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SAR TEST REPORT

Applicant Name: Franklin Technology Inc. 906, gasan-Dong,JEI Platz 186,Gasan digital 1-ro, Geumcheon-gu, Seoul, Korea (08502)	**Date of Issue: 07. 14, 2016** **Test Report No.: HCT-A-1607-F003-1** **Test Site: HCT CO., LTD.**

FCC ID: XHG-U772S

Equipment Type:	**LTE/CDMA USB Dongle**
Model Name:	**U772**
Testing has been carried out in accordance with:	**47CFR §2.1093** **ANSI/ IEEE C95.1 – 1992** **IEEE 1528-2013**
Date of Test:	**07/06/2016 ~ 07/08/2016**

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	**Reviewed By**
Yun-Jeang Heo **Test Engineer / SAR Team** **Certification Division**	**Dong-Seob Kim** **Technical Manager / SAR Team** **Certification Division**

Version

Rev.	DATE	DESCRIPTION
HCT-A-1607-F003	07. 12, 2016	First Approval Report
HCT-A-1607-F003-1	07. 14, 2016	Revised Report sec.1 and sec. 2.1 (BC10 Tx Frequency)

Table of Contents

1. Attestation of Test Result of Device Under Test

Test Laboratory	
Company Name:	HCT Co., LTD
Address	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of Korea
Telephone	+82 31 645 6300
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Attestation of SAR test result		
Applicant Name:	Franklin Technology Inc.	
FCC ID:	XHG-U772S	
Model:	U772	
EUT Type:	LTE/CDMA USB Dongle	
Application Type:	Certification	
The Highest Reported SAR		
Band	**Tx. Frequency (MHz)**	**Reported 1g SAR (W/kg) Body SAR**
BC10	817.90 ~ 823.10 MHz	1.10
CDMA835	824.70 ~ 848.31 MHz	1.10
PCS CDMA	1 851.25 ~ 1 908.75 MHz	1.16
LTE 25	1 850.7 ~ 1 914.3 MHz	1.17
Date(s) of Tests:	07/06/2016 ~ 07/08/2016	

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2. Device Under Test Description

2.1 DUT specification

Device Wireless specification overview		
Band & Mode	**Operating Mode**	**Tx Frequency**
BC10	Data	817.90 ~ 823.10 MHz
CDMA835	Data	824.70 – 848.31 MHz
PCS CDMA	Data	1 851.25 – 1 908.75 MHz
LTE 25	Data	1 850.7 ~ 1 914.3 MHz
Device Description		
Device Dimension	Overall (Length x Width) : 35 mm x 83.8 mm	
Key Feature(s)	This is a USB Dongle. Therefore, there is no voice transmission.	

2.2 LTE information

Item.	Description
Frequency Range:	Band 25: 1 850.7 MHz ~ 1 914.3 MHz
Channel Bandwidths	Band 25: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz

Channel Number s& Frequencies(MHz):

Band 25

1.4 MHz		3 MHz		5 MHz		10 MHz		15 MHz		20 MHz	
Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
26047	1850.7	26055	1 851.5	26055	1 851.5	26090	1 855	26115	1857.5	26140	1860
26365	1882.5	26365	1 882.5	26365	1 882.5	26365	1 882.5	26365	1 882.5	26365	1 882.5
26683	1914.3	26675	1 913.5	26675	1 913.5	26640	1 910	26615	1907.5	26590	1905

UE Category	UE Category 3
Power Class	UE Power Class 3
LTE voice/data requirements	Data Only
LTE MPR options	The EUT incorporates MPR as per 3GPP TS 36.101 sec. 6.2.3 ~ 6.2.5
	The MPR is permanently built-in by design as a mandatory.
	A-MPR is not implemented in the DUT.
Power reduction explanation	This device doesn't implements power reduction.
LTE Carrier Aggregation	These device doses not support downlink and uplink Carrier Aggregation.

2.3 TEST METHODOLOGY and Procedures

The tests documented in this report were performed in accordance with IEEE Standard 1528-2013 & IEEE 1528-2005 and the following published KDB procedures.

- FCC KDB Publication 941225 D01 3G SAR Procedures v03r01
- FCC KDB Publication 941225 D05 SAR for LTE Devices v02r05
- FCC KDB Publication 941225 D06 Hot Spot SAR v02r01
- FCC KDB Publication 447498 D01 General SAR Guidance v06
- FCC KDB Publication 447498 D02 SAR Procedures for Dongle Xmtr v02r01
- FCC KDB Publication 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- FCC KDB Publication 865664 D02 SAR Reporting v01r02

2.4 Nominal and Maximum 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 D01v06.

Mode / Band	Modulated Average (dBm)	
BC10	Maximum	24.5
	Nominal	24.0
CDMA	Maximum	24.0
	Nominal	23.5
PCS	Maximum	21.0
	Nominal	20.5
LTE Band 25	Maximum	21.2
	Nominal	20.7

2.5 SAR Test Exclusions Applied

Licensed Transmitter(s)

LTE SAR for the higher modulations and lower bandwidths were not tested since the maximum average output power of all required channels and configurations was not more than 0.5 dB higher than the highest bandwidth; and the reported LTE SAR for the highest bandwidth was less than 1.45 W/kg for all configurations according to FCC KDB 941225 D05v02r05.

3. 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 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/㎥)

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.

4. DESCRIPTION OF TEST EQUIPMENT

4.1 SAR MEASUREMENT SETUP

These measurements are performed using the DASY4 & DASY5 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 with Windows XP or Windows 7 is working with SAR Measurement system DASY4 & DASY5, 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.

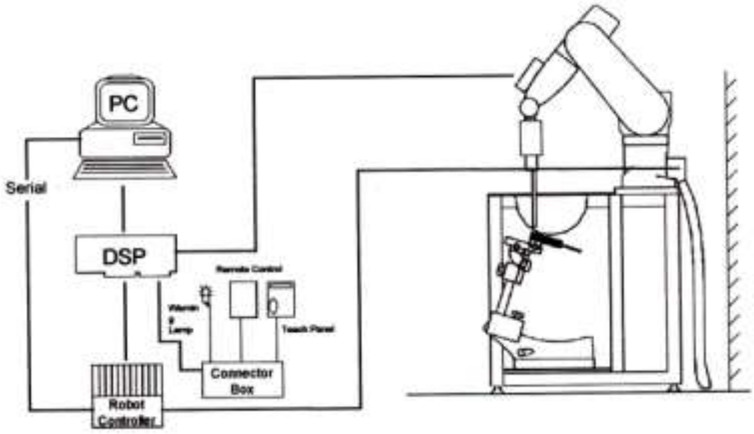

Figure 2. HCT SAR Lab. Test Measurement Set-up

The DAE consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the 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 SAM Phantom

<table>
<tr><th colspan="4">SAR PHANTOMS</th></tr>
<tr><td rowspan="8">TWIN SAM</td><td>Name</td><td>Twin SAM</td><td rowspan="8">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.</td></tr>
<tr><td>Appearance</td><td></td></tr>
<tr><td>Material</td><td>Vinyl ester, Fiberglass reinforced (VE-GF)</td></tr>
<tr><td>Liquid Compatibility</td><td>Compatible with all DGBE Type liquid</td></tr>
<tr><td>Shell Thickness</td><td>2±0.2 mm (6±0.2 mm at ear point)</td></tr>
<tr><td>Dimensions</td><td>Length : 1000 mm
Width : 500 mm
Height : adjustable feet</td></tr>
<tr><td>Filling Volume</td><td>Approx. 25 liters</td></tr>
<tr><td rowspan="7">MFP</td><td>Name</td><td>MFP – Triple Modular Phantom</td><td rowspan="7">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.

Applicable for system performance check from 700 MHz – 6 GHz as well as dosimetric evaluations of body-worn devices.</td></tr>
<tr><td>Appearance</td><td></td></tr>
<tr><td>Material</td><td>Vinyl ester, Fiberglass reinforced (VE-GF)</td></tr>
<tr><td>Liquid Compatibility</td><td>Compatible with all DGBE Type liquid</td></tr>
<tr><td>Shell Thickness</td><td>2±0.2 mm</td></tr>
<tr><td>Dimensions</td><td>Length : 292 mm
Width : 178 mm
Height : 178 mm
Useable area : 280 x 175 mm</td></tr>
<tr><td>Filling Volume</td><td>Approx. 8.1 liters
(filing height 155 mm)</td></tr>
</table>

4.3 Device Holder for Transmitters

Device Holder – Mounting Device	
In combination with the SAM Phantom, the Mounting Device 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 EN 50360:2001/A:2001 and FCC KDB 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.	

5. SAR MEASUREMENT PROCEDURE

The evaluation was performed with the following procedure:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no more than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the DUT's head and body area and the horizontal grid resolution was depending on the FCC KDB 865664 D01v01r04 table 4-1 & IEEE 1528-2013.

2. Based on step, the area of the maximum absorption was determined by sophisticated interpolations routines implemented in DASY software. When an Area Scan has measured all reachable point. DASY system computes the field maximal found in the scanned are, within a range of the maximum. SAR at this fixed point was measured and used as a reference value.

3. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB 865664 D01v01r04 table 4-1 and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (reference from the DASY manual.)

   a. The data at the surface were extrapolated, since the center of the dipoles is no more than 2.7 mm away from the tip of the probe (it is different from the probe type) 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 reference value, at the same location as step 2, was re-measured after the zoom scan. If the value changed by more than 5 %, the SAR evaluation and drift measurements were repeated.

Area scan and zoom scan resolution setting follow KDB 865664 D01v01r04 quoted below.

<table>
<tr><td colspan="3"></td><td>≤ 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>$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ 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>≤ 2 GHz: ≤15 mm
2-3 GHz: ≤12 mm</td><td>3-4 GHz: ≤12 mm
4-6 GHz: ≤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 ≤ 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>≤ 2 GHz: ≤8mm
2-3 GHz: ≤5mm*</td><td>3-4 GHz: ≤5 mm*
4-6 GHz: ≤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>≤ 5 mm</td><td>3-4 GHz: ≤4 mm
4-5 GHz: ≤3 mm
5-6 GHz: ≤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>≤ 4 mm</td><td>3-4 GHz: ≤3 mm
4-5 GHz: ≤2.5 mm
5-6 GHz: ≤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>≥ 30 mm</td><td>3-4 GHz: ≥28 mm
4-5 GHz: ≥25 mm
5-6 GHz: ≥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 reported 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.</td></tr>
</table>

6. DESCRIPTION OF TEST POSITION

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.
USB dongles have a rather small footprint; therefore, the SAR scan resolutions should be smaller than those typically used for testing devices with larger form factors, to maintain acceptable uncertainty for the interpolation and extrapolation algorithms used in the 1-g SAR analysis. In addition, when USB cables are used to connect a dongle to the host for SAR testing, the dongle should be supported in several cm of foamed polystyrene (e.g., Styrofoam) to minimize any field perturbation effects due to test device holder used to position the dongle for SAR testing. Dongles with certain spacers, contours or tapering added to the housing should generally be tested according to the 5 mm test separation requirement required for simple dongles, which is based on overall host platform, device and user operating configurations and exposure conditions of a peripheral device as compared to individual use conditions.
USB dongle transmitters must show compliance at a test separation distance of 5 mm. When the SAR is ≥ 1.2 W/kg, applications for equipment certification require a KDB inquiry for equipment approval. Preliminary data submitted through KDB inquiries showing compliance at test distances greater than 5 mm are usually inapplicable and insufficient for the FCC to determine if potential exposure concerns may be eliminated to enable the device to satisfy compliance. The information must clearly demonstrate that the likelihood of non-compliance is remote. When the SAR is ≥ 1.2 W/kg, especially for SAR > 1.5 W/kg, certain caution statements, labels and other means to ensure compliance may be required.

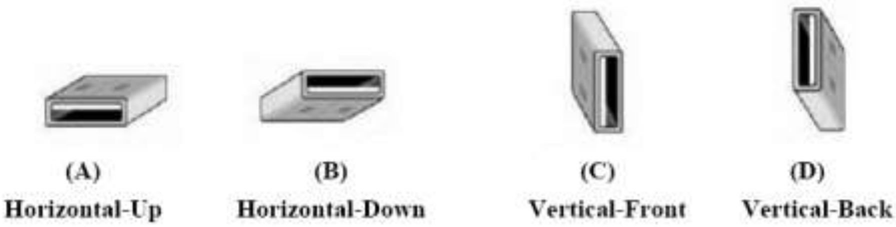

Figure 5.1 USB Connector Orientations Implemented on Laptop Computers

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

HUMAN EXPOSURE	UNCONTROLLED ENVIRONMENT General Population	CONTROLLED ENVIRONMENT Occupational
	(W/kg) or (mW/g)	(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. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be mad fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

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). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

8. FCC SAR GENERAL MEASUREMENT PROCEDURES

8.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v06, when SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as Reported SAR. The highest reported SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

8.2 SAR Measurements Conditions for CDMA2000

The following procedures were performed according to FCC KDB Publication 941225 D01v03r01 "3G SAR Measurement Procedures."

8.2.1 1x Ev-Do Data Devices

The following procedures apply to Access Terminals (AT) operating under CDMA 2000 High Rate packet Data, 1x Ev-Do Rev. 0, Rev. A SAR is required for devices with Ev-Do capabilities in body-worn accessory and other body exposure conditions, such as handsets, laptops, tablets and data modems operating in various consumer electronic devices. When VOIP is supported by Ev-Do devices for next to the ear use, head exposure SAR is required. The default test configuration is to measure SAR with an established radio link between the AT and a communication test set, according to 3GPP2 Test Application Protocols (TAP); FTAP/RTAP for Rev. 0, FETAP/RETAP for Rev. A The code channel power levels, RF channel output power (with All Bits Up) and other operating parameters should be actively monitored and controlled by the communication test set during SAR measurement. The use of FTM should be avoided. Maximum output power is verified by applying the procedures defined in 3GPP2 C.S0033 and TIA-866. SAR must be measured according to these maximum output conditions and requirements in KDB Publication 447498 D01v06.

8.2.2 Output Power Verification

Maximum output power is verified on the high, middle and low channels according to procedures in section 3.1.2.3.4 of 3GPP2 C.S0033-0/TIA-866 for Rev. 0, section 4.3.4 of 3GPP2 C.S0033-A for Rev. A . Maximum output power is measured for Rev. 0 and Rev. A in Subtype 0/1 and Subtype 2 Physical Layer configurations, respectively.

