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SAR TEST REPORT

SNPowercom Co., Ltd #805 Anyang K-Center, 25 Simin-daero 248beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, Korea, 431-815	**Date of Issue: July 24, 2015** **Test Report No.: HCT-A-1507-F004-2** **Test Site: HCT CO., LTD.**

FCC ID: 2AAZ7-SW100

Equipment Type:	**Medical Alert Device**
Model Name:	**SW100**
Testing has been carried out in accordance with:	**47CFR §2.1093** **ANSI/ IEEE C95.1 – 1992** **IEEE 1528-2003**
Date of Test:	**July 07, 2015 ~ July 08, 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;	**Reviewer**
Young-Soo Jang **Test Engineer / SAR Team** **Certification Division**	**Dong-Seob Kim** **Technical Manager / SAR Team** **Certification Division**

Revision History

Rev.	Issue DATE	DESCRIPTION
HCT-A-1507-F004	Jul. 15, 2015	Initial Issue
HCT-A-1507-F004-1	Jul. 21, 2015	• Correction Bluetooth LE descrition (Typo) : BT → BT LE : Sec.3, Sec14 was revised. • Revised Sec. 6.3.2. : Revised sepration distance typo (5 mm → 10 mm) : Revised to add additional user usage. (add the descrition of a speaker mode) • Revised Sec. 10.2 : Revised 1900 MHz Target SAR value (Typo) • Add The SAR test exclusion about BT LE : Add the Sec. 11.4 about BT LE SAR Test exclusion.
HCT-A-1507-F004-2	Jul. 24, 2015	• Revised Sec. 3 : Revised Max SAR value (Typo)

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Table of Contents

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 (d*W*) absorbed by (dissipated in) an incremental mass (d*m*) contained in a volume element (d*V*) of a given density (*r*). 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/m^3)

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

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

2. TEST METHODOLOGY

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

- FCC KDB Publication 941225 D01 3G SAR Procedures v03
- 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)
- April 2015 TCB Workshop Notes (Simultaneous transmission summation clarified)
- FCC KDB Publication 447498 D01 General SAR Guidance v05r02

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).

<table>
<tr><td>EUT Type</td><td colspan="5">Medical Alert Device</td></tr>
<tr><td>FCC ID:</td><td colspan="5">2AAZ7-SW100</td></tr>
<tr><td>Model:</td><td colspan="5">SW100</td></tr>
<tr><td>Trade Name:</td><td colspan="5">SNPowercom Co., Ltd</td></tr>
<tr><td>Application Type:</td><td colspan="5">Certification</td></tr>
<tr><td colspan="2">Production Unit or Identical Prototype:</td><td colspan="4">Prototype</td></tr>
<tr><td rowspan="7">Max. SAR:</td><td rowspan="2">Band</td><td>Tx. Frequency</td><td rowspan="2">Equipment Class</td><td colspan="2">Reported 1g SAR (W/Kg)</td></tr>
<tr><td>(MHz)</td><td>Head</td><td>Body</td></tr>
<tr><td>CDMA 835</td><td>824 – 894</td><td>PCE</td><td>0.74</td><td>1.34</td></tr>
<tr><td>PCS 1900</td><td>1 850 -1 990</td><td>PCE</td><td>0.86</td><td>1.25</td></tr>
<tr><td>Bluetooth LE</td><td>2 402 – 2 480</td><td>DSS/DTS</td><td>-</td><td>0.13*</td></tr>
<tr><td colspan="3">Simultaneous SAR per KDB 690783 D01v01r03</td><td>0.86</td><td>1.540</td></tr>
<tr><td>Date(s) of Tests:</td><td colspan="5">July 07, 2015 ~ July 08, 2015</td></tr>
<tr><td>Antenna Type:</td><td colspan="5">Integral Antenna</td></tr>
<tr><td>Key Feature(s)</td><td colspan="5">BT 4.0(LE), NFC, GPS</td></tr>
</table>

* Note :

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

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4. DESCRIPTION OF TEST EQUIPMENT

4.1 SAR MEASUREMENT SETUP

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

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

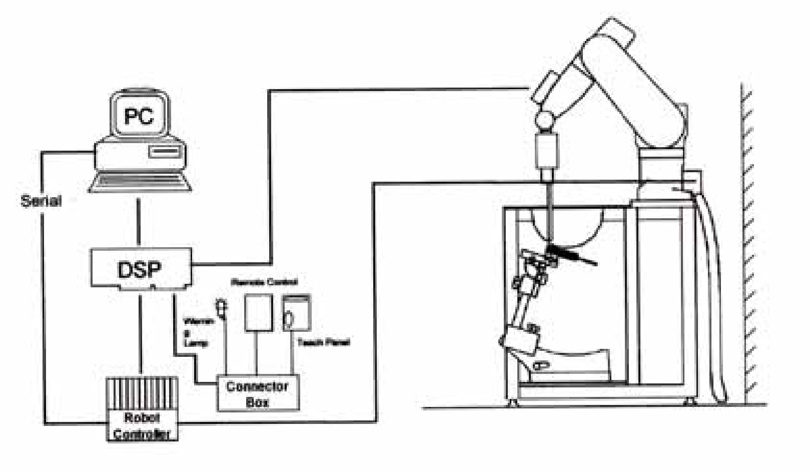

Figure 2. HCT SAR Lab. Test Measurement Set-up

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in.

4.2 DASY E-FIELD PROBE SYSTEM

4.1 ET3DV6 Probe Specification

Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection System Built-in shielding against static charges
Calibration	In air from 10 MHz to 2.5 GHz In brain and muscle simulating tissue at Frequencies of 450 MHz, 900 MHz and 1.8 GHz (accuracy: 8 %)
Frequency	10 MHz to > 2.3 GHz; Linearity: ± 0.2 dB (30 MHz to 2.3 GHz)
Directivity	± 0.2 dB in brain tissue (rotation around probe axis) ± 0.4 dB in brain tissue (rotation normal probe axis)
Dynamic	5 µW/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

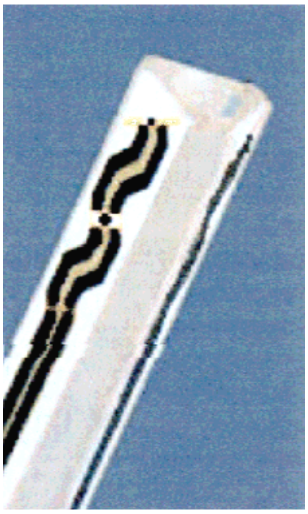

Figure 4. ET3DV6 E-field Probe

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 2^{nd} 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 ± 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 bellow 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/cm³ for brain tissue)

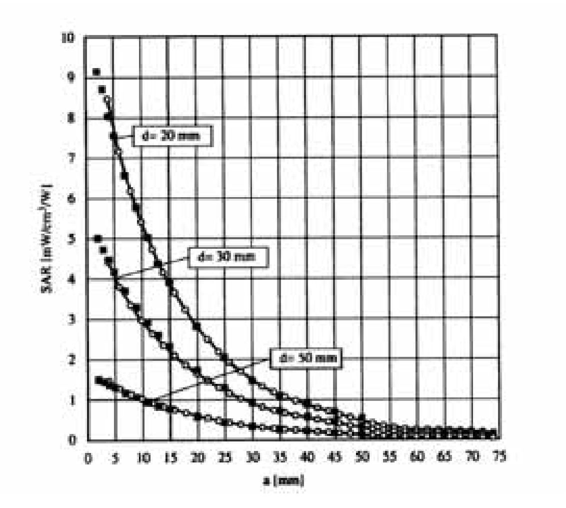

Figure 7. E-Field and Temperature measurements at 900 MHz

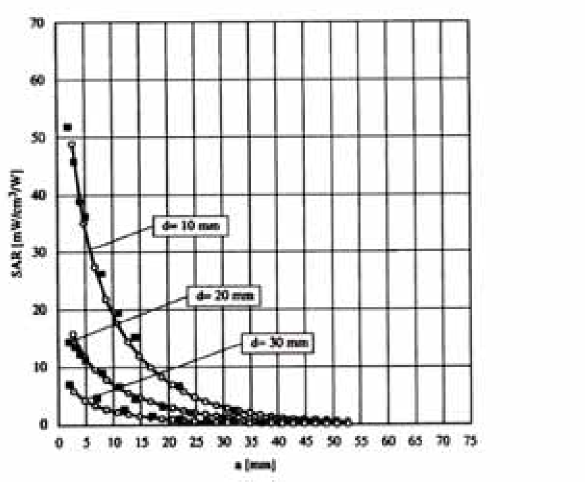

Figure 8. E-Field and temperature measurements at 1.8 GHz

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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;

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

with
V_i = compensated signal of channel i (i=x,y,z)
U_i = input signal of channel i (i=x,y,z)
cf = crest factor of exciting field (DASY parameter)
dcp_i = diode compression poing (DASY parameter)

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

E-field probes:

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

with
V_i = compensated signal of channel i (i=x,y,z)
$Norm_i$ = sensor sensitivity of channel i (i=x,y,z) $\mu V/(V/m)^2$ for E-field probes
$ConvF$ = sensitivity of enhancement in solution
E_i = electric field strength of channel i in V/m

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.

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

with
SAR = local specific absorption rate in W/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

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

$$P_{pwe} = \frac{E_{tot}^2}{3770}$$

with
P_{pwe} = equivalent power density of a plane wave in w/cm^2
E_{tot} = total electric field strength in V/m

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 ± 0.2 mm (6 ± 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 tree 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 ± 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 repeatable positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

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

Figure 11. Device Holder

4.6 Tissue Simulating Mixture Characterization

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

.

Ingredients (% by weight)	Frequency (MHz)			
	835		1 900	
Tissue Type	Head	Body	Head	Body
Water	40.45	53.06	54.9	70.17
Salt (NaCl)	1.45	0.94	0.18	0.39
Sugar	57.0	44.9	0.0	0
HEC	1.0	1.0	0.0	0
Bactericide	0.1	0.1	0.0	0
Triton X-100	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	44.92	29.44
Diethylene glycol hexyl ether	-	-	-	-

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

Table 4.1 Composition of the Tissue Equivalent Matter

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4.7 SAR TEST EQUIPMENT

Manufacturer	Type / Model	S/N	Calib. Date	alib.Interval	Calib.Due
SPEAG	SAM Phantom	-	N/A	N/A	N/A
SPEAG	Triple Modular Phantom	-	N/A	N/A	N/A
Staubli	Robot RX90B L	F01/5K09A1/A/01	N/A	N/A	N/A
Staubli	Robot TX90 Lspeag	F13/5R4XF1/A/01	N/A	N/A	N/A
Staubli	Robot ControllerCS7MB	3403-91935	N/A	N/A	N/A
Staubli	Robot Controller 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	265	N/A	N/A	N/A
SPEAG	Light Alignment Sensor	SE UKS 030 AA	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	D221340.01	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	D21142605	N/A	N/A	N/A
SPEAG	DAE4	652	Mar. 18, 2015	Annual	Mar. 18, 2016
SPEAG	E-Field Probe ET3DV6	1609	Jan. 27, 2015	Annual	Jan. 28, 2016
SPEAG	Dipole D835V2	441	Jan. 23, 2015	Annual	Jan. 23, 2016
SPEAG	Dipole D1900V2	5d032	May 20, 2015	Annual	May 20, 2016
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
SPEAG	DAKS 3.5	1038	May 26, 2015	Annual	May 26, 2016
HP	Dual Directional Coupler 778D	16072	Oct. 27, 2014	Annual	Oct. 27, 2015
Agilent	Base Station E5515C	GB44400269	Feb. 09, 2015	Annual	Feb. 09, 2016
HP	Signal Generator 8664A	3744A02069	Oct. 27, 2014	Annual	Oct. 27, 2015
Agilent	N9020A/ SIGNAL ANALYZER	MY50510407	Mar. 23, 2015	Annual	Mar. 23, 2016
HP	Network Analyzer 8753ES	JP39240221	Mar. 23, 2015	Annual	Mar. 23, 2016

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. 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 DAKS 3.5 to determine the conductivity and permittivity (dielectric constant) of the brain/body-equivalent material.

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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.

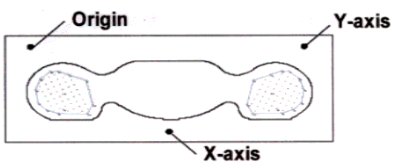

Figure 12. SAR Measurement Point in Area Scan

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 hightest E-field value to determine the averaged SASR-distribution over 10g.
Area scan and zoom scan resolution setting follow KDB 865664 D01v01r03 quoted below

<table>
<tr><td colspan="3"></td><td>$\leq$ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>$\leq$ 2 GHz: $\leq$ 15 mm
2 – 3 GHz: $\leq$ 12 mm</td><td>3 – 4 GHz: $\leq$ 12 mm
4 – 6 GHz: $\leq$ 10 mm</td></tr>
<tr><td colspan="2">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.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>$\leq$ 2 GHz: $\leq$ 8 mm
2 – 3 GHz: $\leq$ 5 mm*</td><td>3 – 4 GHz: $\leq$ 5 mm*
4 – 6 GHz: $\leq$ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm
4 – 5 GHz: $\leq$ 3 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm
4 – 5 GHz: $\leq$ 2.5 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\geq$ 30 mm</td><td>3 – 4 GHz: $\geq$ 28 mm
4 – 5 GHz: $\geq$ 25 mm
5 – 6 GHz: $\geq$ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

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 15º or until the device antenna touch the phantom. Please refer to IEEE 1528-2003 illustration below.

