

SAR TEST REPORT

Franklin Wireless Corp.
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Date of Issue: September 30, 2014
Test Report No.: HCT-A-1409-F001-2
Test Site: HCT CO., LTD.

FCC ID:

RB2-U770

Equipment Type:
Application Type:
Model Name:
Permissive Change:
Testing has been carried out in accordance with:

CDMA / LTE / WIMAX USB Dongle
Class II Permissive Change
U770
Adding 3 and 10 MHz BW to LTE Band 25

Date of Test:

47CFR §2.1093
ANSI / IEEE C95.1 – 1992
IEEE 1528-2003
Sep. 26, 2014

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.

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Revision History

Rev.	Issue DATE	DESCRIPTION
HCT-A-1409-F001	Sep. 15, 2014	Initial Issue
HCT-A-1409-F001-1	Sep. 29, 2014	All SAR data was re-tested.(Antenna matching was modified.) Sec.3 was revised. Sec.10.1 was revised. Sec.10.2 was revised. Sec. 11.1 was revised. Sec. 13.1 was revised. Sec.14 was revised. Attachment 1 was revised. Attachment 2 was revised.
HCT-A-1409-F001-2	Sep. 30, 2014	Sec 13.2 was revised (Add LTE SAR test procedures.)

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1. INTRODUCTION

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

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

SAR Definition

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

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

Figure 1. SAR Mathematical Equation

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

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

Where:

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

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

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

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

2. TEST METHODOLOGY

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

- FCC KDB Publication 941225 D05 SAR for LTE Devices v02r03
- FCC KDB Publication 941225 D06 Hot Spot SAR v01r01
- FCC KDB Publication 447498 D01v05r02 (General SAR Guidance)
- FCC KDB Publication 447498 D02 SAR Procedures for Dongle Xmtr v02
- FCC KDB Publication 865664 D01 SAR measurement 100 MHz to 6 GHz v01r03
- FCC KDB Publication 865664 D02 SAR Reporting v01r01

3. DESCRIPTION OF DEVICE

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

EUT Type	CDMA / LTE / WIMAX USB Dongle	
FCC ID:	RB2-U770	
Model:	U770	
Trade Name	Franklin Wireless Corp.	
Application Type	Class II Permissive Change	
Tx Frequency	1 851.5 – 1 913.5 MHz (LTE Band 25)	
Production Unit or Identical Prototype	Prototype	
Max. SAR	Band	Reported 1g SAR (W/Kg)
		Body SAR
	LTE Band 25	1.17
Date(s) of Tests	Sep. 26, 2014	
Antenna Type	Integral Antenna	
EVDO	Rev.0, A	
Key Feature(s)	This is a USB Dongle. Therefore, there is no voice transmission.	

3.1 KDB 941225 LTE informatio

Frequency Range:	Band 25: 1 851.5MHz – 1 913.5MHz					
Channel Bandwidth:	3 MHz, 5 MHz, 10 MHz					
Channel Number & Frequency:	3 MHz		5 MHz		10 MHz	
	Ch.	Freq.(MHz)	Ch.	Freq.(MHz)	Ch.	Freq.(MHz)
	26055	1 851.5	26065	1 852.5	26090	1 855
	26365	1 882.5	26365	1 882.5	26365	1 882.5
	26675	1 913.5	26665	1 912.5	26640	1 910
UE Category & Uplink Modulation	UE Category 3 QPSK, 16QAM					
Power Class	UE Power Class 3					
Description of the LTE Transmitter & antenna	See section 11.1 and Sec. 12.1 -. Ant.1 & Ant.2 cannot transmit simultaneously -. Ant.1: BC0, BC1, BC10, LTE and WIMAX(Tx1) It can not transmit simultaneously. -. Ant.2: WIMAX(Tx2)					
LTE voice/data requirements	Data Only					
Identify if MPR is optional or mandatory	The EUT incorporates MPR as per 3GPP TS36.101. The MPR is permanently built-in by design as a mandatory. A-MPR is not implemented. During SAR testing, A-MPR was disabled by setting NS=01 on the R&S CMW500.					
Maximum average conducted output power (dBm)	See section 11. RF conducted power measurement in the SAR report.					
Identify all other U.S. wireless operating modes, device exposure configurations and frequency bands	- BC0, BC1, BC10, LTE Band 25 and WIMAX : Body worn SAR is required					
Maximum average conducted output power for other wireless mode and frequency	See section 11 RF output power measurement in the SAR report.					
Simultaneous Transmission condition	This device does not support simultaneous transmission.					
Power reduction explanation	Power reduction implement. Please find the section 11					
Description of the test equipment, software, etc.	LTE SAR Testing was performed using a CMW500. UE transmits with maximum output power during SAR testing.					

4. DESCRIPTION OF TEST EQUIPMENT

4.1 SAR MEASUREMENT SETUP

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

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

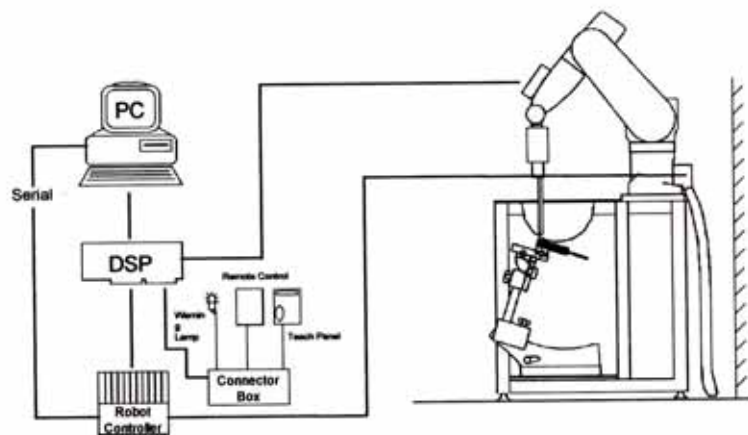


Figure 2. HCT SAR Lab. Test Measurement Set-up

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

4.2 DASY E-FIELD PROBE SYSTEM

4.2.1 ET3DV6 Probe Specification

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



Figure 3. Photograph of the probe and the Phantom

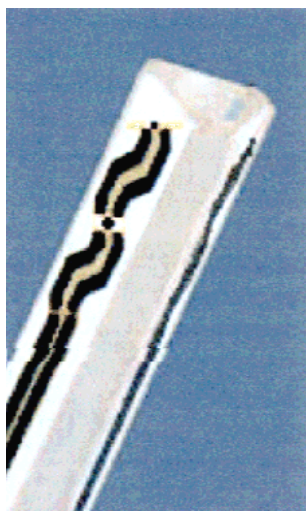


Figure 4. ET3DV6 E-field Probe

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

4.2.2 EX3DV4 Probe Specification

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



Figure 5. Photograph of the probe and the Phantom



Figure 6. EX3DV4 E-field Probe

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

4.3 PROBE CALIBRATION PROCESS

4.3.1 E-Probe Calibration

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

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

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

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

where:

Δt = exposure time (30 seconds),

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

ΔT = temperature increase due to RF exposure.

