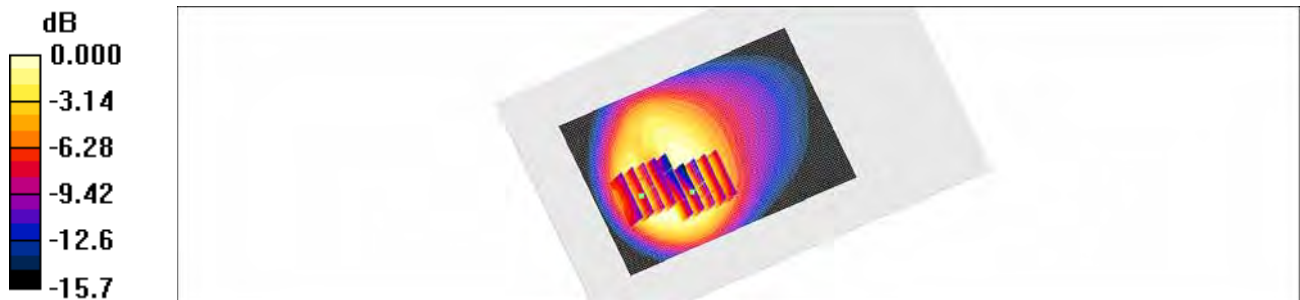
DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(9.78, 9.78, 9.78); Calibrated: 2014-08-28
- 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

LTE Band 5 Body rear QPSK 10MHz 1RB 20525/Area Scan (71x111x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.777 mW/g

LTE Band 5 Body rear QPSK 10MHz 1RB 20525/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.8 V/m; Power Drift = -0.057 dB
Peak SAR (extrapolated) = 0.987 W/kg
SAR(1 g) = 0.606 mW/g; SAR(10 g) = 0.355 mW/g
Maximum value of SAR (measured) = 0.767 mW/g

LTE Band 5 Body rear QPSK 10MHz 1RB 20525/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.8 V/m; Power Drift = -0.057 dB
Peak SAR (extrapolated) = 0.860 W/kg
SAR(1 g) = 0.558 mW/g; SAR(10 g) = 0.357 mW/g
Maximum value of SAR (measured) = 0.719 mW/g



0 dB = 0.719mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.0
Ambient Temperature: 20.2
Test Date: Jan.19, 2015
Plot No.: 15

DUT: SM-A700F; Type: Bar;

Communication System: 2450MHz FCC; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): $f = 2412$ MHz; $\sigma = 1.87$ mho/m; $\epsilon_r = 54.5$; $\rho = 1000$ kg/m³
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(6.97, 6.97, 6.97); Calibrated: 2014-07-24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2014-03-24
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

802.11b Body Rear 1ch 1Mbps/Area Scan (81x151x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 0.123 mW/g

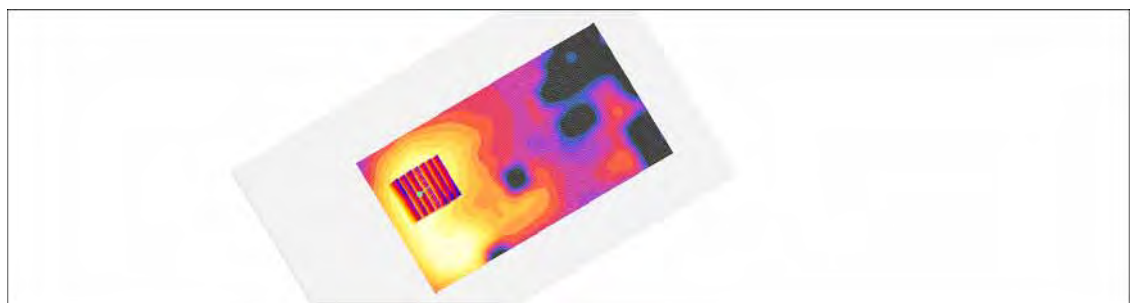
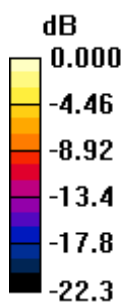
802.11b Body Rear 1ch 1Mbps/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 3.42 V/m; Power Drift = -0.164 dB

Peak SAR (extrapolated) = 0.161 W/kg

SAR(1 g) = 0.086 mW/g; SAR(10 g) = 0.049 mW/g

Maximum value of SAR (measured) = 0.121 mW/g



0 dB = 0.121mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.0
Ambient Temperature: 20.2
Test Date: Jan.19, 2015
Plot No.: 16

DUT: SM-A700F; Type: Bar;

Communication System: 2450MHz FCC; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): $f = 2412$ MHz; $\sigma = 1.87$ mho/m; $\epsilon_r = 54.5$; $\rho = 1000$ kg/m³
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(6.97, 6.97, 6.97); Calibrated: 2014-07-24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2014-03-24
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

802.11b Body Top 1ch 1Mbps/Area Scan (81x81x1): Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 0.288 mW/g

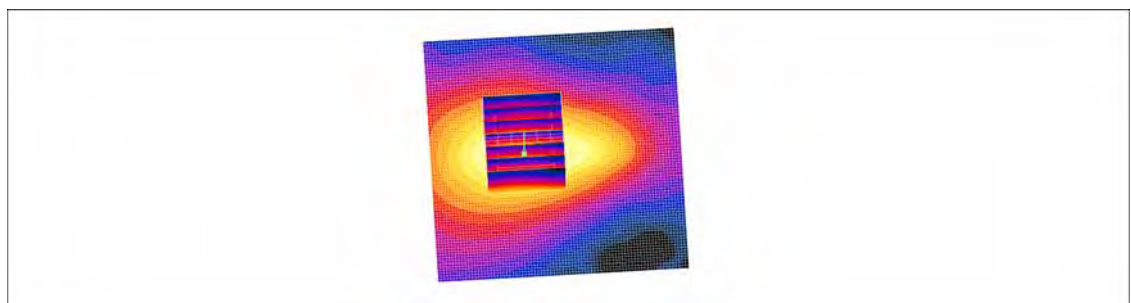
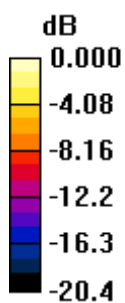
802.11b Body Top 1ch 1Mbps/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 11.9 V/m; Power Drift = 0.007 dB

Peak SAR (extrapolated) = 0.389 W/kg

SAR(1 g) = 0.203 mW/g; SAR(10 g) = 0.104 mW/g

Maximum value of SAR (measured) = 0.293 mW/g



0 dB = 0.293mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.0
Ambient Temperature: 20.2
Test Date: Jan.21, 2015
Plot No.: 17

DUT: SM-A700F; Type: Bar;

Communication System: WIFI 5GHz; Frequency: 5745 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): $f = 5745 \text{ MHz}$; $\sigma = 6.12 \text{ mho/m}$; $\epsilon_r = 46.8$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(4.07, 4.07, 4.07); Calibrated: 2014-07-24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2014-03-24
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

802.11a Body Rear 149ch 6Mbps/Area Scan (101x161x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$
Maximum value of SAR (interpolated) = 0.044 mW/g

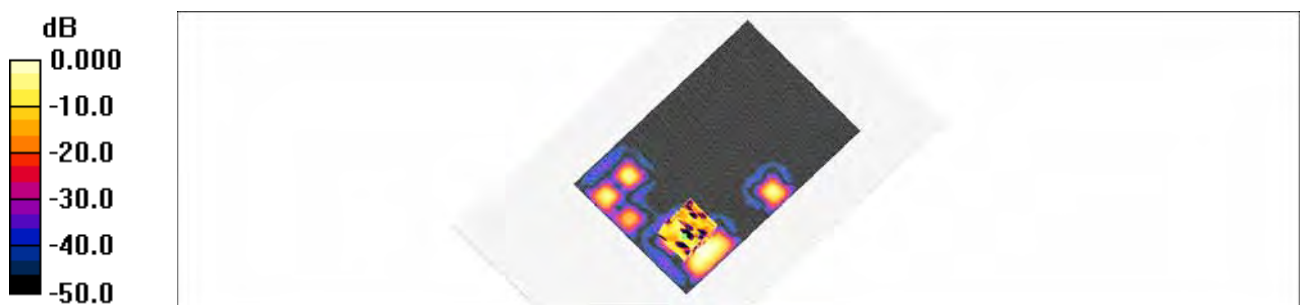
802.11a Body Rear 149ch 6Mbps/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$

Reference Value = 0.385 V/m; Power Drift = -0.169 dB

Peak SAR (extrapolated) = 0.146 W/kg

SAR(1 g) = 0.016 mW/g; SAR(10 g) = 0.00496 mW/g

Maximum value of SAR (measured) = 0.045 mW/g



0 dB = 0.045mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.0
Ambient Temperature: 20.2
Test Date: Jan.21, 2015
Plot No.: 18

DUT: SM-A700F; Type: Bar;

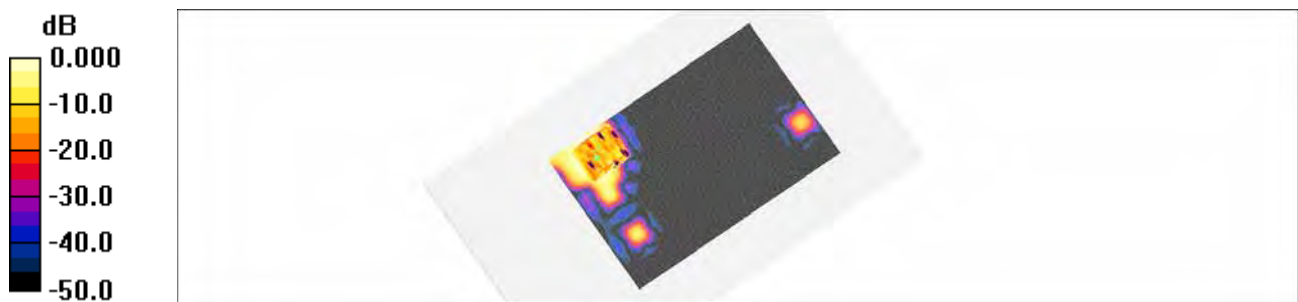
Communication System: WIFI 5GHz; Frequency: 5200 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5200 \text{ MHz}$; $\sigma = 5.17 \text{ mho/m}$; $\epsilon_r = 48.2$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(4.5, 4.5, 4.5); Calibrated: 2014-07-24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2014-03-24
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

802.11a Body Front Side 40ch 6Mbps 10mm/Area Scan (101x161x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$
Maximum value of SAR (interpolated) = 0.064 mW/g

802.11a Body Front Side 40ch 6Mbps 10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$
Reference Value = 0.732 V/m; Power Drift = 0.142 dB
Peak SAR (extrapolated) = 0.130 W/kg
SAR(1 g) = 0.027 mW/g; SAR(10 g) = 0.00984 mW/g
Maximum value of SAR (measured) = 0.066 mW/g



0 dB = 0.066mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.0
Ambient Temperature: 20.2
Test Date: Jan.09, 2015
Plot No.: 19

DUT: SM-A700F; Type: Bar;

Communication System: GSM 850; Frequency: 836.6 MHz; Duty Cycle: 1:8.3
Medium parameters used (interpolated): $f = 836.6 \text{ MHz}$; $\sigma = 0.951 \text{ mho/m}$; $\epsilon_r = 55.9$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(9.78, 9.78, 9.78); Calibrated: 2014-08-28
- 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 front 190ch Body Worn/Area Scan (71x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.394 mW/g

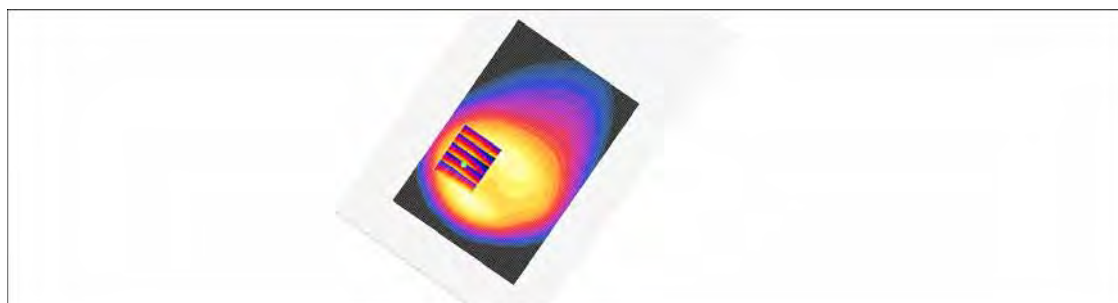
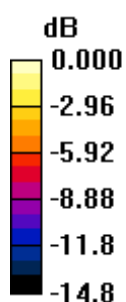
GSM850 Body front 190ch Body Worn/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 9.29 V/m; Power Drift = 0.023 dB

Peak SAR (extrapolated) = 0.557 W/kg

SAR(1 g) = 0.305 mW/g; SAR(10 g) = 0.187 mW/g

Maximum value of SAR (measured) = 0.442 mW/g



0 dB = 0.442mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.5
Ambient Temperature: 20.7
Test Date: Jan.08, 2015
Plot No.: 20

DUT: SM-A700F; Type: Bar;

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.53 \text{ mho/m}$; $\epsilon_r = 54.1$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(7.72, 7.72, 7.72); Calibrated: 2014-08-28
- 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 Body Worn/Area Scan (71x111x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.503 mW/g

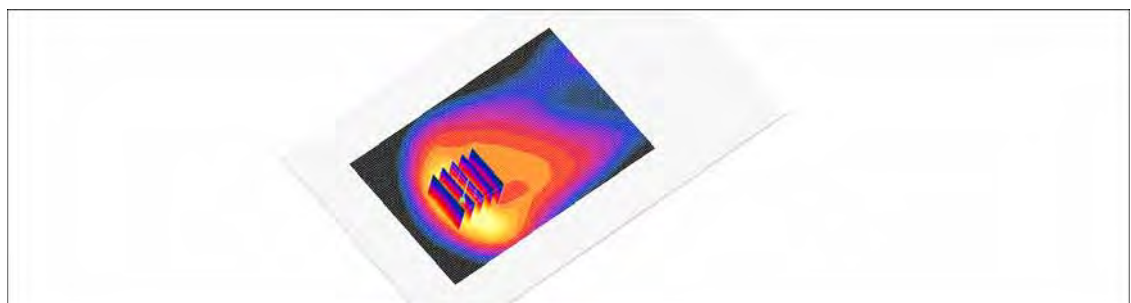
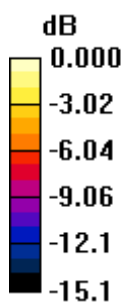
GSM1900 Body rear Body Worn/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 8.36 V/m; Power Drift = -0.174 dB

Peak SAR (extrapolated) = 0.619 W/kg

SAR(1 g) = 0.391 mW/g; SAR(10 g) = 0.229 mW/g

Maximum value of SAR (measured) = 0.510 mW/g



0 dB = 0.510mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.0
Ambient Temperature: 20.2
Test Date: Jan.19, 2015
Plot No.: 21

DUT: SM-A700F; Type: Bar;

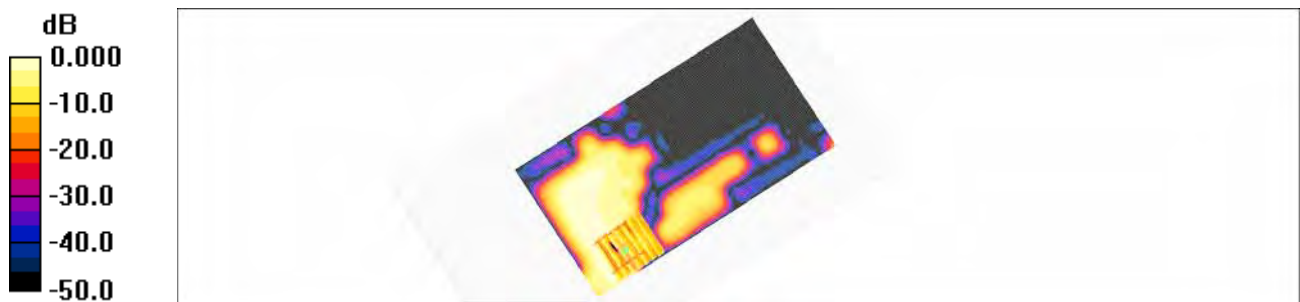
Communication System: Bluetooth; Frequency: 2441 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): $f = 2441 \text{ MHz}$; $\sigma = 1.91 \text{ mho/m}$; $\epsilon_r = 54.3$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(6.97, 6.97, 6.97); Calibrated: 2014-07-24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2014-03-24
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