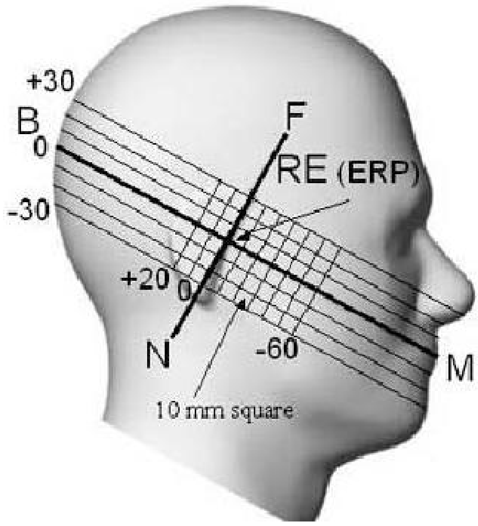

Figure 13. Side view of the phantom

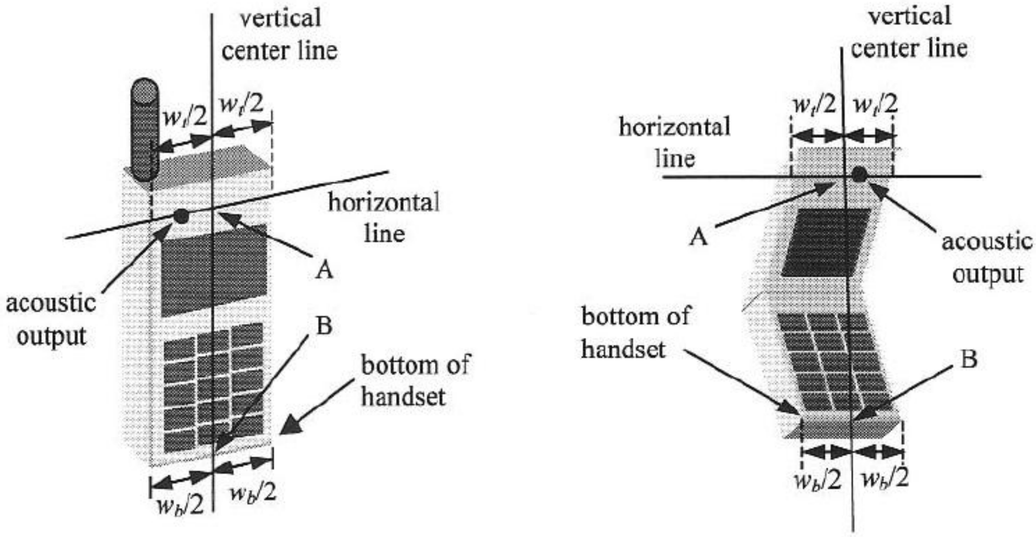

Figure 14. Handset vertical and horizontal reference lines

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 anybody worn accessory to the end user a distance of 0.5 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 Test Configurations

According to KDB 447498, the device was tested with the supplied 2 accessories against the flat phantom.

Accessory;

1. Lanyard: The device cannot be swiveled or reversed with this accessory.
2. Belt-clip

The EUT was tested in following configurations;

6.3.1 Necklace Type (Lanyard): Rear side of the EUT with Lanyard was tested with 5 mm gap against the flat phantom.

6.3.2 Belt Clip Type

A : Rear side of the EUT with Belt-clip accessory was tested with 0 cm gap against the flat phantom.

B : Front side of the EUT with Belt-clip accessory was tested with 10 mm gap against the flat phantom with Head Tissue. (The device can operate on speaker mode.)

6.4 Sides for SAR Testing Configurations

Mode	Rear	Front	Left	Right	Bottom	Top
CDMA835	Yes	Yes	No	No	No	No
PCS1900	Yes	Yes	No	No	No	No

7. MEASUREMENT UNCERTAINTY

Error Description	Tol (± %)	Prob. dist.	Div.	c_i	Standard Uncertainty (± %)	v_{eff}
1. Measurement System						
Probe Calibration	6.00	N	1	1	6.00	∞
Axial Isotropy	4.70	R	1.73	0.7	1.90	∞
Hemispherical Isotropy	9.60	R	1.73	0.7	3.88	∞
Boundary Effects	1.00	R	1.73	1	0.58	∞
Linearity	4.70	R	1.73	1	2.71	∞
System Detection Limits	1.00	R	1.73	1	0.58	∞
Readout Electronics	0.30	N	1.00	1	0.30	∞
Response Time	0.8	R	1.73	1	0.46	∞
Integration Time	2.6	R	1.73	1	1.50	∞
RF Ambient Conditions	3.00	R	1.73	1	1.73	∞
Probe Positioner	0.40	R	1.73	1	0.23	∞
Probe Positioning	2.90	R	1.73	1	1.67	∞
Max SAR Eval	1.00	R	1.73	1	0.58	∞
2.Test Sample Related						
Device Positioning	2.90	N	1.00	1	2.90	145
Device Holder	3.60	N	1.00	1	3.60	5
Power Drift	5.00	R	1.73	1	2.89	∞
3.Phantom and Setup						
Phantom Uncertainty	4.00	R	1.73	1	2.31	∞
Liquid Conductivity(target)	5.00	R	1.73	0.64	1.85	∞
Liquid Conductivity(meas.)	2.50	N	1	0.64	1.60	∞
Liquid Permitivity(target)	5.00	R	1.73	0.6	1.73	∞
Liquid Permitivity(meas.)	2.50	N	1	0.6	1.50	∞
Combind Standard Uncertainty					10.85	
Coverage Factor for 95 %					k=2	
Expanded STD Uncertainty					21.70	

Table 7.1 Uncertainty (750 MHz- 2 450 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
2	1609	ET3DV6	Head	835	441	2015.02.06	41.6	0.89	PASS	PASS	PASS	GMSK	PASS	N/A
2	1609	ET3DV6	Body	835	441	2015.02.06	55.4	0.97	PASS	PASS	PASS	GMSK	PASS	N/A
2	1609	ET3DV6	Head	1900	5d032	2015.05.28	40.1	1.39	PASS	PASS	PASS	GMSK	PASS	N/A
2	1609	ET3DV6	Body	1900	5d032	2015.05.29	52.4	1.51	PASS	PASS	PASS	GMSK	PASS	N/A

SAR System Validation Summary

Note;

All measurement were performed using probes calibrated for CW signal only. Modulations in the table bove 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 [%]
820	July 08, 2015	1609	441	Head	20.5	ε r	41.578	40.510	- 2.57	± 5
						σ	0.899	0.9071	+ 0.90	± 5
835						ε r	41.5	40.329	- 2.82	± 5
						σ	0.90	0.917	+ 1.89	± 5
850						ε r	41.500	40.19	- 3.16	± 5
						σ	0.916	0.9346	+ 2.03	± 5
820	July 08, 2015		441	Body	20.5	ε r	55.258	56.790	+ 2.77	± 5
						σ	0.969	0.9341	- 3.60	± 5
835						ε r	55.2	56.663	+ 2.65	± 5
						σ	0.97	0.949	- 2.16	± 5
850						ε r	55.154	56.47	+ 2.39	± 5
						σ	0.988	0.9638	- 2.45	± 5
1850	July 07, 2015		5d032	Head	21.2	ε r	40.000	40.32	+ 0.80	± 5
						σ	1.400	1.379	- 1.50	± 5
1 900						ε r	40.0	40.148	+ 0.37	± 5
						σ	1.40	1.429	+ 2.07	± 5
1910						ε r	40.000	40.14	+ 0.35	± 5
						σ	1.400	1.436	+ 2.57	± 5
1850	July 07, 2015		5d032	Body	21.2	ε r	53.300	55.12	+ 3.41	± 5
						σ	1.520	1.487	- 2.17	± 5
1 900						ε r	53.3	54.960	+ 3.11	± 5
						σ	1.52	1.540	+ 1.32	± 5
1910						ε r	53.300	55	+ 3.19	± 5
						σ	1.520	1.553	+ 2.17	± 5

NOTE:
The Head /body simulating material is calibrated by HCT using the DAKS 3.5 to determine the conductivity and permittivity

10.2 System Verification

Prior to assessment, the system is verified to the ± 10 % of the specifications at 835 MHz / 1 900 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	Jul. 08, 2015	1609	441	Head	20.7	20.5	9.21	0.911	9.11	- 1.09	± 10
835	Jul. 08, 2015	1609		Body	20.7	20.5	9.34	0.904	9.04	- 3.21	± 10
1 900	Jul. 07, 2015	1609	5d032	Head	21.4	21.2	41.1	3.940	39.4	-4.14	± 10
1 900	Jul. 07, 2015	1609		Body	21.4	21.2	40.9	3.920	39.2	-4.16	± 10

10.3 System Verification Procedure

SAR measurement was prior to assessment, the system is verified to the ± 10 % of the specifications at each frequency band by using the system Verification kit. (Graphic Plots Attached)
- Cabling the system, using the Verification kit equipment.
- 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 then 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.

CDMA & PCS

-Max. Target Power

CDMA : 24dBm

US-PCS : 23.5dBm

-Tolerance : Max. Target Power -0.5dB ~ +0.5dB

BT LE.

Power Class	Maximum Output Power	Nominal Output Power	Power Control
Class 2	2.82mW (+4.5dBm)	1mW (0dBm)	-20dBm~ +4.5dBm

11.2 CDMA

11.2.1 Output Power Verification

See 3GPP2 C.S0011/TIA-98-E as recommended by "SAR Measurement Procedures for 3G Devices", May 2006. MMaximum output power is verified on the High, Middle and Low channels according to procedures defined in section 4.4.5.2 of 3GPP2 C.S0011/TIA-98-E. SO55 tests were measured with power control bits in “All Up” condition.

1. If the mobile station supports Reverse TCH RC 1 and Forward TCH RC 1, set up a call using Fundamental Channel Test Mode 1 (RC=1/1) with 9 600 bps data rate only.
2. Under RC1, C.S0011 Table 4.4.5.2-1 (Table 9.1) parameters were applied.
3. If the MS supports the RC 3 Reverse FCH, RC3 Reverse SCH0 and demodulation of RC 3, 4, or 5, set up a call using Supplemental Channel Test Mode 3 (RC 3/3) with 9 600 bps Fundamental Channel and 9 600 bps SCH0 data rate Channel and 9 600 bps SCH0 data rate.
4. Under RC3, C.S0011 Table 4.4.5.2-2(Table 9.2) was applied.
5. FCHs were configured at full rate for mMaximum SAR with “All Up” power control bits.

Parameters for Max. Power for RC1

Parameter	Units	Value
$\hat{I}_{or}$	dBm/1.23 MHz	-104
Pilot $\frac{E_c}{I_{or}}$	dB	-7
Traffic $\frac{E_c}{I_{or}}$	dB	-7.4

Table. 9.1

Parameters for Max. Power for RC3

Parameter	Units	Value
$\hat{I}_{or}$	dBm/1.23 MHz	-86
Pilot $\frac{E_c}{I_{or}}$	dB	-7
Traffic $\frac{E_c}{I_{or}}$	dB	-7.4

Table. 9.2

11.2.2 Head SAR Measurement

SAR for head exposure configurations is measured in RC3 with the DUT configured to transmit at full rate using Loopback Service Option SO55. SAR for RC1 is not required when the mMaximum average output of each channel is less than ¼ dB higher than that measured in RC3. Otherwise, SAR is measured on the mMaximum output channel in RC1 using the exposure configuration that results in the highest SAR for that channel in RC3.

11.2.3 Body SAR Measurement

SAR for body exposure configurations is measured in RC3 with the DUT configured to transmit at full rate on FCH with all other code channels disabled using TDSO / SO32. SAR for multiple code channels (FCH + SCHn) is not required when the mMaximum average output of each RF channel is less than ¼ dB higher than that measured with FCH only. Otherwise, SAR is measured on the mMaximum output channel (FCH + SCHn) with FCH at full rate and SCH0 enabled at 9 600 bps using the exposure configuration that results in the highest SAR for that channel with FCH only. When multiple code channels are enabled, the DUT output may shift by more than 0.5 dB and lead to higher SAR drifts and SCH dropouts.

Body SAR in RC1 is not required when the mMaximum average output of each channel is less than ¼ dB higher than that measured in RC3. Otherwise, SAR is measured on the mMaximum output channel in RC1; with Loopback Service Option SO55, at full rate, using the body exposure configuration that results in the highest SAR for that channel in RC3.