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

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

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

where:

σ = simulated tissue conductivity,

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

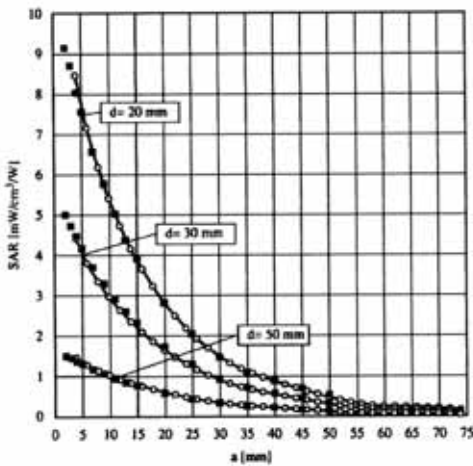


Figure 7. E-Field and Temperature measurements at 900 MHz

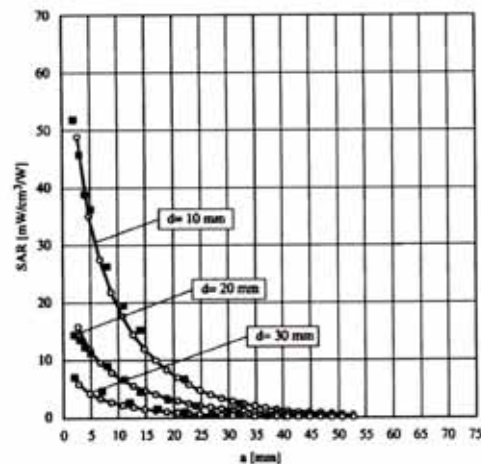


Figure 8. E-Field and temperature measurements at 1.8 GHz

4.3.2 Data Extrapolation

The DASY4 software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given like below;

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

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

E-field probes: with

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

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.

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

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

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

4.4 SAM Phantom

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



Figure 9. SAM Phantom

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

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

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

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



Figure 10. MFP V5.1 Triple Modular Phantom

4.5 Device Holder for Transmitters

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

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



Figure 11. Device Holder

4.6 Tissue Simulating Mixture Characterization

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

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

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

Table 4.1 Composition of the Tissue Equivalent Matter

4.7 SAR TEST EQUIPMENT

Manufacturer	Type / Model	S/N	Calib. Date	Calib.Interval	Calib.Due
SPEAG	SAM Phantom	-	N/A	N/A	N/A
SPEAG	Triple Modular Phantom	-	N/A	N/A	N/A
Staubli	Robot RX90B L	F01/5K09A1/A/01	N/A	N/A	N/A
Staubli	Robot ControllerCS7MB	3403-91935	N/A	N/A	N/A
HP	Pavilion t000_puffer	KRJ51201TV	N/A	N/A	N/A
SPEAG	Light Alignment Sensor	265	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	D221340.01	N/A	N/A	N/A
SPEAG	DAE4	1417	Jan.03, 2014	Annual	Jan.03, 2015
SPEAG	E-Field Probe ET3DV6	1605	Jan.31, 2014	Annual	Jan.31, 2015
SPEAG	Dipole D1900V2	5d061	Jul. 23, 2014	Annual	Jul. 23, 2015
Agilent	Power Meter(F) E4419B	MY41291386	Nov. 01, 2013	Annual	Nov. 01, 2014
Agilent	Power Sensor(G) 8481	MY41090680	Oct. 30, 2013	Annual	Oct. 30, 2014
Agilent	Dielectric Probe Kit 85070C	00721521	CBT		
HP	Dual Directional Coupler 778D	16072	Oct. 31, 2013	Annual	Oct. 31, 2014
Agilent	Base Station E5515C	GB44400269	Feb. 10, 2014	Annual	Feb. 10, 2015
HP	Signal Generator 8664A	3744A02069	Nov. 04, 2013	Annual	Nov. 04, 2014
Hewlett Packard	11636B/Power Divider	11377	Nov. 10, 2013	Annual	Nov. 10, 2014
Agilent	N9020A/ SIGNAL ANALYZER	MY50510407	Mar. 25, 2014	Annual	Mar. 25, 2015
TESCOM	TC-3000C / BLUETOOTH TESTER	3000C000276	Apr. 11, 2014	Annual	Apr. 11, 2015
HP	Network Analyzer 8753ES	JP39240221	Mar. 21, 2014	Annual	Mar. 21, 2015
R&S	Base Station CMW500	1201.0002K50_116858	Jan. 17, 2014	Annual	Jan. 17, 2015

NOTE:

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

5. SAR MEASUREMENT PROCEDURE

The evaluation was performed with the following procedure:

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

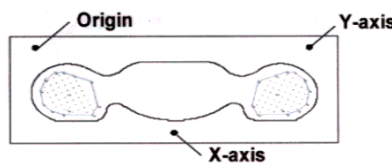


Figure 12. SAR Measurement Point in Area Scan

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extend, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SASR-distribution over 10g. Area scan and zoom scan resolution setting follow KDB 865664 D01v01r03 quoted below.

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

6. DESCRIPTION OF TEST POSITION

The device is a USB Dongle for Body SAR. In all cases SAR measurements are performed to investigate the worst-case positioning. Worstcase positioning is documented and used to perform Body SAR testing.

6.1 Body Test Configurations

According to KDB 447498, the device that can be connected to a host through a cable must be tested with the device positioned in all applicable orientations against the flat phantom. And a separation distance ≤ 0.5 cm is required for USB-dongle transmitters.

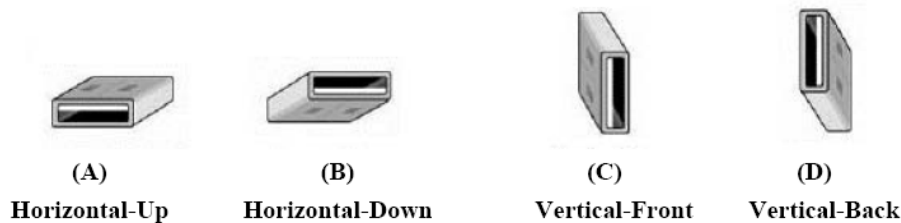


Figure 5.1 USB Connector Orientations Implemented on Laptop Computers

Therefore, the EUT was tested in following orientations;

- 1) **Configuration 1:** Front side of the EUT was tested with the **direct-connection** to the host device with **Horizontal-Up (A)**, and separation distance between EUT and Phantom is 5 mm.
- 2) **Configuration 2:** Back side of the EUT was connected to the host device with **Horizontal-Down (B)** using a **USB cable**, and separation distance between EUT and Phantom is 5 mm.
- 3) **Configuration 3:** Right side of the EUT was connected to the host device with **Vertical-Front (C)** using a **USB cable**, and separation distance between EUT and Phantom is 5 mm.
- 4) **Configuration 4:** Left side of the EUT was tested with the **direct-connection** to the host device with **Vertical-Back (D)**, and separation distance between EUT and Phantom is 5 mm.
- 5) **Configuration 5:** **Top** side of the EUT was tested with the **direct-connection** to the host device, and separation distance between EUT and Phantom is 5 mm.