8.2.3 SAR Measurement

SAR is measured using the F/R TAP configurations required for Rev. 0, Rev. A and Rev. B. The AT is tested with a Reverse Data Channel rate of 153.6 kbps in Subtype 0/1 Physical Layer configurations. A Reverse Data Channel payload size of 4096 bits and Termination Target of 16 slots are used for Subtype 2 and 3. FTAP, FETAP and FMCTAP are all configured with a Forward Traffic Channel data rate corresponding to the 2-slot version of 307.2 kbps with ACK Channel transmitting in all slots. AT power control is in “All Bits Up” conditions for the TAP/ETAP/MCTAP.

Body-worn accessory and other body SAR are measured using Subtype 0/1 Physical Layer configurations for Rev. 0. The 3G SAR test reduction procedure is applied to Rev. A, Subtype 2 Physical layer configuration, with Rev. 0 as the primary mode; otherwise, SAR is measured for Rev. A using the highest reported SAR configuration for body-worn accessory exposure in Rev. 0. SAR is required for Rev. B, Subtype 3; it is measured by applying both the “test 2” and “test 3” configurations used for power measurement. Head SAR is required for Ev-Do devices that support next to the ear use according to the required handset test configurations; for example, with VOIP in Subtype 2 or Subtype 3 Physical Layer configurations.

For Ev-Do data devices that also support 1x RTT voice and/or data operations, the 3G SAR test reduction procedure is applied to 1x RTT RC3 and RC1 with Ev-Do Rev. 0, Rev. A and Rev. B as the respective primary modes

8.3 SAR Measurement Conditions for LTE

LTE modes are tested according to FCC KDB 941225 D05v02r05 publication. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluation SAR [4]. The R&S CMW500 or Anritsu MT8820C simulators are used for LTE output power measurements and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

8.3.1 Spectrum Plots for RB Configurations

A properly configured base station simulator was used for SAR tests and power measurements. Therefore, spectrum plots for RB configurations were not required to be included in this report.

8.3.2 MPR

MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36. 101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.

8.3.3 A-MPR

A-MPR(Additional MPR) has been disabled for all SAR tests by setting NS=01 on the base station simulator.

8.3.4 Required RB Size and RB offsets for SAR testing

According to FCC KDB 941225 D05v02r05

a. Per sec 4.2.1, SAR is required for QPSK 1 RB Allocation for the largest bandwidth
    i. The required channel and offset combination with the highest maximum output power is required for SAR.
    ii. When the reported SAR is ≤ 0.8 W/Kg, testing of the remaining RB offset configurations and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the RB offset configuration with highest output power for that channel.
    iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.
b. Per Sec 4.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Sec 4.2.1.
c. Per Sec. 4.2.3, QPSK SAR is not required for the 100% all0cation when the highest maximum output power for the 100% allocation is less than the highest maximum output power of the 1 RB and 50% RB allocations and the reported SAR for the 1 RB and 50% RB allocations is < 0.8 W/kg.
d. Per Sec. 4.2.4 and 4.3, SAR test for higher order modulations and lower bandwidths configurations are not required when the conducted power of the required test configurations determined by Sec. 4.2.1 through 4.2.3 is less than or equal to 1/2 dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is < 1.45 W/Kg.

9. 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 D01v06.

9.1 BC10/CDMA/PCS

Band	Channel	SO2	SO2	SO55	SO55	TDSO SO32	1xEvD ORev.0	1xEvD O Rev.0	1xEvDO Rev.A	1xEvDO Rev.A
		RC1/1 (dBm)	RC3/3 (dBm)	RC1/1 (dBm)	RC3/3 (dBm)	RC3/3 (dBm)	(FTAP)	(RTAP)	(FETAP)	(RETAP)
BC10	564	23.73	23.73	23.72	23.73	23.80	24.34	24.36	24.40	24.39
CDMA	1013	23.52	23.59	23.61	23.58	23.50	23.64	23.68	23.65	23.66
	384	23.53	23.60	23.53	23.63	23.58	23.63	23.79	23.54	23.61
	777	23.45	23.49	23.46	23.49	23.55	23.69	23.76	23.53	23.54
PCS	25	20.73	20.69	20.69	20.77	20.68	20.79	20.82	20.80	20.80
	600	20.69	20.68	20.74	20.72	20.68	20.96	20.98	20.83	20.85
	1175	20.81	20.86	20.81	20.85	20.76	20.83	20.85	20.78	20.81

9.2 LTE

- LTE Band 25

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				26047 1850.7 MHz	26365 1882.5 MHz	26683 1914.3 MHz	[dB]	[dB]
1.4 MHz	QPSK	1	0	21.18	21.01	21.08	0	0
		1	3	21.03	21.18	21.09	0	0
		1	5	20.99	20.98	21.08	0	0
		3	0	21.14	21.03	21.18	0	0
		3	1	21.06	21.16	21.15	0	0
		3	3	20.74	21.06	21.15	0	0
		6	0	20.18	20.06	20.18	0-1	1
	16QAM	1	0	19.45	20.03	20.06	0-1	1
		1	3	19.38	20.05	19.86	0-1	1
		1	5	19.76	20.09	19.74	0-1	1
		3	0	20.14	19.96	20.14	0-1	1
		3	1	20.08	20.06	20.12	0-1	1
		3	3	20.01	20.07	20.01	0-1	1
		6	0	19.11	19.12	19.11	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				26055 1851.5 MHz	26365 1882.5 MHz	26675 1913.5 MHz	[dB]	[dB]
3 MHz	QPSK	1	0	21.13	21.13	21.14	0	0
		1	7	21.16	20.99	21.09	0	0
		1	14	20.84	21.15	21.11	0	0
		8	0	20.13	20.12	20.15	0-1	1
		8	3	20.16	20.06	20.05	0-1	1
		8	7	20.13	20.13	20.03	0-1	1
		15	0	20.15	19.97	20.09	0-1	1
	16QAM	1	0	20.10	19.98	19.87	0-1	1
		1	7	19.34	20.06	20.01	0-1	1
		1	14	19.98	20.08	19.68	0-1	1
		8	0	19.16	19.14	19.08	0-2	2
		8	3	19.11	19.01	19.05	0-2	2
		8	7	19.11	19.02	19.06	0-2	2
		15	0	19.00	19.04	19.01	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				26065	26365	26665	[dB]	[dB]
				1852.5 MHz	1882.5 MHz	1912.5 MHz		
5 MHz	QPSK	1	0	21.04	21.15	21.01	0	0
		1	12	20.97	21.13	21.11	0	0
		1	24	20.98	21.10	21.08	0	0
		12	0	20.01	20.16	20.02	0-1	1
		12	6	20.06	20.18	20.04	0-1	1
		12	11	19.94	20.13	20.04	0-1	1
		25	0	20.06	20.19	20.05	0-1	1
	16QAM	1	0	19.86	20.01	20.01	0-1	1
		1	12	19.80	20.05	20.01	0-1	1
		1	24	19.67	20.01	19.96	0-1	1
		12	0	19.02	19.18	19.03	0-2	2
		12	6	19.04	19.18	19.06	0-2	2
		12	11	18.94	19.11	19.16	0-2	2
		25	0	19.06	19.13	19.00	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				26090	26365	26640	[dB]	[dB]
				1855 MHz	1882.5 MHz	1910 MHz		
10 MHz	QPSK	1	0	20.79	21.13	20.61	0	0
		1	24	20.63	21.18	21.14	0	0
		1	49	20.53	21.04	21.16	0	0
		25	0	19.97	20.14	19.99	0-1	1
		25	12	19.91	20.04	20.05	0-1	1
		25	24	19.65	20.11	19.97	0-1	1
		50	0	20.01	20.11	20.12	0-1	1
	16QAM	1	0	20.06	19.85	19.85	0-1	1
		1	24	19.19	19.72	20.15	0-1	1
		1	49	19.70	19.77	20.15	0-1	1
		25	0	18.99	18.97	19.00	0-2	2
		25	12	18.92	19.08	19.16	0-2	2
		25	24	18.67	19.00	19.09	0-2	2
		50	0	19.17	19.00	19.08	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP [dB]	MPR [dB]
				26115	26365	26615	[dB]	[dB]
				1857.5 MHz	1882.5 MHz	1907.5 MHz		
15 MHz	QPSK	1	0	20.84	20.80	20.60	0	0
		1	36	20.73	20.96	21.05	0	0
		1	74	20.42	20.80	21.18	0	0
		36	0	19.94	20.18	19.73	0-1	1
		36	18	19.72	20.16	20.09	0-1	1
		36	39	19.45	20.09	20.14	0-1	1
		75	0	19.70	20.13	19.91	0-1	1
	16QAM	1	0	19.97	19.96	19.95	0-1	1
		1	36	19.70	20.14	20.01	0-1	1
		1	74	19.44	20.08	20.18	0-1	1
		36	0	19.12	19.01	18.77	0-2	2
		36	18	18.93	19.14	19.19	0-2	2
		36	39	18.57	19.15	19.00	0-2	2
		75	0	18.83	19.19	19.13	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP [dB]	MPR [dB]
				26140	26365	26590	[dB]	[dB]
				1860 MHz	1882.5 MHz	1905 MHz		
20 MHz	QPSK	1	0	21.00	20.90	20.54	0	0
		1	49	20.57	21.13	20.75	0	0
		1	99	20.77	20.92	21.20	0	0
		50	0	19.83	20.09	19.99	0-1	1
		50	25	19.56	20.14	19.83	0-1	1
		50	49	19.41	20.08	19.87	0-1	1
		100	0	19.58	20.17	19.93	0-1	1
	16QAM	1	0	19.96	19.97	19.85	0-1	1
		1	49	19.56	20.20	19.98	0-1	1
		1	99	19.69	19.95	20.17	0-1	1
		50	0	18.80	19.06	18.65	0-2	2
		50	25	18.43	19.14	18.80	0-2	2
		50	49	18.42	19.16	19.02	0-2	2
		100	0	18.65	19.10	18.91	0-2	2

10. SYSTEM VERIFICATION

10.1 Tissue Verification

The Head /body simulating material are calibrated by HCT using the DAKS 3.5 to determine the conductivity and permittivity.

Table for Body Tissue Verification

Date of Tests	Tissue Temp. (°C)	Tissue Type	Freq. (MHz)	Measured Conductivity σ (S/m)	Measured Dielectric Constant, ε	Target Conductivity σ (S/m)	Target Dielectric Constant, ε	% dev σ	% dev ε
07/08/2016	19.9	835B	820	0.973	54.213	0.969	55.258	0.41%	-1.89%
			835	0.983	54.12	0.970	55.200	1.34%	-1.96%
			850	0.995	54.080	0.988	55.154	0.71%	-1.95%
07/07/2016	19.5	835B	820	0.973	54.196	0.969	55.258	0.41%	-1.92%
			835	0.983	54.107	0.970	55.200	1.34%	-1.98%
			850	0.994	54.077	0.988	55.154	0.61%	-1.95%
07/06/2016	21.1	1900B	1850	1.449	52.519	1.520	53.300	-4.67%	-1.47%
			1900	1.502	52.313	1.520	53.300	-1.18%	-1.85%
			1910	1.511	52.284	1.520	53.300	-0.59%	-1.91%
07/06/2016	20.4	1900B	1850	1.446	52.505	1.520	53.300	-4.87%	-1.49%
			1900	1.500	52.282	1.520	53.300	-1.32%	-1.91%
			1910	1.511	52.263	1.520	53.300	-0.59%	-1.95%

10.2 System Verification

Prior to assessment, the system is verified to the ± 10 % of the specifications at 835 MHz, 1 900 MHz by using the system Verification kit. (Graphic Plots Attached)

System Verification Results

Freq.	Date	Probe (S/N)	Dipole (S/N)	Liquid	Amb. Temp.	Liquid Temp.	1 W Target SAR_{1g} (SPEAG)	Measured SAR_{1g}	1 W Normalized SAR_{1g}	Deviation	Limit [%]
[MHz]					[°C]	[°C]	[W/kg]	[W/kg]	[W/kg]	[%]	[%]
835	07/08/2016	7370	4d165	Body	20.1	19.9	9.47	0.985	9.85	+ 4.01	± 10
835	07/07/2016	7370	4d165	Body	19.7	19.5	9.47	0.939	9.39	- 0.84	± 10
1 900	07/07/2016	3797	5d061	Body	21.3	21.1	39.7	4.05	40.5	+ 2.02	± 10
1 900	07/06/2016	7370	5d061	Body	20.6	20.4	39.7	3.9	39	- 1.76	± 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 D01v01r04.

11. SAR TEST DATA SUMMARY

11.1 Measurement Results

CDMA BC10 Body SAR													
Frequency		Mode	Tune-Up Limit	Meas. Power	Power Drift	Configuration	Configuration	Duty Cycle	Distance	Meas. SAR	Scaling Factor	Scaled SAR	Plot No.
MHz	Ch.		(dBm)	(dBm)	(dB)				(cm)	(W/kg)		(W/kg)	
820.1	564	EVDO Rev.0	24.5	24.36	-0.09	Horizontal Up	Laptop	1:1	0.5	1.06	1.033	**1.095**	1
820.1	564	EVDO Rev.0	24.5	24.36	-0.15	Horizontal Down	USB Cable	1:1	0.5	0.584	1.033	0.603	-
820.1	564	EVDO Rev.0	24.5	24.36	-0.17	Vertical Front	USB Cable	1:1	0.5	0.513	1.033	0.530	-
820.1	564	EVDO Rev.0	24.5	24.36	-0.08	Vertical Back	Laptop	1:1	0.5	0.485	1.033	0.501	-
820.1	564	EVDO Rev.0	24.5	24.36	-0.04	Top	Laptop	1:1	0.5	0.091	1.033	0.094	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population						Body 1.6 W/kg Averaged over 1 gram							

CDMA BC0 Body SAR													
Frequency		Mode	Tune-Up Limit	Meas. Power	Power Drift	Configuration	Configuration	Duty Cycle	Distance	Meas. SAR	Scaling Factor	Scaled SAR	Plot No.
MHz	Ch.		(dBm)	(dBm)	(dB)				(cm)	(W/kg)		(W/kg)	
824.7	1013	EVDO Rev.0	24.0	23.68	-0.04	Horizontal Up	Laptop	1:1	0.5	0.988	1.076	**1.063**	2
836.52	384	EVDO Rev.0	24.0	23.79	-0.18	Horizontal Up	Laptop	1:1	0.5	0.819	1.050	0.860	-
848.31	777	EVDO Rev.0	24.0	23.76	0.11	Horizontal Up	Laptop	1:1	0.5	0.750	1.057	0.793	-
836.52	384	EVDO Rev.0	24.0	23.79	-0.15	Horizontal Down	USB Cable	1:1	0.5	0.455	1.050	0.478	-
836.52	384	EVDO Rev.0	24.0	23.79	-0.14	Vertical Front	USB Cable	1:1	0.5	0.397	1.050	0.417	-
836.52	384	EVDO Rev.0	24.0	23.79	0.17	Vertical Back	Laptop	1:1	0.5	0.379	1.050	0.398	-
836.52	384	EVDO Rev.0	24.0	23.79	0.07	Top	Laptop	1:1	0.5	0.080	1.050	0.084	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population						Body 1.6 W/kg Averaged over 1 gram							