Band	Channel	SO2	SO2	SO55	SO55
		RC1/1 (dBm)	RC3/3 (dBm)	RC1/1 (dBm)	RC3/3 (dBm)
CDMA	1013	24.26	24.27	24.27	24.28
	384	24.22	24.16	24.24	24.25
	777	24.21	24.18	24.22	24.23
PCS	25	23.64	23.58	23.66	23.68
	600	23.64	23.54	23.64	23.67
	1175	23.42	23.34	23.51	23.54

CDMA Avergae Conducted output powers (dBm)

11.3 BT LE

11.3.1 Peak Conducted Output Power

LE Mode			
Frequency[MHz]	Channel No.	Measured Power(dBm)	Limit(dBm)
2402	0	3.685	30
2440	19	4.006	30
2480	39	4.259	30

11.3.2 Averaged-conducted Output Power

LE Mode					
Frequency [MHz]	Channel	Measured Power(dBm)	Duty Cycle Factor	Measured Power(dBm) + Duty Cycle Factor	Limit(dBm)
2402	0	1.903	1.67	3.576	30
2440	19	2.330	1.67	4.003	30
2480	39	2.538	1.67	4.211	30

11.4 SAR Test Exclusions Applied

11.4.1 BT LE

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

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

Mode	Frequency	Maximum Allowed Power	Separation Distance	≤ 3.0
	[MHz]	[mW]	[mm]	
Bluetooth LE	2 480	3	5	0.94

Based on the maximum conducted power of Bluetooth LE and antenna to use separation distance, Bluetooth LE SAR was not required [(3/5)*√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.

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

. Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[mW]	[mm]	[W/kg]
Bluetooth LE	2 480	3	5	0.13

Note :

1) Held-to ear configurations are not applicable to Bluetooth and Bluetooth LE 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 and Bluetooth LE using for estimated SAR was selected highest channel of Bluetooth LE for highest estimated SAR.

12. SAR TEST DATA SUMMARY

12.1-1 Measurement Results (CDMA 835 Head SAR)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Battery	Phantom Position	Separation Distance	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No.
MHz	Ch.		Tune-Up Limit	Conducted Power								
836.52	384	CDMA 835	24.5	24.25	-0.00	Standard	Front	10 mm	**0.744**	1.059	0.788	1
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Head 1.6 W/kg (mW/g) Averaged over 1 gram					

12.1-2 Measurement Results (PCS 1900 Head SAR)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Battery	Phantom Position	Separation Distance	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No.
MHz	Ch.		Tune-Up Limit	Conducted Power								
1 851.25	25	PCS 1900	24.0	23.68	-0.13	Standard	Front	10 mm	**0.863**	1.076	0.929	2
1 880.0	600		24.0	23.67	-0.10	Standard	Front	10 mm	0.770	1.079	0.831	-
1 908.75	1175		24.0	23.54	0.00	Standard	Front	10 mm	0.673	1.112	0.748	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Head 1.6 W/kg (mW/g) Averaged over 1 gram					

12.2-1 Measurement Results (CDMA 835 Body SAR)

Frequency MHz	Frequency Ch.	Mode	Power (dBm) Tune-Up Limit	Power (dBm) Conducted Power	Power Drift (dB)	Configuration	Separation Distance	Measured SAR(mW/g)	Scaling Factor	Scaled SAR(mW/g)	Plot No.
824.70	1013	CDMA 835	24.5	24.28	0.09	Rear clip Touch	0 mm	**1.240**	1.052	1.304	3
836.52	384		24.5	24.25	0.05	Rear clip Touch	0 mm	1.030	1.059	1.091	-
848.31	777		24.5	24.23	0.19	Rear clip Touch	0 mm	0.804	1.064	0.856	-
824.70	1013		24.5	24.28	-0.04	Front	5 mm	**1.340**	1.052	1.410	4
836.52	384		24.5	24.25	-0.03	Front	5 mm	1.170	1.059	1.239	-
848.31	777		24.5	24.23	-0.04	Front	5 mm	0.835	1.064	0.889	-
824.70	1013		24.5	24.28	0.04	Rear	5 mm	1.210	1.052	1.273	-
836.52	384		24.5	24.25	0.05	Rear	5 mm	1.080	1.059	1.144	-
848.31	777		24.5	24.23	-0.07	Rear	5 mm	0.792	1.064	0.843	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 1.6 W/kg (mW/g) Averaged over 1 gram				

12. 2-2 Measurement Results (PCS 1900 Body SAR)

Frequency MHz	Frequency Ch.	Mode	Power (dBm) Tune-Up Limit	Power (dBm) Conducted Power	Power Drift (dB)	Configuration	Separation Distance	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No.
1 851.25	25	PCS 1900	24.0	23.68	-0.15	Rear clip Touch	0 mm	**1.250**	1.076	1.346	5
1 880.0	600		24.0	23.67	0.05	Rear clip Touch	0 mm	1.080	1.079	1.165	-
1 908.75	1175		24.0	23.54	0.00	Rear clip Touch	0 mm	0.949	1.112	1.055	-
1 851.25	25		24.0	23.68	-0.03	Front	5 mm	**1.190**	1.076	1.281	6
1 880.0	600		24.0	23.67	-0.03	Front	5 mm	1.030	1.079	1.111	-
1 908.75	1175		24.0	23.54	-0.07	Front	5 mm	0.922	1.112	1.025	-
1 851.25	25		24.0	23.68	-0.13	Rear	5 mm	1.000	1.076	1.076	-
1 880.0	600		24.0	23.67	0.04	Rear	5 mm	0.851	1.079	0.918	-
1 908.75	1175		24.0	23.54	0.03	Rear	5 mm	0.725	1.112	0.806	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 1.6 W/kg (mW/g) Averaged over 1 gram				

12.3 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 5 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.

CDMA/PCS Test Notes:

1. Head SAR was tested under RC3/SO55
2. Body SAR was tested under RC3/SO32.
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 required test channels is 1/2 dB, instead of the middle channel, the highest output power channel must be used.

13. SAR Measurement Variability and Uncertainty

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

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.

3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10 % from the 1-g SAR limit).

4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Frequency		Modulation	Battery	Configuration	Original SAR (mW/g)	Repeated SAR (mW/g)	Largest to Smallest SAR Ratio	Plot No.
MHz	Channel							
824.7	1013	CDMA835	Standard	Front	1.340	1.32	1.015	7
1 851.25	25	PCS1900	Standard	Rear	1.250	1.20	1.042	8

14. SAR Summation Scenario

According to FCC KDB 447498 D01v05r02, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the EUT are shown below paths and are mode in same rectangle to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.

Simultaneous transmission paths

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB 447498 D01v05r02.

Applicable Combination	Head	Body-Worn
CDMA835 + 2.4 GHz Bluetooth LE	N/A	Yes
PCS1900+ 2.4 GHz Bluetooth LE	N/A	Yes

1. All licensed modes share the same antenna path and cannot transmit simultaneously.
2. The highest reported SAR for each exposure condition is used for SAR summation purpose.

14.1 Simultaneous Transmission Summation for Body

Simultaneous Transmission Summation with Bluetooth LE (5 mm)

Band	Scaled SAR	Estimated BT LE SAR	∑ 1-g SAR
	(W/kg)	(W/kg)	(W/kg)
CDMA835	1.410	0.13	1.540
PCS1900	1.346	0.13	1.476

Note:
* Bluetooth SAR was not required to be measured per FCC KDB 447498. Estimated SAR results were used for SAR summation for body-worn back side at 5 mm to determine simultaneous transmission SAR test exclusion.

15. CONCLUSION

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

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

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Attachment 1. – SAR Test Plots

Test Laboratory: HCT CO., LTD
EUT Type: Medical Alert Device
Liquid Temperature: 20.5 ℃
Ambient Temperature: 20.7 ℃
Test Date: Jul. 08, 2015
Plot No. 1

DUT: SW100; Type: Bar

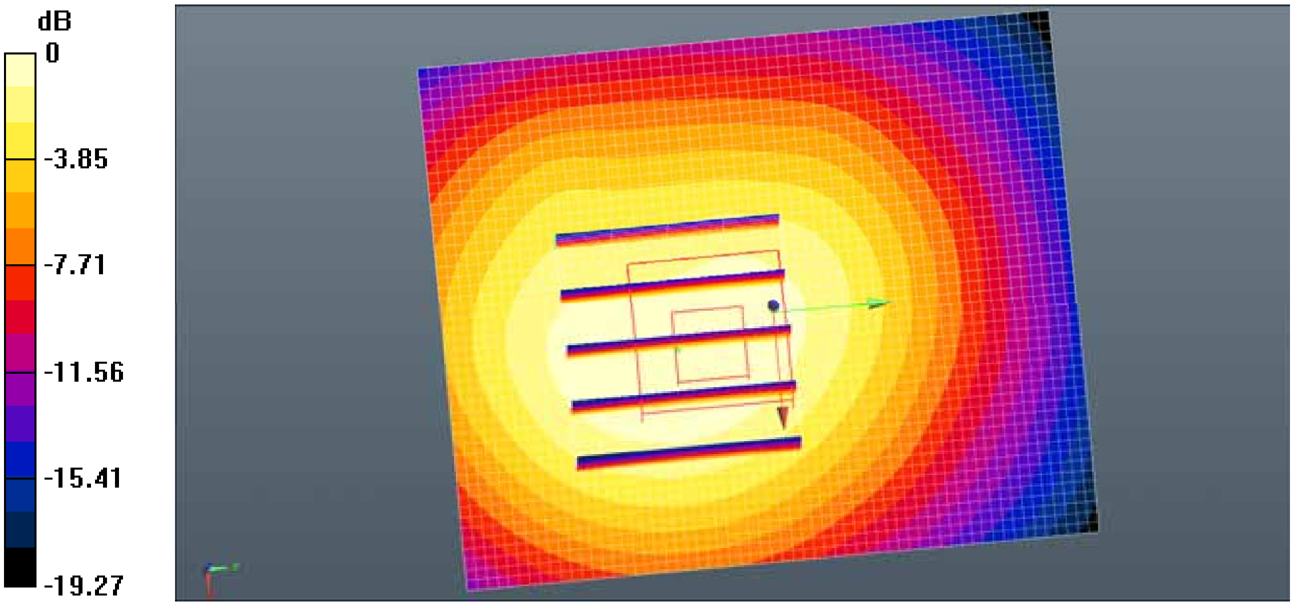
Communication System: UID 0, CDMA 835MHz FCC (0); Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 836.52 MHz; σ = 0.918 S/m; ε_r = 40.317; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ET3DV6 - SN1609; ConvF(6.45, 6.45, 6.45); Calibrated: 2015-01-27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2015-03-18
- Phantom: SAM with CRP v5.0_L
- Measurement SW: DASY52, Version 52.8 (8);

SW100/CDMA835 Head Front 384/Area Scan (51x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.805 W/kg

SW100/CDMA835 Head Front 384/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 29.13 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 1.08 W/kg
SAR(1 g) = 0.744 W/kg; SAR(10 g) = 0.486 W/kg
Maximum value of SAR (measured) = 0.799 W/kg



0 dB = 0.805 W/kg = -0.94 dBW/kg

Test Laboratory: HCT CO., LTD
EUT Type: Medical Alert Device
Liquid Temperature: 21.2 ℃
Ambient Temperature: 21.4 ℃
Test Date: Jul. 07, 2015
Plot No. 2

DUT: SW100; Type: Bar

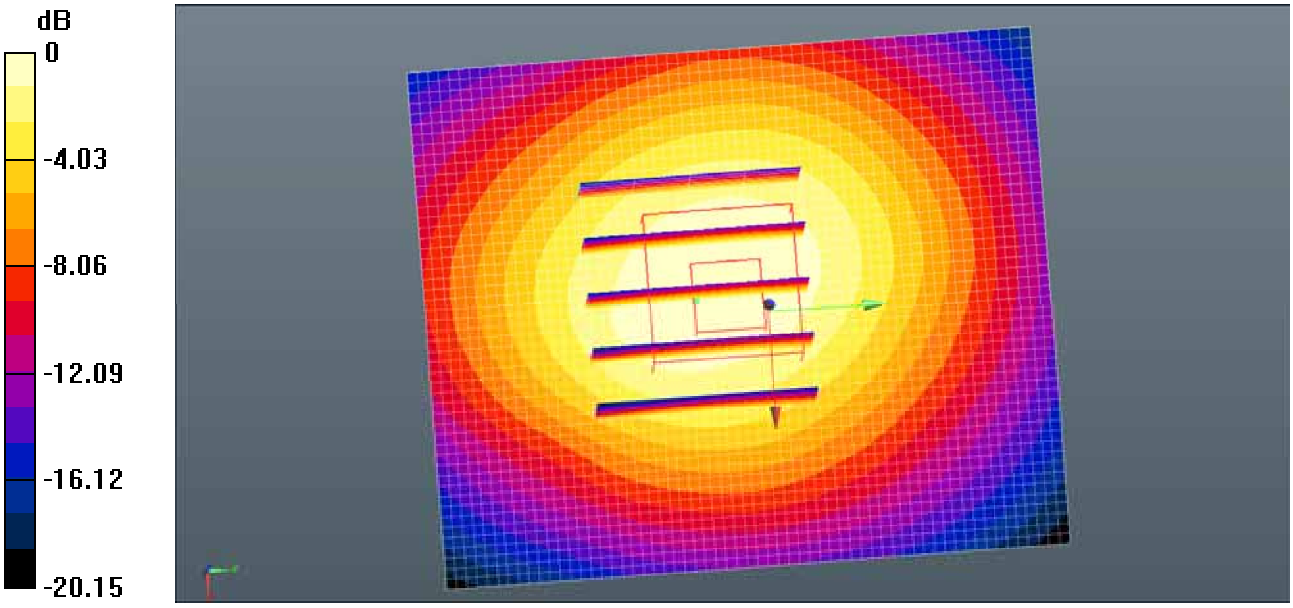
Communication System: UID 0, PCS 1900MHz FCC (0); Frequency: 1851.25 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1851.25 MHz; σ = 1.38 S/m; ε_r = 40.311; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ET3DV6 - SN1609; ConvF(5.18, 5.18, 5.18); Calibrated: 2015-01-27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2015-03-18
- Phantom: SAM with CRP v5.0_R
- Measurement SW: DASY52, Version 52.8 (8);