Note;

This USB cable was used to operate this unit in the highest RF performance capability for SAR testing.

7. MEASUREMENT UNCERTAINTY

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

Table 7.1 Uncertainty (800 MHz- 2 450 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 Isortopy	MOD. Type	Duty Factor	PAR
4	1605	ET3DV6	Body	1900	5d061	Aug.06,2014	52.1	1.52	PASS	PASS	PASS	N/A	N/A	N/A

SAR System Validation Summary

Note;

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

10. SYSTEM VERIFICATION

10.1 Tissue Verification

Band	Date	Liquid	Liquid Temp.[°C]	Parameters	Target Value	Measured Value	Deviation [%]	Limit [%]
LTE Band 25	Sep. 26 , 2014	Body	21.1	ϵ_r	53.3	53.3	+ 0.00	± 5
				σ	1.52	1.49	- 1.97	± 5

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

10.2 System Verification

Prior to assessment, the system is verified to the ± 10 % of the specifications at 1 900 MHz by using the system Verification kit. (Graphic Plots Attached)

[System Verification Results]

Band	Probe (SN)	Dipole (SN)	Date	Liquid	Liquid Temp. [°C]	1 W Target SAR _{1g} (mW/g)	Measured SAR _{1g} (mW/g)	1 W Normalized SAR _{1g} (mW/g)	Deviation [%]	Limit [%]
LTE Band 25	1605	5d061	Sep. 26 , 2014	Body	21.1	40.8	3.74	37.4	- 8.33	± 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 equipments.
- Generate about 100 mW Input Level from the Signal generator to the Dipole Antenna.
- Dipole Antenna was placed below the Flat phantom.
- The measured one-gram SAR at the surface of the phantom above the dipole feed-point should be within 10 % of the target reference value.
- The results are normalized to 1 W input power.

Note;

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

11. RF CONDUCTED POWER MEASUREMENT

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

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



SAR Test for WWAN & LTE were performed with a base station simulator Agilent E5515C & CMW500. Communication between the device and the emulator was established by air link. Set base station emulator to allow DUT to radiate maximum output power during all tests.

11.1 LTE

SAR testing was performed according to the FCC KDB 941225 D05v02r03 publication. The RB2-U770 developed base on MPR. The MPR is mandatory. The device will not operate with any other MPR setting than that stated in the table as indicated. SAR Testing was performed using a CMW500. UE transmits with Maximum output power during SAR testing. A-MPR has been disabled for all SAR tests by setting NS=01 on the R&S CMW500.

Target Power : 22.5 dBm
Tune-up Tolerance : - 1.0 dB / + 0.5dB

- LTE Band 25

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)		
				26055 1851.5MHz	26365 1882.5MHz	26675 1913.5MHz
3MHz	QPSK	1	0	22.12	22.41	21.61
		1	7	22.32	22.38	21.52
		1	14	22.41	22.72	21.56
		8	0	21.27	21.32	20.61
		8	4	21.27	21.44	20.60
		8	7	21.31	21.34	20.51
		15	0	21.19	21.29	20.51
	16QAM	1	0	21.32	21.44	20.81
		1	7	21.44	21.57	20.55
		1	14	21.52	21.72	20.52
		8	0	20.26	20.29	19.56
		8	4	20.20	20.57	19.66
		8	7	20.32	20.46	19.54
		15	0	20.22	20.49	19.64

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)		
				26065 1852.5MHz	26365 1882.5MHz	26665 1912.5MHz
5MHz	QPSK	1	0	22.08	22.35	21.99
		1	12	22.30	22.57	21.62
		1	24	22.43	22.67	21.58
		12	0	21.21	21.41	21.06
		12	6	21.38	21.34	20.59
		12	11	21.22	21.43	20.61
		25	0	21.16	21.16	20.74
	16QAM	1	0	21.20	21.41	21.20
		1	12	21.46	21.40	20.80
		1	24	21.41	21.60	20.54
		12	0	20.35	20.54	20.01
		12	6	20.40	20.40	19.81
		12	11	20.44	20.51	19.71
		25	0	20.28	20.24	19.63

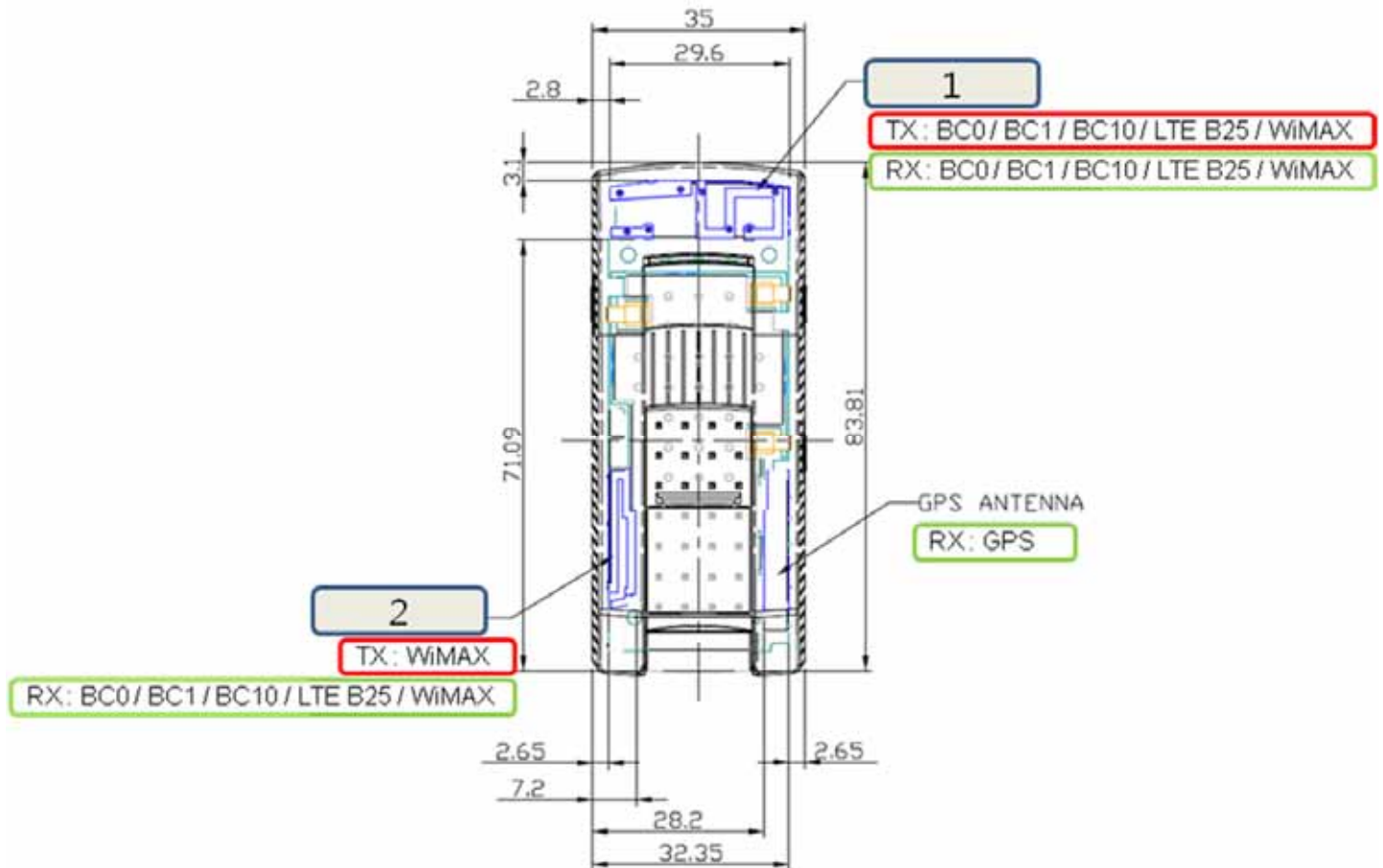
Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)		
				26090 1855MHz	26365 1882.5MHz	26640 1910MHz
10MHz	QPSK	1	0	22.20	22.25	22.50
		1	24	22.39	22.52	22.19
		1	49	22.56	22.79	21.83
		25	0	21.21	21.09	21.55
		25	12	21.44	21.19	21.37
		25	24	21.52	21.57	21.16
		50	0	21.41	21.04	20.79
	16QAM	1	0	21.30	21.11	21.36
		1	24	21.51	21.60	21.19
		1	49	21.64	21.78	20.57
		25	0	20.31	20.27	20.23
		25	12	20.52	20.31	20.17
		25	24	20.53	20.64	19.71
		50	0	20.20	20.13	19.91