PCS1900 Body SAR													
Frequency		Mode	Tune-Up Limit	Meas. Power	Power Drift	Configuration	Configuration	Duty Cycle	Distance	Meas. SAR	Scaling Factor	Scaled SAR	Plot No.
MHz	Ch.		(dBm)	(dBm)	(dB)				(cm)	(W/kg)		(W/kg)	
1 851.25	25	EVDO Rev.0	21.0	20.82	-0.15	Horizontal Up	Laptop	1:1	0.5	0.912	1.042	0.950	-
1 880	600	EVDO Rev.0	21.0	20.98	0.18	Horizontal Up	Laptop	1:1	0.5	1.06	1.005	1.065	-
1 908.75	1175	EVDO Rev.0	21.0	20.85	0.13	Horizontal Up	Laptop	1:1	0.5	1.12	1.035	**1.159**	3
1 851.25	25	EVDO Rev.0	21.0	20.82	0.11	Horizontal Down	USB Cable	1:1	0.5	0.754	1.042	0.786	-
1 880	600	EVDO Rev.0	21.0	20.98	-0.02	Horizontal Down	USB Cable	1:1	0.5	0.933	1.005	0.938	-
1 908.75	1175	EVDO Rev.0	21.0	20.85	-0.12	Horizontal Down	USB Cable	1:1	0.5	0.951	1.035	0.984	-
1 880	600	EVDO Rev.0	21.0	20.98	-0.01	Vertical Front	USB Cable	1:1	0.5	0.626	1.005	0.629	-
1 880	600	EVDO Rev.0	21.0	20.98	-0.18	Vertical Back	Laptop	1:1	0.5	0.502	1.005	0.505	-
1 880	600	EVDO Rev.0	21.0	20.98	-0.15	Top	Laptop	1:1	0.5	0.360	1.005	0.362	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population						Body 1.6 W/kg Averaged over 1 gram							

LTE Band 25 QPSK SAR																
Frequency		Mode	Band width	Tune-Up Limit	Meas. Power	Power Drift	Configuration	Configuration	RB Size	RB offset	Duty Cycle	Distance	Meas. SAR	Scaling Factor	Scaled SAR	Plot No.
MHz	Ch.		(MHz)	(dBm)	(dBm)	(dB)						(cm)	(W/kg)		(W/kg)	
1860	26140	QPSK	20	21.2	21.00	-0.10	Horizontal Up	Laptop	1	0	1:1	0.5	0.879	1.047	0.920	-
1882.5	26365	QPSK	20	21.2	21.13	-0.14	Horizontal Up	Laptop	1	49	1:1	0.5	1.15	1.016	**1.168**	4
1905	26590	QPSK	20	21.2	21.20	-0.18	Horizontal Up	Laptop	1	99	1:1	0.5	0.805	1.000	0.805	-
1860	26140	QPSK	20	20.2	19.83	-0.14	Horizontal Up	Laptop	50	0	1:1	0.5	0.621	1.089	0.676	-
1882.5	26365	QPSK	20	20.2	20.14	-0.01	Horizontal Up	Laptop	50	25	1:1	0.5	0.866	1.014	0.878	-
1905	26590	QPSK	20	20.2	19.99	-0.15	Horizontal Up	Laptop	50	0	1:1	0.5	0.751	1.050	0.789	-
1882.5	26365	QPSK	20	20.2	20.17	-0.12	Horizontal Up	Laptop	100	0	1:1	0.5	0.898	1.007	0.904	-
1860	26140	QPSK	20	21.2	21.00	-0.14	Horizontal Down	USB Cable	1	0	1:1	0.5	0.780	1.047	0.817	-
1882.5	26365	QPSK	20	21.2	21.13	0.12	Horizontal Down	USB Cable	1	49	1:1	0.5	0.945	1.016	0.960	-
1905	26590	QPSK	20	21.2	21.20	0.12	Horizontal Down	USB Cable	1	99	1:1	0.5	0.636	1.000	0.636	-
1882.5	26365	QPSK	20	20.2	20.14	-0.10	Horizontal Down	USB Cable	50	25	1:1	0.5	0.761	1.014	0.772	-
1882.5	26365	QPSK	20	20.2	20.17	-0.06	Horizontal Down	USB Cable	100	0	1:1	0.5	0.695	1.007	0.700	-
1882.5	26365	QPSK	20	21.2	21.13	0.04	Vertical Front	USB Cable	1	49	1:1	0.5	0.709	1.016	0.720	-
1882.5	26365	QPSK	20	20.2	20.14	0.16	Vertical Front	USB Cable	50	25	1:1	0.5	0.503	1.014	0.510	-
1882.5	26365	QPSK	20	21.2	21.13	0.09	Vertical Back	Laptop	1	49	1:1	0.5	0.508	1.016	0.516	-
1882.5	26365	QPSK	20	20.2	20.14	-0.19	Vertical Back	Laptop	50	25	1:1	0.5	0.364	1.014	0.369	-
1882.5	26365	QPSK	20	21.2	21.13	0.10	Top	Laptop	1	49	1:1	0.5	0.333	1.016	0.338	-
1882.5	26365	QPSK	20	20.2	20.14	-0.01	Top	Laptop	50	25	1:1	0.5	0.263	1.014	0.267	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 1.6 W/kg Averaged over 1 gram									

11.2 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2013, 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 D01v06.
6. Test all USB orientations [see figure below: (A) Horizontal-Up, (B) Horizontal-Down, (C) Vertical-Front, and (D) Vertical-Back] with a device-to-phantom separation distance of 5 mm or less, according to KDB Publication 447498 D01 requirements. These test orientations are intended for the exposure conditions found in typical laptop/notebook/netbook or tablet computers with either horizontal or vertical USB connector configurations at various locations in the keyboard section of the computer. Current generation portable host computers should be used to establish the required SAR measurement separation distance. The same test separation distance must be used to test all frequency bands and modes in each USB orientation. The typical Horizontal-Up USB connection (A), found in the majority of host computers, must be tested using an appropriate host computer. A host computer with either Vertical-Front (C) or Vertical-Back (D) USB connection should be used to test one of the vertical USB orientations. If a suitable host computer is not available for testing the Horizontal-Down (B) or the remaining Vertical USB orientation, a high quality USB cable, 12 inches or less, may be used for testing these other orientations. It must be documented that the USB cable does not influence the radiating characteristics and output power of the transmitter.
7. Power Supply: Power supplied through host device (TOSHIBA)

CDMA Notes:

1. CDMA Wireless Router SAR for CDMA2000 mode was tested under EVDO Rev 0.per FCC KDB Publication 941225 D01v03r01.
2. CDMA Wireless Router SAR is measured using Subtype 0/1 Physical Layer configurations for Rev. 0 according to KDB 941225 D01v03r01 procedures for data devices. Since the average output power of Subtype 2 for Rev. A is less than the Rev. 0 power levels, EVDO Rev. A SAR is not required. SAR is not required for 1x RTT for Ev-Do hotspot devices when the maximum average output of each channel is less than 1/4 dB higher than that measured in Subtype 0/1 Physical Layer configurations for Rev. 0..
3. For Ev-Do data devices that also support 1x RTT data operations, the 3G SAR test reduction procedure is applied to 1x RTT RC3 and RC1 with Ev-Do Rev. 0, Rev. A as the respective primary modes
4. Per FCC KDB Publication 447498 D01v06, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is s 0.8 W/kg then testing at the other channels is not required for such test configuration(s).

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Consideration for LTE Devices in FCC KDB 941225 D05v02r05.
2. According to FCC KDB 941225 D05v02r05.
   When the reported SAR is ≤ 0.8 W/kg, testing of the 100%RB allocation and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the 1RB, 50%RB and 100%RB allocation with highest output power for that channel.
   Only one channel, and as reported SAR values for 1RB allocation and 50%RB allocation were less than 1.45W/Kg only the highest power RB offset for each allocation was required.
3. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to target MPR is indicated alongside the SAR results.
4. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator..
5. 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.

12. SAR Measurement Variability and Uncertainty

In accordance with KDB procedure 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz, SAR 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.

SAR Measurement variability was assessed using the following procedures for each frequency band:

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg for 1g SAR or < 2.0 W/kg for 10g SAR ; steps 2) through 4) do not apply.

2) When the original highest measured 1g SAR is ≥ 0.80 W/kg or 10g SAR ≥ 2.0W/kg, repeat that measurement once.

3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg for 1g SAR or ≥ 3.625 W/kg for 10g SAR (~ 10% from the 1-g SAR limit).

4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥1.5 W/kg for 1g SAR or ≥3.75 W/kg for 10g SAR and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Frequency		Modulation	Battery	Configuration	Original SAR (W/kg)	Repeated SAR (W/kg)	Largest to Smallest SAR Ratio	Plot No.
MHz	Channel							
820.1	564	CDMA BC10 EVDO Rev.0	Standard	Horizontal Up Laptop	1.06	1.02	1.04	5
1 908.75	1175	PCS1900 EVDO Rev.0	Standard	Horizontal Up Laptop	1.12	1.05	1.07	6
1882.5	26365	LTE 25	Standard	Horizontal Up Laptop	1.15	1.12	1.03	7

13. MEASUREMENT UNCERTAINTY

Uncertainty (700 MHz ~ 5000 MHz)						
Error Description	**Tol (± %)**	**Prob. dist.**	**Div.**	**c_i**	**Standard Uncertainty (± %)**	**v_{eff}**
1. Measurement System						
Probe Calibration	6.55	N	1	1	6.55	∞
Axial Isotropy	4.70	R	1.73	0.7	1.90	∞
Hemispherical Isotropy	9.60	R	1.73	0.7	3.88	∞
Boundary Effects	1.00	R	1.73	1	0.58	∞
Linearity	4.70	R	1.73	1	2.71	∞
System Detection Limits	1.00	R	1.73	1	0.58	∞
Readout Electronics	0.30	N	1.00	1	0.30	∞
Response Time	0.8	R	1.73	1	0.46	∞
Integration Time	2.6	R	1.73	1	1.50	∞
RF Ambient Conditions	3.00	R	1.73	1	1.73	∞
Probe Positioner	0.40	R	1.73	1	0.23	∞
Probe Positioning	2.90	R	1.73	1	1.67	∞
Max SAR Eval	1.00	R	1.73	1	0.58	∞
2.Test Sample Related						
Device Positioning	2.25	N	1.00	1	2.25	9
Device Holder	3.60	N	1.00	1	3.60	∞
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.)	3.00	N	1	0.64	1.73	∞
Liquid Permitivity(target)	5.00	R	1.73	0.6	1.73	∞
Liquid Permitivity(meas.)	2.30	N	1	0.6	1.14	∞
Combind Standard Uncertainty					10.99	
Coverage Factor for 95 %					k=2	
Expanded STD Uncertainty					21.98	

14. SAR TEST EQUIPMENT

Manufacturer	Type / Model	S/N	Calib. Date	Calib.Interval	Calib.Due
SPEAG	Triple Modular Phantom	-	N/A	N/A	N/A
HP	SAR System Control PC	-	N/A	N/A	N/A
Staubli	TX90 Xlspeag	F13/ 5R4XF1/A/01	N/A	N/A	N/A
Staubli	TX90 XLspeag	F11/5K3RA1/A/01	N/A	N/A	N/A
Staubli	CS8Cspeag-TX90	F13/5R4XF1/C/01	N/A	N/A	N/A
Staubli	CS8Cspeag-TX90	F11/5K3RA1/C/01	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	D21142605	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	D21142603	N/A	N/A	N/A
SPEAG	DAE4	648	05/11/2016	Annual	05/11/2017
SPEAG	DAE4	1225	03/17/2016	Annual	03/17/2017
SPEAG	E-Field Probe EX3DV4	3797	11/24/2015	Annual	11/24/2016
SPEAG	E-Field Probe EX3DV4	7370	09/01/2015	Annual	09/01/2016
SPEAG	Dipole D835V2	4d165	11/24/2015	Annual	11/24/2016
SPEAG	Dipole D1900V2	5d061	04/25/2016	Annual	04/25/2017
Agilent	Power Meter N1991A	MY45101406	10/03/2015	Annual	10/03/2016
Agilent	Power Sensor N1921A	MY55220026	08/19/2015	Annual	08/19/2016
SPEAG	DAKS 3.5	1038	05/31/2016	Annual	05/31/2017
HP	Directional Bridge	86205A	05/18/2016	Annual	05/18/2017
Agilent	Base Station E5515C	GB44400269	02/05/2016	Annual	02/05/2017
HP	Signal Generator N5182A	MY47070230	05/13/2016	Annual	05/13/2017
Hewlett Packard	11636B/Power Divider	58698	02/27/2016	Annual	02/27/2017
TESTO	175-H1/Thermometer	40332651310	02/12/2016	Annual	02/12/2017
TESTO	175-H1/Thermometer	40331939309	02/12/2016	Annual	02/12/2017
EMPOWER	RF Power amplifier	1011	10/20/2015	Annual	10/20/2016
Agilent	Attenuator(3dB)	52744	10/20/2015	Annual	10/20/2016
Agilent	Attenuator(20dB)	52664	10/20/2015	Annual	10/20/2016
HP	Notebook(DAKS)	-	N/A	N/A	N/A
TOSHIBA	Notebook	-	N/A	N/A	N/A
HP	Dual Directional Coupler	16072	10/20/2015	Annual	10/20/2016
R&S	Wideband Radio Communication Tester CMW500	115733	09/18/2015	Annual	09/18/2016

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

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.