SW100/PCS1900 Head Front 25/Area Scan (51x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.993 W/kg

SW100/PCS1900 Head Front 25/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 28.35 V/m; Power Drift = -0.13 dB
Peak SAR (extrapolated) = 1.32 W/kg
SAR(1 g) = 0.863 W/kg; SAR(10 g) = 0.533 W/kg
Maximum value of SAR (measured) = 0.919 W/kg



0 dB = 0.993 W/kg = -0.03 dBW/kg

Test Laboratory: HCT CO., LTD
EUT Type: Medical Alert Device
Liquid Temperature: 20.5 ℃
Ambient Temperature: 20.7 ℃
Test Date: Jul. 08, 2015
Plot No. 3

DUT: SW100; Type: Bar

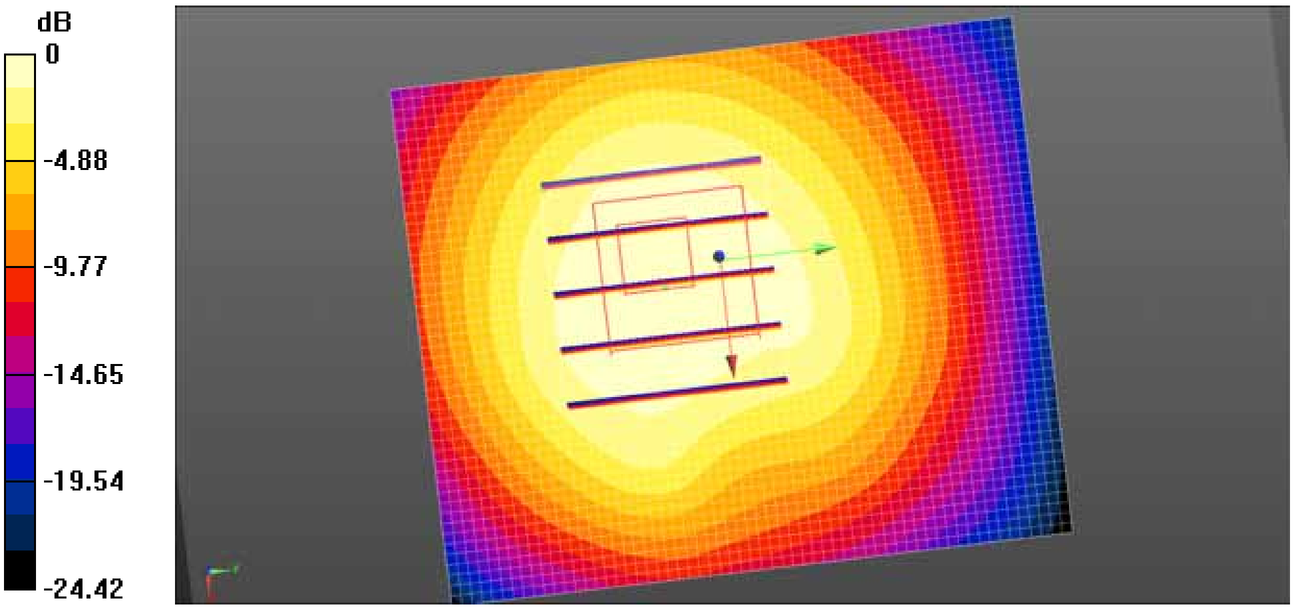
Communication System: UID 0, CDMA 835MHz FCC (0); Frequency: 824.7 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 824.7 MHz; σ = 0.938 S/m; ε_r = 56.785; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: ET3DV6 - SN1609; ConvF(6.35, 6.35, 6.35); Calibrated: 2015-01-27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2015-03-18
- Phantom: Triple Flat Phantom 5.1C-2014-02-21
- Measurement SW: DASY52, Version 52.8 (8);

SW100/CDMA835 Body Rear 1013/Area Scan (51x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.39 W/kg

SW100/CDMA835 Body Rear 1013/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 37.48 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 1.94 W/kg
SAR(1 g) = 1.24 W/kg; SAR(10 g) = 0.817 W/kg
Maximum value of SAR (measured) = 1.30 W/kg



0 dB = 1.39 W/kg = 1.42 dBW/kg

Test Laboratory: HCT CO., LTD
EUT Type: Medical Alert Device
Liquid Temperature: 20.5 ℃
Ambient Temperature: 20.7 ℃
Test Date: Jul. 08, 2015
Plot No. 4

DUT: SW100; Type: Bar

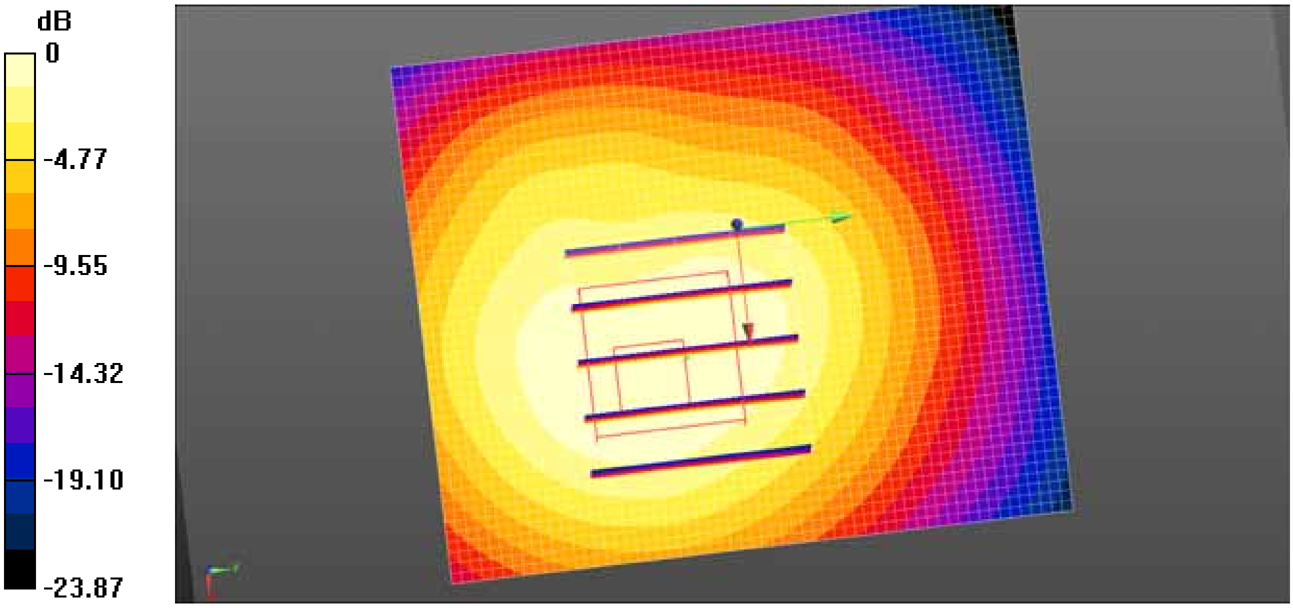
Communication System: UID 0, CDMA 835MHz FCC (0); Frequency: 824.7 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 824.7 MHz; σ = 0.938 S/m; ε_r = 56.785; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: ET3DV6 - SN1609; ConvF(6.35, 6.35, 6.35); Calibrated: 2015-01-27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2015-03-18
- Phantom: Triple Flat Phantom 5.1C-2014-02-21
- Measurement SW: DASY52, Version 52.8 (8);

SW100/CDMA835 Body 5mm Front 1013/Area Scan (51x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.41 W/kg

SW100/CDMA835 Body 5mm Front 1013/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 35.70 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 2.04 W/kg
SAR(1 g) = 1.34 W/kg; SAR(10 g) = 0.861 W/kg
Maximum value of SAR (measured) = 1.42 W/kg



0 dB = 1.41 W/kg = 1.49 dBW/kg

Test Laboratory: HCT CO., LTD
EUT Type: Medical Alert Device
Liquid Temperature: 21.2 ℃
Ambient Temperature: 21.4 ℃
Test Date: Jul. 07, 2015
Plot No. 5

DUT: SW100; Type: Bar

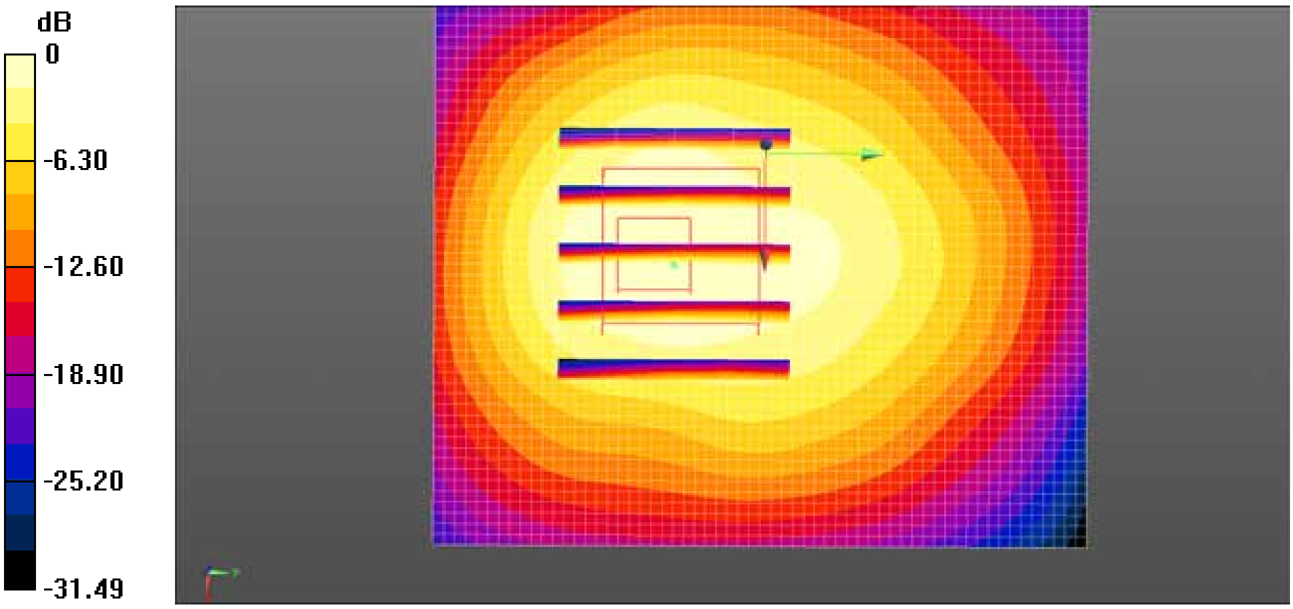
Communication System: UID 0, PCS 1900MHz FCC (0); Frequency: 1851.25 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1851.25 MHz; σ = 1.488 S/m; ε_r = 55.118; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: ET3DV6 - SN1609; ConvF(4.74, 4.74, 4.74); Calibrated: 2015-01-27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2015-03-18
- Phantom: Triple Flat Phantom 5.1C-2014-02-21
- Measurement SW: DASY52, Version 52.8 (8);

SW100/PCS1900 Body Rear 25/Area Scan (51x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.46 W/kg

SW100/PCS1900 Body Rear 25/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 28.76 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 1.89 W/kg
SAR(1 g) = 1.25 W/kg; SAR(10 g) = 0.774 W/kg
Maximum value of SAR (measured) = 1.32 W/kg



0 dB = 1.46 W/kg = 1.65 dBW/kg

Test Laboratory: HCT CO., LTD
EUT Type: Medical Alert Device
Liquid Temperature: 21.2 ℃
Ambient Temperature: 21.4 ℃
Test Date: Jul. 07, 2015
Plot No. 6