Note;

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

12. SAR Test configuration & Antenna information

12.1 Antenna and Device Information



Antenna	Band
1	BC0 / BC1 / BC10 / LTE Band 25 / WIMAX(Tx1)
2	WIMAX(Tx2)

Definition of Antennas

Note:

- Ant.1 & Ant.2 cannot transmit simultaneously.
- As for WiMAX, WiMAX tx1 & tx2 antenna cannot transmit simultaneously since Tx antenna have a just one path. Only it can be operated by a internal switch.

13. SAR TEST DATA SUMMARY

13.1 Measurement Results (LTE Band 25 SAR QPSK)

Frequency		Mode	Power (dBm)		Power Drift (dB)	Configuration	Configuration	RB Size	RB Offset	Separation Distance	Measured SAR (mW/g)	Scaling Factor	Scaled SAR (mW/g)	Plot No.
MHz	Ch.		Tune-Up Limit	Conducted Power										
1 855	26090	QPSK	23.0	22.56	-0.178	Horizontal Up	Laptop	1	49	5 mm	0.784	1.107	0.868	-
1 882.5	26365	QPSK	23.0	22.79	0.047	Horizontal Up	Laptop	1	49	5 mm	0.904	1.050	0.949	-
1 910	26640	QPSK	23.0	22.50	-0.055	Horizontal Up	Laptop	1	0	5 mm	0.828	1.122	0.929	-
1 855	26090	QPSK	22.0	21.52	0.002	Horizontal Up	Laptop	25	24	5 mm	0.738	1.117	0.824	-
1 882.5	26365	QPSK	22.0	21.57	-0.053	Horizontal Up	Laptop	25	24	5 mm	0.807	1.104	0.891	-
1 910	26640	QPSK	22.0	21.55	-0.028	Horizontal Up	Laptop	25	0	5 mm	0.663	1.109	0.735	-
1855	26090	QPSK	22.0	21.41	-0.110	Horizontal Up	Laptop	50	0	5 mm	0.701	1.146	0.803	-
1 855	26090	QPSK	23.0	22.56	0.008	Horizontal Down	USB Cable	1	49	5 mm	1.06	1.107	1.173	1
1 882.5	26365	QPSK	23.0	22.79	-0.041	Horizontal Down	USB Cable	1	49	5 mm	0.779	1.050	0.818	-
1 910	26640	QPSK	23.0	22.50	-0.024	Horizontal Down	USB Cable	1	0	5 mm	0.945	1.122	1.060	-
1 855	26090	QPSK	22.0	21.52	-0.105	Horizontal Down	USB Cable	25	24	5 mm	0.810	1.117	0.905	-
1 882.5	26365	QPSK	22.0	21.57	-0.042	Horizontal Down	USB Cable	25	24	5 mm	0.857	1.104	0.946	-
1 910	26640	QPSK	22.0	21.55	-0.053	Horizontal Down	USB Cable	25	0	5 mm	0.715	1.109	0.793	-
1 855	26090	QPSK	22.0	21.41	-0.005	Horizontal Down	USB Cable	50	0	5 mm	0.775	1.146	0.888	-
1 882.5	26365	QPSK	23.0	22.79	0.004	Vertical Front	USB Cable	1	49	5 mm	0.596	1.050	0.626	-
1 882.5	26365	QPSK	22.0	21.57	0.013	Vertical Front	USB Cable	25	24	5 mm	0.454	1.104	0.501	-
1 882.5	26365	QPSK	23.0	22.79	0.078	Vertical Back	Laptop	1	49	5 mm	0.411	1.050	0.431	-
1 882.5	26365	QPSK	22.0	21.57	0.007	Vertical Back	Laptop	25	24	5 mm	0.319	1.104	0.352	-
1 882.5	26365	QPSK	23.0	22.79	-0.054	Top	Laptop	1	49	5 mm	0.608	1.050	0.638	-
1 882.5	26365	QPSK	22.0	21.57	0.035	Top	Laptop	25	24	5 mm	0.452	1.104	0.499	-
ANSI/ IEEE C95.1 1992 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population								Body 1.6 W/kg (mW/g) Averaged over 1 gram						

13.2 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. Liquid tissue depth was at least 15.0 cm for all frequencies.
3. 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.
4. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB 447498 D01v05r02.
5. Per FCC KDB 865664 D01v01r03, variability SAR tests were performed .Please see Section 14 for variability analysis information.
6. Power Supply: Power supplied through host device (TOSHIBA)

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Consideration for LTE Devices in FCC KDB 941225 D05v02r03.
2. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to target MPR is indicated alongside the SAR results.
3. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator.
4. SAR test reduction is applied using the following criteria:
 - Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB, and 50% RB allocation, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel.
 - When the reported SAR is >0.8 W/kg, testing for other Channels is performed at the highest output power level for 1RB, and 50% RB configuration for that channel.
 - Testing for 100% RB configuration is performed at the highest output power level for 100% RB configuration across the Low, Mid and High Channel when the highest reported SAR for 1 RB and 50% RB are >0.8 W/kg, Testing for the remaining required channels is not needed because the reported SAR for 100% RB Allocation <1.45 W/kg.
 - Testing for 16-QAM modulation is not required because the reported SAR for QPSK is <1.45 W/kg and its output power is not more than 0.5 dB higher than that a QPSK.
 - Testing for the other channel bandwidths is not required because the reported SAR for the highest channel bandwidth is <1.45 W/kg and its output power is not more than 0.5 dB higher than that of the highest channel bandwidth.