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC and Industry Canada. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

16. REFERENCES

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Attachment 1. – SAR Test Plots

Test Laboratory:	HCT CO., LTD
EUT Type:	LTE/CDMA USB Dongle
Liquid Temperature:	19.9 ℃
Ambient Temperature:	20.1 ℃
Test Date:	07/08/2016
Plot No.:	1

DUT: U772; Type: Bar

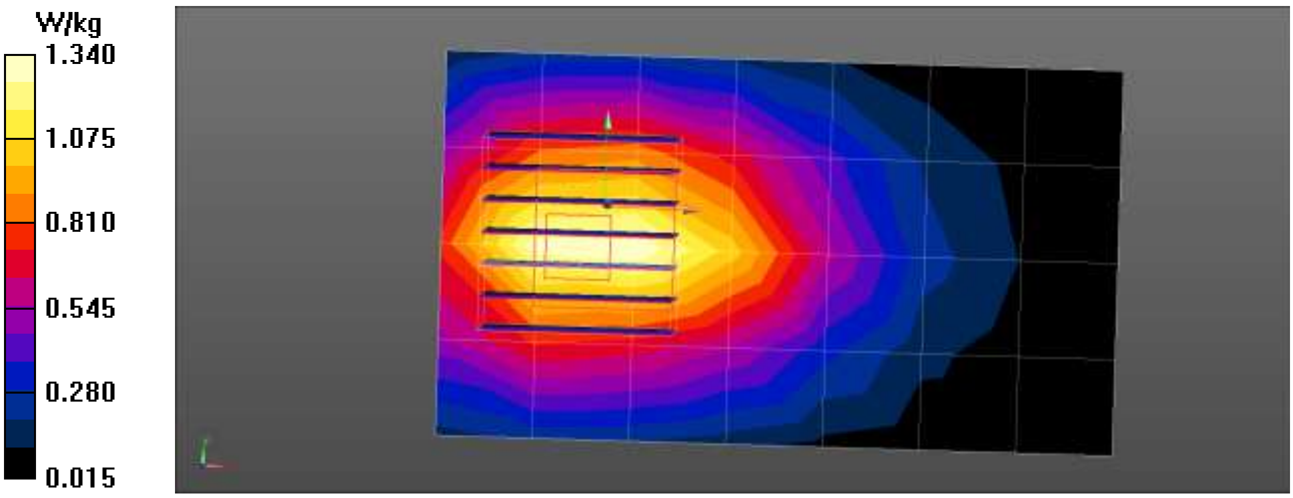
Communication System: UID 0, BC10 (0); Frequency: 820.1 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 820.1 MHz; σ = 0.973 S/m; ε_r = 54.212; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7370; ConvF(9.66, 9.66, 9.66); Calibrated: 2015-09-01;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2016-05-11
- Phantom: Triple Flat Phantom
- Measurement SW: DASY52, Version 52.8 (8);

Configuration/CDMA BC10 EVDO Rev.0 Body Horizontal Up 564ch/Area Scan (5x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.34 W/kg

Configuration/ CDMA BC10 EVDO Rev.0 Body Horizontal Up 564ch/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 37.67 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 1.48 W/kg
SAR(1 g) = 1.06 W/kg; SAR(10 g) = 0.734 W/kg
Maximum value of SAR (measured) = 1.30 W/kg



Test Laboratory:	HCT CO., LTD
EUT Type:	LTE/CDMA USB Dongle
Liquid Temperature:	19.5 ℃
Ambient Temperature:	19.7 ℃
Test Date:	07/07/2016
Plot No.:	2

DUT: U772; Type: Bar

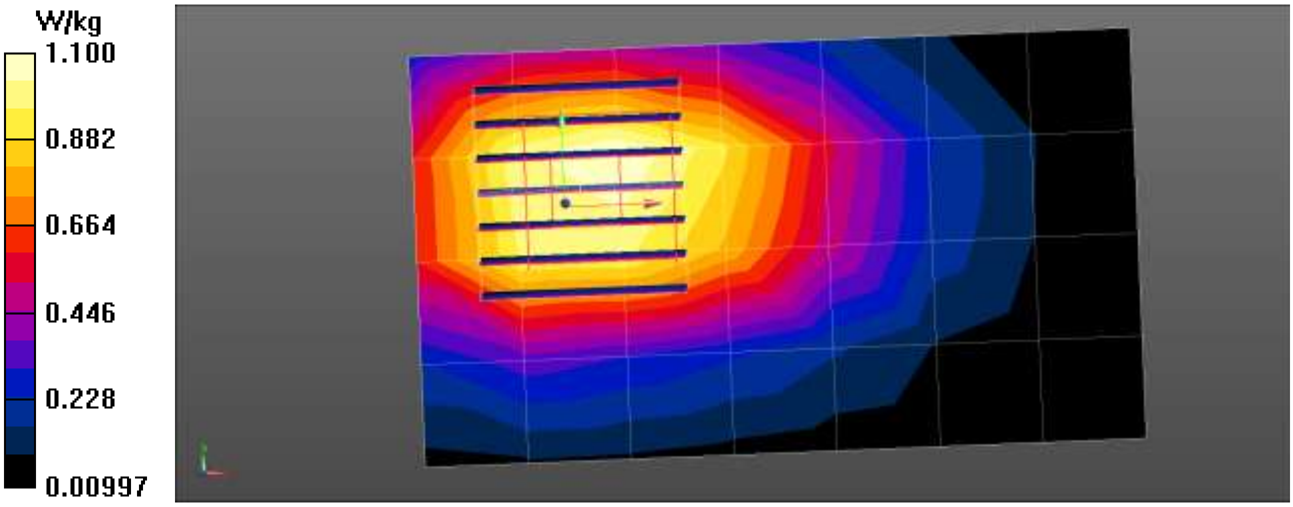
Communication System: UID 0, CDMA 835MHz FCC (0); Frequency: 824.7 MHz;Duty Cycle: 1:1
Medium parameters used: f = 825 MHz; σ = 0.976 S/m; ε_r = 54.163; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7370; ConvF(9.66, 9.66, 9.66); Calibrated: 2015-09-01;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2016-05-11
- Phantom: Triple Flat Phantom
- Measurement SW: DASY52, Version 52.8 (8);

Configuration/CDMA BC0 EVDO Rev.0 Body Horizontal Up 1013ch/Area Scan (5x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.10 W/kg

Configuration/ CDMA BC0 EVDO Rev.0 Body Horizontal Up 1013ch/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 33.51 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 1.40 W/kg
SAR(1 g) = 0.988 W/kg; SAR(10 g) = 0.657 W/kg
Maximum value of SAR (measured) = 1.24 W/kg



Test Laboratory:	HCT CO., LTD
EUT Type:	LTE/CDMA USB Dongle
Liquid Temperature:	21.1 ℃
Ambient Temperature:	21.3 ℃
Test Date:	07/06/2016
Plot No.:	3

DUT: U772; Type: Bar

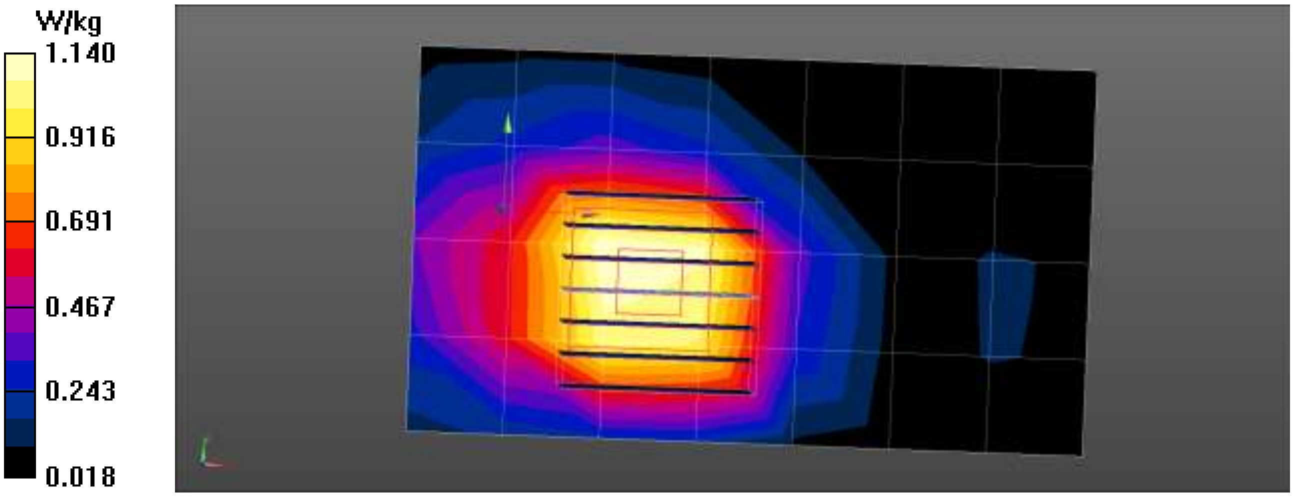
Communication System: UID 0, PCS 1900MHz FCC (0); Frequency: 1908.75 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1908.75 MHz; σ = 1.51 S/m; ε_r = 52.289; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(7.32, 7.32, 7.32); Calibrated: 2015-11-24;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2016-03-17
- Phantom: Triple Flat Phantom
- Measurement SW: DASY52, Version 52.8 (8);

Configuration/PCS 1900 EVDO Rev.0 Body Horizontal Up 1175ch/Area Scan (5x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.14 W/kg

Configuration/1900 EVDO Rev.0 Body Horizontal Up 1175ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 24.17 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 1.79 W/kg
SAR(1 g) = 1.12 W/kg; SAR(10 g) = 0.650 W/kg
Maximum value of SAR (measured) = 1.49 W/kg



Test Laboratory:	HCT CO., LTD
EUT Type:	LTE/CDMA USB Dongle
Liquid Temperature:	20.4 ℃
Ambient Temperature:	20.6 ℃
Test Date:	07/06/2016
Plot No.:	4

DUT: U772; Type: Bar

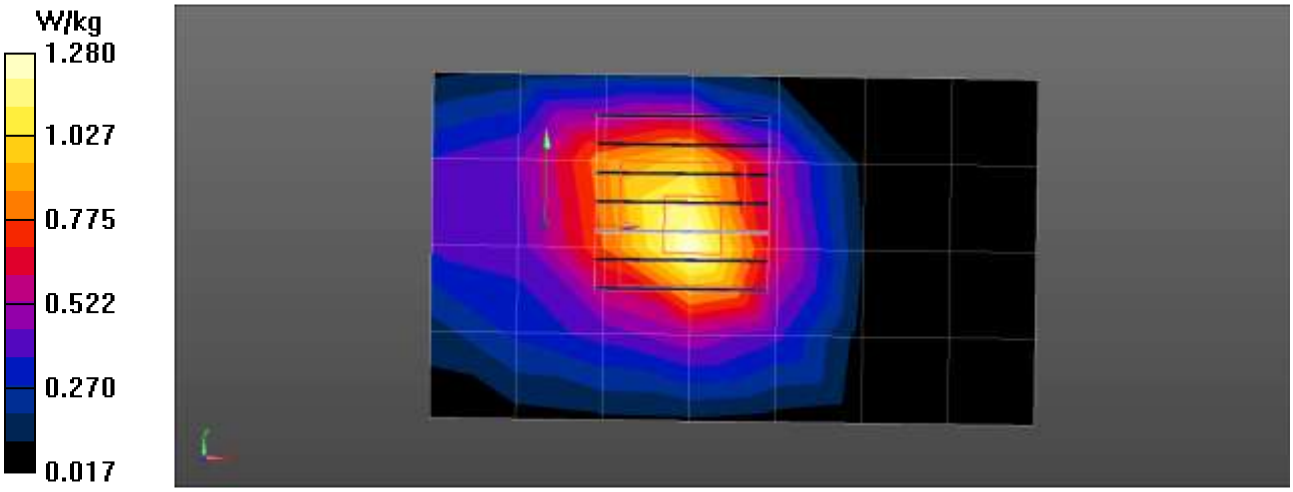
Communication System: UID 0, LTE Band 25 (0); Frequency: 1882.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1882.5 MHz; σ = 1.48 S/m; ε_r = 52.353; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7370; ConvF(7.49, 7.49, 7.49); Calibrated: 2015-09-01;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2016-05-11
- Phantom: Triple Flat Phantom
- Measurement SW: DASY52, Version 52.8 (8);

Configuration/LTE Band 25 Horizontal Up QPSK 20MHz 1RB 49 offset 26365ch/Area Scan (5x8x1):
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.28 W/kg

Configuration/LTE Band 25 Horizontal Up QPSK 20MHz 1RB 49 offset 26365ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 22.99 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 1.96 W/kg
SAR(1 g) = 1.15 W/kg; SAR(10 g) = 0.638 W/kg
Maximum value of SAR (measured) = 1.70 W/kg



Test Laboratory:	HCT CO., LTD
EUT Type:	LTE/CDMA USB Dongle
Liquid Temperature:	19.9 ℃
Ambient Temperature:	20.1 ℃
Test Date:	07/08/2016
Plot No.:	5

DUT: U772; Type: Bar

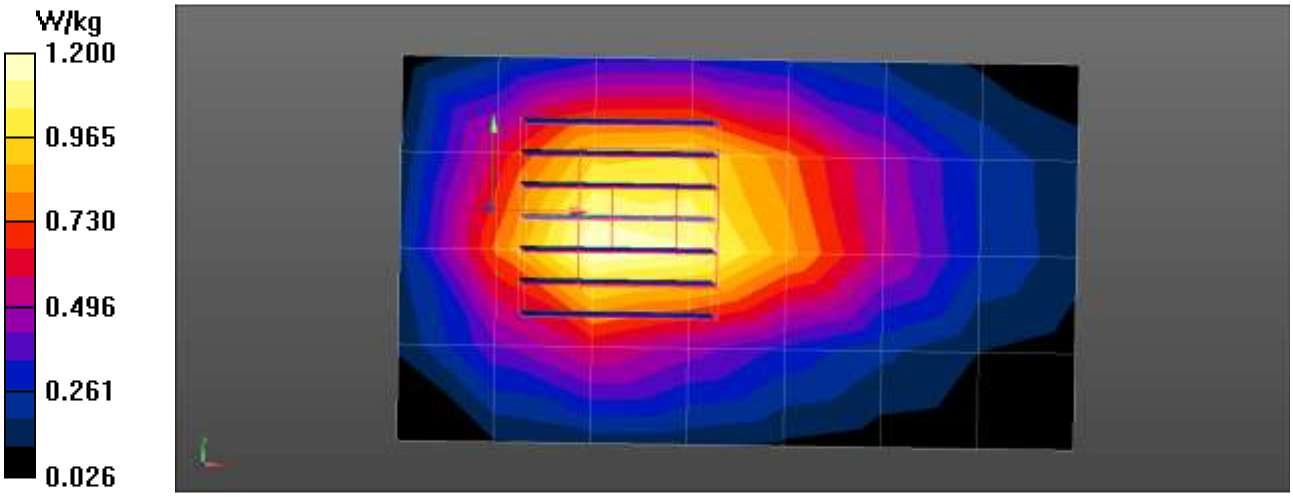
Communication System: UID 0, BC10 (0); Frequency: 820.1 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 820.1 MHz; σ = 0.973 S/m; ε_r = 54.212; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7370; ConvF(9.66, 9.66, 9.66); Calibrated: 2015-09-01;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2016-05-11
- Phantom: Triple Flat Phantom
- Measurement SW: DASY52, Version 52.8 (8);