DUT: SW100; Type: Bar

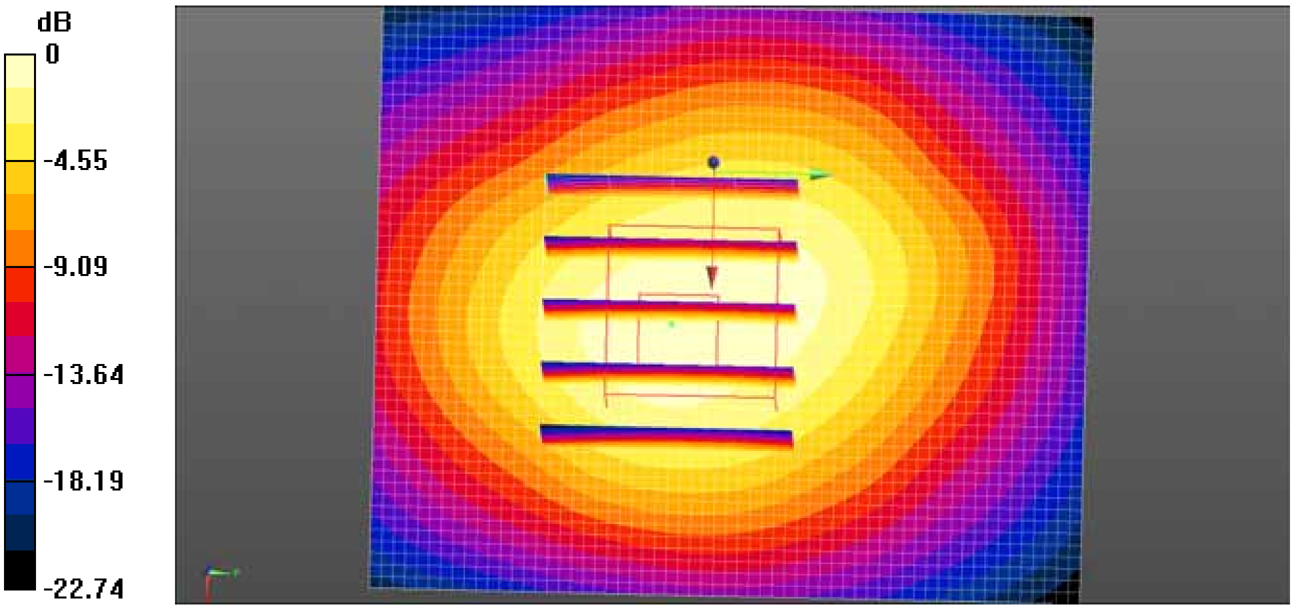
Communication System: UID 0, PCS 1900MHz FCC (0); Frequency: 1851.25 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1851.25 MHz; σ = 1.488 S/m; ε_r = 55.118; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: ET3DV6 - SN1609; ConvF(4.74, 4.74, 4.74); Calibrated: 2015-01-27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2015-03-18
- Phantom: Triple Flat Phantom 5.1C-2014-02-21
- Measurement SW: DASY52, Version 52.8 (8);

SW100/PCS1900 Body 5mm Front 25/Area Scan (51x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.54 W/kg

SW100/PCS1900 Body 5mm Front 25/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 34.31 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 1.89 W/kg
SAR(1 g) = 1.19 W/kg; SAR(10 g) = 0.722 W/kg
Maximum value of SAR (measured) = 1.26 W/kg



0 dB = 1.54 W/kg = 1.88 dBW/kg

Test Laboratory: HCT CO., LTD
EUT Type: Medical Alert Device
Liquid Temperature: 20.5 ℃
Ambient Temperature: 20.7 ℃
Test Date: Jul. 08, 2015
Plot No. 7

DUT: SW100; Type: Bar

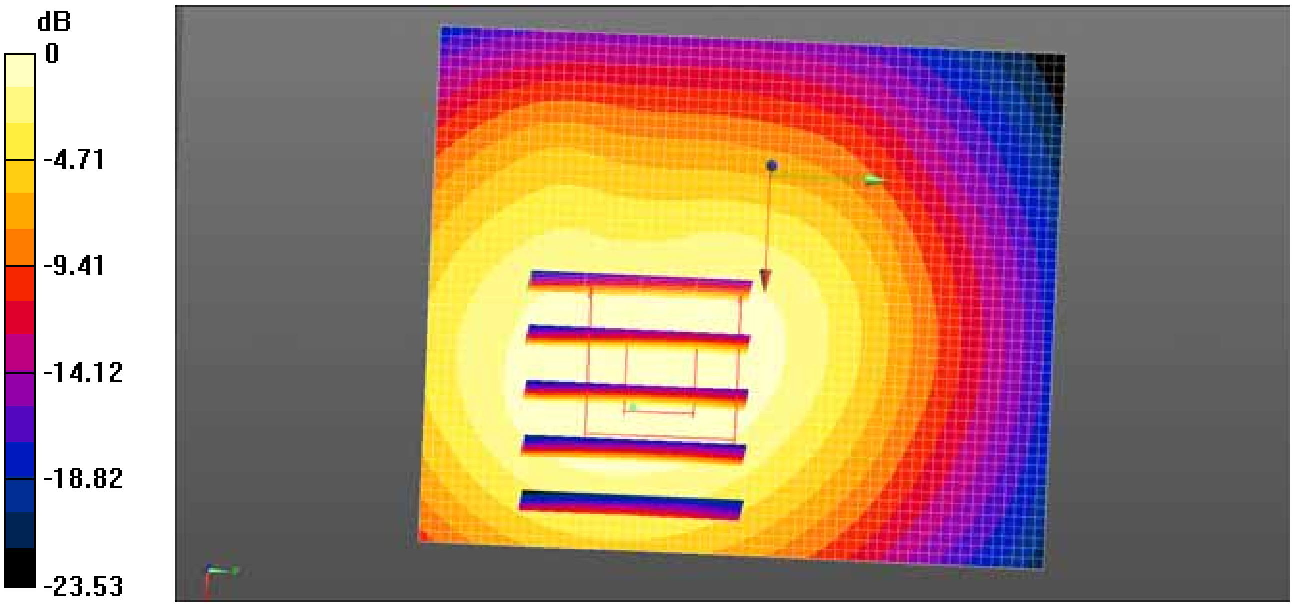
Communication System: UID 0, CDMA 835MHz FCC (0); Frequency: 824.7 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 824.7 MHz; σ = 0.938 S/m; ε_r = 56.785; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: ET3DV6 - SN1609; ConvF(6.35, 6.35, 6.35); Calibrated: 2015-01-27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2015-03-18
- Phantom: Triple Flat Phantom 5.1C-2014-02-21
- Measurement SW: DASY52, Version 52.8 (8);

SW100/CDMA835 Body 5mm Front 1013/Area Scan (51x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.39 W/kg

SW100/CDMA835 Body 5mm Front 1013/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 34.55 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 1.75 W/kg
SAR(1 g) = 1.32 W/kg; SAR(10 g) = 0.932 W/kg
Maximum value of SAR (measured) = 1.40 W/kg



0 dB = 1.39 W/kg = 1.44 dBW/kg

Test Laboratory: HCT CO., LTD
EUT Type: Medical Alert Device
Liquid Temperature: 21.2 ℃
Ambient Temperature: 21.4 ℃
Test Date: Jul. 07, 2015
Plot No. 8

DUT: SW100; Type: Bar

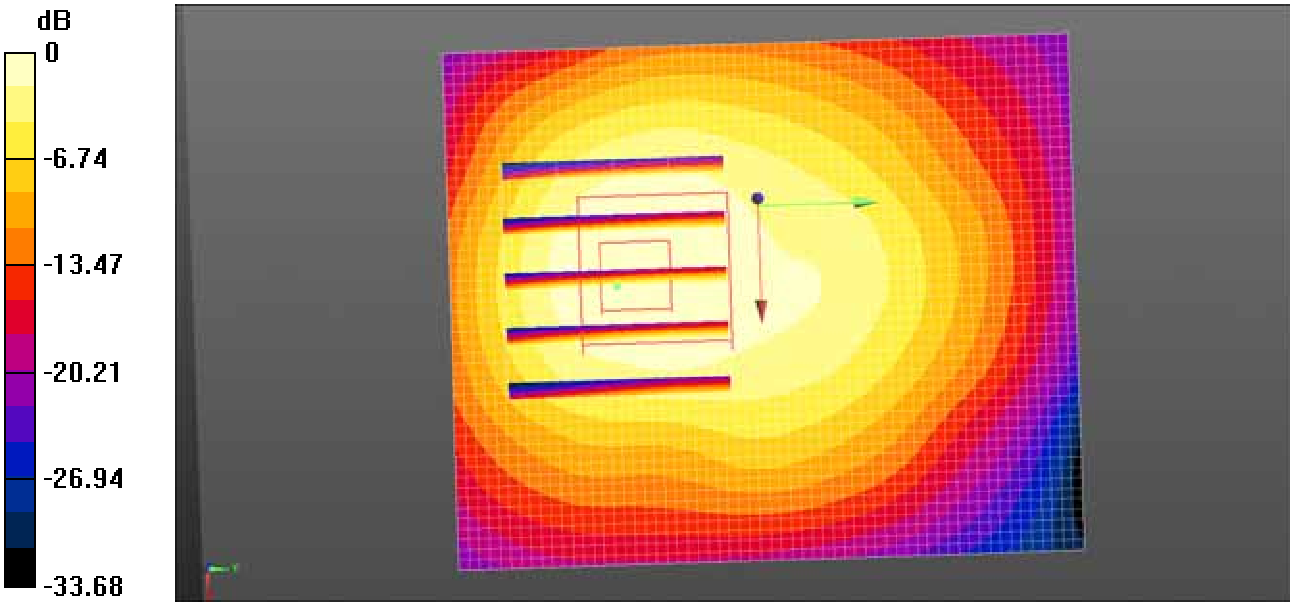
Communication System: UID 0, PCS 1900MHz FCC (0); Frequency: 1851.25 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1851.25 MHz; σ = 1.488 S/m; ε_r = 55.118; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: ET3DV6 - SN1609; ConvF(4.74, 4.74, 4.74); Calibrated: 2015-01-27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2015-03-18
- Phantom: Triple Flat Phantom 5.1C-2014-02-21
- Measurement SW: DASY52, Version 52.8 (8);

SW100/PCS1900 Body Rear 25/Area Scan (51x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.35 W/kg

SW100/PCS1900 Body Rear 25/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.99 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 1.94 W/kg
SAR(1 g) = 1.2 W/kg; SAR(10 g) = 0.729 W/kg
Maximum value of SAR (measured) = 1.30 W/kg



0 dB = 1.35 W/kg = 1.30 dBW/kg

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: Jul. 08, 2015

DUT: Dipole 835 MHz D835V2; Type: D835V2

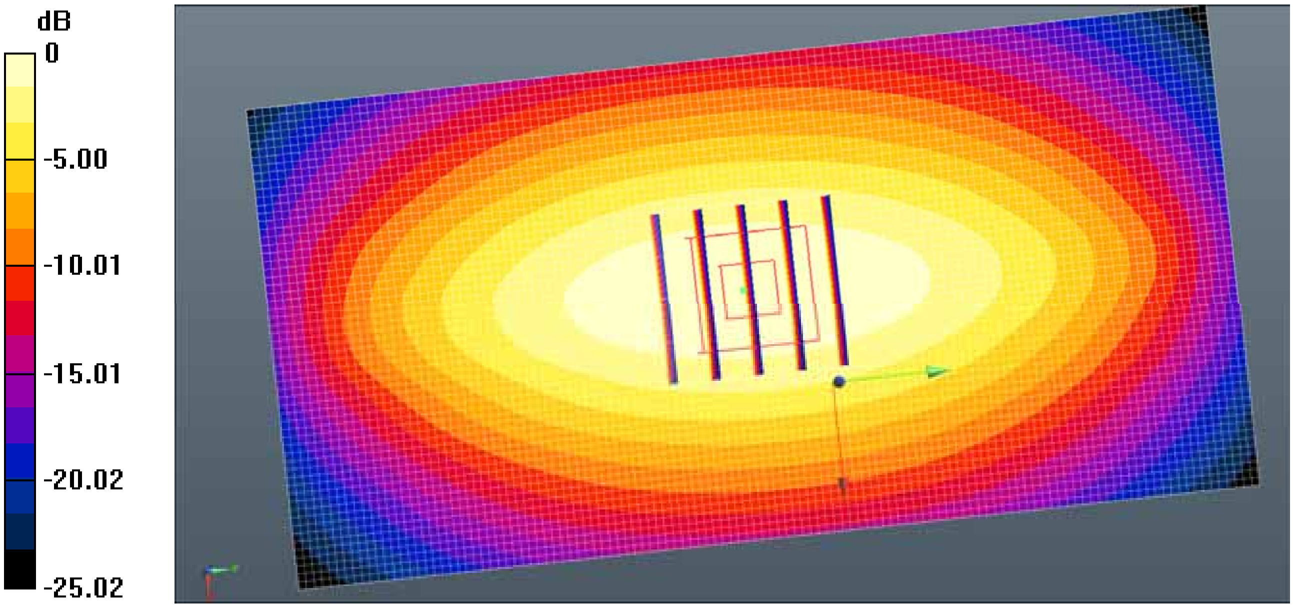
Communication System: UID 0, CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 835 MHz; σ = 0.917 S/m; ε_r = 40.329; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ET3DV6 - SN1609; ConvF(6.45, 6.45, 6.45); Calibrated: 2015-01-27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2015-03-18
- Phantom: SAM with CRP v5.0_Front_20120517
- Measurement SW: DASY52, Version 52.8 (8);