14. SAR Measurement Variability and Uncertainty

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

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

Frequency		Modulation	Battery	Configuration	RB Size	RB Offset	Original SAR(mW/g)	Repeated SAR(mW/g)	Largest to Smallest SAR Ratio	Plot No.
MHz	Channel									
1 855.0	26090	LTE 25	Standard	Horizontal down	1	49	1.06	1.06	1.00	2

Note(s):

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

15. 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: CDMA / LTE / WIMAX USB Dongle
Liquid Temperature: 21.1
Ambient Temperature: 21.3
Test Date: Sep.26, 2014
Plot No. 1

DUT: U770(face); Type: Bar; Serial: #1

Communication System: LTE band 25; Frequency: 1855 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 1855 \text{ MHz}$; $\sigma = 1.45 \text{ mho/m}$; $\epsilon_r = 53.4$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: ET3DV6 - SN1605; ConvF(4.57, 4.57, 4.57); Calibrated: 2014-01-31
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

Horizontal Down QPSK 10MHz 1RB 49 offset 26090/Area Scan (41x71x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.27 mW/g

Horizontal Down QPSK 10MHz 1RB 49 offset 26090/Zoom Scan (7x7x7)/Cube 0: Measurement grid:

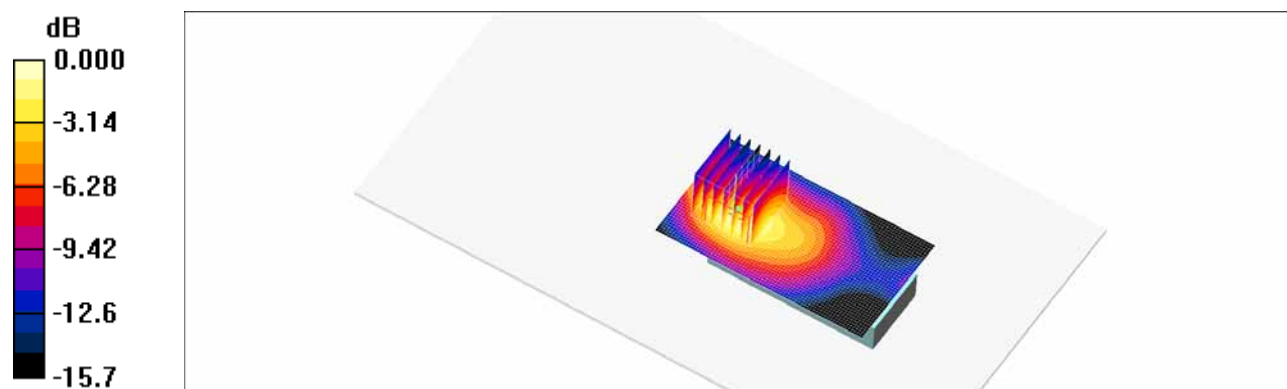
dx=5mm, dy=5mm, dz=5mm

Reference Value = 28.6 V/m; Power Drift = 0.008 dB

Peak SAR (extrapolated) = 1.61 W/kg

SAR(1 g) = 1.06 mW/g; SAR(10 g) = 0.609 mW/g

Maximum value of SAR (measured) = 1.20 mW/g



0 dB = 1.20mW/g

Test Laboratory: HCT CO., LTD
EUT Type: CDMA / LTE / WIMAX USB Dongle
Liquid Temperature: 21.1
Ambient Temperature: 21.3
Test Date: Sep.26, 2014
Plot No. 2

DUT: U770(face); Type: Bar; Serial: #1

Communication System: LTE band 25; Frequency: 1855 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 1855 \text{ MHz}$; $\sigma = 1.45 \text{ mho/m}$; $\epsilon_r = 53.4$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: ET3DV6 - SN1605; ConvF(4.57, 4.57, 4.57); Calibrated: 2014-01-31
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

Horizontal Down QPSK 10MHz 1RB 49 offset 26090/Area Scan (41x71x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 1.29 mW/g

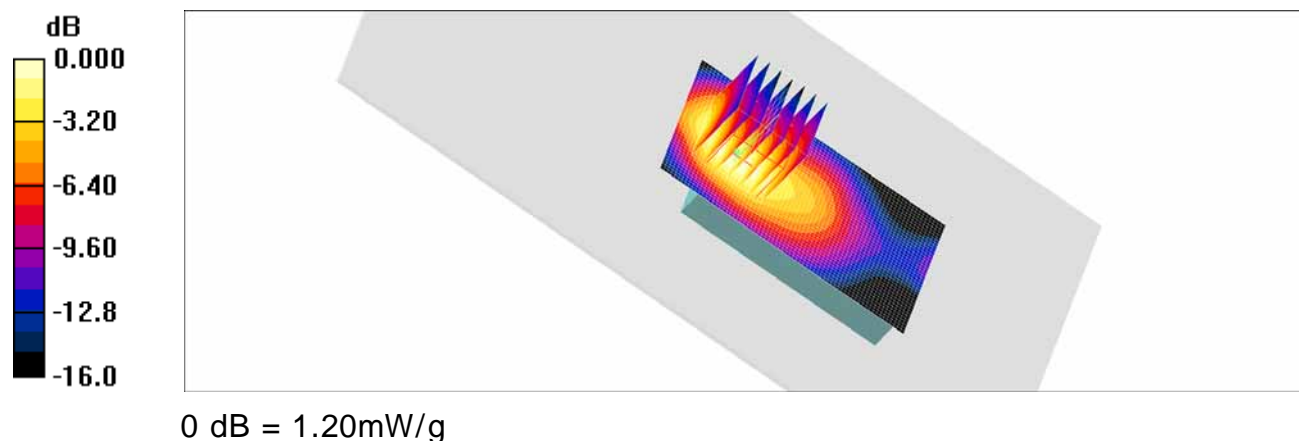
Horizontal Down QPSK 10MHz 1RB 49 offset 26090/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 28.9 V/m; Power Drift = -0.163 dB

Peak SAR (extrapolated) = 1.61 W/kg

SAR(1 g) = 1.06 mW/g; SAR(10 g) = 0.608 mW/g

Maximum value of SAR (measured) = 1.20 mW/g



Attachment 2. – Dipole Verification Plots

■ Verification Data (LTE Band 25 Body)

Test Laboratory: HCT CO., LTD
Input Power: 100 mW (20 dBm)
Liquid Temp: 21.1
Test Date: Sep. 26, 2014