Configuration/CDMA BC10 EVDO Rev.0 Body Horizontal Up 564ch/Area Scan (5x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.20 W/kg

Configuration/ CDMA BC10 EVDO Rev.0 Body Horizontal Up 564ch/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 32.06 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 1.39 W/kg
SAR(1 g) = 1.02 W/kg; SAR(10 g) = 0.694 W/kg
Maximum value of SAR (measured) = 1.23 W/kg



Test Laboratory:	HCT CO., LTD
EUT Type:	LTE/CDMA USB Dongle
Liquid Temperature:	21.1 ℃
Ambient Temperature:	21.3 ℃
Test Date:	07/07/2016
Plot No.:	6

DUT: U772; Type: Bar

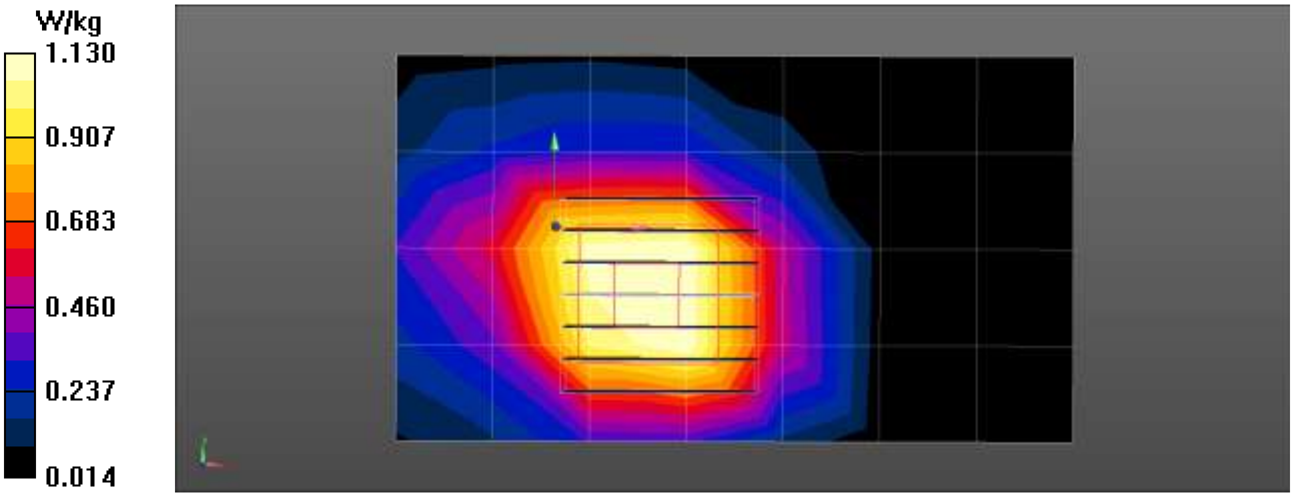
Communication System: UID 0, PCS 1900MHz FCC (0); Frequency: 1908.75 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1908.75 MHz; σ = 1.51 S/m; ε_r = 52.289; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(7.32, 7.32, 7.32); Calibrated: 2015-11-24;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2016-03-17
- Phantom: Triple Flat Phantom
- Measurement SW: DASY52, Version 52.8 (8);

Configuration/PCS 1900 EVDO Rev.0 Body Horizontal Up 1175ch/Area Scan (5x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.13 W/kg

Configuration/ PCS 1900 EVDO Rev.0 Body Horizontal Up 1175ch/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 23.23 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 1.64 W/kg
SAR(1 g) = 1.05 W/kg; SAR(10 g) = 0.619 W/kg
Maximum value of SAR (measured) = 1.38 W/kg



Test Laboratory:	HCT CO., LTD
EUT Type:	LTE/CDMA USB Dongle
Liquid Temperature:	20.4 ℃
Ambient Temperature:	20.6 ℃
Test Date:	07/06/2016
Plot No.:	7

DUT: U772; Type: Bar

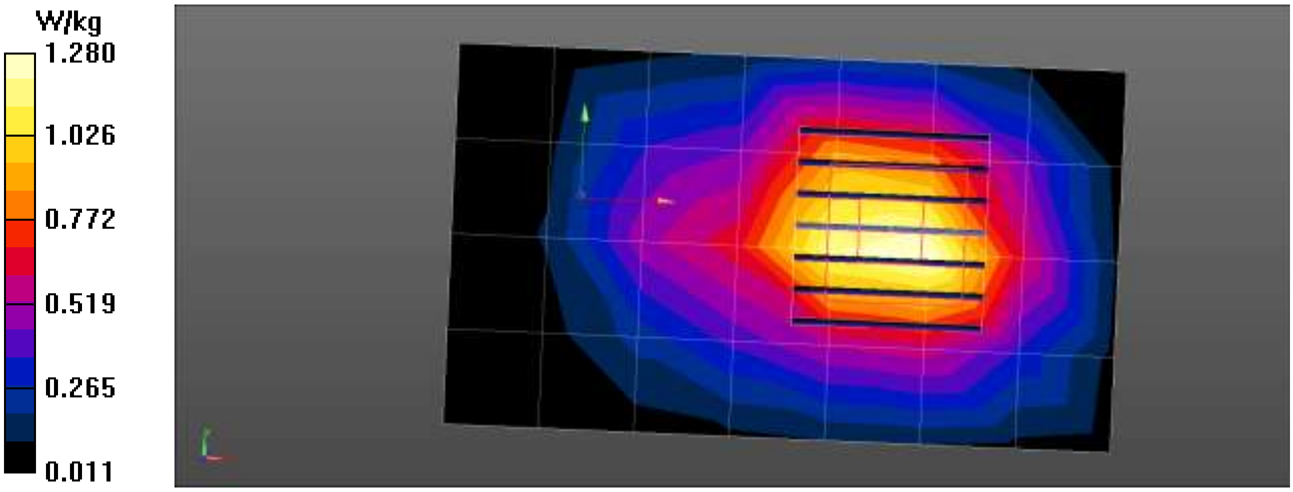
Communication System: UID 0, LTE Band 25 (0); Frequency: 1882.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1882.5 MHz; σ = 1.48 S/m; ε_r = 52.353; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7370; ConvF(7.49, 7.49, 7.49); Calibrated: 2015-09-01;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2016-05-11
- Phantom: Triple Flat Phantom
- Measurement SW: DASY52, Version 52.8 (8);

Configuration/LTE Band 25 Horizontal Up QPSK 20MHz 1RB 49offset 26365ch/Area Scan (5x8x1):
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.28 W/kg

Configuration/LTE Band 25 Horizontal Up QPSK 20MHz 1RB 49offset 26365ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.33 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 1.93 W/kg
SAR(1 g) = 1.12 W/kg; SAR(10 g) = 0.646 W/kg
Maximum value of SAR (measured) = 1.57 W/kg



Attachment 2. – Dipole Verification Plots

Test Laboratory:	HCT CO., LTD
Input Power	100 mW (20 dBm)
Liquid Temp:	19.9 ℃
Test Date:	07/08/2016

DUT: Dipole 835 MHz D835V2; Type: D835V2

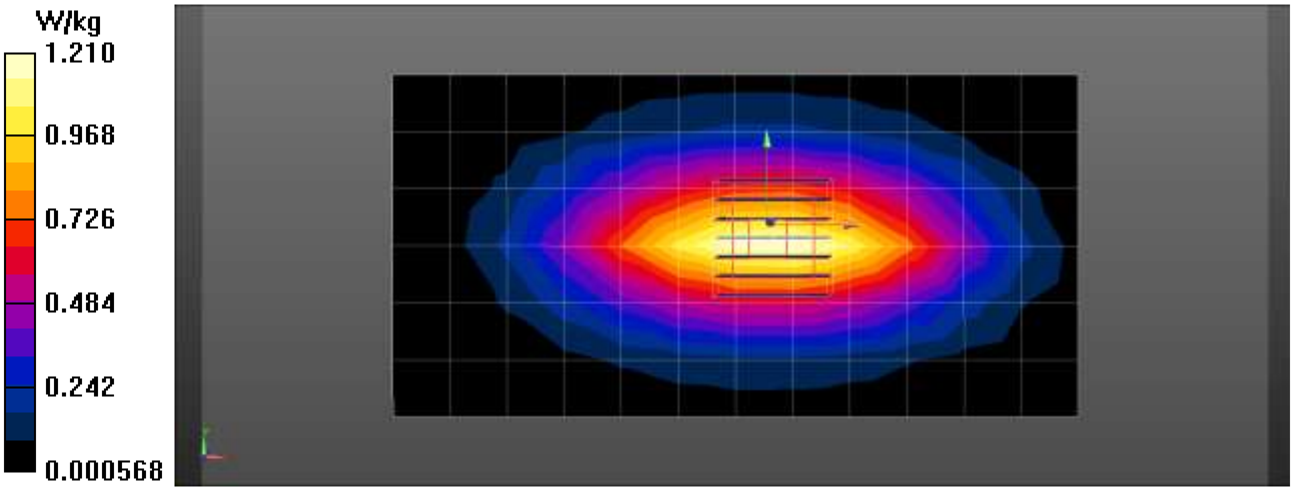
Communication System: UID 0, CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used: f = 835 MHz; σ = 0.983 S/m; ε_r = 54.12; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7370; ConvF(9.66, 9.66, 9.66); Calibrated: 2015-09-01;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2016-05-11
- Phantom: Triple Flat Phantom
- Measurement SW: DASY52, Version 52.8 (8);

Dipole/835MHz Body Verification/Area Scan (7x13x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.21 W/kg

Dipole/835MHz Body Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 36.29 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.42 W/kg
SAR(1 g) = 0.985 W/kg; SAR(10 g) = 0.657 W/kg
Maximum value of SAR (measured) = 1.23 W/kg



Test Laboratory:	HCT CO., LTD
Input Power	100 mW (20 dBm)
Liquid Temp:	19.7 ℃
Test Date:	07/07/2016

DUT: Dipole 835 MHz D835V2; Type: D835V2

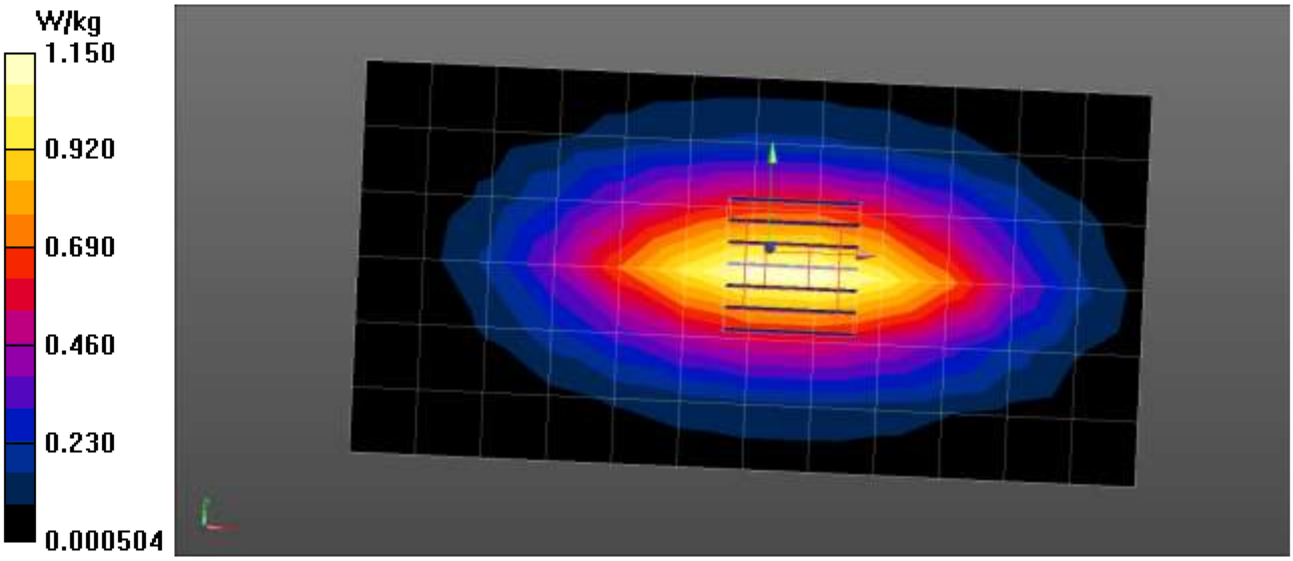
Communication System: UID 0, CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used: f = 835 MHz; σ = 0.983 S/m; ε_r = 54.107; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7370; ConvF(9.66, 9.66, 9.66); Calibrated: 2015-09-01;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2016-05-11
- Phantom: Triple Flat Phantom
- Measurement SW: DASY52, Version 52.8 (8);

Dipole/835MHz Body Verification/Area Scan (7x13x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.15 W/kg

Dipole/835MHz Body Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 35.43 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.35 W/kg
SAR(1 g) = 0.939 W/kg; SAR(10 g) = 0.626 W/kg
Maximum value of SAR (measured) = 1.17 W/kg



Test Laboratory:	HCT CO., LTD
Input Power	100 mW (20 dBm)
Liquid Temp:	21.1 ℃
Test Date:	07/07/2016

DUT: Dipole 1900 MHz D1900V2; Type: D1900V2

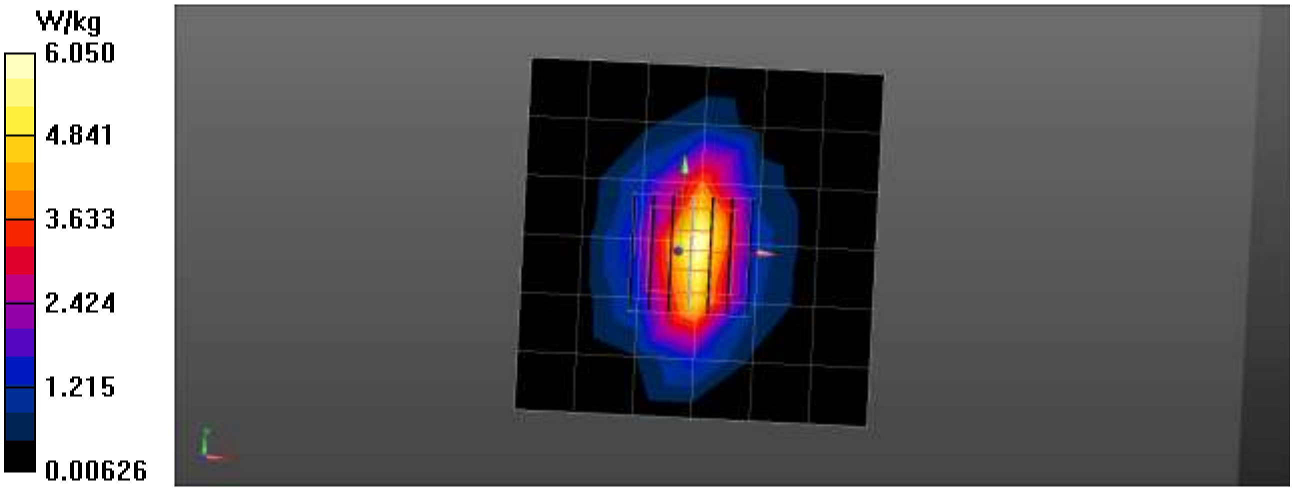
Communication System: UID 0, CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.502 S/m; ε_r = 52.313; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3797; ConvF(7.32, 7.32, 7.32); Calibrated: 2015-11-24;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2016-03-17
- Phantom: Triple Flat Phantom
- Measurement SW: DASY52, Version 52.8 (8);