835MHz SAR verification/Area Scan (61x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.982 W/kg

835MHz SAR verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 34.05 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 1.32 W/kg
SAR(1 g) = 0.911 W/kg; SAR(10 g) = 0.600 W/kg
Maximum value of SAR (measured) = 0.983 W/kg



0 dB = 0.982 W/kg = -0.08 dBW/kg

Verification Data (835 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 19.6 ℃
Test Date: Jul. 08, 2015

DUT: Dipole 835 MHz D835V2; Type: D835V2

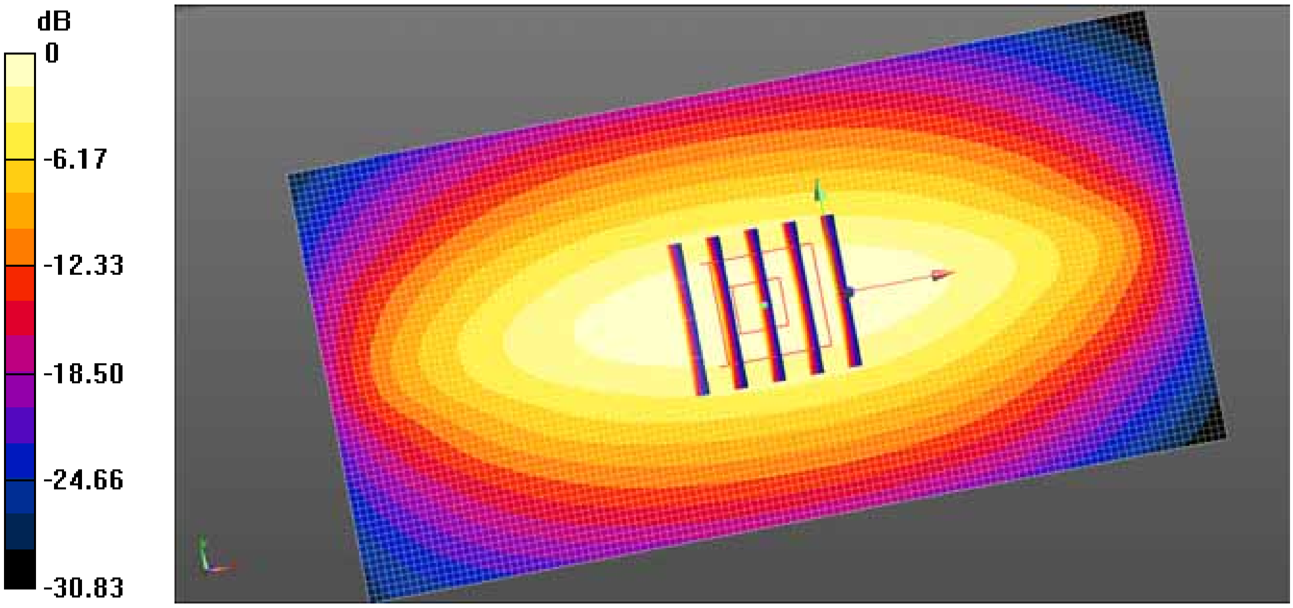
Communication System: UID 0, CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 835 MHz; σ = 0.949 S/m; ε_r = 56.663; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: ET3DV6 - SN1609; ConvF(6.35, 6.35, 6.35); Calibrated: 2015-01-27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2015-03-18
- Phantom: Triple Flat Phantom 5.1C-2014-02-21
- Measurement SW: DASY52, Version 52.8 (8);

835MHz SAR Verification/Area Scan (61x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.995 W/kg

835MHz SAR Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 31.56 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 1.40 W/kg
SAR(1 g) = 0.904 W/kg; SAR(10 g) = 0.567 W/kg
Maximum value of SAR (measured) = 0.992 W/kg



0 dB = 0.995 W/kg = -0.02 dBW/kg

Verification Data (1 900 MHz Head)

Test Laboratory: HCT CO., LTD

Input Power 100 mW (20 dBm)

Liquid Temp: 21.2 ℃

Test Date: Jul. 07, 2015

DUT: Dipole 1900 MHz D1900V2; Type: D1900V2

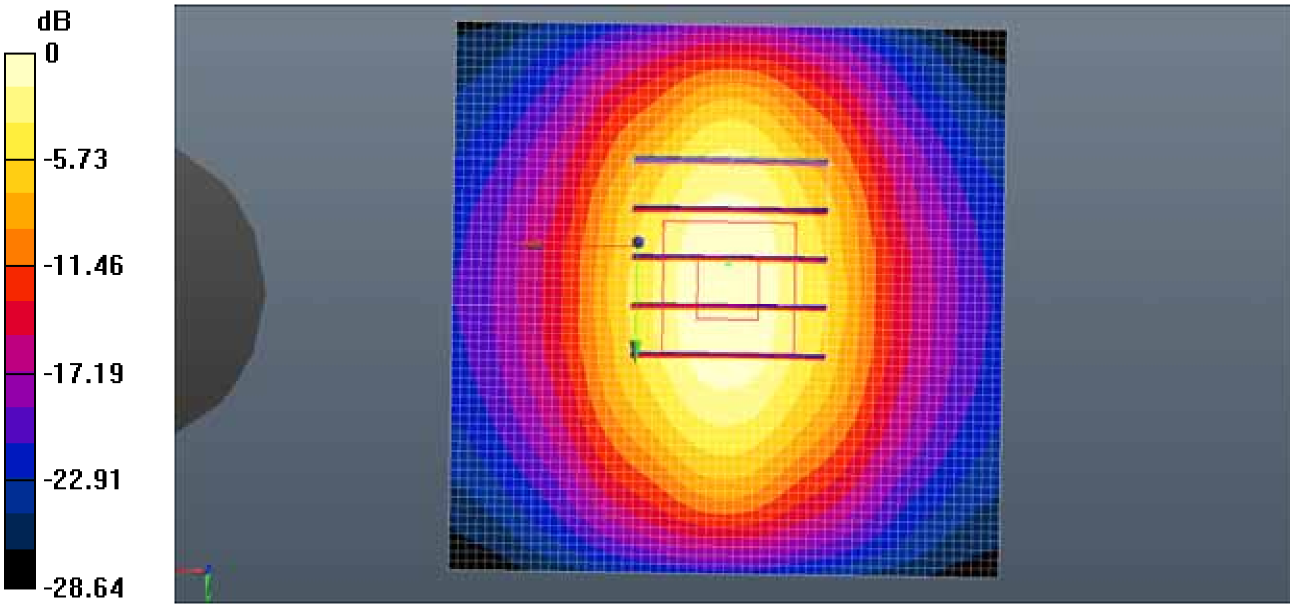
Communication System: UID 0, CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.429 S/m; ε_r = 40.148; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ET3DV6 - SN1609; ConvF(5.18, 5.18, 5.18); Calibrated: 2015-01-27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2015-03-18
- Phantom: SAM with CRP v5.0_Front_20120517
- Measurement SW: DASY52, Version 52.8 (8);

1900MHz SAR Verification/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 4.57 W/kg

1900MHz SAR Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 59.25 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 7.13 W/kg
SAR(1 g) = 3.94 W/kg; SAR(10 g) = 2 W/kg
Maximum value of SAR (measured) = 4.36 W/kg



0 dB = 4.57 W/kg = 6.60 dBW/kg

Verification Data (1 900 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 21.2 ℃
Test Date: Jul. 07, 2015

DUT: Dipole 1900 MHz D1900V2; Type: D1900V2

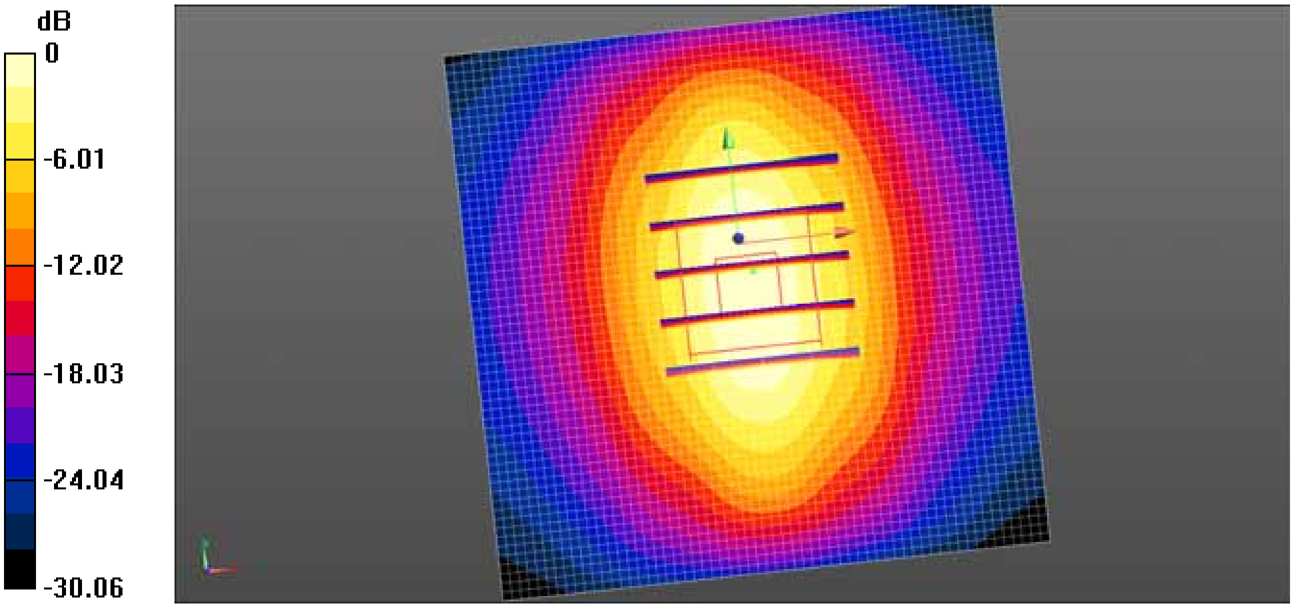
Communication System: UID 0, CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.541 S/m; ε_r = 54.96; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: ET3DV6 - SN1609; ConvF(4.74, 4.74, 4.74); Calibrated: 2015-01-27;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn652; Calibrated: 2015-03-18
- Phantom: Triple Flat Phantom 5.1C-2014-02-21
- Measurement SW: DASY52, Version 52.8 (8);

1900MHz SAR validation/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 4.54 W/kg

1900MHz SAR validation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 57.91 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 6.46 W/kg
SAR(1 g) = 3.92 W/kg; SAR(10 g) = 2.1 W/kg
Maximum value of SAR (measured) = 4.35 W/kg



0 dB = 4.54 W/kg = 6.57 dBW/kg

Attachment 3. – Probe Calibration Data

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

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S Servizio svizzero di taratura
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 0108**

Client **HCT (Dymstec)**

Certificate No: **ET3-1609_Jan15**

CALIBRATION CERTIFICATE

Object: ET3DV6 - SN:1609

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

Calibration date: January 27, 2015

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	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-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
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:	Israe Elnaouq	Laboratory Technician	[signature]
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: January 28, 2015

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

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Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,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., ϑ = 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:

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,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 ≤ 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 *NORMx,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 *NORMx* (no uncertainty required).

Certificate No: ET3-1609_Jan15 Page 2 of 11

Probe ET3DV6

SN:1609

Manufactured: July 27, 2001
Calibrated: January 27, 2015

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

ET3DV6– SN:1609 January 27, 2015

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1609

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	2.00	1.80	1.82	± 10.1 %
DCP (mV)[B]	100.6	100.4	101.2	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	266.1	±3.5 %
		Y	0.0	0.0	1.0		272.1	
		Z	0.0	0.0	1.0		268.9	

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 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.

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ET3DV6– SN:1609 January 27, 2015

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1609

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
835	41.5	0.90	6.45	6.45	6.45	0.29	3.00	± 12.0 %
900	41.5	0.97	6.32	6.32	6.32	0.32	3.00	± 12.0 %
1450	40.5	1.20	5.68	5.68	5.68	0.78	1.88	± 12.0 %
1750	40.1	1.37	5.38	5.38	5.38	0.73	2.10	± 12.0 %
1900	40.0	1.40	5.18	5.18	5.18	0.75	2.17	± 12.0 %
1950	40.0	1.40	5.00	5.00	5.00	0.78	2.22	± 12.0 %
2450	39.2	1.80	4.57	4.57	4.57	0.80	1.73	± 12.0 %

[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.