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

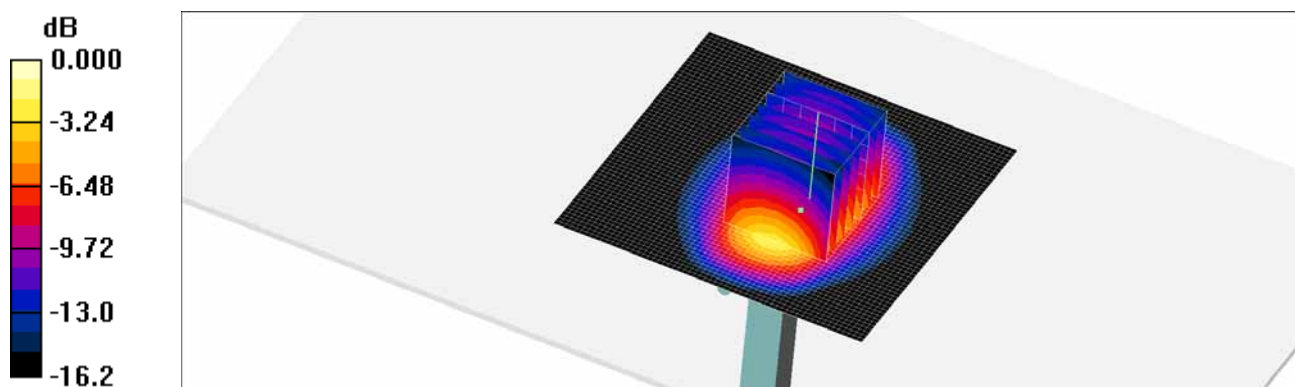
Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 1900$ MHz; $\sigma = 1.49$ mho/m; $\epsilon_r = 53.3$; $\rho = 1000$ kg/m³
Phantom section: Center Section ; Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

DASY4 Configuration:

- Probe: ET3DV6 - SN1605; ConvF(4.57, 4.57, 4.57); Calibrated: 2014-01-31
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2014-01-03
- Phantom: Triple Flat Phantom 5.1C_20120905; Type: QD 000 P51 CA

Verification 1900 MHz/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 4.91 mW/g

Verification 1900 MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 49.6 V/m; Power Drift = 0.061 dB
Peak SAR (extrapolated) = 5.91 W/kg
SAR(1 g) = 3.74 mW/g; SAR(10 g) = 2.08 mW/g
Maximum value of SAR (measured) = 4.21 mW/g



0 dB = 4.21 mW/g

Attachment 3. – Probe Calibration Data

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **HCT (Dymstec)**

Certificate No: **ET3-1605_Jan14/2**

CALIBRATION CERTIFICATE (Replacement of No: ET3-1605_Jan14)

Object **ET3DV6 - SN:1605**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes**

Calibration date: **January 31, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498067	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	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-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: January 31, 2014			

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

Certificate No: ET3-1605_Jan14/2

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Accreditation No.: **SCS 108**

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

ET3DV6 – SN:1605

January 31, 2014

Probe ET3DV6

SN:1605

Manufactured: July 27, 2001
Repaired: January 24, 2014
Calibrated: January 31, 2014

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

Certificate No: ET3-1605_Jan14/2

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ET3DV6- SN:1605

January 31, 2014

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1605

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.49	1.76	1.49	$\pm 10.1 \%$
DCP (mV) ^B	97.1	97.1	98.1	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^C (k=2)
0	CW	X	0.0	0.0	1.0	0.00	176.1	$\pm 3.5 \%$
		Y	0.0	0.0	1.0		186.9	
		Z	0.0	0.0	1.0		183.4	

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

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

^B Numerical linearization parameter; uncertainty not required.

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

ET3DV6- SN:1605

January 31, 2014

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1605

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)
150	52.3	0.76	8.22	8.22	8.22	0.10	1.35	± 13.3 %
300	45.3	0.87	8.06	8.06	8.06	0.23	2.40	± 13.3 %
450	43.5	0.87	7.34	7.34	7.34	0.26	2.82	± 13.3 %
750	41.9	0.89	6.88	6.88	6.88	0.31	3.00	± 12.0 %
835	41.5	0.90	6.57	6.57	6.57	0.33	3.00	± 12.0 %
900	41.5	0.97	6.37	6.37	6.37	0.31	3.00	± 12.0 %
1450	40.5	1.20	5.69	5.69	5.69	0.44	2.69	± 12.0 %
1750	40.1	1.37	5.43	5.43	5.43	0.78	2.13	± 12.0 %
1900	40.0	1.40	5.20	5.20	5.20	0.80	2.05	± 12.0 %
1950	40.0	1.40	5.05	5.05	5.05	0.80	2.18	± 12.0 %
2300	39.5	1.67	4.83	4.83	4.83	0.80	1.92	± 12.0 %
2450	39.2	1.80	4.55	4.55	4.55	0.80	1.72	± 12.0 %

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

^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:1605

January 31, 2014

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1605

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)
150	61.9	0.80	7.44	7.44	7.44	0.15	1.35	± 13.3 %
300	58.2	0.92	7.57	7.57	7.57	0.18	2.03	± 13.3 %
450	56.7	0.94	7.34	7.34	7.34	0.19	2.19	± 13.3 %
750	55.5	0.96	6.45	6.45	6.45	0.27	2.96	± 12.0 %
835	55.2	0.97	6.35	6.35	6.35	0.33	3.00	± 12.0 %
1750	53.4	1.49	4.81	4.81	4.81	0.80	2.59	± 12.0 %
1900	53.3	1.52	4.57	4.57	4.57	0.80	2.39	± 12.0 %
2450	52.7	1.95	3.97	3.97	3.97	0.57	1.04	± 12.0 %

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

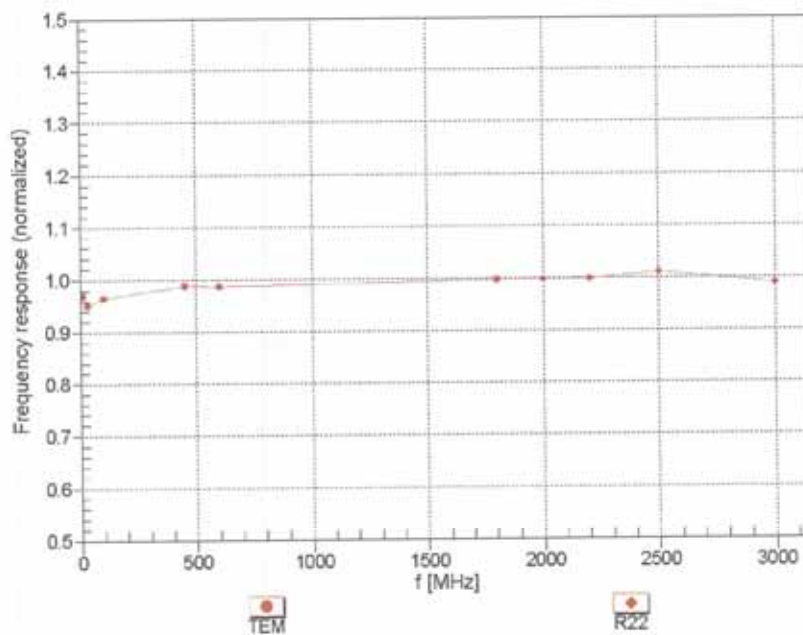
^f At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty 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:1605