BT2450 Body Rear 39ch/Area Scan (81x151x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$
Maximum value of SAR (interpolated) = 0.050 mW/g

BT2450 Body Rear 39ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$
Reference Value = 1.21 V/m; Power Drift = 0.171 dB
Peak SAR (extrapolated) = 0.043 W/kg
SAR(1 g) = 0.020 mW/g; SAR(10 g) = 0.00848 mW/g
Maximum value of SAR (measured) = 0.032 mW/g



0 dB = 0.032mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.0
Ambient Temperature: 20.2
Test Date: Jan.19, 2015
Plot No.: 22

DUT: SM-A700F; Type: Bar;

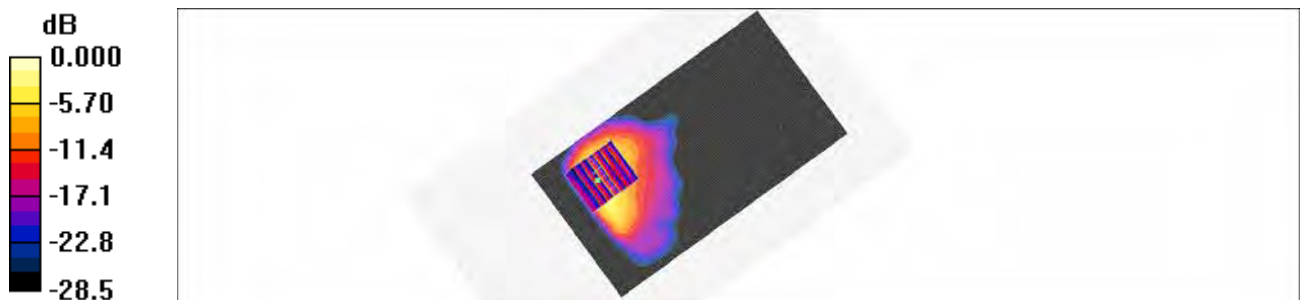
Communication System: Bluetooth; Frequency: 2441 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): $f = 2441$ MHz; $\sigma = 1.91$ mho/m; $\epsilon_r = 54.3$; $\rho = 1000$ kg/m³
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(6.97, 6.97, 6.97); Calibrated: 2014-07-24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2014-03-24
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

BT2450 Body Front 39ch/Area Scan (81x151x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 0.452 mW/g

BT2450 Body Front 39ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.47 V/m; Power Drift = 0.142 dB
Peak SAR (extrapolated) = 0.871 W/kg
SAR(1 g) = 0.283 mW/g; SAR(10 g) = 0.107 mW/g
Maximum value of SAR (measured) = 0.542 mW/g



0 dB = 0.542mW/g

Test Laboratory: HCT CO., LTD
EUT Type: Mobile Phone
Liquid Temperature: 20.0
Ambient Temperature: 20.2
Test Date: Jan.21, 2015
Plot No.: 23

DUT: SM-A700F; Type: Bar;

Communication System: WIFI 5GHz; Frequency: 5500 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5500 \text{ MHz}$; $\sigma = 5.55 \text{ mho/m}$; $\epsilon_r = 47.3$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(4.01, 4.01, 4.01); Calibrated: 2014-07-24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2014-03-24
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

802.11a Body Front Side 100ch 6Mbps 0mm/Area Scan (101x161x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

Maximum value of SAR (interpolated) = 2.16 mW/g

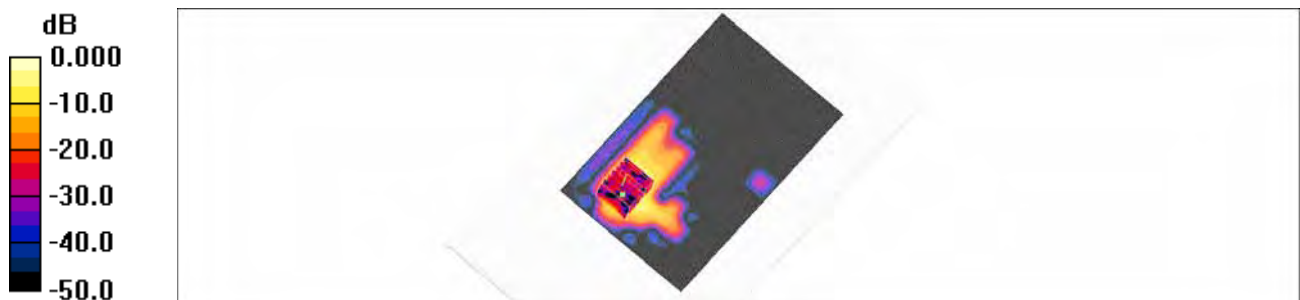
802.11a Body Front Side 100ch 6Mbps 0mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$

Reference Value = 1.93 V/m; Power Drift = 0.127 dB

Peak SAR (extrapolated) = 3.92 W/kg

SAR(1 g) = 0.724 mW/g; SAR(10 g) = 0.180 mW/g

Maximum value of SAR (measured) = 2.14 mW/g



0 dB = 2.14mW/g

Attachment 2. – Dipole Verification Plots

■ Verification Data (835 MHz Head)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 20.5
Test Date: Jan. 08, 2015

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:490

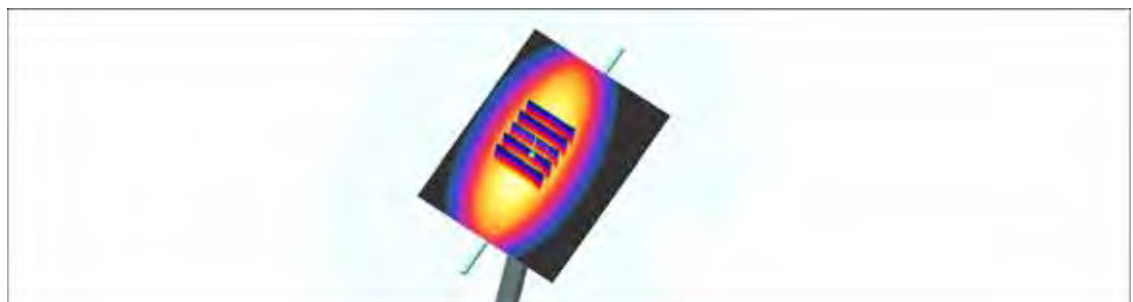
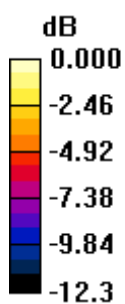
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.919 \text{ mho/m}$; $\epsilon_r = 40.4$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3967; ConvF(9.75, 9.75, 9.75); Calibrated: 2014-12-22
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn479; Calibrated: 2014-10-15
- Phantom: SAM 1800/1900 MHz; Type: SAM

Verification 835 MHz/Area Scan (61x81x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 0.970 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 = 30.0 V/m; Power Drift = 0.003 dB
Peak SAR (extrapolated) = 1.48 W/kg
SAR(1 g) = 0.898 mW/g; SAR(10 g) = 0.544 mW/g
Maximum value of SAR (measured) = 0.986 mW/g



0 dB = 0.986mW/g

■ Verification Data (835 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 20.0
Test Date: Jan. 09, 2015

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:490

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.95 \text{ mho/m}$; $\epsilon_r = 55.9$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(9.78, 9.78, 9.78); Calibrated: 2014-08-28
- 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=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.01 mW/g

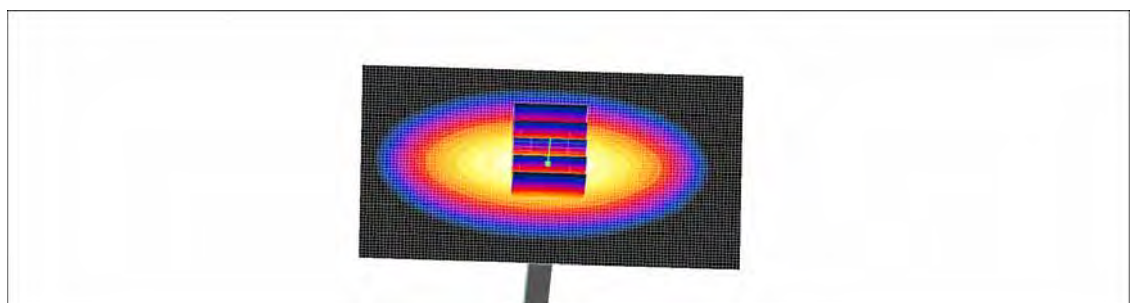
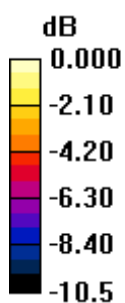
Verification 835 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 32.5 V/m; Power Drift = 0.023 dB

Peak SAR (extrapolated) = 1.36 W/kg

SAR(1 g) = 0.923 mW/g; SAR(10 g) = 0.603 mW/g

Maximum value of SAR (measured) = 0.998 mW/g



0 dB = 0.998mW/g

Verification Data (1 900 MHz Head)

Test Laboratory: HCT CO., LTD
 Input Power: 100 mW (20 dBm)
 Liquid Temp: 20.5
 Test Date: Jan. 08, 2015

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d061

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.41 \text{ mho/m}$; $\epsilon_r = 39.8$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(8.02, 8.02, 8.02); Calibrated: 2014-07-24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2014-03-24
- Phantom: SAM 1800/1900 MHz; Type: SAM

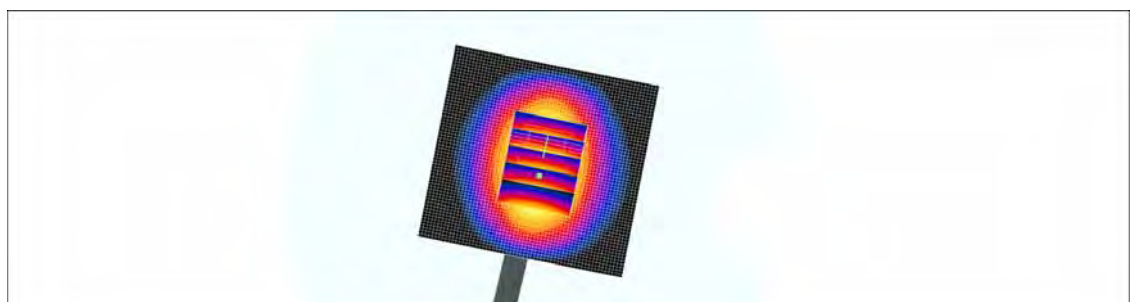
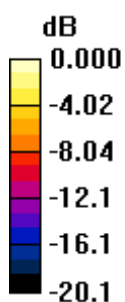
Verification SAR Head1900MHz/Area Scan (61x61x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
 Maximum value of SAR (interpolated) = 4.73 mW/g

Verification SAR Head1900MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 56.4 V/m; Power Drift = -0.009 dB
 Peak SAR (extrapolated) = 7.76 W/kg

SAR(1 g) = 4.01 mW/g; SAR(10 g) = 2.04 mW/g

Maximum value of SAR (measured) = 4.43 mW/g



0 dB = 4.43mW/g

■ Verification Data (1 900 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 20.5
Test Date: Jan. 08, 2015

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d061

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 1900$ MHz; $\sigma = 1.55$ mho/m; $\epsilon_r = 54$; $\rho = 1000$ kg/m³
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(7.72, 7.72, 7.72); Calibrated: 2014-08-28
- 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 1900 MHz/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 5.29 mW/g

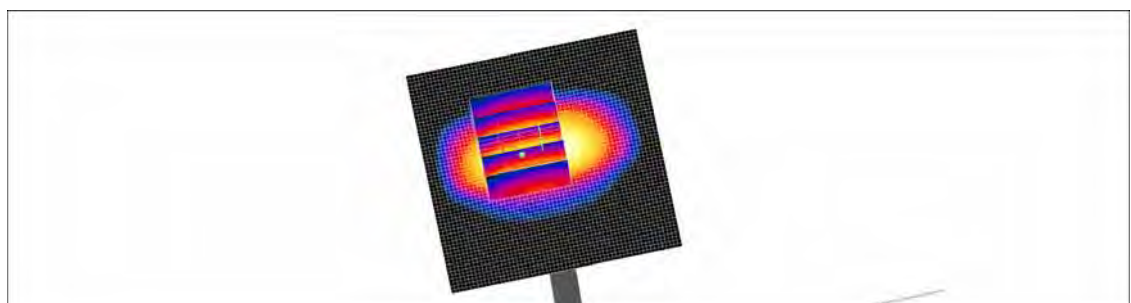
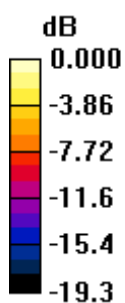
Verification 1900 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 48.8 V/m; Power Drift = -0.031 dB

Peak SAR (extrapolated) = 7.85 W/kg

SAR(1 g) = 3.93 mW/g; SAR(10 g) = 1.92 mW/g

Maximum value of SAR (measured) = 4.41 mW/g



0 dB = 4.41mW/g

■ Verification Data (2 450 MHz Head)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 19.9
Test Date: Jan. 21, 2015

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

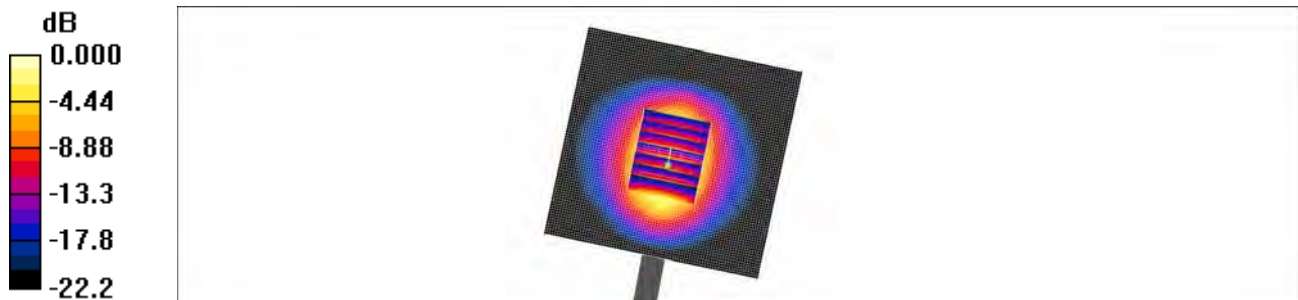
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 2450$ MHz; $\sigma = 1.76$ mho/m; $\epsilon_r = 38.7$; $\rho = 1000$ kg/m³
Phantom section: Flat Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: ET3DV6 - SN1630; ConvF(4.57, 4.57, 4.57); Calibrated: 2014-04-21
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn911; Calibrated: 2014-02-25
- Phantom: 800/900 Phantom; Type: SAM

Verification 2450MHz/Area Scan (81x81x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 6.23 mW/g

Verification 2450MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.6 V/m; Power Drift = -0.024 dB
Peak SAR (extrapolated) = 11.5 W/kg
SAR(1 g) = 5.35 mW/g; SAR(10 g) = 2.5 mW/g
Maximum value of SAR (measured) = 5.98 mW/g



0 dB = 5.98mW/g

■ Verification Data (2 450 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 20.0
Test Date: Jan. 19, 2015

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

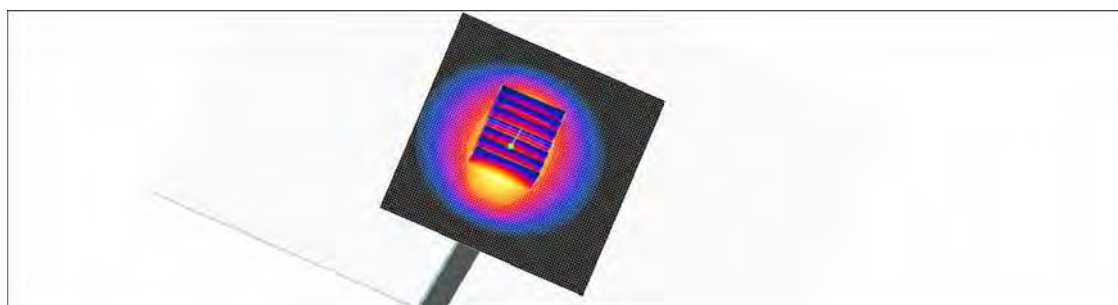
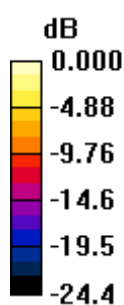
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 2450$ MHz; $\sigma = 1.93$ mho/m; $\epsilon_r = 54.3$; $\rho = 1000$ kg/m³
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(6.97, 6.97, 6.97); Calibrated: 2014-07-24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2014-03-24
- 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) = 8.47 mW/g