Dipole/1900MHz Body Verification/Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 6.05 W/kg

Dipole/1900MHz Body Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 64.96 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 8.58 W/kg
SAR(1 g) = 4.05 W/kg; SAR(10 g) = 1.92 W/kg
Maximum value of SAR (measured) = 6.25 W/kg



Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 20.4 ℃
Test Date: 07/06/2016

DUT: Dipole 1900 MHz D1900V2; Type: D1900V2

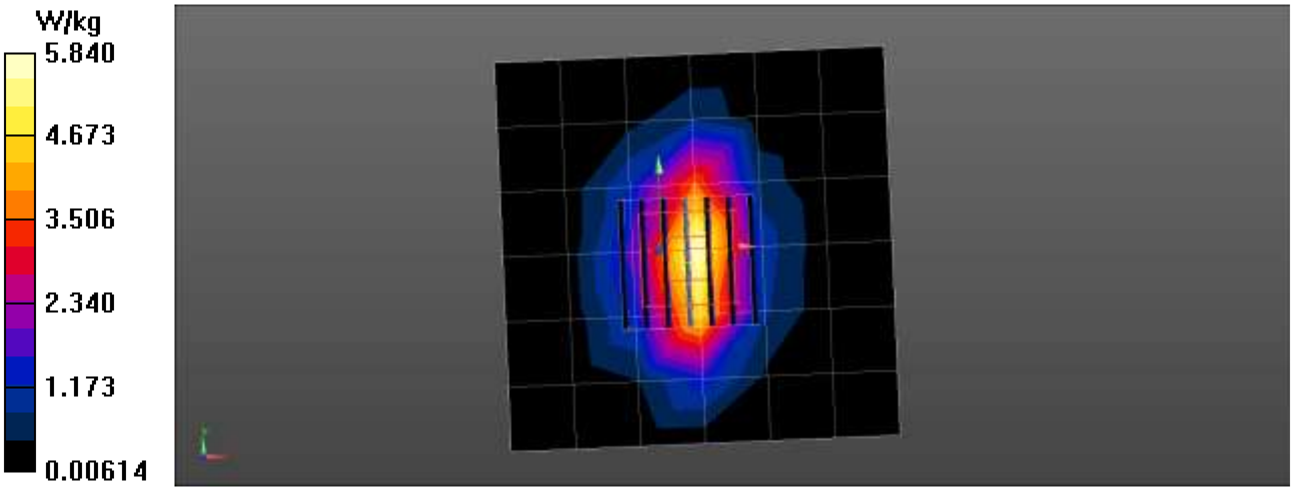
Communication System: UID 0, CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.5 S/m; ε_r = 52.282; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7370; ConvF(7.49, 7.49, 7.49); Calibrated: 2015-09-01;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn648; Calibrated: 2016-05-11
- Phantom: Triple Flat Phantom
- Measurement SW: DASY52, Version 52.8 (8);

Dipole/1900MHz Body Verification/Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 5.84 W/kg

Dipole/1900MHz Body Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 63.32 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 8.35 W/kg
SAR(1 g) = 3.9 W/kg; SAR(10 g) = 1.84 W/kg
Maximum value of SAR (measured) = 6.07 W/kg



Attachment 3. – Probe Calibration Data

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

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Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)**

Certificate No: **EX3-7370_Sep15**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:7370
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	September 1, 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	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
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	
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 2, 2015

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

Certificate No: EX3-7370_Sep15 Page 1 of 11

Calibration Laboratory of
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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
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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).

Probe EX3DV4

SN:7370

Manufactured: March 17, 2015
Calibrated: September 1, 2015

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

EX3DV4– SN:7370 September 1, 2015

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7370

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.47	0.51	0.43	± 10.1 %
DCP (mV)[B]	99.0	105.3	99.8	

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	162.3	±3.3 %
		Y	0.0	0.0	1.0		164.9	
		Z	0.0	0.0	1.0		167.7	

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

[A] The uncertainties of Norm X,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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DASY/EASY - Parameters of Probe: EX3DV4 - SN:7370

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)	Unc (k=2)
450	43.5	0.87	10.67	10.67	10.67	0.16	1.70	± 13.3 %
750	41.9	0.89	9.81	9.81	9.81	0.26	1.24	± 12.0 %
835	41.5	0.90	9.57	9.57	9.57	0.27	1.17	± 12.0 %
900	41.5	0.97	9.29	9.29	9.29	0.29	1.12	± 12.0 %
1450	40.5	1.20	8.08	8.08	8.08	0.26	1.06	± 12.0 %
1750	40.1	1.37	8.05	8.05	8.05	0.34	0.80	± 12.0 %
1900	40.0	1.40	7.80	7.80	7.80	0.34	0.80	± 12.0 %
1950	40.0	1.40	7.57	7.57	7.57	0.40	0.80	± 12.0 %
2300	39.5	1.67	7.43	7.43	7.43	0.33	0.83	± 12.0 %
2450	39.2	1.80	6.94	6.94	6.94	0.32	0.92	± 12.0 %
2600	39.0	1.96	6.81	6.81	6.81	0.43	0.80	± 12.0 %
3500	37.9	2.91	6.92	6.92	6.92	0.29	1.39	± 13.1 %
5200	36.0	4.66	5.13	5.13	5.13	0.35	1.80	± 13.1 %
5300	35.9	4.76	4.95	4.95	4.95	0.35	1.80	± 13.1 %
5500	35.6	4.96	4.53	4.53	4.53	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.35	4.35	4.35	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.53	4.53	4.53	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 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.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7370

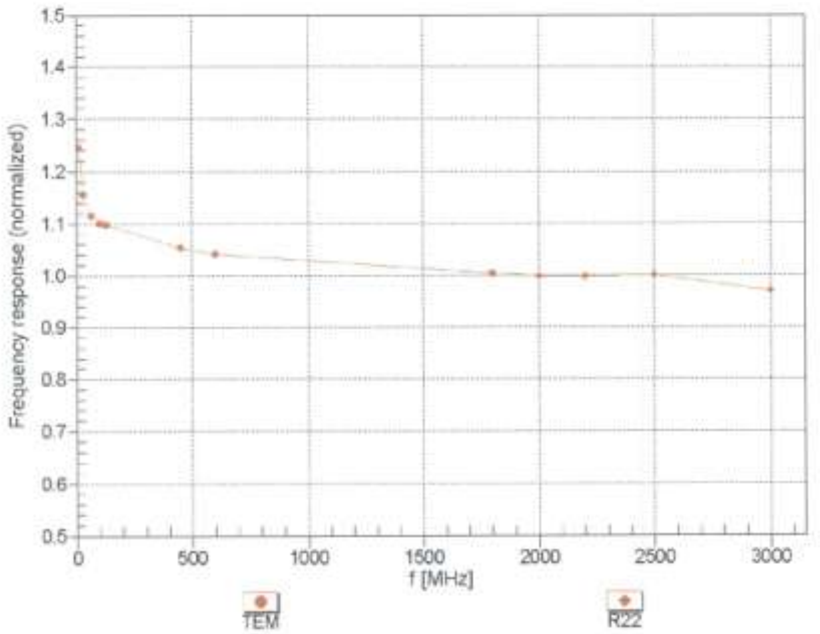
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
450	56.7	0.94	11.08	11.08	11.08	0.11	1.60	± 13.3 %
750	55.5	0.96	9.82	9.82	9.82	0.24	1.27	± 12.0 %
835	55.2	0.97	9.66	9.66	9.66	0.29	1.25	± 12.0 %
1750	53.4	1.49	7.76	7.76	7.76	0.47	0.81	± 12.0 %
1900	53.3	1.52	7.49	7.49	7.49	0.41	0.80	± 12.0 %
2450	52.7	1.95	7.16	7.16	7.16	0.35	0.80	± 12.0 %
2600	52.5	2.16	7.07	7.07	7.07	0.29	0.80	± 12.0 %
5200	49.0	5.30	4.64	4.64	4.64	0.45	1.90	± 13.1 %
5300	48.9	5.42	4.46	4.46	4.46	0.45	1.90	± 13.1 %
5500	48.6	5.65	4.03	4.03	4.03	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.85	3.85	3.85	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.03	4.03	4.03	0.50	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

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

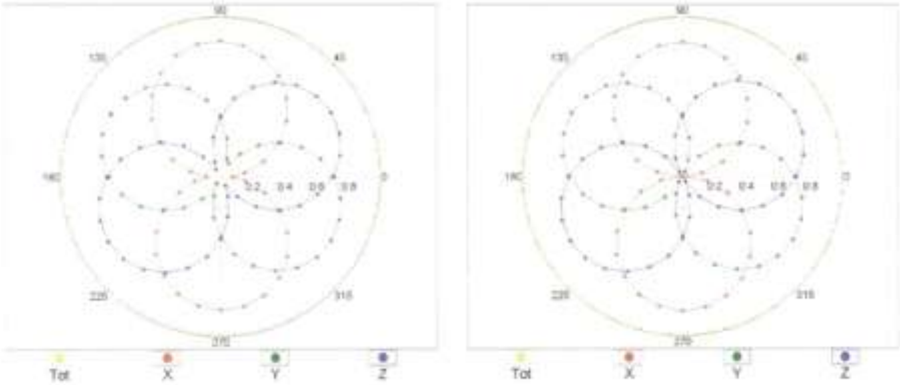


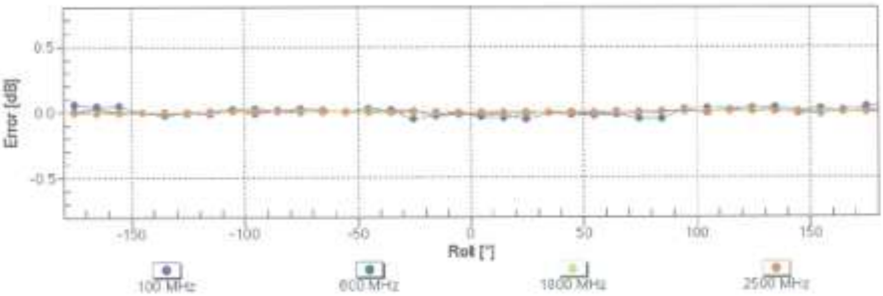
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

EX3DV4– SN:7370 September 1, 2015

Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM f=1800 MHz,R22





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

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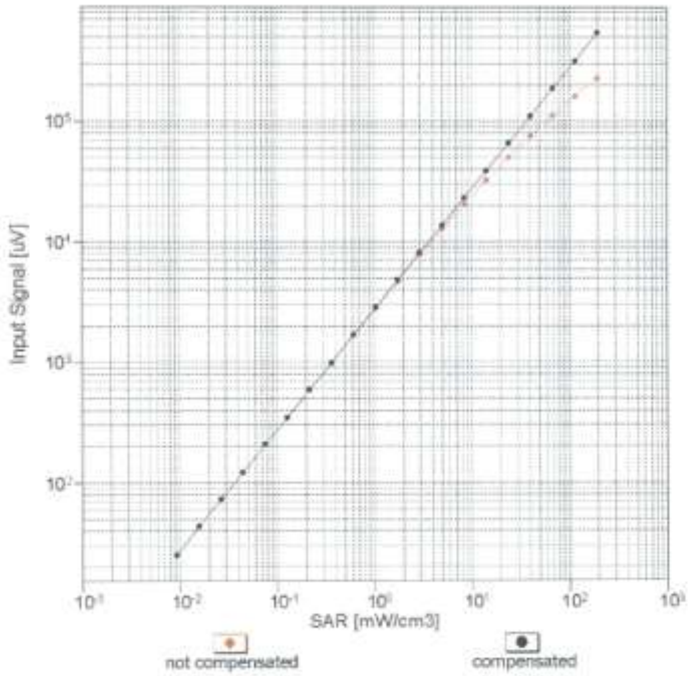
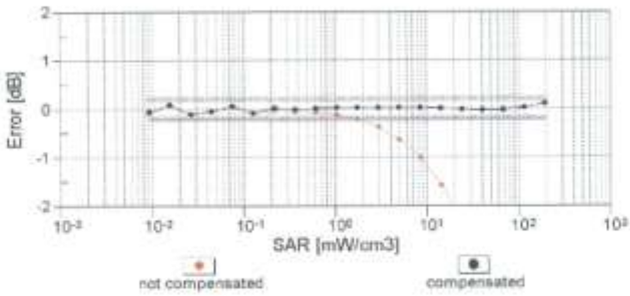
EX3DV4– SN:7370 September 1, 2015

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





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

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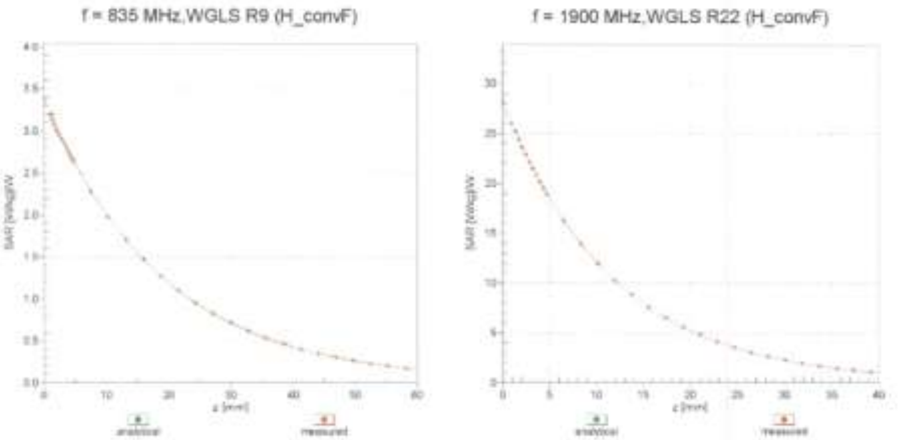
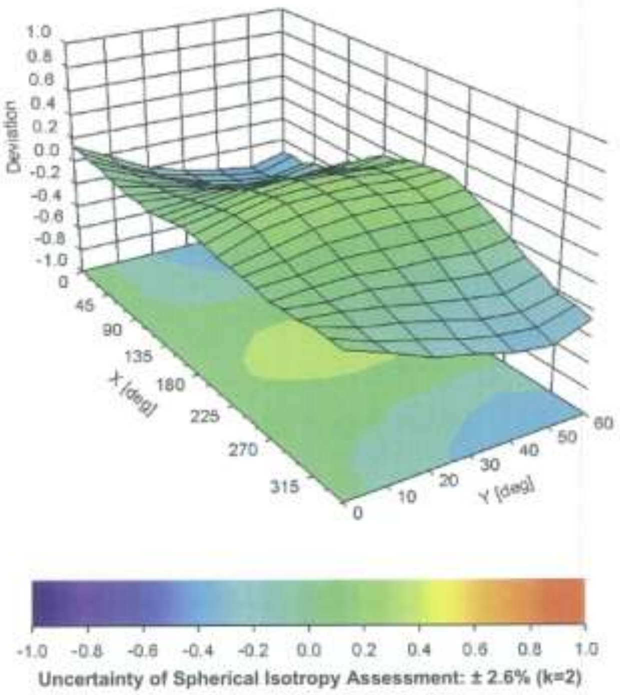
EX3DV4– SN:7370 September 1, 2015

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

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DASY/EASY - Parameters of Probe: EX3DV4 - SN:7370

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	94.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

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Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)**

Certificate No: **EX3-3797_Nov15**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3797

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: November 24, 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)

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Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
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-15)	In house check: Oct-16

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

Issued: November 24, 2015

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Certificate No: EX3-3797_Nov15 Page 1 of 11

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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
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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).