January 31, 2014

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



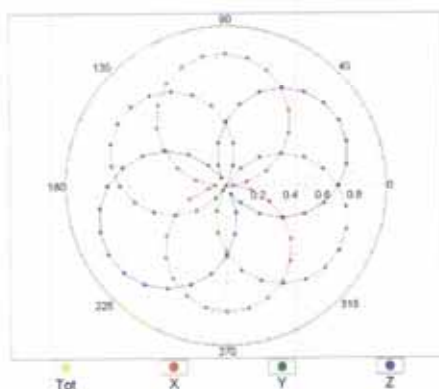
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

ET3DV6-SN:1605

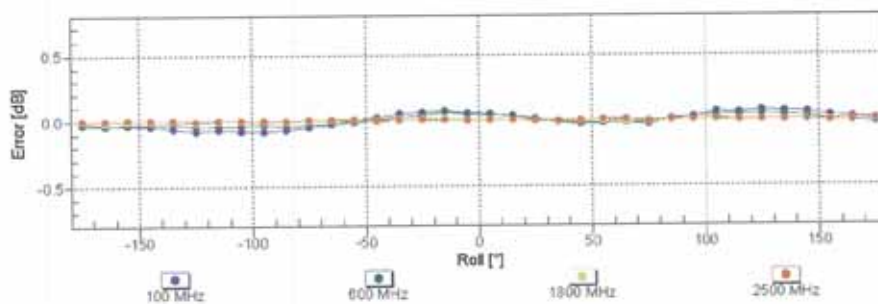
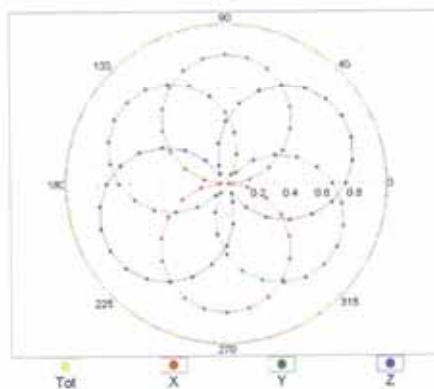
January 31, 2014

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

f=600 MHz, TEM



f=1800 MHz, R22

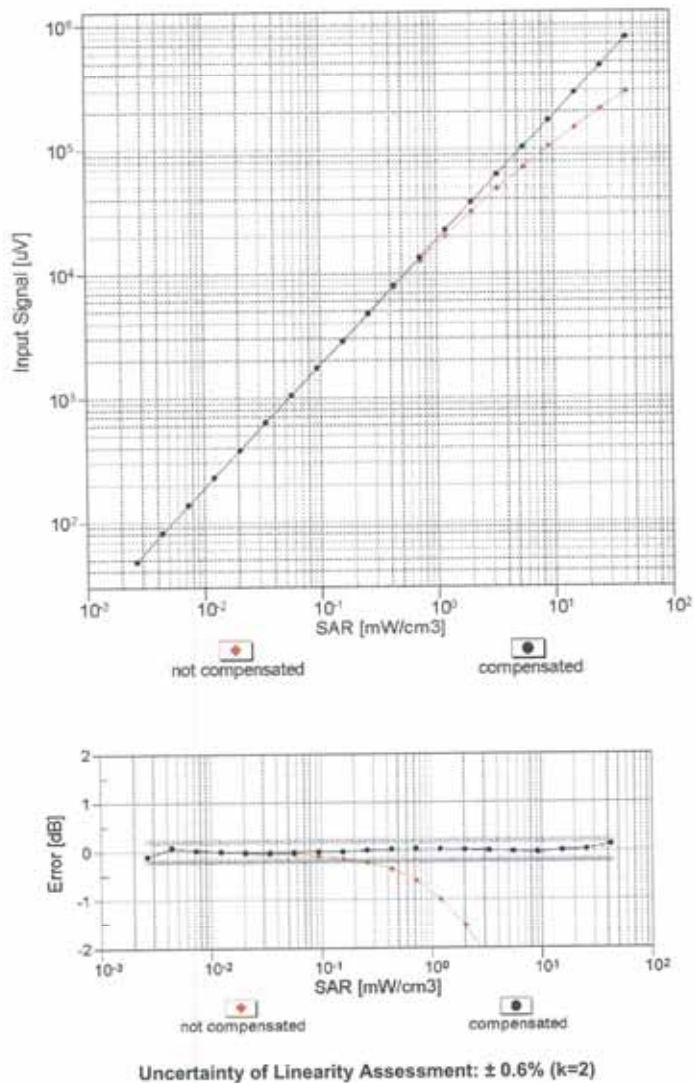


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

ET3DV6- SN:1605

January 31, 2014

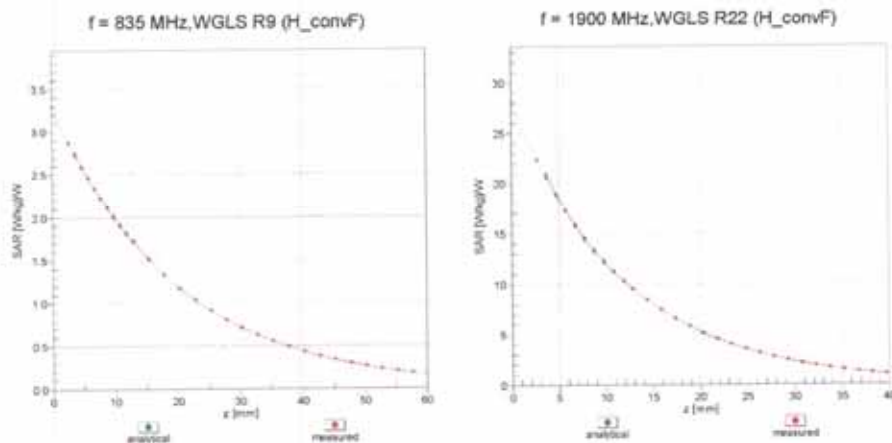
Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f = 900 \text{ MHz}$)