Verification 2450MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 47.9 V/m; Power Drift = -0.079 dB
Peak SAR (extrapolated) = 11.6 W/kg
SAR(1 g) = 5.21 mW/g; SAR(10 g) = 2.32 mW/g
Maximum value of SAR (measured) = 8.25 mW/g



0 dB = 8.25mW/g

Verification Data (5 200 MHz Head)

Test Laboratory: HCT CO., LTD
 Input Power: 100 mW (20 dBm)
 Liquid Temp: 20.1
 Test Date: Jan. 20, 2015

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5000V2 - SN: 1107

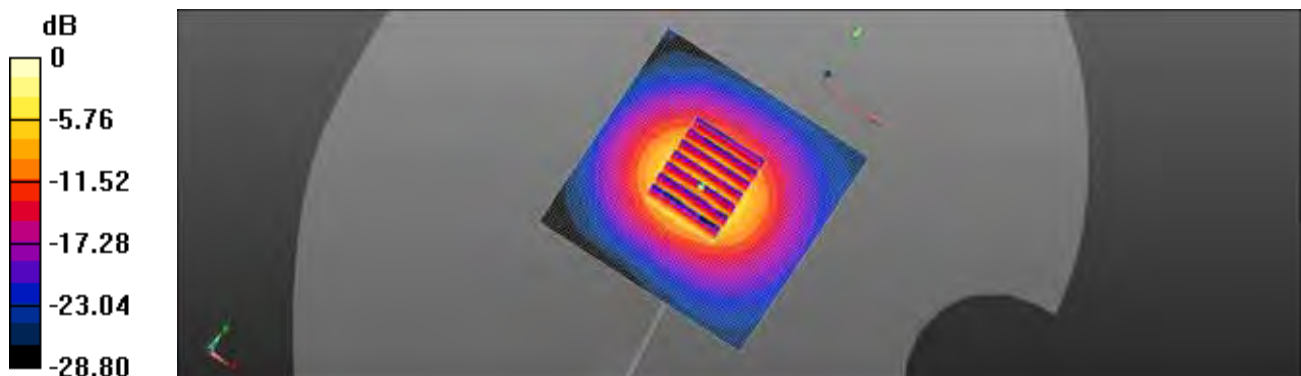
Communication System: UID 0, CW (0); Frequency: 5200 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 5200 \text{ MHz}$; $\sigma = 4.545 \text{ S/m}$; $\epsilon_r = 35.84$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3967; ConvF(5.07, 5.07, 5.07); Calibrated: 2014-12-22;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2014-04-23
- Phantom: SAM (20deg probe tilt) with CRP v5.0_Right_2014_02_25; Type: QD000P40CD; Serial: TP:1804
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Verification 5.2GHz Head/Area Scan (71x71x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$
 Maximum value of SAR (interpolated) = 19.0 W/kg

Verification 5.2GHz Head/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$
 Reference Value = 72.48 V/m; Power Drift = 0.04 dB
 Peak SAR (extrapolated) = 34.0 W/kg
SAR(1 g) = 7.82 W/kg; SAR(10 g) = 2.25 W/kg (SAR corrected for target medium)
 Maximum value of SAR (measured) = 20.2 W/kg



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

■ Verification Data (5 200 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 20.0
Test Date: Jan. 21, 2015

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5000V2 - SN: 1107

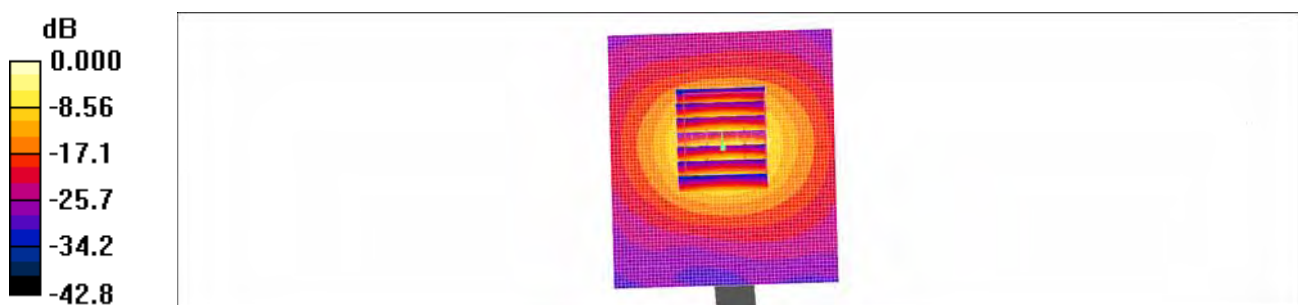
Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5200$ MHz; $\sigma = 5.17$ mho/m; $\epsilon_r = 48.2$; $\rho = 1000$ kg/m³
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(4.5, 4.5, 4.5); Calibrated: 2014-07-24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2014-03-24
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

Verification 5200MHz/Area Scan (61x71x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 8.51 mW/g

Verification 5200MHz/Zoom Scan (7x7x11)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 38.5 V/m; Power Drift = 0.014 dB
Peak SAR (extrapolated) = 31.3 W/kg
SAR(1 g) = 7.41 mW/g; SAR(10 g) = 2.11 mW/g
Maximum value of SAR (measured) = 15.3 mW/g



0 dB = 15.3mW/g

Verification Data (5 300 MHz Head)

Test Laboratory: HCT CO., LTD
 Input Power: 100 mW (20 dBm)
 Liquid Temp: 20.1
 Test Date: Jan. 20, 2015

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5000V2 - SN: 1107

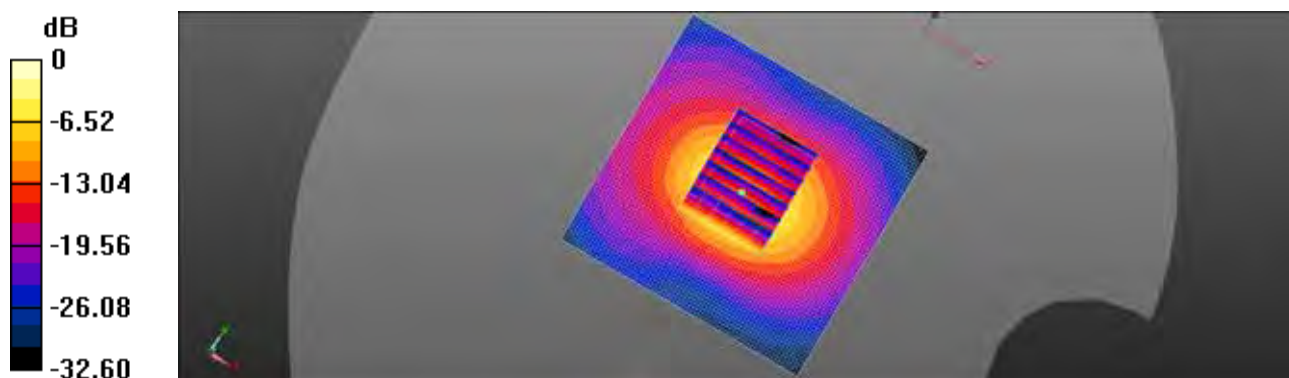
Communication System: UID 0, CW (0); Frequency: 5300 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 5300$ MHz; $\sigma = 4.714$ S/m; $\epsilon_r = 35.532$; $\rho = 1000$ kg/m³
 Phantom section: Flat Section
 Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3967; ConvF(4.88, 4.88, 4.88); Calibrated: 2014-12-22;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2014-04-23
- Phantom: SAM (20deg probe tilt) with CRP v5.0_Right_2014_02_25; Type: QD000P40CD; Serial: TP:1804
- Measurement SW: DASYS2, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Verification 5.3GHz/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
 Maximum value of SAR (interpolated) = 21.6 W/kg

Verification 5.3GHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
 Reference Value = 75.33 V/m; Power Drift = -0.01 dB
 Peak SAR (extrapolated) = 39.1 W/kg
SAR(1 g) = 8.37 W/kg; SAR(10 g) = 2.36 W/kg (SAR corrected for target medium)
 Maximum value of SAR (measured) = 22.2 W/kg



0 dB = 21.6 W/kg = 13.34 dBW/kg

■ Verification Data (5 300 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 20.0
Test Date: Jan. 21, 2015

DUT: Dipole 5GHz; Type: D5000V2; Serial: D5000V2 - SN: 1107

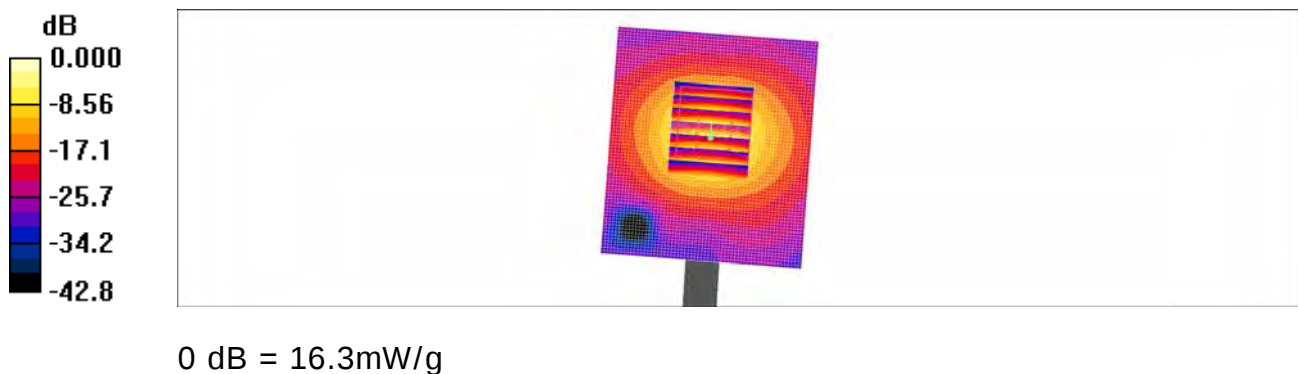
Communication System: CW; Frequency: 5300 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5300$ MHz; $\sigma = 5.31$ mho/m; $\epsilon_r = 47.8$; $\rho = 1000$ kg/m³
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(4.27, 4.27, 4.27); Calibrated: 2014-07-24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2014-03-24
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

Verification 5300MHz/Area Scan (61x71x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 9.09 mW/g

Verification 5300MHz/Zoom Scan (7x7x11)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 39.2 V/m; Power Drift = -0.029 dB
Peak SAR (extrapolated) = 33.0 W/kg
SAR(1 g) = 7.89 mW/g; SAR(10 g) = 2.25 mW/g
Maximum value of SAR (measured) = 16.3 mW/g



■ Verification Data (5 500 MHz Head)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 20.1
Test Date: Jan. 20, 2015

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5000V2 - SN: 1107

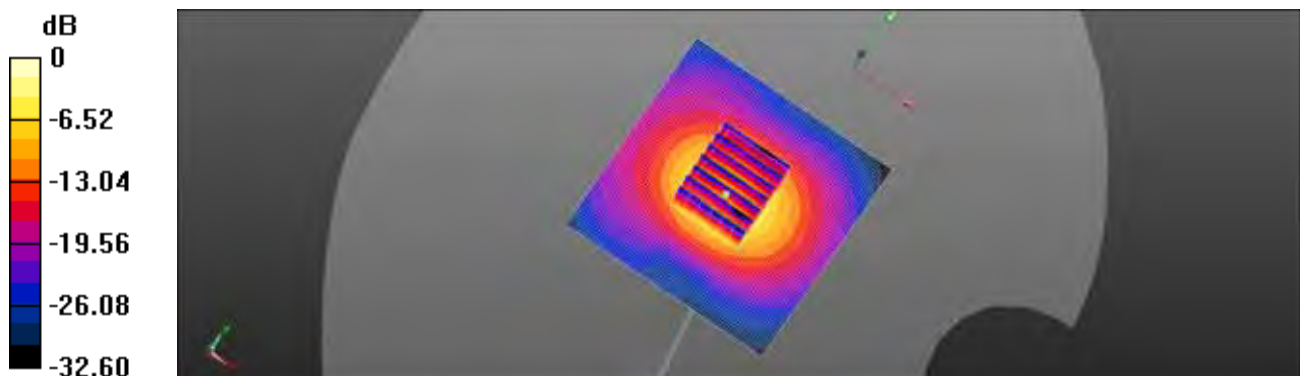
Communication System: UID 0, CW (0); Frequency: 5500 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5500$ MHz; $\sigma = 4.888$ S/m; $\epsilon_r = 35.034$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3967; ConvF(4.84, 4.84, 4.84); Calibrated: 2014-12-22;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2014-04-23
- Phantom: SAM (20deg probe tilt) with CRP v5.0_Right_2014_02_25; Type: QD000P40CD; Serial: TP:1804
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Verification 5.5GHz/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 21.9 W/kg

Verification 5.5GHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 75.64 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 38.7 W/kg
SAR(1 g) = 8.54 W/kg; SAR(10 g) = 2.41 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 22.6 W/kg



0 dB = 21.9 W/kg = 13.41 dBW/kg

■ Verification Data (5 500 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 20.0
Test Date: Jan. 21, 2015

DUT: Dipole 5GHz; Type: D5000V2; Serial: D5000V2 - SN: 1107

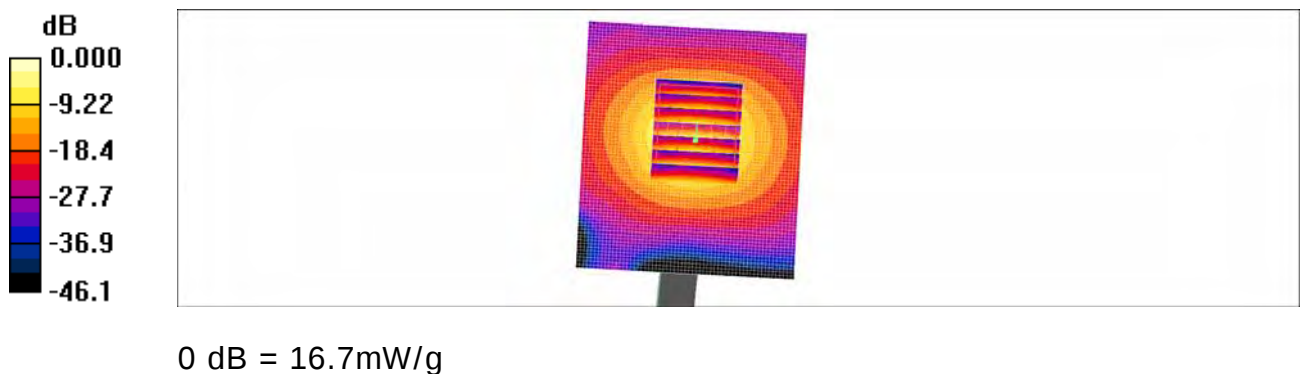
Communication System: CW; Frequency: 5500 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5500$ MHz; $\sigma = 5.55$ mho/m; $\epsilon_r = 47.3$; $\rho = 1000$ kg/m³
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(4.01, 4.01, 4.01); Calibrated: 2014-07-24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2014-03-24
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

Verification 5500MHz/Area Scan (61x71x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 8.93 mW/g

Verification 5500MHz/Zoom Scan (7x7x11)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 38.1 V/m; Power Drift = 0.015 dB
Peak SAR (extrapolated) = 34.2 W/kg
SAR(1 g) = 7.89 mW/g; SAR(10 g) = 2.25 mW/g
Maximum value of SAR (measured) = 16.7 mW/g



■ Verification Data (5 800 MHz Head)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 20.1
Test Date: Jan. 20, 2015