Certificate No: ET3-1609_Jan15 Page 5 of 11

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1609

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
835	55.2	0.97	6.35	6.35	6.35	0.47	2.05	± 12.0 %
1750	53.4	1.49	4.95	4.95	4.95	0.80	2.40	± 12.0 %
1900	53.3	1.52	4.74	4.74	4.74	0.80	2.34	± 12.0 %
2450	52.7	1.95	4.33	4.33	4.33	0.80	1.29	± 12.0 %

[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.

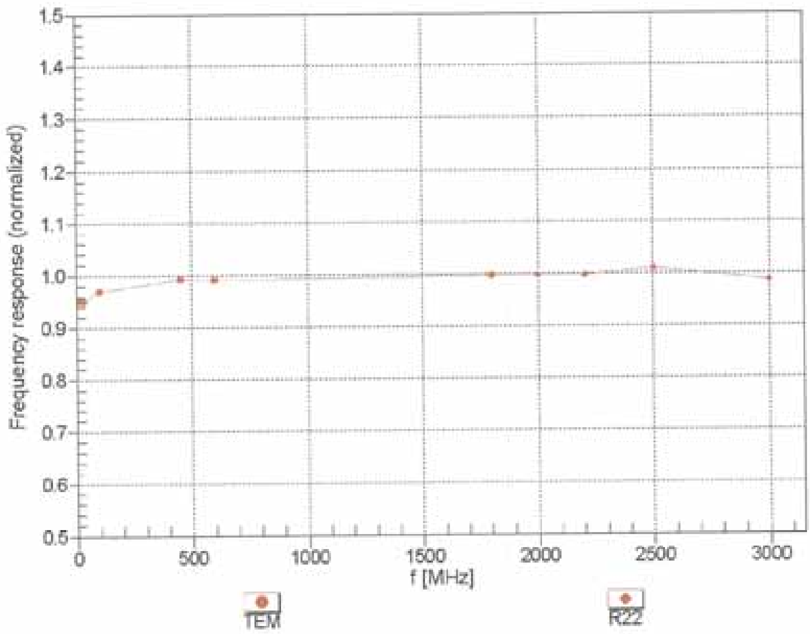
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF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

ET3DV6– SN:1609 January 27, 2015

Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide: R22)

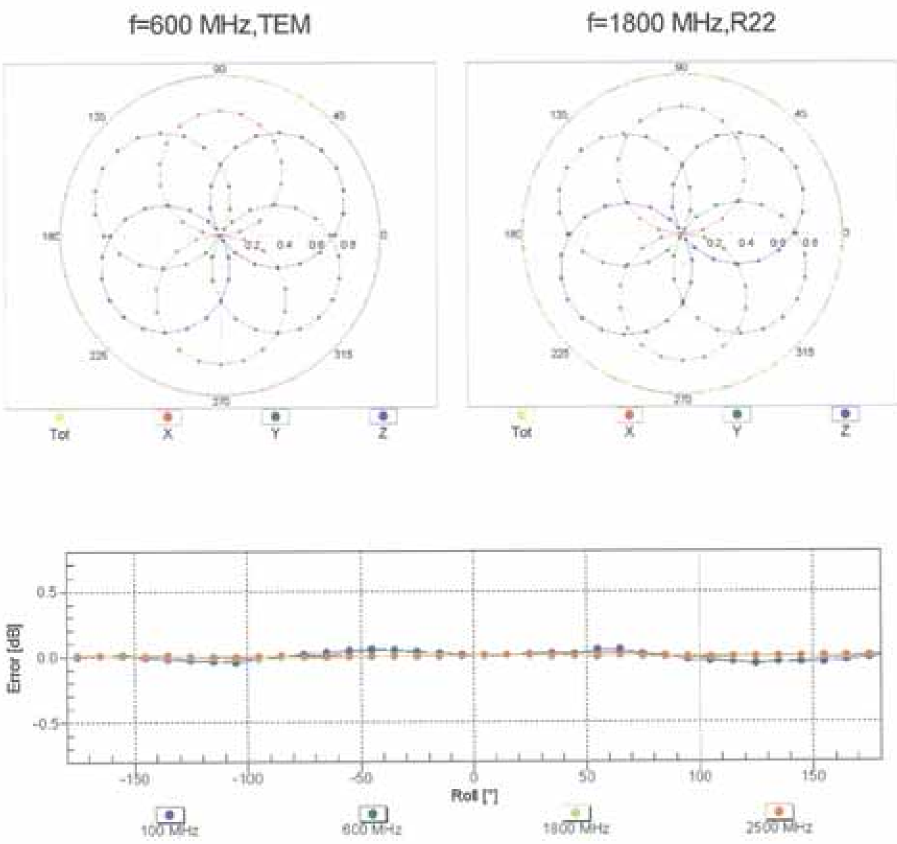


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

HCT CO., LTD.
74, Seoicheon-ro 578 beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea 467-811
TEL: +82 31 645 6300 FAX: +82 31 645 6401

ET3DV6– SN:1609 January 27, 2015

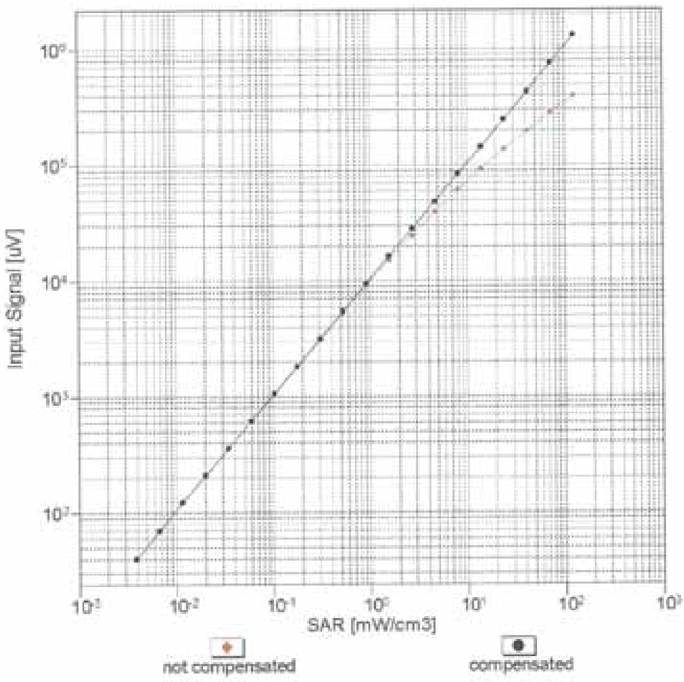
Receiving Pattern (ϕ), ϑ = 0°

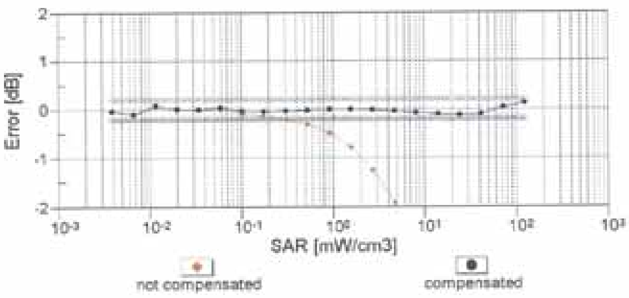


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

ET3DV6– SN:1609 January 27, 2015

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



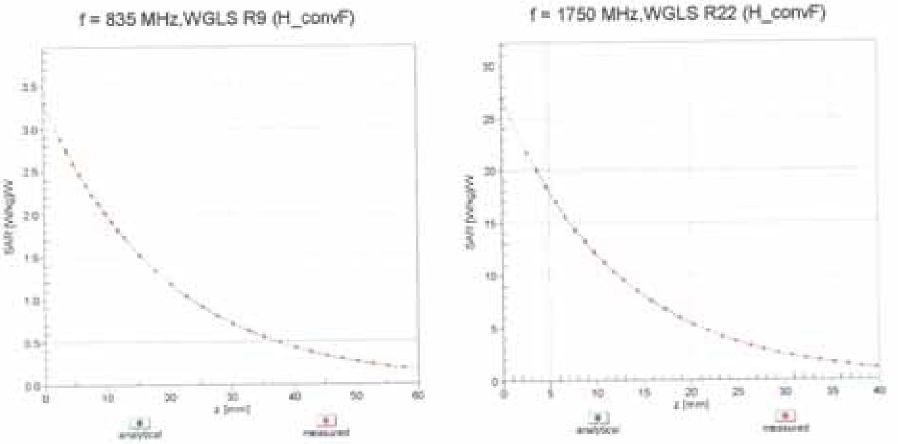


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Certificate No: ET3-1609_Jan15 Page 9 of 11

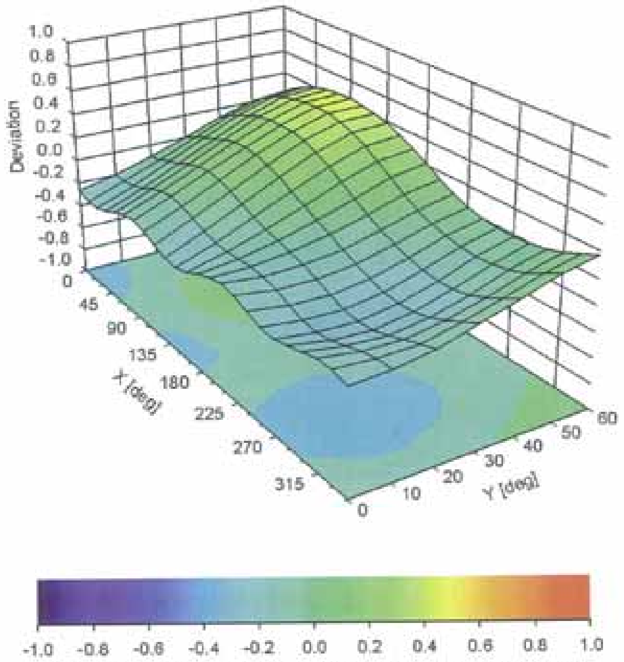
ET3DV6– SN:1609 January 27, 2015

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (φ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

Certificate No: ET3-1609_Jan15 Page 10 of 11

ET3DV6– SN:1609 January 27, 2015

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1609

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-105.1
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

Certificate No: ET3-1609_Jan15 Page 11 of 11

Attachment 4. – Dipole Calibration Data

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

ilac-MRA

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Accreditation No.: SCS 0108

Client **HCT (Dymstec)**

Certificate No: **D835V2-441_Jan15**

CALIBRATION CERTIFICATE

Object: D835V2 - SN: 441

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

Calibration date: January 23, 2015

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

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

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 26, 2015

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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D835V2-441_Jan15 Page 2 of 8

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 ± 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 ± 0.2) °C	41.5 ± 6 %	0.93 mho/m ± 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	**9.21 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.04 W/kg ± 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 ± 0.2) °C	55.8 ± 6 %	1.01 mho/m ± 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	2.40 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.34 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.14 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7 Ω - 1.0 jΩ
Return Loss	- 34.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.2 Ω - 2.7 jΩ
Return Loss	- 27.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.369 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 09, 2001

HCT CO., LTD.
74, Seoicheon-ro 578 beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea 467-811
TEL: +82 31 645 6300 FAX: +82 31 645 6401

DASY5 Validation Report for Head TSL

Date: 22.01.2015

Test Laboratory: SPEAG, Zurich, Switzerland

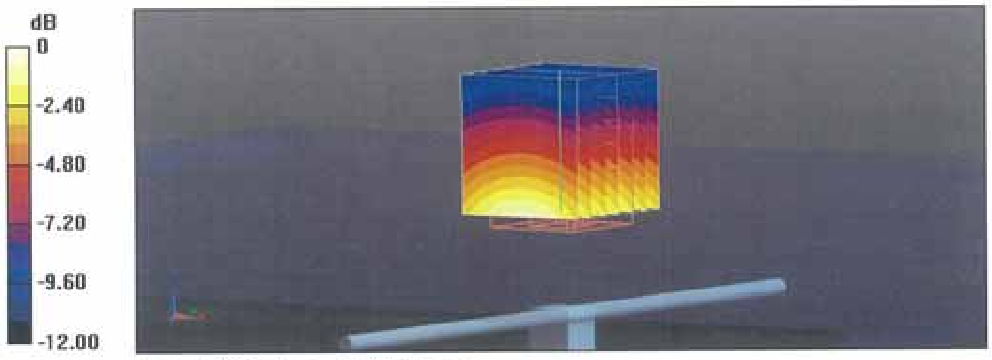
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 441

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.93 S/m; ε_r = 41.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.2, 6.2, 6.2); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