Probe EX3DV4

SN:3797

Manufactured: April 5, 2011
Calibrated: November 24, 2015

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.62	0.58	0.56	± 10.1 %
DCP (mV)[B]	99.5	97.0	98.4	

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	177.5	±2.5 %
		Y	0.0	0.0	1.0		176.9	
		Z	0.0	0.0	1.0		171.8	

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

[A] The uncertainties of Norm X,Y,Z do not affect the 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.

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	41.9	0.89	9.38	9.38	9.38	0.32	0.96	± 12.0 %
835	41.5	0.90	8.98	8.98	8.98	0.16	1.78	± 12.0 %
900	41.5	0.97	8.86	8.86	8.86	0.21	1.53	± 12.0 %
1450	40.5	1.20	7.73	7.73	7.73	0.15	1.77	± 12.0 %
1750	40.1	1.37	7.85	7.85	7.85	0.35	0.80	± 12.0 %
1900	40.0	1.40	7.61	7.61	7.61	0.34	0.80	± 12.0 %
1950	40.0	1.40	7.32	7.32	7.32	0.39	0.83	± 12.0 %
2300	39.5	1.67	7.27	7.27	7.27	0.39	0.85	± 12.0 %
2450	39.2	1.80	6.90	6.90	6.90	0.40	0.80	± 12.0 %
2600	39.0	1.96	6.68	6.68	6.68	0.46	0.80	± 12.0 %
3500	37.9	2.91	6.61	6.61	6.61	0.39	0.99	± 13.1 %
5200	36.0	4.66	4.80	4.80	4.80	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.59	4.59	4.59	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.52	4.52	4.52	0.45	1.80	± 13.1 %
5600	35.5	5.07	4.21	4.21	4.21	0.50	1.80	± 13.1 %
5800	35.3	5.27	4.20	4.20	4.20	0.50	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 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.

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

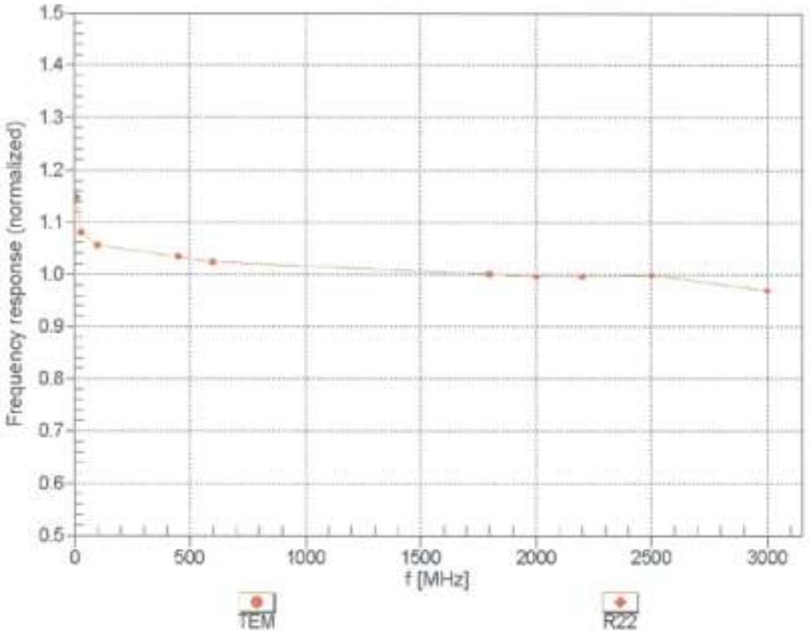
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	55.5	0.96	9.39	9.39	9.39	0.29	1.16	± 12.0 %
835	55.2	0.97	9.17	9.17	9.17	0.32	1.09	± 12.0 %
1750	53.4	1.49	7.52	7.52	7.52	0.42	0.80	± 12.0 %
1900	53.3	1.52	7.32	7.32	7.32	0.31	0.97	± 12.0 %
2450	52.7	1.95	6.91	6.91	6.91	0.34	0.85	± 12.0 %
2600	52.5	2.16	6.75	6.75	6.75	0.16	0.99	± 12.0 %
5200	49.0	5.30	4.24	4.24	4.24	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.07	4.07	4.07	0.50	1.90	± 13.1 %
5500	48.6	5.65	3.80	3.80	3.80	0.55	1.90	± 13.1 %
5600	48.5	5.77	3.54	3.54	3.54	0.60	1.90	± 13.1 %
5800	48.2	6.00	3.84	3.84	3.84	0.60	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

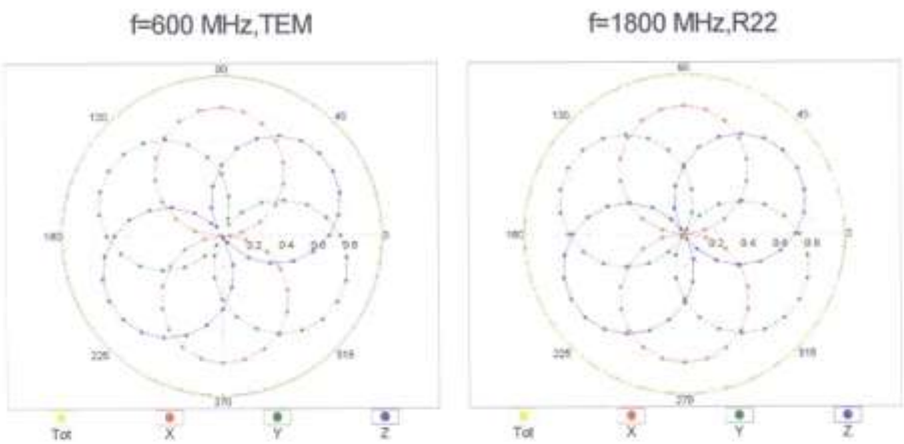
(TEM-Cell:ifi110 EXX, Waveguide: R22)

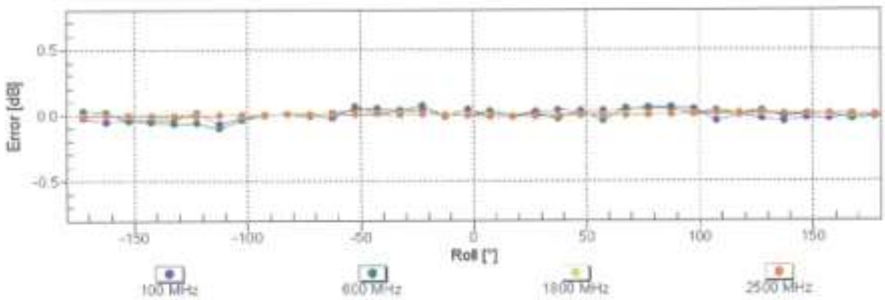


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

EX3DV4– SN:3797 November 24, 2015

Receiving Pattern (ϕ), ϑ = 0°





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

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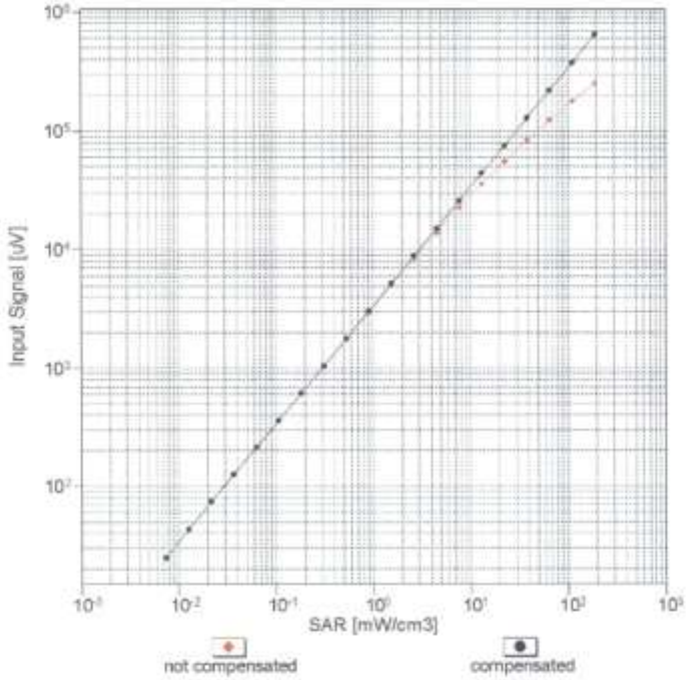
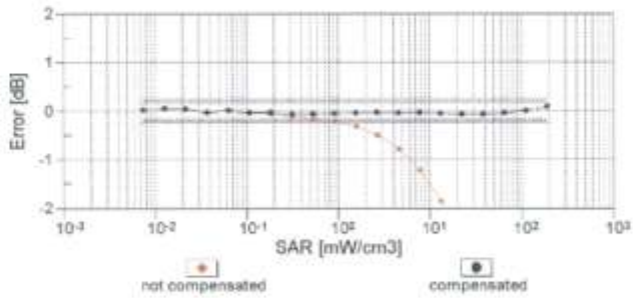
Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)





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

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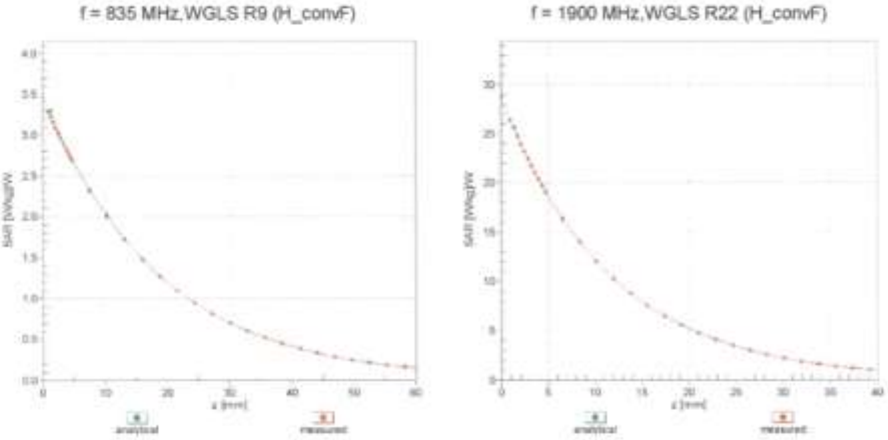
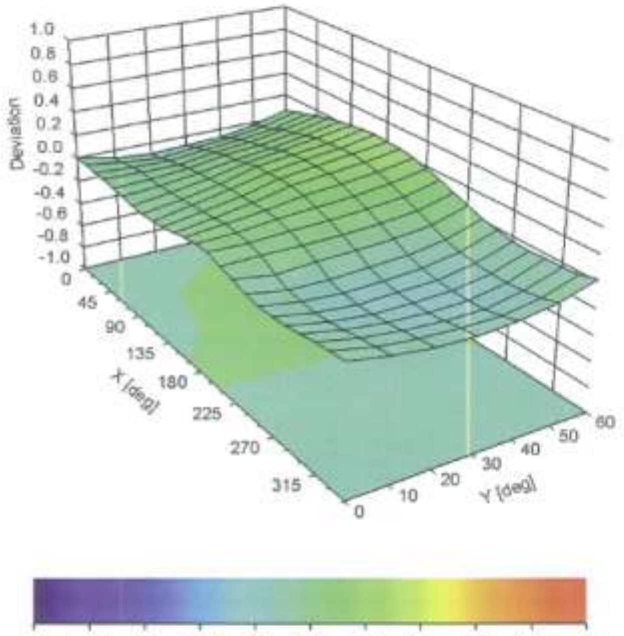
Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	67.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Attachment 4. – Dipole Calibration Data

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

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Accreditation No.: SCS 0108

Client HCT (Dymstec)

Certificate No: D835V2-4d165_Nov15

CALIBRATION CERTIFICATE

Object: D835V2 - SN: 4d165

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

Calibration date: November 24, 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-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	US37292783	07-Oct-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	MY41092317	07-Oct-15 (No. 217-02223)	Oct-16
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 EX3DV4	SN: 7349	30-Dec-14 (No. EX3-7349_Dec14)	Dec-15
DAE4	SN: 601	17-Aug-15 (No. DAE4-601_Aug15)	Aug-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100972	15-Jun-15 (in house check Jun-15)	In house check: Jun-18
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

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

Issued: November 24, 2015

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

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Schmid & Partner
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) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 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	42.6 ± 6 %	0.92 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.06 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.49 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.90 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	55.6 ± 6 %	0.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (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	**9.47 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.58 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.25 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	52.1 Ω - 4.7 jΩ
Return Loss	- 26.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.8 Ω - 6.8 jΩ
Return Loss	- 22.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.440 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 28, 2012