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5000V2 - SN: 1107

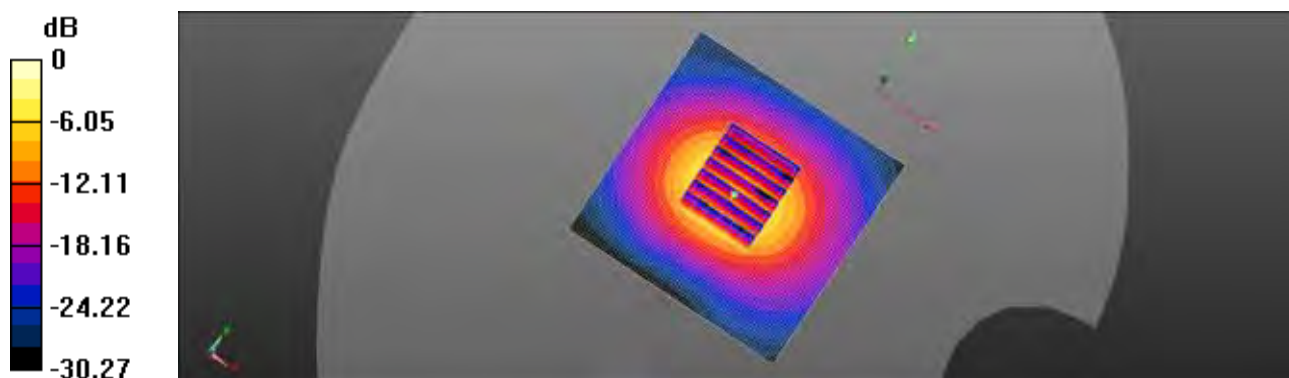
Communication System: UID 0, CW (0); Frequency: 5800 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5800$ MHz; $\sigma = 5.276$ S/m; $\epsilon_r = 34.24$; $\rho = 1000$ kg/m³
Phantom section: Flat Section
Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3967; ConvF(4.64, 4.64, 4.64); Calibrated: 2014-12-22;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2014-04-23
- Phantom: SAM (20deg probe tilt) with CRP v5.0_Right_2014_02_25; Type: QD000P40CD; Serial: TP:1804
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Verification 5.8GHz Head/Area Scan (71x71x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm
Maximum value of SAR (interpolated) = 20.4 W/kg

Verification 5.8GHz Head/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=1.4$ mm
Reference Value = 70.73 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 39.3 W/kg
SAR(1 g) = 7.9 W/kg; SAR(10 g) = 2.23 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 21.7 W/kg



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

Verification Data (5 800 MHz Body)

Test Laboratory: HCT CO., LTD
 Input Power: 100 mW (20 dBm)
 Liquid Temp: 20.0
 Test Date: Jan. 21, 2015

DUT: Dipole 5GHz; Type: D5000V2; Serial: D5000V2 - SN: 1107

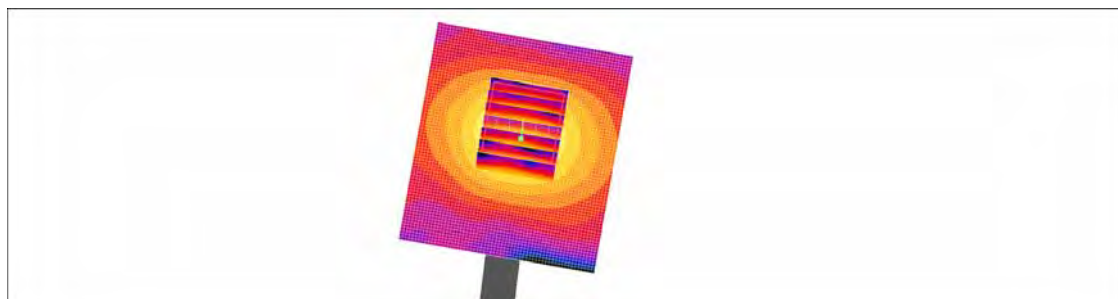
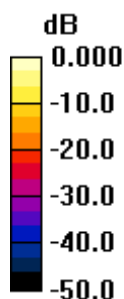
Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 5800$ MHz; $\sigma = 6.08$ mho/m; $\epsilon_r = 46.9$; $\rho = 1000$ kg/m³
 Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(4.07, 4.07, 4.07); Calibrated: 2014-07-24
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2014-03-24
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

Verification 5800MHz/Area Scan (61x71x1): Measurement grid: dx=10mm, dy=10mm
 Maximum value of SAR (interpolated) = 8.00 mW/g

Verification 5800MHz/Zoom Scan (7x7x11)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
 Reference Value = 34.6 V/m; Power Drift = -0.025 dB
 Peak SAR (extrapolated) = 33.1 W/kg
SAR(1 g) = 7.26 mW/g; SAR(10 g) = 2.05 mW/g
 Maximum value of SAR (measured) = 15.4 mW/g



0 dB = 15.4mW/g

Attachment 3. – Probe Calibration Data

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



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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: EX3-3967_Dec14

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3967

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: December 22, 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 E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41496087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 789	30-Apr-14 (No. DAE4-789_Apr14)	Apr-15
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-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	David Laubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: December 22, 2014			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

Certificate No: EX3-3967_Dec14

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**Calibration Laboratory of
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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.
- DCPx,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: EX3-3967_Dec14

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EX3DV4 – SN:3967

December 22, 2014

Probe EX3DV4

SN:3967

Manufactured: September 30, 2013

Calibrated: December 22, 2014

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

EX3DV4-SN:3967

December 22, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3967

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V/m})^2$) ^A	0.53	0.44	0.49	± 10.1 %
DCP (mV) ^B	93.9	96.2	102.2	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB/μV	C	D dB	VR mV	Unc (k=2)
0	CW	X	0.0	0.0	1.0	0.00	148.0	±3.0 %
		Y	0.0	0.0	1.0		134.9	
		Z	0.0	0.0	1.0		138.3	

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 Norm X, 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:3967

December 22, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3967

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^e	Conductivity (S/m) ^e	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^d (mm)	Unct. (ke2)
750	41.9	0.89	10.18	10.18	10.18	0.80	0.61	± 12.0 %
835	41.5	0.90	9.75	9.75	9.75	0.80	0.61	± 12.0 %
900	41.5	0.97	9.56	9.56	9.56	0.39	0.89	± 12.0 %
1450	40.5	1.20	8.40	8.40	8.40	0.32	0.91	± 12.0 %
1750	40.1	1.37	8.59	8.59	8.59	0.64	0.70	± 12.0 %
1900	40.0	1.40	8.13	8.13	8.13	0.69	0.68	± 12.0 %
1950	40.0	1.40	7.81	7.81	7.81	0.69	0.60	± 12.0 %
2300	39.5	1.67	7.57	7.57	7.57	0.51	0.76	± 12.0 %
2450	39.2	1.80	7.16	7.16	7.16	0.50	0.77	± 12.0 %
2600	39.0	1.96	6.86	6.86	6.86	0.40	0.92	± 12.0 %
3500	37.9	2.91	7.10	7.10	7.10	0.41	0.95	± 13.1 %
5200	36.0	4.66	5.07	5.07	5.07	0.35	1.80	± 13.1 %
5300	35.9	4.76	4.88	4.88	4.88	0.35	1.80	± 13.1 %
5500	35.6	4.96	4.64	4.64	4.64	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.70	4.70	4.70	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.64	4.64	4.64	0.40	1.80	± 13.1 %

^c Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^d 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.

^e 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 3967

December 22, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3967

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^e	Conductivity (S/m) ^f	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth (mm) ^h	Unct. (k=2)
750	55.5	0.96	9.68	9.68	9.68	0.58	0.71	± 12.0 %
835	55.2	0.97	9.55	9.55	9.55	0.80	0.58	± 12.0 %
1750	53.4	1.49	7.90	7.90	7.90	0.78	0.63	± 12.0 %
1900	53.3	1.52	7.58	7.58	7.58	0.49	0.82	± 12.0 %
2300	52.9	1.81	7.37	7.37	7.37	0.80	0.63	± 12.0 %
2450	52.7	1.95	7.10	7.10	7.10	0.73	0.66	± 12.0 %
2600	52.5	2.16	6.97	6.97	6.97	0.80	0.57	± 12.0 %
5200	49.0	5.30	4.59	4.59	4.59	0.45	1.90	± 13.1 %
5300	48.9	5.42	4.43	4.43	4.43	0.45	1.90	± 13.1 %
5500	48.6	5.65	4.02	4.02	4.02	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.85	3.85	3.85	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.12	4.12	4.12	0.50	1.90	± 13.1 %

^c Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

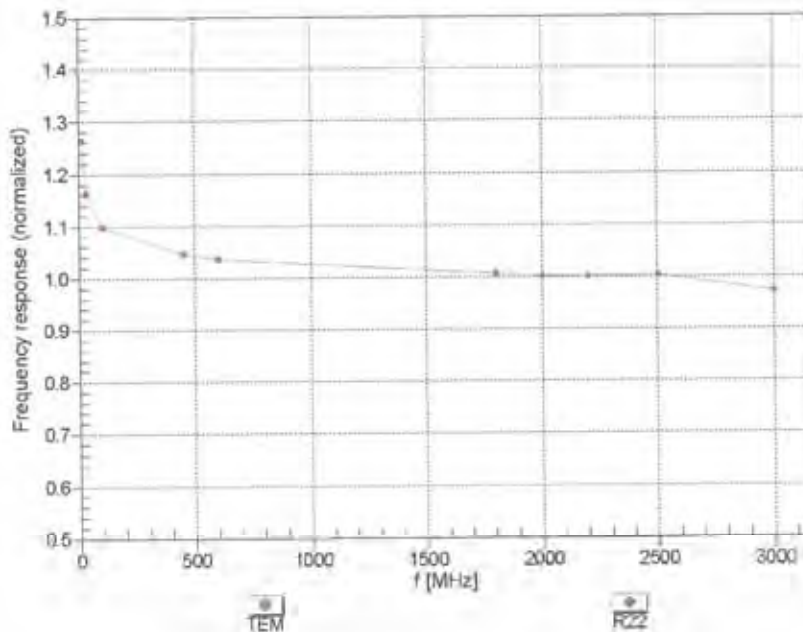
^e At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty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

EX30VA- SN:3967

December 22, 2014

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



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

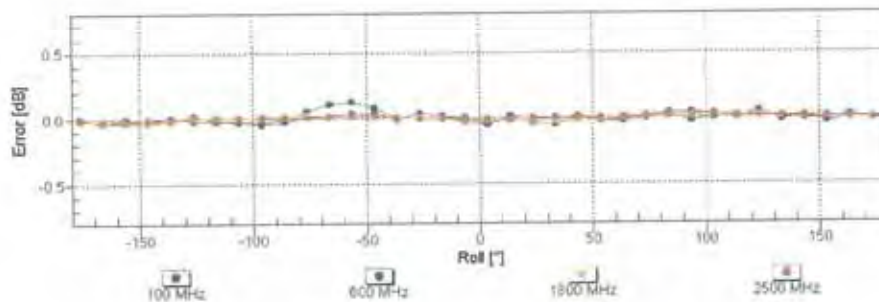
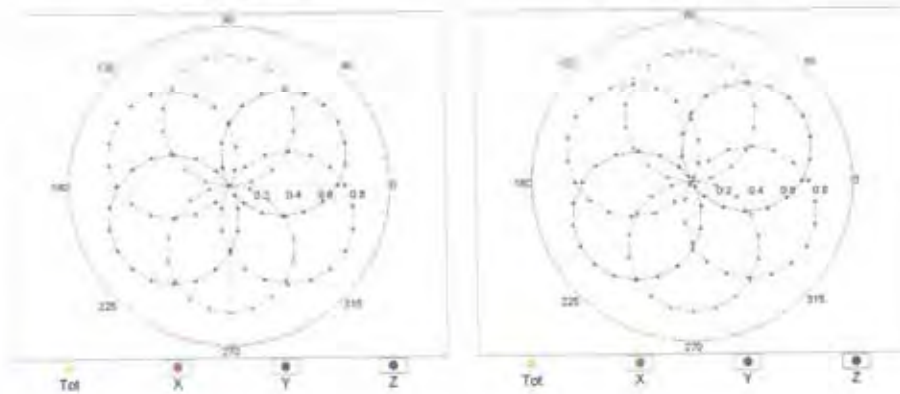
EX3DV4- SN:3967

December 22, 2014

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

f=600 MHz, TEM

f=1800 MHz, R22



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

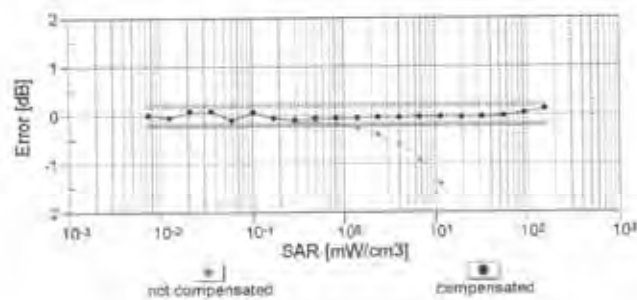
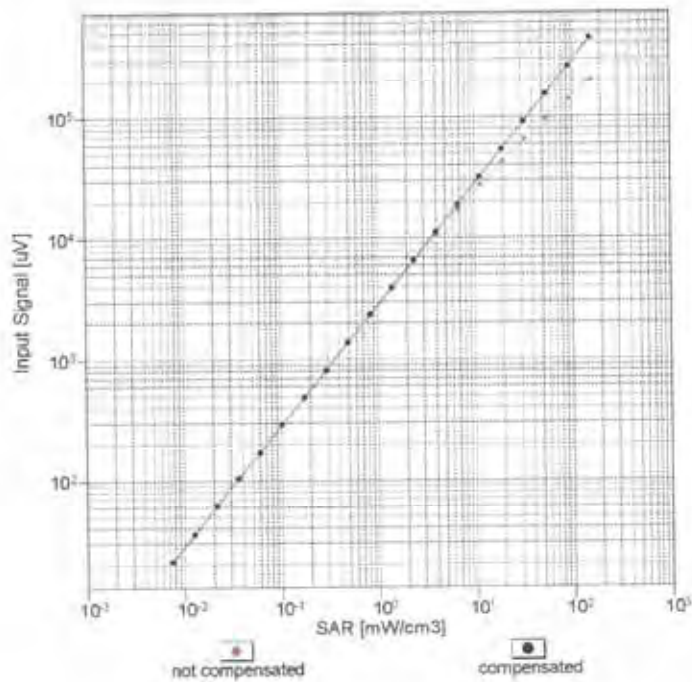
Certificate No: EX3-3967_Dec14

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EX3DV4- SN:3967

December 22, 2014

Dynamic Range f(SAR_{head}) (TEM cell, f_{eval} = 1900 MHz)



Uncertainty of Linearity Assessment: ± 0.6% (k=2)

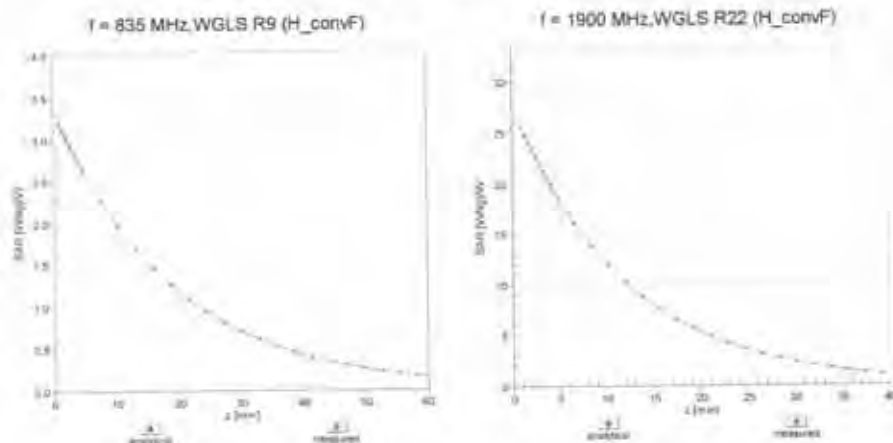
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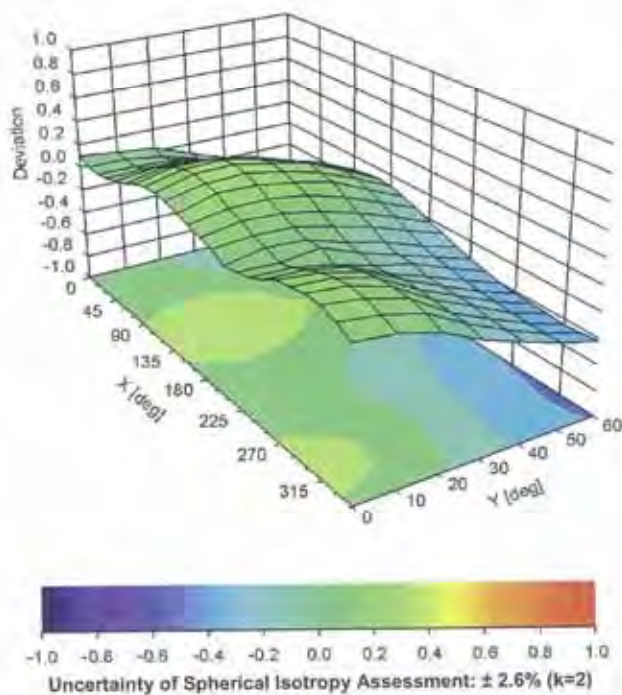
EX3DV4-SN:3967