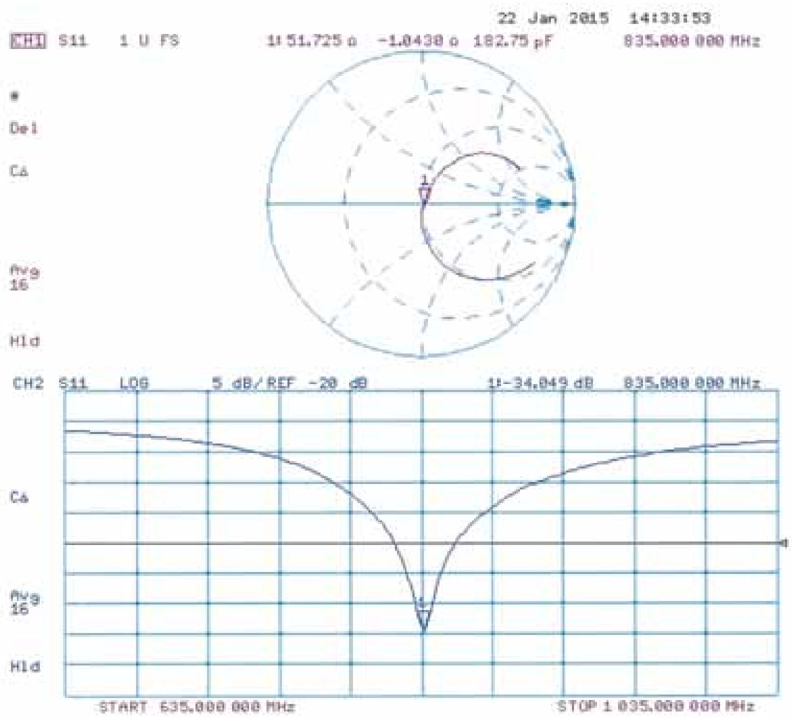
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.43 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 3.49 W/kg
SAR(1 g) = 2.36 W/kg; SAR(10 g) = 1.54 W/kg
Maximum value of SAR (measured) = 2.76 W/kg



0 dB = 2.76 W/kg = 4.41 dBW/kg

Certificate No: D835V2-441_Jan15 Page 5 of 8

Impedance Measurement Plot for Head TSL



Certificate No: D835V2-441_Jan15 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 23.01.2015

Test Laboratory: SPEAG, Zurich, Switzerland

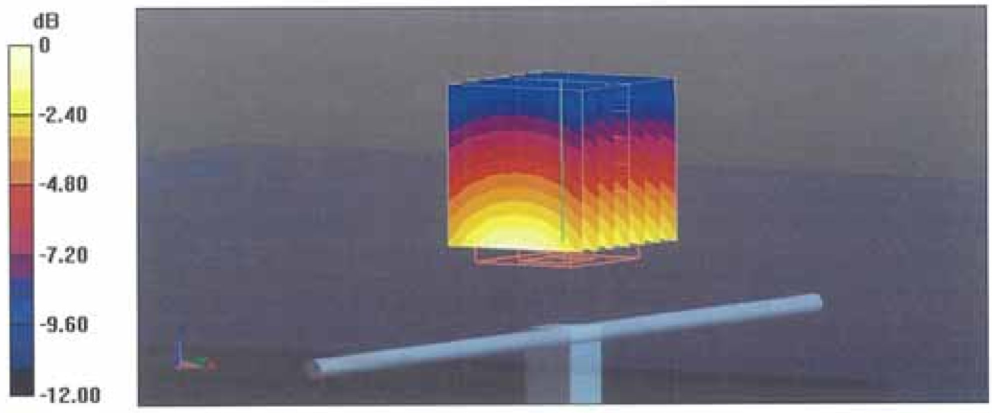
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 441

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.01 S/m; ε_r = 55.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.17, 6.17, 6.17); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.59 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.53 W/kg
SAR(1 g) = 2.4 W/kg; SAR(10 g) = 1.57 W/kg
Maximum value of SAR (measured) = 2.80 W/kg



0 dB = 2.80 W/kg = 4.47 dBW/kg

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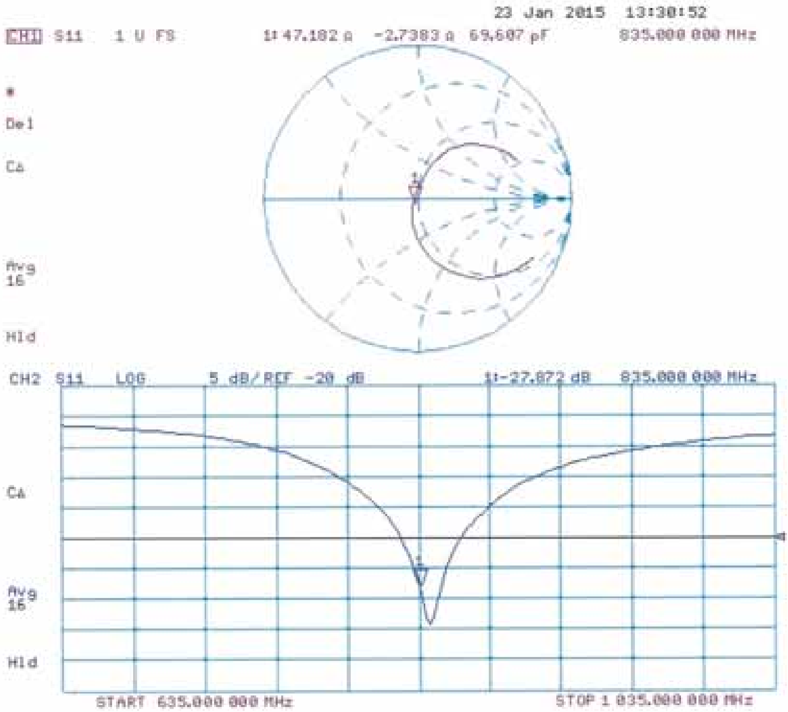
Impedance Measurement Plot for Body TSL



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

ilac-MRA

S **Schweizerischer Kalibrierdienst**
C **Service suisse d'étalonnage**
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Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)**

Certificate No: **D1900V2-5d032_May15**

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d032
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	May 20, 2015

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	[signature]
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: May 20, 2015

Calibration Laboratory of
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Engineering AG
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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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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	1900 MHz ± 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 ± 0.2) °C	38.9 ± 6 %	1.37 mho/m ± 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	10.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**41.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.4 W/kg ± 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 ± 0.2) °C	52.7 ± 6 %	1.51 mho/m ± 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	**40.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.7 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.3 Ω + 5.2 jΩ
Return Loss	- 25.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.4 Ω + 5.5 jΩ
Return Loss	- 24.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.195 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 17, 2003

DASY5 Validation Report for Head TSL

Date: 20.05.2015

Test Laboratory: SPEAG, Zurich, Switzerland

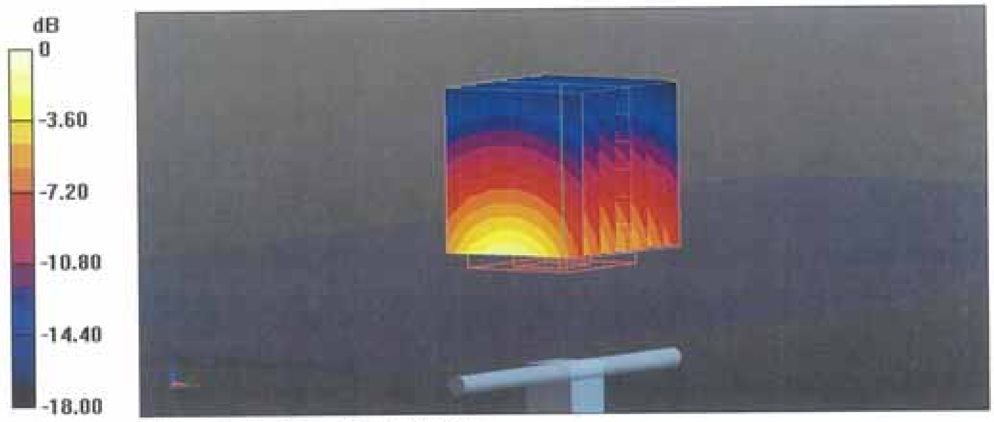
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d032

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.37 S/m; ε_r = 38.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5, 5, 5); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.00 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 18.6 W/kg
SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.33 W/kg
Maximum value of SAR (measured) = 12.7 W/kg



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

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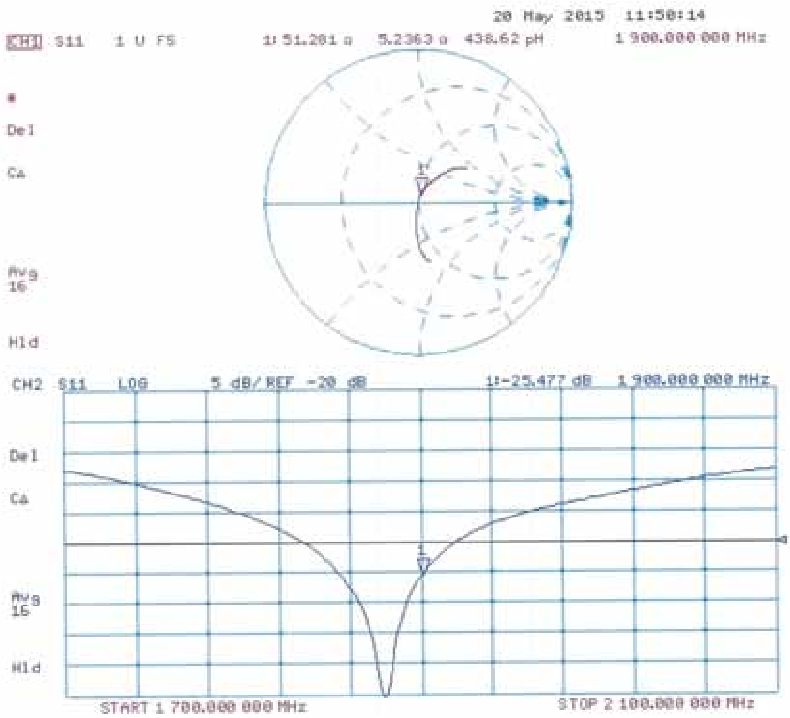
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 20.05.2015

Test Laboratory: SPEAG, Zurich, Switzerland

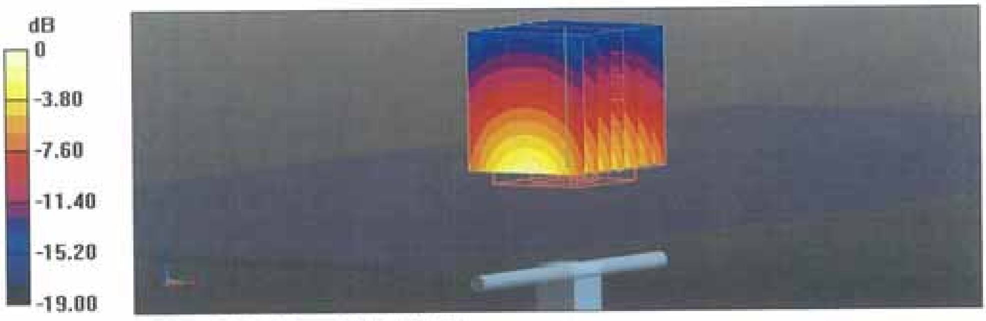
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d032

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.51 S/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.65, 4.65, 4.65); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.54 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 17.3 W/kg
SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.41 W/kg
Maximum value of SAR (measured) = 12.8 W/kg



0 dB = 12.8 W/kg = 11.07 dBW/kg

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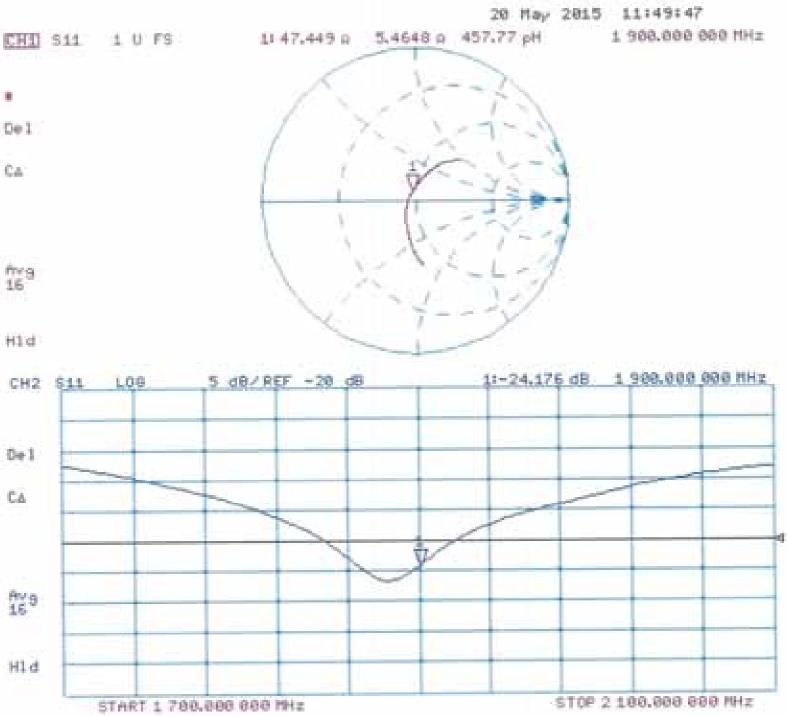
Impedance Measurement Plot for Body TSL



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