DASY5 Validation Report for Head TSL

Date: 24.11.2015

Test Laboratory: SPEAG, Zurich, Switzerland

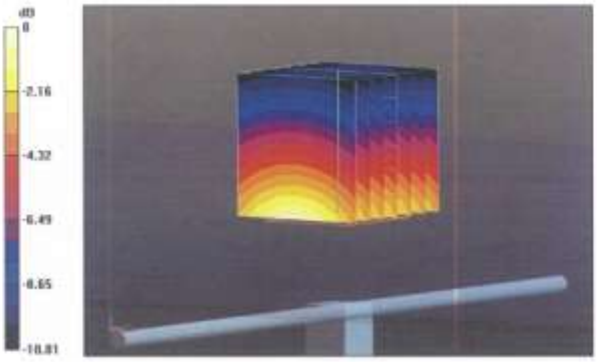
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d165

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.92 S/m; ε_r = 42.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.77, 9.77, 9.77); Calibrated: 30.12.2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- 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 = 60.39 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 3.40 W/kg
SAR(1 g) = 2.29 W/kg; SAR(10 g) = 1.49 W/kg
Maximum value of SAR (measured) = 3.03 W/kg



0 dB = 3.03 W/kg = 4.81 dBW/kg

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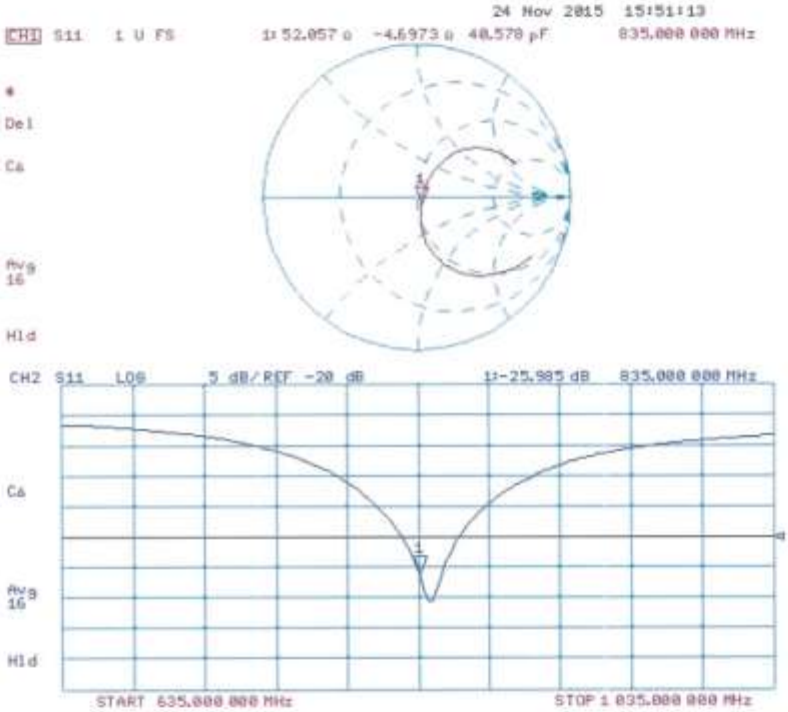
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 24.11.2015

Test Laboratory: SPEAG, Zurich, Switzerland

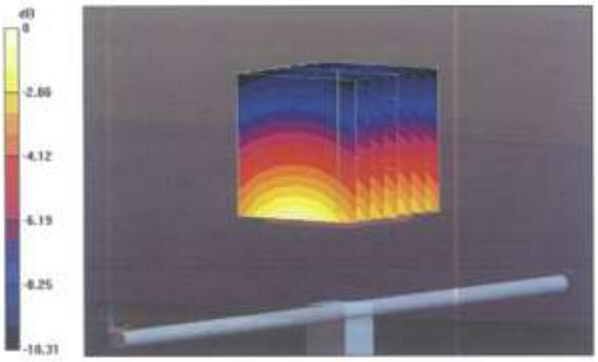
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d165

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma = 0.99$ S/m; $\varepsilon_r = 55.6$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

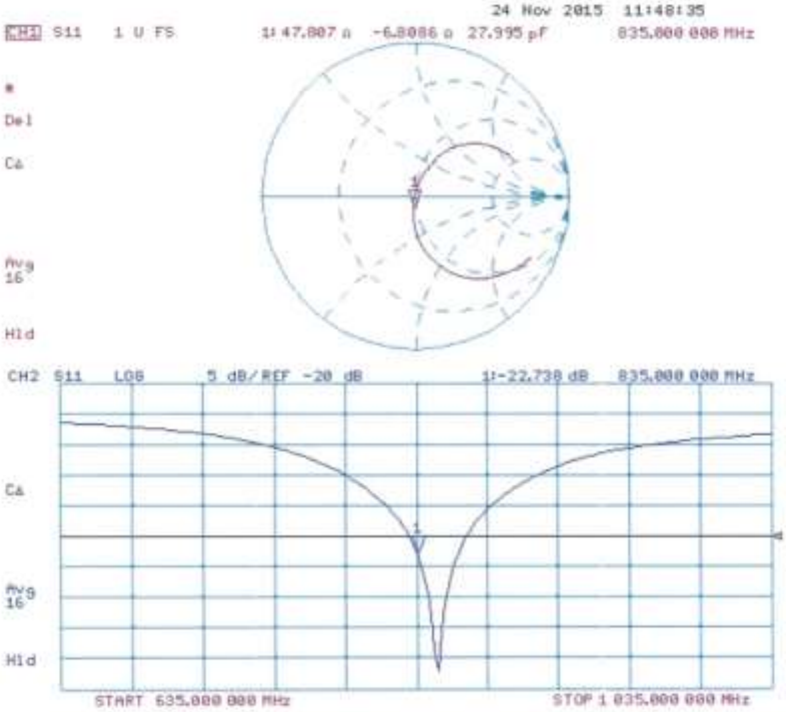
- Probe: EX3DV4 - SN7349; ConvF(9.72, 9.72, 9.72); Calibrated: 30.12.2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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 = 61.95 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.54 W/kg
SAR(1 g) = 2.4 W/kg; SAR(10 g) = 1.58 W/kg
Maximum value of SAR (measured) = 3.17 W/kg



0 dB = 3.17 W/kg = 5.01 dBW/kg

Impedance Measurement Plot for Body TSL



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Calibration Laboratory of
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Accreditation No.: SCS 0108

Client **HCT (Dymstec)**

Certificate No: **D1900V2-5d061_Apr16**

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d061
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	April 25, 2016

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 NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	31-Dec-15 (No. EX3-7349_Dec15)	Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

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

Issued: April 26, 2016

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

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

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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) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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 ± 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	40.0 ± 6 %	1.37 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**38.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.01 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.2 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	52.9 ± 6 %	1.49 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.82 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**39.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.20 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.9 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	52.5 Ω + 7.7 jΩ
Return Loss	- 22.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.9 Ω + 8.5 jΩ
Return Loss	- 21.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.192 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 10, 2004

DASY5 Validation Report for Head TSL

Date: 25.04.2016

Test Laboratory: SPEAG, Zurich, Switzerland

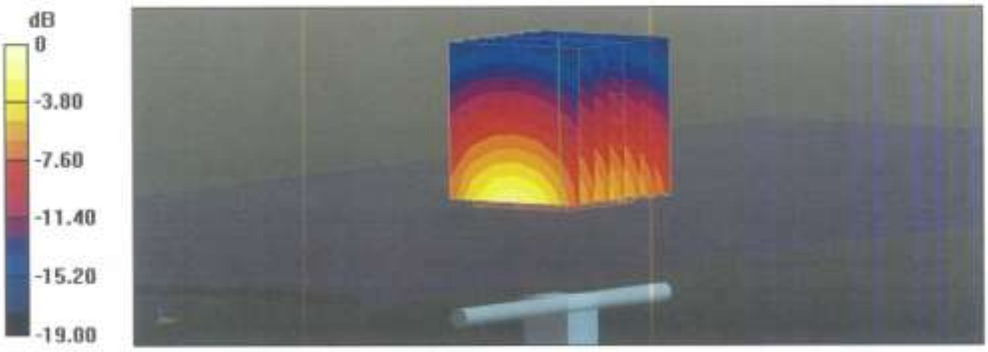
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d061

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.37 S/m; ε_r = 40; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

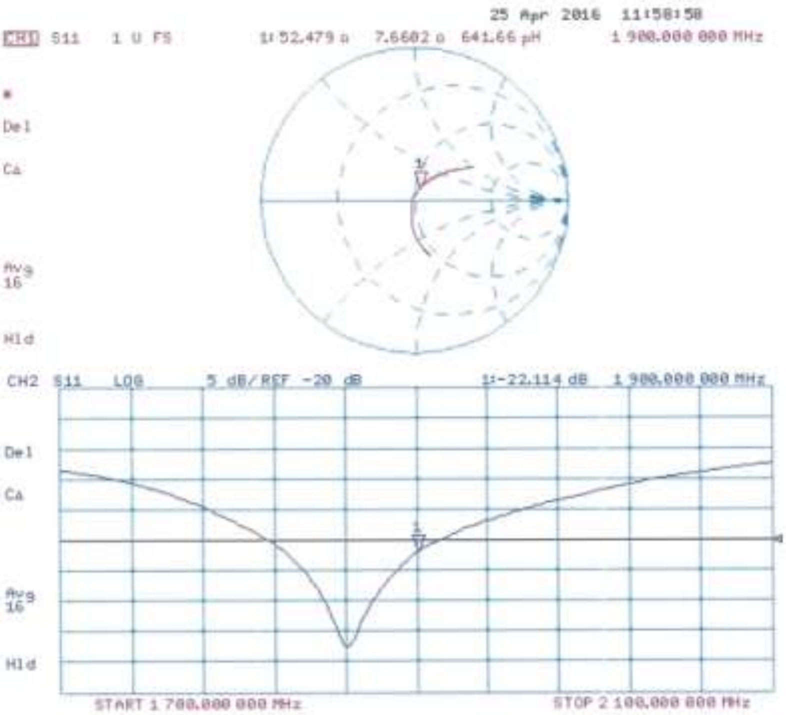
- Probe: EX3DV4 - SN7349; ConvF(8.2, 8.2, 8.2); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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 = 107.4 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 17.2 W/kg
SAR(1 g) = 9.53 W/kg; SAR(10 g) = 5.01 W/kg
Maximum value of SAR (measured) = 14.5 W/kg



0 dB = 14.5 W/kg = 11.61 dBW/kg

Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 25.04.2016

Test Laboratory: SPEAG, Zurich, Switzerland

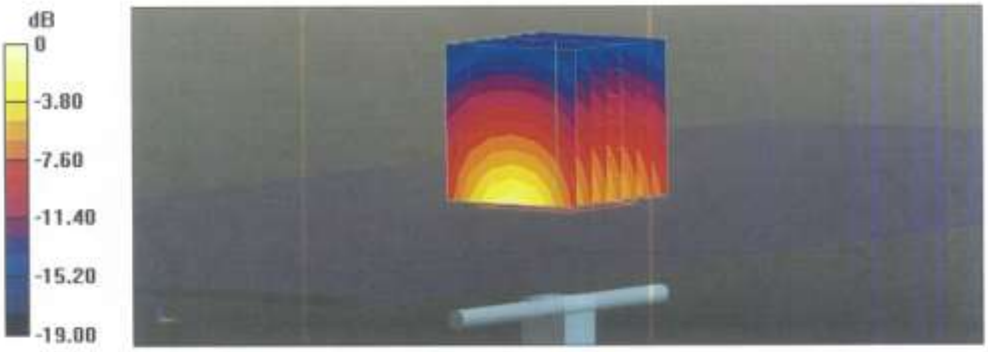
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d061

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.49 S/m; ε_r = 52.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.03, 8.03, 8.03); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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 = 104.3 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 17.3 W/kg
SAR(1 g) = 9.82 W/kg; SAR(10 g) = 5.2 W/kg
Maximum value of SAR (measured) = 14.9 W/kg



0 dB = 14.9 W/kg = 11.73 dBW/kg

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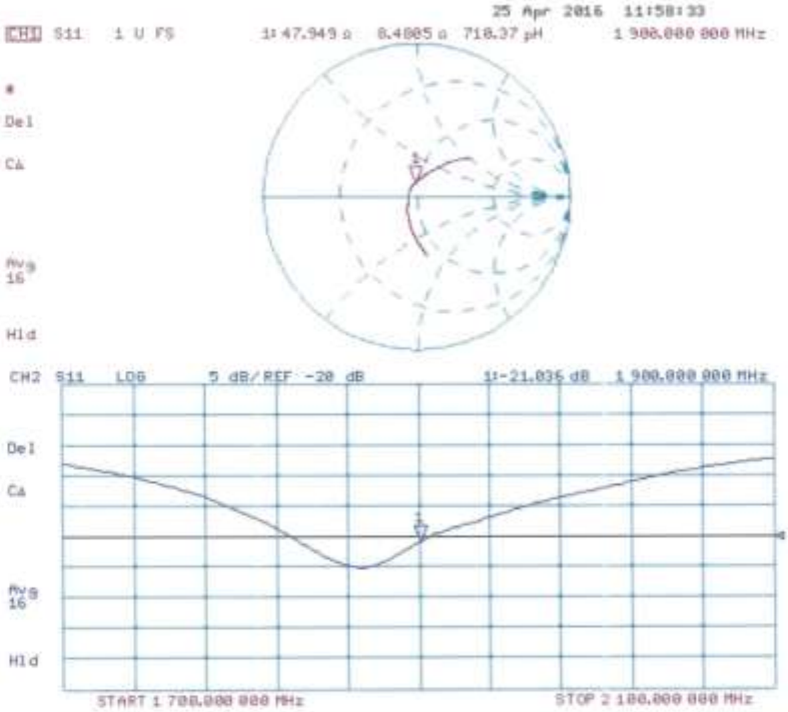
Impedance Measurement Plot for Body TSL



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Attachment 5. – SAR Tissue Characterization

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

Ingredients (% by weight)	Frequency (MHz)			
	750		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		

Composition of the Tissue Equivalent Matter

Attachment 6. – SAR SYSTEM VALIDATION

Per FCC KCB 865664 D02v01r02, 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 1528-2013 and FCC KDB 865664 D01v01r04. 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 No.	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
12	7370	EX3DV4	Body	835	4d165	2015.12.02	54.8	0.98	PASS	PASS	PASS	GMSK	PASS	N/A
12	7370	EX3DV4	Body	835	4d165	2015.12.02	54.8	0.98	PASS	PASS	PASS	GMSK	PASS	N/A
3	3797	EX3DV4	Body	1900	5d061	2016.05.10	53.1	1.51	PASS	PASS	PASS	GMSK	PASS	N/A
12	7370	EX3DV4	Body	1900	5d061	2016.05.10	53.1	1.51	PASS	PASS	PASS	N/A	N/A	N/A

SAR System Validation Summary 1g

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 D01v01r04. 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 D01v01r04.