December 22, 2014

Conversion Factor Assessment



Deviation from Isotropy in Liquid Error (ϕ, θ), $f = 900 \text{ MHz}$



Certificate No: EX3-3967_Dec14

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EX3DV4- SN 3967

December 22, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3967

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	<16.4
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	1.4 mm

Calibration Laboratory of
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Zeughausstrasse 43, 8064 Zurich, Switzerland



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Accreditation No.: SCS 108

Client: HCT (Dymstec)

Certificate No: EX3-3903_Aug14

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3903

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: August 28, 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&E: critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41253874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: 55554 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: 55277 (20x)	03-Apr-14 (No. 217-01918)	Apr-15
Reference 30 dB Attenuator	SN: 55129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. E53-3013, Dec13)	Dec-14
DAEA	SN: 660	13-Dec-13 (No. DAEA-660, Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8549C	US3642UD1700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Heide El-Nopug	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: August 28, 2014			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

Certificate No: EX3-3903_Aug14

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Accredited by the Swiss Accreditation Service (SAS)
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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

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: EX3-3903_Aug14

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EX3DV4 – SN:3903

August 28, 2014

Probe EX3DV4

SN:3903

Manufactured: September 4, 2012
Repaired: August 21, 2014
Calibrated: August 28, 2014

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

EX3DV4- SN:3903

August 28, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3903**Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.41	0.36	0.56	$\pm 10.1 \%$
DCP (mV) ^B	101.7	103.2	98.1	

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	125.2	$\pm 2.7 \%$
		Y	0.0	0.0	1.0		134.1	
		Z	0.0	0.0	1.0		128.7	

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 E^2 -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:3903

August 29, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3903**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 (mm) ^g	Unct. (k=2)
835	41.5	0.90	10.03	10.03	10.03	0.51	0.79	± 12.0 %
900	41.5	0.97	9.87	9.87	9.87	0.50	0.72	± 12.0 %
1450	40.5	1.20	8.69	8.69	8.69	0.27	1.05	± 12.0 %
1750	40.1	1.37	8.33	8.33	8.33	0.55	0.65	± 12.0 %
1900	40.0	1.40	8.11	8.11	8.11	0.76	0.56	± 12.0 %
1950	40.0	1.40	7.83	7.83	7.83	0.80	0.55	± 12.0 %
2300	39.5	1.67	7.70	7.70	7.70	0.53	0.68	± 12.0 %
2450	39.2	1.80	7.39	7.39	7.39	0.42	0.77	± 12.0 %
2600	39.0	1.96	7.22	7.22	7.22	0.46	0.74	± 12.0 %
5200	36.0	4.66	5.55	5.55	5.55	0.30	1.80	± 13.1 %
5300	35.9	4.76	5.32	5.32	5.32	0.30	1.80	± 13.1 %
5500	35.6	4.96	5.05	5.05	5.05	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.85	4.85	4.85	0.35	1.80	± 13.1 %
5800	35.3	5.27	4.74	4.74	4.74	0.40	1.80	± 13.1 %

^c Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10 , 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^f At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to $\pm 10\%$ 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 $\pm 5\%$. 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 $\pm 1\%$ for frequencies below 3 GHz and below $\pm 2\%$ for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

EX3DV4- SN:3903

August 28, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3903

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^d	Conductivity (S/m) ^e	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth (mm) ^h	Unct. (k=2)
835	55.2	0.97	9.78	9.78	9.78	0.20	1.47	± 12.0 %
1750	53.4	1.49	8.02	8.02	8.02	0.42	0.86	± 12.0 %
1900	53.3	1.52	7.72	7.72	7.72	0.41	0.82	± 12.0 %
2300	52.9	1.81	7.59	7.59	7.59	0.80	0.60	± 12.0 %
2450	52.7	1.95	7.29	7.29	7.29	0.80	0.57	± 12.0 %
2600	52.5	2.16	7.21	7.21	7.21	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.75	4.75	4.75	0.45	1.90	± 13.1 %
5300	48.9	5.42	4.53	4.53	4.53	0.45	1.90	± 13.1 %
5500	48.6	5.65	4.15	4.15	4.15	0.50	1.90	± 13.1 %
5600	48.5	5.77	4.01	4.01	4.01	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.29	4.29	4.29	0.50	1.90	± 13.1 %

^c Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

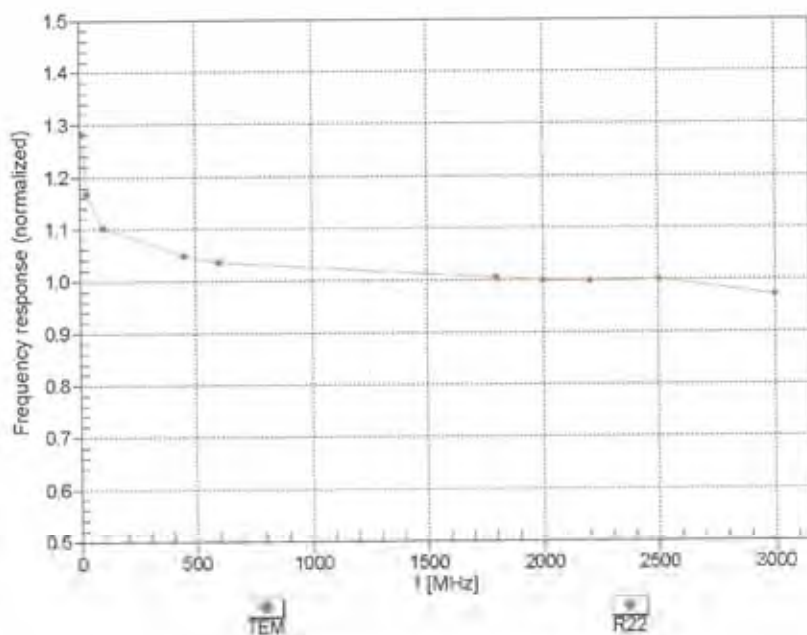
^d At frequencies below 3 GHz, the validity of tissue parameters (ϵ and n) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and n) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty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

^h 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:3903

August 28, 2014

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

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

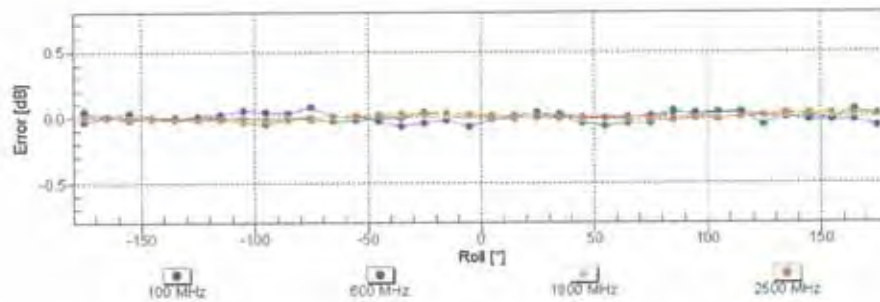
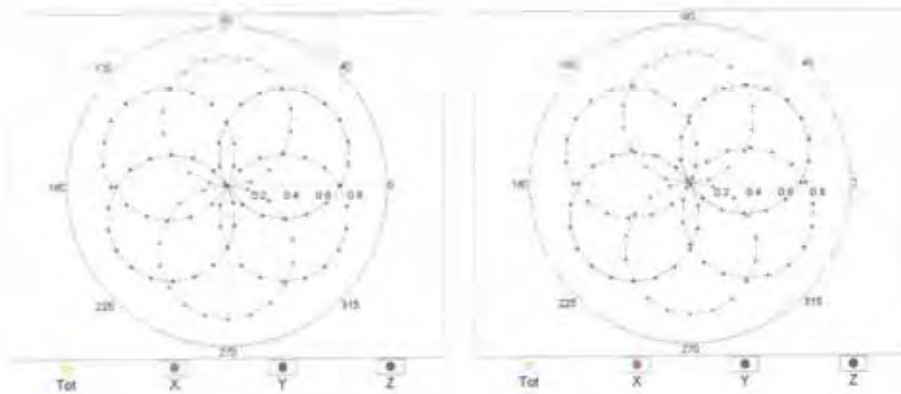
EX3DV4- SN-3903

August 28, 2014

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

f=600 MHz,TEM

f=1800 MHz,R22

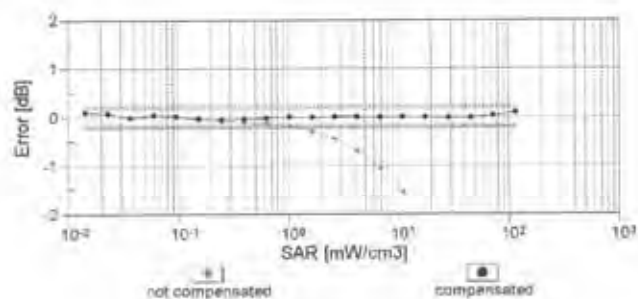
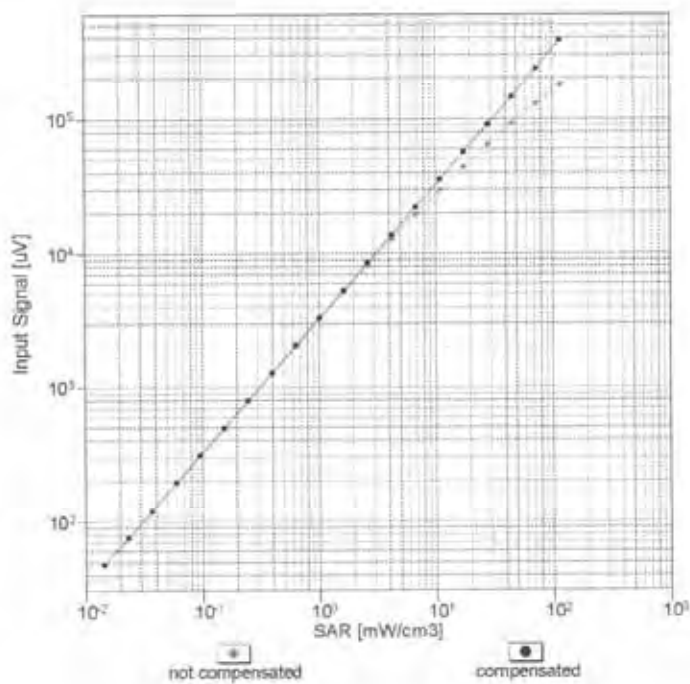


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

EX3DV4-SN3903

August 28, 2014

Dynamic Range f(SAR_{head}) (TEM cell, $f_{eval} = 1900$ MHz)



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

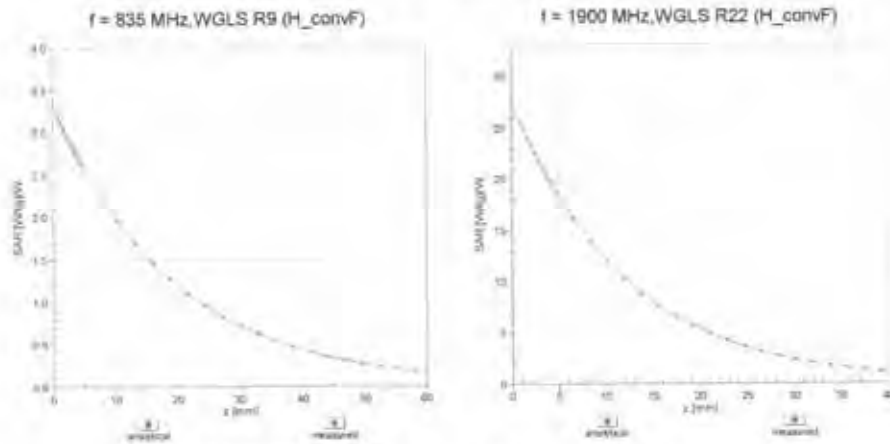
Certificate No. EX3-3903_Aug14

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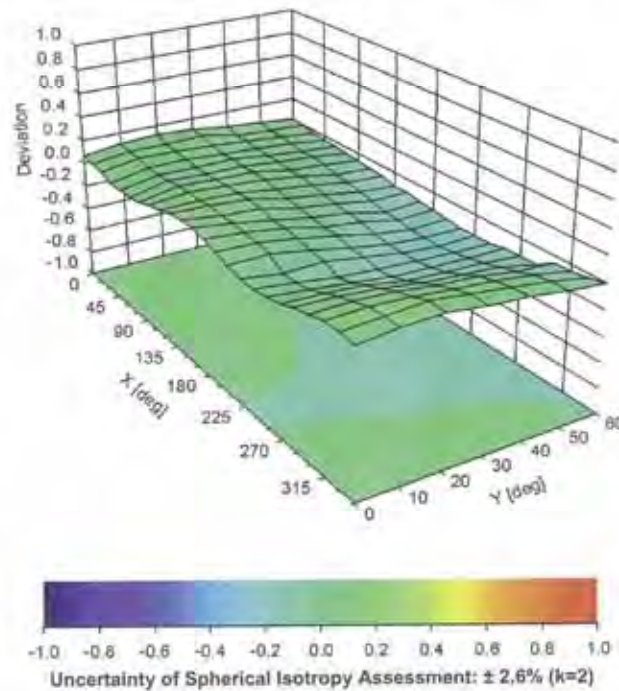
EX3DV4-SN:3903

August 28, 2014

Conversion Factor Assessment



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



EX3DV4 - SN:3903

August 28, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3903

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-35.2
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	1.4 mm

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



S Schweizerischer Kalibrierdienst
S 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: EX3-3863_Jul14

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3863

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: July 24, 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&E critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MV41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: 55054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: 55277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: 55129 (30x)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	U53642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	U637300585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Jeroen Kienhail	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: July 24, 2014			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

Certificate No: EX3-3863_Jul14

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



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

Accredited by the Swiss Accreditation Service (EAS)

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	issue 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).