ET3DV6- SN:1605

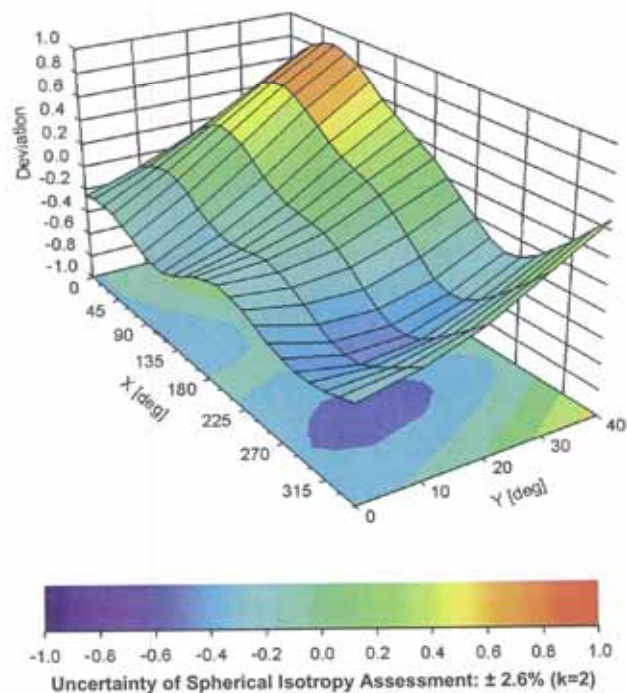
January 31, 2014

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



ET3DV6- SN:1605

January 31, 2014

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1605

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-125
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	6.8 mm
Probe Tip to Sensor X Calibration Point	2.7 mm
Probe Tip to Sensor Y Calibration Point	2.7 mm
Probe Tip to Sensor Z Calibration Point	2.7 mm
Recommended Measurement Distance from Surface	4 mm

Attachment 4. – Dipole Calibration Data

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Client **HCT (Dymstec)**

Certificate No: **D1900V2-5d061_Jul14**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d061**

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

Calibration date: **July 23, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15

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

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

Issued: July 23, 2014

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

Certificate No: D1900V2-5d061_Jul14

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
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 \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	39.5 \pm 6 %	1.38 mho/m \pm 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.6 W/kg \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.2 W/kg \pm 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	52.5 \pm 6 %	1.51 mho/m \pm 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.8 W/kg \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.39 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.6 W/kg \pm 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.1 Ω + 6.2 j Ω
Return Loss	- 24.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.2 Ω + 7.0 j Ω
Return Loss	- 22.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.193 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 10, 2004

DASY5 Validation Report for Head TSL

Date: 23.07.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

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

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

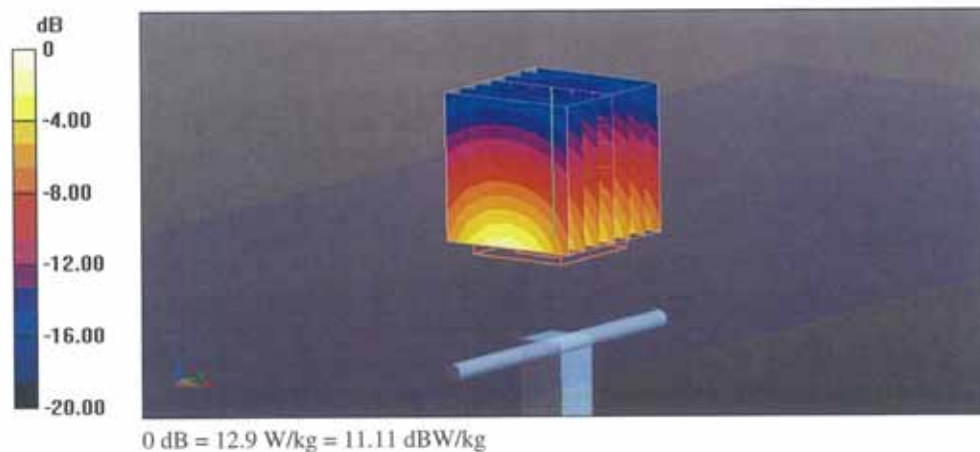
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

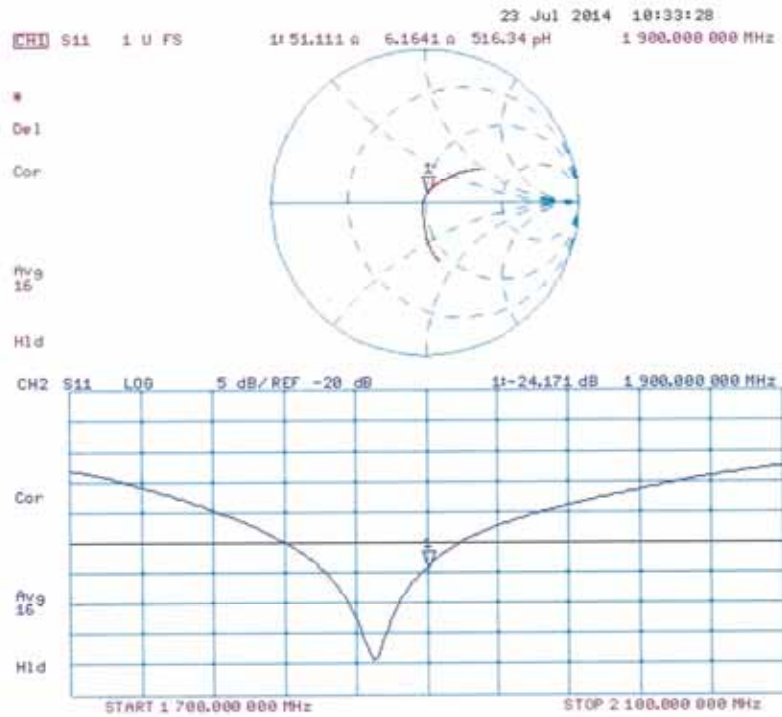
Peak SAR (extrapolated) = 18.6 W/kg

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

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



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 23.07.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

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

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

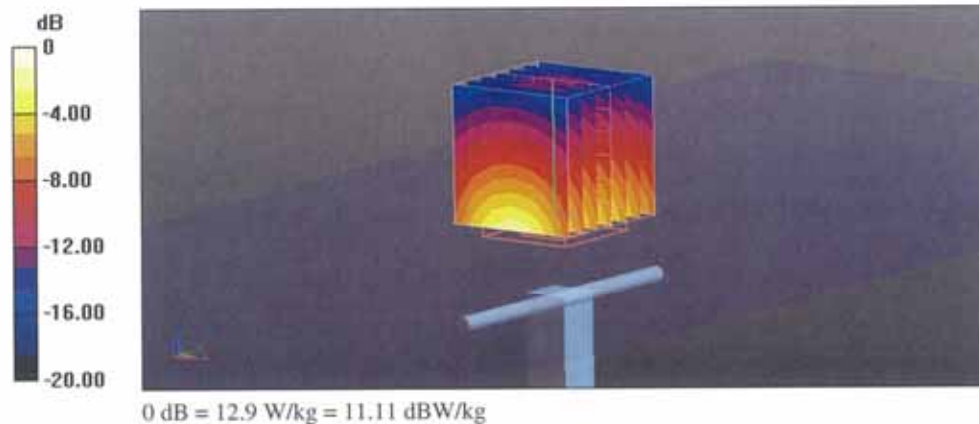
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

Peak SAR (extrapolated) = 17.8 W/kg

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

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



Impedance Measurement Plot for Body TSL