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EX3DV4 – SN:3863

July 24, 2014

Probe EX3DV4

SN:3863

Manufactured: February 2, 2012
Calibrated: July 24, 2014

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

EX3DV4- SN 3863

July 24, 2014

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	0.37	0.35	0.45	± 10.1 %
DCP (mV) ^B	99.8	98.7	100.6	

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	133.0	±2.5 %
		Y	0.0	0.0	1.0		131.3	
		Z	0.0	0.0	1.0		149.9	

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:3863

July 24, 2014

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^d	Conductivity (S/m) ^e	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^h (mm)	Unct. (k=2)
835	41.5	0.90	9.50	9.50	9.50	0.80	0.50	± 12.0 %
900	41.5	0.97	9.21	9.21	9.21	0.59	0.71	± 12.0 %
1450	40.5	1.20	8.50	8.50	8.50	0.66	0.65	± 12.0 %
1750	40.1	1.37	8.38	8.38	8.38	0.76	0.58	± 12.0 %
1900	40.0	1.40	8.02	8.02	8.02	0.78	0.59	± 12.0 %
1950	40.0	1.40	7.71	7.71	7.71	0.56	0.70	± 12.0 %
2300	39.5	1.67	7.48	7.48	7.48	0.54	0.69	± 12.0 %
2450	39.2	1.80	7.15	7.15	7.15	0.70	0.59	± 12.0 %
2600	39.0	1.96	7.05	7.05	7.05	0.50	0.74	± 12.0 %
5200	36.0	4.66	4.98	4.98	4.98	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.77	4.77	4.77	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.76	4.76	4.76	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.58	4.58	4.58	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.55	4.55	4.55	0.45	1.80	± 13.1 %

^c Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^d 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:3863

July 28, 2014

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^e	Conductivity (S/m) ^f	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^d (mm)	Unct. (k=2)
835	55.2	0.97	9.43	9.43	9.43	0.80	0.61	± 12.0 %
1750	53.4	1.49	7.80	7.80	7.80	0.52	0.75	± 12.0 %
1900	53.3	1.52	7.36	7.36	7.36	0.26	1.18	± 12.0 %
2450	52.7	1.95	6.97	6.97	6.97	0.80	0.50	± 12.0 %
2600	52.5	2.16	6.87	6.87	6.87	0.63	0.50	± 12.0 %
5200	49.0	5.30	4.50	4.50	4.50	0.40	1.90	± 13.1 %
5300	48.9	5.42	4.27	4.27	4.27	0.40	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	3.83	3.83	3.83	0.45	1.90	± 13.1 %
5800	48.2	6.00	4.07	4.07	4.07	0.50	1.90	± 13.1 %

^c Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

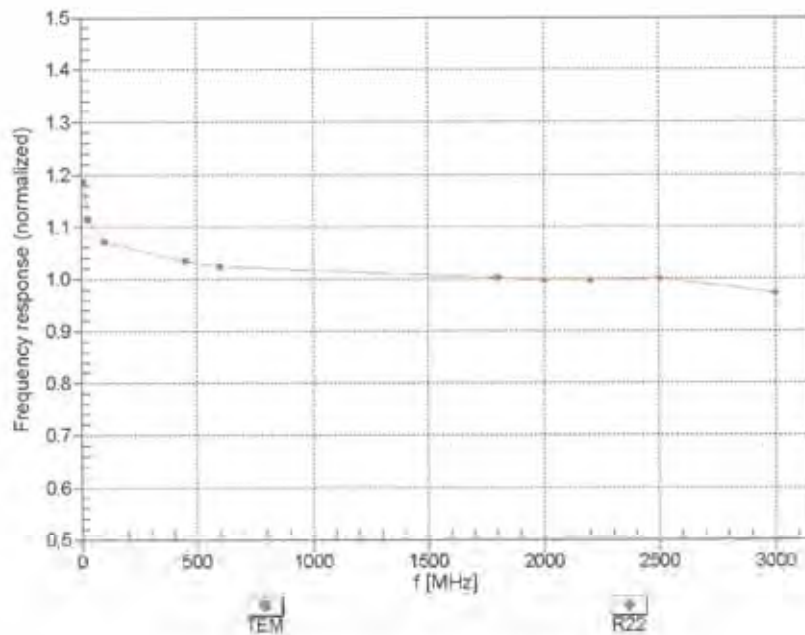
^f At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty 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:3863

July 24, 2014

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



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

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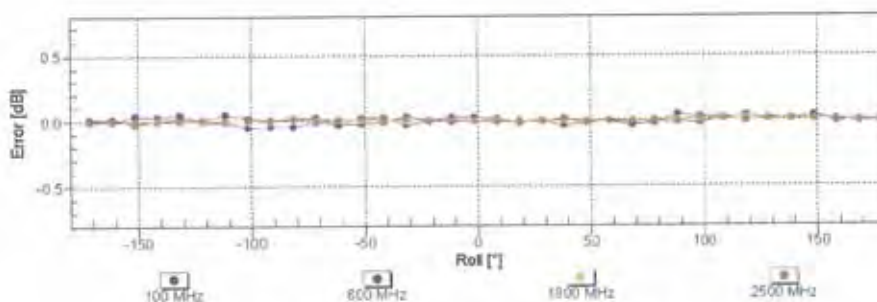
EX3QV4- SN:3863

July 24, 2014

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

f=600 MHz, TEM

f=1800 MHz, R22

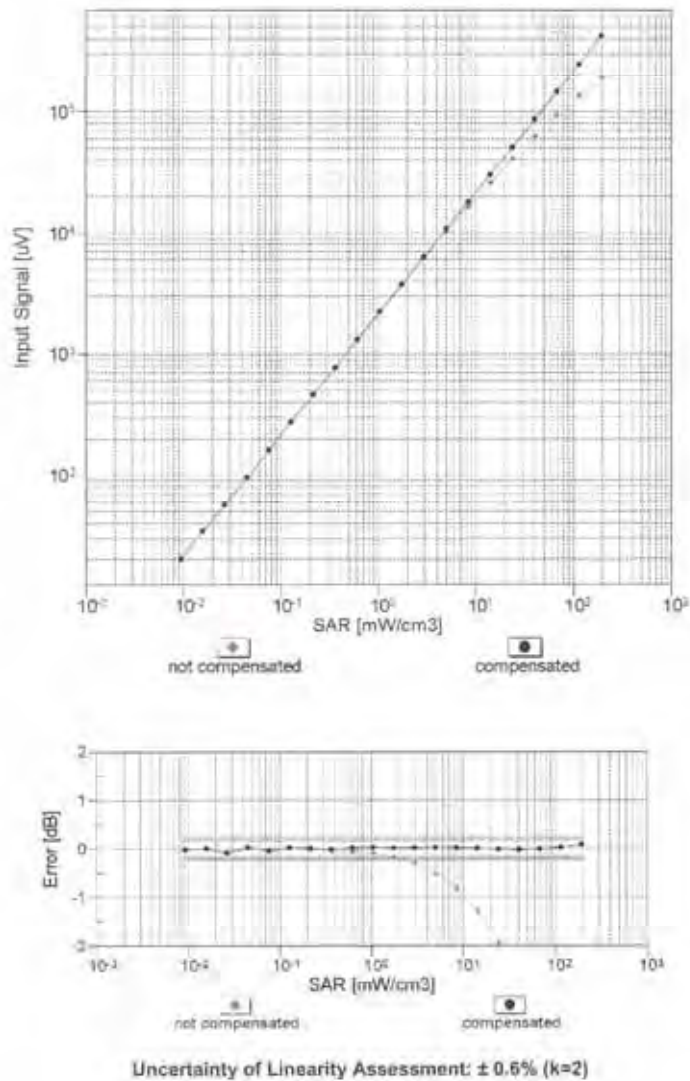


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

EX3DV4-SN:3863

July 24, 2014

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f_{\text{eval}} = 1900 \text{ MHz}$)



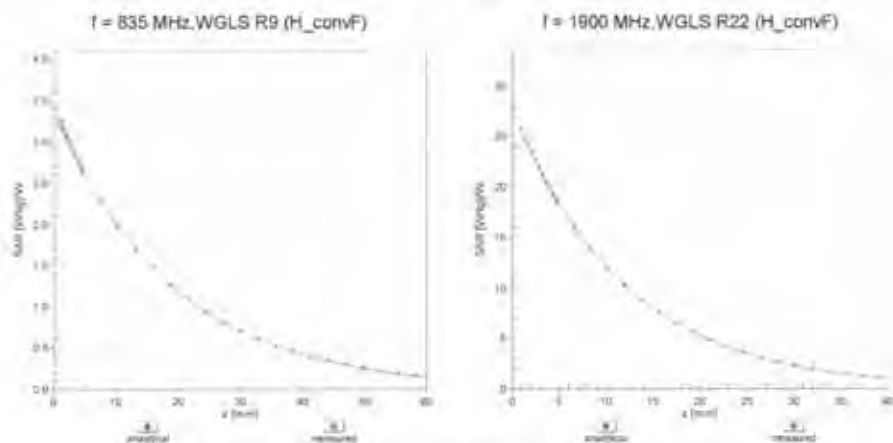
Certificate No: EX3-3863_Jul14

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EX3DV4- SN:3863

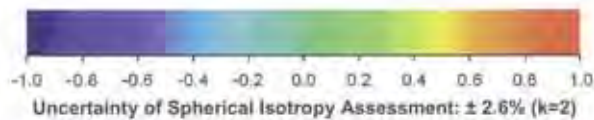
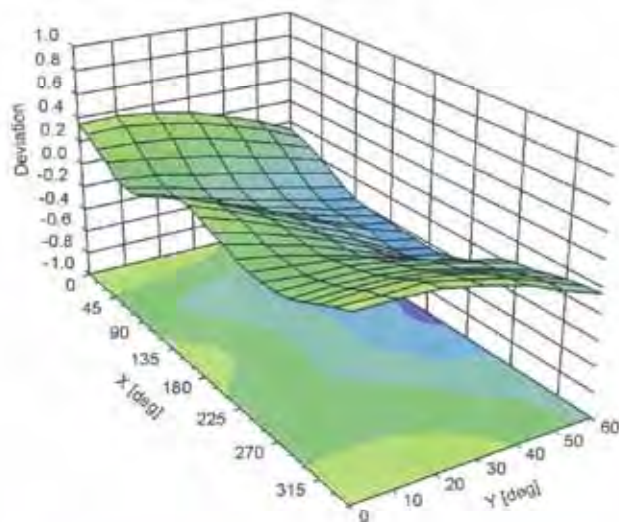
July 24, 2014

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900 \text{ MHz}$



Certificate No: EX3-3863_Jul14

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EX3DV4- SN:3863

July 24, 2014

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-71.6
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	1.4 mm

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Client HCT (Dymstec)

Certificate No: ET3-1630_Apr14

CALIBRATION CERTIFICATE

Object ET3DV6 - SN:1630

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

Calibration date: April 21, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	Q841293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP B548C	US3642U01700	4-Aug-99 (in house check Apr-13)	in house check: Apr-16
Network Analyzer HP 8753E	US37390565	18-Oct-01 (in house check Oct-13)	in house check: Oct-14

	Name	Function	Signature
Calibrated by:	Claudio Leubner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: April 21, 2014			
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Certificate No: ET3-1630_Apr14

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Accreditation No.: SCS 108

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 α	α rotation around probe axis
Polarization β	β rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\beta = 0$ 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 $\beta = 0$ ($f \leq 900$ 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: ET3-1630_Apr14

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ET3DV6 – SN:1630

April 21, 2014

Probe ET3DV6

SN:1630

Manufactured: October 12, 2001

Calibrated: April 21, 2014

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: ET3-1630_Apr14

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ET3DV6- SN:1630

April 21, 2014

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1630**Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^{0.5}$) ^A	1.76	1.81	1.62	$\pm 10.1 \%$
DCP (mV) ^B	99.2	101.0	98.5	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc (k=2) ^E
0	CW	X	0.0	0.0	1.0	0.00	252.3	$\pm 3.5 \%$
		Y	0.0	0.0	1.0		252.3	
		Z	0.0	0.0	1.0		246.1	

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 E^2 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.

ET3DV6-SN 1630

April 21, 2014

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1630

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^a	Conductivity (S/m) ^b	ConvF X	ConvF Y	ConvF Z	Alpha ^d	Depth (mm) ^e	Uncl. (k=2)
835	41.3	0.90	5.67	5.67	5.67	0.80	1.43	± 12.0 %
900	41.5	0.97	5.59	5.59	5.59	0.67	1.29	± 12.0 %
1450	40.5	1.20	5.65	5.65	5.65	0.45	2.67	± 12.0 %
1750	40.1	1.37	5.37	5.37	5.37	0.71	2.22	± 12.0 %
1900	40.0	1.40	5.17	5.17	5.17	0.80	2.02	± 12.0 %
1950	40.0	1.40	5.01	5.01	5.01	0.80	1.95	± 12.0 %
2450	39.2	1.80	4.57	4.57	4.57	0.80	1.64	± 12.0 %

^a 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.

^b 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.

^d 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.

ET3DV6- SN:1630

April 21, 2014

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1630**Calibration Parameter Determined in Body Tissue Simulating Media**

f (MHz) ^c	Relative Permittivity ^e	Conductivity (S/m) ^f	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^h (mm)	Uncl. (k=2)
835	55.2	0.97	6.59	6.59	6.59	0.80	1.32	± 12.0 %
1750	53.4	1.49	4.93	4.93	4.93	0.80	2.40	± 12.0 %
1900	53.3	1.52	4.73	4.73	4.73	0.80	2.35	± 12.0 %
2450	52.7	1.95	4.26	4.26	4.26	0.63	1.14	± 12.0 %

^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.

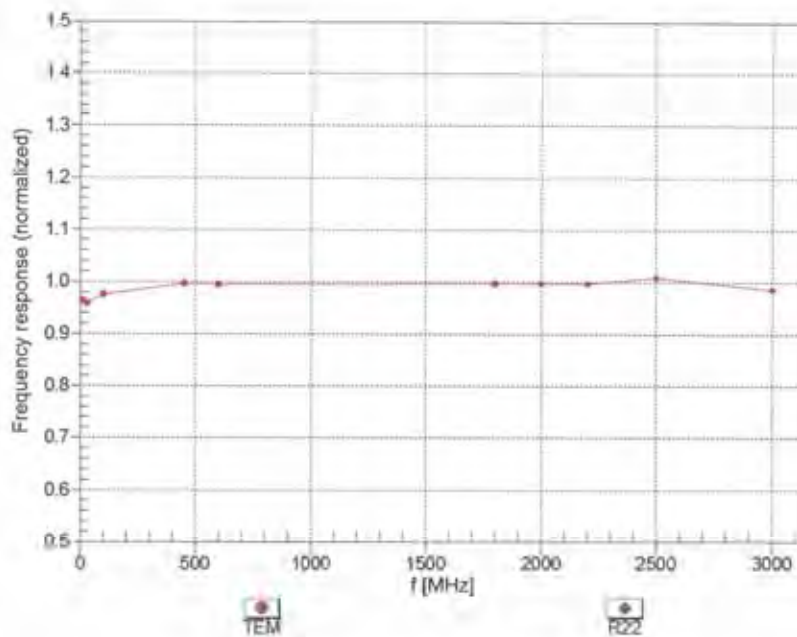
^e At frequencies below 3 GHz, the validity of tissue parameters (ϵ and n) can be related to $\pm 10\%$ if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and n) is restricted to $\pm 5\%$. The uncertainty is the RSS of the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

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

ET3DV6-SN:1630

April 21, 2014

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

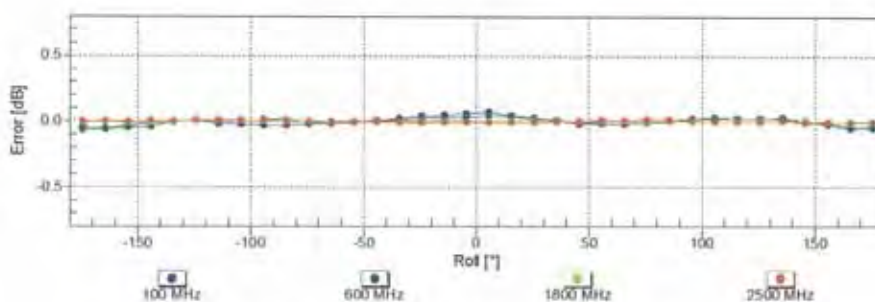
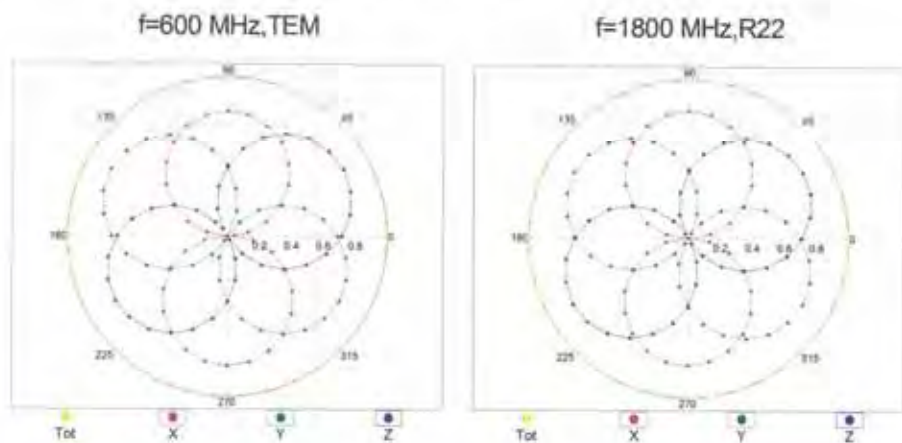


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

ET3DV6-SN:1630

April 21, 2014

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



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

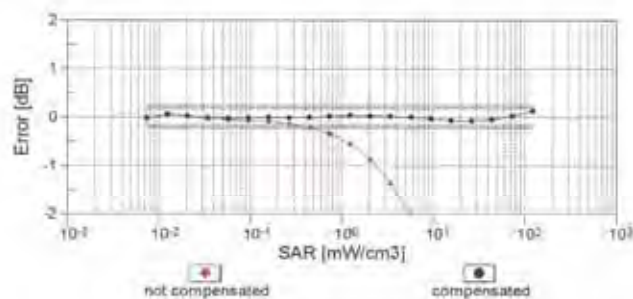
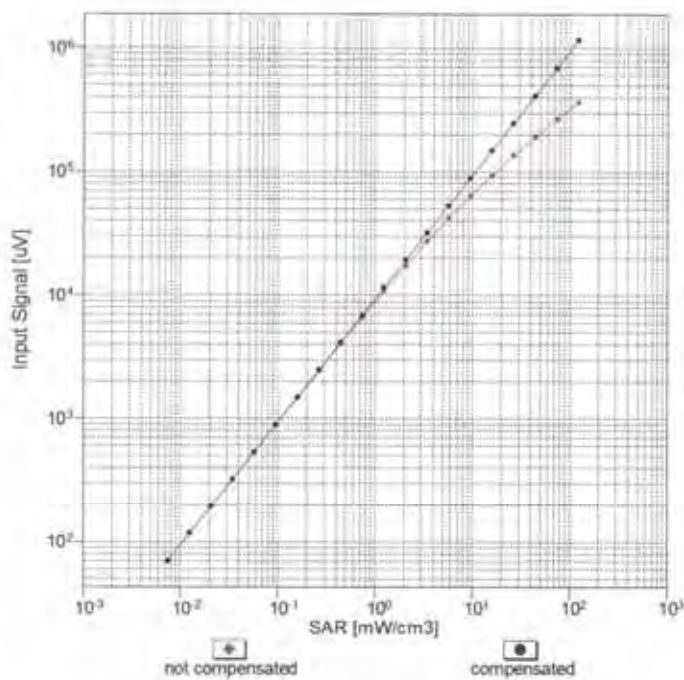
Certificate No: ET3-1630_Apr14

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ET3DV6-SN.1630

April 21, 2014

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f_{\text{eval}} = 1900 \text{ MHz}$)

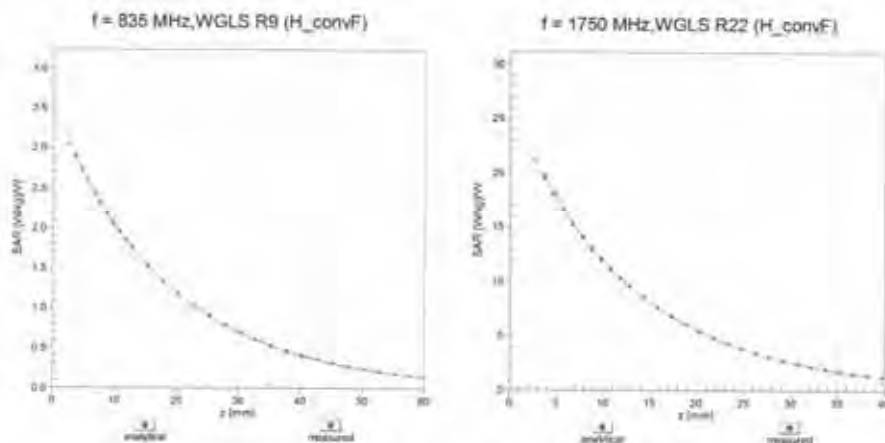


Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

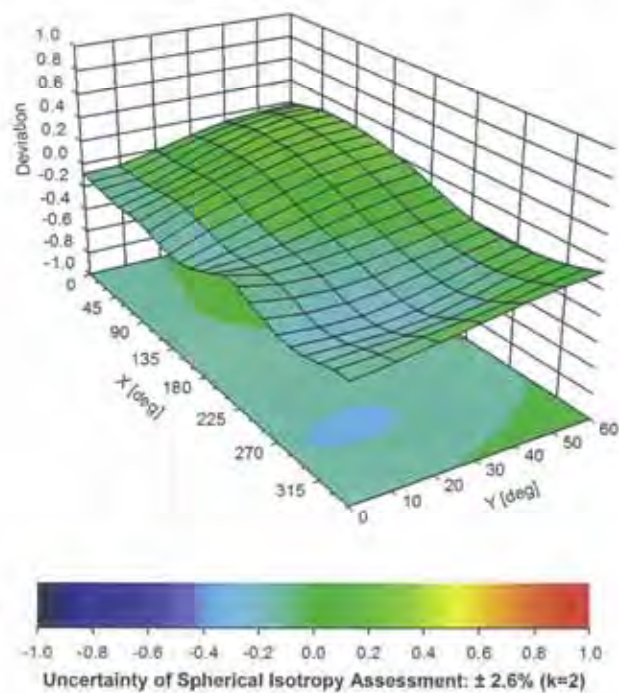
ET3DV6-SN:1630

April 21, 2014

Conversion Factor Assessment



Deviation from Isotropy in Liquid Error (ϕ , θ), $f = 900 \text{ MHz}$



Certificate No: ET3-1630_Apr14

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ET3DV6- SN 1630

April 21, 2014

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1630

Other Probe Parameters

Sensor Arrangement:	Triangular
Connector Angle (°)	-54.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	6.8 mm
Probe Tip to Sensor X Calibration Point	2.7 mm
Probe Tip to Sensor Y Calibration Point	2.7 mm
Probe Tip to Sensor Z Calibration Point	2.7 mm
Recommended Measurement Distance from Surface	4 mm

Attachment 4. – Dipole Calibration Data

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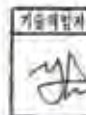


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Client **SGS (Dymstec)**

Certificate No: **D835V2-490_May14** 2014.6.2

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 490**

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

Calibration date: **May 16, 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 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)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Approved by: **Katja Pokovic** Technical Manager

Signature

Issued: May 20, 2014

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Certificate No: D835V2-490_May14

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

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.2 $\pm$ 6 %	0.94 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	2.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.07 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	5.90 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	56.6 $\pm$ 6 %	1.02 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	2.45 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.49 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	1.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.20 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.9 Ω - 2.9 j Ω
Return Loss	- 30.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.3 Ω - 5.0 j Ω
Return Loss	- 22.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.392 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	May 19, 2003

DASY5 Validation Report for Head TSL

Date: 16.05.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 490

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

Medium parameters used: $f = 835$ MHz; $\sigma = 0.94$ S/m; $\epsilon_r = 40.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.22, 6.22, 6.22); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

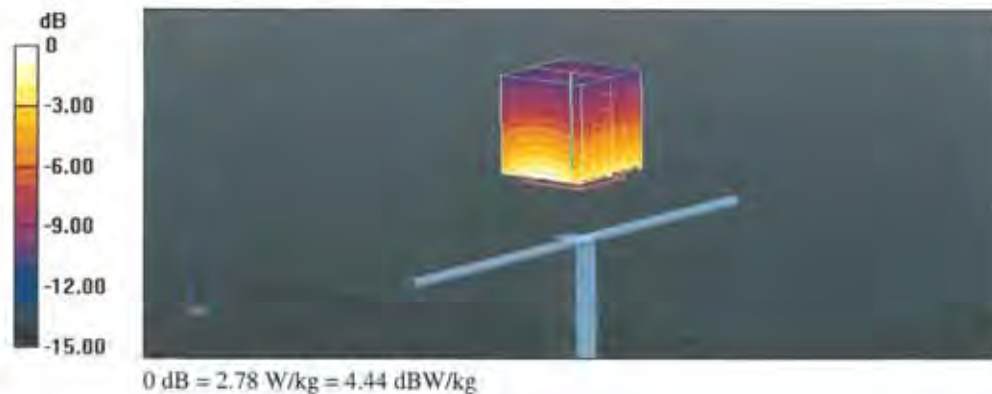
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.09 V/m; Power Drift = 0.03 dB

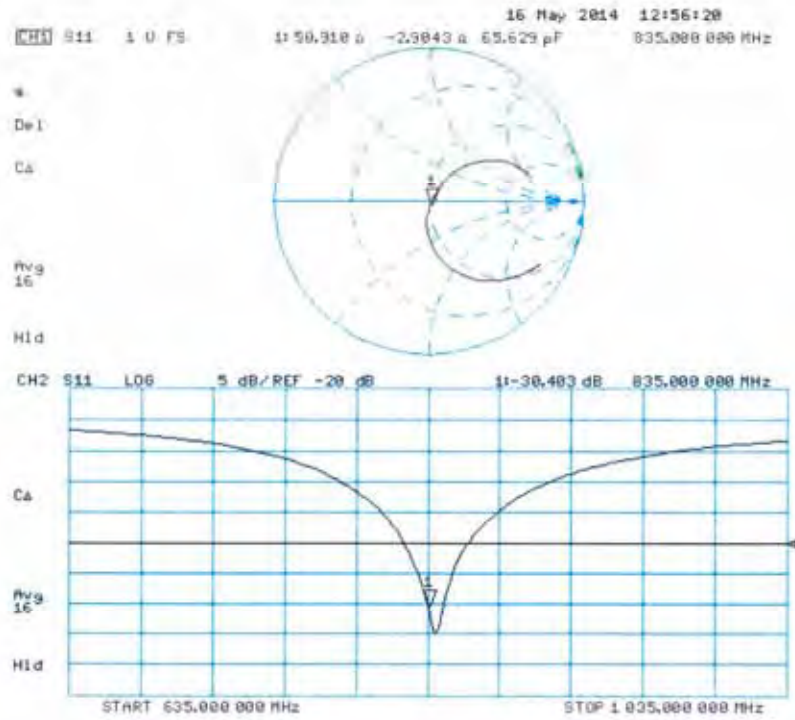
Peak SAR (extrapolated) = 3.57 W/kg

SAR(1 g) = 2.36 W/kg; SAR(10 g) = 1.52 W/kg

Maximum value of SAR (measured) = 2.78 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 15.05.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 490

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

Medium parameters used: $f = 835$ MHz; $\sigma = 1.02$ S/m; $\epsilon_r = 56.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.09, 6.09, 6.09); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

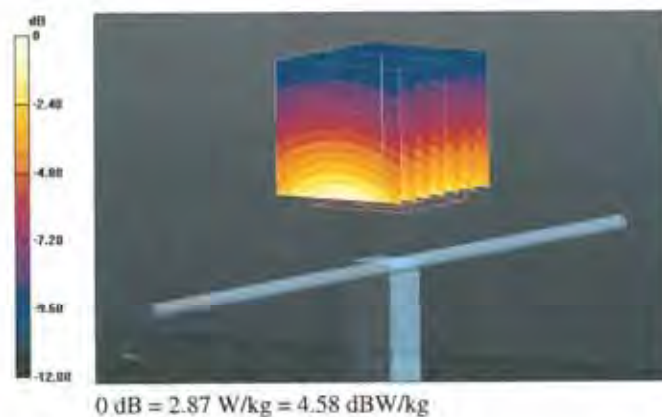
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.12 V/m; Power Drift = -0.03 dB

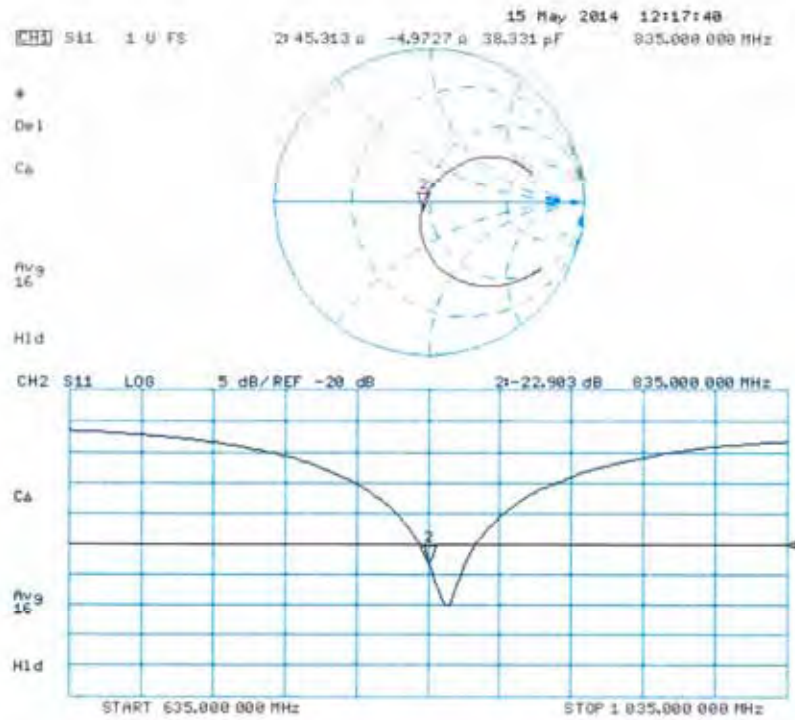
Peak SAR (extrapolated) = 3.64 W/kg

SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.59 W/kg

Maximum value of SAR (measured) = 2.87 W/kg



Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client HCT (Dymstec)

Certificate No: D1900V2-5d061_Jul14

CALIBRATION CERTIFICATE

Object D1900V2 - SN: 5d061

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

Calibration date: July 23, 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 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)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15

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

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

Issued: July 23, 2014

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Certificate No: D1900V2-5d061_Jul14

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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	V52.0.8
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	39.5 $\pm$ 6 %	1.38 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	10.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.6 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	5.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.2 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	52.5 $\pm$ 6 %	1.51 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	10.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.8 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	5.39 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.6 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$51.1 \Omega + 6.2 j\Omega$
Return Loss	-24.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$47.2 \Omega + 7.0 j\Omega$
Return Loss	-22.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.193 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	December 10, 2004

DASY5 Validation Report for Head TSL

Date: 23.07.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d061

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.38$ S/m; $\epsilon_r = 39.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.06, 5.06, 5.06); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

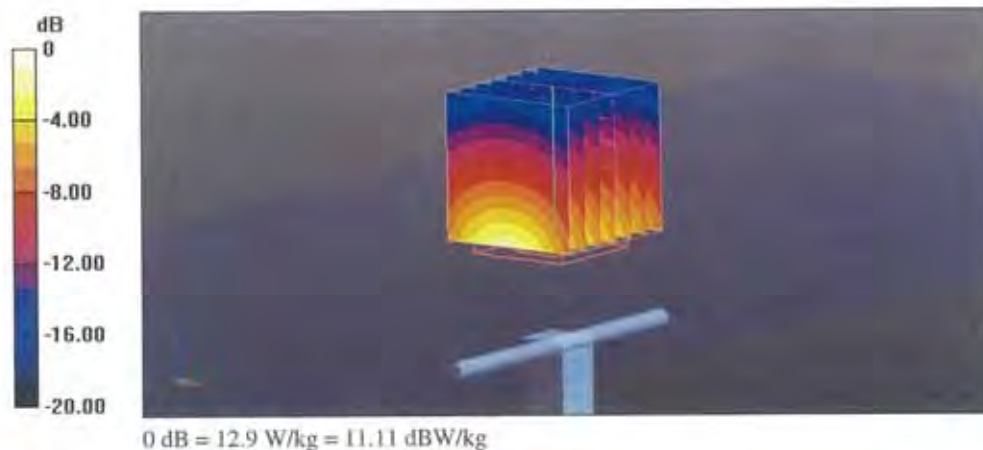
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.40 V/m; Power Drift = 0.02 dB

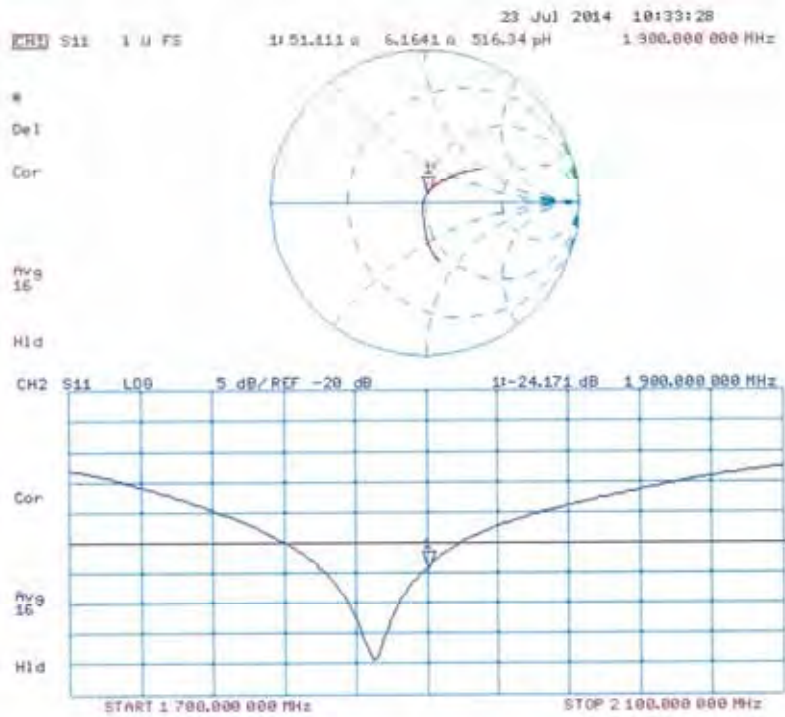
Peak SAR (extrapolated) = 18.6 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.29 W/kg

Maximum value of SAR (measured) = 12.9 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 23.07.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d061

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.51$ S/m; $\epsilon_r = 52.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

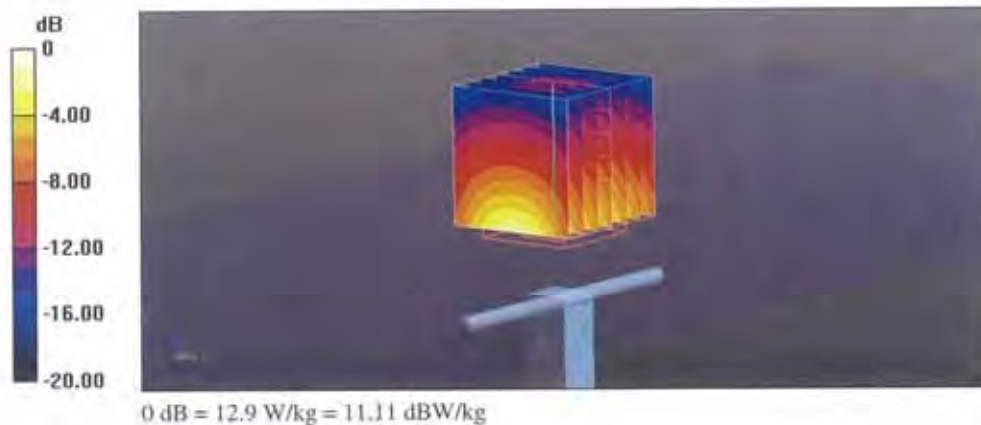
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.22 V/m; Power Drift = -0.01 dB

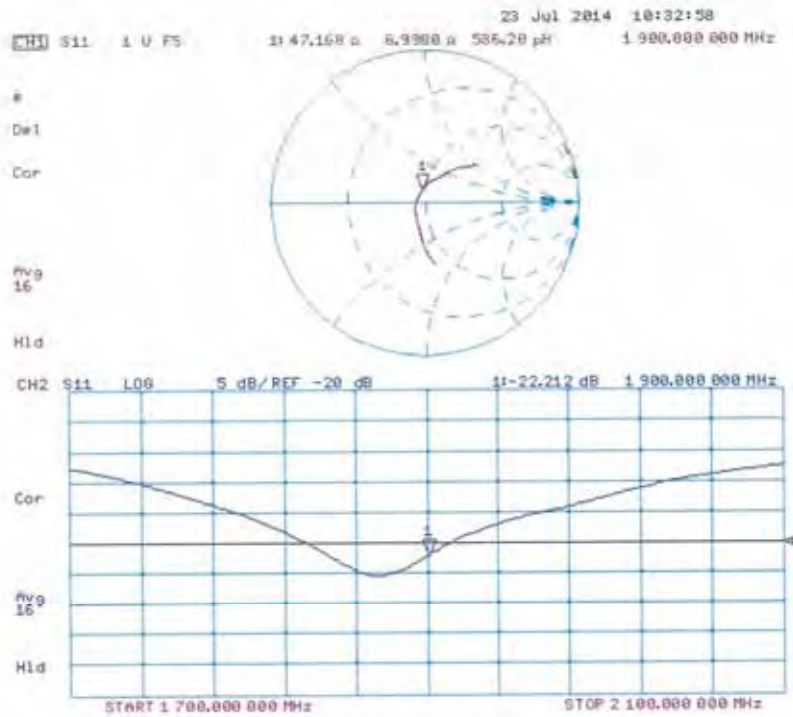
Peak SAR (extrapolated) = 17.8 W/kg

SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.39 W/kg

Maximum value of SAR (measured) = 12.9 W/kg



Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client HCT (Dymstec)

Certificate No: D2450V2-743_Jul14

CALIBRATION CERTIFICATE

Object D2450V2 - SN: 743

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

Calibration date: July 24, 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 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)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15

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

Calibrated by: Name Claudio Leubler Function Laboratory Technician

Approved by: Katja Pokovic Technical Manager

Issued: July 25, 2014

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Certificate No: D2450V2-743_Jul14

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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	V52.8.8
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 %	1.85 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	13.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.2 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	6.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.8 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	13.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	51.3 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	6.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.9 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.2 Ω + 4.5 j Ω
Return Loss	- 25.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.8 Ω + 6.3 j Ω
Return Loss	- 24.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.160 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	December 01, 2003

DASY5 Validation Report for Head TSL

Date: 24.07.2014

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; $\sigma = 1.85$ S/m; $\epsilon_r = 37.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

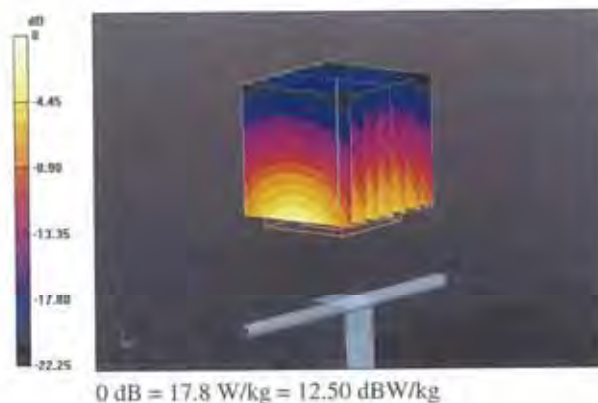
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.3 V/m; Power Drift = 0.01 dB

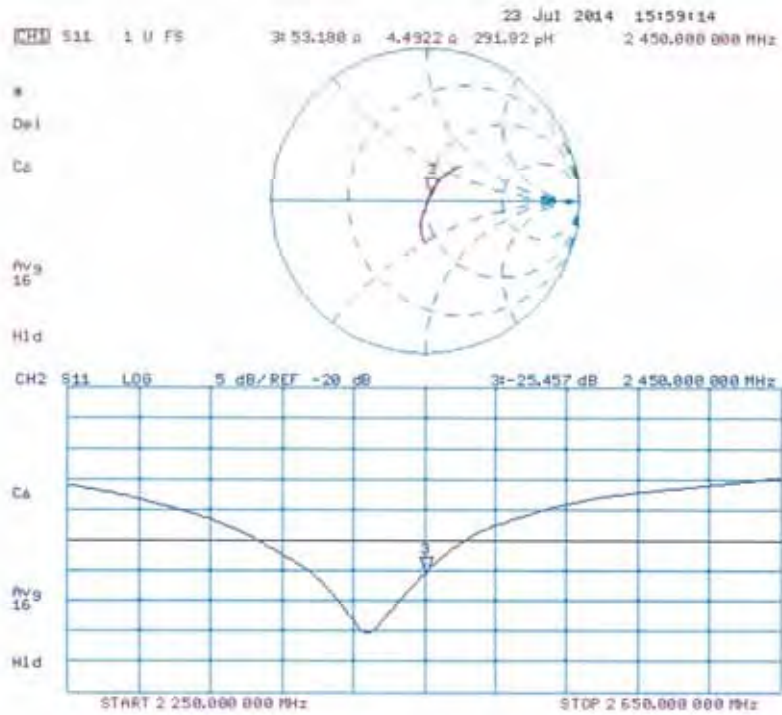
Peak SAR (extrapolated) = 28.0 W/kg

SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.28 W/kg

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



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 16.07.2014

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 C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.35, 4.35, 4.35); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

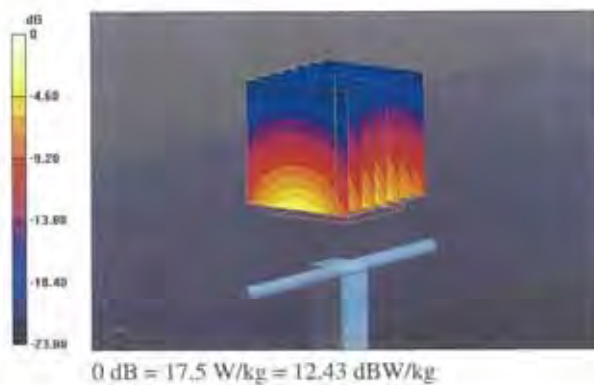
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.80 V/m; Power Drift = -0.01 dB

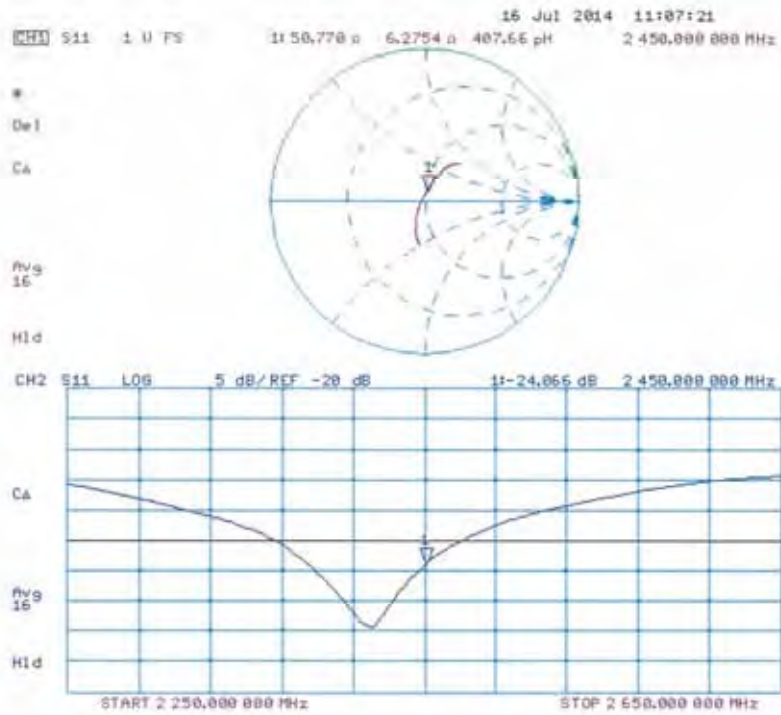
Peak SAR (extrapolated) = 27.7 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.07 W/kg

Maximum value of SAR (measured) = 17.5 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-Nabouq	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 27, 2014

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Certificate No: D5GHzV2-1107_Jan14

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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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"
- 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:

- 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 cm³ (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 cm³ (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 cm³ (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 cm³ (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

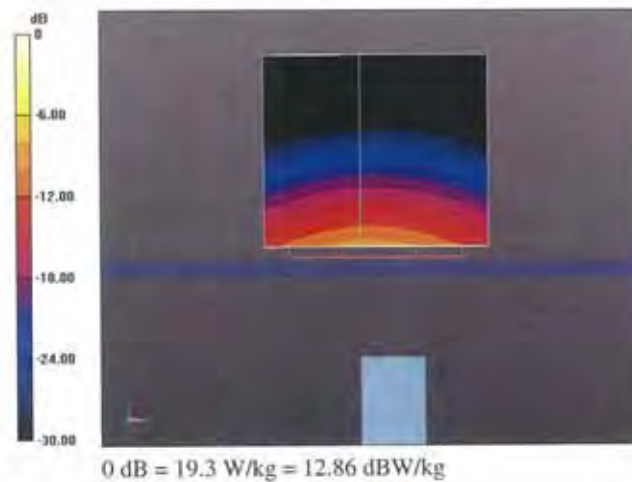
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.499 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 32.9 W/kg
SAR(1 g) = 8.47 W/kg; SAR(10 g) = 2.42 W/kg
Maximum value of SAR (measured) = 19.7 W/kg

Certificate No: D5GHzV2-1107_Jan14

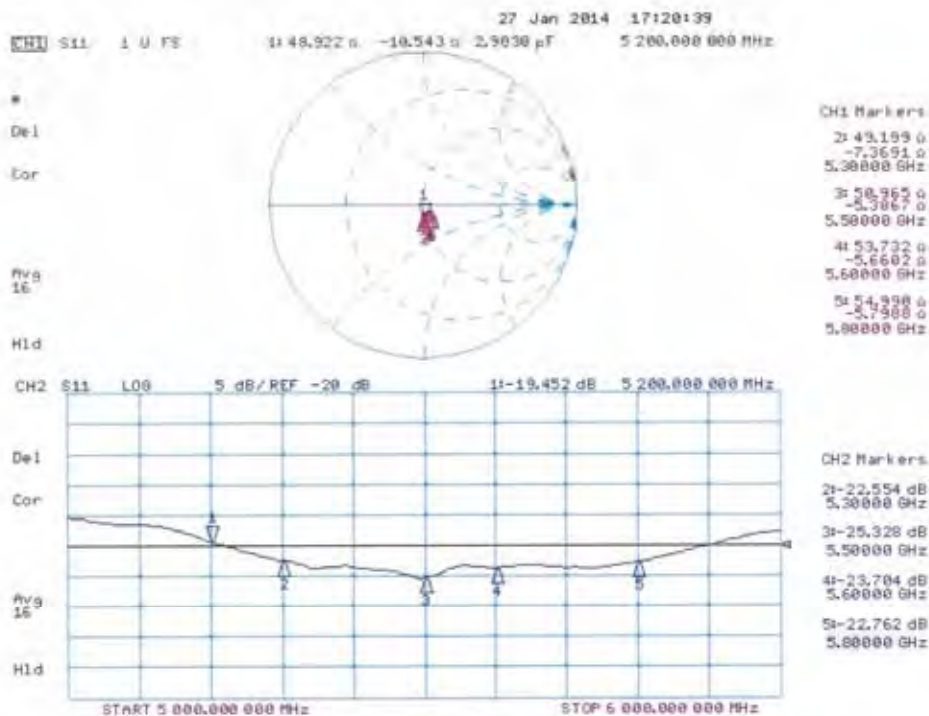
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Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 62.691 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 32.8 W/kg
SAR(1 g) = 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

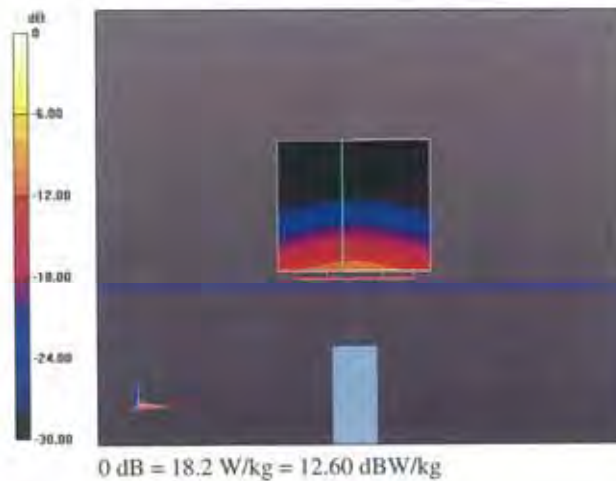
Peak SAR (extrapolated) = 34.3 W/kg

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

